ETSI TS 136 521-4 V18.4.0 (2025-02)

TECHNICAL SPECIFICATION

LTE;
Evolved Universal Terrestrial Radio Access (E-UTRA);
User Equipment (UE) conformance specification;
Radio transmission and reception;
Part 4: Satellite access Radio Frequency (RF)
and performance Conformance Testing
(3GPP TS 36.521-4 version 18.4.0 Release 18)

Reference
RTS/TSGR-0536521-4vi40

Keywords
LTE

ETSI

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Contents

Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

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Introduction

The present document is part 1 of a multi-parts TS:

3GPP TS 36.521-1 [14]: Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification Radio transmission and reception; Part 1: Conformance Testing.

3GPP TS 36.521-2 [15]: Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification Radio transmission and reception; Part 2: Implementation Conformance Statement (ICS).

3GPP TS 36.521-3 [16]: Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification Radio transmission and reception; Part 3: Radio Resource Management (RRM) conformance testing.

3GPP TS 36.521-4: Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 4: Satellite access Radio Frequency (RF) and performance Conformance Testing

1 Scope

The present document specifies the measurement procedures for the conformance test of E-UTRA User Equipment (UE) supporting satellite access operation that contains RF and Performance requirements. Conformance test for the support of RRM (Radio Resource Management) are specified in TS 36.521-3 [16].

The requirements are listed in different clauses only if the corresponding parameters deviate. More generally, tests are only applicable to those UEs that are intended to support the appropriate functionality. To indicate the circumstances in which tests apply, this is noted in the "*definition*" and "*applicability*" part of the test.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document in the same Release as the present document unless the context in which the reference is made suggests a different Release is relevant (information on the applicable release in a particular context can be found in e.g. test case title, description or applicability, message description or content).

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 36.108: "Evolved Universal Terrestrial Radio Access (E-UTRA); Satellite Access Node (SAN) radio transmission and reception".

[3] 3GPP TS 36.211: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Channels and Modulation".

[4] ITU-R Recommendation M.1545: "Measurement uncertainty as it applies to test limits for the terrestrial component of International Mobile Telecommunications-2000".

[5] 3GPP TS 36.307: "Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements on User Equipments (UEs) supporting a release-independent frequency band".

[6] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification".

[7] 3GPP TS 36.101: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception".

[8] 3GPP TS 36.300: "Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; Stage 2".

[9] ITU-R Recommendation SM.329-10, "Unwanted emissions in the spurious domain".

[10] [ANSI C63.26-2015, American National standard for Compliance Testing of Transmitters Used in Licensed Radio Services, Accredited Standards Committee C63 – Electromagnetic compatibility].

[11] 3GPP TS 36.102: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception for satellite access".

[12] 3GPP TS 36.508: "Common test environments for User Equipment (UE)".

[13] 3GPP TS 36.509: "Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Packet Core (EPC); Special conformance testing functions for User Equipment (UE)".

[14] 3GPP TS 36.521-1: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: Conformance testing".

[15] 3GPP TS 36.521-2: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 2: Implementation Conformance Statement (ICS)".

[16] 3GPP TS 36.521-3: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 3: Radio Resource Management (RRM) conformance testing".

[17] 3GPP TR 36.904: "Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Derivation of test tolerances for User Equipment (UE) radio reception conformance tests".

[18] 3GPP TR 36.905: "Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Derivation of test points for radio transmission and reception conformance test cases".

[19] 3GPP TS 36.212: "Evolved Universal Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding".

[20] 3GPP TS 36.213: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures".

[21] 3GPP TR 38.811: "Study on New Radio (NR) to support non-terrestrial networks".

3 Definitions of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

Channel edge: The lowest and highest frequency of the carrier, separated by the channel bandwidth.

Channel bandwidth: The RF bandwidth supporting a single E-UTRA RF carrier with the transmission bandwidth configured in the uplink or downlink of a cell. The channel bandwidth is measured in MHz and is used as a reference for transmitter and receiver RF requirements.

Category NB1/NB2 stand-alone operation: category NB1/NB2 is operating standalone when it utilizes its own spectrum, for example the spectrum used by GERAN systems as a replacement of one or more GSM carriers, as well as scattered spectrum for potential IoT deployment.

Category NB1/NB2 guard band operation: category NB1/NB2 is operating in guard band when it utilizes the unused resource block(s) within a E-UTRA carrier's guard-band.

Category NB1/NB2 in-band operation: category NB1/NB2 is operating in-band when it utilizes the resource block(s) within a normal E-UTRA carrier or within a normal NR carrier plus 15 kHz at each edge (and not within NR minimum guard band).

Geosynchronous Earth Orbit: Earth-centred orbit at approximately 35786 kilometres above Earth's surface and synchronised with Earth's rotation. A geostationary orbit is a non-inclined geosynchronous orbit, i.e. in the Earth's equator plane.

Low Earth Orbit: Orbit around the Earth with an altitude between 300 km, and 1500 km.

Satellite: A space-borne vehicle embarking a bent pipe payload or a regenerative payload telecommunication transmitter, placed into Low-Earth Orbit (LEO), Medium-Earth Orbit (MEO), or Geostationary Earth Orbit (GEO).

Satellite Access Node: see definition in TS 36.108 [2].

sTTI: A transmission time interval (TTI) of either one slot or one subslot as defined in TS 36.211 [3] on either uplink or downlink.

3.2 Symbols

For the purposes of the present document, the following symbols apply:

ΔF_{Raster}	Band dependent channel raster granularity
$BW_{Channel}$	Channel bandwidth
F	Frequency
$F_{Interferer}$ (offset)	Frequency offset of the interferer (between the center frequency of the interferer and the carrier frequency of the carrier measured)
$F_{Interferer}$	Frequency of the interferer
$F_{Ioffset}$	Frequency offset of the interferer (between the center frequency of the interferer and the closest edge of the carrier measured)
F_C	Frequency of the carrier centre frequency
F_{DL_low}	The lowest frequency of the downlink operating band
F_{DL_high}	The highest frequency of the downlink operating band
F_{UL_low}	The lowest frequency of the uplink operating band
F_{UL_high}	The highest frequency of the uplink operating band
F_{OOB}	The boundary between the E-UTRA out of band emission and spurious emission domains.
L_{Ctone}	Transmission bandwidth which represents the length of a contiguous sub-carrier allocation expressed in units of tones
N_{DL}	Downlink EARFCN
$N_{Offs-DL}$	Offset used for calculating downlink EARFCN
$N_{Offs-UL}$	Offset used for calculating uplink EARFCN
N_{RB}	Transmission bandwidth configuration, expressed in units of resource blocks
N_{RB_alloc}	Total number of simultaneously transmitted resource blocks in Channel bandwidth or Aggregated Channel Bandwidth.
N_{tone}	Transmission bandwidth configuration for category NB1 and NB2, expressed in units of tones.
$N_{tone\ 3.75kHz}$	Transmission bandwidth configuration for category NB1 and NB2 with 3.75 kHz sub-carrier spacing, expressed in units of tones.
$N_{tone\ 15kHz}$	Transmission bandwidth configuration for category NB1 and NB2 with 15 kHz sub-carrier spacing, expressed in units of tones.
N_{UL}	Uplink EARFCN.
P_{CMAX}	The configured maximum UE output power.
$P_{Interferer}$	Modulated mean power of the interferer
$P_{PowerClass}$	$P_{PowerClass}$ is the nominal UE power (i.e., no tolerance).
$P_{PowerClass\_Default}$	$P_{PowerClass\_Default}$ is the default nominal UE power (i.e., no tolerance) for the band.
P_{UMAX}	The measured configured maximum UE output power.
Puw	Power of an unwanted DL signal
Pw	Power of a wanted DL signal
Δf_{OOB}	Δ Frequency of Out Of Band emission

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

ACLR	Adjacent Channel Leakage Ratio
ACS	Adjacent Channel Selectivity
A-MPR	Additional Maximum Power Reduction
AWGN	Additive White Gaussian Noise
BW	Bandwidth
CW	Continuous Wave
DL	Downlink
EARFCN	E-UTRA Absolute Radio Frequency Channel Number
E-UTRA	Evolved UMTS Terrestrial Radio Access

EUTRAN	Evolved UMTS Terrestrial Radio Access Network
EVM	Error Vector Magnitude
FDD	Frequency Division Duplex
GEO	Geostationary Earth Orbit
GSO	Geosynchronous Orbit
ITU-R	Radiocommunication Sector of the International Telecommunication Union
LEO	Low Earth Orbit
HD-FDD	Half- Duplex FDD
MEO	Medium Earth Orbit
MPR	Maximum Power Reduction
NGSO	Non-Geosynchronous Orbit
OCNG	OFDMA Channel Noise Generator
OFDMA	Orthogonal Frequency Division Multiple Access
OOB	Out-of-band
QAM	Quadrature Amplitude Modulation
RAN	Radio Access Network
RE	Resource Element
REFSENS	Reference Sensitivity power level
RF	Radio Frequency
UE	User Equipment
UL	Uplink
UMTS	Universal Mobile Telecommunications System
UTRA	UMTS Terrestrial Radio Access
UTRAN	UMTS Terrestrial Radio Access Network

4 General

4.1 Relationship between minimum requirements and test requirements

TS 36.102 [11] is a Single-RAT specification for satellite NR UE, covering RF characteristics and minimum performance requirements. Conformance to the TS 36.102 [11] is demonstrated by fulfilling the test requirements specified in the present document.

The Minimum Requirements given in TS 36.102 [11] makes no allowance for measurement uncertainty (MU). The present document defines test tolerances (TT). These test tolerances are individually calculated for each test. The test tolerances are used to relax the minimum requirements in this specification to create test requirements. For some requirements, including regulatory requirements, the test tolerance is set to zero.

The measurement results returned by the test system are compared - without any modification - against the test requirements as defined by the various levels of “shared risk” principle as described below.

a) Core specification value is not relaxed by any relaxation value (TT=0). For each single measurement, the probability of a borderline good UE being judged as FAIL equals the probability of a borderline bad UE being judged as PASS.

  - Test tolerances equal to 0 (TT=0) are considered in this specification.

b) Core specification value is relaxed by a relaxation value (TT>0). For each single measurement, the probability of a borderline bad UE being judged as PASS is greater than the probability of a borderline good UE being judged as FAIL.

  - Test tolerances lower than measurement uncertainty and greater than 0 (0 < TT < MU) are considered in this specification.

  - Test tolerances up to measurement uncertainty (TT = MU) are considered in this specification which is also known as “Never fail a good DUT” principle.

c) Core specification value is tightened by a stringent value (TT<0). For each single measurement, the probability of a borderline good UE being judged as FAIL is greater than the probability of a borderline bad UE being judged as PASS.

  - Test tolerances lower than 0 (TT<0) are not considered in this specification..

The "Never fail a good DUT" and the "Shared Risk" principles are defined in Recommendation ITU-R M.1545 [4].

4.2 Applicability of minimum requirements

a) Minimum requirements are mandated to be met in all scenarios by UEs supporting the applicable UE category(ies) for which that requirement is specified. In TS 36.102 [11], only minimum requirements for UE categories of M1, NB1, and NB2 are specified.

b) For UE category M1, the applicable minimum requirements in clauses 5, 6 or 7 are specified in the suffix A subclause where they differ from the requirements in the main subclause. Where suffix A does not exist for a requirement, the minimum requirement in the main subclause shall apply.

c) For UE category NB1 and NB2, the applicable minimum requirements in clauses 5, 6 or 7 are specified in the Suffix B subclause, where they differ from the requirements in the main subclause. Where suffix B does not exist for a requirement, the minimum requirement in the main subclause shall apply.

d) The reference sensitivity power levels defined in subclause 7.3 are valid for the specified reference measurement channels.

NOTE: Receiver sensitivity degradation may occur when:

1) The UE simultaneously transmits and receives with bandwidth allocations less than the transmission bandwidth configuration (see Figure 5.3A-1 and Figure 5.3B-1), and

2) Any part of the downlink transmission bandwidth is within an uplink transmission bandwidth from the downlink center subcarrier.

e) The spurious emissions power requirements are for the long-term average of the power. For the purpose of reducing measurement uncertainty it is acceptable to average the measured power over a period of time sufficient to reduce the uncertainty due to the statistical nature of the signal.

f) The requirements related to subslot TTI and/or slot TTI shall apply only if UE supports multiple TTI patterns. And these requirements only apply to subslot and/or slot TTI configurations

g) TS 36.307 [5] specifies which minimum requirements in the present document are applicable to UEs that conform to an earlier specification Release, and from which Release those requirements apply.

4.3 Specification suffix information

The following suffixes are defined at 2nd level for clauses 5, 6 and 7, as shown in Table 4.3-1.

Table 4.3-1: Definition of suffixes

Clause suffix	Variant
A	Cat-M1
B	NB1, NB2

The suffixes shall apply as defined in clause 4.2.

4.4 Relationship with core specifications

TS 36.102 [11] specifies the minimum RF and performance requirements for E-UTRA User Equipment (UE) operating satellite access. TS 36.108 [2] specifies the minimum RF and performance requirements of E-UTRA Satellite Access Node (SAN).

5 Operating bands and channel arrangement

5.1 General

The channel arrangements presented in this clause are based on the operating bands and channel bandwidths defined in the present release of specifications.

NOTE: Other operating bands and channel bandwidths may be considered in future releases.

5.2 Operating bands

E-UTRA satellite access is designed to operate in the operating bands defined in Table 5.2-1.

Table 5.2-1 E-UTRA operating bands for satellite access

E-UTRA Operating Band	Uplink (UL) operating band BS receive UE transmit			Downlink (DL) operating band BS transmit UE receive			Duplex Mode
	F_{UL_low}	–	F_{UL_high}	F_{DL_low}	–	F_{DL_high}	
256	1980 MHz	–	2010 MHz	2170 MHz	–	2200 MHz	FDD
255	1626.5 MHz	–	1660.5 MHz	1525 MHz	–	1559 MHz	FDD
254	1610 MHz	–	1626.5 MHz	2483.5 MHz	–	2500 MHz	FDD
253[2]	1668 MHz	-	1675 MHz	1518 MHz	-	1525 MHz	FDD
NOTE 1: Satellite bands are numbered in descending order from 256 NOTE 2: UE assigned to channels and allocated frequency resources in the lower portion of Band 253 may experience blocking or harmful interference from terrestrial networks in adjacent or nearby frequencies when operating in the proximity with terrestrial base stations.							

5.2A Operating bands for UE category M1

UE category M1 is designed to operate in the E-UTRA satellite access operating bands defined in Table 5.2-1 in both half duplex FDD mode and full-duplex FDD mode.

5.2B Operating bands for category NB1 and NB2

Category NB1 and NB2 UE are designed to operate in the E-UTRA satellite access operating bands defined in Table 5.2-1.

Category NB1 and NB2 UE operate in HD-FDD duplex mode.

For operation in Band 254 in USA and Canada when NS_03N is signalled, only channels positions which guarantee at least 90 kHz guard band from RF channel edge to the lower and upper limit of the band shall be used.

For operation in Band 255 in USA and Canada when NS_02N is signalled, only channels positions which guarantee at least 90 kHz guard band from RF channel edge to the lower and upper limit of the band shall be used.

5.3 Channel bandwidth

This clause is reserved.

5.3A Channel bandwidth for category M1

The requirements in present document are specified for the channel bandwidth listed in Table 5.3A-1.

Table 5.3A-1: Transmission bandwidth configuration N_{RB} in E-UTRA channel bandwidths

Channel bandwidth $BW_{Channel}$ [MHz]	1.4
Transmission bandwidth configuration N_{RB}	6

Figure 5.3A-1 shows the relation between the Channel bandwidth ($BW_{Channel}$) and the Transmission bandwidth configuration (N_{RB}). The channel edges are defined as the lowest and highest frequencies of the carrier separated by the channel bandwidth, i.e. at F_C +/- $BW_{Channel}$ /2.

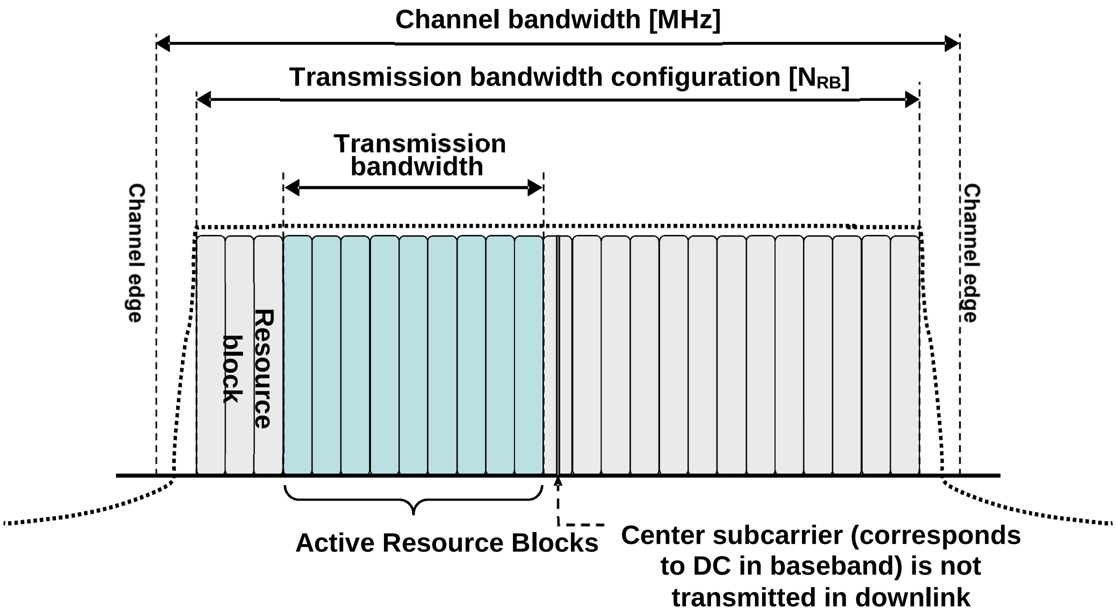

Figure 5.3A-1: Definition of channel bandwidth and transmission bandwidth configuration for one E-UTRA carrier

5.3B Channel bandwidth for category NB1 and NB2

For category NB1 and NB2, requirements in present document are specified for the channel bandwidth listed in Table 5.3B-1.

Table 5.3B-1: Transmission bandwidth configuration N_{RB}, $N_{tone\ 15kHz}$ and $N_{tone\ 3.75kHz}$ in NB1 and NB2 channel bandwidth

Channel bandwidth $BW_{Channel}$ [kHz]	200
Transmission bandwidth configuration N_{RB}	1
Transmission bandwidth configuration $N_{tone\ 15kHz}$	12
Transmission bandwidth configuration $N_{tone\ 3.75kHz}$	48

Figure 5.3B-1 shows the relation between the Category NB1/NB2 channel bandwidth ($BW_{Channel}$) and the Category NB1 /NB2 transmission bandwidth configuration (N_{tone}). The channel edges are defined as the lowest and highest frequencies of the carrier separated by the channel bandwidth, i.e. at F_C +/- $BW_{Channel}$ /2.

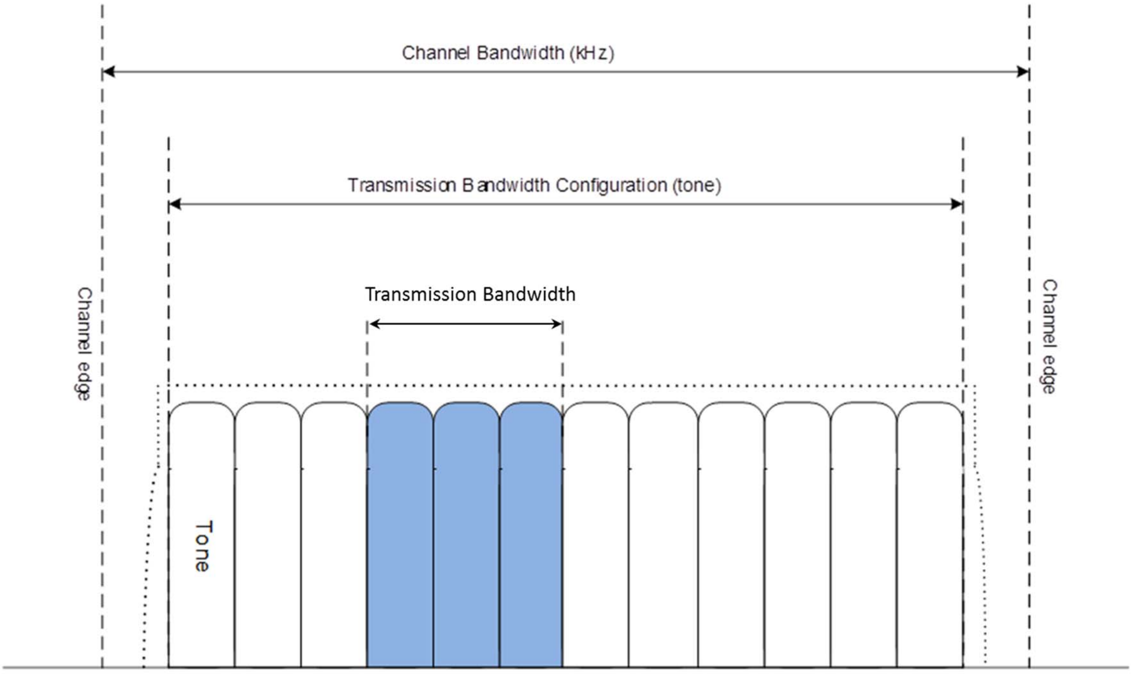

Figure 5.3B-1: Definition of Channel Bandwidth and Transmission Bandwidth configuration

5.4 Channel arrangement

This clause is reserved.

5.4A Channel arrangement for category M1

5.4A.1 Channel spacing

The spacing between carriers will depend on the deployment scenario, the size of the frequency block available and the channel bandwidths. The nominal channel spacing between two adjacent E-UTRA carriers is defined as following:

$$\text{Nominal Channel spacing} = (BW_{Channel(1)} + BW_{Channel(2)})/2$$

where $BW_{Channel(1)}$ and $BW_{Channel(2)}$ are the channel bandwidths of the two respective E-UTRA carriers. The channel spacing can be adjusted to optimize performance in a particular deployment scenario.

5.4A.2 Channel raster, carrier frequency and EARFCN

The global frequency raster is defined for all frequencies. The granularity of the global frequency raster is 100 kHz, which means that the carrier centre frequency must be an integer multiple of 100 kHz. For each operating band, a subset of frequencies from the global frequency raster are applicable and forms a channel raster with a granularity ΔF_{Raster}.

The carrier frequency in the uplink and downlink is designated by the E-UTRA Absolute Radio Frequency Channel Number (EARFCN) in the range 0 – 262143. The relation between EARFCN and the carrier frequency in MHz for the downlink is given by the following equation, where F_{DL_low} and $N_{Offs\text{-}DL}$ are given in Table 5.4A.2-1 and N_{DL} is the downlink EARFCN.

$$F_{DL} = F_{DL\_low} + 0.1(N_{DL} – N_{Offs\text{-}DL})$$

The relation between EARFCN and the carrier frequency in MHz for the uplink is given by the following equation where F_{UL_low} and $N_{Offs-UL}$ are given in Table 5.4.2-1 and N_{UL} is the uplink EARFCN.

$$F_{UL} = F_{UL\_low} + 0.1(N_{UL} – N_{Offs-UL})$$

The applicable channel raster and EARFCNs for each operating band are specified in Table 5.4A.2-1.

For operating bands with a channel raster of 100 kHz, every EARFCN within the operating band shall be applicable for the channel raster, and the step size for the channel raster in Table 5.4A.2-1 is given as <1>. The broadcast parameter *earfcn-LSB* defined in TS 36.331 [6] may be used to assist the UE in synchronizing to the cell.

Table 5.4A.2-1: E-UTRA channel numbers

E-UTRA Operating Band	ΔF_{Raster} (kHz)	Downlink			Uplink		
		F_{DL_low} (MHz)	$N_{Offs-DL}$	Range of N_{DL} (First – <Step size> – Last)	F_{UL_low} (MHz)	$N_{Offs-UL}$	Range of N_{UL} (First – <Step size> – Last)
256	100	2170	229076	229076 –<1>- 229375	1980	261844	261844 –<1>- 262143
255	100	1525	228736	228736 –<1>- 229075	1626.5	261504	261504 –<1>- 261843
254	100	2483.5	228571	228571 –<1>- 228735	1610	261339	261339 –<1>- 261503
253	100	1518	228501	228501-<1>- 228570	1668	261269	261269-<1>- 261338
NOTE 1: The channel numbers that designate carrier frequencies so close to the operating band edges that the carrier extends beyond the operating band edge shall not be used. This implies that the first 7 channel numbers at the lower operating band edge and the last 6 channel numbers at the upper operating band edge shall not be used for channel bandwidth of 1.4 MHz.							

5.4A.3 TX–RX frequency separation

a) The default E-UTRA TX channel (carrier centre frequency) to RX channel (carrier centre frequency) separation is specified in Table 5.4A.3-1 for the TX and RX channel bandwidth defined in Table 5.3A.1-1.

Table 5.4A.3-1: Default UE TX-RX frequency separation

E-UTRA Operating Band	TX – RX carrier centre frequency separation
256	190 MHz
255	-101.5 MHz
254	873.5 MHz
253	-150 MHz

b) The use of other TX channel to RX channel carrier centre frequency separation is not precluded and is intended to form part of a later release.

5.4B Channel arrangement for category NB1 and NB2

5.4B.1 Channel spacing

Nominal channel spacing for UE category NB1 and NB2 in stand-alone mode is 200 kHz.

5.4B.2 Channel raster, carrier frequency and EARFCN

The channel raster of UE category NB1/NB2 shall be as defined in clause 5.4A.2, and the channel raster per-frequency band shall be as defined in table 5.4A.2-1.

The carrier frequency of UE category NB1/NB2 in the downlink is designated by the E-UTRA Absolute Radio Frequency Channel Number (EARFCN) as defined in Table 5.4A.2-1, and the Offset of category NB1/NB2 Channel Number to EARFCN in the range of {-10, -9, -8, -7, -6, -5, -4, -3, -2, -1, -0.5, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9} for FDD. The relation between EARFCN, Offset of category NB1/NB2 Channel Number to EARFCN and the carrier frequency in MHz for the downlink is given by the following equation, where F_{DL} is the downlink carrier frequency of category NB1/NB2, F_{DL_low} and $N_{Offs\text{-}DL}$ are given in table 5.4A.2-1, N_{DL} is the downlink EARFCN, M_{DL} is the Offset of category NB1/NB2 Channel Number to downlink EARFCN.

$$F_{DL} = F_{DL\_low} + 0.1(N_{DL} – N_{Offs\text{-}DL}) + 0.0025*(2M_{DL})$$

The carrier frequency of UE category NB1/NB2 in the uplink is designated by the E-UTRA Absolute Radio Frequency Channel Number (EARFCN) as defined in Table 5.4A.2-1, and the Offset of category NB1/NB2 Channel Number to EARFCN in the range of {-10, -9, -8, -7, -6, -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9} for FDD. The relation between EARFCN, Offset of category NB1/NB2 Channel Number to EARFCN and the carrier frequency in MHz for the uplink is given by the following equation, where F_{UL} is the uplink carrier frequency of category NB1/NB2, F_{UL_low} and $N_{Offs\text{-}UL}$ are given in table 5.4A.2-1, N_{UL} is the uplink EARFCN, M_{UL} is the Offset of category NB1/NB2 Channel Number to uplink EARFCN.

$$F_{UL} = F_{UL\_low} + 0.1(N_{UL} – N_{Offs\text{-}UL}) + 0.0025*(2M_{UL})$$

NOTE 1: Guard-band operation and in-band operation for NB-IoT are not supported in this version of the specification.

NOTE 2: For the carrier including NPSS/NSSS for stand-alone operation, M_{DL} = 0.

5.4B.3 TX–RX frequency separation

For UE category NB1/NB2 operation in stand-alone mode, the default TX-RX frequency separation shall be as specified in Table 5.4A.3-1 for the NB-IoT TX and RX channel bandwidth defined in Table 5.3B-1.

6 Transmitter characteristics

6.1 General

Unless otherwise stated, the transmitter characteristics are specified at the antenna connector of the UE with a single transmit antenna. For UE with integral antenna only, a reference antenna with a gain of 0 dBi is assumed.

All requirements in this section are applicable to devices supporting GSO and/or NGSO satellites.

The transient periods due to power steps, OFF/ON and ON/OFF transitions could occur at slot or symbol boundary with transients, on one or both sides of the boundary. The measurement period and whether to exclude the transient periods are specified in the respective sections below.

For testing of category NB1 in all operation bands, standalone is used as default operation mode unless otherwise stated by the test case.

6.2 Transmit power

6.2A Transmit power for category M1

6.2A.1 UE maximum output power for category M1

6.2A.1.1 Test purpose

To verify that the error of the UE maximum output power does not exceed the range prescribed by the specified nominal maximum output power and tolerance.

An excess maximum output power has the possibility to interfere to other channels or other systems. A small maximum output power decreases the coverage area.

6.2A.1.2 Test applicability

This test case applies to all types of E-UTRA UE release 17 and forward of UE category M1 that support satellite access operation.

6.2A.1.3 Minimum conformance requirements

The following UE Power Classes define the maximum output power for any transmission bandwidth within the channel bandwidth unless otherwise stated. The period of measurement shall be at least one sub frame (1ms).

Table 6.2A.1-1: UE Power Class

EUTRA band	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)	Class 5 (dBm)	Tolerance (dB)
256			23	+/-2	20	+/-2
255			23	+/-2	20	+/-2
254			23	+/-2	20	+/-2
253			23	+/-2	20	+/-2
NOTE 1: $P_{PowerClass}$ is the maximum UE power specified without taking into account the tolerance						

The default power class $P_{PowerClass\_Default}$ for an operating band is Power Class 3 unless otherwise stated.

The normative reference for this requirement is TS 36.102 [11] clause 6.2.A.

6.2A.1.4 Test description

6.2A.1.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths based on operating bands for satellite access that specified in sub-clause 5.2A. All of these configurations shall be tested with applicable test parameters for each channel bandwidth, and are shown in table 6.2A.1.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexe A.2. Configurations of PDSCH and MPDCCH before measurement are specified in Annex C.2.

Table 6.2A.1.4.1-1: Test Configuration Table

<table>
<tr><th colspan="4">Initial Conditions</th></tr>
<tr><td>Test Environment as specified in TS 36.508 [12] subclause 4.1</td><td colspan="3">Normal, TL/VL, TL/VH, TH/VL, TH/VH</td></tr>
<tr><td>Test Frequencies as specified in TS 36.508 [12] subclause 4.3.1</td><td colspan="3">Low range, Mid range, High range</td></tr>
<tr><td>Test Channel Bandwidths as specified in TS 36.508 [12] subclause 4.3.1</td><td colspan="3">1.4MHz</td></tr>
<tr><th colspan="4">Test Parameters for Channel Bandwidths</th></tr>
<tr><th></th><th>Downlink Configuration</th><th colspan="2">Uplink Configuration</th></tr>
<tr><th rowspan="2">Ch BW</th><td rowspan="4">N/A for Max UE output power testing</td><th rowspan="2">Mod'n</th><th>RB allocation</th></tr>
<tr><th>HD-FDD</th></tr>
<tr><td>1.4MHz</td><td>QPSK</td><td>1</td></tr>
<tr><td>1.4MHz</td><td>QPSK</td><td>2</td></tr>
<tr><td colspan="4">NOTE 1: Test Channel Bandwidth is checked separately for each E-UTRA satellite access band, the applicable channel bandwidths are specified in Table 5.3A-1.
NOTE 2: The 1 RB allocation shall be tested at RB#0 with narrowband index 0 for low and mid range, RB #5 with max narrowband index for high range test frequency.
NOTE 3: The RBstart of non-1RB allocation shall be RB #0 with narrowband index 0 for low and mid range, RB# (6 - RB allocation) with max narrowband index for high range test frequency.</td></tr>
</table>

1. Connect the SS to the UE antenna connectors as shown in TS 36.508 [12] Annex A Figure A.3 using only main UE Tx/Rx antenna.
2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1, and C.3.0, and uplink signals according to Annex H.1 and H.3.0.
4. The UL Reference Measurement channel is set according to Table 6.2A.4.1-1.
5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 36.508 [12] clause 5.6.1 is provided to the UE through any preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31 information during the duration of the test as define in TS 36.508[12] clause 5.6.3.1.
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.
9. Ensure the UE is in State 3A-RF-CE according to TS 36.508 [12] clause 5.2A.2AA. Message contents are defined in clause 6.2A.4.3.

6.2A.1.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via MPDCCH DCI format 6-0A for C_RNTI to schedule the UL RMC according to Table 6.2A.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.
2. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200ms for the UE to reach P_{UMAX} level.
3. Measure the mean power of the UE in the channel bandwidth of the radio access mode. The period of measurement shall be at least the continuous duration of one sub-frame (1ms). For HD-FDD slots with transient periods and Half-duplex guard subframe are not under test.

6.2A.1.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 4.6.

6.2A.1.5 Test requirements

The maximum output power derived in step 3 shall be within the range prescribed by the nominal maximum output power and tolerance in Table 6.2A.5-1.

Table 6.2A.1.5-1: UE Power Class test requirements

EUTRA band	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)	Class 5 (dBm)	Tolerance (dB)	Class 6 (dBm)	Tolerance (dB)
256			23	±2.7	20	±2.7		
255			23	±2.7	20	±2.7		
254			23	±2.7	20	±2.7		
253			23	±2.7	20	±2.7		
NOTE 1: $P_{PowerClass}$ is the maximum UE power specified without taking into account the tolerance.								

6.2A.2 UE maximum output power reduction for category M1

6.2A.2.1 Test purpose

To verify that the error of the UE maximum output power does not exceed the range prescribed by the specified nominal maximum output power and tolerance covering configurations where a maximum power reduction is allowed in the UE.

An excess maximum output power has the possibility to interfere to other channels or other systems. A small maximum output power decreases the coverage area.

6.2A.2.2 Test applicability

The requirements of this test apply in test case 6.5A.3.4 Adjacent Channel Leakage Power Ratio for UE category M1 to all types of E-UTRA UE release 17 and forward of UE category M1 that support satellite access operation.

6.2A.2.3 Minimum conformance requirements

For UE Power Class 3 and 5 the allowed Maximum Power Reduction (MPR) for the maximum output power due to higher order modulation and transmit bandwidth configuration (resource blocks) is specified in Table 6.2A.2.3-1.

For subPRB allocation of category M1 UE of Power Class 3, there is no MPR applies.

Table 6.2A.2.3-1: Maximum Power Reduction (MPR) for Power Class 3 and 5

Modulation	Channel bandwidth / Transmission bandwidth (N_{RB})	MPR (dB)
	1.4 MHz	
QPSK	> 2	≤ 1
QPSK	> 5	≤ 2
NOTE: MPR only applicable for $N_{RB} \geq 1$		

For PRACH, PUCCH and SRS transmissions, the allowed MPR is according to that specified for PUSCH QPSK modulation for the corresponding transmission bandwidth.

For each subframe, the MPR is evaluated per slot and given by the maximum value taken over the transmission(s) within the slot; the maximum MPR over the two slots is then applied for the entire subframe.

For the UE maximum output power modified by MPR, the power limits specified in subclause 6.2A.4 apply.

The normative reference for this requirement is TS 36.102 [11] clause 6.2.A.

6.2A.2.4 Test description

6.2A.2.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths based on E-UTRA operating bands specified in clause 5.2E. All of these configurations shall be tested with applicable test parameters for each channel bandwidth and are shown in table 6.2A.2.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of PDSCH and MPDCCH before measurement are specified in Annex C.2.

Table 6.2A.2.4.1-1: Test Configuration Table

Initial Conditions				
Test Environment as specified in TS 36.508 [12] subclause 4.1			Normal	
Test Frequencies as specified in TS 36.508 [12] subclause 4.3.1			Low range, Mid range, High range	
Test Channel Bandwidths as specified in TS 36.508 [12] subclause 4.3.1			1.4MHz	
Test Parameters for Channel Bandwidths and Narrowband positions				
		Downlink Configuration	**Uplink Configuration**	
Configuration ID	**Ch BW**	N/A for Maximum Power Reduction (MPR) test case	**Mod'n**	**RB allocation**
				FDD and HD-FDD
1	1.4MHz		QPSK	2
2	1.4MHz		QPSK	5
3	1.4MHz		QPSK	6

Table 6.2A.2.4.1-2: Test Configuration Table, subPRB allocation

Initial Conditions					
Test Environment as specified in TS 36.508 [12] subclause 4.1			Normal		
Test Frequencies as specified in TS 36.508 [12] subclause 4.3.1			Low range, Mid range, High range		
Test Channel Bandwidths as specified in TS 36.508 [12] subclause 4.3.1			1.4MHz		
Test Parameters for Channel Bandwidths and Narrowband positions					
		Downlink Configuration	**Uplink Configuration**		
Configuration ID	**Ch BW**	N/A for Maximum Power Reduction (MPR) test case	**Mod'n**	**RB allocation**	
				FDD and HD-FDD	**Narrowband index (Note 1)**
Low range, Mid range					
1	1.4MHz		QPSK	½ (6 SCs)	0
High range					
2	1.4MHz		QPSK	½ (6 SCs)	3
NOTE 1: Denotes the lowest narrowband index in the channel bandwidth where the wideband shall be placed. The allocation is contiguous, starting from the lowest narrowband index. Narrowband, Narrowband index and Wideband are defined in TS 36.211 [3], 5.2.7. NOTE 2: Test Channel Bandwidths are checked separately for each E-UTRA band, the applicable channel bandwidths are specified in Table 5.4.2.1-1. NOTE 3: The SC_{start} shall be SC#0 and SC# (72 – RB allocation) of the narrowband, when RB allocation is defined as #SCs					

1. Connect the SS to the UE antenna connectors as shown in TS 36.508 [12] Annex A Figure A.3 using only main UE Tx/Rx antenna.

2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, and C.3.0, and uplink signals according to Annex H.1 and H.3.0.

4. The UL Reference Measurement channel is set according to Table 6.2A.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. UE location according to TS 36.508 [12] clause 5.6.1 is provided to the UE through any preconfigured means.

7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31 information during the duration of the test as define in TS 36.508[12] clause 5.6.3.1.

8. Deactivate UE prediction of satellite trajectory by any preconfigured means.

9. Ensure the UE is in State 3A-RF-CE according to TS 36.508 [12] clause 5.2A.2AA. Message contents are defined in clause 6.2A.4.3.

10. For UE supporting subPRB allocation, repeat step 1-6 with UL RMC according to Table 6.2A.2.4.1-2

6.2A.2.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via MPDCCH DCI format 6-0A for C_RNTI to schedule the UL RMC according to Table 6.2A.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

2. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200ms for the UE to reach P_{UMAX} level.

3. Measure the mean power of the UE in the channel bandwidth of the radio access mode. The period of measurement shall be at least the continuous duration of one sub-frame (1ms). For HD-FDD slots with transient periods and Half-duplex guard subframe are not under test.

6.2A.2.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 4.6 with the condition CEModeA.

6.2A.2.4.4 Test requirements

The maximum output power, derived in step 3 shall be within the range prescribed by the nominal maximum output power and tolerance in Table 6.2A.2.4.4-1

Table 6.2A.2.4.4-1: UE Power Class 3 and 5 test requirements

Configuration ID	Power class 3					Power class 5				
	MPR (dB)	$P_{CMAX\_L,c}$ (dBm)	T($P_{CMAX\_L,c}$) (dB)	Upper limit (dBm)	Lower limit (dBm)	MPR (dB)	$P_{CMAX\_L,c}$ (dBm)	T($P_{CMAX\_L,c}$) (dB)	Upper limit (dBm)	Lower limit (dBm)
1	0	23	2.0	25.7	20.3	0	20	2.0	22.7	17.3
2	1	22	2.0	25.7	19.3	1	19	3.5	22.7	14.8
3	2	21	2.0	25.7	18.3	2	18	4.0	22.7	13.3
NOTE 1: $P_{CMAX,c}$ and T($P_{CMAX\_L,c}$) are defined in TS 36.102 [11] clause 6.2A.4.										

Table 6.2A.2.4.4-1a: UE Power Class 3 test requirements for bands, subPRB allocation

Configuration ID	Power class 3				
	MPR (dB)	$P_{CMAX\_L,c}$ (dBm)	T($P_{CMAX\_L,c}$) (dB)	Upper limit (dBm)	Lower limit (dBm)
1	0	23	2.0	25.7	20.3
2	0	23	2.0	25.7	20.3
NOTE 1: $P_{CMAX,c}$ and T($P_{CMAX\_L,c}$) are defined in TS 36.102 [11] clause 6.2A.4.					

6.2A.3 UE additional maximum output power reduction for category M1 UE

6.2A.3.1 Test purpose

Additional ACLR and spectrum emission requirements can be signalled by the network to indicate that the UE shall also meet additional requirements in a specific deployment scenario. To meet these additional requirements, Additional Maximum Power Reduction A-MPR is allowed for the output power as specified in Table 6.2A.1-1. Unless stated otherwise, an A-MPR of 0 dB shall be used.

6.2A.3.2 Test applicability

The requirements of this test apply in test case 6.5A.3.3 Additional Spectrum Emission Mask for network signalled values NS_02N and NS-24 to all types of E-UTRA UE release 17 and forward of UE category M1 that support satellite access operation.

The requirements of this test apply in test case 6.5A.4.4 Additional Spurious Emissions for network signalled values NS_02N and NS_24 to all types of E-UTRA UE release 17 and forward of UE category M1 that support satellite access operation.

6.2A.3.3 Minimum conformance requirements

Additional ACLR and spectrum emission requirements can be signalled by the network to indicate that the UE shall also meet additional requirements in a specific deployment scenario. To meet these additional requirements, Additional Maximum Power Reduction (A-MPR) is allowed for the output power as specified in Table 6.2A.1-1. Unless stated otherwise, an A-MPR of 0 dB shall be used.

For UE Power Class 3 and 5 the specific requirements and identified subclauses are specified in Table 6.2A.3-1 along with the allowed A-MPR values that may be used to meet these requirements. The allowed A-MPR values specified below in Table 6.2A.3-1 are in addition to the allowed MPR requirements specified in subclause 6.2A.2.

Table 6.2A.3-1: Additional Maximum Power Reduction (A-MPR) for category M1 UE

<table>
<tr><th>Network Signalling value</th><th>Requirements (subclause)</th><th>E-UTRA Band</th><th>Resources Blocks (N_{RB})</th><th colspan="2">A-MPR (dB)</th></tr>
<tr><td>NS_01</td><td>6.5A.4.2</td><td>Table 5.2-1</td><td>Table 5.3.1-1</td><td colspan="2">N/A</td></tr>
<tr><td>NS_02N</td><td>6.5A.4.4.2</td><td>255</td><td>Table 5.3.1-1</td><td colspan="2">N/A</td></tr>
<tr><td rowspan="2">NS_24</td><td rowspan="2">6.5A.4.4.3</td><td rowspan="2">256</td><td rowspan="2">Table 5.3.1-1</td><td>PC3</td><td>PC5</td></tr>
<tr><td>≤3.5</td><td>≤0.5</td></tr>
</table>

For subPRB allocation, the allowed A-MPR values specified below in Table 6.2A.3-2 for category M1 UE are in addition to the allowed MPR requirements specified in subclause 6.2A.2.

Table 6.2A.3-2: Additional Maximum Power Reduction (A-MPR) for category M1 UE for subPRB allocation

<table>
<tr><th>Network Signalling value</th><th>Requirements (subclause)</th><th>E-UTRA Band</th><th colspan="2">A-MPR (dB)</th></tr>
<tr><td>NS_01</td><td>6.5A.4.2</td><td>Table 5.2-1</td><td colspan="2">N/A</td></tr>
<tr><td>NS_02N</td><td>6.5A.4.4.2</td><td>255</td><td colspan="2">N/A</td></tr>
<tr><td>NS_24</td><td>6.5A.4.4.3</td><td>256</td><td colspan="2">[3.5]</td></tr>
<tr><td rowspan="2">NS_24</td><td rowspan="2">6.5A.4.4.3</td><td rowspan="2">256</td><td>PC3</td><td>PC5</td></tr>
<tr><td>≤3.5</td><td>≤0.5</td></tr>
</table>

The normative reference for this requirement is TS 36.102 [11] subclause 6.2A.3

6.2A.3.4 Test description

6.2A.3.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths based on E-UTRA operating bands specified in sub-clause 5.2E. All of these configurations shall be tested with applicable test parameters for each channel bandwidth and are shown in Table 6.2.4EA.4.1-1 to 6.2.4EA.4.1-20. The details of the uplink reference measurement channels (RMCs) are specified in Annex A.2. Configurations of PDSCH and MPDCCH before measurement are specified in Annex C.2.

Table 6.2A.3.4.1-1: Test Configuration Table (network signalled value “NS_02N”)

Initial Conditions				
Test Environment as specified in TS 36.508 [12] subclause 4.1			Normal	
Test Frequencies as specified in TS 36.508 [12] subclause 4.3.1			Low range, Mid range, High range	
Test Channel Bandwidths as specified in TS 36.508 [12] subclause 4.3.1			1.4MHz	
Test Parameters for Channel Bandwidths				
		Downlink Configuration	**Uplink Configuration**	
Configuration ID	Ch BW	N/A	Mod'n	RB allocation
				FDD and HD-FDD
1	1.4MHz		QPSK	2
2	1.4MHz		QPSK	5
3	1.4MHz		QPSK	6
4	1.4MHz		16QAM	2
5	1.4MHz		16QAM	5
Note 1: The RB_{start} of partial RB allocation shall be RB#0				

Table 6.2A.3.4.1-1a: Test Configuration Table, subPRB allocation (network signalled value “NS_02N”)

Initial Conditions				
Test Environment as specified in TS 36.508 [12] subclause 4.1			Normal	
Test Frequencies as specified in TS 36.508 [12] subclause 4.3.1			Low Range, Mid range, High Range	
Test Channel Bandwidths as specified in TS 36.508 [12] subclause 4.3.1			1.4MHz	
Test Parameters for Channel Bandwidths				
		Downlink Configuration	**Uplink Configuration**	
Configuration ID	**Ch BW**	N/A	**Mod'n**	**RB allocation**
				FDD and HD-FDD
1	1.4MHz		QPSK	½
Note 1: the SC_{start} shall be 0.				

Table 6.2A.3.4.1-2: Test Configuration Table (network signalled value "NS_24")

Initial Conditions				
Test Environment as specified in TS 36.508 [12] subclause 4.1			Normal	
Test Frequencies as specified in TS 36.508 [12] subclause 4.3.1			Low range, Mid range, High range	
Test Channel Bandwidths as specified in TS 36.508 [12] subclause 4.3.1			1.4MHz	
Test Parameters for Channel Bandwidths				
		Downlink Configuration	**Uplink Configuration**	
Configuration ID	Ch BW	N/A	Mod'n	RB allocation
				FDD and HD-FDD
1	1.4MHz		QPSK	2
2	1.4MHz		QPSK	5
3	1.4MHz		QPSK	6
4	1.4MHz		16QAM	2
5	1.4MHz		16QAM	5
Note 1: The RB_{start} of partial RB allocation shall be RB#0				

Table 6.2A.3.4.1-2a: Test Configuration Table, subPRB allocation (network signalled value "NS_24")

<table>
<tr><th colspan="5">Initial Conditions</th></tr>
<tr><td colspan="3">Test Environment as specified in
TS 36.508 [12] subclause 4.1</td><td colspan="2">Normal</td></tr>
<tr><td colspan="3">Test Frequencies as specified in
TS 36.508 [12] subclause 4.3.1</td><td colspan="2">Low Range, Mid range, High Range</td></tr>
<tr><td colspan="3">Test Channel Bandwidths as specified in
TS 36.508 [12] subclause 4.3.1</td><td colspan="2">1.4MHz</td></tr>
<tr><th colspan="5">Test Parameters for Channel Bandwidths</th></tr>
<tr><td></td><td></td><th>Downlink Configuration</th><th colspan="2">Uplink Configuration</th></tr>
<tr><th>Configuration ID</th><th>Ch BW</th><td rowspan="2">N/A</td><th>Mod'n</th><th>RB allocation</th></tr>
<tr><td></td><td></td><td></td><th>FDD and HD-FDD</th></tr>
<tr><td>1</td><td>1.4MHz</td><td></td><td>QPSK</td><td>½</td></tr>
<tr><td colspan="5">Note 1: the SC_{start} shall be 0.</td></tr>
</table>

1. Connect the SS to the UE antenna connectors as shown in TS 36.508 [12] Annex A Figure A.3 using only main UE Tx/Rx antenna.
2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1, and C.3.0, and uplink signals according to Annex H.1 and H.3.0.
4. The UL Reference Measurement channel is set according to Table 6.2A.3.4.1-1 to Table 6.2A.3.4.1-2.
5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 36.508 [12] clause 5.6.1 is provided to the UE through any preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31 information during the duration of the test as define in TS 36.508[12] clause 5.6.3.1.
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.
9. Ensure the UE is in State 3A-RF-CE according to TS 36.508 [12] clause 5.2A.2AA. Message contents are defined in clause 6.2A.3.4.3.

6.2A.3.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via M-PDCCH DCI format 6-0A for C_RNTI to schedule the UL RMC according to the applicable table from Table 6.2A.3.4.1-1 to Table 6.2A.3.4.1-2. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.
2. Send continuously uplink power control "up" commands in the uplink scheduling information to the UE until the UE transmits at P_{UMAX} level.
3. Measure the mean power of the UE in the channel bandwidth of the radio access mode. The period of measurement shall be at least the continuous duration one sub-frame (1ms). For HD-FDD slots with transient periods and Half-duplex guard subframe are not under test.
4. For UE supporting subPRB allocation, repeat step 1-3 with UL RMC according to applicable Table from Table 6.2A.3.4.1-1a to Table 6.2A.3.4.1-2a.

6.2A.3.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 4.6 with the condition CEModeA and with the following exceptions for each network signalled value.

6.2A.3.4.3.1 Message contents exceptions (network signalled value “NS_02N”)

1. Information element additionalSpectrumEmission is set to NS_02N. This can be set in the *SystemInformationblockType2* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.2A.3.4.3.1-1: *SystemInformationBlockType2*: Additional spurious emissions test requirement for “NS_02N”

Derivation Path: TS 36.508 [12] clause 4.4.3.3, Table 4.4.3.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	2(NS-02N)		

6.2A.3.4.3.2 Message contents exceptions (network signalled value "NS_24")

1. Information element additionalSpectrumEmission is set to NS_24. This can be set in the *SystemInformationblockType2* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.2A.3.4.3.2-1: *SystemInformationBlockType2*: Additional spurious emissions test requirement for "NS_24"

Derivation Path: TS 36.508 [12] clause 4.4.3.3, Table 4.4.3.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	24 (NS_24)		

6.2A.3.5 Test requirements

The maximum output power derived in step 3 shall be within the range prescribed by the nominal maximum output power and tolerance in the applicable table from Table 6.2.4EA.5-1 to Table 6.2.4EA.5-22. The allowed A-MPR values specified in Table 6.2.4EA-1 are in addition to the allowed MPR requirements specified in clause 6.2.3 EA. For the UE maximum output power modified by MPR and/or A-MPR, the power limits specified in Table 6.2.5 EA.3-1 and 6.2.5EA.3-2 apply.

Table 6.2A.3.5-1: UE Power Class test requirements (network signalled value “NS_02N”)

<table>
<tr><th rowspan="2">Config ID</th><th colspan="6">Power class 3</th><th colspan="6">Power class 5</th></tr>
<tr><th>MPR (dB)</th><th>A_MPR (dB)</th><th>$P_{CMAX\_L,c}$ (dBm)</th><th>$T(P_{CMAX\_L,c})$ (dB)</th><th>Upper limit (dBm)</th><th>Lower limit (dBm)</th><th>MPR (dB)</th><th>A_MPR (dB)</th><th>$P_{CMAX\_L,c}$ (dBm)</th><th>$T(P_{CMAX\_L,c})$ (dB)</th><th>Upper limit (dBm)</th><th>Lower limit (dBm)</th></tr>
<tr><td>1</td><td>0</td><td>N/A</td><td>23</td><td>2</td><td>25.7</td><td>20.3</td><td>0</td><td>N/A</td><td>20</td><td>2</td><td>22.7</td><td>17.3</td></tr>
<tr><td>2</td><td>1</td><td>N/A</td><td>22</td><td>2</td><td>25.7</td><td>19.3</td><td>1</td><td>N/A</td><td>19</td><td>3.5</td><td>22.7</td><td>14.8</td></tr>
<tr><td>3</td><td>2</td><td>N/A</td><td>21</td><td>2</td><td>25.7</td><td>18.3</td><td>2</td><td>N/A</td><td>18</td><td>4</td><td>22.7</td><td>13.3</td></tr>
<tr><td>4</td><td>1</td><td>N/A</td><td>22</td><td>2</td><td>25.7</td><td>19.3</td><td>1</td><td>N/A</td><td>19</td><td>3.5</td><td>22.7</td><td>14.8</td></tr>
<tr><td>5</td><td>2</td><td>N/A</td><td>21</td><td>2</td><td>25.7</td><td>18.3</td><td>2</td><td>N/A</td><td>18</td><td>4</td><td>22.7</td><td>13.3</td></tr>
<tr><td colspan="13">Note 1: $P_{CMAX,c}$ and $T(P_{CMAX\_L,c})$ are defined in TS 36.101 [7] clause 6.2.5</td></tr>
</table>

Table 6.2A.3.5-1a: UE Power Class test requirements, subPRB allocation (network signalled value “NS_02N”)

Config ID	Power class 3						Power class 5					
	MPR (dB)	A_MPR (dB)	$P_{CMAX\_L,c}$ (dBm)	T($P_{CMAX\_L,c}$) (dB)	Upper limit (dBm)	Lower limit (dBm)	MPR (dB)	A_MPR (dB)	$P_{CMAX\_L,c}$ (dBm)	T($P_{CMAX\_L,c}$) (dB)	Upper limit (dBm)	Lower limit (dBm)
1	0	N/A	23	2	25.7	20.3	0	N/A	20	2	22.7	17.3
Note 1: $P_{CMAX,c}$ and T($P_{CMAX\_L,c}$) are defined in TS 36.101 [7] clause 6.2.5												

Table 6.2A.3.5-2: UE Power Class test requirements (network signalled value "NS_24")

Config ID	Power class 3						Power class 5					
	MPR (dB)	A-MPR (dB)	$P_{CMAX\_L,c}$ (dBm)	T($P_{CMAX\_L,c}$) (dB)	Upper limit (dBm)	Lower limit (dBm)	MPR (dB)	A-MPR (dB)	$P_{CMAX\_L,c}$ (dBm)	T($P_{CMAX\_L,c}$) (dB)	Upper limit (dBm)	Lower limit (dBm)
1	0	3.5	19.5	3.5	25.7	15.3	0	0.5	19.5	3.5	22.7	15.3
2	1	3.5	19.5	3.5	25.7	15.3	1	0.5	19.0	3.5	22.7	14.8
3	2	3.5	19.5	3.5	25.7	15.3	2	0.5	18.0	4.0	22.7	13.3
4	1	3.5	19.5	3.5	25.7	15.3	1	0.5	19.0	3.5	22.7	14.8
5	2	3.5	19.5	3.5	25.7	15.3	2	0.5	18.0	4.0	22.7	13.3
Note 1: $P_{CMAX,c}$ and T($P_{CMAX\_L,c}$) are defined in TS 36.101 [7] clause 6.2.5												

Table 6.2A.3.5-1a: UE Power Class test requirements, subPRB allocation (network signalled value "NS_24")

Config ID	Power class 3						Power class 5					
	MPR (dB)	A-MPR (dB)	$P_{CMAX\_L,c}$ (dBm)	T($P_{CMAX\_L,c}$) (dB)	Upper limit (dBm)	Lower limit (dBm)	MPR (dB)	A-MPR (dB)	$P_{CMAX\_L,c}$ (dBm)	T($P_{CMAX\_L,c}$) (dB)	Upper limit (dBm)	Lower limit (dBm)
1	0	3.5	19.5	3.5	25.7	15.3	0	0.5	19.5	3.5	22.7	15.3
Note 1: $P_{CMAX,c}$ and T($P_{CMAX\_L,c}$) are defined in TS 36.101 [7] clause 6.2.5												

6.2A.4 Configured transmitted Power for category M1

6.2A.4.1 Test purpose

To verify the UE does not exceed the minimum between the P_{EMAX} maximum allowed UL TX Power signalled by the E-UTRAN and the P_{UMAX} maximum UE power the UE power class.

6.2A.4.2 Test applicability

This test applies to all types of E-UTRA UE release 17 and forward that support satellite access operation.

6.2A.4.3 Minimum conformance requirements

The configured transmitted power requirements in clause 6.2.5 of TS 36.101 [7] shall apply, wherein

- The Maximum output power requirements are specified in TS 36.102 [11] subclause 6.2A.1
- The MPR requirements are specified in TS 36.102 [11] subclause 6.2A.2

- The A-MPR requirements are specified in TS 36.102 [11] subclause 6.2A.3.

6.2A.4.4 Test description

6.2A.4.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths based on E-UTRA operating bands specified in table 5.2E. All of these configurations shall be tested with applicable test parameters for each channel bandwidth and are shown in table 6.2A.4.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annex A.2. Configurations of PDSCH and MPDCCH before measurement are specified in Annex C.2.

Table 6.2A.4.4.1-1: Test Configuration Table

<table>
<tr><th colspan="5">Initial Conditions</th></tr>
<tr><td colspan="2">Test Environment as specified in TS 36.508 [12] subclause 4.1</td><td colspan="3">Normal, TL/VL, TL/VH, TH/VL, TH/VH</td></tr>
<tr><td colspan="2">Test Frequencies as specified in TS 36.508 [12] subclause 4.3.1</td><td colspan="3">Mid range</td></tr>
<tr><td colspan="2">Test Channel Bandwidths as specified in TS 36.508 [12] subclause 4.3.1</td><td colspan="3">1.4MHz</td></tr>
<tr><th colspan="5">Test Parameters for Channel Bandwidths</th></tr>
<tr><th></th><th>Downlink Configuration</th><th colspan="3">Uplink Configuration</th></tr>
<tr><th rowspan="2">Ch BW</th><td rowspan="3">N/A for Configured UE transmitted Output Power test case</td><th rowspan="2">Mod'n</th><th colspan="2">RB allocation</th></tr>
<tr><th>FDD and HD-FDD</th><th>Narrowband index (Note 1)</th></tr>
<tr><td>1.4MHz</td><td>QPSK</td><td>1 (Note 3),
2 (Note 4)</td><td>0</td></tr>
<tr><td colspan="5">NOTE 1: Denote where in the channel bandwidth the narrowband shall be placed. Narrowband and narrowband index are defined in TS 36.211[3], 5.2.4.
NOTE 2: The RB_{start} of partial RB allocation shall be RB#0 of the narrowband.
NOTE 3: Only applicable for Power class 3.
NOTE 4: Only applicable for Power class 5.</td></tr>
</table>

1. Connect the SS to the UE antenna connectors as shown in TS 36.508 [12] Annex A, in Figure A.3 using only main UE Tx/Rx antenna.
2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1, and C.3.0, and uplink signals according to Annex H.1 and H.3.0.
4. The UL Reference Measurement channel is set according to Table 6.2A.4.4.1-1
5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 36.508 [12] clause 5.6.1 is provided to the UE through any preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31 information during the duration of the test as define in TS 36.508[12] clause 5.6.3.1.
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.
9. Ensure the UE is in State 3A-RF-CE according to TS 36.508 [12] clause 5.2A.2AA. Message contents are defined in clause 6.2A.4.4.3.

6.2A.4.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via MPDCCH DCI format 6-0A for C_RNTI to schedule the UL RMC according to Table 6.2A.4.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

2. Send transmit uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200ms for the UE to reach the Pumax level of the test point.

3. Measure the mean power of the UE in the channel bandwidth for each test point in table 6.2A.4.5-1 for power class 3 and table 6.2A.4.5-2 for power class 5 according to the test configuration from Table 6.2A.4.4.1-1. The period of measurement shall be at least continuous duration of one sub-frame (1ms). For HD-FDD slots with transient periods and Half-duplex guard subframe are not under test.

6.2A.4.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 4.6 with the following exceptions

Table 6.2A.4.4.3-1: SystemInformationBlockType1-BR-r13: Test point 1 for power class 3

Derivation Path: TS 36.508 [12] clause 4.4.3.2, Table 4.4.3.2-3A SystemInformationBlockType1-BR-r13			
Information Element	**Value/remark**	**Comment**	**Condition**
p-Max	-10		

Table 6.2A.4.4.3-2: SystemInformationBlockType1-BR-r13: Test point 2 for power class 3

Derivation Path: TS 36.508 [12] clause 4.4.3.2, Table 4.4.3.2-3A SystemInformationBlockType1-BR-r13			
Information Element	**Value/remark**	**Comment**	**Condition**
p-Max	10		

Table 6.2A.4.4.3-3: SystemInformationBlockType1-BR-r13: Test point 3 for power class 3

Derivation Path: TS 36.508 [12] clause 4.4.3.2, Table 4.4.3.2-3A SystemInformationBlockType1-BR-r13			
Information Element	**Value/remark**	**Comment**	**Condition**
p-Max	15		

Table 6.2A.4.4.3-4: SystemInformationBlockType1-BR-r13: Test point 1 for power class 5

Derivation Path: TS 36.508 [12] clause 4.4.3.2, Table 4.4.3.2-3A SystemInformationBlockType1-BR-r13			
Information Element	**Value/remark**	**Comment**	**Condition**
p-Max	-10		

Table 6.2A.4.4.3-5: SystemInformationBlockType1-BR-r13: Test point 2 for power class 5

Derivation Path: TS 36.508 [12] clause 4.4.3.2, Table 4.4.3.2-3A SystemInformationBlockType1-BR-r13			
Information Element	**Value/remark**	**Comment**	**Condition**
p-Max	7		

Table 6.2A.4.4.3-6: SystemInformationBlockType1-BR-r13: Test point 3 for power class 5

Derivation Path: TS 36.508 [12] clause 4.4.3.2, Table 4.4.3.2-3A SystemInformationBlockType1-BR-r13			
Information Element	**Value/remark**	**Comment**	**Condition**
p-Max	12		

6.2A.4.5 Test requirements

The maximum output power measured shall not exceed the values specified in Table 6.2A.4.5-1 for power class 3 and Table 6.2A.4.5-2 for power class 5.

Table 6.2A.4.5-1: P_{CMAX} configured UE output power for UE category M1 power class 3

	Channel bandwidth / maximum output power
	1.4MHz
Measured UE output power test point 1	For carrier frequency f ≤ 3.0GHz: -10 dBm ± 7.7 For carrier frequency 3.0GHz < f ≤ 4.2GHz: -10 dBm ± 8.0
Measured UE output power test point 2	For carrier frequency f ≤ 3.0GHz: 10 dBm ± 6.7 For carrier frequency 3.0GHz < f ≤ 4.2GHz: 10 dBm ± 7.0
Measured UE output power test point 3	For carrier frequency f ≤ 3.0GHz: 15 dBm ± 5.7 For carrier frequency 3.0GHz < f ≤ 4.2GHz: 15 dBm ± 6.0

Table 6.2A.4.5-2: P_{CMAX} configured UE output power for UE category M1 power class 5

	Channel bandwidth / maximum output power
	1.4MHz
Measured UE output power test point 1	For carrier frequency f ≤ 3.0GHz: -10 dBm ± 7.7 For carrier frequency 3.0GHz < f ≤ 4.2GHz: -10 dBm ± 8.0
Measured UE output power test point 2	For carrier frequency f ≤ 3.0GHz: 7 dBm ± 7.7 For carrier frequency 3.0GHz < f ≤ 4.2GHz: 7 dBm ± 8.0
Measured UE output power test point 3	For carrier frequency f ≤ 3.0GHz: 12 dBm ± 6.7 For carrier frequency 3.0GHz < f ≤ 4.2GHz: 12 dBm ± 7.0

6.2B Transmit power for category NB1 and NB2

6.2B.1 UE maximum output power for category NB1 and NB2

6.2B.1.1 Test purpose

To verify that the error of the UE maximum output power does not exceed the range prescribed by the specified nominal maximum output power and tolerance.

An excess maximum output power has the possibility to interfere to other channels or other systems. A small maximum output power decreases the coverage area.

6.2B.1.2 Test applicability

This test case applies to all types of NB-IoT UE release 17 and forward of category NB1 and NB2 that support satellite access operation.

6.2B.1.3 Minimum conformance requirements

Category NB1 and NB2 UE Power Classes are specified in Table 6.2B.1.3-1 and define the maximum output power for any transmission bandwidth within the category NB1 and NB2 channel bandwidth. For 3.75kHz sub-carrier spacing the maximum output power is defined as mean power of measurement which period is at least one slot (2ms) excluding the 2304Ts gap when UE is not transmitting. For 15kHz sub-carrier spacing the maximum output power is defined as mean power of measurement which period is at least one sub-frame (1ms).

Table 6.2B.1.3-1: UE Power Class

EUTRA band	Class 3 (dBm)	Tolerance (dB)	Class 5 (dBm)	Tolerance (dB)
256	23	+/-2	20	+/-2
255	23	+/-2	20	+/-2
254	23	+/-2	20	+/-2
253	23	+/-2	20	+/-2

The normative reference for this requirement is TS 36.102 [11] clause 6.2B.1.

6.2B.1.4 Test description

6.2B.1.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions and test frequencies based on the subset of E-UTRA operating bands defined for NB-IoT NTN in clause 5.2B. All of these configurations shall be tested with applicable test parameters and are shown in table 6.2B.1.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in TS 36.521 Annex A.2. Configurations of NPDSCH and NPDCCH before measurement are specified in TS 36.521 Annex C.2.

Table 6.2B.1.4.1-1: Test Configuration Initial Conditions for FDD

<table>
<tr><th colspan="5">Initial Conditions</th></tr>
<tr><td colspan="2">Test Environment as specified in
TS 36.508 [12] subclause 8.1.1</td><td colspan="3">Normal, TL/VL, TL/VH, TH/VL, TH/VH</td></tr>
<tr><td colspan="2">Test Frequencies as specified in
TS 36.508 [12] subclause 8.1.3.1</td><td colspan="3">Frequency ranges defined in Annex K.1.2</td></tr>
<tr><th colspan="5">Test Parameters</th></tr>
<tr><th rowspan="2">Configuration ID</th><th>Downlink Configuration</th><th colspan="3">Uplink Configuration</th></tr>
<tr><td rowspan="6">N/A</td><th>Modulation</th><th>N_{tones}</th><th>Sub-carrier spacing (kHz)</th></tr>
<tr><td>1 (Note 2)</td><td>BPSK</td><td>1@0</td><td>3.75</td></tr>
<tr><td>2 (Note 3)</td><td>BPSK</td><td>1@47</td><td>3.75</td></tr>
<tr><td>3 (Note 2)</td><td>QPSK</td><td>1@0</td><td>15</td></tr>
<tr><td>4 (Note 3)</td><td>QPSK</td><td>1@11</td><td>15</td></tr>
<tr><td>5 (Note 1)</td><td>QPSK</td><td>3@3</td><td>15</td></tr>
<tr><td colspan="5">NOTE 1: Applicable to UE supporting UL multi-tone transmissions.
NOTE 2: only applicable for low range.
NOTE 3: only applicable for high range.</td></tr>
</table>

1. Connect the SS to the UE antenna connectors as shown in TS 36.508 [12] Annex A Figure A.3 using only the main UE Tx/Rx antenna.
2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 8.1.4.3.
3. Downlink signals are initially set up according to TS 36.521 Annex C.0, C.1, and C.3.0, and uplink signals according to Annex H.1.1 and H.4.0.
4. The UL Reference Measurement channel is set according to Table 6.2B.1.4.1-1.
5. Propagation conditions are set according to Annex B.0
6. UE location according to TS 36.508 [12] clause 8.2.6.1 is provided to the UE through any preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 8.2.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 8.2.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31-NB information during the duration of the test as define in TS 36.508[12] clause 8.2.6.3.1.

8. Deactivate UE prediction of satellite trajectory by any preconfigured means.
9. Ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5. Message contents are defined in clause 6.2B.1.4.3.

6.2B.1.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via NPDCCH with DCI format N0 for C_RNTI to schedule the UL RMC according to Table 6.2B.1.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC (UE should be already transmitting P_{UMAX} after Initial Conditions setting).
2. Measure the mean power of the UE in the channel bandwidth of the radio access mode. The period of measurement shall be at least the continuous duration of one sub-frame (1ms) for sub-carrier spacing of 15 kHz or one slot (2ms) excluding the 2304Ts gap when UE is not transmitting for sub-carrier spacing of 3.75 kHz. For TDD slots with transient periods are not under test. For Half-Duplex guard subframes are not under test.

NOTE 1: For configuration IDs applicable to UE depending on UE capability in Test Configuration Table with different UL sub-carrier spacing, the SS shall release the connection through State 3A-NB and finally ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5 using the appropriate UL subcarrier spacing in Random Access Response message.

6.2B.1.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 8.1.6.

6.2B.1.5 Test requirements

The maximum output power derived in step 2 shall be within the range prescribed by the nominal maximum output power and tolerance in Table 6.2B.1.5-1.

Table 6.2B.1.5-1: UE Power Class test requirement

EUTRA band	Class 3 (dBm)	Tolerance (dB)	Class 5 (dBm)	Tolerance (dB)
256	23	+/-2.7	20	+/-2.7
255	23	+/-2.7	20	+/-2.7
254	23	+/-2.7	20	+/-2.7
253	23	+/-2.7	20	+/-2.7

6.2B.2 UE maximum output power reduction for category NB1 and NB2

6.2B.2.1 Test purpose

To verify that the error of the UE maximum output power does not exceed the range prescribed by the specified nominal maximum output power and tolerance covering configurations where a maximum power reduction is allowed in the UE.

An excess maximum output power has the possibility to interfere to other channels or other systems. A small maximum output power decreases the coverage area.

6.2B.2.2 Test applicability

The requirements of this test apply in test case 6.6.2.3F Adjacent Channel Leakage power Ratio for category NB1 and NB2 to all types of NB-IoT FDD UE release 17 and forward of category NB2 that support satellite access operation.

6.2B.2.3 Minimum conformance requirements

For UE category NB1 power class 3 and 5 the allowed Maximum Power Reduction (MPR) for the maximum output power given in Table 6.2B.1.3-1 is specified in Table 6.2B.2.3-1.

Table 6.2B.2.3-1: Maximum Power Reduction (MPR) for UE category NB1 and NB2 Power Class 3 and 5

Modulation	QPSK		
Tone positions for 1 Tone allocation	0-11		
MPR	0 dB		
Tone positions for 3 Tones allocation	0-2	3-5 and 6-8	9-11
MPR	≤ 0.5 dB	0 dB	≤ 0.5 dB
Tone positions for 6 Tones allocation	0-5 and 6-11		
MPR	≤ 1 dB	≤ 1 dB	
Tone positions for 12 Tones allocation	0-11		
MPR	≤ 2 dB		

The normative reference for this requirement is TS 36.102 [11] clause 6.2B.2

6.2B.2.4 Test description

6.2B.2.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions and test frequencies based on the subset of E-UTRA operating bands defined for NB-IoT NTN in clause 5.2B. All of these configurations shall be tested with applicable test parameters, and are shown in table 6.2B.1.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in TS 36.521 Annex A.2. Configurations of NPDSCH and NPDCCH before measurement are specified in TS 36.521 Annex C.2.

Table 6.2B.2.4.1-1: Test Configuration Table

Initial Conditions				
Test Environment as specified in TS 36.508 [12] subclause 8.1.1		Normal, TL/VL, TL/VH, TH/VL, TH/VH		
Test Frequencies as specified in TS 36.508 [12] subclause 8.1.3.1		Frequency ranges defined in Annex K.1.2		
Test Parameters				
Configuration ID	**Downlink Configuration**	**Uplink Configuration**		
	N/A for Maximum Power Reduction (MPR) test case	**Modulation**	**N_{tones}**	**Sub-carrier spacing (kHz)**
1		QPSK	1@0	3.75
2		QPSK	1@47	3.75
3		BPSK	1@0	15
4		BPSK	1@11	15
5 (Note 1)		QPSK	3@0	15
6 (Note 1)		QPSK	3@3	15
7 (Note 1)		QPSK	3@9	15
8 (Note 1)		QPSK	6@0	15
9 (Note 1)		QPSK	6@6	15
10 (Note 1)		QPSK	12@0	15
NOTE 1: Applicable to UE supporting UL multi-tone transmissions.				

1. Connect the SS to the UE antenna connectors as shown in TS 36.508 [12] Annex A Figure A.3 using only main UE Tx/Rx antenna.

2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 8.1.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, and C.3.0, and uplink signals according to Annex H.1 and H.3.0.

4. The UL Reference Measurement channels are set according to Table 6.2B.2.4.1-1.

5. UE location according to TS 36.508 [12] clause 8.2.6.1 is provided to the UE through any preconfigured means

6. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 8.2.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 8.2.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31-NB information during the duration of the test as define in TS 36.508[12] clause 8.2.6.3.1.

7. Deactivate UE prediction of satellite trajectory by any preconfigured means.

8. Ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5. Message contents are defined in clause 6.2.3F.4.3.

6.2B.2.4.2 Test procedure

1. SS sends uplink scheduling information via NPDCCH DCI format N0 for C_RNTI to schedule the UL RMC according to Table 6.2B.2.4.1-1 and with scheduling pattern and repetitions according to Annex A.2. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

2. Measure the mean power of the UE in the channel bandwidth of the radio access mode. The period of measurement shall be at least the continuous duration one sub-frame (1ms) for 15 kHz sub-carrier spacing, or for 3.75 kHz sub-carrier spacing at least one slot (2 ms) excluding the 2304Ts gap when UE is not transmitting. For TDD slots with transient periods are not under test.

NOTE 1: For configuration IDs applicable to UE depending on UE capability in Test Configuration Table with different UL sub-carrier spacing, the SS shall release the connection through State 3A-NB and finally ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5 using the appropriate UL subcarrier spacing in Random Access Response message.

6.2B.2.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 8.1.6.

6.2B.2.4.4 Test requirements

The maximum output power derived in step 2 shall be within the range prescribed by the nominal maximum output power and tolerance in Table 6.2B.2.4-1.

Table 6.2B.2.4-1: Maximum Power Reduction test requirements Power Class 3 and 5

Test ID	MPR (dB)	Power class 3				Power class 5			
		$P_{CMAX,c}$ (dBm)	$T(P_{CMAX\_L,c})$ (dB)	Upper limit (dBm)	Lower limit (dBm)	$P_{CMAX,c}$ (dBm)	$T(P_{CMAX\_L,c})$ (dB)	Upper limit (dBm)	Lower limit (dBm)
1	0	23	2.0	25.7	20.3	20	2.0	22.7	17.3
2	0	23	2.0	25.7	20.3	20	2.0	22.7	17.3
3	0	23	2.0	25.7	20.3	20	2.0	22.7	17.3
4	0	23	2.0	25.7	20.3	20	2.0	22.7	17.3
5	0.5	22.5	2.0	25.7	19.8	19.5	2.0	22.7	16.8
6	0	23	2.0	25.7	20.3	20	2.0	22.7	17.3
7	0.5	22.5	2.0	25.7	19.8	19.5	2.0	22.7	16.8
8	1	22	2.0	25.7	19.3	19	2.0	22.7	16.3
9	1	22	2.0	25.7	19.3	19	2.0	22.7	16.3
10	2	21	2.0	25.7	18.3	18	2.0	22.7	15.3
NOTE 1: $P_{CMAX,c}$ and $T(P_{CMAX\_L,c})$ are defined in TS 36.101 [7] clause 6.2.5F									

6.2B.3 UE additional maximum output power reduction for category NB1 and NB2 UE

6.2B.3.1 Test purpose

Additional ACLR and spectrum emission requirements can be signalled by the network to indicate that the UE shall also meet additional requirements in a specific deployment scenario. To meet these additional requirements, Additional Maximum Power Reduction A-MPR is allowed for the output power as specified in Table 6.2B.1-1. Unless stated otherwise, an A-MPR of 0 dB shall be used.

6.2B.3.2 Test applicability

The requirements of this test apply in test case 6.5A.4.4 Additional Spurious Emissions for network signalled values NS_02N and NS_24 to all types of NB-IOT NTN UE release 17 and forward of UE category NB1 and NB2 that support satellite access operation.

6.2B.3.3 Minimum conformance requirements

Additional ACLR and spectrum emission requirements can be signalled by the network to indicate that the UE shall also meet additional requirements in a specific deployment scenario. To meet these additional requirements, Additional Maximum Power Reduction (A-MPR) is allowed for the output power as specified in Table 6.2B.1-1. Unless stated otherwise, an A-MPR of 0 dB shall be used.

For UE Power Class 3 and 5 the specific requirements and identified subclauses are specified in Table 6.2B.3-1 along with the allowed A-MPR values that may be used to meet these requirements. The allowed A-MPR values specified below in Table 6.2B.3.3-1 are in addition to the allowed MPR requirements specified in subclause 6.2B.2.

Table 6.2B.3.3-1: Additional Maximum Power Reduction (A-MPR) for category NB1 and NB2 UE

<table>
<tr><th>Network Signalling value</th><th>Requirements (subclause)</th><th>NB-IOT NTN Band</th><th colspan="2">A-MPR (dB)</th></tr>
<tr><td>NS_01</td><td>6.5B.4.2</td><td>Table 5.2-1</td><td colspan="2">N/A</td></tr>
<tr><td>NS_02N</td><td>6.5B.4.4.2</td><td>255</td><td colspan="2">N/A</td></tr>
<tr><td>NS_24</td><td>6.5B.4.4.3</td><td>256</td><td colspan="2">[3.5]</td></tr>
<tr><td rowspan="2">NS_24</td><td rowspan="2">6.5B.4.4.3</td><td rowspan="2">256</td><td>PC3</td><td>PC5</td></tr>
<tr><td>≤3.5</td><td>≤ 0.5</td></tr>
</table>

The normative reference for this requirement is TS 36.102 [11] subclause 6.2B.3

6.2B.3.4 Test description

6.2B.3.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths based on NB-IOT NTN operating bands specified in sub-clause 5.2B. All these configurations shall be tested with applicable test parameters for each channel bandwidth and are shown in Table 6.2B.3.4.1-1 to 6.2B.3.4.1-2. The details of the uplink reference measurement channels (RMCs) are specified in Annex A.2. Configurations of NPDSCH and NPDCCH before measurement are specified in Annex C.2.

Table 6.2B.3.4.1-1: Test Configuration Table (network signalled value “NS_02N”)

Initial Conditions				
Test Environment as specified in TS 36.508 [12] subclause 8.1.1		NC		
Test Frequencies as specified in TS 36.508 [12] subclause 8.1.3.1		Frequency ranges defined in Annex K.1.2		
Test Parameters				
Configuration ID	**Downlink Configuration**	**Uplink Configuration**		
	N/A for Maximum Power Reduction (MPR) test case	Modulation	N_{tones}	Sub-carrier spacing (kHz)
1 (Note 1)		QPSK	3@0	15
2 (Note 1)		QPSK	3@3	15
3 (Note 1)		QPSK	3@9	15
4 (Note 1)		QPSK	6@0	15
5 (Note 1)		QPSK	6@6	15
6 (Note 1)		QPSK	12@0	15
Note 1: Applicable to UE supporting UL multi-tone transmissions				

Table 6.2B.3.4.1-2: Test Configuration Table (network signalled value "NS_24")

Initial Conditions				
Test Environment as specified in TS 36.508 [12] subclause 8.1.1		NC		
Test Frequencies as specified in TS 36.508 [12] subclause 8.1.3.1		Frequency ranges defined in Annex K.1.2		
Test Parameters				
Configuration ID	**Downlink Configuration**	**Uplink Configuration**		
	N/A for Maximum Power Reduction (MPR) test case	Modulation	N_{tones}	Sub-carrier spacing (kHz)
1 (Note 1)		QPSK	3@0	15
2 (Note 1)		QPSK	3@3	15
3 (Note 1)		QPSK	3@9	15
4 (Note 1)		QPSK	6@0	15
5 (Note 1)		QPSK	6@6	15
6 (Note 1)		QPSK	12@0	15
Note 1: Applicable to UE supporting UL multi-tone transmissions				

1. Connect the SS to the UE antenna connectors as shown in TS 36.508 [12] Annex A Figure A.3 using only main UE Tx/Rx antenna.
2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 8.1.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1, and C.3.0, and uplink signals according to Annex H.1 and H.3.0.
4. The UL Reference Measurement channel is set according to Table 6.2B.3.4.1-1 to Table 6.2B.3.4.1-2.
5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 36.508 [12] clause 8.2.6.1 is provided to the UE through any preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 8.2.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 8.2.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31-NB information during the duration of the test as define in TS 36.508[12] clause 8.2.6.3.1.
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.
9. Ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause8.1.5. Message contents are defined in clause 6.2B.3.4.3.

6.2B.3.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via N-PDCCH DCI format N0 for C_RNTI to schedule the UL RMC according to the applicable table from Table 6.2B.3.4.1-1 to Table 6.2B.3.4.1-2. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.

2. Measure the mean power of the UE in the channel bandwidth of the radio access mode. The period of measurement shall be at least the continuous duration one sub-frame (1ms) for 15 kHz sub-carrier spacing, or for 3.75 kHz sub-carrier spacing at least one slot (2 ms) excluding the 2304Ts gap when UE is not transmitting. For HD-FDD slots with transient periods and Half-duplex guard subframe are not under test.

6.2B.3.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 8.1.6 and with the following exceptions for each network signalled value.

6.2B.3.4.3.1 Message contents exceptions (network signalled value “NS_02N”)

Information element additionalSpectrumEmission is set to NS_02N. This can be set in the *SystemInformationblockType2* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.2B.3.4.3.1-1: *SystemInformationBlockType2*: Additional spurious emissions test requirement for “NS_02N”

Derivation Path: TS 36.508 [12] clause 8.1.4.3, Table 8.1.4.3.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	2(NS_02N)		

6.2B.3.4.3.2 Message contents exceptions (network signalled value "NS_24")

Information element additionalSpectrumEmission is set to NS_24. This can be set in the *SystemInformationblockType2* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.2B.3.4.3.2-1: *SystemInformationBlockType2*: Additional spurious emissions test requirement for "NS_24"

Derivation Path: TS 36.508 [12] clause 8.1.4.3, Table 8.1.4.3.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	24 (NS_24)		

6.2B.3.5 Test requirement

The maximum output power derived in step 3 shall be within the range prescribed by the nominal maximum output power and tolerance in the applicable table from Table 6.2B.3.5-1 to Table 6.2B.3.5-2. The allowed A-MPR values specified in Table 6.2B.3.3-1 are in addition to the allowed MPR requirements specified in clause 6.2B.3. For the UE maximum output power modified by MPR and/or A-MPR, the power limits specified in TS.36.521-1[14] Table 6.2.5 F.3-1 and 6.2.5F.3-2 apply.

Table 6.2B.3.5-1: UE Power Class test requirements (network signalled value “NS_02N”)

Test ID	MPR (dB)	A_MPR (dB)	Power class 3				Power class 5			
			$P_{CMAX,c}$ (dBm)	$T(P_{CMAX\_L,c})$ (dB)	Upper limit (dBm)	Lower limit (dBm)	$P_{CMAX,c}$ (dBm)	$T(P_{CMAX\_L,c})$ (dB)	Upper limit (dBm)	Lower limit (dBm)
1	0.5	N/A	22.5	2.0	25.7	19.8	19.5	2.0	22.7	16.8
2	0	N/A	23	2.0	25.7	20.3	20	2.0	22.7	17.3
3	0.5	N/A	22.5	2.0	25.7	19.8	19.5	2.0	22.7	16.8
4	1	N/A	22	2.0	25.7	19.3	19	2.0	22.7	16.3
5	1	N/A	22	2.0	25.7	19.3	19	2.0	22.7	16.3
6	2	N/A	21	2.0	25.7	18.3	18	2.0	22.7	15.3
NOTE 1: $P_{CMAX,c}$ and $T(P_{CMAX\_L,c})$ are defined in TS 36.101 [7] clause 6.2.5F										

Table 6.2B.3.5-2: UE Power Class test requirements (network signalled value "NS_24")

Test ID	MPR (dB)	A_MPR (dB)	Power class 3				Power class 5			
			$P_{CMAX,c}$ (dBm)	$T(P_{CMAX\_L,c})$ (dB)	Upper limit (dBm)	Lower limit (dBm)	$P_{CMAX,c}$ (dBm)	$T(P_{CMAX\_L,c})$ (dB)	Upper limit (dBm)	Lower limit (dBm)
1	0.5	3.5	19.5	3.5	25.7	15.3	19.5	3.5	22.7	15.3
2	0	3.5	19.5	3.5	25.7	15.3	19.5	3.5	22.7	15.3
3	0.5	3.5	19.5	3.5	25.7	15.3	19.5	3.5	22.7	15.3
4	1	3.5	19.5	3.5	25.7	15.3	19.0	3.5	22.7	15.3
5	1	3.5	19.5	3.5	25.7	15.3	19.0	3.5	22.7	14.8
6	2	3.5	19.5	3.5	25.7	15.3	18.0	4.0	22.7	13.3
NOTE 1: $P_{CMAX,c}$ and $T(P_{CMAX\_L,c})$ are defined in TS 36.101 [7] clause 6.2.5F										

6.2B.4 Configured transmitted Power for category NB1 and NB2

6.2B.4.1 Test purpose

To verify the UE does not exceed the minimum between the P_{EMAX} maximum allowed UL TX Power signalled by the E-UTRAN and the P_{UMAX} maximum UE power for the UE power class.

6.2B.4.2 Test applicability

This test case applies to all types of NB-IoT UE release 17 and forward of category NB1 and NB2 that support satellite access operation.

6.2B.4.3 Minimum conformance requirements

For category M1 UE, the configured transmitted power requirements in clause 6.2.5F of TS 36.101 [7] shall apply, wherein

- The Maximum output power requirements are specified in TS 36.102 [11] subclause 6.2B.1
- The MPR requirements are specified in TS 36.102 [11] subclause 6.2B.2
- The A-MPR requirements are specified in TS 36.102 [11] subclause 6.2B.3.

6.2B.4.4 Test description

6.2B.4.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions and test frequencies based on the subset of E-UTRA operating bands defined for NB-IoT in clause 5.2. All of these configurations shall be tested with applicable test parameters for each channel bandwidth and are shown in table 6.2B.4.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in A.2.4. Configurations of NPDSCH and NPDCCH before measurement are specified in Annex C.2.

Table 6.2B.4.4.1-1: Test Configuration Table for FDD & TDD

Initial Conditions				
Test Environment as specified in TS 36.508 [12] subclause 8.1.1		Normal		
Test Frequencies as specified in TS 36.508 [12] subclause 8.1.3.1		Frequency ranges defined in Annex K.1.1		
Test Parameters				
Configuration ID	**Downlink Configuration**	**Uplink Configuration**		
	N/A	**Modulation**	N_{tones}	**Sub-carrier spacing (kHz)**
1		QPSK	1@0	3.75
2		QPSK	1@47	3.75
3		QPSK	1@0	15
4		QPSK	1@11	15
5 (Note 1)		QPSK	12@0	15
NOTE 1: Applicable to UE supporting UL multi-tone transmissions.				

1. Connect the SS to the UE antenna connectors as shown in TS 36.508 [12] Annex A, in Figure A.3 using only main UE Tx/Rx antenna.
2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 8.1.4.3.
3. Downlink signals are initially set up according to Annex C, and uplink signals according to Annex H.
4. The UL Reference Measurement channel is set according to Table 6.2B.4.4.1-1
5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 36.508 [12] clause 8.2.6.1 is provided to the UE through any preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 8.2.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 8.2.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31-NB information during the duration of the test as define in TS 36.508[12] clause 8.2.6.3.1.
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.
9. Ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5. Message contents are defined in clause 6.2B.4.4.3.

6.2B.4.4.2 Test procedure

1. SS sends uplink scheduling information for UL HARQ process via NPDCCH DCI format N0 for C_RNTI to schedule the UL RMC according to Table 6.2B.4.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.
2. Configure UE to transmit NPUSCH with the Pumax level of each test points.
3. Measure the mean power of the UE in the channel bandwidth for each test point in table 6.2B.4.4-1 according to the test configuration from table 6.2B.4.4-1. The period of measurement shall be at least continuous duration of one sub-frame **(**1ms) for 15 KHz channel spacing, and at least a 2ms slot (excluding the 2304Ts gap when UE is not transmitting) respectively for the 3.75 KHz channel spacing. For TDD slots with transient periods are not under test.

6.2B.4.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 8.1.6 with the following exceptions:

Table 6.2B.4.4.3-1: SystemInformationBlockType1: Test point 1 for power class 3

Derivation Path: TS 36.508 [12] clause 8.1.4, Table 8.1.4.3.2-3 SystemInformationBlockType1			
Information Element	**Value/remark**	**Comment**	**Condition**
p-Max	-10		

Table 6.2B.4.4.3-2: SystemInformationBlockType1: Test point 2 for power class 3

Derivation Path: TS 36.508 [12] clause 8.1.4, Table 8.1.4.3.2-3 SystemInformationBlockType1			
Information Element	**Value/remark**	**Comment**	**Condition**
p-Max	10		

Table 6.2B.4.4.3-3: SystemInformationBlockType1: Test point 3 for power class 3

Derivation Path: TS 36.508 [12] clause 8.1.4, Table 8.1.4.3.2-3 SystemInformationBlockType1			
Information Element	**Value/remark**	**Comment**	**Condition**
p-Max	15		

Table 6.2B.4.4.3-4: SystemInformationBlockType1: Test point 1 for power class 5

Derivation Path: TS 36.508 [12] clause 8.1.4, Table 8.1.4.3.2-3 SystemInformationBlockType1			
Information Element	**Value/remark**	**Comment**	**Condition**
p-Max	-10		

Table 6.2B.4.4.3: SystemInformationBlockType1: Test point 2 for power class 5

Derivation Path: TS 36.508 [12] clause 8.1.4, Table 8.1.4.3.2-3 SystemInformationBlockType1			
Information Element	**Value/remark**	**Comment**	**Condition**
p-Max	7		

Table 6.2B.4.4.3: SystemInformationBlockType1: Test point 3 for power class 5

Derivation Path: TS 36.508 [12] clause 8.1.4, Table 8.1.4.3.2-3 SystemInformationBlockType1			
Information Element	**Value/remark**	**Comment**	**Condition**
p-Max	12		

6.2B.5 Test requirement

The maximum output power measured shall not exceed the values specified in Table 6.2B.5-1.

Table 6.2B.5-1: P_{CMAX} configured UE output power for power class 3

	maximum output power
Measured UE output power test point 1	For carrier frequency f ≤ 3.0GHz: -10 dBm ± 7.7
Measured UE output power test point 2	For carrier frequency f ≤ 3.0GHz: 10 dBm ± 6.7
Measured UE output power test point 3	For carrier frequency f ≤ 3.0GHz: 15 dBm ± 5.7

Table 6.2B.5-2: P_{CMAX} configured UE output power for power class 5

	maximum output power
Measured UE output power test point 1	For carrier frequency f ≤ 3.0GHz: -10 dBm ± 7.7
Measured UE output power test point 2	For carrier frequency f ≤ 3.0GHz: 7 dBm ± 6.7
Measured UE output power test point 3	For carrier frequency f ≤ 3.0GHz: 12 dBm ± 5.7

6.3 Output power dynamics

This clause is reserved.

6.3A Output power dynamics for category M1

6.3A.1 UE Minimum output power for category M1

6.3A.1.1 Test purpose

To verify the UE's ability to transmit with a broadband output power below the value specified in the test requirement when the power is set to a minimum value.

6.3A.1.2 Test applicability

This test case applies to all types of E-UTRA UE release 17 and forward of UE category M1 that support satellite access operation.

6.3A.1.3 Minimum conformance requirements

The minimum output power is defined as the mean power in one sub-frame (1ms). The minimum output power shall not exceed the values specified in Table 6.3A.1-1.

Table 6.3A.1-1: Minimum output power

	Channel bandwidth / minimum output power / measurement bandwidth
	1.4MHz
Minimum output power	-40 dBm
Measurement bandwidth	1.08 MHz

The normative reference for this requirement is TS 36.102 [11] clause 6.3A.1.

Minimum output power test verifies the UE's ability to transmit with a broadband output power below the specified limit when the power is set to a minimum value. The broadband output power is defined as the power in the channel bandwidth, for all transmit bandwidth configurations (resource blocks).

An excess minimum output power potentially increases the Rise Over Thermal (RoT) and therefore reduces the cell coverage area for other UEs.

6.3A.1.4 Test description

6.3A.1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths based on operating bands for satellite access that specified in table 5.2-1. All these configurations shall be tested with applicable test parameters for each channel bandwidth and are shown in table 6.3A.1.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annex A.2. Configurations of PDSCH and MPDCCH before measurement are specified in Annex C.2.

Table 6.3A.1.4.1-1: Test Configuration Table

Initial Conditions			
Test Environment as specified in TS 36.508 [12] subclause 4.1	Normal, TL/VL, TL/VH, TH/VL, TH/VH		
Test Frequencies as specified in TS 36.508 [12] subclause 4.3.1	Low range, Mid range, High range		
Test Channel Bandwidths as specified in TS 36.508 [12] subclause 4.3.1	1.4MHz		
Test Parameters for Channel Bandwidths			
	Downlink Configuration	**Uplink Configuration**	
Ch BW	N/A for min output power test	Mod'n	RB allocation
			FDD and HD-FDD
1.4MHz		QPSK	1
			2

1. Connect the SS to the UE antenna connectors as shown in TS 36.508 [12] Annex A Figure A.3 using only main UE Tx/Rx antenna.

2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, and C.3.0, and uplink signals according to Annex H.1 and H.3.0.

4. The UL Reference Measurement channel is set according to Table 6.3A.1.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. UE location according to TS 36.508 [12] clause 5.6.1 is provided to the UE through any preconfigured means.

7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31 information during the duration of the test as define in TS 36.508[12] clause 5.6.3.1.

8. Deactivate UE prediction of satellite trajectory by any preconfigured means.

9. Ensure the UE is in State 3A-RF-CE according to TS 36.508 [12] clause 5.2A.2AA. Message contents are defined in clause 6.3A.1.4.3.

6.3A.1.4.2 Test procedure

1. The SS sends uplink scheduling information via MPDCCH DCI format 6-0A with TPC command 0dB for C_RNTI to schedule the UL RMC according to Table 6.3A.1.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

2. Send continuous uplink power control "down" commands in the uplink scheduling information to the UE to ensure that the UE transmits at its minimum output power.

3. Measure the mean power of the UE in the associated measurement bandwidth specified in Table 6.3A.1.5-1 for the specific channel bandwidth under test. The period of measurement shall be the continuous duration of one sub-frame (1ms). For HD-FDD slots with transient periods and Half-duplex guard subframe are not under test.

6.3A.1.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 4.6

6.3A.1.5 Test requirement

The minimum output power measured shall not exceed the values specified in Table 6.3A.1.5-1.

Table 6.3A.1.5-1: Minimum output power for UE category M1

	Channel bandwidth / minimum output power / measurement bandwidth
	1.4 MHz
Minimum output power	For carrier frequency f ≤ 3.0GHz: ≤ -39 dBm For carrier frequency 3.0GHz < f ≤ 4.2GHz: ≤ -38.7 dBm
Measurement bandwidth (Note 1)	1.08 MHz
Note 1: Different implementations such as FFT or spectrum analyzer approach are allowed. For spectrum analyzer approach the measurement bandwidth is defined as an equivalent noise bandwidth.	

6.3A.2 Transmit OFF power for category M1

6.3A.2.1 Test purpose

To verify that the UE transmit OFF power is lower than the value specified in the test requirement.

6.3A.2.2 Test applicability

The requirements of this test apply in test cases 6.3A.3.1 ON/OFF time mask and 6.3A.3.2 PRACH and SRS time mask to all types of E-UTRA UE release 17 and forward that support satellite access operation.

6.3A.2.3 Minimum conformance requirements

The minimum output power is defined as the mean power in one sub-frame (1ms). The minimum output power shall not exceed the values specified in Table 6.3A.2.3-1.

Table 6.3A.2.3-1: Minimum output power

	Channel bandwidth / minimum output power / measurement bandwidth
	1.4MHz
Minimum output power	-50 dBm
Measurement bandwidth	1.08 MHz

The normative reference for this requirement is TS 36.102 [11] clause 6.3A.2.

Transmit OFF power is defined as the mean power when the transmitter is OFF. The transmitter is considered to be OFF when the UE is not allowed to transmit or during periods when the UE is not transmitting a sub-frame. During DTX and measurements gaps, the UE is not considered to be OFF.

An excess transmits OFF power potentially increases the Rise over Thermal (RoT) and therefore reduces the cell coverage area for other UEs.

6.3A.2.4 Test description

This test is covered by clause 6.3A.3.1 ON/OFF time mask and 6.3A.3.2 PRACH and SRS time mask.

6.3A.2.5 Test requirement

The minimum output power measured shall not exceed the values specified in Table 6.3A.2.5-1.

Table 6.3A.2.5-1: Minimum output power for UE category M1

	Channel bandwidth / minimum output power / measurement bandwidth
	1.4 MHz
Minimum output power	For carrier frequency f ≤ 3.0GHz: ≤ -48.5 dBm For carrier frequency 3.0GHz < f ≤ 4.2GHz: ≤ -48.2 dBm
Measurement bandwidth	1.08 MHz

6.3A.3 ON/OFF time mask for category M1

6.3A.3.1 General ON/OFF time mask for category M1

6.3A.3.1.1 Test purpose

To verify that the general ON/OFF time mask meets the requirements given in TS 36.521-1[14] clause 6.3.4.1.5.

The time mask for transmit ON/OFF defines the ramping time allowed for the UE between transmit OFF power and transmit ON power.

Transmission of the wrong power increases interference to other channels or increases transmission errors in the uplink channel.

6.3A.3.1.2 Test applicability

This test case applies to all types of E-UTRA UE release 17 and forward of UE category M1 that support satellite access operation.

6.3A.3.1.3 Minimum conformance requirements

The requirements for transmit ON/OFF time mask defined in clause 6.3.4 of TS 36.101 [7] shall apply.

6.3A.3.1.4 Test description

6.3A.3.1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths based on E-UTRA operating bands specified in clause 5.2A. All these configurations shall be tested with applicable test parameters for each channel bandwidth and are shown in table 6.3A.3.1.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of PDSCH and MPDCCH before measurement are specified in Annex C.2.

Table 6.3A.3.1.4.1-1: Test Configuration Table

<table>
<tr><th colspan="4">Initial Conditions</th></tr>
<tr><td colspan="2">Test Environment as specified in TS 36.508 [12] subclause 4.1</td><td colspan="2">Normal, TL/VL, TL/VH, TH/VL, TH/VH</td></tr>
<tr><td colspan="2">Test Frequencies as specified in TS 36.508 [12] subclause 4.3.1</td><td colspan="2">Low range, Mid range, High range</td></tr>
<tr><td colspan="2">Test Channel Bandwidths as specified in TS 36.508 [12] subclause 4.3.1</td><td colspan="2">1.4 MHz</td></tr>
<tr><th colspan="4">Test Parameters for Channel Bandwidths</th></tr>
<tr><td></td><th>Downlink Configuration</th><th colspan="2">Uplink Configuration</th></tr>
<tr><td>Ch BW</td><td rowspan="3">N/A for General On/Off Time Mask test case</td><td>Mod'n</td><td>RB allocation</td></tr>
<tr><td></td><td></td><td>FDD and HD-FDD</td></tr>
<tr><td>1.4MHz</td><td>QPSK</td><td>6</td></tr>
</table>

1. Connect the SS to the UE antenna connectors as shown in TS 36.508 [12] Annex A Figure A.3 using only main UE Tx/Rx antenna.
2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1, and C.3.0, and uplink signals according to Annex H.1 and H.3.0.
4. The UL Reference Measurement channel is set according to Table 6.3A.3.1.4.1-1.
5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 36.508 [12] clause 5.6.1 is provided to the UE through any preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31 information during the duration of the test as define in TS 36.508[12] clause 5.6.3.1.
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.
9. Ensure the UE is in State 3A-RF-CE according to TS 36.508 [12] clause 5.2A.2AA. Message contents are defined in clause 6.3A.3.4.3. Note that MPDCCH DCI format 6-0A sent after resetting uplink power with RRC Connection Reconfiguration, should have TPC command 0dB.

6.3A.3.1.4.2 Test procedure

1. The SS sends uplink scheduling information via MPDCCH DCI format 6-0A with TPC command 0dB for C_RNTI to schedule the UL RMC according to Table 6.3A.3.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. For FDD: The UL assignment is such that the UE transmits on UL sub-frame 2 of every radio frame. For HD-FDD: The UL assignment is such that the UE transmits on UL sub-frame 5 of every radio frame.
2. For FDD and HD-FDD: Measure the UE transmission OFF power during the sub-frame prior to the PUSCH subframe.
3. Measure the output power of the UE PUSCH transmission during one sub-frame, excluding a transient period of 20 µs at the beginning of the subframe.
4. Measure the UE transmission OFF power during one sub-frame following the PUSCH subframe, excluding a transient period of 20 µs at the beginning of the subframe.

6.3A.3.1.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 4.6 with the condition CEModeA and the following exceptions:

Table 6.3A.3.1.4.3-1: UplinkPowerControlCommon: Test point 1

Derivation Path: TS 36.508 [12] clause 4.6.3, Table 4.6.3-25 UplinkPowerControlCommon-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
UplinkPowerControlCommon-DEFAULT ::= SEQUENCE { p0-NominalPUSCH	-105	Test point 1 to verify a UE relative low initial power transmission	

Table 6.3A.3.1.4.3-2: PhysicalConfigDedicated

Derivation Path: TS 36.508 [12] clause 5.5.1.2, Table 5.5.1.2.1 PhysicalConfigDedicated-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
PhysicalConfigDedicated-DEFAULT ::= SEQUENCE {			
UplinkPowerControlDedicated	UplinkPowerControlDedicated-DEFAULT	See subclause 4.6.3	SRB1
	UplinkPowerControlDedicated-DEFAULT	See subclause 4.6.3	RBC

Table 6.3A.3.1.4.3-3: UplinkPowerControlDedicated

Derivation Path: TS 36.508 [12] clause 4.6.3, Table 4.6.3-26 UplinkPowerControlDedicated-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
UplinkPowerControlDedicated-DEFAULT ::= SEQUENCE {			
p0-UE-PUSCH	1		SRB1
	0		RBC
}			

6.3A.3.1.5 Test requirement

The requirement for the power measured in steps (2), (3) and (4) of the test procedure shall not exceed the values specified in Table 6.3A.3.5-1.

Table 6.3A.3.1.5-1: General ON/OFF time mask

	Channel bandwidth / minimum output power / measurement bandwidth
	1.4 MHz
Transmit OFF power	For carrier frequency f ≤ 3.0GHz: ≤ -48.5 dBm For carrier frequency 3.0GHz < f ≤ 4.2GHz: ≤ -48.2 dBm
Transmission OFF Measurement bandwidth	1.08 MHz
Expected Transmission ON Measured power	-14.8 dBm
ON power tolerance f ≤ 3.0GHz 3.0GHz < f ≤ 4.2GHz	± 7.5dB ± 7.8dB

6.3A.3.2 PRACH and SRS ON/OFF time mask for UE category M1

6.3A.3.2.1 PRACH time mask for UE category M1

6.3A.3.2.1.1 Test purpose

To verify that the PRACH time mask meets the requirements given in TS 36.521-1[14] clause 6.3.4.2.1.5.

The time mask for PRACH time mask defines the ramping time allowed for the UE between transmit OFF power and transmit ON power when transmitting the PRACH.

Transmission of the wrong power increases interference to other channels or increases transmission errors in the uplink channel.

6.3A.3.2.1.2 Test applicability

This test case applies to all types of E-UTRA UE release 17 and forward of UE category M1 that support satellite access operation.

6.3A.3.2.1.3 Minimum conformance requirements

For the PRACH Power / Time mask defines the observation period for PRACH transmissions. The PRACH ON power is specified as the mean power over the PRACH measurement period excluding any transient periods. The measurement period for different PRACH preamble format is specified in Table 6.3A.3.2.1.3-1.

There are no additional requirements on UE transmit power beyond that which is required in clause 6.2 and clause 6.5

Table 6.3A.3.2.1.3-1: PRACH ON power measurement period

PRACH preamble format	Measurement period (ms)
0	0.9031
1	1.4844
2	1.8031
3	2.2844
4	0.1479

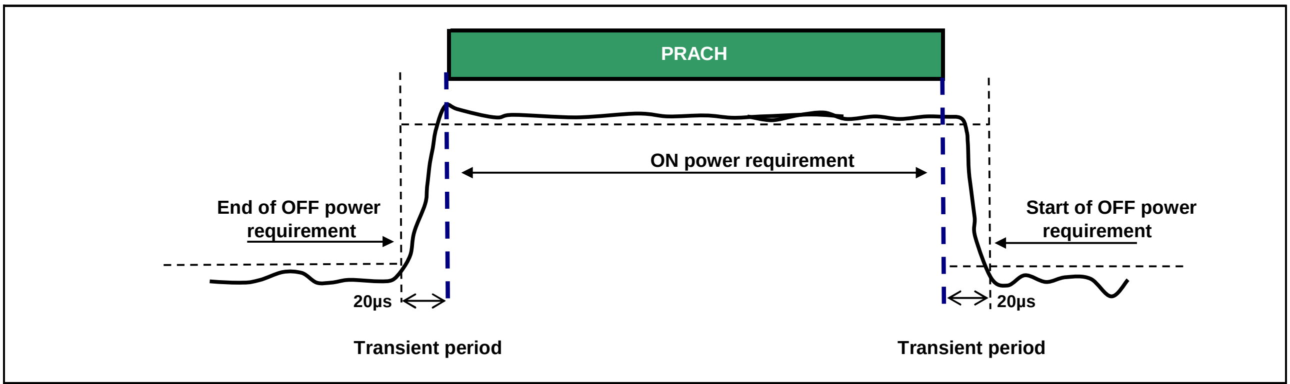

Figure 6.3A.3.2.1.3-1: PRACH ON/OFF time mask

The normative reference for this requirement is TS 36.101 [7] clause 6.3.4.2.1.

6.3A.3.2.1.4 Test description

6.3A.3.2.1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths based on E-UTRA operating bands specified in clause 5.2A. All these configurations shall be tested with applicable test parameters for each channel bandwidth and are shown in table 6.3A.3.2.1.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of PDSCH and MPDCCH before measurement are specified in Annex C.2.

Table 6.3A.3.2.1.4.1-1: Test Configuration Table

Initial Conditions	
Test Environment (as specified in TS 36.508 [12] subclause 4.1)	Normal, TL/VL, TL/VH, TH/VL, TH/VH
Test Frequencies (as specified in TS 36.508 [12] subclause 4.3.1)	Mid range
Test Channel Bandwidths (as specified in TS 36.508 [12] subclause 4.3.1)	1.4 MHz
PRACH preamble format	
	FDD
PRACH Configuration Index	3

1. Connect the SS to the UE antenna connectors as shown in TS 36.508 [12] Annex A Figure A.3 using only main UE Tx/Rx antenna.
2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1, and C.3.0, and uplink signals according to Annex H.1 and H.3.0.
4. Propagation conditions are set according to Annex B.0.
5. UE location according to TS 36.508 [12] clause 5.6.1 is provided to the UE through any preconfigured means.
6. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31 information during the duration of the test as define in TS 36.508[12] clause 5.6.3.1.
7. Deactivate UE prediction of satellite trajectory by any preconfigured means.
8. Ensure the UE is in State 3A-RF-CE according to TS 36.508 [12] clause 5.2A.2. Message contents are defined in clause 6.3A.3.2.1.4.3.

6.3A.3.2.1.4.2 Test procedure

1. The SS shall signal a Random Access Preamble ID via a MPDCCH order to the UE and initiate a Non-contention based Random Access procedure.
2. The UE shall send the signalled preamble to the SS.
3. For FDD UE, the SS measure the UE transmission OFF power during the sub-frame preceding the PRACH preamble excluding a transient period of 20 µs according to Figure 6.3A.3.2.1.3-1.
4. Measure the output power of the transmitted PRACH preamble according to Figure 6.3A.3.2.1.3-1.
5. Measure the UE transmission OFF power, starting 20 µs after the PRACH preamble ends for a measurement period of 980 µs.

6.3A.3.2.1.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 4.6 with the following exceptions:

Table 6.3A.3.2.1.4.3-1: *RACH-ConfigCommon-DEFAULT:* PRACH measurement

Derivation Path: TS 36.508 [12] clause 4.6.3, Table 4.6.3-12 RACH-ConfigCommon-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
RACH-ConfigCommon-DEFAULT ::= SEQUENCE {			
powerRampingParameters SEQUENCE {			
powerRampingStep	dB0		
preambleInitialReceivedTargetPower	dBm-104		PRACH Format 0
	dBm-112		PRACH Format 4
}			
)			

6.3A.3.2.1.5 Test requirement

The requirement for the power measured in steps (3), (4) and (5) of the test procedure shall not exceed the values specified in Table 6.3A.3.2.1.5-1.

Table 6.3A.3.2.1.5-1: PRACH time mask

	Channel bandwidth / Output Power [dBm] / measurement bandwidth
	1.4 MHz
Transmit OFF power	For carrier frequency f ≤ 3.0GHz: ≤ -48.5 dBm For carrier frequency 3.0GHz < f ≤ 4.2GHz: ≤ -48.2 dBm
Transmission OFF Measurement bandwidth	1.08 MHz
Expected PRACH Transmission ON Measured power	-1 dBm
ON power tolerance f ≤ 3.0GHz 3.0GHz < f ≤ 4.2GHz	± 7.5dB ± 7.8dB

6.3A.3.2.2 SRS time mask for UE category M1

6.3A.3.2.2.1 Test purpose

Same test purpose as in TS 36.521-1[14] clause 6.3.4.2.2.1.

6.3A.3.2.2.2 Test applicability

This test case applies to all types of E-UTRA UE release 17 and forward of UE category M1 that support satellite access operation.

6.3A.3.2.2.3 Minimum conformance requirements

Same minimum conformance requirements as in TS 36.521-1[14] clause 6.3.4.2.2.3.

6.3A.3.2.2.4 Test description

6.3A.3.2.2.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths based on E-UTRA operating bands specified in clause 5.2A. All these configurations shall be tested with applicable test parameters for each channel bandwidth and are shown in table 6.3A.3.2.2.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3

Table 6.3A.3.2.2.4.1-1: Test Configuration Table

Initial Conditions	
Test Environment (as specified in TS 36.508 [12] subclause 4.1)	Normal, TL/VL, TL/VH, TH/VL, TH/VH
Test Frequencies (as specified in TS 36.508 [12] subclause 4.3.1)	Mid range
Test Channel Bandwidths (as specified in TS 36.508 [12] subclause 4.3.1)	1.4MHz
SRS configuration	
	FDD
srs-BandwidthConfig	bw7
srs-SubframeConfig	sc3
ackNackSRS-SimultaneousTransmission	FALSE
srsMaxUpPts	N/A
srs-Bandwidth	bw3
srs-HoppingBandwidth	hbw3
freqDomainPosition	0
Duration	TRUE
srs-ConfigIndex	7
transmissionComb	0
cyclicShift	cs0

1. Connect the SS to the UE antenna connectors as shown in TS 36.508 [12] Annex A Figure A.3
2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1, and C.3.0, and uplink signals according to Annex H.1 and H.3.0.
4. Propagation conditions are set according to Annex B.0.
5. UE location according to TS 36.508 [12] clause 5.6.1 is provided to the UE through any preconfigured means.
6. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31 information during the duration of the test as define in TS 36.508[12] clause 5.6.3.1.
7. Deactivate UE prediction of satellite trajectory by any preconfigured means.
8. Ensure the UE is in State 3A-RF-CE according to TS 36.508 [12] clause 5.2A.2AA. Message contents are defined in clause 6.3A.3.2.2.4.3. Note that MPDCCH DCI format 6-0A sent after resetting uplink power with RRC Connection Reconfiguration, should have TPC command 0dB.

6.3A.3.2.2.4.2 Test procedure

1. For FDD UE, the SS measure the UE transmission OFF power during the 13 symbols preceding the SRS symbol excluding a transient period of 20 µs according to TS 36.521-1[14] Figure 6.3.4.2.2.3-1
2. Measure the output power of the transmitted SRS according to TS 36.521-1[14] Figure 6.3.4.2.2.3-1 for FDD and HD-FDD UE and the transient periods are excluded from measurement accordingly.
3. Measure the UE transmission OFF power during the sub-frame following the SRS under test, excluding a transient period of 20 µs according to TS 36.521-1[14] Figure 6.3A.3.2.2.3-1 for FDD and HD-FDD UE

6.3A.3.2.2.4.3 Message contents

Same message contents as in TS 36.521-1[14] clause 6.3.4.2.2.4.3 with the following exception.

Table 6.3A.3.2.2.4.3-1: SchedulingRequest-Config

Derivation Path: 36.331[6] clause 6.3.2			
Information Element	**Value/remark**	**Comment**	**Condition**
SchedulingRequest-Config-DEFAULT ::= CHOICE {			
setup SEQUENCE {			
sr-ConfigIndex	33		HD-FDD
}			
}			

Condition	Explanation
HD-FDD	**Half Duplex FDD cell environment**

6.3A.3.2.2.5 Test requirement

The requirement for the power measured in steps (1), (2) and (3) of the test procedure shall not exceed the values specified in Table 6.3A.3.2.2.5-1.

Table 6.3A.3.2.2.5-1: SRS time mask

	Channel bandwidth / Output Power [dBm] / measurement bandwidth
	1.4 MHz
Transmit OFF power	For carrier frequency f ≤ 3.0GHz: ≤ -48.5 dBm For carrier frequency 3.0GHz < f ≤ 4.2GHz: ≤ -48.2 dBm
Transmission OFF Measurement bandwidth	1.08 MHz
Expected SRS Transmission ON Measured power	-2.6 dBm
ON power tolerance f ≤ 3.0GHz 3.0GHz < f ≤ 4.2GHz	± 7.5dB ± 7.8dB

6.3A.4 Power control for category M1

6.3A.4.1 Power Control Absolute power tolerance for UE category M1

6.3A.4.1.1 Test purpose

To verify the ability of the UE transmitter to set its initial output power to a specific value at the start of a contiguous transmission or non-contiguous transmission with a long transmission gap, i.e. transmission gap is larger than 20 ms.

6.3A.4.1.2 Test applicability

This test case applies to all types of E-UTRA UE release 17 and forward of UE category M1 that support satellite access operation.

6.3A.4.1.3 Minimum conformance requirements

Absolute power tolerance is the ability of the UE transmitter to set its initial output power to a specific value for the first sub-frame at the start of a contiguous transmission or non-contiguous transmission with a transmission gap larger than 20ms.

The minimum requirement on absolute power tolerance is given in Table 6.3A.4.1.3-1 over the power range bounded by the Maximum output power as defined in sub-clause 6.2A. 1 and the Minimum output power as defined in sub clause 6.3A.1.

Table 6.3A.4.1.3-1: Absolute power tolerance

Conditions	Tolerance
Normal conditions	± 9.0 dB
Extreme conditions	± 12.0 dB

The normative reference for this requirement is TS 36.102 [11] clause 6.3A.4.

6.3A.4.1.4 Test description

6.3A.4.1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths based on E-UTRA operating bands specified in clause 5.2A. All these configurations shall be tested with applicable test parameters for each channel bandwidth and are shown in table 6.3A.4.1.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of PDSCH and MPDCCH before measurement are specified in Annex C.2.

Table 6.3A.4.1.4.1-1: Test Configuration Table

Initial Conditions			
Test Environment as specified in TS 36.508 [12] subclause 4.1	Normal, TL/VL, TL/VH, TH/VL, TH/VH		
Test Frequencies as specified in TS 36.508 [12] subclause 4.3.1	Low range, Mid range, High range		
Test Channel Bandwidths as specified in TS 36.508 [12] subclause 4.3.1	1.4MHz		
Test Parameters for Channel Bandwidths and Narrowband positions			
	Downlink Configuration	**Uplink Configuration**	
Ch BW	N/A	Mod'n	RB allocation
			FDD and HD-FDD
1.4MHz		QPSK	6

1. Connect the SS to the UE antenna connectors as shown in TS 36.508 [12] Annex A, Figure A.3 using only main UE Tx/Rx antenna.
2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1, and C.3.0, and uplink signals according to Annex H.1 and H.3.0.
4. The UL Reference Measurement channel is set according to Table 6.3A.4.1.4.1-1.
5. UE location according to TS 36.508 [12] clause 5.6.1 is provided to the UE through any preconfigured means.
6. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31 information during the duration of the test as define in TS 36.508[12] clause 5.6.3.1.
7. Deactivate UE prediction of satellite trajectory by any preconfigured means.
8. Ensure the UE is in State 3A-RF-CE according to TS 36.508 [12] clause 5.2A. 2 AA. Message contents are defined in clause 6.3A.4.1.4.3. Note that MPDCCH DCI format 6-0A sent after resetting uplink power with RRC Connection Reconfiguration, should have TPC command 0dB.

6.3A.4.1.4.2 Test procedure

1. SS sends uplink scheduling information via MPDCCH DCI format 6-0A with TPC command 0dB for C_RNTI to schedule the UL RMC according to Table 6.3A.4.1.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC
2. Measure the initial output power of the first subframe of UE PUSCH first transmission. The transient periods of 20us are excluded.
3. Repeat for the two test points as indicated in section 6.3A.4.1.4.3. The timing of the execution between the two test points shall be larger than 20ms.

6.3A.4.1.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 4.6 with the following exceptions:

Table 6.3A.4.1.4.3-1: UplinkPowerControlCommon: Test point 1

Derivation Path: TS 36.508 [12] clause 4.6.3, Table 4.6.3-25 UplinkPowerControlCommon-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
UplinkPowerControlCommon-DEFAULT ::= SEQUENCE { p0-NominalPUSCH	-105	Test point 1 to verify a UE relative low initial power transmission	

Table 6.3A.4.1.4.3-2: UplinkPowerControlCommon: Test point 2

Derivation Path: TS 36.508 [12] clause 4.6.3, Table 4.6.3-25 UplinkPowerControlCommon-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
UplinkPowerControlCommon-DEFAULT ::= SEQUENCE { p0-NominalPUSCH	-93	Test point 2 to verify a UE relative high initial power transmission	

Table 6.3A.4.1.4.3-3: PhysicalConfigDedicated

Derivation Path: TS 36.508 [12] clause 5.5.1.2, Table 5.5.1.2.1 PhysicalConfigDedicated-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
PhysicalConfigDedicated-DEFAULT ::= SEQUENCE {			
uplinkPowerControlDedicated	UplinkPowerControlDedicated-DEFAULT	See subclause 4.6.3	SRB1
	UplinkPowerControlDedicated-DEFAULT	See subclause 4.6.3	RBC

Table 6.3A.4.1.4.3-4: UplinkPowerControlDedicated

Derivation Path: TS 36.508 [12] clause 4.6.3, Table 4.6.3-26 UplinkPowerControlDedicated-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
UplinkPowerControlDedicated-DEFAULT ::= SEQUENCE {			
p0-UE-PUSCH	1		SRB1
	0		RBC
}			

6.3A.4.1.5 Test requirement

The requirement for the power measured in step (2) of the test procedure is not to exceed the values specified in Table 6.3A.4.1.5-1 and 6.3A.4.1.5-2.

Table 6.3A.4.1.5-1: Absolute power tolerance: test point 1

	UE Power Class / Expected output power (dBm)	
	Class 3	**Class 5**
Expected Measured power Normal conditions	-14.8 dBm	-14.8 dBm
Power tolerance f ≤ 3.0GHz	± 10.0dB	± 10.0dB
Expected Measured power Extreme conditions	-14.8 dBm	-14.8 dBm
Power tolerance f ≤ 3.0GHz	± 13.0dB	± 13.0dB
Note 1: The lower power limit shall not exceed the minimum output power requirements defined in sub-clause 6.3A.1		

Table 6.3A.4.1.5-2: Absolute power tolerance: test point 2

	Expected output power (dBm)	
	Class 3	**Class 5**
Expected Measured power Normal conditions	-2.8 dBm	-2.8 dBm
Power tolerance f ≤ 3.0GHz	± 10.0dB	± 10.0dBm
Expected Measured power Extreme conditions	-2.8 dBm	-2.8 dBm
Power tolerance f ≤ 3.0GHz	± 13.0dB	± 13.0dB
Note 1: The upper power limit shall not exceed the maximum output power requirements defined in sub-clause 6.2A.1		

6.3A.4.2 Power Control Relative power tolerance for UE category M1

6.3A.4.2.1 Test purpose

To verify the ability of the UE transmitter to set its output power relatively to the power in a target sub-frame relatively to the power of the most recently transmitted reference sub-frame if the transmission gap between these sub-frames is ≤ 20 ms.

6.3A.4.2.2 Test applicability

This test case applies to all types of E-UTRA UE release 17 and forward of UE category M1 that support satellite access operation.

6.3A.4.2.3 Minimum conformance requirements

The UE shall meet the requirements specified in Table 6.3A.4.2.3-1.

To account for RF Power amplifier mode changes 2 exceptions are allowed for each of two test patterns. The test patterns are a monotonically increasing power sweep and a monotonically decreasing power sweep over a range bounded by the requirements of minimum power and maximum power specified in clauses 6.3A.1 and 6.2A.1. For these exceptions the power tolerance limit is a maximum of ±6.0 dB in Table 6.3A.4.2.3-1.

Table 6.3A.4.2.3-1: Relative Power Tolerance for Transmission (normal conditions)

Power step ΔP (Up or down) [dB]	All combinations of PUSCH and PUCCH transitions [dB]	All combinations of PUSCH/PUCCH and SRS transitions between sub-frames [dB]	PRACH [dB]
ΔP < 2	±2.5 (Note 3)	±3.0	±2.5
2 ≤ ΔP < 3	±3.0	±4.0	±3.0
3 ≤ ΔP < 4	±3.5	±5.0	±3.5
4 ≤ ΔP ≤ 10	±4.0	±6.0	±4.0
10 ≤ ΔP < 15	±5.0	±8.0	±5.0
15 ≤ ΔP	±6.0	±9.0	±6.0
Note 1: For extreme conditions an additional ± 2.0 dB relaxation is allowed			

The power step (ΔP) is defined as the difference in the calculated setting of the UE Transmit power between the target and reference sub-frames with the power setting according to Clause 5.1 of TS 36.213. The error is the difference between ΔP and the power change measured at the UE antenna port with the power of the cell-specific reference signals kept constant. The error shall be less than the relative power tolerance specified in Table 6.3A.4.2.3-1.

The normative reference for this requirement is TS 36.102 [11] clause 6.3A.4.

6.3A.4.2.4 Test description

6.3A.4.2.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths based on E-UTRA operating bands specified in clause 5.2A. All these configurations shall be tested with applicable test parameters for each channel bandwidth and are shown in table 6.3A.4.2.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of PDSCH and MPDCCH before measurement are specified in Annex C.2.

Table 6.3A.4.2.4.1-1: Test Configuration Table

Initial Conditions			
Test Environment as specified in TS 36.508 [12] subclause 4.1	Normal, TL/VL, TL/VH, TH/VL, TH/VH		
Test Frequencies as specified in TS 36.508 [12] subclause 4.3.1	Low range		
Test Channel Bandwidths as specified in TS 36.508 [12] subclause 4.3.1	1.4MHz		
Test Parameters for Channel Bandwidths and Narrowband positions			
	Downlink Configuration	**Uplink Configuration**	
Ch BW	N/A	Mod'n	RB allocation
			FDD and HD-FDD
1.4MHz		QPSK	See table 6.3A.4.2.5-1 6.3A.4.2.5-2 6.3A.4.2.5-3
Note 1: The RBstart of partial RB allocation shall be RB#0.			

1. Connect the SS to the UE antenna connectors as shown in TS 36.508 [12] Annex A Figure A.3 using only main UE Tx/Rx antenna.

2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, and C.3.0, and uplink signals according to Annex H.1 and H.3.0.

4. The UL Reference Measurement channel is set according to Table 6.3A.4.2.4.1-1.

5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 36.508 [12] clause 5.6.1 is provided to the UE through any preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31 information during the duration of the test as define in TS 36.508[12] clause 5.6.3.1.
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.
9. Ensure the UE is in State 3A-RF-CE according to TS 36.508 [12] clause 5.2A. 2 AA. Message contents are defined in clause 6.3A.4.2.4.3.

6.3A.4.2.4.2 Test procedure

The procedure is separated in various subtests to verify different aspects of relative power control. The power patterns of the subtests are described in figure 6.3A.4.2.4.2-1.

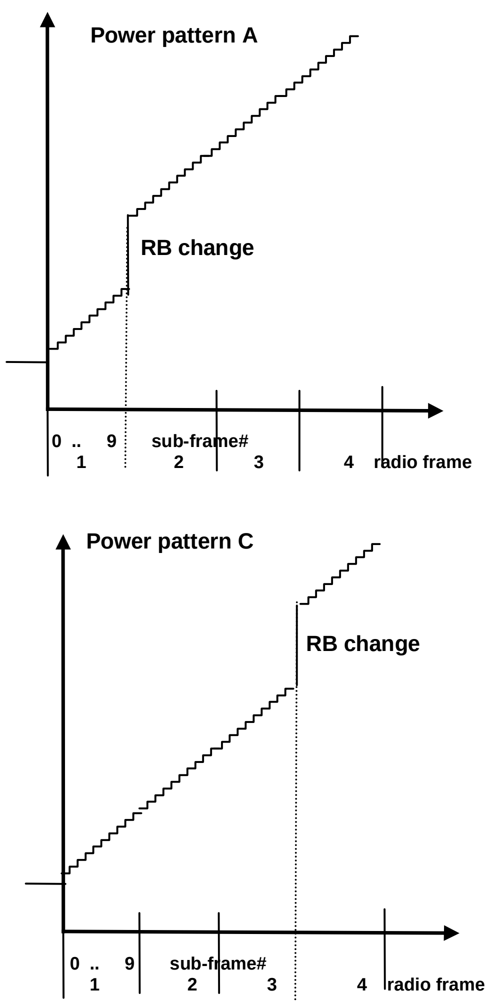

Figure 6.3A.4.2.4.2-1: FDD ramping up test power patterns

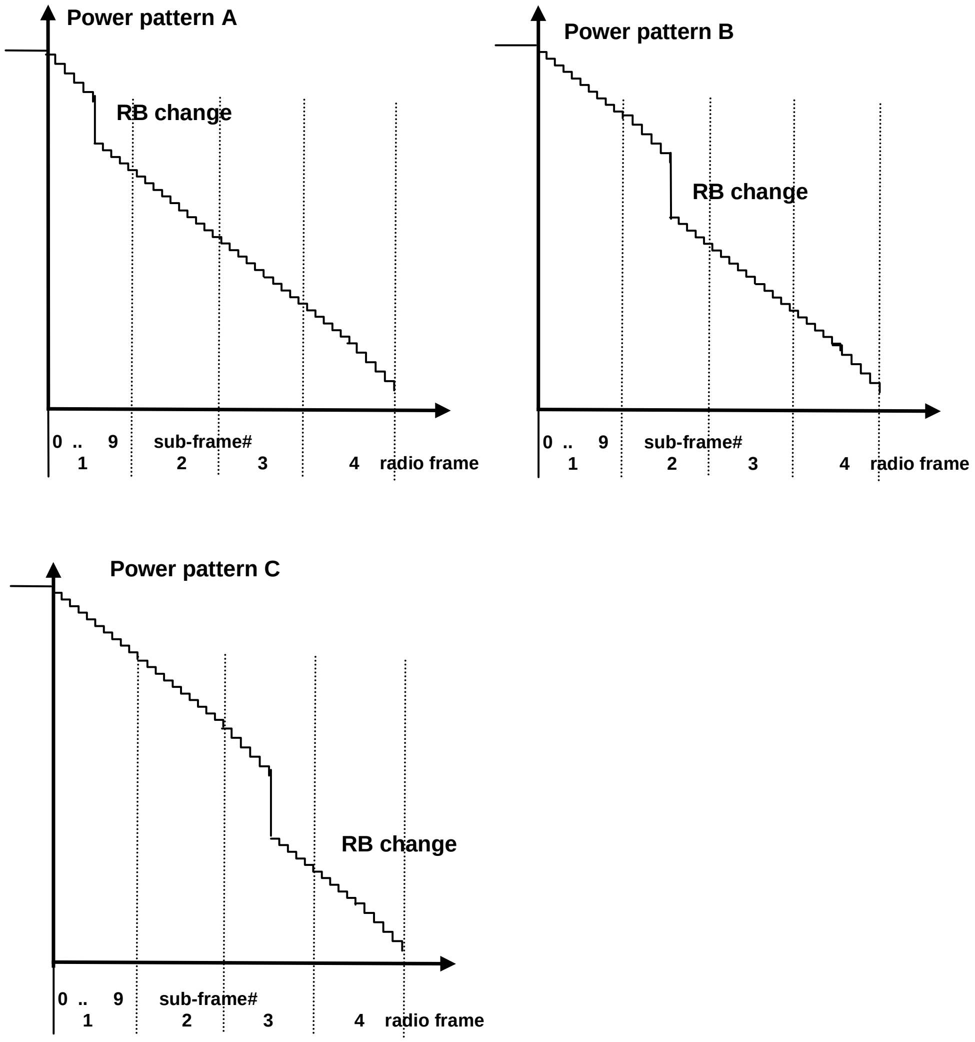

Figure 6.3A.4.2.4.2-2: FDD ramping down test power patterns

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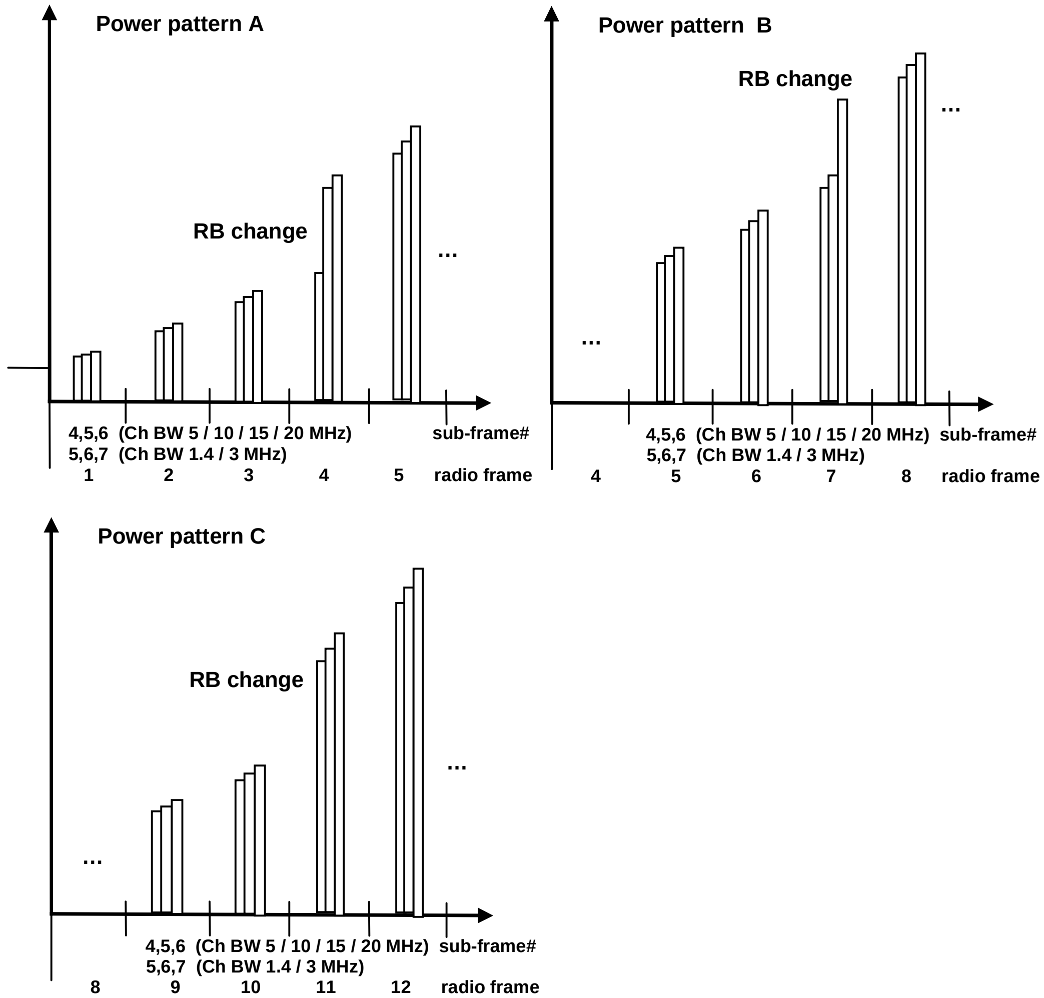


Figure 6.3A.4.2.4.2-3: HD-FDD ramping up test power patterns

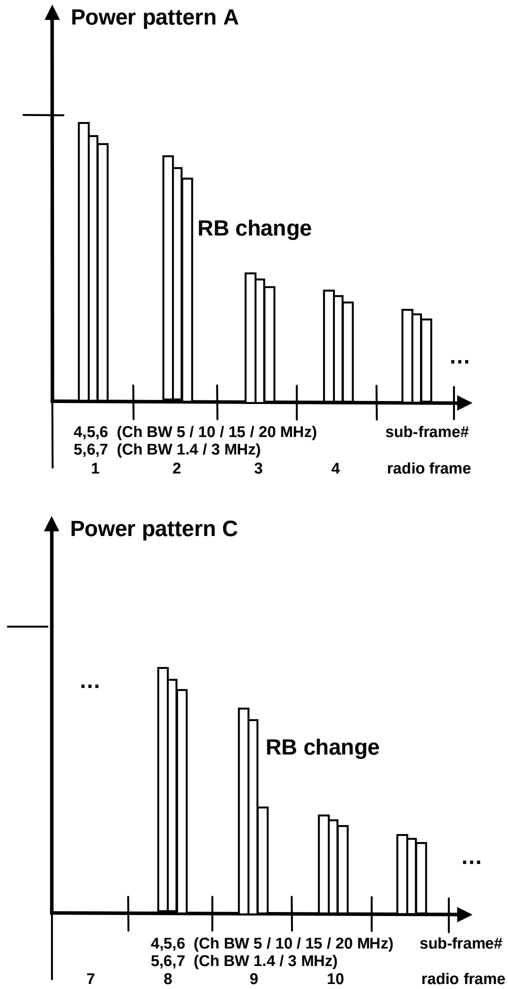


Figure 6.3A.4.2.4.2-4: HD-FDD ramping down test power patterns

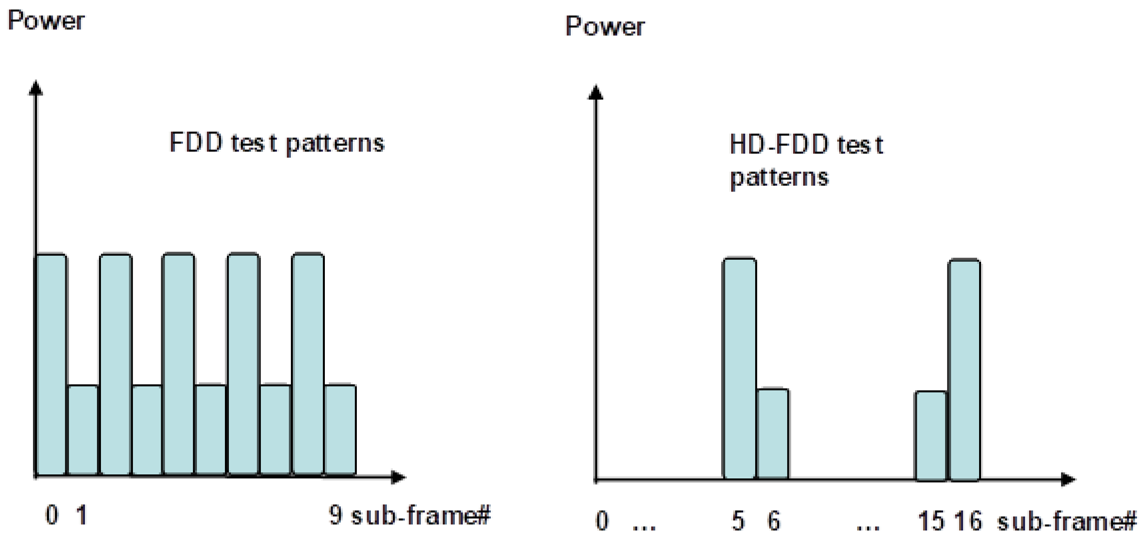


Figure 6.3A.4.2.4.2-5: Alternating Test Power patterns

1. Sub test: ramping up pattern

1.1 SS sends uplink scheduling information for each UL HARQ process via MPDCCH DCI format 6-0A for C_RNTI to schedule the PUSCH. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. Send the appropriate TPC commands for PUSCH to the UE to ensure that the UE transmits PUSCH at -36.8dBm +/- 3.2 dB for carrier frequency f ≤ 3.0GHz.

1.2 Schedule the UE's PUSCH data transmission as described in Figure 6.3A.4.2.4.2-1 (FDD pattern A: sub-test is divided in 4 arbitrary radio frames with 10 active uplink sub-frames per radio frame) and Figure 6.3A4..2.4.2-5 (HD-FDD pattern A: sub-test is divided in 14 arbitrary radio frames with 3 active uplink sub-frames per radio frame) with an uplink RB allocation as defined in tables 6.3A.4.2.5-1. On the MPDCCH DCI format 6-0A for the scheduling of the PUSCH the SS will transmit a +1dB TPC command. Note that the measurement need not be done continuously, provided that interruptions are whole numbers of frames, and TPC commands of 0dB are sent during the interruption.

1.3 Measure the power of PUSCH transmissions to verify the UE relative power control meet test requirements 6.3A.4.2.5. For power transients between subframes, transient periods of 40us between subframes are excluded. For ON/OFF or OFF/ON transients, transient periods of 20 us at the beginning of the subframe are excluded.

1.4 Repeat the subtest different pattern B, C to move the RB allocation change at different points in the pattern as described in Table 6.3A.4.2.5-1 to force bigger UE power steps at various points in the power range.

2. Sub test: ramping down pattern

2.1 SS sends uplink scheduling information for each UL HARQ process via MPDCCH DCI format 6-0A for C_RNTI to schedule the PUSCH. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. Send the appropriate TPC commands for PUSCH to the UE to ensure that the UE transmits PUSCH at +18.0dBm +/- 3.2 dB for carrier frequency f ≤ 3.0GHz with UE power class 3 or +15.0dBm +/- 3.2 dB for carrier frequency f ≤ 3.0GHz with UE power class 5 or +9.0 dBm +/- 3.2 dB for carrier frequency f ≤ 3.0GHz with UE power class 6.

2.2 Schedule the UE's PUSCH data transmission as described in Figure 6.3A.4.2.4.2-2 (FDD pattern A: sub-test is divided in 4 arbitrary radio frames with 10 active uplink sub-frames per radio frame) and Figure 6.3.5EA.2.4.2-6 (HD-FDD pattern A: sub-test is divided in 14 arbitrary radio frames with 3 active uplink sub-frames per radio frame)with an uplink RB allocation as defined in table 6.3A.4.2.5-2. On the MPDCCH DCI format 6-0A for the scheduling of the PUSCH the SS will transmit a -1dB TPC command. Note that the measurement need not be done continuously, provided that interruptions are whole numbers of frames, and TPC commands of 0dB are sent during the interruption.

2.3 Measure the power of PUSCH transmissions to verify the UE relative power control meet test requirements 6.3A.4.2.5. For power transients between subframes, transient periods of 40us between subframes are excluded. For ON/OFF or OFF/ON transients, transient periods of 20 us at the beginning of the subframe are excluded.

2.4 Repeat the subtest different pattern B, C to move the RB allocation change at different points in the pattern as described in Table 6.3A.4.2.5-2 to force bigger UE power steps at various points in the power range.

3. Sub test: alternating pattern

3.1 SS sends uplink scheduling information for each UL HARQ process via P MPDCCH DCI format 6-0A for C_RNTI to schedule the PUSCH. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. Send the appropriate TPC commands for PUSCH to the UE to ensure that the UE transmits PUSCH at -10dBm +/- 3.2 dB for carrier frequency f ≤ 3.0GHz or at -10dBm +/- 3.5 dB for carrier frequency 3.0GHz < f ≤ 4.2GHz. The initial uplink RB allocation is defined as the smaller uplink RB allocation value specified in table 6.3A.4.2.5-3. The power level and RB allocation are reset for each sub-test.

3.2 Schedule the UE's PUSCH data transmission as described in Figure 6.3A.4.2.4.2-5 for 10 sub-frames (FDD) and 20 sub-frames (HD-FDD) with an uplink RB allocation alternating pattern as defined in table 6.3A.4.2.5-3 while transmitting 0dB TPC command for PUSCH via the MPDCCH.

3.3. Measure the power of PUSCH transmissions to verify the UE relative power control meet test requirements specified in clause 6.3A.4.2.5. For power transients between subframes, transient periods of 40us between subframes are excluded. For ON/OFF or OFF/ON transients, transient periods of 20 us at the beginning of the subframe are excluded.

6.3A.4.2.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 4.6.

6.3A.4.2.5 Test requirement

Each UE power step measured in the test procedure 6.3A.4.2.4.2 should satisfy the test requirements specified in Table 6.3A.4.2.5-1, thru 6.3A.4.2.5-3 for normal conditions; for extreme conditions an additional ± 2.0 dB relaxation is allowed.

To account for RF Power amplifier mode changes 2 exceptions are allowed for each of ramping up and ramping down test patterns. For these exceptions the power tolerance limit is a maximum of ±6.7 dB. If there is an exception in the power step caused by the RB change for all test patterns (A, B, C) then fail the UE.

Table 6.3A.4.2.5-1: Test Requirements Relative Power Tolerance for Transmission (normal conditions – Note 5) channel bandwidth 1.4MHz (ramping up)

Sub-test (ramp up)	Uplink RB allocation	TPC command	Expected power step size (Up) ΔP [dB]	Power step size range (Up) ΔP [dB]	PUSCH [dB]
Subframes before RB change	Fixed = 1	TPC=+1dB	1	ΔP < 2	1 ± (1.7)
RB change	Change from 1 to 6 RBs	TPC=+1dB	8.78	4 ≤ ΔP < 10	8.78 ± (4.7) Note 2
Subframes after RB change	Fixed = 6	TPC=+1dB	1	ΔP < 2	1 ± (1.7)

Note 1: Position of RB change:
Pattern A the position of RB uplink allocation change is after 10 active uplink subframes
Pattern B the position of RB uplink allocation change is after 20 active uplink subframes
Pattern C the position of RB uplink allocation change is after 30 active uplink subframes
Note 2: When Note 3 does not apply.
Note 3: N/A
Note 4: N/A
Note 5: For extreme conditions an additional ± 2.0 dB relaxation is allowed.
Note 6: The starting resource block shall be RB# 0.

Table 6.3A.4.2.5-2: Test Requirements Relative Power Tolerance for Transmission (normal conditions – Note 5) channel bandwidth 1.4MHz (ramping down)

Sub-test (ramp down)	Uplink RB allocation	TPC command	Expected power step size (down) ΔP [dB]	Power step size range (down) ΔP [dB]	PUSCH [dB]
Subframes before RB change	Fixed = 5	TPC=-1dB	1	ΔP < 2	1 ± (1.7)
RB change	Change from 5 to 1 RBs	TPC=-1dB	7.99	4 ≤ ΔP < 10	7.99 ± (4.7) Note 2
Subframes after RB change	Fixed = 1	TPC=-1dB	1	ΔP < 2	1 ± (1.7)

Note 1: Position of RB change:
Pattern A the position of RB uplink allocation change is after 6 active uplink subframes
Pattern B the position of RB uplink allocation change is after 16 active uplink subframes
Pattern C the position of RB uplink allocation change is after 26 active uplink subframes
Note 2: When Note 4 does not apply.
Note 3: N/A
Note 4: N/A
Note 5: For extreme conditions an additional ± 2.0 dB relaxation is allowed.
Note 6: The starting resource block shall be RB# 0.

Table 6.3A.4.2.5-3: Test Requirements Relative Power Tolerance for Transmission (normal conditions – Note 5) (Alternating pattern)

Sub-test	Uplink RB allocation	TPC command	Expected power step size (Up or down) ΔP [dB]	Power step size range (Up or down) ΔP [dB]	PUSCH [dB]
1.4 MHz	Alternating 1 and 6	TPC=0dB	7.78	4 ≤ ΔP < 10	7.78 ± (6.7) Note 1,2 7.78 +8.2/-6.7 Note 3 7.78 +6.7/-8.2 Note 4
Note 1: Test tolerance +/- 6.7 dB was selected to allow PA switch possible exceptions to occur. Note 2: When neither Note 3 nor Note 4 applies. Note 3: N/A Note 4: N/A. Note 5: For extreme conditions an additional ± 2.0 dB relaxation is allowed. Note 6: The starting resource block shall be RB# 0.					

6.3A.4.3 Aggregate power control tolerance for UE category M1

6.3A.4.3.1 Test purpose

To verify the ability of category M1 UE to maintain its power level in non-contiguous transmission in response to 0 dB TPC commands with respect to the first UE transmission, when the power control parameters specified in TS 36.213 are constant.

6.3A.4.3.2 Test applicability

This test case applies to all types of E-UTRA UE release 17 and forward of UE category M1 that support satellite access operation.

6.3A.4.3.3 Minimum conformance requirements

The category M1 FD-FDD UEs shall meet the requirements specified in Table 6.3A.4.3.3-1 for aggregate power control over the power range bounded by the minimum output power as defined in subclause 6.3A.1, the maximum output power as defined in subclause 6.2A.1, and the requirements for configured transmitted power are specified in subclause 6.2A.4.

The category M1 HD-FDD UEs and for continuous uplink transmissions of duration ≤ 64 ms, shall meet the requirements specified in Table 6.3A.4.3.3-1 for aggregate power control over the power range bounded by the minimum output power as defined in subclause 6.3A.1, the maximum output power as defined in subclause 6.2A.1, and the requirements for configured transmitted power are specified in subclause 6.2A.4.

Table 6.3A.4.3.3-1: Aggregate power control tolerance

TPC command	UL channel	Aggregate power tolerance within 21 ms [2]
0 dB	PUCCH	±2.5 dB
0 dB	PUSCH	±3.5 dB
NOTE 1: The UE transmission gap is 4 ms for full-duplex FDD. For UE of half-duplex FDD, the transmission gap is 9 ms. TPC command is transmitted via MPDCCH 4 subframes preceding each PUCCH/PUSCH transmission. NOTE 2: For UE of half-duplex FDD, the test interval is 41 ms.		

The normative reference for this requirement is TS 36.102 [11] clause 6.3A.4.

6.3A.4.3.4 Test description

6.3A.4.3.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths based on E-UTRA operating bands specified in clause 5.2A. All these configurations shall be tested with applicable test parameters for each channel bandwidth and are shown in table 6.3A.4.3.4.1-1 and table 6.3A.4.3.4.1-2. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. The details of the OCNG patterns used are specified in Annex A.5. Configurations of PDSCH and MPDCCH before measurement are specified in Annex C.2.

Table 6.3A.4.3.4.1-1: Test Configuration Table Tx test cases UE Cat-M1: PUCCH sub-test

Initial Conditions			
Test Environment as specified in TS 36.508 [12] subclause 4.1		Normal	
Test Frequencies as specified in TS 36.508 [12] subclause 4.3.1		Mid range	
Test Channel Bandwidths as specified in TS 36.508 [12] subclause 4.3.1		1.4MHz	
Test Parameters for Channel Bandwidths and Narrowband positions			
	Downlink Configuration		**Uplink Configuration**
Ch BW	Mod'n	RB allocation	FDD: PUCCH format = Format 1a
		FDD	
1.4MHz	QPSK	4	
Note 1: Downlink RB position shall be RB_{start} = 0 within the narrowband			

Table 6.3A.4.3.4.1-2: Test Configuration Table Tx test cases UE Cat-M1: PUSCH sub-test

Initial Conditions					
Test Environment as specified in TS 36.508 [12] subclause 4.1		Normal			
Test Frequencies as specified in TS 36.508 [12] subclause 4.3.1		Mid range			
Test Channel Bandwidths as specified in TS 36.508 [12] subclause 4.3.1		1.4MHz			
Test Parameters for Channel Bandwidths and Narrowband positions					
	Downlink Configuration	**Uplink Configuration**			
Ch BW	N/A for PUSCH sub-test	Mod'n		RB allocation	
			FDD and HD-FDD		
Low range					
1.4MHz		QPSK	5	5	0

1. Connect the SS to the UE antenna connectors as shown in TS 36.508 [12] Annex A Figure A.3 using only main UE Tx/Rx antenna.

2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, and C.3.0, and uplink signals according to Annex H.1 and H.3.0.

4. The UL and DL Reference Measurement channels are set according to Table 6.3A.4.3.4.1-1 (PUCCH sub-test) and Table 6.3A.4.3.4.1-2 (PUSCH sub-test).

5. UE location according to TS 36.508 [12] clause 5.6.1 is provided to the UE through any preconfigured means.

6. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31 information during the duration of the test as define in TS 36.508[12] clause 5.6.3.1.

7. Deactivate UE prediction of satellite trajectory by any preconfigured means.

8. Ensure the UE is in State 3A-RF-CE according to TS 36.508 [12] clause 5.2A.2AA. Message contents are defined in clause 6.3A.4.1.4.3.

6.3A.4.3.4.2 Test procedure

The procedure is separated in various subtests to verify different aspects of relative power control. The power patterns of the subtests are described in figure 6.3A.4.3.4.2-1.

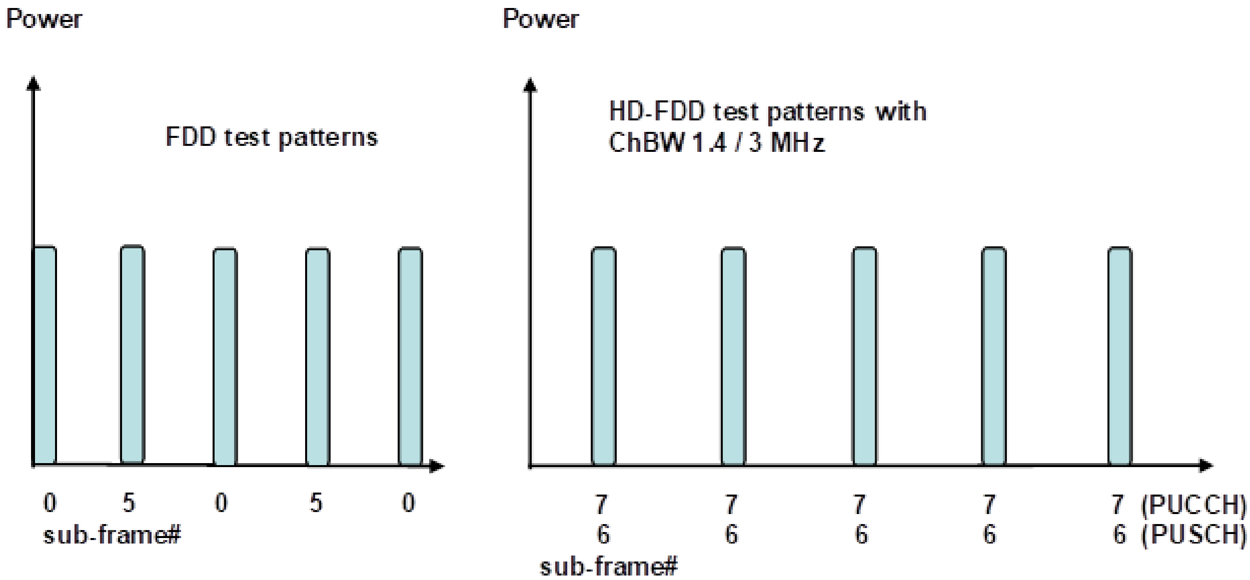


Figure 6.3.A.4.3.4.2-1: Test uplink transmission

1. PUCCH sub test:

1.1 The SS transmits PDSCH via M-PDCCH DCI format 6-1A for C_RNTI to transmit the DL RMC according to Table 6.3A.4.3.4.1-1. The SS sends downlink MAC padding bits on the DL RMC. The transmission of PDSCH will make the UE send uplink ACK/NACK using PUCCH. Send the appropriate TPC commands for PUCCH to the UE to ensure that the UE transmits PUCCH at 0dBm +/- 3.2 dB for carrier frequency f ≤ 3.0GHz or at 0dBm +/- 3.5 dB for carrier frequency 3.0GHz < f ≤ 4.2GHz.

1.2. For FDD: Every 5 subframes transmit to the UE downlink PDSCH MAC padding bits as well as 0 dB TPC command for PUCCH via the MPDCCH to make the UE transmit ACK/NACK on the PUCCH with transmission gap of 4 subframes. For HD-FDD: Subframe #3 every 10 subframes transmit to the UE downlink PDSCH MAC padding bits as well as 0 dB TPC command for PUCCH via the MPDCCH to make the UE transmit ACK/NACK on the PUCCH with transmission gap of 9 ms after subframe #7. The downlink transmission is scheduled in the appropriate sub-frames to make the UE transmit PUCCH as described in figure 6.3A.4.3.4.2-1.

1.3. Measure the power of 5 consecutive PUCCH transmissions to verify the UE transmitted PUCCH power is maintained within 21 ms for FDD and within 41 ms for HD-FDD. The transient periods of 20us are excluded from the power measurement.

2. PUSCH sub test:

2.1. The SS sends uplink scheduling information via M-PDCCH DCI format 6-0A for C_RNTI to schedule the PUSCH. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. Send the appropriate TPC commands for PUSCH to the UE to ensure that the UE transmits PUSCH at 0dBm +/- 3.2 dB for carrier frequency f ≤ 3.0GHz or at 0dBm +/- 3.5 dB for carrier frequency 3.0GHz < f ≤ 4.2GHz.

2.2. For FDD: Every 5 subframes schedule the UE's PUSCH data transmission and transmit 0 dB TPC command for PUSCH via the MPDCCH to make the UE transmit PUSCH with 4 subframes gap. For HD-FDD: Subframe #6 every 10 subframes schedule the UE's PUSCH data transmission and transmit 0 dB TPC command for PUSCH via the MPDCCH to make the UE transmit PUSCH with transmission gap of 9 ms after subframe #6. The uplink transmission patterns are described in figure 6.3A.4.3.4.2-1.

2.3. Measure the power of 5 consecutive PUSCH transmissions to verify the UE transmitted PUSCH power is maintained within 21 ms for FDD and within 41 ms for HD-FDD. The transient periods of 20us are excluded from the power measurement.

6.3A.4.3.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 4.6.

6.3A.4.3.5 Test requirement

The requirement for the power measurements made in step (1.3) and (2.3) of the test procedure shall not exceed the values specified in Table 6.3A.4.3.5-1. The power measurement period shall be 1 sub-frame excluding transient periods.

Table 6.3A.4.3.5-1: Power control tolerance

TPC command	UL channel	Test requirement measured power within 21m [2]
0 dB	PUCCH	Given 5 power measurements in the pattern, the 2nd, 3rd, 4th, and 5th measurements shall be within ± 3.2 dB of the 1st measurement.
0 dB	PUSCH	Given 5 power measurements in the pattern, the 2nd, 3rd, 4th, and 5th measurements shall be within ± 4.2 dB of the 1st measurement.
Note 1: The UE transmission gap is 4 ms for full-duplex FDD. For UE of half-duplex FDD, the transmission gap is 9 ms TPC command is transmitted via PDCCH 4 subframes preceding each PUCCH/PUSCH transmission. Note 2: For UE of half-duplex FDD MHz, the test interval is 41 ms.		

6.3B Output power dynamics for category NB1 and NB2

6.3B.1 UE Minimum output power for category NB1 and NB2

6.3B.1.1 Test purpose

To verify the UE's ability to transmit with a broadband output power below the value specified in the test requirement when the power is set to a minimum value.

6.3B.1.2 Test applicability

This test case applies to all types of E-UTRA UE release 17 and forward of UE category NB11 and NB2 that support satellite access operation.

6.3B.1.3 Minimum conformance requirements

For category NB1 and NB2 UE the single-tone and multi-tone transmission minimum output power requirement for the channel bandwidth is -40 dBm. For 3.75kHz sub-carrier spacing the minimum output power is defined as mean power in one slot (2ms) excluding the 2304Ts gap when UE is not transmitting. For 15kHz sub-carrier spacing the minimum output power is defined as mean power in one sub-frame (1ms).

The normative reference for this requirement is TS 36.102 [11] clause 6.3B.1.

6.3B.1.4 Test description

6.3B.1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions and test frequencies based on the subset of E-UTRA operating bands defined for NB-IoT in clause 5.2B. All of these configurations shall be tested with applicable test parameters and are shown in table 6.3B.1.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in TS 36.521[14] Annex A.2. Configurations of NPDSCH and NPDCCH before measurement are specified in TS 36.521[14] Annex C.2.

Table 6.3B.1.4.1-1: Test Configuration Table

Initial Conditions				
Test Environment as specified in TS 36.508 [12] subclause 8.1.1		Normal, TL/VL, TL/VH, TH/VL, TH/VH		
Test Frequencies as specified in TS 36.508 [12] subclause 8.1.3.1		Frequency ranges defined in Annex K.1.1		
Test Parameters				
Configuration ID	**Downlink Configuration**	**Uplink Configuration**		
	N/A	Modulation	N_{tones}	Sub-carrier spacing (kHz)
1 (Note 2)		BPSK	1@0	3.75
2 (Note 3)		BPSK	1@47	3.75
3 (Note 2)		QPSK	1@0	15
4 (Note 3)		QPSK	1@11	15
5 (Note 1)		QPSK	12@0	15
Note 1: Applicable to UE supporting UL multi-tone transmissions Note 2: only applicable for low range Note 3: only applicable for high range				

1. Connect the SS to the UE antenna connectors as shown in TS 36.508 [12] Annex A Figure A.3 using only main UE Tx/Rx antenna.
2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 8.1.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1, and C.3.0, and uplink signals according to Annex H.1.1 and H.4.0.
4. The UL Reference Measurement channel is set according to Table 6.3B.1.4.1-1.
5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 36.508 [12] clause 8.2.6.1. is provided to the UE through any preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 8.2.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 8.2.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31-NB information during the duration of the test as define in TS 36.508[12] clause 8.2.6.3.1
8. Deactivate UE prediction of satellite trajectory by any preconfigured means
9. Ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5. Message contents are defined in clause 6.3B.1.4.3.

6.3B.1.4.2 Test procedure

1. SS sends uplink scheduling information for UL HARQ process via NPDCCH DCI format N0 for C_RNTI to schedule the UL RMC according to o Table 6.3B.1.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.
2. Measure the mean power of the UE in the channel bandwidth of the radio access mode. The period of measurement shall be at least the continuous duration of one sub-frame (1ms) for sub-carrier spacing of 15 kHz or one slot (2ms) excluding the 2304Ts gap when UE is not transmitting for sub-carrier spacing of 3.75 kHz. Half-Duplex guard subframes are not under test.

NOTE 1: For configuration IDs applicable to UE depending on UE capability in Test Configuration Table with different UL sub-carrier spacing, the SS shall release the connection through State 3A-NB and finally ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5 using the appropriate UL subcarrier spacing in Random Access Response message.

6.3B.1.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 8.1.6 with the following exception.

Table 6.3B.1.4.3-1: NPDSCH-ConfigCommon-NB-DEFAULT

Derivation Path: 36.508 clause 8.1.6.3, Table 8.1.6.3-4			
Information Element	**Value/remark**	**Comment**	**Condition**
NPDSCH-ConfigCommon-NB-DEFAULT ::= SEQUENCE {			
nrs-Power-r13	-39 (dBm)		15 kHz SCS N_{tones} = 1
	-50 (dBm)		15 kHz SCS N_{tones} = 12
	-33 (dBm)		3.75 kHz SCS
}			

Table 6.3B.1.4.3-2: UplinkPowerControlCommon-NB-DEFAULT

Derivation Path: 36.508 clause 8.1.6.3. Table 8.1.6.3-14			
Information Element	**Value/remark**	**Comment**	**Condition**
UplinkPowerControlCommon-NB-DEFAULT ::= SEQUENCE {			
p0-NominalNPUSCH-r13	-95 (-95 dBm)		
alpha-r13	al1 (1)		
deltaPreambleMsg3-r13	4		
}			

6.3B.1.5 Test requirement

The minimum output power measured shall not exceed the value of -39 dBm for the channel bandwidth of category NB1 and NB2 UE.

6.3B.2 Transmit OFF power for category NB1 and NB2

6.3B.2.1 Test purpose

To verify that the UE transmit OFF power is lower than the value specified in the test requirement.

6.3B.2.2 Test applicability

The requirements of this test apply in test cases 6.3B.3.1 General ON/OFF time mask and 6.3B.3.2 NPRACH time mask for all types of NB-IoT FDD UE release 17 and forward of UE category NB1 and NB2 that support satellite access operation.

6.3B.2.3 Minimum conformance requirements

For category NB1 and NB2 UE the transmit OFF power requirement for the channel bandwidth is -50 dBm. For 3.75 kHz sub-carrier spacing the transmit OFF power is defined as mean power in one slot (2ms) excluding the 2304Ts gap when UE is not transmitting. For 15 kHz sub-carrier spacing the transmit OFF power is defined as mean power in one sub-frame (1ms).

The normative reference for this requirement is TS 36.102 [11] clause 6.3B.2.

6.3B.2.4 Test description

This test is covered by clause 6.3B.3.1 General ON/OFF time mask for category NB1 and NB2 and 6.3B.3.2 NPRACH time mask for category NB1 and NB2.

6.3B.2.5 Test requirement

The requirement for the transmit OFF power shall not exceed the values of -48.5 dBm for the channel bandwidth of category NB1 and NB2.

6.3B.3 ON/OFF time mask for category NB1 and NB2

6.3B.3.1 General ON/OFF time mask for category NB1 and NB2

6.3B.3.1.1 Test purpose

To verify that the general ON/OFF time mask meets the requirements given in 6.3B.3.1.5.

The time mask for transmit ON/OFF defines the ramping time allowed for the UE between transmit OFF power and transmit ON power.

Transmission of the wrong power increases interference to other channels or increases transmission errors in the uplink channel.

6.3B.3.1.2 Test applicability

This test case applies to all types of NB-IoT FDD UE release 17 and forward of category NB1 and NB2 that support satellite access operation.

6.3B.3.1.3 Minimum conformance requirements

E-UTRA general ON/OFF time mask in TS 36.521-1[14] subclause 6.3.4.1 applies for category NB1 and NB2 UE with an exception that for 3.75kHz sub-carrier spacing the transmit OFF power is defined as mean power in one slot (2ms) and for 15kHz sub-carrier spacing the transmit OFF power is defined as mean power in one sub-frame (1ms), excluding any transient periods. The ON power is defined as the mean power over one RU excluding any transient periods.

The normative reference for this requirement is TS 36.102 [11] clause 6.3B.3.1.

6.3B.3.1.4 Test description

This test is covered by clause 6.3B.3.1 General ON/OFF time mask for category NB1 and NB2 and 6.3B.3.2 NPRACH time mask for category NB1 and NB2.

6.3B.3.1.4.1 Initial conditions

Initial conditions are set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions and test frequencies based on the subset of E-UTRA operating bands defined for NB-IoT in clause 5.2B. All of these configurations shall be tested with applicable test parameters for each channel bandwidth and are shown in table 6.3B.3.1.4.1-1. The details of the uplink reference measurement channel (RMCs) are specified in Annex A.2. Configurations of NPDSCH and NPDCCH before measurement are specified in Annex C.2.

Table 6.3B.3.1.4.1-1: Test Configuration Table for FDD

Initial Conditions				
Test Environment as specified in TS 36.508 [12] subclause 8.1.1		Normal		
Test Frequencies as specified in TS 36.508 [12] subclause 8.1.3.1		Frequency ranges defined in Annex K.1.1		
Test Parameters				
Configuration ID	**Downlink Configuration**	**Uplink Configuration**		
	N/A	**Modulation**	**N_{tones}**	**Sub-carrier spacing (kHz)**
1		QPSK	1@0	15kHz

1. Connect the SS to the UE antenna connectors as shown in TS 36.508 [12] Annex A Figure A.3 using only main UE Tx/Rx antenna.

2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 8.1.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1 and C.3.0, and uplink signals according to Annex H.1.1 and H.4.0.

4. The UL Reference Measurement channel is set according to Table 6.3B.3.1.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. UE location according to TS 36.508 [12] clause 8.2.6.1 is provided to the UE through any preconfigured means.

7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 8.2.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 8.2.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31-NB information during the duration of the test as define in TS 36.508[12] clause 8.2.6.3.1.

8. Deactivate UE prediction of satellite trajectory by any preconfigured means.

9. Ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5. Message contents are defined in clause 6.3B.3.1.4.3.

6.3B.3.1.4.2 Test procedure

1. SS sends uplink scheduling information via NPDCCH DCI format N0 for C_RNTI to schedule the UL RMC according to Table 6.3B.3.1.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. (UE should be already transmitting PUMAX after Initial Conditions setting)

2. For HD-FDD : Measure the UE transmission OFF power as the mean power in one sub-frame (1ms) prior to the NPUSCH RU, excluding a transient period of 20 µs at the beginning of the sub-frame.

3. Measure the output power of the UE NPUSCH transmission as the mean power in one RU, excluding a transient period of 20 µs at the beginning of the RU.

4. Measure the UE transmission OFF power as the mean power in one sub-frame (1ms) following the NPUSCH RU, excluding a transient period of 20 µs at the beginning of the sub-frame.

6.3B.3.1.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 8.1.6 with the following exceptions.

Table 6.3B.3.1.4.3-1: P0-NominalNPUSCH-r13 configuration

Derivation Path: 36.508 clause 8.1.6.3 Table 8.1.6.3-14: UplinkPowerControlCommon-NB-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
UplinkPowerControlCommon-NB-DEFAULT ::= SEQUENCE {			
p0-NominalNPUSCH-r13	-117 (dBm)		
alpha-r13	al1 (1)		
deltaPreambleMsg3-r13	4		
}			

Table 6.3B.1.4.3-2: NPDSCH-ConfigCommon-NB-DEFAULT configuration

Derivation Path: 36.508 clause 8.1.6.3 Table 8.1.6.3-4: NPDSCH-ConfigCommon-NB-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
NPDSCH-ConfigCommon-NB-DEFAULT ::= SEQUENCE {			
nrs-Power-r13	21 (dBm)		
}			

6.3B.3.1.5 Test requirement

The requirement for the power measured in steps (2), (3) and (4) of the test procedure shall not exceed the values specified in Table 6.3B.1.5-1.

Table 6.3B.1.5-1: General ON/OFF time mask for category NB1 and NB2

	Channel bandwidth / minimum output power / measurement bandwidth
	200 kHz
Transmit OFF power	For carrier frequency f ≤ 3.0GHz: ≤ -48.5 dBm
Transmission OFF Measurement bandwidth	180kHz
Expected Transmission ON Measured power	-11 dBm
ON power tolerance f ≤ 3.0GHz	± 7.5 dB

6.3B.3.2 NPRACH time mask for category NB1 and NB2

6.3B.3.2.1 Test purpose

To verify that the NPRACH time mask meets the requirements given in 6.3B.3.2.5.

The time mask for NPRACH time mask defines the ramping time allowed for the UE between transmit OFF power and transmit ON power when transmitting the NPRACH.

Transmission of the wrong power increases interference to other channels or increases transmission errors in the uplink channel.

6.3B.3.2.2 Test applicability

This test case applies to all types of NB-IoT FDD UE release 17 and forward of category NB1 and NB2 that support satellite access operation.

6.3B.3.2.3 Minimum conformance requirements

The NPRACH ON power is specified as the mean power over the NPRACH measurement period excluding any transient periods as shown in Figure 6.3B.3.2.3-1. The measurement period for different NPRACH preamble format is specified in Table 6.3B.2.3-1.

There are no additional requirements on UE transmit power beyond that which is required in subclause 6.2B and 6.5B

Table 6.3B.3.2.3-1: NPRACH ON power measurement period

NPRACH preamble format	Measurement period (ms)
0	5.6
1	6.4

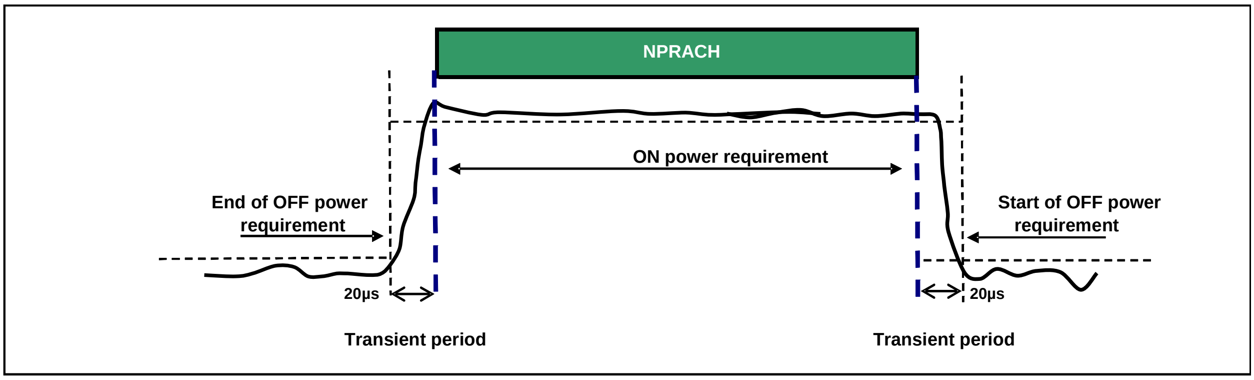


Figure 6.3B.3.2.3-1: NPRACH ON/OFF time mask

The normative reference for this requirement is TS 36.102 [11] clause 6.3B.3.3.

6.3B.3.2.4 Test description

6.3B.3.2.4.1 Initial conditions

Initial conditions are set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions and test frequencies based on the subset of E-UTRA operating bands defined for NB-IoT in clause 5.2B. All of these configurations shall be tested with applicable test parameters for each channel bandwidth and are shown in table 6.3B.3.2.4.1-1. The details of the uplink reference measurement channel (RMCs) are specified in Annex A.2.4.

Table 6.3B.3.2.4.1-1: Test Configuration Table

Initial Conditions	
Test Environment as specified in TS 36.508 [12] subclause 8.1.1	Normal
Test Frequencies as specified in TS 36.508 [12] subclause 8.1.3.1	Frequency ranges defined in Annex K.1.1
NPRACH preamble format	0
	1

1. Connect the SS to the UE antenna connectors as shown in TS 36.508 [12] Annex A Figure A.3 using only main UE Tx/Rx antenna.
2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 8.1.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1 and C.3.0, and uplink signals according to Annex H.1.1 and H.4.0.
4. Propagation conditions are set according to Annex B.0.
5. UE location according to TS 36.508 [12] clause 8.2.6.1 is provided to the UE through any preconfigured means.
6. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 8.2.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 8.2.6.2.1-3

for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31-NB information during the duration of the test as define in TS 36.508[12] clause 8.2.6.3.1.

7. Deactivate UE prediction of satellite trajectory by any preconfigured means.
8. Ensure the UE is in State 3A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5. Message contents are defined in clause 6.3B.3.2.4.3.

6.3B.3.2.4.2 Test procedure

1. The SS shall set RS EPRE according to Table 6.3B.3.2.4.1-1.
2. The SS send the paging and UE shall send a preamble to the SS.
3. The SS measure the UE transmission OFF power during the sub-frame preceding the NPRACH preamble excluding a transient period of 20 µs according to Figure 6.3B.3.2.3-1.
4. Measure the output power of the transmitted NPRACH preamble according to Figure 6.3B.3.2.3-1.
5. Measure the UE transmission OFF power, starting 20 µs after the NPRACH preamble ends for a measurement period of 980 µs.
6. Switches off and on the UE and ensures the UE is in State 3A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5. Message contents are defined in clause 6.3B.3.2.4.3 with NPRACH Format 1.
7. Repeat test with step 1-5.

6.3B.3.2.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 8.1.6 with the following exceptions.

Table 6.3B.3.2.4.3-1: RACH-ConfigCommon-NB-DEFAULT

Derivation Path: TS 36.508 [12] clause 8.1.6.3, Table 8.1.6.3-8 RACH-ConfigCommon-NB-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
RACH-ConfigCommon-NB-DEFAULT ::= SEQUENCE {			
powerRampingParameters-r13 SEQUENCE {			
powerRampingStep	dB0	0 dB	
preambleInitialReceivedTargetPower	-dBm-120	-120 dBm	NPRACH Format 0
	dBm-120	-120 dBm	NPRACH Format 1
}			
)			

Table 6.3B.3.2.4.3-2: NPDSCH-ConfigCommon-NB-DEFAULT

Derivation Path: TS 36.508 [12] clause 8.1.6.3, Table 8.1.6.3-4 NPDSCH-ConfigCommon-NB-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
NPDSCH-ConfigCommon-NB-DEFAULT ::= SEQUENCE {			
nrs-Power-r13	24 (dBm)		
}			

Table 6.3B.3.2.4.3-3: NPRACH-ConfigSIB-NB-DEFAULT

Derivation Path: TS 36.508 [12] clause 8.1.6.3, Table 8.1.6.3-5 NPRACH-ConfigSIB-NB-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
NPRACH-ConfigSIB-NB-DEFAULT ::= SEQUENCE {			
nprach-CP-Length-r13	us66dot7	2048*Ts	NPRACH Format 0
	us266dot7	8192*Ts	NPRACH Format 1
}			

6.3B.3.2.5 Test requirement

The requirement for the power measured in steps (2), (3) and (4) of the test procedure shall not exceed the values specified in Table 6.3B.1.5-1.

Table 6.3B.3.2.5-1: General ON/OFF time mask for category NB1 and NB2

	Channel bandwidth / minimum output power / measurement bandwidth
	200 kHz
Transmit OFF power	For carrier frequency f ≤ 3.0GHz: ≤ -48.5 dBm
Transmission OFF Measurement bandwidth	180kHz
Expected Transmission ON Measured power	-11 dBm
ON power tolerance f ≤ 3.0GHz	± 7.5 dB

6.3B.4 Power Control for category NB1 and NB2

6.3B.4.1 Power Control Absolute power tolerance for category NB1 and NB2

6.3B.4.1.1 Test purpose

To verify the ability of the UE transmitter to set its initial output power to a specific value at the start of a contiguous transmission or non-contiguous transmission with a long transmission gap, i.e., transmission gap is larger than 20 ms.

6.3B.4.1.2 Test applicability

This test case applies to all types of NB-IoT FDD UE release 17 and forward of category NB1 and NB2 that support satellite access operation.

6.3B.4.1.3 Minimum conformance requirements

The minimum requirement for absolute power tolerance is given in Table 6.3B.4.1.3-1 over the power range bounded by the Maximum output power as defined in subclause 6.2B and the Minimum output power as defined in subclause 6.3B

Table 6.3B.4.1.3-1: Absolute power tolerance

Conditions	Tolerance
Normal	± 9.0 dB
Extreme	± 12.0 dB

The normative reference for this requirement is TS 36.102 [11] clause 6.3B.3.4.

6.3B.4.1.4 Test description

6.3B.4.1.4.1 Initial conditions

Initial conditions are set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions and test frequencies based on the subset of E-UTRA operating bands defined for NB-IoT in clause 5.2B. All of these configurations shall be tested with applicable test parameters for each channel bandwidth and are shown in Table 6.3B.4.1.4.1-1. The details of the uplink reference measurement channel (RMCs) are specified in Annex A.2. Configurations of NPDSCH and NPDCCH before measurement are specified in Annex C.2.

Table 6.3B.4.1.4.1-1: Test Configuration Table

Initial Conditions					
Test Environment as specified in TS 36.508 [12] clause 8.1.1			Normal, TL/VL, TL/VH, TH/VL, TH/VH		
Test Frequencies as specified in TS36.508 [12] clause 8.1.3.1			Frequency ranges defined in Annex K.1.1		
Configuration ID	**Downlink Configuration**		**Uplink Configuration**		
	Modulation	Subcarriers	Modulation	N_{tones}	Subcarrier spacing
1	N/A		QPSK	1@0	3.75 kHz
2			QPSK	1@0	15 kHz
3 (NOTE 1)			QPSK	12@0	15 kHz
Note 1: Applicable to UE supporting UL multi-tone transmissions					

1. Connect the SS to the UE antenna connectors as shown in TS 36.508 [12] Annex A Figure A.3 using only main UE Tx/Rx antenna.
2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 8.1.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1 and C.3.0, and uplink signals according to Annex H.1.1 and H.4.0.
4. The UL Reference Measurement channel is set according to Table 6.3B.4.1.4.1-1.
5. UE location according to TS 36.508 [12] clause 8.2.6.1 is provided to the UE through any preconfigured means.
6. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 8.2.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 8.2.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31-NB information during the duration of the test as define in TS 36.508[12] clause 8.2.6.3.1.
7. Deactivate UE prediction of satellite trajectory by any preconfigured means.
8. Ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5. Message contents are defined in clause 6.3B.4.1.4.3.

6.3B.4.1.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via NPDCCH DCI format N0 for C_RNTI to schedule the UL RMC according to Table 6.3B.4.1.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.
2. The SS shall configure the UE to transmit according to Table 6.3B.4.1.4.3-1 and Table 6.3B.4.1.4.3-2.
3. Measure the initial output power of the first resource unit of UE NPUSCH first transmission. The transient periods of 20us are excluded. The period of measurement shall be at least the continuous duration of one sub-frame (1ms) for 15 kHz sub-carrier spacing or one slot (2ms) excluding the 2304Ts gap when UE is not transmitting for 3.75 kHz sub-carrier spacing. Half-Duplex guard subframes are not under test.

4. Release the connection through State 3A-NB.
5. Modify system information elements according to Table 6.3B.4.1.4.3-3 and Table 6.3B.4.1.4.3-4 and notify the UE via paging message with SystemInformationModification included.
6. Ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5 using the new UL power control setting.
7. SS sends uplink scheduling information for each UL HARQ process via NPDCCH DCI format N0 for C_RNTI to schedule the UL RMC according to Table 6.3B.4.1.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.
8. Measure the initial output power of the first resource unit of UE NPUSCH first transmission. The transient periods of 20us are excluded. The period of measurement shall be at least the continuous duration of one sub-frame (1ms) for 15 kHz sub-carrier spacing or one slot (2ms) excluding the 2304Ts gap when UE is not transmitting for 3.75 kHz sub-carrier spacing. Half-Duplex guard subframes are not under test. For TDD slots with transient periods are not under test.

NOTE 1: For configuration IDs applicable to UE depending on UE capability in Test Configuration Table with different UL sub-carrier spacing, the SS shall release the connection through State 3A-NB and finally ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5 using the appropriate UL subcarrier spacing in Random Access Response message.

6.3B.4.1.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 8.1.6 with the following exceptions.

Table 6.3B.4.1.4.3-1: UplinkPowerControlCommon: Test point 1

Derivation Path: TS 36.508 [12] clause 8.1.6.3, Table 8.1.6.3-14 UplinkPowerControlCommon-NB-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
UplinkPowerControlCommon-NB-DEFAULT ::= SEQUENCE {			
p0-NominalNPUSCH-r13	-124 (-124 dBm)	Test point 1 to verify a UE relative low initial power transmission	

Table 6.3B.4.1.4.3-2: NPDSCH-ConfigCommon-NB-DEFAULT: Test Point 1

Derivation Path: 36.331 clause 6.7.3			
Information Element	**Value/remark**	**Comment**	**Condition**
NPDSCH-ConfigCommon-NB-DEFAULT ::= SEQUENCE {			
nrs-Power-r13	20 (dBm)		
}			

Table 6.3B.4.1.4.3-3: UplinkPowerControlCommon: Test point 2

Derivation Path: TS 36.508 [12] clause 8.1.6.3, Table 8.1.6.3-14 UplinkPowerControlCommon-NB-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
UplinkPowerControlCommon-NB-DEFAULT ::= SEQUENCE {			
p0-NominalNPUSCH-r13	-94 (-94 dBm)	Test point 2 to verify a UE relative high initial power transmission	

Table 6.3B.4.1.4.3-4: NPDSCH-ConfigCommon-NB-DEFAULT: Test Point 2

Derivation Path: 36.331 clause 6.7.3			
Information Element	**Value/remark**	**Comment**	**Condition**
NPDSCH-ConfigCommon-NB-DEFAULT ::= SEQUENCE {			
nrs-Power-r13	3 (dBm)		
}			

Table 6.3B.4.1.4.3-5: PhysicalConfigDedicated

Derivation Path: TS 36.508 [12] clause 8.1.8.2, Table 8.1.8.2.1.6-1 PhysicalConfigDedicated-NB-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
PhysicalConfigDedicated-NB-DEFAULT ::= SEQUENCE {			
uplinkPowerControlDedicated-r13	UplinkPowerControlDedicated-NB-DEFAULT	See subclause 8.1.6.3	

Table 6.3B.4.1.4.3-6: UplinkPowerControlDedicated-NB-DEFAULT

Derivation Path: TS 36.508 [12] clause 8.1.6.3, Table 8.1.6.3-15 UplinkPowerControlDedicated-NB-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
UplinkPowerControlDedicated-NB-DEFAULT ::= SEQUENCE {			
p0-UE-NPUSCH-r13	0	Default	
}			

6.3B.4.1.5 Test requirement

The requirement for the power measured in steps (2), (3) and (4) of the test procedure shall not exceed the values specified in Table 6.3B.4.1.5-1 and 6.3B.4.1.5-2.

Table 6.3B.4.1.5-1: Absolute power tolerance: test point 1

	Channel bandwidth / expected output power (dBm)		
	Configuration ID 1 3.75 kHz (1 tone)	**Configuration ID 2 15 kHz (1 tone)**	**Configuration ID 3 15 kHz (12 tones)**
Expected Measured power Normal conditions	-25 dBm	-19 dBm	-8.2 dBm
Power tolerance f ≤ 3.0GHz	± 10.0dB	± 10.0dB	± 10.0dB
Expected Measured power Extreme conditions	-25 dBm	-19 dBm	-8.2 dBm
Power tolerance f ≤ 3.0GHz	± 13.0dB	± 13.0dB	± 13.0dB
Note 1: The lower power limit shall not exceed the minimum output power requirements defined in sub-clause 6.3B.1			

Table 6.3B.4.1.5-2: Absolute power tolerance: test point 2

	Channel bandwidth / expected output power (dBm)		
	Configuration ID 1 3.75 kHz (1 tone)	**Configuration ID 2 15 kHz (1 tone)**	**Configuration ID 3 15 kHz (12 tones)**

Expected Measured power Normal conditions	-12 dBm	-6 dBm	4.8 dBm
Power tolerance f ≤ 3.0GHz	± 10.0dB	± 10.0dB	± 10.0dB
Expected Measured power Extreme conditions	-12 dBm	-6 dBm	4.8 dBm
Power tolerance f ≤ 3.0GHz	± 13.0dB	± 13.0dB	± 13.0dB
Note 1: The upper power limit shall not exceed the maximum output power requirements defined in sub-clause 6.2B.1			

6.3B.4.2 Power Control Relative power tolerance for category NB1 and NB2

6.3B.4.2.1 Test purpose

To verify the ability of the UE transmitter to set its output power relatively to the power in a target sub-frame relatively to the power of the most recently transmitted reference sub-frame if the transmission gap between these sub-frames is ≤ 20 ms.

6.3B.4.2.2 Test applicability

This test case applies to all types of NB-IoT FDD UE release 17 and forward of category NB1 and NB2 that support satellite access operation.

6.3B.4.2.3 Minimum conformance requirements

Category NB1 and NB2 UE relative power control requirement is defined for NPRACH power step values of 0, 2, 4 and 6 dB. For NPRACH transmission, the relative tolerance is the ability of the UE transmitter to set its output power relatively to the power of the most recently transmitted preamble. The measurement period for the NPRACH preamble is specified in Table 6.3B.3.2.3-1.

The requirements specified in Table 6.3B.4.2.3-1 apply when the power of the target and reference sub-frames are within the power range bounded by the Minimum output power as defined in subclause 6.3B.1 and the maximum output power as defined in subclause 6.2B.1

Table 6.3B.4.2.3-1: Relative power tolerance for category NB1 and NB2 NPRACH transmission (normal conditions)

Power step ΔP [dB]	NPRACH [dB]
ΔP = 0	±1.5
ΔP = 2	±2.0
ΔP = 4	±3.5
ΔP = 6	±4.0
NOTE: For extreme conditions an additional ± 2.0 dB relaxation is allowed.	

The power step (ΔP) is defined as the difference in the calculated setting of the UE Transmit power between the target and reference sub-frames. The error is the difference between ΔP and the power change measured at the UE antenna port with the power of the cell-specific reference signals kept constant. The error shall be less than the relative power tolerance specified in Table 6.3B.4.2.3-1.

The normative reference for this requirement is TS 36.102 [11] clause 6.3B.4.

6.3B.4.2.4 Test description

6.3B.4.2.4.1 Initial conditions

Initial conditions are set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions and test frequencies based on the subset of E-UTRA operating bands defined for NB-IoT in clause 5.2B. All of these configurations shall be tested with applicable test parameters for each channel bandwidth and are shown in table 6.3B.4.2.4.1-1. The details of the uplink reference measurement channel (RMCs) are specified in Annex A.2. Configurations of NPDSCH and NPDCCH before measurement are specified in Annex C.2.

Table 6.3B.4.2.4.1-1: Test Configuration Table

Initial Conditions	
Test Environment as specified in TS 36.508 [12] clause 8.1.1	Normal, TL/VL, TL/VH, TH/VL, TH/VH
Test Frequencies as specified in TS36.508 [12] clause 8.1.3.1	Frequency ranges defined in Annex K.1.1
NPRACH preamble format	0

1. Connect the SS to the UE antenna connectors as shown in TS 36.508 [12] Annex A Figure A.3 using only main UE Tx/Rx antenna.
2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 8.1.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1 and C.3.0, and uplink signals according to Annex H.1 and H.3.0.
4. The UL Reference Measurement channel is set according to Table 6.3B.4.2.4.1-1.
5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 36.508 [12] clause 8.2.6.1 is provided to the UE through any preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 8.2.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 8.2.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31-NB information during the duration of the test as define in TS 36.508[12] clause 8.2.6.3.1.
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.
9. Ensure the UE is in State 3A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5. Message contents are defined in clause 6.3B.4.2.4.3.

6.3B.4.2.4.2 Test procedure

1. The SS send the paging and UE shall send a preamble to the SS.
2. NPRACH is set according to Table 6.3B.2.4.1-1.
3. UE shall send a preamble to the SS.
4. In response to the preamble, the SS shall transmit a random access response not corresponding to the transmitted random access preamble, or send no response.
5. The UE shall consider the random access response reception not successful then re-transmit the preamble with the calculated NPRACH transmission power.
6. Measure the output power of the transmitted NPRACH preamble according to Figure 6.3B.3.2.3-1. Note that the measurement does not need to be done for overall measurement range at one time. The measurement range can be divided into few ranges. Each range needs to overlap neighbouring one.
7. Switches off and on the UE and ensure the UE is in State 3A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5. Message contents are defined in clause 6.3B.4.2.4.3.
8. Repeat test with step 1-6 as indicated in section 6.3B.4.2.4.3.

6.3B.4.2.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 8.1.6 with the following exceptions.

Table 6.3B.4.2.4.3-1: NPDSCH-ConfigCommon-NB-DEFAULT: NPRACH measurement

Derivation Path: TS 36.508 [12] clause 8.1.6, Table 8.1.6.3-4 NPDSCH-ConfigCommon-NB-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
NPDSCH-ConfigCommon-NB-DEFAULT ::= SEQUENCE {			
nrs-Power-r13	-22 (dBm)		
}			

Table 6.3B.4.2.4.3-2: RACH-ConfigCommon-NB-DEFAULT: NPRACH measurement (Subtest 1: power step size ΔP = 2 dB)

Derivation Path: TS 36.508 [12] clause 8.1.6, Table 8.1.6.3-8 RACH-ConfigCommon-NB-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
RACH-ConfigCommon-NB-DEFAULT ::= SEQUENCE {			
preambleTransMax-CE-r13	n50		
}			

Table 6.3B.4.2.4.3-3: RACH-ConfigCommon-NB-DEFAULT: NPRACH measurement (Subtest 2: power step size ΔP = 6 dB)

Derivation Path: TS 36.508 [12] clause 8.1.6, Table 8.1.6.3-8 RACH-ConfigCommon-NB-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
RACH-ConfigCommon-NB-DEFAULT ::= SEQUENCE {			
preambleTransMax-CE-r13	n10		
powerRampingParameters-r13 SEQUENCE {			
powerRampingStep	dB6		
}			
}			

6.3B.4.2.5 Test requirement

Each UE power step measured in the test procedure 6.3B.4.2.4.2 should satisfy the test requirements specified in Table 6.3B.4.2.5-1 for normal conditions; for extreme conditions an additional ± 2.0 dB relaxation is allowed.

Table 6.3B.4.2.5-1: Relative power tolerance for category NB1 and NB2 NPRACH transmission (normal conditions – Note 1)

Expected power step size (up) ΔP [dB]	NPRACH [dB]
ΔP = 2	2 ± (2.7)
ΔP = 6	6 ± (4.7)
Note 1: For extreme conditions an additional ± 2.0 dB relaxation is allowed. Note 2: Only UE output power measurements within the range -39.3 to 20.3 dBm for Power Class 3, or -39.3 to 16.8 dBm for Power Class 5 shall be considered in the pass/fail criteria.	

6.3B.4.3 Aggregate power control tolerance for category NB1 and NB2

Editor's Note: This clause is incomplete. The following aspects are either missing or not yet determined:

- Addition to applicability spec is pending.

- The minimum requirements are not testable with Release 17 UEs

- Testability with forward releases is FFS

6.3B.4.3.1 Test purpose

To verify the ability of a category NB1 and NB2 UE to maintain its output power in non-contiguous transmission with respect to the first UE transmission, when the uplink power control parameters as defined in TS 36.213 are constant and α is set to 0.

6.3B.4.3.2 Test applicability

This test case applies to all types of NB-IoT FDD UE release FFS and forward of category NB1 and NB2 that support satellite access operation.

6.3B.4.3.3 Minimum conformance requirements

The UE shall meet the requirements specified in Table 6.3B.4.3.3-1 for aggregate power control over the power range bounded by the minimum output power as defined in subclause 6.3B.1 and the maximum output power as defined in subclause 6.2B.1.

Table 6.3B.4.3.3-1: Aggregate power control tolerance for HD-FDD

UL channel	Aggregate power tolerance	
	15 kHz / 12 tones within 53 ms	15 kHz / 1 tone within 104 ms
NPUSCH	±3.5 dB	
NOTE: For five consecutive UE transmissions the transmission gaps are 12 ms for 12 tone and 16 ms for single tone transmissions. Uplink scheduling grant is transmitted via NPDCCH eight subframes before NPUSCH transmission.		

The normative reference for this requirement is TS 36.102 [11] clause 6.3B.4.

6.3B.4.3.4 Test description

6.3B.4.3.4.1 Initial conditions

Initial conditions are set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions and test frequencies based on the subset of E-UTRA operating bands defined for NB-IoT in clause 5.2B. All of these configurations shall be tested with applicable test parameters for each channel bandwidth and are shown in table 6.3B.4.3.4.1-1. The details of the uplink reference measurement channel (RMCs) are specified in Annex A.2.4. Configurations of NPDSCH and NPDCCH before measurement are specified in Annex C.2.

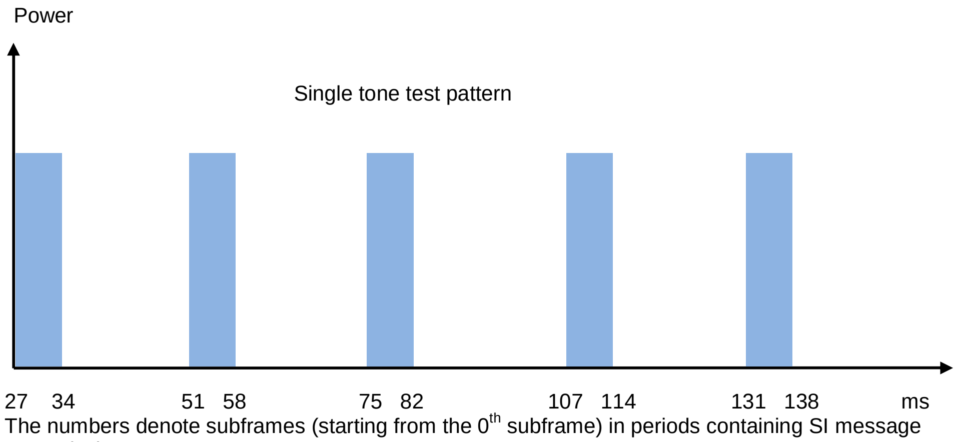
Table 6.3B.4.3.4.1-1: Test Configuration

Initial Conditions				
Test Environment as specified in TS 36.508 [12] subclause 8.1.1		Normal		
Test Frequencies as specified in TS 36.508 [12] subclause 8.1.3.1		Frequency ranges defined in Annex K.1.1		
Test Parameters				
Configuration ID	**Downlink Configuration**	**Uplink Configuration**		
	N/A	Modulation	N_{tones}, start position	Sub-carrier spacing (kHz)
1		QPSK	1@0	15
2		QPSK	1@11	15
3 (Note 1)		QPSK	12@0	15
Note 1: Applicable to UE supporting UL multi-tone transmissions				

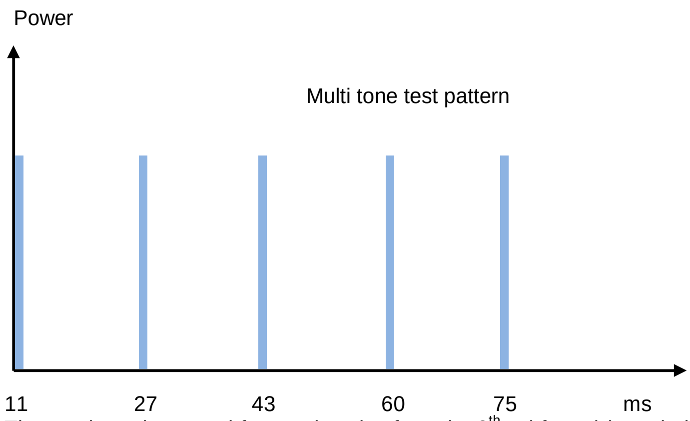
1. Connect the SS to the UE antenna connectors as shown in TS 36.508 [12] Annex A Figure A.3 using only main UE Tx/Rx antenna.
2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 8.1.4.3.
3. Downlink signals are initially set up according to Annex C and uplink signals according to Annex H.
4. The UL Reference Measurement channel is set according to Table 6.3B.4.3.4.1-1.
5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 36.508 [12] clause 8.2.6.1 is provided to the UE through any preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 8.2.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 8.2.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31-NB information during the duration of the test as define in TS 36.508[12] clause 8.2.6.3.1.
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.
9. Ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5. Message contents are defined in clause 6.3B.4.3.4.3.

6.3B.4.3.4.2 Test procedure

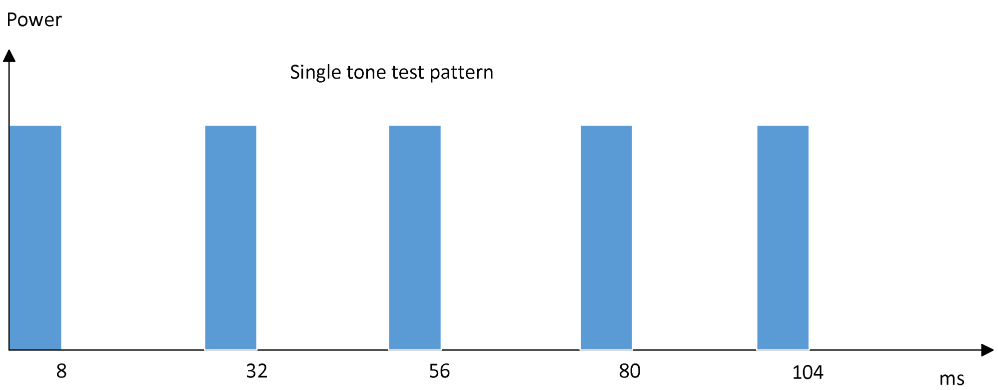
The procedure is separated in two subtests to verify single tone and multi tone NPUSCH aggregate power control tolerance respectively. The uplink transmission patterns are described in figure 6.3B.4.3.4.2-1.



The numbers denote subframes (starting from the 0th subframe) in periods containing SI message transmission.



The numbers denote subframes (starting from the 0th subframe) in periods where there is no transmission of SI messages.



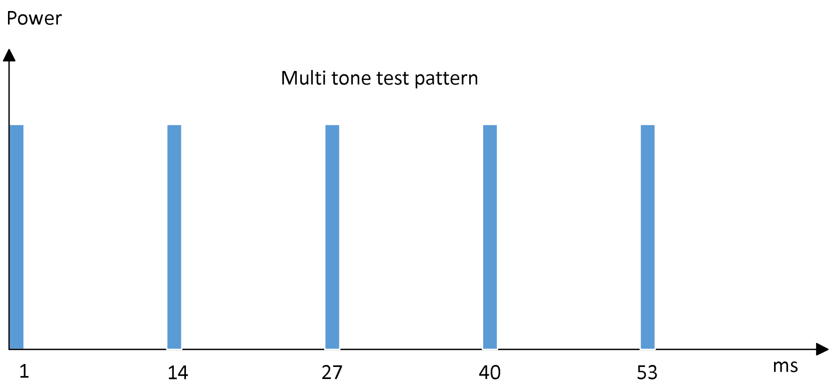


Figure 6.3B.4.3.4.2-1: Test uplink transmission for HD-FDD

For single tone NPUSCH transmission scenario:

1. SS sends uplink scheduling information for each UL HARQ process via NPDCCH DCI format N0 for C_RNTI to schedule the UL RMC according to Table 6.3B.4.3.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.

2. Schedule the UE's NPUSCH data transmission for period containing SI message transmission according to Annex A.2.4 and make the UE transmit NPUSCH with 32 or 48 slots (16 or 24 ms) gap for HD-FDD or 46 slots (23ms) gap for TDD. Uplink scheduling grant is transmitted via NPDCCH 9 subframes before NPUSCH transmission.

3. Measure the power of 5 consecutive NPUSCH transmissions to verify the UE transmitted NPUSCH power is maintained within 112 ms for HD-FDD. The transient periods of 20us are excluded from the power measurement.

4. Repeat step 2 and 3 for configuration ID 2 in Table 6.3B.4.3.4.1-1.

For 12 tones NPUSCH transmission scenario:

0. SS release the connection through State 3A-NB and finally ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5 and configure the UE to the new UL power level with messages in Table 6.3B.4.3.4.3-2.

1. SS sends uplink scheduling information for each UL HARQ process via NPDCCH DCI format N0 for C_RNTI to schedule the UL RMC according to Table 6.3B.4.3.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.

2. Schedule the UE's NPUSCH data transmission for period where there is no transmission of SI messages according to Annex A.2.4 and make the UE transmit NPUSCH with 28, 30 or 32 slots (14, 15 or 16 ms) gap for HD-FDD . Uplink scheduling grant is transmitted via NPDCCH 9 subframes before NPUSCH transmission.

3. Measure the power of 5 consecutive NPUSCH transmissions to verify the UE transmitted NPUSCH power is maintained within 65 ms for HD-FDD. The transient periods of 20us are excluded from the power measurement.

6.3B.4.3.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 8.1.6 with the following exceptions.

Table 6.3B.4.3.4.3-1: P0-NominalNPUSCH-r13 configuration for single tone 15 kHz scenario

Derivation Path: 36.508 clause 8.1.6.3 Table 8.1.6.3-14: UplinkPowerControlCommon-NB-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
UplinkPowerControlCommon-NB-DEFAULT ::= SEQUENCE {			
p0-NominalNPUSCH-r13	0 (0 dBm)		
alpha-r13	al0 (0)		
deltaPreambleMsg3-r13	4		
}			

Table 6.3B.4.3.4.3-2: P0-NominalNPUSCH-r13 configuration for 12 tones 15 kHz scenario

Derivation Path: 36.508 clause 8.1.6.3 Table 8.1.6.3-14: UplinkPowerControlCommon-NB-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
UplinkPowerControlCommon-NB-DEFAULT ::= SEQUENCE {			
p0-NominalNPUSCH-r13	-11 (-0.2 dBm)		
alpha-r13	al0 (0)		
deltaPreambleMsg3-r13	4		
}			

6.3B.4.3.5 Test requirement

The requirement for the power measurements made in step 4 of the test procedure shall not exceed the values specified in Table 6.3B.4.3.5-1. The power measurement period shall be 1 resource unit excluding transient periods.

Table 6.3B.4.3.5-1: Power control tolerance

UL channel	Test requirement measured power
NPUSCH	Given 5 power measurements in the pattern, the 2nd, 3rd, 4th, and 5th measurements shall be within ± 4.2 dB of the 1st measurement.

6.4 Transmit signal quality

This clause is reserved.

6.4A Transmit signal quality for category M1

6.4A.1 Frequency error for UE category M1

6.4A.1_1 Frequency error with GSO ephemeris for UE category M1

6.4A.1_1.1 Test purpose

This test verifies the ability of both, the receiver and the transmitter, to process frequency correctly.

Receiver: to extract the correct frequency from the stimulus signal, offered by the System simulator, under ideal propagation conditions and low level.

Transmitter: to derive the correct modulated carrier frequency from the results, gained by the receiver.

6.4A.1_1.2 Test applicability

This test case applies to all types of E-UTRA FDD UE release 17 and forward of UE category M1 that support satellite access operation and only GSO or both GSO and NGSO.

6.4A.1_1.3 Minimum conformance requirements

For category M1 UE, the basic measurement interval of modulated carrier frequency is 1 UL timeslot (0.5ms). The UE pre-compensates the uplink modulated carrier frequency by the estimated Doppler shift based on received ephemeris information of the SAN in IE EphemerisInfo (TS 36.331 [6]), its own location and UL carrier frequency signalled to the UE by the SAN (according to TS36.300 [8] clause 16.14.2).

For category M1 FD-FDD UEs and for category M1 HD-FDD UEs with continuous uplink transmissions of duration ≤ 64 ms, the mean value of basic measurements of UE pre-compensated modulated carrier frequency shall be accurate to within ± 0.1 PPM observed over a period of one time slot (0.5 ms) compared with the ideally pre-compensated UL carrier frequency.

For category M1 HD-FDD UEs with continuous uplink transmissions of duration > 64 ms, the mean value of basic measurements of UE pre-compensated modulated carrier frequency shall be accurate within the limits in Table 6.4A.1_1-1 observed over a period of one time slot (0.5 ms) compared with ideally pre-compensated UL carrier frequency.

When a repetition period is configured on the uplink for which repetition period (R) >1, the UE shall not change Doppler pre-compensation during an ongoing repetition period, except in the transmission gaps as defined in clause 10.1.3.6 of TS 36.211[3]. When segmentation is applied, then the UE shall update pre-compensation at the beginning of each segment prior to segment transmission.

NOTE: The ideally pre-compensated reference uplink carrier frequency consists of the UL carrier frequency signalled to the UE by SAN and UL pre-compensated Doppler frequency shift corresponding to the estimated Doppler frequency at the beginning of the transmission.

Table 6.4A.1_1.3-1: Frequency error requirement for HD-FDD UE category M1

Carrier frequency [GHz]	Frequency error [ppm]
≤1	±0.2
>1	±0.1

The normative reference for this requirement is TS 36.102 [11] clause 6.4A.1.

6.4A.1_1.4 Test description

6.4A.1_1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, channel bandwidths based on E-UTRA bands specified in sub-clause 5.2A. All of these configurations shall be tested with applicable test parameters for each channel bandwidth are shown in table 6.4A.1_1.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. Configurations of PDSCH and MPDCCH before measurement are specified in Annex C.2.

Table 6.4A.1_1.4.1-1: Test Configuration Table

Initial Conditions				
Test Environment as specified in TS 36.508[12] subclause 4.1			NC, TL/VL, TL/VH, TH/VL, TH/VH	
Test Frequencies as specified in TS36.508 [12] subclause 4.3.1			Low range, Mid range, High range	
Test Channel Bandwidths as specified in TS 36.508 [12] subclause 4.3.1			1.4MHz	
	Test Parameters for Channel Bandwidths and Narrowband positions			
	Downlink Configuration		Uplink Configuration	
Ch BW	Modulation	RB allocation	Modulation	RB allocation
1.4MHz	QPSK	2	QPSK	2
1.4MHz	QPSK	2	QPSK	2

1. Connect the SS to the UE to the UE antenna connectors as shown in TS 36.508 [12] Annex A, Figure A.3 using only main UE Tx/Rx antenna.
2. The parameter settings for the cell are set up according to TS 36.508[12] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C0, C.1 and C.3.0, and uplink signals according to Annex H.1 and H.3.0.
4. The UL and DL Reference Measurement channels are set according to Table 6.4A.1_1.4.1-1.
5. Propagation conditions are set according to Annex B.0
6. UE location for GSO satellite according to TS 36.508 [12] clause 5.6.1 is provided to the UE through any preconfigured means.
7. Deactivate UE prediction of satellite trajectory by any preconfigured means.

6.4A.1_1.4.2 Test procedure

1. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 5.6.2.1-1. Test system shall send same SIB31 information during the duration of the frequency error measurement as defined in TS 36.508[12] clause 5.6.3.1.

2. Ensure the UE is in State 3A-RF-CE according to TS 36.508 [12] clause 5.2A.2AA. Message contents are defined in clause 6.4A.1_1.4.3.

3. SS transmits PDSCH via MPDCCH DCI format 6-1A for C_RNTI to transmit the DL RMC according to Table 6.4A.1_1.4.1-1. The SS sends downlink MAC padding bits on the DL RMC.

4. SS sends uplink scheduling information for each UL HARQ process via MPDCCH DCI format 6-0A for C_RNTI to schedule the UL RMC according to Table 6.4A.1_1.4.1-1, since the UE has no payload data to send, the UE transmit uplink MAC padding bits on the UL RMC

5. Set the Downlink signal level to the appropriate REFSENS value defined in Table 7.3A.5-1. Send continuously uplink power control "up" commands to the UE in every uplink scheduling information to the UE so that the UE transmits at PUMAX level for the duration of the test.

6. Measure the Frequency Error using Global In-Channel Tx-Test (Annex E) according to the UE's declaration on the position of carrier centre frequency. For HDD-FD slots with transient periods are not under test. Half-duplex guard sub frame is not under test

7. Repeat from test procedure steps 1-6 with ephemeris values for maximum positive Doppler replacing ephemeris in step 1 by Table 6.4A.1_1.4.3-1a. Test system shall send same SIB31 information during the duration of this frequency error measurement

8. Repeat from test procedure steps 1-6 with ephemeris values for maximum negative Doppler replacing ephemeris in step 1 by Table 6.4A.1_1.4.3-2a. Test system shall send same SIB31 information during the duration of this frequency error measurement.

9. Repeat from test procedure steps 1-6 with ephemeris values for half of maximum positive Doppler replacing ephemeris in step 1 by Table 6.4A.1_1.4.3-3a. Test system shall send same SIB31 information during the duration of this frequency error measurement.

6.4A.1_1.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 4.6 with the condition CEModeA and 5.6.2, the exceptions in subclause 7.3A.4.3.

Table 6.4A.1_1.4.3-1a: SystemInformationBlockType31- eMTC NTN Ephemeris Information for GSO satellites (maximum positive Doppler)

Derivation Path: TS 36.508 [12] Table 5.6.3.1-1			
Information Element	**Value/remark**	**Comment**	**Condition**
SystemInformationBlockType31-NB-r17 ::= SEQUENCE {			
servingSatelliteInfo-r17 SEQUENCE {			
ephemerisInfo-r17 CHOICE {			
stateVectors SEQUENCE {			
positionX-r17	-17104941		
positionY-r17	27550229		
positionZ-r17	-607219		
velocityVX-r17	258		
velocityVY-r17	299		
velocityVZ-r17	6277		
}			
}			
k-Offset-r17	264		
}			
}			
NOTE 1: Satellite-UE elevation angle equal to 26.15 degrees, one-way delay equal to 129.93 ms and Doppler equal to 0.17 ppm			

Table 6.4A.1_1.4.3-1b: Void

Table 6.4A.1_1.4.3-2a: SystemInformationBlockType31-eMTC NTN Ephemeris Information for GSO satellites (maximum negative Doppler)

Derivation Path: TS 36.508 [12] Table 5.6.3.1-1			
Information Element	**Value/remark**	**Comment**	**Condition**
SystemInformationBlockType31-NB-r17 ::= SEQUENCE {			
servingSatelliteInfo-r17 SEQUENCE {			
ephemerisInfo-r17 CHOICE {			
stateVectors SEQUENCE {			
positionX-r17	-17061001		
positionY-r17	27582763		
positionZ-r17	-276165		
velocityVX-r17	361		
velocityVY-r17	160		
velocityVZ-r17	-6335		
}			
}			
k-Offset-r17	264		
}			
}			
NOTE 1: Satellite-UE elevation angle equal to 26.78 degrees, one-way delay equal to 129.74 ms and Doppler equal to -0.17 ppm.			

Table 6.4A.1_.4.3-2b: Void

Table 6.4A.1_1.4.3-3a: SystemInformationBlockType31-eMTC NTN Ephemeris Information for GSO satellites (maximum positive Doppler/2)

Derivation Path: TS 36.508 [12] Table 5.6.3.1-1			
Information Element	**Value/remark**	**Comment**	**Condition**
SystemInformationBlockType31-NB-r17 ::= SEQUENCE {			
servingSatelliteInfo-r17 SEQUENCE {			
ephemerisInfo-r17 CHOICE {			
stateVectors SEQUENCE {			
positionX-r17	-17062164		
positionY-r17	27354696		
positionZ-r17	-3544856		
velocityVX-r17	-360		
velocityVY-r17	164		
velocityVZ-r17	2993		
}			
}			
k-Offset-r17	264		
}			
}			
NOTE 1: Satellite-UE elevation angle equal to 20.61 degrees, one-way delay equal to 131.70 ms and Doppler equal to 0.085 ppm.			

Table 6.4A.1_1.4.3-3b: Void

6.4A.1_1.5 Test requirement

The 20 frequency error Δf results must fulfil the test requirement:

$$|\Delta f| \leq (0.1 \text{ PPM} + 15 \text{ Hz}) \text{ (Carrier frequency >1 GHz)}$$

$$|\Delta f| \leq (0.2 \text{ PPM} + 15 \text{ Hz}) \text{ (Carrier frequency} \leq 1 \text{ GHz)}$$

6.4A.1_2Frequency error with NGSO ephemeris for UE category M1

6.4A.1_2.1 Test purpose

Same test purpose as in clause 6.4A.1_1.1.

6.4A.1_2.2 Test applicability

This test case applies to all types of E-UTRA FDD UE release 17 and forward of UE category M1 that support satellite access operation and only NGSO or both GSO and NGSO.

6.4A.1_2.3 Minimum conformance requirements

Same minimum conformance requirements as in clause 6.4A.1_1.3

6.4A.1_2.4 Test description

6.4A.1_2.4.1 Initial conditions

Same initial conditions as in clause 6.4A.1_1.4.1 with the following exception:

- In step 6, instead of UE location for GSO satellite → use UE location for NGSO satellite

6.4A.1_2.4.2 Test procedure

Same test procedure as in clause 6.4A.1_1.4.2 with the following exceptions:

- In step 1, instead of TS 36.508 [12] Table 5.6.2.1-1 → use TS 36.508 [12] Table 5.6.2.1-3 (ephemeris for NGSO LEO 1200).
- Instead of Tables 6.4A.1_1.4.3-1a, 6.4A.1_1.4.3-2a, and 6.4A.1_1.4.3-3a → use Tables 6.4A.1_2.4.3-1, 6.4A.1_2.4.3-2, and 6.4A.1_2.4.3-3, respectively.
- If the UE supports GSO and NGSO, skip steps 1 to 6 of the test procedure and start with step 7.

6.4A.1_2.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 4.6 with the condition CEModeA and 5.6.2, the exceptions in subclause 7.3A.4.3.

Table 6.4A.1_1.4.3-1: SystemInformationBlockType31- eMTC NTN Ephemeris Information for NGSO (LEO-600) satellites (maximum positive Doppler)

Derivation Path: TS 36.508 [12] Table 5.6.3.1-1			
Information Element	**Value/remark**	**Comment**	**Condition**
SystemInformationBlockType31-NB-r17 ::= SEQUENCE {			
servingSatelliteInfo-r17 SEQUENCE {			
ephemerisInfo-r17 CHOICE {			
stateVectors SEQUENCE {			
positionX-r17	-2717617		
positionY-r17	4550419		
positionZ-r17	852799		
velocityVX-r17	6164		
velocityVY-r17	-19424		
velocityVZ-r17	124281		
}			
}			
}			
}			
NOTE 1: Satellite-UE elevation angle equal to 10 degrees, one-way delay equal to 6.44 ms and Doppler equal to 22.65 ppm.			

Table 6.4A.1_1.4.3-2: SystemInformationBlockType31-eMTC NTN Ephemeris Information for NGSO (LEO-600) satellites (maximum negative Doppler)

Derivation Path: TS 36.508 [12] Table 5.6.3.1-1			
Information Element	**Value/remark**	**Comment**	**Condition**
SystemInformationBlockType31-NB-r17 ::= SEQUENCE {			
servingSatelliteInfo-r17 SEQUENCE {			
ephemerisInfo-r17 CHOICE {			
stateVectors SEQUENCE {			
positionX-r17	-2199272		
positionY-r17	3404229		
positionZ-r17	3535794		
velocityVX-r17	35394		
velocityVY-r17	-74414		
velocityVZ-r17	94682		
}			
}			
}			
}			
NOTE 1: Satellite-UE elevation angle equal to 169.97 degrees, one-way delay equal to 6.60 ms and Doppler equal to -22.62 ppm.			

Table 6.4A.1_1.4.3-3b: SystemInformationBlockType31 – eMTC NTN Ephemeris Information for NGSO (LEO-600) satellites (maximum positive Doppler/2)

Derivation Path: TS 36.508 [12] Table 5.6.3.1-1			
Information Element	**Value/remark**	**Comment**	**Condition**
SystemInformationBlockType31-NB-r17 ::= SEQUENCE {			
servingSatelliteInfo-r17 SEQUENCE {			
ephemerisInfo-r17 CHOICE {			
stateVectors SEQUENCE {			
positionX-r17	-2592823		
positionY-r17	4245650		
positionZ-r17	2024520		
velocityVX-r17	19359		
velocityVY-r17	-43278		
velocityVZ-r17	116553		
}			
}			
}			
}			
NOTE 1: Satellite-UE elevation angle equal to 60.25 degrees, one-way delay equal to 2.30 ms and Doppler equal to 11.29 ppm			

6.4A.1_2.5 Test requirement

The 20 frequency error Δf results must fulfil the test requirement:

$$|\Delta f| \leq (0.1 \text{ PPM} + 15 \text{ Hz}) \text{ (Carrier frequency >1 GHz)}$$

$$|\Delta f| \leq (0.2 \text{ PPM} + 15 \text{ Hz}) \text{ (Carrier frequency} \leq 1 \text{ GHz)}$$

6.4A.2 Transmit modulation quality for category M1

6.4A.2.1 Error Vector Magnitude (EVM) for category M1

6.4A.2.1.1 Test purpose

Same test purpose as in TS 36.521-1[14] clause 6.5.2.1EA.1.1

6.4A.2.1.2 Test applicability

This test case applies to all types of NB-IoT FDD UE release 17 and forward of UE category NB1 and NB2 that support satellite access operation.

6.4A.2.1.3 Minimum conformance requirements

EVM measurements are evaluated for 10 uplink sub-frames excluding any transient period for the average EVM case, and 60 subframes excluding any transient period for the reference signal EVM case, the different modulations schemes shall not exceed the values specified in Table 6.4.2.1.3-1 for the parameters defined in Table 6.4.2.1.3-2. For EVM evaluation purposes, all PRACH preamble formats 0-4 and all PUCCH formats 1, 1a, 1b, 2, 2a and 2b are considered to have the same EVM requirement as QPSK modulated.

Table 6.4.2.1.3-1: Minimum requirements for Error Vector Magnitude

Parameter	Unit	Average EVM Level	Reference Signal EVM Level
QPSK or BPSK	%	17.5	17.5
16QAM	%	12.5	12.5

Table 6.4.2.1.3-2: Parameters for Error Vector Magnitude

Parameter	Unit	Level
UE Output Power	dBm	≥ -40
Operating conditions		Normal conditions

The normative reference for this requirement is TS 36.102 [11] clause 6.4A.2.

6.4A.2.1.4 Test description

6.4A.2.1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths based on E-UTRA bands specified in table 5.2A. All of these configurations shall be tested with applicable test parameters for each channel bandwidth, and are shown in table 6.4A.2.1.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annex A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4A.2.1.4.1-1: Test Configuration Table for PUSCH

Initial Conditions			
Test Environment (as specified in TS 36.508 [12] subclause 4.1)		**NC**	
Test Frequencies **(as specified in TS36.508 [12] subclause 4.3.1)**		Low range, Mid range, High range	
Test Channel Bandwidths **(as specified in TS 36.508 [12] subclause 4.3.1)**		**1.4MHz**	
Test Parameters for Channel Bandwidths			
	Downlink Configuration	**Uplink Configuration**	
Ch BW	N/A for PUSCH EVM testing	Modulation	RB allocation
			FDD and HD-FDD
1.4MHz		QPSK	6
1.4MHz		QPSK	1
1.4MHz		16QAM	5
1.4MHz		16QAM	1
Note 1: For partial RB allocation, the RB_{start} shall be RB #0 and RB# (max+1 - RB allocation) of the channel bandwidth.			

Table 6.4A.2.1.4.1-2: Test Configuration Table for PUCCH

Initial Conditions			
Test Environment as specified in TS 36.508[12] subclause 4.1		NC	
Test Frequencies as specified in **TS36.508 [12] subclause 4.3.1**		Low range, Mid range, High range	
Test Channel Bandwidths as specified in **TS 36.508 [12] subclause 4.3.1**		1.4MHz	
Test Parameters for Channel Bandwidths			
	Downlink Configuration		**Uplink Configuration**
Ch BW	Mod'n	RB allocation	FDD and HD-FDD: PUCCH format = Format 1a
		FDD	
1.4MHz	QPSK	3	
Note 1: The RB_{start} of partial RB allocation can be either RB#0 or RB# (6 - RB allocation) of the narrowband.			

Table 6.4A.2.1.4.1-3: Test Configuration for PRACH

Initial Conditions	
Test Environment (as specified in TS 36.508 [12] subclause 4.1)	NC
Test Frequencies (as specified in TS36.508 [12] subclause 4.3.1)	Low range, Mid range, High range
Test Channel Bandwidths (as specified in TS 36.508 [12] subclause 4.3.1)	1.4MHz
PRACH preamble format	
	FDD
PRACH Configuration Index	4
RS EPRE setting for test point 1 (dBm/15kHz)	-71
RS EPRE setting for test point 2 (dBm/15kHz)	-86

1. Connect the SS to the UE to the UE antenna connectors as shown in TS 36.508 [12] Annex A, Figure A.3 using only main UE Tx/Rx antenna.

2. The parameter settings for the cell are set up according to TS 36.508[12] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C0, C.1 and C.3.0, and uplink signals according to Annex H.1 and H.3.0.

4. The UL Reference Measurement channels are set according to in Table 6.4A.2.4.1-1.

5. Propagation conditions are set according to Annex B.0

6. UE location according to TS 36.508 [12] clause 5.6.1 is provided to the UE through any preconfigured means.

7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31 information during the duration of the test as define in TS 36.508[12] clause 5.6.3.1

8. Deactivate UE prediction of satellite trajectory by any preconfigured means

9. Ensure the UE is in State 3A-RF-CE according to TS 36.508 [12] clause 5.2A.2AA. Message contents are defined in clause 6.4A.2.1.4.3.

6.4A.2.1.4.2 Test procedure

Test procedure for PUSCH:

1.1. SS sends uplink scheduling information for each UL HARQ process via MPDCCH DCI format 6-0A for C_RNTI to schedule the UL RMC according to Table 6.4A.2.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.

1.2 Send continuously uplink power control "up" commands in the uplink scheduling information to the UE until the UE transmits at PUMAX level.

1.3 Measure the EVM and $\overline{EVM}_{DMRS}$ using Global In-Channel Tx-Test (Annex E) according to the UE’s declaration on the position of carrier centre frequency.

1.4 Send the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is –36.8dBm ±3.2dB for carrier frequency f ≤ 3.0GHz or -36.5dBm ±3.5 dB for carrier frequency 3.0GHz < f ≤ 4.2GHz.

1.5 Measure the EVM and $\overline{EVM}_{DMRS}$ using Global In-Channel Tx-Test (Annex E) according to the UE’s declaration on the position of carrier centre frequency.

Test procedure for PUCCH:

2.1 PUCCH are set according to Table 6.4A.2.4.1-2.

2.2 SS transmits PDSCH via MPDCCH DCI format 6-1A for C_RNTI to transmit the DL RMC according to Table 6.4A.2.4.1-2. The SS sends downlink MAC padding bits on the DL RMC. The transmission of PDSCH will make the UE send uplink ACK/NACK using PUCCH. There is no PUSCH transmission.

2.3 SS send appropriate TPC commands for PUCCH to the UE until the UE transmit PUCCH at PUMAX level.

2.4 Measure PUCCH EVM using Global In-Channel Tx-Test (Annex E) according to the UE’s declaration on the position of carrier centre frequency.

2.5 Send the appropriate TPC commands for PUCCH to the UE until the UE transmits PUCCH at -36.8dBm ±3.2dB for carrier frequency f ≤ 3.0GHz or -36.5dBm ±3.5 dB for carrier frequency 3.0GHz < f ≤ 4.2GHz.

2.6 Measure PUCCH EVM using Global In-Channel Tx-Test (Annex E) according to the UE’s declaration on the position of carrier centre frequency.

Test procedure for PRACH:

3.1 The SS shall set RS EPRE according to Table 6.4A.2.4.1-3.

3.2 PRACH is set according to Table 6.4A.2.4.1-3.

3.3 The SS shall signal a Random Access Preamble ID via a MPDCCH order to the UE and initiate a Non-contention based Random Access procedure

3.4 The UE shall send the signalled preamble to the SS.

3.5 In response to the preamble, the SS shall transmit a random access response not corresponding to the transmitted random access preamble, or send no response.

3.6 The UE shall consider the random access response reception not successful then re-transmit the preamble with the calculated PRACH transmission power.

3.7 Repeat step 5 and 6 until the SS collect enough PRACH preambles (2 preambles for format 0 and 10 preambles for format 4). Measure the EVM in PRACH channel using Global In-Channel Tx-Test (Annex E) according to the UE's declaration on the position of carrier centre frequency.

6.4A.2.1.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 4.6 with the condition CEModeA and the following exceptions:

Table 6.4A.2.4.3-1: *PRACH-Config-DEFAULT*: PRACH EVM measurement for FDD

Derivation Path: TS 36.508 [12] clause 4.6.3, Table 4.6.3-7 PRACH-Config-DEFAULT			
Information Element	Value/remark	Comment	Condition
PRACH-ConfigInfo SEQUENCE {			
prach-ConfigIndex	4		

Table 6.4A.2.4.3-2: *RACH-ConfigCommon-DEFAULT:* PRACH EVM measurement

Derivation Path: TS 36.508 [12] clause 4.6.3, Table 4.6.3-12 RACH-ConfigCommon-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
RACH-ConfigCommon-DEFAULT ::= SEQUENCE {			
preambleInfo SEQUENCE {			
numberOfRA-Preambles	n52		
preamblesGroupAConfig SEQUENCE {}	Not present		
}			
powerRampingParameters SEQUENCE {			
powerRampingStep	dB0		
preambleInitialReceivedTargetPower	dBm-120 Test point 1 dBm-90 Test point 2		
}			
ra-SupervisionInfo SEQUENCE {			
preambleTransMax	n10		FDD
	n20		TDD
ra-ResponseWindowSize	Sf10		
mac-ContentionResolutionTimer	sf48		
}			
ra-SupervisionInfo SEQUENCE {			

6.4A.2.1.5 Test requirement

The PUSCH EVM derived in E.4.2 shall not exceed 17,5 % for QPSK and BPSK, 12,5% for 16 QAM.

The PUSCH $\overline{EVM}_{DMRS}$ derived in E.4.6.2 shall not exceed [17,5 %] when embedded with data symbols of QPSK and BPSK, [12,5%] for 16 QAM.

The PUCCH EVM and derived in E.5.9.2 shall not exceed 17,5 %.

The PRACH EVM derived in FFS shall not exceed 17.5%.

6.4A.2.2 Carrier leakage for category M1

6.4A.2.2.1 Test purpose

Carrier leakage expresses itself as unmodulated sine wave with the carrier frequency or centre frequency of aggregated transmission bandwidth configuration. It is an interference of approximately constant amplitude and independent of the amplitude of the wanted signal. Carrier leakage interferes with the centre sub carriers of the UE under test (if allocated), especially, when their amplitude is small. The measurement interval is defined over one slot in the time domain.

The purpose of this test is to exercise the UE transmitter to verify its modulation quality in terms of carrier leakage.

6.4A.2.2.2 Test applicability

This test case applies to all types of NB-IoT FDD UE release 17 and forward of UE category M1 that support satellite access operation.

6.4A.2.2.3 Minimum conformance requirements

The relative carrier leakage power is a power ratio of the additive sinusoid waveform and the modulated waveform. The relative carrier leakage power shall not exceed the values specified in Table 6.4A.2.2.3-1.

Table 6.4A.2.2.3-1: Minimum requirements for Relative Carrier Leakage Power for UE supporting Rel.11 and higher

Parameters	Relative limit (dBc)	Applicable frequencies
Output power >10 dBm	-28	Carrier centre frequency < 1 GHz
	-25	Carrier centre frequency ≥ 1 GHz
0 dBm ≤ Output power ≤10 dBm	-25	
-30 dBm ≤ Output power ≤0 dBm	-20	
-40 dBm ≤ Output power < -30 dBm	-10	

The normative reference for this requirement is TS 36.102 [11] clause 6.4A.2.

6.4A.2.2.4 Test description

6.4A.2.2.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths based on E-UTRA bands specified in table 5.2A. All of these configurations shall be tested with applicable test parameters for each channel bandwidth, and are shown in table 6.4A.2.2.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annex A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4A.2.2.4.1-1: Test Configuration Table

<table>
<tr><th colspan="4">Initial Conditions</th></tr>
<tr><td colspan="2">Test Environment
(as specified in TS 36.508 [12] subclause 4.1)</td><td colspan="2">NC, TL/VL, TL/VH, TH/VL, TH/VH</td></tr>
<tr><td colspan="2">Test Frequencies
(as specified in TS36.508 [12] subclause 4.3.1)</td><td colspan="2">Low range, Mid range, High range</td></tr>
<tr><td colspan="2">Test Channel Bandwidths
(as specified in TS 36.508 [12] subclause 4.3.1)</td><td colspan="2">1.4MHz</td></tr>
<tr><th colspan="4">Test Parameters for Channel Bandwidths and Narrowband positions</th></tr>
<tr><td></td><th>Downlink Configuration</th><th colspan="2">Uplink Configuration</th></tr>
<tr><td>Ch BW</td><td rowspan="3">N/A for carrier leakage testing</td><td>Mod'n</td><td>RB allocation</td></tr>
<tr><td></td><td></td><td>FDD and HD-FDD</td></tr>
<tr><td>1.4MHz</td><td>QPSK</td><td>1</td></tr>
<tr><td colspan="4">Note 1: For partial RB allocation, the RB_{start} shall be RB #0 and RB# (6 - RB allocation) of the channel bandwidth.</td></tr>
</table>

1. Connect the SS to the UE to the UE antenna connectors as shown in TS 36.508 [12] Annex A, Figure A.3 using only main UE Tx/Rx antenna.
2. The parameter settings for the cell are set up according to TS 36.508[12] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C0, C.1 and C.3.0, and uplink signals according to Annex H.1 and H.3.0.
4. The UL Reference Measurement channels are set according to in Table 6.4A.2.2.4.1-1.
5. Propagation conditions are set according to Annex B.0
6. UE location according to TS 36.508 [12] clause 5.6.1 is provided to the UE through any preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31 information during the duration of the test as define in TS 36.508[12] clause 5.6.3.1
8. Deactivate UE prediction of satellite trajectory by any preconfigured means
9. Ensure the UE is in State 3A-RF-CE according to TS 36.508 [12] clause 5.2A.2AA. Message contents are defined in clause 6.4A.2.1.4.3.

6.4A.2.2.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via MPDCCH DCI format 6-0A for C_RNTI to schedule the UL RMC according to Table 6.4A.2.2.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC
2. Send the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is 13.2 dBm ±3.2dB for carrier frequency f ≤ 3.0GHz or 13.5dBm ±3.5 dB for carrier frequency 3.0GHz < f ≤ 4.2GHz.
3. Measure carrier leakage using Global In-Channel Tx-Test (Annex E) according to the UE’s declaration on the position of carrier centre frequency. For HD-FDD slots with transient periods are not under test. Half-duplex guard subframes are not under test.
4. Send the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is 3.2 dBm ±3.2dB for carrier frequency f ≤ 3.0GHz or 3.5dBm ±3.5 dB for carrier frequency 3.0GHz < f ≤ 4.2GHz.
5. Measure carrier leakage using Global In-Channel Tx-Test (Annex E) according to the UE’s declaration on the position of carrier centre frequency. For HD-FDD slots with transient periods are not under test. Half-duplex guard subframes are not under test.
6. Send the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is -26.8 dBm ±3.2dB for carrier frequency f ≤ 3.0GHz or -26.5dBm ±3.5 dB for carrier frequency 3.0GHz < f ≤ 4.2GHz.
7. Measure carrier leakage using Global In-Channel Tx-Test (Annex E) according to the UE’s declaration on the position of carrier centre frequency. For HD-FDD slots with transient periods are not under test. Half-duplex guard subframes are not under test.
8. Send the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is -36.8dBm ±3.2dB for carrier frequency f ≤ 3.0GHz or -36.5dBm ±3.5 dB for carrier frequency 3.0GHz < f ≤ 4.2GHz.
9. Measure carrier leakage using Global In-Channel Tx-Test (Annex E) according to the UE’s declaration on the position of carrier centre frequency.

6.4A.2.2.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 4.6 with the condition CEModeA.

6.4A.2.2.5 Test requirement

Each of the 20 IQ offset results, derived in Annex E.3.1, shall not exceed the values in table 6.4A.2.5-1

Table 6.4A.2.2.5-1: Test requirements for Relative Carrier Leakage Power

LO Leakage	Parameters	Relative limit (dBc)	Applicable frequencies
	f ≤ 3.0GHz: 13.2 dBm ±3.2dB 3.0GHz < f ≤ 4.2GHz: 13.5 dBm ±3.5dB	-27.2	Carrier centre frequency < 1 GHz
		-24.2	Carrier centre frequency ≥ 1 GHz
	f ≤ 3.0GHz: 3.2 dBm ±3.2dB 3.0GHz < f ≤ 4.2GHz: 3.5 dBm ±3.5dB	-24.2	
	f ≤ 3.0GHz: -26.8 dBm ±3.2dB 3.0GHz < f ≤ 4.2GHz: -26.5 dBm ±3.5dB	-19.2	
	f ≤ 3.0GHz: -36.8dBm±3.2dB 3.0GHz < f ≤ 4.2GHz: -36.5 dBm ±3.5dB	-9.2	

6.4A.2.3 In-band emissions for non allocated RB for category M1

6.4A.2.3.1 Test purpose

The in-band emissions are a measure of the interference falling into the non-allocated resources blocks

The in-band emission is defined as the average across 12 sub-carrier and as a function of the RB offset from the edge of the allocated UL transmission bandwidth. The in-band emission is measured as the ratio of the UE output power in a non–allocated RB to the UE output power in an allocated RB. The basic in-band emissions measurement interval is defined over one slot in the time domain. When the PUSCH or PUCCH transmission slot is shortened due to multiplexing with SRS, the in-band emissions measurement interval is reduced by one SC-FDMA symbol, accordingly. Likewise, when the PUSCH starting position is modified or when the second last symbol is the ending symbol of the PUSCH sub-frame for Frame Structure Type 3, the in-band emissions measurement interval is reduced accordingly.

6.4A.2.3.2 Test applicability

This test case applies to all types of NB-IoT FDD UE release 17 and forward of UE category M1 that support satellite access operation.

6.4A.2.3.3 Minimum conformance requirements

Table 6.4A.2.3.3-1: Minimum requirements for in-band emissions for UE supporting Rel-15 and higher

Parameter description	Unit	Limit (NOTE 1)		Applicable Frequencies
General	dB	$-18-[5]\cdot(\lvert\Delta_{SubG}\rvert-1)/L_{SCG}$		Any non-allocated Subcarrier Group within the subPRB allocation (NOTE 11,12,13)
		$\max\{-25-10\cdot\log_{10}(N_{RB}/L_{CRB}),$ $20\cdot\log_{10}EVM-3-5\cdot(\lvert\Delta_{RB}\rvert-1)/L_{CRB},$ $-57\,dBm/180kHz-P_{RB}\}$		Any non-allocated (NOTE 2)
IQ Image	dB	-28	Image frequencies when carrier centre frequency < 1 GHz and Output power > 10 dBm	Image frequencies (NOTES 2, 3)
		-25	Image frequencies when carrier centre frequency < 1 GHz and Output power ≤ 10 dBm	
		-25	Image frequencies when carrier centre frequency ≥ 1 GHz	
Carrier leakage	dBc	-28	Output power > 10 dBm and carrier centre frequency < 1 GHz	Carrier frequency (NOTES 4, 5)
		-25	Output power > 10 dBm and carrier centre frequency ≥ 1 GHz	
		-25	0 dBm ≤ Output power ≤10 dBm	
		-20	-30 dBm ≤ Output power ≤ 0 dBm	
		-10	-40 dBm ≤ Output power < -30 dBm	

NOTE 1: An in-band emissions combined limit is evaluated in each non-allocated RB. For each such RB, the minimum requirement is calculated as the higher of P_{RB} - 30 dB and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. P_{RB} is defined in NOTE 10.

NOTE 2: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured average power per allocated RB, where the averaging is done across all allocated RBs.

NOTE 3: The applicable frequencies for this limit are those that are enclosed in the reflection of the allocated bandwidth, based on symmetry with respect to the centre carrier frequency, but excluding any allocated RBs. For UE of UL Category M1, applicable frequencies shall alternatively include those found by reflection on the centre of the assigned 6 RB narrowband, but excluding any allocated RBs.

NOTE 4: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured total power in all allocated RBs.

NOTE 5: The applicable frequencies for this limit are those that are enclosed in the RBs containing the DC frequency if N_{RB} is odd, or in the two RBs immediately adjacent to the DC frequency if N_{RB} is even, but excluding any allocated RB. For UE of UL Category M1, the applicable frequencies shall alternatively be the centre frequency of the supported 6RBs additionally.

NOTE 6: L_{CRB} is the Transmission Bandwidth (see Figure 5.6-1).

NOTE 7: N_{RB} is the Transmission Bandwidth Configuration (see Figure 5.6-1).

NOTE 8: EVM is the limit specified in Table 6.5.2.1.1-1 for the modulation format used in the allocated RBs.

NOTE 9: Δ_{RB} is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g. $\Delta_{RB}=1$ or $\Delta_{RB}=-1$ for the first adjacent RB outside of the allocated bandwidth.

NOTE 10: P_{RB} is the transmitted power per 180 kHz in allocated RBs, measured in dBm.

NOTE 11: The measurement bandwidth is 1 subcarrier group ([3] subcarrier per subcarrier group) and the limit is expressed as a ratio of measured power in one non-allocated subcarrier group to the measured total power in all allocated subcarrier.

NOTE 12: Δ_{SubG} is the starting frequency offset between the allocated subcarrier group and the measured non-allocated subcarrier group (e.g. $\Delta_{SubG}=1\ or\ \Delta_{SubG}$ =-1 for the first adjacent subcarrier group outside the allocated subcarrier group.)

NOTE 13: L_{SCG} is the Transmission bandwidth (number of subcarrier group).

The in-band emission is defined as the average across 12 sub-carrier and as a function of the RB offset from the edge of the allocated UL transmission bandwidth. The in-band emission is measured as the ratio of the UE output power in a non–allocated RB to the UE output power in an allocated RB. The basic in-band emissions measurement interval is defined over one slot in the time domain.

The normative reference for this requirement is TS 36.102 [11] clause 6.4A.2.

6.4A.2.3.4 Test description

6.4A.2.3.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths based on E-UTRA bands specified in table 5.2A. All of these configurations shall be tested with applicable test parameters are shown in table 6.4A.2.3.4.1-1 and 6.4A.2.3.4.1-2. The details of the uplink reference measurement channels (RMCs) are specified in Annex A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4A.2.3.4.1-1: Test Configuration Table for PUSCH

Initial Conditions			
Test Environment (as specified in TS 36.508 [12] subclause 4.1)		NC, TL/VL, TL/VH, TH/VL, TH/VH	
Test Frequencies (as specified in TS36.508 [12] subclause 4.3.1)		Low range, Mid range, High range	
Test Channel Bandwidths (as specified in TS 36.508 [12] subclause 4.3.1)		1.4MHz	
Test Parameters for Channel Bandwidths and Narrowband positions			
	Downlink Configuration	**Uplink Configuration**	
Ch BW	N/A for in-band emissions testing	Mod'n	RB allocation
			FDD and HD-FDD
1.4MHz		QPSK	1

Table 6.4A.2.3.4.1-2: Test Configuration Table for PUCCH

		Initial Conditions	
Test Environment as specified in TS 36.508[12] subclause 4.1		**NC, TL/VL, TL/VH, TH/VL, TH/VH**	
Test Frequencies as specified in TS36.508 [12] subclause 4.3.1		**Low range, Mid range, High range**	
Test Channel Bandwidths as specified in TS 36.508 [12] subclause 4.3.1		1.4MHz	
Test Parameters for Channel Bandwidths and Narrowband positions			
	Downlink Configuration		**Uplink Configuration**
Ch BW	Mod'n	RB allocation	FDD: PUCCH format = Format 1a
		FDD and HD-FDD	
1.4MHz	QPSK	3@0	

1. Connect the SS to the UE antenna connectors as shown in TS 36.508 [12] Figure A.3 using only main UE Tx/Rx antenna.

2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, and C.3.0, and uplink signals according to Annex H.1 and H.3.0.

4. The UL and DL Reference Measurement channels are set according to in Table 6.4A.2.3.4.1-1 (PUSCH sub-test) and Table 6.4A.2.3.4.1-2 (PUCCH sub-test).

5. Propagation conditions are set according to Annex B.0

6. UE location according to TS 36.508 [12] clause 5.6.1 is provided to the UE through any preconfigured means.

7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31 information during the duration of the test as define in TS 36.508[12] clause 5.6.3.1

8. Deactivate UE prediction of satellite trajectory by any preconfigured means

9. Ensure the UE is in State 3A-RF-CE according to TS 36.508 [12] clause 5.2A.2AA. Message contents are defined in clause 6.4A.2.3.4.3.

6.4A.2.3.4.2 Test procedure

Test procedure for PUSCH:

1.1 SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0 for C_RNTI to schedule the UL RMC according to Table 6.4A.2.3.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC

1.2 Send the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is 13.2 dBm ±3.2dB for carrier frequency f ≤ 3.0GHz or 13.5dBm ±3.5 dB for carrier frequency 3.0GHz < f ≤ 4.2GHz.

1.3 Measure In-band emission using Global In-Channel Tx-Test (Annex E) according to the UE's declaration on the position of carrier centre frequency.

1.4 Send the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is 3.2 dBm ±3.2dB for carrier frequency f ≤ 3.0GHz or 3.5dBm ±3.5 dB for carrier frequency 3.0GHz < f ≤ 4.2GHz.

1.5 Measure In-band emission using Global In-Channel Tx-Test (Annex E) according to the UE's declaration on the position of carrier centre frequency.

1.6 Send the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is -26.8 dBm ±3.2dB for carrier frequency f ≤ 3.0GHz or -36.5dBm ±2.5 dB for carrier frequency 3.0GHz < f ≤ 4.2GHz.

1.7 Measure In-band emission using Global In-Channel Tx-Test (Annex E) according to the UE's declaration on the position of carrier centre frequency. For HD-FDD slots with transient periods are not under test. Half-duplex guard subframes are not under test.

1.8 Send the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is to -36.8 dBm ±3.2dB for carrier frequency f ≤ 3.0GHz or -36.5dBm ±3.5 dB for carrier frequency 3.0GHz < f ≤ 4.2GHz.

1.9 Measure In-band emission using Global In-Channel Tx-Test (Annex E) according to the UE's declaration on the position of carrier centre frequency. For HD-FDD slots with transient periods are not under test. Half-duplex guard subframes are not under test.

Test procedure for PUCCH:

2.1 PUCCH is set according to Table 6.4A.2.3.4.1-2. SS transmits PDSCH via MPDCCH DCI format 6-1A for C_RNTI to transmit the DL RMC according to Table 6.4A.2.3.4.1-2. The SS sends downlink MAC padding bits on the DL RMC. The transmission of PDSCH will make the UE send uplink ACK/NACK using PUCCH.

2.2 Send the appropriate TPC commands in the uplink scheduling information for PUCCH to the UE until UE output power is 13.2 dBm ±3.2dB for carrier frequency f ≤ 3.0GHz or 13.5dBm ±3.5 dB for carrier frequency 3.0GHz < f ≤ 4.2GHz.

2.3 Measure In-band emission using Global In-Channel Tx-Test (Annex E) according to the UE's declaration on the position of carrier centre frequency.

2.4 Send the appropriate TPC commands in the uplink scheduling information for PUCCH to the UE until UE output power is 3.2 dBm ±3.2dB for carrier frequency f ≤ 3.0GHz or 3.5dBm ±3.5 dB for carrier frequency 3.0GHz < f ≤ 4.2GHz.

2.5 Measure In-band emission using Global In-Channel Tx-Test (Annex E) according to the UE’s declaration on the position of carrier centre frequency.

2.6 Send the appropriate TPC commands for PUCCH in the uplink scheduling information to the UE until UE output power is -26.8 dBm ±3.2dB for carrier frequency f ≤ 3.0GHz or -26.5dBm ±3.5 dB for carrier frequency 3.0GHz < f ≤ 4.2GHz.

2.7 Measure In-band emission using Global In-Channel Tx-Test (Annex E) according to the UE’s declaration on the position of carrier centre frequency.

2.8 Send the appropriate TPC commands for PUCCH in the uplink scheduling information to the UE until UE output power is to -36.8 dBm ±3.2dB for carrier frequency f ≤ 3.0GHz or -36.5dBm ±3.5 dB for carrier frequency 3.0GHz < f ≤ 4.2GHz.

2.9 Measure In-band emission using Global In-Channel Tx-Test (Annex E) according to the UE’s declaration on the position of carrier centre frequency.

6.4A.2.3.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 4.6 with the condition CEModeA and the following exceptions:

Table 6.4A.2.3.4.3-1: *PUCCH-ConfigCommon*: PUCCH in-band emissions measurement

Derivation Path: TS 36.508 [12] clause 6.3.2, Table 4.6.3-8: PUCCH-ConfigCommon-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
PUCCH-ConfigCommon-DEFAULT ::= SEQUENCE {			
nRB-CQI	0		
}			

6.4A.2.3.5 Test requirement

Each of the 20 In-band emissions results, derived in Annex E.4.3 shall not exceed the corresponding values in Table 6.4A.5-1.

Table 6.4A.2.3.5-1: Test requirements for in-band emissions for UE supporting Rel-15 and higher

Parameter description	Unit	Limit (NOTE 1)		Applicable Frequencies
General	dB	$-18-[5]\cdot(\lvert\Delta_{SubG}\rvert-1)/L_{SCG}$		Any non-allocated Subcarrier Group within the subPRB allocation (NOTE 11,12,13)
		$\max\{-25-10\cdot\log_{10}(N_{RB}/L_{CRB}),$ $20\cdot\log_{10}EVM-3-5\cdot(\lvert\Delta_{RB}\rvert-1)/L_{CRB},$ $-57\,dBm/180\,kHz-P_{RB}\}$		Any non-allocated (NOTE 2)
IQ Image	dB	-28	Image frequencies when carrier centre frequency < 1 GHz and Output power > 10 dBm	Image frequencies (NOTES 2, 3)
		-25	Image frequencies when carrier centre frequency < 1 GHz and Output power ≤ 10 dBm	
		-25	Image frequencies when carrier centre frequency ≥ 1 GHz	
Carrier leakage	dBc	-28	Output power > 10 dBm and carrier centre frequency < 1 GHz	Carrier frequency (NOTES 4, 5)
		-25	Output power > 10 dBm and carrier centre frequency ≥ 1 GHz	
		-25	0 dBm ≤ Output power ≤10 dBm	
		-20	-30 dBm ≤ Output power ≤ 0 dBm	
		-10	-40 dBm ≤ Output power < -30 dBm	

NOTE 1: An in-band emissions combined limit is evaluated in each non-allocated RB. For each such RB, the minimum requirement is calculated as the higher of P_{RB} - 30 dB and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. P_{RB} is defined in NOTE 10.

NOTE 2: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured average power per allocated RB, where the averaging is done across all allocated RBs.

NOTE 3: The applicable frequencies for this limit are those that are enclosed in the reflection of the allocated bandwidth, based on symmetry with respect to the centre carrier frequency, but excluding any allocated RBs. For UE of UL Category M1, applicable frequencies shall alternatively include those found by reflection on the centre of the assigned 6 RB narrowband, but excluding any allocated RBs.

NOTE 4: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured total power in all allocated RBs.

NOTE 5: The applicable frequencies for this limit are those that are enclosed in the RBs containing the DC frequency if N_{RB} is odd, or in the two RBs immediately adjacent to the DC frequency if N_{RB} is even, but excluding any allocated RB. For UE of UL Category M1, the applicable frequencies shall alternatively be the centre frequency of the supported 6RBs additionally.

NOTE 6: L_{CRB} is the Transmission Bandwidth (see Figure 5.6-1).

NOTE 7: N_{RB} is the Transmission Bandwidth Configuration (see Figure 5.6-1).

NOTE 8: EVM is the limit specified in Table 6.5.2.1.1-1 for the modulation format used in the allocated RBs.

NOTE 9: Δ_{RB} is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g. $\Delta_{RB}=1$ or $\Delta_{RB}=-1$ for the first adjacent RB outside of the allocated bandwidth.

NOTE 10: P_{RB} is the transmitted power per 180 kHz in allocated RBs, measured in dBm.

NOTE 11: The measurement bandwidth is 1 subcarrier group ([3] subcarrier per subcarrier group) and the limit is expressed as a ratio of measured power in one non-allocated subcarrier group to the measured total power in all allocated subcarrier.

NOTE 12: Δ_{SubG} is the starting frequency offset between the allocated subcarrier group and the measured non-allocated subcarrier group (e.g. $\Delta_{SubG}=1$ or Δ_{SubG} =-1 for the first adjacent subcarrier group outside the allocated subcarrier group.)

NOTE 13: L_{SCG} is the Transmission bandwidth (number of subcarrier group).

6.4A.2.4 EVM equalizer spectrum flatness for category M1

6.4A.2.4.1 Test purpose

The zero-forcing equalizer correction applied in the EVM measurement process (as described in Annex E) must meet a spectrum flatness requirement for the EVM measurement to be valid. The EVM equalizer spectrum flatness is defined in terms of the maximum peak-to-peak ripple of the equalizer coefficients (dB) across the allocated uplink block variation in dB of the equalizer coefficients generated by the EVM measurement process. The EVM equalizer spectrum flatness requirement does not limit the correction applied to the signal in the EVM measurement process but for the EVM result to be valid, the equalizer correction that was applied must meet the EVM equalizer spectrum flatness minimum requirements. The basic measurement interval is the same as for EVM.

6.4A.2.4.2 Test applicability

This test case applies to all types of NB-IoT FDD UE release 17 and forward of UE category M1 that support satellite access operation.

6.4A.2.4.3 Minimum conformance requirements

Same minimum conformance requirements as in TS 36.521-1[14] clause 6.5.2.4.3

6.4A.2.4.4 Test description

6.4A.2.4.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths based on E-UTRA bands specified in table 5.2A. All of these configurations shall be tested with applicable test parameters are shown in table 6.4A.2.4.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in TS Annex A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4A.2.4.4.1-1: Test Configuration Table

<table>
<tr><th colspan="4">Initial Conditions</th></tr>
<tr><td colspan="2">Test Environment
(as specified in TS 36.508 [12] subclause 4.1)</td><td colspan="2">NC, TL/VL, TL/VH, TH/VL, TH/VH</td></tr>
<tr><td colspan="2">Test Frequencies
(as specified in TS36.508 [12] subclause 4.3.1)</td><td colspan="2">Low range, Mid range, High range</td></tr>
<tr><td colspan="2">Test Channel Bandwidths
(as specified in TS 36.508 [12] subclause 4.3.1)</td><td colspan="2">1.4MHz</td></tr>
<tr><th colspan="4">Test Parameters for Channel Bandwidths and Narrowband positions</th></tr>
<tr><th></th><th>Downlink Configuration</th><th colspan="2">Uplink Configuration</th></tr>
<tr><td>Ch BW</td><td rowspan="3">N/A for EVM equalizer spectrum flatness testing</td><td>Mod'n</td><td>RB allocation</td></tr>
<tr><td></td><td></td><td>FDD and HD-FDD</td></tr>
<tr><td>1.4MHz</td><td>QPSK</td><td>6</td></tr>
</table>

1. Connect the SS to the UE antenna connectors as shown in TS 36.508 [12] Figure A.3 using only main UE Tx/Rx antenna.
2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1, and C.3.0, and uplink signals according to Annex H.1 and H.3.0.
4. The UL Reference Measurement channels are set according to in Table 6.4A.2.4.4.1-1.
5. Propagation conditions are set according to Annex B.0
6. UE location according to TS 36.508 [12] clause 5.6.1 is provided to the UE through any preconfigured means.

7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31 information during the duration of the test as define in TS 36.508[12] clause 5.6.3.1
8. Deactivate UE prediction of satellite trajectory by any preconfigured means
9. Ensure the UE is in State 3A-RF-CE according to TS 36.508 [12] clause 5.2A.2AA. Message contents are defined in clause 6.4A.2.4.4.3.

6.4A.2.4.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via MPDCCH DCI format 6-0A for C_RNTI to schedule the UL RMC according to Table 6.4A.2.4.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC
2. Send continuously uplink power control "up" commands in the uplink scheduling information to the UE until the UE transmits at PUMAX level.
3. Measure spectrum flatness using Global In-Channel Tx-Test (Annex E). For HD-FDD slots with transient periods are not under test. Half-duplex guard sub frame is not under test.

6.4A.2.4.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 4.6 with the condition CEModeA.

6.4A.2.4.5 Test requirement

Each of the 20 spectrum flatness functions, shall derive four ripple results in Annex E.4.4, The derived results shall not exceed the values in Figure 6.4A.2.4.5-1:

For normal conditions, the maximum ripple in Range 1 and Range 2 shall not exceed the values specified in Table 6.4A.2.4.5-1 and the following additional requirement: the relative difference between the maximum coefficient in Range 1 and the minimum coefficient in Range 2 must not be larger than 6.4 dB, and the relative difference between the maximum coefficient in Range 2 and the minimum coefficient in Range 1 must not be larger than 8.4 dB (see Figure 6.4A.2.4.5-1).

For extreme conditions, the maximum ripple in Range 1 and Range 2 shall not exceed the values specified in Table 6.4A.2.4.5-2 and the following additional requirement: the relative difference between the maximum coefficient in Range 1 and the minimum coefficient in Range 2 must not be larger than 7.4 dB, and the relative difference between the maximum coefficient in Range 2 and the minimum coefficient in Range 1 must not be larger than 11.4 dB (see Figure 6.4A.2.4.5-1).

Table 6.4A.2.4.5-1: Test requirements for EVM equalizer spectrum flatness (normal conditions)

Frequency Range	Maximum Ripple [dB]
$F_{UL\_Meas} – F_{UL\_Low} \geq 3$ MHz and $F_{UL\_High} – F_{UL\_Meas} \geq 3$ MHz (Range 1)	5.4 (p-p)
$F_{UL\_Meas} – F_{UL\_Low} < 3$ MHz or $F_{UL\_High} – F_{UL\_Meas} < 3$ MHz (Range 2)	9.4 (p-p)
Note 1: F_{UL_Meas} refers to the sub-carrier frequency for which the equalizer coefficient is evaluated Note 2: F_{UL_Low} and F_{UL_High} refer to each E-UTRA frequency band specified in Table 5.2-1	

Table 6.4A.2.4.5-2: Test requirements for spectrum flatness (extreme conditions)

Frequency Range	Maximum Ripple [dB]
$F_{UL\_Meas} – F_{UL\_Low} \geq 5$ MHz and $F_{UL\_High} – F_{UL\_Meas} \geq 5$ MHz (Range 1)	5.4 (p-p)
$F_{UL\_Meas} – F_{UL\_Low} < 5$ MHz or $F_{UL\_High} – F_{UL\_Meas} < 5$ MHz (Range 2)	13.4 (p-p)
Note 1: F_{UL_Meas} refers to the sub-carrier frequency for which the equalizer coefficient is evaluated Note 2: F_{UL_Low} and F_{UL_High} refer to each E-UTRA frequency band specified in Table 5.2-1	

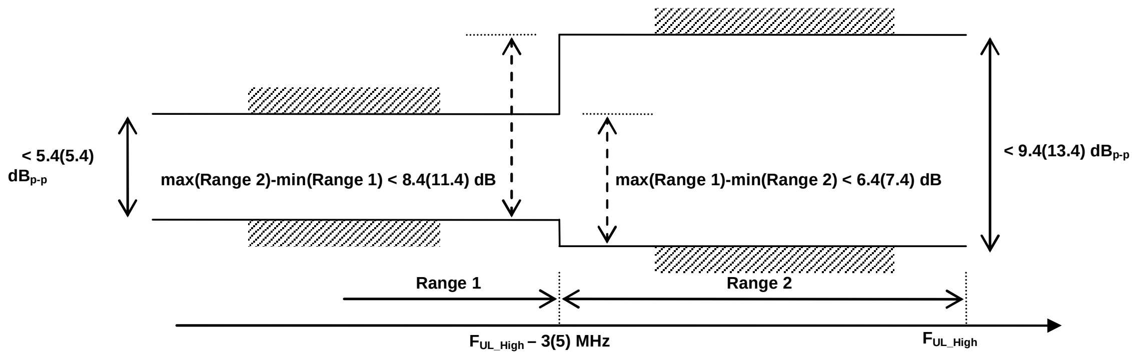


Figure 6.4A.2.4.5-1: The limits for EVM equalizer spectrum flatness with the maximum allowed variation of the coefficients indicated (the ETC minimum requirement within brackets)

6.4B Transmit signal quality for category NB1 and NB2

6.4B.1 Frequency error for UE category NB1 and NB2

6.4B.1_1 Frequency error with GSO ephemeris for UE category NB1 and NB2

6.4B.1_1.1 Test purpose

This test verifies the ability of both, the receiver and the transmitter, to process frequency correctly.

Receiver: to extract the correct frequency from the stimulus signal, offered by the System simulator, under ideal propagation conditions and low level.

Transmitter: to derive the correct modulated carrier frequency from the results, gained by the receiver.

6.4B.1_1.2 Test applicability

This test case applies to all types of NB-IoT FDD UE release 17 and forward of UE category NB1 and NB2 that support satellite access operation and only GSO or both GSO and NGSO.

6.4B.1_1.3 Minimum conformance requirements

For UE category NB1 and NB2, the UE pre-compensates the uplink modulated carrier frequency by the estimated Doppler shift based on received ephemeris information of the SAN in IE *EphemerisInfo* (TS 36.331 [6]), its own location and UL carrier frequency signalled to the UE by the SAN (according to TS36.300 [8] clause 23.21.2.2).

The UE pre-compensated modulated carrier frequency shall be accurate to within the limits in Table 6.4B.1-1, observed over a period of one time slot (0.5 ms for 15 kHz sub-carrier spacing and 2 ms excluding the 2304Ts gap for 3.75 kHz sub-carrier spacing) and averaged over $72/L_{Ctone}$ slots (where L_{Ctone} = {1, 3, 6, 12} is the number of sub-carriers used for the transmission), compared to the ideally pre-compensated reference uplink carrier frequency.

When a repetition period is configured on the uplink for which repetition period (R) >1, the UE shall not change Doppler pre-compensation during an ongoing repetition period, except in the transmission gaps as defined in clause 10.1.3.6 of TS 36.211[3]. When segmentation is applied, then the UE shall update pre-compensation at the beginning of each segment prior to segment transmission.

[NOTE: The ideally pre-compensated reference uplink carrier frequency consists of the UL carrier frequency signalled to the UE by SAN and UL pre-compensated Doppler frequency shift corresponding to the estimated Doppler frequency at the beginning of the transmission.]

Table 6.4B.1_1.3-1: Frequency error requirement for HD-FDD UE category NB1 and NB2

Carrier frequency [GHz]	Frequency error [ppm]
≤1	±0.2
>1	±0.1

The normative reference for this requirement is TS 36.102 [11] clause 6.4B.1.

6.4B.1_1.4 Test description

6.4B.1_1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, channel bandwidths based on E-UTRA bands specified in sub-clause 5.2B. All of these configurations shall be tested with applicable test parameters for each channel bandwidth, and are shown in table 6.4B.1_1.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annex A.2.4. Configurations of NPDSCH and NPDCCH before measurement are specified in Annex C.2.

Table 6.4B.1_1.4.1-1: Test Configuration Table for FDD

		Initial Conditions		
Test Environment as specified in TS 36.508[12] subclause 8.1.1		NC, TL/VL, TL/VH, TH/VL, TH/VH		
Test Frequencies as specified in TS36.508 [12] subclause 8.1.3.1		Frequency ranges defined in Annex K.1.1		
		Test Parameters		
Configuration ID	**Downlink Configuration**	**Uplink Configuration**		
		Modulation	N_{tones}	Subcarrier spacing
1		QPSK	1@0	3.75
2		QPSK	1@0	15
3 (Note 1)		QPSK	3@0	15
4 (Note 1)		QPSK	6@0	15
5 (Note 1)		QPSK	12@0	15
Note 1: Applicable to UE supporting UL multi-tone transmissions				

1. Connect the SS to the UE antenna connectors as shown in TS 36.508 [12] Annex A Figure A.3 using only main UE Tx/Rx antenna.
2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 8.1.4.3.
3. Downlink signals are initially set up according to Annex C0, C.1 and C.3.0, and uplink signals according to Annex [H.1 and H.3.0].
4. The UL Reference Measurement channel is set according to Table 6.4B.1_1.4.1-1.
5. Propagation conditions are set according to Annex B.0.

6. UE location for GSO satellite according to TS 36.508 [12] clause 8.2.6.1 is provided to the UE through any preconfigured means.

7. Deactivate UE prediction of satellite trajectory by any preconfigured means.

6.4B.1_1.4.2 Test procedure

1. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 8.2.6.2.1-1. Test system shall send same SIB31-NB information during the duration of this frequency error measurement as defined in TS 36.508 [12] clause 8.2.6.3.1.

2. Ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5. Message contents are defined in clause 6.4B.1_1.4.3.

3. SS sends uplink scheduling information for each UL HARQ process via NPDCCH DCI format N0 for C_RNTI to schedule the UL RMC according to Table 6.4B.1_1.4.1-1, since the UE has no payload data to send, the UE transmit uplink MAC padding bits on the UL RMC. (UE should be already transmitting PUMAX after Initial Conditions setting).

4. Set the Downlink signal level to the appropriate REFSENS value defined in Table 7.3B.5-1. For the DL signal, Narrowband IoT OCNG pattern 1 in Annex A.5.3.1 is used.

5. Measure the Frequency Error using Global In-Channel Tx-Test (Annex E).

6. Repeat from test procedure steps 1-5 with ephemeris values for maximum positive Doppler replacing ephemeris in step 1 by Table 6.4B.1_1.4.3-1a. Test system shall send same SIB31-NB information during the duration of this frequency error measurement

7. Repeat from test procedure steps 1-5 with ephemeris values for maximum negative Doppler replacing ephemeris in step 1 by Table 6.4B.1_1.4.3-2a. Test system shall send same SIB31-NB information during the duration of this frequency error measurement.

8. Repeat from test procedure steps 1-5 with ephemeris values for half of maximum positive Doppler replacing ephemeris in step 1 by Table 6.4B.1_1.4.3-3a. Test system shall send same SIB31-NB information during the duration of this frequency error measurement.

NOTE 1: For configuration IDs applicable to UE depending on UE capability in Test Configuration Table with different UL sub-carrier spacing, the SS shall release the connection through State 3A-NB and finally ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5 using the appropriate UL subcarrier spacing in Random Access Response message.

6.4B.1_1.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 8.1.6 and 5.6.2

Table 6.4B.1_1.4.3-1a: SystemInformationBlockType31-NB NB-IoT NTN Ephemeris Information for GSO satellites (maximum positive Doppler) for NB-IoT NTN

Derivation Path: TS 36.508 [12] Table 8.2.2.1.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
SystemInformationBlockType31-NB-r17 ::= SEQUENCE {			
servingSatelliteInfo-r17 SEQUENCE {			
ephemerisInfo-r17 CHOICE {			
stateVectors SEQUENCE {			
positionX-r17	-17104941		
positionY-r17	27550229		
positionZ-r17	-607219		
velocityVX-r17	258		
velocityVY-r17	299		
velocityVZ-r17	6277		
}			
}			
k-Offset-r17	264		
}			
}			
NOTE 1: Satellite-UE elevation angle equal to 26.15 degrees, one-way delay equal to 129.93 ms and Doppler equal to 0.17 ppm			

Table 6.4B.1_1.4.3-1b: Void

Table 6.4B.1_1.4.3-2a: SystemInformationBlockType31-NB NB-IoT NTN Ephemeris Information for GSO satellites (maximum negative Doppler)

Derivation Path: TS 36.508 [12] Table 8.2.2.1.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
SystemInformationBlockType31-NB-r17 ::= SEQUENCE {			
servingSatelliteInfo-r17 SEQUENCE {			
ephemerisInfo-r17 CHOICE {			
stateVectors SEQUENCE {			
positionX-r17	-17061001		
positionY-r17	27582763		
positionZ-r17	-276165		
velocityVX-r17	361		
velocityVY-r17	160		
velocityVZ-r17	-6335		
}			
}			
k-Offset-r17	264		
}			
}			
NOTE 1: Satellite-UE elevation angle equal to 26.78 degrees, one-way delay equal to 129.74 ms and Doppler equal to -0.17 ppm.			

Table 6.4B.1_1.4.3-2b: Void

Table 6.4B.1_1.4.3-3a: SystemInformationBlockType31-NB NB-IoT NTN Ephemeris Information for GSO satellites (maximum positive Doppler/2)

Derivation Path: TS 36.508 [12] Table 8.2.2.1.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
SystemInformationBlockType31-NB-r17 ::= SEQUENCE {			
servingSatelliteInfo-r17 SEQUENCE {			
ephemerisInfo-r17 CHOICE {			
stateVectors SEQUENCE {			
positionX-r17	-17062164		
positionY-r17	27354696		
positionZ-r17	-3544856		
velocityVX-r17	-360		
velocityVY-r17	164		
velocityVZ-r17	2993		
}			
}			
k-Offset-r17	264		
}			
}			
NOTE 1: Satellite-UE elevation angle equal to 20.61 degrees, one-way delay equal to 131.70 ms and Doppler equal to 0.085 ppm.			

Table 6.4B.1_1.4.3-3b: Void

6.4B.1_1.5 Test requirement

The 20 frequency error Δf results must fulfil the test requirement:

$$|\Delta f| \leq (0.1\ \text{PPM} + 15\ \text{Hz})\ (\text{Carrier frequency} > 1\ \text{GHz})$$

$$|\Delta f| \leq (0.2\ \text{PPM} + 15\ \text{Hz})\ (\text{Carrier frequency} \leq 1\ \text{GHz})$$

6.4B.1_2 Frequency error with NGSO ephemeris for UE category NB1 and NB2

6.4B.1_2.1 Test purpose

Same test purpose as in clause 6.4B.1_1.1.

6.4B.1_2.2 Test applicability

This test case applies to all types of NB-IoT FDD UE release 17 and forward of UE category NB1 and NB2 that support satellite access operation and only NGSO or both GSO and NGSO.

6.4B.1_2.3 Minimum conformance requirements

Same minimum conformance requirements as in clause 6.4B.1_1.3.

6.4B.1_2.4 Test description

6.4B.1_2.4.1 Initial conditions

Same initial conditions as in clause 6.4B.1_1.4.1 with the following exception:

- In step 6, instead of UE location for GSO satellite → use UE location for NGSO satellite

6.4B.1_2.4.2 Test procedure

Same test procedure as in clause 6.4B.1_1.4.2 with the following exceptions:

- In step 1, instead of TS 36.508 [12] Table 8.2.6.2.1-1 of → use TS 36.508 [12] Table 8.2.6.2.1-3 (ephemeris for NGSO LEO 1200).
- Instead of Tables 6.4B.1_1.4.3-1a, 6.4B.1_1.4.3-2a, and 6.4B.1_1.4.3-3a → use Tables 6.4B.1_2.4.3-1, 6.4B.1_2.4.3-2, and 6.4B.1_2.4.3-3, respectively.
- If the UE supports GSO and NGSO, skip steps 1 to 5 of the test procedure and start with step 6.

6.4B.1_2.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 8.1.6 and 5.6.2

Table 6.4B.1_2.4.3-1: SystemInformationBlockType31- NB NB-IoT NTN Ephemeris Information for NGSO (LEO-600) satellites (maximum positive Doppler)

Derivation Path: TS 36.508 [12] Table 8.2.2.1.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
SystemInformationBlockType31-NB-r17 ::= SEQUENCE {			
servingSatelliteInfo-r17 SEQUENCE {			
ephemerisInfo-r17 CHOICE {			
stateVectors SEQUENCE {			
positionX-r17	-2717617		
positionY-r17	4550419		
positionZ-r17	852799		
velocityVX-r17	6164		
velocityVY-r17	-19424		
velocityVZ-r17	124281		
}			
}			
}			
}			
NOTE 1: Satellite-UE elevation angle equal to 10 degrees, one-way delay equal to 6.44 ms and Doppler equal to 22.65 ppm.			

Table 6.4B.1_2.4.3-2: SystemInformationBlockType31-NB NB-IoT NTN Ephemeris Information for NGSO (LEO-600) satellites (maximum negative Doppler)

Derivation Path: TS 36.508 [12] Table 8.2.2.1.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
SystemInformationBlockType31-NB-r17 ::= SEQUENCE {			
servingSatelliteInfo-r17 SEQUENCE {			
ephemerisInfo-r17 CHOICE {			
stateVectors SEQUENCE {			
positionX-r17	-2199272		
positionY-r17	3404229		
positionZ-r17	3535794		
velocityVX-r17	35394		
velocityVY-r17	-74414		
velocityVZ-r17	94682		
}			
}			
}			
}			
NOTE 1: Satellite-UE elevation angle equal to 169.97 degrees, one-way delay equal to 6.60 ms and Doppler equal to -22.62 ppm.			

Table 6.4B.1_2.4.3-3: SystemInformationBlockType31-NB – NB-IoT NTN Ephemeris Information for NGSO (LEO-600) satellites (maximum positive Doppler/2)

Derivation Path: TS 36.508 [12] Table 8.2.2.1.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
SystemInformationBlockType31-NB-r17 ::= SEQUENCE {			
servingSatelliteInfo-r17 SEQUENCE {			
ephemerisInfo-r17 CHOICE {			
stateVectors SEQUENCE {			
positionX-r17	-2592823		
positionY-r17	4245650		
positionZ-r17	2024520		
velocityVX-r17	19359		
velocityVY-r17	-43278		
velocityVZ-r17	116553		
}			
}			
}			
}			
NOTE 1: Satellite-UE elevation angle equal to 60.25 degrees, one-way delay equal to 2.30 ms and Doppler equal to 11.29 ppm			

6.4B.1_2.5 Test requirement

The 20 frequency error Δf results must fulfil the test requirement:

$$|\Delta f| \leq (0.1 \text{ PPM} + 15 \text{ Hz}) \text{ (Carrier frequency >1 GHz)}$$

$$|\Delta f| \leq (0.2 \text{ PPM} + 15 \text{ Hz}) \text{ (Carrier frequency} \leq 1 \text{ GHz)}$$

6.4B.2 Transmit modulation quality for Category NB1 and NB2

6.4B.2.1 Error Vector Magnitude (EVM) for Category NB1 and NB2

6.4B.2.1.1 Test purpose

The Error Vector Magnitude is a measure of the difference between the reference waveform and the measured waveform. This difference is called the error vector. Before calculating the EVM the measured waveform is corrected by the sample timing offset and RF frequency offset. Then the carrier leakage shall be removed from the measured waveform before calculating the EVM.

The measured waveform is further modified by selecting the absolute phase and absolute amplitude of the Tx chain. The EVM result is defined after the front-end IDFT as the square root of the ratio of the mean error vector power to the mean reference power expressed as a %.

6.4B.2.1.2 Test applicability

This test case applies to all types of NB-IoT FDD UE release 17 and forward of UE category NB1 and NB2 that support satellite access operation.

6.4B.2.1.3 Minimum conformance requirements

The RMS average of the basic EVM measurements for $240/L_{Ctone}$ slots excluding any transient period for the average EVM case, where $L_{Ctone} = \{1, 3, 6, 12\}$ is the number of subcarriers for the NB-IoT transmission, for the different modulations schemes shall not exceed the values specified in Table 6.5.2.1F.1.3-1 for the parameters defined in Table 6.5.2.1F.1.3-2. For EVM evaluation purposes, both NPRACH formats are considered to have the same EVM requirement as QPSK modulated.

Table 6.4B.2.1.3-1: Minimum requirements for Error Vector Magnitude

Parameter	Unit	Average EVM Level	Reference Signal EVM Level
BPSK or QPSK	%	17.5	17.5

Table 6.4B.2.1.3-2: Parameters for Error Vector Magnitude

Parameter	Unit	Level
UE Output Power	dBm	≥ -40
Operating conditions		Normal conditions

The normative reference for this requirement is TS 36.102 [11] clause 6.4B.2.

6.4B.2.1.4 Test description

6.4B.2.1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths based on E-UTRA bands specified in table 5.2B. All of these configurations shall be tested with applicable test parameters for each channel bandwidth, and are shown in table 6.4B.2.1.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annex A.2.4. Configurations of NPDSCH and NPDCCH before measurement are specified in Annex C.2.

Table 6.4B.2.1.4.1-1: Test Configuration for NPUSCH for FDD

Initial Conditions				
Test Environment as specified in TS 36.508[12] subclause 8.1.1		Normal		
Test Frequencies as specified in TS 36.508 [12] subclause 8.1.3.1		Frequency ranges defined in Annex K.1.1		
Test Parameters				
Configuration ID	**Downlink Configuration**	**Uplink Configuration**		
	N/A	Modulation	N_{tones}, start position	Sub-carrier spacing (kHz)
1		QPSK	1@0	3.75
2		QPSK	1@47	3.75
3		QPSK	1@0	15
4		QPSK	1@11	15
5 (Note 1)		QPSK	12@0	15
Note 1: Applicable to UE supporting UL multi-tone transmissions				

Table 6.4B.2.1.4.1-2: Test Configuration for NPRACH for FDD

Initial Conditions	
Test Environment (as specified in TS 36.508 [12] subclause 8.1.1)	Normal
Test Frequencies (as specified in TS36.508 [12] subclause 8.1.3.1)	Frequency ranges defined in Annex K.1.1
NPRACH preamble format	1
NRS EPRE setting for test point (dBm/15kHz)	-110

1. Connect the SS to the UE to the UE antenna connectors as shown in TS 36.508 [12] Annex A, Figure A.3 using only main UE Tx/Rx antenna.
2. The parameter settings for the cell are set up according to TS 36.508[12] subclause 8.1.4.3
3. Downlink signals are initially set up according to Annex C, and uplink signals according to Annex H.
4. The UL Reference Measurement channels are set according to in Table 6.4B.2.1.4.1-1.
5. Propagation conditions are set according to Annex B.0
6. UE location according to TS 36.508 [12] clause 8.2.6.1 is provided to the UE through any preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 8.2.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 8.2.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31-NB information during the duration of the test as define in TS 36.508[12] clause 8.2.6.3.1
8. Deactivate UE prediction of satellite trajectory by any preconfigured means
9. Ensure the UE is State 2A-NB with CP CIoT Optimisation to TS 36.508 [12] clause 8.1.5. Message contents are defined in clause 6.4B.2.1.4.3.

6.4B.2.1.4.2 Test procedure

Test procedure for NPUSCH:

1.1. SS sends uplink scheduling information for UL HARQ process via NPDCCH DCI format N0 for C_RNTI to schedule the UL RMC according to Table 6.4B.2.1.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.

1.2 Configure the UE to transmit at PUMAX level.

1.3 Measure the EVM and $\overline{EVM}_{DMRS}$ using Global In-Channel Tx-Test (Annex E). The measurement period of EVM for 240/Ntones slots should exclude any transient period for the average EVM case, where Ntones = {1, 3, 6, 12} is the number of subcarriers for the NB-IoT transmission.

1.4 Release the connection through State 3A-NB.

1.5 Modify system information elements according to Table 6.4B.2.1.4.3-1 and Table 6.4B.2.1.4.3-2 and notify the UE via paging message with SystemInformationModification included (test point 2).

1.6 Ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5 using the new UL power control setting.

1.7 SS sends uplink scheduling information for UL HARQ process via NPDCCH DCI format 0 for C_RNTI to schedule the UL RMC according to Table 6.4B.2.1.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.

1.8 Measure the EVM and $\overline{EVM}_{DMRS}$ using Global In-Channel Tx-Test (Annex E). The measurement period of EVM for 240/Ntones slots should exclude any transient period for the average EVM case, where Ntones = {1, 3, 6, 12} is the number of subcarriers for the NB-IoT transmission.

Test procedure for NPRACH:

2.1 The SS shall set RS EPRE according to Table 6.4B.2.1.4.1-2.

2.2 NPRACH is set according to Table 6.4B.2.1.4.1-2.

2.3 The UE shall send a preamble to the SS.

2.4 In response to the preamble, the SS shall transmit a random access response not corresponding to the transmitted random access preamble, or send no response.

2.5 The UE shall consider the random access response reception not successful then re-transmit the preamble with the calculated NPRACH transmission power.

2.6 Repeat step 4 and 5 until the SS collect enough NPRACH preambles (64 preambles). Measure the EVM in NPRACH channel using Global In-Channel Tx-Test (Annex E).

NOTE 1: For configuration IDs applicable to UE depending on UE capability in Test Configuration Table with different UL sub-carrier spacing, the SS shall release the connection through State 3A-NB and finally ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5 using the appropriate UL subcarrier spacing in Random Access Response message.

6.4B.2.1.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 8.1.6 with the following exceptions:

Table 6.4B.2.1.4.3-1: P0-NominalNPUSCH-r13 configuration for test point 2

Derivation Path: TS 36.508 [12] clause 8.1.6.3 Table 8.1.6.3-14: UplinkPowerControlCommon-NB-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
UplinkPowerControlCommon-NB-DEFAULT ::= SEQUENCE {			
p0-NominalNPUSCH-r13	-117 (dBm)		
alpha-r13	al1 (1)		
deltaPreambleMsg3-r13	4		
}			

Table 6.4B.2.1.4.3-2: NPDSCH-ConfigCommon-NB-DEFAULT configuration for test point 2

Derivation Path: TS 36.508 [12] clause 8.1.6.3 Table 8.1.6.3-4: NPDSCH-ConfigCommon-NB-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
NPDSCH-ConfigCommon-NB-DEFAULT ::= SEQUENCE {			
nrs-Power-r13	21 (dBm)		
}			

Table 6.4B.2.1.4.3-3: RACH-ConfigCommon-NB-DEFAULT NPRACH EVM Measurement

Derivation Path: TS 36.508 [12] clause 8.1.6.3, Table 8.1.6.3-8 RACH-ConfigCommon-NB-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
RACH-ConfigCommon-NB-DEFAULT ::= SEQUENCE {			
powerRampingParameters-r13 SEQUENCE {			
powerRampingStep	dB0	0 dB	
}			
)			

Table 6.4B.2.1.4.3-4: NPRACH-ConfigSIB-NB-DEFAULT for NPRACH EVM Measurement

Derivation Path: TS 36.508 [12] clause 8.1.6.3, Table 8.1.6.3-5 NPRACH-ConfigSIB-NB-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
NPRACH-ConfigSIB-NB-DEFAULT ::= SEQUENCE {			
nprach-CP-Length-r13	us266dot7	8192*Ts	
}			

6.4B.2.1.5 Test requirement

The NPUSCH EVM derived in E.8.1 shall not exceed 17,5% for BPSK and QPSK.

The NPUSCH $\overline{EVM}_{DMRS}$ derived in E.8.2 shall not exceed 17,5 % when embedded with data symbols of BPSK and QPSK.

The NPRACH EVM derived in E.8.3 shall not exceed 17.5%.

6.4B.2.2 Carrier leakage for Category NB1 and NB2

6.4B.2.2.1 Test purpose

Carrier leakage expresses itself as unmodulated sine wave with the carrier frequency or centre frequency of aggregated transmission bandwidth configuration. It is an interference of approximately constant amplitude and independent of the amplitude of the wanted signal. Carrier leakage interferes with the centre sub carriers of the UE under test (if allocated), especially, when their amplitude is small. The measurement interval is defined over one slot in the time domain.

The purpose of this test is to exercise the UE transmitter to verify its modulation quality in terms of carrier leakage.

6.4B.2.2.2 Test applicability

This test case applies to all types of NB-IoT FDD UE release 17 and forward of UE category NB1 and NB2 that support satellite access operation.

6.4B.2.2.3 Minimum conformance requirements

Carrier leakage is an additive sinusoid waveform that has the same frequency as a modulated waveform carrier frequency. The measurement interval is one slot in the time domain. The relative carrier leakage power is a power ratio of the additive sinusoid waveform and the modulated waveform. The relative carrier leakage power of category NB1 and NB2 UE shall not exceed the values specified in Table 6.4B.2.2.3-1.

Table 6.4B2.2.3-1: Minimum requirements for relative carrier leakage power

Parameters	Relative limit (dBc)
0 dBm ≤ Output power	-25
-30 dBm ≤ Output power ≤ 0 dBm	-20
-40 dBm ≤ Output power < -30 dBm	-10

The normative reference for this requirement is TS 36.102 [11] clause 6.4B.2.

6.4B.2.2.4 Test description

6.4B.2.2.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths based on E-UTRA bands specified in table 5.2B. All of these configurations shall be tested with applicable test parameters for each channel bandwidth, and are shown in table 6.4B.2.2.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annex A.2.4. Configurations of NPDSCH and NPDCCH before measurement are specified in Annex TBD.

Table 6.4B.2.2.4.1-1: Test Configuration Table for FDD

Initial Conditions				
Test Environment as specified in TS 36.508[12] subclause 8.1.1		Normal		
Test Frequencies as specified in TS 36.508 [12] subclause 8.1.3.1		Frequency ranges defined in Annex K.1.1		
Test Parameters				
Configuration ID	**Downlink Configuration**	**Uplink Configuration**		
	N/A	Modulation	N_{tones}, start position	Sub-carrier spacing (kHz)
1		QPSK	1@0	3.75
2		QPSK	1@47	3.75
3		QPSK	1@0	15
4		QPSK	1@11	15

1. Connect the SS to the UE to the UE antenna connectors as shown in TS 36.508 [12] Annex A, Figure A.3 using only main UE Tx/Rx antenna.
2. The parameter settings for the cell are set up according to TS 36.508[12] subclause 8.1.4.3
3. Downlink signals are initially set up according to Annex C, and uplink signals according to Annex H.
4. The UL Reference Measurement channels are set according to in Table 6.4B.2.2.4.1-1.
5. Propagation conditions are set according to Annex B.0
6. UE location according to TS 36.508 [12] clause 8.2.6.1 is provided to the UE through any preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 8.2.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 8.2.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31-NB information during the duration of the test as define in TS 36.508[12] clause 8.2.6.3.1
8. Deactivate UE prediction of satellite trajectory by any preconfigured means
9. Ensure the UE is State 2A-NB with CP CIoT Optimisation to TS 36.508 [12] clause 8.1.5. Message contents are defined in clause 6.4B.2.2.4.3.

6.4B.2.2.4.2 Test procedure

1. SS sends uplink scheduling information for UL HARQ process via NPDCCH DCI format N0 for C_RNTI to schedule the UL RMC according to Table 6.4B.2.2.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC
2. Configure UE to transmit at PUMAX level.
3. Measure carrier leakage using Global In-Channel Tx-Test (Annex E).
4. Release the connection through State 3A-NB.
5. Modify system information elements according to Table 6.4B.2.2.4.3-1 and Table 6.4B.2.2.4.3-2 and notify the UE via paging message with SystemInformationModification included (test point 2).
6. Ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5 using the new UL power control setting.
7. SS sends uplink scheduling information for UL HARQ process via NPDCCH DCI format 0 for C_RNTI to schedule the UL RMC according to Table 6.4B.2.2.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.
8. Measure carrier leakage using Global In-Channel Tx-Test (Annex E).

NOTE 1: For configuration IDs applicable to UE depending on UE capability in Test Configuration Table with different UL sub-carrier spacing, the SS shall release the connection through State 3A-NB and finally ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5 using the appropriate UL subcarrier spacing in Random Access Response message.

6.4B.2.2.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 8.1.6 with the following exceptions:

Table 6.4B.2.2.4.3-1: P0-NominalNPUSCH-r13 configuration for test point 2

Derivation Path: 36.508 clause 8.1.6.3 Table 8.1.6.3-14: UplinkPowerControlCommon-NB-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
UplinkPowerControlCommon-NB-DEFAULT ::= SEQUENCE {			
p0-NominalNPUSCH-r13	-117 (dBm)		
alpha-r13	al1 (1)		
deltaPreambleMsg3-r13	4		
}			

Table 6.4B.2.2.4.3-2: NPDSCH-ConfigCommon-NB-DEFAULT configuration for test point 2

Derivation Path: 36.508 clause 8.1.6.3 Table 8.1.6.3-4: NPDSCH-ConfigCommon-NB-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
NPDSCH-ConfigCommon-NB-DEFAULT ::= SEQUENCE {			
nrs-Power-r13	21 (dBm)		
}			

6.4B.2.2.5 Test requirement

Each of the carrier leakage results, derived in Annex E.3.1, shall not exceed the values in table 6.4A.2.2.5-1

Table 6.4A.2.2.5-1: Test requirements for Relative Carrier Leakage Power

LO Leakage	Parameters	Relative Limit (dBc)
	Test point 1	-24.2

	Test point 2	-19.2

6.4B.2.3 In-band emissions for Category NB1 and NB2

6.4B.2.3.1 Test purpose

The in-band emissions are a measure of the interference falling into the non-allocated tones.

The in-band emission is defined as a function of the tone offset from the edge of the allocated UL transmission tone(s) within the transmission bandwidth configuration. The in-band emission is measured as the ratio of the UE output power in a non–allocated tone to the UE output power in an allocated tone. The basic in-band emissions measurement interval is defined over one slot in the time domain.

6.4B.2.3.2 Test applicability

This test case applies to all types of NB-IoT FDD UE release 17 and forward of UE category NB1 and NB2 that support satellite access operation.

6.4B.2.3.3 Minimum conformance requirements

The category NB1 and NB2 UE relative in-band emission shall not exceed the values specified in Table 6.4B.2.3.3-1.

Table 6.4B.2.3.3-1: Minimum requirements for in-band emissions

Parameter description	Unit	Limit (NOTE 1)		Applicable Frequencies
General	dB	$\max\{ -15-10\cdot\log_{10}(N_{tone}/L_{Ctone}), -18-5\cdot(\lvert\Delta_{tone}\rvert-1)/L_{Ctone}, -57\,dBm/(3.75kHz\ or\ 15kHz)-P_{tone}\}$		Any non-allocated (NOTE 2)
IQ Image	dB	-25		Image frequencies (NOTES 2, 3)
Carrier leakage	dBc	-25	0 dBm ≤ Output power	Carrier frequency (NOTES 4, 5)
		-20	-30 dBm ≤ Output power ≤ 0 dBm	
		-10	-40 dBm ≤ Output power < -30 dBm	

NOTE 1: An in-band emissions combined limit is evaluated in each non-allocated tone. For each such tone, the minimum requirement is calculated as the higher of P_{tone} - 30 dB and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. P_{tone} is defined in NOTE 10.

NOTE 2: The measurement bandwidth is 1 tone and the limit is expressed as a ratio of measured power in one non-allocated tone to the measured average power per allocated tone, where the averaging is done across all allocated tones.

NOTE 3: The applicable frequencies for this limit are those that are enclosed in the reflection of the allocated bandwidth, based on symmetry with respect to the centre carrier frequency, but excluding any allocated tones.

NOTE 4: The measurement bandwidth is 1 tone and the limit is expressed as a ratio of measured power in one non-allocated tone to the measured total power in all allocated tones.

NOTE 5: The applicable frequencies for this limit are those that are enclosed in the tones containing the DC frequency if N_{tone} is odd, or in the two tones immediately adjacent to the DC frequency if N_{tone} is even, but excluding any allocated tone.

NOTE 6: L_{Ctone} is the Transmission Bandwidth (tones).

NOTE 7: N_{tone} is the Transmission Bandwidth Configuration (tones).

NOTE 8: Δ_{tone} is the starting frequency offset between the allocated tone and the measured non-allocated tone. (e.g. $\Delta_{tone}=1$ or $\Delta_{tone}=-1$ for the first adjacent tone outside of the allocated bandwidth.

NOTE 9: P_{tone} is the transmitted power per 3.75 kHz or 15 kHz in allocated tones, measured in dBm.

The normative reference for this requirement is TS 36.102 [11] clause 6.4B.2.

6.4B.2.3.4 Test description

6.4B.2.3.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths based on E-UTRA bands specified in table 5.2B. All of these configurations shall be tested with applicable test parameters for each channel bandwidth, and are shown in table 6.4B.2.3.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annex A.2.4. Configurations of NPDSCH and NPDCCH before measurement are specified in Annex C.2.

Table 6.4B.2.3.4.1-1: Test Configuration Table for FDD

Initial Conditions				
Test Environment as specified in TS 36.508[12] subclause 8.1.1		Normal		
Test Frequencies as specified in TS 36.508 [12] subclause 8.1.3.1		Frequency ranges defined in Annex K.1.1		
Test Parameters				
Configuration ID	**Downlink Configuration**	**Uplink Configuration**		
		Modulation	N_{tones}	Sub-carrier spacing (kHz)
1	N/A	QPSK	1@0	3.75kHz
2		QPSK	1@47	3.75kHz
3		QPSK	1@0	15kHz
4		QPSK	1@11	15kHz

1. Connect the SS to the UE to the UE antenna connectors as shown in TS 36.508 [12] Annex A, Figure A.3 using only main UE Tx/Rx antenna.
2. The parameter settings for the cell are set up according to TS 36.508[12] subclause 8.1.4.3
3. Downlink signals are initially set up according to Annex C, and uplink signals according to Annex H.1 and H.4.0.
4. The UL Reference Measurement channels are set according to in Table 6.4B.2.3.4.1-1.
5. Propagation conditions are set according to Annex B.0
6. UE location according to TS 36.508 [12] clause 8.2.6.1 is provided to the UE through any preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 8.2.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 8.2.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31-NB information during the duration of the test as define in TS 36.508[12] clause 8.2.6.3.1
8. Deactivate UE prediction of satellite trajectory by any preconfigured means
9. Ensure the UE is State 2A-NB with CP CIoT Optimisation to TS 36.508 [12] clause 8.1.5. Message contents are defined in clause 6.4B.2.2.4.3.

6.4B.2.3.4.2 Test procedure

1. SS sends uplink scheduling information via NPDCCH DCI format 0 for C_RNTI to schedule the UL RMC according to Table 6.4B.2.3.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.
2. Measure In-band emission using Global In-Channel Tx-Test (Annex E).
3. Release the connection through State 3A-NB.

4. Modify system information elements according to Table 6.4B.2.3.4.3-1 and Table 6.4B.2.3.4.3-2 and notify the UE via paging message with SystemInformationModification included.

5. Ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5 using the new UL power control setting.

6. SS sends uplink scheduling information for UL HARQ process via NPDCCH DCI format 0 for C_RNTI to schedule the UL RMC according to Table 6.4B.2.3.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.

7. Measure In-band emission using Global In-Channel Tx-Test (Annex E).

NOTE 1: For configuration IDs applicable to UE depending on UE capability in Test Configuration Table with different UL sub-carrier spacing, the SS shall release the connection through State 3A-NB and finally ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5 using the appropriate UL subcarrier spacing in Random Access Response message.

6.4B.2.3.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 8.1.6 with the following exceptions:

Table 6.4B.2.3.4.3-1: P0-NominalNPUSCH-r13 configuration for test point 2

Derivation Path: 36.508 clause 8.1.6.3 Table 8.1.6.3-14: UplinkPowerControlCommon-NB-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
UplinkPowerControlCommon-NB-DEFAULT ::= SEQUENCE {			
p0-NominalNPUSCH-r13	-117 (dBm)		
alpha-r13	al1 (1)		
deltaPreambleMsg3-r13	4		
}			

Table 6.4B.2.3.4.3-2: NPDSCH-ConfigCommon-NB-DEFAULT configuration for test point 2

Derivation Path: 36.508 clause 8.1.6.3 Table 8.1.6.3-4: NPDSCH-ConfigCommon-NB-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
NPDSCH-ConfigCommon-NB-DEFAULT ::= SEQUENCE {			
nrs-Power-r13	21 (dBm)		
}			

6.4B.2.3.5 Test requirement

Each of the 20 In-band emissions results, derived in [Annex E.4.3] shall not exceed the corresponding values in Table 6.4B.2.3.5-1 based on supported UE release version.

Table 6.4B.2.3.5-1: Test requirements for in-band emissions for UE category NB1 and NB2

Parameter description	Test point	Unit	Limit (NOTE 1)		Applicable Frequencies
General	1, 2	dB	$\max\{ -15-10\cdot\log_{10}(N_{tone}/L_{Ctone}),$ $-18-5\cdot(\lvert\Delta_{tone}\rvert-1)/L_{Ctone},$ $-57\,dBm/(3.75kHz\ or\ 15kHz)-P_{tone}\}$ +0.8		Any non-allocated (NOTE 2)
IQ Image		dB	-24.2		Image frequencies (NOTES 2, 3)
Carrier leakage	1	dBc	-24.2	0 dBm ≤ Output power f ≤ 3.0GHz: 3.2dBm ±3.2dB	Carrier frequency (NOTES 4, 5)
	2		-19.2	-30 dBm ≤ Output power ≤ 0 dBm f ≤ 3.0GHz: -26.8 dBm ±3.2dB	

NOTE 1: An in-band emissions combined limit is evaluated in each non-allocated tone. For each such tone, the minimum requirement is calculated as the higher of P_{tone} - 30 dB and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. P_{tone} is defined in NOTE 10.

NOTE 2: The measurement bandwidth is 1 tone and the limit is expressed as a ratio of measured power in one non-allocated tone to the measured average power per allocated tone, where the averaging is done across all allocated tones.

NOTE 3: The applicable frequencies for this limit are those that are enclosed in the reflection of the allocated bandwidth, based on symmetry with respect to the centre carrier frequency, but excluding any allocated tones.

NOTE 4: The measurement bandwidth is 1 tone and the limit is expressed as a ratio of measured power in one non-allocated tone to the measured total power in all allocated tones.

NOTE 5: The applicable frequencies for this limit are those that are enclosed in the tones containing the DC frequency if N_{tone} is odd, or in the two tones immediately adjacent to the DC frequency if N_{tone} is even, but excluding any allocated tone.

NOTE 6: L_{Ctone} is the Transmission Bandwidth (tones).

NOTE 7: N_{tone} is the Transmission Bandwidth Configuration (tones).

NOTE 8: Δ_{tone} is the starting frequency offset between the allocated tone and the measured non-allocated tone. (e.g. $\Delta_{tone}=1$ or $\Delta_{tone}=-1$ for the first adjacent tone outside of the allocated bandwidth.

NOTE 9: P_{tone} is the transmitted power per 3.75 kHz or 15 kHz in allocated tones, measured in dBm.

6.5 Output RF spectrum emissions

The output UE transmitter spectrum consists of the three components; the emission within the occupied bandwidth (channel bandwidth), the Out Of Band (OOB) emissions and the far out spurious emission domain.

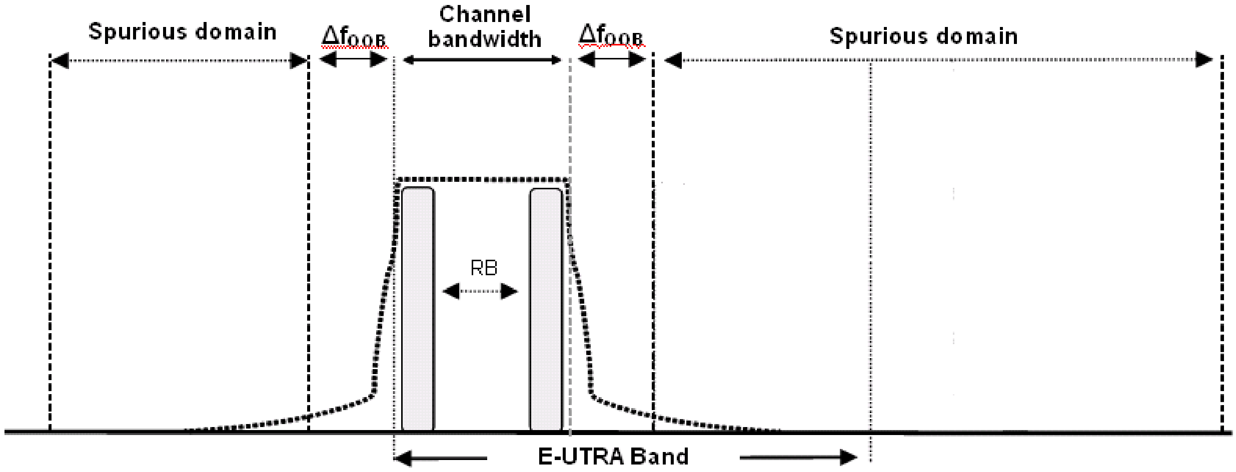


Figure 6.5-1: Transmitter RF spectrum

6.5A Output RF spectrum emissions for category M1

6.5A.1 General

The definitions in clause 6.5 shall apply.

When the UE is operating in an NGSO deployment, to support coexistence, it is assumed that a guardband at least equivalent to the maximum doppler shift expected for the NGSO constellation between the channel edge of the channel bandwidth operated by the UE and the spectrum block edge has been accounted for as part of system deployment configuration by the operator.

6.5A.2 Occupied bandwidth for category M1

6.5A.2.1 Test purpose

To verify that the UE occupied bandwidth for all transmission bandwidth configurations supported by the UE are less than their specific limits.

6.5A.2.2 Test applicability

This test case applies to all types of NB-IoT FDD UE release 17 and forward of UE category M1 that support satellite access operation.

6.5A.2.3 Minimum conformance requirements

Occupied bandwidth is a measure of the bandwidth containing 99 % of the total integrated mean power of the transmitted spectrum on the assigned channel. The occupied channel bandwidth for all transmission bandwidth configurations (Resources Blocks) should be less than the channel bandwidth specified in Table 6.5A.2.3-1

Table 6.5A.2.3-1: Occupied channel bandwidth

	Occupied channel bandwidth / channel bandwidth
	1.4MHz
Channel bandwidth [MHz]	1.4

The normative reference for this requirement is TS 36.102 [11] clause 6.5A.2.

6.5A.2.4 Test description

6.5A.2.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths based on E-UTRA operating bands specified in clause 5.2A. All these configurations shall be tested with applicable test parameters for each channel bandwidth and are shown in table 6.5A.2.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of PDSCH and MPDCCH before measurement are specified in Annex C.2.

Table 6.5A.2.4.1-1: Test Configuration Table

<table>
<tr><th colspan="4">Initial Conditions</th></tr>
<tr><td colspan="2">Test Environment as specified in TS 36.508 [12] subclause 4.1</td><td colspan="2">Normal</td></tr>
<tr><td colspan="2">Test Frequencies as specified in TS36.508 [12] subclause 4.3.1</td><td colspan="2">Mid range</td></tr>
<tr><td colspan="2">Test Channel Bandwidths as specified in TS 36.508 [12] subclause 4.3.1</td><td colspan="2">1.4 MHz</td></tr>
<tr><th colspan="4">Test Parameters for Channel Bandwidths</th></tr>
<tr><th></th><th>Downlink Configuration</th><th colspan="2">Uplink Configuration</th></tr>
<tr><td>Ch BW</td><td rowspan="3">N/A for Occupied bandwidth</td><td>Mod'n</td><td>RB allocation</td></tr>
<tr><td></td><td></td><td>FDD and HD-FDD</td></tr>
<tr><td>1.4MHz</td><td>QPSK</td><td>6</td></tr>
</table>

1. Connect the SS to the UE antenna connectors as shown in TS 36.508 [12] Annex A Figure A.3 using only main UE Tx/Rx antenna.
2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C0, C.1, and C.3.0, and uplink signals according to Annex H.1 and H.3.0.
4. The UL Reference Measurement channels are set according to Table 6.5A.2.4.1-1.
5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 36.508 [12] clause 5.6.1 is provided to the UE through any preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31 information during the duration of the test as define in TS 36.508[12] clause 5.6.3.1
8. Deactivate UE prediction of satellite trajectory by any preconfigured means
9. Ensure the UE is in State 3A-RF-CE according to TS 36.508 [12] clause 5.2A.2AA. Message contents are defined in clause 6.5A.2.4.3.

6.5A.2.4.2 Test procedure

1. The SS sends uplink scheduling information for each UL HARQ process via MPDCCH DCI format 6-0A for C_RNTI to schedule the UL RMC according to Table 6.5A.2.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.
2. Send continuously power control "up" commands to the UE until the UE transmits at P_{UMAX} level.
3. Measure the power spectrum distribution within two times or more range over the requirement for Occupied Bandwidth specification centring on the current carrier frequency. The characteristic of the filter shall be approximately Gaussian (typical spectrum analyzer filter). Other methods to measure the power spectrum

distribution are allowed. The measuring duration is one active uplink subframe. for HD-FDD slots with transient periods and Half-duplex guard subframe are not under test.

4. Calculate the total power within the range of all frequencies measured in '3)' and save this value as "Total Power".
5. Sum up the power upward from the lower boundary of the measured frequency range in '3)' and seek the limit frequency point by which this sum becomes 0,5 % of "Total Power" and save this point as "Lower Frequency".
6. Sum up the power downward from the upper boundary of the measured frequency range in '3)' and seek the limit frequency point by which this sum becomes 0,5 % of "Total Power" and save this point as "Upper Frequency".
7. Calculate the difference ("Upper Frequency" – "Lower Frequency" = "Occupied Bandwidth") between two limit frequencies obtained in '5)' and '6)'.

6.5A.2.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 4.6 with the condition CEModeA.

6.5A.2.5 Test requirement

The measured Occupied Bandwidth shall not exceed values in Table 6.5A.2.5-1.

Table 6.5A.2.5-1: Occupied channel bandwidth

	Occupied channel bandwidth / channel bandwidth
	1.4MHz
Channel bandwidth [MHz]	N/A

6.5A.3 Out of band emission for category M1

6.5A.3.1 General

The out of band emissions are unwanted emissions immediately outside the assigned channel bandwidth resulting from the modulation process and non-linearity in the transmitter but excluding spurious emissions. This out of band emission limit is specified in terms of a spectrum emission mask and an Adjacent Channel Leakage power Ratio.

6.5A.3.2 Spectrum emission mask for category M1

6.5A.3.2.1 Test purpose

To verify that the power of any UE emission shall not exceed specified lever for the specified channel bandwidth.

6.5A.3.2.2 Test applicability

This test case applies to all types of E-UTRA UE release 13 and forward of UE category M1 that support satellite access operation.

6.5A.3.2.3 Minimum conformance requirements

The spectrum emission mask of the UE applies to frequencies (Δf_{OOB}) starting from the edge of the assigned E-UTRA channel bandwidth. For frequencies greater than (Δf_{OOB}) as specified in Table 6.5A.3.2.3-1 the spurious requirements in clause 6.5A.4 are applicable.

The power of any UE emission shall not exceed the levels specified in Table 6.5A.3.2.3-1 for the specified channel bandwidth.

Table 6.5A.3.2.3-1: General E-UTRA spectrum emission mask

Spectrum emission limit (dBm)/ Channel bandwidth		
Δf_{OOB} (MHz)	1.4 MHz	Measurement bandwidth
± 0-1	-10	30 kHz
± 1-2.5	-10	1 MHz
± 2.5-2.8	-25	1 MHz

NOTE: As a general rule, the resolution bandwidth of the measuring equipment should be equal to the measurement bandwidth. However, to improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth may be smaller than the measurement bandwidth. When the resolution bandwidth is smaller than the measurement bandwidth, the result should be integrated over the measurement bandwidth in order to obtain the equivalent noise bandwidth of the measurement bandwidth.

The normative reference for this requirement is TS 36.102 [11] clause 6.5A.3.2.

6.5A.3.2.4 Test description

6.5A.3.2.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths based on E-UTRA bands specified in sub-clause 5.2A. All of these configurations shall be tested with applicable test parameters for each channel bandwidth and are shown in table 6.5A.3.2.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2 respectively. Configurations of PDSCH and MPDCCH before measurement are specified in Annex C.2.

Table 6.5A.3.2.4.1-1: Test Configuration mask

Initial Conditions			
Test Environment as specified in TS 36.508[12] subclause 4.1	NC		
Test Frequencies as specified in TS 36.508 [12] subclause 4.3.1	Low range, Mid range, High range		
Test Channel Bandwidths as specified in TS 36.508 [12] subclause 4.3.1	1.4MHz		
Test Parameters for Channel Bandwidths			
	Downlink Configuration	Uplink Configuration	
Ch BW	N/A for Maximum Power Reduction (MPR) test case	Mod'n	RB allocation
1.4MHz		QPSK	2
1.4MHz		QPSK	5
1.4MHz		QPSK	6
1.4MHz		16QAM	2
1.4MHz		16QAM	5
Note 1: The RB_{start} of partial RB allocation shall be RB#0 and RB# (6 - RB allocation) of the narrowband.			

1. Connect the SS to the UE antenna connectors as shown in Figure TS 36.508 [12] Annex A, Figure A.3 using only main UE Tx/Rx antenna.

2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C0, C.1 and C.3.0, and uplink signals according to Annex H.1 and H.3.0.

4. The UL Reference Measurement channels are set according to Table 6.5A.3.2.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. UE location according to TS 36.508 [12] clause 5.6.1 is provided to the UE through any preconfigured means

7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31 information during the duration of the test as define in TS 36.508[12] clause 5.6.3.1

8. Deactivate UE prediction of satellite trajectory by any preconfigured means

9. Ensure the UE is in State 3A-RF-CE according to TS 36.508[12] clause 5.2A.2AA. Message contents are defined in clause 6.5A.3.2.4.3.

6.5A.3.2.4.2 Test procedure

1. SS sends uplink scheduling information via PDCCH DCI format 6-0A for C_RNTI to schedule the UL RMC according to Table 6.5A.3.2.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.
2. Send continuously uplink power control "up" commands in the uplink scheduling information to the UE until the UE transmits at P_{UMAX} level.
3. Measure the mean power of the UE in the channel bandwidth of the radio access mode according to the test configuration, which shall meet the requirements described in Tables 6.2A.2.3-1. The period of the measurement shall be at least the continuous duration of one sub-frame (1ms). For HD-FDD slots with transient periods are not under test. Half-duplex guard sub frame is not under test.
4. Measure the power of the transmitted signal with a measurement filter of bandwidths according to table 6.5A.3.2.5-1, as applicable. The centre frequency of the filter shall be stepped in continuous steps according to the same table. The measured power shall be recorded for each step. The measurement period shall capture the active TSs.

6.5A.3.2.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 4.6 with the condition CEModeA.

6.5A.3.2.5 Test requirements

The measured UE mean power in the channel bandwidth, derived in step 3, shall fulfil requirements in Tables 6.2A.2.4.4-1 to 6.2A.2.4.4-1a as appropriate, and the power of any UE emission shall fulfil requirements in Table.6.5A.3.2.5-1, as applicable.

Table 6.5A.3.2.5-1: General E-UTRA spectrum emission mask

	Spectrum emission limit (dBm)/ Channel bandwidth	
Δf_{OOB} (MHz)	**1.4 MHz**	**Measurement bandwidth**
0-1	-8.5	30 kHz
1-2.5	-8.5	1 MHz
2.5-2.8	-23.5	1 MHz
Note 1: The first and last measurement position with a 30 kHz filter is at Δf_{OOB} equals to 0.015 MHz and 0.985 MHz. Note 2: At the boundary of spectrum emission limit, the first and last measurement position with a 1 MHz filter is the inside of +0.5MHz and -0.5MHz, respectively. Note 3: The measurements are to be performed above the upper edge of the channel and below the lower edge of the channel Note 4: For the 2.5-2.8 MHz offset range with 1.4 MHz channel bandwidth, the measurement position is at Δf_{OOB} equals to 3 MHz.		

NOTE: As a general rule, the resolution bandwidth of the measuring equipment should be equal to the measurement bandwidth. However, to improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth may be smaller than the measurement bandwidth. When the resolution bandwidth is smaller than the measurement bandwidth, the result should be integrated over the measurement bandwidth in order to obtain the equivalent noise bandwidth of the measurement bandwidth.

6.5A.3.3 Additional Spectrum Emission Mask for category M1

The additional spectrum emission mask is not applicable.

6.5A.3.4 Adjacent Channel Leakage Ratio for category M1

6.5A.3.4.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to adjacent channels in terms of Adjacent Channel Leakage power Ratio (ACLR).

6.5A.3.4.2 Test applicability

This test case applies to all types of E-UTRA UE release 13 and forward of UE category M1 that supports satellite access operation.

6.5A.3.4.3 Minimum conformance requirements

ACLR requirements are specified for two scenarios for an adjacent E -UTRA$_{ACLR}$ and UTRA$_{ACLR1/2}$ as shown in Figure 6.5A.3.4.3-1.

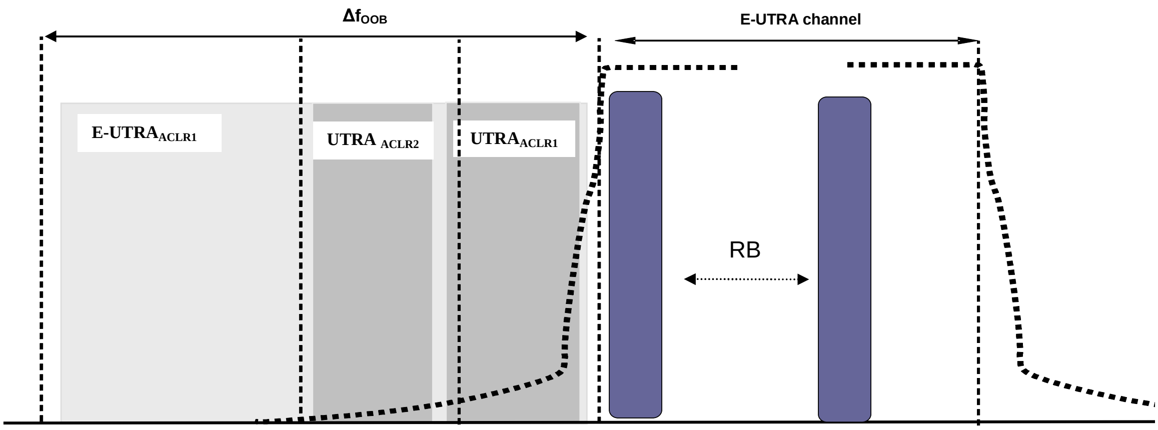


Figure 6.5A.3.4.3-1: Adjacent Channel Leakage Power Ratio requirements

6.5A.3.4.3.1 Minimum conformance requirements for E-UTRA

E-UTRA category M1 Adjacent Channel Leakage power Ratio (E-UTRA$_{ACLR}$) is the ratio of the filtered mean power centred on the assigned channel frequency to the filtered mean power centred on an adjacent channel frequency at nominal channel spacing. The assigned E-UTRA category M1 channel power and adjacent E-UTRA category M1 channel power are measured with rectangular filters with measurement bandwidth specified in Table 6.5A.3.4.3.1-1. If the measured adjacent channel power is greater than –50dBm then the E-UTRA$_{ACLR}$ shall be higher than the valued specified in Table6.5A.3.4.3.1-1.

Table 6.5A.3.4.3.1-1: General requirements for E-UTRA$_{ACLR}$

	Channel bandwidth / E-UTRA$_{ACLR1}$ / measurement bandwidth
	1.4MHz

E-UTRA$_{ACLR1}$	30 dB
E-UTRA channel Measurement bandwidth	1.08 MHz
Adjacent channel centre frequency offset [MHz]	+1.4/-1.4

The normative reference for this requirement is TS 36.102 [11] subclause 6.5A.3.4.

6.5A.3.4.4 Test description

6.5A.3.4.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths based on E-UTRA bands specified in clause 5.2A. All of these configurations shall be tested with applicable test parameters for each channel bandwidth and are shown in table 6.5A3.4.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in AnnexeA.2. Configurations of PDSCH and MPDCCH before measurement are specified in Annex C.2.

Table 6.5A3.4.4.1-1: Test Configuration Table

Test Environment (as specified in TS 36.508 [12] subclause 4.1)			NC, TL/VL, TL/VH, TH/VL, TH/VH	
Test Frequencies (as specified in TS36.508 [12] subclause 4.3.1)			Low range, Mid range, High range	
Test Channel Bandwidths (as specified in TS 36.508 [12] subclause 4.3.1)			1.4MHz	
Test Parameters for Channel Bandwidths				
		Downlink Configuration	**Uplink Configuration**	
Configuration ID	Ch BW	N/A for ACLR test case	Mod'n	RB allocation FDD and HD-FDD
1	1.4MHz		QPSK	2
2	1.4MHz		QPSK	5
3	1.4MHz		QPSK	6
4	1.4MHz		16QAM	2
5	1.4MHz		16QAM	5
Note1: The RBstart of partial RB allocation shall be RB#0 and RB# (6 - RB allocation) of the narrowband.				

Table 6.5A3.4.4.1-2: Test Configuration Table, subPRB allocation

Initial Conditions				
Test Environment as specified in TS 36.508 [12] subclause 4.1			Normal	
Test Frequencies as specified in TS 36.508 [12] subclause 4.3.1			Low range, Mid range, High range	
Test Channel Bandwidths as specified in TS 36.508 [12] subclause 4.3.1			1.4MHz	
Test Parameters for Channel Bandwidths				
		Downlink Configuration	**Uplink Configuration**	
Configuration ID	Ch BW	N/A for Maximum Power Reduction (MPR) test case	Mod'n	RB allocation
				FDD and HD-FDD
1	1.4MHz		QPSK	½ (6 SCs)
Note 1: Denotes the lowest narrowband index in the channel bandwidth where the wideband shall be placed. The allocation is contiguous, starting from the lowest narrowband index. Narrowband, Narrowband index and Wideband are defined in TS 36.211 [3], 5.2.7.				
Note 2: Test Channel Bandwidths are checked separately for each E-UTRA band, the applicable channel bandwidths are specified in Table 5.4.2.1-1.				
Note 3: The SC_{start} shall be SC#0 and SC# (72 – RB allocation) of the narrowband, when RB allocation is defined as #SCs				

1. Connect SS to the UE antenna connectors as shown in TS 36.508[12] Annex A Figure A.3 using only main UE Tx/Rx antenna.
2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C0, C.1 and C.3.0, and uplink signals according to Annex H.1 and H.3.0.
4. The UL Reference Measurement channels are set according to Table 6.5A3.4.4.1-1.
5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 36.508 [12] clause 5.6.1 is provided to the UE through any preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31 information during the duration of the test as define in TS 36.508[12] clause 5.6.3.1
8. Deactivate UE prediction of satellite trajectory by any preconfigured means
9. Ensure the UE is in State 3A-RF-CE according to TS 36.508 [12] clause 5.2A.2AA. Message contents are defined in clause 6.5A.3.4.4.3.
10. For UE supporting subPRB allocation, repeat step 1-6 with UL RMC according to Table 6.5A3.4.4.1-2.

6.5A.3.4.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via MPDCCH DCI format 6-0A for C_RNTI to schedule the UL RMC according to Table 6.5A3.4.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.
2. Send continuously uplink power control "up" commands in the uplink scheduling information to the UE until the UE transmits at PUMAX level.
3. Measure the mean power of the UE in the channel bandwidth of the radio access mode according to the test configuration, which shall meet the requirements described in Table 6.2A.2.4.4-1 to 6.2A.2.4.4-1a. The period of the measurement shall be at least the continuous duration of one sub-frame (1ms). For HD-FDD slots with transient periods and Half-duplex guard subframe are not under test.
4. Measure the rectangular filtered mean power for E-UTRA.

5. Measure the rectangular filtered mean power of the first E-UTRA adjacent channel on both lower and upper side of the E-UTRA channel, respectively.

6. Measure the RRC filtered mean power of the first and the second UTRA adjacent channel on both lower and upper side of the E-UTRA channel, respectively.

7. Calculate the ratios of the power between the values measured in step 4 overstep 5 for lower and upper E-UTRAACLR, respectively.

8. Calculated the ratios of the power between the values measured in step 4 overstep 6 for lower and upper UTRAACLR1, UTRAACLR2, respectively.

6.5A.3.4.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 4.6.

6.5A.3.4.5 Test requirement

6.5A.3.4.5.1 Test requirements E-UTRA

- The measured UE mean power in the channel bandwidth, derived in step 3, shall fulfil requirements in Table 6.2A.2.4.4-1 to 6.2A.2.4.4-1a, as appropriate,

and

- if the measured adjacent channel power is greater than –50 dBm then the measured E-UTRA$_{ACLR}$, derived in step 7, shall be higher than the limits in table 6.5A.3.4.5.1-1.

Table 6.5A.3.4.5.1-1: E-UTRA UE ACLR

	Channel bandwidth / E-UTRA$_{ACLR1}$ / measurement bandwidth
	1.4MHz
E-UTRA$_{ACLR1}$	29.2 dB
E-UTRA channel Measurement bandwidth	1.08 MHz
UE channel	+1.4 MHz or -1.4 MHz

6.5A.4 Spurious emission for category M1

6.5A.4.1 General

Spurious emissions are emissions which are caused by unwanted transmitter effects such as harmonics emission, parasitic emissions, intermodulation products and frequency conversion products, but exclude out of band emissions unless otherwise stated. The spurious emission limits are specified in terms of general requirements inline with SM.329 [9] and E-UTRA operating band requirement to address UE co-existence.

To improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth may be smaller than the measurement bandwidth. When the resolution bandwidth is smaller than the measurement bandwidth, the result should be integrated over the measurement bandwidth in order to obtain the equivalent noise bandwidth of the measurement bandwidth.

6.5A.4.2 Transmitter Spurious emissions for category M1

6.5A.4.2.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to other channels or other systems in terms of transmitter spurious emissions.

6.5A.4.2.2 Test applicability

This test case applies to all types of E-UTRA UE release 13 and forward of UE category M1 that support satellite access operation.

6.5A.4.2.3 Minimum conformance requirements

This clause specifies the requirements for the specified E-UTRA band for Transmitter Spurious emissions requirement with frequency range as indicated in table 6.5A.4.2.3-2.

The spurious emission limits apply for the frequency ranges that are more than Δf_{OOB} (MHz) from the edge of the channel bandwidth.

NOTE: For measurement conditions at the edge of each frequency range, the lowest frequency of the measurement position in each frequency range should be set at the lowest boundary of the frequency range plus MBW/2. The highest frequency of the measurement position in each frequency range should be set at the highest boundary of the frequency range minus MBW/2. MBW denotes the measurement bandwidth defined for the protected band.

Table 6.5A.4.2.3-1: Δf_{OOB} boundary between E-UTRA channel and spurious emission domain

Channel bandwidth	1.4 MHz
Δf_{OOB} (MHz)	2.8

The spurious emission limits in Table 6.5A.4.2.3-2 apply for all transmitter band configurations (RB) and channel bandwidths.

Table 6.5A.4.2.3-2: Spurious emissions limits

Frequency Range	Maximum Level	Measurement bandwidth
9 kHz ≤ f < 150 kHz	-36 dBm	1 kHz
150 kHz ≤ f < 30 MHz	-36 dBm	10 kHz
30 MHz ≤ f < 1000 MHz	-36 dBm	100 kHz
1 GHz ≤ f < 12.75 GHz	-30 dBm	1 MHz

The normative reference for this requirement is TS 36.102 [11] subclause 6.5A.4.2.

6.5A.4.2.4 Test description

6.5A.4.2.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths based on E-UTRA bands specified in clause 5.2A. All of these configurations shall be tested with applicable test parameters for each channel bandwidth and are shown in Table 6.5A.4.2.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexe A.2. Configurations of PDSCH and MPDCCH before measurement are specified in Annex C.2.

Table 6.5A.4.2.4.1-1: Test Configuration Table

Initial Conditions				
Test Environment as specified in TS 36.508[12] subclause 4.1	NC			
Test Frequencies as specified in TS 36.508 [12] subclause 4.3.1	Low range, Mid range, High range			
Test Channel Bandwidths as specified in TS 36.508 [12] subclause 4.3.1	1.4MHz			
Test Parameters for Channel Bandwidths and Narrowband positions				
	Downlink Configuration	**Uplink Configuration**		
Ch BW	N/A	Mod'n	RB allocation	
			FDD and HD-FDD	
Low range, Mid range, High range				
1.4MHz		π/2-BPSK	¼ (Note 3)	
1.4MHz	N/A	QPSK	1	
1.4MHz		QPSK	6	
Note 1: Test Channel Bandwidths are checked separately for each E-UTRA band, the applicable channel bandwidths are specified in Table 5.4.2.1-1. Note 2: The RB_{start} of partial RB allocation shall be RB#0 and RB# (6 - RB allocation) of the narrowband. Note 3: Only applicable for UE supporting subPRB allocation.				

1. Connect SS to the UE antenna connectors as shown in TS 36.508[12] Annex A Figure A.7 using only main UE Tx/Rx antenna.
2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C0, C.1 and C.3.0, and uplink signals according to Annex H.1 and H.3.0.
4. The UL Reference Measurement channels are set according to Table 6.5A.4.2.4.1-1.
5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 36.508 [12] clause 5.6.1 is provided to the UE through any preconfigured means
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31 information during the duration of the test as define in TS 36.508[12] clause 5.6.3.1
8. Deactivate UE prediction of satellite trajectory by any preconfigured means
9. Ensure the UE is in State 3A-RF-CE according to TS 36.508 [12] clause 5.2A.2AA. Message contents are defined in clause 6.5A.4.2.4.3.

6.5A.4.2.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via MPDCCH DCI format 6-0A for C_RNTI to schedule the UL RMC according to Table 6.5A.4.2.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.
2. Send continuously uplink power control "up" commands in the uplink scheduling information to the UE until the UE transmits at P_{UMAX} level.
3. Measure the power of the transmitted signal with a measurement filter of bandwidths according to table 6.5A.4.2.5-1. The centre frequency of the filter shall be stepped in contiguous steps according to table 6.5A.4.2.5-1. The measured power shall be verified for each step. The measurement period shall capture the active time slots. During measurement the spectrum analyser shall be set to 'Detector' = RMS.

6.5A.4.2.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 4.6 with the condition CEmodeA.

6.5A.4.2.5 Test requirement

This clause specifies the requirements for the specified E-UTRA band for Transmitter Spurious emissions requirement with frequency range as indicated in table 6.5A.4.2.5-1.

The measured average power of spurious emission, derived in step 3, shall not exceed the described value in Table 6.5A.4.2.5-1.

The spurious emission limits apply for the frequency ranges that are more than Δf_{OOB} (MHz) from the edge of the channel bandwidth shown in Table 6.5A.4.2.3-1.

NOTE: For measurement conditions at the edge of each frequency range, the lowest frequency of the measurement position in each frequency range should be set at the lowest boundary of the frequency range plus MBW/2. The highest frequency of the measurement position in each frequency range should be set at the highest boundary of the frequency range minus MBW/2. MBW denotes the measurement bandwidth defined for the protected band.

Table 6.5A.4.2.5-1: General spurious emissions test requirements

Frequency Range	Maximum Level	Measurement Bandwidth	Notes
9 kHz ≤ f < 150 kHz	-36 dBm	1 kHz	
150 kHz ≤ f < 30 MHz	-36 dBm	10 kHz	
30 MHz ≤ f < 1000 MHz	-36 dBm	100 kHz	
1 GHz ≤ f < 12.75 GHz	-30 dBm	1 MHz	

6.5A.4.3 Spurious emission band UE co-existence for category M1

6.5A.4.3.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to co-existing systems for the specified bands which has specific requirements in terms of transmitter spurious emissions.

6.5A.4.3.2 Test applicability

This test case applies to all types of E-UTRA UE release 17 and forward of UE category M1 that support satellite access operation.

6.5A.4.3.3 Minimum conformance requirements

This clause specifies the requirements for E-UTRA satellite bands for UE coexistence with protected bands.

Table 6.5A.4.3.3-1: Requirements for spurious emissions for UE co-existence

E-UTRA Band	Spurious emission				
	Protected band	Frequency range (MHz)	Maximum Level (dBm)	MBW (MHz)	NOTE

253	E-UTRA Band 5, 26, 31, 41, 48, 72 NR Band n1, n3, n7, n8, n18, n20, n28, n34, n38, n39, n40, n50, n51, n65, n67, n74, n75, n76, n79, n91, n92, n93, n94, n105, n109	F_{DL_low}	-	F_{DL_high}	-50	1	
	NR Band n77, n78	F_{DL_low}	-	F_{DL_high}	-50	1	2
254	E-UTRA Band 2, 4, 5, 12, 13, 14, 17, 24, 25, 26, 29, 30, 31, 41, 48, 54, 66, 70, 71, 72, 85, 87, 88, 103 NR Band n1, n3, n7, n8, n18, n20, n28, n34, n38, n39, n40, n50, n51, n53, n65, n67, n74, n75, n76, n77, n78, n90, n91, n92, n93, n94, n105, n106, n109	F_{DL_low}	-	F_{DL_high}	-50	1	
	NR Band n79	F_{DL_low}	-	F_{DL_high}	-50	1	2
255	E-UTRA Band 2, 4, 5, 12, 13, 14, 17, 24, 25, 26, 29, 30, 41, 48, 66, 70, 71, 85, 103 NR Band n1, n3, n7, n8, n18, n20, n28, n34, n38, n39, n40, n50, n51, n53, n65, n67, n74, n75, n76, n90, n91, n92, n93, n94, n105, n106, n109	F_{DL_low}	-	F_{DL_high}	-50	1	
	NR Band n77, n78, n79	F_{DL_low}	-	F_{DL_high}	-50	1	2
256	E-UTRA Band 1, 3, 5,7, 8, 11, 18, 19, 20, 21, 22, 26, 27, 28, 31, 33, 32, 35, 38, 40, 41, 42, 43, 50, 51, 54, 65, 68, 69, 72, 74, 75, 76, 87, 88 NR Band n12, n13, n14, n24, n29, n30, n39, n48, n53, n66, n67, n71, n78, n79, n85, n90, n91, n92, n93, n94, n101, n105, n106, n109	F_{DL_low}	-	F_{DL_high}	-50	1	
	NR Band n77	F_{DL_low}	-	F_{DL_high}	-50	1	2
	NR Band n2, n25, n70	F_{DL_low}	-	F_{DL_high}	NA	NA	3
NOTE 1: F_{DL_low} and F_{DL_high} refer to each E-UTRA frequency band specified in Table 5.4A.2-1 NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5A.4.2-2 are permitted for each assigned E-UTRA carrier used in the measurement due to 2nd, 3rd, 4th [or 5th] harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2MHz + N x L_{CRB} x 180kHz), where N is 2, 3, 4, [5] for the 2nd, 3rd, 4th [or 5th] harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval. NOTE 3: The co-existence between 256 and band 2, 25 and 70 is subject to regional/national regulation.							

NOTE: To simplify Table 6.5A.4.3-1, E-UTRA band numbers are listed for bands which are specified only for E-UTRA operation or both E-UTRA and NR operation. NR band numbers are listed for bands which are specified only for NR operation.

The normative reference for this requirement is TS 36.102 [11] subclause 6.5A.4.3.

6.5A.4.3.4 Test description

6.5A.4.3.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths based on E-UTRA bands specified in clause 5.2A. All of these configurations shall be tested with applicable test parameters for each channel bandwidth, and are shown in Table 6.5A.4.3.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexe A.2. Configurations of PDSCH and MPDCCH before measurement are specified in Annex C.2.

Table 6.5A.4.3.4.1-1: Test Configuration Table

Initial Conditions				
Test Environment (as specified in TS 36.508 [12] subclause 4.1)			NC	
Test Frequencies (as specified in TS36.508 [12] subclause 4.3.1) (Note 6, Note 7)			Low range, Mid range, High range	
Test Channel Bandwidths (as specified in TS 36.508 [12] subclause 4.3.1)			1.4MHz	
Test Parameters for Channel Bandwidths				
	Downlink Configuration		**Uplink Configuration**	
Ch BW	Mod'n	RB allocation	Mod'n	RB allocation
		FDD		FDD
1.4MHz	N/A for Spurious Emissions testing		QPSK	6@0
1.4MHz			QPSK	1@0
1.4MHz			QPSK	1@5

1. Connect the SS to the UE antenna connectors as shown in TS 36.508[12] Annex A Figure A.7 using only main UE Tx/Rx antenna.
2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C0, C.1 and C.3.0, and uplink signals according to Annex H.1 and H.3.0.
4. The UL Reference Measurement channels are set according to Table 6.5A.4.3.4.1-1.
5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 36.508 [12] clause 5.6.1 is provided to the UE through any preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31 information during the duration of the test as define in TS 36.508[12] clause 5.6.3.1
8. Deactivate UE prediction of satellite trajectory by any preconfigured means
9. Ensure the UE is in State 3A-RF-CE according to TS 36.508 [12] clause 5.2A.2AA. Message contents are defined in clause 6.5A.4.3.4.3.

6.5A.4.3.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via MPDCCH DCI format 6-0A for C_RNTI to schedule the UL RMC according to Table 6.5A.4.3.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.
2. Send continuously uplink power control "up" commands in the uplink scheduling information to the UE until the UE transmits at PUMAX level.
3. Measure the power of the transmitted signal with a measurement filter of bandwidths according to table 6.5A.4.3.3-1. The centre frequency of the filter shall be stepped in contiguous steps according to table 6.5A.4.3.3-1. The measured power shall be verified for each step. The measurement period shall capture the active time slots. During measurement the spectrum analyser shall be set to 'Detector' = RMS.

6.5A.4.3.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 4.6 with the condition CEModeA.

6.5A.4.3.5 Test requirement

Test requirements for Spurious Emissions UE Co-existence are the same as the minimum requirements and are not repeated in this section.

The measured average power of spurious emission, derived in step 3, shall not exceed the described value in table 6.5A.4.3.3-1

6.5A.4.4 Additional spurious emissions for category M1

6.5A.4.4.0 General

These requirements are specified in terms of an additional spectrum emission requirement. Additional spurious emission requirements are signalled by the network to indicate that the UE shall meet an additional requirement for a specific deployment scenario as part of the cell handover/broadcast message.

NOTE: In addition to the requirements below, additional UE region-specific emissions requirements for European are expected to be added once more information becomes available.

6.5A.4.4.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to other channels or other systems in terms of transmitter spurious emissions under the deployment scenarios where additional requirements are specified.

6.5A.4.4.2 Test applicability

This test case applies to all types of E-UTRA UE release 13 and forward of UE category M1 that support satellite access operation.

6.5A.4.4.3 Minimum conformance requirements

These requirements are specified in terms of an additional spectrum emission requirement. Additional spurious emission requirements are signalled by the network to indicate that the UE shall meet an additional requirement for a specific deployment scenario as part of the cell handover/broadcast message.

NOTE: For measurement conditions at the edge of each frequency range, the lowest frequency of the measurement position in each frequency range should be set at the lowest boundary of the frequency range plus MBW/2. The highest frequency of the measurement position in each frequency range should be set at the highest boundary of the frequency range minus MBW/2. MBW denotes the measurement bandwidth defined for the protected band.

6.5A.4.4.3.1 Minimum requirement (network signalled value "NS_02N")

When "NS_02N" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.5A.4.4.3.1-1. This requirement also applies for the frequency ranges that are less than F_{OOB} (MHz) in Table 6.5A.4.2.3-1 from the edge of the channel bandwidth. Network signalling remark NS_02N applies integer-value 2.

Table 6.5A.4.4.3.1-1: Additional requirements for "NS_02N"

Frequency band (MHz)	Channel bandwidth / Spectrum emission limit[1] (dBm)	Measurement bandwidth	NOTE
	1.4MHz		
1559≤ f ≤ 1605	-50	700 Hz	Averaged over any 2 millisecond active transmission interval
1605≤ f ≤ 1610	-50 + 24/5 (f-1605)	700Hz	
1559 ≤ f ≤ 1605	-40	1MHz	Averaged over any 2 millisecond active transmission interval
1605≤ f ≤ 1610	-40 + 24/5 (f-1605)	1MHz	
NOTE: The EIRP requirement in regulation is converted to conducted requirement using a 0 dBi antenna.			

Table 6.5A.4.4.3.1-2: Additional requirements for "NS_02N"

Δf_{OOB} (MHz)	Spectrum Emission Limit (dBm)	Measurement bandwidth
±0 – 0.7	-2 for PC3 -5 for PC5	4 kHz
±0.7 – 2.8	-12 for PC3 -15 for PC5	4 kHz
±>2.8	-13 for PC3 and PC5	4 kHz

The normative reference for this requirement is TS 36.102[11] subclause 6.5A.4.4.2.

6.5A.4.4.3.2 Minimum requirement (network signalled value "NS_24")

When "NS_24" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.5A.4.4.3.2-1.

Table 6.5A.4.4.3.2-1: Additional requirements for "NS_24"

Frequency band (MHz)	Channel bandwidth / Spectrum emission limit (dBm)	Measurement bandwidth
	1.4MHz	
Band 34	-50	MHz
NOTE 1: This requirement applies at a frequency offset equal or larger than 5 MHz from the upper edge of the channel bandwidth, whenever these frequencies overlap with the specified frequency band.		

The normative reference for this requirement is TS 36.102[11] subclause 6.5A.4.4.3.

6.5A.4.4.3.3 Minimum requirement (network signalled value "NS_03N")

When "NS_03N" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.5A.4.4.3.3-1 where BWchannel equals to 1.4MHz. This requirement also applies for the frequency ranges that are less than F_{OOB} (MHz) in Table 6.5A.4.2.3-1 from the edge of the channel bandwidth.

Table 6.5.4.4.3.3-1: Additional out-of-band requirements for "NS_03N"

Frequency band (MHz)	Channel bandwidth / Spectrum emission limit[1] (dBm)	Measurement bandwidth	NOTE
	BWchannel		
1559 ≤ f ≤ 1605	-50	700 Hz	Discreet emissions averaged over any 2 millisecond active transmission interval
1605 ≤ f ≤ 1610	-50 + 60/5 (f-1605)	700 Hz	
1559 ≤ f ≤ 1605	-40	1MHz	Averaged over any 2 millisecond active transmission interval
1605 ≤ f ≤ 1610	-40 + 60/5 (f-1605)	1MHz	
NOTE: The EIRP requirement in regulation is converted to conducted requirement using a 0dBi antenna.			

Table 6.5A.4.4.3.3-2: Additional requirements for "NS_03N"

Δf_{OOB} (MHz)	Spectrum Emission Limit (dBm)	Measurement bandwidth
±0 – 0.7	-2 for PC3 -5 for PC5	4 kHz
±0.7 – 2.8	-12 for PC3 -15 for PC5	4 kHz
±>2.8	-13 for PC3 and PC5	4 kHz

The normative reference for this requirement is TS 36.102[11] subclause 6.5A.4.4.4.

6.5A.4.4.3.4 Minimum requirement (network signalled value "NS_04N")

When "NS_04N" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.5A.4.4.3.4-1 where BWchannel equals to 1.4MHz. This requirement also applies for the frequency ranges that are less than F_{OOB} (MHz) in Table 6.5A.4.2.3-1 from the edge of the channel bandwidth.

Table 6.5A.4.4.3.4-1: Additional out-of-band requirements for "NS_04N"

Frequency band (MHz)	Channel bandwidth / Spectrum emission limit[1] (dBm)	Measurement bandwidth	NOTE
	BWchannel		
1559 ≤ f ≤ 1605	-40	1MHz	Averaged over any 2 millisecond active transmission interval
1605 ≤ f ≤ 1610	-40 + 60/5 (f-1605)	1MHz	
1628.5 ≤ f ≤ 1631.5	-30	30kHz	
1631.5 ≤ f ≤ 1636.5	-30	100kHz	
1636.5 ≤ f ≤ 1646.5	-30	300kHz	
1646.5 ≤ f ≤ 1666.5	-30	1MHz	
1666.5 ≤ f ≤ 2200	-30	3MHz	
NOTE: The EIRP requirement in regulation is converted to conducted requirement using a 0dBi antenna.			

When "NS_04N" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.5A.4.4.3.4-2 for any carrier configured within 1610-1618.25MHz.

Table 6.5A.4.4.3.4-2: Additional in-band requirements for "NS_04N"

Δf_{OOB} (kHz)	Spectrum emission limit (dBm)	Measurement bandwidth
± 0-160	-2	30kHz
± 160-2300	-2 to -26	
± 2300-18500	-26	
NOTE: Spectrum emissions are linearly interpolated in dBm versus frequency offset.		

The normative reference for this requirement is TS 36.102[11] subclause 6.5A.4.4.5.

6.5A.4.4.3.5 Minimum requirement (network signalled value "NS_05N")

When "NS_05N" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in 6.5A.4.4.3.4-1 where BWchannel equals to 1.4MHz. This requirement also applies for the frequency ranges that are less than F_{OOB} (MHz) in Table 6.5A.4.2.3-1 from the edge of the channel bandwidth.

When "NS_05N" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.5A.4.4.3.5-2 for any carrier configured within 1618.25-1626.5MHz.

Table 6.5A.4.4.3.5-1: Void

Table 6.5A.4.4.3.5-2: Additional in-band requirements for "NS_05N"

Δf_{OOB} (kHz)	Spectrum emission limit (dBm)	Measurement bandwidth
± 0-160	-5	30kHz
± 160-225	-5 to -8.5	
± 225-650	-8.5 to -15	
± 650-1365	-15	
± 1365-1800	-23 to -26	
± 1800-16500	-26	
NOTE: Spectrum emissions are linearly interpolated in dBm versus frequency offset.		

The normative reference for this requirement is TS 36.102[11] subclause 6.5A.4.4.6.

6.5A.4.4.4 Test description

6.5A.4.4.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths based on E-UTRA bands specified in clause 5.2A. All of these configurations shall be tested with applicable test parameters for each channel bandwidth and are shown in Table 6.5A.4.4.4.1-1 to Table 6.5A.4.4.4.1-2a. The details of the uplink reference measurement channels (RMCs) are specified in Annexe A.2. Configurations of PDSCH and MPDCCH before measurement are specified in Annex C.2.

Table 6.5A.4.4.4.1-1: Test Configuration Table (network signalled value "NS_02N, NS_03N, NS_04N, NS_05N")

Initial Conditions				
Test Environment as specified in TS 36.508[12] subclause 4.1			Normal	
Test Frequencies as specified in TS 36.508 [12] subclause 4.3.1			Low range, Mid range, High range	
Test Channel Bandwidths as specified in TS 36.508 [12] subclause 4.3.1			1.4 MHz	
Test Parameters for Channel Bandwidths				
		Downlink Configuration	**Uplink Configuration**	
Configuration ID	**Ch BW**	N/A	**Mod'n**	**RB allocation**
				FDD and HD-FDD
1	1.4 MHz		QPSK	2
2	1.4 MHz		QPSK	5
3	1.4 MHz		QPSK	6
Note 1: The RB_{start} of partial RB allocation shall be RB#0.				

Table 6.5A.4.4.4.1-1a: Test Configuration Table, subPRB allocation (network signalled value "NS_02N, NS_03N, NS_04N, NS_05N")

Initial Conditions				
Test Environment as specified in TS 36.508 [12] subclause 4.1			Normal	
Test Frequencies as specified in TS 36.508 [12] subclause 4.3.1			Low Range, Mid range, High Range	
Test Channel Bandwidths as specified in TS 36.508 [12] subclause 4.3.1			1.4MHz	
Test Parameters for Channel Bandwidths				
		Downlink Configuration	**Uplink Configuration**	
Configuration ID	**Ch BW**	N/A	**Mod'n**	**RB allocation**
				FDD and HD-FDD

1	1.4 MHz		QPSK	½
Note 1: the SC_{start} shall be 0.				

Table 6.5A.4.4.4.1-2: Test Configuration Table (network signalled value "NS_24")

Initial Conditions				
Test Environment as specified in TS 36.508[12] subclause 4.1		Normal		
Test Frequencies as specified in TS 36.508 [12] subclause 4.3.1		Low range, Mid range, High range		
Test Channel Bandwidths as specified in TS 36.508 [12] subclause 4.3.1		1.4 MHz		
Test Parameters for Channel Bandwidths				
		Downlink Configuration	**Uplink Configuration**	
Configuration ID	**Ch BW**		**Mod'n**	**RB allocation**
				FDD and HD-FDD
1	1.4 MHz	N/A	QPSK	2
2	1.4 MHz		QPSK	5
3	1.4 MHz		QPSK	6
Note 1: The RB_{start} of partial RB allocation shall be RB#0.				

Table 6.5A.4.4.4.1-2a: Test Configuration Table, subPRB allocation (network signalled value "NS_24")

Initial Conditions				
Test Environment as specified in TS 36.508 [12] subclause 4.1		Normal		
Test Frequencies as specified in TS 36.508 [12] subclause 4.3.1		Low Range, Mid range, High Range		
Test Channel Bandwidths as specified in TS 36.508 [12] subclause 4.3.1		1.4MHz		
Test Parameters for Channel Bandwidths				
		Downlink Configuration	**Uplink Configuration**	
Configuration ID	**Ch BW**	N/A	**Mod'n**	**RB allocation**
				FDD and HD-FDD
1	1.4MHz		QPSK	½
Note 1: the SC_{start} shall be 0.				

1. Connect SS to the UE antenna connectors as shown in TS 36.508[12] Annex A Figure A.7 using only main UE Tx/Rx antenna.

2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C0, C.1 and C.3.0, and uplink signals according to Annex H.1 and H.3.0.

4. The UL Reference Measurement channels are set according to Table 6.5A.4.4.4.1-1 to Table 6.5A.4.4.4.1-2a.

5. Propagation conditions are set according to Annex B.0.

6. UE location according to TS 36.508 [12] clause 5.6.1 is provided to the UE through any preconfigured means.

7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31 information during the duration of the test as define in TS 36.508[12] clause 5.6.3.1

8. Deactivate UE prediction of satellite trajectory by any preconfigured means

9. Ensure the UE is in State 3A-RF-CE according to TS 36.508 [12] clause 5.2A.2AA. Message contents are defined in clause 6.5A.4.4.4.3.

6.5A.4.4.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via MPDCCH DCI format 6-0A for C_RNTI to schedule the UL RMC according to Table 6.5A.4.4.4.1-1 to Table 6.5A.4.4.4.1-2a depending on NS-value. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC

2. Send continuously uplink power control "up" commands in the uplink scheduling information to the UE to ensure that the UE transmits at PUMAX level.

3. Measure the mean power of the UE in the channel bandwidth of the radio access mode according to the test configuration, which shall meet the requirements described in Tables 6.2A.3.5-1 to 6.2A.3.5-2a as appropriate. The period of measurement shall be at least the continuous duration one sub-frame (1ms). For HD-FDD slots with transient periods and Half-duplex guard subframe are not under test.

4. Measure the power of the transmitted signal with a measurement filter of bandwidths according to Table 6.5A.4.4.3.1-1 to 6.5A.4.4.3.2-1 as appropriate. The centre frequency of the filter shall be stepped in contiguous steps according to the same table. The measured power shall be verified for each step. The measurement period shall capture the active time slots. During measurement the spectrum analyser shall be set to 'Detector' = RMS.

6.5A.4.4.4.3 Message contents

Message contents are same as in clause 6.2A.3.4.3.

6.5A.4.4.5 Test requirement

The measured UE mean power in the channel bandwidth, derived in step 3, shall fulfil requirements in Tables 6.2A.3.5-1 to 6.2A.3.5-2a as appropriate,

Test requirements for Additional Spurious Emissions are the same as the minimum requirements and are not repeated in this section.

6.5B Output RF spectrum emissions for category NB1 and NB2

6.5B.1 General

The definitions in clause 6.5 shall apply.

6.5B.2 Occupied bandwidth for category NB1 and NB2

6.5B.2.1 Test purpose

To verify that the UE occupied bandwidth for all transmission bandwidth configurations supported by the UE are less than their specific limits.

6.5B.2.2 Test applicability

This test case applies to all types of NB-IoT UE release 17 and forward of category NB1 and NB2 that support satellite access operation.

6.5B.2.3 Minimum conformance requirements

The occupied bandwidth is defined as the bandwidth containing 99 % of the total integrated mean power of the transmitted spectrum on the assigned channel at the transmit antenna connector. Occupied bandwidth shall be less than the channel bandwidth of category NB1 and NB2 that is 200 kHz.

The normative reference for this requirement is TS 36.102[11] clause 6.5B.2.

6.5B.2.4 Test description

6.5B.2.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths based on NB-IOT NTN operating bands specified in sub-clause 5.2B. All of these configurations shall be tested with applicable test parameters shown in table 6.5B.2.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annex A.2.4. Configurations of NPDSCH and NPDCCH before measurement are specified in Annex C.2.

Table 6.5B.2.4.1-1: Test Configuration Table for FDD

Initial Conditions				
Test Environment as specified in TS 36.508[12] subclause 8.1.1		Normal		
Test Frequencies as specified in TS 36.508[12] subclause 8.1.3.1		Frequency ranges defined in Annex K.1.1		
Test Parameters				
Configuration ID	**Downlink Configuration**	**Uplink Configuration**		
	N/A	Modulation	N_{tones}	Sub-carrier spacing (kHz)
1		QPSK	1@0	3.75kHz
2		QPSK	1@0	15kHz
3 (Note 1)		QPSK	12@0	15kHz
Note 1: Applicable to UE supporting UL multi-tone transmissions				

1. Connect the SS to the UE antenna connectors as shown in TS 36.508 [12]Annex A, Figure A.3 using only main Tx/Rx antenna.

2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 8.1.4.3.

3. Downlink signals are initially set up according to Annex C0, C.1 and C.3.0, and uplink signals according to Annex H.1 and H.4.0

4. The UL Reference Measurement channels are set according to Table 6.5B.2.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. UE location according to TS 36.508 [12] clause 8.2.6.1 is provided to the UE through any preconfigured means

7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 8.2.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 8.2.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31-NB information during the duration of the test as define in TS 36.508[12] clause 8.2.6.3.1

8. Deactivate UE prediction of satellite trajectory by any preconfigured means

9. Ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5. Message contents are defined in clause 6.5B.2.4.3.

6.5B.2.4.2 Test procedure

1. SS sends uplink scheduling information via NPDCCH DCI format N0 for C_RNTI to schedule the UL RMC according to Table 6.5B.2.4.1-1.Since the UE has no payload and no loopback data to send, the UE sends uplink MAC padding bits on the UL RMC. (UE should be already transmitting P_{UMAX} after Initial Conditions setting).

2. Measure the power spectrum distribution within two times or more range over the requirement for Occupied Bandwidth specification centring on the current carrier frequency. The characteristic of the filter shall be approximately Gaussian (typical spectrum analyzer filter). Other methods to measure the power spectrum distribution are allowed. The measurement duration is at least one sub-frame **(**1ms) for 15 KHz channel spacing, and at least a 2ms slot (excluding the 2304Ts gap when UE is not transmitting) respectively for the 3.75 KHz channel spacing.

3. Calculate the total power within the range of all frequencies measured in '2)' and save this value as "Total Power".

4. Sum up the power upward from the lower boundary of the measured frequency range in '2)' and seek the limit frequency point by which this sum becomes 0,5 % of "Total Power" and save this point as "Lower Frequency".

5. Sum up the power downward from the upper boundary of the measured frequency range in '2)' and seek the limit frequency point by which this sum becomes 0,5 % of "Total Power" and save this point as "Upper Frequency".

6. Calculate the difference ("Upper Frequency " – "Lower Frequency" = "Occupied Bandwidth") using the limit frequencies obtained in '4)' or '5)'.

NOTE 1: For configuration IDs applicable to UE depending on UE capability in Test Configuration Table with different UL sub-carrier spacing, the SS shall release the connection through State 3A-NB and finally ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5 using the appropriate UL subcarrier spacing in Random Access Response message.

6.5B.2.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 8.1.6.

6.5B.2.5 Test requirement

The measured Occupied Bandwidth shall not exceed 200kHz.

6.5B.3 Out of band emission for category NB1 and NB2

6.5B.3.1 General

The out of band emissions are unwanted emissions immediately outside the assigned channel bandwidth resulting from the modulation process and non-linearity in the transmitter but excluding spurious emissions. This out of band emission limit is specified in terms of a spectrum emission mask and an Adjacent Channel Leakage power Ratio.

6.5B.3.2 Spectrum emission mask for category NB1 and NB2

6.5B.3.2.1 Test purpose

To verify that the power of the category NB1 and NB2 UE emission shall not exceed specified level for the specified channel bandwidth.

6.5B.3.2.2 Test applicability

This test case applies to all types of NB-IoT UE release 17 and forward of category NB1 and NB2 that support satellite access operation.

6.5B.3.2.3 Minimum conformance requirements

The spectrum emission mask of the category NB1 and NB2 UE applies to frequencies (Δf_{OOB}) starting from the ± edge of the assigned category NB1 or NB2 channel bandwidth. For frequencies greater than (Δf_{OOB}) as specified in Table 6. 5B.3.2.3-1 the spurious requirements in TS 36.521-1[14] sub-clause 6.6.3 are applicable.

The power of any category NB1 or NB2 UE emission shall not exceed the levels specified in Table 6.5B.3.2.3-1. The spectrum emission limit between each Δf_{OOB} is linearly interpolated.

Table 6.5B.3.2.3-1: category NB1 and NB2 UE spectrum emission mask

Δf_{OOB} (kHz)	Emission limit (dBm)	Measurement bandwidth
± 0	26	30 kHz
± 100	-5	30 kHz
± 150	-8	30 kHz
± 300	-29	30 kHz
± 500-1700	-35	30 kHz

In addition to the spectrum emission mask requirement in Table 6.5B.3.2.3-1 a category NB1 or NB2 UE shall also meet the applicable E-UTRA spectrum emission mask requirement in TS 36.521-1[14] sub-clause 6.6.2. E-UTRA spectrum emission requirement applies for frequencies that are Foffset away from edge of NB1 or NB2 channel edge as defined in Table 6.5B.3.2.3-2.

Table 6.5B.3.2.3-2: Foffset for category NB1 and NB2 UE spectrum emission mask

Channel BW (MHz)	Foffset [kHz]
1.4	165
3	190
5	200
10	225
15	240
20	245

NOTE: Foffset in Table 6.5B.3.2.3-2 is used to guarantee co-existence for guard-band operation.

The normative reference for this requirement is TS 36.102[11] clause 6.5B.3.2.

6.5B.3.2.4 Test description

6.5B.3.2.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths based on NB-IOT NTN operating bands specified in sub-clause 5.2B.All of these configurations shall be tested with applicable test parameters shown in table 6.5B.3.2.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of NPDSCH and NPDCCH before measurement are specified in Annex C.2.

Table 6.5B.3.2.4.1-1: Test Configuration Table for FDD

Initial Conditions				
Test Environment as specified in TS 36.508[12] subclause 8.1.1		Normal		
Test Frequencies as specified in TS 36.508[12] subclause 8.1.3.1		Frequency ranges defined in Annex K.1.2		
Test Parameters				
Configuration ID	**Downlink Configuration**	**Uplink Configuration**		
		Modulation	N_{tones}	Sub-carrier spacing (kHz)
1	N/A	QPSK	1@0	3.75kHz
2		QPSK	1@47	3.75kHz
3		QPSK	1@0	15kHz
4		QPSK	1@11	15kHz
5 (Note 1)		QPSK	3@0	15kHz
6 (Note 1)		QPSK	3@3	15kHz
7 (Note 1)		QPSK	3@9	15kHz
8 (Note 1)		QPSK	6@0	15kHz
9 (Note 1)		QPSK	6@6	15kHz
10 (Note 1)		QPSK	12@0	15kHz
Note 1: The allowed MPR for maximum output power UE might apply is described in clause [6.2B.2.3].				

1. Connect the SS to the UE antenna connectors as shown in Figure TS 36.508 [12] Annex A, Figure A.3 using only main Tx/Rx antenna.

2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 8.1.4.3.

3. Downlink signals are initially set up according to Annex C0, C.1 and C.3.0, and uplink signals according to Annex H.1.1 and H.4.0.

4. The UL Reference Measurement channels are set according to Table 6.5B.3.2.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. UE location according to TS 36.508 [12] clause 8.2.6.1 is provided to the UE through any preconfigured means.

7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 8.2.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 8.2.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31-NB information during the duration of the test as define in TS 36.508[12] clause 8.2.6.3.1

8. Deactivate UE prediction of satellite trajectory by any preconfigured means

9. Ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5. Message contents are defined in clause 6.5B.3.2.4.3.

6.5B.3.2.4.2 Test procedure

1. SS sends uplink scheduling information via NPDCCH DCI format N0 for C_RNTI to schedule the UL RMC according to Table 6.5B.3.2.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC. (UE should be already transmitting P_{UMAX} after Initial Conditions setting).

2. Measure the mean power of the UE in the channel bandwidth of the radio access mode according to the test configuration, which shall meet the requirements described in Table 6.2B.2.4-1. The measurement duration is at least one sub-frame **(**1ms) for 15 KHz channel spacing, and at least a 2ms slot (excluding the 2304Ts gap when UE is not transmitting) respectively for the 3.75 KHz channel spacing.

3. Measure the power of the transmitted signal with a measurement filter of bandwidths according to table 6.5B.3.2.5-1 as applicable. The centre frequency of the filter shall be stepped in continuous steps according to the same table. The measured power shall be recorded for each step. The measurement period shall capture the active TSs.

NOTE 1: For configuration IDs applicable to UE depending on UE capability in Test Configuration Table with different UL sub-carrier spacing, the SS shall release the connection through State 3A-NB and finally ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5 using the appropriate UL subcarrier spacing in Random Access Response message.

6.5B.3.2.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 8.1.6.

6.5B.3.2.5 Test requirements

The measured UE mean power in the channel bandwidth, derived in step 3, shall fulfil requirements in Table 6.2B.2.4-1 as appropriate, and the power of any UE emission shall fulfil requirements in 6.5B.3.2.5-1 as applicable.

Table 6.5B.3.2.5-1: category NB1 and NB2 UE spectrum emission mask, category NB1/NB2 bands ≤ 3GHz

Δf_{OOB} (kHz)	Spectrum emission limit (dBm)	Measurement bandwidth
0 -100	$(27.5 + (F - 0) \times \frac{-3.5 - 27.5}{100 - 0})$	30 kHz
100 - 150	$(-3.5 + (F - 100) \times \frac{-6.5 - (-3.5)}{150 - 100})$	30 kHz
150 - 300	$(-6.5 + (F - 150) \times \frac{-27.5 - (-6.5)}{300 - 150})$	30 kHz
300 - 500	$(-27.5 + (F - 300) \times \frac{-33.5 - (-27.5)}{500 - 300})$	30 kHz
500 - 1700	-33.5	30 kHz
Note 1: The limit shall be calculated for the measurement frequency F given in kHz, cantered in the measurement bandwidth. Note 2: At the boundary of spectrum emission limit, the first and last measurement position with a 30 kHz filter is the inside of +15 kHz and -15 kHz, respectively. The filter shall be stepped to cover the whole range.		

NOTE 1: As a general rule, the resolution bandwidth of the measuring equipment should be equal to the measurement bandwidth. However, to improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth may be smaller than the measurement bandwidth. When the resolution bandwidth is smaller than the measurement bandwidth, the result should be integrated over the measurement bandwidth in order to obtain the equivalent noise bandwidth of the measurement bandwidth.

NOTE 2: The minimum requirements in clause 6.5B.3.2.3 have been combined into table 6.5B.3.2.5-1 to reduce testing complexity and test time.

6.5B.3.3 Additional Spectrum Emission Mask for category NB1 and NB2

The additional spectrum emission mask for category NB1 and NB2 is not applicable.

6.5B.3.4 Adjacent Channel Leakage Ratio for category NB1 and NB2

6.5B.3.4.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to adjacent channels in terms of Adjacent Channel Leakage power Ratio (ACLR).

6.5B.3.4.2 Test applicability

This test case applies to all types of NB-IoT UE release 17 and forward of category NB1 and NB2 that support satellite access operation.

6.5B.3.4.3 Minimum conformance requirements

Adjacent Channel Leakage power Ratio is the ratio of the filtered mean power centred on the assigned channel frequency to the filtered mean power centred on an adjacent channel frequency. The assigned category NB1 or NB2 channel power and adjacent channel power are measured with filters and measurement bandwidths specified in Table 6.5B.3.4-1. If the measured adjacent channel power is greater than –50dBm then the category NB1 or NB2 UE ACLR shall be higher than the value specified in Table 6.5B.3.4-1. GSM_{ACLR} requirement is intended for protection of GSM system. $UTRA_{ACLR}$ requirement is intended for protection of UTRA and E-UTRA systems.

Table 6.5B.3.4-1: category NB1 and NB2 UE ACLR requirements

	GSM_{ACLR}	**$UTRA_{ACLR}$**
ACLR	20 dB	37 dB
Adjacent channel centre frequency offset from category NB1 or NB2 Channel edge	±200 kHz	±2.5 MHz
Adjacent channel measurement bandwidth	180 kHz	3.84 MHz
Measurement filter	Rectangular	RRC-filter α=0.22
Category NB1 and NB2 channel measurement bandwidth	180 kHz	180 kHz
Category NB1 and NB2 channel Measurement filter	Rectangular	Rectangular

The normative reference for this requirement is TS 36.102[11] subclause 6.5B.3.4.

6.5B.3.4.4 Test description

6.5B.3.4.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths based on NB-IOT NTN operating bands specified in sub-clause 5.2B. All of these configurations shall be tested with applicable test parameters shown in table 6.5B.3.4.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annex A.2.4. Configurations of NPDSCH and NPDCCH before measurement are specified in Annex C.2.

Table 6.5B.3.4.4.1-1: Test Configuration Table for FDD

Initial Conditions				
Test Environment as specified in TS 36.508[12] subclause 8.1.1		NC, TL/VL, TL/VH, TH/VL, TH/VH		
Test Frequencies as specified in TS 36.508[12] subclause 8.1.3.1		Frequency ranges defined in Annex K.1.2		
Test Parameters				
Configuration ID	**Downlink Configuration**	**Uplink Configuration**		
		Modulation	N_{tones}	Sub-carrier spacing (kHz)
1	N/A	QPSK	1@0	3.75kHz
2		QPSK	1@47	3.75kHz
3		QPSK	1@0	15kHz
4		QPSK	1@11	15kHz
5 (Note 1)		QPSK	3@0	15kHz
6 (Note 1)		QPSK	3@3	15kHz
7 (Note 1)		QPSK	3@9	15kHz
8 (Note 1)		QPSK	6@0	15kHz
9 (Note 1)		QPSK	6@6	15kHz
10 (Note 1)		QPSK	12@0	15kHz
Note 1: Applicable to UE supporting UL multi-tone transmissions				

1. Connect the SS to the UE antenna connectors as shown in Figure TS 36.508 [12] Annex A, Figure A.3 using only main Tx/Rx antenna.

2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 8.1.4.3.

3. Downlink signals are initially set up according to Annex C0, C.1 and C.3.0, and uplink signals according to Annex H.1.1 and H.4.0.

4. The UL Reference Measurement channels are set according to Table 6.5B.3.4.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. UE location according to TS 36.508 [12] clause 8.2.6.1 is provided to the UE through any preconfigured means.

7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 8.2.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 8.2.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31-NB information during the duration of the test as define in TS 36.508[12] clause 8.2.6.3.1

8. Deactivate UE prediction of satellite trajectory by any preconfigured means

9. Ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5. Message contents are defined in clause 6.5B.3.4.4.3.

6.5B.3.4.4.2 Test procedure

1. SS sends uplink scheduling information for the UL HARQ process via NPDCCH DCI format N0 for C_RNTI to schedule the UL RMC according to Table 6.5B.3.4.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC. (UE should be already transmitting P_{UMAX} after Initial Conditions setting).

2. Measure the mean power of the UE in the channel bandwidth of the radio access mode according to the test configuration, which shall meet the requirements described in Table 6.2B.2.4-1. The measurement period is at least one sub-frame **(**1ms) for 15 KHz channel spacing, and at least a 2ms slot (excluding the 2304Ts gap when UE is not transmitting) respectively for the 3.75 KHz channel spacing.

3. Measure the rectangular filtered mean power for category NB1 or NB2 UE channel.

4. Measure the rectangular filtered mean power of the GSM adjacent channel on both lower and upper side of the category NB1 or NB2 UE channel, respectively.

5. Measure the RRC filtered mean power of UTRA adjacent channel on both lower and upper side of the category NB1 or NB2 UE channel, respectively.

6. Calculate the ratios of the power between the value measured in step 3 over step 4 for lower and upper GSM_{ACLR}.

7. Calculated the ratio of the power between the value measured in step 3 over step 5 for lower and upper $UTRA_{ACLR}$.

NOTE 1: For configuration IDs applicable to UE depending on UE capability in Test Configuration Table with different UL sub-carrier spacing, the SS shall release the connection through State 3A-NB and finally ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5 using the appropriate UL subcarrier spacing in Random Access Response message.

6.5B.3.4.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 8.1.6.

6.5B.3.4.5 Test requirement

- The measured UE mean power in the channel bandwidth, derived in step 3, shall fulfil requirements in Table 6.2B.2.4-1 as appropriate,

and

- if the measured adjacent channel power is greater than –50 dBm then the measured GSM_{ACLR} derived in step 7 and $UTRA_{ACLR}$ derived in step 8 shall be higher than the limits in table 6.5B.3.4.5-1.

Table 6.5B.3.4.5-1: Category NB1 and UE ACLR Test requirements

	GSM_{ACLR}	**$UTRA_{ACLR}$**
ACLR	19.2 dB	36.2 dB
Adjacent channel centre frequency offset from category NB1 or NB2 Channel edge	±200 kHz	±2.5 MHz
Adjacent channel measurement bandwidth	180 kHz	3.84 MHz
Measurement filter	Rectangular	RRC-filter α=0.22
Category NB1 and NB2 channel measurement bandwidth	180 kHz	180 kHz
Category NB1 and NB2 channel Measurement filter	Rectangular	Rectangular

6.5B.4 Spurious emission for category NB1 and NB2

6.5B.4.1 General

Spurious emissions are emissions which are caused by unwanted transmitter effects such as harmonics emission, parasitic emissions, intermodulation products and frequency conversion products, but exclude out of band emissions unless otherwise stated. The spurious emission limits are specified in terms of general requirements inline with SM.329 [9] and E-UTRA operating band requirement to address UE co-existence.

To improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth may be smaller than the measurement bandwidth. When the resolution bandwidth is smaller than the measurement bandwidth, the result should be integrated over the measurement bandwidth in order to obtain the equivalent noise bandwidth of the measurement bandwidth.

6.5B.4.2 Transmitter Spurious emissions for category NB1 and NB2

6.5B.4.2.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to other channels or other systems in terms of transmitter spurious emissions.

6.5B.4.2.2 Test applicability

This test case applies to all types of NB-IoT UE release 17 and forward of category NB1 and NB2 that support satellite access operation.

6.5B.4.2.3 Minimum conformance requirements

Unless otherwise stated, the spurious emission limits apply for the frequency ranges that are more than FOOB (MHz) from the edge of the channel bandwidth. The spurious emission limits in Table 6.5B.4.2.3-1 apply for all transmitter band configurations (NRB) and channel bandwidths.

NOTE: For measurement conditions at the edge of each frequency range, the lowest frequency of the measurement position in each frequency range should be set at the lowest boundary of the frequency range plus MBW/2. The highest frequency of the measurement position in each frequency range should be set at the highest boundary of the frequency range minus MBW/2. MBW denotes the measurement bandwidth defined for the protected band.

Table 6.5B.4.2.3-1: Spurious emissions limits

Frequency Range	Maximum Level	Measurement bandwidth	NOTE
9 kHz ≤ f < 150 kHz	-36 dBm	1 kHz	
150 kHz ≤ f < 30 MHz	-36 dBm	10 kHz	
30 MHz ≤ f < 1000 MHz	-36 dBm	100 kHz	
1 GHz ≤ f < 12.75 GHz	-30 dBm	1 MHz	

When UE is configured for category NB1 or NB2 uplink transmissions the boundary between category NB1 or NB2 out of band and spurious emission domain shall be FOOB = 1.7 MHz.

The normative reference for this requirement is TS 36.102 [11] subclauses 6.5B.4.

6.5B.4.2.4 Test description

6.5B.4.2.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths based on NB-IOT NTN operating bands specified in sub-clause 5.2B. All of these configurations shall be tested with applicable test parameters, and are shown in table 6.5B.4.2.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of NPDSCH and NPDCCH before measurement are specified in Annex C.2.

Table 6.5B.4.2.4.1-1: Test Configuration Table for FDD

Initial Conditions				
Test Environment as specified in TS 36.508[12] subclause 8.1.1		NC		
Test Frequencies as specified in TS 36.508[12] subclause 8.1.3.1		Frequency ranges defined in Annex K.1.2		
Test Parameters				
Configuration ID	**Downlink Configuration**	**Uplink Configuration**		
	N/A for Maximum Power Reduction (MPR) test case	**Modulation**	**N_{tones}**	**Subcarrier spacing (kHz)**
1		QPSK	1@0	3.75
2		QPSK	1@47	3.75
3		BPSK	1@0	15
4		BPSK	1@11	15
5 (Note 1)		QPSK	12@0	15
Note 1: Applicable to UE supporting UL multi-tone transmissions				

1. Connect the SS to the UE antenna connectors as shown in TS 36.508[12] Annex A Figure A.7 using only main UE Tx/Rx antenna.

2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 8.1.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, and C.3.0, and uplink signals according to Annex H.1.1 and H.4.0.

4. The UL Reference Measurement channels are set according to Table 6.5B.4.2.4.1-1.

5. UE location according to TS 36.508 [12] clause 8.2.6.1 is provided to the UE through any preconfigured means.

6. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 8.2.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 8.2.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31-NB information during the duration of the test as define in TS 36.508[12] clause 8.2.6.3.1

7. Deactivate UE prediction of satellite trajectory by any preconfigured means

8. Ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5. Message contents are defined in clause 6.5B.4.2.4.3.

6.5B.4.2.4.2 Test procedure

1. SS sends uplink scheduling information via NPDCCH DCI format N0 for C_RNTI to schedule the UL RMC according to Table 6.5B.4.2.4.1-1 and with the scheduling pattern according to Annex A.2. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC

2. Measure the power of the transmitted signal with a measurement filter of bandwidths according to table 6.5B.4.2.5-1. The centre frequency of the filter shall be stepped in contiguous steps according to table 6.5B.4.2.5-1. The measured power shall be verified for each step. For steps with a measurement bandwidth of 1 MHz, the resolution bandwidth can be reduced to 1% of the measurement bandwidth, and the result should be integrated to achieve the measurement bandwidth. The sweep time shall be set larger than (symbol length)*(number of points in sweep) to improve the measurement accuracy. The measurement period shall capture the active time slots. During measurement the spectrum analyser shall be set to 'Detector' = RMS.

NOTE 1: For configuration IDs applicable to UE depending on UE capability in Test Configuration Table with different UL sub-carrier spacing, the SS shall release the connection through State 3A-NB and finally ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5 using the appropriate UL subcarrier spacing in Random Access Response message.

6.5B.4.2.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 8.1.6.

6.5B.4.2.5 Test requirement

This clause specifies the requirements for the specified E-UTRA band for Transmitter Spurious emissions requirement with frequency range as indicated in table 6.5B.4.2.5-1.

The measured average power of spurious emission, derived in step 3, shall not exceed the described value in Table 6.5B.4.2.5-1.

The spurious emission limits apply for the frequency ranges that are more than Δf_{OOB} (MHz) from the edge of the channel bandwidth.

NOTE: For measurement conditions at the edge of each frequency range, the lowest frequency of the measurement position in each frequency range should be set at the lowest boundary of the frequency range plus MBW/2. The highest frequency of the measurement position in each frequency range should be set at the highest boundary of the frequency range minus MBW/2. MBW denotes the measurement bandwidth defined for the protected band.

Table 6.5B.4.2.5-1: General spurious emissions test requirements

Frequency Range	Maximum Level	Measurement Bandwidth	Notes
9 kHz ≤ f < 150 kHz	-36 dBm	1 kHz	
150 kHz ≤ f < 30 MHz	-36 dBm	10 kHz	
30 MHz ≤ f < 1000 MHz	-36 dBm	100 kHz	
1 GHz ≤ f < 12.75 GHz	-30 dBm	1 MHz	

6.5B.4.3 Spurious emission band UE co-existence for category NB1 and NB2

6.5B.4.3.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to co-existing systems for the specified bands which has specific requirements in terms of transmitter spurious emissions.

6.5B.4.3.2 Test applicability

This test case applies to all types of NB-IoT UE release 17 and forward of category NB1 and NB2 that support satellite access operation.

6.5B.4.3.3 Minimum conformance requirements

This clause specifies the requirements for E-UTRA satellite bands for UE coexistence with protected bands.

NOTE: For measurement conditions at the edge of each frequency range, the lowest frequency of the measurement position in each frequency range should be set at the lowest boundary of the frequency range plus MBW/2. The highest frequency of the measurement position in each frequency range should be set at the highest boundary of the frequency range minus MBW/2. MBW denotes the measurement bandwidth defined for the protected band.

Table 6.5B.4.3.3-1: Spurious emission band UE co-existence limits

E-UTRA Band	Spurious emission				
	Protected band	Frequency range (MHz)	Maximum Level (dBm)	MBW (MHz)	NOTE

253	E-UTRA Band 5, 26, 31, 41, 48, 72 NR Band n1, n3, n7, n8, n18, n20, n28, n34, n38, n39, n40, n50, n51, n65, n67, n74, n75, n76, n79, n91, n92, n93, n94, n105, n109	F_{DL_low}	-	F_{DL_high}	-50	1	
	NR Band n77, n78	F_{DL_low}	-	F_{DL_high}	-50	1	2
254	E-UTRA Band 2, 4, 5, 12, 13, 14, 17, 24, 25, 26, 29, 30, 31, 41, 48, 54, 66, 70, 71, 72, 85, 87, 88, 103 NR Band n1, n3, n7, n8, n18, n20, n28, n34, n38, n39, n40, n50, n51, n53, n65, n67, n74, n75, n76, n77, n78, n90, n91, n92, n93, n94, n105, n106, n109	F_{DL_low}	-	F_{DL_high}	-50	1	
	NR Band n79	F_{DL_low}	-	F_{DL_high}	-50	1	2
255	E-UTRA Band 2, 4, 5, 12, 13, 14, 17, 24, 25, 26, 29, 30, 41, 48, 66, 70, 71, 85, 103 NR Band n1, n3, n7, n8, n18, n20, n28, n34, n38, n39, n40, n50, n51, n53, n65, n67, n74, n75, n76, n90, n91, n92, n93, n94	F_{DL_low}	-	F_{DL_high}	-50	1	
	NR Band n77, n78, n79	F_{DL_low}	-	F_{DL_high}	-50	1	2
256	E-UTRA Band 1, 3, 5,7, 8, 11, 18, 19, 20, 21, 22, 26, 27, 28, 31, 33, 32, 35, 38, 40, 41, 42, 43, 50, 51, 54, 65, 68, 69, 72, 74, 75, 76, 87, 88 NR Band n12, n13, n14, n24, n29, n30, n39, n48, n53, n66, n67, n71, n78, n79, n85, n90, n91, n92, n93, n94, n101	F_{DL_low}	-	F_{DL_high}	-50	1	
	NR Band n77	F_{DL_low}	-	F_{DL_high}	-50	1	2
	NR Band n2, n25, n70	F_{DL_low}	-	F_{DL_high}	NA	NA	3

NOTE 1: F_{DL_low} and F_{DL_high} refer to each E-UTRA frequency band specified in Table 5.4A.2-1

NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5A.4.2-2 are permitted for each assigned E-UTRA carrier used in the measurement due to 2nd, 3rd, 4th [or 5th] harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2MHz + N x L_{CRB} x 180kHz), where N is 2, 3, 4, [5] for the 2nd, 3rd, 4th [or 5th] harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.

NOTE 3: The co-existence between 256 and band 2, 25 and 70 is subject to regional/national regulation.

NOTE: To simplify Table 6.5B.4.3.3-1, E-UTRA band numbers are listed for bands which are specified only for E-UTRA operation or both E-UTRA and NR operation. NR band numbers are listed for bands which are specified only for NR operation.

The normative reference for this requirement is TS 36.102 [11] subclause 6.5B.4.3.

6.5B.4.3.4 Test description

6.5B.4.3.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths based on NB-IOT NTN operating bands specified in sub-clause 5.2B. All of these configurations shall be tested with applicable test parameters, and are shown in Table 6.5B.4.3.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annex A.2. Configurations of NPDSCH and NPDCCH before measurement are specified in Annex C.2.

Table 6.5B.4.3.4.1-1: Test Configuration Table for FDD

<table>
<tr><th colspan="5">Initial Conditions</th></tr>
<tr><td colspan="2">Test Environment as specified in TS 36.508[12] subclause 8.1.1</td><td colspan="3">NC</td></tr>
<tr><td colspan="2">Test Frequencies as specified in TS 36.508[12] subclause 8.1.3.1</td><td colspan="3">Frequency ranges defined in Annex K.1.3</td></tr>
<tr><th colspan="5">Test Parameters</th></tr>
<tr><th>Configuration ID</th><th>Downlink Configuration</th><th colspan="3">Uplink Configuration</th></tr>
<tr><td></td><td rowspan="6">N/A for Spurious Emissions testing</td><th>Modulation</th><th>N_{tones}</th><th>Subcarrier spacing (kHz)</th></tr>
<tr><td>1</td><td>QPSK</td><td>1@0</td><td>3.75</td></tr>
<tr><td>2</td><td>QPSK</td><td>1@47</td><td>3.75</td></tr>
<tr><td>3</td><td>BPSK</td><td>1@0</td><td>15</td></tr>
<tr><td>4</td><td>BPSK</td><td>1@11</td><td>15</td></tr>
<tr><td>5 (Note 1)</td><td>QPSK</td><td>12@0</td><td>15</td></tr>
<tr><td colspan="5">Note 1: Applicable to UE supporting UL multi-tone transmissions</td></tr>
</table>

1. Connect the SS to the UE to the UE antenna connectors as shown in Figure TS 36.508 [12] Annex A, Figure A.7 using only main Tx/Rx antenna.

2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 8.1.4.3.

3. Downlink signals are initially set up according to Annex C0, C.1 and C.3.0, and uplink signals according to Annex H.1.1 and H.4.0.

4. The UL Reference Measurement channels are set according to Table 6.5B.4.3.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. UE location according to TS 36.508 [12] clause 8.2.6.1 is provided to the UE through any preconfigured means.

7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 8.2.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 8.2.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31-NB information during the duration of the test as define in TS 36.508[12] clause 8.2.6.3.1

8. Deactivate UE prediction of satellite trajectory by any preconfigured means

9. Ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5. Message contents are defined in clause 6.5B.4.3.4.3.

6.5B.4.3.4.2 Test procedure

1. SS sends uplink scheduling information via NPDCCH DCI format N0 for C_RNTI to schedule the UL RMC according to Table 6.5B.4.3.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC (UE should be already transmitting P_{UMAX} after Initial Conditions setting).

2. Measure the power of the transmitted signal with a measurement filter of bandwidths according to tables 6.5B.4.3.3-1. The centre frequency of the filter shall be stepped in contiguous steps according to table 6.5B.4.3.3-1. The measured power shall be verified for each step. The measurement period shall capture the active time slots. During measurement the spectrum analyser shall be set to 'Detector' = RMS.

NOTE 1: For configuration IDs applicable to UE depending on UE capability in Test Configuration Table with different UL sub-carrier spacing, the SS shall release the connection through State 3A-NB and finally ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5 using the appropriate UL subcarrier spacing in Random Access Response message.

6.5B.4.3.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 8.1.6.

6.5B.4.3.5 Test requirement

Test requirements for Spurious Emissions UE Co-existence are the same as the minimum requirements and are not repeated in this section.

The measured average power of spurious emission, derived in step 2, shall not exceed the described value in tables 6.5B.4.3.3-1.

6.5B.4.4 Additional spurious emissions for category NB1 and NB2

6.5B.4.4.0 General

These requirements are specified in terms of an additional spectrum emission requirement. Additional spurious emission requirements are signalled by the network to indicate that the UE shall meet an additional requirement for a specific deployment scenario as part of the cell handover/broadcast message.

NOTE: In addition to the requirements below, additional UE region-specific emissions requirements for European are expected to be added once more information becomes available.

6.5B.4.4.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to other channels or other systems in terms of transmitter spurious emissions under the deployment scenarios where additional requirements are specified.

6.5B.4.4.2 Test applicability

This test case applies to all types of NB-IoT UE release 17 and forward of category NB1 and NB2 that support satellite access operation.

6.5B.4.4.3 Minimum conformance requirements

These requirements are specified in terms of an additional spectrum emission requirement. Additional spurious emission requirements are signalled by the network to indicate that the UE shall meet an additional requirement for a specific deployment scenario as part of the cell handover/broadcast message.

NOTE: For measurement conditions at the edge of each frequency range, the lowest frequency of the measurement position in each frequency range should be set at the lowest boundary of the frequency range plus MBW/2. The highest frequency of the measurement position in each frequency range should be set at the highest boundary of the frequency range minus MBW/2. MBW denotes the measurement bandwidth defined for the protected band.

6.5B.4.4.3.1 Minimum requirement (network signalled value "NS_02N")

When "NS_02N" is indicated in the cell, the power of any UE spurious emission shall not exceed the levels specified in Table 6.5B.4.4.3.1-1 and 6.5B.4.4.3.1-2. This requirement also applies for the frequency ranges that are less than F_{OOB} (MHz) specified in 6.5B.4.2 from the edge of the channel bandwidth. Network signalling remark NS_02N applies integer-value 2.

Table 6.5B.4.4.3.1-1: Additional requirements for "NS_02N"

Frequency band (MHz)	Channel bandwidth / Spectrum emission limit[1] (dBm)	Measurement bandwidth	NOTE
	200kHz		
1559≤ f ≤ 1605	-50	700 Hz	Averaged over any 2 millisecond active transmission interval
1605≤ f ≤ 1610	-50 + 24/5 (f-1605)	700Hz	
1559 ≤ f ≤ 1605	-40	1MHz	Averaged over any 2 millisecond active transmission interval
1605≤ f ≤ 1610	-40 + 24/5 (f-1605)	1MHz	
NOTE: The EIRP requirement in regulation is converted to conducted requirement using a 0 dBi antenna.			

Table 6.5B.4.4.3.1-2: Additional requirements for "NS_02N"

Δf_{OOB} (MHz)	Spectrum Emission Limit (dBm)	Measurement bandwidth
± [0.09 – 0.28]	-2 for PC3 -5 for PC5	4 kHz
± [0.28 – 0.85]	-12 for PC3 -15 for PC5	4 kHz
± [>0.85]	-13 for PC3 and PC5	4 kHz

NOTE: Δf_{OOB} = 0.09 MHz corresponds to an authorized bandwidth, as defined in C63.26-2015 [10], of 0.38 MHz.

The normative reference for this requirement is TS 36.102 [11] subclauses 6.5B.4.4.2.

6.5B.4.4.3.2 Minimum requirement (network signalled value "NS_24")

When "NS_24" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.5B.4.4.3.2-1.

Table 6.5B.4.4.3.2-1: Additional requirements for "NS_24"

Frequency band (MHz)	Channel bandwidth / Spectrum emission limit (dBm)	Measurement bandwidth
	200kHz	
Band 34	-50	1MHz
NOTE 1: This requirement applies at a frequency offset equal or larger than 5 MHz from the upper edge of the channel bandwidth, whenever these frequencies overlap with the specified frequency band.		

The normative reference for this requirement is TS 36.102 [11] subclauses 6.5B.4.4.3.

6.5B.4.4.3.3 Minimum requirement (network signalled value "NS_03N")

When "NS_03N" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.5A.4.4.4-1 of TS 36.102 [11] where BWchannel is replaced with 200 kHz, and F_{OOB} (MHz) is replaced with 1.7MHz, in addition to the additional requirements specified in Table 6.5B.4.4.3.3-1 which applies for the frequency ranges that are less than F_{OOB} (MHz) from the edge of the channel bandwidth.

Table 6.5B.4.4.3.3-1: Additional requirements for "NS_03N"

Δf_{OOB} (MHz)	Spectrum Emission Limit (dBm)	Measurement bandwidth
± [0.09 – 0.28]	-2 for PC3 -5 for PC5	4 kHz
± [0.28 – 0.85]	-12 for PC3 -15 for PC5	4 kHz
± [0.85 – 1.7]	-13 for PC3 and PC5	4 kHz

NOTE: Δf_{OOB} = 0.09 MHz corresponds to an authorized bandwidth, as defined in C63.26-2015 [10], of 0.38 MHz.

The normative reference for this requirement is TS 36.102 [11] subclauses 6.5B.4.4.4.

6.5B.4.4.3.4 Minimum requirement (network signalled value "NS_04N")

When "NS_04N" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in 6.5A.4.4.5 of TS 36.102 [11] where BWchannel is replaced with 200 kHz, and F_{OOB} (MHz) is replaced with 1.7MHz.

The normative reference for this requirement is TS 36.102 [11] subclauses 6.5B.4.4.5.

6.5B.4.4.3.5 Minimum requirement (network signalled value "NS_05N")

When "NS_05N" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in 6.5A.4.4.6 of TS 36.102 [11] where BWchannel is replaced with 200 kHz, and F_{OOB} (MHz) is replaced with 1.7MHz.

The normative reference for this requirement is TS 36.102 [11] subclauses 6.5B.4.4.6.

6.5B.4.4.4 Test description

6.5B.4.4.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths based on NB-IOT NTN operating bands specified in sub-clause 5.2B. All of these configurations shall be tested with applicable test parameters for each channel bandwidth, and are shown in Table 6.5B.4.4.4.1-1 to Table 6.5B.4.4.4.1-2. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of NPDSCH and NPDCCH before measurement are specified in Annex C.2.

Table 6.5B.4.4.4.1-1: Test Configuration Table (network signalled value " NS_02N, NS_03N, NS_04N, NS_05N")

Initial Conditions				
Test Environment as specified in TS 36.508 [12] subclause 8.1.1		Normal, TL/VL, TL/VH, TH/VL, TH/VH		
Test Frequencies as specified in TS 36.508 [12] subclause 8.1.3.1		Frequency ranges defined in Annex K.1.2		
Test Parameters				
Configuration ID	**Downlink Configuration**	**Uplink Configuration**		
	N/A for Maximum Power Reduction (MPR) test case	Modulation	N_{tones}	Sub-carrier spacing (kHz)
1 (Note 1)		QPSK	3@0	15
2 (Note 1)		QPSK	3@3	15
3 (Note 1)		QPSK	3@9	15
4 (Note 1)		QPSK	6@0	15
5 (Note 1)		QPSK	6@6	15
6 (Note 1)		QPSK	12@0	15
Note 1: Applicable to UE supporting UL multi-tone transmissions				

Table 6.5B.4.4.4.1-2 Test Configuration Table (network signalled value "NS_24")

Initial Conditions				
Test Environment as specified in TS 36.508 [12] subclause 8.1.1		Normal, TL/VL, TL/VH, TH/VL, TH/VH		
Test Frequencies as specified in TS 36.508 [12] subclause 8.1.3.1		Frequency ranges defined in Annex K.1.2		
Test Parameters				
Configuration ID	**Downlink Configuration**	**Uplink Configuration**		
	N/A for Maximum Power Reduction (MPR) test case	Modulation	N_{tones}	Sub-carrier spacing (kHz)
1 (Note 1)		QPSK	3@0	15
2 (Note 1)		QPSK	3@3	15
3 (Note 1)		QPSK	3@9	15
4 (Note 1)		QPSK	6@0	15
5 (Note 1)		QPSK	6@6	15
6 (Note 1)		QPSK	12@0	15
Note 1: Applicable to UE supporting UL multi-tone transmissions				

1. Connect the SS to the UE antenna connectors as shown in TS 36.508[12] Annex A Figure A.7 using only main UE Tx/Rx antenna.

2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C0, C.1 and C.3.0, and uplink signals according to Annex H.1 and H.3.0.

4. The UL Reference Measurement channels are set according to Table 6.5B.4.4.4.1-1 to Table 6.5B.4.4.4.1-2 depending on network signal value.

5. Propagation conditions are set according to Annex B.0.

6. UE location according to TS 36.508 [12] clause 8.2.6.1 is provided to the UE through any preconfigured means.

7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 8.2.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 8.2.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31-NB information during the duration of the test as define in TS 36.508[12] clause 8.2.6.3.1

8. Deactivate UE prediction of satellite trajectory by any preconfigured means

9. Ensure the UE is in State 3A-RF-CE according to TS 36.508 [12] clause 5.2A.2AA. Message contents are defined in clause 6.5B.4.4.4.3.

6.5B.4.4.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via NPDCCH DCI format N0 for C_RNTI to schedule the UL RMC according to Table 6.5B.4.4.4.1-1 to Table 6.5B.4.4.4.1-2 depending on network signal value. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

2. Send continuously uplink power control "up" commands in the uplink scheduling information to the UE until the UE transmits at P_{UMAX} level.

3. Measure the mean power of the UE in the channel bandwidth of the radio access mode according to the test configuration, which shall meet the requirements described in Tables 6.2B.3.5-1 to 6.2B.3.5-2 for Power Class 3 UEs as appropriate. The period of the measurement shall be at least one sub-frame (1ms).

4. Measure the power of the transmitted signal with a measurement filter of bandwidths according to Table 6.5B.4.4.5.1-1 to 6.5B.4.4.5.2-1 as appropriate. The centre frequency of the filter shall be stepped in contiguous steps according to the same table. The measured power shall be verified for each step. The measurement period shall capture the active time slots. During measurement the spectrum analyser shall be set to 'Detector' = RMS.

6.5B.4.4.4.3 Message contents

Message contents are same as in clause 6.2B.3.4.3.

6.5B.4.4.5 Test requirement

The measured UE mean power in the channel bandwidth, derived in step 3, shall fulfil requirements in Tables 6.2B.3.5-1 to 6.2B.3.5-2 as appropriate.

6.5B.4.4.5.1 Test requirement (network signalled value "NS_02N ")

When "NS_02N" is indicated in the cell, the power of any UE spurious emission shall not exceed the levels specified in Table 6.5B.4.4.5.1-1 and 6.5B.4.4.5.1-2. This requirement also applies for the frequency ranges that are less than F_{OOB} (MHz) specified in 6.5B.4.2 from the edge of the channel bandwidth. Network signalling remark NS_02N applies integer-value 2.

Table 6.5B.4.4.5.1-1: Additional requirements for "NS_02N"

Frequency band (MHz)	Channel bandwidth / Spectrum emission limit[1] (dBm)	Measurement bandwidth	NOTE
	200kHz		
1559≤ f ≤ 1605	-50	700 Hz	Averaged over any 2 millisecond active transmission interval
1605≤ f ≤ 1610	-50 + 24/5 (f-1605)	700Hz	
1559 ≤ f ≤ 1605	-40	1MHz	Averaged over any 2 millisecond active transmission interval
1605≤ f ≤ 1610	-40 + 24/5 (f-1605)	1MHz	
NOTE: The EIRP requirement in regulation is converted to conducted requirement using a 0 dBi antenna.			

Table 6.5B.4.4.5.1-2: Additional requirements for "NS_02N"

Δf_{OOB} (MHz)	Spectrum Emission Limit (dBm)	Measurement bandwidth
± [0.09 – 0.28]	-2 for PC3 -5 for PC5	4 kHz
± [0.28 – 0.85]	-12 for PC3 -15 for PC5	4 kHz
± [>0.85]	-13 for PC3 and PC5	4 kHz

NOTE: Δf_{OOB} = 0.09 MHz corresponds to an authorized bandwidth, as defined in C63.26-2015 [10], of 0.38 MHz.

6.5B.4.4.5.2 Test requirement (network signalled value "NS_24")

When "NS_24" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.5B.4.4.5.2-1.

Table 6.5B.4.4.5.2-1: Additional requirements for "NS_24"

Frequency band (MHz)	Channel bandwidth / Spectrum emission limit (dBm)	Measurement bandwidth
	200kHz	
Band 34	-50	MHz
NOTE 1: This requirement applies at a frequency offset equal or larger than 5 MHz from the upper edge of the channel bandwidth, whenever these frequencies overlap with the specified frequency band.		

6.5B.4.4.5.3 Test requirement (network signalled value "NS_03N ")

When "NS_03N" is indicated in the cell, the power of any UE spurious emission shall not exceed the levels specified in Table 6.5B.4.4.5.3-1 and 6.5B.4.4.5.3-2. This requirement also applies for the frequency ranges that are less than F_{OOB} (MHz) specified in 6.5B.4.2 from the edge of the channel bandwidth.

Table 6.5B.4.4.5.3-1: Additional requirements for "NS_03N"

Frequency band (MHz)	Channel bandwidth / Spectrum emission limit[1] (dBm)	Measurement bandwidth	NOTE
	200kHz		
1559≤ f ≤ 1605	-50	700 Hz	Averaged over any 2 millisecond active transmission interval
1605≤ f ≤ 1610	-50 + 24/5 (f-1605)	700Hz	
1559 ≤ f ≤ 1605	-40	1MHz	Averaged over any 2 millisecond active transmission interval
1605≤ f ≤ 1610	-40 + 24/5 (f-1605)	1MHz	
NOTE: The EIRP requirement in regulation is converted to conducted requirement using a 0 dBi antenna.			

Table 6.5B.4.4.5.3-2: Additional requirements for "NS_03N"

Δf_{OOB} (MHz)	Spectrum Emission Limit (dBm)	Measurement bandwidth
± [0.09 – 0.28]	-2 for PC3 -5 for PC5	4 kHz
± [0.28 – 0.85]	-12 for PC3 -15 for PC5	4 kHz
± [0.85-1.7]	-13 for PC3 and PC5	4 kHz

6.5B.4.4.5.4 Test requirement (network signalled value "NS_04N ")

When "NS_04N" is indicated in the cell, the power of any UE spurious emission shall not exceed the levels specified in Table 6.5B.4.4.5.4-1 and 6.5B.4.4.5.4-2. This requirement also applies for the frequency ranges that are less than F_{OOB} (MHz) specified in 6.5B.4.2 from the edge of the channel bandwidth.

Table 6.5B.4.4.5.4-1: Additional requirements for "NS_04N"

Frequency band (MHz)	Channel bandwidth / Spectrum emission limit[1] (dBm)	Measurement bandwidth	NOTE
	200kHz		
1559≤ f ≤ 1605	-40	1MHz	Averaged over any 2 millisecond active transmission interval
1605≤ f ≤ 1610	-40 + 60/5 (f-1605)	1MHz	
1628.5 ≤ f ≤ 1631.5	-30	30kHz	
1631.5 ≤ f ≤ 1636.5	-30	100kHz	
1636.5 ≤ f ≤ 1646.5	-30	300kHz	
1646.5 ≤ f ≤ 1666.5	-30	1MHz	
1666.5 ≤ f ≤ 2200	-30	3MHz	
NOTE: The EIRP requirement in regulation is converted to conducted requirement using a 0 dBi antenna.			

Table 6.5B.4.4.5.4-2: Additional requirements for "NS_04N"

Δf_{OOB} (KHz)	Spectrum Emission Limit (dBm)	Measurement bandwidth
± 0-160	-2	30kHz
± 160-2300	-2 to -26	
± 2300-18500	-26	
NOTE: Spectrum emissions are linearly interpolated in dBm versus frequency offset.		

6.5B.4.4.5.5 Test requirement (network signalled value "NS_05N ")

When "NS_05N" is indicated in the cell, the power of any UE spurious emission shall not exceed the levels specified in Table 6.5B.4.4.5.5-1 and 6.5B.4.4.5.5-2. This requirement also applies for the frequency ranges that are less than F_{OOB} (MHz) specified in 6.5B.4.2 from the edge of the channel bandwidth.

Table 6.5B.4.4.5.5-1: Additional requirements for "NS_05N"

Frequency band (MHz)	Channel bandwidth / Spectrum emission limit[1] (dBm)	Measurement bandwidth	NOTE
	200kHz		
1559≤ f ≤ 1605	-40	1MHz	Averaged over any 2 millisecond active transmission interval
1605≤ f ≤ 1610	-40 + 60/5 (f-1605)	1MHz	
1628.5 ≤ f ≤ 1631.5	-30	30kHz	
1631.5 ≤ f ≤ 1636.5	-30	100kHz	
1636.5 ≤ f ≤ 1646.5	-30	300kHz	
1646.5 ≤ f ≤ 1666.5	-30	1MHz	
1666.5 ≤ f ≤ 2200	-30	3MHz	
NOTE: The EIRP requirement in regulation is converted to conducted requirement using a 0 dBi antenna.			

Table 6.5B.4.4.5.5-2: Additional requirements for "NS_05N"

Δf_{OOB} (KHz)	Spectrum Emission Limit (dBm)	Measurement bandwidth
± 0-160	-5	30kHz
± 160-225	-5 to -8.5	
± 225-650	-8.5 to -15	
± 650-1365	-15	
± 1365-1800	-23 to -26	
± 1800-16500	-26	
NOTE: Spectrum emissions are linearly interpolated in dBm versus frequency offset.		

6.6 Transmit intermodulation

This clause is reserved.

6.6A Transmit intermodulation for category M1

For category M1 UE, Tx intermodulation requirements are not applicable.

6.6B Transmit intermodulation for category NB1 and NB2

6.6B.1 Test purpose

To verify that the UE transmit intermodulation does not exceed the described value in the test requirement.

6.6B.2 Test applicability

This test case applies to all types of NB-IoT UE release 17 and forward of category NB1 and NB2 that support satellite access operation.

6.6B.3 Minimum conformance requirements

The transmit intermodulation performance is a measure of the capability of the transmitter to inhibit the generation of signals in its non linear elements caused by presence of the wanted signal and an interfering signal reaching the transmitter via the antenna.

The UE category NB1 and NB2 transmitter intermodulation attenuation is defined by the ratio of the mean power of the wanted signal to the mean power of the intermodulation product as defined in Table 6.6B.3-1 when an interfering CW signal is added at a level below the wanted signal at the transmitter antenna port. Both the wanted signal power and the intermodulation product power are measured through rectangular filter with measurement bandwidth shown in Table 6.6B.3-1.

Table 6.6B.3-1: UE category NB1 and NB2 transmitter IM requirement

Parameters for transmitter intermodulation		
BW Channel (UL)	15 kHz (1 tone at sub-carrier 5 or 6)	
Interference Signal Frequency Offset	180 kHz	360 kHz
Interference CW Signal Level	-40dBc	
Intermodulation Product	-20 dBc	-39 dBc
Measurement bandwidth	30 kHz	30 kHz

The normative reference for this requirement is TS 36.102 [11] clause 6.6B.

6.6B.4 Test description

6.6B.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions and test frequencies based on the subset of E-UTRA operating bands defined for NB-IoT in clause 5.2B. All of these configurations shall be tested with applicable test parameters shown in table 6.6B4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2.4. Configurations of NPDSCH and NPDCCH before measurement are specified in Annex C.2.

Table 6.6B.4.1-1: Test Configuration Table for FDD

Initial Conditions				
Test Environment as specified in TS 36.508[12] subclause 8.1.1		Normal		
Test Frequencies as specified in TS 36.508 [12] subclause 8.1.3.1		Frequency ranges defined in Annex K.1.1		
Test Parameters				
Configuration ID	**Downlink Configuration**	**Uplink Configuration**		
	N/A	Modulation	N_{tones}	Sub-carrier spacing (kHz)
1		QPSK	1@5	15kHz

1. Connect the SS to the UE antenna connectors as shown in TS 36.508 [12] Annex A, Figure A.2 using only main Tx/Rx antenna.

2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 8.1.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, and C.3.0, and uplink signals according to Annex H.1.1 and H.4.0.

4. The UL Reference Measurement channels are set according to Table 6.6B.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. UE location according to TS 36.508 [12] clause 8.2.6.1 is provided to the UE through any preconfigured means.

7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 8.2.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 8.2.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31-NB information during the duration of the test as define in TS 36.508[12] clause 8.2.6.3.1

8. Deactivate UE prediction of satellite trajectory by any preconfigured means

9. Ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5. Message contents are defined in clause 6.6B.4.3.

6.6B.4.2 Test procedure

1. SS sends uplink scheduling information for the UL HARQ process via NPDCCH DCI format N0 for C_RNTI to schedule the UL RMC according to Table 6.6B.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. (UE should be already transmitting PUMAX after Initial Conditions setting).

2. Measure the mean power of the UE in the channel bandwidth of the radio access mode according to the test configuration, which shall meet the requirements described in Table 6.2B.2.4-1. The measurement period is at least one sub-frame (1ms) for 15 KHz channel spacing.

3. Set the interference signal frequency below the UL carrier frequency using the first offset in table 6.6B.5-1.

4. Set the interference CW signal level according to table 6.6B.5-1.

5. Measure the rectangular filtered mean power of transmitting intermodulation product signals below and above the UL carrier frequency and calculate the ratios with the power measured in step 2. The centre frequency of the measurement filter shall be (Interference signal frequency - Interference Signal Frequency Offset + 7.5kHz) and (UL carrier frequency - 15 kHz + Interference Signal Frequency Offset), respectively.

6. Set the interference signal frequency above the UL carrier frequency using the first offset in table 6.6B.5-1.

7. Measure the rectangular filtered mean power of transmitting intermodulation product signals below and above the UL carrier frequency and calculate the ratios with the power measured in step 2. The centre frequency of the measurement filter shall be (UL carrier frequency - 15 kHz - Interference Signal Frequency Offset) and (Interference signal frequency + Interference Signal Frequency Offset + 7.5kHz) respectively.

Repeat the measurement using the second offset in table 6.6B.5-1.

6.6B.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 8.1.6.

6.6B.5 Test requirement

The ratio derived in step 5 and 7, shall not exceed the described value in table 6.6B.5-1

Table 6.6B.5-1: Transmit Intermodulation

BW Channel (UL)	15 kHz (1 tone)	
Interference Signal Frequency Offset	180 kHz	360 kHz
Interference CW Signal Level	-40dBc	
Intermodulation Product	-20 dBc	-39 dBc
Measurement bandwidth	30 kHz	30 kHz

7 Receiver characteristics

7.1 General

The requirements in clause 7.1 of TS 36.101 [7] shall apply.

All requirements in this section are applicable to devices supporting GSO and/or NGSO satellites.

7.2 Diversity characteristics

The requirements in clause 7 assume that the receiver is equipped with single Rx port.

7.3 Reference sensitivity power level

This clause is reserved.

7.3A Reference sensitivity power level for UE category M1

7.3A.1 Test purpose

To verify the category M1 UE's ability to receive data with a given average throughput for a specified reference measurement channel, under conditions of low signal level, ideal propagation and no added noise.

A UE unable to meet the throughput requirement under these conditions will decrease the effective coverage area of an e-NodeB.

7.3A.2 Test applicability

This test case applies to all types of NB-IoT FDD UE release 17 and forward of UE category M1 that support satellite access operation.

7.3A.3 Minimum conformance requirements

The reference sensitivity power level REFSENS is the minimum mean power applied to the single antenna port for UE category M1, at which the throughput shall meet or exceed the requirements for the specified reference measurement channel.

The throughput for the REFSENS test is measured based on the Transmission Mode 1 unless specified otherwise.

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes [A.2.2 and A.3.2] (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex [A.5.1.1]) with parameters specified in Table 7.3A-1 and Table 7.3A-2 for category M1.

Table 7.3A.3-1: Reference sensitivity for FDD UE category M1 QPSK $P_{REFSENS}$

NTN Band	REFSENS (dBm)	Duplex Mode
253	-102.7	FDD
254	-102.2	FDD
255	-102.7	FDD
256	-102.2	FDD
NOTE 1: The transmitter shall be set to P_{UMAX} as defined in subclause 6.2.5- in TS 36.101 [7].		

Table 7.3A.3-2: Reference sensitivity for HD-FDD UE category M1 QPSK $P_{REFSENS}$

NTN Band	REFSENS (dBm)	Duplex Mode
253	-103.5	HD-FDD
254	-103.1	HD-FDD
255	-103.5	HD-FDD
256	-103	HD-FDD
NOTE 1: The transmitter shall be set to P_{UMAX} as defined in subclause 6.2.5 in TS 36.101 [7].		

The reference receive sensitivity (REFSENS) requirement specified in Table 7.3A.3-1/Table 7.3A.3-2 shall be met for an uplink transmission bandwidth less than or equal to that specified in Table 7.3A.3-3.

NOTE: Table 7.3A.3-3 is intended for conformance tests and does not necessarily reflect the operational conditions of the network, where the number of uplink and downlink allocated resource blocks will be practically constrained by other factors. Typical receiver sensitivity performance with HARQ retransmission enabled and using a residual BLER metric relevant for e.g. Speech Services is given in the Annex [G] (informative).

Table 7.3A.3-3: FDD UE category M1 Uplink configuration for reference sensitivity

E-UTRA Band	N_{RB}	Duplex Mode
253	6^1	FDD and HD-FDD
254	6^1	FDD and HD-FDD
255	6^1	FDD and HD-FDD
256	6^1	FDD and HD-FDD
NOTE 1: ^{1} refers to the UL resource blocks shall be located as close as possible to the downlink operating band but confined within the transmission bandwidth configuration for the channel bandwidth (Table 5.3A-1).		

The normative reference for this requirement is TS 36.102 [11] clause 7.3A.1.

7.3A.4 Test description

7.3A.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions and test frequencies based on the subset of E-UTRA operating bands defined for CAT M1 in clause 5.2A. All of these configurations shall be tested with applicable test parameters for each channel bandwidth, and are shown in table 7.3A.4.1-1. The details of the downlink and uplink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. The details of the OCNG patterns used are specified in Annex A.5. Configurations of PDSCH and MPDCCH before measurement are specified in Annex C.2.

Table 7.3A.4.1-1: Test Configuration Table

Initial Conditions				
Test Environment as specified in TS 36.508[12] subclause 4.1		NC, TL/VL, TL/VH, TH/VL, TH/VH		
Test Frequencies as specified in TS36.508 [12] subclause 4.3.1		Low range, Mid range, High range		
Test Channel Bandwidths as specified in TS 36.508 [12] subclause 4.3.1		1.4MHz		
Test Parameters for Channel Bandwidths and Narrowband positions				
	Downlink Configuration		**Uplink Configuration**	
Ch BW	**Mod'n**	**RB allocation**	**Mod'n**	**RB allocation**
		FDD		FDD and HD-FDD
1.4MHz	QPSK	4	QPSK	6

1. Connect the SS to the UE antenna connectors as shown in TS 36.508[12] Annex A Figure A.3 using only main UE Tx/Rx antenna.

2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C0, C.1 and C.3.1, and uplink signals according to Annex H.1 and H.3.1.

4. The UL and DL Reference Measurement channels are set according to Table 7.3A.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. UE location according to TS 36.508 [12] clause 5.6.1 is provided to the UE through any preconfigured means.

7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31 information during the duration of the test as define in TS 36.508[12] clause 5.6.3.1

8. Deactivate UE prediction of satellite trajectory by any preconfigured means

9. Ensure the UE is in State 3A-RF-CE according to TS 36.508 [12] clause 5.2A.2AA. Message contents are defined in clause 7.3A.4.3.

7.3A.4.2 Test procedure

1. SS transmits PDSCH via M-PDCCH DCI format 6-1A for C_RNTI to transmit the DL RMC according to Table 7.3A.4.1-1. The SS sends downlink MAC padding bits on the DL RMC. The SS sends one sided dynamic OCNG Pattern OP.1 FDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1.

2. SS sends uplink scheduling information for each UL HARQ process via MPDCCH DCI format 6-0A for C_RNTI to schedule the UL RMC according to Table 7.3A.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.

3. Set the Downlink signal level to the appropriate REFSENS value defined in Table 7.3A.5-1 for FDD and in Table 7.3A.5-2 for HD-FDD. Send continuously uplink power control "up" commands in the uplink scheduling information to the UE to ensure the UE transmits PUMAX level for at least the duration of the Throughput measurement.

4. Measure the average throughput for duration sufficient to achieve statistical significance according to Annex G.2.

7.3A.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 4.6 with the following exceptions.

Table 7.3A.4.3-1: EPDCCH-Config-r11-DEFAULT

Derivation Path: 36.508 Table 4.6.3-2B			
Information Element	**Value/remark**	**Comment**	**Condition**
mpdcch-NumRepetition-r13	r1		

7.3A.4.3.1 Message contents exceptions (network signalled value "NS_01")

Message contents according to TS 36.508 [12] subclause 4.6 can be used without exceptions.

7.3A.4.3.2 Message contents exceptions (network signalled value "NS_02N")

Information element additionalSpectrumEmission is set to NS_02N. This can be set in the SystemInformationblockType2 as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 7.3A.4.3.2-1: *SystemInformationBlockType2*: Additional spurious emissions test requirement for "NS_02N"

Derivation Path: TS 36.508 [12] clause 4.4.3.3, Table 4.4.3.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	2 (NS_02N)		

7.3A.4.3.3 Message contents exceptions (network signalled value "NS_24")

Information element additionalSpectrumEmission is set to NS_24. This can be set in the SystemInformationblockType2 as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 7.3A.4.3.3-1: *SystemInformationBlockType2*: Additional spurious emissions test requirement for "NS_24"

Derivation Path: TS 36.508 [12] clause 4.4.3.3, Table 4.4.3.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	24 (NS_24)		

7.3A.4.3.4 Message contents exceptions (network signalled value "NS_03N")

Information element additionalSpectrumEmission is set to NS_03N. This can be set in the SystemInformationblockType2 as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 7.3A.4.3.4-1: *SystemInformationBlockType2*: Additional spurious emissions test requirement for "NS_03N"

Derivation Path: TS 36.508 [12] clause 4.4.3.3, Table 4.4.3.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	03N(NS_03N)		

7.3A.4.3.5 Message contents exceptions (network signalled value "NS_04N")

Information element additionalSpectrumEmission is set to NS_04N. This can be set in the SystemInformationblockType2 as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 7.3A.4.3.5-1: *SystemInformationBlockType2*: Additional spurious emissions test requirement for "NS_04N"

Derivation Path: TS 36.508 [12] clause 4.4.3.3, Table 4.4.3.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	04N(NS_04N)		

7.3A.4.3.6 Message contents exceptions (network signalled value "NS_05N")

Information element additionalSpectrumEmission is set to NS_05N. This can be set in the SystemInformationblockType2 as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 7.3A.4.3.6-1: *SystemInformationBlockType2*: Additional spurious emissions test requirement for "NS_05N"

Derivation Path: TS 36.508 [12] clause 4.4.3.3, Table 4.4.3.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	05N(NS_05N)		

7.3A.5 Test requirement

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 with parameters specified in Table 7.3A.5-1 and Table 7.3A.5-2.

Table 7.3A.5-1: Reference sensitivity for FDD UE category M1 QPSK $P_{REFSENS}$

NTN Band	REFSENS (dBm)	Duplex Mode
253	-102.0	FDD
254	-101.5	FDD
255	-102.0	FDD
256	-101.5	FDD
NOTE 1: The transmitter shall be set to P_{UMAX} as defined in subclause 6.2.5- in TS 36.101 [7].		

Table 7.3A.5-2: Reference sensitivity for HD-FDD UE category M1 QPSK $P_{REFSENS}$

NTN Band	REFSENS (dBm)	Duplex Mode
253	-102.8	HD-FDD
254	-102.4	HD-FDD
255	-102.8	HD-FDD
256	-102.3	HD-FDD
NOTE 1: The transmitter shall be set to P_{UMAX} as defined in subclause 6.2.5 in TS 36.101 [7].		

7.3B Reference sensitivity power level for UE category NB1 and NB2

7.3B.1 Test purpose

To verify the UE's ability to receive data with a given average throughput for a specified reference measurement channel, under conditions of low signal level, ideal propagation and no added noise.

A UE unable to meet the throughput requirement under these conditions will decrease the effective coverage area.

7.3B.2 Test applicability

This test case applies to all types of NB-IoT UE release 17 and forward of category NB1 and NB2 that support satellite access operation.

7.3B.3 Minimum conformance requirements

The reference sensitivity power level REFSENS is the minimum mean power applied to the single antenna port for UE category NB1 and category NB2, at which the throughput shall meet or exceed the requirements for the specified reference measurement channel.

The throughput for the REFSENS test is measured based on the Transmission Mode 1 unless specified otherwise.

The category NB1 and NB2 UE throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.3.2 of TS 36.101 [7] with received signal level as specified in Table 7.3B.3-1. Requirement in Table 7.3B.3-1 applies for any uplink configuration.

Table 7.3B.3-1: Reference sensitivity for category NB1 and NB2

Operating band	REFSENS [dBm]
According to subclause 5.2B	- 108.2

The normative reference for this requirement is TS 36.102 [11] clause 7.3B.

7.3B.4 Test description

7.3B.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions and test frequencies based on the set of E-UTRA operating bands defined for NB-IoT in clause 5.2.B. All of these configurations shall be tested with applicable test parameters, shown in table 7.3B.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3 respectively. Configurations of NPDSCH and NPDCCH before measurement are specified in Annex C.2.

Table 7.3B.4.1-1: Test Configuration Table

Initial Conditions					
Test Environment as specified in TS 36.508 [12] clause 8.1.1			NC, TL/VL, TL/VH, TH/VL, TH/VH		
Test Frequencies as specified in TS36.508 [12] clause 8.1.3.1			Frequency ranges defined in Annex K.1.2		
Configuration ID	**Downlink Configuration**		**Uplink Configuration**		
	Modulation	Subcarriers	Modulation	N_{tones}	Subcarrier spacing
1	QPSK	12	BPSK	1@0	15kHz

1. Connect the SS to the UE antenna connectors as shown in TS 36.508[12] Annex A Figure A.3 using only the main UE Tx/Rx antenna.

2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 8.1.4.3.

3. Downlink signals are initially set up according to Annex C0, C1 and C.3.0, and NPUSCH Format 2 is used to carry ACK/NACK on the uplink.

4. The DL Reference Measurement channels are set according to Table 7.3B.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. UE location according to TS 36.508 [12] clause 8.2.6.1 is provided to the UE through any preconfigured means.

7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 8.2.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 8.2.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31-NB information during the duration of the test as defined in TS 36.508 [12] clause 8.2.6.3.1.

8. Deactivate UE prediction of satellite trajectory by any preconfigured means.

9. Ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5. Message contents are defined in clause 7.3B.4.3.

7.3B.4.2 Test procedure

1. SS transmits NPDSCH via NPDCCH DCI format N1 for C_RNTI to transmit the DL RMC according to Table 7.3B.4.1-1. The SS sends downlink MAC padding bits on the DL RMC. The UE will send the HARQ feedback based on information contain in DCI format N1.

2. Set the Downlink signal level to the value defined in Table 7.3B.5-1.

3. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex G.2.

7.3B.4.3 Message contents

Message contents are according to TS 36.508 [12] clause 8.1.6.

7.3B.5 Test requirement

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.3.2 with parameters specified in Table 7.3B.5-1.

Table 7.3B.5-1: Maximum input level for category NB1 and NB2

Operating band	REFSENS [dBm]
According to subclause 5.2B	- 108.2 + TT

7.4 Maximum input level

7.4A Maximum input level for category M1

7.4A.1 Test purpose

Maximum input level tests the ability of category M1 UE to receive data with a given average throughput for a specified reference measurement channel, under conditions of high signal level, ideal propagation and no added noise.

A UE unable to meet the throughput requirement under these conditions will decrease the coverage area near to an e-NodeB.

7.4A.2 Test applicability

This test applies to all types of E-UTRA UE release 17 and forward of category M1 that support satellite access operation.

7.4A.3 Minimum conformance requirements

This is defined as the maximum mean power received at the UE antenna port, at which the specified relative throughput shall meet or exceed the minimum requirements for the specified reference measurement channel.

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1) with parameters specified in Table 7.4A.3-1.

Table 7.4A.3-1: Maximum input level

Rx Parameter	Units	Channel bandwidth
		1.4 MHz
Power in Transmission Bandwidth Configuration	dBm	-40[2]
NOTE 1: The transmitter shall be set to 4dB below P_{CMAX_L} at the minimum uplink configuration specified in Table 7.3A-3 with P_{CMAX_L} as defined in subclause 6.2.5 of TS 36.101 [7]. NOTE 2: Reference measurement channel is TS 36.101 [7] Annex A.3.2: 64QAM, R=3/4 variant with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1 of TS 36.101 [7].		

The normative reference for this requirement is TS 36.102 [11] clause 7.4A.

7.4A.4 Test description

7.4A.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths based on E-UTRA operating bands defined for CAT M1 in clause 5.2E. All of these configurations shall be tested with applicable test parameters for each channel bandwidth and are shown in table 7.4A.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3 respectively. The details of the OCNG patterns used are specified in Annex A.5. Configurations of PDSCH and MPDCCH before measurement are specified in Annex C.2.

Table 7.4A.4.1-1: Test Configuration Table RX test cases UE Cat-M1

Initial Conditions							
Test Environment as specified in TS 36.508[12] clause 4.1			NC				
Test Frequencies as specified in TS36.508 [12] clause 4.3.1			Mid range				
Test Channel Bandwidths as specified in TS 36.508 [12] clause 4.3.1			1.4MHz				
Test Parameters for Channel Bandwidths and Narrowband positions							
	Downlink Configuration			**Uplink Configuration**			
Ch BW	**Mod'n**	**RB allocation**		**Mod'n**	**RB allocation**		**UE Category**
		FDD and HD-FDD	**TDD**		**FDD and HD-FDD**	**TDD**	
1.4MHz	16QAM	2	2	QPSK	6	6	M1
Note 1: Downlink RB position shall be RB_{start} = 0 within the narrowband Note 2: The Narrowband index (TS36.211, 5.2.4) shall be set to 0 for all testpoints.							

1. Connect the SS to the UE antenna connectors as shown in TS 36.508[12] Annex A Figure A.3 using only main UE Tx/Rx antenna.

2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C0, C.1 and C.3.1, and uplink signals according to Annex H.1 and H.3.1.

4. The UL and DL Reference Measurement channels are set according to Table 7.4A.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. UE location according to TS 36.508 [12] clause 5.6.1 is provided to the UE through any preconfigured means.

7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31 information during the duration of the test as define in TS 36.508[12] clause 5.6.3.1

8. Deactivate UE prediction of satellite trajectory by any preconfigured means.

9. Ensure the UE is in State 3A-RF-CE according to TS 36.508 [12] clause 5.2A.2AA. Message contents are defined in clause 7.4A.4.3.

7.4A.4.2 Test procedure

1. SS transmits PDSCH via M-PDCCH DCI format 6-1A for C_RNTI to transmit the DL RMC according to Table 7.4A.4.1-1. The SS sends downlink MAC padding bits on the DL RMC.

2. SS sends uplink scheduling information for each UL HARQ process via M-PDCCH DCI format 0 for C_RNTI to schedule the UL RMC according to Table 7.4A.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.

3. Set the Downlink signal level to the value defined in Table 7.4A.5-1. Send Uplink power control commands to the UE (less or equal to 1dB step size should be used), to ensure that the UE output power is within +0, - 3.4 dB of the target level in Table 7.4A.5-1 for carrier frequency $f \leq 3.0GHz$ or within +0, -4.0 dB of the target level for carrier frequency $3.0GHz < f \leq 4.2GHz$, for at least the duration of the Throughput measurement.

4. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex G.2.

7.4A.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 4.6 with the following exception.

Table 7.4A.4.3-1: UplinkPowerControlDedicated

Derivation Path: 36.331 clause 6.3.2			
Information Element	**Value/remark**	**Comment**	**Condition**
UplinkPowerControlDedicated-DEFAULT ::= SEQUENCE {			
p0-UePUSCH	0		
deltaMCS-Enabled	en0		
accumulationEnabled	TRUE		
p0-uePUCCH	0		
pSRS-Offset	3 (-6 dB)		
filterCoefficient	fc8	larger filter length is used to reduce the RSRP measurement variation	
}			

Table 7.4A.4.3-2: EPDCCH-Config-r11-DEFAULT

Derivation Path: 36.331 clause 6.3.2			
Information Element	**Value/remark**	**Comment**	**Condition**
mpdcch-NumRepetition-r13	r1		

7.4A.5 Test requirement

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.2.2, A.2.3 and A.3.2 with parameters specified in Table 7.4A.5-1.

Table 7.4A.5-1: Maximum input level

Rx Parameter	Units	Channel bandwidth
		1.4 MHz
Power in Transmission Bandwidth Configuration	dBm	-40[2] +TT
NOTE 1: The transmitter shall be set to 4dB below P_{CMAX_L} with P_{CMAX_L} as defined in clause 6.2A.4. NOTE 2: Reference measurement channel is Annex A.3.2 64QAM R=3/4variant with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1.		

7.4B Maximum input level for category NB1 and NB2

7.4B.1 Test purpose

Maximum input level tests the UE's ability to receive data with a given average throughput for a specified reference measurement channel, under conditions of high signal level, ideal propagation and no added noise.

A UE unable to meet the throughput requirement under these conditions will decrease the coverage area near to an e-NodeB.

7.4B.2 Test applicability

This test case applies to all types of NB-IoT HD-FDD UE release 17 and forward of category NB1 and NB2 that support satellite access operation.

7.4B.3 Minimum conformance requirements

This is defined as the maximum mean power received at the UE antenna port, at which the specified relative throughput shall meet or exceed the minimum requirements for the specified reference measurement channel.

Category NB1 and NB2 UE maximum input level requirement is -40 dBm. For this input level the throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel as specified in Annex A.3.2 of TS 36.101 [7].

The normative reference for this requirement is TS 36.102 [11] clause 7.4B.

7.4B.4 Test description

7.4B.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions and test frequencies based on the set of E-UTRA operating bands defined for NB-IoT in clause 5.2.F. All of these configurations shall be tested with applicable test parameters, and are shown in table 7.4F.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3 respectively. Configurations of NPDSCH and NPDCCH before measurement are specified in Annex C.2.

Table 7.4B.4.1-1: Test Configuration Table

Initial Conditions					
Test Environment as specified in TS 36.508 [12] clause 8.1.1			NC		
Test Frequencies as specified in TS36.508 [12] clause 8.1.3.1			Frequency ranges defined in Annex K.1.2		
Configuration ID	**Downlink Configuration**		**Uplink Configuration**		
	Modulation	Subcarriers	Modulation	N_{tones}	Subcarrier spacing
1	QPSK	12	BPSK	1@0	15kHz

1. Connect the SS to the UE antenna connectors as shown in TS 36.508[12] Annex A Figure A.3 using only the main UE Tx/Rx antenna.
2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 8.1.4.3.
3. Downlink signals are initially set up according to Annex C0, C1 and C.3.0, and NPUSCH Format 2 is used to carry ACK/NACK on the uplink.
4. The DL Reference Measurement channels are set according to Table 7.4B.4.1-1.
5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 36.508 [12] clause 8.2.6.1 is provided to the UE through any preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 8.2.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 8.2.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31-NB information during the duration of the test as define in TS 36.508[12] clause 8.2.6.3.1
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.
9. Ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5. Message contents are defined in clause 7.4B.4.3.

7.4B.4.2 Test procedure

1. SS transmits NPDSCH via NPDCCH DCI format N1 for C_RNTI to transmit the DL RMC according to Table 7.4B.4.1-1. The SS sends downlink MAC padding bits on the DL RMC. The UE will send the HARQ feedback based on information contain in DCI format N1.
2. Set the Downlink signal level to the value defined in Table 7.4B.5-1.
3. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex G.2.

7.4B.4.3 Message contents

Message contents are according to TS 36.508 [12] clause 8.1.6.

7.4B.5 Test requirement

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.3.2 with parameters specified in Table 7.4B.5-1.

Table 7.4B.5-1: Maximum input level for category NB1 and NB2

Rx Parameter	Units	Maximum input level test requirement
Power in Transmission Bandwidth Configuration	dBm	For carrier frequency f ≤ 3.0GHz: -40 +TT

7.5 Adjacent Channel Selectivity (ACS)

7.5A Adjacent Channel Selectivity for category M1

7.5A.1 Test purpose

Adjacent channel selectivity tests the ability of category M1 UE to receive data with a given average throughput for a specified reference measurement channel, in the presence of an adjacent channel signal at a given frequency offset from the centre frequency of the assigned channel, under conditions of ideal propagation and no added noise.

A UE unable to meet the throughput requirement under these conditions will decrease the coverage area when other e-NodeB transmitters exist in the adjacent channel.

7.5A.2 Test applicability

This test applies to all types of E-UTRA UE release 17 and forward of category M1 that support satellite access operation.

7.5A.3 Minimum conformance requirements

Adjacent Channel Selectivity (ACS) is a measure of a receiver's ability to receive a E-UTRA signal at its assigned channel frequency in the presence of an adjacent channel signal at a given frequency offset from the centre frequency of the assigned channel. ACS is the ratio of the receive filter attenuation on the assigned channel frequency to the receive filter attenuation on the adjacent channel(s).

The UE shall fulfil the minimum requirement specified in Table 7.5A.3-1 for all values of an adjacent channel interferer up to –40 dBm. However it is not possible to directly measure the ACS, instead the lower and upper range of test parameters are chosen in Table 7.5A.3-2 and Table 7.5A.3-3 where the throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in TS 36.101 [7] Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD for the DL-signal as described in TS 36.101 [7] Annex A.5.1.1). For operating bands with an unpaired DL part (as noted in Table 5.5-1), the requirements only apply for carriers assigned in the paired part.

Table 7.5A.3-1: Adjacent channel selectivity

		Channel bandwidth
Rx Parameter	**Units**	**1.4 MHz**
ACS	dB	33.0

Table 7.5A.3-2: Test parameters for Adjacent channel selectivity, Case 1

Rx Parameter	Units	Channel bandwidth
		1.4 MHz

Power in Transmission Bandwidth Configuration	dBm	REFSENS + 14 dB
$P_{Interferer}$	dBm	REFSENS +45.5dB
$BW_{Interferer}$	MHz	1.4
$F_{Interferer}$ (offset)	MHz	1.4+0.0025 / -1.4-0.0025
NOTE 1: The transmitter shall be set to 4dB below P_{CMAX_L} at the minimum uplink configuration specified in Table 7.3A-3 with P_{CMAX_L} as defined in subclause 6.2.5 of TS 36.101 [7]. NOTE 2: The interferer consists of the Reference measurement channel specified in TS 36.101 [7] Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1 and set-up according to Annex C.3.1. NOTE 3: For DL category M1 UE, the reference sensitivity for category M1 in table 7.3A-1 should be used as REFSENS for the power in Transmission Bandwidth Configuration. NOTE 4: For DL category M1 UE, the parameters for the applicable channel bandwidth apply.		

Table 7.5A.3-3: Test parameters for Adjacent channel selectivity, Case 2

Rx Parameter	Units	Channel bandwidth
		1.4 MHz
Power in Transmission Bandwidth Configuration	dBm	-71.5
$P_{Interferer}$	dBm	-40
$BW_{Interferer}$	MHz	1.4
$F_{Interferer}$ (offset)	MHz	1.4+0.0025 / -1.4-0.0025
NOTE 1: The transmitter shall be set to 24dB below P_{CMAX_L} at the minimum uplink configuration specified in Table 7.3A-3 with P_{CMAX_L} as defined in subclause 6.2.5 of TS 36.101 [7]. NOTE 2: The interferer consists of the Reference measurement channel specified in TS 36.101 [7] Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1 and set-up according to Annex C.3.1.		

The normative reference for this requirement is TS 36.102 [11] clause 7.5A.

7.5A.4 Test description

7.5A.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths based on E-UTRA operating bands defined for CAT M1 in clause 5.2E. All of these configurations shall be tested with applicable test parameters for each channel bandwidth, and are shown in table 7.5A.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3 respectively. The details of the OCNG patterns used are specified in Annex A.5. Configurations of PDSCH and MPDCCH before measurement are specified in Annex C.2.

Table 7.5A.4.1-1: Test Configuration Table RX test cases UE Cat-M1

Initial Conditions						
Test Environment as specified in TS 36.508[12] clause 4.1			NC			
Test Frequencies as specified in TS36.508 [12] clause 4.3.1			Mid range			
Test Channel Bandwidths as specified in TS 36.508 [12] clause 4.3.			1.4			
Test Parameters for Channel Bandwidths and Narrowband positions						
	Downlink Configuration			**Uplink Configuration**		
Ch BW	Mod'n	RB allocation		Mod'n	RB allocation	
		FDD and HD-FDD	TDD		FDD and HD-FDD	TDD
1.4MHz	QPSK	4	4	QPSK	6	6
Note 1: Downlink RB position shall be RB_{start} = 0 within the narrowband. Note 2: Use narrowband index (TS36.211, 5.2.4) 0 when interferer is below carrier, and max narrowband index when interferer is above carrier.						

1. Connect the SS to the UE antenna connectors as shown in TS 36.508[12] Annex A Figure A.4 using only main UE Tx/Rx antenna.
2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C0, C.1 and C.3.1, and uplink signals according to Annex H.1 and H.3.1.
4. The UL and DL Reference Measurement channels are set according to Table 7.5A.4.1-1.
5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 36.508 [12] clause 5.6.1 is provided to the UE through any preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31 information during the duration of the test as define in TS 36.508[12] clause 5.6.3.1
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.
9. Ensure the UE is in State 3A-RF-CE according to TS 36.508 [12] clause 5.2A.2AA. Message contents are defined in clause 7.5A.4.3.

7.5A.4.2 Test procedure

1. SS transmits PDSCH via M-PDCCH DCI format 6-1A for C_RNTI to transmit the DL RMC according to Table 7.5A.4.1-1. The SS sends downlink MAC padding bits on the DL RMC.
2. SS sends uplink scheduling information for each UL HARQ process via M-PDCCH DCI format 6-0A for C_RNTI to schedule the UL RMC according to Table 7.5A.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.
3. Set the Downlink signal level to the value as defined in Table 7.5A.5-2 (Case 1). Send Uplink power control commands to the UE (less or equal to 1dB step size should be used), to ensure that the UE output power is within +0, - 3.4 dB of the target level in Table 7.5A.5-2 (Case 1) for carrier frequency f ≤ 3.0GHz or within +0, -4.0 dB of the target level for carrier frequency 3.0GHz < f ≤ 4.2GHz, for at least the duration of the Throughput measurement.
4. Set the Interferer signal level to the value as defined in Table 7.5A.5-2 (Case 1) and frequency below the wanted signal, using a modulated interferer bandwidth as defined in Annex D of the present document.
5. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex G.2.
6. Repeat steps from 3 to 5, using an interfering signal above the wanted signal in Case 1 at step 4.

7. Set the Downlink signal level to the value as defined in Table 7.5A.5-3 (Case 2). Send Uplink power control commands to the UE (less or equal to 1dB step size should be used), to ensure that the UE output power is within +0, - 3.4 dB of the target level in Table 7.5A.5-3 (Case 2) for carrier frequency f ≤ 3.0GHz or within +0, -4.0 dB of the target level for carrier frequency 3.0GHz < f ≤ 4.2GHz, for at least the duration of the Throughput measurement.

8. Set the Interferer signal level to the value as defined in Table 7.5A.5-3 (Case 2) and frequency below the wanted signal, using a modulated interferer bandwidth as defined in Annex D of the present document.

9. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex G.2.

10. Repeat steps from 7 to 9, using an interfering signal above the wanted signal in Case 2 at step 8.

11. Repeat for applicable channel bandwidths and operating band combinations in both Case 1 and Case 2.

7.5A.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 4.6 with the following exception.

Table 7.5A.4.3-1: UplinkPowerControlDedicated

Derivation Path: 36.331 clause 6.3.2			
Information Element	**Value/remark**	**Comment**	**Condition**
UplinkPowerControlDedicated-DEFAULT ::= SEQUENCE {			
p0-UePUSCH	0		
deltaMCS-Enabled	en0		
accumulationEnabled	TRUE		
p0-uePUCCH	0		
pSRS-Offset	3 (-6 dB)		
filterCoefficient	fc8	larger filter length is used to reduce the RSRP measurement variation	
}			

7.5A.5 Test requirement

The throughput R_{av} shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.2.2, A.2.3 and A.3.2 with parameters specified in table 7.5A.5-2, and also under the conditions specified in table 7.5A.5-3.

Table 7.5A.5-1: Adjacent channel selectivity

		Channel bandwidth
Rx Parameter	**Units**	**1.4 MHz**
ACS	dB	33.0

Table 7.5A.5-2: Test parameters for Adjacent channel selectivity, Case 1

Rx Parameter	**Units**	**Channel bandwidth**
		1.4 MHz

Power in Transmission Bandwidth Configuration	dBm	REFSENS + 14 dB
$P_{Interferer}$	dBm	REFSENS +45.5dB
$BW_{Interferer}$	MHz	1.4
$F_{Interferer}$ (offset)	MHz	1.4+0.0025 / -1.4-0.0025
NOTE 1: The transmitter shall be set to 4dB below P_{CMAX_L} at the minimum uplink configuration specified in Table 7.3A-3 with P_{CMAX_L} as defined in clause 6.2.5A. NOTE 2: The interferer consists of the Reference measurement channel specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1 and set-up according to Annex C.3.1. NOTE 3: For DL category M1 UE, the reference sensitivity for category M1 in table 7.3A-1 and 7.3A-2 should be used as REFSENS for the power in Transmission Bandwidth Configuration and $P_{Interferer}$. NOTE 4: For DL category M1 UE, the parameters for the applicable channel bandwidth apply.		

Table 7.5A.5-3: Test parameters for Adjacent channel selectivity, Case 2

Rx Parameter	Units	Channel bandwidth
		1.4 MHz
Power in Transmission Bandwidth Configuration	dBm	-71.5
$P_{Interferer}$	dBm	-40
$BW_{Interferer}$	MHz	1.4
$F_{Interferer}$ (offset)	MHz	1.4+0.0025 / -1.4-0.0025
NOTE 1: The transmitter shall be set to 24dB below P_{CMAX_L} with P_{CMAX_L} as defined in clause 6.2.5A. NOTE 2: The interferer consists of the Reference measurement channel specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1 and set-up according to Annex C.3.1.		

7.5B Adjacent Channel Selectivity for category NB1 and NB2

7.5B.1 Test purpose

Adjacent channel selectivity tests the UE's ability to receive data with a given average throughput for a specified reference measurement channel, in the presence of an adjacent channel signal at a given frequency offset from the centre frequency of the assigned channel, under conditions of ideal propagation and no added noise.

A UE unable to meet the throughput requirement under these conditions will decrease the coverage area when other e-NodeB transmitters exist in the adjacent channel.

7.5B.2 Test applicability

This test case applies to all types of E-UTRA HD-FDD UE release 17 and forward of category NB1 and NB2 that support satellite access.

7.5B.3 Minimum conformance requirements

Adjacent Channel Selectivity (ACS) is a measure of a receiver's ability to receive a E-UTRA signal at its assigned channel frequency in the presence of an adjacent channel signal at a given frequency offset from the centre frequency of the assigned channel. ACS is the ratio of the receive filter attenuation on the assigned channel frequency to the receive filter attenuation on the adjacent channel(s).

Category NB1 and NB2 UE shall fulfil the minimum requirement specified in Table 7.5B.3-1 for all values of an adjacent channel interferer up to -40 dBm. However it is not possible to directly measure the ACS, instead the lower and upper range of test parameters are chosen in Table 7.5B.3-1 where the throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel as specified in TS 36.101 [7] Annex A.3.2.

Table 7.5B.3-1: Adjacent channel selectivity parameters for category NB1 and NB2

ACS1 test Parameters		
Interferer	**GSM (GMSK)**	**E-UTRA**
Category NB1 or NB2 signal power (P_{wanted}) / dBm	REFSENS + 14 dB	
Interferer signal power ($P_{Interferer}$) / dBm	REFSENS + 42 dB	REFSENS + 47 dB
Interferer bandwidth	200 kHz	5 MHz
Interferer offset from category NB1 or NB2 channel edge	±200 kHz	±2.5 MHz
ACS2 test Parameters		
Interferer	**GSM (GMSK)**	**E-UTRA**
Category NB1 or NB2 signal power (P_{wanted}) / dBm	-68 dBm	-73 dBm
Interferer signal power ($P_{Interferer}$) / dBm	-40 dBm	
Interferer bandwidth	200 kHz	5 MHz
Interferer offset from category NB1 or NB2 channel edge	±200 kHz	±2.5 MHz

The normative reference for this requirement is TS 36.102 [11] clause 7.5B.

7.5B.4 Test description

7.5B.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths based on E-UTRA operating bands defined for CAT NB1 and NB2 in clause 5.2E. All of these configurations shall be tested with applicable test parameters for each channel bandwidth, and are shown in table 7.5B.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3 respectively. The details of the OCNG patterns used are specified in Annex A.5. Configurations of PDSCH and MPDCCH before measurement are specified in Annex C.2.

Table 7.5B.4.1-1: Test Configuration Table

Initial Conditions					
Test Environment as specified in TS 36.508 [12] clause 8.1.1			NC		
Test Frequencies as specified in TS36.508 [12] clause 8.1.3.1			Frequency ranges defined in Annex K.1.2		
Configuration ID	**Downlink Configuration**		**Uplink Configuration**		
	Modulation	Subcarriers	Modulation	N_{tones}	Subcarrier spacing
1	QPSK	12	BPSK	1@0	15kHz

1. Connect the SS to the UE antenna connectors as shown in TS 36.508[12] Annex A Figure A.4 using only main UE Tx/Rx antenna.

2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C0, C.1 and C.3.1, and uplink signals according to Annex H.1 and H.3.1.

4. The UL and DL Reference Measurement channels are set according to Table 7.5B.4.1-1.

5 Propagation conditions are set according to Annex B.0.

6. UE location according to TS 36.508 [12] clause 8.2.6.1 is provided to the UE through any preconfigured means.

7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 8.2.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 8.2.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31-NB information during the duration of the test as define in TS 36.508[12] clause 8.2.6.3.1

8. Deactivate UE prediction of satellite trajectory by any preconfigured means.

9. Ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [7] clause 8.1.5. Message contents are defined in clause 7.5B.4.3.

7.5B.4.2 Test procedure

1. SS transmits NPDSCH via NPDCCH DCI format N1 for C_RNTI to transmit the DL RMC according to Table 7.5B.4.1-1. The SS sends downlink MAC padding bits on the DL RMC. The UE will send HARQ feedback based on information contained in DCI format N1.

2. Set the Downlink signal level to the value defined for ACS1, GSM in Table 7.5B.5-1. For steps 2 to 5 and 6 to 9, use the default message contents.

3. Set the Interferer signal level to the value defined for ACS1, GSM in Table 7.5B.5-1, with frequency below the wanted signal according to table 7.5B.5-1, using a modulated interferer bandwidth as defined in Annex D.2 of the present document.

4. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex G.2.

5. Repeat steps 2 to 4, using an interfering signal above the wanted signal at step 3.

6. Set the Downlink signal level to the value defined for ACS1, E-UTRA in Table 7.5B.5-1.

7. Set the Interferer signal level to the value defined for ACS1, E-UTRA in Table 7.5B.5-1, with frequency below the wanted signal according to table 7.5B.5-1, using a modulated interferer bandwidth as defined in Annex D.2 of the present document.

8. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex G.2.

9. Repeat steps 6 to 8, using an interfering signal above the wanted signal at step 7.

10. Release the connection through State 3A-NB.

11. Modify system information elements according to Table 7.5B.4.3-1 and notify the UE via paging message with *SystemInformationModification* included.

12. Ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [7] clause 8.1.5 using the new UL power control setting.

13. SS transmits NPDSCH via NPDCCH DCI format N1 for C_RNTI to transmit the DL RMC according to Table 7.5B.4.1-1. The SS sends downlink MAC padding bits on the DL RMC. The UE will send HARQ feedback based on information contained in DCI format N1.

14. Set the Downlink signal level to the value defined for ACS2, GSM in Table 7.5B.5-1. For steps 14 to 17 and 18 to 21, use message contents with the exceptions defined in Table 7.5B.4.3-1.

15. Set the Interferer signal level to the value defined for ACS2, GSM in Table 7.5B.5-1, with frequency below the wanted signal according to table 7.5B.5-1, using a modulated interferer of 5MHz bandwidth defined in Annex D.2 of the present document.

16. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex G.2.

17. Repeat steps 14 to 16, using an interfering signal above the wanted signal at step 15.

18. Set the Downlink signal level to the value defined for ACS2, E-UTRA in Table 7.5B.5-1.

19. Set the Interferer signal level to the value defined for ACS2, E-UTRA in Table 7.5B.5-1, with frequency below the wanted signal according to table 7.5B.5-1, using a modulated interferer of 5MHz bandwidth defined in Annex D.2 of the present document.

20. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex G.2.

21. Repeat steps 18 to 20, using an interfering signal above the wanted signal at step 19.

7.5B.4.3 Message contents

Message contents are according to TS 36.508 [7] clause 8.1.6 with the following exceptions:

Table 7.5B.4.3-1: UplinkPowerControlCommon-NB-DEFAULT: ACS2

Derivation Path: TS 36.508 [7] clause 8.1.6.3, Table 8.1.6.3-14 UplinkPowerControlCommon-NB-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
UplinkPowerControlCommon-NB-DEFAULT ::= SEQUENCE { p0-NominalNPUSCH-r13	-70		

7.5B.5 Test requirement

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.3.2 with parameters specified in Table 7.5B.5-1.

Table 7.5B.5-1: Test parameters for Adjacent channel selectivity, category NB1 and NB2

ACS1 test Parameters		
Interferer	**GSM (GMSK)**	**E-UTRA**
Category NB1 or NB2 signal power (P_{wanted}) / dBm	REFSENS + 14 dB	
Interferer signal power ($P_{Interferer}$) / dBm	REFSENS + 42 dB	REFSENS + 47 dB
Interferer bandwidth	200 kHz	5 MHz
Interferer offset from category NB1 or NB2 channel edge	±200 kHz	±2.5 MHz
ACS2 test Parameters		
Interferer	**GSM (GMSK)**	**E-UTRA**
Category NB1 or NB2 signal power (P_{wanted}) / dBm	-68 dBm	-73 dBm
Interferer signal power ($P_{Interferer}$) / dBm	-40 dBm	
Interferer bandwidth	200 kHz	5 MHz
Interferer offset from category NB1 or NB2 channel edge	±200 kHz	±2.5 MHz

7.6 Blocking characteristics

This clause is reserved.

7.6A Blocking characteristics for category M1

7.6A.1 General

The blocking characteristic is a measure of the receiver's ability to receive a wanted signal at its assigned channel frequency in the presence of an unwanted interferer on frequencies other than those of the spurious response or the adjacent channels, without this unwanted input signal causing a degradation of the performance of the receiver beyond a specified limit. The blocking performance shall apply at all frequencies except those at which a spurious response occurs.

7.6A.2 In-band blocking for category M1

7.6A.2.1 Test Purpose

In-band blocking is defined for an unwanted interfering signal falling into the UE receive band or into the first 15 MHz below or above the UE receive band at which the relative throughput shall meet or exceed the minimum requirement for the specified measurement channels.

The lack of in-band blocking ability will decrease the coverage area when other e-NodeB transmitters exist (except in the adjacent channels and spurious response).

7.6A.2.2 Test Applicability

This test case applies to all types of E-UTRA UE release 17 and forward of category M1 that support satellite access operation.

7.6A.2.3 Minimum Conformance Requirements

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in TS 36.101 [7] Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD for the DL-signal as described in TS 36.101 [7] Annex A.5.1.1) with parameters specified in Tables 7.6A.2.3-1 and 7.6A.2.3-2. For operating bands with an unpaired DL part (as noted in Table 5.2A-1), the requirements only apply for carriers assigned in the paired part.

Table 7.6A.2.3-1: In band blocking parameters

Rx parameter	Units	Channel bandwidth
		1.4 MHz
Power in Transmission Bandwidth Configuration	dBm	REFSENS + channel bandwidth specific value below
		6
$BW_{Interferer}$	MHz	1.4
$F_{Ioffset, case 1}$	MHz	2.1+0.0125
$F_{Ioffset, case 2}$	MHz	3.5+0.0075

NOTE 1: The transmitter shall be set to 4dB below P_{CMAX_L} at the minimum uplink configuration specified in Table 7.3A-3 with P_{CMAX_L} as defined in subclause 6.2.5 of TS 36.101 [7].
NOTE 2: The interferer consists of the Reference measurement channel specified in TS 36.101 [7] Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1 and set-up according to Annex C.3.1.
NOTE 3: For DL category M1 UE, the reference sensitivity for category M1 in table 7.3A-1 should be used as REFSENS for the power in Transmission Bandwidth Configuration.
NOTE 4: For DL category M1 UE, the parameters for the applicable channel bandwidth apply.

Table 7.6A.2.3-2: In-band blocking

E-UTRA band	Parameter	Unit	Case 1	Case 2
	$P_{Interferer}$	dBm	-56	-44
	$F_{Interferer}$ (offset)	MHz	=-BW/2 – $F_{Ioffset,case 1}$ & =+BW/2 + $F_{Ioffset,case 1}$	≤-BW/2 – $F_{Ioffset,case 2}$ & ≥+BW/2 + $F_{Ioffset,case 2}$
256, 255 254, 253	$F_{Interferer}$	MHz	(NOTE 2)	F_{DL_low} – 15 to F_{DL_high} + 15
NOTE 1: For certain bands, the unwanted modulated interfering signal may not fall inside the UE receive band, but within the first 15 MHz below or above the UE receive band NOTE 2: For each carrier frequency the requirement is valid for two frequencies: a. the carrier frequency -BW/2 - $F_{Ioffset, case 1}$ and b. the carrier frequency +BW/2 + $F_{Ioffset, case 1}$ NOTE 3: $F_{Interferer}$ range values for unwanted modulated interfering signal are interferer center frequencies				

The normative reference for this requirement is TS 36.102 [11] clause 7.6A.2.

7.6A.2.4 Test Description

7.6A.2.4.1 Initial Conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions and test frequencies based on the subset of E-UTRA operating bands defined for category M1 in clause 5.2A. All of these configurations shall be tested with applicable test parameters for each channel bandwidth, and are shown in table 7.6A.2.4.1-1. The details of the downlink and uplink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. The details of the OCNG patterns used are specified in Annex A.5. Configurations of PDSCH and MPDCCH before measurement are specified in Annex C.2.

Table 7.6A.2.4.1-1: Test Configuration Table

Initial Conditions					
Test Environment as specified in TS 36.508[12] subclause 4.1	[Normal]				
Test Frequencies as specified in TS36.508 [12] subclause 4.3.1	[Mid range]				
Test Channel Bandwidths as specified in TS 36.508 [12] subclause 4.3.1	1.4MHz				
Test Parameters for Channel Bandwidths and Narrowband positions					
Configuration ID	**Downlink Configuration**		**Uplink Configuration**		
	Modulation	RB allocation	Modulation	RB allocation	Narrowband index (Note 1)
1	QPSK	4	QPSK	6	0
Note 1: Denotes where in the channel Bandwidth the narrowband shall be placed. Narrowband and Narrowband index are defined in TS36.211[3], 5.2.4. Note 2: Downlink RB position shall be RB_{start} = 0 within the narrowband.					

1. Connect the SS to the UE antenna connectors as shown in TS 36.508[12] Annex A Figure A.4 using only main UE Tx/Rx antenna.

2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C0, C.1 and C.3.1, and uplink signals according to Annex H.1 and H.3.1.

4. The UL and DL Reference Measurement channels are set according to Table 7.6A.2.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. UE location according to TS 36.508 [12] clause 5.6.1 is provided to the UE through any preconfigured means.

7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31 information during the duration of the test as define in TS 36.508[12] clause 5.6.3.1

8. Deactivate UE prediction of satellite trajectory by any preconfigured means.

9. Ensure the UE is in State 3A-RF-CE according to TS 36.508 [12] clause 5.2A.2AA. Message contents are defined in clause 7.6A.2.4.3.

7.6A.2.4.2 Test Procedure

1. SS transmits PDSCH via MPDCCH DCI format 6-1A for C_RNTI to transmit the DL RMC according to Table 7.6A.2.4.1-1. The SS sends downlink MAC padding bits on the DL RMC. The SS sends one sided dynamic OCNG Pattern OP.1 FDD for the DL-signal as described in Annex A.5.1.1.

2. SS sends uplink scheduling information for each UL HARQ process via MPDCCH DCI format 6-0A for C_RNTI to schedule the UL RMC according to Table 7.6A.2.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.

3. Set the parameters of the signal generator for an interfering signal below the wanted signal in Case 1 according to Tables 7.6A.2.5-1 and 7.6A.2.5-2.

4. Set the Downlink signal level to the value as defined in Table 7.6A.2.5-1. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as -MU to -(MU + Uplink power control window size) dB of the target power level in Table 7.6A.2.5-1 for at least the duration of the throughput measurement, where:

- MU is the test system uplink power measurement uncertainty and is specified in Table F.1.3-1 for the carrier frequency f and the channel bandwidth BW

- Uplink power control window size = 1dB (UE power step size) + 1.0dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS 36.101-1 [7], Table 6.3.5.2.1-1 and is 1.0dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.

5. Measure the average throughput for duration sufficient to achieve statistical significance according to Annex G.2.

6. Repeat steps from 3 to 5, using an interfering signal above the wanted signal in Case 1 at step 3.

7. Repeat steps from 3 to 6, using interfering signals in Case 2 at step 3 and 6. The ranges of case 2 are covered in steps equal to the interferer bandwidth. The test frequencies are chosen in analogy to Table 7.6A.2.4.2-1.

Table 7.6A.2.4.2-1: Example for interferer frequencies

	Lower frequency	Upper frequency
Band 256 DL	2170 MHz	2200 MHz
Band 256 Midrange	2185 MHz	
Receive band wanted signal (BW 1.4MHz)	2184.3 MHz	2185.7 MHz
Interferer case 1	2182.1875 MHz	2187.8125 MHz
Interferer case 2 (inner frequency)	2180.7925 MHz	2189.2075 MHz
Interferer case 2 (outer frequency)	2155.5925 MHz	2214.4075 MHz
Outer limit for in band blocking	2155MHz	2215MHz
Number of test frequencies case 2	19	19

7.6A.2.4.3 Message Contents

Message contents are according to TS 36.508 [12] subclause 4.6 with the condition CEModeA and the following exception.

Table 7.6A.2.4.3-1: UplinkPowerControlDedicated

Derivation Path: 36.331 clause 6.3.2			
Information Element	**Value/remark**	**Comment**	**Condition**
UplinkPowerControlDedicated-DEFAULT ::= SEQUENCE {			
p0-UE-PUSCH	0		
deltaMCS-Enabled	en0		
accumulationEnabled	TRUE		
p0-UE-PUCCH	0		
pSRS-Offset	3 (-6 dB)		
filterCoefficient	fc8	larger filter length is used to reduce the RSRP measurement variation	
}			

7.6A.2.5 Test Requirement

The throughput measurement derived in test procedure shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.3.2 with parameters specified in Tables 7.6A.2.5-1 and 7.6A.2.5-2.

Table 7.6A.2.5-1: In band blocking parameters

Rx parameter	Units	Channel bandwidth
		1.4 MHz
Power in Transmission Bandwidth Configuration	dBm	REFSENS + channel bandwidth specific value below
		6
$BW_{Interferer}$	MHz	1.4
$F_{Ioffset, case 1}$	MHz	2.1+0.0125
$F_{Ioffset, case 2}$	MHz	3.5+0.0075

NOTE 1: The transmitter shall be set to 4dB below P_{CMAX_L} at the minimum uplink configuration specified in Table 7.3A-3 with P_{CMAX_L} as defined in subclause 6.2.5 of TS 36.101 [7].
NOTE 2: The interferer consists of the Reference measurement channel specified in TS 36.101 [7] Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1 and set-up according to Annex C.3.1.
NOTE 3: For DL category M1 UE, the reference sensitivity for category M1 in table 7.3A-1 should be used as REFSENS for the power in Transmission Bandwidth Configuration.
NOTE 4: For DL category M1 UE, the parameters for the applicable channel bandwidth apply.

Table 7.6A.2.5-2: In-band blocking

E-UTRA band	Parameter	Unit	Case 1	Case 2
	$P_{Interferer}$	dBm	-56	-44
	$F_{Interferer}$ (offset)	MHz	=-BW/2 – $F_{Ioffset,case 1}$ & =+BW/2 + $F_{Ioffset,case 1}$	≤-BW/2 – $F_{Ioffset,case 2}$ & ≥+BW/2 + $F_{Ioffset,case 2}$
256, 255 254, 253	$F_{Interferer}$	MHz	(NOTE 2)	F_{DL_low} – 15 to F_{DL_high} + 15

NOTE 1: For certain bands, the unwanted modulated interfering signal may not fall inside the UE receive band, but within the first 15 MHz below or above the UE receive band
NOTE 2: For each carrier frequency the requirement is valid for two frequencies:
a. the carrier frequency -BW/2 - $F_{Ioffset, case 1}$ and
b. the carrier frequency +BW/2 + $F_{Ioffset, case 1}$
NOTE 3: $F_{Interferer}$ range values for unwanted modulated interfering signal are interferer center frequencies

7.6A.3 Out-of-band blocking for category M1

7.6A.3.1 Test Purpose

Out-of-band band blocking is defined for an unwanted CW interfering signal falling more than 15 MHz below or above the category M1 UE receive band, at which a given average throughput shall meet or exceed the requirement for the specified measurement channels.

For the first 15 MHz below or above the UE receive band the appropriate in-band blocking or adjacent channel selectivity in sub-clause 7.5A and sub-clause 7.6A.2 shall be applied.

The lack of out-of-band blocking ability will decrease the coverage area when other e-NodeB transmitters exist (except in the adjacent channels and spurious response).

7.6A.3.2 Test Applicability

This test case applies to all types of E-UTRA UE release 17 and forward of category M1 that support satellite access operation.

7.6A.3.3 Minimum Conformance Requirements

Out-of-band band blocking is defined for an unwanted CW interfering signal falling more than 15 MHz below or above the UE receive band. For the first 15 MHz below or above the UE receive band the appropriate in-band blocking or adjacent channel selectivity in subclause 7.5A and subclause 7.6A.2 shall be applied.

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in TS 36.101 [7] Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD for the DL-signal as described in TS 36.101 [7] Annex A.5.1.1) with parameters specified in Tables 7.6A.3-1 and 7.6A.3-2.

Table 7.6A.3-1: Out-of-band blocking parameters for category M1 UE

RX parameter	Units	Channel bandwidth (MHz)
		1.4
Power in transmission bandwidth configuration	dBm	REFSENS + 6 dB
NOTE 1: The transmitter shall be set to 4dB below P_{CMAX_L} at the minimum uplink configuration specified in Table 7.3.1-2 in TS 36.101 [7] with P_{CMAX_L} as defined in subclause 6.2.5.		

Table 7.6A.3-2: Out of-band blocking for category M1 UE

Operating Band	Parameter	Unit	Range 1	Range 2	Range 3
	$P_{interferer}$	dBm	-44	-30	-15
253, 254[2,] 255	$F_{interferer}$ (C`W)	MHz	-60 < f – F_{DL_low} < -15 or 15 < f – F_{DL_high} < 60	-85 < f – F_{DL_low} ≤ -60 or 60 ≤ f – F_{DL_high} < 85	1 ≤ f ≤ F_{DL_low} – 85 or F_{DL_high} + 85 ≤ f ≤ 12750
256[1]	$F_{interferer}$ (CW)	MHz	-100 < f – F_{DL_low} < -15 or 15 < f – F_{DL_high} < 60	-145 < f – F_{DL_low} ≤ -100 or 60 ≤ f – F_{DL_high} < 85	1 ≤ f ≤ F_{DL_low} – 145 or F_{DL_high} + 85 ≤ f ≤ 12750
NOTE 1: Band 256 lower frequency ranges are modified to enable specific implementations. NOTE 2: The power level of the interferer ($P_{interferer}$) for Range 3 shall be modified to -20 dBm for $F_{interferer}$ > 2585 MHz and $F_{Interferer}$ < 2775 MHz.					

For Table 7.6A.3-2 in frequency range 1, 2 and 3, up to $\max(24,\ 6 \cdot \lceil N_{RB}/6 \rceil)$ exceptions are allowed for spurious response frequencies in each assigned frequency channel when measured using a 1MHz step size, where N_{RB} is the number of resource blocks in the downlink transmission bandwidth configuration. For these exceptions the requirements of subclause 7.7A spurious response are applicable.

The normative reference for this requirement is TS 36.102 [11] clause 7.6A.3.

7.6A.3.4 Test Description

7.6A.3.4.1 Initial Conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions and test frequencies based on the subset of E-UTRA operating bands defined for category M1 in clause 5.2A. All of these configurations shall be tested with applicable test parameters for each channel bandwidth, and are shown in Table 7.6A.3.4.1-1. The details of the downlink and uplink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. The details of the OCNG patterns used are specified in Annex A.5. Configurations of PDSCH and MPDCCH before measurement are specified in Annex C.2.

Table 7.6A.3.4.1-1: Test Configuration Table

Initial Conditions					
Test Environment as specified in TS 36.508[12] subclause 4.1		Normal			
Test Frequencies as specified in TS36.508 [12] subclause 4.3.1		One frequency chosen arbitrarily from low or high range			
Test Channel Bandwidths as specified in TS 36.508 [12] subclause 4.3.1		1.4MHz			
Test Parameters for Channel Bandwidths and Narrowband positions					
Configuration ID	**Downlink Configuration**		**Uplink Configuration**		
	Modulation	RB allocation	Modulation	RB allocation	Narrowband index (Note 1)
1	QPSK	4	QPSK	6	0
Note 1: Denotes where in the channel Bandwidth the narrowband shall be placed. Narrowband and Narrowband index are defined in TS36.211[3], 5.2.4.					

1. Connect the SS to the UE antenna connectors as shown in TS 36.508[12] Annex A Figure A.5 using only main UE Tx/Rx antenna.

2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C0, C.1 and C.3.1, and uplink signals according to Annex H.1 and H.3.1.

4. The UL and DL Reference Measurement channels are set according to Table 7.6A.3.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. UE location according to TS 36.508 [12] clause 5.6.1 is provided to the UE through any preconfigured means.

7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] Table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and Table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31 information during the duration of the test as defined in TS 36.508 [12] clause 5.6.3.1.

8. Deactivate UE prediction of satellite trajectory by any preconfigured means.

9. Ensure the UE is in State 3A-RF-CE according to TS 36.508 [12] clause 5.2A.2AA. Message contents are defined in clause 7.6A.3.4.3.

7.6A.3.4.2 Test Procedure

1. SS transmits PDSCH via MPDCCH DCI format 6-1A for C_RNTI to transmit the DL RMC according to Table 7.6A.3.4.1-1. The SS sends downlink MAC padding bits on the DL RMC. The SS sends one sided dynamic OCNG Pattern OP.1 FDD for the DL-signal as described in Annex A.5.1.1.

2. SS sends uplink scheduling information for each UL HARQ process via MPDCCH DCI format 6-0A for C_RNTI to schedule the UL RMC according to Table 7.6A.3.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.

3. Set the parameters of the CW signal generator for an interfering signal below the wanted signal according to Table 7.6A.3.5-2. The frequency step size is 1MHz.

4. Set the Downlink signal level to the value as defined in Table 7.6A.3.5-1. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as -MU to -(MU + Uplink power control window size) dB of the target power level in Table 7.6A.3.5-1 for at least the duration of the throughput measurement, where:

- MU is the test system uplink power measurement uncertainty and is specified in Table F.1.3-1 for the carrier frequency f and the channel bandwidth BW

- Uplink power control window size = 1dB (UE power step size) + 1.0dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS 36.101-1 [7], Table 6.3.5.2.1-1 and is 1.0dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.

5. Measure the average throughput for duration sufficient to achieve statistical significance according to Annex G.2.

6. Record the frequencies for which the throughput doesn't meet the requirements.

7. Repeat steps from 3 to 6, using an interfering signal above the wanted signal at step 3.

7.6A.3.4.3 Message Contents

Message contents are according to TS 36.508 [12] subclause 4.6 with the condition CEModeA and the following exception.

Table 7.6A.3.4.3-1: UplinkPowerControlDedicated

Derivation Path: 36.331 clause 6.3.2			
Information Element	**Value/remark**	**Comment**	**Condition**
UplinkPowerControlDedicated-DEFAULT ::= SEQUENCE {			
p0-UE-PUSCH	0		
deltaMCS-Enabled	en0		
accumulationEnabled	TRUE		
p0-UE-PUCCH	0		
pSRS-Offset	3 (-6 dB)		
filterCoefficient	fc8	larger filter length is used to reduce the RSRP measurement variation	
}			

7.6A.3.5 Test Requirement

Except for the spurious response frequencies recorded at the final step of test procedure, the throughput measurement derived in test procedure shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.3.2 with parameters specified in Tables 7.6A.3.5-1 and 7.6A.3.5-2.

For frequency range 1, 2, and 3, the number of spurious response frequencies recorded in the final step of test procedure shall not exceed $\max(24, \; 6 \cdot \lceil N_{RB} / 6 \rceil)$ in each assigned frequency channel when measured using a 1MHz step size. For these exceptions the requirements of clause 7.7A Spurious Response are applicable.

Table 7.6A.3.5-1: Out-of-band blocking parameters for category M1 UE

RX parameter	Units	Channel bandwidth (MHz)
		1.4
Power in transmission bandwidth configuration	dBm	REFSENS + 6 dB
NOTE 1: The transmitter shall be set to 4dB below P_{CMAX_L} at the minimum uplink configuration specified in Table 7.3.1-2 in TS 36.101 [7] with P_{CMAX_L} as defined in subclause 6.2.5.		

Table 7.6A.3.5-2: Out of-band blocking for category M1 UE

Operating Band	Parameter	Unit	Range 1	Range 2	Range 3
	$P_{interferer}$	dBm	-44	-30	-15
253, 254[2],255	$F_{interferer}$ (C`W)	MHz	$-60 < f - F_{DL\_low} < -15$ or $15 < f - F_{DL\_high} < 60$	$-85 < f - F_{DL\_low} \le -60$ or $60 \le f - F_{DL\_high} < 85$	$1 \le f \le F_{DL\_low} - 85$ or $F_{DL\_high} + 85 \le f \le 12750$
256[1]	$F_{interferer}$ (CW)	MHz	$-100 < f - F_{DL\_low} < -15$ or $15 < f - F_{DL\_high} < 60$	$-145 < f - F_{DL\_low} \le -100$ or $60 \le f - F_{DL\_high} < 85$	$1 \le f \le F_{DL\_low} - 145$ or $F_{DL\_high} + 85 \le f \le 12750$
NOTE 1: Band 256 lower frequency ranges are modified to enable specific implementations. NOTE 2: The power level of the interferer ($P_{interferer}$) for Range 3 shall be modified to -20 dBm for $F_{interferer}$ > 2585 MHz and $F_{Interferer}$ < 2775 MHz					

7.6A.4 Narrow band blocking for category M1

7.6A.4.1 Test Purpose

Verifies a receiver's ability to receive an E-UTRA signal at its assigned channel frequency in the presence of an unwanted narrow band CW interferer at a frequency, which is less than the nominal channel spacing.

The lack of narrow-band blocking ability will decrease the coverage area when other e-NodeB transmitters exist (except in the adjacent channels and spurious response).

7.6A.4.2 Test Applicability

This test case applies to all types of E-UTRA UE release 17 and forward of category M1 that support satellite access operation.

7.6A.4.3 Minimum Conformance Requirements

The relative throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD for the DL-signal as described in Annex A.5.1.1) with parameters specified in Table 7.6A.4.3-1. For operating bands with an unpaired DL part (as noted in Table 5.2-1), the requirements only apply for carriers assigned in the paired part.

Table 7.6A.4.3-1: Narrow-band blocking

Parameter	Unit	Channel Bandwidth
		1.4 MHz
P_w	dBm	$P_{REFSENS}$ + channel-bandwidth specific value below
		22
P_{uw} (CW)	dBm	-55
F_{uw} (offset for Δf = 15 kHz)	MHz	0.9075
F_{uw} (offset for Δf = 7.5 kHz)	MHz	
NOTE 1: The transmitter shall be set a 4 dB below P_{CMAX_L} at the minimum uplink configuration specified in Table 7.3A.3-3 with P_{CMAX_L} as defined in subclause 6.2.5 of TS 36.101 [7]. NOTE 2: Reference measurement channel is specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1. NOTE 3: For DL category M1 UE, the reference sensitivity for category M1 in Table 7.3A.3-1 should be used as $P_{REFSENS}$ for P_w. NOTE 4: For DL category M1 UE, the parameters for the applicable channel bandwidth apply. NOTE 5: For DL category M1 UE, the parameter, P_w, for all the channel bandwidth will be $P_{REFSENS}$ +22 dBm.		

The normative reference for this requirement is TS 36.102 [11] clause 7.6A.4.

7.6A.4.4 Test Description

7.6A.4.4.1 Initial Conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions and test frequencies based on the subset of E-UTRA operating bands defined for category M1 in clause 5.2A. All of these configurations shall be tested with applicable test parameters for each channel bandwidth, and are shown in Table 7.6A.4.4.1-1. The details of the downlink and uplink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. The details of the OCNG patterns used are specified in Annex A.5. Configurations of PDSCH and MPDCCH before measurement are specified in Annex C.2.

Table 7.6A.4.4.1-1: Test Configuration Table

Initial Conditions					
Test Environment as specified in TS 36.508[12] subclause 4.1	Normal				
Test Frequencies as specified in TS36.508 [12] subclause 4.3.1	Mid range				
Test Channel Bandwidths as specified in TS 36.508 [12] subclause 4.3.1	1.4MHz				
Test Parameters for Channel Bandwidths and Narrowband positions					
Configuration ID	**Downlink Configuration**		**Uplink Configuration**		
	Modulation	RB allocation	Modulation	RB allocation	Narrowband index (Note 1)
1	QPSK	4	QPSK	6	0
Note 1: Denotes where in the channel Bandwidth the narrowband shall be placed. Narrowband and Narrowband index are defined in TS36.211[3], 5.2.4.					

1. Connect the SS to the UE antenna connectors as shown in TS 36.508[12] Annex A Figure A.5 using only main UE Tx/Rx antenna.

2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C0, C.1 and C.3.1, and uplink signals according to Annex H.1 and H.3.1

4. The UL and DL Reference Measurement channels are set according to Table 7.6A.4.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. UE location according to TS 36.508 [12] clause 5.6.1 is provided to the UE through any preconfigured means.

7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] Table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and Table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31 information during the duration of the test as defined in TS 36.508 [12] clause 5.6.3.1.

8. Deactivate UE prediction of satellite trajectory by any preconfigured means.

9. Ensure the UE is in State 3A-RF-CE according to TS 36.508 [12] clause 5.2A.2AA. Message contents are defined in clause 7.6A.4.4.3.

7.6A.4.4.2 Test Procedure

1. SS transmits PDSCH via MPDCCH DCI format 6-1A for C_RNTI to transmit the DL RMC according to Table 7.6A.4.4.1-1. The SS sends downlink MAC padding bits on the DL RMC. The SS sends one sided dynamic OCNG Pattern OP.1 FDD for the DL-signal as described in Annex A.5.1.1.

2. SS sends uplink scheduling information for each UL HARQ process via MPDCCH DCI format 6-0A for C_RNTI to schedule the UL RMC according to Table 7.6A.4.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.

3. Set the parameters of the CW signal generator for an interfering signal below the wanted signal according to Table 7.6A.4.5-1.

4. Set the Downlink signal level to the value as defined in Table 7.6A.4.5-1. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as -MU to -(MU + Uplink power control window size) dB of the target power level in Table 7.6A.4.5-1 for at least the duration of the throughput measurement, where:

- MU is the test system uplink power measurement uncertainty and is specified in Table F.1.3-1 for the carrier frequency f and the channel bandwidth BW

- Uplink power control window size = 1dB (UE power step size) + 1.0dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS 36.101-1 [7], Table 6.3.5.2.1-1 and is 1.0dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.

5. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex G.2.

6. Repeat steps from 3 to 5, using an interfering signal above the wanted signal at step 3.

7.6A.4.4.3 Message Contents

Message contents are according to TS 36.508 [12] subclause 4.6 with the condition CEModeA and the following exception.

Table 7.6A.4.4.3-1: UplinkPowerControlDedicated

Derivation Path: 36.331 clause 6.3.2			
Information Element	**Value/remark**	**Comment**	**Condition**
UplinkPowerControlDedicated-DEFAULT ::= SEQUENCE {			
p0-UE-PUSCH	0		
deltaMCS-Enabled	en0		
accumulationEnabled	TRUE		
p0-UE-PUCCH	0		
pSRS-Offset	3 (-6 dB)		
filterCoefficient	fc8	larger filter length is used to reduce the RSRP measurement variation	
}			

7.6A.4.5 Test Requirement

The throughput measurement derived in test procedure shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.3.2 with parameters specified in Table 7.6A.4.5-1.

Table 7.6A.4.5-1: Narrow-band blocking

Parameter	Unit	Channel Bandwidth
		1.4 MHz
P_w	dBm	$P_{REFSENS}$ + channel-bandwidth specific value below
		22
P_{uw} (CW)	dBm	-55
F_{uw} (offset for Δf = 15 kHz)	MHz	0.9075
F_{uw} (offset for Δf = 7.5 kHz)	MHz	
NOTE 1: The transmitter shall be set a 4 dB below P_{CMAX_L} at the minimum uplink configuration specified in Table 7.3A.3-3 with P_{CMAX_L} as defined in subclause 6.2.5 of TS 36.101 [7]. NOTE 2: Reference measurement channel is specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1. NOTE 3: For DL category M1 UE, the reference sensitivity for category M1 in Table 7.3A.3-1 should be used as $P_{REFSENS}$ for P_w. NOTE 4: For DL category M1 UE, the parameters for the applicable channel bandwidth apply. NOTE 5: For DL category M1 UE, the parameter, P_w, for all the channel bandwidth will be $P_{REFSENS}$ +22 dBm.		

7.6B Blocking characteristics for category NB1 and NB2

7.6B.1 General

The blocking characteristic is a measure of the receiver's ability to receive a wanted signal at its assigned channel frequency in the presence of an unwanted interferer on frequencies other than those of the spurious response or the adjacent channels, without this unwanted input signal causing a degradation of the performance of the receiver beyond a specified limit. The blocking performance shall apply at all frequencies except those at which a spurious response occurs.

7.6B.2 In-band blocking for category NB1 and NB2

7.6B.2.1 Test Purpose

In-band blocking is defined for an unwanted interfering signal falling into the UE receive band or into the first 15 MHz below or above the UE receive band at which the relative throughput shall meet or exceed the minimum requirement for the specified measurement channels.

The lack of in-band blocking ability will decrease the coverage area when other e-NodeB transmitters exist (except in the adjacent channels and spurious response).

7.6B.2.2 Test Applicability

This test case applies to all types of E-UTRA UE release 17 and forward of category NB1 and NB2 that support satellite access operation.

7.6B.2.3 Minimum Conformance Requirements

Category NB1 and NB2 UE throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel as specified in TS 36.101 [7] Annex A.3.2 with parameters specified in Table 7.6B.2.3-1.

Table 7.6B.2.3-1: In-band blocking parameters for category NB1 and NB2

IBB1 test Parameters	
Category NB1 or NB2 signal power (P_{wanted}) / dBm	REFSENS + 6 dB
Interferer	E-UTRA
Interferer signal power ($P_{Interferer}$) / dBm	- 56 dBm
Interferer bandwidth	5 MHz
Interferer offset from category NB1 or NB2 channel edge	+7.5 MHz + 0.005 MHz and -7.5 MHz - 0.005 MHz
IBB2 test Parameters	
Category NB1 or NB2 signal power (P_{wanted}) / dBm	REFSENS + 6 dB
Interferer	E-UTRA
Interferer signal power ($P_{Interferer}$) / dBm	- 44 dBm
Interferer bandwidth	5 MHz
Interferer offset range from category NB1 or NB2 channel edge	From +12.5 MHz to F_{DL_high} + 15 MHz and From -12.5 MHz to F_{DL_low} - 15 MHz

The normative reference for this requirement is TS 36.102 [11] clause 7.6B.2.

7.6B.2.4 Test Description

7.6B.2.4.1 Initial Conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions and test frequencies based on the subset of E-UTRA operating bands defined for category NB1 and NB2 in clause 5.2B. All of these configurations shall be tested with applicable test parameters, and are shown in Table 7.6B.2.4.1-1. The details of the downlink reference measurement channels (RMCs) are specified in Annex A.3. Configurations of NPDSCH and NPDCCH before measurement are specified in Annex C.2.

Table 7.6B.2.4.1-1: Test Configuration Table

Initial Conditions					
Test Environment as specified in TS 36.508 [12] clause 8.1.1			Normal		
Test Frequencies as specified in TS36.508 [12] clause 8.1.3.1			Frequency ranges defined in Annex K.1.1		
Configuration ID	**Downlink Configuration**		**Uplink Configuration**		
	Modulation	Subcarriers	Modulation	N_{tones}	Subcarrier spacing
1	QPSK	12	BPSK	1@0	15 kHz

1. Connect the SS to the UE antenna connector as shown in TS 36.508 [12] Annex A, Figure A.4 using only the main UE Tx/Rx antenna.

2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 8.1.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1 and C.2, and NPUSCH Format 2 is used to carry ACK/NACK on the uplink.

4. The DL Reference Measurement channel is set according to Table 7.6B.2.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. UE location according to TS 36.508 [12] clause 8.2.6.1 is provided to the UE through any preconfigured means.

7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 8.2.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 8.2.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31-NB information during the duration of the test as define in TS 36.508[12] clause 8.2.6.3.1

8. Deactivate UE prediction of satellite trajectory by any preconfigured means.

9. Ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5. Message contents are defined in clause 7.6B.2.4.3.

7.6B.2.4.2 Test Procedure

1. SS transmits NPDSCH via NPDCCH DCI format N1 for C_RNTI to transmit the DL RMC according to Table 7.6B.2.4.1-1. The SS sends downlink MAC padding bits on the DL RMC. The UE will send HARQ feedback based on information contained in DCI format N1.

2. Set the downlink signal level according to the Table 7.6B.2.5-1.

3. Set the parameters of the signal generator for an interfering signal below the wanted signal in IBB1 according to Table 7.6B.2.5-1.

4. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex G.2.

5. Repeat steps from 3 to 4, using an interfering signal above the wanted signal in IBB1 at step 3.

6. Repeat steps from 3 to 5, using interfering signals in IBB2 at step 3 and 5. The ranges of IBB2 are covered in steps equal to the interferer bandwidth. The test frequencies are chosen in analogy to Table 7.6B.2.4.2-1.

Table 7.6B.2.4.2-1: Example for interferer frequencies

	Lower frequency	Upper frequency
Band 256 DL	2170 MHz	2200 MHz
Band 256 Midrange	2185 MHz	
Receive band wanted signal (BW 200KHz)	2184.9 MHz	2185.1 MHz
Interferer IBB1	2177.395 MHz	2192.605 MHz
Interferer IBB2	2172.4 MHz	2197.6 MHz
Outer limit for in band blocking	2155MHz	2215MHz

7.6B.2.4.3 Message Contents

Message contents are according to TS 36.508 [7] clause 8.1.6.

7.6B.2.5 Test Requirement

The throughput measurement derived in test procedure shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in clause A.3.2 with parameters specified in Tables 7.6B.2.5-1.

Table 7.6B.2.5-1: In-band blocking parameters for category NB1 and NB2

IBB1 test Parameters	
Category NB1 or NB2 signal power (P_{wanted}) / dBm	REFSENS + 6 dB
Interferer	E-UTRA
Interferer signal power ($P_{Interferer}$) / dBm	- 56 dBm
Interferer bandwidth	5 MHz
Interferer offset from category NB1 or NB2 channel edge	+7.5 MHz + 0.005 MHz and -7.5 MHz - 0.005 MHz
IBB2 test Parameters	
Category NB1 or NB2 signal power (P_{wanted}) / dBm	REFSENS + 6 dB
Interferer	E-UTRA
Interferer signal power ($P_{Interferer}$) / dBm	- 44 dBm
Interferer bandwidth	5 MHz
Interferer offset range from category NB1 or NB2 channel edge	From +12.5 MHz to F_{DL_high} + 15 MHz and From -12.5 MHz to F_{DL_low} - 15 MHz

7.6B.3 Out-of-band blocking for category NB1 and NB2

7.6B.3.1 Test Purpose

Out-of-band band blocking is defined for an unwanted CW interfering signal falling more than 15 MHz below or above the UE receive band, at which a given average throughput shall meet or exceed the requirement for the specified measurement channels.

For the first 15 MHz below or above the UE receive band the appropriate in-band blocking or adjacent channel selectivity in sub-clause 7.5B and sub-clause 7.6B.2 shall be applied.

The lack of out-of-band blocking ability will decrease the coverage area when other e-NodeB transmitters exist (except in the adjacent channels and spurious response).

7.6B.3.2 Test Applicability

This test case applies to all types of E-UTRA UE release 17 and forward of category NB1 and NB2 that support satellite access operation.

7.6B.3.3 Minimum Conformance Requirements

For the first 15 MHz below or above the UE receive band the appropriate in-band blocking or adjacent channel selectivity in subclause 7.5B and subclause 7.6B.2 shall be applied.

The category NB1 and NB2 UE throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in TS 36.101 [7] Annexes A.3.2 with parameters specified in Table 7.6B.3.3-1.

For Table 7.6B.3.3-1 in frequency range 1, 2 and 3, up to 24 exceptions are allowed for spurious response frequencies in each assigned frequency channel when measured using a 1MHz step size. For these exceptions the requirements of subclause 7.7B spurious response are applicable.

Table 7.6B.3.3-1: Out-of-band blocking parameters for category NB1 and NB2 UE

Operating Band	Parameter	Unit	Range 1	Range 2	Range 3
	P_w	dBm	REFSENS + 6 dB		
	$P_{interferer}$	dBm	-44	-30	-15[3]
253, 254[5], 255	$F_{interferer}$ (CW)	MHz	$-60 < f - F_{DL\_low} < -15$ or $15 < f - F_{DL\_high} < 60$	$-85 < f - F_{DL\_low} \leq -60$ or $60 \leq f - F_{DL\_high} < 85$	$1 \leq f \leq F_{DL\_low} - 85$ or $F_{DL\_high} + 85 \leq f \leq 12750$
256[2]	$F_{interferer}$ (CW)	MHz	$-100 < f - F_{DL\_low} < -15$ or $15 < f - F_{DL\_high} < 60$	$-145 < f - F_{DL\_low} \leq -100$ or $60 \leq f - F_{DL\_high} < 85$	$1 \leq f \leq F_{DL\_low} - 145$ or $F_{DL\_high} + 85 \leq f \leq 12750$

NOTE 1: Void.
NOTE 2: Band 256 lower frequency ranges are modified to enable specific implementations.
NOTE 3: For operating bands which downlink band frequency range is between 1475.9 MHz < f < 2690 MHz the power level of the interferer ($P_{Interferer}$) for Range 3 shall be modified to: -20 dBm for the frequency range which is bounded by F_{DL_low}- 200 MHz of the lowest band that UE supports in frequency range 1475.9 MHz < f < 2690 MHz and F_{DL_high} + 200 MHz of the highest band that UE supports in frequency range 1475.9 MHz < f < 2690 MHz."
NOTE 4: The power level of the interferer ($P_{Interferer}$) for Range 3 shall be modified to -20 dBm for $F_{Interferer}$ > 2800 MHz and $F_{Interferer}$ < 4400 MHz.
NOTE 5: The power level of the interferer ($P_{interferer}$) for Range 3 shall be modified to -20 dBm for $F_{interferer}$ > 2585 MHz and $F_{Interferer}$ < 2775 MHz.

The normative reference for this requirement is TS 36.102 [11] clause 7.6B.3.

7.6B.3.4 Test Description

7.6B.3.4.1 Initial Conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions and test frequencies based on the subset of E-UTRA operating bands defined for category NB1 and NB2 in clause 5.2B. All of these configurations shall be tested with applicable test parameters, and are shown in Table 7.6B.3.4.1-1. The details of the downlink reference measurement channels (RMCs) are specified in Annex A.3. Configurations of NPDSCH and NPDCCH before measurement are specified in Annex C.2.

Table 7.6B.3.4.1-1: Test Configuration Table

Initial Conditions					
Test Environment as specified in TS 36.508 [12] clause 8.1.1			Normal		
Test Frequencies as specified in TS36.508 [12] clause 8.1.3.1			Frequency ranges defined in Annex K.1.1 (Note)		
Configuration ID	**Downlink Configuration**		**Uplink Configuration**		
	Modulation	Subcarriers	Modulation	N_{tones}	Subcarrier spacing
1	QPSK	12	BPSK	1@0	15 kHz
Note: For this test procedure, test only one frequency (low or high) on the device among all supported bands of the UE based on Annex K.1.1					

1. Connect the SS to the UE antenna connector as shown in TS 36.508 [12] Annex A, Figure A.5 using only the main UE Tx/Rx antenna.

2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 8.1.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1 and C.2, and NPUSCH Format 2 is used to carry ACK/NACK on the uplink.

4. The DL Reference Measurement channel is set according to Table 7.6B.3.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. UE location according to TS 36.508 [12] clause 8.2.6.1 is provided to the UE through any preconfigured means.

7. Optionally, for GSO only device to reduce the test time, preconfigure the UE by any means to deactivate ephemeris consistency check so that the UE accepts NGSO (LEO-600) ephemeris.

8a In case the ephemeris consistency check on the UE can be deactivated as described in step 7, the test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] Table 8.2.6.2.1-2 for NGSO (LEO-600).

8b. In case the ephemeris consistency check on the UE cannot be deactivated as described in step 7, the test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] Table 8.2.6.2.1-1 for GSO if UE supports only GSO and Table 8.2.6.2.1-2 for NGSO (LEO-600) if UE supports only NGSO satellites or both GSO and NGSO satellites. Test system shall send same SIB31-NB information during the duration of the test as defined in TS 36.508 [12] clause 8.2.6.3.1.

9. Deactivate UE prediction of satellite trajectory by any preconfigured means.

10. Ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5. Message contents are defined in clause 7.6B.3.4.3.

7.6B.3.4.2 Test Procedure

1. SS transmits NPDSCH via NPDCCH DCI format N1 for C_RNTI to transmit the DL RMC according to Table 7.6B.3.4.1-1. The SS sends downlink MAC padding bits on the DL RMC. The UE will send HARQ feedback based on information contained in DCI format N1.

2. Set the downlink signal level according to the Table 7.6B.3.5-1.

3. Set the parameters of the CW signal generator for an interfering signal below the wanted signal according to Table 7.6B.3.5-1. The frequency step size is 1MHz.

4. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex G.2.

5. Record the frequencies for which the throughput doesn't meet the requirements.

6. Repeat steps from 3 to 5, using an interfering signal above the wanted signal at step 3.

7.6B.3.4.3 Message Contents

Message contents are according to TS 36.508 [12] clause 8.1.6.

7.6B.3.5 Test Requirement

Except for the spurious response frequencies recorded at the final step of test procedure, the throughput measurement derived in test procedure shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in clause A.3.2 with parameters specified in Tables 7.6B.3.5-1.

For Table 7.6B.3.5-1 in frequency range 1, 2 and 3, up to 24 exceptions are allowed for spurious response frequencies in each assigned frequency channel when measured using a 1MHz step size. For these exceptions the requirements of subclause 7.7B spurious response are applicable.

Table 7.6B.3.5-1: Out-of-band blocking parameters for category NB1 and NB2 UE

Operating Band	Parameter	Unit	Range 1	Range 2	Range 3
	P_w	dBm	**REFSENS + 6 dB**		
	$P_{interferer}$	dBm	-44	-30	-15[3]
253, 254[5], 255	$F_{interferer}$ (CW)	MHz	$-60 < f - F_{DL\_low} < -15$ or $15 < f - F_{DL\_high} < 60$	$-85 < f - F_{DL\_low} \le -60$ or $60 \le f - F_{DL\_high} < 85$	$1 \le f \le F_{DL\_low} - 85$ or $F_{DL\_high} + 85 \le f \le 12750$
256[2]	$F_{interferer}$ (CW)	MHz	$-100 < f - F_{DL\_low} < -15$ or $15 < f - F_{DL\_high} < 60$	$-145 < f - F_{DL\_low} \le -100$ or $60 \le f - F_{DL\_high} < 85$	$1 \le f \le F_{DL\_low} - 145$ or $F_{DL\_high} + 85 \le f \le 12750$

NOTE 1: Void.
NOTE 2: Band 256 lower frequency ranges are modified to enable specific implementations.
NOTE 3: For operating bands which downlink band frequency range is between 1475.9 MHz < f < 2690 MHz the power level of the interferer ($P_{Interferer}$) for Range 3 shall be modified to: -20 dBm for the frequency range which is bounded by F_{DL_low}- 200 MHz of the lowest band that UE supports in frequency range 1475.9 MHz < f < 2690 MHz and F_{DL_high} + 200 MHz of the highest band that UE supports in frequency range 1475.9 MHz < f < 2690 MHz."
NOTE 4: The power level of the interferer ($P_{Interferer}$) for Range 3 shall be modified to -20 dBm for $F_{Interferer}$ > 2800 MHz and $F_{Interferer}$ < 4400 MHz.
NOTE 5: The power level of the interferer ($P_{interferer}$) for Range 3 shall be modified to -20 dBm for $F_{interferer}$ > 2585 MHz and $F_{Interferer}$ < 2775 MHz.

7.7 Spurious response

This clause is reserved.

7.7A Spurious response for category M1

7.7A.1 Test Purpose

Spurious response verifies the receiver's ability to receive a wanted signal on its assigned channel frequency without exceeding a given degradation due to the presence of an unwanted CW interfering signal at any other frequency at which a response is obtained i.e. for which the out of band blocking limit as specified in sub-clause 7.6A.3 is not met.

The lack of the spurious response ability decreases the coverage area when other unwanted interfering signal exists at any other frequency.

7.7A.2 Test Applicability

This test case applies to all types of E-UTRA UE release 17 and forward of category M1 that support satellite access operation.

7.7A.3 Minimum Conformance Requirements

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD for the DL-signal as described in Annex A.5.1.1) with parameters specified in Tables 7.7A.3-1 and 7.7A.3-2.

Table 7.7A.3-1: Spurious response parameters

Rx parameter	Units	Channel bandwidth
		1.4 MHz
Power in Transmission Bandwidth Configuration	dBm	REFSENS + channel bandwidth specific value below
		6
NOTE 1: The transmitter shall be set to 4dB below P_{CMAX_L} at the minimum uplink configuration specified in Table 7.3A.3-3 with P_{CMAX_L} as defined in subclause 6.2.5 of TS 36.101 [7]. N OTE 2: Reference measurement channel is specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1. NOTE 3: The REFSENS power level is specified in Table 7.3A.3-1.		

Table 7.7A.3-2: Spurious response

Parameter	Unit	Level
$P_{Interferer}$ (CW)	dBm	-44
$F_{Interferer}$	MHz	Spurious response frequencies

The normative reference for this requirement is TS 36.102 [11] clause 7.7A.

7.7A.4 Test Description

7.7A.4.1 Initial Conditions

The initial conditions shall be the same as in clause 7.6A.3.4.1 in order to test spurious responses obtained in clause 7.6A.3 under the same conditions.

7.7A.4.2 Test Procedure

1. SS transmits PDSCH via MPDCCH DCI format 6-1A for C_RNTI to transmit the DL RMC according to Table 7.6A.3.4.1-1. The SS sends downlink MAC padding bits on the DL RMC. The SS sends one sided dynamic OCNG Pattern OP.1 FDD for the DL-signal as described in Annex A.5.1.1.

2. SS sends uplink scheduling information for each UL HARQ process via MPDCCH DCI format 6-0A for C_RNTI to schedule the UL RMC according to Table 7.6A.3.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.

3. Set the parameters of the CW signal generator for an interfering signal according to Table 7.7A.5-2. The spurious frequencies are taken from records in the final step of test procedures in clause 7.6A.3.4.2.

4. Set the Downlink signal level to the value as defined in Table 7.7A.5-1. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as -MU to -(MU + Uplink power control window size) dB of the target power level in Table 7.7A.5-1 for at least the duration of the throughput measurement, where:

- MU is the test system uplink power measurement uncertainty and is specified in Table F.1.3-1 for the carrier frequency f and the channel bandwidth BW

- Uplink power control window size = 1dB (UE power step size) + 1.0dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS 36.101-1 [7], Table 6.3.5.2.1-1 and is 1.0dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.

5. For the spurious frequency, measure the average throughput for a duration sufficient to achieve statistical significance according to Annex G.2.

7.7A.4.3 Message Contents

Message contents are according to TS 36.508 [12] subclause 4.6 with the condition CEModeA and the following exception.

Table 7.7A.4.3-1: UplinkPowerControlDedicated

Derivation Path: 36.331 clause 6.3.2			
Information Element	**Value/remark**	**Comment**	**Condition**
UplinkPowerControlDedicated-DEFAULT ::= SEQUENCE {			
p0-UePUSCH	0		
deltaMCS-Enabled	en0		
accumulationEnabled	TRUE		
p0-uePUCCH	0		
pSRS-Offset	3 (-6 dB)		
filterCoefficient	fc8	larger filter length is used to reduce the RSRP measurement variation	
}			

7.7A.5 Test Requirement

The throughput measurement derived in test procedure shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.3.2 with parameters specified in Tables 7.7A.5-1 and 7.7A.5-2.

Table 7.7A.5-1: Spurious response parameters

Rx parameter	Units	Channel bandwidth
		1.4 MHz
Power in Transmission Bandwidth Configuration	dBm	REFSENS + channel bandwidth specific value below
		6
NOTE 1: The transmitter shall be set to 4dB below P_{CMAX_L} at the minimum uplink configuration specified in Table 7.3A.3-3 with P_{CMAX_L} as defined in subclause 6.2.5 of TS 36.101 [7]. N OTE 2: Reference measurement channel is specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1. NOTE 3: The REFSENS power level is specified in Table 7.3A.3-1.		

Table 7.7A.5-2: Spurious response

Parameter	Unit	Level
$P_{Interferer}$ (CW)	dBm	-44
$F_{Interferer}$	MHz	Spurious response frequencies

7.7B Spurious response for category NB1 and NB2

7.7B.1 Test purpose

Spurious response verifies the receiver's ability to receive a wanted signal on its assigned channel frequency without exceeding a given degradation due to the presence of an unwanted CW interfering signal at any other frequency at which a response is obtained i.e. for which the out of band blocking limit as specified in sub-clause 7.6B.3 is not met.

The lack of the spurious response ability decreases the coverage area when other unwanted interfering signal exists at any other frequency.

7.7B.2 Test applicability

This test case applies to all types of E-UTRA UE release 17 and forward of category NB1 and NB2 that support satellite access operation.

7.7B.3 Minimum conformance requirements

The category NB1 and NB2 UE throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel as specified in Annexe A.3.2 with parameters specified in Tables 7.7B.3-1.

Table 7.7B.3-1: Spurious response parameters for category NB1 and NB2

Parameter	Unit	Level
P_{signal}	dBm	REFSENS+6
$P_{Interferer}$ (CW)	dBm	-44
$F_{Interferer}$	MHz	Spurious response frequencies
Number of spurious response frequencies		24 (in OOB range 1, 2, 3)
NOTE 1: Reference measurement channel is specified in Annex A.3.2. NOTE 2: The REFSENS power level is specified in 7.3B.3-1. NOTE 3: OOB range 1, 2, 3 refers to Table 7.6B.3.3-1.		

The normative reference for this requirement is TS 36.102 [11] clause 7.7B.

7.7B.4 Test description

7.7B.4.1 Initial conditions

The initial conditions shall be the same as in clause 7.6B.3.4.1 in order to test spurious responses obtained in clause 7.6B.3 under the same conditions.

7.7B.4.2 Test procedure

1. SS transmits NPDSCH via NPDCCH DCI format N1 for C_RNTI to transmit the DL RMC according to Table 7.6B.3.4.1-1. The SS sends downlink MAC padding bits on the DL RMC. The UE will send HARQ feedback based on information contained in DCI format N1.

2. Set the parameters of the CW signal generator for an interfering signal according to Table 7.7B.5-1. The spurious frequencies are taken from records in the final step of test procedures in clause 7.6B.3.4.2

3. Set the Downlink signal level according to the Table 7.7B.5-1.

4. For the spurious frequency, measure the average throughput for a duration sufficient to achieve statistical significance according to Annex G.2.

7.7B.4.3 Message contents

Message contents are according to TS 36.508 [12] clause 8.1.6.

7.7B.5 Test requirement

The throughput measurement derived in test procedure shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.3.2 with parameters specified in Tables 7.7B.5-1.

Table 7.7B.5-1: Spurious response parameters for category NB1 and NB2

Parameter	Unit	Level
P_{signal}	dBm	REFSENS+6
$P_{Interferer}$ (CW)	dBm	-44
$F_{Interferer}$	MHz	Spurious response frequencies
Number of spurious response frequencies		24 (in OOB range 1, 2, 3)
NOTE 1: Reference measurement channel is specified in Annex A.3.2. NOTE 2: The REFSENS power level is specified in 7.3B.3-1. NOTE 3: OOB range 1, 2, 3 refers to Table 7.6B.3.3-1.		

7.8 Intermodulation characteristics

Intermodulation response rejection is a measure of the capability of the receiver to receiver a wanted signal on its assigned channel frequency in the presence of two or more interfering signals which have a specific frequency relationship to the wanted signal.

7.8A Intermodulation characteristics for category M1

7.8A.1 Test purpose

Intermodulation response tests the UE's ability to receive data with a given average throughput for a specified reference measurement channel, in the presence of two or more interfering signals which have a specific frequency relationship to the wanted signal, under conditions of ideal propagation and no added noise.

A UE unable to meet the throughput requirement under these conditions will decrease the coverage area when two or more interfering signals exist which have a specific frequency relationship to the wanted signal.

7.8A.2 Test applicability

This test case applies to all types of E-UTRA UE release 17 and forward of category M1 that support satellite access operation.

7.8A.3 Minimum conformance requirements

The definition in clause 7.8 shall apply. The wide band intermodulation requirement is defined following the same principles using modulated E-UTRA carrier and CW signal as interferer.

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD for the DL-signal as described in Annex A.5.1.1) with parameters specified in Table 7.8A.3-1 for the specified wanted signal mean power in the presence of two interfering signals.

Table 7.8A.3-1: Wide band intermodulation

Rx Parameter	Units	Channel bandwidth
		1.4 MHz
Power in Transmission Bandwidth Configuration	dBm	REFSENS + channel bandwidth specific value below
		12
$P_{Interferer\ 1}$ (CW)	dBm	-46
$P_{Interferer\ 2}$ (Modulated)	dBm	-46
$BW_{Interferer\ 2}$		1.4
$F_{Interferer\ 1}$ (Offset)	MHz	-BW/2 –2.1 / +BW/2+ 2.1
$F_{Interferer\ 2}$ (Offset)	MHz	2*$F_{Interferer\ 1}$

NOTE 1: The transmitter shall be set to 4dB below P_{CMAX_L} at the minimum uplink configuration specified in Table 7.3A.3-3 with P_{CMAX_L} as defined in subclause 6.2.5 of TS 36.101 [7].
NOTE 2: Reference measurement channel is specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1.
NOTE 3: The modulated interferer consists of the Reference measurement channel specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1 with set-up according to Annex C.3.1.
NOTE 4: For DL category M1 UE, the reference sensitivity for category M1 in Table 7.3A.3-1 should be used as REFSENS for the power in Transmission Bandwidth Configuration.
NOTE 5: For DL category M1 UE, the parameters for the applicable channel bandwidth apply, and BW refers to the corresponding channel bandwidth.

The normative reference for this requirement is TS 36.102 [11] clause 7.8A.

7.8A.4 Test description

7.8A.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions and test frequencies based on the subset of E-UTRA operating bands defined for category M1 in clause 5.2A. All of these configurations shall be tested with applicable test parameters for each channel bandwidth, and are shown in Table 7.8A.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3 respectively. The details of the OCNG patterns used are specified in Annex A.5. Configurations of PDSCH and MPDCCH before measurement are specified in Annex C.2

Table 7.8A.4.1-1: Test Configuration Table

Initial Conditions					
Test Environment as specified in TS 36.508[12] subclause 4.1	Normal				
Test Frequencies as specified in TS 36.508 [12] subclause 4.3.1	Mid range				
Test Channel Bandwidths as specified in TS 36.508 [12] subclause 4.3.1	1.4MHz				
Test Parameters for Channel Bandwidths and Narrowband positions					
Configuration ID	**Downlink Configuration**		**Uplink Configuration**		
	Mod'n	RB allocation	Mod'n	RB allocation	Narrowband index (Note 1)
1	QPSK	4	QPSK	6	0
Note 1: Denotes where in the channel Bandwidth the narrowband shall be placed. Narrowband and Narrowband index are defined in TS36.211[3], 5.2.4. Note 2: Downlink RB position shall be RB_{start} = 0 within the narrowband.					

1. Connect the SS to the UE antenna connectors as shown in TS 36.508[12] Annex A Figure A.6 using only main UE Tx/Rx antenna.

2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1 and C.3.1, and uplink signals according to Annex H.1 and H.3.1.

4. The UL and DL Reference Measurement channels are set according to Table 7.8A.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. UE location according to TS 36.508 [12] clause 5.6.1 is provided to the UE through any preconfigured means.

7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] Table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and Table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31 information during the duration of the test as defined in TS 36.508 [12] clause 5.6.3.1.

8. Deactivate UE prediction of satellite trajectory by any preconfigured means.

9. Ensure the UE is in State 3A-RF-CE according to TS 36.508 [12] clause 5.2A.2AA. Message contents are defined in clause 7.8A.4.3.

7.8A.4.2 Test procedure

1. SS transmits PDSCH via MPDCCH DCI format 6-1A for C_RNTI to transmit the DL RMC according to Table 7.8A.4.1-1. The SS sends downlink MAC padding bits on the DL RMC. The SS sends one sided dynamic OCNG Pattern OP.1 FDD for the DL-signal as described in Annex A.5.1.1.

2. SS sends uplink scheduling information for each UL HARQ process via MPDCCH DCI format 6-0A for C_RNTI to schedule the UL RMC according to Table 7.8A.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.

3. Set the Downlink signal level to the value as defined in Table 7.8A.5-1. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as -MU to -(MU + Uplink power control window size) dB of the target power level in Table 7.8A.5-1 for at least the duration of the throughput measurement, where:

- MU is the test system uplink power measurement uncertainty and is specified in Table F.1.3-1 for the carrier frequency f and the channel bandwidth BW

- Uplink power control window size = 1dB (UE power step size) + 1.0dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS 36.101-1

[7], Table 6.3.5.2.1-1 and is 1.0dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.

4. Set the Interfering signal levels to the values as defined in Table 7.8A.5-1 and frequency below the wanted signal, using a modulated interferer bandwidth as defined in Annex D of the present document.

5. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex G.2.

6. Repeat steps from 3 to 5, using an interfering signal above the wanted signal at step 4.

7.8A.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 4.6 with the condition CEModeA and the following exception.

Table 7.8A.4.3-1: UplinkPowerControlDedicated

Derivation Path: 36.331 clause 6.3.2			
Information Element	**Value/remark**	**Comment**	**Condition**
UplinkPowerControlDedicated-DEFAULT ::= SEQUENCE {			
p0-UE-PUSCH	0		
deltaMCS-Enabled	en0		
accumulationEnabled	TRUE		
p0-UE-PUCCH	0		
pSRS-Offset	3 (-6 dB)		
filterCoefficient	fc8	larger filter length is used to reduce the RSRP measurement variation	
}			

7.8A.5 Test requirements

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.3.2 with parameters specified in Table 7.8A.5-1 for the specified wanted signal mean power in the presence of two interfering signals.

Table 7.8A.5-1: Wide band intermodulation

Rx Parameter	Units	Channel bandwidth
		1.4 MHz
Power in Transmission Bandwidth Configuration	dBm	REFSENS + channel bandwidth specific value below
		12
$P_{Interferer\ 1}$ (CW)	dBm	-46
$P_{Interferer\ 2}$ (Modulated)	dBm	-46
$BW_{Interferer\ 2}$		1.4
$F_{Interferer\ 1}$ (Offset)	MHz	-BW/2 –2.1 / +BW/2+ 2.1
$F_{Interferer\ 2}$ (Offset)	MHz	$2*F_{Interferer\ 1}$
NOTE 1: The transmitter shall be set to 4dB below P_{CMAX_L} at the minimum uplink configuration specified in Table 7.3A.3-3 with P_{CMAX_L} as defined in subclause 6.2.5 of TS 36.101 [7]. NOTE 2: Reference measurement channel is specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1. NOTE 3: The modulated interferer consists of the Reference measurement channel specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD as described in Annex A.5.1.1 with set-up according to Annex C.3.1. NOTE 4: For DL category M1 UE, the reference sensitivity for category M1 in Table 7.3A.3-1 should be used as REFSENS for the power in Transmission Bandwidth Configuration. NOTE 5: For DL category M1 UE, the parameters for the applicable channel bandwidth apply, and BW refers to the corresponding channel bandwidth.		

7.8B Intermodulation characteristics for category NB1 and NB2

7.8B.1 Test purpose

Intermodulation response tests the UE's ability to receive data with a given average throughput for a specified reference measurement channel, in the presence of two or more interfering signals which have a specific frequency relationship to the wanted signal, under conditions of ideal propagation and no added noise.

A UE unable to meet the throughput requirement under these conditions will decrease the coverage area when two or more interfering signals exist which have a specific frequency relationship to the wanted signal.

7.8B.2 Test applicability

This test case applies to all types of E-UTRA UE release 17 and forward of category NB1 and NB2 that support satellite access operation.

7.8B.3 Minimum conformance requirements

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel as specified in Annex A.3.2 with parameters specified in Table 7.8B.3-1 for the specified wanted signal mean power in the presence of two interfering signals.

Table 7.8B.3-1: Wide band intermodulation for category NB1 and NB2

Parameters for wideband intermodulation	
Category NB1 or NB2 Signal power	REFSENS + 12 dB
CW interferer signal power	- 46 dBm
1.4 MHz E-UTRA interferer signal power	- 46 dBm
CW interferer offset	± 2.2 MHz
1.4 MHz E-UTRA interferer	± 4.4 MHz

The normative reference for this requirement is TS 36.102 [11] clause 7.8B.

7.8B.4 Test description

7.8B.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions and test frequencies based on the subset of E-UTRA operating bands defined for category NB1 and NB2 in clause 5.2B. All of these configurations shall be tested with applicable test parameters, and are shown in Table 7.8B.4.1-1. The details of the downlink reference measurement channels (RMCs) are specified in Annex A.3. Configurations of NPDSCH and NPDCCH before measurement are specified in Annex C.2.

Table 7.8B.4.1-1: Test Configuration Table

Initial Conditions					
Test Environment as specified in TS 36.508 [12] clause 8.1.1			Normal		
Test Frequencies as specified in TS36.508 [12] clause 8.1.3.1			Frequency ranges defined in Annex K.1.1		
Configuration ID	**Downlink Configuration**		**Uplink Configuration**		
	Modulation	Subcarriers	Modulation	N_{tones}	Subcarrier spacing
1	QPSK	12	BPSK	1@0	15 kHz

1. Connect the SS to the UE antenna connector as shown in TS 36.508 [12] Annex A, Figure A.6 using only the main UE Tx/Rx antenna.
2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 8.1.4.3
3. Downlink signals are initially set up according to Annex C.0, C.1 and C.2, and NPUSCH Format 2 is used to carry ACK/NACK on the uplink.
4. The DL Reference Measurement channel is set according to Table 7.8B.4.1-1.
5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 36.508 [12] clause 8.2.6.1 is provided to the UE through any preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] Table 8.2.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and Table 8.2.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31-NB information during the duration of the test as defined in TS 36.508 [12] clause 8.2.6.3.1.
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.
9. Ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5. Message contents are defined in clause 7.8B.4.3.

7.8B.4.2 Test procedure

1. SS transmits NPDSCH via NPDCCH DCI format N1 for C_RNTI to transmit the DL RMC according to Table 7.8B.4.1-1. The SS sends downlink MAC padding bits on the DL RMC. The UE will send HARQ feedback based on information contained in DCI format N1.
2. Set the Downlink signal level according to the Table 7.8B.5-1.
3. Set the Interfering signal levels to the values as defined in Table 7.8B.5-1 and frequency below the wanted signal, using a modulated interferer bandwidth as defined in Annex D of the present document.
4. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex G.2.
5. Repeat steps from 2 to 4, using an interfering signal above the wanted signal at step 3.

7.8B.4.3 Message contents

Message contents are according to TS 36.508 [12] clause 8.1.6.

7.8B.5 Test requirements

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.3.2 with parameters specified in Table 7.8B.5-1 for the specified wanted signal mean power in the presence of two interfering signals.

Table 7.8B.5-1: Test parameters for Wide band intermodulation for category NB1 and NB2

Parameters for wideband intermodulation	
Category NB1 or NB2 Signal power	REFSENS + 12 dB
CW interferer signal power	- 46 dBm
1.4 MHz E-UTRA interferer signal power	- 46 dBm
CW interferer offset [MHz]	-BW/2 – 2.1 / +BW/2 + 2.1
1.4 MHz E-UTRA interferer offset [MHz]	2*CW interferer offset

7.9 Spurious emissions

7.9A Spurious emissions for category M1

7.9A.1 Test Purpose

The spurious emissions power is the power of emissions generated or amplified in a receiver that appear at the UE antenna connector.

Test verifies the UE's spurious emissions meet the requirements described in clause 7.9A.3.

Excess spurious emissions increase the interference to other systems.

7.9A.2 Test Applicability

This test case applies to all types of E-UTRA UE release 17 and forward of category M1 that support satellite access operation.

7.9A.3 Minimum Conformance Requirements

The power of any narrow band CW spurious emission shall not exceed the maximum level specified in Table 7.9A.3-1.

Table 7.9A.3-1: General receiver spurious emission requirements

Frequency Band	Measurement Bandwidth	Maximum level	Note
30MHz ≤ f < 1GHz	100 kHz	-57 dBm	
1GHz ≤ f ≤ 12.75 GHz	1 MHz	-47 dBm	

The normative reference for this requirement is TS 36.102 [11] clause 7.9.

7.9A.4 Test Description

7.9A.4.1 Initial Conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths based on E-UTRA bands specified in Table 5.2-1. All of these configurations shall be tested with applicable test parameters for each channel bandwidth, and are shown in Table 7.9A.4.1-1. The details of the downlink and uplink reference measurement channels (RMCs) are specified in Annexes A.3 and A.2 respectively.

Table 7.9A.4.1-1: Test Configuration Table

Initial Conditions				
Test Environment as specified in TS 36.508[12] subclause 4.1		Normal		
Test Frequencies as specified in TS36.508 [12] subclause 4.3.1		Low range, Mid range, High range		
Test Channel Bandwidths as specified in TS 36.508 [12] subclause 4.3.1		1.4MHz		
Test Parameters for Channel Bandwidths				
	Downlink Configuration		**Uplink Configuration**	
Test ID	**Modulation**	**RB allocation**	**Modulation**	**RB allocation**
1	QPSK	0	QPSK	0

1. Connect a spectrum analyzer (or other suitable test equipment) to the UE antenna connectors as shown in TS 36.508 [12] Annex A, Figure A.7 using only main UE Tx/Rx antenna.
2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C0, C.1 and C.3.1.
4. The DL Reference Measurement channels are set according to Table 7.9A.4.1-1.
5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 36.508 [12] clause 5.6.1 is provided to the UE through any preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31 information during the duration of the test as define in TS 36.508[12] clause 5.6.3.1
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.
9. Ensure the UE is in State 3A-RF-CE according to TS 36.508 [12] clause 5.2A.2AA. Message contents are defined in clause 7.9A.4.3.

7.9A.4.2 Test Procedure

1. Sweep the spectrum analyzer (or equivalent equipment) over a frequency range and measure the average power of spurious emission.

2. Repeat step 1 for all E-UTRA Rx antennas of the UE.

7.9A.4.3 Message Contents

Message contents are according to TS 36.508 [12] subclause 4.6.

7.9A.5 Test Requirement

The measured spurious emissions derived in step 1), shall not exceed the maximum level specified in Table 7.9A.5-1.

Table 7.9A.5-1: General receiver spurious emission requirements

Frequency Band	Measurement Bandwidth	Maximum level	Note
30MHz ≤ f < 1GHz	100 kHz	-57 dBm	
1GHz ≤ f ≤ 12.75 GHz	1 MHz	-47 dBm	

7.9B Spurious emissions for category NB1 and NB2

7.9B.1 Test Purpose

The spurious emissions power is the power of emissions generated or amplified in a receiver that appear at the UE antenna connector.

Test verifies the UE's spurious emissions meet the requirements described in clause 7.9B.3.

Excess spurious emissions increase the interference to other systems.

7.9B.2 Test Applicability

This test case applies to all types of E-UTRA UE release 17 and forward of category NB1 and NB2 that support satellite access operation.

7.9B.3 Minimum Conformance Requirements

The power of any narrow band CW spurious emission shall not exceed the maximum level specified in Table 7.9B.3-1

Table 7.9B.3-1: General receiver spurious emission requirements

Frequency Band	Measurement Bandwidth	Maximum level	Note
30MHz ≤ f < 1GHz	100 kHz	-57 dBm	
1GHz ≤ f ≤ 12.75 GHz	1 MHz	-47 dBm	

The normative reference for this requirement is TS 36.102 [11] clause 7.9.

7.9B.4 Test Description

7.9B.4.1 Initial Conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths based on E-UTRA bands specified in Table 5.2-1. All of these configurations shall be tested with applicable test parameters for each channel bandwidth, and are shown in Table 7.9B.4.1-1. The details of the downlink and uplink reference measurement channels (RMCs) are specified in Annexes A.3 and A.2 respectively.

Table 7.9B.4.1-1: Test Configuration Table

Initial Conditions				
Test Environment as specified in TS 36.508[12] subclause 8.1.1		Normal		
Test Frequencies as specified in TS36.508 [12] subclause 8.1.3.1		Frequency ranges defined in Annex K.1.1		
Test Parameters for Channel Bandwidths				
	Downlink Configuration		**Uplink Configuration**	
Test ID	**Modulation**	**N_{tones}**	**Modulation**	**N_{tones}**
1	QPSK	0	BPSK	0

1. Connect a spectrum analyzer (or other suitable test equipment) to the UE antenna connectors as shown in TS 36.508 [12] Annex A, Figure A.7 using only main UE Tx/Rx antenna.
2. The parameter settings for the cell are set up according to TS 36.508 [12] subclause 8.1.4.3.
3. Downlink signals are initially set up according to Annex C0, C.1 and C.3.1.
4. The DL Reference Measurement channels are set according to Table 7.9B.4.1-1.
5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 36.508 [12] clause 8.2.6.1 is provided to the UE through any preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 8.2.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 8.2.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31-NB information during the duration of the test as define in TS 36.508[12] clause 8.2.6.3.1
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.
9. Ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5. Message contents are defined in clause 7.9B.4.3.

7.9B.4.2 Test Procedure

1. Sweep the spectrum analyzer (or equivalent equipment) over a frequency range and measure the average power of spurious emission.
2. Repeat step 1 for all E-UTRA Rx antennas of the UE.

7.9B.4.3 Message Contents

Message contents are according to TS 36.508 [12] subclause 8.1.6.

7.9B.5 Test Requirement

The measured spurious emissions derived in step 1), shall not exceed the maximum level specified in Table 7.9B.5-1.

Table 7.9B.5-1: General receiver spurious emission requirements

Frequency Band	Measurement Bandwidth	Maximum level	Note
30MHz ≤ f < 1GHz	100 kHz	-57 dBm	
1GHz ≤ f ≤ 12.75 GHz	1 MHz	-47 dBm	

8 Performance requirement

This clause contains performance requirements for the physical channels specified in TS 36.211[3]. The performance requirements for the UE in this clause are specified for the measurement channels specified in TS 36.102[11] Annex A, the propagation conditions in TS 36.102[11] Annex D and the downlink channels in TS 36.102[11] Annex B.

8.1 General

8.1.1 Receiver antenna capability

The performance requirements are based on UE(s) that utilize one or more antenna receivers.

For all test cases, the SNR is defined as

$$SNR = \frac{\sum_{j=1}^{N_{RX}} \hat{E}_s^{(j)}}{\sum_{j=1}^{N_{RX}} N_{oc}^{(j)}}$$

where N_{RX} denotes the number of receiver antenna connectors and the superscript receiver antenna connector j. The above SNR definition assumes that the REs are not precoded. The SNR definition does not account for any gain which can be associated to the precoding operation. The relative power of physical channels transmitted is defined in TS 36.102[11] Annex C. The SNR requirement applies for the UE categories given for each test.

8.1.2 Applicability of requirements

8.1.2.1 Applicability of requirements for different channel bandwidths

In Clause 8 the test cases may be defined with different channel bandwidth to verify the same target FRC conditions with the same propagation conditions, correlation matrix and antenna configuration.

8.1.2.2 Applicability of requirements for optional UE features

The performance requirements in Table 8.1.2.2-1 shall apply for UEs which support optional UE features only. If same test is listed for different UE features/capabilities in Clauses 8.1.2.2, then this test shall apply for UEs which support all corresponding UE features/capabilities.

Table 8.1.2.2-1: Requirements applicability for optional UE features

UE feature/capability	Test list	Applicability notes
NTN access (ntn-Connectivity-EPC-r17)	Clause 8.2.1.1.1 (Test 1, Test 2, Test 3)	The requirements apply only for UE Category M1
	Clause 8.3.1.1.1 (Test 1, Test 2)	The requirements apply only for UE Category NB1, NB2
NTN scenario support (ntn-ScenarioSupport-r17)	Clause 8.2.1.1.1 (Test 1, Test 2, Test 3)	The requirements apply only for UE Category M1, and only when ntn-ScenarioSupport-r17 is "ngso" or is not included
	Clause 8.3.1.1.1 (Test 1, Test 2)	The requirements apply only for UE Category NB1, NB2, and only when ntn-ScenarioSupport-r17 is "ngso" or is not included
Operation in coverage enhancement mode A (ce-ModeA-r13)	Clause 8.2.1.1.1 (Test 1, Test 2)	The requirements apply only for UE Category M1
Operation in coverage enhancement mode B (ce-ModeB-r13)	Clause 8.2.1.1.1 (Test 3)	The requirements apply only for UE Category M1
Note: For UE supports NTN access (*ntn-Connectivity-EPC-r17*), the requirements in TS36.101[7] Clause 8 and Clause 9 also applies to UE according to the UE category and capability		

8.1.3 UE category and UE DL category

UE category and UE DL category refer to ue-Category, ue-CategoryDL, and ue-Category-NB define in 4.1, 4.1A and 4.1C from TS 36.306. A UE that belongs to either a UE category or a UE DL category indicated in UE performance requirements in subclause 8 shall fulfil the corresponding requirements.

8.2 Demodulation for IOT NTN UE category M1

8.2.1 FDD and half-duplex FDD

8.2.1.1 PDSCH

The parameters specified in Table 8.2.1.1-1 and 8.2.1.1-2 are valid for FDD and half-duplex FDD tests unless otherwise stated.

Table 8.2.1.1-1: Common Test Parameters for 8.2.1.1.2 to 8.2.1.1.5(FDD and half-duplex FDD)

Parameter	Unit	CE Mode A	CE Mode B
Number of HARQ processes per component carrier	Processes	8 or 10 (Note 2)	2
Maximum number of HARQ transmission		4	4
Redundancy version coding sequence		{0, 2, 3,1} for QPSK and 16QAM	{0,0,0,0,2,2,2,2,3,3,3,3,1,1,1,1 …} for QPSK
Number of OFDM symbols for PDCCH per component carrier	OFDM symbols	4 for 1.4 MHz bandwidth, 3 for 3 MHz and 5 MHz bandwidths, 2 for 10 MHz, 15 MHz and 20 MHz bandwidths	4 for 1.4 MHz bandwidth, 3 for 3 MHz and 5 MHz bandwidths, 2 for 10 MHz, 15 MHz and 20 MHz bandwidths
Cyclic Prefix		Normal	Normal
Beamforming Precoder for MPDCCH		Annex B.4.4	Annex B.4.4
Precoder update granularity for MPDCCH		Frequency domain: 1 PRB Time domain: identical during the hopping period (interval-FDD for CE Mode A)	Frequency domain: 1 PRB Time domain: identical during the hopping period (interval-FDD for CE Mode B)
BL/CE DL subframe comfiguration (fdd-DownlinkOrTddSubframeBitmapBR)		1111111111	1111111111
Note 1: rvidx is defined in TS 36.213[6] Table 7.1.7.1-2. Note 2: For UE supporting ce-pdsch-tenProcesses-r13, the number of HARQ processese are set to 10, otherwise, it is set to 8.			

Table 8.2.1.1-2: Common Test Parameters for 8.2.1.1.1(FDD and half-duplex FDD)

Parameter	Unit	CE Mode A	CE Mode B
Inter-TTI Distance		1	1
Number of HARQ processes per component carrier	Processes	8	2
Maximum number of HARQ transmission		4	4
Redundancy version coding sequence rv_{idx} (Note 1)		{0, 2, 3, 1} for QPSK and 16QAM	{0,0,0,0,2,2,2,2,3,3,3,3,1,1,1,1 …} for QPSK
Cyclic Prefix		Normal	Normal
Beamforming Precoder for MPDCCH		N/A	N/A
BL/CE DL subframe comfiguration (fdd-DownlinkOrTddSubframeBitmapBR)		1111111111	1111111111
HARQ bundling(ce-HARQ-AckBundling)		Disabled	Disabled
K_{offset} (k-Offset)	ms	8	8
Note 1: rv_{idx} is defined in TS 36.213[6] table 7.1.7.1-2.			

8.2.1.1.1 PDSCH in standalone mode for UE category M1 under NTN fading conditions

Editor's Note: This test is incomplete. The following aspects are not yet determined:

- Minimum Test time is pending.

8.2.1.1.1.1 Test purpose

To verify the UE's ability to receive a predefined test signal, representing a multi-path fading channel that is determined by the SNR with a percentage of the information bit throughput for a specified downlink Reference Measurement Channel (RMC) not falling below a specified value for transmission on one antenna ports.

8.2.1.1.1.2 Test applicability

This test applies to all types of E-UTRA FDD UE release 17 and forward of UE category M1 that supports satellite access operation.

8.2.1.1.1.3 Minimum conformance requirements

The requirements are specified in Table 8.2.1.1.1.3-2, with the addition of the parameters in Table 8.2.1.1.1.3-1, and the downlink physical channel setup according to Annex C.3.2. The purpose is to verify the performance of single antenna port configuration.

Table 8.2.1.1.1.3-1: Test Parameters for single antenna port (FRC)

Parameter		Unit	Test 1	Test 2	Test 3
Downlink power allocation	ρ_A		-3	-3	-3
	ρ_B		-3 (Note 1)	-3 (Note 1)	-3 (Note 1)
	σ		0	0	0
	δ		3	3	3
N_{oc} at antenna port		dBm/15kHz	-98	-98	-98
Coverage enhancement mode			CE Mode A	CE Mode A	CE Mode B
PDSCH transmission mode			1	1	1
OFDM starting symbol (startSymbolBR)			2	2	2
Maximum number of repetitions (for PDSCH (*pdsch-maxNumRepetitionCEmodeA/ pdsch-maxNumRepetitionCEmodeB*))			Not configured	Not configured	Not configured
PDSCH repetition number			1	8	64
Frequency hopping (mpdcch-pdsch-HoppingConfig)			Disabled	Disabled	Disabled
Frequency hopping offset (mpdcch-pdsch-HoppingOffset)			N/A	N/A	N/A
Frequency hopping interval (interval-FDD)		ms	N/A	N/A	N/A
MPDCCH transmission duration (mPDCCH-NumRepetition)		ms	1	8	64
MPDCCH repetition number			1	8	64
Number of narrowbands for frequency hopping (mpdcch-pdsch-HoppingNB)			N/A	N/A	N/A
Starting subframe configuration for MPDCCH (mpdcch_startSF_UESS)			1	4	2.5
Narrowband for MPDCCH (mpdcch_Narrowband)			0	0	0
MPDCCH aggregation level			8	24	24

Note 1: $P_B = 1$.
Note 2: For each test, DC subcarrier puncturing shall be considered.
Note 3: If not otherwise stated, the values in this table refer to parameters in TS 36.211 [3] or/and TS 36.213 as appropriate.

Table 8.2.1.1.1.3-2: Minimum performance for single antenna port (FRC)

Test number	Bandwidth and MCS	Reference Channel	OCNG Pattern	Propagation Condition	Correlation Matrix and Antenna Configuration	Reference value		UE Category
						Fraction of Maximum Throughput (%)	SNR (dB)	
1	1.4MHz 16QAM 1/2	R.1 FDD	OP.1 FDD	NTN-TDLC5-30	1x1	70	10.4	M1
2	1.4MHz QPSK 1/3	R.2 FDD	OP.1 FDD	NTN-TDLA100-200	1x1	70	-4.2	M1
3	1.4MHz QPSK 1/10	R.3 FDD	OP.1 FDD	NTN-TDLA100-10	1x1	70	-11.5	M1

The normative reference for this requirement is TS 36.102[11] clause 8.2.1.1.1.1.

8.2.1.1.1.4 Test description

8.2.1.1.1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

Configurations of PDSCH and MPDCCH before measurement are specified in Annex C.2.

Test Environment: Normal, as defined in TS 36.508 [12] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 36.508 [12] clause 4.3.1.1.

Channel Bandwidths to be tested: As specified in Table 8.2.1.1.1.3-2 as defined in TS 36.508 [12] clause 4.3.1.1.

1. Connect the SS, the faders and AWGN noise sources to the UE antenna connectors as shown in TS 36.508[12] Annex A, Figure A.9 using only main UE Tx/Rx antenna.
2. The parameter settings for the cell are set up according to Tables 8.2.1.1-1, 8.2.1.1-2 and 8.2.1.1.1.3-1 as appropriate.
3. Downlink signals are initially set up according to Annex C.0, C.1 and Annex C.3.2 and uplink signals according to Annex H.1 and H.3.2.
4. Propagation conditions are set according to Annex B.0.
5. UE location according to TS 36.508 [12] clause 5.6.1 is provided to the UE by any preconfigured means.
6. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 5.6.2.1-2 for NGSO (LEO-600). Test system shall send same SIB31 information during the duration of the test as defined in TS 36.508 [12] clause 5.6.3.1.
7. Deactivate UE prediction of satellite trajectory by any preconfigured means.
8. Ensure the UE is in State 3A-RF-CE according to TS 36.508[12] clause 5.2A.2AA. Message contents are defined in clause 8.2.1.1.1.4.3.

8.2.1.1.1.4.2 Test procedure

1. SS transmits PDSCH via MPDCCH DCI with narrowband index nRB = 0 for C_RNTI to transmit the DL RMC according to Tables 8.2.1.1.1.3-1 and 8.2.1.1.1.3-2.
2. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix, antenna configuration and the SNR according to Table 8.2.1.1.1.5-1 as appropriate.
3. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex G clause G.3. Count the number of NACKs, ACKs and statDTXs on the UL during the test interval and decide pass or fail according to Tables G.3.5 and G.3.6 in Annex G clause G.3.

4. Repeat steps from 1 to 3 for each test interval in Tables 8.2.1.1.1.5-1 as appropriate.

8.2.1.1.1.4.3 Message contents

Message contents are according to TS 36.508[12] clause 4.6 and clause 4.14 with condition CEModeA with the following exception.

Table 8.2.1.1.1.4.3-1: EPDCCH-Config-r11-DEFAULT configuration

Derivation Path: 36.508 Table 4.6.3-2B			
Information Element	**Value/remark**	**Comment**	**Condition**
setConfigToAddModList-r11 SEQUENCE {	1 entry		
setConfigId-r11[1]	0		
transmissionType-r11[1]	distributed		
resourceBlockAssignment-r11[1] SEQUENCE{			
numberPRB-Pairs-r11	n2		
resourceBlockAssignment-r11	1110		
}			
dmrs-ScramblingSequenceInt-r11[1]	0		
pucch-ResourceStartOffset-r11[1]	0		
re-MappingQCL-ConfigListId-r11[1]	Not present		
numberPRB-Pairs-v1310 CHOICE[1] {	Not present		
}			
mpdcch-config-r13 CHOICE {			
mpdcch-StartSF-UESS-r13{			
fdd-r13	V1 for test1; v4 for test2; v2dot5 for test3		FDD
}			
mpdcch-NumRepetition-r13	r1 for test1; r8 for test2; r64 for test3		
mpdcch-Narrowband-r13	1	Narrowband index 0	
}			
}			

8.2.1.1.1.5 Test requirement

Table 8.2.1.1.1.3-1 defines the primary level settings.

The fraction of maximum throughput percentage for the downlink reference measurement channels specified in TS 36.102[11] Annex A clause A.1.2.1 for each throughput test shall meet or exceed the specified value in Table 8.2.1.1.1.5-1 for the specified SNR including test tolerances for all throughput tests.

Table 8.2.1.1.1.5-1: Test requirements under standalone with 1 NRS ports

Test number	Bandwidth and MCS	Reference Channel	OCNG Pattern	Propagation Condition	Correlation Matrix and Antenna Configuration	Reference value		UE Category
						Fraction of Maximum Throughput (%)	SNR (dB)	
1	1.4MHz 16QAM 1/2	R.1 FDD	OP.1 FDD	NTN-TDLC5-30	1x1	70	11.2	M1
2	1.4MHz QPSK 1/3	R.2 FDD	OP.1 FDD	NTN-TDLA100-200	1x1	70	--3.4	M1
3	1.4MHz QPSK 1/10	R.3 FDD	OP.1 FDD	NTN-TDLA100-10	1x1	70	-10.7	M1

8.3 Demodulation for IOT NTN UE category NB1 and NB2

8.3.1 Half-duplex FDD

8.3.1.1 NPDSCH

The parameters specified in Table 8.3.1.1-1 and Table 8.3.1.1-2 are valid for all half-duplex FDD tests unless otherwise stated.

Table 8.3.1.1-1: Common Test Parameters

Parameter	Unit	Value
Number of HARQ processes per component carrier	Processes	1
Maximum number of HARQ transmission		4
Cyclic Prefix		Normal
eutraControlRegionSize-r13		N/A
downlinkBitmap-r13 and dl-Gap-r13		Not configured
dl-GapNonAnchor-r13 and downlinkBitmapNonAnchor-r13		Not configured
Unused REs or RB		OCNG
OCNG pattern (Note 1)		NB.OP.1

Table 8.3.1.1-2: Test Parameters of related NPDCCH and NPUSCH format 2 configurations

Parameter	Unit	Value
DCI format		DCI format N1
scheduling delay field (I_{Delay})		1
N_{Rep}^{AN} (*ack-NACK-NumRepetitions-r13*)		1
ACK/NACK resource field		0
Reference channel for NPDCCH (Note 1)		R.NB.3 FDD
α_{offset} (*npdcch-Offset-USS-r13*)		0
K_offset	ms	8

8.3.1.1.1 Demodulation of NPDSCH (Cell-Specific Reference Symbols) in standalone mode for category NB1 and NB2 under NTN fading conditions

8.3.1.1.1.1 Test purpose

To verify the UE's ability to receive a predefined test signal, representing a multi-path fading channel that is determined by the SNR with a percentage of the information bit throughput for a specified downlink Reference Measurement Channel (RMC) not falling below a specified value for transmission on one antenna ports.

8.3.1.1.1.2 Test applicability

This test applies to all types of NB-IoT FDD UE release 17 and forward of category NB1 and NB2 that supports satellite access operation and only NGSO or both GSO and NGSO. Test 2 requires support of non-anchor mode of operation.

8.3.1.1.1.3 Minimum conformance requirements

The requirements are specified in Table 8.3.1.1.1.3-2, with the addition of the parameters in Table 8.3.1.1.1.3-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the performance.

Table 8.3.1.1.1.3-1: Test Parameters for NPDSCH under Standalone

Parameter	Unit		Test 1, 2
N_{oc} at antenna port	N_{oc1}	dBm/15kHz	-93 (Note 1)
	N_{oc2}	dBm/15kHz	-99 (Note 2)
NPDCCH repetition number		subframe	32 for Test 1; 128 for Test 2.
R_{max} (*npdcch-NumRepetitions-r13*)		subframe	64 for Test 1; 256 for Test 2.
G (*nPDCCH-startSF-USS-r13*)			1.5
Note 1: This noise is applied to all subframes from the end of the NPDCCH to the end of the following NPDSCH transmission. Note 2: This noise is applied to all subframes from the end of the NPDSCH to the end of the following NPDCCH transmission.			

Table 8.3.1.1.1.3-2: Minimum performance for NPDSCH under Standalone with 1 NRS port

Test number	Bandwidth	Carrier Type	Reference Channel	Repetition number	Propagation condition	Number of NRS ports	Antenna Configuration	Reference value		UE Category
								Fraction of Maximum Throughput (%)	SNR (dB)	
1	200kHz	Anchor	R.NB.1 FDD	32	NTN-TDLC5-200	1	1x1	70%	-4.7	NB1, NB2
2	200kHz	Non-anchor	R.NB.2 FDD	128	NTN-TDLA100-10	1	1x1	70%	-10.6	NB1, NB2

The normative reference for this requirement is TS 36.102[11] clause 8.3.1.1.1.1.

8.3.1.1.1.4 Test description

8.3.1.1.1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

Configurations of NPDSCH and NPDCCH before measurement are specified in Annex C.2.

Test Environment: Normal, as defined in TS 36.508 [12] clause 4.1.

Frequencies to be tested: K.2.1.

Channel Bandwidths to be tested: As specified per test number in Table 8.3.1.1.1.3-2.

1. Connect the SS, the faders and AWGN noise sources to the UE antenna connectors as shown in TS 36.508 [12] Annex A, Figure A.9 using only main UE Tx/Rx antenna.
2. The parameter settings for the cell are set up according to Tables 8.3.1.1-1 and 8.3.1.1.1.3-1 as appropriate.
3. Downlink signals are initially set up according to Annex C.0, C.1 and Annex C.3.2 and uplink signals according to Annex H.0.1, H.1.1, H.2.1 and Annex H.4.2.
4. Propagation conditions are set according to Annex B.0.
5. UE location according to TS 36.508 [12] clause 8.2.6.1 is provided to the UE by any preconfigured means.
6. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 8.2.6.2.1-2 for NGSO (LEO-600). Test system shall send same SIB31-NB information during the duration of the test as defined in TS 36.508 [12] clause 8.2.6.3.1.
7. Deactivate UE prediction of satellite trajectory by any preconfigured means.
8. Ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5. Message contents are defined in clause 8.3.1.1.1.4.2.

8.3.1.1.1.4.2 Test procedure

1. SS transmits NPDSCH via NPDCCH DCI format N1 for C_RNTI to transmit the DL RMC according to Tables 8.3.1.1.1.3-1 and 8.3.1.1.1.3-2.
2. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix, antenna configuration and the SNR according to Table 8.3.1.1.1.5-1 as appropriate.
3. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex G clause G.3. Count the number of NACKs, ACKs and statDTXs on the UL during the test interval and decide pass or fail according to Tables G.3.5 and G.3.6 in Annex G clause G.3.
4. Repeat steps from 1 to 3 for each test interval in Tables 8.3.1.1.1.5-1 as appropriate.

8.3.1.1.1.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 8.1.5B and 8.1.6 with the following exceptions:

Table 8.3.1.1.1.4.3-1: Configure Non-anchor carrier in subtest 2

Derivation Path: 36.508 Table 8.1.8.2.1.6-1 PhysicalConfigDedicated-NB-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
PhysicalConfigDedicated-NB-DEFAULT ::= SEQUENCE {			
carrierConfigDedicated-NB-r13 ::= SEQUENCE {		Non-anchor carrier	
dl-CarrierConfig-r13::= SEQUENCE {			
dl-CarrierFreq-r13	Note 1		
downlinkBitmapNonAnchor-r13	NULL		
dl-GapNonAnchor-r13	NULL		
}			
ul-CarrierConfig-r13 ::= SEQUENCE {			
ul-CarrierFreq-r13	Note 1		
}			
}			
npdcch-ConfigDedicated-r13	NPDCCH-ConfigDedicated-NB-DEFAULT	See subclause 8.1.6.3 in 36.508	
npusch-ConfigDedicated-r13	NPUSCH-ConfigDedicated-NB-DEFAULT	See subclause 8.1.6.3 in 36.508	
uplinkPowerControlDedicated-r13	UplinkPowerControlDedicated-NB-DEFAULT	See subclause 8.1.6.3 in 36.508	
}			
Note 1: The frequency of Non-anchor carrier is located at 200KHz higher from the centre of the anchor carrier.			

Table 8.3.1.1.1.4.3-2: NPDCCH-ConfigDedicated-NB-DEFAULT

Derivation Path: 36.508 Table 8.1.6.3-3 NPDCCH-ConfigDedicated-NB-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
NPDCCH-ConfigDedicated-NB-DEFAULT ::= SEQUENCE {			
npdcch-NumRepetitions-r13	r64 for Test 1; r256 for Test 2.		
npdcch-StartSF-USS-r13	V1.5		
npdcch-Offset-USS-r13	zero		
}			

Table 8.3.1.1.1.4.3-3: NPUSCH-ConfigDedicated-NB-DEFAULT

Derivation Path: 36.508 Table 8.1.6.3-7			
Information Element	**Value/remark**	**Comment**	**Condition**
NPUSCH-ConfigDedicated-NB-DEFAULT ::= SEQUENCE {			
ack-NACK-NumRepetitions-r13	R1	Default	
npusch-AllSymbols-r13	TRUE	Default	
groupHoppingDisabled-r13	Not present	Default	
}			

Table 8.3.1.1.1.4.3-4: NB-IoT Physical layer parameters for DCI format N1

Derivation Path: 36.508 Table 8.1.3.6.1.2-2			
Parameter	**Value**	**Value in binary**	**Condition**
Repetition number	NRep = 32		For Test Number 1
Repetition number	NRep = 128		For Test Number 2

8.3.1.1.1.5 Test requirement

Table 8.3.1.1.1.3-1 defines the primary level settings.

The fraction of maximum throughput percentage for the downlink reference measurement channels specified in TS 36.102[11] Annex A clause A.1.1.1 for each throughput test shall meet or exceed the specified value in Table 8.3.1.1.1.5-1 for the specified SNR including test tolerances for all throughput tests.

Table 8.3.1.1.1.5-1: Test requirements under standalone with 1 NRS ports

Test number	Bandwidth	Carrier Type	Reference Channel	Repetition number	Propagation condition	Number of NRS ports	Antenna Configuration	Reference value		UE Category
								Fraction of Maximum Throughput (%)	SNR (dB)	
1	200kHz	Anchor	R.NB.1 FDD	32	NTN-TDLC5-200	1	1x1	70%	--3.9	NB1, NB2
2 Note1	200kHz	Non-anchor	R.NB.2 FDD	128	NTN-TDLA100-10	1	1x1	70%	--9.8	NB1, NB2
Note 1: Applicable to UE supporting Non-Anchor mode of operation.										

8.3.1.1.2 Demodulation of NPDSCH (Cell-Specific Reference Symbols) in standalone mode for category NB1 and NB2

8.3.1.1.2.1 Test purpose

To verify the UE's ability to receive a predefined test signal, representing a multi-path fading channel that is determined by the SNR with a percentage of the information bit throughput for a specified downlink Reference Measurement Channel (RMC) not falling below a specified value for transmission on one antenna ports.

8.3.1.1.2.2 Test applicability

This test applies to all types of NB-IoT FDD UE release 17 and forward of category NB1 and NB2 that supports satellite access operation.

8.3.1.1.2.3 Minimum conformance requirements

The requirements are specified in Table 8.3.1.1.2.3-2, with the addition of the parameters in Table 8.3.1.1.2.3-1 and the downlink physical channel setup according to Annex C.3.2. Using this configuration the fraction of maximum throughput percentage shall meet or exceed the minimum requirements specified in Table 8.3.1.1.2.3-2 for the specified SNR.

Table 8.3.1.1.2.3-1: Test Parameters for NPDSCH under standalone

Parameter	Unit		Test 1, 2
N_{oc} at antenna port	N_{oc1}	dBm/15kHz	-93 (Note 1)
	N_{oc2}	dBm/15kHz	-99 (Note 2)
NPDCCH repetition number		subframe	32 for Test 1; 256 for Test 2.
$R_{\max}$ (*npdcch-NumRepetitions-r13*)		subframe	64 for Test 1; 512 for Test 2.
G (*nPDCCH-startSF-USS-r13*)			1.5
Note 1: This noise is applied to all subframes from the end of the NPDCCH to the end of the following NPDSCH transmission; Note 2: This noise is applied to all subframes from the end of the NPDSCH to the end of the following NPDCCH transmission.			

Table 8.3.1.1.2.3-2: Minimum performance under standalone

Test number	Band width	Carrier Type	Reference Channel	Repetition number	Propagation condition	Number of NRS ports	Reference value		UE Category
							Fraction of Maximum Throughput (%)	SNR (dB)	
1	200kHz	Anchor	R.NB.6 FDD (Note 2)	32	EPA5	1	70%	-3.4	NB1, NB2
2 (Note 1)	200kHz	Non-anchor	R.NB.6-1 FDD (Note 2)	256	ETU1	1	70%	-10.2	NB1, NB2
Note 1: Applicable to UE supporting Non-Anchor mode of operation. Note 2: R.NB.6 FDD has the same parameters with R.NB.1 FDD in Table A.3.12.1.1-1. R.NB.6-1 FDD has the same parameters with R.NB.2 FDD in Table A.3.12.1.1-1.									

The normative reference for this requirement is TS 36.101 [2] clause 8.12.1.1.2.

8.3.1.1.2.4 Test description

8.3.1.1.2.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

Configurations of NPDSCH and NPDCCH before measurement are specified in Annex C.2.

Test Environment: Normal, as defined in TS 36.508 [12] clause 4.1.

Frequencies to be tested: K.2.1.

Channel Bandwidths to be tested: As specified per test number in Table 8.3.1.1.2.3-2.

1. Connect the SS, the faders and AWGN noise sources to the UE antenna connectors as shown in TS 36.508 [12] Annex A, Figure A.9 using only main UE Tx/Rx antenna.
2. The parameter settings for the cell are set up according to Tables 8.3.1.1-1 and 8.3.1.1.2.3-1 as appropriate.
3. Downlink signals are initially set up according to Annex C.0, C.1 and Annex C.3.2 and uplink signals according to Annex H.0.1, H.1.1, H.2.1 and Annex H.4.2.
4. Propagation conditions are set according to Annex B.0.
5. UE location according to TS 36.508 [12] clause 8.2.6.1 is provided to the UE by any preconfigured means.
6. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 8.2.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 8.2.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31-NB information during the duration of the test as defined in TS 36.508 [12] clause 8.2.6.3.1.
7. Deactivate UE prediction of satellite trajectory by any preconfigured means.
8. Ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5. Message contents are defined in clause 8.3.1.1.2.4.3.

8.3.1.1.2.4.2 Test procedure

1. SS transmits NPDSCH via NPDCCH DCI format N1 for C_RNTI to transmit the DL RMC according to Tables 8.3.1.1.2.3-1 and 8.3.1.1.2.3-2.
2. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix, antenna configuration and the SNR according to Table 8.3.1.1.2.5-1 as appropriate.
3. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex G clause G.3. Count the number of NACKs, ACKs and statDTXs on the UL during the test interval and decide pass or fail according to Tables G.3.5 and G.3.6 in Annex G clause G.3.
4. Repeat steps from 1 to 3 for each test interval in Tables 8.3.1.1.2.5-1 as appropriate.

8.3.1.1.2.4.3 Message contents

Message contents are same as 8.3.1.1.1.4.3 with the following exceptions:

Table 8.3.1.1.2.4.3-1: NPDCCH-ConfigDedicated-NB-DEFAULT

Derivation Path: 36.508 Table 8.1.6.3-3 NPDCCH-ConfigDedicated-NB-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
NPDCCH-ConfigDedicated-NB-DEFAULT ::= SEQUENCE {			
npdcch-NumRepetitions-r13	r64 for Test 1; r512 for Test 2.		
npdcch-StartSF-USS-r13	V1.5		
}			

Table 8.3.1.1.2.4.3-2: NB-IoT Physical layer parameters for DCI format N1

Derivation Path: 36.508 Table 8.1.3.6.1.2-2			
Parameter	**Value**	**Value in binary**	**Condition**
Repetition number	NRep = 32		For Test Number 1
Repetition number	NRep = 256		For Test Number 2

8.3.1.1.2.5 Test requirement

Table 8.3.1.1.2.3-1 defines the primary level settings.

The fraction of maximum throughput percentage for the downlink reference measurement channels specified in Annex A clause A.3.12.1.1 for each throughput test shall meet or exceed the specified value in Table 8.3.1.1.2.5-1 for the specified SNR including test tolerances for all throughput tests.

Table 8.3.1.1.2.5-1: Test requirements under standalone with 1 NRS ports

Test number	Bandwidth	Carrier Type	Reference Channel	Repetition number	Propagation condition	Number of NRS ports	Reference value	
							Fraction of Maximum Throughput (%)	SNR (dB)
1	200kHz	Anchor	R.NB.6 FDD (Note 2)	32	EPA5	1	70%	-2.6
2 (Note 1)	200kHz	Non-anchor	R.NB.6-1 FDD (Note 2)	256	ETU1	1	70%	-9.4
Note 1: Applicable to UE supporting Non-Anchor mode of operation. Note 2: R.NB.6 FDD has the same parameters with R.NB.1 FDD in Table A.3.12.1.1-1. R.NB.6-1 FDD has the same parameters with R.NB.2 FDD in Table A.3.12.1.1-1.								

8.3.1.1.3 Demodulation of NPDSCH (Cell-Specific Reference Symbols) in standalone for NB2

8.3.1.1.3.1 Test purpose

To verify the UE's ability to receive a predefined test signal, representing a multi-path fading channel that is determined by the SNR with a percentage of the information bit throughput for a specified downlink Reference Measurement Channel (RMC) not falling below a specified value for transmission on one antenna port.

8.3.1.1.3.2 Test applicability

This test applies to all types of NB-IoT FDD UE release 17 and forward of category NB2 that supports satellite access operation.

8.3.1.1.3.3 Minimum conformance requirements

The requirements are specified in Table 8.3.1.1.3.3-2, with the addition of the parameters in Table 8.3.1.1.3.3-1 and the downlink physical channel setup according to Annex C.3.2. Using this configuration the fraction of maximum throughput percentage shall meet or exceed the minimum requirements specified in Table 8.3.1.1.3.3-2 for the specified SNR.

Table 8.3.1.1.3.3-1: Test Parameters for NPDSCH under Standalone

Parameter	Unit		Test 1
N_{oc} at antenna port	N_{oc1}	dBm/15kHz	-93 (Note 1)
	N_{oc2}	dBm/15kHz	-96 (Note 2)
NPDCCH repetition number		subframe	4 for Test 1
$R_{\max}$ (*npdcch-NumRepetitions-r13*)		subframe	8 for Test 1
G (*nPDCCH-startSF-USS-r13*)			1.5
Note 1: This noise is applied to all subframes from the end of the NPDCCH to the end of the following NPDSCH transmission; Note 2: This noise is applied to all subframes from the end of the NPDSCH to the end of the following NPDCCH transmission.			

Table 8.3.1.1.3.3-2: Minimum performance for NPDSCH under Standalone with 1 NRS port

Test number	Band width	Carrier Type	Reference Channel	Repetition number	Propagation condition	Number of NRS ports	Reference value		UE Category
							Fraction of Maximum Throughput (%)	SNR (dB)	
1	200kHz	Non-anchor	R.NB.7 FDD	1	EPA5	1	70%	9.4	NB2

The normative reference for this requirement is TS 36.101 [2] clause 8.12.1.1.3.

8.3.1.1.3.4 Test description

8.3.1.1.3.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

Configurations of NPDSCH and NPDCCH before measurement are specified in Annex C.2.

Test Environment: Normal, as defined in TS 36.508 [12] clause 4.1.

Frequencies to be tested: K.2.1.

Channel Bandwidths to be tested: As specified per test number in Table 8.3.1.1.3.3-2.

1. Connect the SS, the faders and AWGN noise sources to the UE antenna connectors as shown in TS 36.508 [12] Annex A, Figure A.9 using only main UE Tx/Rx antenna.
2. The parameter settings for the cell are set up according to Tables 8.3.1.1-1 and 8.3.1.1.3.3-1 as appropriate.
3. Downlink signals are initially set up according to Annex C.0, C.1 and Annex C.3.2 and uplink signals according to Annex H.0.1, H.1.1, H.2.1 and Annex H.4.2.
4. Propagation conditions are set according to Annex B.0.
5. UE location according to TS 36.508 [12] clause 8.2.6.1 is provided to the UE by any preconfigured means.
6. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 8.2.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 8.2.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31-NB information during the duration of the test as defined in TS 36.508 [12] clause 8.2.6.3.1.
7. Deactivate UE prediction of satellite trajectory by any preconfigured means.
8. Ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5. Message contents are defined in clause 8.3.1.1.3.4.3.

8.3.1.1.3.4.2 Test procedure

1. SS transmits NPDSCH via NPDCCH DCI format N1 for C_RNTI to transmit the DL RMC according to Tables 8.3.1.1.3.3-1 and 8.3.1.1.3.3-2.
2. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix, antenna configuration and the SNR according to Table 8.3.1.1.3.5-1 as appropriate.
3. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex G clause G.3. Count the number of NACKs, ACKs and statDTXs on the UL during the test interval and decide pass or fail according to Tables G.3.5 and G.3.6 in Annex G clause G.3.

8.3.1.1.3.4.3 Message contents

Message contents are same as 8.3.1.1.1.4.3 with the following exceptions:

Table 8.3.1.1.3.4.3-1: Configure Non-anchor carrier in subtest 1

Derivation Path: 36.508 Table 8.1.8.2.1.6-1 PhysicalConfigDedicated-NB-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
PhysicalConfigDedicated-NB-DEFAULT ::= SEQUENCE {			
carrierConfigDedicated-NB-r13 ::= SEQUENCE {		Non-anchor carrier	
dl-CarrierConfig-r13::= SEQUENCE {			
dl-CarrierFreq-r13	Note 1		
downlinkBitmapNonAnchor-r13	NULL		
dl-GapNonAnchor-r13	NULL		
}			
ul-CarrierConfig-r13 ::= SEQUENCE {			
ul-CarrierFreq-r13	Note 1		
}			
}			
npdcch-ConfigDedicated-r13	NPDCCH-ConfigDedicated-NB-DEFAULT	See subclause 8.1.6.3 in 36.508	
npusch-ConfigDedicated-r13	NPUSCH-ConfigDedicated-NB-DEFAULT	See subclause 8.1.6.3 in 36.508	
uplinkPowerControlDedicated-r13	UplinkPowerControlDedicated-NB-DEFAULT	See subclause 8.1.6.3 in 36.508	
}			
Note 1: The frequency of Non-anchor carrier is located at 200KHz higher from the centre of the anchor carrier.			

Table 8.3.1.1.3.4.3-2: NPDCCH-ConfigDedicated-NB-DEFAULT

Derivation Path: 36.508 Table 8.1.6.3-3 NPDCCH-ConfigDedicated-NB-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
NPDCCH-ConfigDedicated-NB-DEFAULT ::= SEQUENCE {			
npdcch-NumRepetitions-r13	R8		
npdcch-StartSF-USS-r13	V1.5		
}			

Table 8.3.1.1.3.4.3-3: NB-IoT Physical layer parameters for DCI format N1

Derivation Path: 36.508 Table 8.1.3.6.1.2-2			
Parameter	**Value**	**Value in binary**	**Condition**
Repetition number	NRep = 1		For Test Number 1

8.3.1.1.3.5 Test requirement

Table 8.3.1.1.3.3-1 defines the primary level settings.

The fraction of maximum throughput percentage for the downlink reference measurement channels specified in Annex A clause A.3.12.1.1 for each throughput test shall meet or exceed the specified value in Table 8.3.1.1.3.5-1 for the specified SNR including test tolerances for all throughput tests.

Table 8.3.1.1.3.5-1: Test requirements under standalone with 1 NRS ports

Test number	Band width	Carrier Type	Reference Channel	Repetition number	Propagation condition	Number of NRS ports	Reference value		UE Category
							Fraction of Maximum Throughput (%)	SNR (dB)	
1	200k Hz	Non-anchor	R.NB.7 FDD	1	EPA5	1	70%	10.3	NB2

8.3.1.2 NPDCCH

The parameters specified in Table 8.3.1.2-1 and 8.3.1.2-2 are valid for all half-duplex FDD tests unless otherwise stated.

Table 8.3.1.2-1: Test Parameters for NPDCCH

Parameter	Unit	Single antenna port
Narrowband physical layer Cell ID		0
N_{oc} at antenna port	dBm/15kHz	-98
Cyclic prefix		Normal
Maximum number of repetitions $R_{\max}$ (*npdcch-NumRepetitions-r13*)		128 for Test 1; 1024 for Test 2.
NPDCCH start subframe G (*npdcch-startSF-USS-r13*)		2 for test1, 1.5 for test2
NPDCCH fractional period offset of starting subframe α_{offset} (*npdcch-Offset-USS-r13*)		0
NB-IoT downlink subframe bitmap for anchor carrier *(downlinkBitmap-r13)*		Not configured
NB-IoT downlink subframe bitmap for non-anchor carrier *(downlinkBitmapNonAnchor-r13)*		Not configured
Downlink gap configuration for anchor carrier *(dl-Gap-r13)*		Not configured
Downlink gap configuration for non-anchor carrier *(dl-GapNonAnchor-r13)*		Not configured
Unused REs or RBs		OCNG
OCNG pattern		NB.OP.1

Table 8.3.1.2-2: Test Parameters of related NPDSCH and NPUSCH format 2 configurations

Parameter	Unit	Value
Scheduling delay field (I_{Delay})		0
NPDSCH Repetition number		1
N_{oc} at antenna port for NPDSCH	dBm/15kHz	-98
N_{Rep}^{AN} (*ack-NACK-NumRepetitions-r13*)		1
ACK/NACK resource field		0
Reference channel for NPDSCH		R.NB.6 and R.NB.6-1 for one NRS antenna port; R.NB.5 and R.NB.5-1 for two NRS antenna ports

8.3.1.2.1 Demodulation of NPDCCH single-antenna performance for category NB1 and NB2

Editor's Note: This test case has been completed under the current working assumption of minimum test time. Further optimisation to the minimum test time is FFS.

8.3.1.2.1.1 Test purpose

This test verifies the demodulation performance of NPDCCH for single-antenna scenario with a given SNR for which the average probability of miss-detection of the Downlink Scheduling Grant, remains below a given reference value.

8.3.1.2.1.2 Test applicability

This test applies to all types of NB-IoT FDD UE release 17 and forward of category NB1 and NB2 that supports satellite access operation.

8.3.1.2.1.3 Minimum conformance requirements

The purpose of these tests is to verify the probability of miss-detection of the Downlink Scheduling Grant (Pm-dsg). The requirements are specified in Table 8.3.1.2.1.3-1, with the parameters in Table 8.3.1.2-1 and the downlink physical channel setup according to Annex C.3.2. The purpose of these tests is to verify the performance.

Table 8.3.1.2.1.3-1: Minimum performance NPDCCH

Test number	Deployment mode	Repetition number (R)	Carrier Type	Reference Channel	Propagation Condition	Number of NRS ports	Reference value		UE Category
							Pm-dsg (%)	SNR (dB)	
1	Stand-alone	128	Anchor	R.NB.3 FDD	EPA5	1	1	-4.9	NB1, NB2
2 (Note 1)	Stand-alone	1024	Non-anchor	R.NB.3 FDD	ETU1	1	1	-11.4	NB1, NB2
Note 1: Applicable to UE supporting Non-Anchor mode of operation.									

The normative reference for this requirement is TS 36.101 [2] clause 8.12.2.1.1.

8.3.1.2.1.4 Test description

8.3.1.2.1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

Configurations of NPDSCH and NPDCCH before measurement are specified in Annex C.2.

Test Environment: Normal, as defined in TS 36.508 [12] clause 4.1.

Operation mode: Standalone.

Frequencies to be tested: K.2.1.

Channel Bandwidths to be tested: As specified per test number in Table 8.3.1.2.1.3-1.

1. Connect the SS, the faders and AWGN noise sources to the UE antenna connectors as shown in TS 36.508 [12] Annex A, Figure A.9 using only main UE Tx/Rx antenna.
2. The parameter settings for the cell are set up according to Tables 8.3.1.2-1 and 8.3.1.2.1.3-1 as appropriate.
3. Downlink signals are initially set up according to Annex C.0, C.1 and Annex C.3.2 and uplink signals according to Annex H.0.1, H.1.1, H.2.1 and Annex H.4.2.
4. Propagation conditions are set according to Annex B.0.
5. UE location according to TS 36.508 [12] clause 8.2.6.1 is provided to the UE by any preconfigured means.
6. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 36.508 [12] table 8.2.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 8.2.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB31-NB information during the duration of the test as defined in TS 36.508 [12] clause 8.2.6.3.1.
7. Deactivate UE prediction of satellite trajectory by any preconfigured means.
8. Ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5. Message contents are defined in clause 8.3.1.2.1.4.3.

8.3.1.2.1.4.2 Test procedure

1. SS transmits NPDSCH via NPDCCH DCI format N1 for C_RNTI to transmit the DL RMC according to Tables 8.3.1.2-1, 8.3.1.2-2 and 8.3.1.2.1.3-1. The details of NPDCCH are specified in TS36.521-2 Table A.3.13.1. The SS sends downlink MAC padding bits on the DL RMC.
2. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition and the SNR according to Tables 8.3.1.2.1.5-1 as appropriate.
3. Measure the Pm-dsg for a duration sufficient to achieve statistical significance according to Annex G clause G.4. Count the number of NACKs, ACKs and statDTXs on the UL NPUSCH during each subtest. Pm-dsg is the radio (statDTX)/(NACK +ACK+statDTX). If Pm-dsg is less than the value specified in table 8.3.1.2.1.5-1, UE pass the subtest. Otherwise fail the UE.
4. SS release the connection through State 3A-NB and finally ensure the UE is in State 2A-NB with CP CIoT Optimisation according to TS 36.508 [12] clause 8.1.5. Configure the Non-anchor carrier according to table 8.3.1.2.1.4.3-1.
5. Repeat steps from 1 to 3 for subtest 2 in Table 8.3.1.2.1.5-1 as appropriate.

8.3.1.2.1.4.3 Message contents

Message contents are according to TS 36.508 [12] subclause 8.1.5B and 8.1.6 with the following exceptions:

Table 8.3.1.2.1.4.3-1: Configure Non-anchor carrier in subtest 2

Derivation Path: 36.508 Table 8.1.8.2.1.6-1 PhysicalConfigDedicated-NB-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
PhysicalConfigDedicated-NB-DEFAULT ::= SEQUENCE {			
carrierConfigDedicated-NB-r13 ::= SEQUENCE {		Non-anchor carrier	
dl-CarrierConfig-r13::= SEQUENCE {			
dl-CarrierFreq-r13	Note 1		
downlinkBitmapNonAnchor-r13	NULL		
dl-GapNonAnchor-r13	NULL		
}			
ul-CarrierConfig-r13 ::= SEQUENCE {			
ul-CarrierFreq-r13	Note 1		
}			
}			
npdcch-ConfigDedicated-r13	NPDCCH-ConfigDedicated-NB-DEFAULT	See subclause 8.1.6.3 in 36.508	
npusch-ConfigDedicated-r13	NPUSCH-ConfigDedicated-NB-DEFAULT	See subclause 8.1.6.3 in 36.508	
uplinkPowerControlDedicated-r13	UplinkPowerControlDedicated-NB-DEFAULT	See subclause 8.1.6.3 in 36.508	
}			
Note 1: The frequency of Non-anchor carrier is located at 200KHz higher from the centre of the anchor carrier.			

Table 8.3.1.2.1.4.3-2: NPDCCH-ConfigDedicated-NB-DEFAULT

Derivation Path: 36.508 Table 8.1.6.3-3 NPDCCH-ConfigDedicated-NB-DEFAULT			
Information Element	**Value/remark**	**Comment**	**Condition**
NPDCCH-ConfigDedicated-NB-DEFAULT ::= SEQUENCE {			
npdcch-NumRepetitions-r13	R128 for Test 1; r1024 for Test 2.		
npdcch-StartSF-USS-r13	V2 for Test 1; V1.5 for Test 2.		
npdcch-Offset-USS-r13	zero		
}			

Table 8.3.1.2.1.4.3-3: NB-IoT Physical layer parameters for DCI format N1

Derivation Path: 36.508 Table 8.1.3.6.1.2-2			
Parameter	**Value**	**Value in binary**	**Condition**
Repetition number	NRep = 1		For Test Number 1 and 2

8.3.1.2.1.5 Test requirement

For the parameters specified in Tables 8.3.1.2-1 and 8.3.1.2.1.3-1 the average probability of a missed downlink scheduling grant (Pm-dsg) shall be below the specified value in Table 8.3.1.2.1.5-1.

Table 8.3.1.2.1.5-1: Test Parameters for NPDCCH performance

Test number	Deployment mode	Repetition number (R_{max})	Operated carrier	Reference Channel	Propagation Condition	Number of NRS ports	Reference value	
							Pm-dsg (%)	SNR (dB)
1	Stand-alone	128	Anchor	R.NB.3 FDD	EPA5	1	1	-4.1
2 (Note 1)	Stand-alone	1024	Non-anchor	R.NB.3 FDD	ETU1	1	1	-10.6
Note 1: Applicable to UE supporting Non-Anchor mode of operation.								

Annex A (normative): Measurement Channels

A.1 General

A schematic overview of the encoding process for the reference measurement channels is provided in Figure A-1.

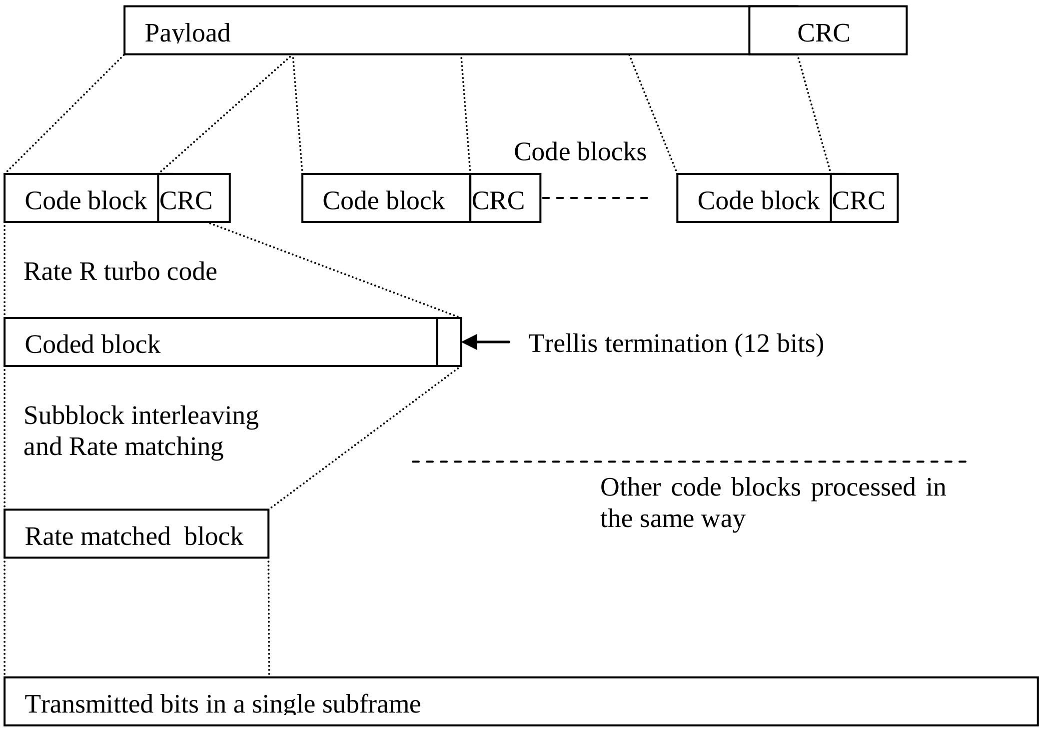


Figure A-1: Schematic overview of the encoding process

The throughput values defined in the measurement channels specified in Annex A, are calculated and are valid per data stream (codeword). For multi-stream (more than one codeword) transmissions, the throughput referenced in the minimum requirements is the sum of throughputs of all data streams (codewords).

The UE category entry in the definition of the reference measurement channels in Annex A is only informative and reveals the UE categories, which can support the corresponding measurement channel. Whether the measurement channel is used for testing a certain UE category or not is specified in the individual test cases.

Rate matching process in Figure A-1 is dependent on the parameter “Total number of Soft Channel bits” which has been defined for each UE category in TS 36.306 [15] clause 4.1. The SS shall use the Soft Channel bits size according to the UE category.

A.2 UL reference measurement channels

A.2.1 General

A.2.1.1 Applicability and common parameters

The following sections define the UL signal applicable to the Transmitter Characteristics (clause 6) and for the Receiver Characteristics (clause 7) where the UL signal is relevant.

The Reference channels in this section assume transmission of PUSCH and Demodulation Reference signal only. The following conditions apply:

- 1 HARQ transmission
- Cyclic Prefix normal
- PUSCH hopping off
- Link adaptation off
- Demodulation Reference signal as per TS 36.211 [3] clause 5.5.2.1.2.

Where ACK/NACK is transmitted, it is assumed to be multiplexed on PUSCH as per TS 36.212 [19] subclause 5.2.2.6.

- ACK/NACK 1 bit
- ACK/NACK mapping adjacent to Demodulation Reference symbol
- ACK/NACK resources punctured into data
- Max number of resources for ACK/NACK: 4 SC-FDMA symbols per subframe
- No CQI transmitted, no RI transmitted

A.2.1.2 Determination of payload size

The algorithm for determining the payload size A is as follows; given a desired coding rate R and radio block allocation N_{RB}:

1. Calculate the number of channel bits N_{ch} that can be transmitted during the first transmission of a given sub-frame.
2. Find A such that the resulting coding rate is as close to R as possible, that is,

$$\min\left|R-(A+24*(N_{CB}+1))/N_{ch}\right|,\ where\ N_{CB}=\begin{cases}0, if\ C=1\\ C, if\ C>1\end{cases},$$

subject to

   a) A is a valid TB size according to clause 7.1.7 of TS 36.213 [20] assuming an allocation of N_{RB} resource blocks.

   b) C is the number of Code Blocks calculated according to section 5.1.2 of TS 36.212 [19].

   c) For RMC-s, which at the nominal target coding rate do not cover all the possible UE categories for the given modulation, reduce the target coding rate gradually (within the same modulation), until the maximal possible number of UE categories is covered.

3. If there is more than one A that minimises the equation above, then the larger value is chosen per default and the chosen code rate should not exceed 0.93.

A.2.1.3 Overview of UL reference measurement channels

In Table A.2.1.3-1 are listed the UL reference measurement channels specified in Annexes A.2.2 and A.2.3 of this release of TS 36.521-4. This table is informative and serves only to a better overview. The reference for the concrete reference measurement channels and corresponding implementation's parameters as to be used for testing are annexes A.2.2 and A.2.3 as appropriate.

Table A.2.1.3-1: Overview of UL reference measurement channels

Duplex	Table	Name	BW	Mod	TCR	RB	RB Offset	UE Categ	Notes
FDD, Full RB allocation, QPSK									
FDD / HD-FDD	Table A.2.2.1.1-1		1.4	QPSK	1/3	6		M1	
FDD, Full RB allocation, 16-QAM									
FDD / HD-FDD	Table A.2.2.1.2-1		1.4	16QAM	1/3	6		M1	
FDD, Partial RB allocation, QPSK									
FDD / HD-FDD	Table A.2.2.2.1-1		1.4	QPSK	1/3	1		M1	
FDD / HD-FDD	Table A.2.2.2.1-1		1.4	QPSK	1/3	2		M1	
FDD / HD-FDD	Table A.2.2.2.1-1		1.4	QPSK	1/3	3		M1	
FDD / HD-FDD	Table A.2.2.2.1-1		1.4	QPSK	1/3	4		M1	
FDD / HD-FDD	Table A.2.2.2.1-1		1.4	QPSK	1/3	5		M1	
FDD, Partial RB allocation, 16-QAM									
FDD / HD-FDD	Table A.2.2.2.2-1		1.4	16QAM	1/2	1		M1	
FDD / HD-FDD	Table A.2.2.2.2-1		1.4	16QAM	1/2	2		M1	
FDD / HD-FDD	Table A.2.2.2.2-1		1.4	16QAM	1/2	3		M1	
FDD / HD-FDD	Table A.2.2.2.2-1		1.4	16QAM	2/5	4		M1	
FDD, SubPRB allocation									
FDD / HD-FDD	Table A.4.2.3-1		1.4	π/2 BPSK	1/3	1		M1	2 out of 3 subcarriers
FDD / HD-FDD	Table A.4.2.3-1		1.4	QPSK	1/3	1		M1	3 subcarriers
FDD / HD-FDD	Table A.4.2.3-1		1.4	QPSK	1/3	1		M1	6 subcarriers

Table A.2.1.3-2: Overview of UL reference measurement channels (HD-FDD, NB-IoT)

Duplex	Table	Name	BW	Mod	TCR	RB	RB Offset	UE Categ	Notes
HD-FDD	Table A.2.3-1		0.2	π/2 BPSK	1/3	1		NB1	
HD-FDD	Table A.2.3-1		0.2	π/4 QPSK	1/3	1		NB1	
HD-FDD	Table A.2.3-1		0.2	π/2 BPSK	1/3	1		NB1	
HD-FDD	Table A.2.3-1		0.2	π/4 QPSK	1/3	1		NB1	
HD-FDD	Table A.2.3-1		0.2	QPSK	1/3	1		NB1	
HD-FDD	Table A.2.3-1		0.2	QPSK	1/3	1		NB1	
HD-FDD	Table A.2.3-1		0.2	QPSK	1/3	1		NB1	

A.2.2 Reference measurement channels for FDD

A.2.2.1 Full RB allocation

A.2.2.1.1 QPSK

Table A.2.2.1.1-1: Reference Channels for QPSK with full/maximum RB allocation for UE category M1

Parameter	Unit	Value
Channel bandwidth	MHz	1.4
Allocated resource blocks		6
DFT-OFDM Symbols per Sub-Frame		12
Modulation		QPSK
Target Coding rate		1/3
Payload size	Bits	600
Transport block CRC	Bits	24
Number of code blocks per Sub-Frame		1
Total number of bits per Sub-Frame	Bits	1728
Total symbols per Sub-Frame		864
UE Category		M1
NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) NOTE 2: For HD-FDD UE, the uplink subframes are scheduled at the 4th, 5th and 6th subframes every 10ms for the channel bandwidth 5MHz/10MHz/15MHz/20MHz. For HD-FDD UE, the uplink subframes are scheduled at the 5th, 6th, and 7th subframes every 10ms for the channel bandwidth 1.4MHz/3MHz. Information bit payload is available if uplink subframe is scheduled. N_{abs}^{PUSCH} is total number of absolute subframes a PUSCH with repetition spans [4]. NOTE 3: For HD-FDD UE with $N_{abs}^{PUSCH} > 1$, MPDCCH are scheduled at 0th DL subframe every N_{abs}^{PUSCH} +5 subframes (starting from the 0th subframe). The associated PUSCH is scheduled at the 4th to (N_{abs}^{PUSCH} +3)-th UL subframes every N_{abs}^{PUSCH} +5 subframes. Information bit payload is available if uplink subframe is scheduled.		

A.2.2.1.2 16-QAM

Table A.2.2.1.2-1: Reference Channels for 16-QAM with maximum RB allocation for UE category M1

Parameter	Unit	Value
Channel bandwidth	MHz	1.4
Allocated resource blocks		6
DFT-OFDM Symbols per Sub-Frame		12
Modulation		16QAM
Target Coding rate		1/3
Payload size	Bits	872
Transport block CRC	Bits	24
Number of code blocks per Sub-Frame		1
Total number of bits per Sub-Frame	Bits	2880
Total symbols per Sub-Frame		720
UE Category		M1
NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) NOTE 2: For HD-FDD UE, the uplink subframes are scheduled at the 5th, 6th, and 7th subframes every 10ms for the channel bandwidth 1.4MHz. Information bit payload is available if uplink subframe is scheduled.		

A.2.2.2 Partial RB allocation

For each channel bandwidth, various partial RB allocations are specified. The number of allocated RBs is chosen according to values specified in the Tx and Rx requirements. The single allocated RB case is included.

The allocated RBs are contiguous and start from one end of the channel bandwidth. A single allocated RB is at one end of the channel bandwidth.

A.2.2.2.1 QPSK

Table A.2.2.2.1-1: Reference Channels for QK with partial RB allocation for UE category M1

Parameter	Ch BW	Allocated RBs	DFT-OFDM Symbols per Sub-Frame	Mod'n	Target Coding rate	Payload size	Trans-port block CRC	Number of code blocks per Sub-Frame (Note 1)	Total number of bits per Sub-Frame	Total symbols per Sub-Frame	UE Category
Unit	**MHz**					**Bits**	**Bits**		**Bits**		
	1.4	1	12	QPSK	1/3	72	24	1	288	144	M1
	1.4	2	12	QPSK	1/3	176	24	1	576	288	M1
	1.4	3	12	QPSK	1/3	256	24	1	864	432	M1
	1.4	4	12	QPSK	1/3	392	24	1	1152	576	M1
	1.4 - 20	5	12	QPSK	1/3	424	24	1	1440	720	M1
Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) Note 2: For HD-FDD UE, the uplink subframes are scheduled at the 5th, 6th, and 7th subframes every 10ms for the channel bandwidth 1.4MHz. Information bit payload is available if uplink subframe is scheduled.											

A.2.2.2.2 16-QAM

Table A.2.2.2.2-1: Reference Channels for 16-QAM with partial RB allocation for UE category M1

Parameter	Ch BW	Allocated RBs	DFT-OFDM Symbols per Sub-Frame	Mod'n	Target Coding rate	Payload size	Trans port block CRC	Number of code blocks per Sub-Frame (Note 1)	Total number of bits per Sub-Frame	Total symbols per Sub-Frame	UE Category
Unit	**MHz**					**Bits**	**Bits**		**Bits**		
	1.4	1	12	16QAM	1/2	256	24	1	576	144	M1
	1.4	2	12	16QAM	1/2	552	24	1	1152	288	M1
	1.4	3	12	16QAM	1/2	840	24	1	1728	432	M1
	1.4	4	12	16QAM	2/5	904	24	1	2304	576	M1
Note 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). Note 2: For HD-FDD UE, the uplink subframes are scheduled at the 5th, 6th, and 7th subframes every 10ms for the channel bandwidth 1.4MHz. Information bit payload is available if uplink subframe is scheduled.											

A.2.2.3 subPRB allocation

The location of allocated RB for subPRB allocation is chosen according to values specified in the Tx requirements.

Table A.2.2.3-1: Reference Channels for SubPRB allocation

Parameter	Unit	Value		
Channel bandwidth	MHz	1.4	1.4	1.4
Allocated resource blocks		1	1	1
Number of subcarriers		2 out of 3	3	6
DFT-OFDM Symbols per Sub-Frame		12	12	12
Modulation		π/2 BPSK	QPSK	QPSK
Target Coding rate		1/3	1/3	1/3
Payload size	Bits	32	72	72
Transport block CRC	Bits	24	24	24
Number of code blocks		1	1	1
Total number of bits per resource unit	Bits	192	288	288
Total symbols per resource unit		192	144	144
Tx time	ms	8	4	2
UE UL Category		M1	M1	M1
NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)				

A.2.3 Reference measurement channels for category NB1

Table A.2.3-1 Reference Channels for category NB1

Parameter	Value						
Sub-carrier spacing (kHz)	3.75	3.75	15	15	15	15	15
Number of tone	1	1	1	1	3	6	12
Modulation	π/2 BPSK	π/4 QPSK	π/2 BPSK	π/4 QPSK	QPSK	QPSK	QPSK
Number of NPUSCH repetition (NOTE 5)	1	1	1	1	1	1	1
IMCS / ITBS	0 / 0	3 / 3	0 / 0	3 / 3	5 / 5	5 / 5	5 / 5
Payload size (bits)	32	40	32	40	72	72	72
Allocated resource unit	2	1	2	1	1	1	1
Code rate (target)	1/3	1/3	1/3	1/3	1/3	1/3	1/3
Code rate (effective)	0.29	0.33	0.29	0.33	0.33	0.33	0.33
Transport block CRC (bits)	24	24	24	24	24	24	24
Code block CRC size (bits)	0	0	0	0	0	0	0
Number of code blocks - C	1	1	1	1	1	1	1
Total number of bits per resource unit	96	192	96	192	288	288	288
Total symbols per resource unit	96	96	96	96	144	144	144
Tx time (ms)	64	32	16	8	4	2	1
NOTE 1: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). NOTE 2: Parameters related to NPUSCH format 1 scheduling are defined in Table A.2.4-2. NOTE 3: NPDCCH is not transmitted in the subframes used for transmission of SI messages. NOTE 4: SI messages transmission should be prioritized over NPDCCH transmission in case of collision. NPDCCH transmission is postponed until the next NB-IoT downlink subframe in case NPDCCH transmission occurs in a non NB-IoT downlink subframe, where an NB-IoT downlink subframe is a subframe that does not contain NPSS/NSSS/NPBCH/SIB1-NB transmission. NOTE 5: Number of repetition N_{Rep} as defined in table 16.5.1.1-3 in TS 36.213 [20].							

Table A.2.3-2: NPDCCH configuration for NPUSCH format 1 scheduling

Parameter	Unit	Value
DCI format		DCI format N0
NPDCCH format		1
Scheduling delay (I_{Delay})		0
DCI subframe repetition number		00
$R_{\max}$ (*npdcch-NumRepetitions*)		1
G (*NPDCCH-startSF-USS*)		8
α_{offset} (*npdcch-Offset-USS*)		1/4

A.3 DL reference measurement channels

A.3.1 General

The number of available channel bits varies across the sub-frames due to PBCH and PSS/SSS overhead. The payload size per sub-frame is varied in order to keep the code rate constant throughout a frame.

No user data is scheduled on subframes #5 in order to facilitate the transmission of system information blocks (SIB).

The algorithm for determining the payload size *A* is as follows; given a desired coding rate *R* and radio block allocation N_{RB}

1. Calculate the number of channel bits N_{ch} that can be transmitted during the first transmission of a given sub-frame.

2. Find *A* such that the resulting coding rate is as close to *R* as possible, that is,

$$\min\left|R-(A+24*(N_{CB}+1))/N_{ch}\right|,\ where\ \ N_{CB}=\begin{cases}0,\ if\ \ C=1\\ C,\ if\ \ C>1\end{cases},$$

subject to

a) A is a valid TB size (according to TS 36.213 [10] clause 7.1.7) assuming an allocation of N_{RB} resource blocks

b) *C* is the number of Code Blocks calculated according to section 5.1.2 of TS 36.212 [19].

3. If there is more than one *A* that minimizes the equation above, then the larger value is chosen per default and the chosen code rate should not exceed 0.93.

4. For TDD, the measurement channel is based on DL/UL configuration ratio of 2DL+DwPTS (12 OFDM symbol): 2UL.

A.3.1.1 Overview of DL reference measurement channels

In Table A.3.1.1-1 are listed the DL reference measurement channels specified in Annexes A.3.2 to A.3.17 of this release of TS 36.521-1. This table is informative and serves only to a better overview. The reference for the concrete reference measurement channels and corresponding implementation's parameters as to be used for testing are annexes A.3.2 to A.3.17 as appropriate.

Table A.3.1.1-1: Overview of DL reference measurement channels

Duplex	Table	Name	BW	Mod	TCR	RB	RB Offset	UE Categ	Notes
FDD, Receiver requirements									
FDD / HD-FDD	Table A.3.2-1b		1.4	QPSK	1/3	4		M1	
HD-FDD	Table A.3.2-1c		0.2	QPSK	1/3			NB1	
HD-FDD	Table A.3.2-1d		0.2	QPSK	1/3			NB1	
FDD, Receiver requirements, Maximum input level for UE Categories 0									
FDD	Table A.3.2-3c		1.4	64QAM	3/4	2		-	
FDD, Receiver requirements, Maximum input level for UE Categories M1									
FDD/HD-FDD	Table A.3.2-3d		1.4	16QAM	3/5	2		-	
FDD, Transmitter requirements									
FDD	Table A.3.2A-1a		1.4	QPSK	1/3	4		M1	
FDD, PDSCH Performance, Single-antenna transmission (CRS)									
FDD	FFS	FFS	FFS	FFS	FFS	FFS		FFS	
FDD, PDSCH Performance, Single-antenna transmission (CRS), Single PRB (Channel edge)									
FDD	FFS	FFS	FFS	FFS	FFS	FFS		FFS	
FDD, PDSCH Performance (UE specific RS) without CSI-RS									
FDD	FFS	FFS	FFS	FFS	FFS	FFS		FFS	
FDD, PDCCH / PCFICH Performance									
FDD	Table A.3.5.1-1	R.16 FDD	1.4	PDCCH					
FDD / TDD, PHICH Performance									
FDD	Table A.3.6-1	R.19A	1.4	PHICH					

A.3.2 Reference measurement channel for receiver characteristics

Unless otherwise stated, Tables A.3.2-1, A.3.2-1a, A.3.2-1b, A.3.2-2, A.3.2-2a and A.3.2-2b are applicable for measurements on the Receiver Characteristics (clause 7) with the exception of subclause 7.4 (Maximum input level).

Unless otherwise stated, Tables A.3.2-3, A.3.2-3a, A.3.2-3b, A.3.2-4, A.3.2-4a and A.3.2-4b are applicable for subclause 7.4 (Maximum input level).

Unless otherwise stated, Tables A.3.2-1, A.3.2-1a, A.3.2-1b, A.3.2-2, A.3.2-2a and A.3.2-2b also apply for the modulated interferer used in Clauses 7.5, 7.6 and 7.8 with test specific bandwidths.

Table A.3.2-1: Fixed Reference Channel for Receiver Requirements (FDD) for UE Category M1

Parameter	Unit	Value
Channel bandwidth	MHz	1.4
Allocated resource blocks		4
Subcarriers per resource block		12
Allocated subframes per Radio Frame		2
Modulation		QPSK
Target Coding Rate		1/3
Number of HARQ Processes	Processes	8
Maximum number of HARQ transmissions		1
Information Bit Payload per Sub-Frame		
For Sub-Frames 3, 8	Bits	256
For Sub-Frames 0,1,2,5,7,9	Bits	N/A
For Sub-Frame 4	Bits	N/A
For Sub-Frame 6	Bits	N/A
Transport block CRC	Bits	24
Number of Code Blocks per Sub-Frame		
For Sub-Frames 3, 8	Bits	1
For Sub-Frames 0,1,2,5,7,9	Bits	N/A
For Sub-Frame 4	Bits	N/A
For Sub-Frame 6	Bits	N/A
Binary Channel Bits Per Sub-Frame		
For Sub-Frames 3, 8	Bits	912
For Sub-Frames 0,1,2,5,7,9	Bits	N/A
For Sub-Frame 4	Bits	N/A
For Sub-Frame 6	Bits	N/A
Max. Throughput averaged over 1 frame for FDD	kbps	51.2
Max. Throughput averaged over 1 frames for HD-FDD	kbps	25.6
UE DL Category		M1
Note 1: 4 symbols allocated to PDCCH for 1.4 MHz Note 2: Reference signal, Synchronization signals and PBCH allocated as per TS 36.211 [3]. Note 3: For HD-FDD UE, PDSCH are scheduled at the 3rd subframe every 1 radio frame for 1.4MHz channel BW. Information bit payload is available if downlink subframe is scheduled. The corresponding M-PDCCH is scheduled 2 subframes before the corresponding PDSCH transmission. Note 4: 2 resource blocks allocated to M-PDCCH		

Table A.3.2-2: Fixed Reference Channel for Receiver Requirements (HD-FDD) without repetition – for CAT-NB1

Parameter	Unit	Value
Channel bandwidth	MHz	0.2
Number of subcarriers		12
Modulation		QPSK
Target Coding Rate		1/3
Number of HARQ Processes	Processes	1
Maximum number of HARQ transmissions		1
Transport block size	Bits	88
Number of Sub-Frames per transport block		1
Transport block CRC	Bits	24
Binary Channel Bits Per Sub-Frame	Bits	320
LTE CRS port		N/A
Number of NRS ports		1
Number of NPDSCH repetitions		0
UE DL Category		NB1
Note 1: NB-IoT in stand-alone mode has been considered here Note 2: Reference signal, Synchronization signals and NPBCH allocated as per TS 36.211 [3]. Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) Note 4: Parameters related to NPDSCH scheduling are defined in Table A.3.2-1e to Table A.3.2-1g. Note 5: NPDCCH and information bit payload are not transmitted in the subframes used for transmission of SI messages. Note 6: SI messages transmission should be prioritized over NPDCCH transmission in case of collision. NPDCCH transmission is postponed until the next NB-IoT downlink subframe in case NPDCCH transmission occurs in a non NB-IoT downlink subframe, where an NB-IoT downlink subframe is a subframe that does not contain NPSS/NSSS/NPBCH/SIB1-NB transmission.		

Table A.3.2-3 Example scheduling pattern with SI periodicity of 64 radio frames for Receiver Requirements (HD-FDD) without repetition – for CAT-NB1

	NPDCCH	NPDSCH	NPUSCH
Subframe th from the 0^{th} subframe	18, 42, 66, 98, 122, 146, 171, 194, 218, 242, 266, 291, 314, 338, 362, 386, 411, 434, 458, 482, 506, 531, 554, 578, 602, 626	+5 from corresponding NPDCCH	+13 and +14 from corresponding NPDSCH. NPUSCH transmission occupies 2 subframes

Table A.3.2-4: Fixed Reference Channel for Receiver Requirements (HD-FDD) with repetition – for CAT-NB1

Parameter	Unit	Value
Channel bandwidth	MHz	0.2
Number of subcarriers		12
Modulation		QPSK
Target Coding Rate		1/3
Number of HARQ Processes	Processes	1
Maximum number of HARQ transmissions		1
Transport block size	Bits	88
Number of Sub-Frames per transport block		1
Transport block CRC	Bits	24
Binary Channel Bits Per Sub-Frame	Bits	320
LTE CRS port		N/A
Number of NRS ports		1
Number of NPDSCH repetitions		TBD
UE DL Category		NB1
Note 1: NB-IoT in stand-alone mode has been considered here Note 2: Reference signal, Synchronization signals and NPBCH allocated as per TS 36.211 [3]. Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) Note 4: Parameters related to NPDSCH scheduling are defined in Table A.3.2-1e to Table A.3.2-1g.		

Table A.3.2-5: General configuration for CAT-NB1

Parameter	Unit	Value
NB-IoT downlink subframe bitmap for anchor carrier *(downlinkBitmap)*		Not configured
NB-IoT downlink subframe bitmap for non-anchor carrier *(downlinkBitmapNonAnchor)*		Not configured
Downlink gap configuration for anchor carrier *(dl-Gap)*		Not configured
Downlink gap configuration for non-anchor carrier *(dl-GapNonAnchor)*		Not configured

Table A.3.2-6: NPDCCH configuration for NPDSCH scheduling

Parameter	Unit	Value
DCI format		DCI format N1
NPDCCH format		1
Scheduling delay (I_{Delay})		0
DCI subframe repetition number		00
$R_{\max}$ (*npdcch-NumRepetitions*)		1
G (*NPDCCH-startSF-USS*)		8
α_{offset} (*npdcch-Offset-USS*)		1/4

Table A.3.2-7: NPUSCH format 2 configurations for NPDSCH scheduling

Parameter	Unit	Value
Scheduling delay (I_{Delay})		0
N_{Rep}^{AN} (*ack-NACK-NumRepetitions*)		1
ACK/NACK resource field		0

Table A.3.2-8: Fixed Reference Channel for Maximum input level for UE DL Category M1 (FDD and HD-FDD)

Parameter	Unit	Value
Channel bandwidth	MHz	1.4
Allocated resource blocks		2
Subcarriers per resource block		12
Allocated subframes per Radio Frame		2
Modulation		16QAM
Target Coding Rate		3/5
Number of HARQ Processes	Processes	8
Maximum number of HARQ transmissions		1
Information Bit Payload		
For Sub-Frames 3,8	Bits	552
For Sub-Frames 0,1,2,5,7,9	Bits	N/A
For Sub-Frame 4	Bits	N/A
For Sub-Frame 6	Bits	N/A
Transport block CRC	Bits	24
Number of Code Blocks per Sub-Frame		
For Sub-Frames 3, 8		1
For Sub-Frames 0,1,2,5,7,9		N/A
For Sub-Frame 4		N/A
For Sub-Frame 6		N/A
Binary Channel Bits Per Sub-Frame		
For Sub-Frames 1,2,3,4,6,7,8,9	Bits	832
For Sub-Frame 5	Bits	N/A
For Sub-Frame 0	Bits	N/A
Max. Throughput averaged over 1 frame for FDD	kbps	110.4
Max. Throughput averaged over 1 frame for HD-FDD		55.2
Note 1: 4 symbols allocated to PDCCH for all channel bandwidths. Note 2: Reference signal, Synchronization signals and PBCH allocated as per TS 36.211 [3]. Note 3: For HD-FDD UE, PDSCH are scheduled at the 3rd subframe every 1 radio frame for 1.4MHz. Information bit payload is available if downlink subframe is scheduled. The corresponding MPDCCH is scheduled 2 subframes before the corresponding PDSCH transmission. Note 4: 2 resource blocks allocated to MPDCCH.		

A.3.2A Downlink Reference measurement channel for TX characteristics

Tables A.3.2A-1 and A.3.2A-2 describes the reference measurement channels to be used on the downlink during Transmitter Characteristics (clause 6) for FDD. The number of allocated resource blocks have been defined (partial allocation) to allow the transmission of PBCH, PSS/SSS and system information mapped on PDSCH.

Table A.3.2A-1: Fixed DL PDSCH Dedicated Reference Channel for TX Requirements (FDD) for UE Category M1

Parameter	Unit	Value
Channel bandwidth	MHz	1.4
Allocated resource blocks		4
Subcarriers per resource block		12
Allocated subframes per Radio Frame		2
Modulation		QPSK
Target Coding Rate		1/3
Number of HARQ Processes	Processes	[8]
Maximum number of HARQ transmissions		1
Information Bit Payload per Sub-Frame		
For Sub-Frames 3, 8	Bits	256
For Sub-Frames 0,1,2,5,7,9	Bits	N/A
For Sub-Frame 4	Bits	N/A
For Sub-Frame 6	Bits	N/A
Transport block CRC	Bits	24
Number of Code Blocks per Sub-Frame		
For Sub-Frames 3, 8	Bits	1
For Sub-Frames 0,1,2,5,7,9	Bits	N/A
For Sub-Frame 4	Bits	N/A
For Sub-Frame 6	Bits	N/A
Binary Channel Bits Per Sub-Frame		
For Sub-Frames 3, 8	Bits	912
For Sub-Frames 0,1,2,5,7,9	Bits	N/A
For Sub-Frame 4	Bits	N/A
For Sub-Frame 6	Bits	N/A
Max. Throughput averaged over 1 frame for FDD	kbps	51.2
Max. Throughput averaged over 1 frames for HD-FDD	kbps	25.6
UE DL Category		M1
Note 1: 4 symbols allocated to PDCCH for 1.4 MHz Note 2: Reference signal, Synchronization signals and PBCH allocated as per TS 36.211 [3]. Note 3: For HD-FDD UE, PDSCH are scheduled at the [3rd] subframe every 1 radio frame for 1.4MHz channel BW. Information bit payload is available if downlink subframe is scheduled. The corresponding M-PDCCH is scheduled 2 subframes before the corresponding PDSCH transmission. Note 3: 2 resource blocks allocated to M-PDCCH		

A.3.3 Reference measurement channel for PDSCH performance requirements (FDD)

A.3.3.1 Single-antenna transmission (Common Reference Symbols)

Table A.3.3.1-1: Fixed Reference Channel Single Antenna Port

Parameter	Unit	Value		
Reference channel		R.1 FDD	R.2 FDD	R.3 FDD
Channel bandwidth	MHz	1.4	1.4	1.4
Allocated resource blocks		Note3	6	6
Allocated DL subframes per Radio Frame		Note 4	Note 5	Note 6
Modulation		16QAM	QPSK	QPSK
Target Coding Rate		1/2	1/3	1/10
Information Bit Payload				
For Sub-Frames 0,1,2,3,4,5,6,7,8,9	Bits	744	504	152
Number of Code Blocks				
For Sub-Frames 0,1,2,3,4,5,6,7,8,9	Code blocks	1	1	1
Binary Channel Bits				
For Sub-Frames 0,1,2,3,4,5,6,7,8,9	Bits	1656 (Note 7, 8)	1656 (Note 7, 8)	1656 (Note 7, 8)
Max. Throughput averaged over one period	Kbps	149	15.75	0.950
UE DL Category		M1	M1	M1
Note 1: Void. Note 2: Reference signal, synchronization signals and PBCH are allocated as per TS 36.211 [3]. Note 3: Allocated PRB positions for PDSCH are {3, 4, 5}. Note 4: The downlink subframes are scheduled at the 8th and 9th subframes every 10ms (starting from 0th subframe). Information bit payload is available from the 8th to 9th subframes. The corresponding MPDCCH is scheduled 2 subframes before the corresponding PDSCH transmissions. Note 5: PDSCH subframes are scheduled at the 10th to 17th subframes every period (32ms). Information bit payload is available from the 10th to 17th subframes with repetition. (Starting from the 0th subframe). The corresponding MPDCCH is scheduled from 1st to 8th subframe every 32ms (starting from 0th subframe). Note 6: PDSCH subframes are scheduled at the 96th to 159th subframes every period (160ms). Information bit payload is available at the 96th to 159th subframes with repetition. (Starting from the 0th subframe) The corresponding MPDCCH is scheduled from 31st to 94th subframe every 160ms (starting from 0th subframe). Note 7: MPDCCH, and PDSCH are dropped when overlapped with SIB1-BR, or SIB2 or SIB3. Note 8: MPDCCH, and PDSCH are punctured in overlapping Resource Elements (RE)s with PSS/SSS/PBCH.				

A.3.4 FFS

A.3.5 FFS

A.3.7 FFS

A.3.8 FFS

A.3.9 FFS

A.3.10 FFS

A.3.11 Reference Measurement Channels for MPDCCH performance requirements

A.3.11.1 FDD and half-duplex FDD

FFS

A.3.12 Reference measurement channels for NPDSCH performance requirements

Editor's note: The note 2 in Table A.3.12.1.2-1 and note 1 in Table A.3.12.2.1-1 are still under discussion with RAN4.

A.3.12.1 Standalone

A.3.12.1.1 Single-antenna transmission

Table A.3.12.1.1-1: NPDSCH Reference Channel with 1Tx Antenna for UE Category NB1 and NB2 for FDD

Parameter	Unit	Value	Value
Reference channel		R.NB.1 FDD	R.NB.2 FDD
Carrier Type		Anchor	Non-anchor
Channel bandwidth	KHz	200	200
Allocated subframes per Radio Frame		Note 1	Note 1
Modulation		QPSK	QPSK
I_{TBS}/I_{SF}		9/3	6/3
Target Coding Rate		1/2	1/3
Coding Rate		0.5	0.33
Information Bit Payload			
For Sub-Frames 1,2,3,6,7,8	Bits	616	392
For Sub-Frame 0,5	Bits	N/A	392
For Sub-Frame 4,9	Bits	Note 2	392
Number of Code Blocks			
For Sub-Frames 1,2,3,6,7,8		1	1
For Sub-Frame 0,5	Bits	N/A	1
For Sub-Frame 4,9	Bits	Note 3	1
Binary Channel Bits			
For Sub-Frames 1,2,3,6,7,8	Bits	320	320
For Sub-Frame 0,5	Bits	N/A	320
For Sub-Frame 4,9	Bits	Note 4	320
Max. Average Throughput	Bps	Note 5	Note 5
UE Category		NB1,NB2	NB1,NB2
Note 1: It shall depend on the specific NPDSCH scheduling. Note 2: N/A when n_f mod 2 = 0, otherwise 616. Note 3: N/A when n_f mod 2 = 0, otherwise 1. Note 4: N/A when n_f mod 2 = 0, otherwise 320. Note 5: Maximum Average Throughput equals to sum of TB(i) divided by sum of T(i), where TB(i) is the TB size of NPDSCH over i^{th} NPDSCH scheduling period, and T(i) is the total time consisting of NPDCCH transmission duration, NPDCCH to NPDSCH scheduling delay, NPDSCH transmission duration, NPDSCH to NPUSCH format 2 scheduling delay, NPUSCH format 2 transmission duration, possible delay between NPUSCH format 2 and NPDCCH for next NPDSCH scheduling and subframes used for NPSS/NSSS/NPBCH/NB-SIB1/NB-SIB2 transmission during the i^{th} NPDSCH scheduling period.			

Table A.3.12.2.1-2: NPDSCH Reference Channel with 1Tx Antenna for UE Category NB2

Parameter	Unit	Value	Value
Reference channel		R.NB.7 FDD	
Carrier Type		Non-anchor	
Channel bandwidth	KHz	200	
Allocated subframes per Radio Frame		Note 1	
Modulation		QPSK	
I_{TBS}/I_{SF}		9/5	
Target Coding Rate		1/2	
Coding Rate		0.5	
Information Bit Payload			
For Sub-Frames 1,2,3,6,7,8	Bits	936	
For Sub-Frame 0,5	Bits	936	
For Sub-Frame 4,9	Bits	936	
Number of Code Blocks			
For Sub-Frames 1,2,3,6,7,8	Bits	1	
For Sub-Frame 0,5	Bits	1	
For Sub-Frame 4,9	Bits	1	
Binary Channel Bits			
For Sub-Frames 1,2,3,6,7,8	Bits	320	
For Sub-Frame 0,5	Bits	320	
For Sub-Frame 4,9	Bits	320	
Max. Average Throughput	Bps	Note 2	
UE Category		NB2	
Note 1: It shall depend on the specific NPDSCH scheduling. Note 2: Maximum Average Throughput equals to sum of TB(i) divided by sum of T(i), where TB(i) is the TB size of NPDSCH over i^{th} NPDSCH scheduling period, and T(i) is the total time consisting of NPDCCH transmission duration, NPDCCH to NPDSCH scheduling delay, NPDSCH transmission duration, NPDSCH to NPUSCH format 2 scheduling delay, NPUSCH format 2 transmission duration, possible delay between NPUSCH format 2 and NPDCCH for next NPDSCH scheduling and subframes used for NPSS/NSSS/NPBCH/NB-SIB1/NB-SIB2 transmission during the i^{th} NPDSCH scheduling period.			

A.3.13 Reference measurement channels for NPDCCH performance requirements

A.3.13.1 Half-duplex FDD

Table A.3.13.1-1 NPDCCH Reference Channel for Category NB1 and NB2 UE

Parameter	Unit	Value
Reference channel		R.NB.3 FDD
Number of NRS ports		1
Channel bandwidth	MHz	0.2
Aggregation level	NCCE	2
DCI Format		N1
Payload (without CRC)	Bits	23

A.3.14 Reference measurement channels for NPBCH performance requirements for Cat NB1 UEs

Table A.3.14-1: Reference Channel for Category NB1 UE

Parameter	Unit	Value	
Reference channel		R.NB.1	R.NB.2
Number of transmitter antennas		1	2
Channel bandwidth	KHz	200	200
Modulation		QPSK	QPSK
Target coding rate		50/1600	50/1600
Payload (without CRC)	Bits	34	34

A.4 CQI reference measurement channels

FFS

A.5 OFDMA Channel Noise Generator (OCNG)

A.5.1 OCNG Patterns for FDD

The following OCNG patterns are used for modelling allocations to virtual UEs (which are not under test). The OCNG pattern for each sub frame specifies the allocations that shall be filled with OCNG, and furthermore, the relative power level of each such allocation.

In each test case the OCNG is expressed by parameters OCNG_RA and OCNG_RB which together with a relative power level (γ) specifies the PDSCH EPRE-to-RS EPRE ratios in OFDM symbols with and without reference symbols, respectively. The relative power, which is used for modelling boosting per virtual UE allocation, is expressed by:

$$\gamma_i = PDSCH_i\_RA / OCNG\_RA = PDSCH_i\_RB / OCNG\_RB,$$

where γ_i denotes the relative power level of the *i:th* virtual UE. The parameter settings of OCNG_RA, OCNG_RB, and the set of relative power levels γ are chosen such that when also taking allocations to the UE under test into account, as given by a PDSCH reference channel, a transmitted power spectral density that is constant on an OFDM symbol basis is targeted.

Moreover, the OCNG pattern is accompanied by a PCFICH/PDCCH/PHICH reference channel which specifies the control region. For any aggregation and PHICH allocation, the PDCCH and any unused PHICH groups are padded with resource element groups with a power level given respectively by PDCCH_RA/RB and PHICH_RA/RB as specified in the test case such that a total power spectral density in the control region that is constant on an OFDM symbol basis is targeted.

A.5.1.1 OCNG FDD pattern 1: One sided dynamic OCNG FDD pattern

This OCNG Pattern fills with OCNG all empty PRB-s (PRB-s with no allocation of data or system information) of the DL sub-frames, when the unallocated area is continuous in frequency domain (one sided).

Table A.5.1.1-1: OP.1 FDD: One sided dynamic OCNG FDD Pattern

Relative power level γ_{PRB} [dB]			PDSCH Data
Subframe			
0	5	1 – 4, 6 – 9	
Allocation			
First unallocated PRB – Last unallocated PRB	First unallocated PRB – Last unallocated PRB	First unallocated PRB – Last unallocated PRB	
0	0	0	Note 1
Note 1: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. The parameter γ_{PRB} is used to scale the power of PDSCH. Note 2: If two or more transmit antennas with CRS are used in the test, the OCNG shall be transmitted to the virtual users by all the transmit antennas with CRS according to transmission mode 2. The parameter γ_{PRB} applies to each antenna port separately, so the transmit power is equal between all the transmit antennas with CRS used in the test. The antenna transmission modes are specified in section 7.1 in 3GPP TS 36.213.			

A.5.1.2 OCNG FDD Pattern 2: Two sided dynamic OCNG FDD pattern

This OCNG Pattern fills with OCNG all empty PRB-s (PRB-s with no allocation of data or system information) of the DL sub-frames, when the unallocated area is discontinuous in frequency domain (divided in two parts by the allocated area – two sided), starts with PRB 0 and ends with PRB $N_{RB}-1$.

Table A.5.1.2-1: OP.1 FDD: Two sided dynamic OCNG FDD Pattern

Relative power level γ_{PRB} [dB]			PDSCH Data
Subframe			
0	5	1 – 4, 6 – 9	
Allocation			
0 – (First allocated PRB-1) and (Last allocated PRB+1) – (N_{RB} –1)	0 – (First allocated PRB-1) and (Last allocated PRB+1) – (N_{RB} –1)	0 – (First allocated PRB-1) and (Last allocated PRB+1) – (N_{RB} –1)	
0	0	0	Note 1
Note 1: These physical resource blocks are assigned to an arbitrary number of virtual UEs with one PDSCH per virtual UE; the data transmitted over the OCNG PDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. The parameter γ_{PRB} is used to scale the power of PDSCH.			

A.5.2 FFS

A.5.3 OCNG Patterns for Narrowband IoT

The following OCNG patterns are used for modelling allocations to virtual narrowband IoT UEs (which are not under test). The OCNG pattern for each sub frame specifies the allocations that shall be filled with OCNG, and furthermore, the relative power level of each such allocation.

In each test case the OCNG is expressed by parameters OCNG_RA and OCNG_RB which together with a relative power level (γ) specifies the NPDSCH EPRE-to-NRS EPRE ratios in OFDM symbols with and without Narrowband reference symbols, respectively. The relative power, which is used for modelling boosting per virtual UE allocation, is expressed by:

$$\gamma_i = NPDSCH_i\_RA / OCNG\_RA = NPDSCH_i\_RB / OCNG\_RB,$$

where γ_i denotes the relative power level of the *i:th* virtual UE. The parameter settings of OCNG_RA, OCNG_RB, and the set of relative power levels γ are chosen such that when also taking allocations to the UE under test into account, as given by a NPDSCH or NPDCCH reference channel, a transmitted power spectral density that is constant on an OFDM symbol basis is targeted.

A.5.3.1 Narrowband IoT OCNG pattern 1

Table A.5.3.1-1: NB.OP.1 FDD: OCNG FDD Pattern 1

Bandwidth	**Relative power level γ [dB]**	**NPDCCH and corresponding NPDSCH Data**
	Subframe	
	Unused subframes	
200KHz	0	Note 2
Note 1: These subframes are assigned to an arbitrary number of virtual UEs with one NPDSCH per virtual UE with corresponding NPDCCH; the data transmitted over the OCNG NPDSCHs shall be uncorrelated pseudo random data, which is QPSK modulated. The parameter γ is used to scale the power of NPDSCH and NPDCCH. Note 2: Subframes and/or REs available for narrowband IOT DL transmission depend on the in-band, guard band or standalone mode indicated in MIB, and scheduling delay between NPDCCH, NPDSCH, NPUSCH format 2 and NPDCCH specified in test cases.		

A.6 Testing related to Satellite Access

A.6.1 General

The following test conditions should be maintained for Satellite Access

- The same ephemeris info will be maintained during each test.
- A set of ephemeris information are pre-defined for each satellite corresponding to respective epoch times in TS 36.508 [12].
- The range of the selected constant delay shift is as follows:
    - For NGSO an altitude of 600km and 1200km on a circular orbit are considered. The range of the one-way delay between UE and satellite is from 2ms (lowest value for LEO orbit 600km) to 6.67ms (highest value for LEO orbit 1200km).
- Constant delay value is derived from ephemeris info (SIB31) and UE location associated to zero Doppler or non-zero Doppler value under test.

A.6.2 Test condition for transmitter characteristics

All requriements in section 6 for transmitter characteristics, other than frequency error in clauses 6.4A.1 and 6.4B.1 shall be verified when Doppler conditions are set to zero and delay conditions are set to constant for all types of satellites.

Frequency error requirement in clauses 6.4A.1 and 6.4B.1 shall be verified for at least two cases: one with zero Doppler condition and the other one with constant Doppler (different from zero) up to [0.93] ppm for GSO satellites and up to 24 ppm for NGSO satellites.

A.6.3 Test condition for receiver characteristics

All requirements in section 7 for receiver characteristics shall be verified when Doppler conditions related to satellite motion for DL in service link are set to zero and delay conditions are set to constant for all types of satellites.

A.6.4 Test condition for performance requirements

All requirements in section 8 for performance requirements shall be verified when Doppler conditions related to satellite motion for DL in service link are set to zero and delay conditions are set to constant for all types of NGSO satellites. The one-way delay between UE and satellite for NGSO at an altitude of 600km is 2ms.

Annex B (normative): Propagation Conditions

The propagation conditions and channel models for various environments are specified. For each environment a propagation model is used to evaluate the propagation pathless due to the distance. Channel models are formed by combining delay profiles with a Doppler spectrum, with the addition of correlation properties in the case of a multi-antenna scenario.

B.0 No interference

The downlink connection between the System Simulator and the UE is without Additive White Gaussian Noise, and has no fading or multipath effects.

B.1 Static propagation condition

The downlink connection between the System Simulator and the UE is an Additive White Gaussian Noise (AWGN) environment (unless otherwise stated) with no fading or multipath effects.

B.1.1 Definition of Additive White Gaussian Noise (AWGN) Interferer

Note that the AWGN interferer can be used in static propagation conditions, or in conjunction with multi-path fading.

The acceptable uncertainties of the AWGN interferer are defined in Annex F.

B.2 Multi-path fading Propagation Conditions

The multipath propagation conditions consist of several parts:

- A delay profile in the form of a "tapped delay-line", characterized by a number of taps at fixed positions on a sampling grid. The profile can be further characterized by the r.m.s. delay spread and the maximum delay spanned by the taps.
- A combination of channel model parameters that include the Delay profile and the Doppler spectrum that is characterized by a classical spectrum shape and a maximum Doppler frequency
- A set of correlation matrices defining the correlation between the UE and eNodeB antennas in case of multi-antenna systems.

B.2.1 Delay profiles

The delay profiles are derived from the TR 38.811 [13] NTN-TDL models for the desired delay spread and tap resolution. After scaling the normalized delay spread values for each tap by the desired RMS delay spread, the tap delays are quantized to a delay resolution of 5ns by rounding to the nearest multiple of the delay resolution.

Table B.2.1-1: Delay profiles for IoT NTN channel models

Type	Model	Delay spread (r.m.s.)	Delay resolution
NLOS	NTN-TDLA100	100 ns	5 ns
LOS	NTN-TDLC5	5 ns	5 ns

Table B.2.1-2: NTN-TDLA100 (DS = 100 ns)

Tap #	Delay [ns]	Power [dB]	Fading distribution
1	0	0	Rayleigh
2	110	-4.7	Rayleigh
3	285	-6.5	Rayleigh

Table B.2.1-3 NTN-TDLC5 (DS = 5 ns)

Tap #	Delay [ns]	Power [dB]	Fading distribution
1	0	-0.6	LOS path
	0	-8.9	Rayleigh
2	60	-21.5	Rayleigh
Note 1: Tap #1 follows a Rician distribution.			

Table B.2.1-4: Delay profiles for E-UTRA channel models

Model	Number of channel taps	Delay spread (r.m.s.)	Maximum excess tap delay (span)
Extended Pedestrian A (EPA)	7	45 ns	410 ns
Extended Vehicular A model (EVA)	9	357 ns	2510 ns
Extended Typical Urban model (ETU)	9	991 ns	5000 ns

Table B.2.1-5: Extended Pedestrian A model (EPA)

Excess tap delay [ns]	Relative power [dB]
0	0.0
30	-1.0
70	-2.0
90	-3.0
110	-8.0
190	-17.2
410	-20.8

Table B.2.1-6: Extended Vehicular A model (EVA)

Excess tap delay [ns]	Relative power [dB]
0	0.0
30	-1.5
150	-1.4
310	-3.6
370	-0.6
710	-9.1
1090	-7.0
1730	-12.0
2510	-16.9

Table B.2.1-7: Extended Typical Urban model (ETU)

Excess tap delay [ns]	Relative power [dB]
0	-1.0
50	-1.0
120	-1.0
200	0.0
230	0.0
500	0.0
1600	-3.0
2300	-5.0
5000	-7.0

B.2.2 Combinations of channel model parameters

The propagation conditions used for the performance measurements in multi-path fading environment are indicated as a combination of a channel model name and a maximum Doppler frequency, i.e., NTN-TDLA<DS>-<Doppler>, or NTN-TDLC<DS>-<Doppler> where '<DS>' indicates the desired delay spread and '<Doppler>' indicates the maximum Doppler frequency (Hz).

Table B.2.2-1 show the propagation conditions that are used for the performance measurements in multi-path fading environment for NLOS and LOS propagation conditions.

Table B.2.2-1: Channel model parameters for NTN

Combination name	Model	Maximum Doppler frequency
NTN-TDLA100-10	NTN-TDLA100	10 Hz
NTN-TDLA100-200	NTN-TDLA100	200 Hz
NTN-TDLC5-30	NTN-TDLC5	30 Hz
NTN-TDLC5-200	NTN-TDLC5	200 Hz

Annex C (normative): Downlink Physical Channels

This annex specifies the downlink physical channels that are needed for setting a connection and channels that are needed during a connection.

C.0 Downlink signal levels

The downlink power settings in Table C.0-1 or Table C.0-2 are used unless otherwise specified in a test case.

For the UE has one Rx antenna, the downlink signal is applied to it.

Table C.0-1: Default Downlink power levels for category M1

	Unit	**Channel bandwidth**
		1.4 MHz
Number of RBs		6
Channel BW Power	dBm	-66
RS EPRE	dBm/15kHz	-85
Note 1: The channel bandwidth powers and RB allocations are informative, based on -85dBm/15kHz RS_EPRE, then scaled according to the number of RBs and rounded to the nearest integer dBm value. Full RE allocation with no boost or deboost is assumed in this calculation, but allocation may vary during setup. Note 2: The power level is specified at each UE Rx antenna.		

Table C.0-2: Default Downlink power levels for category NB1 and NB2

	Unit	
Subcarriers		12
Channel BW Power	dBm	-74
NRS EPRE	dBm/15kHz	-85
Note 1: The channel bandwidth power is informative, based on -85dBm/15kHz NRS_EPRE, then scaled according to the number of subcarriers and rounded to the nearest integer dBm value. Full RE allocation with no boost or deboost is assumed in this calculation, but allocation may vary during setup. Note 2: The power level is specified at the UE Rx antenna		

The default signal level uncertainty is +/-3dB at each test port, for any level specified. If the uncertainty value is critical for the test purpose, a tighter uncertainty is specified for the related test case in Annex F.

C.1 General

Table C.1-1 describes the mapping of downlink physical channels and signals to physical resources for category M1 FDD.

Table C.1-2 describes the mapping of downlink physical channels and signals to physical resources for category NB1 and NB2.

Table C.1-1: Mapping of downlink physical channels and signals to physical resources for category M1 FDD

Physical channel	Time Domain Location	Frequency Domain Location	Note
RS	Symbols 0, 4 of each subframe for antenna port 0 & 1 Symbol 1 of each subframe for antenna port 2 & 3	Downlink system bandwidth dependent	Mapping rule is specified in TS 36.211 6.10.1.2 - CELL_ID = 0
PBCH	Symbols 0 to 3 of slot 1 of subframe 0 of each radio frame	Occupies 72 subcarriers centred on the DC subcarrier	Mapping rule is specified in TS 36.211 Section 6.6.4 (Note 2)
PSS	Symbol 6 of slot 0 and 10 of each radio frame	Occupies 62 subcarriers centred on the DC subcarrier. Additional 10 subcarriers (5 on each side) adjacent to the centred 62 subcarriers are reserved.	Mapping rule is specified in TS 36.211 Section 6.11.1.2
SSS	Symbol 5 of slots 0 and 10 of each radio frame	Occupies 62 subcarriers centred on the DC subcarrier. Additional 10 subcarriers (5 on each side) adjacent to the centred 62 subcarriers are reserved.	Mapping rule is specified in TS 36.211 Section 6.11.2.2
PCFICH	Symbol 0 of each subframe	Downlink system bandwidth dependent. Maps into 4 REGs uniformly spread in the frequency domain over the whole system bandwidth.	Mapping rule is specified in TS 36.211 Section 6.7.4 (Note 1) - CELL_ID = 0
PHICH	Symbol 0 of each subframe	Downlink system bandwidth dependent. Each PHICH group maps into 3 REGs in the frequency domain on the REGs not assigned to PCFICH over the whole system bandwidth	Mapping rule is specified in TS 36.211 Section 6.9.3 (Note 1) - CELL_ID = 0 - Ng = 1 - Normal PHICH duration -Number of PHICH groups = 1(BW=1.4MHz)/2(BW=3MHz)/ 4(BW=5MHz)/7(BW=10MHz)/ 10(BW=15MHz)/13(BW=20MHz) Not required for UE category M1 testing
PDCCH	Symbols 0, 1, 2, 3 of each subframe for 1.4 MHz Symbols 0, 1, 2, of each subframe for 3 and 5 MHz Symbols 0, 1 of each subframe for 10, 15 and 20 MHz	The remaining REGs not allocated to both PCFICH and PHICH are used for PDCCH	Mapping rule is specified in TS 36.211 Section 6.8.5 (Note 1)
MPDCCH	Same as PDSCH	For Subframe 0, subcarriers corresponding to resource elements not allocated to RS, PSS, SSS and PBCH (core set and repetitions) and reserved for PBCH antenna ports 3 and 4 on the 72 central subcarriers. For Subframe 5, subcarriers corresponding to resource elements not allocated to RS, PSS and SSS. For Subframe 9, subcarriers corresponding to resource elements not allocated to RS, PSS, SSS and PBCH (repetitions). For other subframes, subcarriers corresponding to resource elements not allocated to RS.	Mapping rule is specified in TS 36.211 Section 6.8B.5 (Note 1) Only required for UE category M1 testing

PDSCH	All remaining OFDM symbols of each subframe not allocated to PDCCH	For Subframe 0, REs not allocated to RS, PSS, SSS and PBCH, is allocated to PDSCH For Subframe 5, REs not allocated to RS, PSS and SSS, is allocated to PDSCH For other subframes, REs not allocated to RS, is allocated to PDSCH	Note that there are reserved REs that are not used for transmission of any physical channels (Note 3) & (Note 4) which need to be taken into account when allocating REs to PDSCH
Note 1: In case a single cell-specific RS is configured, cell-specific RS shall be assume to be present on antenna ports 0 and 1 for the purpose of mapping a symbol-quadruplet to a REG (resource-element group). (See TS 36.211 Section 6.2.4). Note 2: PBCH is mapped into RE assuming RS from 4 antennas are used at the eNB transmitter, irrespective of the actual number of Tx antenna. Resource elements assumed to be reserved for RS but not used for transmission of RS shall not be used for transmission of any physical channel. (See TS 36.211 Section 6.6.4). Note 3: In slot 0 and slot 10 of each radio frame, there are reserved REs for PSS and SSS that are not used for transmission of any physical channels. (See TS 36.211 Section 6.11.1.2 & 6.11.2.2). Note 4: REs used for RS transmission on any of the antenna ports in a slot shall not be used for any transmission on any other antenna port in the same slot and set to zero. (See TS 36.211 Section 6.10.1.2).			

Table C.1-2: Mapping of downlink physical channels and signals to physical resources for category NB1 and NB2

Physical channel	Time Domain Location	Frequency Domain Location	Note
NPBCH	NPBCH is transmitted in subframe 0 in every radio frame. NPBCH consists of 8 independently decodable blocks of 80 ms duration. The time interval where MIB remains unchanged is 640 ms. NPBCH does not use the first 3 symbols in a subframe in in-band operation. For stand-alone and guard-band, the first 3 symbols (of the subframe transmitting NPBCH) contain no NPBCH.	Occupies any of the 12 subcarriers not reserved for transmission of reference signals	Mapping rule is specified in TS 36.211 [8] sub clause 10.2.4.4
NPSS	NPSS is transmitted in subframe 5. NPSS uses the last 11 OFDM symbols of subframes in which NB-PSS occurs for normal CP. NB-IoT PSS/SSS do not use: - the LTE PDCCH control region - REs used by LTE CRS NSSS periodicity is 10ms.	NPSS is mapped to sub-carriers #0-10 of the NB-IoT carrier	Mapping rule is specified in TS 36.211 [8] sub clause 10.2.7.1.2
NSSS	NSSS is transmitted in subframe 9. NSSS uses the last 11 OFDM symbols of subframes in which NB-SSS occurs for normal CP. NB-IoT PSS/SSS do not use: - the LTE PDCCH control region - REs used by LTE CRS NSSS periodicity is 20ms.	The number of subcarriers for NSSS is 12	Mapping rule is specified in TS 36.211 [8] sub clause 10.2.7.2.2
NPDCCH	NPDCCH on a given NB-IoT carrier are not mapped to the subframes containing NPSS/NSSS/PBCH on that carrier. NPDCCH are not be mapped onto resources elements used for NRS. NPDCCH are not overlapped with PBCH, PSS, SSS, or CRS. One or two NPDCCHs can be transmitted in a subframe. In in-band, first 3 OFDM symbols are not used for NPDCCH. In stand-alone and guard-band, all OFDM symbols are available for NPDCCH. NPDCCH and NPDSCH are multiplexed only based on TDM at subframe level: - It means that only cross subframe scheduling is supported - The start of an NPDCCH search space is >=4ms after the end of the last NPDCCH search space	NPDCCH is transmitted on an aggregation of one or two consecutive narrowband control channel elements (NCCEs), where a narrowband control channel element corresponds to 6 consecutive subcarriers in a subframe where NCCE 0 occupies subcarriers 0 through 5 and NCCE 1 occupies subcarriers 6 through 11	Mapping rule is specified in TS36.211 [8] sub clause 10.2.5.5

NPDSCH	The start of NB-PDSCH transmission is >=4ms later than the end of its associated DL assignment. NPDSCH on a given NB-IoT carrier are not mapped to the subframes containing NPSS/NSSS/PBCH on that carrier. NPDSCH resource elements should be different from the ones used for NRS. NPDSCH resource elements should be different from the ones used for CRS.	Occupies any of the 12 subcarriers not reserved for transmission of reference signals	Mapping rule is specified in TS 36.211 [8] sub clause 10.2.3.4
NRS	Narrowband reference signals are transmitted in all NB-IoT downlink subframes in a cell supporting NPDSCH transmission. NRS is not transmitted in subframes that are not NB-IoT downlink subframes, except if these subframes contain NPBCH or NPDSCH carrying SystemInformationBlockType1-NB where NRS shall be transmitted Narrowband reference signals are transmitted in subframes #0 and #4 and in subframes #9 not containing NSSS [when no NB-IoT downlink subframes configuration has not been established]. The narrowband reference signals shall not be mapped to subframes containing NPSS or NSSS. NRS are transmitted on one or two antenna ports 0 to 1 (Figure 10.2.6.2-1 in TS 36.211 [8]).	2 subcarriers per antenna port in any OFDM symbol where NRS is transmitted	

C.2 Set-up

Table C.2-1 and C.2-1a describes the downlink Physical Channels that are required for connection set up.

Table C.2-1: Downlink Physical Channels required for category M1 connection set-up

Physical Channel
PBCH
SSS
PSS
MPDCCH
PDSCH

Table C.2-1a: Downlink Physical Channels required for category NB1 and NB2 connection set-up

Physical Channel
NPBCH
NSSS
NPSS
NPDCCH
NPDSCH

Table C.2-2 describes the configuration of PDSCH and MPDCCH before measurement for FDD.

Table C.2-2: PDSCH and MPDCCH configuration for FDD

Parameter	Unit	Value	Comments
Allocated resource blocks		[6]	
MCS Index		-	TB Size with transmitting message in 1TTI
Number of HARQ processes, CE Mode A	Processes	[8]	
Number of HARQ processes, CE Mode B	Processes	[2]	
Maximum number of HARQ transmission		[5]	
Aggregation level	CCE	[2]	Note 4
DCI Format for PDSCH		Format 6-1A	CE Mode A
DCI Format for PDSCH		Format 6-1B	CE mode B
DCI Format for PUSCH		Format 6-0A	CE Mode A
DCI Format for PUSCH		Format 6-0B	CE mode B
Note 1: [2] symbols allocated to PDCCH for 20 MHz, 15 MHz and 10 MHz channel BW. [3] symbols allocated to PDCCH for 5 MHz and 3 MHz. [4] symbols allocated to PDCCH for 1.4 MHz. Note 2: Reference signal, Synchronization signals and PBCH allocated as per TS 36.211 [8]. Note 3: Void. Note 4: For MPDCCH using SI-RNTI, Aggregation level: a)Tables C.3.0-3, C.3.1-3, and C.3.2-3 for RF tests b)Table A.2.1-1 of 36.521-3 for RRM tests.			

Table C.2-3: Downlink Physical Channels required for connection set-up, category NB1 and NB2

Physical Channel	EPRE Ratio	Note
NPBCH	NPBCH_RA = 0 dB	
	NPBCH_RB = 0 dB	
NPSS	NPSS_RA = 0 dB	
NSSS	NSSS_RA = 0 dB	
NPDCCH	NPDCCH_RA = 0 dB	
	NPDCCH_RB = 0 dB	
NPDSCH	NPDSCH_RA = 0 dB	
	NPDSCH_RB = 0 dB	
Note 1: No boosting is applied.		

Table C.2-4 describes the configuration of NPDSCH and NPDCCH before measurement for category NB1 and NB2.

Table C.2-4: NPDSCH and NPDCCH configuration for category NB1 and NB2

Parameter	Unit	Value	Comments
Allocated subcarriers		[FFS]	
MCS Index		-	TB Size with transmitting message in 1TTI
Number of HARQ processes	Processes	1	
Maximum number of HARQ transmission		1	
Aggregation level	NCCE	2	
DCI Format for NPDSCH		Format N1	
DCI Format for NPUSCH		Format N0	
Note 1: Reference signal NRS, Synchronization signals NPSS, NSSS and NPBCH allocated as per TS 36.211 [8]			

C.3 Connection

The following clauses describes the downlink Physical Channels that are transmitted during a connection i.e., when measurements are done.

C.3.0 Measurement of Transmitter Characteristics

Table C.3.0-1 is applicable for measurements on the Transmitter Characteristics (clause 6).

Table C.3.0-1: Downlink Physical Channels transmitted for category M1 during a connection (FDD)

Physical Channel	EPRE Ratio	Note
PBCH	PBCH_RA = 0 dB	
	PBCH_RB = 0 dB	
PSS	PSS_RA = 0 dB	
SSS	SSS_RA = 0 dB	
MPDCCH	MPDCCH_RA = 0 dB	Only required for UE category M1 testing
	MPDCCH_RB = 0 dB	
PDSCH	PDSCH_RA = 0 dB	
	PDSCH_RB = 0 dB	

NOTE 1: No boosting is applied.

Table C.3.0-2: Power allocation for OFDM symbols and reference signals

Parameter	Unit	Value	Note
Transmitted power spectral density I_{or}	dBm/15 kHz	Test specific	1. I_{or} shall be kept constant throughout all OFDM symbols
Cell-specific reference signal power ratio E_{RS} / I_{or}		0 dB	

Table C.3.0-3: PDCCH Aggregation Level (in CCE-s)

Bandwidth	DCI for DL (SI-RNTI)	DCI for DL (C-RNTI)	DCI for UL (C-RNTI)	Notes
1.4 MHz	4	1	1	Note 1

Table C.3.0-3a: MPDCCH Aggregation Level (in ECCE-s)

Bandwidth	DCI for DL (C-RNTI)	DCI for UL (C-RNTI)
1.4 MHz	2	4

C.3.1 Measurement of Receiver Characteristics

Unless otherwise stated, Table B.3.1-1 is applicable for measurements on the Receiver Characteristics (clause 7).

Table B.3.1-1: Downlink Physical Channels transmitted during a connection

Physical Channel	EPRE Ratio
PBCH	PBCH_RA = 0 dB
	PBCH_RB = 0 dB
PSS	PSS_RA = 0 dB
SSS	SSS_RA = 0 dB
PDSCH	PDSCH_RA = 0 dB
	PDSCH_RB = 0 dB
OCNG	OCNG_RA = 0 dB
	OCNG_RB = 0 dB

NOTE 1: No boosting is applied.

Table B.3.1-2: Power allocation for OFDM symbols and reference signals

Parameter	Unit	Value	Note
Transmitted power spectral density I_{or}	dBm/15 kHz	Test specific	1. I_{or} shall be kept constant throughout all OFDM symbols
Cell-specific reference signal power ratio E_{RS}/I_{or}		0 dB	

C.3.2 Measurement of Performance requirements

Table C.3.2-1 is applicable for measurements in which uniform RS-to-EPRE boosting for all downlink physical channels, unless otherwise stated.

Table C.3.2-1: Downlink Physical Channels transmitted during a connection

Physical Channel	EPRE Ratio	Note
PBCH	PBCH_RA = $\rho_A + \sigma$	
	PBCH_RB = $\rho_B + \sigma$	
PSS	PSS_RA = 0 (Note 3)	
SSS	SSS_RA = 0 (Note 3)	
MPDCCH	MPDCCH_RA = $\rho_A+\delta$	Only required for UE category M1 testing
	MPDCCH_RB = $\rho_B+\delta$	
PDSCH	PDSCH_RA = ρ_A	
	PDSCH_RB = ρ_B	
OCNG	OCNG_RA = $\rho_A + \sigma$	
	OCNG_RB = $\rho_B + \sigma$	

NOTE 1: $\rho_A = \rho_B$ = 0 dB means no RS boosting.

NOTE 2: OCNG are not defined downlink physical channels in [4].

NOTE 3: Assuming PSS and SSS transmitted on a single antenna port.

NOTE 4: ρ_A, ρ_B, σ, and δ are test specific.

Table C.3.2-2: Power allocation for OFDM symbols and reference signals

Parameter	Unit	Value	Note
Total transmitted power spectral density I_{or}	dBm/15 kHz	Test specific	1. I_{or} shall be kept constant throughout all OFDM symbols
Cell-specific reference signal power ratio E_{RS} / I_{or}		Test specific	1. Applies for antenna port *p*
Energy per resource element EPRE		Test specific	1. The complex-valued symbols $y^{(p)}(i)$ and $a_{k,l}^{(p)}$ defined in TS 36.211 [3] shall conform to the given EPRE value.

Table C.3.2-3: MPDCCH Aggregation Level (in ECCE-s) for PDSCH demodulation tests

Bandwidth	DCI for DL (C-RNTI)	DCI for UL (C-RNTI)	Notes
1.4 MHz	16	16	Note 1, 2
Note 1: No DL data allocated on subframe 5 Note 2: For using 2PRB for MPDCCH, aggregation level 2 and 4 are used to transmit DCI for DL(C-RNTI) and UL(C-RNTI), respectively.			

C.3.3 Measurement of Receiver Characteristics for Narrowband IoT

For the performance requirements for Narrowband IoT, the power allocation for the physical channels is listed in Table C.3.3-1

Table C.3.3-1: Downlink Physical Channels transmitted during a connection

Physical Channel	EPRE Ratio for one NRS antenna port	EPRE Ratio for two NRS antenna ports
NPBCH	0 dB	-3 dB
NPDCCH	0 dB	-3 dB
NPDSCH	0 dB	-3 dB
NPSS	0 dB	0 dB
NSSS	0 dB	0 dB

NOTE 1: Assuming NPSS and NSSS transmitted on one NRS antenna port.

Table C.3.3-2: Power allocation for OFDM symbols and reference signals

Parameter	Unit	Value	Note
Transmitted power spectral density I_{or}	dBm/15 kHz	Test specific	I_{or} shall be kept constant throughout all OFDM symbols
Narrowband reference signal power ratio E_{CRS}/I_{or}		0 dB	Applicable for Stand-alone operation
Narrowband reference signal power over cell-specific reference signal power E_{NRS}/E_{RS}		0 dB	Applicable for In-band operation

Annex D (normative): Characteristics of the Interfering Signal

D.1 General

Some RF performance requirements for the category M1 and category NB1 and NB2 UE receiver are defined with interfering signals present in addition to the wanted signal. For wanted channel band widths below 1.4MHz, the band width of the modulated interferer should be equal to the channel band width of the wanted signal.

D.2 Interference signals

Table D.2-1 describes the modulated interferer for different channel band width options.

Table D.2-1: Description of modulated category M1 interferer

	Channel bandwidth
	1.4 MHz
RB	6
$BW_{Interferer}$	1.4 MHz

Table D.2-2 and D.2-3 describe the category NB1 and NB2 interferers.

Table D.2-2: Description of category NB1 and NB2 GSM interferer

$BW_{Interferer}$	200kHz
Modulation	GMSK

Table D.2-3: Description of category NB1 and NB2 modulated E-UTRA interferer

	Channel bandwidth
	5 MHz
RB	25
$BW_{Interferer}$	5 MHz

Annex E (normative): Global In-Channel TX-Test

Note: Clauses E.2.2 to E.5.9.3 are descriptions, which assume no power ramping adjacent to the measurement period. *Power ramping adjacent to the measurement period requires exclusion periods, described in clause E.7*

E.1 General

The global in-channel TX test enables the measurement of all relevant parameters that describe the in-channel quality of the output signal of the TX under test in a single measurement process.

The parameters describing the in-channel quality of a transmitter, however, are not necessarily independent. The algorithm chosen for description inside this annex places particular emphasis on the exclusion of all interdependencies among the parameters.

E.2 Signals and results

E.2.1 Basic principle

The process is based on the comparison of the actual **output signal of the TX under test**, received by an ideal receiver, with a **reference signal**, that is generated by the measuring equipment and represents an ideal error free received signal. All signals are represented as equivalent (generally complex) baseband signals.

The description below uses numbers as examples. These numbers are taken from frame structure 1 with normal CP length and 20 MHz bandwidth. The application of the text below, however, is not restricted to this frame structure and bandwidth.

E.2.2 Output signal of the TX under test

The output signal of the TX under test is acquired by the measuring equipment and stored for further processing. It is sampled at a sampling rate of 30.72 Msps. In the time domain it comprises at least 10 uplink subframes. The measurement period is derived by concatenating the correct number of individual uplink slots until the correct measurement period is reached. The output signal is named z(ν). Each slot is modelled as a signal with the following parameters: demodulated data content, carrier frequency, amplitude and phase for each subcarrier, timing, carrier leakage.

NOTE 1: TDD

For frame structure type 2, subframes with special fields (UpPTS) do not undergo any evaluation. Since the uplink subframes are not continuous, the 20 slots should be extracted from more than 1 continuous radio frame:

Figure E.2.2-1 is an example for uplink-downlink configuration 1 (DSUUDDSUUD) as specified in TS 36.211 [8] Table 4.2-2,assuming all uplink subframes are active.

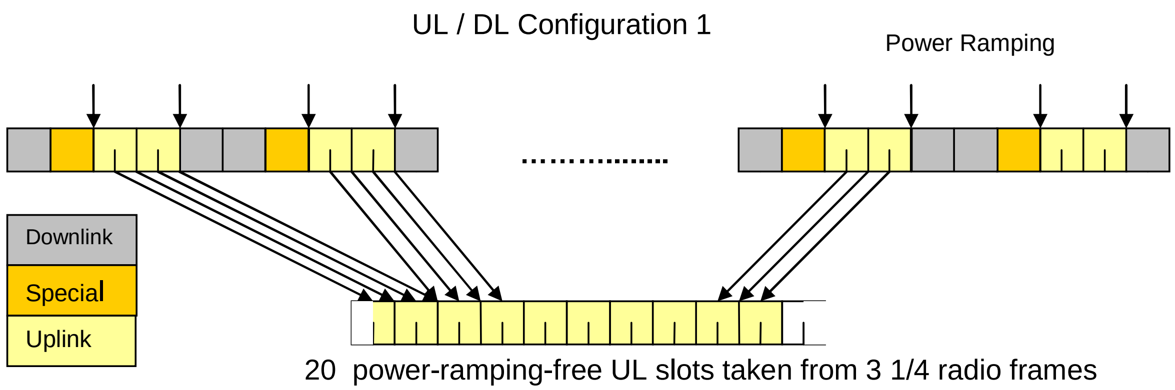


Figure E.2.2-1: Example of uplink – downlink configuration 1

E.2.3 Reference signal

Two types of reference signal are defined:

The reference signal $i_1(\nu)$ is constructed by the measuring equipment according to the relevant TX specifications, using the following parameters: demodulated data content, nominal carrier frequency, nominal amplitude and phase for each subcarrier, nominal timing, no carrier leakage. It is represented as a sequence of samples at a sampling rate of 30.72 Msps in the time domain.

The reference signal $i_2(\nu)$ is constructed by the measuring equipment according to the relevant TX specifications, using the following parameters: restricted data content: nominal reference symbols, (all modulation symbols for user data symbols are set to 0V), nominal carrier frequency, nominal amplitude and phase for each applicable subcarrier, nominal timing, no carrier leakage. It is represented as a sequence of samples at a sampling rate of 30.72 Msps in the time domain.

NOTE: The PUCCH is off during the time under test.

E.2.4 Measurement results

The measurement results, achieved by the global in channel TX test are the following:

- Carrier Frequency error
- EVM (Error Vector Magnitude)
- Carrier leakage
- Unwanted emissions, falling into non allocated resource blocks.
- EVM equalizer spectrum flatness

E.2.5 Measurement points

The unwanted emission falling into non-allocated RB(s) is calculated directly after the FFT as described below. In contrast to this, the EVM for the allocated RB(s) is calculated after the IDFT. The samples after the TX-RX chain equalizer are used to calculate EVM equalizer spectrum flatness. Carrier frequency error and carrier leakage is calculated in the block "RF correction".

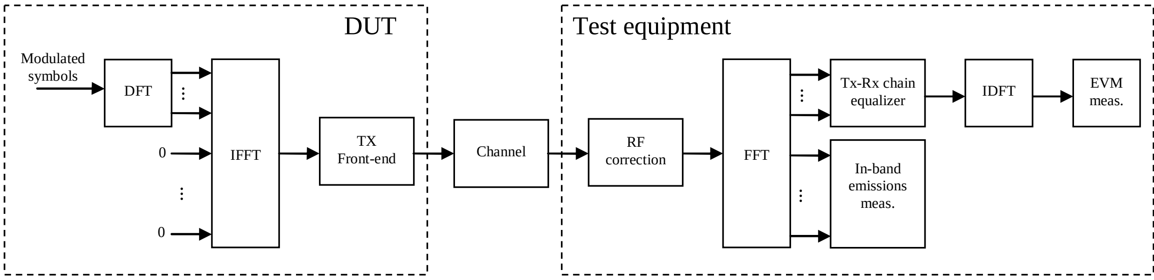


Figure E.2.5-1: EVM measurement points

E.3 Signal processing

E.3.1 Pre FFT minimization process

Before applying the pre-FFT minimization process, z(ν) and i(ν) are portioned into 20 pieces, comprising one slot each. Each slot is processed separately. Sample timing, Carrier frequency and carrier leakage in z(ν) are jointly varied in order to minimise the difference between z(ν) and i(ν). Best fit (minimum difference) is achieved when the RMS difference value between z(ν) and i(ν) is an absolute minimum.

The carrier frequency variation and the IQ variation are the measurement results: Carrier Frequency Error and Carrier leakage.

From the acquired samples 20 carrier frequencies and 20 carrier leakages can be derived.

NOTE 1: The minimisation process, to derive carrier leakage and RF error can be supported by Post FFT operations. However the minimisation process defined in the pre FFT domain comprises all acquired samples (i.e. it does not exclude the samples in between the FFT widths and it does not exclude the bandwidth outside the transmission bandwidth configuration

NOTE 2: The algorithm would allow deriving Carrier Frequency error and Sample Frequency error of the TX under test separately. However there are no requirements for Sample Frequency error. Hence the algorithm models the RF and the sample frequency commonly (not independently). It returns one error and does not distinguish between both.

After this process the samples z(ν) are called $z^0(\nu)$.

E.3.2 Timing of the FFT window

The FFT window length is 2048 samples per OFDM symbol. 7 FFTs (14336 samples) cover less than the acquired number of samples (15360 samples) The position in time for FFT must be determined.

In an ideal signal, the FFT may start at any instant within the cyclic prefix without causing an error. The TX filter, however, reduces the window. The EVM requirements shall be met within a window W<CP. There are three different instants for FFT:

Centre of the reduced window, called $\Delta\tilde{c}$, $\Delta\tilde{c}$ –W/2 and $\Delta\tilde{c}$ +W/2.

The timing of the measured signal is determined in the pre FFT domain as follows, using $z^0(\nu)$ and $i_2(\nu)$:

1. The measured signal is delay spread by the TX filter. Hence the distinct boarders between the OFDM symbols and between Data and CP are also spread and the timing is not obvious.
2. In the Reference Signal $i_2(\nu)$ the timing is known.
3. Correlation between (1.) and (2.) will result in a correlation peak. The meaning of the correlation peak is approx. the “impulse response” of the TX filter. The meaning of “impulse response” assumes that the autocorrelation of

the reference signal $i_2(\nu)$ is a Dirac peak and that the correlation between the reference signal $i_2(\nu)$ and the data in the measured signal is 0. The correlation peak, (the highest, or in case of more than one, the earliest) indicates the timing in the measured signal.

From the acquired samples 20 timings can be derived.

For all calculations, except EVM, the number of samples in $z^0(\nu)$ is reduced to 7 blocks of samples, comprising 2048 samples (FFT width) and starting with $\Delta\tilde{c}$ in each OFDM symbol including the demodulation reference signal.

For the EVM calculation the output signal under test is reduced to 14 blocks of samples, comprising 2048 samples (FFT width) and starting with $\Delta\tilde{c}$ –W/2 and $\Delta\tilde{c}$ +W/2 in each OFDM symbol including the demodulation reference signal.

The number of samples, used for FFT is reduced compared to $z^0(\nu)$. This subset of samples is called $z'(\nu)$.

The timing of the centre $\Delta\tilde{c}$ with respect to the different CP length in a slot is as follows: (Frame structure 1, normal CP length)

$\Delta\tilde{c}$ is on T_f=72 within the CP of length 144 (in OFDM symbol 1 to 6)

$\Delta\tilde{c}$ is on T_f=88 (=160-72) within the CP of length 160 (in OFDM symbol 0)

E.3.3 Post FFT equalisation

Perform 7 FFTs on $z'(\nu)$, one for each OFDM symbol in a slot using the timing $\Delta\tilde{c}$, including the demodulation reference symbol. The result is an array of samples, 7 in the time axis t times 2048 in the frequency axis f. The samples represent the DFT coded data symbols (in OFDM-symbol 0,1,2,4,5and 6 in each slot) and demodulation reference symbols (OFDM symbol 3 in each slot) in the allocated RBs and inband emissions in the non allocated RBs within the transmission BW.

Only the allocated resource blocks in the frequency domain are used for equalisation.

The nominal demodulation reference symbols and nominal DFT coded data symbols are used to equalize the measured data symbols. (Location for equalization see Figure E.2.5-1)

NOTE: The nomenclature inside this note is local and not valid outside.

The nominal DFT coded data symbols are created by a demodulation process. The location to gain the demodulated data symbols is "EVM" in Figure E.2.5-1. A demodulation process as follows is recommended:

1. Equalize the measured DFT coded data symbols using the reference symbols for equalisation. Result: Equalized DFT coded data symbols
2. iDFT transform the equalized DFT coded data symbols: Result: Equalized data symbols
3. Decide for the nearest constellation point: Result: Nominal data symbols
4. DFT transform the nominal data symbols: Result: Nominal DFT coded data symbols

At this stage we have an array of Measured DFT coded data-Symbols and reference-Symbols (MS(f,t))

versus an array of Nominal DFT coded data-Symbols and reference Symbols (NS(f,t))

(complex, the arrays comprise 6 DFT coded data symbols and 1 demodulation reference symbol in the time axis and the number of allocated subcarriers in the frequency axis.)

MS(f,t) and NS(f,t) are processed with a least square (LS) estimator, to derive one equalizer coefficient per time slot and per allocated subcarrier. EC(f)

$$EC(f) = \frac{\sum_{t=0}^{6} NS(f,t)^{*} NS(f,t)}{\sum_{t=0}^{6} NS(f,t)^{*} MS(f,t)}$$

With * denoting complex conjugation.

EC(f) are used to equalize the DFT-coded data symbols. The measured DFT-coded data and the references symbols are equalized by:

$$Z'(f,t) = MS(f,t) \cdot EC(f)$$

With · denoting multiplication.

Z'(f,t), restricted to the data symbol (excluding t=3) is used to calculate EVM, as described in E.4.1.

EC(f) is used in E.4.4 to calculate EVM equalizer spectral flatness.

NOTE: although an exclusion period for EVM may be applicable in E.7, the post FFT minimisation process is done over 7 symbols (6 DFT-coded data symbols and 1 reference symbol).

The samples of the non allocated resource blocks within the transmission bandwidth configuration in the post FFT domain are called Y(f,t) (f covering the non allocated subcarriers within the transmission bandwidth configuration, t covering the OFDM symbols during 1 slot).

E.4 Derivation of the results

E.4.1 EVM

For EVM create two sets of Z'(f,t)., according to the timing " $\Delta\tilde{c}$ –W/2 and $\Delta\tilde{c}$ +W/2" using the equalizer coefficients from E.3.3.

Perform the iDFTs on Z'(f,t). The IDFT-decoding preserves the meaning of t but transforms the variable f (representing the allocated sub carriers) into another variable g, covering the same count and representing the demodulated symbols. The samples in the post IDFT domain are called iZ'(g, t). The equivalent ideal samples are called iI(g,t). Those samples of Z'(f,t), carrying the reference symbols (=symbol 3) are not iDFT processed.

The EVM is the difference between the ideal waveform and the measured and equalized waveform for the allocated RB(s)

$$EVM = \sqrt{\frac{\sum_{t \in T} \sum_{g \in G} \left| iZ'(g,t) - iI(g,t) \right|^2}{|G| \cdot |T| \cdot P_0}},$$

where

t covers the count of demodulated symbols with the considered modulation scheme being active within the measurement period, (i.e. symbol 0,1,2,4,5and 6 in each slot, →|T|=6)

g covers the count of demodulated symbols with the considered modulation scheme being active within the allocated bandwidth. (|G|=12* L_{CRBs} (with L_{CRBs} : number of allocated resource blocks)).

$iZ'(g,t)$ are the samples of the signal evaluated for the EVM.

$iI(g,t)$ is the ideal signal reconstructed by the measurement equipment, and

P_0 is the average power of the ideal signal. For normalized modulation symbols P_0 is equal to 1.

From the acquired samples 40 EVM value can be derived, 20 values for the timing $\Delta\tilde{c}$ –W/2 and 20 values for the timing $\Delta\tilde{c}$ +W/2

E.4.2 Averaged EVM

EVM is averaged over all basic EVM measurements.

For subslot TTI, The averaging comprises 60 UL subslots (for frame structure 2: excluding special fields(UpPTS)) for PUCCH, PUSCH, PDSCH.

For subframe/slot TTI, the averaging comprises n UL slots (for frame structure 2: excluding special fields(UpPTS))

$$\overline{EVM} = \sqrt{\frac{1}{n}\sum_{i=1}^{n} EVM_i^2}$$

where n is

n = 20 for PUCCH, PUSCH, PSDCH, PSCCH, and PSSCH,

n = 48 for PBSCH. The averaging is done separately for timing $\Delta\tilde{c}$ –W/2 and $\Delta\tilde{c}$ +W/2 leading to $\overline{\mathrm{EVM}}_l$ and $\overline{\mathrm{EVM}}_h$

$EVM_{\mathrm{final}} = \max(\overline{\mathrm{EVM}}_l, \overline{\mathrm{EVM}}_h)$ is compared against the test requirements.

E.4.3 In-band emissions measurement

The in-band emissions are a measure of the interference falling into the non-allocated resources blocks.

Explanatory Note:

The inband emission measurement is only meaningful with allocated RBs next to non allocated RB. The allocated RBs are necessary but not under test. The non allocated RBs are under test. The RB allocation for this test is as follows: The allocated RBs are at one end of the channel BW, leaving the other end unallocated. The number of allocated RBs is smaller than half of the number of RBs, available in the channel BW. This means that the vicinity of the carrier in the centre is unallocated.

There are 3 types of inband emissions:

1. General
2. IQ image
3. Carrier leakage

Carrier leakage are inband emissions next to the carrier.

IQ image are inband emissions symmetrically (with respect to the carrier) on the other side of the allocated RBs.

General are applied to all unallocated RBs.

For each evaluated RB, the minimum requirement is calculated as the higher of P_{RB} - 30 dB and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply.

In specific the following combinations:

- Power (General)
- Power (General + Carrier leakage)
- Power (General + IQ Image)

  1 and 2 is expressed in terms of power in one non allocated RB under test, normalized to the average power of an allocated RB (unit dB).

3 is expressed in terms of power in one non allocated RB, normalized to the power of all allocated RBs. (unit dBc).

This is the reason for two formulas *Emissions* $_{relative}$.

Create one set of Y(t,f) per slot according to the timing " $\Delta\tilde{c}$ "

For the non-allocated RBs below the in-band emissions are calculated as follows

$$Emissions_{absolute}(\Delta_{RB}) = \begin{cases} \dfrac{1}{|T_s|}\sum_{t\in T_s} \sum_{\max(f_{\min},(c_l+12\cdot\Delta_{RB}*\Delta f))}^{c_l+(12\cdot\Delta_{RB}+11)*\Delta f} |Y(t,f)|^2, \Delta_{RB} < 0 \\ \dfrac{1}{|T_s|}\sum_{t\in T_s} \sum_{c_h+(12\cdot\Delta_{RB}-11)*\Delta f}^{\min(f_{\max},(c_h+12\cdot\Delta_{RB}*\Delta f))} |Y(t,f)|^2, \Delta_{RB} > 0 \end{cases},$$

where

the upper formula represents the in band emissions below the allocated frequency block and the lower one the in band emissions above the allocated frequency block.

T_s is a set of $|T_s|$ SC-FDMA symbols with the considered modulation scheme being active within the measurement period,

Δ_{RB} is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g. $\Delta_{RB} = 1$ for the first upper or $\Delta_{RB} = -1$ for the first lower adjacent RB),

$f_{\min}$ and $f_{\max}$ are the lower and upper edge of the UL transmission BW configuration,

c_l and c_h are the lower and upper edge of the allocated BW,

Δf is 15kHz,and

$Y(t, f)$ is the frequency domain signal evaluated for in-band emissions as defined in the subsection E.3.3

The allocated RB power per RB and the total allocated RB power are given by:

$$P_{RB} = \frac{1}{|T_s|\cdot L_{CRBs}} \sum_{t\in T_s} \sum_{c_l}^{c_l+(12\cdot L_{CRBs}-1)*\Delta f} |\mathrm{MS}(t,f)|^2 \ [\mathrm{dBm/180\,kHz}]$$

$$P_{All-RBs} = \frac{1}{|T_s|} \sum_{t\in T_S} \sum_{c_l}^{c_l+(12\cdot L_{CRBs}-1)*\Delta f} |\mathrm{MS}(t,f)|^2 \ [\mathrm{dBm}]$$

The relative in-band emissions, applicable for General and IQ image, are given by:

$$Emissions_{relative}(\Delta_{RB}) = 10\cdot\log_{10}\left(\frac{Emissions_{absolute}(\Delta_{RB})}{\dfrac{1}{|T_s|\cdot L_{CRBs}}\sum_{t\in T_s}\sum_{c_l}^{c_l+(12\cdot L_{CRBs}-1)*\Delta f}|\mathrm{MS}(t,f)|^2}\right)[\mathrm{dB}]$$
$$= Emissions_{absolute}(\Delta_{RB})\,[\mathrm{dBm/180kHz}] - P_{RB}\,[\mathrm{dBm/180kHz}]$$

where

L_{CRBs} is the number of allocated resource blocks,

and

$\mathrm{MS}(t, f)$ is the frequency domain samples for the allocated bandwidth, as defined in the subsection E.3.3.

The relative in-band emissions, applicable for carrier leakage, is given by:

$$Emissions_{relative} = 10 \cdot \log_{10} \left(\frac{Emissions_{absolute}(RBnextDC)}{\frac{1}{|T_s|} \sum_{t \in T_s} \sum_{c_1}^{c_1 + (12 \cdot L_{CRBs} - 1) * \Delta f} |\mathrm{MS}(t, f)|^2} \right) [\mathrm{dBc}]$$
$$= Emissions_{absolute}(RBnextDC)\,[\mathrm{dBm}/180\,\mathrm{kHz}] - P_{All-RBs}\,[\mathrm{dBm}]$$

where RBnextDC means: Resource Block next to the carrier.

This is one RB, namely the central one in case of an odd number of RBs in the channel BW.

This is one pair of RBs, namely the immediately adjacent RBs to the carrier in case of an even number of RBs in the channel BW.

Although an exclusion period may be applicable in the time domain, when evaluating EVM (clause E.7), the inband emissions measurement interval is defined over one complete slot in the time domain.

From the acquired samples 20 functions for general in band emissions and IQ image inband emissions can be derived. 20 values or 20 pairs of carrier leakage inband emissions can be derived. They are compared against different limits.

E.4.4 EVM equalizer spectrum flatness

For EVM equalizer spectrum flatness use EC(f) as defined in E.3.3. Note, EC(f) represents equalizer coefficient $f \in F$, f is the allocated subcarriers within the transmission bandwidth ((|F|=12* L_{CRBs})

From the acquired samples 20 functions EC(f) can be derived.

EC(f) is broken down to 2 functions:

$$\mathrm{EC}_1(\mathrm{f}),\ f \in Range\ \ 1$$

$$\mathrm{EC}_2(\mathrm{f}),\ f \in Range\ \ 2$$

Where Range 1 and Range 2 are as defined in Table 6.5.2.4.5-1 for normal condition and Table 6.5.2.4.5-2 for extreme condition

The following peak to peak ripple is calculated:

$\mathrm{RP}_1 = 20 * \log(\max(|\mathrm{EC}_1(\mathrm{f})|) / \min(|\mathrm{EC}_1(\mathrm{f})|))$,which denote the maximum ripple in Range 1

$\mathrm{RP}_2 = 20 * \log(\max(|\mathrm{EC}_2(\mathrm{f})|) / \min(|\mathrm{EC}_2(\mathrm{f})|))$,which denote the maximum ripple in Range 2

$\mathrm{RP}_{12} = 20 * \log(\max(|\mathrm{EC}_1(\mathrm{f})|) / \min(|\mathrm{EC}_2(\mathrm{f})|))$,which denote the maximum ripple between the upper side of Range 1 and lower side of Range 2

$\mathrm{RP}_{21} = 20 * \log(\max(|\mathrm{EC}_2(\mathrm{f})|) / \min(|\mathrm{EC}_1(\mathrm{f})|))$,which denote the maximum ripple between the upper side of Range 2 and lower side of Range 1

E.4.5 Frequency error and Carrier leakage

See E.3.1.

E.4.6 EVM of Demodulation reference symbols (EVM_{DMRS})

For the purpose of EVM $_{DMRS}$, the steps E.2.2 to E.4.2 are repeated 6 times, constituting 6 EVM $_{DMRS}$ sub-periods. The only purpose of the repetition is to cover the longer gross measurement period of EVM $_{DMRS}$ (120 time slots) and to derive the FFT window timing per sub-period.

The bigger of the EVM results in one 20 TS period corresponding to the timing $\Delta\tilde{c}$ –W/2 or $\Delta\tilde{c}$ +W/2 is compared against the limit. (Clause E.4.2) This timing is re-used for EVM $_{DMRS}$ in the equivalent EVM $_{DMRS}$ sub-period.

For EVM the demodulation reference symbols are excluded, while the data symbols are used. For EVM_{DMRS} the data symbols are excluded, while the demodulation references symbols are used. This is illustrated in figure E.4.6-1

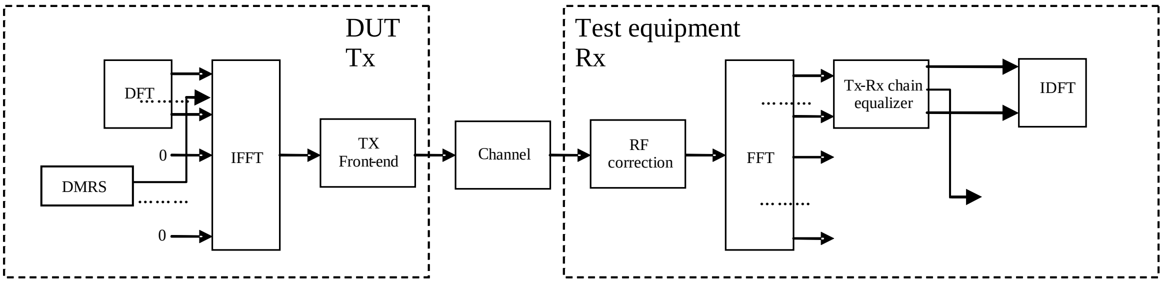


Figure E.4.6-1: EVM_{DMRS} measurement points

Re-use the following formula from E.3.3:

$$Z'(f,t) = MS(f,t) \cdot EC(f)$$

To calculate EVM_{DMRS} , the data symbol (t=0,1,2,4,5,6) in Z'(f,t) are excluded and only the reference symbol (t=3) is used.

The EVM $_{DMRS}$ is the difference between the ideal waveform and the measured and equalized waveform for the allocated RB(s)

$$EVM_{DMRS} = \sqrt{\frac{\sum_{t \in T} \sum_{f \in F} \left| Z'(f,t) - I(f,t) \right|^2}{|T| \cdot P_0 \cdot |F|}},$$

where

t covers the count of demodulation reference symbols (i.e. only symbol 3 in each slot, so count =1)

f covers the count of demodulation reference symbols within the allocated bandwidth. (|F|=12* L_{CRBs} (with L_{CRBs} : number of allocated resource blocks)).

$Z'(f,t)$ are the samples of the signal evaluated for the EVM $_{DMRS}$

$I(f,t)$ is the ideal signal reconstructed by the measurement equipment, and

P_0 is the average power of the ideal signal. For normalized modulation symbols P_0 is equal to 1.

20 such results are generated per measurement sub-period.

E.4.6.1 1st average for EVM $_{DMRS}$

EVM $_{DMRS}$ is averaged over all basic EVM $_{DMRS}$ measurements in one sub-period

For subslot TTI, The averaging comprises 60 UL subslots (for frame structure 2: excluding special fields(UpPTS)) for PUCCH, PUSCH, PDSCH.

For subframe/slot TTI, the averaging comprises 20 UL slots (for frame structure 2: excluding special fields(UpPTS))

$$1stEVM_{DMRS} = \sqrt{\frac{1}{20}\sum_{i=1}^{20} EVM_{DMRS}{}_i^2}$$

The timing is taken from the EVM for the data. 6 of those results are achieved from the samples. In general the timing is not the same for each result.

E.4.6.2 Final average for EVM $_{DMRS}$

$$finalEVM_{DMRS} = \sqrt{\frac{1}{6}\sum_{i=1}^{6} 1stEVM_{DMRS}{}_i^2}$$

E.5 EVM and inband emissions for PUCCH

For the purpose of worst case testing, the PUCCH shall be located on the edges of the Transmission Bandwidth Configuration (6,15,25,50,75,100 RBs).

The EVM for PUCCH (EVM_{PUCCH}) is averaged over 20 slots. At least 20 TSs shall be transmitted by the UE without power change. SRS multiplexing shall be avoided during this period. The following transition periods are applicable: One OFDM symbol on each side of the slot border (instant of band edge alternation).

The description below is generic in the sense that all 6 PUCCH formats are covered. Although the number of OFDM symbols in one slot is 6 or 7 (depending on the cyclic prefix length), the text below uses 7 without excluding 6.

E.5.1 Basic principle

The basis principle is the same as described in E.2.1

E.5.2 Output signal of the TX under test

The output signal of the TX under test is processed same as described in E.2.2

E.5.3 Reference signal

The reference signal is defined same as in E.2.3. Same as in E.2.3, $i_1(\nu)$ is the ideal reference for EVM_{PUCCH} and $i_2(\nu)$ is used to estimate the FFT window timing.

Note PUSCH is off during the PUCCH measurement period.

E.5.4 Measurement results

The measurement results are:

- EVM_{PUCCH}

- Inband emissions with the sub-results: General in-band emission, IQ image (according to: 36.101. Annex F.4, Clause starting with: “At this stage the ….”)

E.5.5 Measurement points

The measurement points are illustrated in the figure below:

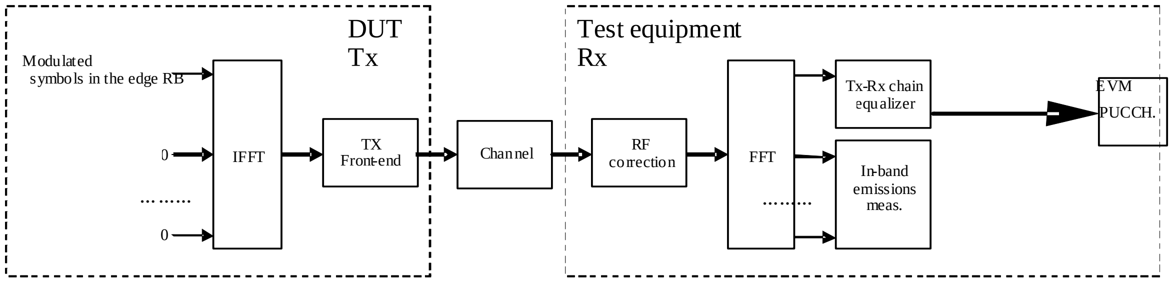


Figure E.5.5-1

E.5.6 Pre FFT minimization process

The pre FFT minimisation process is the same as describes in clause E.3.1.

NOTE: although an exclusion period for EVM_{PUCCH} is applicable in E.5.9.1, the pre FFT minimisation process is done over the complete slot.

RF error, and carrier leakage are necessary for best fit of the measured signal towards the ideal signal in the pre FFT domain. However they are not used to compare them against the limits.

E.5.7 Timing of the FFT window

Timing of the FFT window is estimated with the same method as described in E.3.2.

E.5.8 Post FFT equalisation

The post FFT equalisation is described separately without reference to E.3.3:

Perform 7 FFTs on z’(v), one for each OFDM symbol in a slot using the timing $\Delta\tilde{c}$, including the demodulation reference symbol. The result is an array of samples, 7 in the time axis t times 2048 in the frequency axis f. The samples represent the OFDM symbols (data and reference symbols) in the allocated RBs and inband emissions in the non allocated RBs within the transmission BW.

Only the allocated resource blocks in the frequency domain are used for equalisation.

The nominal reference symbols and nominal OFDM data symbols are used to equalize the measured data symbols.

Note: (The nomenclature inside this note is local and not valid outside)

The nominal OFDM data symbols are created by a demodulation process. A demodulation process as follows is recommended:

1. Equalize the measured OFDM data symbols using the reference symbols for equalisation. Result: Equalized OFDM data symbols

2. Decide for the nearest constellation point, however not independent for each subcarrier in the RB. 12 constellation points are decided dependent, using the applicable CAZAC sequence. Result: Nominal OFDM data symbols

At this stage we have an array of Measured data-Symbols and reference-Symbols (MS(f,t))

versus an array of Nominal data-Symbols and reference Symbols (NS(f,t))

The arrays comprise in sum 7 data and reference symbols, depending on the PUCCH format, in the time axis and the number of allocated sub-carriers in the frequency axis.

MS(f,t) and NS(f,t) are processed with a least square (LS) estimator, to derive one equalizer coefficient per time slot and per allocated subcarrier. EC(f)

$$EC(f) = \frac{\sum_{t=0}^{6} NS(f,t)^{*} NS(f,t)}{\sum_{t=0}^{6} MS(f,t)^{*} NS(f,t)}$$

With * denoting complex conjugation.

EC(f) are used to equalize the OFDM data together with the demodulation reference symbols by:

$$Z'(f,t) = MS(f,t) \cdot EC(f)$$

With · denoting multiplication.

Z'(f,t) is used to calculate EVM_{PUCCH}, as described in E.5.9 1

NOTE: although an exclusion period for EVM_{PUCCH} is applicable in E.5.9.1, the post FFT minimisation process is done over 7 OFDM symbols.

The samples of the non allocated resource blocks within the transmission bandwidth configuration in the post FFT domain are called Y(f,t) (f covering the non allocated subcarriers within the transmission bandwidth configuration, t covering the OFDM symbols during 1 slot).

E.5.9 Derivation of the results

E.5.9.1 EVM_{PUCCH}

For EVM_{PUCCH} create two sets of Z'(f,t)., according to the timing " $\Delta\tilde{c}$ –W/2 and $\Delta\tilde{c}$ +W/2" using the equalizer coefficients from E.5.8

The EVM_{PUCCH} is the difference between the ideal waveform and the measured and equalized waveform for the allocated RB(s)

$$EVM_{PUCCH} = \sqrt{\frac{\sum_{t \in T} \sum_{f \in F} \left| Z'(f,t) - I(f,t) \right|^{2}}{|T| \cdot P_0 \cdot |F|}},$$

where

the OFDM symbols next to slot boarders (instant of band edge alternation) are excluded:

t covers less than the count of demodulated symbols in the slot (|T|= 5)

f covers the count of subcarriers within the allocated bandwidth. (|F|=12)

$Z'(f,t)$ are the samples of the signal evaluated for the EVM_{PUCCH}

$I(f,t)$ is the ideal signal reconstructed by the measurement equipment, and

P_0 is the average power of the ideal signal. For normalized modulation symbols P_0 is equal to 1.

From the acquired samples 40 EVM_{PUCCH} value can be derived, 20 values for the timing $\Delta\tilde{c}$ –W/2 and 20 values for the timing $\Delta\tilde{c}$ +W/2

E.5.9.2 Averaged EVM_{PUCCH}

EVM_{PUCCH} is averaged over all basic EVM_{PUCCH} measurements

For subslot TTI, The averaging comprises 60 UL subslots (for frame structure 2: excluding special fields(UpPTS)) for PUCCH, PUSCH, PDSCH.

For subframe/slot TTI, the averaging comprises 20 UL slots (for frame structure 2: excluding special fields(UpPTS))

$$\overline{EVM}_{PUCCH} = \sqrt{\frac{1}{20}\sum_{i=1}^{20} EVM_{PUCCH\,i}^{\;2}}$$

The averaging is done separately for timing $\Delta\tilde{c}$ –W/2 and $\Delta\tilde{c}$ +W/2 leading to $\overline{EVM}_{PUCCH,low}$ and $\overline{EVM}_{PUCCH,high}$

$EVM_{PUCCH,final} = \max(\overline{EVM}_{PUCCH,low}, \overline{EVM}_{PUCCH,high})$ is compared against the test requirements.

E.5.9.3 In-band emissions measurement

The in-band emissions are a measure of the interference falling into the non-allocated resources blocks

Create one set of Y(t,f) per slot according to the timing "$\Delta\tilde{c}$"

For the non-allocated RBs the in-band emissions are calculated as follows

$$Emissions_{absolute}(\Delta_{RB}) = \begin{cases} \dfrac{1}{|T_s|}\sum_{t\in T_s} \sum_{\max(f_{\min},(c_l+12\cdot\Delta_{RB}*\Delta f))}^{c_l+(12\cdot\Delta_{RB}+11)*\Delta f} |Y(t,f)|^2, \Delta_{RB} < 0 \\ \dfrac{1}{|T_s|}\sum_{t\in T_s} \sum_{c_h+(12\cdot\Delta_{RB}-11)*\Delta f}^{\min(f_{\max},(c_h+12\cdot\Delta_{RB}*\Delta f))} |Y(t,f)|^2, \Delta_{RB} > 0 \end{cases},$$

where

the upper formula represents the inband emissions below the allocated frequency block and the lower one the inband emissions above the allocated frequency block.

T_s is a set of $|T_s|$ OFDM symbols in the measurement period,

Δ_{RB} is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g. $\Delta_{RB} = 1$ for the first upper or $\Delta_{RB} = -1$ for the first lower adjacent RB),

$f_{\min}$ and $f_{\max}$ are the lower and upper edge of the UL system BW,

c_l and c_h are the lower and upper edge of the allocated BW,

Δf is 15kHz,and

$Y(t,f)$ is the frequency domain signal evaluated for in-band emissions as defined in the subsection E.5.8

The relative in-band emissions are, given by

$$Emissions_{relative}(\Delta_{RB}) = 10 * \log_{10} \frac{Emissions_{absolute}(\Delta_{RB})}{\frac{1}{|T_s| \cdot L_{CRBs}} \sum_{t \in T_s} \sum_{c_1}^{c_1+(12 \cdot L_{CRBs}-1)*\Delta f} |\mathrm{MS}(t,f)|^2} [dB]$$

where

L_{CRBs} is the number of allocated RBs, which is always 1 in case of PUCCH

and $\mathrm{MS}(t,f)$ is the frequency domain samples for the allocated bandwidth, as defined in the subsection E.5.8

Although an exclusion period for EVM is applicable in E.5.9.1, the inband emissions measurement interval is defined over one complete slot in the time domain.

From the acquired samples 20 functions for inband emissions can be derived.

Since the PUCCH allocation is always on the upper or lower band-edge, the opposite of the allocated one represents the IQ image, and the remaining inner RBs represent the general inband emissions. They are compared against different limits.

E.6 EVM for PRACH

The description below is generic in the sense that all 5 PRACH formats are covered. The numbers, used in the text below are taken from PRACH format#0 without excluding the other formats. The sampling rate for the PUSCH, 30.72 Msps in the time domain, is re-used for the PRACH. The carrier spacing of the PUSCH is 12 (format 0 to 3) and 2 (format 4) times of the PRACH. This results in an oversampling factor of 12 (format 0 to 3) and 2 (format 4), when acquiring the time samples for the PRACH. The pre-FFT algorithms (clauses E.6.6 and E.6.7) use all time samples, although oversampled. For the FFT the time samples are decimated by the factor of 12 (format 0 to 3) and 2 (format 4), resulting in the same FFT size as for the other transmit modulation tests (2048). Decimation requires a decision, which samples are used and which ones are rejected. The algorithm in E.6.6, Timing of the FFT window, can also be used to decide about the used samples.

E.6.1 Basic principle

The basis principle is the same as described in E.2.1

E.6.2 Output signal of the TX under test

The output signal of the TX under test is processed same as described in E.2.2

The measurement period is different:

- 2 PRACH preambles are recorded for format 0and 1,
- 1 PRACH preamble is recorded for format 2 and 3, each containing 1 CP and 2 preamble sequences
- 10 RPRACH preambles are recorded for format 4.

E.6.3 Reference signal

The test description in 6.5.2.1.4.1A is based on non contention based access:

- PRACH configuration index (responsible for Preamble format, System frame number and subframe number)
- Preamble ID

- Preamble power

signalled to the UE, defines the reference signal unambiguously, such that no demodulation process is necessary to gain the reference signal.

The reference signal i(v) is constructed by the measuring equipment according to the relevant TX specifications, using the following parameters: the applicable Zadoff Chu sequence, nominal carrier frequency, nominal amplitude and phase for each subcarrier, nominal timing, no carrier leakage. It is represented as a sequence of samples at a sampling rate of 30.72 Msps in the time domain.

E.6.4 Measurement results

The measurement result is:

- EVMPRACH

E.6.5 Measurement points

The measurement points are illustrated in the figure below:

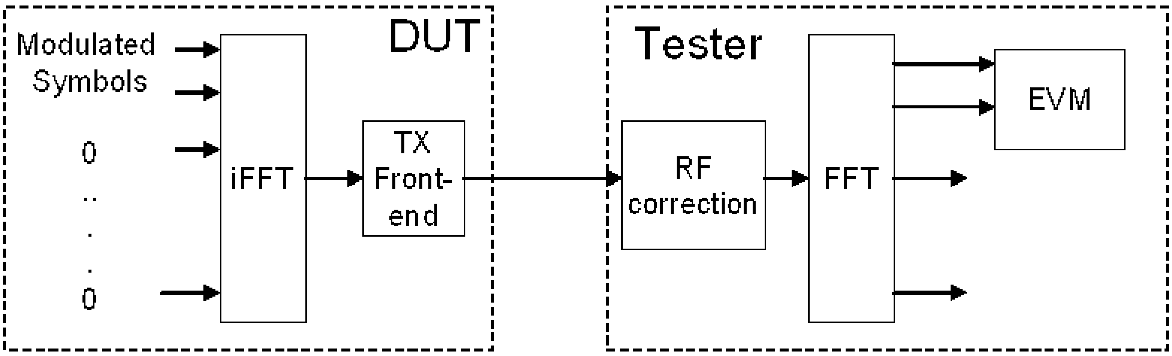


Figure E.6.5-1

E.6.6 Pre FFT minimization process

The pre-FFT minimization process is applied to each PRACH preamble separately. The time period for the pre- FFT minimisation process includes the complete CP and Zadoff-Chu sequence (in other words, the power transition period is per definition outside of this time period) Sample timing, Carrier frequency and carrier leakage in z(v) are jointly varied in order to minimise the difference between z(v) and i(v). Best fit (minimum difference) is achieved when the RMS difference value between z(v) and i(v) is an absolute minimum.

After this process the samples z(v) are called $z^0(v)$.

RF error, and carrier leakage are necessary for best fit of the measured signal towards the ideal signal in the pre FFT domain. However they are not used to compare them against the limits.

E.6.7 Timing of the FFT window

The FFT window length is 24576 samples for preamble format 0, however in the measurement period is at least 27744 samples are taken. The position in time for FFT must be determined.

In an ideal signal, the FFT may start at any instant within the cyclic prefix without causing an error. The TX filter, however, reduces the window. The EVM requirements shall be met within a window W<CP.

The reference instant for the FFT start is the centre of the reduced window, called $\Delta\tilde{c}$, EVM is measured at the following two instants: $\Delta\tilde{c}$ –W/2 and $\Delta\tilde{c}$ +W/2.

The timing of the measured signal $z^0(v)$ with respect to the ideal signal i(v) is determined in the pre FFT domain as follows:

Correlation between $z^0(v)$ and i(v) will result in a correlation peak. The meaning of the correlation peak is approx. the "impulse response" of the TX filter. The correlation peak, (the highest, or in case of more than one, the earliest) indicates the timing in the measured signal with respect to the ideal signal.

W is different for different preamble formats and shown in TableE.6.7-1.

Table E.6.7-1EVM window length for PRACH

Preamble format	Cyclic prefix length[1] N_{cp}	Nominal FFT size[2]	EVM window length *W* in FFT samples	Ratio of *W* to CP[3]
0	3168	24576	3072	96.7%
1	21024	24576	20928	99.5%
2	6240	49152	6144	98.5%
3	21024	49152	20928	99.5%
4	448	4096	432	96.4%
Note 1: The unit is number of samples, sampling rate of 30.72MHz is assumed Note 2: Decimation of time samples by 12(format 0 to 3) and factor 2 (format 4) is assumed, leading to a uniform FFT size of 2048 for all formats. Note 3: These percentages are informative				

The number of samples, used for FFT is reduced compared to $z^0(v)$. This subset of samples is called z''(v).

The sample frequency 30.72 MHz is oversampled with respect to the PRACH-subcarrier spacing of 1.25kHz (format 0 to 3) and 7.5kHz (format 4). EVM is based on 2048 samples per PRACH preamble and requires decimation of the time samples by the factor of 12 (format 0 to 3) and factor 2 (format 4). The final number of samples per PRACH preamble, used for FFT is reduced compared to z''(v) by the factor of 12 (format 0 to 3) and factor 2 (format 4). This subset of samples is called z'(v).

E.6.8 Post FFT equalisation

Equalisation is not applicable for the PRACH.

E.6.9 Derivation of the results

E.6.9.1 $\mathrm{EVM}_{\mathrm{PRACH}}$

Perform FFT on z'(v) and i(v) using the FFT timing $\Delta\tilde{c}$ –W/2 and $\Delta\tilde{c}$ +W/2.

For format 2 and 3 the first and the repeated preamble sequence are FFT-converted separately. using the standard FFT length 0f 2048

The $\mathrm{EVM}_{\mathrm{PRACH}}$ is the difference between the ideal waveform and the measured and equalized waveform for the allocated RB(s).

$$EVM_{PRACH} = \sqrt{\frac{\sum_{f \in F} \left| Z'(f) - I(f) \right|^2}{N_{ZC} \cdot P_0}},$$

where

f covers the count of demodulated symbols within the allocated bandwidth.

$Z'(f)$ are the samples of the signal evaluated for the EVM_{PRACH}

$I(f)$ is the ideal signal reconstructed by the measurement equipment, and

P_0 is the average power of the ideal signal. For normalized modulation symbols P_0 is equal to 1.

N_{ZC} is random access preamble sequence length.

From the acquired samples 4 EVM_{PRACH} value can be derived, 2 values for the timing $\Delta\tilde{c}$ –W/2 and 2 values for the timing $\Delta\tilde{c}$ +W/2 (4 and 2 applies for format 0,1,2,3. 20 and 10 applies for format 4).

E.6.9.2 Averaged EVM_{PRACH}

The PRACH EVM, EVM_{PRACH}, is averaged over two preamble sequence measurements for preamble formats 0, 1, 2, 3, and it is averaged over 10 preamble sequence measurements for preamble format 4.

$$\overline{EVM}_{PRACH} = \sqrt{\frac{1}{2}\sum_{i=1}^{2} EVM_{PRACH}{}_{i}^{2}} \quad \text{for preamble formats 0,1,2,3}$$

$$\overline{EVM}_{PRACH} = \sqrt{\frac{1}{10}\sum_{i=1}^{10} EVM_{PRACH}{}_{i}^{2}} \quad \text{for preamble format 4}$$

The averaging is done separately for timing $\Delta\tilde{c}$ –W/2 and $\Delta\tilde{c}$ +W/2 leading to $\overline{EVM}_{PRACH,low}$ and $\overline{EVM}_{PRACH,high}$

$EVM_{PRACH,final} = \max(\overline{EVM}_{PRACH,low}, \overline{EVM}_{PRACH,high})$ is compared against the test requirements.

E.7 [FFS]

E.8 EVM for category NB1

E.8.1 Averaged EVM

The general EVM for category NB1 is calculated using the procedure defined in Annex E.4 with the exception that the general EVM is averaged over basic EVM measurements for $240/L_{Ctone}$ slots in the time domain, where L_{Ctone} = {1, 3, 6, 12} is the number of subcarriers for the transmission.

E.8.2 EVM of Demodulation reference symbols (EVM_{DMRS})

The calculation of the EVM for the demodulation reference symbols for category NB1 follows the procedure defined for DMRS in Annex E.4 with the exception that the basic EVM_{DMRS} measurements are first averaged over $240/L_{Ctone}$ slots to obtain the intermediate average EVM.

E.8.3 EVM for NPRACH

The calculation of the NPRACH EVM for both formats follows the procedure defined for PRACH in Annex E.6 with the exception that EVM_{PRACH} is averaged over 64 preamble measurements.

E.8.4 Window length for category NB1

The EVM window length, W, for NPUSCH is set to 1 (in FFT samples where the nominal FFT size is 128 for 15 kHz sub-carrier spacing and 512 for 3.75 kHz sub-carrier spacing).
The EVM window length, W, for NPRACH is set to 110 for preamble format 0 and to 494 for preamble format 1 (both in FFT samples where the nominal FFT size is 512).

Annex F (normative): Measurement uncertainties and Test Tolerances

F.1 Acceptable uncertainty of Test System (normative)

The maximum acceptable uncertainty of the Test System is specified below for each test, where appropriate. The Test System shall enable the stimulus signals in the test case to be adjusted to within the specified range, and the equipment under test to be measured with an uncertainty not exceeding the specified values. All ranges and uncertainties are absolute values, and are valid for a confidence level of 95 %, unless otherwise stated.

A confidence level of 95 % is the measurement uncertainty tolerance interval for a specific measurement that contains 95 % of the performance of a population of test equipment.

For RF tests it should be noted that the uncertainties in clause F.1 apply to the Test System operating into a nominal 50 ohm load and do not include system effects due to mismatch between the DUT and the Test System.

The downlink signal uncertainties apply at each receiver antenna connector.

F.1.1 Measurement of test environments

The measurement accuracy of the UE test environments defined in TS 36.508 subclause 4.1, Test environments shall be.

- Pressure ±5 kPa.
- Temperature ±2 degrees.
- Relative Humidity ±5 %.
- DC Voltage ±1,0 %.
- AC Voltage ±1,5 %.
- Vibration 10 %.
- Vibration frequency 0,1 Hz.

The above values shall apply unless the test environment is otherwise controlled and the specification for the control of the test environment specifies the uncertainty for the parameter.

F.1.2 Measurement of transmitter

Table F.1.2-1: Maximum Test System Uncertainty for transmitter tests

Subclause	Maximum Test System Uncertainty	Derivation of Test System Uncertainty
6.2A.1 UE maximum output power for category M1	Same as clause 6.2.2EA in TS 36.521-1 [14] for FDD band with “f ≤ 3.0GHz”.	
6.2A.2 UE maximum output power reduction for category M1	Same as clause 6.2.3EA in TS 36.521-1 [14] for FDD band with “f ≤ 3.0GHz”.	
6.2A.3 UE additional maximum output power reduction for category M1 UE	Same as clause 6.2.4EA in TS 36.521-1 [14] for FDD band with “f ≤ 3.0GHz”.	
6.2A.4 Configured transmitted Power for category M1	Same as clause 6.2.5EA in TS 36.521-1 [14] for FDD band with “f ≤ 3.0GHz”.	
6.2B.1 UE maximum output power for category NB1 and NB2	Same as clause 6.2.2F in TS 36.521-1 [14] for FDD band with “f ≤ 3.0GHz”.	
6.2B.2 UE maximum output power reduction for category NB1 and NB2	Same as clause 6.2.3F in TS 36.521-1[14] for FDD band with “f ≤ 3.0GHz”.	
6.2B.3 UE additional maximum output power reduction for category NB1 and NB2 UE	Same as clause 6.2.3F in TS 36.521-1 [14] for FDD band with “f ≤ 3.0GHz”.	
6.2B.4 Configured transmitted Power for category NB1 and NB2	Same as clause 6.2.5F in TS 36.521-1 [14] for FDD band with “f ≤ 3.0GHz”.	
6.3A.1 UE Minimum output power for category M1	Same as clause 6.3.2EA in TS 36.521-1 [14] for FDD band with “f ≤ 3.0GHz”.	
6.3A.2 Transmit OFF power for category M1	Same as clause 6.3.3EA in TS 36.521-1 [14] for FDD band with “f ≤ 3.0GHz”.	
6.3A.3.1 General ON/OFF time mask for category M1	Same as clause 6.3.4EA.1 in TS 36.521-1 [14] for FDD band with “f ≤ 3.0GHz”.	
6.3A.3.2.1 PRACH time mask for UE category M1	Same as clause 6.3.4EA.2 in TS 36.521-1 [14] for FDD band with “f ≤ 3.0GHz”.	
6.3A.3.2.2 SRS time mask for UE category M1	Same as clause 6.3.4EA.2 in TS 36.521-1 [14] for FDD band with “f ≤ 3.0GHz”.	
6.3A.4.1 Power Control Absolute power tolerance for UE category M1	Same as clause 6.3.5EA.1 in TS 36.521-1 [14] for FDD band with “f ≤ 3.0GHz”.	
6.3A.4.2 Power Control Relative power tolerance for UE category M1	Same as clause 6.3.5EA.2 in TS 36.521-1 [14]	
6.3A.4.3 Aggregate power control tolerance for UE category M1	Same as clause 6.3.5EA.3 in TS 36.521-1 [14]	
6.3B.1 UE Minimum output power for category NB1 and NB2	Same as clause 6.3.2F in TS 36.521-1 [14] for FDD band with “f ≤ 3.0GHz”	
6.3B.2 Transmit OFF power for category NB1 and NB2	Same as clause 6.3.3F in TS 36.521-1 [14] for FDD band with “f ≤ 3.0GHz”	
6.3B.3.1 General ON/OFF time mask for category NB1 and NB2	Same as clause 6.3.4F.1 in TS 36.521-1 [14] for FDD band with “f ≤ 3.0GHz”	
6.3B.3.2 NPRACH time mask for category NB1 and NB2	Same as clause 6.3.4F.2 in TS 36.521-1 [14] for FDD band with “f ≤ 3.0GHz”	
6.3B.4.1 Power Control Absolute power tolerance for category NB1 and NB2	Same as clause 6.3.5F.1 in TS 36.521-1 [14] for FDD band with “f ≤ 3.0GHz”	
6.3B.4.2 Power Control Relative power tolerance for category NB1 and NB2	Same as clause 6.3.5F.2 in TS 36.521-1 [14]	
6.3B.4.3 Aggregate power control tolerance for category NB1 and NB2	Same as clause 6.3.5F.3 in TS 36.521-1 [14]	

6.4A.1_1 Frequency error with GSO ephemeris for UE category M1	Same as clause 6.5.1EA in TS 36.521-1 [14]	
6.4A.1_2 Frequency error with NGSO ephemeris for UE category M1	Same as clause 6.5.1EA in TS 36.521-1 [14]	
6.4A.2.1 Error Vector Magnitude (EVM) for category M1	Same as clause 6.5.2.1EA.1 in TS 36.521-1 [14]	
6.4A.2.2 Carrier leakage for category M1	Same as clause 6.5.2.2EA in TS 36.521-1 [14]	
6.4A.2.3 In-band emissions for non allocated RB for category M1	Same as clause 6.5.2.3EA in TS 36.521-1 [14]	
6.4A.2.4 EVM equalizer spectrum flatness for category M1	Same as clause 6.5.2.4EA in TS 36.521-1 [14]	
6.4B.1_1 Frequency error with GSO ephemeris for UE category NB1 and NB2	Same as clause 6.5.1F in TS 36.521-1 [14]	
6.4B.1_2 Frequency error with NGSO ephemeris for UE category NB1 and NB2	Same as clause 6.5.1F in TS 36.521-1 [14]	
6.4B.2.1 Error Vector Magnitude (EVM) for Category NB1 and NB2	Same as clause 6.5.2.1F.1 in TS 36.521-1 [14]	
6.4B.2.2 Carrier leakage for Category NB1 and NB2	Same as clause 6.5.2.2F in TS 36.521-1 [14]	
6.4B.2.3 In-band emissions for Category NB1 and NB2	Same as clause 6.5.2.3F in TS 36.521-1 [14]	
6.5A.2 Occupied bandwidth for category M1	Same as clause 6.6.1EA in TS 36.521-1 [14] for FDD band with “channel bandwidth = 1.4MHz”.	
6.5A.3.2 Spectrum emission mask for category M1	Same as clause 6.6.2.1EA in TS 36.521-1 [14] for FDD band with “f ≤ 3.0GHz”	
6.5A.3.4 Adjacent Channel Leakage Ratio for category M1	Same as clause 6.6.2.3EA in TS 36.521-1 [14]	
6.5A.4.2 Transmitter Spurious emissions for category M1	Same as clause 6.6.3EA.1 in TS 36.521-1 [14] for FDD band for spurious frequencies up to 12.75 GHz	
6.5A.4.3 Spurious emission band UE co-existence for category M1	Same as clause 6.6.3EA.2 in TS 36.521-1 [14] for FDD band with “results > -60 dBm, f ≤ 3.0GHz”	
6.5A.4.4 Additional spurious emissions for category M1	± 2.0 dB, f ≤ 3.0GHz	
6.5B.2 Occupied bandwidth for category NB1 and NB2	Same as clause 6.6.1F in TS 36.521-1 [14]	
6.5B.3.2 Spectrum emission mask for category NB1 and NB2	Same as clause 6.6.2.1F in TS 36.521-1 [14] for FDD band with “f ≤ 3.0GHz”	
6.5B.3.4 Adjacent Channel Leakage Ratio for category NB1 and NB2	Same as clause 6.6.2.3F in TS 36.521-1 [14]	
6.5B.4.2 Transmitter Spurious emissions for category NB1 and NB2	Same as clause 6.6.3F.1 in TS 36.521-1[14] for f < 5th harmonic of the upper frequency edge of the UL operating band in GHz	
6.5B.4.3 Spurious emission band UE co-existence for category NB1 and NB2	Same as clause 6.6.3F.2 in TS 36.521-1 [14] for FDD band with “results > -60 dBm, f ≤ 3.0GHz”	
6.5B.4.4 Additional spurious emissions for category NB1 and NB2	± 2.0 dB, f ≤ 3.0GHz	
6.6B Transmit intermodulation for category NB1 and NB2	Same as clause 6.7F in TS 36.521-1 [14] for FDD band with “f ≤ 3.0GHz”	

F.1.3 Measurement of receiver

Table F.1.3-1: Maximum Test System Uncertainty for receiver tests

Subclause	Maximum Test System Uncertainty[1]	Derivation of Test System Uncertainty
7.3A Reference sensitivity power level for UE category M1	Same as clause 7.3EA in TS 36.521-1 [14]	**Same as clause 7.3EA in TS 36.521-1 [14]**
7.3B Reference sensitivity power level for UE category NB1 and NB2	Same as clause 7.3F.1 in TS 36.521-1 [14]	
7.4A Maximum input level for category M1	Same as clause 7.4EA in TS 36.521-1 [14] for FDD band with “f ≤ 3.0GHz”.	
7.4B Maximum input level for category NB1 and NB2	Same as clause 7.4F in TS 36.521-1 [14] for FDD band with “f ≤ 3.0GHz”.	
7.5A Adjacent Channel Selectivity for category M1	Same as clause 7.5EA in TS 36.521-1 [14] for FDD band with “f ≤ 3.0GHz”.	
7.5B Adjacent Channel Selectivity for category NB1 and NB2	Same as clause 7.5F in TS 36.521-1 [14] for FDD band with “f ≤ 3.0GHz”.	
7.6A.2 In-band blocking for category M1	Same as clause 7.6.1EA in TS 36.521-1 [14].	Same as clause 7.6.1EA in TS 36.521-1 [14].
7.6A.3 Out-of-band blocking for category M1	Same as clause 7.6.2EA in TS 36.521-1 [14].	Same as clause 7.6.2EA in TS 36.521-1 [14].
7.6A.4 Narrow band blocking for category M1	Same as clause 7.6.3EA in TS 36.521-1 [14].	Same as clause 7.6.3EA in TS 36.521-1 [14].
7.6B.2 In-band blocking for category NB1 and NB2	Same as clause 7.6.1F in TS 36.521-1 [14].	Same as clause 7.6.1F in TS 36.521-1 [14].
7.6B.3 Out-of-band blocking for category NB1 and NB2	Same as clause 7.6.2F in TS 36.521-1 [14].	Same as clause 7.6.2F in TS 36.521-1 [14].
7.7A Spurious response for category M1	Same as clause 7.6A.3.	Same as clause 7.6A.3.
7.7B Spurious response for category NB1 and NB2	Same as clause 7.6B.3.	Same as clause 7.6B.3.
7.8A Intermodulation characteristics for category M1	Same as clause 7.8.1EA in TS 36.521-1 [14] for FDD band with “f ≤ 3.0GHz”.	Same as clause 7.8.1EA in TS 36.521-1 [14] for FDD band with “f ≤ 3.0GHz”.
7.8B Intermodulation characteristics for category NB1 and NB2	Same as clause 7.8.1F in TS 36.521-1 [14].	Same as clause 7.8.1F in TS 36.521-1 [14].
7.9A Spurious emissions for category M1	Same as clause 7.9EA in TS 36.521-1 [14] except for the spurious frequency range to be limited to up to 12.75GHz.	
7.9B Spurious emissions for category NB1 and NB2	Same as clause 7.9F in TS 36.521-1 [14].	
Note 1: Unless otherwise noted, only the Test System stimulus error is considered here. The effect of errors in the throughput measurements due to finite test duration is not considered.		

F.1.4 Measurement of performance requirements

Table F.1.4-1: Maximum Test System Uncertainty for Performance Requirements

Subclause	Maximum Test System Uncertainty[1]	Derivation of Test System Uncertainty
8.2.1.1.1 PDSCH in standalone mode for UE category M1 under NTN fading conditions	± 0.8 dB	Overall system uncertainty for fading conditions comprises three quantities: 1. Signal-to-noise ratio uncertainty 2. Fading profile power uncertainty 3. Effect of AWGN flatness and signal flatness Items 1, 2 and 3 are assumed to be uncorrelated so can be root sum squared: AWGN flatness and signal flatness has x 0.25 effect on the required SNR, so use sensitivity factor of x 0.25 for the uncertainty contribution. Test System uncertainty = SQRT (Signal-to-noise ratio uncertainty ^{2} + Fading profile power uncertainty ^{2} + (0.25 x AWGN flatness and signal flatness) ^{2}) Signal-to-noise ratio uncertainty ±0.3 dB Fading profile power uncertainty ±0.5 dB for single Tx AWGN flatness and signal flatness ±2.0 dB
8.3.1.1.1 Demodulation of NPDSCH (Cell-Specific Reference Symbols) in standalone mode for category NB1 and NB2 under NTN fading conditions	± 0.8 dB	Overall system uncertainty for fading conditions comprises four quantities: 1. Signal-to-noise ratio uncertainty 2. Fading profile power uncertainty 3. Effect of AWGN flatness and signal flatness 4. Result variation due to finite test time Items 1, 2, 3 and 4 are assumed to be uncorrelated so can be root sum squared: AWGN flatness and signal flatness has x 0.25 effect on the required SNR, so use sensitivity factor of x 0.25 for the uncertainty contribution. Test System uncertainty = SQRT (Signal-to-noise ratio uncertainty^2 + Fading profile power uncertainty^2 + (0.25 x AWGN flatness and signal flatness)^2 + variation due to finite test time^2) Signal-to-noise ratio uncertainty ±0.3 dB Fading profile power uncertainty ±0.5 dB for single Tx AWGN flatness and signal flatness ±2.0 dB Result variation due to finite test time ±0.15 dB for Test 1 and ±0.2 dB for Test 2.
8.3.1.1.2 Demodulation of NPDSCH (Cell-Specific Reference Symbols) in standalone mode for category NB1 and NB2	Same as clause 8.3.1.1.1.	Same as clause 8.3.1.1.1 with following exception, Result variation due to finite test time ±0.35 dB for Test 1 and ±0.3 dB for Test 2.
8.3.1.1.3 Demodulation of NPDSCH (Cell-Specific Reference Symbols) in standalone for NB2	± 0.9 dB	Same as clause 8.3.1.1.1 with following exception, Result variation due to finite test time ±0.5 dB for Test 1
8.3.1.2.1 Demodulation of NPDCCH single-antenna performance for category NB1 and NB2	Same as clause 8.12.2.1.1 in TS 36.521-1 [14].	
Note 1: Unless otherwise noted, only the Test System stimulus error is considered here. The effect of errors in the throughput measurements due to finite test duration is not considered.		

F.2 Interpretation of measurement results (normative)

The Test Requirements in the present document have been calculated by relaxing the Minimum Requirements of the core specification using the Test Tolerances (TT) defined in F.3. The measurement results returned by the Test System are compared – without any modification – against the Test Requirements as defined by either the “Never fail a good DUT” principle for Test Tolerance equal measurement uncertainty (TT = MU) or “Shared Risk” principle for Test Tolerance equal to 0 (TT = 0).

The “Never fail a good DUT” and the “Shared Risk” principles are defined in ETR 273-1-2 clause 6.5.

The actual measurement uncertainty of the Test System for the measurement of each parameter shall be included in the test report.

The recorded value for the Test System uncertainty shall be, for each measurement, equal to or lower than the appropriate figure in clause F.1 of the present document.

If the Test System for a test is known to have a measurement uncertainty greater than that specified in clause F.1, it is still permitted to use this apparatus provided that an adjustment is made value as follows:

Any additional uncertainty in the Test System over and above that specified in clause F.1 shall be used to tighten the Test Requirement, making the test harder to pass. For some tests, for example receiver tests, this may require modification of stimulus signals. This procedure will ensure that a Test System not compliant with clause F.1does not increase the chance of passing a device under test where that device would otherwise have failed the test if a Test System compliant with clause F.1 had been used.

F.3 Test Tolerance and Derivation of Test Requirements (informative)

The Test Requirements in the present document have been calculated by relaxing the Minimum Requirements of the core specification using the Test Tolerances defined in this clause. When the Test Tolerance is zero, the Test Requirement will be the same as the Minimum Requirement. When the Test Tolerance is non-zero, the Test Requirements will differ from the Minimum Requirements, and the formula used for the relaxation is given in this clause.

The Test Tolerances are derived from Test System uncertainties, regulatory requirements and criticality to system performance. As a result, the Test Tolerances may sometimes be set to zero.

The test tolerances should not be modified for any reason e.g. to take account of commonly known test system errors (such as mismatch, cable loss, etc.).

The downlink Test Tolerances apply at each receiver antenna connector.

F.3.1 Measurement of test environments

The UE test environments are set to the values defined in TS 36.508 subclause 4.1, without any relaxation. The applied Test Tolerance is therefore zero.

F.3.2 Measurement of transmitter

Table F.3.2-1: Derivation of Test Requirements (Transmitter tests)

Test	Minimum Requirement in TS 36.102	Test Tolerance (TT)	Test Requirement in TS 36.521-1
6.2A.1 UE maximum output power for category M1	Same as clause 6.2.2EA in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz, Power class 3" and "f ≤ 3.0GHz, Power class 5".	Same as clause 6.2.2EA in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz, Power class 3" and "f ≤ 3.0GHz, Power class 5".	Same as clause 6.2.2EA in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz, Power class 3" and "f ≤ 3.0GHz, Power class 5".
6.2A.2 UE maximum output power reduction for category M1	Same as clause 6.2.3EA in TS 36.521-1 [14] for FDD band with "Power class 3, f ≤ 3.0GHz" and "Power class 5, f ≤ 3.0GHz".	Same as clause 6.2.3EA in TS 36.521-1 [14] for FDD band with "Power class 3, f ≤ 3.0GHz" and "Power class 5, f ≤ 3.0GHz".	Same as clause 6.2.3EA in TS 36.521-1 [14] for FDD band with "Power class 3, f ≤ 3.0GHz" and "Power class 5, f ≤ 3.0GHz".
6.2A.3 UE additional maximum output power reduction for category M1 UE	Same as clause 6.2.4EA in TS 36.521-1 [14]	Same as clause 6.2.4EA in TS 36.521-1 [14]] for FDD band with "f ≤ 3.0GHz".	Same as clause 6.2.4EA in TS 36.521-1 [14]
6.2A.4 Configured transmitted Power for category M1	Same as clause 6.2.5EA in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz".	Same as clause 6.2.5EA in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz".	Same as clause 6.2.5EA in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz".
6.2B.1 UE maximum output power for category NB1 and NB2	Same as clause 6.2.2F in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz, Power class 3" and "f ≤ 3.0GHz, Power class 5"	Same as clause 6.2.2F in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz".	Same as clause 6.2.2F in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz".
6.2B.2 UE maximum output power reduction for category NB1 and NB2	Same as clause 6.2.3F in TS 36.521-1 [14] for FDD band with "Power class 3, f ≤ 3.0GHz" and "Power class 5, f ≤ 3.0GHz".	Same as clause 6.2.3F in TS 36.521-1 [14] for FDD band with "Power class 3, f ≤ 3.0GHz" and "Power class 5, f ≤ 3.0GHz".	Same as clause 6.2.3F in TS 36.521-1 [14] for FDD band with "Power class 3, f ≤ 3.0GHz" and "Power class 5, f ≤ 3.0GHz".
6.2B.3 UE additional maximum output power reduction for category NB1 and NB2 UE	Same as clause 6.2.3F in TS 36.521-1[14] for FDD band with "f ≤ 3.0GHz"	Same as clause 6.2.3F in TS 36.521-1[14] for FDD band with "f ≤ 3.0GHz"	Same as clause 6.2.3F in TS 36.521-1[14] for FDD band with "f ≤ 3.0GHz"
6.2B.4 Configured transmitted Power for category NB1 and NB2	Same as clause 6.2.5F in TS 36.521-1 [14]	Same as clause 6.2.5F in TS 36.521-1 [14]	Same as clause 6.2.5F in TS 36.521-1 [14]
6.3A.1 UE Minimum output power for category M1	Same as clause 6.3.2EA in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz".	Same as clause 6.3.2EA in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz".	Same as clause 6.3.2EA in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz".
6.3A.2 Transmit OFF power for category M1	Same as clause 6.3.3EA in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz".	Same as clause 6.3.3EA in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz".	Same as clause 6.3.3EA in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz".
6.3A.3.1 General ON/OFF time mask for category M1	Same as clause 6.3.4EA.1 in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz".	Same as clause 6.3.4EA.1 in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz".	Same as clause 6.3.4EA.1 in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz".
6.3A.3.2.1 PRACH time mask for UE category M1	Same as clause 6.3.4EA.2 in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz".	Same as clause 6.3.4EA.2 in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz".	Same as clause 6.3.4EA.2 in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz".
6.3A.3.2.2 SRS time mask for UE category M1	Same as clause 6.3.4EA.2 in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz".	Same as clause 6.3.4EA.2 in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz".	Same as clause 6.3.4EA.2 in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz".
6.3A.4.1 Power Control Absolute power tolerance for UE category M1	Same as clause 6.3.5EA.1 in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz".	Same as clause 6.3.5EA.1 in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz".	Same as clause 6.3.5EA.1 in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz".
6.3A.4.2 Power Control Relative power tolerance for UE category M1	Same as clause 6.3.5EA.2 in TS 36.521-1 [14].	Same as clause 6.3.5EA.2 in TS 36.521-1 [14].	Same as clause 6.3.5EA.2 in TS 36.521-1 [14].

6.3A.4.3 Aggregate power control tolerance for UE category M1	Same as clause 6.3.5EA.3 in TS 36.521-1 [14].	Same as clause 6.3.5EA.3 in TS 36.521-1 [14].	Same as clause 6.3.5EA.3 in TS 36.521-1 [14].
6.3B.1 UE Minimum output power for category NB1 and NB2	Same as clause 6.3.2F in TS 36.521-1 [14]	Same as clause 6.3.2F in TS 36.521-1 [14]	Same as clause 6.3.2F in TS 36.521-1 [14]
6.3B.2 Transmit OFF power for category NB1 and NB2	Same as clause 6.3.3F in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz".	Same as clause 6.3.3F in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz".	Same as clause 6.3.3F in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz".
6.3B.3.1 General ON/OFF time mask for category NB1 and NB2	Same as clause 6.3.4F.1 in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz".	Same as clause 6.3.4F.1 in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz".	Same as clause 6.3.4F.1 in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz".
6.3B.3.2 NPRACH time mask for category NB1 and NB2	Same as clause 6.3.4F.2 in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz".	Same as clause 6.3.4F.2 in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz".	Same as clause 6.3.4F.2 in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz".
6.3B.4.1 Power Control Absolute power tolerance for category NB1 and NB2	Same as clause 6.3.5F.1 in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz".	Same as clause 6.3.5F.1 in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz".	Same as clause 6.3.5F.1 in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz".
6.3B.4.2 Power Control Relative power tolerance for category NB1 and NB2	Same as clause 6.3.5F.2 in TS 36.521-1 [14]	Same as clause 6.3.5F.2 in TS 36.521-1 [14]	Same as clause 6.3.5F.2 in TS 36.521-1 [14]
6.3B.4.3 Aggregate power control tolerance for category NB1 and NB2	Same as clause 6.3.5F.3 in TS 36.521-1 [14]	Same as clause 6.3.5F.3 in TS 36.521-1 [14]	Same as clause 6.3.5F.3 in TS 36.521-1 [14]
6.4A.1_1 Frequency error with GSO ephemeris for UE category M1	Same as clause 6.5.1EA in TS 36.521-1 [14]	Same as clause 6.5.1EA in TS 36.521-1 [14]	Same as clause 6.5.1EA in TS 36.521-1 [14]
6.4A.1_2 Frequency error with NGSO ephemeris for UE category M1	Same as clause 6.5.1EA in TS 36.521-1 [14]	Same as clause 6.5.1EA in TS 36.521-1 [14]	Same as clause 6.5.1EA in TS 36.521-1 [14]
6.4A.2.1 Error Vector Magnitude (EVM) for category M1	Same as clause 6.5.2.1EA.1 in TS 36.521-1 [14]	Same as clause 6.5.2.1EA.1 in TS 36.521-1 [14]	Same as clause 6.5.2.1EA.1 in TS 36.521-1 [14]
6.4A.2.2 Carrier leakage for category M1	Same as clause 6.5.2.2EA in TS 36.521-1 [14]	Same as clause 6.5.2.2EA in TS 36.521-1 [14]	Same as clause 6.5.2.2EA in TS 36.521-1 [14]
6.4A.2.3 In-band emissions for non allocated RB for category M1	Same as clause 6.5.2.3EA in TS 36.521-1 [14]	Same as clause 6.5.2.3EA in TS 36.521-1 [14]	Same as clause 6.5.2.3EA in TS 36.521-1 [14]
6.4A.2.4 EVM equalizer spectrum flatness for category M1	Same as clause 6.5.2.4EA in TS 36.521-1 [14]	Same as clause 6.5.2.4EA in TS 36.521-1 [14]	Same as clause 6.5.2.4EA in TS 36.521-1 [14]
6.4B.1_1 Frequency error with GSO ephemeris for UE category NB1 and NB2	Same as clause 6.5.1F in TS 36.521-1 [14]	Same as clause 6.5.1F in TS 36.521-1 [14]	Same as clause 6.5.1F in TS 36.521-1 [14]
6.4B.1_2 Frequency error with NGSO ephemeris for UE category NB1 and NB2	Same as clause 6.5.1F in TS 36.521-1 [14]	Same as clause 6.5.1F in TS 36.521-1 [14]	Same as clause 6.5.1F in TS 36.521-1 [14]

6.4B.2.1 Error Vector Magnitude (EVM) for Category NB1 and NB2	Same as clause 6.5.2.1F.1 in TS 36.521-1 [14]	Same as clause 6.5.2.1F.1 in TS 36.521-1 [14]	Same as clause 6.5.2.1F.1 in TS 36.521-1 [14]
6.4B.2.2 Carrier leakage for Category NB1 and NB2	Same as clause 6.5.2.2F in TS 36.521-1 [14]	Same as clause 6.5.2.2F in TS 36.521-1 [14]	Same as clause 6.5.2.2F in TS 36.521-1 [14]
6.4B.2.3 In-band emissions for Category NB1 and NB2	Same as clause 6.5.2.3F in TS 36.521-1 [14]	Same as clause 6.5.2.3F in TS 36.521-1 [14]	Same as clause 6.5.2.3F in TS 36.521-1 [14]
6.5A.2 Occupied bandwidth for category M1	Same as clause 6.6.1EA in TS 36.521-1 [14] for FDD band with “channel bandwidth = 1.4MHz”.	Same as clause 6.6.1EA in TS 36.521-1 [14]	Same as clause 6.6.1EA in TS 36.521-1 [14]
6.5A.3.2 Spectrum emission mask for category M1	Same as clause 6.6.2.1EA in TS 36.521-1 [14] for FDD band with “channel bandwidth = 1.4MHz”.	Same as clause 6.6.2.1EA in TS 36.521-1 [14] for FDD band with “f ≤ 3.0GHz”.	Same as clause 6.6.2.1EA in TS 36.521-1 [14]
6.5A.3.4 Adjacent Channel Leakage Ratio for category M1	Same as clause 6.6.2.3EA in TS 36.521-1 [14]	Same as clause 6.6.2.3EA in TS 36.521-1 [14]	Same as clause 6.6.2.3EA in TS 36.521-1 [14]
6.5A.4.2 Transmitter Spurious emissions for category M1	Same as clause 6.6.3EA.1 in TS 36.521-1 [14] for FDD band for spurious frequencies up to 12.75 GHz.	Same as clause 6.6.3EA.1 in TS 36.521-1 [14]	Same as clause 6.6.3EA.1 in TS 36.521-1 [14]
6.5A.4.3 Spurious emission band UE co-existence for category M1	Same as clause 6.6.3EA.2 in TS 36.521-1 [14]	Same as clause 6.6.3EA.2 in TS 36.521-1 [14]	Same as clause 6.6.3EA.2 in TS 36.521-1 [14]
6.5A.4.4 Additional spurious emissions for category M1	-26 dBm / 700kHz -50 dBm / 700kHz -2 dBm / 4kHz -5 dBm / 4kHz -12 dBm / 4kHz -13 dBm / 4kHz -15 dBm / 4kHz -16 dBm / 1MHz -40 dBm / 1MHz Frequencies as detailed in core requirement	0 dB	Formula: Minimum Requirement + TT
6.5B.2 Occupied bandwidth for category NB1 and NB2	Same as clause 6.6.1F in TS 36.521-1 [14]	Same as clause 6.6.1F in TS 36.521-1 [14]	Same as clause 6.6.1F in TS 36.521-1 [14]
6.5B.3.2 Spectrum emission mask for category NB1 and NB2	Same as clause 6.6.2.1F in TS 36.521-1 [14]	Same as clause 6.6.2.1F in TS 36.521-1 [14] for FDD band with “f ≤ 3.0GHz”.	Same as clause 6.6.2.1F in TS 36.521-1 [14]
6.5B.3.4 Adjacent Channel Leakage Ratio for category NB1 and NB2	Same as clause 6.6.2.3F in TS 36.521-1 [14]	Same as clause 6.6.2.3F in TS 36.521-1 [14]	Same as clause 6.6.2.3F in TS 36.521-1 [14]
6.5B.4.2 Transmitter Spurious emissions for category NB1 and NB2	Same as clause 6.6.3F.1 in TS 36.521-1[14] for f < 5^{th} harmonic of the upper frequency edge of the UL operating band in GHz	Same as clause 6.6.3F in TS 36.521-1[14] for f < 5^{th} harmonic of the upper frequency edge of the UL operating band in GHz	Same as clause 6.6.3F in TS 36.521-1[14] for f < 5^{th} harmonic of the upper frequency edge of the UL operating band in GHz
6.5B.4.3 Spurious emission band UE co-existence for category NB1 and NB2	Same as 6.6.3F.2 in TS 36.521-1 [14]	Same as 6.6.3F.2 in TS 36.521-1 [14]	Same as 6.6.3F.2 in TS 36.521-1 [14]

6.5B.4.4 Additional spurious emissions for category NB1 and NB2	-26 dBm / 700kHz -50 dBm / 700kHz -2 dBm / 4kHz -5 dBm / 4kHz -12 dBm / 4kHz -13 dBm / 4kHz -15 dBm / 4kHz -16 dBm / 1MHz -40 dBm / 1MHz Frequencies as detailed in core requirement	0 dB	Formula: Minimum Requirement + TT
6.6B Transmit intermodulation for category NB1 and NB2	Same as clause 6.7F in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz"	Same as clause 6.7F in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz"	Same as clause 6.7F in TS 36.521-1 [14] for FDD band with "f ≤ 3.0GHz"

F.3.3 Measurement of receiver

Table F.3.3-1: Derivation of Test Requirements (Receiver tests)

Test	Minimum Requirement in TS 36.102	Test Tolerance (TT)	Test Requirement in TS 36.521-1
7.3A Reference sensitivity power level for UE category M1	Same as clause 7.3EA in TS 36.521-1 [14]	Same as clause 7.3EA in TS 36.521-1 [14]	Same as clause 7.3EA in TS 36.521-1 [14]
7.3B Reference sensitivity power level for UE category NB1 and NB2	Same as clause 7.3F.1 in TS 36.521-1 [14]	Same as clause 7.3F.1 in TS 36.521-1 [14] for FDD band with “f ≤ 3.0GHz”.	Same as clause 7.3F.1 in TS 36.521-1 [14]
7.4A Maximum input level for category M1	Same as clause 7.4EA in TS 36.521-1 [14]	Same as clause 7.4EA in TS 36.521-1 [14] for FDD band with “f ≤ 3.0GHz”.	Same as clause 7.4EA in TS 36.521-1 [14] for FDD band with “f ≤ 3.0GHz”.
7.4B Maximum input level for category NB1 and NB2	Same as clause 7.4F in TS 36.521-1 [14]	Same as clause 7.4F in TS 36.521-1 [14] for FDD band with “f ≤ 3.0GHz”.	Same as clause 7.4F in TS 36.521-1 [14] for FDD band with “f ≤ 3.0GHz”.
7.5A Adjacent Channel Selectivity for category M1	Same as clause 7.5EA in TS 36.521-1 [14] for FDD band with “Case 1, channel bandwidth=1.4MHz” and “Case 2, channel bandwidth=1.4MHz”.	Same as clause7.5EA in TS 36.521-1 [14] for FDD band with “f ≤ 3.0GHz”.	Same as clause7.5EA in TS 36.521-1 [14]
7.5B Adjacent Channel Selectivity for category NB1 and NB2	Same as clause 7.5F in TS 36.521-1 [14]	Same as clause 7.5F in TS 36.521-1 [14]	Same as clause 7.5F in TS 36.521-1 [14]
7.6A.2 In-band blocking for category M1	Same as clause 7.6.1EA in TS 36.521-1 [14].	Same as clause 7.6.1EA in TS 36.521-1 [14].	Same as clause 7.6.1EA in TS 36.521-1 [14].
7.6A.3 Out-of-band blocking for category M1	Same as clause 7.6.2EA in TS 36.521-1 [14].	Same as clause 7.6.2EA in TS 36.521-1 [14].	Same as clause 7.6.2EA in TS 36.521-1 [14].
7.6A.4 Narrow band blocking for category M1	Same as clause 7.6.3EA in TS 36.521-1 [14].	Same as clause 7.6.3EA in TS 36.521-1 [14].	Same as clause 7.6.3EA in TS 36.521-1 [14].
7.6B.2 In-band blocking for category NB1 and NB2	Same as clause 7.6.1F in TS 36.521-1 [14].	Same as clause 7.6.1F in TS 36.521-1 [14].	Same as clause 7.6.1F in TS 36.521-1 [14].
7.6B.3 Out-of-band blocking for category NB1 and NB2	Same as clause 7.6.2F in TS 36.521-1 [14].	Same as clause 7.6.2F in TS 36.521-1 [14].	Same as clause 7.6.2F in TS 36.521-1 [14].

7.7A Spurious response for category M1	Same as clause 7.7EA in TS 36.521-1 [14].	Same as clause 7.7EA in TS 36.521-1 [14].	Same as clause 7.7EA in TS 36.521-1 [14].
7.7B Spurious response for category NB1 and NB2	Same as clause 7.7F in TS 36.521-1 [14].	Same as clause 7.7F in TS 36.521-1 [14].	Same as clause 7.7F in TS 36.521-1 [14].
7.8A Intermodulation characteristics for category M1	Same as clause 7.8.1EA in TS 36.521-1 [14].	Same as clause 7.8.1EA in TS 36.521-1 [14].	Same as clause 7.8.1EA in TS 36.521-1 [14].
7.8B Intermodulation characteristics for category NB1 and NB2	Same as clause 7.8.1F in TS 36.521-1 [14].	Same as clause 7.8.1F in TS 36.521-1 [14].	Same as clause 7.8.1F in TS 36.521-1 [14].
7.9A Spurious emissions for category M1	Same as clause 7.9EA in TS 36.521-1 [14] except for the spurious frequency range to be limited to up to 12.75GHz.	Same as clause 7.9EA in TS 36.521-1 [14].	Same as clause 7.9EA in TS 36.521-1 [14].
7.9B Spurious emissions for category NB1 and NB2	Same as clause 7.9F in TS 36.521-1 [14].	Same as clause 7.9F in TS 36.521-1 [14].	Same as clause 7.9F in TS 36.521-1 [14].

F.3.4 Measurement of performance requirements

Table F.3.4-1: Derivation of Test Requirements (performance tests)

Test	Minimum Requirement in TS 36.102	Test Tolerance (TT)	Test Requirement in TS 36.521-1
8.2.1.1.1 PDSCH in standalone mode for UE category M1 under NTN fading conditions	SNRs as specified in clause 8.2.1.1.1	0.8 dB	Formula: SNR + TT T-put limit unchanged
8.3.1.1.1 Demodulation of NPDSCH (Cell-Specific Reference Symbols) in standalone mode for category NB1 and NB2 under NTN fading conditions	SNRs as specified in clause 8.3.1.1.1	0.8 dB	Formula: SNR + TT T-put limit unchanged
8.3.1.1.2 Demodulation of NPDSCH (Cell-Specific Reference Symbols) in standalone mode for category NB1 and NB2	SNRs as specified in clause 8.3.1.1.2	Same as clause 8.3.1.1.1	Same as clause 8.3.1.1.1
8.3.1.1.3 Demodulation of NPDSCH (Cell-Specific Reference Symbols) in standalone for NB2	SNRs as specified in clause 8.3.1.1.3	0.9 dB	Formula: SNR + TT T-put limit unchanged
8.3.1.2.1 Demodulation of NPDCCH single-antenna performance for category NB1 and NB2	SNRs as specified in clause 8.12.2.1.1 in TS 36.521-1 [14]	Same as clause 8.12.2.1.1 in TS 36.521-1 [14]	Same as clause 8.12.2.1.1 in TS 36.521-1 [14]

Annex G (normative): Statistical Testing

G.1 General

FFS.

G.2 Statistical testing of receiver characteristics

G.2.1 General

The test of receiver characteristics is two fold.

1. A signal or a combination of signals is offered to the RX port(s) of the receiver.
2. The ability of the receiver to demodulate /decode this signal is verified by measuring the throughput.

In (2) is the statistical aspect of the test and is treated here.

The minimum requirement for all receiver tests is >95% of the maximum throughput.

All receiver tests are performed in static propagation conditions. No fading conditions are applied.

G.2.2 Mapping throughput to error ratio

a) The measured information bit throughput R is defined as the sum (in kilobits) of the information bit payloads successfully received during the test interval, divided by the duration of the test interval (in seconds).

b) In measurement practice the UE indicates successfully received information bit payload by signalling an ACK to the SS.
If payload is received, but damaged and cannot be decoded, the UE signals a NACK.

c) Only the ACK and NACK signals, not the data bits received, are accessible to the SS.
The number of bits is known in the SS from knowledge of what payload was sent.

d) For the reference measurement channel, applied for testing, the number of bits is different in different subframes, however in a radio frame it is fixed during one test.

e) The time in the measurement interval is composed of successfully received subframes (ACK), unsuccessfully received subframes (NACK) and no reception at all (DTX-subframes).

f) DTX-subframes may occur regularly according the applicable reference measurement channel (regDTX).
In real live networks this is the time when other UEs are served. In TDD these are the UL and special subframes.
regDTX vary from test to test but are fixed within the test.

g) Additional DTX-subframes occur statistically when the UE is not responding ACK or NACK where it should. (statDTX)
This may happen when the UE was not expecting data or decided that the data were not intended for it.

The pass / fail decision is done by observing the:

- number of NACKs
- number of ACKs and
- number of statDTXs (regDTX is implicitly known to the SS)

The ratio `(NACK + statDTX)/(NACK+ statDTX + ACK)`is the Error Ratio (ER). Taking into account the time consumed by the ACK, NACK, and DTX-TTIs (regular and statistical), ER can be mapped unambiguously to throughput for any single reference measurement channel test.

G.2.3 Design of the test

The test is defined by the following design principles (see clause G.x, Theory….):

1. The early decision concept is applied.
2. A second limit is introduced: Bad DUT factor M>1
3. To decide the test pass:

   Supplier risk is applied based on the Bad DUT quality

   To decide the test fail

   Customer Risk is applied based on the specified DUT quality

The test is defined by the following parameters:

1. Limit ER = 0.05 (Throughput limit = 95%)
2. Bad DUT factor M=1.5 (selectivity)
3. Confidence level CL = 95% (for specified DUT and Bad DUT-quality)

G.2.4 Numerical definition of the pass fail limits

Table G.2.4-1: pass fail limits

ne	ns_p	ns_f	ne	ns_p	ns_f	ne	ns_p	ns_f	ne	ns_p	ns_f
0	67	NA	39	763	500	78	1366	1148	117	1951	1828
1	95	NA	40	778	516	79	1381	1166	118	1965	1845
2	119	2	41	794	532	80	1396	1183	119	1980	1863
3	141	7	42	810	548	81	1412	1200	120	1995	1881
4	162	14	43	826	564	82	1427	1217	121	2010	1899
5	183	22	44	842	580	83	1442	1234	122	2025	1916
6	202	32	45	858	596	84	1457	1252	123	2039	1934
7	222	42	46	873	612	85	1472	1269	124	2054	1952
8	241	53	47	889	629	86	1487	1286	125	2069	1969
9	259	64	48	905	645	87	1502	1303	126	2084	1987
10	278	76	49	920	661	88	1517	1321	127	2099	2005
11	296	88	50	936	678	89	1532	1338	128	2113	2023
12	314	100	51	952	694	90	1547	1355	129	2128	2040
13	332	113	52	967	711	91	1562	1373	130	2143	2058
14	349	126	53	983	727	92	1577	1390	131	2158	2076
15	367	140	54	998	744	93	1592	1407	132	2172	2094
16	384	153	55	1014	760	94	1607	1425	133	2187	2111
17	401	167	56	1029	777	95	1623	1442	134	2202	2129
18	418	181	57	1045	793	96	1637	1459	135	2217	2147
19	435	195	58	1060	810	97	1652	1477	136	2231	2165
20	452	209	59	1076	827	98	1667	1494	137	2246	2183
21	469	224	60	1091	844	99	1682	1512	138	2261	2201
22	486	238	61	1106	860	100	1697	1529	139	2275	2218
23	503	253	62	1122	877	101	1712	1547	140	2290	2236
24	519	268	63	1137	894	102	1727	1564	141	2305	2254

25	536	283	64	1153	911	103	1742	1582	142	2320	2272
26	552	298	65	1168	928	104	1757	1599	143	2334	2290
27	569	313	66	1183	944	105	1772	1617	144	2349	2308
28	585	328	67	1199	961	106	1787	1634	145	2364	2326
29	602	343	68	1214	978	107	1802	1652	146	2378	2344
30	618	359	69	1229	995	108	1817	1669	147	2393	2361
31	634	374	70	1244	1012	109	1832	1687	148	2408	2379
32	650	389	71	1260	1029	110	1847	1704	149	2422	2397
33	667	405	72	1275	1046	111	1861	1722	150	2437	2415
34	683	421	73	1290	1063	112	1876	1740	151	2452	2433
35	699	436	74	1305	1080	113	1891	1757	152	2466	2451
36	715	452	75	1321	1097	114	1906	1775	153*)	NA	2469
37	731	468	76	1336	1114	115	1921	1793			
38	747	484	77	1351	1131	116	1936	1810	*) note 2 in G.2.5		

NOTE 1: The first column is the number of errors (ne = number of NACK + statDTX)

NOTE 2: The second column is the number of samples for the pass limit (ns_p, ns=Number of Samples= number of `NACK + statDTX + ACK`)

NOTE 3: The third column is the number of samples for the fail limit (ns_f)

G.2.5 Pass fail decision rules

The pass fail decision rules apply for a single test, comprising one component in the test vector. The over all Pass /Fail conditions are defined in clause G.2.6and G.2A.6

Having observed 0 errors, pass the test at 67+ samples, otherwise continue

Having observed 1 error, pass the test at 95+ otherwise continue

Having observed 2 errors, pass the test at 119+ samples, fail the test at 2- samples, otherwise continue

Etc. etc.

Having observed 151 errors, pass the test at 2452+ samples, fail the test at 2433- samples, otherwise continue

Having observed 152 errors, pass the test at 2466+ samples, fail the test at 2451- samples.

Where x+ means: x or more, x- means x or less

NOTE 1: an ideal DUT passes after 67 samples. The maximum test time is 2466 samples.

NOTE 2: It is allowed to deviate from the early decision concept by postponing the decision (pass/fail or continue). Postponing the decision to or beyond the end of Table G.2.4-1 requires a pass fail decision against the test limit: pass the DUT for ER<0.0618, otherwise fail.

G.3 Statistical testing of Performance Requirements with throughput

G.3.1 General

The test of receiver performance characteristics is two fold.

1. A signal or a combination of signals is offered to the RX port(s) of the receiver.
2. The ability of the receiver to demodulate /decode this signal is verified by measuring the throughput.

In (2) is the statistical aspect of the test and is treated here.

The minimum requirement for all receiver performance tests is either 70% or 30% of the maximum throughput.

All receiver performance tests are performed in fading conditions. In addition to the statistical considerations, this requires the definition of a minimum test time.

G.3.2 Mapping throughput to error ratio

G.2.2 applies

G.3.3 Design of the test

The test is defined by the following design principles (see clause G.x, Theory….):

1. The standard concept is applied. (not the early decision concept)
2. A second limit is introduced: The second limit is different, whether 30% or 70% throughput is tested.
3. To decide the test pass:

   Supplier risk is applied based on the Bad DUT quality

   To decide the test fail:

   Customer Risk is applied based on the specified DUT quality

The test is defined by the following parameters:

1a) Limit Error Ratio = 0.3 (in case 70% Throughput is tested) or

1b) Limit Throughput = 0.3 (in case 30% Throughput is tested)

2a) Bad DUT factor M=1.378 (selectivity)

2b) Bad DUT factor m=0.692 (selectivity)

justification see: TS 34.121 Clause F.6.3.3

3) Confidence level CL = 95% (for specified DUT and Bad DUT-quality)

G.3.4 Pass Fail limit

Testing Throughput = 30%, then the test limit is

Number of successes (ACK) / number of samples ≥ 59 / 233

Testing Throughput = 70% then the test limit is

Number of fails (NACK and statDTX) / number of samples ≤ 66 / 184

We have to distinguish 3 cases:

a) The duration for the number of samples (233 or 184) is greater than the minimum test time:

Then the number of samples (233 or 184) is predefined and the decision is done according to the number of events (59 successes or 66 fails)

b) Since subframe 0 and 5 contain less bits than the remaining subframes, it is allowed to predefine a number of samples contained in an integer number of frames. In this case test-limit-ratio applies.

c) The minimum test time is greater than the duration for the number of samples:

The minimum test time is predefined and the decision is done comparing the measured ratio at that instant against the test-limit-ratio.

NOTE: The test time for most of the tests is governed by the Minimum Test Time

G.3.5 Minimum Test time

If a pass fail decision in G.3.4 can be achieved earlier than the minimum test time, then the test shall not be decided, but continued until the minimum test time is elapsed.

The tables below contain the minimum number of subframes for FDD.

By simulations the minimum number of active subframes (carrying DL payload) was derived (MNAS),

then adding inactive subframes to the active ones (e.g. subframe 5 contains no DL payload. For TDD additional subframes contain no DL payload)

then rounding up to full thousand and

then adding a bias of 1000 (BMNSF).

Simulation method to derive minimum test time:

With a level, corresponding a throughput at the test limit (here 30 % or 70 % of the max. throughput) the preliminary throughput versus time converges towards the final throughput. The allowance of ± 2% throughput variation around the above mentioned level is predefined by RAN5 to find the minimum test time. The allowance of ± 2% maps through the function "final throughput versus level" into a throughput corridor. The minimum test time is achieved when the preliminary throughput escapes the corridor the last time. The two functions "final throughput versus level" and "preliminary throughput versus time" are simulation results, which are done individual for each demodulation scenario.

In the case where the throughput does not converge across all the seeds used in the simulation within a reasonable time duration, then the throughput corridor is expanded to +/- 3.5% of the target throughput to see if the all the seeds converge. In order to account for the additional throughput variation, a SNR uncertainty due to finite test time term is added to the overall MU calculation.

The entire procedure is summarized as below.

G.3.5.1 Minimum Test Time procedure for PDSCH scenarios with 30% or 70% Throughput requirement

1. Run the PDSCH simulations for an extended period of time at the SNR of interest for multiple seeds.
2. The minimum test time is determined by the time it took the throughput curve to settle within +/- 2% of the target throughput value across all seeds.
3. If the throughput does not settle within the +/- 2% throughput limit within a reasonable amount of time for any seed, expand the threshold (for example, +/- 3.5%) of the target throughput value.
4. To account for the additional 1.5% throughput variation, determine from the Throughput vs SNR curve, what is the SNR delta corresponding to this 1.5 % throughput increase.
5. That SNR value is the added SNR uncertainty due to finite test time.

G.3.5.2 Minimum Test Time procedure for PDSCH and PDCCH scenarios with 1% BLER requirement

1. Run the PDSCH simulations for an extended period of time at the SNR of interest for multiple seeds.
2. The minimum test time is determined by the time it took the residual BLER curve to converge within +/- 10% of the target 1% residual BLER (i.e. within 0.9% and 1.1% BLER) across all seeds.

3. If the residual BLER does not converge within the +/- 10% of the 1% target limit within a reasonable amount of time for any seed, increase SNR in steps of 0.1 dB and rerun the simulations within the same target BLER limit
4. The additional delta SNR required to meet the residual BLER convergence limit is the added SNR uncertainty due to finite test time.
5. This SNR uncertainty due to finite test time would be one of the MU term in the overall MU calculation.

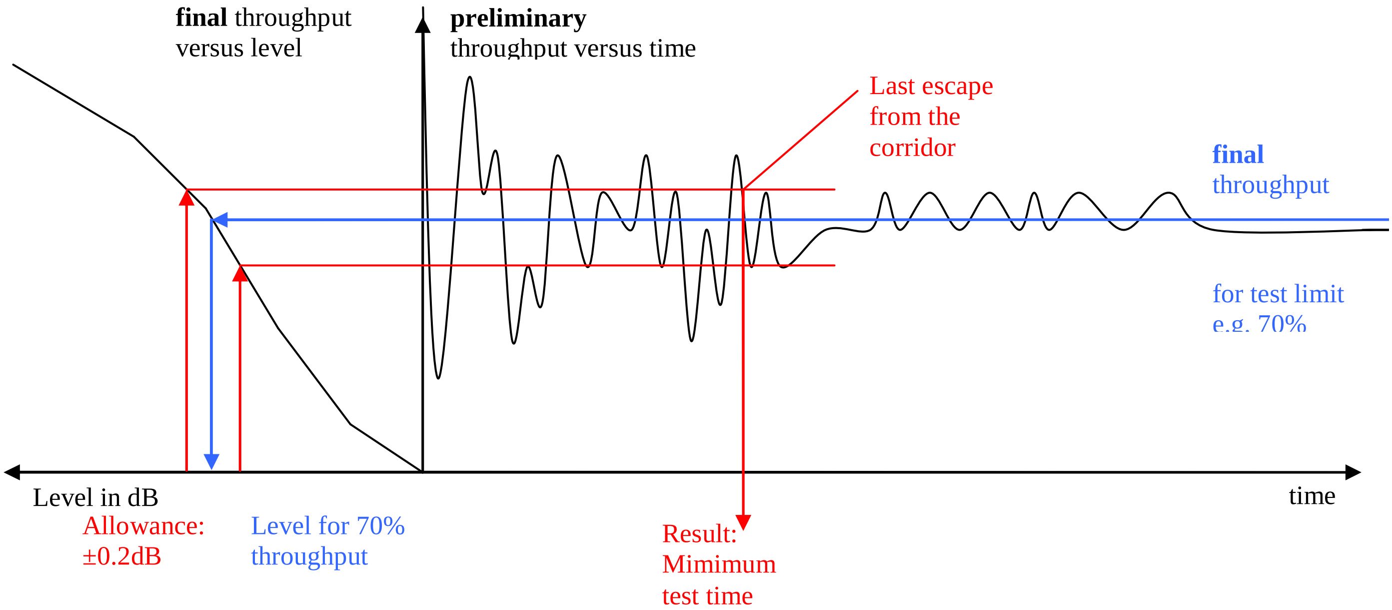


Figure G.3.5-1: Simulation method to derive minimum test time

Table G.3.5-1: Minimum Test time for PDSCH for UE Category NB1

Test No	Demodulation scenario (info only)	MNAS (Simulation)	Min Gap between consecutive NPDCCH taking into account RTT (ms)	Actual Gap between consecutive NPDCCH taking into account RTT (ms)	MNSF (Min No Sub frames) HD-FDD (Note2)
8.3.1.1.1 Test 1	R.NB.1 FDD (200kHz, QPSK,1/2) (1x1) NTN TDLC5-200	845 (Note 1)	241	288	243360
8.3.1.1.1 Test 2	R.NB.2 FDD (200kHz, QPSK,1/3) (1x1) NTN TDLA100-10	523 (Note 1)	881	1152	602496
8.3.1.1.2 Test 1	R.NB.6 FDD (200kHz, QPSK,1/2) (1x1) EPA5	683 (Note 1)	489	576	393408
8.3.1.1.2 Test 2	R.NB.6-1 FDD (200kHz, QPSK,1/2) (1x1) ETU1	440 (Note 1)	1982	2304	1013760
Note1: Minimum test time has been derived by simulating the test scenario taking into account the minimum scheduling gap needed between successive NPDCCH/NPDSCH Note2: For MNSF calculations, with the current assumption of SIB2/SIB31 scheduling every 640ms with max 8 subframes and max 2 repetition per SI window, 16 additional subframes are needed every 640ms to avoid collisions with NPDSCH.					

Table G.3.5-2: Minimum Test time for PDSCH for UE Category NB2

Test No	Demodulation scenario (info only)	MNAS (Simulation)	Min Gap between consecutive NPDCCH taking into account RTT (ms)	Actual Gap between consecutive NPDCCH taking into account RTT (ms)	MNSF (Min No Sub frames) HD-FDD (Note2)
8.3.1.1.3 Test 1	R.NB.7 FDD (200kHz, QPSK,1/2) (1x1) EPA5	600	283	288	599904
Note1: Minimum test time has been derived by simulating the test scenario taking into account the minimum scheduling gap needed between successive NPDCCH/NPDSCH Note2: For MNSF calculations, with the current assumption of SIB2/SIB31 scheduling every 640ms with max 8 subframes and max 2 repetition per SI window, 16 additional subframes are needed every 640ms to avoid collisions with NPDSCH.					

G.4 Statistical testing of Performance Requirements with probability of misdetection

G.4.1 General

The test of receiver performance characteristics is two fold.

1. A signal or a combination of signals is offered to the RX port(s) of the receiver.
2. The ability of the receiver to demodulate /decode this signal is verified by analyzing the reaction of the UE to this signal.

In (2) is the statistical aspect of the test and is treated here.

The minimum requirement for those receiver performance tests are 1% or 0.1% misdetection probability

All receiver performance tests are performed in fading conditions. In addition to the statistical considerations, this requires the definition of a minimum test time.

NOTE: All demodulation performance tests (state from version 9.5.0) require a minimum test time, which exceeds the maximum test time in tables G.4.4. Under this circumstances only the test limit at the end of tables G.4.4.-1 resp. G.4.4.-2 is applicable.

G.4.2 Mapping the UE reaction to error ratio

The UE can not indicate the detection or misdetection of the physical channel under test directly. Indirect methods are described in the procedure of the applicable test.

G.4.3 Design of the test

G.2.3 applies, exception:

Limit ER = 0.01

G.4.4 Numerical definition of the pass fail limits

Table G.4.4-1: pass fail limits for ER = 0.01

ne	ns_p	ns_f	ne	ns_p	ns_f	ne	ns_p	ns_f	ne	ns_p	ns_f
0	344	NA	40	3929	2553	80	7033	5874	120	10036	9354
1	485	NA	41	4009	2632	81	7109	5960	121	10110	9442
2	607	10	42	4089	2712	82	7185	6046	122	10184	9530
3	719	33	43	4168	2792	83	7261	6131	123	10259	9619
4	826	66	44	4247	2873	84	7336	6217	124	10333	9707
5	929	107	45	4327	2953	85	7412	6303	125	10407	9796
6	1029	152	46	4406	3034	86	7488	6389	126	10481	9884
7	1127	202	47	4484	3115	87	7564	6475	127	10555	9972
8	1223	255	48	4563	3196	88	7639	6561	128	10629	10061
9	1317	311	49	4642	3278	89	7715	6648	129	10703	10150
10	1409	370	50	4720	3359	90	7790	6734	130	10777	10238
11	1501	430	51	4799	3441	91	7866	6820	131	10851	10327
12	1592	492	52	4877	3523	92	7941	6907	132	10925	10416
13	1681	555	53	4955	3605	93	8017	6993	133	10999	10504
14	1770	620	54	5033	3688	94	8092	7080	134	11073	10593
15	1858	686	55	5111	3770	95	8167	7167	135	11147	10682
16	1946	754	56	5189	3853	96	8242	7253	136	11221	10771
17	2032	822	57	5267	3935	97	8317	7340	137	11295	10860
18	2119	891	58	5344	4018	98	8393	7427	138	11369	10949
19	2204	961	59	5422	4101	99	8468	7514	139	11442	11038
20	2290	1032	60	5499	4185	100	8543	7601	140	11516	11127
21	2374	1103	61	5577	4268	101	8618	7688	141	11590	11216
22	2459	1175	62	5654	4352	102	8693	7775	142	11664	11305
23	2543	1248	63	5731	4435	103	8768	7863	143	11737	11394
24	2627	1321	64	5809	4519	104	8843	7950	144	11811	11483
25	2710	1395	65	5886	4603	105	8917	8037	145	11885	11573
26	2793	1470	66	5963	4687	106	8992	8125	146	11958	11662
27	2876	1544	67	6039	4771	107	9067	8212	147	12032	11751
28	2958	1620	68	6116	4855	108	9142	8300	148	12105	11840
29	3040	1696	69	6193	4940	109	9216	8387	149	12179	11930
30	3122	1772	70	6270	5024	110	9291	8475	150	12252	12019
31	3204	1848	71	6346	5109	111	9366	8562	151	12326	12109
32	3285	1925	72	6423	5193	112	9440	8650	152	12399	12198
33	3366	2003	73	6499	5278	113	9515	8738	153	12473	12288
34	3447	2080	74	6576	5363	114	9589	8826	154	12546	12377
35	3528	2158	75	6652	5448	115	9664	8914	155	12620	12467
36	3609	2237	76	6728	5533	116	9738	9002	156	12693	12556
37	3689	2315	77	6805	5618	117	9813	9090	157	12767	12646
38	3769	2394	78	6881	5704	118	9887	9178	158	12840	12736
39	3850	2473	79	6957	5789	119	9962	9266	159	12913	12826
									160	NA	12915
									Test limit = 1.2352E-2		

NOTE 1: The first column is the number of errors (ne = number of misdetections)

NOTE 2: The second column is the number of samples for the pass limit (ns_p, ns=Number of Samples= number misdetections + number of detections)

NOTE 3: The third column is the number of samples for the fail limit (ns_f)

NOTE 4: The test limit at the end of the table is applicable, when the minimum test time in clause 3.5 governs the test. Pass the test for ER ≤ Test limit, otherwise fail.

G.4.5 Pass fail decision rules

G.2.5 applies

NOTE: For ER=0.01 an ideal DUT passes after 344 samples. The maximum test time is 12913 samples.

G.4.6 Minimum Test time

Table G.4.6-1: Minimum Test time for NPDCCH for UE Category NB1

Test No	Demodulation scenario (info only)	MNAS (Simulation)	MNS (Calculation)	MNSF (Min No Sub Frames, mandatory)
			HD-FDD	HD-FDD
8.3.1.2.1: Test 1	R.NB.3 FDD (200kHz, QPSK,1/2) (1x1) EPA5	36166	15430827	15431000
8.3.1.2.1: Test 2	R.NB.3 FDD (200kHz, QPSK,1/2) (1x1) ETU1	36166	55550976	55551000

G.5 [FFS]

G.6 [FFS]

G.7 Theory to derive the numbers in Table G.2.4-1 (Informative)

Editor's note: This clause of the Annex G is for information only and it described the background theory and information to derive the entries in the table G.2.4-1.

G.7.1 Error Ratio (ER)

The Error Ratio (ER) is defined as the ratio of number of errors (ne) to all results, number of samples (ns).

(1-ER is the success ratio).

G.7.2 Test Design

A statistical test is characterised by:

Test-time, Selectivity and Confidence level.

G.7.3 Confidence level

The outcome of a statistical test is a decision. This decision may be correct or in-correct. The Confidence Level CL describes the probability that the decision is a correct one. The complement is the wrong decision probability (risk) D = 1-CL

G.7.4 Introduction: Supplier Risk versus Customer Risk

There are two targets of decision:

(a) A measurement on the pass-limit shows, that the DUT has the specified quality or is better with probability CL (CL e.g.95%) This shall lead to a "pass decision"

The pass-limit is on the good side of the specified DUT-quality. A more stringent CL (CL e.g.99%) shifts the pass-limit farer into the good direction. Given the quality of the DUTs is distributed, a greater CL passes less and better DUTs.

A measurement on the bad side of the pass-limit is simply “not pass” (undecided or artificial fail).

(aa) Complementary:

A measurement on the fail-limit shows, that the DUT is worse than the specified quality with probability CL.

The fail-limit is on the bad side of the specified DUT-quality. A more stringent CL shifts the fail-limit farer into the bad direction. Given the quality of the DUTs is distributed, a greater CL fails less and worse DUTs.

A measurement on the good side of the fail-limit is simply “not fail”.

(b) A DUT, known to have the specified quality, shall be measured and decided pass with probability CL. This leads to the test limit.

For CL e.g. 95%, the test limit is on the bad side of the specified DUT-quality. CL e.g.99% shifts the pass-limit farer into the bad direction. Given the DUT-quality is distributed, a greater CL passes more and worse DUTs.

(bb) A DUT, known to be an ($\varepsilon \rightarrow 0$) beyond the specified quality, shall be measured and decided fail with probability CL.

For CL e.g.95%, the test limit is on the good side of the specified DUT-quality.

NOTE 1: The different sense for CL in (a), (aa) versus (b), (bb).

NOTE 2: For constant CL in all 4 bullets (a) is equivalent to (bb) and (aa) is equivalent to (b).

G.7.5 Supplier Risk versus Customer Risk

The table below summarizes the different targets of decision.

Table G.X.5-1: Equivalent statements

	Equivalent statements, using different cause-to-effect-directions, and assuming CL = constant >1/2	
cause-to-effect-directions	Known measurement result → estimation of the DUT’s quality	Known DUT’s quality → estimation of the measurement’s outcome
Supplier Risk	A measurement on the pass-limit shows, that the DUT has the specified quality or is better (a)	A DUT, known to have an ($\varepsilon \rightarrow 0$) beyond the specified DUT-quality, shall be measured and decided fail (bb)
Customer Risk	A measurement on the fail-limit shall shows, that the DUT is worse than the specified quality (aa)	A DUT, known to have the specified quality, shall be measured and decided pass (b)

The shaded area shown the direct interpretation of Supplier Risk and Customer Risk.

The same statements can be based on other DUT-quality-definitions.

G.7.6 Introduction: Standard test versus early decision concept

In standard statistical tests, a certain number of results (ns) is predefined in advance to the test. After ns results the number of bad results (ne) is counted and the error ratio (ER) is calculated by ne/ns.

Applying statistical theory, a decision limit can be designed, against which the calculated ER is compared to derive the decision. Such a limit is one decision point and is characterised by:

- D: the wrong decision probability (a predefined parameter)
- ns: the number of results (a fixed predefined parameter)
- ne: the number of bad results (the limit based on just ns)

In the formula for the limit, D and ns can be understood as variable parameter and variable. However the standard test execution requires fixed ns and D. The property of such a test is: It discriminate between two states only, depending on the test design:

- pass (with CL) / undecided (undecided in the sense: finally undecided)
- fail (with CL) / undecided (undecided in the sense: finally undecided)
- pass(with CL) / fail (with CL) (however against two limits).

In contrast to the standard statistical tests, the early decision concept predefines a set of (ne,ns) co-ordinates, representing the limit-curve for decision. After each result a preliminary ER is calculated and compared against the limit-curve. After each result one may make the decision or not (undecided for later decision). The parameters and variables in the limit-curve for the early decision concept have a similar but not equal meaning:

- D: the wrong decision probability (a predefined parameter)
- ns: the number of results (a variable parameter)
- ne: the number of bad results (the limit. It varies together with ns)

To avoid a “final undecided” in the standard test, a second limit must be introduced and the single decision co-ordinate (ne,ns) needs a high ne, leading to a fixed (high) test time. In the early decision concept, having the same selectivity and the same confidence level an “undecided” need not to be avoided, as it can be decided later. A perfect DUT will hit the decision coordinate (ne,ns) with ne=0. This test time is short.

G.7.7 Standard test versus early decision concept

For Supplier Risk:

The wrong decision probability D in the standard test is the probability, to decide a DUT in-correct in the single decision point. In the early decision concept there is a probability of in-correct decisions d at each point of the limit-curve. The sum of all those wrong decision probabilities accumulate to D. Hence d<D

For Customer Risk:

The correct decision probability CL in the standard test is the probability, to decide a DUT correct in the single decision point. In the early decision concept there is a probability of correct decisions cl at each point of the limit-curve. The sum of all those correct decision probabilities accumulate to CL. Hence cl<CL or d>D

G.7.8 Selectivity

There is no statistical test which can discriminate between a limit DUT and a DUT which is an ($\varepsilon \rightarrow 0$) apart from the limit in finite time and high confidence level CL. Either the test discriminates against one limit with the results pass (with CL)/undecided or fail (with CL)/undecided, or the test ends in a result pass (with CL)/fail (with CL) but this requires a second limit.

For CL>1/2, a (measurement-result = specified-DUT-quality), generates undecided in test “supplier risk against pass limit” (a, from above) and also in the test “customer risk against the fail limit “ (aa)

For CL>1/2, a DUT, known to be on the limit, will be decided pass for the test "customer risk against pass limit" (b) and also "supplier risk against fail limit" (bb).

This overlap or undecided area is not a fault or a contradiction, however it can be avoided by introducing a Bad or a Good DUT quality according to:

- Bad DUT quality: specified DUT-quality * M (M>1)
- Good DUT quality: specified DUT-quality * m (m<1)

Using e.g. M>1 and CL=95% the test for different DUT qualities yield different pass probabilities:

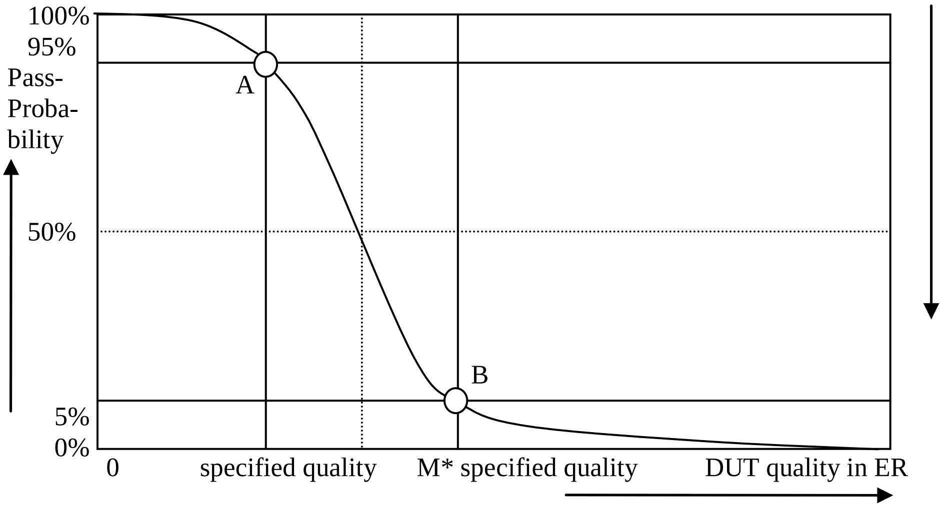


Figure G.X.8-1: Pass probability versus DUT quality

G.7.9 Design of the test

The receiver characteristic test are defined by the following design principles:

1. The early decision concept is applied.
2. A second limit is introduced: Bad DUT factor M>1
3. To decide the test pass:

   Supplier risk is applied based on the Bad DUT quality

   To decide the test fail

   Customer Risk is applied based on the specified DUT quality

The receiver characteristic test are defined by the following parameters:

1. Limit ER = 0.05
2. Bad DUT factor M=1.5 (selectivity)
3. Confidence level CL = 95% (for specified DUT and Bad DUT-quality)

This has the following consequences:

1. A measurement on the fail limit is connected with 2 equivalent statements:

A measurement on the fail-limit shows, that the DUT is worse than the specified DUT-quality	A DUT, known have the specified quality, shall be measured and decided pass

2. A measurement on the pass limit is connected with the complementary statements:

A measurement on the pass limit shows, that the DUT is better than the Bad DUT-quality.	A DUT, known to have the Bad DUT quality, shall be measured and decided fail

   The left column is used to decide the measurement.

   The right column is used to verify the design of the test by simulation.

   The simulation is based on the two fulcrums A and B only in Figure G.x.8-1

3. Test time

   The minimum and maximum test time is fixed.

   The average test time is a function of the DUT's quality.

   The individual test time is not predictable.

4. The number of decision co-ordinates (ne,ns) in the early decision concept is responsible for the selectivity of the test and the maximum test time. Having fixed the number of decision co-ordinates there is still freedom to select the individual decision co-ordinates in many combinations, all leading to the same confidence level.

G.7.10 Simulation to derive the pass fail limits in Table G.2.4-1

There is freedom to design the decision co-ordinates (ne,ns).

The binomial distribution and its inverse is used to design the pass and fail limits. Note that this method is not unique and that other methods exist.

$$\mathrm{fail}(ne, d_f) := \frac{ne}{(ne + \mathrm{qnbinom}(d_f, ne, ER))}$$

$$\mathrm{pass}(ne, cl_p, M) := \frac{ne}{(ne + \mathrm{qnbinom}(cl_p, ne, ER \cdot M))}$$

Where

- fail(..) is the error ratio for the fail limit
- pass(..) is the error ratio for the pass limit
- ER is the specified error ratio 0.05
- ne is the number of bad results. This is the variable in both equations
- M is the Bad DUT factor M=1.5
- d_f is the wrong decision probability of a single (ne,ns) co-ordinate for the fail limit.
  It is found by simulation to be $d_f = 0.004$
- cl_p is the confidence level of a single (ne,ns) co-ordinate for the pass limit.
  It is found by simulation to be $cl_p = 0.9975$
- qnbinom(..): The inverse cumulative function of the negative binomial distribution

The simulation works as follows:

- A large population of limit DUTs with true ER = 0.05 is decided against the pass and fail limits.
- cl_p and d_f are tuned such that CL (95%) of the population passes and D (5%) of the population fails.
- A population of Bad DUTs with true ER = M*0.05 is decided against the same pass and fail limits.
- cl_p and d_f are tuned such that CL (95%) of the population fails and D (5%) of the population passes.
- This procedure and the relationship to the measurement is justified in clause G.x.9. The number of DUTs decrease during the simulation, as the decided DUTs leave the population. That number decreases with an approximately exponential characteristics. After 169 bad results all DUTs of the population are decided.

NOTE: The exponential decrease of the population is an optimal design goal for the decision co-ordinates (ne,ns), which can be achieved with other formulas or methods as well.

Annex H (normative): Uplink Physical Channels

H.0 Uplink Signal Levels

Uplink signal power is a UE figure, which is configured by the Test System by means of:

RRC messages (IE-s), such as:

- IE-s affecting directly or indirectly the uplink power,

and L1/2 Power control commands (TPC).

The uplink power settings are specified in the test case.

Otherwise, the uplink power settings result from the default RRC messages described in 3GPP TS 36.508 [12], and appropriate TPC-s, which are sent to the UE to transmit with an UL power level necessary for maintaining the call during the test.

H.0.1 Uplink Signal Levels for NB1

Uplink signal power is a UE figure, which is configured by the Test System by means of:

RRC messages (IE-s), such as:

- NPUSCH-ConfigCommon-NB
- NPUSCH-ConfigDedicated-NB
- UplinkPowerControl-NB
- Other IE-s affecting directly or indirectly the uplink power,

The uplink power settings are specified in the test case.

Otherwise, the uplink power settings result from the default RRC messages described in 3GPP TS 36.508 [12], which are sent to the UE to transmit with an UL power level necessary for maintaining the call during the test.

H.1 General

This annex specifies the uplink physical channels that are needed for setting a connection and channels that are needed during a connection. Table H.1-1 describes the mapping of uplink physical channels and signals to physical resources for FDD.

Table H.1-1: Mapping of uplink physical channels and signals to physical resources for FDD

Physical channel	Time Domain Location	Frequency Domain Location	Note
PRACH	Allowed for the parameter *prach-Configuration Index* provided by higher layers	Allowed for the parameter *prach-FrequencyOffset* provided by higher layers	Mapping rule is specified in TS 36.211 [3] Section 5.7.1
DMRS	For PUCCH: Symbols 2 to 4 of each slot (PUCCH format: 1, 1a, 1b) Symbol 1 and 5 of each slot (PUCCH format: 2, 2a, 2b) For PUSCH: Symbol 3 of each slot	Uplink system bandwidth dependent.	Mapping rule of DMRS for PUCCH is specified in TS 36.211 [3] 5.5.2.2.2 Mapping rule of DMRS for PUSCH is specified in TS 36.211 [3] 5.5.2.1.2
PUCCH	Slot 0 and 1 of each subframe	Each 12 subcarriers of both ends of the bandwidth	Mapping rule is specified in TS 36.211 [3] Section 5.4.3
PUSCH	All remaining SC-FDMA symbols of each subframe not allocated to DMRS	RBs allocated according to Reference Measurement channel in Annex A.2	Mapping rule is specified in TS 36.211 [3] Section 5.4.2
SRS	Allowed for the cell-specific parameter *srs-BandwidthConfig* and the UE-specific parameter *srs-Bandwidth* provided by higher layers	Allowed for the cell-specific parameter *srsMaxUpPt* and the UE-specific parameter *transmissionComb* or *transmissionComb-ap* provided by higher layers	Mapping rule is specified in TS 36.211 [3] Section 5.5.3.2

H.1.1 General for NB1

This annex specifies the uplink physical channels that are needed for setting a connection and channels that are needed during a connection. Table H.1.1-1 describes the mapping of uplink physical channels and signals to physical resources for NB1 UE.

Table H.1.1-1: Mapping of uplink physical channels and signals to physical resources for NB1

Physical channel	Time Domain Location	Frequency Domain Location	Note
NPRACH	Allowed for the parameter n*prach-Configuration Index* provided by higher layers	Allowed for the parameter *nprach-SubcarrierOffset* provided by higher layers	Mapping rule is specified in TS 36.211 [3] Section 10.1.6
NPUSCH	All the SC-FDMA symbols of each subframe.	RUs allocated according to Reference Measurement channel in Annex A.2	Mapping rule is specified in TS 36.211 [3] Section 10.1.3

H.2 Set-up

Table H.2-1 describes the uplink physical channels that are required for connection set up.

Table H.2-1: Uplink Physical Channels required for connection set-up

Physical Channel
PRACH
DMRS
PUCCH
PUSCH

H.2.1 Set-up for NB1

Table H.2.1-1 describes the uplink physical channels that are required for connection set up.

Table H.2.1-1: Uplink Physical Channels required for connection set-up

Physical Channel
NPRACH
NPUSCH

H.3 Connection

The following clauses describes the uplink physical channels that are transmitted during a connection i.e., when measurements are done.

H.3.0 Measurement of Transmitter Characteristics

As specified in the test case. Otherwise:

- PUSCH + DMRS for PUSCH (and DMRS) measurements.
- PUCCH + DMRS for PUCCH (and DMRS) measurements.
- PRACH for PRACH measurements.
- SRS for SRS measurements.

H.3.1 Measurement of Receiver Characteristics

As specified in the test case. Otherwise:

- PUSCH + DMRS for measurements with uplink interference configured.
- PUCCH + DMRS for measurements without uplink interference configured.

H.3.2 Measurement of Performance Requirements

As specified in the test case. Otherwise:

- PUCCH + DMRS for measurements without CSI feedback, or with CSI feedback in PUCCH mode.
- PUSCH + DMRS for measurements with CSI feedback in PUSCH mode.

H.4 Connection for NB1

The following clauses describes the uplink physical channels that are transmitted during a connection i.e., when measurements are done.

H.4.0 Measurement of Transmitter Characteristics

As specified in the test case. Otherwise:

- NPUSCH for measurements.
- NPRACH for PRACH measurements.

H.4.1 Measurement of Receiver Characteristics

As specified in the test case. Otherwise:

- NPUSCH (format 2) for measurements.

H.4.2 Measurement of Performance Requirements

As specified in the test case. Otherwise:

- NPUSCH (format 2) for measurements.

Annex I (reserved):

Annex J (reserved):

Annex K (normative): NB-IoT Test Frequencies

K.1 NB-IoT Test frequencies for TRx Tests

Testing frequencies for all NB-IoT TRx test cases (sections 6 and 7 in TS 36.521-4) should be selected across the bands UE supports from any of the following subclauses indicated by each test case.

For transmitter test cases (section 6 in TS 36.521-4), UL frequencies should be considered on the test frequency selection algorithm described above, while DL frequencies should be used for receiver test cases (section 7 in TS 36.521-4).

Refer to TS 36.508 [12] section 8.1.3.1 for testing frequencies associated to each frequency band and each operation mode.

K.1.1 Test frequencies selection criteria 1

Among all frequency bands ranges supported by the UE, testing points are defined as:

- @ low range of the lowest supported band
- @ high range of the highest supported band

K.1.2 Test frequencies selection criteria 2

Among all frequency bands ranges supported by the UE, testing points are defined as:

- @ low range of the lowest supported band
- @ high range of the highest supported band
- All mid range of all supported mid bands (supported bands between lowest supported band and highest supported band)

K.1.3 Test frequencies selection criteria 3

Among all frequency bands ranges supported by the UE, testing points are defined as:

- @ low range of each supported band
- @ high range of each supported band

K.2 NB-IoT Test frequencies for Demodulation Tests

Testing frequencies for all NB-IOT demodulation (Section 8 in TS 36.521-4) should be selected across the bands UE supports from any of the following subclauses indicated by each test case.

For NB-IOT demodulation (section 8 in TS 36.521-4) DL frequencies should be used from the frequency selection algorithm described below.

Refer to section 8.1.3.1 in TS 36.508 [12] for testing frequencies associated to each frequency band and each operation mode.

K.2.1 Test frequencies selection criteria 1

Among all frequency bands ranges supported by the UE, testing points are defined as:

- @ mid range of any one of the NB1 and NB2 UE supported band

Annex L (informative): Change history

Change history							
Date	Meeting	TDoc	CR	Rev	Cat	Subject/Comment	New version
2023-03	RAN5#98	R5-230406	-	-	-	TP to add Foreword and Introduction to TS 36.521-4	0.1.0
2023-03	RAN5#98	R5-230407	-	-	-	TP to add clause 1-3 to TS 36.521-4	0.1.0
2023-03	RAN5#98	R5-230408	-	-	-	TP to add clause 4 to TS 36.521-4	0.1.0
2023-03	RAN5#98	R5-230409	-	-	-	TP to add clause 5 to TS 36.521-4	0.1.0
2023-03	RAN5#98	R5-230410	-	-	-	Skeleton for TS 36.521-4 v0.1.0	0.1.0
2023-03	RAN5#98	R5-231824	-	-	-	New addition of RX test case of Maximum input level for category M1 with NTN	0.1.0
2023-03	RAN5#98	R5-231825	-	-	-	New addition of RX test case of Maximum input level for category NB1 and NB2 with NTN	0.1.0
2023-03	RAN5#98	R5-231826	-	-	-	New addition of RX test case of Adjacent Channel Selectivity for category M1 with NTN	0.1.0
2023-03	RAN5#98	R5-231827	-	-	-	New addition of RX test case of Adjacent Channel Selectivity for category NB1 and NB2 with NTN	0.1.0
2023-03	RAN5#98	R5-231868	-	-	-	Adding new test cases for 36.521-4 transmit power of category M1	0.1.0
2023-03	RAN5#98	R5-231869	-	-	-	Adding new test cases for 36.521-4 transmit power of category NB1 and NB2	0.1.0
2023-05	RAN5#99	R5-232367	-	-	-	Introduction of new test case 7.6A.2 In-band blocking for category M1	0.2.0
2023-05	RAN5#99	R5-232368	-	-	-	Introduction of new test case 7.6B.2 In-band blocking for category NB1 and NB2	0.2.0
2023-05	RAN5#99	R5-232369	-	-	-	Introduction of new test case 7.9A Spurious emissions for category M1	0.2.0
2023-05	RAN5#99	R5-232370	-	-	-	Correction of title of TS 36.521-1 in clause 2 References	0.2.0
2023-05	RAN5#99	R5-232382	-	-	-	Introduction of new test case 7.9B Spurious emissions for category NB1 and NB2	0.2.0
2023-05	RAN5#99	R5-232521	-	-	-	Editorial correction for some type error in 6.2A	0.2.0
2023-05	RAN5#99	R5-232522	-	-	-	Adding test case 6.2B.3 for UE A-MPR for category NB1 and NB2 UE	0.2.0
2023-05	RAN5#99	R5-232523	-	-	-	Adding test case 6.3A.1 for UE Minimum output power for category M1	0.2.0
2023-05	RAN5#99	R5-232524	-	-	-	Adding test case 6.3A.2 for Transmit OFF power for category M1	0.2.0
2023-05	RAN5#99	R5-232525	-	-	-	Adding test case 6.3A.3.1 for General ON/OFF time mask	0.2.0
2023-05	RAN5#99	R5-232526	-	-	-	Adding test case 6.3A.3.2.1 for PRACH time mask	0.2.0
2023-05	RAN5#99	R5-232527	-	-	-	Adding test case 6.3A.3.2.2 for SRS time mask	0.2.0
2023-05	RAN5#99	R5-232549	-	-	-	Adding test case 6.3A.4.1 for Power Control Absolute power tolerance	0.2.0
2023-05	RAN5#99	R5-232550	-	-	-	Adding test case 6.3A.4.2 Power Control Relative power tolerance	0.2.0
2023-05	RAN5#99	R5-232551	-	-	-	Adding test case 6.3A.4.3 for Aggregate power control tolerance	0.2.0
2023-05	RAN5#99	R5-232552	-	-	-	Adding test case 6.3B.1 for UE Minimum output power	0.2.0
2023-05	RAN5#99	R5-232553	-	-	-	Adding test case 6.3B.2 for Transmit OFF power	0.2.0
2023-05	RAN5#99	R5-232554	-	-	-	Adding test case 6.3B.3.1 General ON/OFF time mask	0.2.0
2023-05	RAN5#99	R5-232555	-	-	-	Adding test case 6.3B.3.2 NPRACH time mask	0.2.0
2023-05	RAN5#99	R5-232556	-	-	-	Adding test case 6.3B.4.1 Power Control Absolute power tolerance	0.2.0
2023-05	RAN5#99	R5-232557	-	-	-	Adding test case 6.3B.4.2 Power Control Relative power tolerance	0.2.0
2023-05	RAN5#99	R5-232558	-	-	-	Adding test case 6.3B.4.3 Aggregate power control tolerance	0.2.0
2023-05	RAN5#99	R5-232815	-	-	-	Introduction of eMTC/NB-IoT NTN Output RF spectrum emissions TC 6.5	0.2.0
2023-05	RAN5#99	R5-233574	-	-	-	Introduction of eMTC NTN Output RF spectrum emissions TC 6.5A	0.2.0
2023-05	RAN5#99	R5-232817	-	-	-	Introduction of NB-IoT NTN Output RF spectrum emissions TC 6.5B	0.2.0
2023-05	RAN5#99	R5-233575	-	-	-	Update of editor notes for IoT NTN TCs	0.2.0
2023-08	RAN5#100	R5-233923	-	-	-	Addition of clause 8.1 general description for NTN test	0.3.0
2023-08	RAN5#100	R5-233924	-	-	-	Addition of new test case 8.2.1.1.1 eMTC PDSCH test	0.3.0
2023-08	RAN5#100	R5-233925	-	-	-	Addition of new test case 8.3.1.1.1 NB-IoT NPDSCH test under NTN fading condition	0.3.0
2023-08	RAN5#100	R5-233926	-	-	-	Addition of new test case 8.3.1.1.2 NB-IoT NPDSCH test	0.3.0
2023-08	RAN5#100	R5-233927	-	-	-	Addition of new test case 8.3.1.1.3 NB-IoT NPDSCH test for NB2 only	0.3.0
2023-08	RAN5#100	R5-235757	-	-	-	Addition of new test case 8.3.1.2.1 NB-IoT NPDCCH test	0.3.0
2023-08	RAN5#100	R5-234189	-	-	-	NTN NB-IoT REFSENS test case definition	0.3.0
2023-08	RAN5#100	R5-234231	-	-	-	Correction of A-MPR NS value in 6.2A.3	0.3.0
2023-08	RAN5#100	R5-234232	-	-	-	Correction of A-MPR NS value in 6.2B.3	0.3.0
2023-08	RAN5#100	R5-234233	-	-	-	Adding test case 6.4A.2.1 Error Vector Magnitude (EVM) for category M1	0.3.0
2023-08	RAN5#100	R5-234234	-	-	-	Adding test case 6.4A.2.2 Carrier leakage for category M1	0.3.0

2023-08	RAN5#100	R5-234237	-	-	-	Adding test case 6.4A.2.3 In-band emissions for non allocated RB for category M1	0.3.0
2023-08	RAN5#100	R5-234238	-	-	-	Adding test case 6.4A.2.4 EVM equalizer spectrum flatness for category M1	0.3.0
2023-08	RAN5#100	R5-234239	-	-	-	Adding test case 6.4B.2.1 Error Vector Magnitude (EVM) for Category NB1 and NB2	0.3.0
2023-08	RAN5#100	R5-234245	-	-	-	Adding test case 6.4B.2.2 Carrier leakage for Category NB1 and NB2	0.3.0
2023-08	RAN5#100	R5-234246	-	-	-	Adding test case 6.4B.2.3 In-band emissions for Category NB1 and NB2	0.3.0
2023-08	RAN5#100	R5-234247	-	-	-	Adding test case 6.5A.2 Occupied bandwidth for category M1	0.3.0
2023-08	RAN5#100	R5-234248	-	-	-	Adding test case 6.5A.3.2 Spectrum emission mask	0.3.0
2023-08	RAN5#100	R5-234249	-	-	-	Adding test case 6.5A.3.4 Adjacent Channel Leakage Ratio for category M1	0.3.0
2023-08	RAN5#100	R5-234250	-	-	-	Adding test case 6.5A.4.2 Transmitter Spurious emissions	0.3.0
2023-08	RAN5#100	R5-234251	-	-	-	Adding test case 6.5A.4.3 Spurious emission band UE co-existence	0.3.0
2023-08	RAN5#100	R5-234252	-	-	-	Adding test case 6.5A.4.4 Additional spurious emissions	0.3.0
2023-08	RAN5#100	R5-234253	-	-	-	Adding test case 6.5B.2 Occupied bandwidth for category NB1 and NB2	0.3.0
2023-08	RAN5#100	R5-234258	-	-	-	Adding test case 6.5B.3.2 Spectrum emission mask	0.3.0
2023-08	RAN5#100	R5-234259	-	-	-	Adding test case 6.5B.3.4 Adjacent Channel Leakage Ratio for category NB1 and NB2	0.3.0
2023-08	RAN5#100	R5-234260	-	-	-	Adding test case 6.5B.4.2 Transmitter Spurious emissions	0.3.0
2023-08	RAN5#100	R5-234261	-	-	-	Adding test case 6.5B.4.3 Spurious emission band UE co-existence	0.3.0
2023-08	RAN5#100	R5-234262	-	-	-	Adding test case 6.5B.4.4 Additional spurious emissions	0.3.0
2023-08	RAN5#100	R5-234263	-	-	-	Adding test case 6.6B Transmit intermodulation for category NB1 and NB2	0.3.0
2023-08	RAN5#100	R5-234758	-	-	-	Correction of TC 6.3A.4.3 Aggregate power control tolerance for UE category M1	0.3.0
2023-08	RAN5#100	R5-235761	-	-	-	Editorial changes in References of 36521-4	0.3.0
2023-08	RAN5#100	R5-235762	-	-	-	Addition of Annex A in 36521-4	0.3.0
2023-08	RAN5#100	R5-234761	-	-	-	Revise Annex B into Annex L in 36521-4	0.3.0
2023-08	RAN5#100	R5-235774	-	-	-	Addition of Annex B in 36521-4	0.3.0
2023-08	RAN5#100	R5-235775	-	-	-	Addition of Annex C in 36521-4	0.3.0
2023-08	RAN5#100	R5-235776	-	-	-	Addition of Annex D in 36521-4	0.3.0
2023-08	RAN5#100	R5-235942	-	-	-	Addition of Annex E and Annex F in 36521-4	0.3.0
2023-08	RAN5#100	R5-235777	-	-	-	Addition of Annex G in 36521-4	0.3.0
2023-08	RAN5#100	R5-235778	-	-	-	Addition of Annex H and Annex I in 36521-4	0.3.0
2023-08	RAN5#100	R5-235779	-	-	-	Addition of Annex J and Annex K in 36521-4	0.3.0
2023-08	RAN5#100	R5-235455	-	-	-	Clarifications to 36.521-4	0.3.0
2023-08	RAN5#100	R5-235943	-	-	-	Initial conditions update for multiple test cases	0.3.0
2023-08	RAN5#100	R5-235944	-	-	-	Editor's note clean-up	0.3.0
2023-11	RAN5#101	R5-237675	-	-	-	Correction of performance applicability of requirements in 36.521-4	0.4.0
2023-11	RAN5#101	R5-237676	-	-	-	Deletion of several editors notes for IoT NTN Demodulation test cases	0.4.0
2023-11	RAN5#101	R5-237878	-	-	-	Initial condition update for IoT NTN Demod cases	0.4.0
2023-11	RAN5#101	R5-237870	-	-	-	Adding test case 6.4A.1 Frequency Error for category M1	0.4.0
2023-11	RAN5#101	R5-237871	-	-	-	Adding test case 6.4B.1 Frequency Error for category NB1 and NB2	0.4.0
2023-11	RAN5#101	R5-237686	-	-	-	Adding test case 7.3A Reference sensitivity power level for UE category M1	0.4.0
2023-11	RAN5#101	R5-237856	-	-	-	Initial conditions update for multiple TX test cases	0.4.0
2023-11	RAN5#101	R5-237857	-	-	-	Initial conditions update for multiple RX test cases	0.4.0
2023-11	RAN5#101	R5-237680	-	-	-	Addition of test configuration and error correction for 7.6A.2 In-band blocking for category M1	0.4.0
2023-11	RAN5#101	R5-237691	-	-	-	Introduction of new test case 7.6A.3 Out-of-band blocking for category M1	0.4.0
2023-11	RAN5#101	R5-237692	-	-	-	Introduction of new test case 7.6A.4 Narrow band blocking for category M1	0.4.0
2023-11	RAN5#101	R5-237681	-	-	-	Confirmation of test configuration and error correction for 7.6B.2 In-band blocking for category NB1 and NB2	0.4.0
2023-11	RAN5#101	R5-237693	-	-	-	Introduction of new test case 7.6B.3 Out-of-band blocking for category NB1 and NB2	0.4.0
2023-11	RAN5#101	R5-236131	-	-	-	Removal of 7.6B.4 Narrow band blocking for category NB1 and NB2	0.4.0
2023-11	RAN5#101	R5-237682	-	-	-	Introduction of new test case 7.7A Spurious response for category M1	0.4.0
2023-11	RAN5#101	R5-237683	-	-	-	Introduction of new test case 7.7B Spurious response for category NB1 and NB2	0.4.0

2023-11	RAN5#101	R5-237694	-	-	-	Introduction of new test case 7.8A Intermodulation characteristics for category M1	0.4.0
2023-11	RAN5#101	R5-237695	-	-	-	Introduction of new test case 7.8B Intermodulation characteristics for category NB1 and NB2	0.4.0
2023-11	RAN5#101	R5-237684	-	-	-	Update of test configuration for 7.9A Spurious emissions for category M1	0.4.0
2023-11	RAN5#101	R5-237685	-	-	-	Update of test configuration for 7.9B Spurious emissions for category NB1 and NB2	0.4.0
2023-11	RAN5#101	R5-236138	-	-	-	Introduction of measurement uncertainties and test tolerances for test cases from 7.6 to 7.9	0.4.0
2023-11	RAN5#101	R5-236154	-	-	-	Addition of downlink physical channels for connection set-up for Cat NB1 and NB2	0.4.0
2023-11	RAN5#101	R5-236278	-	-	-	Editor's Note removing for IoT NTN TX test cases	0.4.0
2023-11	RAN5#101	R5-237687	-	-	-	Update of NTN NB-IoT Maximum input level & ACS test cases	0.4.0
2023-11	RAN5#101	R5-236634	-	-	-	Correction of Clause 6.2B for IoT NTN	0.4.0
2023-11	RAN5#101	R5-237879	-	-	-	Clear-up pCR for Editor notes of message exception and MUTT	0.4.0
2023-11	RAN5#101	R5-236646	-	-	-	Clear-up pCR for Annex references	0.4.0
2023-11	RAN5#101	R5-236647	-	-	-	Update of Annex F Test Tolerances	0.4.0
2023-11	RAN5#101	R5-236648	-	-	-	Update of Annex F Measurement Uncertainties	0.4.0
2023-11	RAN5#101	R5-236649	-	-	-	Editorial correction to TC titles of NB-IoT/eMTC NTN	0.4.0
2023-11	RAN5#101	R5-237965	-	-	-	Core requirements alignment for IoT NTN test cases	0.4.0
2023-12	RAN#102	RP-233449	-	-	-	Presented at RAN#102 for 1-step approval	1.0.0
2023-12	RAN#102	-	-	-	-	put under change control as v18.0.0 with no change	18.0.0
2024-03	RAN#103	R5-240144	0009	-	F	Update content of Statistical testing of Performance Requirements with probability of misdetection in Annex G.4	18.1.0
2024-03	RAN#103	R5-240145	0010	-	F	Update TT value to NTN demod cases	18.1.0
2024-03	RAN#103	R5-240862	0012	-	F	Clarification on NPDSCH repetitions for Demod NB-IoT NTN test cases	18.1.0
2024-03	RAN#103	R5-241387	0016	-	F	Updates to PDSCH RMC	18.1.0
2024-03	RAN#103	R5-241797	0001	1	F	Editorial correction to the wrong table number in 36.521-4 annex C	18.1.0
2024-03	RAN#103	R5-241798	0002	1	F	Update of Annex F Measurement Uncertainties in TS 36.521-4	18.1.0
2024-03	RAN#103	R5-241799	0004	1	F	Editorial correction to the wrong citation number	18.1.0
2024-03	RAN#103	R5-241800	0005	1	F	Editorial alignment for the test applicability	18.1.0
2024-03	RAN#103	R5-241801	0006	1	F	Update of reference measurement channels in Annex A.3.12	18.1.0
2024-03	RAN#103	R5-241804	0003	1	F	Clear-up CR for Editor notes of applicability	18.1.0
2024-03	RAN#103	R5-241954	0014	1	F	Splitting the IoT NTN frequency error test case	18.1.0
2024-03	RAN#103	R5-242005	0011	1	F	Addition and correction to the NTN related abbreviations in 36.521-4	18.1.0
2024-03	RAN#103	R5-242006	0015	1	F	UL RMCs updates for IoT NTN	18.1.0
2024-03	RAN#103	R5-242020	0008	1	F	Editorial correction to Additional spurious emissions TCS	18.1.0
2024-06	RAN#104	R5-242285	0018	-	F	Editorial correction to test description of Clause 6.5A and 6.5B	18.2.0
2024-06	RAN#104	R5-242418	0019	-	F	Addition of Editors note for 8.2.1.1.1	18.2.0
2024-06	RAN#104	R5-242588	0022	-	F	Update to the simulation method of minimun test time	18.2.0
2024-06	RAN#104	R5-243114	0024	-	F	Correction of MOP for NB1 and NB2 test case	18.2.0
2024-06	RAN#104	R5-243115	0025	-	F	Update of frequency error test cases	18.2.0
2024-06	RAN#104	R5-243116	0026	-	F	Update of test case 8.3.1.1.1	18.2.0
2024-06	RAN#104	R5-243905	0028	1	F	Update applicability for NB-NTN Demod TC 8.3.1.1.1	18.2.0
2024-06	RAN#104	R5-243924	0020	1	F	Correction and update to the RMC and minimum test time of NB-IoT NTN demod cases	18.2.0
2024-09	RAN#105	R5-244127	0030	-	F	Addition of band 254 into test case 6.2A.1 UE MOP for category M1	18.3.0
2024-09	RAN#105	R5-244129	0032	-	F	Addition of band 254 into test case 6.2B.1 UE MOP for category NB1 and NB2	18.3.0
2024-09	RAN#105	R5-244130	0033	-	F	Addition of band 254 into test case 6.5A.4.3 Spurious emission band UE co-existence for category M1	18.3.0
2024-09	RAN#105	R5-244131	0034	-	F	Addition of band 254 into test case 6.5B.4.3 Spurious emission band UE co-existence for category NB1 and NB2	18.3.0
2024-09	RAN#105	R5-244133	0036	-	F	Addition of band 254 into test case 7.6A.2 In-band blocking for category M1	18.3.0
2024-09	RAN#105	R5-244134	0037	-	F	Addition of band 254 into test case 7.6A.3 Out-of-band blocking for category M1	18.3.0
2024-09	RAN#105	R5-244135	0038	-	F	Addition of band 254 into test case 6.5A.4.4 Additional spurious emissions for category M1	18.3.0
2024-09	RAN#105	R5-244136	0039	-	F	Addition of band 254 into test case 7.6B.3 Out-of-band blocking for category NB1 and NB2	18.3.0
2024-09	RAN#105	R5-244220	0040	-	F	Addition of IoT NTN band 254 in Operating bands and channel arrangement	18.3.0
2024-09	RAN#105	R5-244457	0044	-	F	Addition of band 254 into test case 6.5B.4.4 Additional spurious emissions for category NB1 and NB2	18.3.0
2024-09	RAN#105	R5-244468	0045	-	F	Update to IoT NTN test cases	18.3.0
2024-09	RAN#105	R5-244469	0046	-	F	Editorial correction to IoT NTN Reference	18.3.0
2024-09	RAN#105	R5-245746	0041	1	F	Update of TT in NTN demod case	18.3.0

2024-09	RAN#105	R5-245748	0047	1	F	min test time update for nb-ntn demod test cases	18.3.0
2024-09	RAN#105	R5-245861	0035	1	F	Addition of band 254 into test case 7.3A Reference sensitivity power level for UE category M1	18.3.0
2024-12	RAN#106	R5-246294	0048	-	F	Addition of band 253 into test case 6.2A.1 UE MOP for category M1	18.4.0
2024-12	RAN#106	R5-246295	0049	-	F	Addition of band 253 into test case 6.2B.1 UE MOP for category NB1 and NB2	18.4.0
2024-12	RAN#106	R5-246296	0050	-	F	Addition of band 253 into test case 6.5A.4.3 Spurious emission band UE co-existence for category M1	18.4.0
2024-12	RAN#106	R5-246297	0051	-	F	Addition of band 253 into test case 6.5B.4.3 Spurious emission band UE co-existence for category NB1 and NB2	18.4.0
2024-12	RAN#106	R5-246299	0053	-	F	Addition of band 253 into test case 7.6A.2 In-band blocking for category M1	18.4.0
2024-12	RAN#106	R5-246300	0054	-	F	Addition of band 253 into test case 7.6A.3 Out-of-band blocking for category M1	18.4.0
2024-12	RAN#106	R5-246301	0055	-	F	Addition of band 253 into test case 7.6B.3 Out-of-band blocking for category NB1 and NB2	18.4.0
2024-12	RAN#106	R5-246304	0058	-	F	Update of A-MPR TC 6.2A.3 for NS_24	18.4.0
2024-12	RAN#106	R5-246305	0059	-	F	Update of A-MPR TC 6.2B.3 for NS_24	18.4.0
2024-12	RAN#106	R5-246349	0060	-	F	Addition of IoT NTN band 253 in Operating bands and channel arrangement	18.4.0
2024-12	RAN#106	R5-246353	0061	-	F	Correction to MPR requirements for NB-IoT NTN	18.4.0
2024-12	RAN#106	R5-246354	0062	-	F	Correction to MOP requirements on sTTI for eMTC NTN	18.4.0
2024-12	RAN#106	R5-247184	0067	-	F	Correction to test procedure of 6.2B.3	18.4.0
2024-12	RAN#106	R5-247333	0068	-	F	Update of test conditions for IoT-NTN OOB blocking	18.4.0
2024-12	RAN#106	R5-247792	0056	1	F	Correction to TC 7.3A Reference sensitivity power level for UE category M1	18.4.0
2024-12	RAN#106	R5-247796	0052	1	F	Addition of band 253 into test case 7.3A Reference sensitivity power level for UE category M1	18.4.0
2024-12	RAN#106	R5-247797	0064	1	F	Modifications of the table note to further clarify the required test frequencies	18.4.0
2024-12	RAN#106	R5-247851	0063	1	F	Include Notes to further specify test frequency selection criteria of Annex K.1.1 and K.1.2 in the cases when UE supports only one band or supports two bands	18.4.0
2024-12	RAN#106	R5-247916	0065	1	F	min test time update for nb-ntn npdcch and npdsch demod test cases	18.4.0

History

Document history		
V18.1.0	May 2024	Publication
V18.2.0	August 2024	Publication
V18.3.0	October 2024	Publication
V18.4.0	February 2025	Publication