



IEEE Standard for Minimum Performance Characteristics of IEEE 802.20 Terminals and Base Stations/Access Nodes

IEEE Computer Society

Sponsored by the
LAN/MAN Standards Committee

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Withdrawn Standard

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**LAN/MAN Standards Committee
of the
IEEE Computer Society**

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Abstract: This standard specifies minimum performance parameters and the associated test methodologies for implementation of IEEE 802.20 compliant systems.

Keywords: LAN, MAN, mobile, wireless

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1. Overview

1.1 Scope

This standard details definitions, method of measurements and minimum performance characteristics for IEEE 802.20™ MBWA terminals and base stations (BSs)/access nodes (ANs). The test methods are specified in this document; however, methods other than those specified may suffice for the same purpose.

1.2 Purpose

The purpose of this standard is to specify minimum performance characteristics for IEEE 802.20 implementations. Service providers deploying equipment meeting this specification can expect to meet a particular service level with user terminals that also comply with this specification.

2. Normative references

The following referenced documents are indispensable for the application of this document (i.e., they must be understood and used, so each referenced document is cited in text and its relationship to this document is explained). For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

ITU Radio Regulations: “International Telecommunications Union Radio Regulations,” Edition 2004, Volume 1—Articles, ITU, December 2004.¹

ITU-R SM.328-10, Spectra and Bandwidth of Emissions.

3. Definitions, acronyms, and abbreviations

For the purposes of this document, the following terms and definitions apply. *The IEEE Standards Dictionary: Glossary of Terms & Definitions* should be referenced for terms not defined in this clause.²

3.1 Definitions

emission bandwidth (BW): The x dB bandwidth (MHz): is defined in ITU-R SM.328-10; $x = 26$ dB is used in FCC definitions; $EBW_{26dB} > OBW_{99\%}$. It is commonly used in regulations when specifying the emission requirement in the first 1 MHz to the channel edge. For instance, FCC requires -13 dBm for 1% of the 26 dB-EBW in that region.

occupied bandwidth (BW): Provides a verification of channel bandwidth. Occupied bandwidth is less than channel bandwidth. It is defined as the width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage $\beta/2$ of the total mean power of a given emission. Unless otherwise specified by the Radiocommunication Assembly for the appropriate class of emission, the value of $\beta/2$ should be taken as 0.5%. (ITU Radio Regulations, ITU-R SM.328-10.)

3.2 Acronyms and abbreviations

ACLR	Adjacent Channel Leakage Ratio
ACP	adjacent carrier power
ACPR	Adjacent Carrier Power Ratio
ACS	adjacent channel selectivity
AN	access node
AT	access terminal
AWGN	Additive White Gaussian Noise
BCH	broadcast channel

¹ ITU publications are available from Publication Sales, International Telecommunication Union, Place des Nations, 1211 Geneva 20, Switzerland (<http://www.itu.int/>).

² *The IEEE Standards Dictionary: Glossary of Terms & Definitions* is available at <http://shop.ieee.org/>.

BS	base station
BW	bandwidth
CBW	channel bandwidth
CRC	Cyclic Redundancy Check
CW	continuous waveform
DSSI	Desired Signal Strength Indicator
EBW	emission bandwidth
EVM	error vector magnitude
FER	frame error rate
FFT	Fast Fourier Transform
FL	forward link
HARQ	Hybrid Automatic Repeat Request
ITU	International Telecommunication Union
MA	modulation accuracy
MAC	Media Access Control
MBWA	Mobile Broadband Wireless Access
MC	multicarrier
MCIP	multicarrier intermodulation product
MPS	Minimum Performance Specification
OBW	occupied bandwidth
PHS	Personal Handy-phone System
PSD	power spectral density
QAM	Quadrature Amplitude Modulation
QPSK	quadrature phase shift keying
RBW	resolution bandwidth
REFSENS	reference sensitivity
RF	radio frequency
RL	reverse link
SINR	Signal Interference Noise Ratio
SNR	signal-to-noise ratio
SRRC	Square Root Raised Cosine
UT	user terminal
TBW	transmission bandwidth
TX	transmit

4. Minimum performance requirements for the Wideband Mode

4.1 General

This subclause details definitions, methods of measurement, and minimum performance requirements for access nodes and access terminals. This standard shares the purpose of IEEE Std 802.20 (and subsequent revisions thereof) by ensuring that an access terminal can obtain service in any system that meets the compatibility requirements of IEEE Std 802.20.

Compatibility, as used in connection with this standard and IEEE Std 802.20 is understood to mean that any access terminal is able to open data connections in any suitably implemented Mobile Broadband Wireless Access (MBWA) system supporting the same mode of operation. Conversely, all suitably implemented MBWA systems are able to open connections with any access terminal.

Test methods are recommended in this standard; however, methods other than those recommended may suffice for the same purpose.

The performance metrics in this clause require an access terminal to provide a single antenna connector for testing. Access terminals having multiple antennas, such as for receive diversity, shall provide a single antenna connector for testing. If an access terminal has more than one antenna connector, only one connector shall be used for testing.

4.2 Bandwidth

Table 1 presents the different channel bandwidths to be used for MBWA signal transmission measurements.

Table 1—MBWA channel bandwidths

N_{FFT}	512	1024	2048
CBW ^a	5	10	20
$N_{\text{T, tiles}}$	32	64	128
$N_{\text{guard, tiles}}$	1	2	4
TBW, tiles ^b	30	60	120

^aCBW: Channel bandwidth in MHz.

^bTBW: Transmission bandwidth that varies from one tile to the maximum transmission BW as defined in Figure 1 Note 4. If the TBW is not associated with a number of tiles, then what is meant is the maximum TBW.

5 MHz and larger channel bandwidths include guard-bands of 1 tile for 5 MHz, 2 tiles for 10 MHz, and 4 tiles for 20 MHz channels.

Figure 1 illustrates the spectral arrangement of a 10 MHz bandwidth IEEE 802.20 Wideband Mode signal.³

³ Notes in text, tables, and figures are given for information only and do not contain requirements needed to implement the standard.

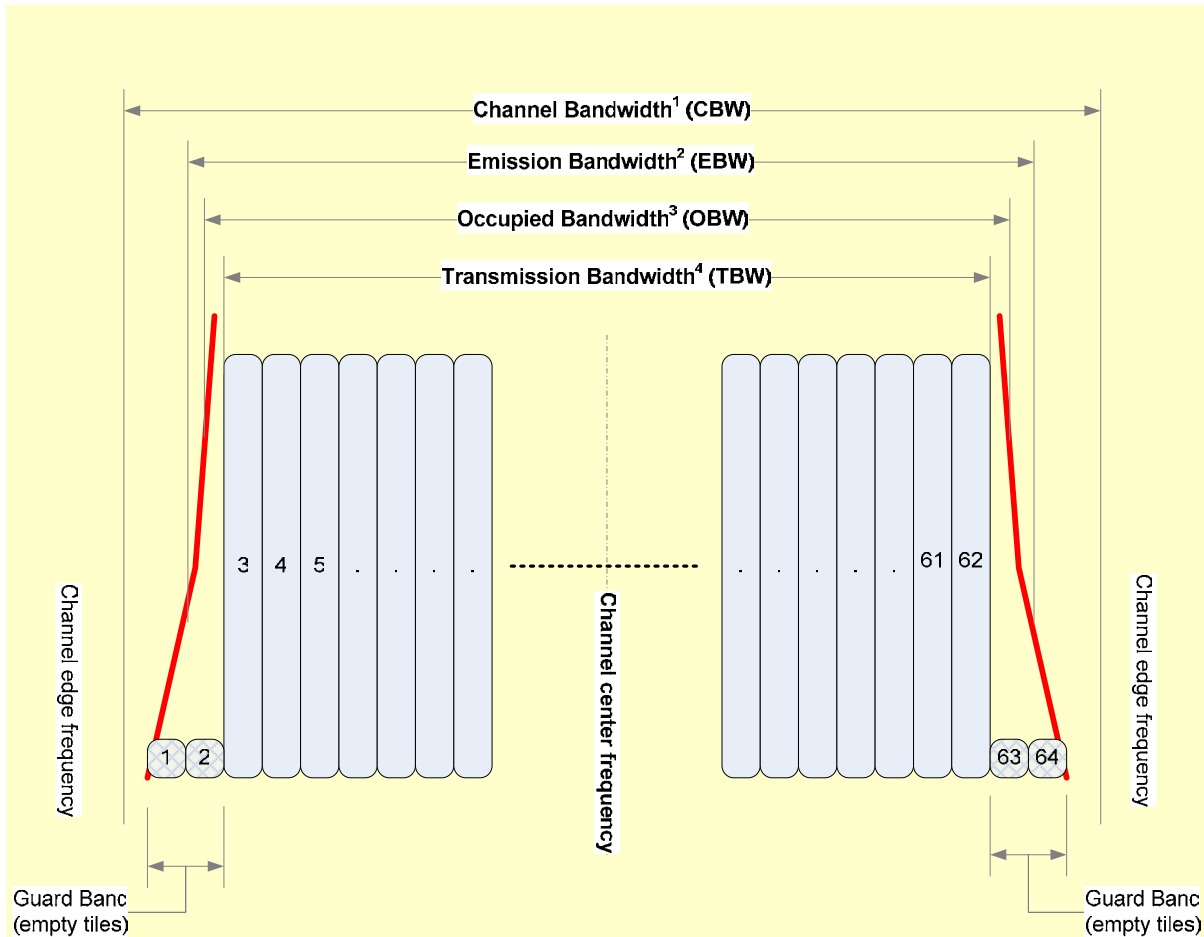


Figure 1—10 MHz signal example

NOTE 1—Channel bandwidth (CBW) = (1.25; 2.5; 5; 10; 20), **MHz**; $CBW > EBW$.

NOTE 2—Emission bandwidth (EBW) = x dB Bandwidth, **MHz**; is defined in ITU-R SM.328-10; $x=26$ dB is used in FCC definitions; $EBW_{26dB} > OBW_{99\%}$.

NOTE 3—Occupied bandwidth (OBW) = $x\%$ Bandwidth, **MHz**; defined in ITU-R SM.328-10; $x=99\%$ is typical value; $OBW \geq TBW$.

NOTE 4—Transmission bandwidth (TBW) = $(N_{FFT} - N_{guard} \times 2) \times 0.0096 / 16$, **tiles**; N_{guard} is number of guard subcarriers on each side of the carrier.

4.2.1 Requirements

The occupied bandwidth for MBWA shall be based on $\beta/2 = 0.5\%$. The occupied bandwidth shall be less than the channel bandwidth.

The measurement shall employ a resolution BW (RBW) of $\geq 1\%$ of the CBW, except where it is explicitly set otherwise.

4.3 Band classes

This subclause specifies the different band classes and subclasses and their respective duplexer gaps. In Table 2, for each band class/subclass, the band for forward link channels and reverse link channels are listed. The duplexer gap is the gap between the forward link (FL) band and reverse link (RL) band.

Table 2—Duplexer gaps for all band classes and subclasses

Band class	Sub class	Reverse link band (MHz)	Forward link band (MHz)	Duplexer gap (MHz)	Recommended bandwidth (MHz)
0	0	824.000 – 849.000	869.000 – 894.000	20.000	4.608 (See NOTE 1), 9.216 (See NOTE 2)
	1	824.000 – 849.000	869.000 – 894.000	20.000	4.608, 9.216
	2	824.000 – 830.000	869.000 – 875.000	39.000	4.608, 9.216
	3	815.000 – 830.000	860.000 – 875.000	30.000	4.608, 9.216
1		1850.000 – 1910.000	1930.000 – 1990.000	20.000	4.608, 9.216
2	0	890.000 – 905.000	935.000 – 950.000	30.000	4.608, 9.216
	1	890.000 – 915.000	935.000 – 960.000	20.000	4.608, 9.216
	2	872.000 – 905.000	917.000 – 950.000	12.000	4.608, 9.216
3		887.000 – 889.000	832.000 – 834.000	17.000	4.608, 9.216
		893.000 – 901.000	838.000 – 846.000		
		915.000 – 925.000	860.000 – 870.000		
4		1750.000 – 1780.000	1840.000 – 1870.000	60.000	4.608, 9.216
5	0	452.500 – 457.475	462.500 – 467.475	5.025	4.608
	1	452.000 – 456.475	462.000 – 466.475	5.525	4.608
	2	450.000 – 454.800	460.000 – 464.800	5.200	4.608
	3	411.675 – 415.850	421.675 – 425.850	5.825	4.608
	4	415.500 – 419.975	425.500 – 429.975	5.525	4.608
	5	479.000 – 483.480	489.000 – 493.480	5.520	4.608
	6	455.230 – 459.990	465.230 – 469.990	5.240	4.608
	7	451.310 – 455.730	461.310 – 465.730	5.580	4.608
	8	451.325 – 455.725	461.325 – 465.725	5.600	4.608
	9	455.250 – 459.975	465.250 – 469.975	5.275	4.608
	10	479.000 – 483.475	489.000 – 493.475	5.525	4.608
	11	410.000 – 414.975	420.000 – 424.975	5.025	4.608
6		1920.000 – 1980.000	2110.000 – 2170.000	130.000	4.608, 9.216

Band class	Sub class	Reverse link band (MHz)	Forward link band (MHz)	Duplexer gap (MHz)	Recommended bandwidth (MHz)
7		776.000 – 788.000	746.000 – 758.000	18.000	4.608, 9.216
8		1710.000 – 1785.000	1805.000 – 1880.000	20.000	4.608, 9.216
9		880.000 – 915.000	925.000 – 960.000	10.000	4.608, 9.216
10	0	806.000 – 811.000	851.000 – 856.000	40.000	4.608, 9.216
	1	811.000 – 816.000	856.000 – 861.000	40.000	4.608, 9.216
	2	816.000 – 821.000	861.000 – 866.000	40.000	4.608, 9.216
	3	821.000 – 824.000	866.000 – 869.000	42.000	4.608, 9.216
	4	896.000 – 901.000	935.000 – 940.000	34.000	4.608, 9.216
11	0	452.500 – 457.475	462.500 – 467.475	5.025	4.608
	1	452.000 – 456.475	462.000 – 466.475	5.525	4.608
	2	450.000 – 454.800	460.000 – 464.800	5.200	4.608
	3	411.675 – 415.850	421.675 – 425.850	5.825	4.608
	4	415.500 – 419.975	425.500 – 429.975	5.525	4.608
	5	Not specified	Not specified	Not specified	Not specified
	6	Not specified	Not specified	Not specified	Not specified
	7	Not specified	Not specified	Not specified	Not specified
	8	451.325 – 455.725	461.325 – 465.725	5.600	4.608
	9	455.250 – 459.975	465.250 – 469.975	5.275	4.608
	10	479.000 – 483.475	489.000 – 493.475	5.525	4.608
	11	410.000 – 414.975	420.000 – 424.975	5.025	4.608
12	0	870.000 – 876.000	915.000 – 921.000	39.000	4.608, 9.216
	1	871.500 – 874.500	916.500 – 919.500	42.000	4.608, 9.216
	2	870.000 – 876.000	915.000 – 921.000	39.000	4.608, 9.216
13		2500.000 – 2570.000	2620.000 – 2690.000	50.000	4.608, 9.216
14		1850.000 – 1915.000	1930.000 – 1995.000	15.000	4.608, 9.216
15		1710.000 – 1755.000	2110.000 – 2155.000	355.000	4.608, 9.216
16		2502.000 – 2568.000	2624.000 – 2690.000	56.000	4.608, 9.216
17		Not specified	Not specified	Not specified	Not specified
18		787.000 – 799.000	757.000 – 769.000	18.000	4.608, 9.216
19		698.000 – 716.000	728.000 – 746.000	12.000	4.608, 9.216
NOTE 1— The recommend bandwidth of 4.608 MHz corresponds to a system with 480 non-guard subcarriers.					
NOTE 2— The recommend bandwidth of 9.216 MHz corresponds to a system with 960 non-guard subcarriers.					

4.4 Access node (AN) Minimum Performance Specification (MPS)

4.4.1 AN receiver minimum standards

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

4.4.1.1 Receiver sensitivity

4.4.1.1.1 Definition

The reference sensitivity (REFSENS) level is defined for one receive antenna as the minimum mean power received at the antenna connector to attain 1% frame error rate (FER) for the configurations specified in Table 3.

4.4.1.1.2 Method of measurement

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

- a) Configure the sector under test and an access terminal simulator as shown in Figure 2.
- b) Disable the Additive White Gaussian Noise (AWGN) generators (set their output powers to zero).
- c) Configure the access node to use reference channel parameters specified in the first column of Table 3 for the channel bandwidth being used for the test.
- d) Fix the access node transmit power to the maximum supported for the configuration.
- e) The power level should be fixed such that the access node REFSENS level is at the value specified in Table 4 for the channel bandwidth being used.
- f) Measure the FER.

Table 3—Encoder parameters for receiver sensitivity

Reference channel parameter	Value
Allocated tiles	30
Guard Band (tiles per side)	1
Symbols per tile	8
Modulation	QPSK
Packet format	0
Number of Hybrid Automatic Repeat Request (HARQ) transmissions	1
Payload size (bits)	1666
Tones per tile	16
Data channel Cyclic Redundancy Check (CRC) (bits)	24
Cyclic prefix (μ s)	13.02
Symbol duration (μ s)	120.44
Frame duration (μ s)	963.52
PHY layer throughput (kbps)	1729

Table 4—Access node REFSENS level

Channel bandwidth (MHz)	Access node REFSENS 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. $x = -0.5$ dB for 1% FER and $y = 2.5$ dB is the implementation loss	

4.4.1.1.3 Minimum standard

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

4.4.1.2 Receiver dynamic range

4.4.1.2.1 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 5.

4.4.1.2.2 Method of measurement

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

- a) Configure the sector under test and an access terminal simulator as shown in Figure 2.
- b) Configure the access node to use reference channel parameters specified Table 5 for the channel bandwidth being used for the test.
- c) Fix the access node transmit power to the maximum supported for the configuration.
- d) Adjust the interfering signal's mean power to the level specified in Table 6.
- e) Measure the FER.

Table 5—Encoding parameters for receiver dynamic range test^a

Reference channel parameter	Value
Allocated tiles	30
Guard Band (tiles per side)	1
Symbols per tile	8
Modulation	64-QAM
Packet format	7
Number of HARQ transmissions	1
Payload size (bits)	9576
Subcarriers per tile	16
Data channel CRC (bits)	24
Cyclic prefix (μsec)	13.02
Symbol duration (μs)	120.44
Frame duration (μs)	963.52
Phy layer throughput (kbps)	9939

^aThe channel code is Turbo code R1/5.

Table 6—Access node 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—requirement shall be met in consecutive application of the configuration in Table 1 to groups of 30 tiles.			
NOTE 2— $x = 14.5$ for 1% FER assuming 1 receive antenna and $y = 2.5$ dB.			

4.4.1.2.3 Minimum standard

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

4.4.1.3 Intermodulation spurious response attenuation

4.4.1.3.1 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. It is measured by specifying signals at a carefully chosen frequency offset, such that their third order intermodulation product falls in the desired signal channel, increasing the noise floor. The desired signal is allowed to desense the receiver by at most 6 dB.

4.4.1.3.2 Method of measurement

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

- a) Configure the sector under test and an access terminal simulator as shown in Figure 4.
- b) Configure the access node to use the reference channel configuration in Table 3 (receiver sensitivity).
- c) Fix the access node transmit power to the maximum supported for the configuration.
- d) Adjust the mean power of the interfering signals to the level specified in Table 7 and Table 8.
- e) For broadband intermodulation test, the power level should be fixed such that the access node receiver power is at the level specified in Table 7. For narrowband intermodulation test, the power level should be fixed such that the access node receiver power is at the level specified in Table 8.
- f) Measure the FER.

Table 7—Access node broadband intermodulation performance requirement

MBWA channel bandwidth (MHz)	Configuration	Desired signal mean power (dBm) (The value of REFSENS is as specified in Table 4)	Interfering signal mean power (dBm)	Interfering signal center frequency offset to the channel edge of the desired carrier (MHz)	Type of interfering signal
5	See Table 3	REFSENS + 6 dB	−52	7.5	CW
			−52	17.5	5 MHz MBWA signal
10	See Table 3	REFSENS + 6 dB	−52	7.5	CW
			−52	17.7	5 MHz MBWA signal
20	See Table 3	REFSENS + 6 dB	−52	7.5	CW
			−52	17.95	5 MHz MBWA signal

Table 8—Access node narrowband intermodulation performance requirement

MBWA channel bandwidth (MHz)	Configuration	Wanted signal mean power (dBm) (The value of REFSENS is as specified in Table 4)	Interfering signal mean power (dBm)	Interfering signal offset to the channel edge of the desired carrier (kHz)	Type of interfering signal
5	See Table 3	REFSENS + 6 dB	−52	384	CW
			−52	1040.8	5 MHz MBWA signal, 1 tile ^a (10th tile from center)
10	See Table 3	REFSENS + 6 dB	−52	439.6	CW
			−52	1348	5 MHz MBWA signal, 1 tile ^a (8th tile from center)
20	See Table 3	REFSENS + 6 dB	−52	474	CW
			−52	1655.2	5 MHz MBWA signal, 1 tile ^a (6th tile from center)

^aInterfering signal consisting of one tile positioned at the stated offset.

4.4.1.3.3 Minimum standard

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

4.4.1.4 Adjacent channel selectivity

4.4.1.4.1 Definition

Adjacent channel selectivity (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 center frequency offset of the interfering signal to the channel edge of a victim system equal to 272.8 kHz as shown in Table 9.
- 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 center frequency offset of the interfering signal to the band edge of a victim system equal to 2.5 MHz as shown in Table 10.

4.4.1.4.2 Method of measurement

The test shall be carried out for every band class and CBW supported by the sector using the relevant configuration as specified in Table 9 and Table 10.

- a) Configure the sector under test and an access terminal simulator as shown in Figure 3.
- b) Configure the access node to use the reference channel configuration in Table 3 (receiver sensitivity).
- c) Fix the access node transmit power to the maximum supported for the configuration.
- d) Adjust the mean power of the interfering signals to the level specified in Table 9 and Table 10.
- e) For narrowband ACS test, the power level should be fixed such that the access node receiver power is at the level specified in Table 9. For wideband ACS test, the power level should be fixed such that the access node receiver power is at the level specified in Table 10.
- f) Measure the FER.

Table 9—MBWA AN ACS (narrowband) requirement

MBWA channel bandwidth (MHz)	Reference measurement channel	Wanted signal mean power (dBm) (The value of REFSENS is as specified in Table 4)	Interfering signal mean power (dBm)	Interfering tile center frequency offset to the channel edge of the wanted carrier (kHz)	Type of interfering signal
5	See Table 3	REFSENS + 6 dB	−49	$272.8 + m \times 153.6$, $m = 0, 14, 30$	5 MHz MBWA signal, 1 tile ^a
10	See Table 3	REFSENS + 6 dB	−49	$272.8 + m \times 153.6$, $m = 0, 14, 30$	5 MHz MBWA signal, 1 tile ^a
20	See Table 3	REFSENS + 6 dB	−49	$272.8 + m \times 153.6$, $m = 0, 14, 30$	5 MHz MBWA signal, 1 tile ^a

^aInterfering 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.