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Abstract	This contribution presents the minimum performance specification (MPS) for the access network (AN) on both the transmitter and the receiver. We define the different metrics used, present the method of measurement and specify the required performance.
Purpose	For consideration of 802.20
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1 ACCESS NETWORK (AN) MPS

1.1 Introduction

The contribution covers the minimum performance specifications on the access network (AN) and access terminal (AT) sides for the transmitter and receiver. All the information in this document pertains to wide area networks.

1.2 AN Receiver Minimum Standards

The sector receiving equipment shall include two diversity RF input ports. Receiver tests employ both inputs, unless otherwise specified. The equipment setups referenced in this section are functional. Other configurations may be necessary for actual testing due to equipment limitations and tolerances.

1.2.1 Receiver Sensitivity

1.2.1.1 Definition

The reference sensitivity level is defined for one receive antenna as the minimum mean power received at the antenna connector to attain 1% FER for the configurations specified in Table 1 Method of Measurement

The test shall be carried out for every band class and channel bandwidth (CBW) [1] supported by the sector using the relevant configuration as specified in Table 1.

1. Configure the sector under test and an access terminal simulator as shown in Figure 1.

1. Disable the AWGN generators (set their output powers to zero).
2. Configure the access network to use reference channel specified in the first column of Table 1 for the channel bandwidth being used for the test.
3. Fix the access network transmit power to the maximum supported for the configuration.
4. The power level should be fixed such that the access network reference sensitivity level is at the value specified in Table 2 for the channel bandwidth being used.
5. Measure the FER

Table 1: Encoder parameters for receiver sensitivity

Reference channel	(Channel Bandwidth = 5, 10 or 20 MHz)
Allocated Tiles	30
Guard Band (tiles per side)	1
Symbols per Tile	8
Modulation	QPSK
Packet format	0
Number of HARQ transmissions	1
Payload size (bits)	1666
Tones per Tile	16
Data channel CRC (bits)	24
Cyclic prefix (us)	13.02
Symbol duration (us)	120.44
Frame duration (us)	963.52
PHY layer throughput [kbps]	1729

Table 2: Access network reference sensitivity level

Channel bandwidth (MHz)	Access network reference sensitivity level (dBm)
5	[-102.2+x+y]
10	[-102.2+x+y]
20	[-102.2+x+y]
Note : x is the reference signal C/I requirement. x=-0.5dB for 1% FER and y=2.5 dB is the implementation loss	

1.2.1.2 Minimum Standard

The FER in all the tests shall not exceed 1% with 95% confidence

1.2.2 Receiver Dynamic Range

1.2.2.1 Definition

The dynamic range requirement of the MBWA system is specified as a measure of the capability of the receiver to receive a desired MBWA signal in the presence of an AWGN interfering signal of the same bandwidth as that of the desired signal in the reception frequency channel. The requirement is to attain a FER less than or equal to 1% for transmission configurations in Table 3.

1.2.2.2 Method of Measurement

The test shall be carried out for every band class and channel bandwidth (CBW) supported by the sector using the relevant configuration as specified in Table 3.

1. Configure the sector under test and an access terminal simulator as shown in Figure 1.
2. Configure the access network to use reference channel specified Table 3 for the channel bandwidth being used for the test.
3. Fix the access network transmit power to the maximum supported for the configuration.
4. Adjust the interfering signal's mean power to the level specified in Table 4.
5. Measure the FER

Table 3: Encoding parameters for receiver dynamic range test. The channel code is Turbo code R1/5

Reference channel	(Channel Bandwidth = 5, 10 or 20 MHz)
Allocated Tiles	30
Guard Band (tiles per side)	1
Symbols per Tile	8
Modulation	64QAM
Packet format	7
Number of HARQ transmissions	1
Payload size (bits)	9576
Subcarriers per Tile	16
Data channel CRC (bits)	24
Cyclic prefix (usec)	13.02
Symbol duration (us)	120.44
Frame duration (us)	963.52
Phy layer throughput [kbps]	9939

Table 4: Access network receive power level for dynamic range test

MBWA channel bandwidth (MHz)	Desired signal mean power [dBm]	Interfering signal mean power [dBm] /transmission BW	Type of interfering signal
5	[-86.2+x+y]	[-86.2]	AWGN
10	[-86.2+x+y]	[-83.2.]	AWGN
20	[-86.2+ x+y]	[-80.2]	AWGN
Note 1: The requirement shall be met in consecutive application of the configuration inTable 1 to groups of 30 tiles Note 2: x=14.5 for 1% FER assuming 1 receive antenna and y=2.5dB			

1.2.2.3 Minimum Standard

The FER in all the tests shall not exceed 1% with 95% confidence.

1.2.3 Intermodulation Spurious Response Attenuation

1.2.3.1 Definition

The intermodulation spurious response attenuation requirement of the MBWA system is specified as a measure of the capability of the receiver to receive a desired MBWA signal in the presence of interfering signals at a carefully chosen frequency offsets such that their third order inter-modulation product falls in the desired signal channel increasing the noise floor. The desired signal is allowed to desense by at most 6dB. .

1.2.3.2 Method of Measurement

The test shall be carried out for every band class and channel bandwidth (CBW) supported by the sector using the relevant configuration as specified in Table 5 and Table 6.

1. Configure the sector under test and an access terminal simulator as shown in Figure 3.
2. Configure the access network to use the reference channel configuration in Table 1 (receiver sensitivity).
3. Fix the access network transmit power to the maximum supported for the configuration.
4. Adjust the mean power of the interfering signals to the level specified in Table 5 and Table 6
5. For broadband intermodulation test, the power level should be fixed such that the access network receiver power is at the level specified in Table 5. For narrowband intermodulation test, the power level should be fixed such that the access network receiver power is at the level specified in Table 6.
6. Measure the FER.

Table 5: Access network broadband intermodulation performance requirement

MBWA channel bandwidth (MHz)	Configuration	Desired signal mean power [dBm]	Interfering signal mean power [dBm]	Interfering signal centre frequency offset to the channel edge of the desired carrier [MHz]	Type of interfering signal
5	See Table 1	[REFSENS + [6]dB]	[-52]	[7.5]	CW
			[-52]	[17.5]	5MHz MBWA signal
10	See Table 1	[REFSENS + [6]dB]	[-52]	[7.5]	CW
			[-52]	[17.7]	5MHz MBWA signal
20	See Table 1	[REFSENS + [6]dB]	[-52]	[7.5]	CW
			[-52]	[17.95]	5MHz MBWA signal

Table 6: Access network narrowband intermodulation performance requirement

MBWA channel bandwidth (MHz)	Configuration	Wanted signal mean power [dBm]	Interfering signal mean power [dBm]	Interfering signal offset to the channel edge of the desired carrier [kHz]	Type of interfering signal
5	See Table 1	[REFSENS + [6]dB]	[-52]	[384]	CW
			[-52]	[1040.8]	5 MHz MBWA signal, 1 Tile* (10th tile from center)
10	See Table 1	[REFSENS + [6]dB]	[-52]	[439.6]	CW
			[-52]	[1348]	5 MHz MBWA signal, 1 Tile* (8th tile from center)
20	See Table 1	[REFSENS + [6]dB]	[-52]	[474]	CW
			[-52]	[1655.2]	5MHz MBWA signal, 1 Tile* (6th tile from center)
Note*: Interfering signal consisting of one Tile positioned at the stated offset.					

1.2.3.3 Minimum Standard

The FER in all the tests shall not exceed 1% with 95% confidence.

1.2.4 Adjacent Channel Selectivity

1.2.4.1 Definition

ACS is defined by specifying a certain receiver performance (FER = 0.01) at a specified data rate, desired signal mean power and interfering signal mean power, where the interferer is a MBWA signal located on the adjacent channel. The following two signals specify the MBWA ACS requirement:

- A single Tile signal from an adjacent MBWA system with minimum centre frequency offset of the interfering signal to the channel edge of a victim system equal to 272.8 kHz as shown in Table 7.

- A wideband signal in an adjacent channel position. The wideband signal is a 5 MHz MBWA carrier, independent of the MBWA channel bandwidth with minimum centre frequency offset of the interfering signal to the band edge of a victim system equal to 2.5MHz as shown in Table 8.

1.2.4.2 Method of Measurement

The test shall be carried out for every band class and channel bandwidth (CBW) supported by the sector using the relevant configuration as specified in Table 7 and Table 8.

1. Configure the sector under test and an access terminal simulator as shown in Figure 2.
2. Configure the access network to use the reference channel configuration in Table 1 (receiver sensitivity).
3. Fix the access network transmit power to the maximum supported for the configuration.
4. Adjust the mean power of the interfering signals to the level specified in Table 7 and Table 8.
5. For narrowband adjacent channel selectivity test, the power level should be fixed such that the access network receiver power is at the level specified in Table 7. For wideband adjacent channel selectivity test, the power level should be fixed such that the access network receiver power is at the level specified in Table 8.
6. Measure the FER.

Table 7: MBWA AN ACS (Narrowband) requirement

MBWA channel bandwidth (MHz)	Reference measurement channel	Wanted signal mean power [dBm]	Interfering signal mean power [dBm]	Interfering Tile centre frequency offset to the channel edge of the wanted carrier [kHz]	Type of interfering signal
5	See Table 1	[REFSENS + [6]dB]	[-49]	[272.8+m*153.6, m=0, 14, 30]	5 MHz MBWA signal, 1 tile*
10	See Table 1	[REFSENS + [6]dB]	[-49]	[272.8+m*153.6, m=0, 14, 30]	5 MHz MBWA signal, 1 tile*
20	See Table 1	[REFSENS + [6]dB]	[-49]	[272.8+m*153.6, m=0, 14, 30]	5 MHz MBWA signal, 1 tile*
Note*: Interfering signal consisting of one Tile. The requirement applies to both upper and lower frequency edge of the MBWA channel. Add offset to the upper frequency edge and subtract offset from the lower frequency edge					

Table 8: MBWA AN ACS (wideband) requirement

MBWA channel bandwidth	Reference measurement channel	Desired signal mean power	Interfering signal mean power	Interfering signal centre frequency offset to the	Type of interfering signal

(MHz)		[dBm]	[dBm]	channel edge* of the wanted carrier [MHz]	
5	See Table 1	[REFSENS + [6]dB]	[-52]	[2.5]	5MHz MBWA signal
10	See Table 1	[REFSENS + [6]dB]	[-52]	[2.5]	5MHz MBWA signal
20	See Table 1	[REFSENS + [6]dB]	[-52]	[2.5]	5MHz MBWA signal

*The requirement applies to both upper and lower frequency edge of the MBWA channel. Add offset to the upper frequency edge and subtract offset from the lower frequency edge

1.2.4.3 Minimum Standard

The FER in all the tests shall not exceed 1% with 95% confidence.

1.2.5 In-Channel Selectivity

1.2.5.1 Definition

The In-channel selectivity (ICS) requirement of the MBWA system is specified as a measure of the capability of the receiver to receive a desired MBWA signal (denoted as the victim) at its assigned Tile locations in the presence of another in-channel desired signal (denoted as the aggressor) received at adjacent Tile allocations which are received at a higher PSD.

Table 9 and Table 10 specify the tile allocations for the victim and aggressor signal as well as the received energy level for both. The victim signal uses QPSK modulation and the aggressor resembles a 64QAM received signal. The aggressor PSD is set at 25dB above the noise floor. The requirement is to have a selectivity of 25dB on the aggressor such that the noise it causes at the victim tiles is at the same level as the its own noise floor, i.e. the total noise floor on the victim tiles increases by 3dB or alternatively the aggressor causes 3dB desense.

1.2.5.2 Method of Measurement

The test shall be carried out for every band class and channel bandwidth (CBW) supported by the sector using the relevant configuration as specified in Table 9.

1. Configure the sector under test and an access terminal simulator (victim) and another access terminal simulator (aggressor) as shown in Figure 2.
2. Configure the access network to use reference channel in Table 9.

3. Fix the access network transmit power to the maximum supported for the configuration.
4. Fix the transmit power on the access terminal (aggressor) simulator and start the data packet transmission on the reverse link. The power level should be fixed such that the access network receiver power is at the level specified in Table 10 for the channel bandwidth being used.
5. Set up a connection between the access terminal (victim) and the access network
6. The power level should be fixed such that the access network receiver power is at the level specified in Table 10 for the channel bandwidth being used.
7. Measure the FER.

Table 9: Encoding Parameters for In-Channel Selectivity

Reference channel	A1	A2
Allocated Tiles for victim	16	32
Guard Band (tiles per side)	1	2 for Channel Bandwidth=10MHz; 4 for Channel Bandwidth=20MHz
Symbols per Tile	8	8
Modulation	QPSK	QPSK
Packet format	0	0
Number of HARQ transmissions	1	1
Payload size (bits)	877	2860
Cyclic prefix (usec)	13.02	13.02
Tones per Tile	16	16
Data channel CRC (bits)	24	24
Symbol duration (us)	120.44	120.44
Frame duration (us)	963.52	963.52
PHY layer throughput [kbps]	910	1820

Table 10: Victim/aggressor tiles allocations and received energy levels

MBWA Channel Bandwidth (MHz)	Reference measurement channel	Tiles victim signal	Tiles aggressor signal	Desired signal mean power [dBm]	Interfering signal mean power, (dBm)
5	A1 in **Table 9**	16	14	[-105 +x + y +3]	-80.6
10	A2 in **Table 9**	32	28	[-102 +x + y +3]	-77.6
20	A2 in **Table 9**	32	28	[-102 +x + y +3]	-77.6
Note: x=0.5dB and y=2.5dB					

1.2.5.3 Minimum Standard

The FER in all the tests shall not exceed 1% with 95% confidence.

1.2.6 Receiver Blocking Characteristics

1.2.6.1 Definition

The blocking performance requirement of the MBWA system is specified as a measure of the receiver ability to receive a desired signal at its assigned channel frequency in the presence of an unwanted interferer. Two different cases are specified: 1) In-band blocking using 5MHz MBWA signal as interference signal and 2) Out-of-band blocking with CW signal as interference signal on frequencies other than those “close-in” to the desired channel

1.2.6.2 Method of Measurement

The test shall be carried out for each channel bandwidth (CBW) supported by the sector using the configuration as specified in Table 1(receiver sensitivity).

1. Configure the sector under test and an access terminal simulator as shown in Figure 2.
2. Configure the access network to use the reference channel configuration in Table 1 (receiver sensitivity).
3. Fix the access network transmit power to the maximum supported for the configuration.
4. Adjust the mean power of the interfering signals to the level specified in Table 11 and Table 12. Table 12 shall be used for the frequency range of 1MHz to f3 and f4 to 12.750 GHz. The frequency ranges f3 and f4 are defined in Table 13.
5. Set up a connection between the access terminal and the access network and ensure that the configuration specified in step
6. Fix the transmit power on the access terminal (aggressor) simulator and start the data packet transmission on the reverse link. The power level should be fixed such that the access network receiver power is at the level specified in Table 11 and Table 12 for the channel bandwidth being used.
7. Measure the FER.

Table 11: MBWA Access Network in-band blocking requirements

MBWA Assigned Bandwidth (MHz)	Wanted signal mean power [dBm]	Interfering signal mean power [dBm]	Interfering signal minimum offset to the channel edge of the wanted carrier [MHz]	Type of interfering signal
5	[REFSENS + [3]dB]	[-43]	[7.5]	5MHz MBWA signal
10	[REFSENS + [3]dB]	[-43]	[7.5]	5MHz MBWA signal
20	[REFSENS + [3]dB]	[-43]	[7.5]	5MHz MBWA signal

Table 12: MBWA Access Network out of band blocking requirements

MBWA Assigned Bandwidth (MHz)	Wanted signal mean power [dBm]	Interfering signal mean power above access terminal mean power [dB]	Type of interfering signal
5	[REFSENS + [3]dB]	[+75]	CW carrier
10	[REFSENS + [3]dB]	[+75]	CW carrier
20	[REFSENS + [3]dB]	[+75]	CW carrier

Table 13: Frequency range definition for use in Table 12

f_3 [MHz]	f_4 [MHz]
20 below the left edge of the band	20 above the right edge of the band

1.2.6.3 Minimum Standard

The FER in all the tests shall not exceed 1% with 95% confidence. .

1.2.7 Limitations on Emissions

1.2.7.1 Definition

Conducted spurious emissions are spurious emissions generated or amplified in the sector equipment and appearing at the receiver RF input ports.

1.2.7.2 Method of Measurement

1. Connect a spectrum analyzer (or other suitable test equipment) to a receiver RF input port.
2. For each band class that the sector supports, configure the sector to operate in that band class and perform steps 3 through 5.
3. Disable all transmitter RF outputs.
4. Perform step 5 for all receiver input ports.
5. Sweep the spectrum analyzer over a frequency range from the lowest intermediate frequency or lowest oscillator frequency used in the receiver or 1 MHz, whichever is lower, to at least 2600 MHz for Band Classes [2] 0, 2, 5, 7, 9, 10, 11 and 12, at least 3 GHz for Band Class 3 or at least 6 GHz for Band Classes 1, 4 and 8. For Band Class 6, sweep the spectrum analyzer over a frequency range from 30 MHz to at least 12.75 GHz and measure the spurious emissions levels.

1.2.7.3 Minimum Standard

The mean conducted spurious emission shall not exceed the levels in Table 14.

Table 14: General spurious emission minimum requirement

Band	Maximum level	Measurement Bandwidth
30MHz - 1 GHz	-57 dBm	100 kHz
1 GHz - 12.75 GHz	-47 dBm	1 MHz
Within access network Receive band	-80 dBm	30 kHz
1884.5 – 1919.6 MHz	-41dBm	300 kHz
NOTE: The frequency range between 2.5 × CBW_l below the first carrier frequency and 2.5× CBW above the last carrier frequency transmitted by the AN is excluded from the requirement. However, frequencies that are more than 10 MHz below the lowest frequency of the AN transmitter operating band or more than 10 MHz above the highest frequency of the AN transmitter operating band shall not be excluded from the requirement.		

Current region-specific radio regulation rules shall also apply.

For example,

[1] A Band Class 3 sector operating under Japan regional requirements shall limit conducted emissions to less than –54 dBm, measured in a 30 kHz resolution bandwidth at the sector RF input ports, for all other frequencies.

[2] A Band Class 6 sector operating under Japan regional requirements shall limit conducted emissions to less than -41 dBm, measured in a 300 kHz resolution bandwidth at the sector RF input ports, for frequencies within the PHS band from 1884.5 to 1919.6 MHz.

1.3 AN Transmitter MPS

1.3.1 Frequency Tolerance

1.3.1.1 Definition

The frequency tolerance is defined as the maximum allowed difference between the actual transmit carrier frequency and the specified transmit frequency assignment. This test shall apply to every band class that the sector supports.

1.3.1.2 Method of Measurement

Frequency shall be measured using appropriate test equipment with sufficient accuracy to ensure compliance with the minimum standard. Frequency should be measured as part of the error vector magnitude test of 3.2.1.

1.3.1.3 Minimum Standard

For all operating temperatures specified by the manufacturer, the average frequency difference between the actual transmit carrier frequency and specified transmit frequency assignment shall be less than $\pm 5 \times 10^{-8}$ of the frequency assignment (±0.05 ppm).

1.3.2 Modulation Requirements

1.3.2.1 Error Vector Magnitude

1.3.2.1.1 Definition

The error vector magnitude is measured by determining the root mean square error between the ideal constellation point and the actual one to be received after equalizing for some of the access network transmitter imperfections. This test is performed with a single carrier and single sector only. This test also evaluates the resulting spectral flatness that is a consequence for error vector magnitude being computed for equalized waveform. The equalized waveform may not capture any ripples or droop in the transmit waveform.

The test shall be carried out for every band class and channel bandwidth (CBW) supported by the sector

1.3.2.1.2 Method of Measurement

1. Configure the sector under test as shown in Figure 4.
2. Connect the error vector magnitude measuring equipment to the sector RF output port.
3. Configure the access network to use the tile assignment for a given maximum transmission bandwidth in Table 15.

4. Fix the access network transmit power to the maximum supported when testing for QPSK and 8-PSK, 5dB below maximum when testing for 16QAM and 10dB below maximum when testing for 64QAM.

5. Measure the error vector magnitude as follows:
   a. The transmitted signal is cable-connected to the receiver with one receive antenna. Denote the received samples by r
   b. After down conversion, the EVM analyzer determines the beginning of the cyclic prefix of the received signal. It computes the frequency offset for the given PHY frame n [1], $f_{o,n}$, and corrects for it by applying a phase ramp on each sample of r with a slope of $f_{o,n}$. Denote the resulted signal by y.
   c. The EVM analyzer then performs an FFT operation with an FFT window that centers the channel in the cyclic prefix. Consequently, the frequency domain tones are then corrected with a phase ramp of slope CP/2; denote the resulted samples by Z.
   d. The EVM analyzer estimates the complex channel response for every sample in the assignment. Channel estimation is done within every tile by first averaging the pilots in the tile then doing linear interpolation in time and frequency to get the channel response on the data tones. Denote the frequency domain channel estimate on a given tone by H.
   e. The EVM analyzer performs channel equalization to get samples $\hat{X} = \frac{Z}{H}$.
   f. The EVM analyzer computes the EVM metric as

$$EVM\left(\hat{X}\right) = \sqrt{\frac{\sum_{j=1}^{N_f}\sum_{k=1}^{N_p}\left(X_I(j,k) - \hat{X}_I(j,k)\right)^2 + \left(X_Q(j,k) - \hat{X}_Q(j,k)\right)^2}{\sum_{j=1}^{N_f}\sum_{k=1}^{N_p}\left(X_I(j,k)\right)^2 + \left(X_Q(j,k)\right)^2}}$$

where

a_I, a_Q are the real and imaginary parts of a, $\hat{X}$ is the frequency domain equalized sample by the EVM analyzer as explained above, X [2] is the frequency domain ideal transmitted constellation point by the AN, N_p is the number of modulation symbols in all assignment tiles in one frame and N_f is the total number of frames used for averaging EVM, i.e. $N_f = N_s \times N_{f,SF}$, N_s being the number of super frames and

[1] The EVM equalizer may also use an average estimate of the frequency offset or an estimate that is constant over a super frame

[2] It may not be possible for the EVM analyzer equipment to have the ideal transmitted constellation point. In this case, we can map $\hat{X}$ to the nearest constellation point from an Euclidean distance sense and denote the hard-decision constellation point by X. In this case, the EVM calculation is optimistic since there is a probability that hard decision is wrong so that the real constellation point is farther from the hard decision one, i.e. EVM calculated is smaller than actual.

$N_{f,SF}$ is the number of frames in a super frame. This test shall run for $N_s = 1$ super frames. The number of frames used in each super frame, $N_{f,SF}$, shall be at least 3.

6. Measure the spectral flatness factor defined as follows:
    1. From channel estimation we have the estimated frequency response H_i for tone i, $i = 1, 2, \cdots, M$, where M is the total Number of tones in an OFDM symbol
    2. Obtain the magnitude square $B_i = |H_i|^2$ for each tone and average it over multiple OFDM symbols to obtain $\bar{B}_i$, for $i = 1, 2, \cdots, M$
    3. Compute the spectral flatness metric $F = 10\log_{10}\left(B_{\max}/B_{\min}\right)$, where $B_{\max} = \max_{i=1,2,\cdots M} \bar{B}_i$, $B_{\min} = \min_{i=1,2,\cdots M} \bar{B}_i$.

Table 15: AN assignment used for EVM computation

Channel BW (MHz)	**5**	**10**	**20**
Nominal maximum Number of Tiles (N_T) for maximum transmission BW	30	60	120
Nominal maximum transmission BW (MHz)	4.61	9.22	18.44

1.3.2.1.3 Minimum Standard

The measured error vector magnitude at the transmit power specified shall be less than the values in Table 16.

Table 16: Error Vector Magnitude Minimum Limits as a Function of Modulation Type

AN Type	**Modulation Type**	**EVM (%)**	**C/N (dBc)**	**Transmit Power used-max transmit power (dB)**
Wide Area	QPSK	17.5	15.13	0
	8-PSK	12.5	18.06	0
	16QAM	9	20.91	-5

	64QAM	5	26.02	-10

The measured spectral flatness metric shall be less than 3 dB.

1.3.3 Limitations on Emissions

1.3.3.1 Conducted Spurious Emissions

1.3.3.1.1 Definition

The conducted spurious emissions are emissions at frequencies that are outside the assigned MBWA Channel, measured at the sector RF output port.

1.3.3.1.2 Method of Measurement

The test shall be carried out for every band class and channel bandwidth (CBW) supported by the sector.

1. Configure the sector under test and an access terminal as shown in Figure 1. The AWGN generators are not applicable in this test.
2. Connect a spectrum analyzer (or other suitable test equipment) to the sector RF output port, using an attenuator or directional coupler if necessary.
3. Fix the access network transmit power to the maximum supported for the configuration.
4. Measure the spurious emissions using appropriate measurement bandwidth.
5. For ACLR measurement, measure the in-band power and also the power in the first and second adjacent channels for the specified channel bandwidths. Compute the difference between the in-band power and the power in the adjacent channels to measure the ACLR.

1.3.3.1.3 Minimum Standard

In the sequel the following definitions are to be observed:

- Δf is the separation between the carrier edge frequency and the nominal -3dB point of the measuring filter closest to the carrier frequency
- Δf_{max} is the offset to the frequency 10 MHz outside the operating band edge minus half of the bandwidth of the measuring filter.

When transmitting in Band Classes less than 1GHz, the spurious emissions shall be less than the limits specified in Table 17. When transmitting in band class 0, the spurious emissions shall be less than the limits specified in Table 18. When transmitting in band classes greater than 1GHz, the spurious emissions shall be less than the limits specified in Table 19. When transmitting in Band Class 1 or 15, the additional spurious emissions shall be less than the limits specified in Table 20.

The out-of-band spurious emissions shall be less than the limits specified in Table 21 and Table 22. The spurious emissions shall be less than the limits for the protection of the access network receiver as specified in Table 23.

The measured ACLR shall be equal to or more than the limits specified in Table 24.

Table 17: Band Classes less than 1GHz transmit Spurious Emission Limits

Frequency offset, Δ f, MHz			Emission Limit			Comments	
				Unit	RBW, kHz	Restrictions	Applicable range
0		5	-7 -7/5 * □f	dBm	100	all CBW ≥ 5 MHz	**f_c < 1 GHz**
5		10	-14	dBm	100	all CBW ≥ 5 MHz	**f_c < 1 GHz**
10	Δ	Δ f_{max}	-16	dBm	100	all CBW ≥ 5 MHz	**f_c < 1 GHz**

Table 18: Band Classe 0 Additional Transmitter Spurious Emission Limits

Frequency offset, Δ f, MHz			Emission Limit			Comments	
				Unit	RBW, kHz	Restrictions	Applicable range
0		1	-10	dBm	100	CBW= 5 MHz	**f_c < 1 GHz**
0		1	-13	dBm	100	CBW=10 MHz	**f_c < 1 GHz**
0		1	-16	dBm	100	CBW=20 MHz	**f_c < 1 GHz**
1		5	-13	dBm	100	all CBW ≥ 5 MHz	**f_c < 1 GHz**
5		10	-14	dBm	100	all CBW ≥ 5 MHz	**f_c < 1 GHz**
10	Δ	Δ f_{max}	-16	dBm	100	all CBW ≥ 5 MHz	**f_c < 1 GHz**

Table 19: Band Classes greater than 1GHz Transmitter Spurious Emission Limits

Frequency offset, Δ f, MHz			Emission Limit	Unit	RBW, kHz	Comments: Restrictions	Comments: Applicable range
0		5	-7 -7/5 * □f	dBm	100	all CBW ≥ 5 MHz	**f_c > 1 GHz**
5		10	-14	dBm	100	all CBW ≥ 5 MHz	**f_c > 1 GHz**
10	Δ	Δ f_{max}	-15	dBm	1000	all CBW ≥ 5 MHz	**f_c > 1 GHz**

Table 20: Additional Band Class 1 and 15 Transmitter Spurious Emission Limits

Frequency offset, Δ f, MHz			Emission Limit	Unit	RBW, kHz	Comments: Restrictions	Comments: Applicable range
0		1	-10	dBm	100	CBW=5 MHz	**f_c > 1 GHz**
0		1	-13	dBm	100	CBW=10 MHz	**f_c > 1 GHz**
0		1	-16	dBm	100	CBW=20 MHz	**f_c > 1 GHz**
1		10	-13	dBm	1000	all CBW ≥ 5 MHz	**f_c > 1 GHz**
10	Δ	Δ f_{max}	-15	dBm	1000	all CBW ≥ 5 MHz	**f_c > 1 GHz**

Table 21: Out of Band Spurious Emission Limits for Category A

Band	Maximum level	Measurement Bandwidth	Note
9kHz - 150kHz	-13 dBm	1 kHz	Note 1
150kHz - 30MHz		10 kHz	Note 1
30MHz - 1GHz		100 kHz	Note 1
1GHz - 12.75 GHz		1 MHz	Note 2
NOTE 1: Bandwidth as in ITU-R SM.329 [2] , s4.1 NOTE 2: Bandwidth as in ITU-R SM.329 [2] , s4.1. Upper frequency as in ITU-R SM.329 [2] , s2.5 table 1			

Table 22: Out of Band Spurious Emission Limits for Category B

Band	Maximum Level	Measurement Bandwidth	Note
9 kHz ↔ 150 kHz	-36 dBm	1 kHz	Note 1
150 kHz ↔ 30 MHz	-36 dBm	10 kHz	Note 1
30 MHz ↔ 1 GHz	-36 dBm	100 kHz	Note 1
1 GHz ↔ 12.75 GHz	-30 dBm	1 MHz	Note 2
NOTE 1: Bandwidth as in ITU-R SM.329 [2] , s4.1 NOTE 2: Bandwidth as in ITU-R SM.329 [2] , s4.1. Upper frequency as in ITU-R SM.329 [4] , s2.5 table 1			

Table 23: Wide Area Access Network Spurious Emission Limits for Protection of Access Network Receiver

Operating Bands	Access Network class	Maximum Level	Measurement Bandwidth
All	Wide Area	-96 dBm	100 kHz

Current region-specific radio regulation rules shall also apply.

Table 24: ACLR Limits

Channel BW (MHz)		ACLR limit for 1st and 2nd Adjacent channel relative to assigned channel frequency [dB]		
		MBWA[1] 5.0 MHz	MBWA[1] 10 MHz	MBWA[1] 20 MHz
5	ACLR 1	[45]	-	-
	ACLR 2	[45]	-	-
10	ACLR 1	-	[45]	-
	ACLR 2	-	[45]	-
20	ACLR 1	-	-	[45]
	ACLR 2	-	-	[45]
NOTES: [1] Measured on the maximum transmission BW on the 1st or 2nd adjacent channels				

1.3.3.2 Inter-Sector Transmitter Intermodulation

1.3.3.2.1 Definition

The inter-sector transmitter intermodulation occurs when an external signal source is introduced to the antenna connector of the sector. This test verifies that conducted spurious emissions are still met with the presence of the interfering source.

1.3.3.2.2 Method of Measurement

The test shall be carried out for every band class and the maximum bandwidth (denoted by B in the following steps) supported by the sector.

1. Connect the two sectors under test and two access terminal simulators as shown in Figure 5. Configure the setup so that Sector 2 total power is 30 dB less than the power of Sector 1. The frequency offset of the centre frequency of the interference signal shall be B/2 +2.5MHz and –B/2 -2.5MHz from the desired signal carrier centre frequency, but excluded are interference frequencies that are partially or completely outside of operating frequency band of the base station.
2. Connect a spectrum analyzer (or other suitable test equipment) to the sector RF output port, using an attenuator or directional coupler if necessary.
3. Fix the Sector 1 transmit power to the maximum supported for the configuration.
4. Set up a connection between the access terminal simulator 1 and sector 1 and access terminal simulator 2 and sector 2
5. Measure the spurious emissions for Sector 1.

1.3.3.2.3 Minimum Standard

The sector shall meet the conducted spurious emission requirements in Section 3.3.1.

1.3.3.3 Coexistence Requirements

1.3.3.3.1 Co-existence requirements for MBWA FDD

1.3.3.3.1.1 Definition

These requirements may be applied for the protection of access terminal and/or access network operating in other frequency bands in the same geographical area. The requirements may apply in geographic areas in which both MBWA FDD operating in some frequency band and a system operating in another frequency band than the MBWA operating band are deployed.

1.3.3.3.1.2 Minimum Requirements

The power of any spurious emission shall not exceed the limits of Table 25 for an access network where requirements for co-existence with the system listed in the first column apply.

Table 25: Access Network Spurious emissions limits for MBWA FDD Access Networks in geographic coverage area of systems operating in other frequency bands

System type operating in the same geographical area	Band for co-existence requirement	Maximum Level	Measurement Bandwidth	Note
GSM900	921 - 960 MHz	-57 dBm	100 kHz	This requirement does not apply to MBWA AN operating in BC9
	876 - 915 MHz	-61 dBm	100 kHz	For the frequency range 880-915 MHz, this requirement does not apply to MBWA AN operating in BC9, since it is already covered by the requirement in Table 23
DCS1800	1805 - 1880 MHz	-47 dBm	100 kHz	This requirement does not apply to MBWA AN operating in BC8
	1710 - 1785 MHz	-61 dBm	100 kHz	This requirement does not apply to MBWA AN operating in BC8, since it is already covered by the requirement in Table 23.
PCS1900	1930 - 1990 MHz	-47 dBm	100 kHz	This requirement does not apply to MBWA AN operating in frequency BC1
	1850 - 1910 MHz	-61 dBm	100 kHz	This requirement does not apply to MBWA AN operating in frequency BC1, since it is already covered by the requirement in Table 23
GSM850	869 - 894 MHz	-57 dBm	100 kHz	This requirement does not apply to MBWA AN operating in frequency BC0
	824 - 849 MHz	-61 dBm	100 kHz	This requirement does not apply to MBWA AN operating in frequency BC0, since it is already covered by the requirement in Table 23
MBWA FDD BC6	2110 - 2170 MHz	-52 dBm	1 MHz	This requirement does not apply to MBWA AN operating in BC6,
	1920 - 1980 MHz	-49 dBm	1 MHz	This requirement does not apply to MBWA AN operating in BC6, since it is already covered by the requirement in Table 23
MBWA FDD BC1	1930 - 1990 MHz	-52 dBm	1 MHz	This requirement does not apply to MBWA AN operating in BC1
	1850 - 1910 MHz	-49 dBm	1 MHz	This requirement does not apply to MBWA AN operating in BC1, since it is already covered by the requirement in Table 23
MBWA FDD BC8	1805 - 1880 MHz	-52 dBm	1 MHz	This requirement does not apply to MBWA AN operating in BC8

	1710 - 1785 MHz	-49 dBm	1 MHz	This requirement does not apply to MBWA AN operating in BC8, since it is already covered by the requirement in Table 23
MBWA FDD BC15	2110 - 2155 MHz	-52 dBm	1 MHz	This requirement does not apply to MBWA AN operating in BC15
	1710 - 1755 MHz	-49 dBm	1 MHz	This requirement does not apply to MBWA AN operating in BC15, since it is already covered by the requirement in Table 23
MBWA FDD BC0	869 - 894 MHz	-52 dBm	1 MHz	This requirement does not apply to MBWA AN operating in BC0
	824 - 849 MHz	-49 dBm	1 MHz	This requirement does not apply to MBWA AN operating in BC0, since it is already covered by the requirement in Table 23
MBWA FDD BC13	2620 - 2690 MHz	-52 dBm	1 MHz	This requirement does not apply to MBWA AN operating in BC13,
	2500 – 2570 MHz	-49 dBm	1 MHz	This requirement does not apply to MBWA AN operating in BC13, since it is already covered by the requirement in Table 23
MBWA FDD BC9	925 - 960 MHz	-52 dBm	1 MHz	This requirement does not apply to MBWA AN operating in BC9.
	880 - 915 MHz	-49 dBm	1 MHz	This requirement does not apply to MBWA AN operating in BC9, since it is already covered by the requirement in Table 23

1.3.3.3.2 Co-existence with co-located base stations

1.3.3.3.2.1 Definition

These requirements may be applied for the protection of other access network receivers when GSM900, DCS1800, PCS1900, GSM850, FDD UTRA are co-located with a MBWA FDD access network.

1.3.3.3.2.2 Minimum Requirements

The power of any spurious emission shall not exceed the limits of Table 26 for a Wide Area (WA) access network where requirements for co-location with an access network type listed in the first column apply.

Table 26: Access Network Spurious emissions limits for Wide Area FDD AN co-located with another Access Netowrk

Type of co-located AN	Band for co-location requirement	Maximum Level	Measurement Bandwidth
Macro GSM900	876-915 MHz	-98 dBm	100 kHz
Macro DCS1800	1710 - 1785 MHz	-98 dBm	100 kHz
Macro PCS1900	1850 - 1910 MHz	-98 dBm	100 kHz
Macro GSM850	824 - 849 MHz	-98 dBm	100 kHz
WA MBWA FDD BC6	1920 - 1980 MHz	-96 dBm	100 kHz
WA MBWA FDD BC1	1850 - 1910 MHz	-96 dBm	100 kHz
WA MBWA FDD BC8	1710 - 1785 MHz	-96 dBm	100 kHz
WA MBWA FDD BC15	1710 - 1755 MHz	-96 dBm	100 kHz
WA MBWA FDD BC0	824 - 849 MHz	-96 dBm	100 kHz
WA MBWA FDD BC13	2500 - 2570 MHz	-96 dBm	100 KHz
WA MBWA FDD BC9	880 - 915 MHz	-96 dBm	100 KHz

1.3.3.3.3 Co-existence with PHS

1.3.3.3.3.1 Definition

This requirement may be applied for the protection of PHS in geographic areas in which both PHS and MBWA FDD are deployed. This requirement is also applicable at specified frequencies falling between 10 MHz below the lowest access network transmitter frequency and 10 MHz above the highest AN transmitter frequency of the operating band.

1.3.3.3.3.2 Minimum Requirements

The power of any spurious emission shall not exceed the limits shown in Table 27.

Table 27: FDD AN Spurious emissions limits for AN in geographic coverage area of PHS

Band	Maximum Level	Measurement Bandwidth
1884.5 - 1919.6 MHz	-41 dBm	300 kHz

2 ACCESS TERMINAL (AT) MPS

2.1 AT Receiver MPS

The receiver performance includes the following tests: sensitivity, dynamic range, high throughput, intermodulation spurious response attenuation, blocking and adjacent channel selectivity tests.

2.1.1 Receiver Sensitivity ,Dynamic Range and High Throughput

2.1.1.1 Definition

The receiver sensitivity, <REFSENS>, of the access terminal receiver is the minimum received power, measured at the access terminal antenna connector, at which the packet error rate (PER) for a specified packet format does not exceed a specified value. The receiver dynamic range is the input power range at the access terminal antenna connector over which the PER for a specified packet format does not exceed a specific value. The high throughput level is the minimum mean power, measured at the access terminal antenna connector, at which the PER for a specified packet format corresponding to some specified high throughput does not exceed a specific value.

2.1.1.2 Method of Measurement

The test shall be carried out for every band class and channel bandwidth supported by the terminal using the relevant column in Table 28.

1. Connect the sector to the access terminal antenna connector as shown in **Error! Reference source not found.**. The AWGN generator and the CW generator are not applicable in these tests.
2. Ensure that MAC and Physical layer configuration meet the requirements specified in the column of **Error! Reference source not found.** corresponding to CBW used for the specified test.
3. Set up a connection between the access terminal and the access network and ensure that the configuration specified in step 2 is in use.
4. Instruct the access network to transmit power control commands such that the mean transmit power from the access terminal is 20 dBm.
5. For sensitivity test, adjust the received power level to the level specified in Table 29 for the corresponding channel bandwidth used for the test. For high throughput test and Dynamic Range test, adjust the received power level to the level specified in Table 30 for the corresponding channel bandwidth used for the test.
6. Measure the FER for the test

Table 28. Test Parameters for Receiver Sensitivity, High Throughput and Dynamic Range

Transmission configuration for Reference channel	Sensitivity Test			High Throughput and Dynamic Range Test		
	A1	**A2**	**A3**	**A4**	**A5**	**A6**
Allocated Tiles	30	60	120	30	60	120
Guard Band (tiles per side)	1	2	4	1	2	4
Symbols per Tile	8	8	8	8	8	8
Modulation	QPSK	QPSK	QPSK	64QAM	64QAM	64QAM
Packet format	1	1	1	6	6	6
Number of HARQ transmissions	1	1	1	1	1	1
Payload size (bits)	2544	5120	10264	11496	23016	40,640
Tones per Tile	16	16	16	16	16	16
Data channel CRC (bits)	24	24	24	24	24	24
Cyclic Prefix (usec)	13.02	13.02	13.02	13.02	13.02	13.02
Symbol duration (μs)	120.44	120.44	120.44	120.44	120.44	120.44
Frame duration (μs)	963.52	963.52	963.52	963.52	963.52	963.52
PHY layer throughput [kbps]	2669	5338	10676	11956	23912	41514
Channel bandwidth (MHz)	5	10	20	5	10	20
Transmission bandwidth (MHz)	4.61	9.22	18.44	4.61	9.22	18.44

Table 29. Received power levels corresponding to Sensitivity test

Transmission configuration	Received signal level or reference sensitivity level <REFSENS>, dBm
A1 in Table 28	-96+x+y
A2 in Table 28	-93+x+y
A3 in Table 28	-90+x+y
Note: 1. x is the SNR required to decode the packet format and y is the implementation loss. x = -1dB and y = 2dB. 2. The requirement shall be met at maximum transmit power of 21 dBm	

Table 30.Received levels corresponding to High throughput and Dynamic Range test

Transmission configuration	Received signal level, dBm (High Throughput test)	Received signal level, dBm (Dynamic Range test)
A4 in Table 28	-96+x+y	-25
A5 in Table 28	-93+x+y	-25
A6 in Table 28	-90+x+y	-25
Note: 1. x is the SNR required to decode the packet format and y is the implementation loss. x = 12 dB and y = 2 dB. 2. The requirement shall be met at maximum transmit power of 21dBm.		

2.1.1.3 Minimum Standard

The FER in all the tests shall not exceed 1% with 95% confidence.

2.1.2 Intermodulation Spurious Response Attenuation

This test shall be performed for each band class supported by the access terminal. This test specifies the intermodulation spurious response attenuation requirements for channel bandwidth greater than or equal to 5 MHz.

2.1.2.1 Definition

The intermodulation spurious response attenuation is a measure of a receiver's ability to receive a MBWA signal on its assigned channel frequency in the presence of two interfering CW tones (narrowband test) and an interfering 5 MHz MBWA signal along with an interfering CW tone (broadband test). These tones are separated from the assigned channel frequency and are separated from each other such that the third order mixing of the two interfering CW tones can occur in the non-linear elements of the receiver, producing an interfering signal in the band of the desired signal. The receiver performance is measured by the frame error rate (FER).

2.1.2.2 Method of Measurement

The test shall be carried out for every band class and channel bandwidth supported by the terminal.

1. Connect the sector to the access terminal antenna connector as shown in **Error! Reference source not found.**.
2. Ensure that MAC and Physical layer configuration meet the requirements specified in the column of Table 28 (receiver sensitivity section) corresponding to channel bandwidth used for the specified test.
3. Set up a connection between the access terminal and the access network and ensure that the configuration specified in step 2 is in use.

4. Instruct the access network to transmit power control commands such that the mean transmit power from the access terminal is 20 dBm.

5. Adjust the received power level of the desired signal and the interferers to the level specified in Table 31 (for broadband blocker) or Table 32 (for narrowband blocker) for the channel bandwidth used for the test.

6. Measure the FER for the test

Table 31.Test Parameters for Intermodulation Spurious Response Attenuation for Broadband Interference

Transmission configuration	Signal Level	1st Blocker (CW)		2nd Blocker (Note 1)	
		Level (dBm)	Frequency Offset (MHz)	Level (dBm)	Frequency Offset (MHz)
A1 in Table 28	<REFSENS> + 3 dB dBm/4.61 MHz	-46	±10	-46	±20
A2 in Table 28	<REFSENS> + 3 dB dBm/9.22 MHz	-46	±12.5	-46	±25
A3 in Table 28	<REFSENS> + 3 dB dBm/18.44 MHz	-46	±17.5	-46	±35

Note
1. The second blocker is a 5 MHz MBWA signal occupying the maximum transmission BW (i.e. 5 MHz minus guard band).
2. Frequency offset is measured from the carrier frequency of the MBWA signal under test to the carrier frequency of the blocker.
3. The requirements shall be met while the access terminal is transmitting a MBWA signal occupying the maximum transmission bandwidth (i.e. the channel bandwidth minus guard band) of the desired signal at a mean power of 20 dBm.

Table 32.Test Parameters for Intermodulation Spurious Response Attenuation for Narrowband Interference

Transmission configuration	Signal Level	1st Blocker (CW)		2nd Blocker (CW)	
		Level (dBm)	Frequency Offset (MHz)	Level (dBm)	Frequency Offset (MHz)
A1 in Table 28	<REFSENS> + 10 dB dBm/4.61 MHz	-44	±3.5	-44	±5.9
A2 in Table 28	<REFSENS> + 10 dB dBm/9.22 MHz	-44	±6	-44	±8.4
A3 in Table 28	<REFSENS> + 10 dB dBm/18.44 MHz	-44	±11	-44	±13.4

Note:
1. The requirements shall be met while the access terminal is transmitting a MBWA signal occupying the maximum transmission bandwidth (i.e. the channel bandwidth minus guard band) of the desired signal at a mean power of 20 dBm.
2. Frequency offset is measured from the carrier frequency of the MBWA signal under test to the carrier frequency of the blocker.

2.1.2.3 Minimum Standard

The FER in all the tests shall not exceed 1% with 95% confidence.

2.1.3 Adjacent Channel Selectivity

This test shall be performed for each band class supported by the access terminal for channel bandwidth greater than or equal to 5 MHz.

2.1.3.1 Definition

The adjacent channel selectivity is a measure of the ability to receive a MBWA signal on the assigned frequency in the presence of a 5 MHz MBWA signal at a given frequency offset from the centre frequency of the assigned channel.

2.1.3.2 Method of Measurement

The test shall be carried out for every band class and channel bandwidth supported by the terminal.

1. Connect the sector to the access terminal antenna connector as shown in Figure 7
2. Ensure that MAC and Physical layer configuration meet the requirements specified in the column of Table 28 (receiver sensitivity section) corresponding to channel bandwidth used for the specified test.
3. Set up a connection between the access terminal and the access network and ensure that the configuration specified in step **Error! Reference source not found.** is in use.
4. Instruct the access network to transmit power control commands such that the mean transmit power from the access terminal is 20 dBm.
5. Adjust the received signal power and interference power to the level specified in Table 33 for Test 1 for the channel bandwidth used for the test.
6. Measure the FER for the test
7. Adjust the received signal power and interference power to the level specified in Table 33 for Test 2 for the channel bandwidth used for the test.
8. Measure the FER for the test

Table 33. Test Parameters for Adjacent Channel Selectivity

Transmission configuration	**Frequency Offset, MHz**	**Signal level Unit**	**Test 1**		**Test 2**	
			Signal Level	**Interferer Level (dBm/4.61 MHz)**	**Signal Level**	**Interferer Level (dBm/4.61 MHz)**
A1 in Table 28	± 5	dBm/4.61 MHz	<REFSENS> + 14 dB	-52+x+y	-55	-25
A2 in Table 28	± 10	dBm/9.22 MHz	<REFSENS> + 14 dB	-52+x+y	-52	-25
A3 in Table 28	± 20	dBm/18.44 MHz	<REFSENS> + 14 dB	-52+x+y	-49	-25

Note:
1. x is the SNR required to decode the respective transmission configuration and y is the implementation loss. x= -1dB and y= 2 dB.
2. Frequency offset is measured from the carrier frequency of the MBWA signal under test to the carrier frequency of the blocker.
3. The requirements shall be met while the access terminal is transmitting a MBWA signal occupying the maximum transmission bandwidth (i.e. the channel bandwidth minus guard band) of the desired signal at a mean power of 20 dBm

2.1.3.3 Minimum Standard

The FER in Tests 1 and 2 shall not exceed 1% with 95% confidence. For any signal level between the levels defined in Test 1 and 2, the FER shall not exceed 1% FER with 95% confidence.

2.1.4 Receiver Blocking Characteristics

This test shall be performed for each band class supported by the access terminal for channel bandwidth greater than or equal to 5 MHz.

2.1.4.1 Definition

The blocking characteristic is a measure of the receiver's ability to receive a wanted signal at its assigned channel frequency in the presence of an unwanted interferer on frequencies other than those of the spurious response (or the adjacent channel covered by Adjacent Channel Selectivity test), without this unwanted input signal causing a degradation of the performance of the receiver beyond a specified limit. The blocking performance shall apply at all frequencies except those at which spurious response occurs.

The specifications are divided into in-band, out of band, and narrow band blocking.

In-band blocking: The in-band blocking specifications pertain only to the cases where the blockers are located at a carrier frequency offset up to ± 15MHz from the signal carrier frequency; the blockers are MBWA signals with a channel bandwidth of 5 MHz.

Out of band blocking: The out of band blocking specifications pertain to those cases where the blockers are located at a carrier frequency offset greater than 15 MHz from the signal carrier frequency; the blockers are CW. The out of band blocking is divided into 3 basic frequency ranges:

- Frequency Range 1: 15 MHz < Blocker carrier frequency offset from the signal ≤ 60 MHz
- Frequency Range 2: 60 MHz < Blocker carrier frequency offset from the signal ≤ 85 MHz
- Frequency Range 3: Blocker carrier frequency offset from the signal > 85 MHz

In addition a 4th range is defined that is the transmit channel of some band classes.

Narrowband blocking: The narrow band blocking specifications pertain to a case of a CW blocker close to the signal channel edge.

2.1.4.2 Method of Measurement

The test shall be carried out for every band class and channel bandwidth supported by the terminal.

1. Connect the sector to the access terminal antenna connector as shown in **Error! Reference source not found.**.
2. Ensure that MAC and Physical layer configuration meet the requirements specified in the column of Table 28 (receiver sensitivity section) corresponding to channel bandwidth used for the specified test.
3. Set up a connection between the access terminal and the access network and ensure that the configuration specified in step 2 is in use.
4. Instruct the access network to transmit power control commands such that the mean transmit power from the access terminal is 20 dBm.
5. For In-band blocking test, adjust the desired signal and blocker signal level to the level specified Table 34 for case 1 for the channel bandwidth used for the test. For out of band

blocking test, adjust the desired signal and blocker signal level to the level specified in Table 35 for case 1 for the channel bandwidth used for the test. For narrowband blocking test, adjust the desired signal and blocker signal level to the level specified in Table 37 for the channel bandwidth used for the test.

6. Measure the FER for the test
7. For In-band blocking test, adjust the desired signal and blocker signal level specified in Table 34 for case 2 for the channel bandwidth used for the test.
8. Repeat steps 5-6 for in-band blocking
9. For out of band blocking test, adjust the desired signal and blocker signal level to the level specified in Table 35 for cases 2 through 4 for the channel bandwidth used for the test.
10. Repeat steps 5-6 for out of band blocking

Table 34. Test Parameters for Receiver Blocking Characteristics (In-Band)

Channel Bandwidth	Transmission configuration	Signal level Unit	Signal Level	Case 1 (Note 1)		Case 2 (Note 1)	
				Blocker Level dBm/4.61 MHz	Blocker Offset, MHz	Blocker Level dBm/4.61 MHz	Blocker Offset, MHz
5 MHz	A1 in Table 28	dBm/4.61 MHz	<REFSENS> + 3 dB	-56	±10	-44	≤-15 & ≥15
10 MHz	A2 in Table 28	dBm/9.22 MHz	<REFSENS> + 3 dB	-56	±12.5	-44	≤-17.5 & ≥17.5
20 MHz	A3 in Table 28	dBm/28.44 MHz	<REFSENS> + 3 dB	-56	±17.5	-44	≤-22.5 & ≥22.5

Note:
1. The Blocker is a 5 MHz MBWA modulated signal occupying the maximum transmission bandwidth (5 MHz minus guard band).
2. Frequency offset is measured from the carrier frequency of the MBWA signal under test to the carrier frequency of the blocker.
3. The requirements shall be met while the access terminal is transmitting a MBWA signal occupying the maximum transmission bandwidth (i.e. the CBW minus guard band) of the desired signal at a mean power of 20 dBm.
4. Note that the specifications shall apply even if the blockers fall outside the band class of operation.

Table 35. Test Parameters for Receiver Blocking Characteristics (Out-Of-Band)

Parameter	Unit	Case 1 (frequency range 1)	Case 2 (frequency range 2)	Case 3 (frequency range 3)	Case 4 (frequency range 4)
Signal Level	dBm/4.61 MHz (A1 in Table 28)	<REFSENS> +3 dB	<REFSENS> +3 dB	<REFSENS> +3 dB	<REFSENS> +3 dB
	dBm/9.22 MHz (A2 in Table 28)				
	dBm/18.44 MHz (A3 in Table 28)				
Blocker Level (CW)	dBm	-44	-30	-15	-15
Blocker Offset for all Band classes	MHz	$f_{FL}-15$ to $f_{FL}-60$ & $f_{FL}+15$ to $f_{FL}+60$	$f_{FL}-60$ to $f_{FL}-85$ & $f_{FL}+60$ to $f_{FL}+85$	$f_{FL}-85$ to $1MH$ & $f_{FL}+85$ to 12750	-
Blocker Offset for BC 0 and BC 1	MHz	-	-	-	$f_{RL,low}$ to $f_{RL,high}$

Note 1: The spec needs to be met while the AT is transmitting a MBWA signal occupying the maximum transmission BW (i.e. the CBW minus guard band) of the desired signal at a mean power of 20 dBm
2. f_{FL} is the carrier frequency of the desired receive signal.
3. $f_{RL,high}$ and $f_{RL,low}$ are the lowest and the highest frequency edges for reverse link in band class 0 and 1. For example, for band class 0, $f_{RL,low}$= 824 MHz and $f_{RL,high}$= 849 MHz.

Table 36.Spurious response specifications

Channel Bandwidth	Signal level Unit	Signal Level	Blocker Level (Note 1) In dBm
5 MHz	dBm/4.61 MHz	<REFSENS> + 3 dB	-44
10 MHz	dBm/9.22 MHz	<REFSENS> + 3 dB	-44
20 MHz	dBm/18.44 MHz	<REFSENS> + 3 dB	-44
Note 1: The Blocker is CW and is located at spurious response frequencies. The spec needs to be met while the AT is transmitting a MBWA signal occupying the maximum transmission BW (i.e. the CBW minus guard band) of the desired signal at a mean power of 20 dBm			

Table 37.Narrow band blocking specifications

CBW (MHz)	Transmission Configuration	Signal Level	Blocker Offset from carrier (MHz)	Blocker level (dBm)
5MHz	A1 in Table 28	<REFSENS> + 10 dB dBm/4.61 MHz	2.7	-57
10MHz	A2 in Table 28	<REFSENS> + 10 dB dBm/9.22 MHz	5.2	-57
20MHz	A3 in Table 28	<REFSENS> + 10 dB dBm/18.44 MHz	10.2	-57
Note: The spec needs to be met while the AT is transmitting a MBWA signal occupying the maximum transmission BW (i.e. the CBW minus guard band) of the desired signal at a mean power of 20 dBm				

2.1.4.3 Minimum Standards

In-band blocking: The FER in cases 1 and 2 shall not exceed 1% with 95% confidence.

Out-of-band blocking: The FER in cases 1 through 4 shall not exceed 1% with 95% confidence. For frequency ranges 1, 2 and 3, up to 24 exceptions are allowed for spurious response frequencies in each assigned frequency channel when measured using a 1 MHz step size. For these exceptions the requirements in Table 36 apply. For frequency range 4, up to 8 exceptions are allowed for spurious response frequencies in each assigned frequency channel when measured using a 1 MHz step size. For these exceptions the requirements in Table 36 apply.

Narrowband blocking: The FER shall not exceed 1% with 95% confidence.

2.1.5 Conducted Spurious Emissions

2.1.5.1 Definition

The conducted spurious emissions are spurious emissions generated or amplified in a receiver that appear at the access terminal antenna connector.

2.1.6 Method of Measurement

1. Connect a spectrum analyzer (or other suitable test equipment) to the access terminal antenna connector.
2. For each band class that the access terminal supports, configure the access terminal to operate in that band and perform steps 3 and 4.
3. Enable the access terminal receiver, so that the access terminal continuously cycles between the system determination and acquisition
4. Sweep the spectrum analyzer over a frequency range from the lowest intermediate frequency or lowest oscillator frequency used in the receiver or 1 MHz, whichever is lowest, to at least 2600 MHz for Band Classes 0, 2, 5, 7, 9, 10, 11, and 12, 3 GHz for Band Class 3 or at least 6 GHz for Band Classes 1, 4 and 8, and measure the spurious emission levels. For Band Class 6, sweep the spectrum analyzer over a frequency range from 30 MHz to at least 12.75 GHz and measure the spurious emissions levels.

2.1.6.1 Minimum Standard

The mean conducted spurious emissions with ten or more averages for an access terminal shall be:

(a) Less than –76 dBm for Band Classes 0, 1, 2, 4, 5, 6, 7, 8, 9, 10, 11, and 12, or –81 dBm for Band Class 3, measured in a 1 MHz resolution bandwidth at the access terminal antenna connector, for frequencies within the access terminal receive band associated with each band class that the access terminal supports.

(b) Less than -61 dBm, measured in a 1 MHz resolution bandwidth at the access terminal antenna connector, for frequencies within the access terminal transmit band associated with each band class that the access terminal supports.

(c) Less than –57 dBm for Band Class 6, measured in a 100 kHz resolution bandwidth at the access terminal antenna connector, for frequencies from 30 MHz to 1 GHz.

(d) Less than -47 dBm for Band Classes 0, 1, 2, 4, 5, 7, 8, 9, 10, 11, and 12, or –54 dBm for Band Class 3, measured in a 30 kHz resolution bandwidth at the access terminal antenna connector, for all other frequencies. Less than –47 dBm for Band Class 6, measured in a 1 MHz resolution bandwidth at the access terminal antenna connector, for all frequencies in the range from 1 GHz to 12.75 GHz.

Current region-specific radio regulation rules shall also apply.

For example, a Band Class 6 access terminal operating under Japan regional requirements shall limit conducted emissions to:

less than –41 dBm, measured in a 300 kHz resolution bandwidth at the access terminal antenna connector, for frequencies within the PHS band from 1884.5 to 1919.6 MHz

2.2 AT Transmitter MPS

2.2.1 Frequency Accuracy Requirements

2.2.1.1 Definition

The frequency accuracy is the ability of an access terminal transmitter to transmit at an assigned carrier frequency.

2.2.1.2 Method of Measurement

The method of measurement specified in Section 2.2 may be used to perform this test.

2.2.1.3 Minimum Standard

The modulated carrier frequency of the access terminal shall be accurate to within the accuracy range of 0.1ppm observed over a period of at least one PHY frame in the time domain and at least 1 sub-zone= 128 sub-carriers in the frequency domain.

2.2.2 Error Vector Magnitude (EVM)

2.2.2.1 Definition

The error vector magnitude is measured by determining the root mean square error between the ideal constellation point and the actual received one after equalizing for some of the access terminal transmitter imperfections. This test also evaluates the resulting spectral flatness that is affected as a consequence of equalizing the transmit waveform that can introduce ripples or droops in the transmit waveform. This test specifies the error vector magnitude and frequency accuracy requirements for channel bandwidth greater than or equal to 5 MHz.

The EVM for any assignment size in tiles is computed as

$$EVM\left(\hat{X}\right)=\sqrt{\frac{\sum_{j=1}^{N_f}\sum_{k=1}^{N_p}\left(X_I(j,k)-\hat{X}_I(j,k)\right)^2+\left(X_Q(j,k)-\hat{X}_Q(j,k)\right)^2}{\sum_{j=1}^{N_f}\sum_{k=1}^{N_p}\left(X_I(j,k)\right)^2+\left(X_Q(j,k)\right)^2}}$$

Equation 1

where a_I, a_Q are the real and imaginary parts of a, $\hat{X}$ is the frequency domain equalized sample by the EVM analyzer as explained below, X [3] is the frequency domain ideal

[3] It may not be possible for the EVM analyzer equipment to have the ideal transmitted constellation point. In this case, we can map $\hat{X}$ to the nearest constellation point from an Euclidean distance sense and denote the hard-decision constellation point by X .In this case, the EVM calculation is optimistic since there is a probability that hard decision is wrong so that

(footnote continues on next page)

transmitted constellation point by the AN, N_p is the number of modulation symbols in all assignment tiles in one frame and N_f is the total number of frames used for averaging EVM, i.e. $N_f = N_s \times N_{f,SF}$, N_s being the number of super frames and $N_{f,SF}$ is the number of frames in a super frame.

2.2.2.2 Method of Measurement

The test shall be carried out for every band class and channel bandwidth supported by the access terminal.

1. Connect the sector to the access terminal antenna connector as shown in **Error! Reference source not found.**. The AWGN generator and the CW generator are not applicable in this test.
2. Ensure that the AT is assigned a number of tiles as specified in Table 38.
3. Set up a connection between the access terminal and the access network and ensure that the configuration specified in step 2 is in use.
4. Instruct the access network to transmit closed loop power control commands to the access terminal such that the mean output power of the access terminal measured at the antenna connector is 4 dB lower than its maximum allowable output power.
5. Measure error vector magnitude, frequency error and spectral flatness using an EVM-meter described below:
    - **a.** The transmitted signal is cable-connected to the receiver with one receive antenna. Denote the received samples by r
    - **b.** After down conversion, the EVM analyzer determines the beginning of the cyclic prefix of the received signal. It computes the frequency offset for the given PHY frame n [4], $f_{o,n}$, and corrects for it by applying a phase ramp on each sample of r with a slope of $f_{o,n}$. Denote the resulted signal by y
    - **c.** The EVM analyzer then performs an FFT operation with an FFT window that centers the channel in the cyclic prefix. Consequently, the frequency domain tones are then corrected with a phase ramp of slope CP/2; denote the resulted samples by Z
    - **d.** The EVM analyzer estimates the complex channel response for every sample in the assignment. Channel estimation is done within every tile by

the real constellation point is farther from the hard decision one, i.e. EVM calculated is smaller than actual.

[4] The EVM equalizer may also use an average estimate of the frequency offset or an estimate that is constant over a super frame

first averaging the pilots in the tile then doing linear interpolation in time and frequency to get the channel response on the data tones. Denote the frequency domain channel estimate on a given tone by H

e. The EVM analyzer performs channel equalization to get samples $\hat{X} = \frac{Z}{H}$

f. The EVM analyzer computes the EVM metric as defined in Equation 1

g. This test shall run for at least N_s=2 super frames. The number of frames used in each super frame, $N_{f,SF}$, shall be at least 1

6. The Spectral fltaness is measured as follows: From channel estimation we have the estimated frequency response H_i for tone i , $i = 1, 2, \cdots, M$, where M is the number of tones in the assignment in one OFDM symbol. We obtain the magnitude square $B_i = |H_i|^2$ for each tone and average it over multiple OFDM symbols to obtain $\overline{B}_i$, for $i = 1, 2, \cdots, M$. Next we compute the following spectral flatness metric $F = 10\log_{10}\left(B_{\max}/B_{\min}\right)$, where $B_{\max} = \max_{i=1,2,\cdots M} \overline{B}_i$, $B_{\min} = \min_{i=1,2,\cdots M} \overline{B}_i$.

Table 38. Access terminal assignment used for error vector magnitude computation

Channel bandwidth (MHz)	5	10	20
Nominal maximum number of Tiles for maximum transmission bandwidth	30	60	120
Nominal maximum transmission bandwidth (MHz)	4.61	9.22	18.44

2.2.2.3 Minimum Standard

The measured error vector magnitude shall be less than the values specified in Table 39

Table 39. Access terminal assignment used for error vector magnitude computation

AN Type	Modulation Type	EVM (%)	C/N (dBc)
Wide Area	QPSK	17.5	15.14
	8-PSK	14	17.07
	16QAM	12.5	18.06
	64QAM	8.9%	21

The measured spectral flatness metric shall be less than 4 dB. The frequency error from the carrier center frequency shall be less than +/- 0.1 ppm.

2.2.3 Maximum RF Output Power

2.2.3.1 Definition

The maximum radiated RF output power is determined by the measurement of the maximum power that the access terminal transmits as measured at the access terminal antenna connector plus the antenna gain recommended by the access terminal manufacturer.

2.2.3.2 Method of Measurement

The test shall be carried out for every band class and channel bandwidth supported by the access terminal. This test shall be carried out for any packet format index corresponding to modulation order of 64-QAM.

1. Connect the sector to the access terminal antenna connector as shown in **Error! Reference source not found.**. The AWGN generator and the CW generator are not applicable in this test. Connect a spectrum analyzer (or other suitable test equipment) to the access terminal antenna connector.
2. Set up a connection between the access terminal and the access network
3. Instruct the access network to transmit 'up' power control commands continuously to the access terminal.
4. Measure the mean access terminal output power at the access terminal antenna connector.

2.2.3.3 Minimum Standard

The minimum standard applies to the maximum radiated power from the access terminal using the antenna gain recommended by the access terminal manufacturer. The maximum output power from the access terminal shall be 23 dBm while complying with the general spectral emissions mask Table 40. For complying with additional spectral emissions mask-1 (Table 41) and additional spectral emissions mask-2 (Table 42), the maximum output power requirements for general emissions mask may be reduced by an applicable output power backoff reduction for Table 41 and Table 42 of 0.5 dB and 1.0 dB, respectively. These proposed requirements shall be allowed a tolerance of $\pm$2dB.

2.2.4 Maximum Output Power Boost

The MBWA specifications define special assignments where the signal content is confined to a narrow band or to some aprt of the band. The idea of the special assignments is to utilize the fact that in most cases when maximum power is needed, BW is not needed as much. The scheduler can then allocate the AT an assignment that is as far from the edge as possible to facilitate meeting the emission requirements. The assignment can also be as small as one tile and requires full power (edge of the cell scenario) and due to being narrowband it still meets emission requirements with higher radiated power. The specifications define three different special assignment types:

- Case 1: 16 tones at the edge of the band
- Case 2: 128 tones not at the edge of the band
- Case 3: 128 tones at the edge of the band

The AT maximum transmit power is allowed to increase up to 2dB above the level specified in Section 2.3 for special assignments cases 1 and 2 provided that the emission requirements in Section 2.5 are met. The AT maximum transmit output power is allowed to increase up to 0.5dB for special assignment case 3 provided that the emission requirements in Section 2.5 are met.

2.2.5 Conducted Spuriouis Emissions

Specifications of the emission requirements include a general Spectral Emissions Mask (SEM) and two additional spectral emission masks (A-SEM1and A-SEM2, respectively). The additional requirements are to be signaled to the access terminal via some broadcast control channel. The concept of additional requirement being signaled to access terminal is helpful since the the deployment of various technologies and the channelization on each band is not readily available.

2.2.5.1 Definition

The conducted spurious emissions are emissions at frequencies that are outside the assigned MBWA Channel, measured at the access terminal antenna connector. This test measures the spurious emissions during continuous transmission.

2.2.5.2 Method of Measurement

The test shall be carried out for every band class and channel bandwidth supported by the access terminal. This test shall be carried out for any packet format index corresponding to modulation order of 64-QAM.

1. Connect the sector to the access terminal antenna connector as shown in **Error! Reference source not found.**. The AWGN generator and the CW generator are not applicable in this test. Connect a spectrum analyzer (or other suitable test equipment) to the access terminal antenna connector.
2. Set up a connection between the access terminal and the access network
3. Instruct the access network to transmit ‘up’ power control commands continuously to the access terminal.
4. Measure the spurious emission levels.
5. For adjacent channel power leakage ratio measurement, measure the in-band power and also the power in the first and second adjacent channels for the specified channel

bandwidths. Compute the difference between the in-band power and the power in the adjacent channels to measure the adjacent channel power leakage ratio.

2.2.5.3 Minimum Standard

The spurious emissions with ten or more averages shall be less than the limits specified for general spectral emissions mask in **Table 40**

Table 40.General Spectral Emission Mask for different bandwidths

Offset from channel edge (MHz)	5MHz Emissions in dBm/measurement BW	10MHz Emissions in dBm/measurement BW	20MHz Emissions in dBm/measurement BW	Measurement BW
± 0-1	-15	-18	-21	30KHz
± 1-5	-10	-10	-10	1MHz
± 5-6	-13	-13	-13	1MHz
± 6-10	-25	-13	-13	1MHz
± 10-15		-25	-13	1MHz
± 15-20			-13	1MHz
± 20-25			-25	1MHz

The spurious emissions with ten or more averages shall be less than the limits specified additional spectral emission masks (A-SEM1) in Table 41

Table 41.Additional Spectral Emission Mask (A-SEM1) for different bandwidths

Offset from channel edge (MHz)	5MHz Emissions in dBm/measurement BW	10MHz Emissions in dBm/measurement BW	20MHz Emissions in dBm/measurement BW	Measurement BW
± 0-1	-15	-18	-21	30KHz
± 1-5	-13	-13	-13	1MHz
± 5-6	-13	-13	-13	1MHz
± 6-10	-13	-13	-13	1MHz
± 10-15		-13	-13	1MHz
± 15-20			-13	1MHz
± 20-25			-13	1MHz

The spurious emissions with ten or more averages shall be less than the limits specified for additional spectral emission masks (A-SEM2) in Table 42

Table 42.Additional Spectral Emission Mask (A-SEM2) for different bandwidths

Offset from channel edge (MHz)	5MHz Emissions in dBm/measurement BW	10MHz Emissions in dBm/measurement BW	20MHz Emissions in dBm/measurement BW	Measurement BW
± 0-1	-15	-18	-21	30KHz
± 1-5.5	-15	-13	-13	1MHz
± 5.5-10	-25	-25	-25	1MHz
± 10-15		-25	-25	1MHz
± 15-25			-25	1MHz

In additional to the spectral emission mask requirements, for frequency offsets greater than Δ_{SEM} from the channel edge specified in Table 43, the spurious emissions with ten or more averages shall also be less than the requirements in Table 44for ITU category A and in

Table 45 for ITU category B. .

Table 43. Δ_{SEM} as a function of the channel BW

Channel Bandwidth (MHz)	5	10	20
Δ_{SEM} (MHz)	10	15	25

Table 44.Spurious requirements – ITU Category A

Frequency Range	Maximum Level	Measurement BW
$9KHz \le f < 150KHz$	-13dBm	1Khz
$150KHz \le f < 30MHz$	-13dBm	10KHz
$30MHz \le f < 1GHz$	-13dBm	100KHz
$1GHz \le f < 10GHz$	-13dBm	1MHz

Table 45.Spurious requirements – ITU Category B

Frequency Range	Maximum Level	Measurement BW
$9KHz \leq f < 150KHz$	-36dBm	1Khz
$150KHz \leq f < 30MHz$	-36dBm	10KHz
$30MHz \leq f < 1GHz$	-36dBm	100KHz
$1GHz \leq f < 12.75GHz$	-30dBm	1MHz

When transmitting in Band Class 6, the spurious emissions with ten or more averages shall also be less than the requirements in Table 46 to support coexistence with PHS.

Table 46. PHS coexistence emission requirements

Frequency Range	Maximum Level	Measurement BW
$1844.5MHz \leq f < 1919.6MHz$	-41dBm	300Khz

The measured adjacent channel leakage ratio (ACLR1) and alternate channel leakage ratio (ACLR2) shall be greater or equal to the values specified in Table 47

Table 47.ACLR specifications

Channel Bandwidth (MHz)	5MHz	10MHz	20MHz
ACLR1 (dB)	30	30	30
ACLR2 (dB)	36	36	36
Signal and Adjacent Channel measurement BW (MHz)	4.61	9.22	18.44

Current region-specific radio regulation rules shall also apply.

3 FUNCTIONAL BLOCK DIAGRAMS

3.1 AN Side

Figure 1 through Figure 5 show the test setups used for access network testing. These are functional diagrams only. Actual test setups may differ provided the functionality remains the same.

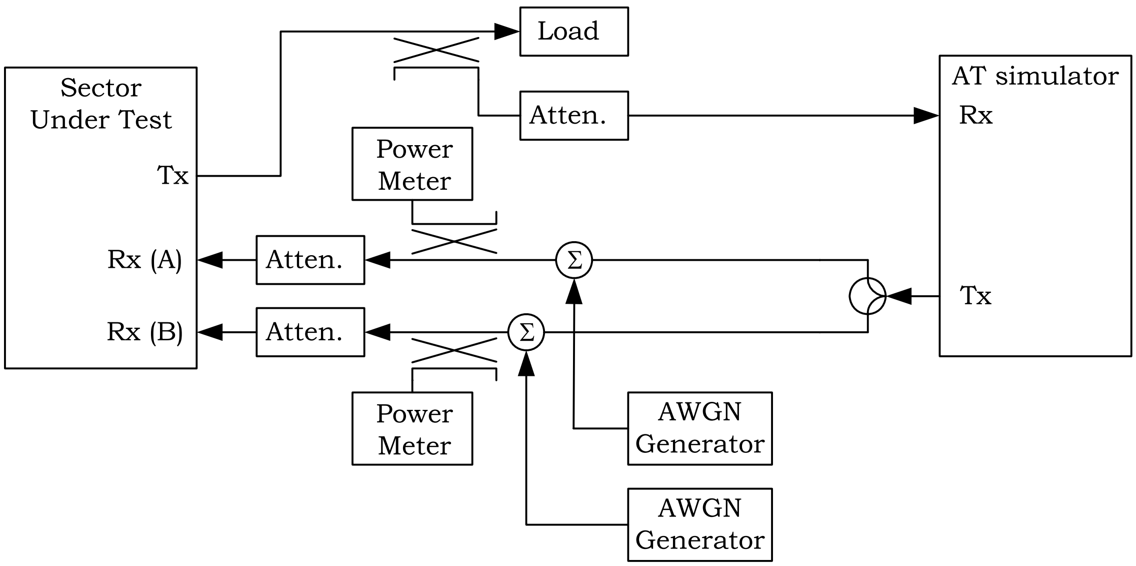

Figure 1: Functional Setup for one Access Network AWGN Demodulation Tests and Sensitivity Tests

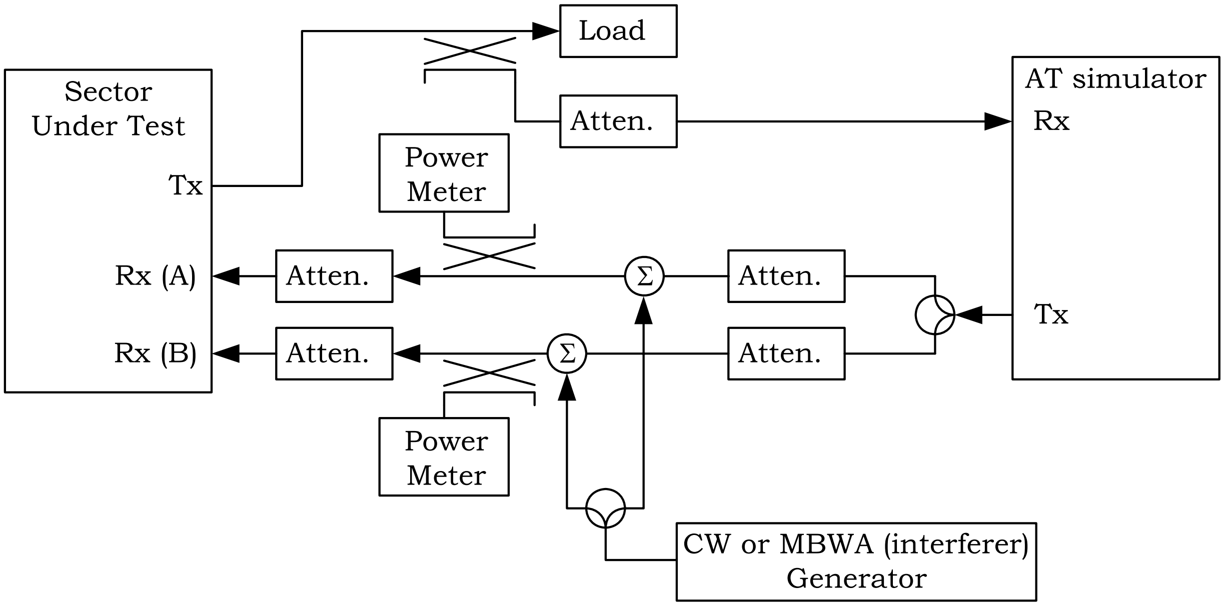

Figure 2: Functional Setup for Access Network Desensitization Tests

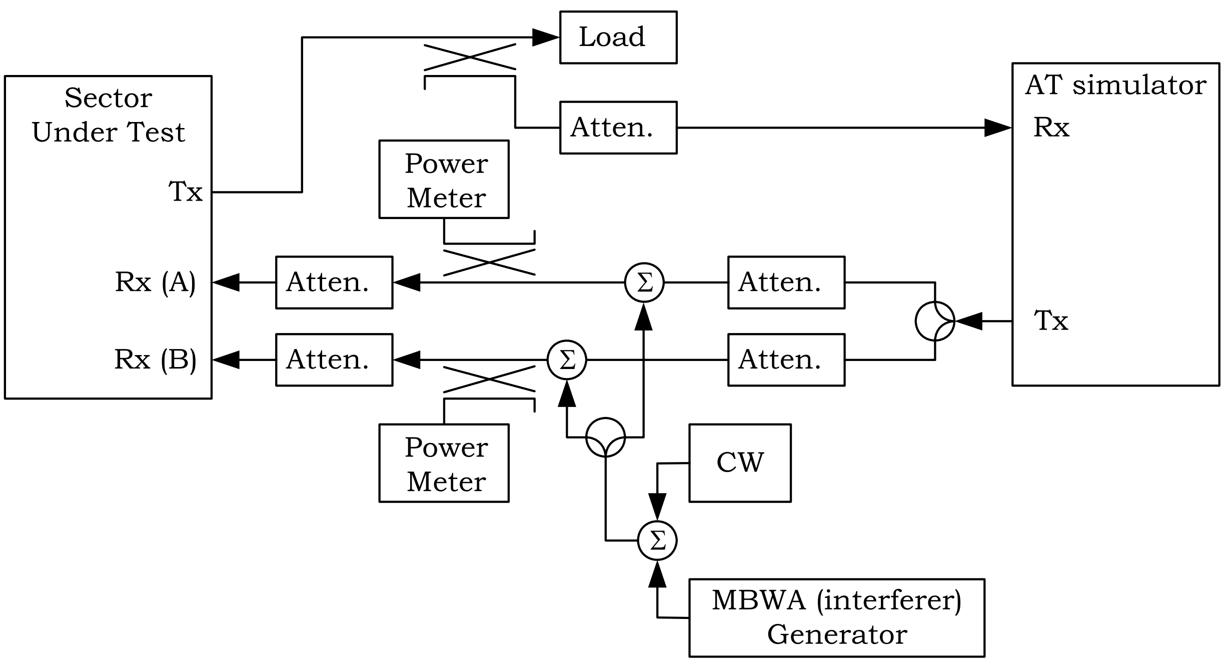

Figure 3: Functional Setup for Access Network Intermodulation Spurious Response Tests

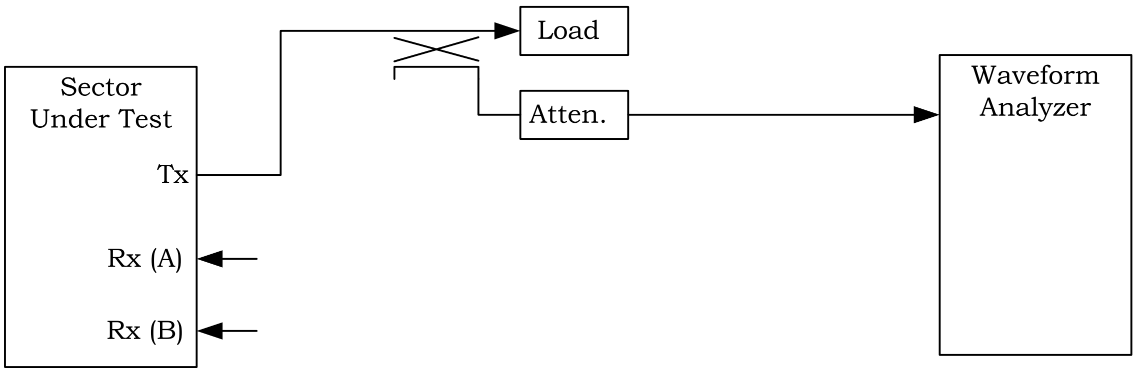

Figure 4: Functional Setup for Waveform Quality Test

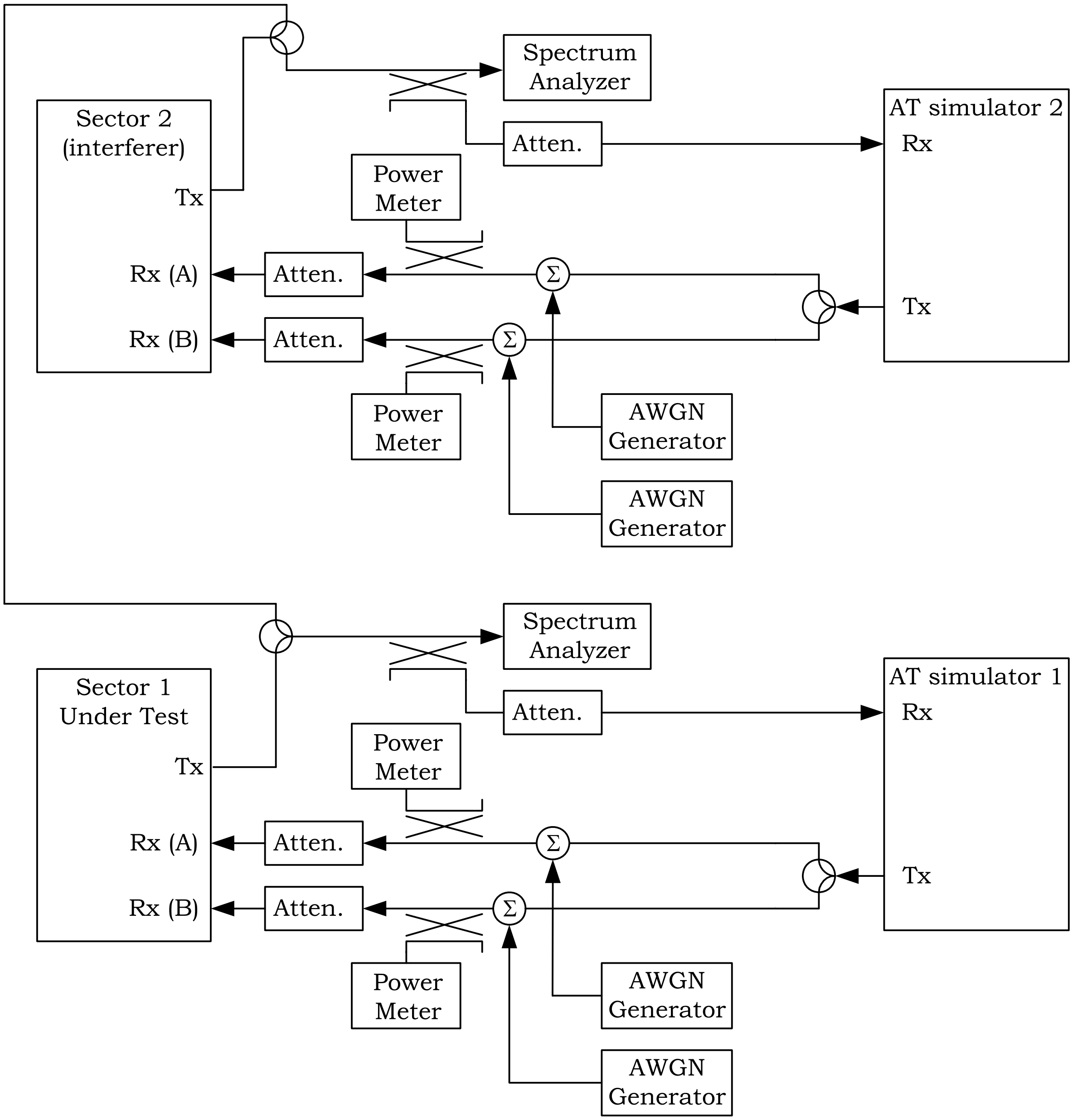

Figure 5: Functional Setup for Emissions Tests

3.2 AT Side

Figure 6 and Figure 7 show the functional block diagrams of the set-up for different tests:

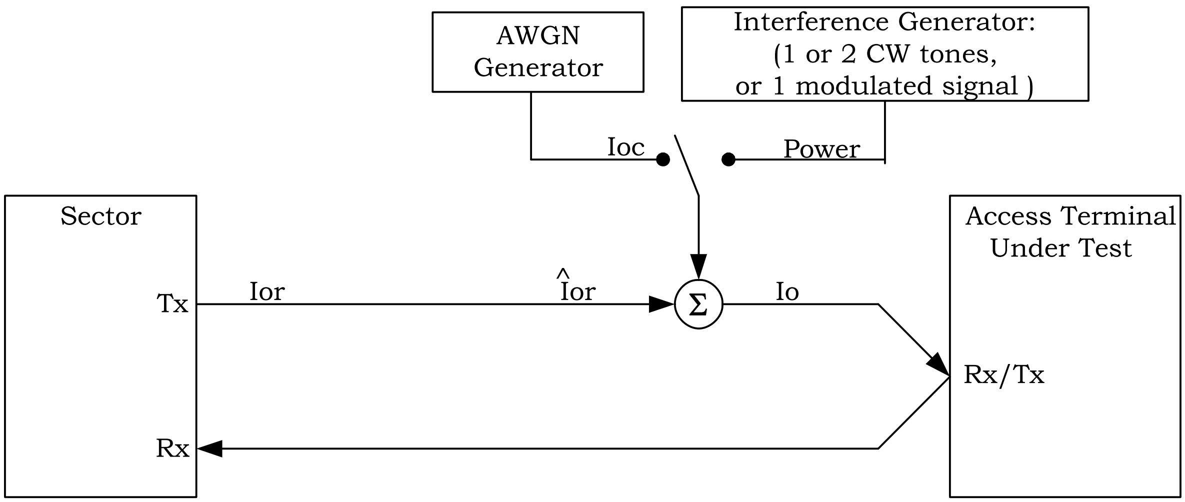

Figure 6. Functional Set-up for Tests without Fading

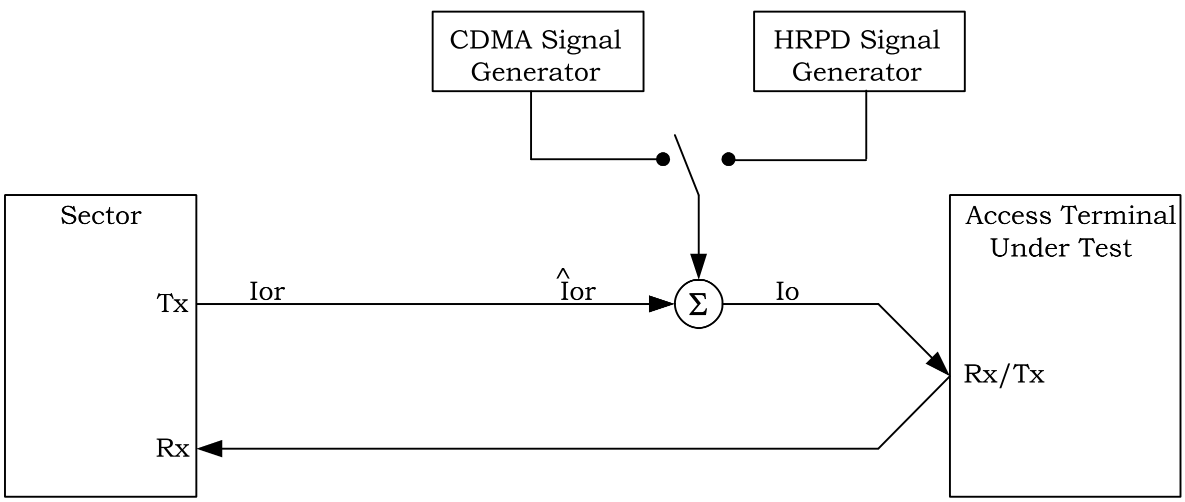

Figure 7. Functional Set-up for Test for Adjacent Channel Selectivity

4 REFERENCES

[1] "BW definitions", 802.20 submission on 14th of July 2008

[2] "Band classes considered fro MBWA MPS", 802.20 submission on 14th of July 2008