Test Report

REP072051

Date of issue: December 6, 2024

Applicant:

TEXA S.p.A.
Via I Maggio, 9
31050 – Monastier di Treviso (TV) – Italy

Product:

Diagnostic Black Box

Model:

NAVIGATOR TXB 1

FCC ID:	IC Registration number:
T8RTXB124	23618-TXB124

Specifications:

- FCC 47 CFR Part 15 Subpart C, §15.247

  Operation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz

- RSS-247, Issue 3, August 2023, Section 5

  Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices Standard specifications for frequency hopping systems and digital transmission systems operating in the bands 902–928 MHz, 2400–2483.5 MHz and 5725–5850 MHz

Test location

Company name	Nemko S.p.A.
Address	Via Del Carroccio, 4
City	Biassono
Province	MB
Postal code	20853
Country	Italy
Telephone	+39 039 220 12 01
Facsimile	+39 039 220 12 21
Website	www.nemko.com
Site number	FCC: 682159; IC: 9109A

Tested by	P. Barbieri
Test engineer signature	Firmato digitalmente da Barbieri Paolo
Reviewed by	O. Frau
Reviewer signature	Firmato digitalmente da Frau Oscar

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 S.p.A. ISO/IEC 17025 accreditation.

Copyright notification

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Section 1. Report summary

1.1 Applicant and manufacturer

Company name	TEXA S.p.A.
Address	Via 1 Maggio, 9
City	Monastier di Treviso
Province/State	Treviso
Postal/Zip code	31050
Country	Italy

1.2 Test specifications

FCC 47 CFR Part 15, Subpart C Clause 15.247	Operation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–585 MHz
RSS-247, Issue 3, August 2023, Section 5	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices. Standard specifications for frequency hopping systems and digital transmission systems operating in the bands 902 928 MHz, 2400-2483.5 MHz and 5725-5850 MHz
RSS-Gen, Issue 5, April 2018, Amendment 1 (March 2019), Amendment 2 (February 2021)	General Requirements for Compliance of Radio Apparatus

1.3 Test methods

558074 D01 DTS Meas Guidance v05r02 (April 2, 2019)	Guidance for compliance measurements on digital transmission system, frequency hopping spread spectrum system, and hybrid system devices operating under section 15.247 of the FCC rules
662911 D01 Multiple Transmitter Output v02r01 (October 31, 2013)	Emissions Testing of Transmitters with Multiple Outputs in the Same Band
DA 00-705, Released March 30, 2000	Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems
ANSI C63.10 v2020	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

1.4 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was completed against all relevant requirements of the test standard. 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 Exclusions

None

1.6 Test report revision history

Revision #	Details of changes made to test report
REP072051	Original report issued

Section 2. Summary of test results

2.1 FCC Part 15 Subpart C, general requirements test results

Part	Test description	Verdict
§15.31(e)	Variation of power source	Pass[1]
§15.203	Antenna requirement	Pass[2]
§15.207(a)	Conducted limits	Not applicable[3]

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.

[3] The EUT is supplied by a vehicle battery

2.2 FCC Part 15 Subpart C, intentional radiators test results

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	Pass
§15.247(a)(2)	Minimum 6 dB bandwidth for systems using digital modulation techniques	Not applicable
§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	Pass
§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	Not applicable
§15.247(c)(1)	Fixed point-to-point operation with directional antenna gains greater than 6 dBi	Not applicable
§15.247(c)(2)	Transmitters operating in the 2400–2483.5 MHz band that emit multiple directional beams	Not applicable
§15.247(d)	Spurious emissions	Pass
§15.247(e)	Power spectral density for digitally modulated devices	Not applicable
§15.247(f)	Time of occupancy for hybrid systems	Not applicable

2.3 ISED RSS-GEN, Issue 5, test results

Part	Test description	Verdict
7.3	Receiver radiated emission limits	Not applicable[1]
7.4	Receiver conducted emission limits	Not applicable[1]
8.8	AC power line conducted emissions limits	Not applicable[2]

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.

[2] The EUT is supplied by a vehicle battery

2.4 ISED RSS-247, Issue 3, test results

Part	Test description	Verdict
5.1	Frequency Hopping Systems (FHSs)	
5.1 (a)	Bandwidth of a frequency hopping channel	Pass
5.1 (b)	Minimum channel spacing for frequency hopping systems	Pass
5.1 (c)	Frequency hopping systems operating in the 902–928 MHz band	Not applicable
5.1 (d)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Pass
5.1 (e)	Frequency hopping systems operating in the 5725–5850 MHz band	Not applicable
5.2	Digital Transmission Systems (DTSs)	
5.2 (a)	Minimum 6 dB bandwidth	Not applicable
5.2 (b)	Maximum power spectral density	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)	Frequency hopping systems operating in the 902–928 MHz band	Not applicable
5.4 (b)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Pass
5.4 (c)	Frequency hopping systems operating in the 5725–5850 MHz	Not applicable
5.4 (d)	Systems employing digital modulation techniques	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	Pass

Note: None

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	November 22, 2024
Nemko sample ID number	PRJ00696000003

3.2 EUT information

Product name	Diagnostic Black Box
Model	NAVIGATOR TXB 1
Model variant	n/a
Serial number	DNZAT000018

3.3 Technical information

Frequency band	2400–2483.5 MHz
Frequency Min (MHz)	2402.0 MHz
Frequency Max (MHz)	2480.0 MHz
RF power Max (W), EIRP	0.000076 W (-11.2 dBm)
Field strength, Units @ distance	N/A
Measured BW (kHz) (20 dB)	1380 kHz
Measured BW (kHz) (99%)	1159 kHz
Type of modulation	GFSK, π/4-DQPSK, and 8-DPSK
Emission classification (F1D, G1D, D1D)	W7D
Transmitter spurious, dBµV/m @ 3 m	50.6 dBµV/m (@ 4804 MHz, 8-DPSK modulation)
Power requirements	12 / 24 V DC
Antenna information	The EUT uses a unique antenna coupling/ non-detachable antenna to the intentional radiator.

3.4 Product description and theory of operation

The EUT is a vehicle diagnosis interface device.

3.5 EUT exercise details

The EUT was supplied by the vehicle battery and set up to transmit at full power. It was controlled and channels selected using a proprietary test software provided by client:

```
*******************************************
*           BT TEST TXB1 TEXA             *
*        (use K line 115200bps)           *
*******************************************

Type the COM port number. Press ENTER to confirm
COM port number: 37


** TEST SELECTION **

1. Continuous Transmission Test
2. Continuous Reception Test
3. LE Continuous Transmission Test
4. LE Continuous Reception Test
5. LE Set TX Power (only cypress)
e. Exit

Select the approval test to perform (Press ENTER to confirm, press 'e' to exit)
***     BT DEVICE ADDRESS

Set the BT device address: 11:22:33:44:55:66

***     HOPPING MODE

0 -> 79 channel
1 -> single frequency
2 -> fixed pattern

Set Hopping Mode: 1

***     FREQUENCY

Single Frequency has been selected, Set Frequency: 1
```

```
***     LOGICAL CHANNEL

0 -> ACL EDR
1 -> ACL Basic
2 -> eSCO EDR
3 -> eSCO Basic
4 -> SCO Basic

Logical Channel: 0

***     BB Packet Type

0 -> NULL
1 -> POLL
2 -> FHS
3 -> DM1
4 -> DH1 / 2-DH1
5 -> HV1
6 -> HV2 / 2-EV3
7 -> HV3 / EV3 / 3-EV3
8 -> DV / 3-DH1
9 -> AUX1 / PS
A -> DM3 / 2-DH3
B -> DH3 / 3-DH3
C -> EV4 / 2-EV5
D -> EV5 / 3-EV5
E -> DM5 / 2-DH5
F -> DH5 / 3-DH5

Set BB Packet Type: F

***     BB Packet Length

BB Packet Length (1 - 65535):65535

***     TX Power Level

0 -> 0 dBm
1 -> -4 dBm
2 -> -8 dBm
```

3.6 EUT setup diagram

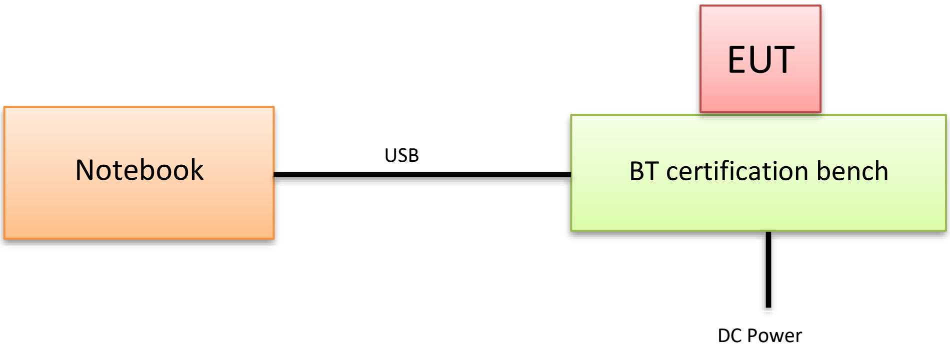


Figure 3.6-1: *Setup diagram*

3.7 EUT sub assemblies

Table 3.7-1: *EUT sub assemblies*

Description	Brand name	Model/Part number	Serial number
Notebook	HP	PROBOOK 450 G2	--
Test bench	TEXA	BT certification bench	--

Section 4. Engineering considerations

4.1 Modifications incorporated in the EUT

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

4.2 Technical judgment

None

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 5. Test conditions

5.1 Atmospheric conditions

Temperature	18–33 °C
Relative humidity	20–70 %
Air pressure	860–1060 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 cycle	Next cal.
Thermo-hygrometer	Testo	175-H2	20012380/305	2022-12	2024-12
Thermo-hygrometer	Testo	175-H2	38203337/703	2022-12	2024-12
Barometer	Castle	GPB 3300	072015	2024-04	2025-04

5.2 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 6. Measurement uncertainty

6.1 Uncertainty of measurement

The measurement uncertainty was calculated for each test and quantity listed in this test report, according to CISPR 16-4-2, ETSI TR 100 028-1, ETSI TR 100 028-2 and other specific test standards and is documented in Nemko Spa working manuals WML1002 and WML0078.

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 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	2024-01	2025-01
EMI Receiver	Rohde & Schwarz	ESU8	100202	2024-09	2025-09
EMI Receiver	Rohde & Schwarz	ESW44	101620	2024-08	2025-08
RF Vector Signal Generator	Rohde & Schwarz	SMBV100A	263254	2024-05	2025-05
RF Vector Signal Generator	Rohde & Schwarz	SMBV100A	263397	2024-09	2025-09
Climatic Chamber	MSL	EC500DA	15022	2024-01	2025-01
Antenna Trilog 25MHz - 8GHz	Schwarzbeck Mess-Elektronik	VULB9162	9162-025	2024-07	2027-07
Antenna 1 - 18 GHz	Schwarzbeck Mess-Elektronik	STLP9148	STLP 9148-152	2024-09	2027-09
Double Ridge Horn Antenna	RFSpin	DRH40	061106A40	2023-04	2026-04
Broadband Amplifier	Schwarzbeck Mess-Elektronik	BBV9718C	00121	2024-01	2025-01
Broadband Bench Top Amplifier	Sage	STB-1834034030-KFKF-L1	18490-01	2024-04	2025-04
Semi-anechoic chamber	Nemko S.p.a.	10m semi-anechoic chamber	530	2023-09	2025-09
Semi-anechoic chamber	Comtest	3m SAC	1711-150	2024-09	2026-09
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
Controller	Maturo	FCU3.0	10237	NCR	NCR
Tilt antenna mast	Maturo	TAM4.0-E	3466.01	NCR	NCR
Turntable	Maturo	TT4.0	-	NCR	NCR
Pyramidal Horn Antenna 40-60 GHz	Sage	SAR-2507-19VF-R2	15715-01	2024-06	2027-06
Harmonic Mixer	Radiometer Physics	FS-Z60	100988	2024-01	2027-01
Cable set	Rosenberger	ST.ALO-02	1.650	2024-10	2025-10
Cable set	Rosenberger and Huber + Suhner	RE01+RE02	1.654+1.655	2024-09	2025-09
Cable set	Rosenberger+Huber-Suhner	RE03+RE04	1.510+1.511	2024-09	2025-09

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

Section 8. Testing data

8.1 FCC 15.31(e) Variation of power source

8.1.1 Definitions and limits

FCC §15.31(e):

For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

8.1.2 Test summary

Test date	December 2, 2024	Verdict	Pass
Test engineer	P. Barbieri	Sample tested	DNZAT000018

8.1.3 Observations, settings and special notes

The testing was performed as per ANSI C63.10 Section 5.13.

a) Where the device is intended to be powered from an external power adapter, the voltage variations shall be applied to the input of the adapter provided with the device at the time of sale. If the device is not marketed or sold with a specific adapter, then a typical power adapter shall be used.

b) For devices, where operating at a supply voltage deviating ±15% from the nominal rated value may cause damages or loss of intended function, test to minimum and maximum allowable voltage per manufacturer's specification and document in the report.

c) For devices with wide range of rated supply voltage, test at 15% below the lowest and 15% above the highest declared nominal rated supply voltage.

d) For devices obtaining power from an input/output (I/O) port (USB, firewire, etc.), a test jig is necessary to apply voltage variation to the device from a support power supply, while maintaining the functionalities of the device.

e) For battery-operated equipment, the equipment tests shall be performed using a variable power supply.

8.1.4 Test data

EUT Power requirements:	☐ AC	☒ DC	☐ Battery
If EUT is an AC or a DC powered, was the noticeable output power variation observed?	☐ YES	☒ NO	☐ N/A
If EUT is battery operated, was the testing performed using fresh batteries?	☐ YES	☐ NO	☒ N/A
If EUT is rechargeable battery operated, was the testing performed using fully charged batteries?	☐ YES	☐ NO	☒ N/A

8.2 FCC 15.31(m) and RSS-Gen §6.9 Number of frequencies

8.2.1 Definitions and limits

FCC §15.31(m):
Measurements on intentional radiators or receivers shall be performed and, if required, reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in the following table.

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 8.2-1: *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.

8.2.2 Test summary

Test date	December 2, 2024	Verdict	Pass
Test engineer	P. Barbieri	Sample tested	DNZAT000018

8.2.3 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.

8.2.1 Test data

Table 8.2-2: *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	2441	2480

8.3 FCC 15.203 and RSS-Gen §6.8 Antenna requirement

8.3.1 Definitions and limits

FCC §15.203:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

FCC §15.247:

(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:

(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

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.

8.3.2 Test summary

Test date	December 2, 2024	Verdict	Pass
Test engineer	P. Barbieri	Sample tested	DNZAT000018

8.3.3 Observations, settings and special notes

None

8.3.4 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 8.3-1: *Antenna information*

Antenna type	Manufacturer	Model	Connector type	Maximum gain
Integral PCB Ceramic Monopole Antenna	Ethertronics	M310221	n/a	1.7 dBi

8.4 FCC 15.247(a)(1) and RSS-247 5.1 Frequency Hopping Systems requirements

8.4.1 Definitions and limits

FCC:

(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

(iii) Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

ISED:

a) The bandwidth of a frequency hopping channel is the 20 dB emission bandwidth, measured with the hopping stopped. The system's radio frequency (RF) bandwidth is equal to the channel bandwidth multiplied by the number of channels in the hopset. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

b) FHSs shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, FHSs operating in the band 2400–2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided that the systems operate with an output power no greater than 0.125 W.

d) FHSs operating in the band 2400–2483.5 MHz shall use at least 15 hopping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds, multiplied by the number of hopping channels employed. Transmissions on particular hopping frequencies may be avoided or suppressed provided that at least 15 hopping channels are used.

8.4.2 Test summary

Test date	December 6, 2024	Verdict	Pass
Test engineer	P. Barbieri	Sample tested	DNZAT000018

8.4.3 Observations, settings and special notes

Spectrum analyser settings for carrier frequency separation:

Resolution bandwidth	Approximately 30% of the channel spacing
Video bandwidth	≥ RBW
Frequency span	Wide enough to capture the peaks of two adjacent channels
Detector mode	Peak
Trace mode	Max Hold

Spectrum analyser settings for number of hopping frequencies:

Resolution bandwidth	30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
Video bandwidth	≥ RBW
Frequency span	The frequency band of operation
Detector mode	Peak
Trace mode	Max Hold

Spectrum analyser settings for time of occupancy (dwell time):

Resolution bandwidth	1 MHz
Video bandwidth	≥ RBW
Frequency span	Zero span
Detector mode	Peak
Trace mode	Max Hold

Spectrum analyser settings for 20 dB bandwidth:

Resolution bandwidth	≥ 1% of the 20 dB bandwidth
Video bandwidth	≥ RBW
Frequency span	Approximately 2 to 5 times the 20 dB bandwidth, centered on a hopping channel
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
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	Comtest	3m SAC	1711-150
Cable set	Rosenberger and Huber + Suhner	RE01+RE02	1.654+1.655
Software turntable and mast	Maturo	mcApp	8.1.0.5410

8.4.5 Test data

Table 8.4-1: *20 dB bandwidth results*

Frequency, MHz	Modulation	20 dB bandwidth, MHz
2402	GFSK	1.15
2441	GFSK	1.16
2480	GFSK	1.14
2402	π/4-DQPSK	1.36
2441	π/4-DQPSK	1.37
2480	π/4-DQPSK	1.37
2402	8-DPSK	1.38
2441	8-DPSK	1.38
2480	8-DPSK	1.37

Table 8.4-2: *99% occupied bandwidth results*

Frequency, MHz	Modulation	99% occupied bandwidth, MHz
2402	GFSK	0.935
2441	GFSK	0.936
2480	GFSK	0.935
2402	π/4-DQPSK	1.154
2441	π/4-DQPSK	1.155
2480	π/4-DQPSK	1.158
2402	8-DPSK	1.159
2441	8-DPSK	1.158
2480	8-DPSK	1.157

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

Table 8.4-3: *Carrier frequency separation results*

Carrier frequency separation, kHz	Minimum limit, kHz	Margin, kHz
1003.5	920.0	-83.5

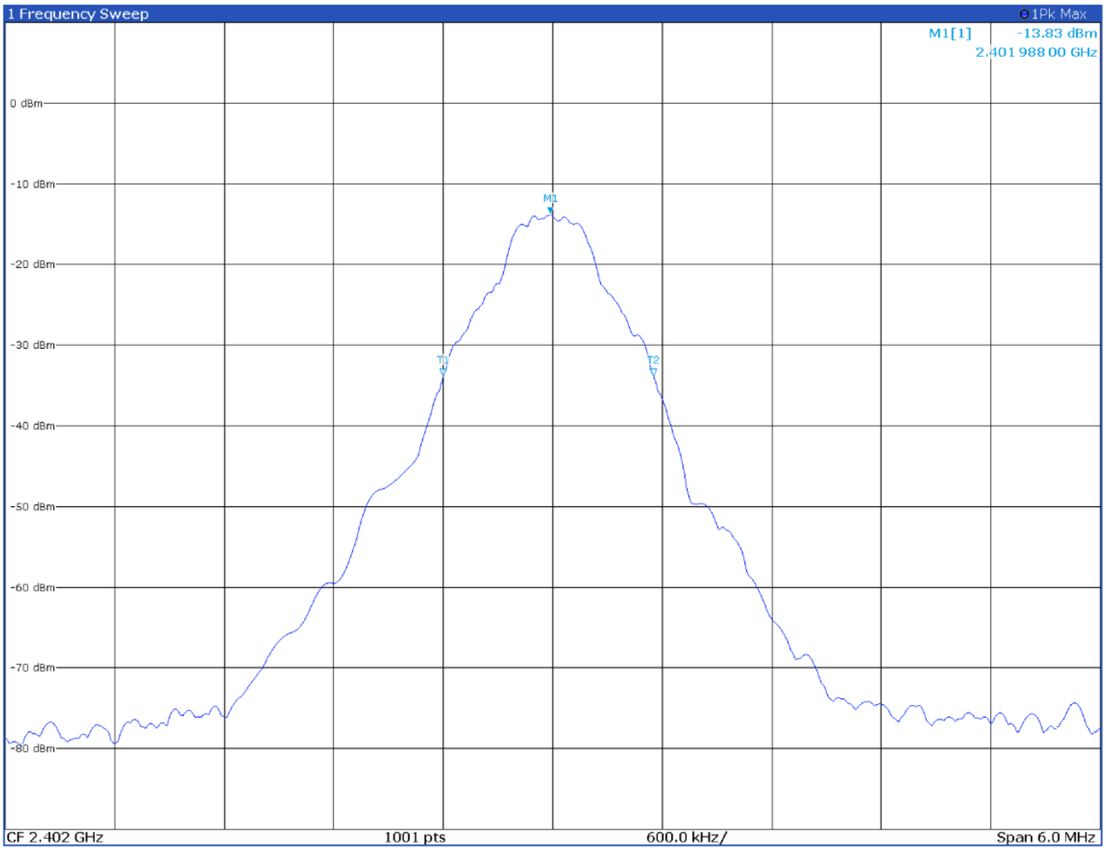
Table 8.4-4: Number of hopping frequencies results

Number of hopping frequencies	Minimum limit	Margin
79	15	-64

Table 8.4-5: Average time of occupancy results

Modulation	Dwell time of each pulse, ms	Number of pulses within period	Total dwell time within period, ms	Limit, ms	Margin, ms
GFSK	0.380	218	82.84	400	-317.16
π/4-DQPSK	2.890	99	286.11	400	-113.89
8-DPSK	2.890	99	286.11	400	-113.89

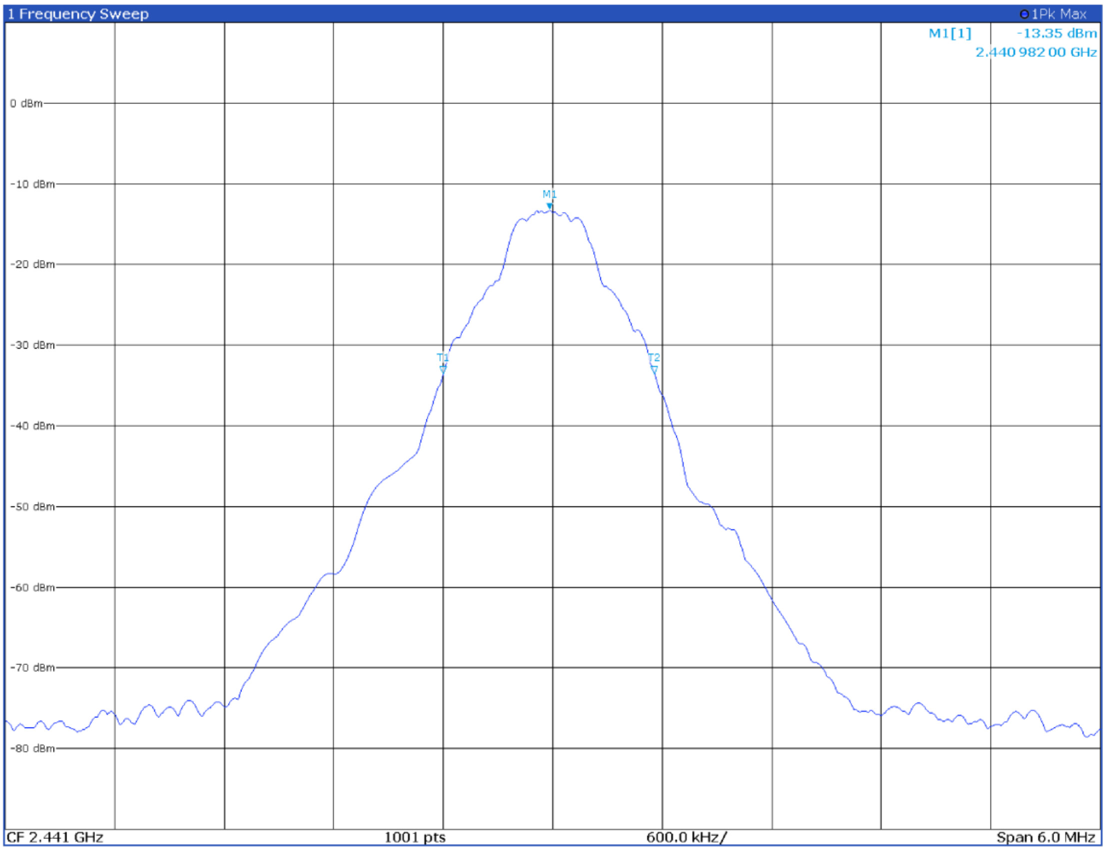
Measurement Period is 31.6 s



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**2.401 988 GHz**	**-13.83 dBm**	ndB	20.0 dB
T1		1	2.401 400 6 GHz	-33.86 dBm	ndB down BW	**1.15 MHz**
T2		1	2.402 551 4 GHz	-33.84 dBm	Q Factor	2087.1

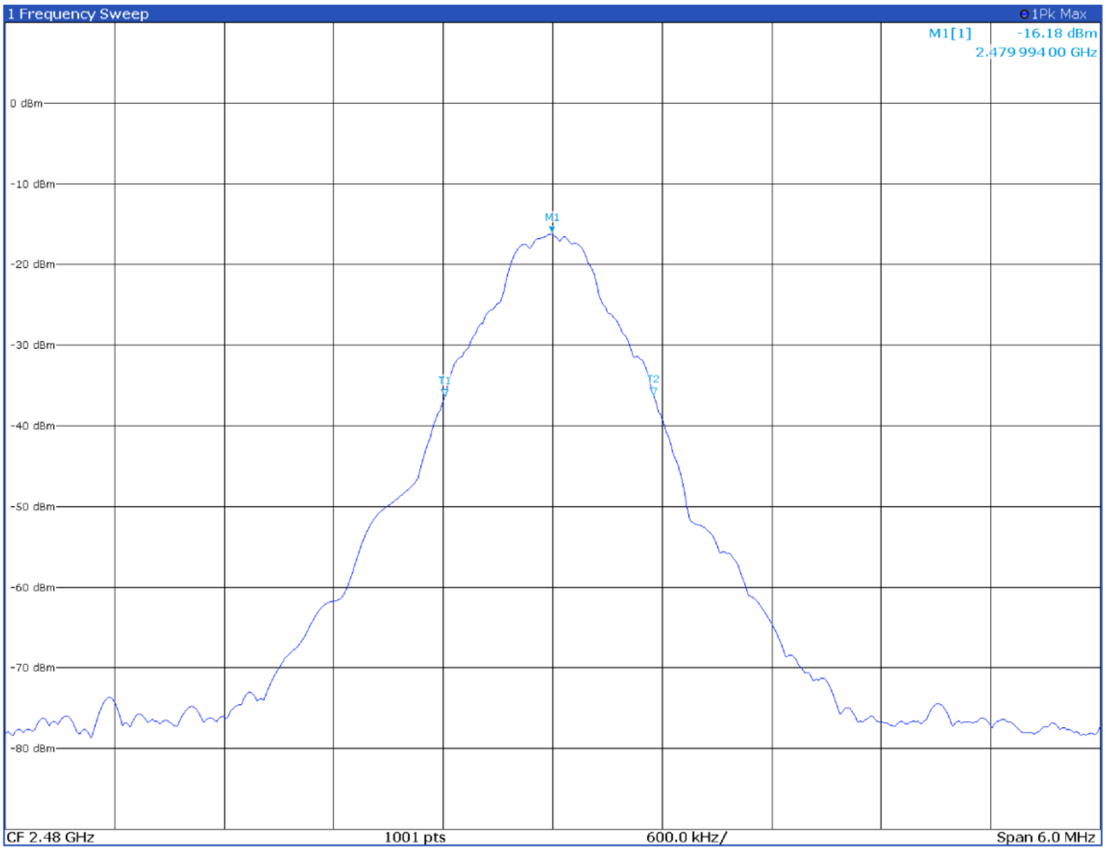
Figure 8.4-1: *20 dB bandwidth on low channel with GFSK modulation*



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**2.440 982 GHz**	**-13.35 dBm**	ndB	20.0 dB
T1		1	2.440 400 6 GHz	-33.55 dBm	ndB down BW	**1.16 MHz**
T2		1	2.441 557 4 GHz	-33.52 dBm	Q Factor	2 110.0

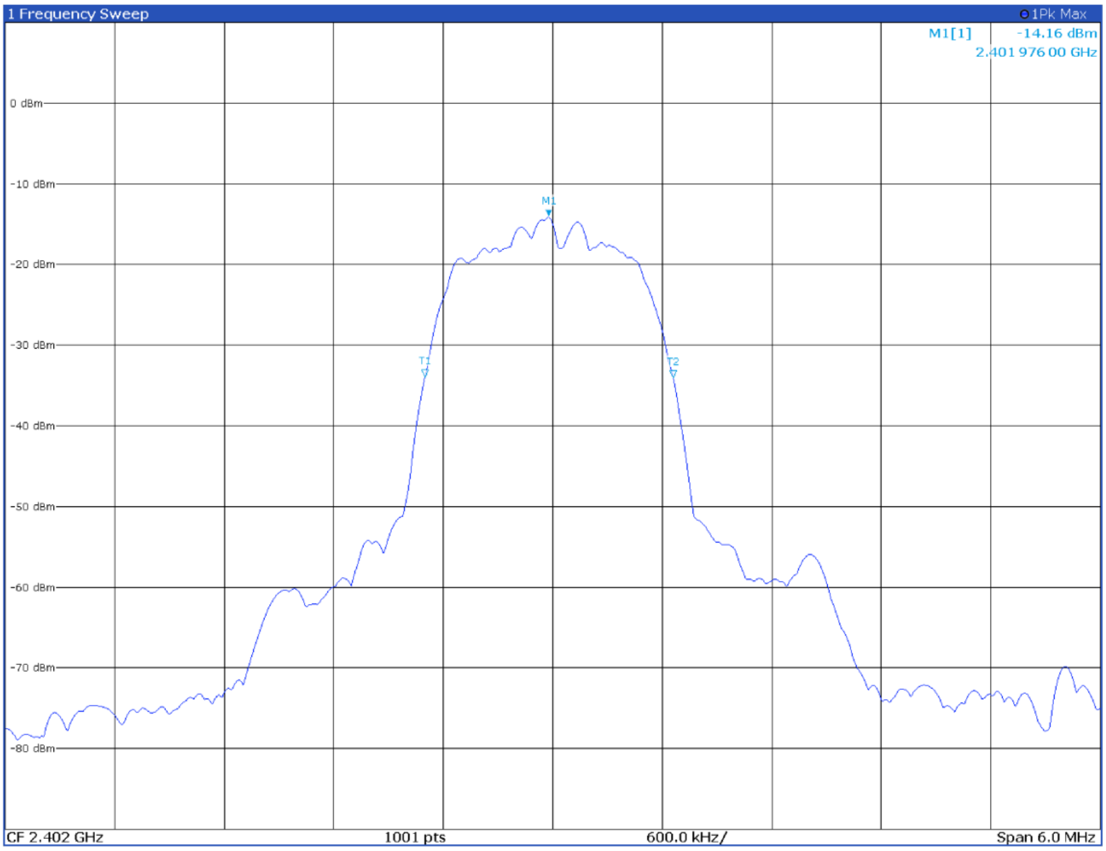
Figure 8.4-2: *20 dB bandwidth on mid channel with GFSK modulation*



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**2.479 994 GHz**	**-16.18 dBm**	ndB	20.0 dB
T1		1	2.479 406 6 GHz	-36.42 dBm	ndB down BW	**1.14 MHz**
T2		1	2.480 551 4 GHz	-36.20 dBm	Q Factor	2166.2

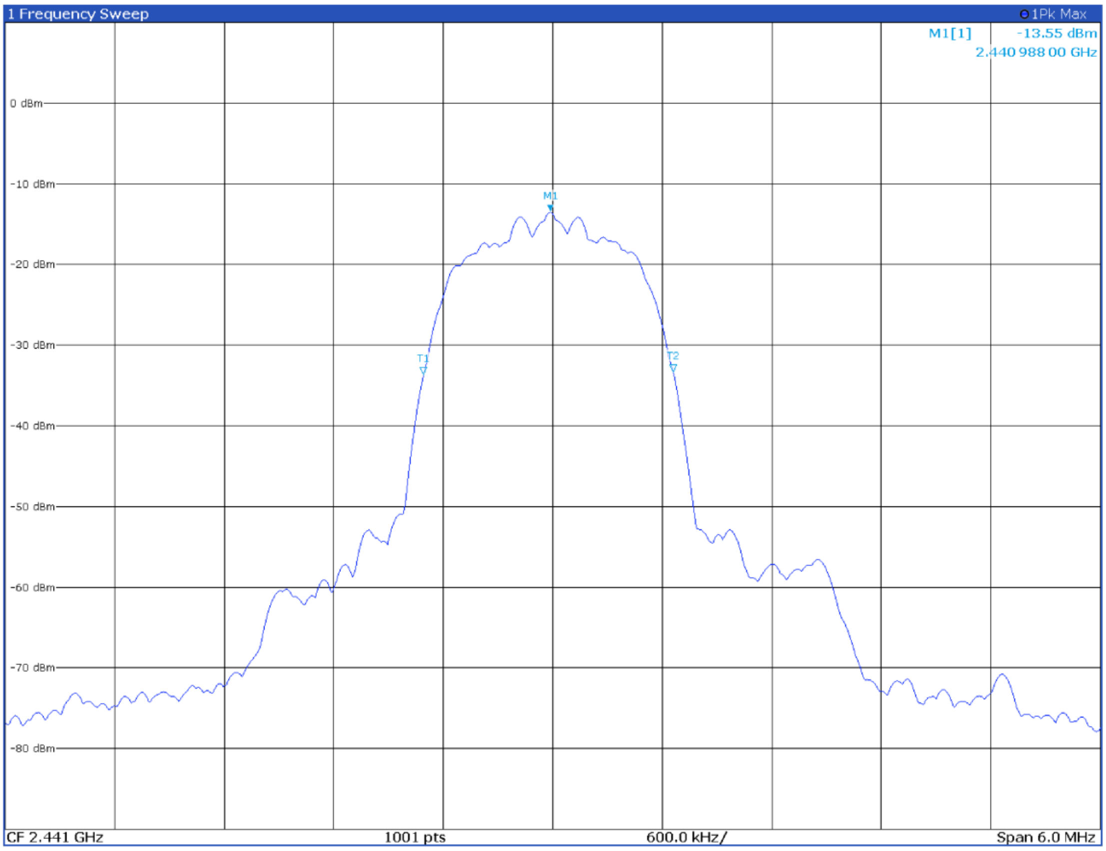
Figure 8.4-3: *20 dB bandwidth on high channel with GFSK modulation*



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**2.401 976 GHz**	**-14.16 dBm**	ndB	20.0 dB
T1		1	2.401 298 7 GHz	-34.01 dBm	ndB down BW	**1.36 MHz**
T2		1	2.402 659 3 GHz	-34.04 dBm	Q Factor	1 765.3

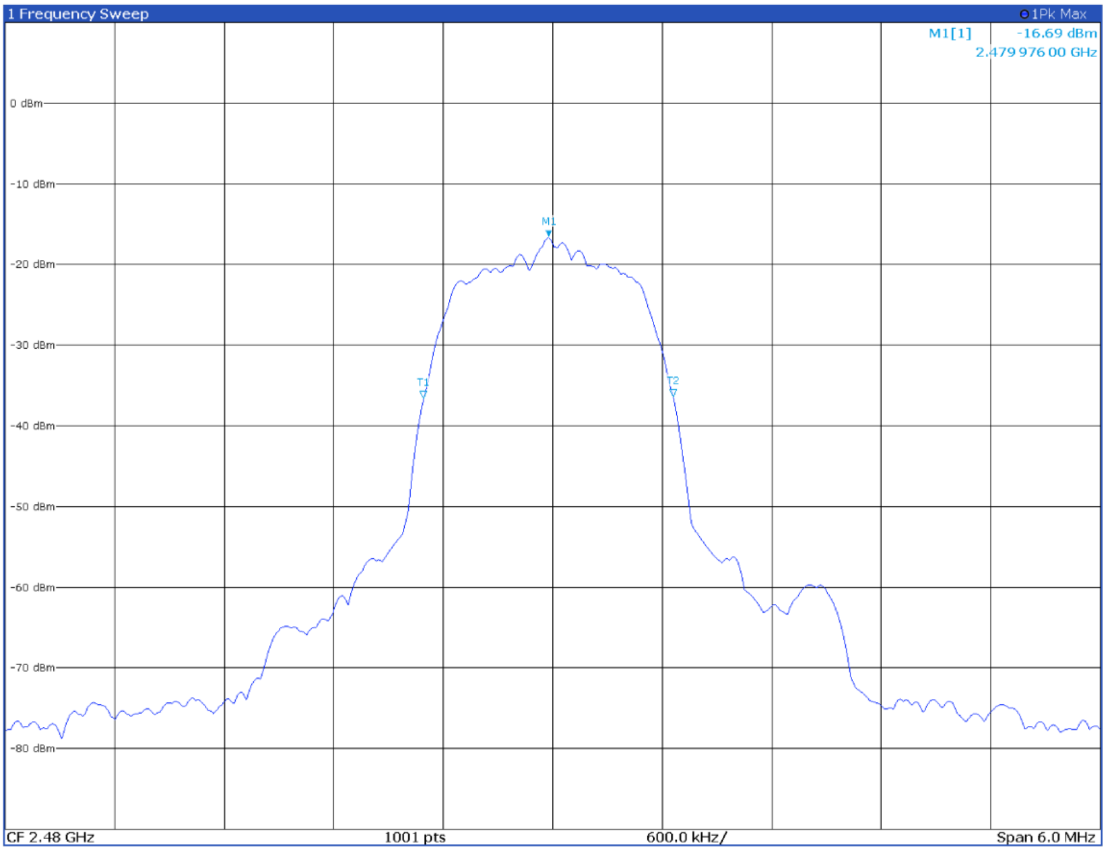
Figure 8.4-4: *20 dB bandwidth on low channel with π/4-DQPSK modulation*



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**2.440 988 GHz**	**-13.55 dBm**	ndB	20.0 dB
T1		1	2.440 292 7 GHz	-33.62 dBm	ndB down BW	**1.37 MHz**
T2		1	2.441 659 3 GHz	-33.32 dBm	Q Factor	1 786.1

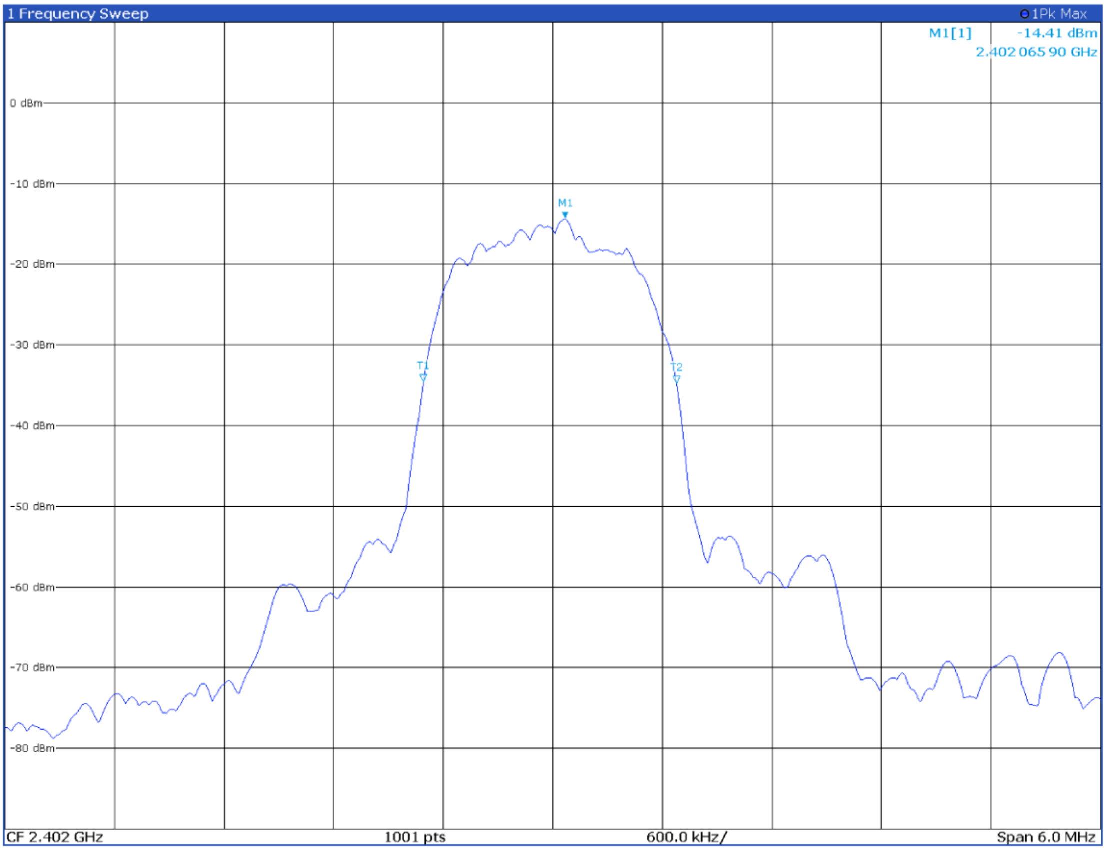
Figure 8.4-5: *20 dB bandwidth on mid channel with π/4-DQPSK modulation*



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**2.479 976 GHz**	**-16.69 dBm**	ndB	20.0 dB
T1		1	2.479 292 7 GHz	-36.64 dBm	ndB down BW	**1.37 MHz**
T2		1	2.480 659 3 GHz	-36.43 dBm	Q Factor	1 814.7

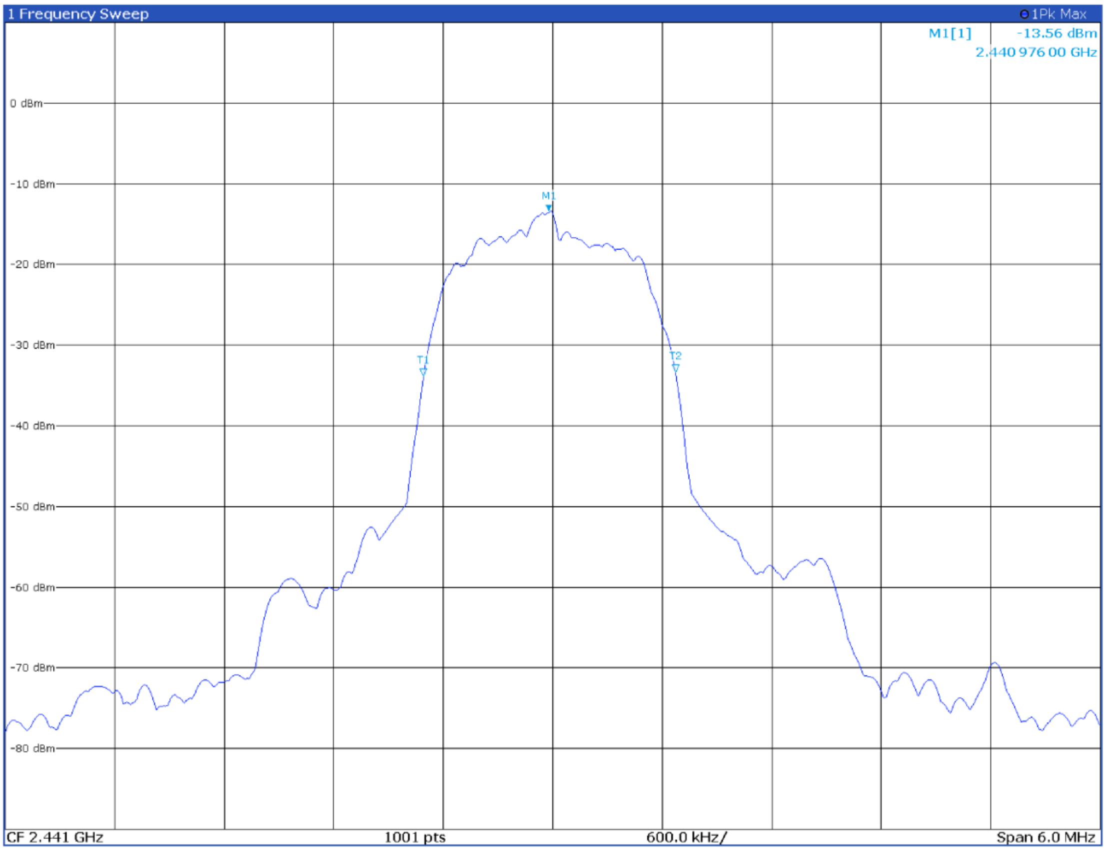
Figure 8.4-6: *20 dB bandwidth on high channel with π/4-DQPSK modulation*



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**2.402 065 9 GHz**	**-14.41 dBm**	ndB	20.0 dB
T1		1	2.401 292 7 GHz	-34.55 dBm	ndB down BW	**1.38 MHz**
T2		1	2.402 677 3 GHz	-34.79 dBm	Q Factor	1 734.8

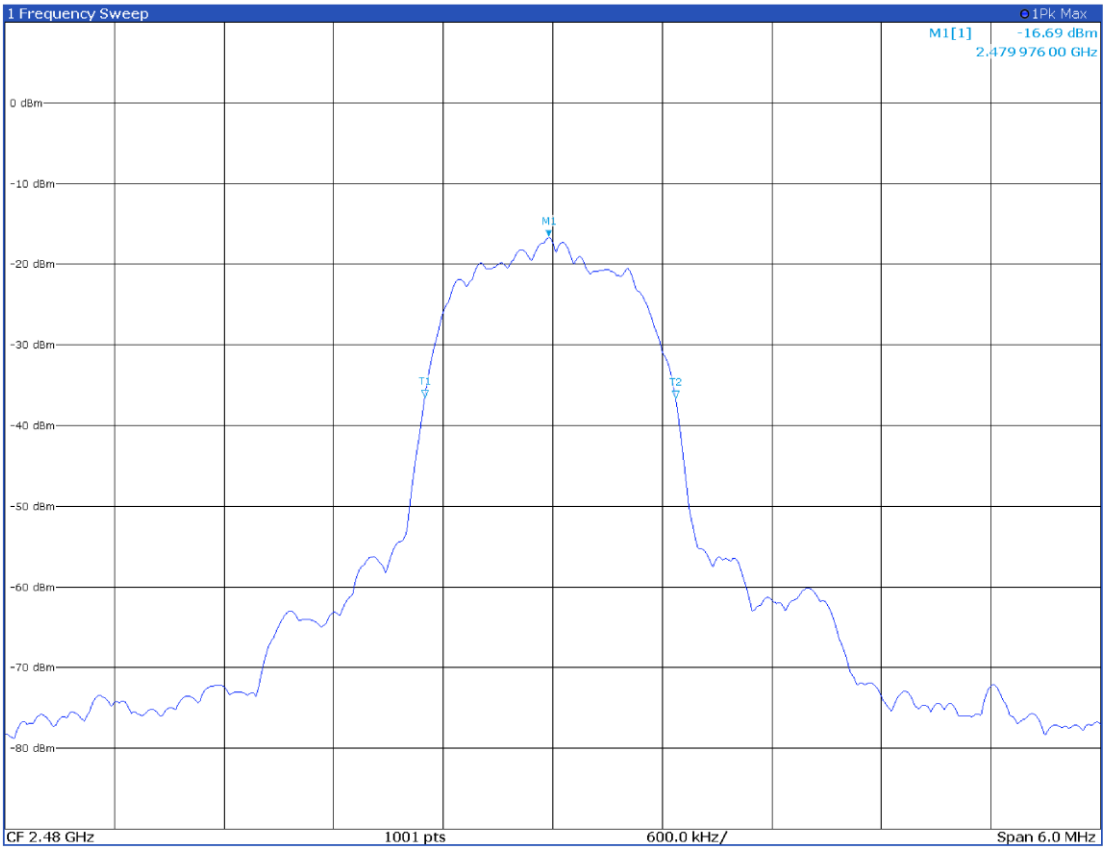
Figure 8.4-7: *20 dB bandwidth on low channel with 8-DPSK modulation*



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**2.440 976 GHz**	**-13.56 dBm**	ndB	20.0 dB
T1		1	2.440 292 7 GHz	-33.83 dBm	ndB down BW	**1.38 MHz**
T2		1	2.441 671 3 GHz	-33.37 dBm	Q Factor	1 770.6

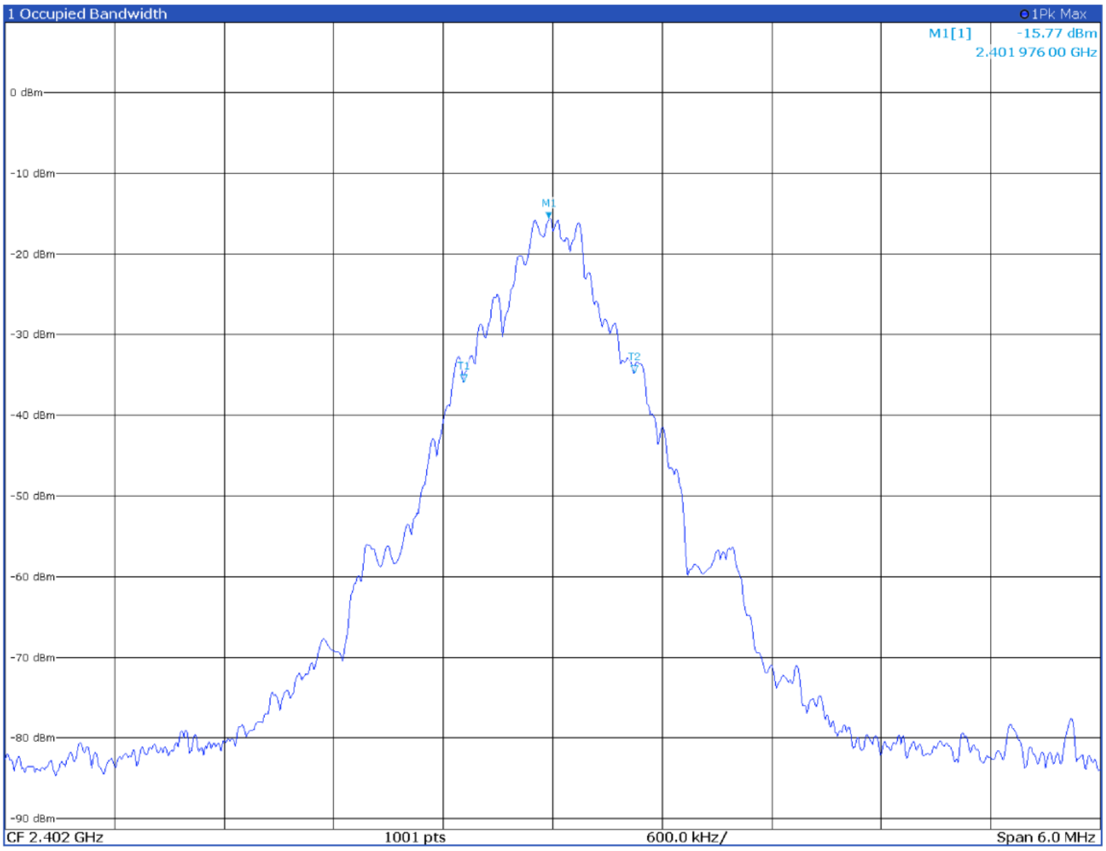
Figure 8.4-8: *20 dB bandwidth on mid channel with 8-DPSKmodulation*



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**2.479 976 GHz**	**-16.69 dBm**	ndB	20.0 dB
T1		1	2.479 298 7 GHz	-36.57 dBm	ndB down BW	**1.37 MHz**
T2		1	2.480 671 3 GHz	-36.59 dBm	Q Factor	1 806.7

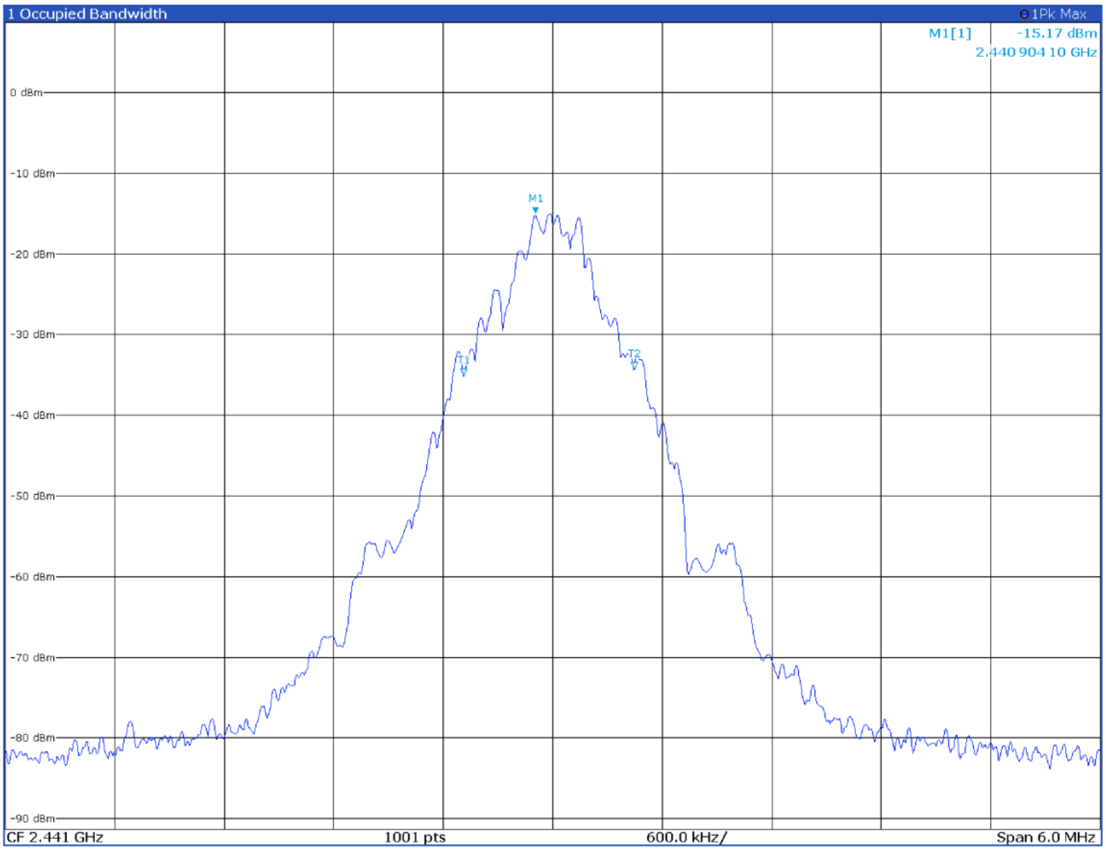
Figure 8.4-9: *20 dB bandwidth on high channel with 8-DPSK modulation*



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**2.401 976 GHz**	**-15.77 dBm**	Occ Bw	**935.400 703 594 kHz**
T1		1	2.401 511 05 GHz	-35.91 dBm	Occ Bw Centroid	2.401 978 75 GHz
T2		1	2.402 446 45 GHz	-34.72 dBm	Occ Bw Freq Offset	-21.249 678 808 kHz

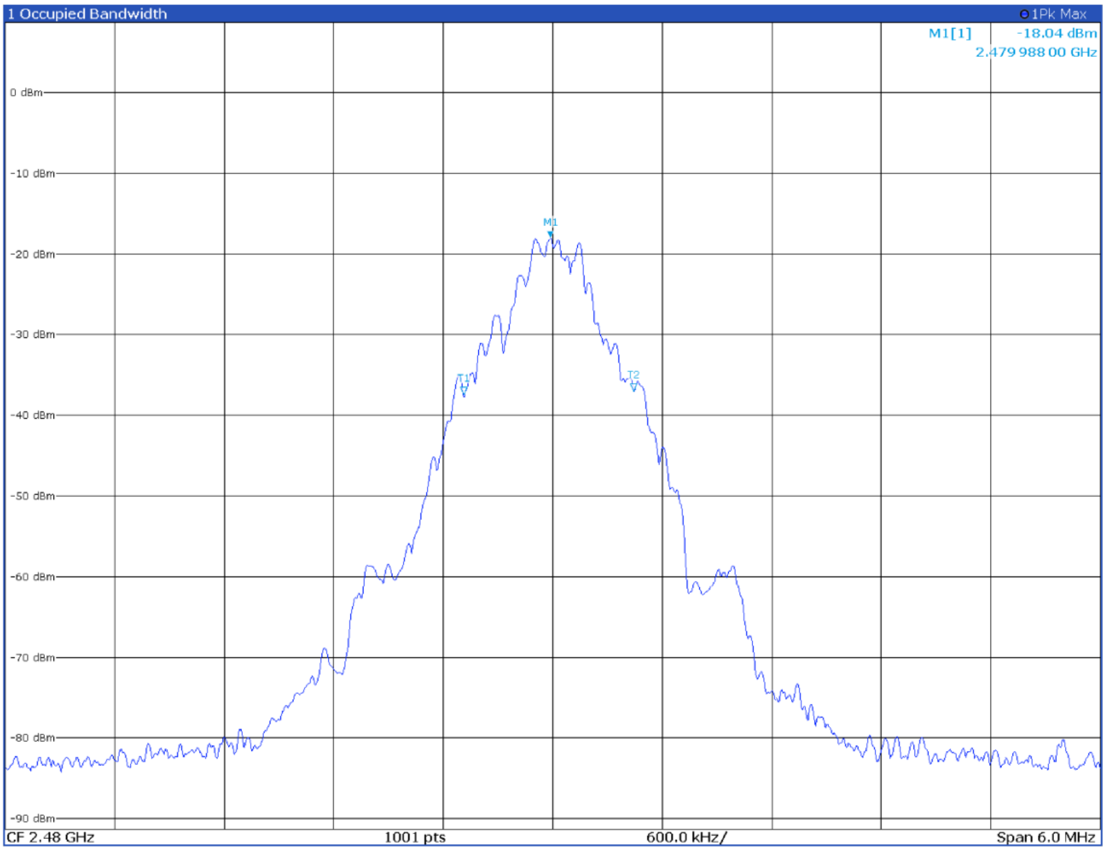
Figure 8.4-10: *99% bandwidth on low channel with GFSK modulation*



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**2.440 904 1 GHz**	**-15.17 dBm**	Occ Bw	**935.599 890 931 kHz**
T1		1	2.440 510 87 GHz	-35.12 dBm	Occ Bw Centroid	2.440 978 668 GHz
T2		1	2.441 446 47 GHz	-34.31 dBm	Occ Bw Freq Offset	-21.331 517 965 kHz

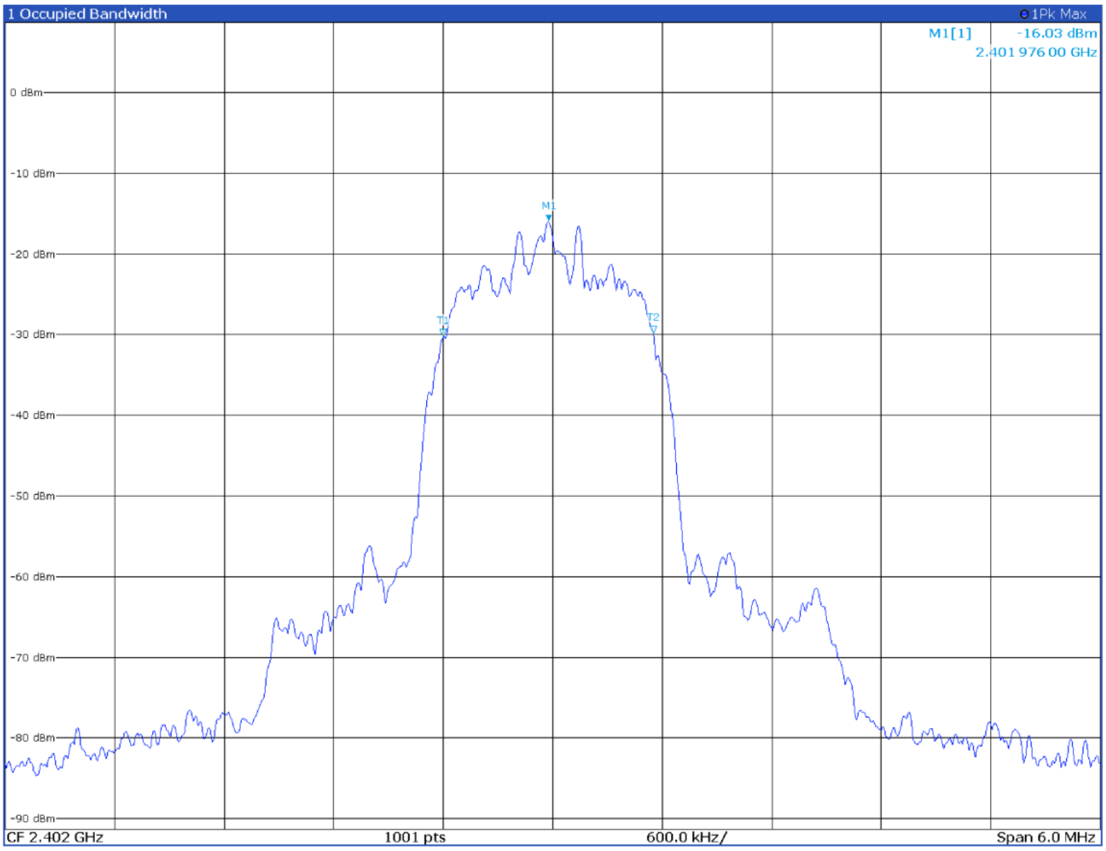
Figure 8.4-11: *99% bandwidth on mid channel with GFSK modulation*



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**2.479 988 GHz**	**-18.04 dBm**	Occ Bw	**935.009 884 873 kHz**
T1		1	2.479 509 94 GHz	-37.42 dBm	Occ Bw Centroid	2.479 977 449 GHz
T2		1	2.480 444 95 GHz	-37.00 dBm	Occ Bw Freq Offset	-22.551 312 581 kHz

Figure 8.4-12: *99% bandwidth on high channel with GFSK modulation*

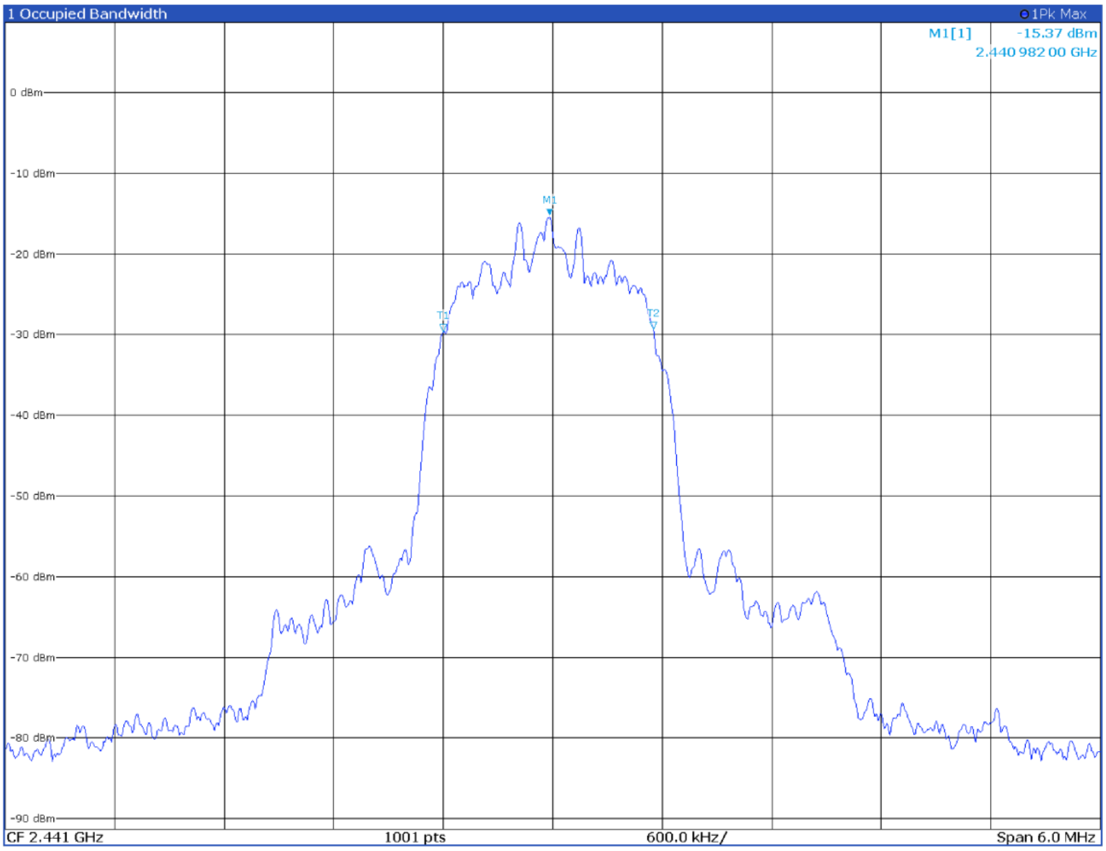


2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**2.401 976 GHz**	**-16.03 dBm**	Occ Bw	**1.154 175 506 MHz**
T1		1	2.401 398 87 GHz	-30.21 dBm	Occ Bw Centroid	2.401 975 96 GHz
T2		1	2.402 553 05 GHz	-29.87 dBm	Occ Bw Freq Offset	-24.039 766 067 kHz

Figure 8.4-13: *99% bandwidth on low channel with π/4-DQPSK modulation*

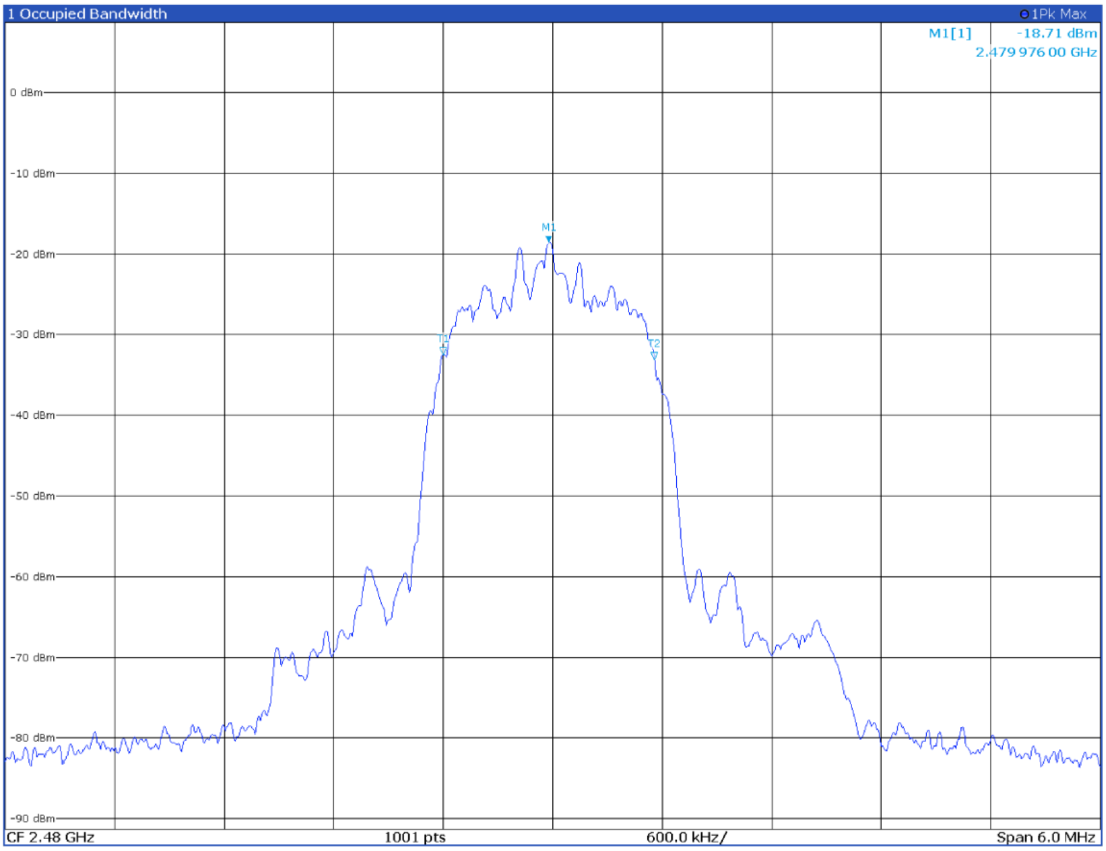
Test data, continued



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**2.440 982 GHz**	**-15.37 dBm**	Occ Bw	**1.154 789 347 MHz**
T1		1	2.440 398 44 GHz	-29.65 dBm	Occ Bw Centroid	2.440 975 833 GHz
T2		1	2.441 553 23 GHz	-29.30 dBm	Occ Bw Freq Offset	-24.167 076 99 kHz

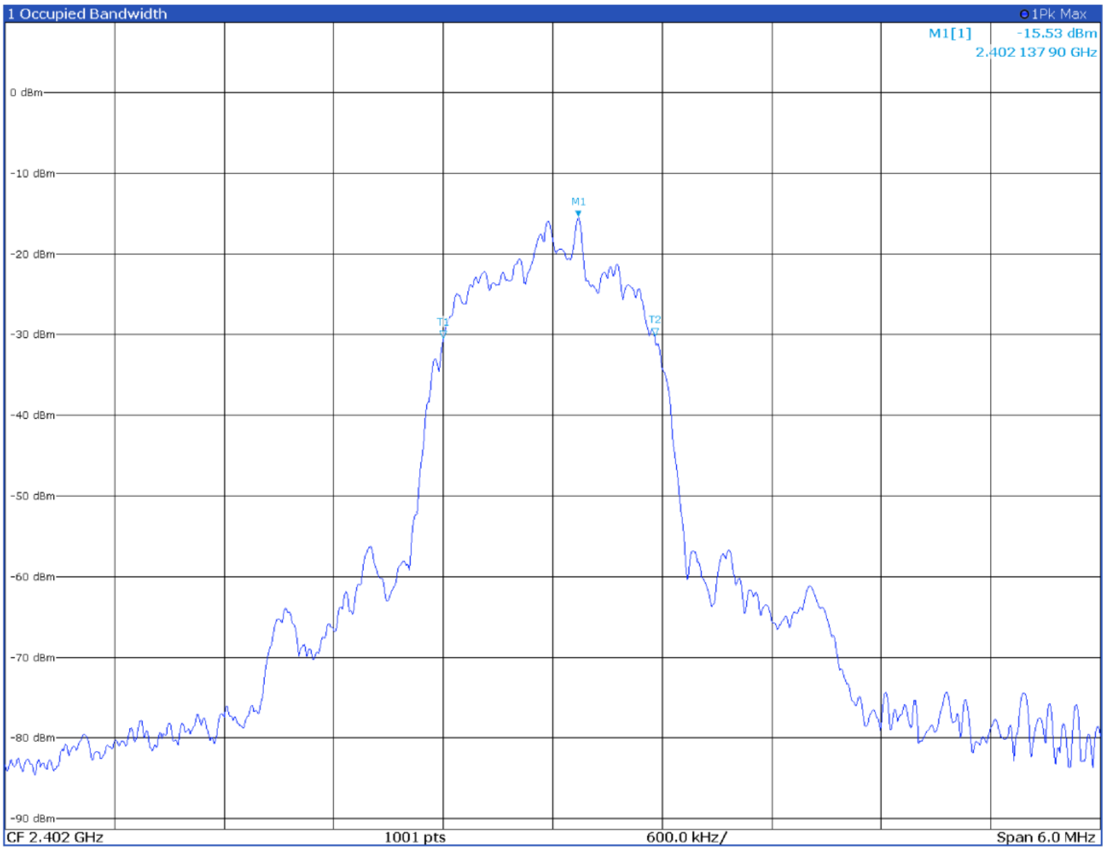
Figure 8.4-14: *99% bandwidth on mid channel with π/4-DQPSK modulation*



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**2.479 976 GHz**	**-18.71 dBm**	Occ Bw	**1.158 168 17 MHz**
T1		1	2.479 397 77 GHz	-32.50 dBm	Occ Bw Centroid	2.479 976 857 GHz
T2		1	2.480 555 94 GHz	-33.14 dBm	Occ Bw Freq Offset	-23.142 726 997 kHz

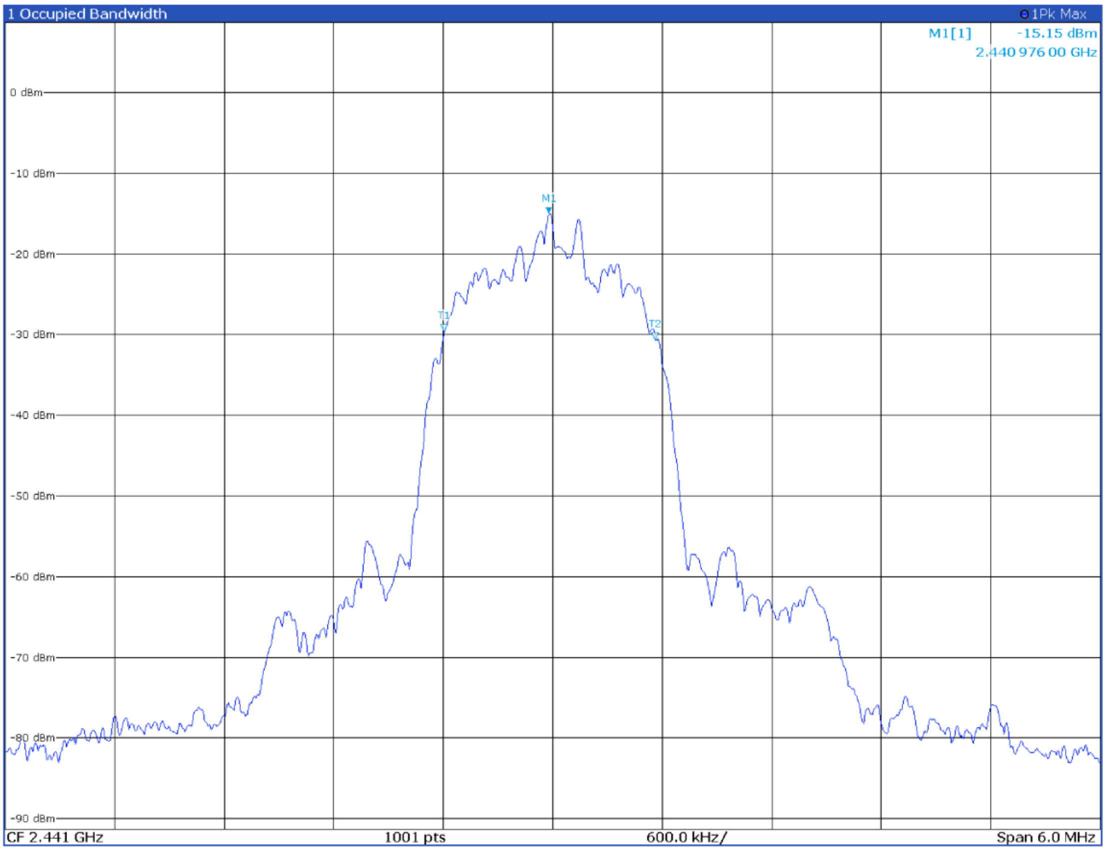
Figure 8.4-15: *99% bandwidth on high channel with π/4-DQPSK modulation*



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**2.402 137 9 GHz**	**-15.53 dBm**	Occ Bw	**1.159 120 658 MHz**
T1		1	2.401 401 07 GHz	-30.43 dBm	Occ Bw Centroid	2.401 980 633 GHz
T2		1	2.402 560 19 GHz	-30.20 dBm	Occ Bw Freq Offset	-19.367 396 108 kHz

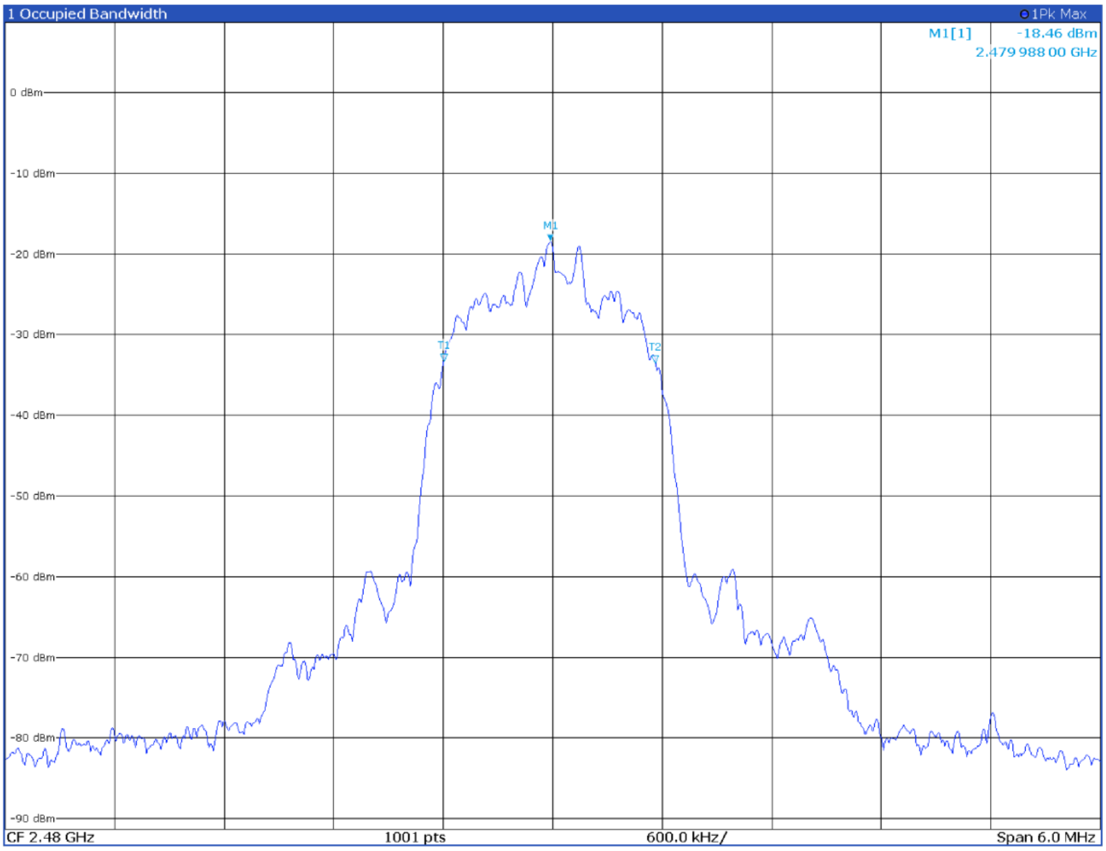
Figure 8.4-16: *99% bandwidth on low channel with 8-DPSK modulation*



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**2.440 976 GHz**	**-15.15 dBm**	Occ Bw	**1.158 199 904 MHz**
T1		1	2.440 403 78 GHz	-29.65 dBm	Occ Bw Centroid	2.440 982 882 GHz
T2		1	2.441 561 98 GHz	-30.67 dBm	Occ Bw Freq Offset	-17.118 328 961 kHz

Figure 8.4-17: *99% bandwidth on mid channel with 8-DPSKmodulation*



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**2.479 988 GHz**	**-18.46 dBm**	Occ Bw	**1.157 112 775 MHz**
T1		1	2.479 403 55 GHz	-33.36 dBm	Occ Bw Centroid	2.479 982 107 GHz
T2		1	2.480 560 66 GHz	-33.50 dBm	Occ Bw Freq Offset	-17.892 741 687 kHz

Figure 8.4-18: *99% bandwidth on high channel with 8-DPSK modulation*

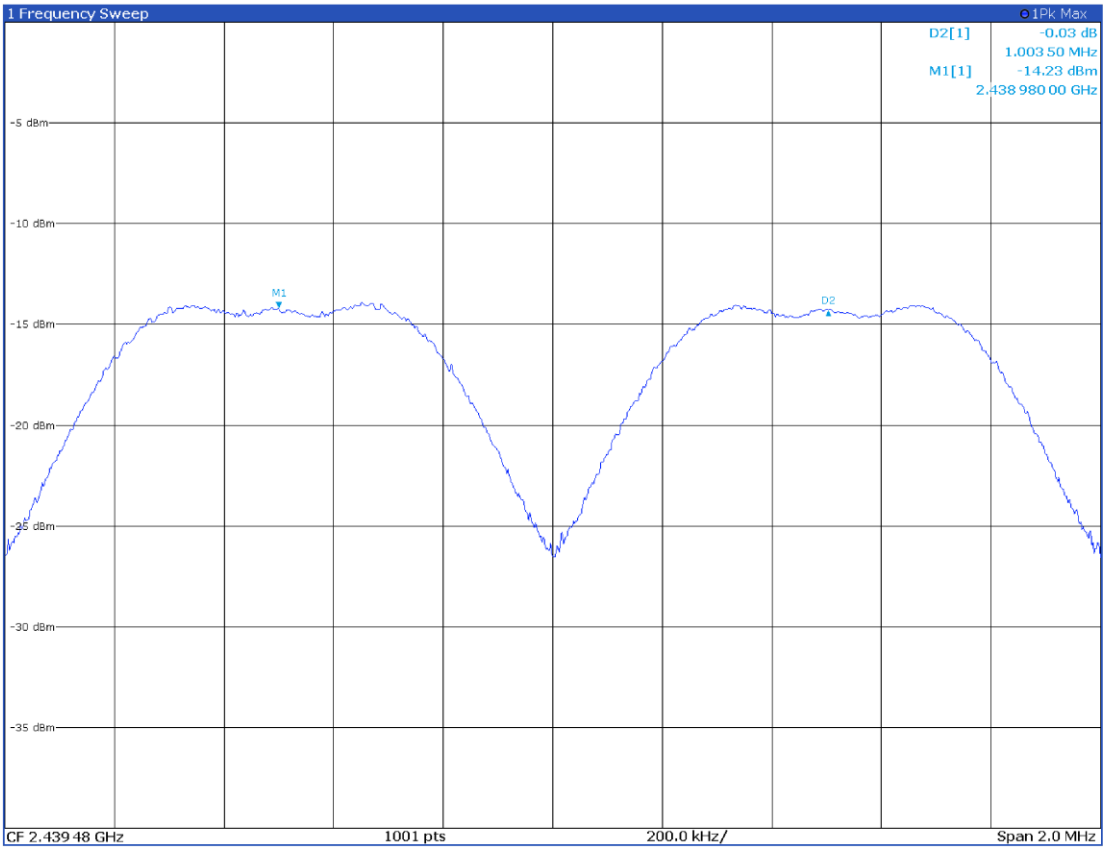


Figure 8.4-19: *Carrier frequency separation*

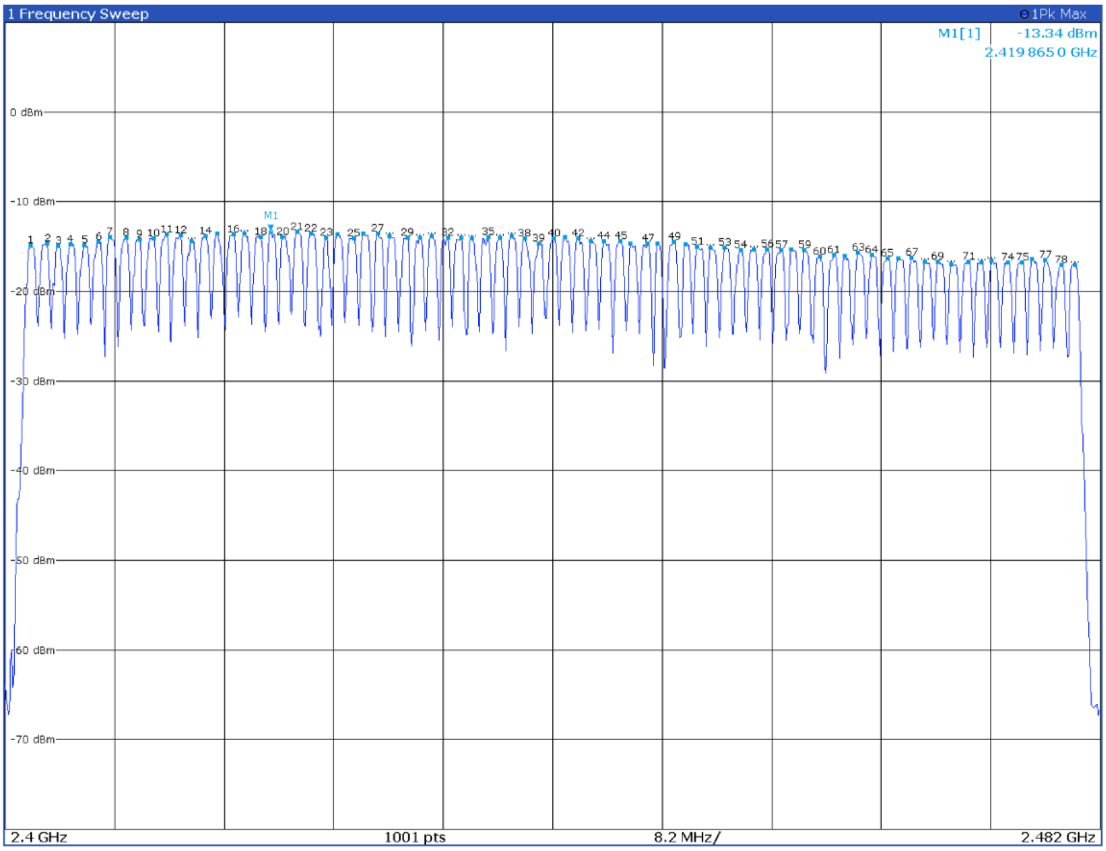


Figure 8.4-20: *Number of hopping channels*

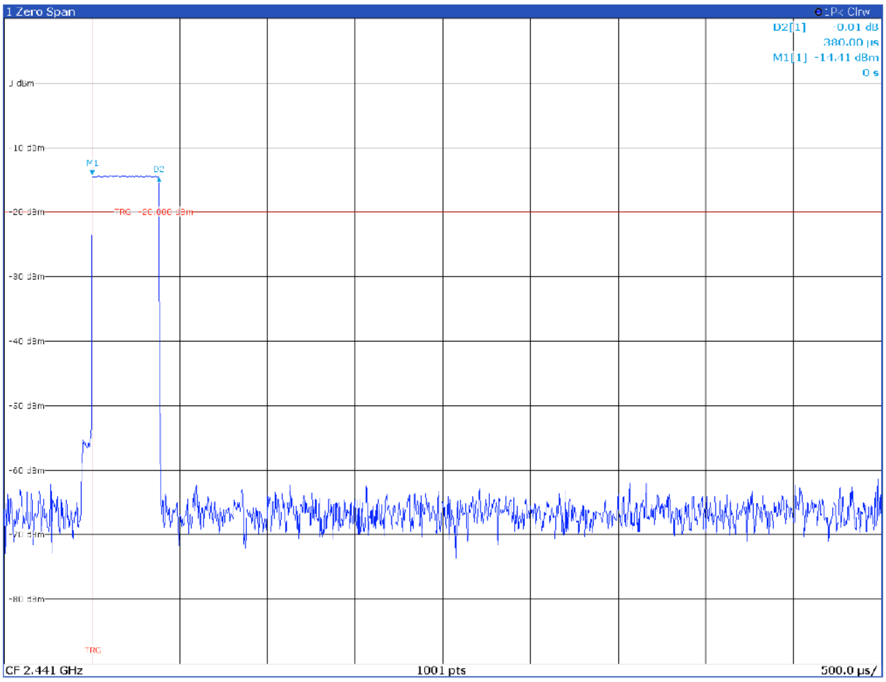


Figure 8.4-21: *Dwell time for GFSK modulation*

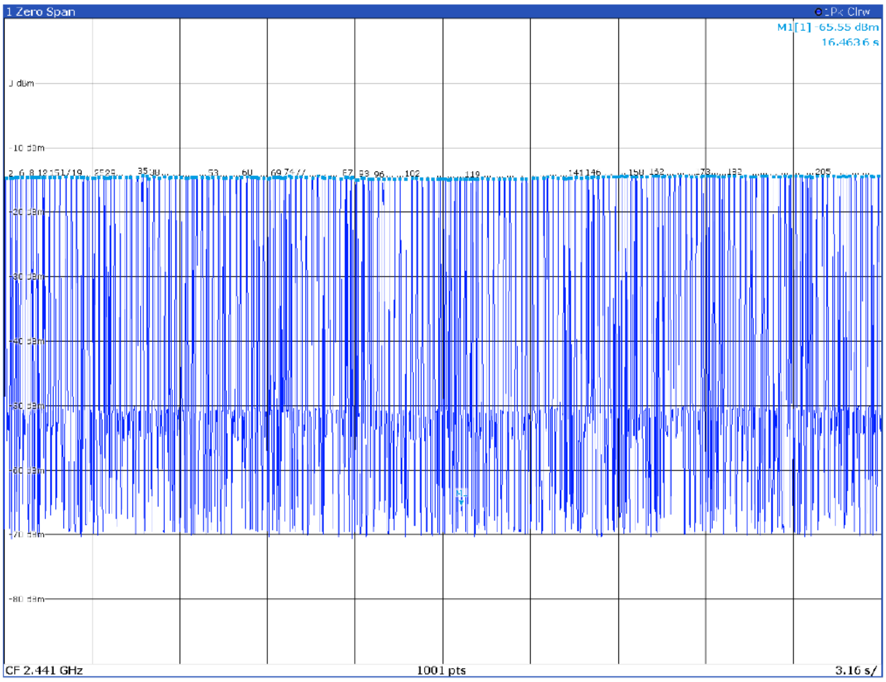


Figure 8.4-22: *Number of pulses within period for GFSK modulation*

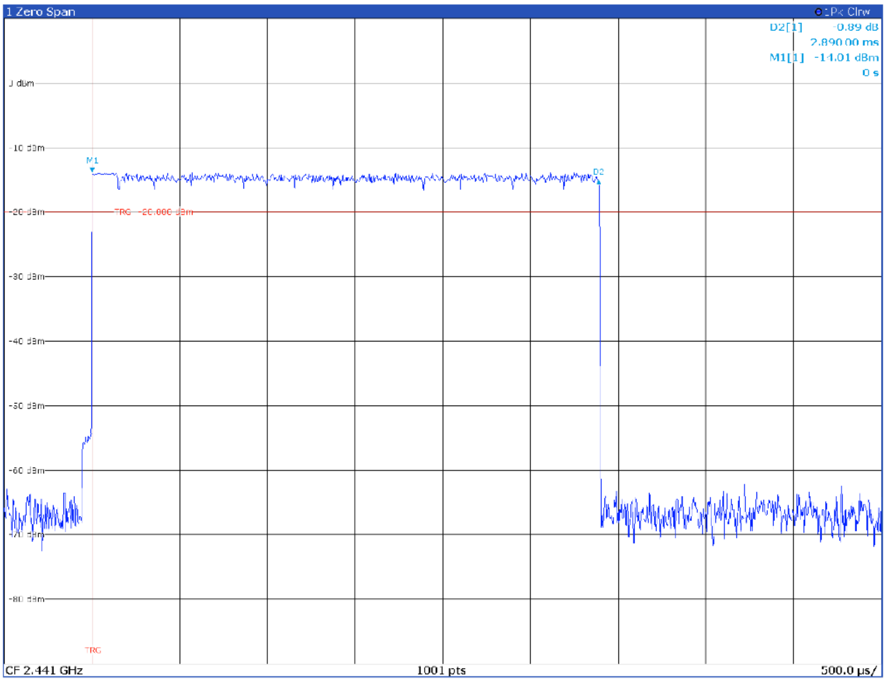


Figure 8.4-23: *Dwell time for π/4-DQPSK modulation*

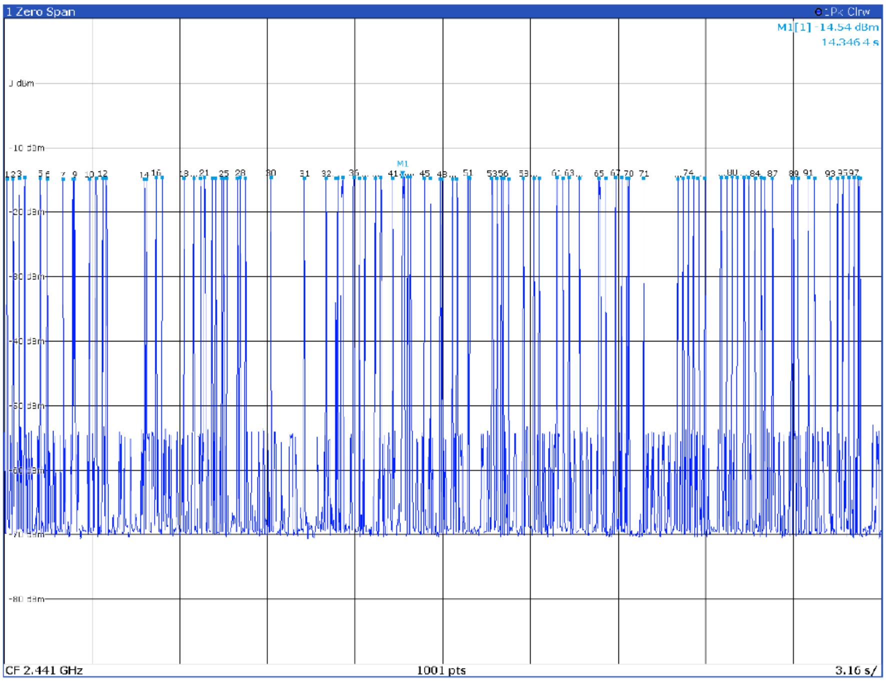


Figure 8.4-24: *Number of pulses within period for π/4-DQPSK modulation*

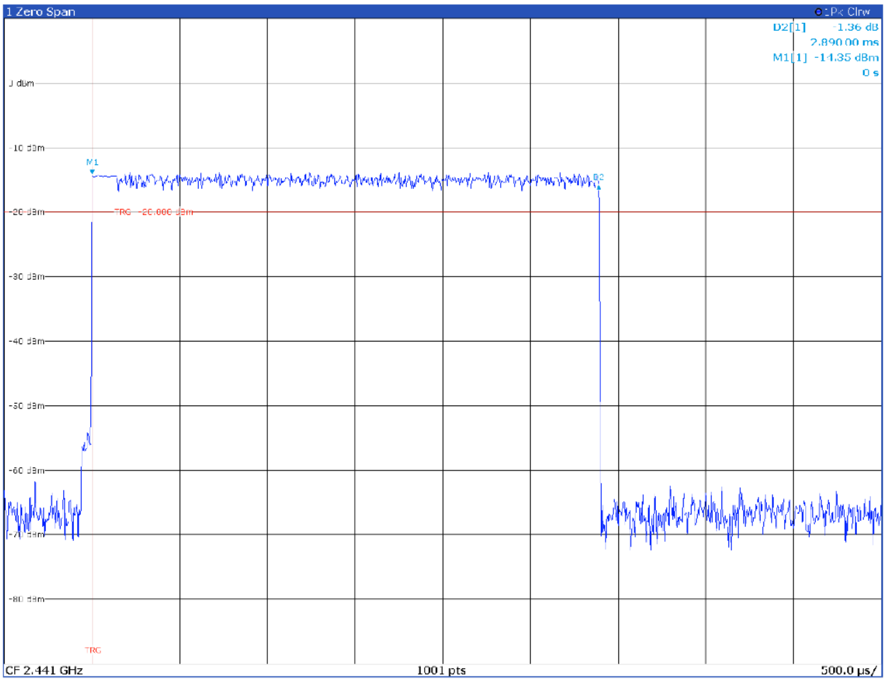


Figure 8.4-25: *Dwell time for 8-DPSK modulation*

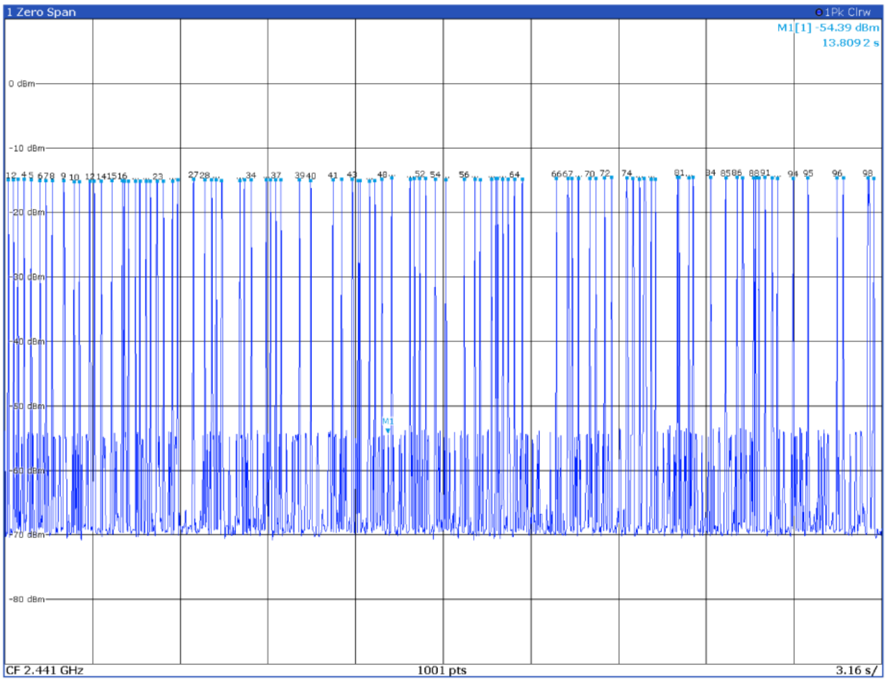


Figure 8.4-26: *Number of pulses within period for 8-DPSK modulation*

8.5 FCC 15.247(b) and RSS-247 5.4 (b) Transmitter output power and e.i.r.p. requirements

8.5.1 Definitions and limits

FCC:

(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:

(1) For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt (30 dBm). For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts (21 dBm).

(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

ISED:

For FHSs operating in the band 2400–2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W (30 dBm) if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W (21 dBm) if the hopset uses less than 75 hopping channels. The e.i.r.p. shall not exceed 4 W (36 dBm), except as provided in section 5.4(e).

Section 5.4(e)

Fixed point-to-point systems in the bands 2400–2483.5 MHz and 5725–5850 MHz 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.

8.5.2 Test summary

Test date	December 5, 2024	Verdict	Pass
Test engineer	P. Barbieri	Sample tested	DNZAT000018

8.5.3 Observations, settings and special notes

Spectrum analyser settings for output power:

Resolution bandwidth	> the 20 dB bandwidth of the emission being measured
Video bandwidth	≥ RBW
Frequency span	Approximately 5 times the 20 dB bandwidth, centered on a hopping channel
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 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	Comtest	3m SAC	1711-150
Cable set	Rosenberger and Huber + Suhner	RE01+RE02	1.654+1.655
Software turntable and mast	Maturo	mcApp	8.1.0.5410

8.5.5 Test data

Table 8.5-1: *Output power and EIRP results*

Modulation	Frequency, MHz	Output power, dBm	Output power limit, dBm	Margin, dB	Antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dB
GFSK	2402	-13.9	30.00	-43.9	1.7	-12.2	36.00	-48.2
	2441	-14.5	30.00	-44.5	1.7	-12.8	36.00	-48.8
	2480	-14.1	30.00	-44.1	1.7	-12.4	36.00	-48.4
π/4-DQPSK	2402	-13.3	30.00	-43.3	1.7	-11.6	36.00	-47.6
	2441	-13.9	30.00	-43.9	1.7	-12.2	36.00	-48.2
	2480	-13.4	30.00	-43.4	1.7	-11.7	36.00	-47.7
8-DPSK	2402	-12.9	30.00	-42.9	1.7	-11.2	36.00	-47.2
	2441	-13.5	30.00	-43.5	1.7	-11.8	36.00	-47.8
	2480	-13.0	30.00	-43.0	1.7	-11.3	36.00	-47.3

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

Test data, continued

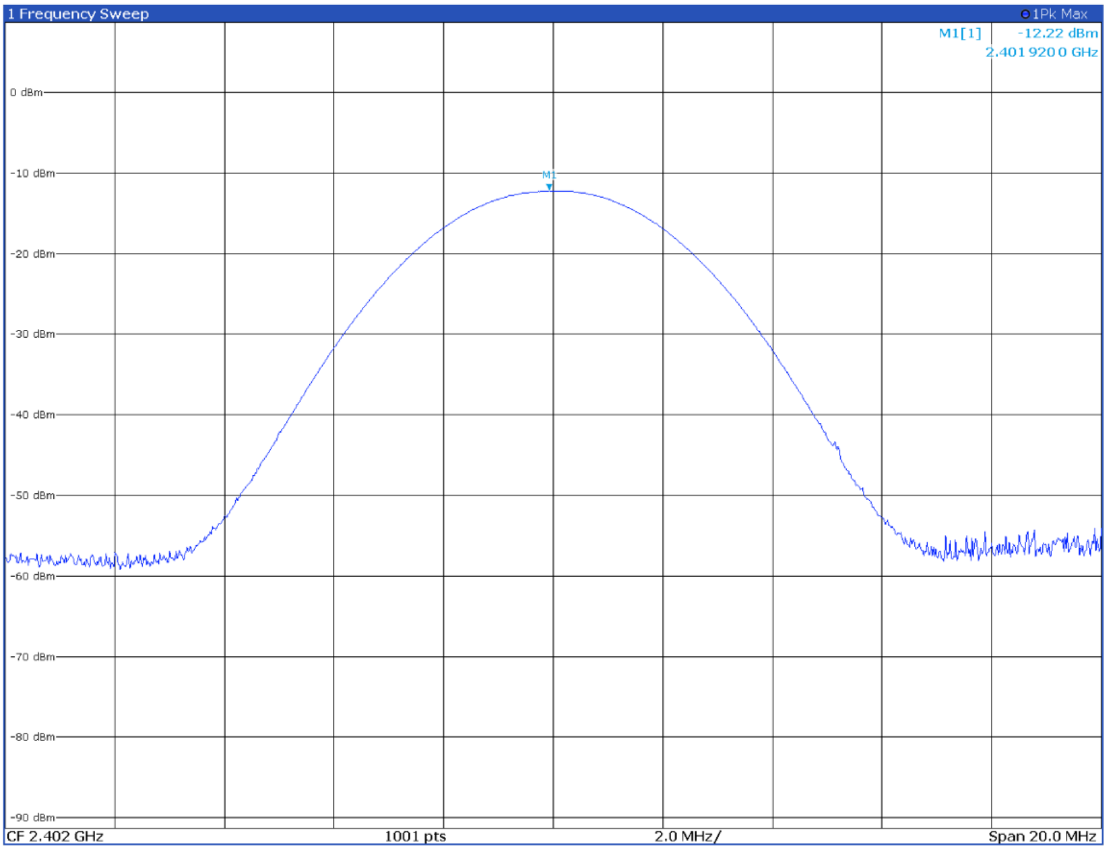


Figure 8.5-1: *Output power on low channel for GFSK modulation*

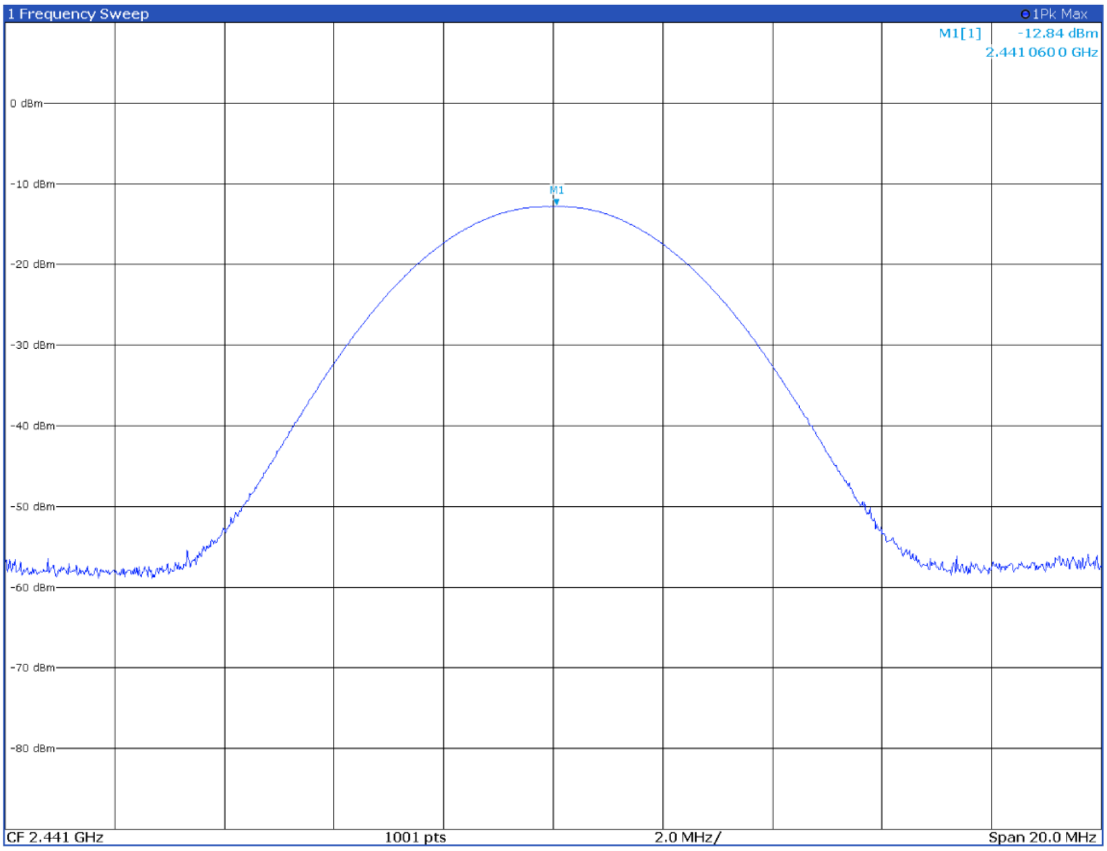


Figure 8.5-2: *Output power on mid channel for GFSK modulation*

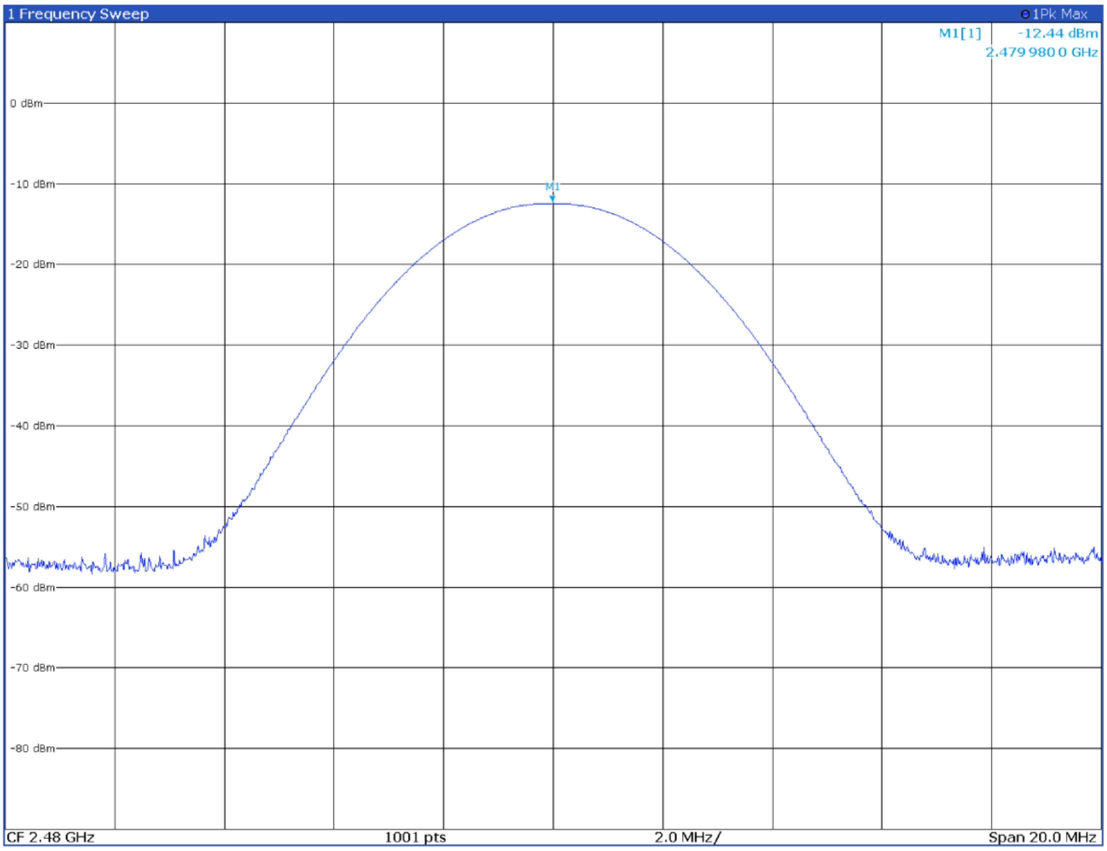


Figure 8.5-3: *Output power on high channel for GFSK modulation*

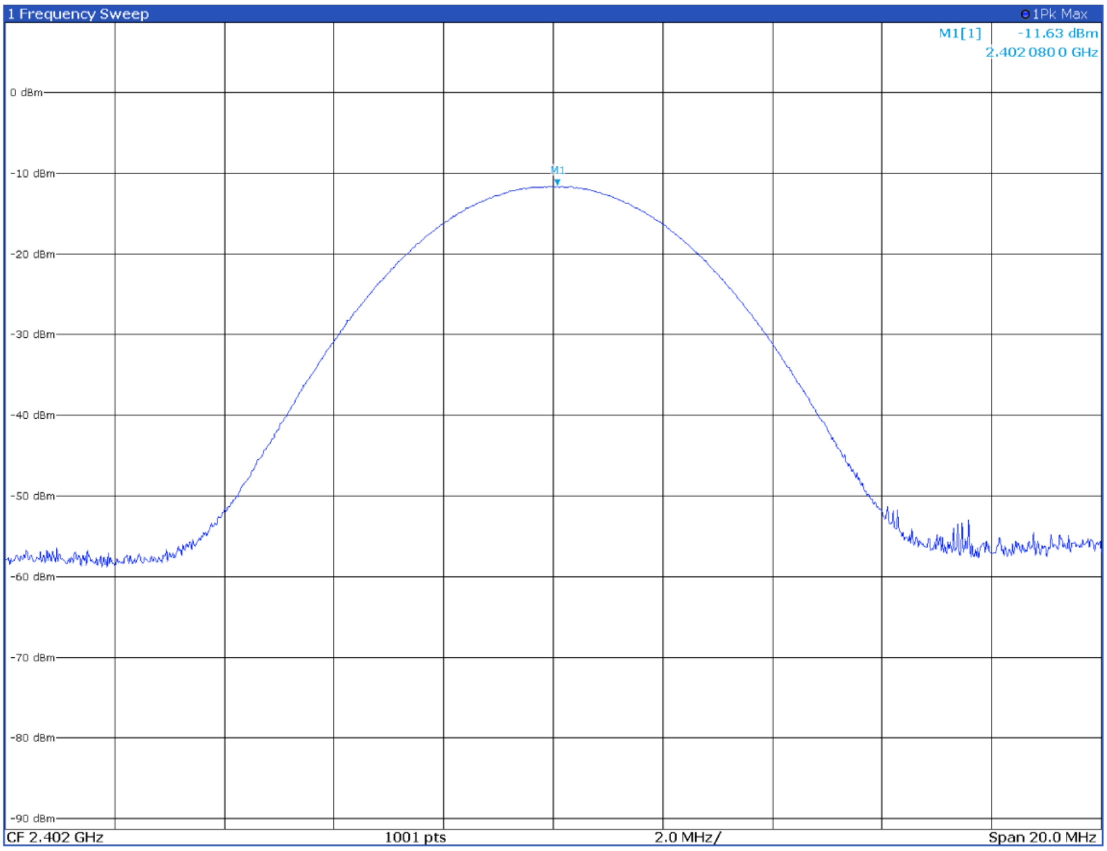


Figure 8.5-4: *Output power on low channel for π/4-DQPSK modulation*

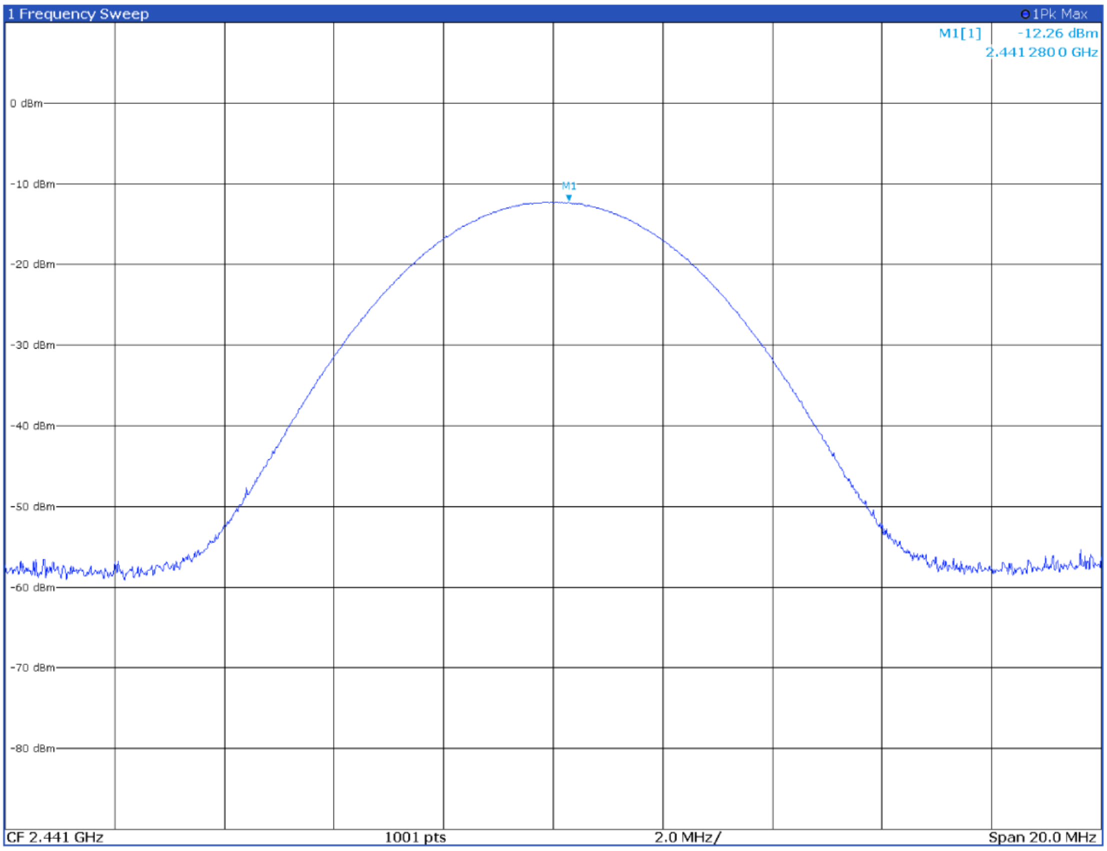


Figure 8.5-5: *Output power on mid channel for π/4-DQPSK modulation*

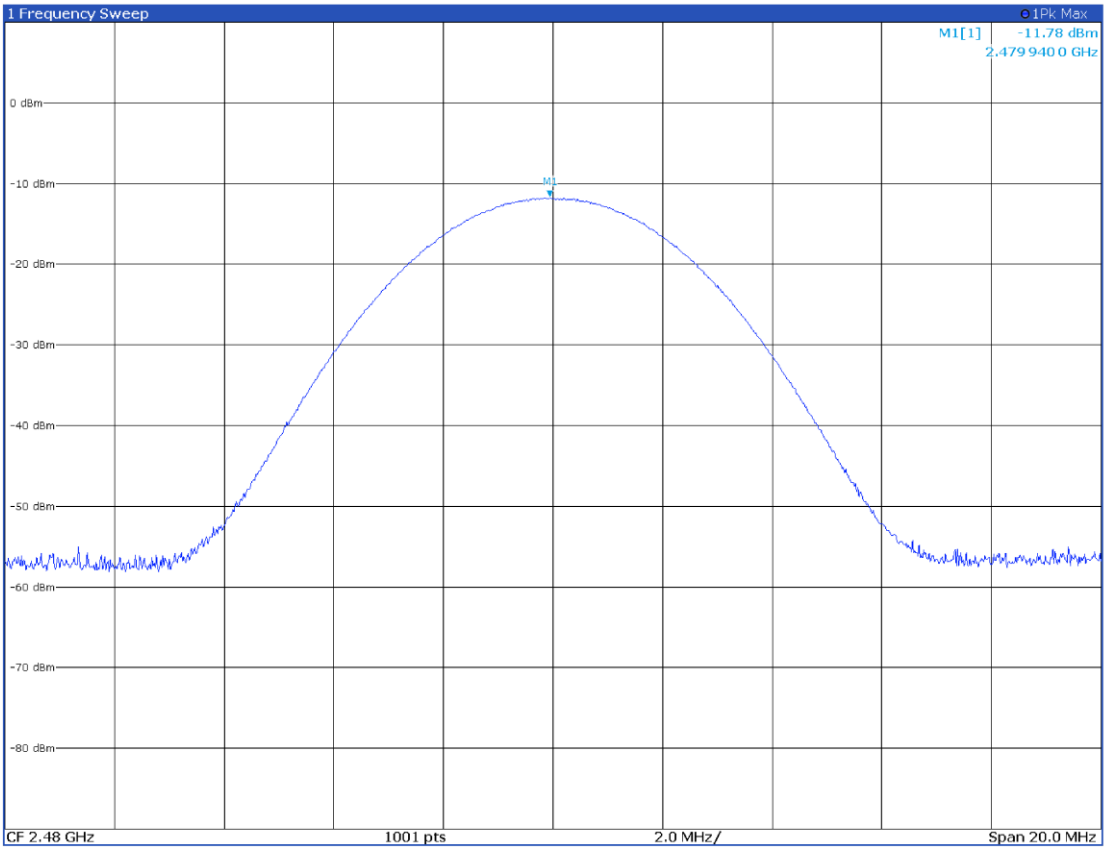


Figure 8.5-6: *Output power on high channel for π/4-DQPSK modulation*

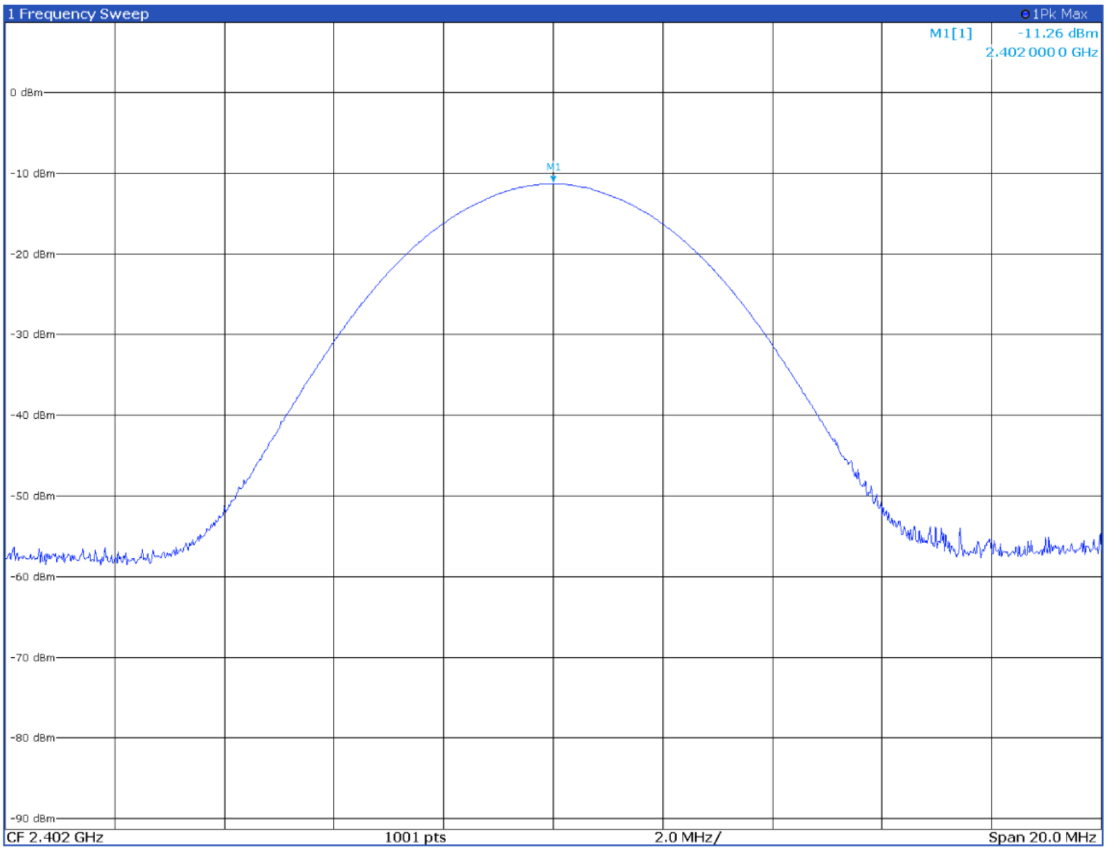


Figure 8.5-7: *Output power on low channel for 8-DPSK modulation*

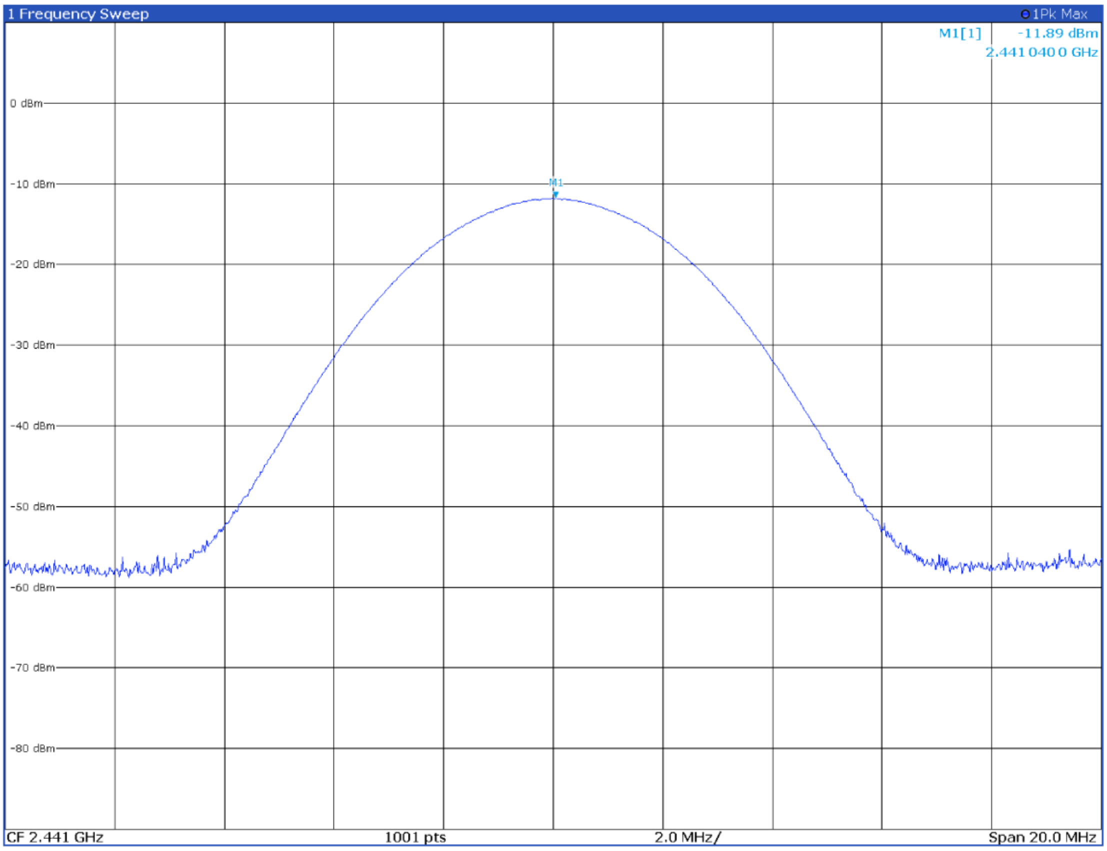


Figure 8.5-8: *Output power on mid channel for 8-DPSK modulation*

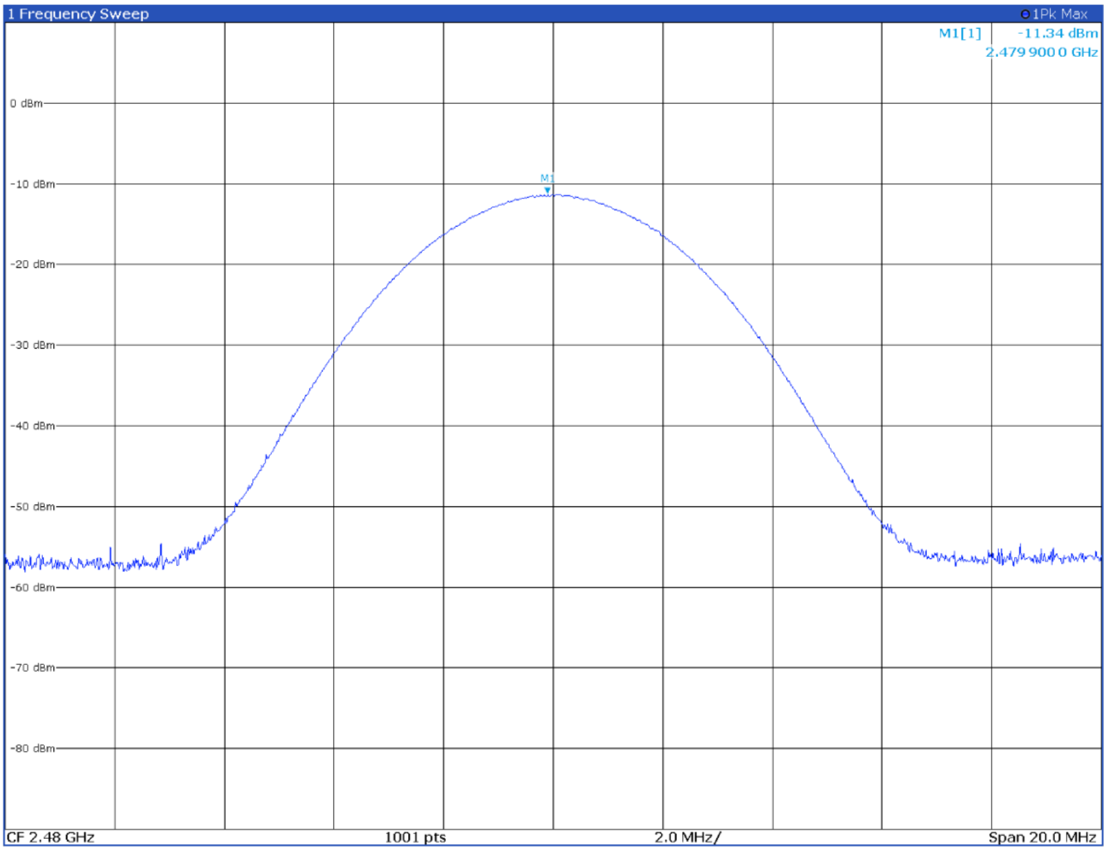


Figure 8.5-9: *Output power on high channel for 8-DPSK modulation*

8.6 FCC 15.247(d) and RSS-247 5.5 Spurious (out-of-band) unwanted emissions

8.6.1 Definitions and limits

FCC:
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator 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 the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

ISED:
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 8.6-1: *FCC §15.209 and RSS-Gen – Radiated emission limits*

Frequency, MHz	Field strength of emissions μV/m	Field strength of emissions dBμV/m	Measurement distance, m
0.009–0.490	2400/F	$67.6 - 20 \times \log_{10}(F)$	300
0.490–1.705	24000/F	$87.6 - 20 \times \log_{10}(F)$	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 8.6-2: *ISED restricted frequency bands*

MHz	MHz	MHz	GHz
0.090–0.110	12.51975–12.52025	399.9–410	5.35–5.46
2.1735–2.1905	12.57675–12.57725	608–614	7.25–7.75
3.020–3.026	13.36–13.41	960–1427	8.025–8.5
4.125–4.128	16.42–16.423	1435–1626.5	9.0–9.2
4.17725–4.17775	16.69475–16.69525	1645.5–1646.5	9.3–9.5
4.20725–4.20775	16.80425–16.80475	1660–1710	10.6–12.7
5.677-5.683	25.5–25.67	1718.8–1722.2	13.25–13.4
6.215–6.218	37.5–38.25	2200–2300	14.47–14.5
6.26775–6.26825	73–74.6	2310–2390	15.35–16.2
6.31175–6.31225	74.8–75.2	2655–2900	17.7–21.4
8.291–8.294	108–138	3260–3267	22.01–23.12
8.362–8.366	156.52475–156.52525	3332–3339	23.6–24.0
8.37625–8.38675	156.7–156.9	3345.8–3358	31.2–31.8
8.41425–8.41475	240–285	3500–4400	36.43–36.5
12.29–12.293	322–335.4	4500–5150	Above 38.6

Note: Certain frequency bands listed in Table 8.6-2 and above 38.6 GHz are designated for low-power licence-exempt applications. These frequency bands and the requirements that apply to the devices are set out in this Standard

Table 8.6-3: *FCC restricted frequency bands*

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2690–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	Above 38.6
13.36–13.41			

8.6.2 Test summary

Test date	December 3, 2024	Verdict	Pass
Test engineer	P. Barbieri	Sample tested	DNZAT000018

8.6.3 Observations, settings and special notes

The spectrum was searched from 30 MHz to the 10^{th} harmonic.
EUT was set to transmit with 100 % duty cycle.
Radiated measurements were performed at a distance of 3 m.

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

Re000solution 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

Spectrum analyser settings for conducted spurious emissions measurements:

Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
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
EMI Receiver	Rohde & Schwarz	ESU8	100202
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
Cable set	Rosenberger and Huber + Suhner	RE01+RE02	1.654+1.655
Software turntable and mast	Maturo	mcApp	8.1.0.5410
Semi-anechoic chamber	Comtest	3m SAC	1711-150

8.6.5 Test data

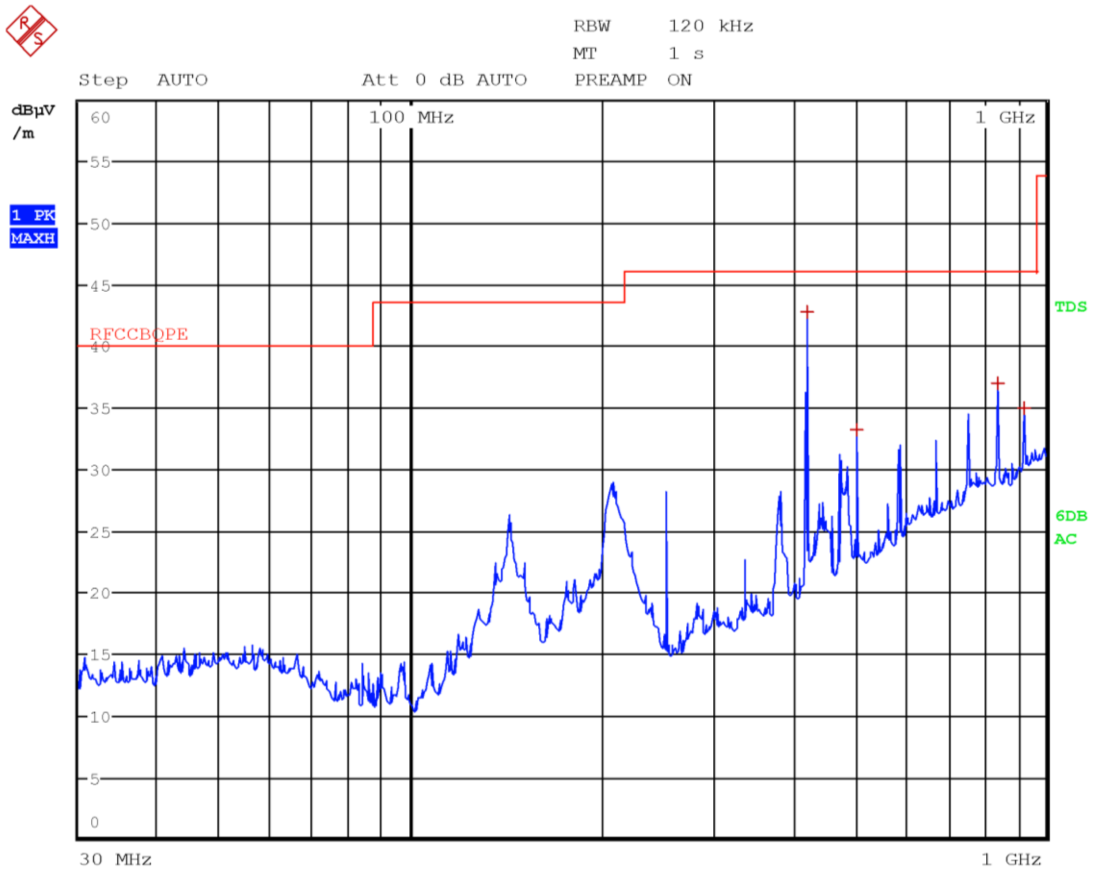


Figure 8.6-1: *Radiated spurious emissions for low channel GFSK modulation – Antenna in horizontal polarization*

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
420.0000	42.8	46.0	-3.2	QP
504.0300	33.3	46.0	-12.7	QP
839.8800	37.0	46.0	-9.0	QP
923.9400	35.0	46.0	-11.0	QP

Note: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

Test data, continued

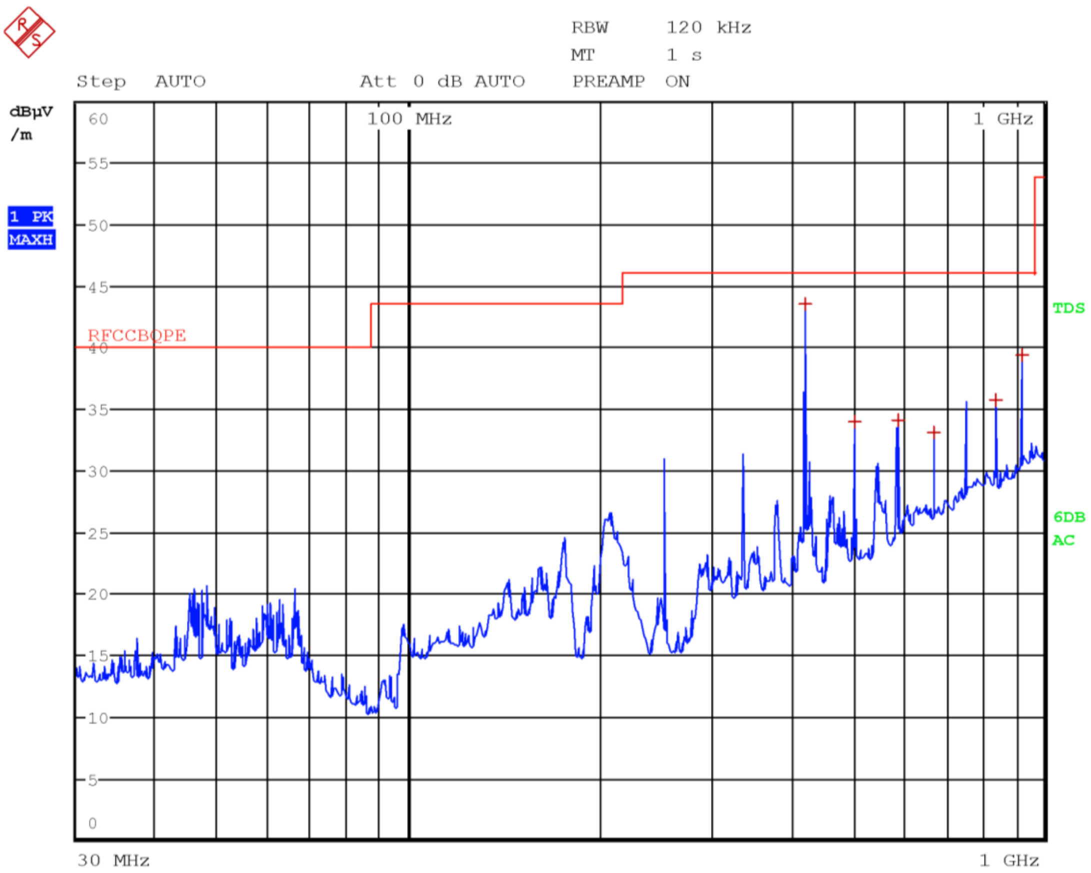


Figure 8.6-2: *Radiated spurious emissions for low channel GFSK modulation – Antenna in vertical polarization*

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
420.0300	43.6	46.0	-2.4	QP
504.0000	34.0	46.0	-12.0	QP
588.0000	34.2	46.0	-11.8	QP
672.0000	33.1	46.0	-12.9	QP
839.8800	35.8	46.0	-10.2	QP
924.0300	39.4	46.0	-6.6	QP

Note: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

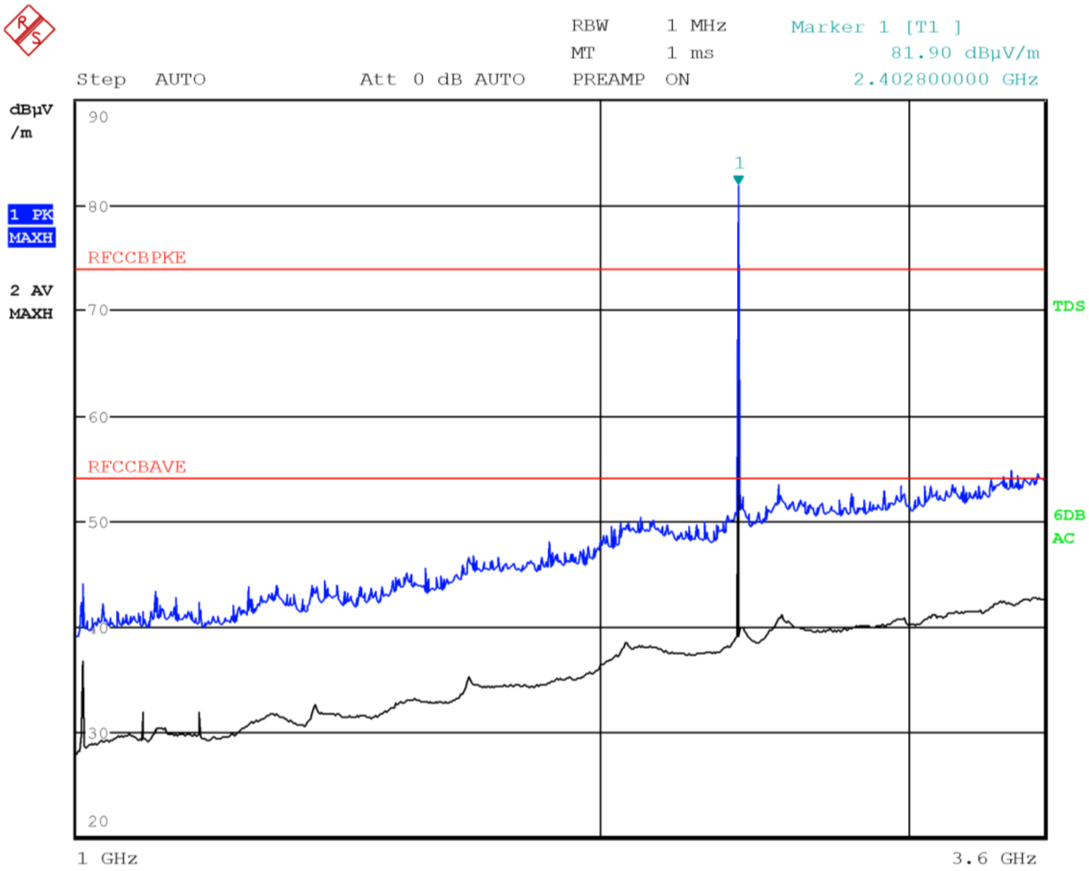


Figure 8.6-3: *Radiated spurious emissions for low channel GFSK modulation – Antenna in horizontal polarization*

No spurious detected – Limit exceeded by the carrier

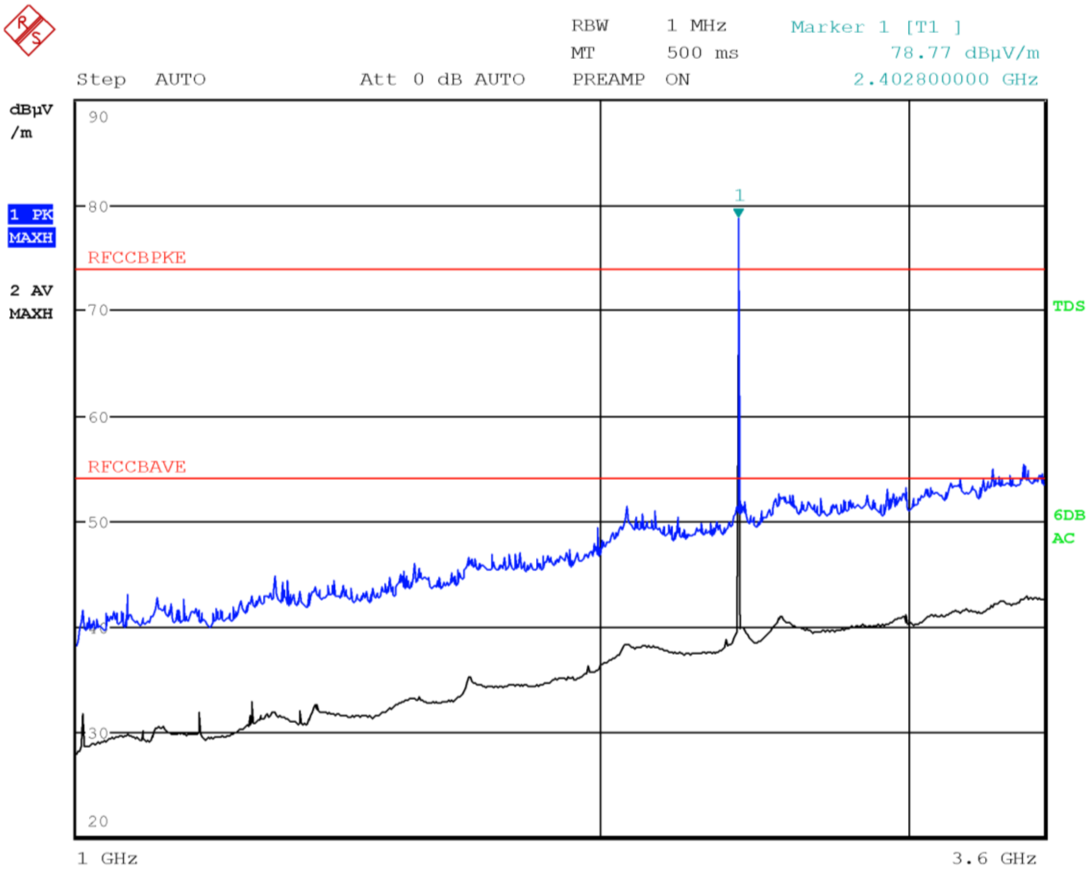


Figure 8.6-4: *Radiated spurious emissions for low channel GFSK modulation – Antenna in vertical polarization*

No spurious detected – Limit exceeded by the carrier

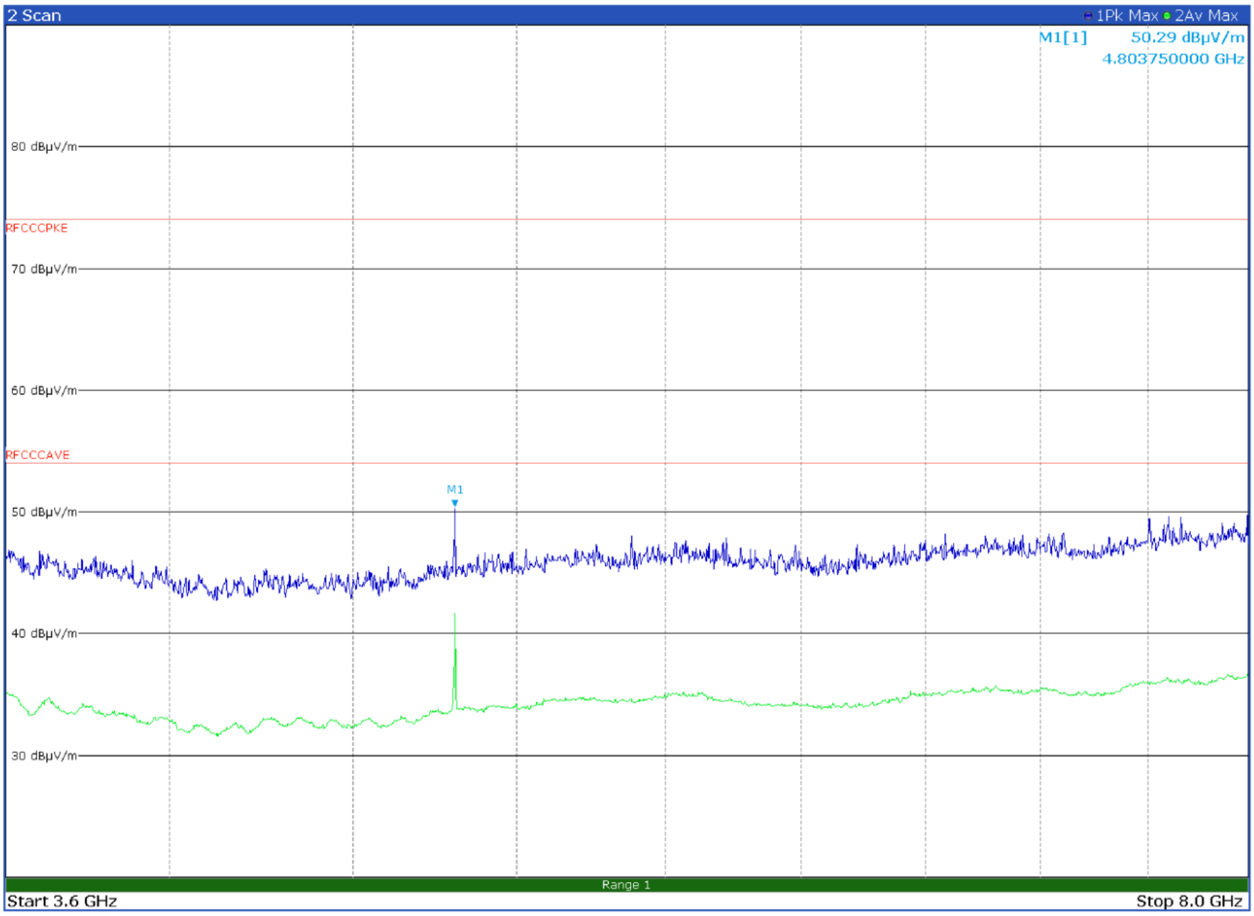


Figure 8.6-5: *Radiated spurious emissions for low channel GFSK modulation – Antenna in horizontal polarization*

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
4803.7500	50.3	74.0	-23.7	PK
4803.7500	49.7	54.0	-4.3	AV

Note: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

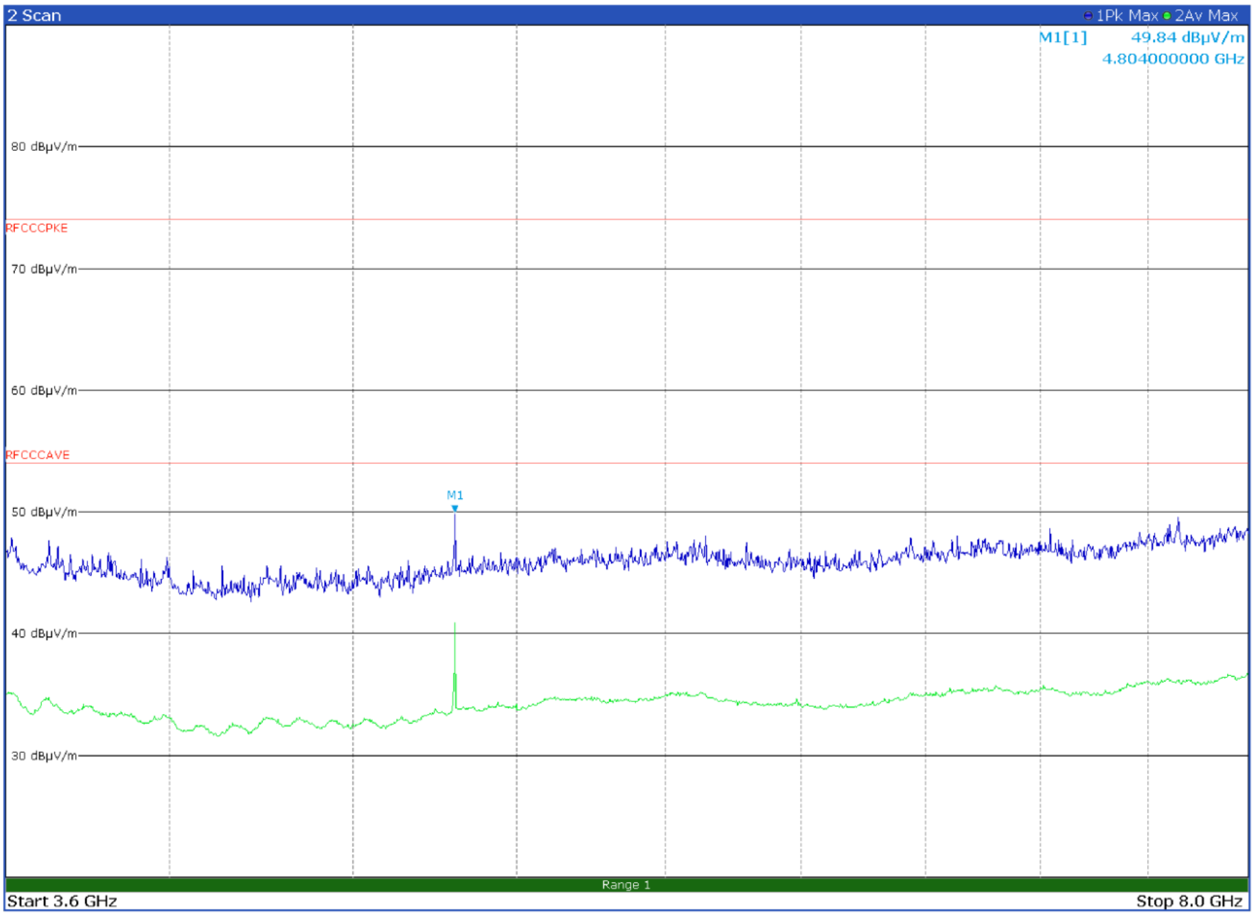


Figure 8.6-6: *Radiated spurious emissions for low channel GFSK modulation – Antenna in vertical polarization*

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
4804.0000	49.8	74.0	-24.2	PK
4804.0000	49.3	54.0	-4.7	AV

Note: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

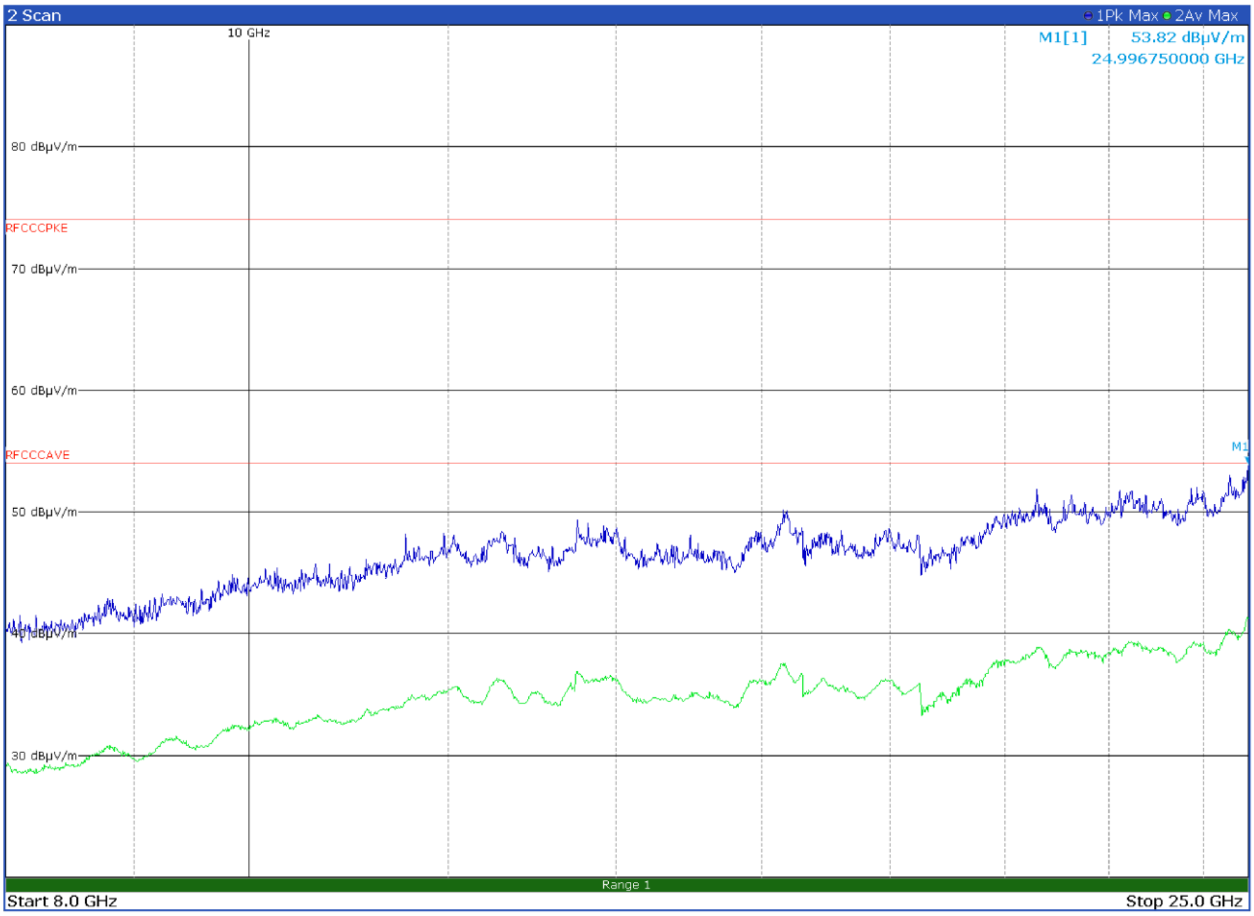


Figure 8.6-7: *Radiated spurious emissions for low channel GFSK modulation – Antenna in horizontal polarization*

No spurious detected

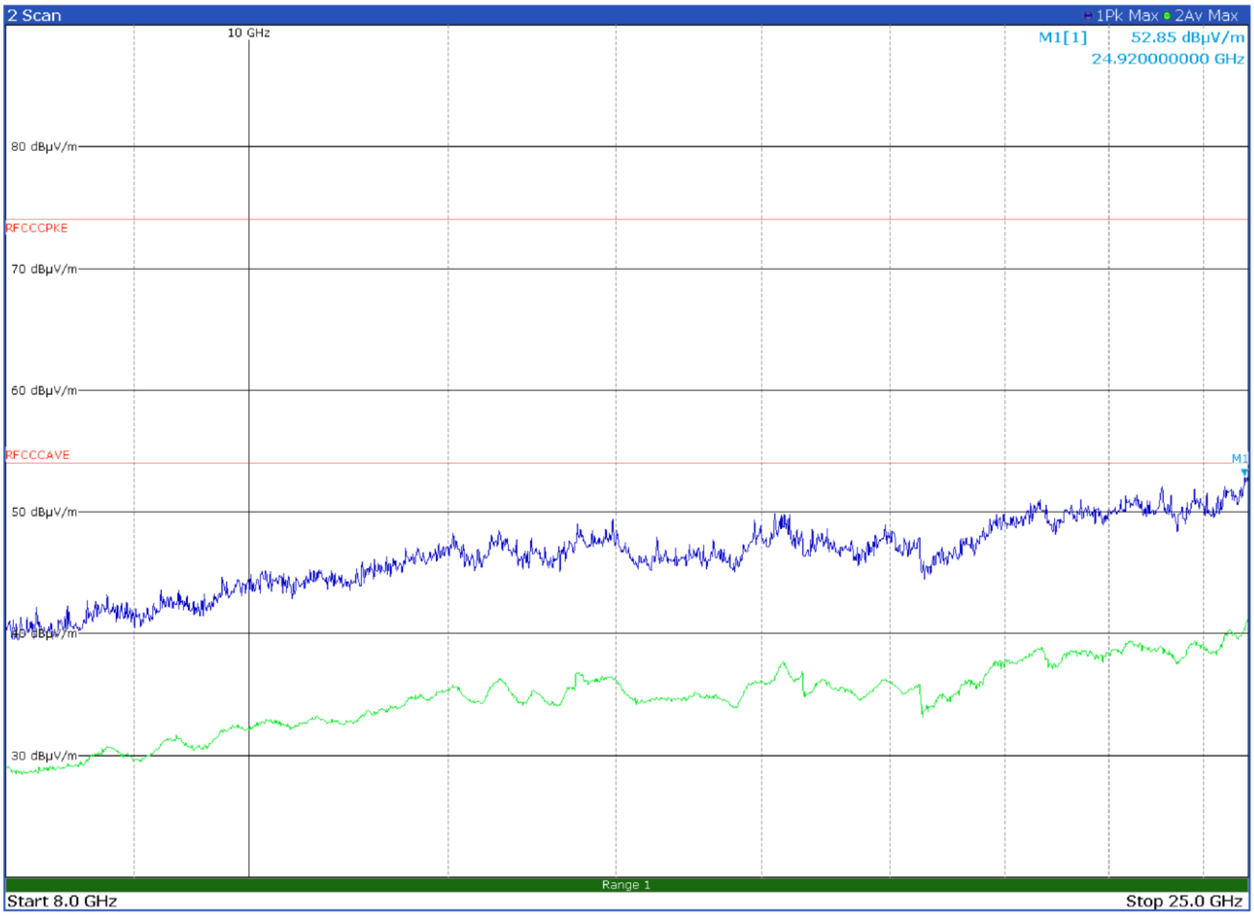


Figure 8.6-8: *Radiated spurious emissions for low channel GFSK modulation – Antenna in vertical polarization*

No spurious detected

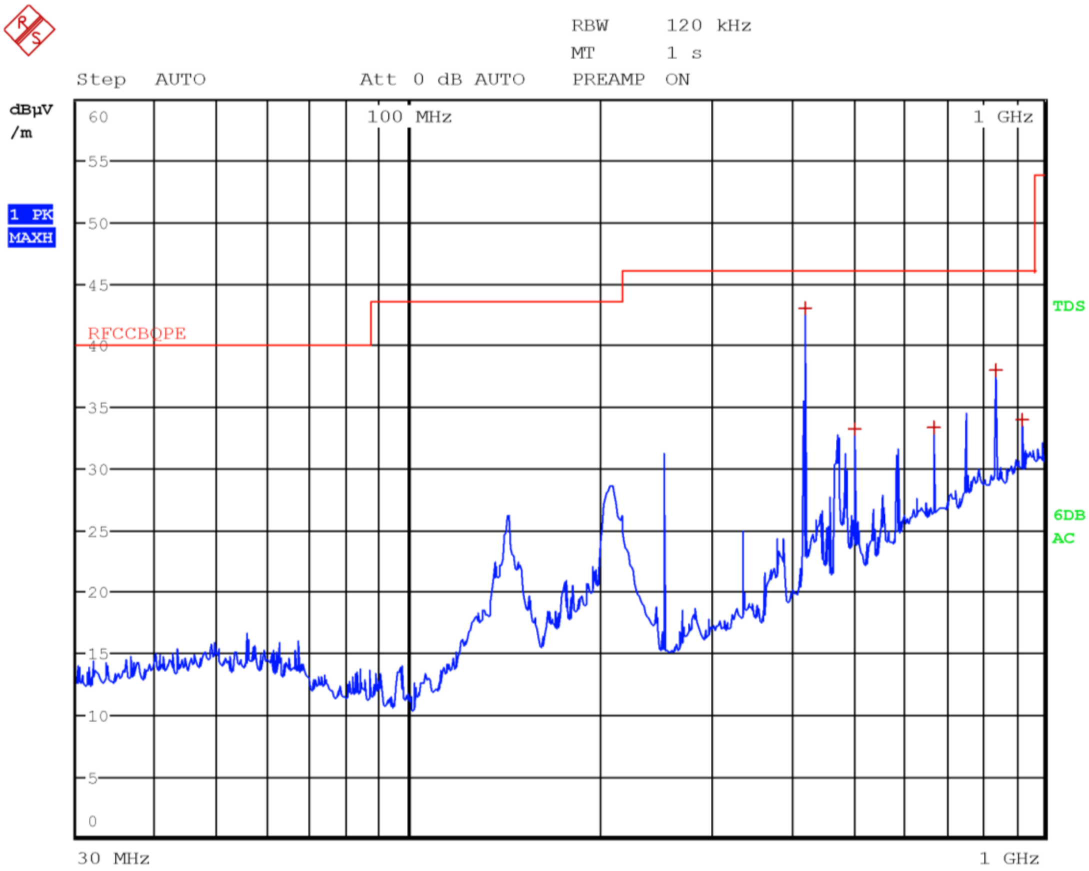


Figure 8.6-9: *Radiated spurious emissions for low channel π/4-DQPSK modulation – Antenna in horizontal polarization*

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
420.0000	43.0	46.0	-3.0	QP
504.0300	33.2	46.0	-12.8	QP
672.1500	33.5	46.0	-12.5	QP
840.0000	38.1	46.0	-7.9	QP
924.1200	34.1	46.0	-11.9	QP

Note: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

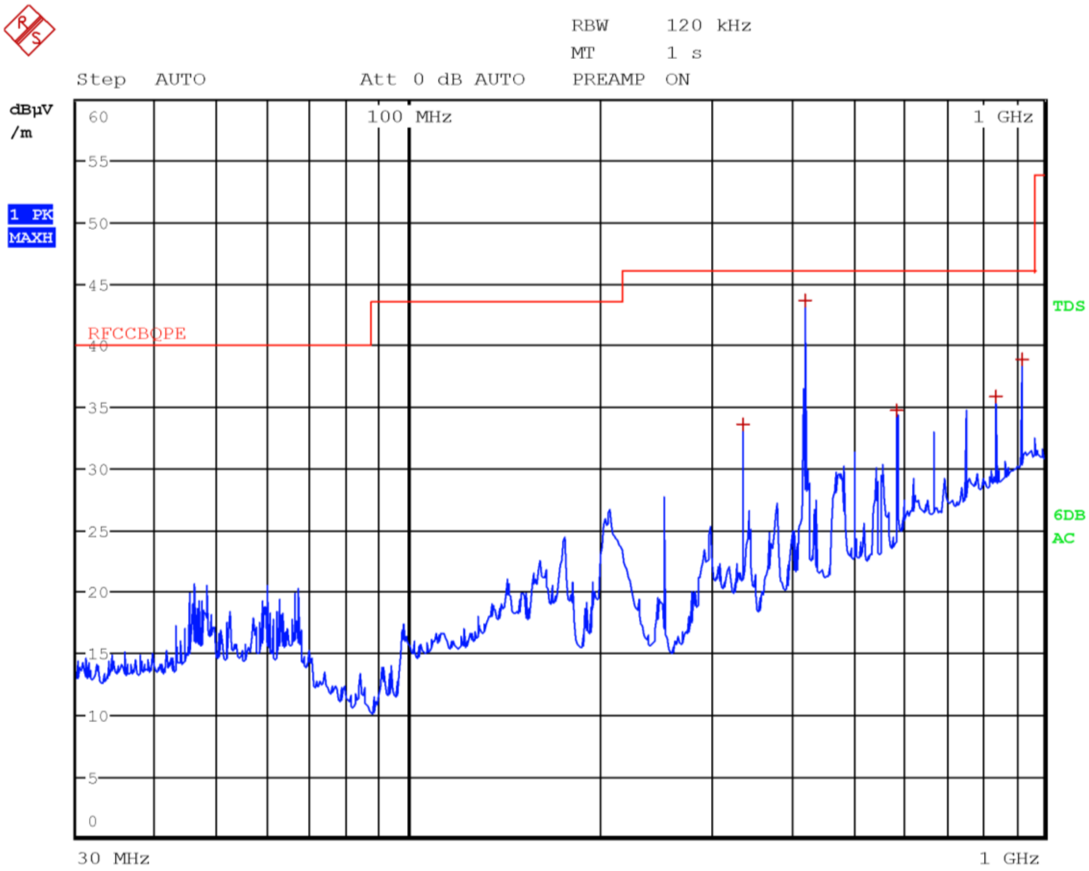


Figure 8.6-10: *Radiated spurious emissions for low channel π/4-DQPSK modulation – Antenna in vertical polarization*

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
336.0300	33.7	46.0	-12.3	QP
419.9700	43.7	46.0	-2.3	QP
587.9100	34.7	46.0	-11.3	QP
840.2100	35.8	46.0	-10.2	QP
924.0600	39.0	46.0	-7.0	QP

Note: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

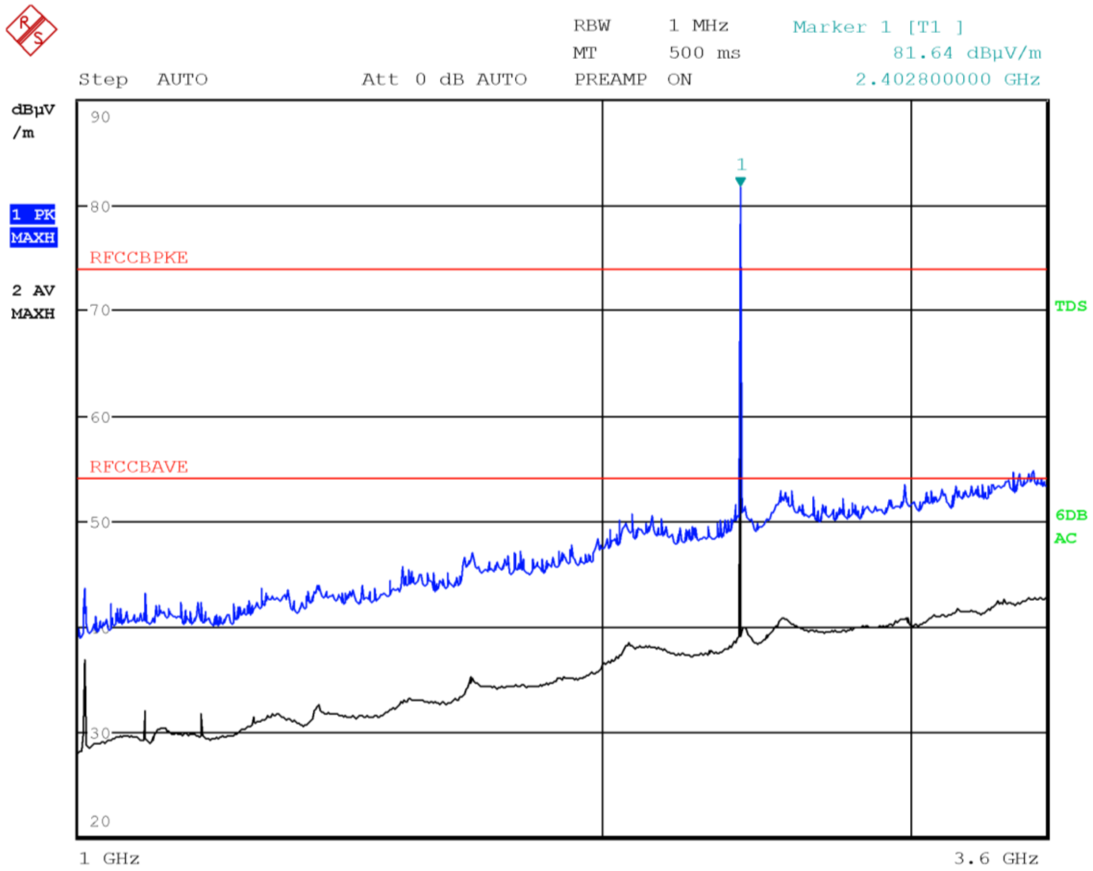


Figure 8.6-11: *Radiated spurious emissions for low channel π/4-DQPSK modulation – Antenna in horizontal polarization*

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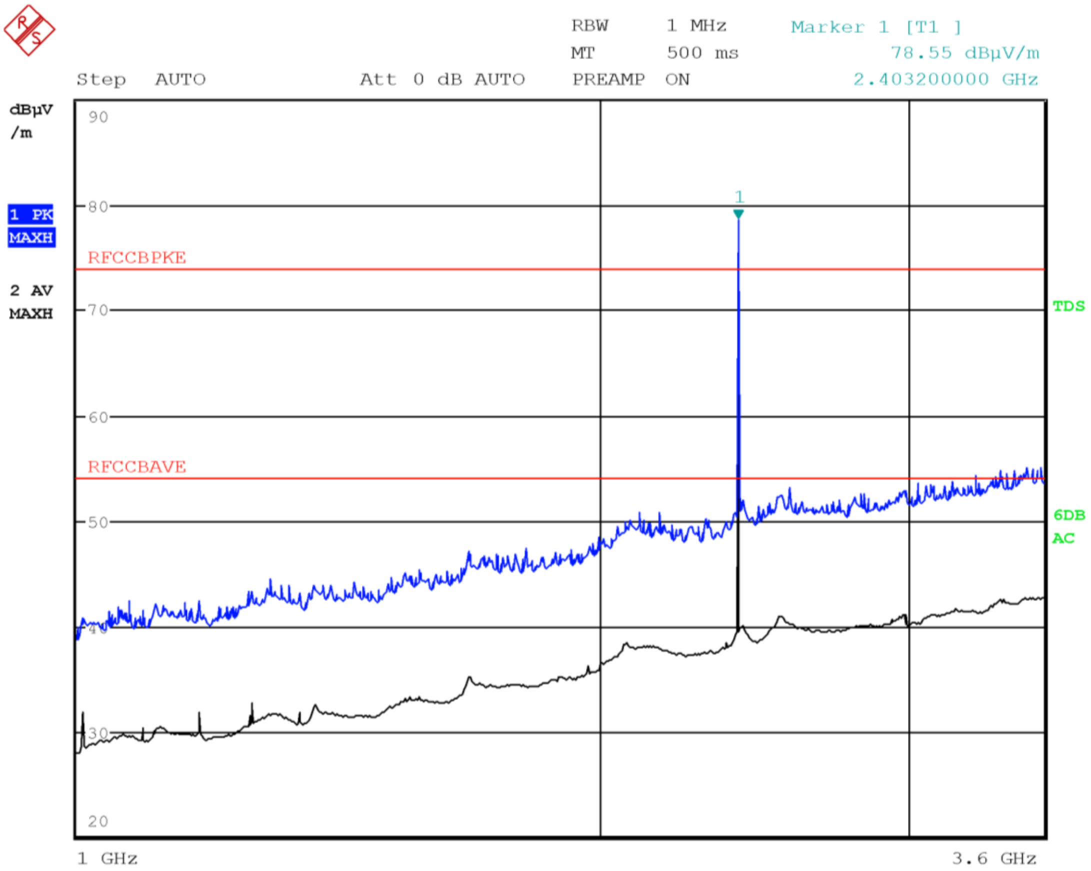

Figure 8.6-12: *Radiated spurious emissions for low channel π/4-DQPSK modulation – Antenna in vertical polarization*

No spurious detected – Limit exceeded by the carrier

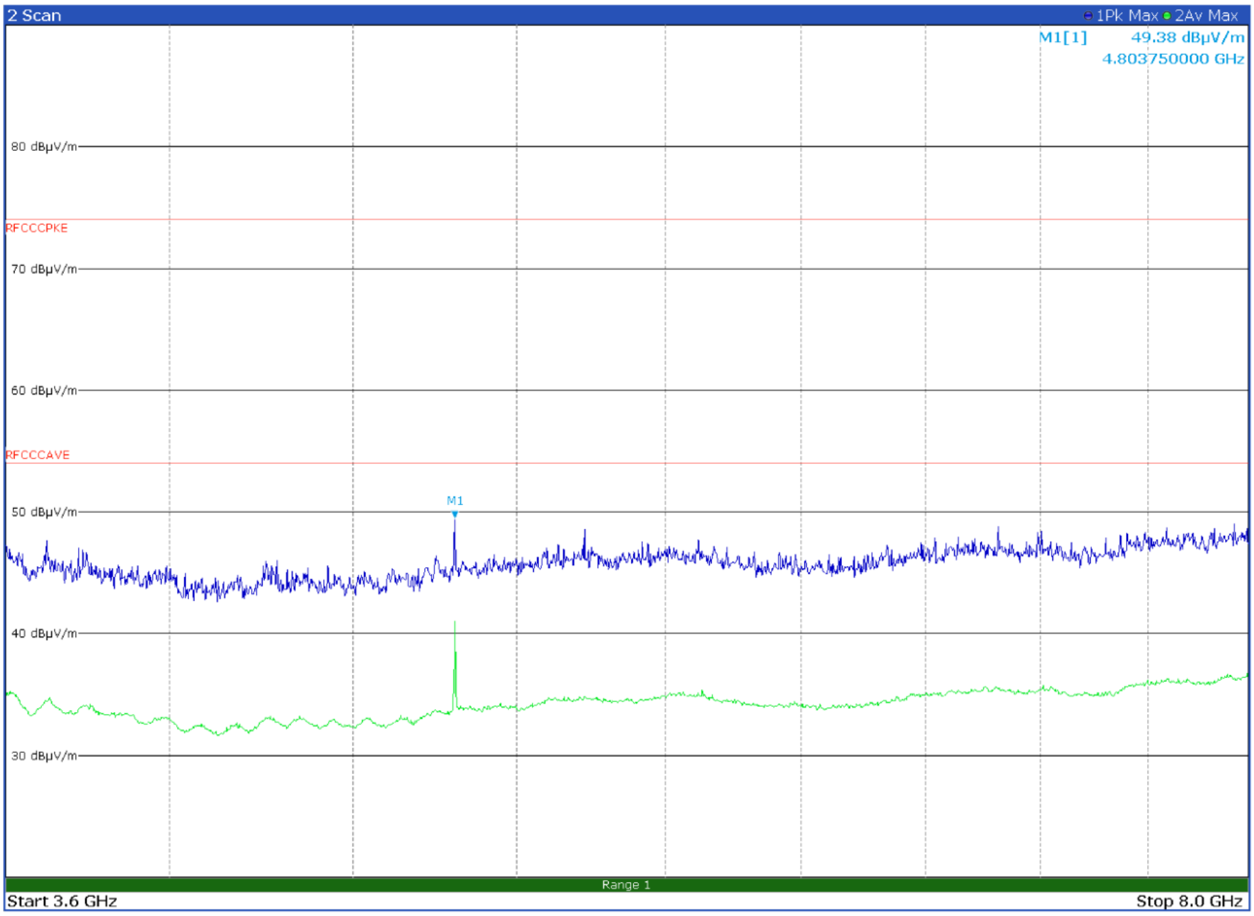

Figure 8.6-13: *Radiated spurious emissions for low channel π/4-DQPSK modulation – Antenna in horizontal polarization*

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
4803.75	49.4	74.0	-24.6	PK
4803.75	48.8	54.0	-5.2	AV

Note: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

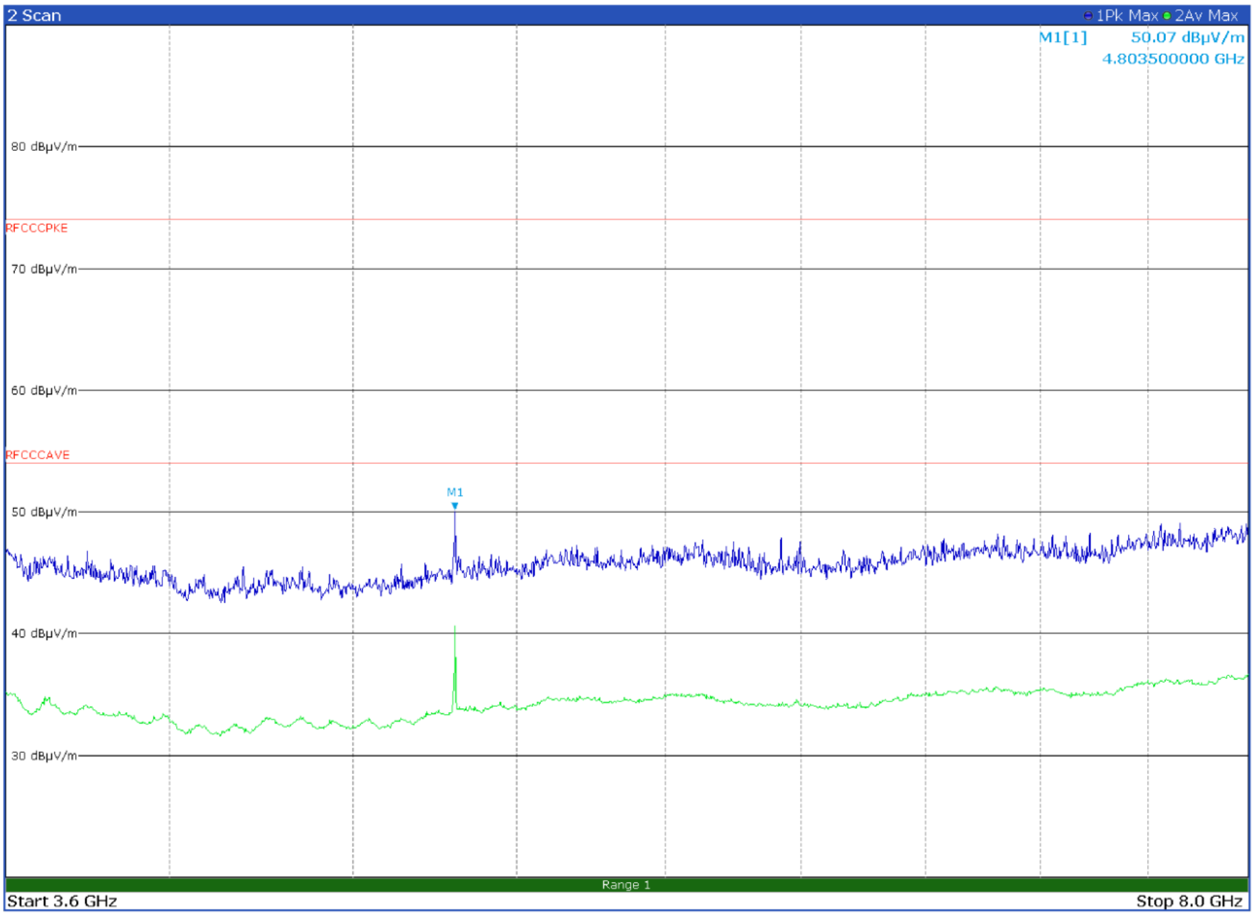

Figure 8.6-14: *Radiated spurious emissions for low channel π/4-DQPSK modulation – Antenna in vertical polarization*

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
4803.50	50.1	74.0	-23.9	PK
4803.50	49.5	54.0	-4.5	AV

Note: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

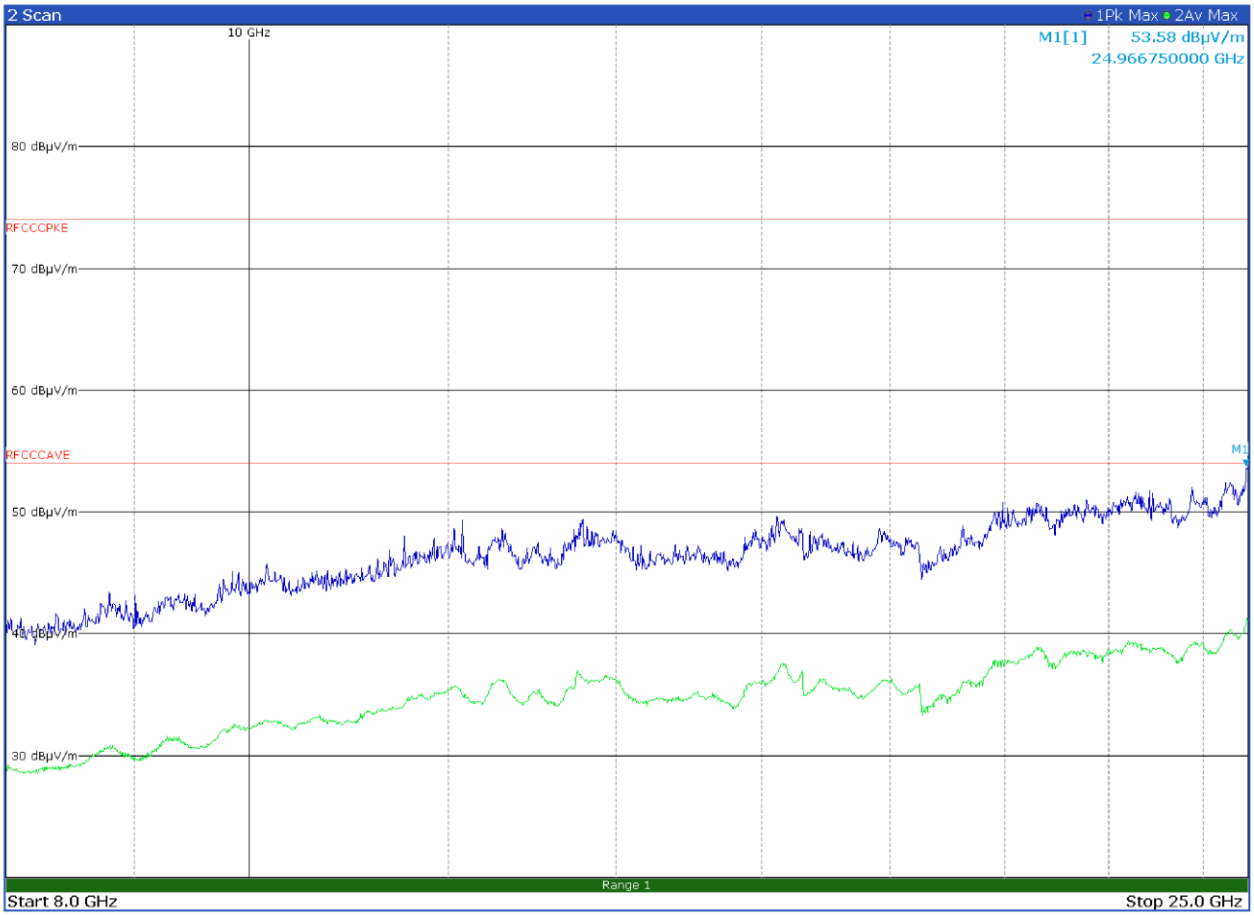

Figure 8.6-15: *Radiated spurious emissions for low channel π/4-DQPSK modulation – Antenna in horizontal polarization*

No spurious detected

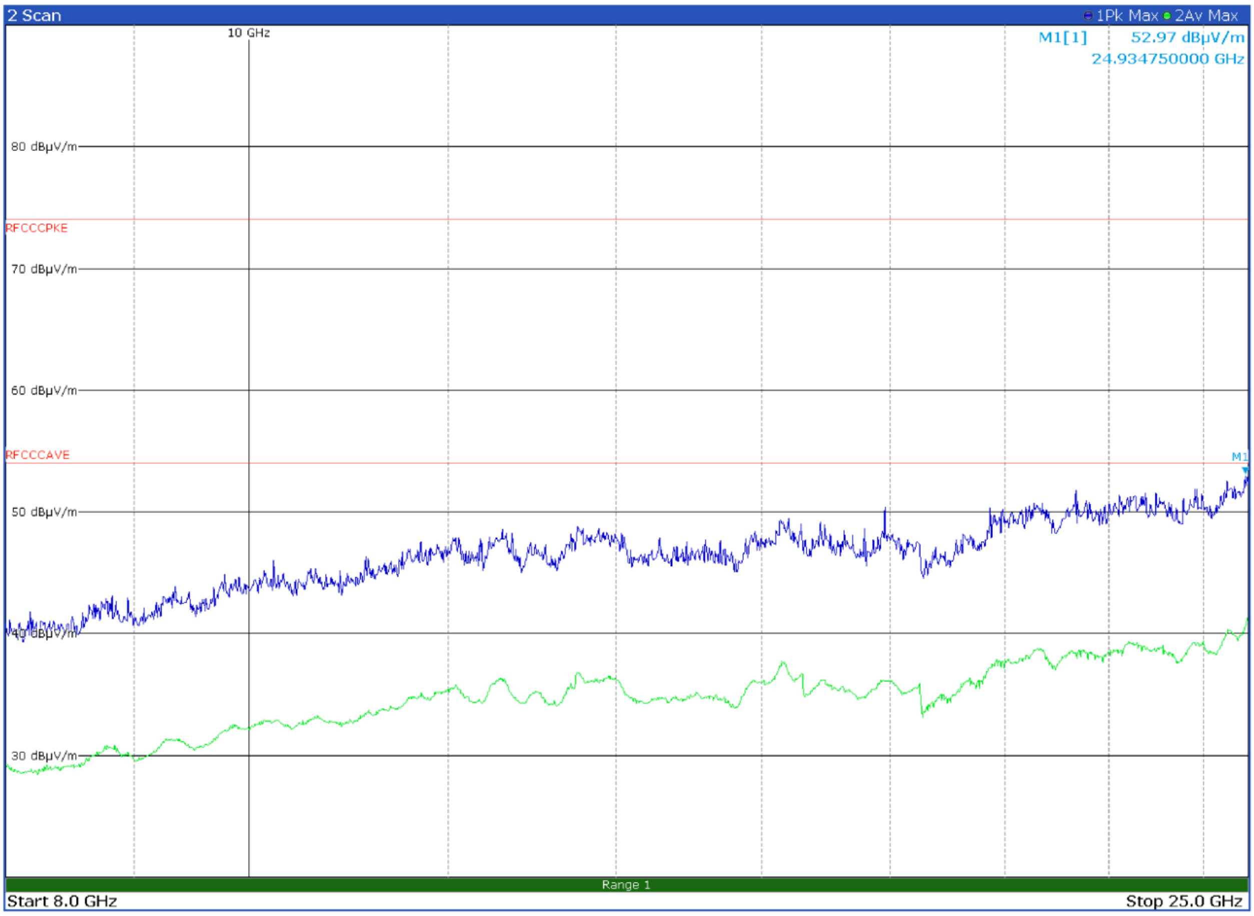

Figure 8.6-16: *Radiated spurious emissions for low channel π/4-DQPSK modulation – Antenna in vertical polarization*

No spurious detected