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Candidate Harmonized European Standard (Telecommunications series)

**Electromagnetic compatibility
and Radio spectrum Matters (ERM);
ElectroMagnetic Compatibility (EMC) standard
for radio equipment and services;
Part 4: Specific requirements for fixed radio links
and ancillary equipment and services**



Reference

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Contents

Intellectual Property Rights	5
Foreword.....	5
1 Scope	6
2 References	6
3 Definitions and abbreviations	7
3.1 Definitions	7
3.2 Abbreviations	7
4 Test conditions	7
4.1 General	7
4.1.1 Test conditions and configurations	7
4.1.2 Emission tests	8
4.1.3 Immunity tests.....	9
4.2 Arrangements for test signals	10
4.2.1 Arrangements for test signals at the input of the transmitter.....	10
4.2.2 Arrangements for test signals at the output of the transmitter.....	10
4.2.3 Arrangements for test signals at the input of the receiver	10
4.2.4 Arrangements for test signals at the output of the receiver	11
4.3 Exclusion bands.....	11
4.3.1 Exclusion bands for receivers	11
4.3.2 Exclusion bands for transmitters.....	11
5 Performance assessment.....	11
5.1 General	11
5.2 Equipment which can provide a communications link	11
5.3 Equipment which does not provide a communications link.....	11
5.4 Ancillary equipment	11
5.5 Equipment classification.....	12
6 Performance criteria	12
6.1 Performance criterion for Continuous phenomena applied to Transmitters (CT) and Receivers (CR)	12
6.2 Performance criterion for Transient phenomena applied to Transmitters (TT) and Receivers (RT).....	12
6.3 Specific performance criteria.....	12
6.3.1 Digital signal ports.....	12
6.3.1.1 Performance criterion for continuous phenomena.....	12
6.3.1.2 Performance criterion for transient phenomena.....	13
6.3.2 Analogue voice frequency signal ports	13
6.3.2.1 Performance criterion for continuous phenomena.....	13
6.3.2.2 Performance criterion for transient phenomena.....	13
6.3.3 Ethernet and packet-data interfaces	13
6.3.3.1 Performance criterion for continuous phenomena.....	13
6.3.3.2 Performance criterion for transient phenomena.....	13
6.3.4 Service and maintenance interfaces	13
6.3.5 Synchronization interfaces	14
6.3.5.1 Performance criterion for continuous phenomena.....	14
6.3.5.2 Performance criteria for transient phenomena.....	14
6.3.6 Remote alarm interfaces.....	14
6.3.6.1 Performance criterion for continuous phenomena.....	14
6.3.6.2 Performance criterion for transient phenomena.....	14
7 Applicability overview tables	14
7.1 Emission	14
7.1.1 General.....	14
7.1.2 Special conditions	14
7.2 Immunity	14

7.2.1	General	14
7.2.2	Special conditions	15
Annex A (informative):	Point to Multipoint fixed radio links; General system architecture.....	16
History		17

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Foreword

This Candidate Harmonized European Standard (Telecommunications series) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM) and is now submitted for the Public Enquiry phase of the ETSI standards Two-step Approval Procedure.

The present document has been produced by ETSI in response to a mandate from the European Commission issued under Council Directive 98/34/EC (as amended) laying down a procedure for the provision of information in the field of technical standards and regulations.

The present document, together with the EN 300 489-1 [1], is intended to become a Harmonized EMC Standard, the reference of which will be published in the Official Journal of the European Communities referencing the Council Directive on the approximation of the laws of the Member States relating to electromagnetic compatibility ("the EMC Directive") (89/336/EEC [3] as amended), and the Council Directive on the approximation of the laws of the Member States relating to radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity (the "R&TTE Directive" 1999/5/EC [2]).

The present document is part 4 of a multi-part EN covering the ElectroMagnetic Compatibility (EMC) standard for radio equipment and services, as identified below:

- Part 1: "Common technical requirements";
- Part 2: "Specific requirements for radio paging equipment";
- Part 3: "Specific requirements for Short-Range Devices (SRD) operating on frequencies between 9 kHz and 25 GHz";
- Part 4: "Specific requirements for fixed radio links and ancillary equipment and services";**
- Part 5: "Specific requirements for Private land Mobile Radio (PMR) and ancillary equipment (speech and non-speech)".

Proposed national transposition dates	
Date of latest announcement of this EN (doa):	3 months after ETSI publication
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Date of withdrawal of any conflicting National Standard (dow):	36 months after doa

1 Scope

The present document, together with the EN 300 489-1 [1], covers the assessment of Fixed Radio Links and ancillary equipment in respect of ElectroMagnetic Compatibility (EMC).

Technical specifications related to the antenna port of the radio equipment are not included in the present document. Such technical specifications are found in the relevant product standards for the effective use of the radio spectrum.

The present document specifies the applicable test conditions, performance assessment and performance criteria for Analogue and Digital Fixed Radio Links operating as fixed Point to Point, and Point to Multipoint systems as defined in annex A, including the associated ancillary equipment.

In case of differences (for instance concerning special conditions, definitions, abbreviations) between the present document and the EN 300 489-1 [1], the provisions of the present document take precedence.

The processing and protection switch, (de)modulator, transmitter, receiver, RF filters, branching networks, feeders are covered by the present document. The multiplexing and/or de-multiplexing elements are covered if they form part of the transmitter, receiver and/or transceiver.

The environmental classification and the emission and immunity requirements used in the present document are as stated in the EN 300 489-1 [1], except for any special conditions included in the present document.

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.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

- [1] EN 301 489-1: "Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements".
- [2] 1999/5/EC: "Council Directive on the approximation of the laws of the Member States relating to radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity".
- [3] 89/336/EEC: "Council Directive on the approximation of the laws of the Member States relating to electromagnetic compatibility".
- [4] ITU-R Recommendation F 1191-1: "Bandwidths and unwanted emissions of digital radio-relay systems".
- [5] ITU-R Recommendation F 746-3: "Radio-frequency channel arrangements for radio-relay systems".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in the EN 301 489-1 [1], clause 3 and the following apply.

channel separation: according to ITU-R Recommendation F.1191-1 [4], the CHannel Separation (CHS) is taken as $XS/2$ for alternated frequency channel arrangements and XS for co-channel and interleaved frequency channel arrangements as defined by ITU-R Recommendation F.746-3 [5], XS is the radio-frequency separation between the centre frequencies of adjacent radio-frequency channels on the same polarization and in the same direction of transmission.

operating frequency range: the range(s) of radio frequencies covered by the Equipment Under Test (EUT) without any change of units.

3.2 Abbreviations

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

BER	Bit Error Ratio
CCS	Central Controller station
CHS	Channel Separation
CRS	Central Radio Station
EM	Electromagnetic
EMC	ElectroMagnetic Compatibility
EUT	Equipment Under Test
RF	Radio Frequency
RS	Repeater Stations
TS	Terminal Stations

4 Test conditions

For the purposes of the present document, the test conditions of the EN 300 489-1 [1], clause 4, shall apply as appropriate. Further product related test conditions for fixed radio links are specified in the present document.

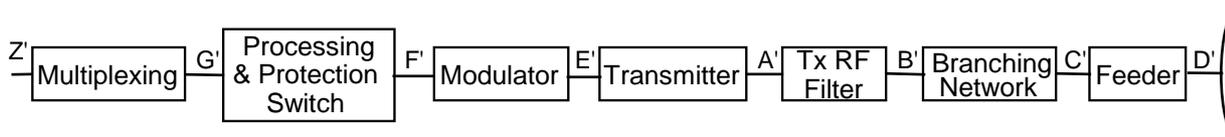
4.1 General

For emission and immunity tests the test modulation, test arrangements, etc., as specified in the present document, subclauses 4.1.1 to 4.3.2, shall apply.

4.1.1 Test conditions and configurations

This subclause defines the test conditions and configurations for the emission and immunity tests as follows:

- a transmitter shall, as a minimum, comprise the element between E' and A' of figure 1. Additionally the transmitter may comprise any of the other elements from the transmitter chain shown in figure 1. If these additional elements are part of the transmitter or system they shall also meet the requirements of the present document;

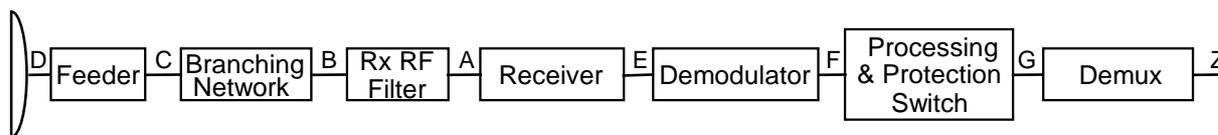


NOTE 1: For the purposes of defining the reference points, the branching network (B' to C') does not include a hybrid.

NOTE 2: Points B' and C' may coincide, dependent on the equipment configuration.

Figure 1: Elements of a transmitter

- a receiver shall, as a minimum, comprise the element between A and E of figure 2. Additionally the receiver may comprise any of the other elements from the receiver chain shown in figure 2. If these additional elements are part of the receiver or system they shall also meet the requirements of the present document;



NOTE 1: For the purposes of defining the reference points, the branching network (B to C) does not include a hybrid.

NOTE 2: Points B and C may coincide, dependent on the equipment configuration.

Figure 2: Elements of a receiver

- a transceiver shall comprise as a minimum the elements E' to A' and A to E shown in figures 2 and 3, and additionally it may comprise any combinations of the other elements. If these additional elements are part of the transceiver they shall also meet the requirements of the present document;
- the equipment shall be tested under conditions which are within the manufacturer's declared range of humidity, temperature and supply voltage;
- 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;
- ports which in normal operation are connected to ancillary or other equipment shall be either connected to such equipment, or to a representative termination to simulate the input/output characteristics of the ancillary or other equipment. Radio Frequency (RF) input/output ports shall be correctly terminated;
- 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;
- ports which are not connected to cables during normal intended operation, e.g. service connectors, programming connectors, temporary connectors etc. shall not be connected to any cables for the purpose of Electromagnetic Compatibility (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 conditions, test configuration and mode of operation shall be recorded in the test report.

4.1.2 Emission tests

The provisions the EN 300 489-1 [1], clause 8 shall apply with the following modification.

For Point to Multipoint systems a communications link shall be established, which shall comprise of the Central Station and a minimum of one Terminal Station. These stations are tested separately. See annex A for definition of Central Station and Terminal Station.

4.1.3 Immunity tests

The provisions of the EN 300 489-1 [1], subclause 9.1 shall apply with the following modifications.

The test configuration shall for transmitters be in accordance with the principle of figure 3, and for receivers it shall be in accordance with the principle of figure 4, and for transceiver shall be in accordance with the principle of figure 5.

The measuring equipment shall be located outside the test environment. Adequate measures shall be taken to avoid any effects of the unwanted signals on the measuring equipment.

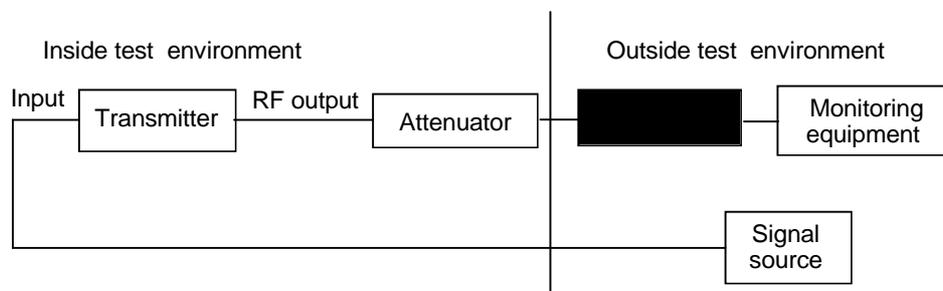


Figure 3: Test configuration for transmitters

During immunity tests the transmitter shall be operated at its rated output power. The input to the transmitter shall be in accordance with subclause 4.2.1 (see figure 3). A communication link shall be established at the start of the test and be maintained during the test.

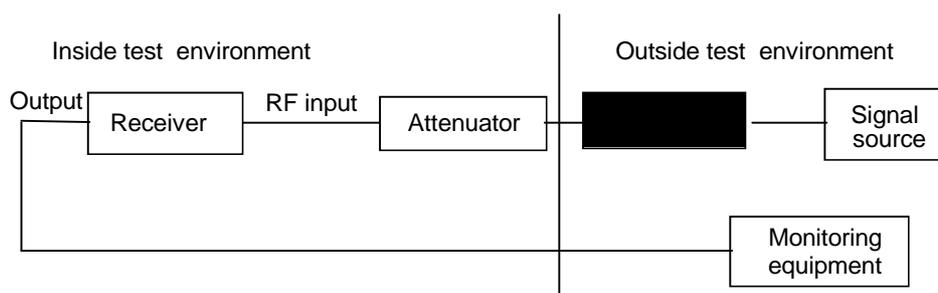


Figure 4: Test configuration for receivers

During immunity tests for receivers, the wanted RF input signal, coupled to the receiver, shall be in accordance with subclause 4.2.3 (see figure 4). A communication link shall be established at the start of the test and be maintained during the test.

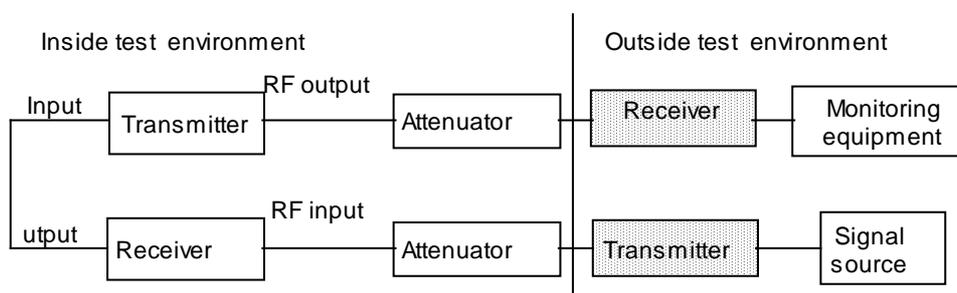


Figure 5: Test configuration of transceivers

In the case of duplex transceivers where the transmitter and receiver cannot operate at the same radio frequency, the wanted input signal, coupled to the receiver, shall be in accordance subclause 4.2.3. The transmitter shall be operated at its rated output power, and with its input coupled to the output of the receiver (repeater mode) (see figure 5).

The same test configuration also applies where the transmitters and receivers operate at the same radio frequency.

The measurement shall be made in the mode of operation as required in this subclause.

A communication link shall be established at the start of the test and be maintained during the test.

For the immunity tests of ancillary equipment without a separate pass/fail criteria, the receiver, transmitter or transceiver coupled to the ancillary equipment, shall be used to judge whether the ancillary equipment passes or fails.

For Point to Multipoint systems the minimum configuration shall comprise of one Central Station and one terminal station, unless more terminal stations are required to establish a representative test configuration.

A communication link shall be established at the start of the test and maintained during the test, between the Central Station and a Terminal Station(s).

These stations are tested separately.

4.2 Arrangements for test signals

The provisions of the EN 300 489-1 [1], subclause 4.2 shall apply.

4.2.1 Arrangements for test signals at the input of the transmitter

The provisions of the EN 300 489-1 [1], subclause 4.2.1 shall apply with the following modifications.

The input of the transmitter shall be coupled via the normal input connector to the signal source shown in figures 4 to 6.

The wanted signal(s) shall be (a) representative baseband input signal(s) corresponding to normal operation.

4.2.2 Arrangements for test signals at the output of the transmitter

The provisions of the EN 300 489-1 [1], subclause 4.2.2 shall apply with the following modifications.

To establish a communication link the wanted output signal shall be delivered from the transmitter RF output via suitable attenuation through a coaxial cable or wave guide. Adequate measures shall be taken to minimize the effects of unwanted currents on the external conductor of the coaxial cable or wave guide at the point of entry to the EUT. Mismatch errors may be avoided by placing the attenuators close to the EUT.

If the transmitter RF output cannot be recovered via connection another antenna of the same type may be used to retrieve the wanted output signal from the transmitter.

4.2.3 Arrangements for test signals at the input of the receiver

The provisions of the EN 300 489-1 [1], subclause 4.2.3 shall apply with the following modifications.

The wanted signal shall be a representative modulated RF input signal corresponding to normal operation.

To establish a communication link the wanted input signal shall be applied to the RF input of the receiver via a coaxial cable or wave guide. Adequate measures shall be taken to minimize the effects of unwanted currents on the external conductor of the coaxial cable or wave guide at the point of entry to the EUT. Mismatch errors may be avoided by placing the attenuators close to the EUT.

If the receiver RF input cannot be applied via connection another antenna of the same type may be used to apply the wanted input signal to the receiver. The source of the wanted input signal shall be located outside of the test environment.

For digital equipment, including Point to Multipoint equipment, the input signal level shall be at a nominal value of 15 dB above the receiver input level for a Bit Error Ratio (BER) of 1×10^{-5} .

The input signal level for analogue equipment shall be set to 15 dB above the input signal level that produces the reference signal to noise ratio. If the reference signal to noise ratio is not specified in the appropriate product standard, the level specified by the manufacturer shall be used.

These levels are close to normal operation and sufficient to avoid the broad band noise from the power amplifiers, which generate the disturbing EM phenomena, from influencing the measurement.

4.2.4 Arrangements for test signals at the output of the receiver

The provisions of the EN 300 489-1 [1], subclause 4.2.4 shall apply.

4.3 Exclusion bands

The provisions of the EN 300 489-1 [1], subclause 4.3 shall apply.

4.3.1 Exclusion bands for receivers

The exclusion band is the relevant operating frequency band, extended at each end by $\pm 5\%$ of the centre frequency.

4.3.2 Exclusion bands for transmitters

Exclusion bands shall not be applied when measuring transmitters in standby mode.

For the purpose of this present document, the exclusion band shall extend over the frequencies above and below the fundamental transmitting frequency, but separated from the centre frequency of the emission by 250 % of the relevant Channel Separation (CHS) of the radio-frequency channel arrangement where the system is to be placed. When the CHS is not defined the exclusion band shall extend over the frequencies above and below the fundamental transmitting frequency but separated from the centre frequency of the emission by 250 % of the necessary bandwidth.

5 Performance assessment

5.1 General

The provision of the EN 300 489-1 [1], subclause 5.1 shall apply.

5.2 Equipment which can provide a communications link

The test arrangement and signals given in clause 4 apply to radio equipment or a combination of a radio equipment and ancillary equipment which permits the establishment of a communications link.

5.3 Equipment which does not provide a communications link

If the equipment is of a specialized nature (see clause 6) which does not permit a communications link to be established, such as protection switching equipment, or ancillary equipment tested in isolation, (i.e. not connected to radio equipment), the manufacturer shall define the method of test to determine the acceptable level of performance or degradation of performance during and/or after the test. The manufacturer shall provide the method of observing the degradation of performance of the equipment.

The performance assessment carried out shall be simple, but at the same time give adequate proof that the primary functions of the equipment are operational.

5.4 Ancillary equipment

The provision of the EN 300 489-1 [1], subclause 5.4 shall apply.

5.5 Equipment classification

Radio link equipment covered by the present document is only intended for fixed use and powered either by AC mains or DC power supply.

Therefore, for emission and immunity tests only the requirements for radio and ancillary equipment for fixed used shall apply (see the EN 300 489-1 [1], subclauses 7.1 and 7.2, table 1 and table 2 respectively).

6 Performance criteria

The equipment shall meet the minimum performance criteria as specified in subclauses 6.1, 6.2 and 6.3, as appropriate.

6.1 Performance criterion for Continuous phenomena applied to Transmitters (CT) and Receivers (CR)

The provision of the EN 300 489-1 [1], subclause 6.1 shall apply with the following modifications.

The communication link shall be maintained during and after the test.

The specific performance criteria of subclause 6.3, for continuous phenomena, shall additionally apply.

6.2 Performance criterion for Transient phenomena applied to Transmitters (TT) and Receivers (RT)

The provision of the EN 300 489-1 [1], subclause 6.2 shall apply with the following modifications.

The communication link shall be maintained after the test.

The specific performance criteria of subclause 6.3, for transient phenomena, shall additionally apply.

6.3 Specific performance criteria

6.3.1 Digital signal ports

The performance of the equipment shall be verified for digital signal ports:

- by measuring the number of induced bit errors on the main signal port during all exposures;
- by testing the functionality of the main signal port and the other signal ports after the exposure;
- by verifying that corruption of software and data held in memory has not occurred.

To allow for background errors which may occur at any time, the test can be repeated up to three times to determine any correlation between eventual errors and the EMC phenomena.

6.3.1.1 Performance criterion for continuous phenomena

The number of bit errors at each individual exposure shall not exceed the maximum number of errors stated by the manufacturer for intended operation.

The number of errors is calculated as:

$$\text{(the maximum bit error ratio specified by the manufacturer)} \times \text{(bit rate)} \times \text{(test time)}.$$

The test time is taken to be the dwell time at each frequency of the exposure.

6.3.1.2 Performance criterion for transient phenomena

Loss of frame alignment or loss of synchronization is not allowed during each individual exposure. No alarms shall be generated as a result of the electromagnetic stress.

The above does not apply to surge testing where some loss of frame alignment may be expected. For this test, the EUT shall operate as intended following the cessation of the exposure.

6.3.2 Analogue voice frequency signal ports

The performance of the equipment shall be verified for analogue voice frequency signal ports:

- by measuring the audio signal break-through (demodulated 1 kHz) on the signal port during continuous exposures in both signal path directions covering both analogue to digital conversion and digital to analogue conversion;
- by testing the functionality of the main signal port and the other signal ports after the transient exposures;
- by verifying that corruption of software and data held in memory has not occurred.

6.3.2.1 Performance criterion for continuous phenomena

- The noise signal level received from the EUT measured in an impedance of 600 Ω shall not be greater than -40 dBm.

6.3.2.2 Performance criterion for transient phenomena

- The EUT shall return automatically to normal performance after the cessation of the exposure.

6.3.3 Ethernet and packet-data interfaces

To interfaces operating in packet mode the criteria below apply.

6.3.3.1 Performance criterion for continuous phenomena

For interfaces which are intended for the transmission of third party data traffic, a selected port shall be connected to test equipment (e.g. a data communications analyser) as a single point-to-point data link. This will avoid excessive failed transmission attempts caused by data collisions and bus contention problems.

The interface shall be suitably exercised and monitored throughout the test period for errored frames.

No more than 5 % additional errored frames above the quiescent level shall be permitted during the exposure.

6.3.3.2 Performance criterion for transient phenomena

The data link connection shall be maintained.

6.3.4 Service and maintenance interfaces

This type of ports is not intended to be permanently connected, and therefore is not subjected to immunity tests. After the conclusion of immunity tests it shall be verified that the performance of these ports meets the manufacturer's specifications.

6.3.5 Synchronization interfaces

The performance of slave clock ports shall be checked with the equipment synchronized with an external source.

6.3.5.1 Performance criterion for continuous phenomena

During the exposure, synchronization shall not be lost.

6.3.5.2 Performance criteria for transient phenomena

No alarm indications shall persist after the exposure.

The functional performance according to the manufacturer's specification shall be verified following cessation of the exposure.

6.3.6 Remote alarm interfaces

These interfaces are defined by the manufacturer.

6.3.6.1 Performance criterion for continuous phenomena

No false alarms shall occur during continuous exposures.

6.3.6.2 Performance criterion for transient phenomena

No false alarm indications shall persist after the exposure.

7 Applicability overview tables

7.1 Emission

7.1.1 General

The table 1 in the EN 300 489-1 [1], contains the applicability of EMC emission measurements to the relevant ports of radio and/or associated ancillary equipment.

For fixed radio link equipment, only the part of table 1 which specifies the requirements for radio and ancillary equipment for fixed use shall apply.

7.1.2 Special conditions

The radiated emissions from the enclosure of the radio equipment shall meet the same requirements as stated for the enclosure of ancillary equipment in the EN 300 489-1 [1], subclause 8.2.

7.2 Immunity

7.2.1 General

The table 2 in the EN 300 489-1 [1], contains the applicability of EMC immunity measurements to the relevant ports of radio and/or associated ancillary equipment.

For fixed radio link equipment, only the part of table 2 which specifies the requirements for radio and ancillary equipment for fixed use shall apply.

7.2.2 Special conditions

The following special conditions set out in table 1 relate to the immunity test methods and performance criteria used in the EN 300 489-1 [1], clause 9.

Table 1: Special conditions for EMC immunity tests

Reference to subclauses in the EN 300 489-1 [1]	Special product-related conditions, additional to or modifying the test conditions in the EN 300 489-1 [1], clause 9
9.7.3: Performance criteria; Voltage dips and interruptions	Voltage interruptions: For voltage interruptions, temporary loss of function is allowed, provided the function is self-recoverable or can be restored by the operation of the controls.

Annex A (informative): Point to Multipoint fixed radio links; General system architecture

A system could consist of physical sub-systems as follows (see figure A.1):

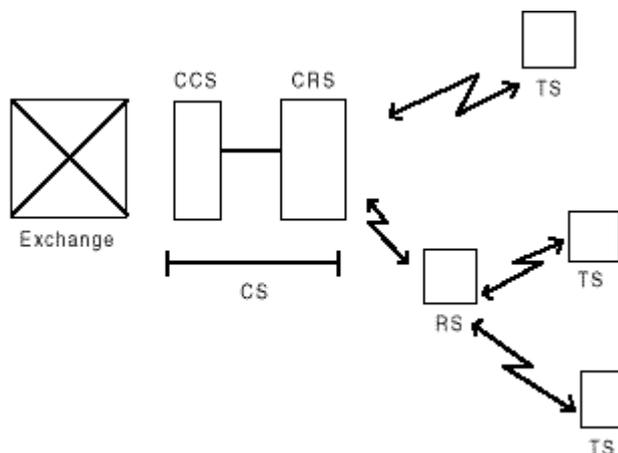


Figure A.1: General system architecture

CS: Central Station which can be subdivided into two units:

- the exchange unit, also called Central Controller Station (CCS) - (interface to the local switch); and
- the radio unit, also called Central Radio Station (CRS) - (central base band/radio transceiver).

TS: Terminal station (outstations with subscriber interfaces).

RS: Repeater Station (radio repeater outstations with or without subscriber interfaces).

The central station performs the interconnection with the local switching exchange, carrying out a concentration function by sharing the total number of available channels in the system. The central station is linked to all remote stations (Repeater Stations (RS) or Terminal Stations (TS)) by radio transmission paths.

Whenever an existing digital transmission link is available, the network implementation can be optimized by separating the CCS installed at the exchange site and the CRS.

Terminal stations are situated as close as possible to the "centre of gravity" of the subscriber locations.

They interface directly with the subscriber loops.

History

Document history			
V1.1.1	December 1999	Public Enquiry	PE 200015: 1999-12-15 to 2000-04-14