FCC 47 CFR PART 15 SUBPART C 15.247

TEST REPORT

FOR

Wireless Keyboard

Model : FK408BTS, FK408XXXXXXX-XXXXXX,

FK406XXXXXXX-XXXXXX

Trade Name : Matias

Issued to

Matias Corporation
221 Narinia Crescent, Newmarket, Ontario, L3X 2E1, Canada

Issued by
WH Technology Corp.

Open Site		**No. 120, Lane 180, Hsin Ho Rd., Lung-Tan Dist., Tao Yuan City 325, Taiwan, R.O.C.**
EMC Test Site	**Xizhi Office and Lab**	**7F., No.262, Sec. 3, Datong Rd., Xizhi Dist., New Taipei City 221, Taiwan (R.O.C.)**
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Contents

1. General Information

Applicant	:	**Matias Corporation**
Address	:	**221 Narinia Crescent, Newmarket, Ontario, L3X 2E1, Canada**
Manufacturer	:	**Lita Electronics Technology Co., Ltd.**
Address	:	**No.6, Kun Ming Road, Yao Le Village, Liaobu Town, Dongguan City, Guangdong Province, China. Post Code: 523418**
EUT	:	**Wireless Keyboard**
Model Name	:	**FK408BTS, FK408XXXXXXX-XXXXXX, FK406XXXXXXX-XXXXXX**
Model Differences	:	**N/A**

Is here with confirmed to comply with the requirements set out in the FCC Rules and Regulations Part 15 Subpart C and the measurement procedures were according to ANSI C63.4-2014. The said equipment in the configuration described in this report shows the maximum emission levels emanating from equipment are within the compliance requirements.

FCC part 15 subpart C

Receipt Date : 08/31/2017 Final Test Date : 07/27/2018

Tested By:		**Reviewed by:**	
Jul. 27, 2018		Jul. 27, 2018	
Date	Bell Wei/ Engineer	**Date**	Mike Lee / Manager Designation Number: TW1083

2. Report of Measurements and Examinations

2.1 List of Measurements and Examinations

FCC Rule	. Description of Test	Result
15.203	. Antenna Requirement	Pass
15.207	. Conducted Emission	Pass
15.209	. Radiated Emission	Pass
15.247(a)(1)	. Channel Carrier Frequencies Separation	Pass
15.247(a)(1)	. 20dB Bandwidth Measurement	Pass
15.247(a)(1)	. Dwell Time	Pass
15.247(b)	. Number of Hopping Channels	Pass
15.247(b)	. Peak Output Power Measurement Data	Pass
15.247(d)	. Band Edges Measurement Data	Pass

3. Test Configuration of Equipment under Test

3.1 Description of the tested samples

EUT Name	:	Wireless Keyboard
Model Number	:	FK408BTS
FCCID	:	WKMFK408BT
Receipt Date	:	08/31/2017
Input Voltage	:	DC 5V
Power From	:	☑Inside ☐Outside ☐Adaptor ☑Battery ☐AC Power Source ☐DC Power Source ☑Support Unit PC
Operate Frequency	:	Refer to the channel list as described below (2.402 ~2.480 GHz)
Modulation Technique	:	GFSK , π/4-DQPSK, 8DPSK
Number of Channels	:	79
Channel spacing	:	☐N/A ☑ 1 MHz
Operating Mode	:	☐Simplex ☑ Duplex
Antenna Type	:	PCB antenna
Channel bandwidth	:	1 MHz
Antenna gain		1.87 dBi

3.2 Carrier Frequency of Channels

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
00	2402	20	2422	40	2442	60	2462
01	2403	21	2423	41	2443	61	2463
02	2404	22	2424	42	2444	62	2464
03	2405	23	2425	43	2445	63	2465
04	2406	24	2426	44	2446	64	2466
05	2407	25	2427	45	2447	65	2467
06	2408	26	2428	46	2448	66	2468
07	2409	27	2429	47	2449	67	2469
08	2410	28	2430	48	2450	68	2470
09	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	---	---

3.3 Test Mode and Test Software

a. During testing, the interface cables and equipment positions were varied according to ANSI C63.4.
b. The complete test system included Notebook and EUT for RF test.
c. An executive “BLUETEST3” under WIN7 was executed to keep transmitting and receiving data via Wireless.
d. The following test modes were performed for test:
   - GFSK: CH 00: 2402MHz, CH 39: 2441MHz, CH 78: 2480MHz.
   - π/4-DQPSK: CH 00: 2402MHz, CH 39: 2441MHz, CH 78: 2480MHz.
   - 8DPSK: CH 00: 2402MHz, CH 39: 2441MHz, CH 78: 2480MHz.

3.4 TEST Methodology & General Test Procedures

All testing as described bellowed were performed in accordance with ANSI C63.4:2014 and FCC CFR 47 Part 15 Subpart C.

Conducted Emissions

The EUT is placed on a polystyrene table, which is at 1.5 m above ground plane acceding to clause 15.207 and requirements of ANSI C63.4:2014. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz are using CISPR Quasi-Peak / Average detectors.

Radiated Emissions

The EUT is a placed on a turn table, which is 0.8 m above ground plane. The turntable was rotated through 360 degrees to determine the position of maximum emission level. The EUT is placed at 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.

1) Putting the EUT on the platform and turning on the EUT (on/off button on the bottom of the EUT).
2) Setting test channel described as “Channel setting and operating condition”, and testing channel by channel.
3) For the spurious emission test based on ANSI(2014), at the frequency where below 1GHz
used quasi-peak detector mode; where above 1GHz used the peak and average detector mode. IF the peak value may be under average limit, the average mode will not be performed.

3.5 Measurement Uncertainty

Measurement Item	Uncertainty
Radiated emission	±5.00dB
Peak Output Power(conducted)	±1.36dB
Peak Output Power(Radiated)	±1.68dB
Power Spectral Density	±1.35dB
Radiated emission(3m)	±5.00dB
Radiated emission(10m)	±3.89dB

3.6 Description of the Support Equipments

Setup Diagram

See test photographs attached in appendix 1 for the actual connections between EUT and support equipment.

Support Equipment

Peripherals Devices:

OUTSIDE SUPPORT EQUIPMENT							
No.	Equipment	Model	Serial No.	FCC ID/ BSMI ID	Trade name	Data Cable	Power Cord
1.	Notebook	TPN-Q113	N/A	PD92230 BNH/ R33001	HP	N/A	Unshielded 1.8m
2.	Printer	D4360	N/A	FCC DoC approved/ R33001	HP	Shielded/ 1.8m	Unshielded 1.8m
3.	USB Flash	TS2GJFV30	156511-6400	FCC DoC approved/ D33193	TRANSCEND	Shielded/ 1m	N/A

Note: All the above equipment /cable were placed in worse case position to maximize emission signals during emission test

Grounding: Grounding was in accordance with the manufacturer's requirement and conditions for the intended use.

4. Test and measurement equipment

4.1 calibration

The measuring equipment utilized to perform the tests documented in the report has been calibrated once a year or in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2 equipment

The following list contains measurement equipment used for testing. The equipment conforms to the requirement of CISPR 16-1, ANSI C63.2 and. Other required standards.

Calibration of all test and measurement, including any accessories that may effect such calibration, is checked frequently to ensure the accuracy. Adjustments are made and correction factors are applied in accordance with the instructions contained in the respective.

Table 1 List of Test and Measurement Equipment

Test Site	Instrument	Manufacturer	Model No.	S/N	Next Cal. Date
Conduction	Spectrum (9K--3GHz)	R&S	FSP3	833387/010	2018/12/07
	EMI Receiver	R&S	ESHS10	830223/008	2019/06/10
	LISN	Rolf Heine Hochfrequenztechnik	NNB-2/16z	98062	2019/06/13
	ISN	Schwarzbeck	8-Wire ISN CAT5	CAT5-8158-0094	2018/10/19
	RF Cable	N/A	N/A	EMI-3	2018/10/17
	Power Meter	Anritsu	ML2487A	6K00003893	2019/10/31
	High Accuracy Sensor	Anritsu	MA2444A	OD1295	2019/10/31
Radiation	Bilog antenna(30M-1GHz)	ETC	MCTD2786B	BLB16M04004/JB-5-004	2019/05/30
	Double Ridged Guide Horn antenna(1G-18GHz)	ETC	MCTD 1209	DRH15N02009	2018/11/28
	Horn antenna (18G-26GHz)	com-power	AH-826	81000	2018/08/16
	LOOP Antenna (Below 30MHz)	com-power	AL-130	17117	2018/11/12
	Pre amplifier (30M-1GHz)	EMC INSTRUMENT	EMC9135	980334	2019/05/08
	Microwave Preamplifier (1G-18GHz)	EMC INSTRUMENT	EMC051845	980108&AT-18001	2018/11/27

	Pre amplifier (18G~26GHz)	MITEQ	JS4-18002600-30-5A	808329	2018/08/09
	EMI Test Receiver	R&S	ESVS30 (20M-1000MHz)	826006/002	2018/11/07
	RF Cable (9K-1GHz)	EMCI	N male on end of both sides (EMI4)	30m	2018/11/09
	RF CABLE (1~26GHz)	SUCOFLEX	104PEA	NA	2019/05/07
	RF CABLE (1~18GHz)	HARBOUR INDUSTRIES	LL142MI(7M)	NA	2018/08/09
	RF CABLE (18~26GHz)	AGILENT	EMC102-KM-KM-600	160102	2019/04/18
	Spectrum (9K--7GHz)	R&S	FSP7	830180/006	2019/04/18
	Spectrum (9K--40GHz)	AGILENT	8564EC	4046A0032	2019/02/28
Software	e3	AUDIX	N/A	N/A	N/A
SG	SINGAL GENTERATOR (100k-1GHz)	HP	8648A	3619U00426	N/A

CALIBRATION INTERVAL OF INSTRUMENTS LISTED ABOVE IS ONE YEAR

5. Antenna Requirements

5.1 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 (b), 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.

5.2 Antenna Construction and Directional Gain

Antenna Type: PCB Antenna
Antenna Gain: 1.87 dBi

6. Test of Conducted Emission

6.1 Test Limit

Conducted Emissions were measured from 150 kHz to 30 MHz with a bandwidth of 9 KHz on the 120 VAC power and return leads of the EUT according to the methods defined in ANSI C63.4-2014 Section 3.1. The EUT was placed on a nonmetallic stand in a shielded room 0.8 meters above the ground plane as shown in section 2.2. The interface cables and equipment positioning were varied within limits of reasonable applications to determine the position produced maximum conducted emissions.

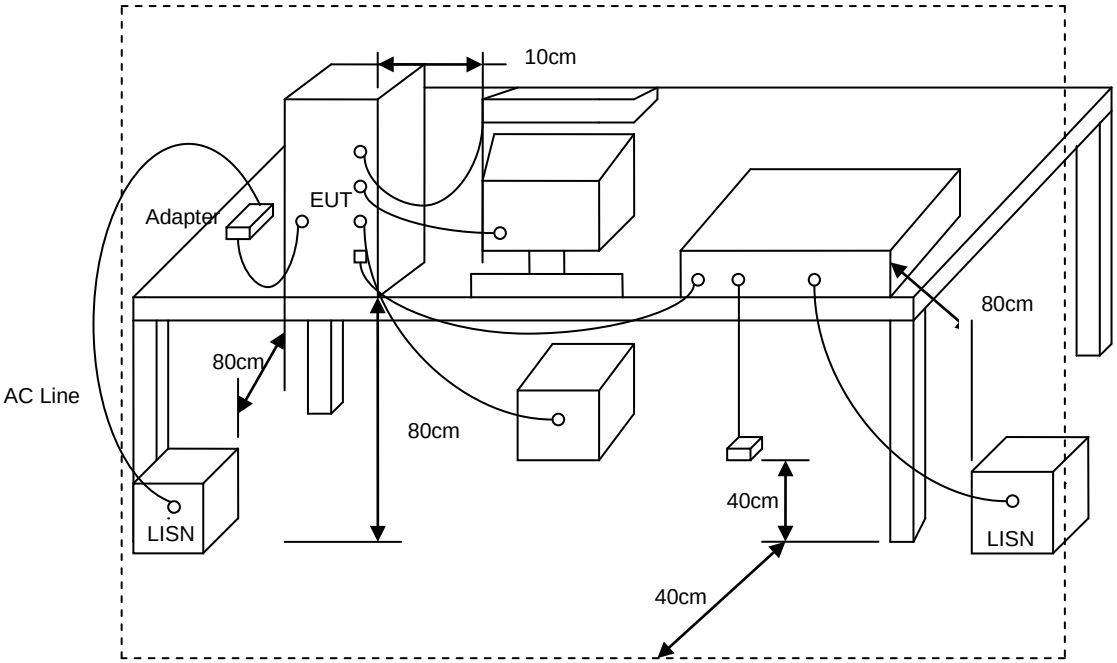
Frequency (MHz)	Quasi Peak (dB μ V)	Average (dB μ V)
0.15 – 0.5	66-56*	56-46*
0.5 – 5.0	56	46
5.0 – 30.0	60	50

*Decreases with the logarithm of the frequency.

6.2 Test Procedures

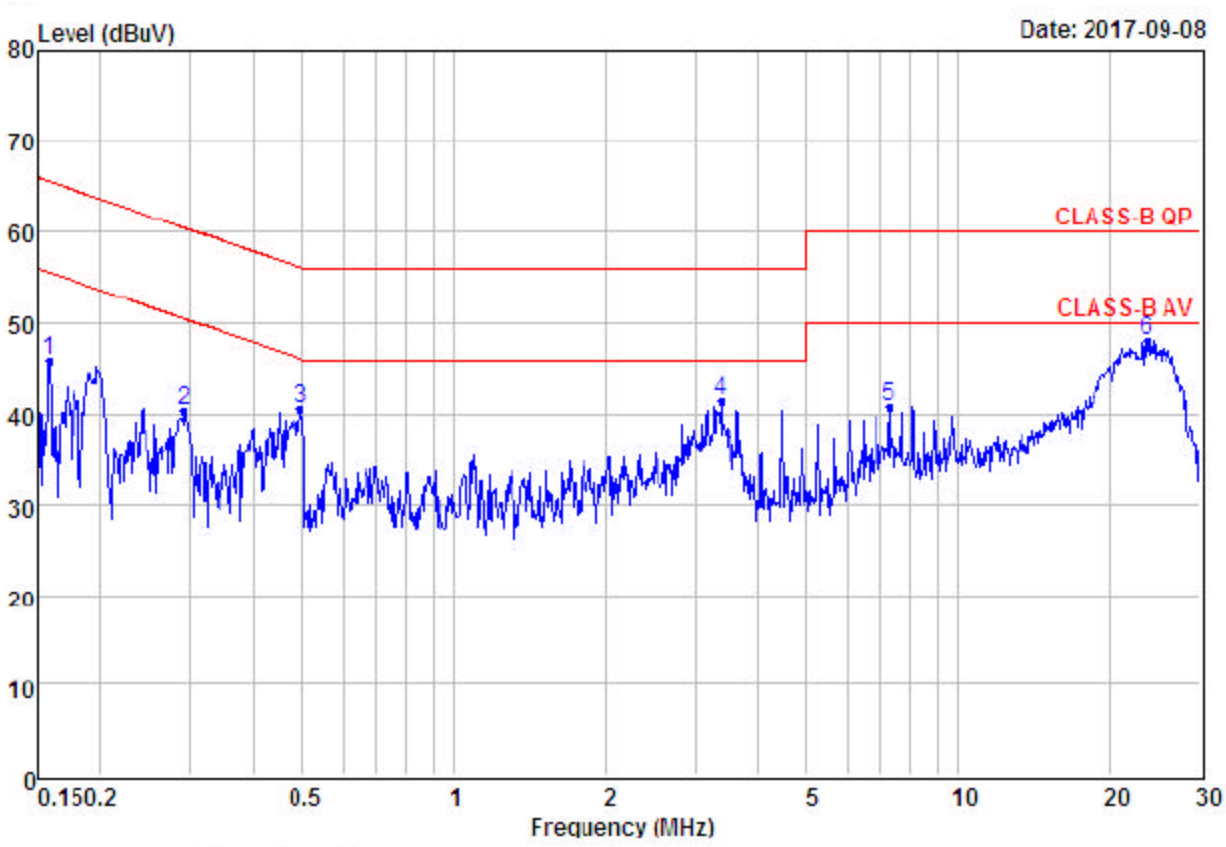
a. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
b. Connect EUT to the power mains through a line impedance stabilization network (LISN).
c. All the support units are connecting to the other LISN.
d. The LISN provides 50 ohm coupling impedance for the measuring instrument.
e. The FCC states that a 50 ohm, 50 micro-Henry LISN should be used.
f. Both sides of AC line were checked for maximum conducted interference.
g. The frequency range from 150 kHz to 30 MHz was searched.
h. Set the test-receiver system to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

6.3 Typical Test Setup



6.4 Test Result and Data

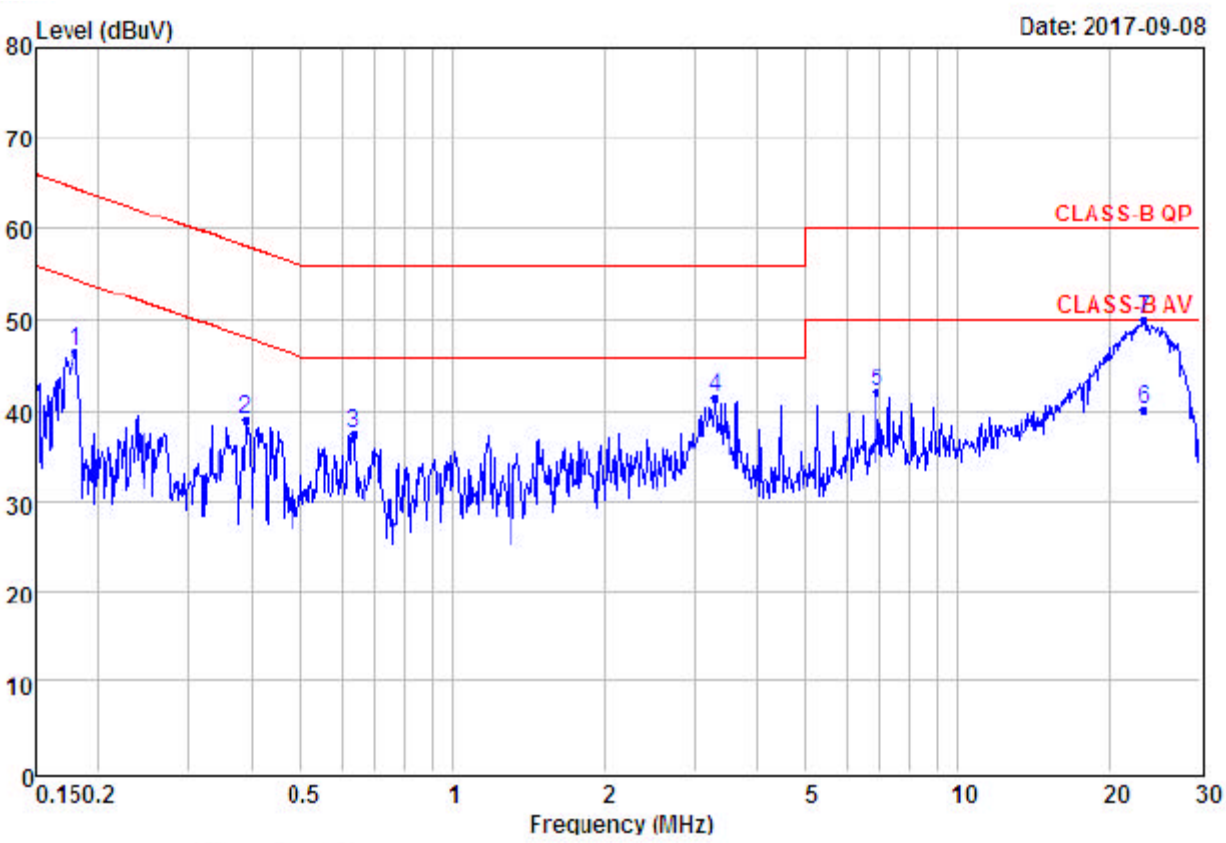
Power	:	DC 5V	Pol/Phase	:	LINE
Test Mode 1	:	Charging BT	Temperature	:	26 °C
Memo	:		Humidity	:	42 %



Remarks: : Factor=Insertion loss+Cable loss

	Freq	Read Level	Level	Factor	Over Limit	Limit Line	Remark
	MHz	dBuV	dBuV	dB	dB	dBuV	
1	0.16	35.79	45.91	10.12	-19.65	65.56	Peak
2	0.29	30.08	40.21	10.13	-20.25	60.46	Peak
3	0.49	30.45	40.59	10.14	-15.51	56.10	Peak
4	3.36	31.13	41.40	10.27	-14.60	56.00	Peak
5	7.29	30.31	40.70	10.39	-19.30	60.00	Peak
6 @	23.51	37.28	48.02	10.74	-11.98	60.00	Peak

Power	:	DC 5V	Pol/Phase	:	NEUTRAL
Test Mode 1	:	Charging BT	Temperature	:	26 °C
Memo	:		Humidity	:	42 %



Remarks: : Factor=Insertion loss+Cable loss

	Freq	Read Level	Level	Factor	Over Limit	Limit Line	Remark
	MHz	dBuV	dBuV	dB	dB	dBuV	
1	0.18	36.28	46.47	10.19	18.03	64.50	Peak
2	0.39	28.73	38.95	10.22	-19.17	58.12	Peak
3	0.63	27.30	37.54	10.24	-18.46	56.00	Peak
4	3.29	31.09	41.49	10.40	-14.51	56.00	Peak
5	6.88	31.49	42.01	10.52	-17.99	60.00	Peak
6 @	23.26	29.30	40.05	10.75	-9.95	50.00	Average
7	23.26	39.15	49.90	10.75	-10.10	60.00	Peak

7. Test of Radiated Emission

7.1 Test Limit

In any 100kHz 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 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. If the transmitter measurement is based on the maximum conducted output power, the attenuation required under this paragraph shall be 30dB instead of 20dB. In addition, radiated emissions which fall in section 15.205(a) the restricted bands must also comply with the radiated emission limit specified in section 15.209(a).

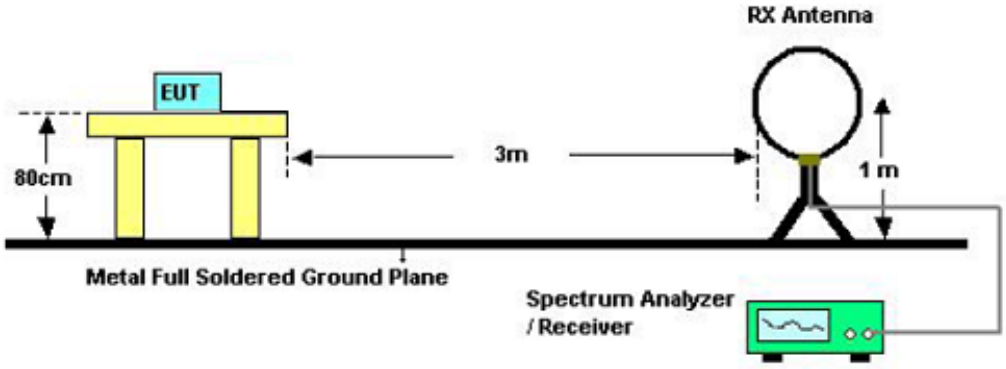
Frequency (MHz)	Field Strength (microvolt/meter)	Measurement Distance (meters)
0.009 ~ 0.490	2400/F(kHz)	300
0.490 ~ 1.705	24000/F(kHz)	30
1.705 ~ 30.0	30	30
30 ~ 88	100	3
88 ~ 216	150	3
216 ~ 960	200	3
Above 960	500	3

7.2 Test Procedures

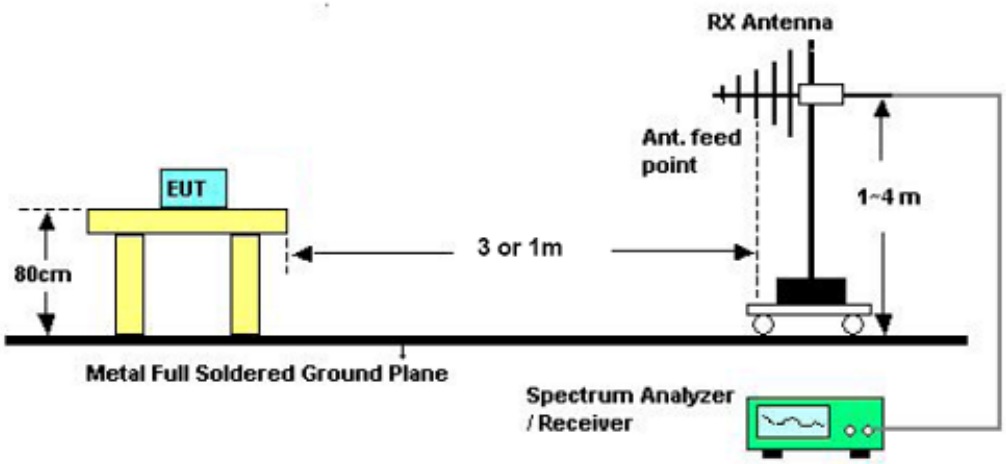
a. The EUT was placed on a rotatable table top 0.8 meter above ground.
b. The EUT was set 3 meters from the interference receiving antenna which was mounted on the top of a variable height antenna tower.
c. The table was rotated 360 degrees to determine the position of the highest radiation.
d. The antenna is a broadband antenna and its height is varied between one meter and four meters above ground to find the maximum value of the field strength both horizontal polarization and vertical polarization of the antenna are set to make the measurement.
e. For each suspected emission the EUT was arranged to its worst case and then tune the antenna tower (from 1 M to 4 M) and turn table (from 0 degree to 360 degrees) to find the maximum reading.
f. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function and specified bandwidth with Maximum Hold Mode.
g. If the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method and reported.
h. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
i. “Cone of radiation” has been considered to be 3dB bandwidth of the measurement antenna.

7.3 Typical Test Setup

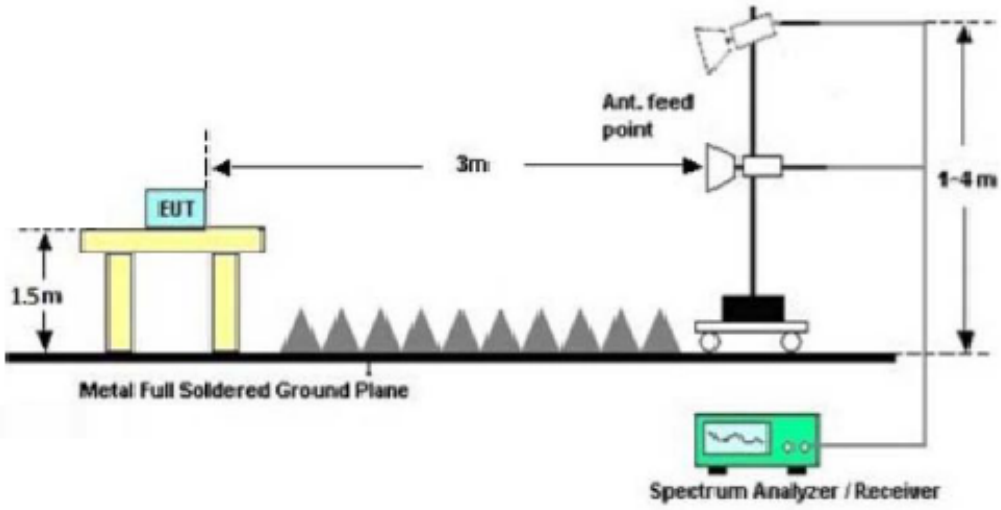
For radiated emissions below 30MHz



For radiated emissions above 30MHz



For radiated emissions above **1GHz**

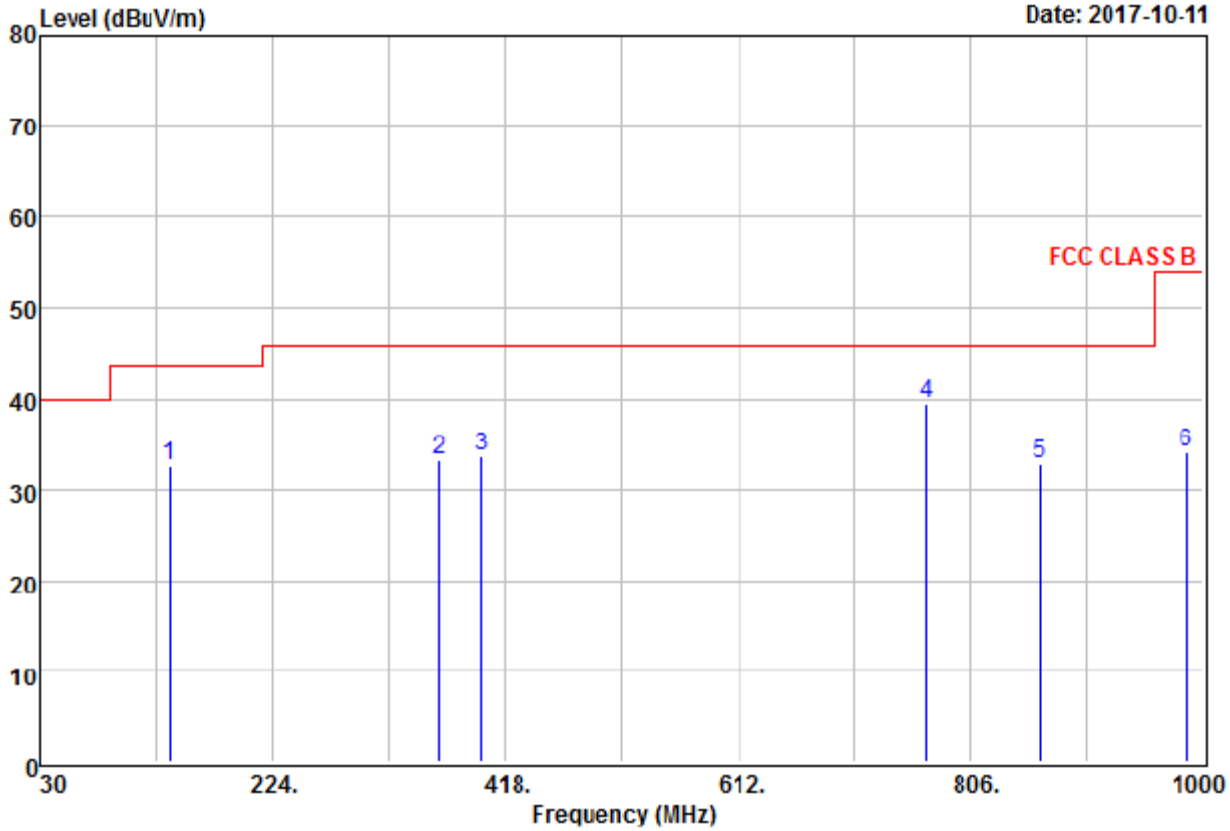


7.4 Test Result and Data (9kHz ~ 30MHz)

The 9kHz - 30MHz spurious emission is under limit 20dB more.

7.5 Test Result and Data (30MHz ~ 1GHz, worst emissions found)

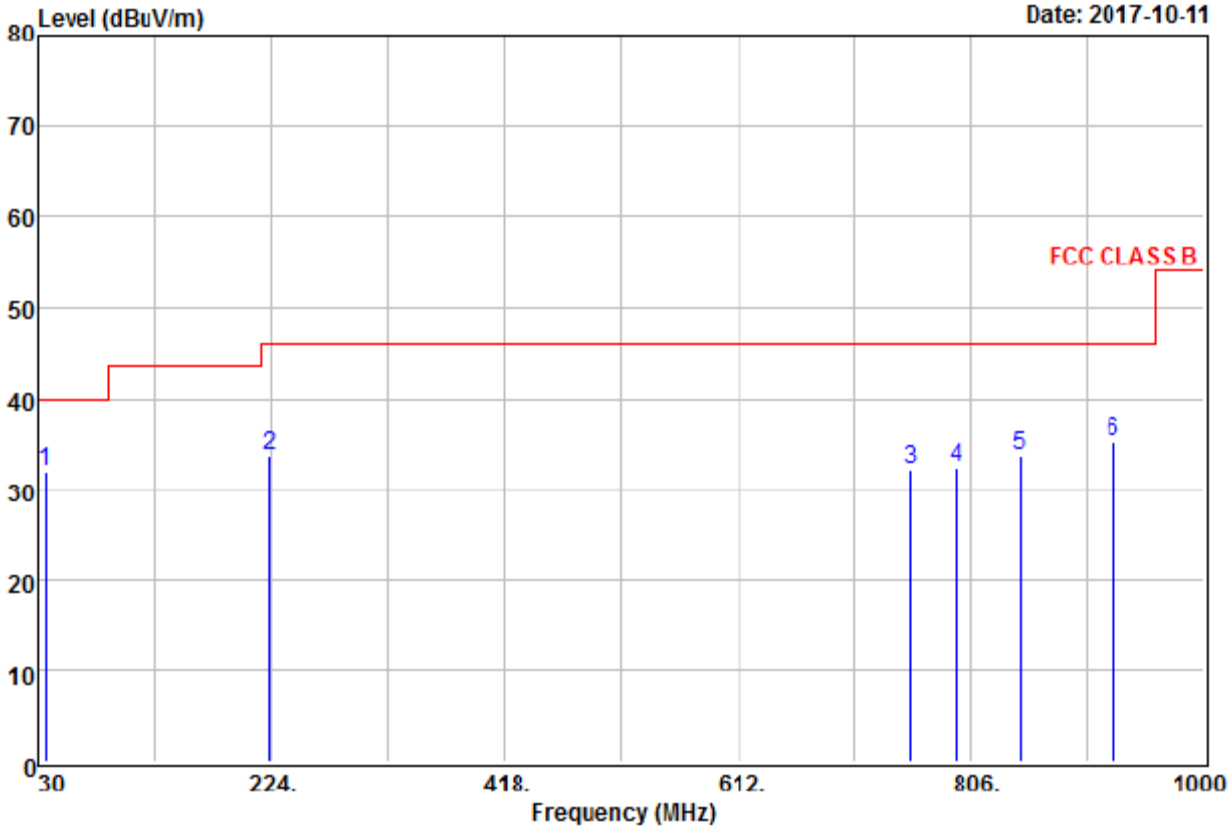
Power	:	DC 5V	Pol/Phase	:	HORIZONTAL
Test Mode 1	:	GFSK CH0	Temperature	:	31 °C
Memo	:		Humidity	:	67 %



Remarks: : 1.Result=Read Value+Factor
: 2.Factor=Antenna Factor+Cable loss-
: Amplifier Factor

		Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	
1		138.640	47.64	-15.05	32.59	43.50	-10.91	QP
2		362.710	45.16	-12.01	33.15	46.00	-12.85	QP
3		398.600	44.49	-10.92	33.57	46.00	-12.43	QP
4	@	769.140	45.28	-5.86	39.42	46.00	-6.58	QP
5		864.200	36.91	-4.04	32.87	46.00	-13.13	QP
6		986.420	35.42	-1.37	34.05	54.00	-19.95	QP

Power	:	DC 5V	Pol/Phase	:	VERTICAL
Test Mode 1	:	GFSK CH0	Temperature	:	31 °C
Memo	:		Humidity	:	67 %

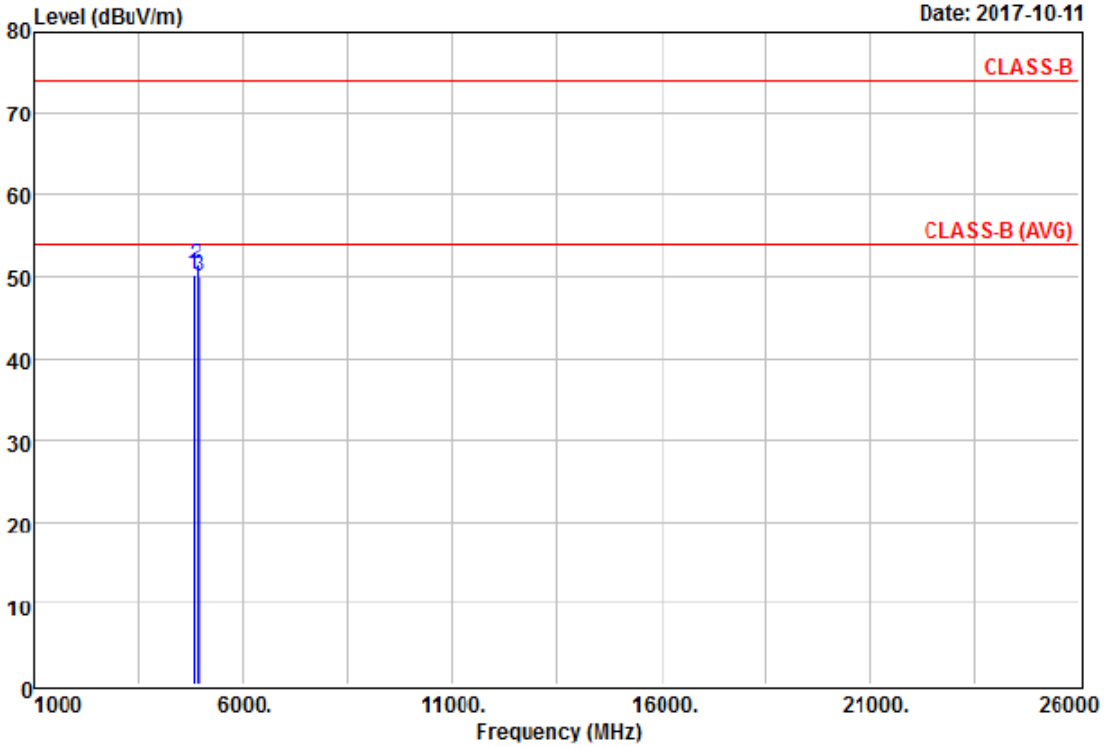


Remarks: **: 1.Result=Read Value+Factor**
: 2.Factor=Antenna Factor+Cable loss-
: Amplifier Factor

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	
1 @	35.940	49.48	-17.53	31.95	40.00	-8.05	QP
2	222.060	51.51	-17.94	33.57	46.00	-12.43	QP
3	755.930	38.35	-6.11	32.24	46.00	-13.76	QP
4	793.390	37.86	-5.38	32.48	46.00	-13.52	QP
5	846.740	37.73	-4.14	33.59	46.00	-12.41	QP
6	924.340	37.91	-2.78	35.13	46.00	-10.87	QP

7.6 Test Result and Data (Above 1GHz)

Power	:	DC 5V	Pol/Phase	:	HORIZONTAL
Test Mode 1	:	GFSK CH0, CH39, CH78	Temperature	:	31 °C
Memo	:		Humidity	:	67 %

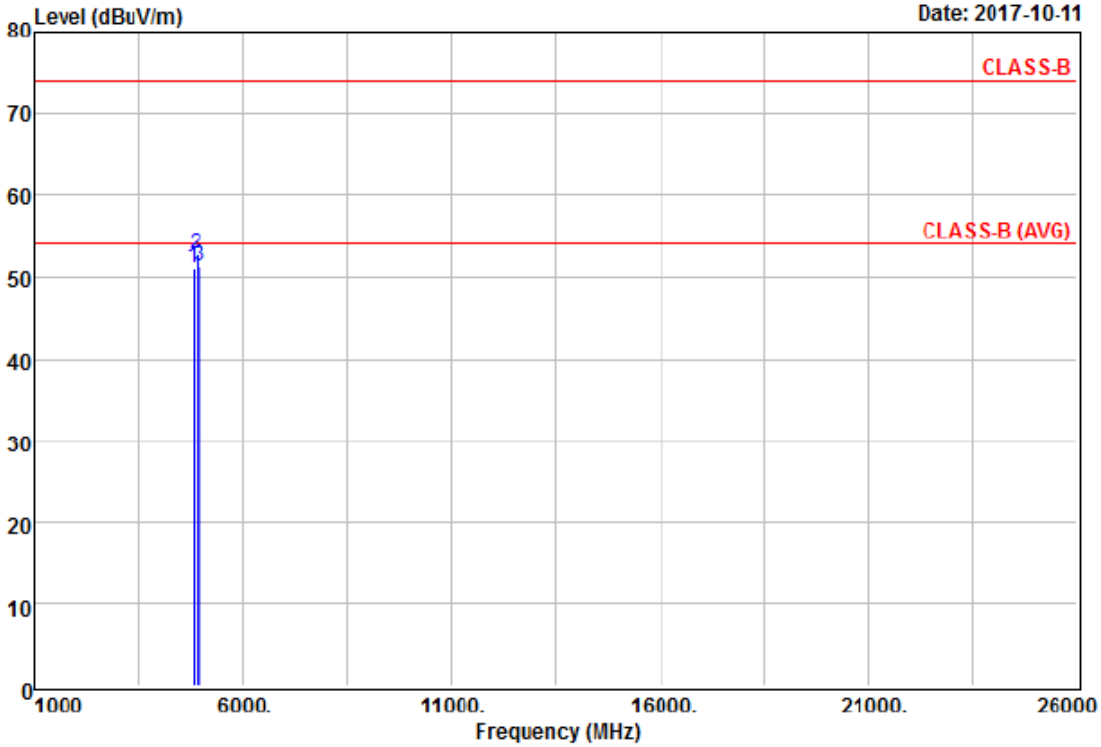


	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	
1	4804.000	56.63	-6.37	50.26	74.00	-23.74	Peak
2 @	4882.000	57.63	-6.15	51.48	74.00	-22.52	Peak
3	4960.000	55.83	-5.94	49.89	74.00	-24.11	Peak

Note:

1. Emission level = Reading level + Correction factor
2. Correction factor : Antenna factor, Cable loss, Pre-Amp, etc.
3. Measurements above 1000 MHz, Peak detector setting: 1 MHz RBW with 1 MHz VBW.
4. Measurements above 1000 MHz, Average detector setting: 1 MHz RBW with 10Hz VBW.
5. Peak detector measurement data will represent the worst case results.
6. Where limits are specified for both average and peak detector functions, if the peak measured value complies with the average limit, it is unnecessary to perform an average measurement.
7. The other emission levels were 20dB below the limit.

Power	:	DC 5V	Pol/Phase	:	VERTICAL
Test Mode 1	:	GFSK CH0, CH39, CH78	Temperature	:	31 °C
Memo	:		Humidity	:	67 %

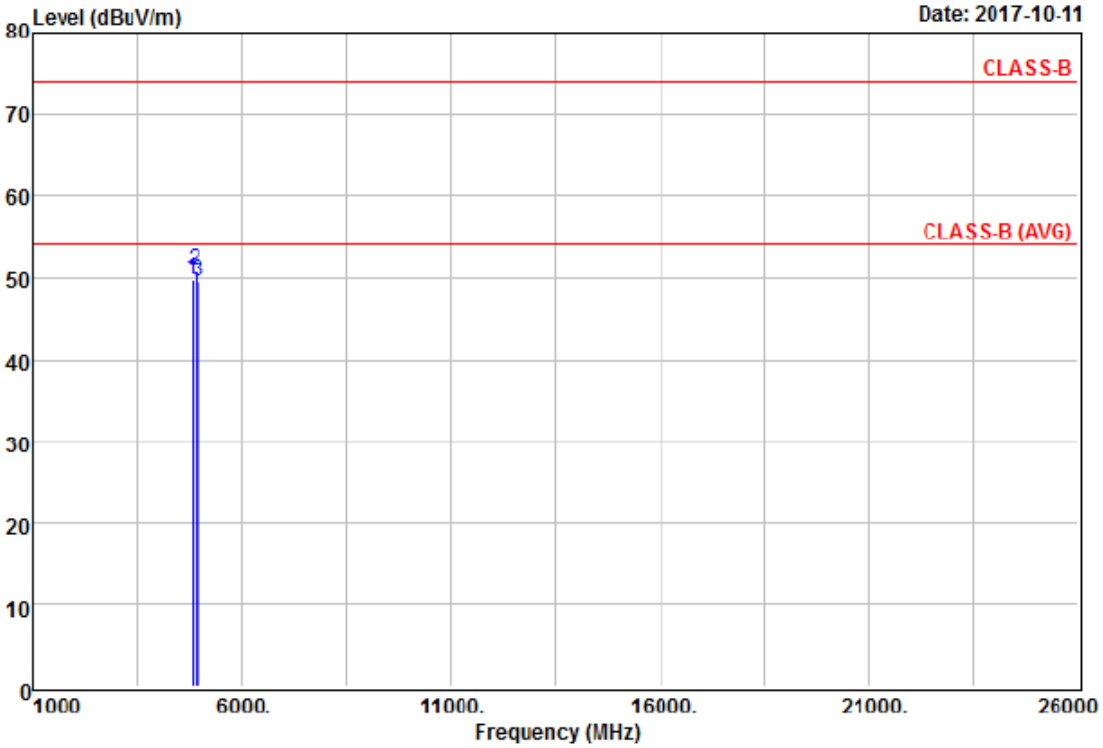


	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	
1	4804.000	57.52	-6.37	51.15	74.00	-22.85	Peak
2 @	4882.000	58.99	-6.15	52.84	74.00	-21.16	Peak
3	4960.000	57.24	-5.94	51.30	74.00	-22.70	Peak

Note:

1. Emission level = Reading level + Correction factor
2. Correction factor : Antenna factor, Cable loss, Pre-Amp, etc.
3. Measurements above 1000 MHz, Peak detector setting: 1 MHz RBW with 1 MHz VBW.
4. Measurements above 1000 MHz, Average detector setting: 1 MHz RBW with 10Hz VBW.
5. Peak detector measurement data will represent the worst case results.
6. Where limits are specified for both average and peak detector functions, if the peak measured value complies with the average limit, it is unnecessary to perform an average measurement.
7. The other emission levels were 20dB below the limit.

Power	:	DC 5V	Pol/Phase	:	HORIZONTAL
Test Mode 1	:	PI/4-DQPSK CH0, CH39, CH78	Temperature	:	31 °C
Memo	:		Humidity	:	67 %

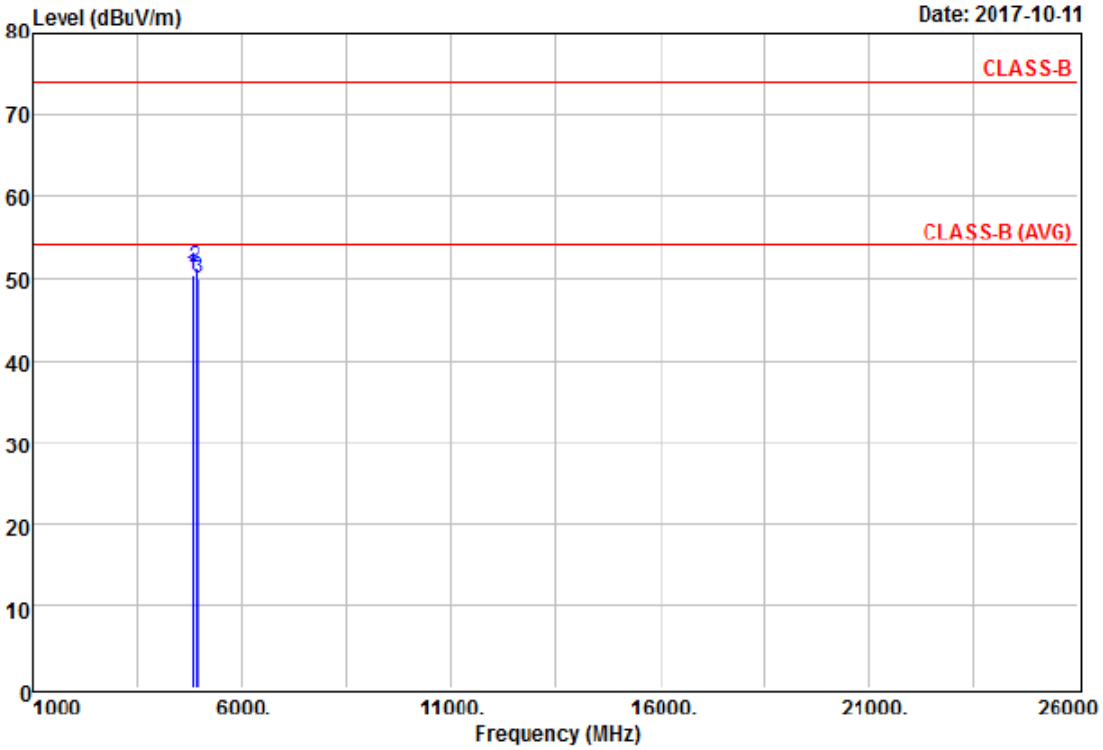


	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	
1	4804.000	56.14	-6.37	49.77	74.00	-24.23	Peak
2 @	4882.000	56.88	-6.15	50.73	74.00	-23.27	Peak
3	4960.000	55.39	-5.94	49.45	74.00	-24.55	Peak

Note:

1. Emission level = Reading level + Correction factor
2. Correction factor : Antenna factor, Cable loss, Pre-Amp, etc.
3. Measurements above 1000 MHz, Peak detector setting: 1 MHz RBW with 1 MHz VBW.
4. Measurements above 1000 MHz, Average detector setting: 1 MHz RBW with 10Hz VBW.
5. Peak detector measurement data will represent the worst case results.
6. Where limits are specified for both average and peak detector functions, if the peak measured value complies with the average limit, it is unnecessary to perform an average measurement.
7. The other emission levels were 20dB below the limit.

Power	:	DC 5V	Pol/Phase	:	VERTICAL
Test Mode 1	:	PI/4-DQPSK CH0, CH39, CH78	Temperature	:	31 °C
Memo	:		Humidity	:	67 %

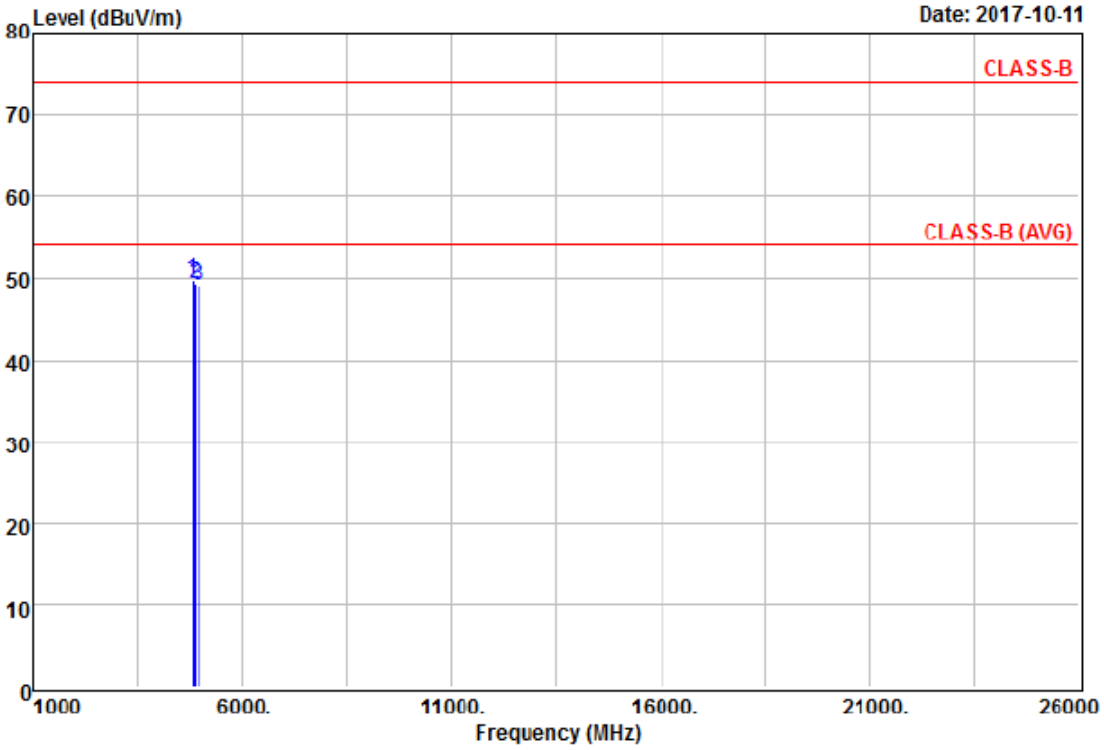


	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	
1	4804.000	56.75	-6.37	50.38	74.00	-23.62	Peak
2 @	4882.000	57.44	-6.15	51.29	74.00	-22.71	Peak
3	4960.000	55.85	-5.94	49.91	74.00	-24.09	Peak

Note:

1. Emission level = Reading level + Correction factor
2. Correction factor : Antenna factor, Cable loss, Pre-Amp, etc.
3. Measurements above 1000 MHz, Peak detector setting: 1 MHz RBW with 1 MHz VBW.
4. Measurements above 1000 MHz, Average detector setting: 1 MHz RBW with 10Hz VBW.
5. Peak detector measurement data will represent the worst case results.
6. Where limits are specified for both average and peak detector functions, if the peak measured value complies with the average limit, it is unnecessary to perform an average measurement.
7. The other emission levels were 20dB below the limit.

Power	:	DC 5V	Pol/Phase	:	HORIZONTAL
Test Mode 1	:	8DPSK CH0, CH39, CH78	Temperature	:	31 °C
Memo	:		Humidity	:	67 %

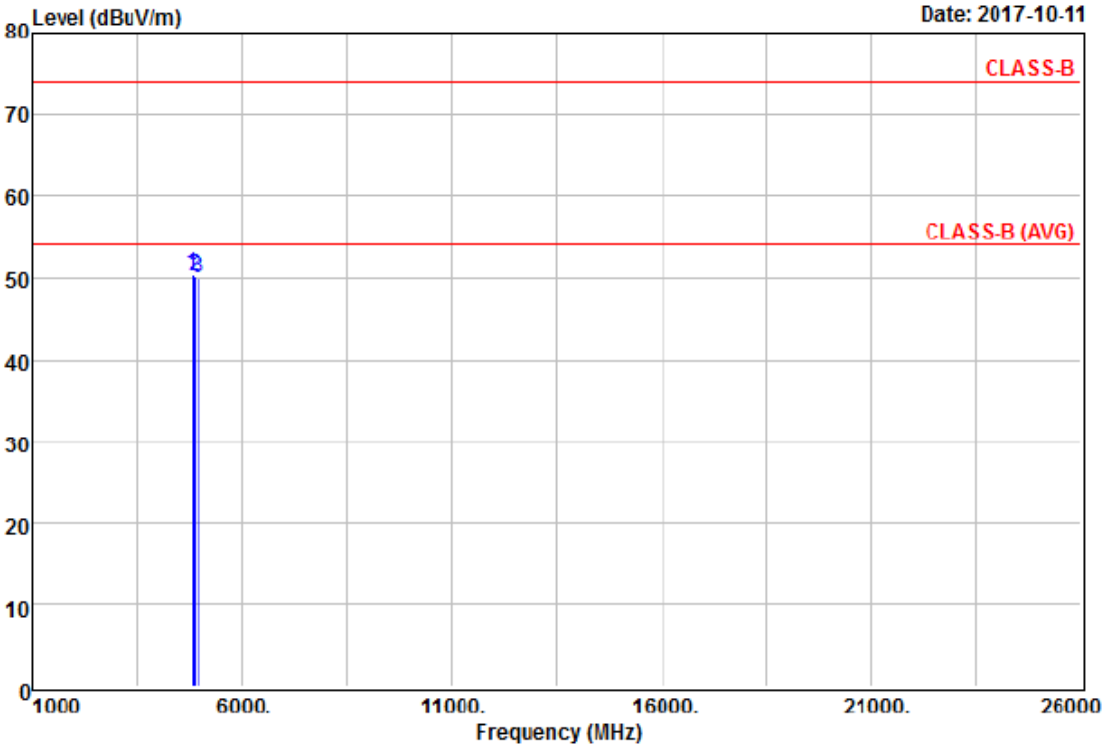


	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	
1 @	4804.000	56.10	-6.37	49.73	74.00	-24.27	Peak
2	4880.000	55.52	-6.17	49.35	74.00	-24.65	Peak
3	4960.000	55.11	-5.94	49.17	74.00	-24.83	Peak

Note:

1. Emission level = Reading level + Correction factor
2. Correction factor : Antenna factor, Cable loss, Pre-Amp, etc.
3. Measurements above 1000 MHz, Peak detector setting: 1 MHz RBW with 1 MHz VBW.
4. Measurements above 1000 MHz, Average detector setting: 1 MHz RBW with 10Hz VBW.
5. Peak detector measurement data will represent the worst case results.
6. Where limits are specified for both average and peak detector functions, if the peak measured value complies with the average limit, it is unnecessary to perform an average measurement.
7. The other emission levels were 20dB below the limit.

Power	:	DC 5V	Pol/Phase	:	VERTICAL
Test Mode 1	:	8DPSK CH0, CH39, CH78	Temperature	:	31 °C
Memo	:		Humidity	:	67 %



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	
1 @	4804.000	56.83	-6.37	50.46	74.00	-23.54	Peak
2	4880.000	56.38	-6.17	50.21	74.00	-23.79	Peak
3	4960.000	55.82	-5.94	49.88	74.00	-24.12	Peak

Note:

1. Emission level = Reading level + Correction factor
2. Correction factor : Antenna factor, Cable loss, Pre-Amp, etc.
3. Measurements above 1000 MHz, Peak detector setting: 1 MHz RBW with 1 MHz VBW.
4. Measurements above 1000 MHz, Average detector setting: 1 MHz RBW with 10Hz VBW.
5. Peak detector measurement data will represent the worst case results.
6. Where limits are specified for both average and peak detector functions, if the peak measured value complies with the average limit, it is unnecessary to perform an average measurement.
7. The other emission levels were 20dB below the limit.

8. 20dB Bandwidth Measurement Data

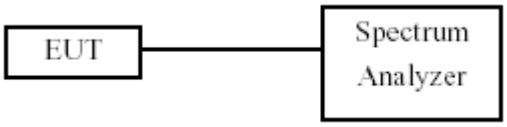
8.1 Test Limit

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

8.2 Test Procedures

a. The transmitter output was connected to the spectrum analyzer.
b. Set RBW of spectrum analyzer to 30 KHz and VBW to 100 KHz.
c. The 20 dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20 dB.

8.3 Test Setup Lavout

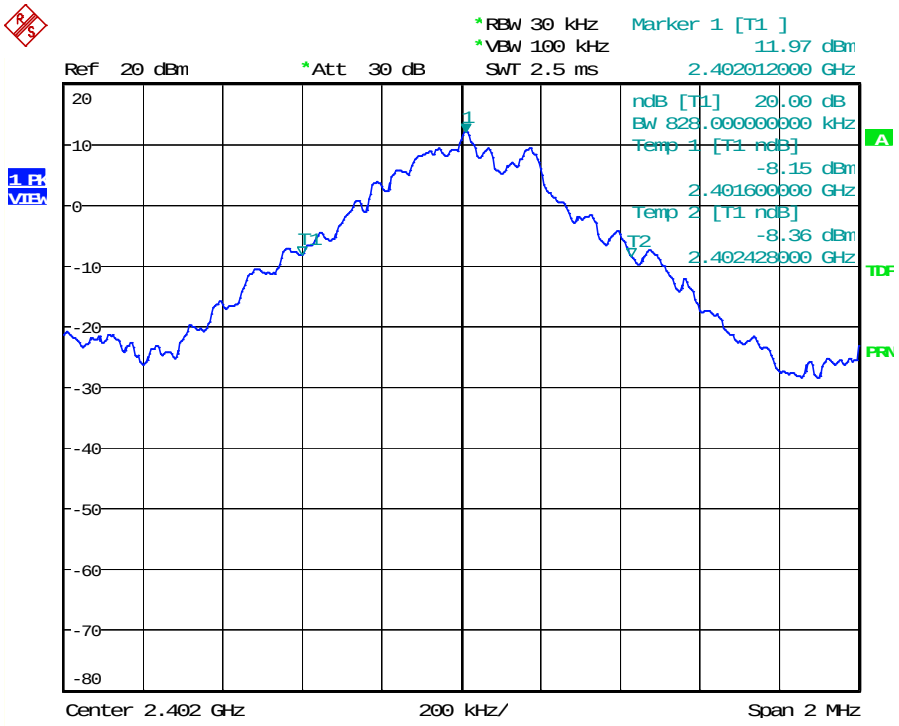


8.4 Test Result and Data

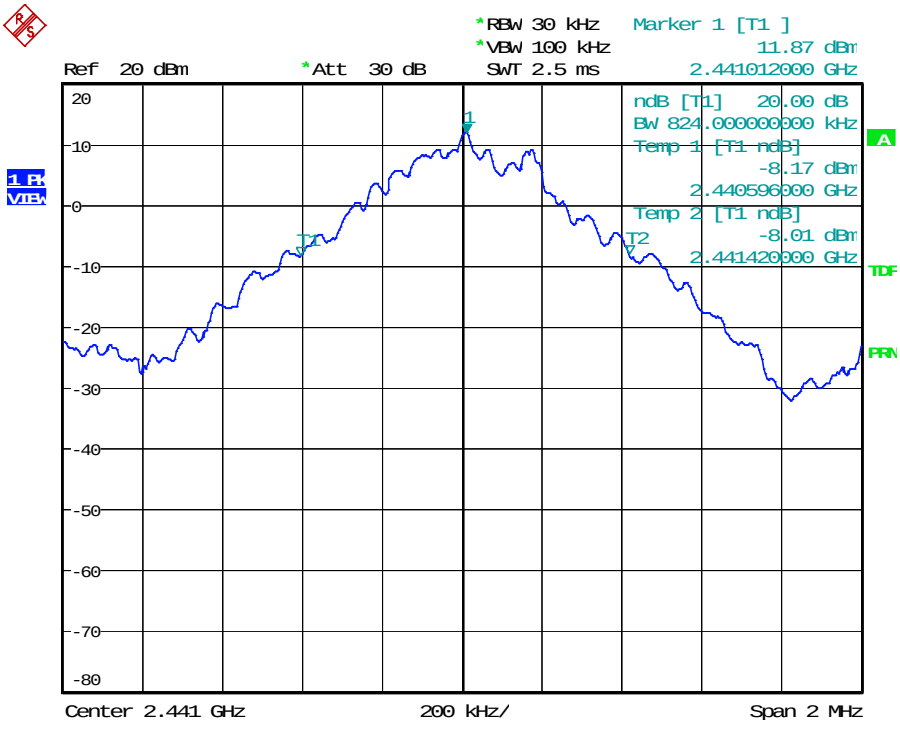
Test Date: Oct. 06, 2017 Temperature: 26 °C
Atmospheric pressure: 1010 hPa Humidity: 51 %

Modulation Type	Channel	Frequency (MHz)	20dB Bandwidth (KHz)	2/3 20dB Bandwidth (KHz)
GFSK (1Mbps)	00	2402	828.00	552.00
	39	2441	824.00	549.33
	78	2480	820.00	546.67
π/4-DQPSK (2 Mbps)	00	2402	1316.00	877.33
	39	2441	1284.00	856.00
	78	2480	1272.00	848.00
8DPSK (3Mbps)	00	2402	1308.00	872.00
	39	2441	1304.00	869.33
	78	2480	1272.00	848.00

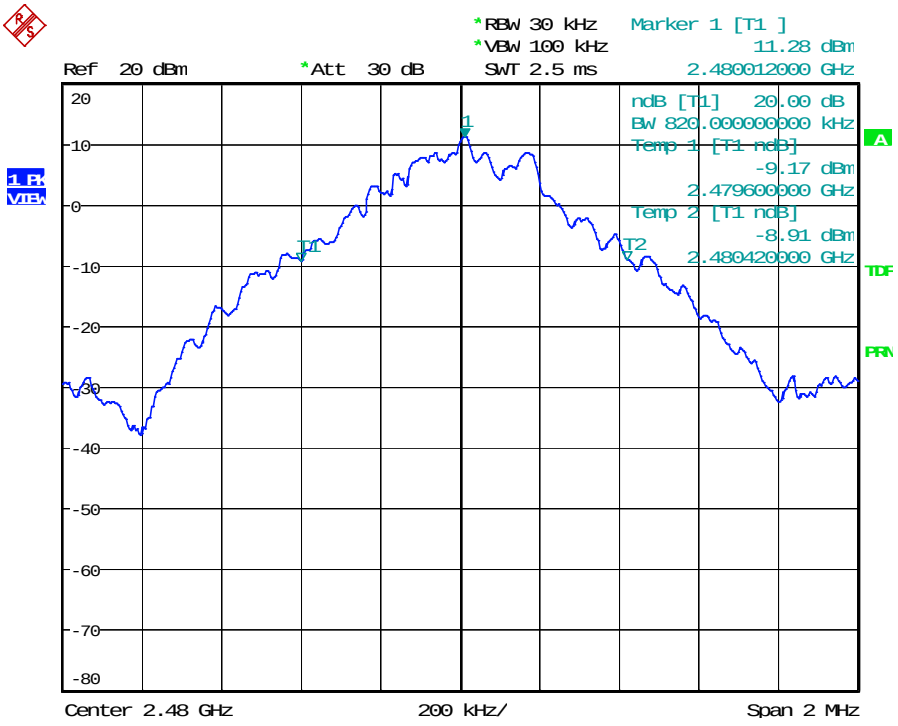
Modulation Standard: GFSK (1Mbps)
Channel: 00



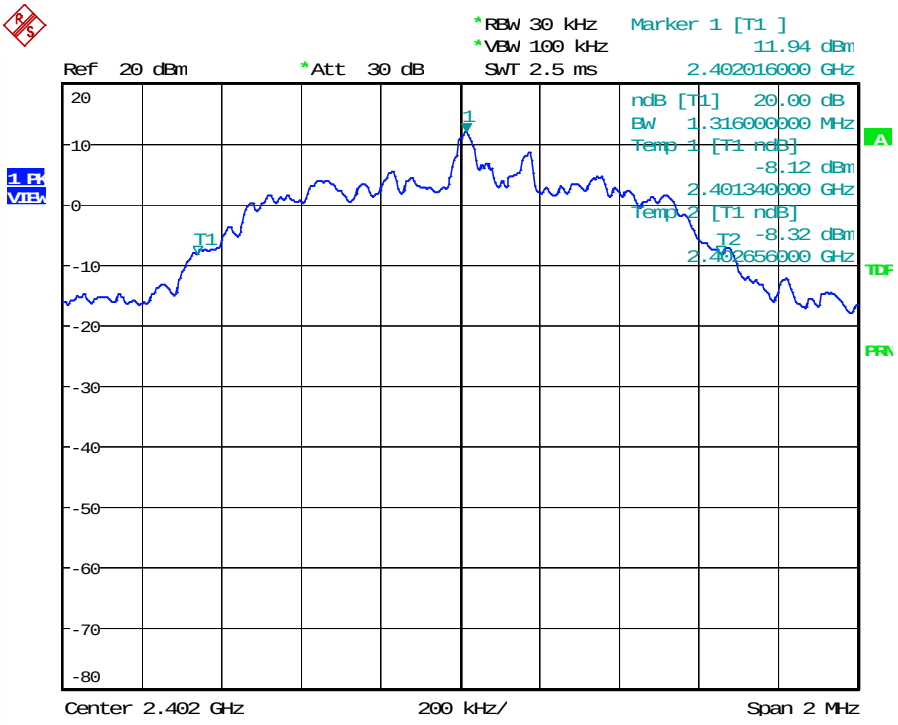
Modulation Standard: GFSK (1Mbps)
Channel: 39



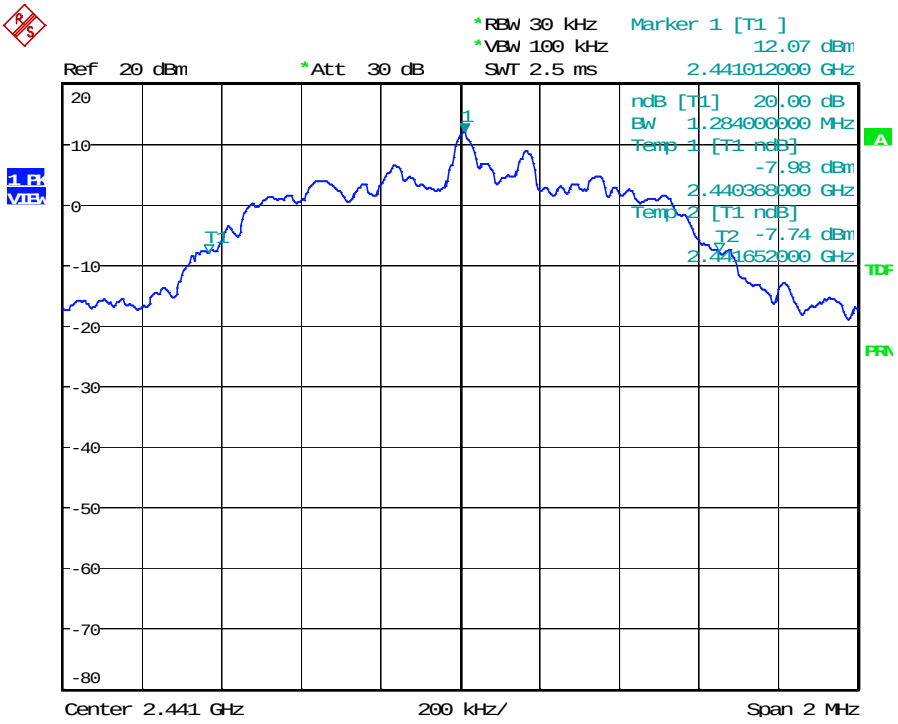
Modulation Standard: GFSK (1Mbps)
Channel: 78



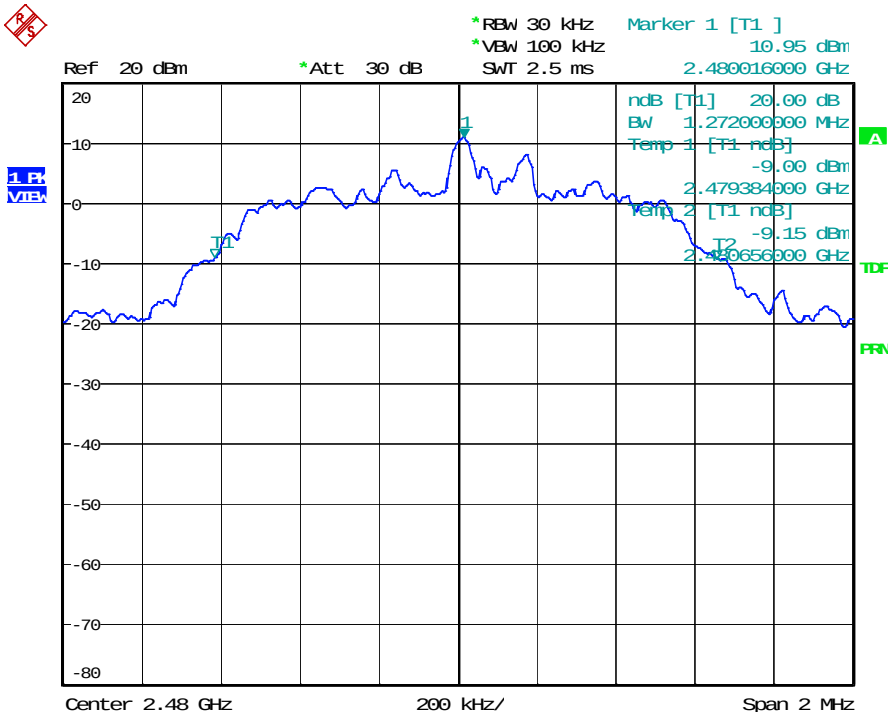
Modulation Standard: π/4-DQPSK (2Mbps)
Channel: 00



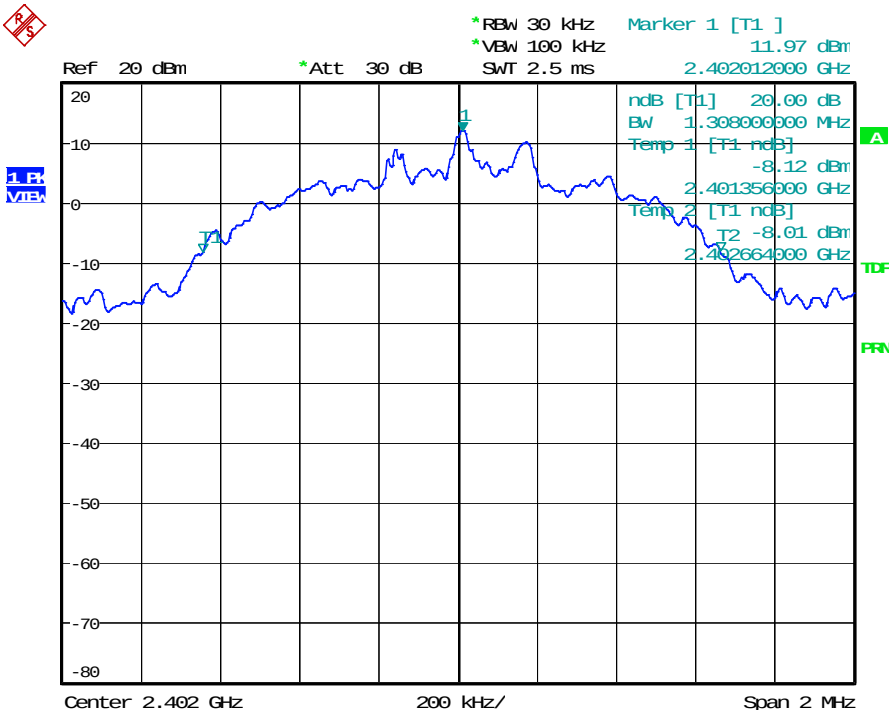
Modulation Standard: π/4-DQPSK (2Mbps)
Channel: 39



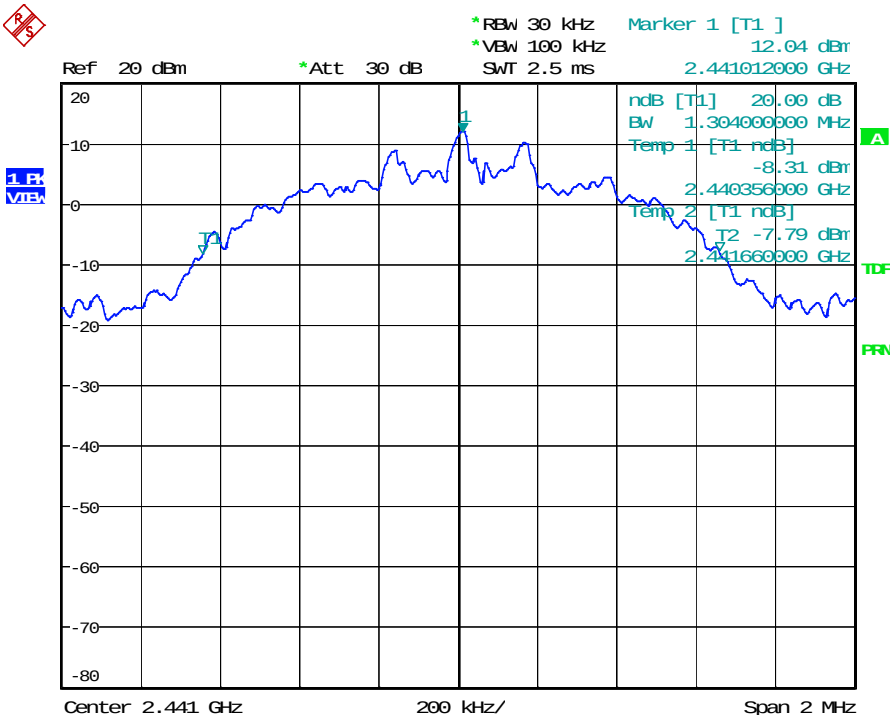
Modulation Standard: π/4-DQPSK (2Mbps)
Channel: 78



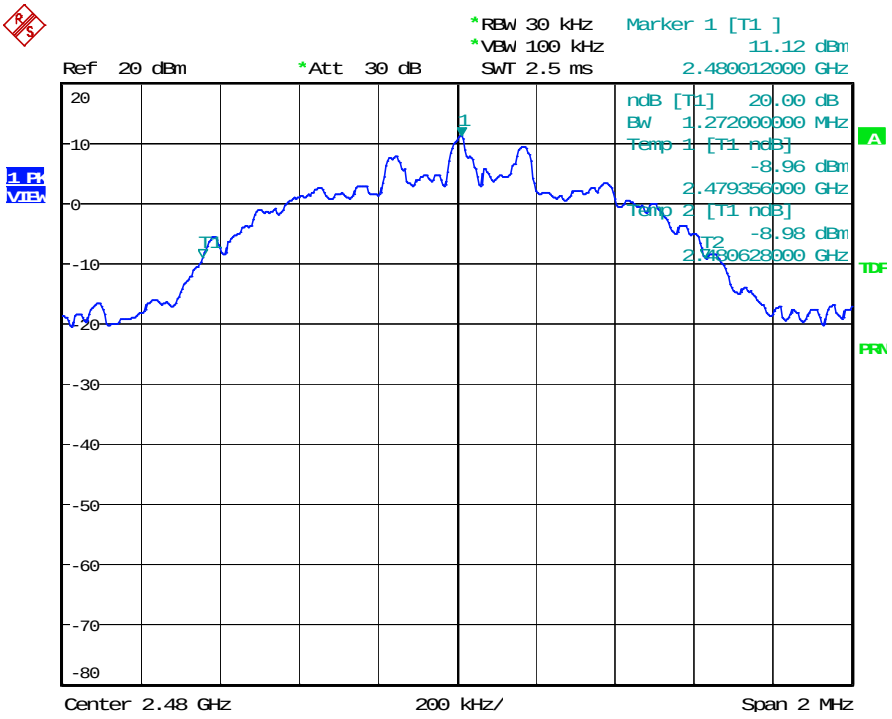
Modulation Standard: 8DPSK (3Mbps)
Channel: 00



Modulation Standard: 8DPSK (3Mbps)
Channel: 39



Modulation Standard: 8DPSK (3Mbps)
Channel: 78



9. Frequencies Separation

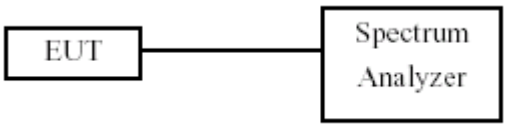
9.1 Test Limit

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

9.2 Test Procedures

a. The transmitter output was connected to the spectrum analyzer.
b. Set RBW of spectrum analyzer to 30 KHz and VBW to 100 KHz.
c. By using the MaxHold function record the separation of two adjacent channels.
d. Measure the frequency difference of these two adjacent channels.

9.3 Test Setup Layout

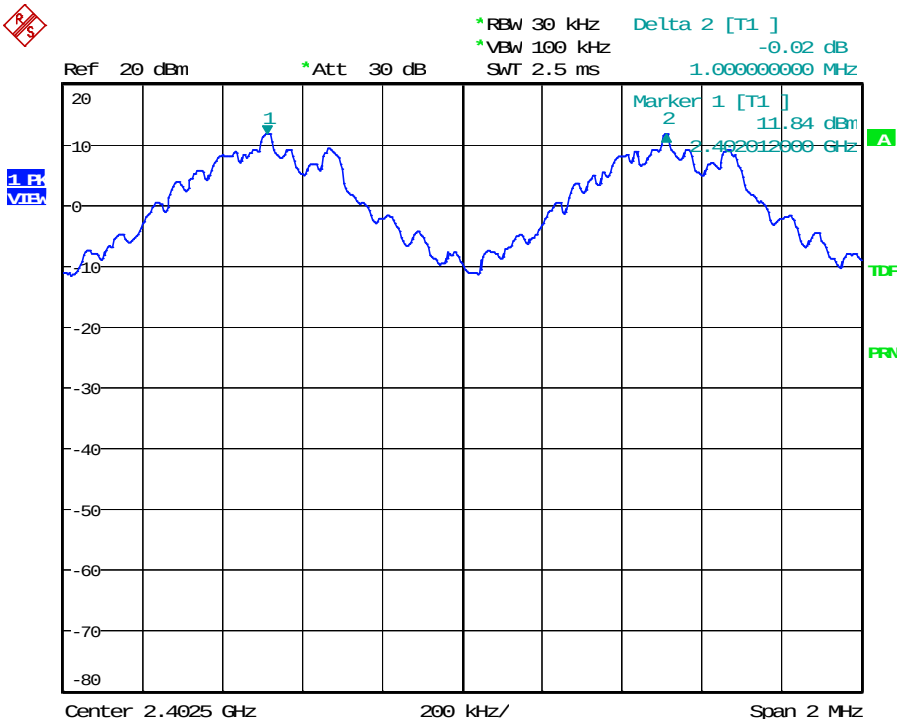


9.4 Test Result and Data

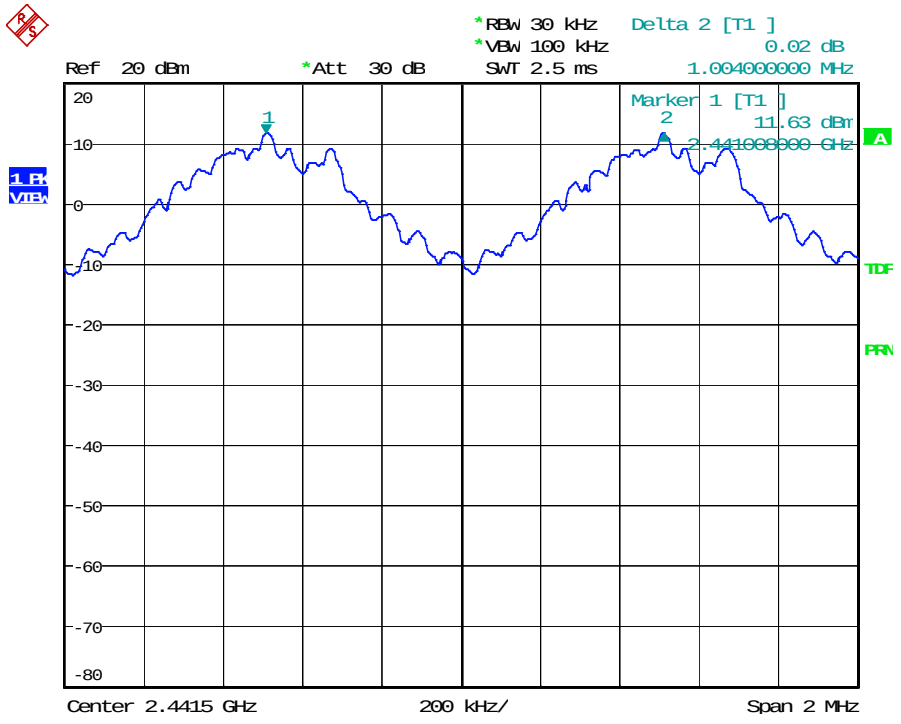
Test Date: Oct. 06, 2017 Temperature: 26 °C
Atmospheric pressure: 1010 hPa Humidity: 51 %

Modulation Type	Channel	Frequency (MHz)	Frequency Sepration (MHz)	Limit (KHz)
GFSK (1Mbps)	00	2402	1.000	25
	39	2441	1.004	25
	78	2480	0.996	25
π/4-DQPSK (2 Mbps)	00	2402	1.004	25
	39	2441	1.004	25
	78	2480	1.000	25
8DPSK (3Mbps)	00	2402	1.004	25
	39	2441	1.000	25
	78	2480	1.004	25

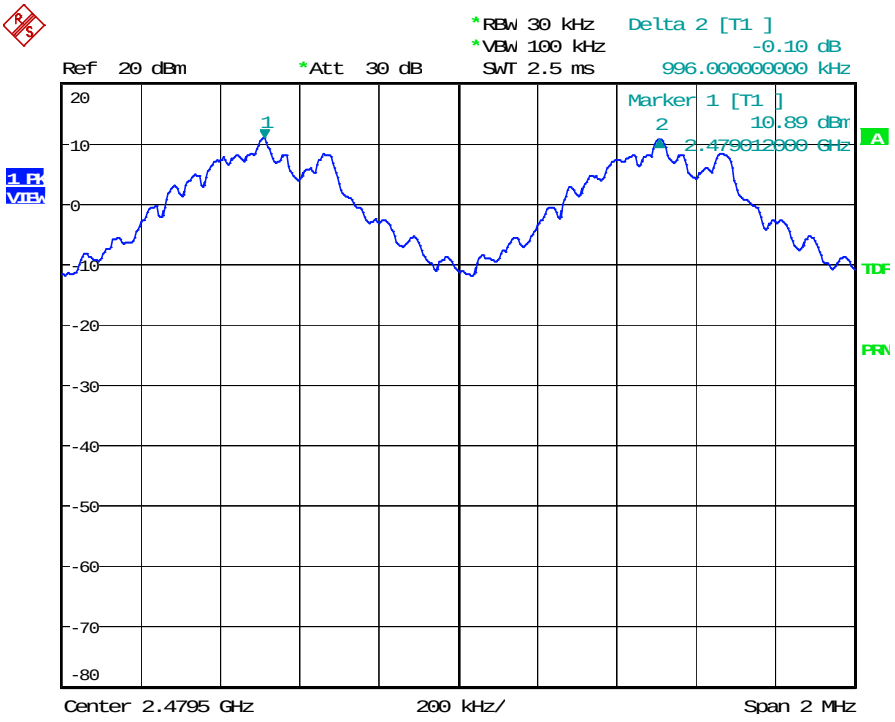
Modulation Standard: GFSK (1Mbps)
Channel: 00



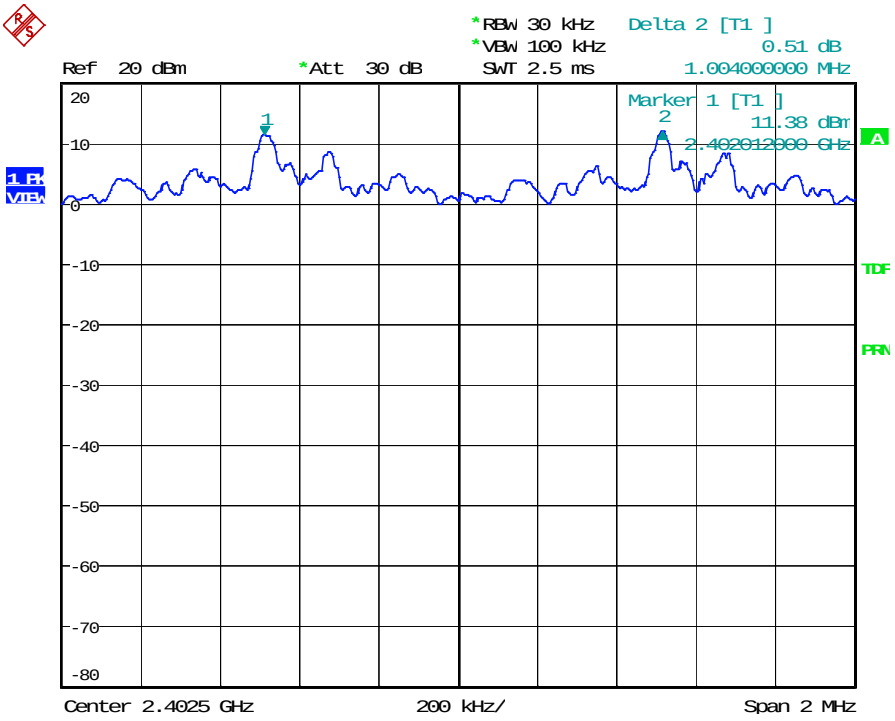
Modulation Standard: GFSK (1Mbps)
Channel: 39



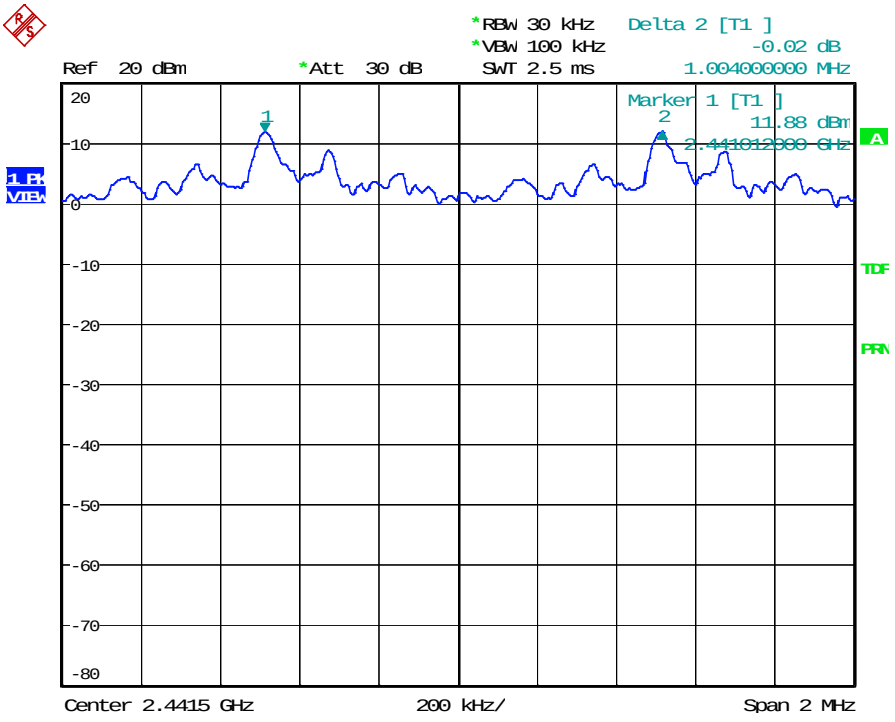
Modulation Standard: GFSK (1Mbps)
Channel: 78



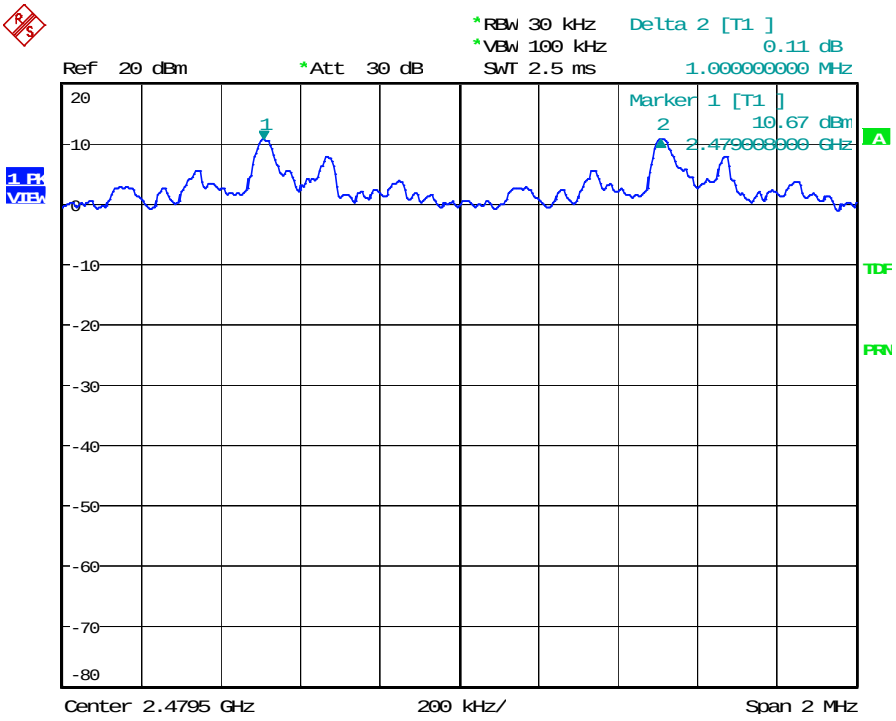
Modulation Standard: π/4-DQPSK (2Mbps)
Channel: 00



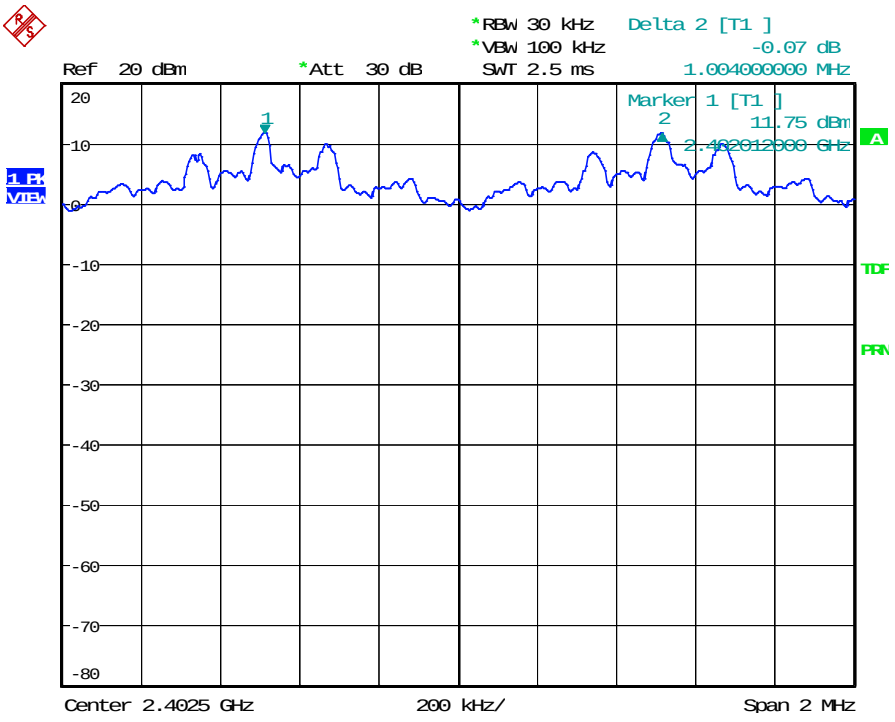
Modulation Standard: π/4-DQPSK (2Mbps)
Channel: 39



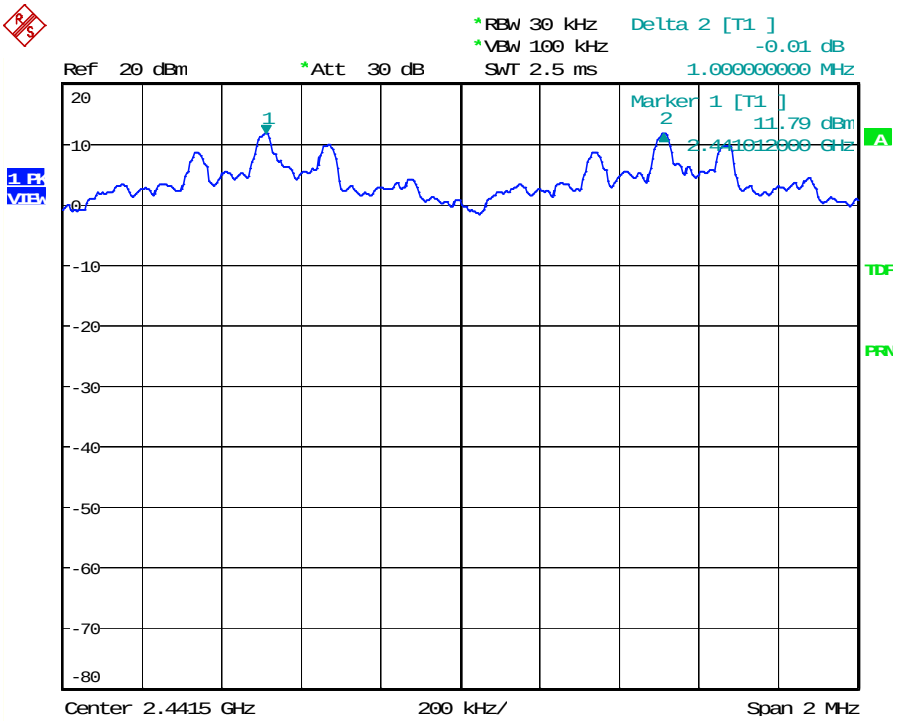
Modulation Standard: π/4-DQPSK (2Mbps)
Channel: 78



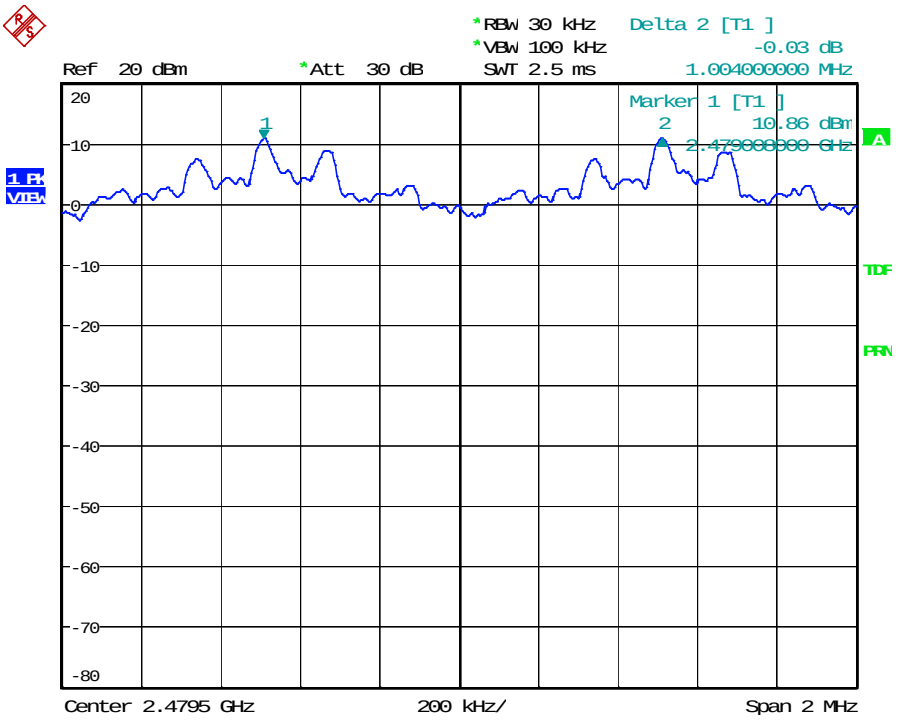
Modulation Standard: 8DPSK (3Mbps)
Channel: 00



Modulation Standard: 8DPSK (3Mbps)
Channel: 39



Modulation Standard: 8DPSK (3Mbps)
Channel: 78



10. Dwell Time on each channel

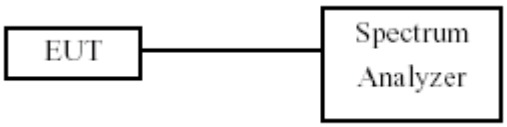
10.1 Test Limit

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.

10.2 Test Procedures

1. The transmitter output was connected to the spectrum analyzer.
2. Adjust the center frequency to measure frequency, then set zero span mode.
2. Set RBW of spectrum analyzer to 1 MHz and VBW to 1 MHz.
4. Measure the time duration of one transmission on the measured frequency.

10.3 Test Setup Layout



10.4 Test Result and Data

Test Date: Oct. 06, 2017 Temperature: 26 °C

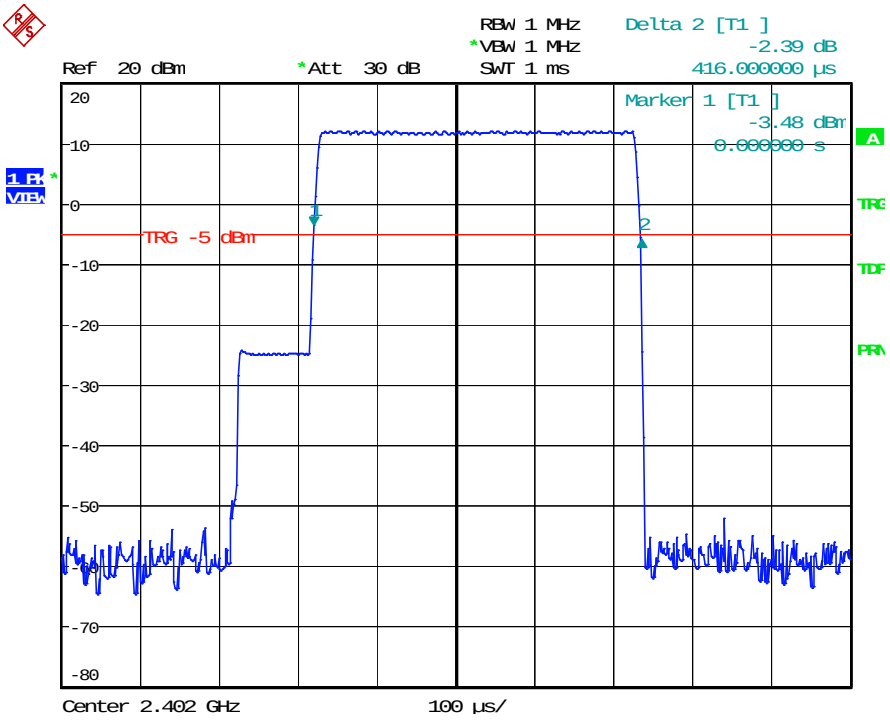
Atmospheric pressure: 1010 hPa Humidity: 51 %

Modulation Type	Channel	Frequency (MHz)	Reading Data (ms)	Dwell Time (ms)
GFSK DH1	00	2402	0.416	133.17
	39	2441	0.416	133.17
	78	2480	0.416	133.17
GFSK DH3	00	2402	1.680	268.63
	39	2441	1.680	268.63
	78	2480	1.680	268.63
GFSK DH5	00	2402	2.930	312.95
	39	2441	2.930	312.95
	78	2480	2.930	312.95
π/4-DQPSK 2DH5	00	2402	2.930	312.95
	39	2441	2.930	312.95
	78	2480	2.930	312.95
8DPSK 3DH5	00	2402	2.940	314.02
	39	2441	2.940	314.02
	78	2480	2.940	314.02

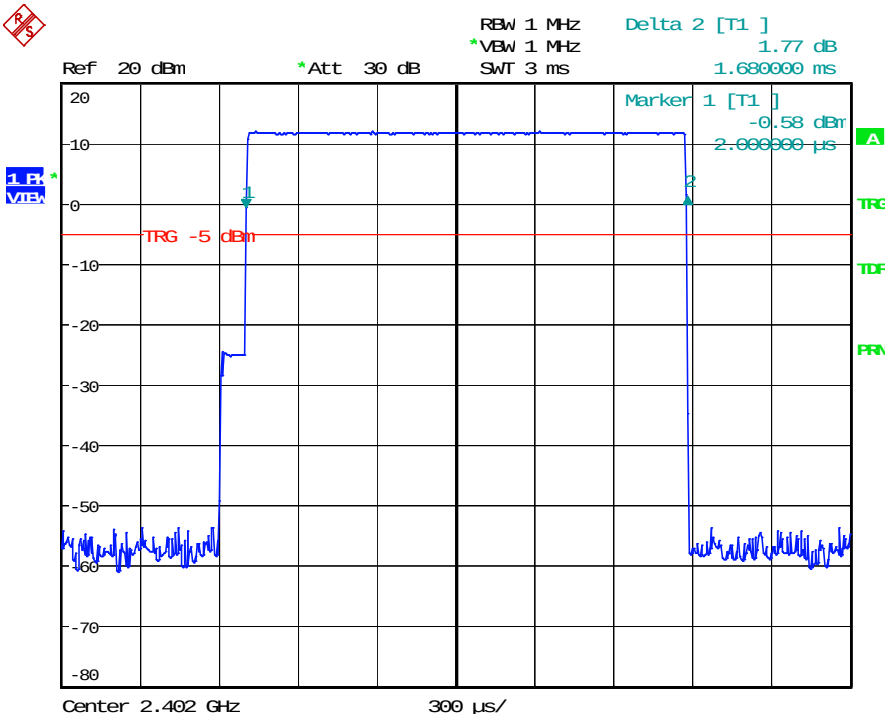
Test period: 0.4(second/ channel) x 79 channel= 31.6 second

Example:
CH0,DH1 mode = 0.416 (ms)*[(1600/2)/79]*31.6= 133.17 (ms)
CH0,DH3 mode = 1.680 (ms)*[(1600/4)/79]*31.6= 268.63 (ms)
CH0,DH5 mode = 2.930 (ms)*[(1600/6)/79]*31.6= 312.95 (ms)

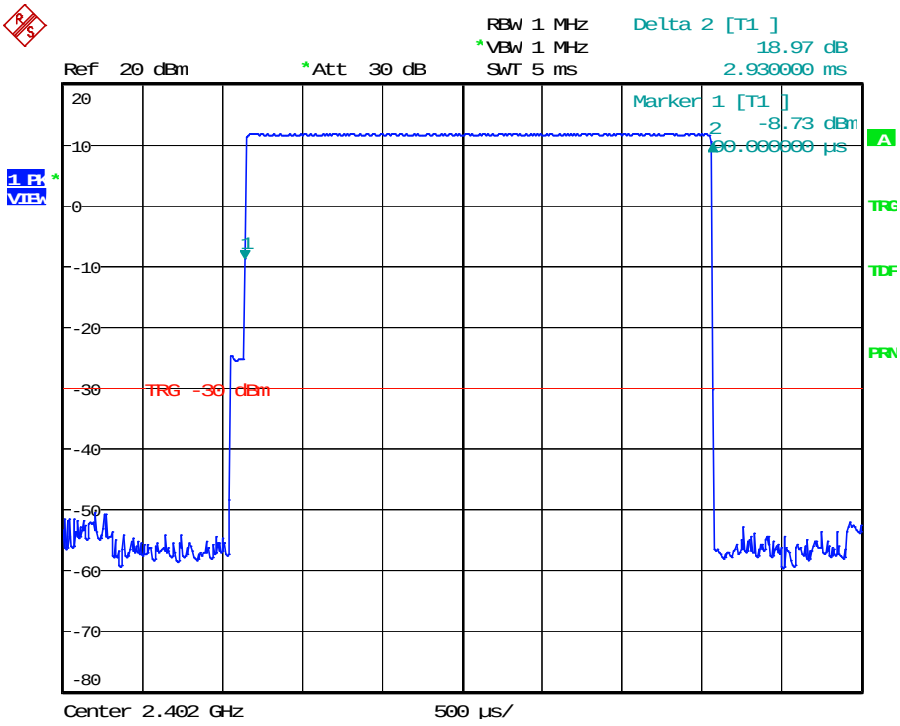
Modulation Standard: GFSK (1Mbps)
Channel: 00, Rate: DH1



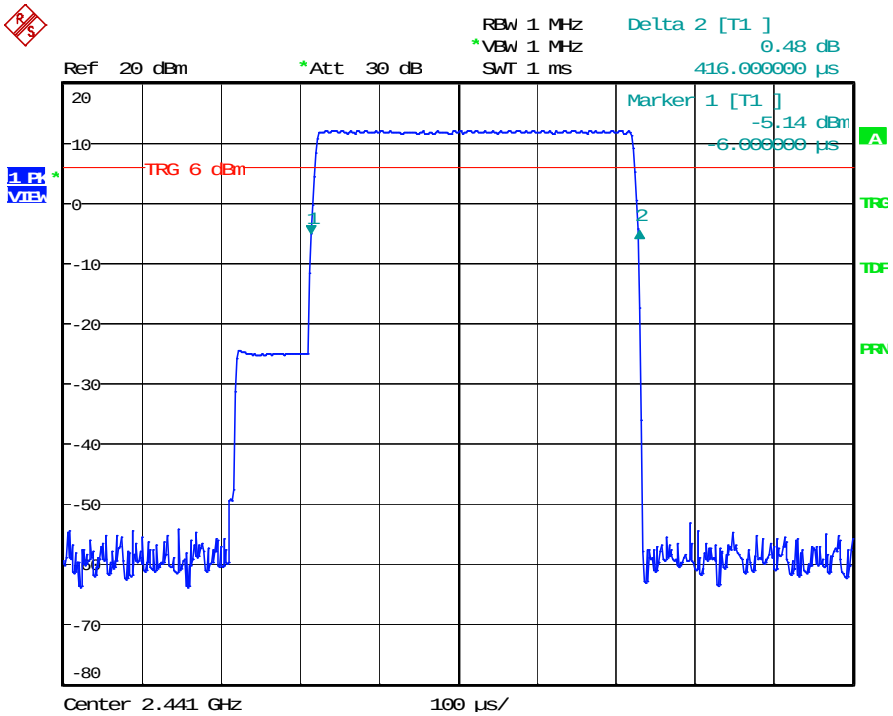
Modulation Standard: GFSK (1Mbps)
Channel: 00, Rate: DH3



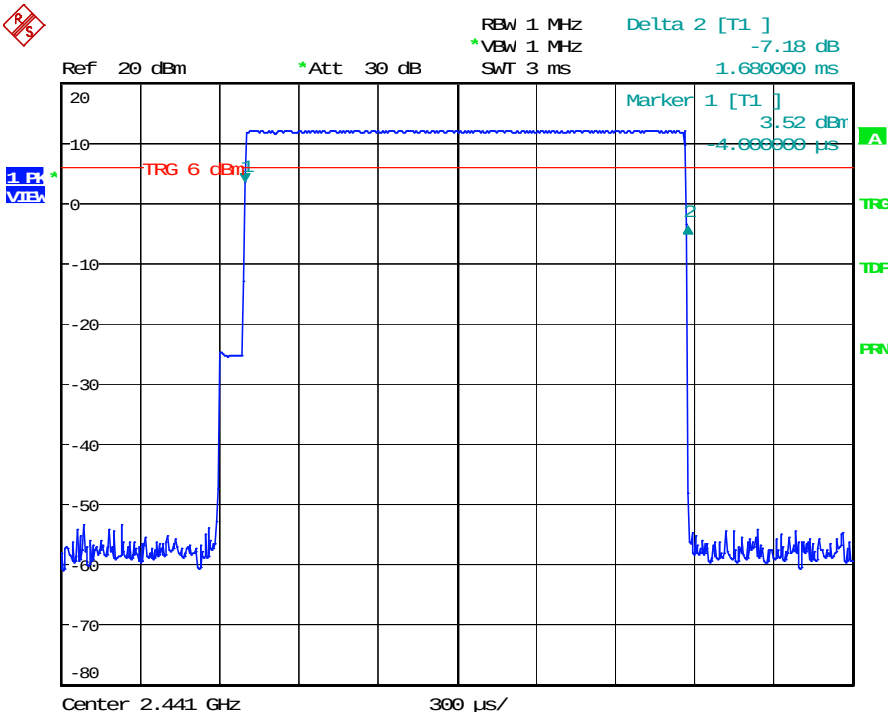
Modulation Standard: GFSK (1Mbps)
Channel: 00, Rate: DH5



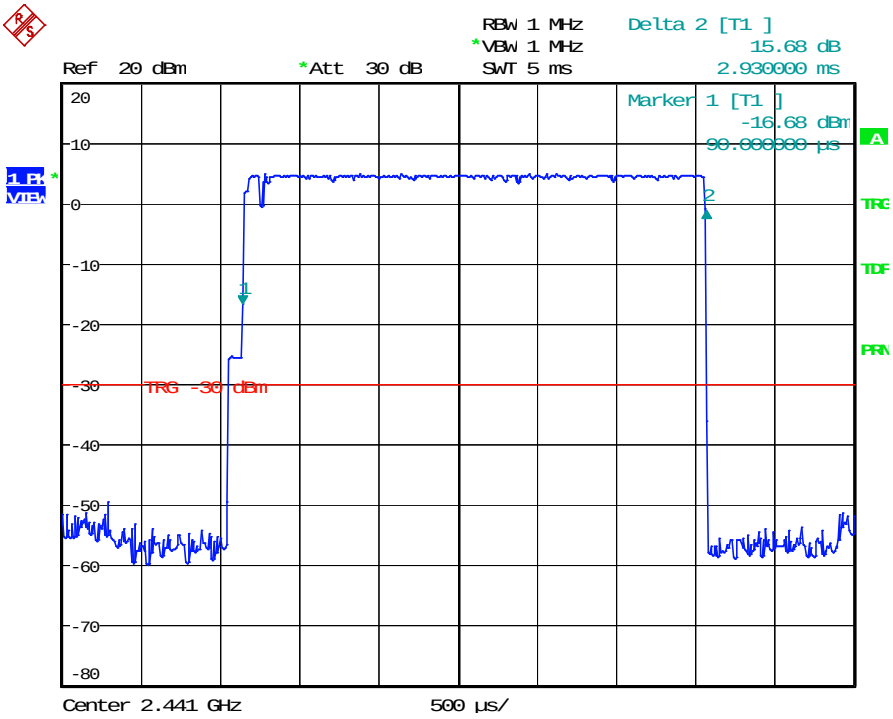
Modulation Standard: GFSK (1Mbps)
Channel: 39, Rate: DH1



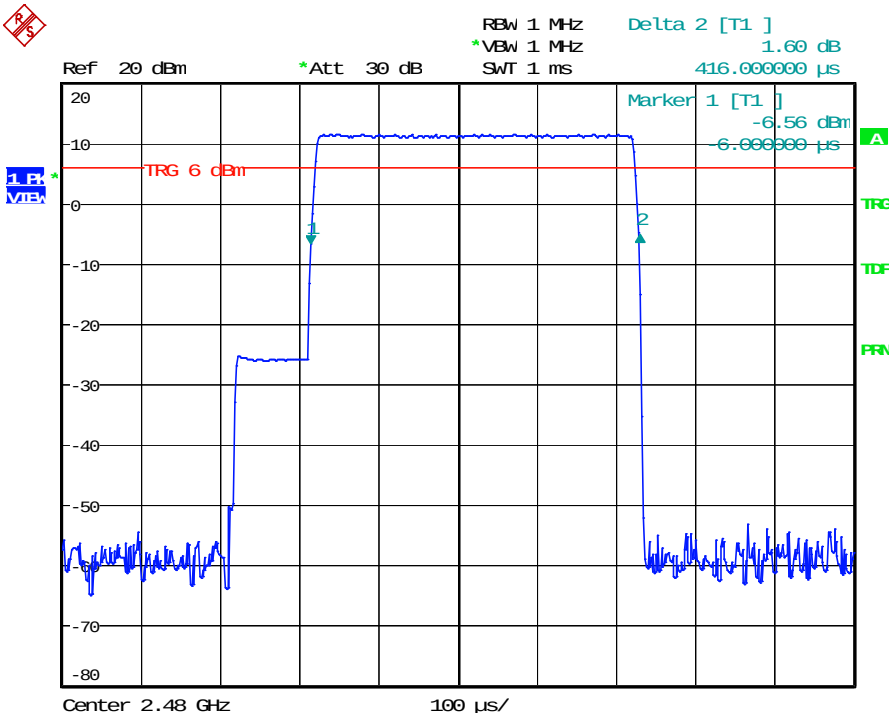
Modulation Standard: GFSK (1Mbps)
Channel: 39, Rate: DH3



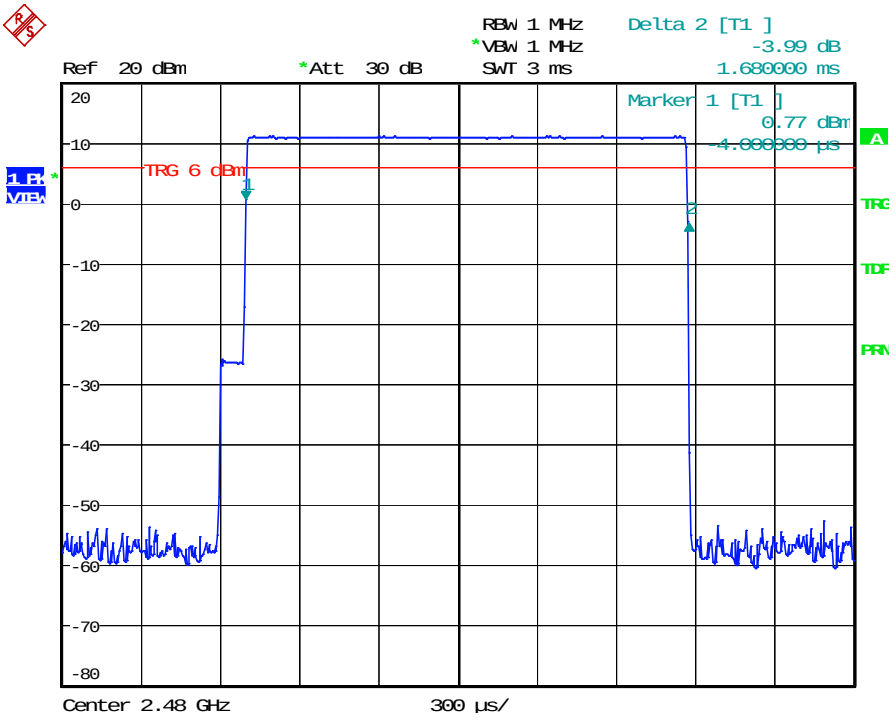
Modulation Standard: GFSK (1Mbps)
Channel: 39, Rate: DH5



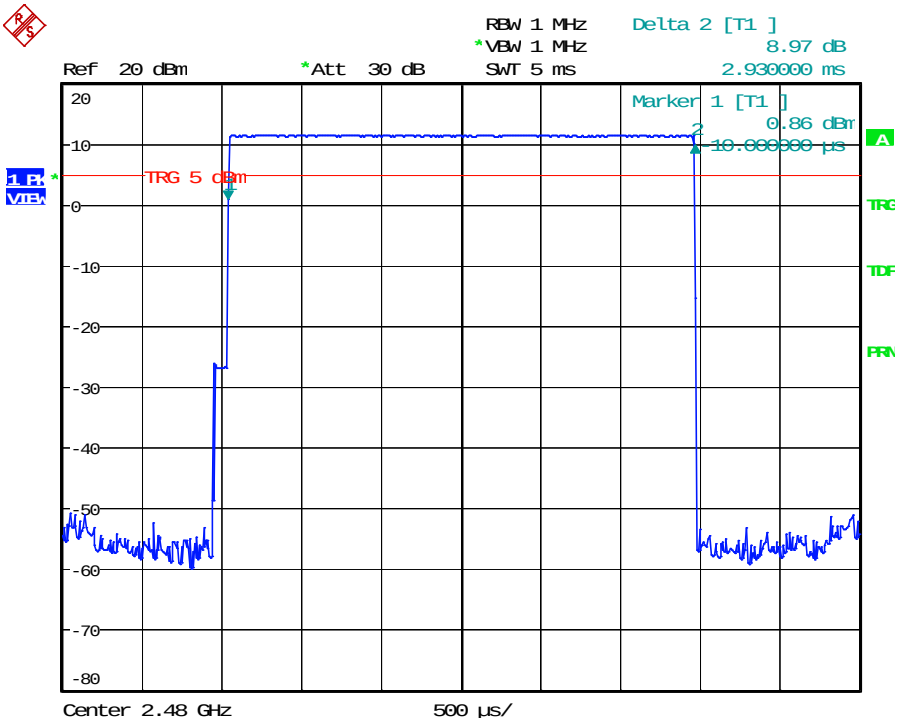
Modulation Standard: GFSK (1Mbps)
Channel: 78, Rate: DH1



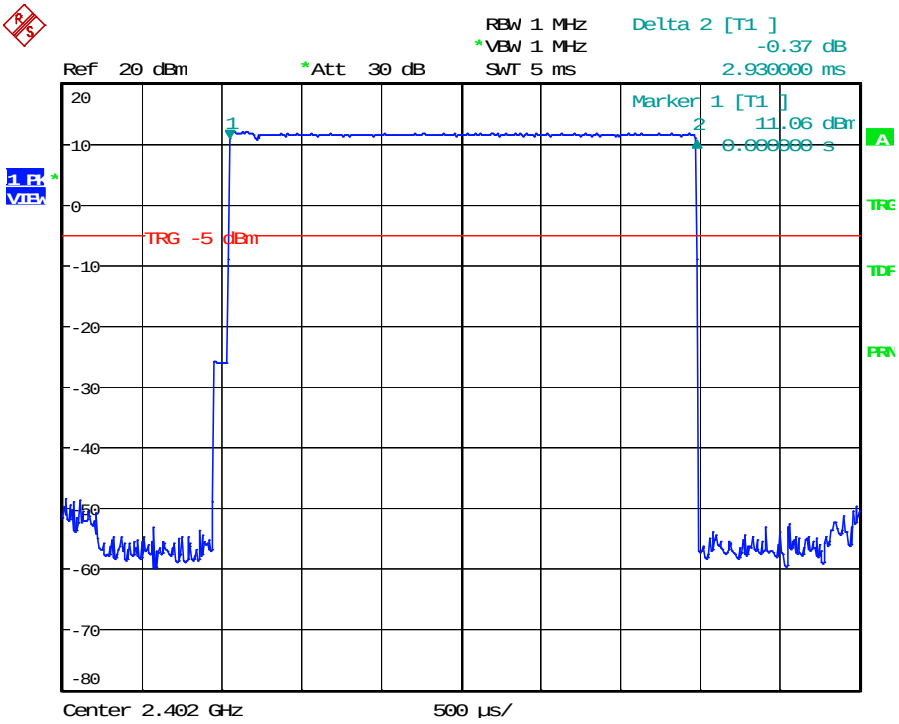
Modulation Standard: GFSK (1Mbps)
Channel: 78, Rate: DH3



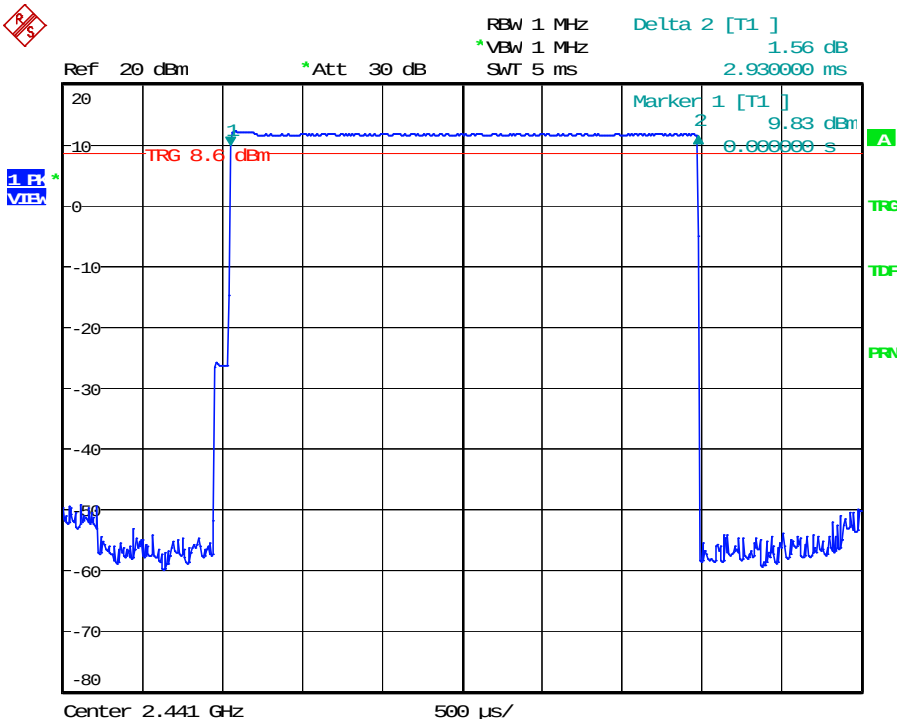
Modulation Standard: GFSK (1Mbps)
Channel: 78, Rate: DH5



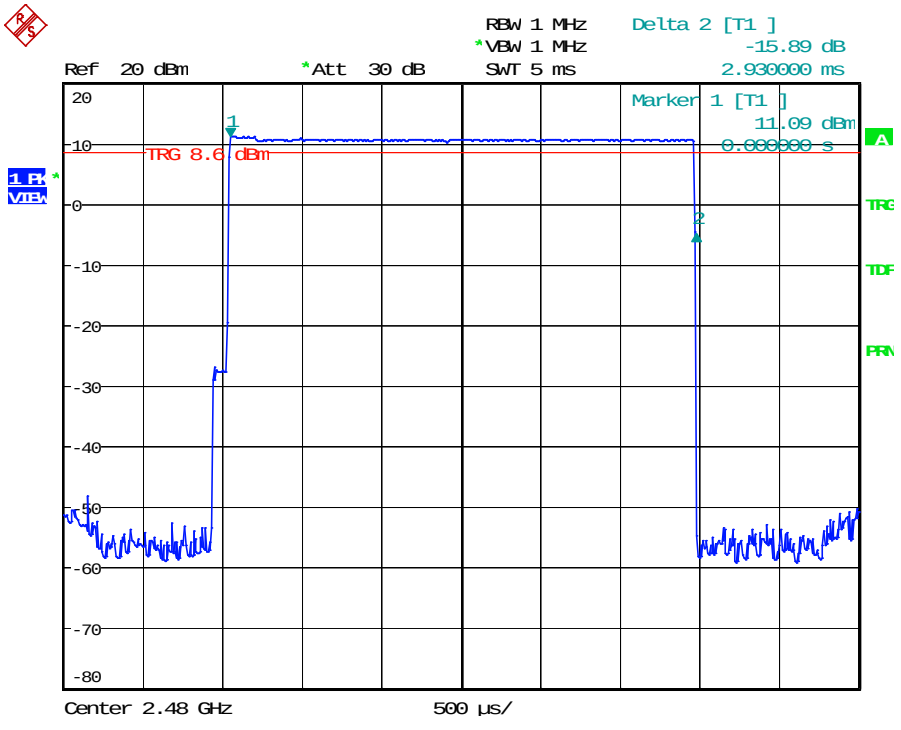
Modulation Standard: π/4-DQPSK (2Mbps)
Channel: 00, Rate: 2DH5



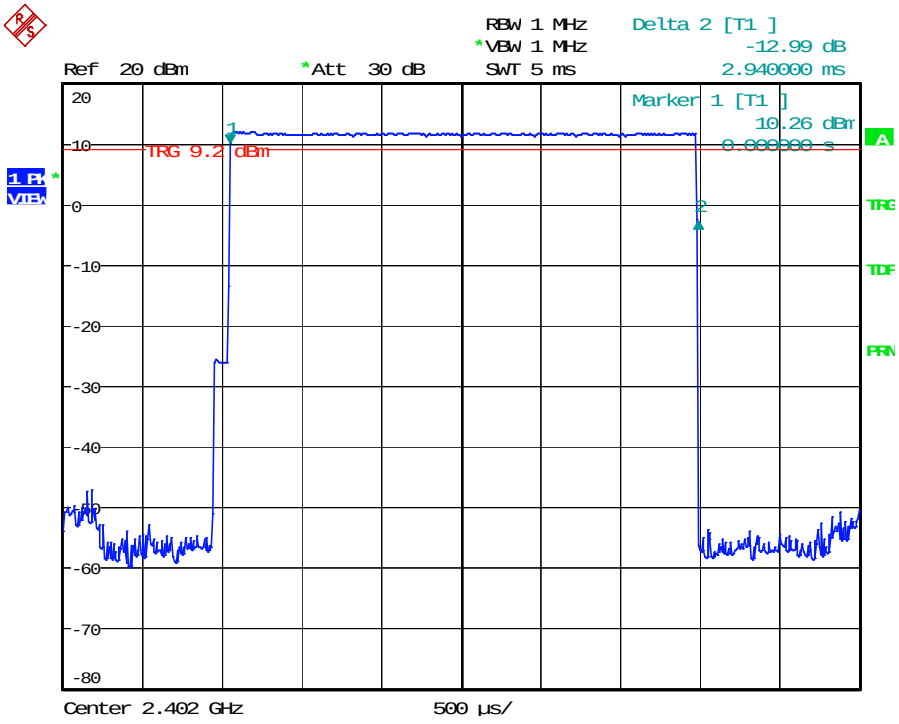
Modulation Standard: π/4-DQPSK (2Mbps)
Channel: 39, Rate: 2DH5



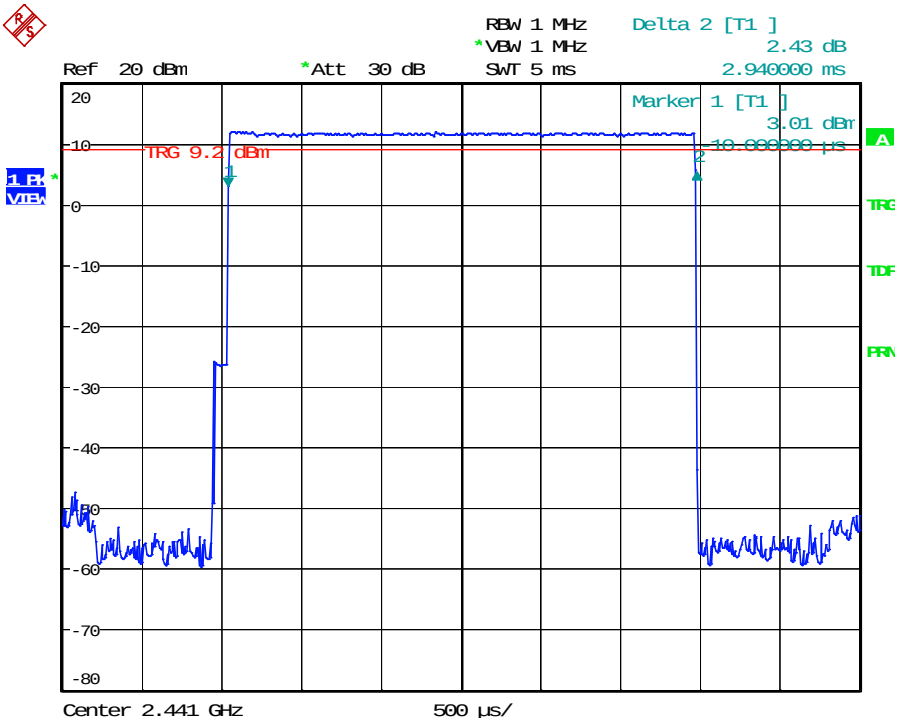
Modulation Standard: π/4-DQPSK (2Mbps)
Channel: 78, Rate: 2DH5



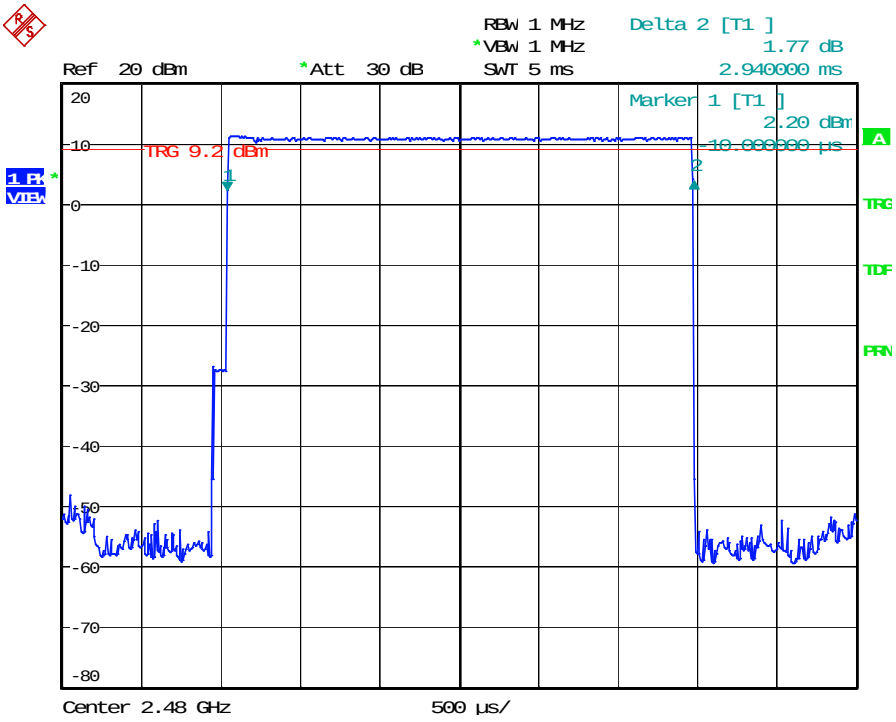
Modulation Standard: 8DPSK (3Mbps)
Channel: 00, Rate: 3DH5



Modulation Standard: 8DPSK (3Mbps)
Channel: 39, Rate: 3DH5



Modulation Standard: 8DPSK (3Mbps)
Channel: 78, Rate: 3DH5



11. Number of Hopping Channels

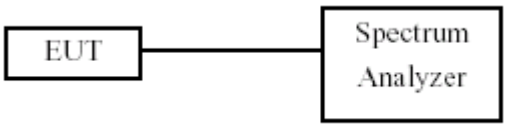
11.1 Test Limit

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

11.2 Test Procedures

a. The transmitter output was connected to the spectrum analyzer.
b. Set RBW of spectrum analyzer to 100 KHz and VBW to 300 KHz.
c. Set the MaxHold function, and then keep the EUT in hopping mode. Record all the signals from each channel until each one has been record.

11.3 Test Setup Layout

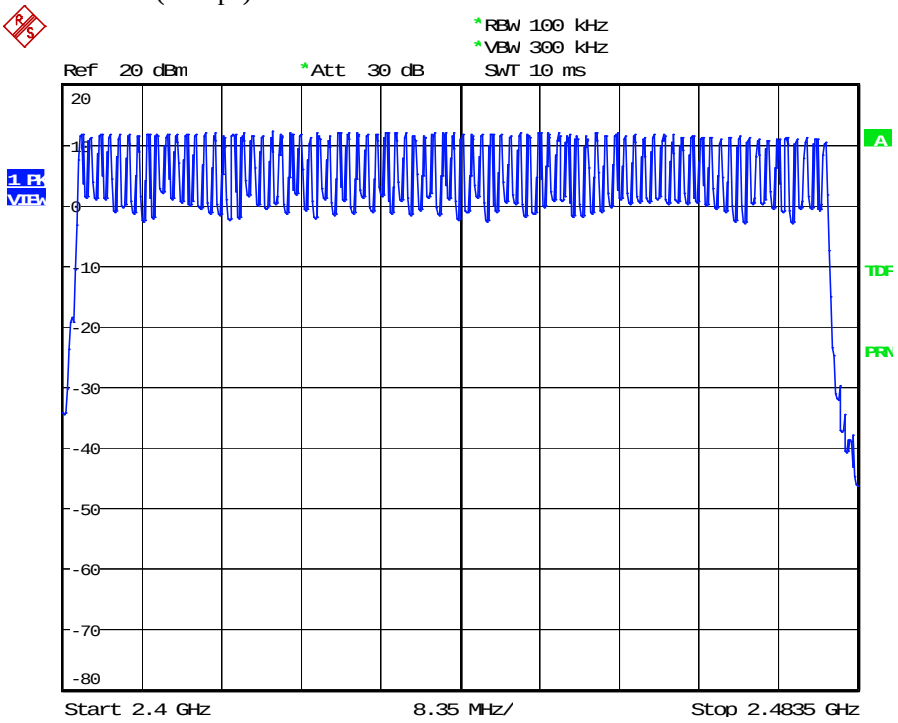


11.4 Test Result and Data

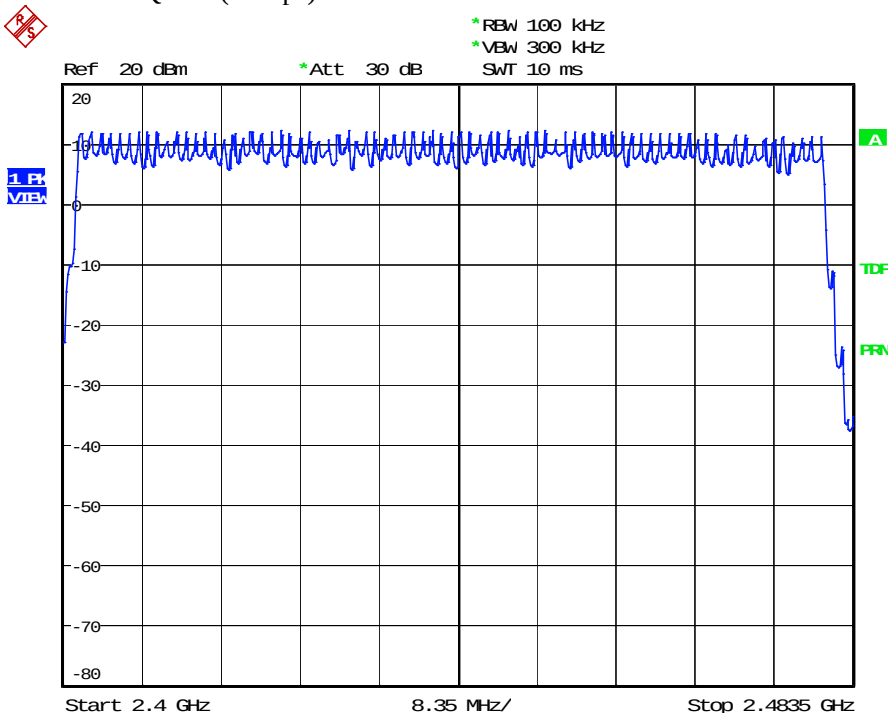
Test Date: Oct. 06, 2017 Temperature: 26 °C
Atmospheric pressure: 1010 hPa Humidity: 51 %

Modulation Type	Hopping Channels
GFSK (1Mbps)	79
π/4-DQPSK (2Mbps)	79
8DPSK (3Mbps)	79

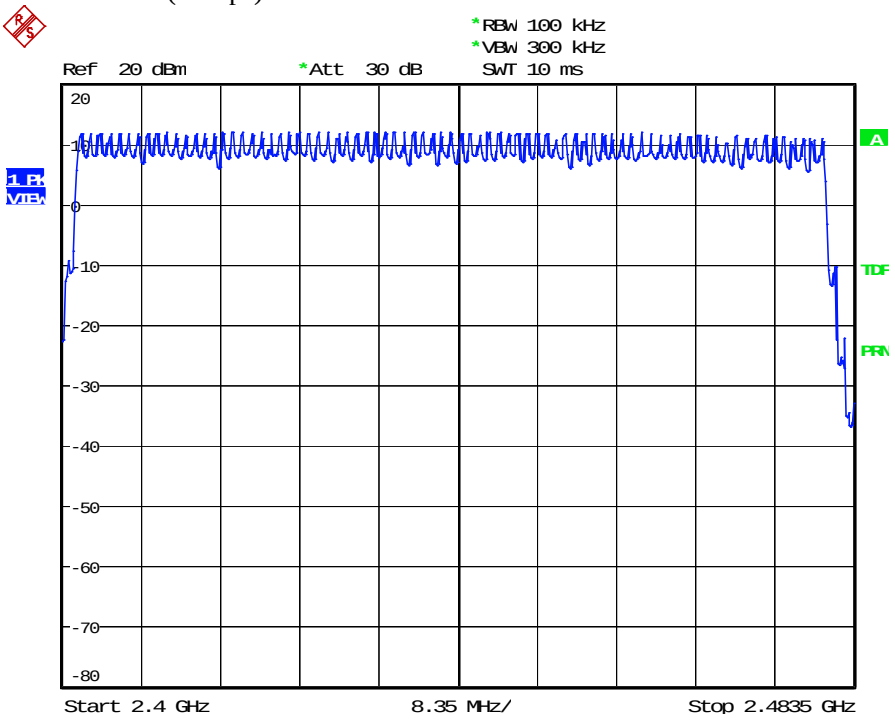
Modulation Standard: GFSK (1Mbps)



Modulation Standard: π/4-DQPSK (2Mbps)



Modulation Standard: 8DPSK (3Mbps)



12. Maximum Peak Output Power

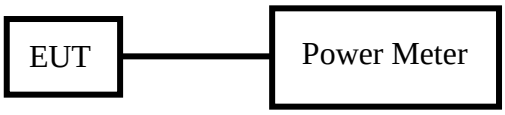
12.1 Test Limit

The Maximum Peak Output Power Measurement is 30dBm.

12.2 Test Procedures

The antenna port（RF output）of the EUT was connected to the input（RF input）of a power meter. Power was read directly from the meter and cable loss connection was added to the reading to obtain power at the EUT antenna terminal. The EUT Output Power was set to maximum to produce the worse case test result.

12.3 Test Setup Layout



12.4 Test Result and Data

Test Date: Oct. 06, 2017 Temperature: 26 °C

Atmospheric pressure: 1010 hPa Humidity: 51 %

Modulation Type	Channel	Frequency (MHz)	Output Power (dBm)	Output Power (mW)
GFSK (1Mbps)	00	2402	2.73	1.87
	39	2441	2.69	1.86
	78	2480	2.02	1.59
π/4-DQPSK (2Mbps)	00	2402	2.27	1.69
	39	2441	2.16	1.64
	78	2480	1.44	1.39
8DPSK (3Mbps)	00	2402	2.30	1.70
	39	2441	2.38	1.73
	78	2480	1.50	1.41

13. Band Edges Measurement

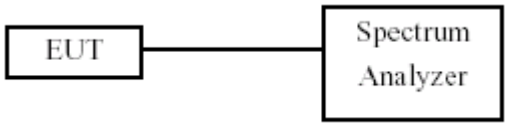
13.1 Test Limit

Below –20dB of the highest emission level of operating band (in 100kHz Resolution Bandwidth).

13.2 Test Procedure

a. The transmitter output was connected to the spectrum analyzer via a low lose cable.
b. Set RBW of spectrum analyzer to 100 KHz and VBW to 300 KHz, span including 100 KHz bandwidth from band edge.
c. The band edges was measured and recorded.

13.3 Test Setup Layout

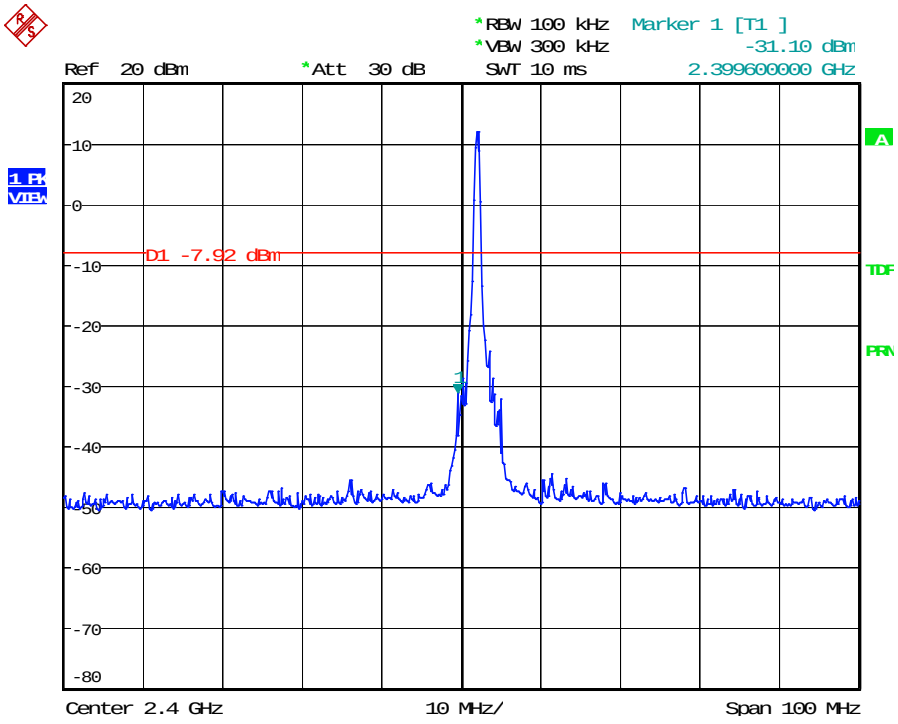


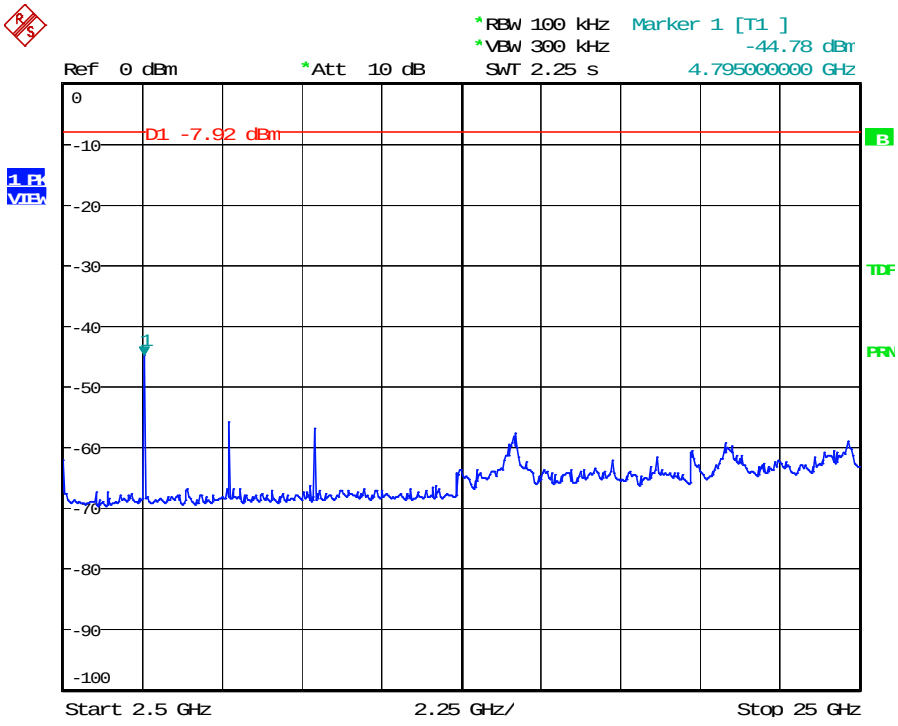
13.4 Test Result and Data

Test Date: Oct. 06, 2017 Temperature: 26 °C
Atmospheric pressure: 1010 hPa Humidity: 51 %

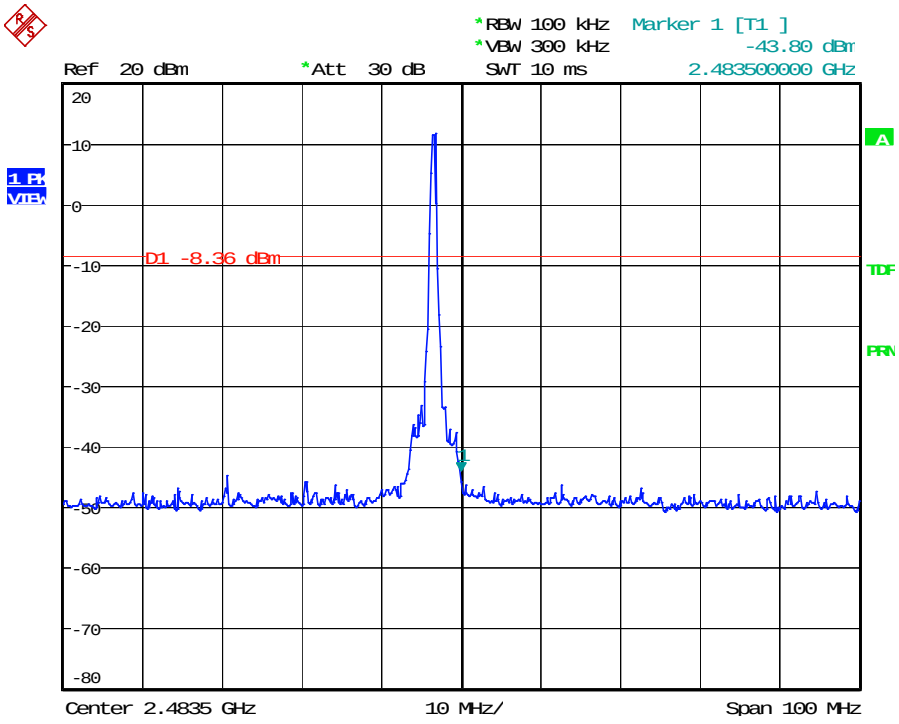
Modulation Type	Channel	Frequency	Max. Value in frequency(MHz)	Max. Value (dBm)
GFSK (1Mbps)	00	2402	2399.60	-31.10
	78	2480	2483.50	-43.80
π/4-DQPSK (2Mbps)	00	2402	2400.00	-20.25
	78	2480	2483.50	-34.12
8DPSK (3Mbps)	00	2402	2399.60	-21.00
	78	2480	2483.50	-29.56

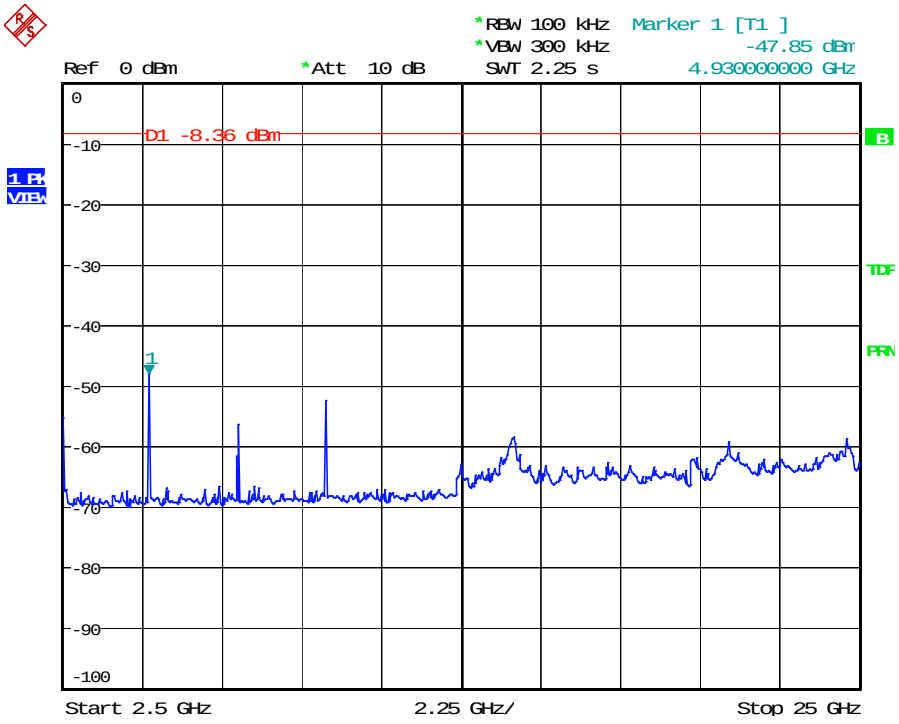
Modulation Standard: GFSK (1Mbps)
Channel: 00



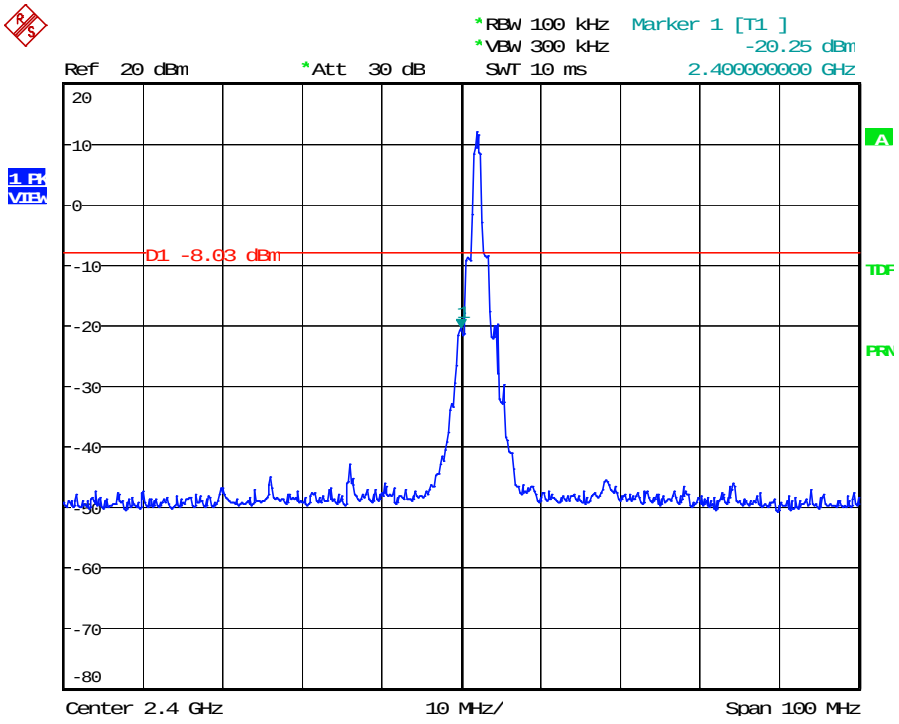


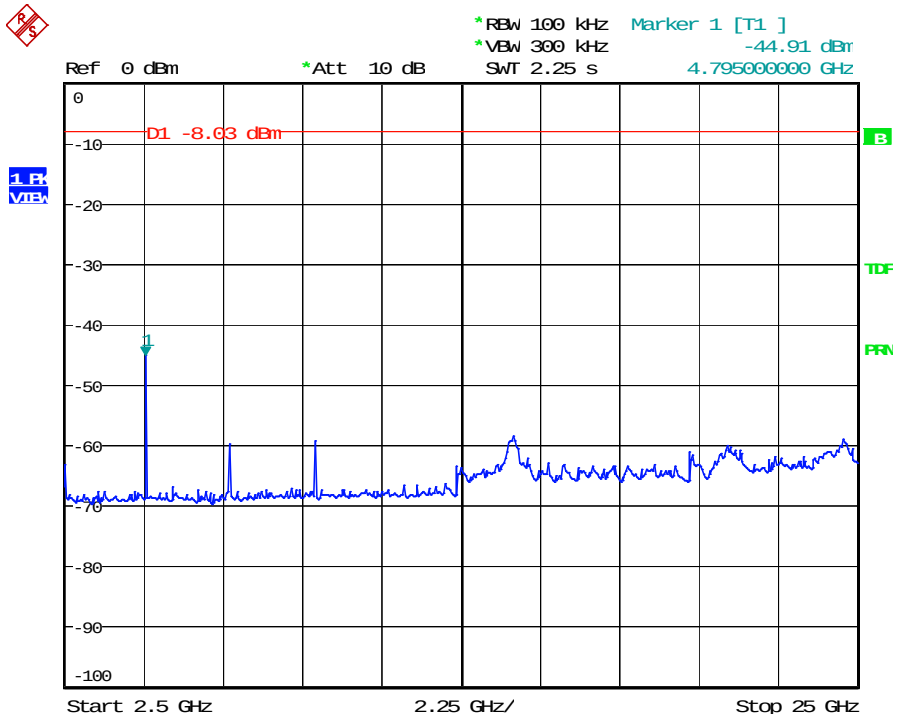
Modulation Standard: GFSK (1Mbps)
Channel: 78



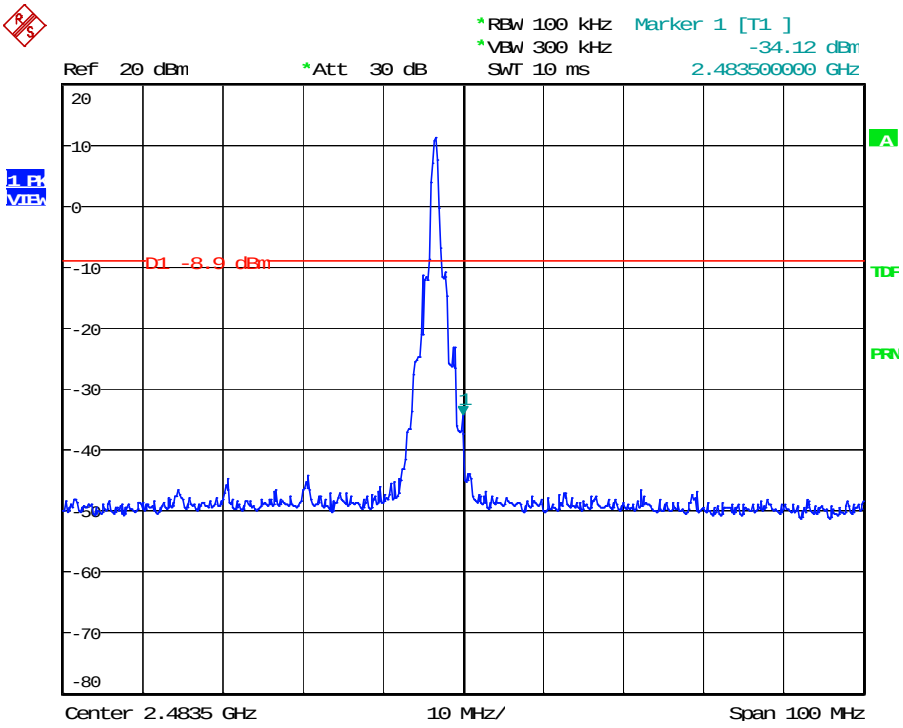


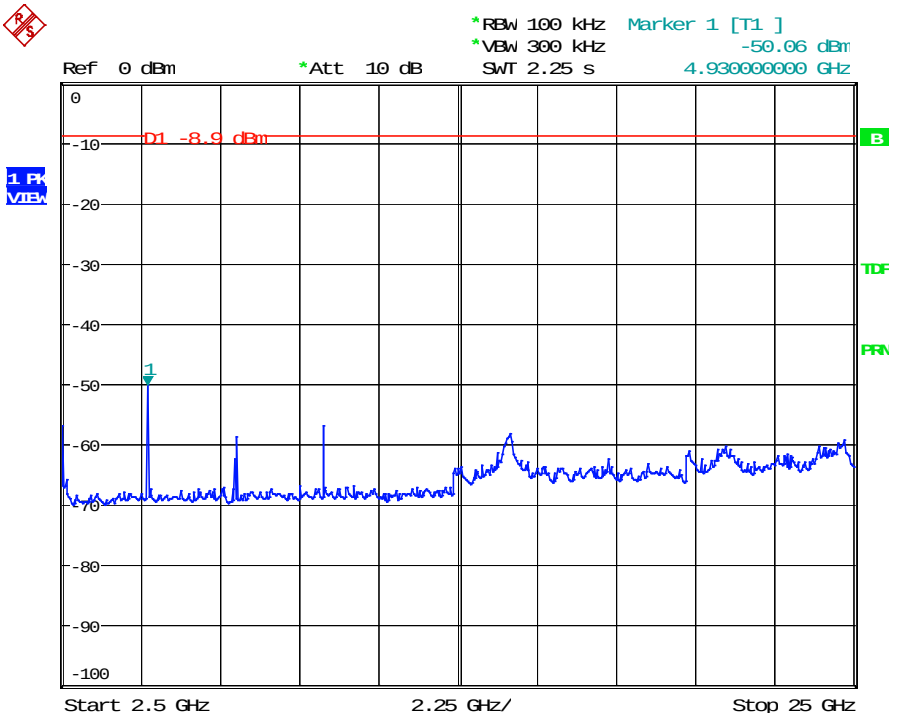
Modulation Standard: π/4-DQPSK (2Mbps)
Channel: 00



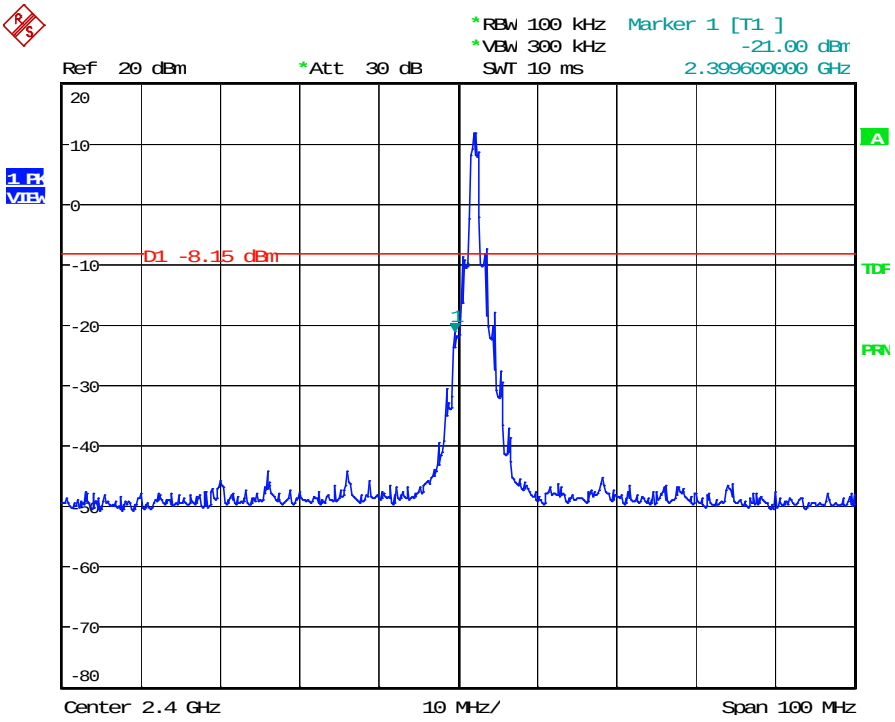


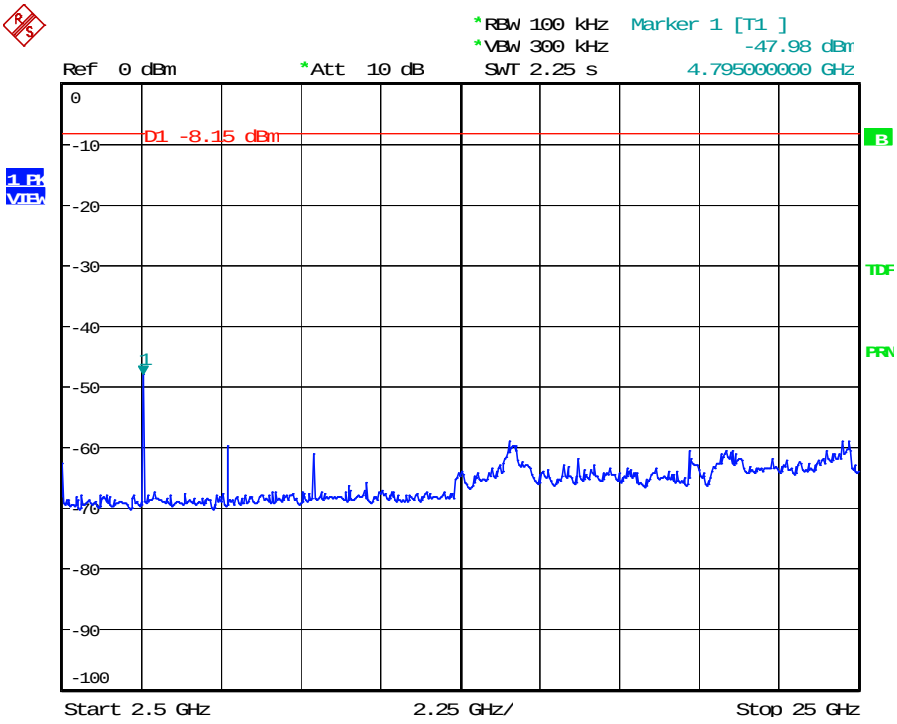
Modulation Standard: π/4-DQPSK (2Mbps)
Channel: 78



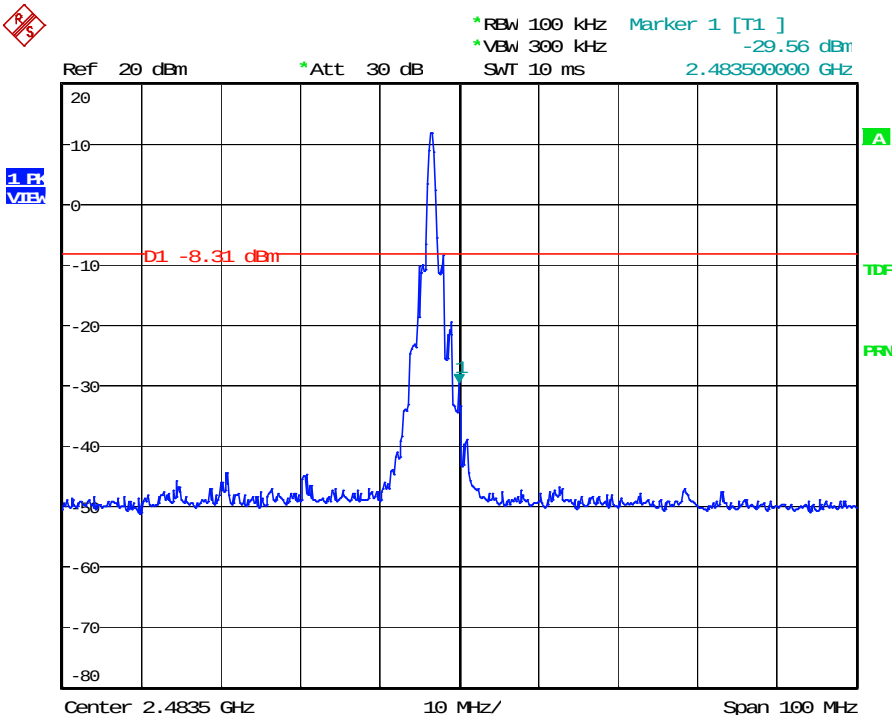


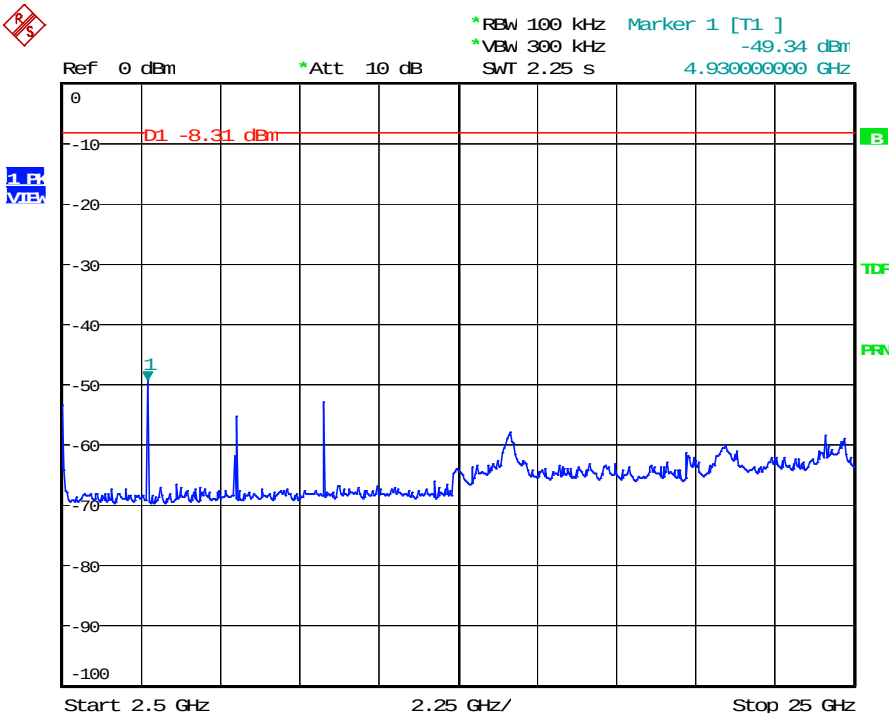
Modulation Standard: 8DPSK (3Mbps)
Channel: 00





Modulation Standard: 8DPSK (3Mbps)
Channel: 78





13.5 Restrict Band Emission Measurement Data

Test Date: Oct. 06, 2017 Temperature: 26 °C

Atmospheric pressure: 1010 hPa Humidity: 51 %

Modulation Standard: GFSK (1Mbps)

Channel 0										Fundamental Frequency: 2402 MHz
Frequency (MHz)	Ant-Pol H/V	Meter Reading	Corrected Factor	Result (dBuV/m)	Remark	Limit@3m (dBuV/m)		Margin (dB)	Table (Deg.)	Ant High (m)
						Peak	Ave.			
2389.7	H	60.26	-14.05	46.21	Peak	74	54	-27.79	150	1.50
	H				Ave	74	54			
2389.8	V	64.42	-14.05	50.37	Peak	74	54	-23.63	150	1.50
---	V	---	---	---	Ave	74	54	---	---	---
Channel 78										Fundamental Frequency: 2480 MHz
2498.6	H	59.19	-13.79	45.33	Peak	74	54	-28.67	190	1.50
	H				Ave	74	54			
2496.3	V	63.44	-13.79	49.65	Peak	74	54	-24.35	186	1.50
---	V	---	---	---	Ave	74	54	---	---	---

Notes:

1. Result = Meter Reading + Factor
2. Factor = Antenna Factor + Cable Loss – Amplifier
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and video bandwidth is 3 MHz for Peak detection at frequency above 1GHz.
4. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 10Hz for Average detection at frequency above 1GHz

Test Date: Oct. 06, 2017 Temperature: 26 °C
Atmospheric pressure: 1010 hPa Humidity: 51 %
Modulation Standard: π/4-DQPSK (2Mbps)

Channel 0										Fundamental Frequency: 2402 MHz
Frequency (MHz)	Ant-Pol H/V	Meter Reading	Corrected Factor	Result (dBuV/m)	Remark	Limit@3m (dBuV/m)		Margin (dB)	Table (Deg.)	Ant High (m)
						Peak	Ave.			
2389.9	H	61.20	-14.05	47.15	Peak	74	54	-26.85	135	1.50
	H				Ave	74	54			
2389.5	V	63.67	-14.05	49.62	Peak	74	54	-24.38	160	1.50
---	V	---	---	---	Ave	74	54	---	---	---
Channel 78										Fundamental Frequency: 2480 MHz
2488.7	H	59.33	-13.81	45.52	Peak	74	54	-28.48	127	1.50
	H				Ave	74	54			
2501.3	V	62.28	-13.79	48.49	Peak	74	54	-25.51	166	1.50
---	V	---	---	---	Ave	74	54	---	---	---

Notes:

1. Result = Meter Reading + Factor
2. Factor = Antenna Factor + Cable Loss – Amplifier
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and video bandwidth is 3 MHz for Peak detection at frequency above 1GHz.
4. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 10Hz for Average detection at frequency above 1GHz

Test Date: Oct. 06, 2017 Temperature: 26 °C
Atmospheric pressure: 1010 hPa Humidity: 51 %
Modulation Standard: 8DPSK (3Mbps)

Channel 0										Fundamental Frequency: 2402 MHz
Frequency (MHz)	Ant-Pol H/V	Meter Reading	Corrected Factor	Result (dBuV/m)	Remark	Limit@3m (dBuV/m)		Margin (dB)	Table (Deg.)	Ant High (m)
						Peak	Ave.			
2389.8	H	62.74	-14.05	48.69	Peak	74	54	-25.31	125	1.50
	H				Ave	74	54			
2389.3	V	65.29	-13.82	51.24	Peak	74	54	-22.76	175	1.50
---	V	---	---	---	Ave	74	54	---	---	---
Channel 78										Fundamental Frequency: 2480 MHz
2486.5	H	61.83	-13.82	48.01	Peak	74	54	-25.99	128	1.50
	H				Ave	74	54			
2487.1	V	64.62	-13.82	50.80	Peak	74	54	-23.20	186	1.50
---	V	---	---	---	Ave	74	54	---	---	---

Notes:

1. Result = Meter Reading + Factor
2. Factor = Antenna Factor + Cable Loss – Amplifier
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and video bandwidth is 3 MHz for Peak detection at frequency above 1GHz.
4. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 10Hz for Average detection at frequency above 1GHz

14. Restricted Bands of Operation

Only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.09000 – 0.11000	16.42000 – 16.42300	399.9 – 410.0	4.500 – 5.150
0.49500 – 0.505**	16.69475 – 16.69525	608.0 – 614.0	5.350 – 5.460
2.17350 – 2.19050	16.80425 – 16.80475	960.0 – 1240.0	7.250 – 7.750
4.12500 – 4.12800	25.50000 – 25.67000	1300.0 – 1427.0	8.025 – 8.500
4.17725 – 4.17775	37.50000 – 38.25000	1435.0 – 1626.5	9.000 – 9.200
4.20725 – 4.20775	73.00000 – 74.60000	1645.5 – 1646.5	9.300 – 9.500
6.21500 – 6.21800	74.80000 – 75.20000	1660.0 – 1710.0	10.600 – 12.700
6.26775 – 6.26825	108.00000 – 121.94000	1718.8 – 1722.2	13.250 – 13.400
6.31175 – 6.31225	123.00000 – 138.00000	2200.0 – 2300.0	14.470 – 14.500
8.29100 – 8.29400	149.90000 – 150.05000	2310.0 – 2390.0	15.350 – 16.200
8.36200 – 8.36600	156.52475 – 156.52525	2483.5 – 2500.0	17.700 – 21.400
8.37625 – 8.38675	156.70000 – 156.90000	2655.0 – 2900.0	22.010 – 23.120
8.41425 – 8.41475	162.01250 – 167.17000	3260.0 – 3267.0	23.600 – 24.000
12.29000 – 12.29300	167.72000 – 173.20000	3332.0 – 3339.0	31.200 – 31.800
12.51975 – 12.52025	240.00000 – 285.00000	3345.8 – 3358.0	36.430 – 36.500
12.57675 – 12.57725	322.00000 – 335.40000	3600.0 – 4400.0	Above 38.6
13.36000 – 13.41000			

**: Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz

14.1 Labeling Requirement

The device shall bear the following statement in a conspicuous location on the device:
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.