

TEST REPORT



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Manufacturer or Supplier	Shenzhen Hopewin Electronic Material Co.,Ltd
Address	Room O-P,Floor 4,Block 9C,Baoneng Science Park,Qingxiang Road,QingHu Industrial Estate,Longhua Street ,Longhua District,Shenzhen
Product	Gateway
Brand Name	Cloudleaf
Model	GW-1.5-E
Additional Model & Model Difference	N/A
Date of tests	Nov. 12, 2019 ~ Dec. 08, 2019

the tests have been carried out according to the requirements of the following standard:

☒ **FCC Part 15, Subpart C, Section 15.247**

CONCLUSION: The submitted sample was found to COMPLY with the test requirement

Tested by Breeze Jiang Project Engineer / EMC Department	Approved by Glyn He Supervisor / EMC Department
	 Date: Nov. 16, 2019

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TABLE OF CONTENTS

RELEASE CONTROL RECORD	4
1 SUMMARY OF TEST RESULTS.....	5
2 MEASUREMENT UNCERTAINTY	5
3 GENERAL INFORMATION	6
3.1 GENERAL DESCRIPTION OF EUT	6
3.2 DESCRIPTION OF TEST MODES	7
3.2.1. CONFIGURATION OF SYSTEM UNDER TEST	7
3.2.2. TEST MODE APPLICABILITY AND TESTED CHANNEL DETAIL.....	7
3.3 GENERAL DESCRIPTION OF APPLIED STANDARDS	10
3.4 DESCRIPTION OF SUPPORT UNITS	10
4 TEST TYPES AND RESULTS.....	11
4.1 CONDUCTED EMISSION MEASUREMENT	11
4.1.1 LIMITS OF CONDUCTED EMISSION MEASUREMENT	11
4.1.2 TEST INSTRUMENTS.....	11
4.1.3 TEST PROCEDURES	12
4.1.4 DEVIATION FROM TEST STANDARD	12
4.1.5 TEST SETUP	12
4.1.6 EUT OPERATING CONDITIONS	13
4.1.7 TEST RESULTS	14
4.2 RADIATED EMISSION MEASUREMENT	16
4.2.1 LIMITS OF RADIATED EMISSION MEASUREMENT	16
4.2.2 TEST INSTRUMENTS.....	17
4.2.3 TEST PROCEDURES	18
4.2.4 DEVIATION FROM TEST STANDARD	19
4.2.5 TEST SETUP	19
4.2.6 EUT OPERATING CONDITIONS	20
4.2.7 TEST RESULTS	21
4.3 6DB BANDWIDTH MEASUREMENT	26
4.3.1 LIMITS OF 6DB BANDWIDTH MEASUREMENT	26
4.3.2 TEST INSTRUMENTS.....	26
4.3.3 TEST PROCEDURE.....	27
4.3.4 DEVIATION FROM TEST STANDARD	27
4.3.5 TEST SETUP	28
4.3.6 EUT OPERATING CONDITIONS	28
4.3.7 TEST RESULTS	29



**BUREAU
VERITAS**

Test Report No.: RF191119N028-FCC

4.4	CONDUCTED OUTPUT POWER	30
4.4.1	LIMITS OF CONDUCTED OUTPUT POWER MEASUREMENT	30
4.4.2	TEST SETUP	30
4.4.3	TEST INSTRUMENTS	30
4.4.4	TEST PROCEDURES	31
4.4.5	DEVIATION FROM TEST STANDARD	31
4.4.6	EUT OPERATING CONDITIONS	31
4.4.7	TEST RESULTS	32
4.4.7.1	MAXIMUM AVERAGE OUTPUT POWER	32
4.5	POWER SPECTRAL DENSITY MEASUREMENT	33
4.5.1	LIMITS OF POWER SPECTRAL DENSITY MEASUREMENT	33
4.5.2	TEST SETUP	33
4.5.3	TEST INSTRUMENTS	33
4.5.4	TEST PROCEDURE	33
4.5.5	DEVIATION FROM TEST STANDARD	33
4.5.6	EUT OPERATING CONDITION	33
4.5.7	TEST RESULTS	34
4.6	OUT OF BAND EMISSION MEASUREMENT	35
4.6.1	LIMITS OF OUT OF BAND EMISSION MEASUREMENT	35
4.6.2	TEST SETUP	35
4.6.3	TEST INSTRUMENTS	35
4.6.4	TEST PROCEDURE	35
4.6.5	DEVIATION FROM TEST STANDARD	36
4.6.6	EUT OPERATING CONDITION	36
4.6.7	TEST RESULTS	37
5	PHOTOGRAPHS OF THE TEST CONFIGURATION	39
6	APPENDIX A - MODIFICATIONS RECORDERS FOR ENGINEERING CHANGES TO THE EUT BY THE LAB	40



Test Report No.: RF191119N028-FCC

RELEASE CONTROL RECORD

ISSUE NO.	REASON FOR CHANGE	DATE ISSUED
RF191119N028-FCC	Original release	Nov. 16, 2019

1 SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC PART 15, SUBPART C (SECTION 15.247)			
STANDARD SECTION	TEST TYPE AND LIMIT	RESULT	REMARK
15.207	AC Power Conducted Emission	PASS	Meet the requirement of limit.
15.205 15.209	Radiated Emission	PASS	Meet the requirement of limit.
15.247(d)	Out of band Emission Measurement	PASS	Meet the requirement of limit.
15.247(a)(2)	6dB bandwidth	PASS	Meet the requirement of limit.
15.247(b)	Conducted Output power	PASS	Meet the requirement of limit.
15.247(e)	Power Spectral Density	PASS	Meet the requirement of limit.
15.203	Antenna Requirement	PASS	No antenna connector is used

2 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

MEASUREMENT	FREQUENCY	UNCERTAINTY
Conducted emissions	0.15MHz ~ 30MHz	2.66 dB
Radiated emissions	9KHz ~ 30MHz	2.90dB
	30MHz ~ 1GMHz	3.47 dB
	1GHz ~ 18GHz	4.84 dB
	18GHz ~ 40GHz	4.62 dB

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k = 2$.

3 GENERAL INFORMATION

3.1 GENERAL DESCRIPTION OF EUT

PRODUCT	Gateway
BRAND	Cloudleaf
MODEL NO.	GW-1.5-E
ADDITIONAL MODEL	N/A
FCC ID	2AM29-HBW06
NOMINAL VOLTAGE	DC 5V from adapter:AC100-240V~50/60Hz DC48V from PoE RJ45 port input
MODULATION TECHNOLOGY	DTS
MODULATION TYPE	BT-LE GFSK
OPERATING FREQUENCY	2402-2480MHz
AVERAGE OUTPUT POWER	0.582mW (Max. Measured)
ANTENNA TYPE	Dipole Antenna, 1.5dBi Gain
I/O PORTS	Refer to user's manual
CABLE SUPPLIED	USB Line: unshielded detachable 0.3m

NOTES:

1. For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.
2. For the test results, the EUT had been tested with all conditions. But only the worst case was shown in test report.
3. Please refer to the EUT photo document (Reference No.: 191119N028) for detailed product photo.
4. The adaptor information as below:

Model name:	M050200E111
Input:	AC100-240V~50/60Hz 0.35A
Output:	DC5V2A
Cable support:	DC Line: Shielding, 1.8m, no core.

3.2 DESCRIPTION OF TEST MODES

40 channels are provided for BT-LE(GFSK):

CHANNEL	FREQ. (MHZ)	CHANNEL	FREQ. (MHZ)	CHANNEL	FREQ. (MHZ)	CHANNEL	FREQ. (MHZ)
0	2402	10	2422	20	2442	30	2462
1	2404	11	2424	21	2444	31	2464
2	2406	12	2426	22	2446	32	2466
3	2408	13	2428	23	2448	33	2468
4	2410	14	2430	24	2450	34	2470
5	2412	15	2432	25	2452	35	2472
6	2414	16	2434	26	2454	36	2474
7	2416	17	2436	27	2456	37	2476
8	2418	18	2438	28	2458	38	2478
9	2420	19	2440	29	2460	39	2480

3.2.1. CONFIGURATION OF SYSTEM UNDER TEST

Please see section 5 photographs of the test configuration for reference.

3.2.2. TEST MODE APPLICABILITY AND TESTED CHANNEL DETAIL

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates, XYZ axis and antenna ports

The worst case was found when positioned on **X** axis for radiated emission. Following test modes were selected for the final test, and the final worst case is marked in boldface and recorded in the report:

TX Frequency	Azimuth/ axis	Antenna ports	Note
2402MHz	X	ANT1	Worst case mode in axis
2402MHz	Y	ANT1	-
2402MHz	Z	ANT1	-
2402MHz	X	ANT2	Worst case mode in axis and ANT por
2402MHz	X	ANT3	-
2402MHz	X	ANT4	-

EUT CONFIGURE MODE	APPLICABLE TO				DESCRIPTION
	RE<1G	RE≥1G	PLC	APCM	
A	√	√	X	√	DC 5V from adapter

Where

RE<1G: Radiated Emission below 1GHz

RE≥1G: Radiated Emission above 1GHz

PLC: Power Line Conducted Emission

APCM: Antenna Port Conducted Measurement

RADIATED EMISSION TEST (BELOW 1GHz):

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates, XYZ axis and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channels were selected for the final test as listed below.

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)
BT-LE	0 to 39	39	DTS	GFSK	1 Mbps

For the test results, only the worst case was shown in test report.

RADIATED EMISSION TEST (ABOVE 1GHz):

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates, XYZ axis and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channels were selected for the final test as listed below.

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)
BT-LE	0 to 39	0, 19, 39	DTS	GFSK	1 Mbps

ANTENNA PORT CONDUCTED MEASUREMENT:

- ☒ This item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.
- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channels were selected for the final test as listed below.

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)
BT-LE	0 to 39	0, 19, 39	DTS	GFSK	1 Mbps

TEST CONDITION:

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	TEST VOLTAGE	TESTED BY
RE<1G	22deg. C, 55%RH	DC 5V from adapter	Tank Tan
RE≥1G	22deg. C, 55%RH	DC 5V from adapter	Tank Tan
PLC	22deg. C, 55%RH	DC 5V from adapter	Rex Yang
APCM	22deg. C, 55%RH	DC 5V from adapter	Rex Yang

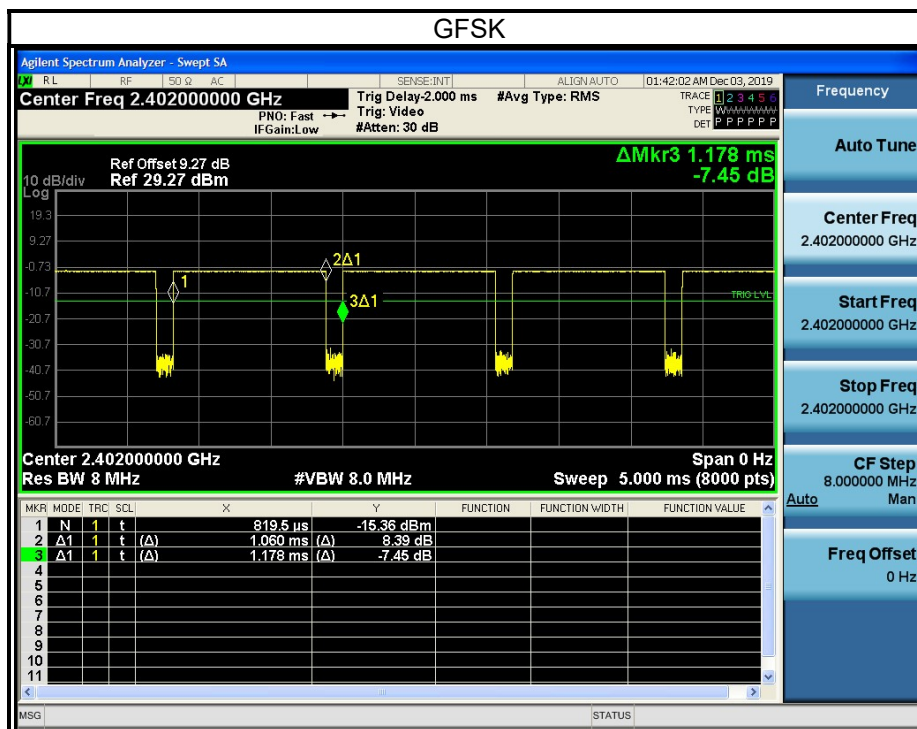
DUTYCYCLE OF TEST SIGNAL

GFSK:

Duty cycle of test signal is 89.998 %, Duty cycle of test signal is <98%

Duty cycle = $1.060 / 0.1780 = 89.998 \%$,

Duty factor = $10 \cdot \log(1/0.89998) = 0.458\text{dB}$



3.3 GENERAL DESCRIPTION OF APPLIED STANDARDS

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

FCC Part 15, Subpart C, Section 15.247

558074 D01 15.247 Meas Guidance v05r02

ANSI C63.10-2013

Note: All test items have been performed and recorded as per the above standards.

3.4 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested as an dependent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

NO.	PRODUCT	BRAND	MODEL NO.	SERIAL NO.	FCC ID
1	Notebook	LENOVO	Thinkpad	KKA9196S	N/A

NO.	DESCRIPTION OF THE ABOVE SUPPORT UNITS
1	N/A

4 TEST TYPES AND RESULTS

4.1 CONDUCTED EMISSION MEASUREMENT

4.1.1 LIMITS OF CONDUCTED EMISSION MEASUREMENT

FREQUENCY OF EMISSION (MHz)	CONDUCTED LIMIT (dBμV)	
	Quasi-peak	Average
0.15 ~ 0.5	66 to 56	56 to 46
0.5 ~ 5	56	46
5 ~ 30	60	50

- NOTES:** 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.
3. All emanations from a class A/B digital device or system, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified above.

4.1.2 TEST INSTRUMENTS

Description & Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration
EMI Test Receiver Rohde&Schwarz	ESCI3	101418	2019-09-18	2020-09-17
Artificial Mains Network Rohde&Schwarz	ENV216	3560.6550.15	2019-10-18	2020-10-17
Test software FARAD	EZ EMC V1.1.4.2	N/A	N/A	N/A
Hygrothermograph Yuhuaize	HTC-1	NA	2019-10-18	2020-10-17
Digital Multimeter FLUKE	15B+	43512617WS	2019-10-18	2020-10-17

- Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to CEPREI/CHINA.
2. The test was performed in Hwa-Hsing(Dongguan) Testing Co., Ltd.

4.1.3 TEST PROCEDURES

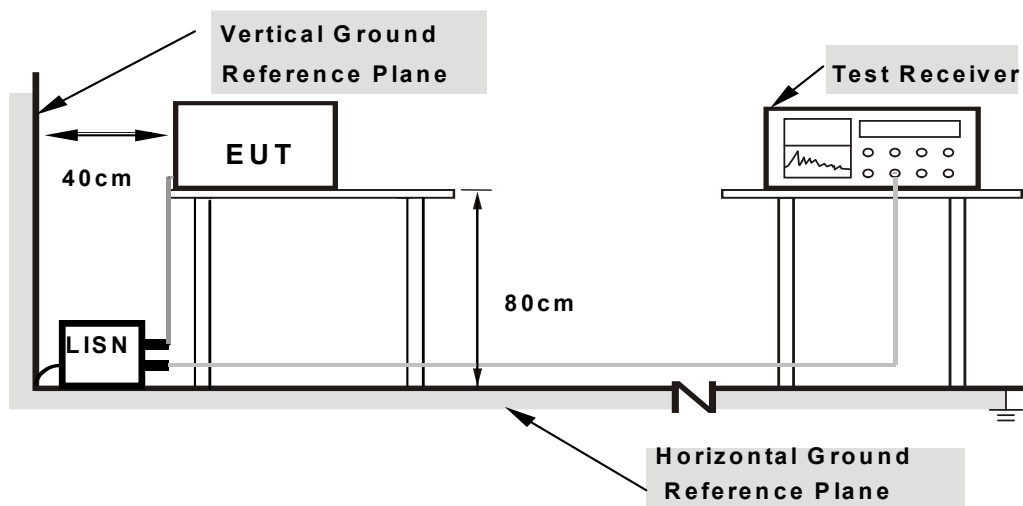
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance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

NOTE: All modes of operation were investigated and the worst-case emissions are reported.

4.1.4 DEVIATION FROM TEST STANDARD

No deviation.

4.1.5 TEST SETUP



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

2.Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes

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



Test Report No.: RF191119N028-FCC

4.1.6 EUT OPERATING CONDITIONS

- a. Turned on the power and connected of all equipment.
- b. EUT was operated according to the type used was description in manufacturer's specifications or the User's Manual.

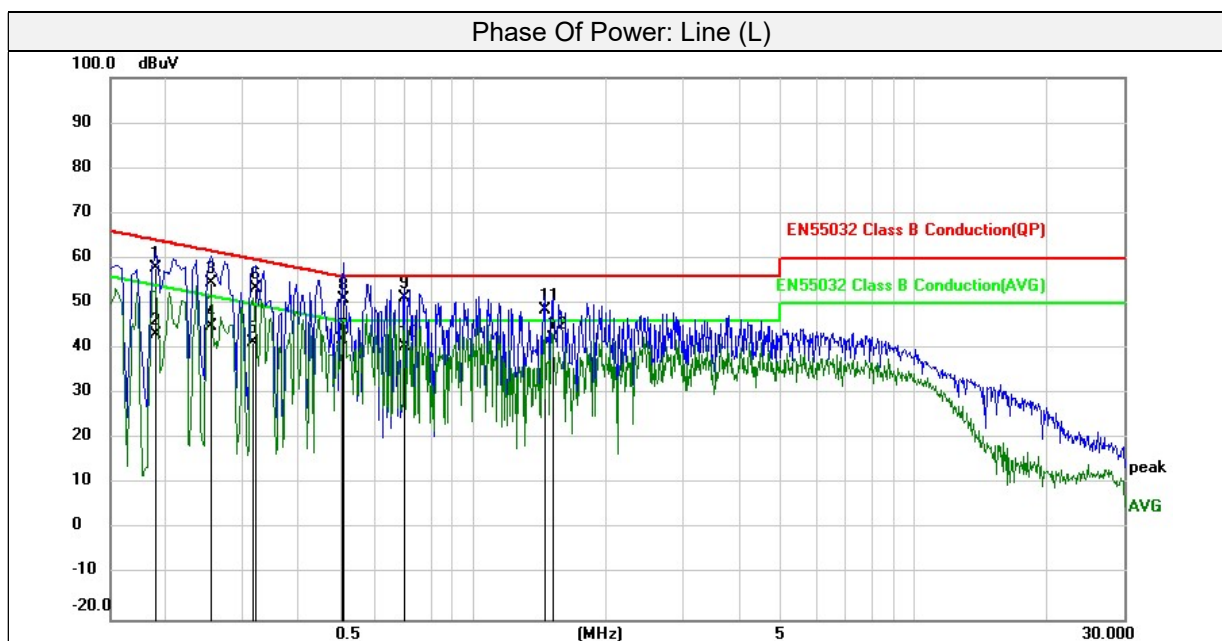


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Test Report No.: RF191119N028-FCC

4.1.7 TEST RESULTS

Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
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No	Frequency (MHz)	Reading (dBuV)	Correct Factor	Emission Level	Limit	Margin	Remark
			dB	(dBuV)	(dBuV)	(dB)	Detector
1	0.1905	48.14	9.69	57.83	64.01	-6.18	QP
2	0.1905	33.34	9.69	43.03	54.01	-10.98	AVG
3	0.2535	44.78	9.70	54.48	61.64	-7.16	QP
4	0.2535	35.21	9.70	44.91	51.64	-6.73	AVG
5	0.3209	43.62	9.71	53.33	59.68	-6.35	QP
6	0.3165	31.67	9.71	41.38	49.80	-8.42	AVG
7	0.5100	41.19	9.72	50.91	56.00	-5.09	QP
8	0.5055	32.31	9.72	42.03	46.00	-3.97	AVG
9	0.6990	41.53	9.69	51.22	56.00	-4.78	QP
10	0.6990	30.67	9.69	40.36	46.00	-5.64	AVG
11	1.4550	38.81	9.64	48.45	56.00	-7.55	QP
12	1.5045	32.72	9.65	42.37	46.00	-3.63	AVG

REMARKS:

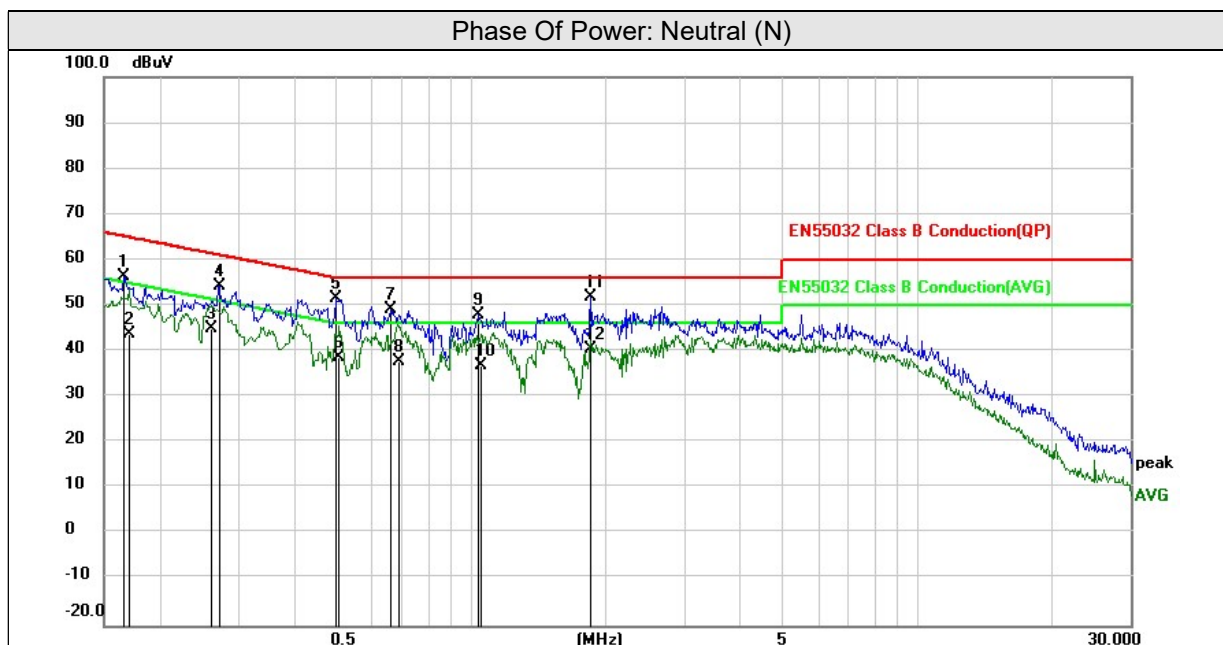
1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level - Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.

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Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
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No	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB)	Emission Level (dBuV)	Limit (dBuV)	Margin (dB)	Remark
1	0.1659	46.62	9.70	56.32	65.16	-8.84	QP
2	0.1703	33.92	9.70	43.62	54.95	-11.33	AVG
3	0.2714	44.50	9.70	54.20	61.07	-6.87	QP
4	0.2625	35.30	9.70	45.00	51.35	-6.35	AVG
5	0.4967	41.75	9.72	51.47	56.06	-4.59	QP
6	0.5055	28.94	9.72	38.66	46.00	-7.34	AVG
7	0.6585	39.44	9.70	49.14	56.00	-6.86	QP
8	0.6855	28.09	9.69	37.78	46.00	-8.22	AVG
9	1.0365	38.30	9.63	47.93	56.00	-8.07	QP
10	1.0500	27.17	9.63	36.80	46.00	-9.20	AVG
11	1.8510	42.25	9.66	51.91	56.00	-4.09	QP
12	1.8510	30.69	9.66	40.35	46.00	-5.65	AVG

REMARKS:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level - Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.

4.2 RADIATED EMISSION MEASUREMENT

4.2.1 LIMITS OF RADIATED EMISSION MEASUREMENT

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).

FREQUENCIES (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

NOTES:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. As shown in 15.35(b), 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.

4.2.2 TEST INSTRUMENTS

Description & Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration
EMI Test Receiver Rohde&Schwarz	ESCI 7	100962	2019-7-16	2020-7-15
Broadband antenna Schwarzbeck	VULB 9168	00937	2019-10-18	2020-10-17
3m Semi-anechoic Chamber MAORUI	9m*6m*6m	NSEMC003	2018-10-20	2020-10-19
Signal Amplifier Com-power	PAM-103	18020051	2019-10-18	2020-10-17
Attenuator Rohde&Schwarz	TS2GA-6dB	18101101	N/A	N/A
Test software FARAD	FARAD	EZ_EMCV1.1.4.2	N/A	N/A
Fixed Attenuator Mini-Circuits	MDCS18N-10	MDCS18N-10-01	2019-10-18	2020-10-17
Loop Antenna	HLA 6121	45745	2019-10-18	2020-10-17
Preamplifier EMCI	EMC001340	980201	2019-10-18	2020-10-17
Digital Multimeter FLUKE	15B+	43512617WS	2019-10-18	2020-10-17
Horn Antenna Schwarzbeck	BBHA 9170	01959	2019-10-18	2020-10-17
Spectrum Analyzer Rohde&Schwarz	FSV-40N	101783	2019-10-18	2020-10-17
Broadband Coaxial Preamplifier Schwarzbeck	BBV 9718	00025	2019-10-18	2020-10-17
Horn Antenna Schwarzbeck	BBHA 9170	BBHA9170242	2019-05-05	2020-05-04
Pre-Amplifier EMCI	EMC 184045	980102	2019-10-18	2020-10-17
Spectrum Keysight	N9020A	MY51240612	2019-10-18	2020-10-17
Antenna Tower MF	MFA-440H	NA	NA	NA
Turn Table MF	MFT-201SS	NA	NA	NA
Antenna Tower&Turn Table Controller MF	MF-7802	NA	NA	NA

Note: 3. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to CEPREI/CHINA.

4. The test was performed in Hwa-Hsing (Dongguan) Testing Co., Ltd.

4.2.3 TEST PROCEDURES

- a. The EUT was placed on the top of a rotating table 1.5 meters (above 1GHz) and 0.8 meters (below 1GHz) above the ground at a 3 meters semi-anechoic chamber. 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 antenna is a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- 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 Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- f. For below 30MHz, a loop antenna with its vertical plane is place 3m from the EUT and rotated about its vertical axis for maximum response at each azimuth about the EUT. And the centre of the loop shall be 1m above the ground.
- g. 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, For battery operated equipment, the equipment tests shall be perform using fresh batteries. The turntable was rotated to maximize the emission level.

NOTES:

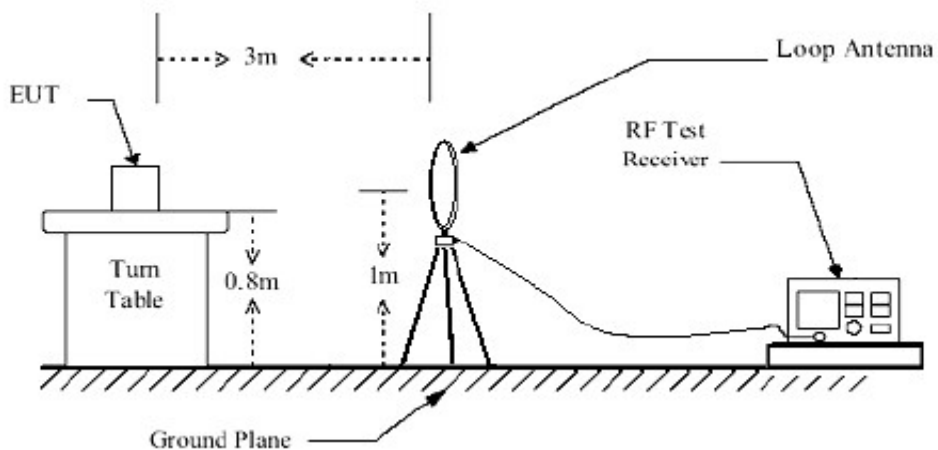
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and video bandwidth is 3MHz for Peak detection at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is $\geq 1/T$ (Duty cycle < 98%) or 10Hz(Duty cycle > 98%) for Average detection (AV) at frequency above 1GHz.
4. All modes of operation were investigated and the worst-case emissions are reported.
5. The testing of the EUT was performed on all 3 orthogonal axes; the worst-case test configuration was reported on the file test setup photo.

4.2.4 DEVIATION FROM TEST STANDARD

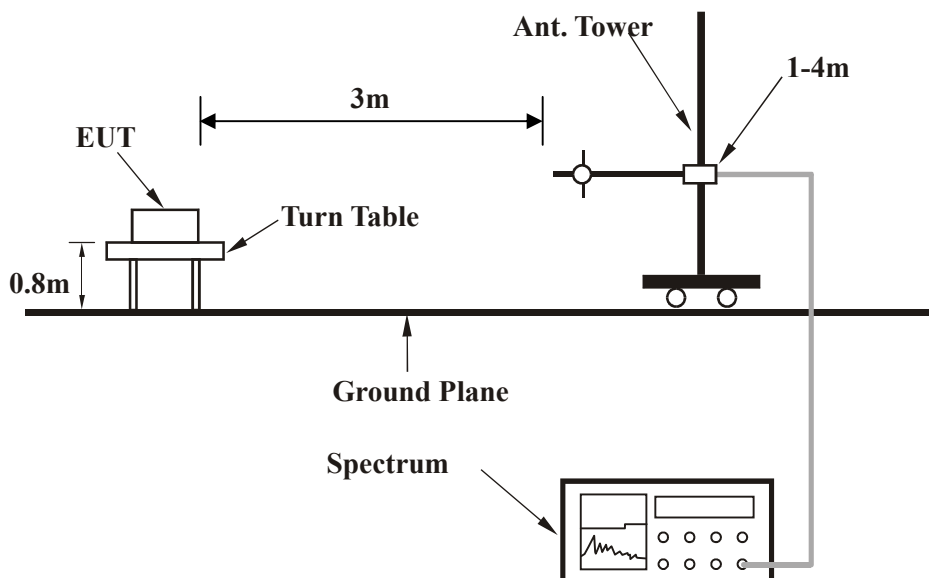
No deviation.

4.2.5 TEST SETUP

Below 30MHz test setup

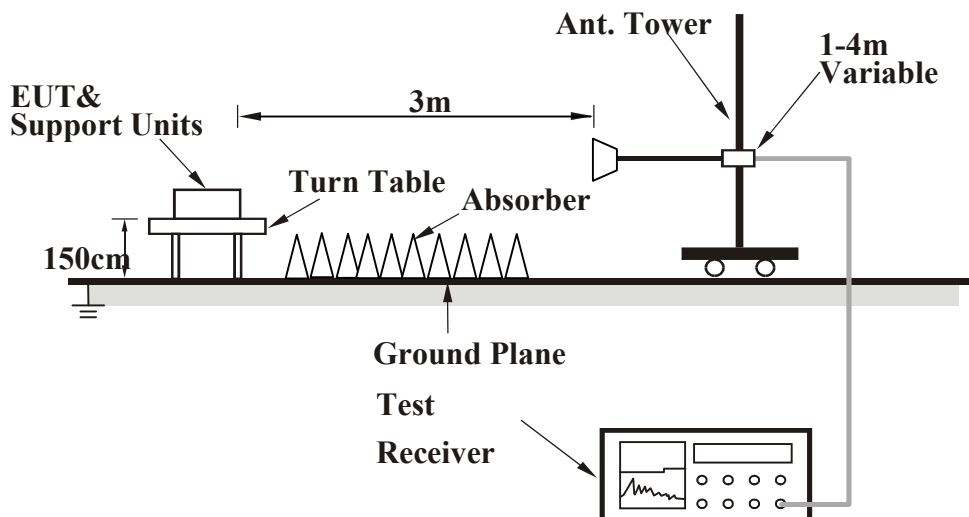


Below 1GHz test setup



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

Above 1GHz test setup



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

4.2.6 EUT OPERATING CONDITIONS

- Set the EUT under full load condition and placed them on a testing table.
- Set the transmitter part of EUT under transmission condition continuously at specific channel frequency.
- The necessary accessories enable the EUT in full functions.



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Test Report No.: RF191119N028-FCC

4.2.7 TEST RESULTS

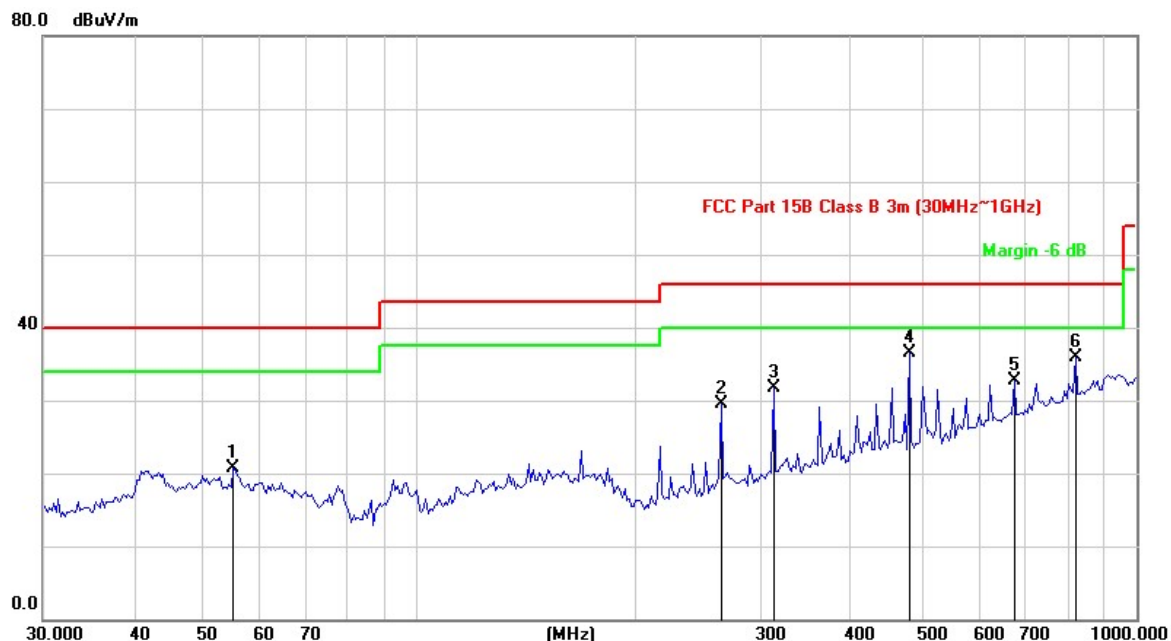
BELOW 1GHz DATA:

CHANNEL	TX Channel 39	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	9KHz ~ 1GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M									
NO.	FREQ. (MHz)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	Det.	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)
1	55.2207	34.97	-14.35	20.62	40.00	-19.38	QP	175	162
2	263.8190	43.40	-13.90	29.50	46.00	-16.50	QP	200	288
3	312.1794	44.29	-12.60	31.69	46.00	-14.31	QP	163	214
4	482.2156	44.71	-8.21	36.50	46.00	-9.50	QP	187	156
5	675.2080	36.20	-3.51	32.69	46.00	-13.31	QP	152	234
6	821.7103	36.12	-0.29	35.83	46.00	-10.17	QP	200	101

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m).
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
3. The emission levels of other frequencies were less than 20dB margin against the limit.
4. Margin value = Emission level – Limit value.

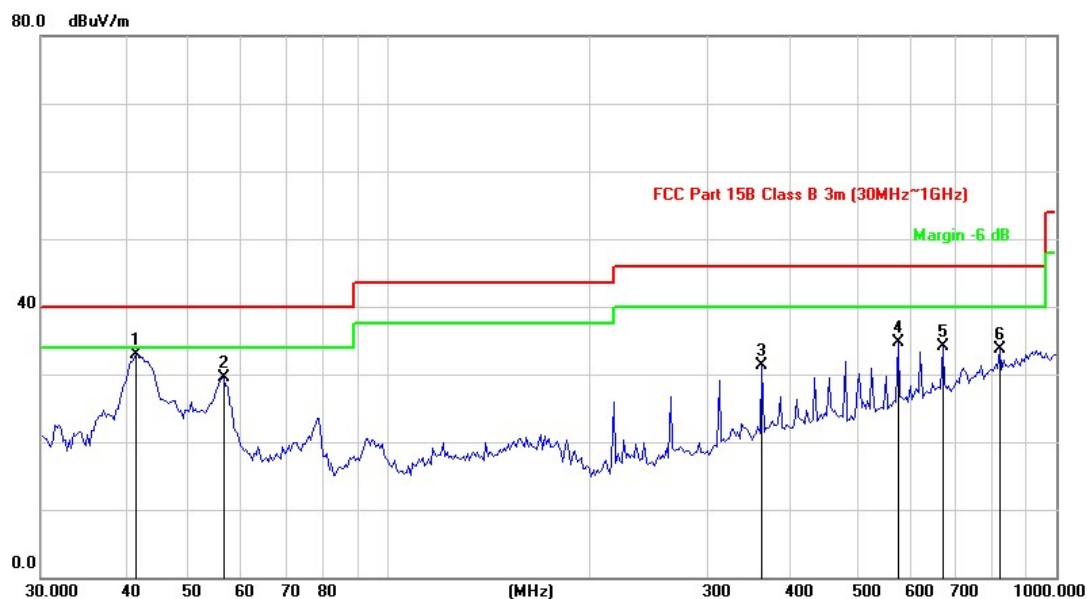


CHANNEL	TX Channel 39	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	9KHz ~ 1GHz		

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M									
NO.	FREQ. (MHz)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	Det.	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)
1	41.7129	47.99	-15.07	32.92	40.00	-7.08	QP	100	251
2	56.3948	43.84	-14.34	29.50	40.00	-10.50	QP	110	274
3	361.7139	42.05	-10.71	31.34	46.00	-14.66	QP	100	169
4	578.6699	40.32	-5.66	34.66	46.00	-11.34	QP	105	147
5	675.2080	37.67	-3.51	34.16	46.00	-11.84	QP	102	101
6	821.7103	34.02	-0.29	33.73	46.00	-12.27	QP	124	248

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m).
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
3. The emission levels of other frequencies were less than 20dB margin against the limit.
4. Margin value = Emission level – Limit value.



ABOVE 1GHz TEST DATA:

CHANNEL	TX Channel 0	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz		Average (AV)

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M									
NO.	FREQ. (MHz)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	Det.	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)
1	2390.000	49.33	-0.77	48.56	74.00	-25.44	peak	132	196
2	2390.000	27.47	-0.77	26.70	54.00	-27.30	AVG	132	196
3*	2402.000	93.85	-0.75	93.10			peak	132	196
4*	2402.000	86.59	-0.75	85.84			AVG	132	196
5	4804.000	50.70	5.36	56.06	74.00	-17.94	peak	100	170
6	4804.000	33.91	5.36	39.27	54.00	-14.73	AVG	100	170
7	7206.000	38.87	11.75	50.62	74.00	-23.38	peak	100	174
8	7206.000	26.78	11.75	38.53	54.00	-15.47	AVG	100	174
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M									
NO.	FREQ. (MHz)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	Det.	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)
1	2390.000	46.92	-0.77	46.15	74.00	-27.85	peak	290	252
2	2390.000	26.76	-0.77	25.99	54.00	-28.01	AVG	290	252
3*	2402.000	90.35	-0.75	89.60			peak	290	252
4*	2402.000	83.40	-0.75	82.65			AVG	290	252
5	4804.000	46.18	5.36	51.54	74.00	-22.46	peak	106	256
6	4804.000	39.57	5.36	44.93	54.00	-9.07	AVG	106	256
7	7206.000	38.69	11.75	50.44	74.00	-23.56	peak	113	241
8	7206.000	26.76	11.75	38.51	54.00	-15.49	AVG	113	241

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m).
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
3. The emission levels of other frequencies were less than 20dB margin against the limit.
4. Margin value = Emission level – Limit value.
5. " * ": Fundamental frequency.

CHANNEL	TX Channel 19	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz		Average (AV)

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M									
NO.	FREQ. (MHz)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	Det.	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)
1*	2440.000	95.10	-0.64	94.46			peak	100	198
2*	2440.000	87.70	-0.64	87.06			AVG	100	198
3	4880.000	49.16	6.24	55.40	74.00	-18.60	peak	100	183
4	4880.000	41.63	6.24	47.87	54.00	-6.13	AVG	100	183
5	7320.000	39.80	12.13	51.93	74.00	-22.07	peak	132	148
6	7320.000	27.39	12.13	39.52	54.00	-14.48	AVG	132	148
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M									
NO.	FREQ. (MHz)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	Det.	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)
1*	2440.000	90.30	-0.64	89.66			peak	147	241
2*	2440.000	83.09	-0.64	82.45			AVG	147	241
3	4880.000	45.42	6.24	51.66	74.00	-22.34	peak	102	232
4	4880.000	37.57	6.24	43.81	54.00	-10.19	AVG	102	232
5	7320.000	39.50	12.13	51.63	74.00	-22.37	peak	100	185
6	7320.000	27.35	12.13	39.48	54.00	-14.52	AVG	100	185

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m).
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
3. The emission levels of other frequencies were less than 20dB margin against the limit.
4. Margin value = Emission level – Limit value.
5. " * ": Fundamental frequency.

CHANNEL	TX Channel 39	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz		Average (AV)

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M									
NO.	FREQ. (MHz)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	Det.	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)
1*	2480.000	95.09	-0.52	94.57			peak	143	198
2*	2480.000	88.33	-0.52	87.81			AVG	143	198
3	2483.500	45.41	-0.51	44.90	74.00	-29.10	peak	143	198
4	2483.500	35.45	-0.51	34.94	54.00	-19.06	AVG	143	198
5	4960.000	47.71	6.09	53.80	74.00	-20.20	peak	100	172
6	4960.000	37.13	6.09	43.22	54.00	-10.78	AVG	100	172
7	7440.000	39.36	12.53	51.89	74.00	-22.11	peak	100	181
8	7440.000	26.76	12.53	39.29	54.00	-14.71	AVG	100	181
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M									
NO.	FREQ. (MHz)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	Det.	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)
1*	2480.000	90.04	-0.52	89.52			peak	149	263
2*	2480.000	84.03	-0.52	83.51			AVG	149	263
3	2483.500	49.02	-0.51	48.51	74.00	-25.49	peak	149	263
4	2483.500	31.56	-0.51	31.05	54.00	-22.95	AVG	149	263
5	4960.000	45.44	6.09	51.53	74.00	-22.47	peak	102	245
6	4960.000	38.25	6.09	44.34	54.00	-9.66	AVG	102	245
7	7440.000	39.51	12.53	52.04	74.00	-21.96	peak	127	218
8	7440.000	26.79	12.53	39.32	54.00	-14.68	AVG	127	218

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m).
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
3. The emission levels of other frequencies were less than 20dB margin against the limit.
4. Margin value = Emission level – Limit value.
5. " * ": Fundamental frequency.

4.3 6DB BANDWIDTH MEASUREMENT

4.3.1 LIMITS OF 6dB BANDWIDTH MEASUREMENT

The minimum of 6dB Bandwidth Measurement is 0.5MHz.

4.3.2 TEST INSTRUMENTS

Description & Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration
Spectrum Keysight	N9020A	MY51240612	2018/10/29	2019/10/28
Spectrum Analyzer Rohde&Schwarz	FSV-40N	101783	2018/12/11	2019/12/10
Power Meter10Hz~18GHz Tonscend	JS0806-2	188060126	2018-11-10	2019-11-09
Signal generator Keysight	N5182A	GB40051020	2018/10/29	2019/10/28
Signal generator Keysight	N5182A	MY47420944	2018/10/29	2019/10/28
Test Software Tonscend	JS0806-2	NA	NA	NA
Hygrothermograph Yuhuaze	HTC-1	NA	2018/10/30	2019/10/29

NOTES:

1. The test was performed in RF Oven room in Hwa-Hsing(Dongguan) Testing Co., Ltd..
2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to CEPREI/CHINA, GRGT/CHINA and NIM/CHINA.

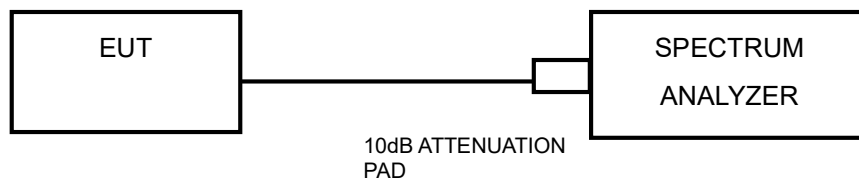
4.3.3 TEST PROCEDURE

- 1) Set RBW = 100 kHz.
- 2).Set the video bandwidth (VBW) ≥ 3 RBW.
- 3). Detector = Peak.
- 4).Trace mode = max hold.
- 5).Sweep = auto couple.
- 6).Allow the trace to stabilize.
- 7).Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

4.3.4 DEVIATION FROM TEST STANDARD

No deviation.

4.3.5 TEST SETUP



4.3.6 EUT OPERATING CONDITIONS

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.3.7 TEST RESULTS

BT-LE (GFSK) (1 Mbps)

CHANNEL	CHANNEL FREQUENCY (MHz)	6dB BANDWIDTH (MHz)	MINIMUM LIMIT (MHz)	PASS / FAIL
0	2402	0.912	0.5	PASS
19	2440	0.864	0.5	PASS
39	2480	0.824	0.5	PASS

WORSE PLOT

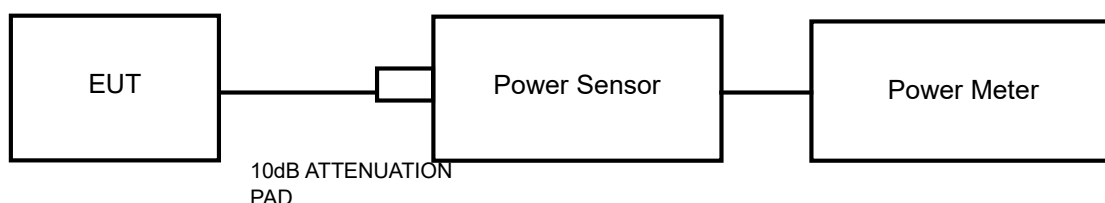


4.4 CONDUCTED OUTPUT POWER

4.4.1 LIMITS OF CONDUCTED OUTPUT POWER MEASUREMENT

For systems using digital modulation in the 2400–2483.5 MHz band: 1 Watt (30dBm)

4.4.2 TEST SETUP



4.4.3 TEST INSTRUMENTS

Description & Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration
Spectrum Keysight	N9020A	MY51240612	2019/10/18	2020/10/17
Spectrum Analyzer Rohde&Schwarz	FSV-40N	101783	2019/10/18	2020/10/17
Power Meter 10Hz~18GHz Tonscend	JS0806-2	188060126	2019/10/18	2020/10/17
Signal generator Keysight	N5182A	GB40051020	2019/10/18	2020/10/17
Signal generator Keysight	N5182A	MY47420944	2019/10/18	2020/10/17
Test Software Tonscend	JS0806-2	NA	NA	NA
Hygrothermograph Yuhuaze	HTC-1	NA	2019/10/18	2020/10/17

NOTES:

1. The test was performed in RF Oven room in Hwa-Hsing(Dongguan) Testing Co., Ltd..
2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to CEPREI/CHINA, GRGT/CHINA and NIM/CHINA.



Test Report No.: RF191119N028-FCC

4.4.4 TEST PROCEDURES

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

4.4.5 DEVIATION FROM TEST STANDARD

No deviation.

4.4.6 EUT OPERATING CONDITIONS

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.4.7 TEST RESULTS

4.4.7.1 MAXIMUM AVERAGE OUTPUT POWER

BT-LE (GFSK) (1 Mbps)

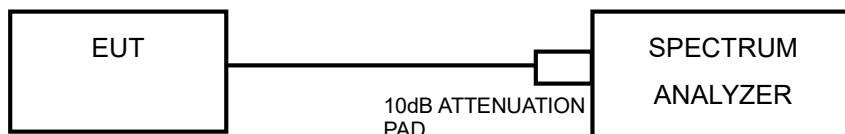
CHANNEL	CHANNEL FREQUENCY (MHz)	AVG POWER (dBm)	AVG POWER (mW)	AVG POWER LIMIT (W)	PASS/FAIL
0	2402	-2.35	0.582	1	PASS
19	2440	-2.62	0.547	1	PASS
39	2480	-2.45	0.569	1	PASS

4.5 POWER SPECTRAL DENSITY MEASUREMENT

4.5.1 LIMITS OF POWER SPECTRAL DENSITY MEASUREMENT

The Maximum of Power Spectral Density Measurement is 8dBm/3KHz.

4.5.2 TEST SETUP



4.5.3 TEST INSTRUMENTS

Refer to section 4.4.3 to get information of above instrument.

4.5.4 TEST PROCEDURE

1. Set the span to 1.5 times the DTS bandwidth
2. Set the RBW = 3 kHz, VBW $\geq 3 \times$ RBW, Detector = peak.
3. Sweep time = auto couple, Trace mode = max hold, allow trace to fully stabilize.
4. Use the peak marker function to determine the maximum amplitude level.

4.5.5 DEVIATION FROM TEST STANDARD

No deviation.

4.5.6 EUT OPERATING CONDITION

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.5.7 TEST RESULTS

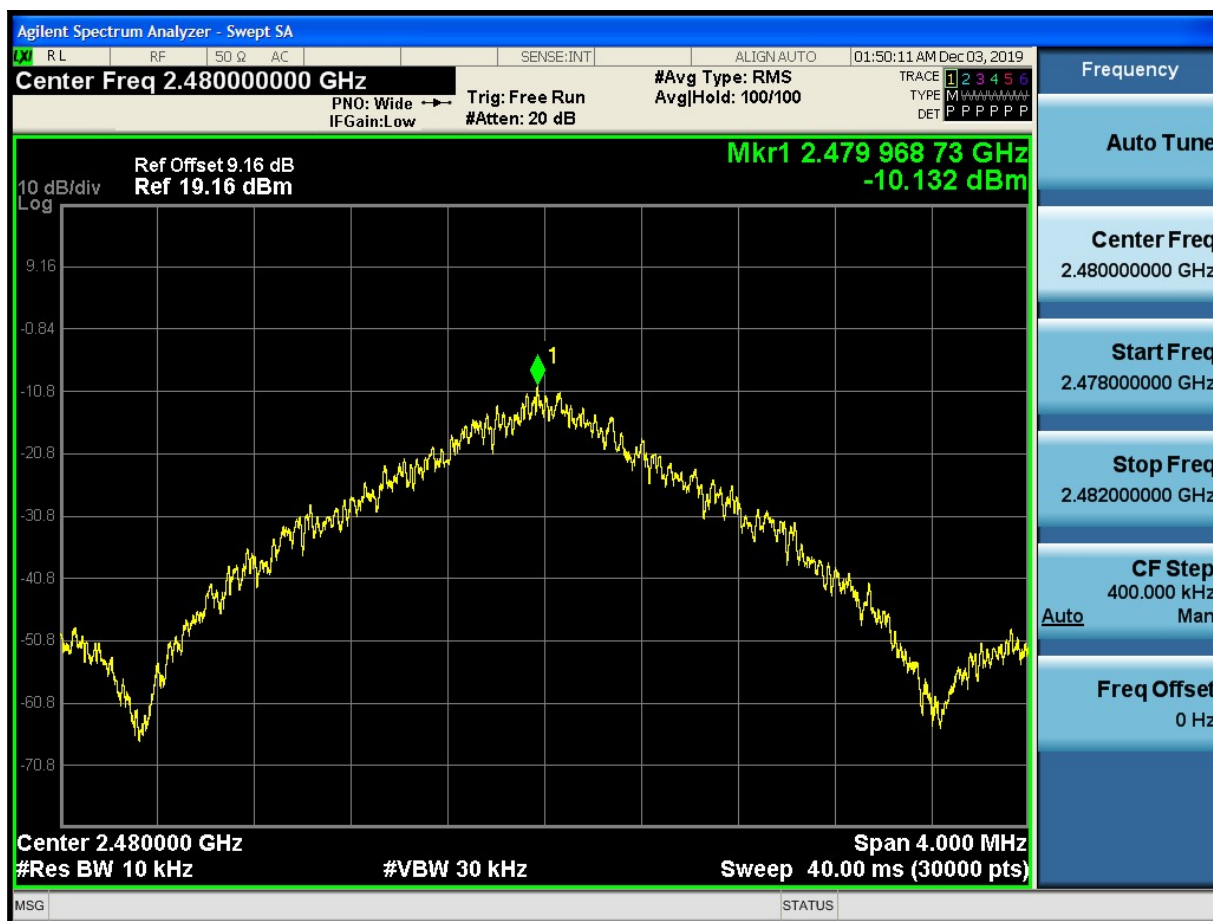
BT-LE (GFSK) (1 Mbps)

Channel	FREQ. (MHz)	PSD (dBm/10kHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	PASS /FAIL
0	2402	-11.099	-16.33	8	PASS
19	2440	-11.300	-16.53	8	PASS
39	2480	-10.132	-15.36	8	PASS

PSD(dBm/10kHz) conversion PSD(dBm/3kHz) factor= $10 \cdot \log(10/3)=5.22\text{dB}$

PSD(dBm/3kHz)=PSD(dBm/10kHz)+5.22dB

WORSE PLOT

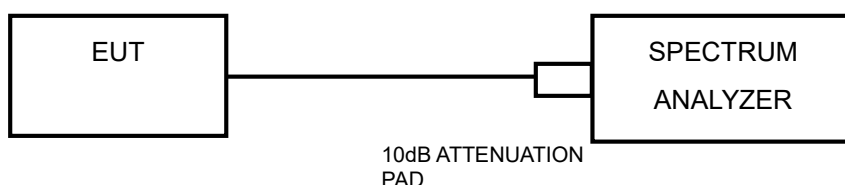


4.6 OUT OF BAND EMISSION MEASUREMENT

4.6.1 LIMITS OF OUT OF BAND EMISSION MEASUREMENT

Below -30dB of the highest emission level of operating band (in 100kHz Resolution Bandwidth).

4.6.2 TEST SETUP



4.6.3 TEST INSTRUMENTS

Refer to section 4.4.3 to get information of above instrument.

4.6.4 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 OOB

1. Set RBW = 100 kHz.
2. Set VBW \geq 300 kHz.
3. Set span to encompass the spectrum to be examined
4. Detector = peak.
5. Trace Mode = max hold.
6. Sweep = auto couple.

4.6.5 DEVIATION FROM TEST STANDARD

No deviation.

4.6.6 EUT OPERATING CONDITION

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.



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Test Report No.: RF191119N028-FCC

4.6.7 TEST RESULTS

BT-LE (GFSK) (1 Mbps)

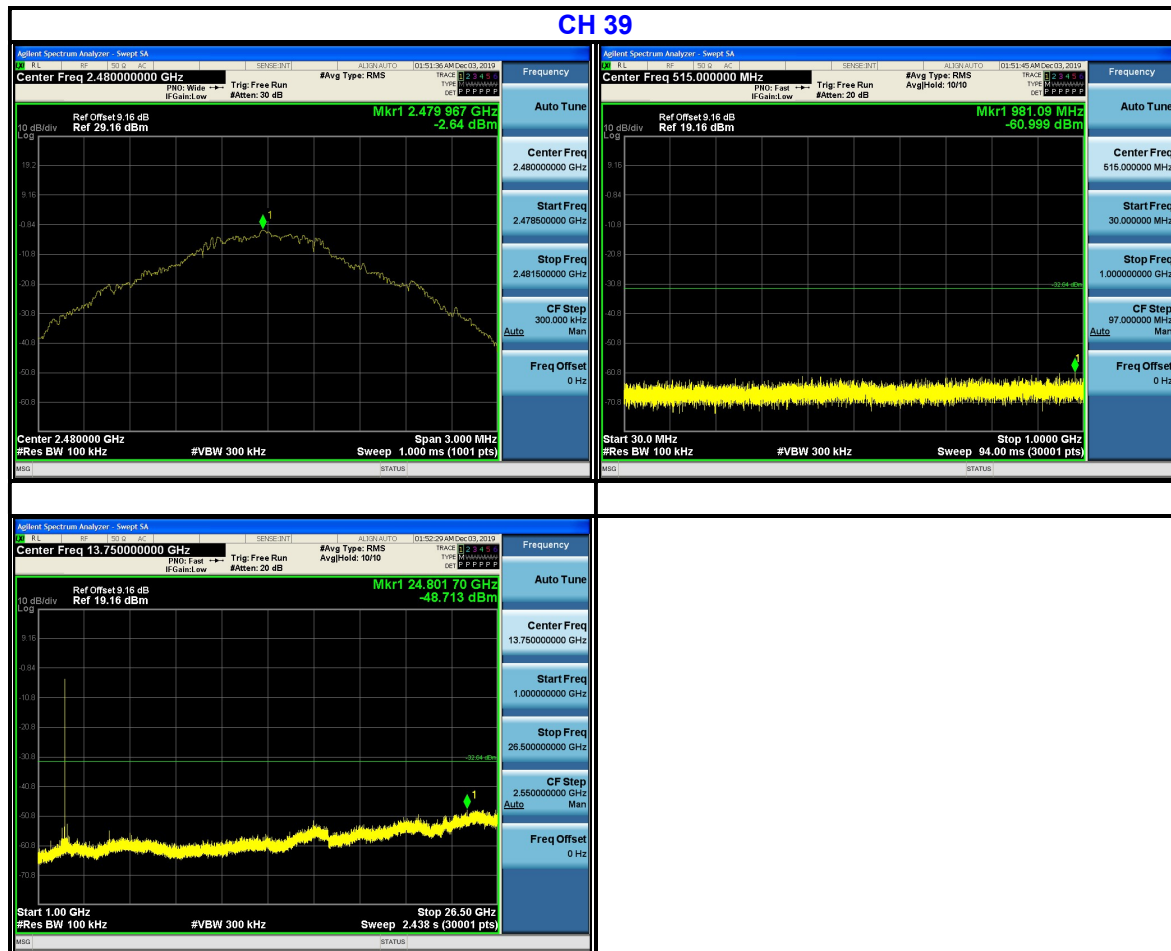


Bureau Veritas Shenzhen Co., Ltd.
Dongguan Branch

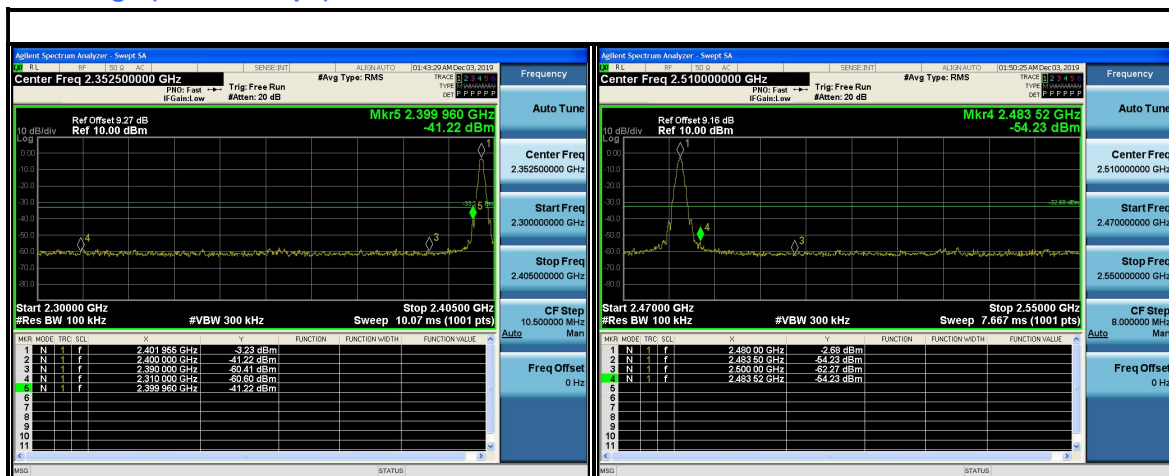
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Email: customerservice.dg@cn.bureauveritas.com

BT-LE (GFSK) (1 Mbps)



Band Edge (GFSK 1Mbps):





Test Report No.: RF191119N028-FCC

5 PHOTOGRAPHS OF THE TEST CONFIGURATION

Please refer to the attached file (Test Setup Photo).



Test Report No.: RF191119N028-FCC

6 APPENDIX A - MODIFICATIONS RECORDERS FOR ENGINEERING CHANGES TO THE EUT BY THE LAB

No any modifications are made to the EUT by the lab during the test.

---END---