

Prüfbericht-Nr.: <i>Test report no.:</i>	CN21A790 (P15C-2.4G) 001	Auftrags-Nr.: <i>Order no.:</i>	238513784	Seite 1 von 29 Page 1 of 29
Kunden-Referenz-Nr.: <i>Client reference no.:</i>	N/A	Auftragsdatum: <i>Order date:</i>	2021-04-16	
Auftraggeber: <i>Client:</i>	Acrox Technologies Co., Ltd 4f.,No.89, Minshan St. NEIHU DIST., TAIPEI CITY 114			
Prüfgegenstand: <i>Test item:</i>	Wireless dongle			
Bezeichnung / Typ-Nr.: <i>Identification / Type no.:</i>	MQJ; MQJ1			
Auftrags-Inhalt: <i>Order content:</i>	FCC Part 15C Test report (2.4 GHz FHSS)			
Prüfgrundlage: <i>Test specification:</i>	FCC 47CFR Part 15: Subpart C Section 15.247			
Wareneingangsdatum: <i>Date of sample receipt:</i>	2021-04-16			
Prüfmuster-Nr.: <i>Test sample no.:</i>	A003035287-007 A003035287-004			
Prüfzeitraum: <i>Testing period:</i>	2021-04-27 - 2021-05-19			
Ort der Prüfung: <i>Place of testing:</i>	EMC/RF Taipei Testing Site			
Prüflaboratorium: <i>Testing laboratory:</i>	Taipei Testing Laboratories			
Prüfergebnis*: <i>Test result*:</i>	Pass			
überprüft von: <i>reviewed by:</i>	genehmigt von: <i>authorized by:</i>			
Datum: <i>Date:</i> 2021-05-19	 Jack Chang		 Ryan Chen	
Stellung / Position:	Senior Project Manager		Senior Project Manager	
Sonstiges / Other:	The models are electrically identical, different models are for marketing purpose.			
Zustand des Prüfgegenstandes bei Anlieferung: <i>Condition of the test item at delivery:</i>	Prüfmuster vollständig und unbeschädigt <i>Test item complete and undamaged</i>			
* Legende:	1 = sehr gut P(ass) = entspricht o.g. Prüfgrundlage(n)	2 = gut F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	3 = befriedigend N/A = nicht anwendbar	4 = ausreichend N/T = nicht getestet
* Legend:	1 = very good P(ass) = passed a.m. test specification(s)	2 = good F(ail) = failed a.m. test specification(s)	3 = satisfactory N/A = not applicable	4 = sufficient N/T = not tested
Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens. <i>This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.</i>				

TEST SUMMARY

Report Section	FCC Clause	Test Item	Result
5.1.1	15.247(b) & 15.203	Antenna Requirement	Pass
5.1.2	15.247(b)(1)	Peak Output Power	Pass
5.1.3	15.247(a)(1)	20 dB Bandwidth	Pass
5.1.3	2.1049	99% Occupied Bandwidth	Pass
5.1.4	15.247(d)	Conducted Spurious Emission and Band Edges	Pass
5.1.5	15.247(d) & 15.205 & 15.209	Radiated Spurious Emissions and Band Edges	Pass
5.1.6	15.247(a)(1)	Hopping Channel Separation	Pass
5.1.7	15.247(a)(1) (iii)	Number of Hopping Frequency Used	Pass
5.1.8	15.247(a)(1) (iii)	Dwell Time on Each Channel	Pass
5.2.1	15.207	Mains Conducted Emission	Pass

Note:

1. If the Frequency Hopping Systems operating in 2400-2483.5 MHz band and the output power less than 125 mW. The hopping channel carrier frequencies separated by a minimum of 25 kHz or two-thirds of the 20 dB bandwidth of hopping channel whichever is greater.
2. Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

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APPENDIX A - TEST RESULT OF CONDUCTED

APPENDIX B - TEST RESULT OF RADIATED EMISSIONS & MAINS CONDUCTED EMISSION

APPENDIX SP - PHOTOGRAPHS OF TEST SETUP

APPENDIX EP - PHOTOGRAPHS OF EUT

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HISTORY OF THIS TEST REPORT

Report No.	Description	Date Issued
CN21A790 (P15C-2.4G) 001	Original Release	2021-05-19

1. General Remarks

1.1 Complementary Materials

All attachments are integral parts of this test report. This applies especially to the following appendix:

Appendix A - Test Result of Conducted

Appendix B - Test Result of Radiated Emissions & Mains Conducted Emission

Appendix SP - Photographs of Test Setup

Appendix EP - Photographs of EUT

Applied Standard and Test Levels

Radio
FCC 47CFR Part 15: Subpart C Section 15.247
FCC 47CFR Part 2: Subpart J Section 2.1049
ANSI C63.10:2013
KDB 558074 D01 15.247 Meas Guidance v05r02

1.2 Decision Rule of Conformity

The decision rule of conformity of this test report is following the requirements of the requested standard in the quotation, and agreed among testing laboratory and manufacturer (applicant) to exclude the consideration of Measurement Uncertainty, unless it is required by the specific standard.

2. Test Sites

2.1 Test Laboratory

Taipei Testing Laboratories

11F. No.758, Sec. 4, Bade Rd., Songshan Dist.
Taipei City 105
Taiwan (R.O.C.)

2.2 Test Facility

Taipei Testing Laboratories

No.458-18, Sec. 2, Fenliao Rd., Linkou Dist.,
New Taipei City 244
Taiwan (R.O.C.)
FCC Registration No.: 226631
ISED Registration No.: 25563

2.3 Traceability

All measurement equipment calibrations are traceable to NML(Taiwan)/NIST(USA) or where calibration is performed outside Taiwan, to equivalent nationally recognized standards organizations.

2.4 Calibration

Equipment requiring calibration is calibrated periodically in a suitably accredited Calibration Lab. Additionally all equipment is verified for proper performance on a regular basis using in house standards or comparisons.

2.5 Measurement Uncertainty

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

Emission Measurement Uncertainty

Parameter	Uncertainty
Radiated Emission (9 kHz ~ 30 MHz)	± 1.15 dB
Radiated Emission (30 MHz ~ 200 MHz)	± 1.30 dB
Radiated Emission (200 MHz ~ 1 GHz)	± 1.30 dB
Radiated Emission (1 GHz ~ 18 GHz)	± 1.54 dB
Radiated Emission (18 GHz ~ 40 GHz)	± 2.52 dB
Mains Conducted Emission	± 1.65 dB

3. General Product Information

3.1 Product Function and Intended Use

The EUT is a Wireless dongle. It contains a 2.4 GHz compatible module enabling the user to communicate data through a Wireless interface.

For details refer to the User Guide, Data Sheet and Circuit Diagram.

3.2 System Details and Ratings

Basic Information of EUT

Item	EUT information
Kind of Equipment/Test Item	Wireless dongle
Type Identification	MQJ; MQJ1
FCC ID	PRDRX0Z

Technical Specification of EUT

Item	EUT information
Operating Frequency	2402 MHz ~ 2480 MHz
Channel Number	40
Operation Voltage	5 Vdc
Modulation	GFSK
Maximum Output Power (mW)	0.07
Antenna Information	Refer to 5.1.1
Accessory Device	Refer to 4.4

3.3 Noise Generating and Noise Suppressing Parts

Refer to the Circuit Diagram.

3.4 Submitted Documents

- Circuit Diagram
- Instruction Manual
- Rating Label
- Technical Description

4. Test Set-up and Operation Modes

4.1 Principle of Configuration Selection

The test modes were adapted accordingly in reference to the instructions for use.

During testing, Channel and Power Controlling Software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output expected by the customer and is going to be fixed on the firmware of the final end product.

Table for Parameters of Test Software Setting

Frequency (MHz)	Power Setting
2402	2
2440	2
2480	2

4.2 Carrier Frequency and Channel

Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
1	2402	11	2422	21	2442	31	2462
2	2404	12	2424	22	2444	32	2464
3	2406	13	2426	23	2446	33	2466
4	2408	14	2428	24	2448	34	2468
5	2410	15	2430	25	2450	35	2470
6	2412	16	2432	26	2452	36	2472
7	2414	17	2434	27	2454	37	2474
8	2416	18	2436	28	2456	38	2476
9	2418	19	2438	29	2458	39	2478
10	2420	20	2440	30	2460	40	2480

4.3 Test Operation and Test Software

Setup for testing: Test samples are provided with a USB interface which makes it possible to control them through a test software installed on a notebook computer.
 This software was running on the laptop computer connected to the EUT. It was used to enable the operation modes listed as below.

Test Software	SE67T_FccTest_V6.7.0_Aoto_Test.exe
---------------	------------------------------------

The samples were used as follows:

A003035287-007

A003035287-004

Full test was applied on all test modes, but only worst case was shown.

EUT Configure Mode	Applicable To			Mains Conducted Emission	Description
	Antenna Port Conducted Measurement	Radiated Spurious Emissions above 1 GHz	Radiated Spurious Emissions below 1 GHz		
-	√	√	√	√	-

Note:

1. The EUT had been pre-tested on the positioned of each 3 axis. The worst case was found when position on **Z-plane**.
2. "-" means no effect.

Antenna Port Conducted Measurement

- Pre-Scan full test was applied on all test modes, but only worst case was shown.
- Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Frequency (MHz)	Tested Frequency (MHz)
-	2402 to 2480	2402, 2440, 2480

Radiated Spurious Emissions (Above 1 GHz)

- Pre-Scan full test was applied on all test modes, but only worst case was shown.
- Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Frequency (MHz)	Tested Frequency (MHz)
-	2402 to 2480	2402, 2440, 2480

Radiated Spurious Emissions (Below 1 GHz)

- Pre-Scan full test was applied on all test modes, but only worst case was shown.
- Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Frequency (MHz)	Tested Frequency (MHz)
-	2402 to 2480	2402

Mains Conducted Emission

- Pre-Scan full test was applied on all test modes, but only worst case was shown.
- Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Frequency (MHz)	Tested Frequency (MHz)
-	2402 to 2480	2402

Test Condition

Test Item	Ambient Temperature	Relative Humidity	Tested by
Conducted Measurement	24.4 °C	57.8 %	Stanislas Charles
Radiated Spurious Emissions above 1 GHz	23.9-25.9 °C	55-60 %	Eagle Tsai
Radiated Spurious Emissions below 1 GHz	23.9-25.9 °C	55-60 %	Eagle Tsai
Mains Conducted Emission	19.1-20.3 °C	68-71 %	Temo Chen

4.4 Special Accessories and Auxiliary Equipment

The product has been tested together with the following additional accessories:

Accessory of EUT

None

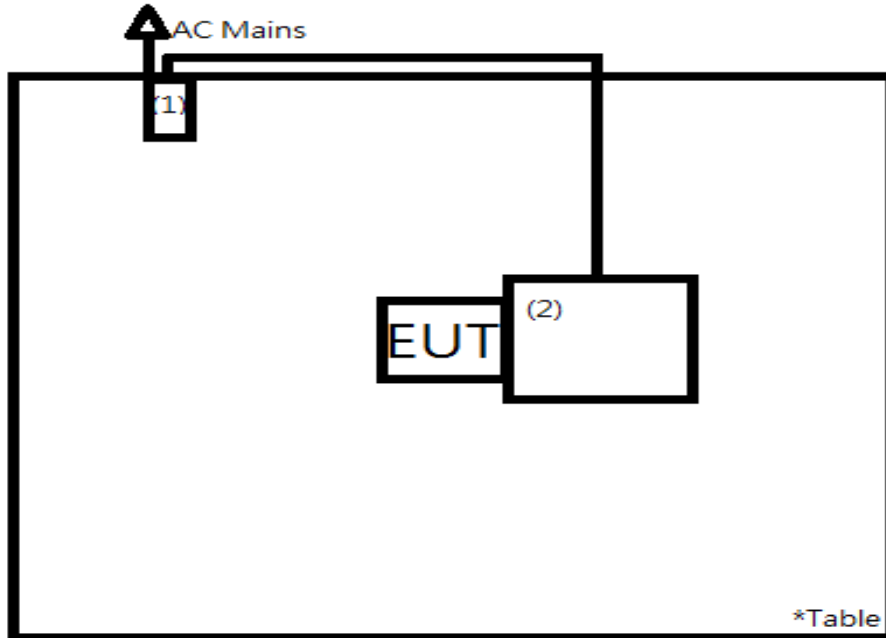
Support Unit

Support Unit					
No.	Description	Brand	Model	S/N	Remark
1	Adapter	Lenovo	ADLX65NCC3A	N/A	Radiated
2	Notebook	Lenovo	81BL	MP1DCD6Y	Radiated
1	NB	HP	TPN-C135	N/A	Mains Conducted
2	Adaptor	HP	TPN-DA17	N/A	Mains Conducted

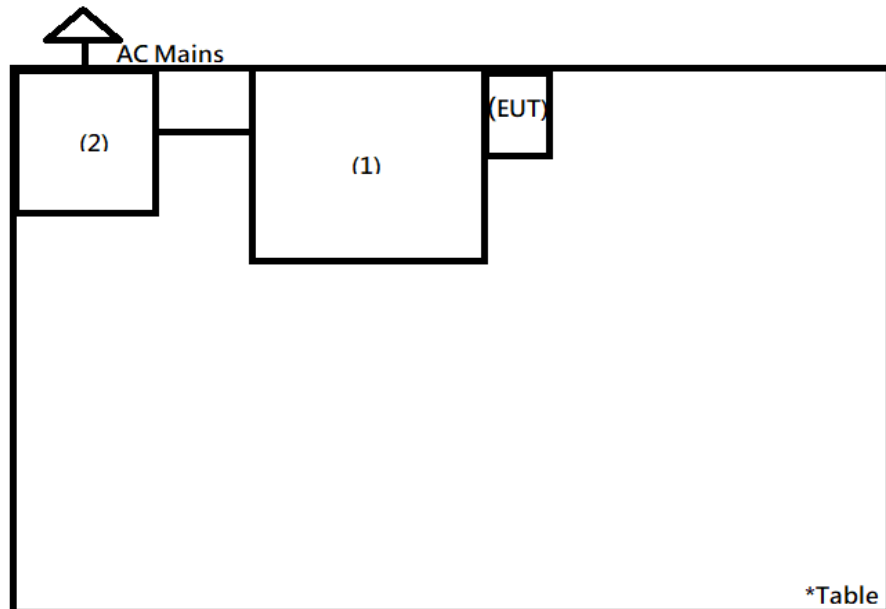
Interface Cable					
No.	Description	Shielded Type	Ferrite Core (Qty)	Length	Remark
1	Adapter Cable	NO	YES	150	Radiated
2	Adapter Cable	YES	NO	180	Mains Conducted

4.5 Test Setup Diagram

<Radiated Spurious Emissions mode>



<Mains Conducted Emission mode>



5. Test Results

5.1 Transmitter Requirement & Test Suites

5.1.1 Antenna Requirement

Requirement Use of approved antennas only

According to the manufacturer declaration, the EUT has an antenna with a directional gain of 0.9 dBi. The antenna is a PIFA antenna with no possibility of replacement with a non-approved antenna by the end-user. Therefore, the EUT is considered to comply with this provision.
Refer to EUT photo for details.

5.1.2 Peak Output Power

Limit

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

Kind of Test Site Shielded room

Test Setup



Test Instruments

Kind of Equipment	Manufacturer	Type	S/N	Calibration Date	Calibration Due Date	Test Date	
						From	Until
Power Meter	Anritsu	ML2495A	1901008	2021/3/24	2022/3/23	2021/5/4	2021/5/4
Power Sensor	Anritsu	MA2411B	1725269	2021/3/24	2022/3/23	2021/5/4	2021/5/4

Test Procedures

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.

Average power sensor was used to perform output power measurement, trigger and gating function of wide band power meter is enabled to measure max output power of TX on burst. Duty factor is not added to measured value.

Test Result**Peak Output Power**

Channel	Channel Frequency	Peak Output Power		Limit (mW)
	(MHz)	(dBm)	(mW)	
Low Channel	2402	-11.30	0.07	125
Middle Channel	2440	-11.35	0.07	125
High Channel	2480	-11.40	0.07	125

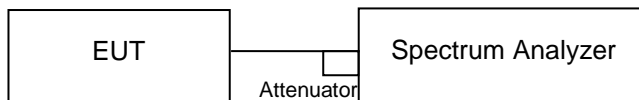
Average Power

Channel	Channel Frequency	Average Power	
	(MHz)	(dBm)	(mW)
Low Channel	2402	-11.67	0.07
Middle Channel	2440	-11.73	0.07
High Channel	2480	-11.80	0.07

5.1.3 20 dB Bandwidth and 99% Occupied Bandwidth

Kind of Test Site Shielded room

Test Setup



Test Instruments

Kind of Equipment	Manufacturer	Type	S/N	Calibration Date	Calibration Due Date	Test Date	
						From	Until
Spectrum Analyzer	R&S	FSV40	101512	2021/1/29	2022/1/28	2021/5/4	2021/5/11

Test Procedure

- a. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- b. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
- c. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
- d. Repeat above procedures until all frequencies measured were complete.
- e. The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with resolution bandwidth in the range of 1 % to 5 % of the anticipated emission bandwidth, and a video bandwidth at least 3x the resolution bandwidth and set the detector to PEAK. The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage 0.5 % of the total mean power of a given emission.

Test Results

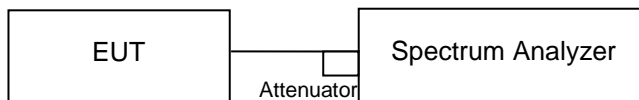
Please refer to Appendix A.

5.1.4 Conducted Spurious Emissions and Frequency Band Edges Measured in 100kHz Bandwidth

Limit

20dB (below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.)

Kind of Test Site Shielded room

Test Setup

Test Instruments

Kind of Equipment	Manufacturer	Type	S/N	Calibration Date	Calibration Due Date	Test Date	
						From	Until
Spectrum Analyzer	R&S	FSV40	101512	2021/1/29	2022/1/28	2021/5/4	2021/5/11

Test Procedure

Measurement procedure REF

1. Set the RBW = 100 kHz.
2. Set the VBW \geq 300 kHz.
3. Detector = peak.
4. Sweep time = auto couple.
5. Trace mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

Measurement procedure OOBE

1. Set RBW = 100 kHz.
2. Set VBW \geq 300 kHz.
3. Detector = peak.
4. Sweep = auto couple.
5. Trace Mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum amplitude level.

Test Results

Please refer to Appendix A.

5.1.5 Radiated Spurious Emissions and Band Edges

Limit

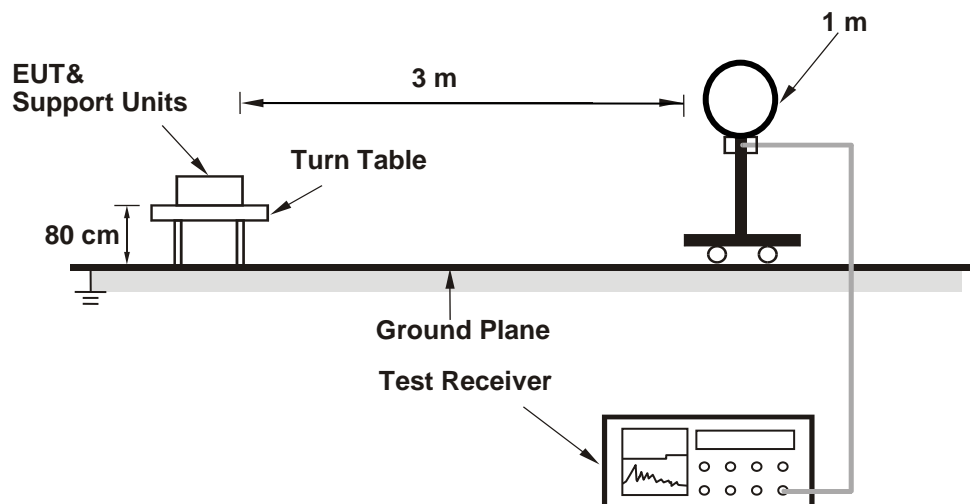
Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must comply with the radiated emission limits specified in §15.209(a).

Emissions radiated outside the restricted and authorized frequency bands must either comply with the radiated emission limits specified for the restricted bands or in §15.247(d).

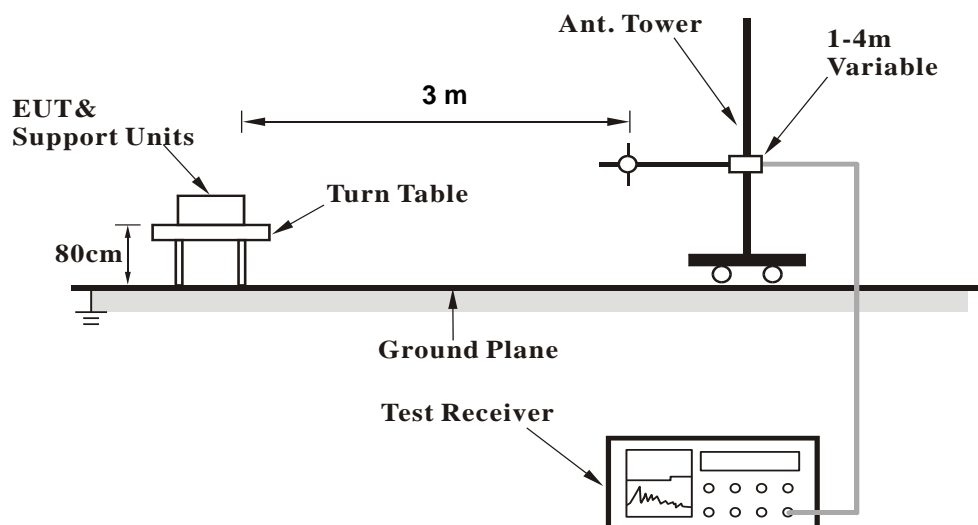
Kind of Test Site 3m Semi-Anechoic Chamber

Test Setup

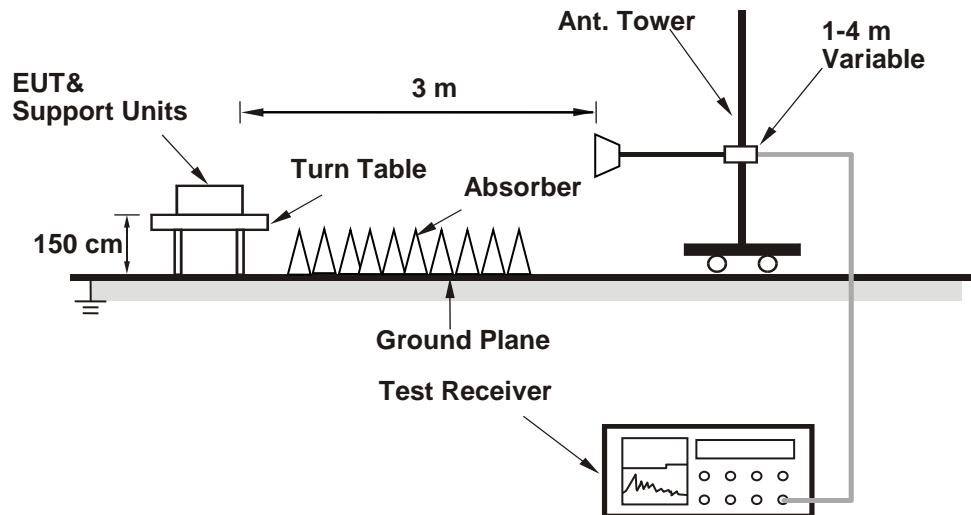
<Radiated Emissions below 30 MHz>



<Radiated Emissions 30 MHz to 1 GHz>



<Radiated Emissions above 1 GHz>



For the actual test configuration, please refer to the attached file (Test Setup Photo).

Test Instruments

Kind of Equipment	Manufacturer	Type	S/N	Calibration Date	Calibration Due Date
Signal Analyzer	R&S	FSV40	101508	2021/3/16	2022/3/15
Receiver	R&S	ESR7	102109	2021/3/16	2022/3/15
Bilog Antenna	SCHWARZBECK	VULB-9168	00951	2021/2/18	2022/2/17
Horn Antenna	ETS-Lindgren	3117	00218930	2020/12/1	2021/11/30
LF-AMP	Agilent	8447D	2944A10772	2021/2/18	2022/2/17
HF-AMP + AC source	EMCI	EMC051845SE	980633	2021/2/9	2022/2/8
HF-AMP + AC source	EMCI	EMC184045SE	980657	2021/2/1	2022/1/31
Horn Antenna	SCHWARZBECK	BBHA 9170	00887	2021/4/8	2022/4/7
Microwave Cable	HUBER+SUHNER	SUCOFLEX 104EA	800056/4EA	2021/3/17	2022/3/16
Microwave Cable	HUBER+SUHNER	SUCOFLEX 104	804680/4	2021/3/17	2022/3/16
Microwave Cable	HUBER+SUHNER	SUCOFLEX 104	MY37202/4	2021/3/17	2022/3/16
Microwave Cable	HUBER+SUHNER	SUCOFLEX 102EA	800898/2EA	2021/4/16	2022/4/15
Microwave Cable	HUBER+SUHNER	SUCOFLEX 102EA	800901/2EA	2021/4/16	2022/4/15
Microwave Cable	HUBER+SUHNER	SUCOFLEX 102EA	801027/2EA	2021/4/16	2022/4/15
Loop Antenna	Chance Most	EMCILPA600 +calibration	287	2020/6/17	2021/6/16

Test Procedures**For Radiated Emissions below 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 (OPEN), perpendicular (CLOSE), and ground-parallel (GROUND) 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. The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

Note:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9 kHz at frequency below 30 MHz.
2. All modes of operation were investigated and the worst-case emissions are reported.

For Radiated Emissions above 30 MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters (for 30 MHz ~ 1 GHz) / 1.5 meters (for above 1 GHz) 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. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
- f. The test-receiver system was set to peak and average detected 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:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection (QP) or Peak detection (PK) at frequency below 1 GHz.
2. 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 1 GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is $\geq 1/T$ (Duty cycle < 98 %) or 10 Hz (Duty cycle ≥ 98 %) for Average detection (AV) at frequency above 1 GHz.
4. All modes of operation were investigated and the worst-case emissions are reported.
5. The Radiated Emissions testing was performed in the X(E1), Y(H) and Z(E2) axis orientation. The worst-case Axis orientation is recorded in this test report.

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Test Results

Factor (dB/m) = Antenna Factor (dB/m) + Cable Loss (dB)
Level (dBuV/m) = Reading (dBuV) + Factor (dB/m)

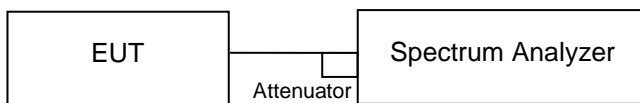
Please refer to Appendix B.

5.1.6 Hopping Channel Separation

Limit ≥ 25 kHz or 2/3 of 20 dB bandwidth, whichever is greater

Kind of Test Site Shielded room

Test Setup



Test Instruments

Kind of Equipment	Manufacturer	Type	S/N	Calibration Date	Calibration Due Date	Test Date	
						From	Until
Spectrum Analyzer	R&S	FSV40	101512	2021/1/29	2022/1/28	2021/5/4	2021/5/11

Test Procedure

Measurement Procedure REF

- a. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- b. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range.
- c. By using the MaxHold function record the separation of two adjacent channels.
- d. Measure the frequency difference of these two adjacent channels by SA MARK function. And then plot the result on SA screen.
- e. Repeat above procedures until all frequencies measured were complete.

Test Results

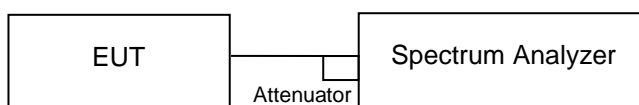
Please refer to Appendix A.

5.1.7 Number of Hopping Frequency

Limit ≥ 15 non-overlapping channels

Kind of Test Site Shielded room

Test Setup



Test Instruments

Kind of Equipment	Manufacturer	Type	S/N	Calibration Date	Calibration Due Date	Test Date	
						From	Until
Spectrum Analyzer	R&S	FSV40	101512	2021/1/29	2022/1/28	2021/5/4	2021/5/11

Test Procedure

- a. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
- b. Turn on the EUT and connect its antenna terminal to measurement via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
- c. Set the SA on MaxHold Mode, and then keep the EUT in hopping mode. Record all the signals from each channel until each one has been recorded.
- d. Set the SA on View mode and then plot the result on SA screen.
- e. Repeat above procedures until all frequencies measured were complete.

Test Results

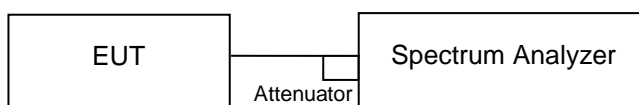
Please refer to Appendix A.

5.1.8 Dwell Time

Limit 0.4s

Kind of Test Site Shielded room

Test Setup



Test Instruments

Kind of Equipment	Manufacturer	Type	S/N	Calibration Date	Calibration Due Date	Test Date	
						From	Until
Spectrum Analyzer	R&S	FSV40	101512	2021/1/29	2022/1/28	2021/5/4	2021/5/19

Test Procedures

- Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
- Turn on the EUT and connect its antenna terminal to measurement via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
- Adjust the center frequency of SA on any frequency be measured and set SA to zero span mode. And then, set RBW and VBW of spectrum analyzer to proper value.
- Measure the time duration of one transmission on the measured frequency. And then plot the result with time difference of this time duration.
- Repeat above procedures until all different time-slot modes have been completed.

Test Results

Please refer to Appendix A.

5.2 Mains Emission

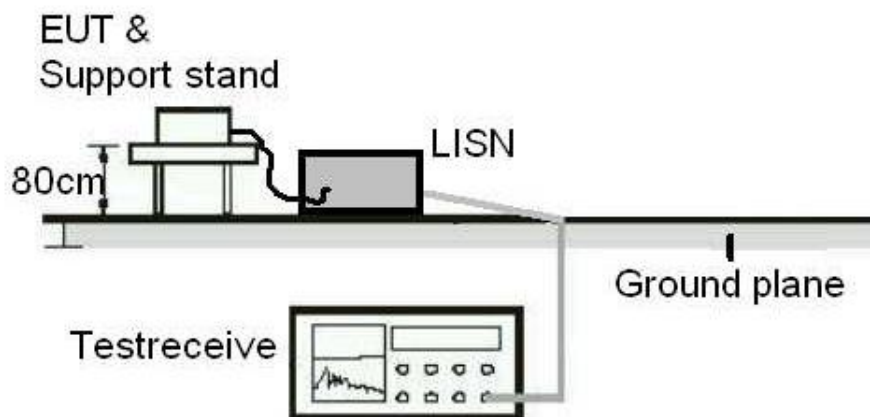
5.2.1 Mains Conducted Emission

Limit

Mains Conducted Emission as defined in §15.207 must comply with the mains conducted emission limits.

Kind of Test Site Shielded room

Test Setup



Test Instruments

Kind of Equipment	Manufacturer	Type	S/N	Calibration Date	Calibration Due Date
EMI Test Receiver	Rohde & Schwarz	ESCI 3	101094	2020/11/17	2021/11/17
Two-Line V-Network (for EUT)	Rohde & Schwarz	ENV216	101938	2020/09/10	2021/09/10
Two-Line V-Network	Schwarzbeck	NSLK 8127	8127-00975	2020/10/29	2021/10/29
Test Software	Audix	e3	Ver. 9	N/A	N/A

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/50 uH 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 150 kHz to 30 MHz was searched. Emission levels under (Limit – 20 dB) was not recorded.

Note: The resolution bandwidth and video bandwidth of test receiver is 9 kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15 MHz – 30 MHz.

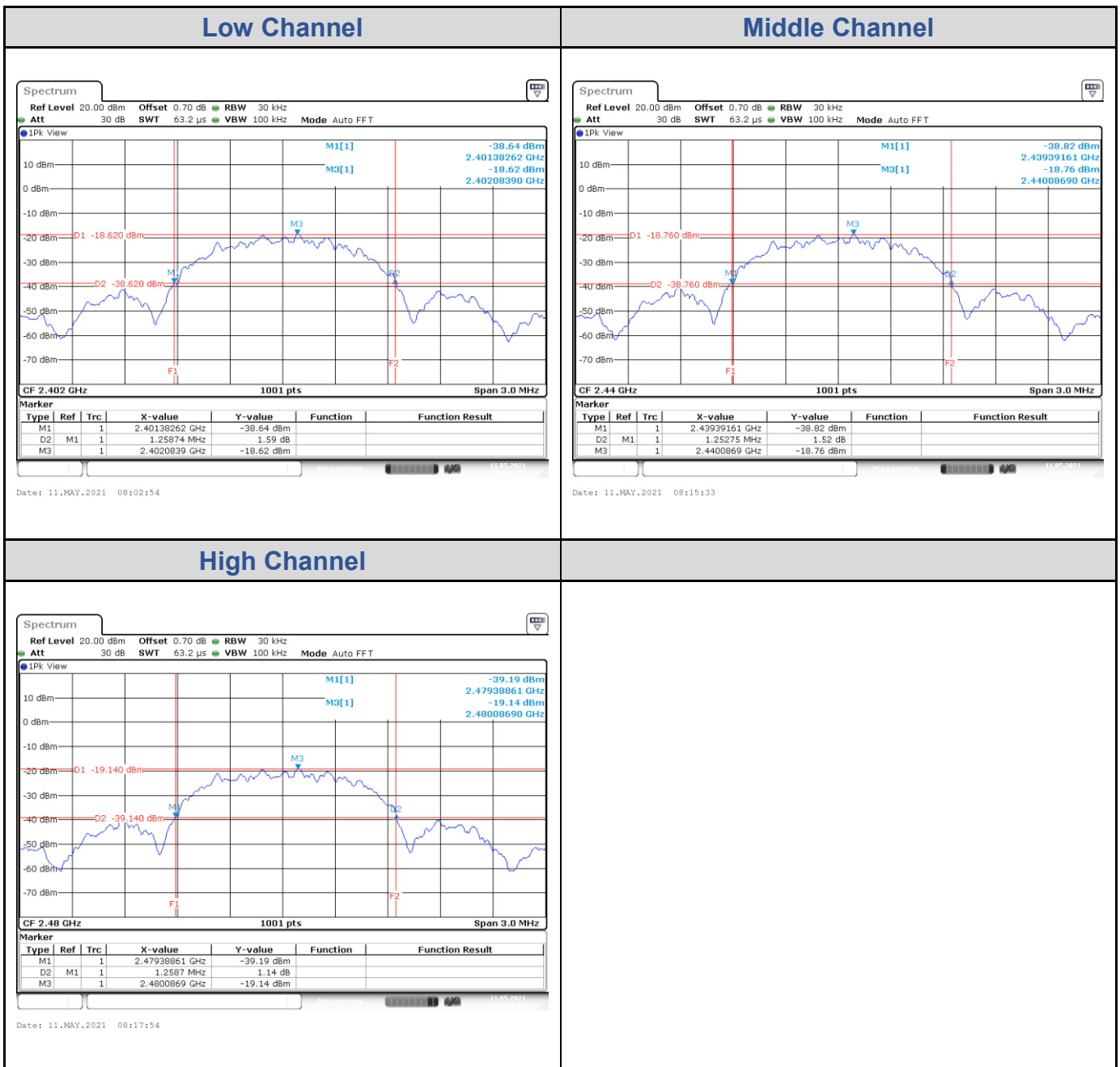
Test Results

Please refer to Appendix B.

Appendix A: Test Results of Conducted Test

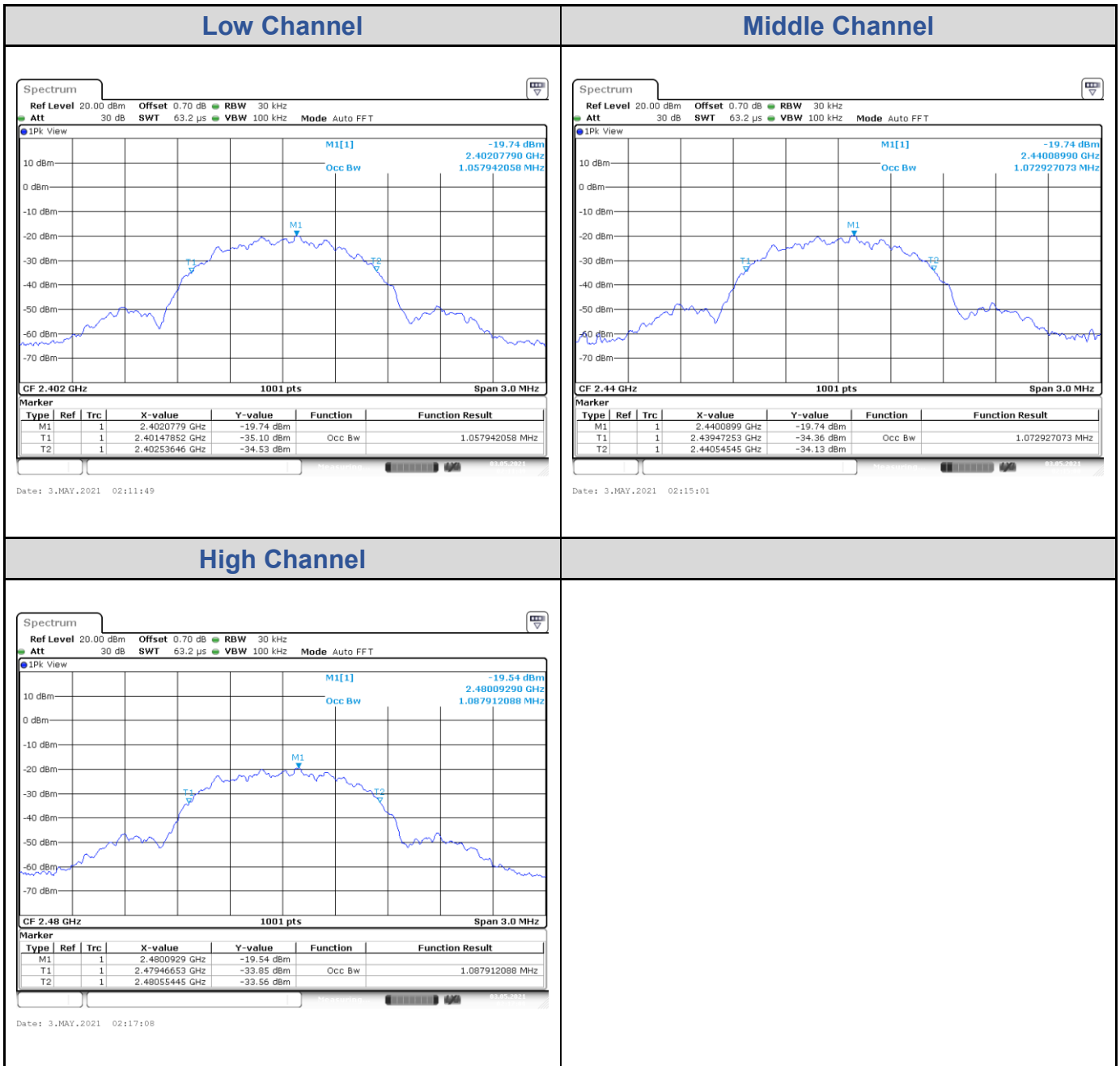
Test Result of 20 dB Bandwidth

Channel	Channel Frequency (MHz)	20 dB Bandwidth (kHz)	Result
Low Channel	2402	1258.74	Pass
Middle Channel	2440	1252.75	Pass
High Channel	2480	1258.70	Pass

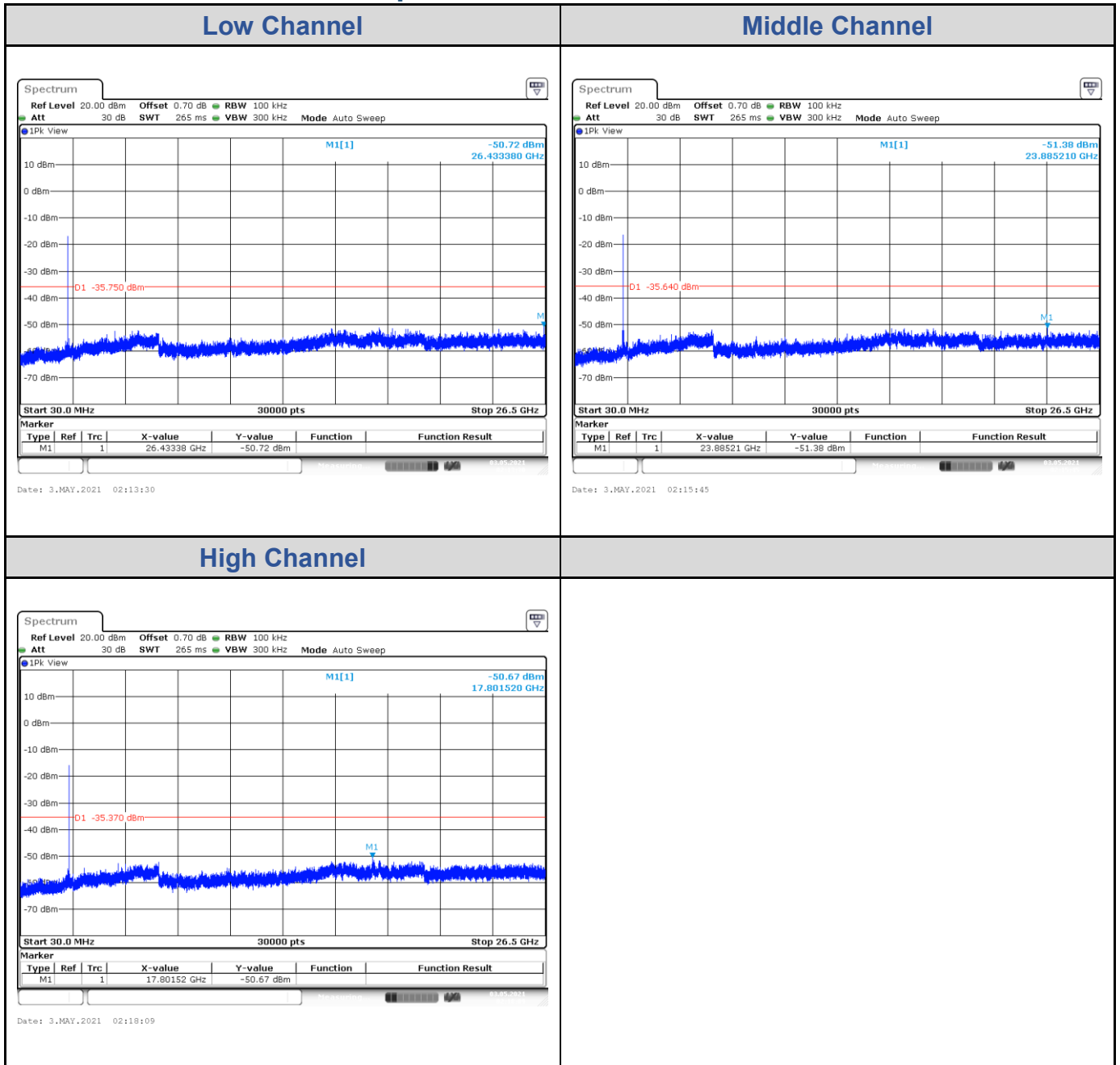


Test Result of 99% Occupied Bandwidth

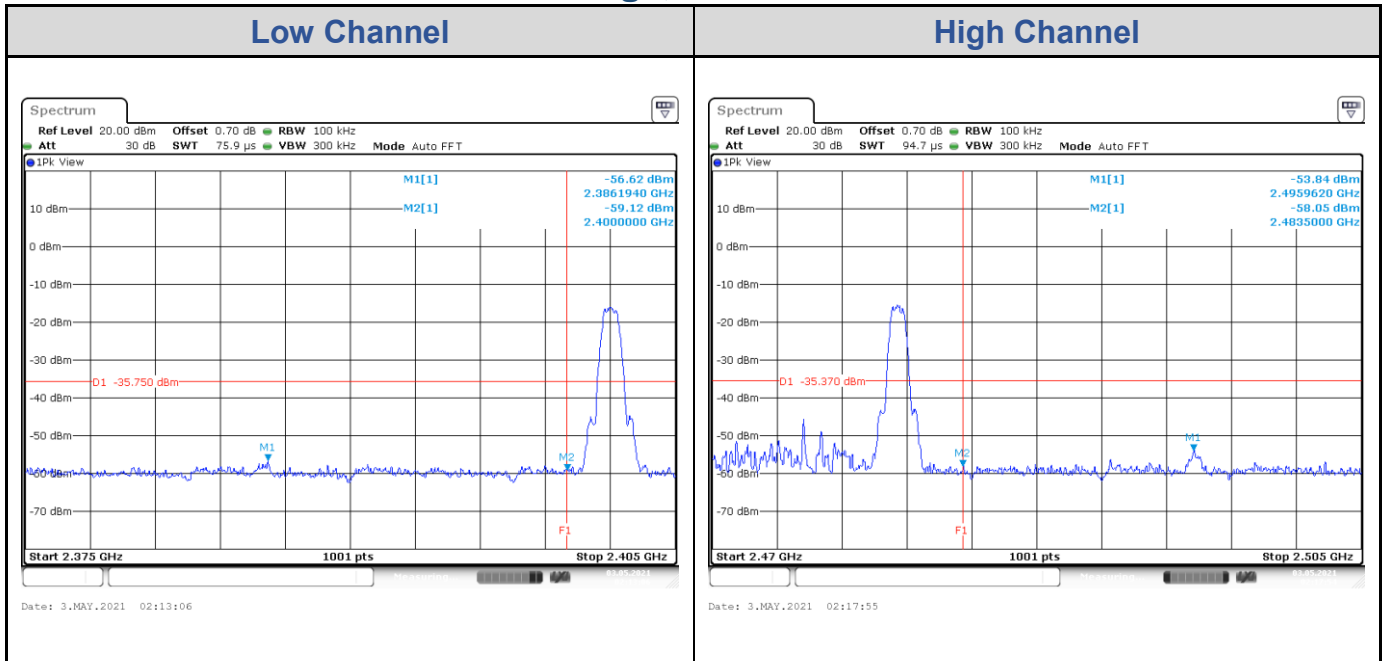
Channel	Channel Frequency (MHz)	99% Bandwidth (MHz)
Low Channel	2402	1.058
Middle Channel	2440	1.073
High Channel	2480	1.088



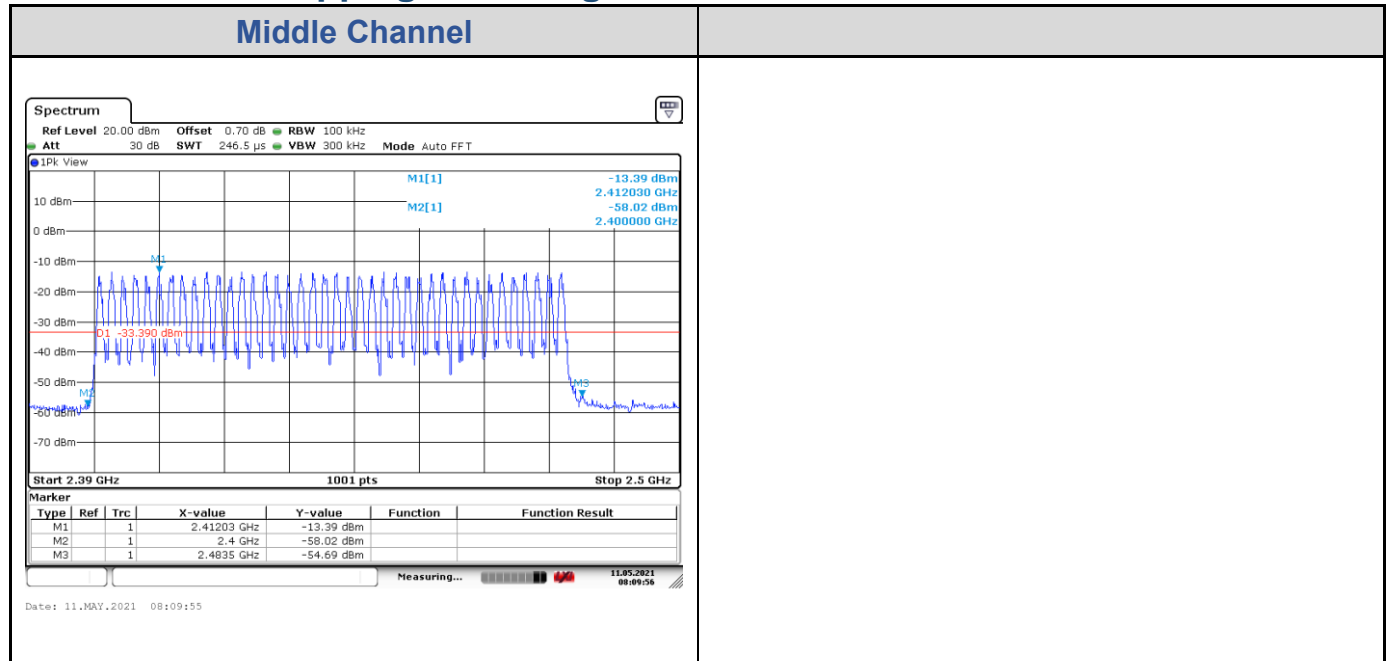
Test Result of Conducted Spurious Emissions, Tx Mode



Test Result of Conducted Band Edge, Tx Mode



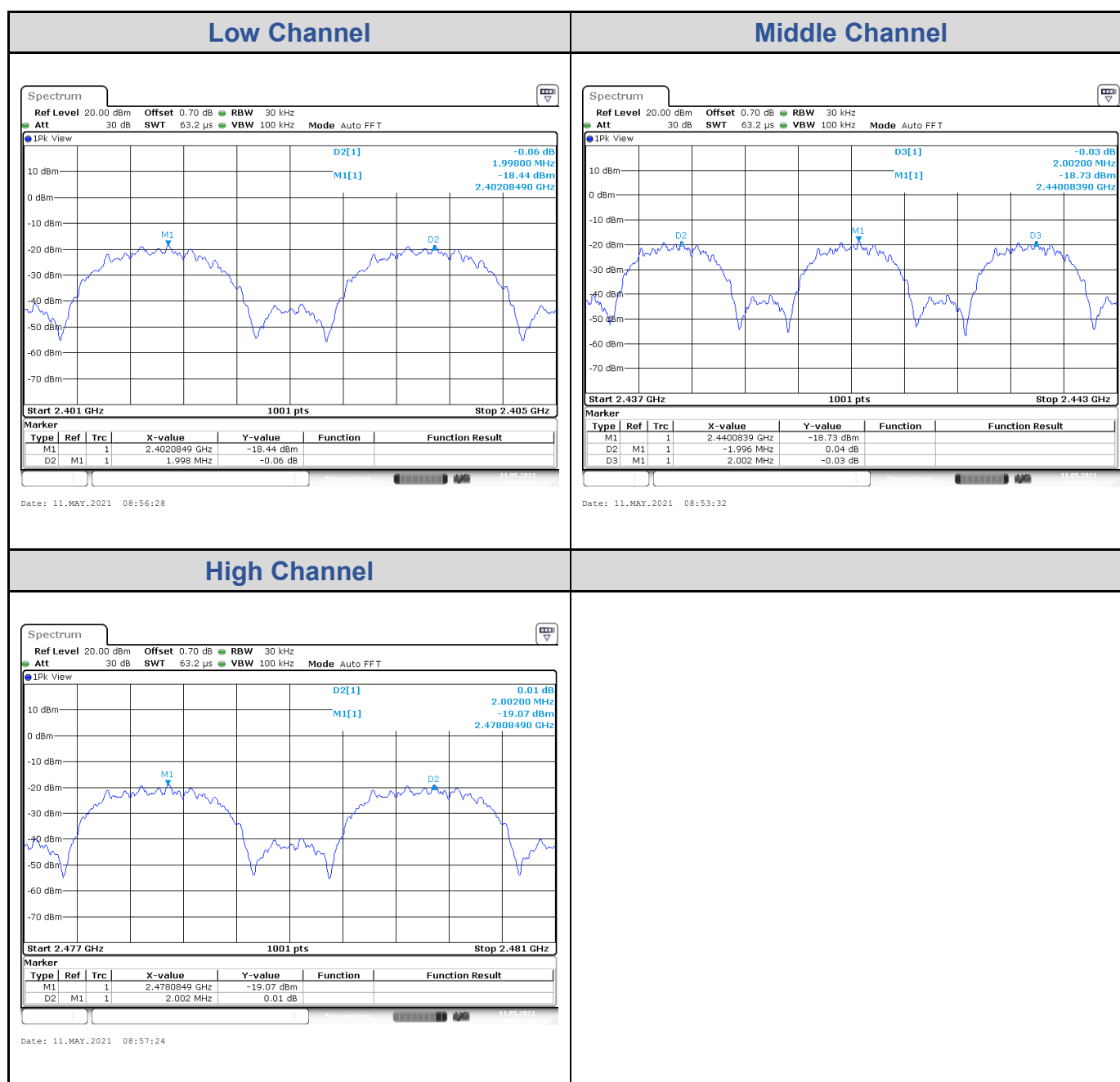
Test Result of Hopping Band Edge



Test Result of Hopping Channel Separation

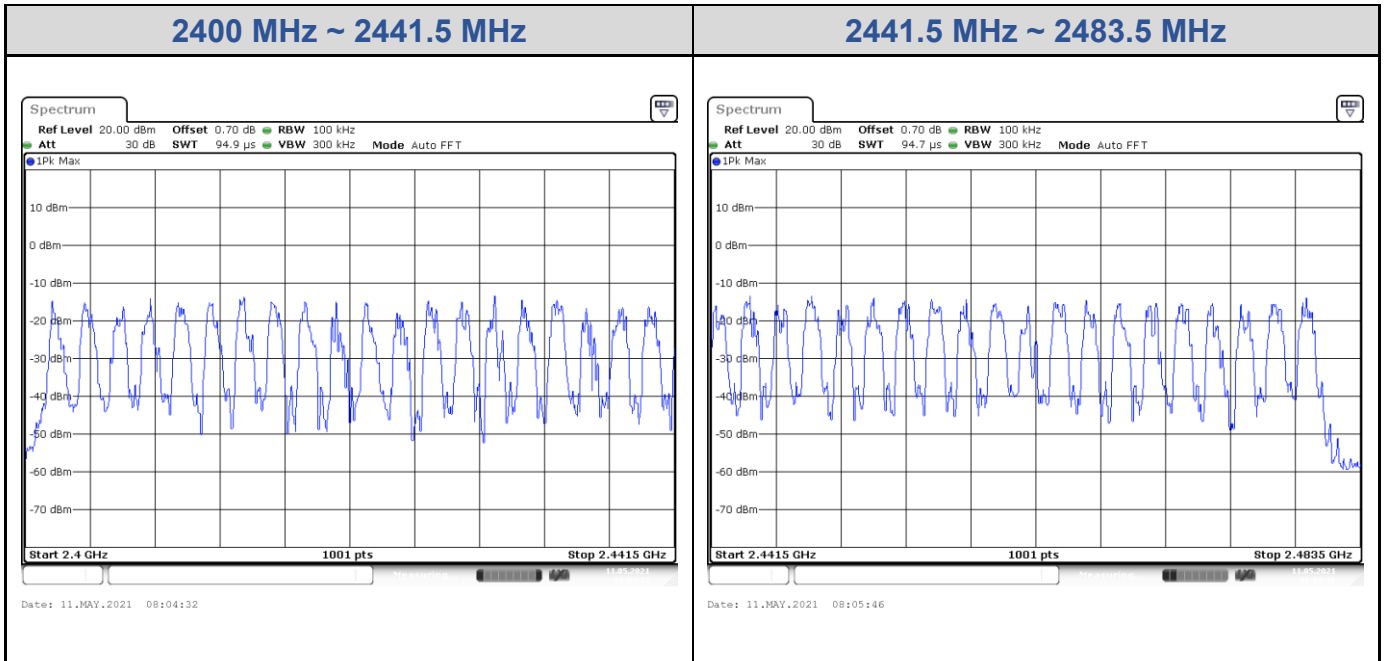
GFSK

Channel	Channel Frequency (MHz)	Adjacent Channel Separation (MHz)	20 dB Bandwidth (kHz)	Minimum Limit (MHz)	Result
Low Channel	2402	2.00	1258.74	0.839	Pass
Middle Channel	2440	2.00	1252.75	0.835	Pass
High Channel	2480	2.00	1258.70	0.839	Pass



Test Result of Number of Hopping Frequency

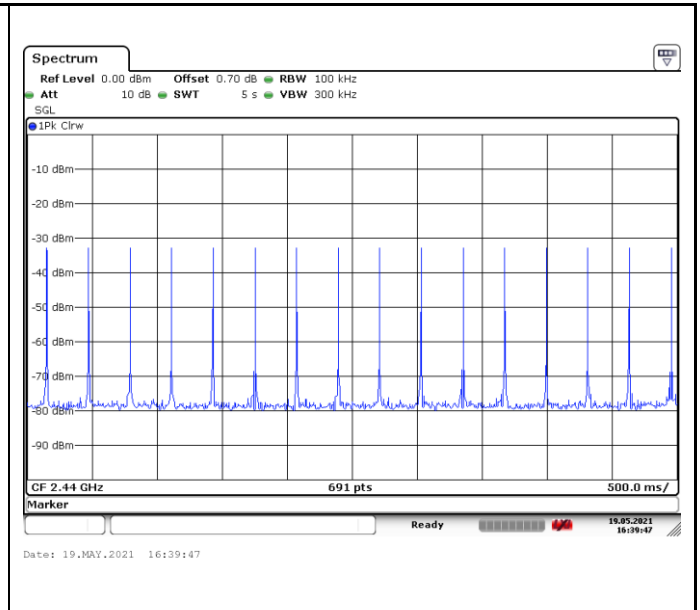
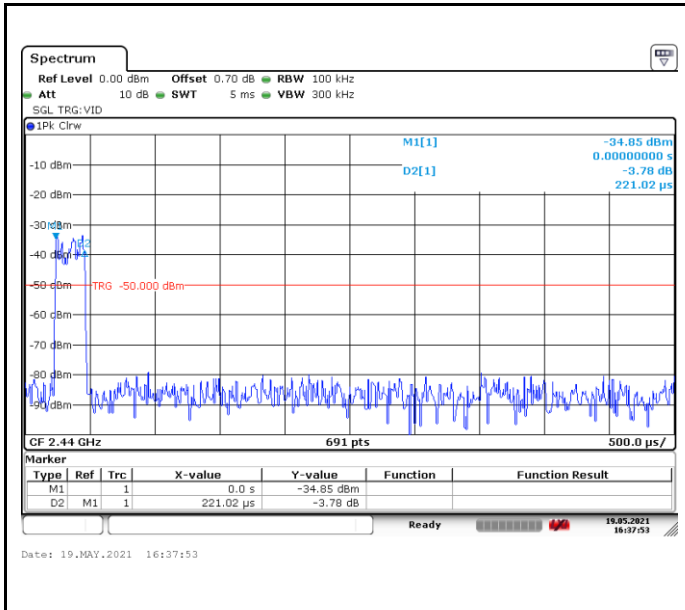
Frequency Range	Measured Quantity of Hopping Channel	Limit	Result
2400 to 2483.5 MHz	40	≥15	Pass



Test Result of Dwell Time

GFSK

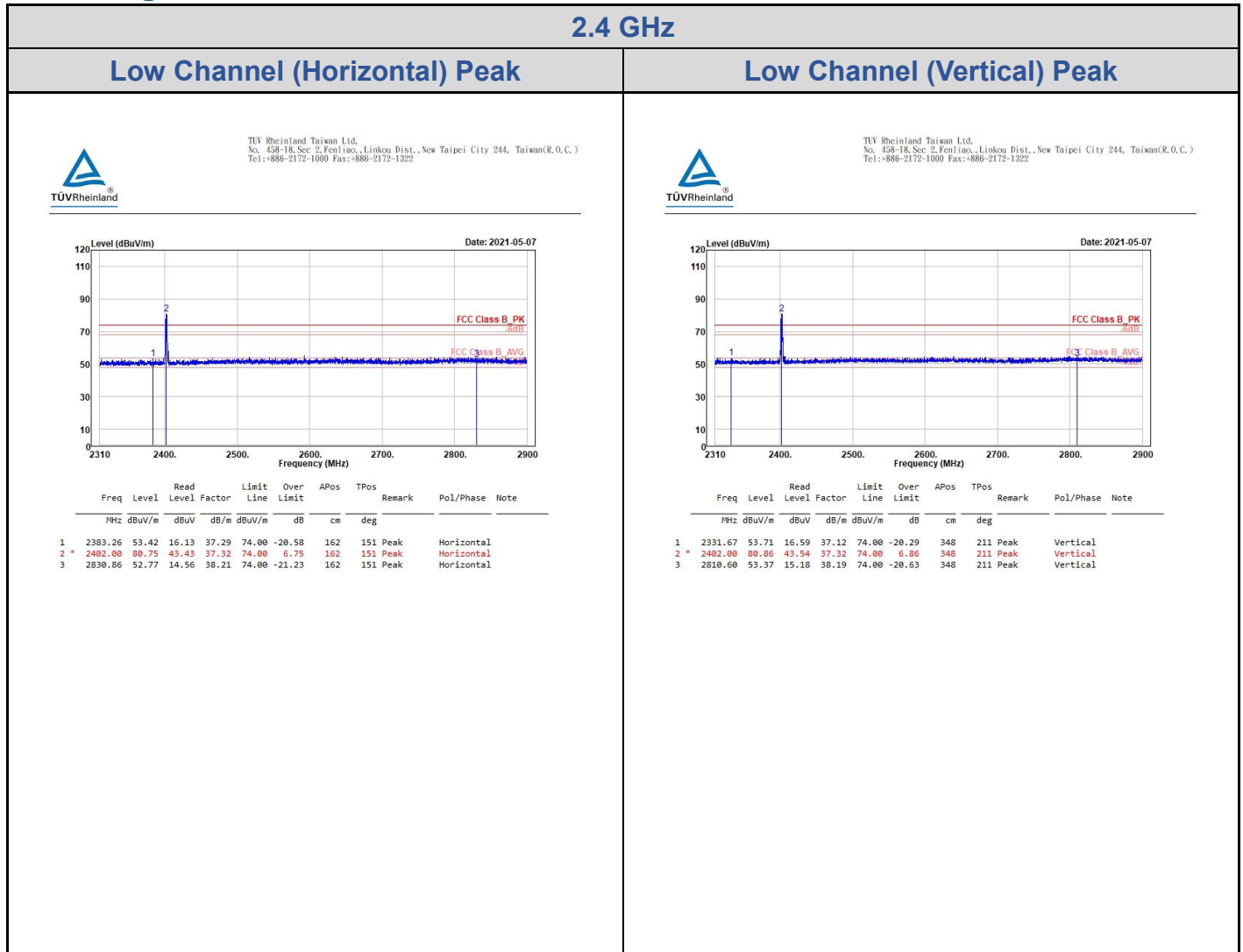
Number of transfer in a 16 (40Hopping*0.4s)	Package transfer time (msec)	Dwell time (s)	Limit (s)	Result
16 (times / 5 sec) * 3.2 = 51.2 times	0.22	0.0113	0.4	Pass



Appendix B: Test Results of Radiated Emissions & Mains Conducted

Emission Test

Band Edges, 2.31GHz ~ 2.9GHz



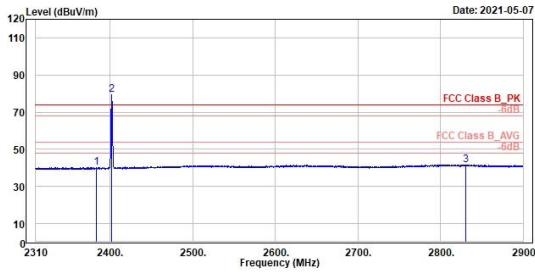
2.4 GHz

Low Channel (Horizontal) Average

Low Channel (Vertical) Average



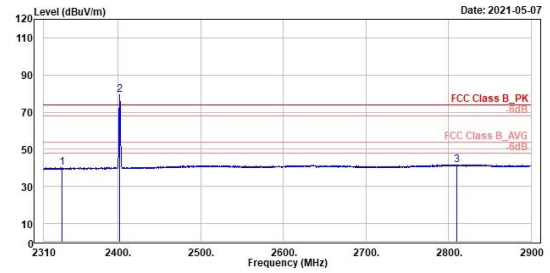
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Freq	Level	Read	Limit	Over	APos	TPos	Remark	Pol/Phase	Note
MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg		
1	2383.26	40.22	2.93	37.29	54.00	-13.78	162	151 Average	Horizontal
2 *	2402.00	79.34	42.02	37.32	54.00	25.34	162	151 Average	Horizontal
3	2830.86	41.70	3.49	38.21	54.00	-12.30	162	151 Average	Horizontal



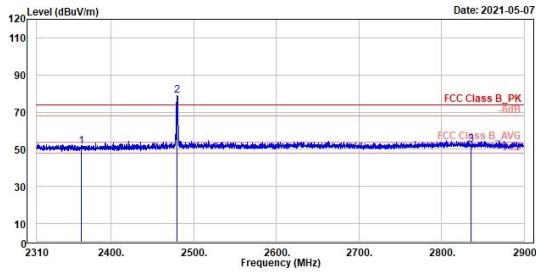
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Freq	Level	Read	Limit	Over	APos	TPos	Remark	Pol/Phase	Note
MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg		
1	2331.67	40.17	3.05	37.12	54.00	-13.83	348	211 Average	Vertical
2 *	2402.00	79.43	42.11	37.32	54.00	25.43	348	211 Average	Vertical
3	2810.60	41.73	3.54	38.19	54.00	-12.27	348	211 Average	Vertical

2.4 GHz
High Channel (Horizontal) Peak
High Channel (Vertical) Peak

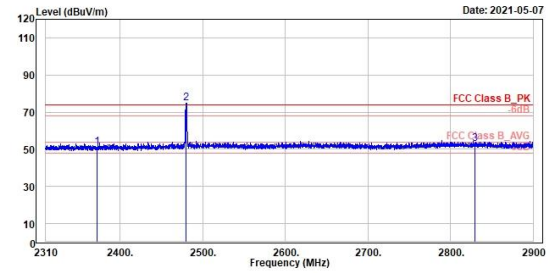

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Peak	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Remark	Pol/Phase	Note
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg			
1	2363.71	51.67	14.40	37.27	74.00	-22.33	268	154	Peak	Horizontal	
2 *	2480.00	78.77	41.08	37.69	74.00	4.77	268	154	Peak	Horizontal	
3	2835.92	52.33	14.11	38.22	74.00	-21.67	268	154	Peak	Horizontal	

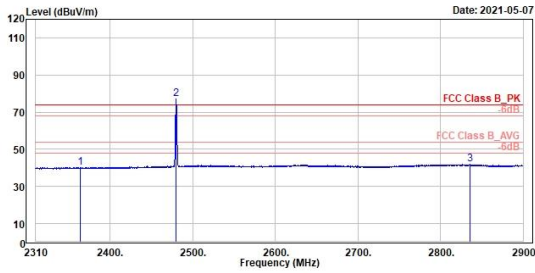


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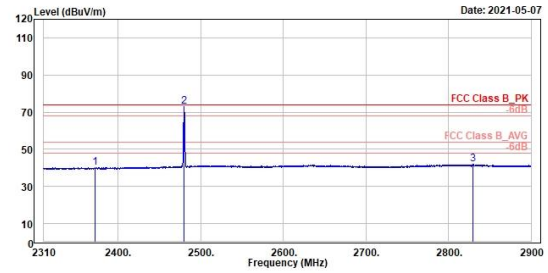


Peak	Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Remark	Pol/Phase	Note
	MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg			
1	2372.31	51.15	13.87	37.28	74.00	-22.85	100	298	Peak	Vertical	
2 *	2480.00	74.87	37.18	37.69	74.00	0.87	100	298	Peak	Vertical	
3	2829.56	52.89	14.68	38.21	74.00	-21.11	100	298	Peak	Vertical	

2.4 GHz
High Channel (Horizontal) Average
High Channel (Vertical) Average

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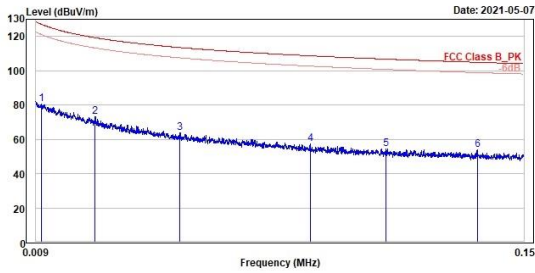
Peak	Freq (MHz)	Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit Line (dBuV/m)	Over Limit (dB)	APos (cm)	TPos (deg)	Remark	Pol/Phase	Note
1	2363.71	40.38	3.11	37.27	54.00	-13.62	268	154	Average	Horizontal	
2 *	2480.00	77.08	39.39	37.69	54.00	23.08	268	154	Average	Horizontal	
3	2835.92	41.86	3.64	38.22	54.00	-12.14	268	154	Average	Horizontal	


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Peak	Freq (MHz)	Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit Line (dBuV/m)	Over Limit (dB)	APos (cm)	TPos (deg)	Remark	Pol/Phase	Note
1	2372.31	40.22	2.94	37.28	54.00	-13.78	100	298	Average	Vertical	
2 *	2480.00	72.00	35.11	37.69	54.00	18.00	100	298	Average	Vertical	
3	2829.56	41.81	3.60	38.21	54.00	-12.19	100	298	Average	Vertical	

Spurious Emissions, Tx Mode, 9kHz ~ 30MHz
2.4 GHz
Low Channel (Open) 9kHz~150kHz
Low Channel (Open) 150kHz~30MHz

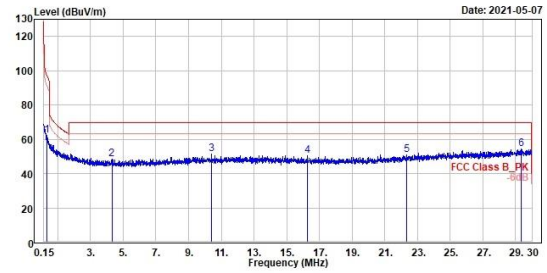

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Freq	Level	Read	Limit	Over	APos	TPos	Remark	Pol/Phase	Note
MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg		
1	80.51	4.04	76.47	127.03	-46.52	100	355 QP	Open	
2	73.31	3.03	70.28	119.24	-45.93	100	117 QP	Open	
3	63.99	0.21	63.78	113.52	-49.53	100	247 QP	Open	
4	57.15	-1.66	58.81	108.68	-51.53	100	323 QP	Open	
5	54.43	-2.39	56.82	106.75	-52.32	100	208 QP	Open	
6	53.77	-1.92	55.69	104.89	-51.12	100	226 QP	Open	



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Freq	Level	Read	Limit	Over	APos	TPos	Remark	Pol/Phase	Note
MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg		
1	62.23	13.87	48.36	97.58	-35.35	100	368 QP	Open	
2	46.27	11.72	36.55	69.58	-21.23	100	79 QP	Open	
3	51.52	13.37	38.15	69.58	-17.98	100	258 QP	Open	
4	50.32	12.59	37.73	69.58	-19.18	100	356 QP	Open	
5	50.88	12.34	38.54	69.58	-18.62	100	79 QP	Open	
6	54.17	12.35	41.82	69.58	-15.33	100	195 QP	Open	

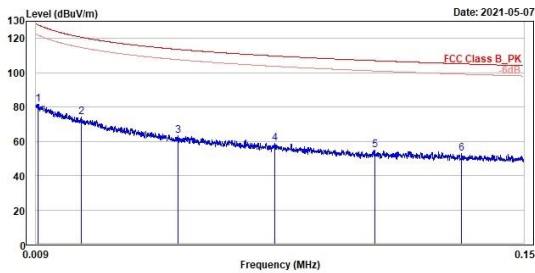
2.4 GHz

Low Channel (Close) 9kHz~150kHz

Low Channel (Close) 150kHz~30MHz



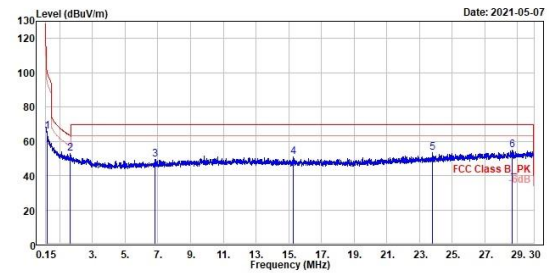
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Freq	Level	Read	Limit	Over	Apos	TPos	Remark	Pol/Phase	Note
MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg		
1	81.72	4.69	77.03	127.92	-46.10	100	121	QP	Close
2	74.27	2.38	71.89	120.70	-46.43	100	124	QP	Close
3	63.16	-0.67	63.83	113.59	-50.43	100	70	QP	Close
4	58.58	-1.56	60.14	109.74	-51.16	100	201	QP	Close
5	54.65	-2.31	56.96	107.02	-52.37	100	143	QP	Close
6	53.09	-2.79	55.88	105.19	-52.10	100	0	QP	Close



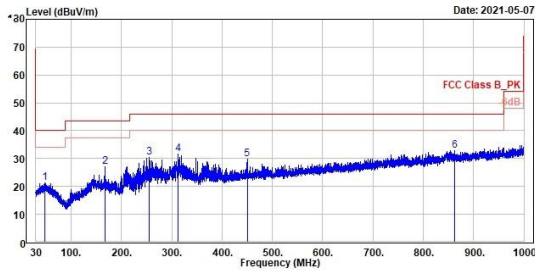
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Freq	Level	Read	Limit	Over	Apos	TPos	Remark	Pol/Phase	Note
MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg		
1	65.51	12.96	52.55	101.17	-35.66	100	101	QP	Close
2	52.81	13.04	39.77	63.29	-10.48	100	169	QP	Close
3	49.61	12.59	37.02	69.50	-19.89	100	235	QP	Close
4	50.89	13.09	37.80	69.50	-18.61	100	146	QP	Close
5	53.24	14.02	39.22	69.50	-16.26	100	85	QP	Close
6	54.89	13.37	41.52	69.50	-14.61	100	216	QP	Close

Spurious Emissions, Tx Mode, 30MHz ~ 1GHz
2.4 GHz
Low Channel (Horizontal)
Low Channel (Vertical)

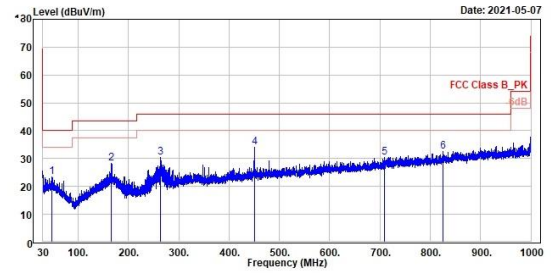

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Freq	Level	Read	Limit	Over	APos	TPos	Remark	Pol/Phase	Note
MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg		
1	47.46	21.37	28.67	-7.30	40.00	-18.63	100	175 QP	Horizontal
2	167.93	26.93	34.37	-7.44	43.50	-16.57	300	233 QP	Horizontal
3	255.72	30.41	38.34	-7.93	46.00	-15.59	100	230 QP	Horizontal
4	312.37	31.64	37.70	-6.06	46.00	-14.36	100	231 QP	Horizontal
5	450.11	29.93	33.44	-3.51	46.00	-16.07	100	92 QP	Horizontal
6	861.97	32.85	29.71	3.14	46.00	-13.15	200	76 QP	Horizontal



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Freq	Level	Read	Limit	Over	APos	TPos	Remark	Pol/Phase	Note
MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg		
1	47.07	23.33	30.59	-7.26	40.00	-16.67	200	358 QP	Vertical
2	166.58	28.19	35.59	-7.40	43.50	-15.31	400	96 QP	Vertical
3	264.26	30.52	38.16	-7.64	46.00	-15.48	200	276 QP	Vertical
4	450.59	34.15	37.65	-3.50	46.00	-11.85	114	360 QP	Vertical
5	709.39	30.44	29.94	0.50	46.00	-15.56	100	166 QP	Vertical
6	825.01	32.62	30.09	2.53	46.00	-13.38	200	95 QP	Vertical

Spurious Emissions, Tx Mode, 1GHz ~ 26.5GHz

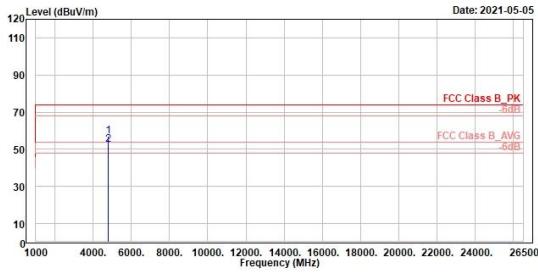
2.4 GHz

Low Channel (Horizontal)

Low Channel (Vertical)



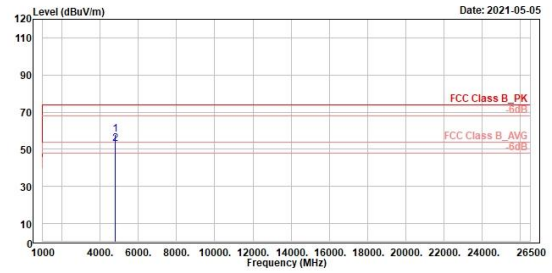
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Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Remark	Pol/Phase	Note
MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg			
1	4894.00	57.06	66.47	-9.41	74.00	-16.94	180	164 Peak	Horizontal	
2	4894.00	52.54	61.95	-9.41	54.00	-1.46	180	164 Average	Horizontal	



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Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Remark	Pol/Phase	Note
MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg			
1	4894.00	57.96	67.37	-9.41	74.00	-16.04	259	225 Peak	Vertical	
2	4894.00	52.81	62.22	-9.41	54.00	-1.19	259	225 Average	Vertical	

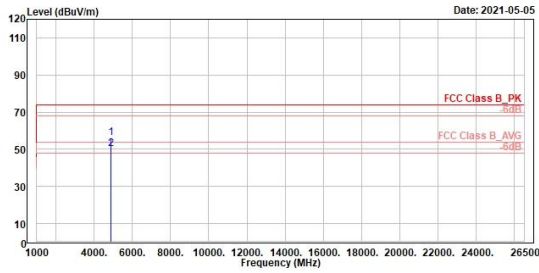
2.4 GHz

Middle Channel (Horizontal)

Middle Channel (Vertical)



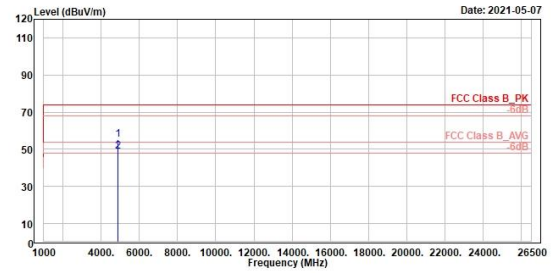
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Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Remark	Pol/Phase	Note
MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg			
1	4880.00	56.08	65.44	-9.36	74.00	-17.92	280	199 Peak	Vertical	
2	4880.00	50.09	59.45	-9.36	54.00	-3.91	280	199 Average	Vertical	



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Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Remark	Pol/Phase	Note
MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg			
1	4880.00	55.34	64.70	-9.36	74.00	-18.66	296	157 Peak	Horizontal	
2	4880.00	48.93	58.29	-9.36	54.00	-5.07	296	157 Average	Horizontal	

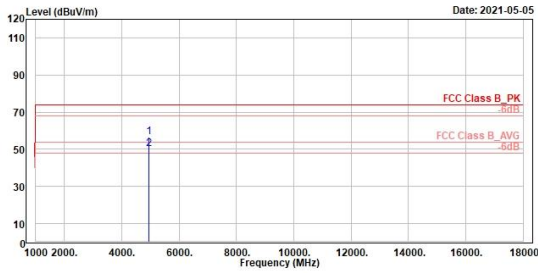
2.4 GHz

High Channel (Horizontal)

High Channel (Vertical)



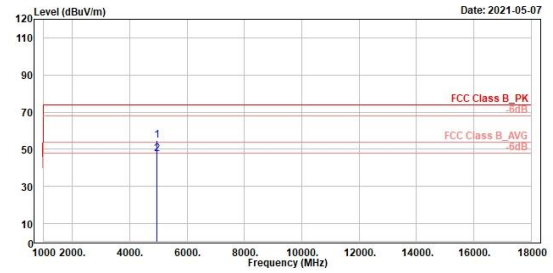
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Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Remark	Pol/Phase	Note
MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg			
1	4960.00	56.43	65.70	-9.27	74.00	-17.57	301	203 Peak	Vertical	
2	4960.00	50.17	59.44	-9.27	54.00	-3.83	301	203 Average	Vertical	



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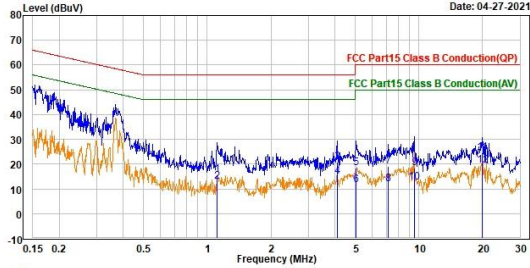


Freq	Level	Read Level	Factor	Limit Line	Over Limit	APos	TPos	Remark	Pol/Phase	Note
MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	cm	deg			
1	4960.00	54.53	63.80	-9.27	74.00	-19.47	116	157 Peak	Horizontal	
2	4960.00	47.58	56.85	-9.27	54.00	-6.42	116	157 Average	Horizontal	

Mains Conducted Emission, 150kHz ~ 30MHz
Worst Band
(Line)
(Neutral)


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Date: 04-27-2021

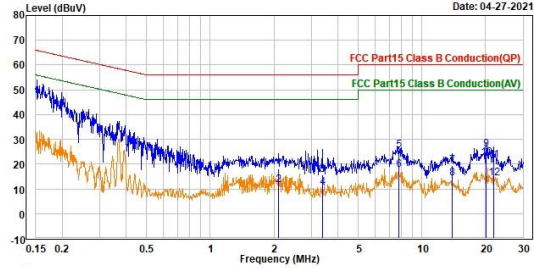


Trace: 1	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark	Po1/Phase	Note
	MHz	dBuV	dB	dBuV	dBuV	dB			
1	1.112	6.15	9.67	15.82	56.00	-40.18	QP	line1	
2	1.112	3.38	9.67	13.05	46.00	-32.95	Average	line1	
3	4.106	11.00	9.70	20.70	56.00	-35.30	QP	line1	
4	4.106	5.26	9.70	14.96	46.00	-31.04	Average	line1	
5	5.062	8.65	9.72	18.37	60.00	-41.63	QP	line1	
6	5.062	1.81	9.72	11.53	50.00	-38.47	Average	line1	
7	7.140	9.31	9.74	19.05	60.00	-40.95	QP	line1	
8	7.140	2.31	9.74	12.05	50.00	-37.95	Average	line1	
9	9.486	8.75	9.76	18.51	60.00	-41.49	QP	line1	
10	9.486	2.90	9.76	12.66	50.00	-37.34	Average	line1	
11	19.836	14.83	9.74	24.57	60.00	-35.43	QP	line1	
12	19.836	9.54	9.74	19.28	50.00	-30.72	Average	line1	



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Trace: 1	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark	Po1/Phase	Note
	MHz	dBuV	dB	dBuV	dBuV	dB			
1	2.106	8.20	9.70	17.90	56.00	-38.10	QP	neutral	
2	2.106	1.79	9.70	11.49	46.00	-34.51	Average	neutral	
3	3.381	5.89	9.71	15.60	56.00	-40.40	QP	neutral	
4	3.381	0.69	9.71	10.40	46.00	-35.60	Average	neutral	
5	7.771	15.75	9.77	25.52	60.00	-34.48	QP	neutral	
6	7.771	7.84	9.77	17.61	50.00	-32.39	Average	neutral	
7	13.855	9.71	9.82	19.53	60.00	-40.47	QP	neutral	
8	13.855	4.52	9.82	14.34	50.00	-35.66	Average	neutral	
9	20.035	16.19	9.83	26.02	60.00	-33.98	QP	neutral	
10	20.035	12.58	9.83	22.41	50.00	-27.59	Average	neutral	
11	21.806	11.60	9.82	21.42	60.00	-38.58	QP	neutral	
12	21.806	4.61	9.82	14.43	50.00	-35.57	Average	neutral	