FCC / ISED RF Test Report

Report No.:	FCC_IC_RF_SL20113001-HAR-291_BT
FCC ID:	2AHPN-BE2843
IC ID	6434C-BE2843
Model:	GM MY20
Received Date:	01/05/2020
Test Date:	01/06/2021 - 01/07/2021
Issued Date:	01/07/2021
Applicant:	Harman International Industries Inc.
Address:	30001 Cabot Drive, Novi, MI 48377, USA
Manufacturer:	Harman International Industries Inc.
Address:	30001 Cabot Drive, Novi, MI 48377, USA
Issued By:	Bureau Veritas Consumer Products Services, Inc.
Lab Address:	775 Montague Expressway, Milpitas, CA 95035
FCC Registration / Designation Number:	540430
ISED# / CAB identifier:	4842D

ACCREDITED
TESTING CERT # 2742-01

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Release Control Record

Issue No.	Description	Date Issued
FCC_IC_RF_SL20113001-HAR-291_BT	Original Report	01/07/2021

1 Certificate of Conformity

Product:	Unlicensed National Information Infrastructure Device
Brand:	HARMAN
Model:	GM MY20
Sample Status:	Engineering Sample
Applicant:	Harman International Industries Inc.
Test Date:	01/06/2021 - 01/07/2021
Standards:	47 CFR FCC Part 15, Subpart C (Section 15.247) RSS-247 Issue 2, February 2017 ANSI C63.10: 2013 RSS-Gen Issue 5, March 2019 558074 D01 15.247 Meas Guidance v05r02

The above equipment has been tested by **Bureau Veritas Consumer Products Services, Inc., Milpitas Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

Prepared by : Gary Chou , **Date:** 01/07/2021

Gary Chou / Test Engineer

Approved by : Deon , **Date:** 01/07/2021

Deon Dai / Engineer Review

2 Summary of Test Results

47 CFR FCC Part 15, Subpart C (SECTION 15.247) RSS 247 Issue2, RSS Gen Issue5				
FCC Clause	RSS Section(s)	Test Item	Result	Remarks
15.207	RSS-Gen [8.8]	AC Power Conducted Emission	N/A	Note
15.247(a)(1)(iii)	RSS-Gen [8.9] RSS-247 [5.5]	Number of Hopping Frequency Used	N/A	Note1
15.247(a)(1)(iii)	RSS-247 [5.5]	Dwell Time on Each Channel	N/A	Note1
15.247(a)(1)	RSS-247[5.2]	1. Hopping Channel Separation 2. Spectrum Bandwidth of a Frequency Hopping Sequence Spread Spectrum System	N/A	Note1
15.247(b)	RSS-247 [5.4(4)]	Maximum Peak Output Power	PASS	Meet the requirement of limit.
15.205 & 15.209 & 15.247(d)	RSS-247 [5.2)]	Radiated Emissions	PASS	Meet the requirement of limit. Minimum passing QP margin.
15.247(d)	RSS-Gen [8.8]	Antenna Port Emission	PASS	Note1*
15.203		Antenna Requirement	PASS	PCB antenna

1. If The Frequency Hopping System operating in 2400-2483.5MHz band and the output power less than 125mW. The hopping channel carrier frequencies separated by a minimum of 25kHz or two-thirds of the 20dB 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.
3. Note: The EUT is DC powered.
4. Note1*: Please refer to report FCC ID" 2AHPN-BE2843".

2.1 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	Expanded Uncertainty (k=2) (±)
Conducted Emissions at mains ports	150kHz ~ 30MHz	3.856 dB
Radiated Emissions up to 1 GHz	30MHz ~ 1GHz	4.638 dB
Radiated Emissions above 1 GHz	Above 1GHz	4.580dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product Type	Unlicensed National Information Infrastructure Device
Brand	HARMAN
Test Model	GM MY20
Status of EUT	Engineering Sample
Power Input	12Vdc
Modulation Type	GFSK, π/4-DQPSK, 8DPSK
Modulation Technology	FHSS
Transfer Rate	BDR/EDR: up to 3MB/s
Operating Frequency	2402~2480MHz
Number of Channel	79
Output Power	0.787mW (-1.04 dBm)
Antenna Type	PCB Antenna
Antenna Gain	5.98 dBi
Antenna Connector	N/A

3.2 Description of Test Modes

79 channels are provided for BT-BDR/EDR mode:

Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
0	2402	20	2422	40	2442	60	2462
1	2403	21	2423	41	2443	61	2463
2	2404	22	2424	42	2444	62	2464
3	2405	23	2425	43	2445	63	2465
4	2406	24	2426	44	2446	64	2466
5	2407	25	2427	45	2447	65	2467
6	2408	26	2428	46	2448	66	2468
7	2409	27	2429	47	2449	67	2469
8	2410	28	2430	48	2450	68	2470
9	2411	29	2431	49	2451	69	2471
10	2412	30	2432	50	2452	70	2472
11	2413	31	2433	51	2453	71	2473
12	2414	32	2434	52	2454	72	2474
13	2415	33	2435	53	2455	73	2475
14	2416	34	2436	54	2456	74	2476
15	2417	35	2437	55	2457	75	2477
16	2418	36	2438	56	2458	76	2478
17	2419	37	2439	57	2459	77	2479
18	2420	38	2440	58	2460	78	2480
19	2421	39	2441	59	2461		

3.2.1 Test Mode Applicability and Tested Channel Detail

EUT CONFIGURE MODE	APPLICABLE TO				DESCRIPTION
	RE≥1G	RE<1G	PLC	APCM	
-	√	√	N/A	√	-

Where **RE≥1G:** Radiated Emission above 1GHz **RE<1G:** Radiated Emission below 1GHz
PLC: Power Line Conducted Emission **APCM:** Antenna Port Conducted Measurement

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

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 and antenna ports (if EUT with antenna diversity architecture).
☒ Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	PACKET TYPE
-	0 to 78	78	FHSS	GFSK	DH5
-	0 to 78	-	FHSS	8DPSK	3DH5

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 and antenna ports (if EUT with antenna diversity architecture).
☒ Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	PACKET TYPE
-	0 to 78	78	FHSS	GFSK	DH5
-	0 to 78	-	FHSS	8DPSK	3DH5

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 channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	PACKET TYPE
-	0 to 78	0, 39, 78	FHSS	GFSK	DH5
-	0 to 78	0, 39, 78	FHSS	8DPSK	3DH5

Test Condition:

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	INPUT POWER	TESTED BY
RE≥1G	25deg. C, 65%RH	120Vac	Gary Chou
RE<1G	25deg. C, 65%RH	120Vac	Gary Chou
APCM	21deg. C, 60%RH	120Vac	Gary Chou

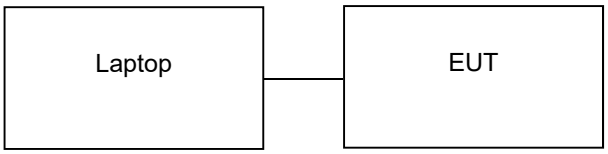
3.3 Description of Support Units

The EUT has been tested as an independent 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.

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Laptop	Dell	Latitude 3550	2MHWY32	N/A	Provided by Lab

Note: The core(s) is (are) originally attached to the cable(s).

3.3.1 Configuration of System under Test



3.4 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:

47 CFR FCC Part 15, Subpart C (Section 15.247)
RSS-247 Issue 2, February 2017
ANSI C63.10: 2013
RSS-Gen Issue 5, March 2019
558074 D01 15.247 Meas Guidance v05r02

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

4 Test Types and Results

4.1 Radiated Emission and Bandedge Measurement

4.1.1 Limits of Radiated Emission and Bandedge Measurement

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

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

NOTE:

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

4.1.2 Test Instruments

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	DATE OF CALIBRATION	DUE DATE OF CALIBRATION
EMI Test Receiver	ESW44	1328.4100K44-101662-MH	10/23/2020	10/23/2021
Biconilog Antenna Sunol	JB6	A111717	03/09/2020	03/09/2021
Horn Antenna ETS-Lindgren	3117	218554	12/20/2020	12/20/2021
Pre-Amplifier RF-Lambda	RAMP00M50GA	17032300048	06/18/2020	06/18/2021

NOTE:

1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The horn antenna and RF-Lambda preamplifier are used only for the measurement of emission frequency above 1GHz if tested.

TEST PROCEDURES
For Radiated emission below 30MHz

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. Both Parallel, perpendicular, and ground-parallel orientations of the antenna are set to make the measurement.

d. For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

e. 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 9kHz at frequency below 30MHz.

For Radiated emission above 30MHz

a. The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

e. 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 detect 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:

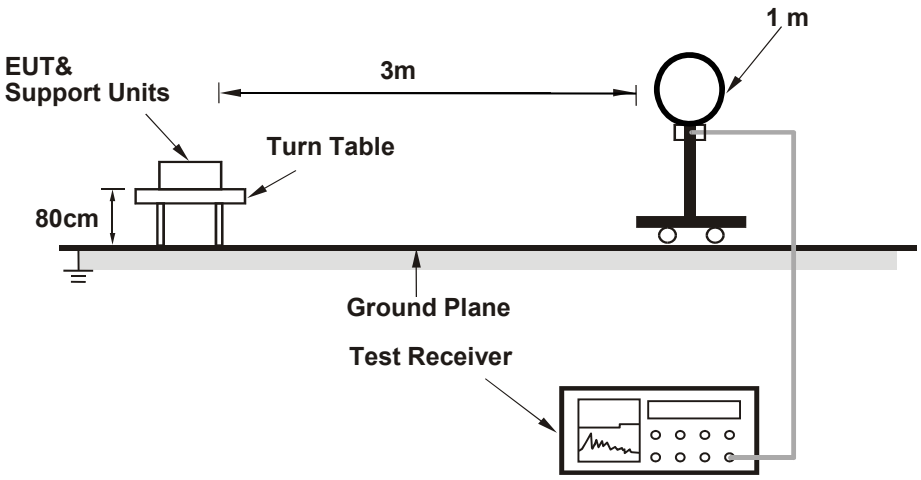
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is ≥ 1/T (Duty cycle < 98%) or 10Hz (Duty cycle ≥ 98%) for Average detection (AV) at frequency above 1GHz.
4. All modes of operation were investigated and the worst-case emissions are reported.

4.1.3 Deviation from Test Standard

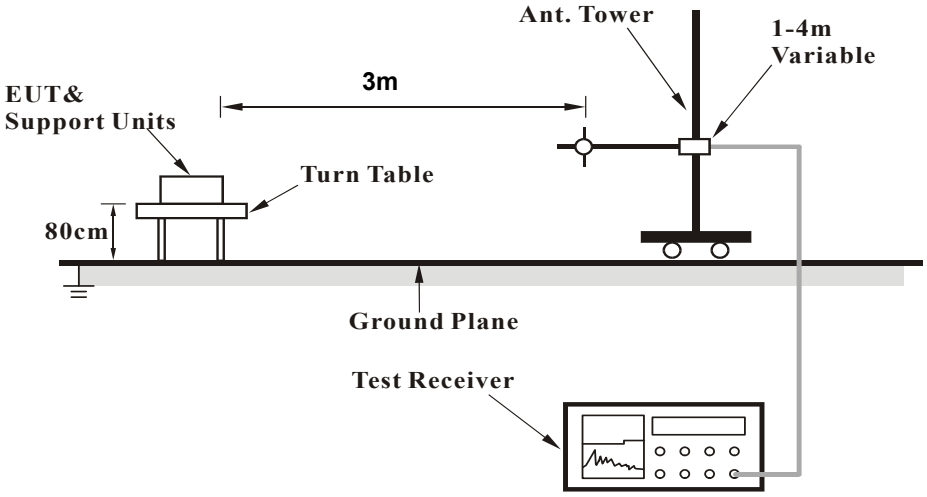
No deviation.

4.1.4 Test Setup

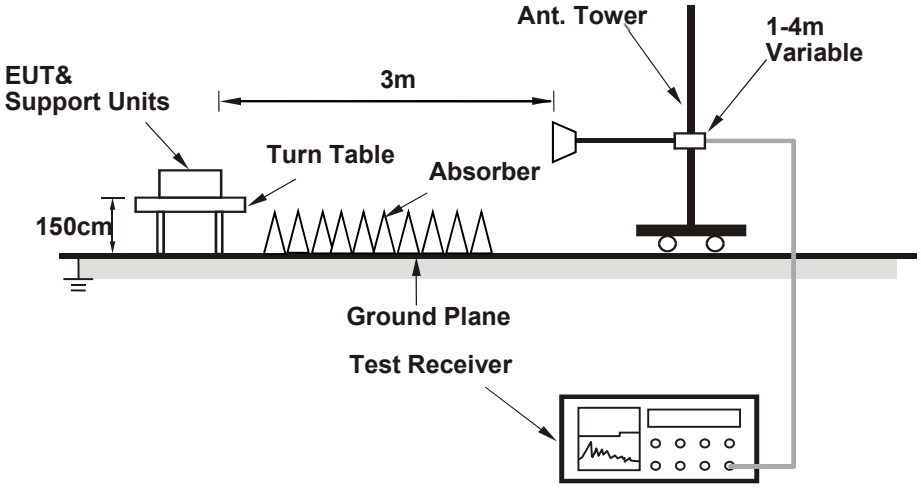
For Radiated emission below 30MHz



For Radiated emission 30MHz to 1GHz



For Radiated emission above 1GHz



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

4.1.5 EUT Operating Conditions

a. Connected the EUT with the Notebook Computer which is placed on remote site.
b. Controlling software has been activated to set the EUT on specific status.

4.1.6 Test Results

Above 1GHz Data:

BT_GFSK

CHANNEL	TX MODE 2480 MHz	**DETECTOR FUNCTION**	Peak Average
FREQUENCY RANGE	1GHz ~ 25GHz		

Antenna Polarity & Test Distance: Vertical and Horizontal at 3m														
No.	Frequency (MHz)	Polarization (H/V)	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK dB(uV/m)	Limit\AV dB(uV/m)	Limit\PK [dB(uV/m)	Margin AV [dB]	Margin PK [dB]	Height (cm)	Angle (Deg)	Pass/ Fail
1	4959.533	V	39.6	50.8	-7	32.6	43.8	54	74	-21.4	-30.2	298	192.2	Pass
2	4960.782	H	39.1	50.6	-7	32.1	43.6	54	74	-21.9	-30.4	328	341.3	Pass
3	7439.993	V	36.3	46.7	-1.9	34.4	44.8	54	74	-19.6	-29.2	298	202.5	Pass
4	7439.945	H	35.1	46.4	-1.9	33.2	44.5	54	74	-20.8	-29.5	389	286.8	Pass
5	9920.123	V	32.3	42.8	1.5	33.8	44.3	54	74	-20.2	-29.7	223	242.3	Pass
6	9919.805	H	31.9	42.6	1.5	33.4	44.1	54	74	-20.6	-29.9	117	0	Pass

REMARKS:

1. Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
2. Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB) –Preamplifier Gain (dB)

Below 1GHz Data:

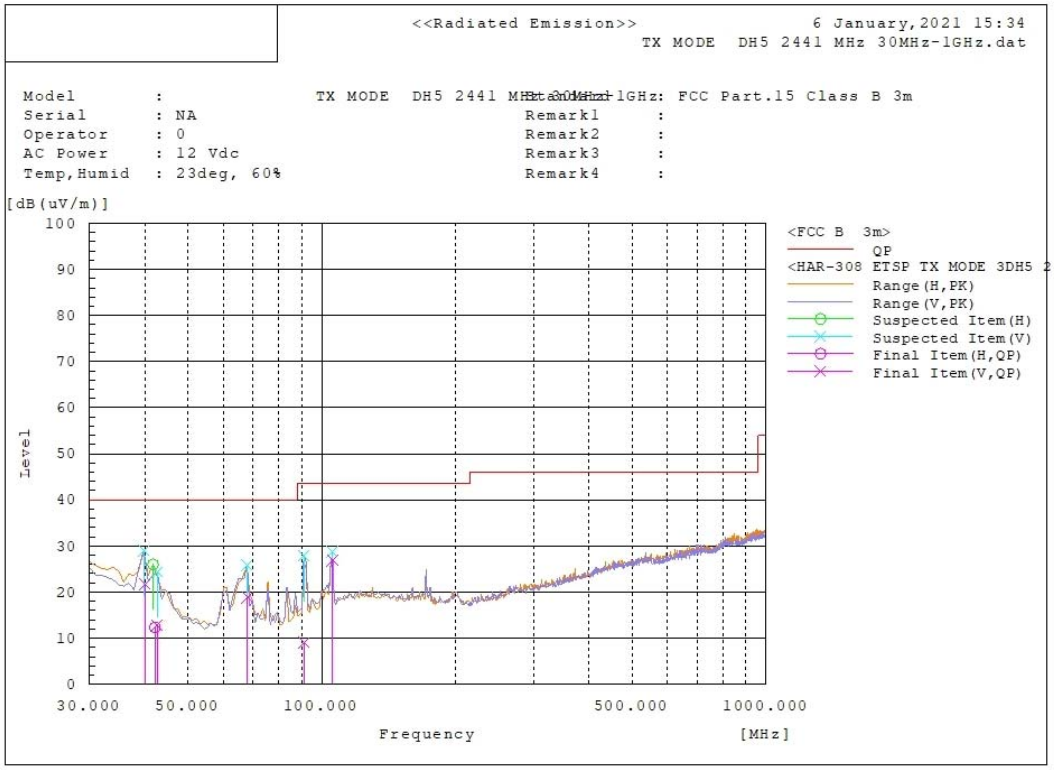
BT_GFSK

CHANNEL	TX MODE 2441 MHz	**DETECTOR FUNCTION**	Quasi Peak
FREQUENCY RANGE	30MHz – 1GHz		

Antenna Polarity & Test Distance: Vertical and Horizontal at 3m										
No.	Frequency (MHz)	Polarization (H/V)	Reading QP [dB(uV)]	Factor [dB(1/m)]	Level QP [dB(uV/m)]	Limit\QP dB(uV/m)	Margin QP [dB]	Height (cm)	Angle (Deg)	Pass/ Fail
1	40.001	V	3.3	18.5	21.8	40	-18.2	100	139.2	Pass
2	42.091	H	-5.8	18.2	12.4	40	-27.6	115	198.5	Pass
3	42.553	V	-3.9	16.8	12.9	40	-27.1	134	223.5	Pass
4	68.037	V	5.6	13.2	18.8	40	-21.2	134	15.9	Pass
5	91.311	V	-5.5	14.5	9	43.5	-34.5	186	202.4	Pass
6	105.698	V	9	17.9	26.9	43.5	-16.6	228	179.7	Pass

REMARKS:

1. Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
2. Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)



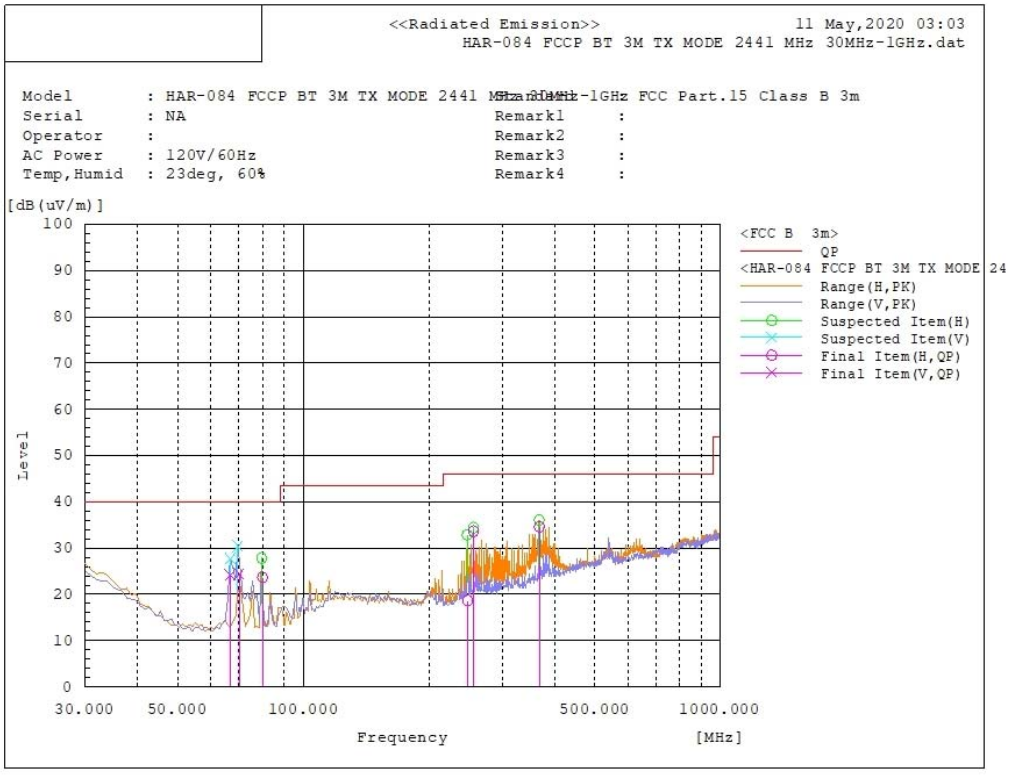
BT_8DPSK

CHANNEL	TX MODE 2440 MHz	**DETECTOR FUNCTION**	Quasi Peak
FREQUENCY RANGE	30MHz – 1GHz		

Antenna Polarity & Test Distance: Vertical and Horizontal at 3m										
No.	Frequency (MHz)	Polarization (H/V)	Reading QP [dB(uV)]	Factor [dB(1/m)]	Level QP [dB(uV/m)]	Limit\QP dB(uV/m)	Margin QP [dB]	Height (cm)	Angle (Deg)	Pass/ Fail
1	66.782	V	11.3	12.9	24.2	40	-15.8	106	359	Pass
2	70.22	V	11.4	13	24.4	40	-15.6	378	73.9	Pass
3	79.97	H	10.6	13.1	23.7	40	-16.3	228	88.5	Pass
4	247.737	H	0.3	18.4	18.7	46	-27.3	134	261.4	Pass
5	256	H	15.2	18.4	33.6	46	-12.4	115	271.1	Pass
6	368.005	H	12.1	22.5	34.6	46	-11.4	100	113.3	Pass

REMARKS:

1. Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
2. Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB)
3. Margin = Level (dBuV/m) - Limit value(dBuV/m)

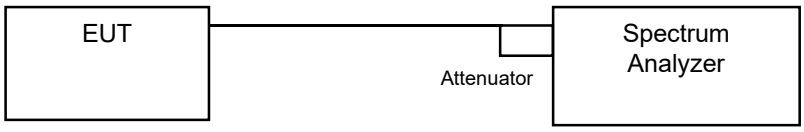


4.2 Maximum Output Power

4.2.1 Limits of Maximum Output Power Measurement

The Maximum Output Power Measurement is 1W.

4.2.2 Test Setup



4.2.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.2.4 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. The center frequency of the spectrum analyzer is set to the fundamental frequency and using 3MHz RBW and 10 MHz VBW.

d. Measure the captured power within the band and recording the plot.

e. Repeat above procedures until all frequencies required were complete.

4.2.5 Deviation from Test Standard

No deviation.

4.2.6 EUT Operating Condition

The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

4.2.7 Test Results

Channel	Frequency (MHZ)	Output Power (mW)		Output Power (dBm)		Power Limit (W)	Pass / Fail
		GFSK	8DPSK	GFSK	8DPSK		
0	2402	0.787	0.555	-1.04	-2.55	1	Pass
39	2441	0.669	0.512	-1.74	-2.9	1	Pass
78	2480	0.647	0.544	-1.89	-2.64	1	Pass

Spectrum Plot of Worst Value	
GFSK / CH0	8DPSK / CH0
	
GFSK / CH39	8DPSK / CH39
	
GFSK / CH78	8DPSK / CH78
	

5 Pictures of Test Arrangements

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

Appendix – Information on the Testing Laboratories

Bureau Veritas is a global leader in testing, inspection and certification (TIC) services. We help businesses improve safety, sustainability and productivity; and our clients include the majority of leading brands in retail, manufacturing and other industries. With a presence in every major country around the world, our quality assurance and compliance solutions are vital in helping our customers enhance product quality and concept-to-consumer journeys. We also assist with increasing speed to market, profitability and brand equity throughout the supply chain. Bureau Veritas is a leading wireless/IoT testing, inspection, audit and certification provider, with a global network of test laboratories to support the IoT industry in areas of connectivity, security, interoperability as well as quality, health & safety, and environmental/chemical requirements.

If you have any comments, please feel free to contact us at the following:

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Web Site: www.cpsusa-bureauveritas.com

The address and road map of all our labs can be found in our web site also.

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