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RADIO TEST REPORT – REP009237

Type of assessment:

Final product testing

Applicant:

Texa Spa
Via I Maggio, 9
31050 Monastier di Treviso (TV) – Italy

Product:

Vehicle diagnostic system with Bluetooth connectivity

Model:

DP2.2-488

FCC ID:	IC Registration number:
T8RDP22	23618-DP22

Specifications:

- FCC 47 CFR Part 15 Subpart C, §15.247
- RSS-247, Issue 2, Feb 2017, Section 5
- RSS-Gen, Issue 5, April 2018 - Amendment 1 (March 2019) - Amendment 2 (February 2021)

Date of issue: April 21, 2023

D. Guarnone	Donatella Guarnone
Tested by	Signature
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Lab locations

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Website	www.nemko.com
ISED number	FCC: 682159; IC: 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

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Section 1 Report summary

1.1 Test specifications

RSS-247, Issue 2, Feb 2017, Section 5	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS-Gen, Issue 5, April 2018 – Amendment 1 (March 2019) – Amendment 2 (February 2021)	General Requirements for Compliance of Radio Apparatus

FCC 47 CFR Part 15 Subpart C, §15.247	Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.

1.2 Test methods

DA 00-705, Released March 30, 2000	Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems
ANSI C63.10 v2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
RSS-102, Issue 5, March 19, 2015 - Amendment 1 (February 2, 2021)	Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)

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 complies 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
REP009237	April 21, 2023	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	2022-04	2023-04
Thermo-hygrometer data loggers	Testo	175-H2	38203337/703	2022-12	2024-12
Barometer	Castle	GPB 3300	072015	2022-12	2024-12

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	Texa Spa
Applicant address	Via I Maggio, 9 – 31050 Monastier di Treviso (TV) – Italy
Manufacture name	Same as applicant
Manufacture address	Same as applicant

5.3 EUT information

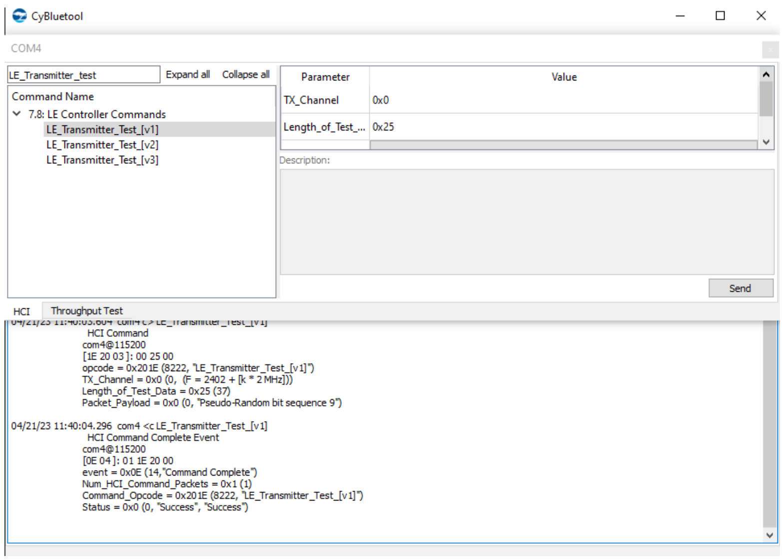
Product	Device to gain useful information for the driver and mechanical
Model	DP2.2-488
Serial number	TONPY000056
Power supply requirements	12 V DC, 80 mA max
Product description and theory of operation	The EUT is a compact device that, during normal vehicle operation, can acquire information useful both to the driver and the mechanic. The data acquired is useful to detect problems connected to the vehicle's management and its maintenance status. The device must be connected to a specific diagnostic socket called OBD socket. The device communicates with the vehicle's control unit through the OBD socket and acquires the required data. The device is able to acquire the required data from the vehicle and to transmit it in real time via Bluetooth to the smartphone selected as a display unit. For this to occur, a specific app must be installed in the display unit.

5.4 Radio technical information

Category of Wideband Data Transmission equipment	☐ Frequency Hopping Spread Spectrum (FHSS) equipment
	☒ Other types of Wideband Data Transmission equipment (e.g. DSSS, OFDM, etc.).
Frequency band	2400–2483.5 MHz
Frequency Min (MHz)	2402 MHz
Frequency Max (MHz)	2480 MHz
Channel numbers	0-39
RF power Max (W), Conducted	1.57 mW (1.96 dBm)
Field strength, dBµV/m @ 3 m	98.82 dBµV/m
Measured BW (kHz), 99% OBW	1089.7 kHz
Type of modulation	BLE (GFSK)
Emission classification	F1D
Transmitter spurious, dBµV/m @ 3 m	47.4 dBµV/m @ 4879.0 MHz
Antenna information	PCB antenna Part No. M310221 ETHERTRONICS with gain of 1.7 dBi

5.5 EUT setup details

5.5.1 Radio exercise details

Operating conditions	The EUT has been tested with the Bluetooth_test_V2 software provided by the applicant, as following: 
Transmitter state	Transmitter set into continuous mode.

5.5.2 EUT setup configuration

Table 5.5-1: *EUT sub assemblies*

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

Table 5.5-2: *EUT interface ports*

Description	Qty.
ODB connector	1

Table 5.5-3: *Support equipment*

Description	Brand name	Model, Part number, Serial number, Revision level
Test Bench	Texa Spa	BT certification bench
Notebook	Dell	Latitude 7480

Table 5.5-4: *Inter-connection cables*

Cable description	From	To	Length (m)
ODB cable	EUT	Test Bench	1.4
USB cable	Test Bench	PC	1.8
DC cable	Test Bench	Power supply	2.3

EUT setup configuration, continued

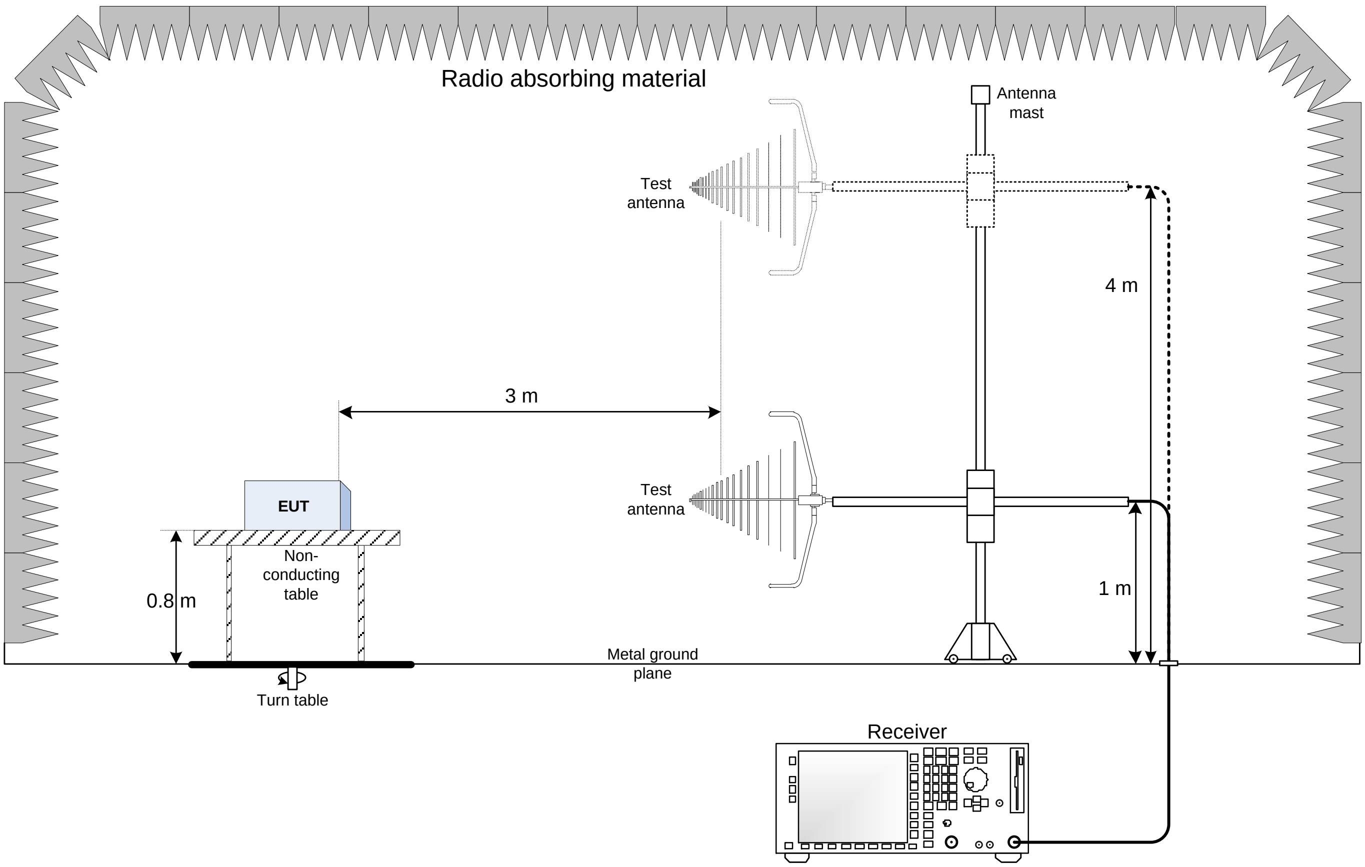


Figure 5.5-1: *Radiated testing block diagram (below 1 GHz)*

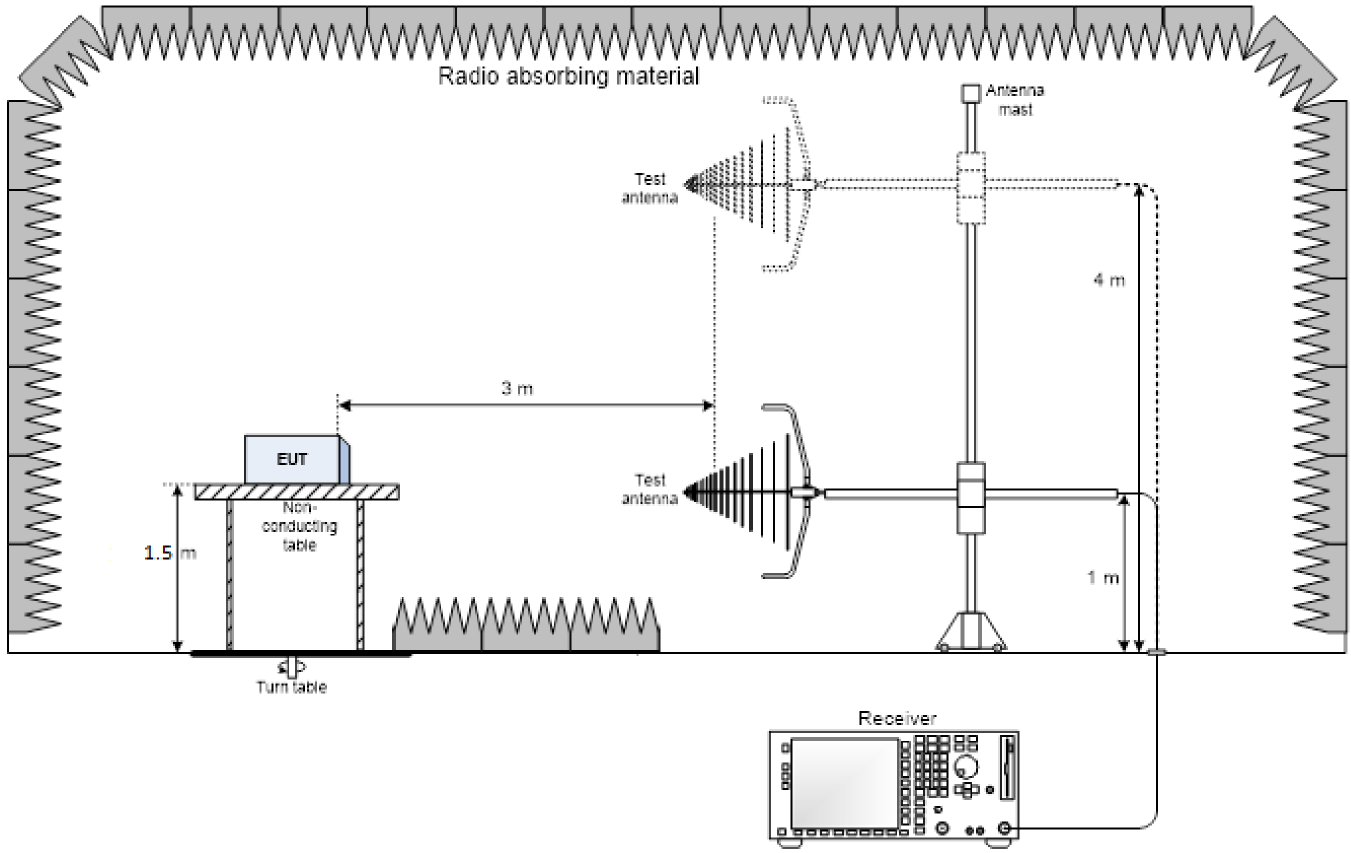


Figure 5.5-2: *Radiated testing block diagram (above 1 GHz)*

Section 6 Summary of test results

6.1 Testing location

Test location (s)	Nemko S.p.A. Via Del Carroccio, 4 20853 Biassono (MB) Italy

6.2 Testing period

Test start date	March 17, 2023	Test end date	April 21, 2023

6.3 Sample information

Receipt date	March 17, 2023	Nemko sample ID number(s)	--

6.4 ISED RSS-Gen, Issue 5, test results

Table 6.4-1: *RSS-Gen requirements results*

Part	Test description	Verdict
7.3	Receiver radiated emission limits	Not applicable
7.4	Receiver conducted emission limits	Not applicable
6.9	Operating bands and selection of test frequencies	Pass
8.8	AC power-line conducted emissions limits	Not applicable

Notes: [1]According to sections 5.2 and 5.3 of RSS-Gen, Issue 5 the EUT does not have a stand-alone receiver neither scanner receiver, therefore exempt from receiver requirements.
The EUT is a DC powered device supply by the vehicle battery

6.5 ISED RSS-247, Issue 2, test results for frequency hopping spread spectrum systems (FHSS)

Table 6.5-1: *ISED FHSS requirements results*

Part	Test description	Verdict
5.1 (a)	Bandwidth of a frequency hopping channel	Not applicable
5.1 (b)	Minimum channel spacing	Not applicable
5.1 (c)	Systems operating in the 902–928 MHz band	Not applicable
5.1 (d)	Systems operating in the 2400–2483.5 MHz band	Not applicable
5.1 (e)	Systems operating in the 5725–5850 MHz band	Not applicable
5.3	Hybrid Systems	
5.3 (a)	Digital modulation turned off	Not applicable
5.3 (b)	Frequency hopping turned off	Not applicable
5.4	Transmitter output power and e.i.r.p. requirements	
5.4 (a)	Systems operating in the 902–928 MHz band	Not applicable
5.4 (b)	Systems operating in the 2400–2483.5 MHz band	Not applicable
5.4 (c)	Systems operating in the 5725–5850 MHz	Not applicable
5.4 (e)	Point-to-point systems in 2400–2483.5 MHz and 5725–5850 MHz band	Not applicable
5.4 (f)	Transmitters which operate in the 2400–2483.5 MHz band with multiple directional beams	Not applicable
5.5	Unwanted emissions	Not applicable

Notes: --

6.6 ISED RSS-247, Issue 2, test results for digital transmission systems (DTS)

Table 6.6-1: *ISED DTS requirements results*

Part	Test description	Verdict
5.2 (a)	Minimum 6 dB bandwidth	Pass
5.2 (b)	Maximum power spectral density	Pass
5.3	Hybrid Systems	
5.3 (a)	Digital modulation turned off	Not applicable
5.3 (b)	Frequency hopping turned off	Not applicable
5.4	Transmitter output power and e.i.r.p. requirements	
5.4 (d)	Systems employing digital modulation techniques	Pass
5.4 (e)	Point-to-point systems in 2400–2483.5 MHz and 5725–5850 MHz band	Not applicable
5.4 (f)	Transmitters which operate in the 2400–2483.5 MHz band with multiple directional beams	Not applicable
5.5	Unwanted emissions	Pass

Notes: --

6.7 FCC Part 15 Subpart C, general requirements test results

Part	Test description	Verdict
§15.207(a)	Conducted limits	Not applicable
§15.31(e)	Variation of power source	Pass[1]
§15.31(m)	Number of tested frequencies	Pass
§15.203	Antenna requirement	Pass[2]

Notes: [1] Measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, was performed with the supply voltage varied between 85 % and 115 % of the nominal rated supply voltage. No noticeable output power variation was observed

[2] The Antennas are located within the enclosure of EUT and not user accessible.

6.8 FCC Part 15 Subpart C, intentional radiators test results for digital transmission system (DTS)

Part	Test description	Verdict
§15.247(a)(1)(i)	Frequency hopping systems operating in the 902–928 MHz band	Not applicable
§15.247(a)(1)(ii)	Frequency hopping systems operating in the 5725–5850 MHz band	Not applicable
§15.247(a)(1)(iii)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Not applicable
§15.247(a)(2)	Minimum 6 dB bandwidth for systems using digital modulation techniques	Pass
§15.247(b)(1)	Maximum peak output power of frequency hopping systems operating in the 2400–2483.5 MHz band and 5725–5850 MHz band	Not applicable
§15.247(b)(2)	Maximum peak output power of Frequency hopping systems operating in the 902–928 MHz band	Not applicable
§15.247(b)(3)	Maximum peak output power of systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands	Pass
§15.247(c)(1)	Fixed point-to-point operation with directional antenna gains greater than 6 dBi	Not applicable
§15.247(c)(2)	Section 7 Transmitters operating in the 2400–2483.5 MHz band that emit multiple directional beams	Not applicable
§15.247(d)	Section 8 Spurious emissions	Pass
§15.247(e)	Section 9 Power spectral density for digitally modulated devices	Pass
§15.247(f)	Time of occupancy for hybrid systems	Not applicable

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	2023-01	2024-01
EMI Receiver	Rohde & Schwarz	ESW44	101620	2022-08	2023-08
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	2023-03	2024-03
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 Number of frequencies

8.1.1 References, definitions and limits

RSS-Gen, Clause 6.9:

Except where otherwise specified, measurements shall be performed for each frequency band of operation for which the radio apparatus is to be certified, with the device operating at the frequencies in each band of operation shown in table below. The frequencies selected for measurements shall be reported in the test report.

Table 8.1-1: *Frequency Range of Operation*

Frequency range over which the device operates (in each band)	Number of test frequencies required	Location of measurement frequency inside the operating frequency range
1 MHz or less	1	Center (middle of the band)
1–10 MHz	2	1 near high end, 1 near low end
Greater than 10 MHz	3	1 near high end, 1 near center and 1 near low end

Notes: "near" means as close as possible to or at the centre / low end / high end of the frequency range over which the device operates.

8.1.2 Test summary

Verdict	Pass		
Tested by	D. Guarnone	Test date	March 24, 2023

8.1.3 Observations, settings and special notes

ANSI C63.10, Clause 5.6.2.1:

The number of channels tested can be reduced by measuring the center channel bandwidth first and then applying the following relaxations as appropriate:

a) For each operating mode, if the measured channel bandwidth on the middle channel is at least 150% of the minimum permitted bandwidth, then it is not necessary to measure the bandwidth on the high and low channels.

b) For multiple-input multiple-output (MIMO) systems, if the measured channel bandwidth on testing the middle channel exceeds the minimum permitted bandwidth by more than 50% on one transmit chain, then it is not necessary to repeat testing on the other chains.

c) If the measured channel bandwidth on the middle channel is less than 50% of the maximum permitted bandwidth, then it is not necessary to measure the bandwidth on the high and low channels.

ANSI C63.10, Clause 5.6.2.2:

For devices with multiple operating modes, measurements on the middle channel can be used to determine the worst-case mode(s). The worst-case modes are as follows:

a) Band edge requirements—Measurements on the mode with the widest bandwidth can be used to cover the same channel (center frequency) on modes with narrower bandwidth that have the same or lower output power for each modulation family (e.g., OFDM and direct sequence spread spectrum).

b) Spurious emissions—Measure the mode with the highest output power and the mode with the highest output power spectral density for each modulation family (e.g., OFDM and direct sequence spread spectrum).

c) In-band PSD—Measurements on the mode with the narrowest bandwidth can be used to cover all modes within the same modulation family of an equal or lower output power provided the result is less than 50% of the limit.

8.1.4 Test data

Table 8.1-2: *Test channels selection*

Start of Frequency range, MHz	End of Frequency range, MHz	Frequency range bandwidth, MHz	Low channel, MHz	Mid channel, MHz	High channel, MHz
2400	2483.5	83.5	2402	2440	2480

8.2 Antenna requirement

8.2.1 References, definitions and limits

RSS-Gen, Clause 6.8:

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report.

8.2.2 Test summary

Verdict	Pass		
Tested by	D. Guarnone	Test date	March 24, 2023

8.2.3 Observations, settings and special notes

None

8.2.4 Test data

Must the EUT be professionally installed?	☐ YES	☒ NO	
Does the EUT have detachable antenna(s)?	☐ YES	☒ NO	
If detachable, is the antenna connector(s) non-standard?	☐ YES	☐ NO	☒ N/A

Table 8.2-1: *Antenna information*

Antenna type	Manufacturer	Model number	Maximum gain	Connector type
PCB	ETHERTRONICS	M310221	1.7	--

8.3 Minimum 6 dB bandwidth for DTS systems

8.3.1 References, definitions and limits

RSS-247, Clause 5.2:

DTSs include systems that employ digital modulation techniques resulting in spectral characteristics similar to direct sequence systems. The following applies to the bands 902-928 MHz and 2400-2483.5 MHz:

a. The minimum 6 dB bandwidth shall be 500 kHz.

RSS-Gen, Clause 6.7:

6 dB bandwidth is defined as the frequency range between two points, one at the lowest frequency below and one at the highest frequency above the carrier frequency, at which the maximum power level of the transmitted emission is attenuated 6 dB below the maximum in-band power level of the modulated signal, where the two points are on the outskirts of the in-band emission.

For the 99% emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99% emission bandwidth).

8.3.2 Test summary

Verdict	Pass		
Tested by	D. Guarnone	Test date	March 24, 2023

8.3.3 Observations, settings and special notes

The test was performed as per KDB 558074, section 8.2 with reference to ANSI C63.10 subclause 11.8.
Spectrum analyser settings:

Resolution bandwidth	6 dB BW: 100 kHz; 99% OBW: 1–5% of OBW
Video bandwidth	≥3 × RBW
Frequency span	≥2 × OBW
Detector mode	Peak
Trace mode	Max Hold

8.3.4 Test equipment used

Equipment	Manufacturer	Model no.	Asset no.
EMI Receiver	Rohde & Schwarz	ESW44	101620
Spectrum Analyzer	Rohde & Schwarz	FSW43	101767
Antenna 1 - 18 GHz	Schwarzbeck Mess-Elektronik	STLP9148	STLP 9148-152
Controller	Maturo	FCU3.0	10041
Tilt antenna mast	Maturo	TAM4.0-E	10042
Turntable	Maturo	TT4.0-5T	2.527
Semi-anechoic chamber	Nemko S.p.a.	10m semi-anechoic chamber	530

8.3.5 Test data

Table 8.3-1: *99% occupied bandwidth results*

Modulation	Frequency, MHz	99% occupied bandwidth, kHz
GFSK	2402	1083.3
GFSK	2441	1089.7
GFSK	2480	1089.7

Notes: There is no 99% occupied bandwidth limit in the standard's requirements, the measurement results provided for information purposes only.

Table 8.3-2: *6 dB bandwidth results*

Modulation	Frequency, MHz	6 dB bandwidth, MHz	Minimum limit, MHz	Margin, MHz
GFSK	2402	0.7051	0.5	0.2051
	2440	0.6923	0.5	0.1923
	2480	0.6987	0.5	0.1987

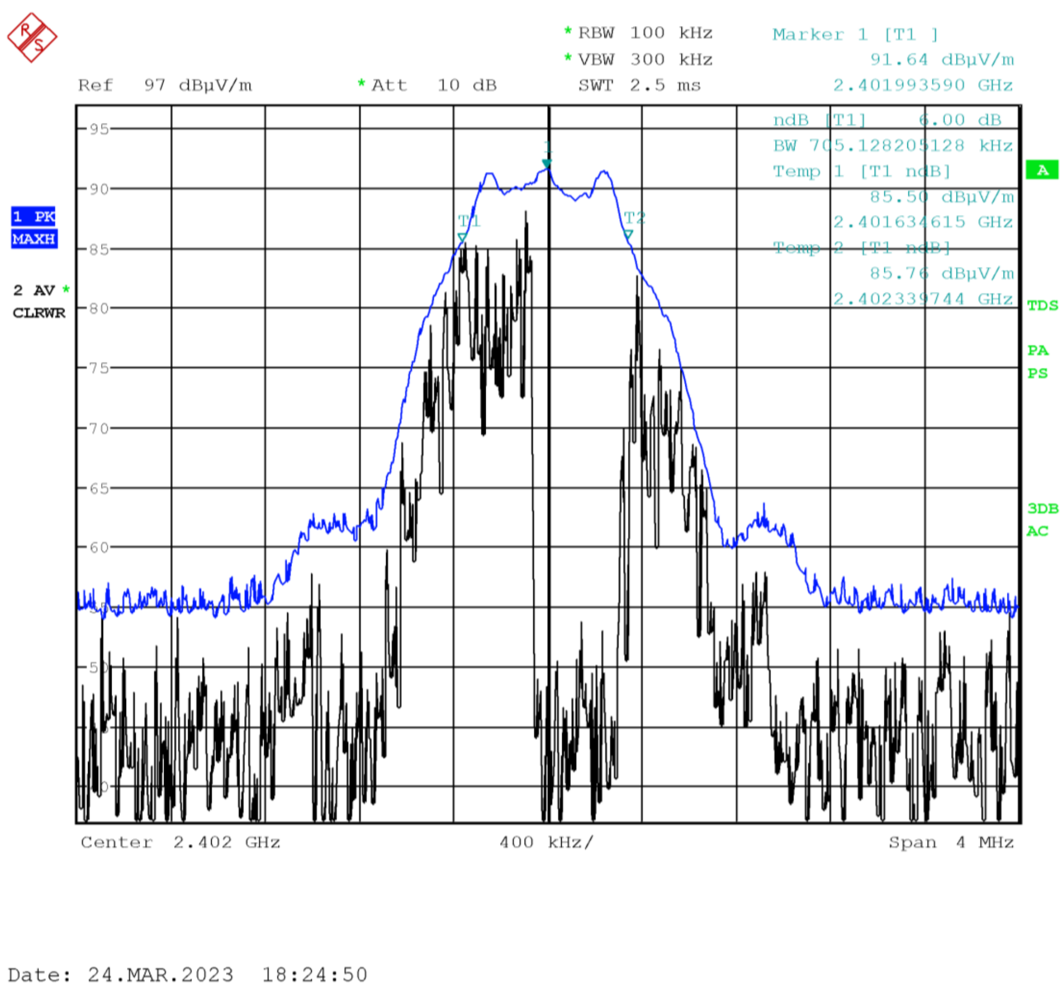


Figure 8.3-1: *6 dB bandwidth on low channel*

Test data, continued

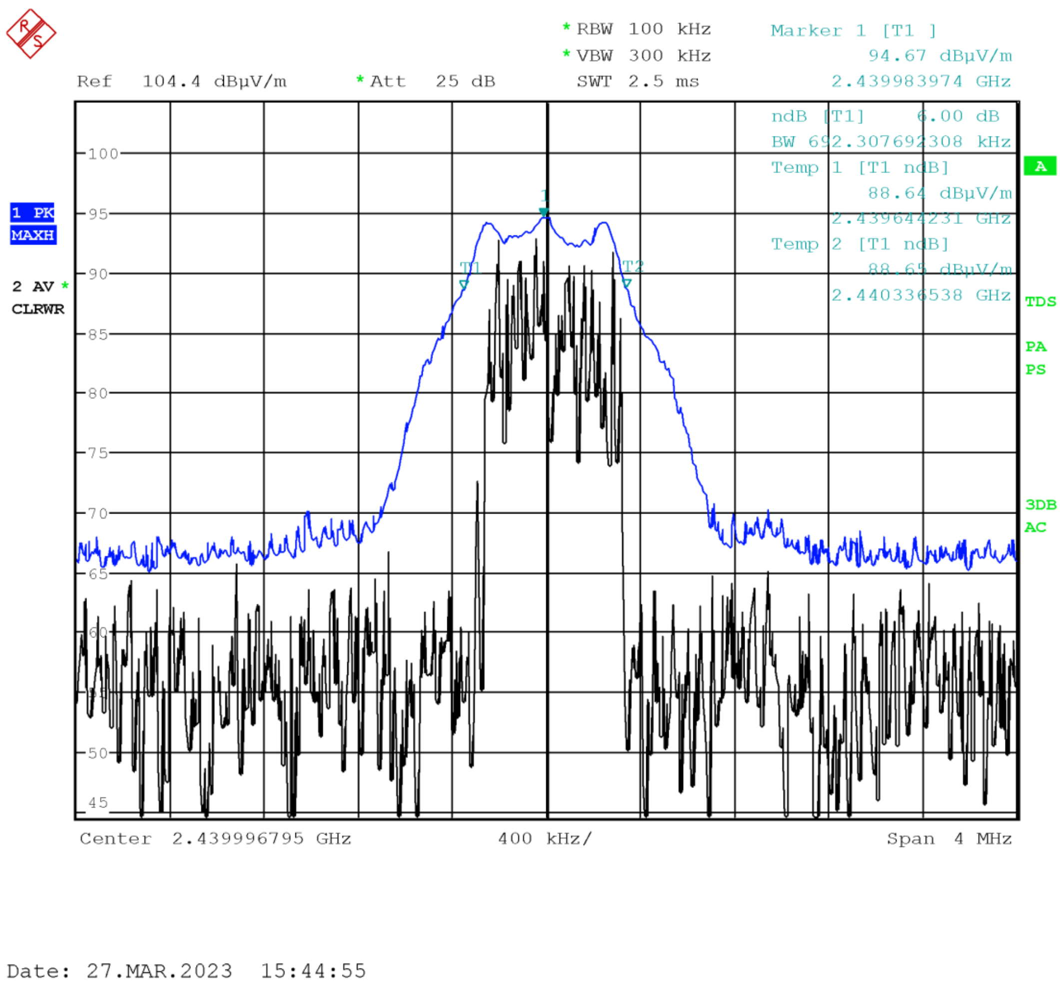


Figure 8.3-2: *6 dB bandwidth on mid channel*

Test data, continued

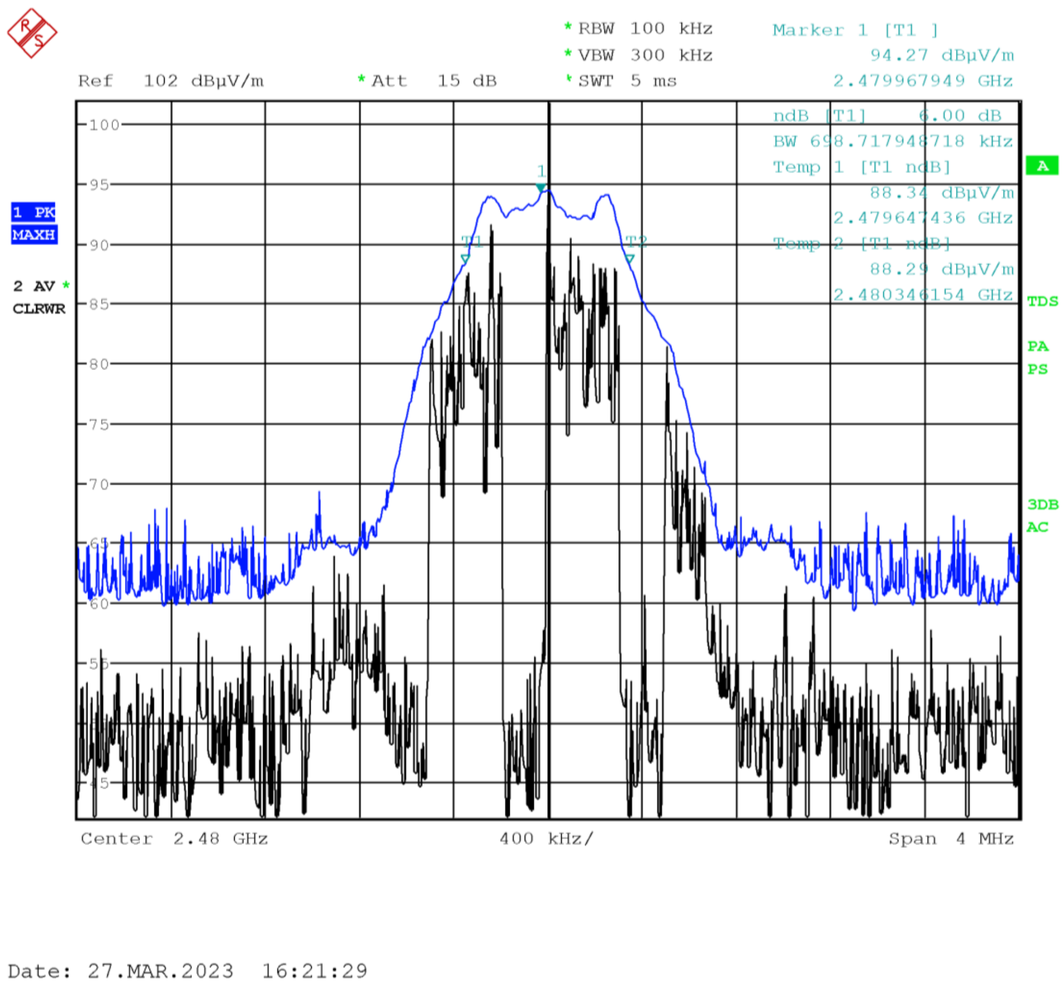


Figure 8.3-3: *6 dB bandwidth on high channel*

Test data, continued

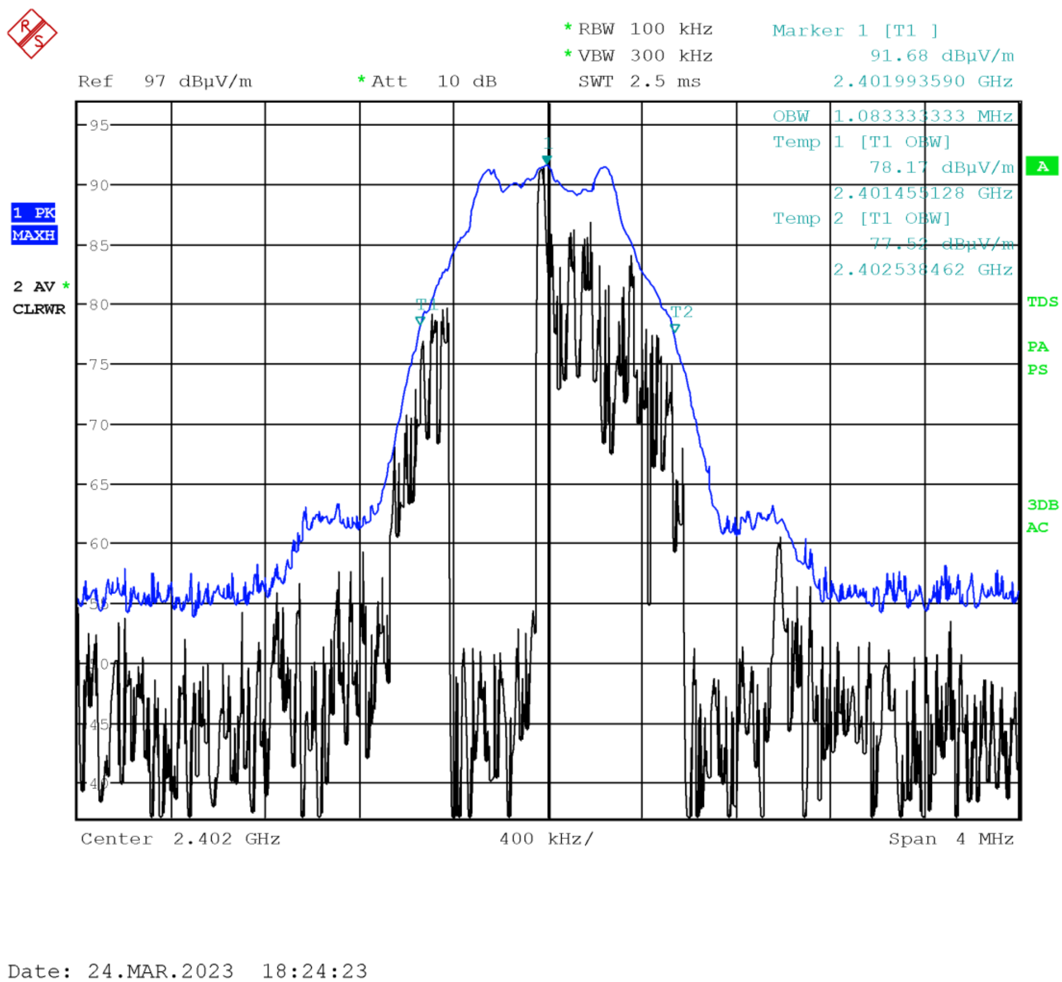


Figure 8.3-4: *99% bandwidth on low channel*

Test data, continued

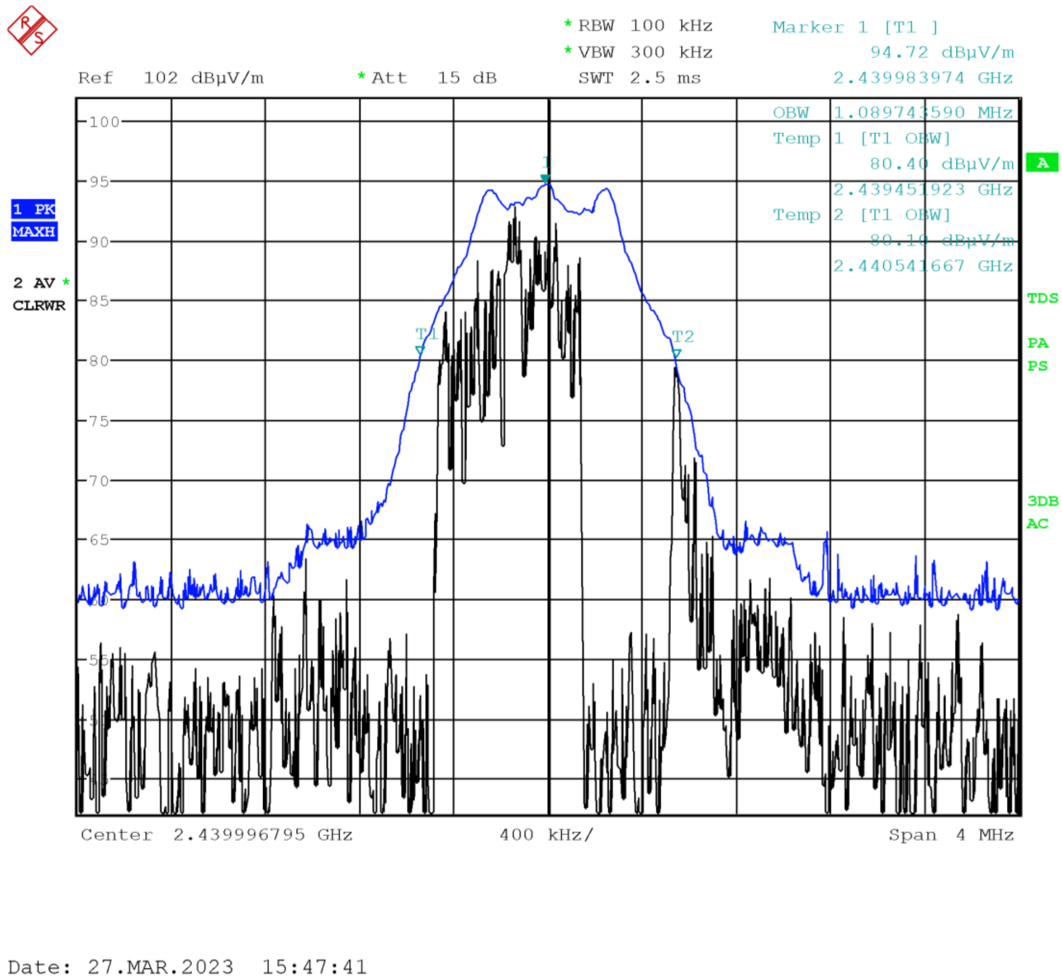


Figure 8.3-5: *99% bandwidth on mid channel*

Test data, continued

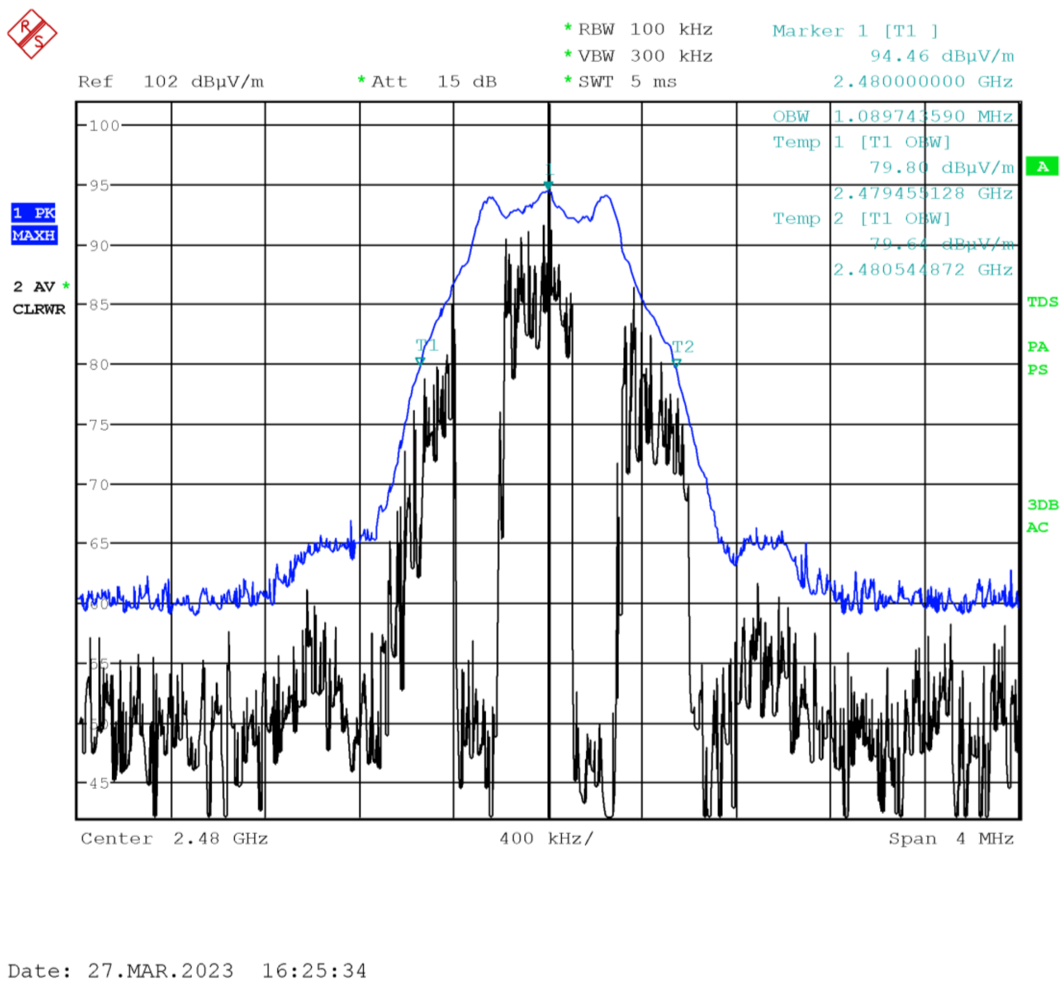


Figure 8.3-6: *99% bandwidth on high channel*

8.4 Transmitter output power and e.i.r.p. requirements for DTS in 2.4 GHz

8.4.1 References, definitions and limits

RSS-247, Clause 5.4:

Devices shall comply with the following requirements, where applicable:

d. For DTSs employing digital modulation techniques operating in the 2400–2483.5 MHz band,, the maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power. The maximum conducted output power is the total transmit power delivered to all antennas and antenna elements, averaged across all symbols in the signalling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or transmitting at a reduced power level. If multiple modes of operation are implemented, the maximum conducted output power is the highest total transmit power occurring in any mode.

e. Fixed point-to-point systems in the 2400–2483.5 MHz band are permitted to have an e.i.r.p. higher than 4 W provided that the higher e.i.r.p. is achieved by employing higher gain directional antennas and not higher transmitter output powers. Point-to-multipoint systems, omnidirectional applications and multiple co-located transmitters transmitting the same information are prohibited from exceeding an e.i.r.p. of 4 W.

f. Transmitters operating in the band 2400–2483.5 MHz, may employ antenna systems that emit multiple directional beams simultaneously or sequentially, for the purpose of directing signals to individual receivers or to groups of receivers, provided that the emissions comply with the following:

i. Different information must be transmitted to each receiver.

ii. If the transmitter employs an antenna system that emits multiple directional beams, but does not emit multiple directional beams simultaneously, the total output power conducted to the array or arrays that comprise the device (i.e. the sum of the power supplied to all antennas, antenna elements, staves, etc., and summed across all carriers or frequency channels) shall not exceed the applicable output power limit specified in sections 5.4(b) and 5.4(d). However, the total conducted output power shall be reduced by 1 dB below the specified limits for each 3 dB that the directional gain of the antenna/antenna array exceeds 6 dBi. The directional antenna gain shall be computed as the sum of 10 log (number of array elements or staves) plus the directional gain of the element or stave having the highest gain.

iii. If a transmitter employs an antenna that operates simultaneously on multiple directional beams using the same or different frequency channels, the power supplied to each emission beam is subject to the applicable power limit specified in sections 5.4(b) and 5.4(d). If transmitted beams overlap, the power shall be reduced to ensure that their aggregate power does not exceed the applicable limit specified in sections 5.4(b) and 5.4(d). In addition, the aggregate power transmitted simultaneously on all beams shall not exceed the applicable limit specified in sections 5.4(b) and 5.4(d) by more than 8 dB.

iv. Transmitters that transmit a single directional beam shall operate under the provisions of sections 5.4(b), 5.4(d) and 5.4(e).

8.4.2 Test summary

Verdict	Pass		
Tested by	D. Guarnone	Test date	March 27, 2023

8.4.3 Observations, settings and special notes

The test was performed as per KDB 558074, section 8.3 with reference to ANSI C63.10 subclause 11.9.1 (peak power) using method PKPM1 (Peak power meter method)
Spectrum analyser settings:

Resolution bandwidth	> OBW
Video bandwidth	≥3 × RBW
Frequency span	approximately 5 times the OBW
Detector mode	Peak
Trace mode	Max Hold

8.4.4 Test equipment used

Equipment	Manufacturer	Model no.	Asset no.
EMI Receiver	Rohde & Schwarz	ESW44	101620
Spectrum Analyzer	Rohde & Schwarz	FSW43	101767
Antenna 1 - 18 GHz	Schwarzbeck Mess-Elektronik	STLP9148	STLP 9148-152
Controller	Maturo	FCU3.0	10041
Tilt antenna mast	Maturo	TAM4.0-E	10042
Turntable	Maturo	TT4.0-5T	2.527
Semi-anechoic chamber	Nemko S.p.a.	10m semi-anechoic chamber	530

8.4.5 Test data

Table 8.4-1: *Output power and EIRP results (radiated measurement)*

Frequency, MHz	Field strength, dBµV/m	EIRP, dBm	EIRP limit, dBm	EIRP margin, dB	Antenna gain, dBi	Output power, dBm	Output power limit, dBm	Output power margin, dB
2402	97.76	2.60	36	-33.40	1.7	0.90	30	-29.10
2440	98.82	3.66	36	-32.34	1.7	1.96	30	-28.04
2480	97.54	2.38	36	-33.62	1.7	0.68	30	-29.32

Note: EIRP [dBm] = Field Strength [dBµV/m] – 95.23 [dB]; Output power [dBm] = EIRP [dBm] – Antenna gain [dBi]

Test data, continued

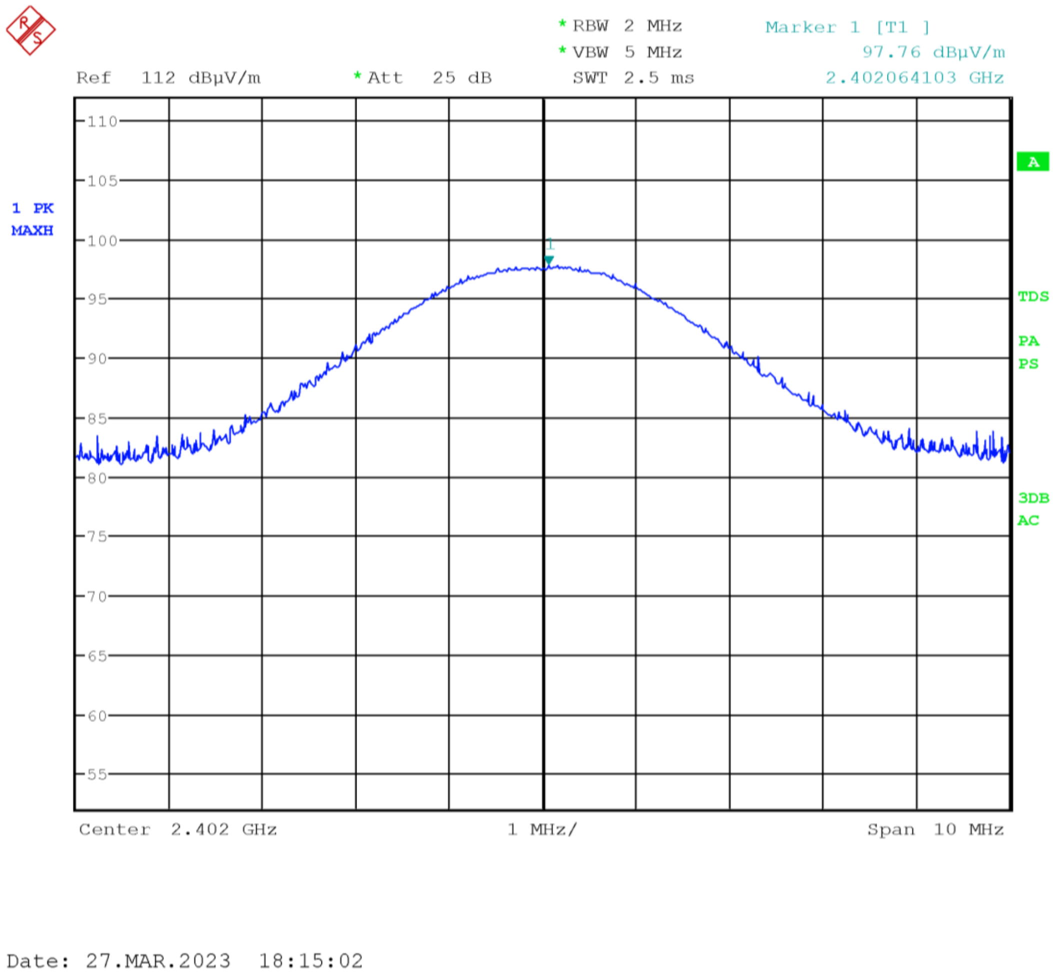


Figure 8.4-1: *Output power on low channel*

Test data, continued

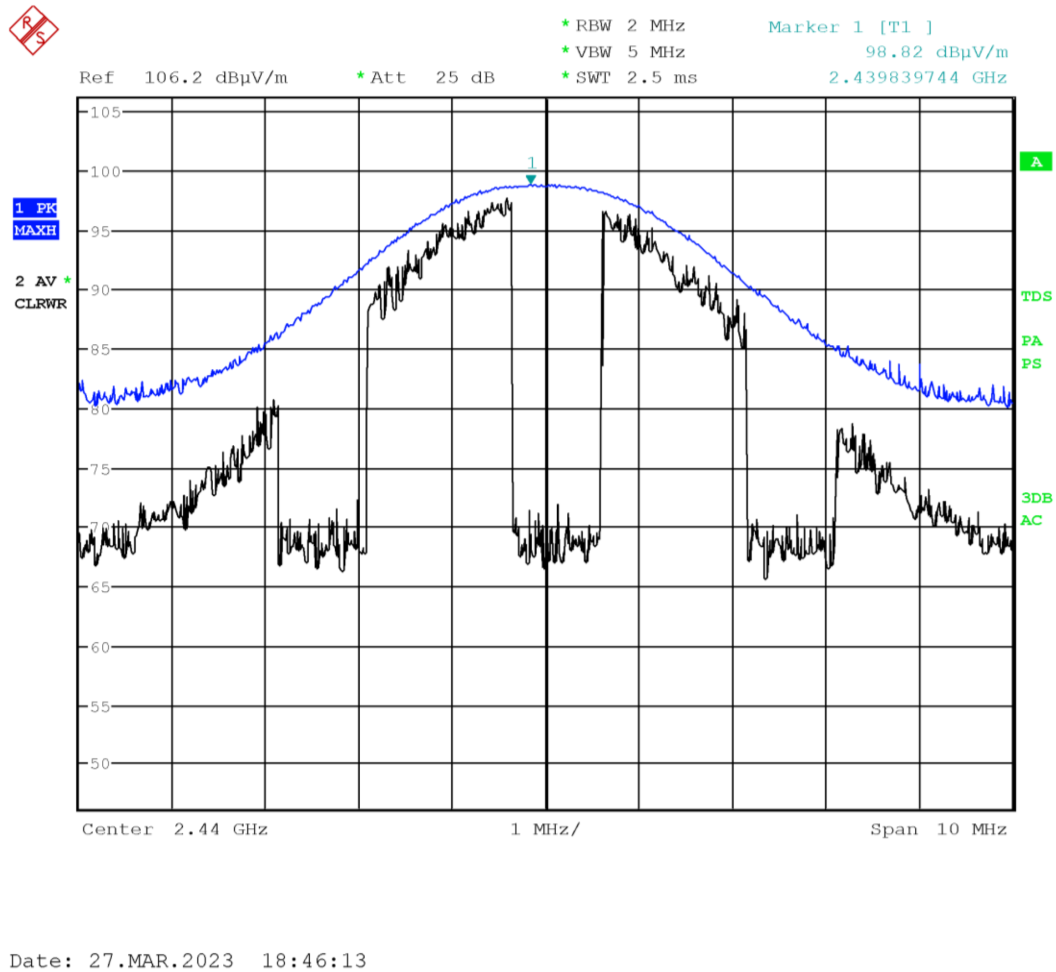


Figure 8.4-2: *Output power on mid channel*

Test data, continued

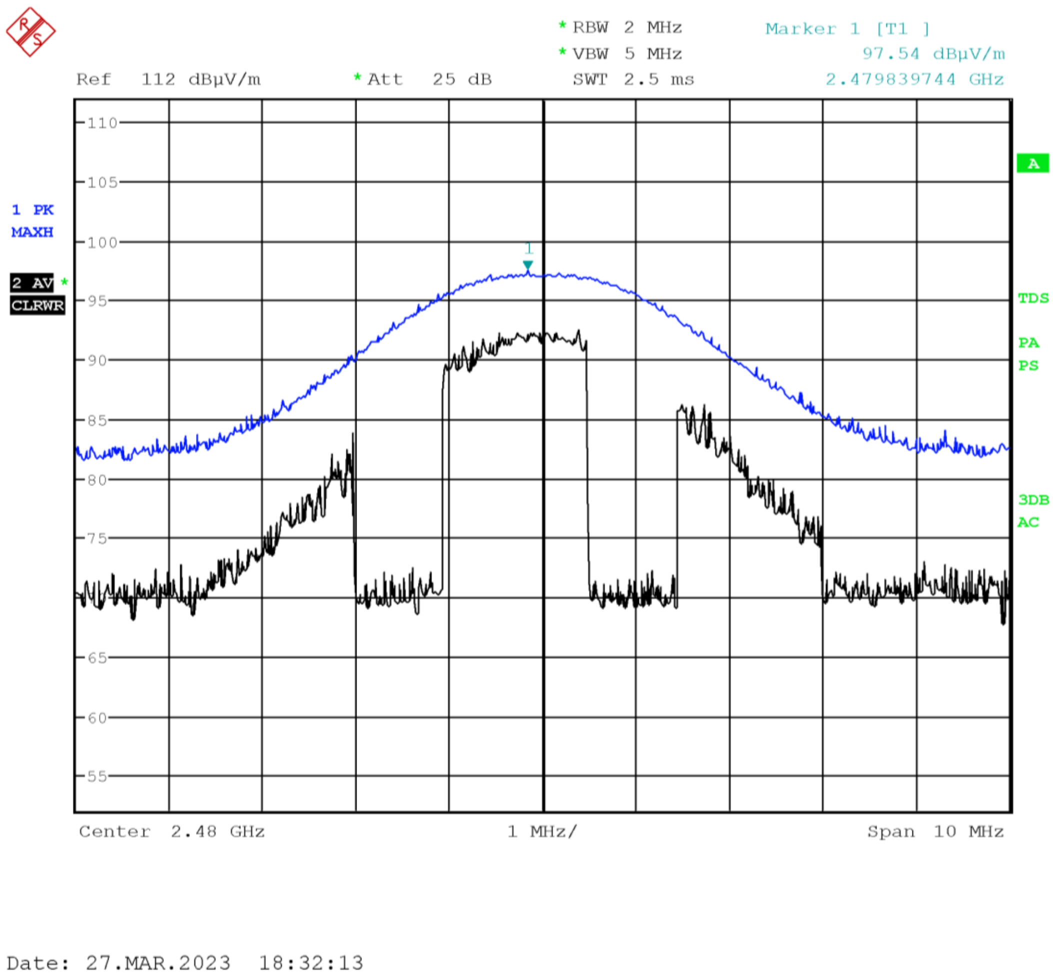


Figure 8.4-3: *Output power on high channel*

8.5 Spurious (out-of-band) unwanted emissions

8.5.1 References, definitions and limits

RSS-247, Clause 5.5:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

Table 8.5-1: *RSS-Gen – Radiated emission limits*

	Field strength of emissions		
Frequency, MHz	**µV/m**	**dBµV/m**	**Measurement distance, m**
0.009–0.490	2400/F	67.6 – 20 × $\log_{10}$(F)	300
0.490–1.705	24000/F	87.6 – 20 × $\log_{10}$(F)	30
1.705–30.0	30	29.5	30
30–88	100	40.0	3
88–216	150	43.5	3
216–960	200	46.0	3
above 960	500	54.0	3

Notes: In the emission table above, the tighter limit applies at the band edges.
For frequencies above 1 GHz the limit on peak RF emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test.

Table 8.5-2: *ISED restricted frequency bands*

MHz	MHz	MHz	GHz
0.090–0.110	12.57675–12.57725	399.9–410	7.25–7.75
0.495–0.505	13.36–13.41	608–614	8.025–8.5
2.1735–2.1905	16.42–16.423	960–1427	9.0–9.2
3.020–3.026	16.69475–16.69525	1435–1626.5	9.3–9.5
4.125–4.128	16.80425–16.80475	1645.5–1646.5	10.6–12.7
4.17725–4.17775	25.5–25.67	1660–1710	13.25–13.4
4.20725–4.20775	37.5–38.25	1718.8–1722.2	14.47–14.5
5.677–5.683	73–74.6	2200–2300	15.35–16.2
6.215–6.218	74.8–75.2	2310–2390	17.7–21.4
6.26775–6.26825	108–138	2483.5–2500	22.01–23.12
6.31175–6.31225	149.9–150.05	2655–2900	23.6–24.0
8.291–8.294	156.52475–156.52525	3260–3267	31.2–31.8
8.362–8.366	156.7–156.9	3332–3339	36.43–36.5
8.37625–8.38675	162.0125–167.17	3345.8–3358	Above 38.6
8.41425–8.41475	167.72–173.2	3500–4400	
12.29–12.293	240–285	4500–5150	
12.51975–12.52025	322–335.4	5350–5460	

Note: Certain frequency bands listed in Table 8.5-2 and above 38.6 GHz are designated for licence-exempt applications. These frequency bands and the requirements that apply to related devices are set out in the 200 and 300 series of RSSs.

8.5.2 Test summary

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

8.5.3 Observations, settings and special notes

- As part of the current assessment, the test range of 9 kHz to 10th harmonic has been fully considered and compared to the actual frequencies utilized within the EUT. Since the EUT contains a transmitter in the GHz range, the EUT has been deemed compliant without formal testing in the 9 kHz to 30 MHz test range, therefore formal test results (tabular data and/or plots) are not provided within this test report.
- EUT was set to transmit with 100 % duty cycle.
- Radiated measurements were performed at a distance of 3 m.
- Since fundamental power was tested using the maximum peak conducted output power procedure to demonstrate compliance, the spurious emissions limit is −20 dBc/100 kHz.

Spectrum analyser settings for radiated measurements within restricted bands below 1 GHz:

Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Detector mode:	Peak
Trace mode:	Max Hold

Spectrum analyser settings for peak radiated measurements within restricted bands above 1 GHz:

Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Detector mode:	Peak
Trace mode:	Max Hold

Spectrum analyser settings for average radiated measurements within restricted bands above 1 GHz:

Resolution bandwidth:	1 MHz
Video bandwidth:	10 Hz
Detector mode:	Peak
Trace mode:	Max Hold

8.5.4 Test equipment used

Equipment	Manufacturer	Model no.	Asset no.
EMI Receiver	Rohde & Schwarz	ESW44	101620
Antenna Trilog 25MHz - 8GHz	Schwarzbeck Mess-Elektronik	VULB9162	9162-025
Antenna 1 - 18 GHz	Schwarzbeck Mess-Elektronik	STLP9148	STLP 9148-152
Double Ridge Horn Antenna	RFSpin	DRH40	061106A40
Broadband Amplifier	Schwarzbeck Mess-Elektronik	BBV9718C	00121
Broadband Bench Top Amplifier	Sage	STB-1834034030-KFKF-L1	18490-01
Controller	Maturo	FCU3.0	10041
Tilt antenna mast	Maturo	TAM4.0-E	10042
Turntable	Maturo	TT4.0-5T	2.527
Semi-anechoic chamber	Nemko S.p.a.	10m semi-anechoic chamber	530

8.5.5 Test data

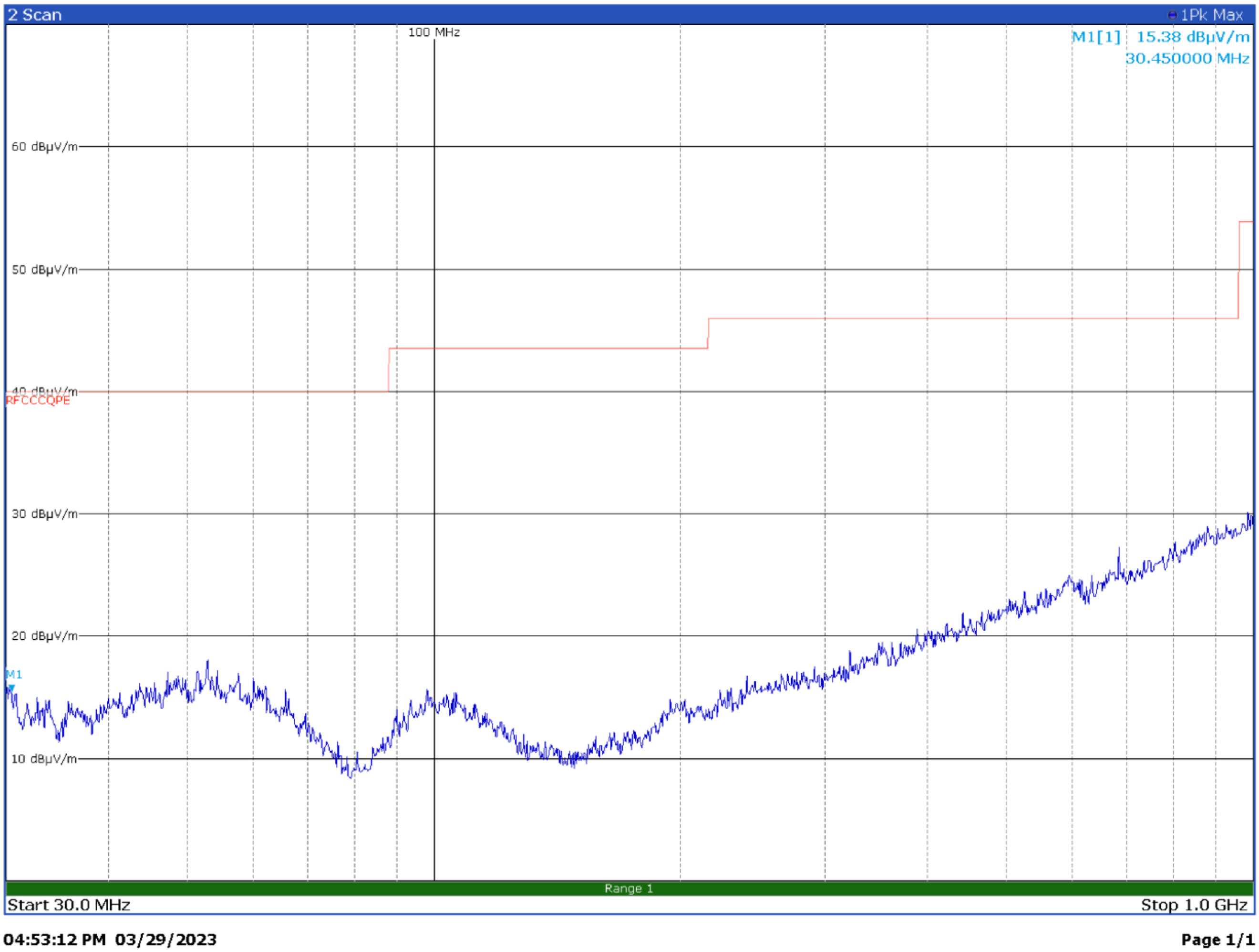


Figure 8.5-1: *Radiated spurious emissions on low channel with EUT in horizontal position - antenna in horizontal polarization*

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
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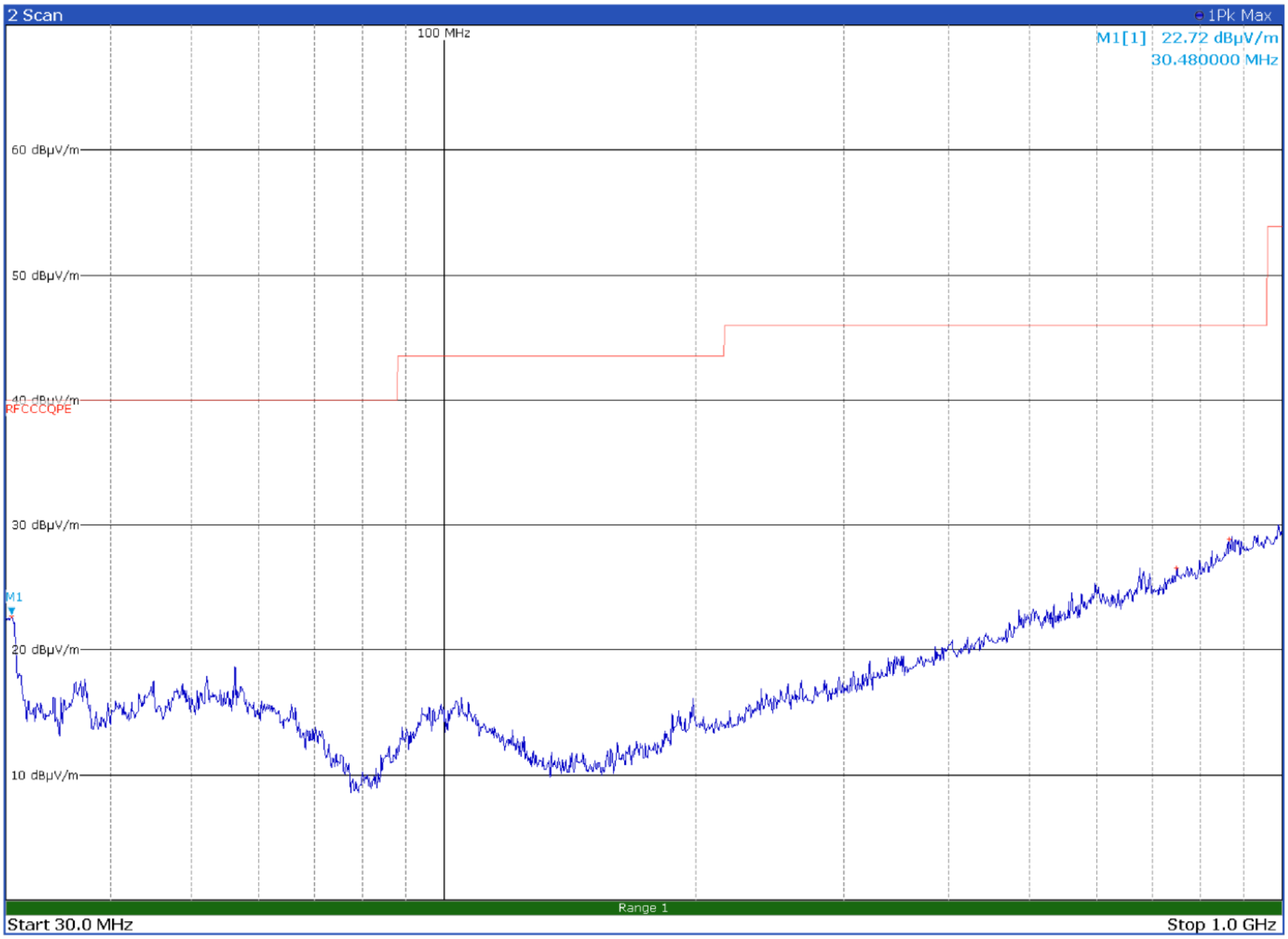
Test data, continued

Figure 8.5-2: *Radiated spurious emissions on low channel with EUT in horizontal position - antenna in vertical polarization*



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Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
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Test data, continued

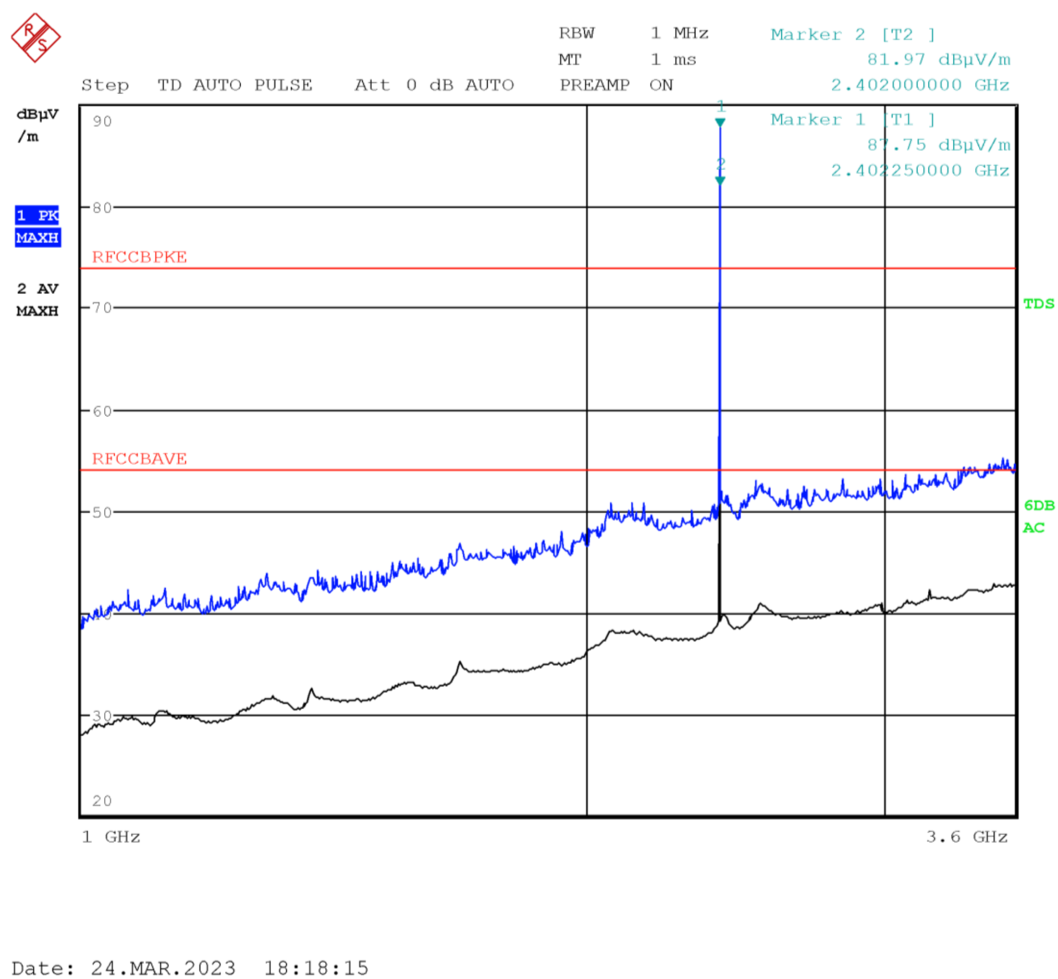


Figure 8.5-3: *Radiated spurious emissions on low channel with EUT in horizontal position - antenna in horizontal polarization*

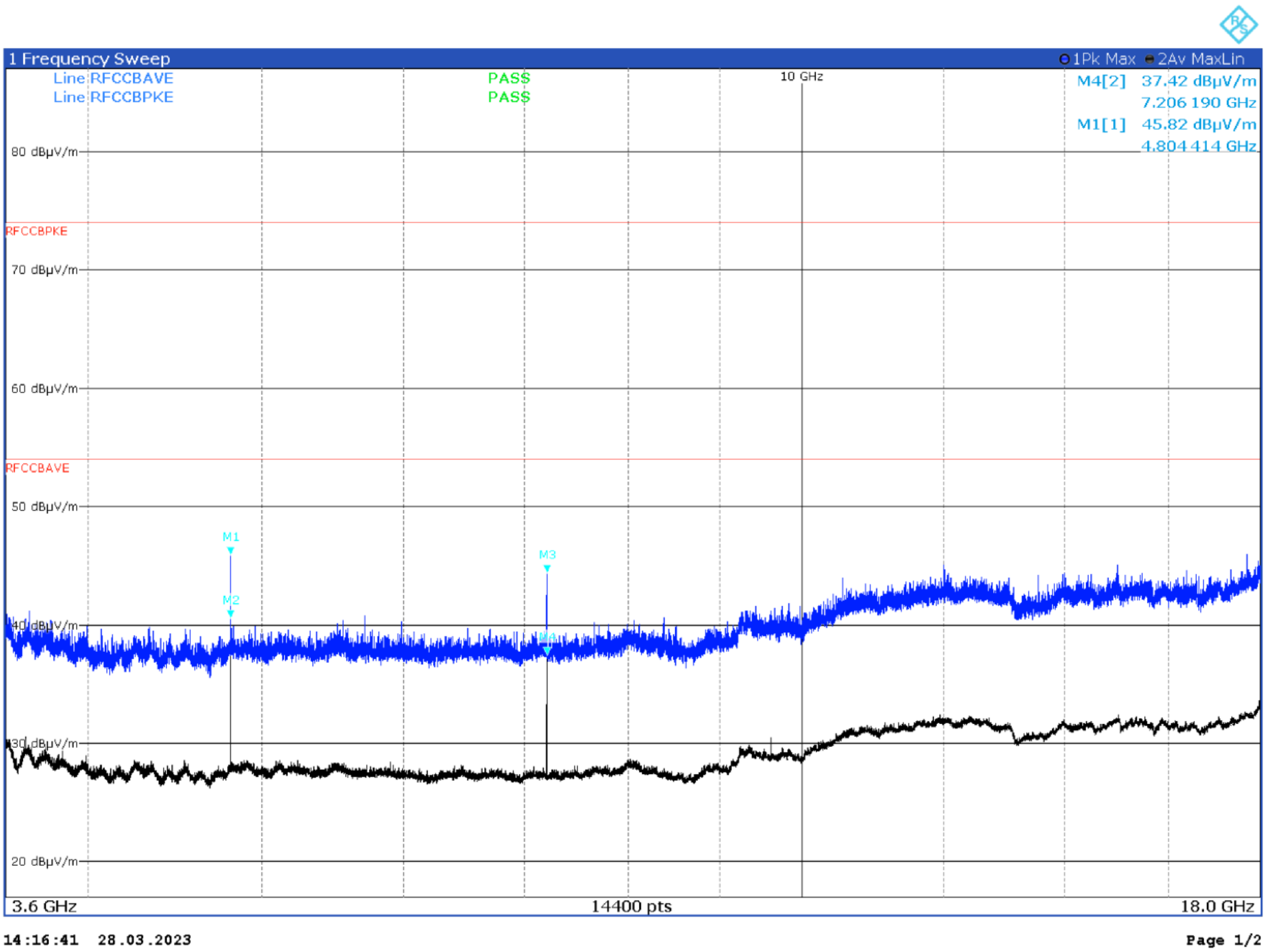
Limit exceeded by the carrier

Test data, continued

Figure 8.5-4: *Radiated spurious emissions on low channel with EUT in horizontal position - antenna in vertical polarization*

Limit exceeded by the carrier

Test data, continued



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	4.804 41 GHz	45.82 dBµV/m		
M2		2	4.803 88 GHz	40.48 dBµV/m		
M3		1	7.207 GHz	44.33 dBµV/m		
M4		2	7.206 19 GHz	37.42 dBµV/m		

Figure 8.5-5: *Radiated spurious emissions on low channel with EUT in horizontal position - antenna in horizontal polarization*

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
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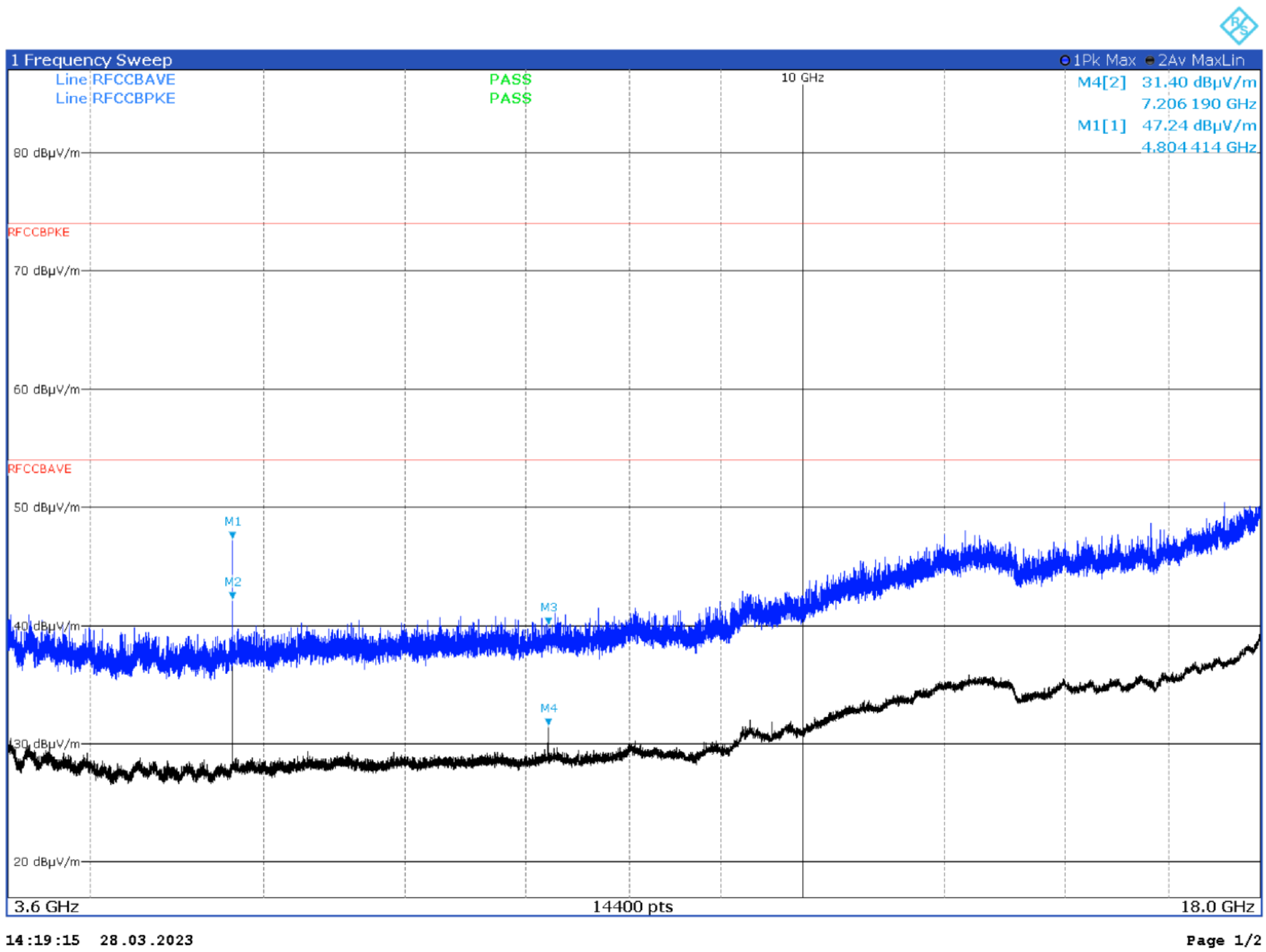
Test data, continued



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	4.804 41 GHz	47.24 dBµV/m		
M2		2	4.803 88 GHz	42.13 dBµV/m		
M3		1	7.207 GHz	39.93 dBµV/m		
M4		2	7.206 19 GHz	31.40 dBµV/m		

Figure 8.5-6: *Radiated spurious emissions on low channel with EUT in horizontal position - antenna in vertical polarization*

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
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Test data, continued

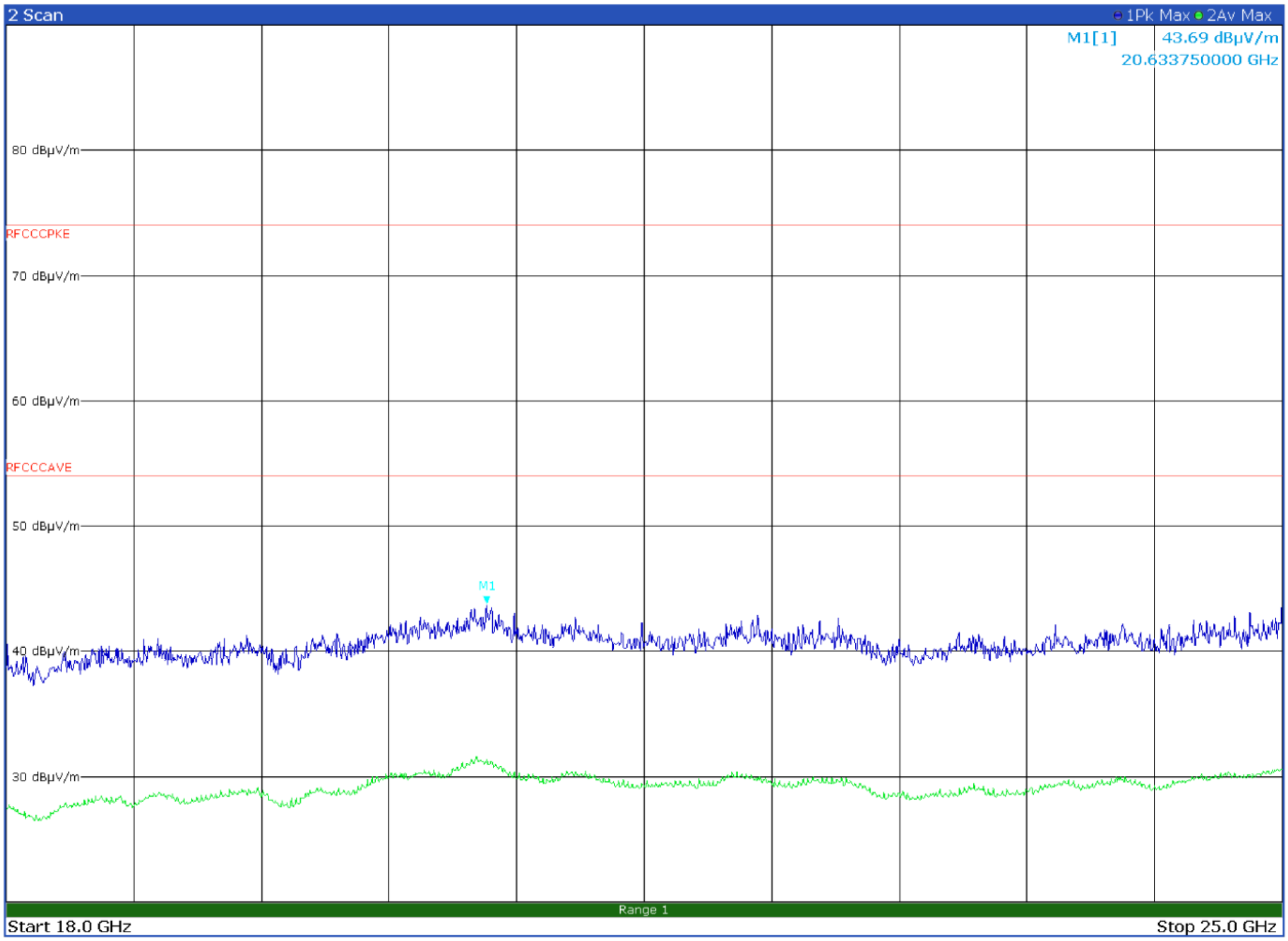

Figure 8.5-7: *Radiated spurious emissions on low channel with EUT in horizontal position - antenna in horizontal polarization*

No spurious emissions found

Test data, continued

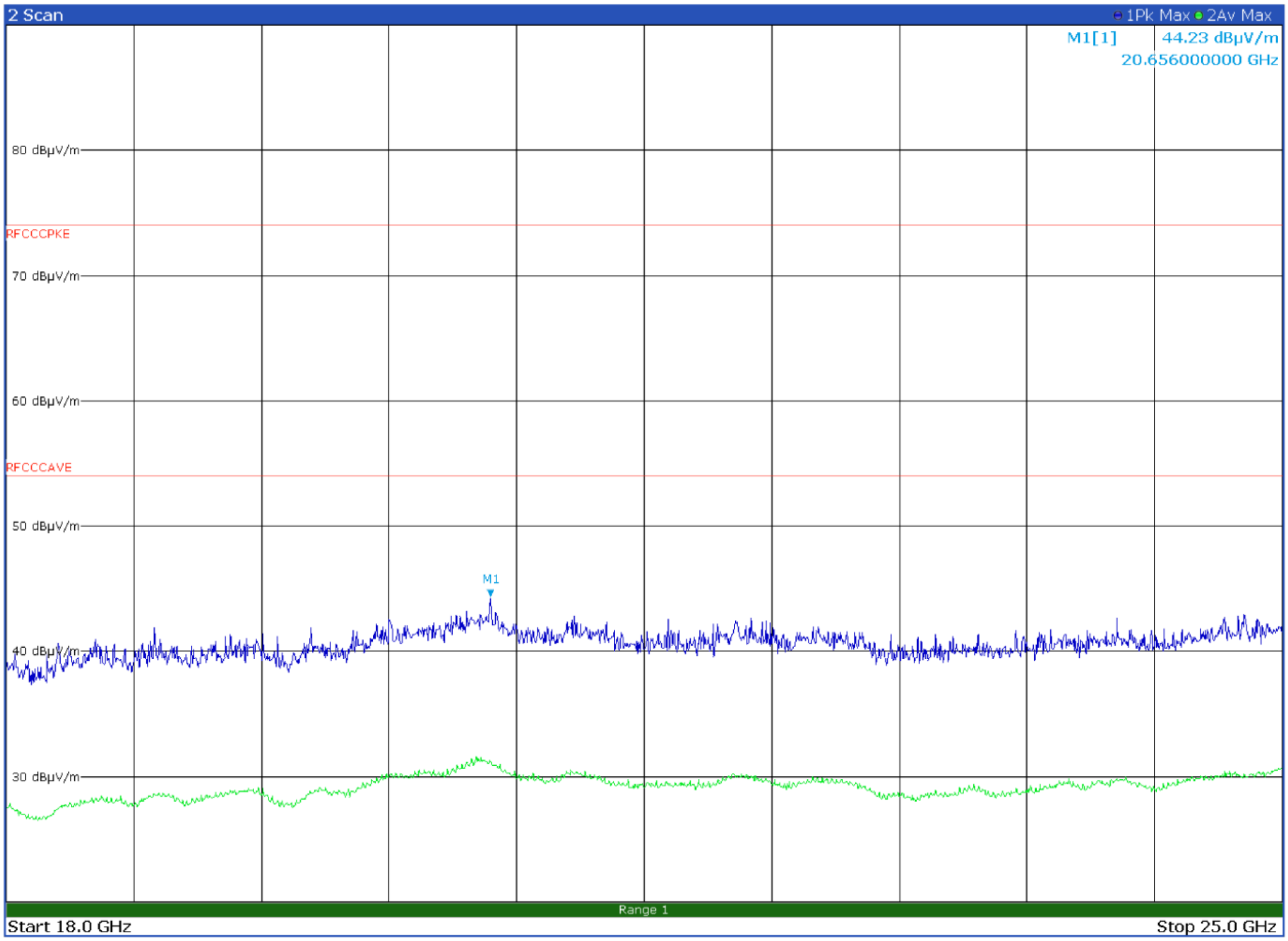

Figure 8.5-8: *Radiated spurious emissions on low channel with EUT in horizontal position - antenna in vertical polarization*

No spurious emissions found

Test data, continued

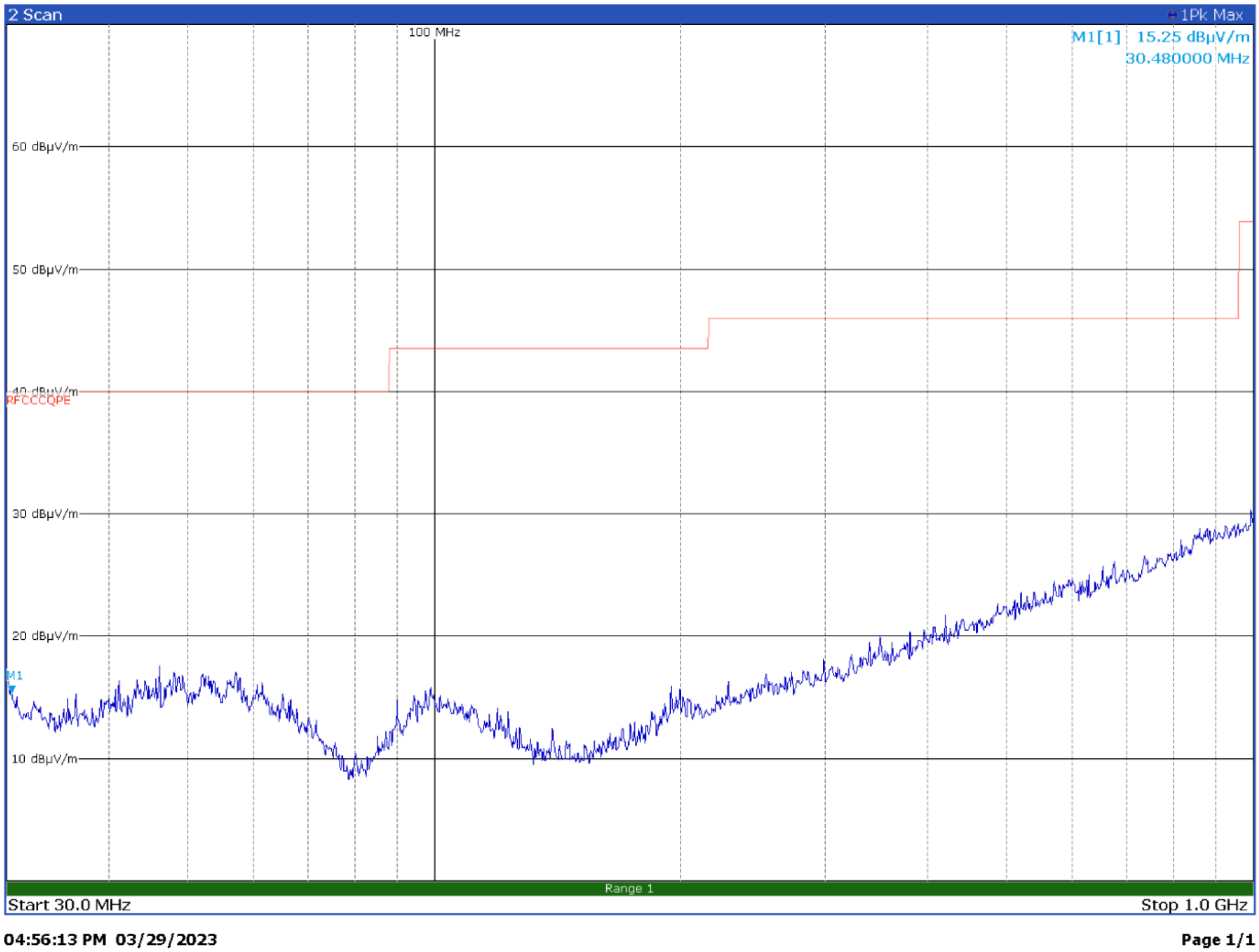

Figure 8.5-9: *Radiated spurious emissions on mid channel with EUT in horizontal position - antenna in horizontal polarization*

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
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Test data, continued

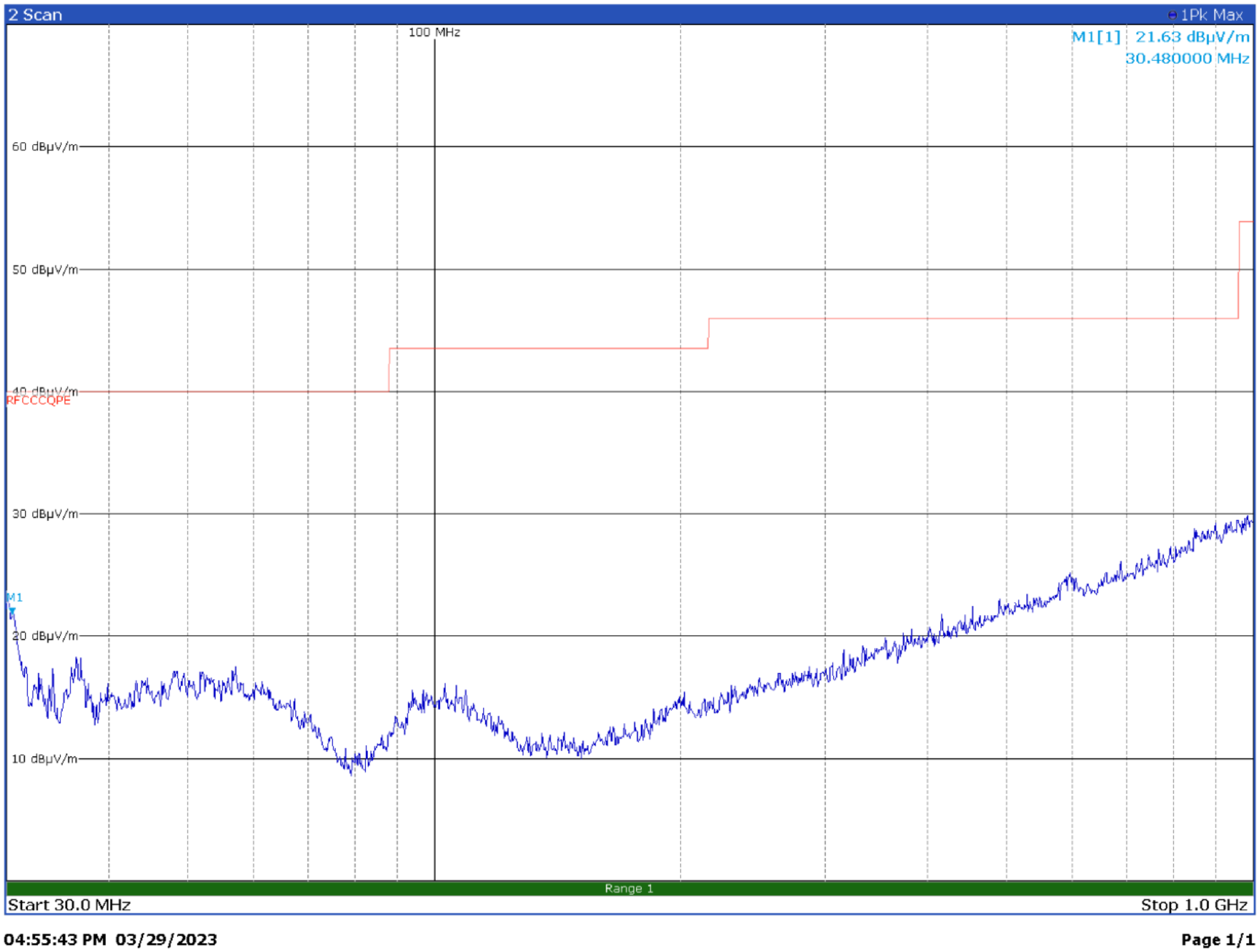

Figure 8.5-10: *Radiated spurious emissions on mid channel with EUT in horizontal position - antenna in vertical polarization*

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
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Test data, continued

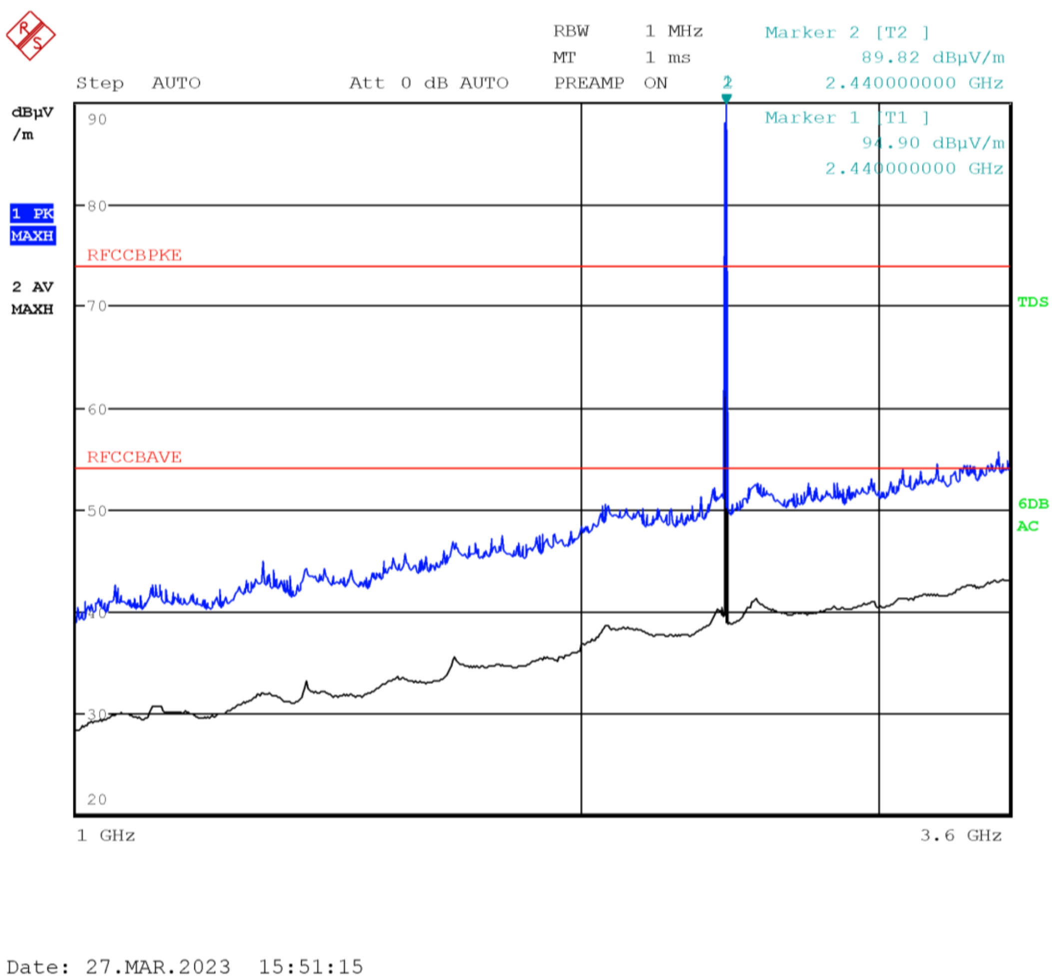


Figure 8.5-11: *Radiated spurious emissions on mid channel with EUT in horizontal position - antenna in horizontal polarization*

Limit exceeded by the carrier

Test data, continued

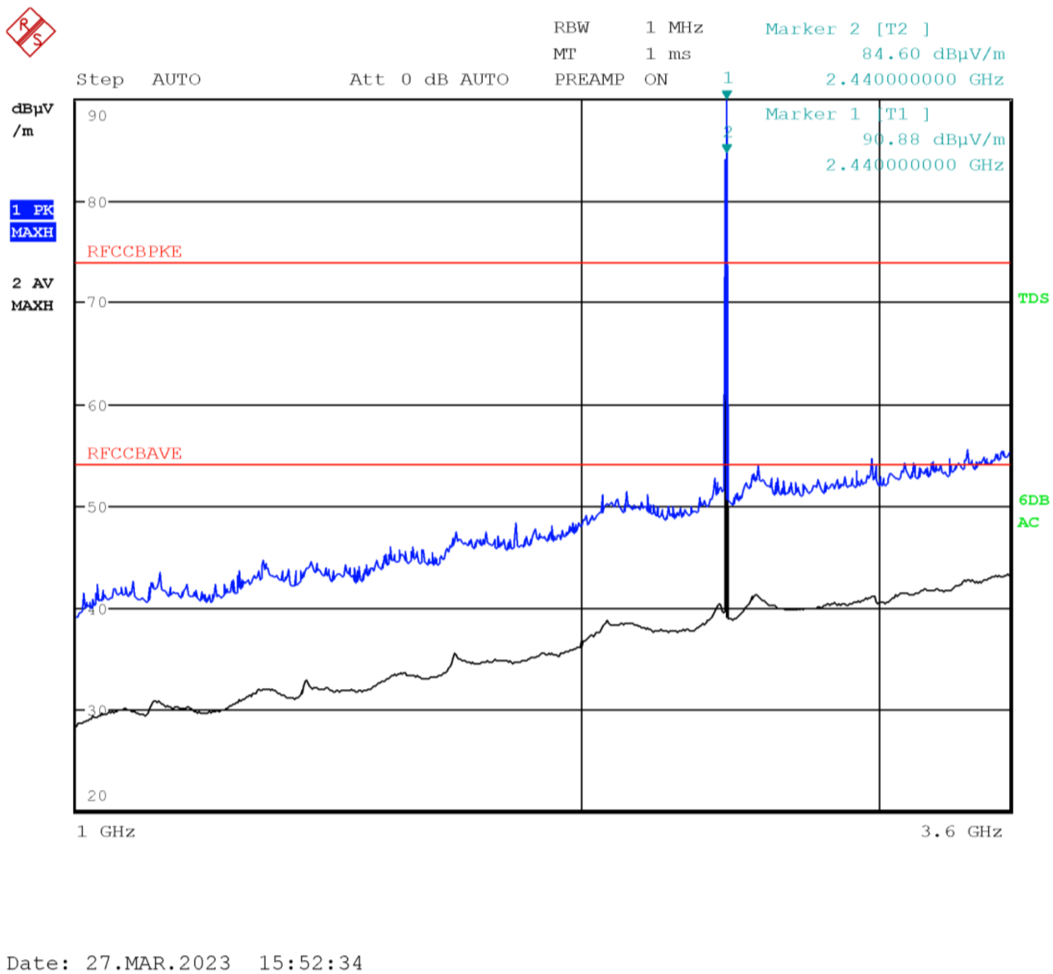
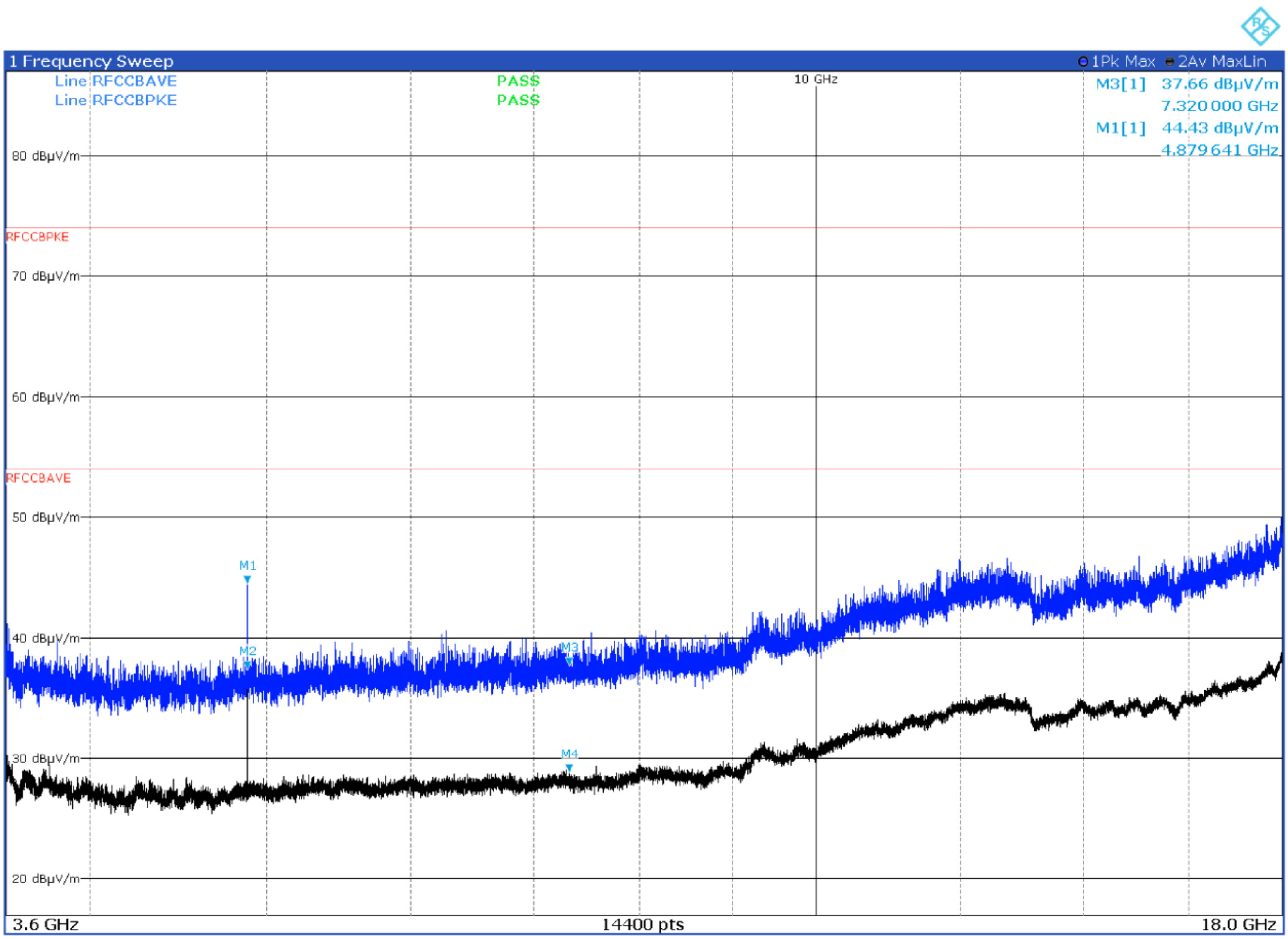


Figure 8.5-12: *Radiated spurious emissions on mid channel with EUT in horizontal position - antenna in vertical polarization*

Limit exceeded by the carrier

Test data, continued



14:26:46 28.03.2023 Page 1/2

2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	4.879 64 GHz	44.43 dBµV/m		
M2		2	4.879 64 GHz	37.35 dBµV/m		
M3		1	7.32 GHz	37.66 dBµV/m		
M4		2	7.320 65 GHz	28.83 dBµV/m		

Figure 8.5-13: *Radiated spurious emissions on mid channel with EUT in horizontal position - antenna in horizontal polarization*

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
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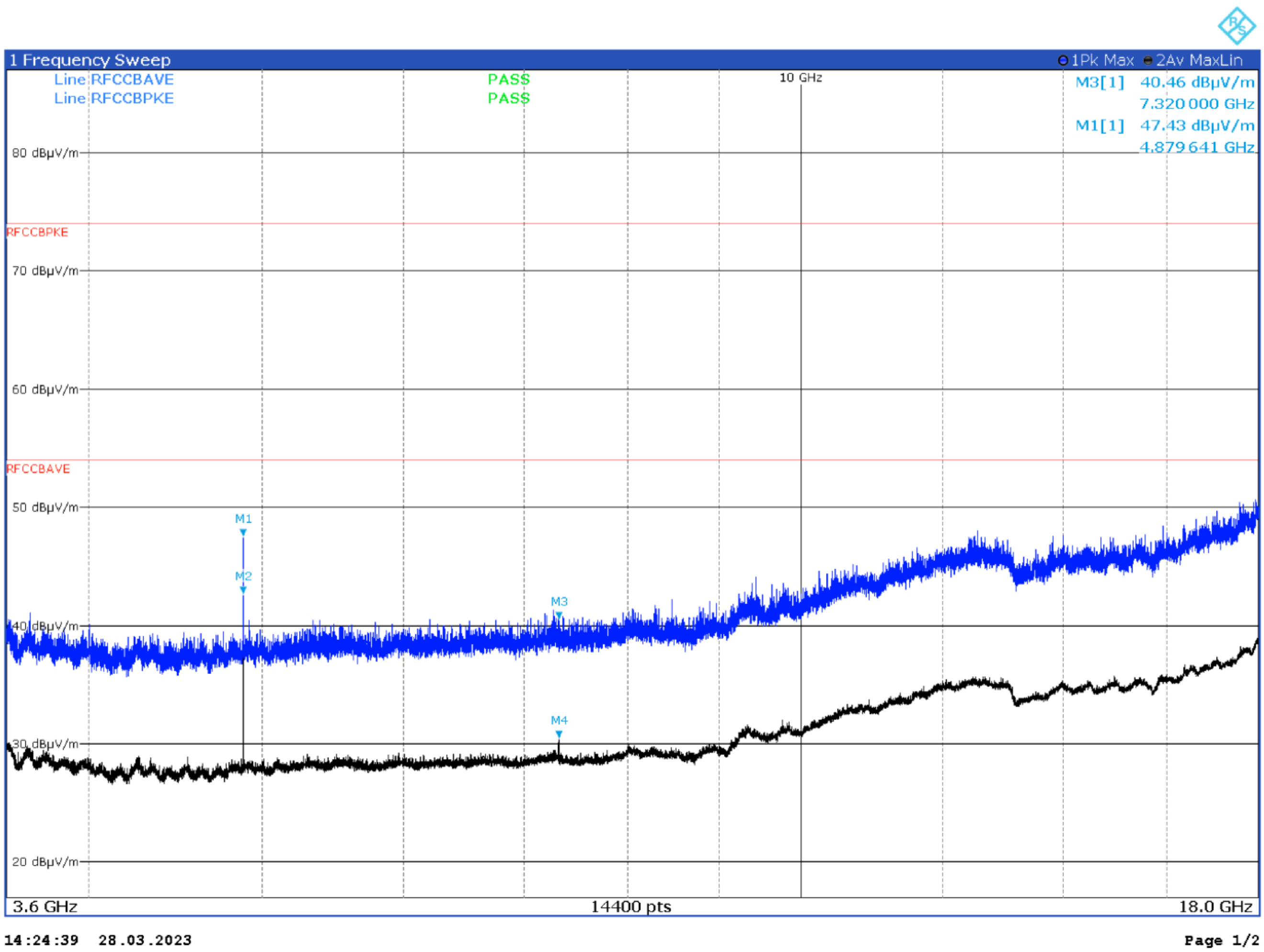
Test data, continued



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	4.879 64 GHz	47.43 dBµV/m		
M2		2	4.879 64 GHz	42.56 dBµV/m		
M3		1	7.32 GHz	40.46 dBµV/m		
M4		2	7.320 65 GHz	30.38 dBµV/m		

Figure 8.5-14: *Radiated spurious emissions on mid channel with EUT in horizontal position - antenna in vertical polarization*

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
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Test data, continued

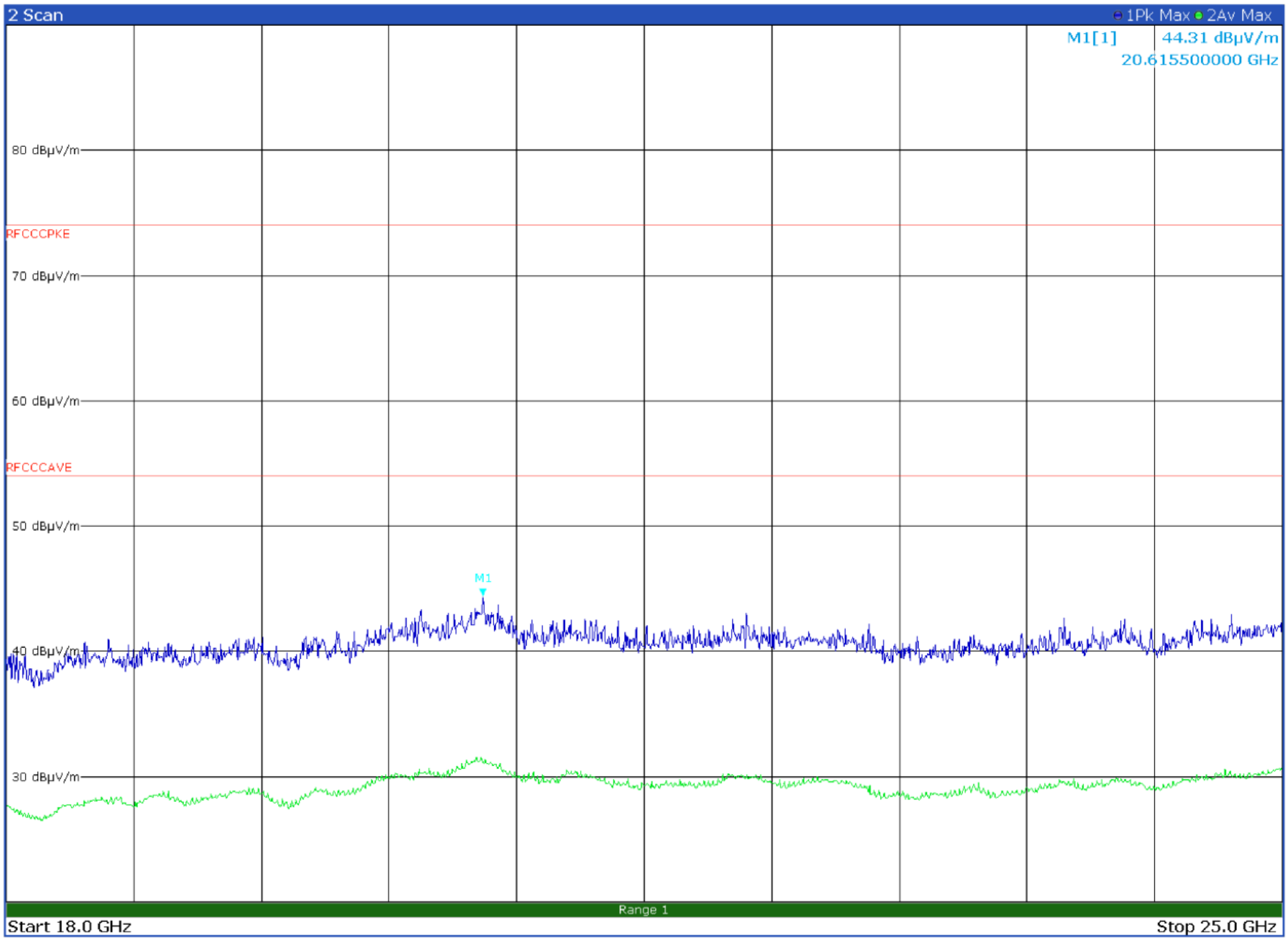

Figure 8.5-15: *Radiated spurious emissions on mid channel with EUT in horizontal position - antenna in horizontal polarization*

No spurious emissions found

Test data, continued

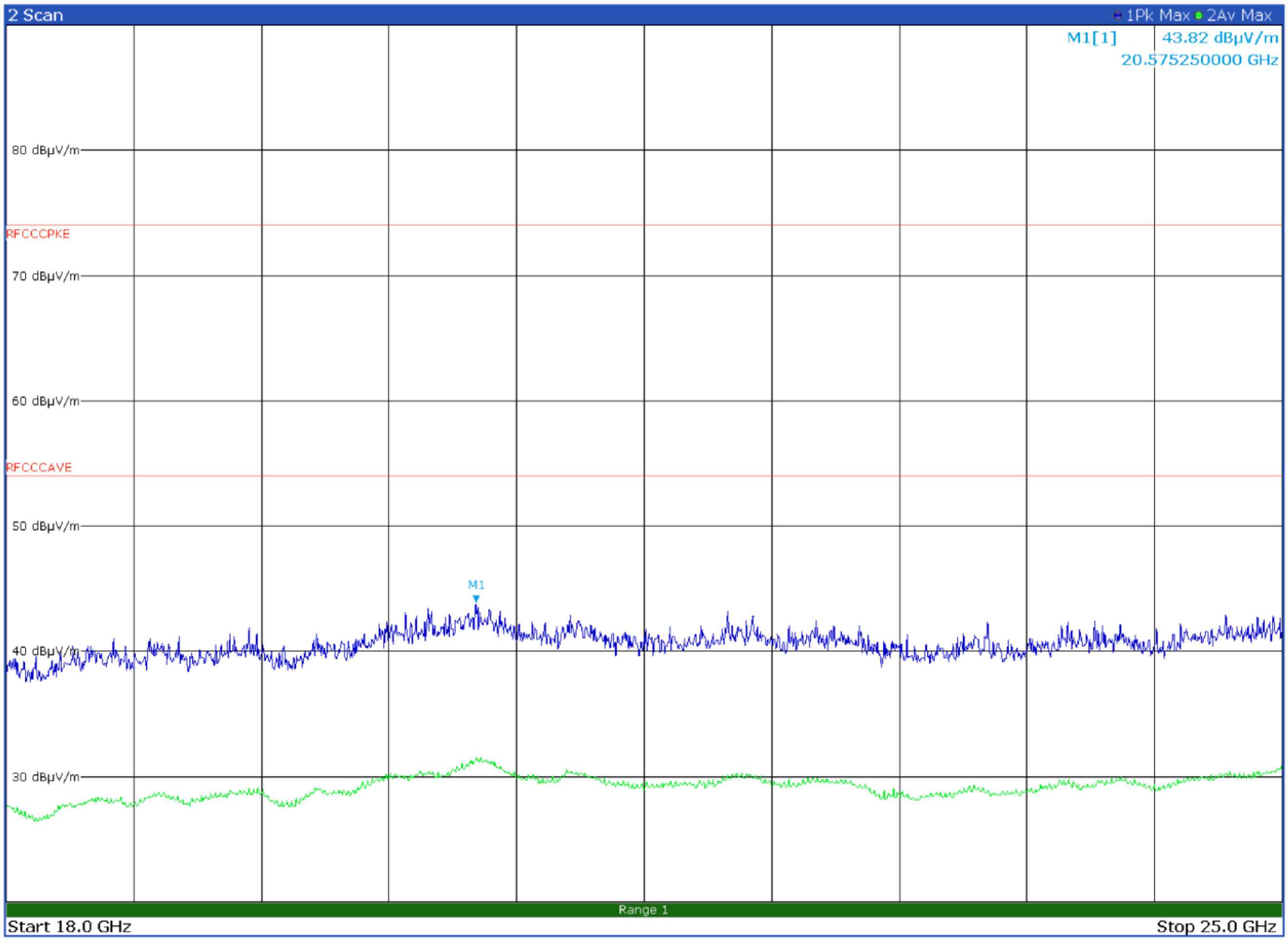

Figure 8.5-16: *Radiated spurious emissions on mid channel with EUT in horizontal position - antenna in vertical polarization*

No spurious emissions found

Test data, continued

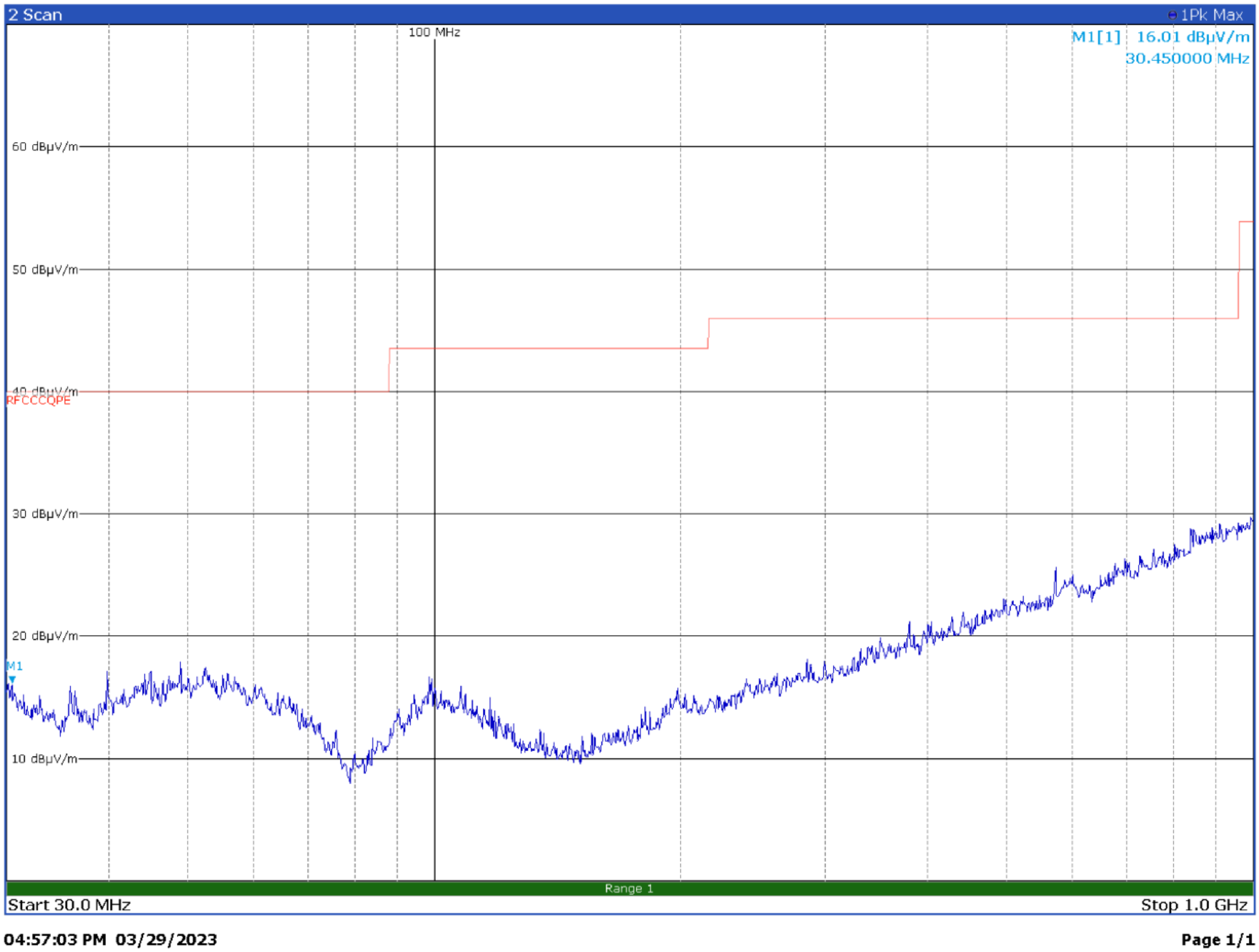

Figure 8.5-17: *Radiated spurious emissions on high channel with EUT in horizontal position - antenna in horizontal polarization*

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
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Test data, continued

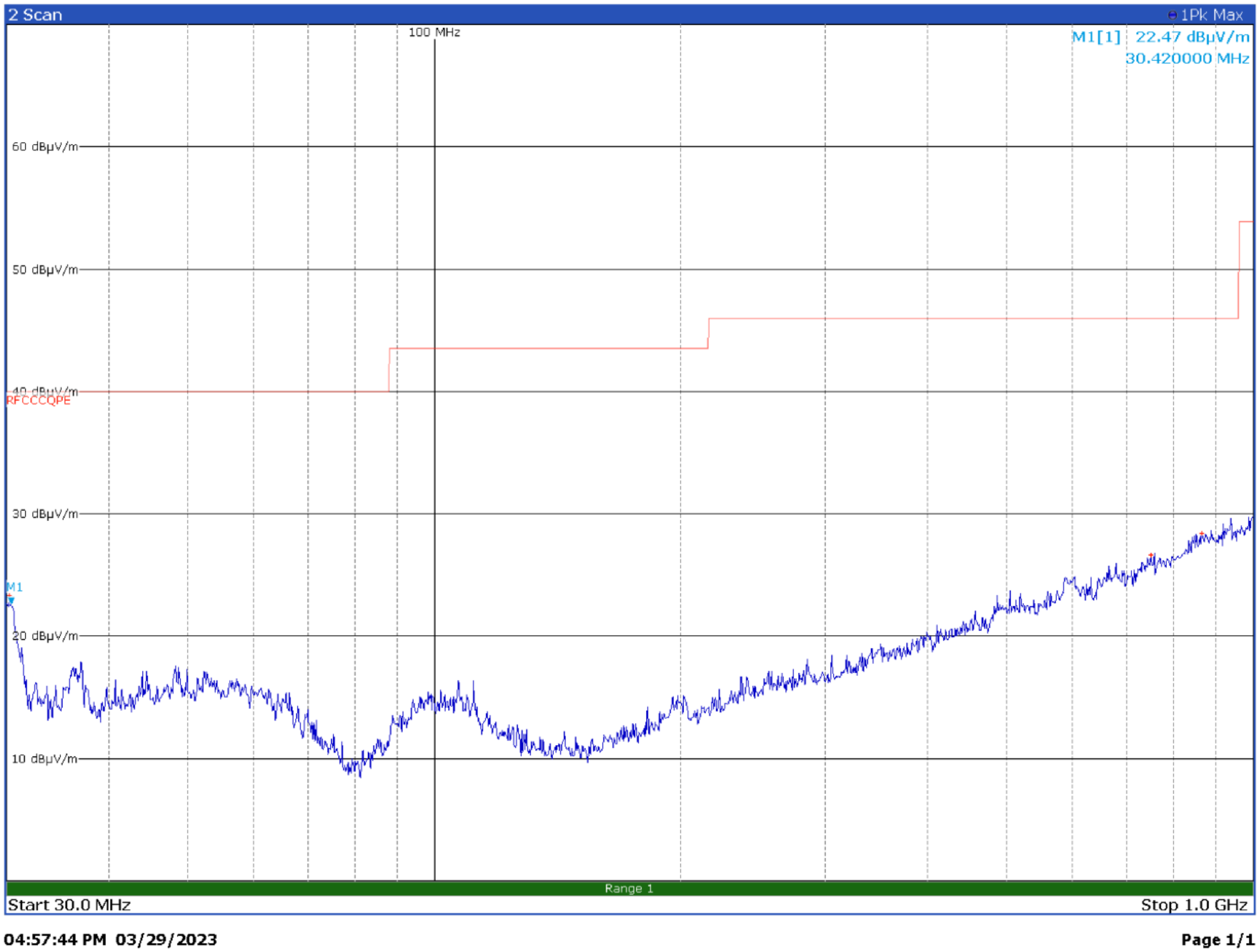

Figure 8.5-18: *Radiated spurious emissions on high channel with EUT in horizontal position - antenna in vertical polarization*

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
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Test data, continued

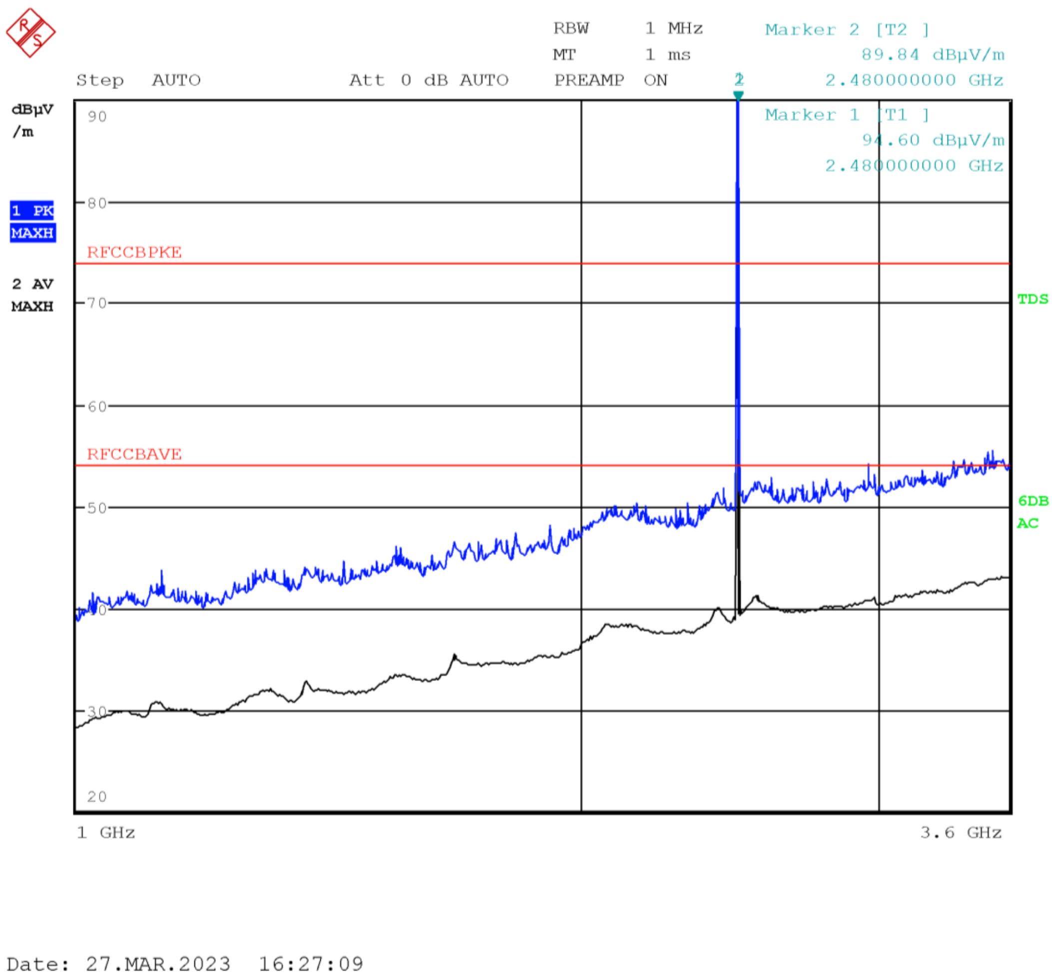


Figure 8.5-19: *Radiated spurious emissions on high channel with EUT in horizontal position - antenna in horizontal polarization*

Limit exceeded by the carrier

Test data, continued

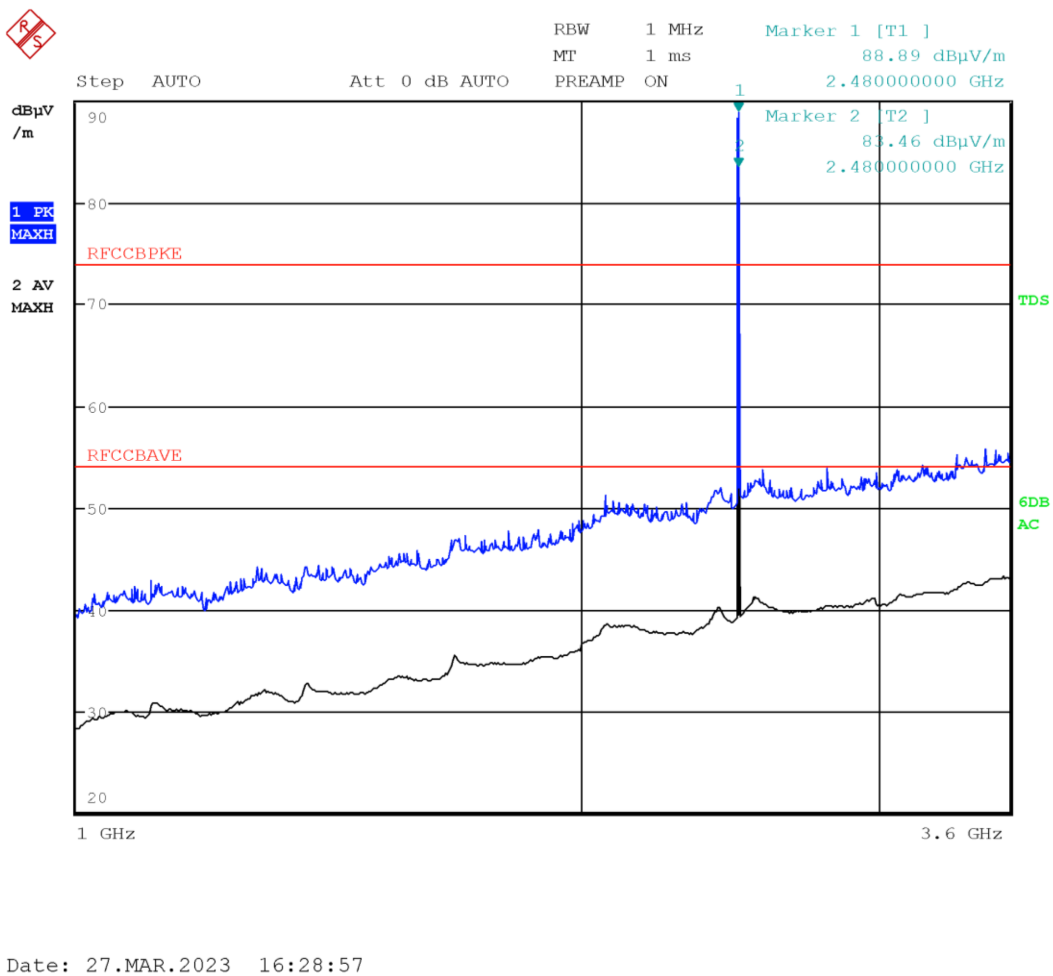
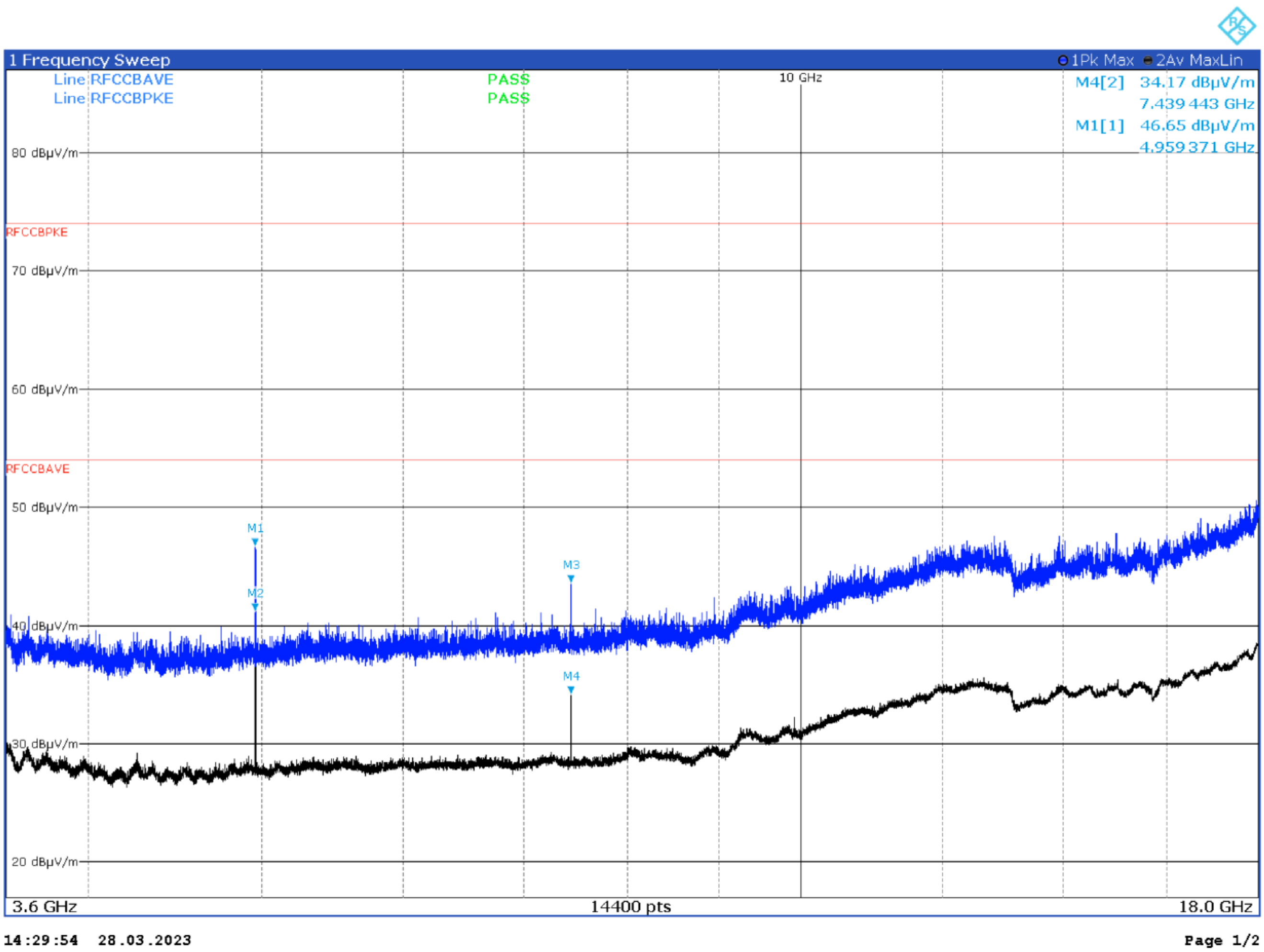


Figure 8.5-20: *Radiated spurious emissions on high channel with EUT in horizontal position - antenna in vertical polarization*

Limit exceeded by the carrier

Test data, continued



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	4.959 37 GHz	46.65 dBµV/m		
M2		2	4.959 93 GHz	41.14 dBµV/m		
M3		1	7.440 28 GHz	43.57 dBµV/m		
M4		2	7.439 44 GHz	34.17 dBµV/m		

Figure 8.5-21: *Radiated spurious emissions on high channel with EUT in horizontal position - antenna in horizontal polarization*

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
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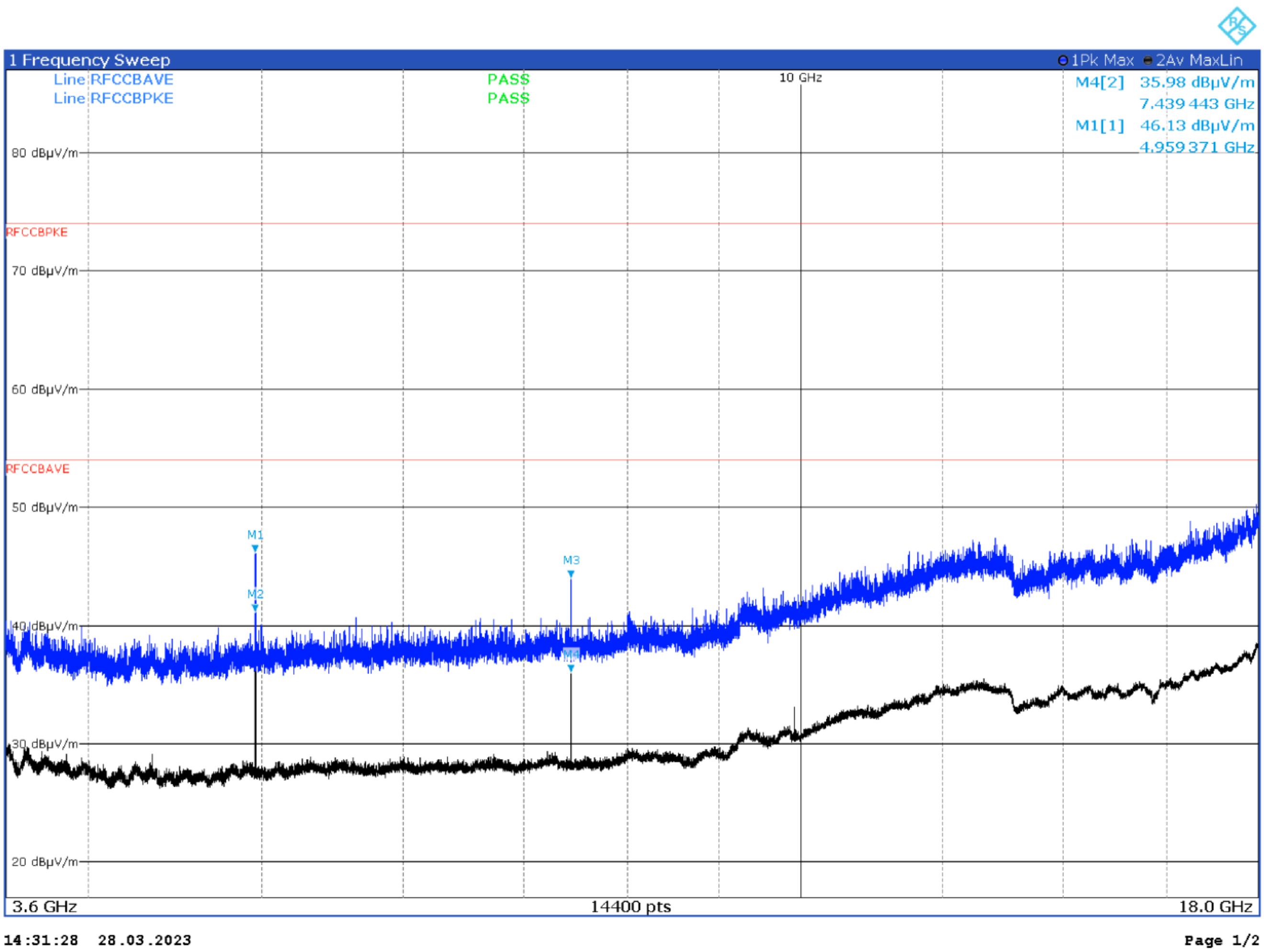
Test data, continued



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	4.959 37 GHz	46.13 dBµV/m		
M2		2	4.959 93 GHz	41.05 dBµV/m		
M3		1	7.440 28 GHz	43.94 dBµV/m		
M4		2	7.439 44 GHz	35.98 dBµV/m		

Figure 8.5-22: *Radiated spurious emissions on high channel with EUT in horizontal position - antenna in vertical polarization*

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
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Test data, continued

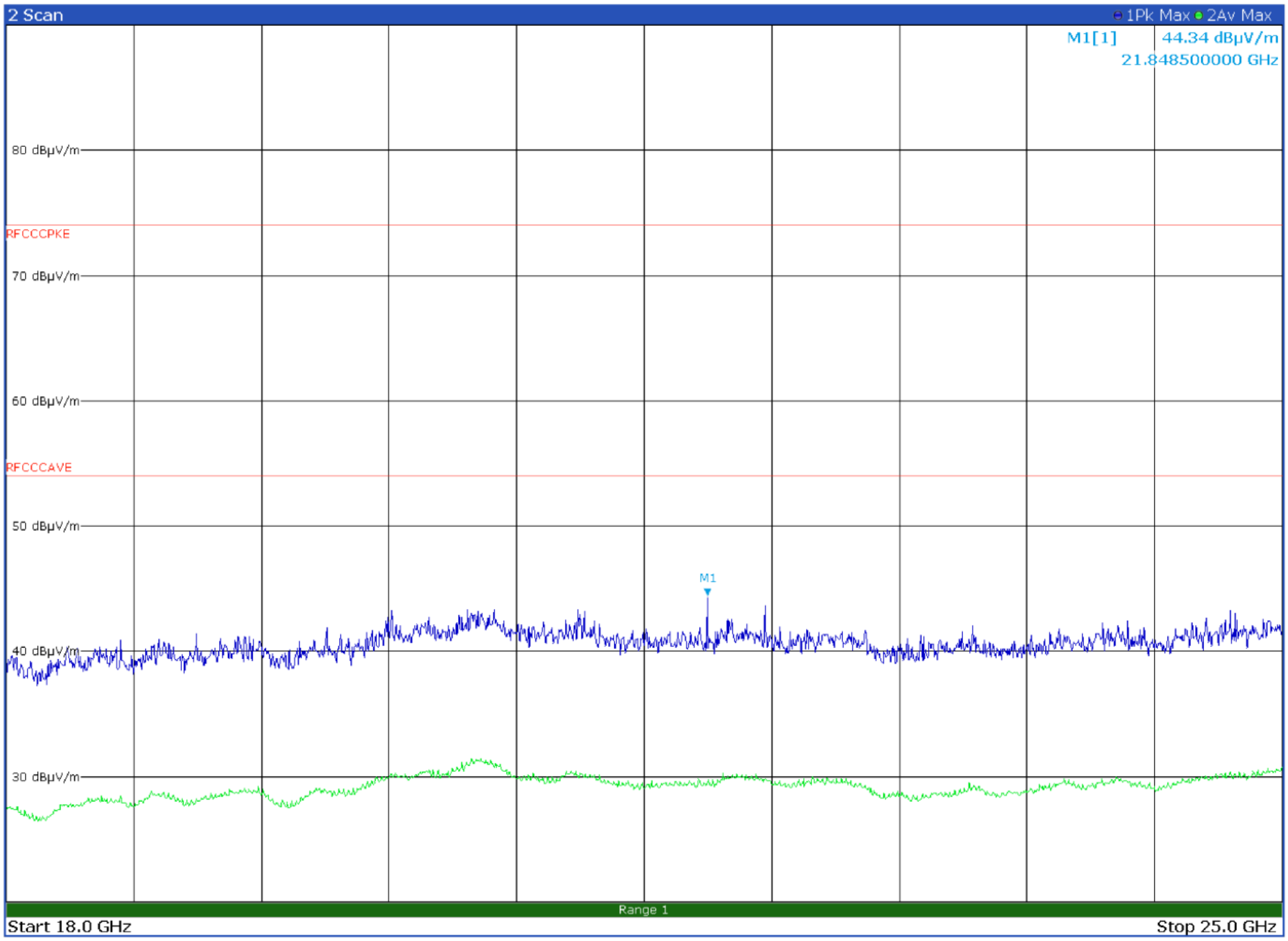

Figure 8.5-23: *Radiated spurious emissions on high channel with EUT in horizontal position - antenna in horizontal polarization*

No spurious emissions found

Test data, continued

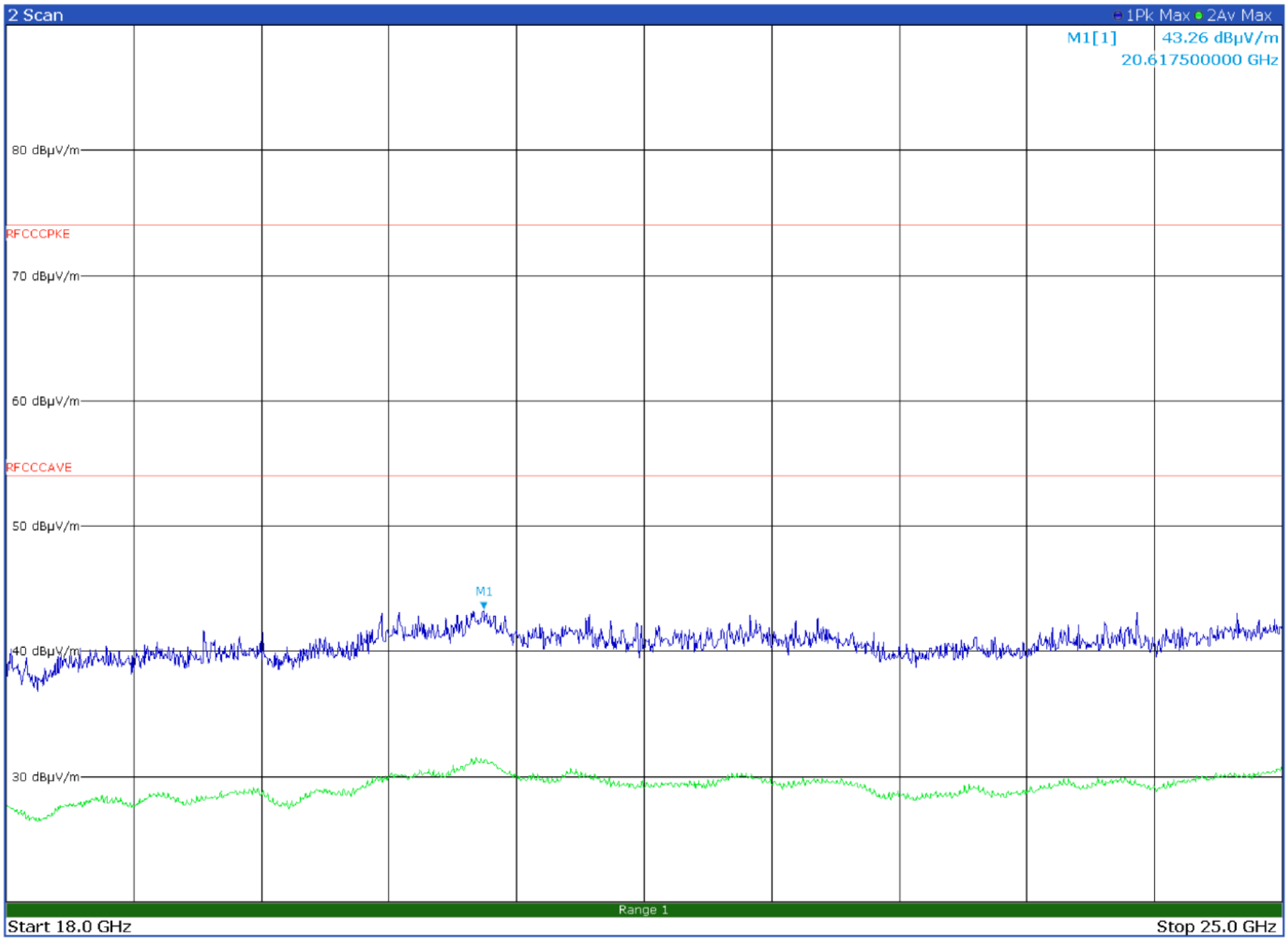

Figure 8.5-24: *Radiated spurious emissions on high channel with EUT in horizontal position - antenna in vertical polarization*

No spurious emissions found

Test data, continued

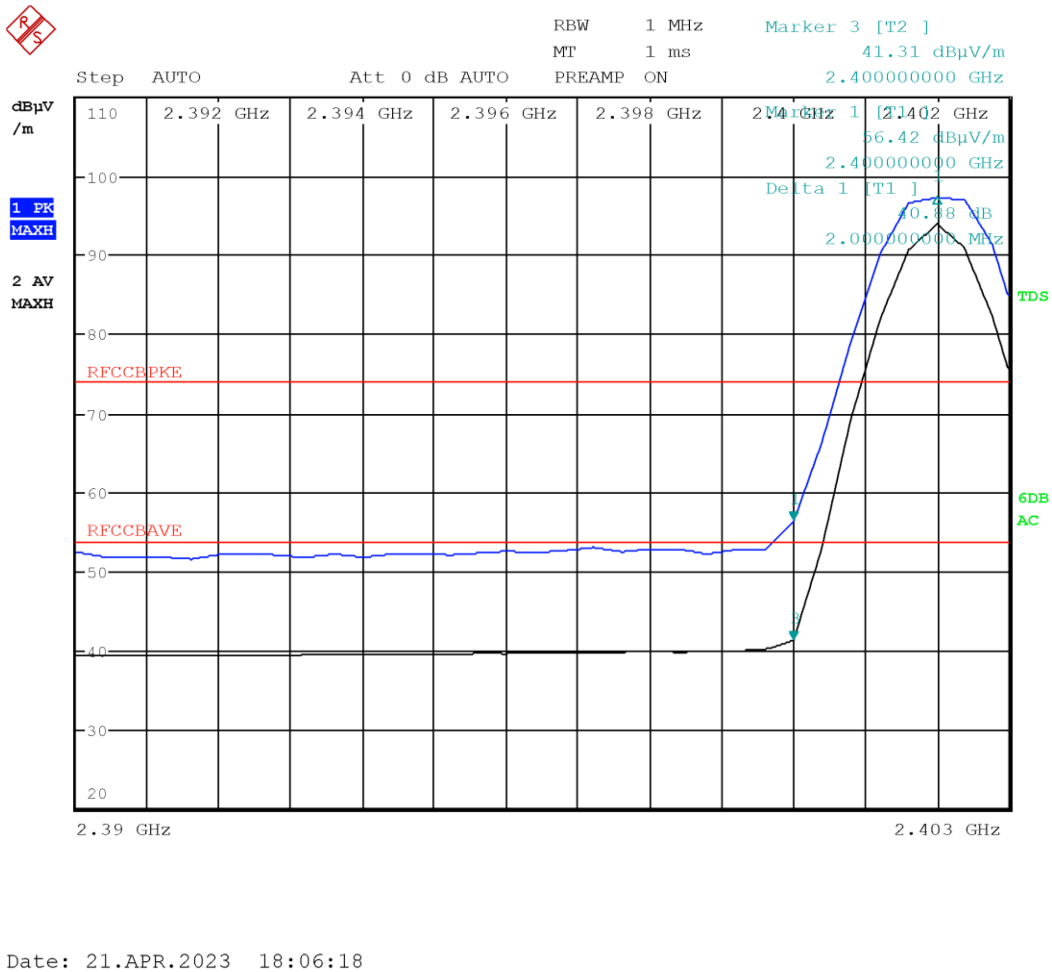

Figure 8.5-25: *Band edge spurious emissions at 2400 MHz*

Test data, continued

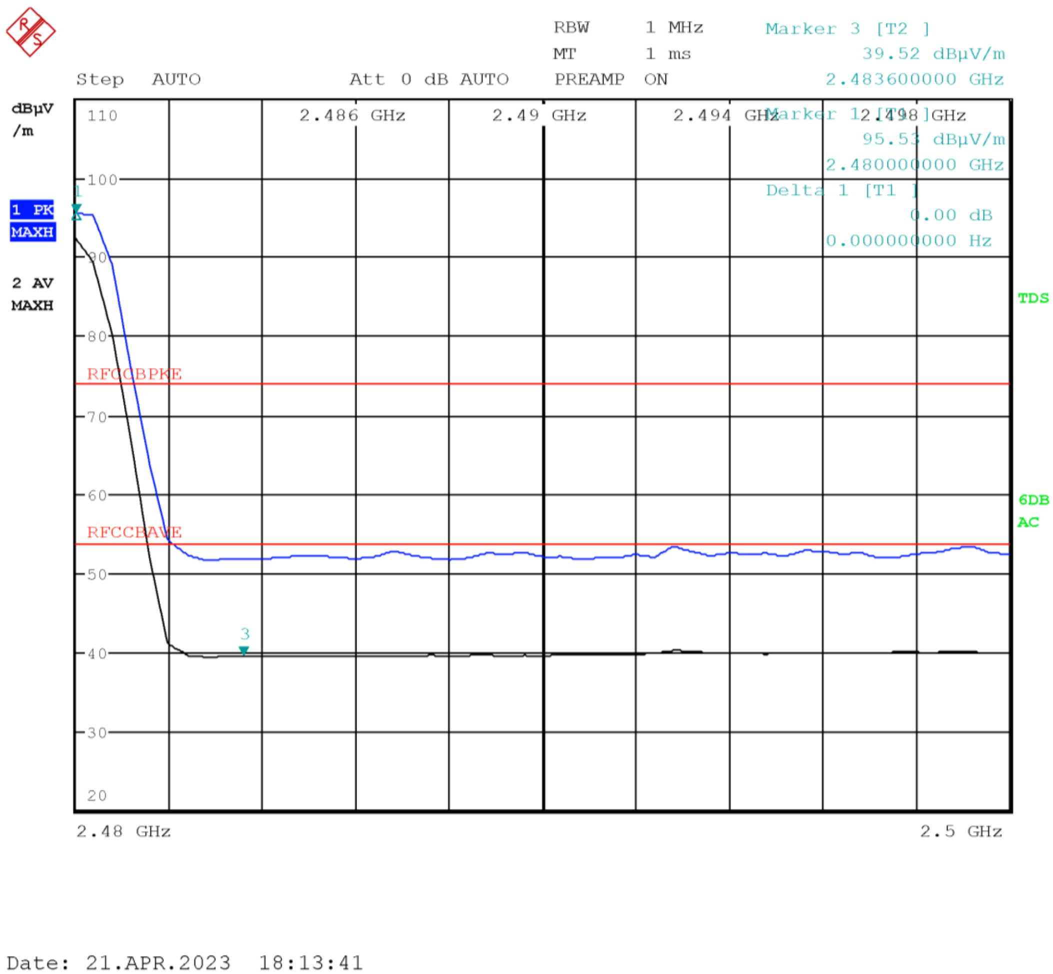

Figure 8.5-26: *Band edge spurious emissions at 2483.5 MHz*

8.6 Power spectral density for digitally modulated devices

8.6.1 References, definitions and limits

RSS-247, Clause 5.2:

DTSs include systems that employ digital modulation techniques resulting in spectral characteristics similar to direct sequence systems. The following applies to the bands 902-928 MHz and 2400-2483.5 MHz:

b. The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of section 5.4(d), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

RSS-247, Clause 5.3:

Hybrid systems employ a combination of both frequency hopping and digital transmission techniques and shall comply with the following:

b. With the frequency hopping turned off, the digital transmission operation shall comply with the power spectral density requirements for digital modulation systems set out in of section 5.2(b) or section 6.2.4 for hybrid devices operating in the band 5725–5850 MHz.

8.6.2 Test summary

Verdict	Pass		
Tested by	D. Guarnone	Test date	April 14, 2023

8.6.3 Observations, settings and special notes

Power spectral density test was performed as per KDB 558074, section 8.4 with reference to ANSI C63.10 subclause 11.10.
The test was performed using method PKPSD (peak PSD).
Spectrum analyser settings:

Resolution bandwidth:	3 kHz ≤ RBW ≤ 100 kHz
Video bandwidth:	≥3 × RBW
Frequency span:	1.5 times the DTS BW (Peak)
Detector mode:	Peak
Trace mode:	Max hold

8.6.4 Test equipment used

Equipment	Manufacturer	Model no.	Asset no.
EMI Receiver	Rohde & Schwarz	ESW44	101620
Antenna Trilog 25MHz - 8GHz	Schwarzbeck Mess-Elektronik	VULB9162	9162-025
Antenna 1 - 18 GHz	Schwarzbeck Mess-Elektronik	STLP9148	STLP 9148-152
Double Ridge Horn Antenna	RFSpin	DRH40	061106A40
Broadband Amplifier	Schwarzbeck Mess-Elektronik	BBV9718C	00121
Broadband Bench Top Amplifier	Sage	STB-1834034030-KFKF-L1	18490-01
Controller	Maturo	FCU3.0	10041
Tilt antenna mast	Maturo	TAM4.0-E	10042
Turntable	Maturo	TT4.0-5T	2.527
Semi-anechoic chamber	Nemko S.p.a.	10m semi-anechoic chamber	530

8.6.5 Test data

Table 8.6-1: *PSD results (radiated measurement)*

Frequency, MHz	Field strength, dBµV/m/3 kHz	EIRPSD, dBm/3 kHz	Antenna gain, dBi	PSD, dBm/3 kHz	PSD limit, dBm/3 kHz	Margin, dB
2402	77.5	-17.73	-1.3	-16.43	8	-24.43
2440	75.8	-19.43	-1.3	-18.13	8	-26.13
2480	76.9	-18.33	-1.3	-17.03	8	-25.03

Note: EIRPSD [dBm/3 kHz] = Field Strength [dBµV/m/3 kHz] – 95.23 [dB]; PSD [dBm/3 kHz] = EIRP [dBm/3 kHz] – Antenna gain [dBi]

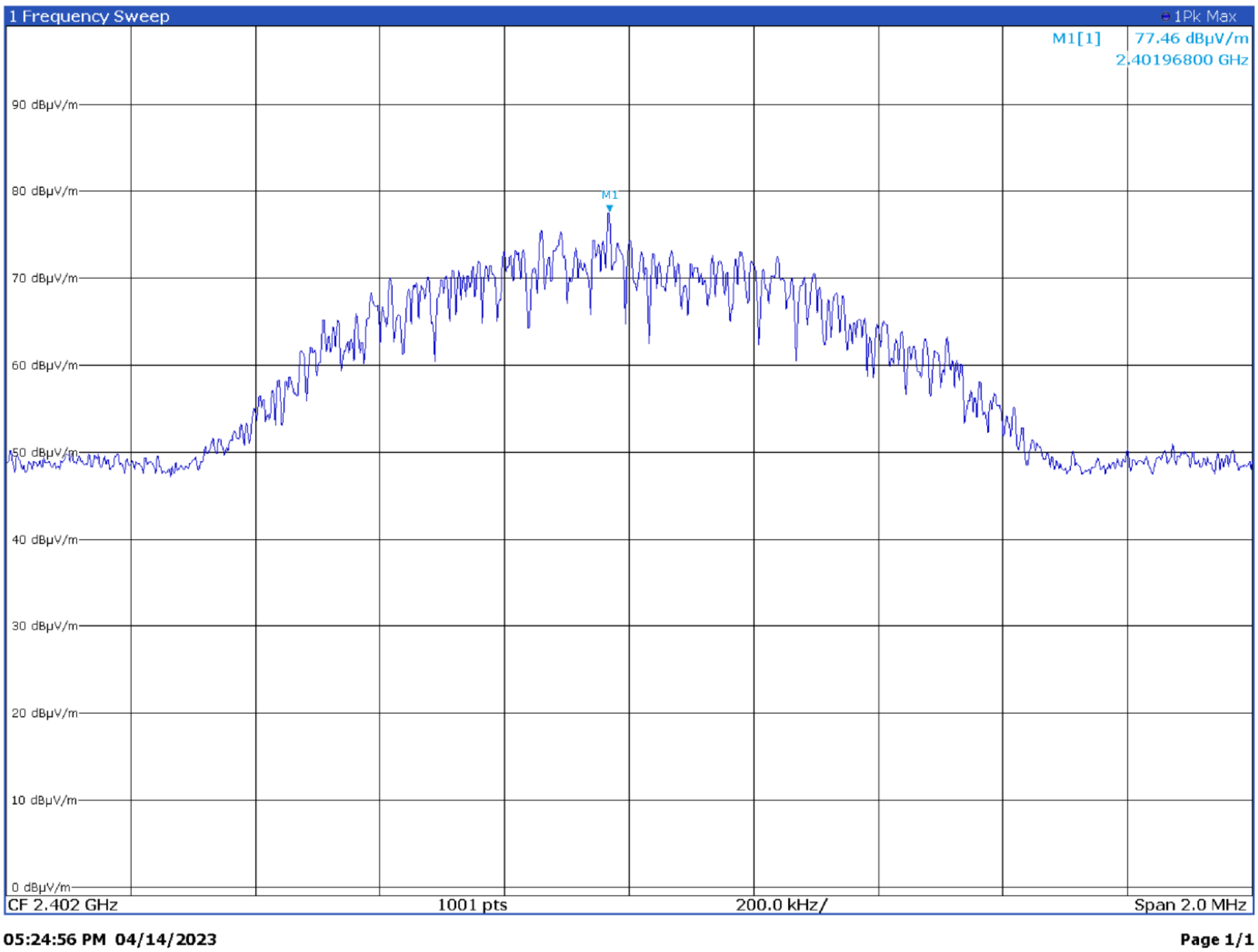

Figure 8.6-1: *PSD on low channel*

Test data, continued

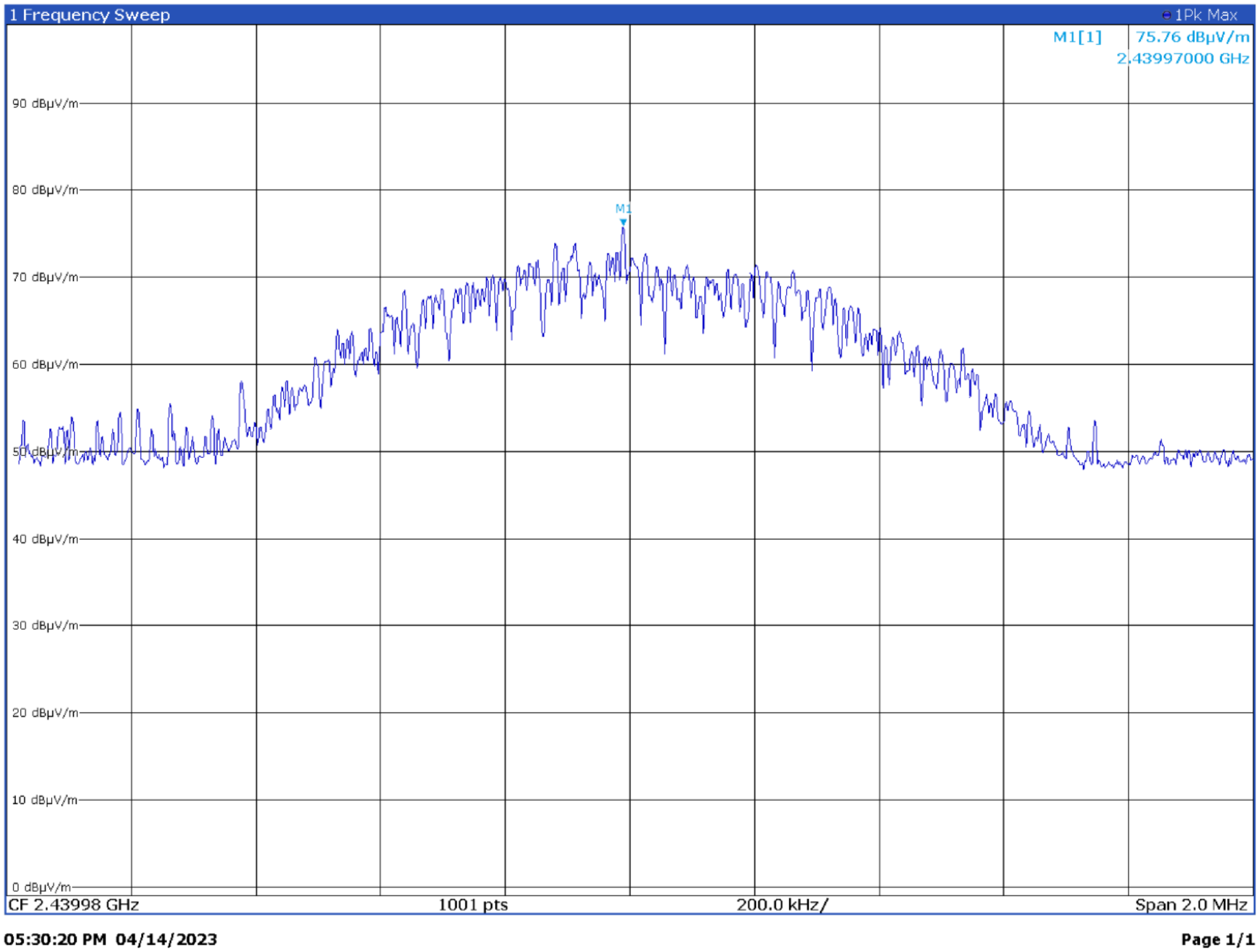

Figure 8.6-2: *PSD on mid channel*

Test data, continued

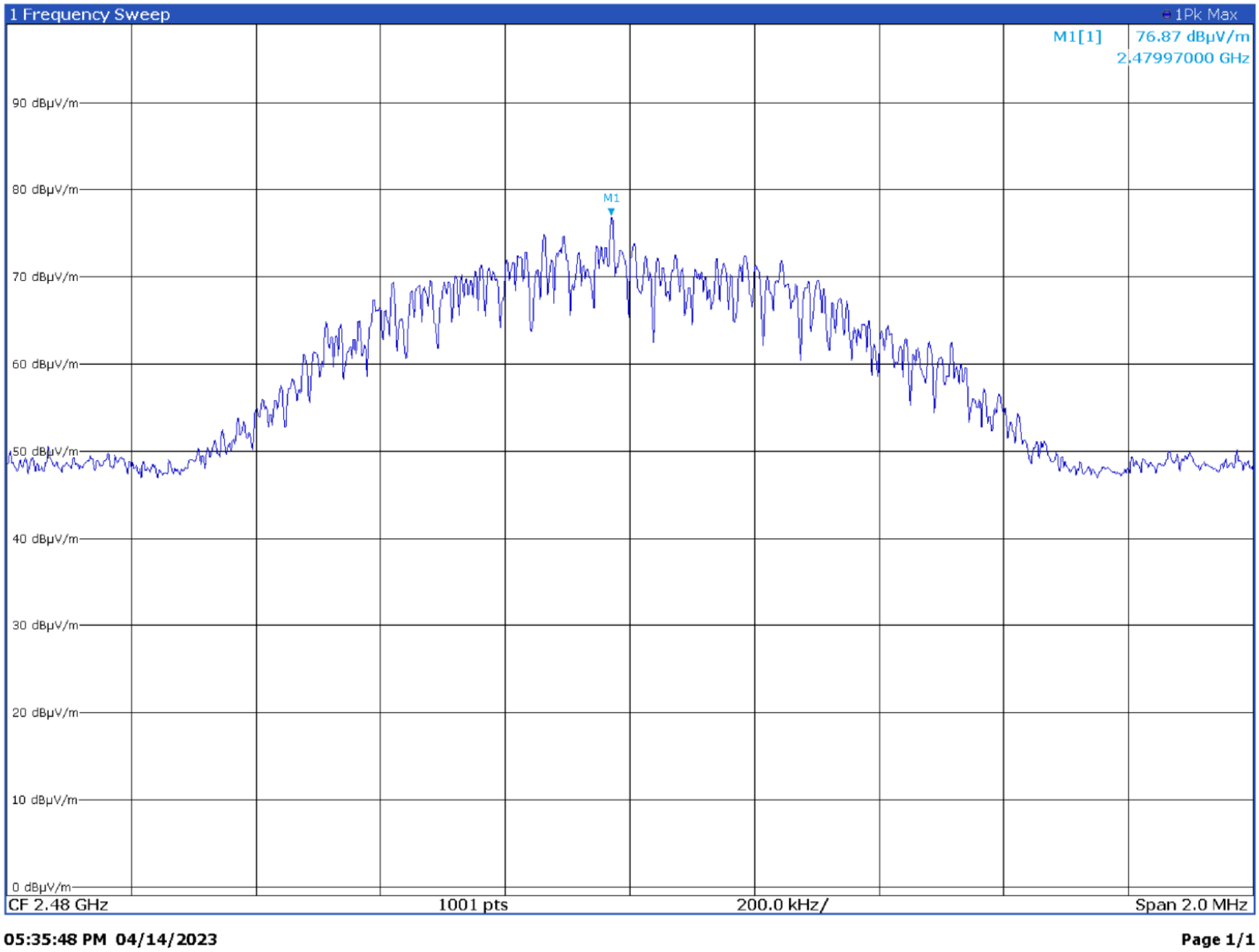

Figure 8.6-3: *PSD on high channel*

Section 9 EUT photos

9.1 Set-up photos

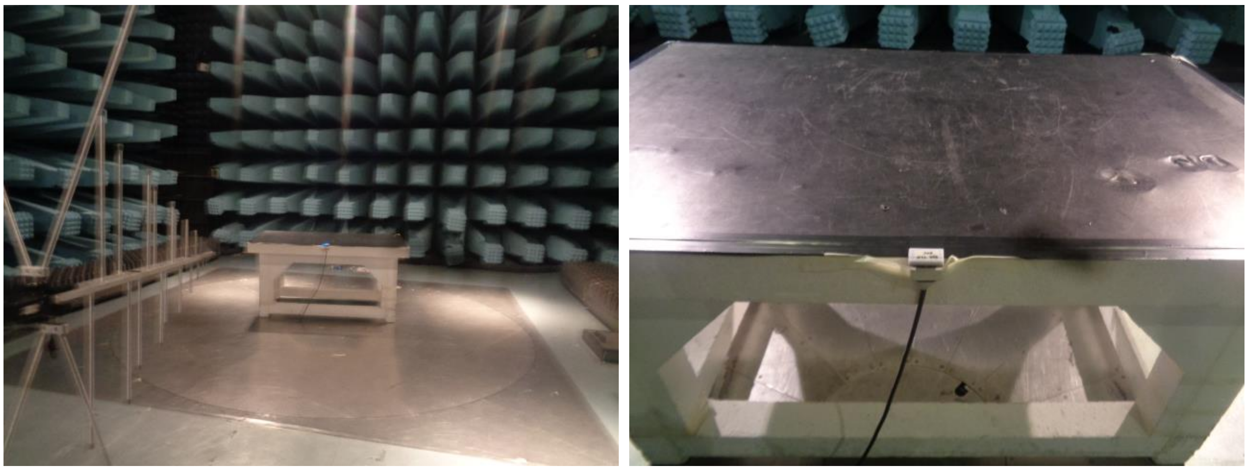

Figure 9.1-1: *Radiated emissions set-up for frequencies below 1 GHz*

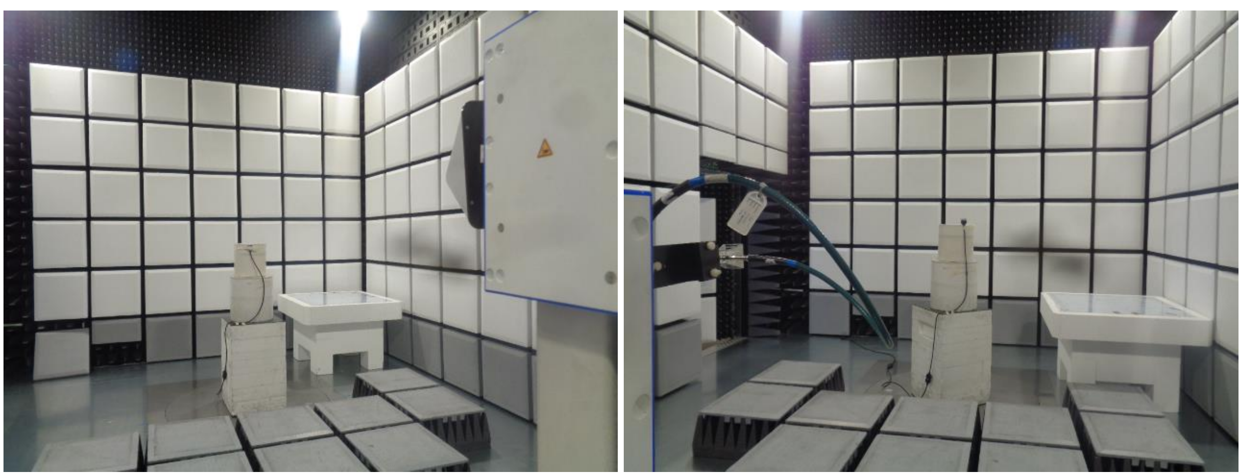

Figure 9.1-2: *Radiated emissions set-up for frequencies above 1 GHz*

9.2 External photos

Figure 9.2-1: *Front view photo*

Figure 9.2-2: *Rear view photo*

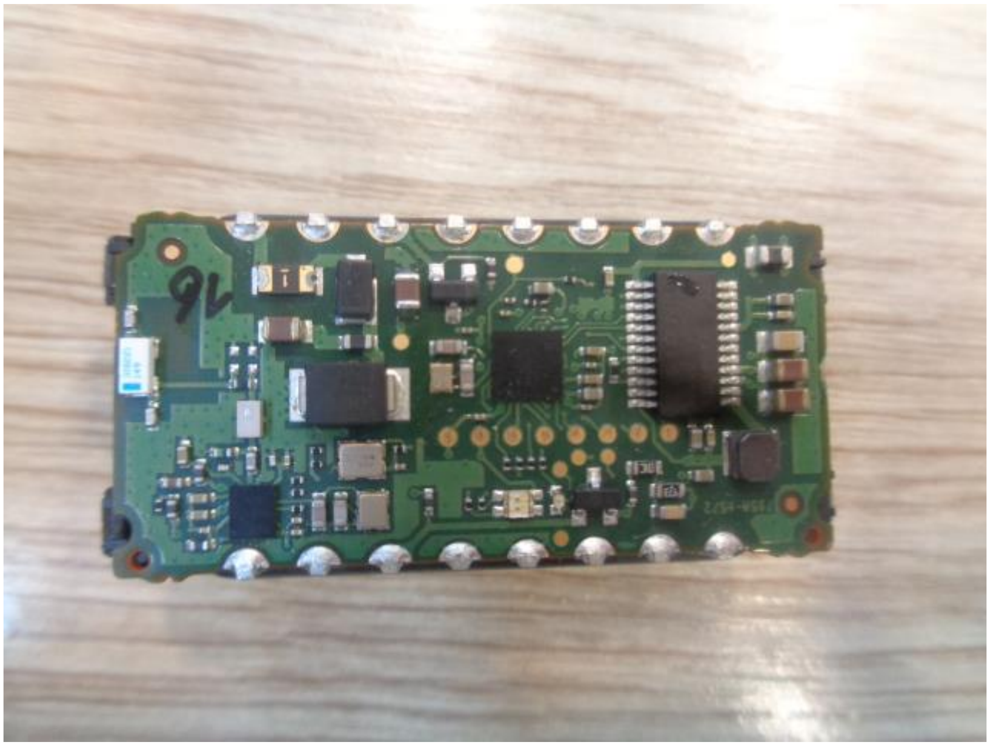

Figure 9.2-3: *Inside view photo*

End of the test report