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Contents

| | |
|--|----|
| Intellectual Property Rights | 2 |
| Legal Notice | 2 |
| Modal verbs terminology..... | 2 |
| Foreword..... | 5 |
| 1 Scope | 7 |
| 2 References | 7 |
| 3 Definitions, symbols and abbreviations | 8 |
| 3.1 Definitions | 8 |
| 3.2 Symbols..... | 10 |
| 3.3 Abbreviations | 10 |
| 4 Test conditions | 11 |
| 4.1 General | 11 |
| 4.2 Arrangements for establishing a communication link | 11 |
| 4.3 Narrow band responses on receivers | 12 |
| 4.4 Exclusion bands..... | 12 |
| 4.4.1 Transmitter exclusion band..... | 12 |
| 4.4.2 Receiver exclusion band | 13 |
| 4.5 IAB test configurations | 13 |
| 5 Performance assessment..... | 14 |
| 5.1 General | 14 |
| 5.2 Assessment of throughput of IAB-DU | 15 |
| 5.3 Assessment of throughput of IAB-MT | 15 |
| 5.4 Ancillary equipment | 15 |
| 6 Performance criteria | 15 |
| 6.1 Performance criteria for continuous phenomena for IAB | 15 |
| 6.2 Performance criteria for transient phenomena for IAB | 16 |
| 6.3 Performance criteria for continuous phenomena for Ancillary equipment..... | 16 |
| 6.4 Performance criteria for transient phenomena for Ancillary equipment | 17 |
| 7 Applicability overview | 17 |
| 7.1 Emission | 17 |
| 7.2 Immunity | 17 |
| 8 Emission | 18 |
| 8.1 Test configurations | 18 |
| 8.2 Radiated emission..... | 19 |
| 8.2.1 Radiated emission, IAB | 19 |
| 8.2.1.1 Definition | 19 |
| 8.2.1.2 Test method..... | 19 |
| 8.2.1.3 Limits | 20 |
| 8.2.1.4 Interpretation of the measurement results | 20 |
| 8.2.2 Radiated emission, ancillary equipment | 21 |
| 8.2.2.1 Definition | 21 |
| 8.2.2.2 Test method..... | 21 |
| 8.2.2.3 Limits | 21 |
| 8.3 Conducted emission DC power input/output port | 21 |
| 8.3.1 Definition..... | 22 |
| 8.3.2 Test method | 22 |
| 8.3.3 Limits..... | 22 |
| 8.4 Conducted emissions, AC mains power input/output port | 22 |
| 8.4.1 Definition..... | 22 |
| 8.4.2 Test method | 22 |
| 8.4.3 Limits..... | 22 |

| | | |
|---------|--|-----------|
| 8.5 | Conducted emissions, telecommunication port | 23 |
| 8.5.1 | Definition | 23 |
| 8.5.2 | Test method | 23 |
| 8.5.3 | Limits | 23 |
| 8.6 | Harmonic Current emissions (AC mains input port) | 23 |
| 8.7 | Voltage fluctuations and flicker (AC mains input port) | 23 |
| 9 | Immunity | 23 |
| 9.1 | Test configurations | 23 |
| 9.2 | RF electromagnetic field (80 MHz - 6000 MHz) | 24 |
| 9.2.1 | Definition | 24 |
| 9.2.2 | Test method and level | 24 |
| 9.2.3 | Performance criteria | 26 |
| 9.3 | Electrostatic discharge | 26 |
| 9.3.1 | Definition | 26 |
| 9.3.2 | Test method and level | 27 |
| 9.3.3 | Performance criteria | 27 |
| 9.4 | Fast transients common mode | 27 |
| 9.4.1 | Definition | 27 |
| 9.4.2 | Test method and level | 27 |
| 9.4.3 | Performance criteria | 27 |
| 9.5 | RF common mode (0.15 MHz - 80 MHz) | 28 |
| 9.5.1 | Definition | 28 |
| 9.5.2 | Test method and level | 28 |
| 9.5.3 | Performance criteria | 28 |
| 9.6 | Voltage dips and interruptions | 28 |
| 9.6.1 | Definition | 29 |
| 9.6.2 | Test method and level | 29 |
| 9.6.3 | Performance criteria | 29 |
| 9.7 | Surges, common and differential mode | 29 |
| 9.7.1 | Definition | 29 |
| 9.7.2 | Test method and level | 29 |
| 9.7.2.1 | Test method for telecommunication ports directly connected to outdoor cables | 30 |
| 9.7.2.2 | Test method for telecommunication ports connected to indoor cables | 30 |
| 9.7.2.3 | Test method for AC power ports | 30 |
| 9.7.3 | Performance criteria | 30 |
| | Annex A (informative): Change history | 31 |
| | History | 32 |

Foreword

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

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- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

In the present document, modal verbs have the following meanings:

- shall** indicates a mandatory requirement to do something
- shall not** indicates an interdiction (prohibition) to do something

The constructions "shall" and "shall not" are confined to the context of normative provisions, and do not appear in Technical Reports.

The constructions "must" and "must not" are not used as substitutes for "shall" and "shall not". Their use is avoided insofar as possible, and they are not used in a normative context except in a direct citation from an external, referenced, non-3GPP document, or so as to maintain continuity of style when extending or modifying the provisions of such a referenced document.

- should** indicates a recommendation to do something
- should not** indicates a recommendation not to do something
- may** indicates permission to do something
- need not** indicates permission not to do something

The construction "may not" is ambiguous and is not used in normative elements. The unambiguous constructions "might not" or "shall not" are used instead, depending upon the meaning intended.

- can** indicates that something is possible
- cannot** indicates that something is impossible

The constructions "can" and "cannot" are not substitutes for "may" and "need not".

- will** indicates that something is certain or expected to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document
- will not** indicates that something is certain or expected not to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document
- might** indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

might not indicates a likelihood that something will not happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

In addition:

is (or any other verb in the indicative mood) indicates a statement of fact

is not (or any other negative verb in the indicative mood) indicates a statement of fact

The constructions "is" and "is not" do not indicate requirements.

1 Scope

The present document covers the assessment for NR Integrated access and backhaul (IAB) node and associated ancillary equipment in respect of Electromagnetic Compatibility (EMC).

The present document specifies the applicable test conditions, performance assessment and performance criteria for NR Integrated access and backhaul (IAB) node and associated ancillary equipment.

Technical requirements related to the antenna and TAB connectors are not included in the present document. These are found in the relevant product standards [2, 24, 25].

The environment classification used in the present document refers to the residential, commercial and light industrial environment classification used in IEC 61000-6-1 [4], IEC 61000-6-3 [5] and IEC 61000-6-8 [26].

The EMC requirements have been selected to ensure an adequate level of compatibility for apparatus at residential, commercial and light industrial environments. The levels, however, do not cover extreme cases which may occur in any location but with low probability of occurrence.

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*.

- [1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications"
- [2] 3GPP TS 38.174: "NR; Integrated access and backhaul radio transmission and reception".
- [3] 3GPP TR 38.809: "NR; Background for Integrated access and backhaul radio transmission and reception".
- [4] IEC 61000-6-1: "Electromagnetic compatibility (EMC) - Part 6-1: Generic standards - Immunity for residential, commercial and light-industrial environments".
- [5] IEC 61000-6-3: "Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for equipment in residential environments".
- [6] CISPR 32: "Electromagnetic compatibility of multimedia equipment - Emission requirements".
- [7] IEC 60050-161: "International Electrotechnical Vocabulary (IEV) - Part 161: Electromagnetic compatibility".
- [8] IEC 61000-3-2: "Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)".
- [9] IEC 61000-3-12: "Electromagnetic compatibility (EMC) - Part 3-12: Limits - Limits for harmonic currents produced by equipment connected to public low-voltage system with input current >16 A and ≤ 75 A per phase".
- [10] IEC 61000-3-3: "Electromagnetic compatibility (EMC) - Part 3-3: Limits - Limitation of voltage changes, voltage fluctuations and flicker in low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection".

- [11] IEC 61000-3-11: "Electromagnetic compatibility (EMC) - Part 3-11: Limits – Limitation of voltage changes, voltage fluctuations and flicker in low-voltage supply systems - Equipment with rated current ≤ 75 A and subject to conditional connections".
- [12] IEC 61000-4-2: "Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test".
- [13] IEC 61000-4-3: "Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test".
- [14] IEC 61000-4-4: "Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test".
- [15] IEC 61000-4-5: "Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test".
- [16] IEC 61000-4-6: "Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio frequency fields".
- [17] IEC 61000-4-11: "Electromagnetic compatibility (EMC) - Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests".
- [18] IEC 61000-4-21: "Electromagnetic compatibility (EMC) - Part 4-21: Testing and measurement techniques - Reverberation chamber test methods".
- [19] ETSI EN 301 489-1: "ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements; Harmonised Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU and the essential requirements of article 6 of Directive 2014/30/EU".
- [20] Recommendation ITU-R SM.329: "Unwanted emissions in the spurious domain".
- [21] Recommendation ITU-R SM.1539: "Variation of the boundary between the out-of-band and spurious domains required for the application of Recommendations ITU-R SM.1541 and ITU-R SM.329".
- [22] 3GPP TS 38.104: "NR; Base Station (BS) radio transmission and reception"
- [23] CISPR 16-1-4: 2019-01: "Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-4: Radio disturbance and immunity measuring apparatus – Antennas and test sites for radiated disturbance measurements"
- [24] 3GPP TS 38.176-1: "NR; Integrated access and backhaul (IAB) conformance testing; Part 1: Conducted conformance testing".
- [25] 3GPP TS 38.176-2: "NR; Integrated Access and Backhaul (IAB) conformance testing; Part 2: Radiated conformance testing;".
- [26] IEC 61000-6-8: "Electromagnetic compatibility (EMC) - Part 6-8: Generic standards - Emission standard for professional equipment in commercial and light-industrial locations".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions 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 bandwidth: the RF bandwidth supporting a single NR 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.

continuous phenomena: electromagnetic disturbance, the effects of which on a particular device or equipment cannot be resolved into a succession of distinct effects (IEC 60050-161 [7]).

enclosure port: physical boundary of the equipment through which electromagnetic fields may radiate or impinge.

NOTE: In the case of *integral antenna* equipment, this port is inseparable from the antenna port.

exclusion band: frequency range(s) not subject to test or assessment.

IAB-node: RAN node that supports wireless access to UEs and wirelessly backhauls the access traffic.

IAB type 1-H: IAB-MT and IAB-DU operating at FR1 with a requirement set holding requirements defined at the respective TAB and OTA requirements defined at the respective RIB

IAB type 1-O: IAB-MT and IAB-DU operating at FR1 with a requirement set consisting only of OTA requirements defined at the respective RIB.

IAB type 2-O: IAB-MT and IAB-DU operating at FR2 with a requirement set consisting only of OTA requirements defined at the respective RIB

integral antenna: antenna designed for permanent connection to the equipment and considered part of the enclosure port.

NOTE: An *integral antenna* may be fitted internally or externally.

operating band: frequency range in which NR operates (paired or unpaired), that is defined with a specific set of technical requirements.

port: particular interface of EUT used for EMC requirements testing purposes.

NOTE: Any connection point on EUT intended for connection of cables to or from EUT during the EMC testing is considered as a port.

EXAMPLE 1: Examples of ports for *IAB type 1-H* are as presented in figure 3.1-1:

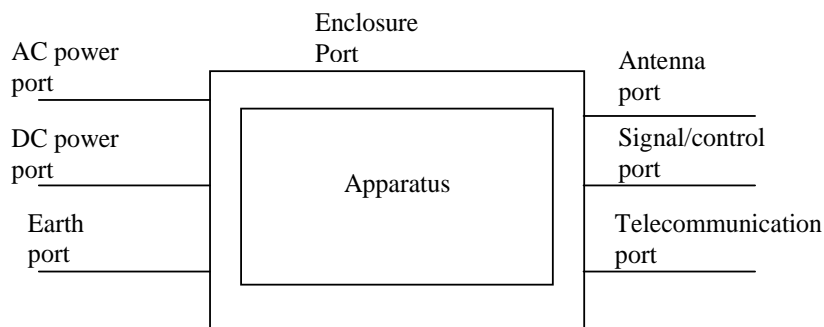


Figure 3.1-1: Examples of ports for IAB type 1-H

EXAMPLE 2: Examples of ports for *IAB type 1-O* and *IAB type 2-O* (i.e. with no antenna ports) are as presented in figure 3.1-2:

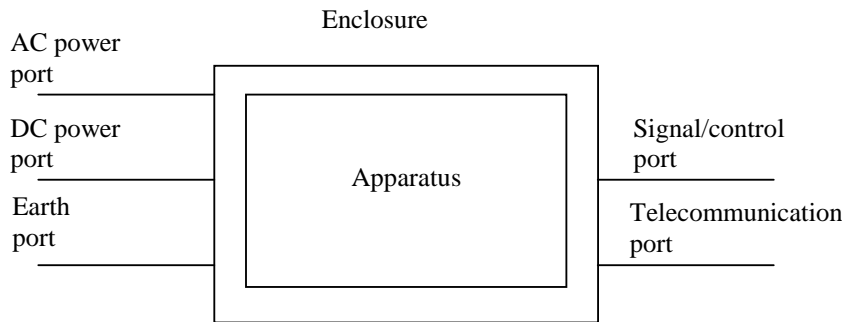


Figure 3.1-2: Examples of ports for IAB type 1-O and IAB type 2-O

receiver exclusion band: band of frequencies over which no tests of radiated immunity of a receiver are made, and expressed relative to the IAB receive band.

signal port: port intended for the interconnection of components of an EUT, or between an EUT and associated equipment and used in accordance with relevant functional specifications (for example for the maximum length of cable connected to it).

spatial exclusion zone: range of angles where no tests of radiated immunity are made for *IAB type 1-O* or *IAB type 2-O* (i.e. half sphere around the EUT's radiating direction).

Throughput: number of payload bits successfully received per second for a reference measurement channel in a specified reference condition.

telecommunication port: ports which are intended to be connected to telecommunication networks (e.g. public switched telecommunication networks, integrated services digital networks), local area networks (e.g. Ethernet, Token Ring) and similar networks.

NOTE: *Telecommunication port* is called "wired network port" in CISPR 32 [6] and ETSI EN 301 489-1 [19].

transient phenomena: pertaining to or designating a phenomena or a quantity which varies between two consecutive steady states during a time interval short compared with the time-scale of interest (IEC 60050-161 [7]).

3.2 Symbols

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

| | |
|--------------------------|--|
| BW_{Channel} | Channel bandwidth |
| Δf_{OBUE} | Maximum offset of the <i>operating band</i> unwanted emissions mask from the downlink <i>operating band</i> edge |
| $F_{\text{DL,low}}$ | The lowest frequency of the downlink <i>operating band</i> |
| $F_{\text{DL,high}}$ | The highest frequency of the downlink <i>operating band</i> |
| $F_{\text{UL,low}}$ | The lowest frequency of the uplink <i>operating band</i> |
| $F_{\text{UL,high}}$ | The highest frequency of the uplink <i>operating band</i> |

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].

| | |
|-----|-----------------------------|
| AC | Alternating Current |
| AMN | Artificial Mains Network |
| BC | Band Category |
| BH | Backhaul |
| CA | Carrier Aggregation |
| CDN | Coupling/Decoupling Network |
| CS | Capability Set |

| | |
|----------|---|
| DC | Direct Current |
| EIRP | Equivalent Isotropic Radiated Power |
| EMC | Electromagnetic Compatibility |
| e.r.p. | Effective Radiated Power |
| ESD | Electrostatic Discharge |
| EUT | Equipment Under Test |
| FR | Frequency Range |
| FRC | Fixed Reference Channel |
| IAB | Integrated Access and Backhaul |
| NC | Non Contiguous |
| NG | Next Generation |
| NGC | Next Generation Core |
| NR | New Radio |
| NR-ARFCN | NR Absolute Radio Frequency Channel Number |
| NRTC | NR Test Configuration |
| NTC | Test Configuration for Non-contiguous operation |
| RAT | Radio Access Technology |
| RF | Radio Frequency |
| RIB | Radiated Interface Boundary |
| rms | root mean square |
| SC | Single Carrier |
| TC | Test Configuration |

4 Test conditions

4.1 General

Requirements throughout the EMC specifications are in some cases defined separately for different frequency ranges (FR). The frequency ranges FR1 and FR2 are defined in subclause 5.1 of TS 38.174 [2].

The equipment shall be tested in normal test environment defined in the corresponding IAB conformance testing specification TS38.176-1[24] and TS38.176-2[25]. The test conditions shall be recorded in the test report.

For IAB Node capable of multi-band operation, the requirements in the present document apply for each supported *operating band* unless otherwise stated. *Operating bands* shall be activated according to the test configuration in subclause 4.5. Tests shall be performed relating to each type of port and all *operating bands* shall be assessed during the tests.

The manufacturer shall declare the supported *operating band(s)* according to the list of NR IAB *operating bands* defined in TS 38.174 [2].

NOTE 1: NR IAB *operating bands* for IAB type 1-H, are declared by the manufacturer according to the declarations specified in TS38.176-1[24], Table 4.6-1 and TS38.176-2[25], Table 4.6-1.

NOTE 2: NR IAB *operating bands* for IAB type 1-O and IAB type 2-O, are declared by the manufacturer according to the declarations specified in TS38.176-2[25], Table 4.6-1.

4.2 Arrangements for establishing a communication link

The wanted RF input signal nominal frequency shall be selected by setting the NR Absolute Radio Frequency Channel Number (NR-ARFCN) to an appropriate number.

A communication link shall be set up with a suitable test system capable of evaluating the required performance criteria (hereafter called "the test system") at the radio interface and *telecommunication port/ports* (the NG interface). The test system shall be located outside of the test environment.

When the EUT is required to be in the transmit/receive mode, the following conditions shall be met:

- For the IAB type 1-H testing, the EUT shall be commanded to operate at rated transmit power;

- For the *IAB type 1-O* and *IAB type 2-O* testing, the EUT transmit power shall be configured as stated in clause 8.1 for emission test and clause 9.1 for immunity test accordingly,
- Adequate measures shall be taken to avoid the effect of the unwanted signal on the measuring equipment;
- The wanted input signal level shall be set to a level where the performance is not limited by the receiver noise floor or strong signal effects.

NOTE: 15 dB above the conducted reference sensitivity level has been used as an example of wanted input signal level in legacy 3GPP EMC specifications for establishing a communication link.

For immunity tests clause 4.3 shall apply and the conditions shall be as follows.

4.3 Narrow band responses on receivers

Responses on receivers or duplex transceivers occurring during the immunity test at discrete frequencies which are narrow band responses (spurious responses), are identified by the following method:

- if during an immunity test the quantity being monitored goes outside the specified tolerances (clause 6), it is necessary to establish whether the deviation is due to a narrow band response or to a wide band (EMC) phenomenon. Therefore, the test shall be repeated with the unwanted signal frequency increased, and then decreased by $2 \times BW_{\text{Channel}}$ MHz, where BW_{Channel} is the channel bandwidth as defined in TS 38.174 [2], clause 5.3;
- if the deviation disappears in either one or both of the above MHz offset cases, then the response is considered as a narrow band response;
- if the deviation does not disappear, this may be due to the fact that the offset has made the frequency of the unwanted signal correspond to the frequency of another narrow band response. Under these circumstances the procedure is repeated with the increase and decrease of the frequency of the unwanted signal set to $2.5 \times BW_{\text{Channel}}$ MHz;
- if the deviation does not disappear with the increased and/or decreased frequency, the phenomenon is considered wide band and therefore an EMC problem and the equipment fails the test.

For immunity test narrow band responses are disregarded.

4.4 Exclusion bands

4.4.1 Transmitter exclusion band

The *transmitter exclusion band* for IAB is the frequency range over which no tests of radiated immunity of a transmitter are made. As the IAB node may operate its access and backhaul link in different NR IAB *operating band*, the *transmitter exclusion band* for IAB applies separately for the access and backhaul link. The *transmitter exclusion band* applies to *IAB type 1-O*.

The *transmitter exclusion band* is defined as:

$$F_{\text{DL,low}} - \Delta f_{\text{OBUE}} < f < F_{\text{DL,high}} + \Delta f_{\text{OBUE}}$$

Where:

- Values of $F_{\text{DL,low}}$ and $F_{\text{DL,high}}$, $F_{\text{UL,low}}$ and $F_{\text{UL,high}}$ are defined for each NR IAB *operating band* in TS 38.174 [2], clause 5.2.
- The value of Δf_{OBUE} is derived considering the width of the NR IAB *operating band*, and is defined as in table 4.4.1-1 and table 4.4.1-2.

Table 4.4.1-1: Δf_{OBUE} offset value for NR IAB-DU

| IAB-DU type | Operating band characteristics | Δf_{OBUE} (MHz) |
|-----------------|--|--------------------------------|
| IAB-DU type 1-O | $F_{\text{DL,high}} - F_{\text{DL,low}} < 100$ MHz | 10 |
| | $100 \text{ MHz} \leq F_{\text{DL,high}} - F_{\text{DL,low}} \leq 900$ MHz | 40 |

Table 4.4.1-2: Δf_{OBUE} offset value for NR IAB-MT

| IAB-MT type | Operating band characteristics | Δf_{OBUE} (MHz) |
|-----------------|--|--------------------------------|
| IAB-MT type 1-O | $F_{\text{UL,high}} - F_{\text{UL,low}} < 100$ MHz | 10 |
| | $100 \text{ MHz} \leq F_{\text{UL,high}} - F_{\text{UL,low}} \leq 900$ MHz | 40 |

For IAB node capable of multi-band operation, the total transmitter exclusion band is a combination of the exclusion bands for each operating band supported by IAB node.

NOTE: As the radiated immunity testing is defined in the frequency range 80 MHz to 6 GHz, there is no *transmitter exclusion band* defined for *IAB type 2-O*.

4.4.2 Receiver exclusion band

The *receiver exclusion band* for IAB is the frequency range over which no tests of radiated immunity of a receiver are made. As the IAB node may operate its access and backhaul link in different NR IAB *operating band*, the *receiver exclusion band* for IAB applies separately for the access and backhaul link. The *receiver exclusion band* applies to *IAB type 1-O*.

The *receiver exclusion band* is defined as:

$$F_{\text{UL,low}} - \Delta f_{\text{RX}} < f < F_{\text{UL,high}} + \Delta f_{\text{RX}}$$

Where:

- Values of $F_{\text{UL,low}}$ and $F_{\text{UL,high}}$ are defined for each NR IAB *operating band* in in TS 38.174 [2], clause 5.2.
- The value of Δf_{RX} is derived considering the width of the NR IAB *operating band*, and is defined as in table 4.4.2-1. Value of the Δf_{RX} also depends on the RI test setup, i.e. whether or not the *spatial exclusion zone* (as described in subclause 9.2.2) is considered during the RI test.

Table 4.4.1-1: Δf_{RX} offset values for IAB

| IAB type | IAB operating band characteristics | RI test setup | Δf_{RX} (MHz) |
|--------------|--|------------------------|------------------------------|
| IAB type 1-O | $F_{\text{UL,high}} - F_{\text{UL,low}} < 100$ MHz | With exclusion zone | 20 |
| | | Without exclusion zone | 60 |
| | $100 \text{ MHz} \leq F_{\text{UL,high}} - F_{\text{UL,low}} \leq 900$ MHz | With exclusion zone | 60 |
| | | Without exclusion zone | 200 |

NOTE: As the radiated immunity testing is defined in the frequency range 80 MHz to 6 GHz, there is no *receiver exclusion band* defined for *IAB type 2-O*.

4.5 IAB test configurations

The present clause defines the IAB test configurations that shall be used for demonstrating conformance. A single IAB carrier shall be used for testing of single-carrier capable IAB.

Single carrier configuration (SC) tests shall be performed using signal with narrowest supported *IAB channel bandwidth* with the smallest supported subcarrier spacing declared per *operating band* in TS 38.176-1 [24] clause 4.6, and TS 38.176-2 [25] clause 4.6.

For other IAB node, the test configurations in table 4.5-1 and table 4.5-2 shall be used. The IAB test configurations (IABTC_x) are defined in TS 38.176-1 [24], clause 4.7 for *IAB type 1-H* and in TS 38.176-2 [25], clause 4.7 for *IAB type 1-O* and *IAB type 2-O*.

Table 4.5-1: Test configurations for *IAB type 1-H*

| IAB test case | IAB capable of multi-carrier and/or CA in a single band | | | IAB capable of multi-band operation | |
|---|---|--|--|-------------------------------------|---------------------------------------|
| | Contiguous spectrum capable IAB | C and NC capable IAB with identical parameters | C and NC capable IAB with different parameters | Common connector | Separate connectors |
| Emission tests | IABTC1 | IABTC3 | IABTC1, IABTC3 | IABTC1/3 (Note 1), IABTC5 | IABTC1/3 (Note 1, 2), IABTC5 (Note 2) |
| Immunity tests | IABTC1 | IABTC3 | IABTC1, IABTC3 | IABTC5 | IABTC1/3 (Note 1), IABTC5 (Note 3) |
| NOTE 1: IABTC1 and/or IABTC3 shall be applied in each supported <i>operating band</i> . | | | | | |
| NOTE 2: For single-band operation test, other TAB connector(s) is (are) terminated. | | | | | |
| NOTE 3: IABTC5 is only applicable for multi-band receiver. | | | | | |

Table 4.5-2: Test configurations for *IAB type 1-O*

| IAB test case | single-band RIB | | | multi-band RIB |
|---|---------------------------------|--|--|---------------------------|
| | Contiguous spectrum capable IAB | C and NC capable IAB with identical parameters | C and NC capable IAB with different parameters | |
| Emission tests | IABTC1 | IABTC3 | IABTC1, IABTC3 | IABTC1/3 (Note 1), IABTC5 |
| Immunity tests | IABTC1 | IABTC3 | IABTC1, IABTC3 | IABTC5 |
| NOTE 1: IABTC1 and/or IABTC3 shall be applied in each supported <i>operating band</i> . | | | | |

Table 4.5-3: Test configurations for *IAB type 2-O*

| IAB test case | single-band RIB | | |
|----------------|---------------------------------|--|--|
| | Contiguous spectrum capable IAB | C and NC capable IAB with identical parameters | C and NC capable IAB with different parameters |
| Emission tests | IABTC1 | IABTC3 | IABTC1, IABTC3 |
| Immunity tests | IABTC1 | IABTC3 | IABTC1, IABTC3 |

5 Performance assessment

5.1 General

The following information shall be recorded in or annexed to the test report:

- the primary functions of the radio equipment to be tested during and after the EMC testing;
- the intended functions of the radio equipment which shall be in accordance with the documentation accompanying the equipment;
- the method to be used to verify that a communications link is established and maintained;
- the user-control functions and stored data that are required for normal operation and the method to be used to assess whether these have been lost after EMC stress;
- the *ancillary equipment* to be combined with the radio equipment for testing (where applicable);
- the information about *ancillary equipment* intended to be used with the radio equipment;
- information about the common and/or band-specific active RF components and other hardware blocks for a communication link in IAB node capable of multi-band operation;

- an exhaustive list of ports (and RIBs), classified as either power or signal/control. Power ports shall further be classified as AC or DC power.

Performance assessment of a IAB Node with multiple enclosures may be done separately for the IAB Node part with the Radio digital unit and the Radio unit respectively, according to the manufacturer's choice.

A communication link used by more than one operating band, shall be assessed on all operating bands. Communication link(s) and/or radio performance parameters for the operating bands can during the test be assessed simultaneously or separately for each band, depending on the test environment capability.

5.2 Assessment of throughput of IAB-DU

For downlink assessment of the IAB-DU, a communication link shall be established between the transmitter (via port for the IAB type 1-H, or via RIB for the IAB type 1-O and IAB type 2-O) and the test equipment. Test equipment shall meet the requirements for the throughput assessment defined in TS38.176-1[24] and TS38.176-2[25] for the bearer used in the immunity tests. The level of the signal supplied to the equipment should be within the range for which the assessment of throughput is not impaired. Power control shall be OFF during the immunity testing.

For uplink assessment of the IAB-DU, the value of the throughput at the output of the receiver shall be monitored at NG interface by using suitable test equipment.

5.3 Assessment of throughput of IAB-MT

The test arrangement and signals, given in clause 4, apply to IAB-MT. The assessment of equipment performance shall be based on data transfer according to the criteria in clause 6.

5.4 Ancillary equipment

At the manufacturer's discretion the test may be performed on the ancillary equipment separately or on a representative configuration of the combination of radio and ancillary equipment. In each case EUT is tested against all applicable immunity and emission clauses of the present document and in each case, compliance enables the ancillary equipment to be used with different radio equipment.

6 Performance criteria

6.1 Performance criteria for continuous phenomena for IAB

The test should, where possible, be performed using a bearer with the characteristics of data rate and throughput defined in table 6.1-1 and table 6.1-2. If the test is not performed using one of these bearers (for example, none of them are supported by the IAB node), the characteristics of the bearer used shall be recorded in the test report.

The throughput in table 6.1-1 and table 6.1-2 is stated relative to the maximum throughput of the FRC.

The IAB node uplink and downlink paths shall each meet the performance criteria defined in table 6.1-1 and table 6.1-2 during the test. If the uplink and downlink paths are evaluated as a one loop then the criteria is two times the throughput reduction shown in table 6.1-1 and table 6.1-2 (i.e. throughput > 90 % instead of throughput > 95 %). After each test case IAB node shall operate as intended with no loss of user control function, stored data and the communication link to both UE and donor test equipments shall be maintained.

Table 6.1-1: FR1 performance criteria for continuous phenomena for IAB

| NR channel bandwidth (MHz) as defined in TS 38.174 section 5.3.2 [2] for IAB-MT and TS 38.104 section 5.3.2-1 [22] for IAB-DU | Sub-carrier spacing (kHz) | Bearer information data rate for IAB-MT | Bearer information data rate for IAB-DU | Performance criteria (Note 1, Note 2) |
|--|---------------------------|---|---|---------------------------------------|
| 10, 15 | 30 | G-FR1-A1-22 in annex A.1 in TS 38.174 [2] | G-FR1-A1-2 in annex A.1 in TS 38.104 [22] | Throughput > 95 %, no loss of service |
| 10, 15 | 60 | G-FR1-A1-23 in annex A.1 in TS 38.174 [2] | G-FR1-A1-3 in annex A.1 in TS 38.104 [22] | |
| 20 to 100 | 30 | G-FR1-A1-25 in annex A.1 in TS 38.174 [2] | G-FR1-A1-5 in annex A.1 in TS 38.104 [22] | |
| 20 to 100 | 60 | G-FR1-A1-26 in annex A.1 in TS 38.174 [2] | G-FR1-A1-6 in annex A.1 in TS 38.104 [22] | |
| NOTE 1: The performance criteria, throughput > 95 %, no loss of service, applies also if a bearer with another characteristics is used in the test. | | | | |
| NOTE 2: The performance criteria, throughput > 90 %, no loss of service, applies instead if the uplink and downlink paths are evaluated as a one loop. | | | | |

Table 6.1-2: FR2 performance criteria for continuous phenomena for IAB

| NR channel bandwidth (MHz) | Sub-carrier spacing (kHz) | Bearer information data rate for IAB-MT | Bearer information data rate for IAB-DU | Performance criteria (Note 1, Note 2) |
|--|---------------------------|---|---|---------------------------------------|
| 50, 100, 200 | 60 | G-FR2-A1-21 in annex A.1 in TS 38.174 [2] | G-FR2-A1-1 in annex A.1 in TS 38.104 [22] | Throughput > 95 %, no loss of service |
| 50 | 120 | G-FR2-A1-22 in annex A.1 in TS 38.174 [2] | G-FR2-A1-2 in annex A.1 in TS 38.104 [22] | |
| 100, 200, 400 | 120 | G-FR2-A1-23 in annex A.1 in TS 38.174 [2] | G-FR2-A1-3 in annex A.1 in TS 38.104 [22] | |
| NOTE 1: The performance criteria, throughput > 95 %, no loss of service, applies also if a bearer with another characteristics is used in the test. | | | | |
| NOTE 2: The performance criteria, throughput > 90 %, no loss of service, applies instead if the uplink and downlink paths are evaluated as a one loop. | | | | |

6.2 Performance criteria for transient phenomena for IAB

At the conclusion of the total test (comprising the series of individual exposures to transient phenomena) the IAB node shall operate as intended with no user noticeable loss of control functions or stored data. At the conclusion of each exposure the IAB node shall operate with no user noticeable loss of the communication link to both UE and donor test equipments.

The channel bandwidth, sub-carrier spacing and bearer information data rate should be chosen based on manufacturer's declaration and defined according to table 6.1-1 and table 6.1-2.

6.3 Performance criteria for continuous phenomena for Ancillary equipment

The apparatus shall continue to operate as intended during and after the test. No degradation of performance or loss of function is allowed below the performance level specified by the manufacturer, when the apparatus is used as intended. The performance level may be replaced by a permissible performance loss. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, either of these may be derived from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.

6.4 Performance criteria for transient phenomena for Ancillary equipment

The apparatus shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below the performance level specified by the manufacturer, when the apparatus is used as intended. The performance level may be replaced by a permissible performance loss. During the test, degradation of performance is however allowed. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, either of these may be derived from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.

7 Applicability overview

7.1 Emission

Throughout this specification, whenever the IAB requirement is referred, its applicability shall be considered as applicable to the IAB node as a whole (MT and DU), irrespective of its implementation. Performance assessment of an IAB node with multiple enclosures may be done separately for each of them, according to the manufacturer's choice.

Table 7.1-1: Emission requirements applicability

| Phenomenon | Application | Equipment test requirement | | Reference clause in the present document | Reference standard |
|----------------------------------|---|---|---------------------|--|---|
| | | IAB equipment | Ancillary equipment | | |
| Radiated emission | IAB enclosure (Note 1) | applicable for <i>IAB type 1-H</i> (Note 2) | not applicable | 8.2.1 | ITU-R SM.329 [20] |
| Radiated emission | Enclosure of <i>ancillary equipment</i> | not applicable | applicable | 8.2.2 | CISPR 32 [6] |
| Conducted emission | DC power input/output port | applicable | applicable | 8.3 | CISPR 32 [6] |
| Conducted emission | AC mains input/output port | applicable | applicable | 8.4 | CISPR 32 [6] |
| Conducted emission | <i>Telecommunication port</i> | applicable | applicable | 8.5 | CISPR 32 [6] |
| Harmonic current emissions | AC mains input port | applicable | applicable | 8.6 | IEC 61000-3-2 [8] or IEC 61000-3-12 [9] |
| Voltage fluctuations and flicker | AC mains input port | applicable | applicable | 8.7 | IEC 61000-3-3 [10] or IEC 61000-3-11 [11] |

NOTE 1: Radiated emission measurement of an IAB node with multiple enclosures may be done separately for each of them, according to the manufacturer's choice.
NOTE 2: Radiated emission requirements for *IAB type 1-O* and *IAB type 2-O* are described in clause 8.2.1.

7.2 Immunity

Table 7.2-1: Immunity requirements applicability

| Phenomenon | Application | Equipment test requirement | | Reference clause in the present document | Reference standard |
|--|---|----------------------------|---------------------|--|---------------------|
| | | IAB equipment | Ancillary equipment | | |
| RF electromagnetic field (80 – 6000 MHz) | Enclosure | applicable | applicable | 9.2 | IEC 61000-4-3 [13] |
| Electrostatic discharge | Enclosure | applicable | applicable | 9.3 | IEC 61000-4-2 [12] |
| Fast transients common mode | Signal, telecommunications and control ports, DC and AC power input ports | applicable | applicable | 9.4 | IEC 61000-4-4 [14] |
| RF common mode 0.15 - 80 MHz | Signal, telecommunications and control ports, DC and AC power input ports | applicable | applicable | 9.5 | IEC 61000-4-6 [16] |
| Voltage dips and interruptions | AC mains power input <i>ports</i> | applicable | applicable | 9.6 | IEC 61000-4-11 [17] |
| Surges, common and differential mode | AC power input <i>ports</i> and <i>telecommunications port</i> | applicable | applicable | 9.7 | IEC 61000-4-5 [15] |

8 Emission

8.1 Test configurations

This clause defines the configurations for emission tests as follows:

- The equipment shall be tested under normal test conditions as specified in the functional standards;
- The test configuration shall be as close to normal intended use as possible;
- If the equipment is part of a system, or can be connected to ancillary equipment, then it shall be acceptable to test the equipment while connected to the minimum configuration of *ancillary equipment* necessary to exercise the ports;
- If the equipment has a large number of ports, then a sufficient number shall be selected to simulate actual operation conditions and to ensure that all the different types of termination are tested;
- The test conditions, test configuration and mode of operation shall be recorded in the test report;
- Ports which in normal operation are connected shall be connected to an *ancillary equipment* or to a representative piece of cable correctly terminated to simulate the input/output characteristics of the *ancillary equipment*; in case of *IAB type 1-H*, *antenna ports* shall be correctly terminated;
- For *IAB type 1-O* and *IAB type 2-O* without *antenna ports* but intentionally radiating through the *antenna array*, the equipment shall be placed in a test setup suitable for the radiated power;
- Ports which are not connected to cables during normal operation, e.g. service connectors, programming connectors, temporary connectors etc. shall not be connected to any cables for the purpose of EMC testing. Where cables have to be connected to these ports, or interconnecting cables have to be extended in length in order to exercise the EUT, precautions shall be taken to ensure that the evaluation of the EUT is not affected by the addition or extension of these cables;
- The test arrangements for transmitter and receiver clauses of the transceiver are described separately for the sake of clarity. However, where possible the test of the transmitter clause and receiver clause of the EUT may be carried out simultaneously to reduce test time.

8.2 Radiated emission

8.2.1 Radiated emission, IAB

This test is applicable to *IAB type 1-H*. This test shall be performed on a representative configuration of IAB node.

For *IAB type 1-O* and *IAB type 2-O*, the radiated emission is covered by radiated spurious emission requirement in TS 38.174 [2], conforming to the test requirement in TS 38.174[2].

8.2.1.1 Definition

This test assesses the ability of IAB node to limit unwanted emission from the *enclosure port*.

8.2.1.2 Test method

- a) A test site fulfilling the requirements of ITU-R SM.329 [20] shall be used. The IAB node shall be placed on a non-conducting support and shall be operated from a power source via a RF filter to avoid radiation from the power leads. One of the following two alternative measurement methods shall be used:

1) Field strength method measurement

The test method shall be in accordance with CISPR 32 [6]. The field strength measurements shall be performed on a test site that is validated according to the methods and requirements of CISPR 16-1-4 [23].

Unless otherwise stated, measurements are conducted at 3 m or 10 m on an open area test site (OATS) or semi anechoic chamber (SAC) for frequencies up to 1 GHz, or at 3 m on a free space open area test site (FSOATS) or fully-anechoic room (FAR) for frequencies above 1 GHz. Unless otherwise stated, all measurements are done with RMS detector and with the -3 dB bandwidth of the measuring filter equal to the reference bandwidth in table 8.2.1.3-1.

NOTE 1: Test site validation methods for radiated emissions tests are defined in CISPR 16-1-4 [23], clause 6 and 7. Examples of test site validation methods are listed below:

- 30 - 1000 MHz frequency range: Normalized Site Attenuation (NSA), Reference Site Method (RSM).
- 1 - 18 GHz frequency range: S_{VSWR} standard test procedure, S_{VSWR} reciprocal test procedure.

2) Substitution method measurement (also called a substitution method)

Mean power of any spurious components shall be detected by the test antenna and measuring receiver (e.g. a spectrum analyser). At each frequency at which a component is detected, the IAB node shall be rotated and the height of the test antenna adjusted to obtain maximum response, and the effective radiated power (e.r.p.) of that component determined by a substitution measurement. The measurement shall be repeated with the test antenna in the orthogonal polarization plane.

NOTE: Effective radiated power (e.r.p.) refers to the radiation of a half wave tuned dipole instead of an isotropic antenna. There is a constant difference of 2.15 dB between e.i.r.p. and e.r.p., as defined in ITU-R SM.329 annex 1 [20].

$$\text{e.r.p. (dBm)} = \text{e.i.r.p. (dBm)} - 2.15$$

- b) The IAB node shall transmit with maximum power declared by the manufacturer with all transmitters active. Set the base station to transmit a signal as stated in subclause 4.5.
- c) For IAB-DU the received power shall be measured over the frequency range from 30 MHz to $F_{DL,low} - \Delta f_{OBUE}$ and from $F_{DL,high} + \Delta f_{OBUE}$ up to 12750 MHz. The video bandwidth shall be approximately three times the resolution bandwidth. If this video bandwidth is not available on the measuring receiver, it shall be the maximum available and at least 1 MHz. For some *operating bands*, the upper limit is higher than 12.75 GHz in order to comply with the 5th harmonic limit of the downlink *operating band*, as specified in ITU-R recommendation SM.329 [20]. Unless otherwise stated, all measurements are done as mean power (RMS).

- d) For IAB-MT the received power shall be measured over the frequency range from 30 MHz to $F_{UL,low} - \Delta f_{OBUE}$ and from $F_{UL,high} + \Delta f_{OBUE}$ up to 12750 MHz. The video bandwidth shall be approximately three times the resolution bandwidth. If this video bandwidth is not available on the measuring receiver, it shall be the maximum available and at least 1 MHz. For some *operating bands*, the upper limit is higher than 12.75 GHz in order to comply with the 5th harmonic limit of the uplink *operating band*, as specified in ITU-R recommendation SM.329 [20]. Unless otherwise stated, all measurements are done as mean power (RMS).

8.2.1.3 Limits

The frequency boundary and reference bandwidths for the detailed transitions of the limits between the requirements for out of band emissions and spurious emissions are based on ITU-R Recommendations SM.329 [20] and SM.1539 [21]. The *IAB type 1-H* shall meet the limits below:

Table 8.2.1.3-1: Limits for radiated emissions from IAB type 1-H

| Frequency Range | e.r.p. (dBm) | Field strength at 3 m (dB μ V/m) (NOTE 4) | Field strength at 10 m (dB μ V/m) (NOTE 4) | Reference bandwidth | NOTE |
|--|--------------|---|--|---------------------|------|
| $30 \text{ MHz} \leq f < 1000 \text{ MHz}$ | -36 | 65.4 (NOTE 5) | 54.9 (NOTE 5) | 100 kHz | |
| $1 \text{ GHz} \leq f < 12.75 \text{ GHz}$ | -30 | 67.4 | Not applicable | 1 MHz | |
| 12.75 GHz $\leq f <$ 5 th harmonic of the upper frequency edge of the DL operating band in GHz | -30 | 67.4 | Not applicable | 1 MHz | 1 |
| $F_{DL,low} - \Delta f_{OBUE} < f < F_{DL,high} + \Delta f_{OBUE}$ (for IAB-DU) | Not defined | Not defined | Not defined | Not defined | 2,3 |
| $F_{UL,low} - \Delta f_{OBUE} < f < F_{UL,high} + \Delta f_{OBUE}$ (for IAB-MT) | | | | | |
| <p>NOTE 1: For IAB-DU, this spurious frequency range applies only for <i>operating bands</i> for which the 5th harmonic of the upper frequency edge of the DL <i>operating band</i> is reaching beyond 12.75 GHz. For IAB-MT, this spurious frequency range applies only for <i>operating bands</i> for which the 5th harmonic of the upper frequency edge of the UL <i>operating band</i> is reaching beyond 12.75 GHz.</p> <p>NOTE 2: For IAB node capable of multi-band operation, the frequency ranges relating to the RF bandwidths of all supported <i>operating bands</i> apply.</p> <p>NOTE 3: Δf_{OBUE} is defined in clause 6.6.1 of TS 38.174 [2].</p> <p>NOTE 4: The field strength measurements shall be conducted on OATS or SAC for frequencies up to 1 GHz, or on FSOATS or FAR for frequencies above 1 GHz.</p> <p>NOTE 5: Limits for radiated emissions are translated from the e.r.p. limit of -36 dBm into the field strength limit of 61.4 dBμV/m (at 3m) or 50.9 dBμV/m (at 10m), and increased by the site gain value of 4 dB. The value of the site gain is based on ITU-R Recommendations SM.329 [20].</p> | | | | | |

8.2.1.4 Interpretation of the measurement results

The interpretation of the results recorded in a test report for the radiated emission measurements described in the present document shall be as follows:

- the measured value related to the corresponding limit will be used to decide whether an equipment meets the requirements of the present document;
- the value of the measurement uncertainty for the measurement of each parameter shall be included in the test report;
- the recorded value of the measurement uncertainty shall be, for each measurement, equal to or lower than the values in table 8.2.1.4-1 for IAB node.

Table 8.2.1.4-1 specifies the maximum measurement uncertainty of the test system. The test system shall enable the equipment under test to be measured with an uncertainty not exceeding the specified values. All tolerances 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.

Table 8.2.1.4-1: Maximum measurement uncertainty (IAB node)

| Parameter | Uncertainty for EUT dimension ≤ 1 m | Uncertainty for EUT dimension >1 m |
|---|--|--------------------------------------|
| Effective radiated RF power between 30 MHz to 180 MHz | ± 6 dB | ± 6 dB |
| Effective radiated RF power between 180 MHz to 4 GHz | ± 4 dB | ± 6 dB |
| Effective radiated RF power between 4 GHz to 12,75 GHz | ± 6 dB | ± 9 dB (NOTE) |
| Field strength between 30 MHz to 12,75 GHz | ± 6 dB | ± 6 dB |
| NOTE: This value may be reduced to ± 6 dB when further information on the potential radiation characteristic of the EUT is available. | | |

NOTE: If the test system for a test is known to have a measurement uncertainty greater than that specified in table 8.2.1.4-1, this equipment can still be used, provided that an adjustment is made follows:

Any additional uncertainty in the test system over and above that specified in table 8.2.1.4-1 is used to tighten the test requirements - making the test harder to pass.

This procedure will ensure that a test system not compliant with table 8.2.1.4-1 does not increase the probability of passing an EUT that would otherwise have failed a test if a test system compliant with table 8.2.1.4-1 had been used.

8.2.2 Radiated emission, ancillary equipment

This test is only applicable to *ancillary equipment* not incorporated in the radio equipment and intended to be measured on a stand-alone basis, as declared by the manufacturer. This test shall be performed on a representative configuration of the *ancillary equipment*.

This test is not applicable for *ancillary equipment* incorporated in the radio equipment, or for *ancillary equipment* intended to be measured in combination with the radio equipment. In these cases, the requirements of the relevant product standard for the effective use of the radio spectrum shall apply.

8.2.2.1 Definition

This test assesses the ability of *ancillary equipment* to limit unwanted emission from the *enclosure port*.

8.2.2.2 Test method

The test method shall be in accordance with CISPR 32[6].

8.2.2.3 Limits

The *ancillary equipment* shall meet the limits according to CISPR 32[6] table A.4 and table A.5.

For the referred limit values, the following shall apply:

Where the limits value varies over a given frequency range, it changes linearly with respect to the logarithm of the frequency.

Where there is a step in the relevant limit, the lower value shall be applied at the transition frequency.

Alternatively, for *ancillary equipment* intended to be used in telecommunication centres only, the class A limits given in CISPR 32 [6], annex A, table A.2 and table A.3 may be used.

8.3 Conducted emission DC power input/output port

If the DC power cable of the radio equipment is intended to be less than 3 m in length, and intended only for direct connection to a dedicated AC to DC power supply, then the measurement shall be performed only on the AC power input of that power supply as specified in clause 8.4.

This test shall be performed on a representative configuration of the radio equipment, the associated *ancillary equipment*, or representative configuration of the combination of radio and *ancillary equipment*.

8.3.1 Definition

This test assesses the ability of radio equipment and *ancillary equipment* to limit internal noise from the DC power input/output ports.

8.3.2 Test method

The test method shall be in accordance with CISPR 32 [6] and the Artificial Mains Network (AMN) shall be connected to a DC power source.

In the case of DC output ports, the ports shall be connected via an AMN to a load drawing the rated current of the source.

A measuring receiver shall be connected to each AMN measurement port in turn and the conducted emission recorded.

The equipment shall be installed with a ground plane as defined in CISPR 32 [6]. The reference earth point of the AMN shall be connected to the reference ground plane with a conductor as short as possible.

8.3.3 Limits

The equipment shall meet the limits according to CISPR 32 [6] table A.9, which are defined for average detector receiver and for quasi-peak detector receiver. If the average limit is met when using a quasi-peak detector, the equipment shall be deemed to meet both limits and measurement with the average detector receiver is not necessary.

Where there is a step in the referred limit values, the lower value shall be applied at the transition frequency.

8.4 Conducted emissions, AC mains power input/output port

This test is applicable to equipment powered by the AC mains.

This test is not applicable to AC output ports which are connected directly (or via a circuit breaker) to the AC power port of the EUT.

This test shall be performed on a representative configuration of the radio equipment, the associated *ancillary equipment*, or representative configuration of the combination of radio and *ancillary equipment*.

8.4.1 Definition

This test assesses the ability of radio equipment and *ancillary equipment* to limit internal noise from the AC mains power input/output ports.

8.4.2 Test method

The test method shall be in accordance with CISPR 32 [6].

8.4.3 Limits

The equipment shall meet the limits according to CISPR 32 [6] table A.10, which are defined for the average detector receiver and for quasi-peak detector receiver. If the average limit is met when using a quasi-peak detector, the equipment shall be deemed to meet both limits and measurement with the average detector receiver is not necessary.

For the referred limit values following shall apply:

Where the limits value varies over a given frequency range, it changes linearly with respect to the logarithm of the frequency.

Where there is a step in the relevant limit, the lower value shall be applied at the transition frequency.

Alternatively, for equipment intended to be used in telecommunication centres the limits given in CISPR 32 [6] table A.9 shall be used.

8.5 Conducted emissions, telecommunication port

This test is applicable for radio equipment and/or *ancillary equipment* for fixed use which have *telecommunication ports*.

This test shall be performed on a representative configuration of radio equipment, the associated *ancillary equipment*, or a representative configuration of the combination of radio and *ancillary equipment*.

8.5.1 Definition

This test assesses the EUT unwanted emission present at the *telecommunication ports*.

8.5.2 Test method

The test method shall be in accordance with CISPR 32 [6].

8.5.3 Limits

The *telecommunication ports* shall meet the limits according to CISPR 32 [6] table A.12.

For the referred limit values, following shall apply:

Where the limits value varies over a given frequency range, it changes linearly with respect to the logarithm of the frequency.

Where there is a step in the relevant limit, the lower value shall be applied at the transition frequency.

Alternatively, for equipment intended to be used in telecommunication centres only, the limits given in CISPR 32 [6] table A.11 may be used.

8.6 Harmonic Current emissions (AC mains input port)

The requirements of IEC 61000-3-2 [8] for harmonic current emission apply for equipment covered by the scope of the present document. For equipment with an input current of greater than 16A per phase, IEC 61000-3-12 [9] applies.

8.7 Voltage fluctuations and flicker (AC mains input port)

The requirements of IEC 61000-3-3 [10] for voltage fluctuations and flicker apply for equipment covered by the scope of the present document. For equipment with an input current of greater than 16 A per phase, IEC 61000-3-11 [11] applies.

9 Immunity

9.1 Test configurations

This clause defines the configurations for immunity tests as follows:

- the equipment shall be tested under normal test conditions as specified in the functional standards;
- during the test, the RF output power may be reduced to a power level sufficient for establishing and maintaining the required communication link;
- the test configuration shall be as close to normal intended use as possible;
- if the equipment is part of a system, or can be connected to *ancillary equipment*, then it shall be acceptable to test the equipment while connected to the minimum configuration of *ancillary equipment* necessary to exercise the ports;

- if the equipment has a large number of ports, then a sufficient number shall be selected to simulate actual operation conditions and to ensure that all the different types of termination are tested;
- the test conditions, test configuration and mode of operation shall be recorded in the test report;
- ports which in normal operation are connected shall be connected to an *ancillary equipment* or to a representative piece of cable correctly terminated to simulate the input/output characteristics of the *ancillary equipment*. In case of *IAB type 1-H*, *antenna ports* shall be correctly terminated;
- ports which are not connected to cables during normal operation, e.g. service connectors, programming connectors, temporary connectors etc. shall not be connected to any cables for the purpose of EMC testing. Where cables have to be connected to these ports, or interconnecting cables have to be extended in length in order to exercise the EUT, precautions shall be taken to ensure that the evaluation of the EUT is not affected by the addition or extension of these cables;
- immunity tests on the entire IAB Node shall be performed by establishing communication links at the radio interface (e.g. with the mobile simulator) and the NG interface (e.g. with an NGC simulator) and evaluating the throughput;
- immunity tests shall be performed on both the uplink and downlink paths. The tests shall also include both the radio interface and the NG interface. Throughput evaluation may be carried out at either interface, where appropriate, and the measurements for the uplink and downlink paths may be carried out as a single path looped at either the radio interface or NG interface. In case of looping is used care have to be taken that the throughput information doesn't change due to looping;
- for IAB node capable of multi-band operation, communication links shall be established in such a way that all *operating band(s)* are activated during the test according to the applicable test configurations in clause 4.5. Performance assessment may be done separately for each *operating band*.

9.2 RF electromagnetic field (80 MHz - 6000 MHz)

The test shall be performed on a representative configuration of the equipment, the associated ancillary equipment, or representative configuration of the combination of radio and ancillary equipment.

9.2.1 Definition

This test assesses the ability of radio equipment and *ancillary equipment* to operate as intended in the presence of a radio frequency electromagnetic field disturbance at the enclosure.

9.2.2 Test method and level

The test method shall be in accordance with IEC 61000-4-3 [13], which specifies test methodology based on anechoic chamber. The use of reverberation chamber test method according to IEC 61000-4-21 [18], clause 6.1 and Annex D as alternative method is allowed.

The following requirements shall apply:

- The test level shall be 3 V/m amplitude modulated to a depth of 80 % by a sinusoidal audio signal of 1 kHz;
- The stepped frequency increments shall be 1 % of the momentary frequency;
- The test shall be performed over the frequency range 80 MHz - 6000 MHz; with the exception of the exclusion band for receivers (see clause 4.4);
- Responses in stand-alone receivers or receivers which are part of transceivers occurring at discrete frequencies which are narrow band responses, shall be disregarded, see clause 4.3;
- The frequencies selected during the test shall be recorded in the test report.
- For the test method in accordance with IEC 61000-4-3[13], the *spatial exclusion zone* can be chosen to protect the IAB node receiver(s). For the frequency range above 690 MHz (according to ETSI EN 301 489-50 [28]), the EMC RF electromagnetic field immunity requirement with a level of 10 V/m applies on the non-radiating faces of the *IAB type 1-O*, or *IAB type 2-O*, as depicted on figures 9.2.2-1.

NOTE: Depending on the IAB implementation, application of the spatial exclusion to all radiating faces of the IAB may not allow proper execution of the RI testing. In such cases as depicted on figures 9.2.2-2, to protect the IAB node receiver(s), exclusion bands shall be considered, as in table 4.4.1-1.

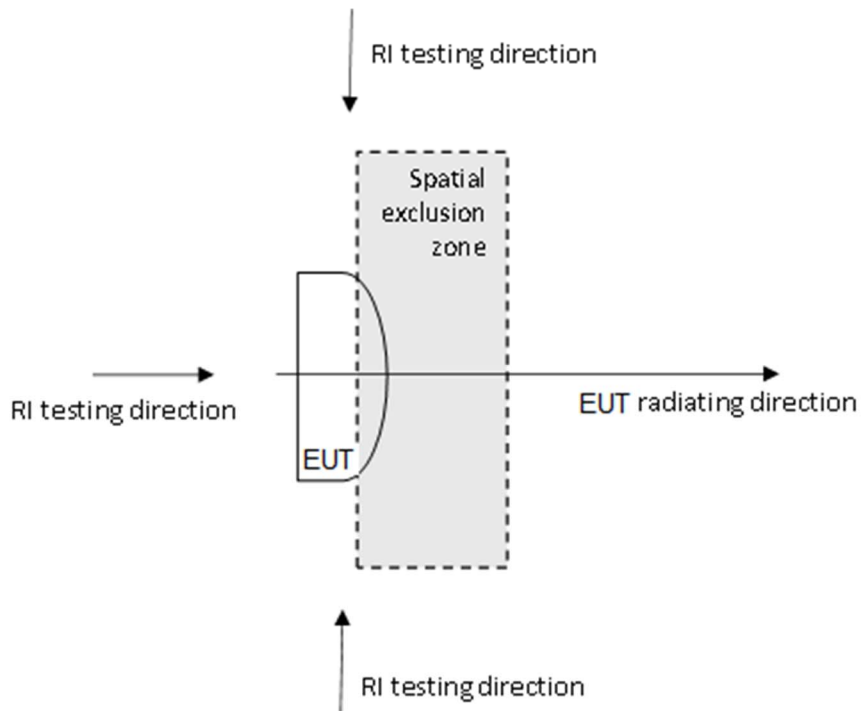


Figure 9.2.2-1: Example of the spatial exclusion application in case of a single instance of the IAB radiating face (horizontal plane depicted)

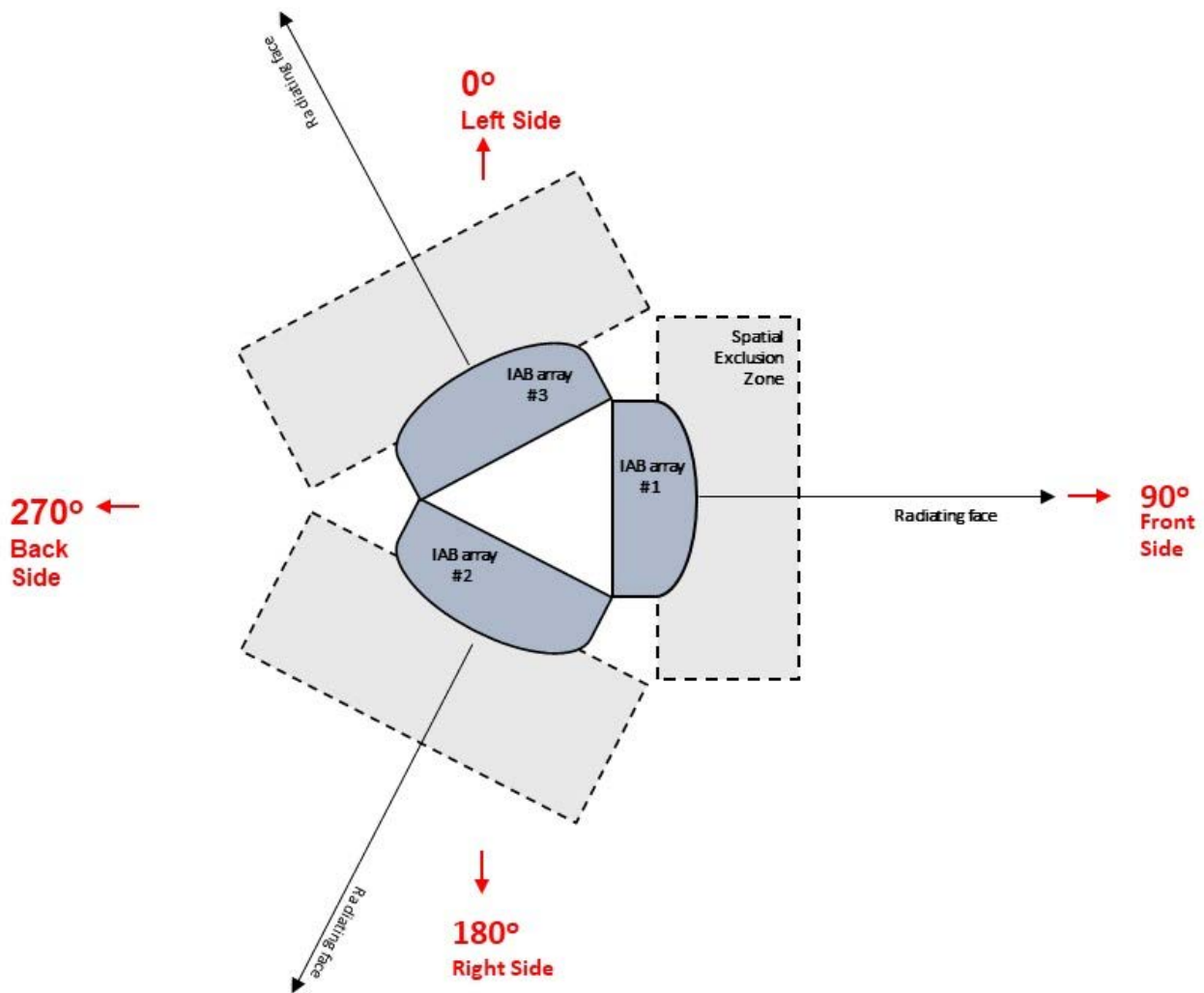


Figure 9.2.2-2: Example of the spatial exclusion application in case of a 3-panel IAB node (horizontal plane depicted) – proper execution of the RI test may not be feasible

9.2.3 Performance criteria

IAB node:

The performance criteria of clause 6.1 shall apply.

Ancillary equipment:

The performance criteria of clause 6.3 shall apply.

9.3 Electrostatic discharge

The test shall be performed on a representative configuration of the radio equipment, the associated *ancillary equipment*, or representative configuration of the combination of radio and *ancillary equipment*.

9.3.1 Definition

This test assesses the ability of radio equipment and *ancillary equipment* to operate as intended in the event of an electrostatic discharge.

9.3.2 Test method and level

The test method shall be in accordance with IEC 61000-4-2 [12]:

- for contact discharge, the equipment shall pass at ± 4 kV;
- for air discharge shall pass at ± 8 kV;
- electrostatic discharge shall be applied to all exposed surfaces of the EUT except where the user documentation specially indicates a requirement for appropriate protective measures.

NOTE: Ensure that the EUT is fully discharged between each ESD exposure.

9.3.3 Performance criteria

IAB node:

The performance criteria of clause 6.2 shall apply.

Ancillary equipment:

The performance criteria of clause 6.4 shall apply.

9.4 Fast transients common mode

The test shall be performed on AC mains power input ports.

This test shall be performed on *signal ports*, *telecommunication ports*, *control ports* and DC power input/output ports if the cables may be longer than 3 m.

Where this test is not carried out on a port or any other ports because the manufacturer declares that it is not intended to be used with cables longer than 3 m, a list of ports which were not tested for this reason shall be included in the test report.

This test shall be performed on a representative configuration of the equipment, the associated *ancillary equipment*, or representative configuration of the combination of radio and *ancillary equipment*.

9.4.1 Definition

This test assesses the ability of radio equipment and *ancillary equipment* to operate as intended in the event of fast transients present on one of the input/output ports.

9.4.2 Test method and level

The test method shall be in accordance with IEC 61000-4-4 [14]:

- The test level for *signal ports*, *telecommunication ports* and *control ports* shall be 0.5 kV open circuit voltage as given in IEC 61000-4-4 [14];
- The test level for DC power input/output ports shall be 0.5 kV open circuit voltage as given in IEC 61000-4-4 [14];
- The test level for AC mains power input ports shall be 1 kV open circuit voltage as given in IEC 61000-4-4 [14].

For AC and DC power input ports the transients shall be applied (in parallel) to all the conductors in the cable with reference to the cabinet reference earth (true common mode) and the source impedance shall be 50 Ω .

9.4.3 Performance criteria

IAB node:

The performance criteria of clause 6.2 shall apply.

Ancillary equipment:

The performance criteria of clause 6.4 shall apply.

9.5 RF common mode (0.15 MHz - 80 MHz)

The test shall be performed on AC mains power input/output ports.

This test shall be performed on *signal ports*, telecommunication *ports*, control and DC power input/output ports, which may have cables longer than 3 m.

Where this test is not carried out on a port or any other ports because the manufacturer declares that it is not intended to be used with cables longer than stated above, a list of ports which were not tested shall be included in the test report.

This test shall be performed on a representative configuration of the equipment, the associated *ancillary equipment*, or representative configuration of the combination of radio and *ancillary equipment*.

NOTE: This test can also be performed using the clamp injection method, where appropriate, see IEC 61000-4-6 [16].

9.5.1 Definition

This test assesses the ability of radio equipment and *ancillary equipment* to operate as intended in the presence of a radio frequency electromagnetic disturbance.

9.5.2 Test method and level

The test method shall be in accordance with IEC 61000-4-6 [16]:

- The test signal shall be amplitude modulated to a depth of 80 % by a sinusoidal audio signal of 1 kHz;
- The stepped frequency increments shall be 50 kHz in the frequency range 150 kHz to 5 MHz and 1% frequency increment of the momentary frequency in the frequency range 5 MHz to 80 MHz;
- The test level shall be severity level 2 as given in IEC 61000-4-6 [16] corresponding to 3 V rms, at a transfer impedance of 150 Ω ;
- The test shall be performed over the frequency range 150 kHz - 80 MHz;
- The injection method to be used shall be selected according to the basic standard IEC 61000-4-6 [16];
- Responses of stand-alone receivers or receivers which are part of transceivers occurring at discrete frequencies which are narrow band responses, shall be disregarded, see clause 4.3;
- The frequencies of the immunity test signal selected and used during the test shall be recorded in the test report.

9.5.3 Performance criteria

IAB node:

The performance criteria of clause 6.1 shall apply.

Ancillary equipment:

The performance criteria of clause 6.3 shall apply.

9.6 Voltage dips and interruptions

The tests shall be performed on AC mains power input ports.

These tests shall be performed on a representative configuration of the equipment, the associated *ancillary equipment*, or representative configuration of the combination of radio and *ancillary equipment*.

9.6.1 Definition

These tests assess the ability of radio equipment and *ancillary equipment* to operate as intended in the event of voltage dips and interruptions present on the AC mains power input ports.

9.6.2 Test method and level

The test method shall be in accordance with IEC 61000-4-11 [17], where the test levels shall be:

- Voltage dip: 0 % residual voltage for 0.5 cycle;
- Voltage dip: 0 % residual voltage for 1 cycle;
- Voltage dip: 70 % residual voltage for 25/30 cycles (at 50/60 Hz);
- Voltage interruption: 0 % residual voltage for 250/300 cycles (at 50/60 Hz).

9.6.3 Performance criteria

For a 0 % residual voltage dip test, the performance criteria for transient phenomena shall be applied:

- Criteria 6.2 for IAB node
- Criteria 6.4 for *ancillary equipment*

For a 70% residual voltage dip test and for voltage interruption test, the following applies:

1. In the case where the equipment is fitted with or connected to a battery back-up, the following performance criteria shall be applied:
 - Criteria 6.2 for IAB node
 - Criteria 6.4 for *ancillary equipment*
2. In the case where the equipment is powered solely from the AC mains supply (without the use of a parallel battery back-up) volatile user data may have been lost and if applicable the communication link need not to be maintained and lost functions should be recoverable by user or operator:
 - No unintentional responses shall occur at the end of the test, when the voltage is restored to nominal
 - In the event of loss of communications link or in the event of loss of user data, this fact shall be recorded in the test report

9.7 Surges, common and differential mode

The tests shall be performed on AC mains power input ports.

This test shall be additionally performed on *telecommunication ports*.

These tests shall be performed on a representative configuration of the equipment, the associated *ancillary equipment*, or representative configuration of the combination of radio and *ancillary equipment*.

9.7.1 Definition

These tests assess the ability of radio equipment and *ancillary equipment* to operate as intended in the event of surges being present at the AC mains power input ports and *telecommunication ports*.

9.7.2 Test method and level

The test method shall be in accordance with IEC 61000-4-5 [15].

The requirements and evaluation of test results given in clause 9.7.2.1 (*telecommunication ports*, outdoor cables), clause 9.7.2.2 (*telecommunication ports*, indoor cables) and clause 9.7.2.3 (AC power ports) shall apply, but no test shall be required where normal functioning cannot be achieved, because of the impact of the CDN on the EUT.

9.7.2.1 Test method for telecommunication ports directly connected to outdoor cables

The test level for *telecommunications ports*, intended to be directly connected to the telecommunications network via outdoor cables, shall be 1 kV line to ground as given in IEC 61000-4-5 [15]. In this case the total output impedance of the surge generator shall be in accordance with the basic standard IEC 61000-4-5 [15].

The test generator shall provide the 1.2/50 μ s pulse as defined in IEC 61000-4-5 [15].

9.7.2.2 Test method for telecommunication ports connected to indoor cables

The test level for telecommunication *ports*, intended to be connected to indoor cables (longer than 10 m) shall be 0.5 kV line to ground. In this case the total output impedance of the surge generator shall be in accordance with the basic standard IEC 61000-4-5 [15].

The test generator shall provide the 1.2/50 μ s pulse as defined in IEC 61000-4-5 [15].

9.7.2.3 Test method for AC power ports

The test level for AC power input *ports* shall be 2 kV line to ground, and 1 kV line to line, with the output impedance of the surge generator as given in IEC 61000-4-5 [15].

In telecommunication centres 1 kV line to ground and 0.5 kV line to line shall be used.

The test generator shall provide the 1.2/50 μ s pulse as defined in IEC 61000-4-5 [15].

9.7.3 Performance criteria

IAB node:

The performance criteria of clause 6.2 shall apply.

Ancillary equipment:

The performance criteria of clause 6.4 shall apply.

Annex A (informative): Change history

| Change history | | | | | | | |
|----------------|----------|-----------|------|-----|-----|---|-------------|
| Date | Meeting | TDoc | CR | Rev | Cat | Subject/Comment | New version |
| 2020-09 | RAN#89-e | RP-201714 | | | | Capture contributions approved in RAN4#96-e: R4-2012636 TPs to TS on IAB EMC section 1 (Scope) R4-2012639 , Definitions and immunity of IAB EMC R4-2012640, IAB EMC specification: Exclusion bands (4.4) R4-2012641, IAB EMC specification: Emission (7.1) R4-2012642, Emission for IAB EMC R4-2012643, References for IAB EMC R4-2012638, TPs to TS on IAB EMC section 9 (Immunity) | 1.0.0 |
| 2020-09 | RAN#89 | RP-202108 | | | | Approved by plenary – Rel-16 spec under change control | 16.0.0 |
| 2020-12 | RAN#90 | RP-202504 | 0001 | | F | CR to TS 38.175: IAB definition | 16.1.0 |
| 2020-12 | RAN#90 | RP-202504 | 0002 | 1 | F | CR to TS 38.175: Radiated emission, IAB | 16.1.0 |
| 2020-12 | RAN#90 | RP-202504 | 0003 | 1 | F | CR to TS 38.175 on Voltage dips and interruptions, Release 16 | 16.1.0 |
| 2020-12 | RAN#90 | RP-202420 | 0007 | 1 | B | CR to TS 38.175 on IAB EMC performance requirements | 16.1.0 |
| 2021-06 | RAN#92 | RP-211101 | 0014 | 1 | F | CR to TS 38.175: Radiated emission, ancillary equipment | 16.2.0 |
| 2021-06 | RAN#92 | RP-211101 | 0015 | 1 | B | CR on exclusion bands and spatial exclusion for IAB EMC Radiated Immunity testing | 16.2.0 |
| 2021-06 | RAN#92 | RP-211101 | 0016 | | B | Draft CR to TS 38.175: IAB EMC test configurations and performance requirements (updated) | 16.2.0 |
| 2021-09 | RAN#93 | RP-211892 | 0018 | | F | Big CR for TS 38.175 Maintenance (Rel-16, CAT F) | 16.3.0 |

| Change history | | | | | | | |
|----------------|---------|-----------|------|-----|-----|---|-------------|
| Date | Meeting | TDoc | CR | Rev | Cat | Subject/Comment | New version |
| 2022-03 | RAN#95 | | | | | Update to Rel-17 version (MCC) | 17.0.0 |
| 2022-09 | RAN#97 | RP-222028 | 0022 | | F | Big CR for TS 38.175 Maintenance (Rel-17, CAT F) | 17.1.0 |
| 2023-03 | RAN#99 | RP-230502 | 0024 | | A | CR to TS 38.175 IAB clause 4.1, 5.2, 6.1, 6.2 R17 | 17.2.0 |
| 2023-03 | RAN#99 | RP-230515 | 0026 | | A | TS 38.175: Corrections in clause 1 Scope and clause 9 Immunity NOTE: This CR was not implemented because the CR is actually for Rel-16 specification and duplicate the Rel-16 tdoc in R4-2302326 | 17.2.0 |
| 2023-06 | RAN#100 | RP-231358 | 0028 | 1 | F | CR on TS 38.175 IAB performance criteria | 17.3.0 |
| 2023-06 | RAN#100 | RP-231353 | 0029 | | F | TS 38.175: Corrections in clause 1 Scope and clause 9 Immunity | 17.3.0 |
| 2023-09 | RAN#101 | RP-232502 | 0030 | 1 | F | [NR_newRAT-Core] CR on TS 38.175 IAB reference maintenance R17 | 17.4.0 |

History

| Document history | | |
|-------------------------|--------------|-------------|
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| V17.1.0 | October 2022 | Publication |
| V17.2.0 | July 2023 | Publication |
| V17.3.0 | July 2023 | Publication |
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