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RADIO TEST REPORT – 449947-1TRFWL

Type of assessment:

Final product testing

Applicant:

Andrew Wireless Systems
Industriering 10, Buchdorf 86675
Germany

Product:

ERA L2 Radio Module

Model:

Radio Module L2 B66

Model variant(s):

--

FCC ID:

XS5-RML2B66

IC Registration number:

2237E-RML2B66

Specifications:

- FCC 47 CFR Part 27
- RSS-131 Issue 3
- RSS-139 Issue 3

Date of issue: February 9, 2022

P. Barbieri
Tested by

Signature

D. Guarnone
Reviewed by

Signature

Lab locations

Company name	Nemko Spa
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Province	MB
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Facsimile	+39 039 220 12 21
Website	www.nemko.com
Site number	682159 and 9109A (10 m semi anechoic chamber)

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report. This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this report are within Nemko Spa ISO/IEC 17025 accreditation.

Copyright notification

Table of Contents

Section 1 Report summary

1.1 Test specifications

FCC 47 CFR Part 2	Frequency Allocations and Radio Treaty Maters; General Rules and Regulations
FCC 47 CFR Part 27	Miscellaneous wireless communications services
RSS-131 Issue 3, May 2017	Zone Enhancers
RSS-139 Issue 3, July 2015	Advanced Wireless Services (AWS) equipment operating in the bands 1710–1780 MHz and 2110–2180 MHz
RSS-Gen, Issue 5, April 2018 + A1 (March 2019) + A2 (February 2021	General Requirements for Compliance of Radio Apparatus

1.2 Test methods

ANSI C63.26-2015	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services
KDB 935210 D05	Indus Booster Basic Meas v01r04
KDB 662911 D01	Multiple Transmitter Output v02r01
KDB 662911 D02	MIMO with Cross-Polarized Antennas v01

1.3 Exclusions

None

1.4 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was performed against all relevant requirements of the test standard except as noted in section 1.3 above. Results obtained indicate that the product under test Choose an item. In full with the requirements tested. The test results relate only to the items tested.

See "Summary of test results" for full details.

1.5 Test report revision history

Table 1.5-1: *Test report revision history*

Revision #	Date of issue	Details of changes made to test report
449947-1TRFWL	February 9, 2022	Original report issued

Section 2 Engineering considerations

2.1 Modifications incorporated in the EUT for compliance

There were no modifications performed to the EUT during this assessment.

2.2 Technical judgment

None

2.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 3 Test conditions

3.1 Atmospheric conditions

Temperature	15 °C – 35 °C
Relative humidity	20 % – 75 %
Air pressure	86 kPa (860 mbar) – 106 kPa (1060 mbar)

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

The following instruments are used to monitor the environmental conditions:

Equipment	Manufacturer	Model no.	Asset no.	Cal date	Next cal.
Thermo-hygrometer data loggers	Testo	175-H2	20012380/305	2020-12	2022-12
Thermo-hygrometer data loggers	Testo	175-H2	38203337/703	2020-12	2022-12
Barometer	Castle	GPB 3300	072015	2021-04	2022-04

3.2 Power supply range

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages ±5 %, for which the equipment was designed.

Section 4 Measurement uncertainty

4.1 Uncertainty of measurement

The measurement uncertainty was calculated for each test and quantity listed in this test report, according to CISPR 16-4-2 and other specific test standard and is documented in Nemko Spa working manual WML1002.
The assessment of conformity for each test performed on the equipment is performed not taking into account the measurement uncertainty. The two following possible verdicts are stated in the report:
P (Pass) - The measured values of the equipment respect the specification limit at the points tested. The specific risk of false accept is up to 50% when the measured result is close to the limit.
F (Fail) - One or more measured values of the equipment do not respect the specification limit at the points tested. The specific risk of false reject is up to 50% when the measured result is close to the limit.
Hereafter Nemko's measurement uncertainties are reported:

EUT	Type	Test	Range	Measurement Uncertainty	Notes
Transmitter	Conducted	Frequency error	0.001 MHz ÷ 40 GHz	0.08 ppm	(1)
		Carrier power RF Output Power	0.009 MHz ÷ 30 MHz	1.1 dB	(1)
			30 MHz ÷ 18 GHz	1.5 dB	(1)
			18 MHz ÷ 40 GHz	3.0 dB	(1)
			40 MHz ÷ 140 GHz	5.0 dB	(1)
		Adjacent channel power	1 MHz ÷ 18 GHz	1.4 dB	(1)
		Conducted spurious emissions	0.009 MHz ÷ 18 GHz	3.0 dB	(1)
			18 GHz ÷ 40 GHz	4.2 dB	(1)
			40 GHz ÷ 220 GHz	6.0 dB	(1)
		Intermodulation attenuation	1 MHz ÷ 18 GHz	2.2 dB	(1)
		Attack time – frequency behaviour	1 MHz ÷ 18 GHz	2.0 ms	(1)
		Attack time – power behaviour	1 MHz ÷ 18 GHz	2.5 ms	(1)
		Release time – frequency behaviour	1 MHz ÷ 18 GHz	2.0 ms	(1)
		Release time – power behaviour	1 MHz ÷ 18 GHz	2.5 ms	(1)
		Transient behaviour of the transmitter– Transient frequency behaviour	1 MHz ÷ 18 GHz	0.2 kHz	(1)
		Transient behaviour of the transmitter – Power level slope	1 MHz ÷ 18 GHz	9%	(1)
		Frequency deviation - Maximum permissible frequency deviation	0.001 MHz ÷ 18 GHz	1.3%	(1)
		Frequency deviation - Response of the transmitter to modulation frequencies above 3 kHz	0.001 MHz ÷ 18 GHz	0.5 dB	(1)
		Dwell time	-	3%	(1)
		Hopping Frequency Separation	0.01 MHz ÷ 18 GHz	1%	(1)
		Occupied Channel Bandwidth	0.01 MHz ÷ 18 GHz	2%	(1)
		Modulation Bandwidth	0.01 MHz ÷ 18 GHz	2%	(1)
	Radiated	Radiated spurious emissions	0.009 MHz ÷ 26.5 GHz	6.0 dB	(1)
			26.5 GHz ÷ 66 GHz	8.0 dB	(1)
			66 GHz ÷ 220 GHz	10 dB	(1)
		Effective radiated power transmitter	10 kHz ÷ 26.5 GHz	6.0 dB	(1)
			26.5 GHz ÷ 66 GHz	8.0 dB	(1)
			66 GHz ÷ 220 GHz	10 dB	(1)

NOTES:
(1) The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k = 2, which for a normal distribution corresponds to a coverage probability of approximately 95 %

Section 5 Information provided by the applicant

5.1 Disclaimer

This section contains information provided by the applicant and has been utilized to support the test plan. Inaccurate information provided by the applicant can affect the validity of the results contained within this test report. Nemko accepts no responsibility for the information contained within this section and the impact it may have on the test plan and resulting measurements.

5.2 Applicant/Manufacture

Applicant name	Andrew Wireless Systems
Applicant address	Industriering 10, Buchdorf 86675 Germany
Manufacture name	Andrew Wireless Systems
Manufacture address	Industriering 10, Buchdorf 86675 Germany

5.3 EUT information

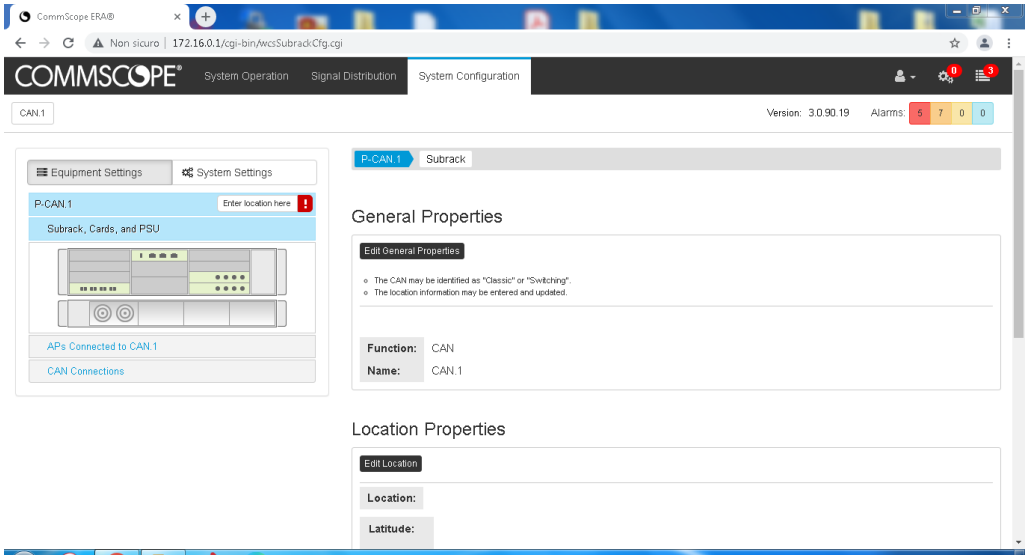
Product name	Carrier Access Point Radio Module
Model	L2 B66
Model variant(s)	--
Serial number	BGRMAZ21400010
Part number	7847637-01
Power supply requirements	DC: 48 V
Product description and theory of operation	The EUT is a MIMO 1 +1 radio module used inside a CAP L2 Access Point. The Era product is a digital distribution system with focus on flexibility, easy installing, commissioning, and reliable operation. The system is designed in a way to satisfy all of today's needs as well as unknown future standards and requirements. The Era system comprises of two main parts. A base station interface (Master or Head End Unit) that takes RF signals as well as digital signals from the base stations, conditions the signals for the given application and assigns them to the coverage zones. The coverage side is built of one or more Access Points. The "Access Point" (hereinafter referred to as "AP") is connected via a 10GBASE SFP+ fiber optical link to the Era Master Unit. This link gives a total RF bandwidth of up to 320 MHz. For higher bandwidth requirements, a secondary 10G link can be used in parallel. RF signals between Master Unit and Access Points are sent digitally over the fiber optical link. At the receiver side these signals are converted back to analog and amplified up to appropriate transmit levels. The AP unit is designed to support up to 4 Radio Cards within one CAP L2 cabinet. Depending on the market needs the outputs of the PAs can be all combined to one common or multiple antenna ports. The AP is equipped with a Digital Board for signal processing and controlling functionality. The AP is powered by an external DC power supply. The Era CAP L2 is primarily intended for indoor and outdoor use, while the master unit mainly operates in indoor environments. Although this is not a rule especially in cases where master unit components are used together with air-conditioned outdoor racks.

5.4 Technical information

Frequency band	2110 MHz to 2180 MHz
Frequency Min (MHz)	2112.5 MHz for LTE 5 MHz
Frequency Max (MHz)	2172.5 MHz for LTE 5 MHz
RF power Max (W), Conducted	0.251 W (24 dBm)
Measured BW (kHz), 99% OBW	4.164 MHz
Type of modulation	LTE
Emission classification	D7W
Transmitter spurious, dBm @ 3 m	--
Antenna information	RF connector (antenna not provided)

5.5 EUT setup details

5.5.1 Radio exercise details

Operating conditions	The EUT has been tested connected to a dedicated server. The following software has been used to configure the EUT:  A signal generator with an AWGN5 signal with 4.1 MHz 99% OBW representative of a 5 MHz LTE channel has been connected to the RF input of the server. The RF output of the EUT was connected to a spectrum analyzer or a dummy load.

5.5.2 EUT setup configuration

Table 5.5-1: *EUT sub assemblies*

Description	Brand name	Model, Part number, Serial number, Revision level
--	--	--
--	--	--
--	--	--
--	--	--

The EUT is composed by a single unit

Table 5.5-2: *EUT interface ports*

Description	Qty.
Optical link	1
RF output	2
DC power port	1

Table 5.5-3: *Support equipment*

Description	Part number	Serial number
SUBRACK	7642110-00	13017180026
OPT.L1	7642123-00	SZBEAD1645A0037
SUI.M3	7642125-00	SZBEAC1649A0001
RFD.R1	7633229-01	SZBEAG1906A0104
PSU	7663610-00	psu12V_1_0_1

Table 5.5-4: *Inter-connection cables*

Cable description	From	To	Length (m)
DC power cable	EUT	DC power source	1.5 m
Optical fibre	EUT	Server	5 m
Coaxial cable	EUT	Spectrum analyzer	0.5 m

EUT setup configuration, continued

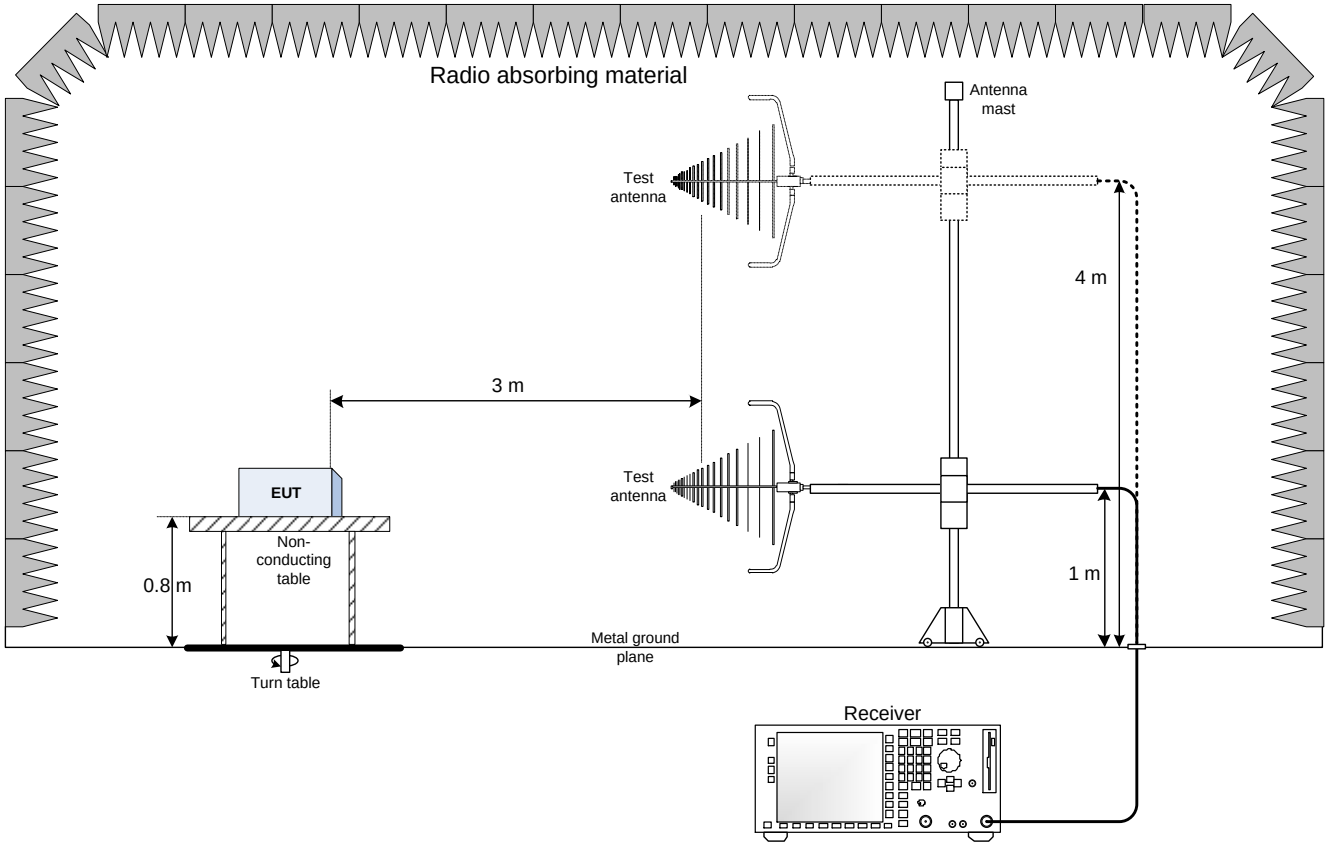


Figure 5.5-1: *Radiated emissions set-up for frequencies below 1 GHz*

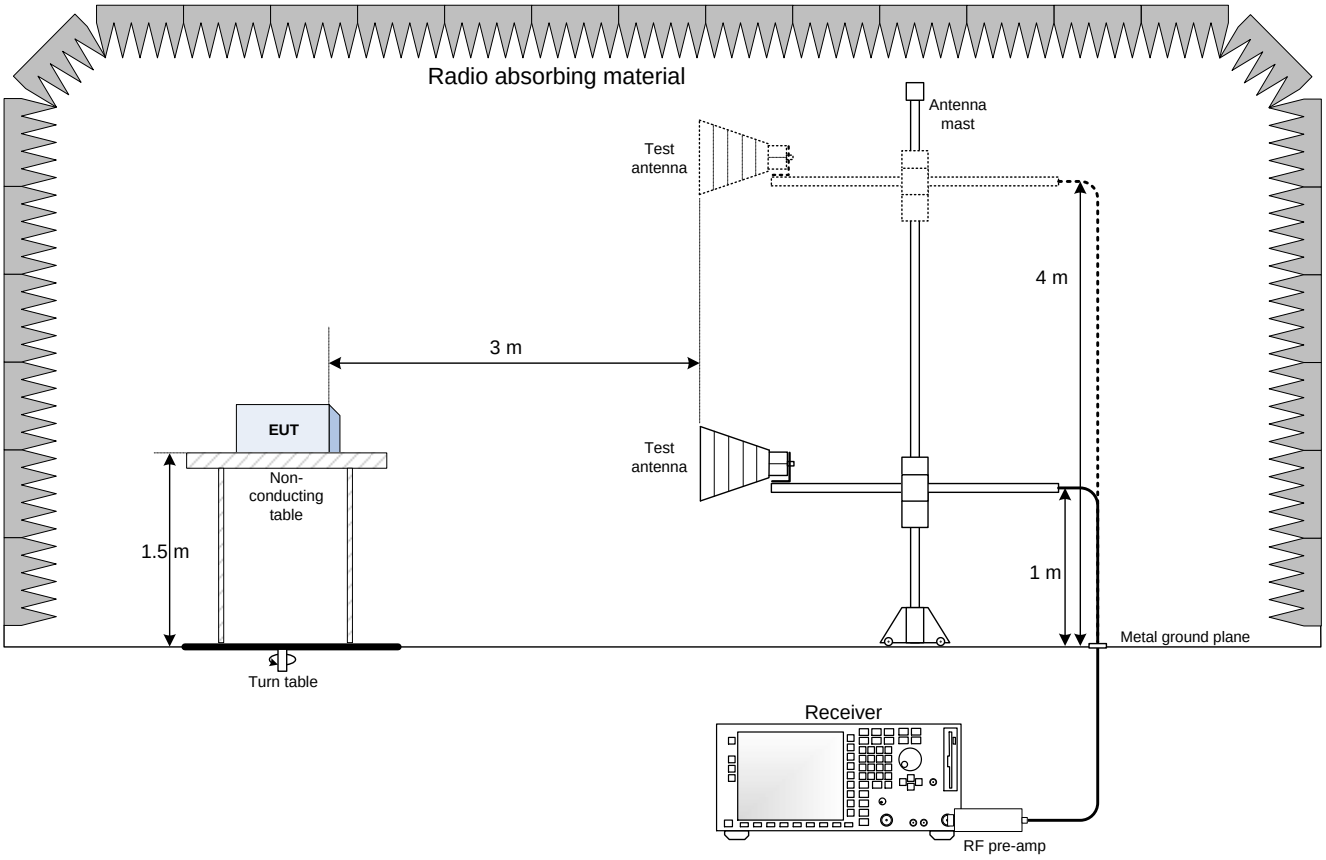


Figure 5.5-2: *Radiated emissions set-up for frequencies above 1 GHz*

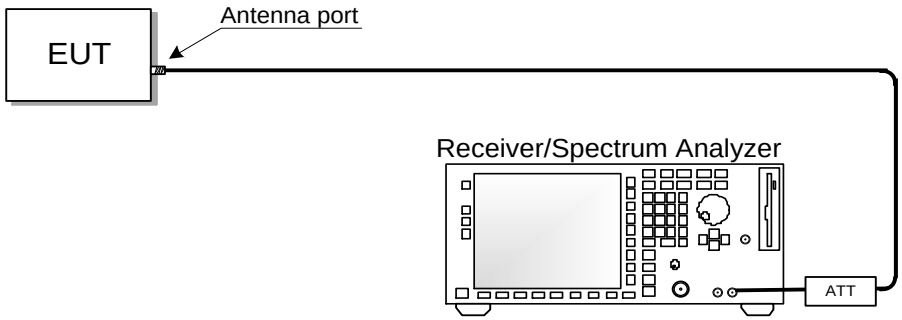


Figure 5.5-3: *Antenna port testing set-up*

Section 6 Summary of test results

6.1 Testing location

Test location (s)	Nemko Spa Via del Carroccio, 4 – 20853 Biassono (MB) - Italy

6.2 Testing period

Test start date	January 27, 2022	Test end date	February 9, 2022

6.3 Sample information

Receipt date	January 17, 2022	Nemko sample ID number(s)	4499470001

6.4 FCC Part 27 test requirements results

Table 6.4-1: *FCC requirements results*

Part	Method (clause)	Test description	Verdict
--	935210 (3.2)	Measuring AGC threshold level	Pass
--	935210 (3.3)	Out-of-band-rejection	Pass
--	935210 (3.4)	Input-versus-output signal comparison	Pass
FCC 27.50(d)	935210 (3.5)	Mean output power and amplifier/booster gain	Pass
FCC 27.53(h)	935210 (3.6.2)	Out-of-band/out-of-block emissions conducted measurements	Pass
FCC 27.53(h)	935210 (3.6.3)	Spurious emissions conducted measurements	Pass
FCC 27.54	935210 (3.7)	Frequency stability measurements	Pass
FCC 27.53(h)	935210 (3.8)	Spurious emissions radiated measurements	Pass

Notes:

6.5 ISED RSS-131 and RSS-139 test requirements results

Table 6.5-1: *ISED requirements results*

Clause	Method (clause)	Test description	Verdict
--	935210 (3.2)	Measuring AGC threshold level	Pass
RSS-131 §5.2.1	935210 (3.3)	Out-of-band-rejection	Pass
RSS-131 §5.2.2	935210 (3.4)	Input-versus-output signal comparison	Pass
RSS-131 §5.2.3 / RSS-139 §6.5	935210 (3.5)	Mean output power and amplifier/booster gain	Pass
RSS-131 §5.2 / RSS-139 §6.6	935210 (3.6.2)	Out-of-band/out-of-block emissions conducted measurements	Pass
RSS-131 §5.2 / RSS-139 §6.6	935210 (3.6.3)	Spurious emissions conducted measurements	Pass
RSS-131 §5.2.4 / RSS-139 §6.4	935210 (3.7)	Frequency stability measurements	Pass
RSS-131 §5.2 / RSS-139 §6.6	935210 (3.8)	Spurious emissions radiated measurements	Pass

Notes:

Section 7 Test equipment

7.1 Test equipment list

Table 7.1-1: *Equipment list*

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
Spectrum Analyzer	Rohde & Schwarz	FSW43	101767	2022-01	2023-01
EMI Receiver	Rohde & Schwarz	ESU8	100202	2021-09	2022-09
EMI Receiver	Rohde & Schwarz	ESW44	101620	2021-08	2022-08
RF Vector Signal Generator	Rohde & Schwarz	SMBV100A	263254	2021-05	2022-05
RF Vector Signal Generator	Rohde & Schwarz	SMBV100A	263397	2021-09	2022-09
Climatic Chamber	MSL	EC500DA	15022	2021-01	2022-01
Antenna Trilog 25MHz - 8GHz	Schwarzbeck Mess-Elektronik	VULB9162	9162-025	2021-07	2024-07
Antenna 1 - 18 GHz	Schwarzbeck Mess-Elektronik	STLP9148	STLP 9148-152	2021-09	2024-09
Double Ridge Horn Antenna	RFSpin	DRH40	061106A40	2020-04	2023-04
Broadband Amplifier	Schwarzbeck Mess-Elektronik	BBV9718C	00121	2022-01	2023-01
Broadband Bench Top Amplifier	Sage	STB-1834034030-KFKF-L1	18490-01	2021-04	2022-04
Controller	Maturo	FCU3.0	10041	NCR	NCR
Tilt antenna mast	Maturo	TAM4.0-E	10042	NCR	NCR
Turntable	Maturo	TT4.0-5T	2.527	NCR	NCR
Semi-anechoic chamber	Nemko S.p.a.	10m semi-anechoic chamber	530	2021-09	2023-09

Notes: NCR - no calibration required, VOU - verify on use

Section 8 Testing data

8.1 Measuring AGC threshold level

8.1.1 References, definitions and limits

935210 D05 Indus Booster Basic Meas v01r04, Clause 3.2

The AGC threshold is to be determined as follows. In the case of fiber-optic distribution systems, the RF input port of the equipment under test (EUT) refers to the RF input of the supporting equipment RF to optical convertor; see also descriptions and diagrams for typical DAS booster systems in KDB Publication 935210 D02. Devices intended to be directly connected to an RF source (donor port) only need to be evaluated for any over-the-air transmit paths.

a) Connect a signal generator to the input of the EUT.

b) Connect a spectrum analyzer or power meter to the output of the EUT using appropriate attenuation as necessary.

c) The signal generator should initially be configured to produce either of the required test signals (i.e., broadband or narrowband).

d) Set the signal generator frequency to the center frequency of the EUT operating band.

e) While monitoring the output power of the EUT, measured using the methods of 3.5.3 or 3.5.4, increase the input level until a 1 dB increase in the input signal power no longer causes a 1 dB increase in the output signal power.

f) Record this level as the AGC threshold level.

g) Repeat the procedure with the remaining test signal.

8.1.2 Test summary

Verdict	Pass		
Tested by	P. Barbieri	Test date	February 2, 2022

8.1.3 Observations, settings and special notes

AWGN5 signal with 4.1 MHz 99% OBW representative of a 5 MHz LTE channel used

Spectrum analyzer settings:

Detector mode	RMS
Resolution bandwidth	100 kHz
Video bandwidth	300 kHz
Measurement mode	Power over emission bandwidth
Trace mode	Averaging
Measurement time	Auto

8.1.4 Test equipment used

Equipment	Manufacturer	Model no.	Asset no.
Spectrum Analyzer	Rohde & Schwarz	FSW43	101767
RF Vector Signal Generator	Rohde & Schwarz	SMBV100A	263254
RF Vector Signal Generator	Rohde & Schwarz	SMBV100A	263397

Notes: NCR - no calibration required, VOU - verify on use

8.1.5 Test data

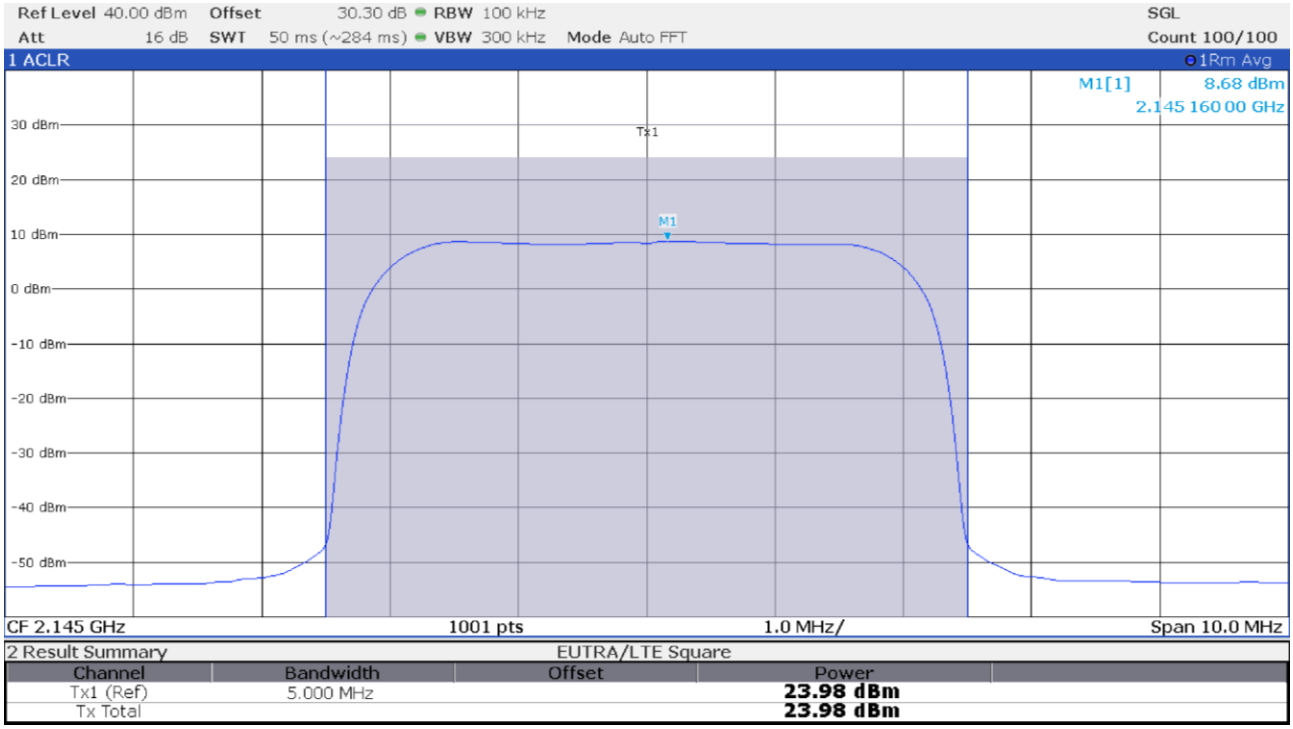


Figure 8.1-1: *Antenna port 1 output spectral plot with input at AGC threshold*

Test data, continued

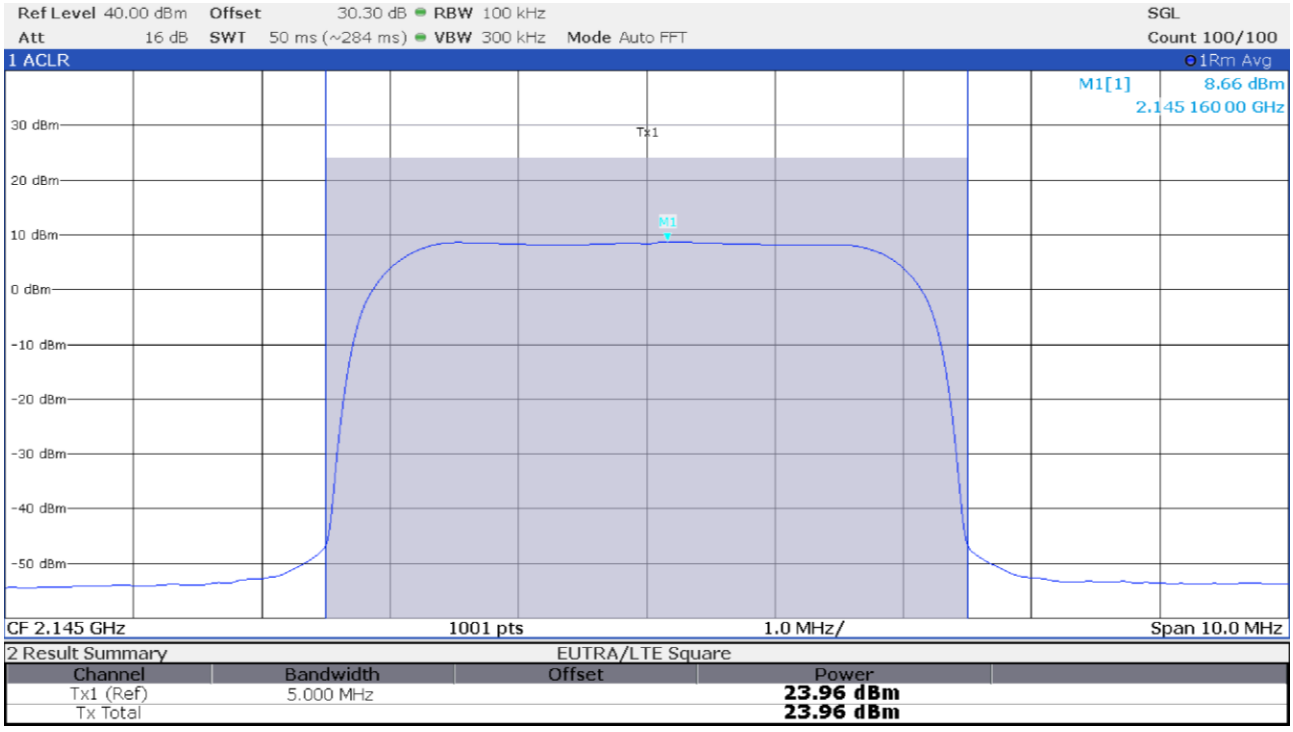


Figure 8.1-2: *Antenna port 1 output spectral plot with input at AGC threshold +1 dBm*

Test data, continued

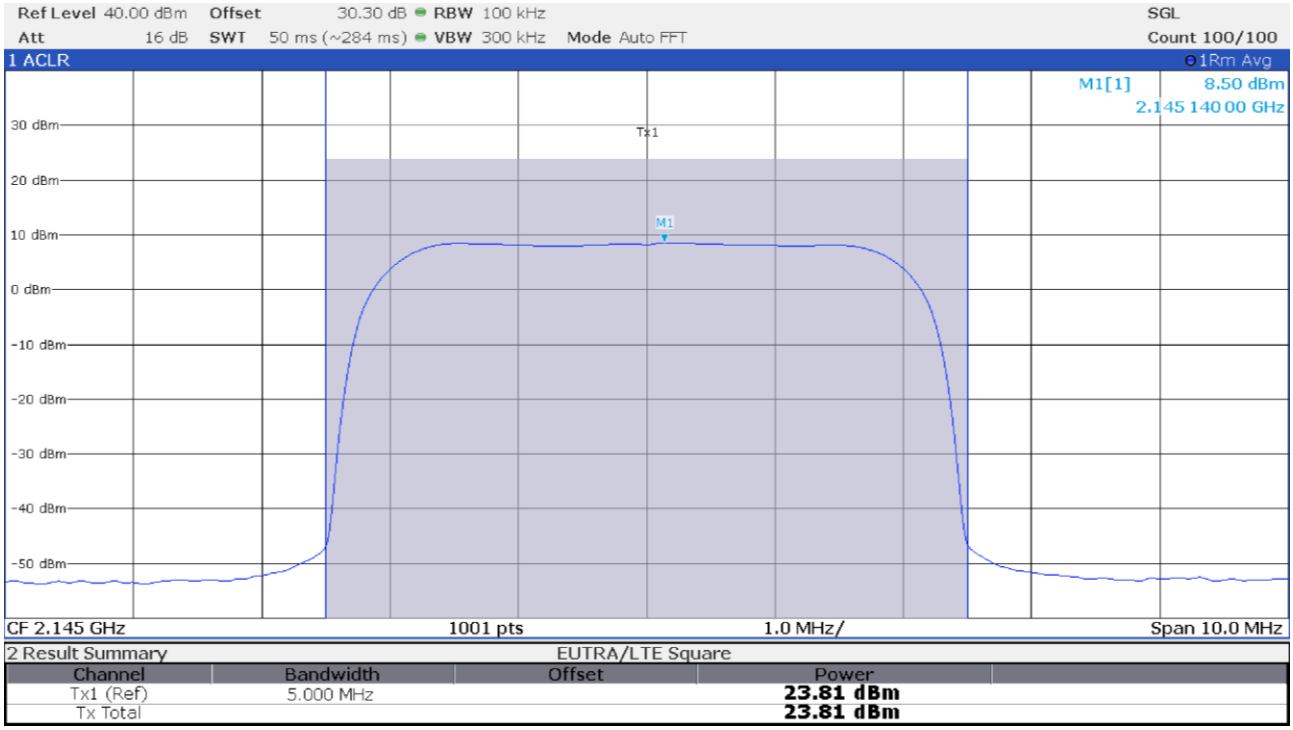


Figure 8.1-3: *Antenna port 2 output spectral plot with input at AGC threshold*

Test data, continued

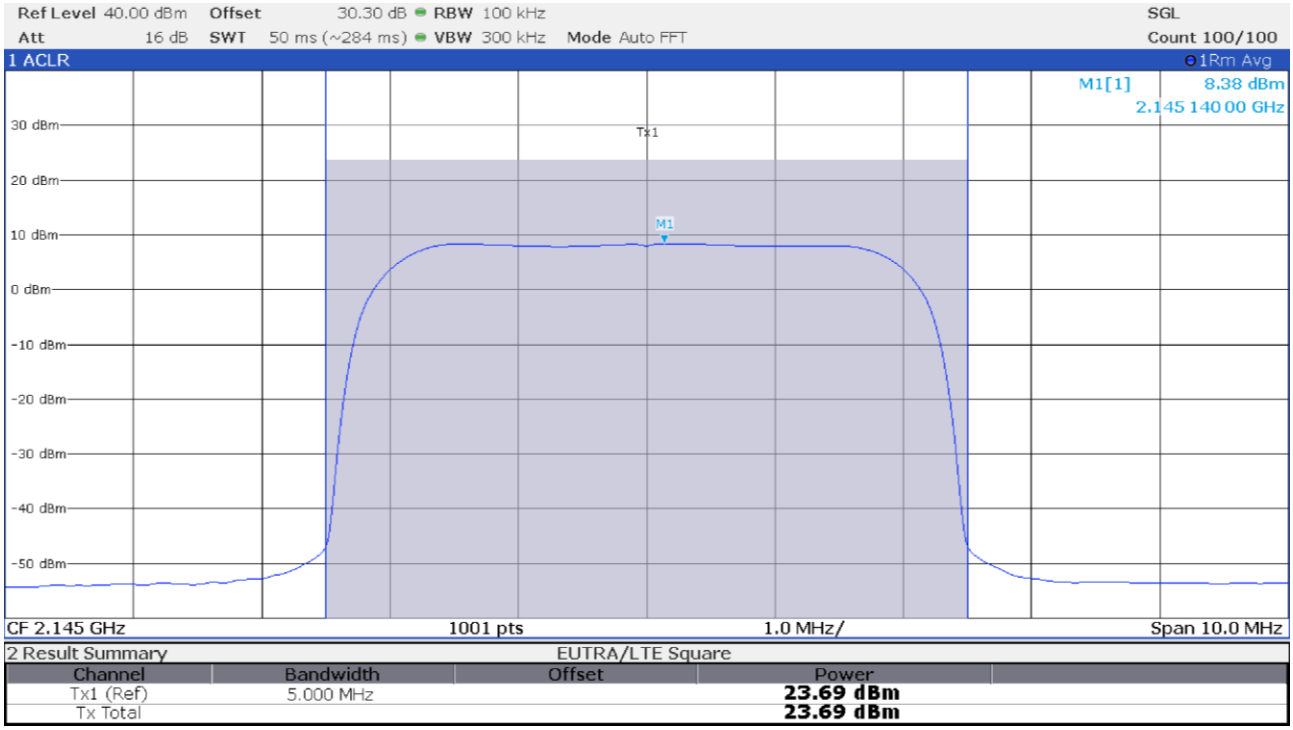


Figure 8.1-4: *Antenna port 2 output spectral plot with input at AGC threshold +1 dBm*

8.2 Out-of-band-rejection

8.2.1 References, definitions and limits

935210 D05 Indus Booster Basic Meas v01r04, Clause 3.3

A signal booster shall reject amplification of other signals outside of its passband. Adjust the internal gain control of the EUT (if so equipped) to the maximum gain for which equipment certification is sought.

RSS-131, Clause 5.2.1
Out-of-band rejection
The gain-versus-frequency response and the 20 dB bandwidth of the zone enhancer shall be reported. The zone enhancer shall reject amplification of other signals outside the passband of the zone enhancer.

8.2.2 Test summary

Verdict	Pass		
Tested by	P. Barbieri	Test date	February 2, 2022

8.2.3 Observations, settings and special notes

CW signal used with a frequency sweep in the range ± 250 % of the passband with a dwell time of 10 ms

Spectrum analyzer settings:

Resolution bandwidth	1 % to 5 % of the EUT passband
Video bandwidth	≥3 × RBW
Frequency span	± 250 % of the passband
Detector mode	Peak
Trace mode	Max Hold

8.2.4 Test equipment used

Equipment	Manufacturer	Model no.	Asset no.
Spectrum Analyzer	Rohde & Schwarz	FSW43	101767
RF Vector Signal Generator	Rohde & Schwarz	SMBV100A	263254
RF Vector Signal Generator	Rohde & Schwarz	SMBV100A	263397

Notes: NCR - no calibration required, VOU - verify on use

8.2.5 Test data

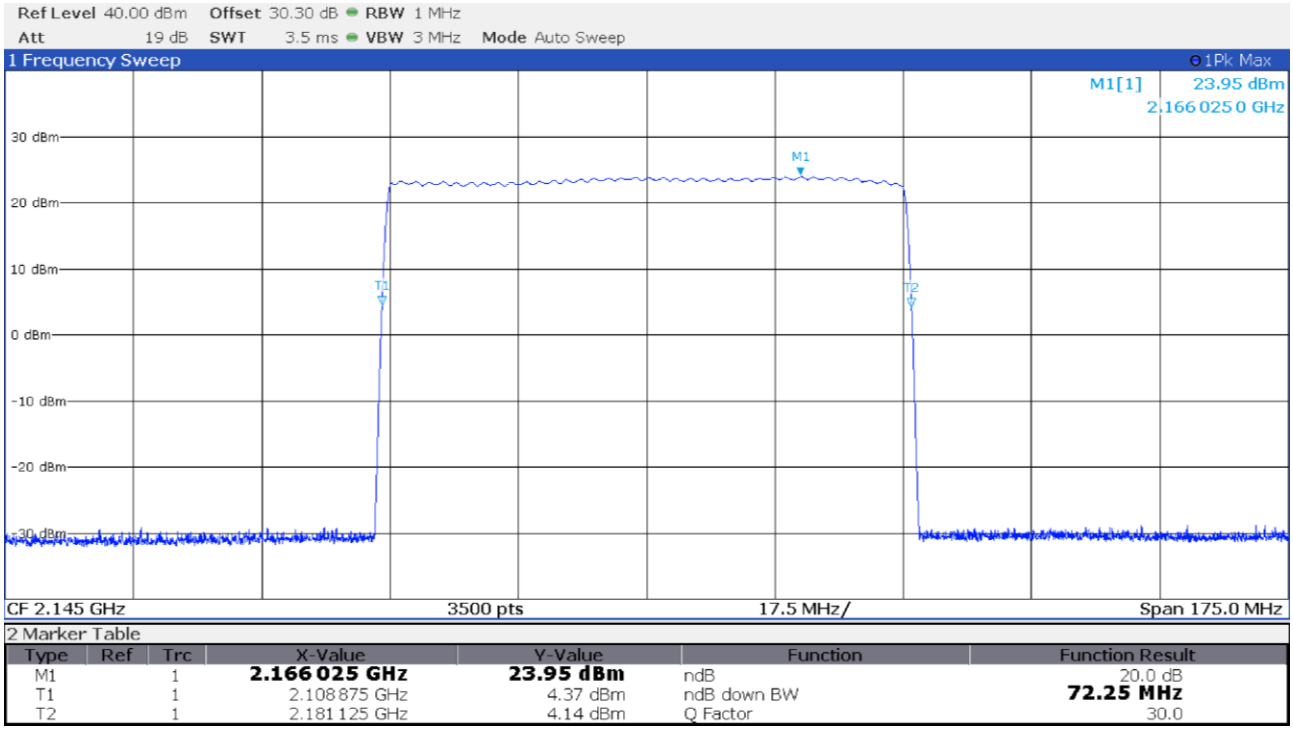


Figure 8.2-1: *Out-of-band-rejection 20dB BW spectral plot for Antenna port 1*

Test data, continued

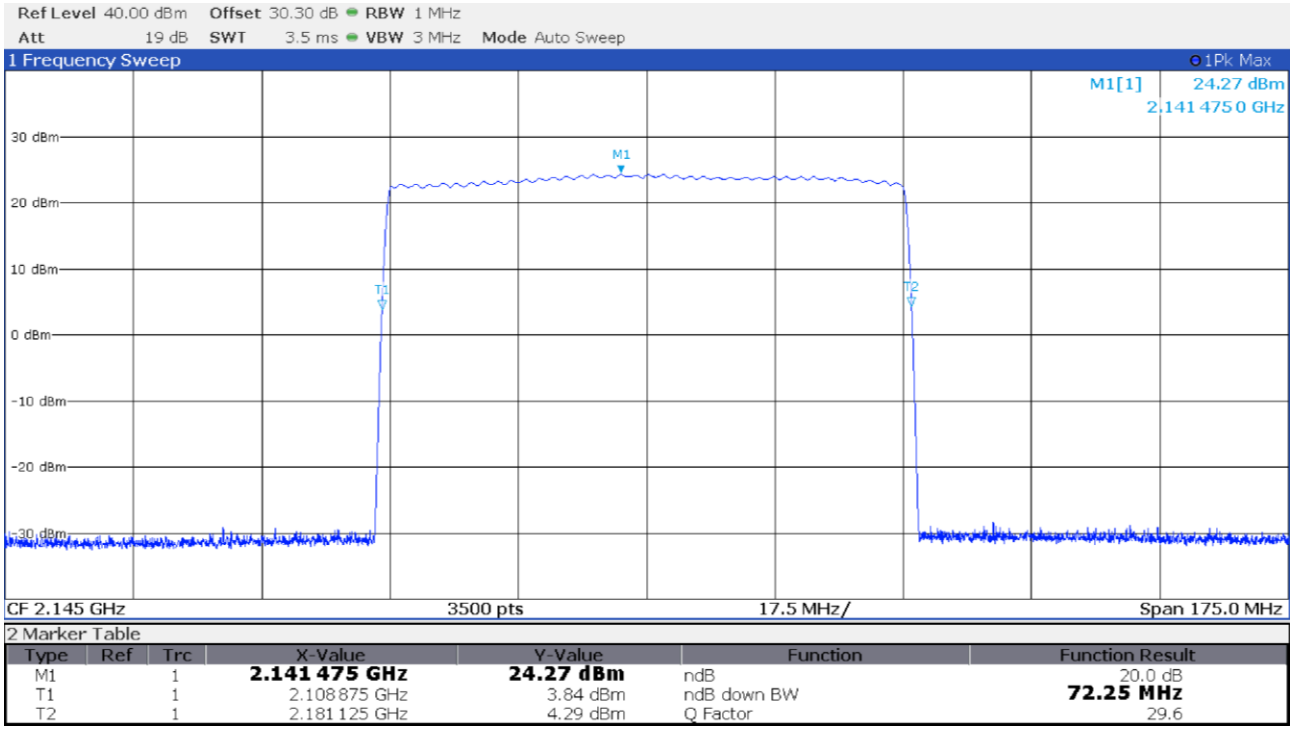


Figure 8.2-2: *Out-of-band-rejection 20dB BW spectral plot for Antenna port 2*

8.3 Input-versus-output signal comparison

8.3.1 References, definitions and limits

935210 D05 Indus Booster Basic Meas v01r04, Clause 3.4
A 26 dB bandwidth measurement shall be performed on the input signal and the output signal; alternatively, the 99% OBW can be measured and used.
RSS-131, Clause 5.2.2
Input-versus-output spectrum
The spectral growth of the 26 dB bandwidth of the output signal shall be less than 5% of the input signal spectrum.

8.3.2 Test summary

Verdict	Pass		
Tested by	P. Barbieri	Test date	February 2, 2022

8.3.3 Observations, settings and special notes

AWGN5 signal with 4.1 MHz 99% OBW representative of a 5 MHz LTE channel used.
EUT input power set to a level that is just below the AGC threshold, but not more than 0.5 dB below.
Repeated the test with the input signal amplitude set to 3 dB above the AGC threshold.

Spectrum analyzer settings:

Resolution bandwidth	of 1 % to 5 % of the OBW
Video bandwidth	≥3 × RBW
Frequency span	2 × to 5 × the emission bandwidth (EBW) or alternatively, the OBW
Detector mode	Peak
Trace mode	Max Hold

8.3.4 Test equipment used

Equipment	Manufacturer	Model no.	Asset no.
Spectrum Analyzer	Rohde & Schwarz	FSW43	101767
RF Vector Signal Generator	Rohde & Schwarz	SMBV100A	263254
RF Vector Signal Generator	Rohde & Schwarz	SMBV100A	263397

Notes: NCR - no calibration required, VOU - verify on use

8.3.5 Test data

Table 8.3-1: *Occupied bandwidth results*

Antenna port	Signal measured	Input signal level	Frequency, MHz	99% OBW, MHz	26 dB BW, MHz
1	Input	AGC threshold	2145	4.164	4.67
1	Output	AGC threshold	2145	4.164	4.66
1	Input	AGC threshold +3 dB	2145	4.163	4.67
1	Output	AGC threshold +3 dB	2145	4.164	4.66
2	Input	AGC threshold	2145	4.164	4.67
2	Output	AGC threshold	2145	4.164	4.66
2	Input	AGC threshold +3 dB	2145	4.163	4.67
2	Output	AGC threshold +3 dB	2145	4.164	4.66

Test data, continued

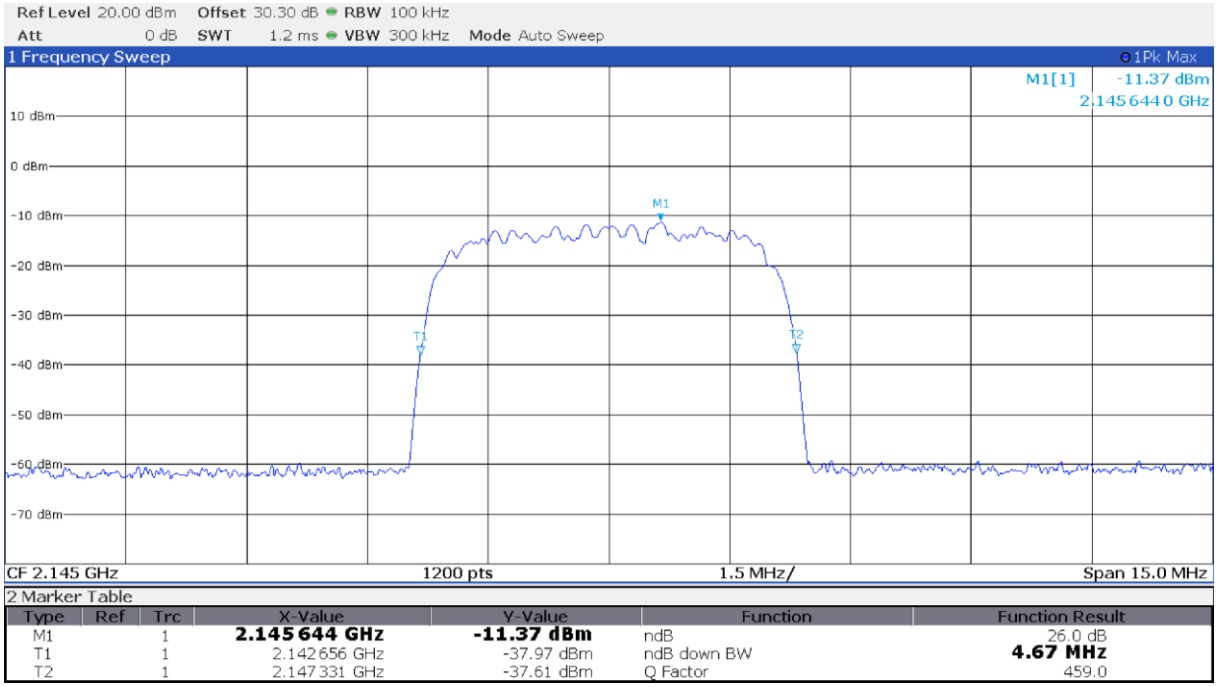


Figure 8.3-1: *26 dB occupied bandwidth, antenna port 1 input signal at AGC threshold spectral plot*

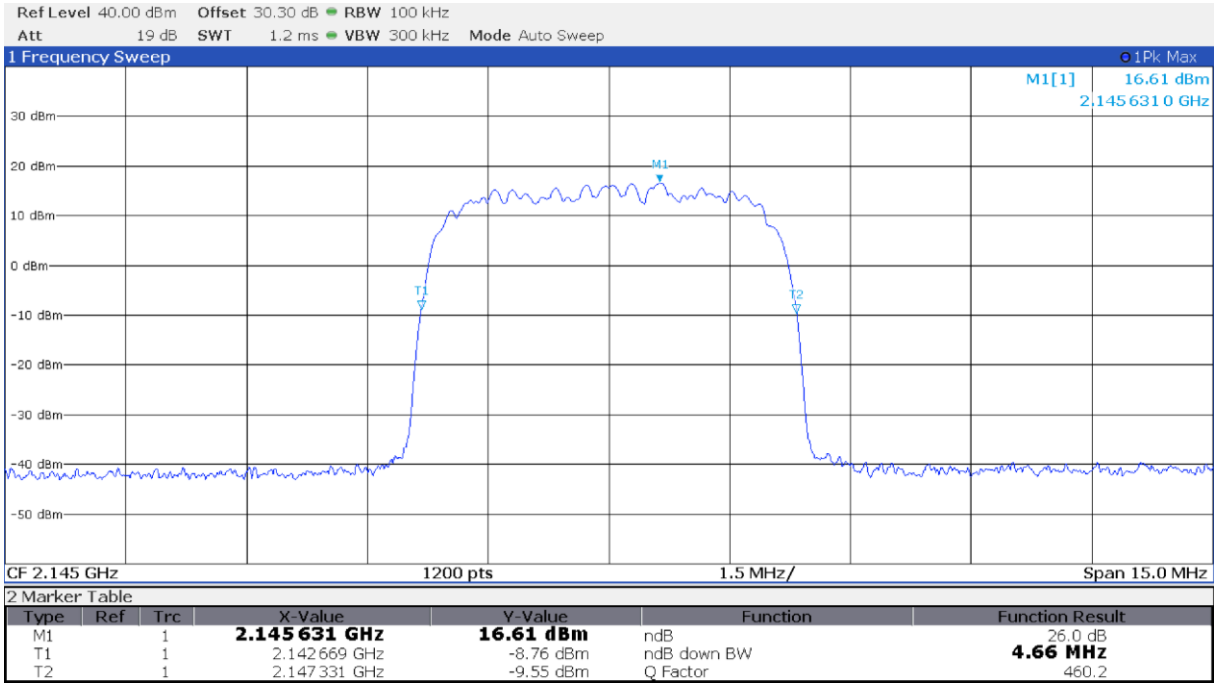


Figure 8.3-2: *26 dB occupied bandwidth, antenna port 1 output signal at AGC threshold spectral plot*

Test data, continued

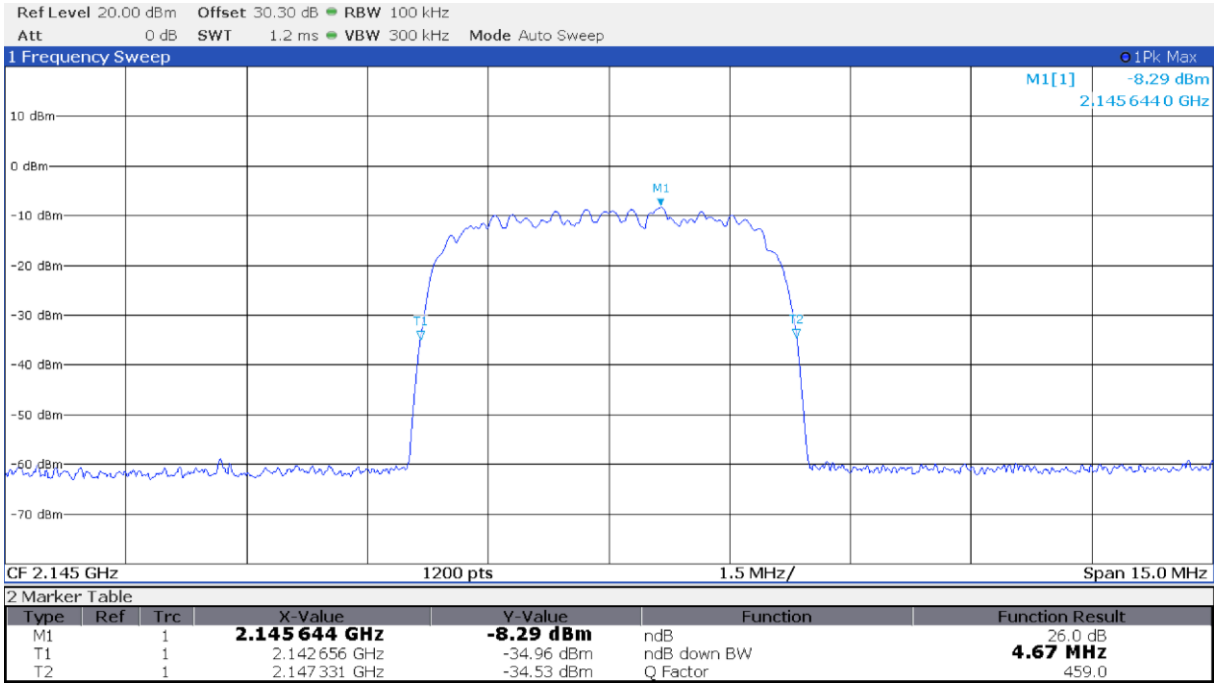


Figure 8.3-3: *26 dB occupied bandwidth, antenna port 1 input signal at AGC threshold +3 dB spectral plot*

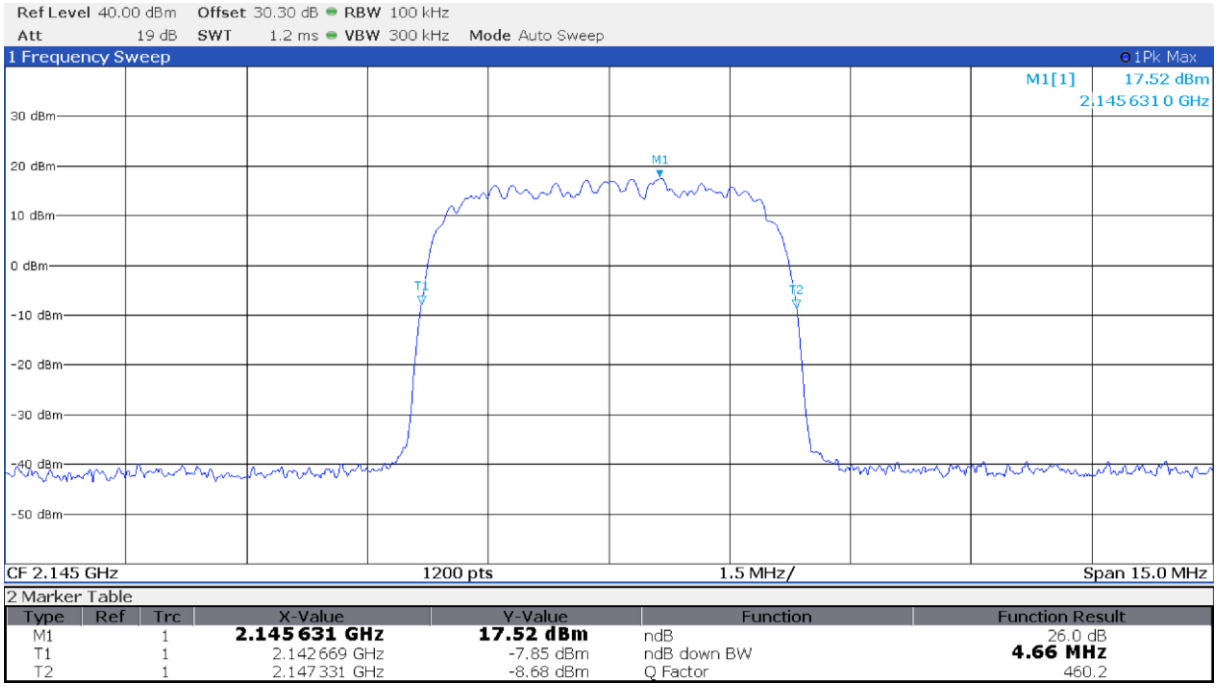


Figure 8.3-4: *26 dB occupied bandwidth, antenna port 1 output signal at AGC threshold +3 dB spectral plot*

Test data, continued

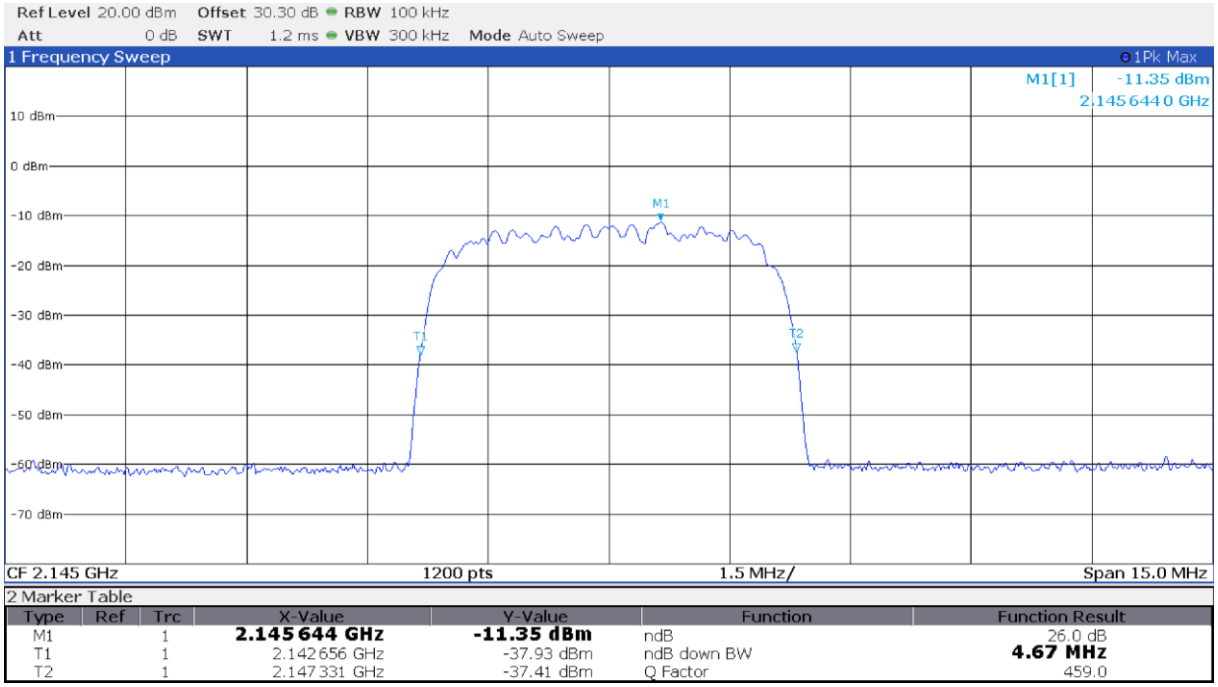


Figure 8.3-5: *26 dB occupied bandwidth, antenna port 2 input signal at AGC threshold spectral plot*

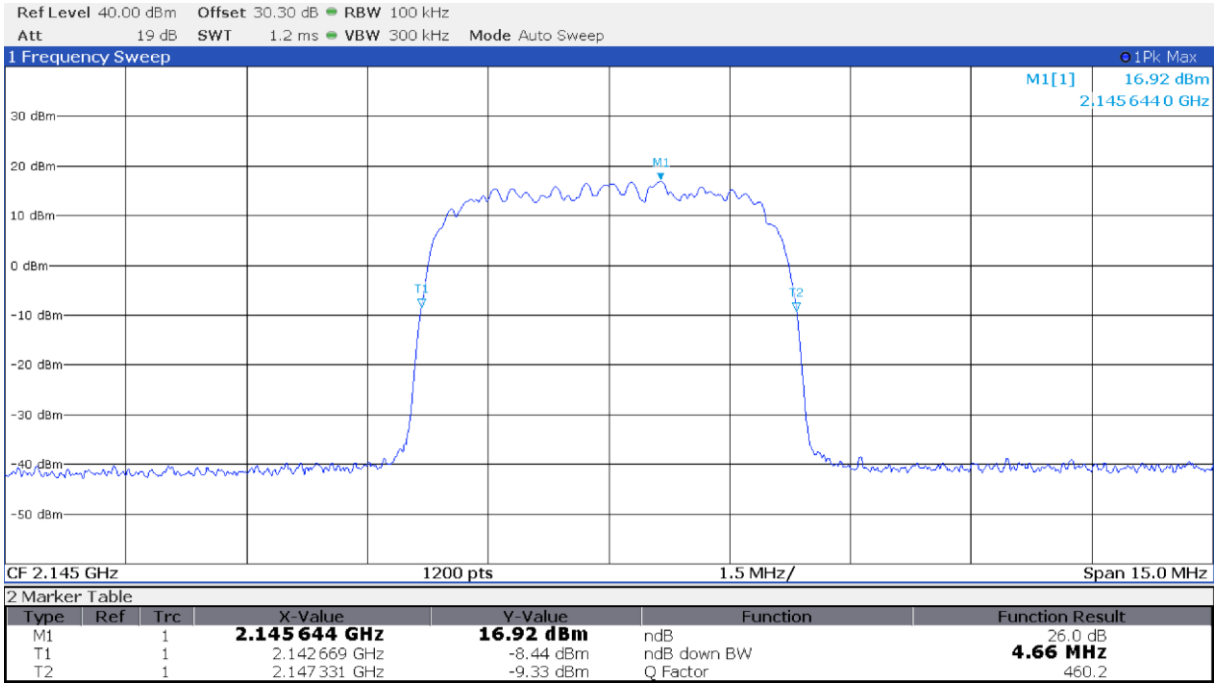


Figure 8.3-6: *26 dB occupied bandwidth, antenna port 2 output signal at AGC threshold spectral plot*

Test data, continued

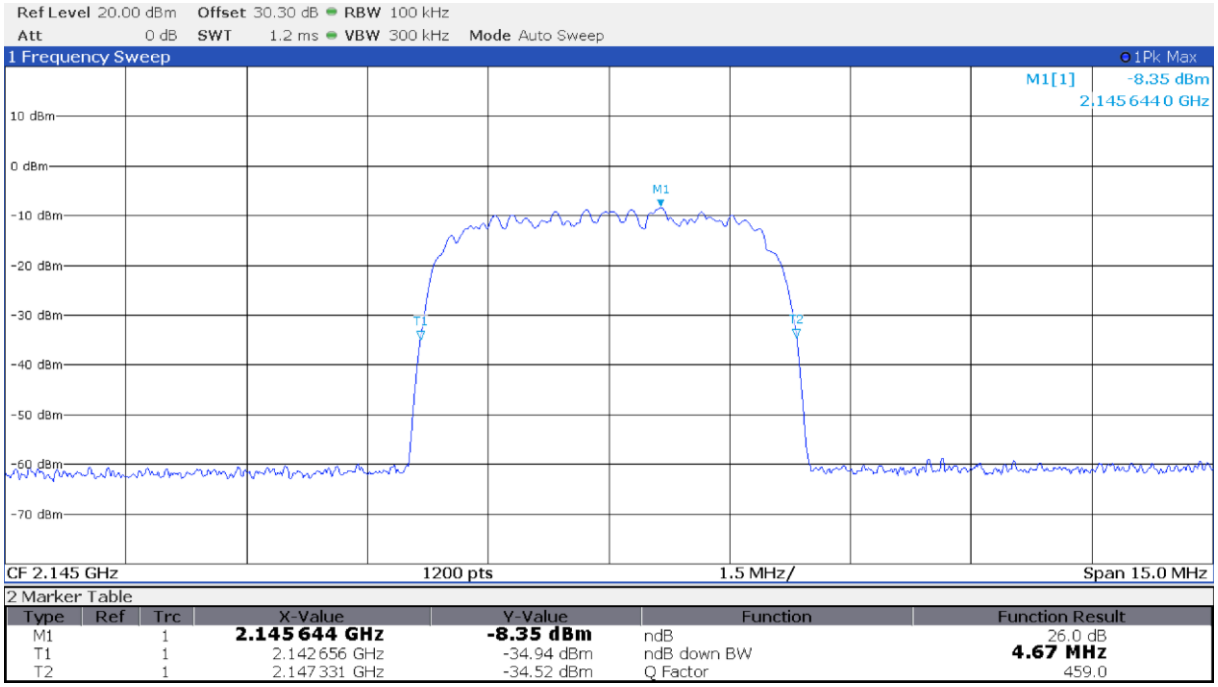


Figure 8.3-7: *26 dB occupied bandwidth, antenna port 2 input signal at AGC threshold +3 dB spectral plot*

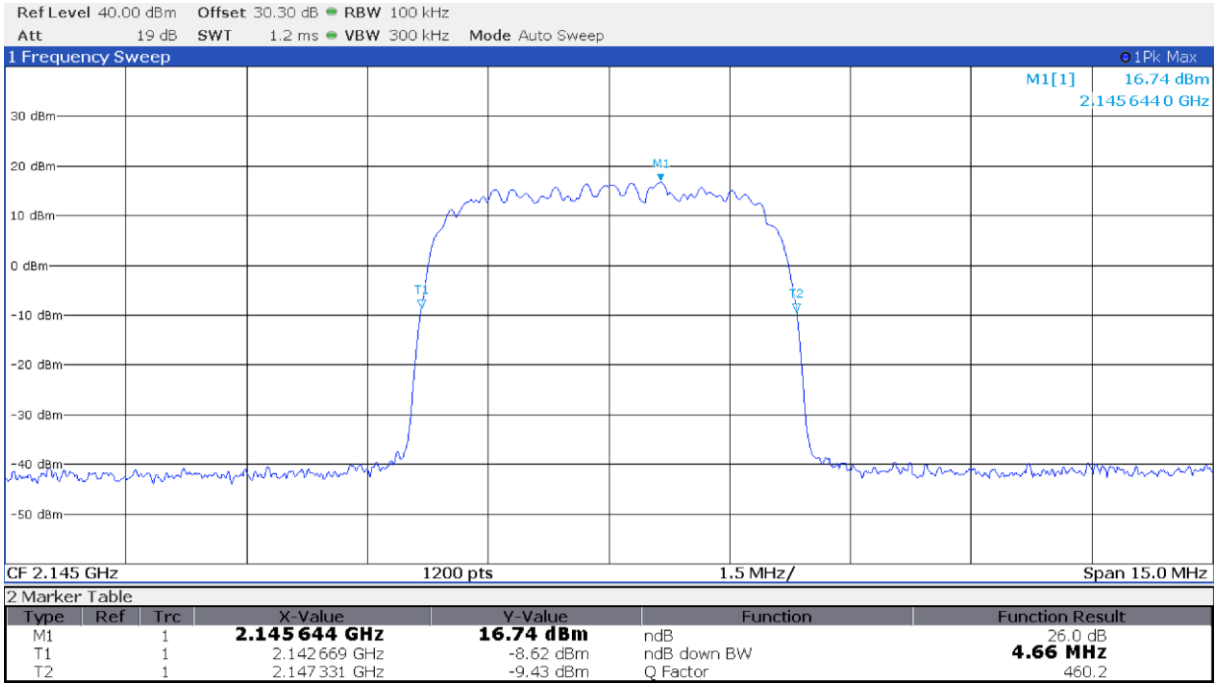


Figure 8.3-8: *26 dB occupied bandwidth, antenna port 2 output signal at AGC threshold +3 dB spectral plot*

Test data, continued

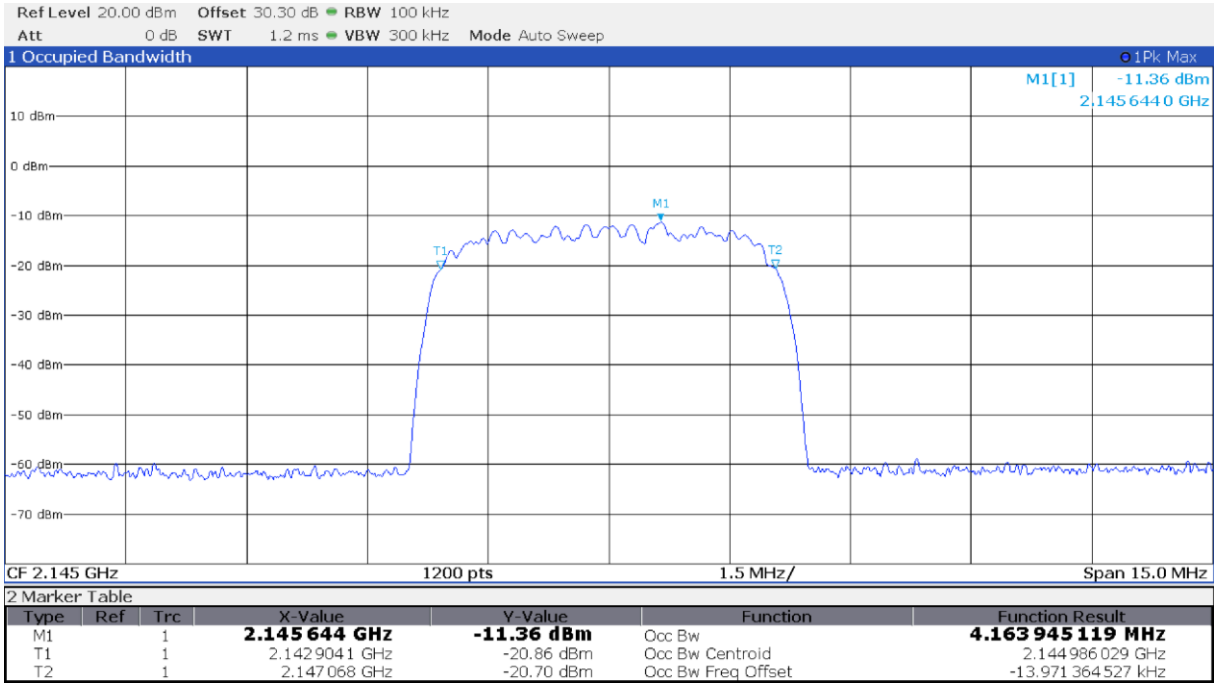


Figure 8.3-9: *99% occupied bandwidth, antenna port 1 input signal at AGC threshold spectral plot*

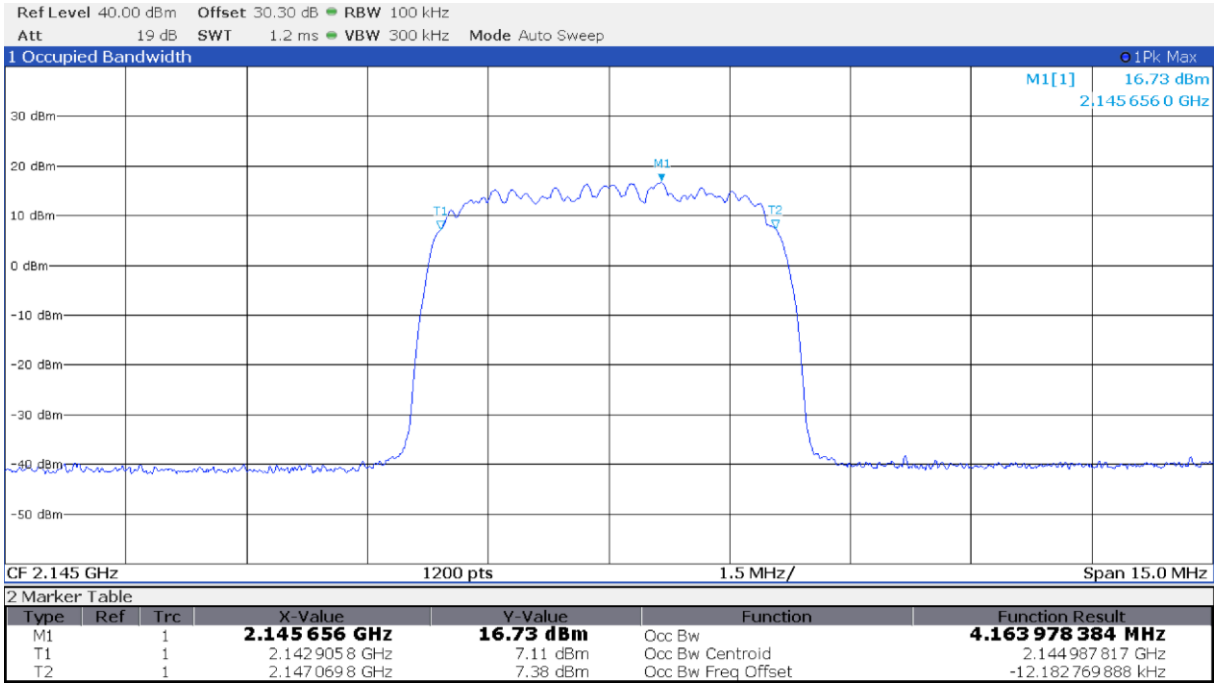


Figure 8.3-10: *99% occupied bandwidth, antenna port 1 output signal at AGC threshold spectral plot*

Test data, continued

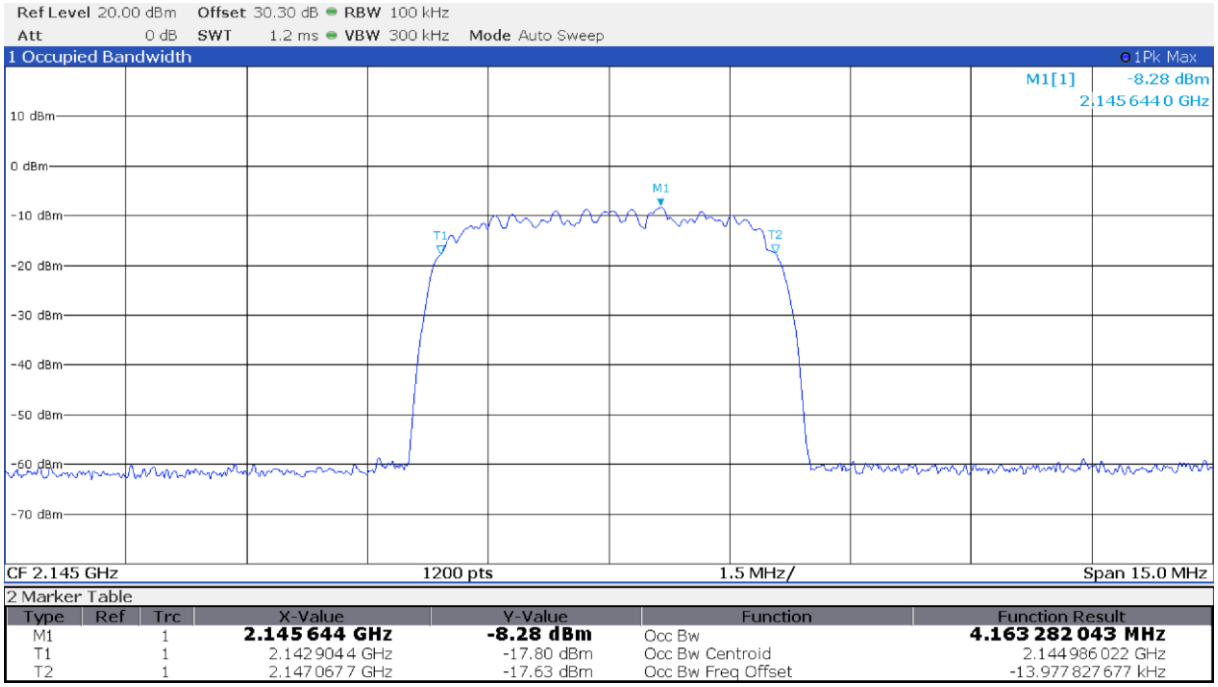


Figure 8.3-11: *99% occupied bandwidth, antenna port 1 input signal at AGC threshold +3 dB spectral plot*

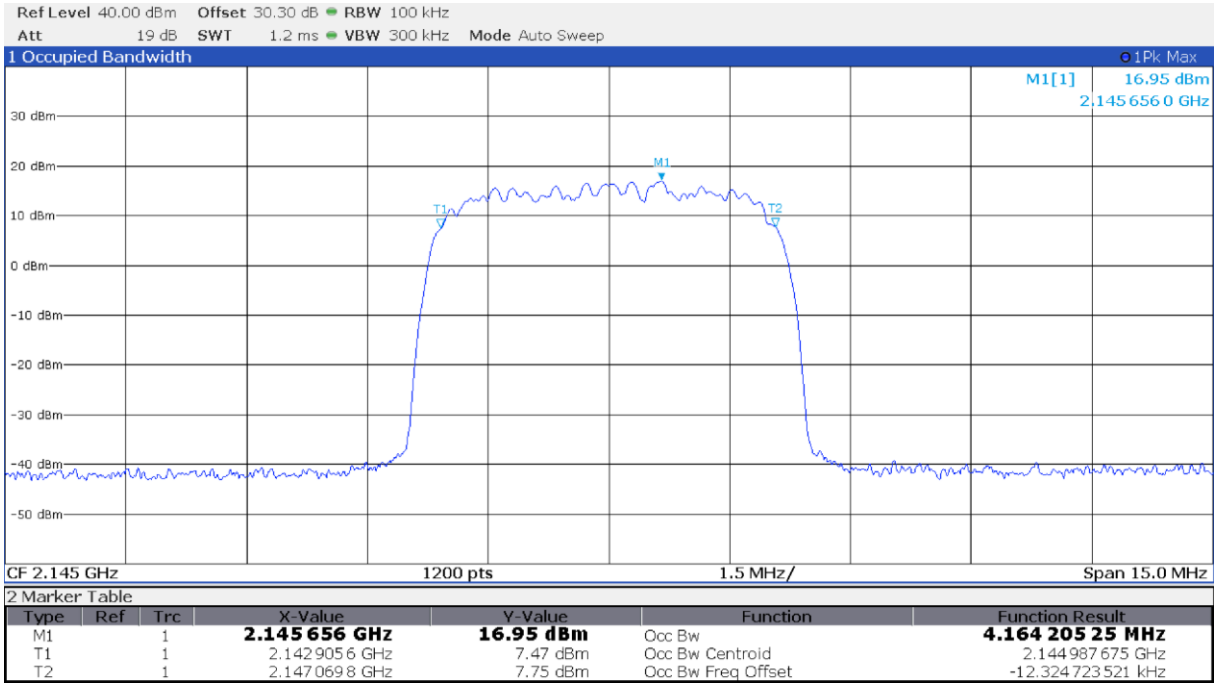


Figure 8.3-12: *99% occupied bandwidth, antenna port 1 output signal at AGC threshold +3 dB spectral plot*

Test data, continued

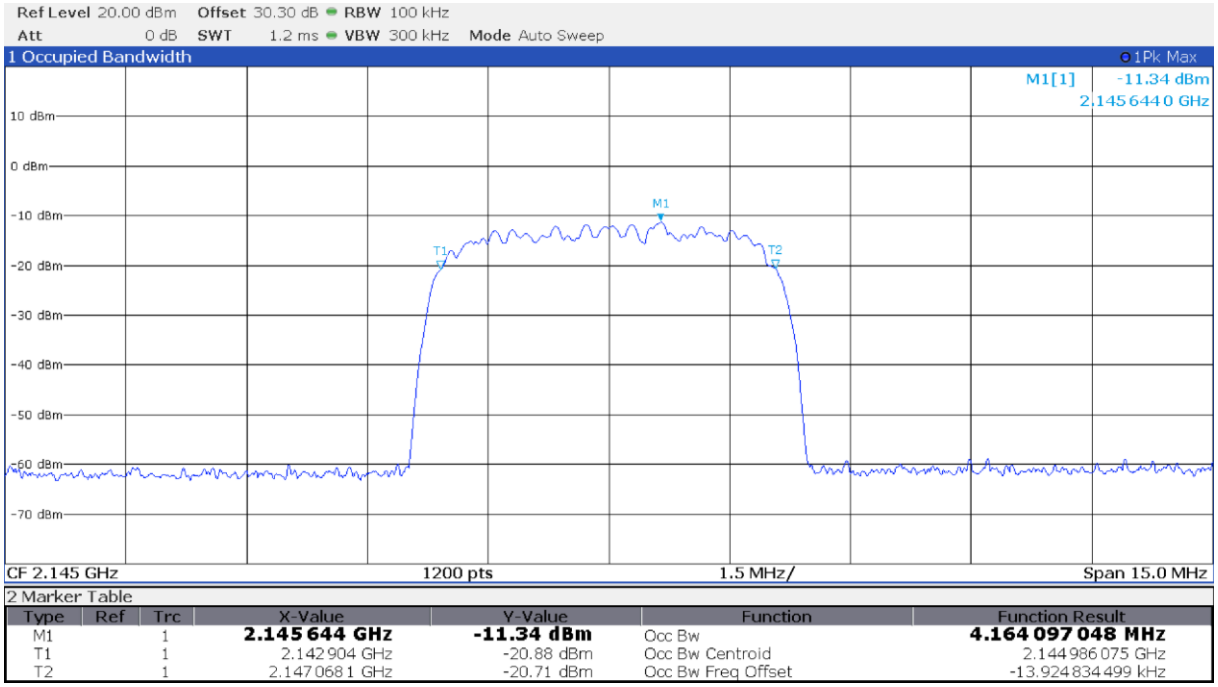


Figure 8.3-13: *99% occupied bandwidth, antenna port 2 input signal at AGC threshold spectral plot*

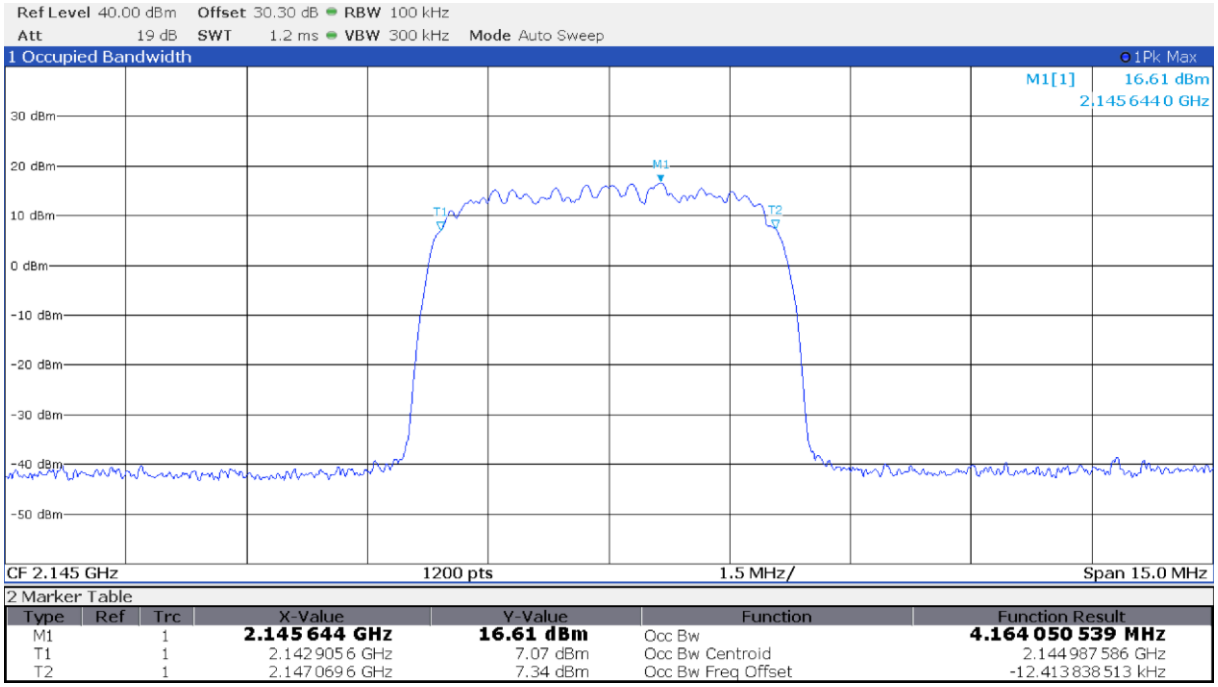


Figure 8.3-14: *99% occupied bandwidth, antenna port 2 output signal at AGC threshold spectral plot*

Test data, continued

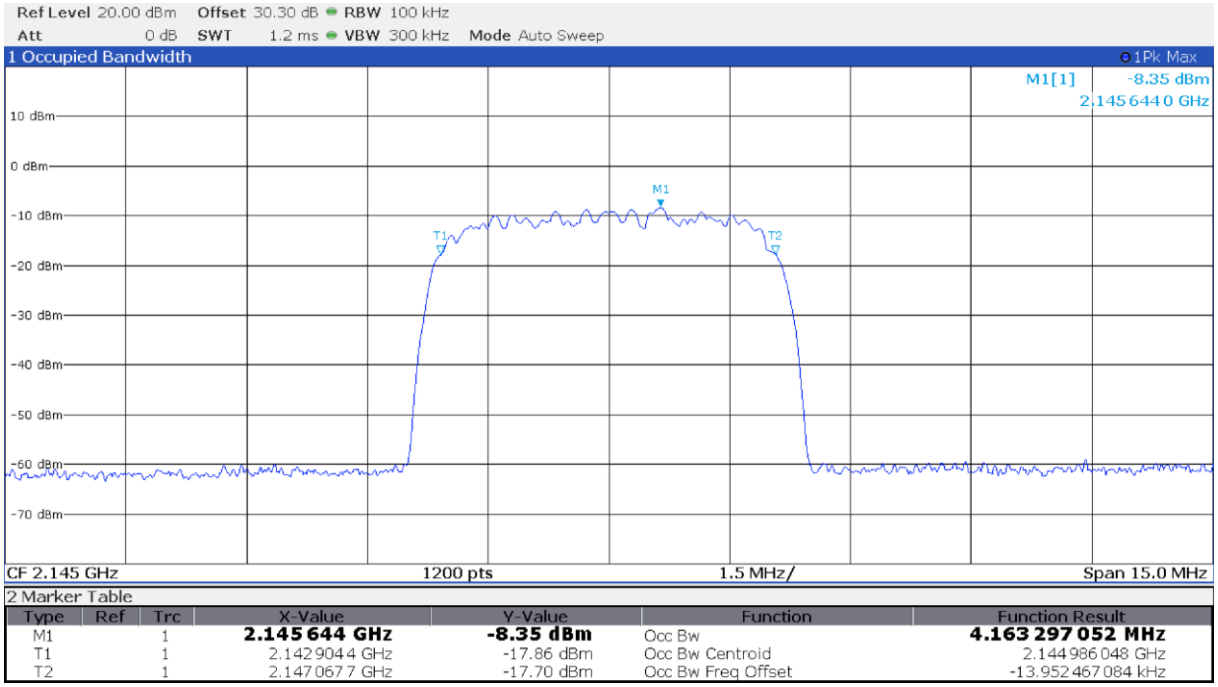


Figure 8.3-15: *99% occupied bandwidth, antenna port 2 input signal at AGC threshold +3 dB spectral plot*

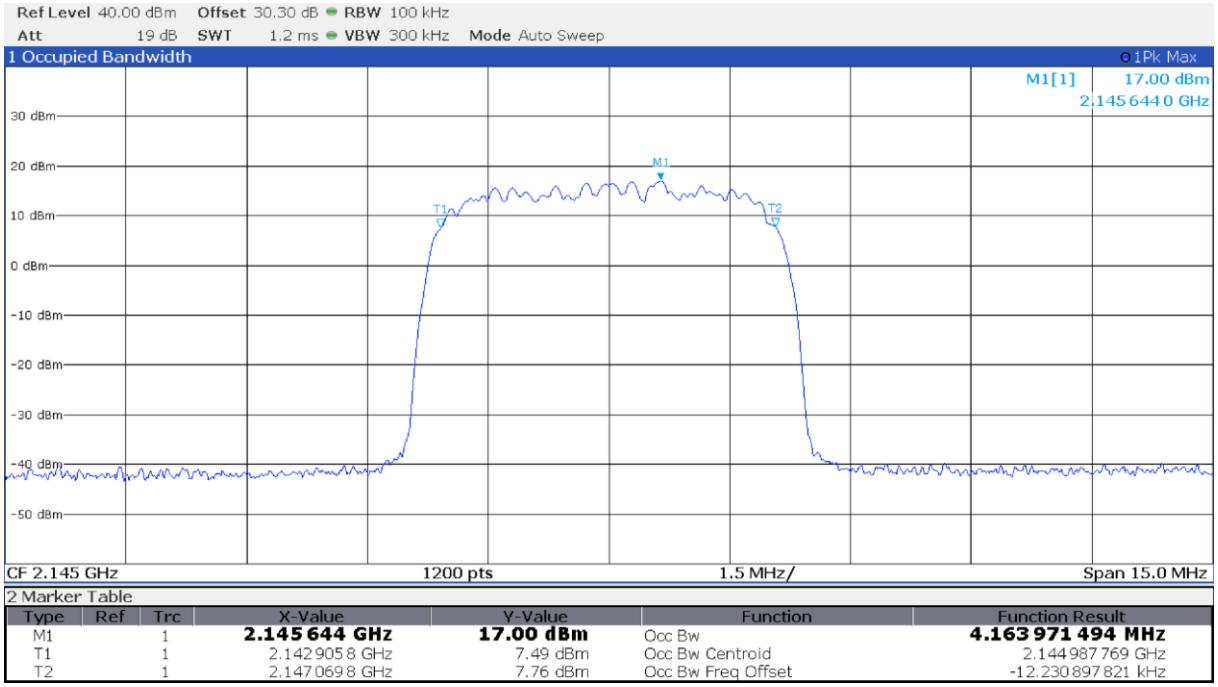


Figure 8.3-16: *99% occupied bandwidth, antenna port 2 output signal at AGC threshold +3 dB spectral plot*

8.4 Mean output power and amplifier/booster gain

8.4.1 References, definitions and limits

FCC §27.50(d)

(d) The following power and antenna height requirements apply to stations transmitting in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz and 2180-2200 MHz bands:

(1) The power of each fixed or base station transmitting in the 1995-2000 MHz, 2110-2155 MHz, 2155-2180 MHz or 2180-2200 MHz band and located in any county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, is limited to:

(i) An equivalent isotropically radiated power (EIRP) of 3280 watts when transmitting with an emission bandwidth of 1 MHz or less;

(ii) An EIRP of 3280 watts/MHz when transmitting with an emission bandwidth greater than 1 MHz.

(2) The power of each fixed or base station transmitting in the 1995-2000 MHz, the 2110-2155 MHz 2155-2180 MHz band, or 2180-2200 MHz band and situated in any geographic location other than that described in paragraph (d)(1) of this section is limited to:

(i) An equivalent isotropically radiated power (EIRP) of 1640 watts when transmitting with an emission bandwidth of 1 MHz or less;

(ii) An EIRP of 1640 watts/MHz when transmitting with an emission bandwidth greater than 1 MHz.

(3) A licensee operating a base or fixed station in the 2110-2155 MHz band utilizing a power greater than 1640 watts EIRP and greater than 1640 watts/MHz EIRP must coordinate such operations in advance with all Government and non-Government satellite entities in the 2025-2110 MHz band. A licensee operating a base or fixed station in the 2110-2180 MHz band utilizing power greater than 1640 watts EIRP and greater than 1640 watts/MHz EIRP must be coordinated in advance with the following licensees authorized to operate within 120 kilometers (75 miles) of the base or fixed station operating in this band: All Broadband Radio Service (BRS) licensees authorized under this part in the 2155-2160 MHz band and all advanced wireless services (AWS) licensees authorized to operate on adjacent frequency blocks in the 2110-2180 MHz band.

(4) Fixed, mobile, and portable (hand-held) stations operating in the 1710-1755 MHz band and mobile and portable stations operating in the 1695-1710 MHz and 1755-1780 MHz bands are limited to 1 watt EIRP. Fixed stations operating in the 1710-1755 MHz band are limited to a maximum antenna height of 10 meters above ground. Mobile and portable stations operating in these bands must employ a means for limiting power to the minimum necessary for successful communications.

(5) Equipment employed must be authorized in accordance with the provisions of § 24.51. Power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with paragraph (d)(6) of this section. In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

(6) Peak transmit power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage. The measurement results shall be properly adjusted for any instrument limitations, such as detector response times, limited resolution bandwidth capability when compared to the emission bandwidth, sensitivity, etc., so as to obtain a true peak measurement for the emission in question over the full bandwidth of the channel.

(7) Fixed, mobile, and portable (hand-held) stations operating in the 2000-2020 MHz band are limited to 2 watts EIRP, except that the total power of any portion of an emission that falls within the 2000-2005 MHz band may not exceed 5 milliwatts. A licensee of AWS-4 authority may enter into private operator-to-operator agreements with all 1995-2000 MHz licensees to operate in 2000-2005 MHz at power levels above 5 milliwatts EIRP; except the total power of the AWS-4 mobile emissions may not exceed 2 watts EIRP.

(8) A licensee operating a base or fixed station in the 2180-2200 MHz band utilizing a power greater than 1640 watts EIRP and greater than 1640 watts/MHz EIRP must be coordinated in advance with all AWS licensees authorized to operate on adjacent frequency blocks in the 2180-2200 MHz band.

(9) Fixed, mobile and portable (hand-held) stations operating in the 1915-1920 MHz band are limited to 300 milliwatts EIRP.

(10) A licensee operating a base or fixed station in the 1995-2000 MHz band utilizing a power greater than 1640 watts EIRP and greater than 1640 watts/MHz EIRP must be coordinated in advance with all PCS G Block licensees authorized to operate on adjacent frequency blocks in the 1990-1995 MHz band within 120 kilometers of the base or fixed station operating in this band.

References, definitions and limits, continued

RSS-131, Clause 5.2.3
Mean output power and zone enhancer gain
The zone enhancer gain shall not exceed the nominal gain by more than 1.0 dB. Outside of the 20 dB bandwidth, the gain shall not exceed the gain at the 20 dB point.
RSS-139, Clause 6.5
Transmitter Output Power
The equivalent isotropically radiated power (e.i.r.p.) for mobile and portable transmitters shall not exceed one watt. The e.i.r.p. for fixed and base stations in the band 1710-1780 MHz shall not exceed one watt.
Consult SRSP-513 for e.i.r.p. limits on fixed and base stations operating in the band 2110-2180 MHz.
In addition, the peak to average power ratio (PAPR) of the equipment shall not exceed 13 dB for more than 0.1% of the time, using a signal that corresponds to the highest PAPR during periods of continuous transmission.

8.4.2 Test summary

Verdict	Pass		
Tested by	P. Barbieri	Test date	February 2, 2022

8.4.3 Observations, settings and special notes

Input and output power was measured with a spectrum analyzer per ANSI C63.26 Paragraph 5.2.4.4.
AWGN5 signal with 4.1 MHz 99% OBW representative of a 5 MHz LTE channel used.
EUT input power set to a level that is just below the AGC threshold, but not more than 0.5 dB below.
Repeated the test with the input signal amplitude set to 3 dB above the AGC threshold.
PAR measure is performed by the “CCDF” function installed on Spectrum analyzer that provides average power, peak power and PAR.

Spectrum analyzer settings:

Detector mode	RMS
Resolution bandwidth	100 kHz
Video bandwidth	300 kHz
Measurement mode	Power over emission bandwidth
Trace mode	Averaging
Measurement time	Auto

8.4.4 Test equipment used

Equipment	Manufacturer	Model no.	Asset no.
Spectrum Analyzer	Rohde & Schwarz	FSW43	101767
RF Vector Signal Generator	Rohde & Schwarz	SMBV100A	263254
RF Vector Signal Generator	Rohde & Schwarz	SMBV100A	263397

Notes: NCR - no calibration required, VOU - verify on use

8.4.5 Test data

Table 8.4-1: *Output power measurement results*

Antenna port	Input signal level	Frequency, MHz	RF input power, dBm	RF output power, dBm	RF output power, W	Gain, dB
1	AGC threshold	2145	-4.4	23.7	0.234	28.1
1	AGC threshold +3 dB	2145	-1.3	24.0	0.251	25.3
2	AGC threshold	2145	-4.4	23.7	0.234	28.1
2	AGC threshold +3 dB	2145	-1.4	24.0	0.251	25.4

Amplifier gain = measured RF output power (dBm) – measured RF input power (dBm) =

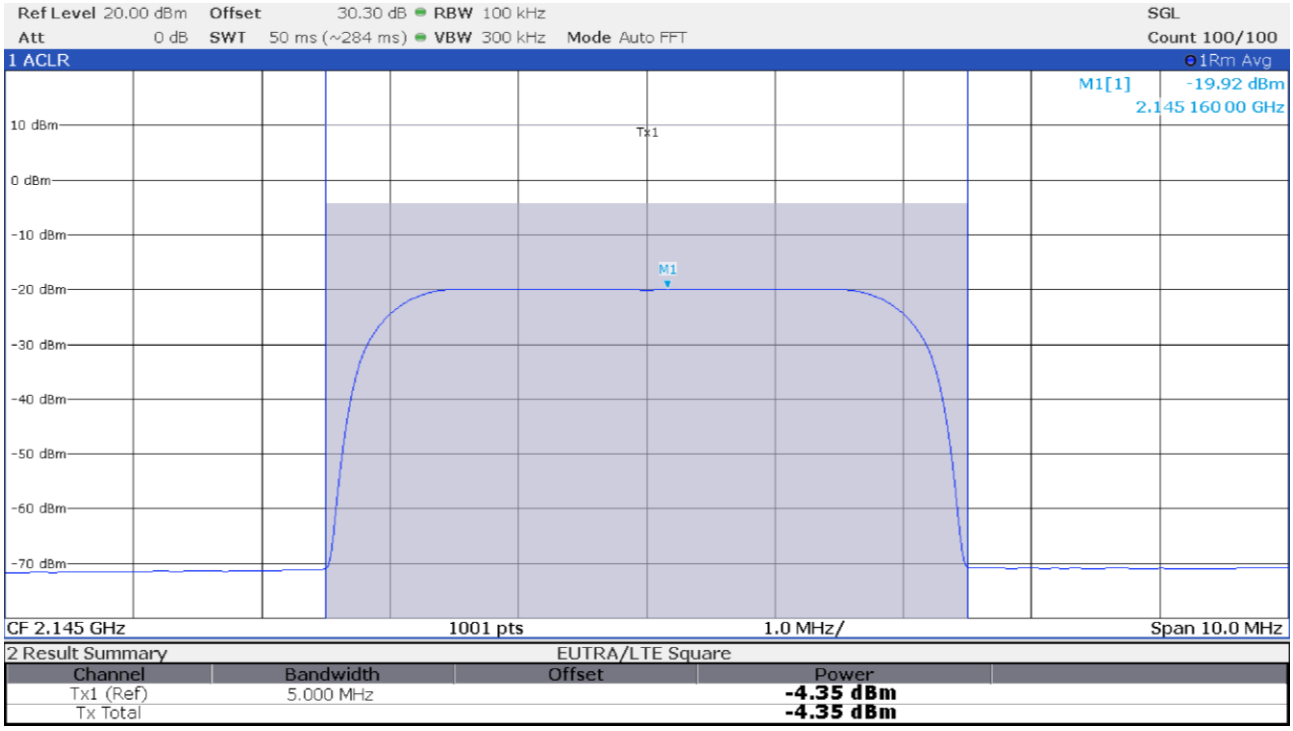


Figure 8.4-1: *Input power at antenna port 1 with input signal at AGC threshold*

Test data, continued

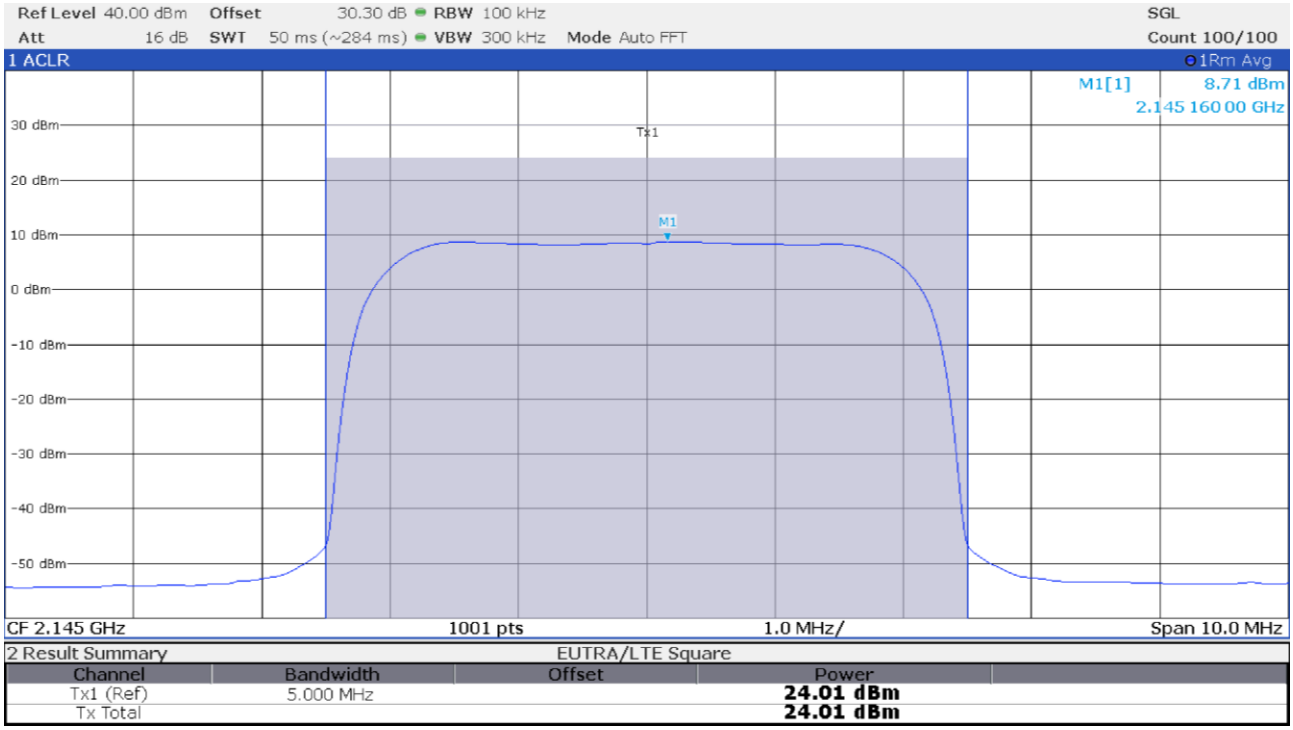


Figure 8.4-2: *Output power at antenna port 1 with input signal at AGC threshold*

Test data, continued

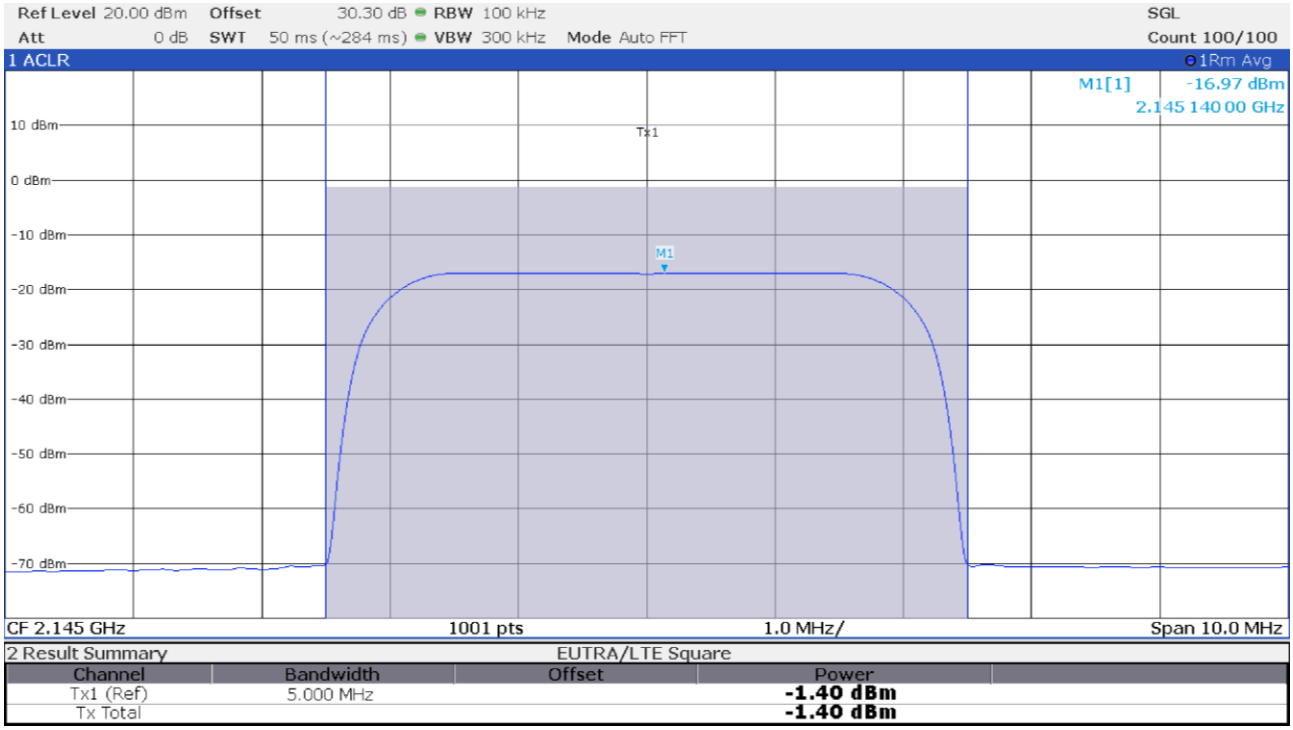


Figure 8.4-3: *Input power at antenna port 1 with input signal at AGC threshold +3 dB*

Test data, continued

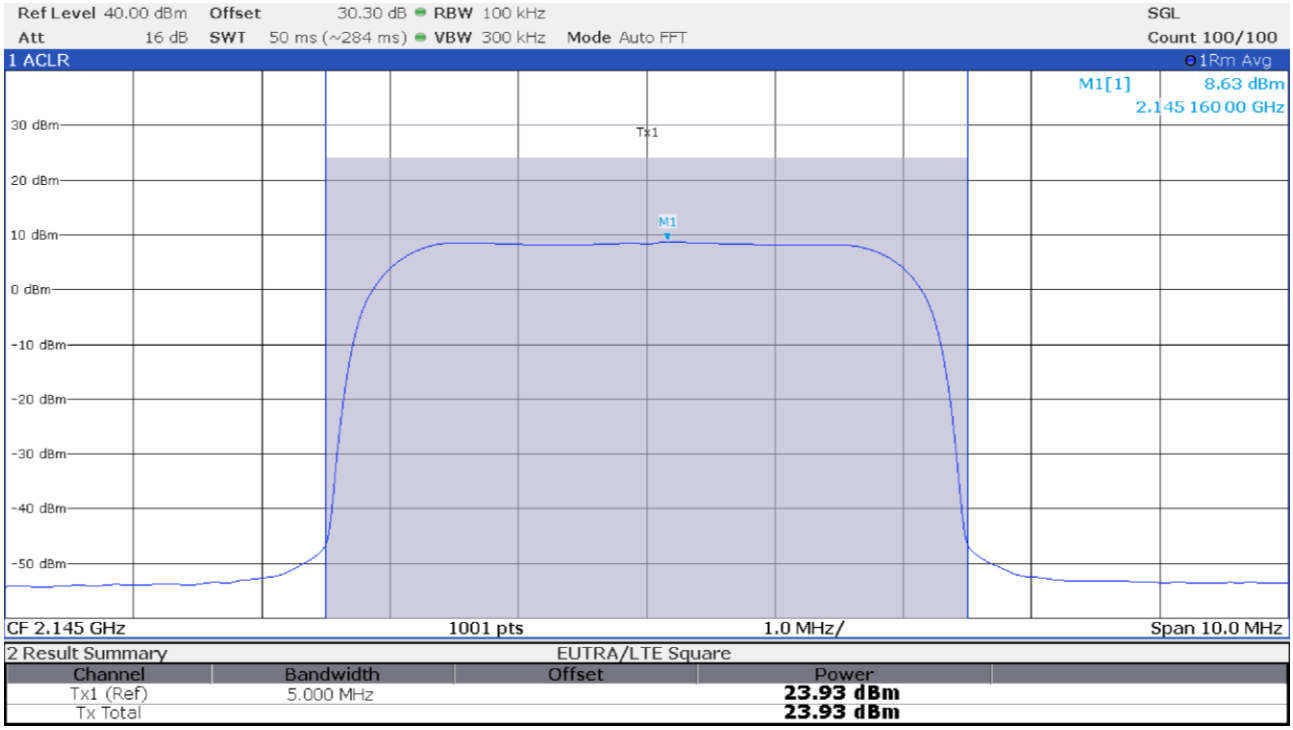


Figure 8.4-4: *Output power at antenna port 1 with input signal at AGC threshold +3 dB*

Test data, continued

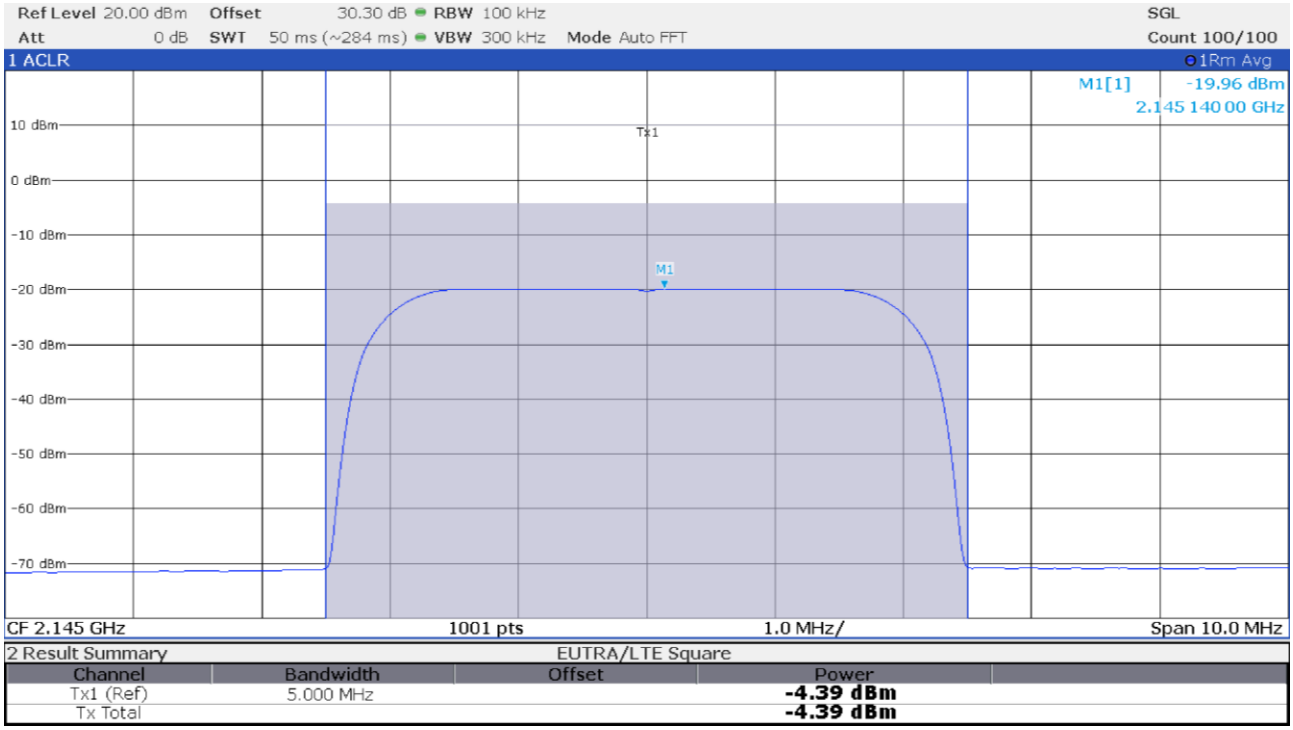


Figure 8.4-5: *Input power at antenna port 2 with input signal at AGC threshold*

Test data, continued

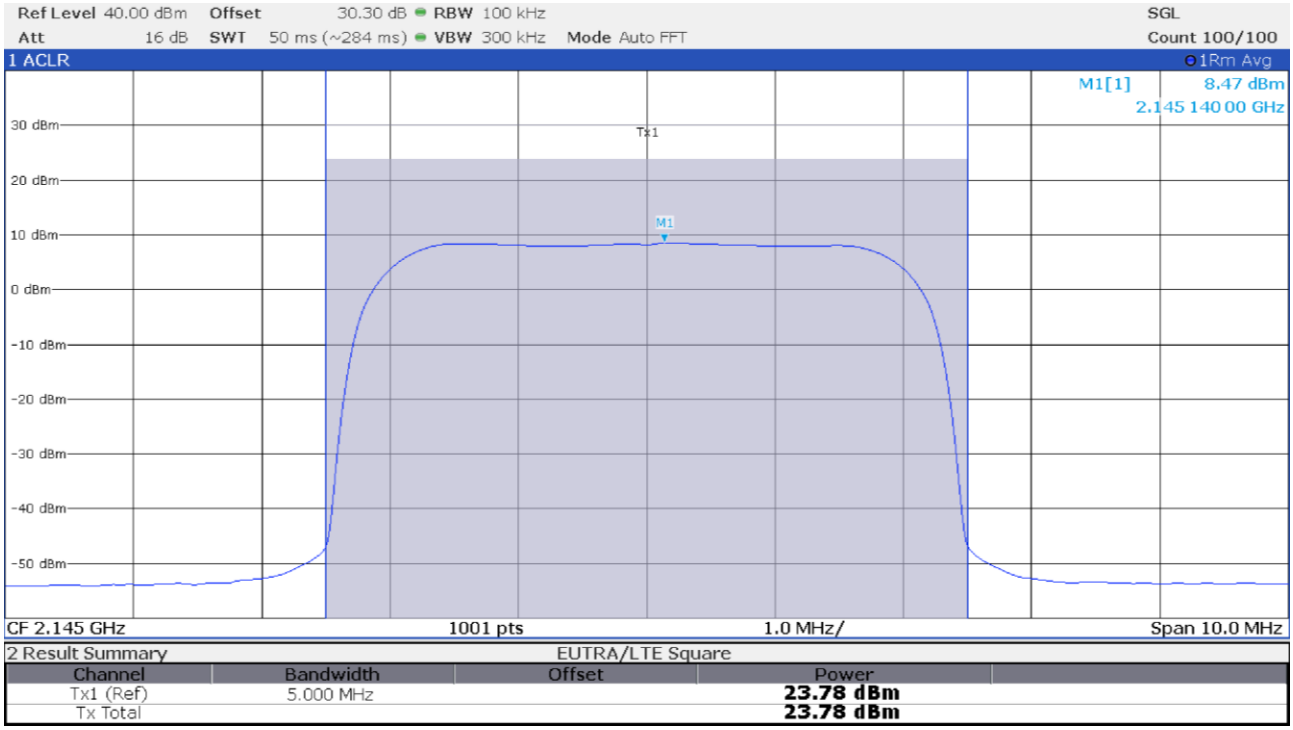


Figure 8.4-6: *Output power at antenna port 2 with input signal at AGC threshold*

Test data, continued

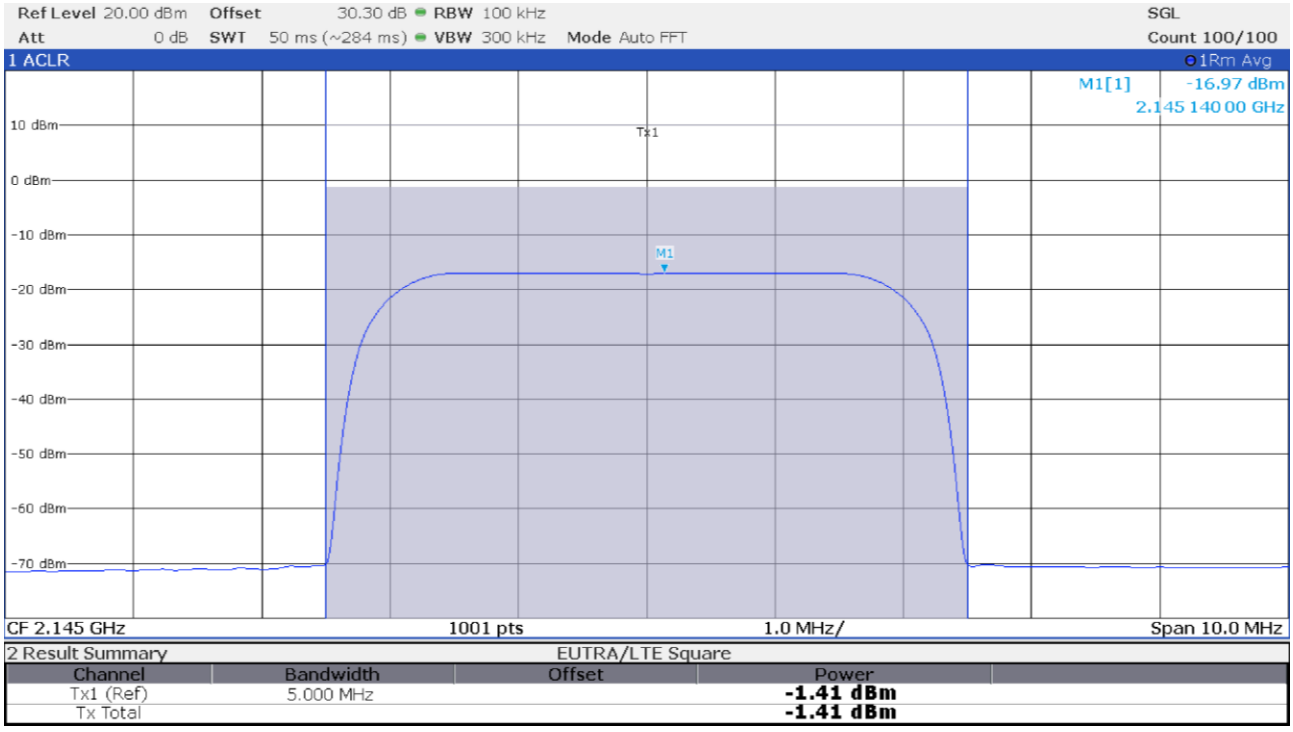


Figure 8.4-7: *Input power at antenna port 2 with input signal at AGC threshold +3 dB*

Test data, continued

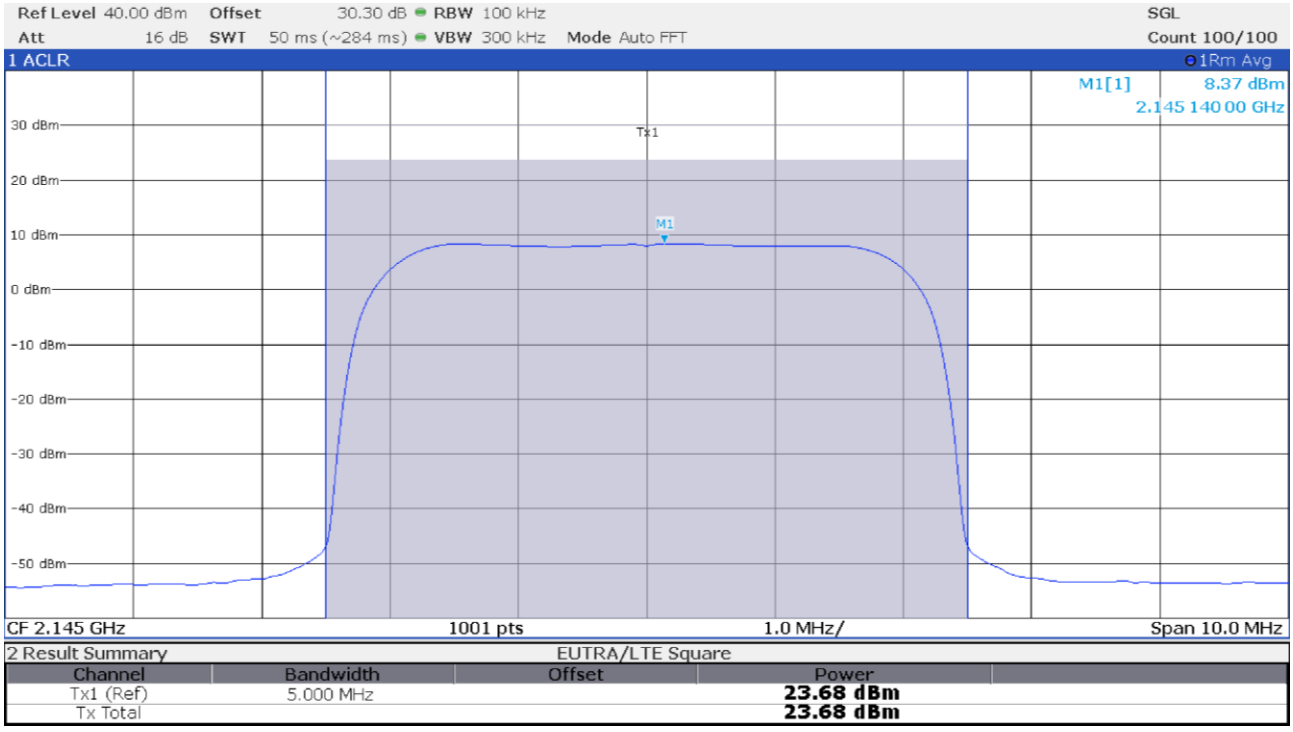


Figure 8.4-8: *Output power at antenna port 2 with input signal at AGC threshold +3 dB*

Test data, continued

Table 8.4-2: *Complementary Cumulative Distribution Function (CCDF) of the PAPR reduction measurement results*

Antenna port	Input signal level	Frequency, MHz	0.1% CCDF, dB	PAPR reduction limit, dB	Margin, dB
1	AGC threshold	2145	4.44	13.00	-8.56
1	AGC threshold +3 dB	2145	4.42	13.00	-8.58
2	AGC threshold	2145	4.42	13.00	-8.58
2	AGC threshold +3 dB	2145	4.44	13.00	-8.56

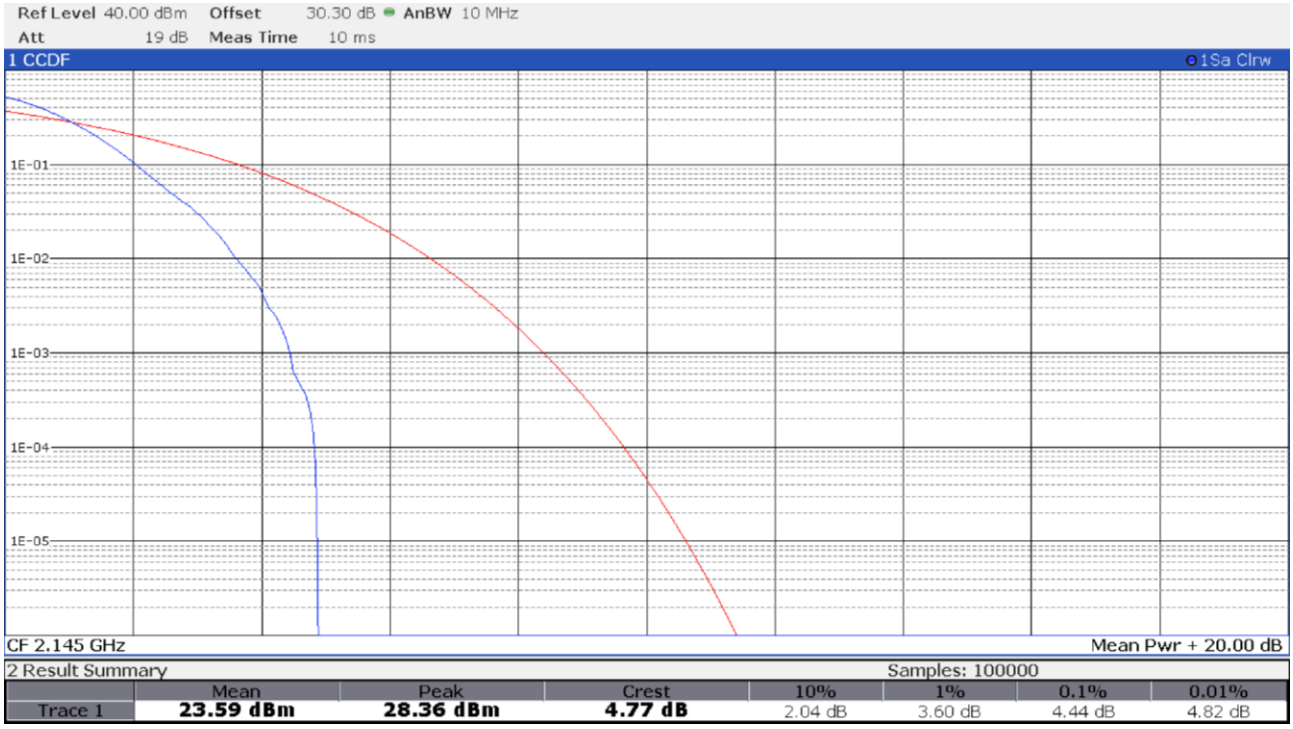


Figure 8.4-9: *PAPR at antenna port 1 with input signal at AGC threshold*

Test data, continued

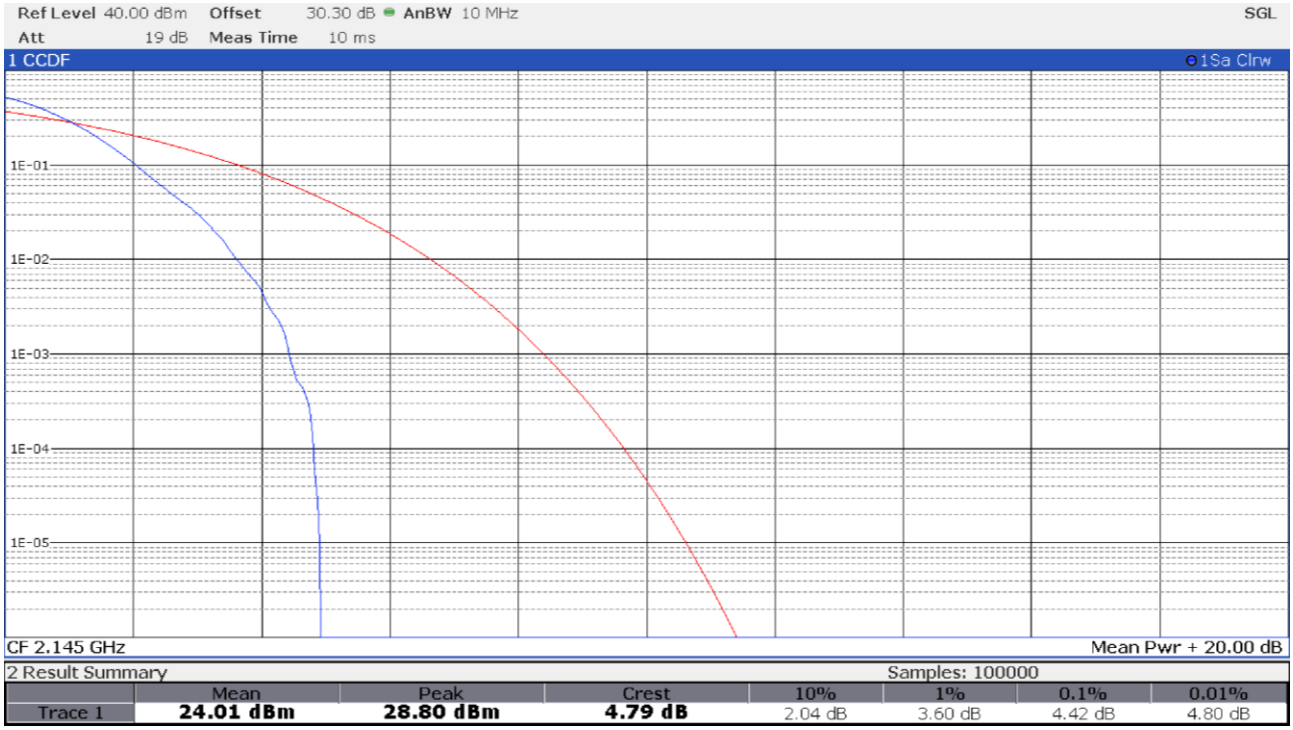


Figure 8.4-10: *PAPR at antenna port 1 with input signal at AGC threshold +3 dB*

Test data, continued

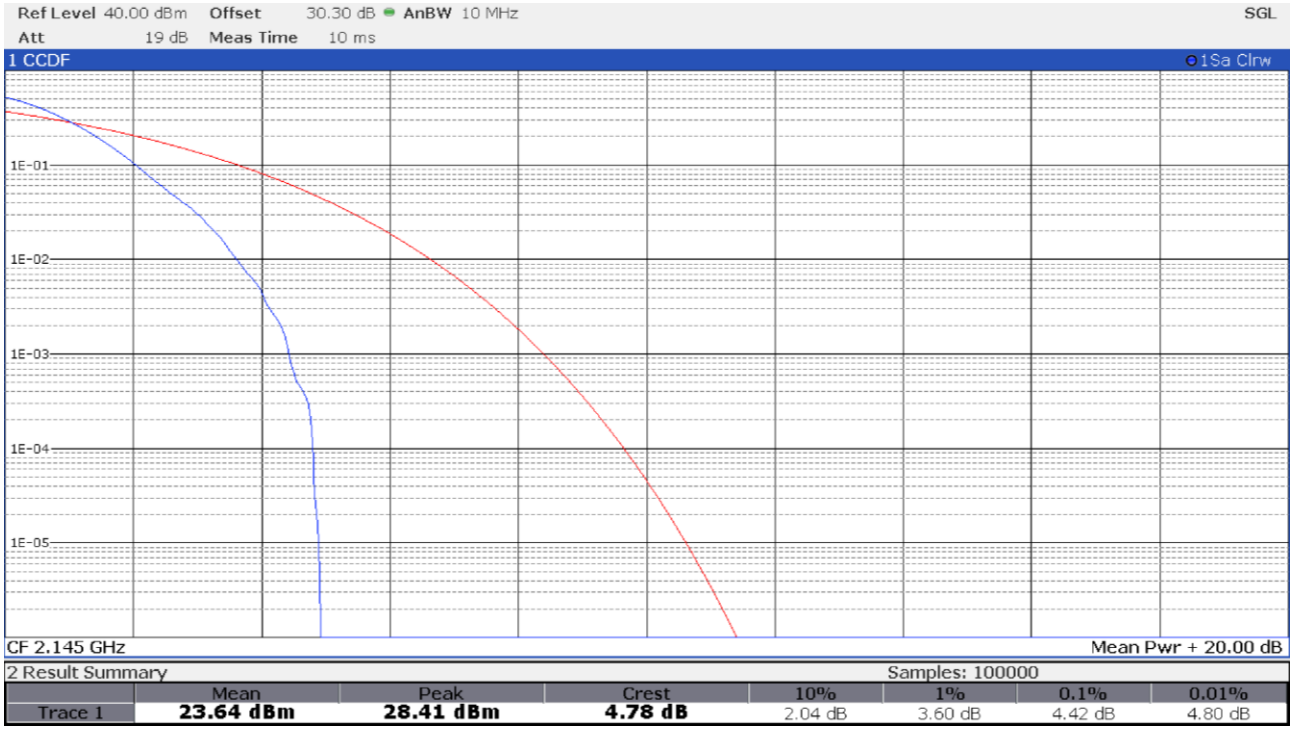


Figure 8.4-11: *PAPR at antenna port 2 with input signal at AGC threshold*

Test data, continued

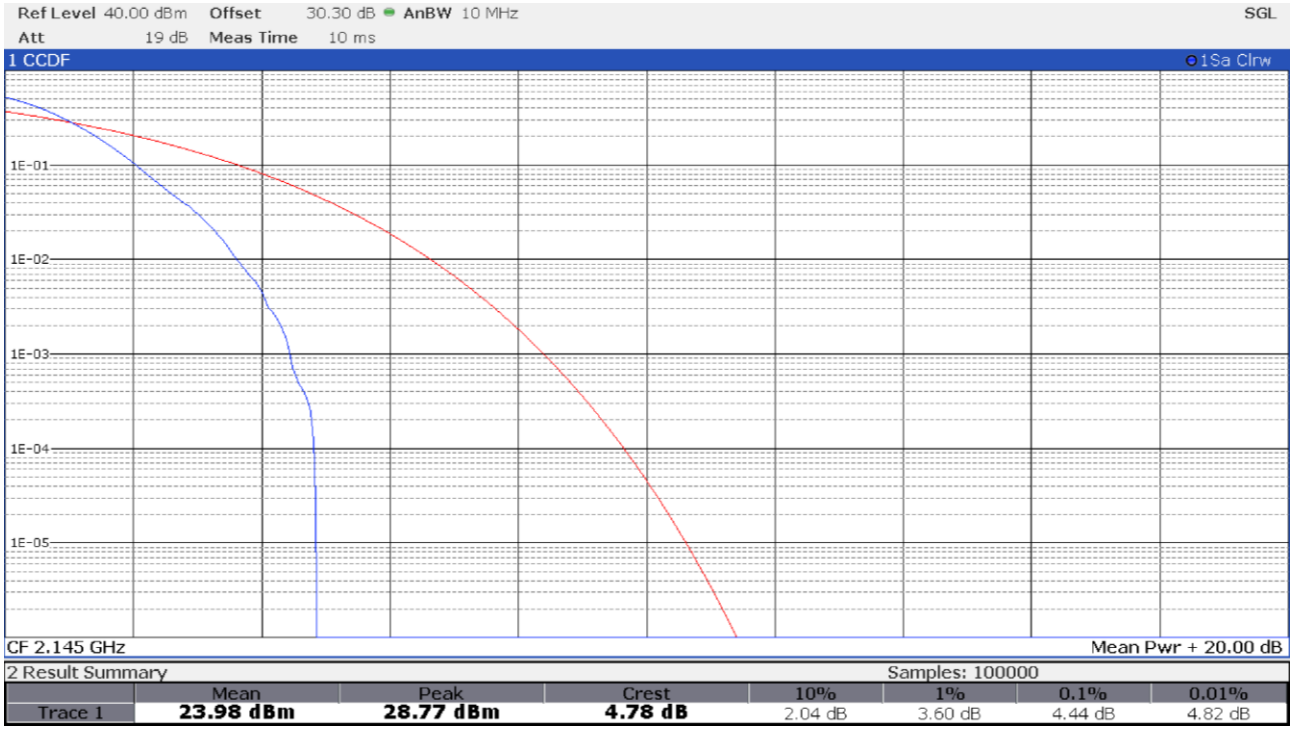


Figure 8.4-12: *PAPR at antenna port 2 with input signal at AGC threshold +3 dB*

8.5 Out-of-band/out-of-block emissions conducted measurements

8.5.1 References, definitions and limits

FCC §27.53(h):

AWS emission limits

(1) General protection levels. Except as otherwise specified below, for operations in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz, and 2180-2200 bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least 43 + 10 log10 (P) dB.

(2) Additional protection levels. Notwithstanding the foregoing paragraph (h)(1) of this section:

(i) Operations in the 2180-2200 MHz band are subject to the out-of-band emission requirements set forth in § 27.1134 for the protection of federal government operations operating in the 2200-2290 MHz band.

(ii) For operations in the 2000-2020 MHz band, the power of any emissions below 2000 MHz shall be attenuated below the transmitter power (P) in watts by at least 70 + 10 log10(P) dB.

(iii) For operations in the 1915-1920 MHz band, the power of any emission between 1930-1995 MHz shall be attenuated below the transmitter power (P) in watts by at least 70 + 10 log10(P) dB.

(iv) For operations in the 1995-2000 MHz band, the power of any emission between 2005-2020 MHz shall be attenuated below the transmitter power (P) in watts by at least 70 + 10 log10(P) dB

(3) Measurement procedure

(i) Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 megahertz bands immediately outside and adjacent to the licensee's frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

(ii) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the licensee's frequency block edges, both upper and lower, as the design permits.

(iii) The measurements of emission power can be expressed in peak or average values, provided they are expressed in the same parameters as the transmitter power.

(4) Private agreements.

(i) For AWS operations in the 2000-2020 MHz and 2180-2200 MHz bands, to the extent a licensee establishes unified operations across the AWS blocks, that licensee may choose not to observe the emission limit specified in paragraph (h)(1), above, strictly between its adjacent block licenses in a geographic area, so long as it complies with other Commission rules and is not adversely affecting the operations of other parties by virtue of exceeding the emission limit.

(ii) For AWS operations in the 2000-2020 MHz band, a licensee may enter into private agreements with all licensees operating between 1995 and 2000 MHz to allow the 70 + 10 log10(P) dB limit to be exceeded within the 1995-2000 MHz band.

(iii) An AWS licensee who is a party to a private agreement described in this section (4) must maintain a copy of the agreement in its station files and disclose it, upon request, to prospective AWS assignees, transferees, or spectrum lessees and to the Commission.

RSS-131, Clause 5.2

Industrial zone enhancers

Industrial Zone Enhancers, including DASs, shall employ a gain control feature and shall comply with all the requirements in the RSS which applies to the equipment with which the zone enhancer is to be used. In addition, the equipment shall comply with the requirements specified in this section.

RSS-139, Clause 6.6

Transmitter Unwanted Emissions

(i) In the first 1.0 MHz bands immediately outside and adjacent to the equipment's smallest operating frequency block,2 which can contain the equipment's occupied bandwidth, the emission power per any 1% of the emission bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least 43 + 10 log10 p (watts) dB.

(ii) After the first 1.0 MHz outside the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power in any 1 MHz bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least 43 + 10 log10 p (watts) dB.

8.5.2 Test summary

Verdict	Pass		
Tested by	P. Barbieri	Test date	October 2, 2021

8.5.3 Observations, settings and special notes

AWGN5 signal with 4.1 MHz 99% OBW representative of a 5 MHz LTE channel used.
EUT input power set to a level that is just below the AGC threshold, but not more than 0.5 dB below.
Repeated the test with the input signal amplitude set to 3 dB above the AGC threshold.
Test performed with one single carrier and two adjacent carriers.
Limit line (43 + 10 $\log_{10}$ (P) or −13 dBm) was adjusted for MIMO operation by 3 dB*: −13 dBm – 3 dB = −16 dBm
*MIMO correction factor for 2 antenna ports: 10 × Log_{10}(2) = 3.01 dB

Spectrum analyser settings for spurious emissions in the 1 MHz bands immediately outside and adjacent to the licensee's frequency block:

Resolution bandwidth:	At least 1% of EBW
Video bandwidth:	> RBW
Detector mode:	RMS
Trace mode:	Averaging

Input signal frequency

Upper block edge intermodulation products:	2172.5 MHz and 2177.5 MHz
Lower block edge intermodulation products:	2112.5 MHz and 2117.5 MHz
Upper block edge, single carrier:	2177.5 MHz
Lower block edge, single carrier:	2112.5 MHz

8.5.4 Test equipment used

Equipment	Manufacturer	Model no.	Asset no.
Spectrum Analyzer	Rohde & Schwarz	FSW43	101767
RF Vector Signal Generator	Rohde & Schwarz	SMBV100A	263254
RF Vector Signal Generator	Rohde & Schwarz	SMBV100A	263397

Notes: NCR - no calibration required, VOU - verify on use

8.5.5 Test data

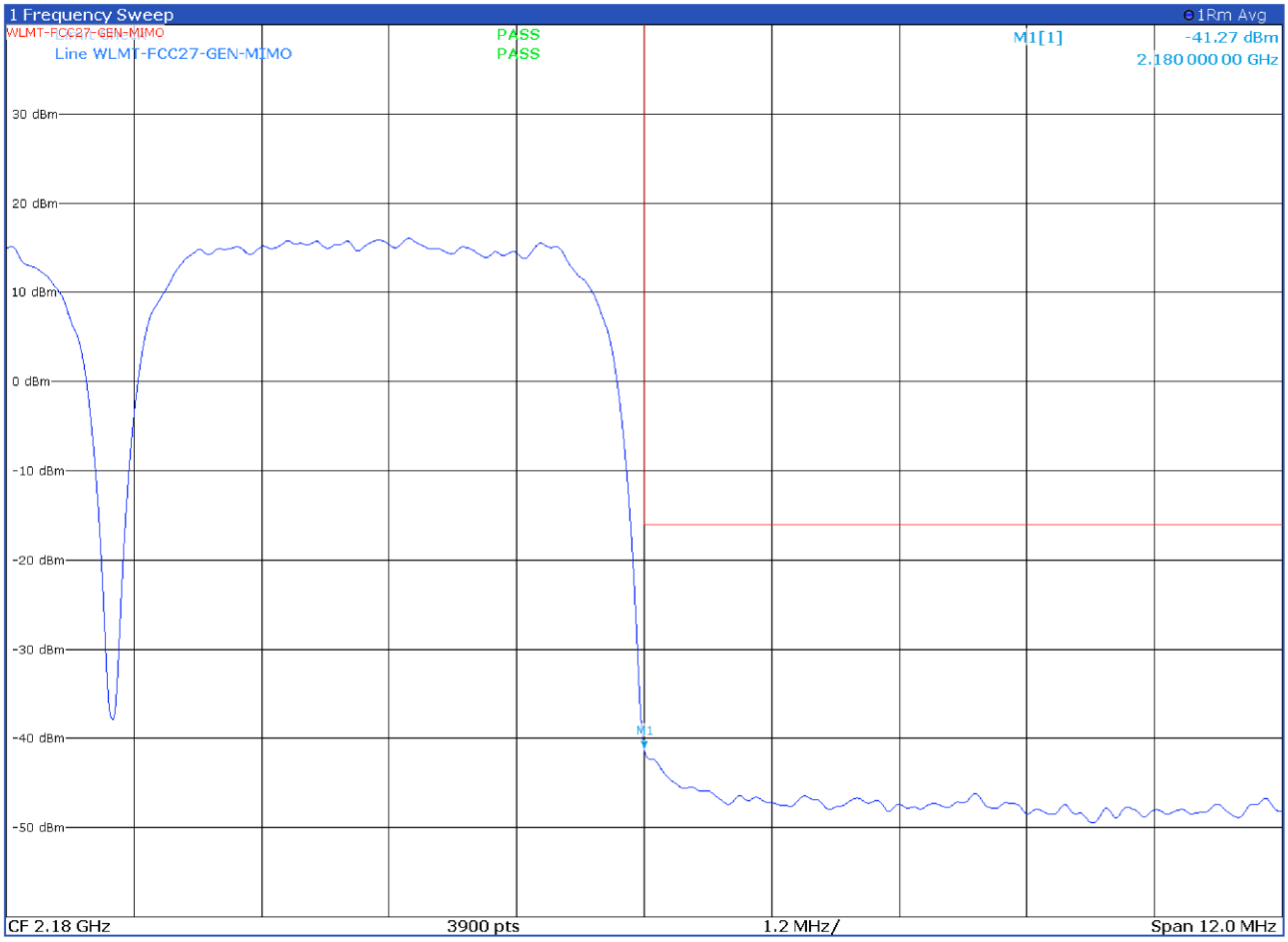


Figure 8.5-1: *Antenna port 1 upper block edge intermodulation products with input signal at AGC threshold*

Test data, continued

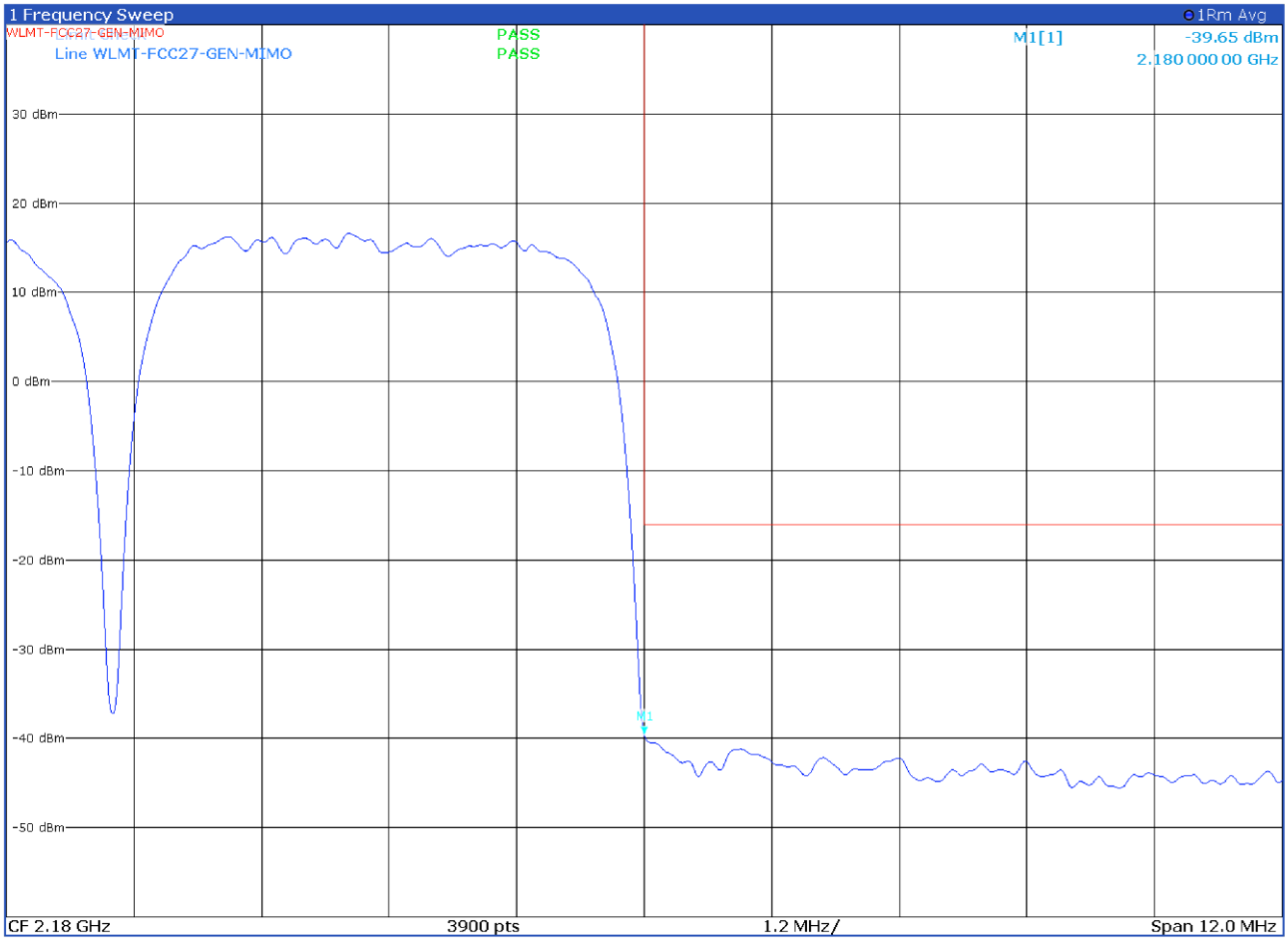


Figure 8.5-2: *Antenna port 1 upper block edge intermodulation products with input signal at AGC threshold +3 dB*

Test data, continued

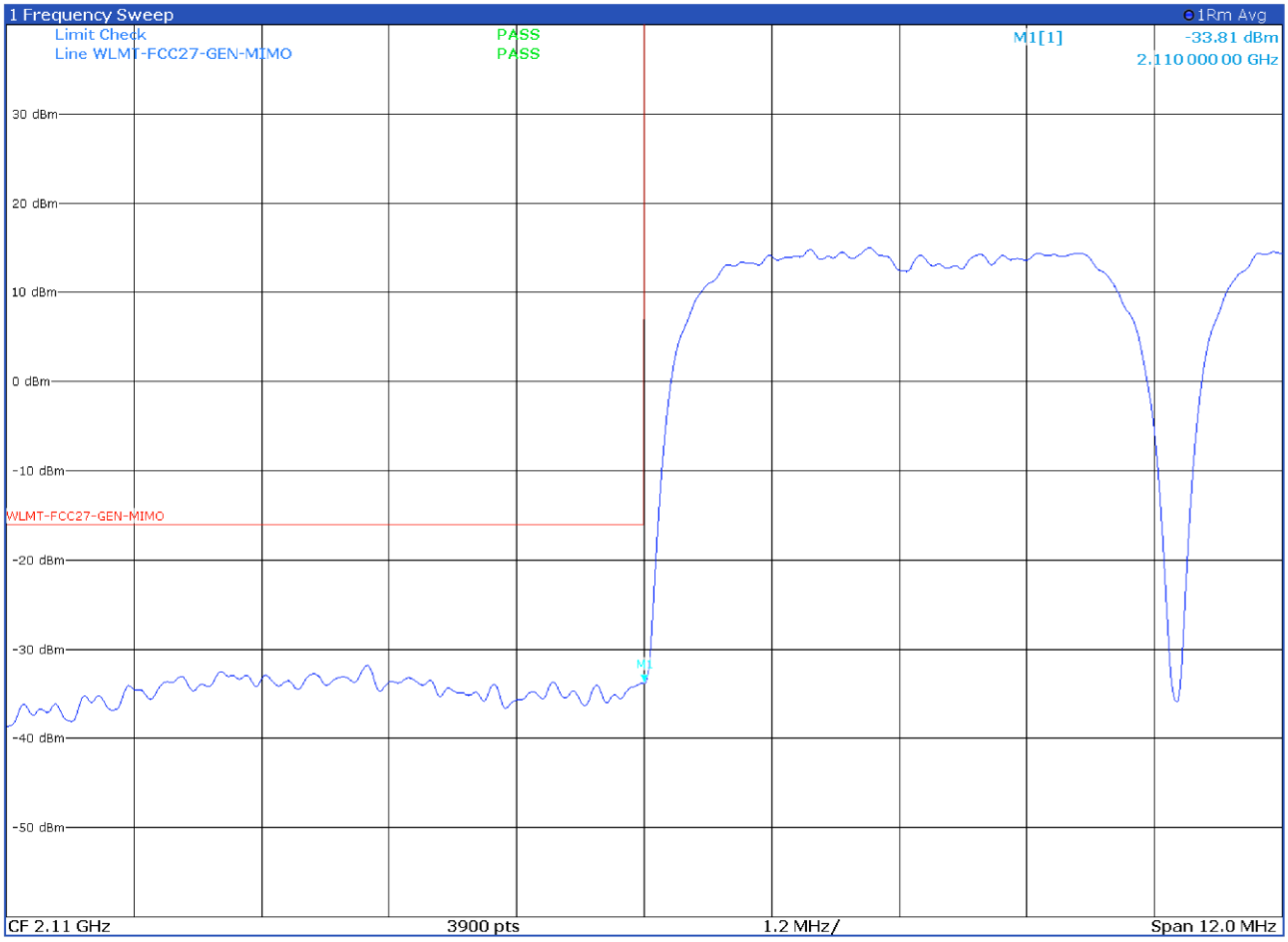


Figure 8.5-3: *Antenna port 1 lower block edge intermodulation products with input signal at AGC threshold*

Test data, continued

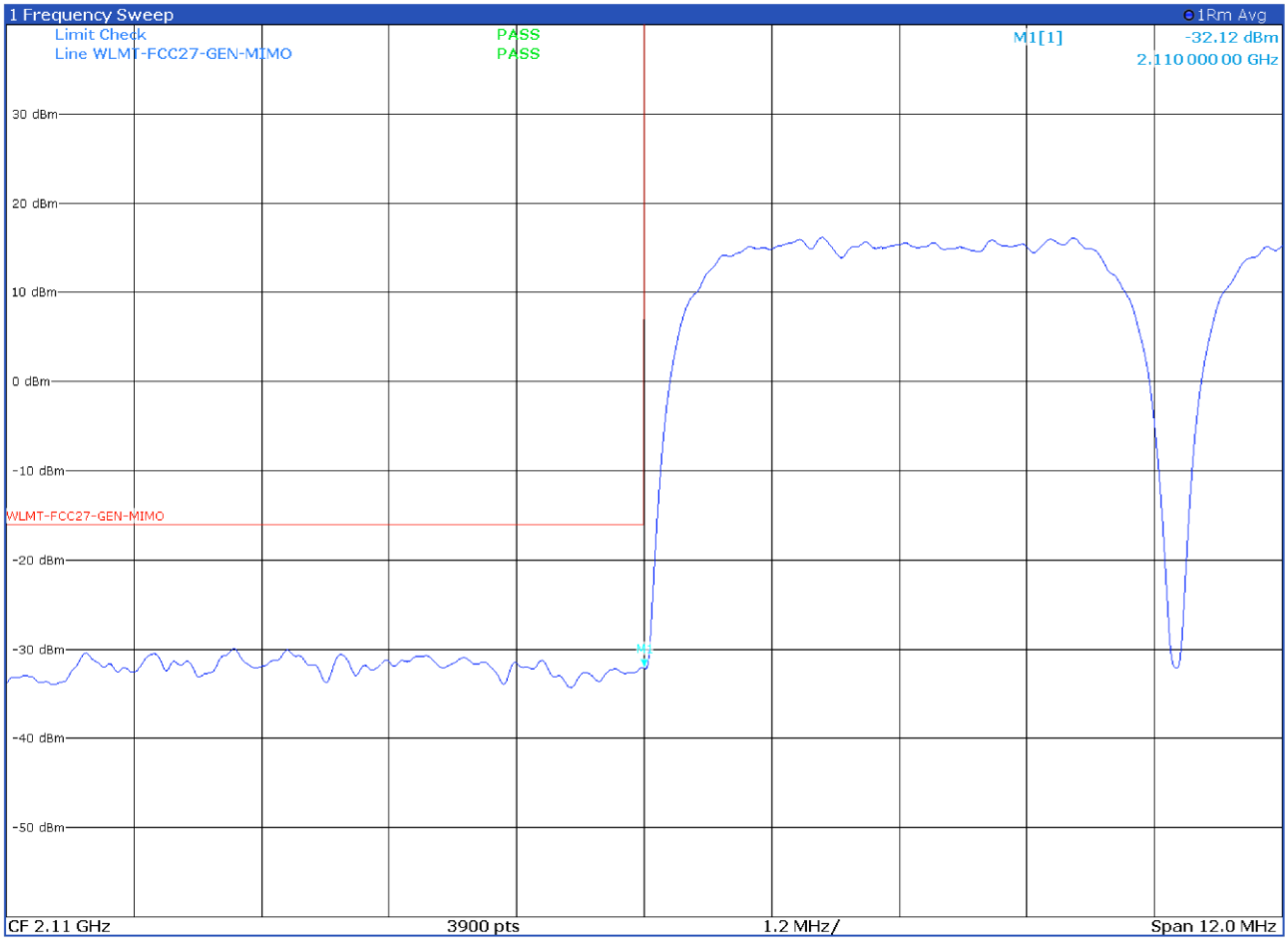


Figure 8.5-4: *Antenna port 1 lower block edge intermodulation products with input signal at AGC threshold +3 dB*

Test data, continued

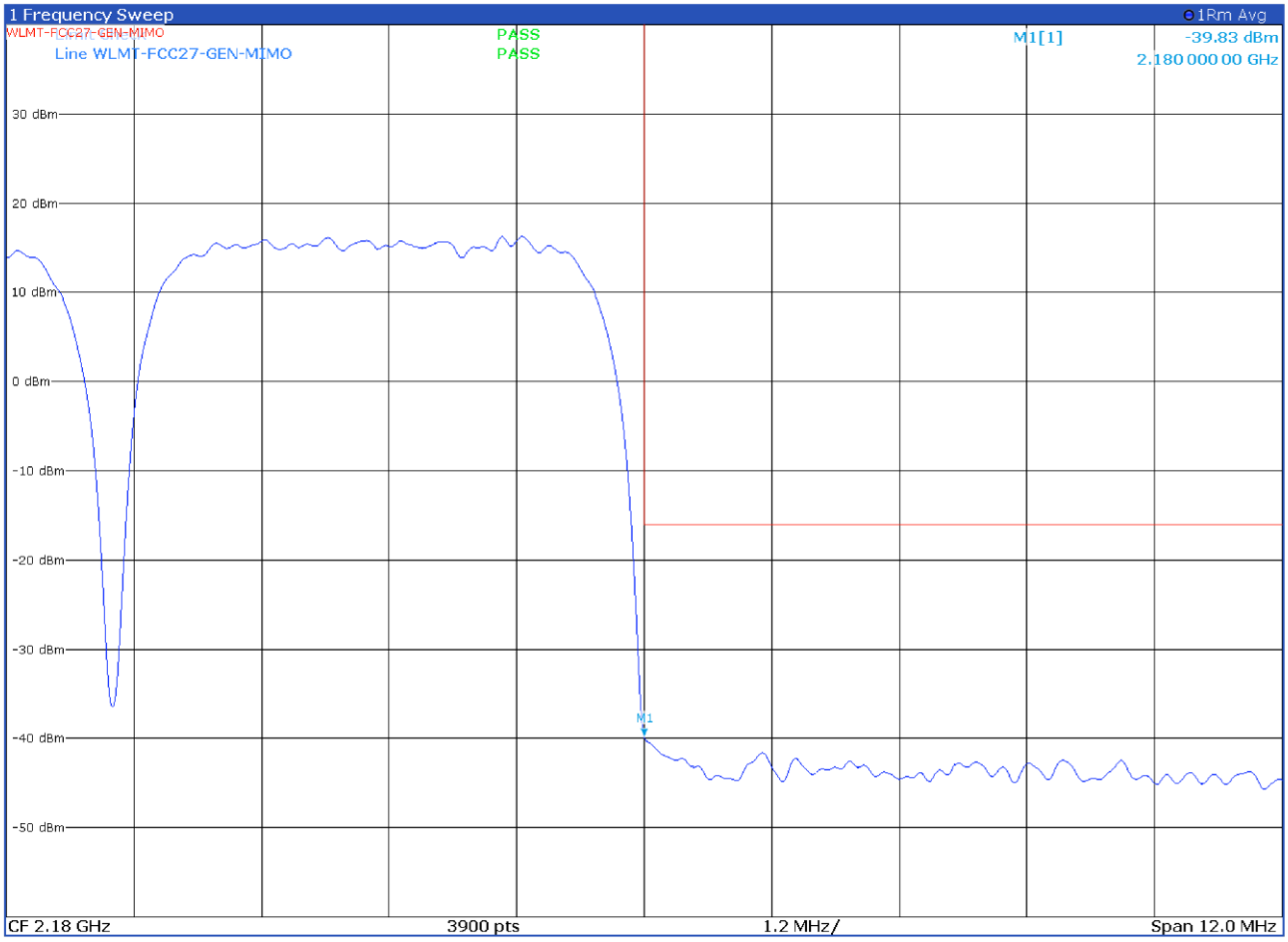


Figure 8.5-5: *Antenna port 2 upper block edge intermodulation products with input signal at AGC threshold*

Test data, continued

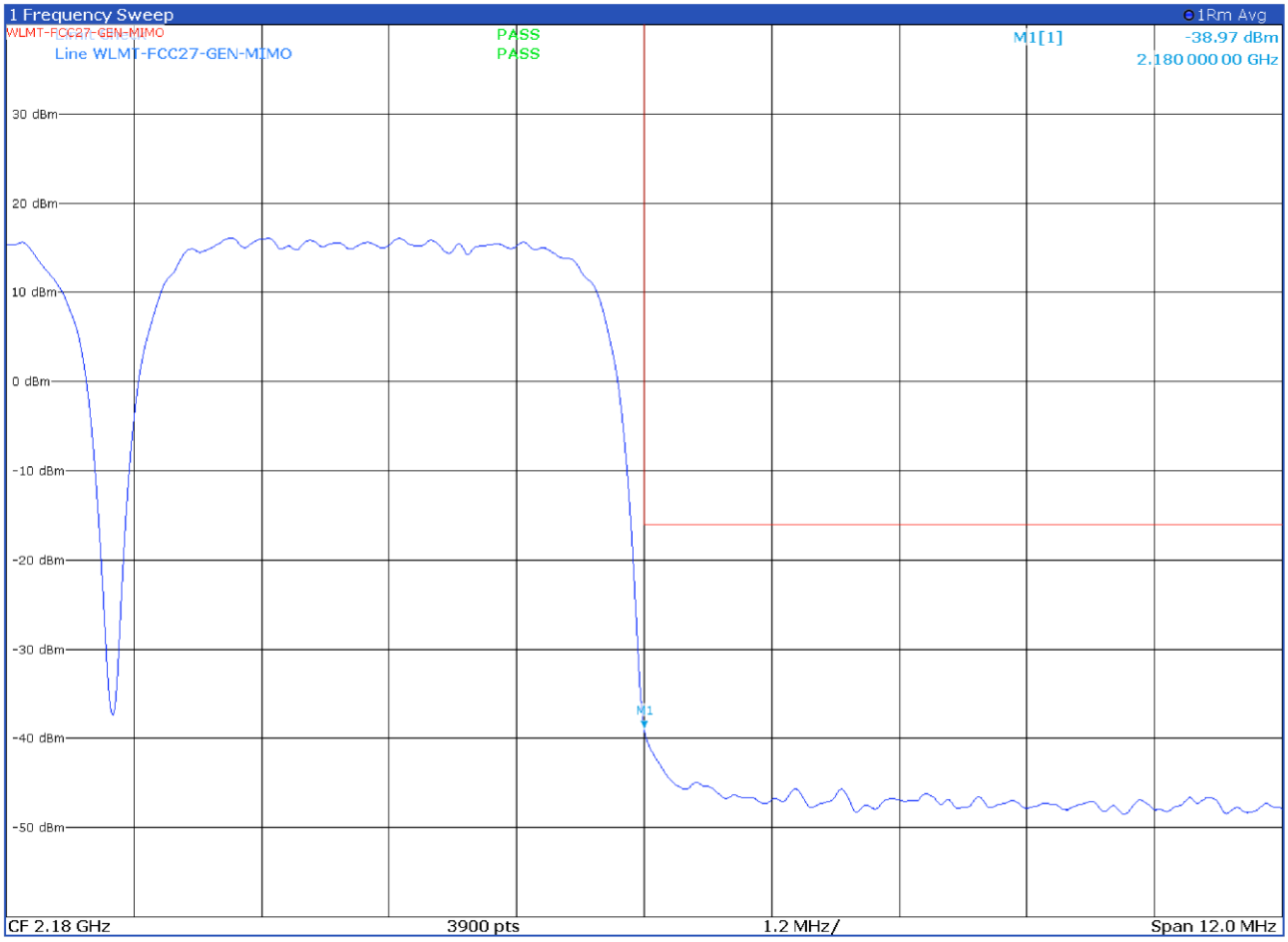


Figure 8.5-6: *Antenna port 2 upper block edge intermodulation products with input signal at AGC threshold +3 dB*

Test data, continued

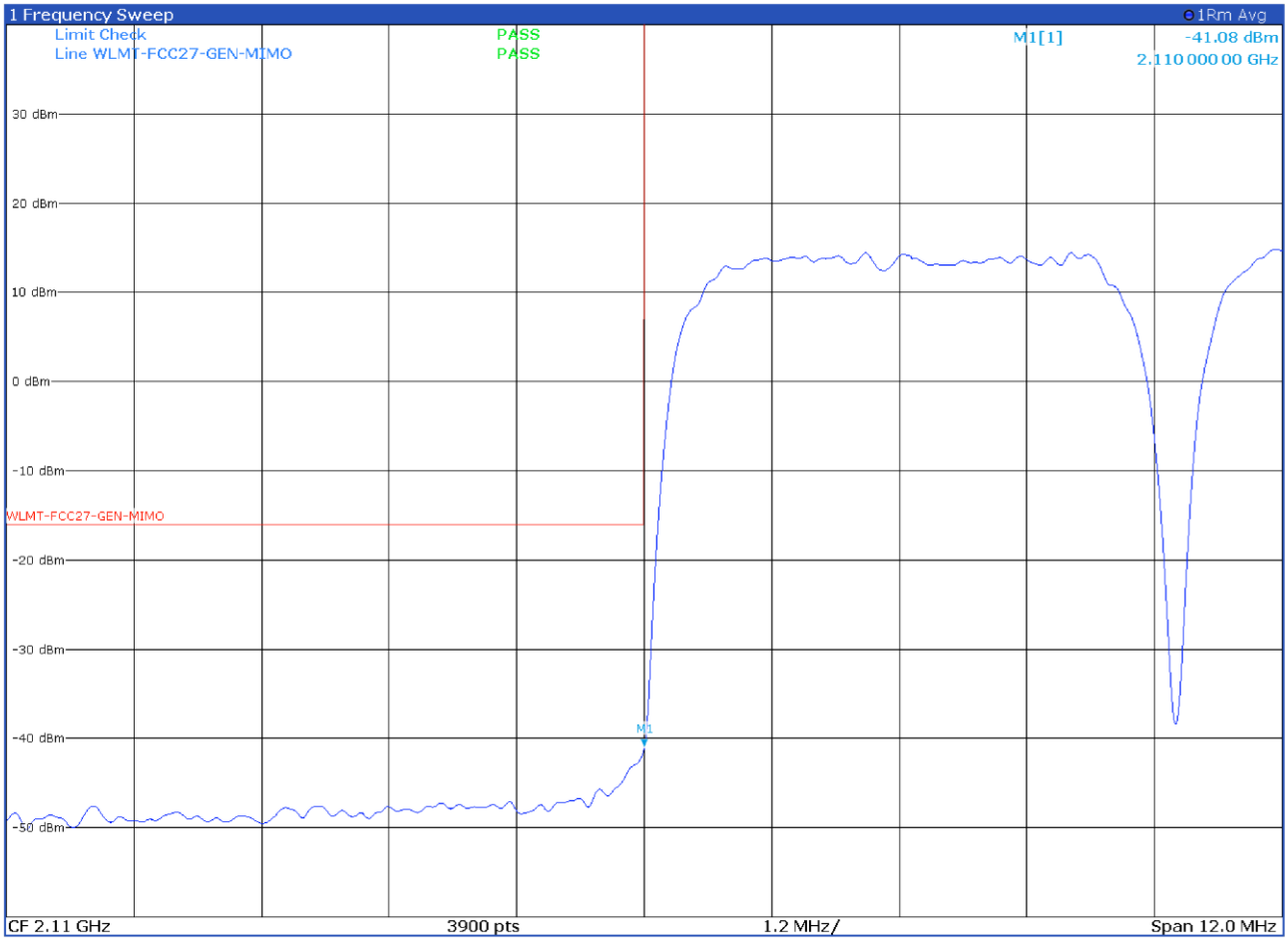


Figure 8.5-7: *Antenna port 2 lower block edge intermodulation products with input signal at AGC threshold*

Test data, continued

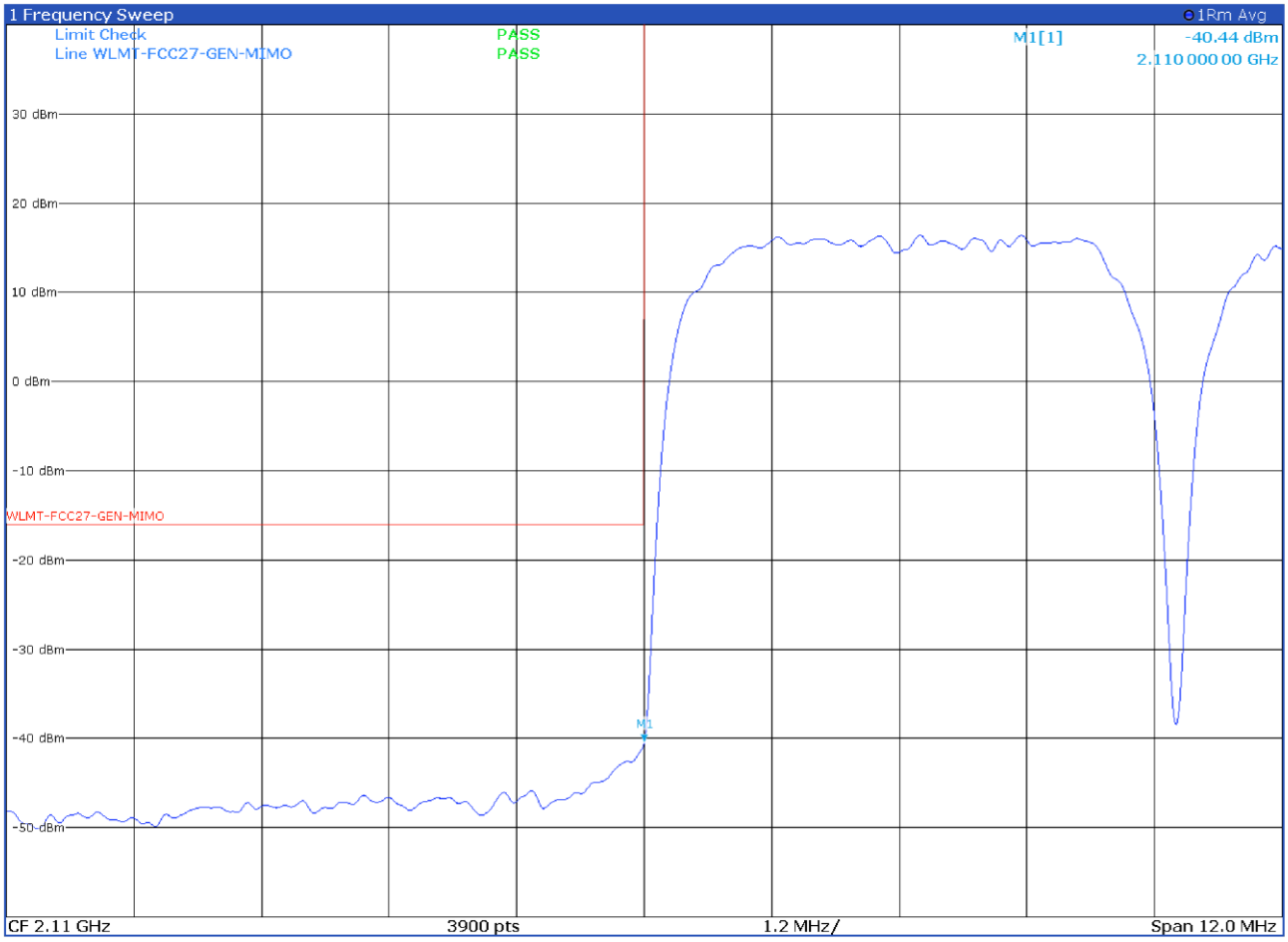


Figure 8.5-8: *Antenna port 2 lower block edge intermodulation products with input signal at AGC threshold +3 dB*

Test data, continued

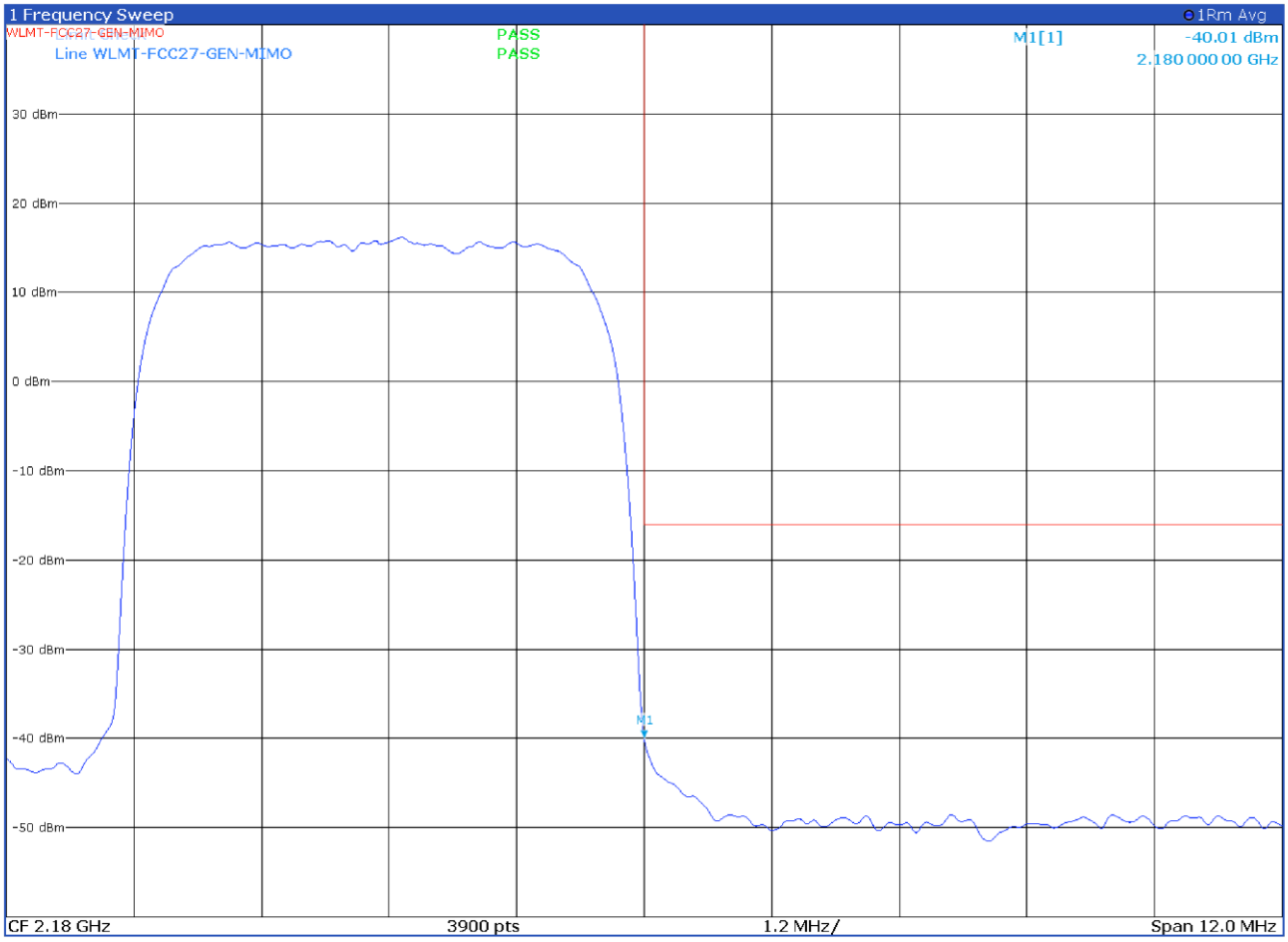


Figure 8.5-9: *Antenna port 1 single carrier upper block edge with input signal at AGC threshold*

Test data, continued

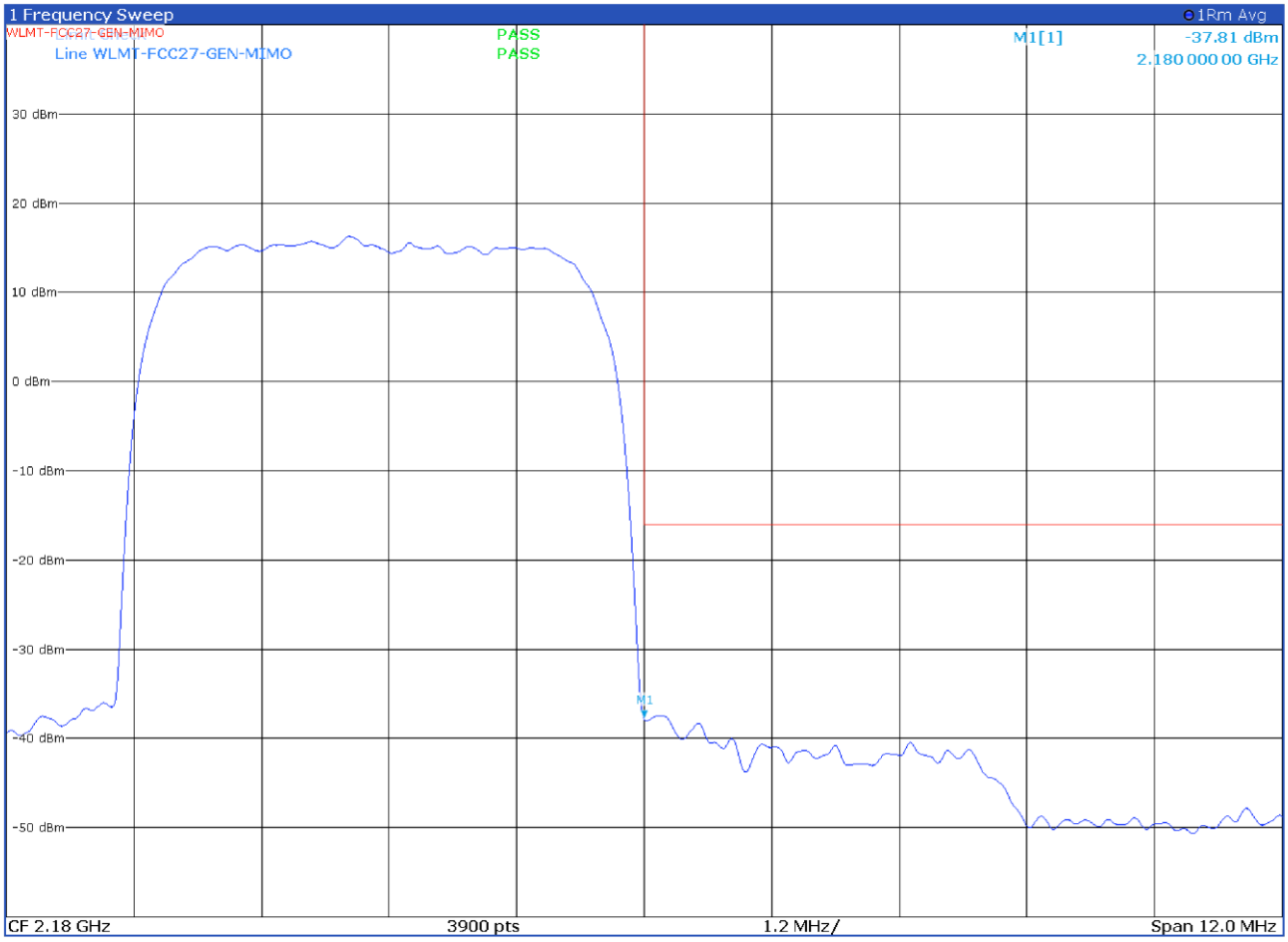


Figure 8.5-10: *Antenna port 1 single carrier upper block edge with input signal at AGC threshold +3 dB*

Test data, continued

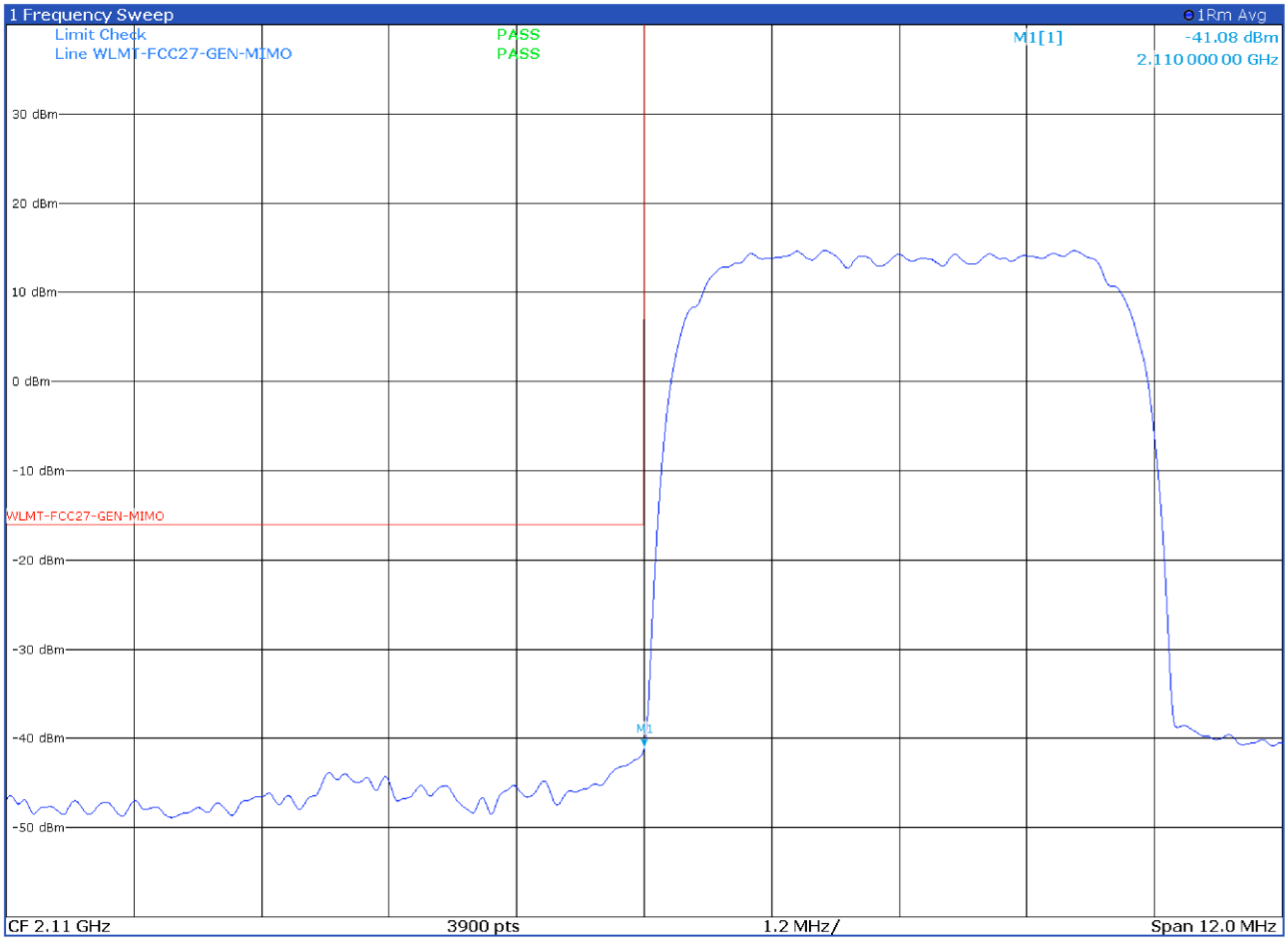


Figure 8.5-11: *Antenna port 1 single carrier lower block edge with input signal at AGC threshold*

Test data, continued

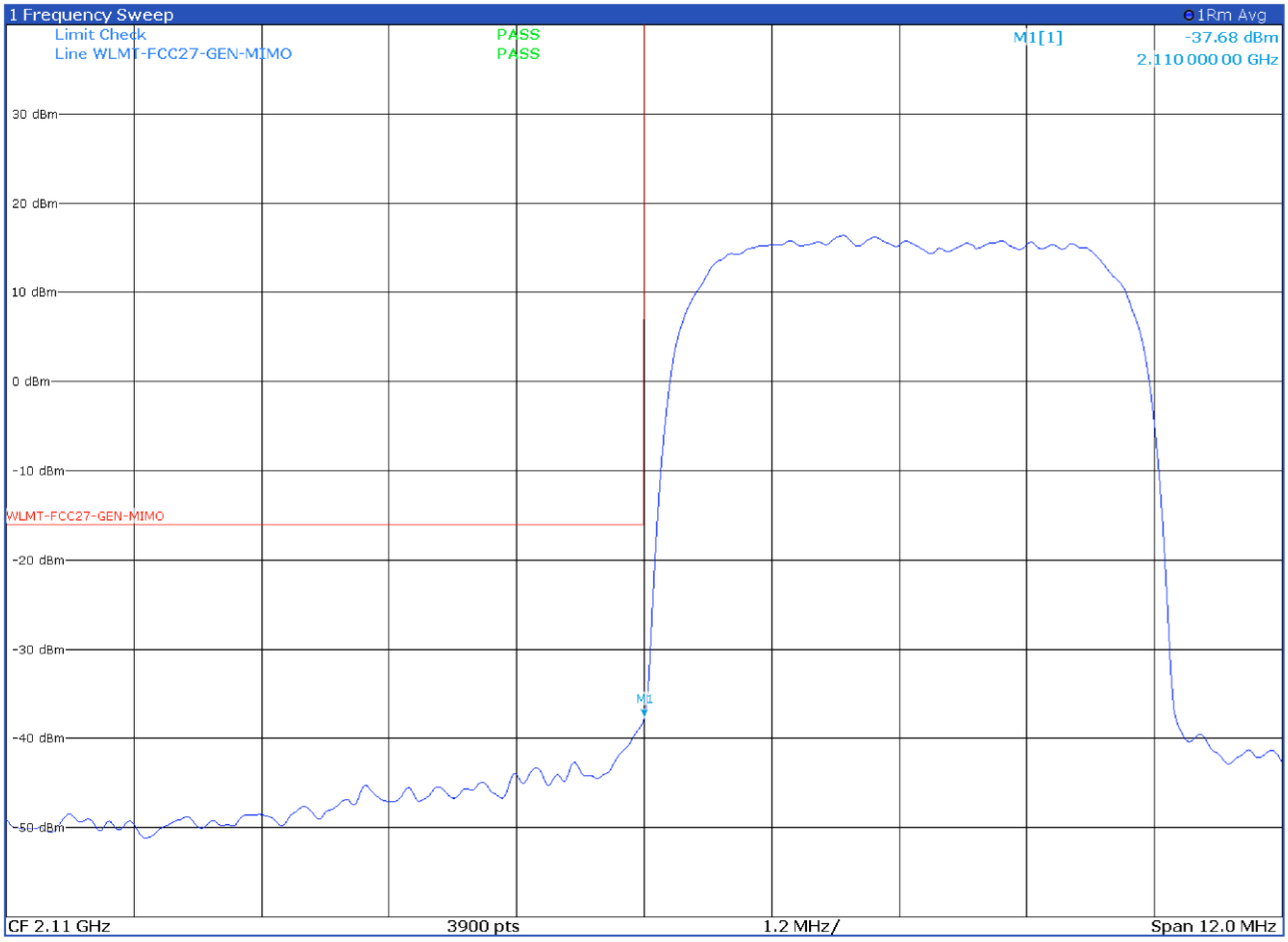


Figure 8.5-12: *Antenna port 1 single carrier lower block edge with input signal at AGC threshold +3 dB*

Test data, continued

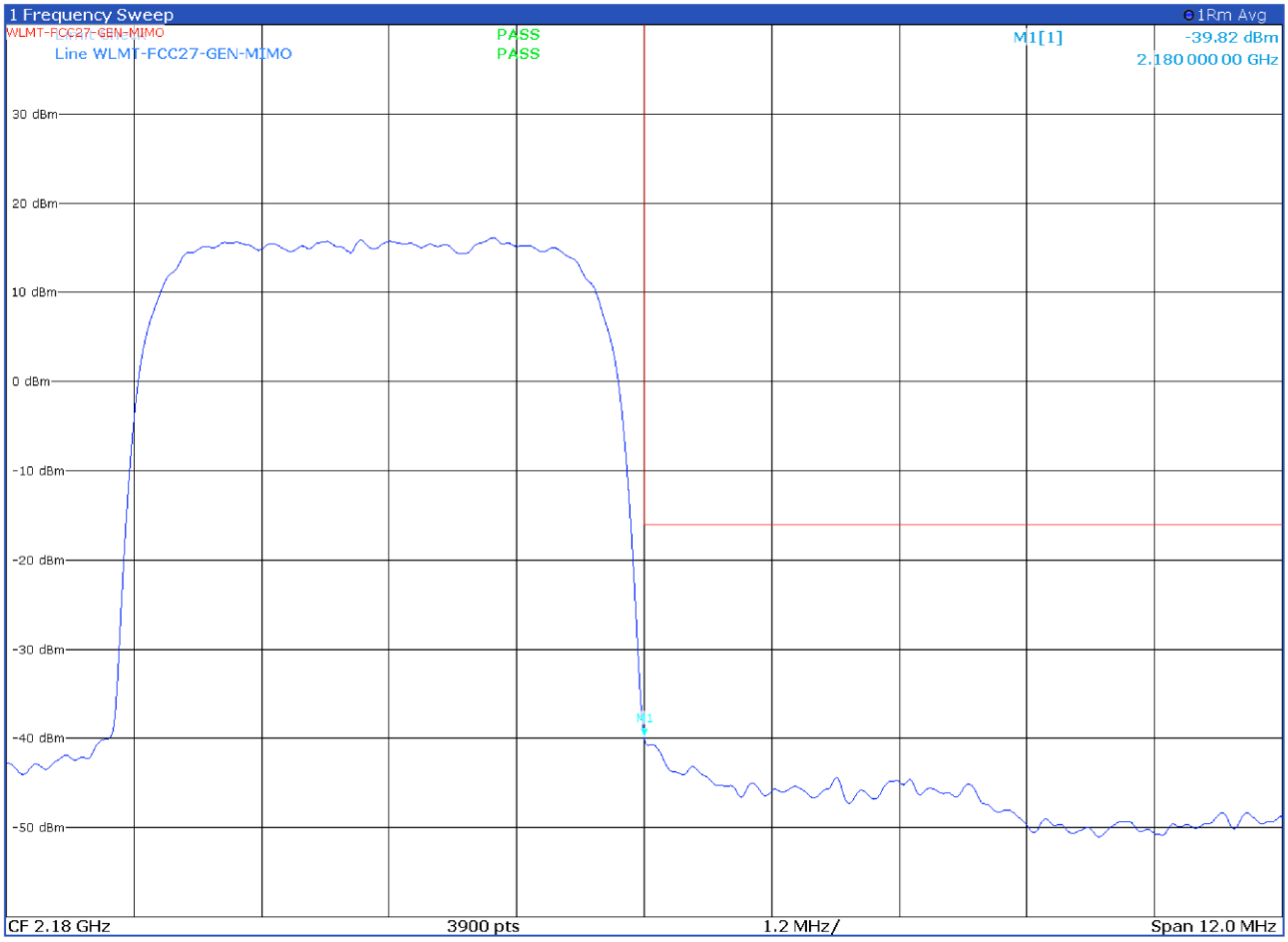


Figure 8.5-13: *Antenna port 2 single carrier upper block edge with input signal at AGC threshold*

Test data, continued

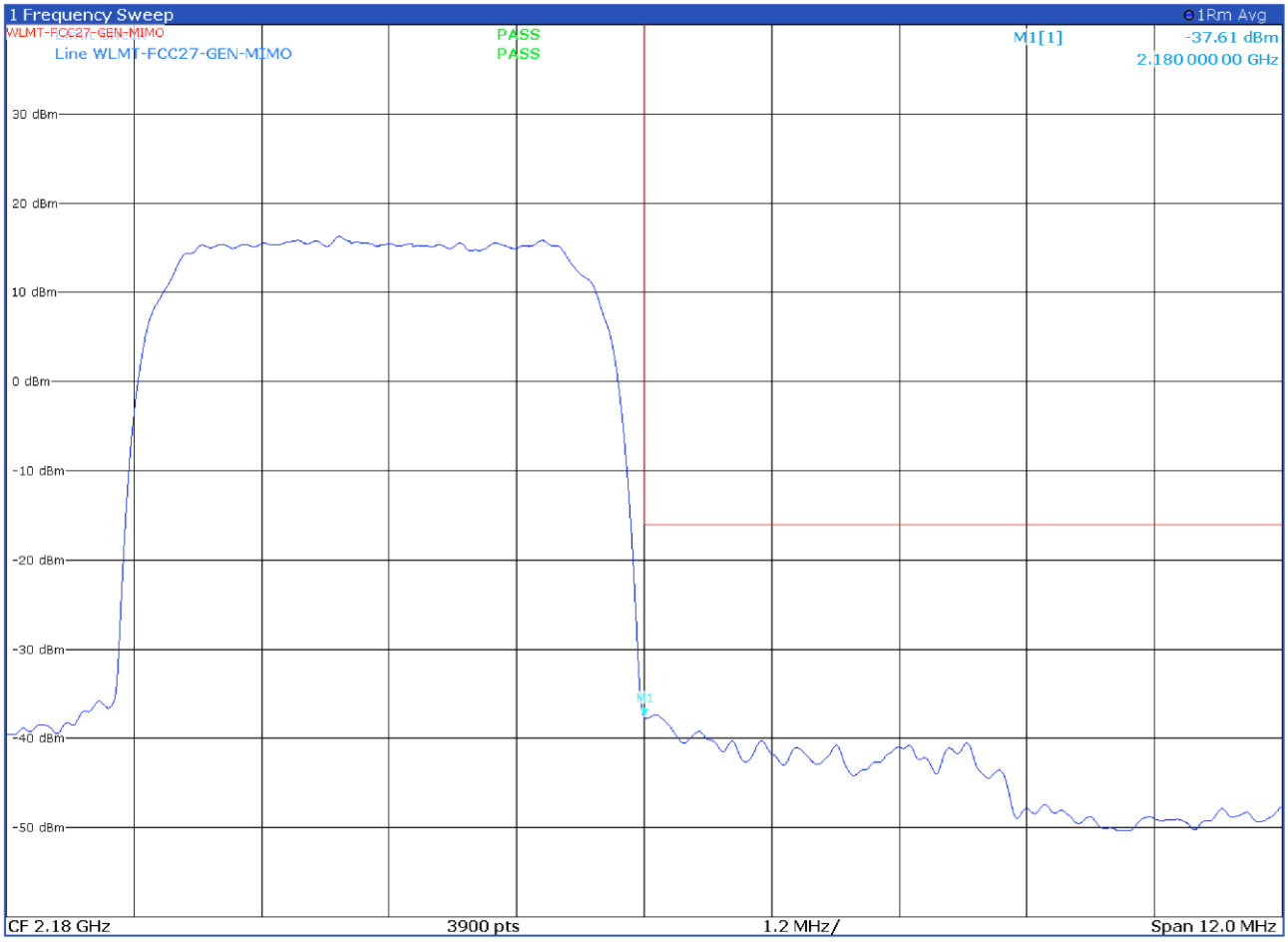


Figure 8.5-14: *Antenna port 2 single carrier upper block edge with input signal at AGC threshold +3 dB*