

TEST REPORT

of

FCC Part 15 Subpart C §15.247

FCC ID: RMN-CTS-RMDA-2G

Equipment Under Test : RF Module
Model Name : CTS-RMDA-2G
Variant Model Name(s) : -
Applicant : CanTops Co., Ltd.
Manufacturer : Cantops Co., Ltd.
Date of Receipt : 2026.07.13
Date of Test(s) : 2026.07.27 ~ 2026.08.28
Date of Issue : 2026.09.01

In the configuration tested, the EUT complied with the standards specified above.
This test report does not assure KOLAS accreditation.

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- 2) The SGS Korea is not responsible for the sampling, the results of this test report apply to the sample as received.
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- 4) The data marked ※ in this report was provided by the customer and may affect the validity of the test results.

We are responsible for all the information of this test report except for the data(※) provided by the customer

Tested by:



Finn Nam

Technical
Manager:



Jinhyoung Cho

SGS Korea Co., Ltd. Gunpo Laboratory

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1. General Information

1.1. Testing Laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)

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- 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807
- Designation number: KR0150

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1.2. Details of Applicant

FCC Applicant : CanTops Co., Ltd.

FCC Address : B-1202, Digital Empire BLDG, 16, Deongyeong-daero 1556beon-gil,
Yeongtong-gu, Suwon-si, Gyeonggi-do, South Korea, 16690

Contact Person : Han, Sang-gyu

Phone No. : +82 10 4607 6910

1.3. Details of Manufacturer

Company : Same as applicant

Address : Same as applicant

1.4. Description of EUT

Kind of Product		RF Module
Model Name		CTS-RDMA-2G
Serial Number		Conducted: 000001 Radiated: 000002
Power Supply		DC 3.3 V
Frequency Range		2 402 MHz ~ 2 480 MHz
Modulation Technique		GFSK
Number of Channels		79 channels
Antenna Type		Chip Antenna
Antenna Gain *	ea Port	2 402 MHz ~ 2 480 MHz: 2.1 dBi
	ia Port	2 402 MHz ~ 2 480 MHz: 2.1 dBi
H/W Version		0.3
S/W Version		1.0

1.5. Test Equipment List

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Interval	Cal. Due
Spectrum Analyzer	R&S	FSV30	103453	10/17/2025	Annual	10/17/2026
DC Power Supply	R&S	HMP2020	022802108	02/23/2026	Annual	02/23/2027
Attenuator	AEROFLEX / INMET	40AH2W-6	2	05/19/2026	Annual	05/19/2027
Power Sensor	R&S	NRP-Z81	100748	06/19/2026	Annual	06/19/2027
Signal Generator	R&S	SMA100B	106887	10/20/2025	Annual	10/20/2026
EMI Test Receiver	R&S	ESW26	103047	03/09/2026	Annual	03/09/2027
EMI Test Receiver	R&S	ESU26	100109	01/21/2026	Annual	01/21/2027
Two-Line V-Network	R&S	ENV216	100190	06/02/2026	Annual	06/02/2027
PXA SIGNAL ANALYZER ¹⁾	Keysight	N9030A	MY53120526	08/05/2026	Annual	08/05/2027
Spectrum Analyzer	Agilent	N9020A	MY53421758	09/10/2025	Annual	09/10/2026
Loop Antenna	Schwarzbeck Mess-Elektronik	FMZB 1519	1519-039	10/01/2025	Biennial	10/01/2027
TRILOG BROADBAND ANTENNA	Schwarzbeck Mess-Elektronik	VULB9163	01126	03/09/2026	Biennial	03/09/2028
DOUBLE RIDGED HORN ANTENNA	R&S	HF906	100326	03/03/2026	Annual	03/03/2027
Horn Antenna	Schwarzbeck Mess-Elektronik	BBHA 9170	9170-540	12/05/2025	Annual	12/05/2026
High Pass Filter	Wainwright Instrument GmbH	WHK3.0/18G-10SS	344	06/26/2026	Annual	06/26/2027
SIGNAL CONDITIONING UNIT	R&S	SCU18F	101058	06/02/2026	Annual	06/02/2027
RF AMPLIFIER	H.P	8447F-OPT H64	2944A03909	03/31/2026	Annual	03/31/2027
Pre Amplifier	TESTEK	TK-PA1840H	130016	03/06/2026	Annual	03/06/2027
Coaxial Cable	SENSORVIEW	NMST-13A26-NMST-5 m	TPC2402190004	04/17/2026	Semi-Annual	10/17/2026
Coaxial Cable	SENSORVIEW	NMST-13A26-NMST-10 m	TPC2402190001	04/17/2026	Semi-Annual	10/17/2026
Coaxial Cable	Qualwave	QT50P-40-KK-1.5	24270074	04/10/2026	Semi-Annual	10/10/2026
Turn Table	Innco systems GmbH	DS 1200 S	N/A	N.C.R.	N/A	N.C.R.
Controller	Innco systems GmbH	CONTROLLER CO3000-4P	CO3000/963/383305 16/L	N.C.R.	N/A	N.C.R.
Antenna Mast	Innco systems GmbH	MA4640-XP-ET	MA4640/536/383305 16/L	N.C.R.	N/A	N.C.R.
Shield Room	SY Corporation	L × W × H (6.5 m × 3.5 m × 3.5 m)	N/A	N.C.R.	N/A	N.C.R.
Anechoic Chamber	SY Corporation	L × W × H (9.6 m × 6.4 m × 6.6 m)	N/A	N.C.R.	N/A	N.C.R.

Note;

1) The equipment was not used for testing during the period from 07/27/2026 to 08/06/2026.

1.6. Declaration by the Manufacturer

- The EUT has two antennas, but it can not operate simultaneously.

1.7. Summary of Test Results

The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC Part 15 Subpart C		
Section in FCC	Test Item(s)	Result
15.205(a) 15.209 15.247(d)	Transmitter Radiated Spurious Emissions and Conducted Spurious Emission	Pass
15.247(a)(2)	6 dB Bandwidth	Pass
15.247(b)(3)	Maximum Peak Conducted Output Power	Pass
15.247(e)	Power Spectral Density	Pass
15.207	AC Power Line Conducted Emission	Pass

1.8. Test Procedure(s)

The measurement procedures described in the American National Standard of Procedure for Compliance Testing of Unlicensed Wireless Devices (ANSI C63.10-2020, as well as the guidance provided in KDB 558074 D01 15.247 Meas Guidance v05r02, were used in the measurement of the DUT.

1.9. Sample Calculation

Where relevant, the following sample calculation is provided:

1.9.1. Conducted Test

Offset value (dB) = Attenuator (dB) + Cable loss (dB)

1.9.2. Radiation Test

Field strength level (dB μ V/m) = Measured level (dB μ V) + Antenna factor (dB/m) + Cable loss (dB) - Amplifier gain (dB) + Duty factor (dB)

1.10. Information of software for test and power setting

- Using the software of putty Release 0.78 to testing of EUT.
- The EUT was configured with the following output power settings during the tests

Antenna	Frequency (MHz)	Power setting
ia port	2 402	3
	2 440	3
	2 480	3
ea port	2 402	3
	2 440	3
	2 480	3

1.11. Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Parameter	Uncertainty	
Maximum Peak Conducted Output Power	0.35 dB	
Power Spectral Density	0.64 dB	
99 % Bandwidth	0.01 MHz	
6 dB Bandwidth	0.02 MHz	
Conducted Spurious Emission	0.86 dB	
AC Power Line Conducted Emission	3.10 dB	
Radiated Emission, 9 kHz to 30 MHz	H	3.60 dB
	V	3.60 dB
Radiated Emission, below 1 GHz	H	5.50 dB
	V	5.10 dB
Radiated Emission, above 1 GHz	H	3.50 dB
	V	3.40 dB

All measurement uncertainty values are shown with a coverage factor of $k=2$ to indicate a 95 % level of confidence.

1.12. Test Report Revision

Revision	Report number	Date of Issue	Description
0	F690501-RF-RTL007287	2026.09.01pp	Initial

1.13. Duty Cycle of EUT

Regarding to KDB 558074 D01 15.247 Meas Guidance v05r02, 6, the maximum duty cycles of all modes were investigated and set the spectrum analyzer as below;
 Set RBW ≥ OBW if possible; otherwise, set RBW to the largest available value. Set detector = peak or average. The zero-span measurement method shall not be used unless both RBW and VBW are > 50/T and the number of sweep points across duration T exceeds 100.

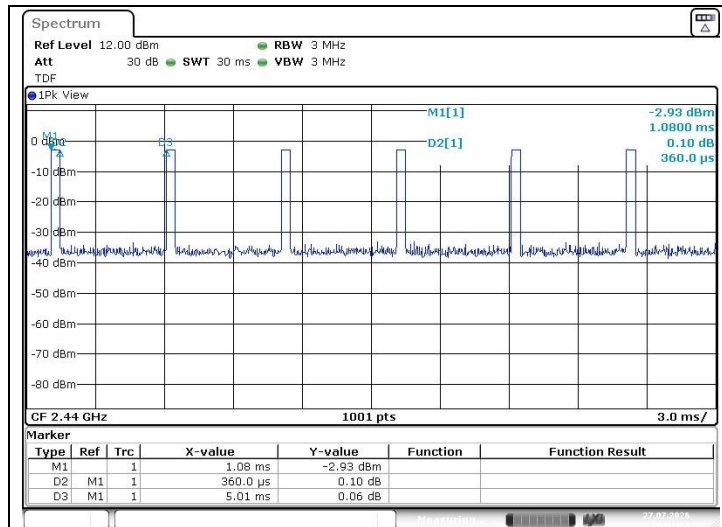
Test Mode	ea port	ia port
Duty Cycle (%)	7.19	7.23
Correction Factor (dB)	11.43	11.41
On time (ms)	0.36	0.36
On time + off time (ms)	5.01	4.98

Remark;

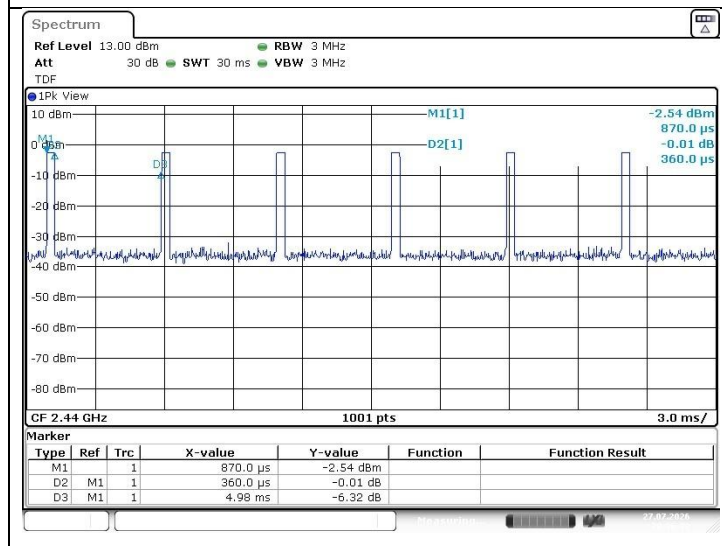
1. Duty Cycle (%) = (Tx on time / Tx on + off time) x 100
2. Correction Factor (dB) = 10 log (1 / Duty Cycle)

- Test plots

ea port



ia port

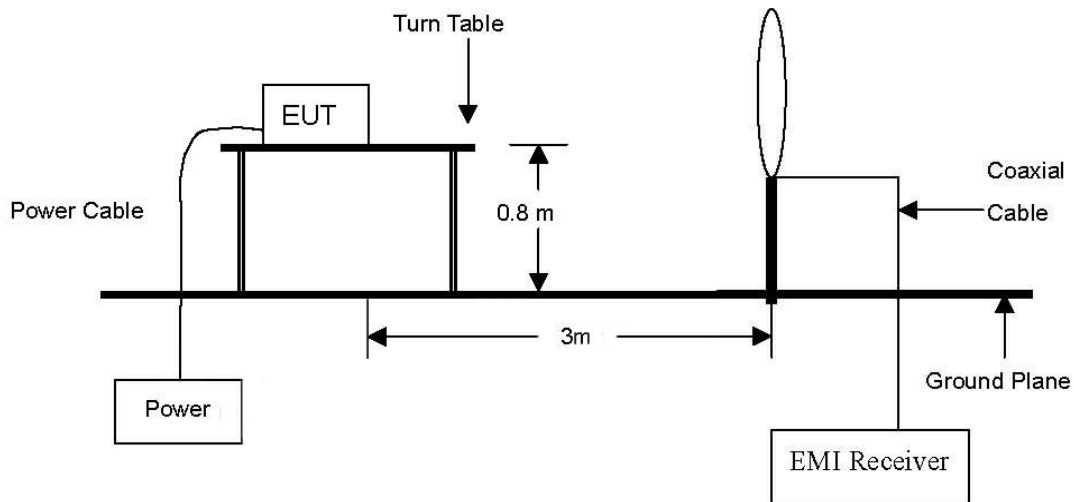


2. Transmitter Radiated Spurious Emissions and Conducted Spurious Emissions

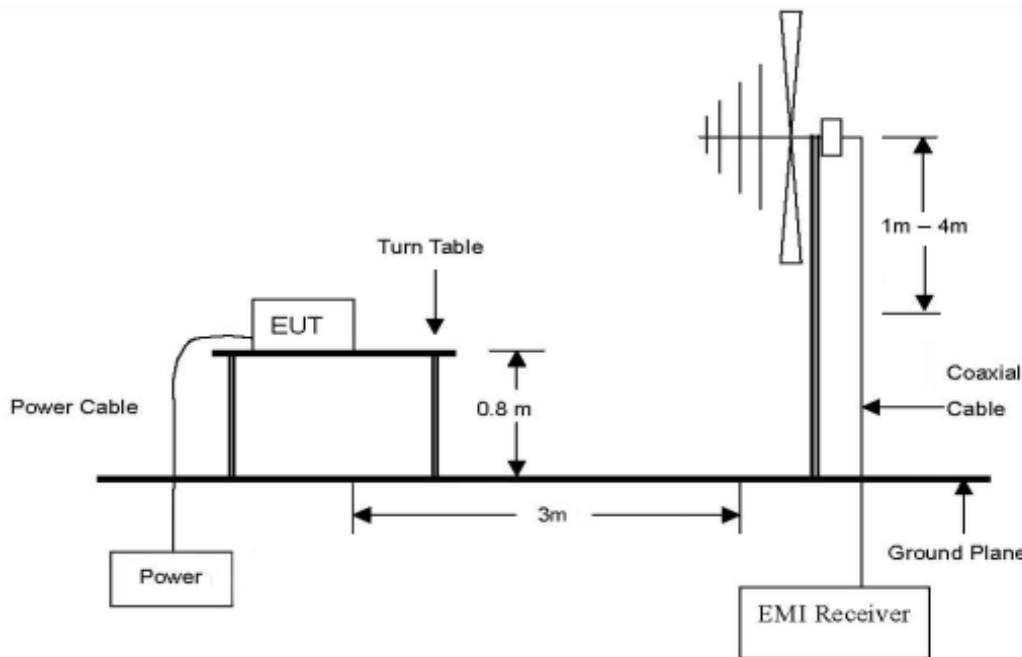
2.1. Test Setup

2.1.1. Transmitter Radiated Spurious Emissions

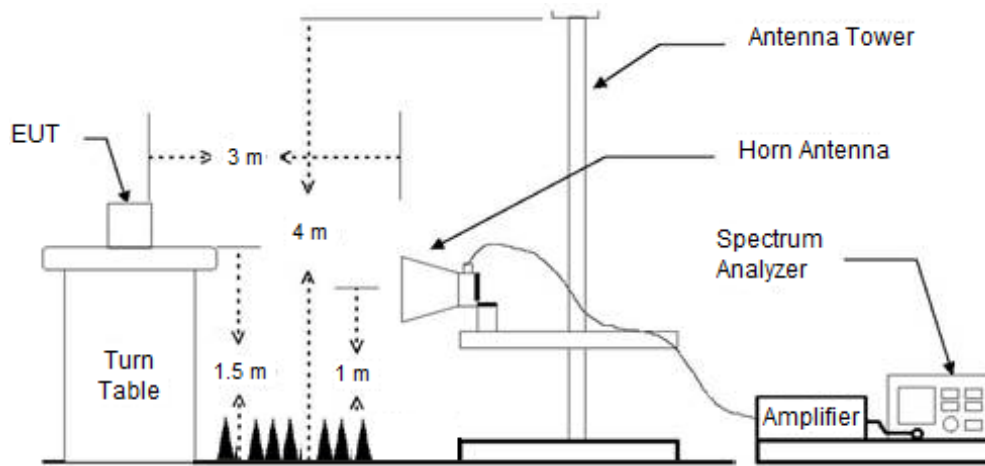
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 kHz to 30 MHz emissions.



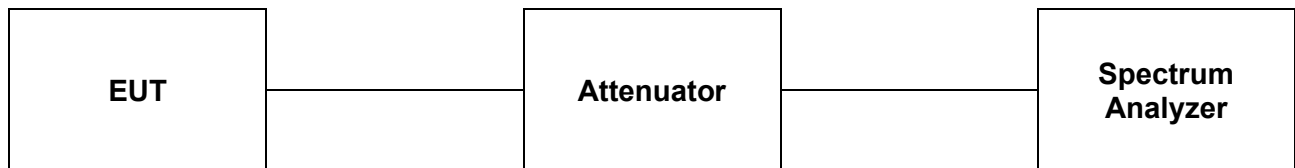
The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz Emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission. The spurious emissions were investigated from 1 GHz to the 10th harmonic of the highest fundamental frequency or 40 GHz, whichever is lower.



2.1.2. Conducted Spurious Emissions



2.2. Limit

According to §15.247(d), 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 emission 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)).

According to §15.209(a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength ($\mu\text{V/m}$)	Measurement Distance (Meters)
0.009-0.490	2 400/F(kHz)	300
0.490-1.705	24 000/F(kHz)	30
1.705-30.0	30	30
30-88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

2.3. Test Procedures

Radiated emissions from the EUT were measured in accordance with sections 11.11 & 11.12 of ANSI C63.10-2020.

2.3.1. Test Procedures for emission below 30 MHz

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
2. Then antenna is a loop antenna is fixed at one meter above the ground to determine the maximum value of the field strength. Both parallel and perpendicular of the antenna are set to make the measurement.
3. For each suspected emission, the EUT was arranged to its worst case and then the table was turned from 0 degrees to 360 degrees to find the maximum reading.
4. The test-receiver system was set to average or quasi peak detect function and Specified Bandwidth with Maximum Hold Mode.

2.3.2. Test Procedures for emission from above 30 MHz

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site below 1 GHz and 1.5 meters above the ground at a 3 meter anechoic chamber test site above 1 GHz. The table was rotated 360 degrees to determine the position of the highest radiation.
2. During performing radiated emission below 1 GHz, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 GHz, the EUT was set 3 meter away from the interference-receiving antenna.
3. The antenna is a bi-log antenna, a horn antenna and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. For measurements below 1 GHz resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.
6. For measurements Above 1 GHz resolution bandwidth is set to 1 MHz, the video bandwidth is set to 3 MHz for peak measurements and as applicable for average measurements.

2.3.3. Test Procedures for Radiated Spurious Emissions

1. Unwanted Emissions into Non-Restricted Frequency Bands

- The Reference Level Measurement refer to section 11.11.2

Set analyzer center frequency to DTS channel center frequency, SPAN ≥ 1.5 times the DTS bandwidth, the RBW = 100 kHz and VBW $\geq 3 \times$ RBW, Detector = Peak, Sweep time = No faster than coupled (auto) time, Trace = Max hold.

- Unwanted Emissions Level Measurement refer to section 11.11.3

Set the center frequency and span to encompass frequency range to be measured, the RBW = 100 kHz and VBW $\geq 3 \times$ RBW, Detector = Peak, Sweep time = No faster than coupled (auto) time, Trace = Max hold.

2. Unwanted Emissions into Restricted Frequency Bands

- Peak Power measurement procedure refer to section 11.12.2.4

Set RBW = as specified in Table 16, VBW $\geq 3 \times$ RBW, Detector = Peak, Sweep time = No faster than coupled (auto) time, Trace = Max hold.

Table 16 – RBW as a function of frequency

Frequency	RBW
9 kHz to 150 kHz	200 Hz to 300 Hz
0.15 MHz to 30 MHz	9 kHz to 10 kHz
30 MHz to 1 000 MHz	100 kHz to 120 kHz
> 1 000 MHz	1 MHz

If the peak – detected amplitude can be shown to comply with the average limit, then it is not necessary to perform a separate average measurement.

- Average Power measurements procedure refer to section 11.12.2.5.2

The EUT shall be configured to operate at the maximum achievable duty cycle.

Measure the duty cycle D of the transmitter output signal as described in section 11.6.

Set RBW = 1 MHz, VBW $\geq 3 \times$ RBW, Detector = Power averaging (rms), if span / (# of points in sweep) $\leq$ (RBW/2). Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied then the detector mode shall be set to peak.

Averaging type = power (i.e., RMS).

As an alternative the detector and averaging type may be set for linear voltage averaging.

Some instruments require linear display mode in order to use linear voltage averaging. Log or dB averaging shall not be used. Sweep time = auto, Perform a trace average of at least 100 traces.

A correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle. The correction factor is computed as follows:

- 1) If power averaging (rms) mode was used in step f), then the applicable correction factor is $[10 \log (1 / D)]$, where D is the duty cycle.
- 2) If a specific emission is demonstrated to be continuous (D $\geq 98\%$) rather than turning ON and OFF with the transmit cycle, then no duty cycled correction is required for that emission.

3. Definition of DUT Axis.

The radiation test of the EUT was investigated in three orthogonal orientations X, Y, and Z described in the test setup photo. All radiated testing of EUT was performed with worst case axis.

2.3.4. Test Procedures for Conducted Spurious Emissions

Per the guidance of ANSI C63.10-2020, the reference level for out of band emissions is established from the plots of this section since the band edge emissions are measured with a RBW of 100 kHz. This reference level is then used as the limit in subsequent plots for out of band spurious emissions shown in section 2.4.3. The limit for out of band spurious emission at the band edge is 20 dB below the fundamental emission level measured in a 100 kHz bandwidth.

1. Conducted Emissions at Band Edge

- The Measurement refer to section 11.11.3

Set the center frequency and span to encompass frequency range to be measured, the RBW = 100 kHz and VBW $\geq 3 \times$ RBW, Detector = Peak, Sweep time = No faster than coupled (auto) time, Trace mode = Max hold, The trace was allowed to stabilize.

2. Conducted Spurious Emissions

- The Measurement refer to section 11.11.3

Start frequency was set to 9 kHz and stop frequency was set to 25 GHz (separated plots per channel), RBW = 1 MHz, VBW $\geq 3 \times$ RBW, Detector = Peak, Sweep time = No faster than coupled (auto) time, Trace = Max hold, The trace was allowed to stabilize.

3. TDF function

- For plots showing conducted spurious emissions from 9 kHz to 25 GHz, all path loss of wide frequency range was investigated and compensated to spectrum analyzer as TDF function.
So, the reading values shown in plots were final result.

2.4. Test Results

Ambient temperature : (23 ± 1) °C
Relative humidity : 47 %

2.4.1. Radiated Spurious Emissions below 1 000 MHz

ea port

The frequency spectrum from 9 kHz to 1 000 MHz was investigated.

Radiated Emissions			Ant.	Correction Factors (dB/m)	Total	Limit	
Frequency (MHz)	Reading (dBμV)	Detect Mode	Pol.		Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
60.29	33.27	Quasi Peak	V	-8.66	24.61	40.00	15.39
151.09	37.37	Quasi Peak	V	-12.02	25.35	43.50	18.15
183.80	37.58	Quasi Peak	H	-9.91	27.67	43.50	15.83
352.31	31.75	Quasi Peak	H	-4.25	27.50	46.00	18.50
Above 400.00	Not detected	-	-	-	-	-	-

ia port

The frequency spectrum from 9 kHz to 1 000 MHz was investigated.

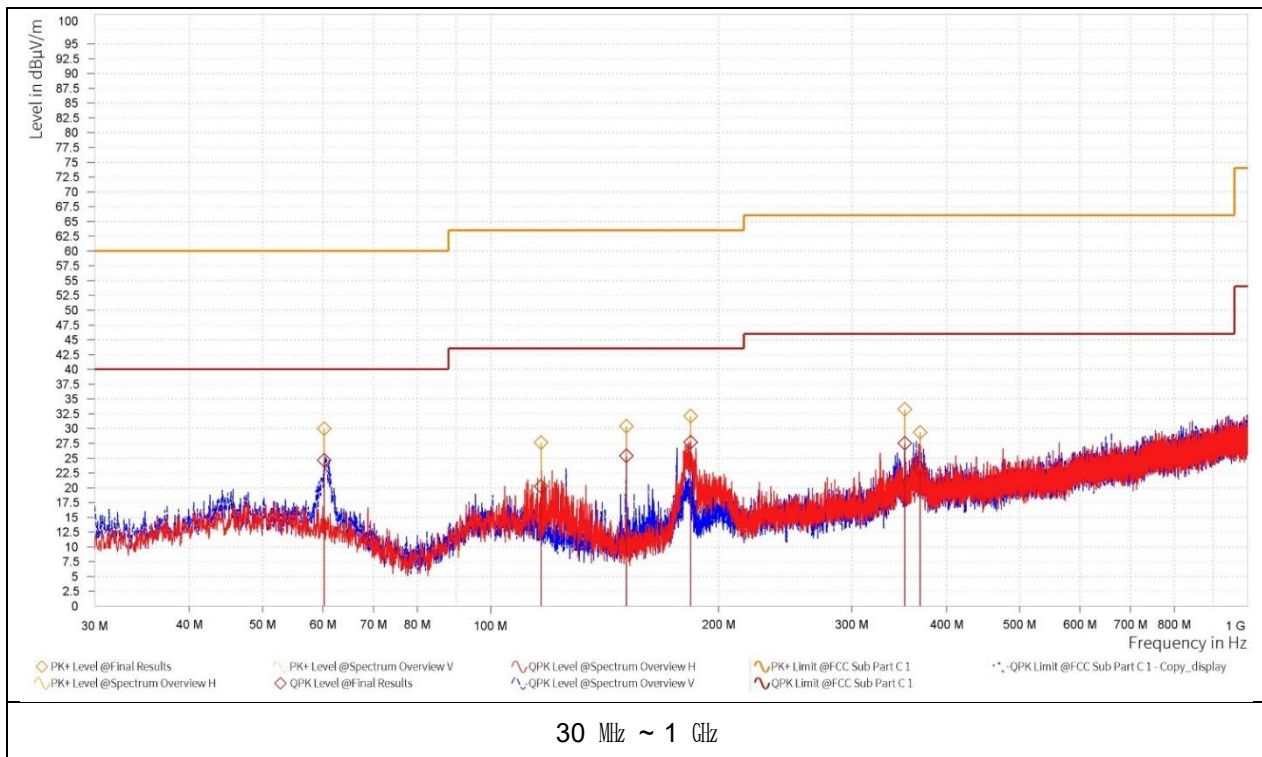
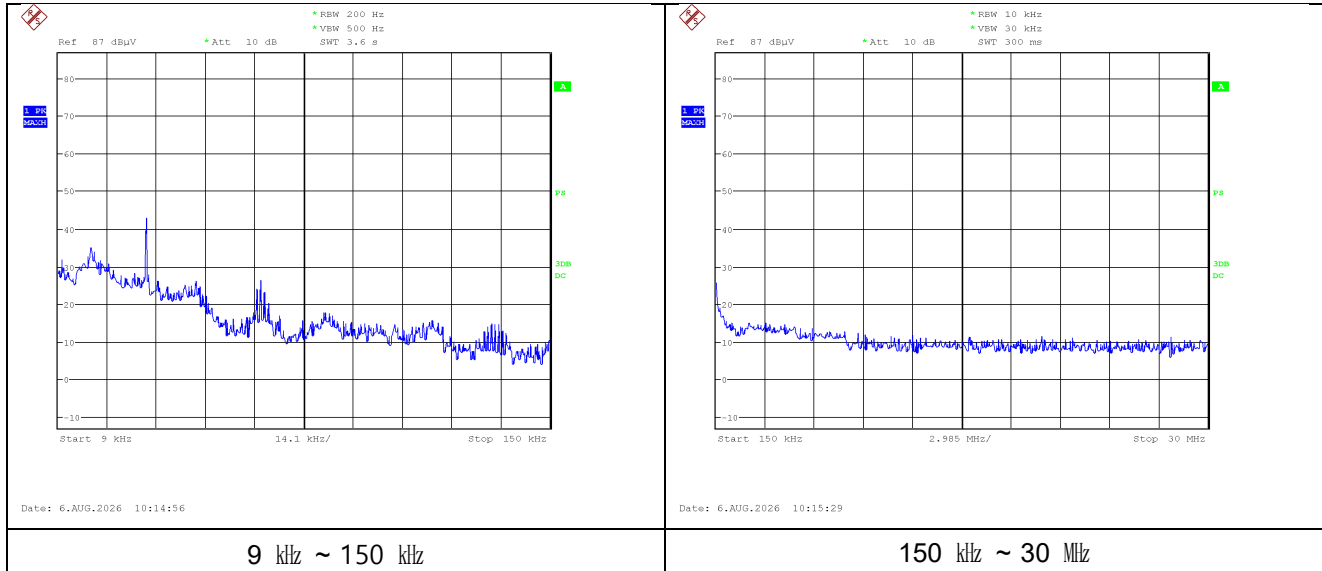
Radiated Emissions			Ant.	Correction Factors (dB/m)	Total	Limit	
Frequency (MHz)	Reading (dBμV)	Detect Mode	Pol.		Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
60.29	32.10	Quasi Peak	V	-8.66	23.44	40.00	16.56
150.98	37.11	Quasi Peak	V	-12.03	25.08	43.50	18.42
183.96	37.62	Quasi Peak	H	-9.89	27.73	43.50	15.77
352.36	31.20	Quasi Peak	V	-4.26	26.94	46.00	19.06
Above 400.00	Not detected	-	-	-	-	-	-

Remark;

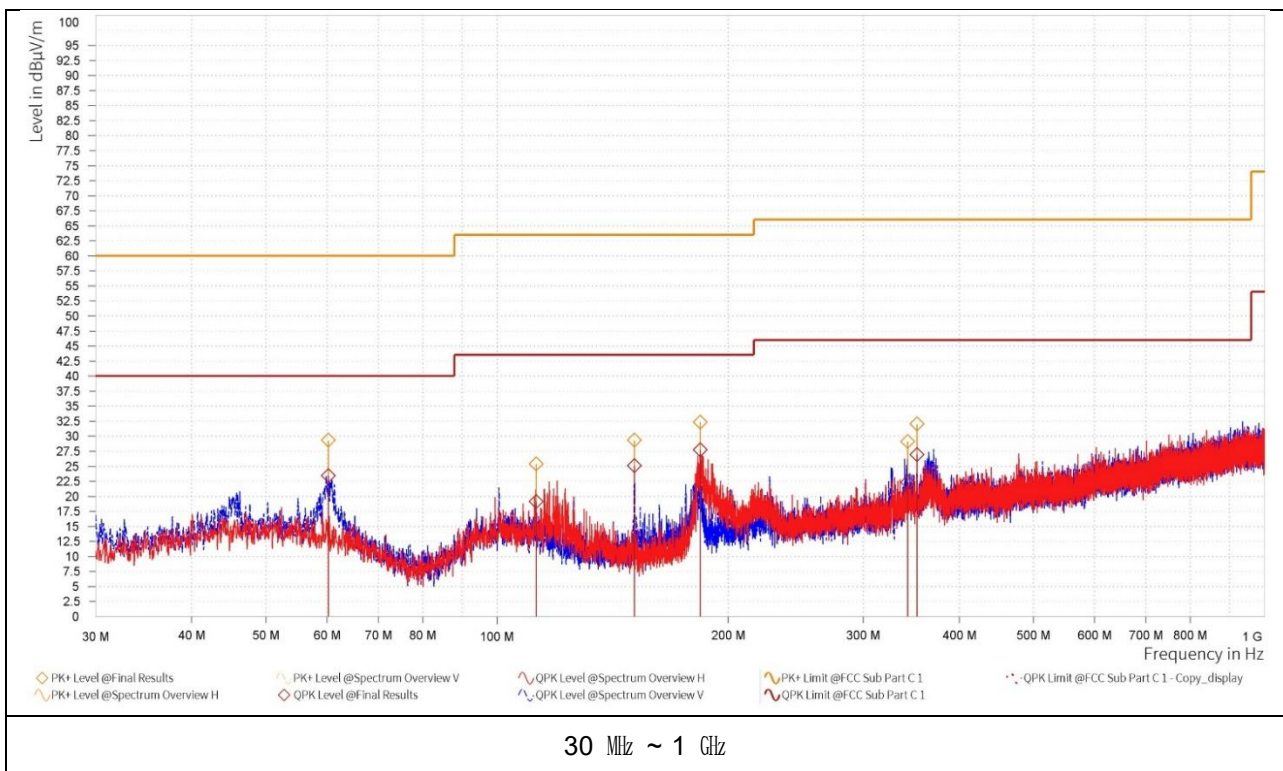
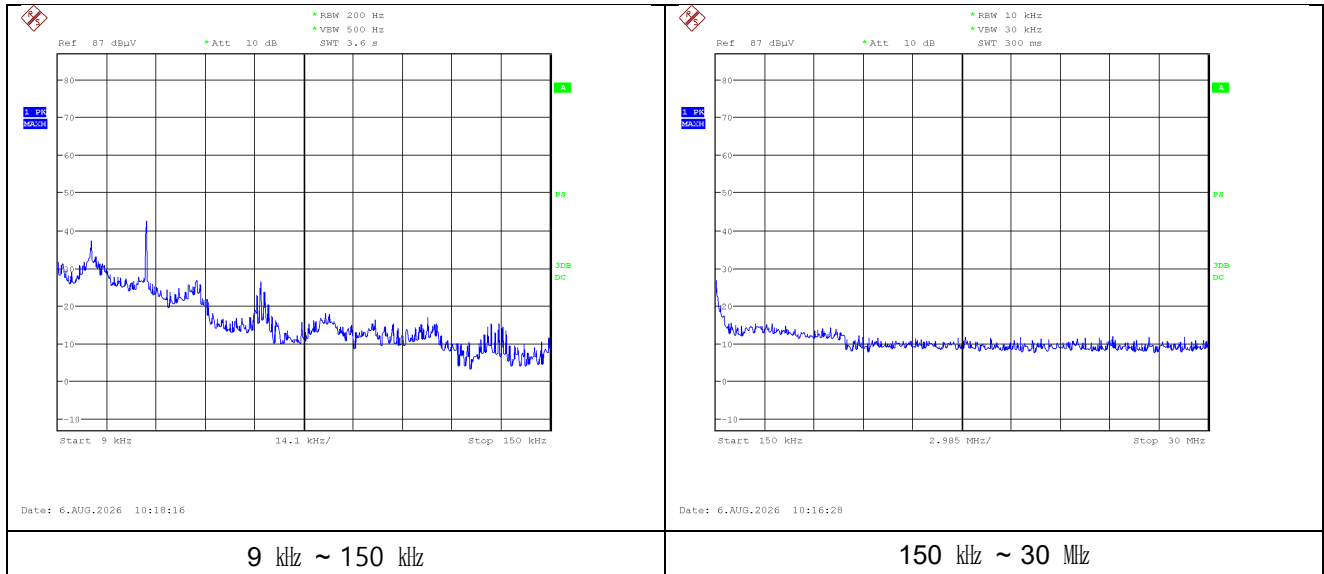
- Spurious emissions for all channels were investigated and almost the same below 1 GHz.
- Test from 30 MHz to 1 000 MHz was performed using the software of ELEKTRA(V5.02) from Rohde & Schwarz GmbH & Co. KG.
- Reported spurious emissions are in High channel as worst case among other channels.
- Radiated spurious emission measurement as below.
(Actual = Reading + Correction)
(Correction = Antenna Factor + AMP Factor + Cable Loss)
- According to §15.31(o), emission levels are not report much lower than the limits by over 20 dB.

- Test plots

-ea



-ia



2.4.2. Radiated Spurious Emissions above 1 000 MHz

The frequency spectrum above 1 000 MHz was investigated. All reading values are peak and average values.

- ea port

Low Channel (2 402 MHz)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	DF (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
*2 310.00	14.09	Peak	V	28.06	7.32	-	49.47	74.00	24.53
*2 310.00	3.68	Average	V	28.06	7.32	11.43	50.49	54.00	3.51
*2 389.49	20.99	Peak	V	28.22	7.60	-	56.81	74.00	17.19
*2 384.15	4.13	Average	V	28.23	7.57	11.43	51.36	54.00	2.64
*2 390.00	20.71	Peak	V	28.22	7.60	-	56.53	74.00	17.47
*2 390.00	3.84	Average	V	28.22	7.60	11.43	51.09	54.00	2.91

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	DF (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
*4 804.37	42.99	Peak	V	32.72	-29.61	-	46.10	74.00	27.90
Above 4 900.00	Not detected	-	-	-	-	-	-	-	-

Middle Channel (2 440 MHz)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	DF (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
*4 879.88	43.62	Peak	V	33.02	-28.89	-	47.75	74.00	26.25
Above 4 900.00	Not detected	-	-	-	-	-	-	-	-

High Channel (2 480 MHz)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	DF (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
*2 483.50	35.92	Peak	V	28.40	7.61	-	71.93	74.00	2.07
*2 483.50	4.30	Average	V	28.40	7.61	11.43	51.74	54.00	2.26
*2 483.58	35.82	Peak	V	28.40	7.61	-	71.83	74.00	2.17
*2 483.91	5.44	Average	V	28.40	7.61	11.43	52.88	54.00	1.12
*2 500.00	21.13	Peak	V	28.50	7.69	-	57.32	74.00	16.68
*2 500.00	4.19	Average	V	28.50	7.69	11.43	51.81	54.00	2.19

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	DF (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
*4 959.80	44.75	Peak	V	33.22	-29.04	-	48.93	74.00	25.07
Above 5 000.00	Not detected	-	-	-	-	-	-	-	-

- ia port

Low Channel (2 402 MHz)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	DF (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
*2 310.00	14.60	Peak	H	28.06	7.32	-	49.98	74.00	24.02
*2 310.00	3.53	Average	H	28.06	7.32	11.41	50.32	54.00	3.68
*2 389.16	19.30	Peak	H	28.22	7.60	-	55.12	74.00	18.88
*2 385.67	4.29	Average	H	28.23	7.58	11.41	51.51	54.00	2.49
*2 390.00	18.01	Peak	H	28.22	7.60	-	53.83	74.00	20.17
*2 390.00	3.67	Average	H	28.22	7.60	11.41	50.90	54.00	3.10

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	DF (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
*4 804.03	42.58	Peak	H	32.72	-29.61	-	45.69	74.00	28.31
Above 4 900.00	Not detected	-	-	-	-	-	-	-	-

Middle Channel (2 440 MHz)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	DF (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
*4 880.63	40.40	Peak	H	33.02	-28.89	-	44.53	74.00	29.47
Above 4 900.00	Not detected	-	-	-	-	-	-	-	-

High Channel (2 480 MHz)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	DF (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
*2 483.50	28.35	Peak	H	28.40	7.61	-	64.36	74.00	9.64
*2 483.50	3.93	Average	H	28.40	7.61	11.41	51.35	54.00	2.65
*2 483.55	29.03	Peak	H	28.40	7.61	-	65.04	74.00	8.96
*2 483.88	4.46	Average	H	28.40	7.61	11.41	51.88	54.00	2.12
*2 500.00	14.91	Peak	H	28.50	7.69	-	51.10	74.00	22.90
*2 500.00	4.27	Average	H	28.50	7.69	11.41	51.87	54.00	2.13

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	DF (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
*4 960.70	40.47	Peak	H	33.22	-29.02	-	44.67	74.00	29.33
Above 5 000.00	Not detected	-	-	-	-	-	-	-	-

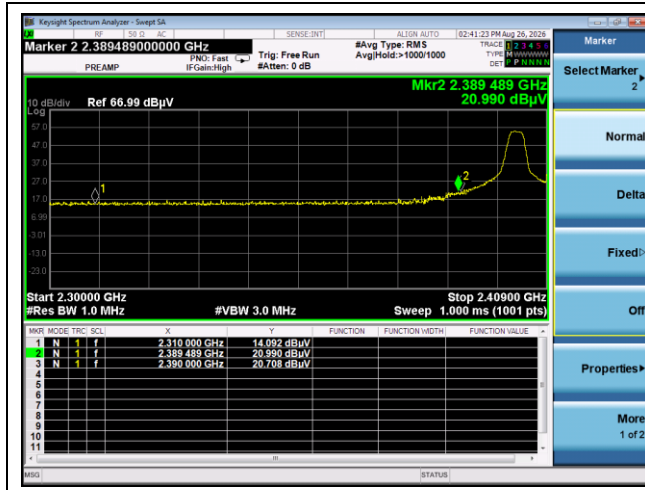
Remarks;

1. "*" means the restricted band.
2. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
3. Radiated emissions measured in frequency above 1 000 MHz were made with an instrument using peak/average detector mode.
4. Actual = Reading + AF + CL + (DF) or Reading + AF + AMP + CL + (DF).
5. According to § 15.31(o), emission levels are not reported much lower than the limits by over 20 dB.
6. The maximized peak measured value complies with the average limit, to perform an average measurement is unnecessary.
7. AF = Antenna Factor, CL = Cable Loss, DF = Duty Correction Factor.

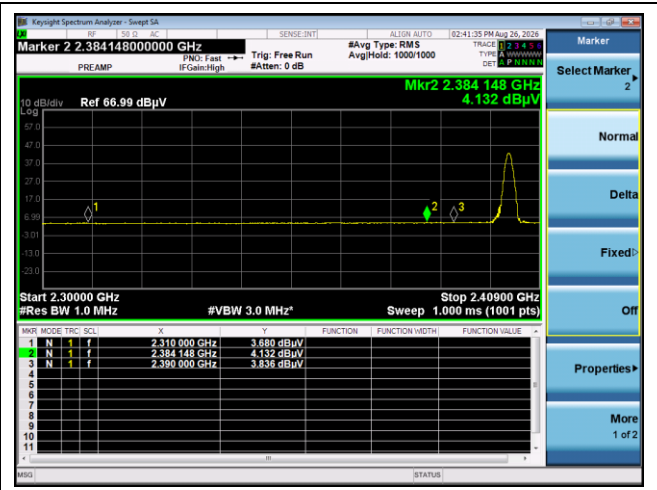
- Test plots

- ea port

Low channel band edge (Peak)



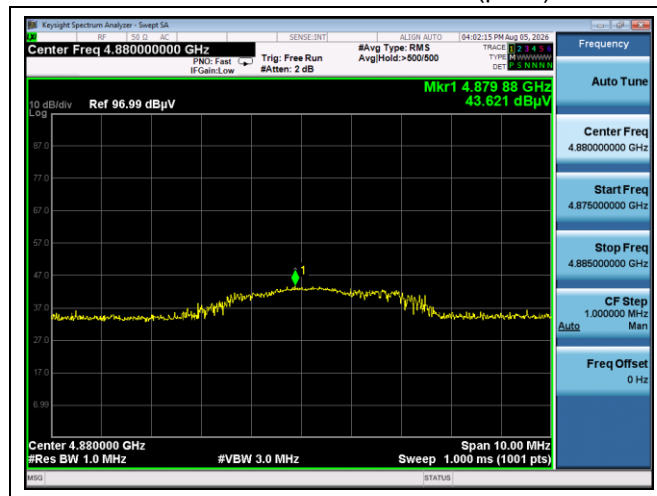
Low channel band edge (Average)



Low channel 2nd Harmonic (peak)



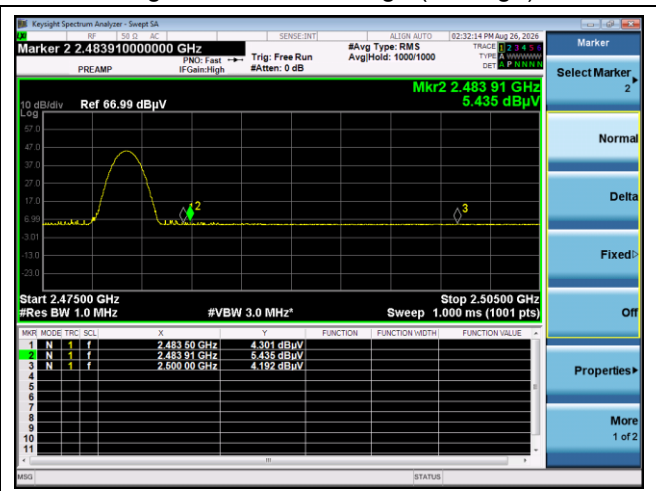
Middle channel 2nd Harmonic (peak)



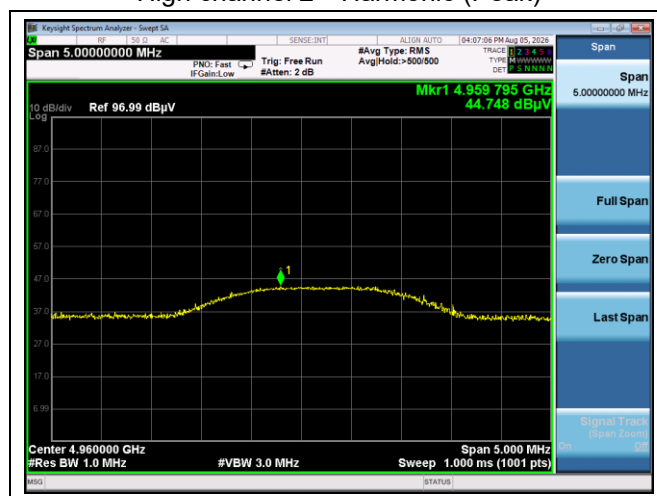
High channel band edge (Peak)



High channel band edge (Average)

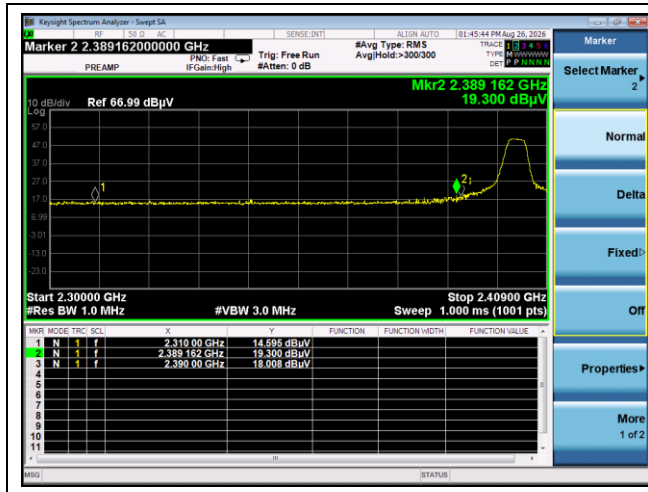


High channel 2nd Harmonic (Peak)

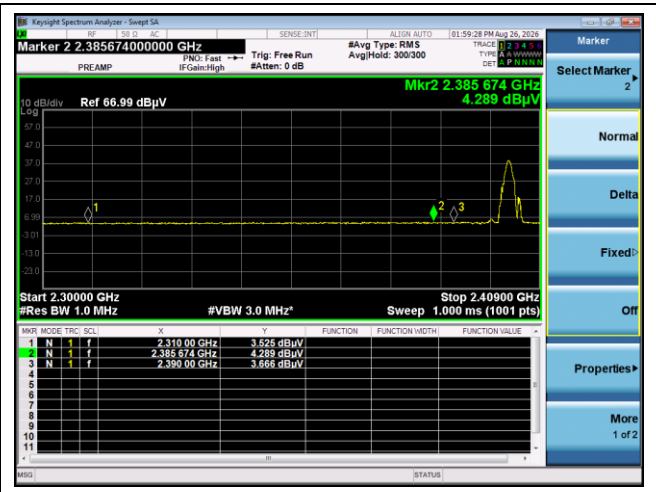


- ia port

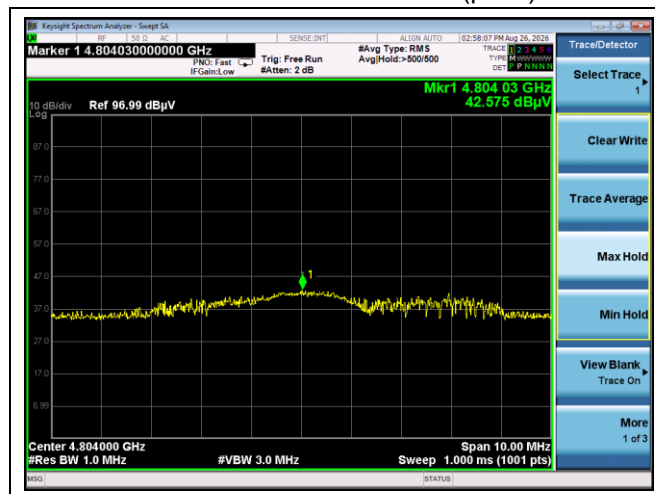
Low channel band edge (Peak)



Low channel band edge (Average)



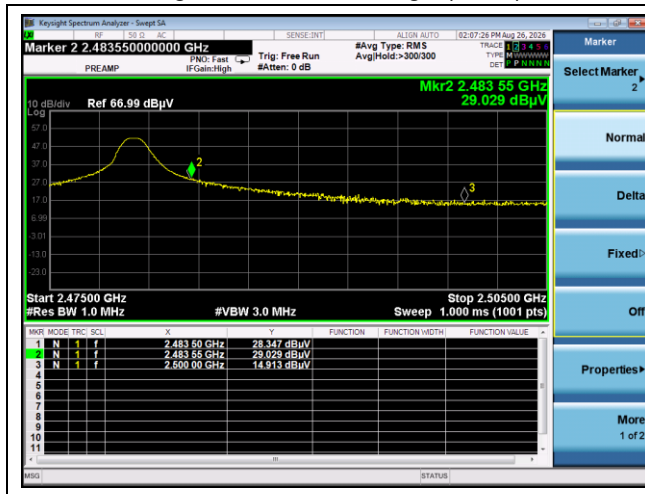
Low channel 2nd Harmonic (peak)



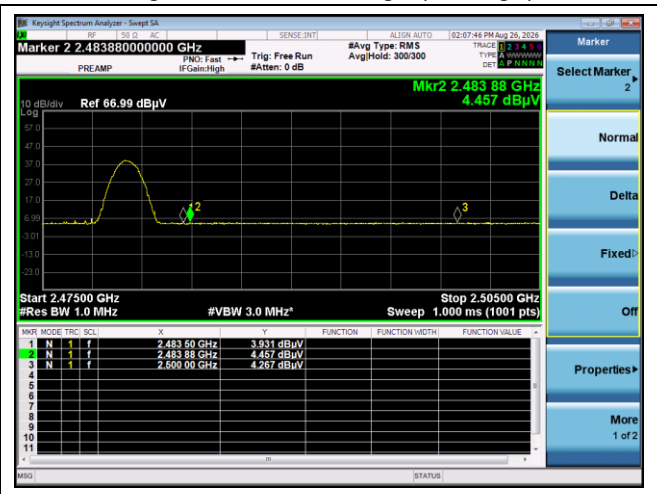
Middle channel 2nd Harmonic (peak)



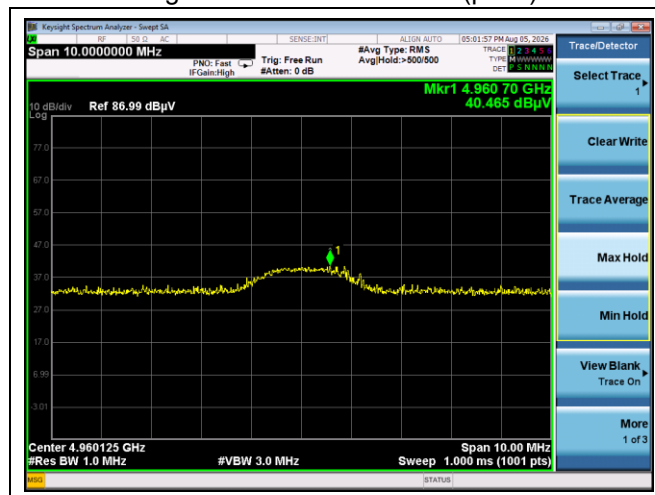
High channel band edge (Peak)



High channel band edge (Average)



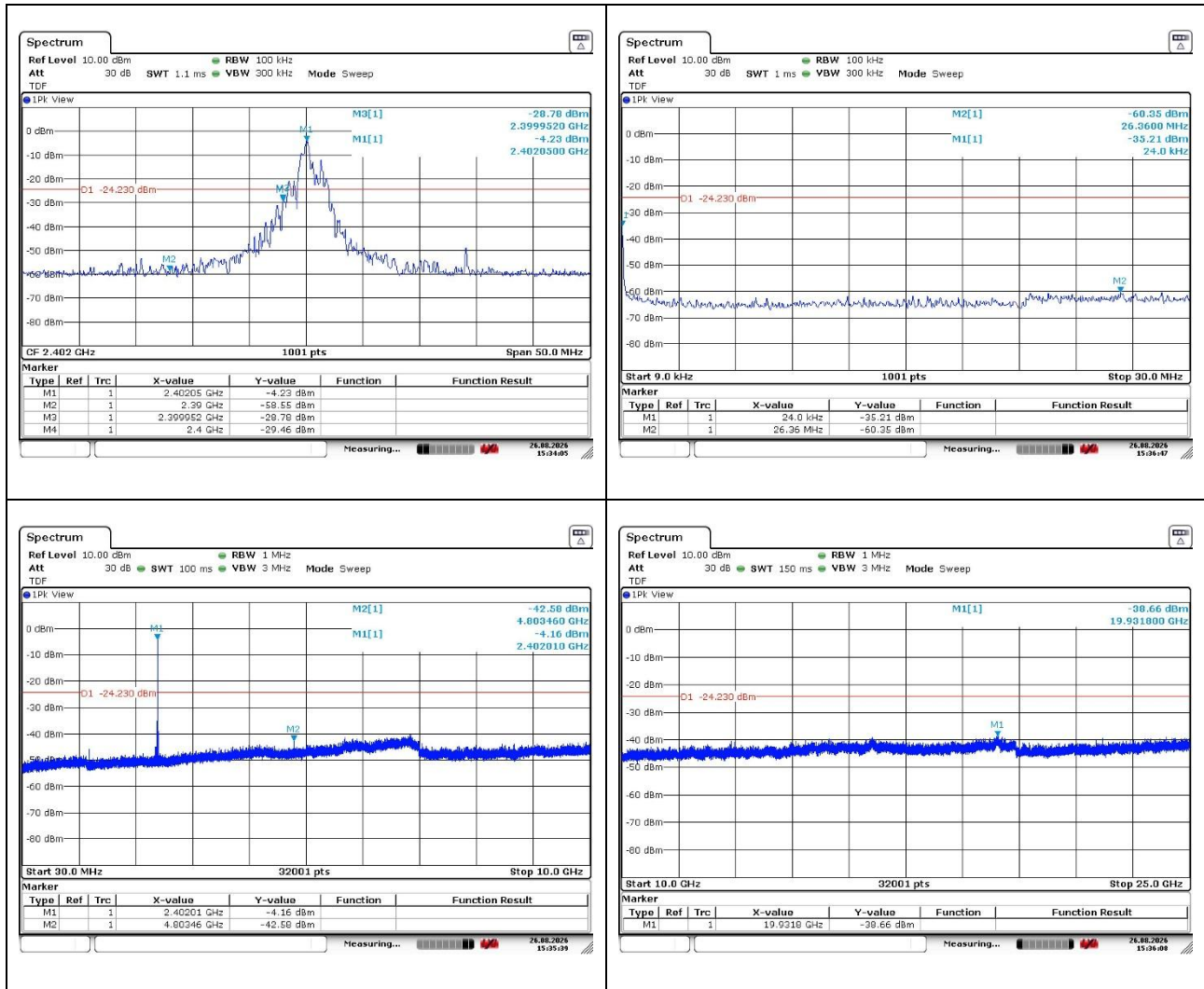
High channel 2nd Harmonic (peak)



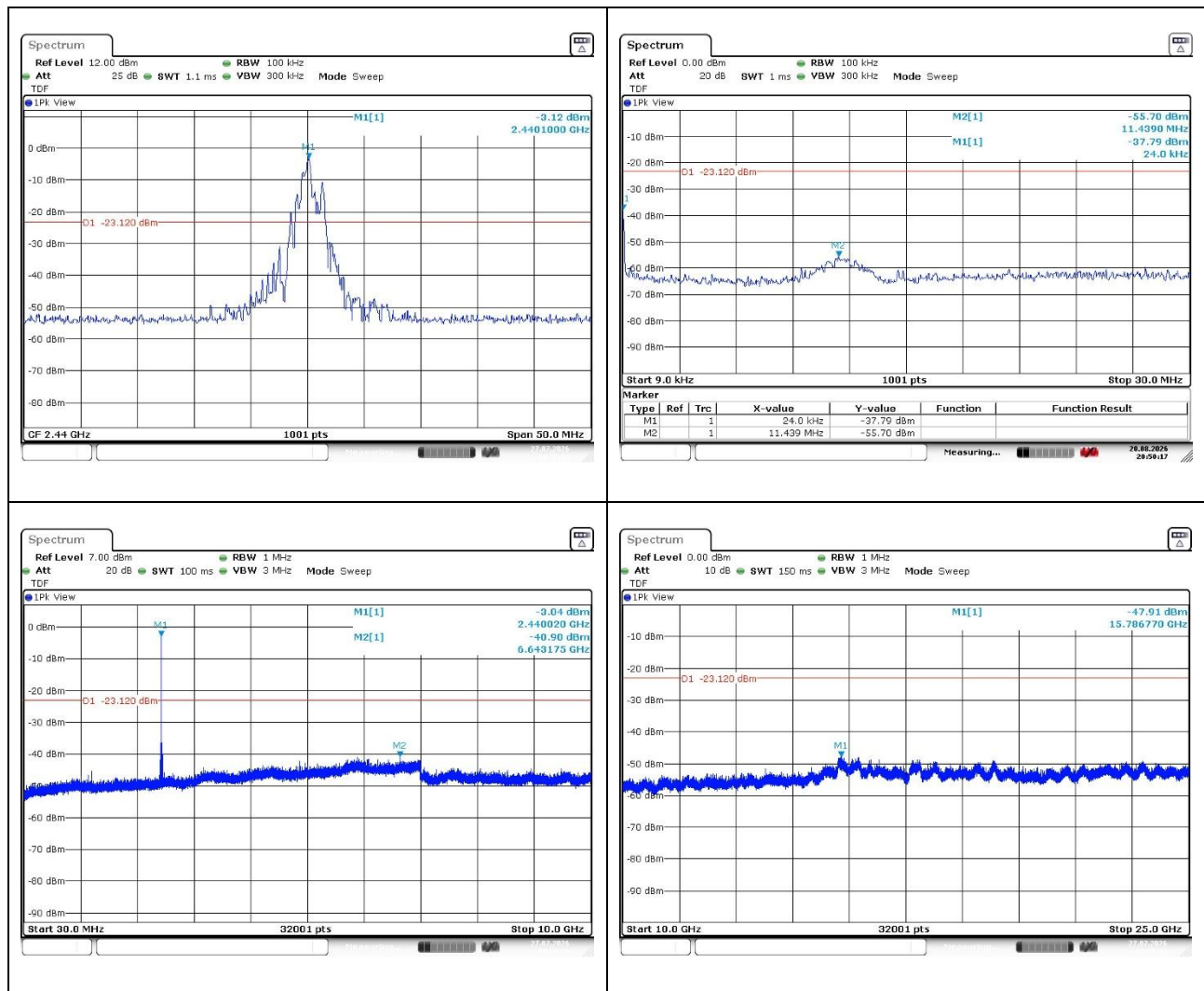
2.4.3. Plot of Conducted Spurious Emissions

- ea port

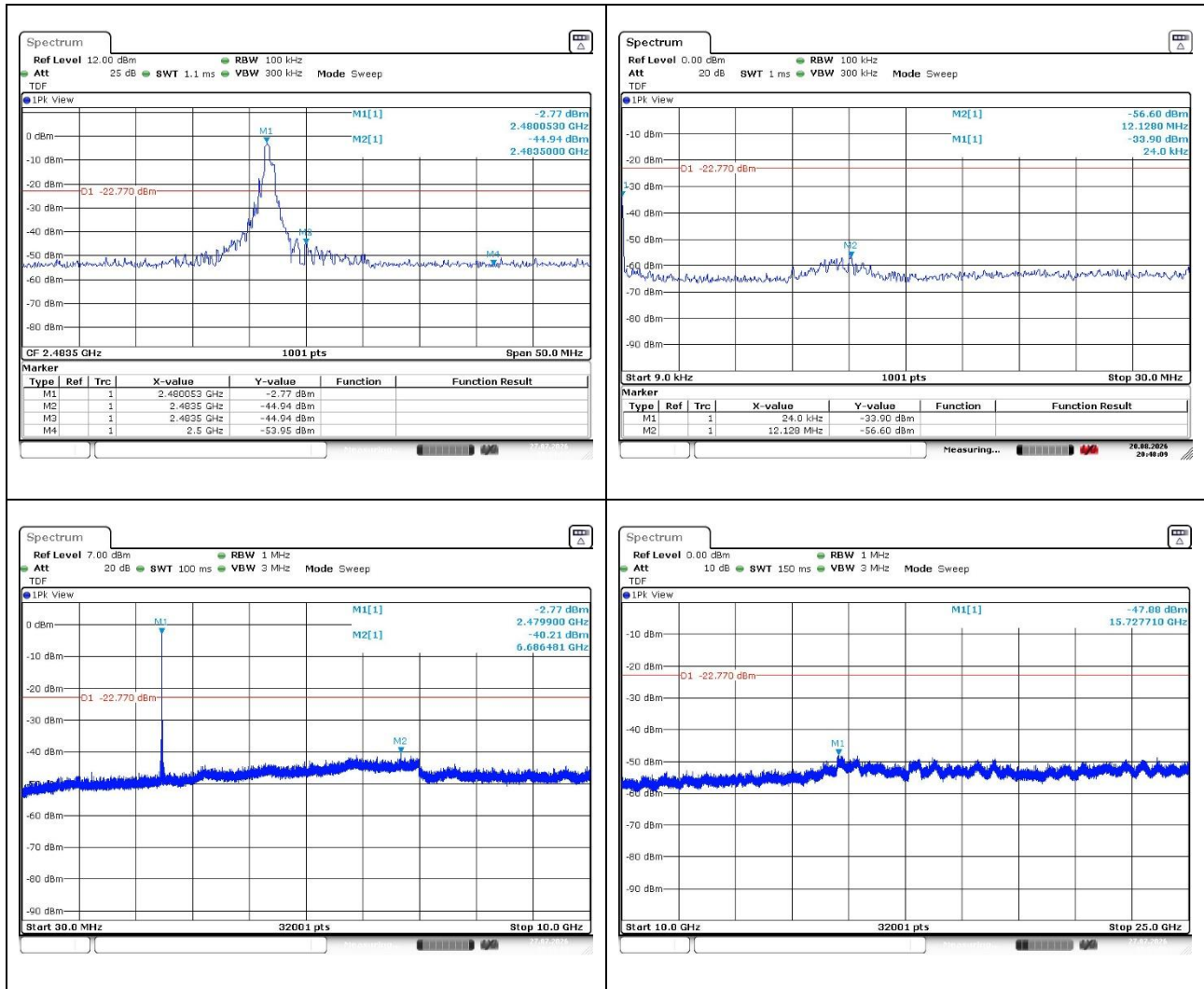
Low Channel



Middle Channel

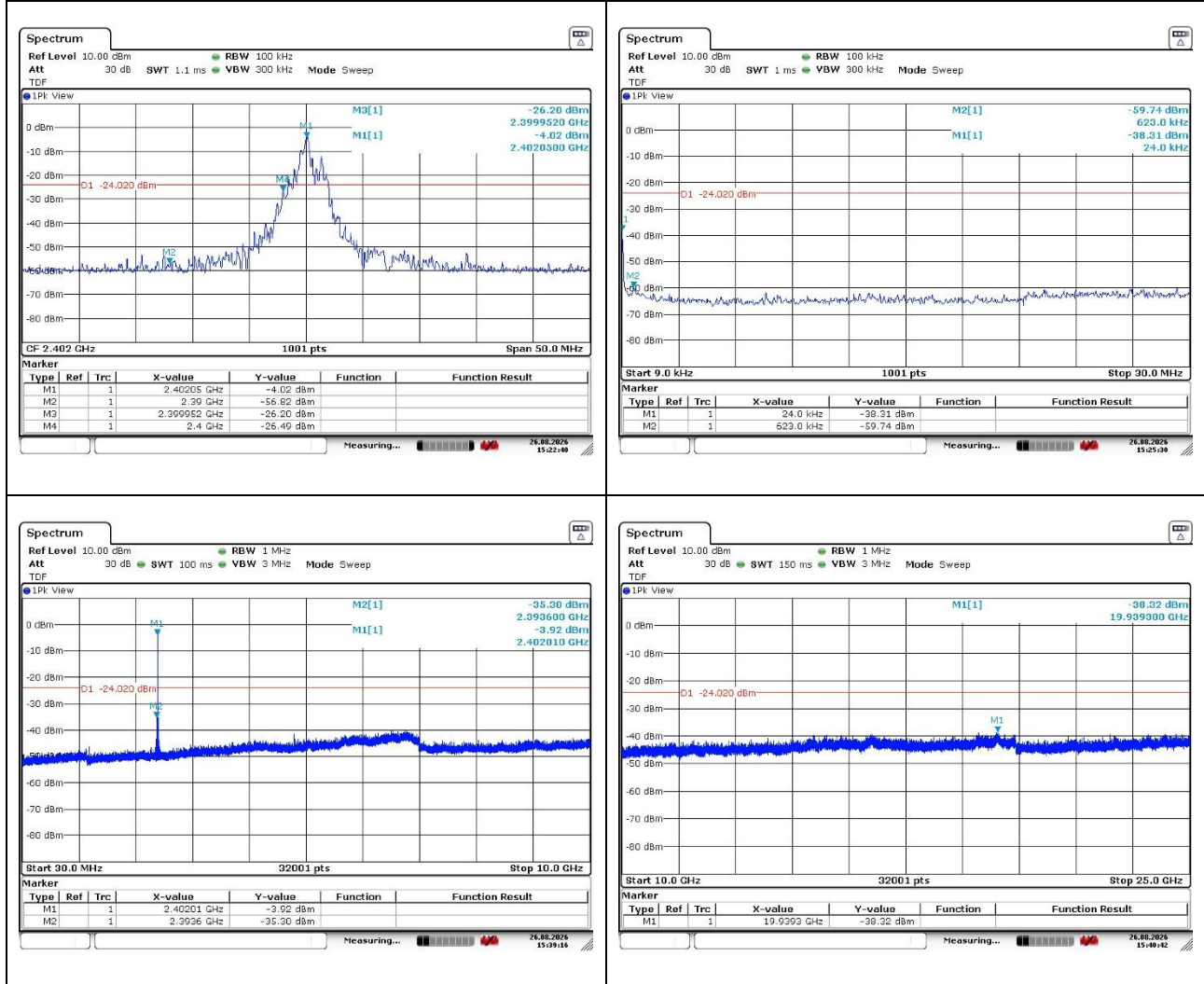


High Channel

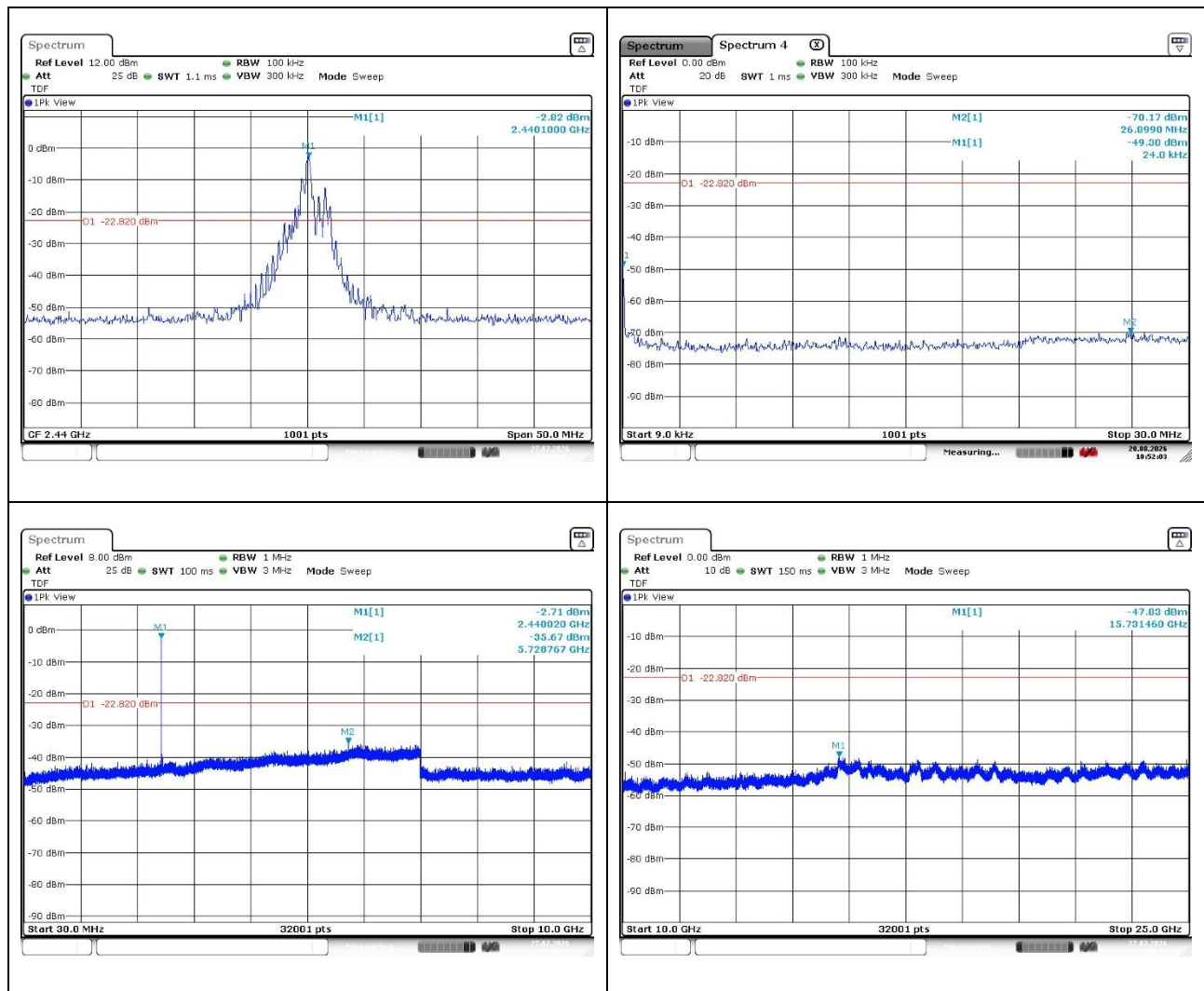


- ia port

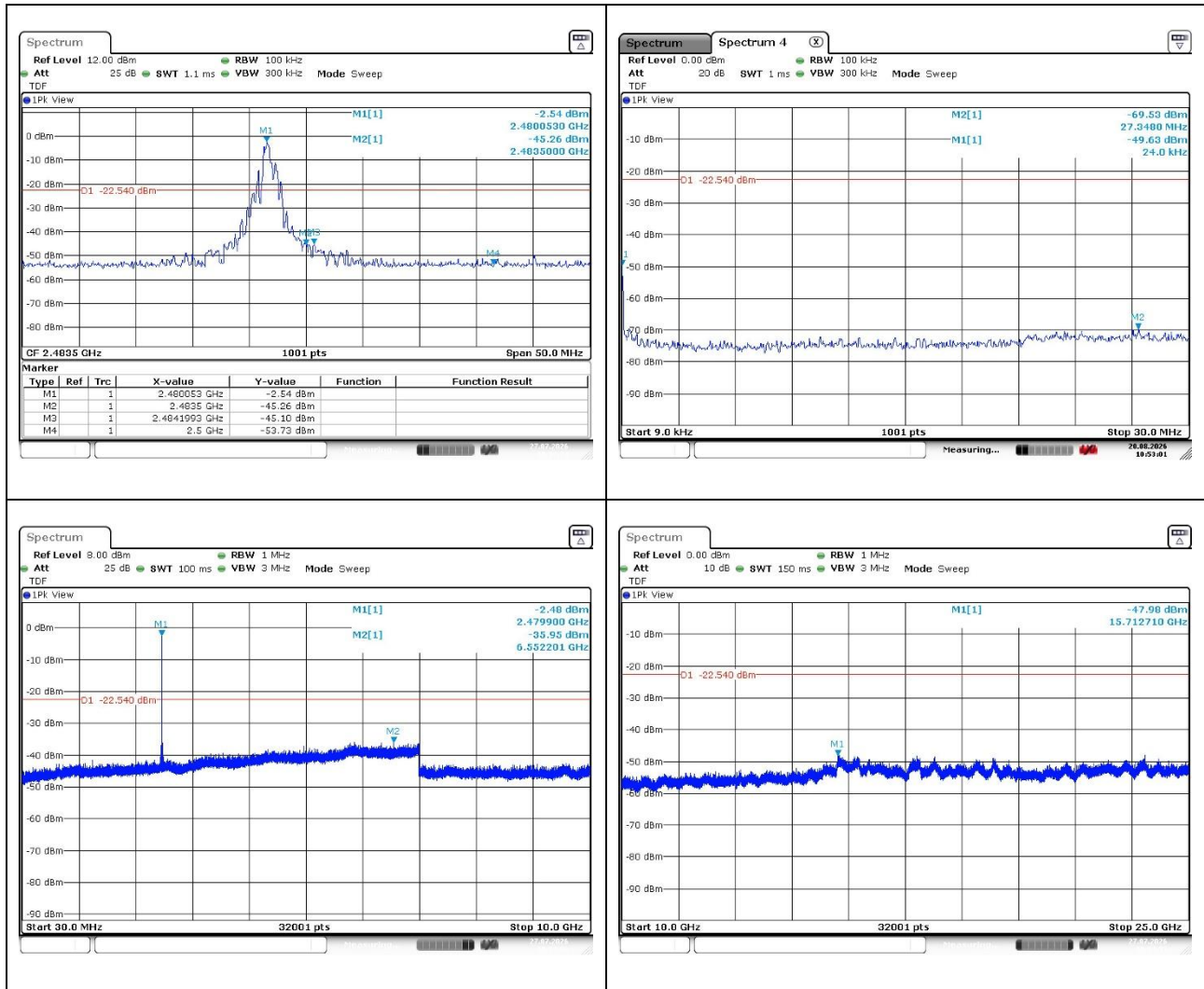
Low Channel



Middle Channel



High Channel



3.6 dB Bandwidth & 99% bandwidth

3.1. Test Setup



3.2. Limit

According to §15.247(a)(2), systems using digital modulation techniques may operate in the 902-928 MHz, 2 400-2 483.5 MHz, and 5 725-5 850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

3.3. Test Procedure

The test follows section 11.8 DTS bandwidth of ANSI C63.10-2020.

3.3.1. 6 dB Bandwidth

Tests performed using section 11.8.1 Option 1.

- Option 1:

1. Set RBW to = shall be in the range of 1% to 5% of the OBW but not less than 100 kHz.
2. Set the VBW $\geq [3 \times \text{RBW}]$.
3. Detector = peak.
4. Trace mode = max hold.
5. Sweep = No faster than coupled (auto) time.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission by placing two markers, one at the lowest frequency and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the "-6 dB down amplitude". If a marker is below this "-6 dB down amplitude" value, then it shall be as close as possible to this value.

3.3.2. 99 % Bandwidth

The test follows section 6.9.3 of ANSI C63.10-2020.

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.

The following procedure shall be used for measuring 99% power bandwidth:

- a) The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.
- b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be at least three times the RBW, unless otherwise specified by the applicable requirement.
- c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than $[10 \log (OBW/RBW)]$ below the reference level. Specific guidance is given in 4.1.6.2.
- d) Step a) through step c) might require iteration to adjust within the specified range.
- e) Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max-hold mode (until the trace stabilizes) shall be used.
- f) Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.
- g) If the instrument does not have a 99% power bandwidth function, then the trace data points are recovered and directly summed in linear power terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% power bandwidth is the difference between these two frequencies.
- h) The occupied bandwidth shall be reported by providing spectral plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

3.4. Test Results

Ambient temperature : (23 ± 1) °C
 Relative humidity : 47 %

- 6 dB Bandwidth

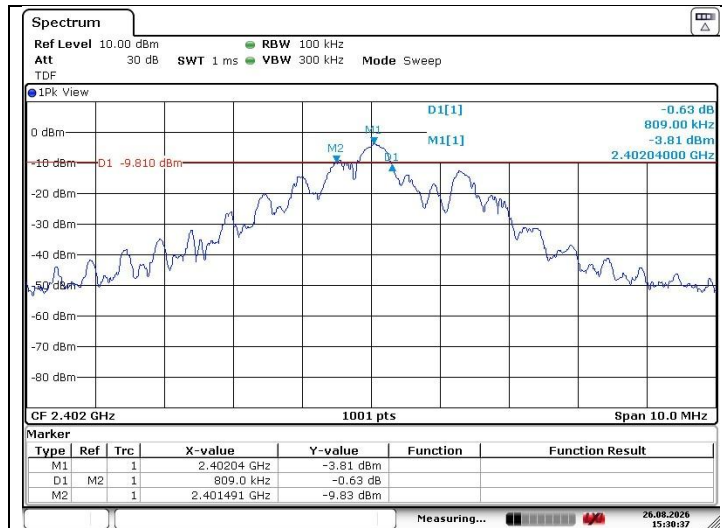
Port	Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Bandwidth (kHz)
ea port	Low	2 402	0.809	500
	Middle	2 440	0.749	
	High	2 480	0.529	
ia port	Low	2 402	0.776	
	Middle	2 440	0.819	
	High	2 480	0.599	

- 99% Bandwidth

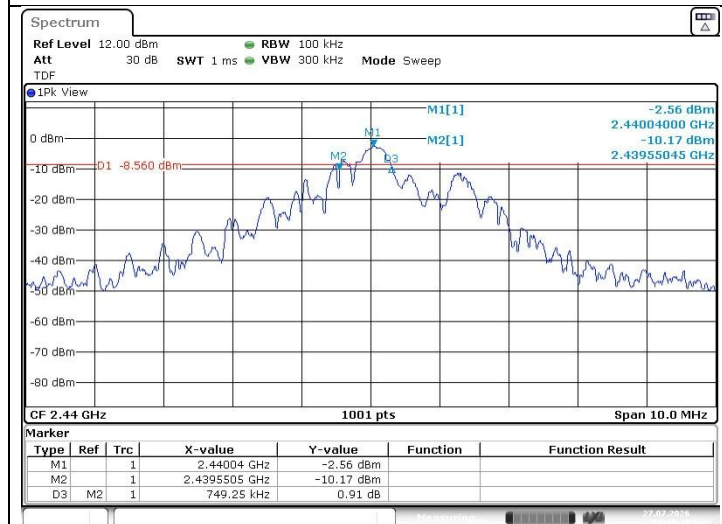
Port	Channel	Frequency (MHz)	99% Bandwidth (MHz)	Minimum Bandwidth (kHz)
ea port	Low	2 402	3.092	500
	Middle	2 440	2.817	
	High	2 480	1.284	
ia port	Low	2 402	3.032	
	Middle	2 440	3.322	
	High	2 480	1.693	

- Test plots
- 6 dB Bandwidth
- ea port

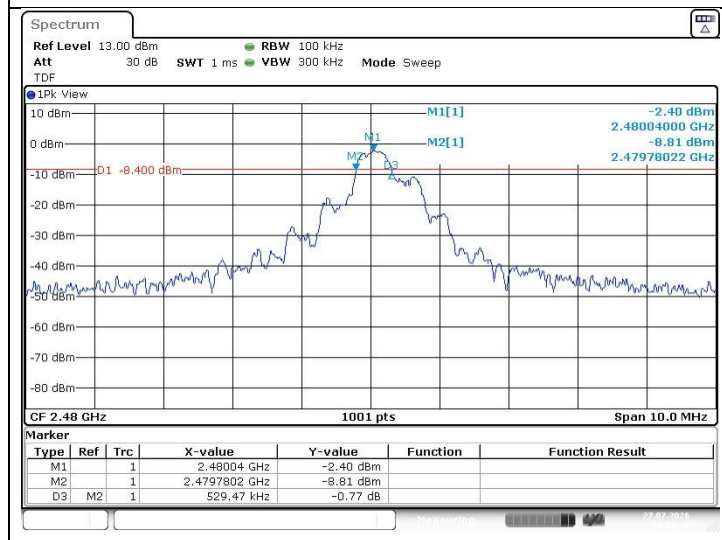
Low Channel



Middle Channel

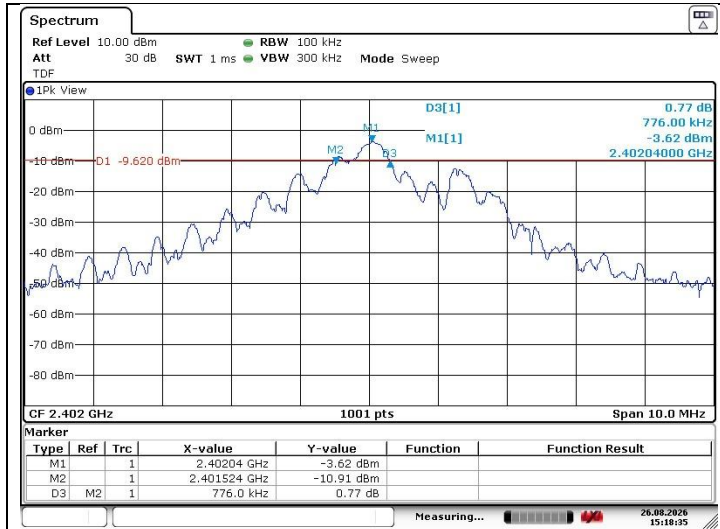


High Channel

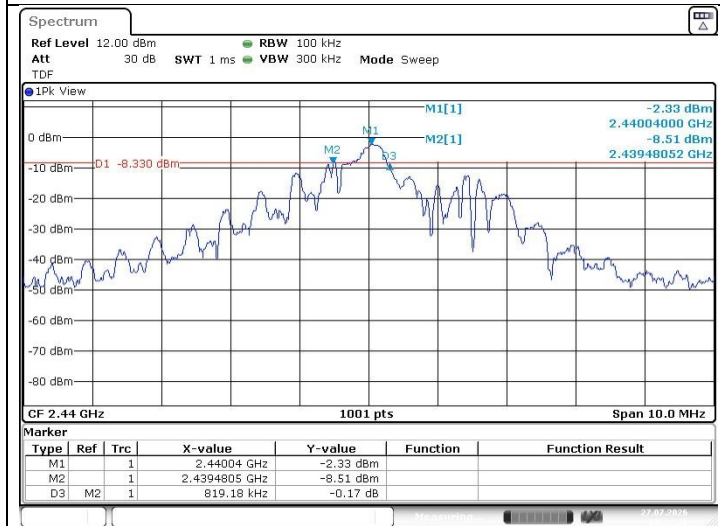


- ia port

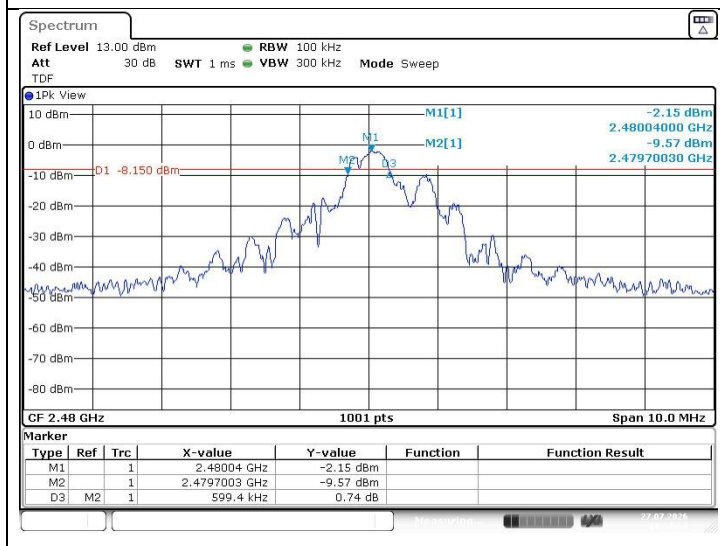
Low Channel



Middle Channel



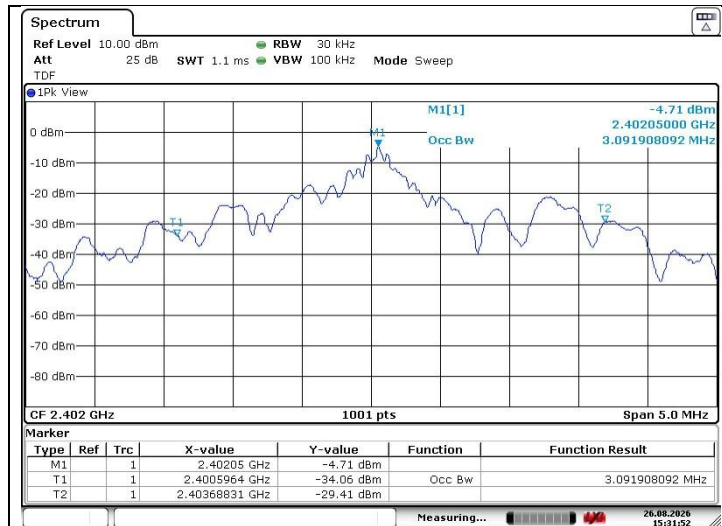
High Channel



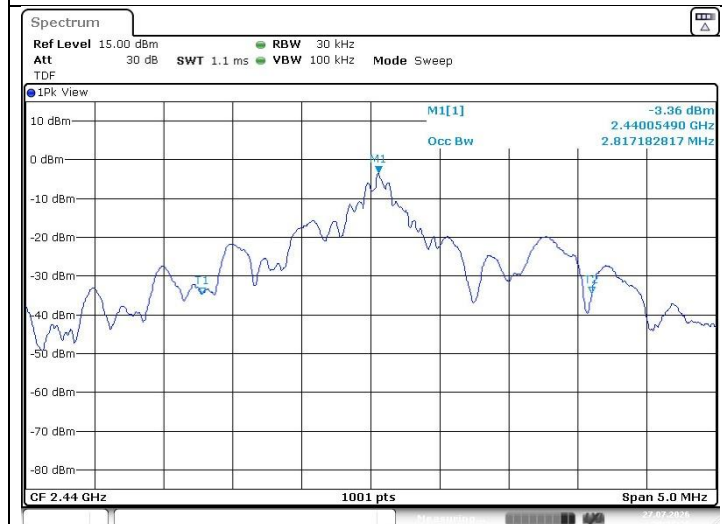
- 99% Bandwidth

- ea port

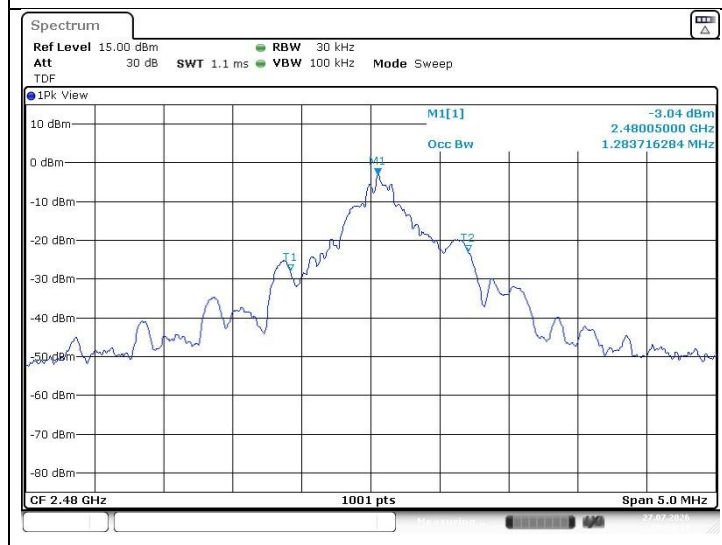
Low Channel



Middle Channel

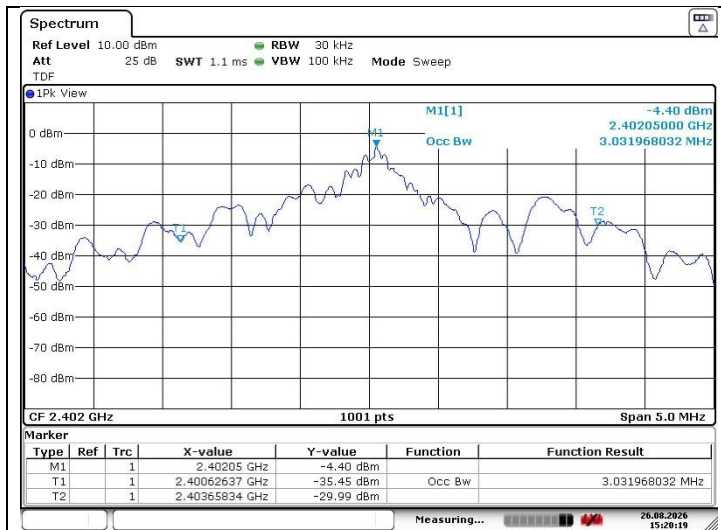


High Channel

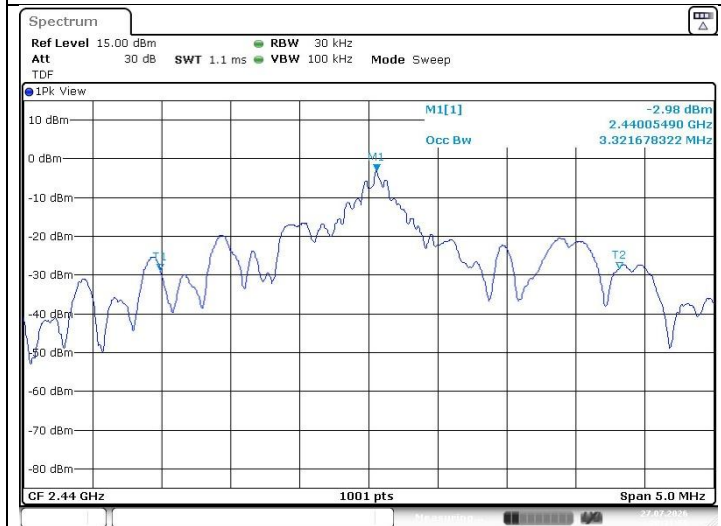


- ia port

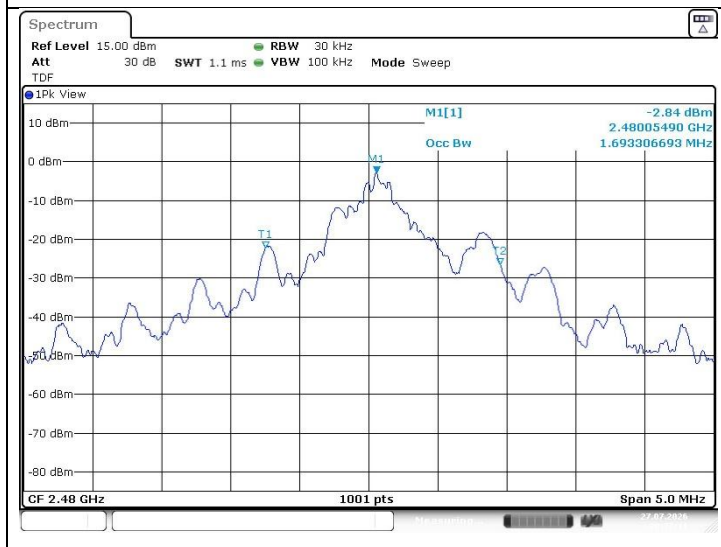
Low Channel



Middle Channel

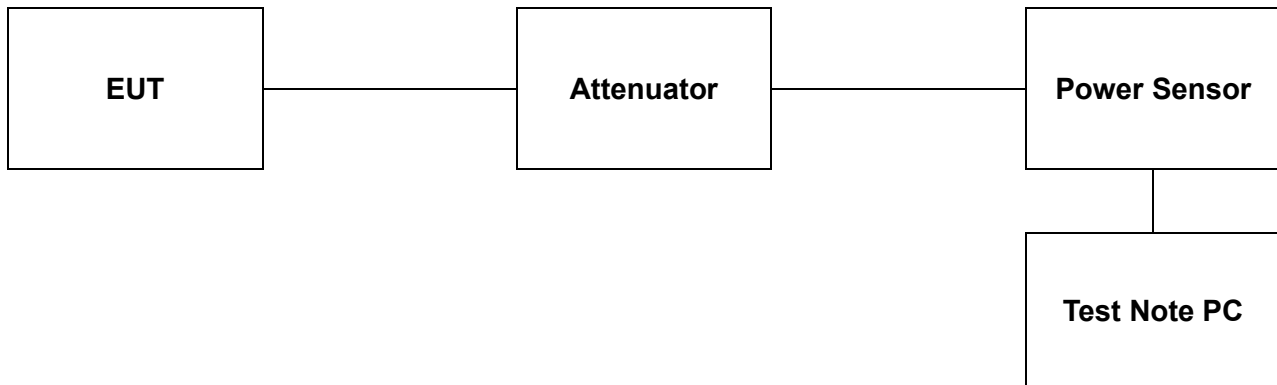


High Channel



4. Maximum Peak Conducted Output Power

4.1. Test Setup



4.2. Limit

According to §15.247(b)(3), for systems using digital modulation in the 902-928 MHz, 2 400-2 483.5 MHz, and 5 725-5 850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

According to §15.247(b)(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 paragraph (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.

4.3. Test Procedure

The test follows section 11.9.1.3 of ANSI C63.10-2020.

PKPM1 Peak-reading power meter method

- The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall utilize a fast-responding diode detector.

The test follows section 11.9.2.3.2 of ANSI C63.10-2020 (for FCC) and ANSI C63.10-2020 + Cor.1-2023 + C63.10a-2024 + Errata to C63.10a-2024 (for ISSED).

Method AVGPM-G (Measurement using a gated RF average-reading power meter)

- Alternatively, measurements may be performed using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since this measurement is made only during the ON time of the transmitter, no duty cycle correction is required.

Gate triggering can be implemented in such a way that the sweep of the instrument is only active during the burst period of the device. Any Gate triggering shall be performed on the full power portion of the pulses and care must be taken to ensure that static portions of the pulse are not included in the measurement (ensuring that the trace is averaged over the entire symbol range). All Gate triggered measurements shall be accompanied by a Gate setup plot in the test report.

Test program: (S/W name: R&S Power Viewer, Version: 3.2.0)

1. Initially overall offset for attenuator and cable loss is measured per frequency.
2. Measured offset is inserted in test program in advance of measurement for output power.
3. Power for each frequency (channel) of device is investigated as final result.
4. Final result reported on this section from R&S power viewer program includes with several factors and test program shows only final result.

4.4. Test Results

Ambient temperature : (23 ± 1) °C
 Relative humidity : 47 %

- ea port

Mode	Channel	Frequency (MHz)	Average Power Result (dB m)	Peak Power Result (dB m)	Limit (dB m)
GFSK	Low	2 402	-3.79	-3.26	30
	Middle	2 440	-3.45	-2.81	
	High	2 480	-3.02	<u>-2.57</u>	

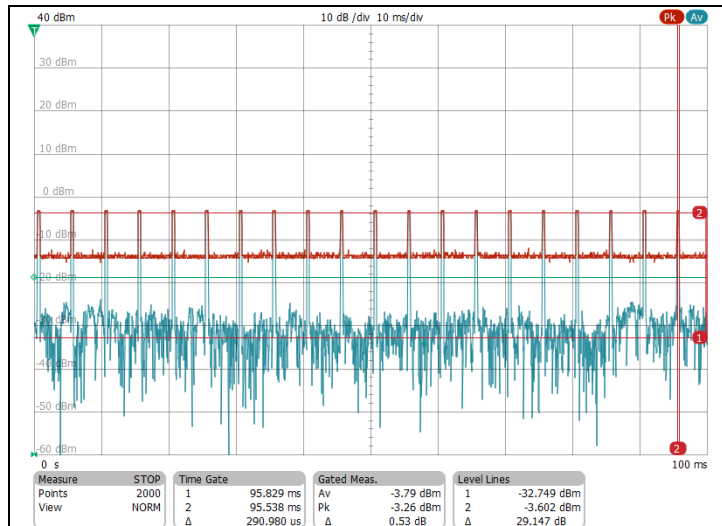
- ia port

Mode	Channel	Frequency (MHz)	Average Power Result (dB m)	Peak Power Result (dB m)	Limit (dB m)
GFSK	Low	2 402	-3.52	-3.07	30
	Middle	2 440	-3.23	-2.47	
	High	2 480	-3.10	<u>-2.36</u>	

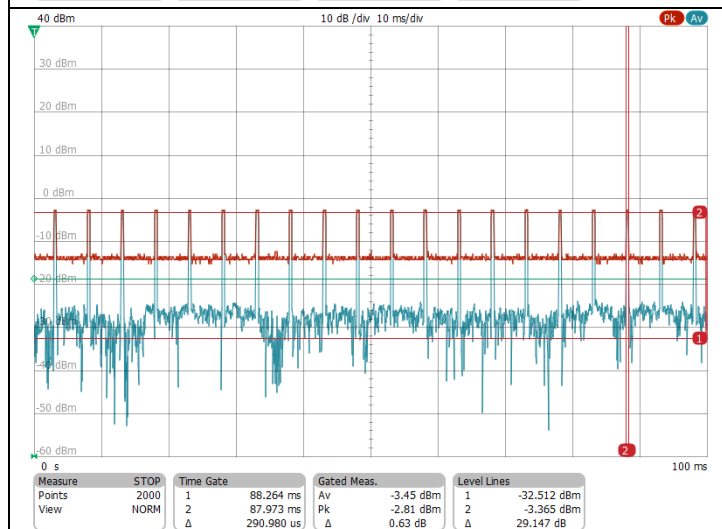
Test plots

- ea port

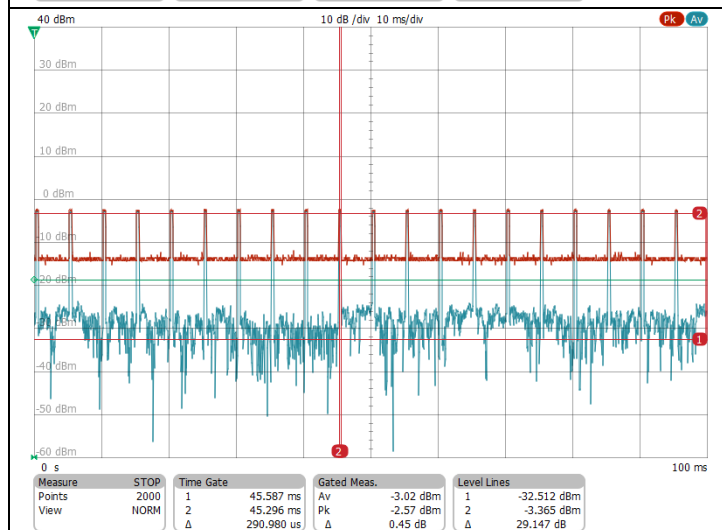
Low Channel



Middle Channel

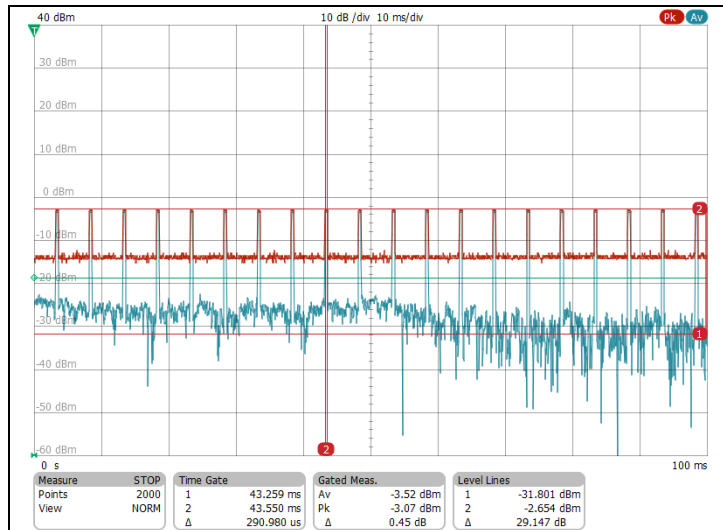


High Channel

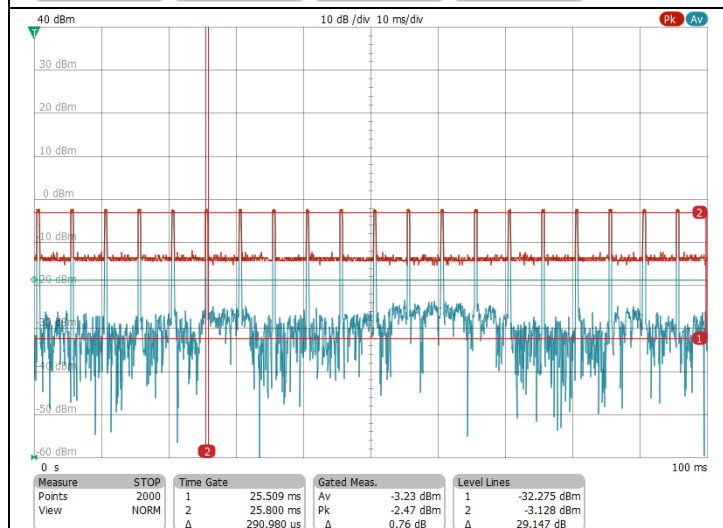


- ia port

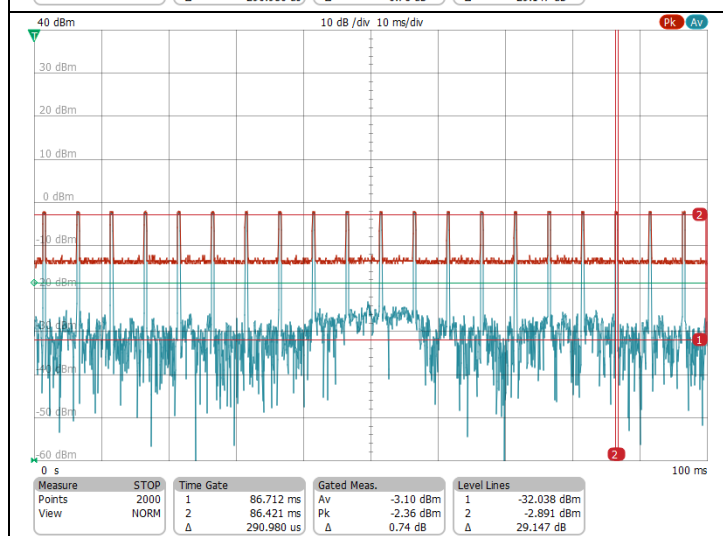
Low Channel



Middle Channel



High Channel



5. Power Spectral Density

5.1. Test Setup



5.2. Limit

According to §15.247(e), for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

5.3. Test Procedure

The measurements are recorded using the PKPSD measurement procedure in section 11.10.2 of ANSI C63.10-2020.

- The following procedure shall be used if maximum peak conducted output power was used to determine compliance, and is optional if the maximum conducted (average) output power was used to determine compliance.

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span > 1.5 times the DTS bandwidth.
3. Set the RBW to $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
4. Set the VBW $\geq [3 \times \text{RBW}]$.
5. Detector = peak.
6. Sweep time = No faster than coupled (auto) time.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat.

Note;

- For test plots, the reading values shown in plots were final results because all path loss of the cable and attenuator were investigated and compensated to spectrum analyzer as TDF function.

5.4. Test Results

Ambient temperature : (23 ± 1) °C
 Relative humidity : 47 %

- ea port

Mode	Channel	Frequency (MHz)	Measured PSD (dB m/3 kHz)	Limit (dB m/3 kHz)
GFSK	Low	2 402	-15.30	8
	Middle	2 440	-14.41	
	High	2 480	-12.76	

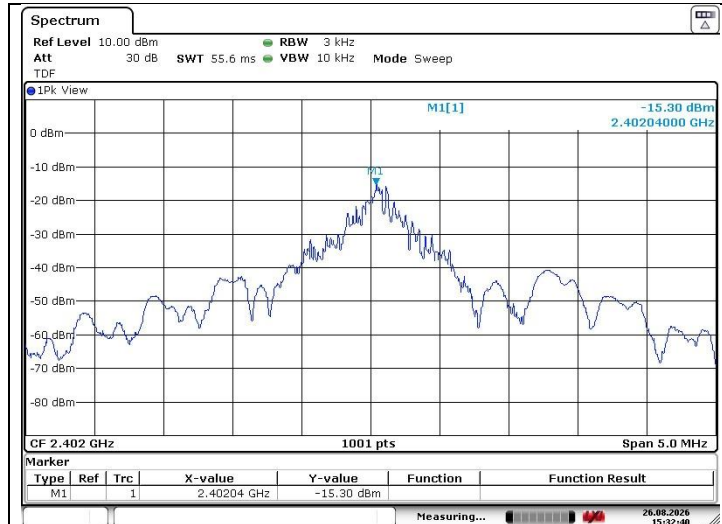
- ia port

Mode	Channel	Frequency (MHz)	Measured PSD (dB m/3 kHz)	Limit (dB m/3 kHz)
GFSK	Low	2 402	-14.80	8
	Middle	2 440	-14.49	
	High	2 480	-12.54	

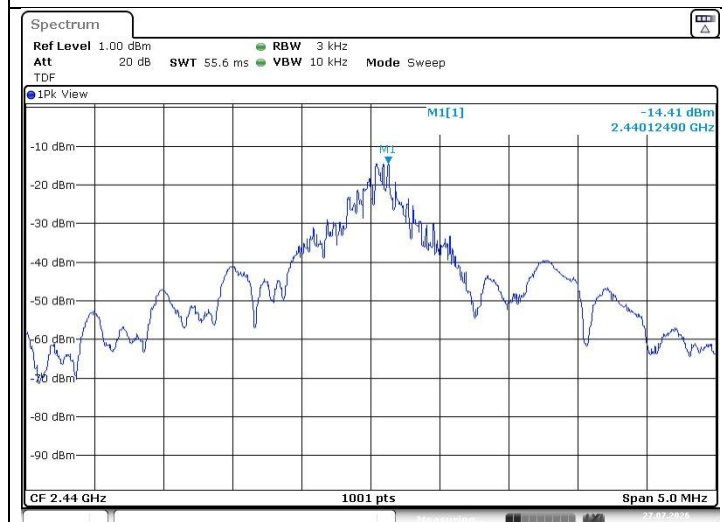
- Test plots

- ea port

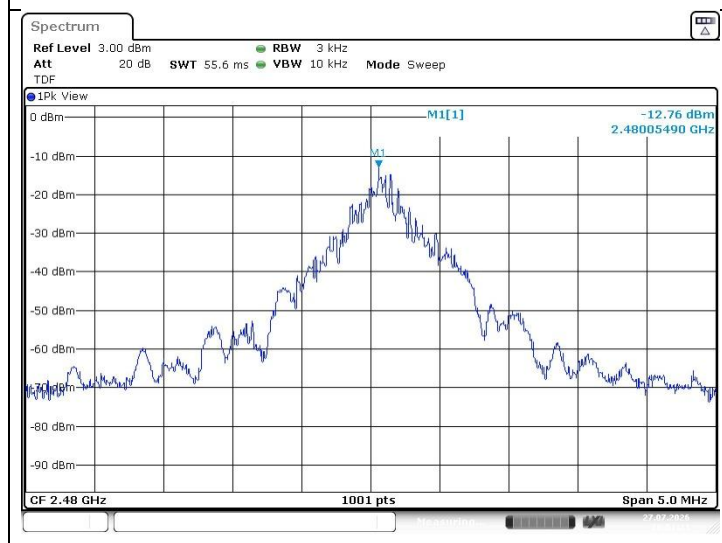
Low Channel



Middle Channel

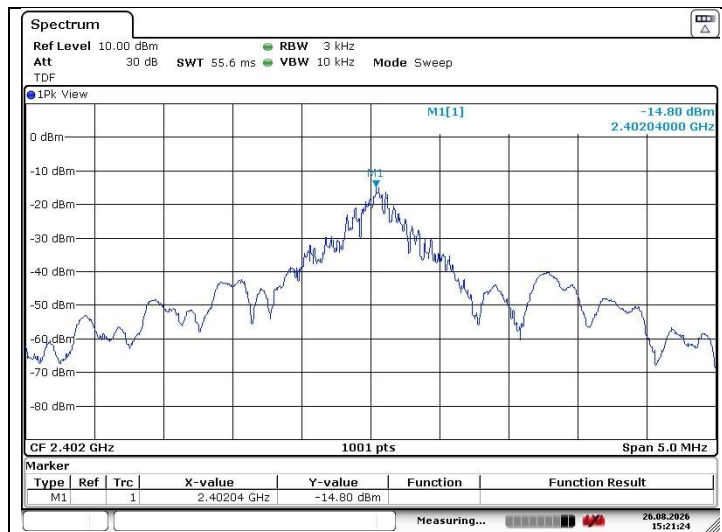


High Channel

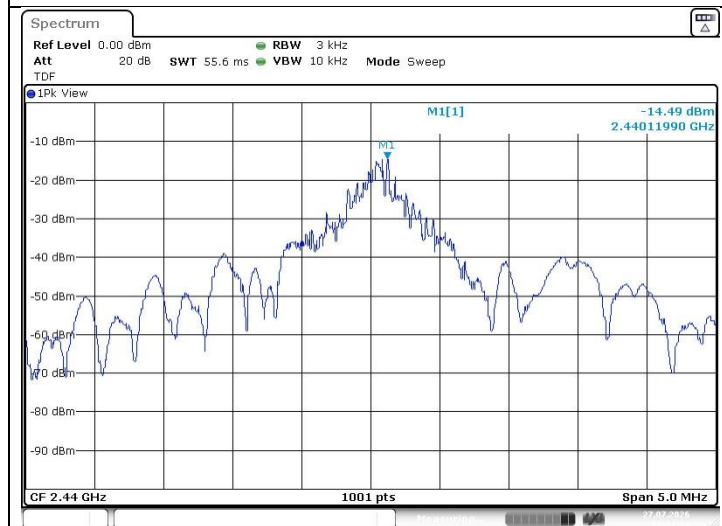


- ia port

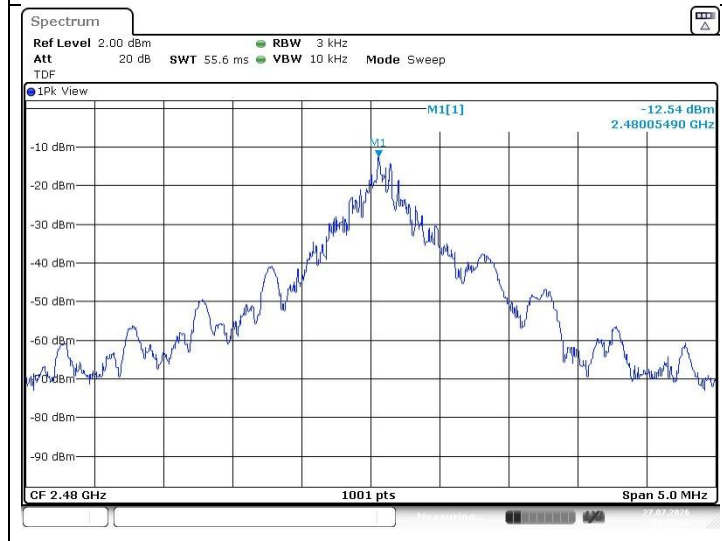
Low Channel



Middle Channel

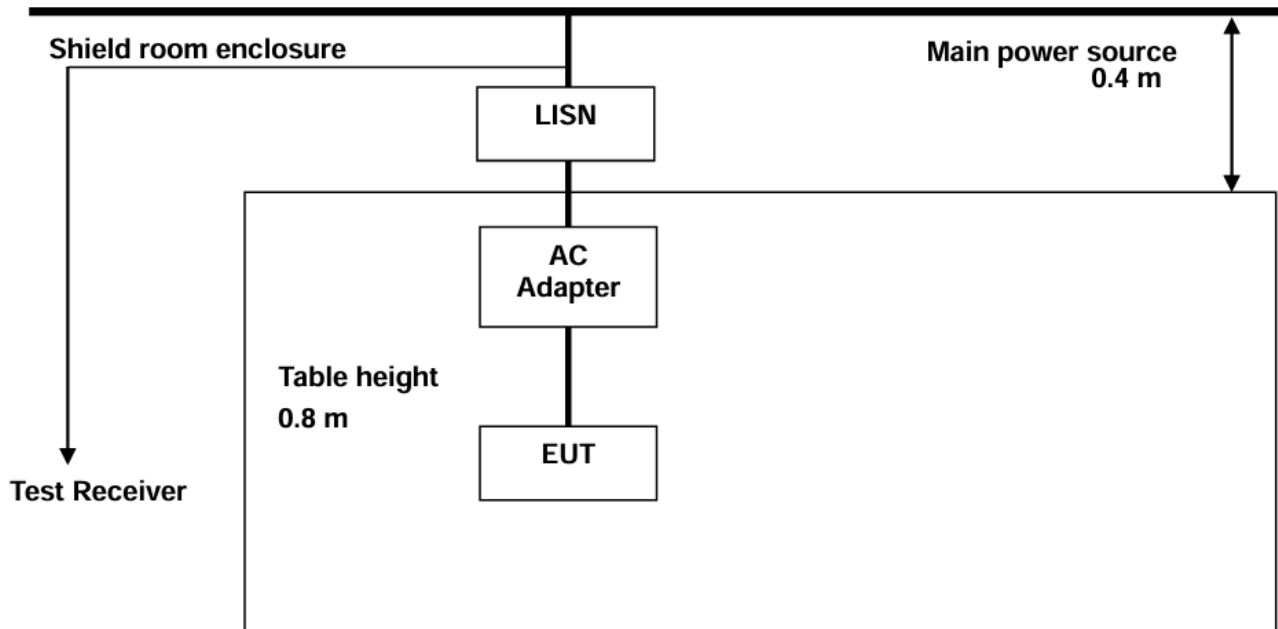


High Channel



6. AC Power Line Conducted Emission

6.1 Test Setup



6.2. Limit

According to §15.207(a), for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H /50 ohms line impedance stabilization network (LISN).

Compliance with the provision of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission (MHz)	Conducted limit (dB μ V)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

6.3. Test Procedures

AC conducted emissions from the EUT were measured according to the dictates of ANSI C63.10-2020.

1. The test procedure is performed in a 6.5 m × 3.5 m × 3.5 m (L × W × H) shielded room. The EUT along with its peripherals were placed on a 1.0 m (W) × 1.5 m (L) and 0.8 m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane.
2. The EUT was connected to power mains through a line impedance stabilization network (LISN) which provides 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room.
3. All peripherals were connected to the second LISN and the chassis ground also bounded to the horizontal ground plane of shielded room.
4. The excess power cable between the EUT and the LISN was bundled. The power cables of peripherals were unbundled. All connecting cables of EUT and peripherals were moved to find the maximum emission.

6.4. Test Results

The following table shows the highest levels of conducted emissions on both phase of Hot and Neutral line.

Ambient temperature : (23 ± 1) °C
Relative humidity : 47 %

Frequency range : 0.15 MHz - 30 MHz
Measured Bandwidth : 9 kHz

- EA port: 2 402 MHz ~ 2 480 MHz

Freq. (MHz)	Reading (dBμV)		Correction Factor (dB)	Result (dBμV)		Line	Limit (dBμV)		Margin (dB)	
	Quasi-peak	Average		Quasi-peak	Average		Quasi-peak	Average	Quasi-peak	Average
0.19	16.22	-2.78	9.83	26.05	7.05	N	64.04	54.04	37.99	46.99
0.31	4.63	-5.25	9.84	14.47	4.59	N	59.86	49.86	45.39	45.27
1.94	3.47	-3.29	9.99	13.46	6.70	N	56.00	46.00	42.54	39.30
4.80	3.04	-3.80	10.07	13.11	6.27	N	56.00	46.00	42.89	39.73
19.18	18.47	12.46	10.87	29.34	23.33	N	60.00	50.00	30.66	26.67
21.44	21.69	15.73	10.94	32.63	26.67	N	60.00	50.00	27.37	23.33
0.17	19.18	-2.52	9.73	28.91	7.21	H	65.16	55.16	36.25	47.95
0.25	10.43	-4.35	9.74	20.17	5.39	H	61.63	51.63	41.46	46.24
1.94	3.79	-2.92	9.90	13.69	6.98	H	56.00	46.00	42.31	39.02
4.89	3.54	-3.39	9.97	13.51	6.58	H	56.00	46.00	42.49	39.42
19.27	19.66	13.65	10.59	30.25	24.24	H	60.00	50.00	29.75	25.76
21.77	21.94	15.95	10.66	32.59	26.61	H	60.00	50.00	27.41	23.39

Remark;

1. Line (H): Hot, Line (N): Neutral.
2. All channels were investigated and the worst-case emissions were reported using **High channel**.
3. The limit for Class B device(s) from 150 kHz to 30 MHz are specified in Section of the Title 47 CFR.
4. Traces shown in plot were made by using a Quasi-peak detector and average detector.
5. Deviations to the Specifications: None.

- 1A port: 2 402 MHz ~ 2 480 MHz

Freq. (MHz)	Reading (dBμV)		Correction Factor (dB)	Result (dBμV)		Line	Limit (dBμV)		Margin (dB)	
	Quasi-peak	Average		Quasi-peak	Average		Quasi-peak	Average	Quasi-peak	Average
0.19	16.89	-2.54	9.83	26.72	7.29	N	64.21	54.21	37.49	46.92
0.27	8.26	-3.63	9.84	18.10	6.21	N	61.12	51.12	43.02	44.91
2.02	2.74	-3.73	10.00	12.74	6.27	N	56.00	46.00	43.26	39.73
4.90	2.91	-3.88	10.07	12.98	6.19	N	56.00	46.00	43.02	39.81
19.18	20.23	14.22	10.87	31.10	25.09	N	60.00	50.00	28.90	24.91
21.29	22.75	16.89	10.94	33.69	27.83	N	60.00	50.00	26.31	22.17
0.16	20.17	-2.08	9.73	29.90	7.65	H	65.36	55.36	35.46	47.71
0.79	0.82	-5.73	9.77	10.59	4.04	H	56.00	46.00	45.41	41.96
1.93	3.36	-3.34	9.90	13.26	6.56	H	56.00	46.00	42.74	39.44
4.87	5.64	-2.47	9.97	15.61	7.50	H	56.00	46.00	40.39	38.50
19.08	18.92	12.81	10.58	29.50	23.39	H	60.00	50.00	30.50	26.61
21.62	21.51	15.49	10.66	32.17	26.15	H	60.00	50.00	27.83	23.85

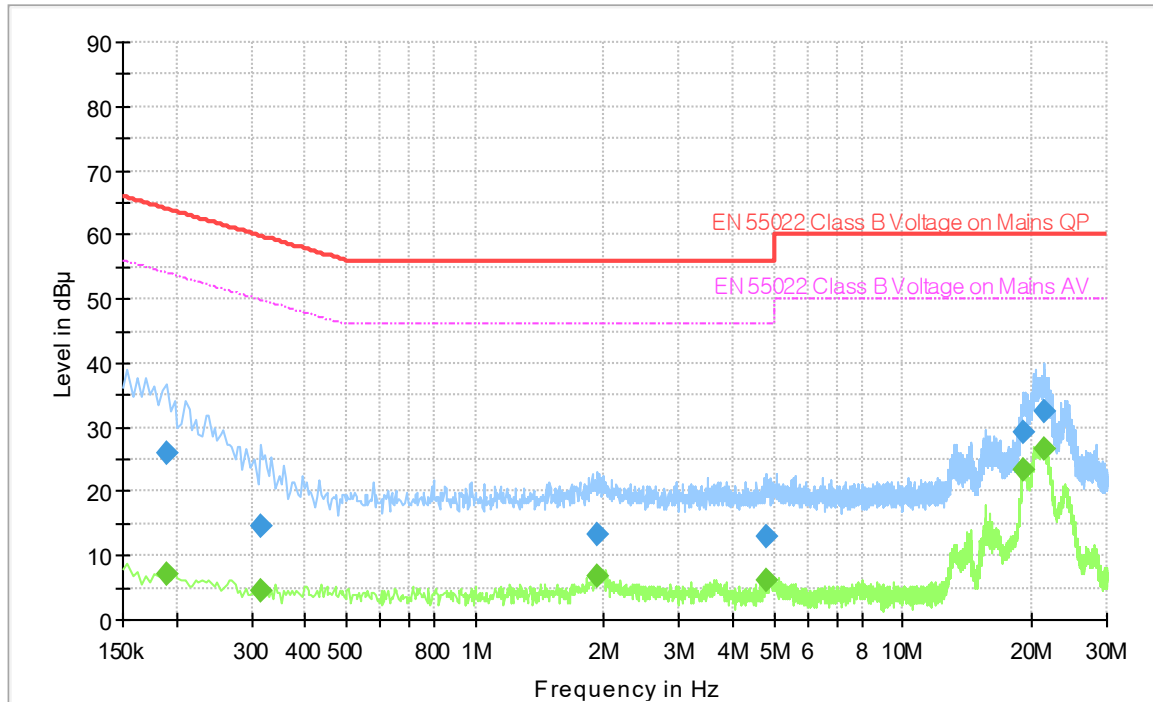
Remark;

1. Line (H): Hot, Line (N): Neutral.
2. All channels were investigated and the worst-case emissions were reported using **High channel**.
3. The limit for Class B device(s) from 150 kHz to 30 MHz are specified in Section of the Title 47 CFR.
4. Traces shown in plot were made by using a Quasi-peak detector and average detector.
5. Deviations to the Specifications: None.

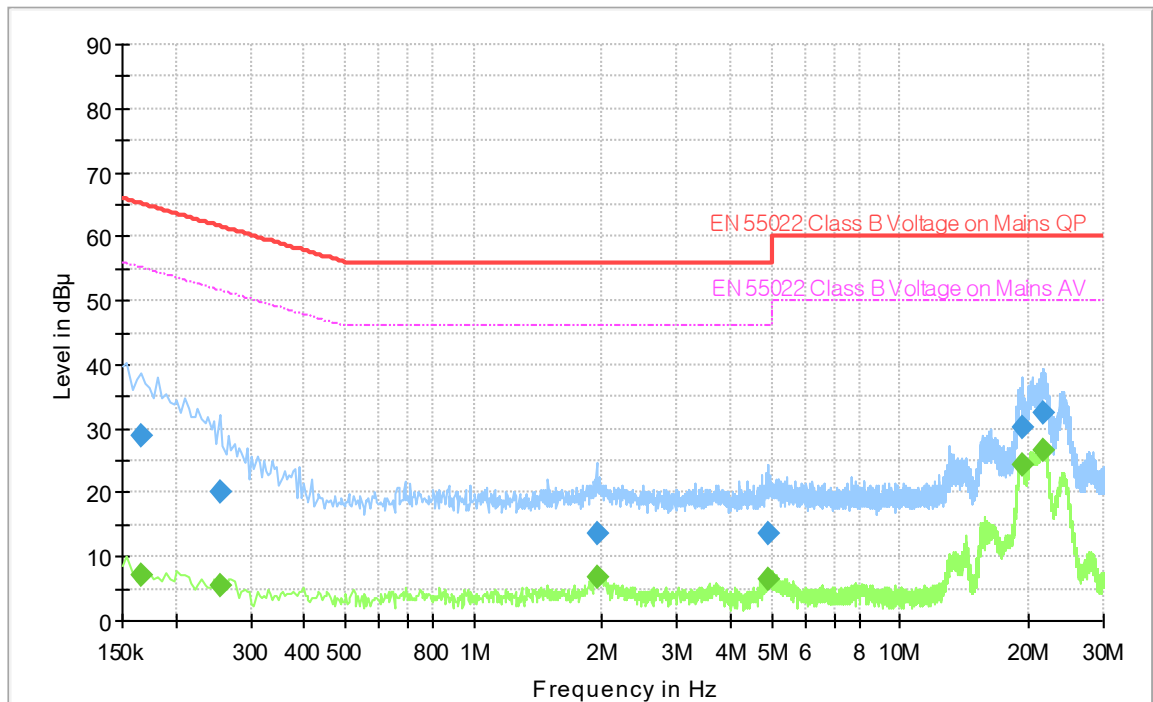
- Test plots

EA port

Test mode: (Neutral)

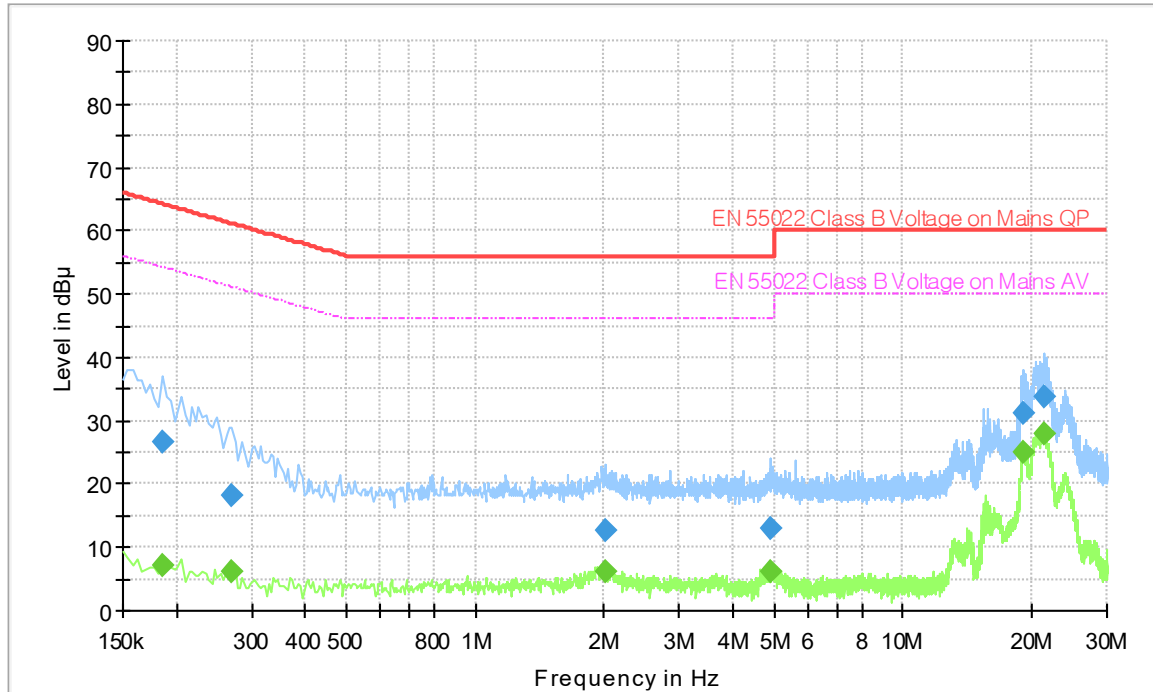


Test mode: (Hot)

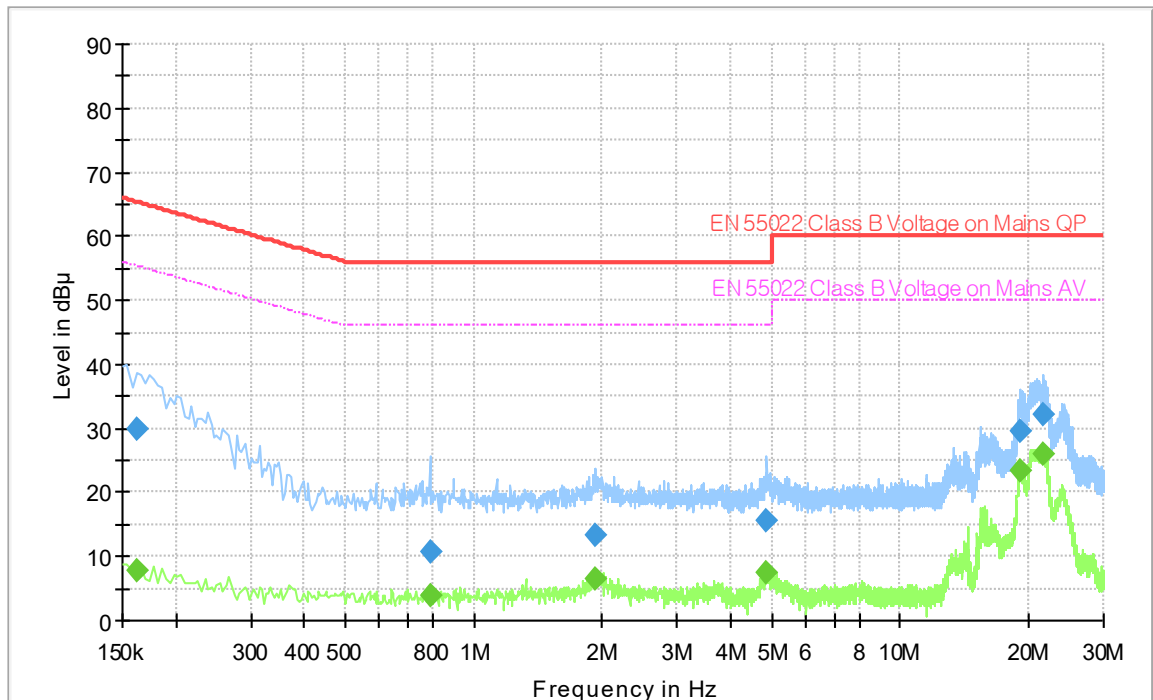


IA port

Test mode: (Neutral)



Test mode: (Hot)



7. Antenna Requirement

7.1. Standard Applicable

For intentional device, according to FCC 47 CFR Section §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. Further, 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. And according to FCC 47 CFR Section §15.247(b) if transmitting antennas of directional gain greater than 6 dB i are used, the conducted output power shall be reduced appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dB i.

7.2. Antenna Connected Construction

Antenna used in this product is chip Antenna with gain of 2.1 dB i.

- End of the Test Report -