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Contents

Foreword

This document is the Publicly Available Specification (PAS) of the TETRAPOL land mobile radio system, which shall provide digital narrow band voice, messaging, and data services. Its main objective is to provide specifications dedicated to the more demanding PMR segment: the public safety. These specifications are also applicable to most PMR networks.

This PAS is a multipart document which consists of:

Part 1 General Network Design

Part 2 Radio Air interface

Part 3 Air Interface Protocol

Part 4 Gateway to X.400 MTA

Part 5 Dispatch Centre interface

Part 6 Line Connected Terminal interface

Part 7 Codec

Part 8 Radio conformance tests

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Part 10 Inter System Interface

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Part 12 Network Management Centre interface

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TTR 1 Guide to TETRAPOL features

Part 18 Base station to Radioswitch interface

Part 19 Stand Alone Dispatch Position interface

1. Scope

This part of the specification deals with the minimum radio performances of TETRAPOL base station and radio terminal equipment and the related radio test methods used for type approval testing. The purpose of these specifications is to provide a sufficient confidence in the quality of radio transmission and reception for equipment operating in a TETRAPOL system and to minimise harmful interference to other equipment.

These specifications do not necessary include all the characteristics which may be required by a user of equipment nor do they necessarily represent the optimum performance achievable.

2. Normative References

This PAS incorporates by dated and undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this PAS only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

[1] PAS 0001-2: "TETRAPOL Specification; Radio Air Interface".

[2] ETS 300-113: "Radio equipment system (RES) Land mobile. transmission of data and speech and having, an antenna connector"

[3] ITU-T 0.153: "Basic parameters for the measurement of error performance at bit rates below the primary rate".

3. Abbreviations

For the purposes of this PAS, the following abbreviations apply:

A/I	Air Interface
AFC	Automatic Frequency Control
AGC	Automatic Gain Control
BER	Transmitter Receiver Unit
BN	Base Network
BS	Base Station
CCH	Control CHannel
CRP	Connection Reference Point
CUG	Closed User Group
DB	DataBase
DCN	Delivery Confirmation Notification
DCS	Dispatch Centre Server
DFN	Delivery Failure Notification
DM	Direct Mode
DM/NM	Direct Mode / Network Monitoring
DP	Dispatch Position
DC	Dispatch Centre
DPS	Dispatch Position Switch
DPSI	Dispatch Position Switch Interface
EDT	External Data Terminal
EUT	Equipment Under Test
FBM	FallBack Mode
FER	Frame erasure rate
HRSW	Home RadioSWitch
ISI	Inter System Interface
KMC	Key Management Centre
LCIU	Line Connection Interface Unit
LCT	Line Connected Terminal
LLC	Logical Link Control
MAC	Medium Access Control

MER	Message erasure Rate
MM	Mobility Management
MOCH	Multisite Open CHannel
MRI	Mobile Random Identity
MS	Mobile Station
MSG APPLI	Messaging APPLIcation
NMC	Network Management Centre
OG	Operational Group
OMC	Operation and Maintenance Centre
PABX	Private Automatic Branch eXchange
PAS	Publicly Available Specification
PC	Personal Computer
(P)DN	(Public) Data Network
PDU	Protocol Data Unit
PMR	Private Mobile Radiocommunication
PSTN	Public Switched Telecommunications Network
PTT	Push-To-Talk
Ri	Reference point index i
RP	RePeater
RSW	RadioSWitch
RT	Radio Terminal
SADP	Stand Alone Dispatch Position
SDL	Specification and Description Language
SDP	Submit Delivery Protocol
SFN	Submit Failure Notification
SIM	Subscriber Identity Module
ST	System Terminal
SwMI	Switching and Management Infrastructure
TCH	Traffic CHannel
TCP/IP	Transmission Control Protocol/Internet Protocol
TDX	Telephone and Data eXchange
TMSG-Id	Temporary MeSsaGe Identifier
TP	TransPort layer
TTI	Temporary Terminal Identifier
UA	User Agent
UDT	User Data Terminal
VRSW	Visited RadioSWitch
X.400 MTA	X.400 Message Transfer Agent

4. General

Each equipment submitted for type testing shall fulfil the requirements of this standard on all channels over which it is intended to operate. the manufacturer or other applicant shall provide one or more production or pre-production model(s) of the equipment as appropriate for type testing.

If type approval is given on the basis of tests on pre-production models, those models shall be manufactured in accordance with the same file of manufacturers specifications as the later production models. This fact shall be declined by the manufacturer in the application form (see for more details; "Radio equipment system (RES) Land mobile. Transmission of data and speech and having, an antenna connector" ETS 300 113 [2]).

4.1. Alignment range switching range, radio frequency channel to be tested

The manufacturer shall when submitting equipment for type testing state the alignment ranges for the receiver and the transmitter. The alignment range is defined as the frequency range over which the receiver and the transmitter can be programmed and/or realigned to operate, without any physical change of components other than programmable read only memories or crystals or passive components.

The manufacturer shall also state the switching range of the receiver and the transmitter. The switching range is the maximum frequency range over which the receiver or the transmitter can be operated without reprogramming or realignment.

For the purpose of all measurement, the receiver and transmitter shall be considered separately.

One sample of the equipment shall be tested. Full tests shall be carried out on a frequency within 100 kHz of the centre frequency of the switching range. Limited test shall be carried out on a frequency within 100 kHz of the lowest and also on a frequency within 100 kHz of the highest frequency of the switching range.

4.2. Facilities and information required for testing

The equipment submitted for type testing shall provide the following facilities:

- at least one antenna connector as a test point. All power level and frequency characteristics specified shall be, unless otherwise stated referred to the antenna connector of the equipment under test;

- for equipment supporting diversity or for any other reason having more than one antenna connector, the applicant can supply coupling and/or terminating devices so that the tests can be performed via a single antenna connector;

- a test connector and a means to connect the equipment under test to a test equipment controller (see figure 1). This means is a PC additional card and a cable to connect it to the equipment under test through its test connector;

- a means to connect the equipment under test to the power source according to clause 5.2.

Via the test connector the equipment under test provides the test equipment with receiver part output signals and signalling informations on the states of the equipment, the test equipment provides the equipment under test with signalling informations to control the states of the equipment under test and to configure it for all test to be performed either in test transmit or test receive modes. The test equipment can also provide the equipment under test with transmitter part input signals (see also clause 7).

When in test mode, all the operational internal or external radio commands (AGC, AFC, power control, PTT) shall be accessible through the test connector. The applicant shall provide all the necessary informations on these commands to the test laboratory.

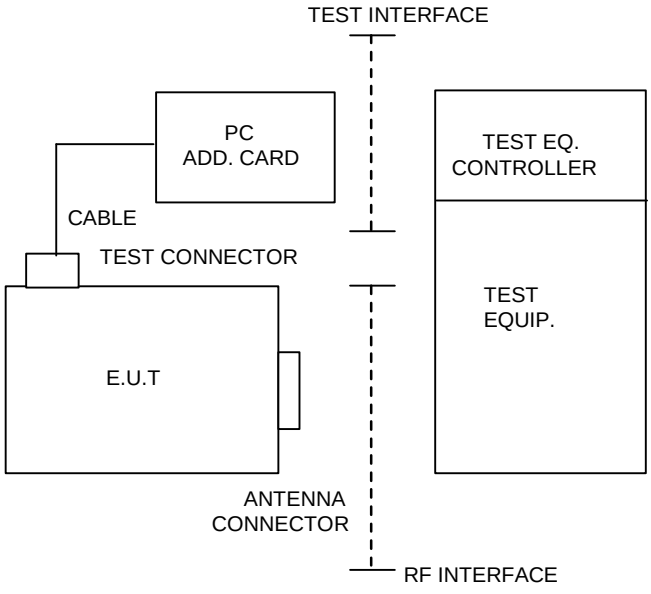


Figure 1: Test arrangement

The applicant shall provide the following information to the test authority:

- power class of equipment;
- other capabilities and options implemented in the equipment;
- information related to radio subsystem of equipment i;e; transmit and receive frequency switching and alignment ranges, first local oscillator frequency (flo) and intermediate frequencies (if 1 **....** if m) of receiver;

- description how to use equipment in specific test modes and details on test interface if necessary
- information of power source used in normal operation.

4.3. Mechanical and electrical design

The equipment submitted for type testing by the manufacturer or his representative shall be designed constructed and manufactured in accordance with good engineering practice and with the aim of minimising harmful interference to other equipment and services.

4.3.1. Controls

Those controls which if maladjusted might increase the interfering potentialities of the equipment shall not be accessible for adjustment by the user.

4.3.2. Transmitter shut off facility

When a timer for an automatic shut off is operative at the moment of the time-out, the transmitter shall automatically be switched off. A shut off facility shall be inoperative for the duration of the type test measurements unless it has to remain operative to protect the equipment.

4.3.3. Marking

The marking shall be in accordance with EC directives and/or CEPT decisions or recommendations as appropriate.

4.4. Interpretation of the measurement results

The interpretation of the results, recorded in a test report for the measurements described in this specification shall be as follows:

a) the measured value related to the corresponding limit shall be used to decide whether an equipment meets the requirement;
b) the actual measurement uncertainty of the test laboratory carrying out the measurements for each particular measurement shall be included in the test report;
c) the value of the actual measurement uncertainty should for each measurement, equal to or lower than the figures given in clause 11 of ETS 300-113 [2] "Radio equipment system (RES) Land mobile. transmission of data and speech and having, an antenna connector".

5. Test conditions, power sources and ambient temperatures

5.1. Normal and extreme test conditions

Type testing shall be made under normal test conditions and also, where stated, under extreme test conditions.

5.2. Test power source

During type testing, the power source of the equipment shall be replaced by a test power source, capable of producing normal and extreme test voltages as specified in subclause 5.3 and 5.4. The internal impedance of the test power source shall be low enough for its effects on the test results to be negligible.

For the purpose of tests, the voltage of the power source shall be measured at the input terminals of the equipment.

If the equipment is provided with a permanently connected power cable the test voltage shall be that measured at the point of connection of the power cable to the equipment.

For battery operated equipment the battery shall be removed and the test power source shall be applied as close to the battery terminals as practicable.

During tests, the power source voltages shall be maintained within tolerance a +/- 1% relative to the voltage at the beginning of each test. The value of this tolerance is critical for power measurements.

5.3. Normal test conditions

5.3.1. Normal temperature and humidity

The normal temperature and humidity conditions for tests shall be any convenient combination of temperature and humidity within the following ranges:

- temperature: + 15 ° C to + 35° C
- relative humidity: 20% to 75%

When it is impracticable to carry out the tests under these conditions a note to this effect stating the ambient temperature and relative humidity during the tests, shall be added to the test report.

5.3.2. Normal test power source

5.3.2.1. Mains voltage

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage.

For the purpose of this specification the nominal voltage shall be the declared voltage or any of the declared voltages for which the equipment was designed.

The frequency of the test power source corresponding to the a.c. mains shall be between 49 Hz and 51 Hz.

5.3.2.2. Regulated lead acid battery power sources used on vehicles

When the radio equipment is intended for operation from the usual types of regulated lead acid battery power sources used on vehicles the normal test voltage shall be 1.1 times the nominal voltage of the battery (6,6 v for a nominal voltage of 6 v and 13.2 v for a nominal voltage of 12v).

5.3.2.3. Other power sources

For operation from other power sources or types of battery (primary or secondary), the normal test voltage shall be that declared by the equipment manufacturer.

5.4. Extreme test conditions

The following four extreme test condition combinations are applied while testing an equipment under extreme test conditions:

- Lower temperature / lower voltage (LT LV);
- Lower temperature / higher voltage (LT HV);
- Higher temperature / lower voltage (HT LV);
- Higher temperature / higher voltage (HT HV).

Unless otherwise stated, tests to be conducted under extreme test conditions shall include all the above temperature and voltage combinations.

5.4.1. Extreme temperature

For tests at extreme temperature, measurements shall be made in accordance with the procedures specified in subclause 6.5: ETS 300-113 [2] "Radio equipment system (RES) Land mobile. transmission of data and speech and having, an antenna connector " at the upper and lower temperatures of the following ranges:

- outdoor equipment: -20°C to +55°C
- indoor equipment: 0°C to 40°C

5.4.2. Extreme test sources voltages

5.4.2.1. Mains voltage

The extreme test voltages for equipment to be connected to an **a.c.** mains source shall be nominal mains voltage +/- 10%.

5.4.2.2. Regulated lead acid battery power sources on vehicles

When the radio equipment is intended for operation from the usual type of regulated lead-acid battery power sources used on vehicles, the extreme test voltages shall be 1.3 and 0.9 times the nominal voltage of the battery (for a nominal voltage of 6v, these are 7,8 v and 5,4 v respectively and for a nominal voltage of 12v, these are 15,6 v and 10,8 v respectively).

5.4.2.3. Power sources using other types of batteries

The lower extreme test voltage for equipment with power sources using batteries shall be as follow:

- for the Leclanché or the lithium type of battery: 0.85 times the nominal voltage of the battery;
- for the mercury or the nickel-cadmium type of battery 0.90 times the nominal voltage of the battery.

No upper extreme test voltages apply.

5.4.2.4. Other power sources

For equipment using other power sources or capable of being operated from a variety of power sources the extreme test voltages shall be those agreed between the equipment manufacturer and the testing laboratory and shall be recorded in the test report.

6. General conditions

6.1. Arrangements for test signals applied to the receiver input

Sources of test signals for signals applied to the receiver input shall be connected in such a way that the sources impedance presented to the receiver input is 50 Ω (non reactive). This requirement shall be met irrespective of whether one or more signals using a combining network are applied to the receiver simultaneously.

The effects of any intermodulation products and noise produced in the test signal sources shall be negligible.

6.2. Normal test signals (wanted and unwanted)

6.2.1. Test of transmitter

When in test mode the transmitter under test shall be able to generate the following RF signals.

D0: Transmit unmodulated signal

The nominal frequency of this carrier shall be at + 2 kHz (or - 2 kHz) from the nominal center frequency of the channel.

For a MS transmitter the modulator input shall be a continuous stream of (0 or 1 bits) when the carrier is 2 kHz above the center frequency of the channel.

For a MS transmitter the modulator input shall be a continuous stream of a alternated bit (0,1,0,1,0 ...) when the carrier is 2 kHz below the center frequency of the channel.

For a BS transmitter, the modulator input shall be a continuous stream of a alternated bit (0,1,0,1,0) when the carrier is 2 kHz above the center frequency of the channel.

For BS transmitter, the modulator input shall be a continuous stream of o (or 1) bits when the carrier is 2 kHz below the center frequency of the channel.

(see subclause clause 7 of PAS 0001-2: "TETRAPOL Specification; Radio Air Interface" [1]).

D11: Transmit modulated type 1 signal

The modulation scheme of this RF signal shall be in accordance with the clause 7 of PAS 0001.2: "TETRAPOL Specification; Radio Air Interface".[1], the input signal of the modulator being a continuous pseudo-random bit stream issued from a pseudo random sequence generator of at least 511 bits in conformity with the UIT-T recommendation 0.153 [3].

D12: Transmit modulated type 2 signal

Like D11, the modulation scheme of this continuously modulated RF signal shall be compliant with the clause 7 of PAS 0001-2: "TETRAPOL Specification; Radio Air Interface" [1]. But in addition, the modulator input signal shall be framed, each 20 ms block of 160 bits shall contain a fixed preamble of 8 bits { 011 000 10} and the remaining 152 bits shall be issued from a pseudo-random sequence generator compliant with the UIT-T recommendation 0.153 [3], the length of the sequence being of at least 511 bits.

For a MS, the RF level of D0 or D1x can be externally controlled within the dynamic range of the adaptive power control as specified in clause 8 of PAS 0001-2: « TETRAPOL specifications », Part 2: « Radio air Interface ».

For MS and BS, the channel center frequency of D0 or D1x can be externally chosen within the switching range of the equipment as declared by the equipment manufacturer.

6.2.2. Test of receiver

When in test mode, the receiver under test (or the transmitter in some specific cases) can be connected to one or more test RF signal generator. These generators shall be able to generate the following types of RF signals.

D2: Received unmodulated signal

This unmodulated continuous sinusoïdal radio signal shall present a spectral purity compatible with an acceptable measurement accuracy of the receiver performances as specified in subclause 8.4 of PAS 0001-2 "TETRAPOL Specification; Radio Air Interface" [1].

D3: Received wanted signal

This signal shall simulate a VCH (clauses 5, 6 and 7 of PAS 0001-2: "TETRAPOL Specification; Radio Air Interface" [1]). The 122 voice bits of each block at the channel coder input shall be issued from a pseudo-random generator compliant with UIT-T recommendation 0.153: "Basic parameters for the measurement of error performance at bit rates below the primary rate" [3]. The period of the pseudo-random bitstream shall be at least 511 bits length.

D4: Received unwanted signal type 1

The modulation scheme of this RF signal shall be compliant with the clause 7 of PAS 0001-2: "TETRAPOL Specification; Radio Air Interface".[1]. The input signal of the modulator being a continuous pseudo-random bitstream issued form a pseudo-random sequence generator of at least 255 bits. The pseudo random bit stream used for D3 and the one used for D4 shall be decorrelated. The spectral purity of this signal shall be compatible with an acceptable measurements accuracy of the receiver performances as specified in subclauses 8.4 and 8.5.2 of PAS 0001-2: "TETRAPOL Specification; Radio Air Interface" [1].

D5: Received unwanted signal type 2 (optional)

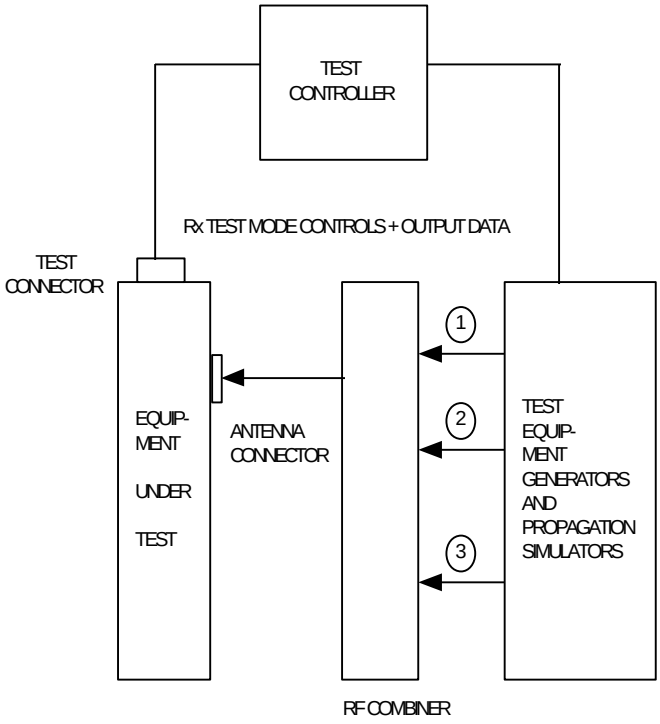
This last signal shall simulate an analogue FM interferer, it is frequency modulated by a sine wave at 400 Hz with a deviation of 12% of the channel separation. Like D4, the spectral purity of this test signal shall be compatible with an acceptable measurement accuracy of the receiver performances as specified in subclause 8.4 and 8.5.2 of PAS 0001-2: "TETRAPOL Specification; Radio Air Interface" [1].

7. General radio test configuration

The radio test configuration shown in figure 2, 3, 4 is functional and is presented for information only. For the details of the physical implementation of the tests see ETS 300-113 [2] as far as necessary.

For tests of the transmitting part the input data may be internally generated by the equipment under test when it is in transmit test mode.

7.1. Test of the receiving part (MS or BS)

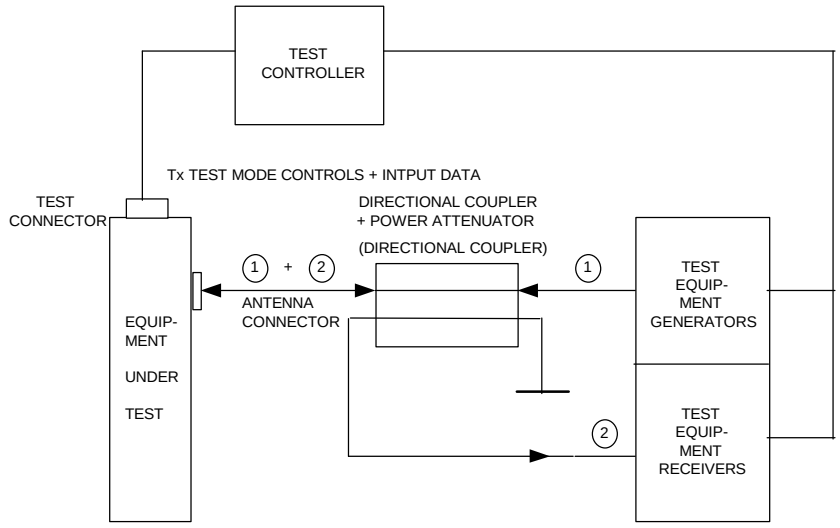


signal ① = Wanted RF signal (D3)
signal ② = RF interferer one (D4 or D5)
signal ③ = RF interferer two (D2)

Figure 2: Test of receiving part

Note: In the case of BS receiver testing the D3 signal may be generated by the transmitting part of the BS in test mode, its output RF centre frequency being translated by an external device with a frequency shift equal to the duplex spacing.

7.2. Test of the transmitting part (BS or MS in direct mode)

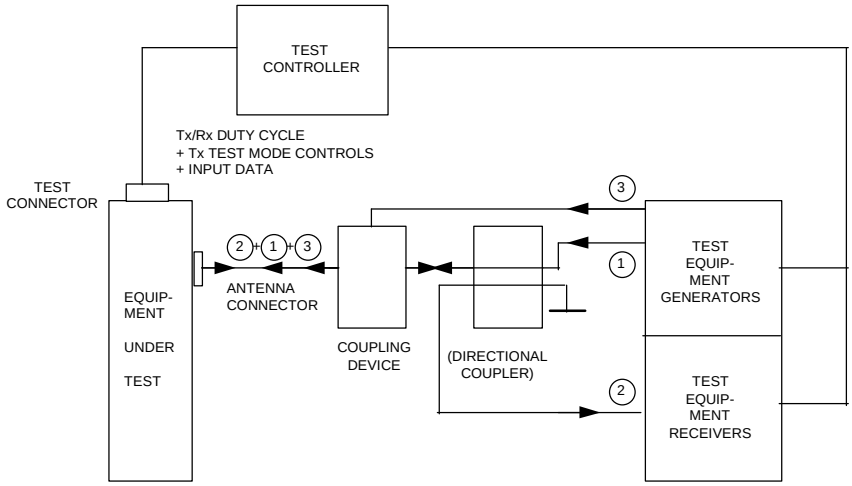


Signal ① = interferer (D2)
Signal ② = transmitter output RF signal (D0 or D11 or D12)

Figure 3: Test of transmitting part (DMO)

Remark: The signal ① is needed only for intermodulation attenuation testing.

7.3. Test of the transmitting part (MS in trunked mode)



signal ① = RF interferer (D2)
signal ② = Transmitter output RF signal (D0 or D11 or D12)
signal ③ = BS downlink signal (D3)

Figure 4: Test of transmitting part (trunked mode)

Remark: The signal ① is needed only for intermodulation attenuation testing. The signal ③ is used for MS synchronisation purpose.

The Tx/Rx duty cycle can be 1 sec/29 sec approximately, when the MS under test is an half duplex equipment. The difference between the nominal centre frequencies of the channels corresponding to the signals ② and ③ shall be equal to the duplex spacing.

8. Technical characteristics

8.1. Transmitter parameters limits

8.1.1. Output power

8.1.1.1. Definition

The output power is defined as the average power measured through an at least 10 kHz bandwidth filter over the transmitted bits at the transmitter antenna connector.

8.1.1.2. Limits for nominal power

The output power under the normal test conditions shall be within +/- 1.5 dB of the nominal value specified for the BS and the MS in PAS 0001-2: "TETRAPOL Specification; Radio Air Interface" [1] clauses 8.3.1.1 and 8.3.1.2.

Under extreme conditions, the output power shall be within + 2 dB, - 3 dB of the nominal value specified above.

8.1.1.3 Limits for power control

For the MS, the minimum level value shall be within +/- 3 dB of the minimum value specified in PAS 0001-2 [1] clause 8.3.1.2 under level test conditions, the transmitter power being controlled through the test connector.

8.1.2. Unwanted conducted emissions

8.1.2.1. General definition

Unwanted conducted emissions are defined as conducted emissions at frequencies outside of the allocated channel. A transmitter having two modes, transmit operating mode and transmit standby mode, unless otherwise stated, unwanted emissions are specified for an equipment in transmit operating mode, i.e. whenever this equipment is transmitting or whenever it ramps-up or ramps-down.

8.1.2.2. Unwanted emissions close to the carrier

Measurements shall be done at the nominal centre frequency when the transmitter is in transmit operating mode and at the frequencies corresponding to the specified frequency offsets. When applicable, relative measurements (dBc) shall refer to the level measured at the nominal center frequency in steady state transmit mode.

8.1.2.2.1.Measurement over the useful part of the frame

For a channel separation of 12.5 kHz, the unwanted emission close to the carrier shall not exceed:

-60 dBc for a frequency offset of 12.5 kHz and
-70 dBc for frequency offsets of 25KHz.

For a channel separation of 10.0 kHz, the unwanted emission close to the carrier shall not exceed:

-36 dBc for a frequency offset of 10 KHz and -60 dBc for a frequency offset of 20 kHz. For MS in direct mode, under extreme conditions, when the channel separation is 12.5 kHz the unwanted emission close to the carrier shall not exceed -50 dBc for a frequency offset of 12.5 kHz and when the channel separation is 10.0 kHz the unwanted emission close to carrier shall not exceed -26 dBc for a frequency offset of 10.0 kHz.

In any case no requirement in excess of -36 dBm shall apply.

The signals transmitted by the equipment under test can be D0 or D11 for the reference level measurements and shall be D11 for the unwanted emission levels measurements.

These levels shall correspond to mean power when the transmitter is transmitting outside the ramp-up and ramp-down periods.

8.1.2.2.2. Measurement during the switching transients

The unwanted emissions during the switching transients are related to the unwanted emissions peak levels close to the carrier frequency when the transmitter under test ramps-up and ramps-down. These ramp-up and ramp-down periods are defined by the RF output power time mask requirement (see subclause 8.3.5 of PAS 0001-2: "TETRAPOL Specification; Radio Air Interface" [1]).

The following maximum hold level shall not be exceed under normal test conditions:

For a channel spacing of 12.5 kHz, the maximum hold level limit is - 50 dBc when the frequency offset is 12.5 kHz. In any case no limit below -27 dBm shall apply.

For a channel spacing of 10.0 kHz, the maximum hold level limit is - 26 dBc when the frequency offset is 10.0 kHz. In any case no limit below -27 dBm shall apply.

0 dBc refers to the signal transmit mean power when measured in the nominal channel and outside the ramp-up and ramp-down periods. The signal transmitted by the equipment under test shall be D0 or D11 for the reference and the transient levels measurement.

8.1.2.3. Unwanted emissions far from the carrier

8.1.2.3.1. Definition

These unwanted emissions are emissions not covered by subclause 8.1.2.2 and measured in the range 9 kHz to 4 GHz. Two kind of spurious shall be considered: discrete spurious (narrow bandwidth) and wideband noise spurious.

8.1.2.3.2. Limits

Under normal conditions:

Discrete spurious: the maximum allowed power for each spurious emission shall be less than - 36dbm below 1 GHz and -30 dBm between 1 GHz and 4 GHz. the lower part of the spectrum (near 9 kHz) is subject to specific measurements methods if necessary.

Wide-band noise: the following wide-band noise levels shall not exceed the limits shown in the following table at frequencies corresponding to the listed offsets from the nominal carrier frequency. The requirements apply symmetrically to both sides of the transmitter band. The wideband noise shall be measured in a 8 $\pm$ 0,5 kHz bandwidth filter. The signal generated by the transmitter under test shall be modulated (D11 or D12 test signal).

Table 1: Limits

Frequency Offset	Maximum Level	
	Mobile station	Base station
25 kHz - 40 kHz	- 70 dBc	- 70 dBc
40 kHz- 100 kHz	- 75 dBc	- 75 dBc
100 kHz- 150 kHz	-85 dBc	- 85 dBc
150 kHz- 500 kHz	- 90 dBc	- 95 dBc
500 kHz- 10 MHz	- 100 dBc	- 105 dBc
> 10 MHz and in the receive band	- 80 dBm	- 100 dBm

8.1.2.4. Unwanted conducted emission in the transmit standby mode

8.1.2.4.1. Definition

When in standby mode only the discrete spurious emissions are considered (see subclause 8.1.2.3.1).

8.1.2.4.2. Limits

The power emitted by the equipment shall not exceed - 57 dBm at frequencies between 9 kHz and 1 GHz and - 47 dBm at frequencies from 1GHz to 4 GHz. The lower part of the spectrum (near 9 kHz) is subject to specific measurements methods if necessary.

8.1.3. Unwanted radiated emissions

Specifications of ETS 300-113: "Radio equipment system (RES) Land mobile. transmission of data and speech and having, an antenna connector" [2] shall apply. A 50 Ω load shall be connected to the antenna connector(s) for the test.

8.1.4. Radiofrequency tolerance

8.1.4.1. Definition

The frequency tolerance of the transmitter is the difference between the measured central frequency of the transmitted signal and the nominal frequency of the transmitter or the central frequency of a reference signal.

8.1.4.2. Limits

Under normal and extreme test conditions:

a) The BS central frequency shall be accurate to within +/- 0.2 p.p.m. (part per million).
b) In trunked mode, the MS central frequency shall be accurate to within +/- 0.2 p.p.m. compared to the central frequency of the signal received from the BS.
For test purpose, the signal received from the BS shall be simulated by a D3 test signal which is applied to the MS at its antenna connector at a level 3 dB below the limit of the static reference sensitivity level (-122 dBm) under static propagation conditions.
The central frequency of the D3 signal can be controlled on a range of +/- 200 Hz. In the case of half duplex MS the TX/RX duty cycle may be approximately 29/1 seconds.

c) In direct mode, the MS central frequency shall be accurate to within +/- 1.3 kHz.

8.1.5. RF output power time mask

This specification does not apply to transmitters intended for continuous transmissions only. It is related to the transmitter attack time and the transmitter release time. The specified transmit power level is the level measured in the band of the transmit channel at the transmitter output.

8.1.5.1. Definition

Pc = steady state power

Txon = time at which the final irrevocable logic decision to power on the transmitter is taken : Time at which the first modulated symbol of the frame is transmitted. If an access point is unavailable then the time after which the transmit power exceeds (Pc - 50 dB) may be taken.

T1 = time when the transmit power exceeds (Pc - 30 dB)

T2 = time when the transmit power reaches (Pc - 6 dB)

T3 = time when the transmit power has reached a level 3 dB below or above the steady state power and maintains a level within +/- 3 dB from Pc thereafter.

T4 = time at which the transmit power has reached a level 1.5 dB below or above the steady state powerand maintains a level within +/-1.5 dB from Pc thereafter.

Tx off = time at which the irrevocable logic decision to power off the transmitter is taken. If an access point is unavailable then the time after which the transmit power remains below (Pc - 3 dB) may be taken.

T5 = time when the transmit power falls below (Pc - 6 dB)

T6 = time when the transmit power falls below (Pc - 30 dB)

T7 = Time after which the transmit power falls below (Pc - 70 dB)

8.1.5.2. Limits

The following limits shall hold for the time intervals listed

Table 2: Time intervals limits

Time interval between instants defined above	specified limits
T3 - Txon	between 1 and 3 ms
T2 - T1	> 0.2 ms
T4 - T3	between 0 and 2 ms
T6 - T5	> 0.2 ms
T7 - Tx off	< 2.5 ms

This limits shall be met under normal conditions.

8.1.6. Intermodulation attenuation

8.1.6.1. Definition

The intermodulation attenuation is the ratio of the power level of the wanted signal to the power level of an intermodulation component. It is a measure of the capability of the transmitter to inhibit the generation of signals in its non-linear elements caused by the presence of the useful carrier and an interfering signal reaching the transmitter via its antenna connector.

8.1.6.2. Limits

a) Base station: Two classes of transmitter intermodulation attenuation are defined, the BS transmitter shall fulfil one of the requirements under normal test conditions:

- In general the intermodulation attenuation ratio shall be at least 40 dB for any intermodulation component when the power level of the interfering signal is 30 dB below the power level of the wanted signal at the antenna connector of the equipment under test and

when its central frequency is within 50 kHz to 100 kHz above or below the central frequency of the wanted signal.

- In special service conditions the intermodulation attenuation radio shall be at least 70 dB for any intermodulation component with the same conditions as above. In the case where the performance is achieved by additional internal or external isolating devices (such as circulators), they shall be supplied at the time of testing and shall be used for the measurements.

b) Mobile station: Under normal test conditions, for an MS transmitter operating at the nominal power defined by its class the intermodulation attenuation shall be at least 40 dB (power class 1) and 45 dB (power class 2 and 3) for any intermodulation component when the power level of the interfering signal is 30 dB (class 1) and 40 dB (class 2 and 3) below the power level of the wanted signal at the antenna connector of the equipment under test and when its central frequency is within 50 kHz to 100 kHz above or below the central frequency of the wanted signal.

8.2. Receiver parameters limits

8.2.1. Introduction

In the present subclause, the levels of the test signals are given in terms of power levels (dBm) or in terms of relative levels (dBc) with respect to the power level of the wanted signal at the antenna connector of the receiver.

Sources of test signals, wanted or unwanted, shall be connected in such a way that the impedance presented to the receiver input (antenna connector) is a 50 Ω non-reactive impedance. this requirement shall be met irrespective of whether one or more signals using a combining device are applied to the receiver simultaneously.

Static propagations conditions are assumed for both wanted and unwanted signals. For blocking, spurious response rejection and intermodulation response rejection the performances are related to the static reference sensitivity performances concerning the VCH class 2 bits, the BER limit being equal to 1,5% (see subclause 8.5.2.4 of PAS 0001.2 [1].

In the case of a static channel, the process of error occurrence can be estimated as stationary and bi-nomial, due to the small BER limit figure this process can be approximated as gaussian. A « good » equipment being one for which the actual BER value is equal or smaller to the BER limit and adopting the rule to have a probability to refuse a « good » equipment smaller than 1% and to have a probability to accept a « bad » equipment smaller than 0,5% (a « bad » equipment presenting an actual BER performance equal or larger than 1,5 x BER limit corresponding approximately to a degradation of less than 1 dB in static conditions) it can be shown that the estimated BER figure threshold (measured number of bits in error/total number of tested bits = n/N) has to be equal to 1,21 x BER limit and that the minimum number N of tested bits has to be equal to 8000, so the number of VCH frames to be tested shall be at least 80 (see subclause 6.1 of PAS 0001-2 [1]). The duration of each individual test shall be at least 1,6 seconds and the limit value of the number "n" of bits in error to accept or refuse a test shall be $1{,}82 \times 10^{-2} \times N$.

8.2.2. Blocking or desensitisation

8.2.2.1. Definition

Blocking is a measure of the capability of the receiver to receive a modulated wanted input signal in the presence of an unwanted unmodulated input signal on frequencies other than those of the spurious responses or the adjacent channels without this unwanted input signal causing a degradation of the performance of the receiver beyond a specified limit.

8.2.2.2 Limits

The static reference sensitivity performance for the VCH class 2 bits shall be met under normal test conditions when the following signals are simultaneously applied to the receiver under test.

- a modulated wanted signal (D3 signal) at the nominal frequency of the receiver and 3 dB above the limit of the static reference sensitivity level (-116 dBm for the MS and -118 dBm for the BS);

- a unmodulated unwanted signal (D2 signal) at a frequency from 1 MHz to 10 MHz away from the nominal frequency of the receiver avoiding those frequencies at which spurious responses could occur and the adjacent channels and at a level 84 dBc above the level of the wanted signal.

8.2.3. Spurious response rejection

8.2.3.1. Definition

The spurious response rejection is a measure of the capability of the receiver under test to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal at any other frequency at which a response has been obtained (see clause 5.2.6 of ETSI 300-113[2]).

8.2.3.2. Limits

The static reference sensitivity performance for the VCH class 2 bits shall be met under normal test conditions when the following signals are simultaneously applied to the receiver:

- a modulated wanted signal (D3 signal) at the nominal frequency of the receiver and 3 dB above the limit of usable sensitivity);
- a modulated unwanted signal (D4 or D5 signals) at a frequency for which a spurious response is obtained (see subclauses 9.7.2 and 9.7.3 of ETS 300-113 [2]) and at a level 70 dBc above the level of the wanted signal.

In the limited frequency range as defined in ETS 300-113 [2] (see subclause 9.7.2), the number of spurious responses for which the blocking specification is not met shall not exceed 5% of the total number of frequency channels in the limited frequency range.8.2.4.Intermodulation response rejection

8.2.4.1. Definition

Intermodulation response rejection is a measure of the capability of the receiver under test to receive a wanted modulated signal without exceeding a given degradation due to the presence of two or more unwanted signals with a specific frequency relationship to the wanted signal frequency (see clause 5.2.7 of ETSI 300-113[2]).

8.2.4.2. Limits

The static reference sensitivity performance for the VCH class 2 bits shall be met under normal test conditions when the 3 following signals are simultaneously applied to the receiver under test.

- a modulated wanted signal (D3 signal) at the nominal frequency of the receiver and 3 dB above the limit of usable sensitivity.
- a first unwanted and unmodulated signal (D2 signal) at a frequency 50 kHz away from the nominal frequency of the receiver and 65 dB in the case of MS testing or 70 dB in the case of BS testing above the level of the wanted signal.
- a second unwanted and modulated signal (D4 or D5 signals) at a frequency 100 kHz away from the nominal frequency of the receiver, the difference between the frequencies of the two unwanted signals being 50 kHz, and at the same level than the first unwanted signal.

8.2.5. Unwanted conducted emissions

8.2.5.1. Definition

The subclause 8.1.2.4.1. above shall apply.

8.2.5.2. Limits

The subclause 8.1.2.4.2. above shall apply.

8.2.6. Unwanted radiated emissions

The subclause 8.1.3. above shall apply.

8.3. Transmitter/Receiver performance

8.3.1. Transmitter phase accuracy

8.3.1.1. Definition

The transmitter phase error trajectory is defined as the difference between the phase of the actual transmitting signal wave form and the phase of the corresponding ideal signal wave form.

The transmitter phase accuracy is defined as the difference between the phase error trajectory and its linear regression on a frame duration.

8.3.1.2. Limits

Outside any transmitter attack time and release time and under normal test conditions, the RMS phase accuracy shall be less than 8° and its maximum peak deviation shall be less than 20° when measured over one frame duration and when the sampling rate is at least 2/TB, TB being the bit duration (125 μs). this measurement shall be repeated at least for 20 frames not necessarily contiguous. The test signal shall be the D12 signal.

8.3.2. Receiver performances

The receiver minimum performances of this subclause are defined in term of error rates. These error rates performances are specified for the Voice CHannel (VCH) (see subclause 6 of PAS 0001-2: "TETRAPOL Specification; Radio Air Interface".[1]). The information bits of this type of channel are subdivided into two classes: class 1 bits are protected by the concatenation of one error correcting code with one error detecting code and class 2 bits are not protected. Frame erasure occurs when a block of class 1 bits is declared in error by the receiver (FER is defined as the ratio of the number of erased blocks to the total number of transmitted blocks). Bit error rate (BER) are stated for class 2 bits in the accepted blocks.

FER and BER are estimated taking into account that transmitter errors do not occur and that the transmitter shall be tested separately. The FER and BER limits are function of the propagation conditions. The received power levels under multipath conditions are the sum of the mean power of each individual multipath.

Due to the randomness of the error events occurrence only estimations of BER and FER are achievable by test. The threshold values of BER and FER estimations for test are related to the BER and FER specified limits by the following rules:

– a « good » equipment presents actual BER and FER performances equal or smaller than the BER and FER limits;
– a « bad » equipment presents actual BER and FER performances equal or larger than the BER and FER limits multiplied by K (K = 1,5 in static propagation condition and K = 1,25 in multipath propagation conditions). These K figures correspond approximately in average to a 1 dB performances degradation.

Moreover, the duration of the tests (number of samples to be tested) are estimated to obtain low probabilities to refuse a « good » equipment or to accept a « bad » one. 1% and 0,5% have been respectively considered. Due to the multipath effects the external test conditions cannot be considered as stationary and the « error events » are not independent so and extension factor has also been adopted for the duration of the test (x 2 for the FER measurement if the vehicle speed is 50 and 100 km/h and if the central frequency of the signal is below 150 MHz and x20 for the BER measurements).

For the test, the wanted signal shall be the D3 signal.

Under extreme test conditions only BER shall be estimated.

8.3.2.1. Nominal error rates

8.3.2.1.1. Definition

This test measures the receiver performances under normal conditions i.e. without interference and with an input level of -85 dBm. It measures also the receiver performances when the level of the input signal is high.

8.3.2.1.2. Limits

Under normal test conditions and when the input level is between -85 dBm and -40 dBm, the limits are given in the following table. The propagation conditions shall be dynamic (TU50) or static.

Table 3: Limits

Condition	Logical channel	BER limit	Test threshold	Samples number
Static	VCH class 2 (BER)	$5 . 10^{-5}$	$6,05 . 10^{-5}$	$2,5 . 10^{6}$ bits
TU 50	VCH class 2 (BER)	0.15%	0.167%	$6,0 . 10^{6}$ bits

Under normal and extreme test condition, when the input level is -20 dBm, the limits are given in the following table.

Table 4: Limits at -20 dBm

condition	Logical channel	BER limit	Test threshold	Samples number
Static	VCH class 2 (BER)	0.1%	0.121%	$12,5 . 10^{5}$ bits

8.3.2.2. Dynamic reference sensitivity performance

8.3.2.2.1. Definition

The dynamic reference sensitivity performance measures the quality of the receiver when the input level of the wanted signal is equal to the dynamic reference sensitivity level. The dynamic propagation conditions shall be TU50 and HT200 The dynamic reference sensitivity level are:

Table 5: Dynamic reference sensitivity

	Normal test conditions	Extreme test conditions
MS	- 111 dBm	- 108 dBm
BS	- 113 dBm	- 110 dBm

8.3.2.2.2. Limits

Under normal and extreme test conditions when the input level is equal to the dynamic reference sensitivity level, the limits of error rates are given in the following table:

Table 6: Limits of error rates

propagation condition	Logical channel	Limit	Test Threshold	Samples number
TU 50	VCH class 1 (FER)	1%	1,11%	45000 frames (90000), see note1
TU 50	VCH class 2 (BER)	1,5%	1,67%	$600 . 10^{3}$ bits
HT 200	VCH class 1 (FER)	1,5%	1,67%	30000 frames
HT 200	VCH class 2 (BER)	2,5%	2,78%	$350 . 10^{3}$ bits

Note1: If the channel frequency is below 150 MHz

8.3.2.3. Reference interference performance

8.3.2.3.1. Definition

The reference interference performance measures the capability of the receiver to receive a wanted modulation signal without exceeding a given degradation due to the presence of an unwanted modulated signal.

The central frequency of the unwanted signal:

a) shall be equal to the nominal frequency of the receiver (cochannel interference);
b) shall differ from the nominal frequency of the receiver by an amount equal to 12.5 kHz (adjacent channel interference).

For the test, the unwanted signal shall be the D4 signal.

The difference of levels between the wanted and the unwanted signals shall be equal to the dynamic reference interference ratio.

The dynamic reference interference ratio values are:

– for cochannel interference under normal test conditions: C/Ic = + 15 dB - with C = -85 dBm and Ic = -100 dBm,
– for adjacent interference under normal test conditions: C/Ia = -45 dB
with for the MS: C = - 108 dBm and Ia = - 63 dBm
with for the BS: C = - 110 dBm and Ia = - 65 dBm
– for adjacent interference under extreme test conditions: C/Ia = - 39 dB
with for the MS: C = - 105 dBm and Ia = - 66 dBm
with for the BS: C = - 107 dBm and Ia = - 68 dBm

The dynamic propagation conditions shall be the same for C and for I. The realisations of these propagation conditions shall be statistically independent.

8.3.2.3.2. Limits

Under the above conditions (§ 8.3.2.3.1.), the limits of error rates are given in the following table:

Table 7: limits of error rates

propagation condition	Logical channel	Limit	Test Threshold	Samples number
TU 100	VCH class 1 (FER)	2%	2,22%	25000 frames (50000) see note 1
TU 100	VCH class 2 (BER)	3%	3,33%	300 . 10^3 bits

NOTE 1: if the channel frequency is below 150 MHz.

8.3.2.4. Static reference sensitivity performance

8.3.2.4.1. Definition

The static reference sensitivity performance measures the quality of the receiver when the input level of the wanted signal is equal to the static reference sensitivity level.

The propagation conditions shall be static. The static reference sensitivity level under normal test conditions are:

MS: - 119 dBm
BS: - 121 dBm

8.3.2.4.2. Limits

Under the above conditions (subclause 8.3.2.4.1), the limits of error rates are given in the following table:

Table 8: Limits of error rates

propagation condition	Logical channel	Limit	Test Threshold	Samples number
Static	VCH class 1 (FER)	1 %	1,21 %	$12{,}5 \cdot 10^3$ frames
Static	VCH class 2 (BER)	1,5 %	1,82 %	$10 \cdot 10^3$ bits

9. Methods of measurement

9.1. Methods of measurement for transmitters

The modulator input data to generate D0, D11 or D12 can be issued from the test equipment and introduced into the transmitter under test through its test connector or can be internally generated by the transmitter under test when it is in transmit test mode.

9.1.1. Output power measurement

Unless otherwise specified the measurement shall be performed in absence of modulation in that case the transmitter shall transmit the D0 test signal.

When it is not possible, the fact shall be stated in the test report and the test signals to be used shall be the D11 or D12 test signals.

The measurement shall be made under normal and extreme conditions at nominal output power, the limits are defined in subclause 8.1.1.2.

9.1.2. Unwanted conducted emissions measurement

9.1.2.1. Unwanted emissions close to the carrier measurement

9.1.2.1.1. Useful part of the frames measurement

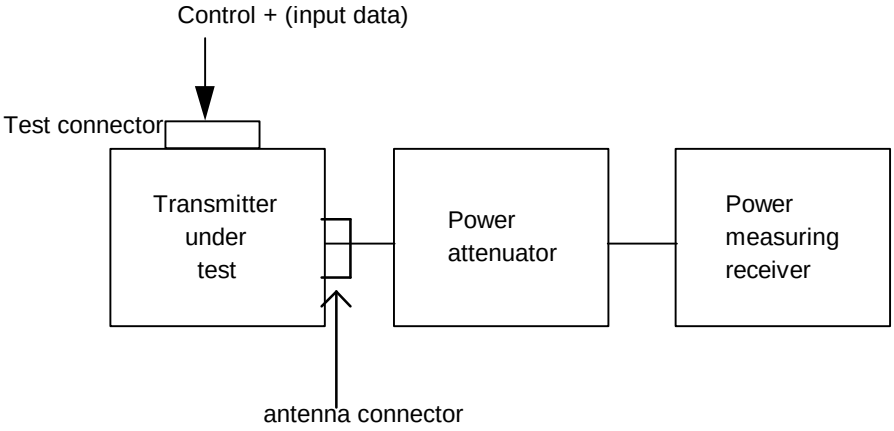


Figure 5: Useful part of the frames measurement

The unwanted emissions power may be measured with a power measuring receiver which is conforms to annex B of ETS 300-113 [2]. In particular the IF filter of the power measuring receiver shall be compliant with the specifications of the ETS 300-113 [2] annex B for a channel separation of 12.5 kHz.

The frequency of the measuring receiver shall be adjusted above the channel transmitter so that its - 6 dB response nearest to the transmitter channel is located at a displacement from the nominal central frequency of the transmitter under test as given in the following table:

Table 9: Displacement from the - 6 dB point

Channel separation	Displacement from the - 6 dB point
12.5 kHz	8.25 kHz
25.0 kHz	20.75 kHz
37.5 kHz	33.25kHz
10.0 kHz	6.50 kHz
20.0 kHz	16.50 kHz
30.0 kHz	26.50 kHz

The ratio of the unwanted emissions close to the carrier r.m.s power to the r.m.s. output power shall be measured.

The measurement shall be repeated with the frequency of the measuring receive adjusted below the carrier following the above table.

For a MS transmitter in trunked mode, the measurement shall be made outside the period when the MS is receiving the D3 test signal for synchronisation purpose and the relevant ramp up and ramp down periods.

The measurement shall be mode under normal and extreme conditions at nominal output power and minimum level.

The output power of the transmitter shall be the power according to its class as defined in subclause 8.3.1 of PAS 001-2: "TETRAPOL Specification; Radio Air Interface".

9.1.2.1.2. Switching transients measurements

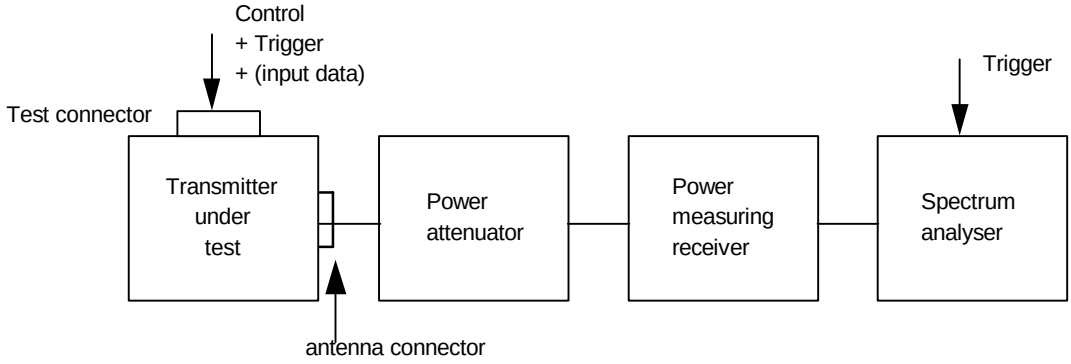


Figure 6: Switching transients measurements

The switching transients power may be measured with the power measuring receiver (see subclause 9.1.2.1.1.) connected to a spectrum analyser.

During the transients measurements, the frequency of the measuring receiver shall be adjusted above (then below), the transmitter channel so that its - 6 dB response nearest to the transmitter channel is located at a displacement from the nominal central frequency of the transmitter under test as given in the following table.

Table 10: Displacement from the - 6 dB point

Channel separation	Displacement from the - 6 dB point
12.5 kHz	8.25 kHz
10.0 kHz	6.50 kHz

The spectrum analyser shall be used to record the envelope of the transmit signal during the transmitter attack time (ramp up) and release time (ramp down). The record duration of each transient period shall be at least 20 ms.

The peak value shall be noted in dBc with respect to the mean steady state output power of the transmitter measured in the nominal channel. The steady state output power shall be the power according to the power class of the transmitter under test.

The measurements shall be repeated at least 5 times, the 5 noted peak values shall be ordered, the highest one corresponds to the switching transient measurement.

The measurement shall be made under normal test conditions at nominal output power.

In the case of the test of an half duplex capacity MS in trunked mode, the synchronisation of the MS transmitter by the D3 test signal (see subclause 7.3) can occur when the MS transmitter is in standby mode.

9.1.2.2. Unwanted emissions far from the carrier measurements

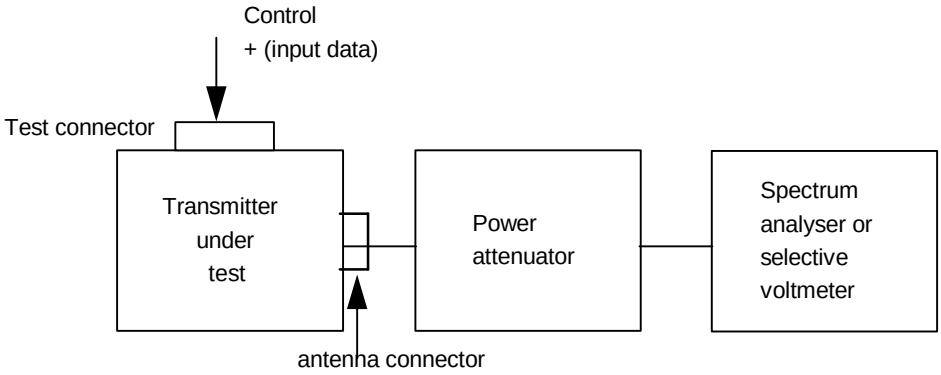


Figure 7: Spurious level measured

The spurious level (wideband and discrete) shall be measured when the output signal of the transmitter under test is the D11 or D12 test signal.

The signal power shall be the power according to the power class of the transmitter. In the case of MS the measurement shall be repeated with a signal power corresponding to its minimum power according to subclause 8.3.1.2 of PAS 0001-2 [1].

For MS, with direct mode capability the test can be conducted only with the equipment under test in this mode.

In case of dBc measurement, the reference power is the steady state mean power of the transmitter in the nominal channel.

The test equipment shall measure the mean power (r.m.s. value) of the spurious at the output of its receive filter.

For wide band level measurement, the bandwidth of this filter shall be if possible equal to 8 +/- 0.5 kHz.

If it is not possible, the band width of the filter shall be noted and a correcting factor equal to 10 log. (8/B) (in dB) shall be introduced where B (in kHz) is equal to the actual bandwidth of the receive filter. In any case B shall be within the range (0.1 kHz-15 KHz).

For discrete spurious measurement the method described in subclause 8.6. of ETS 1000-113 [2] may be applicable.

The test shall be conducted under normal test conditions at nominal output power.

9.1.2.3. Unwanted conducted emission in the standby mode measurement.

The spurious level (discrete spurious only) shall be measured when the transmitter under test is in standby mode.

The method of measurement described in 9.1.2.2. is applicable.

9.1.3. Unwanted radiated emissions measurement

The method of measurement described in ETS 300-113 [2] shall apply.

The test shall be conducted under normal test conditions at nominal output power.

9.1.4. Radio frequency tolerance measurement

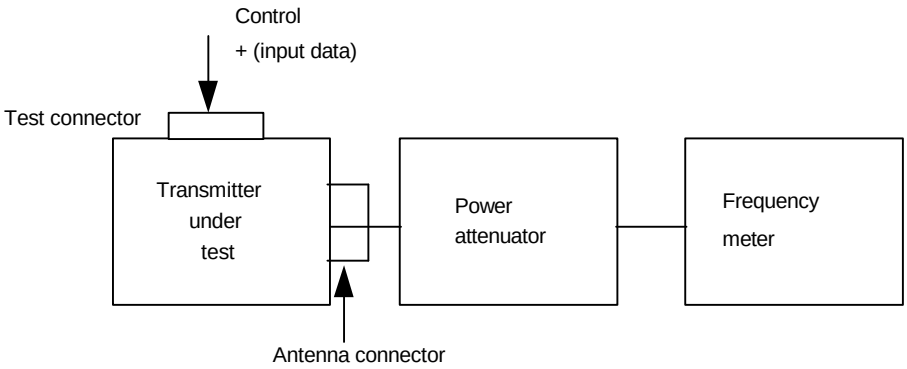


Figure 8: Radio frequency tolerance measurement

The frequency of the transmitter shall be measured when the output signal of the transmitter under test is by the D0 signal. The signal power shall be the power according to the power class of the transmitter.

In a first step, the modulation signal shall produce a D0 signal the frequency of which being 2 kHz above the nominal frequency of the channel. The frequency measurement fA shall be noted.

In a second step, the modulation signal shall produce a D0 signal the frequency of which being 2 kHz below the nominal frequency of the channel. The frequency measurement fB shall be noted.

The central frequency tolerance is equal to f0 - [(fA + fB): 2] f0 being the nominal frequency of the transmit channel in the case of BS or MS in direct mode, f0 being the nominal frequency of the uplink channel corresponding to the frequency of the D3 signal in the case of MS in trunked mode.

In the case of MS in trunked mode, the D3 test signal at the input of the MS shall be -3db with respect to the static reference sensitivity level (-122 dBm in normal test conditions, -119 dBm in extreme test conditions). The propagation conditions are static. Moreover to check the capability, of a MS in trunked mode to track the D3 signal frequency variations, the test shall be repeated with a D3 signal frequency shifted by +/- 0.4 p.p.m with respect to its nominal value. In the case of half duplex MS, the frequency measurement shall be mode at least 15 seconds after the end of a period of synchronisation, the MS being in steady state transmit mode. Before the test, the central frequency of the D3 test/signal shall be measured.

If the transmitter under tests cannot generate a D0 test signal the radio frequency tolerance can be measured by a vector signal analyser (see subclause 9.3.1), the slope of the linear regression line of the phase error trajectory being equal to the radio frequency tolerance of the equipment under test.

In any case, the test shall be conducted under normal and extreme test conditions, at nominal output power.

9.1.5. RF output power time mask measurement

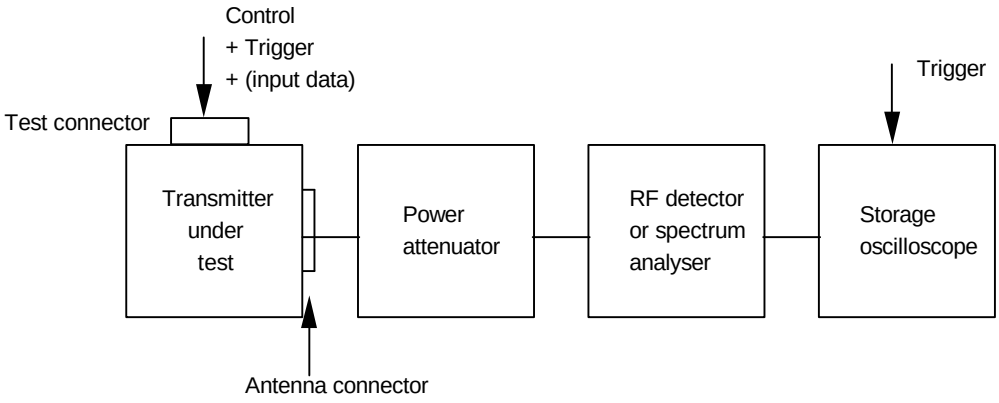


Figure 9: RF output power time mask measurement

The storage oscilloscope (or a transient recorder) shall record the amplitude transient from the detector (or the spectrum analyser) on a logarithm scale. The spectrum analyser shall be set in the «zero span mode».

The trace of the oscilloscope shall be calibrated in power (dB).

A trigger device may be required to ensure that the start of the sweep of the oscilloscope time base occurs at the instant at which the «transmitter on» function or the «transmitter off» function is initiated.

The output signal from the transmitter shall be the D0 or D11 or D12 test signal. Its power shall be the power according to power class of the transmitter. For MS, the test shall be repeated with an output signal level corresponding to its minimum power according to subclause 8.3.1.2. of PAS 0001-2: "TETRAPOL Specification; Radio Air Interface". In this last case, specifications concerning T1, T2 , T5 and T6 shall not be considered.

For MS with direct mode capability, the test can be conducted only with the equipment under test in this mode.

The measurement shall be made under normal test conditions, at nominal output power and minimum level.

9.1.6. Intermodulation attenuation measurement

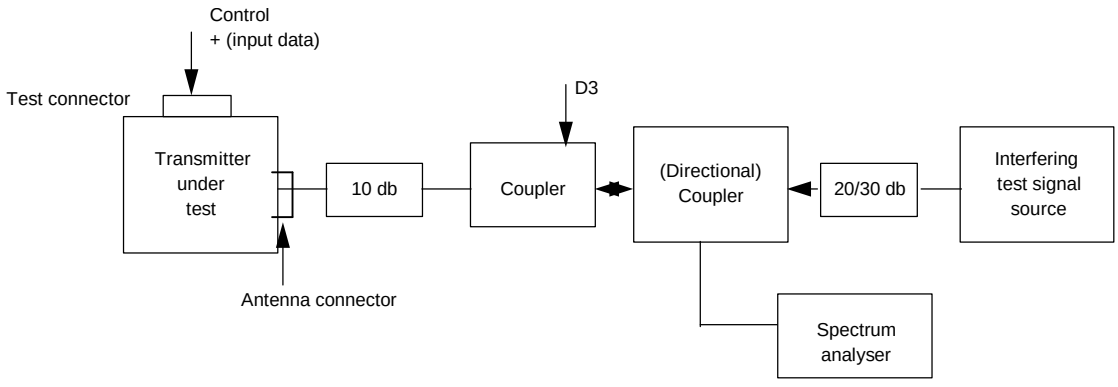


Figure 10: Intermodulation attenuation measurement

The measurement arrangement shown in the above figure may be used.

In order to reduce the influence of mismatch errors it is important that the 10 dB power attenuator is coupled to the transmitter under test with the shortest possible connection.

The interfering test signal source shall provide the same power output as the transmitter under test.

The couplers shall have an overall direct insertion loss of less than 1,5 dB.

The output signal from the transmitter under test shall be the D0 test signal if possible.

The interfering test signal shall be unmodulated its frequency shall be in a first step within 50 kHz to 100 kHz above the central frequency of the D0 signal. the measurement shall be repeated with the interfering test signal frequency within 50 kHz to 100 kHz below the central frequency of the D0 signal.

The frequency shall be chosen in such a way that the intermodulation components do not coincide with other spurious components.

The attenuator at the output of the interfering test signal source shall be 20 dB for BS and MS class 1 and 30 dB for MS class 2 and class 3.

For MS with direct mode capability, the test can be conducted only with the equipment under test in this mode.

The intermodulation component shall be measured by direct observation on the spectrum analyser of the ratio of the largest third order intermodulation component with respect to the signal issued from the transmitter under test.

The measurement shall be made under normal test conditions, at nominal output power.

9.2. Methods of measurements for receivers

9.2.1. Blocking measurement

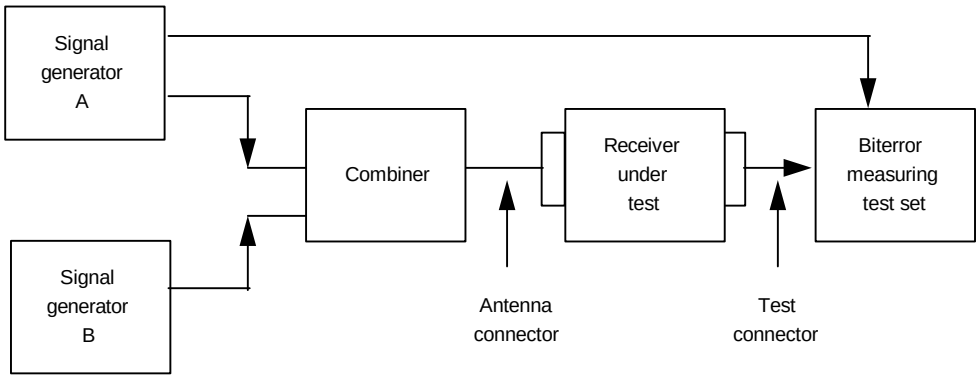


Figure 11: Blocking measurement

The wanted signal (D3 test signal) is provided by the generator A. Its level at the antenna connector of the receiver under test shall be 3 dB above the static reference sensitivity level. Its central frequency shall be the nominal central frequency of the receiver.

The unwanted signal (D2 test signal) is provided by the signal generator B. Its level at the antenna connector of the receiver shall be 84 dB above the level of the wanted signal. Its frequency shall be from 1 MHz to 10 MHz away from the nominal frequency of the receiver. For practical reasons, the measurements shall be carried out at frequencies of the unwanted signal at approximately +/- 1 MHz, +/- 2 MHz, +/- 5 MHz +/- 10 MHz from the nominal receiver frequency avoiding those frequencies at which spurious responses could occur. For this reason to test the spurious response rejection before is suitable.

The BER on VCH class 2 bit shall be estimated as explained in subclause 8.2.1.

The test shall be conducted under normal test conditions.

9.2.2. Spurious response rejection measurement

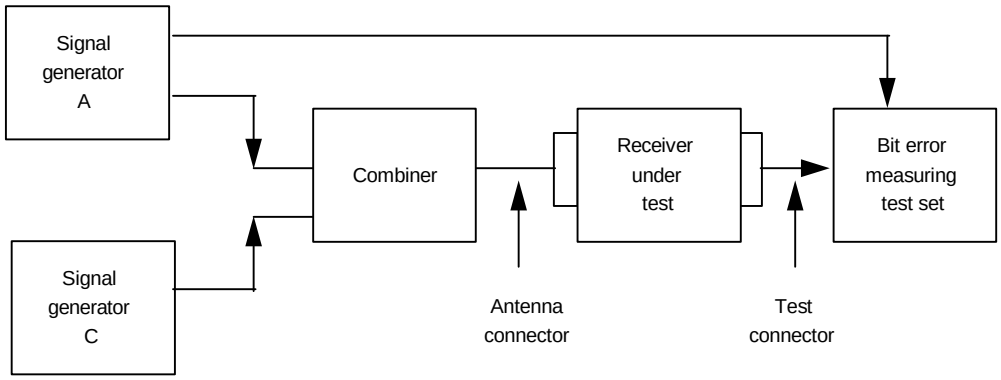


Figure 12: Spurious response rejection measurement

Spurious responses may occur at all frequencies throughout the frequency spectrum and the requirement of this clause shall be met for all frequencies. However for practical reasons the measurements for type testing shall be performed only on frequencies that have a high probability to present spurious responses.

These frequencies are:

a) those that belong to the « limited frequency range » as defined in subclause 9.7.2. of ETS 300-113: "Radio equipment system (RES) Land mobile. transmission of data and speech and having, an antenna connector" [2].

b) those that belong to the range from fr/3.2 (or 30 MHz which ever is higher) to 3,2 xfr where fr is the nominal frequency of the receiver and that are equal to nfl0 +/- fi1 where fl0 is the frequency of the local oscillator applied to the first mixer of the receiver, fi1 is the first intermediate frequency of the receiver and n is an integer greater than or equal to 2.

The wanted signal (D3 test signal) is provided by the generator A. Its level at the antenna connector of the receiver under test shall be 3 dB above the static reference sensitivity level. Its central frequency shall be the nominal central frequency of the receiver.

The unwanted signal (D4 or D5 test signal) is provided by the signal generator B. Its level at the antenna connector of the receiver shall be 80 dB above the level of the wanted signal. Its frequency shall be varied in increments of 5 kHz over the limited frequency range (see a) above and over the frequencies in accordance with the calculation b) above and outside the nominal channel of the receiver and its 6 first adjacent channels.

For each unwanted frequency, the BER on the VCH class 2 bits shall be estimated. Every time an estimated BER is above the limit threshold as defined in subclause 8.2.1, the level of the generator B shall be adjusted 70 dB above the wanted signal. The BER shall be estimated one more time and the result of this second estimation shall be below the limit threshold as defined in subclause 8.2.1 to be compliant.

The test shall be conducted under normal test conditions.

9.2.3. Intermodulation response rejection measurement

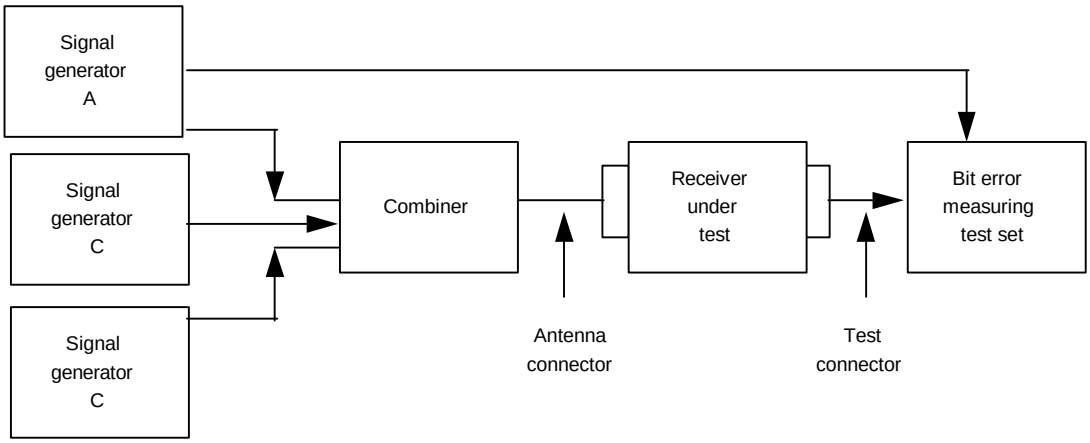


Figure 13: Intermodulation response rejection measurement

The wanted signal (D3 test signal) is provided by the signal generator A. Its level at the antenna connector of the receiver under test shall be 3 dB above the static reference sensitivity level. Its central frequency shall be at the nominal frequency of the receiver.

The first unwanted signal (D2 test signal) shall be unmodulated and is provided by the signal generator B. Its central frequency shall be 50 kHz above the nominal frequency of the receiver.

The second unwanted signal (D4 or D5 test signal) shall be modulated and is provided by the signal generator C. Its central frequency shall be 100 kHz above the nominal frequency of the receiver.

The level of the unwanted signals shall be 65 dB (if MS receiver) or 70 dB (if BS receiver) above the level of the wanted signal.

The BER on VCH class 2 bit shall be estimated as explained in subclause 8.2.1.

The test shall be repeated with the frequency of the first unwanted signal 50 kHz below the nominal frequency of the receiver and the frequency of the second unwanted signal 100 kHz below the nominal frequency of the receiver.

The test shall be conducted under normal test conditions.

9.2.4. Unwanted conducted emissions measurements

The method of measurements describes in 9.1.2.3. shall apply.

9.2.5. Unwanted radiated emissions measurements

The method of measurements described in ETS 300-113: "Radio equipment system (RES) Land mobile. transmission of data and speech and having, an antenna connector" [2] shall apply.

The test shall be conducted under normal test conditions, at nominal output power.

9.3. Transmitter/Receiver performances measurements

9.3.1. Transmitter phase accuracy measurement

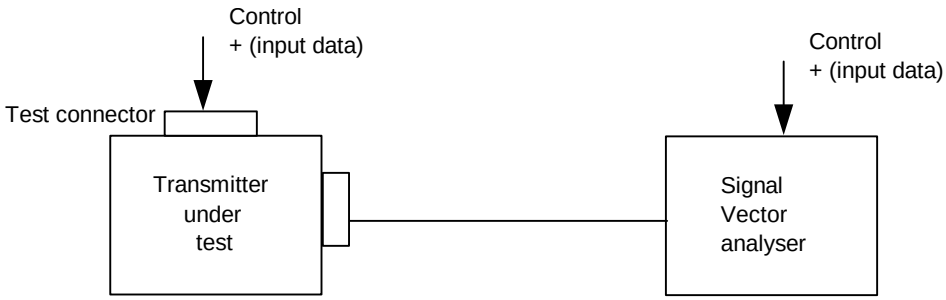


Figure 14: Transmitter phase accuracy measurement

The transmitter under test shall transmit the D12 test signal.

The measurement shall be made when the transmitter is in transmit steady state outside any attack or release periods.

After a synchronisation period, the signal vector analyser shall estimate the phase error trajectory and its linear regression line. It shall calculate the difference between the phase error trajectory and its linear regression line.

The peak value and the r.ms value of this difference shall be estimated and calculated on a frame duration basis. The sampling rate being at least 2/TB with TB equal to the bit duration. The peak and r.m.s. values estimation and calculation shall be repeated at least on 20 frames.

The test shall be conducted under normal test conditions, at nominal output power and minimum level.

9.3.2. Receiver performances measurements

9.3.2.1. Nominal error rates measurement

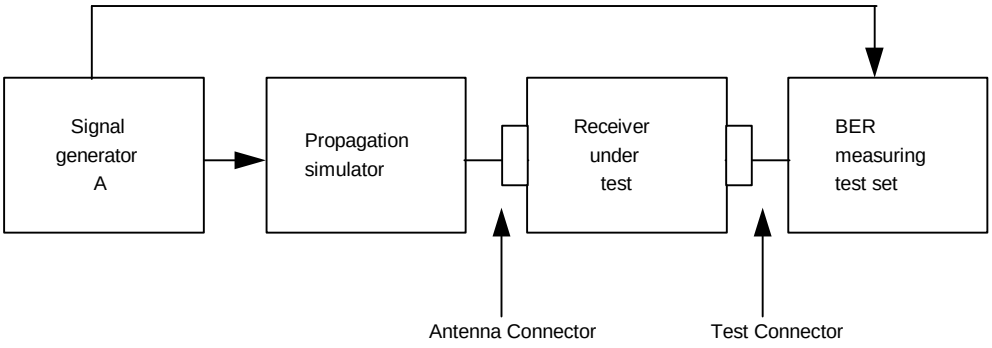


Figure 15: Nominal error rates measurement

The signal generator A shall provide the D3 test signal. The level of the test signal at the antenna connector of the receiver under test shall be adjusted following subclause 8.3.2.1. Its central frequency shall be equal to the nominal frequency of the receiver.

The test shall be conducted under normal and extreme conditions following the requirements of subclause 8.3.2. and subclause 8.3.2.1.2.

9.3.2.2. Dynamic reference sensitivity performance measurements

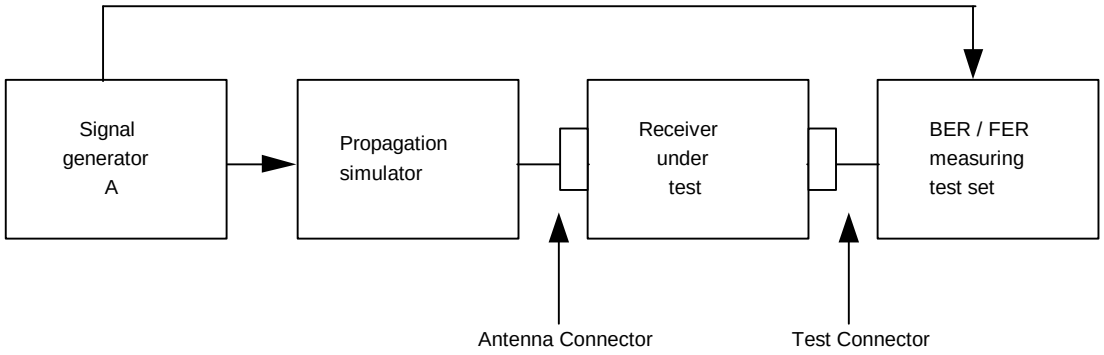


Figure 16: Dynamic reference sensitivity performance measurements

The signal generator A shall provide the D3 test signal. The level of the test signal at the antenna connector of the receiver under test shall be the dynamic reference sensitivity level (see subclause 8.3.2.2.1.). Its central frequency shall be equal to the nominal frequency of the receiver.

The test shall be conducted under normal and extreme conditions following the requirements of subclause 8.3.2. and subclause 8.3.2.2.2.

9.3.2.3. Reference interference performance measurement

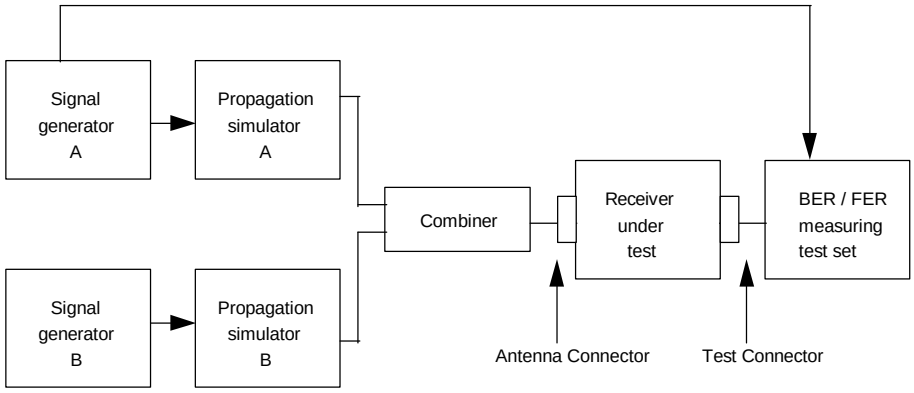


Figure 17: Reference interference performance measurement

The signal generator A shall provide the wanted signal (D3 test signal). The central frequency of the wanted signal shall be the nominal frequency of the receiver under test. Its level at the antenna connector of the receiver shall be adjusted following the requirements of subclause 8.3.2.3.1.

The signal generator B shall provide the unwanted signal (D4 test signal). The unwanted signal frequency and level at the antenna connector of the receiver shall be adjusted following the requirements of subclause 8.3.2.3.1.

The propagation simulators A and B shall provide the same TU 100 propagation conditions, they shall be independent form each other.

The test shall be conducted in three steps under normal test conditions and following the requirements of subclause 8.3.2 and 8.3.2.3.2:

- first step: the central frequency of the unwanted signal shall be the nominal frequency of the receiver (cochannel interference);
- second step: the central frequency of the unwanted signal shall be 12.5 kHz below the nominal frequency of the receiver (lower adjacent channel interference);
- third step: the central frequency of the unwanted signal shall be 12.5 kHz above the nominal frequency of the receiver (higher adjacent channel interference).

Under extreme test conditions only the second and third steps shall be conducted and only BER shall be estimated following the subclause 8.3.2 and 8.3.2.3.2 requirements.

9.3.2.4. Static reference sensitivity performance measurement

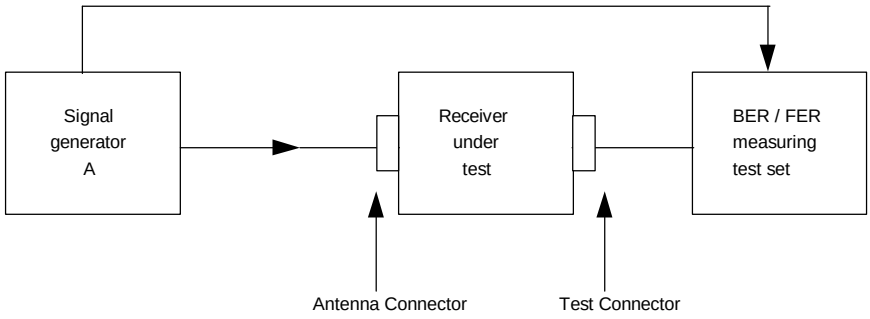


Figure 18: Static reference sensitivity performance measurement

The signal generator A shall provide the wanted signal (D3 test signal). The central frequency of the wanted signal shall be the nominal frequency of the receiver under test. Its level at the antenna connector of the receiver shall be the static reference sensitivity level as defined in subclause 8.3.2.4.1.

The test shall be conducted in normal test conditions following the requirements of subclause 8.3.2.4.2.

History

Document history		
Date	**Status**	**Comment**
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