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RADIO TEST REPORT – 449947-3TRFWL

Type of assessment:

Final product testing

Applicant:

Andrew Wireless Systems
Industriering 10, Buchdorf 86675
Germany

Product:

ERA L2 Radio Module

Model:

Radio Module L2 B30

Model variant(s):

--

FCC ID:

XS5-RML2B30

IC Registration number:

2237E-RML2B30

Specifications:

- FCC 47 CFR Part 27
- RSS-131 Issue 3
- RSS-195 Issue 2

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
Postal code	20853
Country	Italy
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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-195 Issue 2, April 2014	Wireless Communication Service (WCS) Equipment Operating in the Bands 2305-2320 MHz and 2345-2360 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
449947-3TRFWL	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

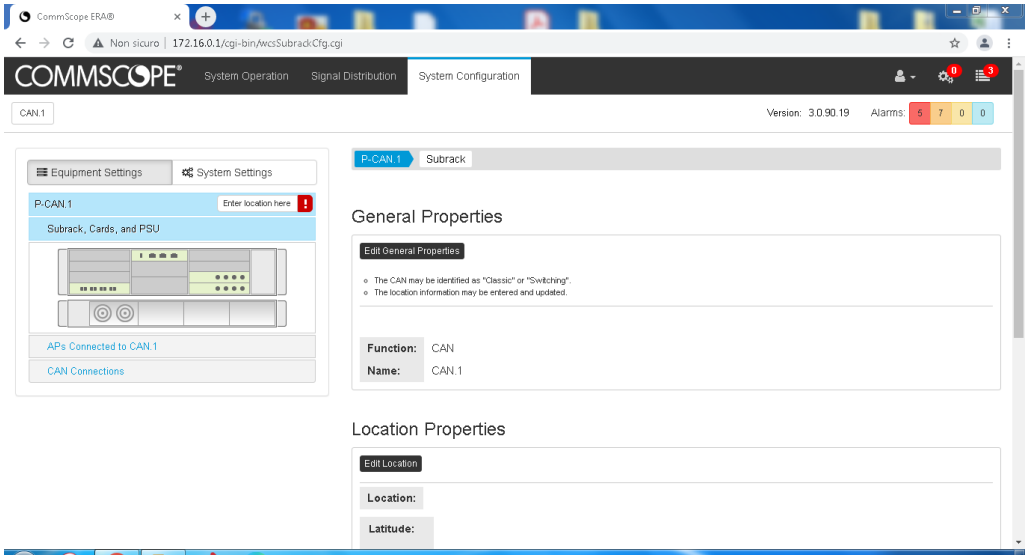
Product name	Carrier Access Point Radio Module
Model	L2 B30
Model variant(s)	--
Serial number	BGRMAM21250004
Part number	7847632-01
Power supply requirements	DC: 48 V
Product description and theory of operation	The EUT is a MIMO 1 +1 radio module used inside a CAP L2 Access Point. The Era product is 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	2350 MHz to 2360 MHz
Frequency Min (MHz)	2352.5 MHz for LTE 5 MHz
Frequency Max (MHz)	2357.5 MHz for LTE 5 MHz
RF power Max (W), Conducted	0.182 W (22.6 dBm)
Measured BW (kHz), 99% OBW	4.108 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

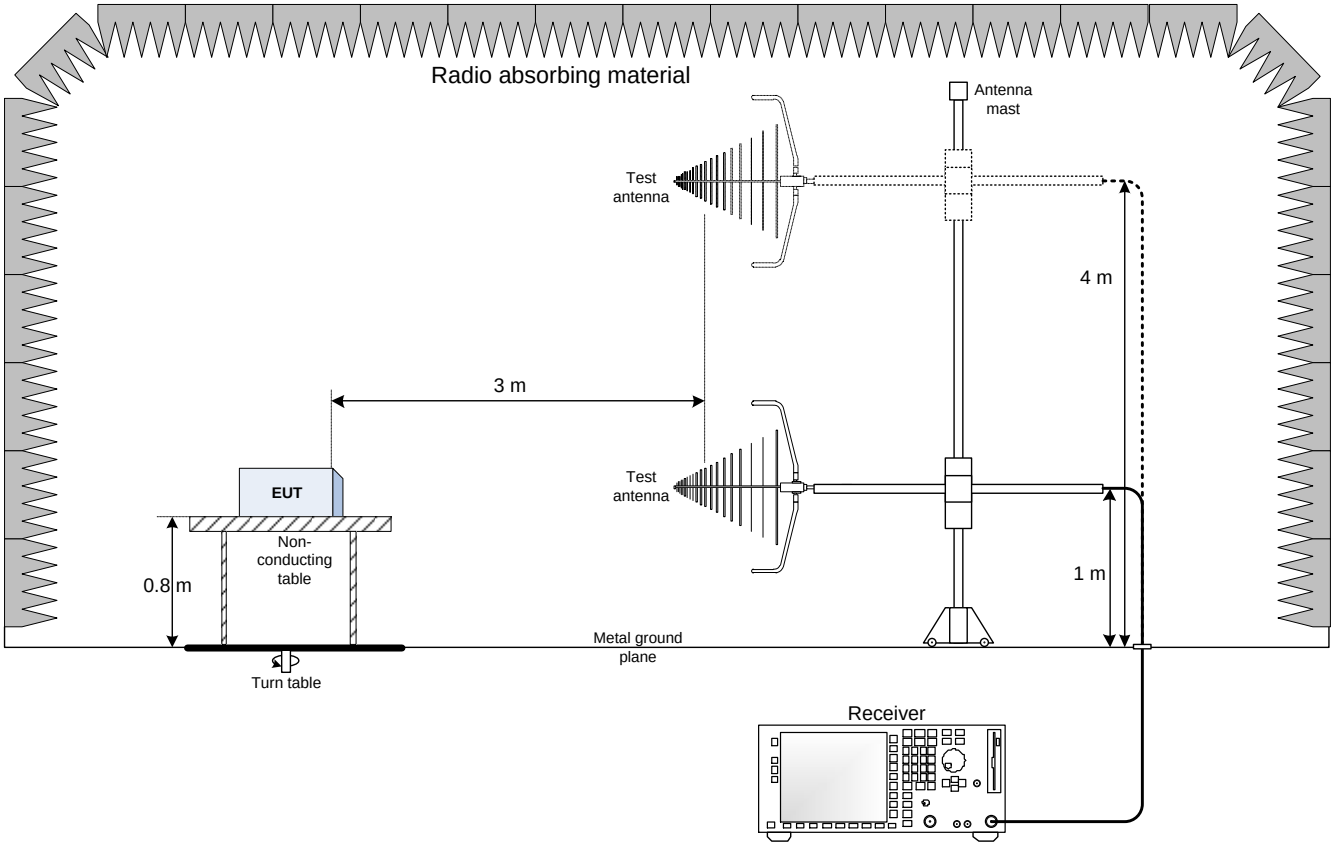


Figure 5.5-1: *Radiated emissions set-up for frequencies below 1 GHz*

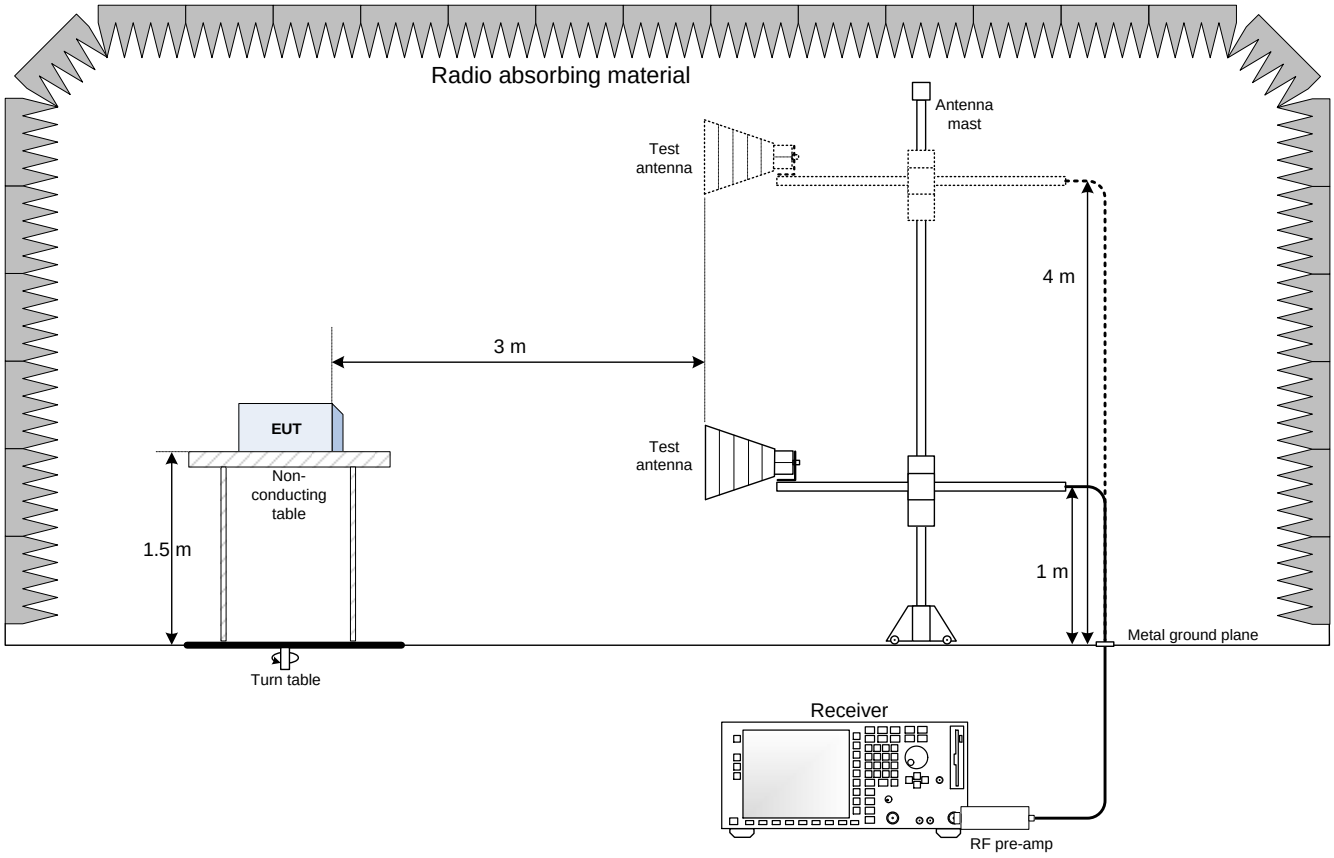


Figure 5.5-2: *Radiated emissions set-up for frequencies above 1 GHz*

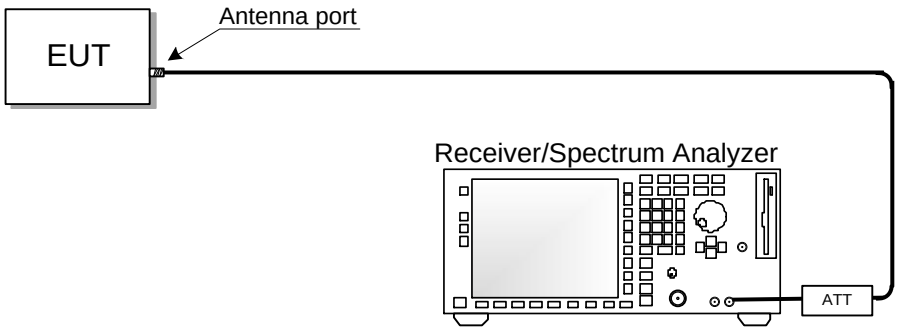


Figure 5.5-3: *Antenna port testing set-up*

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(a)(1)(i)	935210 (3.5)	Mean output power and amplifier/booster gain	Pass
FCC 27.53(a)(1)	935210 (3.6.2)	Out-of-band/out-of-block emissions conducted measurements	Pass
FCC 27.53(a)(1))	935210 (3.6.3)	Spurious emissions conducted measurements	Pass
FCC 27.54	935210 (3.7)	Frequency stability measurements	Pass
FCC 27.53(a)(1)	935210 (3.8)	Spurious emissions radiated measurements	Pass

Notes:

6.5 ISED RSS-131 and RSS-195 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-195 §5.5	935210 (3.5)	Mean output power and amplifier/booster gain	Pass
RSS-131 §5.2 / RSS-195 §5.6.1	935210 (3.6.2)	Out-of-band/out-of-block emissions conducted measurements	Pass
RSS-131 §5.2 / RSS-195 §5.6.1	935210 (3.6.3)	Spurious emissions conducted measurements	Pass
RSS-131 §5.2.4 / RSS-195 §5.4	935210 (3.7)	Frequency stability measurements	Pass
RSS-131 §5.2 / RSS-195 §5.6.1	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	2021-01	2022-01
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	2021-01	2022-01
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 3, 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

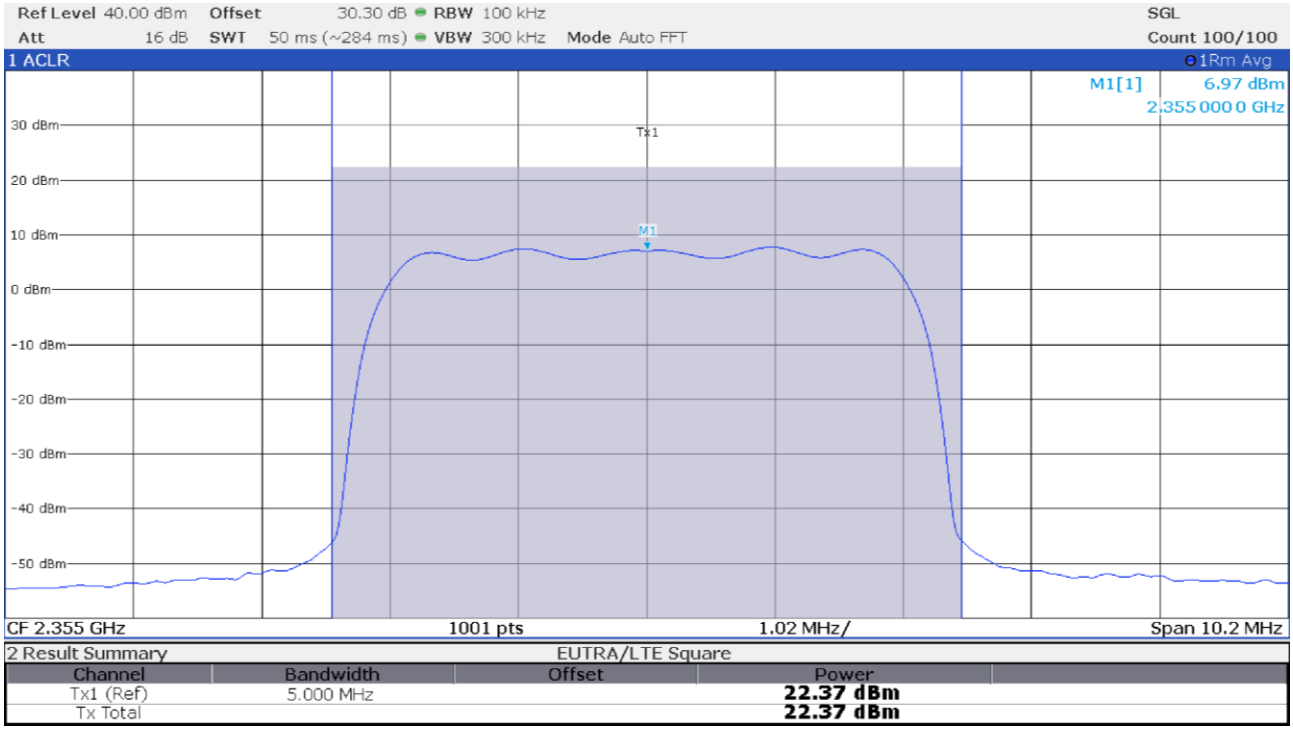


Figure 8.1-1: *Antenna port 1 output spectral plot with input at AGC threshold*

Test data, continued

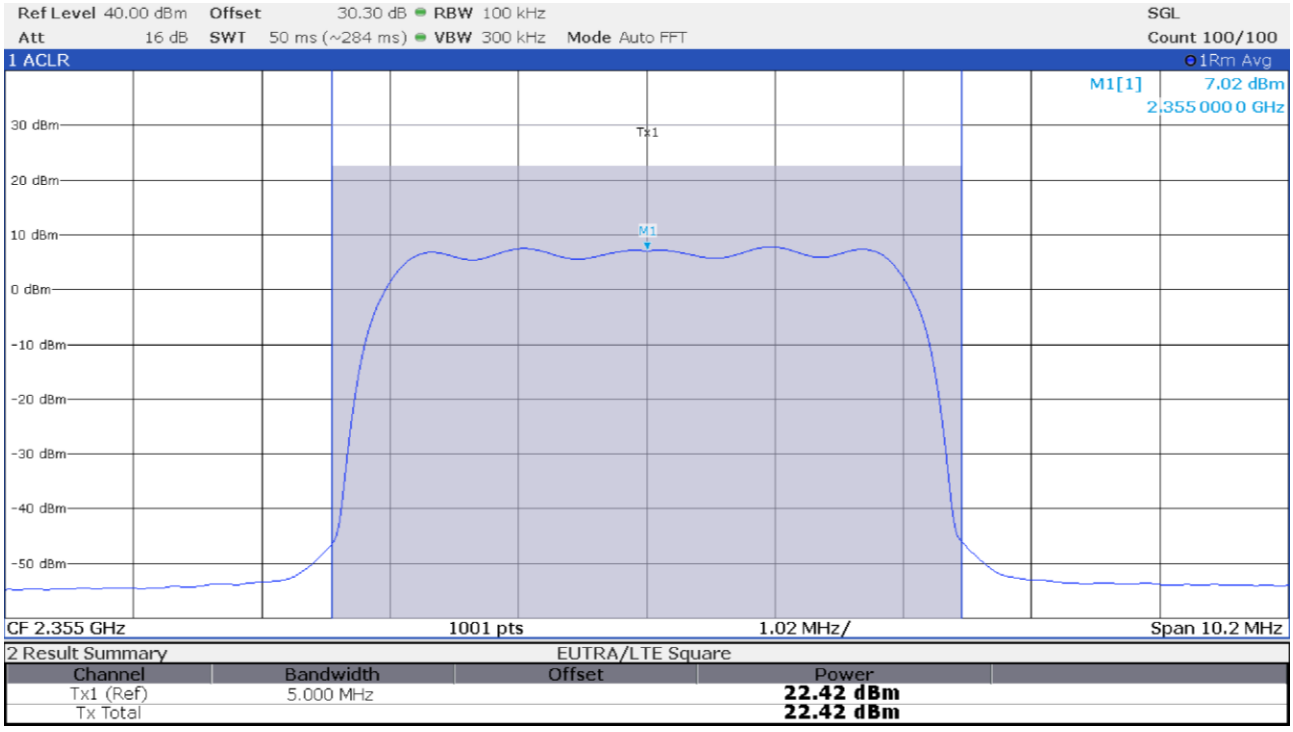


Figure 8.1-2: *Antenna port 1 output spectral plot with input at AGC threshold +1 dBm*

Test data, continued

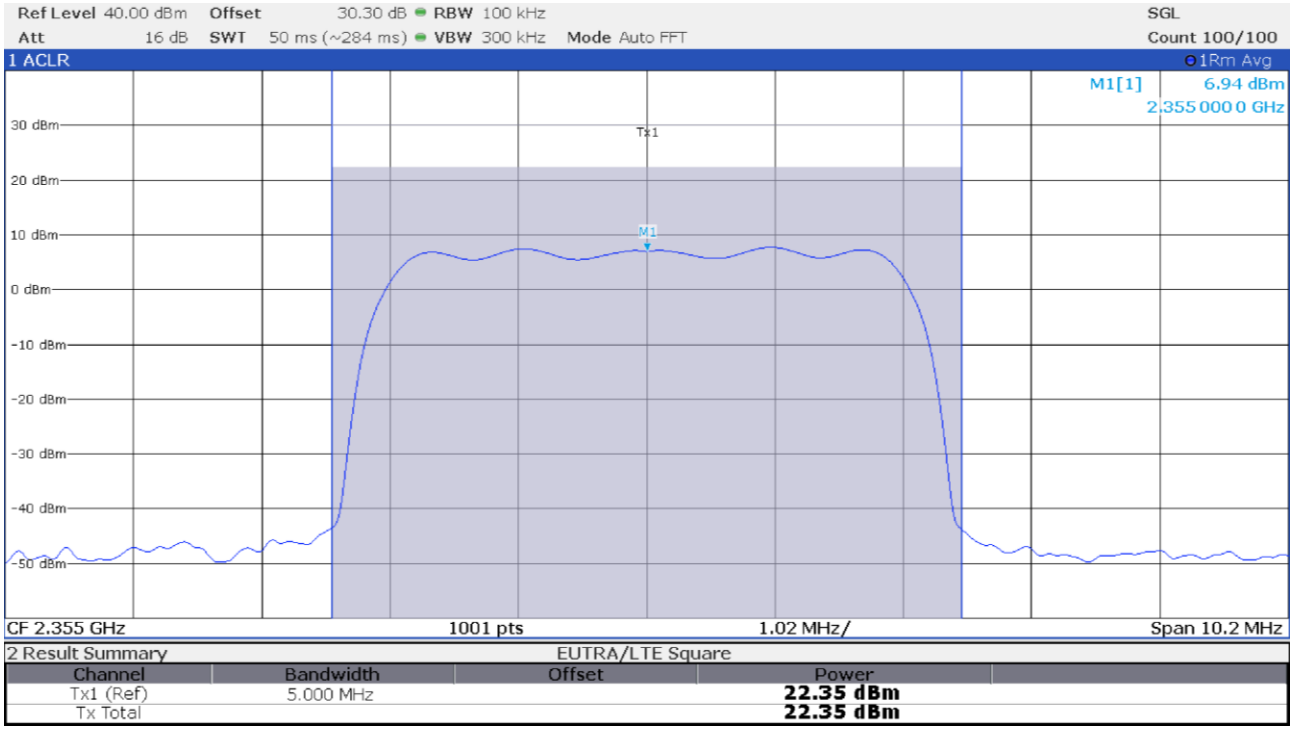


Figure 8.1-3: *Antenna port 2 output spectral plot with input at AGC threshold*

Test data, continued

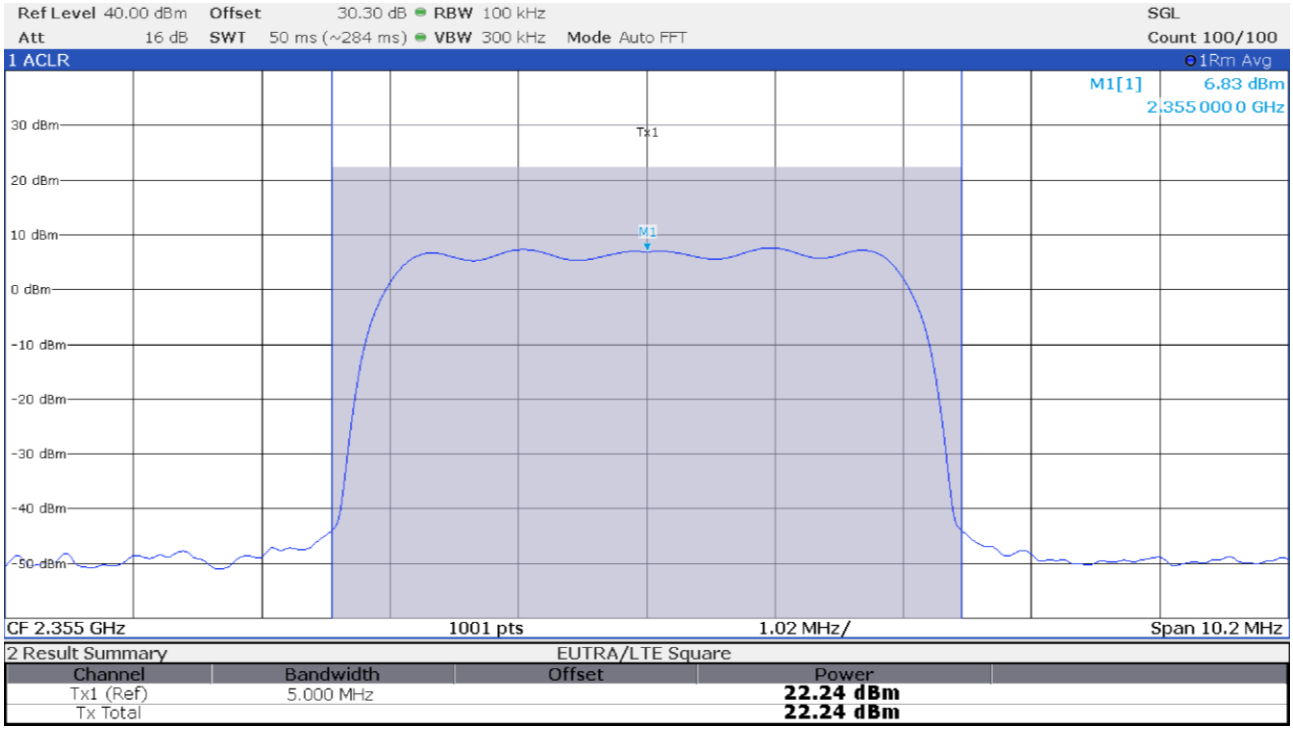


Figure 8.1-4: *Antenna port 2 output spectral plot with input at AGC threshold +1 dBm*

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 3, 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

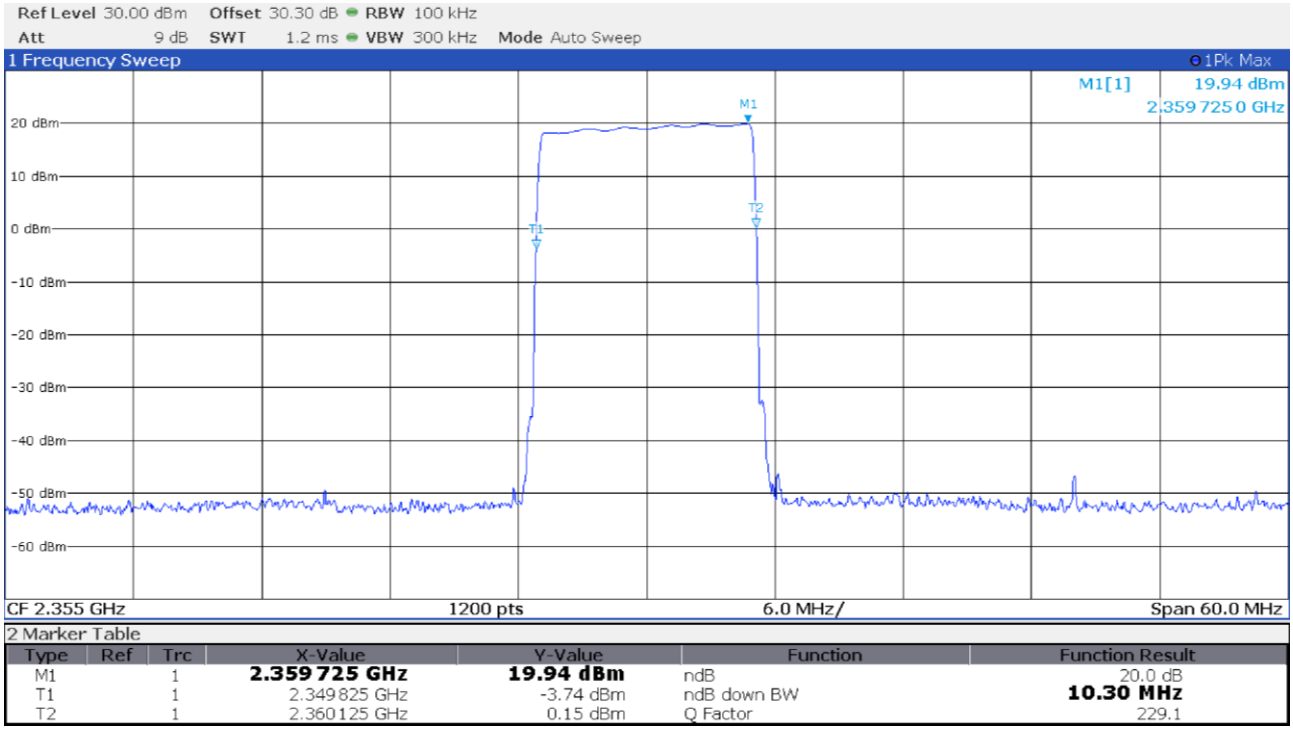


Figure 8.2-1: *Out-of-band-rejection 20dB BW spectral plot for Antenna port 1*

Test data, continued

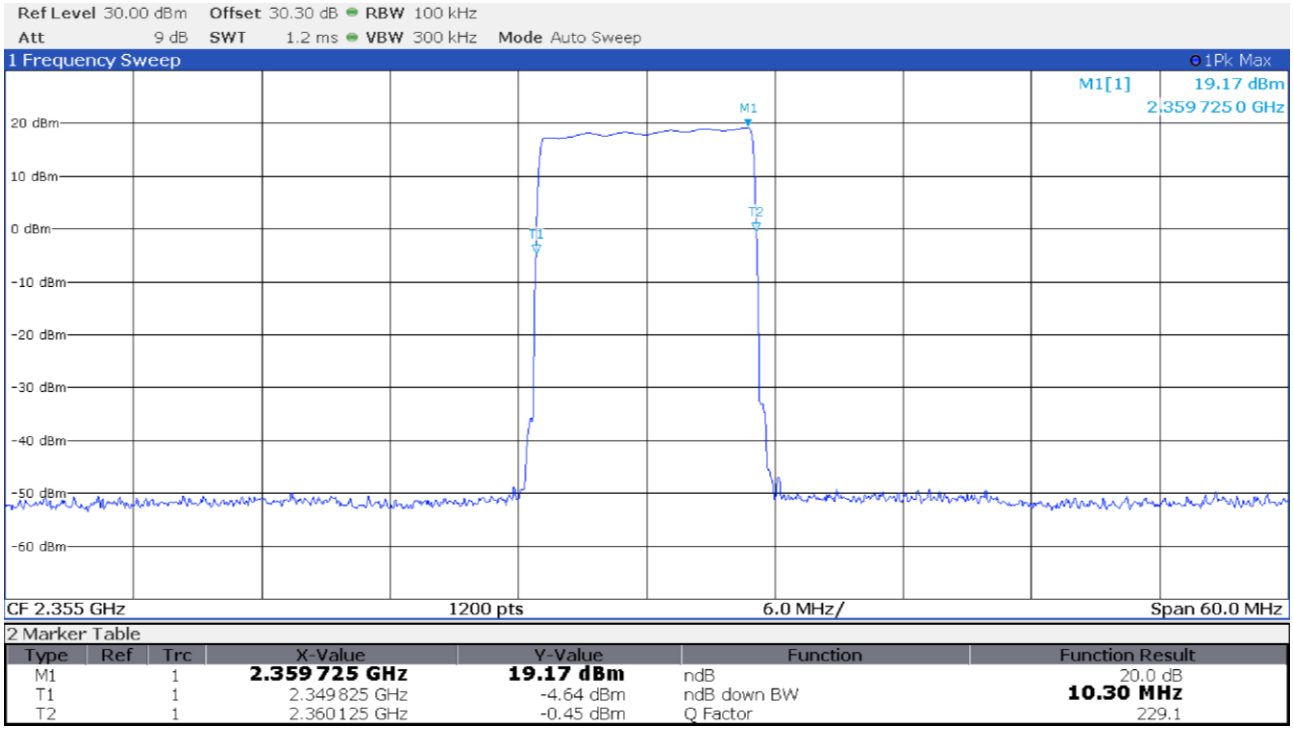


Figure 8.2-2: *Out-of-band-rejection 20dB BW spectral plot for Antenna port 2*

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 3, 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	2355	4.117	4.61
1	Output	AGC threshold	2355	4.106	4.61
1	Input	AGC threshold +3 dB	2355	4.116	4.61
1	Output	AGC threshold +3 dB	2355	4.106	4.61
2	Input	AGC threshold	2355	4.117	4.61
2	Output	AGC threshold	2355	4.108	4.61
2	Input	AGC threshold +3 dB	2355	4.116	4.61
2	Output	AGC threshold +3 dB	2355	4.108	4.61

Test data, continued

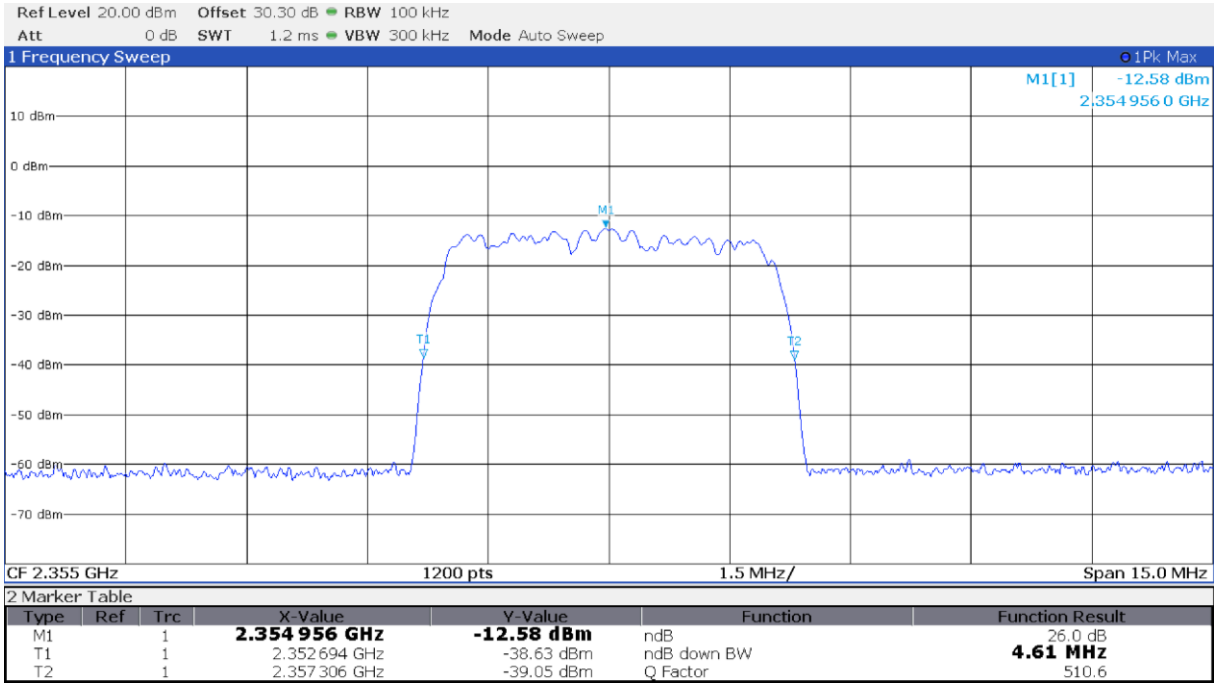


Figure 8.3-1: *26 dB occupied bandwidth, antenna port 1 input signal at AGC threshold spectral plot*

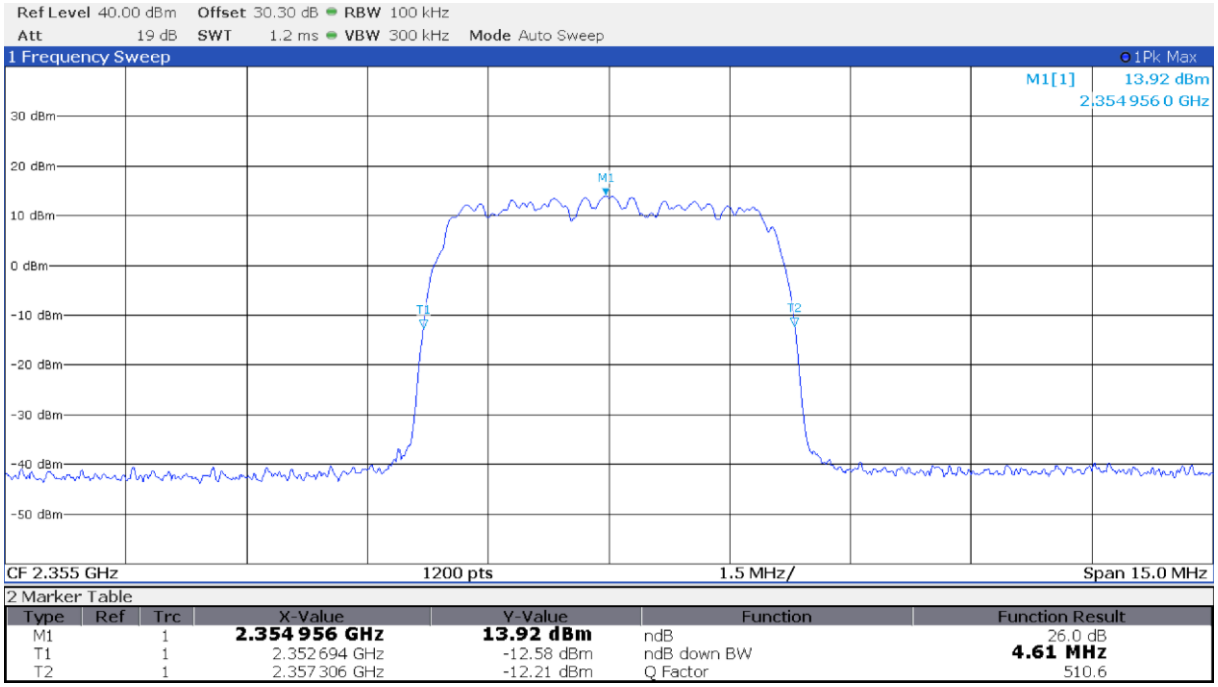


Figure 8.3-2: *26 dB occupied bandwidth, antenna port 1 output signal at AGC threshold spectral plot*

Test data, continued

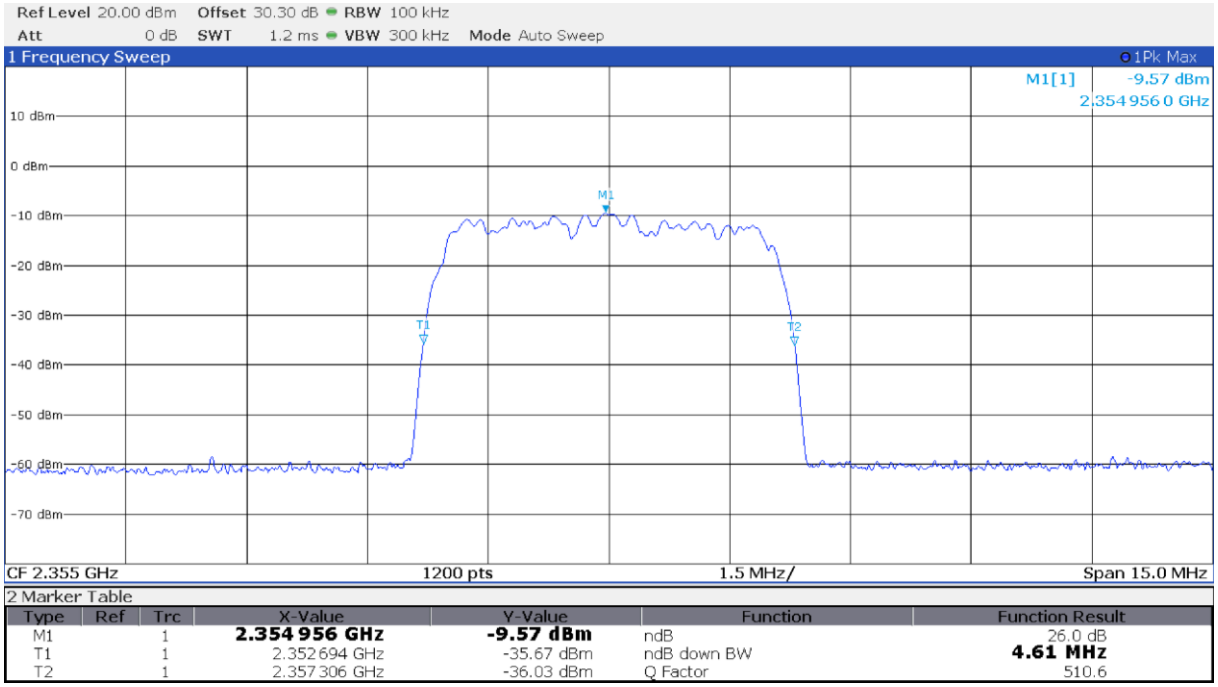


Figure 8.3-3: *26 dB occupied bandwidth, antenna port 1 input signal at AGC threshold +3 dB spectral plot*

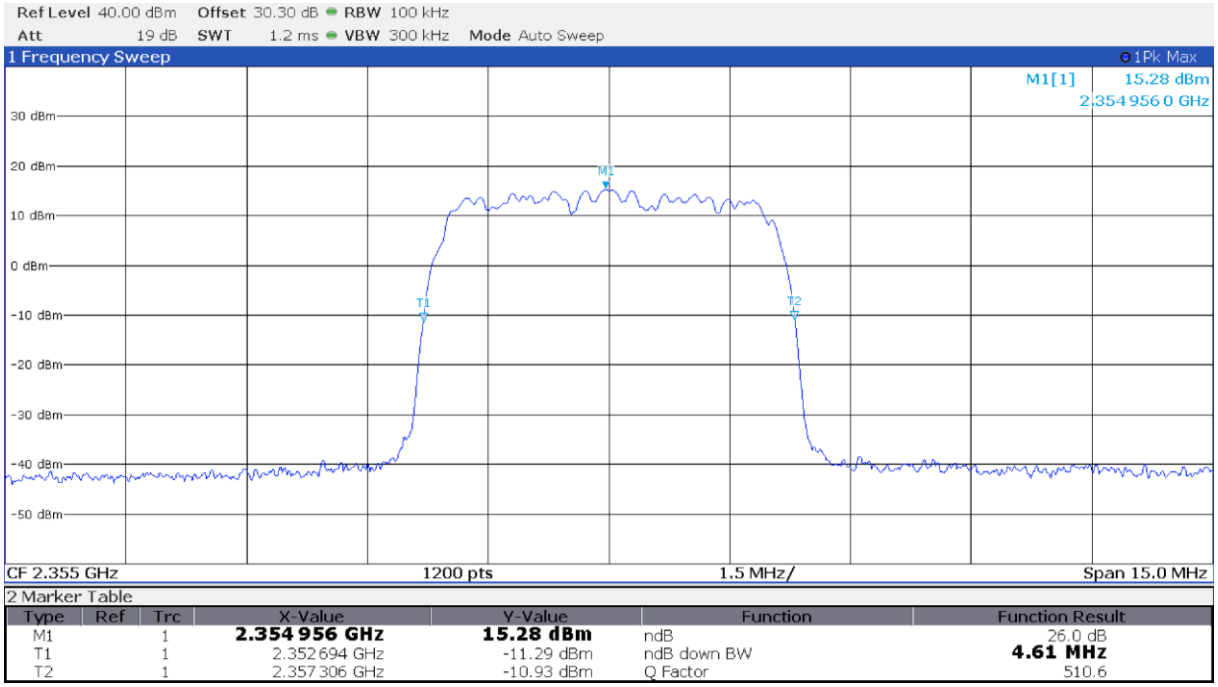


Figure 8.3-4: *26 dB occupied bandwidth, antenna port 1 output signal at AGC threshold +3 dB spectral plot*

Test data, continued

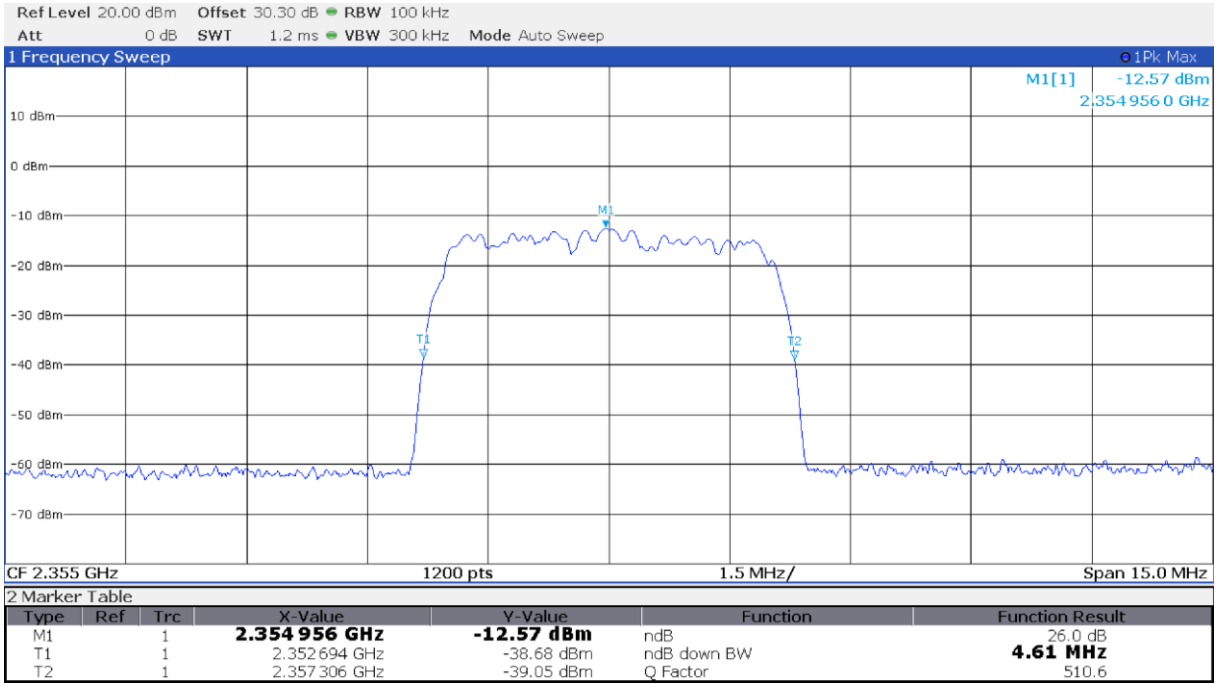


Figure 8.3-5: *26 dB occupied bandwidth, antenna port 2 input signal at AGC threshold spectral plot*

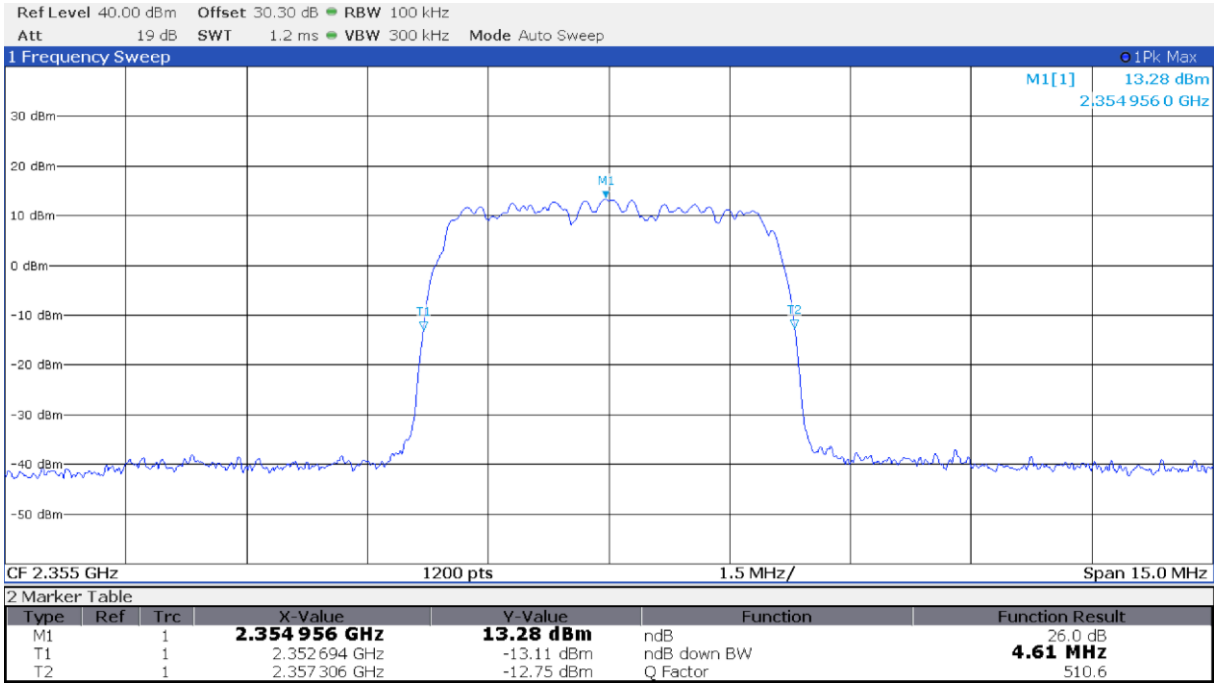


Figure 8.3-6: *26 dB occupied bandwidth, antenna port 2 output signal at AGC threshold spectral plot*

Test data, continued

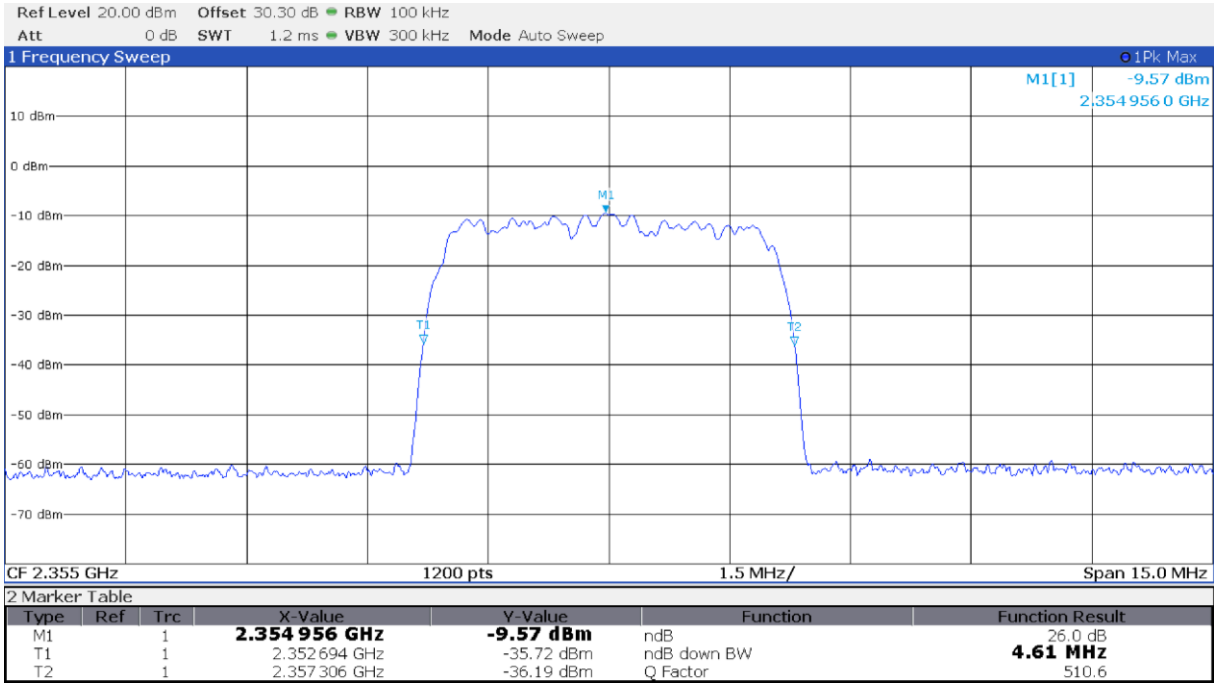


Figure 8.3-7: *26 dB occupied bandwidth, antenna port 2 input signal at AGC threshold +3 dB spectral plot*

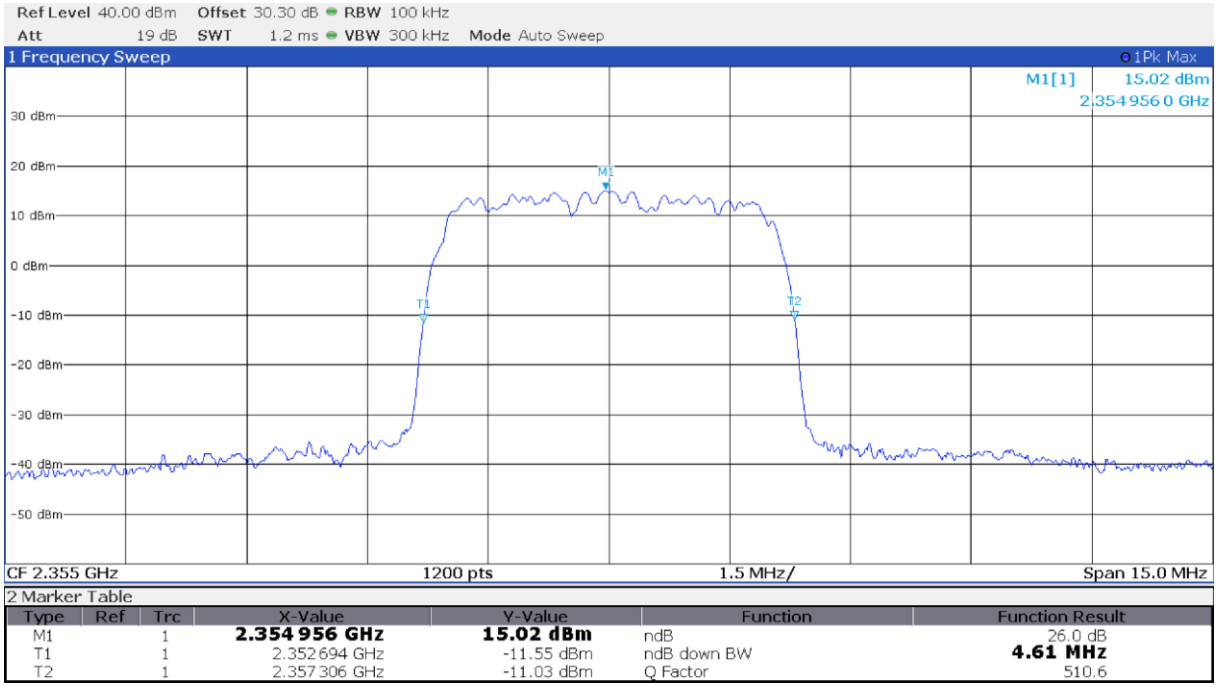


Figure 8.3-8: *26 dB occupied bandwidth, antenna port 2 output signal at AGC threshold +3 dB spectral plot*

Test data, continued

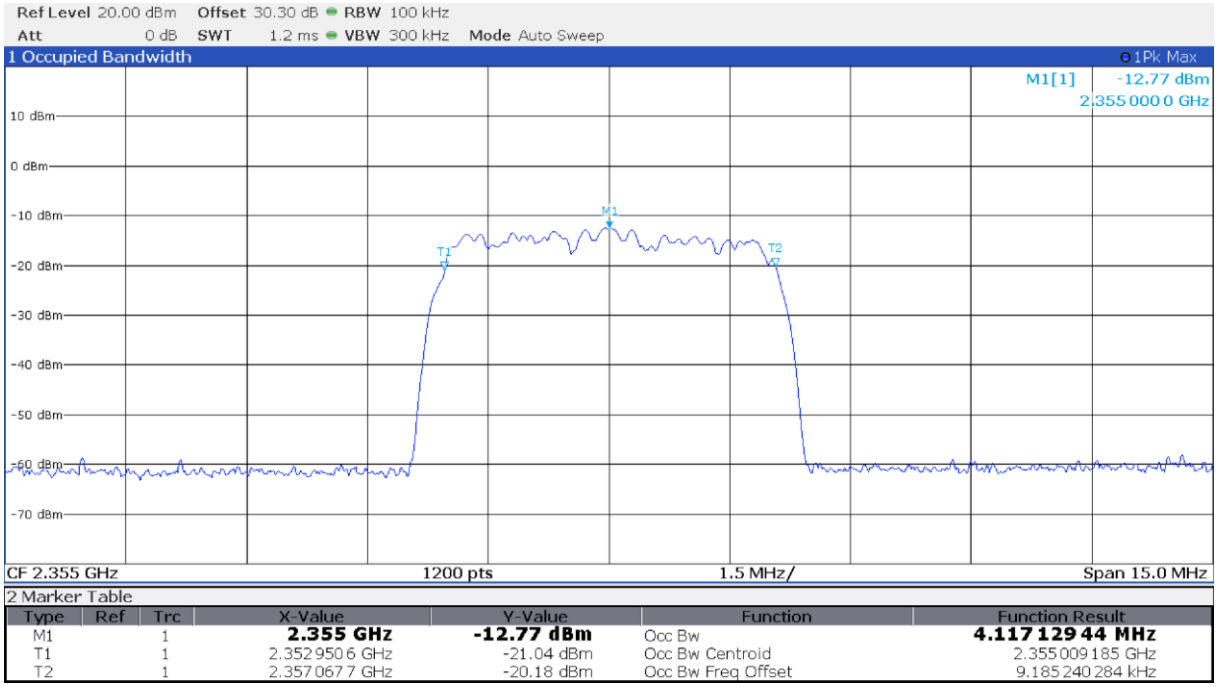


Figure 8.3-9: *99% occupied bandwidth, antenna port 1 input signal at AGC threshold spectral plot*

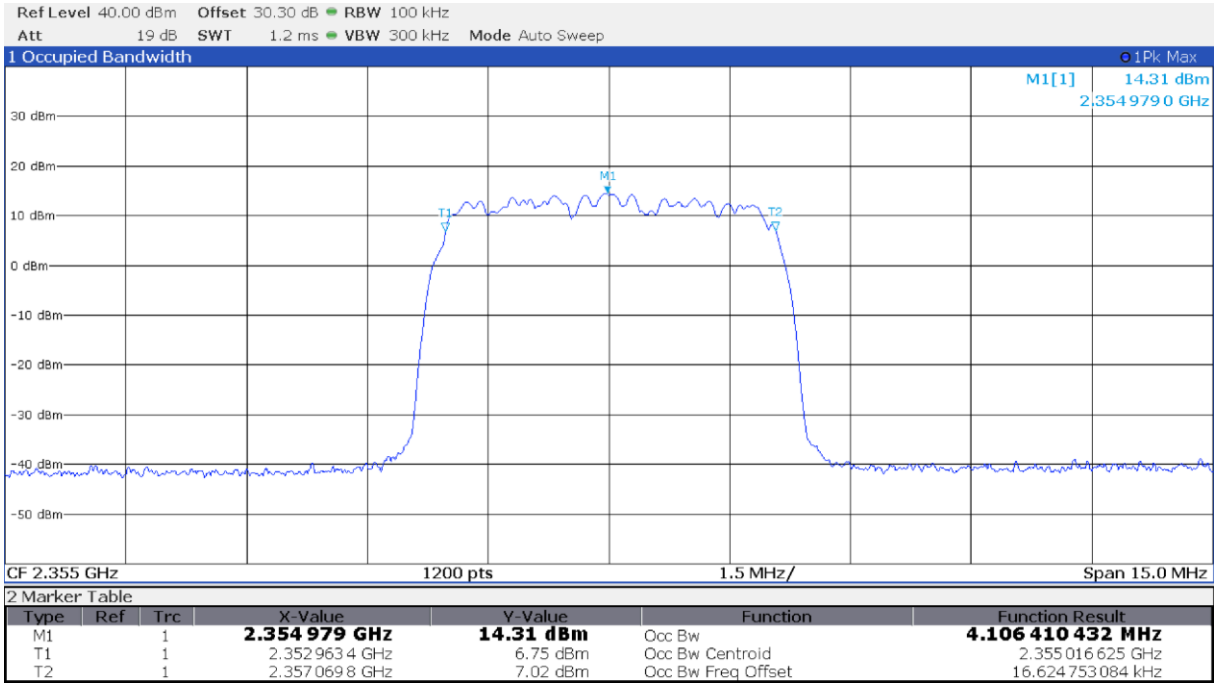


Figure 8.3-10: *99% occupied bandwidth, antenna port 1 output signal at AGC threshold spectral plot*

Test data, continued

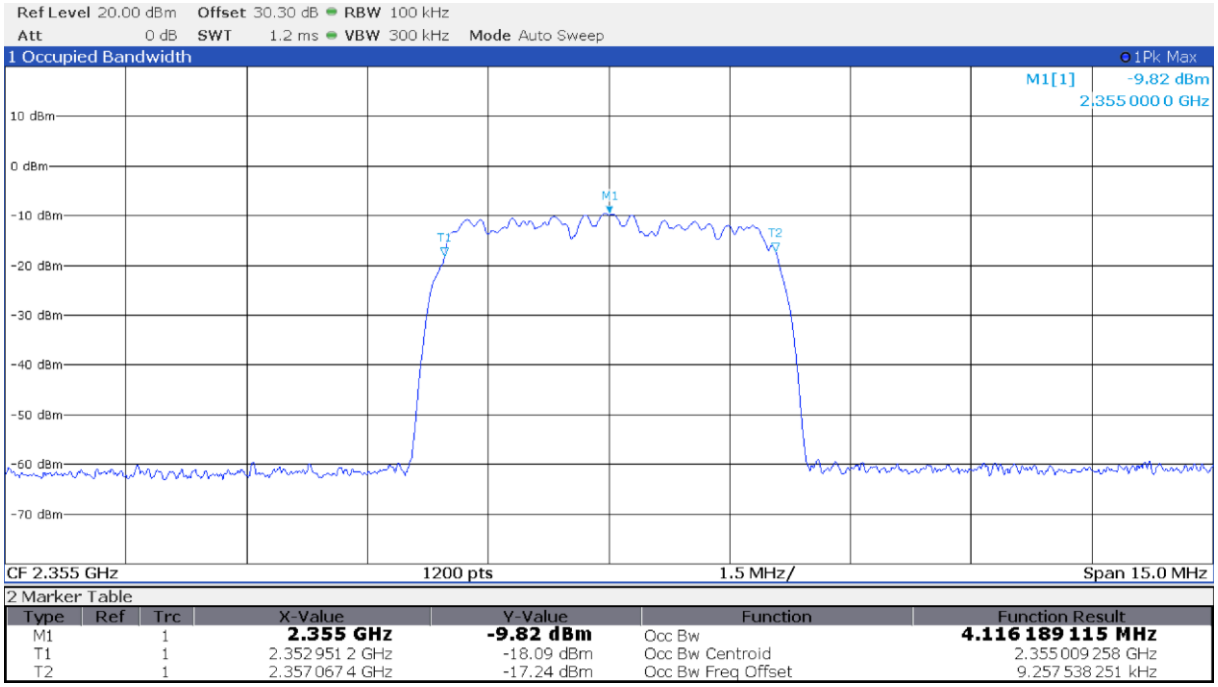


Figure 8.3-11: *99% occupied bandwidth, antenna port 1 input signal at AGC threshold +3 dB spectral plot*

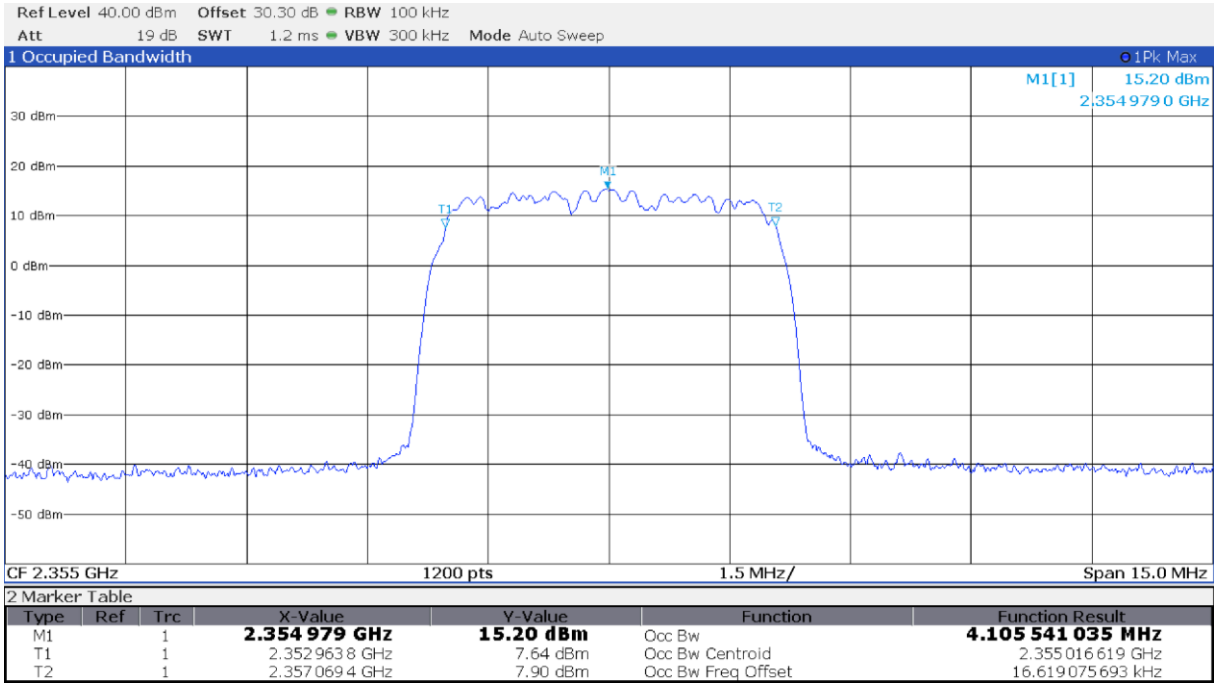


Figure 8.3-12: *99% occupied bandwidth, antenna port 1 output signal at AGC threshold +3 dB spectral plot*

Test data, continued

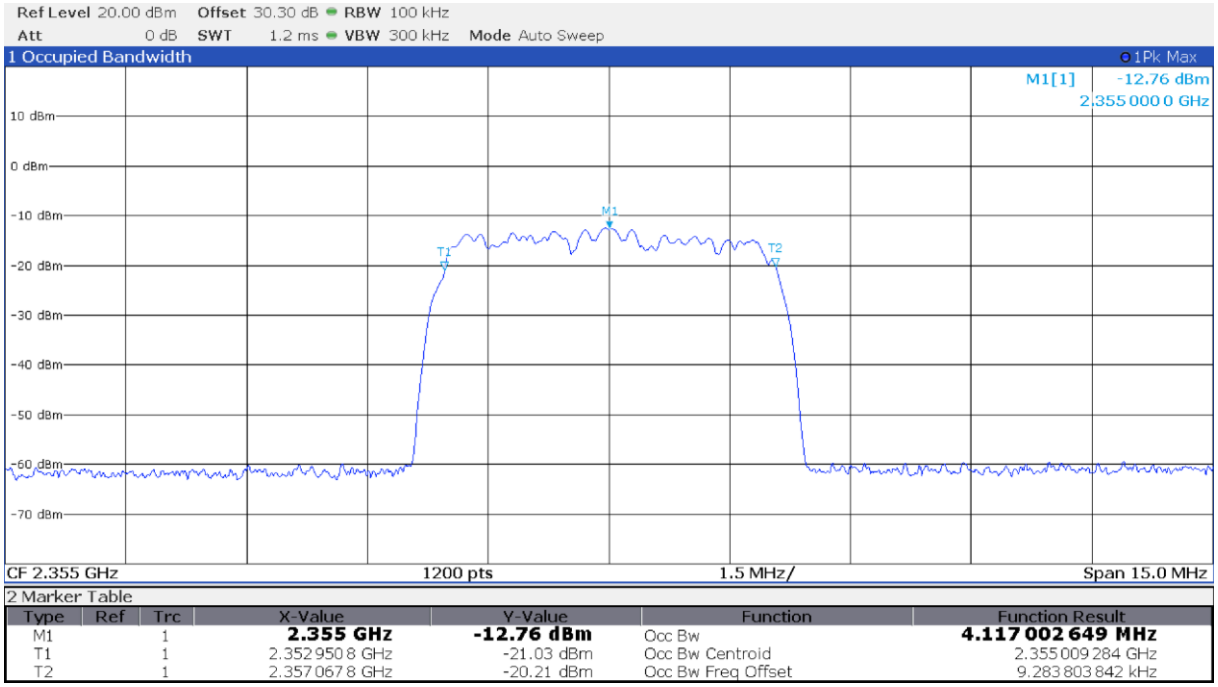


Figure 8.3-13: *99% occupied bandwidth, antenna port 2 input signal at AGC threshold spectral plot*

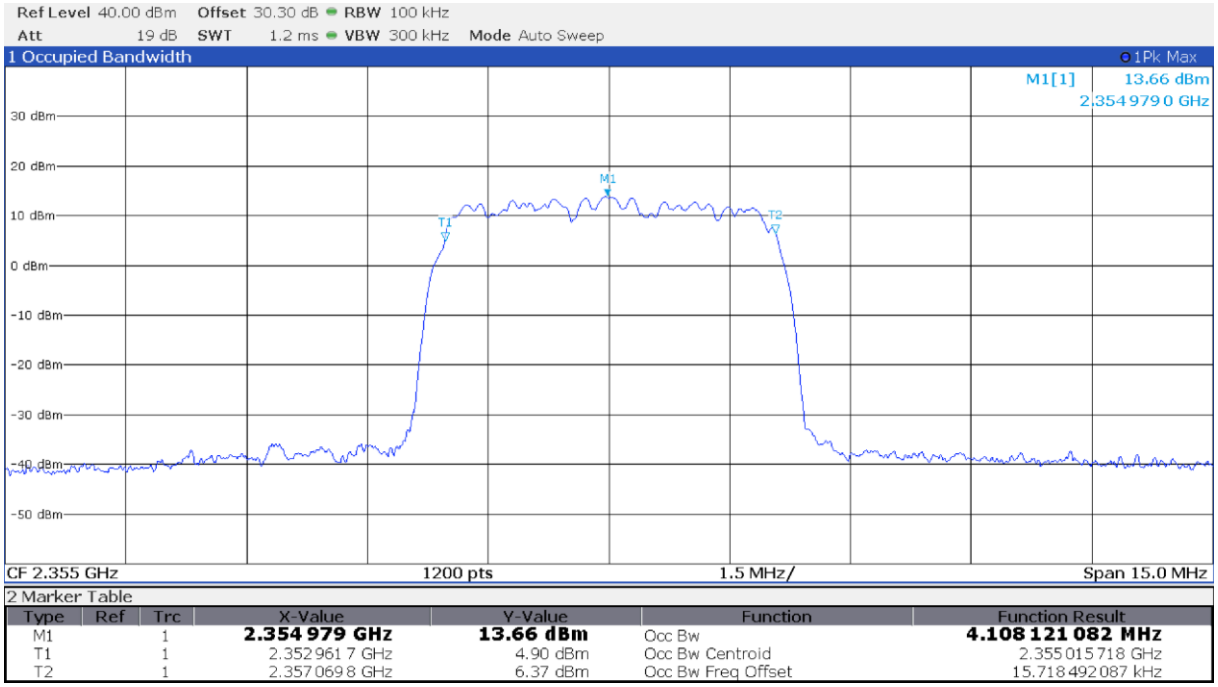


Figure 8.3-14: *99% occupied bandwidth, antenna port 2 output signal at AGC threshold spectral plot*

Test data, continued

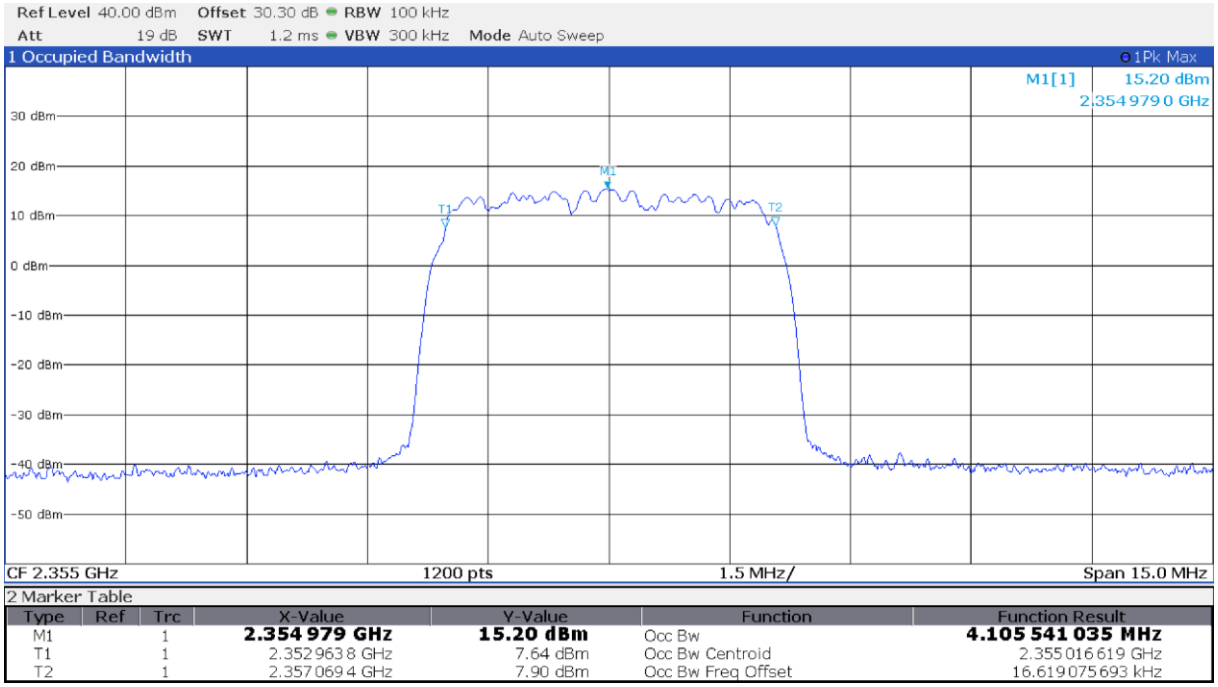


Figure 8.3-15: *99% occupied bandwidth, antenna port 2 input signal at AGC threshold +3 dB spectral plot*

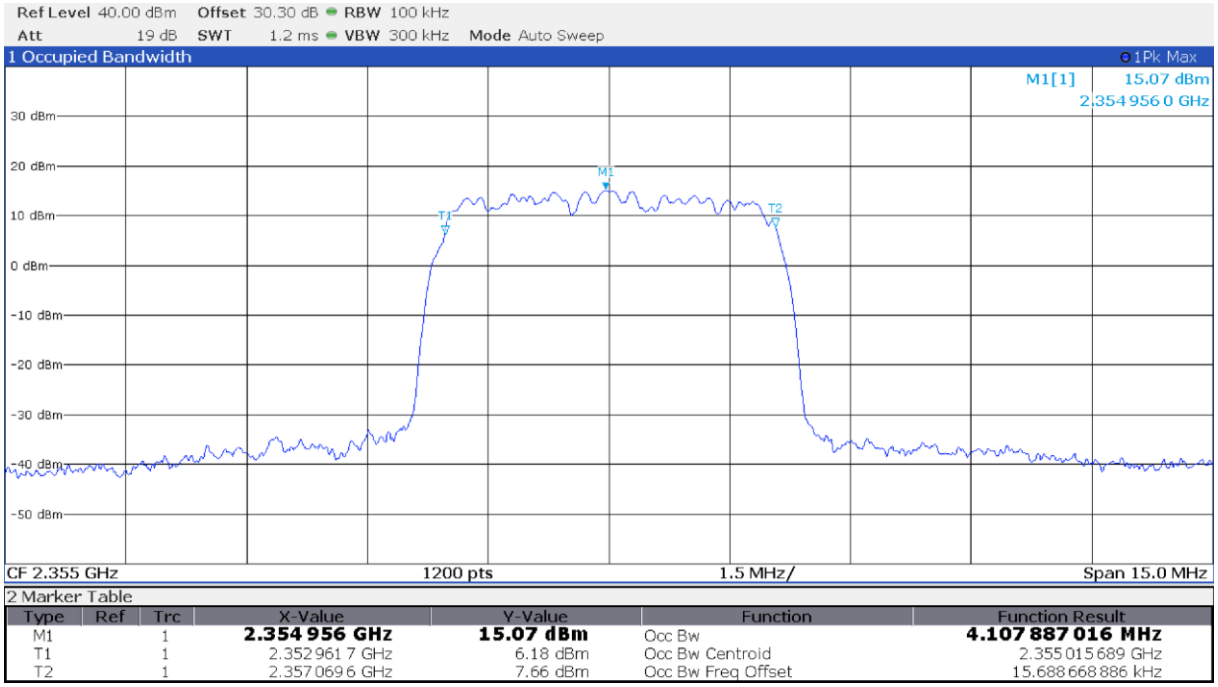


Figure 8.3-16: *99% occupied bandwidth, antenna port 2 output signal at AGC threshold +3 dB spectral plot*

8.4 Mean output power and amplifier/booster gain

8.4.1 References, definitions and limits

FCC §27.50(a)

(a) The following power limits and related requirements apply to stations transmitting in the 2305-2320 MHz band or the 2345-2360 MHz band.

(1) Base and fixed stations.

(i) For base and fixed stations transmitting in the 2305-2315 MHz band or the 2350-2360 MHz band:

(A) The average equivalent isotropically radiated power (EIRP) must not exceed 2,000 watts within any 5 megahertz of authorized bandwidth and must not exceed 400 watts within any 1 megahertz of authorized bandwidth.

(B) The peak-to-average power ratio (PAPR) of the transmitter output power must not exceed 13 dB. The PAPR measurements should be made using either an instrument with complementary cumulative distribution function (CCDF) capabilities to determine that PAPR will not exceed 13 dB for more than 0.1 percent of the time or other Commission approved procedure. The measurement must be performed using a signal corresponding to the highest PAPR expected during periods of continuous transmission.

(ii) For base and fixed stations transmitting in the 2315-2320 MHz band or the 2345-2350 MHz band, the peak EIRP must not exceed 2000 watts.

(2) Fixed customer premises equipment stations. For fixed customer premises equipment (CPE) stations transmitting in the 2305-2320 MHz band or in the 2345-2360 MHz band, the peak EIRP must not exceed 20 watts within any 5 megahertz of authorized bandwidth. Fixed CPE stations transmitting in the 2305-2320 MHz band or in the 2345-2360 MHz band must employ automatic transmit power control when operating so the stations operate with the minimum power necessary for successful communications. The use of outdoor antennas for CPE stations or outdoor CPE station installations operating with 2 watts per 5 megahertz or less average EIRP using the stepped emissions mask prescribed in § 27.53(a)(3) is prohibited except if professionally installed in locations removed by 20 meters from roadways or in locations where it can be shown that the ground power level of −44 dBm in the A or B blocks or −55 dBm in the C or D blocks will not be exceeded at the nearest road location. The use of outdoor antennas for fixed CPE stations operating with 2 watts per 5 megahertz or less average EIRP and the emissions mask prescribed in § 27.53(a)(1)(i) through (iii) is permitted in all locations. For fixed WCS CPE using TDD technology, the duty cycle must not exceed 38 percent;

(3) Mobile and portable stations.

(i) For mobile and portable stations transmitting in the 2305-2315 MHz band or the 2350-2360 MHz band, the average EIRP must not exceed 50 milliwatts within any 1 megahertz of authorized bandwidth, except that for mobile and portable stations compliant with 3GPP LTE standards or another advanced mobile broadband protocol that avoids concentrating energy at the edge of the operating band the average EIRP must not exceed 250 milliwatts within any 5 megahertz of authorized bandwidth but may exceed 50 milliwatts within any 1 megahertz of authorized bandwidth. For mobile and portable stations using time division duplexing (TDD) technology, the duty cycle must not exceed 38 percent in the 2305-2315 MHz and 2350-2360 MHz bands. Mobile and portable stations using FDD technology are restricted to transmitting in the 2305-2315 MHz band. Power averaging shall not include intervals in which the transmitter is off.

(ii) Mobile and portable stations are not permitted to transmit in the 2315-2320 MHz and 2345-2350 MHz bands.

(iii) Automatic transmit power control. Mobile and portable stations transmitting in the 2305-2315 MHz band or in the 2350-2360 MHz band must employ automatic transmit power control when operating so the stations operate with the minimum power necessary for successful communications.

(iv) Prohibition on external vehicle-mounted antennas. The use of external vehicle-mounted antennas for mobile and portable stations transmitting in the 2305-2315 MHz band or the 2350-2360 MHz band is prohibited.

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-195, Clause 5.5
Transmitter Output Power and Equivalent Isotropically Radiated Power
The equivalent isotropically radiated power (e.i.r.p.) of base and fixed station equipment shall comply with the e.i.r.p. limit in SRSP-516.
The e.i.r.p. of fixed subscriber equipment shall not exceed 20 W/5 MHz.
The e.i.r.p. of mobile or portable equipment transmitting in the band 2305-2315 MHz or the band 2350-2360 MHz, employing 3GPP LTE (Third Generation Partnership Project Long Term Evolution) standards, shall not exceed 250 mW within any 5 MHz bandwidth. For other technologies, the e.i.r.p. shall not exceed 50 mW within any 1 MHz bandwidth.
RSS-195, Clause 5.5.1
Peak to Average Power Ratio (PAPR) for Base and Fixed Station Equipment in the Frequency Ranges 2305-2315 MHz and 2350-2360 MHz
The PAPR of the transmitter output power of base and fixed station 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 3, 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	2355	-4.9	22.4	0.174	27.3
1	AGC threshold +3 dB	2355	-1.9	22.6	0.182	24.5
2	AGC threshold	2355	-5.0	22.4	0.174	27.4
2	AGC threshold +3 dB	2355	-2.0	22.5	0.178	24.5

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

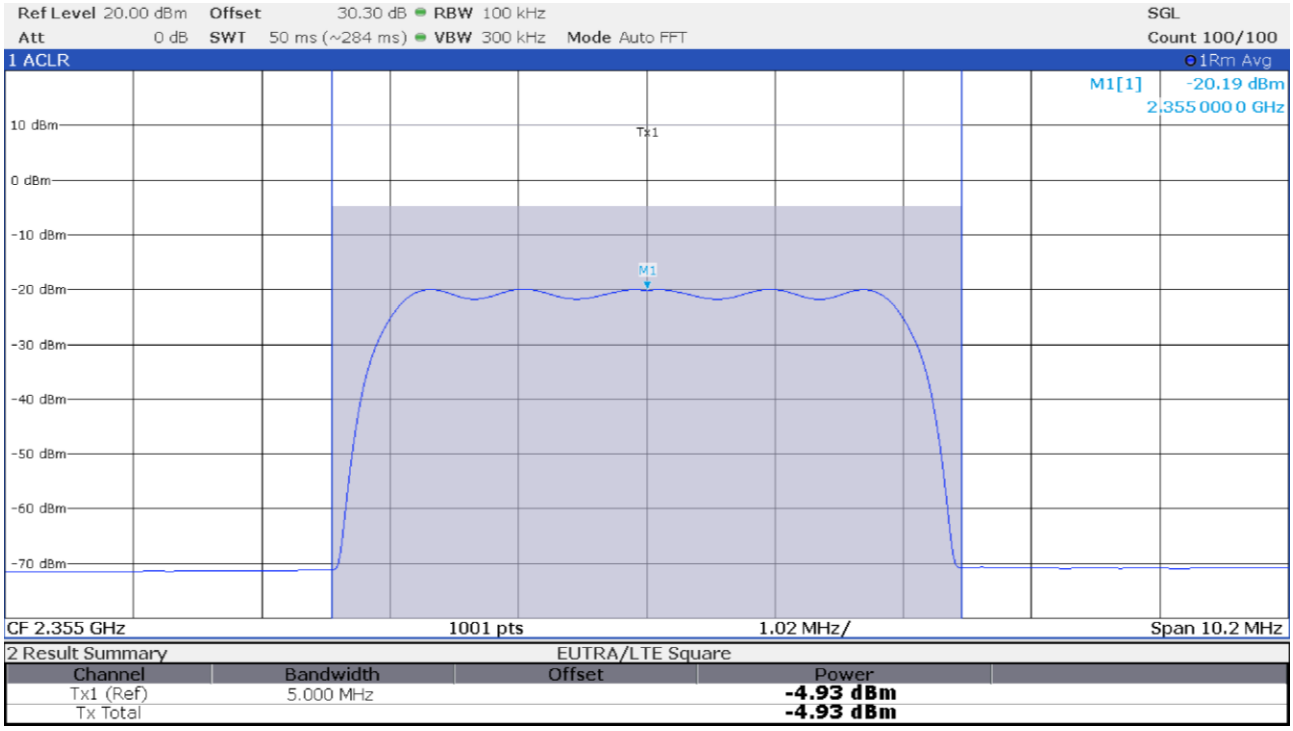


Figure 8.4-1: *Input power at antenna port 1 with input signal at AGC threshold*

Test data, continued

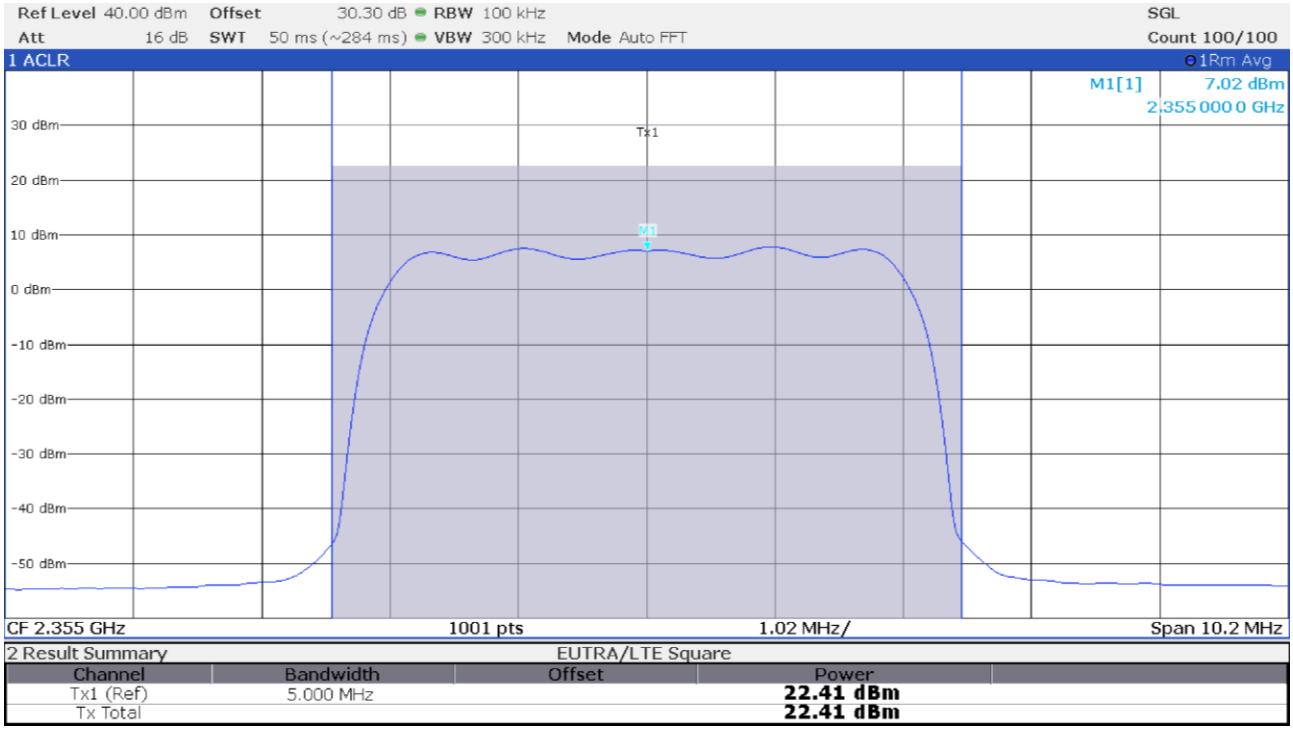


Figure 8.4-2: *Output power at antenna port 1 with input signal at AGC threshold*

Test data, continued

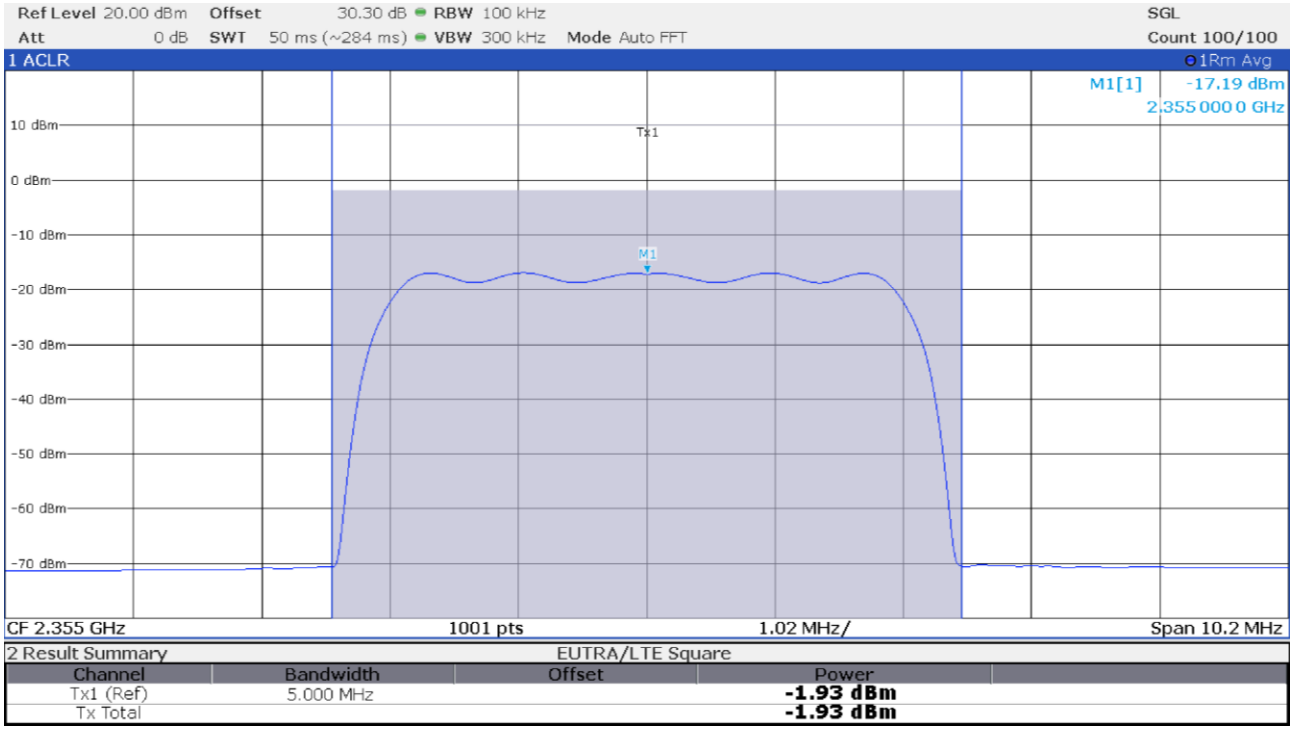


Figure 8.4-3: *Input power at antenna port 1 with input signal at AGC threshold +3 dB*

Test data, continued

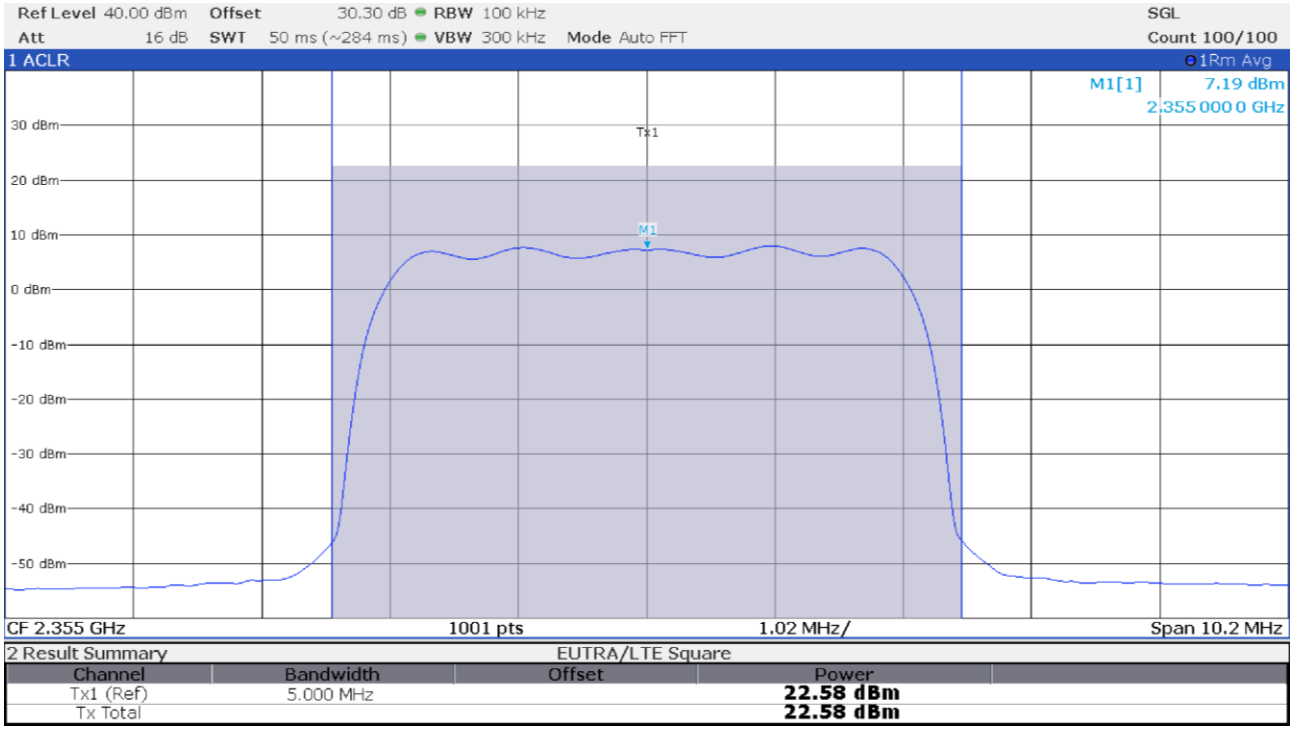


Figure 8.4-4: *Output power at antenna port 1 with input signal at AGC threshold +3 dB*

Test data, continued

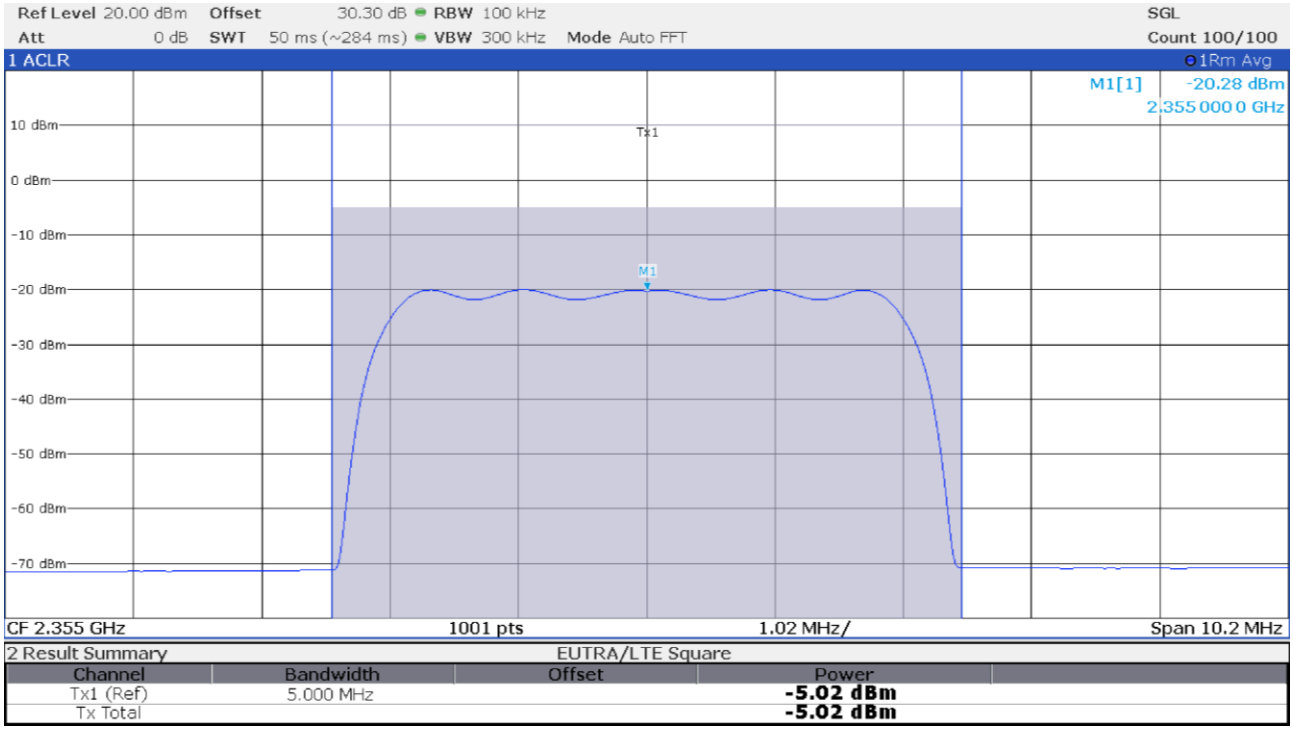


Figure 8.4-5: *Input power at antenna port 2 with input signal at AGC threshold*

Test data, continued

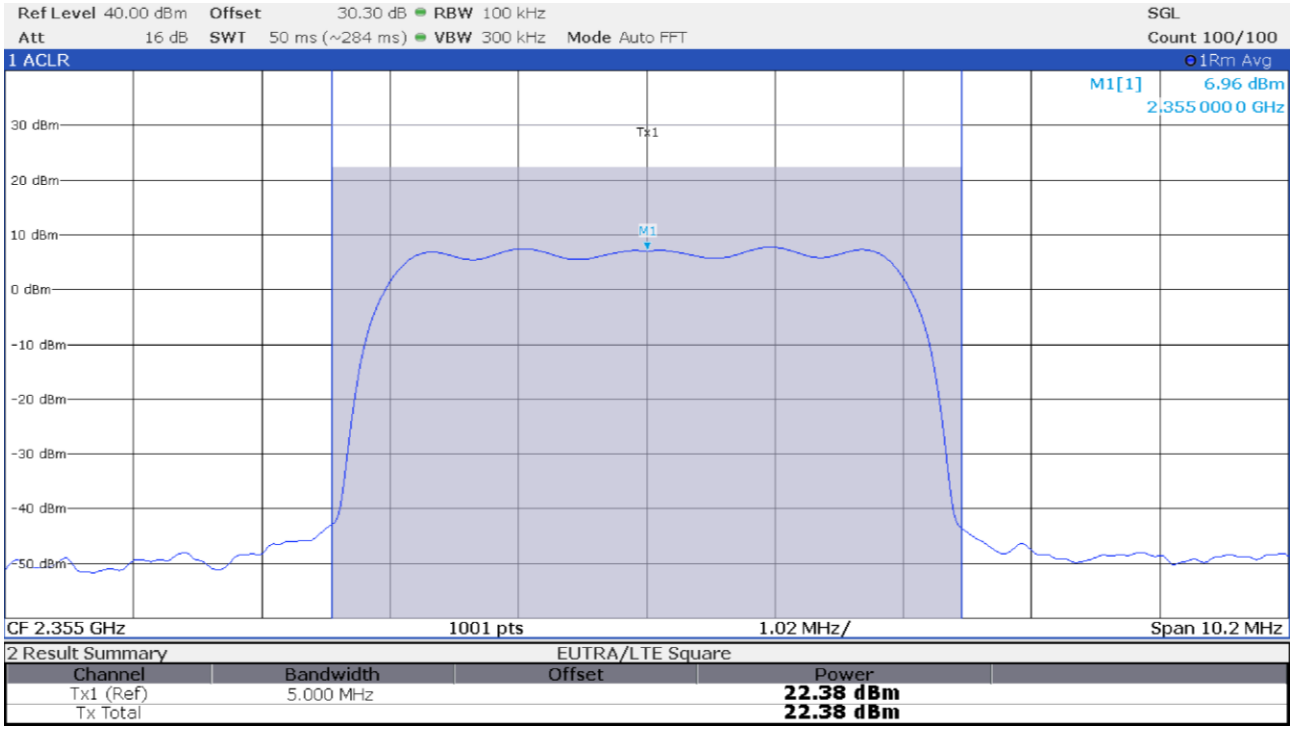


Figure 8.4-6: *Output power at antenna port 2 with input signal at AGC threshold*

Test data, continued

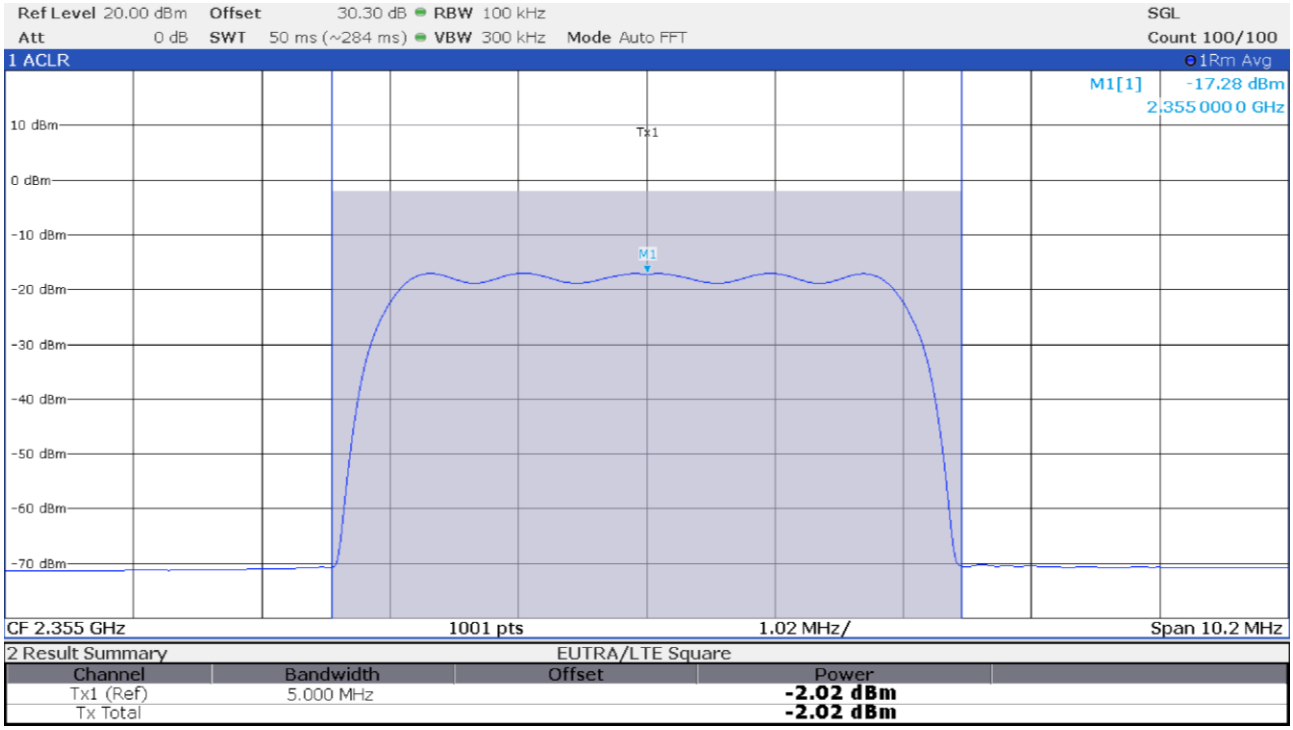


Figure 8.4-7: *Input power at antenna port 2 with input signal at AGC threshold +3 dB*

Test data, continued

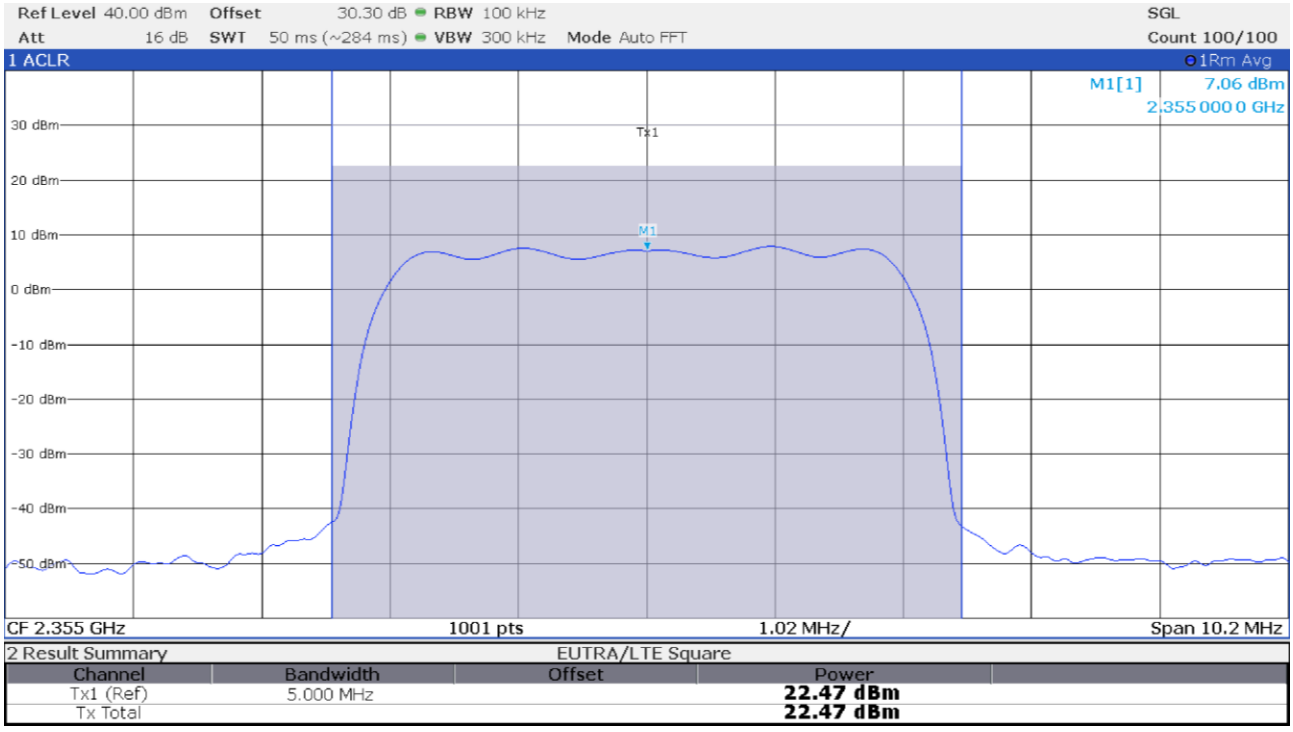


Figure 8.4-8: *Output power at antenna port 2 with input signal at AGC threshold +3 dB*

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	2355	4.44	13.00	-8.56
1	AGC threshold +3 dB	2355	4.44	13.00	-8.56
2	AGC threshold	2355	4.44	13.00	-8.56
2	AGC threshold +3 dB	2355	4.44	13.00	-8.56

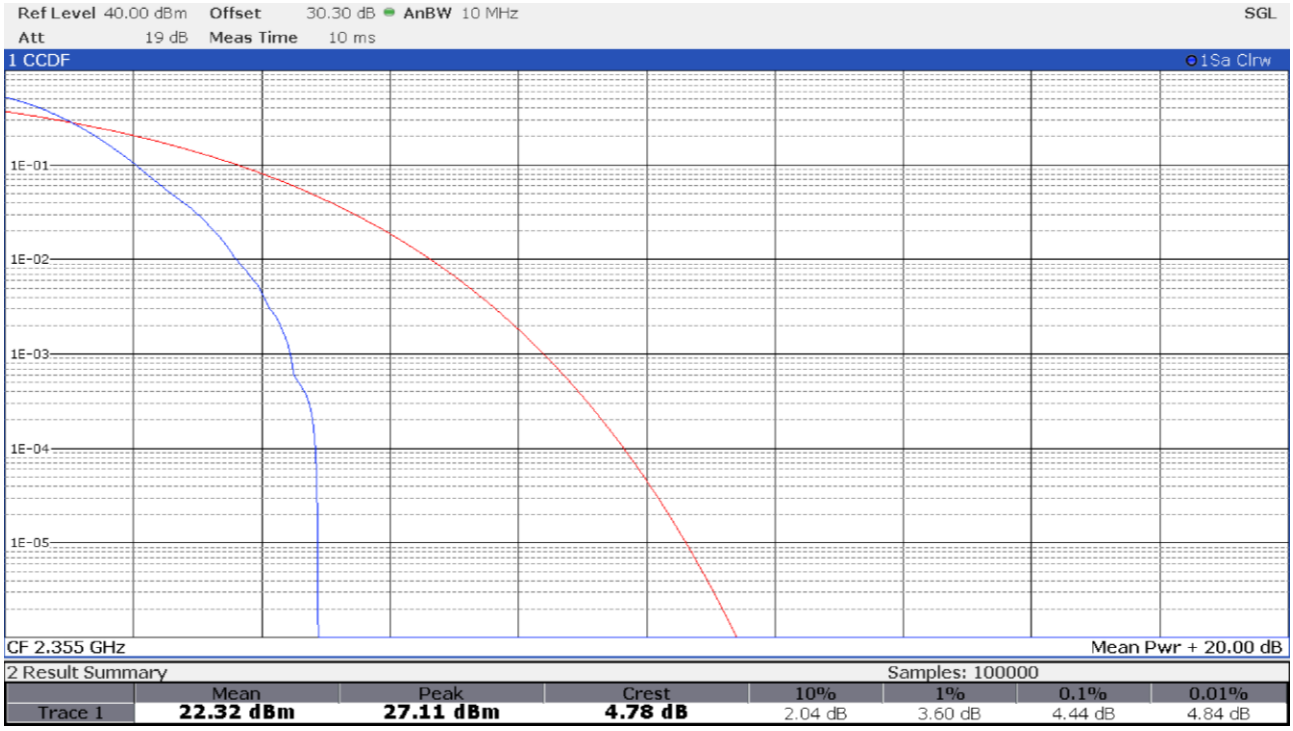


Figure 8.4-9: *PAPR at antenna port 1 with input signal at AGC threshold*

Test data, continued

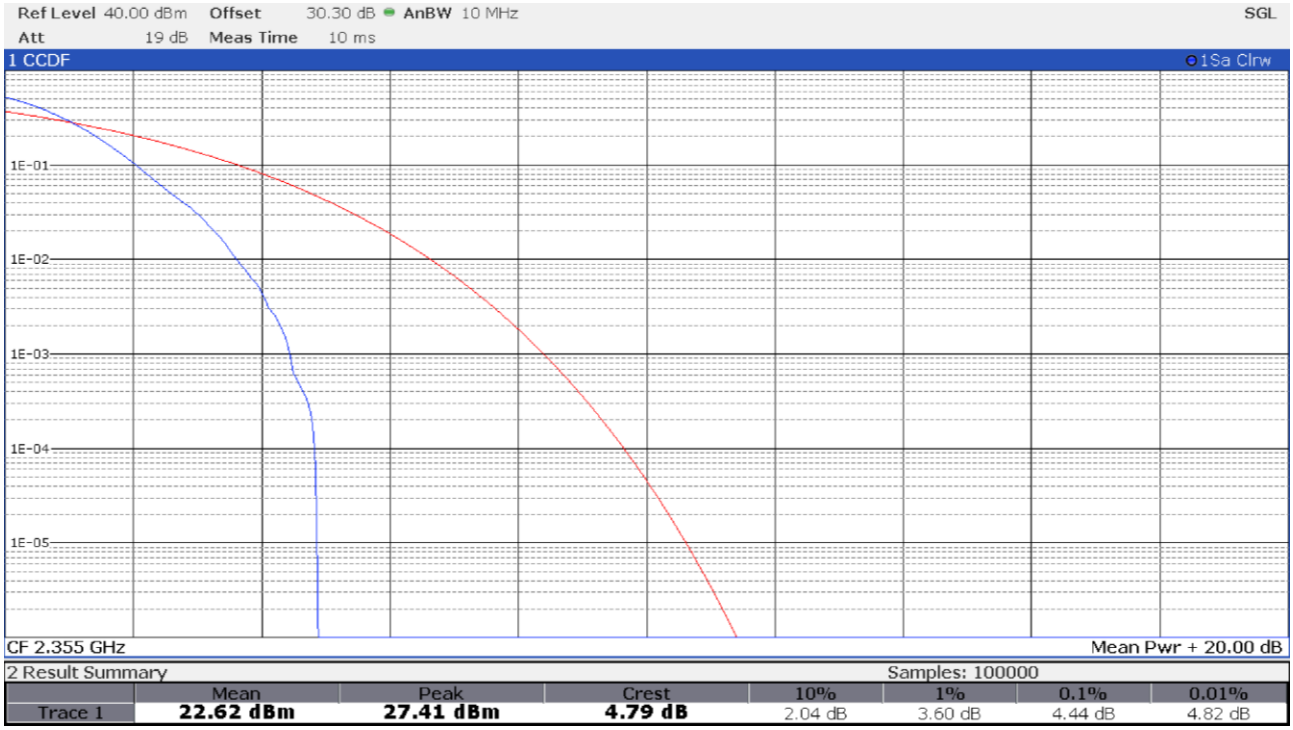


Figure 8.4-10: *PAPR at antenna port 1 with input signal at AGC threshold +3 dB*

Test data, continued

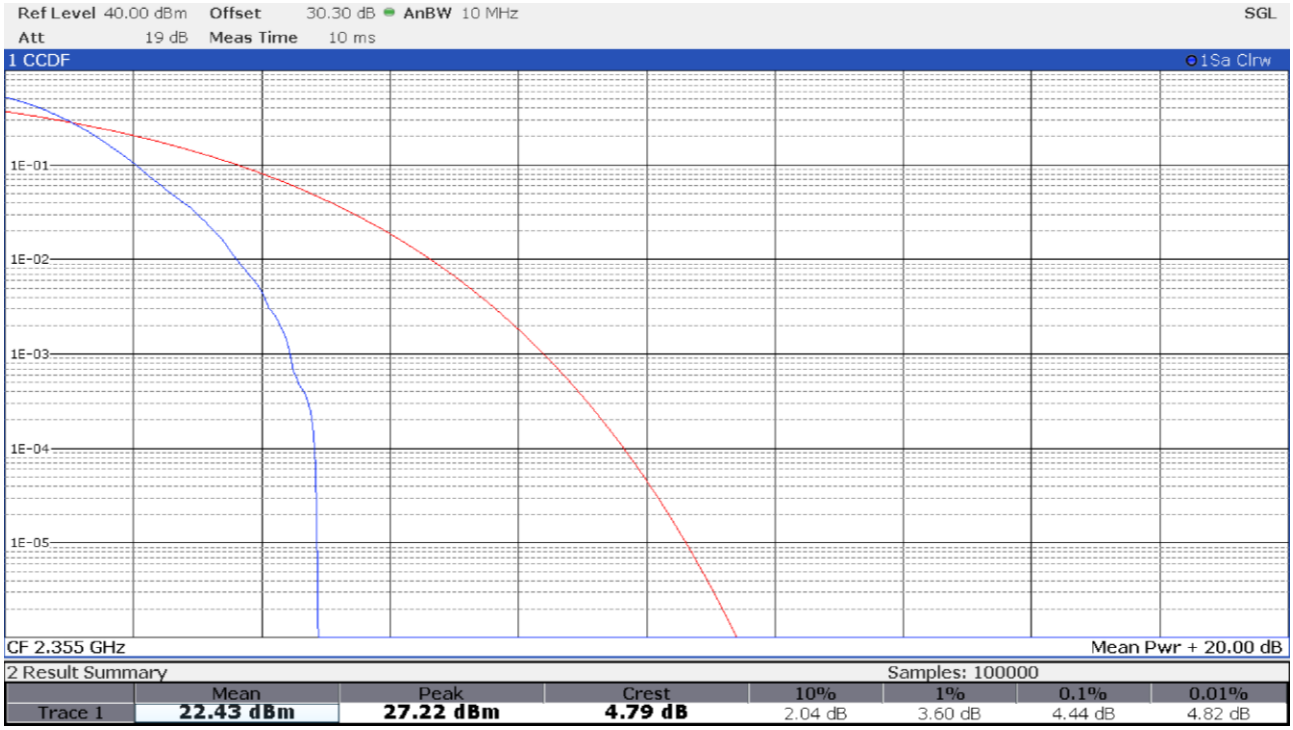


Figure 8.4-11: *PAPR at antenna port 2 with input signal at AGC threshold*

Test data, continued

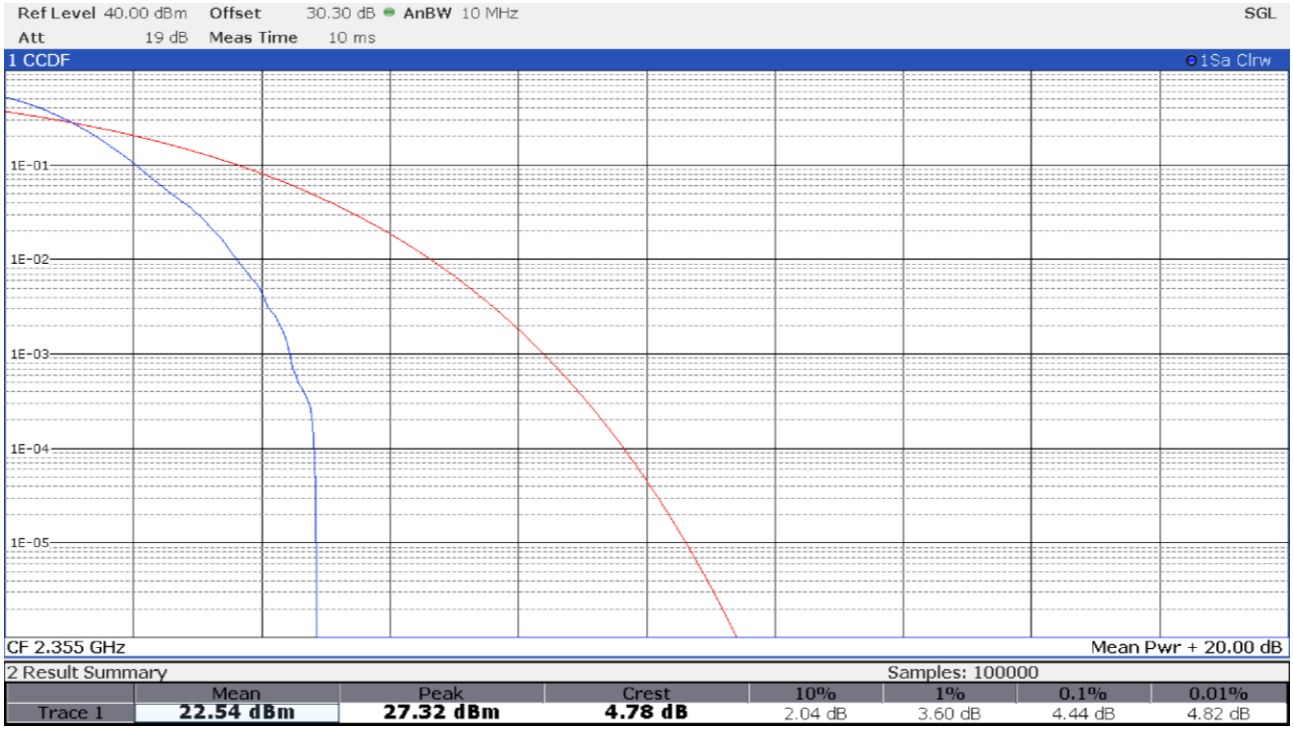


Figure 8.4-12: *PAPR at antenna port 2 with input signal at AGC threshold +3 dB*

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

8.5.1 References, definitions and limits

FCC §27.53(a):

(a) For operations in the 2305-2320 MHz band and the 2345-2360 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power P (with averaging performed only during periods of transmission) within the licensed band(s) of operation, in watts, by the following amounts:

(1) For base and fixed stations' operations in the 2305-2320 MHz band and the 2345-2360 MHz band:

(i) By a factor of not less than 43 + 10 log (P) dB on all frequencies between 2305 and 2320 MHz and on all frequencies between 2345 and 2360 MHz that are outside the licensed band(s) of operation, and not less than 75 + 10 log (P) dB on all frequencies between 2320 and 2345 MHz;

(ii) By a factor of not less than 43 + 10 log (P) dB on all frequencies between 2300 and 2305 MHz, 70 + 10 log (P) dB on all frequencies between 2287.5 and 2300 MHz, 72 + 10 log (P) dB on all frequencies between 2285 and 2287.5 MHz, and 75 + 10 log (P) dB below 2285 MHz;

(iii) By a factor of not less than 43 + 10 log (P) dB on all frequencies between 2360 and 2362.5 MHz, 55 + 10 log (P) dB on all frequencies between 2362.5 and 2365 MHz, 70 + 10 log (P) dB on all frequencies between 2365 and 2367.5 MHz, 72 + 10 log (P) dB on all frequencies between 2367.5 and 2370 MHz, and 75 + 10 log (P) dB above 2370 MHz.

(2) For fixed customer premises equipment (CPE) stations operating in the 2305-2320 MHz band and the 2345-2360 MHz band transmitting with more than 2 watts per 5 megahertz average EIRP:

(i) By a factor of not less than 43 + 10 log (P) dB on all frequencies between 2305 and 2320 MHz and on all frequencies between 2345 and 2360 MHz that are outside the licensed band(s) of operation, and not less than 75 + 10 log (P) dB on all frequencies between 2320 and 2345 MHz;

(ii) By a factor of not less than 43 + 10 log (P) dB on all frequencies between 2300 and 2305 MHz, 70 + 10 log (P) dB on all frequencies between 2287.5 and 2300 MHz, 72 + 10 log (P) dB on all frequencies between 2285 and 2287.5 MHz, and 75 + 10 log (P) dB below 2285 MHz;

(iii) By a factor of not less than 43 + 10 log (P) dB on all frequencies between 2360 and 2362.5 MHz, 55 + 10 log (P) dB on all frequencies between 2362.5 and 2365 MHz, 70 + 10 log (P) dB on all frequencies between 2365 and 2367.5 MHz, 72 + 10 log (P) dB on all frequencies between 2367.5 and 2370 MHz, and 75 + 10 log (P) dB above 2370 MHz.

(3) For fixed CPE stations operating in the 2305-2320 MHz and 2345-2360 MHz bands transmitting with 2 watts per 5 megahertz average EIRP or less:

(i) By a factor of not less than 43 + 10 log (P) dB on all frequencies between 2305 and 2320 MHz and on all frequencies between 2345 and 2360 MHz that are outside the licensed band(s) of operation, not less than 55 + 10 log (P) dB on all frequencies between 2320 and 2324 MHz and between 2341 and 2345 MHz, not less than 61 + 10 log (P) dB on all frequencies between 2324 and 2328 MHz and between 2337 and 2341 MHz, and not less than 67 + 10 log (P) dB on all frequencies between 2328 and 2337 MHz;

(ii) By a factor of not less than 43 + 10 log (P) dB on all frequencies between 2300 and 2305 MHz, 55 + 10 log (P) dB on all frequencies between 2296 and 2300 MHz, 61 + 10 log (P) dB on all frequencies between 2292 and 2296 MHz, 67 + 10 log (P) dB on all frequencies between 2288 and 2292 MHz, and 70 + 10 log (P) dB below 2288 MHz;

(iii) By a factor of not less than 43 + 10 log (P) dB on all frequencies between 2360 and 2365 MHz, and not less than 70 + 10 log (P) dB above 2365 MHz.

(4) For mobile and portable stations operating in the 2305-2315 MHz and 2350-2360 MHz bands:

(i) By a factor of not less than: 43 + 10 log (P) dB on all frequencies between 2305 and 2320 MHz and on all frequencies between 2345 and 2360 MHz that are outside the licensed band(s) of operation, not less than 55 + 10 log (P) dB on all frequencies between 2320 and 2324 MHz and on all frequencies between 2341 and 2345 MHz, not less than 61 + 10 log (P) dB on all frequencies between 2324 and 2328 MHz and on all frequencies between 2337 and 2341 MHz, and not less than 67 + 10 log (P) dB on all frequencies between 2328 and 2337 MHz;

(ii) By a factor of not less than 43 + 10 log (P) dB on all frequencies between 2300 and 2305 MHz, 55 + 10 log (P) dB on all frequencies between 2296 and 2300 MHz, 61 + 10 log (P) dB on all frequencies between 2292 and 2296 MHz, 67 + 10 log (P) dB on all frequencies between 2288 and 2292 MHz, and 70 + 10 log (P) dB below 2288 MHz;

(iii) By a factor of not less than 43 + 10 log (P) dB on all frequencies between 2360 and 2365 MHz, and not less than 70 + 10 log (P) dB above 2365 MHz.

(5) Measurement procedure. Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the channel blocks at 2305, 2310, 2315, 2320, 2345, 2350, 2355, and 2360 MHz, a resolution bandwidth of at least 1 percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e., 1 MHz). 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.

(6) [Reserved]
(7) 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;
(8) Waiver requests of any of the out-of-band emission limits in paragraphs (a)(1) through (a)(7) of this section shall be entertained only if interference protection equivalent to that afforded by the limits is shown;
(9) [Reserved]
(10) The out-of-band emissions limits in paragraphs (a)(1) through (a)(3) of this section may be modified by the private contractual agreement of all affected licensees, who must maintain a copy of the agreement in their station files and disclose it to prospective assignees, transferees, or spectrum lessees and, upon request, 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-195, Clause 5.6.1

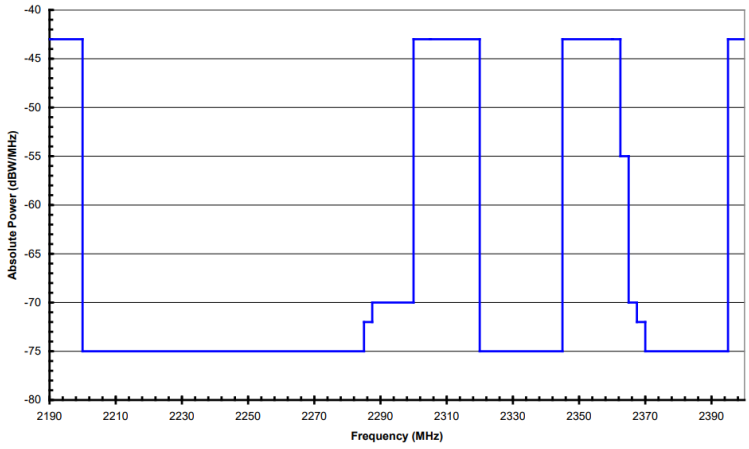
The power of any emission outside the frequency range(s) in which the equipment operates shall be attenuated below the transmitter power, P(dBW), by the amount indicated in Table 1 and graphically represented in Figure 1, where p is the transmitter output power measured in watts.

Table 1 — Unwanted Emissions for Base Station, Fixed Station and High-Power Fixed Subscriber Equipment

Frequency (MHz)	Attenuation (dB)
<2200	$43 + 10 \log_{10}(p)$
2200 - 2285	$75 + 10 \log_{10}(p)$
2285 - 2287.5	$72 + 10 \log_{10}(p)$
2287.5 - 2300	$70 + 10 \log_{10}(p)$
2300 - 2305	$43 + 10 \log_{10}(p)$
2305 - 2320	$43 + 10 \log_{10}(p)$ Note
2320 - 2345	$75 + 10 \log_{10}(p)$
2345 - 2360	$43 + 10 \log_{10}(p)$ Note
2360 - 2362.5	$43 + 10 \log_{10}(p)$
2362.5 - 2365	$55 + 10 \log_{10}(p)$
2365 - 2367.5	$70 + 10 \log_{10}(p)$
2367.5 - 2370	$72 + 10 \log_{10}(p)$
2370 - 2395	$75 + 10 \log_{10}(p)$
>2395	$43 + 10 \log_{10}(p)$

Note: Measured at the edges of the highest and lowest frequency range(s) in which the equipment is designed to operate. See Section 5.2 for the permitted frequency ranges for the various equipment types.

Figure 1: Unwanted Emissions for Base Station, Fixed Station and High-Power Fixed Subscriber Equipment



8.5.2 Test summary

Verdict	Pass		
Tested by	P. Barbieri	Test date	February 3, 2022

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
The other limits are reduced by 3 dB as for -13 dBm limit.

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:	2352.5 MHz and 2357.5 MHz
Lower block edge intermodulation products:	2352.5 MHz and 2357.5 MHz
Upper block edge, single carrier:	2357.5 MHz
Lower block edge, single carrier:	2352.5 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

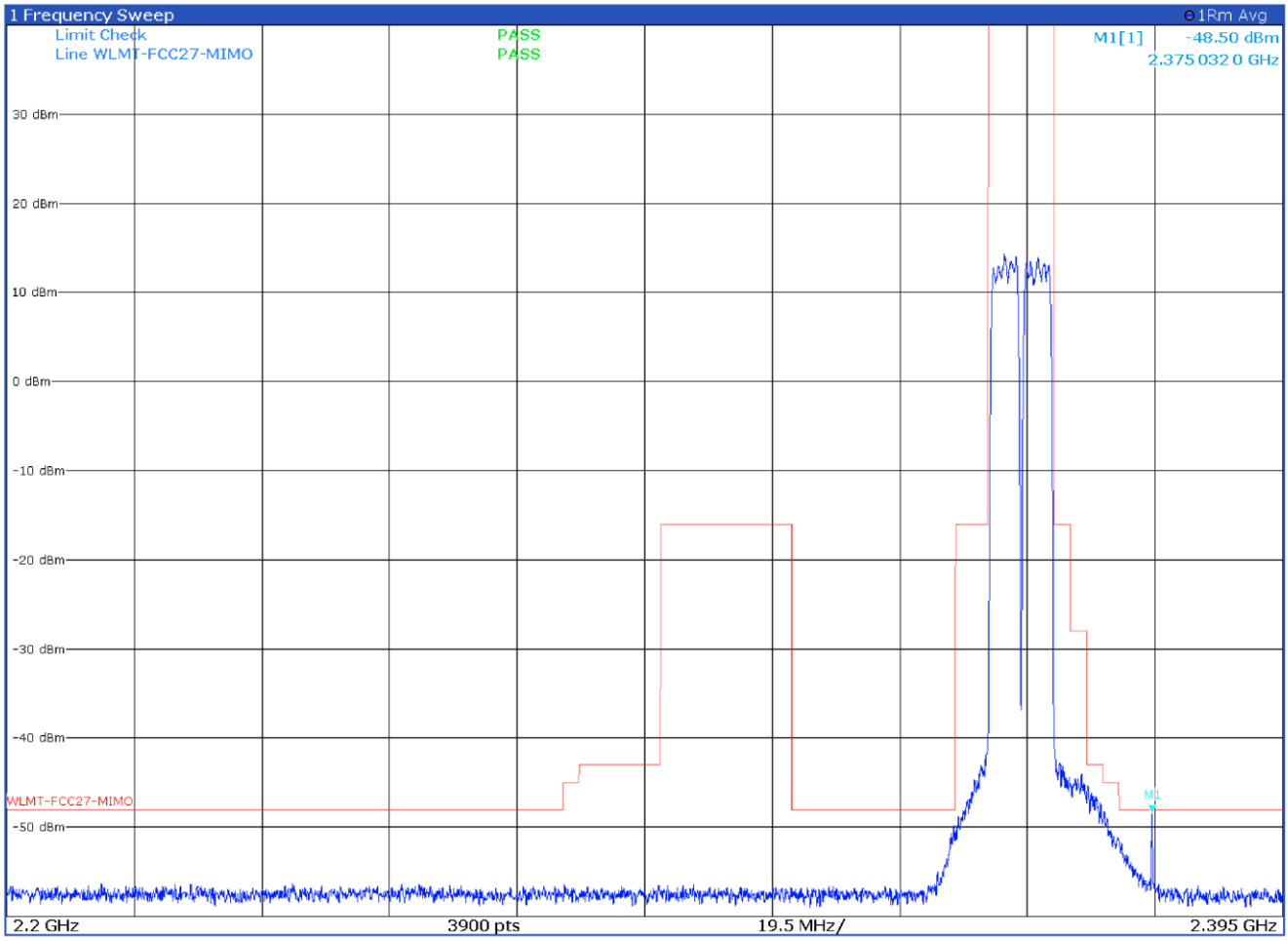


Figure 8.5-1: *Antenna port 1 upper and lower block edge intermodulation products with input signal at AGC threshold*

Test data, continued

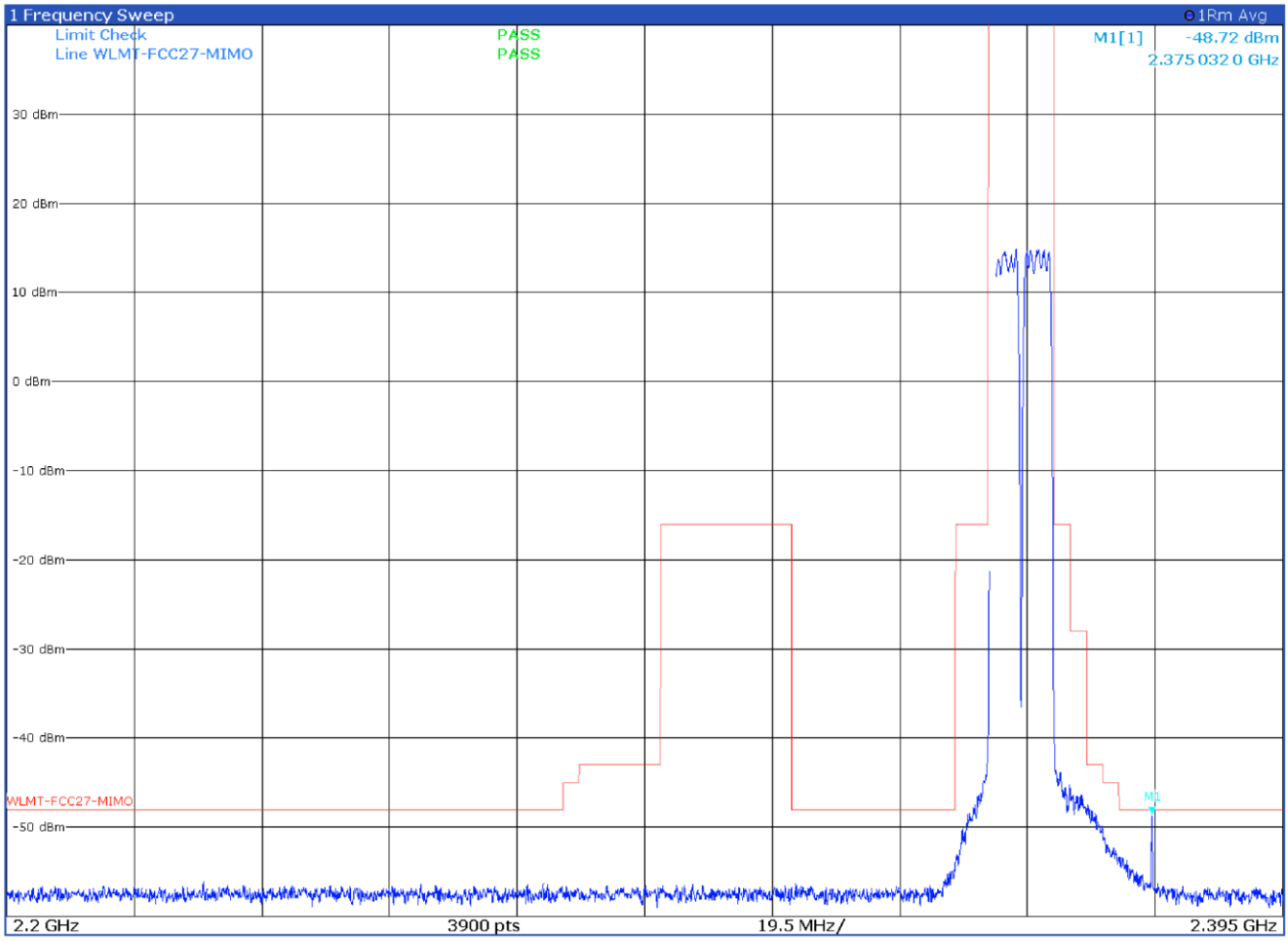


Figure 8.5-2: *Antenna port 1 upper and lower block edge intermodulation products with input signal at AGC threshold +3 dB*

Test data, continued

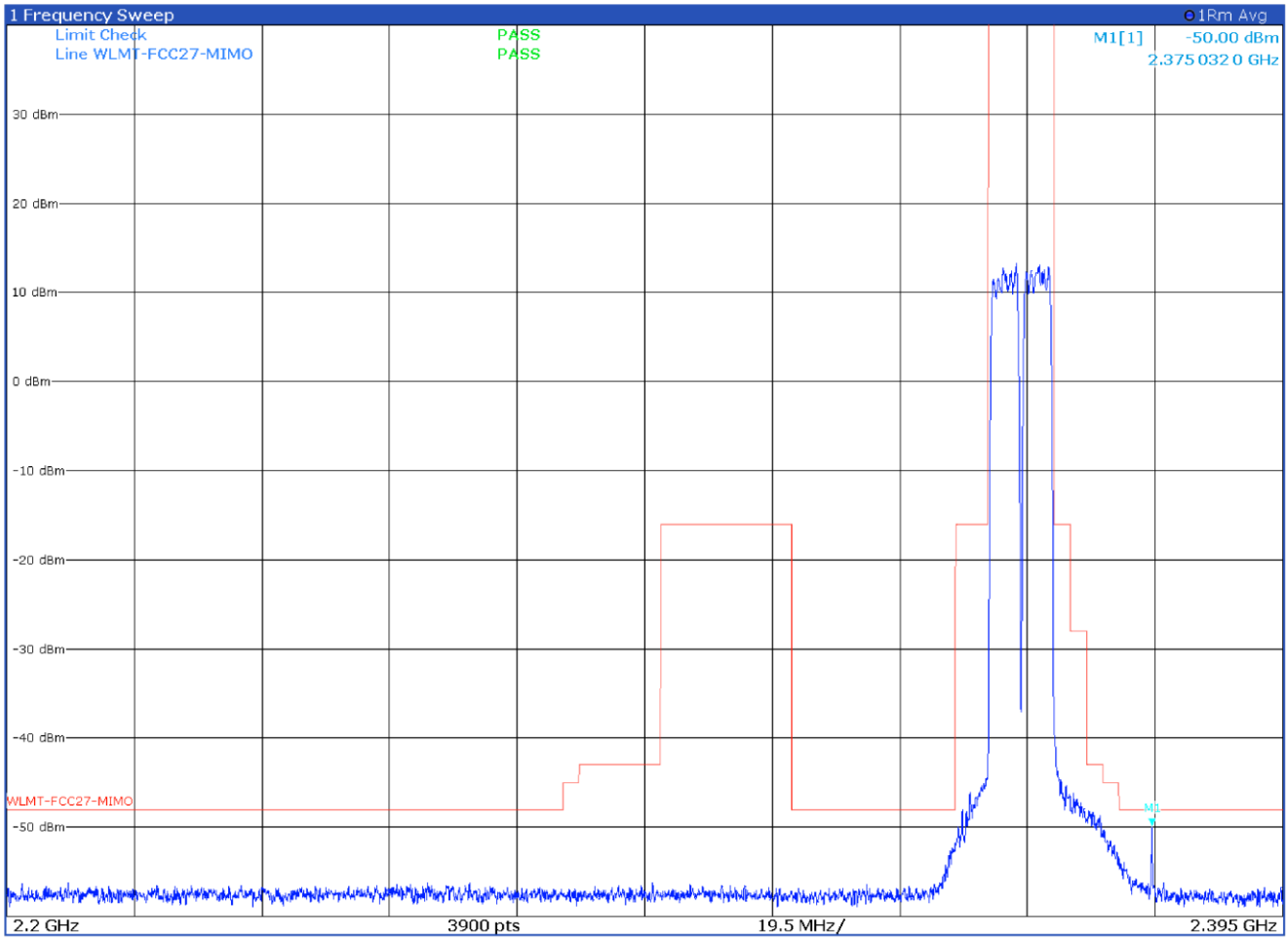


Figure 8.5-3: *Antenna port 2 upper and lower block edge intermodulation products with input signal at AGC threshold*

Test data, continued

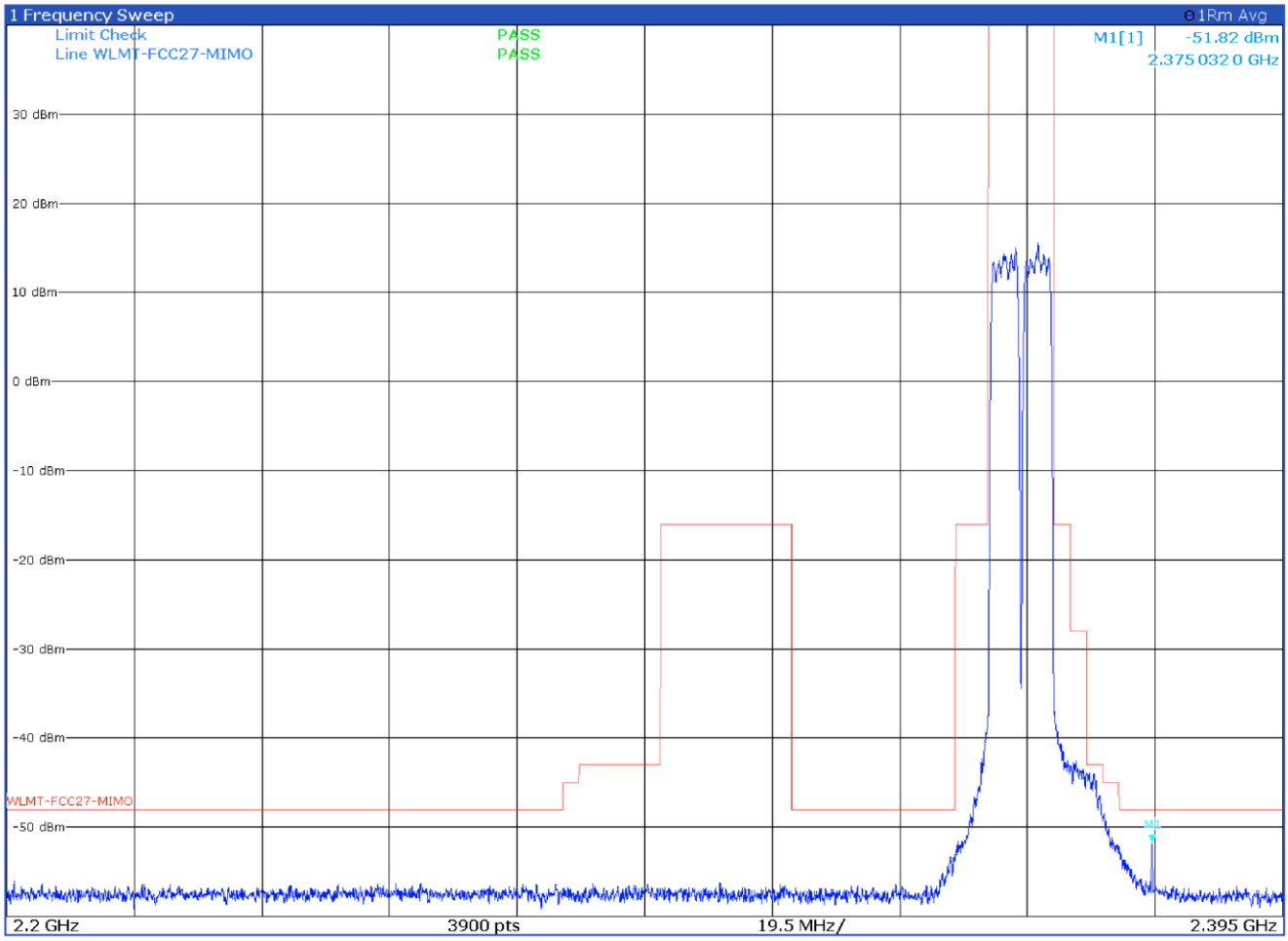


Figure 8.5-4: *Antenna port 2 upper and lower block edge intermodulation products with input signal at AGC threshold +3 dB*

Test data, continued

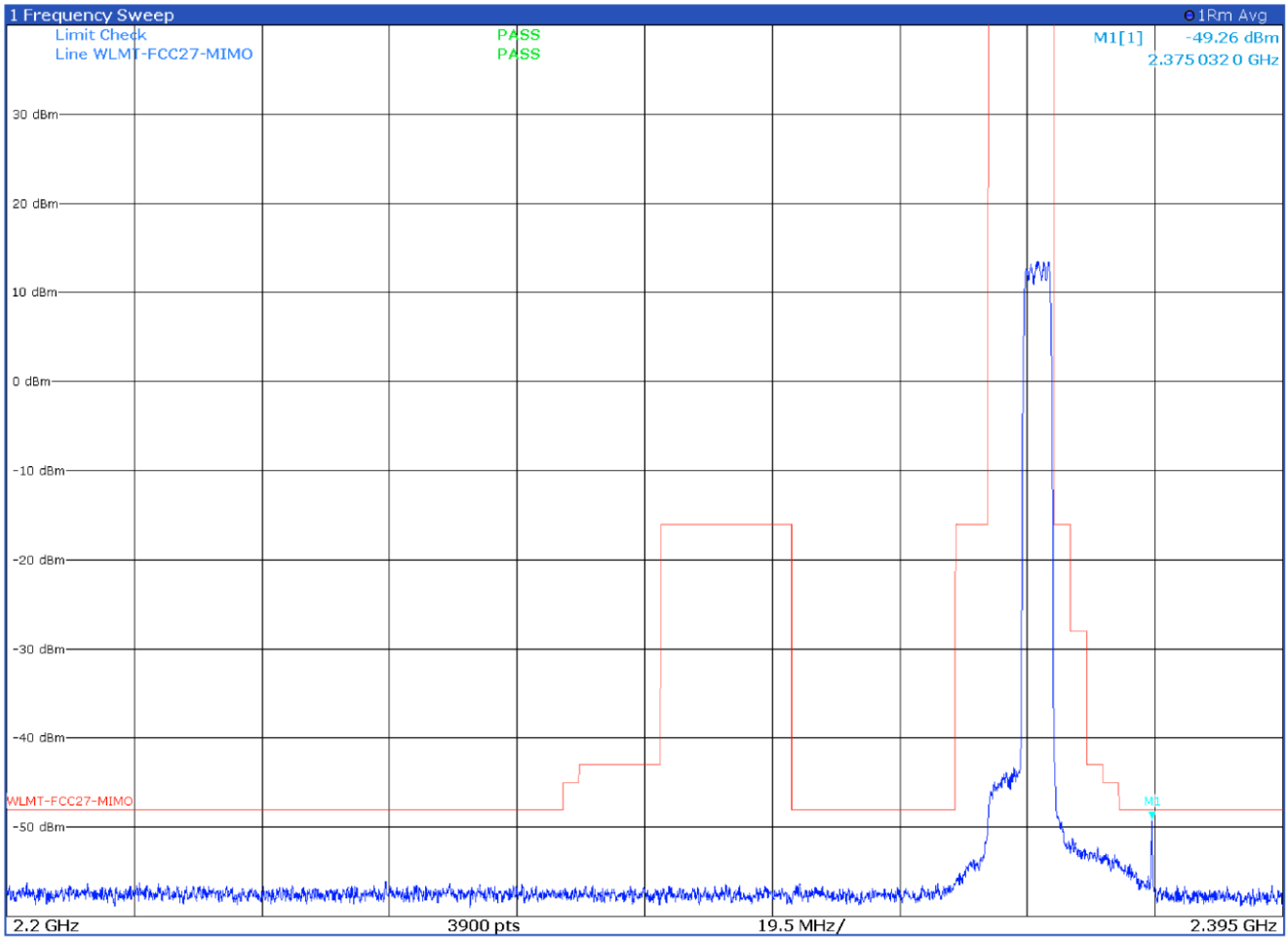


Figure 8.5-5: *Antenna port 1 single carrier upper block edge with input signal at AGC threshold*

Test data, continued

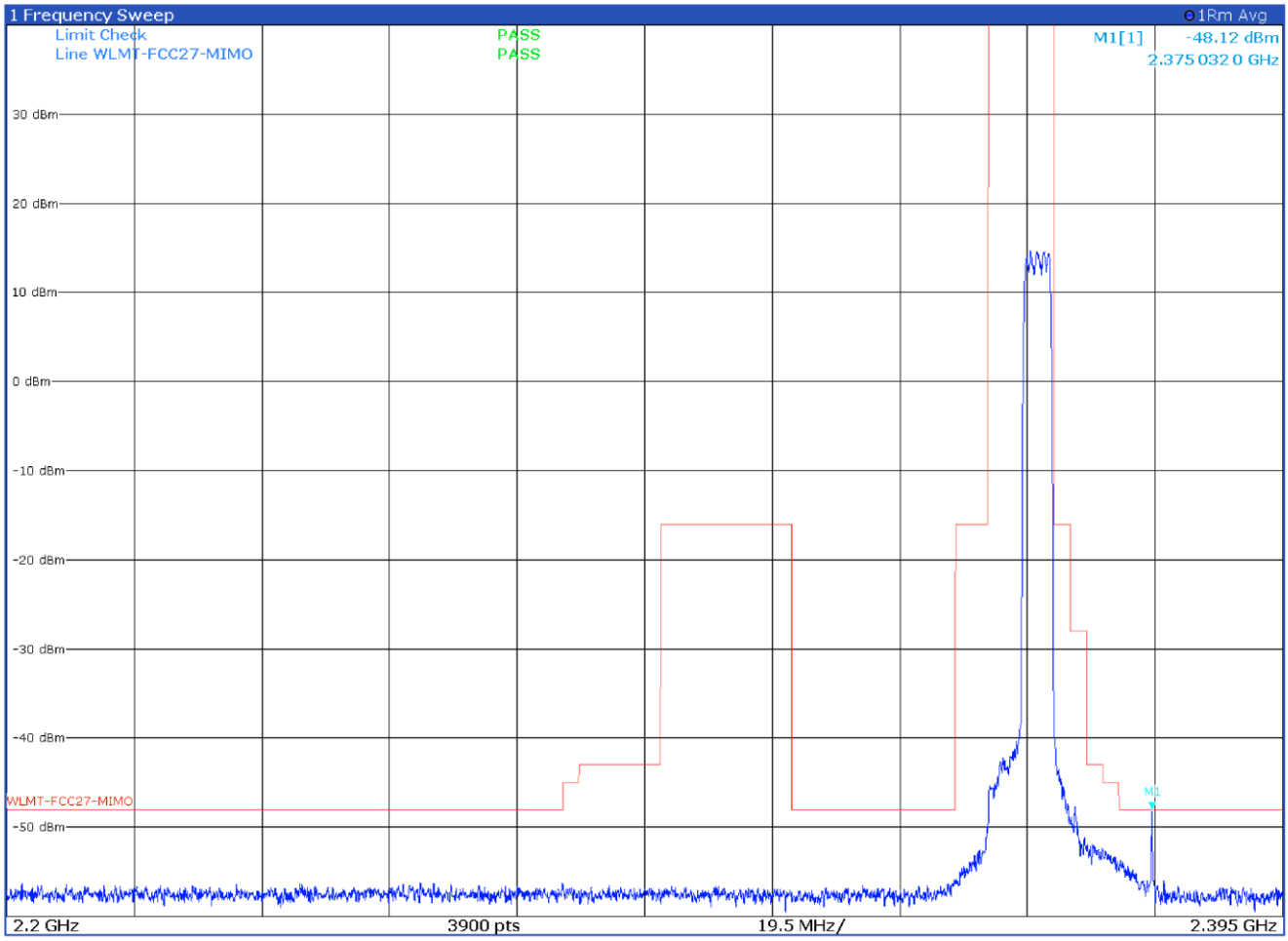


Figure 8.5-6: *Antenna port 1 single carrier upper block edge with input signal at AGC threshold +3 dB*

Test data, continued

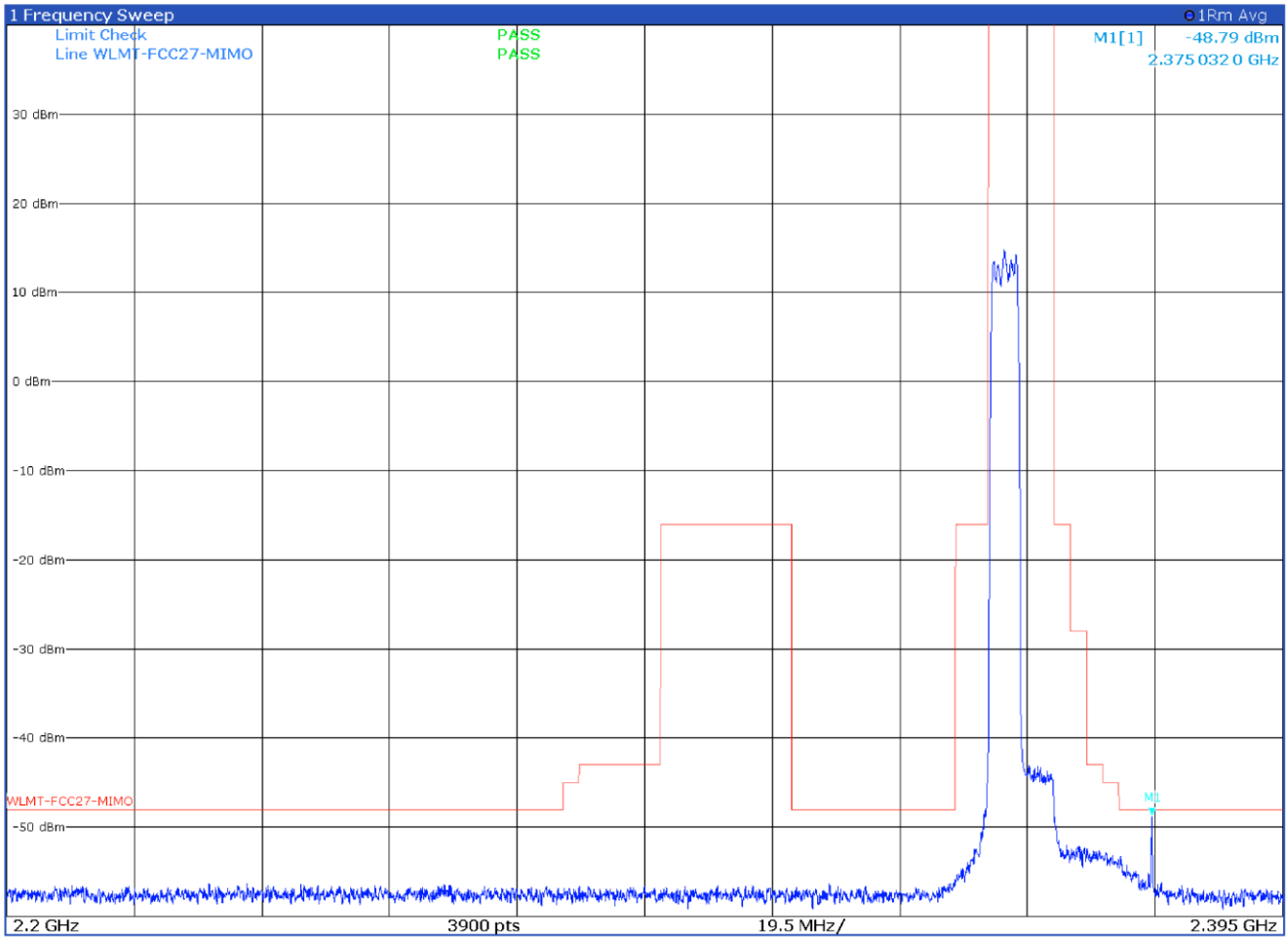


Figure 8.5-7: *Antenna port 1 single carrier lower block edge with input signal at AGC threshold*

Test data, continued

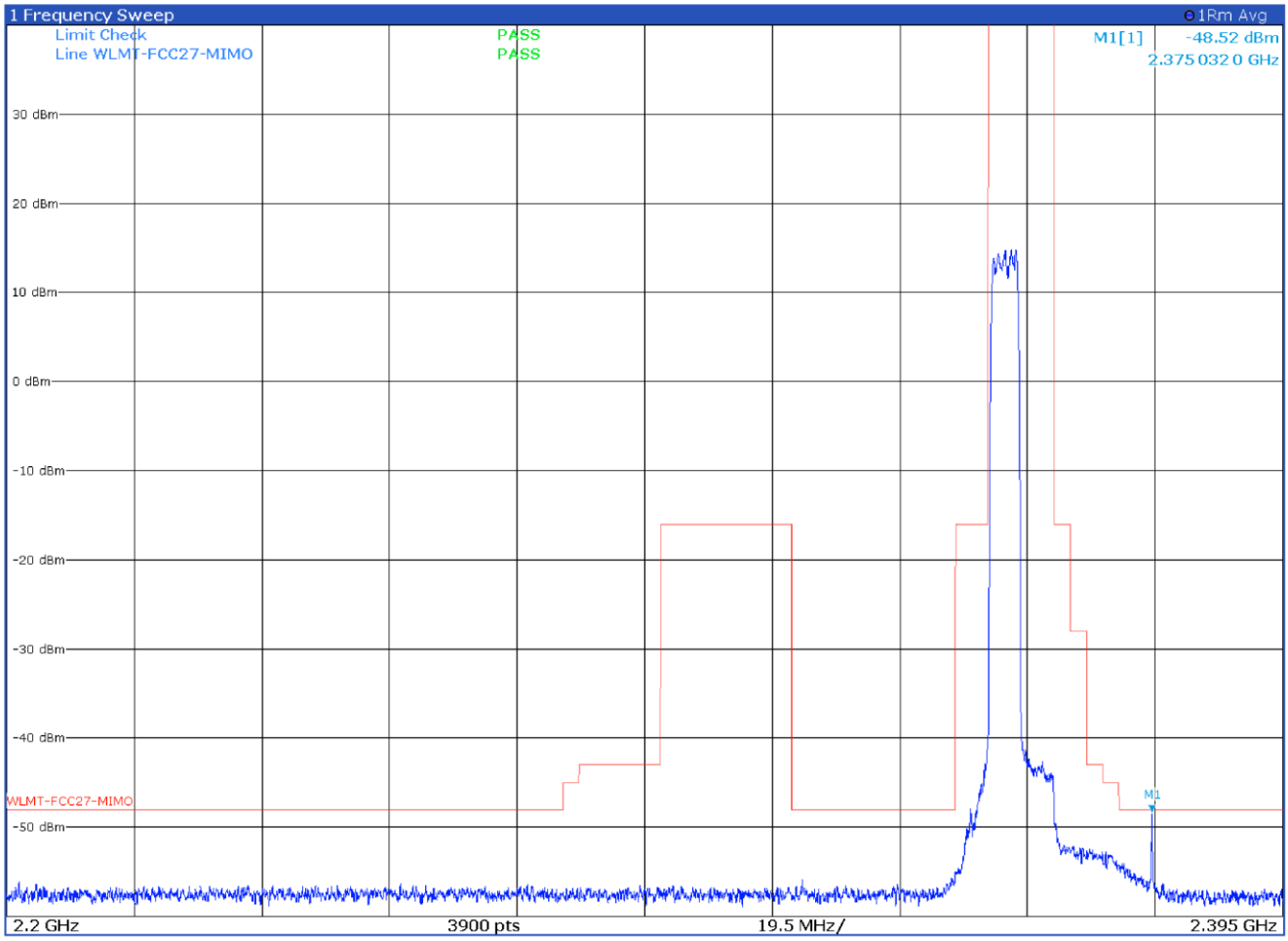


Figure 8.5-8: *Antenna port 1 single carrier lower block edge with input signal at AGC threshold +3 dB*

Test data, continued

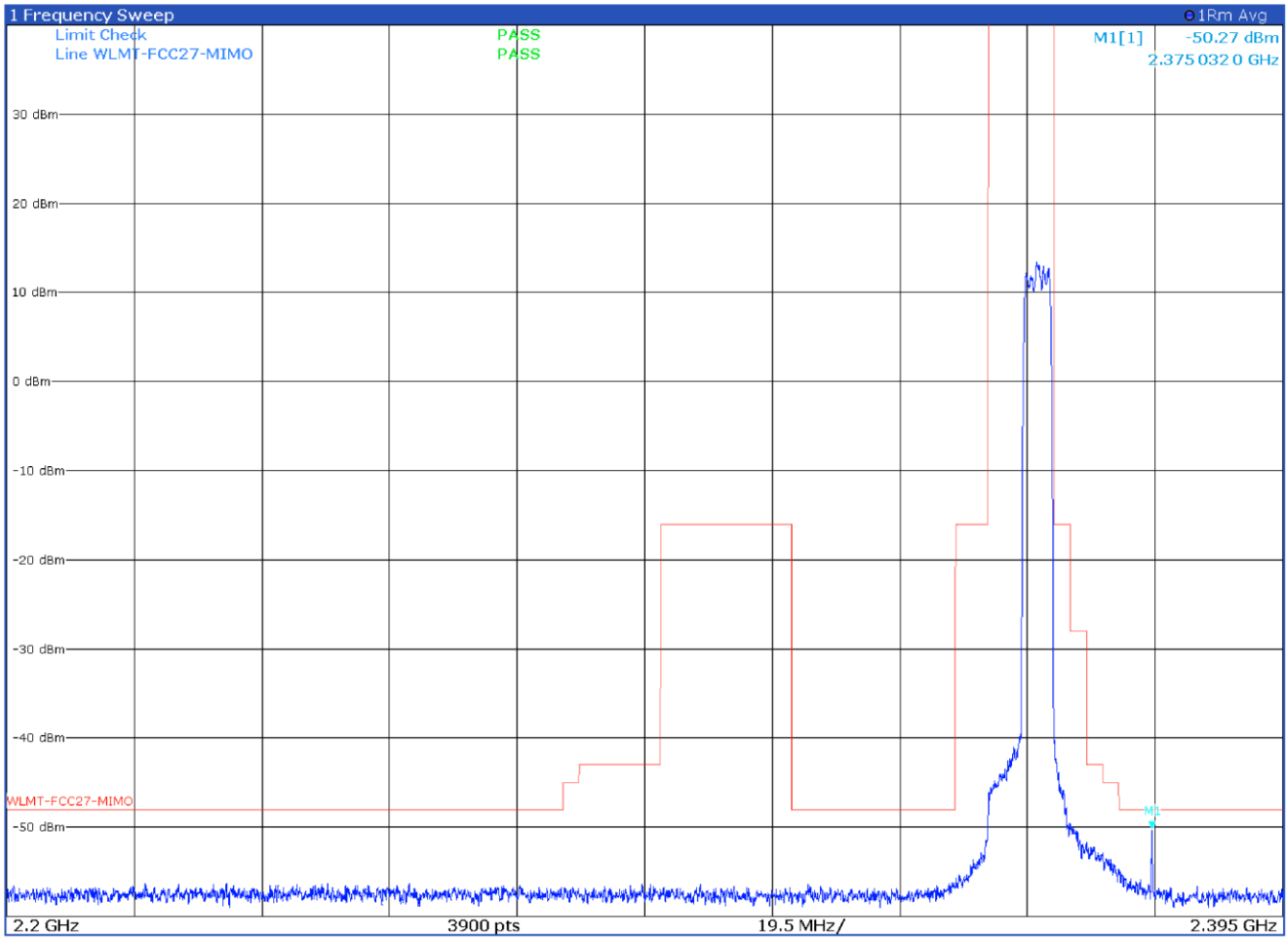


Figure 8.5-9: *Antenna port 2 single carrier upper block edge with input signal at AGC threshold*

Test data, continued

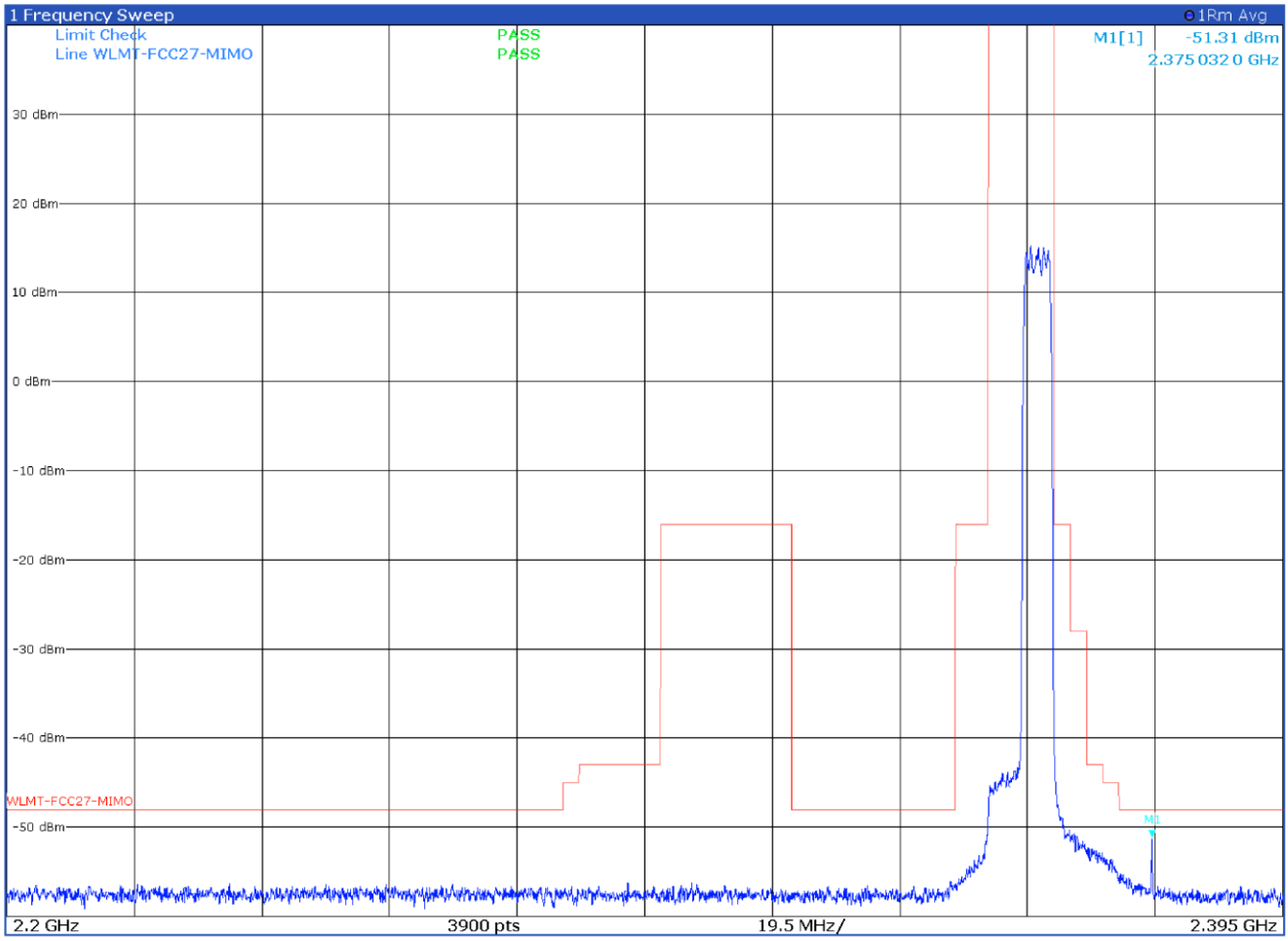


Figure 8.5-10: *Antenna port 2 single carrier upper block edge with input signal at AGC threshold +3 dB*

Test data, continued

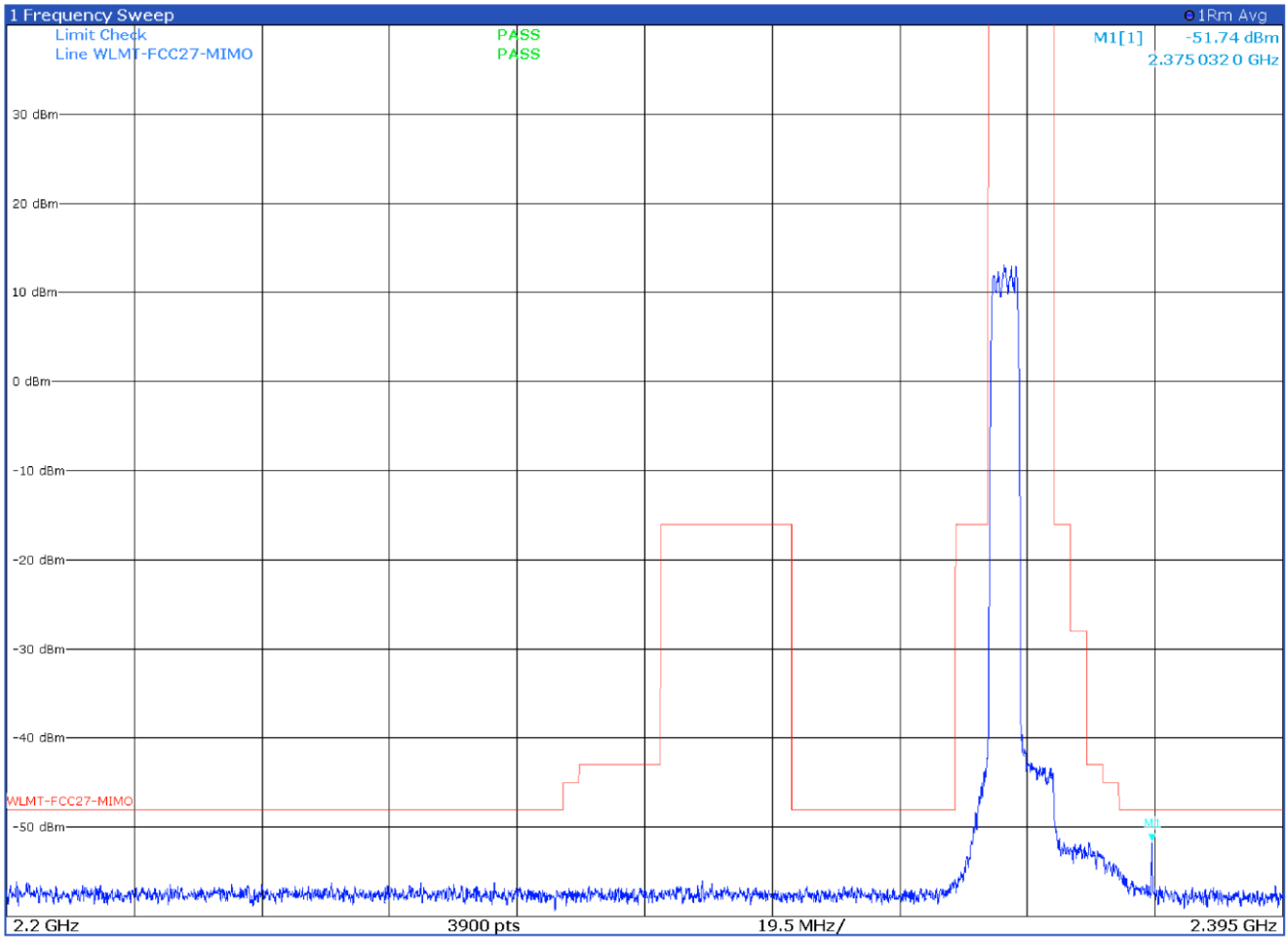


Figure 8.5-11: *Antenna port 2 single carrier lower block edge with input signal at AGC threshold*