

**Terrestrial Trunked Radio (TETRA);  
Conformance testing specification;  
Part 4: Protocol testing specification for  
Direct Mode Operation (DMO);  
Sub-part 6: Abstract Test Suite (ATS) for  
Direct Mode Repeater (DM-REP) type 1**

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**Reference**

DTS/TETRA-02009-4-6

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**Keywords**TETRA, DMO, protocol, testing, TTCN, ATS,  
radio**ETSI**

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## Foreword

This Technical Specification (TS) has been produced by ETSI Project Terrestrial Trunked Radio (TETRA).

The present document consists of the following parts:

- Part 1: "Radio";
- Part 2: "Protocol testing specification for Voice plus Data (V+D)";
- Part 4: "Protocol testing specification for Direct Mode Operation (DMO)";**
- Part 5: "Security".

---

# 1 Scope

The present document contains the Abstract Test Suite (ATS) to test the TETRA Direct Mode Operation (DMO) Repeater type 1 (DM-REP1) protocol at layer 2, the Medium Access Control (MAC) protocol. The MAC protocol is specified in ETS 300 396-3 [1] and in EN 300 396-4 [2]. The Test Suite Structure (TSS) and Test Purposes (TPs) for this ATS are defined in EN 300 394-4-4 [4].

The objective of this test specification is to provide a basis for approval tests for TETRA equipment giving a high probability of air interface inter-operability between different manufacturer's TETRA equipment.

The ISO standard for the methodology of conformance testing, ISO/IEC 9646-1 [5], ISO/IEC 9646-2 [6], ISO/IEC 9646-3 [7] and ISO/IEC 9646-5 [8], as well as the ETSI rules for conformance testing, ETS 300 406 [9] and ETR 141 [10] are used as a basis for the test methodology.

Annex A provides the Tree and Tabular Combined Notation (TTCN) part of this ATS.

Annex B provides the partial Protocol Implementation eXtra Information for Testing (PIXIT) Proforma of this ATS.

Annex C provides the Protocol Conformance Test Report (PCTR) Proforma of this ATS.

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# 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.

- [1] ETSI ETS 300 396-3: "Terrestrial Trunked Radio (TETRA); Technical requirements for Direct Mode Operation (DMO); Part 3: Mobile Station to Mobile Station (MS-MS) Air Interface (AI) protocol".
- [2] ETSI EN 300 396-4: "Radio Equipment and Systems (RES); Trans-European Trunked Radio (TETRA); Direct Mode (DM); Part 4: Type 1 Repeater Air Interface".
- [3] ETSI EN 300 396-8-2: "Radio Equipment and Systems (RES); Trans-European Trunked Radio (TETRA); Direct Mode Operation (DMO); Part 8: Protocol Implementation Conformance Statement (PICS) proforma specification; Part 8-2: Type 1 repeater Air Interface".
- [4] ETSI EN 300 394-4-4: "Radio Equipment and Systems (RES); Trans-European Trunked Radio (TETRA) system; Direct Mode Operation (DMO); Part 4: Protocol testing specification; Test Suite Structure and Test Purposes; Part 4-4 Repeater type 1 (DM REP1) Air Interface (AI)".
- [5] ISO/IEC 9646-1 (1994): "Information technology - Open Systems Interconnection - Conformance Testing Methodology and Framework - Part 1: General Concepts". (See also ITU-T Recommendation X.290 (1991)).
- [6] ISO/IEC 9646-2 (1994): "Information technology - Open Systems Interconnection - Conformance Testing Methodology and Framework - Part 2: Abstract Test Suite Specification". (See also ITU-T Recommendation X.291 (1991)).
- [7] ISO/IEC 9646-3 (1994): "Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 3: The tree and tabular combined notation". (See also ITU-T Recommendation X.292 (1992)).

- [8] ISO/IEC 9646-5 (1994): "Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 5: Requirements on test laboratories and clients for the conformance assessment process". (See also ITU-T Recommendation X.292 (1992)).
- [9] ETSI ETS 300 406: "Methods for Testing and Specification (MTS); Protocol and profile conformance testing specifications; Standardization methodology".
- [10] ETSI ETR 141: "Methods for Testing and Specification (MTS); Protocol and profile conformance testing specifications; The Tree and Tabular Combined Notation (TTCN) style guide".

## 3 Definitions and abbreviations

### 3.1 TETRA definitions

For the purposes of the present document, the terms and definitions given in EN 300 396-4 [2] apply.

### 3.2 TETRA abbreviations

For the purposes of the present document the following TETRA abbreviations apply:

DM-REP1	Direct Mode Repeater Type 1
MAC	Medium Access Control
MS	Mobile Station
SDS	Short Data Service
SDU	Service Data Unit

### 3.3 ISO 9646 definitions

For the purposes of the present document the following ISO/IEC 9646 definitions apply:

TTCN.GR	
TTCN.MP	
PCTR	Protocol Conformance Test Report (PCTR proforma)

### 3.4 ISO 9646 abbreviations

For the purposes of the present document the following ISO/IEC 9646-1 [5] abbreviations apply:

ASP	Abstract Service Primitive
ATM	Abstract Test Method
ATS	Abstract Test Suite
ICS	Implementation Conformance Statement
IUT	Implementation Under Test
IXIT	Implementation eXtra Information for Testing
LT	Lower Tester
PCO	Point of Control and Observation
PCTR	Protocol Conformance Test Report
PDU	Protocol Data Unit
PICS	Protocol Implementation Conformance Statements
PIXIT	Protocol Implementation eXtra Information for Testing
SAP	Service Access Point
SPyT	Single Party Testing
SUT	System Under Test
TC	Test Case
TP	Test Purpose
TSS	Test Suite Structure
TTCN	Tree and Tabular Combined Notation

UT

Upper Tester

## 4 Abstract Test Method (ATM)

This clause describes the ATM used for testing the DM-REP1 MAC layer protocol. The selected method is the remote method, as defined in ISO/IEC 9646-2 [6], clause 11. This test method has been selected, because:

- this test method implies no specific requirements from the Implementation Under Test (IUT);
- the upper Service Access Point (SAP) of the IUT cannot be directly observed;
- the variety of the possible TETRA implementations is a serious technical obstacle for the adoption of a different ATM;
- this test method places minimum limitations in the realization of conformance testing.

The DM-REP1 MAC protocol defines the operation of a DM-REP1 serving two air interfaces, the master and the slave link. To test the repeater operation in some cases both interfaces need to be controlled and observed simultaneously. This implies that two testing methods are used: the remote single-party test method (with one PCO) and the remote multiparty test method with two PCOs.

### 4.1 Single PCO testing

The remote Single Party test method with a single PCO is illustrated in figure 1.

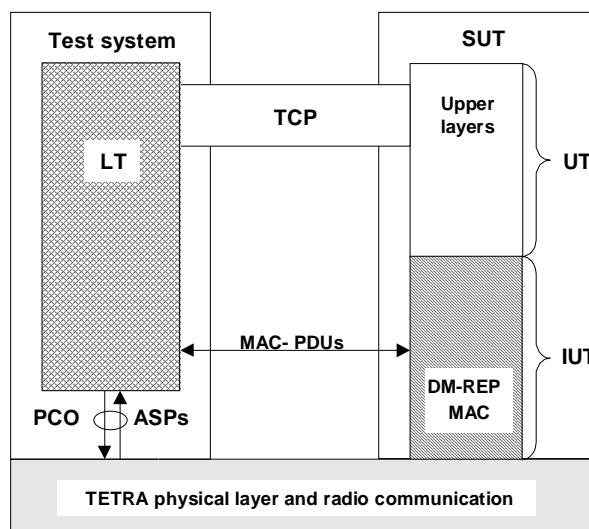


Figure 1: Remote SPyT test method for TETRA DM-REP1 MAC layer

#### 4.1.1 Lower Tester (LT)

A LT is located in a remote TETRA test system. It controls and observes the behaviour of the IUT.

#### 4.1.2 Upper Tester (UT)

There is no explicit UT in the remote test method, but the DM-REP1 MAC layer and the layers above inside the System Under Test (SUT) are used implicitly for testing the MAC layer.

#### 4.1.3 Test Coordination Procedures (TCP)

The implicit send events defined by the provider of an implementation in annex B serve the purpose of the TCP. They are used as an input to the IUT communicating with the UT to initiate test events at the DMO MAC layer.



#### 4.1.4 Point of Control and Observation (PCO)

All test events at the PCO carrying service user data are specified in terms of MAC layer PDUs. Only few Abstract Service Primitives (ASPs) are defined for control or observation purposes. The mapping of the MAC PDUs into the physical layer frame structure is left to the test implementation.

### 4.2 Multiple PCO testing

The selected test method is illustrated in figure 2.

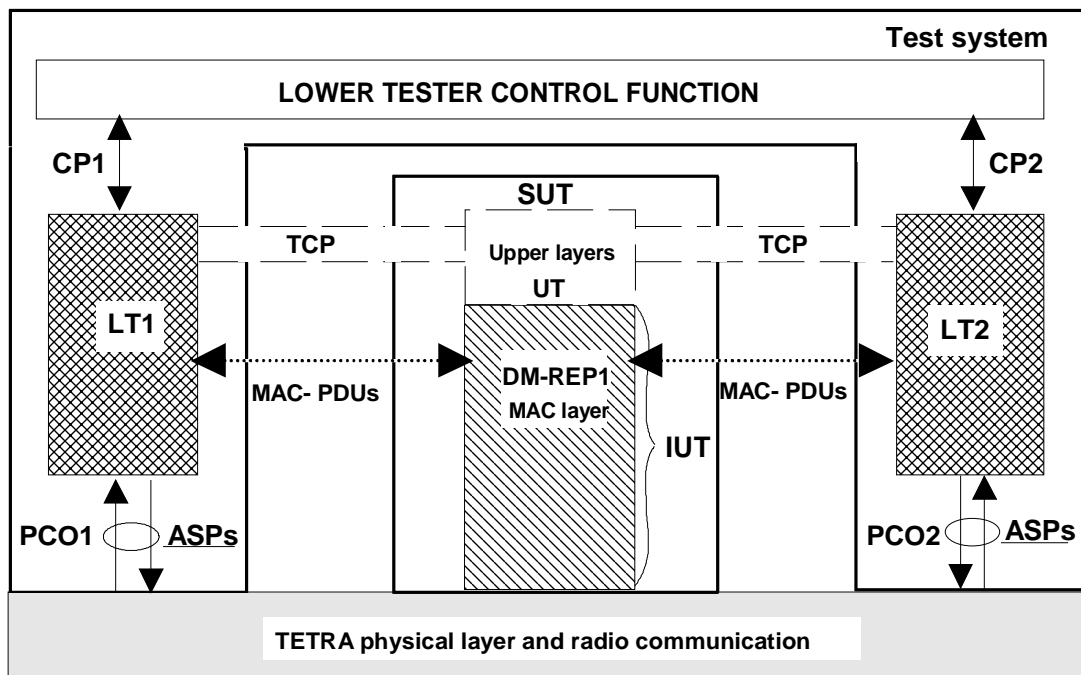


Figure 2: Remote multi party test method for TETRA DM-REP1 MAC protocol

#### 4.2.1 Lower Testers (LT)

Two LTs: LT1 and LT2 are located in a remote TETRA test system. They observe the behaviour of the IUT. They are controlled and synchronized by the lower tester control function.

#### 4.2.2 Upper Tester (UT)

There is no explicit UT in the remote test method, but the layers above inside the System Under Test (SUT) are used implicitly for testing the DM-REP1 MAC layer.

#### 4.2.3 Test Coordination Procedures (TCP)

The implicit send events defined by the provider of an implementation in annex B serve the purpose of the TCP. They are used as an input to the IUT communicating with the UT to initiate test events at the MAC protocol layer.

#### 4.2.4 Point of Control and Observation (PCO)

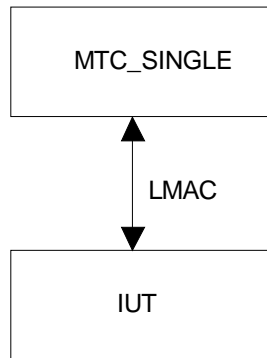
The PCOs are located inside the protocol.

All test events at the PCOs carrying service user data are specified in terms of MAC PDUs. The mapping of the PDUs to possible physical layer service primitives is left to the test implementation.

### 4.3 Test configurations and use of concurrent TTCN

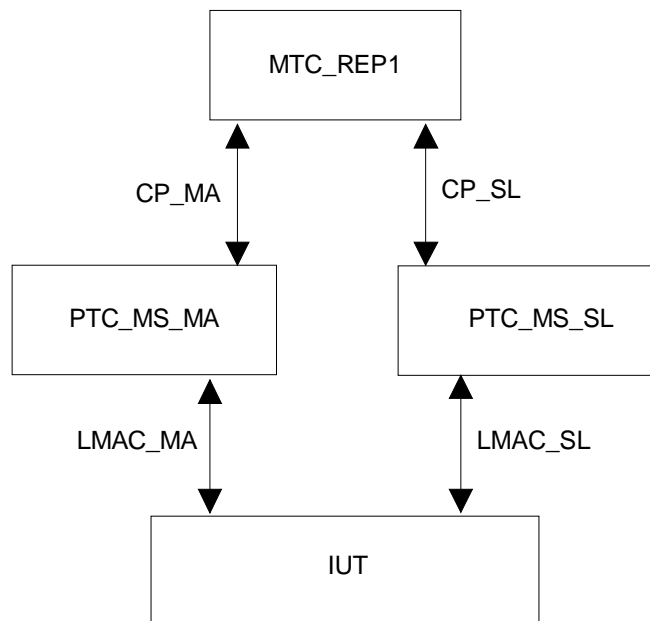
As this ATS covers both single-party testing using non-concurrent TTCN, and multi-party testing using concurrent TTCN, the notation chosen for the complete ATS is concurrent TTCN syntax. Therefore, tests components are defined to describe the two configurations: the "single\_party" configuration and the "multi\_party" configuration, as shown in figures 3 and 4.

The single\_party configuration is used in case of single-party testing, i.e. for testing a single air interface only, a master link or slave link interface. In this case only a single test component is needed. It is the Main Test Component (MTC) MTC\_SINGLE connected to the IUT via the PCO LMAC.



**Figure 3: Single\_party configuration**

The Multi\_party configuration is used when testing the DM-REP1 MAC layer protocol involves both the master link and slave link interface. In this case, three test components are needed. These are the Main Test Component (MTC) MTC\_REP1, and the two Parallel Test Components (PTCs) PTC\_MS\_ML and PTC\_MS\_SL. The two PTCs are connected to the MTC via the coordination points CP\_ML and CP\_SL. The PTC\_MS\_ML and PTC\_MS\_SL are further connected to the IUT via the two PCOs LMAC\_ML and LMAC\_SL.



**Figure 4: Multi\_party configuration for DM-REP1 MAC testing**

## 5 ATS conventions

This clause describes the conventions applied to define the ATS and gives the naming conventions chosen for the different elements of the ATS.

The ATS conventions are intended to give a better understanding of the ATS but they describe also the conventions made for the development of the ATS, thus for any later maintenance purposes or further development of the ATS, the conventions described in this clause shall be considered.

### 5.1 Naming conventions

#### 5.1.1 Declarations part

This subclause describes the naming conventions chosen for the elements of the ATS declarations part.

##### 5.1.1.1 Test suite type and structured type definitions

The test suite type and test suite structured type identifiers describe the information elements, and each whole word included in the name is written in lowercase starting by an uppercase letter:

```
EXAMPLE:  CallOwnershipType    simple type;
          SSI_Type              simple type;
          ITSI_Type             structured type.
```

In the case an abbreviation is included in the declaration name, there is an underscore ("\_") before and/or after it, separating it from the rest of the identifier. This rule with abbreviations apply to all the naming conventions in the whole test suite.

##### 5.1.1.2 Test suite operations definitions

The test suite operation identifiers are composed of strings in uppercase letters starting by the uppercase string "TSO\_". The different strings in the definition are separated with underscores.

```
EXAMPLE:  TSO_RADIO_LINK_FAILURE.
```

##### 5.1.1.3 Test suite parameter declarations

The test suite parameter identifiers are composed of strings in uppercase letters starting by the uppercase string "PIC\_" or "PIX\_" and separated by underscores.

If the test suite parameter references a PICS item, the prefix "PIC\_" is used.

```
EXAMPLE 1:  PIC_CM_CALL.
```

If the test suite parameter references a PIXIT item, the prefix "PIX\_" is used.

```
EXAMPLE 2:  PIX_MS_ITSI.
```

Complete names as defined in the specifications are used.

##### 5.1.1.4 Test case selection expression definitions

The naming conventions for the test case selection expression definitions use free text starting with an uppercase letter. The name of the expression shall explain clearly the selection rule. The test case selection expressions are generally logical combinations of the PICS element definitions.

### 5.1.1.5 Test suite constant declarations

The test suite constant identifiers are composed of strings in lowercase letters starting by the lowercase string "tsc\_".

EXAMPLE:     tsc\_slot\_1;  
                  tsc\_initial\_frame\_number.

Complete names as defined in the specifications are used. However, in the parameters including a dot character, the dot is replaced by an underscore.

### 5.1.1.6 Test suite variable declarations

The test suite variable identifiers are composed of string in lowercase letters starting by the lowercase string "tsv\_".

EXAMPLE:     tsv\_call\_active.

If the test suite variable represents a system parameter or value, the name defined in the specifications is used. However, in the variables including a dot character, the dot is replaced by an underscore.

### 5.1.1.7 Test case variable declarations

The test case variable identifiers are composed of strings in lowercase letters starting by the lowercase string "tcv\_".

EXAMPLE:     tcv\_energy\_economy\_group.

### 5.1.1.8 PCO declarations

The point of control and observation identifiers are composed of three to six capital letters, beginning with an "L", as there are only LTs.

EXAMPLE:     LMAC\_SL       Represents a lower tester MAC PCO.

### 5.1.1.9 Timer declarations

Two kinds of timers can be distinguished:

1) standardized:

Those defined in the standard, e.g. DT303, use the same name as in the standard, beginning with capital "DT".

As there is a tolerance margin accepted for these timers, two values are needed:

- the minimum value allowed, which will use the suffix "\_Min";
- the maximum value allowed, which will use the suffix "\_Max".

EXAMPLE 1:   DT303\_Min, DT303\_Max

2) non-standardized:

Those not defined in the standard, i.e. for execution use, e.g. a timer waiting for a response. These timers begin with the prefix "T\_", followed by a string in lowercase letters with each word in the following string starting with an uppercase letter.

EXAMPLE 2:   T\_IUT\_Response

              T\_NoResponse

### 5.1.1.10 ASP type definitions

ASP definitions follow the specification in the EN 300 396-4 [2] when a corresponding definition exists. If not, a free name is used.

EXAMPLE: LINK\_indication  
RESET\_MS.

#### 5.1.1.11 PDU type definitions

The identifier of a PDU is given in a string in uppercase letters, which represents the layer message.

EXAMPLE: DM\_SETUP for the SETUP layer 3 PDU;  
DMAC\_FRAG\_PDU\_Type for the DMAC FRAC layer 2 PDU.

#### 5.1.1.12 Alias definitions

No alias definitions are used in the test suite.

### 5.1.2 Constraints part

This subclause describes the naming conventions chosen for the elements of the ATS constraints part.

Constraint identifiers commence with uppercase. The remaining part of the name is separated from the beginning with an underscore and is written in lowercase with each word starting with an uppercase letter.

Identifier names of elements concerning the same subject have equivalent names in the declaration and the constraint part:

- declaration part: U\_STATUS;
- constraint part: U\_STATUS\_IgnoreAll.

The name of the modified constraint describes the particularity of the modified constraint:

EXAMPLE 1: D\_LOCATION\_UPDATE\_ACCEPT\_HomeNetwork.

If formal parameter lists are used, the variable names are written in lowercase. The variable name is the same as the name of the element it is representing starting with prefix "cpa\_".

EXAMPLE 2: U\_STATUS\_No\_EG(cpa\_Status: StatusType).

### 5.1.3 Dynamic part

This subclause describes the naming conventions chosen for the elements of the ATS dynamic part.

#### 5.1.3.1 Test case identifier

The identifier of a TC is built according to the test purpose name, as in table 1.

**Table 1: TC naming convention**

DMO/<ts>/<fm>/<x>/<ss>/<nn>		
<ts> = test suite type	DMREP1	Repeater type 1
<fm> = functional module	MAC	Upper MAC (layer 2)
x = Type of testing	CA BV BI TI	Capability Tests Valid Behaviour Tests Invalid Behaviour Tests Timer expiry and counter mismatch tests
<nn> = sequential number	01-99	Test Purpose Number

#### 5.1.3.2 Test step identifier

The test step identifier is built with a string of lowercase letters led by a string of capital letter and joined by an underscore character. The first string indicates the main function of the test step; e.g. PRE for preamble, PST for postamble, LTS for local tree name and STP for general step. The second string indicates the meaning of the step.

EXAMPLES: PRE\_Name;  
PST\_Name;  
LTS\_Name;  
STP\_Name.

#### 5.1.3.3 Default identifier

The default identifier MAC\_OtherwiseFail is used. For the multi party configuration the identifiers DEF\_mtc, DEF\_ptc\_ml, and DEF\_ptc\_sl are also used.

## 5.2 Implementation conventions

A fully functional underlying physical layer is assumed from the test system.

## 5.3 TC and TP naming

There is a single name used for both the TC identifiers and the TP identifiers.

---

## Annex A (normative): ATS for DMO Repeater type 1 (DM-REP1) MAC layer

This ATS has been produced using the Tree and Tabular Combined Notation (TTCN) according to ISO/IEC 9646-3 [7].

The ATS was developed on a separate TTCN software tool and therefore the TTCN tables are not completely referenced in the table of contents. The ATS itself contains a test suite overview part which provides additional information and references.

---

### A.1 The TTCN Graphical form (TTCN.GR)

The TTCN.GR representation of this ATS is contained in an Adobe Portable Document Format™ file (dmrep1.PDF) contained in archive ts\_1003940406v010101p0.ZIP) which accompanies the present document.

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### A.2 The TTCN Machine Processable form (TTCN.MP)

The TTCN.MP representation corresponding to this ATS is contained in an ASCII file (dmrep1.MP contained in archive ts\_1003940406v010101p0.ZIP) which accompanies the present document.

**NOTE:** Where an ETSI Abstract Test Suite (in TTCN) is published in both .GR and .MP format these two forms shall be considered equivalent. In the event that there appears to be syntactical or semantic differences between the two then the problem shall be resolved and the erroneous format (whichever it is) shall be corrected.

---

## Annex B (normative): Partial PIXIT proforma for TETRA DMO Repeater type 1 MAC layer protocol

Notwithstanding the provisions of the copyright clause related to the text of the present document, ETSI grants that users of the present document may freely reproduce the PIXIT proforma in this annex so that it can be used for its intended purposes and may further publish the completed PIXIT.
--

The PIXIT proforma is based on ISO/IEC 9646-5. Any additional information needed can be found in this international standard document.

---

### B.1 Identification summary

**Table B.1**

PIXIT number:	
Test laboratory name:	
Date of issue:	
Issued to:	

---

### B.2 ATS summary

**Table B.2**

Protocol specification:	EN 300 396-4
Protocol to be tested:	
ATS specification:	ETS 300 394-4-6.
Abstract test method:	Remote test method, embedded variant.

---

### B.3 Test laboratory

**Table B.3**

Test laboratory identification:	
Test laboratory manager:	
Means of testing:	
SAP address:	

---

### B.4 Client identification

**Table B.4**

Client identification:	
Client test manager:	
Test facilities required:	



## B.5 SUT

**Table B.5**

Name:	
Version:	
SCS number:	
Machine configuration:	
Operating system identification:	
IUT identification:	
PICS reference for IUT:	
Limitations of the SUT:	
Environmental conditions:	

## B.6 Protocol layer information

### B.6.1 Protocol identification

**Table B.6**

Name:	TETRA - DMO - Repeater type 1 Air Interface EN 300 396-4
Version:	
PICS references:	EN 300 396-8-2

### B.6.2 IUT information

#### B.6.2.1 Implicit send events

None are used.

#### B.6.2.2 Parameter values

**Table B.7: Parameter values**

Item	Parameter	Parameter type	Explanation	Value or reference
1	PIX_CIRCUIT_MODE_TYPE	Circuit_Mode_Type_Type	Traffic channel type and interleaving depth supported by the IUT.	
2	PIX_MNI	MNI_Type	MNI to be used by the tester.	
3	PIX_MS_MASTER_SSI	SSI_Type	SSI of an MS operating on the master link.	
4	PIX_MS_SLAVE_SSI	SSI_Type	SSI of an MS operating on the slave link.	
5	PIX_POWER_CLASSES	Power_Class_Type	Power class of the tester as required by the IUT.	
6	PIX_POWER_CONTROL_FLAG	Power_Control_Flag_Type	Power control flag as required by the IUT.	
7	PIX_REPEATER_ADDRESS	Repeater_Address_Type	Repeater address of the IUT.	
8	PIC_NON_REPEATER_ADDRESS	Repeater_Address_Type	An SSI not recognized as the repeater address of the IUT.	

## Annex C (normative): Protocol Conformance Test Report (PCTR) proforma for TETRA DMO Repeater type 1 MAC layer protocol

Notwithstanding the provisions of the copyright clause related to the text of the present document, ETSI grants that users of the present document may freely reproduce the PCTR proforma in this annex so that it can be used for its intended purposes and may further publish the completed PCTR.

The PCTR Proforma is based on ISO/IEC 9646-5. Any additional information needed can be found in this referenced document.

### C.1 Identification summary

#### C.1.1 Protocol conformance test report

**Table C.1**

PCTR number:	
PCTR date:	
Test laboratory identification:	
Accreditation status:	
Accreditation reference:	
Technical authority:	
Signature:	
Test laboratory manager:	
Signature:	

#### C.1.2 IUT identification

**Table C.2**

Name:	
Version:	
Protocol specification:	
PICS:	
Previous PCTR if any:	

#### C.1.3 Testing environment

**Table C.3**

PIXIT number:	
ATS specification:	
Abstract test method:	Remote test method, embedded variant.
Means of testing identification:	
Period of testing:	
Conformance log reference(s):	
Retention date for log reference(s):	

### C.1.4 Limits and reservation

Additional information relevant to the technical contents or further use of the test report, or the rights and obligations of the test laboratory and the client, may be given here. Such information may include restriction on the publication of the report.

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### C.1.5 Comments

Additional comments may be given by either the client or the test laboratory on any of the contents of the PCTR, for example, to note disagreement between the two parties.

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## C.2 IUT conformance status

This IUT has or has not been shown by conformance assessment to be non-conforming to the specified protocol specification.

Strike the appropriate words in this sentence. If the PICS for this IUT is consistent with the static conformance requirements as specified in clause C.3 in the present document and there are no "FAIL" verdicts to be recorded in clause C.6 strike the words "has or". otherwise strike the words "or has not".

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## C.3 Static conformance summary

The PICS for this IUT is or is not consistent with the static conformance requirements in the specified protocol.

Strike the appropriate words in this sentence.

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## C.4 Dynamic conformance summary

The test campaign did or did not reveal errors in the IUT.

Strike the appropriate words in this sentence. If there are no "FAIL" verdicts to be recorded in clause C.6 of this report strike the words "did or" otherwise strike the words "or did not".

Summary of the results of groups of test:

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## C.5 Static conformance review report

If clause C.3 indicates non-conformance, this subclause itemizes the mismatches between the PICS and the static conformance requirements of the specified protocol specification.

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## C.6 Test campaign report

**Table C.4**

ATS reference	Selected	Run	Verdict	Observations (see note)
DMO_DMREP1_MAC_CA_01	Yes/No	Yes/No		
DMO_DMREP1_MAC_CA_02	Yes/No	Yes/No		
DMO_DMREP1_MAC_BV_01	Yes/No	Yes/No		
DMO_DMREP1_MAC_BV_02	Yes/No	Yes/No		
DMO_DMREP1_MAC_BV_03	Yes/No	Yes/No		
DMO_DMREP1_MAC_BV_04	Yes/No	Yes/No		
DMO_DMREP1_MAC_BV_05	Yes/No	Yes/No		
DMO_DMREP1_MAC_BV_06	Yes/No	Yes/No		
DMO_DMREP1_MAC_BV_07	Yes/No	Yes/No		
DMO_DMREP1_MAC_BV_08	Yes/No	Yes/No		
DMO_DMREP1_MAC_BV_09	Yes/No	Yes/No		
DMO_DMREP1_MAC_BV_10	Yes/No	Yes/No		
DMO_DMREP1_MAC_BI_01	Yes/No	Yes/No		
DMO_DMREP1_MAC_BI_02	Yes/No	Yes/No		
DMO_DMREP1_MAC_TI_01	Yes/No	Yes/No		
DMO_DMREP1_MAC_TI_02	Yes/No	Yes/No		
DMO_DMREP1_MAC_TI_03	Yes/No	Yes/No		
NOTE: Reference to any observations made in clause C.7 of the present document.				

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## C.7 Observations

Additional information relevant to the technical content of the PCTR are given here.

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## History

<b>Document history</b>		
	November 2000	According to EPT#12 decision, TS 100 394-4-6 was created when EN 300 394-4-6 was sent to Vote
V1.1.1	November 2000	Publication