FCC PART 15 SUBPART C TEST REPORT

FCC PART 15.247

Report Reference No.....:	**A150J166117-BLE**
FCC ID..... :	**2AE4C-M210**
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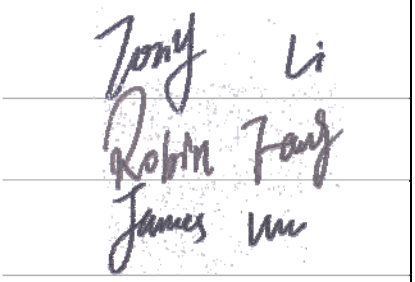
Date of issue.....:	July 28, 2015



Representative Laboratory Name ....:	Shenzhen CTL Electron Technology Co., Ltd.
Address .....:	A0402, Block 1, Kefa Industrial District, Huanguan Nan Rd, Xintian community, Guanlan, Baoan, Shenzhen, China
Testing Laboratory Name.....:	Dongguan Dongdian Testing Service Co.,Ltd
Address .....:	No.17, Zongbu Road 2, Songshan Lake Sci&Tech, Industry Park, Dongguan City, Guangdong Province, China
Applicant's name.....:	**HwaCom Systems Inc.**
Address .....:	11Fl., No.108, Sec. 1, Hsin-Tai-Wu Rd., Hsi-Chih District, New Taipei City 221, Taiwan, R.O.C.
Test specification .....**:**	
Standard .....:	**FCC Part 15.247: Operation within the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz**
TRF Originator.....:	Shenzhen CTL Electron Technology Co., Ltd.
Master TRF.....:	Dated 2012-06

Test item description .....:	IP Set top box
Trade Mark .....:	HawCom
Model/Type reference.....:	M210
Listed Models .....:	HC-J3600
Manufacturer .....:	**Zhuhai Gotech Intelligent Technology Co., Ltd.**
Modulation Type .....:	GFSK
Operation Frequency.....:	From 2402MHz to 2480MHz
Rating .....:	DC 12.0V Adapter from AC 120V/60Hz
Result.....:	**PASS**

T E S T R E P O R T

Test Report No. :	A150J166117-BLE	July 28, 2015 Date of issue

Equipment under Test	:	IP Set top box
Model /Type	:	M210
Listed Models	:	HC-J3600
Applicant	:	**HwaCom Systems Inc.**
Address	:	11Fl., No.108, Sec. 1, Hsin-Tai-Wu Rd., Hsi-Chih District, New Taipei City 221, Taiwan, R.O.C.
Manufacturer	:	**Zhuhai Gotech Intelligent Technology Co., Ltd.**
Address	:	66 Yongda Road, Hongqi Town, Jinwan District, Zhuhai, China

Test Result:	**PASS**

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

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1. TEST STANDARDS

The tests were performed according to following standards:

FCC Rules Part 15.247: Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices

2. SUMMARY

2.1. General Remarks

Date of receipt of test sample	:	July 05, 2015
Testing commenced on	:	July 06, 2015
Testing concluded on	:	July 28, 2015

2.2. Product Description

The **HwaCom Systems Inc.**'s Model: M210 or the "EUT" as referred to in this report; more general information as follows, for more details, refer to the user's manual of the EUT.

Name of EUT	IP Set top box
Model Number	M210, HC-J3600
FCC ID	2AE4C-M210
WLAN	Supported 802.11b/802.11g/802.11n/802.11a
Bluetooth	Supported BT 4.0+EDR
Antenna Type	Internal
WLAN FCC Operation frequency	IEEE 802.11b: 2412MHz—2462MHz IEEE 802.11g: 2412MHz—2462MHz IEEE 802.11n HT20: 2412MHz—2462MHz/5150MHz—5250MHz/5725MHz—5850MHz IEEE 802.11a: 5150MHz—5250MHz/5725MHz—5850MHz
Bluetooth FCC Operation frequency	2402MHz-2480MHz
WLAN Modulation	IEEE 802.11b: DSSS(CCK,DQPSK,DBPSK) IEEE 802.11a OFDM(64QAM, 16QAM, QPSK, BPSK) IEEE 802.11g: OFDM(64QAM, 16QAM, QPSK, BPSK) IEEE 802.11n HT20: OFDM (64QAM, 16QAM, QPSK,BPSK)
Bluetooth Modulation	EDR(GFSK,8DPSK,π/4DQPSK)/BLE(GFSK)

2.3. Equipment Under Test

Power supply system utilised

Power supply voltage	:	○	120V / 60 Hz	○	115V / 60Hz
		○	12 V DC	○	24 V DC
		●	Other (specified in blank below)		

DC 12.0V Adapter from AC 120V/60Hz

2.4. Short description of the Equipment under Test (EUT)

2.4GHz (IP Set top box (M/N: M210))

For more details, refer to the user's manual of the EUT.

2.5. EUT operation mode

The application provider specific test software to control sample in continuous TX and RX (Duty Cycle >98%)

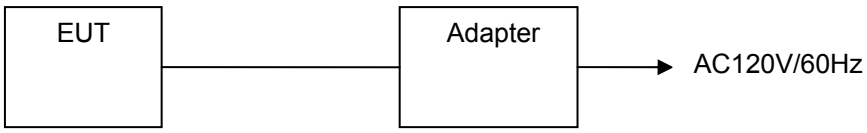
for testing meet KDB558074 test requirement.

The EUT has been tested under typical operating condition. The Applicant provides communication tools software to control the EUT for staying in continous transmitting and receiving mode for testing. There are 40 channels of EUT, and the test carried out at the lowest channel, middle channel and highest channel .

Channel	Frequency(MHz)	Channel	Frequency(MHz)
00	**2402**	20	2442
01	2404	21	2444
02	2406	22	2446
03	2408	23	2448
04	2410	24	2450
05	2412	25	2452
06	2414	26	2454
07	2416	27	2456
08	2418	28	2458
09	2420	29	2460
10	2422	30	2462
11	2424	31	2464
12	2426	32	2466
13	2428	33	2468
14	2430	34	2470
15	2432	35	2472
16	2434	36	2474
17	2436	37	2476
18	2438	38	2478
19	**2440**	**39**	**2480**

2.6. Block Diagram of Test Setup

Fig. 2-1 Configuration of Tested System



Adapter:

MODEL:KNC010D-120100V
INPUT:100-240V～0.3A 50/60Hz 0.4A Max
OUTPUT: 12V DC 1A
◇ Shielded ◆ Unshielded

2.7. Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for **FCC ID: 2AE4C-M210** filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

2.8. Modifications

No modifications were implemented to meet testing criteria.

2.9. NOTE

1. The EUT is a IP Set top box with WLAN and Bluetooth function,The functions of the EUT listed as below:

	Test Standards	Reference Report
WLAN-2.4GHz	FCC Part 15 Subpart C	A150J166117-WLAN1
WLAN-5.8GHz	FCC Part 15 Subpart E	A150J166117-WLAN2
Bluetooth-EDR	FCC Part 15 Subpart C	A150J166117-EDR
Bluetooth-BLE	FCC Part 15 Subpart C	A150J166117-BLE
MPE	FCC Per 47 CFR 2.1091(b)	A150J166117-MPE

2. The frequency bands used in this EUT are listed as follows:

Frequency Band(MHz)	2400-2483.5	5150-5350	5470-5725	5725-5850
EUT	√	—	—	—

3. TEST ENVIRONMENT

3.1. Address of the test laboratory

Dongguan Dongdian Testing Service Co.,Ltd

No.17, Zongbu Road 2, Songshan Lake Sci&Tech, Industry Park, Dongguan City, Guangdong Province, China

The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 (2003) and CISPR Publication 22.

3.2. Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

IC Registration No.: 10288A-1

The 3m alternate test site of Dongguan Dongdian Testing Service Co.,Ltd EMC Laboratory has been registered by Certification and Engineer Bureau of Industry Canada for the performance of with Registration No.: 10288A-1 on May, 2012.

FCC-Registration No.: 270092

Dongguan Dongdian Testing Service Co.,Ltd EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 270092, Mar, 2015.

3.3. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature:	15-35 ° C
Humidity:	30-60 %
Atmospheric pressure:	950-1050mbar

3.4. Test Description

Test Specification clause	Test case	Test Mode	Test Channel	Recorded In Report		Pass	Fail	NA	NP	Remark
§15.247(b)(4)	Antenna gain	GFSK	☒ Lowest ☒ Middle ☒ Highest	GFSK	☒ Lowest ☒ Middle ☒ Highest	☒	☐	☐	☐	complies
§15.247(e)	Power spectral density	GFSK	☒ Lowest ☒ Middle ☒ Highest	GFSK	☒ Lowest ☒ Middle ☒ Highest	☒	☐	☐	☐	complies
§15.247(a)(1)	Spectrum bandwidth – 6 dB bandwidth	GFSK	☒ Lowest ☒ Middle ☒ Highest	GFSK	☒ Lowest ☒ Middle ☒ Highest	☒ ☒	☐	☐	☐	complies
§15.247(b)(1)	Maximum output power	GFSK	☒ Lowest ☒ Middle ☒ Highest	GFSK	☒ Lowest ☒ Middle ☒ Highest	☒ ☒ ☒	☐	☐	☐	complies
§15.247(d)	Band edge compliance conducted	GFSK	☒ Lowest ☒ Highest	GFSK	☒ Lowest ☒ Highest	☒ ☒	☐	☐	☐	complies
§15.205	Band edge compliance radiated	GFSK	☒ Lowest ☒ Highest	GFSK	☒ Lowest ☒ Highest	☒	☐	☐	☐	complies
§15.247(d)	TX spurious emissions conducted	GFSK	☒ Lowest ☒ Middle ☒ Highest	GFSK	☒ Lowest ☒ Middle ☒ Highest	☒ ☒	☐	☐	☐	complies
§15.247(d)	TX spurious	GFSK	☒ Lowest	GFSK	☒ Lowest	☒	☐	☐	☐	complies

	emissions radiated		☒ Middle ☒ Highest		☒ Middle ☒ Highest					
§15.109	RX spurious emissions radiated	-/-	-/-	-/-	-/-	☒	☐	☐	☐	complies
§15.209(a)	TX spurious Emissions radiated < 30 MHz	GFSK	-/-	GFSK	-/-	☒	☐	☐	☐	complies
§15.107(a) §15.207	Conducted Emissions < 30 MHz	GFSK	-/-	GFSK	-/-	☒	☐	☐	☐	complies

Remark:
1. The measurement uncertainty is not included in the test result.
2. NA = Not Applicable; NP = Not Performed

3.5. Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16 - 4 „Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements“ and is documented in the Dongguan Dongdian Testing Service Co.,Ltd quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.
Hereafter the best measurement capability for Dongguan Dongdian Testing Service Co.,Ltd laboratory is reported:

Test	Range	Measurement Uncertainty	Notes
Radiated Emission	30~1000MHz	3.16 dB	(1)
Radiated Emission	1~18GHz	2.56 dB	(1)
Radiated Emission	18-40GHz	2.56 dB	(1)
Conducted Disturbance	0.15~30MHz	2.44 dB	(1)

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

3.6. Equipments Used during the Test

Radiated Emission						
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1	Ultra-Broadband Antenna	ShwarzBeck	VULB9163	462	2014/04/12	3 years
2	EMI TEST Receiver	Rohde&Schwarz	ESU8	100316	2014/10/25	1 years
3	EMI TEST Software	Audix	E3	6.111111	N/A	N/A
4	Horn Anternna	EMCO	3116	00060095	2014/04/12	3 years
5	Pre-Amplifer	Rohde&Schwarz	SCU-01	10049	2014/10/25	1 years
6	Pre-Amplifer	A.H.	PAM0-0118	360	2014/10/25	1 years
7	Pre-Amplifer	A.H.	PAM-1840VH	562	2014/10/25	1 years
8	Double Ridged Horn Antenna	Rohde&Schwarz	HF907	100265	2014/04/12	3 years
9	Active Loop Antenna	Schwarz beck	FMZB1519	0.38	2014/04/12	3 years
11	TURNTABLE	MATURO	TT2.0	----	N/A	N/A
12	ANTENNA MAST	MATURO	TAM-4.0-P	----	N/A	N/A
13	Spectrum Analyzer	R&S	FSU26	1166.1660.26	2014/10/25	1 years

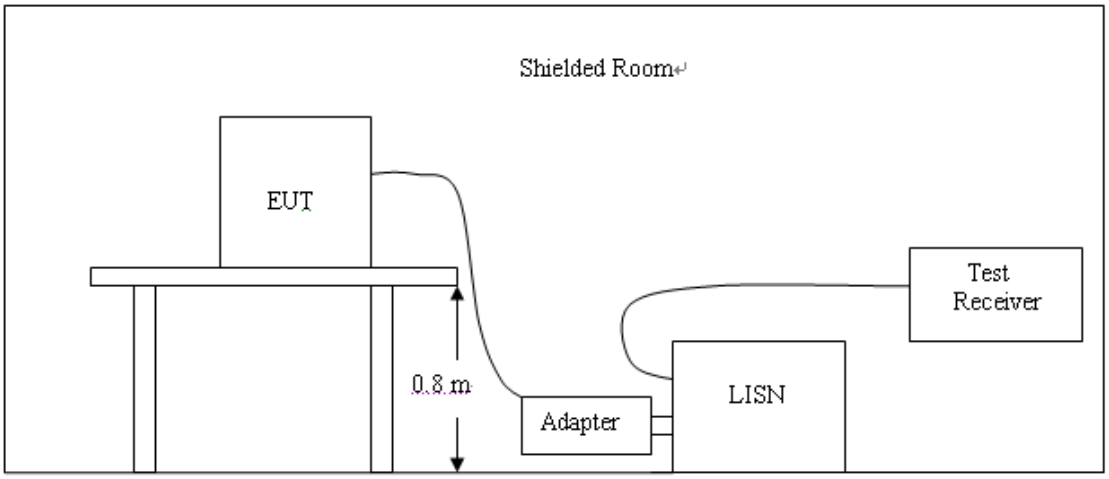
Maximum Peak Output Power / 20dB Bandwidth / Number of hopping frequency& Time of Occupancy / Band Edge Compliance of RF Emission / Spurious RF Conducted Emission/ Frequency Separation						
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1	Power Sensor	Rohde&Schwarz	NRP-Z81	102638	2014/11/02	1 years
2	Spectrum Analyzer	Agilent	N9030A	MY49430428	2014/11/02	1 years

AC Power Conducted Emission						
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1	Artificial Mains	Rohde&Schwarz	ENV216	101109	2014/10/25	1 years
2	Artificial Mains	Rohde&Schwarz	ESH3-Z5	100309	2014/10/25	1 years
3	EMI Test Receiver	Rohde&Schwarz	ESU8	100316	2014/10/25	1 years
4	Pulse Limiter	Rohde&Schwarz	ESH3-Z2	101242	2014/10/25	1 years

4. TEST CONDITIONS AND RESULTS

4.1. AC Power Conducted Emission

TEST CONFIGURATION



TEST PROCEDURE

1 The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10-2013.
2 Support equipment, if needed, was placed as per ANSI C63.10-2013;
3 All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10-2013;
4 The EUT received DC12V power from PC, the adapter of PC received AC120V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
5 All support equipments received AC power from a second LISN, if any.
6 The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
7 Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
8 During the above scans, the emissions were maximized by cable manipulation.

AC Power Conducted Emission Limit

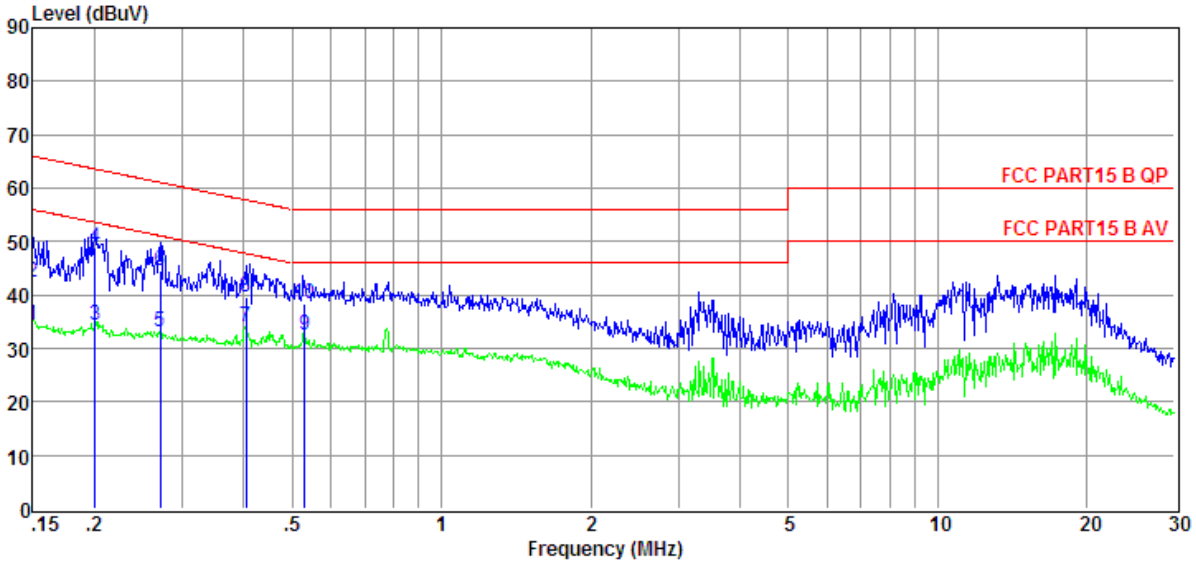
For intentional device, according to § 15.207(a) AC Power Conducted Emission Limits is as following：

Frequency (MHz)	Maximum RF Line Voltage (dBμV)			
	CLASS A		CLASS B	
	Q.P.	Ave.	Q.P.	Ave.
0.15 - 0.50	79	66	66-56*	56-46*
0.50 - 5.00	73	60	56	46
5.00 - 30.0	73	60	60	50

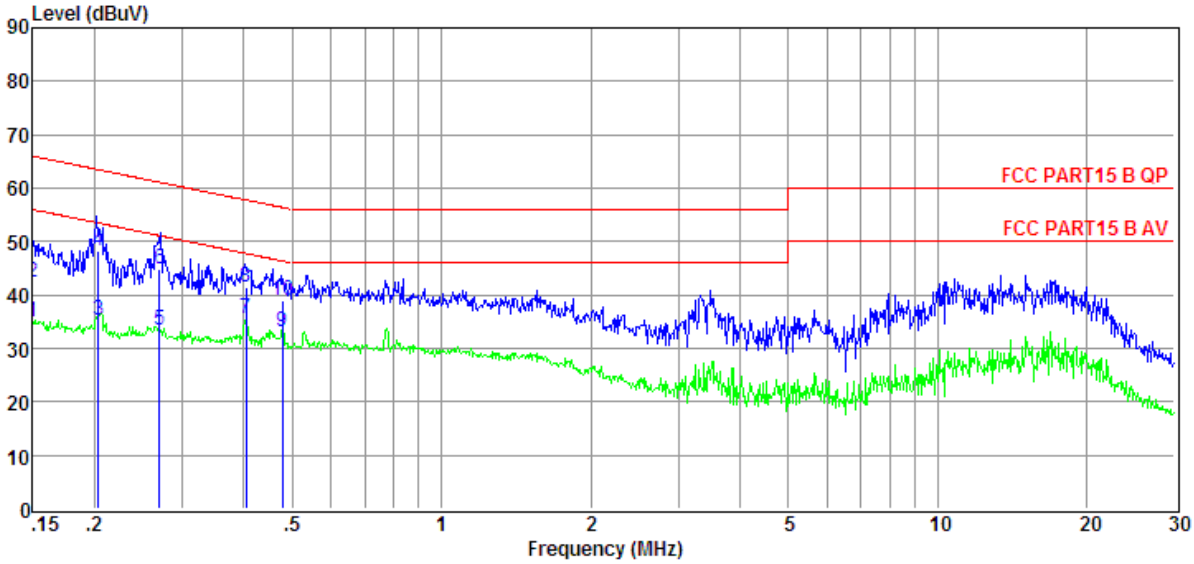
* Decreasing linearly with the logarithm of the frequency

TEST RESULTS

The AC Power Conducted Emission measurement are performed BT Link mode.



Item (Mark)	Freq (MHz)	Read Level (dBuV)	LISN Factor (dB)	Cable Loss (dB)	Pulse Limiter Factor (dB)	Results Level (dBuV)	Limit Line (dBuV)	Over Limit (dB)	Detector	Phase
1	0.15	14.95	9.60	0.01	9.84	34.40	56.00	-21.60	Average	NEUTRAL
2	0.15	22.88	9.60	0.01	9.84	42.33	66.00	-23.67	QP	NEUTRAL
3	0.20	15.10	9.59	0.02	9.85	34.56	53.58	-18.89	Average	NEUTRAL
4	0.20	29.42	9.59	0.02	9.85	48.88	63.58	-14.57	QP	NEUTRAL
5	0.27	13.67	9.60	0.02	9.85	33.14	51.07	-17.98	Average	NEUTRAL
6	0.27	25.10	9.60	0.02	9.85	44.57	61.07	-16.55	QP	NEUTRAL
7	0.40	14.61	9.61	0.03	9.86	34.11	47.77	-13.66	Average	NEUTRAL
8	0.40	20.19	9.61	0.03	9.86	39.69	57.77	-18.08	QP	NEUTRAL
9	0.53	12.83	9.61	0.04	9.87	32.35	46.00	-14.01	Average	NEUTRAL
10	0.53	18.75	9.61	0.04	9.87	38.27	56.00	-18.09	QP	NEUTRAL



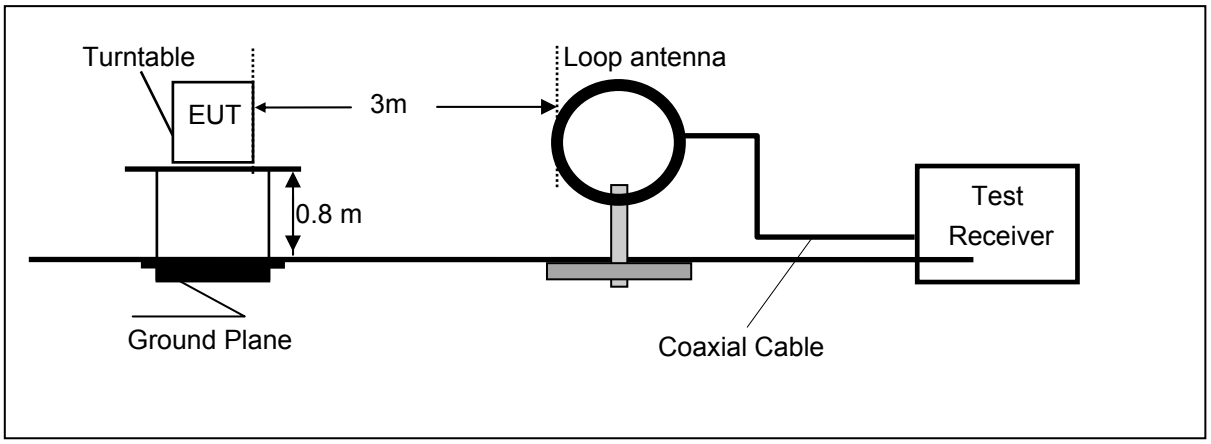
Item (Mark)	Freq (MHz)	Read Level (dBuV)	LISN Factor (dB)	Cable Loss (dB)	Pulse Limiter Factor (dB)	Results Level (dBuV)	Limit Line (dBuV)	Over Limit (dB)	Detector	Phase
1	0.15	15.96	9.61	0.01	9.84	35.42	56.00	-20.58	Average	LINE
2	0.15	22.92	9.61	0.01	9.84	42.38	66.00	-23.62	QP	LINE
3	0.20	15.82	9.62	0.02	9.85	35.31	53.45	-18.14	Average	LINE
4	0.20	29.00	9.62	0.02	9.85	48.49	63.45	-14.96	QP	LINE
5	0.27	14.06	9.62	0.02	9.85	33.55	51.12	-17.57	Average	LINE
6	0.27	25.54	9.62	0.02	9.85	45.03	61.12	-16.09	QP	LINE
7	0.40	16.12	9.63	0.03	9.86	35.64	47.77	-12.13	Average	LINE
8	0.40	21.73	9.63	0.03	9.86	41.25	57.77	-16.52	QP	LINE
9	0.48	13.80	9.63	0.03	9.87	33.33	46.36	-13.03	Average	LINE
10	0.48	19.76	9.63	0.03	9.87	39.29	56.36	-17.07	QP	LINE

Note:
1. Result Level = Read Level +LISN Factor + Pulse Limiter Factor + Cable loss.
2. If QP Result complies with AV limit, AV Result is deemed to comply with AV limit.
3. Test setup: RBW: 200 Hz (9 kHz—150 kHz), 9 kHz (150 kHz—30 MHz), Step size: 4 kHz, Scan time: auto.

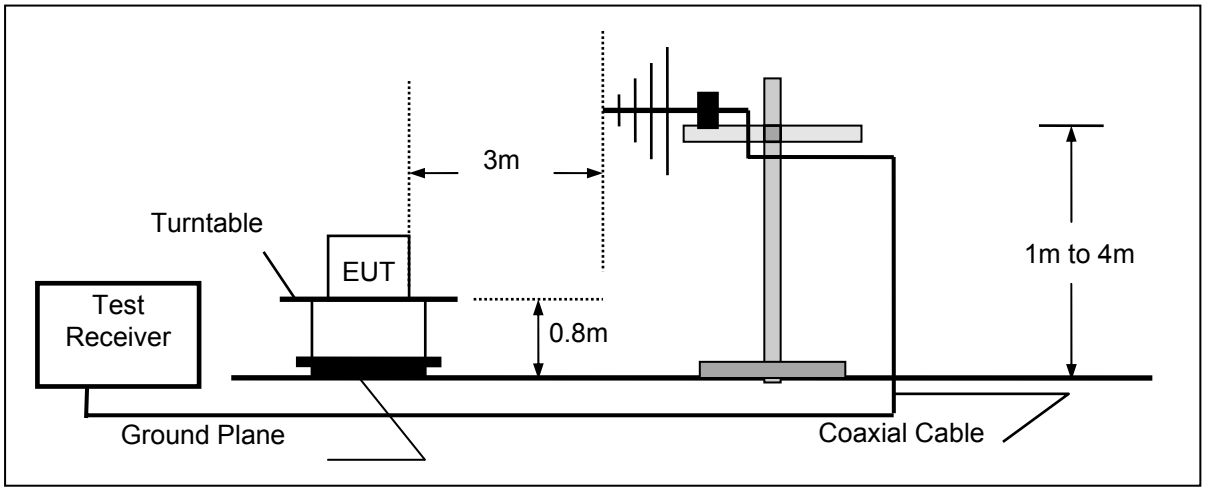
4.2. Radiated Emission

TEST CONFIGURATION

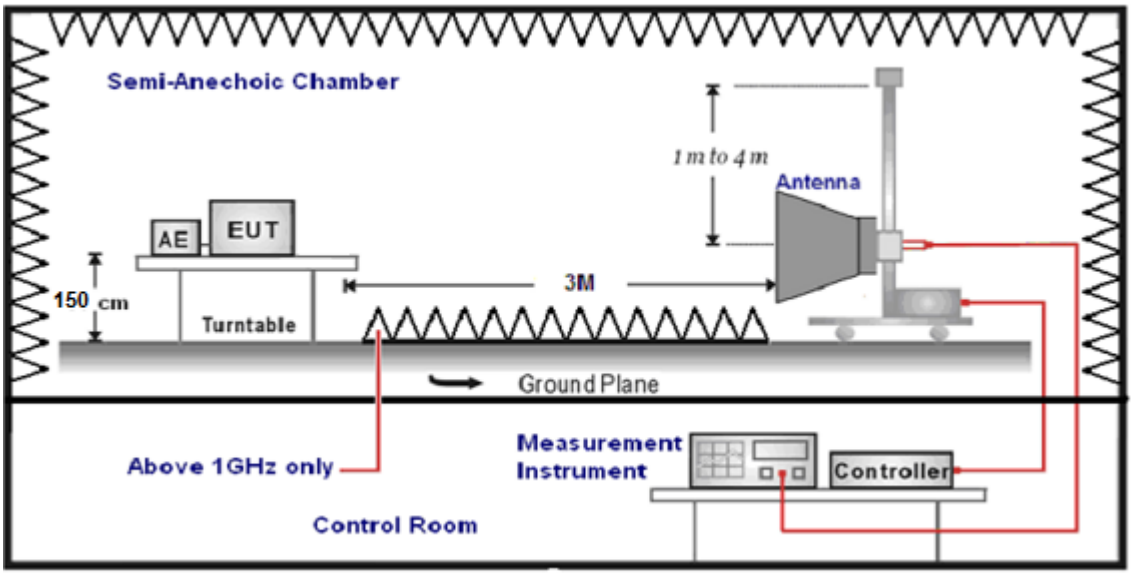
Frequency range 9KHz – 30MHz



Frequency range 30MHz – 1000MHz



Frequency range above 1GHz-25GHz



TEST PROCEDURE

1. The EUT was placed on a turn table which is 0.8m above ground plane.

2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0℃ to 360℃ to acquire the highest emissions from EUT.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed.
5. The EUT minimum operation frequency was 24MHz and maximum operation frequency was 2480MHz.so radiated emission test frequency band from 9KHz to 25GHz.
6. The distance between test antenna and EUT as following table states:

Test Frequency range	Test Antenna Type	Test Distance
9KHz-30MHz	Active Loop Antenna	3
30MHz-1GHz	Ultra-Broadband Antenna	3
1GHz-18GHz	Double Ridged Horn Antenna	3
18GHz-40GHz	Horn Anternna	1

7. Setting test receiver/spectrum as following table states:

Test Frequency range	Test Receiver/Spectrum Setting	Detector
9KHz-150KHz	RBW=200Hz/VBW=3KHz,Sweep time=Auto	QP
150KHz-30MHz	RBW=9KHz/VBW=100KHz,Sweep time=Auto	QP
30MHz-1GHz	RBW=120KHz/VBW=1000KHz,Sweep time=Auto	QP
1GHz-40GHz	Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto Average Value: RBW=1MHz/VBW=10Hz, Sweep time=Auto	Peak

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor(if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CL - AG

Where FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
RA = Reading Amplitude	AG = Amplifier Gain
AF = Antenna Factor	

For example

Frequency (MHz)	FS (dBμV/m)	RA (dBμV/m)	AF (dB)	CL (dB)	AG (dB)	Transd (dB)
300.00	40	58.1	12.2	1.6	31.90	-18.1

Transd=AF +CL-AG

RADIATION LIMIT

For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emission from intentional radiators at a distance of 3 meters shall not exceed the following table. According to § 15.247(d), in any 100kHz bandwidth outside the frequency band in which the EUT is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the100kHz bandwidth within the band that contains the highest level of desired power.

The pre-test have done for the EUT in three axes and found the worst emission at position shown in test setup photos.

Frequency (MHz)	Distance (Meters)	Radiated (dBμV/m)	Radiated (μV/m)
0.009-0.49	3	20log(2400/F(KHz))+40log(300/3)	2400/F(KHz)
0.49-1.705	3	20log(24000/F(KHz))+ 40log(30/3)	24000/F(KHz)
1.705-30	3	20log(30)+ 40log(30/3)	30
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

TEST RESULTS

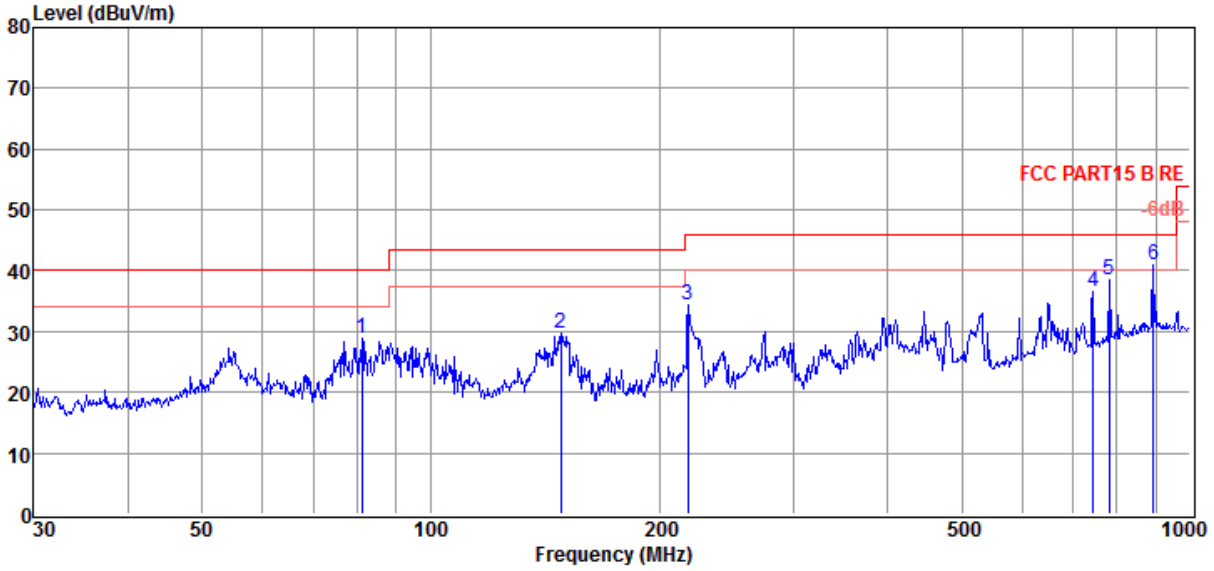
Remark: 1. We tested BT Link mode for below 1G;

For 9KHz to 30MHz

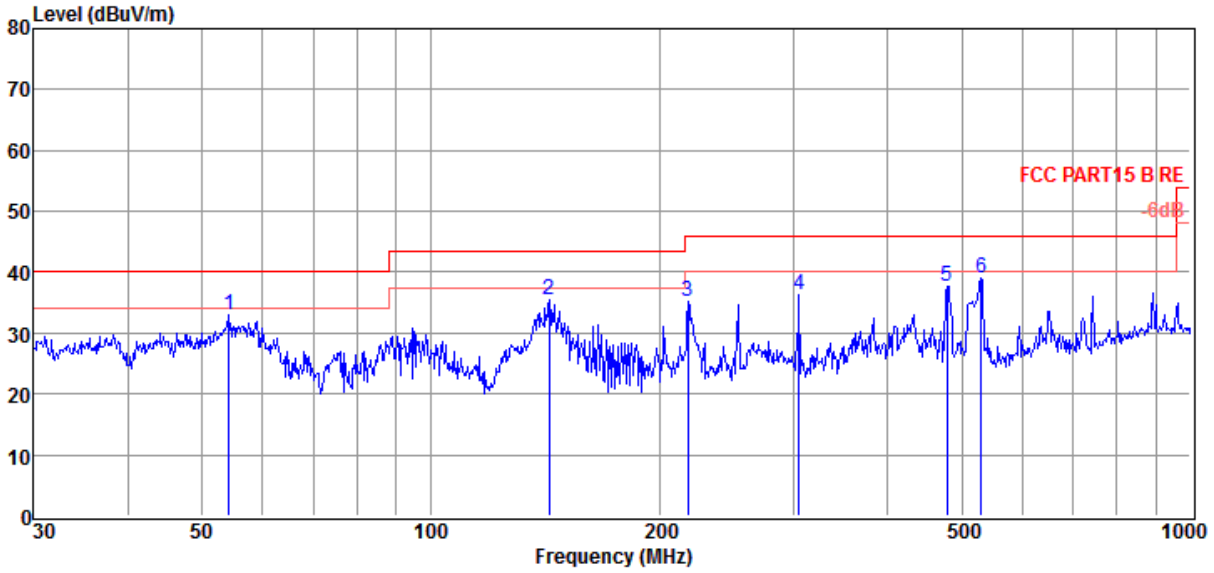
Frequency (MHz)	Corrected Reading (dBμV/m)@3m	FCC Limit (dBμV/m) @3m	Over Limit (dB)	Detector
---	---	---	---	***QP***

Remark:
1. Over Limit = Emission level - Limit value
2. "---" states emission level at least lower than limit 20dB, so without recorded any values;

For 30MHz to 1000MHz



Item (Mark)	Frequency (MHz)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss dB	Result Level (dBμV/m)	Limit Line (dBμV/m)	Over Limit (dB)	Detector	Polarization
1	81.35	18.52	9.15	1.36	29.03	40.00	-10.97	QP	HORIZONTAL
2	148.44	19.46	8.67	1.79	29.92	43.50	-13.58	QP	HORIZONTAL
3	218.22	20.94	10.90	2.20	34.04	46.00	-11.96	QP	HORIZONTAL
4	744.92	12.50	19.33	4.52	36.35	46.00	-9.65	QP	HORIZONTAL
5	782.79	13.76	20.17	4.66	38.59	46.00	-7.41	QP	HORIZONTAL
6	894.06	14.36	22.03	4.95	41.34	46.00	-4.66	QP	HORIZONTAL



Item (Mark)	Frequency (MHz)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss dB	Result Level (dBμV/m)	Limit Line (dBμV/m)	Over Limit (dB)	Detector	Polarization
1	54.61	16.96	14.20	1.09	32.25	40.00	-7.75	QP	VERTICAL
2	143.98	25.42	8.83	1.72	35.97	43.50	-7.53	QP	VERTICAL
3	217.79	22.48	10.90	2.20	35.58	46.00	-10.42	QP	VERTICAL
4	305.68	19.82	13.50	2.72	36.04	46.00	-9.96	QP	VERTICAL
5	479.42	18.56	15.98	3.62	38.16	46.00	-7.84	QP	VERTICAL
6	531.34	19.43	16.51	3.73	39.67	46.00	-6.33	QP	VERTICAL

Remark:
1. Over Limit = Emission level - Limit value
2. "---" states emission level at least lower than limit 20dB, so without recorded any values;
3. Result Level = Read Level + Antenna Factor + Cable loss - PRM Factor.

For 1GHz to 25GHz

Low Channel @ Channel 00 @ 2402 MHz

Item (Mark)	Freq (MHz)	Read Level (dBμV)	Antenna Factor (dB/m)	PRM Factor dB	Cable Loss (dB)	Result Level (dBμV/m)	Limit Line (dBμV/m)	Over Limit (dB)	Detector	Polarization
1	4804.00	35.81	35.40	29.13	12.07	54.15	74.00	-19.85	Peak	Horizontal
1	4804.00	24.28	35.40	29.13	12.07	42.62	54.00	-11.38	AV[1]	Horizontal
2	7206.00	33.97	37.22	29.68	15.18	56.69	74.00	-17.31	Peak	Horizontal
2	7206.00	20.63	37.22	29.68	15.18	43.35	54.00	-10.65	AV[1]	Horizontal

Item (Mark)	Freq (MHz)	Read Level (dBμV)	Antenna Factor (dB/m)	PRM Factor dB	Cable Loss (dB)	Result Level (dBμV/m)	Limit Line (dBμV/m)	Over Limit (dB)	Detector	Polarization
1	4804.00	31.72	35.40	29.13	12.07	50.06	74.00	-23.94	Peak	Vertical
1	4804.00	22.79	35.40	29.13	12.07	41.13	54.00	-12.87	AV[1]	Vertical
2	7206.00	30.62	37.22	29.68	15.18	53.34	74.00	-20.66	Peak	Vertical
2	7206.00	19.18	37.22	29.68	15.18	41.90	54.00	-12.10	AV[1]	Vertical

Middle Channel @ Channel 19 @ 2440 MHz

Item (Mark)	Freq (MHz)	Read Level (dBμV)	Antenna Factor (dB/m)	PRM Factor dB	Cable Loss (dB)	Result Level (dBμV/m)	Limit Line (dBμV/m)	Over Limit (dB)	Detector	Polarization
1	4880.00	38.90	35.51	29.08	12.04	57.37	74.00	-16.63	Peak	Horizontal
1	4880.00	27.41	35.51	29.08	12.04	45.88	54.00	-8.12	AV[1]	Horizontal
2	7320.00	36.55	37.30	29.88	15.32	59.29	74.00	-14.71	Peak	Horizontal
2	7320.00	25.01	37.30	29.88	15.32	47.75	54.00	-6.25	AV[1]	Horizontal

Item (Mark)	Freq (MHz)	Read Level (dBμV)	Antenna Factor (dB/m)	PRM Factor dB	Cable Loss (dB)	Result Level (dBμV/m)	Limit Line (dBμV/m)	Over Limit (dB)	Detector	Polarization
1	4880.00	33.65	35.51	29.08	12.04	52.12	74.00	-21.88	Peak	Vertical
1	4880.00	24.40	35.51	29.08	12.04	42.87	54.00	-11.13	AV[1]	Vertical
2	7320.00	32.33	37.30	29.88	15.32	55.07	74.00	-18.93	Peak	Vertical
2	7320.00	19.24	37.30	29.88	15.32	41.98	54.00	-12.02	AV[1]	Vertical

High Channel @ Channel 39 @ 2480 MHz

Item (Mark)	Freq (MHz)	Read Level (dBμV)	Antenna Factor (dB/m)	PRM Factor dB	Cable Loss (dB)	Result Level (dBμV/m)	Limit Line (dBμV/m)	Over Limit (dB)	Detector	Polarization
1	4960.00	37.32	35.64	29.04	12.02	55.94	74.00	-18.06	Peak	Horizontal
1	4960.00	26.41	35.64	29.04	12.02	45.03	54.00	-8.97	AV[1]	Horizontal
2	7440.00	36.87	37.37	30.12	15.60	59.72	74.00	-14.28	Peak	Horizontal
2	7440.00	25.03	37.37	30.12	15.60	47.88	54.00	-6.12	AV[1]	Horizontal

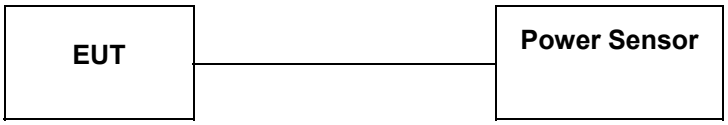
Item (Mark)	Freq (MHz)	Read Level (dBμV)	Antenna Factor (dB/m)	PRM Factor dB	Cable Loss (dB)	Result Level (dBμV/m)	Limit Line (dBμV/m)	Over Limit (dB)	Detector	Polarization
1	4960.00	32.74	35.64	29.04	12.02	51.36	74.00	-22.64	Peak	Vertical
1	4960.00	23.43	35.64	29.04	12.02	42.05	54.00	-11.95	AV[1]	Vertical
2	7440.00	31.69	37.37	30.12	15.60	54.54	74.00	-19.46	Peak	Vertical
2	7440.00	18.57	37.37	30.12	15.60	41.42	54.00	-12.58	AV[1]	Vertical

REMARKS:

1. Result Level = Read Level + Antenna Factor + Cable loss - PRM Factor.
2. The other emission levels were very low against the limit.
3. Over Limit=Emission Level - Limit.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. Detector AV is setting spectrum/receiver. RBW=1MHz/VBW=10Hz/Sweep time=Auto/Detector=Peak;

4.3. Maximum Peak Output Power

TEST CONFIGURATION



TEST PROCEDURE

According to KDB558074 D01 DTS Measurement Guidance Section 9.1 Maximum peak conducted output power,9.1.2.
The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall utilize a fast-responding diode detector.

LIMIT

The Maximum Peak Output Power Measurement is 30dBm.

TEST RESULTS

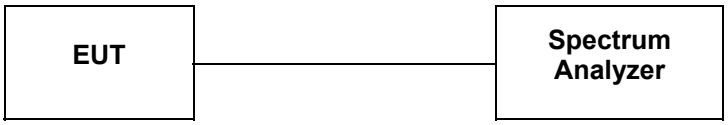
A. Test Verdict

Channel	Frequency (MHz)	Measured Output Peak Power (dBm)	Limits (dBm)	Verdict
00	2402	-5.14	30	PASS
19	2440	-5.27	30	PASS
39	2480	-5.23	30	PASS

Note: 1.The test results including the cable lose.

4.4. Power Spectral Density

TEST CONFIGURATION



TEST PROCEDURE

1.Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2.Set the RBW =100 kHz.
3.Set the VBW =300 KHz.
4.Set the span to 1.5 times the DTS channel bandwidth.
5.Detector = peak.
6.Sweep time = auto couple.
7.Trace mode = max hold.
8.Allow trace to fully stabilize.
9.Use the peak marker function to determine the maximum power level.
10.If measured value exceeds limit,reduce RBW(no less than 3 kHz)and repeat.
11.The resulting peak PSD level must be 8 dBm.

LIMIT

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

TEST RESULTS

A. Test Verdict

Channel	Frequency (MHz)	Report PSD (dBm/100kHz)	Refer to Plot	Limits (dBm/3KHz)	Verdict
00	2402	-6.871	Plot 4.4.1 A	8	PASS
19	2440	-7.028	Plot 4.4.1 B	8	PASS
39	2480	-6.986	Plot 4.4.1 C	8	PASS

B. Test Plots

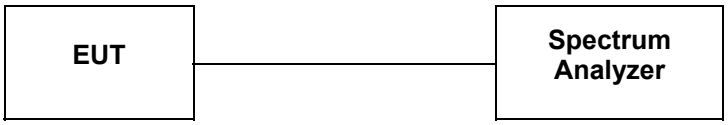
(Plot 4.4.1 A : Channel 00: 2402MHz @ GFSK)

(Plot 4.4.1 B : Channel 19: 2440MHz @ GFSK)

(Plot 4.4.1 C : Channel 39: 2480MHz @ GFSK)

4.5. 6dB Bandwidth

TEST CONFIGURATION



TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with RBW=100 KHz and VBW=300KHz.
The 6dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 6dB.
According to KDB558074 D01 V03 for one of the following procedures may be used to determine the modulated DTS device signal bandwidth.
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.

LIMIT

For digital modulation systems, the minimum 6 dB bandwidth shall be at least 500 kHz

TEST RESULTS

A. Test Verdict

Channel	Frequency (MHz)	6 dB Bandwidth (KHz)	Refer to Plot	Limits (kHz)	Verdict
00	2402	694.9	Plot 4.5.1 A	≥500	PASS
19	2440	704.1	Plot 4.5.1 B	≥500	PASS
39	2480	703.5	Plot 4.5.1 C	≥500	PASS

Note: 1.The test results including the cable lose.

B. Test Plots

(Plot 4.5.1 A: Channel 00: 2402MHz @ GFSK)

(Plot 4.5.1 B: Channel 19: 2440MHz @ GFSK)

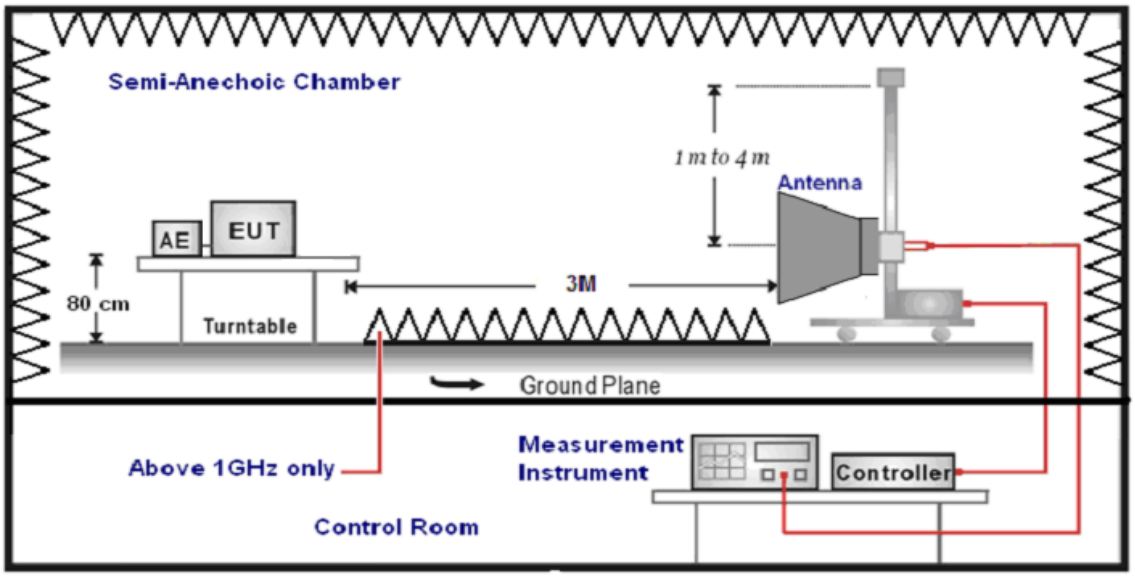
(Plot 4.5.1 C: Channel 39: 2480MHz @ GFSK)

4.6. Band Edge Compliance of RF Emission

TEST REQUIREMENT

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

TEST CONFIGURATION



TEST PROCEDURE

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0℃ to 360℃ to acquire the highest emissions from EUT.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed..
5. The distance between test antenna and EUT was 3 meter:
6. Setting test receiver/spectrum as following table states:

Test Frequency range	Test Receiver/Spectrum Setting	Detector
1GHz-40GHz	Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto Average Value: RBW=1MHz/VBW=10Hz, Sweep time=Auto	Peak

LIMIT

Below -20dB of the highest emission level in operating band.
Radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a)

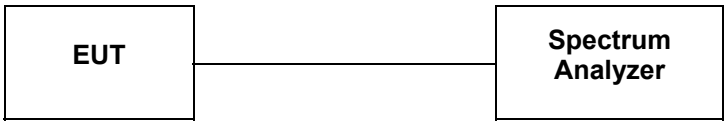
TEST RESULTS

Freq (MHz)	Read Level (dBμV)	Antenna Factor (dB/m)	PRM Factor (dB)	Cable Loss (dB)	Result Level (dBμV/m)	Limit Line (dBμV/m)	Over Limit (dB)	Detector	Polarization
2390.00	40.35	29.99	30.21	8.35	48.48	74.00	-25.52	Peak	Horizontal
2390.00	31.81	29.99	30.21	8.35	39.94	54.00	-14.06	AV[1]	Horizontal
2390.00	35.23	29.99	30.21	8.35	43.36	74.00	-30.64	Peak	Vertical
2390.00	29.58	29.99	30.21	8.35	37.71	54.00	-16.29	AV[1]	Vertical
2483.50	51.14	30.25	30.25	8.50	59.64	74.00	-14.36	Peak	Horizontal
2483.50	39.69	30.25	30.25	8.50	48.19	54.00	-5.81	AV[1]	Horizontal
2483.50	44.63	30.25	30.25	8.50	53.13	74.00	-20.87	Peak	Vertical
2483.50	34.22	30.25	30.25	8.50	42.72	54.00	-11.28	AV[1]	Vertical
2491.20	47.96	30.25	30.25	8.50	56.46	74.00	-17.54	Peak	Horizontal
2489.91	37.25	30.25	30.25	8.50	45.75	54.00	-8.25	AV[1]	Horizontal
2500.00	44.52	30.25	30.25	8.50	53.02	74.00	-20.98	Peak	Vertical
2485.56	33.44	30.25	30.25	8.50	41.94	54.00	-12.06	AV[1]	Vertical

REMARKS:
1. Result Level = Read Level + Antenna Factor + Cable loss - PRM Factor.
2. The other emission levels were very low against the limit.
3. Over Limit=Emission Level - Limit.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. Detector AV is setting spectrum/receiver. RBW=1MHz/VBW=10Hz/Sweep time=Auto/Detector=Peak;

4.7. Spurious RF Conducted Emission

TEST CONFIGURATION



TEST PROCEDURE

The Spurious RF conducted emissions compliance of RF radiated emission should be measured by following the guidance in ANSI C63.10-2013 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization etc. Set RBW=100kHz and VBW= 300KHz to measure the peak field strength , and mwasure frequeny range from 9KHz to 26.5GHz.

LIMIT

1. Below -20dB of the highest emission level in operating band.
2. Fall in the restricted bands listed in section 15.205. The maximum permitted average field strength is listed in section 15.209.

TEST RESULTS

Remark: The measurement frequency range is from 9KHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions and bandege measurement data.

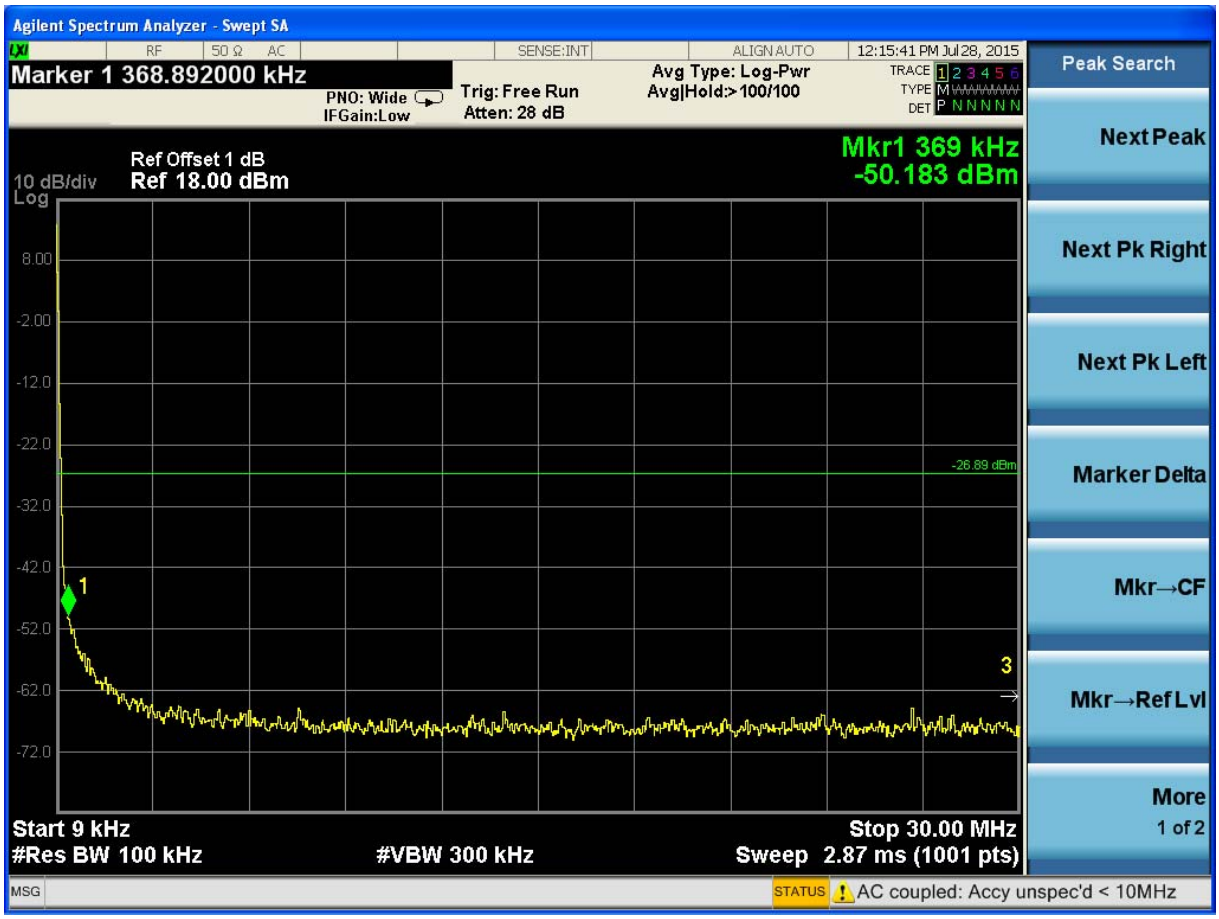
A. Test Verdict

Channel	Frequency (MHz)	Frequency Range	Refer to Plot	Limit (dBc)	Verdict
00	2402	2402MHz	Plot 4.7.1 A1	N/A	PASS
		9KHz-30MHz	Plot 4.7.1 A2	-20	PASS
		30MHz-1GHz	Plot 4.7.1 A3	-20	PASS
		1GHz-8GHz	Plot 4.7.1 A4	-20	PASS
		8GHz-16GHz	Plot 4.7.1 A5	-20	PASS
		16GHz-26.5GHz	Plot 4.7.1 A6	-20	PASS
19	2440	2440MHz	Plot 4.7.1 B1	N/A	PASS
		9KHz-30MHz	Plot 4.7.1 B2	-20	PASS
		30MHz-1GHz	Plot 4.7.1 B3	-20	PASS
		1GHz-8GHz	Plot 4.7.1 B4	-20	PASS
		8GHz-16GHz	Plot 4.7.1 B5	-20	PASS
		16GHz-26.5GHz	Plot 4.7.1 B6	-20	PASS
39	2480	2480MHz	Plot 4.7.1 C1	N/A	PASS
		9KHz-30MHz	Plot 4.7.1 C2	-20	PASS
		30MHz-1GHz	Plot 4.7.1 C3	-20	PASS
		1GHz-8GHz	Plot 4.7.1 C4	-20	PASS
		8GHz-16GHz	Plot 4.7.1 C5	-20	PASS
		16GHz-26.5GHz	Plot 4.7.1 C6	-20	PASS

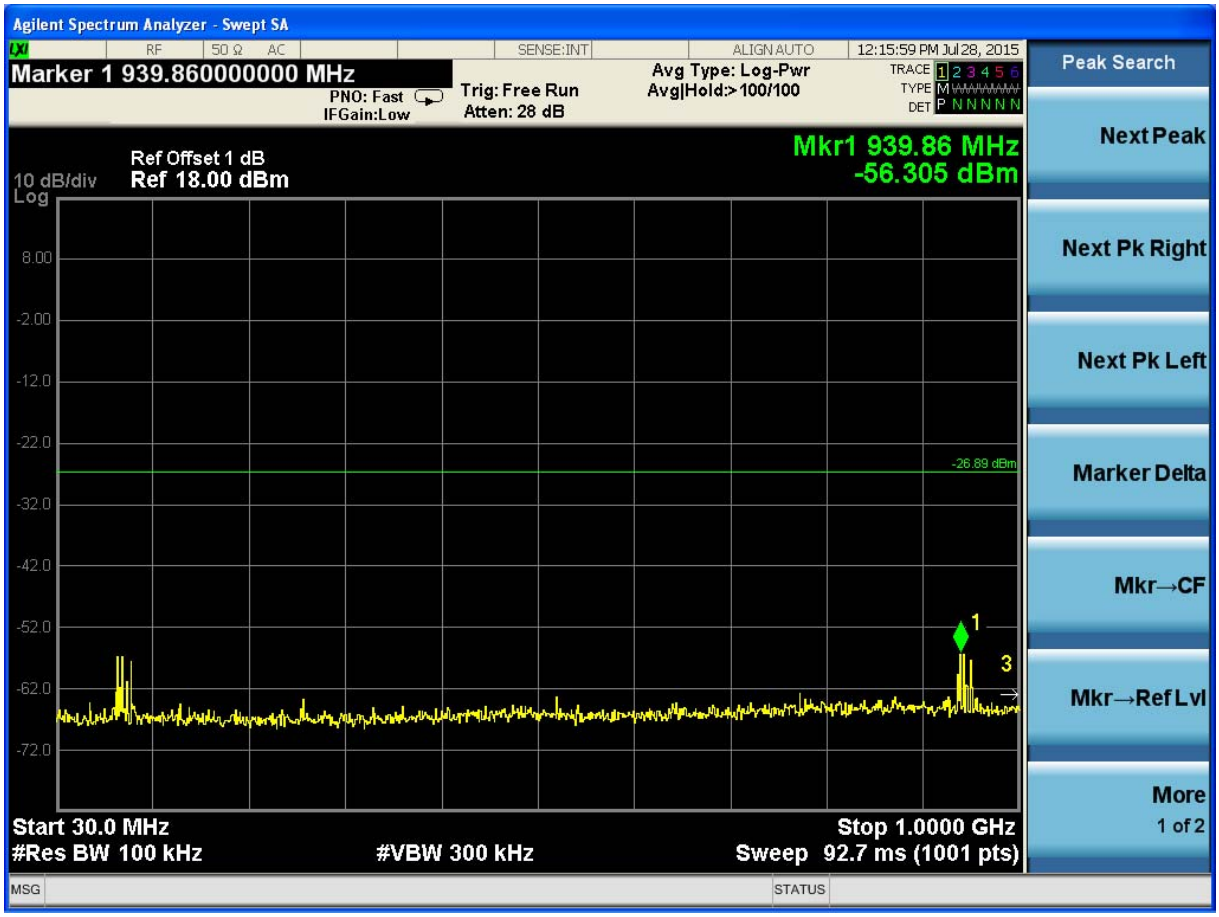
Frequency (MHz)	Delta Peak to Band emission (dBc)	Detector	Limit (dBc)	Refer to Plot	Verdict
2400.00	-53.055	Peak	-20	Plot 4.7.1 D	PASS
2483.50	-55.423	Peak	-20	Plot 4.7.1 E	PASS

B. Test Plots

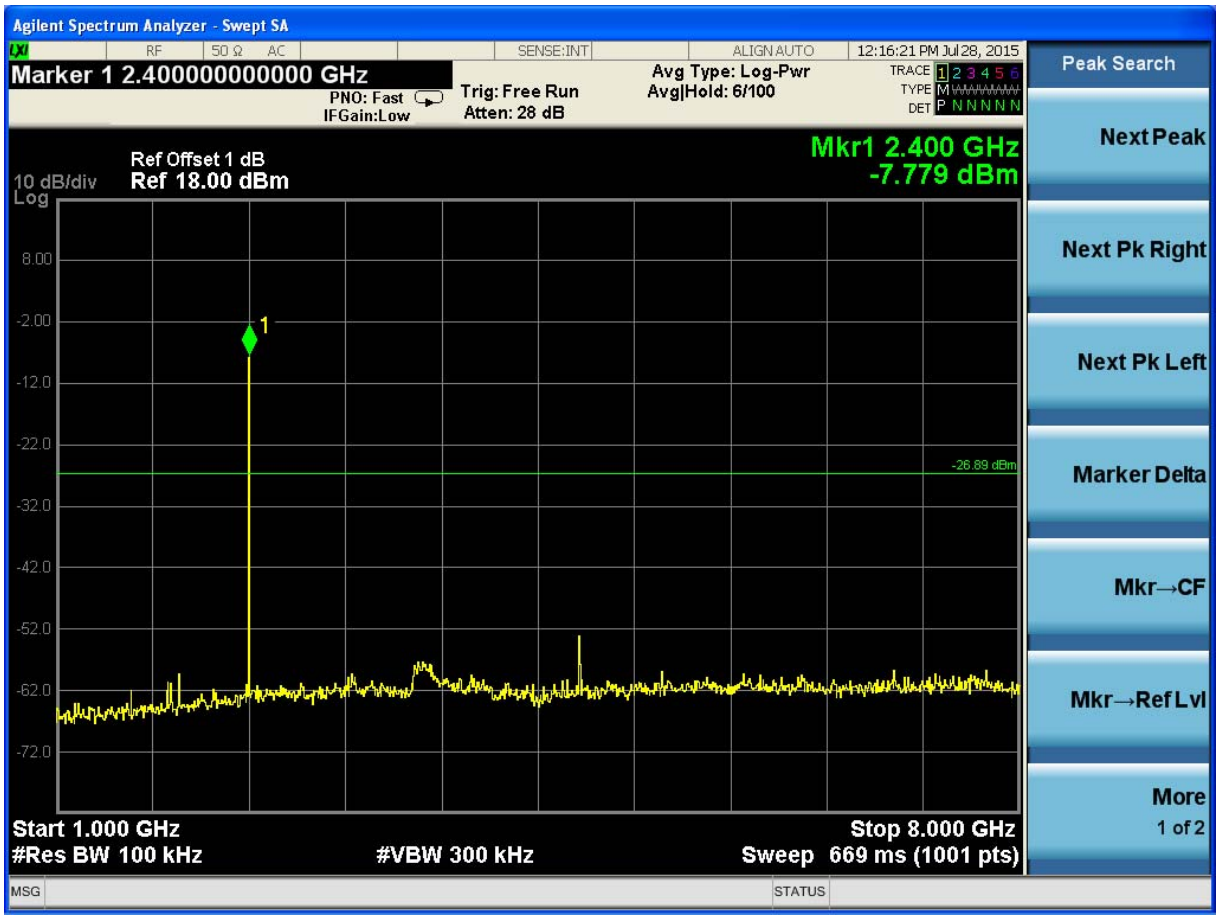
(Plot 4.7.1 A1: Channel 00: 2402MHz @ GFSK)



(Plot 4.7.1 A2: Channel 00: 2402MHz @ GFSK)



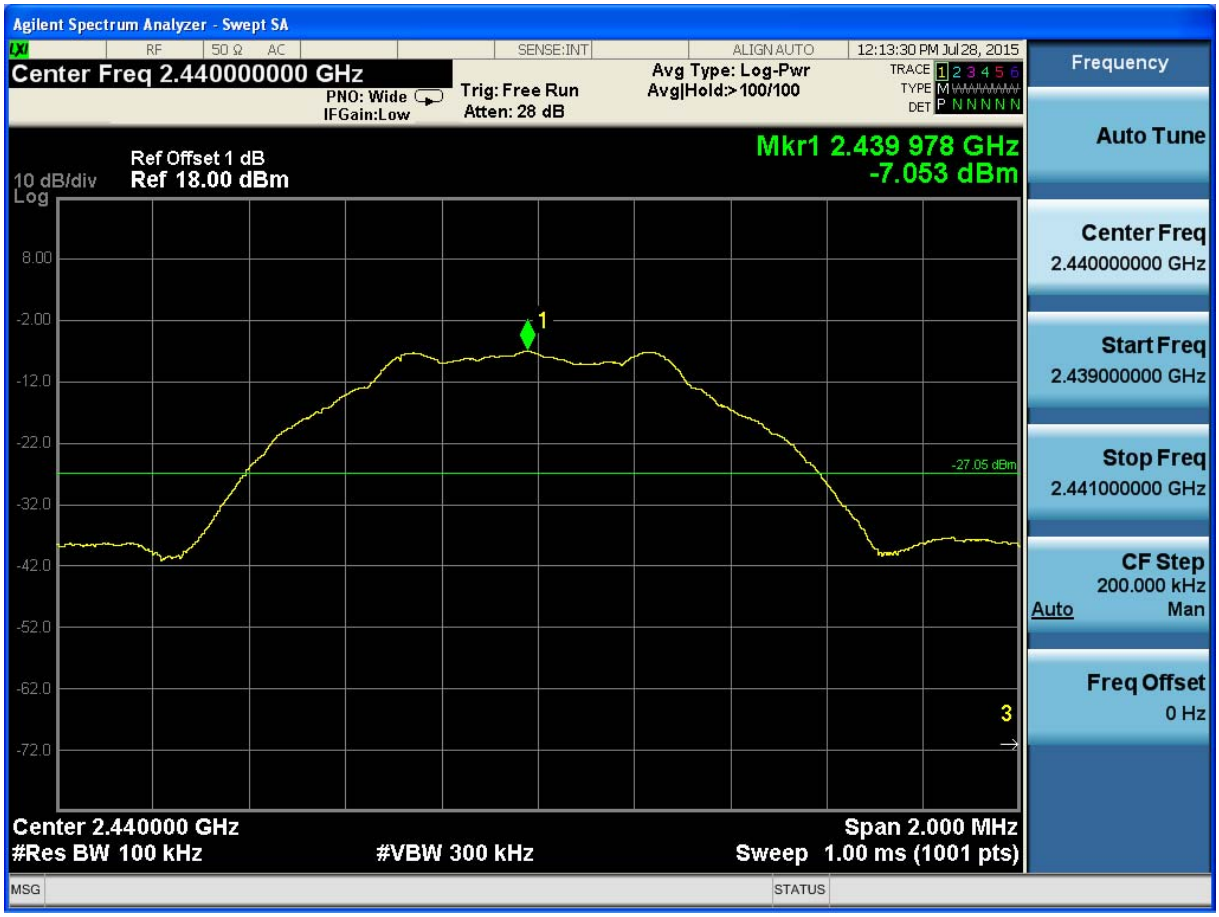
(Plot 4.7.1 A3: Channel 00: 2402MHz @ GFSK)



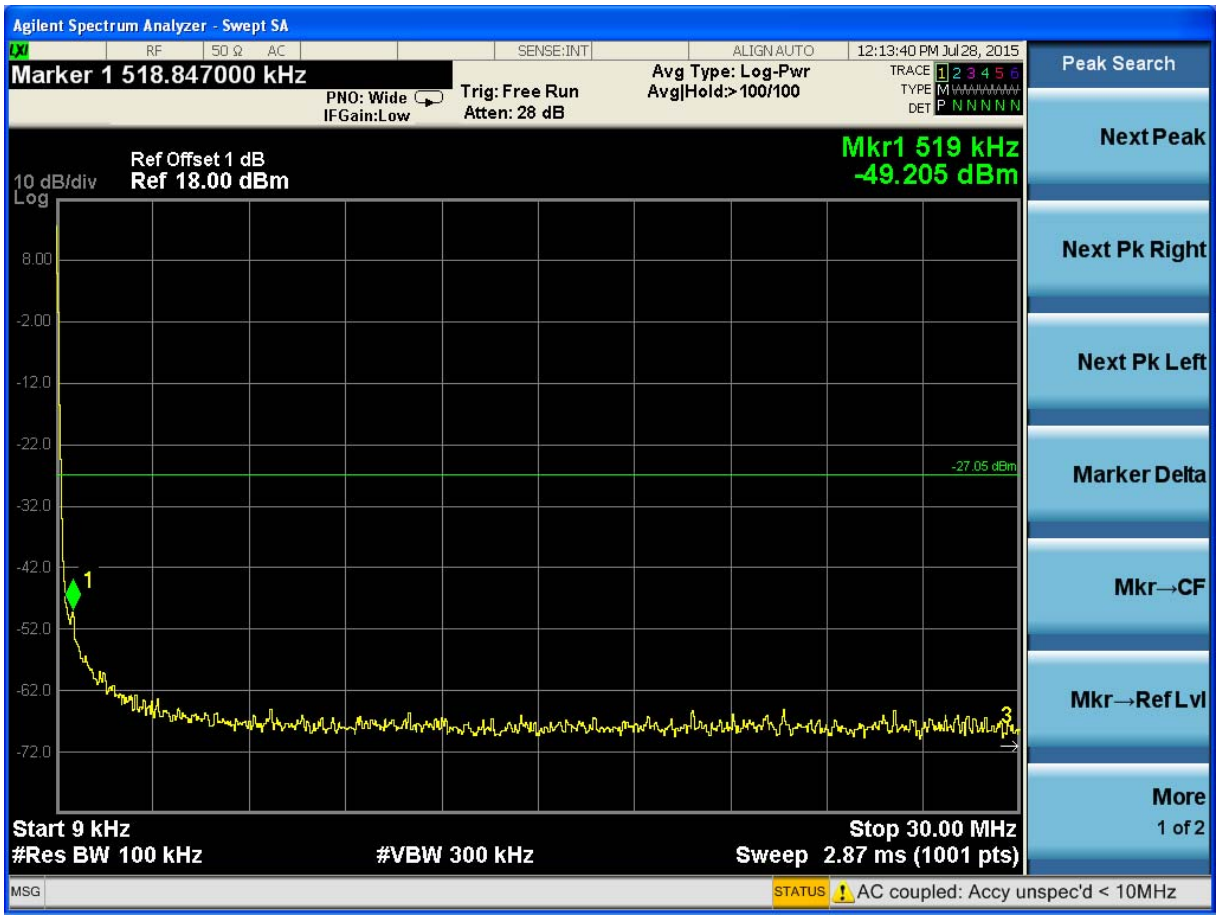
(Plot 4.7.1 A4: Channel 00: 2402MHz @ GFSK)

(Plot 4.7.1 A5: Channel 00: 2402MHz @ GFSK)

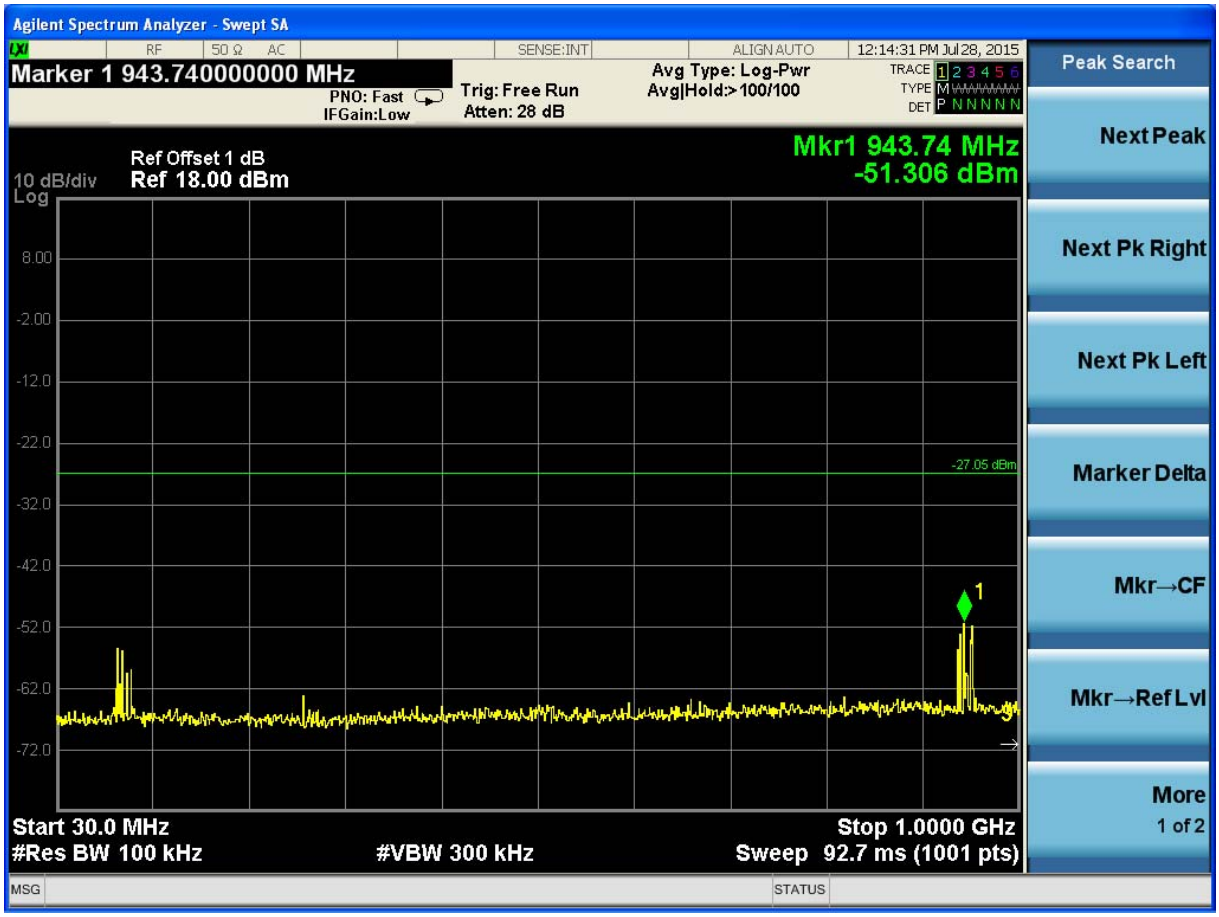
(Plot 4.7.1 A6: Channel 00: 2402MHz @ GFSK)



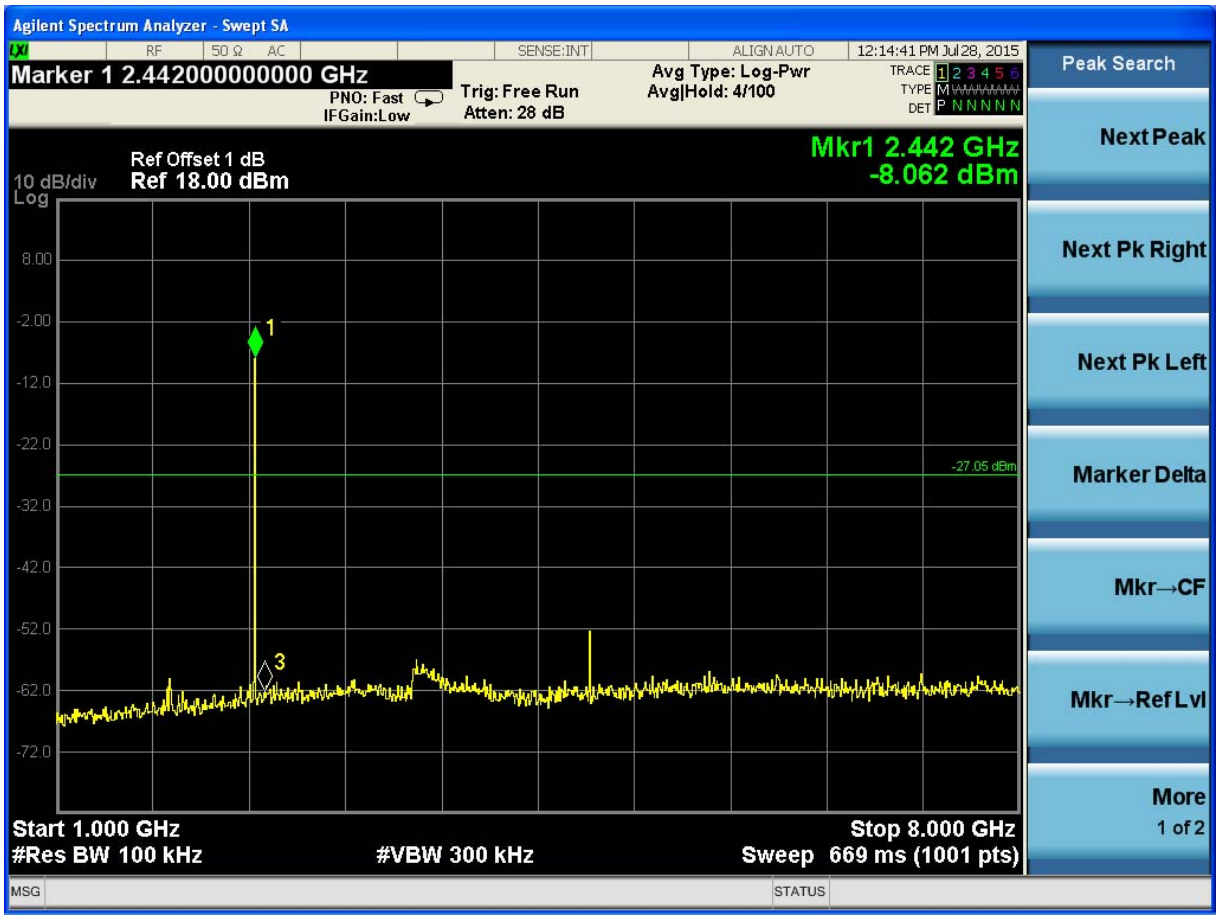
(Plot 4.7.1 B1: Channel 19: 2440MHz @ GFSK)



(Plot 4.7.1 B2: Channel 19: 2440MHz @ GFSK)

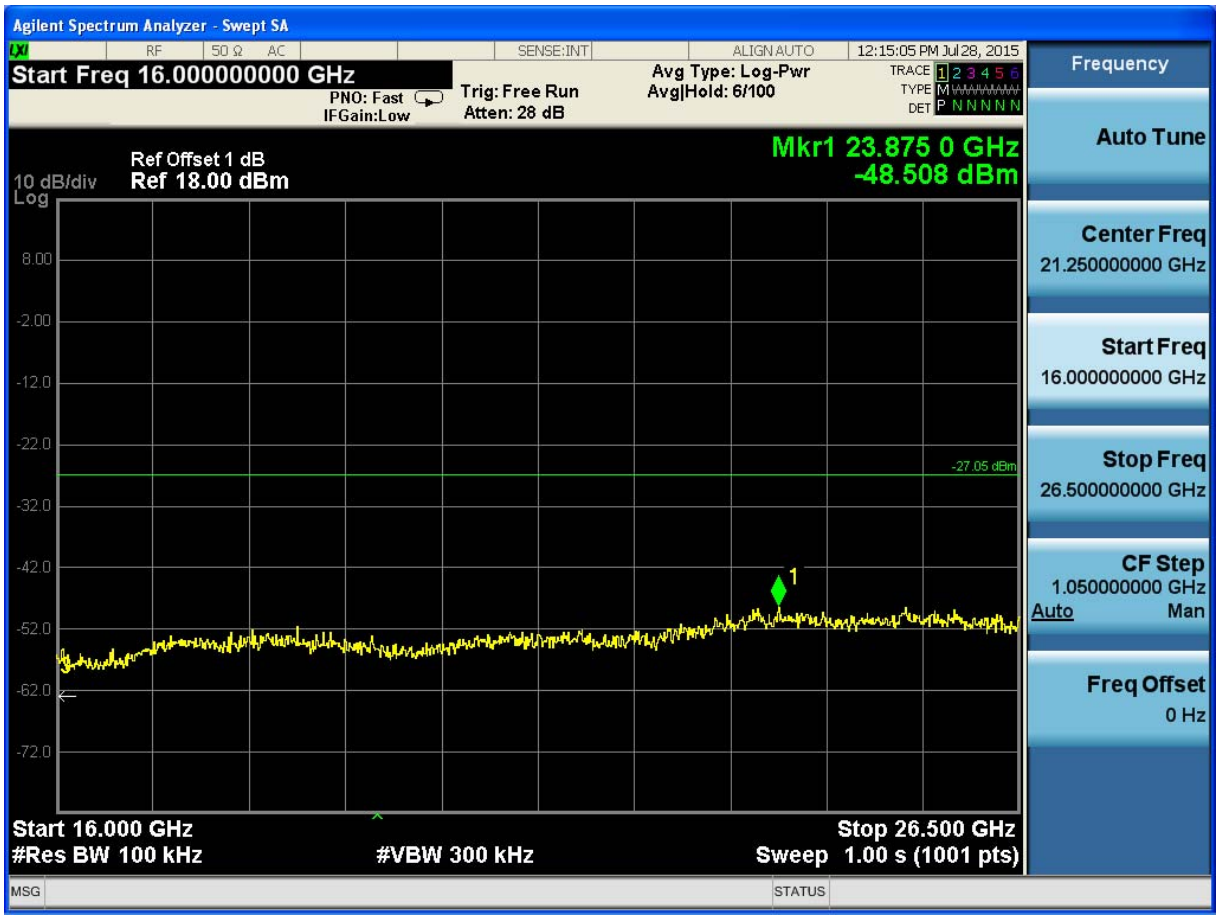


(Plot 4.7.1 B3: Channel 19: 2440MHz @ GFSK)



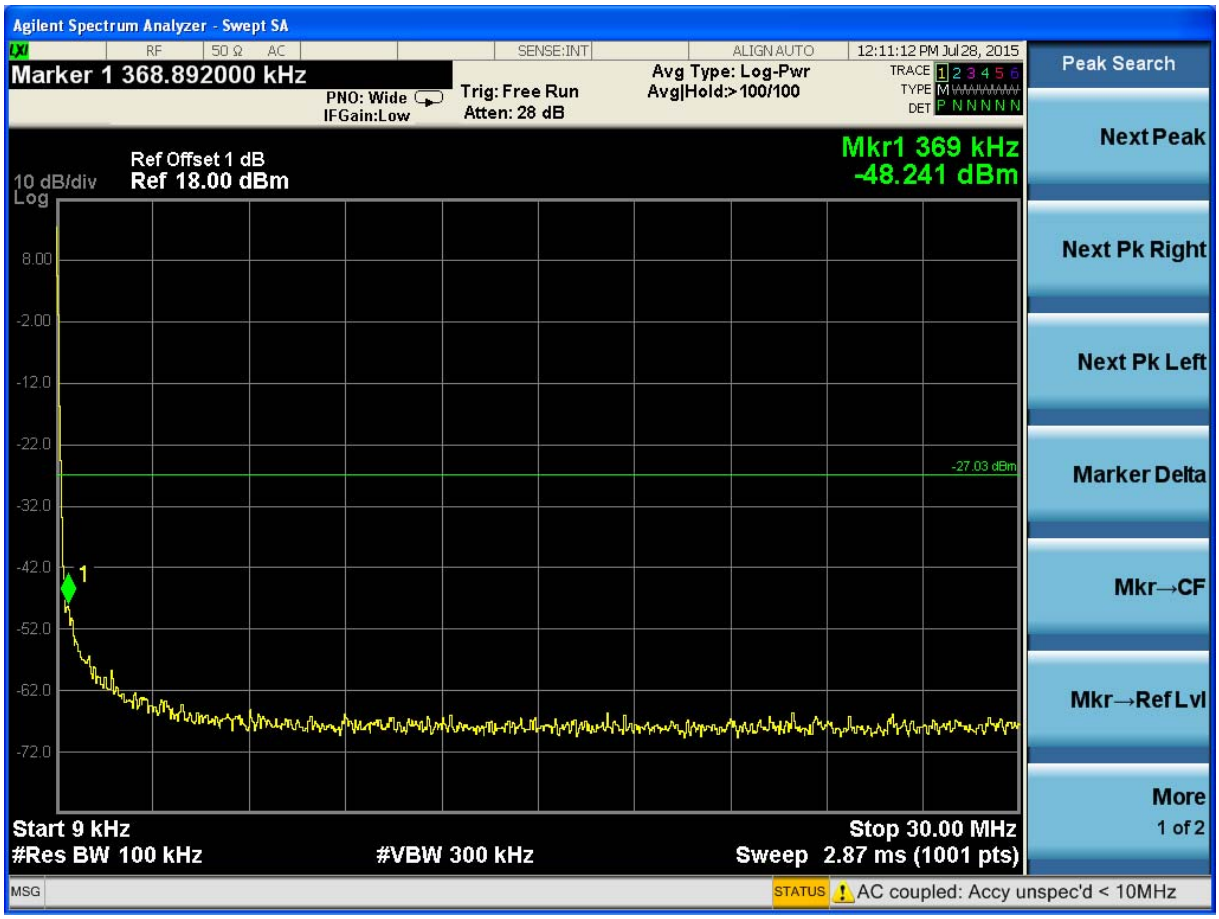
(Plot 4.7.1 B4: Channel 19: 2440MHz @ GFSK)

(Plot 4.7.1 B5: Channel 19: 2440MHz @ GFSK)

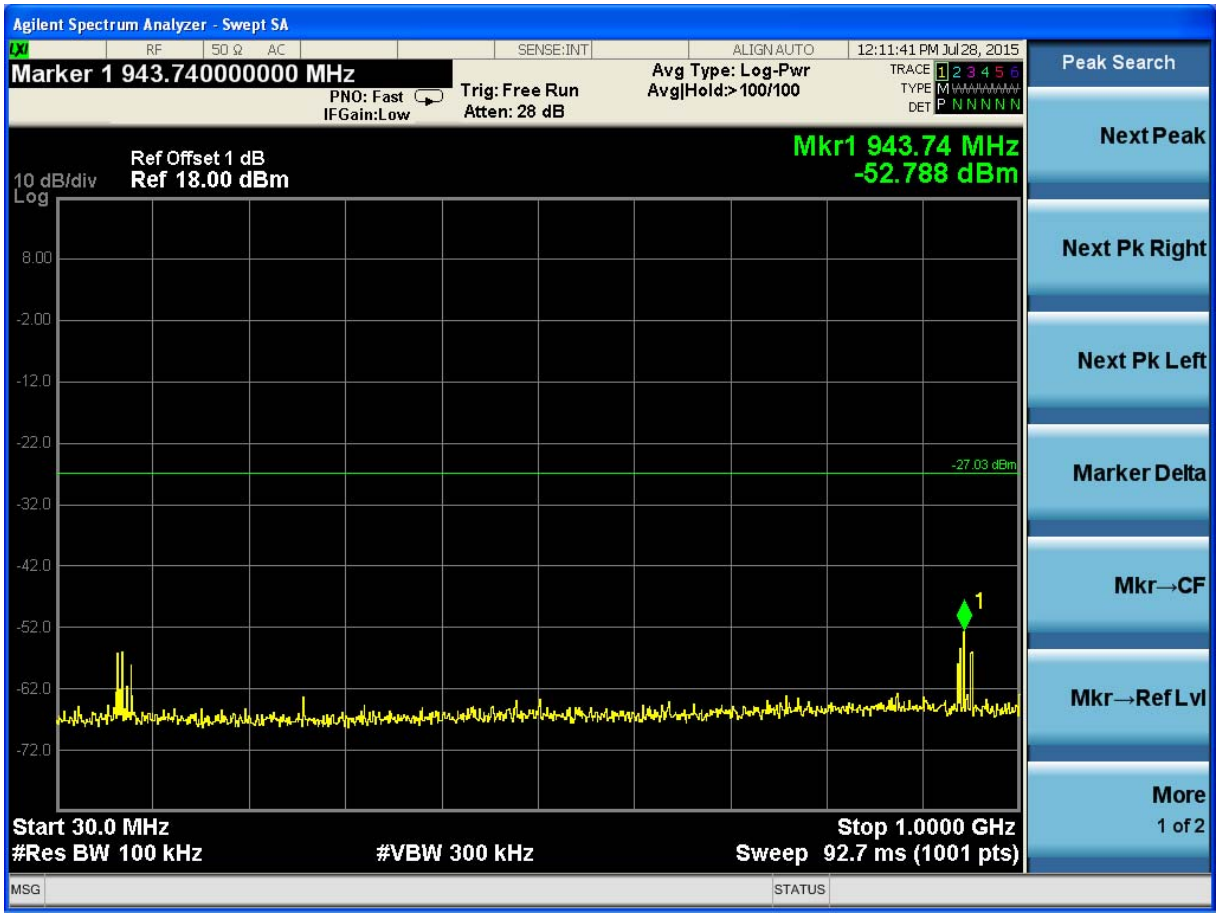


(Plot 4.7.1 B6: Channel 19: 2440MHz @ GFSK)

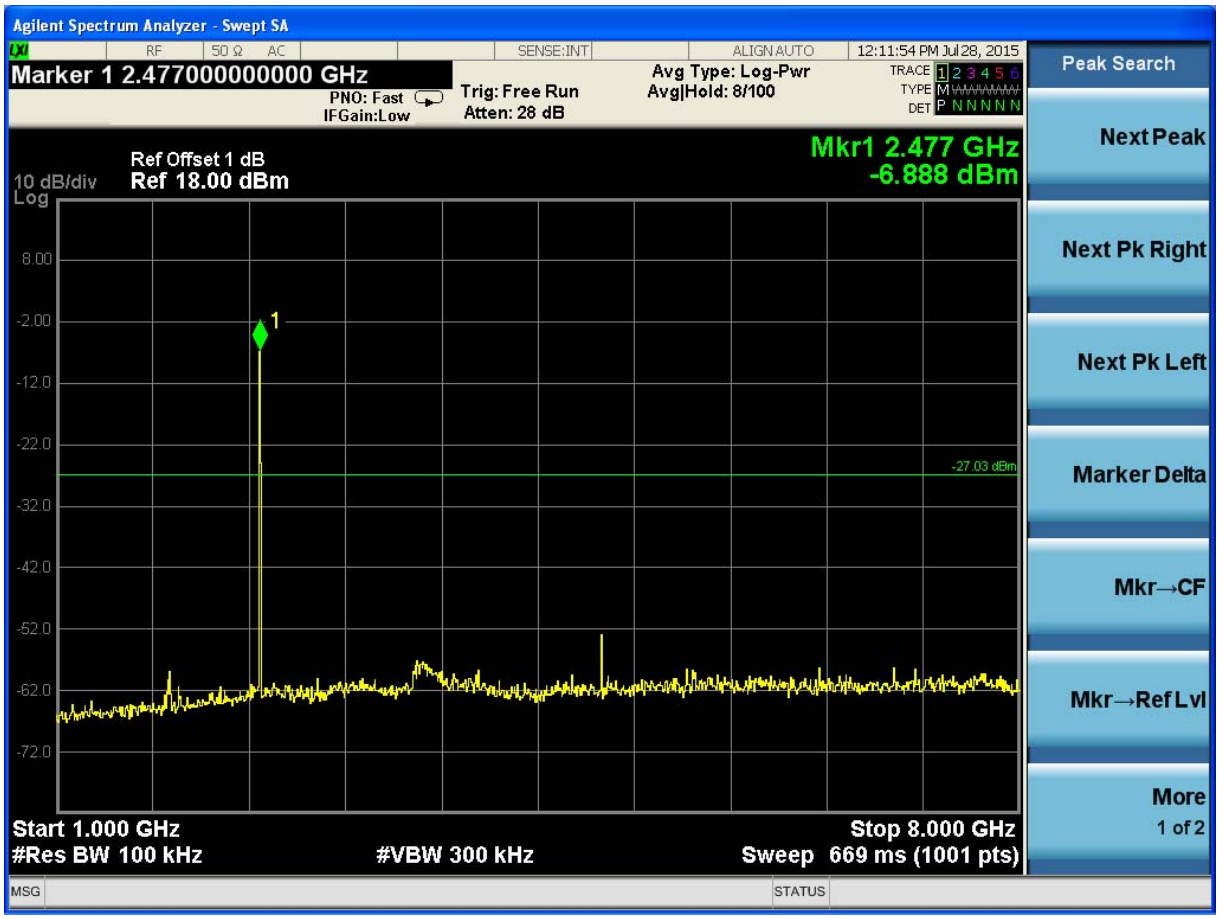
(Plot 4.7.1 C1: Channel 39: 2480MHz @ GFSK)



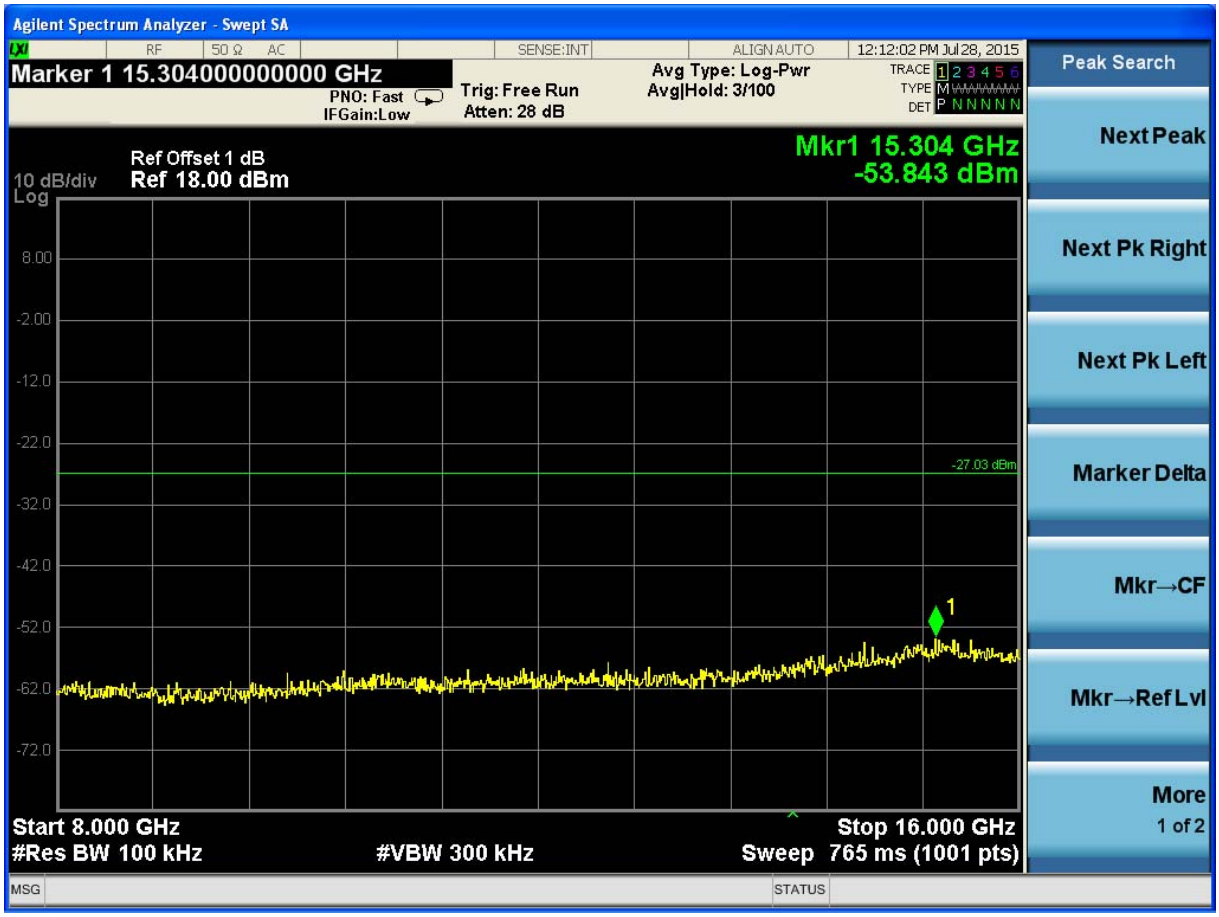
(Plot 4.7.1 C2: Channel 39: 2480MHz @ GFSK)



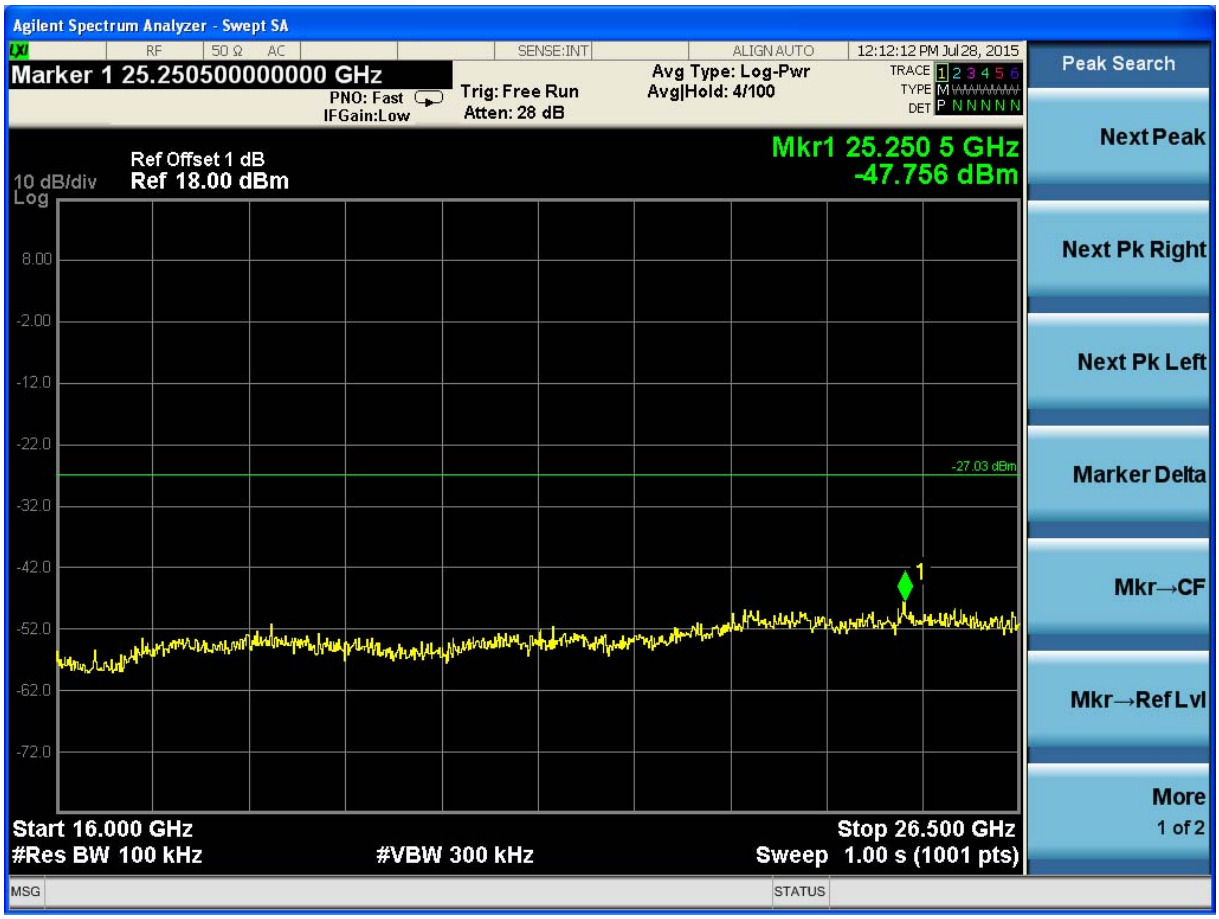
(Plot 4.7.1 C3: Channel 39: 2480MHz @ GFSK)



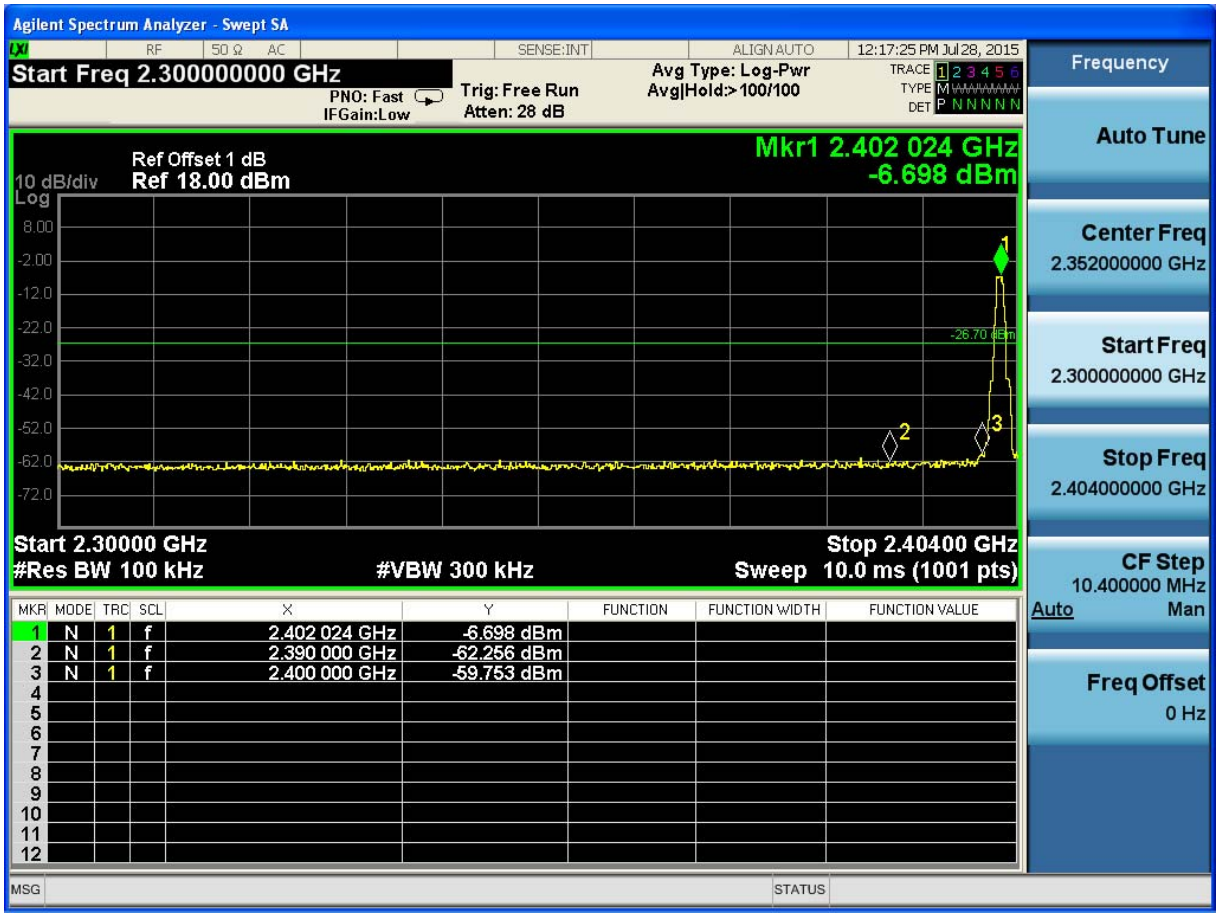
(Plot 4.7.1 C4: Channel 39: 2480MHz @ GFSK)



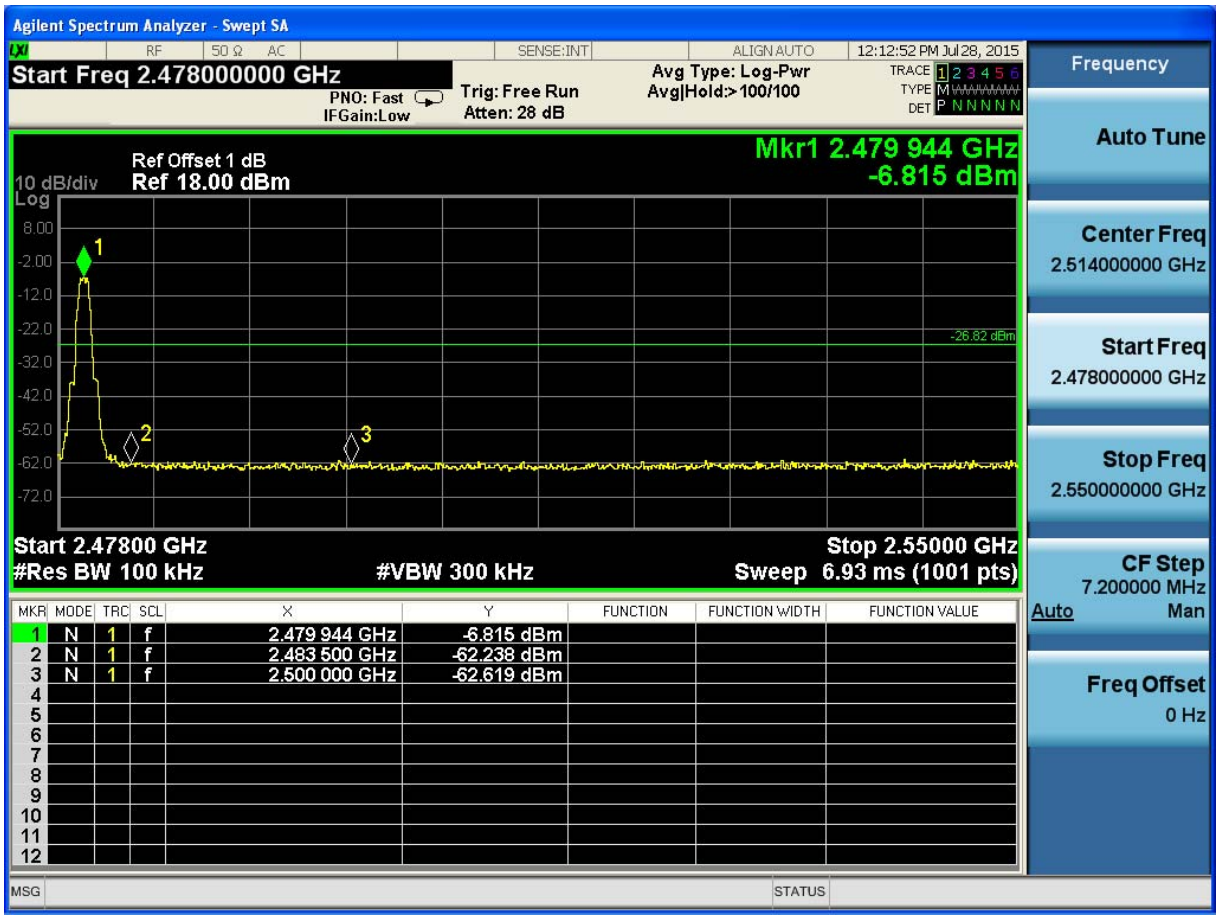
(Plot 4.7.1 C5: Channel 39: 2480MHz @ GFSK)



(Plot 4.7.1 C6: Channel 39: 2480MHz @ GFSK)



(Plot 4.7.1 D: Channel 00: 2402MHz @ GFSK)



(Plot 4.7.1 E: Channel 39: 2480MHz @ GFSK)

4.8. Antenna Requirement

Standard Applicable

For intentional device, according to FCC 47 CFR Section 15.203, 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.

And according to FCC 47 CFR Section 15.247 (c), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

Refer to statement below for compliance

The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. Further, this requirement does not apply to intentional radiators that must be professionally installed.

Measurement

The antenna gain of the complete system is calculated by the difference of radiated power in EIRP and the conducted power of the module.

Measurement parameters

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	1MHz
Video bandwidth:	3MHz
Trace-Mode:	Max hold

Limits

FCC	IC
Antenna Gain	
6 dBi	

Results

T_{nom}	V_{nom}	Lowest Channel 2402 MHz	Middle Channel 2440 MHz	Highest Channel 2480 MHz
Conducted power [dBm] Measured with GFSK modulation		-5.326	-5.417	-5.298
Radiated power [dBm] Measured with GFSK modulation		-7.629	-6.793	-7.971
Gain [dBi] Calculated		-2.303	-1.376	-2.673
Measurement uncertainty		± 0.6 dB (cond.) / ± 2.56 dB (rad.)		

.....End of Report.....