Test report

REP020328-03R1TRFWL

Date of issue: January 10, 2024

Applicant:

Canary Medical

Product:

CTE Implant

Model:

Canturio® se (Canturio Smart Extension)

Variant(s):

None

FCC ID:

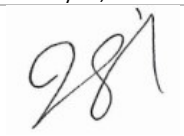
2AYAJ-CTE2

Specifications:

- FCC 47 CFR Part 95 Subpart I – Medical Device Radiocommunication Service

Lab and test locations

Company name	Nemko USA Inc.
Address	2210 Faraday Ave, Suite 150
City	Carlsbad
State	California
Postal code	92008
Country	USA
Telephone	+1 760 444 3500
Website	www.nemko.com
FCC Site Number	Test Firm Registration Number: 392943; Designation Number: US5058
ISED Test Site	2040B-3

Tested by	Chenhao Ma, Wireless Test Technician
Reviewed by	James Cunningham, EMC/WL Manager
Review date	January 10, 2024
Reviewer signature	

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 USA's ISO/IEC 17025 accreditation.
This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government.

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Table of Contents

Section 1 Report summary

1.1 Test specifications

FCC 47 CFR Part 95, Subpart I	Medical Device Radio Communications Service

1.2 Test methods

ANSI C63.10, 2013	American National Standard for Compliance Testing of Unlicensed Wireless Devices.

1.3 Exclusions

None.

1.4 Statement of compliance

Testing was performed against all relevant requirements of the test standard(s).

Results obtained indicate that the product under test complies in full with the tested requirements.

The test results relate only to the item(s) tested.

See “Section 2 Summary of test results” for full details.

1.5 Test report revision history

Table 1.5-1: *Test report revision history*

Revision #	Issue Date	Details of changes made to test report
REP020328-03TRFWL	January 2, 2024	Original report issued
REP020328-03R1TRFWL	January 10, 2024	Update sample information, add FCC ID

Section 2 Summary of test results

2.1 Sample information

Receipt date	08-Dec-23
Nemko sample ID number	PRJ0032596

2.2 Testing period

Test start date	08-Dec-23
Test end date	12-Dec-23

2.3 Test results

Table 2.3-1: *FCC Par15 Subpart C, general requirements*

Part	Test description	Verdict
§15.207(a)	Conducted limits	Not applicable
§15.31(e)	Variation of power source	Not applicable
§15.203	Antenna requirements	Pass

Notes: None

Table 2.3-2: *Part 95, Subpart I, Medical Device Radio Communications Service results*

Clause	Test description	Verdict
§95.2565	Frequency Accuracy	Pass
§95.2567(a)	Field strength of fundamental	Pass
§95.2573(a)	Emission Bandwidth (20 dB)	Pass
§95.2579	Band Edges	Pass
§95.2579	Unwanted Emissions	Pass
§2.202(a)	99% Occupied bandwidth	Pass

Notes: None

Section 3 Equipment under test (EUT) details

3.1 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 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.

3.2 Applicant

Company name	Canary Medical
Address	2710 Loker Ave West, Suite 350
City	Carlsbad
State	CA
Postal/Zip code	92010
Country	USA

3.3 Manufacturer

Company name	Canary Medical
Address	2710 Loker Ave West, Suite 350
City	Carlsbad
State	CA
Postal/Zip code	92010
Country	USA

3.4 EUT information

Product name	CTE Implant
Model	Canturio ® se (Canturio Smart Extension)
Variant(s)	None
Serial number	000213
Part number	SA-250880
Model number	43-5570-030-14

Frequency band(s)	402 – 405 MHz
Minimum frequency(ies)	402 MHz
Maximum frequency(ies)	405 MHz
Type of modulation	FSK
Power requirements	Battery powered.
Description/theory of operation	Tibal extension (14mm (D) X 30mm (H)) that provides objective kinematic data from the implanted medical device during a patient's total knee arthroplasty (TKA) post-surgical care as an adjunct to other physiological parameter measurement tools applied or utilized by the physician.
Antenna gain	-35dBi

3.5 EUT exercise and monitoring details

Exercising Details:
For the life of this device, it spends the majority in deep sleep mode, i.e., all components are shut down while in deep sleep except one component, the real time clock (internal clock is 32.768kHz), runs all the time.

During all radio tests except the frequency stability test, the EUT is wirelessly uploading data to the base station at specified MICS channel per the test requirements. In this data upload mode, the EUT is transmitting at a specified MICS channel while its transmitting power, channel bandwidth, band edges are measured

3.6 EUT setup details

Table 3.6-1: *EUT sub assemblies*

Description	Brand name	Model/Part number	Serial number	Rev.
N/A				

Table 3.6-2: *EUT interface ports*

Description	Qty.
N/A	

Table 3.6-3: *Support equipment*

Description	Brand name	Model/Part number	Serial number	Rev.
Microchip Base Station	Microchip/Microsemi	BSM300A	047	
Windows Laptop Computer	Dell	Latitude 7420	GKHD6G3	

Table 3.6-4: *Inter-connection cables*

Cable description	From	To	Length (m)
N/A			

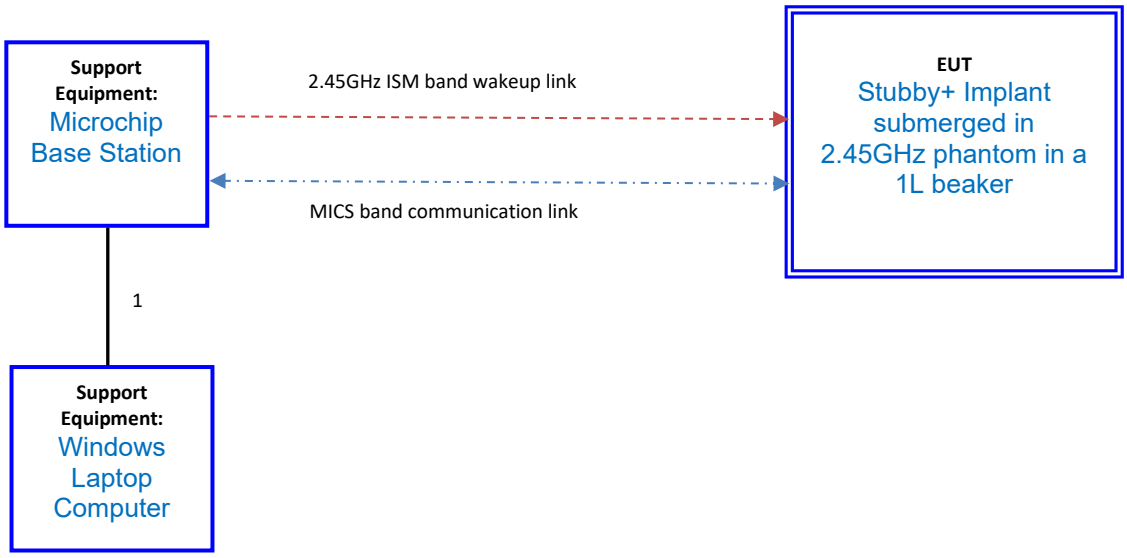

Figure 3.6-1: Test setup diagram

Section 4 Engineering considerations

4.1 Modifications incorporated in the EUT

None.

4.2 Technical judgement

None.

4.3 Deviations from laboratory test procedures

None.

Section 5 Test conditions

5.1 Atmospheric conditions

Temperature	15–30 °C
Relative humidity	20–75 %
Air pressure	86–106 kPa

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.

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

Nemko USA Inc. has calculated measurement uncertainty and is documented in EMC/MUC/001 "Uncertainty in EMC measurements." Measurement uncertainty was calculated using the methods described in CISPR 16-4-2 Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainties, statistics, and limit modelling – Measurement instrumentation uncertainty. The expression of Uncertainty in EMC testing. Measurement uncertainty calculations assume a coverage factor of K=2 with 95% certainty.

Table 6.1-1: *Measurement uncertainty calculations*

Measurement		**U_{cispr} dB**	**U_{lab} dB**
Conducted disturbance at AC mains and other port power using a V-AMN	9 kHz to 150 kHz	3.8	2.9
	150 kHz to 30 MHz	3.4	2.3
Conducted disturbance at telecommunication port using AAN	150 kHz to 30 MHz	5.0	4.3
Conducted disturbance at telecommunication port using CVP	150 kHz to 30 MHz	3.9	2.9
Conducted disturbance at telecommunication port using CP	150 kHz to 30 MHz	2.9	1.4
Conducted disturbance at telecommunication port using CP and CVP	150 kHz to 30 MHz	4.0	3.1
Radiated disturbance (electric field strength in a SAC)	30 MHz to 1 GHz	6.3	5.5
Radiated disturbance (electric field strength in a FAR)	1 GHz to 6 GHz	5.2	4.7
Radiated disturbance (electric field strength in a FAR)	6 GHz to 18 GHz	5.5	5.0

Notes: Compliance assessment:

If U_{lab} is less than or equal to U_{cispr} then:

- compliance is deemed to occur is no measured disturbance level exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance level exceeds the disturbance limit

If U_{lab} is greater than U_{cispr} then:

- compliance is deemed to occur is no measured disturbance level, increased by (U_{lab} - U_{cispr}), exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance level, increased by (U_{lab} - U_{cispr}), exceeds the disturbance limit

V-AMN: V type artificial mains network
AAN: Asymmetric artificial network
CP: Current probe
CVP: Capacitive voltage probe
SAC: Semi-anechoic chamber
FAR: Fully anechoic room

Section 7 Test equipment

7.1 Test equipment list

Table 7.1-1: *Test equipment list*

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
Antenna, Horn (1)	EMCO	3115	0529	NCR	NCR
Antenna, Bilog	Schaffner	CBL 6111D	1763	2 years	01-Apr-2024
Signal and Spectrum Analyzer	Rohde & Schwarz	FSV40	E1120	2 years	28-Aug-2025
EMI Test Receiver	Rohde & Schwarz	ESU 40	E1121	1 year	23-Aug-2024
DRG Horn (medium	ETS-Lindgren	3117-PA	E1160	NCR	NCR
Temperature Chamber	Thermotron	WP-605	S1033	1 year	27-Jan-2024
System controller	Sunol Sciences	SC104V	E1191	NCR	NCR

Notes: N/A – not applicable
NCR – no calibration required
VOU – verify on use
(1) Antenna used for frequency stability only. Calibration not required for frequency measurement.

Table 7.1-2: *Test software details*

Manufacturer of Software	Details
Rohde & Schwarz	EMC 32 V10.60.15

Notes: None

Section 8 Testing data

8.1 Frequency accuracy

8.1.1 References and limits

- §95.2565
- Test method: ANSI C63.10

Each MedRadio transmitter type must be designed to maintain a frequency stability of ±100 ppm of the operating frequency over the applicable temperature range set forth in this section. Frequency stability testing shall be performed over the appropriate temperature range.

(a) 25 °C to 45 °C in the case of medical implant transmitters; and
(b) 0 °C to 55 °C in the case of MedRadio programmer/control transmitters and medical body-worn transmitters

8.1.2 Test summary

Verdict	Pass		
Test date	December 12, 2023	Temperature	22 °C
Test engineer	Chenhao Ma, Wireless test technician	Air pressure	1015 mbar
Test location	☐ 10m semi anechoic chamber ☐ 3m semi anechoic chamber ☒ Wireless bench ☐ Other:	Relative humidity	45 %

8.1.3 Notes

The test was performed as a radiated measurement. The EUT was configured to transmit at maximum power on the middle channel.

8.1.4 Setup details

EUT power input during test	Battery power supply
EUT setup configuration	☒ Table-top ☐ Floor standing ☐ Other:

Receiver/spectrum analyzer settings:

Resolution bandwidth	1% - 5% OBW
Video bandwidth	3*RBW
Span	Between two times and five times OBW
Detector mode	Peak
Trace mode	Max Hold
Measurement time	Long enough for trace to stabilize
Measurement method:	Marker signal count function of spectrum analyzer

8.1.5 Test data

Table 8.1-1: *Frequency accuracy test results*

Temperature (°C)	Center Frequency (Hz)	Drift (ppm)	Limit	Verdict
25	403.6495	-1.238696891	100	PASS
30	403.6465	-8.670878236	100	PASS
35	403.6465	-8.670878236	100	PASS
40	403.6475	-6.193484454	100	PASS
45	403.648	-4.954787563	100	PASS

Note: Middle channel, 403.65 MHz was evaluated.

8.2 Field strength of fundamental

8.2.1 References and limits

- §95.2567(a)
- Test method: ANSI C63.10

Each MedRadio transmitter type must be designed such that the MedRadio equivalent isotropically radiated power (M-EIRP) does not exceed the limits in this section. Compliance with these limits must be determined as set forth in §95.2569.

(a) Transmitters subject to frequency monitoring—401-406 MHz. For MedRadio transmitters that are not excepted under §95.2559(b) from the frequency monitoring requirements of §95.2559(a):
(1) The M-EIRP within any 300 kHz bandwidth within the 402-405 MHz band must not exceed 25 microwatts.

8.2.2 Test summary

Verdict	Pass		
Test date	December 11, 2023	Temperature	19 °C
Test engineer	Chenhao Ma, Wireless test technician	Air pressure	1008 mbar
Test location	☒ 10m semi anechoic chamber ☐ 3m semi anechoic chamber ☐ Other:	Relative humidity	44 %

8.2.3 Notes

The test was performed as a radiated measurement. The EUT was configured to transmit at maximum power on the lowest, middle, and highest channel. The limit of 25 µW was converted to the equivalent field strength at 3 m measurement distance in dBµV/m:

1. Convert µW to dBm: 25 µW = 0.025 mW => 10 x LOG10(0.025) = -16.02 dBm
2. Convert dBm to dBµV/m at 3 m measurement distance (ERP): = EIRP (dBm) + 97.38 = -16.02 + 97.38 = 81.36 dBµV/m @ 3 m

8.2.4 Setup details

EUT power input during test	Battery powered
EUT setup configuration	☒ Table-top ☐ Floor standing ☐ Other:
Measuring distance	☐ 10m ☒ 3m ☐ Other:
Antenna height variation	1 – 4 m
Turn table position	0 – 360°
Measurement details	Preview measurements were performed with the receiver in continuous scan or sweep mode. Emissions detected within 6 dB or above limit (minimum of 6 frequencies) were maximized by rotating the EUT and adjusting the antenna height and polarization. At the position of maximum emission, the signal was measured with the appropriate detector against the corresponding limit and recorded as the final measurement.

Receiver/spectrum analyzer settings for frequencies below 1 GHz:

Resolution bandwidth	300 kHz
Video bandwidth	1000 MHz
Detector mode	– Peak
Trace mode	Max Hold
Measurement time	– 100 ms (Peak preview measurement) – 5000 ms (Final measurement)

8.2.5 Test data

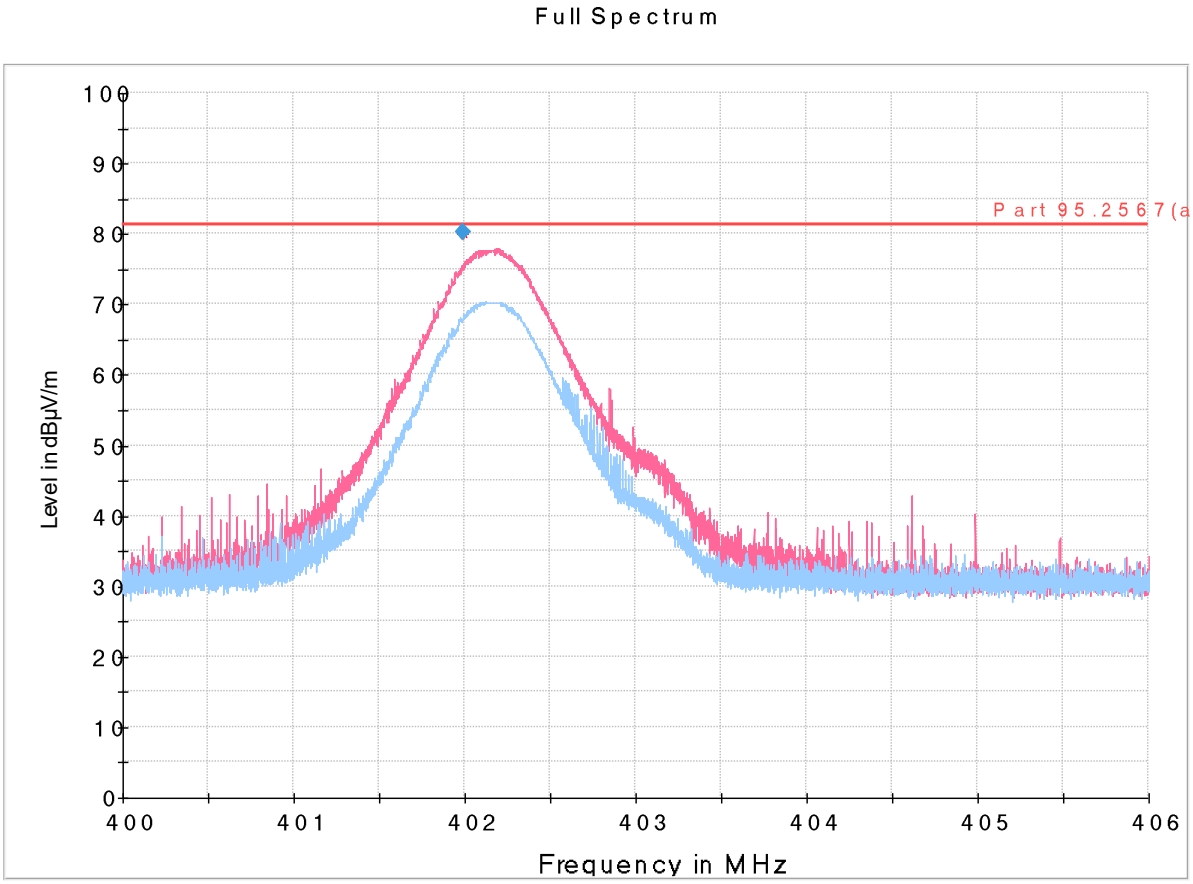

Figure 8.2-1: *Field strength of fundamental, low channel (402.15 MHz) plot (400 MHz - 406 MHz)*

Table 8.2-1*: Field strength of fundamental, low channel (402.15 MHz) results*

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
401.987800	**80.15**	**81.38**	**1.23**	**5000.0**	**300.000**	**137.0**	**V**	**247.0**	**24.8**

Notes:
[1] Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB)
[3] Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

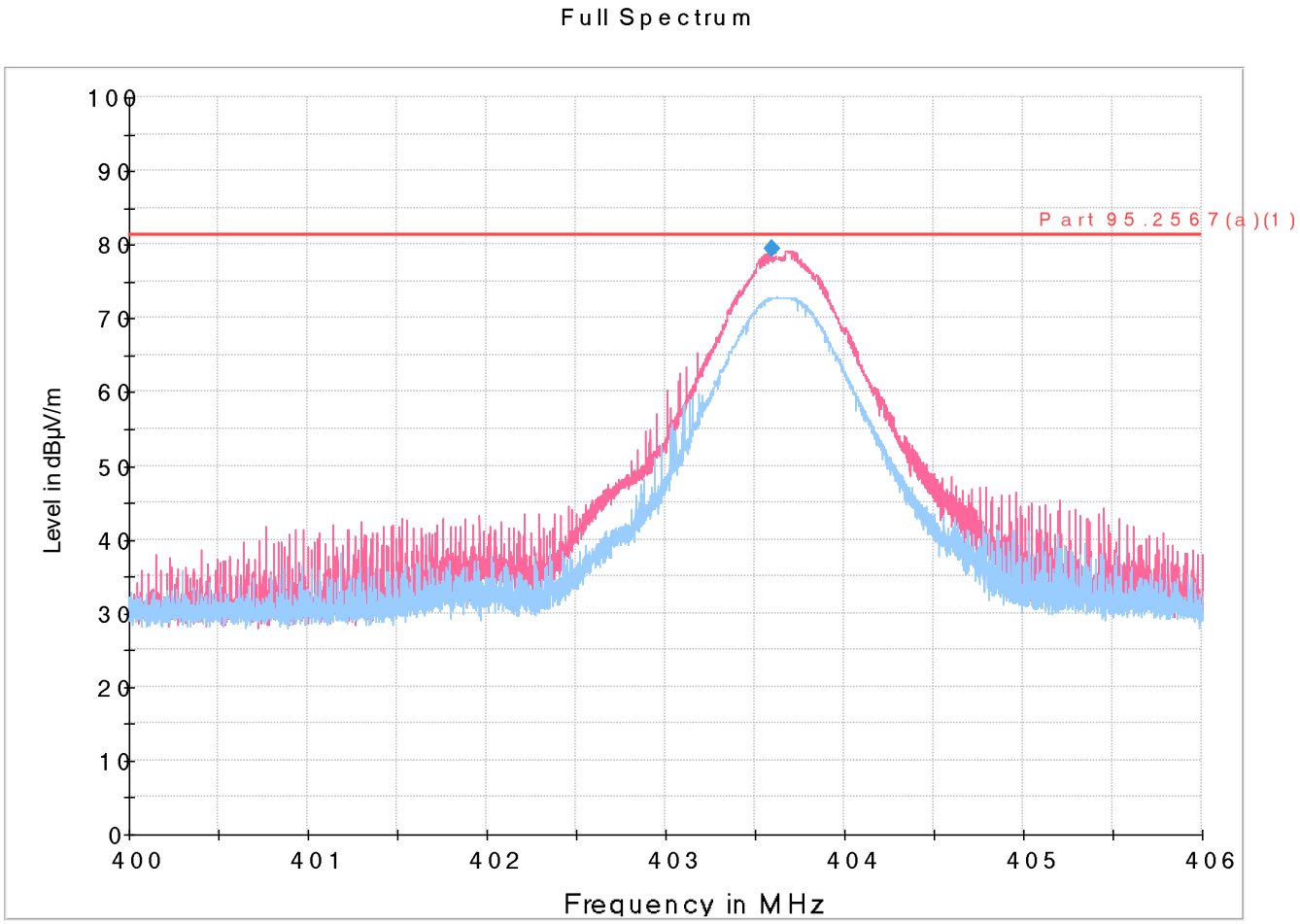

Figure 8.2-2: *Field strength of fundamental, mid channel (403.65 MHz) plot (400 MHz - 406 MHz)*

Table 8.2-2*: Field strength of fundamental, mid channel (403.65 MHz) results*

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
403.600000	79.42	81.38	1.96	5000.0	300.000	113.0	V	244.0	24.8

Notes:
[1] Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB)
[3] Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

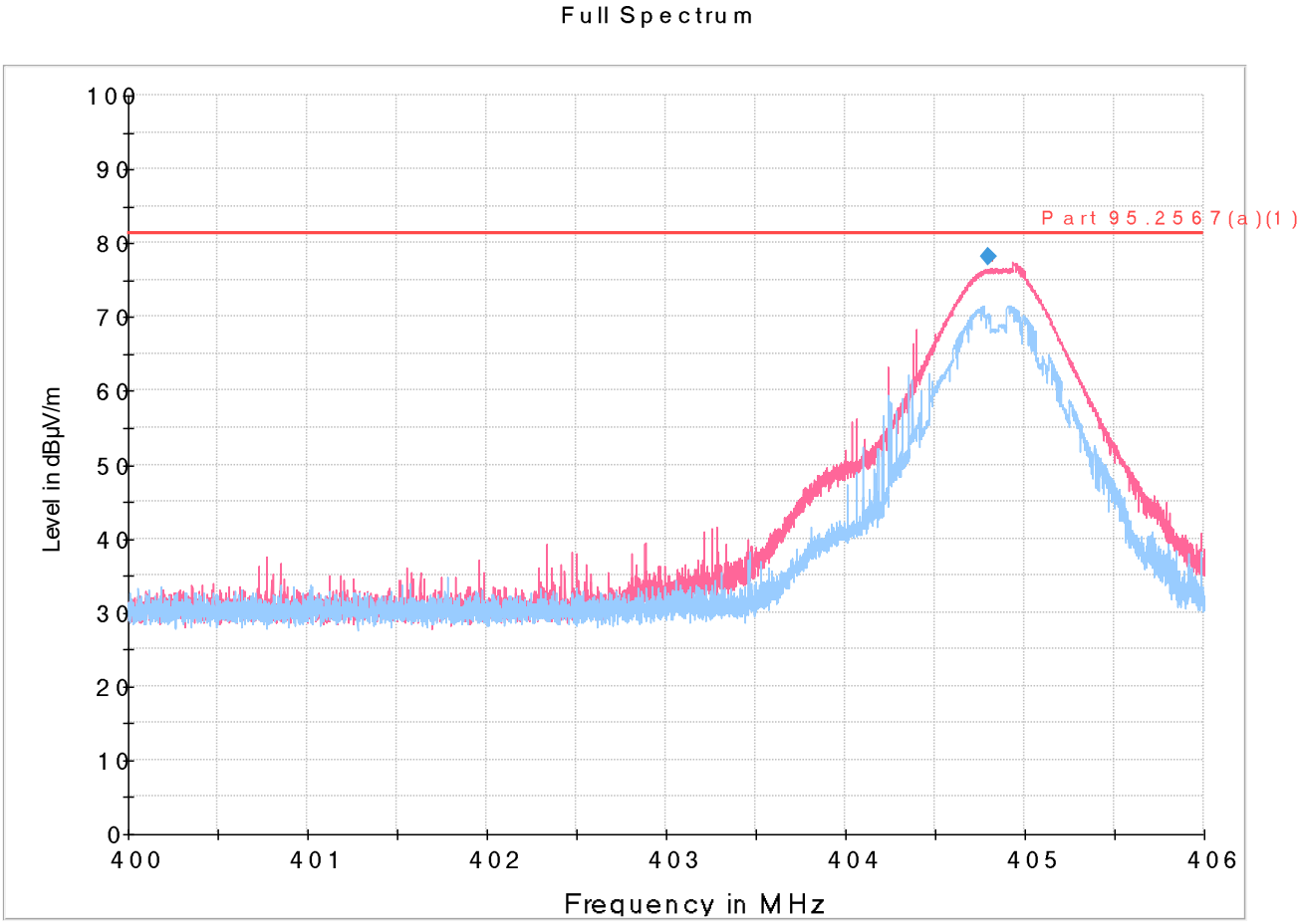

Figure 8.2-3: *Radiated emissions spectral plot, high channel (404.85 MHz) plot (400 MHz - 406 MHz)*

Table 8.2-3*: Radiated emissions, high channel (404.85 MHz) results*

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
404.800200	**78.03**	**81.38**	**3.35**	**5000.0**	**300.000**	**106.0**	**V**	**249.0**	**24.9**

Notes:
[1] Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB)
[3] Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

Final Results:

Table 8.2-4*: M-EIRP final results*

Channel (MHz)	Field Strength @ 3m (dBµV/m)	M-EIRP (dBm)	M-EIRP (µW)	Limit (µW)
402.15	80.15	-17.23	18.923	25
403.65	79.42	-17.96	15.996	25
404.85	78.03	-19.35	11.614	25

Sample Calculation (403.65 MHz):
M-EIRP (dBm) = Field Strength @ 3m (dBµV/m) – 97.38
M-EIRP (dBm) = 79.42 – 97.38
M-EIRP (dBm) = -17.96 dBm

M-EIRP (µW) = 10^ (ERP (dBm)/10) *1000
M-EIRP (µW) = 10^ (-17.96/10) *1000
M-EIRP (µW) = 15.996 µW

8.3 Emission bandwidth; 20 dB bandwidth

8.3.1 References and limits

- §95.2573(a)
- Test method: ANSI C63.10

Each MedRadio transmitter type must be designed such that the MedRadio emission bandwidth does not exceed the applicable authorized bandwidth set forth in this section.

(a) For MedRadio transmitters operating in the 402-405 MHz band, the maximum authorized bandwidth is 300 kHz. Such transmitters must not use more than 300 kHz of bandwidth (total) during a MedRadio communications session. This provision does not preclude full duplex or half duplex communications provided that the total bandwidth of all of the channels employed in a MedRadio communications session does not exceed 300 kHz.

8.3.2 Test summary

Verdict	Pass		
Test date	December 11, 2023	Temperature	19 °C
Test engineer	Chenhao Ma, Wireless test technician	Air pressure	1008 mbar
Test location	☐ 10m semi anechoic chamber ☒ 3m semi anechoic chamber ☐ Other:	Relative humidity	44 %

8.3.3 Notes

The test was performed as a radiated measurement with the EUT oriented to the position of maximum fundamental emission. The EUT was configured to transmit at maximum power on the lowest, middle, and highest channels.

8.3.4 Setup details

EUT power input during test	Battery powered
EUT setup configuration	☒ Table-top ☐ Floor standing ☐ Other:

Receiver / spectrum analyzer settings:

Resolution bandwidth	1% - 5% OBW
Video bandwidth	3*RBW
Span	Between 1.5 times and 5 times OBW
Detector mode	Peak
Trace mode	Max Hold
Measurement time	Long enough for trace to stabilize

8.3.5 Test data

Table 8.3-1: *Emission bandwidth; 20 dB bandwidth test results*

Test Frequency (MHz)	20 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)
402.15	269.23	300	30.77
403.65	263.46	300	36.54
404.85	275.96	300	24.04

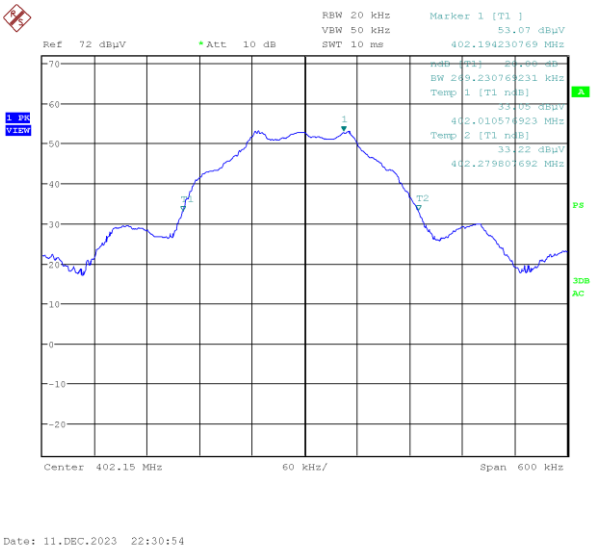

Figure 8.3-1: *Emission bandwidth; 20 dB bandwidth, low channel (402.15 MHz)*

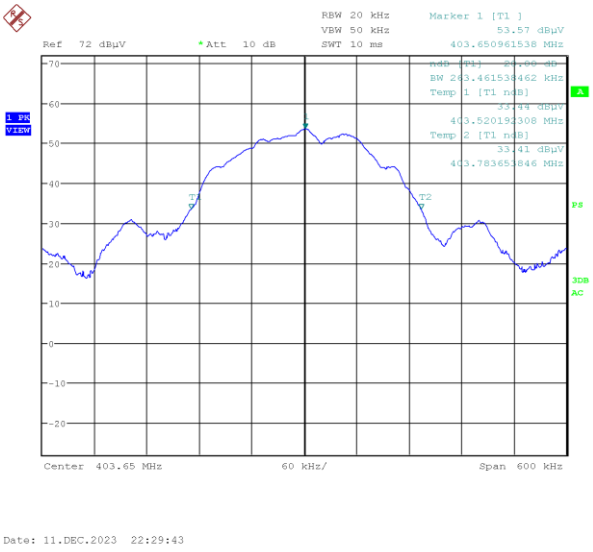

Figure 8.3-2: *Emission bandwidth; 20 dB bandwidth, mid channel (403.65 MHz)*

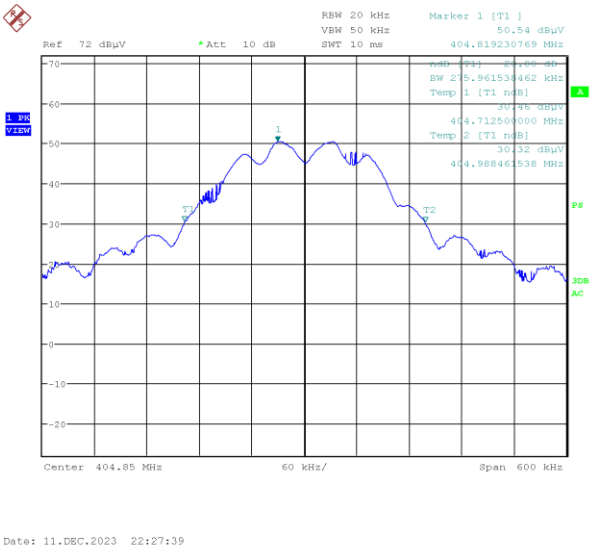

Figure 8.3-3: *Emission bandwidth; 20 dB bandwidth, high channel (404.85MHz)*

8.4 Transmitter unwanted emissions and band edges

8.4.1 References and limits

- §95.2579
- Test method: ANSI C63.10

Unwanted emission field strength limits and attenuation requirements apply to each MedRadio transmitter type, as set forth in this section and part 2.

(a) Field strength limits. The field strengths of unwanted emissions from each MedRadio transmitter type, measured at a distance of 3 meters, must not exceed the field strength limits shown in the table in this paragraph for the indicated frequency ranges, if the frequencies of these emissions are:

(1) More than 250 kHz outside of the 402-405 MHz band (for devices designed to operate in the 402-405 MHz band);

Frequency (MHz)	Field strength (µV/m at 3 meters)
30 – 88	100
88 – 216	150
216 – 960	200
Above 960	500

Note to table in paragraph (a)(5): At the boundaries between frequency ranges, the tighter limit (lower field strength) applies. Below 1 GHz, field strength is measured using a CISPR quasi-peak detector. Above 1 GHz, field strength is measured using an average detector with a minimum reference bandwidth of 1 MHz. See also part 2, subpart J of this chapter.

(b) Harmonic emissions. Radiated unwanted emissions from a MedRadio transmitter type must be measured to at least the tenth harmonic of the highest fundamental frequency emitted.

(c) Attenuation requirements, 402-405 MHz. For MedRadio transmitter types designed to operate in the 402-405 MHz band, unwanted emissions must be attenuated below the maximum permitted transmitter output power by at least:

(1) 20 dB, on any frequency within the 402-405 MHz band that is more than 150 kHz away from the center frequency of the occupied bandwidth;

(g) Measurements. Compliance with the limits in paragraphs (c), (d), and (e) of this section is based on the use of measurement instrumentation using a peak detector function with an instrument reference bandwidth approximately equal to 1.0 percent of the emission bandwidth of the device under measurement.

8.4.2 Test summary

Verdict	Pass		
Test date	December 11, 2023	Temperature	19 °C
Test engineer	Chenhao Ma, wireless test technician	Air pressure	1008 mbar
Test location	☐ 10m semi anechoic chamber ☒ 3m semi anechoic chamber ☐ Other:	Relative humidity	44 %

8.4.3 Notes

The test was performed as a radiated measurement. The EUT was configured to transmit at maximum power on the middle channel. The spectrum was searched from 30 MHz to 5 GHz (> 10th harmonic of the highest transmit frequency). Measurements were performed at a 3 m measurement distance. Spectral plots are corrected with their associate transducer factors (i.e., antenna factors, cable loss, amplifier gains, etc.).

8.4.4 Setup details

EUT power input during test	Battery powered
EUT setup configuration	☒ Table-top ☐ Floor standing ☐ Other:
Measuring distance	☐ 10m ☒ 3m ☐ Other:
Antenna height variation	1 – 4 m
Turn table position	0 – 360°
Measurement details	Preview measurements were performed with the receiver in continuous scan or sweep mode. Emissions detected within 6 dB or above limit (minimum of 6 frequencies) were maximized by rotating the EUT and adjusting the antenna height and polarization. At the position of maximum emission, the signal was measured with the appropriate detector against the corresponding limit and recorded as the final measurement.

Receiver/spectrum analyzer settings for frequencies below 1 GHz:

Resolution bandwidth	120 kHz
Detector mode	– Peak (Preview measurement) – Quasi-peak (Final measurement)
Trace mode	Max Hold
Measurement time	– 100 ms (Peak preview measurement) – 5000 ms (Quasi-peak final measurement)

Receiver/spectrum analyzer settings for frequencies above 1 GHz:

Resolution bandwidth	1 MHz
Detector mode	Peak (Preview measurement) Peak and Average (Final measurement)
Trace mode	Max Hold
Measurement time	– 100 ms (Peak preview measurement) – 5000 ms (Peak and Average final measurement)

8.4.5 Test data

***Table 8.4-1**: Radiated emissions results summary*

Frequency (MHz)	Field strength Limit (µV/m at 3 meters)	Field strength limit (dBµV/m at 3 meters)	Verdict (worst case margin)
30 – 88	100	40.0 (quasi-peak)	Pass (9.29 dB)
88 – 216	150	43.5 (quasi-peak)	Pass (16.20 dB)
216 – 960	200	46.0 (quasi-peak)	Pass (11.51 dB)
Above 960	500	53.9 (average)	Pass (20.10 dB)
		73.9 (peak)	Pass (31.65 dB)

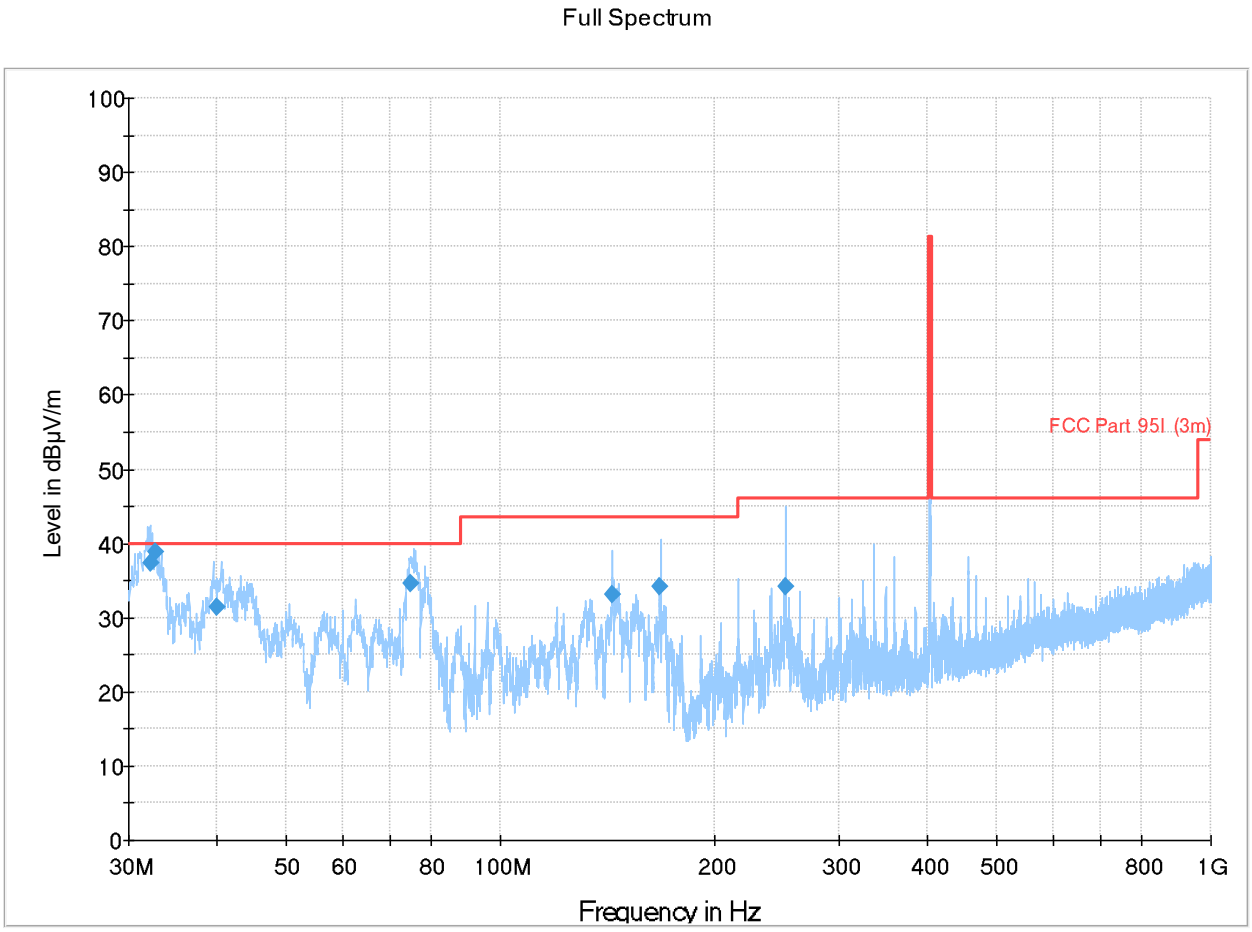

***Figure 8.4-1:** Radiated emissions spectral plot, low channel (402.15 MHz) (30 MHz - 1 GHz)*

***Table 8.4-2**: Radiated emissions, low channel (402.15 MHz) results*

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
32.186333	37.38	40.00	2.62	5000.0	120.000	124.0	V	150.0	24.0
32.739333	38.75	40.00	1.25	5000.0	120.000	104.0	V	31.0	23.6
39.981333	31.43	40.00	8.57	5000.0	120.000	107.0	V	99.0	19.1
74.968333	34.56	40.00	5.44	5000.0	120.000	131.0	V	346.0	13.5
144.014667	33.08	43.50	10.42	5000.0	120.000	168.0	V	100.0	18.6
167.723333	34.25	43.50	9.25	5000.0	120.000	206.0	H	0.0	16.9
251.459000	34.15	46.00	11.85	5000.0	120.000	187.0	V	51.0	20.4

Notes:
[1] Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB)
[3] Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

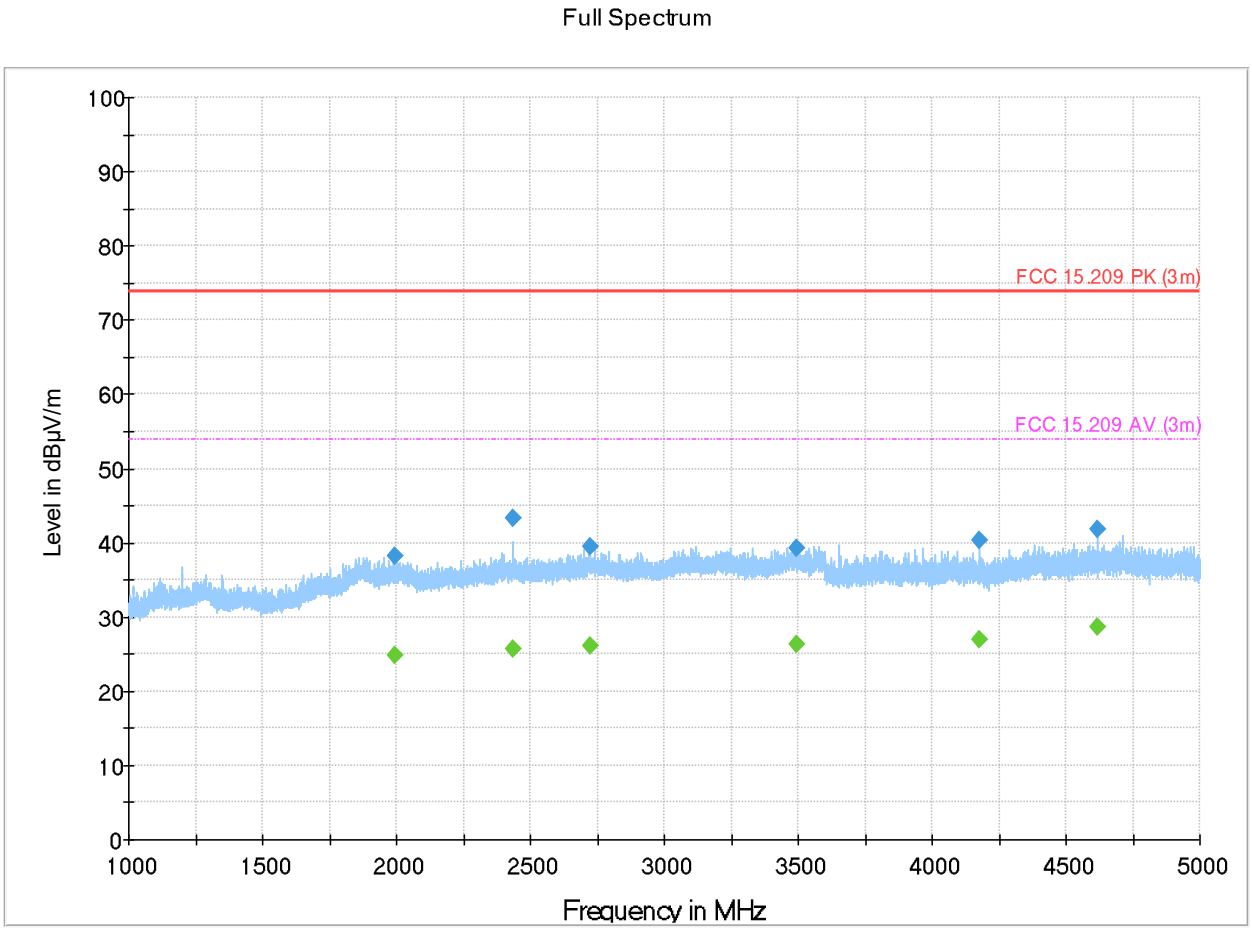

Figure 8.4-2: *Radiated emissions spectral plot, low channel (402.15 MHz) (1 GHz - 5 GHz)*

Table 8.4-3*: Radiated emissions, low channel (402.15 MHz) results*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1994.549100	---	24.87	53.90	29.03	5000.0	1000.000	189.0	H	0.0	-10.8
1994.549100	38.28	---	73.90	35.62	5000.0	1000.000	189.0	H	0.0	-10.8
2436.764266	43.34	---	73.90	30.56	5000.0	1000.000	317.0	H	317.0	-9.8
2436.764266	---	25.69	53.90	28.21	5000.0	1000.000	317.0	H	317.0	-9.8
2722.373167	---	26.04	53.90	27.86	5000.0	1000.000	227.0	H	312.0	-8.7
2722.373167	39.38	---	73.90	34.52	5000.0	1000.000	227.0	H	312.0	-8.7
3496.865667	---	26.24	53.90	27.66	5000.0	1000.000	372.0	V	259.0	-6.4
3496.865667	39.22	---	73.90	34.68	5000.0	1000.000	372.0	V	259.0	-6.4
4179.312700	40.36	---	73.90	33.54	5000.0	1000.000	289.0	H	199.0	-3.6
4179.312700	---	26.95	53.90	26.95	5000.0	1000.000	289.0	H	199.0	-3.6
4617.754533	---	28.68	53.90	25.22	5000.0	1000.000	360.0	V	21.0	-2.0
4617.754533	41.81	---	73.90	32.09	5000.0	1000.000	360.0	V	21.0	-2.0

Notes: [1] Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB)
[3] Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

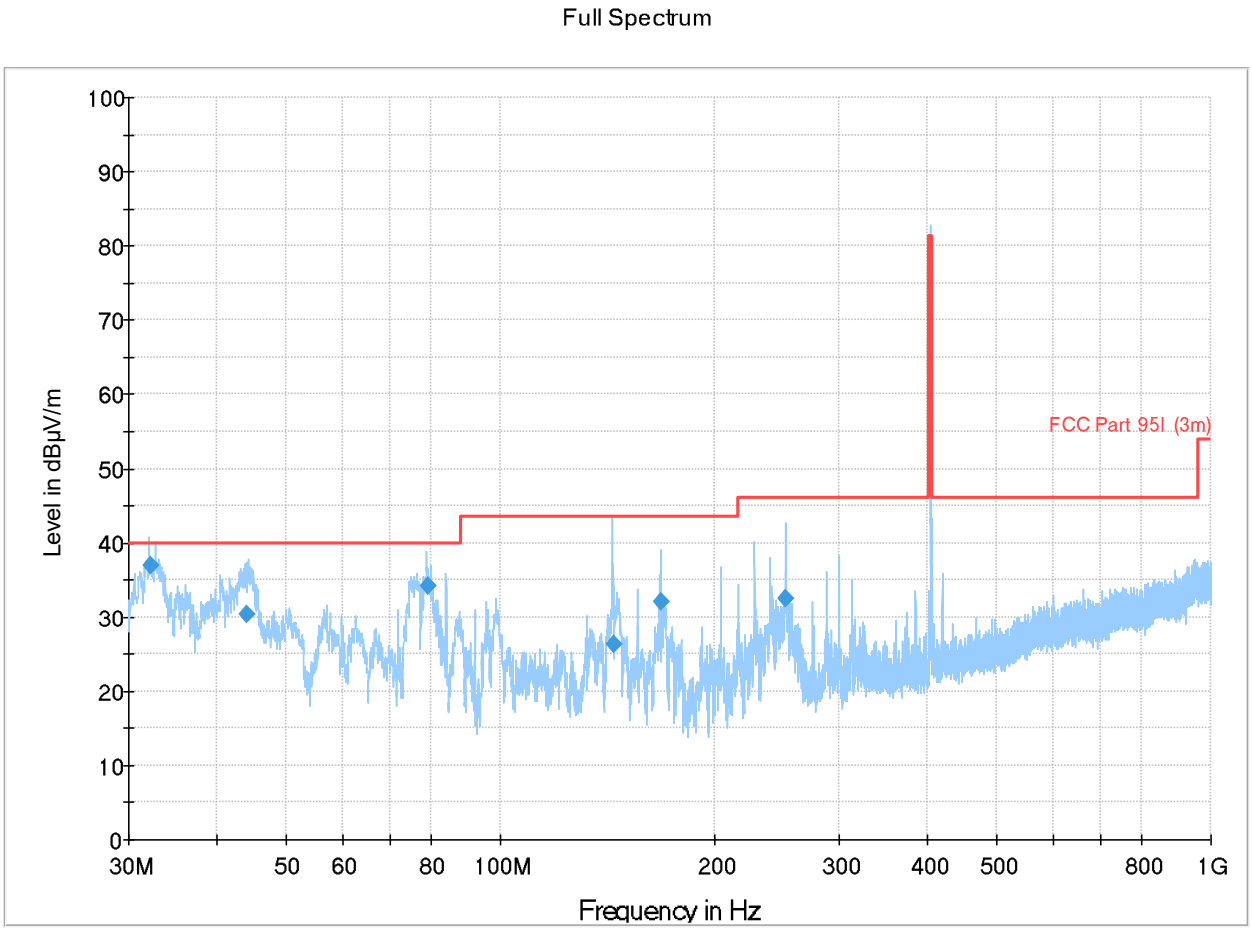

Figure 8.4-3: *Radiated emissions spectral plot, mid channel (403.65 MHz) (30 MHz - 1 GHz)*

Table 8.4-4*: Radiated emissions, mid channel (403.65 MHz) results*

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
32.161667	36.95	40.00	3.05	5000.0	120.000	104.0	V	124.0	24.0
44.086667	30.37	40.00	9.63	5000.0	120.000	130.0	V	260.0	16.9
78.937000	34.18	40.00	5.82	5000.0	120.000	117.0	V	146.0	13.9
144.595000	26.24	43.50	17.26	5000.0	120.000	137.0	V	238.0	18.6
168.157333	32.07	43.50	11.43	5000.0	120.000	113.0	H	88.0	16.9
251.891333	32.50	46.00	13.50	5000.0	120.000	114.0	H	296.0	20.5

Notes:
[1] Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB)
[3] Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

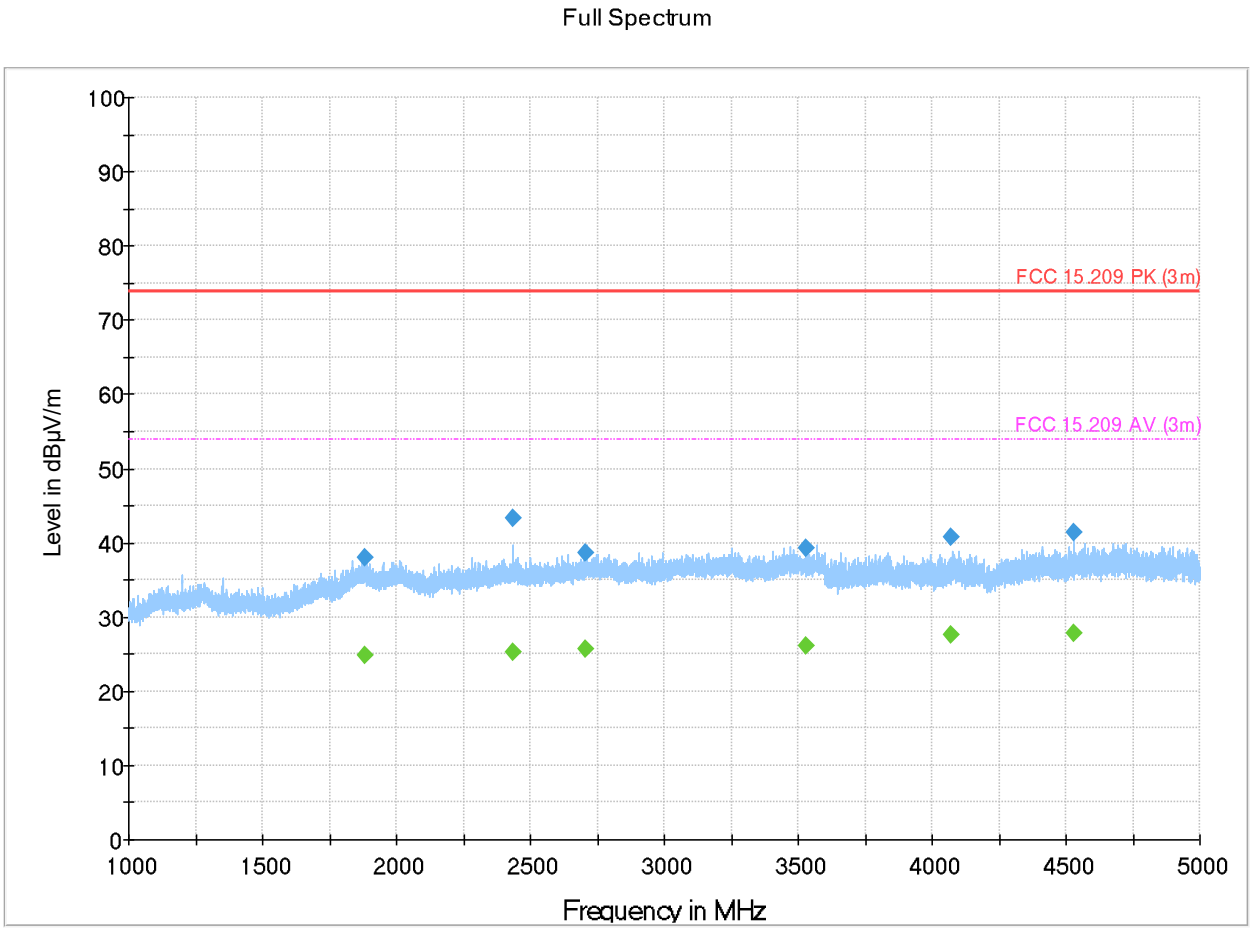

Figure 8.4-4: *Radiated emissions spectral plot, mid channel (403.65 MHz) (1 GHz - 5 GHz)*

Table 8.4-5*: Radiated emissions, mid channel (403.65 MHz) results*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1882.490700	38.06	---	73.90	35.84	5000.0	1000.000	210.0	H	339.0	-10.7
1882.490700	---	24.91	53.90	28.99	5000.0	1000.000	210.0	H	339.0	-10.7
2437.261467	---	25.22	53.90	28.68	5000.0	1000.000	319.0	H	160.0	-9.8
2437.261467	43.38	---	73.90	30.52	5000.0	1000.000	319.0	H	160.0	-9.8
2708.644800	38.55	---	73.90	35.35	5000.0	1000.000	372.0	V	98.0	-8.7
2708.644800	---	25.76	53.90	28.14	5000.0	1000.000	372.0	V	98.0	-8.7
3528.642733	39.30	---	73.90	34.60	5000.0	1000.000	100.0	V	287.0	-6.1
3528.642733	---	26.09	53.90	27.81	5000.0	1000.000	100.0	V	287.0	-6.1
4070.934300	---	27.61	53.90	26.29	5000.0	1000.000	319.0	H	172.0	-3.5
4070.934300	40.76	---	73.90	33.14	5000.0	1000.000	319.0	H	172.0	-3.5
4531.031300	41.46	---	73.90	32.44	5000.0	1000.000	311.0	H	292.0	-2.2
4531.031300	---	27.84	53.90	26.06	5000.0	1000.000	311.0	H	292.0	-2.2

Notes: [1] Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB)
[3] Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

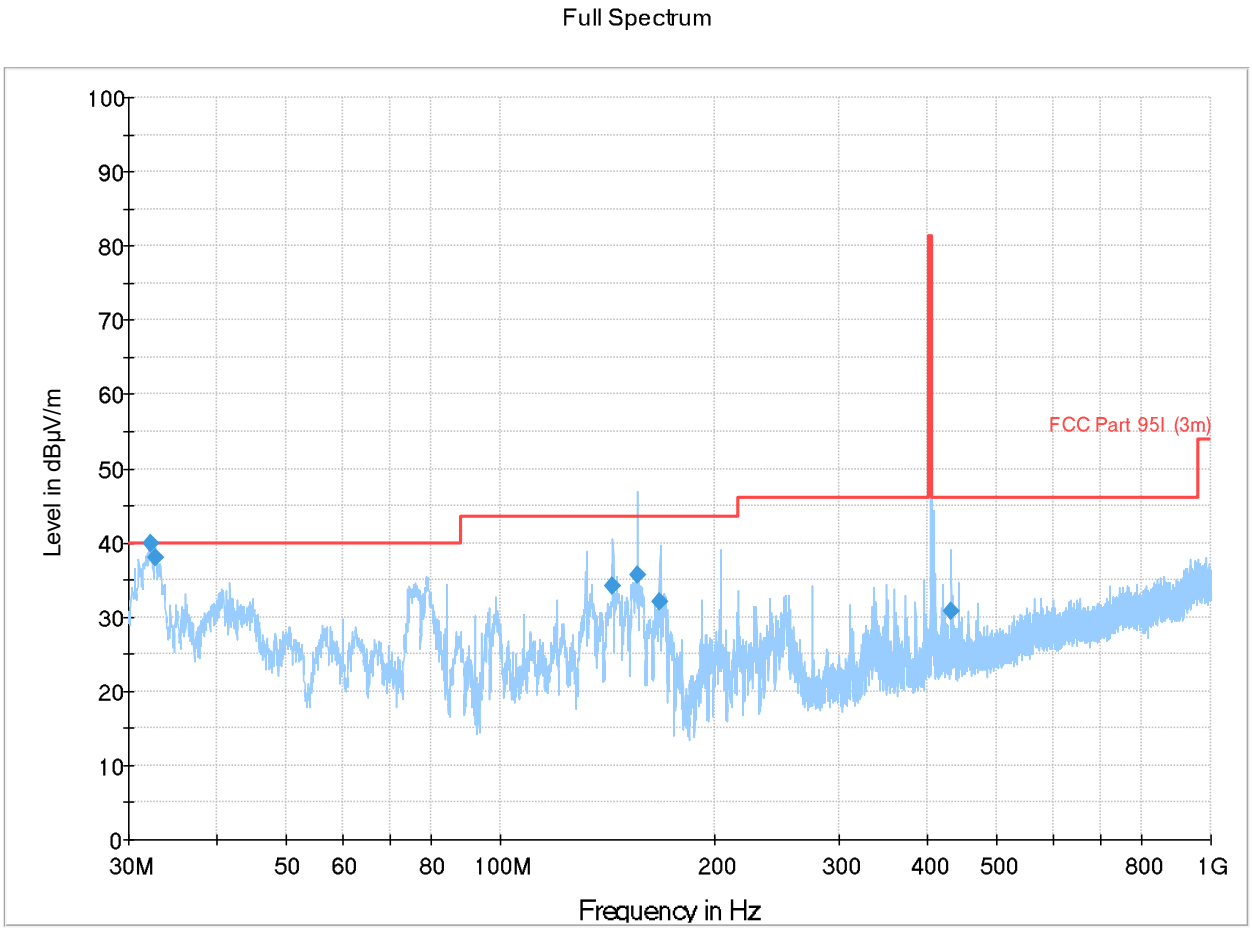

Figure 8.4-5: *Radiated emissions spectral plot, high channel (404.85 MHz) (30 MHz - 1 GHz)*

Table 8.4-6*: Radiated emissions, high channel (404.85 MHz) results*

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
32.165000	39.86	40.00	0.14	5000.0	120.000	100.0	V	149.0	24.0
32.758000	38.05	40.00	1.95	5000.0	120.000	113.0	V	89.0	23.6
144.124333	34.23	43.50	9.27	5000.0	120.000	144.0	V	321.0	18.6
155.943000	35.72	43.50	7.78	5000.0	120.000	375.0	H	159.0	17.7
167.738667	32.14	43.50	11.36	5000.0	120.000	192.0	H	238.0	16.9
431.514000	30.72	46.00	15.28	5000.0	120.000	107.0	H	32.0	25.4

Notes:
[1] Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB)
[3] Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

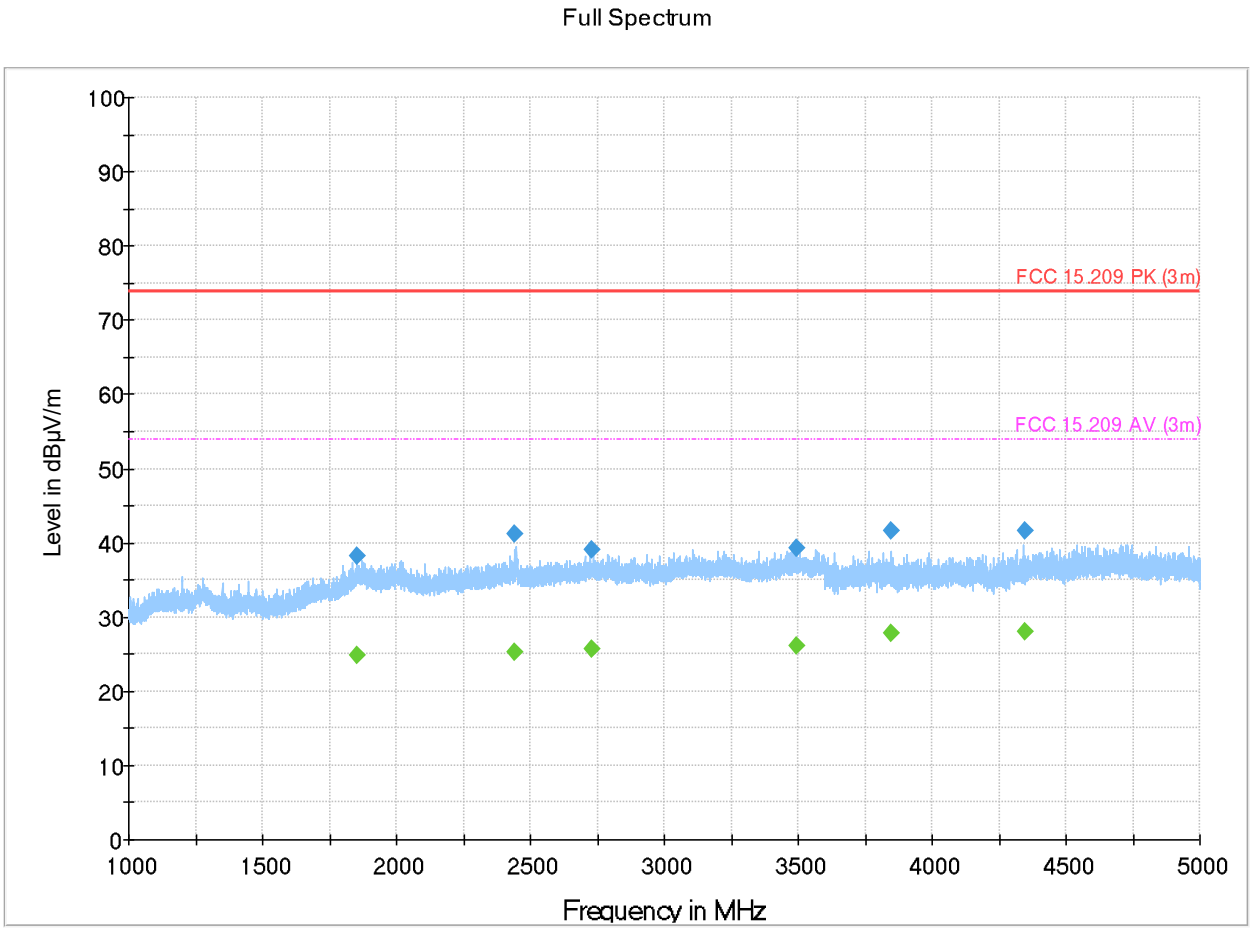

Figure 8.4-6: *Radiated emissions spectral plot, high channel (404.85 MHz) (1 GHz - 5 GHz)*

Table 8.4-7*: Radiated emissions, high channel (404.85 MHz) results*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1854.359000	38.18	---	73.90	35.72	5000.0	1000.000	390.0	V	252.0	-11.2
1854.359000	---	24.76	53.90	29.14	5000.0	1000.000	390.0	V	252.0	-11.2
2443.160934	41.14	---	73.90	32.76	5000.0	1000.000	276.0	H	0.0	-9.8
2443.160934	---	25.26	53.90	28.64	5000.0	1000.000	276.0	H	0.0	-9.8
2727.112334	39.16	---	73.90	34.74	5000.0	1000.000	399.0	V	258.0	-8.7
2727.112334	---	25.71	53.90	28.19	5000.0	1000.000	399.0	V	258.0	-8.7
3494.073566	39.18	---	73.90	34.72	5000.0	1000.000	400.0	H	331.0	-6.4
3494.073566	---	26.08	53.90	27.82	5000.0	1000.000	400.0	H	331.0	-6.4
3849.172100	---	27.74	53.90	26.16	5000.0	1000.000	100.0	H	21.0	-4.4
3849.172100	41.59	---	73.90	32.31	5000.0	1000.000	100.0	H	21.0	-4.4
4345.934034	---	27.92	53.90	25.98	5000.0	1000.000	387.0	V	11.0	-3.4
4345.934034	41.59	---	73.90	32.31	5000.0	1000.000	387.0	V	11.0	-3.4

Notes: [1] Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB)
[3] Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

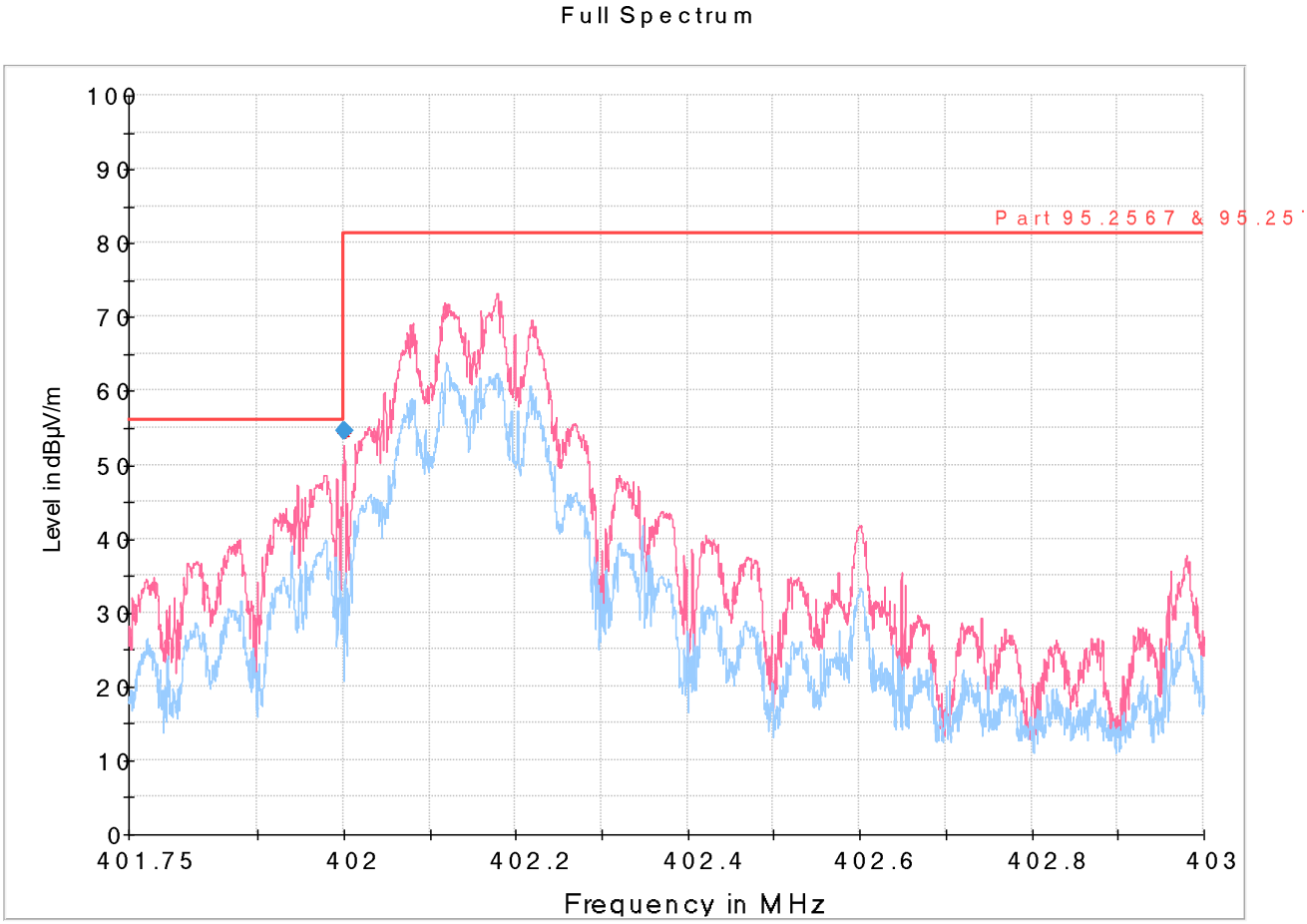

Figure 8.4-7: *Radiated emissions spectral plot, low band edge (401.75 MHz - 403 MHz)*

Table 8.4-8*: Radiated emissions, low band edge results*

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
402.000000	**54.47**	**56.00**	**1.53**	**5000.0**	**10.000**	**260.0**	**V**	**140.0**	**24.8**
402.000000	**54.60**	**56.00**	**1.40**	**5000.0**	**10.000**	**267.0**	**V**	**139.0**	**24.8**

Notes:
[1] Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB)
[3] Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

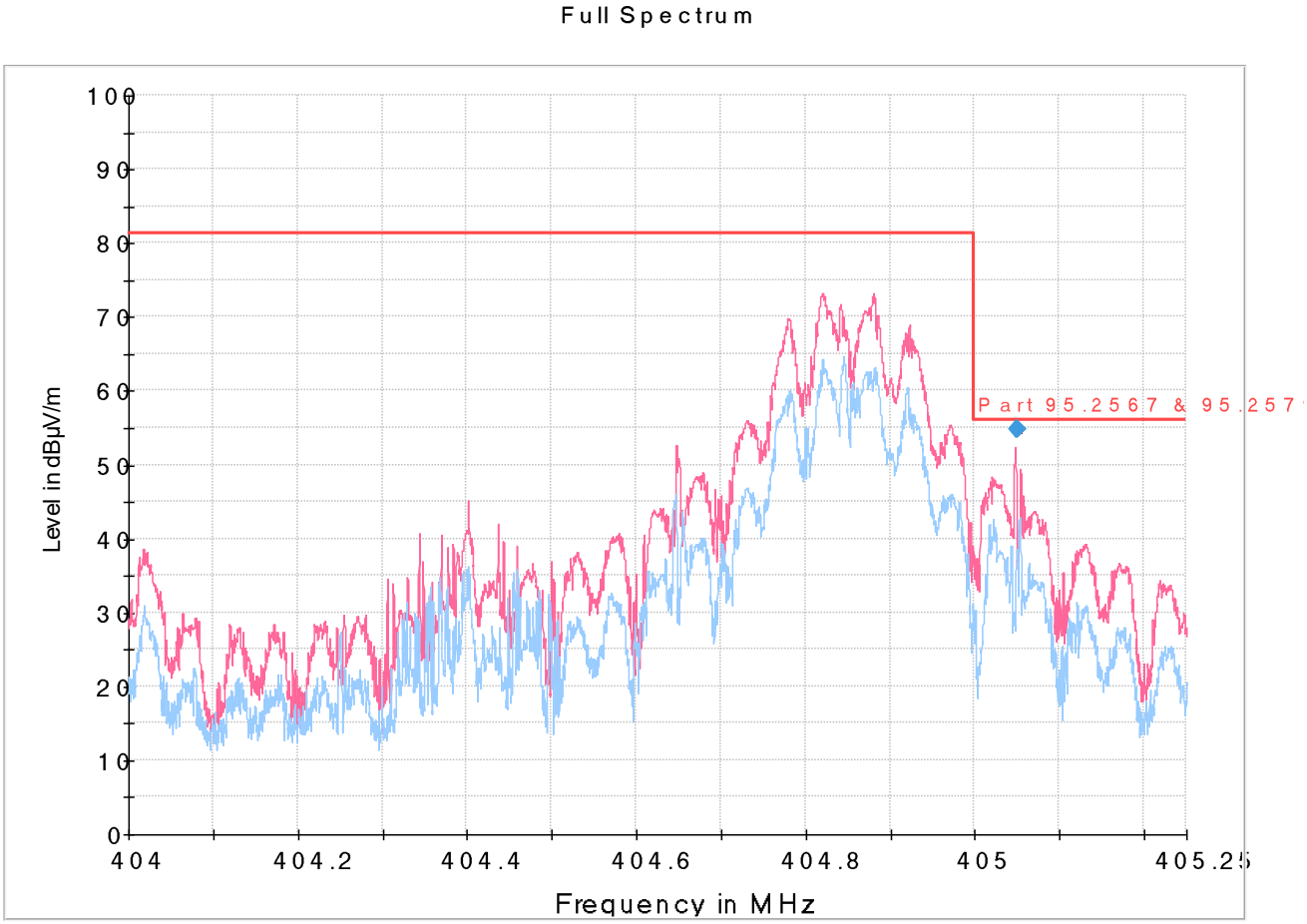

Figure 8.4-8: *Radiated emissions spectral plot, high band edge (404 MHz - 405.25 MHz)*

Table 8.4-9*: Radiated emissions, high band edge results*

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
405.050250	**54.81**	**56.00**	**1.19**	**5000.0**	**10.000**	**106.0**	**V**	**50.0**	**24.9**
405.050625	**54.77**	**56.00**	**1.23**	**5000.0**	**10.000**	**106.0**	**V**	**50.0**	**24.9**

Notes:
[1] Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB)
[3] Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

8.5 99% Occupied bandwidth

8.5.1 References and limits

- §2.202(a)
- Test method: ANSI C63.10

(a) Occupied bandwidth. The frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission. In some cases, for example multichannel frequency-division systems, the percentage of 0.5 percent may lead to certain difficulties in the practical application of the definitions of occupied and necessary bandwidth; in such cases a different percentage may prove useful.

8.5.2 Test summary

Verdict	Pass		
Test date	December 12, 2023	Temperature	22 °C
Test engineer	Chenhao Ma, Wireless test technician	Air pressure	1015 mbar
Test location	☐ 10m semi anechoic chamber ☒ 3m semi anechoic chamber ☐ Other:	Relative humidity	45 %

8.5.3 Notes

The test was performed as a radiated measurement with the EUT oriented to the position of maximum fundamental emission. The EUT was configured to transmit at maximum power on the lowest, middle, and highest channels.

8.5.4 Setup details

EUT power input during test	Battery powered
EUT setup configuration	☒ Table-top ☐ Floor standing ☐ Other:

Receiver / spectrum analyzer settings:

Resolution bandwidth	1% - 5% OBW
Video bandwidth	3*RBW
Span	Between 1.5 times and 5 times OBW
Detector mode	Peak
Trace mode	Max Hold
Measurement time	Long enough for trace to stabilize

8.5.5 Test data

Table 8.5-1: *99% Occupied bandwidth test results*

Test Frequency (MHz)	99% Bandwidth (kHz)
402.15	250.80
403.65	241.19
404.85	238.78

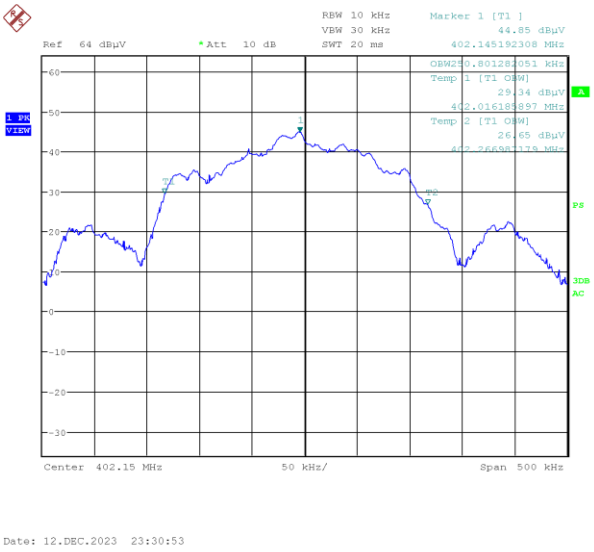

Figure 8.5-1: *99% Occupied bandwidth, low channel (402.15 MHz)*

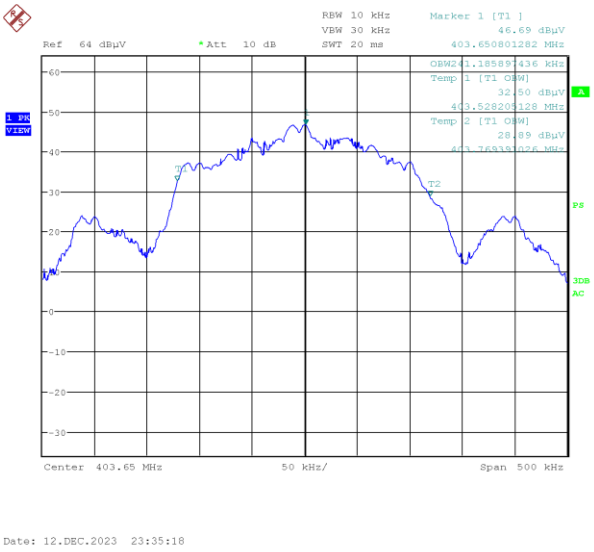

Figure 8.5-2: *99% Occupied bandwidth, mid channel (403.65 MHz)*

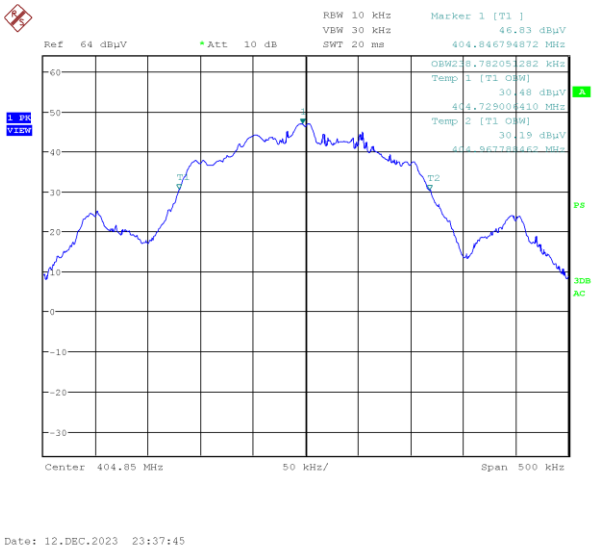

Figure 8.5-3: *99% Occupied bandwidth, high channel (404.85 MHz)*

End of test report