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

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Foreword

This European Standard (Telecommunications series) has been produced by ETSI Technical Committee Transmission and Multiplexing (TM), and is now submitted for the Vote phase of the ETSI standards Two-step Approval Procedure.

The present document is part 2-4 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 hopping code division multiple access method (FH-CDMA). It should be noted that this part 2-4 can only be applied in conjunction with part 2-1.

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

Parts 2-2, 2-3 and 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".

Proposed national transposition dates	
Date of latest announcement of this EN (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	6 months after doa
Date of withdrawal of any conflicting National Standard (dow):	6 months after doa

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 hopping code division multiple access method (FH-CDMA).

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 the present document are relevant to be able to fulfil the Conformance assessment procedure described in Chapter II of the R&TTE Directive 1999/5/EC [2] in order to demonstrate the compliance of the DRRS with the relevant essential requirements identified in Article 3.2 of the R&TTE Directive.

The present document is intended to be applied in conjunction with EN 301 126-2-1 [1] and in conjunction with the individual equipment ENs/ETSs describing FH-CDMA 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] ETSI EN 301 126-2-1: "Fixed Radio Systems; Conformance testing; Part 2-1: Point-to-Multipoint equipment; Definitions and general requirements".

[2] 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.

[3] EN 60 835: "Methods of Measurement for Equipment used in Digital Microwave Radio Transmission Systems".

[4] CEPT/ERC Recommendation 74-01: "Spurious emissions".

[5] 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.

3 Definitions, symbols and abbreviations

3.1 Definitions

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

3.2 Symbols

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

3.3 Abbreviations

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

4 General characteristics

Where necessary, for better understanding of the application of test methods, reference is made to EN 60 835 [3] (Test methods).

4.1 Equipment configuration

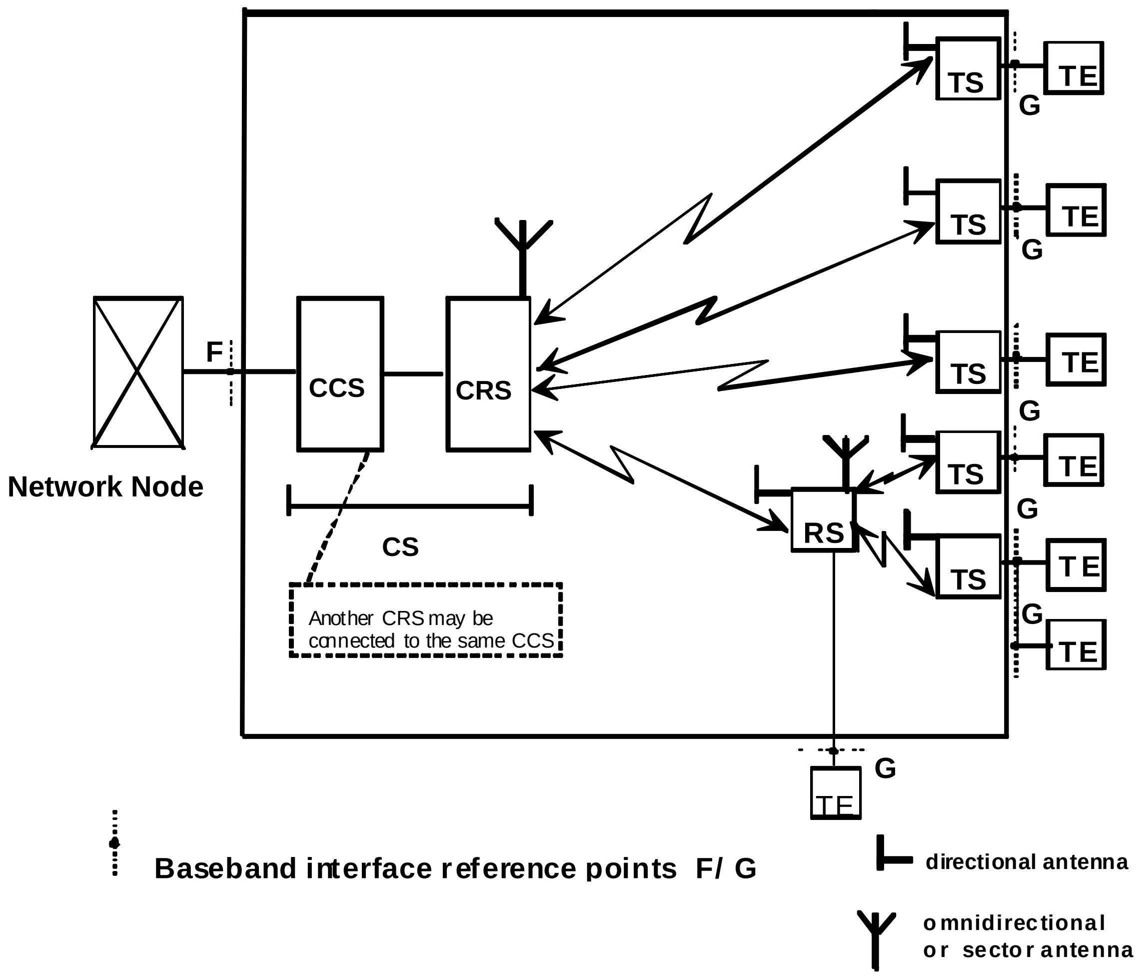


Figure 1: General System Architecture

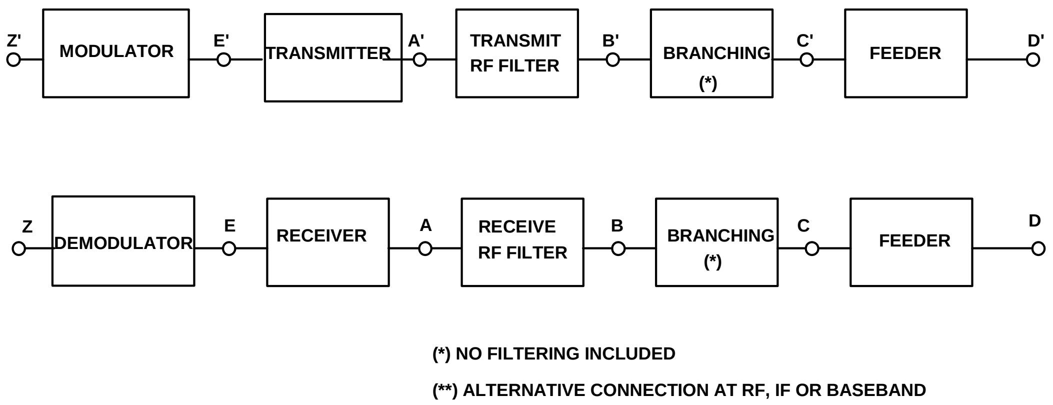


Figure 2: RF System block diagram

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 (figure 3) as required for the individual tests, either to provide test points or sources of interfering signals.

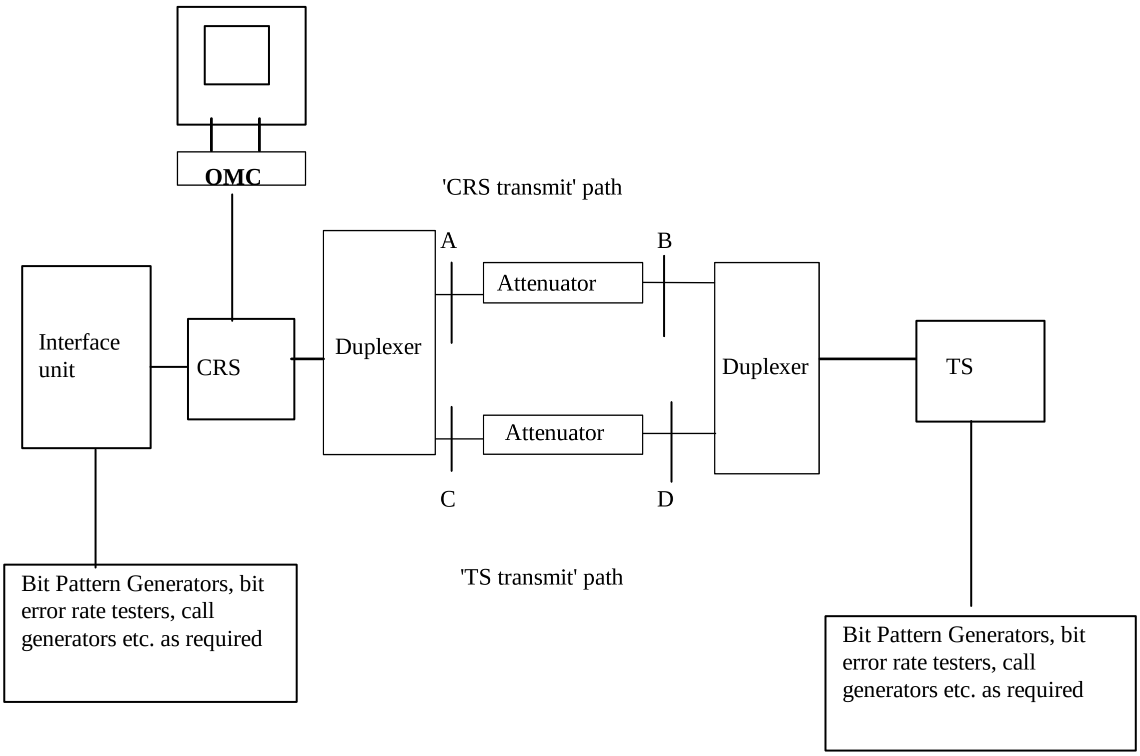


Figure 3: Test configuration for a single Terminal Station

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 sub-sections 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.

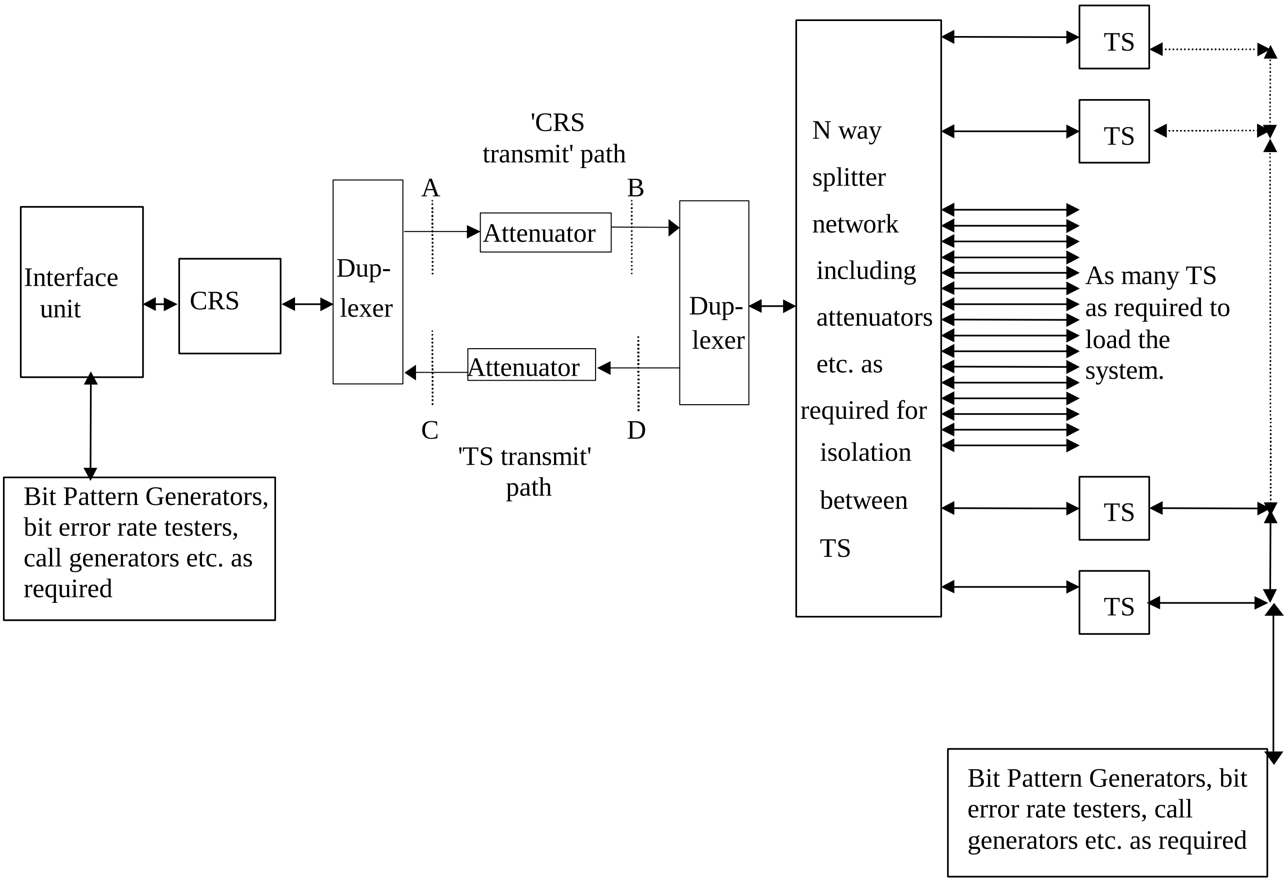
Central or remote stations incorporating integral antennas shall be provided with an appropriate coaxial or waveguide transition by the supplier in order to facilitate the measurements described.

For tests where the simultaneous use of several TSs is necessary, then an arrangement similar to that shown 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.

For systems where it is necessary to simulate traffic load an arrangement similar to figure 4 will be necessary. The traffic load is simulated and facilities such as remote loop back may be used to route traffic through the system. In general the same test pattern may be used on all of the inputs since it will be normal for the data to be either scrambled or encrypted before passing over the air interface.

This is to ensure that the system is operating in a normal operating 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

For systems where separate links are required for different hopping sequences the configuration of figure 5 may be needed. In this case a CRS is linked to one or several TSs.

NOTE: See appropriate notes below figure 3.

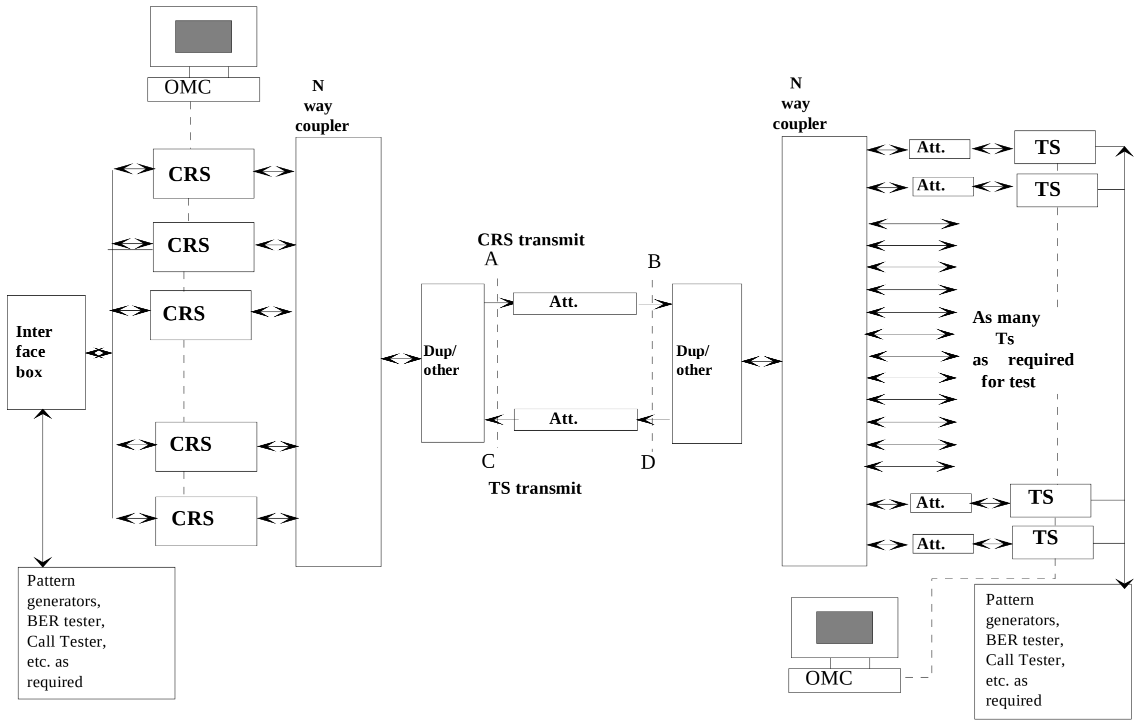


Figure 5: Test configuration for multiple CRS and TS

NOTE: See appropriate notes below figure 3.

For test purposes it may be required to set the frequency hopping pattern in one of the following conditions:

- the normal way of operation, as declared by the supplier. This sequence maybe random or deterministic, however it shall go through all the frequency sub-channels within the band;
- some given known hopping sequence for some specific test(s);
- in a 'single frequency sequence' - where the system hops on the same frequency;
- in a CW mode, no hopping is performed.

If possible, the normal way of operation is preferred, however some tests may require a different configuration.

4.2 Transmitter characteristics

4.2.1 Maximum nominal output power

Objective:

Verify that the highest average RF output power measured during a transmission burst at reference point B' or C' (figure 6) is within the supplier's declared value, plus / minus the EN/ETS tolerance, and does not exceed the EN/ETS maximum value.

Test Instruments:

- Average Power Meter with a time gating function or an appropriate alternate.

Test Configuration:

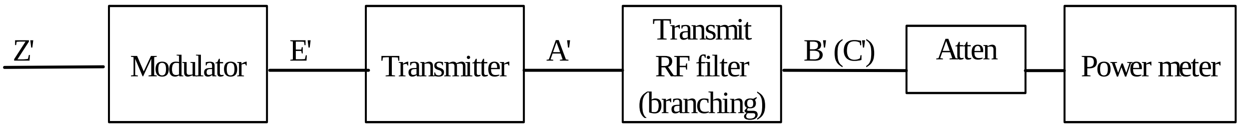


Figure 6: Test configuration for maximum RF output power

CRS → TS direction

If transmission is not continuous a power meter with a time gating function or a properly calibrated Spectrum Analyser with the peak hold function enabled will be required to make this measurement. Another option is to divide the result by the transmitter duty cycle declared by the supplier.

NOTE: To support the power level measurements, it may be useful to include two definitions:

1) Average Power: The in-phase (dissipative) component of the instantaneous complex product of voltage and current, averaged over a sequence of cycles of the wave;

2) Maximum Average Power: The highest value of average power.

Test Procedure:

Set the CRS to a normal hopping mode with the maximum number of sub channels active.

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

TS → CRS direction

For the purpose of the tests below, the equipment (TS) shall provide the maximum output power stated by the supplier. Measurements will be made on a single TS. With the transmitter power level set to maximum, the maximum average output power of the transmitter at point B' (figure 6) during the transmission burst is to be measured. If transmission is not continuous a power meter with a time gating function or a properly calibrated Spectrum Analyser with the peak hold function enabled will be required to make this measurement. Another option is to divide the result by the transmitter duty cycle declared by the supplier.

If applicable, set the TS output power to maximal value.

Test Configuration:

A calibrated directional coupler is inserted at reference point D in the test configuration of figure 4.

Test Procedure:

Set the TS to a normal hopping mode or a single frequency mode.

The TS transmitter is modulated with a PRBS signal. The output power of the TS at point B' or C' shall not exceed the maximum output power specified by the relevant standard.

4.2.2 Minimum nominal output power (if applicable)

Objective:

Verify that the minimum output average power of equipment, fitted with power control circuitry, measured at reference point B' or C' (figure 6) is within the specified limit of the declared value.

Test Instruments:

As for maximum power test.

Test Configuration:

As for maximum power test.

Test Procedure:

With the transmitter power level set to minimum the transmitter output at B' (C') is to be measured.

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 (Automatic):

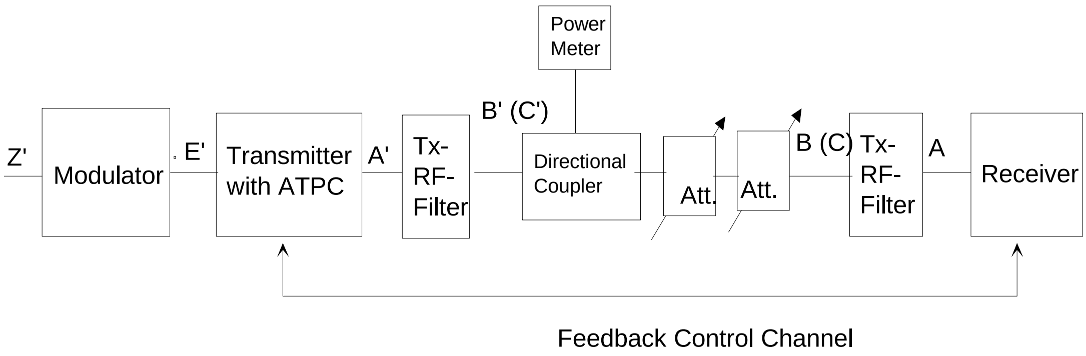


Figure 7: Test configuration for ATPC

Test Procedure:

Set the system at its normal hopping mode. With the maximum transmitter output level selected the average power level at point B'(C') is to be measured. The test is to be repeated with minimum transmitter output power selected. The transmitter output level is measured at point B' or C'.

Attenuator B (figure 7), initially set to produce the minimum transmitter output level is to be adjusted 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 ETS or suppliers 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 ETS or suppliers performance limits.

An alternative test procedure is the use of a single frequency sequence at the lowest, middle and highest frequency sub channels.

4.2.4 Remote Transmit Power Control (RTPC)

Where remote transmit power control is an available management function (e.g. for re-configuring networks) it is to be checked and recorded during the transmitter output power test.

Repeat tests of subclauses 4.2.1 and 4.2.2 with remote transmit power control.

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

4.2.5 Frequency accuracy

Objective:

The frequency accuracy is measured against an agreed frequency close to the centre of the hopping range.

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

The supplier has to declare the function of the frequency synchronization of the CRS and the TS.

Test Instruments:

- Typically Frequency Counter.

Test Configuration:

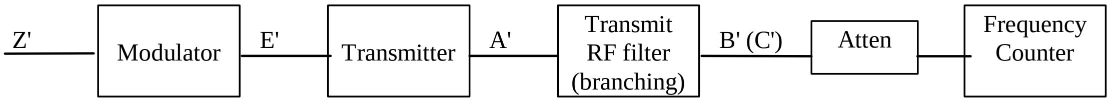


Figure 8: Test configuration for frequency accuracy

Test Procedure:

The transmitter is to be operated in the CW mode condition. Where this cannot be done other procedures would be acceptable with the agreement of the Type Approval Laboratory. The measured frequency shall be within the tolerance stated in the relevant EN/ETS.

All systems should be tested at 3 frequencies (high, medium, low).

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 frequency 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:

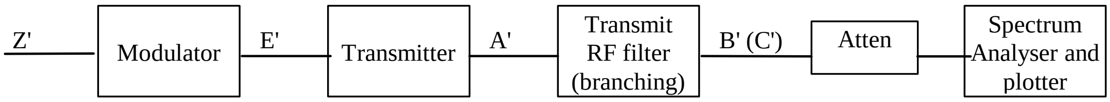


Figure 9: Test configuration for spectrum mask

A calibrated directional coupler is inserted at reference point B in the test configuration of figure 5.

CRS → TS direction

Test Procedure:

The measurement shall be made with a suitable Spectrum Analyser connected to the transmitter port via a suitable attenuator.

The spectrum mask for a system restricted to the highest, lowest and mid RF channels shall be tested. The system shall be set to hop between the highest and the lowest sub-channel within the RF channel tested.

TS → CRS direction

Test Procedure:

The transmitter of one TS is modulated with a PRBS generator test signal. The signal from the directional coupler shall be observed on a spectrum analyser and plotted. The 0 dB level is set to the top of the modulated spectrum disregarding residual carriers. Where not specified, the spectrum analyser settings shown in table 1 should be used for this test.

The spectrum mask for a system restricted to the highest, lowest and mid RF channels shall be tested. The system shall be set to hop between the highest and the lowest sub-channel within the RF channel tested.

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

RF channel spacing (MHz)	1	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.			

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 of 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.

2) Spectrum Analyser Mixer Units - as required.

3) Plotter.

Test Configuration:

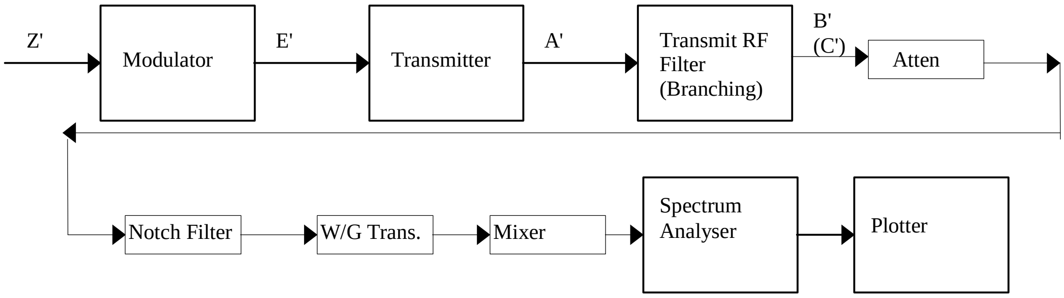


Figure 10: Test configuration for conducted antenna port spurious emissions

Test Procedure:

Set the transmitter in a hopping mode, with a sequence of frequencies limited to one RF channel. 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' (see figure 10) is not exceeded.

The transmitter is to be operated at the supplier's 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.

(Spurious emissions are to be measured in a 1 MHz resolution bandwidth for emissions above 1 GHz and in a 100 kHz bandwidth for emissions between 30 MHz and 1 GHz) - from the relevant EN/ETS.

NOTE: 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.

Due to the low levels of RF signal and the wideband 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.

Due to the low levels of RF signal and the wideband 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.

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.

Where the equipment standard refers to CEPT/ERC Recommendation 74-01 [4], 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

4.3.1 Input level range (if applicable)

Objective:

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

Test Instruments:

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

Test Configuration:

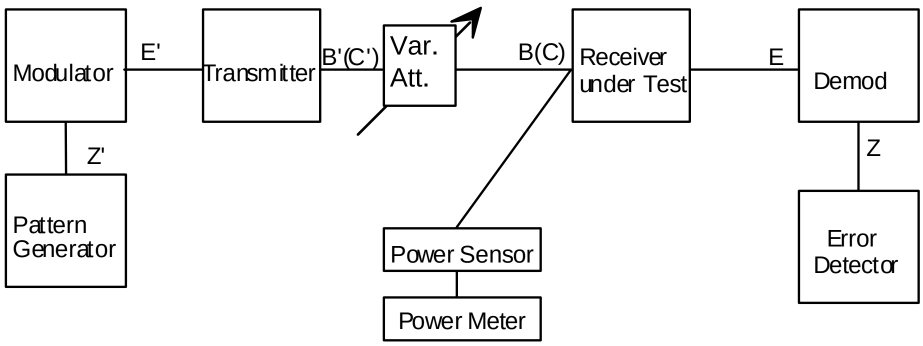


Figure 11: Test configuration for input level range

Set the hopping pattern to a normal operating mode, using the full bandwidth of the system under test.

Make sure that the measurement result is not affected by any possible change in the transmitter output power level. Connect the pattern generator output to the transmitter input (either CRS or TS) and the error detector to the Rx output (TS or CRS respectively).

Switch the transmitter to standby and adjust the variable attenuator to provide maximum attenuation. Make sure the only signal received by the receiver is the one coming through the main path. Disconnect the receiver under test. Connect the power meter, through a suitable power sensor, to point B(C) - at the receiver input. Switch on the transmitter and adjust the attenuator to set the power to the upper limit for the input level range test until the signal input level at the receiver causes a BER equal to the limit quoted in the relevant specification. Switch the transmitter to standby and reconnect the receiver under test.

The input level to the Rx shall be set to the upper and lower levels specified in the relevant ETS/EN or declared by the manufacturer, which ever is the greater and the BER at those RSLs recorded. If required increase the level of attenuation until the signal input level at the receiver causes BER equals to the limit quoted in the relevant specification and calculate the signal level i.e. upper receiver input level minus increase in attenuation. The receiver input level range is the signal range between the upper and lower receiver input levels.

NOTE: When the baseband interface precludes the use of a Bit Error Ratio detector, e.g. in an analogue output or a packet data system, another measure of error performance may be specified by the supplier provided that its numerical equivalence to the BER test can be shown. This proof of equivalence should be recorded in the report.

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.

Objective:

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

4.4 System characteristics

4.4.1 Dynamic level range (if applicable)

Objective:

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:

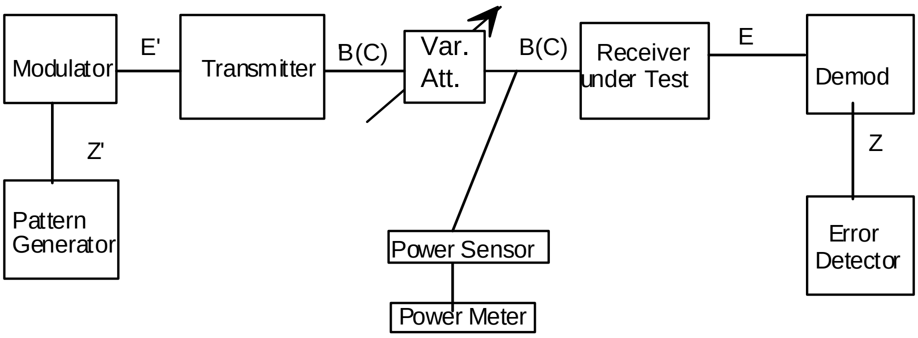


Figure 12: Test configuration for dynamic level range

Test Procedure:

Set the system to a normal hopping mode.

Make sure that the ATPC is switched on, where applicable.

The following measurements should be made for both outbound and inbound direction accordingly.

CRS → TS direction

The procedure for determining the RSL level (referred to point C in figure 12) has been described in subclause 4.4.2. In order to determine the dynamic range of the TS receiver, the received signal level is increased in steps of 10 dB maximum up to the limit stated in the standard by adjusting the attenuation in the path AB. The measured BER should not fall below 10^{-3} for each setting of the attenuator.

TS → CRS direction

The procedure for determining the RSL level (referred to point C in figure 12) has been described in subclause 4.4.2. In order to determine the dynamic range of the CRS receiver, the received signal level is increased by a level in dB as stated in the standard by adjusting the attenuation in the path CD. The measured BER should not fall below 10^{-3}.

4.4.2 BER as a function of receiver input signal level

CRS → TS direction

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(s).
2) Error detector.
3) Power sensor and meter.
4) Traffic generator.

Test Configuration:

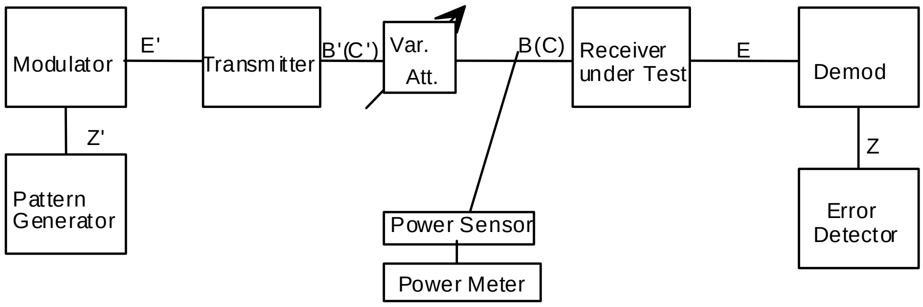


Figure 13: Test configuration for BER as a function of RSL

The test configuration is as shown in figure 13. A calibrated coupler or a suitable splitter is inserted at reference point A in the test configuration of figure 5.

Test Procedure:

Set the system to a normal hopping sequence. The CRS is modulated with a PRBS test signal (as specified in the relevant ETS) from a pattern generator. The attenuation in path A - B is increased such that the RSL level at point C (figure 5) is as specified in the standard. For this received signal level the measured BER at the TS shall be [10^{-3}] as stated in the relevant standard or lower.

Repeat the above process for [a BER of 10^{-6}] other BER requirements from the relevant standard.

TS → CRS direction

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.
2) Error detector.
3) Power sensor and meter.
4) Traffic generator.

Test Configuration

The test configuration is shown in figure 13.

Test Procedure

Set the system to a normal hopping sequence. The TS is modulated with a PRBS test signal (as specified in the relevant ETS/EN) from a pattern generator. The attenuation in path C - D is increased such that the RSL level at point C (figure 5) is as specified in the standard. For this received signal level the measured BER at the CRS shall be 10^{-x} as required by the relevant standard or lower.

Repeat the above process for a BER of 10^{-y} other BER as required by the relevant standard.

4.4.3 Equipment background BER (if applicable)

Objective:

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

Test Instruments:

1) Pattern Generator/Error Detector.
2) Power Meter.

Test Configuration:

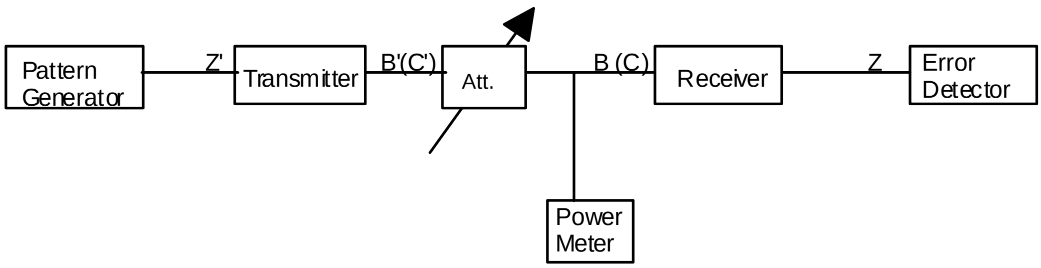


Figure 14: Test Configuration for background BER

4.4.4 Interference sensitivity tests

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

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

Objective

The objective is to verify co-channel interference sensitivity of the system to the levels as stated in the relevant EN/ETS.

TS → CRS direction

Test Instruments:

1) 2 Bit pattern generators.
2) Error detector.
3) Power sensor and meter.
4) Traffic generator.

Test Configuration

For co-channel interference sensitivity assessment the test configuration shown in figure 5 is used. A calibrated directional coupler is inserted at reference point C in order to allow injection of co-channel interference signal.

The number of TS's to be used in the test of the CRS receiver shall be determined according to the system mode of operation and selectivity, as declared by the supplier.

- For a non-orthogonal hopping pattern the full capacity as defined by the supplier. In this case all the transmitters shall operate in their normal hopping sequence.
- For an orthogonal FH-CDMA system: two TS units (and two CRS units, if necessary) shall be used. If possible, all the transmitters shall operate with their normal hopping sequence, using the same correlated hopping sequence (for both time and frequency), but the system will be restricted to use the same RF channel at a given time. If such an arrangement is not possible, all the CRS's and TS's shall work in a single frequency mode (hopping on the same sub-channels).

Test Procedure:

- Set the CRS1 receiver under test to a normal frequency hopping pattern (pattern f_0).
- Set one transmitter (TS1) to the same hopping pattern and increase the transmission path attenuation such that the level at the receiver input will be I_e, which is higher by the level specified in standard than the minimum RSL. This transmitter produces the wanted signal.
- Connect the necessary pattern generators to the transmitters and BER measurement device to the receiver.
- Set one transmitter (TS2) same correlated hopping sequence pattern (for both time and frequency) (f_1). This transmitter shall produce the co-channel interference signal.
- In case of a non-orthogonal frequency hopping pattern set all the TSs in their normal operation mode. Set the level of each transmitter at the CRS1 receiver input to I_e.
- Adjust the level of TS2 or its path attenuation to provide the required signal level at the input of the receiver under test and measure the BER. The measured BER should be lower than the level required by the standard.

CRS → TS direction

Test Instruments:

1) 2 Bit pattern generators.
2) Error detector.
3) Power sensor and meter.
4) Traffic generator.

Test Configuration

For co-channel interference sensitivity assessment the test configuration shown in figure 5 is used. A calibrated directional coupler is inserted at reference point C in order to allow injection of co-channel interference signal.

Two CRS units and one or two TS units, if necessary, shall be used, hopping on the same correlated hopping sequence (for both time and frequency) as in the TS-> CRS measurement, using the configuration of figure 5.

The supplier should provide the hopping pattern codes.

Test Procedure

1) Set the TS under test (TS1) to a normal frequency hopping sequence (sequence f_0).
2) Set one CRS (CRS1) to the same hopping sequence (for both time and frequency) and increase the transmission path attenuation such that the level at the receiver input will be I_e, which is higher by the level specified in the standard than the minimum RSL. This transmitter produces the wanted signal.

3) Connect the necessary pattern generators to the transmitters and BER measurement device to the receiver. Set the other CRS (CRS2), and if necessary, the other TS (used to complete the link) to a second same correlated hopping sequence (for both time and frequency) (f_1). This transmitter shall produce the interference signal.

4) Adjust the level of CRS2 or its path attenuation to provide the required signal level at the input of the receiver under test and measure the BER. The measured BER should be lower than the level required by the standard.

4.4.4.2 Adjacent RF channel interference sensitivity

Objective

The objective is to verify that adjacent RF channel interference sensitivity of the system to the levels as stated in the relevant EN/ETS.

TS → CRS direction

Test Instruments:

1) 2 Bit pattern generators.
2) Error detector.
3) Power sensor and meter.
4) Traffic generator.

Test Configuration:

For adjacent channel interference sensitivity assessment the test configuration shown in figure 4 is used. A calibrated directional coupler is inserted at reference point C in order to allow injection of adjacent channel interference signal.

Two TS units and one or two CRS units, if necessary, shall be used, hopping on two adjacent same correlated pattern, each of them restricted to a single RF-channel. The supplier should provide the hopping pattern codes.

Test Procedure:

1) Set the CRS1 receiver under test to a normal frequency hopping pattern (pattern f_0), restricted to a certain RF channel.

2) Set one transmitter (TS1) to the same hopping pattern and increase its transmission path attenuation such that the level at the CRS1 receiver input will be I_e, which is higher by the level specified in the standard than the minimum RSL. This transmitter produces the wanted signal.

3) Connect the necessary pattern generators to the transmitters and BER measurement device to the receiver.

4) Set one transmitter (TS2) to the adjacent frequency, time correlated sequence pattern (f_1), restricted to an adjacent RF-channel. This transmitter shall produce the interference signal.

5) Adjust the TS2 path attenuation to provide the required signal level at the input of the receiver under test and measure the BER. The measured BER should be lower than the level required by the standard.

CRS → TS direction

Test Instruments:

1) 2 Bit pattern generators.
2) Error detector.
3) Power sensor and meter.
4) Traffic generator.

Test Configuration

For adjacent channel interference sensitivity assessment the test configuration shown in figure 4 is used. A calibrated directional coupler is inserted at reference point C in order to allow injection of adjacent channel interference signal.

Two CRS units and one or two TS units, if necessary, shall be used, hopping on two adjacent same correlated patterns, each of them restricted to a single RF-channel using the configuration of figure 5. The supplier should provide the hopping pattern codes.

Test Procedure

1) Set the TS1 receiver under test to a normal frequency hopping pattern (pattern f_0).

2) Set one transmitter (CRS1) to the same hopping pattern and increase its transmission attenuators such that the level at the receiver input will be I_e, which is higher by the level specified in the standard than the minimum RSL This transmitter produces the wanted signal.

3) Connect the necessary pattern generators to the transmitters and BER measurement device to the receiver.

4) Set one transmitter (CRS2) to the second, adjacent same correlated frequency sequence pattern (f_1). This transmitter shall produce the interference signal.

5) Adjust the level of CRS2 or its path attenuation to provide the required signal level at the input of the receiver under test and measure the BER. The measured BER should be lower than the level required by the standard.

4.4.4.3 CW Spurious interference

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 receive 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:

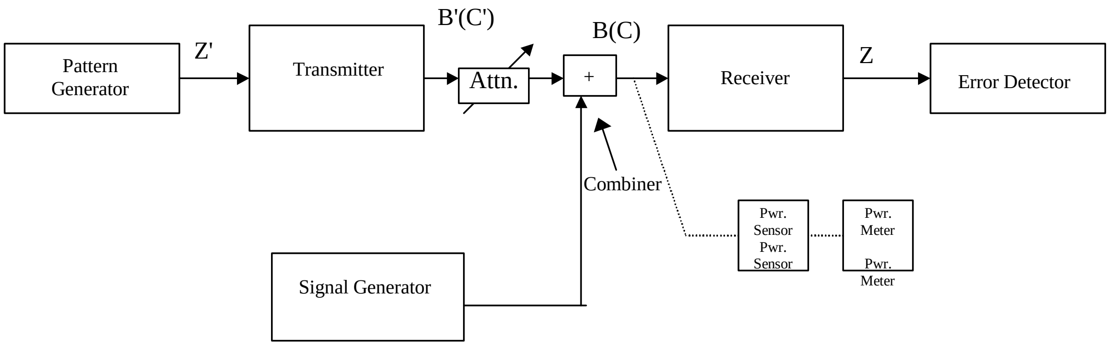


Figure 15: Test configuration for CW spurious interference

Test Procedure:

Set the system to a normal hopping mode. With the signal generator output turned off, increase the level of the transmission path attenuation until the RSL level stated in the EN/ETS is reached.

Switch off the transmitter. Calibrate the signal generator across the frequency range required by the EN/ETS at a level x dB above the RSL level (dBm), where x is the required increase in level for the interfering CW signal.

Switch on the transmitter. Sweep 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: 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 (e.g.: 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.

History

Document history			
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V1.1.1	September 2000	Vote	V 20001124: 2000-09-25 to 2000-11-24