Radio Test Report

FCC ID: TJI-K71216P

This report concerns (check one) : ☒ **Original Grant** ☐ **Class II Change**

Issued Date	:	Jun. 07, 2013
Project No.	:	1305107
Equipment	:	2.4GHz GFSK Transceiver module
Model Name	:	K71216P
Applicant	:	KINGWAVE TECHNOLOGY CO., LTD
Address	:	18F.-3, No.186, Jian 1st Rd., Zhonghe Dist., New Taipei City 235, Taiwan (R.O.C.)

Tested by: Neutron Engineering Inc. EMC Laboratory
Date of Receipt: May 10, 2013
Date of Test: May 10, 2013 ~ Jun. 05, 2013

Testing Engineer : (Josh Lin)

Technical Manager : (Jeff Yang)

Authorized Signatory : (Andy Chiu)

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Testing Laboratory
0659

Declaration

Neutron represents to the client that testing is done in accordance with standard procedures as applicable and that test instruments used has been calibrated with the standards traceable to National Measurement Laboratory (**NML**) of **R.O.C**., or National Institute of Standards and Technology (**NIST**) of **U.S.A.**

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Limitation

For the use of the authority's logo is limited unless the Test Standard(s)/Scope(s)/Item(s) mentioned in this test report is (are) included in the conformity assessment authorities acceptance respective.

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REPORT ISSUED HISTORY

Revised Version No.	Description	Issued Date
-	Initial Issue.	Jun. 07, 2013

1 CERTIFICATION

Equipment : 2.4GHz GFSK Transceiver module
Brand Name : KINGWAVE
Model Name : K71216P
Applicant : KINGWAVE TECHNOLOGY CO., LTD
Date of Test : May 10, 2013 ~ Jun. 05, 2013
Standards : FCC Part 15, Subpart C: 2012
ANSI C63.4: 2009

The above equipment has been tested and found compliance with the requirement of the relative standards by Neutron Engineering Inc. EMC Laboratory.
The test data, data evaluation, and equipment configuration contained in our test report (Ref No. NEI-FCCP-2-1305107) were obtained utilizing the test procedures, test instruments, test sites that has been accredited by the Authority of TAF according to the ISO-17025 quality assessment standard and technical standard(s).

2. SUMMARY OF TEST RESULTS

Standard Clause	Test Item	Result
15.207	Conducted Emission	**N/A**
15.247 (c)	Antenna conducted Spurious Emission	**PASS**
15.247 (a)(1)	Hopping Channel Separation	**PASS**
15.247 (b)	Maximum Peak Conducted Output Power	**PASS**
15.247 (c)	Radiated Spurious Emission	**PASS**
15.247 (b)(1)	Number of Hopping Frequency	**PASS**
15.247 (a)(1)	Average time of occupancy	**PASS**
15.205	Restricted Bands	**PASS**
15.203	Antenna Requirement	**PASS**
1.1307 1.1310 2.1091 2.1093	RF Exposure Compliance	**PASS**

NOTE:

1. **N/A**: denotes test is not applicable in this Test Report
2. Portable device; SAR report is required.

2.1 TEST FACILITY

The test facilities used to collect the test data in this report:

Radiated emission Test:

CB08: (FCC RN: 614388; FCC DN: TW1054; IC Assigned Code: 4428C-1)
1F., No. 61, Ln. 77, Sing-ai Rd., Neihu Dist., Taipei City 114, Taiwan (R.O.C.)

2.2 MEASUREMENT UNCERTAINTY

The measurement uncertainty is not specified by FCC rules and for reference only.

The reported uncertainty of measurement **y ± U**，where expended uncertainty **U** is based on a standard uncertainty multiplied by a coverage factor of **k=2**，providing a level of confidence of approximately **95**%.

The measurement instrumentation uncertainty considerations contained in CISPR 16-4-2.

Radiated emission test:

Test Site	Item	Measurement Frequency Range		Uncertainty	NOTE
CB08	Radiated emission at 3m	Horizontal Polarization	30 - 200MHz	3.35 dB	
			200 - 1000MHz	3.11 dB	
			1 - 18GHz	3.97 dB	
			18 - 40GHz	4.01 dB	
		Vertical Polarization	30 - 200MHz	3.22 dB	
			200 - 1000MHz	3.24 dB	
			1 - 18GHz	4.05 dB	
			18 - 40GHz	4.04 dB	

Our calculated Measurement Instrumentation Uncertainty is shown in the tables above. These are our U_{lab} values in CISPR 16-4-2 terminology.

Since Table 1 of CISPR 16-4-2 has values of measurement instrumentation uncertainty, called U_{CISPR}, as follows:

Conducted Disturbance (mains port) – 150 kHz – 30 MHz : 3.6 dB

Radiated Disturbance (electric field strength on an open area test site or alternative test site) – 30 MHz – 1000 MHz : 5.2 dB

It can be seen that our U_{lab} values are smaller than U_{CISPR}.

3 GENERAL INFORMATION

3.1 GENERAL DESCRIPTION OF EUT

Equipment	2.4GHz GFSK Transceiver module
Brand Name	KINGWAVE
Model Name	K71216P
OEM Brand/Model Name	LB / K71216P JESMAY / K71216P
Model Difference	N/A
Product Description	The EUT is a 2.4GHz GFSK Transceiver module. Operation Frequency: 2408.625 MHz ~ 2473.875 MHz Modulation Type: GFSK Bit Rate of Transmitter: 3 Mbps Number Of Channel: Please refer to the Note 2. Antenna Designation: Please refer to the Note 3. Antenna Gain(Peak): Please refer to the Note 3. Maximum Conducted Output Power: 4.82dBm More details of EUT technical specification, please refer to the User's Manual.
Power Source	Supplied from System.
Power Rating	I/P: DC3.3V
Connecting I/O Port(s)	Please refer to the User's Manual
Products Covered	1 * PCB Chip Antenna
EUT Modification(s)	N/A

NOTE:

1. For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.
2. Channel List:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
00	2408.625	08	2432.250	16	2453.625
01	2412.000	09	2434.500	17	2457.000
02	2414.250	10	2436.750	18	2459.250
03	2417.625	11	2439.000	19	2461.500
04	2422.125	12	2442.375	20	2464.875
05	2425.500	13	2444.625	21	2467.125
06	2427.750	14	2448.000	22	2470.500
07	2430.000	15	2450.250	23	2473.875

3. Table for Filed Antenna

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)
1	CHEN MOUN	ANT-W070302	Chip	N/A	2.00

3.2 DESCRIPTION OF TEST MODES

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

Test Items	Mode	Data Rate	Tested Channel/Mode
Antenna conducted Spurious Emission	GFSK	3 Mbps	2408.625 MHz, 2439.000 MHz, 2473.875 MHz
Hopping Channel Separation	GFSK	3 Mbps	2408.625 MHz, 2439.000 MHz, 2473.875 MHz
Maximum Peak Conducted Output Power	GFSK	3 Mbps	2408.625 MHz, 2439.000 MHz, 2473.875 MHz
Radiated Spurious Emission (30 MHz to 1 GHz)	GFSK	3 Mbps	2439.000 MHz
Radiated Spurious Emission (above 1 GHz)	GFSK	3 Mbps	2408.625 MHz, 2439.000 MHz, 2473.875 MHz
Number of Hopping Frequency	GFSK	3 Mbps	2408.625 MHz, 2439.000 MHz, 2473.875 MHz
Average time of occupancy	GFSK	3 Mbps	2408.625 MHz, 2439.000 MHz, 2473.875 MHz
Restricted Bands	GFSK	3 Mbps	2408.625 MHz, 2439.000 MHz, 2473.875 MHz
Antenna Requirement	GFSK	---	---
RF Exposure Compliance	GFSK	---	---

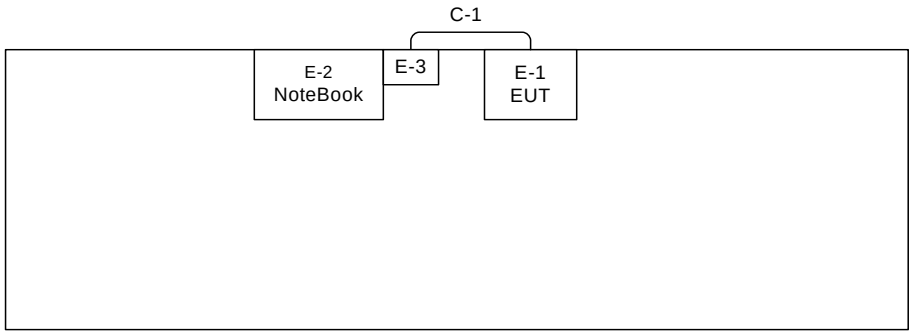
NOTE: The measurements are performed at the highest, middle, lowest available channels.

3.3 TABLE OF PARAMETERS OF TEXT SOFTWARE SETTING

During testing channel & power controlling software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product.

Data Rate	3 Mbps		
Test software Version	N/A		
Frequency	2408.625 MHz	2439.000 MHz	2473.875 MHz
Parameter	Def.	Def.	Def.

3.4 BLOCK DIAGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED



E-3 Fxture C-1 DATA Cable

3.5 DESCRIPTION OF SUPPORT UNITS

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

Item	Equipment	Mfr/Brand	Model/Type No.	FCC ID	Series No.	Note
E-1	2.4GHz GFSK Transceiver module	KINGWAVE	K71216P	TJI-K71216P	N/A	EUT
E-2	Notebook PC	DELL	D600	DOC	7T390 A03	
E-3	Fixture	N/A	N/A	N/A	N/A	

Item	Shielded Type	Ferrite Core	Length	Note
C-1	NO	NO	0.5M	

NOTE: The support equipment was authorized by Declaration of Conformity (DOC).

4 ANTENNA CONDUCTED SPURIOUS EMISSION

4.1 LIMIT

Test Item	Frequency Range (MHz)	Limit
Antenna conducted Spurious Emission	30-25000	20 dB less than the peak value of fundamental frequency

4.2 MEASUREMENT INSTRUMENTS LIST

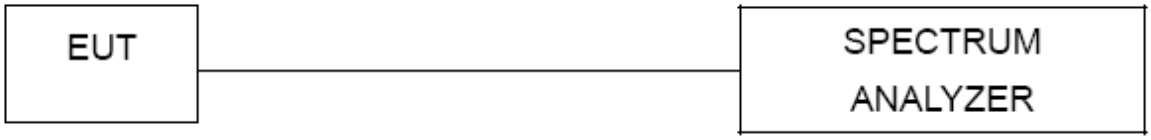
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	FSP-40	100129	Oct. 01, 2013

NOTE: **N/A**: denotes No Model Name, No Serial No. or No Calibration specified.

4.3 TEST PROCEDURES

a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below,
b. Spectrum Setting : RBW= 100KHz, VBW=100KHz, Sweep time = Auto.

4.4 TEST SETUP LAYOUT



4.5 DEVIATION FROM TEST STANDARD

No deviation

4.6 EUT OPERATING CONDITIONS

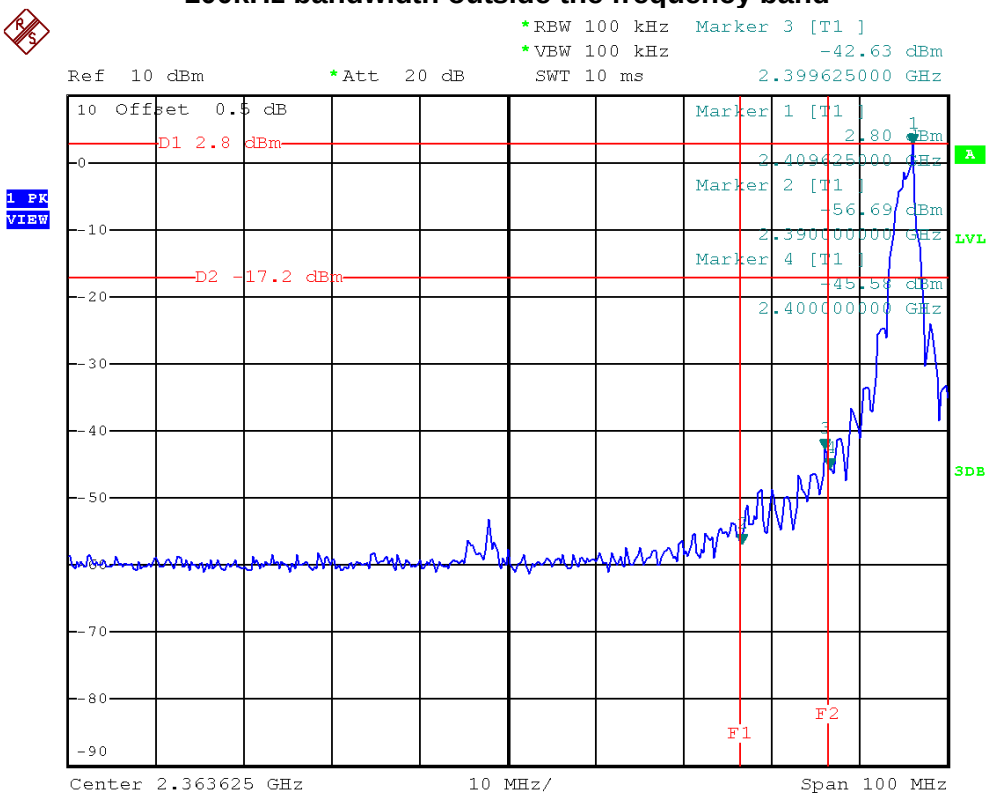
The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

4.7 TEST RESULTS

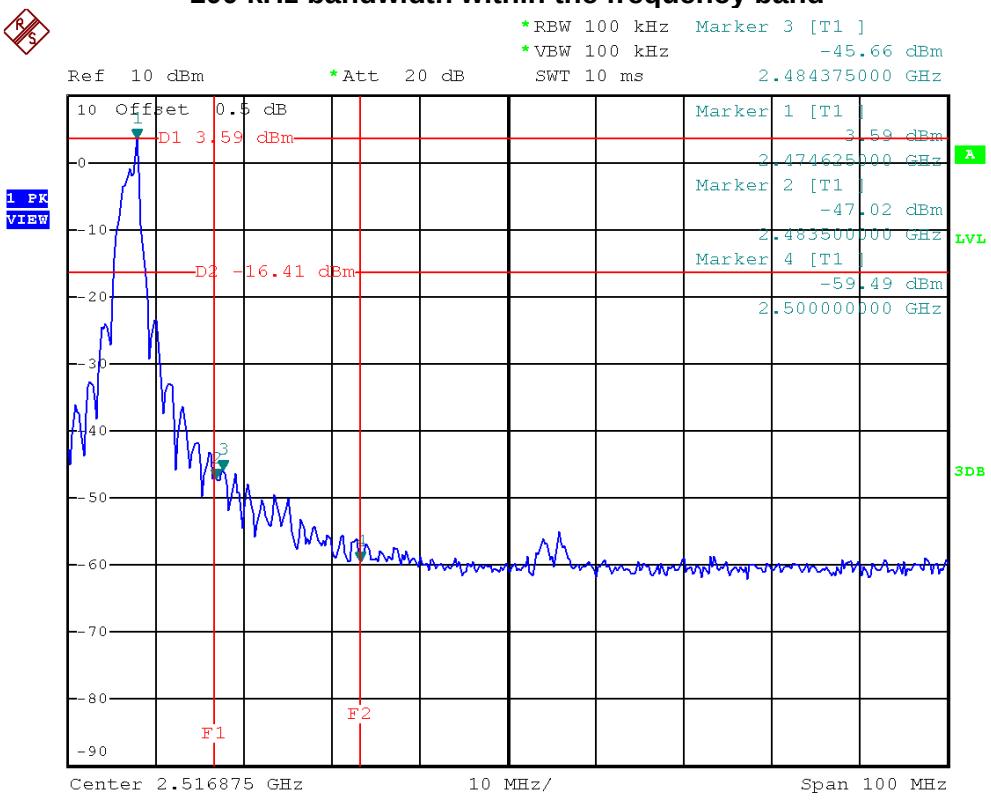
E.U.T	2.4GHz GFSK Transceiver module	Model Name	K71216P
Temperature	26°C	Relative Humidity	46%
Test Voltage	AC 120V/60Hz (System)		
Test Mode	3 Mbps		

Channel of Worst Data			
The max. radio frequency power in any 100kHz bandwidth outside the frequency band		The max. radio frequency power in any 100 kHz bandwidth within the frequency band.	
FREQUENCY(MHz)	POWER(dBm)	FREQUENCY(MHz)	POWER(dBm)
2399.625	-42.63	2484.375	-45.66
Result			
In any 100kHz bandwidth outside the frequency band, the radio frequency power is at least 20dB below that in the 100kHz bandwidth within the band that contains the highest lever of the desired power.			

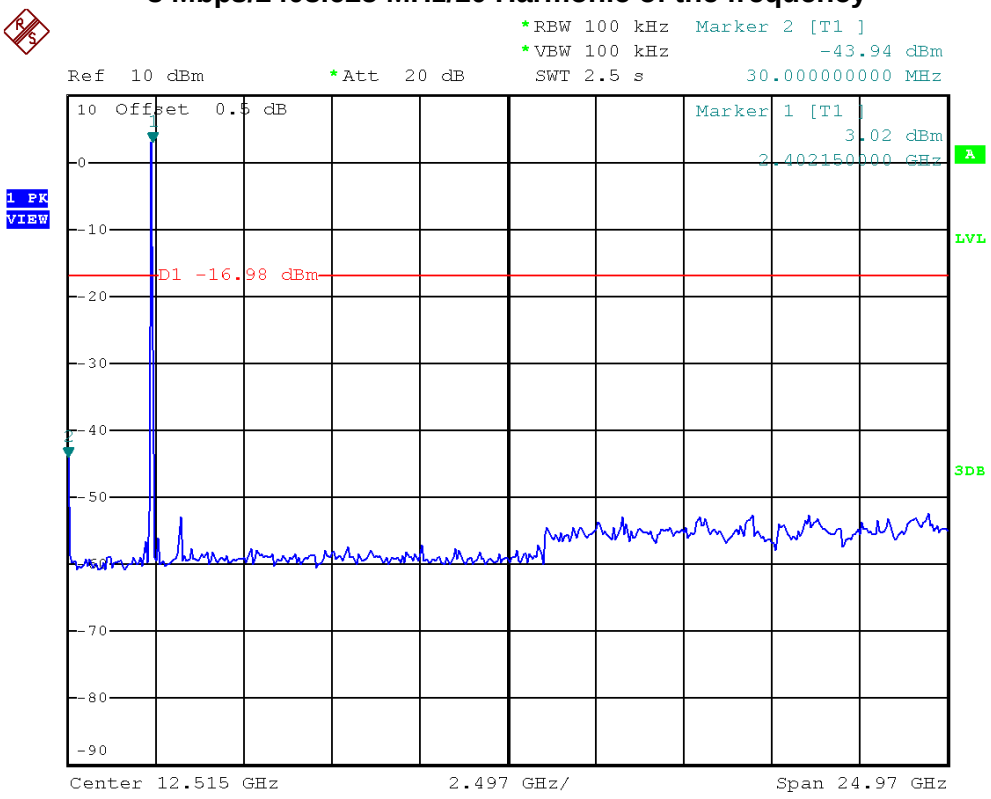
3 Mbps/The max. radio frequency power in any 100kHz bandwidth outside the frequency band



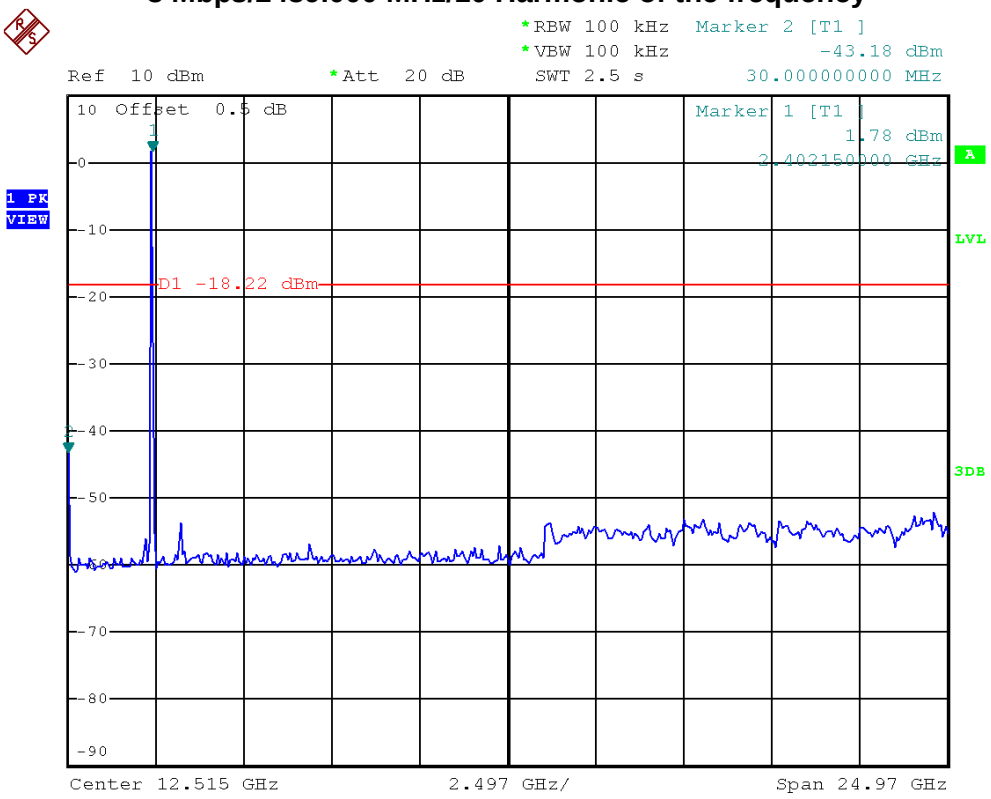
3 Mbps/The max. radio frequency power in any 100 kHz bandwidth within the frequency band



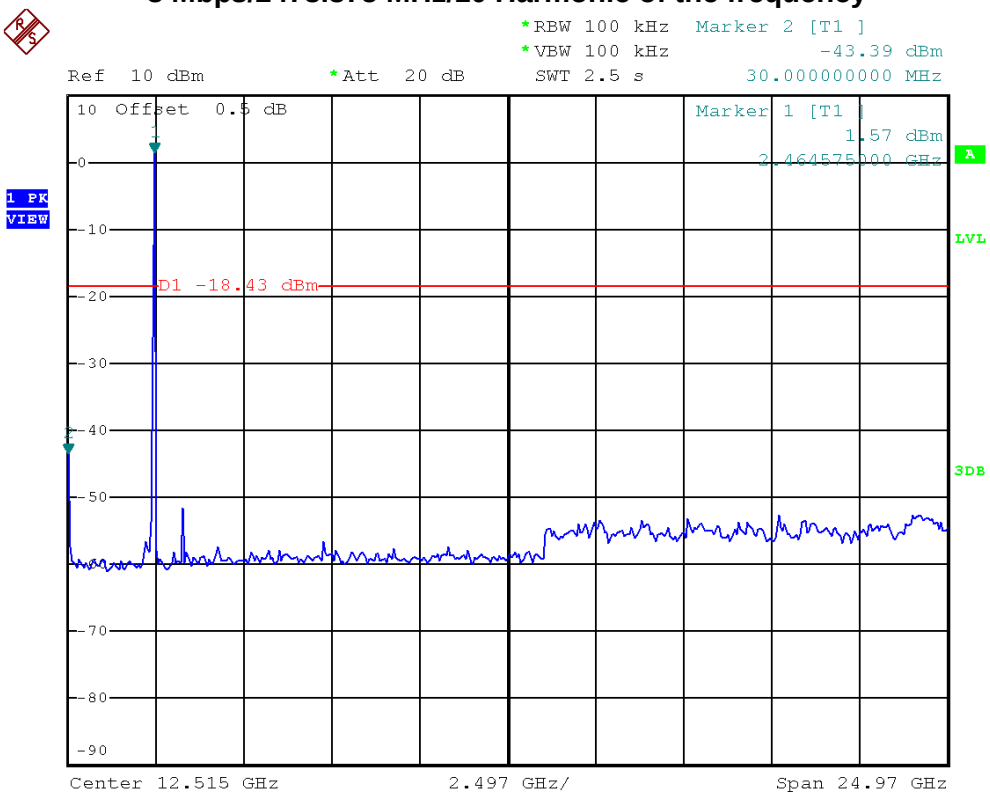
3 Mbps/2408.625 MHz/10 Harmonic of the frequency



3 Mbps/2439.000 MHz/10 Harmonic of the frequency



3 Mbps/2473.875 MHz/10 Harmonic of the frequency



5 HOPPING CHANNEL SEPARATION

5.1 LIMIT

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.

5.2 MEASUREMENT INSTRUMENTS LIST

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	FSP-40	100129	Oct. 01, 2013

NOTE: **N/A**: denotes No Model Name, No Serial No. or No Calibration specified.

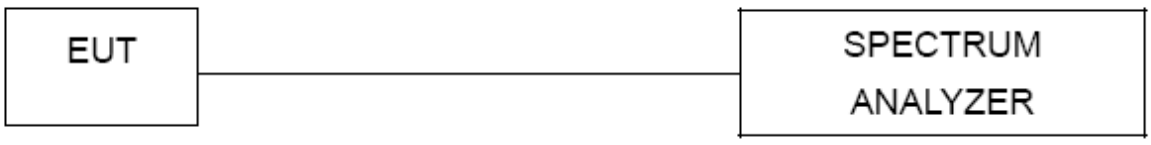
5.3 MEASURING INSTRUMENTS SETTING

EMI Test Receiver	Parameter Setting
Attenuation	Auto
Span Frequency	> Measurement Bandwidth or Channel Separation
RB	30 kHz (20dB Bandwidth) / 100 kHz (Channel Separation)
VB	100 kHz (20dB Bandwidth) / 300 kHz (Channel Separation)
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

5.4 TEST PROCEDURES

a. The transmitter output (antenna port) was connected to the spectrum analyser in peak hold mode.
b. The resolution bandwidth of 30 kHz and the video bandwidth of 100 kHz were utilised for 20 dB bandwidth measurement.
c. The resolution bandwidth of 100 kHz and the video bandwidth of 300 kHz were utilised for channel separation measurement.

5.5 TEST SETUP LAYOUT



5.6 DEVIATION FROM TEST STANDARD

No deviation

5.7 EUT OPERATING CONDITIONS

The EUT tested system was configured as the statements of 4.6 Unless otherwise a special operating condition is specified in the follows during the testing.

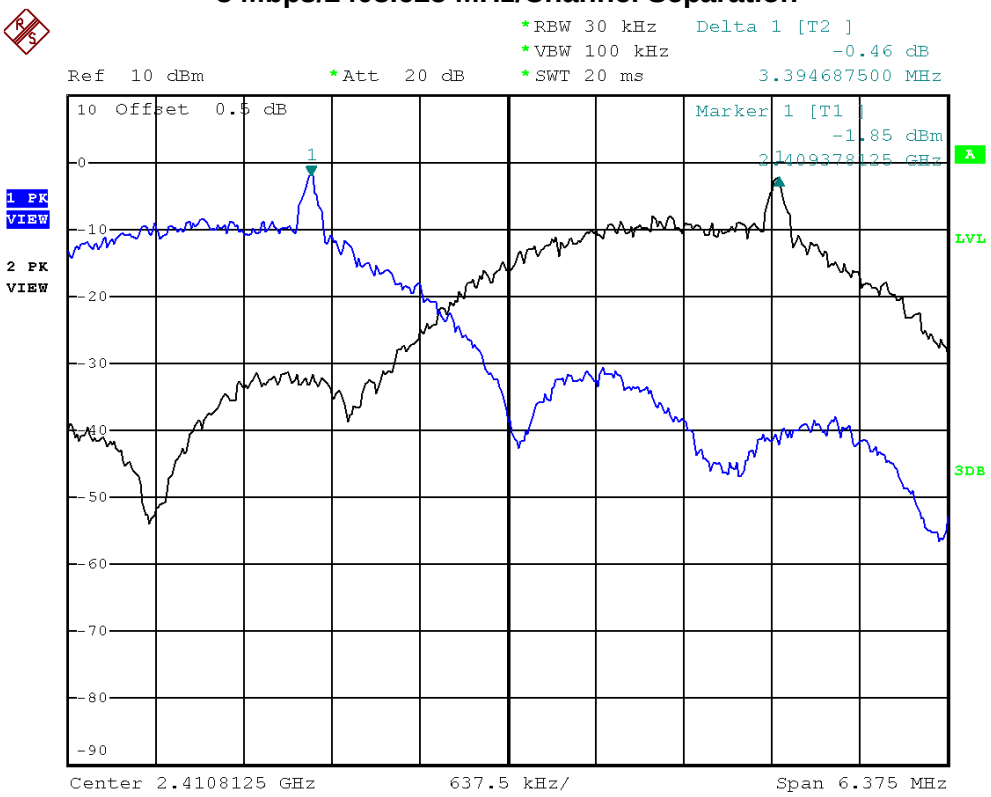
5.8 TEST RESULTS

E.U.T	2.4GHz GFSK Transceiver module	Model Name	K71216P
Temperature	26°C	Relative Humidity	46%
Test Voltage	AC 120V/60Hz (System)		
Test Mode	3 Mbps/2408.625 MHz, 2439.000 MHz, 2473.875 MHz		

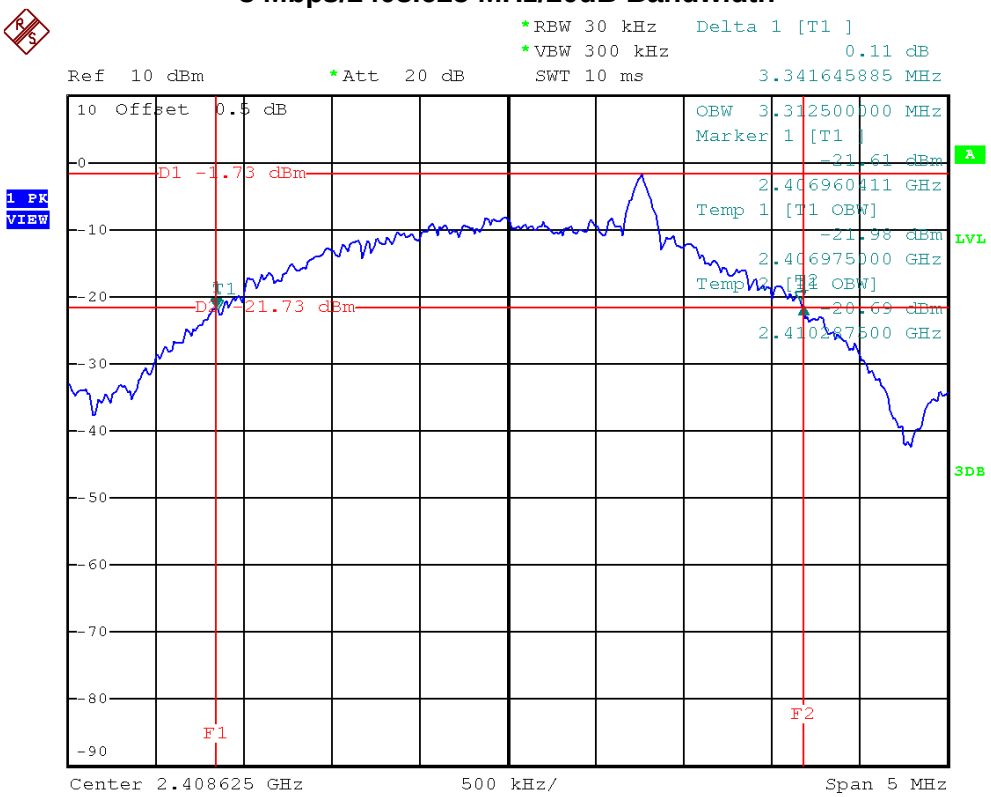
Frequency	Channel Separation (MHz)	20 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)	Two-thirds of the 20 dB Bandwidth	Result
2408.625 MHz	3.39	3.342	3.313	2.228	PASS
2439.000 MHz	3.38	3.354	3.300	2.253	PASS
2473.875 MHz	3.41	3.466	3.313	2.311	PASS

NOTE: Ch. Separation Limits: >25 KHz or >2/3 of 20dB bandwidth

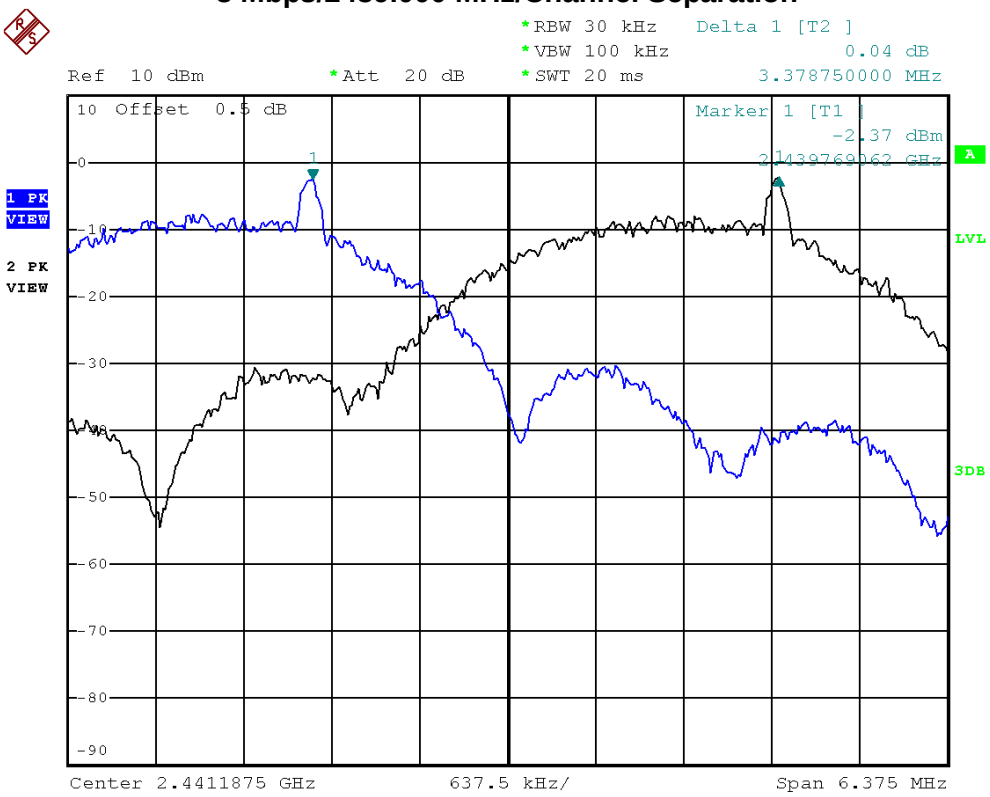
3 Mbps/2408.625 MHz/Channel Separation



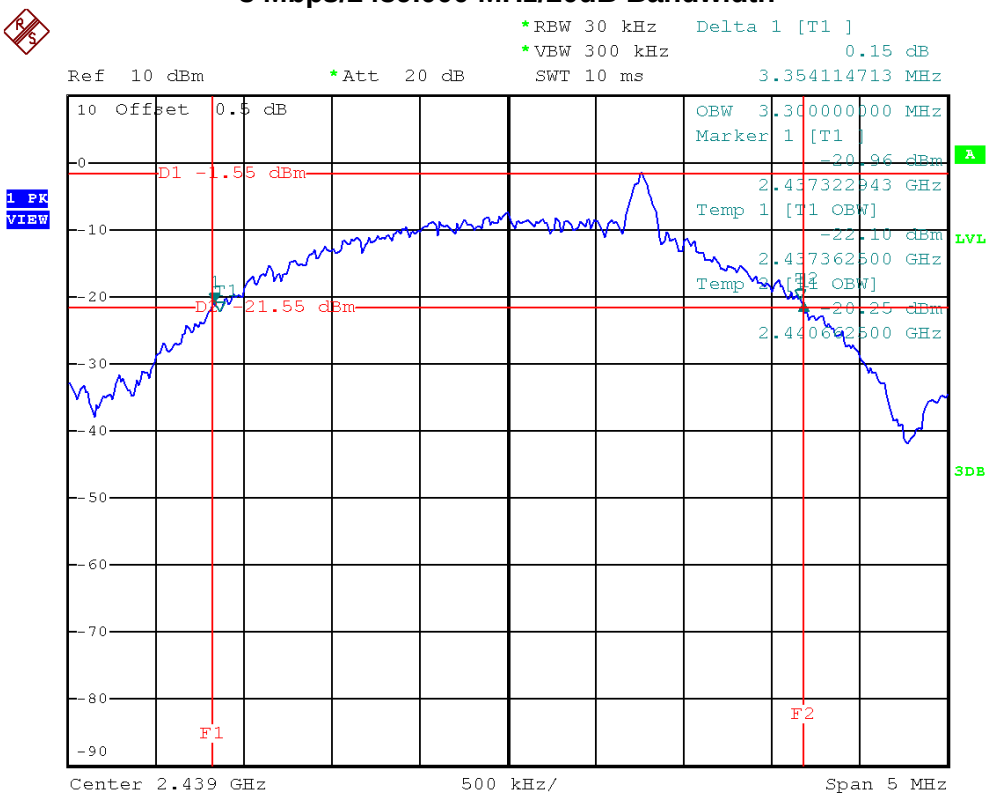
3 Mbps/2408.625 MHz/20dB Bandwidth



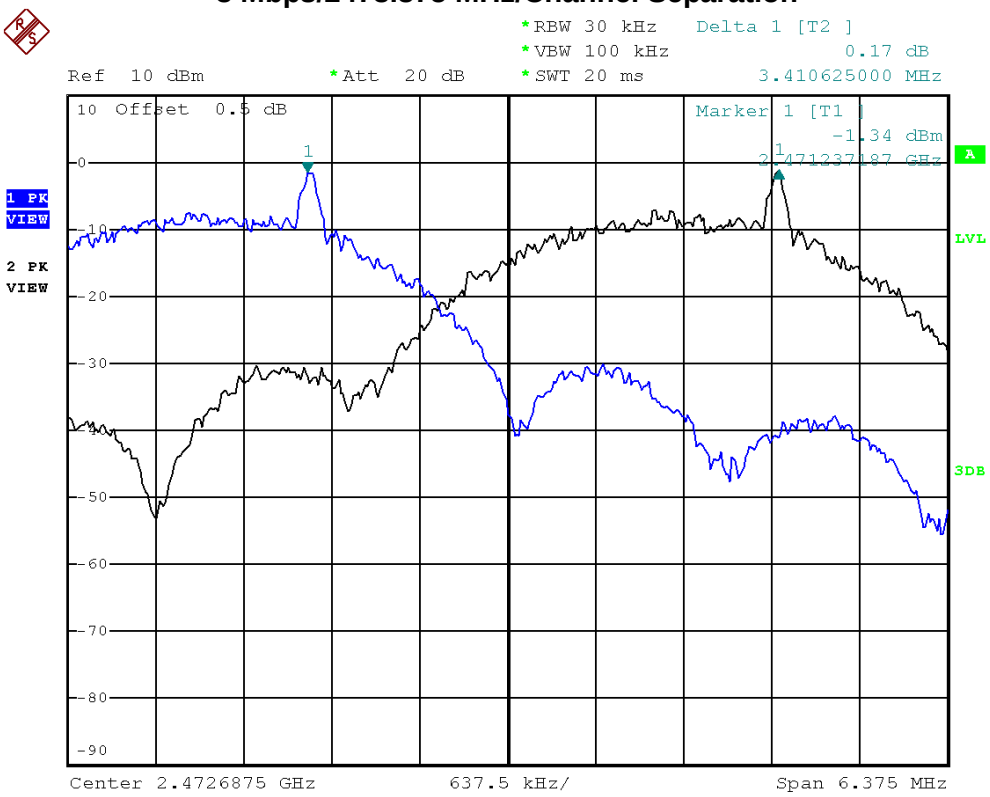
3 Mbps/2439.000 MHz/Channel Separation



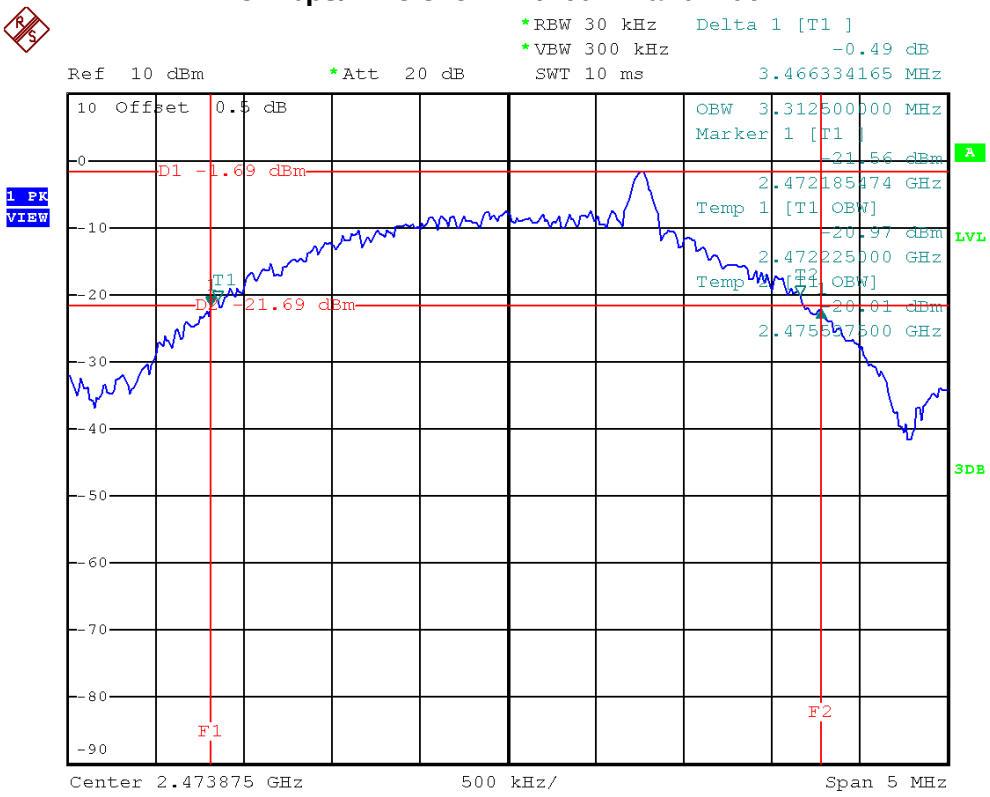
3 Mbps/2439.000 MHz/20dB Bandwidth



3 Mbps/2473.875 MHz/Channel Separation



3 Mbps/2473.875 MHz/20dB Bandwidth



6 MAXIMUM PEAK CONDUCTED OUTPUT POWER

6.1 LIMIT

Test Item	Frequency Range (MHz)	Limit
Maximum Peak Conducted Output Power	2400-2483.5	1 watt or 30 dBm

6.2 MEASUREMENT INSTRUMENTS LIST

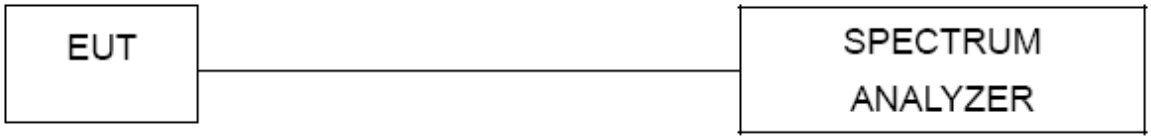
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	FSP-40	100129	Oct. 01, 2013

NOTE: **N/A**: denotes No Model Name, No Serial No. or No Calibration specified.

6.3 TEST PROCEDURES

a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below,
b. Spectrum Setting: RBW= 3 MHz, VBW= 3 MHz, Sweep time = Auto.

6.4 TEST SETUP LAYOUT



6.5 DEVIATION FROM TEST STANDARD

No deviation

6.6 EUT OPERATING CONDITIONS

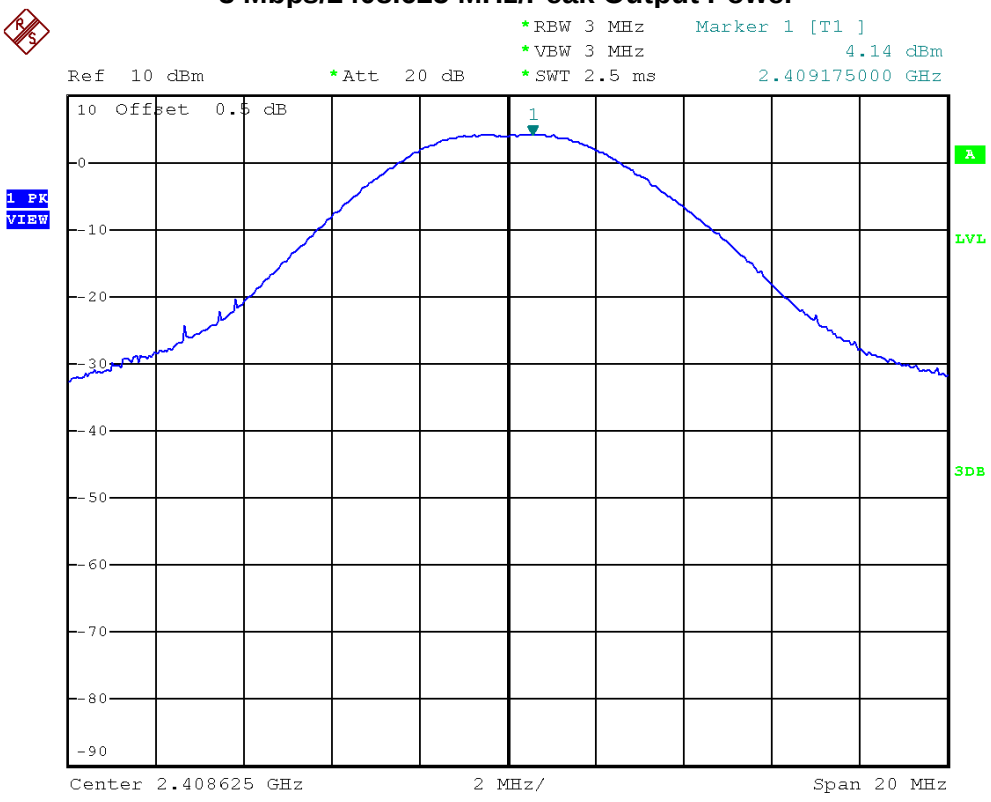
The EUT tested system was configured as the statements of 4.6 Unless otherwise a special operating condition is specified in the follows during the testing.

6.7 TEST RESULTS

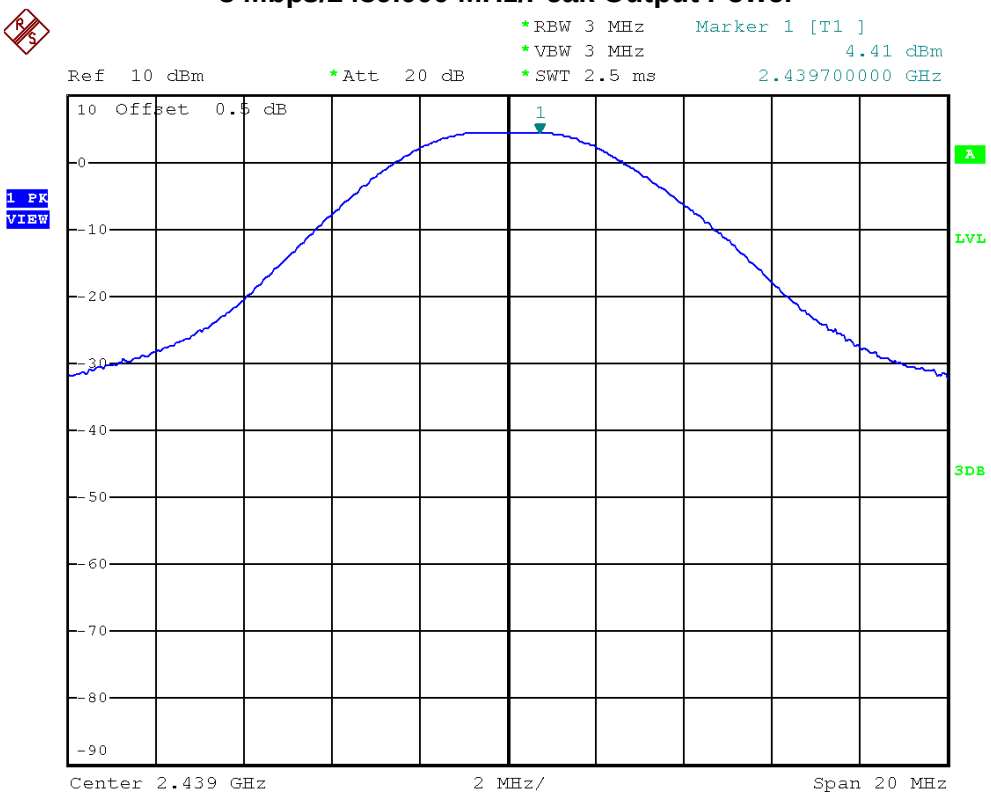
E.U.T	2.4GHz GFSK Transceiver module	Model Name	K71216P
Temperature	26°C	Relative Humidity	46%
Test Voltage	AC 120V/60Hz (System)		
Test Mode	3 Mbps/2408.625 MHz, 2439.000 MHz, 2473.875 MHz		

Frequency	Peak Output Power (dBm)	LIMIT (dBm)	Result
2408.625 MHz	4.14	30	PASS
2439.000 MHz	4.41	30	PASS
2473.875 MHz	4.82	30	PASS

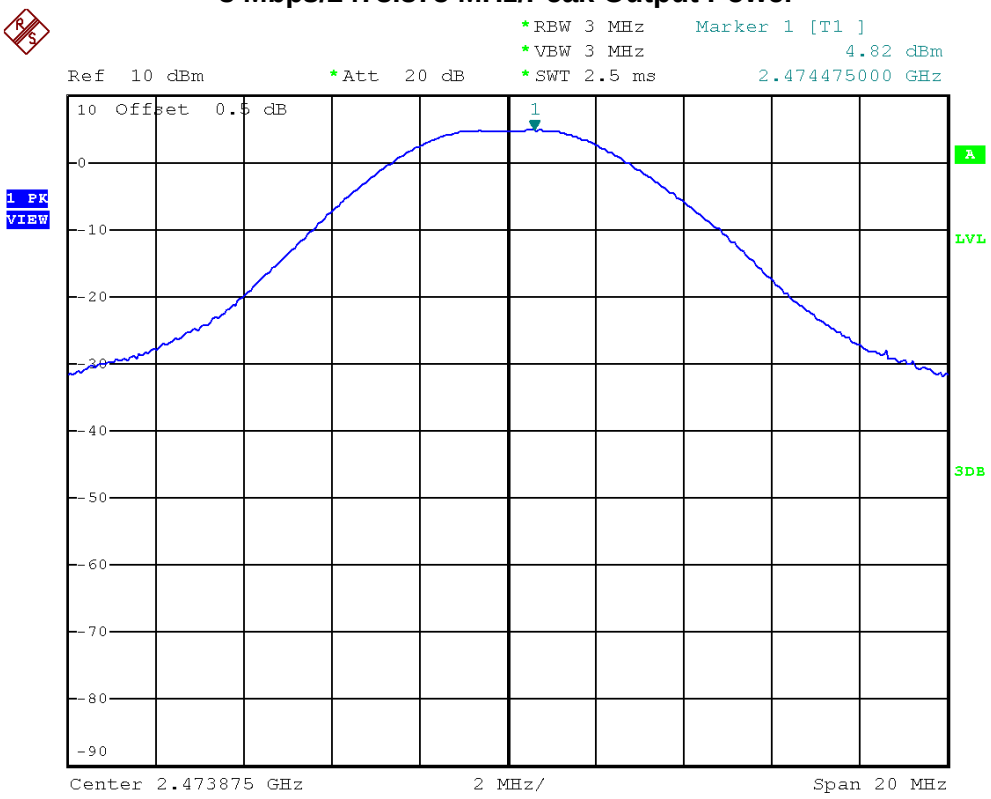
3 Mbps/2408.625 MHz/Peak Output Power



3 Mbps/2439.000 MHz/Peak Output Power



3 Mbps/2473.875 MHz/Peak Output Power



7 RADIATED SPURIOUS EMISSION (9 KHZ TO 1 GHZ)

7.1 LIMIT

20 dB in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequency Range: 9 kHz to 1 GHz		
FREQUENCY (MHz)	Field Strength (micorvolts/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

Frequency Range: above 1 GHz				
FREQUENCY (MHz)	Class A (dBuV/m) (at 3m)		Class B (dBuV/m) (at 3m)	
	PEAK	AVERAGE	PEAK	AVERAGE
above 1 GHz	80	60	74	54

NOTE:

(1) The limit for radiated test was performed according to FCC PART 15B.
(2) The tighter limit applies at the band edges.
(3) Emission level (dBuV/m)=20log Emission level (uV/m).
(4) The test result calculated as following:
Measurement Value = Reading Level + Correct Factor
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain(if use)
Margin Level = Measurement Value – Limit Value

7.2 MEASUREMENT INSTRUMENTS LIST

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	FSP-40	100129	Oct. 01, 2013
2	Horn Antenna	Schwarzbeck	BBHA 9120	D-325	Apr. 15, 2014
3	Microwave Pre_amplifier	Agilent	8449B	3008A01714	Apr. 16, 2014
4	Microflex Cable	Harbour industries	27478LL142	1m	May. 13, 2014
5	Microflex Cable	EMC	S104-SMA	8m	May. 13, 2014
6	Microflex Cable	Harbour industries	27478LL142	3m	May. 13, 2014
7	Test Cable	LMR	LMR-400	12m	May. 14, 2014
8	Test Cable	LMR	LMR-400	3m	May. 14, 2014
9	Pre-Amplifier	EMC	EMC-330	980001	Jun. 07, 2013
10	Log-Bicon Antenna	Schwarzbeck	VULB9168-352	9168-352	Jun. 12, 2013

Remark: “N/A” denotes No Model Name, No Serial No. or No Calibration specified.

7.3 MEASURING INSTRUMENTS SETTING

EMI Test Receiver	Parameter Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB 200Hz for QP
Start ~ Stop Frequency	150kHz~30MHz / RB 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RB 120kHz for QP

7.4 TEST PROCEDURES

a. The measuring distance of at 3 m shall be used for measurements at frequency up to 1 GHz. For frequencies above 1 GHz, any suitable measuring distance may be used.
b. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3m Semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
c. The height of the equipment or of the substitution antenna shall be 0.8 m; the height of the test antenna shall vary between 1 m to 4 m. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
d. The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.
e. If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit, the EUT shall be deemed to meet QP Limits and then no additional QP Mode measurement performed.
f. For the actual test configuration, please refer to the related Item –EUT Test Photos.
g. The testing follows the guidelines in ANSI C63.4 and FCC Public Notice DA 00-705 Measurement Guidelines. In case the emission is fail due to the used RBW/VBW is too wide, marker-delta method of FCC Public Notice DA 00-705 will be followed.

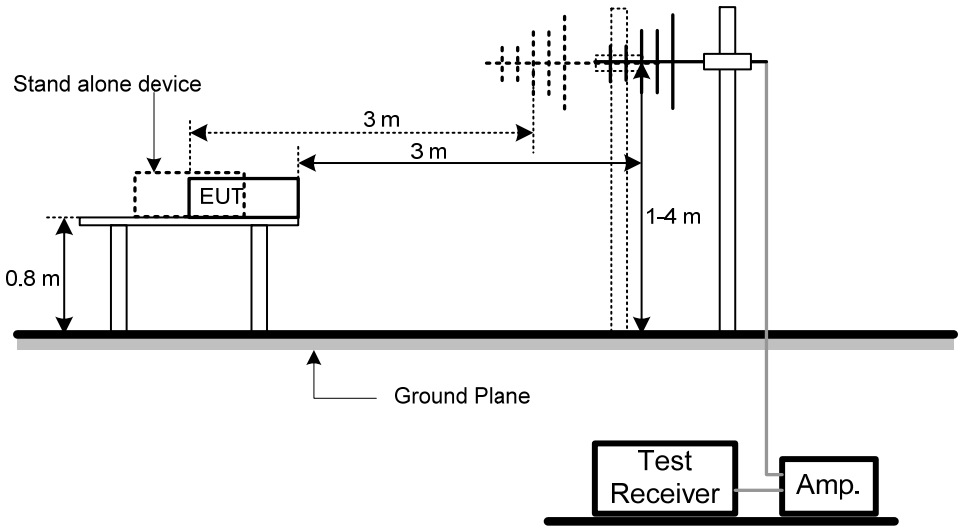
NOTE:

a. Reading in which marked as QP or Peak means measurements by using are Quasi-Peak Mode with Detector BW=120 kHz; SPA setting in RBW=100 kHz, VBW =100 kHz, Swp. Time = 0.3 sec./ MHz.
b. All readings are Peak unless otherwise stated QP in column of Note. Peak denotes that the Peak reading compliance with the QP Limits and then QP Mode measurement didn‘t perform.

7.5 DEVIATION FROM TEST STANDARD

No deviation

7.6 TEST SETUP LAYOUT



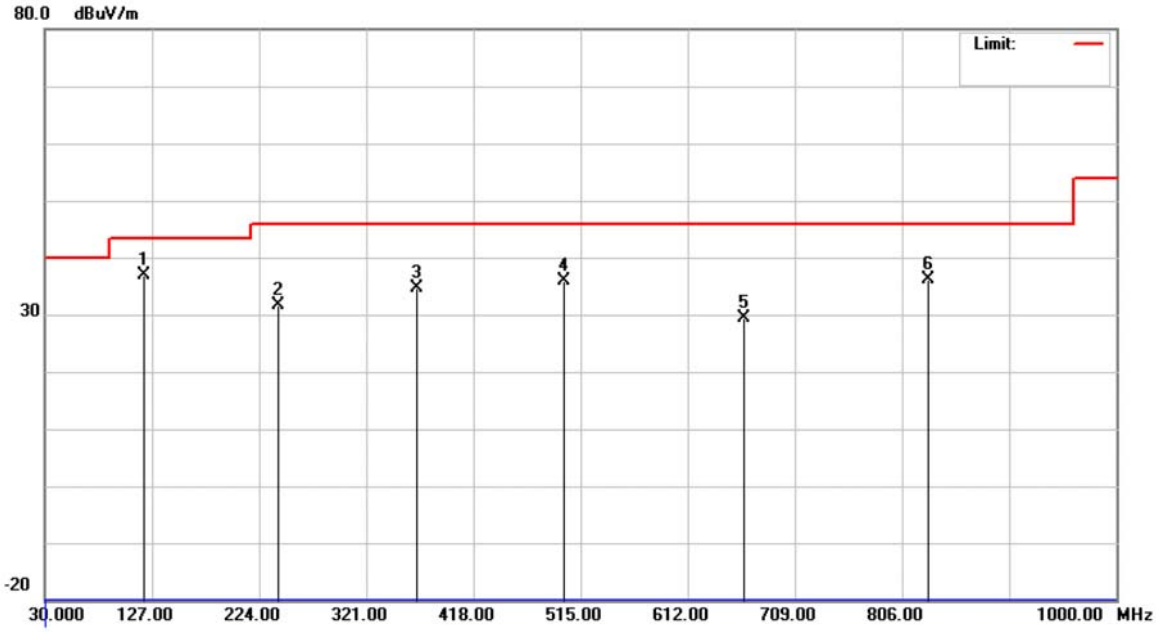
7.7 EUT OPERATING CONDITIONS

The EUT tested system was configured as the statements of 4.6 Unless otherwise a special operating condition is specified in the follows during the testing.

7.8 TEST RESULTS

E.U.T	2.4GHz GFSK Transceiver module	Model Name	K71216P
Temperature	26°C	Relative Humidity	60%
Test Voltage	AC 120V/60Hz (System)		
Test Mode	3 Mbps/2439.000 MHz		

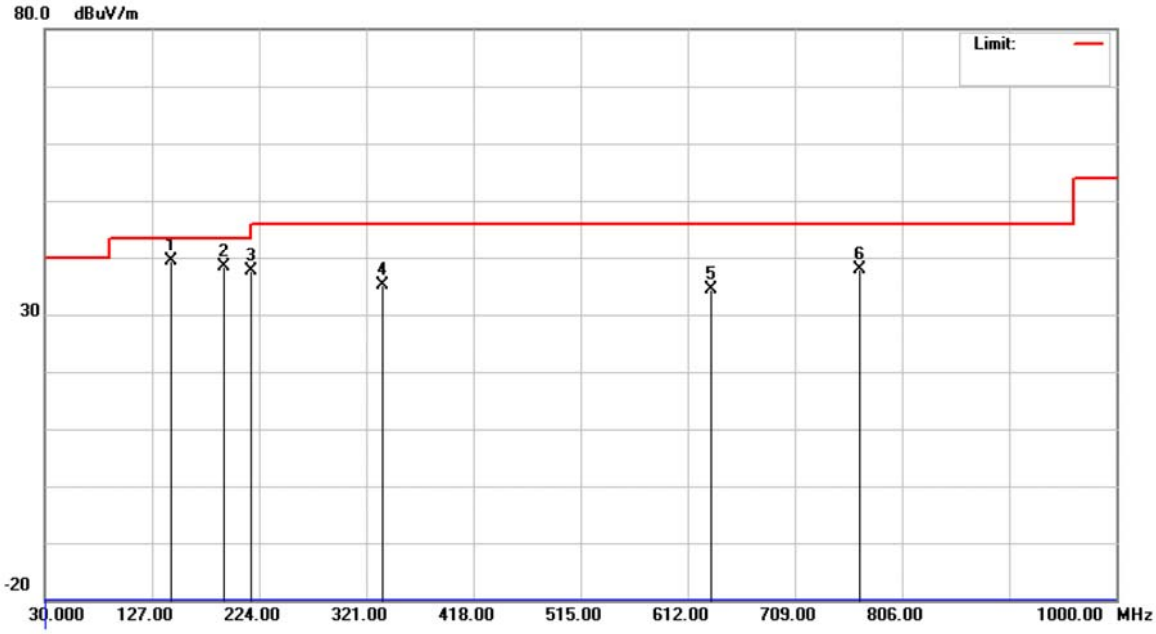
Polarization: Vertical



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	*	119.7248	58.36	-21.46	36.90	43.50	-6.60	peak	
2		240.9750	52.26	-20.51	31.75	46.00	-14.25	peak	
3		367.0750	51.33	-16.68	34.65	46.00	-11.35	peak	
4		500.4500	49.76	-13.95	35.81	46.00	-10.19	peak	
5		662.9249	39.81	-10.39	29.42	46.00	-16.58	peak	
6		830.2500	44.30	-8.11	36.19	46.00	-9.81	peak	

E.U.T	2.4GHz GFSK Transceiver module	Model Name	K71216P
Temperature	26°C	Relative Humidity	60%
Test Voltage	AC 120V/60Hz (System)		
Test Mode	3 Mbps/2439.000 MHz		

Polarization: Horizontal



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	*	143.9750	58.82	-19.50	39.32	43.50	-4.18	peak	
2		192.4750	60.38	-21.92	38.46	43.50	-5.04	peak	
3		216.7250	59.62	-21.94	37.68	46.00	-8.32	peak	
4		335.5498	52.63	-17.45	35.18	46.00	-10.82	peak	
5		633.8250	45.12	-10.72	34.40	46.00	-11.60	peak	
6		767.2000	46.75	-8.93	37.82	46.00	-8.18	peak	

8 RADIATED SPURIOUS EMISSION (ABOVE 1 GHZ)

8.1 LIMIT

20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequency Range: 9 kHz to 1 GHz		
FREQUENCY (MHz)	Field Strength (micorvolts/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

Frequency Range: above 1 GHz				
FREQUENCY (MHz)	Class A (dBuV/m) (at 3m)		Class B (dBuV/m) (at 3m)	
	PEAK	AVERAGE	PEAK	AVERAGE
above 1 GHz	80	60	74	54

NOTE:

(1) The limit for radiated test was performed according to FCC PART 15B.
(2) The tighter limit applies at the band edges.
(3) Emission level (dBuV/m)=20log Emission level (uV/m).
(4) The test result calculated as following:
Measurement Value = Reading Level + Correct Factor
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain(if use)
Margin Level = Measurement Value – Limit Value

8.2 MEASUREMENT INSTRUMENTS LIST

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	FSP-40	100129	Oct. 01, 2013
2	Horn Antenna	Schwarzbeck	BBHA 9120	D-325	Apr. 15, 2014
3	Microwave Pre_amplifier	Agilent	8449B	3008A01714	Apr. 16, 2014
4	Microflex Cable	Harbour industries	27478LL142	1m	May. 13, 2014
5	Microflex Cable	EMC	S104-SMA	8m	May. 13, 2014
6	Microflex Cable	Harbour industries	27478LL142	3m	May. 13, 2014
7	Test Cable	LMR	LMR-400	12m	May. 14, 2014
8	Test Cable	LMR	LMR-400	3m	May. 14, 2014
9	Pre-Amplifier	EMC	EMC-330	980001	Jun. 07, 2013
10	Log-Bicon Antenna	Schwarzbeck	VULB9168-352	9168-352	Jun. 12, 2013

Remark: “N/A” denotes No Model Name, No Serial No. or No Calibration specified.

8.3 MEASURING INSTRUMENTS SETTING

Spectrum Analyzer	Parameter Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RB / VB (emission in restricted band)	1MHz / 1MHz for Peak, 1 MHz / 10Hz for Average
RB / VB (other emission)	1MHz / 1MHz for Peak, 1 MHz / 10Hz for Average

8.4 TEST PROCEDURES

a. The measuring distance of at 3 m shall be used for measurements at frequency up to 1 GHz. For frequencies above 1 GHz, any suitable measuring distance may be used.
b. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3m Semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
c. The height of the equipment or of the substitution antenna shall be 0.8 m; the height of the test antenna shall vary between 1 m to 4 m. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
d. The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.
e. If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit, the EUT shall be deemed to meet QP Limits and then no additional QP Mode measurement performed.
f. For the actual test configuration, please refer to the related Item –EUT Test Photos.
g. The testing follows the guidelines in ANSI C63.4 and FCC Public Notice DA 00-705 Measurement Guidelines. In case the emission is fail due to the used RBW/VBW is too wide, marker-delta method of FCC Public Notice DA 00-705 will be followed.

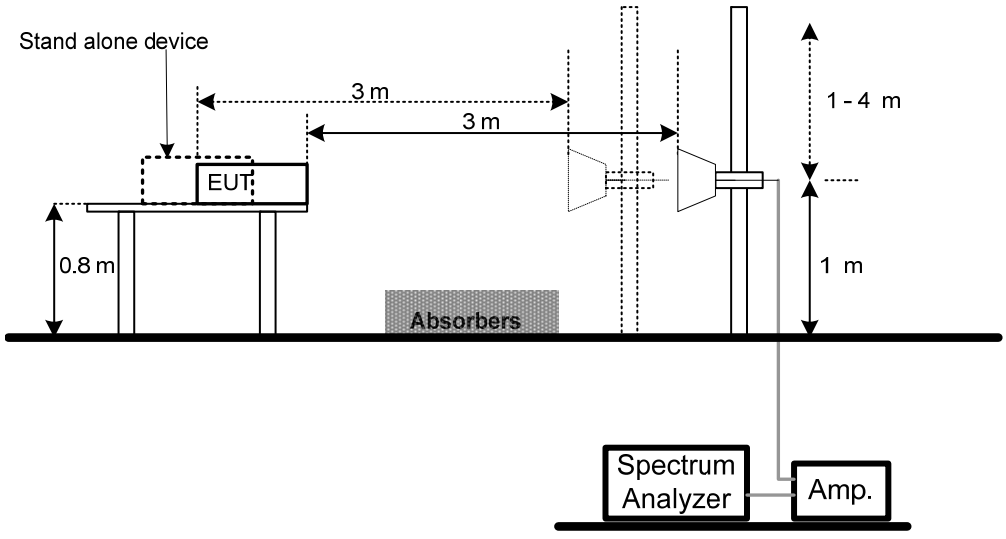
NOTE:

a. Reading in which marked as Peak means measurements by using are Peak Mode with instrument setting in RBW= 1 MHz, VBW= 1 MHz, Swp. Time = Auto.
Reading in which marked as AV means measurements by using are Average Mode with instrument setting in RBW= 1 MHz, VBW= 10 Hz, Swp. Time = Auto.
b. All readings are Peak Mode value unless otherwise stated AVG in column of Note. If the Peak Mode Measured value compliance with the Peak Limits and lower than AVG Limits, the EUT shall be deemed to meet both Peak & AVG Limits and then only Peak Mode was measured, but AVG Mode didn't perform.

8.5 DEVIATION FROM TEST STANDARD

No deviation

8.6 TEST SETUP LAYOUT



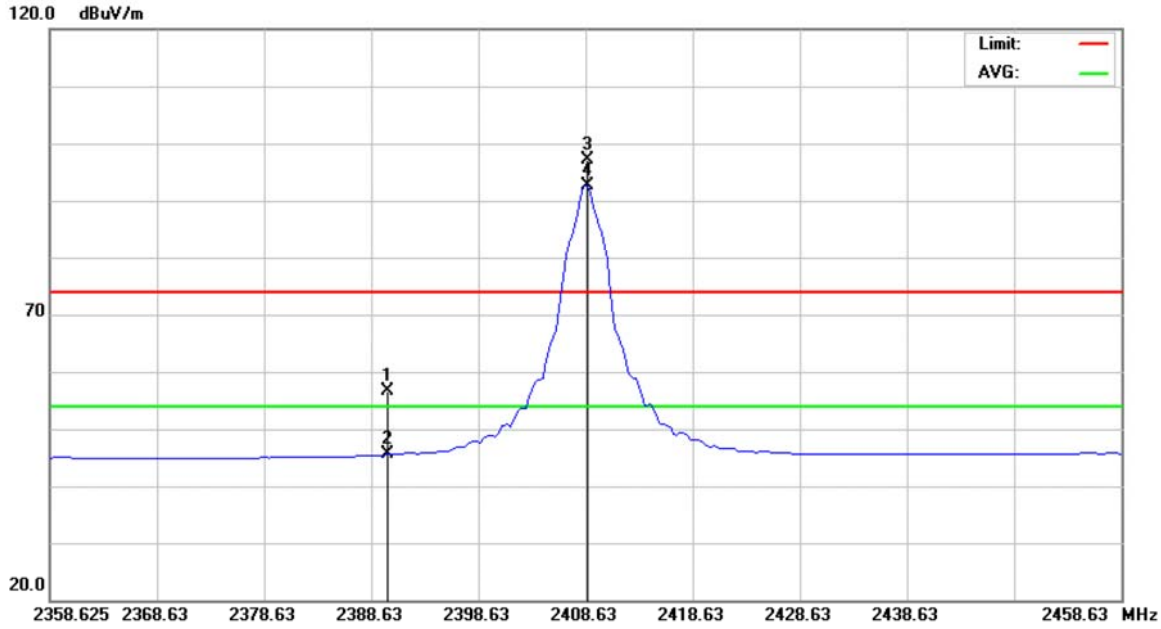
8.7 EUT OPERATING CONDITIONS

The EUT tested system was configured as the statements of 4.6 Unless otherwise a special operating condition is specified in the follows during the testing.

8.8 TEST RESULTS

E.U.T	2.4GHz GFSK Transceiver module	Model Name	K71216P
Temperature	26°C	Relative Humidity	60%
Test Voltage	AC 120V/60Hz (System)		
Test Mode	3 Mbps/2408.625 MHz		

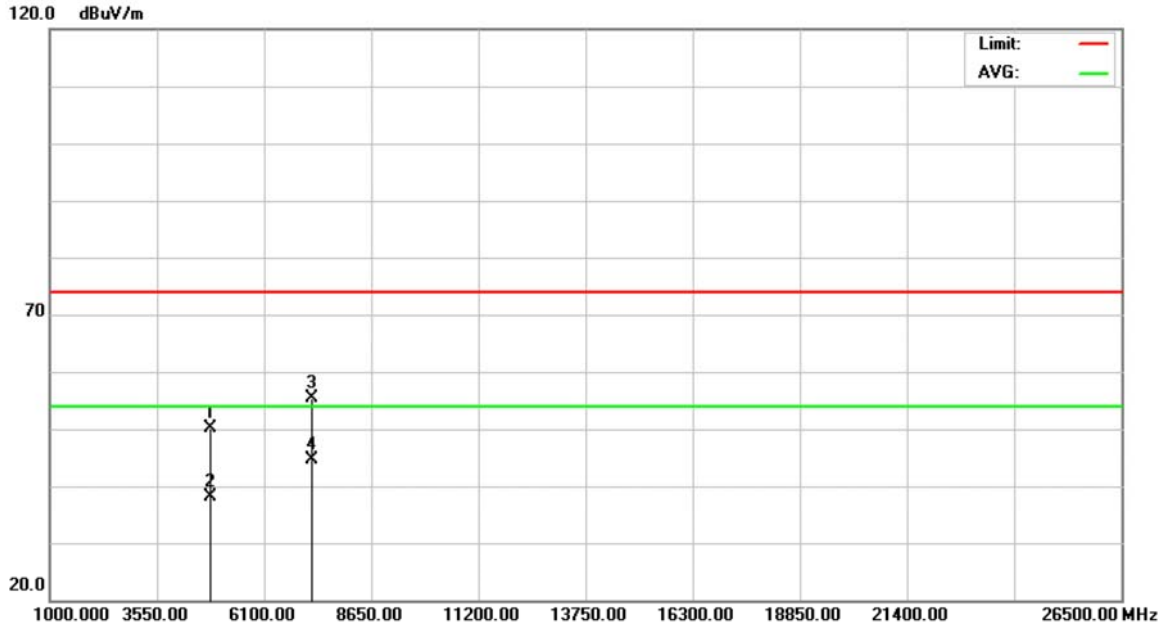
Polarization: Vertical



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		2390.000	24.95	31.67	56.62	74.00	-17.38	peak	
2		2390.000	13.87	31.67	45.54	54.00	-8.46	AVG	
3	X	2408.875	65.36	31.75	97.11	74.00	23.11	peak	
4	*	2408.875	60.88	31.75	92.63	54.00	38.63	AVG	

E.U.T	2.4GHz GFSK Transceiver module	Model Name	K71216P
Temperature	26°C	Relative Humidity	60%
Test Voltage	AC 120V/60Hz (System)		
Test Mode	3 Mbps/2408.625 MHz		

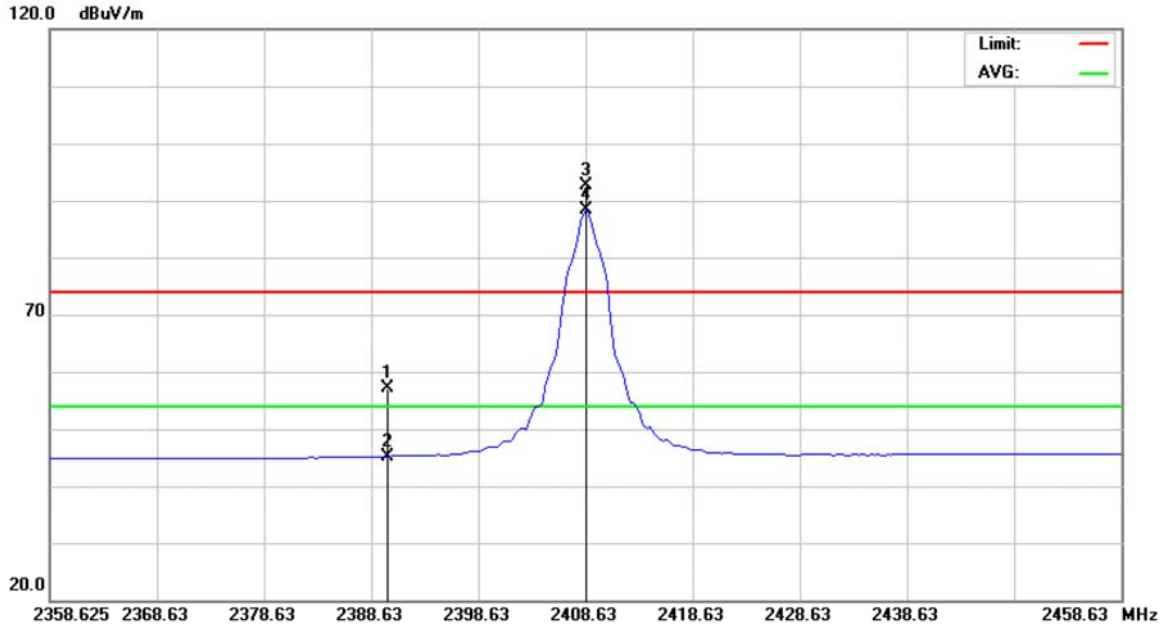
Polarization: Vertical



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		4815.962	44.52	5.70	50.22	74.00	-23.78	peak	
2		4815.962	32.51	5.70	38.21	54.00	-15.79	AVG	
3		7227.888	43.19	12.26	55.45	74.00	-18.55	peak	
4	*	7227.888	32.44	12.26	44.70	54.00	-9.30	AVG	

E.U.T	2.4GHz GFSK Transceiver module	Model Name	K71216P
Temperature	26°C	Relative Humidity	60%
Test Voltage	AC 120V/60Hz (System)		
Test Mode	3 Mbps/2408.625 MHz		

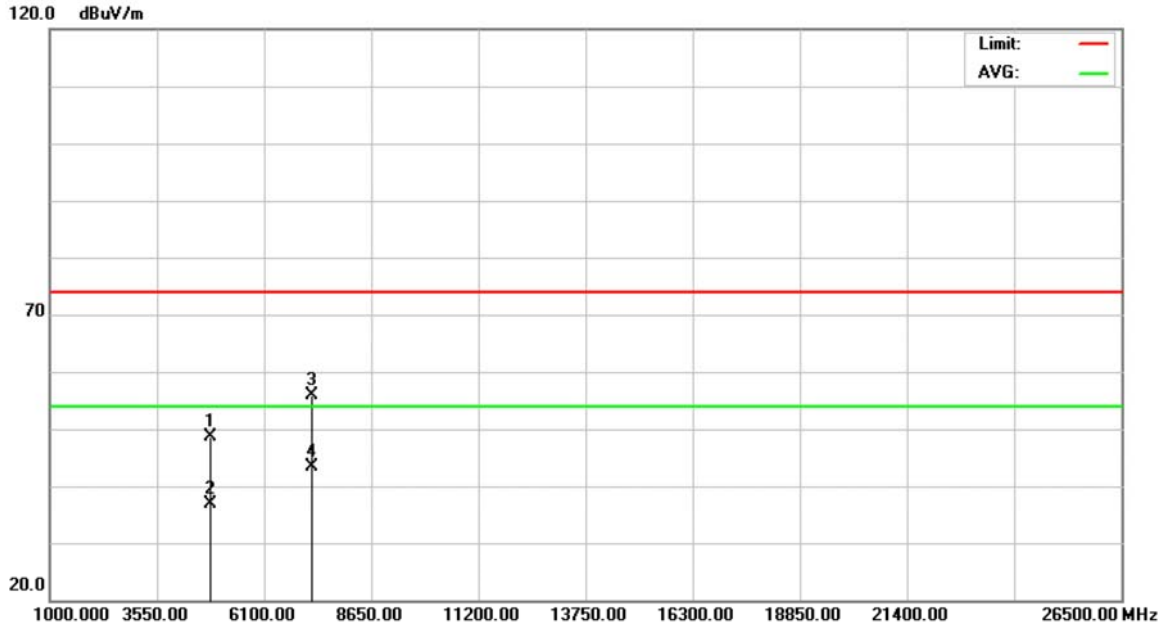
Polarization: Horizontal



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		2390.000	25.41	31.67	57.08	74.00	-16.92	peak	
2		2390.000	13.51	31.67	45.18	54.00	-8.82	AVG	
3	X	2408.625	60.96	31.75	92.71	74.00	18.71	peak	
4	*	2408.625	56.66	31.75	88.41	54.00	34.41	AVG	

E.U.T	2.4GHz GFSK Transceiver module	Model Name	K71216P
Temperature	26°C	Relative Humidity	60%
Test Voltage	AC 120V/60Hz (System)		
Test Mode	3 Mbps/2408.625 MHz		

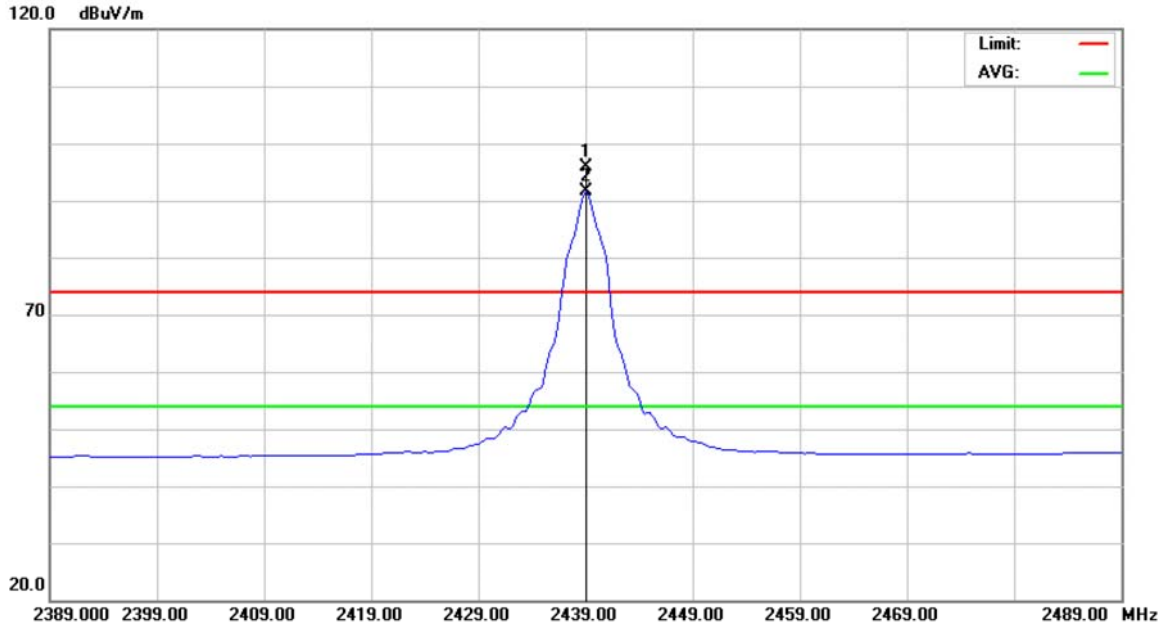
Polarization: Horizontal



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		4818.650	42.95	5.71	48.66	74.00	-25.34	peak	
2		4818.650	31.23	5.71	36.94	54.00	-17.06	AVG	
3		7228.075	43.54	12.26	55.80	74.00	-18.20	peak	
4	*	7228.075	31.22	12.26	43.48	54.00	-10.52	AVG	

E.U.T	2.4GHz GFSK Transceiver module	Model Name	K71216P
Temperature	26°C	Relative Humidity	60%
Test Voltage	AC 120V/60Hz (System)		
Test Mode	3 Mbps/2439.000 MHz		

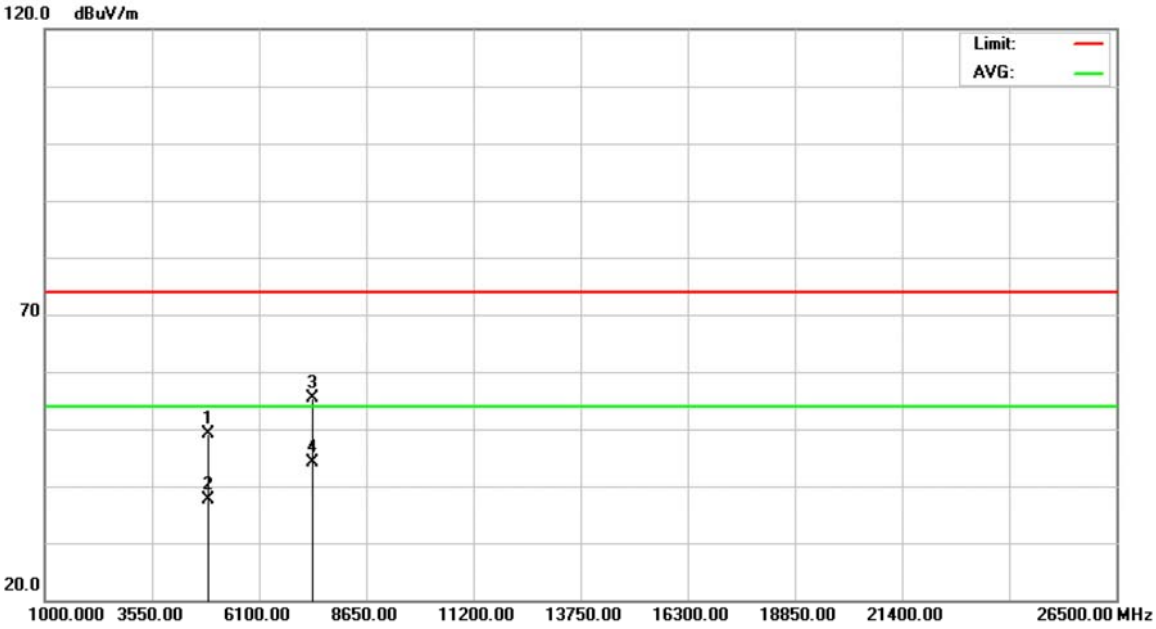
Polarization: Vertical



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	X	2439.000	64.07	31.89	95.96	74.00	21.96	peak	
2	*	2439.000	59.65	31.89	91.54	54.00	37.54	AVG	

E.U.T	2.4GHz GFSK Transceiver module	Model Name	K71216P
Temperature	26°C	Relative Humidity	60%
Test Voltage	AC 120V/60Hz (System)		
Test Mode	3 Mbps/2439.000 MHz		

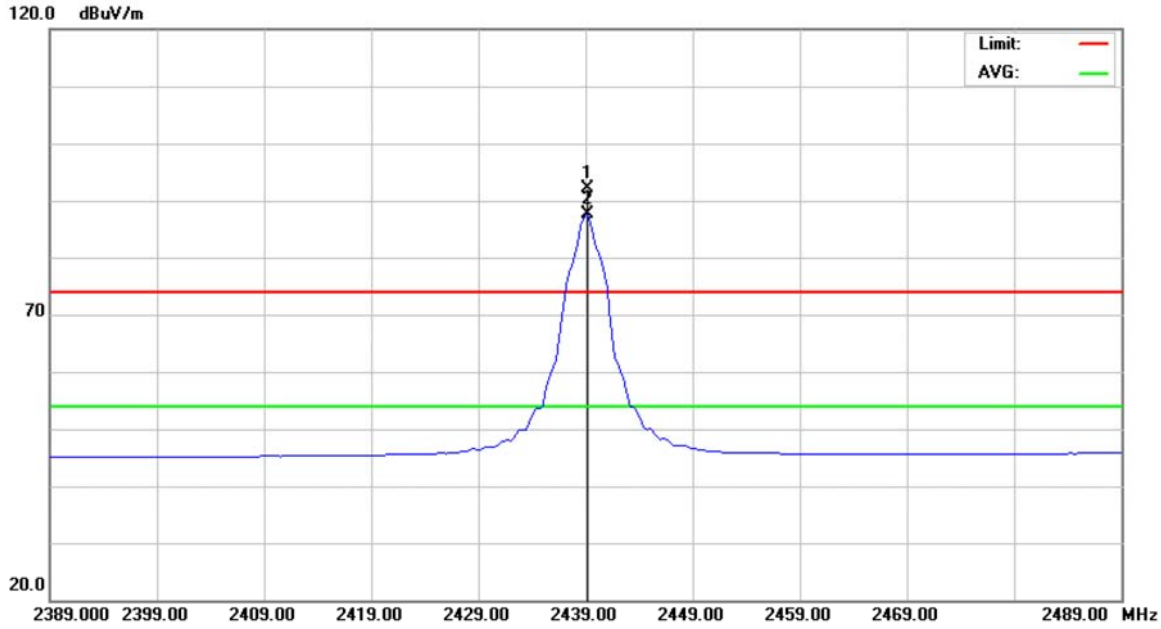
Polarization: Vertical



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		4876.475	43.32	5.78	49.10	74.00	-24.90	peak	
2		4876.475	31.86	5.78	37.64	54.00	-16.36	AVG	
3		7319.150	42.73	12.60	55.33	74.00	-18.67	peak	
4	*	7319.150	31.64	12.60	44.24	54.00	-9.76	AVG	

E.U.T	2.4GHz GFSK Transceiver module	Model Name	K71216P
Temperature	26°C	Relative Humidity	60%
Test Voltage	AC 120V/60Hz (System)		
Test Mode	3 Mbps/2439.000 MHz		

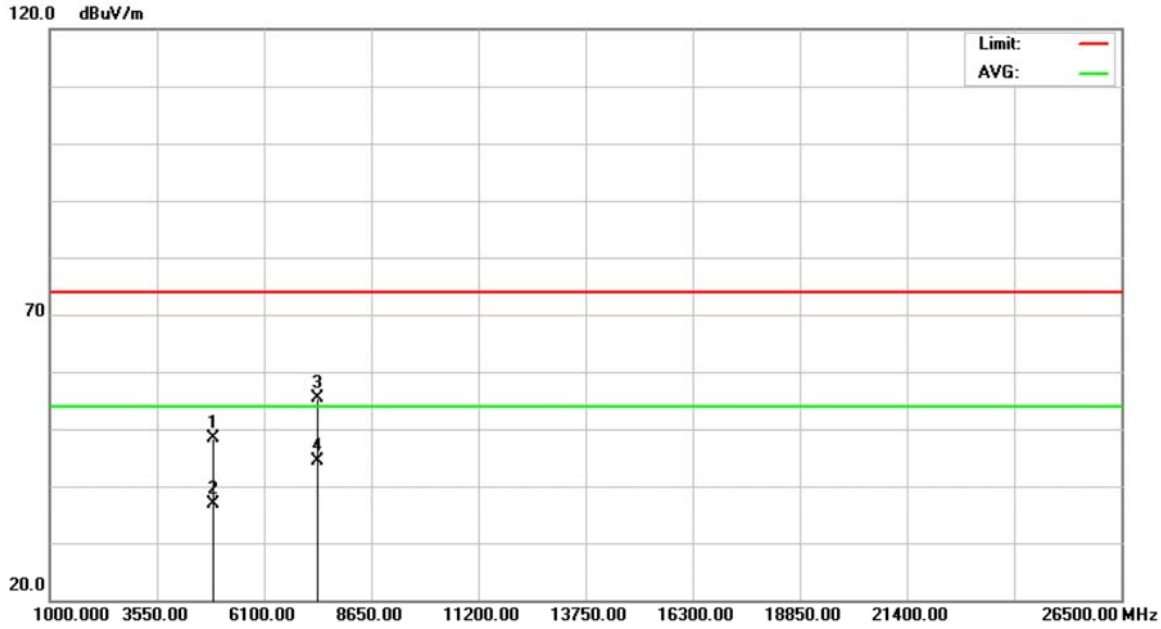
Polarization: Horizontal



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	X	2439.250	60.18	31.89	92.07	74.00	18.07	peak	
2	*	2439.250	55.74	31.89	87.63	54.00	33.63	AVG	

E.U.T	2.4GHz GFSK Transceiver module	Model Name	K71216P
Temperature	26°C	Relative Humidity	60%
Test Voltage	AC 120V/60Hz (System)		
Test Mode	3 Mbps/2439.000 MHz		

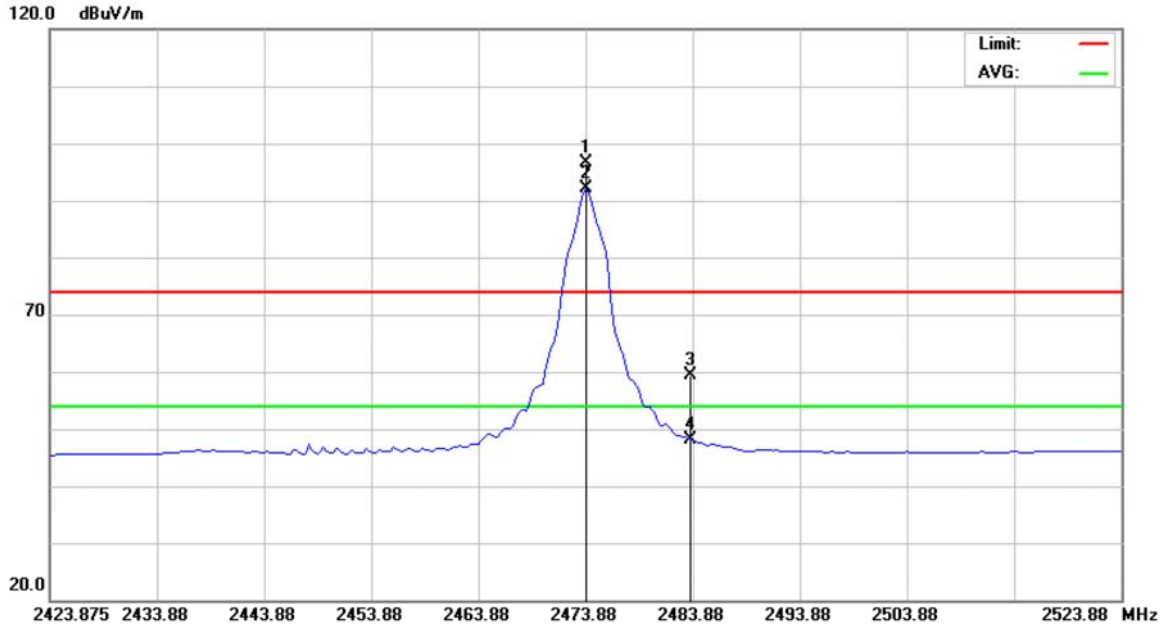
Polarization: Horizontal



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		4879.375	42.54	5.79	48.33	74.00	-25.67	peak	
2		4879.375	30.98	5.79	36.77	54.00	-17.23	AVG	
3		7319.475	42.90	12.60	55.50	74.00	-18.50	peak	
4	*	7319.475	31.78	12.60	44.38	54.00	-9.62	AVG	

E.U.T	2.4GHz GFSK Transceiver module	Model Name	K71216P
Temperature	26°C	Relative Humidity	60%
Test Voltage	AC 120V/60Hz (System)		
Test Mode	3 Mbps/2473.875 MHz		

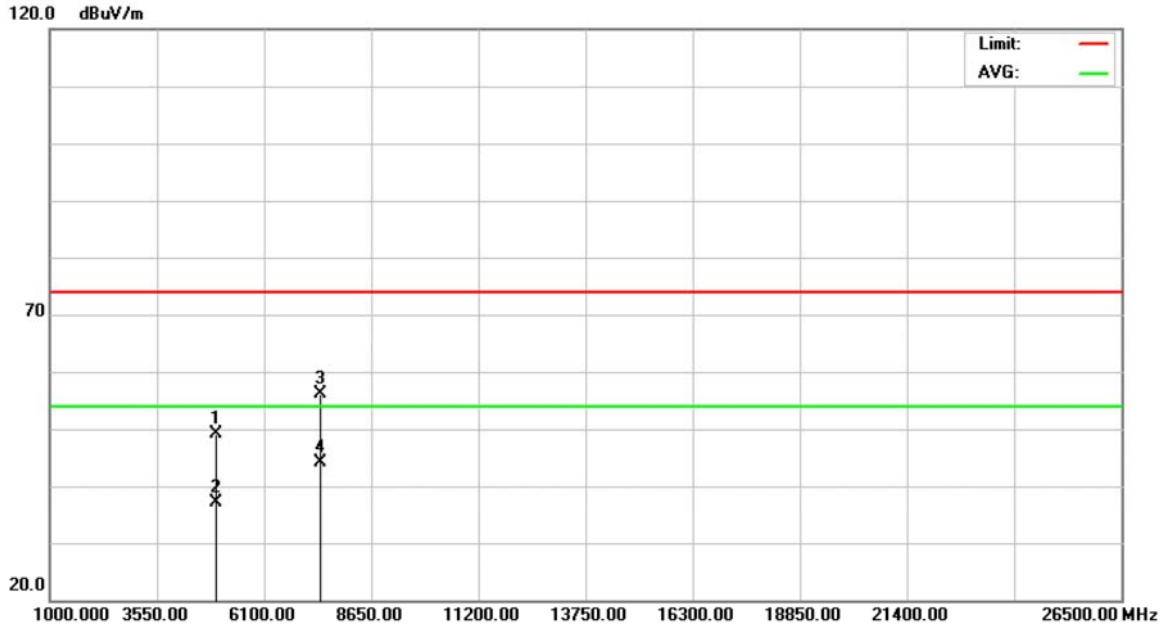
Polarization: Vertical



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	X	2473.875	64.50	32.04	96.54	74.00	22.54	peak	
2	*	2473.875	60.07	32.04	92.11	54.00	38.11	AVG	
3		2483.500	27.19	32.09	59.28	74.00	-14.72	peak	
4		2483.500	15.96	32.09	48.05	54.00	-5.95	AVG	

E.U.T	2.4GHz GFSK Transceiver module	Model Name	K71216P
Temperature	26°C	Relative Humidity	60%
Test Voltage	AC 120V/60Hz (System)		
Test Mode	3 Mbps/2473.875 MHz		

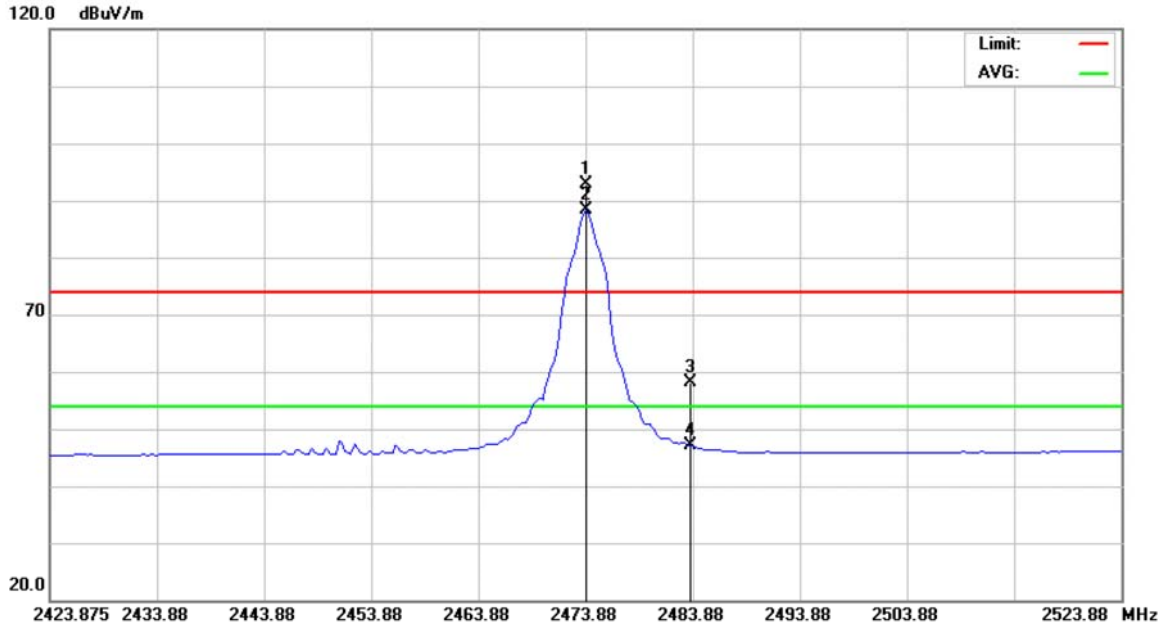
Polarization: Vertical



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		4949.075	43.26	5.87	49.13	74.00	-24.87	peak	
2		4949.075	31.14	5.87	37.01	54.00	-16.99	AVG	
3		7419.425	43.16	12.97	56.13	74.00	-17.87	peak	
4	*	7419.425	31.25	12.97	44.22	54.00	-9.78	AVG	

E.U.T	2.4GHz GFSK Transceiver module	Model Name	K71216P
Temperature	26°C	Relative Humidity	60%
Test Voltage	AC 120V/60Hz (System)		
Test Mode	3 Mbps/2473.875 MHz		

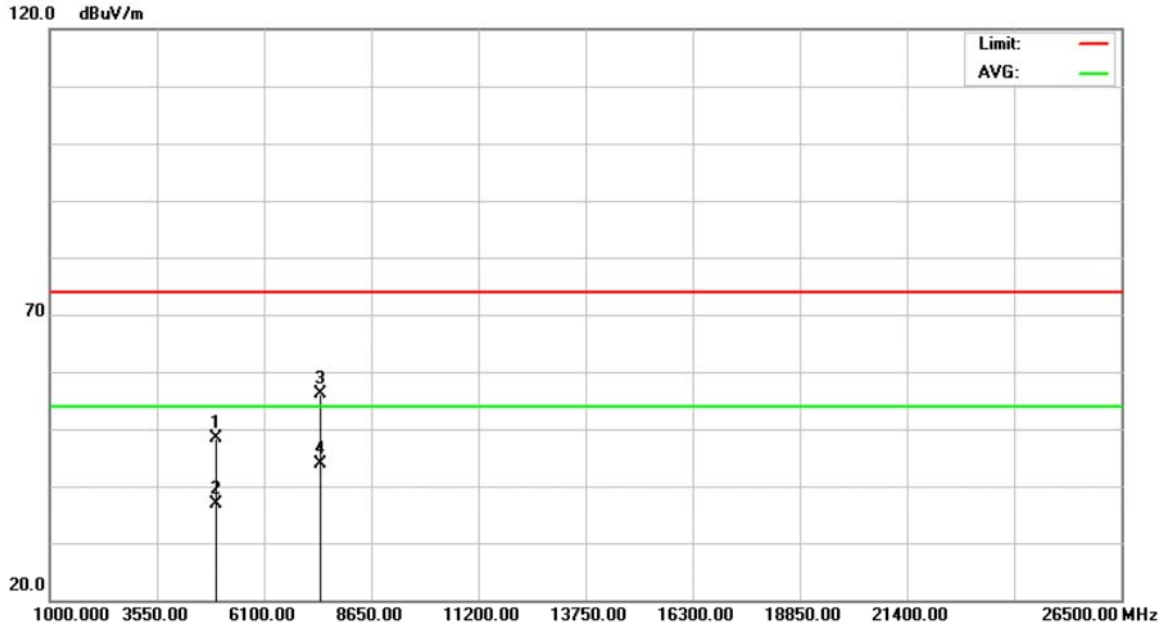
Polarization: Horizontal



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	X	2473.875	60.80	32.04	92.84	74.00	18.84	peak	
2	*	2473.875	56.41	32.04	88.45	54.00	34.45	AVG	
3		2483.500	25.98	32.09	58.07	74.00	-15.93	peak	
4		2483.500	15.00	32.09	47.09	54.00	-6.91	AVG	

E.U.T	2.4GHz GFSK Transceiver module	Model Name	K71216P
Temperature	26°C	Relative Humidity	60%
Test Voltage	AC 120V/60Hz (System)		
Test Mode	3 Mbps/2473.875 MHz		

Polarization: Horizontal

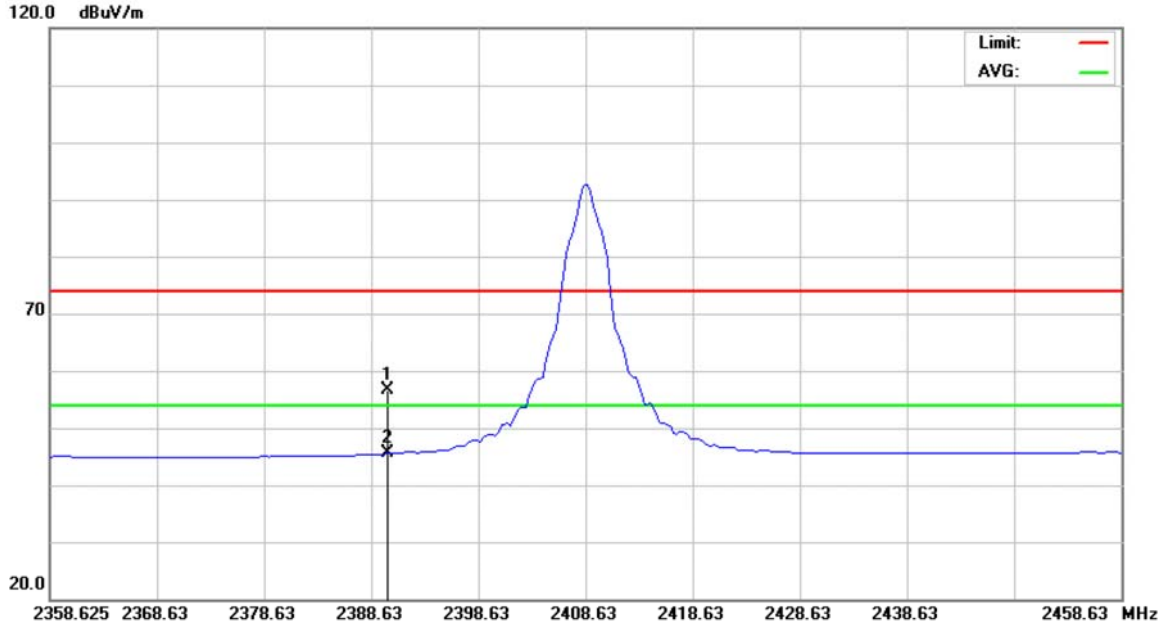


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		4949.100	42.50	5.87	48.37	74.00	-25.63	peak	
2		4949.100	31.08	5.87	36.95	54.00	-17.05	AVG	
3		7423.675	43.24	12.99	56.23	74.00	-17.77	peak	
4	*	7423.675	30.82	12.99	43.81	54.00	-10.19	AVG	

8.9 TEST RESULTS (RESTRICTED BANDS)

E.U.T	2.4GHz GFSK Transceiver module	Model Name	K71216P
Temperature	24°C	Relative Humidity	46%
Test Voltage	AC 120V/60Hz (System)		
Test Mode	3 Mbps/2408.625 MHz		
NOTE	The transmitter was setup to transmit at the lowest channel and the field strength was measured at 2310-2390 MHz.		

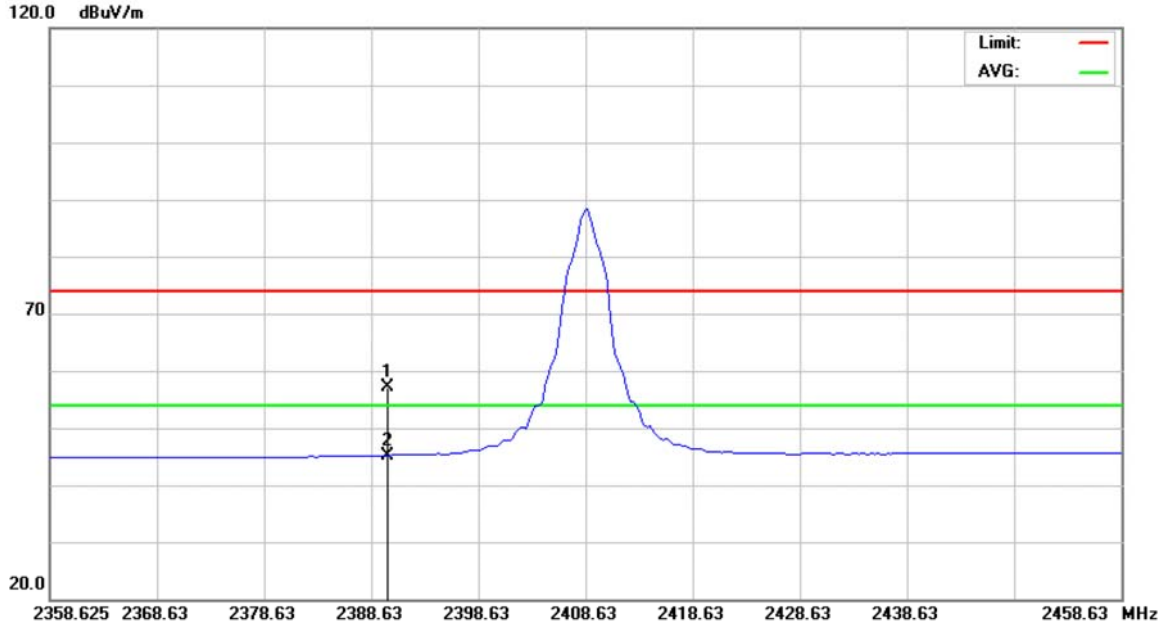
Polarization: Vertical



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		2390.000	24.95	31.67	56.62	74.00	-17.38	peak	
2	*	2390.000	13.87	31.67	45.54	54.00	-8.46	AVG	

E.U.T	2.4GHz GFSK Transceiver module	Model Name	K71216P
Temperature	24°C	Relative Humidity	46%
Test Voltage	AC 120V/60Hz (System)		
Test Mode	3 Mbps/2408.625 MHz		
NOTE	The transmitter was setup to transmit at the lowest channel and the field strength was measured at 2310-2390 MHz.		

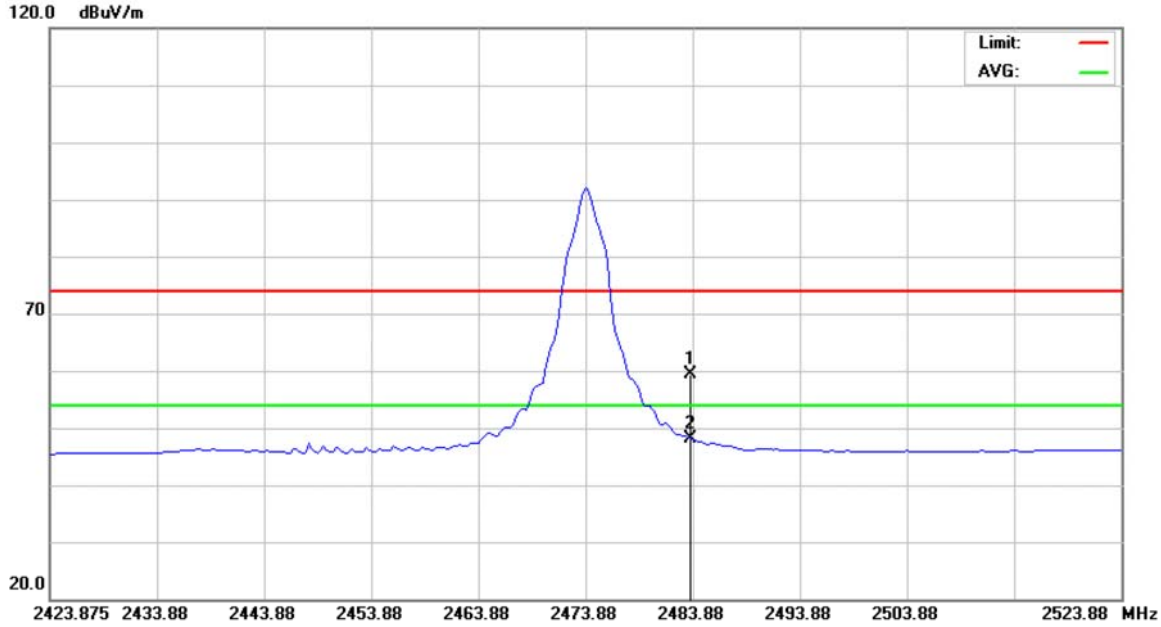
Polarization: Horizontal



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		2390.000	25.41	31.67	57.08	74.00	-16.92	peak	
2	*	2390.000	13.51	31.67	45.18	54.00	-8.82	AVG	

E.U.T	2.4GHz GFSK Transceiver module	Model Name	K71216P
Temperature	24°C	Relative Humidity	46%
Test Voltage	AC 120V/60Hz (System)		
Test Mode	3 Mbps/2473.875 MHz		
NOTE	The transmitter was setup to transmit at the highest channel and the field strength was measured at 2483.5-2500 MHz.		

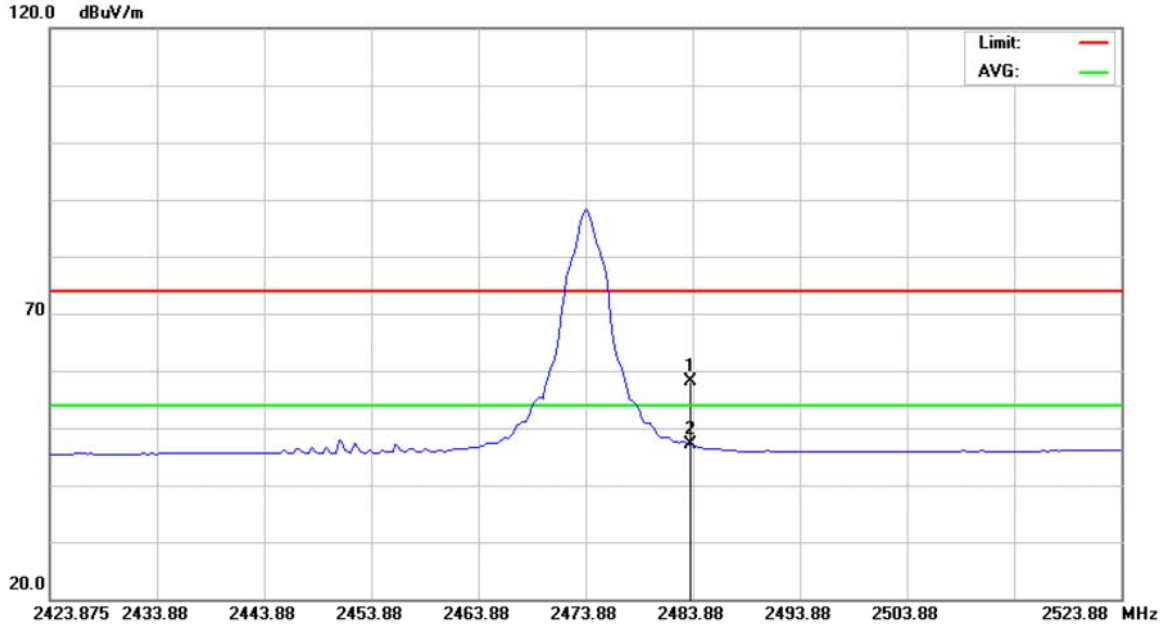
Polarization: Vertical



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		2483.500	27.19	32.09	59.28	74.00	-14.72	peak	
2	*	2483.500	15.96	32.09	48.05	54.00	-5.95	AVG	

E.U.T	2.4GHz GFSK Transceiver module	Model Name	K71216P
Temperature	24°C	Relative Humidity	46%
Test Voltage	AC 120V/60Hz (System)		
Test Mode	3 Mbps/2473.875 MHz		
NOTE	The transmitter was setup to transmit at the highest channel and the field strength was measured at 2483.5-2500 MHz.		

Polarization: Horizontal



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		2483.500	25.98	32.09	58.07	74.00	-15.93	peak	
2	*	2483.500	15.00	32.09	47.09	54.00	-6.91	AVG	

9 NUMBER OF HOPPING FREQUENCY

9.1 LIMIT

Test Item	Frequency Range (MHz)	Limit
Number of Hopping Channel	2400-2483.5	shall use at least 15 channels

9.2 MEASUREMENT INSTRUMENTS LIST

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	FSP-40	100129	Oct. 01, 2013

NOTE: **N/A**: denotes No Model Name, No Serial No. or No Calibration specified.

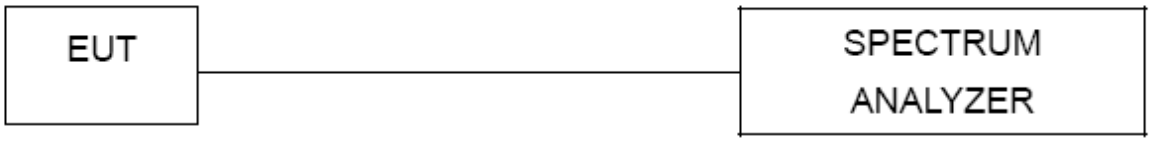
9.3 MEASURING INSTRUMENTS SETTING

Spectrum Analyzer	Parameter Setting
Attenuation	Auto
Span Frequency	> Operating Frequency Range
RB	100 kHz
VB	100 kHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

9.4 TEST PROCEDURES

a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
b. Spectrum Setting: RBW= 100 kHz, VBW=100 kHz, Sweep time = Auto.

9.5 TEST SETUP LAYOUT



9.6 DEVIATION FROM TEST STANDARD

No deviation

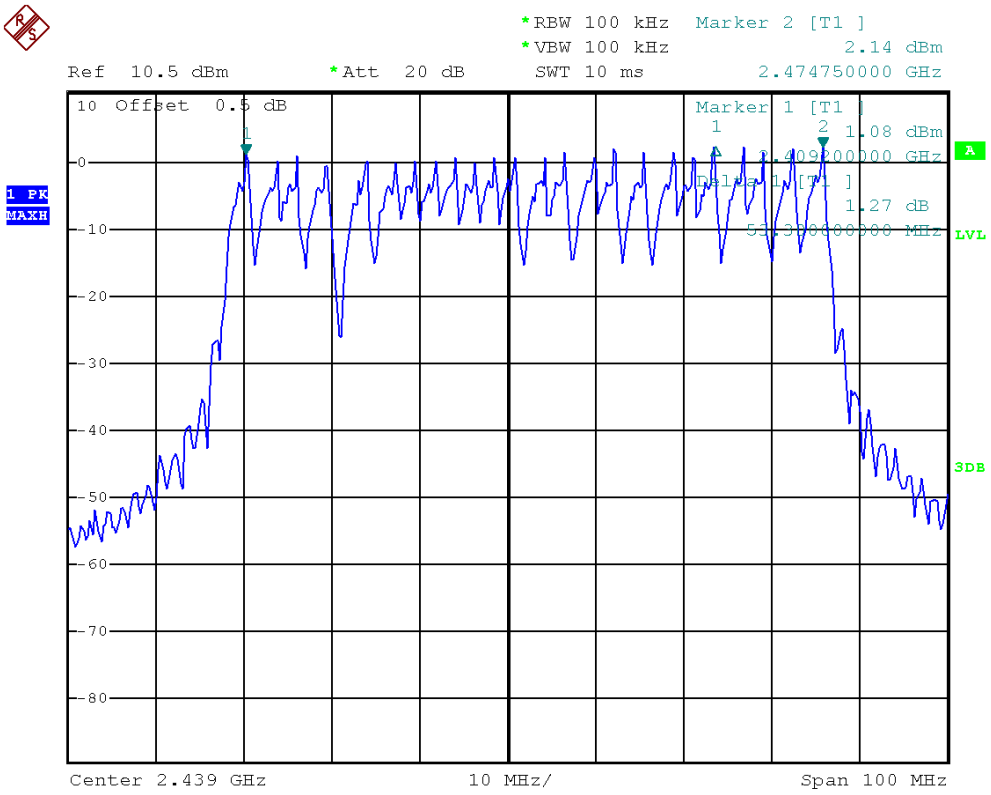
9.7 EUT OPERATING CONDITIONS

The EUT tested system was configured as the statements of 4.6 Unless otherwise a special operating condition is specified in the follows during the testing.

9.8 TEST RESULTS

E.U.T	2.4GHz GFSK Transceiver module	Model Name	K71216P
Temperature	26°C	Relative Humidity	60%
Test Voltage	AC 120V/60Hz (System)		
Test Mode	3 Mbps		

Number of Hopping Channel	Limit	Result
24	15	Pass



10 AVERAGE TIME OF OCCUPANCY

10.1LIMIT

Test Item	Frequency Range (MHz)	Limit
Average time of occupancy	2400-2483.5	shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

10.2MEASUREMENT INSTRUMENTS LIST

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	FSP-40	100129	Oct. 01, 2013

NOTE: **N/A**: denotes No Model Name, No Serial No. or No Calibration specified.

10.3TEST PROCEDURES

a. The transmitter output (antenna port) was connected to the spectrum analyzer
b. Set RBW of spectrum analyzer to 100 kHz and VBW to 100 kHz.
c. Use a video trigger with the trigger level set to enable triggering only on full pulses.
d. Sweep Time is more than once pulse time.
e. Set the center frequency on any frequency would be measure and set the frequency span to zero span.
f. Measure the maximum time duration of one single pulse.

10.4TEST SETUP LAYOUT

10.5DEVIATION FROM TEST STANDARD

No deviation

10.6 EUT OPERATING CONDITIONS

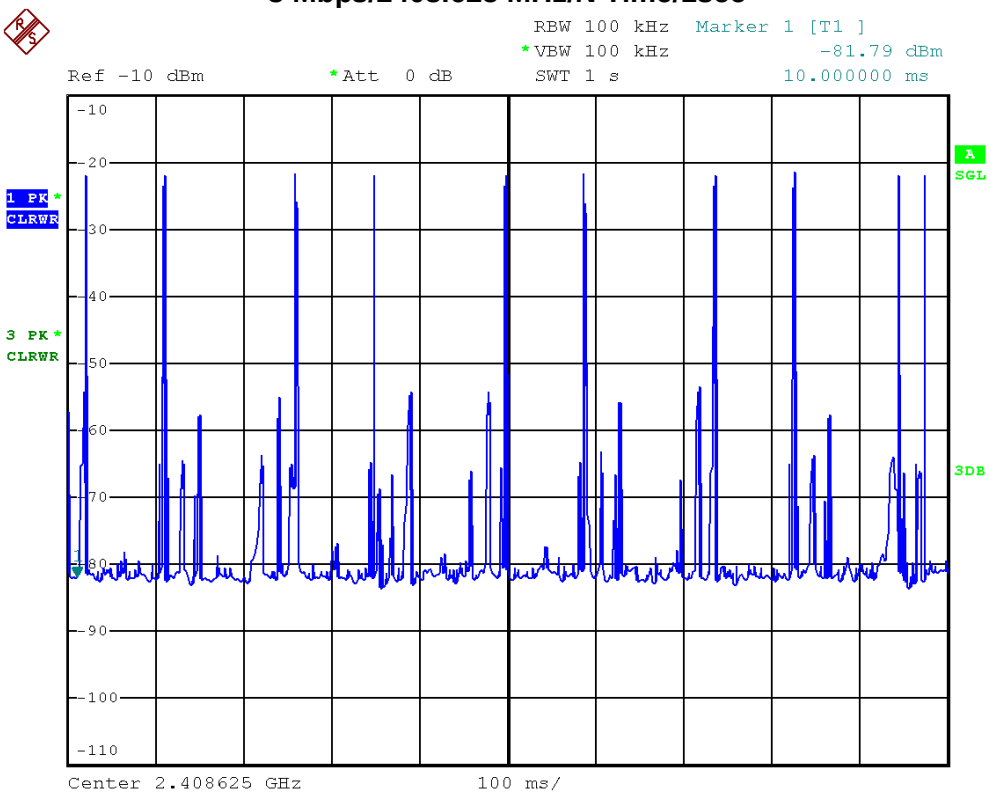
The EUT tested system was configured as the statements of 4.6 Unless otherwise a special operating condition is specified in the follows during the testing.

10.7TEST RESULTS

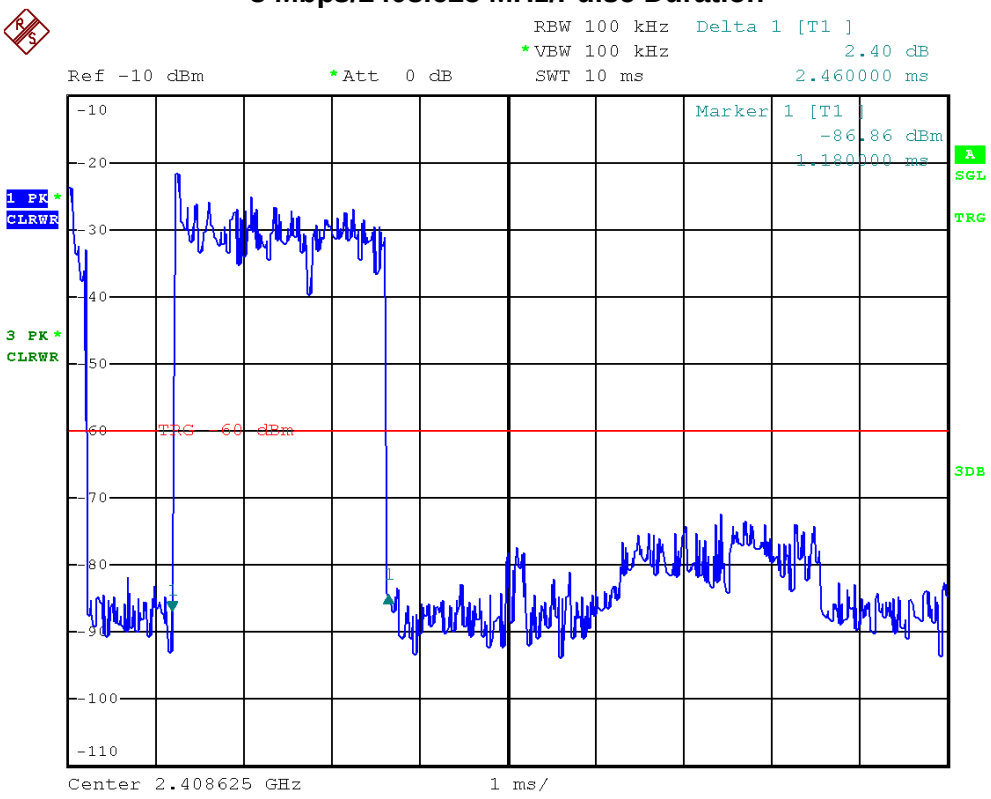
E.U.T	2.4GHz GFSK Transceiver module	Model Name	K71216P
Temperature	26°C	Relative Humidity	46%
Test Voltage	AC 120V/60Hz (System)		
Test Mode	3 Mbps/2408.625 MHz, 2439.000 MHz, 2473.875 MHz		

Frequency	N Time/1sec	Pulse Duration (ms)	Dwell Time (s)	Limit (s)	Result
2408.625 MHz	10	2.460	0.2362	0.4	PASS
2439.000 MHz	8	2.460	0.1889	0.4	PASS
2473.875 MHz	8	2.500	0.1920	0.4	PASS

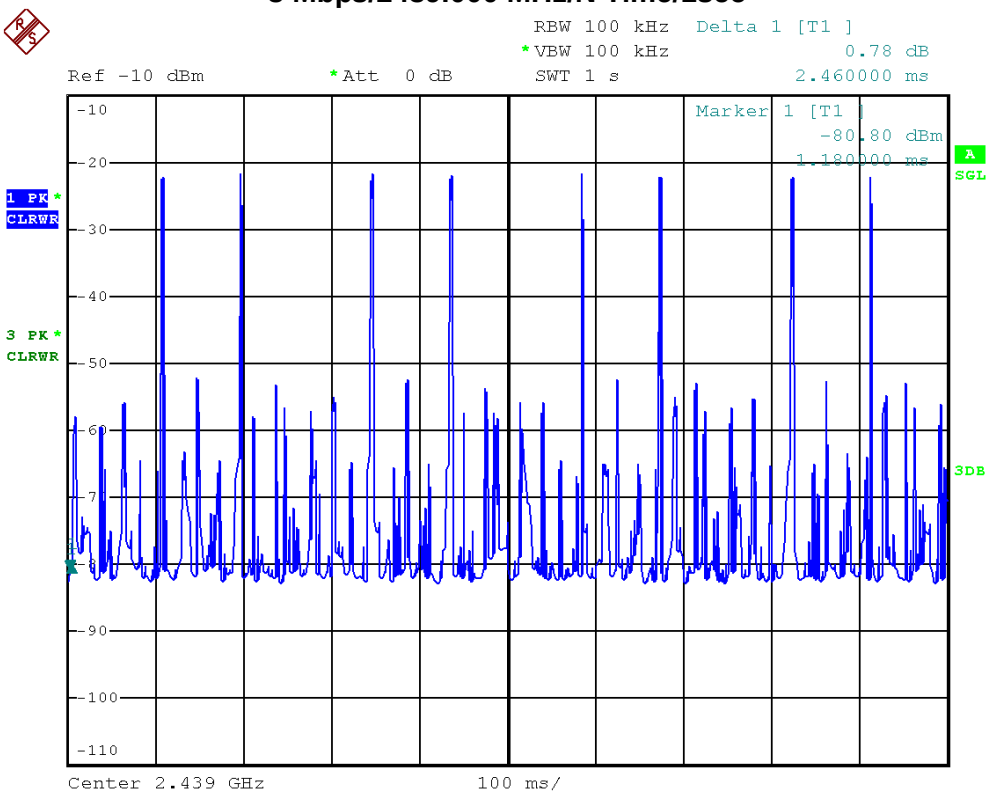
3 Mbps/2408.625 MHz/N Time/1sec



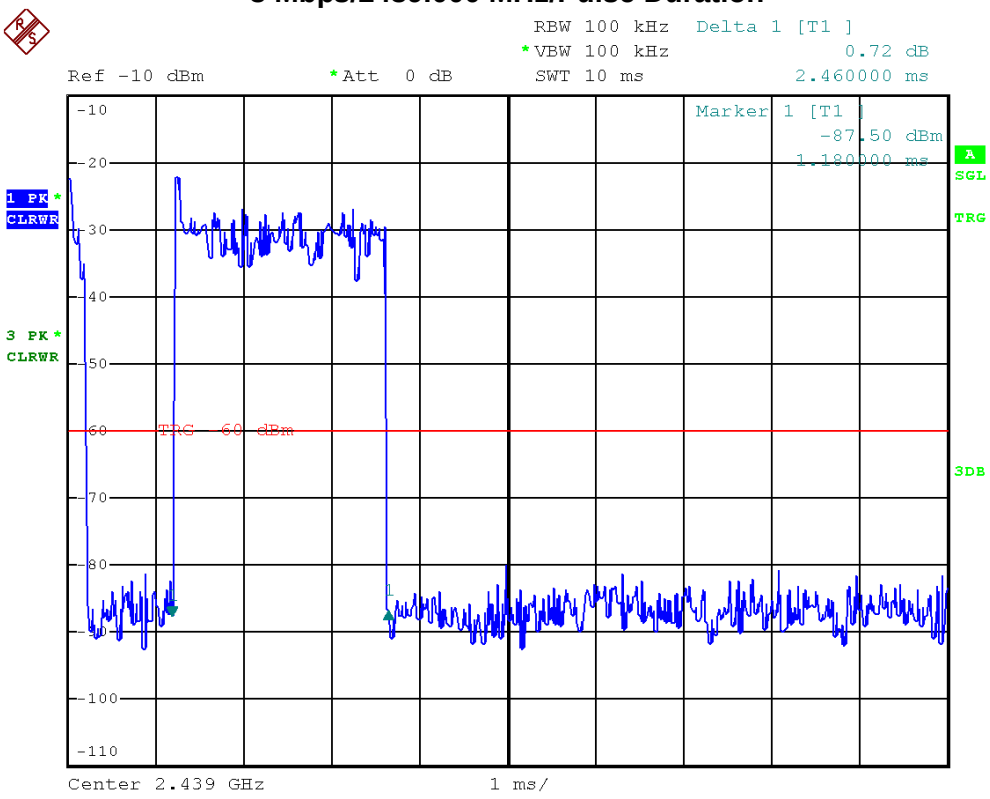
3 Mbps/2408.625 MHz/Pulse Duration



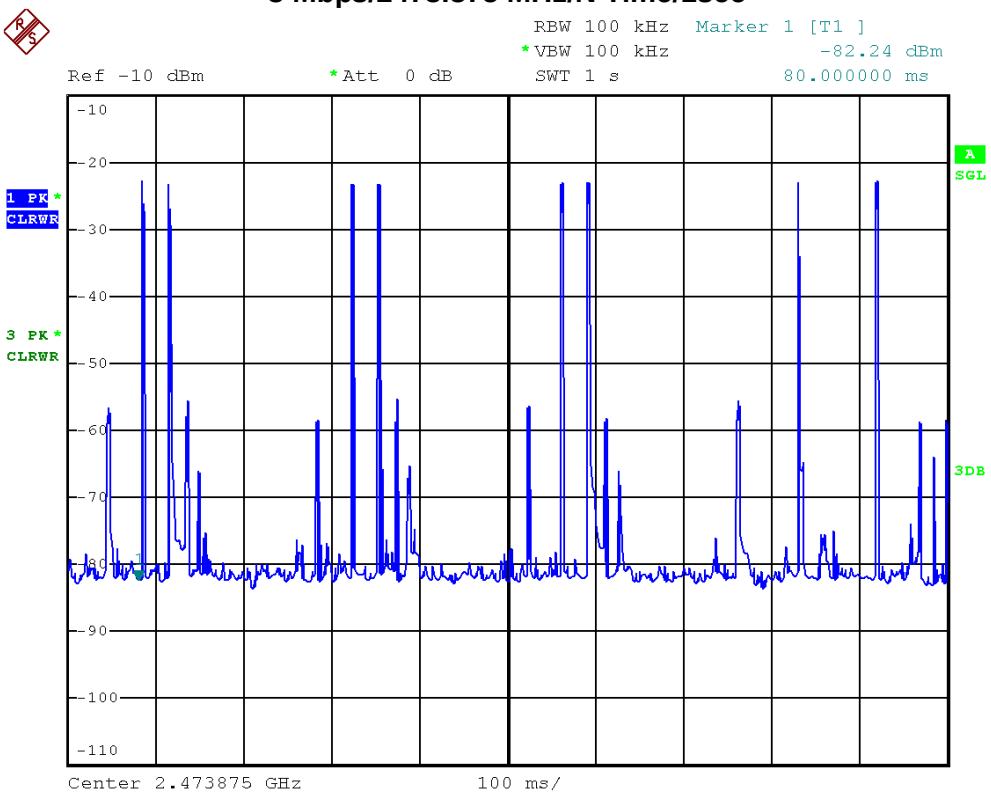
3 Mbps/2439.000 MHz/N Time/1sec



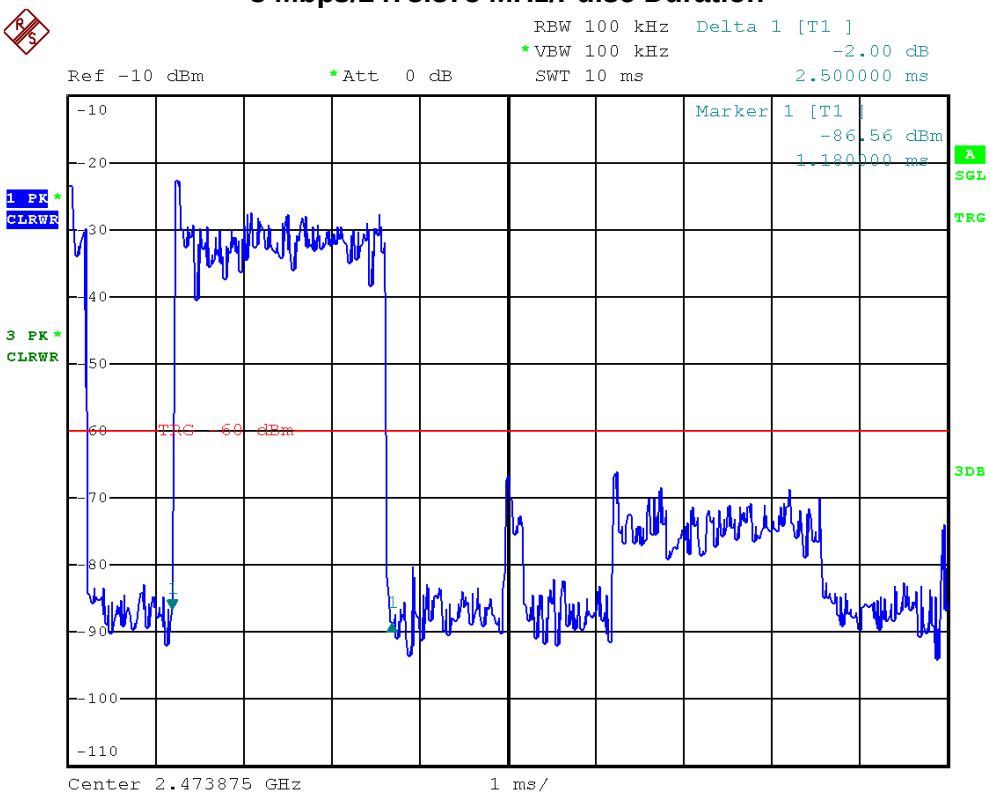
3 Mbps/2439.000 MHz/Pulse Duration



3 Mbps/2473.875 MHz/N Time/1sec



3 Mbps/2473.875 MHz/Pulse Duration



11 RF EXPOSURE COMPLIANCE

11.1 LIMIT

Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess limit for maximum permissible exposure. In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as a mobile device whereby a distance of 0.2 m normally can be maintained between the user and the device.

(A) Limits for Occupational / Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm^2)	Averaging Time $\|E\|^2$,$\|H\|^2$or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842 / f	4.89 / f	(900 / f)*	6
30-300	61.4	0.163	1.0	6
300-1500			F/300	6
1500-100,000			5	6

(B) Limits for General Population / Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm^2)	Averaging Time $\|E\|^2$,$\|H\|^2$ or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f)*	30
30-300	27.5	0.073	0.2	30
300-1500			F/1500	30
1500-100,000			1.0	30

NOTE: f = frequency in MHz ; *Plane-wave equivalent power density.

11.2 MEASUREMENT INSTRUMENTS LIST

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Power Meter	Anritsu	ML2487A	6K00004714	Feb. 26, 2014
2	Power Meter Sensor	Anritsu	MA2491A	34138	Feb. 26, 2014

NOTE: **N/A**: denotes No Model Name, No Serial No. or No Calibration specified.

11.3 MPE CALCULATION METHOD

E (V/m) $= \frac{\sqrt{30 \times P \times G}}{d}$ Power Density: *Pd* (W/m²) $= \frac{E^2}{377}$

E = Electric field (V/m)

P = Peak RF output power (W)

G = EUT Antenna numeric gain (numeric)

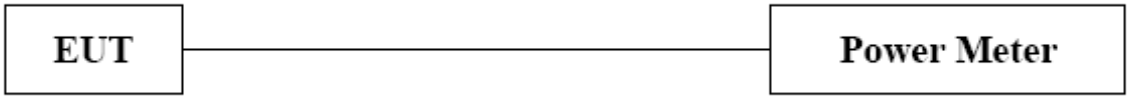
d = Separation distance between radiator and human body (m)

The formula can be changed to

Pd $= \frac{30 \times P \times G}{377 \times d^2}$

From the peak EUT RF output power, the minimum mobile separation distance, d=0.2m, as well as the gain of the used antenna, the RF power density can be obtained

11.4TEST SETUP LAYOUT



11.5DEVIATION FROM TEST STANDARD

No deviation

11.6EUT OPERATING CONDITIONS

The EUT tested system was configured as the statements of 4.6 Unless otherwise a special operating condition is specified in the follows during the testing.

11.7TEST RESULTS

The power is so low so there is no need for RF calculations.