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RADIO TEST REPORT – 449947-8TRFWL

Type of assessment:

Final product testing

Applicant:

Andrew Wireless Systems
Industriering 10, Buchdorf 86675
Germany

Product:

ERA L2 Radio Module

Model:

Radio Module L2 B12+13+14

Model variant(s):

--

FCC ID:

XS5-RML2B12-13-14

IC Registration number:

2237E-RML2B121314

Specifications:

- FCC 47 CFR Part 27
- RSS-130 Issue 2
- RSS-131 Issue 3

Date of issue: February 9, 2022

P. Barbieri	
Tested by	Signature
D. Guarnone	
Reviewed by	Signature

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Doc. n. TRF001; Rev. 0; Date: 2020-11-30

Lab locations

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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.

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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-130 Issue 2, February 2019	Equipment Operating in the Frequency Bands 617-652 MHz, 663-698 MHz, 698-756 MHz and 777-787 MHz
RSS-131 Issue 3, May 2017	Zone Enhancers
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
449947-8TRFWL	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

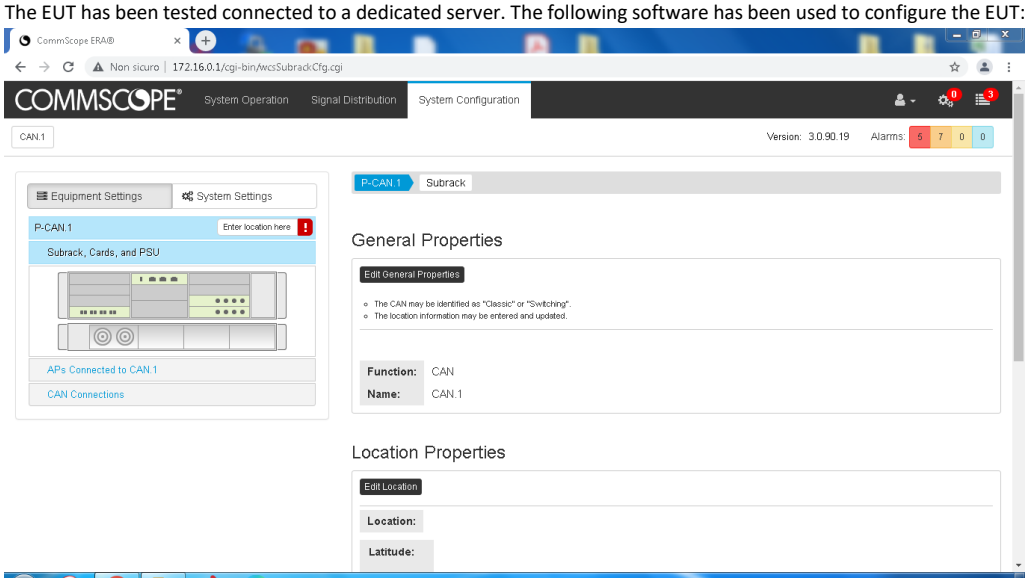
Product name	Radio Module
Model	L2 B12+13+14
Model variant(s)	--
Serial number	BGRMAD21460008
Part number	7847627-01
Power supply requirements	DC: 48 V
Product description and theory of operation	The EUT is a MIMO 1 +1 radio module used inside a CAP L2 Access Point. The Era product is a digital distribution 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	746 MHz to 756 MHz
Frequency Min (MHz)	748.5 MHz for LTE 5 MHz
Frequency Max (MHz)	753.5 MHz for LTE 5 MHz
RF power Max (W), Conducted	0.182 W (22.6 dBm)
Measured BW (kHz), 99% OBW	4.157 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

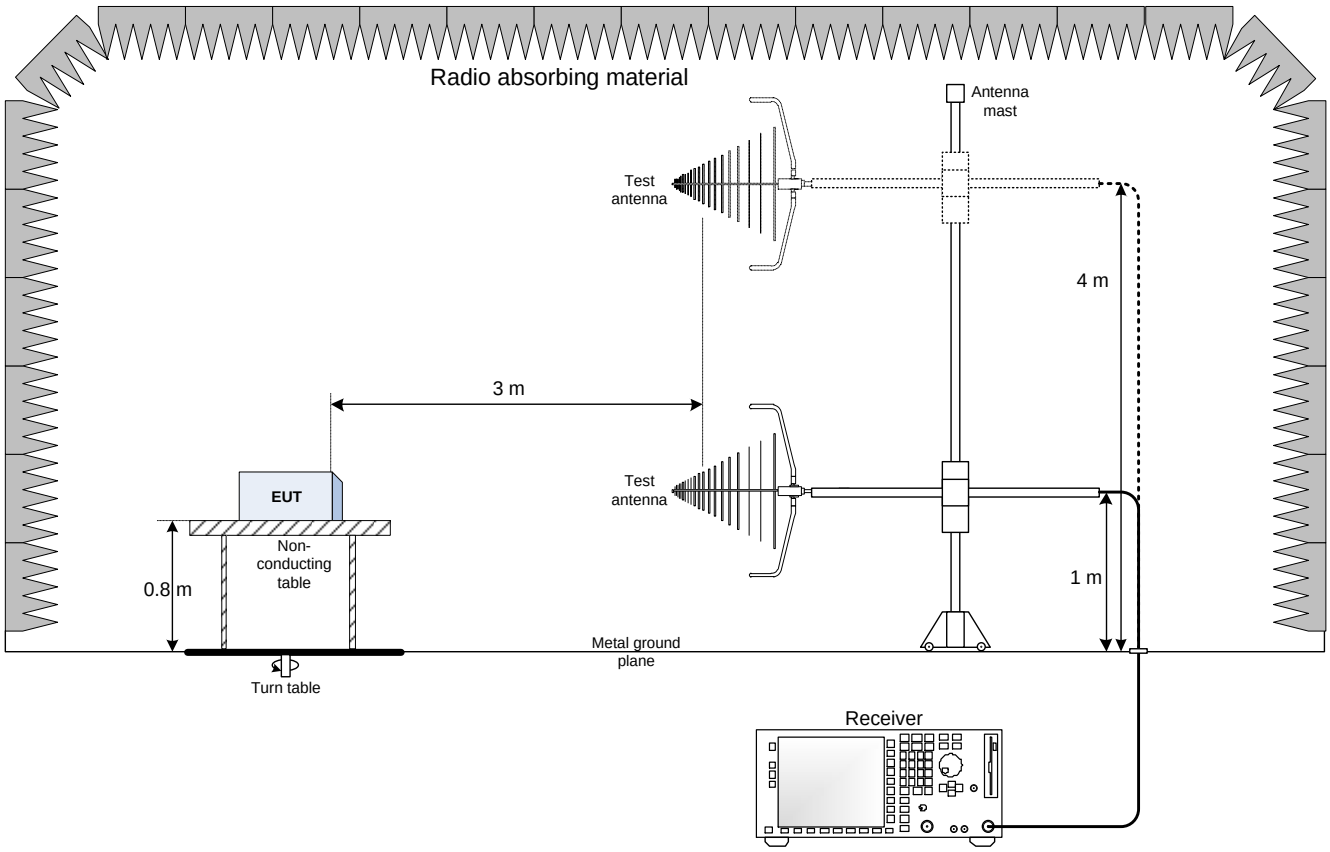


Figure 5.5-1: *Radiated emissions set-up for frequencies below 1 GHz*

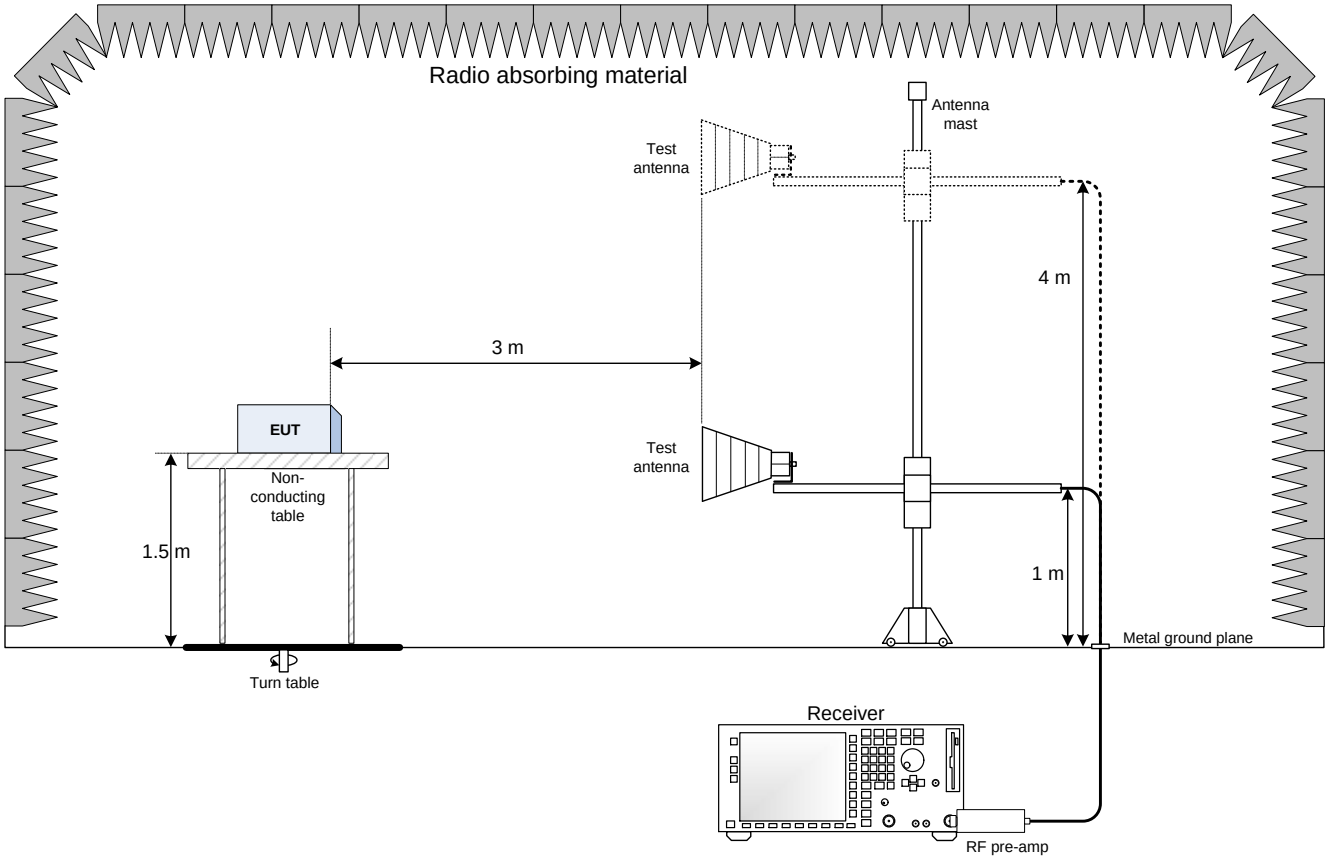


Figure 5.5-2: *Radiated emissions set-up for frequencies above 1 GHz*

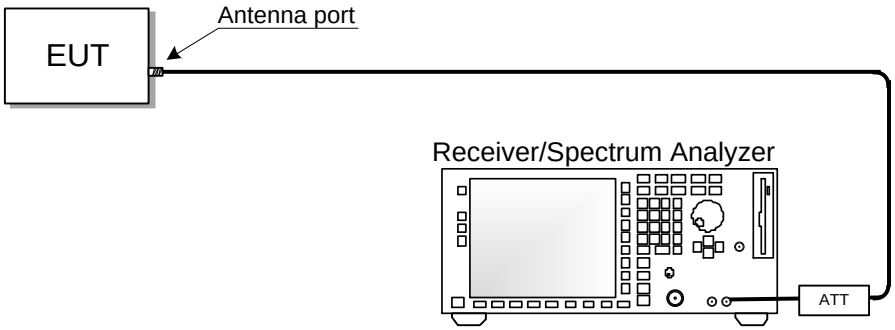


Figure 5.5-3: *Antenna port testing set-up*

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)	4499470002

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
27.50(b)(4)	935210 (3.5)	Mean output power and amplifier/booster gain	Pass
27.53(c)(1)(3)	935210 (3.6.2)	Out-of-band/out-of-block emissions conducted measurements	Pass
27.53(c)(1)(3)	935210 (3.6.3)	Spurious emissions conducted measurements	Pass
27.54	935210 (3.7)	Frequency stability measurements	Pass
27.53(c)(1)(3), 27.53(f)	935210 (3.8)	Spurious emissions radiated measurements	Pass

Notes:

6.5 ISED RSS-131 and RSS-130 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-130 §4.6.3 - 4.6.1	935210 (3.5)	Mean output power and amplifier/booster gain	Pass
RSS-131 §5.2 / RSS-130 §4.7.1	935210 (3.6.2)	Out-of-band/out-of-block emissions conducted measurements	Pass
RSS-131 §5.2 / RSS-130 §4.7.1 - 4.7.2(a)	935210 (3.6.3)	Spurious emissions conducted measurements	Pass
RSS-131 §5.2.4 / RSS-130 §4.5	935210 (3.7)	Frequency stability measurements	Pass
RSS-131 §5.2 / RSS-130 §4.7.1 - 4.7.2 (a)(b)	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	2022-01	2023-01
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	January 27, 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

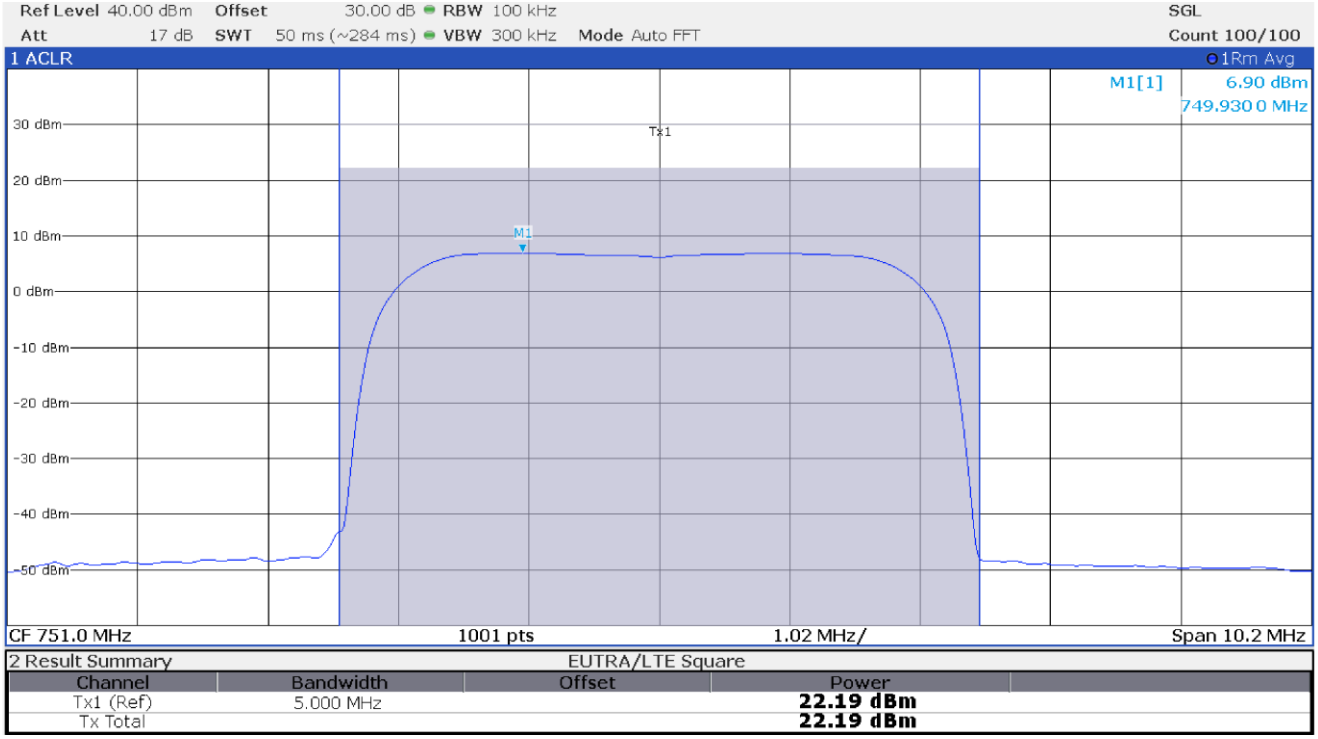


Figure 8.1-1: *Antenna port 1 output spectral plot with input at AGC threshold*

Test data, continued

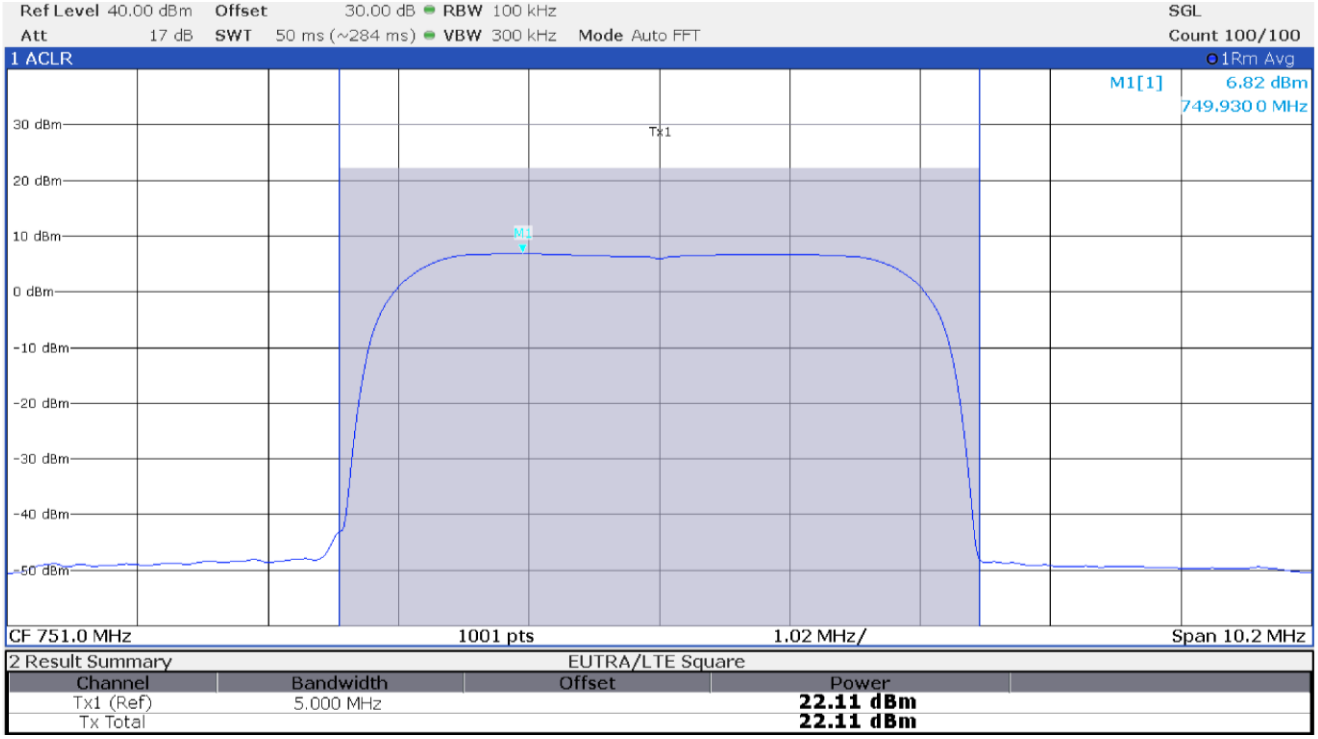


Figure 8.1-2: *Antenna port 1 output spectral plot with input at AGC threshold +1 dBm*

Test data, continued

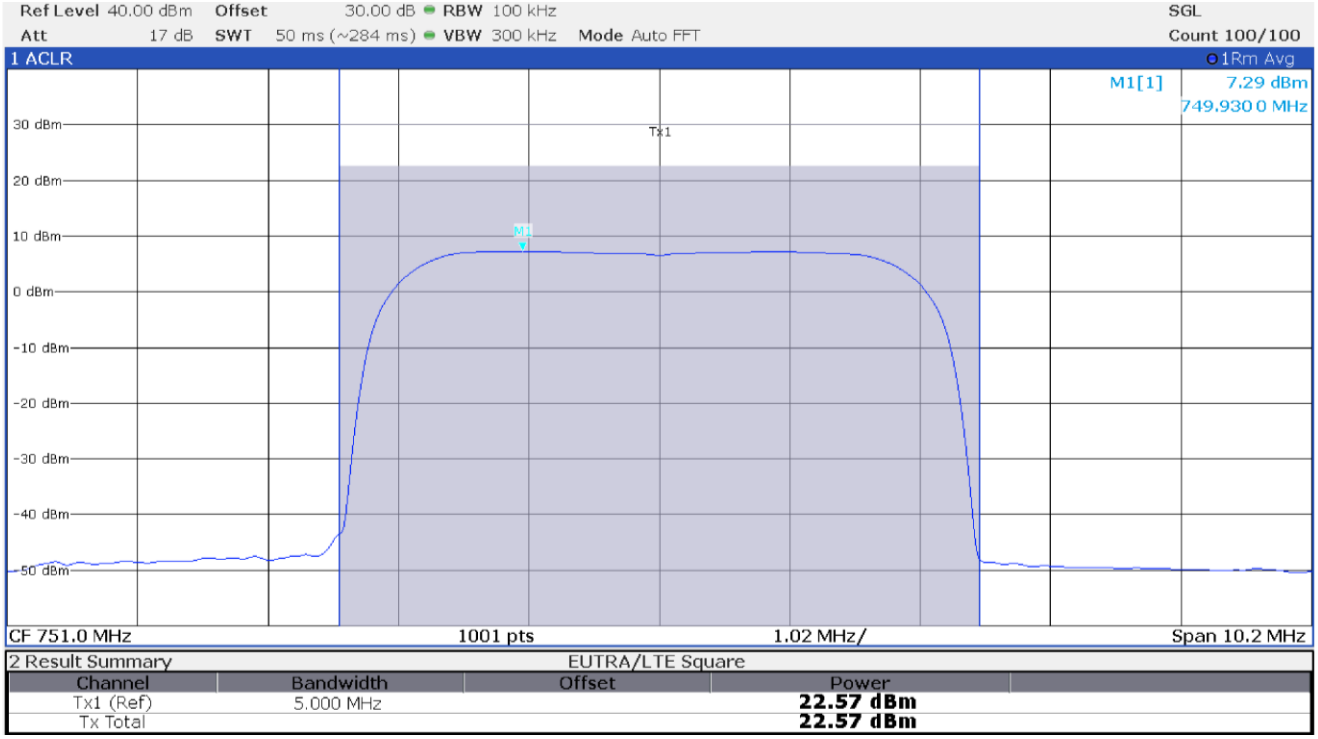


Figure 8.1-3: *Antenna port 2 output spectral plot with input at AGC threshold*

Test data, continued

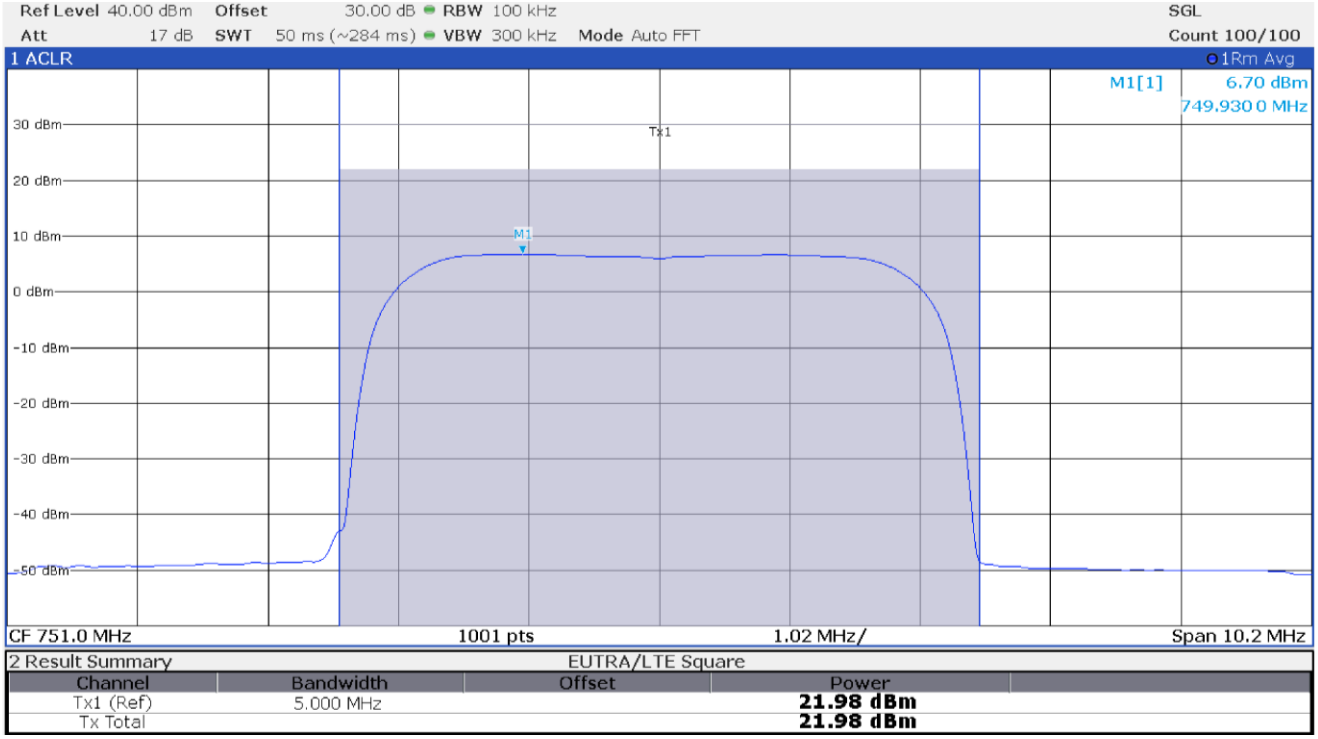


Figure 8.1-4: *Antenna port 2 output spectral plot with input at AGC threshold +1 dBm*

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	January 27, 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:

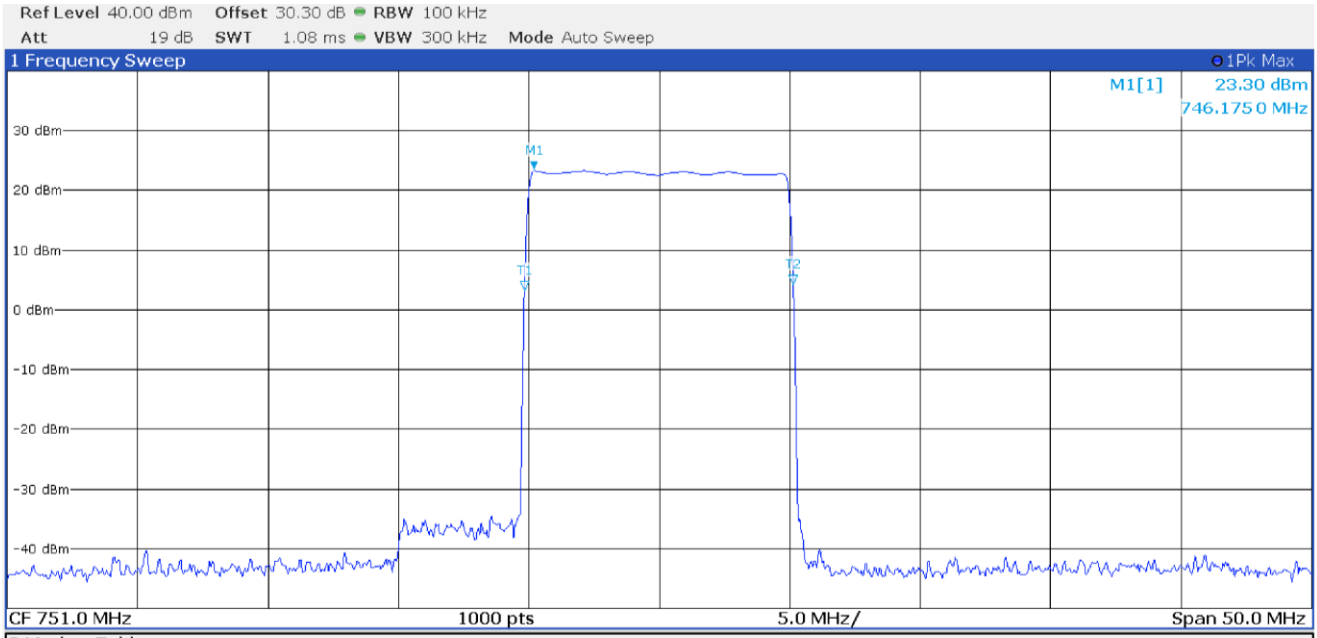
Resolution bandwidth	1 % to 5 % of the EUT passband
Video bandwidth	≥3 × RBW
Frequency span	± 250 % of the passband
Detector mode	Peak
Trace mode	Max Hold

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

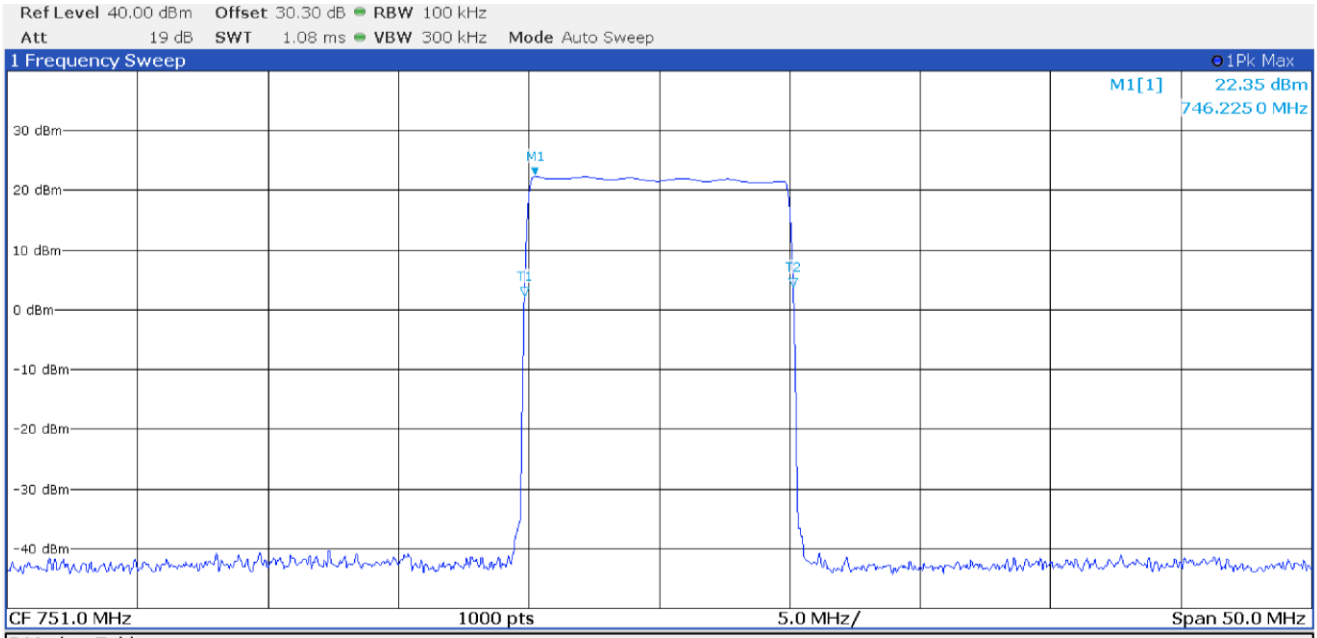


2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**746.175 MHz**	**23.30 dBm**	ndB	20.0 dB
T1		1	745.825 MHz	3.18 dBm	ndB down BW	**10.30 MHz**
T2		1	756.125 MHz	4.33 dBm	Q Factor	72.4

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

Test data, continued



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**746.225 MHz**	**22.35 dBm**	ndB	20.0 dB
T1		1	745.825 MHz	2.25 dBm	ndB down BW	**10.30 MHz**
T2		1	756.125 MHz	3.73 dBm	Q Factor	72.4

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	January 27, 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

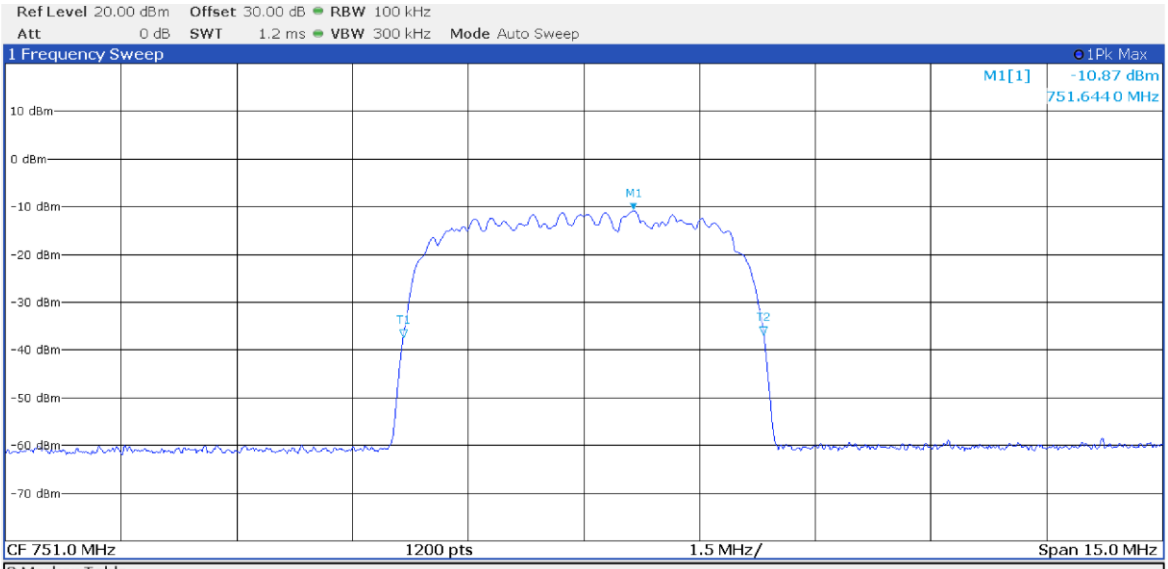
Notes: NCR - no calibration required, VOU - verify on use

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	751.0	4.163	4.67
1	Output	AGC threshold	751.0	4.157	4.66
1	Input	AGC threshold +3 dB	751.0	4.163	4.66
1	Output	AGC threshold +3 dB	751.0	4.158	4.66
2	Input	AGC threshold	751.0	4.163	4.67
2	Output	AGC threshold	751.0	4.155	4.66
2	Input	AGC threshold +3 dB	751.0	4.163	4.66
2	Output	AGC threshold +3 dB	751.0	4.160	4.66

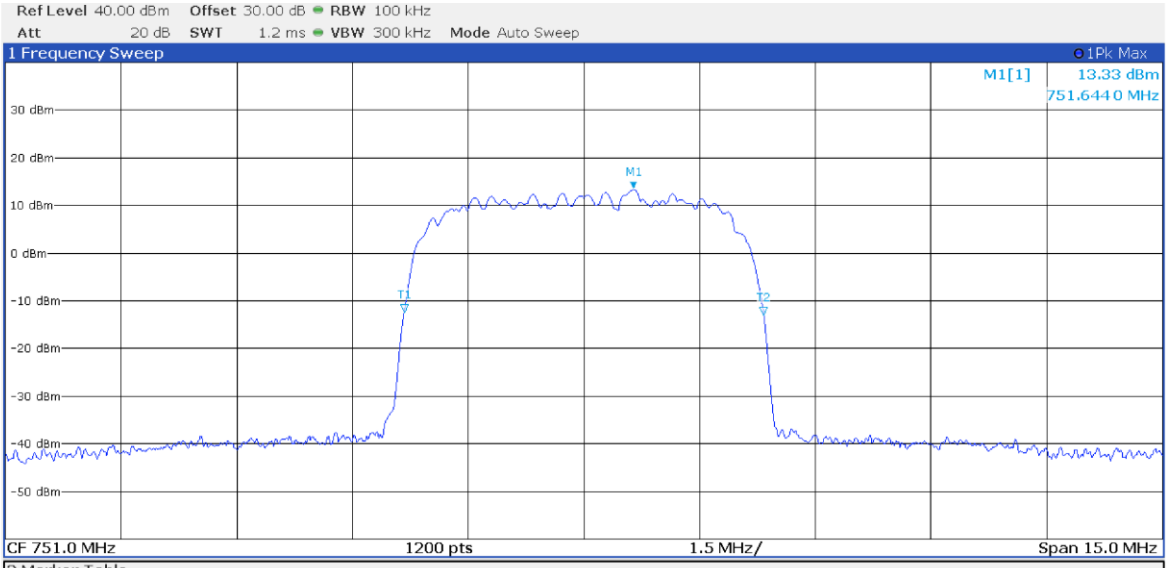
Test data, continued



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**751.644 MHz**	**-10.87 dBm**	ndB	26.0 dB
T1		1	748.656 MHz	-37.40 dBm	ndB down BW	**4.67 MHz**
T2		1	753.331 MHz	-36.86 dBm	Q Factor	160.8

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

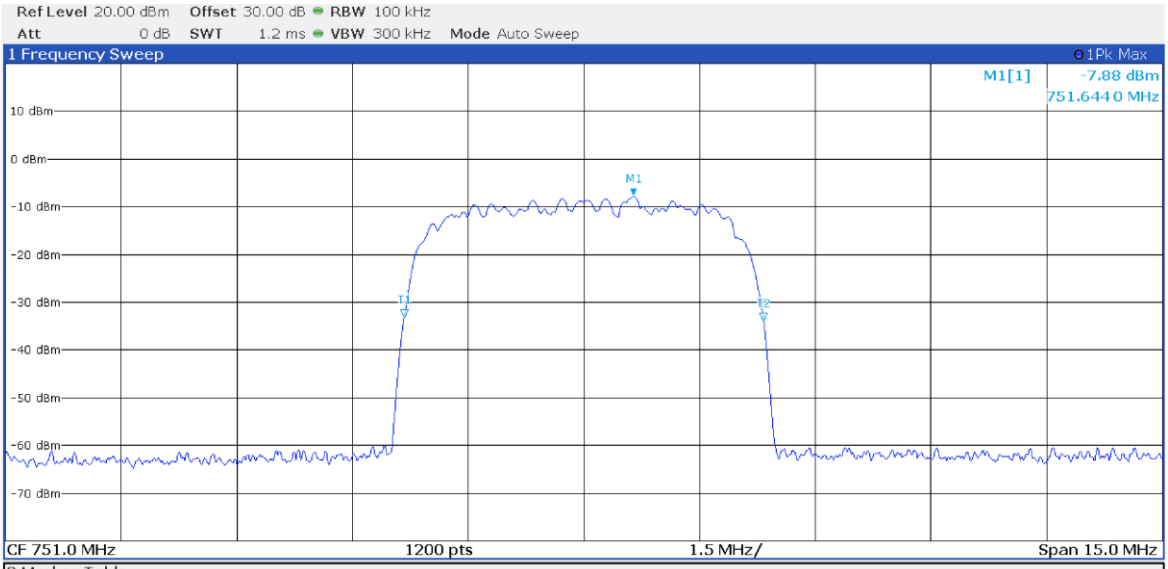


2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**751.644 MHz**	**13.33 dBm**	ndB	26.0 dB
T1		1	748.669 MHz	-12.41 dBm	ndB down BW	**4.66 MHz**
T2		1	753.331 MHz	-13.15 dBm	Q Factor	161.2

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

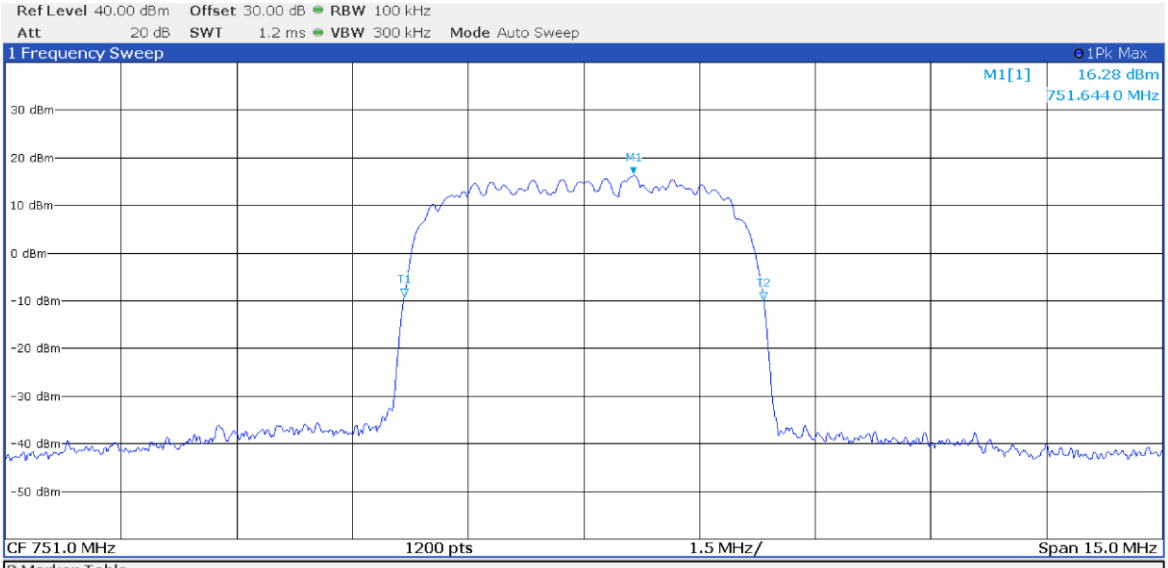
Test data, continued



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**751.644 MHz**	**-7.88 dBm**	ndB	26.0 dB
T1		1	748.669 MHz	-33.20 dBm	ndB down BW	**4.66 MHz**
T2		1	753.331 MHz	-34.07 dBm	Q Factor	161.2

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

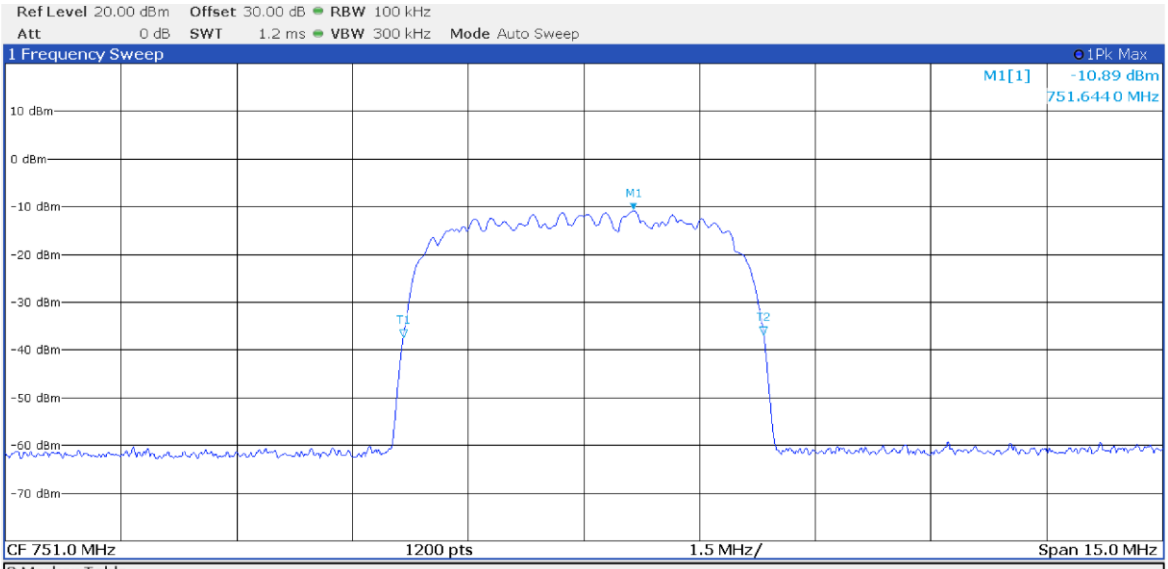


2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**751.644 MHz**	**16.28 dBm**	ndB	26.0 dB
T1		1	748.669 MHz	-9.30 dBm	ndB down BW	**4.66 MHz**
T2		1	753.331 MHz	-10.06 dBm	Q Factor	161.2

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

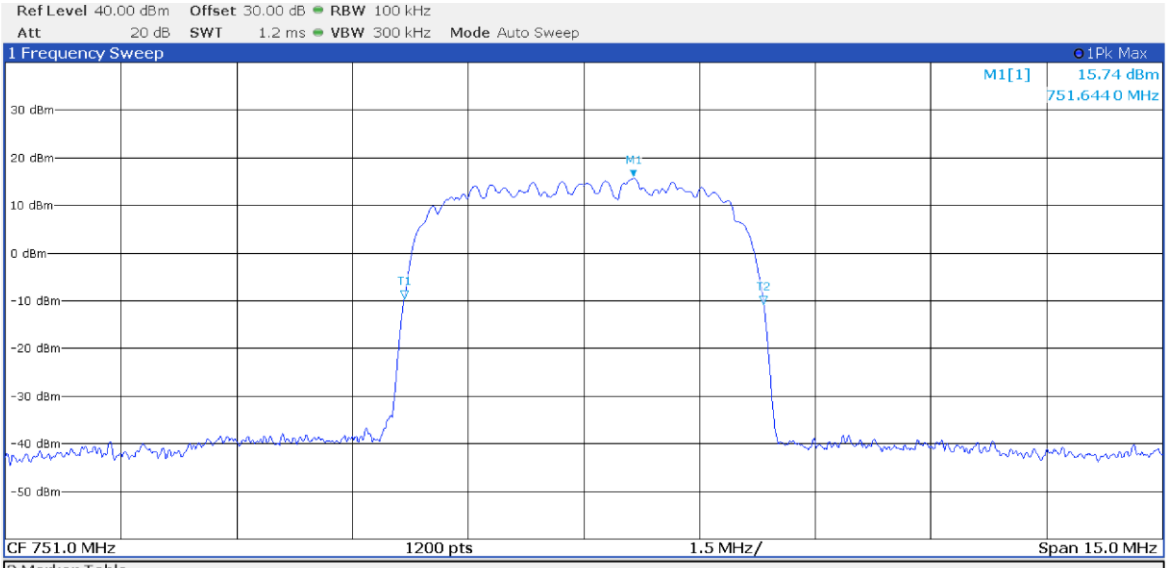
Test data, continued



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**751.644 MHz**	**-10.89 dBm**	ndB	26.0 dB
T1		1	748.656 MHz	-37.48 dBm	ndB down BW	**4.67 MHz**
T2		1	753.331 MHz	-36.96 dBm	Q Factor	160.8

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

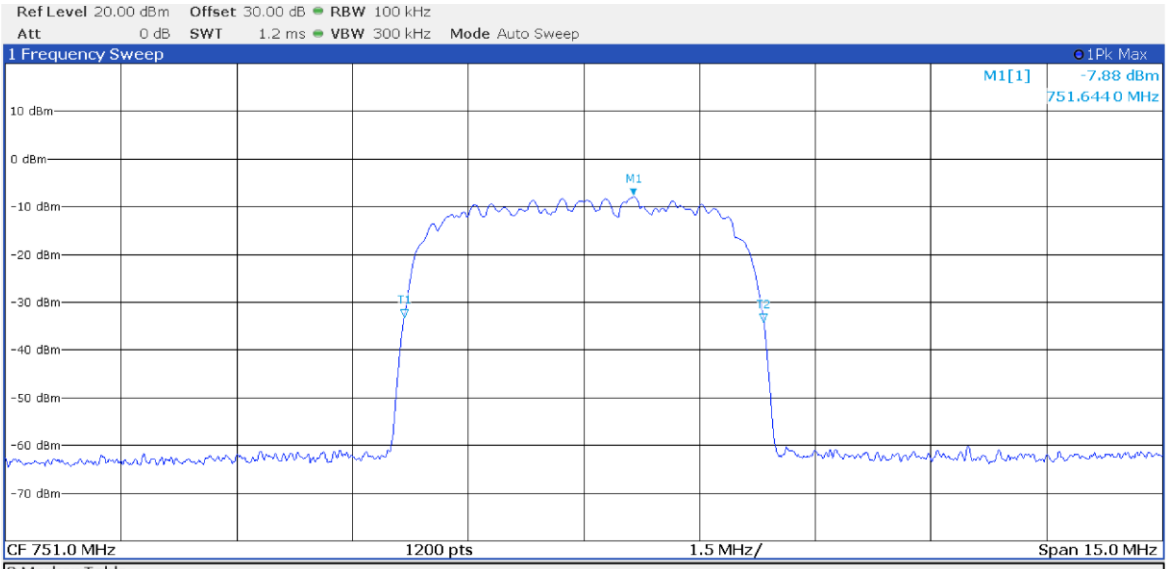


2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**751.644 MHz**	**15.74 dBm**	ndB	26.0 dB
T1		1	748.669 MHz	-9.69 dBm	ndB down BW	**4.66 MHz**
T2		1	753.331 MHz	-10.79 dBm	Q Factor	161.2

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

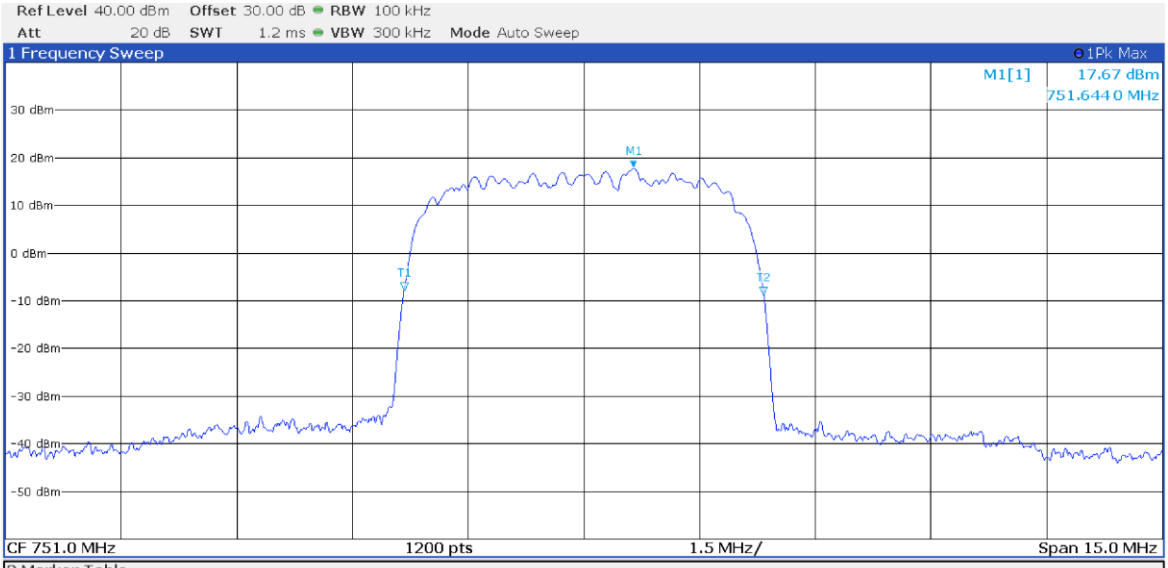
Test data, continued



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**751.644 MHz**	**-7.88 dBm**	ndB	26.0 dB
T1		1	748.669 MHz	-33.27 dBm	ndB down BW	**4.66 MHz**
T2		1	753.331 MHz	-34.17 dBm	Q Factor	161.2

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

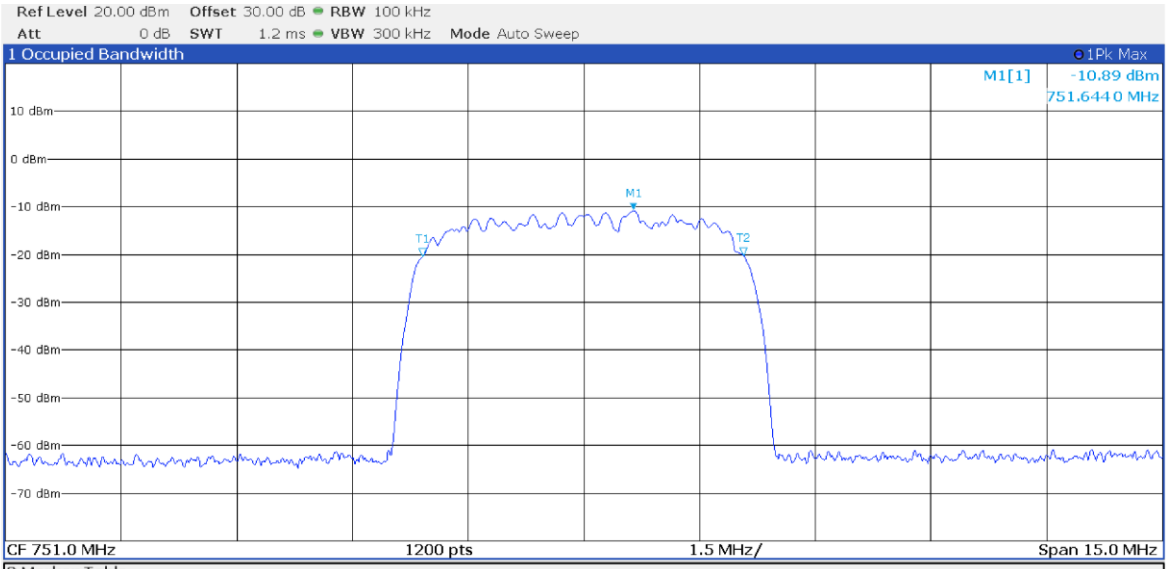


2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**751.644 MHz**	**17.67 dBm**	ndB	26.0 dB
T1		1	748.669 MHz	-7.81 dBm	ndB down BW	**4.66 MHz**
T2		1	753.331 MHz	-8.82 dBm	Q Factor	161.2

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

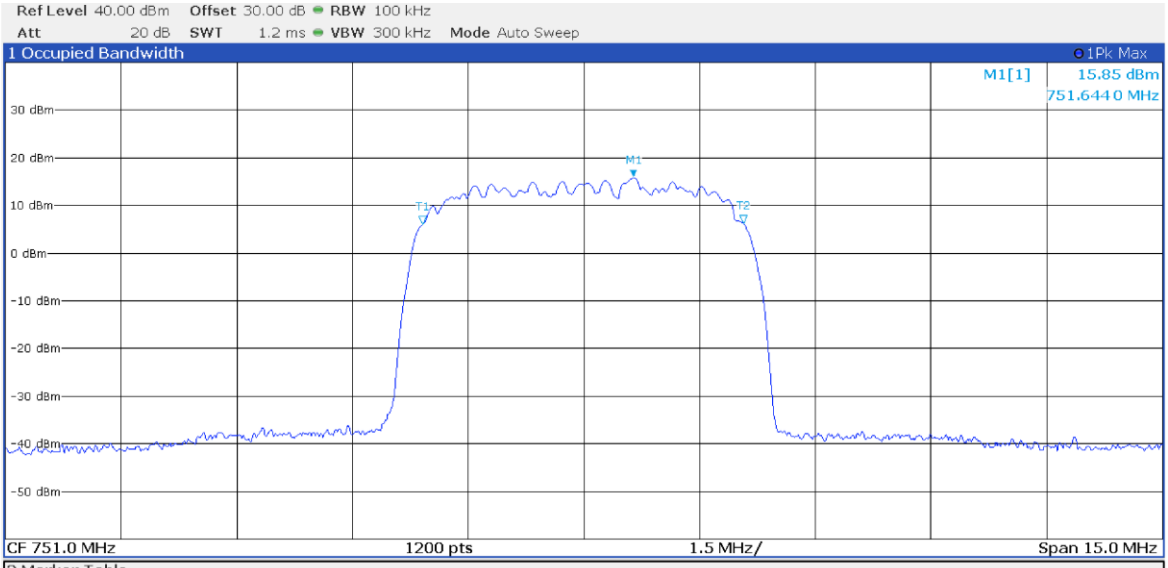
Test data, continued



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**751.644 MHz**	**-10.89 dBm**	Occ Bw	**4.163 507 275 MHz**
T1		1	748.9049 MHz	-20.42 dBm	Occ Bw Centroid	750.986 695 115 MHz
T2		1	753.0684 MHz	-20.20 dBm	Occ Bw Freq Offset	-13.304 884 773 kHz

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

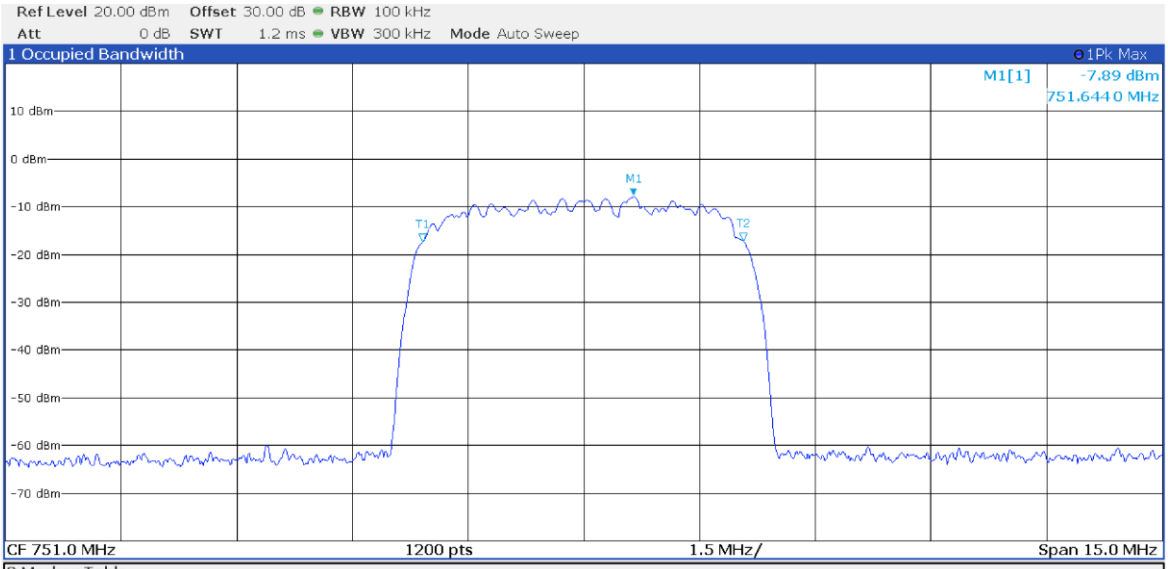


2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**751.644 MHz**	**15.85 dBm**	Occ Bw	**4.157 290 039 MHz**
T1		1	748.9088 MHz	5.97 dBm	Occ Bw Centroid	750.987 430 766 MHz
T2		1	753.0661 MHz	6.20 dBm	Occ Bw Freq Offset	-12.569 233 739 kHz

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

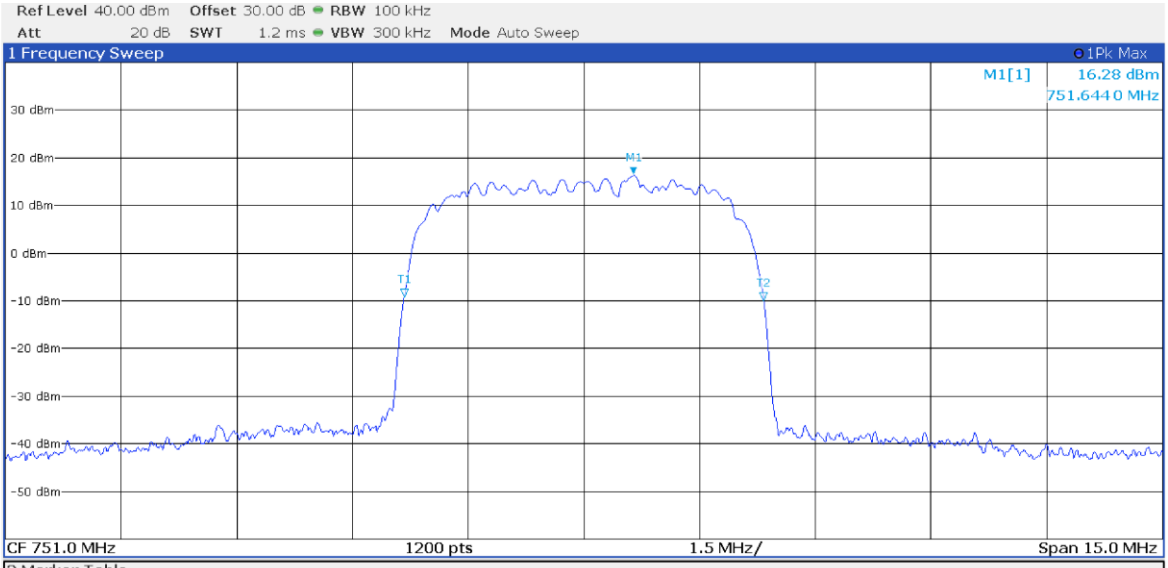
Test data, continued



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**751.644 MHz**	**-7.89 dBm**	Occ Bw	**4.163 103 578 MHz**
T1		1	748.905 2 MHz	-17.42 dBm	Occ Bw Centroid	750.986 733 414 MHz
T2		1	753.068 3 MHz	-17.23 dBm	Occ Bw Freq Offset	-13.266 586 192 kHz

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

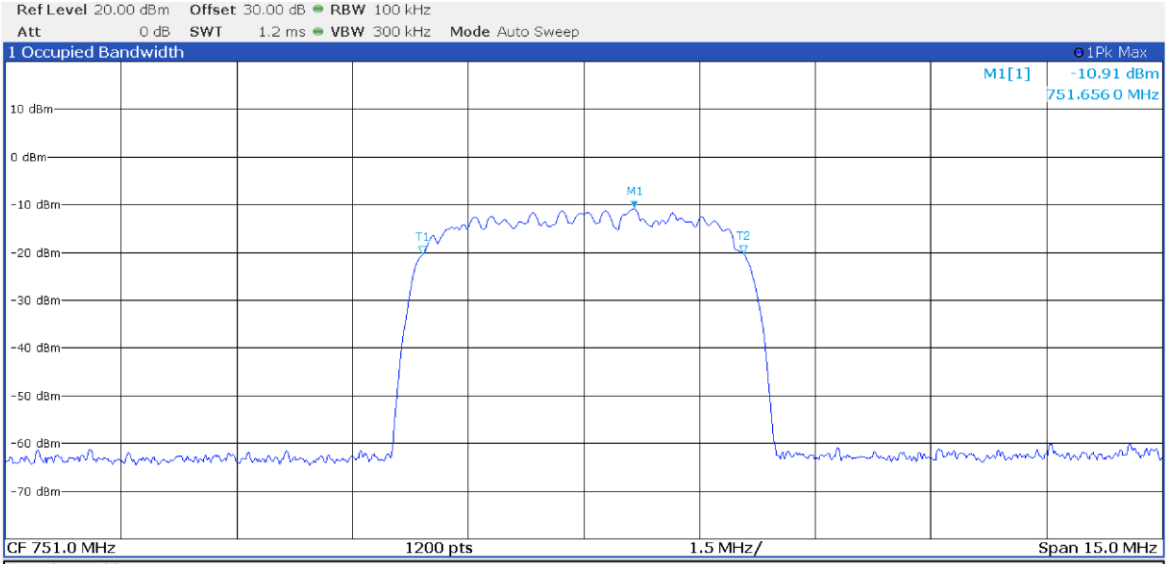


2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**751.644 MHz**	**16.28 dBm**	ndB	26.0 dB
T1		1	748.669 MHz	-9.30 dBm	ndB down BW	**4.66 MHz**
T2		1	753.331 MHz	-10.06 dBm	Q Factor	161.2

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

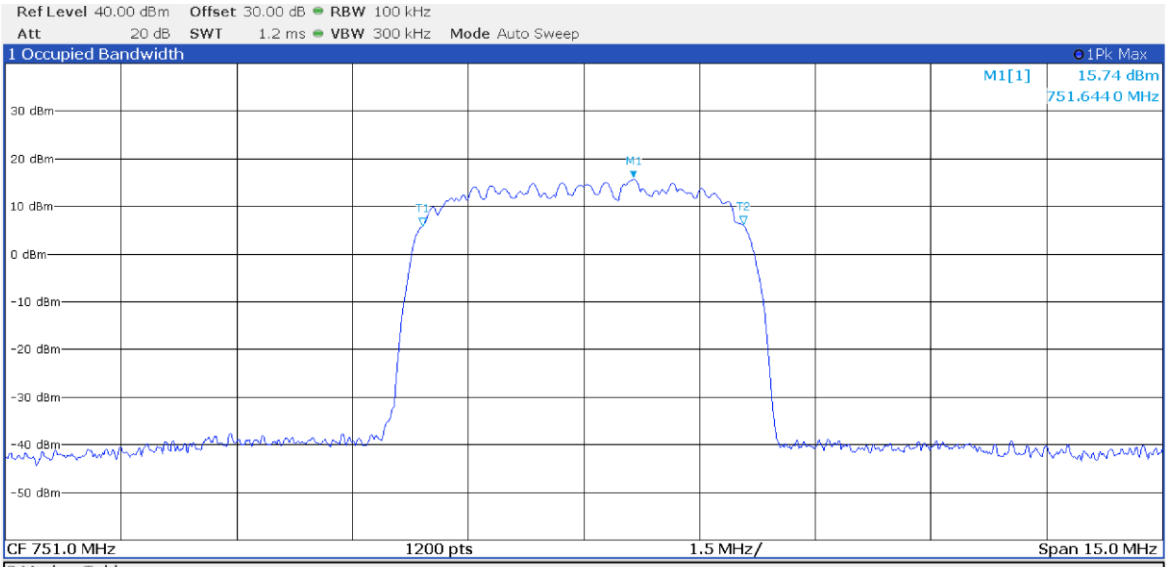
Test data, continued



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**751.656 MHz**	**-10.91 dBm**	Occ Bw	**4.163 472 331 MHz**
T1		1	748.904 9 MHz	-20.42 dBm	Occ Bw Centroid	750.986 670 87 MHz
T2		1	753.068 4 MHz	-20.23 dBm	Occ Bw Freq Offset	-13.329 129 666 kHz

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

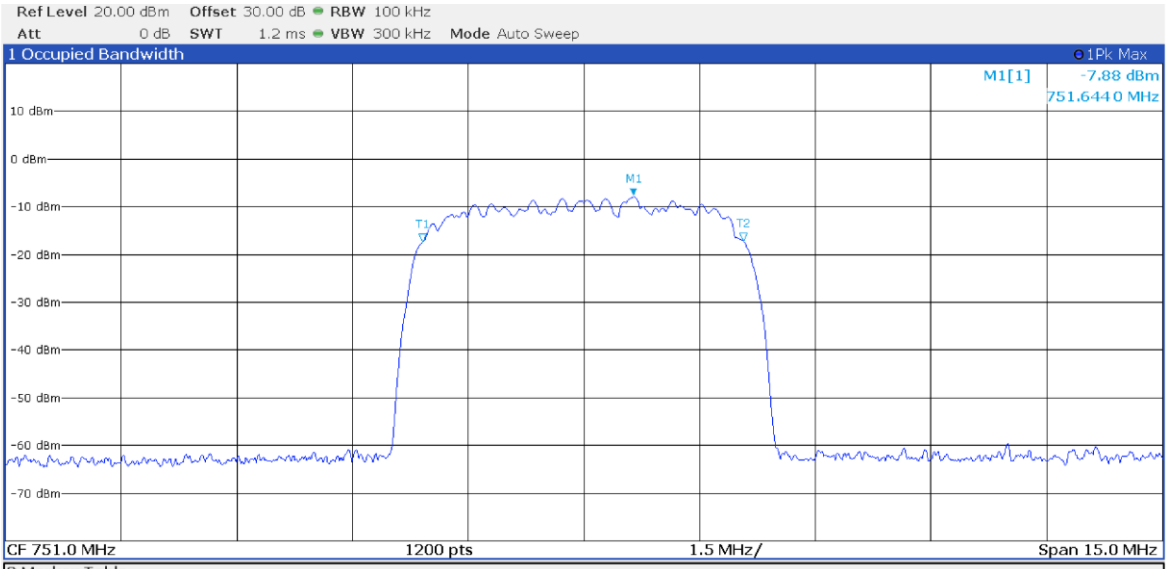


2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**751.644 MHz**	**15.74 dBm**	Occ Bw	**4.155 503 048 MHz**
T1		1	748.907 MHz	5.90 dBm	Occ Bw Centroid	750.984 724 748 MHz
T2		1	753.062 5 MHz	6.13 dBm	Occ Bw Freq Offset	-15.275 252 382 kHz

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

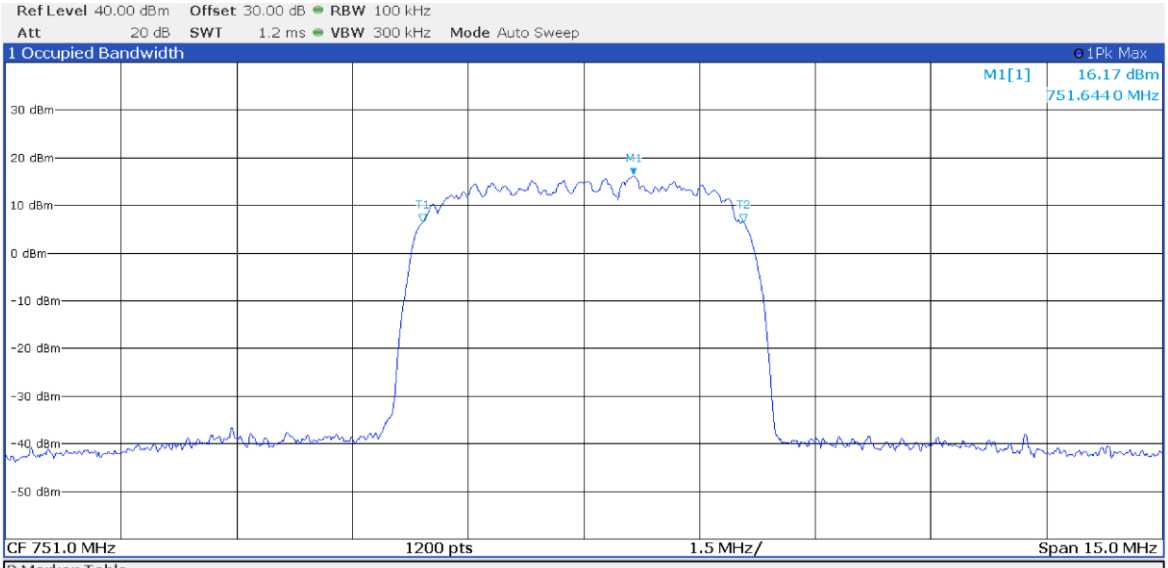
Test data, continued



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**751.644 MHz**	**-7.88 dBm**	Occ Bw	**4.162 987 962 MHz**
T1		1	748.905 2 MHz	-17.42 dBm	Occ Bw Centroid	750.986 734 605 MHz
T2		1	753.068 2 MHz	-17.23 dBm	Occ Bw Freq Offset	-13.265 394 635 kHz

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



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**751.644 MHz**	**16.17 dBm**	Occ Bw	**4.159 808 558 MHz**
T1		1	748.905 2 MHz	6.42 dBm	Occ Bw Centroid	750.985 075 585 MHz
T2		1	753.065 MHz	6.47 dBm	Occ Bw Freq Offset	-14.924 414 571 kHz

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(b)

The following power and antenna height limits apply to transmitters operating in the 746-758 MHz, 775-788 MHz and 805-806 MHz bands:

(4) Fixed and base stations transmitting a signal in the 746-757 MHz and 776-787 MHz bands with an emission bandwidth greater than 1 MHz must not exceed an ERP of 1000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts/MHz ERP in accordance with Table 3 of this section.

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-130, Clause 4.6

Transmitter output power and effective radiated power (e.r.p.)

4.6.1 General.

The transmitter output power shall be measured in terms of average power. In addition, the peak-toaverage power ratio (PAPR) of the transmitter shall not exceed 13 dB for more than 0.1% of the time and shall use a signal corresponding to the highest PAPR during periods of continuous transmission.

4.6.3 The e.r.p. shall not exceed 30 watts for mobile equipment and outdoor fixed subscriber equipment. The e.r.p. shall not exceed 3 watts for portable equipment and indoor fixed subscriber equipment.

For base and fixed equipment other than fixed subscriber equipment, refer to SRSP-518 for the e.i.r.p. limits.

8.4.2 Test summary

Verdict	Pass		
Tested by	P. Barbieri	Test date	January 27, 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	751.0	-3.8	22.2	0.166	26.0
1	AGC threshold +3 dB	751.0	-0.8	22.5	0.178	23.3
2	AGC threshold	751.0	-3.8	22.6	0.182	26.4
2	AGC threshold +3 dB	751.0	-0.8	22.6	0.182	23.4

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

Test data, continued

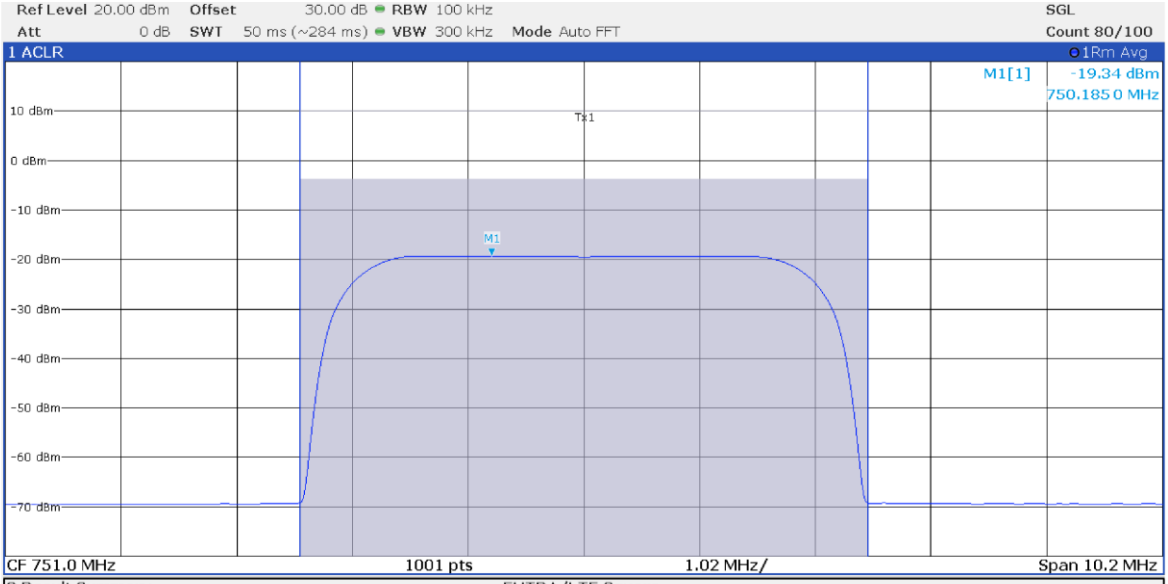


Figure 8.4-1: *Input power at antenna port 1 with input signal at AGC threshold*

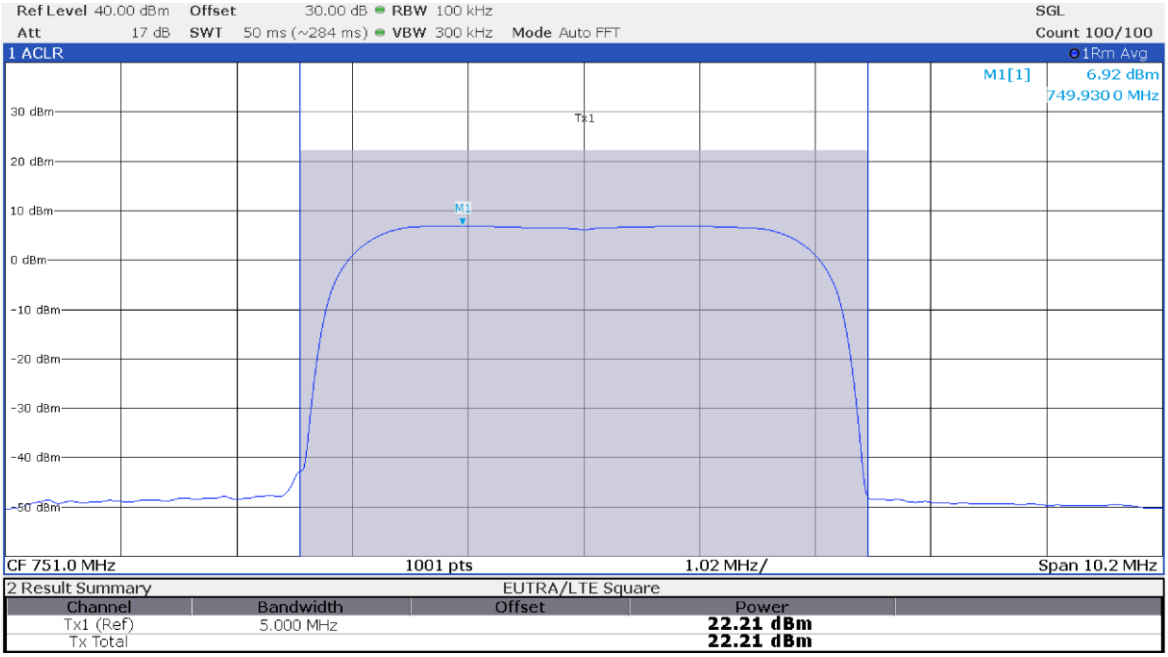


Figure 8.4-2: *Output power at antenna port 1 with input signal at AGC threshold*

Test data, continued

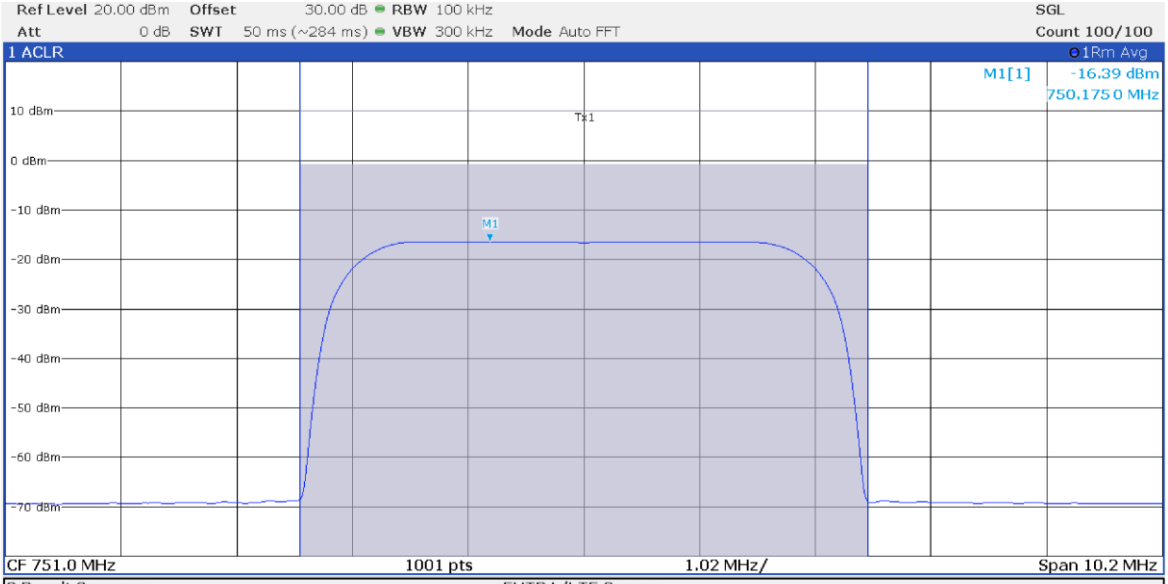


Figure 8.4-3: *Input power at antenna port 1 with input signal at AGC threshold +3 dB*

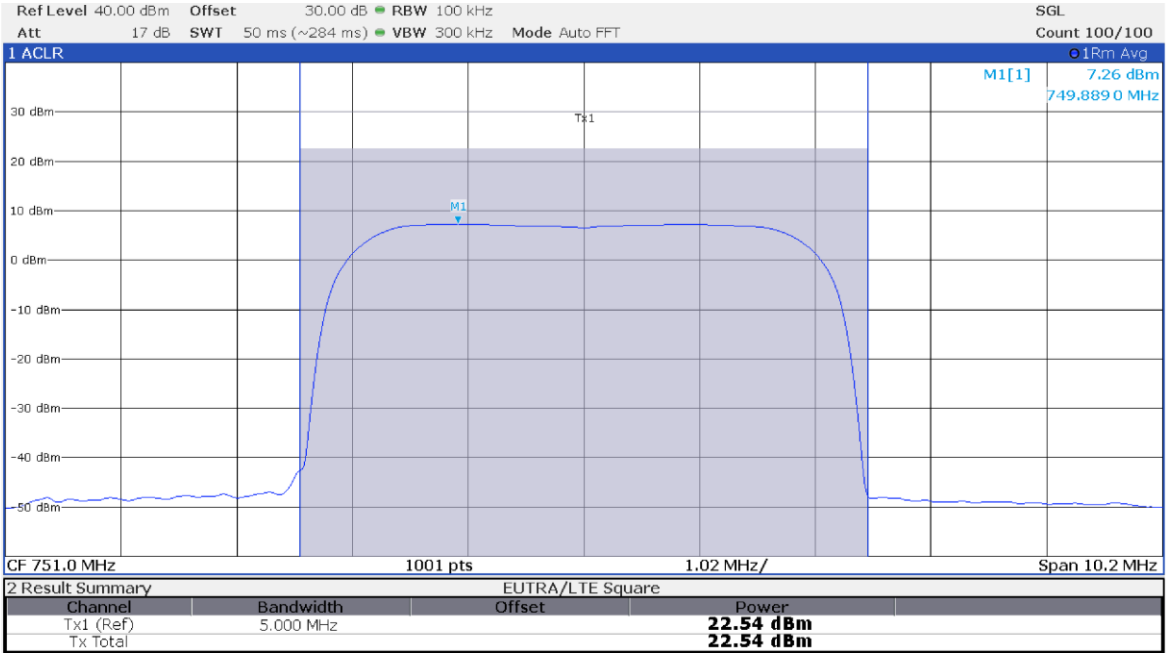


Figure 8.4-4: *Output power at antenna port 1 with input signal at AGC threshold +3 dB*

Test data, continued

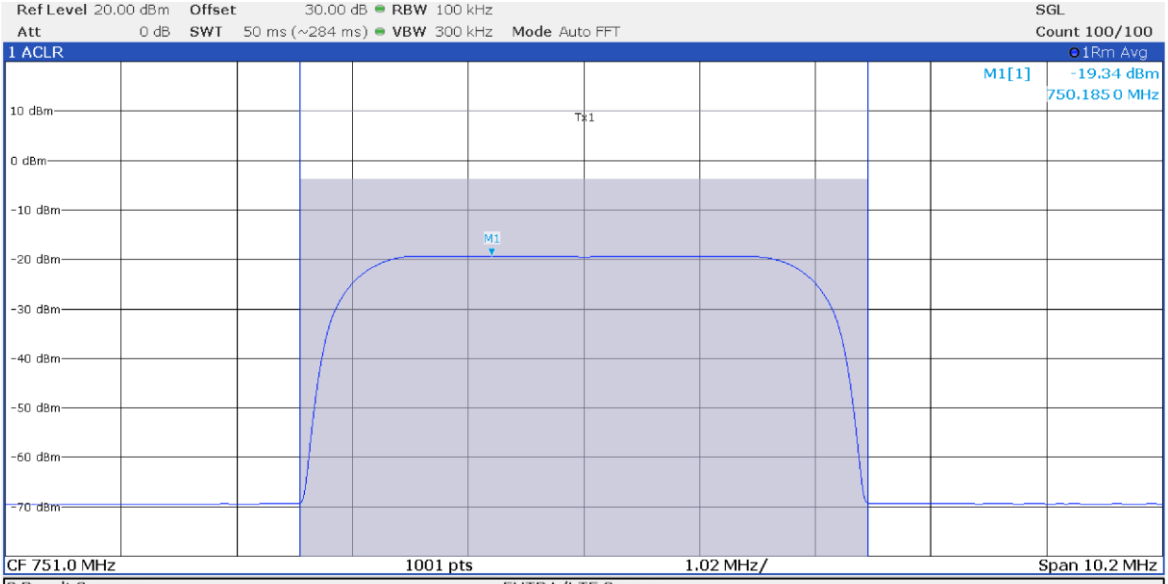


Figure 8.4-5: *Input power at antenna port 2 with input signal at AGC threshold*

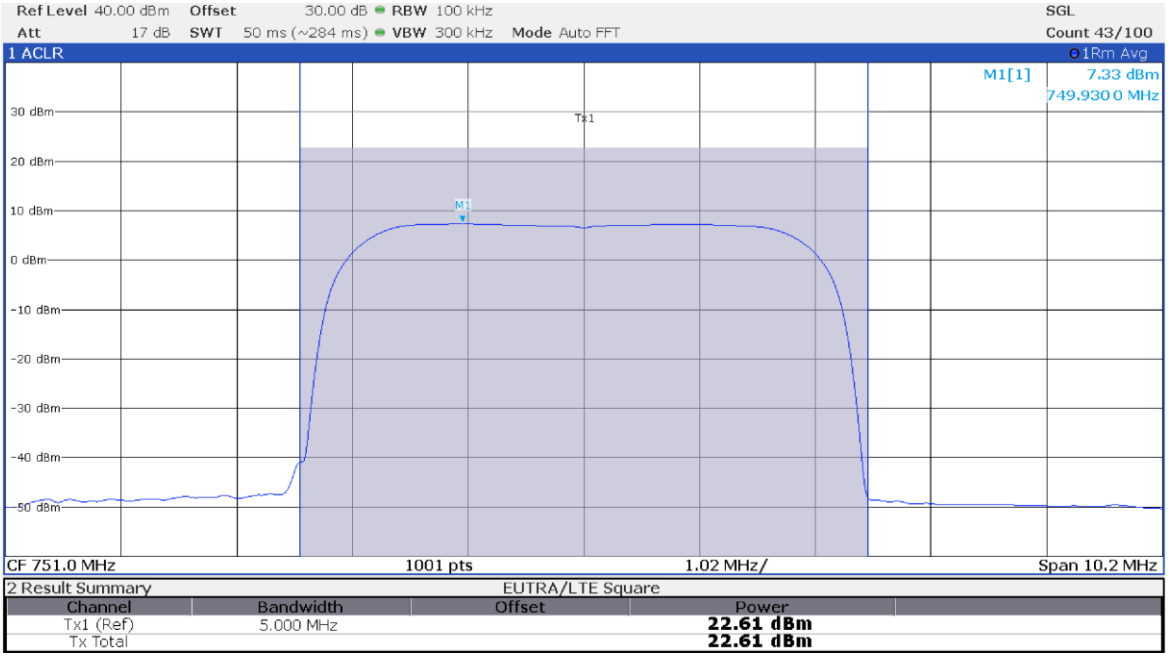


Figure 8.4-6: *Output power at antenna port 2 with input signal at AGC threshold*

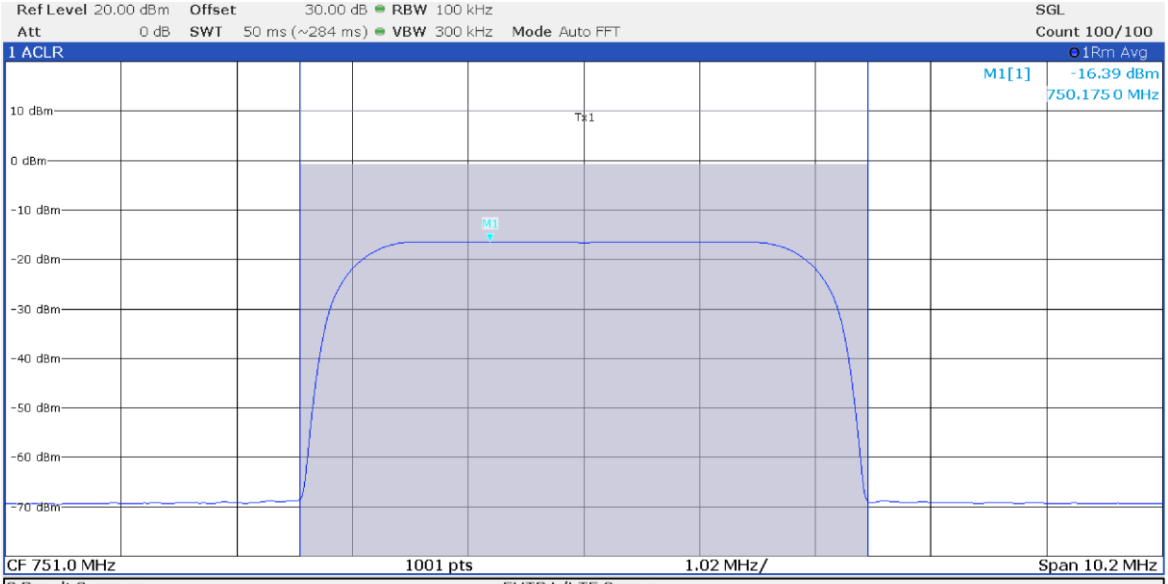


Figure 8.4-7: *Input power at antenna port 2 with input signal at AGC threshold +3 dB*

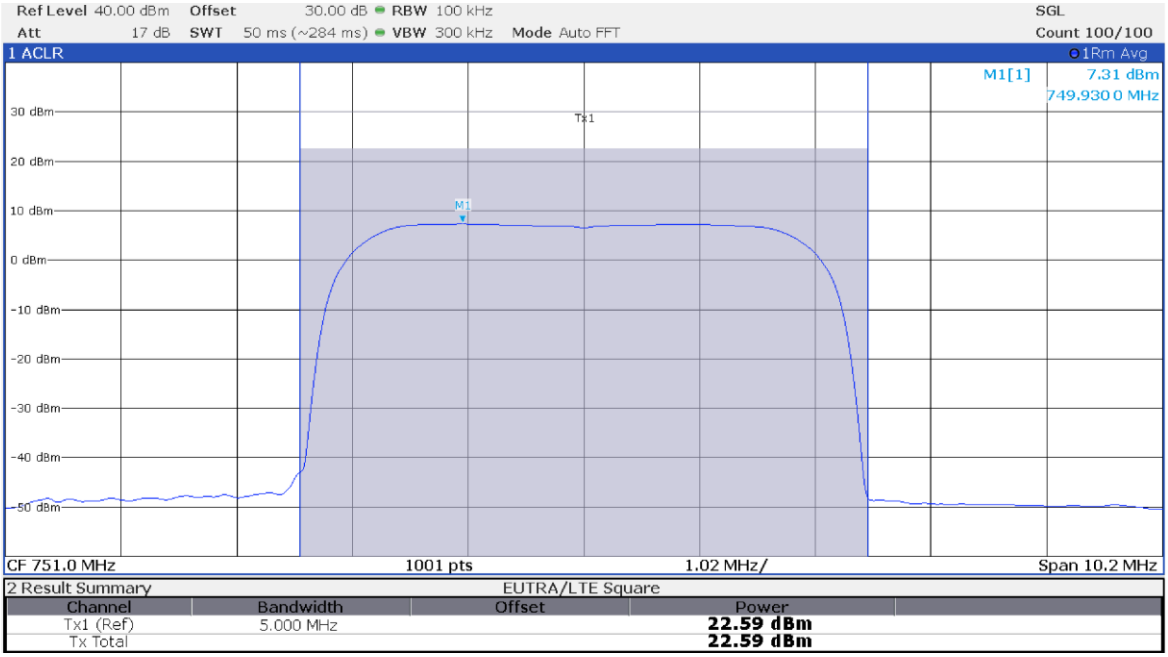


Figure 8.4-8: *Output power at antenna port 2 with input signal at AGC threshold +3 dB*

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	751.0	4.62	13.00	-8.38
1	AGC threshold +3 dB	751.0	4.50	13.00	-8.50
2	AGC threshold	751.0	4.48	13.00	-8.52
2	AGC threshold +3 dB	751.0	4.50	13.00	-8.50

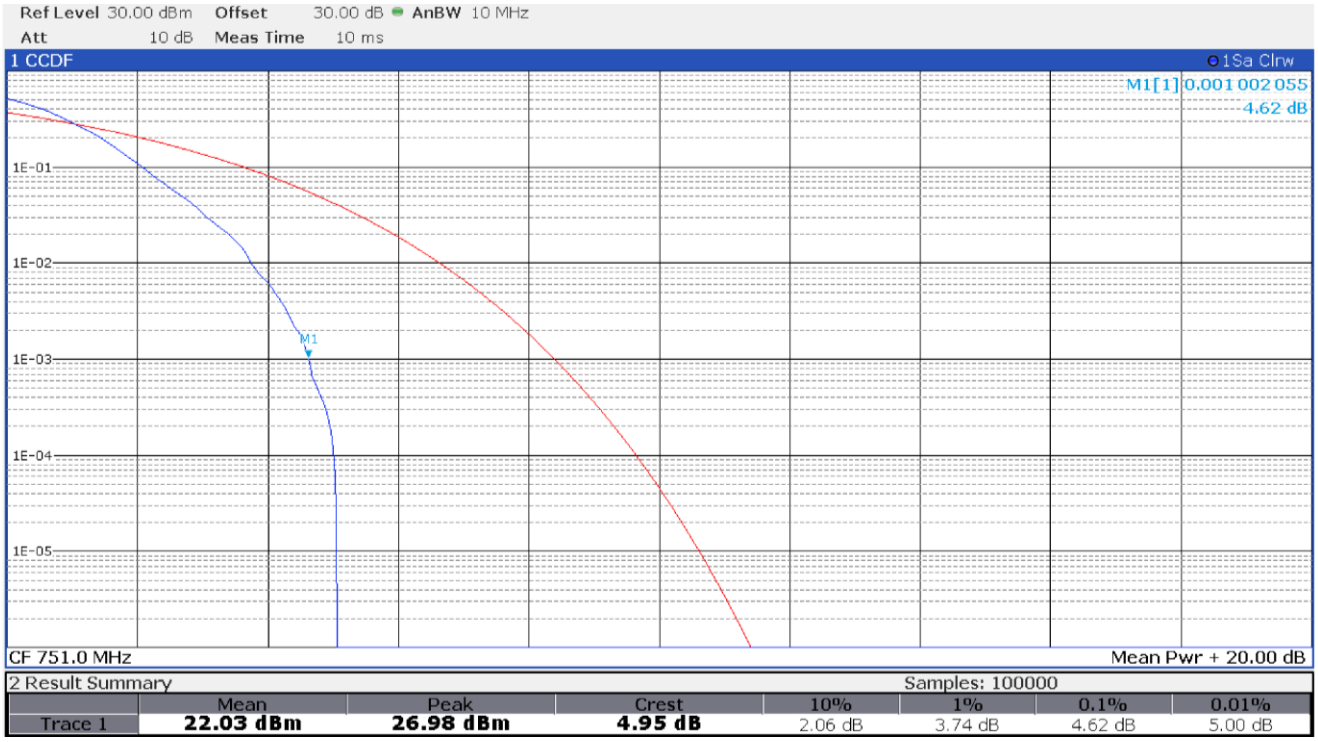
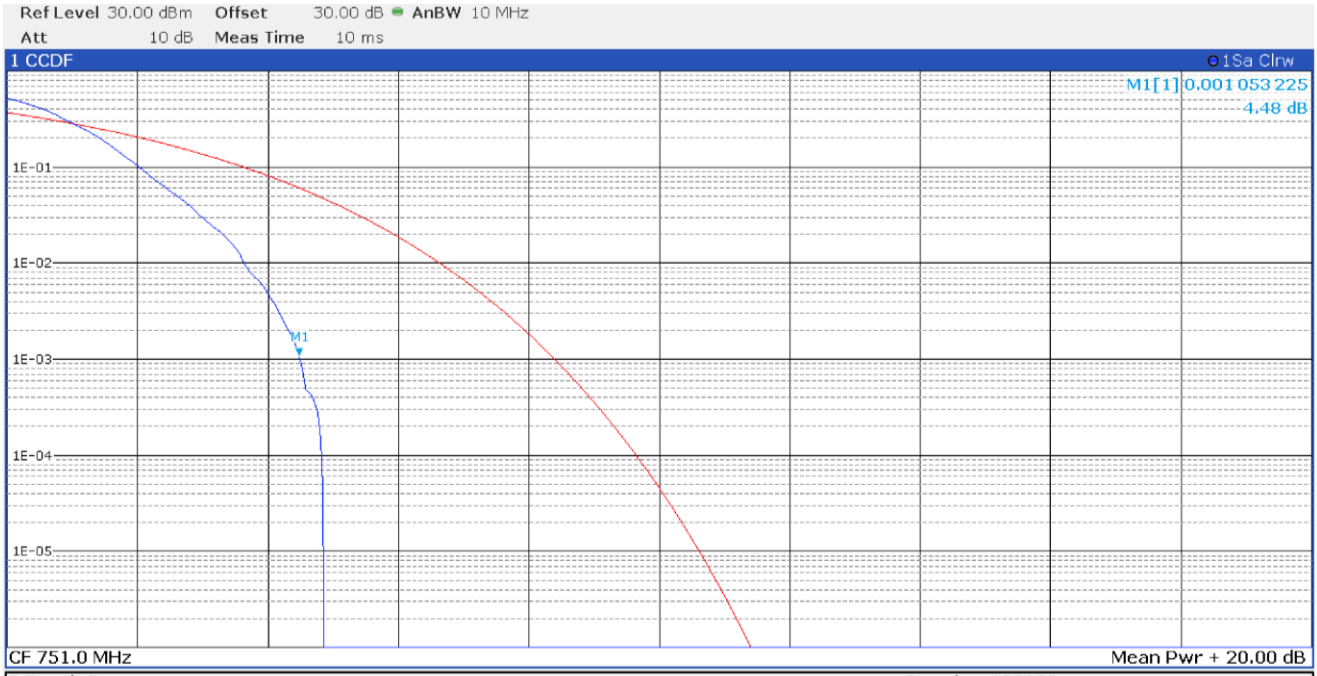


Figure 8.4-9: *PAPR at antenna port 1 with input signal at AGC threshold*

Test data, continued

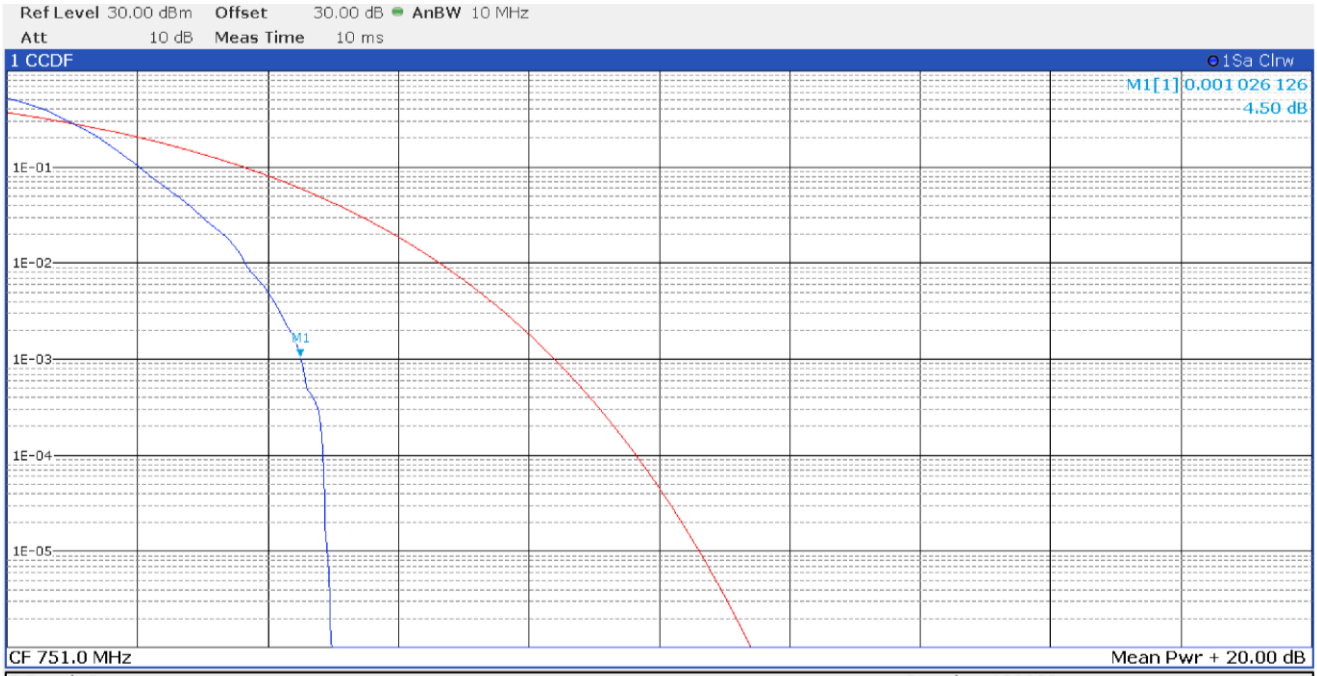


2 Result Summary — Samples: 100000

	Mean	Peak	Crest	10%	1%	0.1%	0.01%
Trace 1	**22.52 dBm**	**27.31 dBm**	**4.79 dB**	2.02 dB	3.62 dB	4.48 dB	4.82 dB

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

Test data, continued

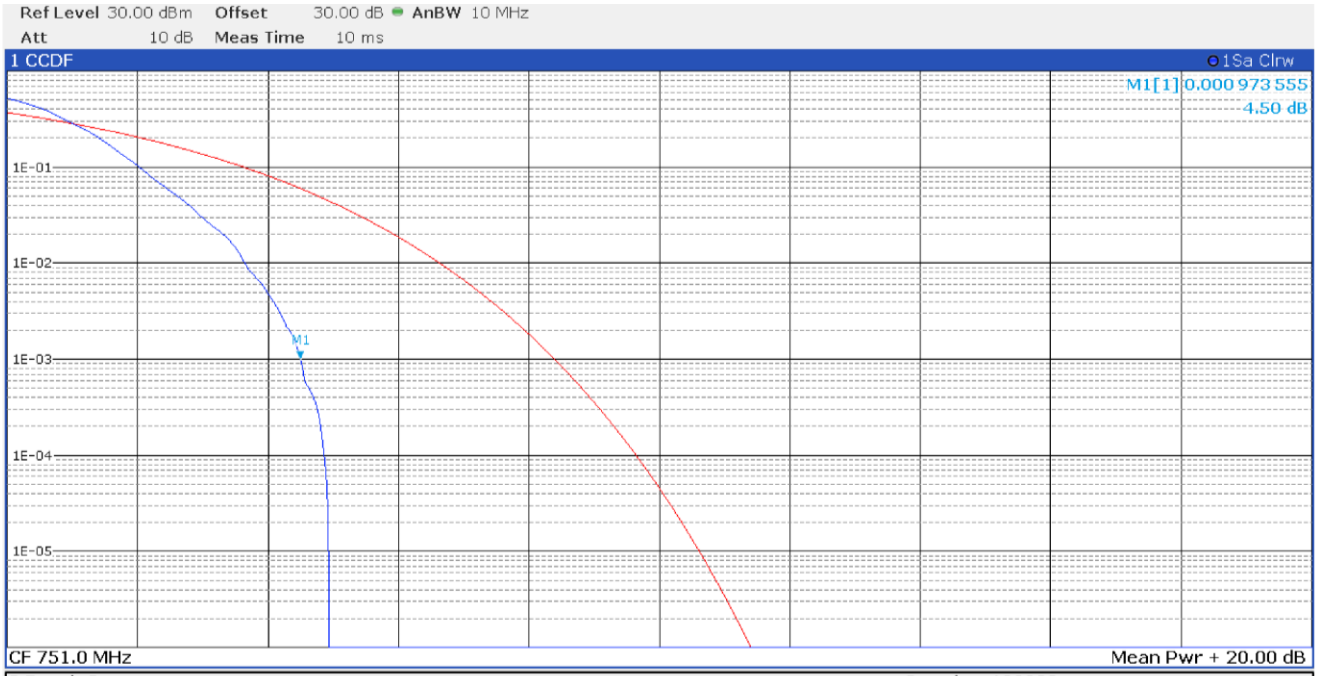


2 Result Summary — Samples: 100000

	Mean	Peak	Crest	10%	1%	0.1%	0.01%
Trace 1	**22.50 dBm**	**27.33 dBm**	**4.83 dB**	2.02 dB	3.64 dB	4.50 dB	4.84 dB

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

Test data, continued



2 Result Summary — Samples: 100000

	Mean	Peak	Crest	10%	1%	0.1%	0.01%
Trace 1	**22.53 dBm**	**27.34 dBm**	**4.81 dB**	2.02 dB	3.64 dB	4.50 dB	4.86 dB

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(c)

For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(3) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations;

RSS-131, Clause 5.2

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-130, Clause 4.7.1

General unwanted emissions limits

The unwanted emissions in any 100 kHz bandwidth on any frequency outside the low frequency edge and the high frequency edge of each frequency block range(s), shall be attenuated below the transmitter power, P (dBW), by at least 43 + 10 log10 p (watts), dB. However, in the 100 kHz band immediately outside of the equipment's frequency block range, a resolution bandwidth of 30 kHz may be employed.

8.5.2 Test summary

Verdict	Pass		
Tested by	P. Barbieri	Test date	January 27, 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 × $\text{Log}_{10}(2)$ = 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:	748.5 MHz and 753.5 MHz
Lower block edge intermodulation products:	748.5 MHz and 753.5 MHz
Upper block edge, single carrier:	753.5 MHz
Lower block edge, single carrier:	748.5 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

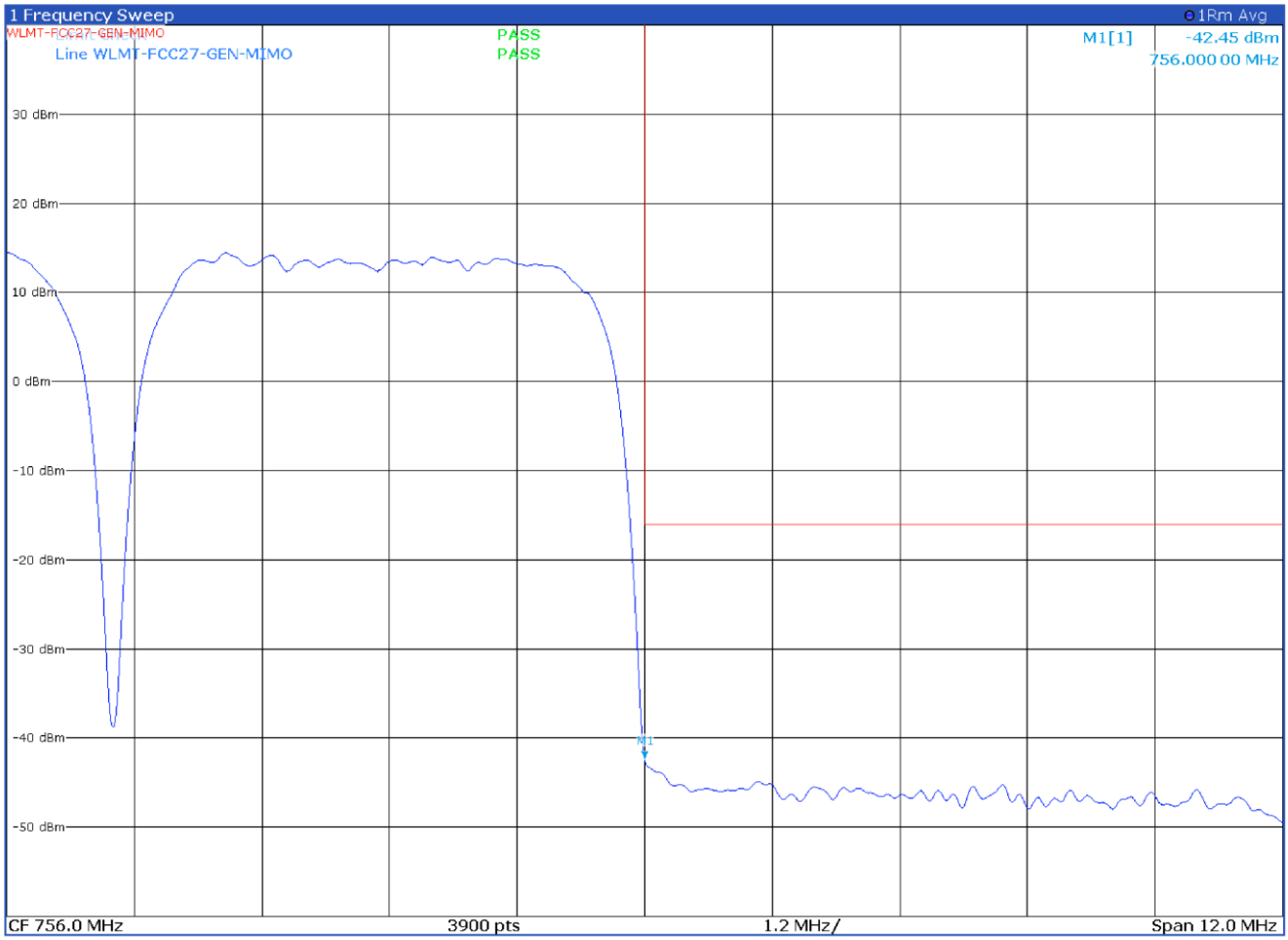


Figure 8.5-1: *Antenna port 1 upper block edge intermodulation products with input signal at AGC threshold*

Test data, continued

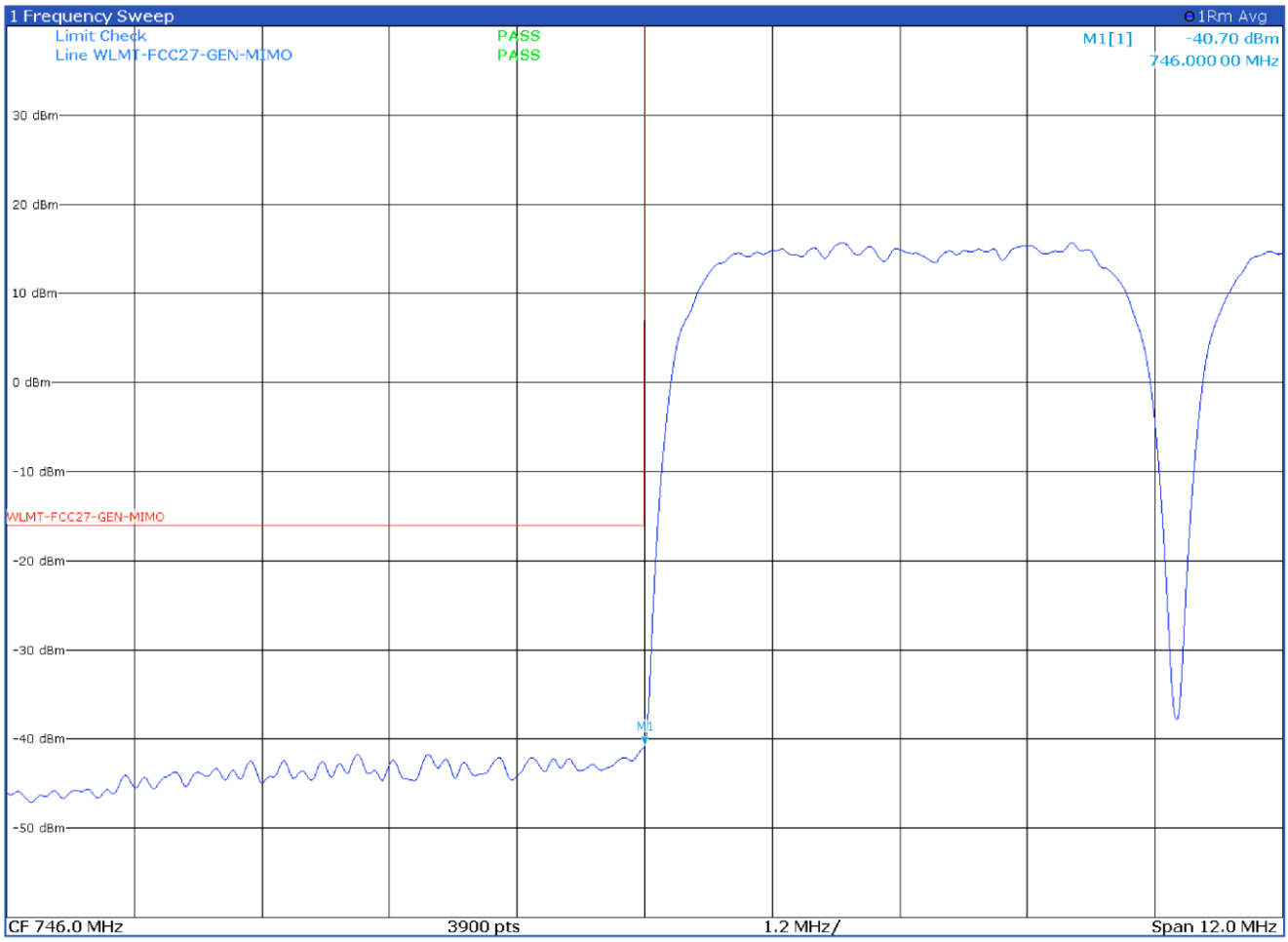


Figure 8.5-2: *Antenna port 1 lower block edge intermodulation products with input signal at AGC threshold*

Test data, continued

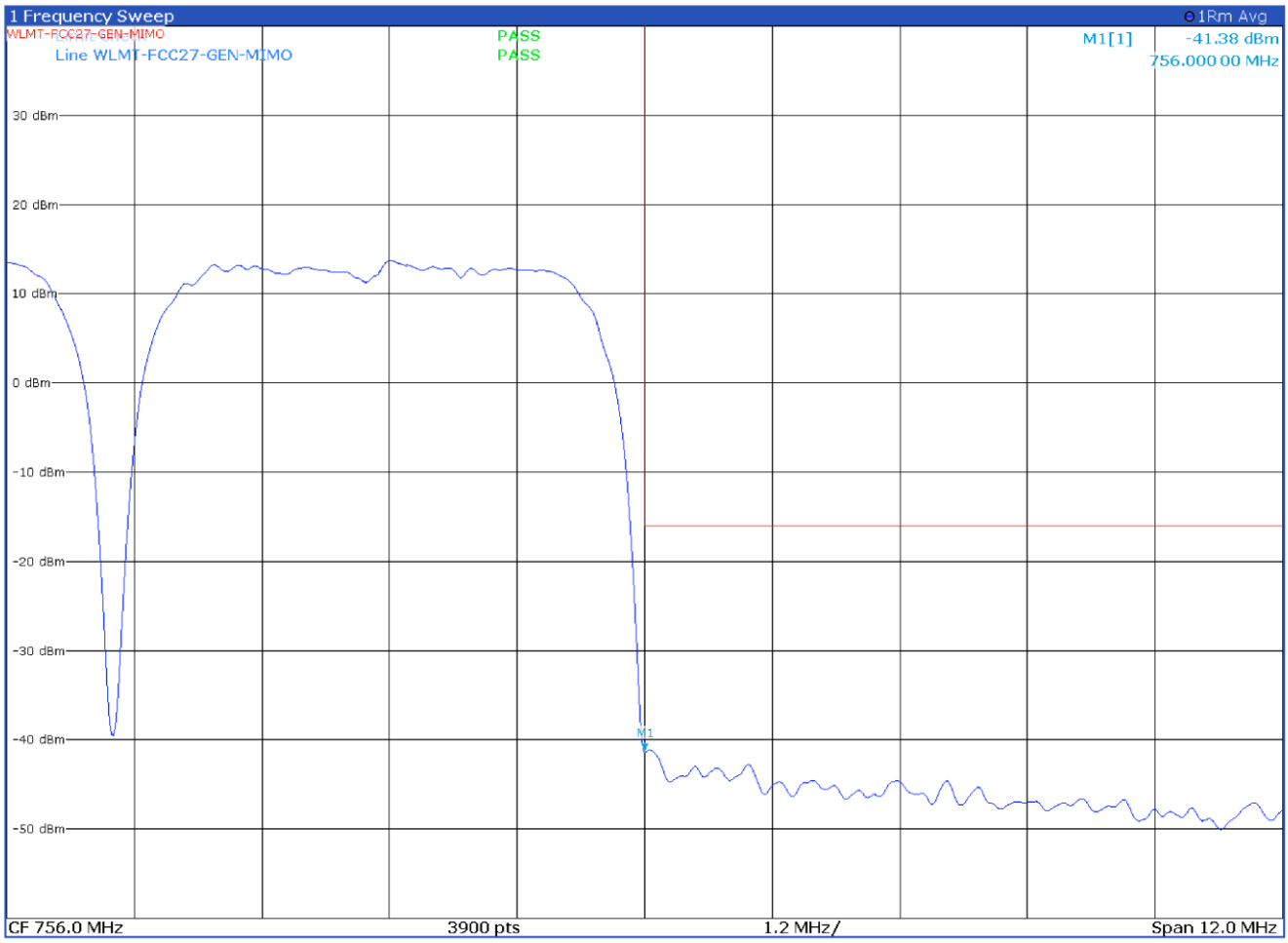


Figure 8.5-3: *Antenna port 1 upper block edge intermodulation products with input signal at AGC threshold +3 dB*

Test data, continued

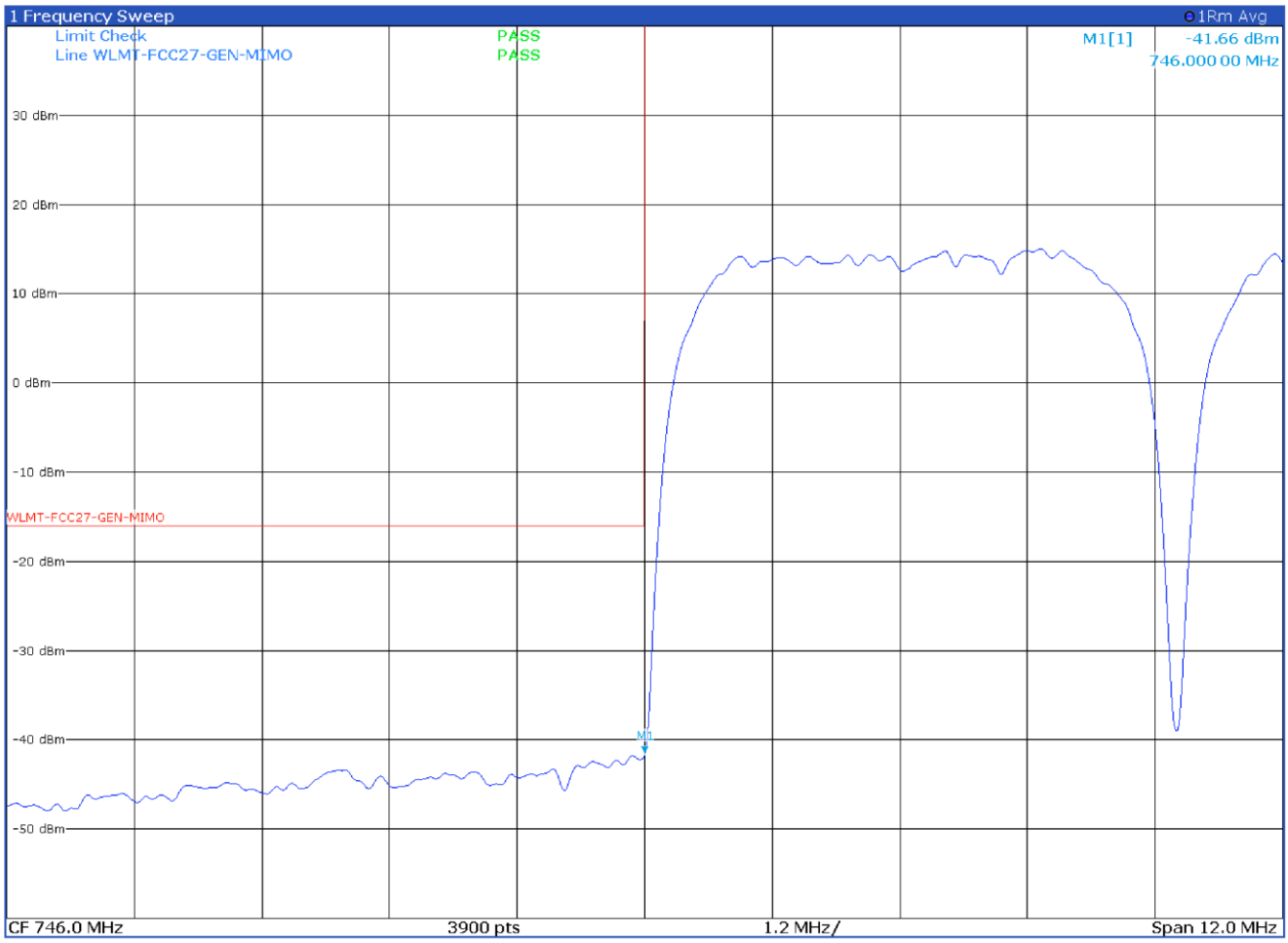


Figure 8.5-4: *Antenna port 1 lower block edge intermodulation products with input signal at AGC threshold +3 dB*

Test data, continued

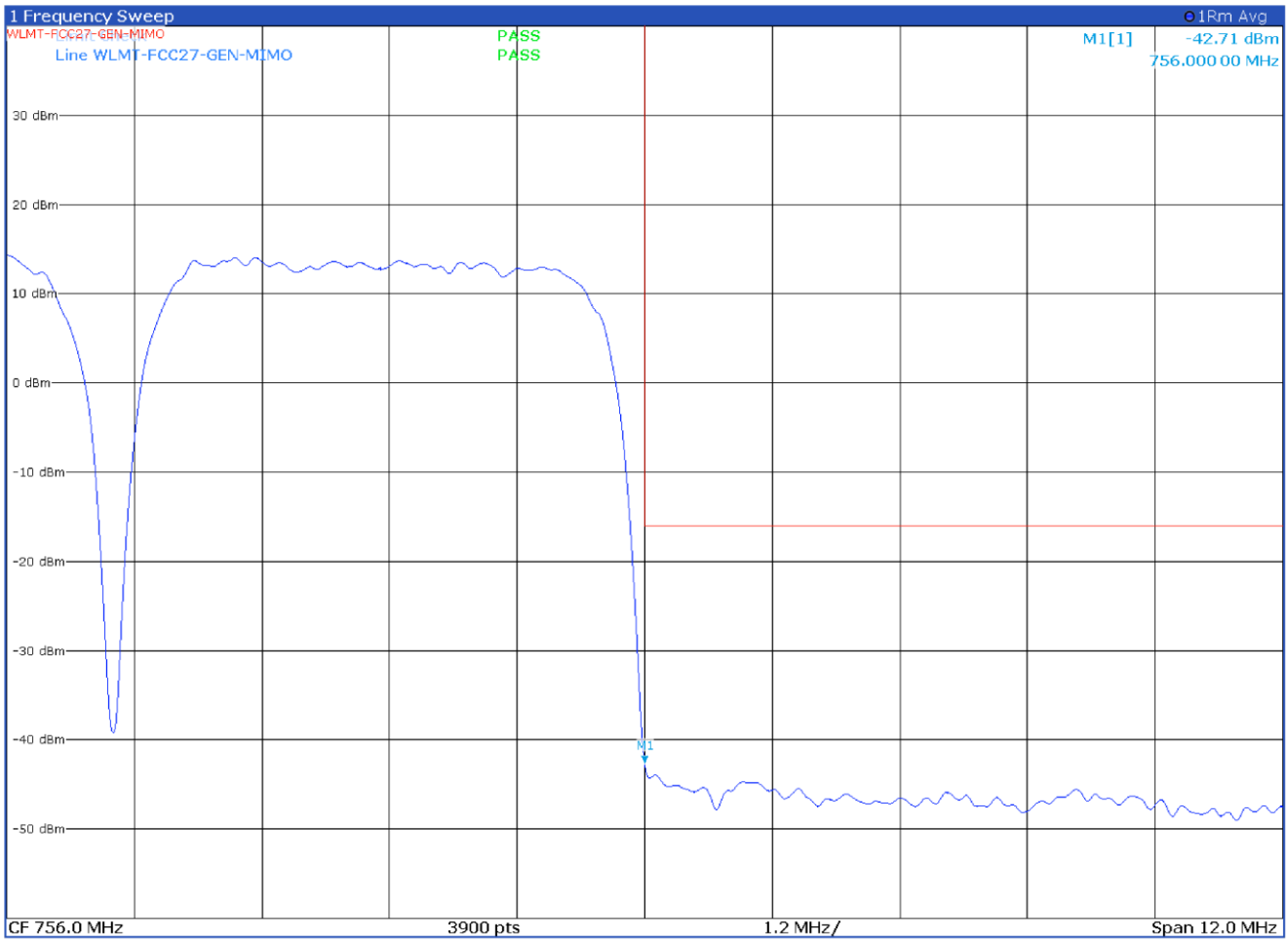


Figure 8.5-5: *Antenna port 2 upper block edge intermodulation products with input signal at AGC threshold*

Test data, continued

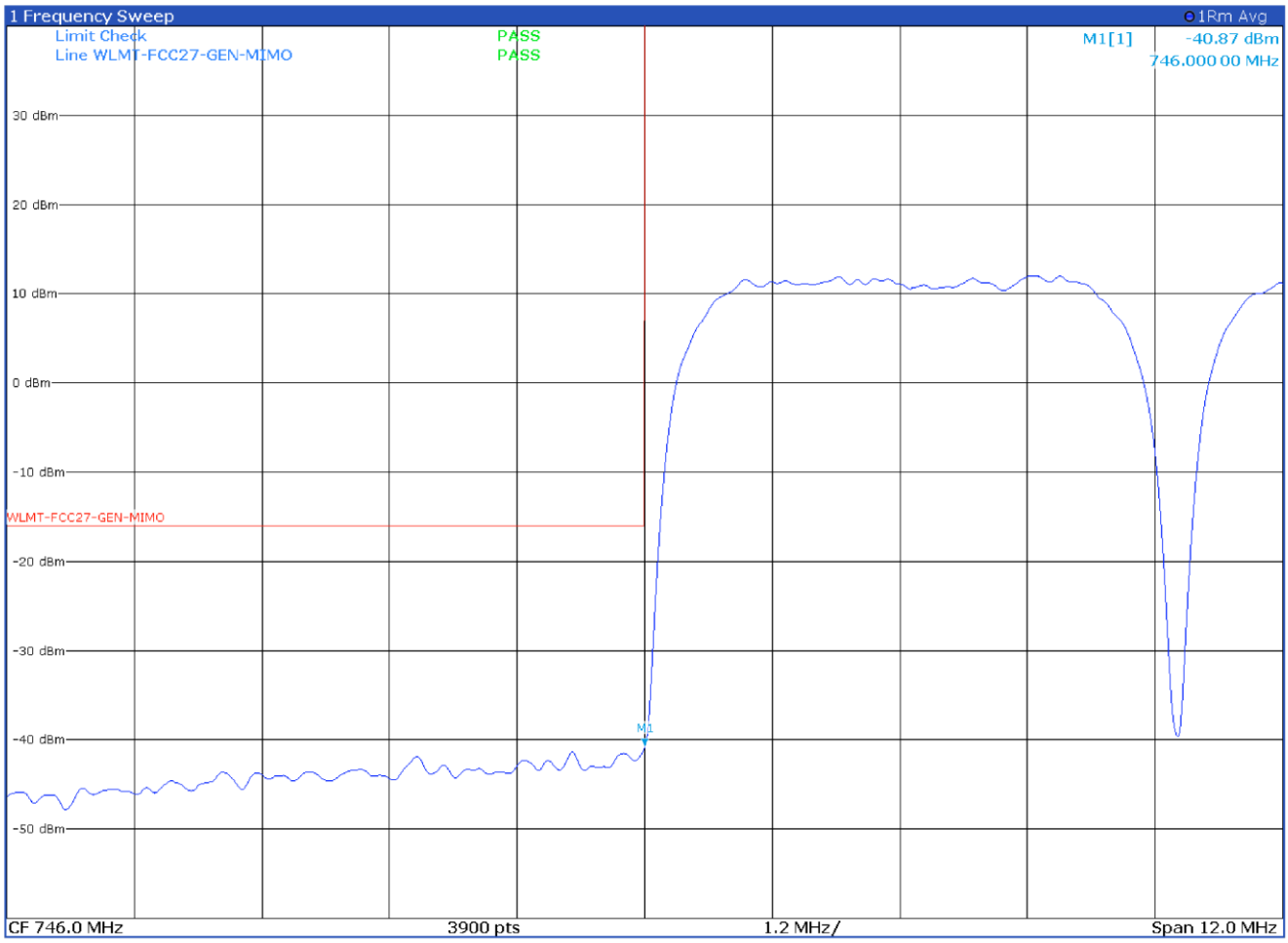


Figure 8.5-6: *Antenna port 2 lower block edge intermodulation products with input signal at AGC threshold*

Test data, continued

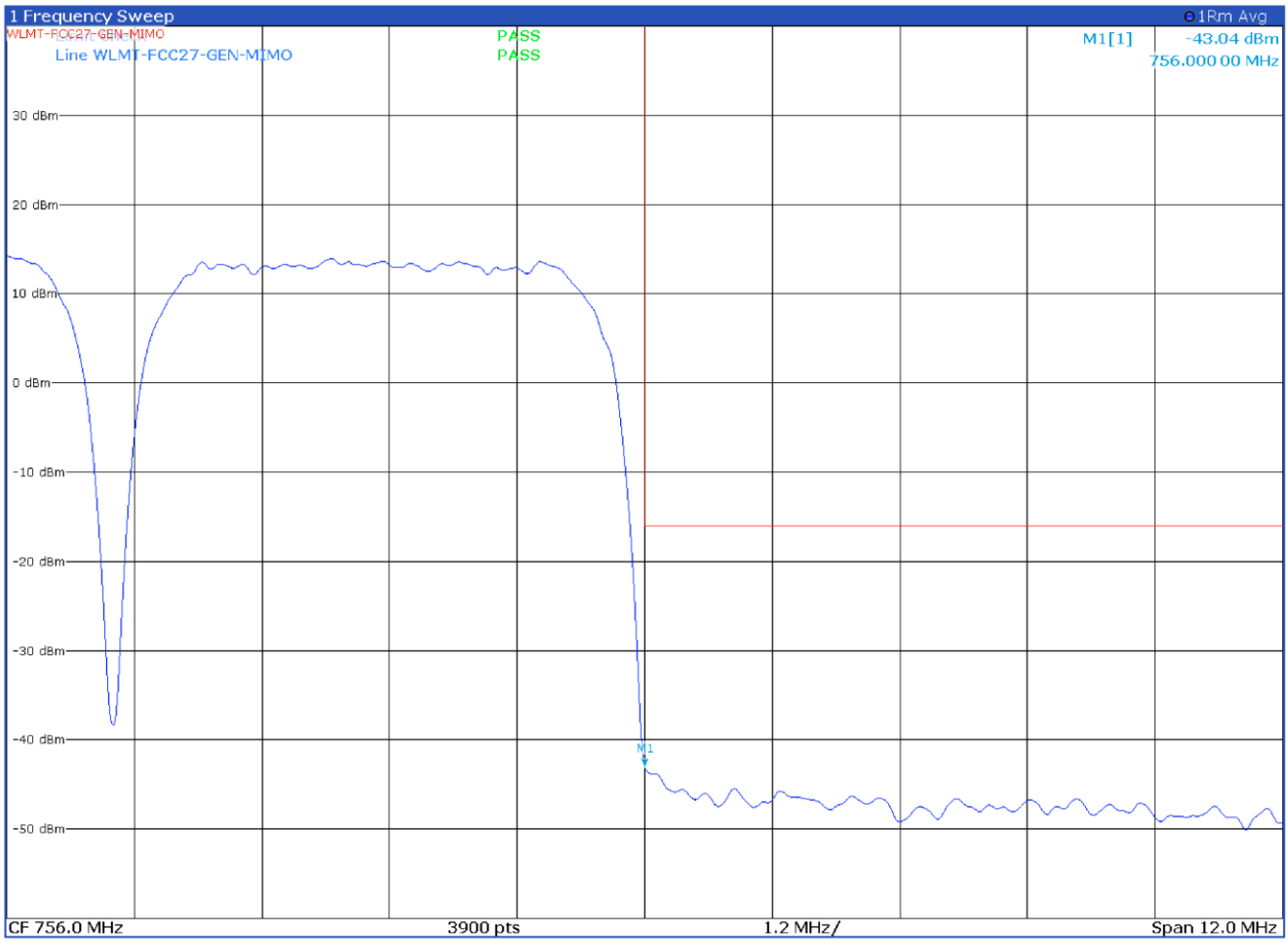


Figure 8.5-7: *Antenna port 2 upper block edge intermodulation products with input signal at AGC threshold +3 dB*

Test data, continued

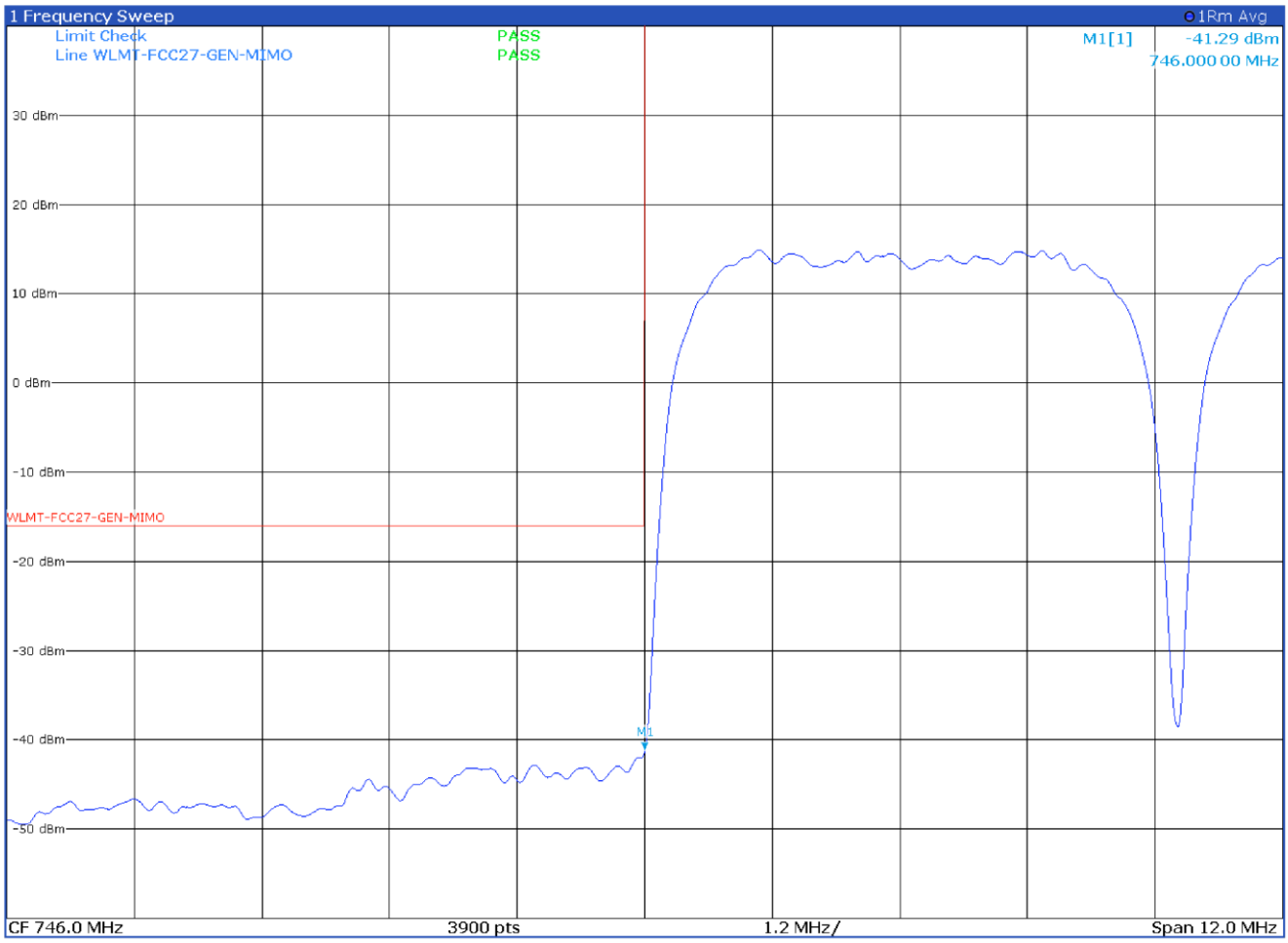


Figure 8.5-8: *Antenna port 2 lower block edge intermodulation products with input signal at AGC threshold +3 dB*

Test data, continued

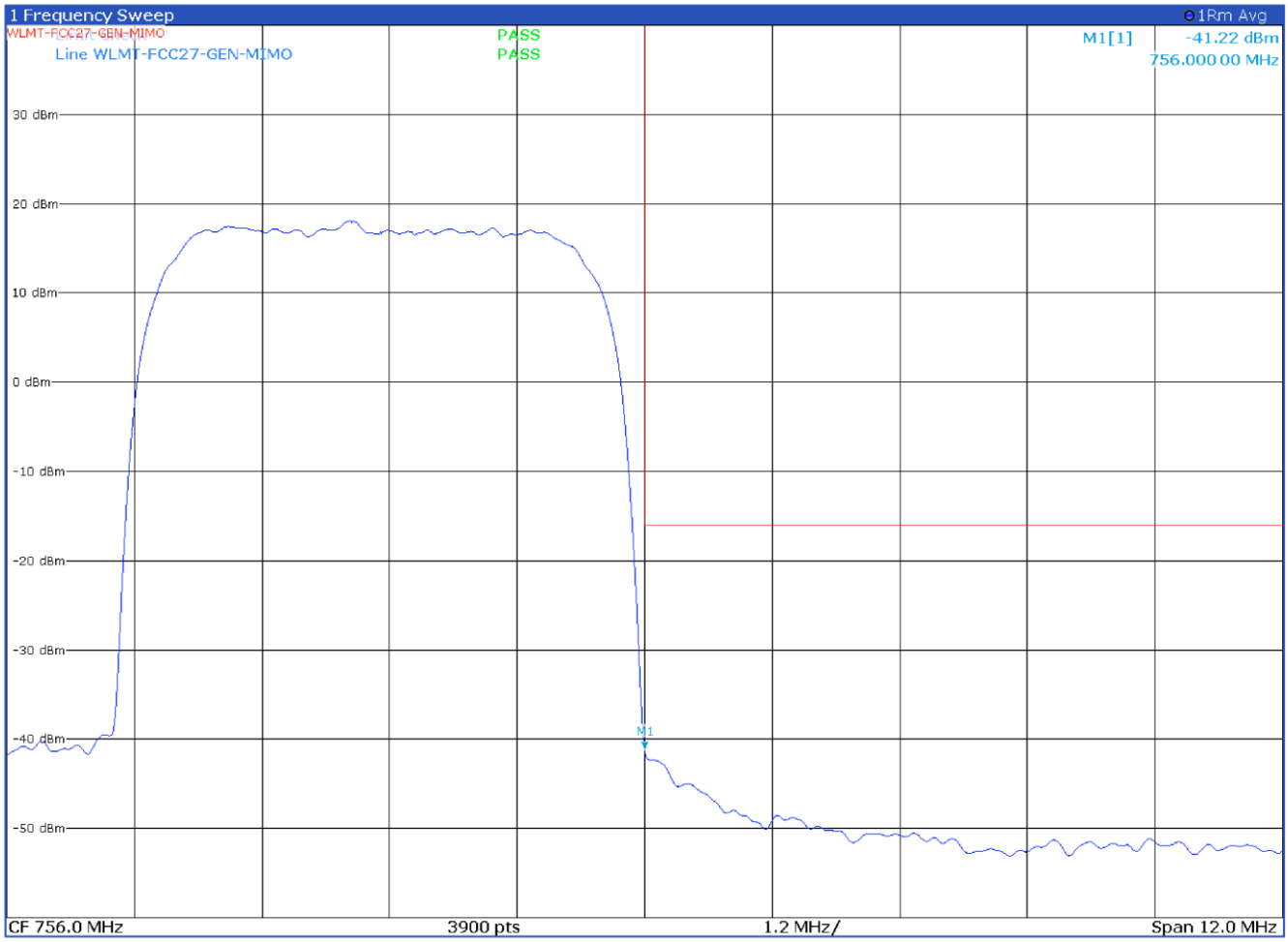


Figure 8.5-9: *Antenna port 1 single carrier upper block edge with input signal at AGC threshold*

Test data, continued

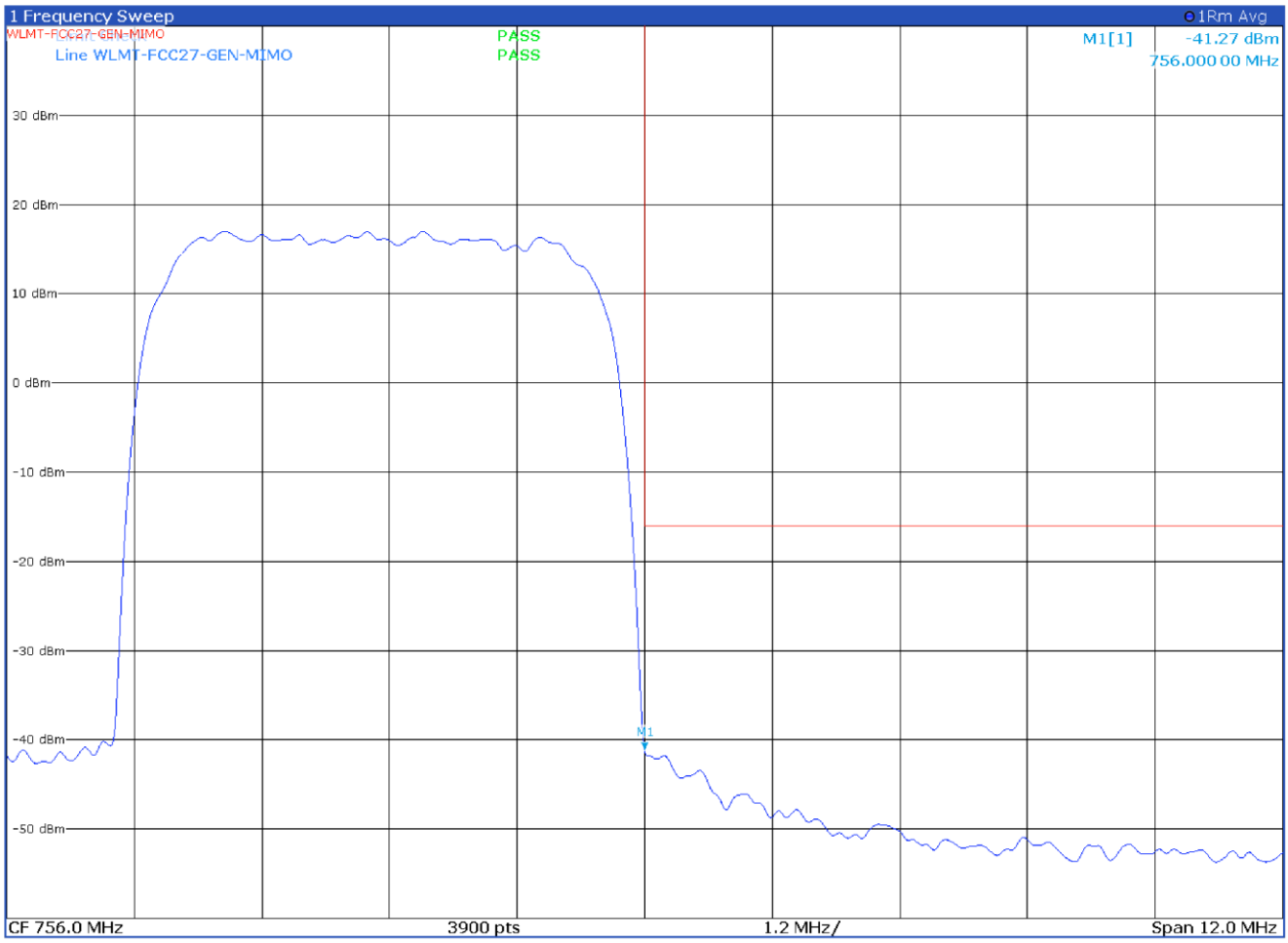


Figure 8.5-10: *Antenna port 1 single carrier upper block edge with input signal at AGC threshold +3 dB*

Test data, continued

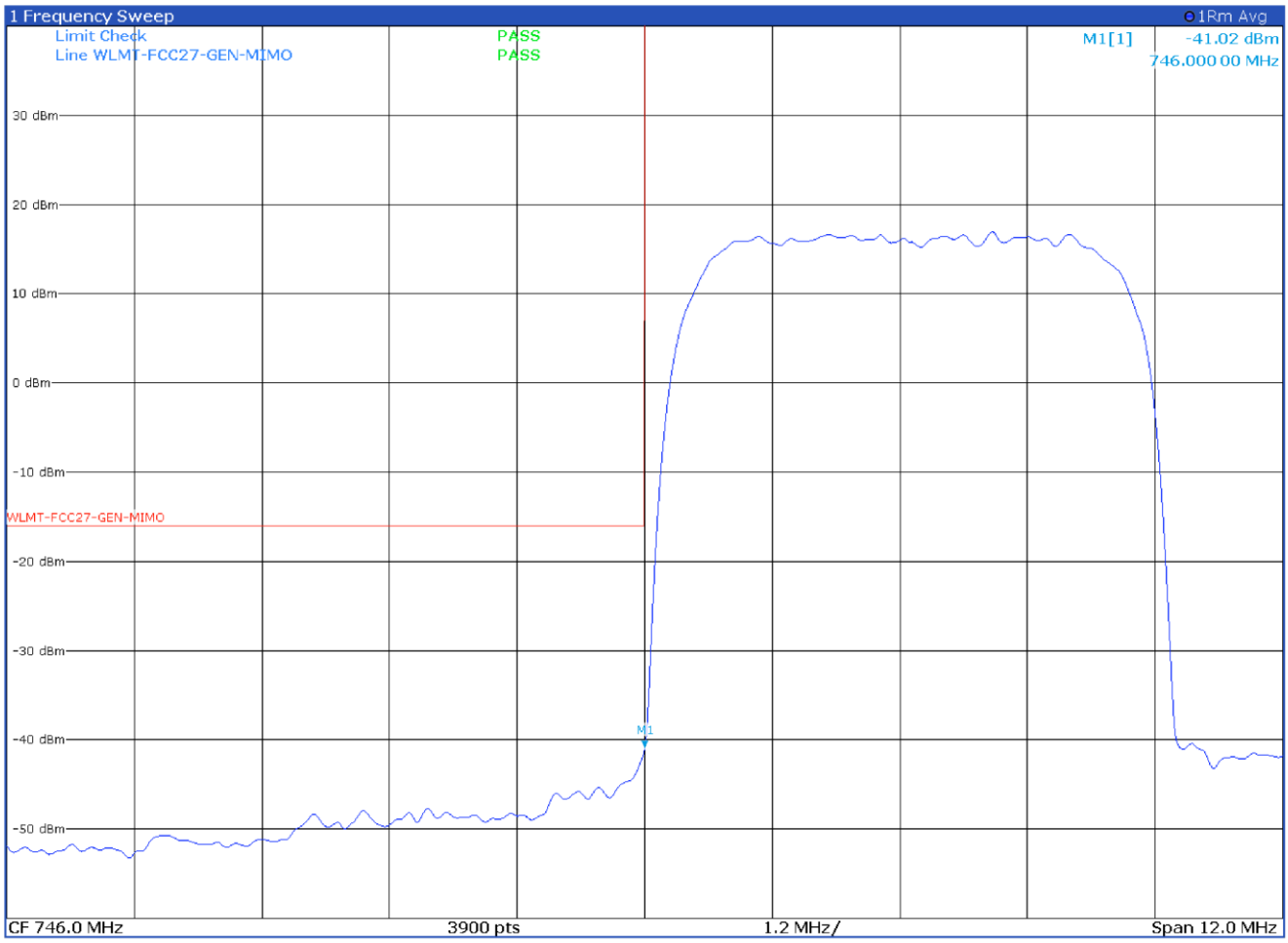


Figure 8.5-11: *Antenna port 1 single carrier lower block edge with input signal at AGC threshold*

Test data, continued

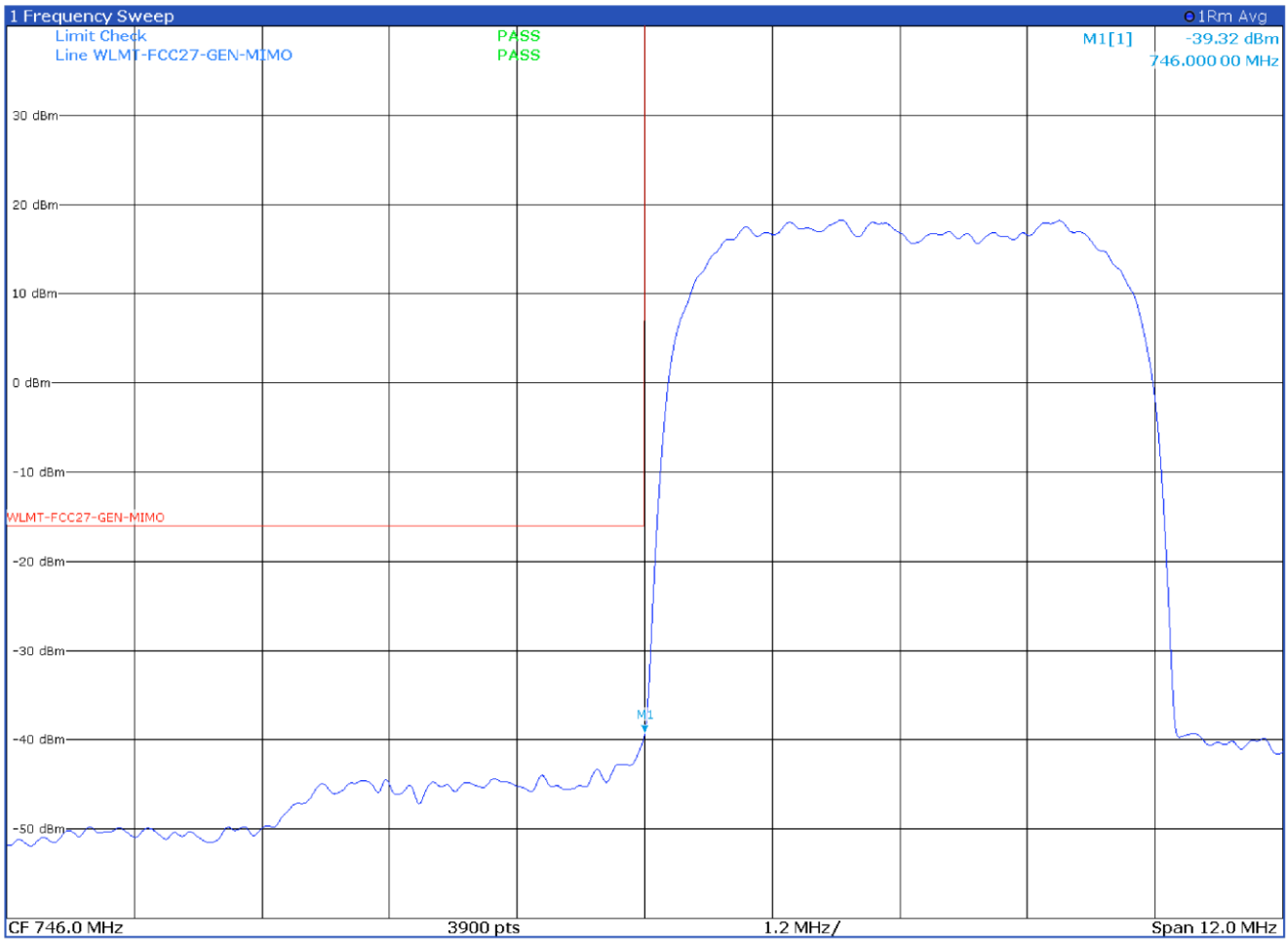


Figure 8.5-12: *Antenna port 1 single carrier lower block edge with input signal at AGC threshold +3 dB*

Test data, continued

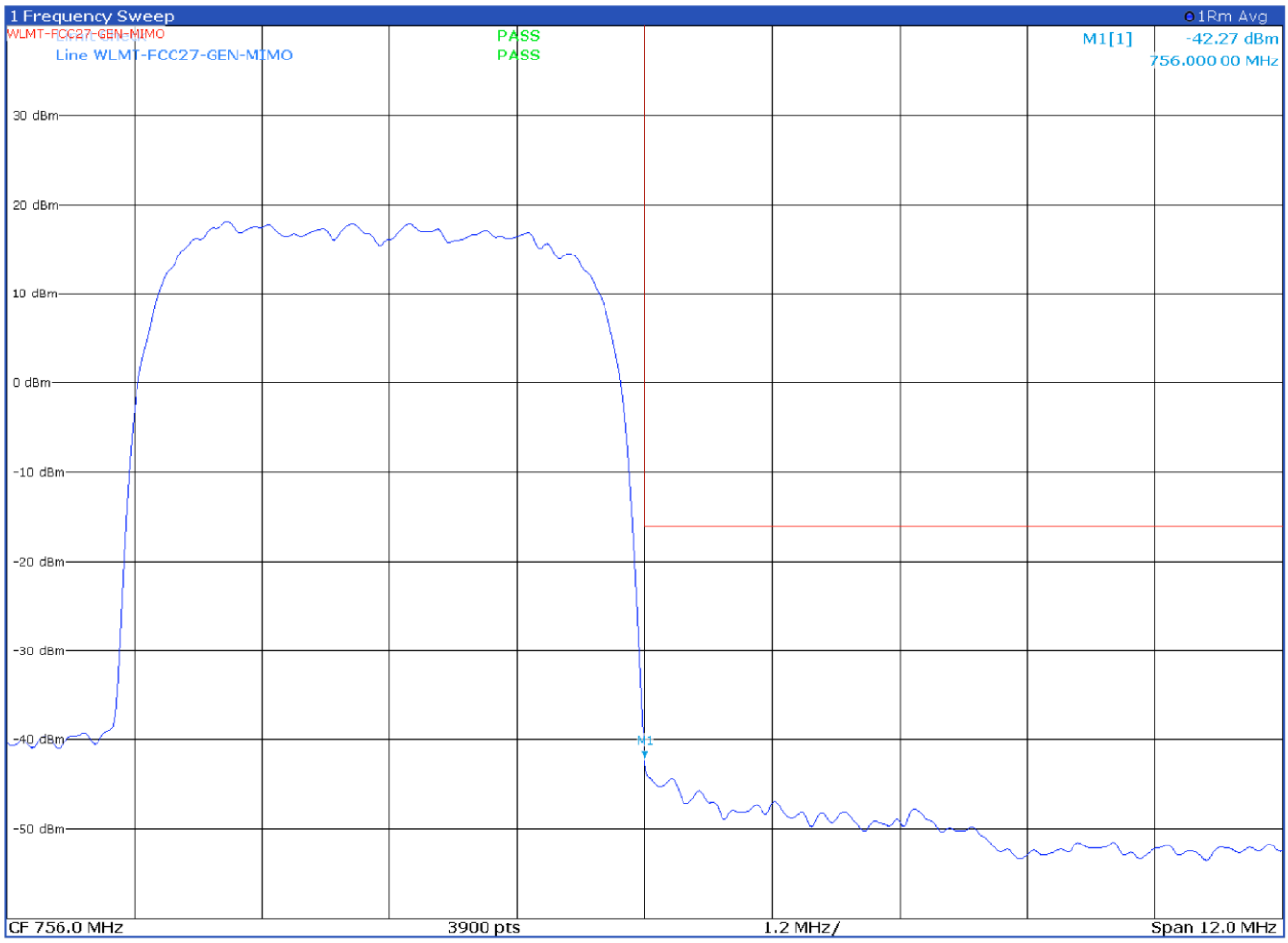


Figure 8.5-13: *Antenna port 2 single carrier upper block edge with input signal at AGC threshold*

Test data, continued

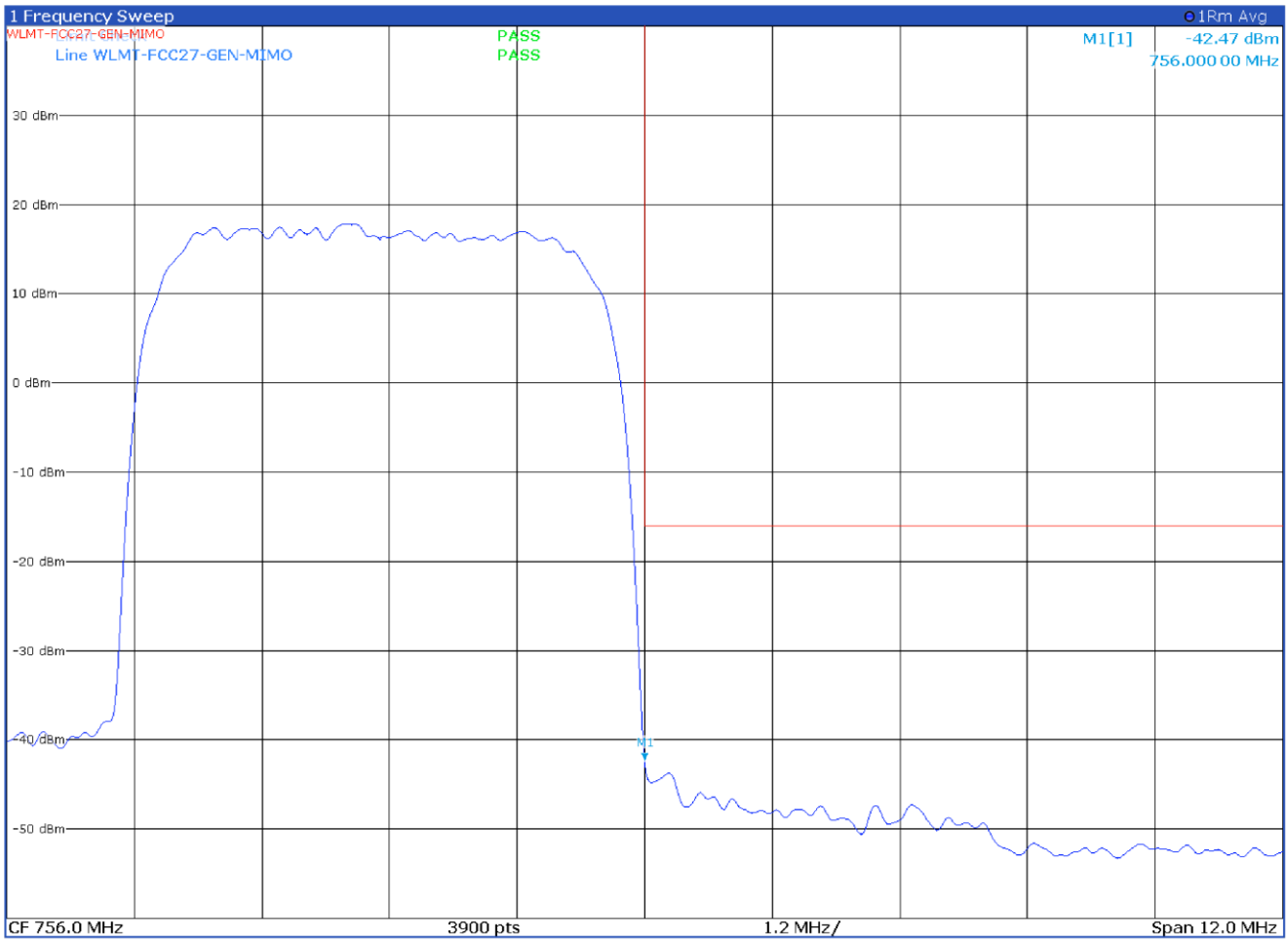


Figure 8.5-14: *Antenna port 2 single carrier upper block edge with input signal at AGC threshold +3 dB*

Test data, continued

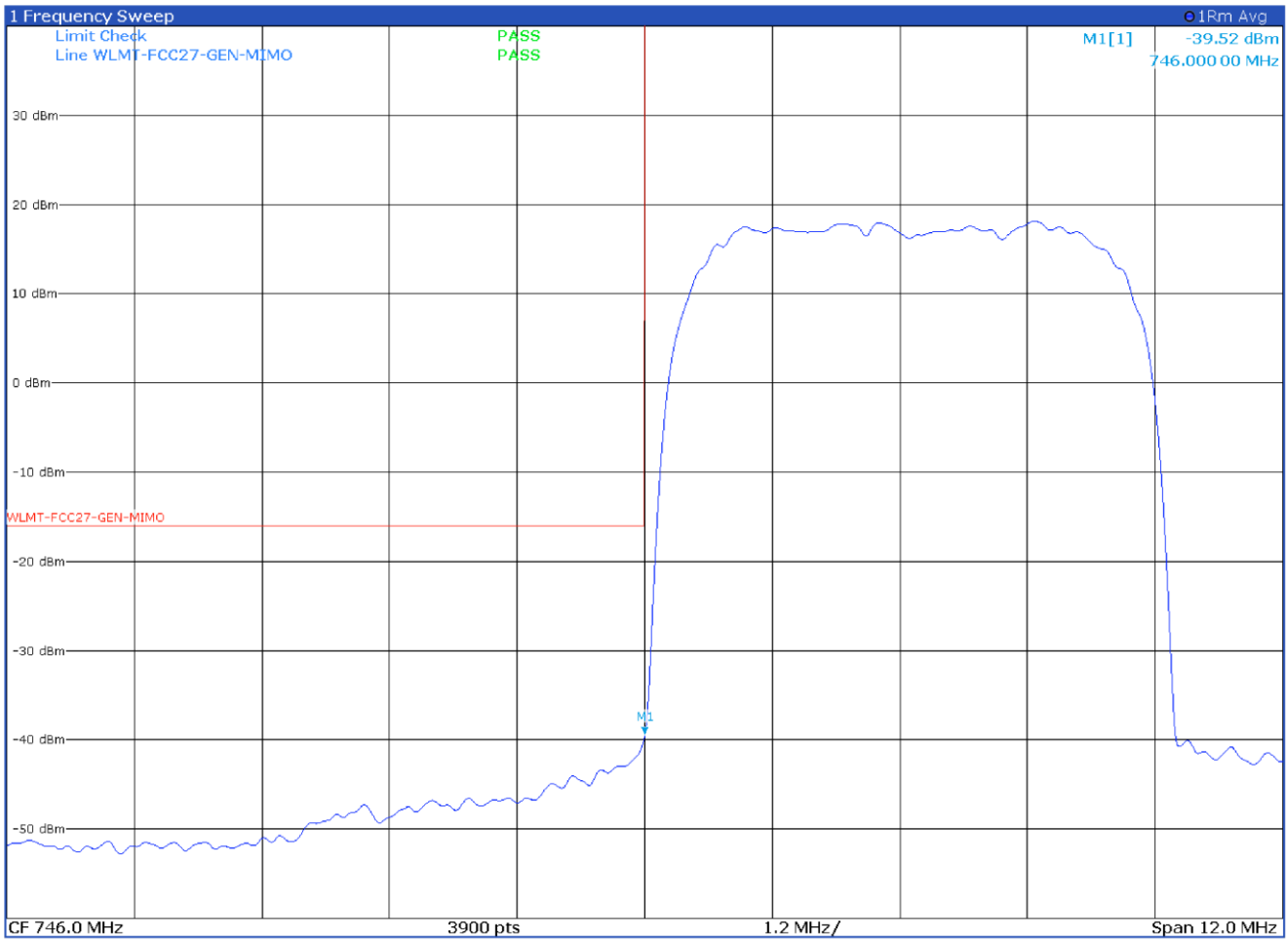


Figure 8.5-15: *Antenna port 2 single carrier lower block edge with input signal at AGC threshold*

Test data, continued

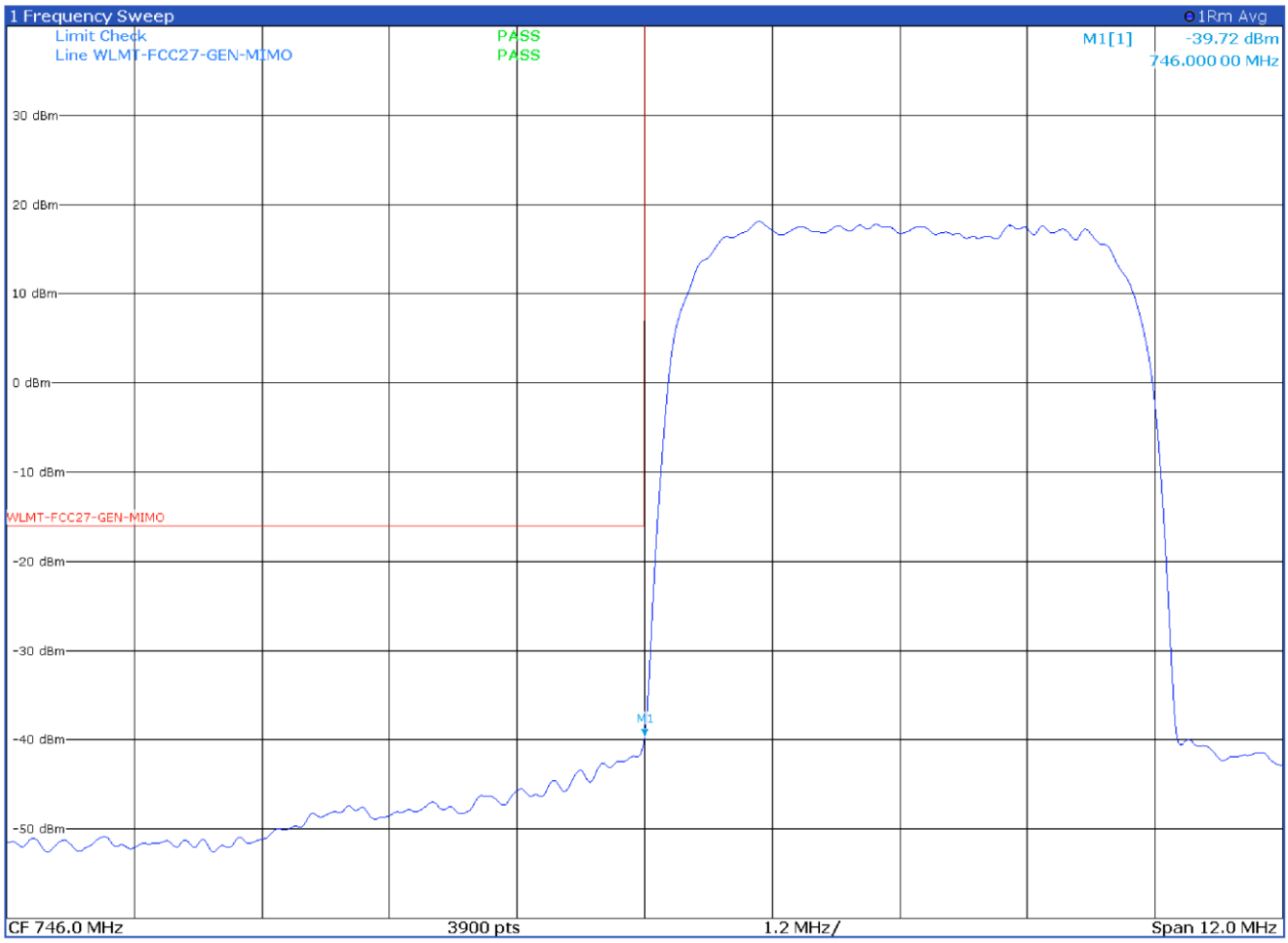


Figure 8.5-16: *Antenna port 2 single carrier lower block edge with input signal at AGC threshold +3 dB*

8.6 Spurious emissions conducted measurements

8.6.1 References, definitions and limits

FCC §27.53(c)

For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(3) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations;

FCC §27.53(f)

For operations in the 746-758 MHz, 775-788 MHz, and 805-806 MHz bands, emissions in the band 1559-1610 MHz shall be limited to −70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and −80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

RSS-131, Clause 5.2

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-130, Clause 4.7.1

General unwanted emissions limits

The unwanted emissions in any 100 kHz bandwidth on any frequency outside the low frequency edge and the high frequency edge of each frequency block range(s), shall be attenuated below the transmitter power, P (dBW), by at least 43 + 10 log10 p (watts), dB. However, in the 100 kHz band immediately outside of the equipment’s frequency block range, a resolution bandwidth of 30 kHz may be employed.

RSS-130, Clause 4.7.2

Additional unwanted emissions limits

In addition to the limit outlined in section 4.7.1 above, equipment operating in the frequency bands 746-756 MHz and 777-787 MHz shall also comply with the following restrictions:

(a) the power of any unwanted emissions in any 6.25 kHz bandwidth for all frequencies between 763-775 MHz and 793-806 MHz shall be attenuated below the transmitter power, P (dBW), by at least:
76 + 10 log10 p (watts), dB, for base and fixed equipment and
65 + 10 log10 p (watts), dB, for mobile and portable equipment

(b) the e.i.r.p. in the band 1559-1610 MHz shall not exceed −70 dBW/MHz for wideband signal and −80 dBW for discrete emission with bandwidth less than 700 Hz.

8.6.2 Test summary

Verdict	Pass		
Tested by	P. Barbieri	Test date	January 27, 2022

8.6.3 Observations, settings and special notes

The spectrum was searched from 9 kHz to the 10th harmonic.
All measurements were performed using peak detector according to note 4 of 935210 D05 Indus Booster Basic Meas v01r04 paragraph 3.6.3.
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 × $\text{Log}_{10}(2)$ = 3.01 dB

Spectrum analyser settings:

Resolution bandwidth:	Reference bandwidth in the applicable rule section for the supported frequency band
Video bandwidth:	VBW ≥ 3 × RBW
Detector mode:	Peak
Trace mode:	Max Hold

Input signal frequency

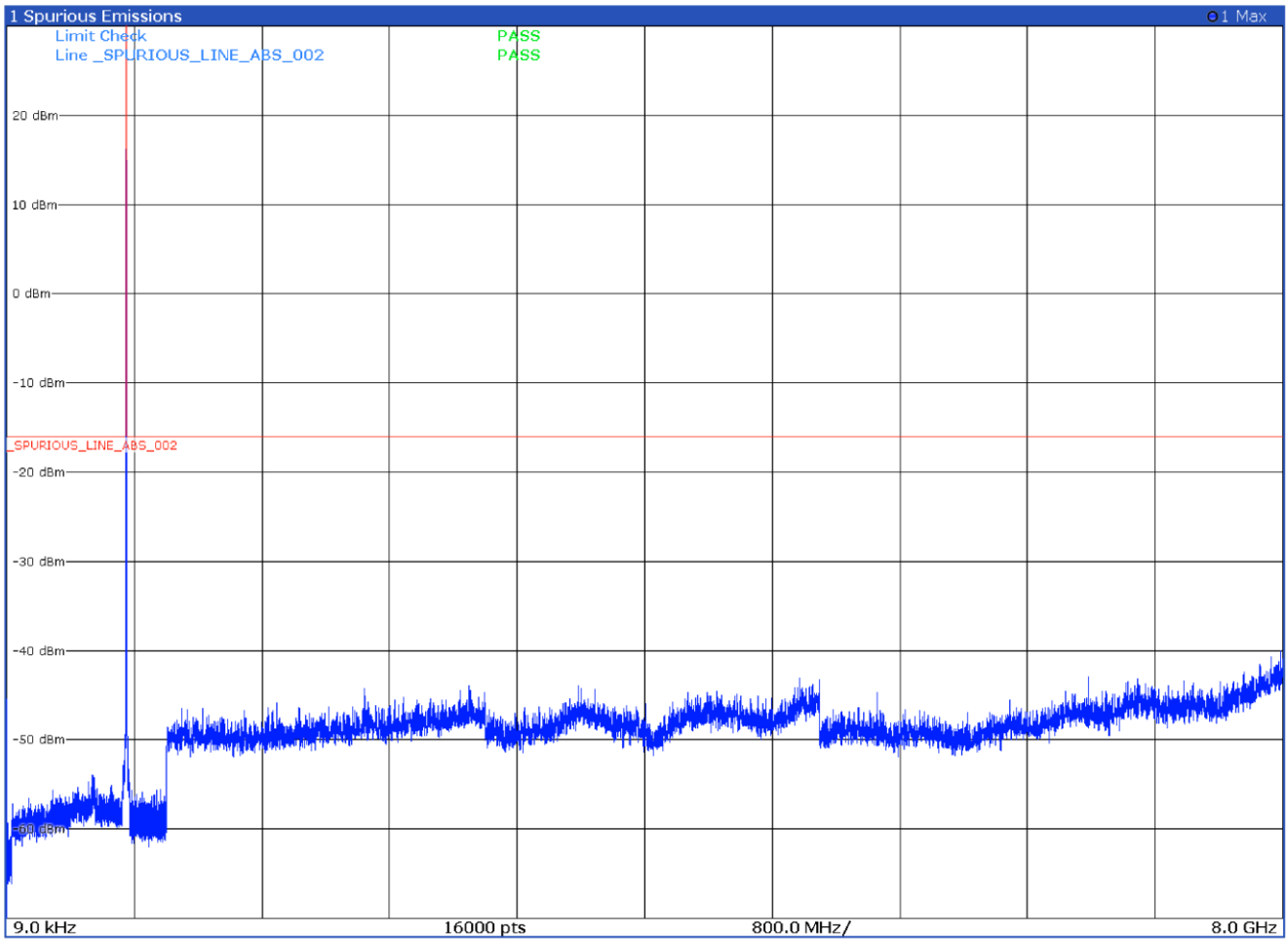
Low channel	748.5 MHz
Mid channel	751.0 MHz
High channel	753.5 MHz

8.6.4 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

8.6.5 Test data

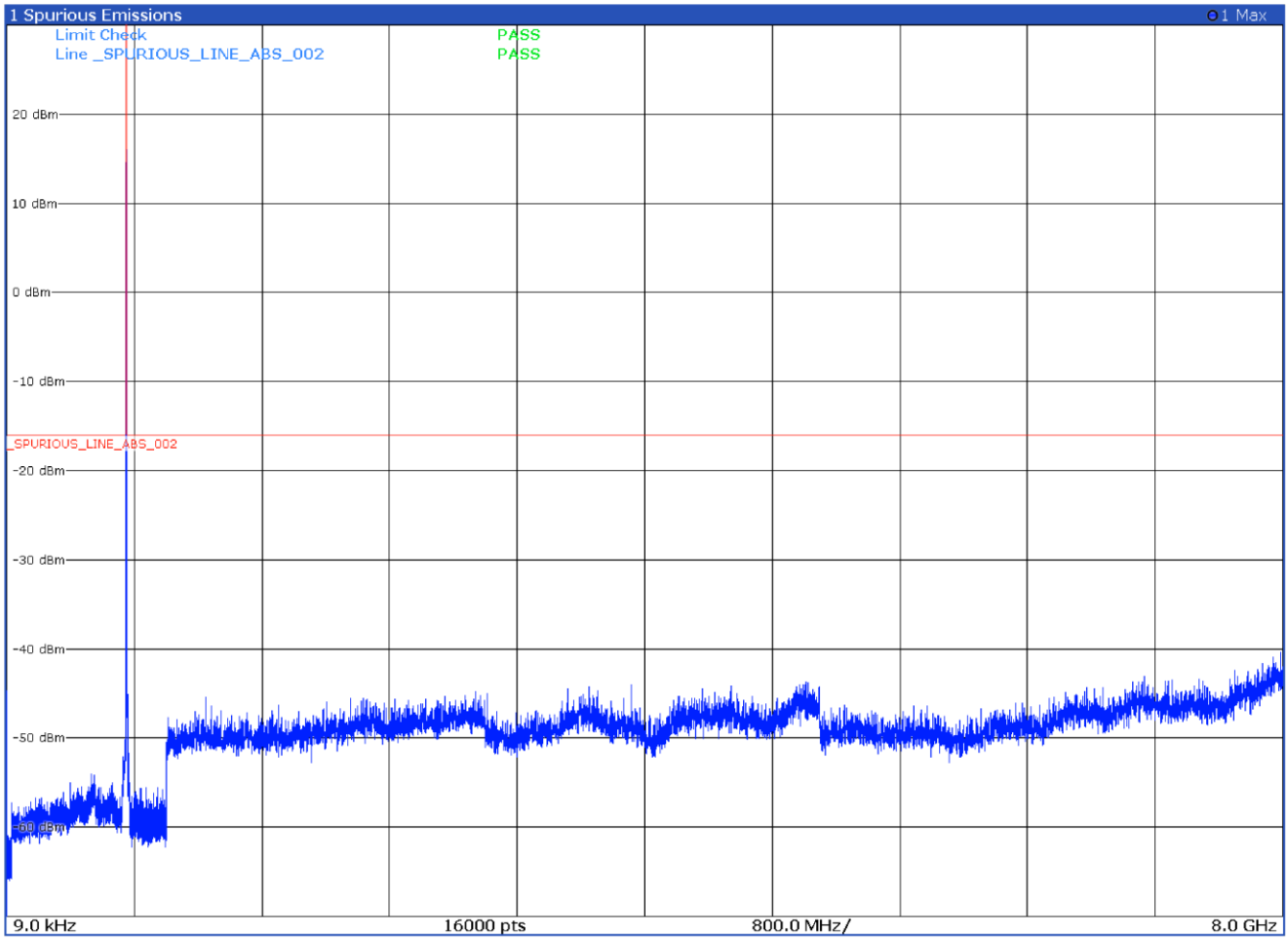


2 Result Summary

Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
9.000 kHz	150.000 kHz	1.000 kHz	**11.326 50 kHz**	**-65.19 dBm**	**-49.19 dB**
150.000 kHz	30.000 MHz	10.000 kHz	**702.225 00 kHz**	**-45.41 dBm**	**-29.41 dB**
30.000 MHz	746.000 MHz	100.000 kHz	**745.821 00 MHz**	**-42.70 dBm**	**-26.70 dB**
746.000 MHz	756.000 MHz	100.000 kHz	**748.217 50 MHz**	**16.20 dBm**	**-33.80 dB**
756.000 MHz	1.000 GHz	100.000 kHz	**756.061 00 MHz**	**-48.15 dBm**	**-32.15 dB**
1.000 GHz	8.000 GHz	1.000 MHz	**7.986 44 GHz**	**-40.05 dBm**	**-24.05 dB**

Figure 8.6-1: *Conducted spurious emissions of low channel, antenna port 1*

Test data, continued



2 Result Summary

Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
9.000 kHz	150.000 kHz	1.000 kHz	**136.111 50 kHz**	**-67.10 dBm**	**-51.10 dB**
150.000 kHz	30.000 MHz	10.000 kHz	**702.225 00 kHz**	**-44.64 dBm**	**-28.64 dB**
30.000 MHz	746.000 MHz	100.000 kHz	**745.821 00 MHz**	**-47.39 dBm**	**-31.39 dB**
746.000 MHz	756.000 MHz	100.000 kHz	**751.657 50 MHz**	**16.04 dBm**	**-33.96 dB**
756.000 MHz	1.000 GHz	100.000 kHz	**756.061 00 MHz**	**-44.38 dBm**	**-28.38 dB**
1.000 GHz	8.000 GHz	1.000 MHz	**7.988 19 GHz**	**-40.38 dBm**	**-24.38 dB**

Figure 8.6-2: *Conducted spurious emissions of mid channel, antenna port 1*