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European Standard (Telecommunications series)

Fixed Radio Systems;
Conformance testing;
Part 2-2: Point-to-Multipoint equipment;
Test procedures for FDMA systems

Reference

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Keywords

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Contents

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Foreword

This European Standard (Telecommunications series) has been produced by ETSI Technical Committee Transmission and Multiplexing (TM).

The present document is part 2-2 of a multi-part deliverable covering the Fixed Radio Systems; Conformance testing, as identified below:

Part 1: "Point-to-point equipment - Definitions, general requirements and test procedures";

Part 2-1: "Point-to-Multipoint equipment; Definitions and general requirements";

Part 2-2: "Point-to-Multipoint equipment; Test procedures for FDMA systems";

Part 2-3: "Point-to-Multipoint equipment; Test procedures for TDMA systems";

Part 2-4: "Point-to-Multipoint equipment; Test procedures for FH-CDMA systems";

Part 2-5: "Point-to-Multipoint equipment; Test procedures for DS-CDMA systems";

Part 3-1: "Point-to-Point antennas - Definitions, general requirements and test procedures";

Part 3-2: "Point-to-Multipoint antennas - Definitions, general requirements and test procedures".

The present document defines harmonized test methods for the conformance testing of point-to-multipoint fixed radio systems applying frequency division multiple access method (FDMA). It should be noted that this part 2-2 can only be applied in conjunction with part 2-1.

EN 301 126-2-1 [2] defines the conformance testing requirements (definitions and general requirements) for radio specific parameters required directly by the relevant EN/ETS for point-to-multipoint system. Annex A of that part 2-1 contains the supplier declaration, annex B contains the test report format.

Parts 2-3 to 2-5 contain the appropriate test procedures for the other access methods.

It is recommended that where a clarification of a test procedure or an agreed test procedure is required, this should be described on the final page of the test report titled "Additional information supplementary to the test report".

National transposition dates	
Date of adoption of this EN:	24 November 2000
Date of latest announcement of this EN (doa):	28 February 2001
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	31 August 2001
Date of withdrawal of any conflicting National Standard (dow):	31 August 2001

1 Scope

The present document details standardized test procedures for conformance testing of equipment for Point-to-Multipoint (P-MP) digital radio relay systems applying frequency division multiple access method (FDMA).

Standardized procedures are required in order to fulfil CEPT/ERC/DEC/(97)10 [1] on the mutual recognition, within CEPT, of the results of conformance tests on equipment carried out in individual CEPT Countries. Furthermore the procedures described in this part two of the EN 301 126-2 are relevant to be able to fulfil the Conformance assessment procedure described in Chapter II of the R&TTE Directive 1999/5/EC [3] in order to demonstrate the compliance of the DRRS with the relevant essential requirements identified in article 3.2 of the R&TTE Directive 1999/5/EC [3].

The present document is intended to be applied in conjunction with EN 301 126-2-1 [2] and in conjunction with the individual equipment ENs/ETSs describing FDMA methods and will enable commonality of test results, irrespective of the Accredited Laboratory carrying out the test.

The conformance tests described in the present document are those related to radio specific parameters required directly by the relevant radio relay ENs/ETSs. Conformance tests to other boundary EN/ETS (e.g. those for system input/output interfaces and related base band process) are outside the scope of 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] CEPT/ERC/DEC(97)10 ERC Decision of 30 June 1997 on the mutual recognition of conformity assessment procedures including marking of radio equipment and radio terminal equipment.

[2] ETSI EN 301 126-2-1: "Fixed Radio Systems; Conformance testing; Part 2-1: Point-to-Multipoint equipment; Definitions and general requirements".

[3] Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity.

[4] EN 60835-1: "Methods of measurement for equipment used in digital microwave radio transmission systems. Part 1: Measurements common to terrestrial radio-relay systems and satellite earth stations".

[5] CEPT/ERC/REC 74-01: "Spurious emissions".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document see terms and definitions given in EN 301 126-2-1 [2].

3.2 Symbols

For the purposes of the present document see symbols given in EN 301 126-2-1 [2].

3.3 Abbreviations

For the purposes of the present document see abbreviations given in EN 301 126-2-1 [2].

4 General characteristics

Where necessary, for better understanding of the application of test methods, reference is made to EN 60835-1 [4] (Test methods).

4.1 Equipment configuration

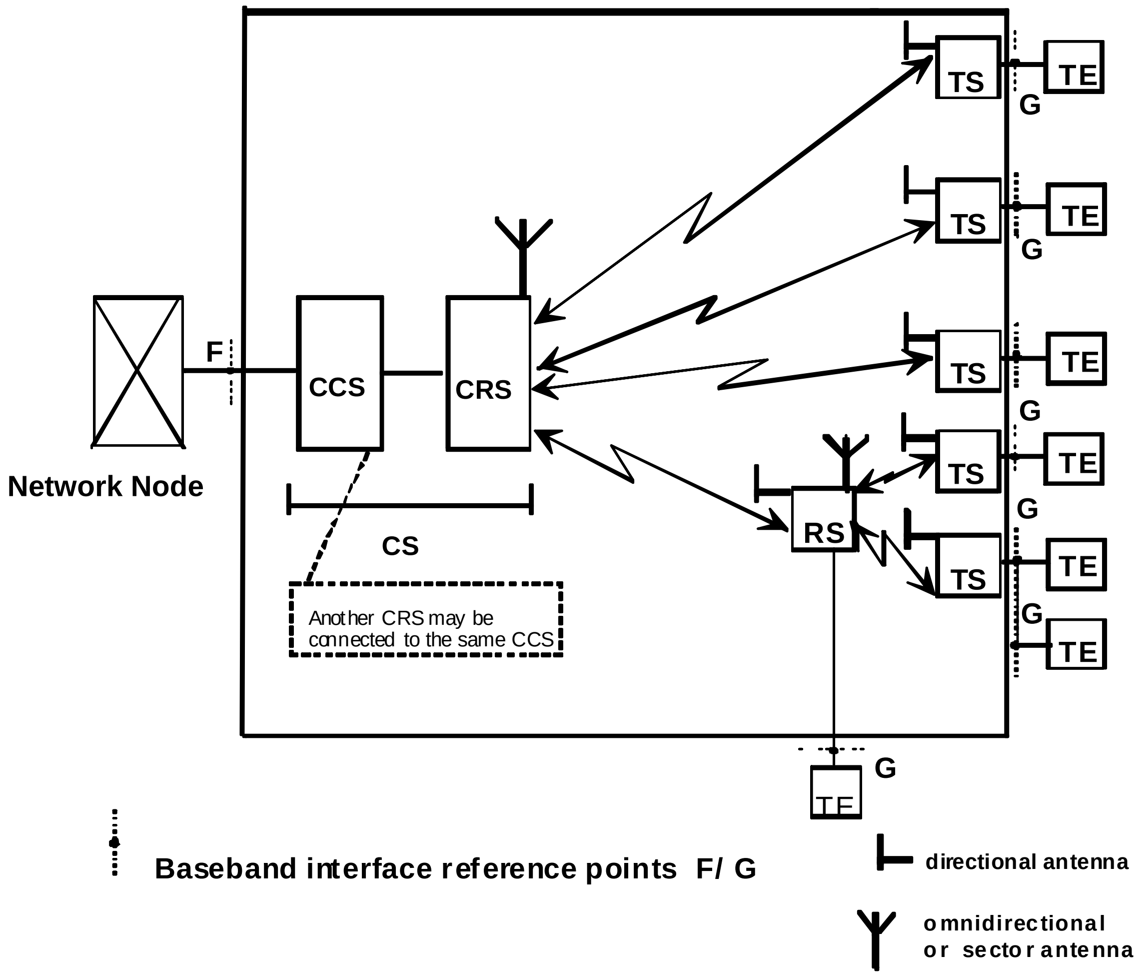


Figure 1: General System Architecture

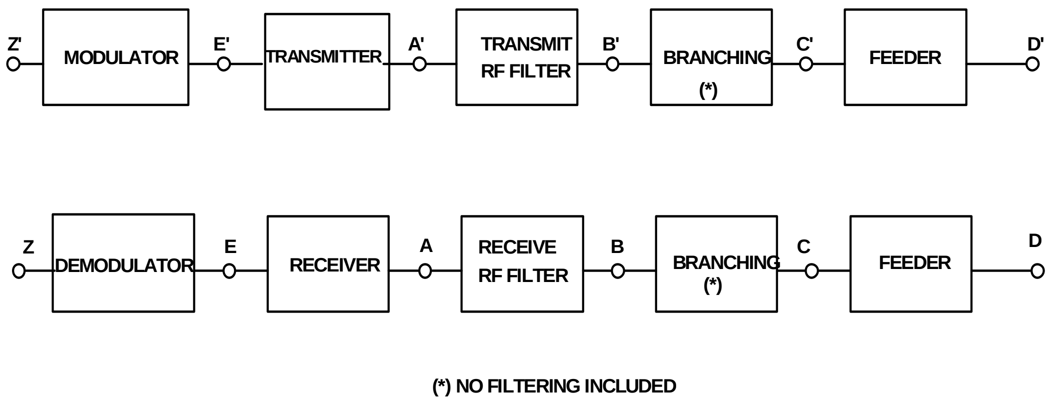
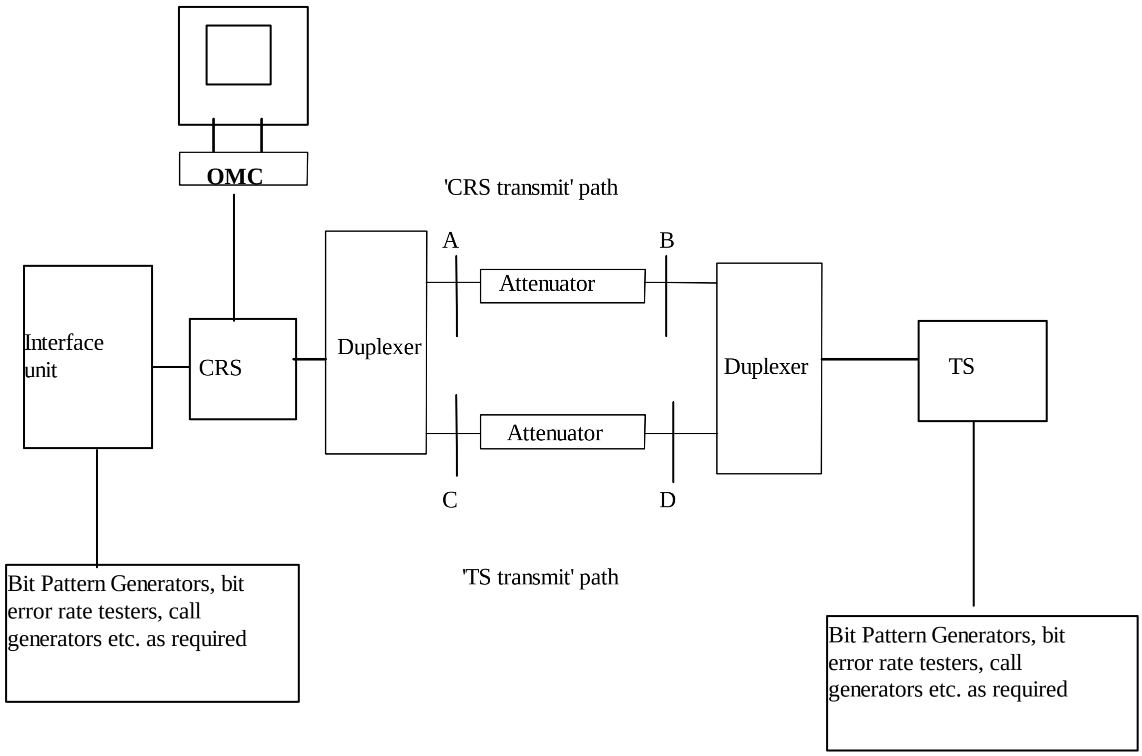


Figure 2: RF System Block diagram

4.1.1 System configuration

P-MP equipment is designed to operate as an access system connected to a network node (e.g. local switch) and user terminal equipment's (figure 1). The individual conformance tests are made in a single link direction (figure 2) but for certain tests, e.g. for equipment to set up signalling, both forward and reverse links have to operate, the minimum equipment arrangement for tests with only one subscriber is shown in figure 3, where the forward and return RF paths are separated by a pair of duplexers and separate attenuators are inserted in each path. In the absence of any more specific instructions from the supplier it is suggested that the links are operated at threshold (RSL) + n dB where n is half of the link dynamic range except when the receiver is being tested. The other receiver(s) should continue to be operated at threshold (RSL) + n dB.

Calibrated splitters or directional couplers will be inserted at points A, B, C and D (figures 3 and 4) as required for the individual tests, either to provide test points or sources of interfering signals.



NOTE: TDD systems may only require a single path with one attenuator.

Figure 3: Test configuration for a single Terminal Station

NOTE 1: Calibrated splitters or directional couplers will be inserted at points A, B, C and D as required for the individual tests, either as test points or as sources of interfering signals.

NOTE 2: When measuring the TS transmitter to demonstrate that it meets the emission mask and spurious emissions limits, the splitter network will have only one TS connected and this network may be removed.

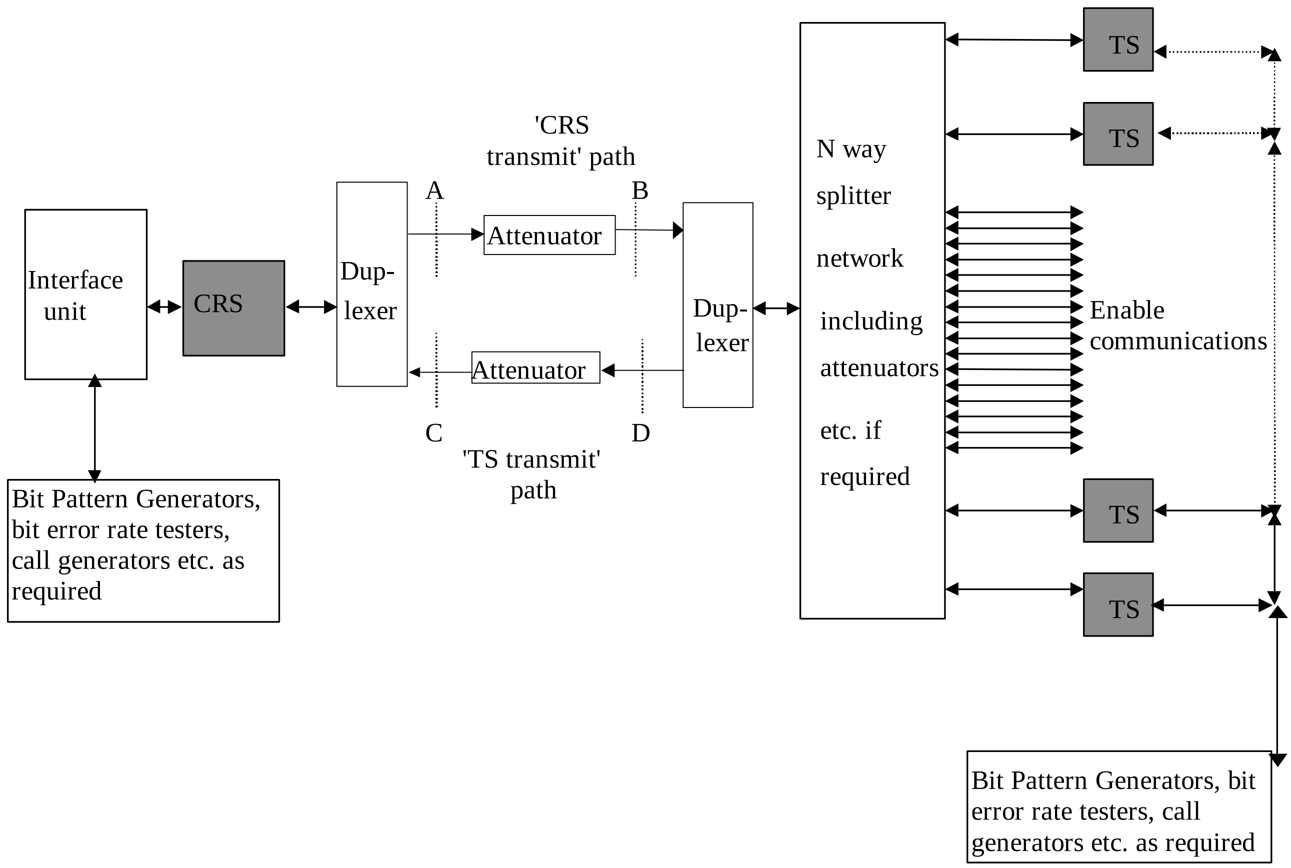
NOTE 3: The P-MP systems to be tested are duplex systems and features such as time/frequency synchronization and APC require both paths to be functioning correctly. To ensure that the results of measurements on either the forward or return paths, e.g. receiver RSL, are not influenced by conditions in the other path it may be necessary to provide lower attenuation, or raise the transmitter power, in this other path. In the absence of any more specific instructions from the supplier it is suggested that this other path is operated at threshold (RSL) + n dB.

All the test procedures, presented in the following subclauses below, shall apply to both CRS(s) and TS(s), unless otherwise stated. Unless otherwise stated, all essential requirements (ER) tests shall be undertaken at the nominal and extremes of power supply and environmental parameters and at maximum output power. RF power, spectrum and frequency measurements shall be undertaken at low, medium and high frequencies within the declared range of frequencies. These RF frequencies may be selected by remote control or otherwise.

Central or remote stations incorporating integral antennas shall be provided with an appropriate coaxial or waveguide transition by the supplier in order to facilitate the measurements described.

For tests where the simultaneous use of several TSs is necessary, then an arrangement similar to that shown in Figure 4 is required. To enable communication the traffic load may be simulated and facilities such as remote loop back may be used to route traffic through the system.

This arrangement ensures that the system operates in a normal manner similar to its configuration for measurements such as transmitter mask and RSL.



NOTE: TDD systems may only require a single path with one attenuator.

Figure 4: Test Configuration for multiple Terminal Stations

Systems applying the FDMA access method are by definition orthogonal (by applying frequency decoupling between the modulated carriers of the multicarrier signal). For the outbound direction (CRS → TS) the orthogonality is proved by measurement when applying the test methods described below in the relevant clause of the present document.

It is sufficient to demonstrate the orthogonality when testing in the inbound direction (TS → CRS) to operate only three TS simultaneously. This method presupposes that the carriers each are like modulated and carry the same bit rate.

Furthermore the characteristics of the pulse forming and the cosine roll-off factor of the carriers each are identical due to digital signal processing in the modulator and the demodulates of the CRS / TS. One TS is used as the wanted link the other two are used as adjacent like-modulated carriers (interferes) in respect to the wanted link.

In order to demonstrate that the unwanted emissions within the RF-channel spacing assigned to the P-MP system coming from each TS transmitting in the inbound direction do not unduly degrade the wanted link (signal), the supplier has to declare the spectrum mask of the TS at least within the width of the RF-channel spacing.

The necessary suppression of the unwanted emissions of the TS which are allowed to be emitted in the inbound direction, can be derived from the formula below (see Figure 5):

$$\frac{C}{P_{unwa}} \equiv X - 10\log(N-3) \geq \frac{C}{I} + 3 \quad \text{[dB]} \qquad (1)$$

$$X \geq \frac{C}{I} + 3 + 10\log(N-3) \quad \text{[dB]} \qquad (2)$$

Where:

- X is the difference between the max. Spectral power density of the single modulated carrier according to the Full Load Condition of the TS of the wanted link and the max. Value of the spectral power density of the noise like unwanted emission from the TS measured within the RF-channel bandwidth,
- N Number of modulated carriers according to the Full Load Condition of the inbound direction, declared by the supplier,
- $\frac{C}{I}$ is taken from the limits of the co-channel interference sensitivity for 1 dB degradation for a BER of 10^{-6} of the respective EN.

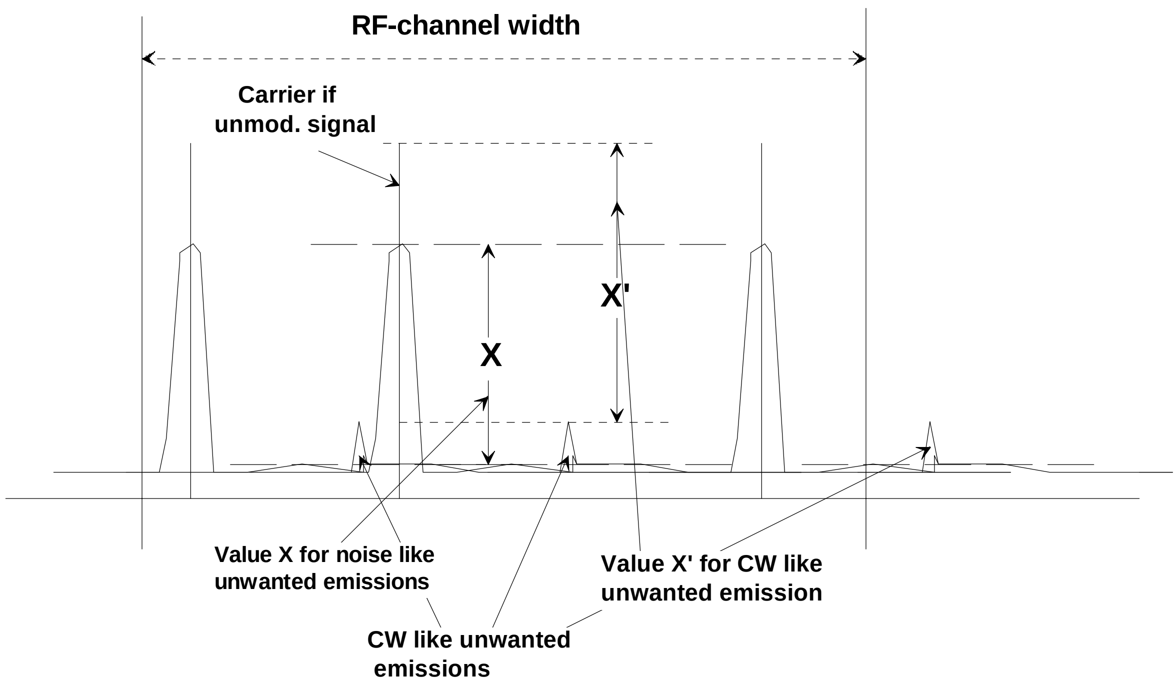


Figure 5: Example of necessary suppression of unwanted emissions of the TS

NOTE: The spectral power density of the noise like emissions P_{unwa} is taken outside $\pm$ 2 x $\Delta f_{carrier}$, where $\Delta f_{carrier}$ conforms to the carrier spacing according to the Full Load Condition in inbound direction, declared by the supplier in accordance with the respective EN.

For CW like unwanted emissions of the single TS, the value X' shall be:

$$X' = 10 \log \left(\frac{P_C}{P_{CW}} \right) \quad \text{[dB]} \qquad (3)$$

where P_C is the carrier power of the single TS (according to the Full Load Condition), P_{CW} is the power of the unwanted CW emission.

The unwanted emissions mentioned above for both the noise like and the CW like signals have to be verified on either side of the respective TS carrier over the full width of the RF-channel spacing assigned to the P-MP system.

4.2 Transmitter characteristics

General remarks:

Measurement procedures for transmitter characteristics (CRS).

For the measurement of the tests stated below the equipment (CRS) shall provide the maximum nominal output power stated by the supplier or another output power appropriate for the applied test. Furthermore the number of the carriers (N) of the central radio station modulated with the maximum bit rate each and the same modulation scheme is declared by the supplier.

The specified parameters are tested under Full Load Conditions.

Each carrier using the same modulation scheme shall provide an output power equal to 1/N of the maximum nominal output power declared by the supplier. The transmission capacity of the CRS shall be equally distributed among the N single carriers.

The specified parameters are tested under Full Load Conditions.

Each carrier shall provide an average output power equal to 1/N of the maximum nominal average power declared by the supplier.

NOTE: For the RF spectrum measurement (see subclause 4.2.6) the link (CRS $\rightarrow$ TS) has to be installed and the bit error rate of the wanted receiver signal has to be < 10^{-x} with a signal level specified in the relevant product standard.

Measurement procedures for transmitter characteristics (TS).

The transmitter characteristics of the TS shall be verified in measuring only one TS being the representative for all TS under the limit values of Full Load Conditions declared by the supplier. The spectrum mask of the TS shall be verified according to the spectrum mask declared by the supplier.

4.2.1 Maximum nominal output power

Objective:

Verify that the maximum nominal output average power measured at reference point B' or C' is within the supplier declared value plus / minus the EN/ETS tolerance and does not exceed the maximum value stated in the ETS/EN.

Test instruments:

- Average Power Meter or an appropriate alternate.

Test Configuration:

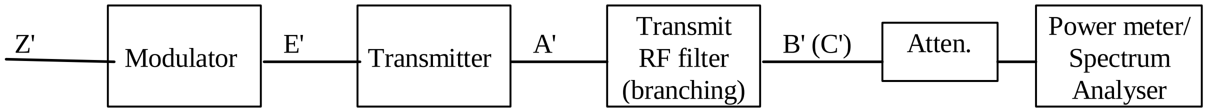


Figure 6: Test configuration for transmitter output power measurements

Test Procedure:

With the transmitter power level set to maximum, the average output power of the transmitter at point B (C') is to be measured.

4.2.2 Minimum nominal output power

Objective:

Verify that the minimum output average power of equipment, fitted with power control circuitry, measured at reference point B' or C' is within the specified limit of the declared value.

Test Instruments:

As for the maximum nominal output power test.

Test Configuration:

As for the maximum nominal output power test.

Test Procedure:

With the transmitter power level set to minimum the transmitter output at B' (C') is to be measured. Full account shall be taken of all losses between the test point and power meter.

4.2.3 Automatic Transmit Power Control (ATPC)

ATPC is an optional feature. However, when fitted, the minimum and maximum output average power levels shall be checked. In addition, satisfactory operation of the automatic facility shall be demonstrated.

Objective:

When ATPC is implemented, the control loop is to be checked for satisfactory operation i.e.: Tx output power is related to the input level at the far receiver.

Test Instruments:

As for maximum power test.

Test Configuration:

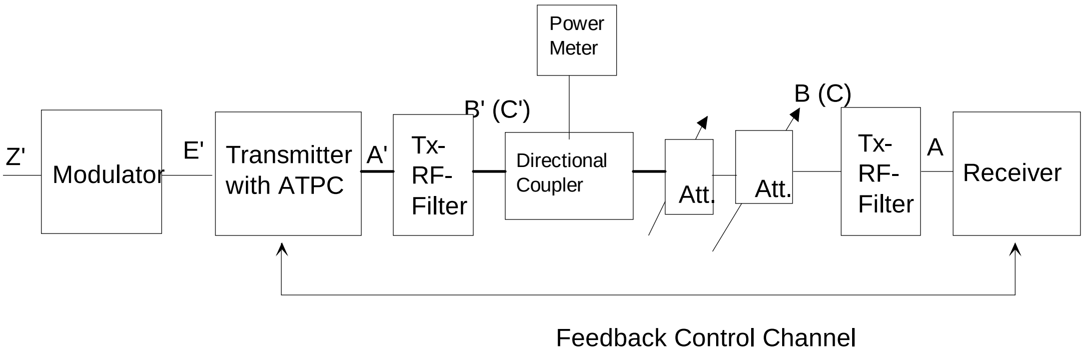


Figure 7: Test configuration for transmitter max. / min. output power measurements where ATPC is implemented. (ATPC set to automatic)

Test Procedure:

All equipment fitted with automatic power control shall be checked for satisfactory closed loop operation. Attenuator B (figure 7), initially set to produce the minimum transmitter output level is to be increased until the transmitter reaches its maximum output level. Throughout the transmitter's power range the receiver input level is to be maintained within the limits stated in the relevant EN/ETS or supplier guaranteed operating criteria. The test is to be repeated to verify that the automatic power control performance, between maximum transmitter power and minimum transmitter power meets the EN/ETS or supplier's performance limits.

For verifying the inbound direction see subclause 4.1.1.

The power control range and the function of the ATPC are declared by the supplier.

4.2.4 Remote Transmit Power Control (RTPC)

Where remote transmit power control is an available function it is to be checked and recorded during the transmitter output power test.

For verifying the inbound direction see subclause 4.1.1.

The power control range and the function of the RTPC are declared by the supplier.

The maximum power shall not exceed that applied in subclause 4.2.1 as an essential requirement.

4.2.5 Frequency accuracy

Objective:

To verify that the transmit frequency of the CRS / TS is within the limits specified in the relevant EN/ETS.

NOTE 1: For systems that do not shut down on loss of synchronization, frequency accuracy should also be measured in the non-synchronized condition.

Where transmitters cannot be placed in the CW condition the supplier is to seek an agreement with the accredited laboratory on the frequency accuracy test method.

The preferred method is to use a frequency counter capable of measuring the centre frequency of one modulated carrier signal. The relative location of the carrier within the RF channel has to be declared by the manufacturer.

When this type of counter is not available the LO frequency is to be measured and the output frequency is to be calculated using the relevant formula.

The frequency accuracy of this modulated carrier is to be regarded as representative for the frequency accuracy for the multicarrier signal.

Frequency accuracy measurements are to be conducted at the lowest, mid-band and highest channel of the unit under test.

Test Instruments:

- Frequency Counter

Test Configuration:

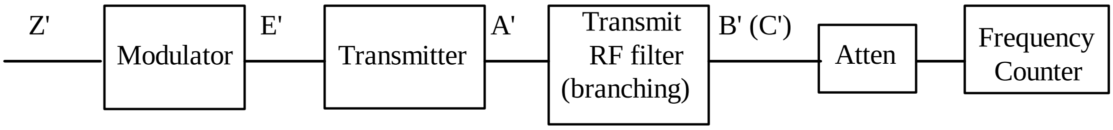


Figure 8: Test configuration for frequency accuracy

Test Procedure:

The transmitter is to be operated in the CW condition, where possible, and frequency measurements conducted on the channel previously selected by the test house. The measured frequency is to be within the tolerance stated in the relevant EN/ETS.

NOTE 2: The nominal frequency of the CW signal might be at the nominal frequency of the RF channel (the centre of the RF channel) or at a fixed offset from the nominal frequency of the RF channel (for example a non-modulated carrier). In the later case the fixed frequency offset shall be declared by the manufacturer.

4.2.6 RF spectrum mask

RF spectrum mask measurements are to be conducted at the lowest, mid-band and highest channel of the unit under test.

Objective:

To verify that the output spectrum is within the specified limits of the relevant EN/ETS for the CRS and within the declared mask for the TS.

Test Instruments:

1) Spectrum Analyser.

2) Plotter.

Test Configuration:

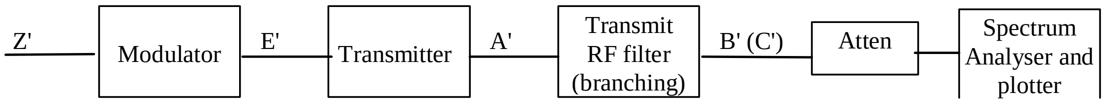


Figure 9: Test configuration for spectrum mask

Test Procedure:

The transmitter output port shall be connected to either a Spectrum Analyser via an attenuator or an artificial load with some means of monitoring the emissions with a Spectrum Analyser. The Spectrum Analyser shall have a variable persistence display or digital storage facility. The resolution bandwidth, frequency span, scan time and video filter settings of the Spectrum Analyser are to be set in accordance with the relevant EN/ETS.

With the transmitter modulated by a signal having the characteristics given in the relevant EN/ETS, the Tx power density shall be measured by the Spectrum Analyser and plotter. Where possible, transmitter spectral power density plots at the lowest, mid-band and highest channels, are to be recorded. In addition, plots shall be taken at normal and extreme power supply voltages at the ambient temperature and environmental extremes.

The spectrum of a single carrier has to be verified (figure 2) at both edges of the spectrum mask for the RF channel of the relevant product standard.

The values for the Spectrum Analyser settings are listed in tables 1 (referring to the RF channel spacing) and 2 (referring to the carrier spacing of a multicarrier signal).

Table 1: Spectrum Analyser settings for RF Power Spectrum Measurement RF-channel spacing

RF channel spacing (MHz)	<1,75	1,75 to 20	>20
Centre frequency	actual	actual	actual
Sweep width (MHz)	note	note	note
Scan time	auto	auto	auto
IF bandwidth (kHz)	30	30	100
Video bandwidth (kHz)	0,1	0,3	0,3
NOTE: 5 x channel spacing < sweep width < 7 x channel spacing.			

The Spectrum Analyser settings of table 1 are to be used when measuring the spectrum according to the RF-channel spacing f_s.

The Spectrum Analyser settings according to table 2 is stated to verify that the modulated carrier at the lower or the higher RF channel spacing edge of a multicarrier signal doesn't exceed the spectrum mask.

Table 2: Spectrum Analyser settings for RF Spectrum Measurement at the lower and the higher RF channel spacing edge of a multicarrier signal

RF channel spacing fs / MHz	≤ 0,5	0,5 < fs ≤ 1
Centre Frequency	actual	actual
Sweep width / MHz	1	3
Scan time	auto	auto
IF bandwidth / kHz	10	30
Video bandwidth / kHz	0,03	0,1

The sweep width should be in the order of 100 times the IF bandwidth. For carrier spacing ≥1 MHz of a multicarrier signal the table 1 shall be applied to.

NOTE 1: Where an EN/ETS permits spectral lines at the symbol rate to exceed the spectrum mask, this relaxation should be taken into consideration.

NOTE 2: Recall the tolerance of the Spectrum Analyser settings when measuring at the lower or the higher edge of the RF-channel spacing.

To measure the spectrum mask of the TS, declared by the supplier, the Spectrum Analyser settings shall be used according to the bandwidth of the modulated signal of the TS.

4.2.7 Remote frequency control

Remote frequency control is an optional feature. However, when fitted the function shall be tested during the frequency accuracy test. If necessary, repeat test as in subclause 4.2.5 with frequency settings controlled using the remote frequency control option.

4.2.8 Spectral lines at the symbol rate

The test for spectral lines at the symbol rate are performed at the same time as the RF spectrum mask, see subclause 4.2.6 if applicable to the standard.

4.2.9 Spurious emissions (external)

Objective:

To verify that any spurious emissions generated by the transmitter are within the limits quoted in the relevant EN/ETS. Spurious emissions are emissions outside the bandwidth necessary to transfer the input data at the transmitter to the receiver of which level may be reduced without affecting the corresponding transfer of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products.

Test Instruments:

1) Spectrum Analyser, Plotter.

2) Spectrum Analyser Mixer Units - as required.

Test Configuration:

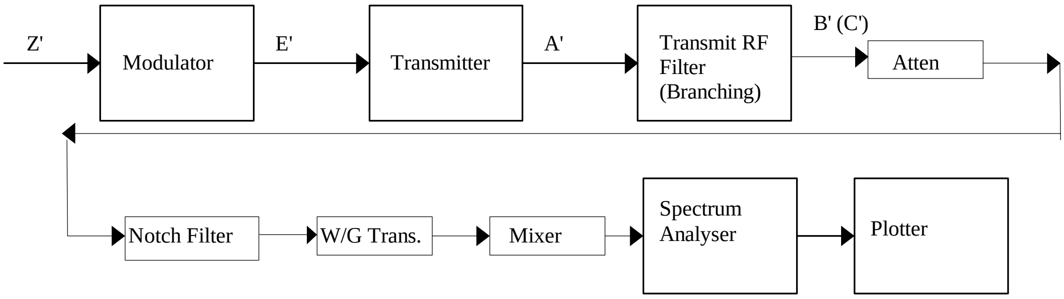


Figure 10: Test configuration for conducted antenna port spurious emissions

Test Procedure:

The transmitter output port shall be connected to either a Spectrum Analyser via a suitable attenuator and/or notch filter to limit the power into the front end of the Analyser. In some cases, where the upper frequency limit exceeds the basic operating range of the Analyser, suitable waveguide transitions and mixer will be required. It is important that the circuit between the transmitter and the input to the mixer, or Spectrum Analyser, is characterized over the frequency range to be measured. These losses should be used to set the limit line of the Analyser to a value which ensures that the specification criteria at point C' is not exceeded.

The transmitter is to be operated at the supplier maximum rated output power and the level and frequency of all significant signals are to be measured and plotted throughout the frequency band quoted in the relevant specification. It is recommended that each scan be taken in 5 GHz steps below 21,2 GHz and 10 GHz steps above 21,2 GHz. However, spurious emissions close to the limit should be plotted over a restricted range, which clearly demonstrates that the signal does not exceed the relevant limit.

The measurement for the TS is performed with one single carrier only.

NOTE 1: Where a specification states that the spurious emission test is to be conducted with the equipment in the modulated condition, the resolution bandwidth of the Spectrum Analyser is to be set to the level quoted in the specification. The frequency span and scan rate of the Analyser should be adjusted to maintain the noise floor below the limit line and maintain the Spectrum Analyser in the calibrated condition.

NOTE 2: Measurement of spurious emission levels from equipment operating in the CW condition can be conducted with resolution bandwidth, frequency span and scan rates which maintain the Spectrum Analyser in the calibrated condition while keeping the difference between noise floor and limit line at least 10 dB.

NOTE 3: Due to the low levels of RF signal and the wide band modulation used in this type of equipment, radiated RF power measurements are imprecise compared to conducted measurements. Therefore where equipment is normally fitted with an integral antenna, the supplier shall supply a documented test fixture that converts the radiated signal into a conducted signal into a 50 Ω termination.

NOTE 4: The RF conducted signal shall be measured into a 50 Ω coaxial line to the Spectrum Analyser for all frequencies below the operating frequency if below 26,5 GHz. This is to prevent any external waveguide acting as a high pass filter.

As most of the modern DRRS are not able to deliver an unmodulated carrier, in this case the measurement shall be carried out with modulated carrier, provided that the level limits for noise like spurious emissions (e.g. harmonics and mixer image frequencies) were regarded as "maximum level in any elementary band equal to BW_e".

In other cases the relevant EN/ETS may ask explicitly for modulated carrier conditions and give the parameters for test procedure.

NOTE 5: Where the equipment standard refers to CEPT/ERC Recommendation 74-01 [5], then the measurements are taken for the mean power of the spurious emissions during the transmission burst. For spurious emission measurement's on the TS it may not be possible to complete a Spectrum Analyser frequency scan during a synchronized pulse (i.e. the sweep time of the Spectrum Analyser is much greater than the pulse time of the TS). In this case it shall be deemed that if the peak power over a statistically sufficient number of Spectrum Analyser sweeps is below the mean power limit, that the mean power limit is met. If this cannot be shown, then alternatives may be used as long as they detail the rational behind the measurements in the report.

Measurements shall be made in accordance to the Published standard. Any variations shall be detailed and agreed with each Nation Regulator.

4.3 Receiver characteristics

General calibration:

NOTE: This calibration procedure of the receiver signal level (procedures for outbound (CRS to TS) and inbound (TS to CRS) measurements) to be used for the receiver characteristics as well as for the system characteristics, where applicable.

Objective:

To calibrate the artificial hop in respect to the receiver signal level (RSL).

Test instruments:

- Power sensor and meter.

Configuration:

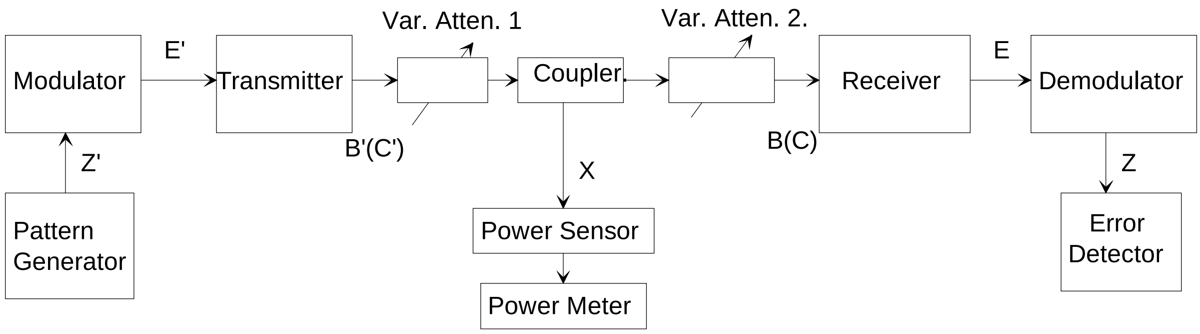


Figure 11: Configuration for calibration and measurement procedures

Procedure for Calibration:

Make sure that ATPC is switched off / or the transmitter output power be kept fixed during the calibration.

Set the variable attenuator A1 at the transmitter output B'(C') (Figure 11) to a reasonable value (A1). Measure the power received at the decoupled output X of the coupler and record that value (LX1). Disconnect at point B(C) the receiver under test and connect the power meter. Set the variable attenuator A2 in front of the receiver to a useful value which provides a power level in the linear range of the power sensor. Record the setting (A2) of that variable attenuator A2 as well as the power meter reading (LB). Reconnect the receiver at point B(C) to the variable attenuator A2 in front and reconnect the power meter to the decoupled output X of the coupler. The relation between values A1, LX1 and LB with regard to A2 provides a calibration of the test bed of Figure 11.

The calibration of the test bed is performed with a single modulated carrier or with all carriers transmitting according to the full load condition (declared by the manufacturer), whichever is easier to achieve. In the first case the remaining N-1 modulated carriers (of the CRS) are switched off, while in the later case the measured total transmitter power is divided by N.

For calibration of the inbound direction proceed accordingly while taking subclause 4.1.1 into account.

4.3.1 Input level range

<u>Objective (if applicable):</u>

To verify that the receiver meets the BER criteria, given in the relevant specification, over a defined range of receiver input levels.

<u>Test Instruments:</u>

1) See subclause 4.3.

2) Pattern Generator/Error Detector.

<u>Test Configuration:</u>

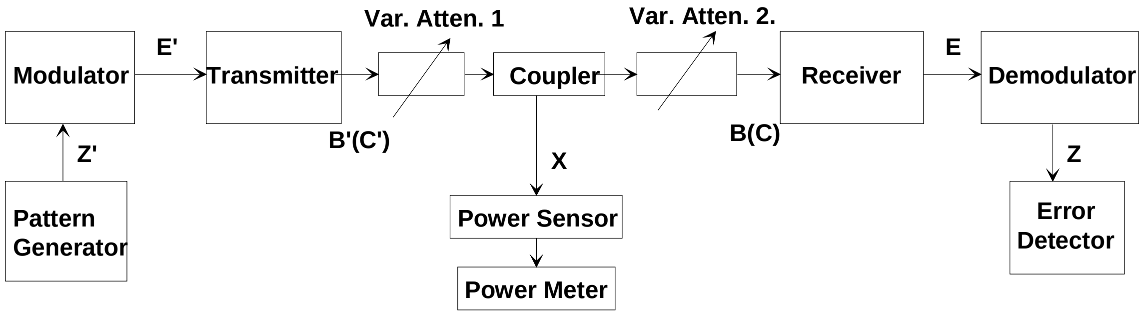


Figure 12: Test configuration for input level range

<u>Test Procedure:</u>

Make sure that the measurement result is not affected by any possible change in the transmitter output power level.

Direction CRS to TS (Outbound)

Connect the pattern generator to the transmitter input Z' and the error detector to the receiver output Z.

Adjust the variable attenuator 1 and / or variable attenuator 2 such that the signal level at point B (C) is the minimum RSL, and verify that the BER criterion is met. Adjust both variable attenuators, A1 and A2, such that the signal level at point B (C) is the maximum RSL, and verify that the BER criterion is met.

Calculate the difference between the maximum and minimum RSL which is the input level range of the receiver.

Direction TS to CRS (inbound)

The inbound measurement is performed for TS signals details may be found in subclause 4.1.1.

4.3.2 Spurious emissions

The same test method as described in subclause 4.2.9 is applicable. Spurious emission levels from a transmitter and receiver of duplex equipment using a common port are measured simultaneously and the test only needs to be conducted once.

<u>Objective:</u>

To verify that spurious emissions from the receiver are within the limits.

For further details see subclause 4.2.9.

4.4 System characteristics

4.4.1 Dynamic level range

Objective (if applicable):

To verify that the system, with ATPC operating (where applicable) meets the BER criteria, given in the relevant specification, over a defined range of input levels.

Test Instruments:

1) Power Sensor and Meter.

2) Pattern Generator/Error Detector.

Test Configuration:

see Figure 12.

Make sure that the ATPC is switched on.

Test Procedure:

For calibration see subclause 4.3.

Connect the pattern generator to the BB transmitter input Z' and the error detector to the BB receiver output Z.

Adjust the variable attenuator 1 and / or variable attenuator 2 such that the signal level at point B (C) is the minimum RSL, and verify that the BER criterion is met. Adjust both variable attenuators, A1 and A2, such that the signal level at point B (C) is the maximum RSL, and verify that the BER criterion is met.

The dynamic input level range is calculated by the measured input level range between the minimum and the maximum receiver input level, increased by the declared and measured control range of an ATPC or RTPC (see subclauses 4.2.3 and 4.2.4).

The receiver of the CRS has to operate under the test conditions stated in subclause 4.1.1 for the inbound measurement.

4.4.2 BER as a function of Receiver input Signal Level RSL

Objective:

To verify that the received signal levels versus BER thresholds are within the limits specified, (at a minimum of two BER levels), in the relevant EN/ETS.

Test Instruments:

1) Pattern Generator/Error Detector.

2) Power Sensor and Meter.

Test Configuration:

See figure 12.

Test Procedure:

For calibration see subclause 4.3.

Connect the pattern generator output to the BB input of the Tx. Send the BB output signal of the Rx to the Error Detector. Then take record of BER curve by varying the received signal level. Verify that the RSL corresponding to the BER thresholds are within the specifications.

For Outbound measurement the CRS shall operated under Full Load Condition.

For inbound measurement the receiver of the CRS has to operate under the test conditions stated in subclause 4.1.1.

4.4.3 Equipment background BER

Objective:

To verify that the equipment background BER is below the value specified in the relevant EN/ETS.

Test Instruments:

1) Pattern Generator/Error Detector;

2) Power Meter.

For calibration see subclause 4.3.

Test Configuration:

See figure 12 above.

Test Procedure:

Increase the receiver signal level to the value stated in the relevant EN/ETS and check that the bit errors, if any within the time frame stated, are below the value stated in the EN/ETS.

For outbound measurements the CRS shall operate under full load conditions.

For inbound measurement, the receiver of the CRS has to operate under the test conditions stated in subclause 4.1.1.

4.4.4 Interference sensitivity

The following test procedures shall be used for measuring the interference sensitivities in both the CRS to Ts and the TS to CRS directions.

For the measurement of the direction CRS to TS at least one of the transmitters Tx 1 or Tx 2 shall be operated under full load conditions. The other transmitter may be operated with only one carrier signal, details may be found in subclause 4.1.1.

For the measurement of the direction TS to CRS the load condition shall be taken as described in subclause 4.1.1.

All tests shall be carried out around the middle of the RF range of interest where appropriate or on a RF-channel to be declared by the manufacturer.

4.4.4.1 Co-channel interference sensitivity

The Test House should apply Method 1 or Method 2 as appropriate to the relevant equipment EN/ETS.

Method 1:

Objectives:

To verify that the BER at point Z, of the system under test, does not degrade below the relevant specification limit in the presence of a co channel (co carrier) signal.

Test Instruments:

1) 2 Bit Pattern Generators.

2) Error Detector.

3) Power Sensor and meter.

4) For calibration see subclause 4.3.

Test Configuration.

Method 1:

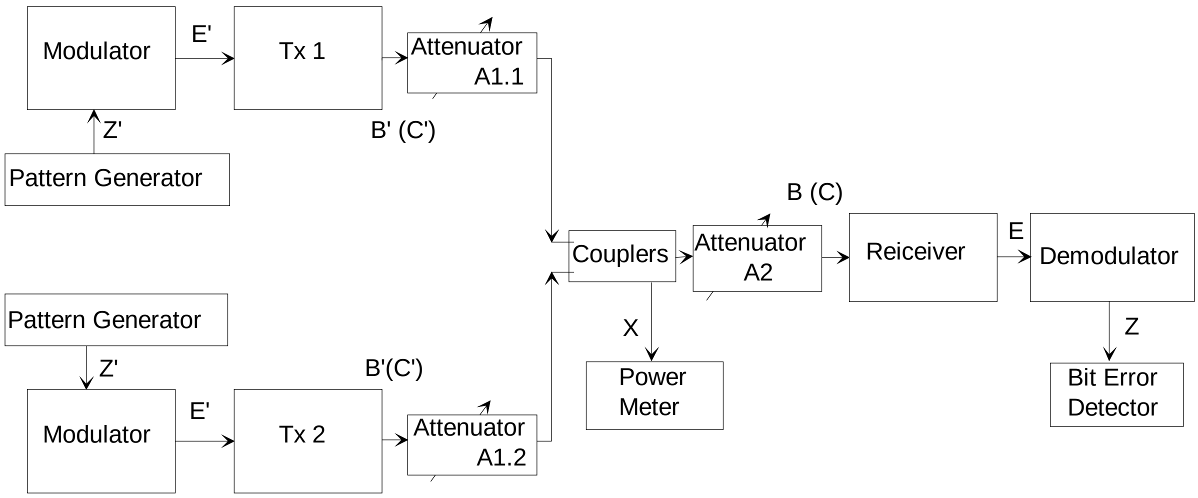


Figure 13: Test configuration for co-channel interference sensitivity - external

During this test both transmitters shall transmit on the same frequency and be modulated with different signals having the same characteristics.

Adjust attenuator A1.1 to set the signal to a convenient level while Tx 2 is set to standby (signal level to be neglected during calibration). Record the level at X.

The signal level at B (C) of the system under test should be set to the receive limit level equal for a BER of 10^{-6} required by the relevant EN/ETS in adjusting the attenuator A2 accordingly. Record the BER value.

Switch Tx 2 on. Adjust attenuator A1.2 such that a C/I level at B (C) is achieved according to the relevant EN/ETS and record the BER for the C/I as stated in the EN/ETS. The BER shall be less or equal to that stated in the relevant EN/ETS (typically10^{-5}).

Method 2:

Objective:

To verify that the BER remains below the relevant specification limit in the presence of a co-channel (co-carrier) signal.

Test Instruments:

1) 2 Pattern Generator.
2) Error Detector.
3) Power Sensor and Meter.

Test Configuration:

See Figure 13.

Test Procedure:

Apply the test procedure of Method 1 above, with the exemption of setting the receive signal level to 1 dB and 3 dB above the limit values of the RSL for a BER of 10^{-x} stated in the relevant EN/ETS for the interference free RSL measurements. This may be done by setting attenuator A2 accordingly.

Record the power level and the settings of the attenuators Check that the BER is less or equal to the specified value of the relevant EN/ETS (typically BER 10^{-6}).

4.4.4.2 Adjacent RF-channel interference sensitivity

The Test House should apply Method 1 or Method 2 as appropriate to the relevant equipment EN/ETS.

For measurement details follow the Method 1 or 2 whichever is applied to the appropriate product standard.

Method 1:

Objective:

To verify that the BER at point Z, of the system under test, does not degrade below the relevant specification limit in the presence of an adjacent channel signal.

Test Instruments:

Same as co-channel test.

Test Configuration 1:

Same as co-channel test (see Figure 13).

Test procedures:

For calibration and basic test method see subclauses 4.3 and 4.4.4.1 with the exemption, that the interfering signal is at the adjacent RF channel at a carrier position which is the nearest to the wanted carrier signal and that the interfering signal has a different level from that of the co-channel measurement procedure.

Check that the BER is less or equal to that stated in the relevant EN/ETS (typically10^{-5}). For this test procedure the supplier has to declare the carrier arrangement within the RF channel.

Method 2:

Objective:

To verify that the BER remains below the specification limit given in the relevant EN/ETS in presence of an adjacent-channel signal.

Test Instruments:

1) Pattern Generator.
2) Error Detector.
3) Power Sensor and Meter.

Test Configuration:

See Figure 13.

Test Procedure:

Apply the test procedure of Method 1 above, with the exemption of setting the receive signal level to 1 dB and 3 dB above the limit values of the RSL for a BER of 10^{-x} stated in the relevant EN/ETS for the interference free RSL measurements. This may be done by setting attenuator A2 accordingly.

Record the power level and the settings of the attenuators. Check that the BER is less or equal to the specified value of the relevant EN/ETS (typically BER 10^{-6}).

4.4.4.3 CW Spurious interference

This measurement shall be performed for both directions (outbound and inbound).

Objective:

This test is designed to identify specific frequencies at which the receiver may have a spurious response e.g. image frequency, harmonic response of the receiver filter etc. The frequency range of the test should be in accordance with the relevant specification.

Test Instruments:

1) Pattern Generator.
2) Error Detector.
3) Signal Generator.
4) Power Sensor and Meter.

Test Configuration:

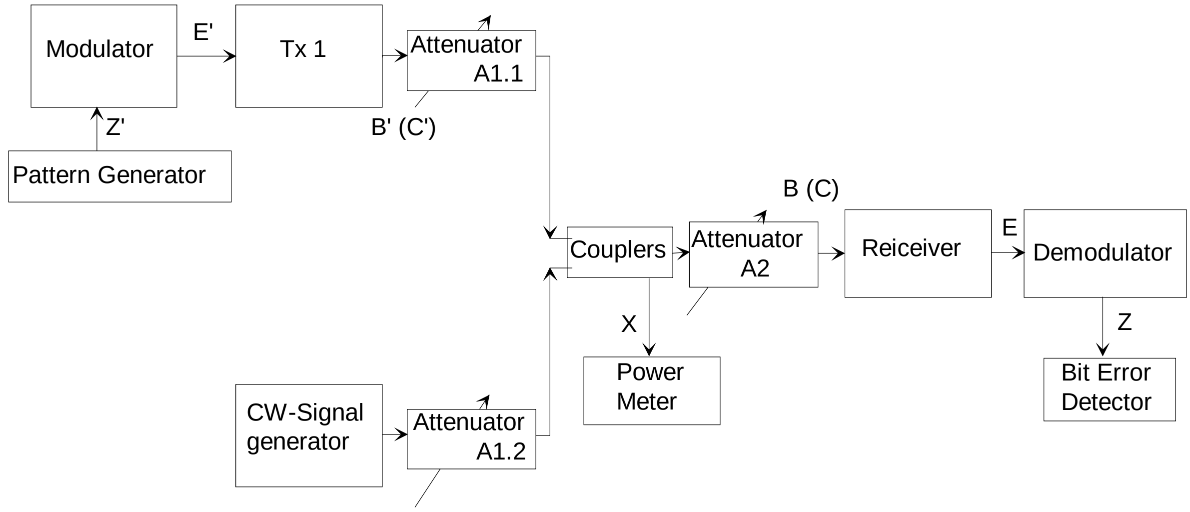


Figure 14: Test configuration for CW spurious interference

Test Procedure:

With the signal generator output turned off, apply the calibration procedure of subclause 4.3 accordingly.

Switch off the transmitter. Calibrate the CW-signal generator across the frequency range required by the EN/ETS at a level x dB above the level (dBm), where x is the required increase in level for the interfering CW signal in respect to the receive signal level for a BER (typically 10^{-6}) stated in the relevant EN/ETS.

Switch on the transmitter (Tx1).

Confirm the BER does not exceed the value specified in the relevant ETS/EN when sweeping the signal generator through the required frequency range at the calibrated level, taking into account any exclusion band stated in the EN/ETS.

Any frequencies, which cause the BER to exceed the level stated in the EN/ETS, shall be recorded. It is recommended that the calibration be rechecked at these frequencies.

NOTE 1: Level specified according to the relevant EN. The use of a stepped signal generator is permitted provided that the step size is not greater than one third of the bandwidth of the receiver under test.

NOTE 2: This test may require the use of low pass filters on the output of the signal generator to prevent harmonics of the signal generator falling into the receiver exclusion band.

NOTE 3: If the total sweep time makes the test very time consuming, it may be acceptable to calibrate the level of the CW spurious interferer at (x + 3) dB and look for an increased maximum BER (eg: 10^{-3} instead of 10^{-6}). If the increased maximum BER limit is exceeded at any points then a slower sweep shall be performed across those frequency points with the CW interferer calibrated to x dB and the lower BER requirement. Either requirement may be met for any frequency point.

This measurement is performed for one wanted single carrier and an unwanted CW signal of the output power.

History

Document history			
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