RADIO TEST REPORT

Product	:	Wireless transceiver unit
Model Name	:	MR-2400MB
FCC ID	:	2AJE9MR-2400MB
Test Regulation	:	FCC 47 CFR Part 15 Subpart C (Section 15.247)
Received Date	:	2023/2/7
Test Date	:	2023/2/10 ~ 2023/2/17
Issued Date	:	2023/6/29
Applicant	:	Kyowa Electronic Instruments Co., Ltd. 3-5-1 Chofugaoka, Chofu, Tokyo 182-8520 Japan
Issued By	:	Underwriters Laboratories Taiwan Co., Ltd. Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Testing Laboratory
3398

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REVISION HISTORY

Original Test Report No.: 4790723321-US-R0-V0

Rev.	Test report No.	Date	Page revised	Contents
Original	4790723321-US-R0-V0	2023/6/29	-	Initial issue

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1. Attestation of Test Results

APPLICANT:	Kyowa Electronic Instruments Co., Ltd. 3-5-1 Chofugaoka, Chofu, Tokyo 182-8520 Japan
MANUFACTURER:	Kyowa Electronic Instruments Co., Ltd. 3-5-1 Chofugaoka, Chofu, Tokyo 182-8520 Japan
EUT DESCRIPTION:	Wireless transceiver unit
BRAND:	KYOWA
MODEL:	MR-2400MB
SAMPLE STAGE:	Engineering Verification Test sample
DATE of TESTED:	2023/2/10 ~ 2023/2/17

APPLICABLE STANDARDS	
STANDARD	**Test Results**
FCC 47 CFR PART 15 Subpart C (Section 15.247)	PASS

Underwriters Laboratories Taiwan Co., Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by Underwriters Laboratories Taiwan Co., Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by Underwriters Laboratories Taiwan Co., Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Underwriters Laboratories Taiwan Co., Ltd. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Prepared By:

Cindy Hsin Date : 2023/6/29
Project Handler

Approved and Authorized By:

Eric Lee Date : 2023/6/29
Senior Laboratory Engineer

2. Summary of Test Results

Summary of Test Results		
FCC Clause	**Test Items**	**Result**
15.247(a)(2)	6dB Bandwidth	PASS
15.247(b)	Conducted Output Power	PASS
15.247(e)	Power Spectral Density	PASS
15.247(d)	Antenna Port Emission	PASS
15.205 / 15.209 / 15.247(d)	Radiated Emissions and Band Edge Measurement	PASS
15.207	AC Power Conducted Emission	PASS
15.203	Antenna Requirement	PASS

3. Test Methodology and Reference Procedures

The tests documented in this report were performed in accordance with 47 CFR FCC Part 2, KDB558074 D01 Meas Guidance v05r02, KDB414788 D01 Radiated Test Site v01r01, ANSI C63.10-2013.

4. Facilities and Accreditation

Test Location	Underwriters Laboratories Taiwan Co., Ltd.
Address	Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan
Accreditation Certificate	Underwriters Laboratories Taiwan Co., Ltd. is accredited by TAF, Laboratory Code 3398.

5. Measurement Uncertainty

For statement of conformity, Simple acceptance (Section 4.3.4 of ISO Guide 115) was applied as decision rule for measurement in this test report.

The following uncertainties have been calculated to provide a confidence level of 95 % using a coverage factor k=2.

Determining compliance based on the results of the compliance measurement, not considering measurement instrumentation uncertainty.

Measurement	Frequency	Uncertainty
Conducted disturbance at mains terminals ports	150kHz ~ 30MHz	±2.9 dB
RF Conducted	9 kHz - 40GHz	±2.4 dB
Radiated disturbance below 30MHz	9 kHz - 30 MHz	±1.9 dB
Radiated disturbance below 1 GHz	30MHz ~ 1GHz	±5.8 dB
Radiated disturbance above 1 GHz	1GHz ~ 40GHz	±4.8 dB

6. Equipment under Test

6.1. Description of EUT

Product	Wireless transceiver unit
Brand Name	KYOWA
Model Name	MR-2400MB
Operating Frequency	2405MHz ~ 2480MHz
Modulation	GFSK
Transfer Rate	Up to 2 Mbps
Number of Channel	16
Maximum Output Power	8.58 dBm
Normal Voltage	3Vdc
Sample ID	5763416

Note:

1. MR-2400MB uses 32MHz crystal provided by two companies:
   (1) TZ3124CIW-B4017: TAI-SAW TECHNOLOGY CO., LTD.
   (2) FA-118T: SEIKO EPSON CORPORATION
   Both crystals have the same performances.

2. The above EUT information is declared by manufacturer and for more detailed features description, please refer the manufacturer's or user's manual, the laboratory shall not be held responsible.

6.2. Channel List

16 channels are provided to this EUT:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2405	8	2445
1	2410	9	2450
2	2415	10	2455
3	2420	11	2460
4	2425	12	2465
5	2430	13	2470
6	2435	14	2475
7	2440	15	2480

6.3. Test Condition

Test Item	Test Site No.	Environmental Condition	Input Power	Test Date	Tested by
Antenna Port Conducted Measurement	SR4	21~26℃/ 51~68%RH	3Vdc	2023/02/10~ 2023/02/17	Rex Chen
Radiated Spurious Emission	966-2	21~26℃/ 51~68%RH	3Vdc	2023/02/10~ 2023/02/17	Rex Chen
AC power Line Conducted Emission	SR1	21~26℃/ 51~68%RH	3Vdc	2023/02/10~ 2023/02/17	Rex Chen

FCC Test Firm Registration Number: 498077

Sample Calculation:

Antenna Port Conducted Measurement:

- Where relevant, the follow sample calculation is provided:
  Result Value (dBm) = Reading Value (dBm) +Attenuator Factor (dB) + Cable Loss (dB).
  Example: Result Value (10dBm) = Reading Value (-2dBm) +Attenuator Factor (10dB) + Cable Loss(2dB).
  *Test plot only shown the “Result Value”.

Radiated Spurious Emission:

- Where relevant, the follow sample calculation is provided:
  Result Value (dBuV/m) = Reading Value (dBuV) + Correction Factor (dB/m).
  Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Loss (dB) - Preamp Factor (dB).
  Example: Result Value (34.5dBuV/m) = Reading Value (40.1dBuV) + Antenna Factor (18.7dB/m) + Cable Loss (4.2dB) - Preamp Factor (28.5dB).

AC power Line Conducted Emission:

- Where relevant, the follow sample calculation is provided:
  Result Value (dBuV) = Reading Value (dBuV) + Correction Factor (dB).
  Correction Factor (dB) = Insertion loss(dB) + Cable loss(dB).
  Example: Result Value (53.7dBuV) = Reading Value (35.1dBuV) + Insertion loss(18.1dB) + Cable loss(0.5dB).

6.4. Description of Available Antennas

Ant. No.	Brand Name	Model Name	Ant. Type	Maximum Gain (dBi)
1	HWaYaoTek	DA-2450-03RP-SMA-04	Dipole	3.29
2	FUTABA	EXT-ANT2	Patch	0.94

Note: The above antenna information was provided from customer and for more detailed features description, please refer the manufacturer's specification or user's manual, the laboratory shall not be held responsible.

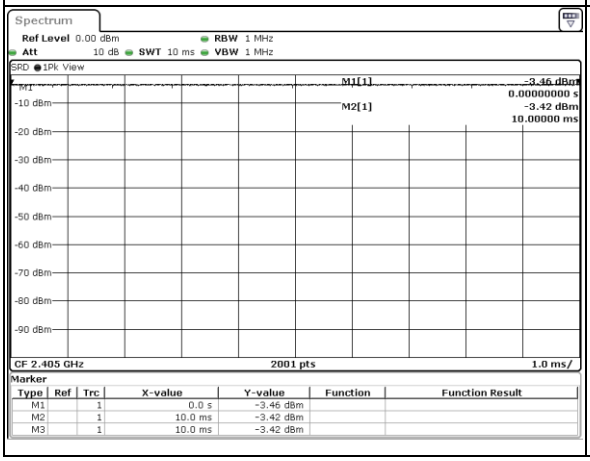
6.5. Test Mode Applicability and Tested Channel Detail

- The fundamental of the dipole antenna was investigated in two orthogonal (lay and stand), it was determined that stand mode was worst-case. Therefore, all final radiated testing was performed with the dipole antenna in stand mode.
- The fundamental of the patch antenna was investigated in three orthogonal axes X-Y/Y-Z/X-Z, it was determined that X-Z plane was worst-case. Therefore, all final radiated testing was performed with the patch antenna in X-Z plane.
- The EUT has two crystal sources:1st from TAI-SAW TECHNOLOGY CO., LTD (TZ3124CIW-B4017) and 2nd from SEIKO EPSON CORPORATION (FA-118T), above two types was pre-tested, the worst case was found in the 1st. Therefore only the test data of the 1st was recorded in this report.
- For Antenna Port Conducted Measurement, this item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.
- For below 30MHz testing, investigation was done on three antenna orientations (parallel, perpendicular, and ground-parallel), parallel and perpendicular are the worst orientations, therefore testing was performed on these two orientations only.
- For below 1 GHz radiated emission and AC power line conducted emission have performed all modes of operation were investigated and the worst-case emissions are reported.
- Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antennas.
- Radiated emission test were evaluate DA-2450-03RP-SMA-04 and EXT-ANT2.
- AC Power Line Conducted Emission was evaluate EXT-ANT2 only. (the worst case)

Test item	Modulation Type	Available Channel	Test Channel	Data Rate
Radiated Emissions	GFSK	0 to 15	0,7,15	2 Mbps
Radiated Emissions (Below 1GHz)	GFSK	0 to 15	15	2 Mbps
AC Power Line Conducted Emission	GFSK	0 to 15	15	2 Mbps
Antenna Port Conducted Measurement	GFSK	0 to 15	0,7,15	2 Mbps

6.6. Duty cycle

Mode	On Time (ms)	On+Off Time (ms)	Duty Cycle	Duty Factor (dB)	VBW Set (above 1GHz)
SRD	10.000	10.000	1.0000	N/A	10Hz

SRD	
	

7. Test Equipment

Test Equipment List					
Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Cal. Date**	**Expired date**
Radiated Spurious Emission					
Spectrum Analyzer	Keysight	N9010A	MY56070834	2022/10/24	2023/10/23
EMI Test Receiver	Rohde & Schwarz	ESR7	101754	2022/12/13	2023/12/12
Loop Antenna	ETS lindgren	6502	00213440	2023/1/4	2024/1/3
Trilog-Broadband Antenna with 5dB Attenuator	Schwarzbeck & EMCI	VULB 9168 & N-6-05	9168-773 & AT-N0539	2022/4/6	2023/4/5
Horn Antenna (1-18 GHz)	Schwarzbeck	BBHA 9120 D	01690	2022/12/21	2023/12/20
Horn Antenna (18-40 GHz)	Schwarzbeck	BBHA 9170	781	2022/12/30	2023/12/29
Preamplifier (30-1000 MHz)	EMCI	EMC330E	980405	2022/6/7	2023/6/6
Preamplifier (1-18 GHz)	EMCI	EM01G18G	060680	2022/3/18	2023/3/17
Preamplifier (18-40GHz)	EMCI	EMC184040SEE	980426	2022/5/17	2023/5/16
Cables	Hanyitek	K1K50-UP0264-K1K50-2500	170214-4 & 170425-2	2022/12/1	2023/11/30
Cables	Hanyitek	K1K50-UP0264-K1K50-2500	170214-1 & 170214-2	2022/12/1	2023/11/30

Test Equipment List					
Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Cal. Date**	**Expired date**
Antenna Port Conducted Measurement					
Spectrum Analyzer	Rohde & Schwarz	FSV40	101490	2022/9/12	2023/9/11
Attenuator	EMCI	EMC-40ATK2W10	17002	2022/12/9	2023/12/8
Pulse Power Sensor	Anritsu	MA2411B	1531202	2023/1/4	2024/1/3
Power Meter	Anritsu	ML2495A	1645002	2023/1/4	2024/1/3
AC power Line Conducted Emission					
EMI Test Receiver	Rohde & Schwarz	ESR7	101753	2022/11/10	2023/11/9
Two-Line V-Network	Rohde & Schwarz	ENV216	102136	2022/8/29	2023/8/28
Impuls-Begrenzer Pulse Limiter	Rohde & Schwarz	ESH3-Z2	102219-Qt	2022/8/30	2023/8/29
Cables	TITAN	CFD200	T0732ACFD200 20A300-2	2022/4/9	2023/4/8

UL Software		
Description	**Name**	**Version**
Radiated measurement	e3	6.191211 (V6)
Conducted measurement	RF-Conducted-FCC 15247	ver 1.0
AC power Line Conducted Emission	EZ_EMC	UL-3A1.2

8. Description of Test Setup

Support Equipment

ID	Equipment	Brand Name	Model Name	S/N	Remark
A	Adapter	KYOWA	UI318-12	E09-0359311	Supplied by client
B	MRS Receiver	KYOWA	MRS-114A	NA	Supplied by client
C	Laptop	SONY	VJS131C11N	5147948	Supplied by client
D	Test Tool	KYOWA	WL-456-5010	NA	Supplied by client
E	DC Power Supply	Gwinstek	GPD-2303S	NA	Provided by Lab

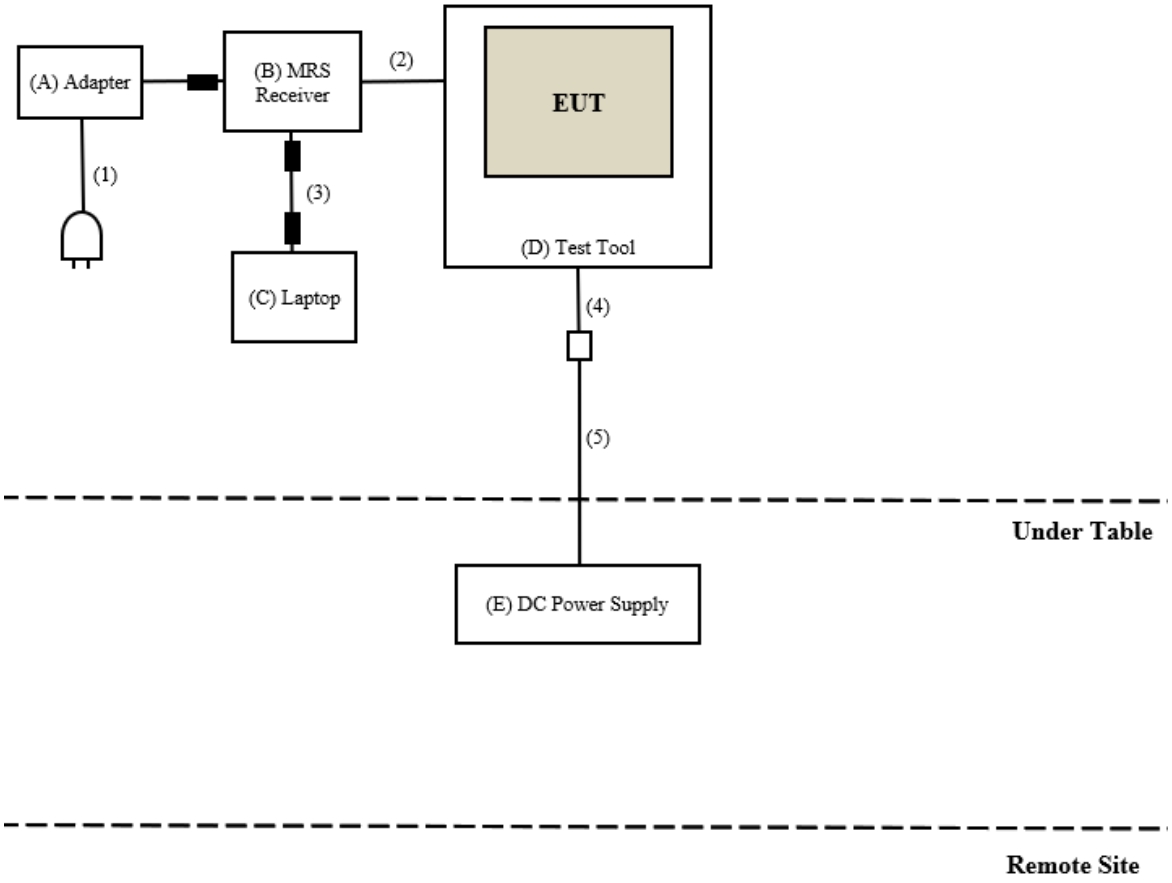
I/O Cables

ID	Equipment	Brand Name	Model Name	Length (m)	Remark
1	AC Cable	Kyowa	UNI318-1215-EDS	1.8	Supplied by client
2	Type A to Type B Cable	Kyowa	N-38	0.88	Supplied by client with two cores
3	MRS-DUT connection cable (Data transmission part)	Kyowa	WL-456-9011	0.4	Supplied by client
4	MRS-DUT connection cable (DC cable part)	Kyowa	WL-456-9011	0.47	Supplied by client
5	DC Cable	TAYA	PT0020-2	2	Provided by Lab

Test Setup

Controlled using a bespoke application (MrsMultiTestApp_v0.04.exe) on a test Notebook. The application was used to enable a continuous transmission mode and to select the test channels, data rates, modulation schemes and power setting as required.

Setup Diagram for Test



9. Test Results

9.1. 6dB Bandwidth

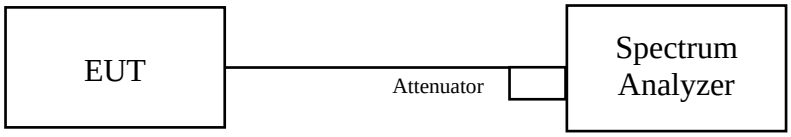
Requirements

The minimum 6 dB bandwidth shall be at least 500 kHz.

Test procedure

a. Set resolution bandwidth (RBW) = 100kHz
b. Set the video bandwidth (VBW) ≥ 3 x RBW, Detector = Peak.
c. Trace mode = max hold.
d. Sweep = auto couple.
e. Measure the maximum width of the emission that is constrained by the frequencies associated with the two amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

Test Setup

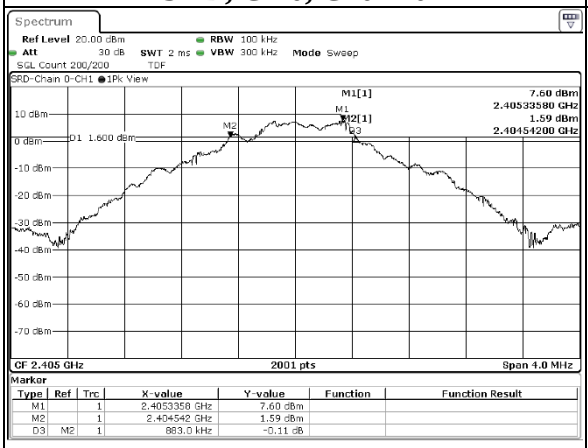


The loss between RF output port of the EUT and the input port of the Spectrum Analyzer has been taken into consideration.

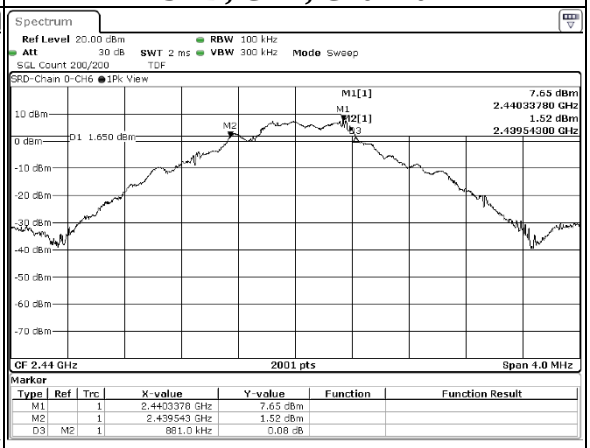
Test Data

Mode	CH	Freq (MHz)	6dB BW (MHz)	Limit (MHz)	Result
SRD	0	2405	0.883	0.5	PASS
SRD	7	2440	0.881	0.5	PASS
SRD	15	2480	0.891	0.5	PASS

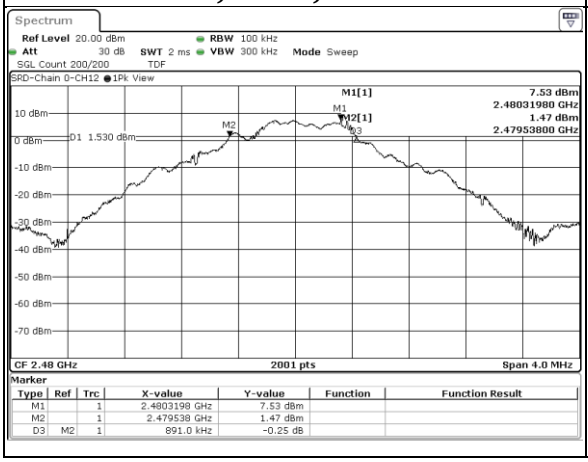
SRD, CH0, Chain 0



SRD, CH7, Chain 0



SRD, CH15, Chain 0



9.2. Conducted Output Power

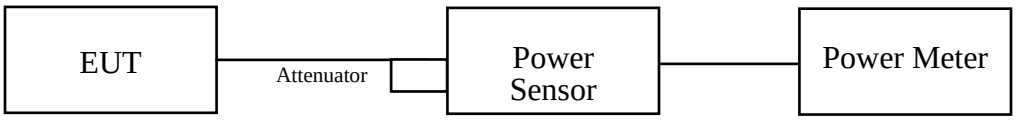
Requirements

For systems using digital modulation in the 2400-2483.5 MHz bands: 1 Watt.

Test Procedure

A peak power sensor was used on the output port of the EUT. A power meter was used to read the response of the peak power sensor. Record the power level.

Test Setup



The loss between RF output port of the EUT and the input port of the Power Meter has been taken into consideration.

Test Data

Peak Power

SRD

Channel	Frequency (MHz)	Peak Power (mW)	Peak Power (dBm)	Limit (dBm)	Pass/Fail
0	2405	7.096	8.51	30	PASS
7	2440	7.178	8.56	30	PASS
15	2480	7.211	8.58	30	PASS

Average Power (Reference Only)

SRD

Channel	Frequency (MHz)	Average Power (mW)	Average Power (dBm)
0	2405	6.982	8.44
7	2440	7.112	8.52
15	2480	7.129	8.53

9.3. Power Spectral Density

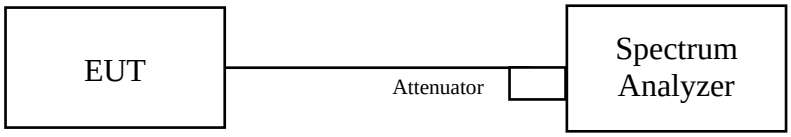
Requirements

The Maximum of Power Spectral Density Measurement is 8dBm in any 3 kHz.

Test procedure

a. Set analyzer center frequency to DTS channel center frequency.
b. Set the span to 1.5 times the DTS bandwidth.
c. Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
d. Set the VBW ≥ 3 × RBW.
e. Detector = peak.
f. Sweep time = auto couple.
g. Trace mode = max hold.
h. Allow trace to fully stabilize.
i. Use the peak marker function to determine the maximum amplitude level within the RBW.

Test Setup

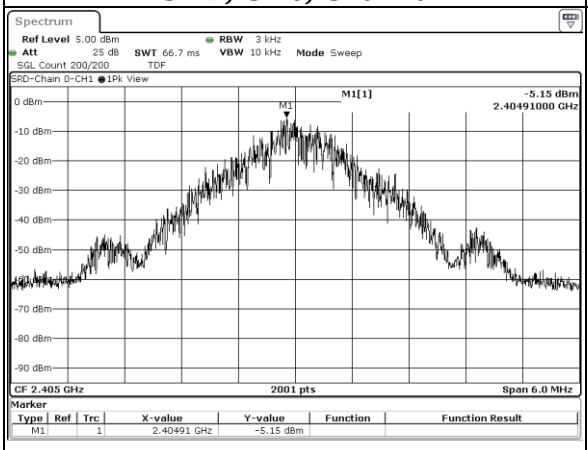


The loss between RF output port of the EUT and the input port of the Spectrum Analyzer has been taken into consideration.

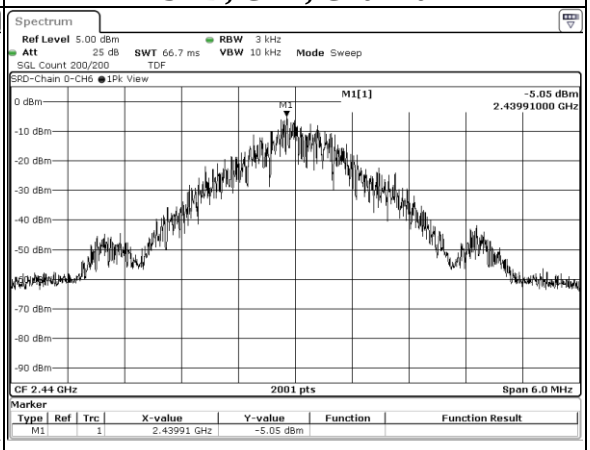
Test Data

Mode	CH	Freq (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Result
SRD	0	2405	-5.15	8	PASS
SRD	7	2440	-5.05	8	PASS
SRD	15	2480	-4.95	8	PASS

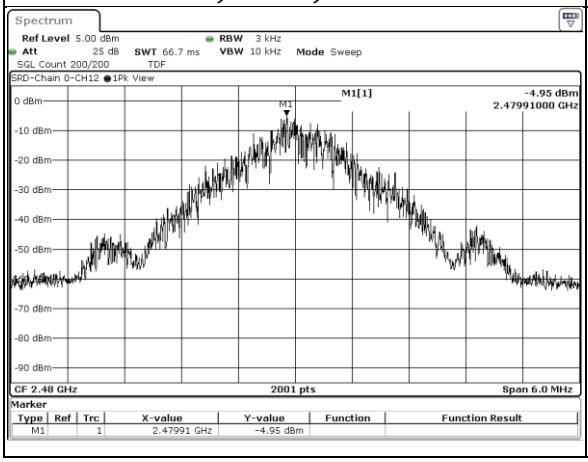
SRD, CH0, Chain 0



SRD, CH7, Chain 0



SRD, CH15, Chain 0



9.4. Conducted Out of Band Emission

Requirements

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.

Test procedure

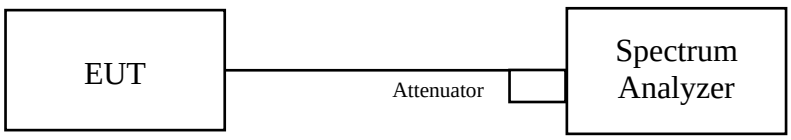
Measurement Procedure REF

a. Set the RBW = 100 kHz.
b. Set the VBW ≥ 300 kHz.
c. Set the span to 1.5 times the DTS bandwidth.
d. Detector = peak.
e. Sweep time = auto couple.
f. Trace mode = max hold.
g. Allow trace to fully stabilize.
h. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

Measurement Procedure OOBE

a. Set RBW = 100 kHz.
b. Set VBW ≥ 300 kHz.
c. Detector = peak.
d. Sweep = auto couple.
e. Trace Mode = max hold.
f. Allow trace to fully stabilize.
g. Use the peak marker function to determine the maximum amplitude level.

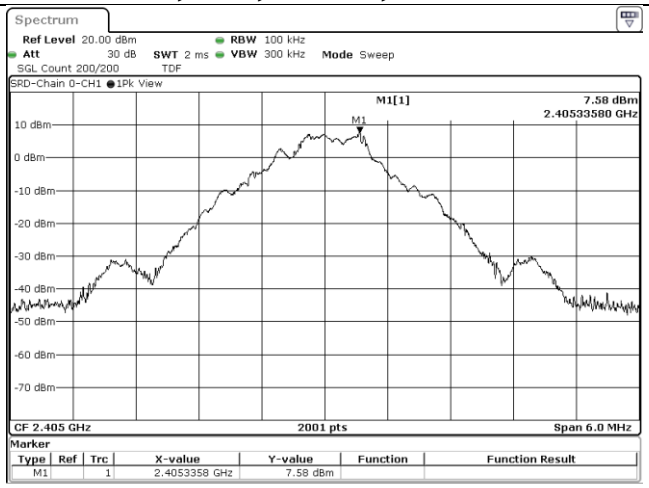
Test Setup



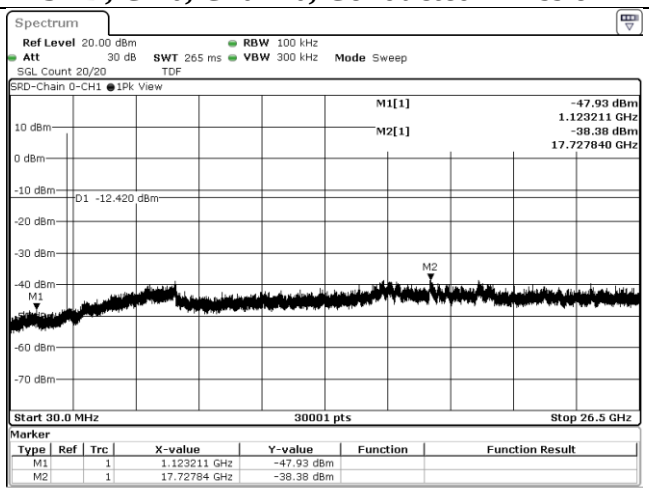
The loss between RF output port of the EUT and the input port of the Spectrum Analyzer has been taken into consideration.

Test Data

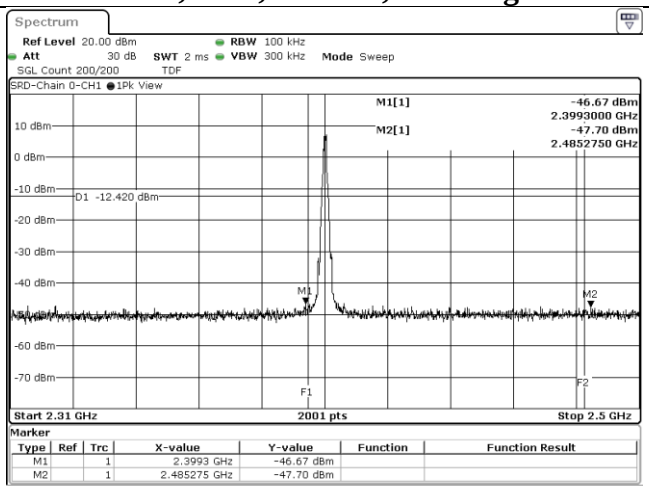
SRD, CH0, Chain 0, Reference



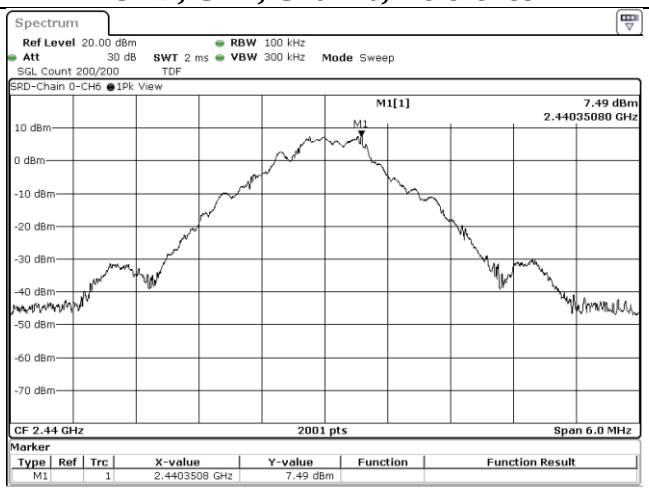
SRD, CH0, Chain 0, Conducted Emission



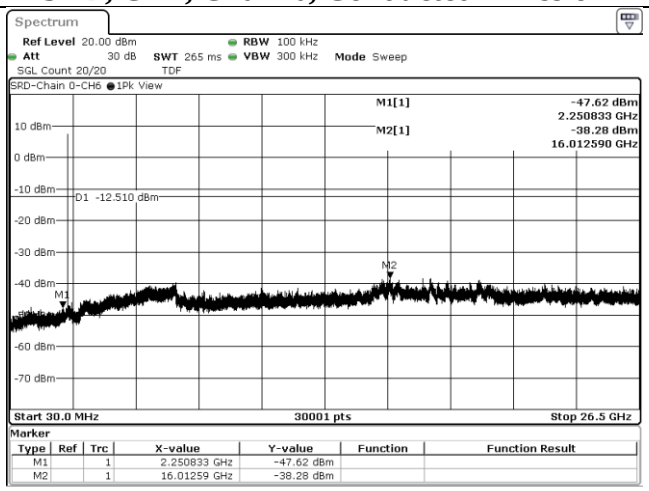
SRD, CH0, Chain 0, Bandedge



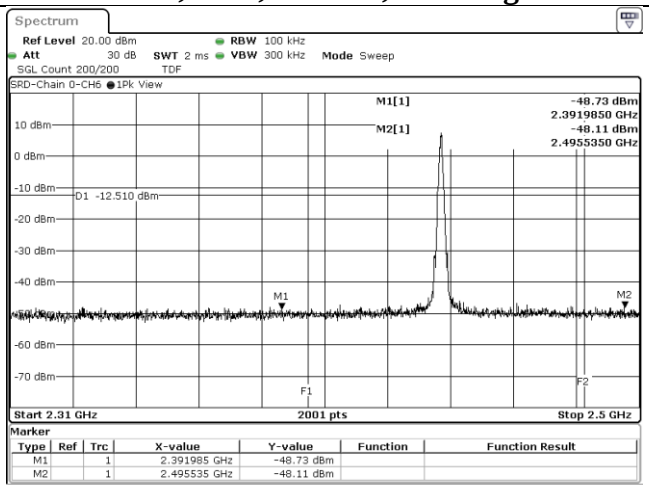
SRD, CH7, Chain 0, Reference



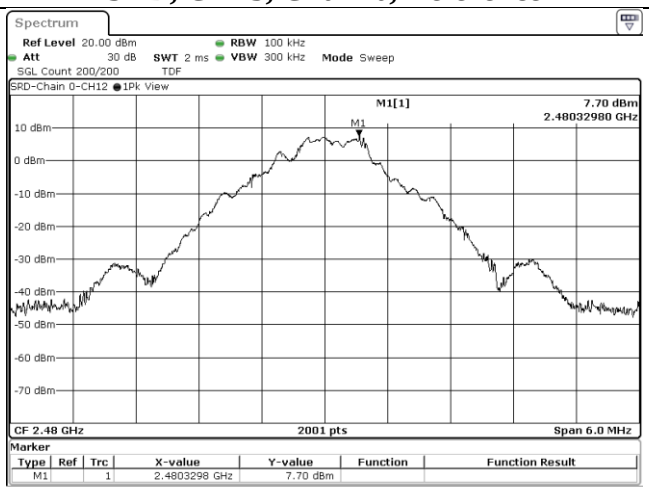
SRD, CH7, Chain 0, Conducted Emission



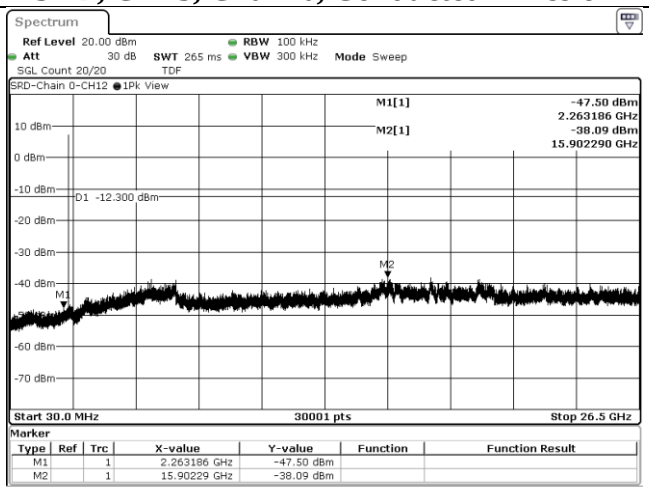
SRD, CH7, Chain 0, Bandedge



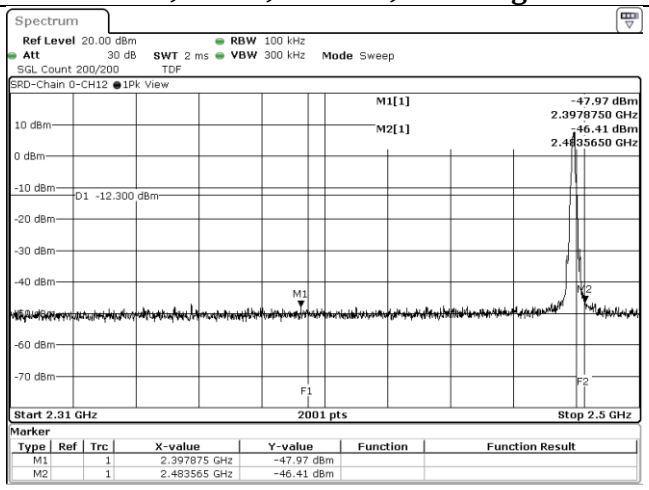
SRD, CH15, Chain 0, Reference



SRD, CH15, Chain 0, Conducted Emission



SRD, CH15, Chain 0, Bandedge



9.5. Radiated Spurious Emission

Requirements

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table. Other emissions shall be at least 20dB below the highest level of the desired power:

Frequency(MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/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

NOTE:
1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.

Test Procedures

[For 9 kHz ~ 30 MHz]

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
c. Parallel, perpendicular, and ground-parallel orientations of the antenna are set to make the measurement.
d. For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
e. For measurement below 30MHz, the initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured. If the emission level of the EUT measured by the peak detector is lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

NOTE:
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

[For above 30 MHz]

a. The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
c. The height of antenna 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.
d. 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 rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
e. For measurement below 1GHz, the initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured. If the emission level of the EUT measured by the peak detector is lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.
f. The test-receiver system was set to peak and average detects function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

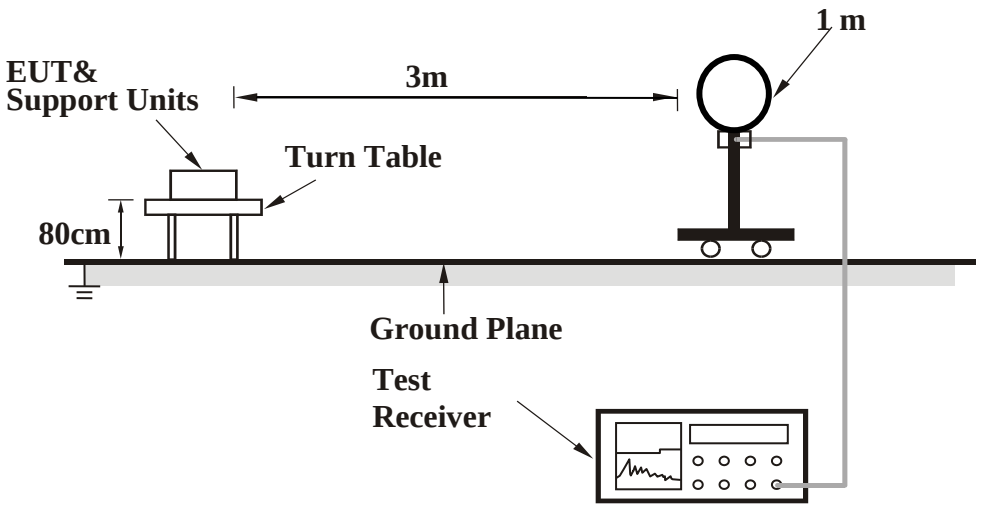
a. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
b. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
c. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is ≥ 1/T (Duty cycle < 98%) or 10Hz (Duty cycle ≥ 98%) for Average detection (AV) at frequency above 1GHz.

Configuration	Average	
	RBW	VBW
SRD	1MHz	Refer to section 6.6 for duty cycle.

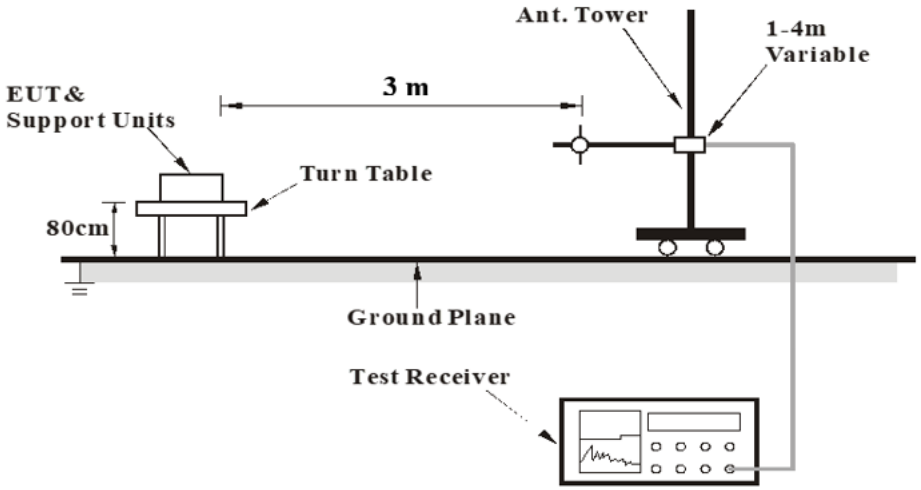
d. All modes of operation were investigated (includes all external accessories) and the worst-case emissions are reported, the other emission levels were low against the limit.
e. Test data of Result value (dBuV/m) = Reading value (dBuV/m) + Correction Factor (dB/m).
f. Test data of Margin(dB) = Result value (dBuV/m) - Limit value (dBuV/m).
g. Test data of Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Loss (dB) - Preamp Factor (dB).
h. Test data of Notation "@" = Fundamental Frequency
i. Test data of Notation " * " = The peak result under 20 dB above and complies with AVG limit, AVG result is deemed to comply with AVG limit.

Test Setup

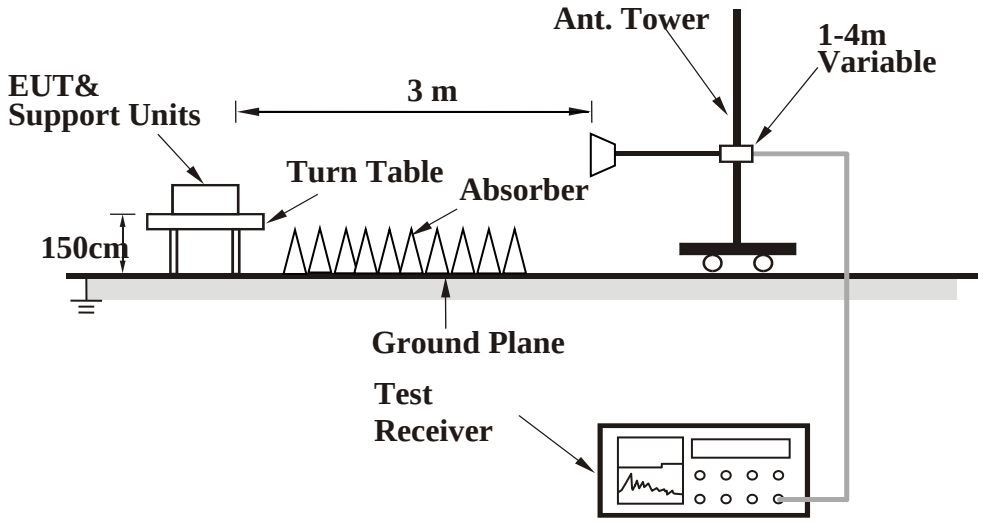
<Frequency Range 9 kHz ~ 30 MHz>



<Frequency Range 30 MHz ~ 1 GHz >



<Frequency Range above 1 GHz>



For the actual test configuration, please refer to the Setup Configurations.

Test Data

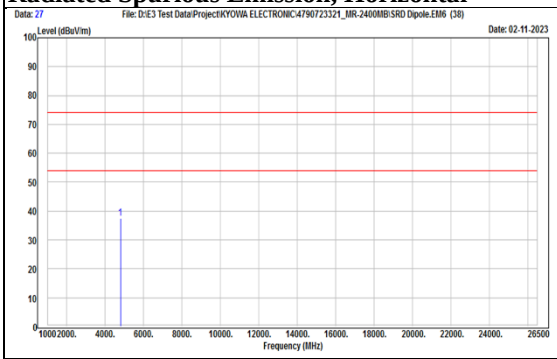
Dipole Antenna

Above 1 GHz

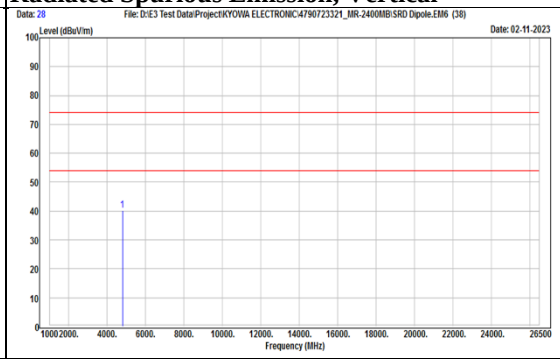
Mode	SRD	Channel	0

Polarization	Notation	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
Horizontal		2330.14	41.74	16.1	57.84	74	-16.16	PK
		2352.94	30.17	16.08	46.25	54	-7.75	AVG
	@	2405	83.49	16	99.49	N/A	N/A	PK
	@	2405	82.65	16	98.65	N/A	N/A	AVG
	*	4810	35.14	2.28	37.42	74	-36.58	PK
Vertical		2372.89	31.51	16.04	47.55	54	-6.45	AVG
		2386.57	42.5	16.01	58.51	74	-15.49	PK
	@	2405	93.37	16	109.37	N/A	N/A	PK
	@	2405	92.35	16	108.35	N/A	N/A	AVG
	*	4810	37.91	2.28	40.19	74	-33.81	PK

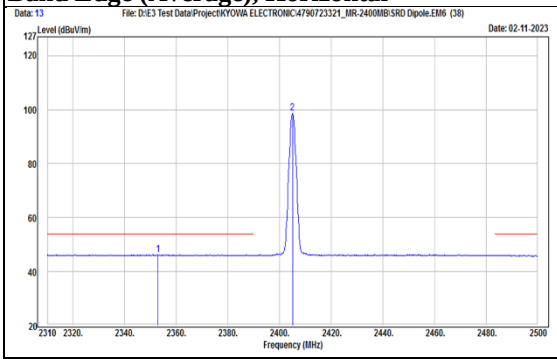
TX, SRD (Ch 0)
Radiated Spurious Emission, Horizontal



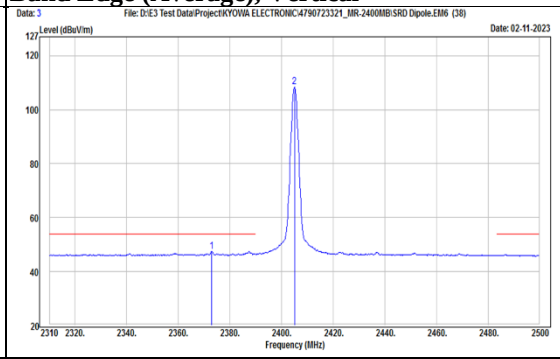
TX, SRD (Ch 0)
Radiated Spurious Emission, Vertical



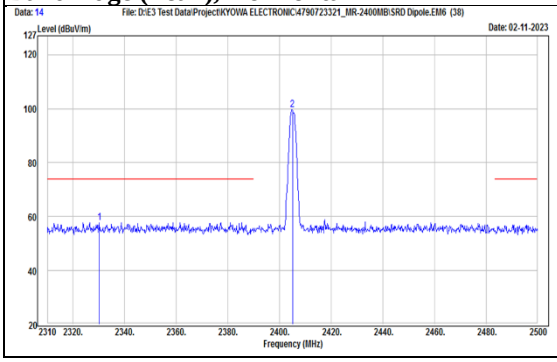
TX, SRD (Ch 0)
Band Edge (Average), Horizontal



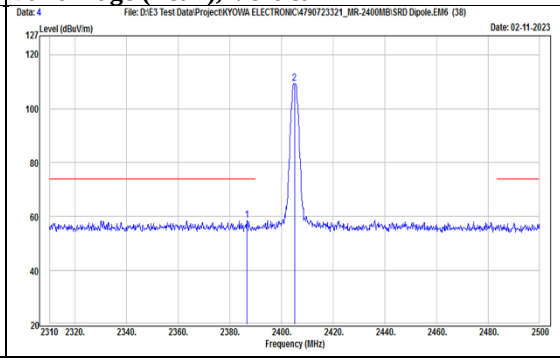
TX, SRD (Ch 0)
Band Edge (Average), Vertical



TX, SRD (Ch 0)
Band Edge (Peak), Horizontal



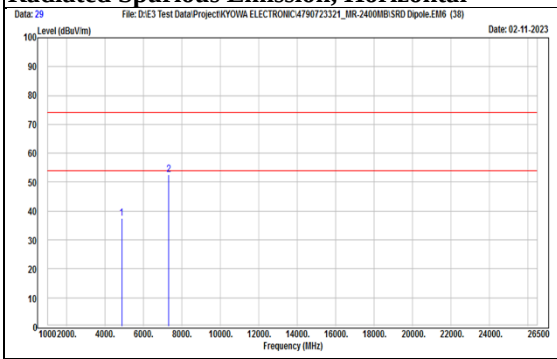
TX, SRD (Ch 0)
Band Edge (Peak), Vertical



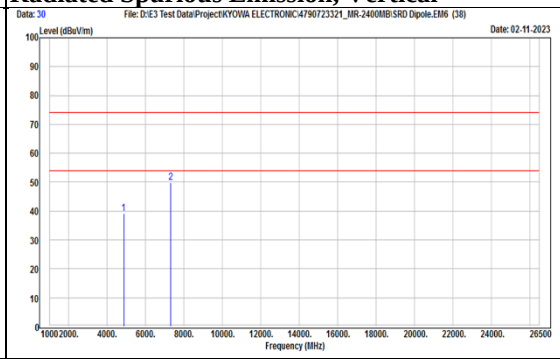
Mode	SRD	Channel	7

Polarization	Notation	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
Horizontal		2324.25	42.38	16.09	58.47	74	-15.53	PK
		2342.11	30.17	16.1	46.27	54	-7.73	AVG
	@	2440	81.87	16.13	98	N/A	N/A	PK
	@	2440	81	16.13	97.13	N/A	N/A	AVG
		2488.22	41.79	15.92	57.71	74	-16.29	PK
		2495.82	30.17	15.87	46.04	54	-7.96	AVG
	*	4880	35.05	2.34	37.39	74	-36.61	PK
	*	7320	42.21	10.37	52.58	74	-21.42	PK
Vertical		2312.09	30.51	16.1	46.61	54	-7.39	AVG
		2362.25	42.05	16.06	58.11	74	-15.89	PK
	@	2440	91.48	16.13	107.61	N/A	N/A	PK
	@	2440	90.94	16.13	107.07	N/A	N/A	AVG
		2486.51	30.5	15.94	46.44	54	-7.56	AVG
		2492.21	41.86	15.9	57.76	74	-16.24	PK
	*	4880	36.88	2.34	39.22	74	-34.78	PK
	*	7320	39.42	10.37	49.79	74	-24.21	PK

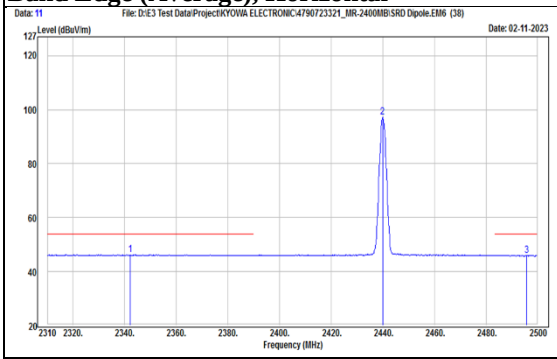
TX, SRD (Ch 7)
Radiated Spurious Emission, Horizontal



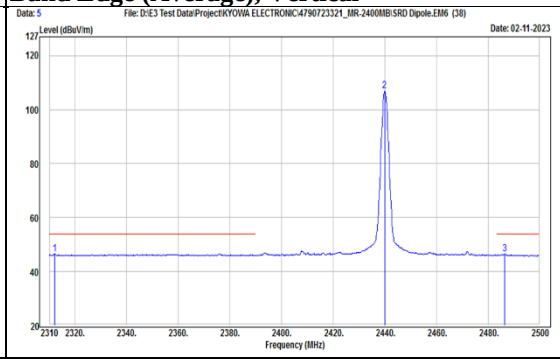
TX, SRD (Ch 7)
Radiated Spurious Emission, Vertical



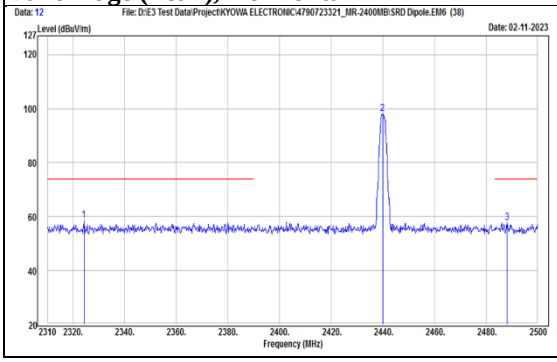
TX, SRD (Ch 7)
Band Edge (Average), Horizontal



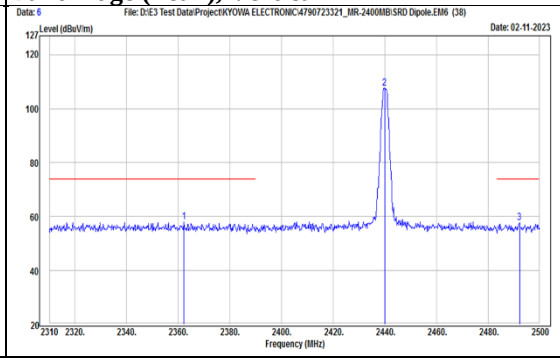
TX, SRD (Ch 7)
Band Edge (Average), Vertical



TX, SRD (Ch 7)
Band Edge (Peak), Horizontal



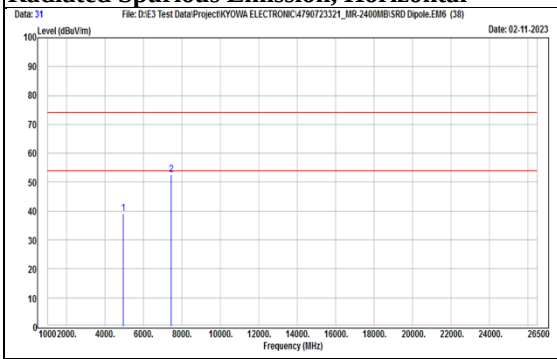
TX, SRD (Ch 7)
Band Edge (Peak), Vertical



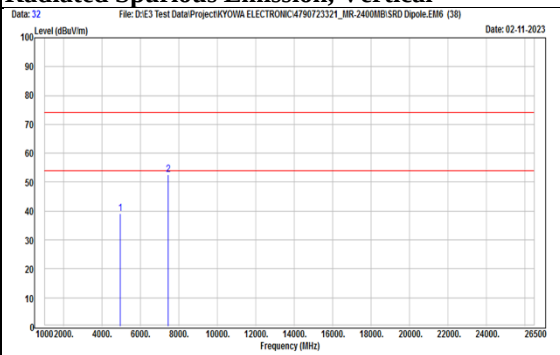
Mode	SRD	Channel	15

Polarization	Notation	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
Horizontal	@	2480	83.3	15.97	99.27	N/A	N/A	PK
	@	2480	81.72	15.97	97.69	N/A	N/A	AVG
		2483.66	31.11	15.95	47.06	54	-6.94	AVG
		2497.53	41.42	15.87	57.29	74	-16.71	PK
	*	4960	36.7	2.43	39.13	74	-34.87	PK
	*	7440	41.73	10.81	52.54	74	-21.46	PK
Vertical	@	2480	91.32	15.97	107.29	N/A	N/A	PK
	@	2480	90.12	15.97	106.09	N/A	N/A	AVG
		2483.66	34.47	15.95	50.42	54	-3.58	AVG
		2488.22	43.09	15.92	59.01	74	-14.99	PK
	*	4960	36.77	2.43	39.2	74	-34.8	PK
	*	7440	41.91	10.81	52.72	74	-21.28	PK

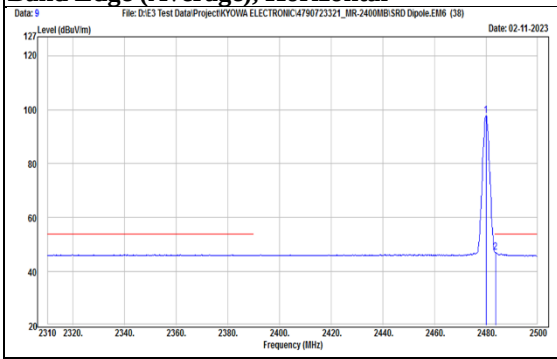
TX, SRD (Ch 15)
Radiated Spurious Emission, Horizontal



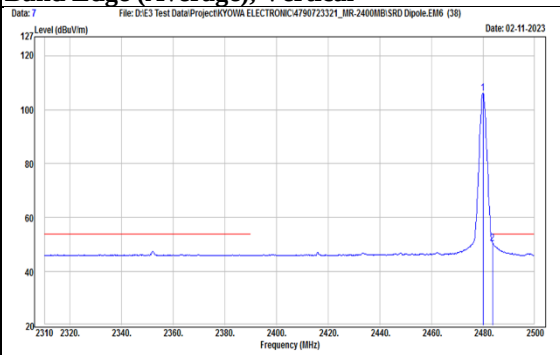
TX, SRD (Ch 15)
Radiated Spurious Emission, Vertical



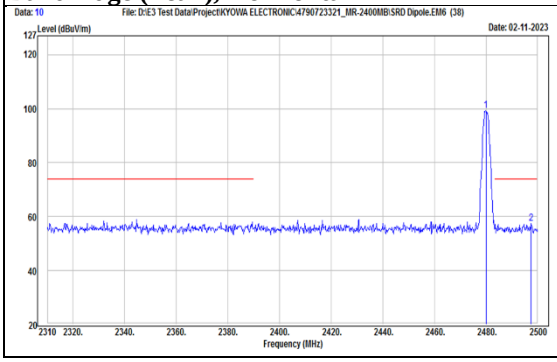
TX, SRD (Ch 15)
Band Edge (Average), Horizontal



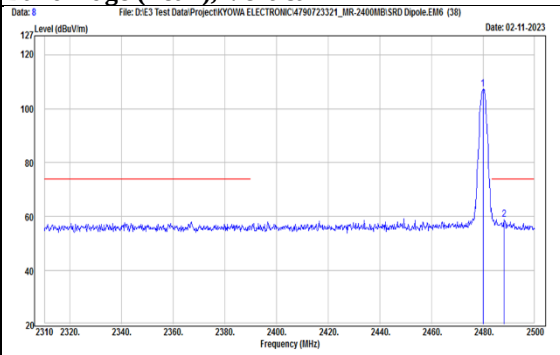
TX, SRD (Ch 15)
Band Edge (Average), Vertical



TX, SRD (Ch 15)
Band Edge (Peak), Horizontal



TX, SRD (Ch 15)
Band Edge (Peak), Vertical

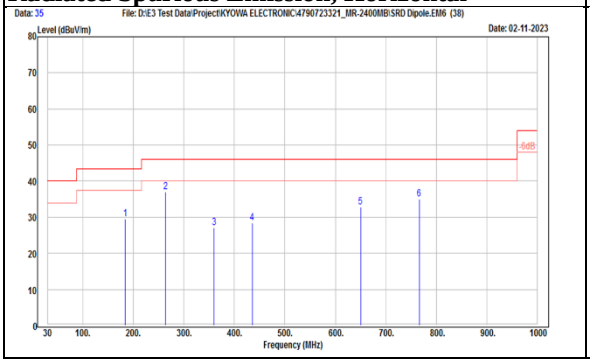


Below 1 GHz

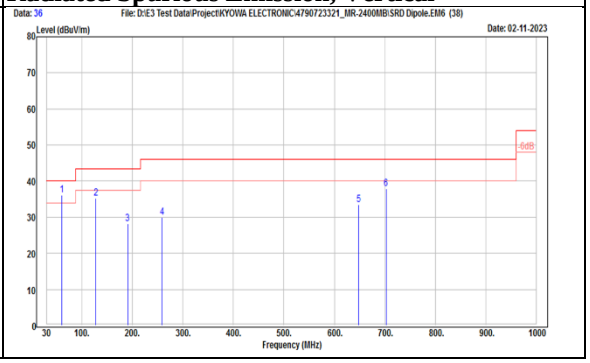
Mode	SRD	Channel	15

Polarization	Notation	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
Horizontal		184.23	42.8	-13.17	29.63	43.5	-13.87	PK
		263.77	48.81	-11.79	37.02	46	-8.98	PK
		359.8	36.44	-9.33	27.11	46	-18.89	PK
		435.46	35.16	-6.76	28.4	46	-17.6	PK
		649.83	34.8	-1.95	32.85	46	-13.15	PK
		766.23	34.78	0.19	34.97	46	-11.03	PK
Vertical		61.04	48.71	-12.52	36.19	40	-3.81	PK
		127.97	48.68	-13.44	35.24	43.5	-8.26	PK
		191.02	42.06	-13.88	28.18	43.5	-15.32	PK
		258.92	42	-12.1	29.9	46	-16.1	PK
		647.89	35.54	-1.95	33.59	46	-12.41	PK
		702.21	39.14	-1.32	37.82	46	-8.18	PK

TX, SRD (Ch 15)
Radiated Spurious Emission, Horizontal



TX, SRD (Ch 15)
Radiated Spurious Emission, Vertical



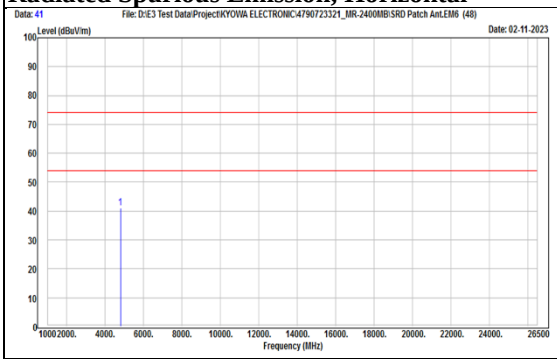
Patch Antenna

Above 1 GHz

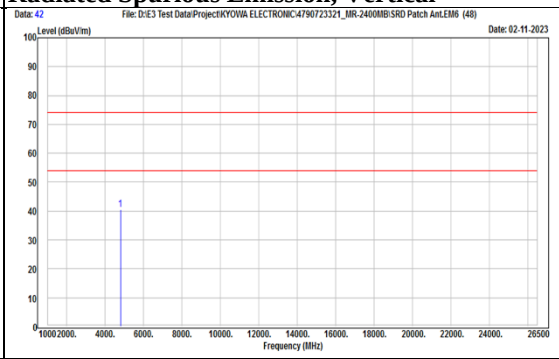
Mode	SRD	Channel	0

Polarization	Notation	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
Horizontal		2329.57	42.23	16.09	58.32	74	-15.68	PK
		2346.1	30.15	16.09	46.24	54	-7.76	AVG
	@	2405	77.67	16	93.67	N/A	N/A	PK
	@	2405	76.76	16	92.76	N/A	N/A	AVG
	*	4810	38.74	2.28	41.02	74	-32.98	PK
Vertical		2312.66	43.87	16.09	59.96	74	-14.04	PK
		2372.89	30.84	16.04	46.88	54	-7.12	AVG
	@	2405	91.1	16	107.1	N/A	N/A	PK
	@	2405	90.14	16	106.14	N/A	N/A	AVG
	*	4810	38.35	2.28	40.63	74	-33.37	PK

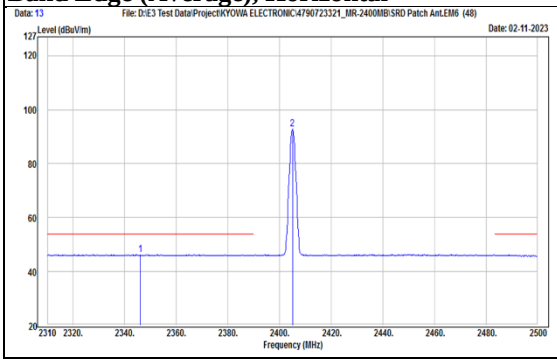
TX, SRD (Ch 0)
Radiated Spurious Emission, Horizontal



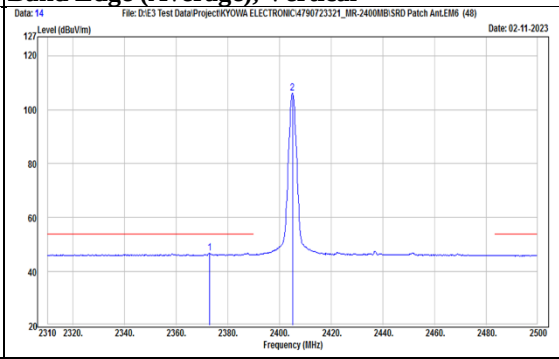
TX, SRD (Ch 0)
Radiated Spurious Emission, Vertical



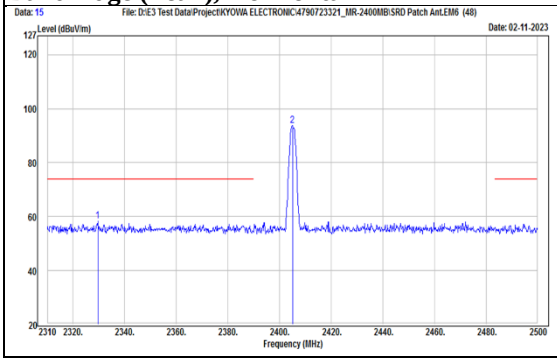
TX, SRD (Ch 0)
Band Edge (Average), Horizontal



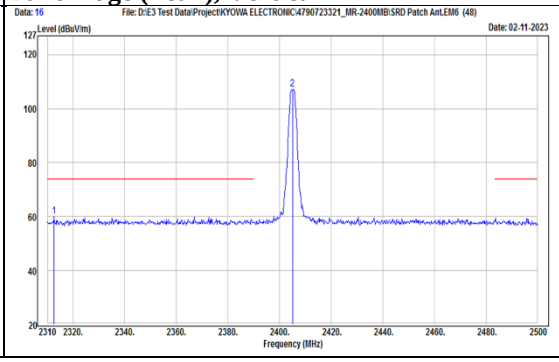
TX, SRD (Ch 0)
Band Edge (Average), Vertical



TX, SRD (Ch 0)
Band Edge (Peak), Horizontal

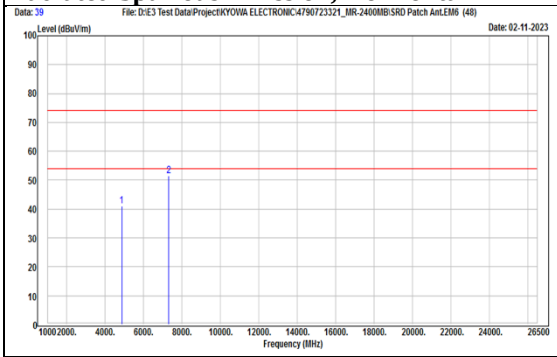
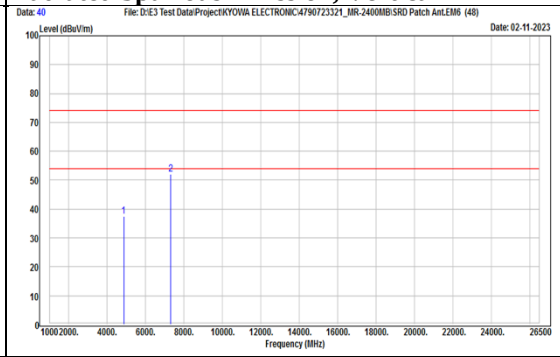
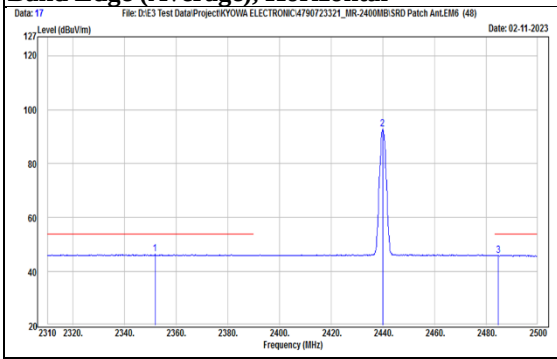
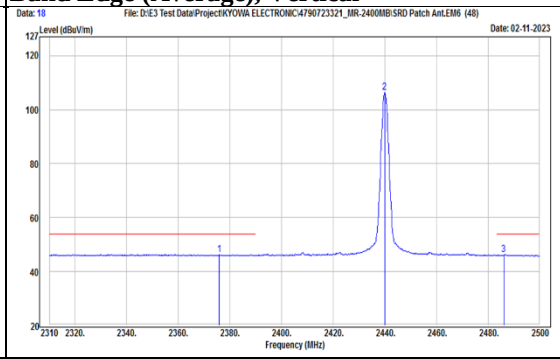
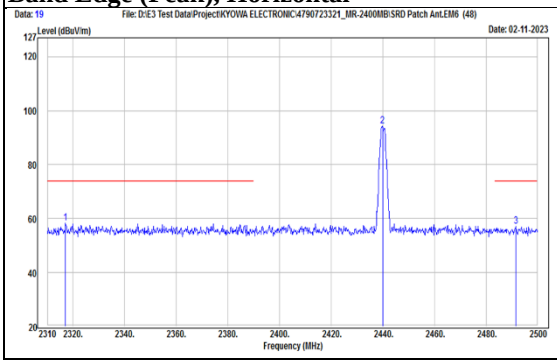
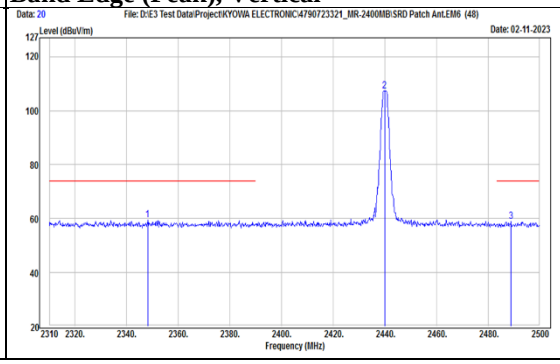


TX, SRD (Ch 0)
Band Edge (Peak), Vertical



Mode	SRD	Channel	7

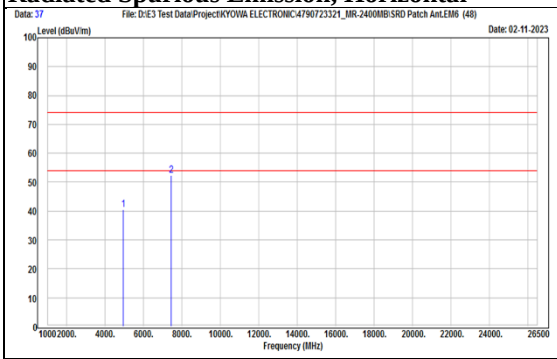
Polarization	Notation	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
Horizontal		2317.03	42.3	16.1	58.4	74	-15.6	PK
		2351.8	30.35	16.08	46.43	54	-7.57	AVG
	@	2440	78.08	16.13	94.21	N/A	N/A	PK
	@	2440	76.7	16.13	92.83	N/A	N/A	AVG
		2484.8	30.11	15.94	46.05	54	-7.95	AVG
		2491.64	41.26	15.9	57.16	74	-16.84	PK
	*	4880	38.84	2.34	41.18	74	-32.82	PK
	*	7320	41.12	10.37	51.49	74	-22.51	PK
Vertical		2348.19	43.33	16.08	59.41	74	-14.59	PK
		2375.93	30.23	16.04	46.27	54	-7.73	AVG
	@	2440	91.24	16.13	107.37	N/A	N/A	PK
	@	2440	90.15	16.13	106.28	N/A	N/A	AVG
		2486.13	30.29	15.93	46.22	54	-7.78	AVG
		2488.98	43.07	15.92	58.99	74	-15.01	PK
	*	4880	35.07	2.34	37.41	74	-36.59	PK
	*	7320	41.59	10.37	51.96	74	-22.04	PK

TX, SRD (Ch 7) **Radiated Spurious Emission, Horizontal**	**TX, SRD (Ch 7)** **Radiated Spurious Emission, Vertical**
	
TX, SRD (Ch 7) **Band Edge (Average), Horizontal**	**TX, SRD (Ch 7)** **Band Edge (Average), Vertical**
	
TX, SRD (Ch 7) **Band Edge (Peak), Horizontal**	**TX, SRD (Ch 7)** **Band Edge (Peak), Vertical**
	

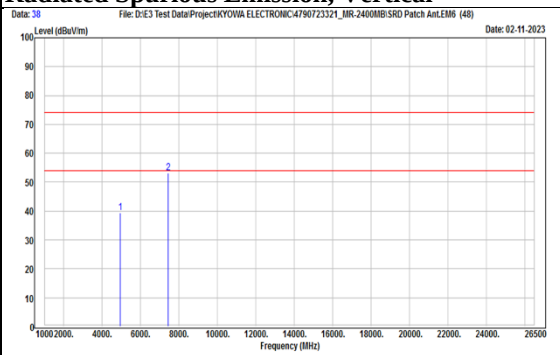
Mode	SRD	Channel	15

Polarization	Notation	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
Horizontal	@	2480	78.43	15.97	94.4	N/A	N/A	PK
	@	2480	77.77	15.97	93.74	N/A	N/A	AVG
		2483.66	30.17	15.95	46.12	54	-7.88	AVG
		2490.5	42.22	15.91	58.13	74	-15.87	PK
	*	4960	38.04	2.43	40.47	74	-33.53	PK
	*	7440	41.42	10.81	52.23	74	-21.77	PK
Vertical	@	2480	91.09	15.97	107.06	N/A	N/A	PK
	@	2480	89.91	15.97	105.88	N/A	N/A	AVG
		2483.66	34.6	15.95	50.55	54	-3.45	AVG
		2483.85	47.79	15.95	63.74	74	-10.26	PK
	*	4960	36.91	2.43	39.34	74	-34.66	PK
	*	7440	42.4	10.81	53.21	74	-20.79	PK

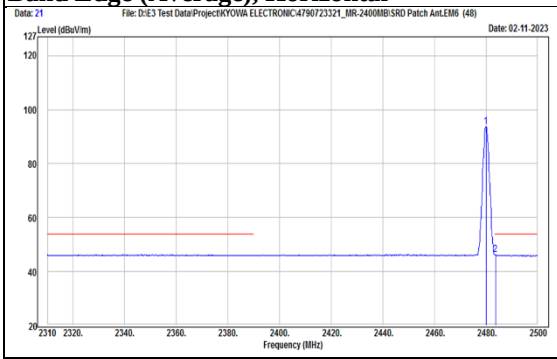
TX, SRD (Ch 15)
Radiated Spurious Emission, Horizontal



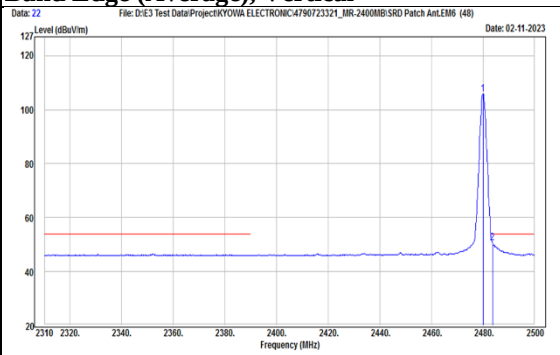
TX, SRD (Ch 15)
Radiated Spurious Emission, Vertical



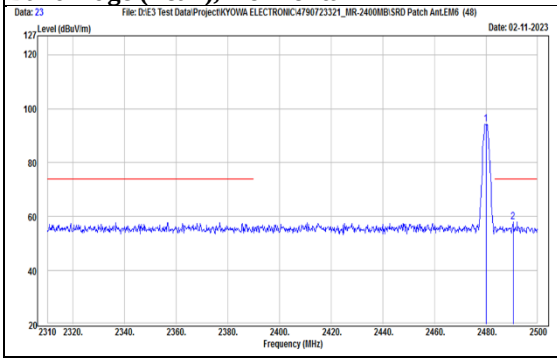
TX, SRD (Ch 15)
Band Edge (Average), Horizontal



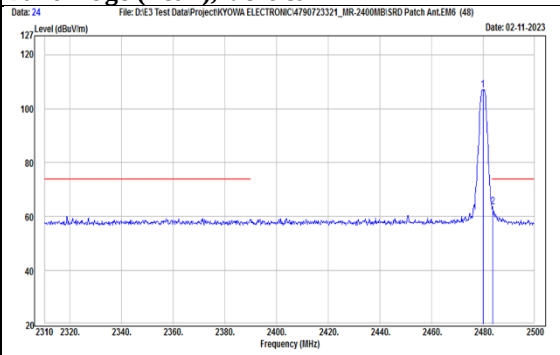
TX, SRD (Ch 15)
Band Edge (Average), Vertical



TX, SRD (Ch 15)
Band Edge (Peak), Horizontal



TX, SRD (Ch 15)
Band Edge (Peak), Vertical

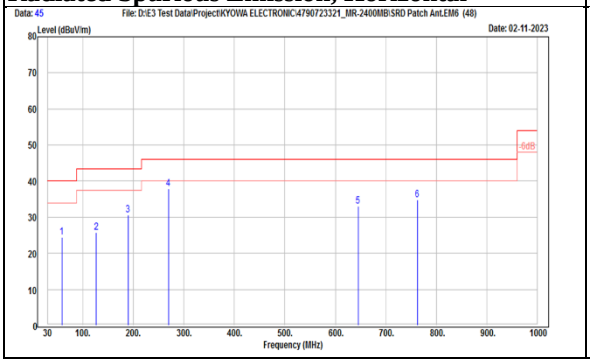


Below 1 GHz

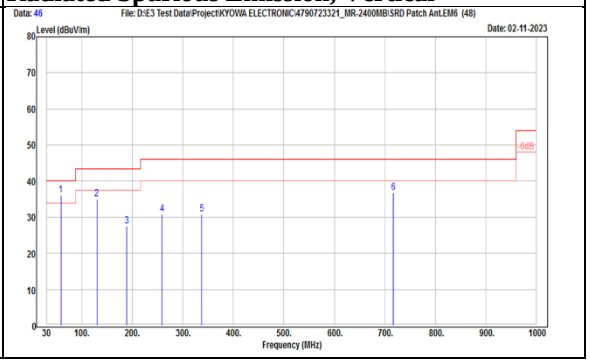
Mode	SRD	Channel	15

Polarization	Notation	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
Horizontal		59.1	36.79	-12.31	24.48	40	-15.52	PK
		127	39.44	-13.56	25.88	43.5	-17.62	PK
		190.05	44.58	-13.88	30.7	43.5	-12.8	PK
		269.59	49.45	-11.6	37.85	46	-8.15	PK
		644.98	34.96	-1.96	33	46	-13	PK
		762.35	34.47	0.27	34.74	46	-11.26	PK
Vertical		59.1	48.36	-12.31	36.05	40	-3.95	PK
		129.91	48.29	-13.33	34.96	43.5	-8.54	PK
		189.08	41.44	-13.8	27.64	43.5	-15.86	PK
		258.92	43.03	-12.1	30.93	46	-15.07	PK
		337.49	40.38	-9.55	30.83	46	-15.17	PK
		716.76	37.62	-0.88	36.74	46	-9.26	PK

TX, SRD (Ch 15)
Radiated Spurious Emission, Horizontal



TX, SRD (Ch 15)
Radiated Spurious Emission, Vertical



9 kHz ~ 30 MHz Data:

For 9 kHz to 30 MHz radiated emission have performed all modes of operation were investigated. The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

No non-compliance noted:

KDB 414788 D01 OATS and Chamber Correlation Justification

- Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.

- OATs and chamber correlation testing had been performed and chamber measured test results is the worst case test result.

Although these tests were performed other than open area test site, adequate comparison measurements were confirmed against 30m open area test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.

9.6. AC Power Line Conducted Emission

Requirements

Frequency (MHz)	Conducted limit (dBµV)	
	Quasi-peak	Average
0.15 - 0.5	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30	60	50

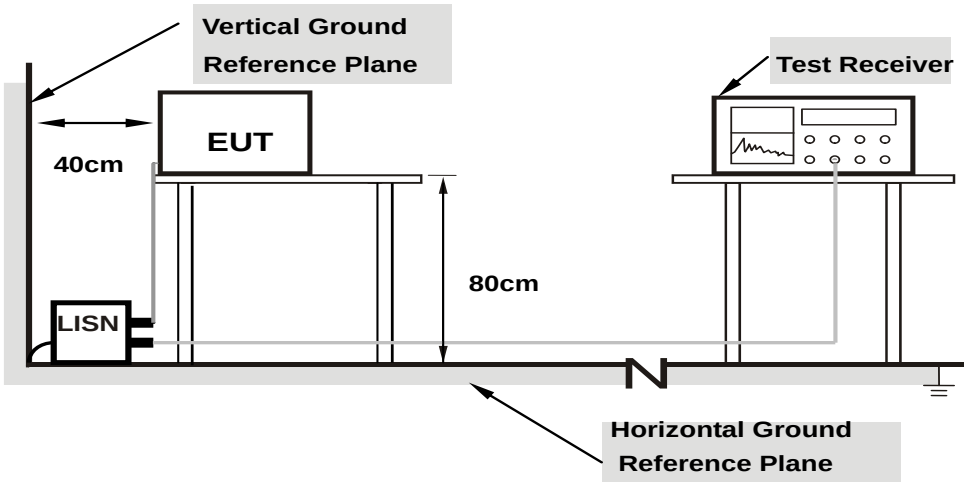
Note:
1. The lower limit shall apply at the transition frequencies.
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

Test Procedures

a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.
b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
c. The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

NOTE:
1. The resolution bandwidth and video bandwidth of test receiver is 9kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15MHz-30MHz.
2. All modes of operation were investigated (includes all external accessories) and the worst-case emissions are reported, the other emission levels were low against the limit.
3. Test data of Result value (dBuV) = Reading value (dBuV) + Correction Factor (dB).
4. Test data of Margin(dB) = Result value (dBuV) - Limit value (dBuV).
5. Test data of Correction Factor (dB) = Insertion loss(dB) + Cable loss(dB).

Test Setup



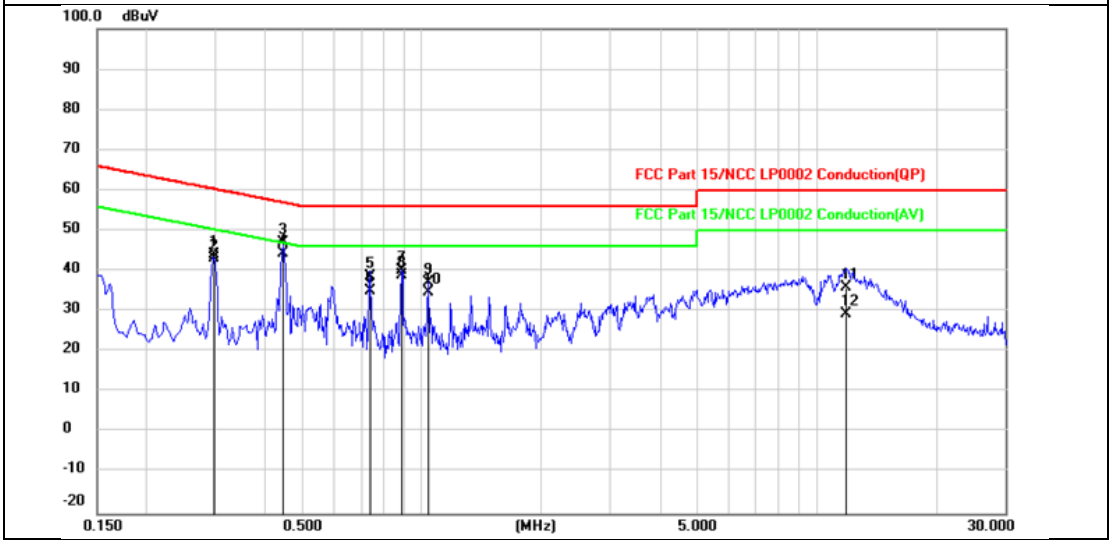
Note: 1.Support units were connected to second LISN.

For the actual test configuration, please refer to the Setup Configurations.

Test Data

Mode	SRD TX2480	Channel	15

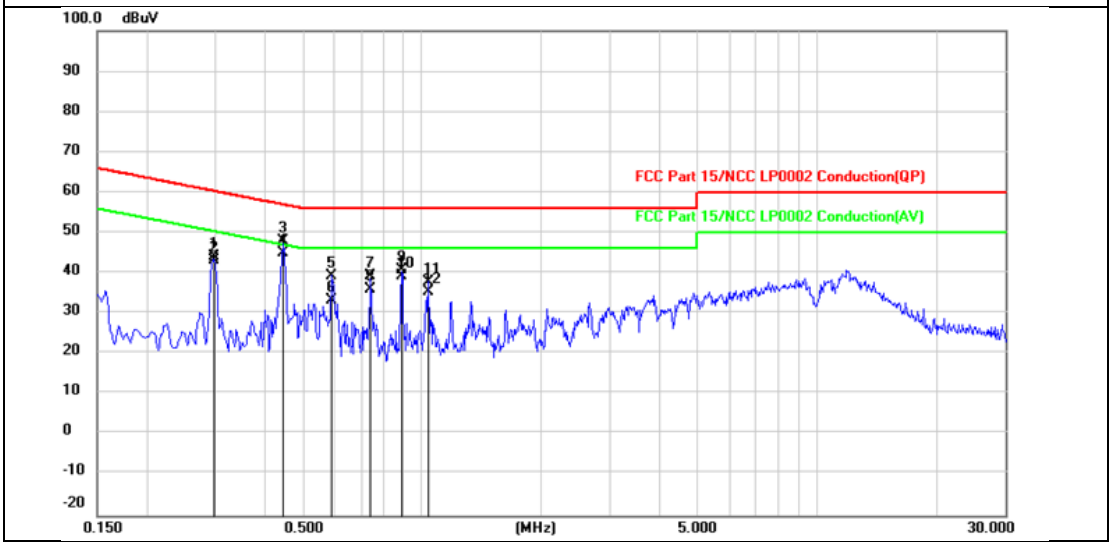
Phase: Line



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
1	0.2962	24.63	19.53	44.16	60.35	-16.19	QP
2	0.2962	23.75	19.53	43.28	50.35	-7.07	AVG
3	0.4445	27.54	19.54	47.08	56.98	-9.90	QP
4	0.4445	24.93	19.54	44.47	46.98	-2.51	AVG
5	0.7394	19.02	19.55	38.57	56.00	-17.43	QP
6	0.7394	15.59	19.55	35.14	46.00	-10.86	AVG
7	0.8873	20.47	19.56	40.03	56.00	-15.97	QP
8	0.8873	19.27	19.56	38.83	46.00	-7.17	AVG
9	1.0361	17.65	19.56	37.21	56.00	-18.79	QP
10	1.0361	15.33	19.56	34.89	46.00	-11.11	AVG
11	11.9160	16.18	19.77	35.95	60.00	-24.05	QP
12	11.9160	9.59	19.77	29.36	50.00	-20.64	AVG

Mode	SRD_TX2480	Channel	15

Phase: Neutral



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
1	0.2961	24.63	19.54	44.17	60.35	-16.18	QP
2	0.2961	23.65	19.54	43.19	50.35	-7.16	AVG
3	0.4447	28.28	19.55	47.83	56.97	-9.14	QP
4	0.4447	25.51	19.55	45.06	46.97	-1.91	AVG
5	0.5930	19.57	19.55	39.12	56.00	-16.88	QP
6	0.5930	13.76	19.55	33.31	46.00	-12.69	AVG
7	0.7397	19.84	19.55	39.39	56.00	-16.61	QP
8	0.7397	16.31	19.55	35.86	46.00	-10.14	AVG
9	0.8891	21.06	19.56	40.62	56.00	-15.38	QP
10	0.8891	19.80	19.56	39.36	46.00	-6.64	AVG
11	1.0365	18.11	19.56	37.67	56.00	-18.33	QP
12	1.0365	15.79	19.56	35.35	46.00	-10.65	AVG

END OF REPORT