Test Report

Date : 2020-06-10
No. : HMD20030011

Applicant	:	TG3 Electronics Inc. 4615 70th Ave, Kenosha, WI 53144, United States
Supplier / Manufacturer	:	TG3 Electronics Inc. 4615 70th Ave, Kenosha, WI 53144, United States
Description of Sample(s)	:	Submitted sample(s) said to be Product: Keyboard Brand Name: N/A Model No.: D4239 FCC ID: IHU-D4239
Date Samples Received	:	2020-03-04
Date Tested	:	2020-03-31
Investigation Requested	:	Perform ElectroMagnetic Interference measurement in accordance with FCC 47CFR [Codes of Federal Regulations] Part 15 and ANSI C63.10: 2013 for FCC Certification.
Conclusions	:	The submitted product COMPLIED with the requirements of Federal Communications Commission [FCC] Rules and Regulations Part 15. The tests were performed in accordance with the standards described above and on Section 2.2 in this Test Report.
Remarks	:	2.4GHz wireless (GFSK)

LEUNG Kwun Hang, Joey
Authorized Signatory

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1.0 General Details

1.1 Test Laboratory

The Hong Kong Standards and Testing Centre Ltd.
EMC Laboratory
10 Dai Wang Street, Taipo Industrial Estate, New Territories, Hong Kong
Telephone: 852 2666 1888
Fax: 852 2664 4353

1.2 Equipment Under Test [EUT]

Description of Sample(s)

Product:	Keyboard
Manufacturer:	TG3 Electronics Inc. 4615 70th Ave, Kenosha, WI 53144, United States
Brand Name:	N/A
Model Number:	D4239
Rating:	3Vd.c.("AA" size battery x2)

1.3 Description of EUT Operation

The Equipment Under Test (EUT) is a Keyboard. It is a transceiver operating at 2404MHz~2475MHz and the RF signal was modulated by IC.

1.4 Date of Order

2020-03-04

1.5 Submitted Sample(s):

1 Sample

1.6 Test Duration

2020-03-31

1.7 Country of Origin

China

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2.0 Technical Details

2.1 Investigations Requested

Perform Electromagnetic Interference measurements in accordance with FCC 47CFR [Codes of Federal Regulations] Part 15 Regulations and ANSI C63.10: 2013 for FCC Certification.
The device was realized by test software.

2.2 Test Standards and Results Summary Tables

EMISSION Results Summary						
Test Condition	Test Requirement	Test Method	Class / Severity	Test Result		
				Pass	Failed	N/A
Field Strength of Fundamental & Harmonics Emissions	FCC 47CFR 15.249	ANSI C63.10: 2013	N/A	☒	☐	☐
Radiated Emissions	FCC 47CFR 15.209	ANSI C63.10: 2013	N/A	☒	☐	☐
AC Mains Conducted Emissions	FCC 47CFR 15.207	ANSI C63.10: 2013	N/A	☐	☐	☒
Antenna requirement	FCC 47CFR 15.203	N/A	N/A	☒	☐	☐
20dB Emission bandwith	FCC 47CFR 15.215(c)	ANSI C63.10: 2013	N/A	☒	☐	☐

Note: N/A - Not Applicable

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3.0 Test Results

3.1 Emission

3.1.1 Radiated Emissions

Ambient temperature 25°C Relative humidity 57%

Test Requirement:	FCC 47CFR 15.249 & FCC 47CFR 15.209
Test Method:	ANSI C63.10:2013
Test Date:	2020-03-31
Mode of Operation:	Tx mode

Test Method:

For emission measurements at or below 1 GHz, the sample was placed 0.8m above the ground plane of semi-anechoic Chamber*. For emission measurements above 1 GHz, the sample was placed 1.5m above the ground plane of semi-anechoic Chamber*. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. The emissions worst-case are shown in Test Results of the following pages.

* Semi-Anechoic chamber located on the G/F of The Hong Kong Standards and Testing Centre Ltd. with a metal ground plane filed with the FCC pursuant to section 2.948 of the FCC rules, with Registration Number: 607756.

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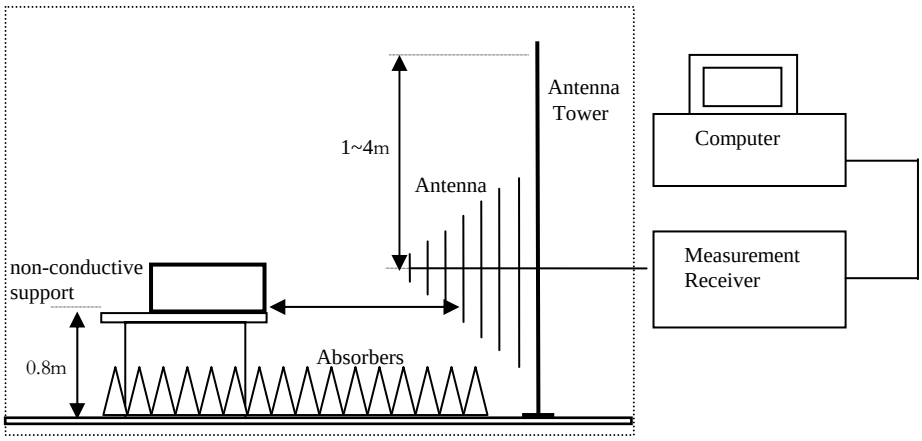
Spectrum Analyzer Setting:

9KHz – 30MHz (Pk & Av)	RBW:	10kHz
	VBW:	30kHz
	Sweep:	Auto
	Span:	Fully capture the emissions being measured
	Trace:	Max. hold
30MHz – 1GHz (QP)	RBW:	120kHz
	VBW:	120kHz
	Sweep:	Auto
	Span:	Fully capture the emissions being measured
	Trace:	Max. hold
Above 1GHz (Pk)	RBW:	1MHz
	VBW:	1MHz
	Sweep:	Auto
	Span:	Fully capture the emissions being measured
	Trace:	Max. hold
Above 1GHz (Av)	RBW:	1MHz
	VBW:	10Hz
	Sweep:	Auto
	Span:	Fully capture the emissions being measured
	Trace:	Max. hold

Test Setup:



Ground Plane

- Absorbers placed on top of the ground plane are for measurements above 1000MHz only.
- Measurements between 30MHz to 1000MHz made with Bi-log antennas, above 1000MHz horn antennas are used.

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Limits for Field Strength of Fundamental & Harmonics Emissions [FCC 47CFR 15.249]:

Frequency Range of Fundamental [MHz]	Field Strength of Fundamental Emission [microvolts/meter]	Field Strength of Harmonics Emission [microvolts/meter]
902-928	50,000 [Quasi-Peak]	500 [Average]
2400-2483.5	50,000 [Average]	500 [Average]

Remarks:
No additional spurious emissions found between lowest internal used/generated frequency and 30 MHz

Calculated measurement uncertainty (9kHz-30MHz): 2.0dB
(30MHz -1GHz): 4.9dB
(1GHz -6GHz): 4.02dB
(6GHz -26.5GHz): 4.03dB

Emissions in the vertical and horizontal polarizations have been investigated and the worst-case test results are recorded in this report.

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Results of Tx mode (Lowest Frequency Channel-2404 MHz): Pass

Field Strength of Fundamental Emissions Peak Value						
Frequency MHz	Measured Level @3m dBμV/m	Correction Factor dBμV/m	Field Strength dBμV/m	Field Strength μV/m	Limit @3m μV/m	E-Field Polarity
2404.00	50.1	36.8	86.9	22,003.9	500,000	Vertical
2404.00	49.0	36.4	85.4	18,685.3	500,000	Horizontal

Field Strength of Fundamental Emissions Average Value						
Frequency MHz	Measured Level @3m dBμV/m	Correction Factor dBμV/m	Field Strength dBμV/m	Field Strength μV/m	Limit @3m μV/m	E-Field Polarity
2404.00	27.2	36.8	64.0	1,581.2	50,000	Vertical
2404.00	26.4	36.4	62.8	1,380.4	50,000	Horizontal

Field Strength of Harmonics Emission Peak Value						
Frequency MHz	Measured Level @3m dBμV/m	Correction Factor dBμV/m	Field Strength dBμV/m	Field Strength μV/m	Limit @3m μV/m	E-Field Polarity
4808.0	13.7	41.5	55.2	578.1	5,000	Vertical
4808.0	13.0	42.4	55.4	590.9	5,000	Horizontal
7212.0	9.8	45.1	54.9	552.7	5,000	Vertical
7212.0	8.8	46.2	55.0	559.8	5,000	Horizontal
9616.0	7.2	48.0	55.2	578.1	5,000	Vertical
9616.0	6.4	48.8	55.2	574.1	5,000	Horizontal
12020.0	4.0	51.8	55.8	617.3	5,000	Vertical
12020.0	2.6	52.4	55.0	563.6	5,000	Horizontal

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Field Strength of Harmonics Emission Average Value						
Frequency MHz	Measured Level @3m dBμV/m	Correction Factor dBμV/m	Field Strength dBμV/m	Field Strength μV/m	Limit @3m μV/m	E-Field Polarity
4808.0	0.8	41.5	42.3	130.8	500	Vertical
4808.0	-1.7	42.4	40.7	108.6	500	Horizontal
7212.0	-5.3	45.1	39.8	97.3	500	Vertical
7212.0	-5.7	46.2	40.5	105.7	500	Horizontal
9616.0	-8.7	48.0	39.3	92.6	500	Vertical
9616.0	-9.1	48.8	39.8	97.2	500	Horizontal
12020.0	-11.4	51.8	40.5	105.3	500	Vertical
12020.0	-12.3	52.4	40.1	101.5	500	Horizontal

Results of Tx mode (Middle Frequency Channel- 2442MHz): Pass

Field Strength of Fundamental Emissions Peak Value						
Frequency MHz	Measured Level @3m dBμV/m	Correction Factor dBμV/m	Field Strength dBμV/m	Field Strength μV/m	Limit @3m μV/m	E-Field Polarity
2442.00	51.1	36.8	87.9	24,802.8	500,000	Vertical
2442.00	49.2	36.4	85.6	19,098.5	500,000	Horizontal

Field Strength of Fundamental Emissions Average Value						
Frequency MHz	Measured Level @3m dBμV/m	Correction Factor dBμV/m	Field Strength dBμV/m	Field Strength μV/m	Limit @3m μV/m	E-Field Polarity
2442.00	26.6	36.8	63.4	1,474.0	50,000	Vertical
2442.00	26.5	36.4	62.9	1,398.0	50,000	Horizontal

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Field Strength of Harmonics Emission Peak Value						
Frequency MHz	Measured Level @3m dBμV/m	Correction Factor dBμV/m	Field Strength dBμV/m	Field Strength μV/m	Limit @3m μV/m	E-Field Polarity
4884.0	14.1	41.6	55.7	608.1	5,000	Vertical
4884.0	12.4	42.5	54.9	555.3	5,000	Horizontal
7326.0	1.9	53.2	55.1	570.8	5,000	Vertical
7326.0	8.9	46.3	55.2	574.8	5,000	Horizontal
9768.0	7.1	48.1	55.2	574.8	5,000	Vertical
9768.0	6.4	48.9	55.3	579.4	5,000	Horizontal
12210.0	3.7	51.6	55.3	582.8	5,000	Vertical
12210.0	2.5	52.5	55.0	562.3	5,000	Horizontal

Field Strength of Harmonics Emission Avarage Value						
Frequency MHz	Measured Level @3m dBμV/m	Correction Factor dBμV/m	Field Strength dBμV/m	Field Strength μV/m	Limit @3m μV/m	E-Field Polarity
4884.0	-1.0	41.6	40.6	107.5	500	Vertical
4884.0	-2.8	42.5	39.7	97.1	500	Horizontal
7326.0	-5.1	45.2	40.1	100.9	500	Vertical
7326.0	-7.0	46.3	39.3	91.9	500	Horizontal
9768.0	-8.7	48.1	39.5	93.9	500	Vertical
9768.0	-8.1	48.9	40.8	109.3	500	Horizontal
12210.0	-11.1	51.6	40.5	106.2	500	Vertical
12210.0	-12.3	52.5	40.2	102.0	500	Horizontal

Results of Tx mode (Highest Frequency Channel – 2475MHz): Pass

Field Strength of Fundamental Emissions Peak Value						
Frequency MHz	Measured Level @3m dBμV/m	Correction Factor dBμV/m	Field Strength dBμV/m	Field Strength μV/m	Limit @3m μV/m	E-Field Polarity
2475.00	50.5	36.8	87.3	23,227.4	500,000	Vertical
2475.00	49.1	36.4	85.5	18,771.5	500,000	Horizontal

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Field Strength of Fundamental Emissions Average Value						
Frequency MHz	Measured Level @3m dBμV/m	Correction Factor dBμV/m	Field Strength dBμV/m	Field Strength μV/m	Limit @3m μV/m	E-Field Polarity
2475.00	27.2	36.8	64.0	1,586.7	50,000	Vertical
2475.00	25.9	36.4	62.3	1,309.2	50,000	Horizontal

Field Strength of Harmonics Emission Peak Value						
Frequency MHz	Measured Level @3m dBμV/m	Correction Factor dBμV/m	Field Strength dBμV/m	Field Strength μV/m	Limit @3m μV/m	E-Field Polarity
4950.0	14.4	41.4	55.8	613.1	5,000	Vertical
4950.0	12.5	42.7	55.2	576.8	5,000	Horizontal
7425.0	9.6	45.6	55.2	576.1	5,000	Vertical
7425.0	8.7	46.5	55.2	572.8	5,000	Horizontal
9900.0	7.3	48.6	55.9	623.0	5,000	Vertical
9900.0	6.1	49.7	55.8	618.0	5,000	Horizontal
12375.0	3.5	51.7	55.2	572.8	5,000	Vertical
12375.0	2.7	52.7	55.4	590.2	5,000	Horizontal

Field Strength of Harmonics Emission Avarage Value						
Frequency MHz	Measured Level @3m dBμV/m	Correction Factor dBμV/m	Field Strength dBμV/m	Field Strength μV/m	Limit @3m μV/m	E-Field Polarity
4950.0	0.0	41.4	41.4	117.9	500	Vertical
4950.0	-2.8	42.7	39.9	99.0	500	Horizontal
7425.0	-6.4	45.6	39.3	91.7	500	Vertical
7425.0	-6.2	46.5	40.3	103.2	500	Horizontal
9900.0	-9.2	48.6	39.4	93.8	500	Vertical
9900.0	-9.6	49.7	40.1	100.9	500	Horizontal
12375.0	-11.4	51.7	40.3	103.9	500	Vertical
12375.0	-12.5	52.7	40.2	102.2	500	Horizontal

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Radiated Emissions Measurement:
Limit：
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. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 5.205(c)).

Result： RF Radiated Emissions (1GHz-26GHz) (Lowest)

Field Strength of Band-edge Compliance Peak Value						
Frequency MHz	Measured Level @3m dBµV	Correction Factor dB/m	Field Strength dBµV/m	Limit @3m dBµV/m	Margin dBµV/m	E-Field Polarity
2400.0	26.6	36.8	63.4	74.0	10.6	Horizontal

Field Strength of Band-edge Compliance Average Value						
Frequency MHz	Measured Level @3m dBµV	Correction Factor dB/m	Field Strength dBµV/m	Limit @3m dBµV/m	Margin dBµV/m	E-Field Polarity
2400.0	4.6	36.8	41.4	54.0	12.6	Horizontal

Result： RF Radiated Emissions (1GHz-26GHz) (Highest)

Field Strength of Band-edge Compliance Peak Value						
Frequency MHz	Measured Level @3m dBµV	Correction Factor dB/m	Field Strength dBµV/m	Limit @3m dBµV/m	Margin dBµV/m	E-Field Polarity
2483.5	17.8	36.8	54.6	74.0	19.4	Horizontal

Field Strength of Band-edge Compliance Average Value						
Frequency MHz	Measured Level @3m dBµV	Correction Factor dB/m	Field Strength dBµV/m	Limit @3m dBµV/m	Margin dBµV/m	E-Field Polarity
2483.5	-4.9	36.8	31.9	54.0	22.1	Horizontal

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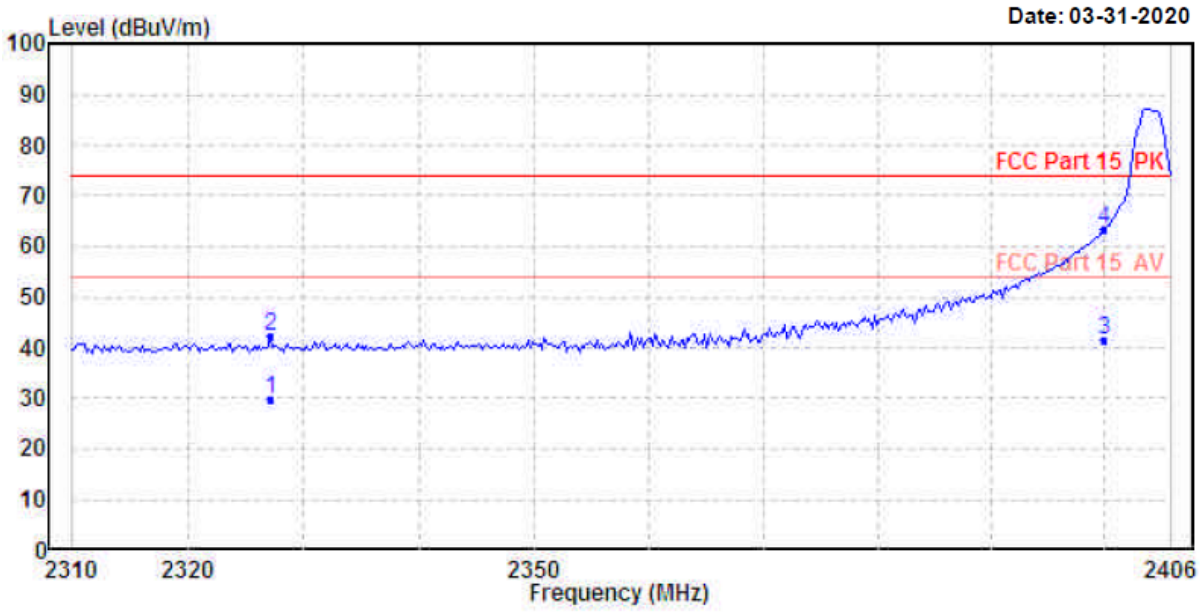
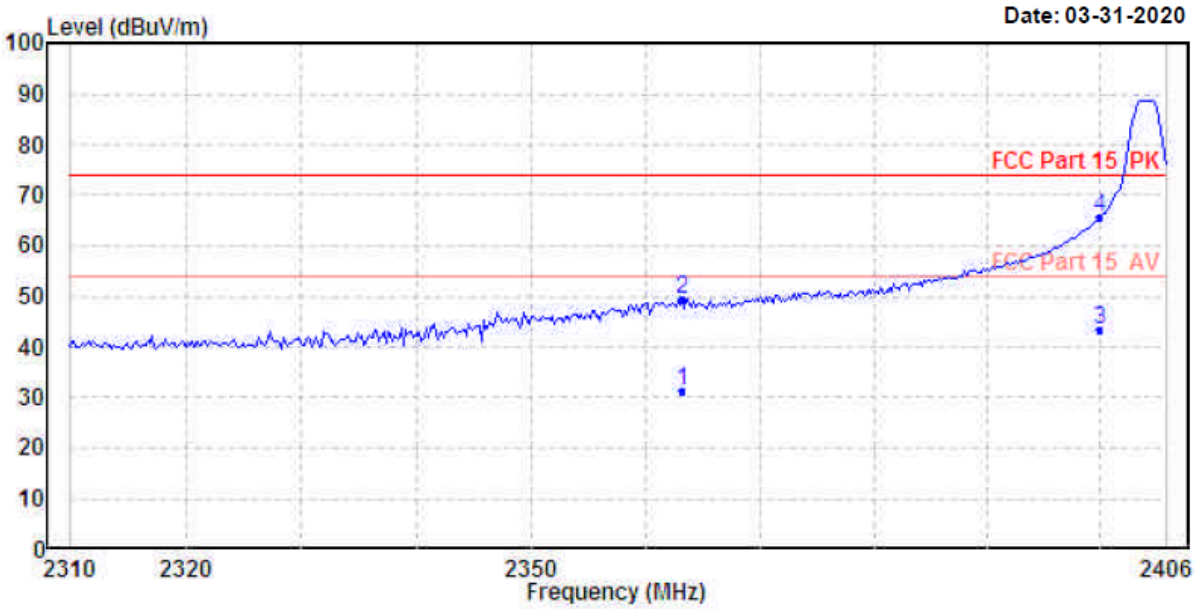
Emissions radiated outside of the specified frequency bands (Lowest)

Horizontal



Vertical



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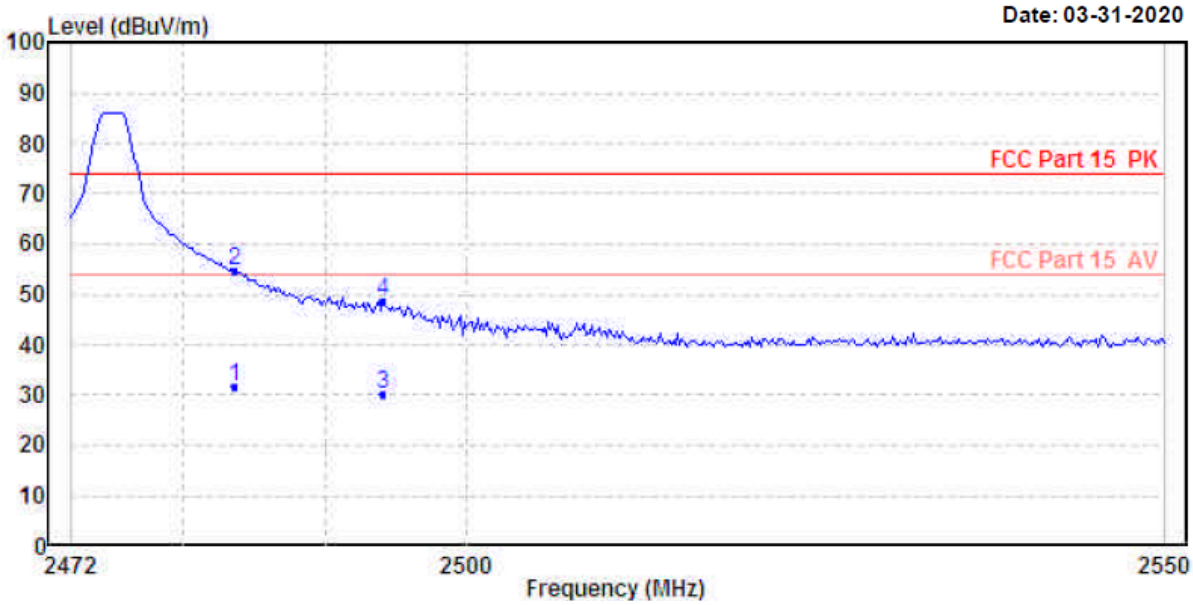
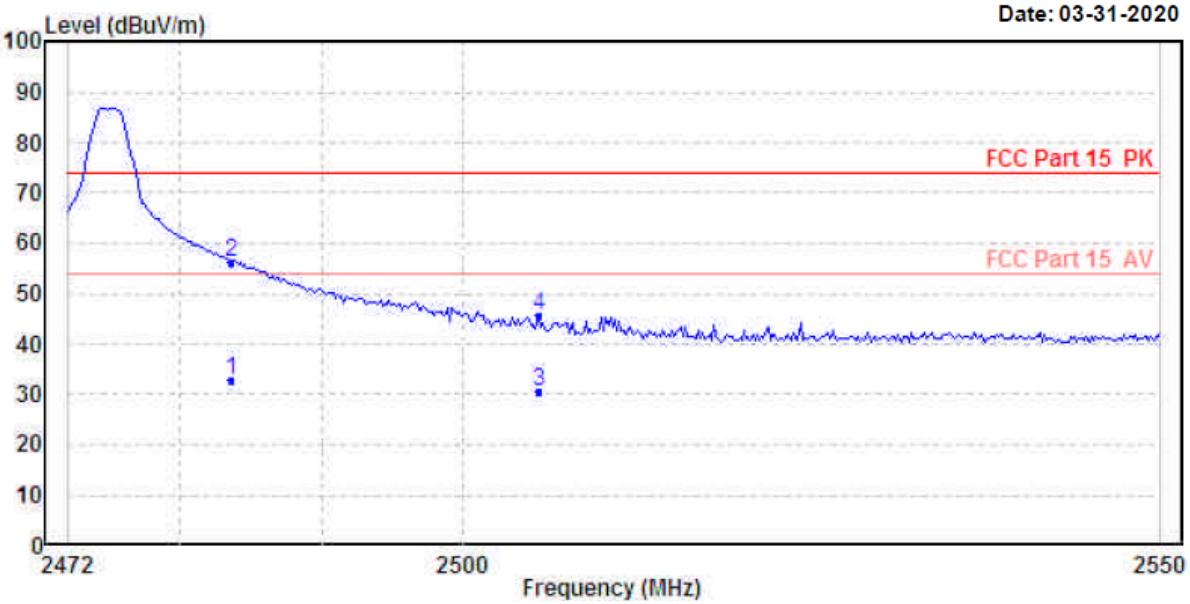
Emissions radiated outside of the specified frequency bands (Highest)

Horizontal



Vertical



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Limits for Radiated Emissions [FCC 47 CFR 15.209 Class B]:

Frequency Range [MHz]	Quasi-Peak Limits [μV/m]
0.009-0.490	2400/F (kHz)
0.490-1.705	24000/F (kHz)
1.705-30	30
30-88	100
88-216	150
216-960	200
Above960	500

The emission limits shown in the above table are based on measurement employing a CISPR quasi-peak detector and above 1000MHz are based on measurements employing an average detector.

Remarks:
Calculated measurement uncertainty (9kHz-30MHz): 2.0dB /(30MHz – 1GHz): 4.9dB
Emissions in the vertical and horizontal polarizations have been investigated and the worst-case test results are recorded in this report.

Results of TX mode (9kHz – 30MHz): PASS
Emissions detected are more than 20 dB below the FCC Limits, not reported.

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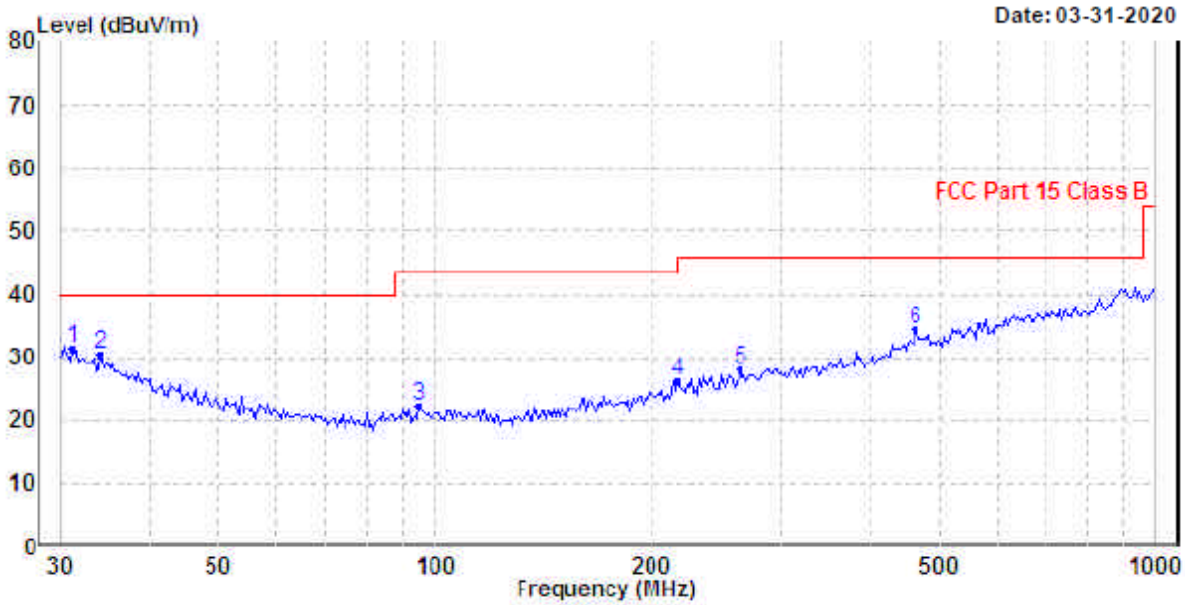
Results of TX mode (30MHz – 1GHz)(2404MHz worst case): PASS
Horizontal



Ambient Temperature: 25C
Relative Humidity : 50%

	Freq	Level	Limit Line	Over Limit	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB		
1	31.289	31.42	40.00	-8.58	Peak	Horizontal
2	34.276	30.41	40.00	-9.59	Peak	Horizontal
3	94.760	22.46	43.50	-21.04	Peak	Horizontal
4	216.783	26.37	46.00	-19.63	Peak	Horizontal
5	263.819	28.16	46.00	-17.84	Peak	Horizontal
6	462.346	34.47	46.00	-11.53	Peak	Horizontal

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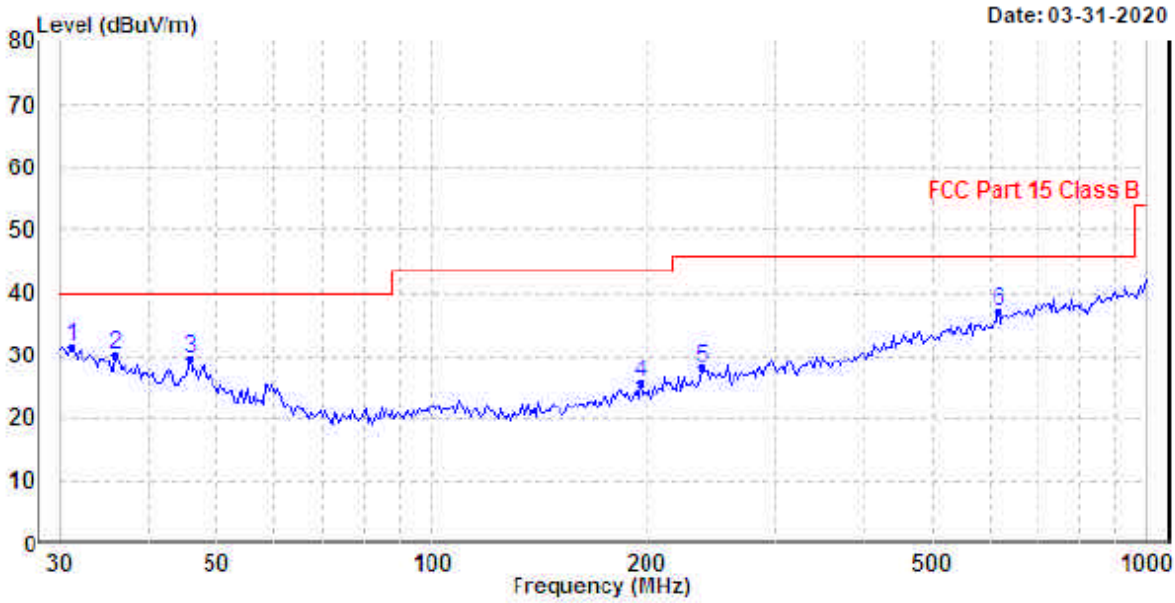
Results of TX mode (30MHz – 1GHz) (2404MHz worst case): PASS
Vertical



Ambient Temperature: 25C
Relative Humidity : 50%

	Freq	Level	Limit Line	Over Limit	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB		
1	31.289	31.52	40.00	-8.48	Peak	Vertical
2	36.001	30.21	40.00	-9.79	Peak	Vertical
3	45.695	29.66	40.00	-10.34	Peak	Vertical
4	195.137	25.67	43.50	-17.83	Peak	Vertical
5	239.147	28.16	46.00	-17.84	Peak	Vertical
6	620.710	37.12	46.00	-8.88	Peak	Vertical

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3.1.2 Antenna Requirement

Ambient temperature 25°C Relative humidity 57%

Test Requirements: § 15.203

Test Specification:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

Test Results:

This is PCB antenna. There is no external antenna, the antenna gain =0dBi. User is unable to remove or changed the Antenna.

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3.1.3 20dB Bandwidth of Fundamental Emission

Ambient temperature 25°C Relative humidity 57%

Test Requirement:	FCC 47 CFR 15.249
Test Method:	ANSI C63.10:2013
Test Date:	2020-03-31
Mode of Operation:	Tx mode

Test Method:

The bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency. Once the reference level is established, the equipment is conditioned with typical modulating signal to produce the worst-case (i.e. the widest) bandwidth.

Test Setup:

As Test Setup of clause 3.1.1 in this test report.

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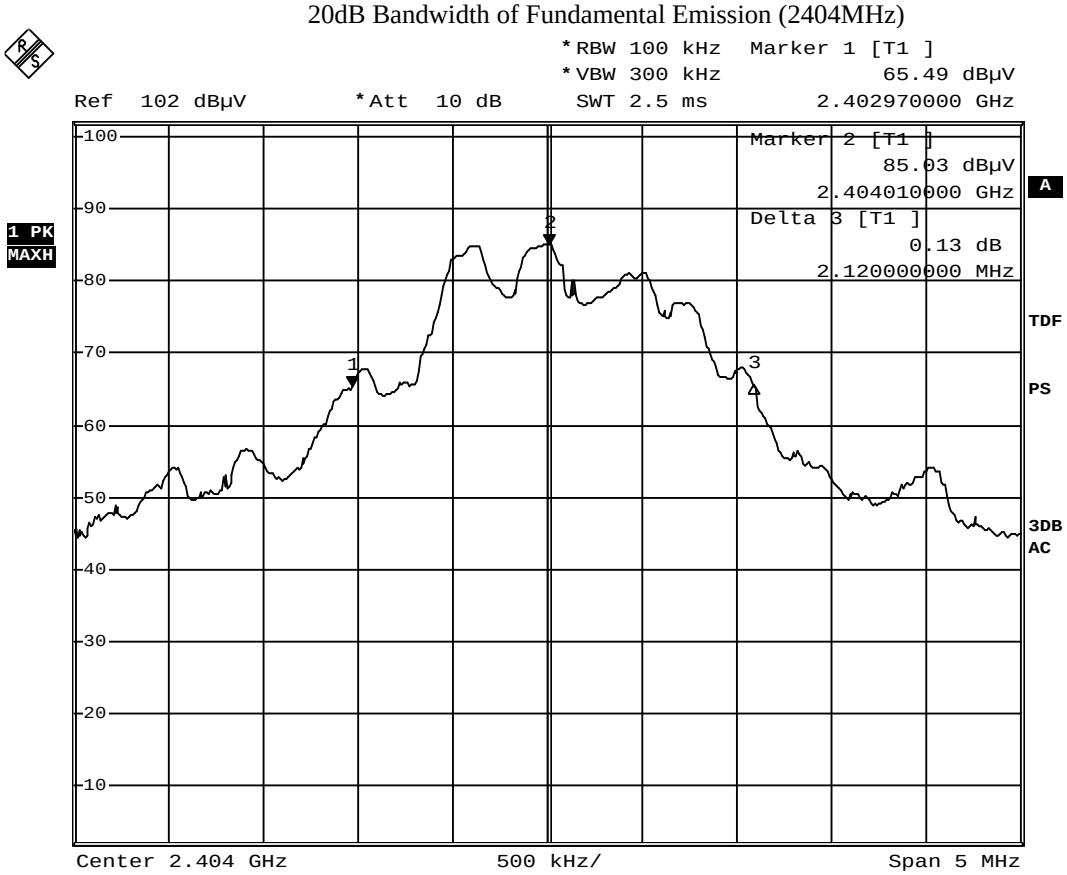
Limits for 20dB Bandwidth of Fundamental Emission (Low Frequency Channel):

Frequency Range [MHz]	20dB Bandwidth [MHz]
2404.0	2.120

20dB Bandwidth of Fundamental Emission (2404MHz)



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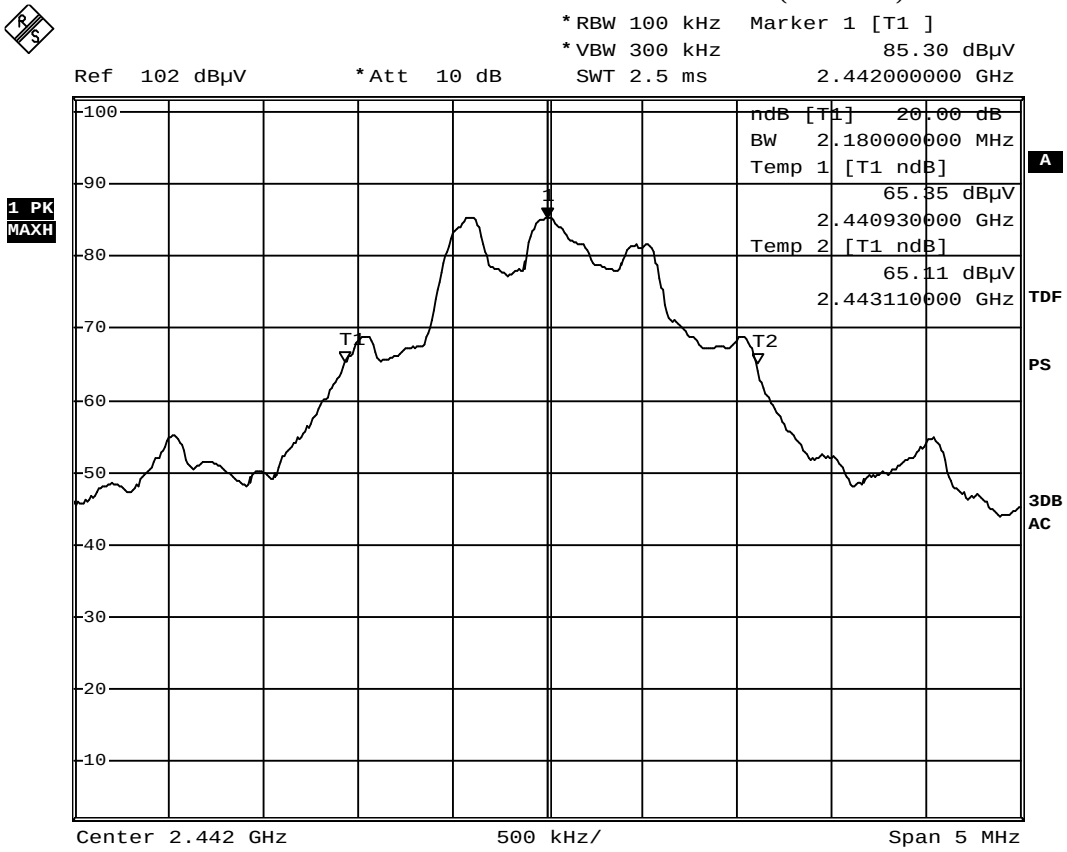
Limits for 20dB Bandwidth of Fundamental Emission (Middle Frequency Channel):

Frequency Range [MHz]	20dB Bandwidth [MHz]
2442.0	2.180

20dB Bandwidth of Fundamental Emission (2442MHz)



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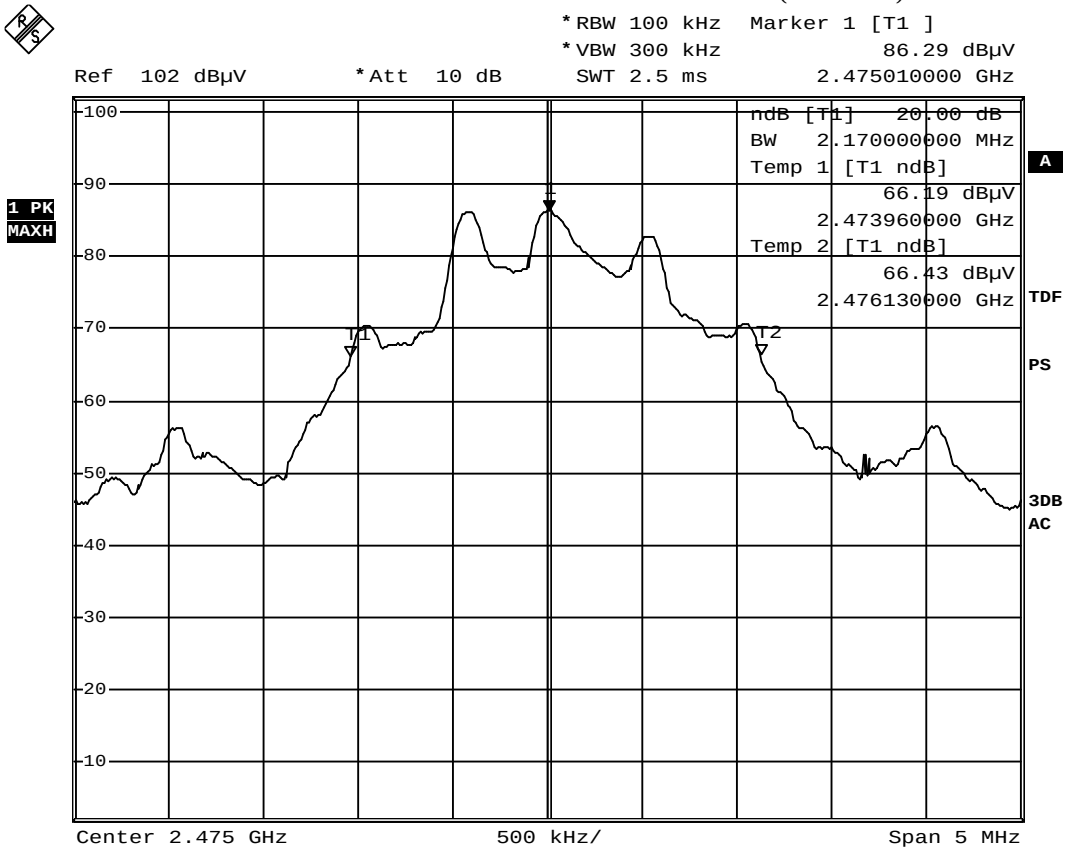
Limits for 20dB Bandwidth of Fundamental Emission (High Frequency Channel):

Frequency Range [MHz]	20dB Bandwidth [MHz]
2475.0	2.170

20dB Bandwidth of Fundamental Emission (2475MHz)



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Appendix A

List of Measurement Equipment

Radiated Emission

EQP NO.	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CAL	DUE CAL
EM215	MULTIDEVICE CONTROLLER	EMCO	2090	00024676	N/A	N/A
EM217	ELECTRIC POWERED TURNTABLE	EMCO	2088	00029144	N/A	N/A
EM218	ANECHOIC CHAMBER	ETS-LINDGREN	FACT-3	--	2018/04/20	2020/04/20
EM356	ANTENNA POSITIONING TOWER	ETS-LINDGREN	2171B	00150346	N/A	N/A
EM355	Biconilog Antenna	ETS-Lindgren	3143B	00094856	2018/05/24	2020/05/24
EM229	EMI TEST RECEIVER	R&S	ESIB40	100248	2018/06/01	2020/06/01
EM276	BROADBAND HORN ANTENNA	A-INFOMW	JXTXLB-10180-SF	J2031090903007	2018/04/27	2020/04/27
EM300	PYRAMIDAL STANDARD GAIN HORN ANTENNA	ETS-LINDGREN	3160-09	00130130	2018/05/13	2020/05/13
EM301	PYRAMIDAL STANDARD GAIN HORN ANTENNA	ETS-LINDGREN	3160-10	00130988	2018/05/13	2020/05/13
EM302	PRECISION OMNIDIRECTIONAL DIPOLE (1 – 6GHZ)	SEIBERSDORF LABORATORIES	POD 16	161806/L	2018/05/11	2020/05/11
EM303	PRECISION OMNIDIRECTIONAL DIPOLE (6 – 18GHZ)	SEIBERSDORF LABORATORIES	POD 618	6181908/L	2018/05/11	2020/05/11
EM353	LOOP ANTENNA	ETS_LINDGREN	6502	00206533	2018/04/16	2020/04/16
EM045	POWER METER	ROHDE & SCHWARZ	NRVD	843246/028	2018/06/01	2020/06/01

Remarks:-

N/A Not Applicable or Not Available

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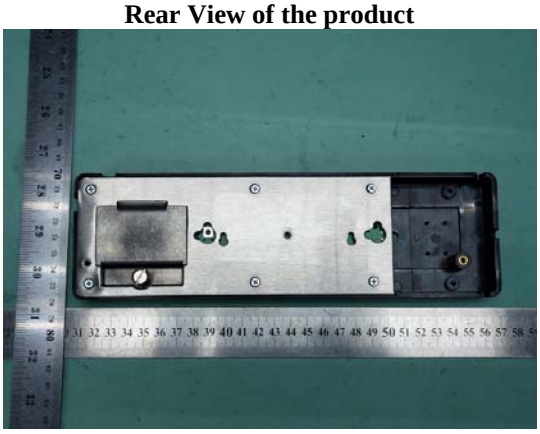
Appendix B

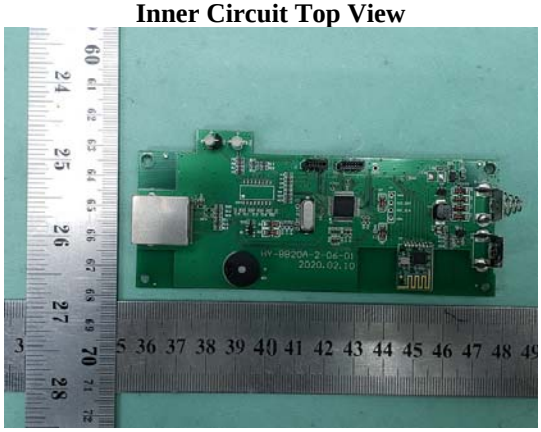
Photographs of EUT

Front View of the product

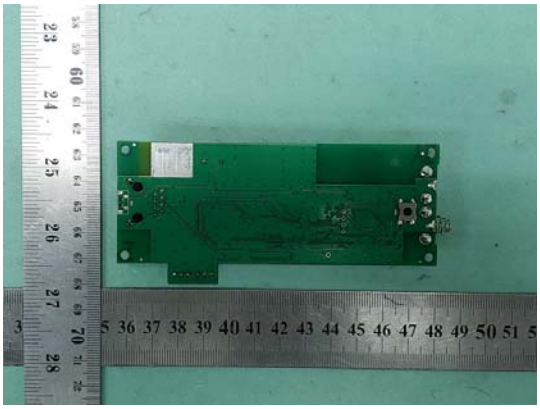
Rear View of the product



Inner Circuit Top View



Inner Circuit Bottom View



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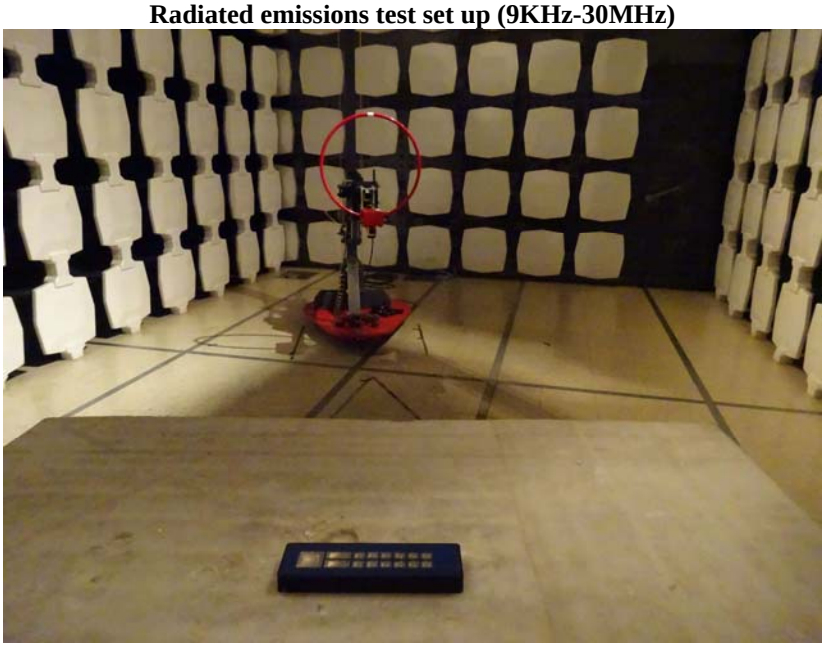
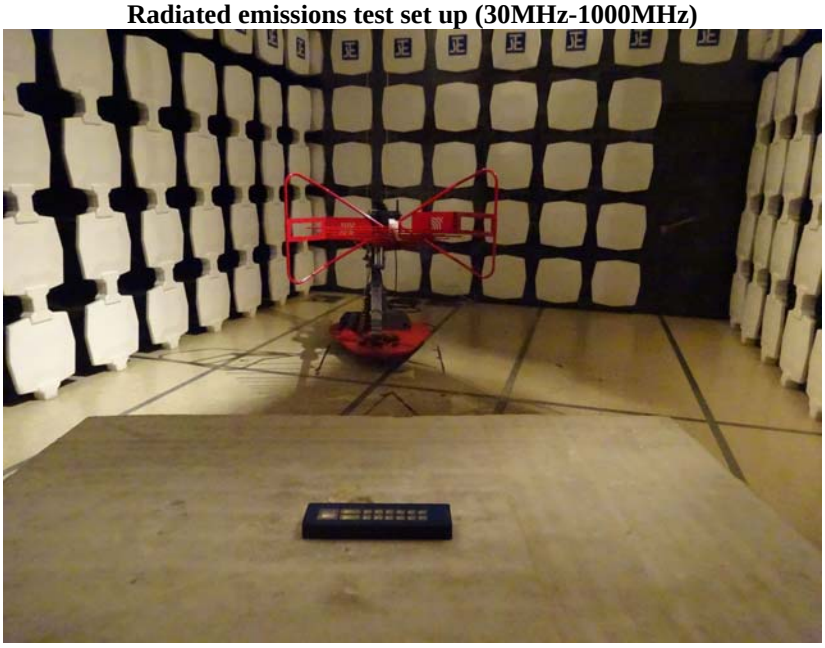
Photographs of EUT

Radiated emissions test set up (9KHz-30MHz)



Radiated emissions test set up (30MHz-1000MHz)



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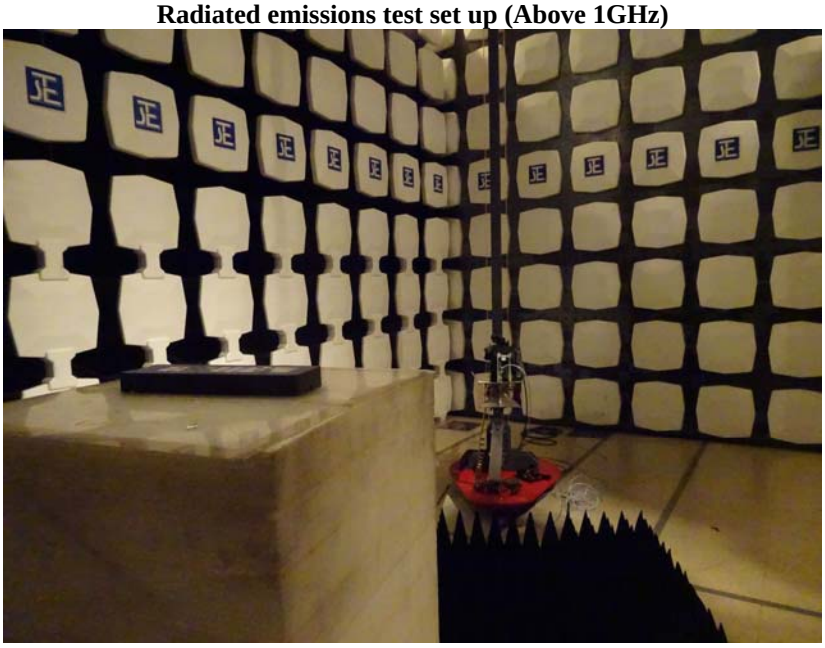
Photographs of EUT

Radiated emissions test set up (Above 1GHz)



******* End of Test Report *******

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2. Any report issued by the Company as a result of this application for testing service (the "Report") shall be issued in confidence to the Clients and the Report will be strictly treated as such by the Company. It may not be reproduced either in its entirety or in part and it may not be used for advertising or other unauthorized purposes without the written consent of the Company. The Clients to whom the Report is issued may, however, show or send it, or a certified copy thereof prepared by the Company to his customer, supplier or other persons directly concerned. Subject to clause 3, the Company will not, without the consent of the Clients, enter into any discussion or correspondence with any third party concerning the contents of the Report, unless required by the relevant governmental authorities, laws or court orders.

3. The Company shall be at liberty to disclose the testing-related documents and/or files anytime to any third-party accreditation and/or recognition bodies for audit or other related purposes. No liabilities whatsoever shall attach to the Company's act of disclosure.

4. The Company shall not be called or be liable to be called to give evidence or testimony on the Report in a court of law without its prior written consent, unless required by the relevant governmental authorities, laws or court orders.

5. The results in Report apply only to the sample as received and do not apply to the bulk, unless the sampling has been carried out by the Company and is stated as such in the Report.

6. When a statement of conformity to a specification or standard is provided, the ILAC-G8 Guidance document (and/or IEC Guide 115 in the electrotechnical sector) will be adopted as a decision rule for the determination of conformity unless it is inherent in the requested specification or standard, or otherwise specified in the Report.

7. In the event of the improper use the report as determined by the Company, the Company reserves the right to withdraw it, and to adopt any other additional remedies which may be appropriate.

8. Sample submitted for testing are accepted on the understanding that the Report issued cannot form the basis of, or be the instrument for, any legal action against the Company.

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11. Subject to the variable length of retention time for test data and report stored hereinto as to otherwise specifically required by individual accreditation authorities, the Company will only keep the supporting test data and information of this test report for a period of three years. The data and information will be disposed of after the aforementioned retention period has elapsed. Under no circumstances shall we provide any data and information which has been disposed of after the retention period. Under no circumstances shall we be liable for damages of any kind, including (but not limited to) compensatory damages, lost profits, lost data, or any form of special, incidental, indirect, consequential or punitive damages of any kind, whether based on breach of contract of warranty, tort (including negligence), product liability or otherwise, even if we are informed in advance of the possibility of such damages.

12. Issuance records of the Report are available on the internet at www.stc.group. Further enquiry of validity or verification of the Reports should be addressed to the Company.