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# TEST REPORT

## FCC PART 15.247

Report Reference No.: CTL1606012027-WF-03

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Product Name.....: Smartwatch

Model/Type reference.....: HB03

List Model(s).....: HB04, HB05, HB06, HB07, HB08, G4, G5, G6, G7

Trade Mark.....: HOPU

FCC ID.....: 2AIZ6-HB03

Applicant's name.....: Shenzhen HOPU Smart-Tech Co., Limited

Address of applicant.....: F5, Bldg4, Hua Feng No.1 Science & Technology Zone, Xixiang street, Bao'an District, Shenzhen, China

Test Firm.....: Shenzhen CTL Testing Technology Co., Ltd.

Address of Test Firm.....: Floor 1-A, Baisha Technology Park, No.3011, Shahexi Road, Nanshan District, Shenzhen, China 518055

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 Testing Technology Co., Ltd.

Master TRF.....: Dated 2011-01

Date of Receipt.....: Jun. 02, 2016

Date of Test Date.....: Jun. 26, 2016 –Jul. 05, 2016

Data of Issue.....: Jul. 06, 2016

Result.....: Pass

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# TEST REPORT

<b>Test Report No. :</b>	<b>CTL1606012027-WF-03</b>	Jul. 06, 2016
		Date of issue

Equipment under Test : Smartwatch

Model /Type : HB03

Listed Models : HB04, HB05, HB06, HB07, HB08, G4, G5, G6, G7

**Applicant** : **Shenzhen HOPU Smart-Tech Co.,Limited**

Address : F5, Bldg4, Hua Feng No.1 Science &Technology  
Zone, Xixiang street, Bao'an District, Shenzhen,  
China

**Manufacturer** : **Shenzhen YQT Electronic Technology Co.,Ltd**

Address : F5, Bldg4, Hua Feng No.1 Science &Technology  
Zone, Xixiang street, Bao'an District, Shenzhen,  
China

<b>Test result</b>	<b>Pass *</b>
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\*In the configuration tested, the EUT complied with the standards specified page 5.

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.

**\*\* Modified History \*\***

Revisions	Description	Issued Data	Report No.	Remark
Version 1.0	Initial Test Report Release	2016-07-06	CTL1606012027-WF-03	Tracy Qi



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# 1. SUMMARY

## 1.1. 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

## 1.2. Test Description

FCC PART 15.247		
FCC Part 15.207	AC Power Conducted Emission	PASS
FCC Part 15.247(a)(1)(i)	20dB Bandwidth	PASS
FCC Part 15.247(d)	Spurious RF Conducted Emission	PASS
FCC Part 15.247(b)	Maximum Peak Output Power	PASS
FCC Part 15.247(b)	Pseudorandom Frequency Hopping Sequence	PASS
FCC Part 15.247(a)(1)(iii)	Number of hopping frequency& Time of Occupancy	PASS
FCC Part 15.247(a)(1)	Frequency Separation	PASS
FCC Part 15.205/15.209	Radiated Emissions	PASS
FCC Part 15.247(d)	Band Edge Compliance of RF Emission	PASS
FCC Part 15.203/15.247 (b)	Antenna Requirement	PASS



### 1.3. Test Facility

#### 1.3.1 Address of the test laboratory

Shenzhen CTL Testing Technology Co., Ltd.

Floor 1-A, Baisha Technology Park, No. 3011, Shahexi Road, Nanshan, Shenzhen 518055 China

There is one 3m semi-anechoic chamber and two line conducted labs for final test. The Test Sites meet the requirements in documents ANSI C63.4 and CISPR 22/EN 55022 requirements.

#### 1.3.2 Laboratory accreditation

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

##### IC Registration No.: 9618B

The 3m alternate test site of Shenzhen CTL Testing Technology Co., Ltd. EMC Laboratory has been registered by Certification and Engineer Bureau of Industry Canada for the performance of with Registration No.: 9618B on November 13, 2013.

##### FCC-Registration No.: 970318

Shenzhen CTL Testing Technology 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 970318, December 19, 2013.

### 1.4. 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 Shenzhen CTL Testing Technology 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 CTL laboratory is reported:

Test	Measurement Uncertainty	Notes
Transmitter power conducted	$\pm 0.57$ dB	(1)
Transmitter power Radiated	$\pm 2.20$ dB	(1)
Conducted spurious emission 9KHz-40 GHz	$\pm 2.20$ dB	(1)
Occupied Bandwidth	$\pm 0.01$ ppm	(1)
Radiated Emission 30~1000MHz	$\pm 4.10$ dB	(1)
Radiated Emission Above 1GHz	$\pm 4.32$ dB	(1)
Conducted Disturbance 0.15~30MHz	$\pm 3.20$ dB	(1)

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

## 2. GENERAL INFORMATION

### 2.1. Environmental conditions

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

Normal Temperature:	25°C
Relative Humidity:	55 %
Air Pressure:	101 kPa

### 2.2. General Description of EUT

Product Name:	Smartwatch
Model/Type reference:	HB03
Power supply:	DC 3.7V from battery
Hardware version:	V1.1
Software version:	V4.0
<b>Bluetooth :</b>	
Version:	Supported BT3.0
Modulation:	GFSK, $\pi/4$ DQPSK, 8DPSK
Operation frequency:	2402MHz~2480MHz
Channel number:	79
Channel separation:	1MHz
Antenna type:	PIFA Antenna
Antenna gain:	-0.61dBi

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

### 2.3. Description of Test Modes and Test Frequency

The Applicant provides communication tools software to control the EUT for staying in continuous transmitting (Duty Cycle more than 98%) and receiving mode for testing .There are 79 channels provided to the EUT and Channel 00/39/78 were selected to test.

#### Operation Frequency :

Channel	Frequency (MHz)
00	2402
01	2403
:	:
38	2440
39	2441
40	2442
:	:
77	2479
78	2480

Preliminary tests were performed in each mode and packet length of BT, and found worst case as below, finally test were conducted at those mode and recorded in this report.

Test Items	Worst case
Conducted Emissions	DH5 Middle channel
Radiated Emissions and Band Edge	DH5
Maximum Conducted Output Power	DH5/2DH5/3DH5
20dB Bandwidth	DH5/2DH5/3DH5
Frequency Separation	DH5/2DH5/3DH5 Middle channel
Number of hopping frequency	DH5/2DH5/3DH5
Time of Occupancy (Dwell Time)	DH1/DH3/DH5 Middle channel 2DH1/2DH3/2DH5 Middle channel 3DH1/3DH3/3DH5 Middle channel
Out-of-band Emissions	DH5/2DH5/3DH5

## 2.4. Equipments Used during the Test

Test Equipment	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Due Date
LISN	R&S	ENV216	3560.6550.1 2	2016/06/02	2017/06/01
LISN	R&S	ESH2-Z5	860014/010	2016/06/02	2017/06/01
Bilog Antenna	Sunol Sciences Corp.	JB1	A061713	2016/06/02	2017/06/01
EMI Test Receiver	R&S	ESCI	103710	2016/06/02	2017/06/01
Spectrum Analyzer	Agilent	E4407B	MY41440676	2016/05/21	2017/05/20
Spectrum Analyzer	Agilent	N9020	US46220290	2016/01/17	2017/01/16
Controller	EM Electronics	Controller EM 1000	N/A	2016/05/21	2017/05/20
Horn Antenna	Sunol Sciences Corp.	DRH-118	A062013	2016/05/19	2017/05/18
Active Loop Antenna	SCHWARZBECK	FMZB1519	1519-037	2016/05/19	2017/05/18
Amplifier	Agilent	8349B	3008A02306	2016/05/19	2017/05/18
Amplifier	Agilent	8447D	2944A10176	2016/05/19	2017/05/18
Temperature/Humidity Meter	Gangxing	CTH-608	02	2016/05/20	2017/05/19
High-Pass Filter	K&L	9SH10-2700/X1 2750-O/O	N/A	2016/05/20	2017/05/19
High-Pass Filter	K&L	41H10-1375/U1 2750-O/O	N/A	2016/05/20	2017/05/19
Coaxial Cables	HUBER+SUHNER	SUCOFLEX 104PEA-10M	10m	2016/06/02	2017/06/01
Coaxial Cables	HUBER+SUHNER	SUCOFLEX 104PEA-3M	3m	2016/06/02	2017/06/01
Coaxial Cables	HUBER+SUHNER	SUCOFLEX 104PEA-3M	3m	2016/06/02	2017/06/01



RF Cable	Megalon	RF-A303	N/A	2016/06/02	2017/06/01
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The calibration interval was one year

## 2.5. Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for FCC ID:2AIZ6-HB03 filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

## 2.6. Modifications

No modifications were implemented to meet testing criteria.



### 3. TEST CONDITIONS AND RESULTS

#### 3.1. Conducted Emissions Test

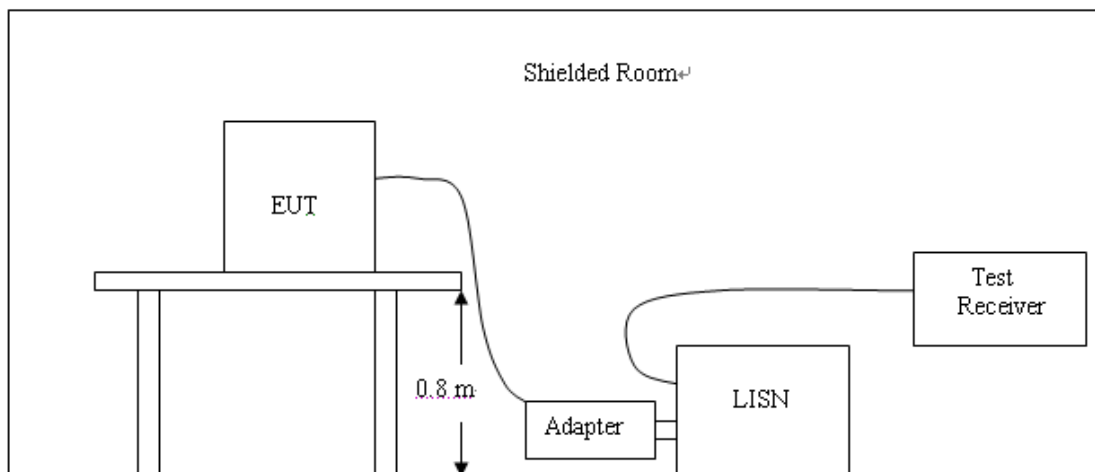
##### LIMIT

FCC CFR Title 47 Part 15 Subpart C Section 15.207

Frequency range (MHz)	Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

\* Decreases with the logarithm of the frequency.

##### TEST CONFIGURATION



##### TEST PROCEDURE

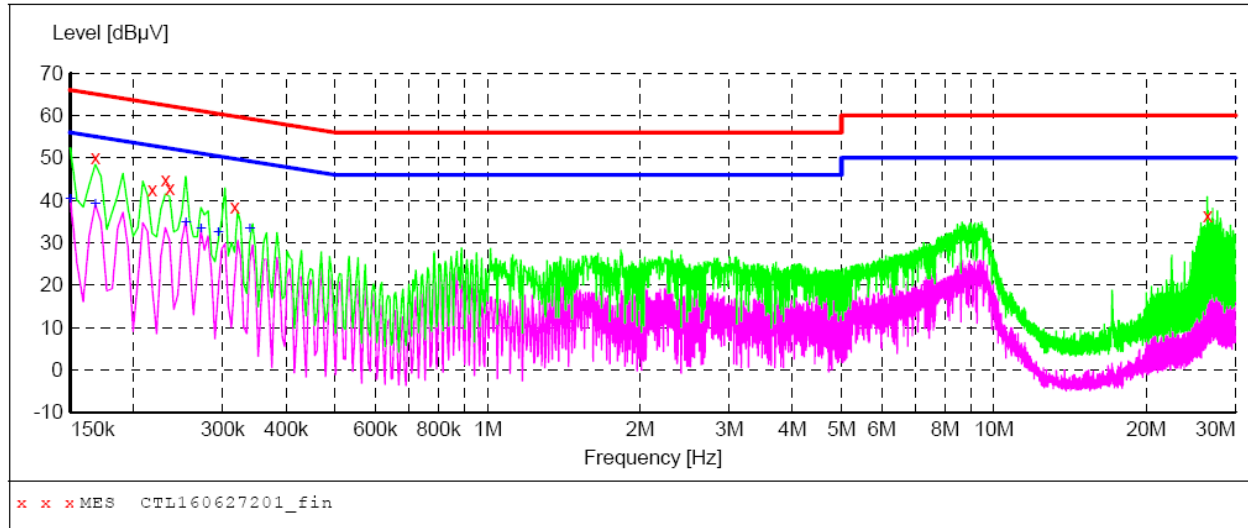
1. The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system; a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10:2013.
2. Support equipment, if needed, was placed as 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 adapter 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.

**TEST RESULTS**

Remark: All modes of GFSK, Pi/4 DQPSK, and 8DPSK were test at Low, Middle, and High channel; only the worst result of 8DPSK High Channel was reported as below:

**SCAN TABLE: "Voltage (9K-30M)FIN"**

Short Description: 150K-30M Voltage

**MEASUREMENT RESULT: "CTL160627201\_fin"**

6/27/2016 9:44AM

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.168001	50.00	10.2	65	15.1	QP	L1	GND
0.217501	42.60	10.2	63	20.3	QP	L1	GND
0.231001	44.90	10.2	62	17.5	QP	L1	GND
0.235501	42.90	10.2	62	19.4	QP	L1	GND
0.316501	38.30	10.2	60	21.5	QP	L1	GND
26.412001	36.30	11.2	60	23.7	QP	L1	GND

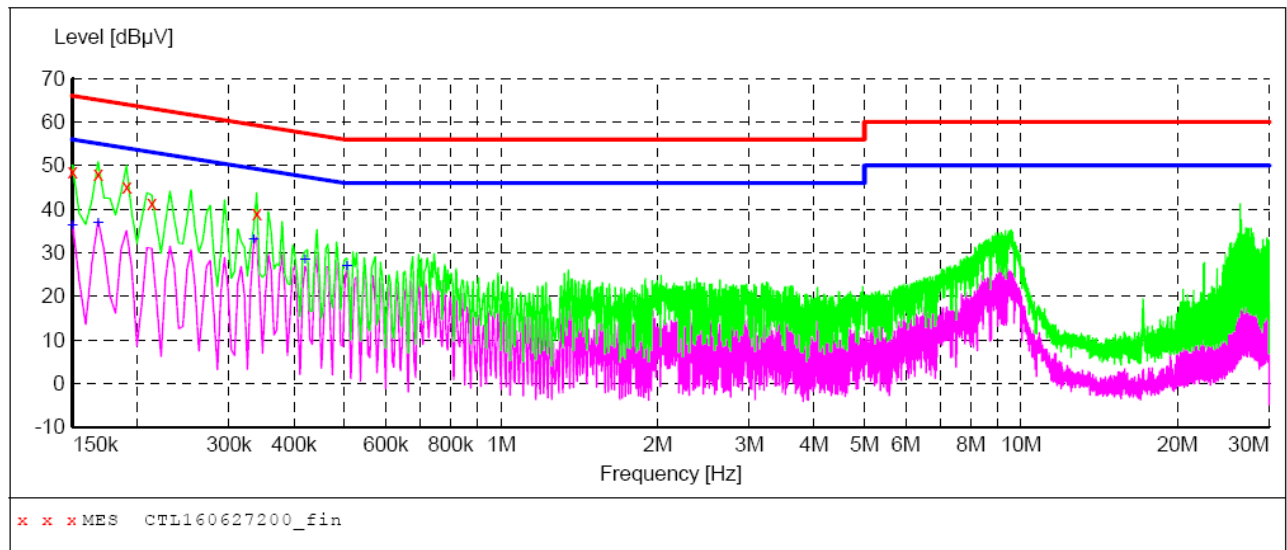
**MEASUREMENT RESULT: "CTL160627201\_fin2"**

6/27/2016 9:44AM

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.150001	40.20	10.2	56	15.8	AV	L1	GND
0.168001	39.10	10.2	55	16.0	AV	L1	GND
0.253501	34.80	10.2	52	16.8	AV	L1	GND
0.271501	33.10	10.2	51	18.0	AV	L1	GND
0.294001	32.20	10.2	50	18.2	AV	L1	GND
0.339001	33.30	10.2	49	15.9	AV	L1	GND

**SCAN TABLE: "Voltage (9K-30M) FIN"**

Short Description: 150K-30M Voltage

**MEASUREMENT RESULT: "CTL160627200\_fin"**

6/27/2016 9:37AM

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.150001	48.60	10.2	66	17.4	QP	N	GND
0.168001	47.90	10.2	65	17.2	QP	N	GND
0.190501	45.00	10.2	64	19.0	QP	N	GND
0.213001	41.50	10.2	63	21.6	QP	N	GND
0.339001	38.90	10.2	59	20.3	QP	N	GND

**MEASUREMENT RESULT: "CTL160627200\_fin2"**

6/27/2016 9:37AM

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Detector	Line	PE
0.150001	36.10	10.2	56	19.9	AV	N	GND
0.168001	36.60	10.2	55	18.5	AV	N	GND
0.334501	32.90	10.2	49	16.4	AV	N	GND
0.420001	28.20	10.2	47	19.2	AV	N	GND
0.505501	26.80	10.2	46	19.2	AV	N	GND

### 3.2. Radiated Emissions and Band Edge

#### Limit

For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emission out of authorized band shall not exceed the following table at a 3 meters measurement distance.

FCC PART 15.249(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

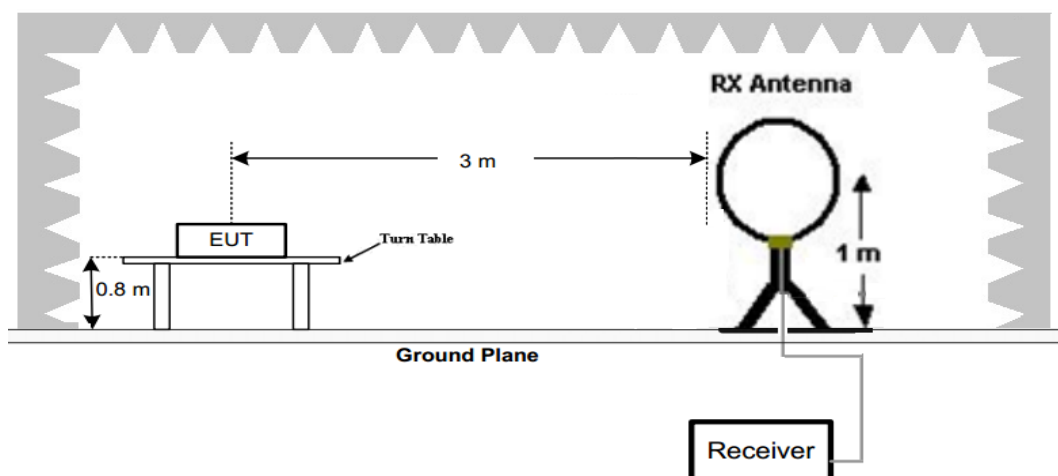
In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a)

Radiated emission limits

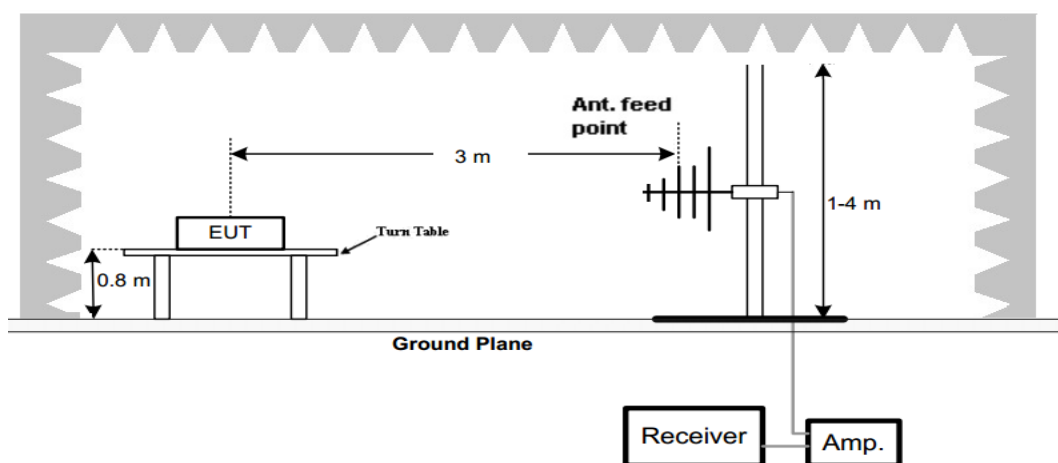
Frequency (MHz)	Distance (Meters)	Radiated (dB $\mu$ V/m)	Radiated ( $\mu$ V/m)
0.009-0.49	3	$20\log(2400/F(\text{KHz}))+40\log(300/3)$	$2400/F(\text{KHz})$
0.49-1.705	3	$20\log(24000/F(\text{KHz}))+40\log(30/3)$	$24000/F(\text{KHz})$
1.705-30	3	$20\log(30)+40\log(30/3)$	30
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

#### TEST CONFIGURATION

(A) Radiated Emission Test Set-Up, Frequency Below 30MHz

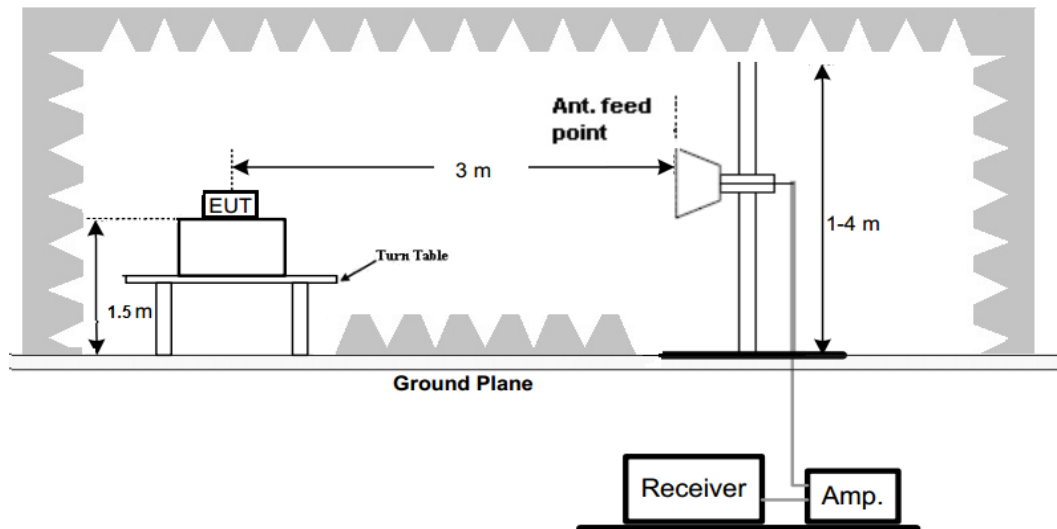


(B) Radiated Emission Test Set-Up, Frequency below 1000MHz





## (C) Radiated Emission Test Set-Up, Frequency above 1000MHz

**Test Procedure**

1. Below 1GHz measurement the EUT is placed on a turntable which is 0.8m above ground plane, and above 1GHz measurement EUT was placed on a low permittivity and low loss tangent turn table which is 1.5m 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.

**TEST RESULTS**

Remark:

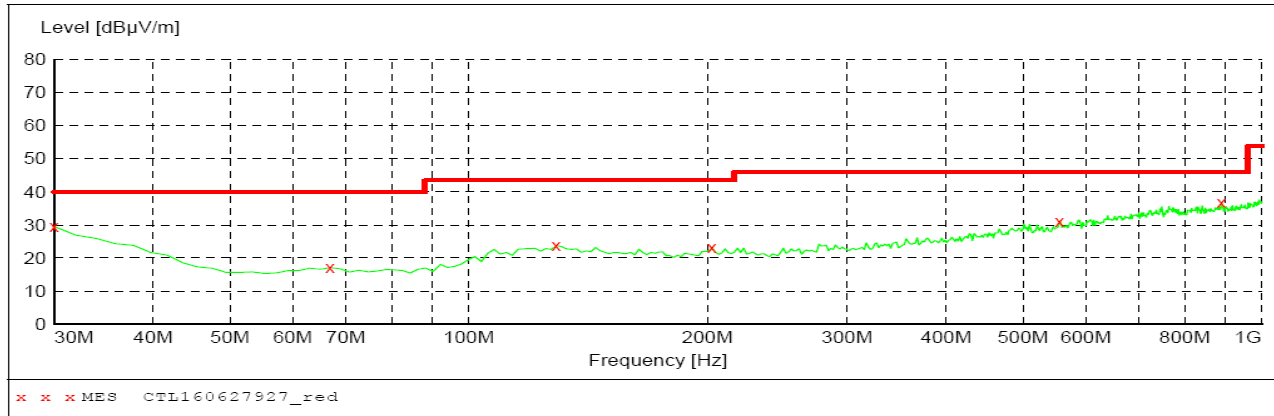
1. We measured Radiated Emission at GFSK,  $\pi/4$  DQPSK and 8DPSK mode from 9 KHz to 25GHz and recorded worst case at GFSK DH5 mode.
2. For below 1GHz testing recorded worst at GFSK DH5 low channel.
3. Radiated emission test from 9 KHz to 10th harmonic of fundamental was verified, and no emission found except system noise floor in 9 KHz to 30MHz and not recorded in this report.

## For 30MHz-1GHz

## Horizontal

**SWEEP TABLE: "test (30M-1G)"**

Short Description:		Field Strength			
Start	Stop	Detector	Meas. Time	IF Bandw.	Transducer
Frequency 30.0 MHz	Frequency 1.0 GHz	MaxPeak	300.0 ms	120 kHz	JB1

**MEASUREMENT RESULT: "CTL160627927\_red"**

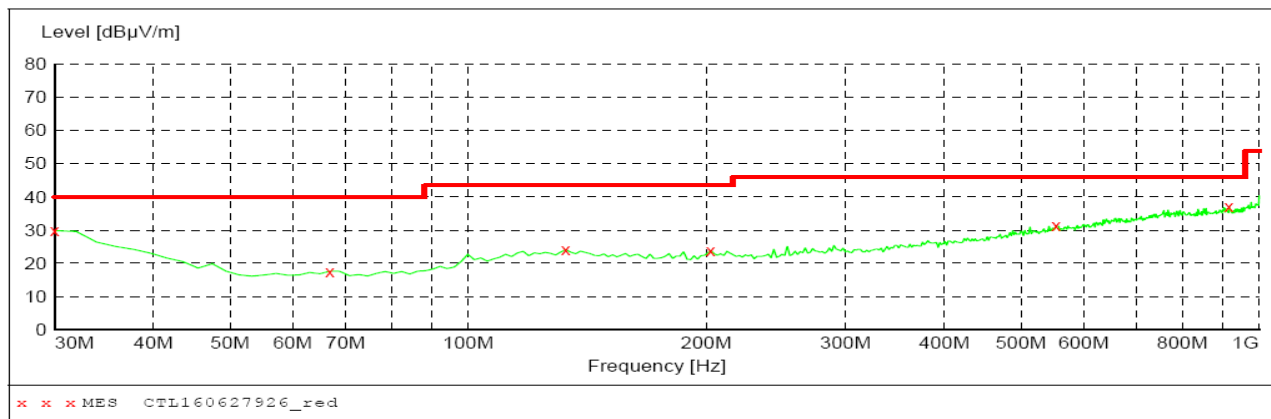
6/27/2016 9:50PM

Frequency MHz	Level dBuV/m	Transd dB	Limit dBuV/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization
30.000000	29.50	20.8	40.0	10.5	---	0.0	0.00	HORIZONTAL
66.860000	17.10	8.2	40.0	22.9	---	0.0	0.00	HORIZONTAL
128.940000	23.80	14.5	43.5	19.7	---	0.0	0.00	HORIZONTAL
202.660000	23.10	14.1	43.5	20.4	---	0.0	0.00	HORIZONTAL
555.740000	31.10	21.1	46.0	14.9	---	0.0	0.00	HORIZONTAL
889.420000	36.70	25.8	46.0	9.3	---	0.0	0.00	HORIZONTAL

## Vertical

**SWEEP TABLE: "test (30M-1G)"**

Short Description:		Field Strength			
Start	Stop	Detector	Meas. Time	IF Bandw.	Transducer
Frequency 30.0 MHz	Frequency 1.0 GHz	MaxPeak	300.0 ms	120 kHz	JB1

**MEASUREMENT RESULT: "CTL160627926\_red"**

6/27/2016 9:49PM

Frequency MHz	Level dBuV/m	Transd dB	Limit dBuV/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization
30.000000	29.80	20.8	40.0	10.2	---	0.0	0.00	VERTICAL
66.860000	17.60	8.2	40.0	22.4	---	0.0	0.00	VERTICAL
132.820000	24.10	14.4	43.5	19.4	---	0.0	0.00	VERTICAL
202.660000	23.90	14.1	43.5	19.6	---	0.0	0.00	VERTICAL
553.800000	31.40	21.0	46.0	14.6	---	0.0	0.00	VERTICAL
916.580000	37.10	26.1	46.0	8.9	---	0.0	0.00	VERTICAL

**For 1GHz to 25GHz****GFSK (above 1GHz)**

Frequency(MHz):				2402		Polarity:			HORIZONTAL	
No.	Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
1	2402.00	94.25	PK	--	--	60.85	28.78	4.61	0.00	33.40
1	2402.00	85.24	AV	--	--	51.84	28.78	4.61	0.00	33.40
2	2390.00	36.25	PK	74	37.75	2.93	28.72	4.60	0.00	33.32
2	2390.00	--	AV	54	--	--	--	--	--	--
3	2400.00	44.52	PK	74	29.48	11.13	28.78	4.61	0.00	33.39
3	2400.00	--	AV	54	--	--	--	--	--	--
4	4804.00	55.66	PK	74	18.34	51.15	33.49	6.91	35.89	4.51
4	4804.00	47.41	AV	54	6.59	42.90	33.49	6.91	35.89	4.51
5	5025.50	43.21	PK	74	30.79	36.33	34.07	7.05	34.24	6.88
5	5025.50	--	AV	54	--	--	--	--	--	--
6	7206.00	46.39	PK	74	27.61	35.28	36.95	9.18	35.03	11.11
6	7206.00	--	AV	54	--	--	--	--	--	--

Frequency(MHz):				2402		Polarity:			VERTICAL	
No.	Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
1	2402.00	95.21	PK	--	--	61.81	28.78	4.61	0.00	33.40
1	2402.00	86.52	AV	--	--	53.12	28.78	4.61	0.00	33.40
2	2390.00	36.87	PK	74	37.13	3.55	28.72	4.60	0.00	33.32
2	2390.00	--	AV	54	--	--	--	--	--	--
3	2400.00	44.69	PK	74	29.31	11.30	28.78	4.61	0.00	33.39
3	2400.00	--	AV	54	--	--	--	--	--	--
4	4804.00	55.74	PK	74	18.26	51.23	33.49	6.91	35.89	4.51
4	4804.00	46.85	AV	54	7.15	42.34	33.49	6.91	35.89	4.51
5	5133.75	42.69	PK	74	31.31	35.46	34.40	7.11	34.28	7.23
5	5133.75	--	AV	54	--	--	--	--	--	--
6	7206.00	47.11	PK	74	26.89	36.00	36.95	9.18	35.03	11.11
6	7206.00	--	AV	54	--	--	--	--	--	--

**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)-Pre-amplifier Factor
3. Margin value = Limit value- Emission level.
4. -- Mean the PK detector measured value is below average limit.
5. The other emission levels were very low against the limit.
6. RBW1MHz VBW3MHz Peak detector is for PK value; RBW 1MHz VBW10Hz Peak detector is for AV value.
7. For fundamental frequency, RBW 3MHz VBW 3MHz Peak detector is for PK Value ; RMS detector is for AV value.

Frequency(MHz):				2441		Polarity:			HORIZONTAL	
No.	Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
1	2441.00	94.36	PK	--	--	60.85	28.85	4.66	0.00	33.51
1	2441.00	85.41	AV	--	--	51.90	28.85	4.66	0.00	33.51
2	3085.50	40.58	PK	74	33.42	39.73	30.92	5.36	35.43	0.85
2	3085.50	--	AV	54	--	--	--	--	--	--
3	4882.00	55.69	PK	74	18.31	49.33	33.60	6.95	34.19	6.36
3	4882.00	46.51	AV	54	7.49	40.15	33.60	6.95	34.19	6.36
4	5022.75	43.14	PK	74	30.86	36.25	34.06	7.04	34.22	6.89
4	5022.75	--	AV	54	--	--	--	--	--	--
5	7323.00	46.52	PK	74	27.48	34.82	37.46	9.23	35.00	11.70
5	7323.00	--	AV	54	--	--	--	--	--	--

Frequency(MHz):				2441		Polarity:			VERTICAL	
No.	Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
1	2441.00	95.45	PK	--	--	61.94	28.85	4.66	0.00	33.51
1	2441.00	86.85	AV	--	--	53.34	28.85	4.66	0.00	33.51
2	3188.75	40.69	PK	74	33.31	39.38	31.21	5.46	35.36	1.31
2	3188.75	--	AV	54	--	--	--	--	--	--
3	4882.00	56.22	PK	74	17.78	49.86	33.60	6.95	34.19	6.36
3	4882.00	47.45	AV	54	6.55	41.09	33.60	6.95	34.19	6.36
4	5345.25	42.62	PK	74	31.38	34.74	34.69	7.23	34.03	7.88
4	5345.25	--	AV	54	--	--	--	--	--	--
5	7323.00	46.45	PK	74	27.55	34.75	37.46	9.23	35.00	11.70
5	7323.00	--	AV	54	--	--	--	--	--	--

## 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)-Pre-amplifier Factor
3. Margin value = Limit value- Emission level.
4. -- Mean the PK detector measured value is below average limit.
5. The other emission levels were very low against the limit.
6. RBW1MHz VBW3MHz Peak detector is for PK value; RBW 1MHz VBW10Hz Peak detector is for AV value.
7. For fundamental frequency, RBW 3 MHz VBW 3 MHz Peak detectors are for PK Value; RMS detector is for AV value.

Frequency(MHz):				2480		Polarity:			HORIZONTAL	
No.	Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
1	2480.00	94.62	PK	--	--	61.00	28.92	4.70	0.00	33.62
1	2480.00	85.58	AV	--	--	51.96	28.92	4.70	0.00	33.62
2	2483.50	45.26	PK	74	28.74	11.63	28.93	4.70	0.00	33.63
2	2483.50	--	AV	54	--	--	--	--	--	--
3	2500.00	38.45	PK	74	35.55	4.77	28.96	4.72	0.00	33.68
3	2500.00	--	AV	54	--	--	--	--	--	--
4	4960.00	56.24	PK	74	17.76	51.32	33.84	7.00	35.92	4.92
4	4960.00	47.85	AV	54	6.15	42.93	33.84	7.00	35.92	4.92
5	5138.25	43.26	PK	74	30.74	36.02	34.41	7.11	34.28	7.24
5	5138.25	--	AV	54	--	--	--	--	--	--
6	7440.00	47.82	PK	74	26.18	35.87	37.64	9.28	34.97	11.95
6	7440.00	--	AV	54	--	--	--	--	--	--

Frequency(MHz):				2480		Polarity:			VERTICAL	
No.	Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
1	2480.00	96.01	PK	--	--	62.39	28.92	4.70	0.00	33.62
1	2480.00	85.88	AV	--	--	52.26	28.92	4.70	0.00	33.62
2	2483.50	45.36	PK	74	28.64	11.73	28.93	4.70	0.00	33.63
2	2483.50	--	AV	54	--	--	--	--	--	--
3	2500.00	39.14	PK	74	34.86	5.46	28.96	4.72	0.00	33.68
3	2500.00	--	AV	54	--	--	--	--	--	--
4	4960.00	56.25	PK	74	17.75	51.33	33.84	7.00	35.92	4.92
4	4960.00	47.85	AV	54	6.15	42.93	33.84	7.00	35.92	4.92
5	5215.25	42.54	PK	74	31.46	35.14	34.56	7.15	34.31	7.40
5	5215.25	--	AV	54	--	--	--	--	--	--
6	7440.00	46.97	PK	74	27.03	35.02	37.64	9.28	34.97	11.95
6	7440.00	--	AV	54	--	--	--	--	--	--

## 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)-Pre-amplifier Factor
3. Margin value = Limit value- Emission level.
4. -- Mean the PK detector measured value is below average limit.
5. The other emission levels were very low against the limit.
6. RBW1MHz VBW3MHz Peak detector is for PK value; RBW 1MHz VBW10Hz Peak detector is for AV value.
7. For fundamental frequency, RBW 3MHz VBW 3MHz Peak detector is for PK Value ; RMS detector is for AV value.



### 3.3. Maximum Peak Output Power

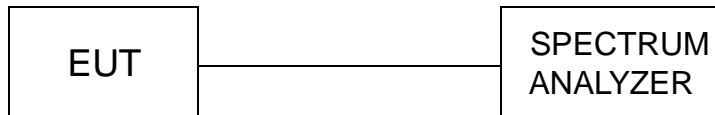
#### Limit

The Maximum Peak Output Power Measurement is 30dBm.

#### Test Procedure

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum.

#### Test Configuration

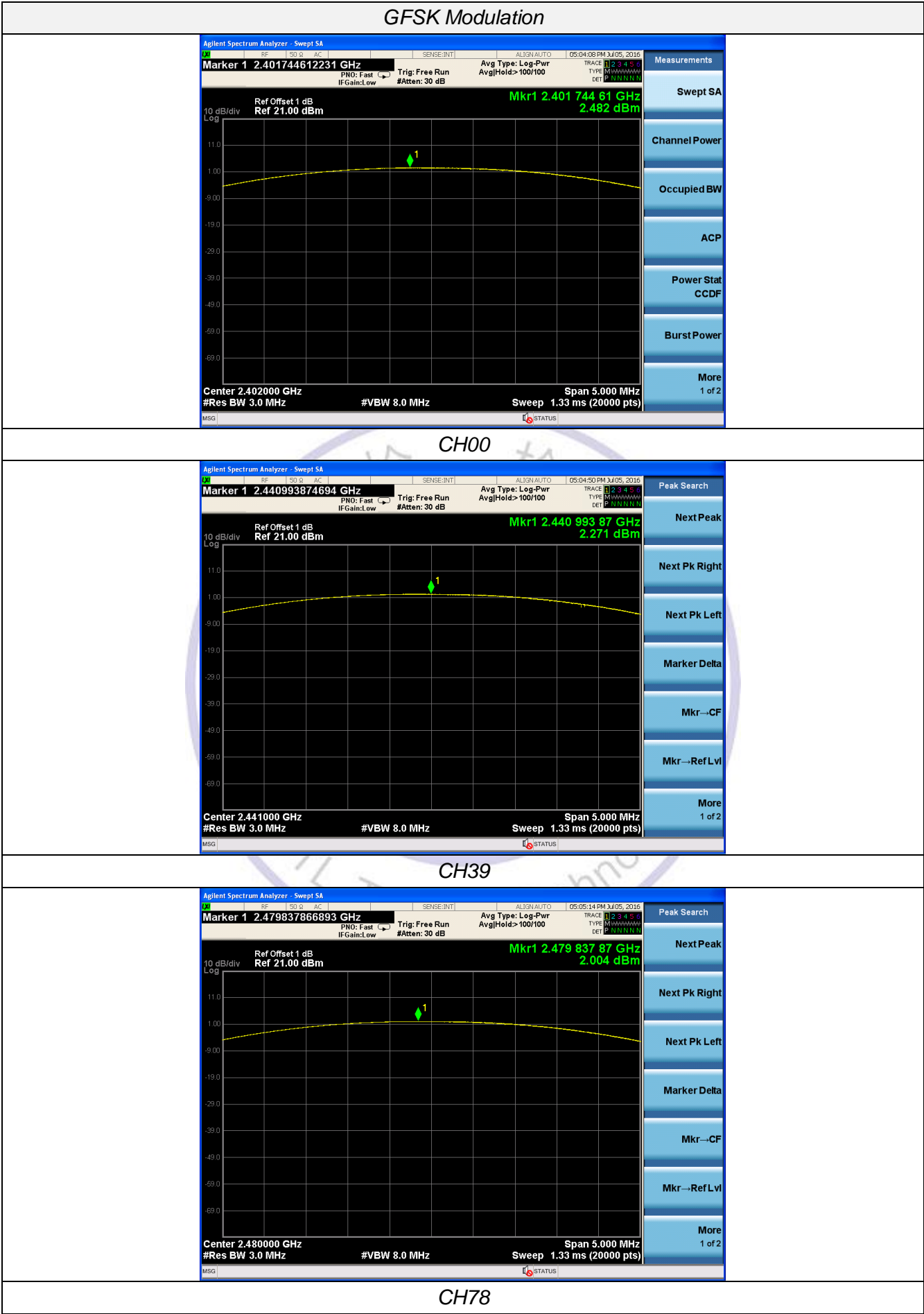


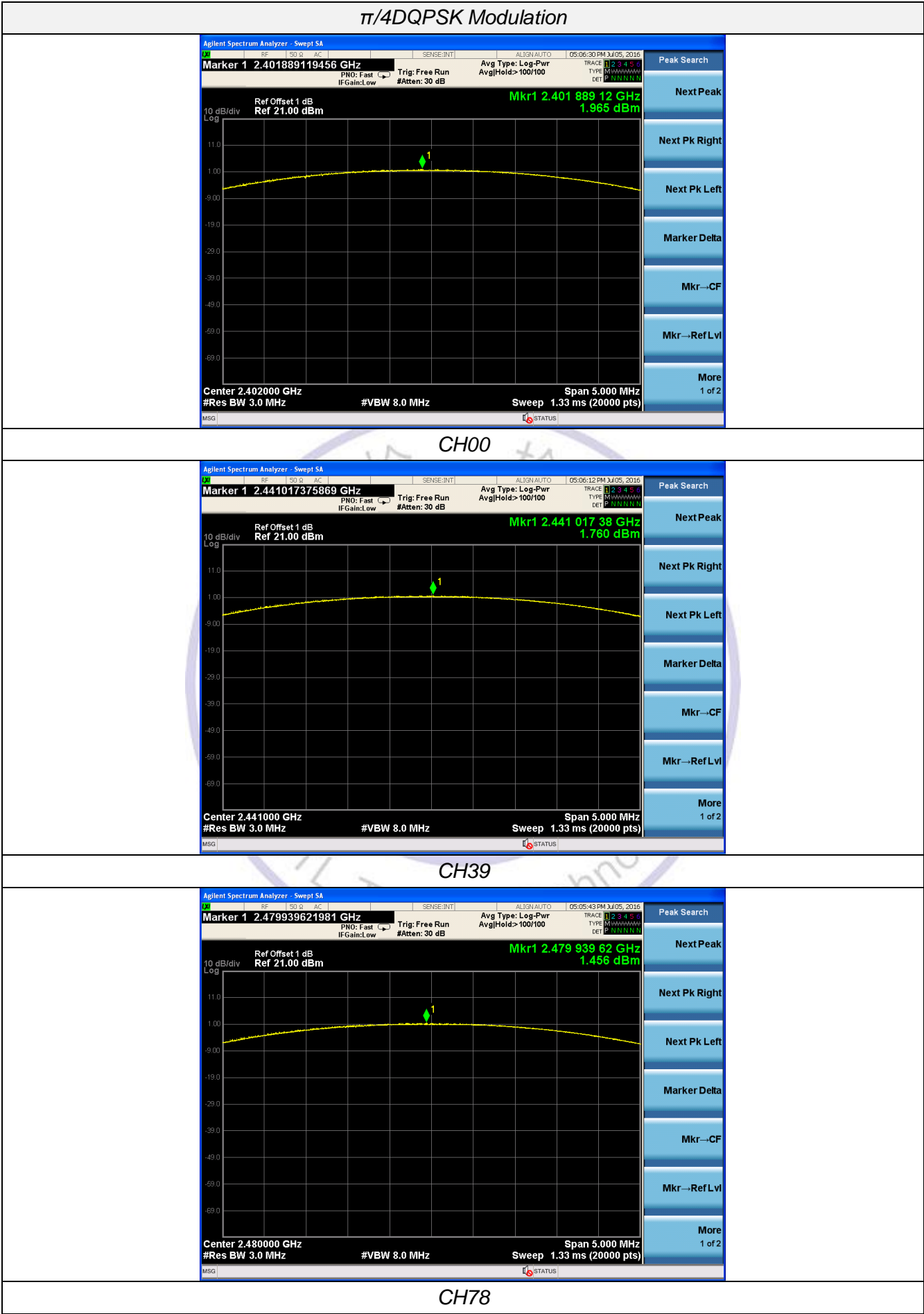
#### Test Results

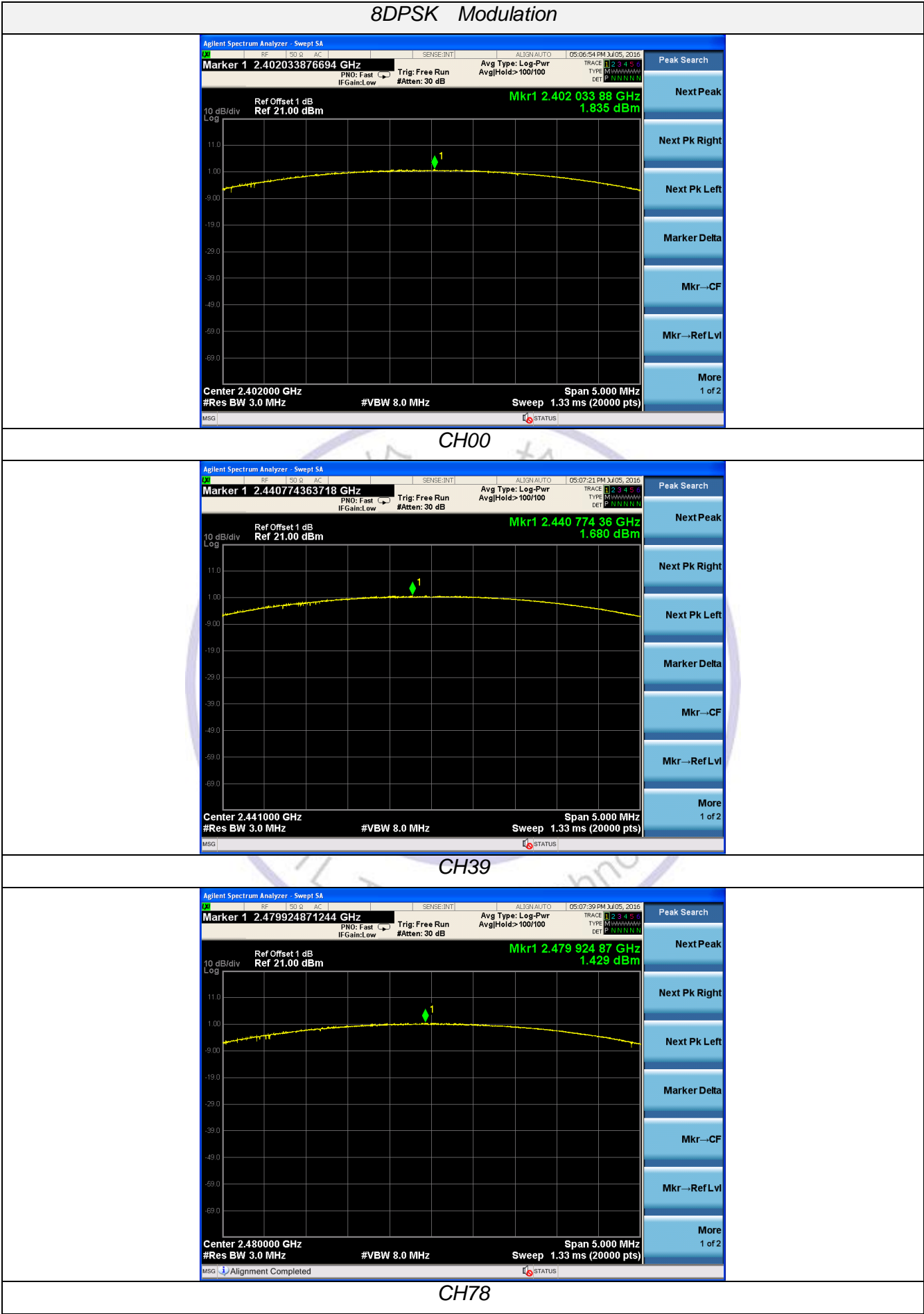
Type	Channel	Output power (dBm)	Limit (dBm)	Result
GFSK	00	2.482	30.00	Pass
	39	2.271		
	78	2.004		
π/4DQPSK	00	1.965	30.00	Pass
	39	1.760		
	78	1.456		
8DPSK	00	1.835	30.00	Pass
	39	1.680		
	78	1.429		

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

Test plot as follows:







### 3.4. 20dB Bandwidth

#### Limit

For frequency hopping systems operating in the 2400MHz-2483.5MHz no limit for 20dB bandwidth.

#### 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 30 KHz RBW and 100 KHz VBW.

The 20dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20dB.

#### Test Configuration



#### Test Results

Modulation	Channel	20dB bandwidth (MHz)	99% OBW(MHz)	Result
GFSK	CH00	0.829	0.831	Pass
	CH39	0.829	0.822	
	CH78	0.828	0.826	
$\pi/4$ DQPSK	CH00	1.113	1.079	
	CH39	1.114	1.085	
	CH78	1.116	1.074	
8DPSK	CH00	1.117	1.058	
	CH39	1.113	1.070	
	CH78	1.115	1.071	

Test plot as follows:





Agilent Spectrum Analyzer - Occupied BW

10 dB/div RF 50.0 AC SENSE:INT ALIGN: AUTO 07:35:44 PM 3/04, 2016

Span 3.0000 MHz Center Freq: 2.402000000 GHz Radio Std: None  
 Trig: Free Run Avg/Hold: >10/10  
 #Fft: 20 dB Radio Device: BSTS  
 #IFGain: Low

Ref Offset 1 dB  
 Ref 20.00 dBm

Log

Center 2.402 GHz Span 3 MHz  
 #Res BW 30 kHz #VBW 100 kHz Sweep 3.2 ms

Occupied Bandwidth	Total Power
1.0789 MHz	7.95 dBm

Transmit Freq Error	OBW Power
-8.580 kHz	99.00 %

x dB Bandwidth	x dB
1.113 MHz	-20.00 dB

MSG STATUS

Agilent Spectrum Analyzer - Occupied BW

Center Freq 2.441000000 GHz

Ref Offset 1 dB  
Ref 20.00 dBm

Log

10 dB/div

0.00

-10.00

-20.00

-30.00

-40.00

-50.00

-60.00

-70.00

Center 2.441 GHz  
#Res BW 30 kHz

#VBW 100 kHz

Span 3 MHz  
Sweep 3.2 ms

Occupied Bandwidth

2.10853 MHz

Total Power

7.28 dBm

Transmit Freq Error

-5.744 kHz

OBW Power

99.00 %

x dB Bandwidth

1.114 MHz

x dB

-20.00 dB

Agilent Spectrum Analyzer - Occupied BW

RF: 2.48000000 GHz SENSE: INT1 ALIGN: AUTO 07:37:49 PM 3/04/2016

Center Freq 2.48000000 GHz Center Freq: 2.48000000 GHz Radio Std: None  
 Trig: Free Run AvgHld: >10/10  
 #IFGain: Low #Atten: 20 dB Radio Device: BST

Ref Offset 1 dB  
Ref 20.00 dBm

Center 2.48 GHz Span 3 MHz  
 #Res BW 30 kHz #VBW 100 kHz Sweep 3.2 ms

Occupied Bandwidth		Total Power	
1.0739 MHz		7.38 dBm	

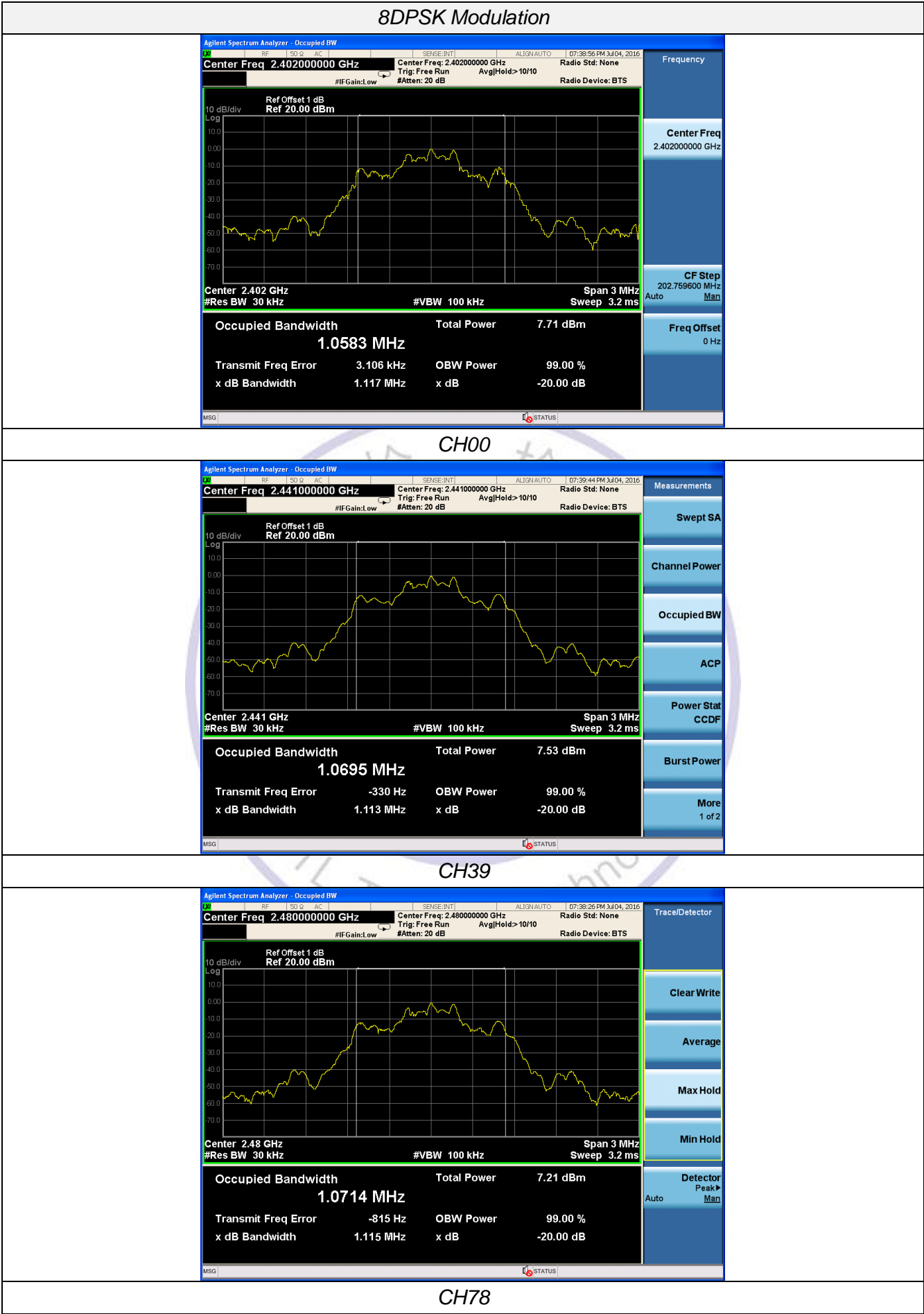
Transmit Freq Error		OBW Power	
-8.581 kHz		99.00 %	

x dB Bandwidth		x dB	
1.116 MHz		-20.00 dB	

Measurements

- Swept Signal
- Channel Power
- Occupied BW
- AC Power
- Power Spectral Density
- Burst Power
- Mor...

## CH78



### 3.5. Frequency Separation

#### LIMIT

According to 15.247(a)(1), frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25KHz or the  $2/3 \times 20\text{dB}$  bandwidth of the hopping channel, whichever is greater.

#### 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 100 KHz RBW and 300 KHz VBW.

#### TEST CONFIGURATION



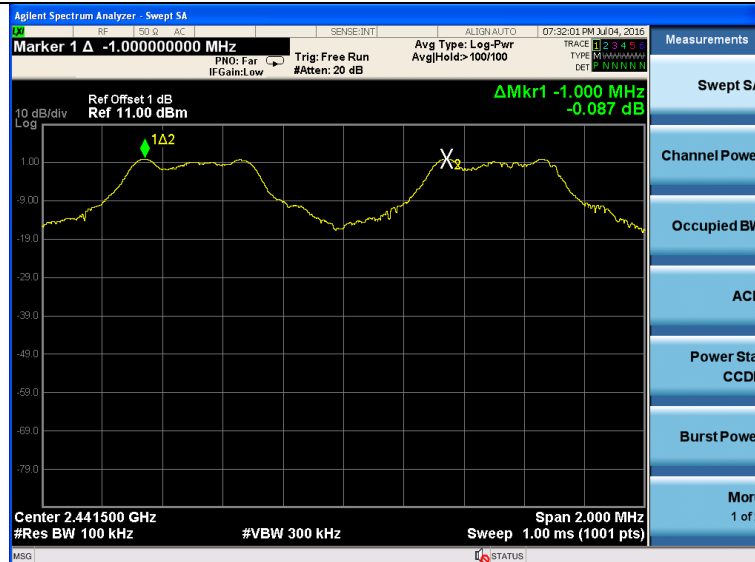
#### TEST RESULTS

Modulation	Channel	Channel Separation (MHz)	Limit(MHz)	Result
GFSK	CH39	1.000	25KHz or $2/3 \times 20\text{dB}$ bandwidth	Pass
	CH40			
$\pi/4$ DQPSK	CH39	1.006	25KHz or $2/3 \times 20\text{dB}$ bandwidth	Pass
	CH40			
8DPSK	CH39	1.002	25KHz or $2/3 \times 20\text{dB}$ bandwidth	Pass
	CH40			

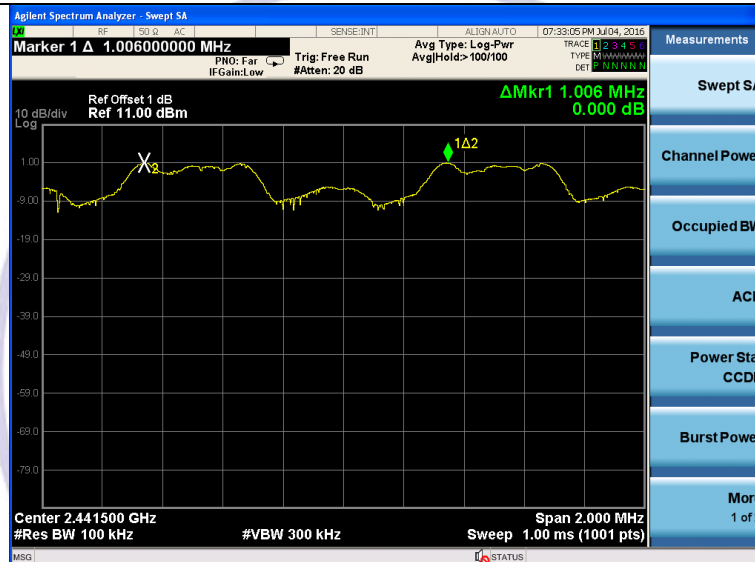
Note:

We have tested all mode at high, middle and low channel, and recorded worst case at middle

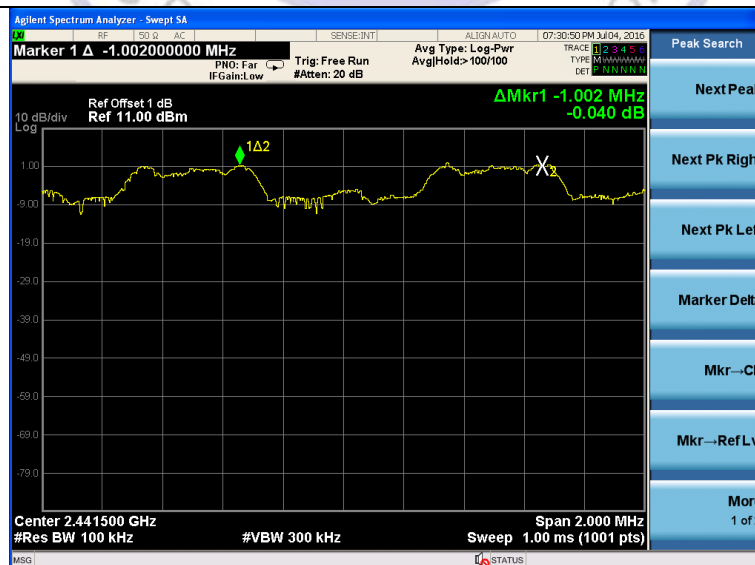
Test plot as follows:



GFSK



8DPSK

 $\pi/4$ DQPSK



### 3.6. Number of hopping frequency

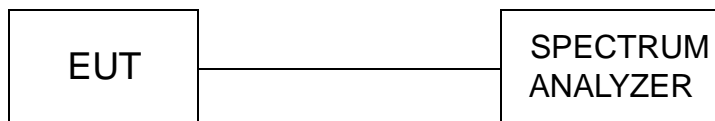
#### Limit

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.

#### Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. Set spectrum analyzer start 2400MHz to 2483.5MHz with 100 KHz RBW and 300 KHz VBW.

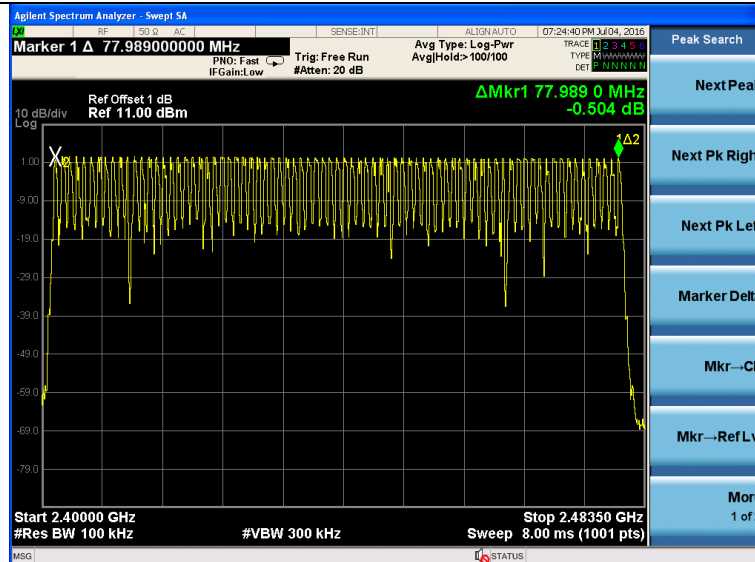
#### Test Configuration



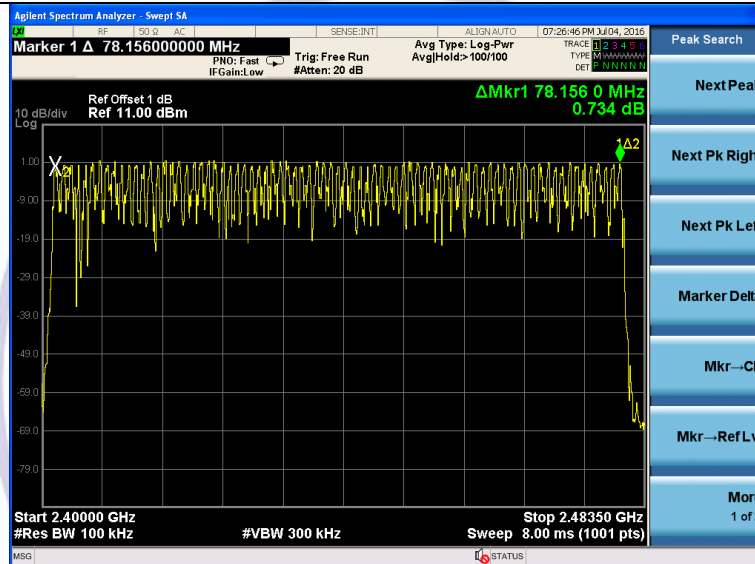
#### Test Results

Modulation	Number of Hopping Channel	Limit	Result
GFSK	79	≥15	Pass
π/4DQPSK	79		
8DPSK	79		

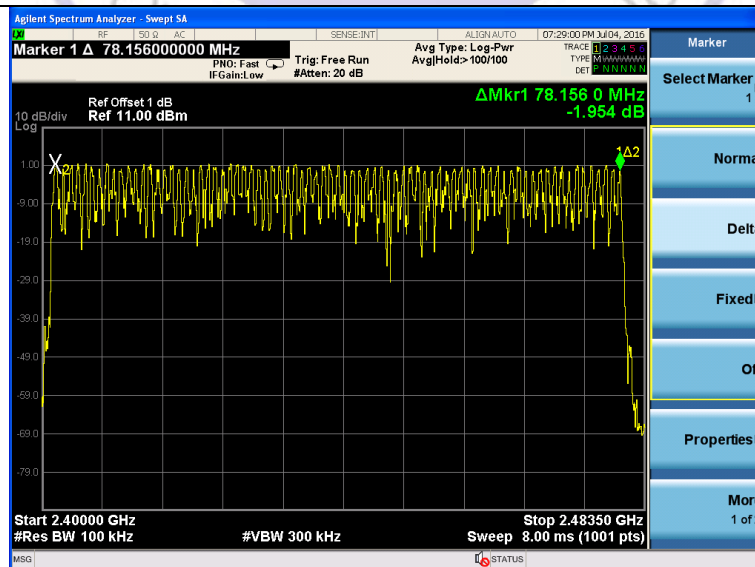
#### Test plot as follows:



### GFSK Modulation



### $\pi/4$ DQPSK Modulation



### 8DPSK Modulation

### 3.7. Time of Occupancy (Dwell Time)

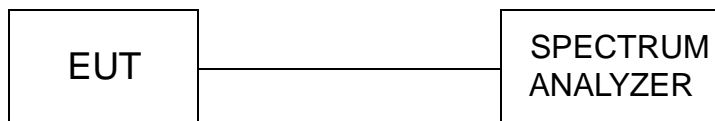
#### Limit

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

#### Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. Set center frequency of spectrum analyzer=operating frequency with 1MHz RBW and 1MHz VBW, Span 0Hz.

#### Test Configuration



#### Test Results

Modulation	Packet	Pulse time (ms)	Dwell time (s)	Limit (s)	Result
GFSK	DH1	0.367	0.117	0.40	Pass
	DH3	1.627	0.260		
	DH5	2.870	0.306		
π/4DQPSK	2-DH1	0.375	0.120	0.40	Pass
	2-DH3	1.627	0.260		
	2-DH5	2.880	0.307		
8DPSK	3-DH1	0.378	0.121	0.40	Pass
	3-DH3	1.627	0.260		
	3-DH5	2.870	0.306		

Note:

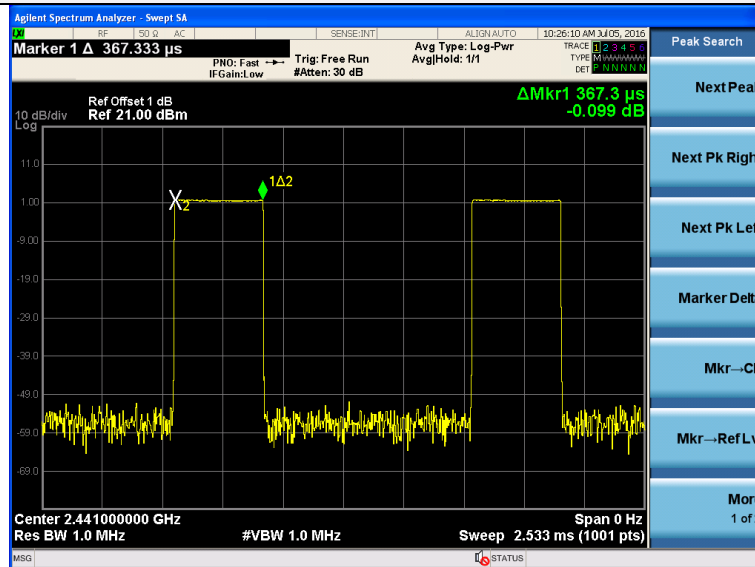
- We have tested all mode at high,middle and low channel,and recoreded worst case at middle channel.
- $$\text{Dwell time} = \text{Pulse time (ms)} \times (1600 \div 2 \div 79) \times 31.6 \text{ Second for DH1, 2-DH1, 3-DH1}$$

$$\text{Dwell time} = \text{Pulse time (ms)} \times (1600 \div 4 \div 79) \times 31.6 \text{ Second for DH3, 2-DH3, 3-DH3}$$

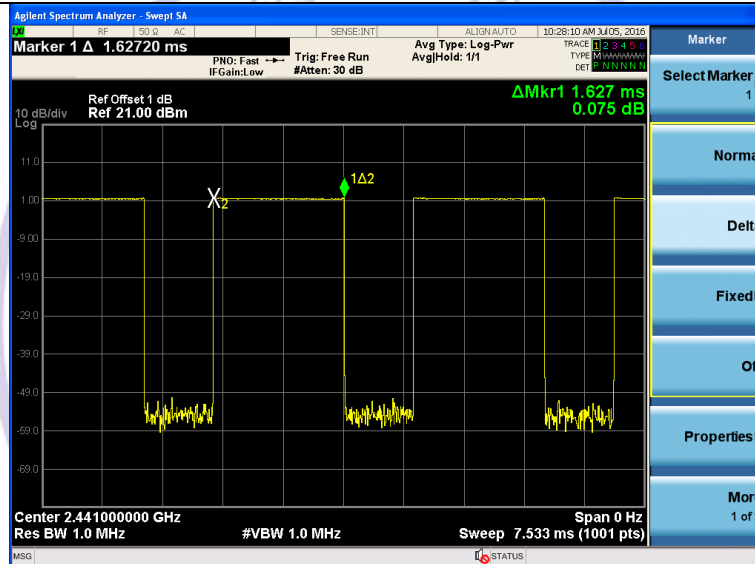
$$\text{Dwell time} = \text{Pulse time (ms)} \times (1600 \div 6 \div 79) \times 31.6 \text{ Second for DH5, 2-DH5, 3-DH5}$$

#### Test plot as follows:

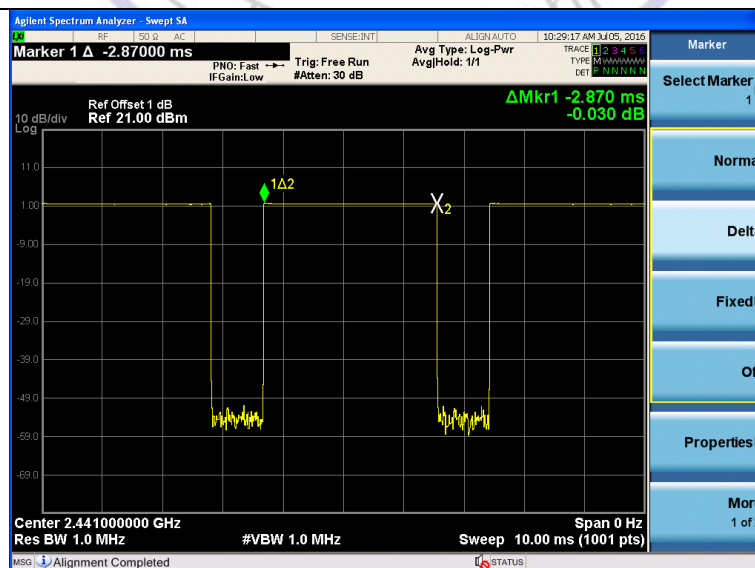
## GFSK Modulation



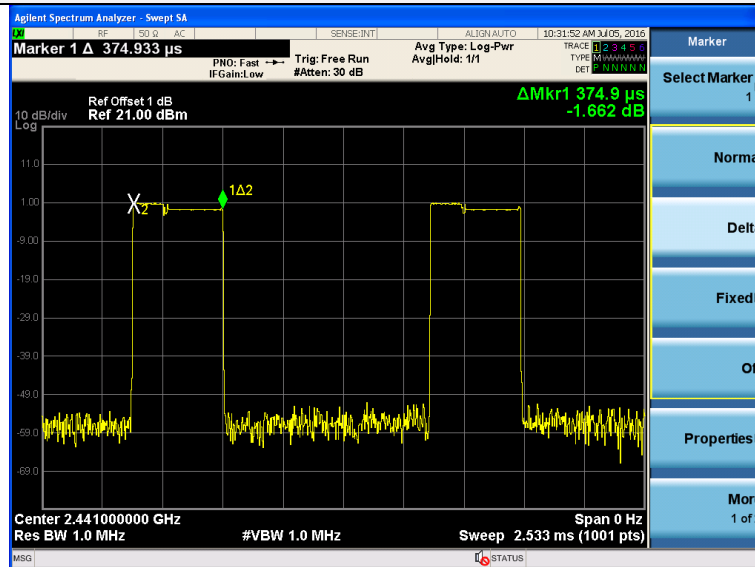
## DH1



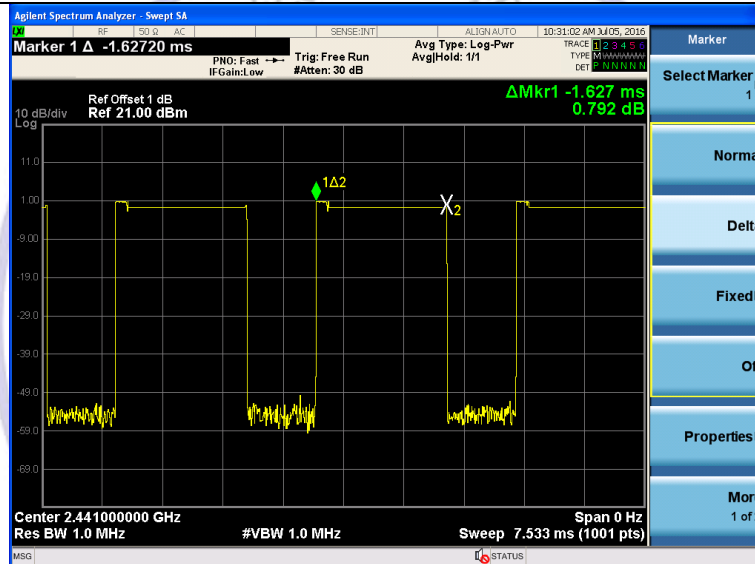
## DH3



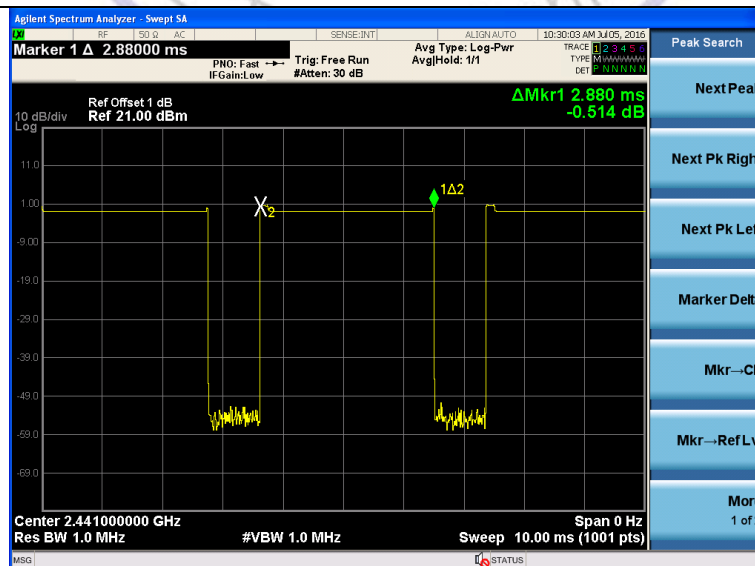
## DH5

$\pi/4$ DQPSK Modulation

## 2-DH1

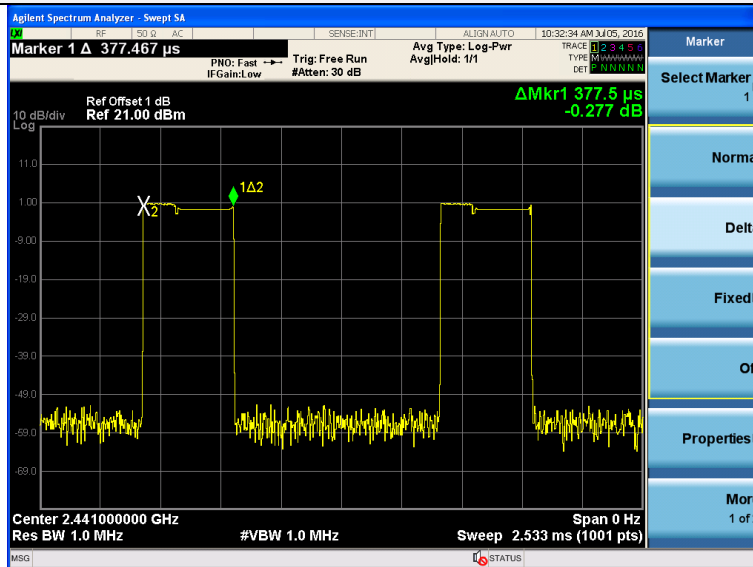


## 2-DH3

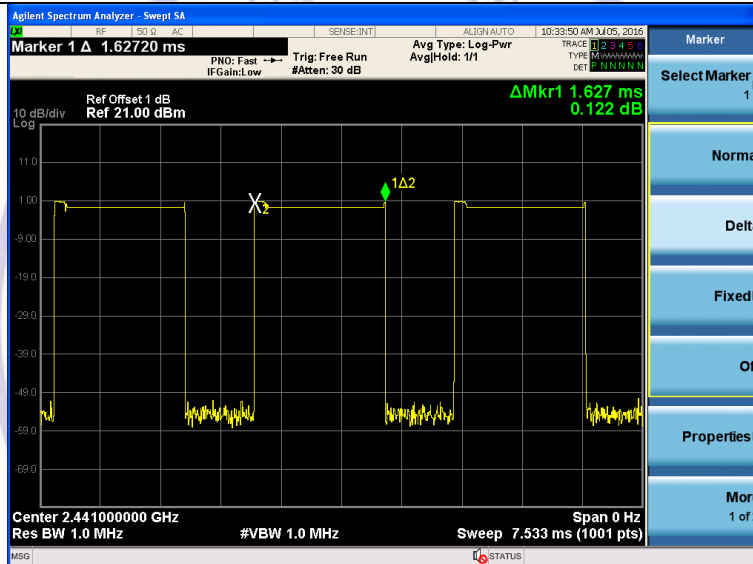


## 2-DH5

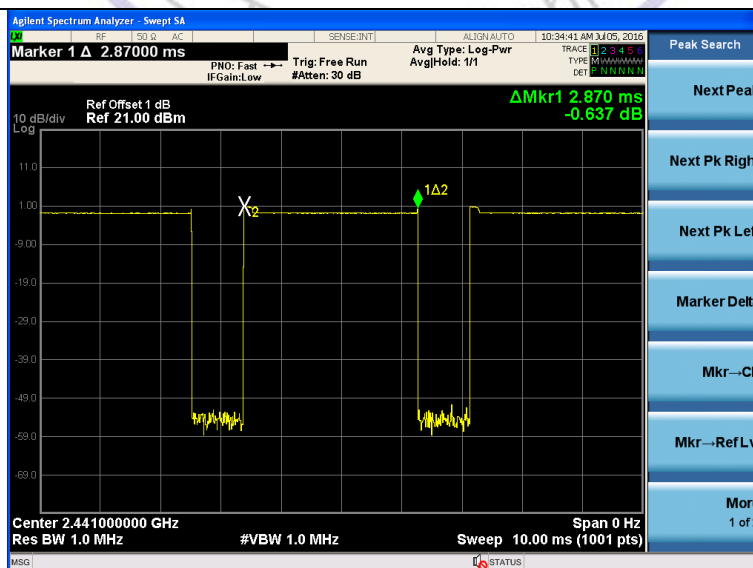
## 8DPSK Modulation



## 3-DH1



## 3-DH3



## 3-DH5