EMC
TEST REPORT

Report No.: TS12080133-EME
Model No.: VK-5000
Issued Date: Nov. 15, 2012

Applicant:	**Vencer Co., Ltd** **20F-1 No.77, Sec.1, Hsin Tai Wu Rd., His-Chih Taipei Hsien, Taiwan**
Test Method/ Standard:	**FCC Part 15 Subpart C Section §15.205、§15.207、§15.209、§15.247, KDB558074 and ANSI C63.4/2003.**
Test By:	**Intertek Testing Services Taiwan Ltd.** **No. 11, Lane 275, Ko-Nan 1 Street, Chia-Tung Li, Shiang-Shan District, Hsinchu City, Taiwan**

Testing Laboratory
0597

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Hugo Yeh/ Engineer

The test report was reviewed by: Jimmy Yang

Name Jimmy Yang
Title Engineer

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Summary of Tests

Test	Reference	Results
Maximum 6 dB Bandwidth	15.247 (a)(2)	Pass
Power Spectral Density	15.247(e)	Pass
Maximum Output Power test	15.247(b)	Pass
RF Antenna Conducted Spurious test	15.247(d)	Pass
Radiated Spurious Emission test	15.205, 15.209	Pass
Duty Cycle Correction Factor test	15.247(a)(1)	Pass
Emission on the Band Edge test	15.247(d)	Pass
AC Power Line Conducted Emission test	15.207	N/A

1. General information

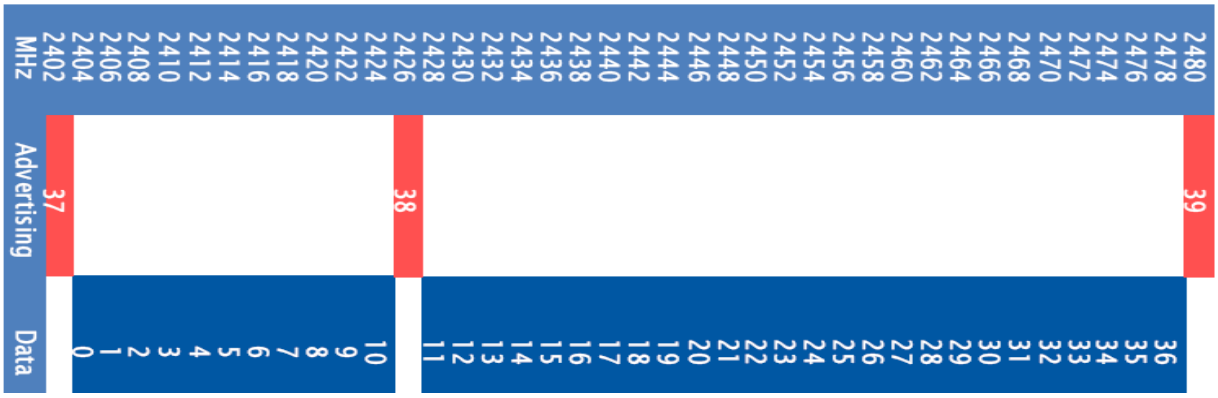
1.1 Identification of the EUT

Product:	Buletooth Low Energy V4.0 Tag
Model No.:	VK-5000
FCC ID.:	VHVBTVK5000
Frequency Range:	2402 MHz ~ 2480 MHz
Channel Number:	40 channels
Frequency of Each Channel:	Ch0~ch10: 2404 MHz ~2424MHz ; Ch11~ch36: 2428 MHz ~2478MHz ; Ch37~ch39 :2402MHz/ 2426MHz/2480MHz
Channel Bandwidth:	2MHz
Type of Modulation:	GFSK
Rated Power:	DC 3 V
Power Cord:	N/A
Sample Received:	Aug. 27, 2012
Test Date(s):	Sep. 10, 2012 ~ Nov. 1, 2012
Note 1:	This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to permit copying or distribution of this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.
Note 2:	When determining the test conclusion, the Measurement Uncertainty of test has been considered.

1.2 Additional information about the EUT

The EUT is a Buletooth Low Energy V4.0 Tag, and was defined as information technology equipment.

Frequency & Channel List



For more detail features, please refer to User's manual as file name “Installation guide.pdf”

1.3 Antenna description

The EUT uses a permanently connected antenna.

Antenna Gain	: -2 dBi max
Antenna Type	: PCB printed antenna
Connector Type	: Fixed

2. Test specifications

2.1 Test standard

The EUT was performed according to the procedures in FCC Part 15 Subpart C Section § 15.205、§15.207、§15.209、§15.247, KDB558074 and ANSI C63.4/2003.

The test of radiated measurements according to FCC Part15 Section 15.33(a) had been conducted and the field strength of this frequency band were all meet limit requirement, thus we evaluate the EUT pass the specified test.

2.2 Operation mode

The EUT was supplied with DC 3 V from Coin cell and the transmission mode was running in control “CSR uEnergy Tools1_3.exe” program.

2.3 Test equipment

Equipment	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
EMI Test Receiver	Rohde & Schwarz	ESCI	100018	2011/12/6	2012/12/4
Spectrum Analyzer	Rohde&schwarz	FSP30	100137	2012/06/25	2013/6/25
Spectrum Analyzer	Rohde&schwarz	FSEK30	100186	2012/2/6	2013/2/5
Horn Antenna (1-18G)	Schwarzbeck	BBHA 9120 D	9120D-456	2010/08/31	2012/08/30
				2012/9/3	2014/9/3
Horn Antenna (14-42G)	SHWARZBECK	BBHA 9170	BBHA9170159	2010/09/03	2012/09/02
				2012/9/5	2014/9/5
Broadband Antenna	SCHWARZBECK	VULB 9168	9168-172	2011/7/26	2013/7/25
Pre-Amplifier	MITEQ	AFS44-00102650--42-10P-44	1495287	2011/10/27	2013/10/26
Pre-Amplifier	MITEQ	JS4-26004000--27-8A	828825	2010/09/08	2012/09/08
				2012/9/8	2014/9/7
Power Meter	Anritsu	ML2495A	0844001	2011/10/13	2012/10/12
				2012/10/9	2013/10/9
Power Senor	Anritsu	MA2411B	0738452	2011/10/13	2012/10/12
				2012/10/9	2013/10/9
WiMAX PSA Spectrum Analyzer	Agilent	E4440A	MY46186191	2012/6/1	2013/6/1

Note: The above equipments are within the valid calibration period.

3. Maximum 6 dB Bandwidth

3.1 Operating environment

Temperature:	23	℃
Relative Humidity:	50	%
Atmospheric Pressure:	1008	hPa

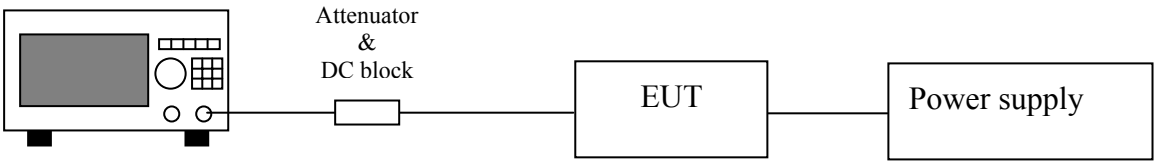
3.2 Test setup & procedure

Method of Measurement:

Reference FCC document: KDB558074

A portion of the transmitted signal is coupled to a Spectrum Analyzer with a resolution bandwidth of 1~5 % of the bandwidth of the transmitted signal. The resolution bandwidth is chosen so as not to reduce the peak level of the measured waveform. The appropriate bandwidth mask is applied to the output waveform to verify compliance.

Test Diagram:



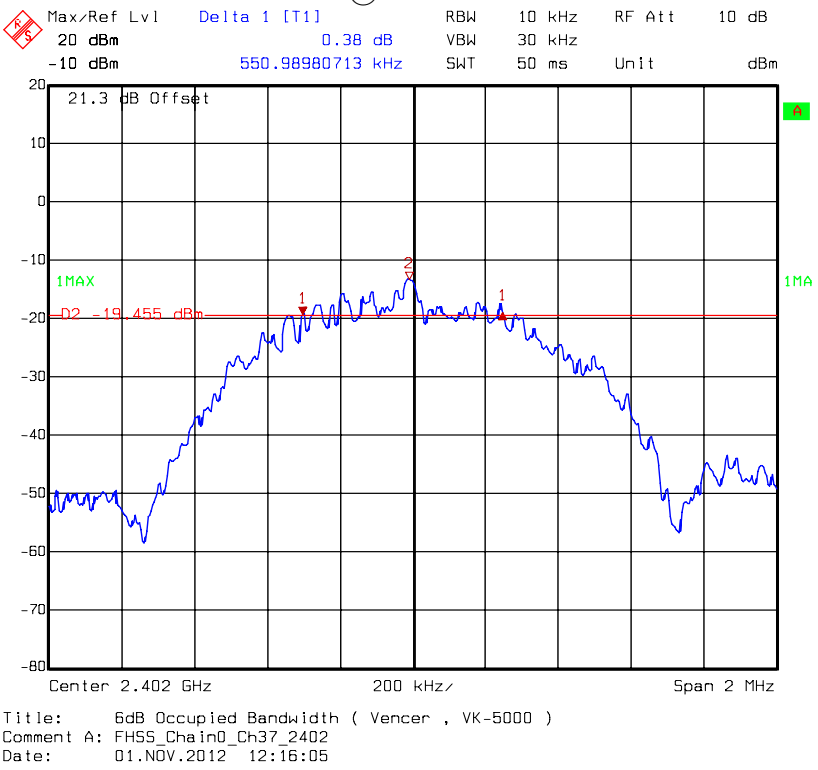
Spectrum Analyzer

Note: The EUT was tested while in a continuous transmit mode and the data rates are 1 Mbps for GFSK. The EUT was tuned to a low, middle and high channel.

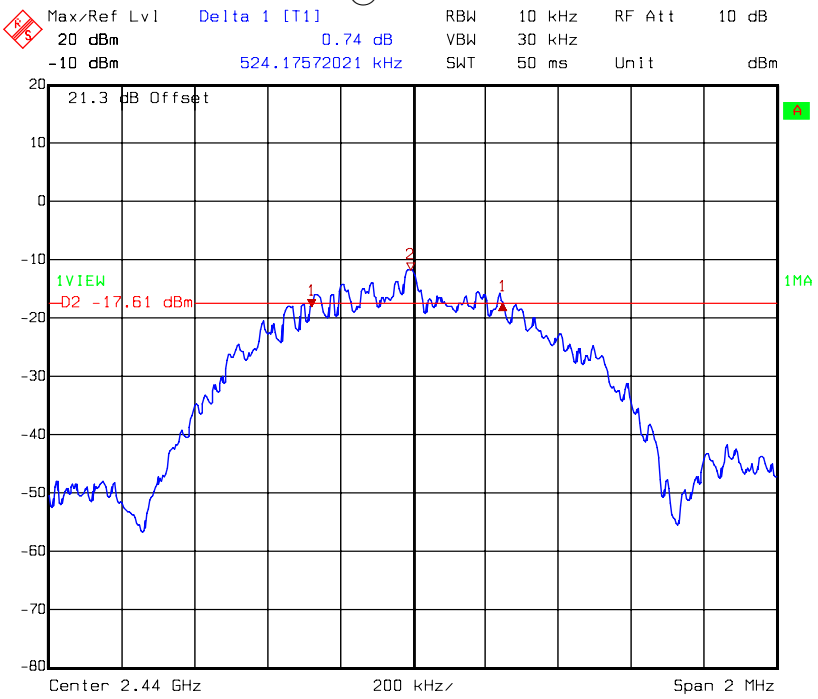
3.3 Measured data of Maximum 6 dB Bandwidth test results

Mode	Channel	Frequency (MHz)	Bandwidth (MHz)	Min. Limit (MHz)	Pass/Fail
GFSK	37	2402	0.551	0.5	Pass
	17	2440	0.524	0.5	Pass
	39	2480	0.594	0.5	Pass

6 dB Bandwidth @ GFSK mode channel 37

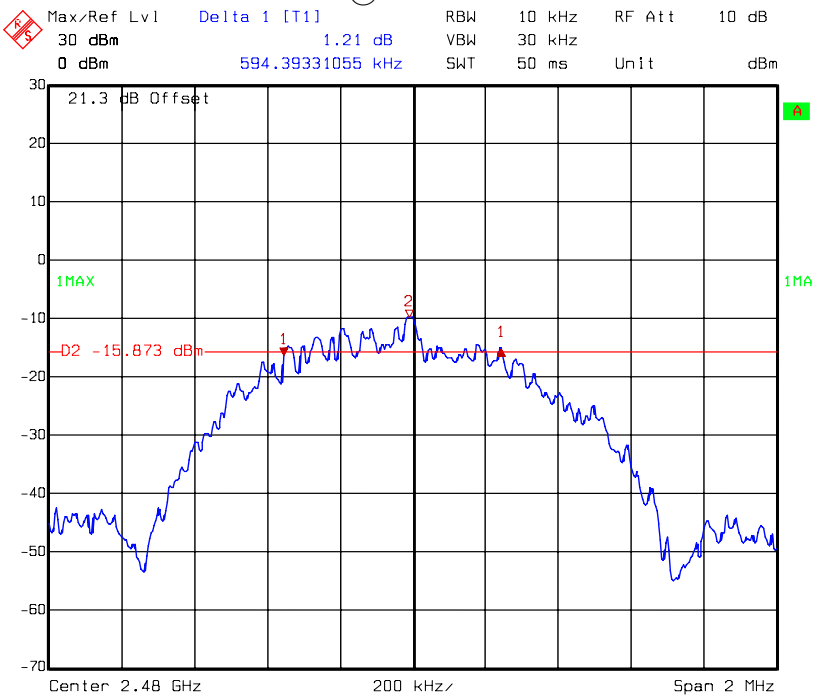


6 dB Bandwidth @ GFSK mode channel 17



Title: 6dB Occupied Bandwidth (Vencer , VK-5000)
Comment A: FHSS_Chain0_Ch17_2440
Date: 01.NOV.2012 12:07:42

6 dB Bandwidth @ GFSK mode channel 39



Title: 6dB Occupied Bandwidth (Vencer , VK-5000)
Comment A: FHSS_Chain0_Ch39_2480
Date: 01.NOV.2012 12:24:21

4. Power Spectral Density

4.1 Operating environment

Temperature:	23	℃
Relative Humidity:	50	%
Atmospheric Pressure:	1008	hPa

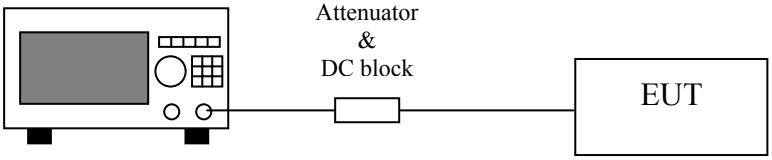
4.2 Test setup & procedure

Method of Measurement:

Reference FCC document: KDB558074

The power spectrum density was measured from the antenna port of the EUT using a 50 ohm spectrum analyzer. Locate and zoom in on emission peak(s) within the passband. Set RBW ≥ 3 kHz, VBW ≥ 3×RBW, sweep time = auto couple. The peak level measured must be no greater than + 8 dBm. Power spectrum density was read directly and cable loss (1 dB)/external attenuator (20 dB) correction was added to the reading to obtain power at the EUT antenna terminals.

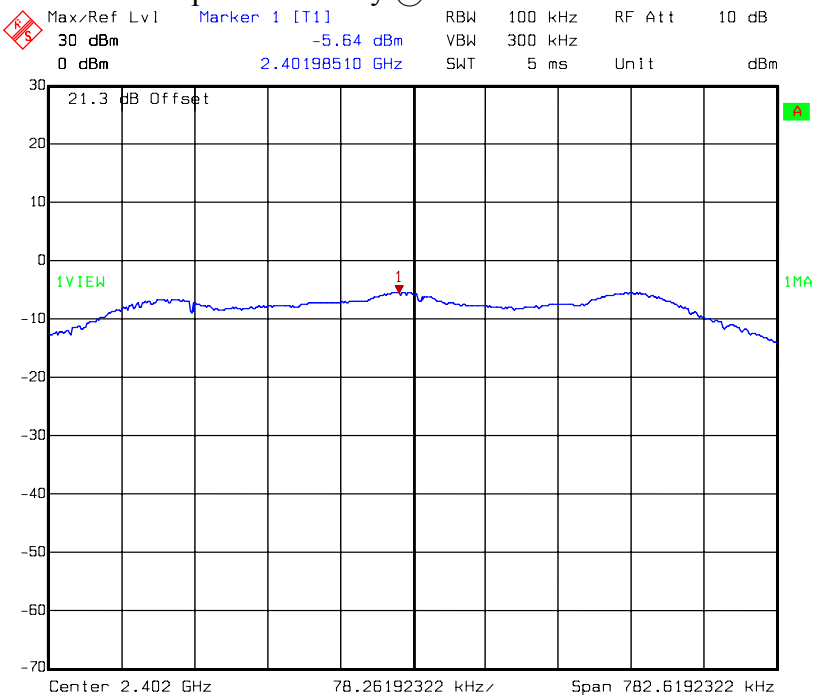
Test Diagram:



4.3 Measured data of Power Spectral Density test results

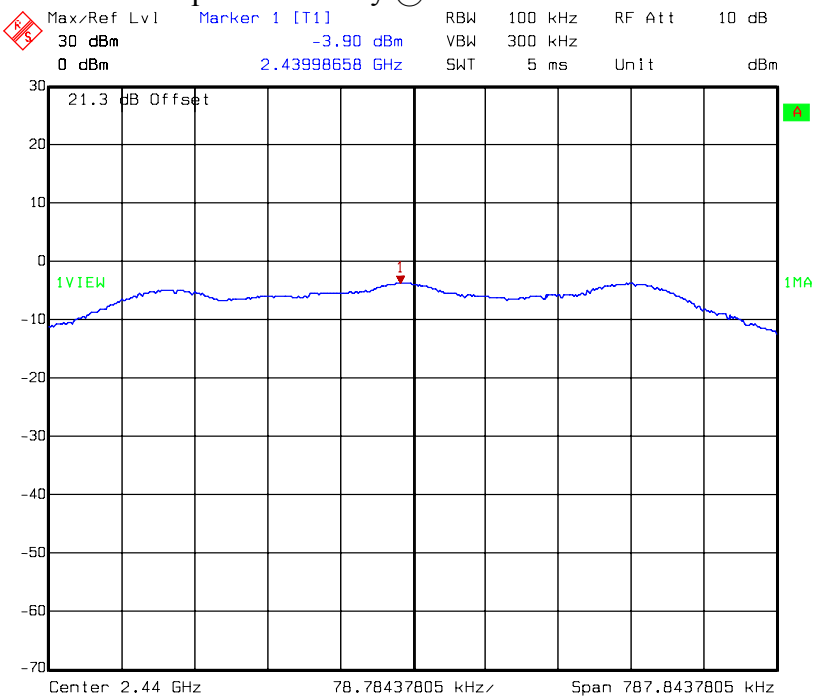
Mode	Channel	Frequency (MHz)	Power spectrum density (dBm)	Limit (dBm)
GFSK	37	2402	-5.64	8
	17	2440	-3.9	8
	39	2480	-2.08	8

Power Spectral Density @ GFSK mode channel 37



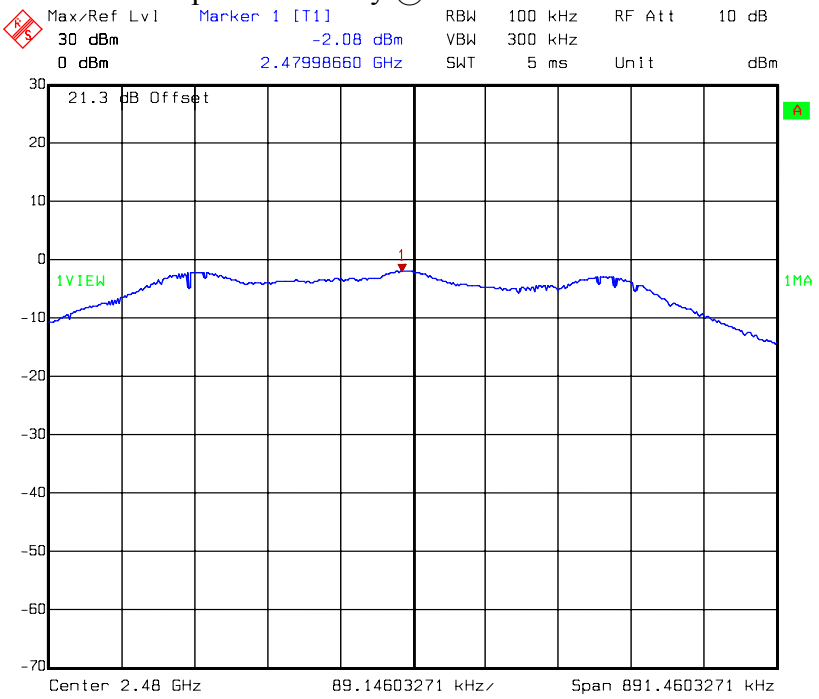
Title: Power Density (Vencer , VK-5000)
Comment A: FHSS_Chain0_Ch37_2402
Date: 01.NOV.2012 11:50:38

Power Spectral Density @ GFSK mode channel 17



Title: Power Density (Vencer , VK-5000)
Comment A: FHSS_Chain0_Ch17_2440
Date: 01.NOV.2012 11:57:43

Power Spectral Density @ GFSK mode channel 39



Title: Power Density (Vencer , VK-5000)
Comment A: FHSS_Chain0_Ch39_2480
Date: 01.NOV.2012 12:22:28

5. Maximum Output Power test

5.1 Operating environment

Temperature:	23	℃
Relative Humidity:	50	%
Atmospheric Pressure:	1008	hPa

5.2 Test setup & procedure

The test procedure was according to FCC measurement guidelines KDB558074.
The power output per FCC §15.247(b) was measured on the EUT using a 50 ohm SMA cable connected to peak power meter via power sensor. Power was read directly and cable loss correction (1 dB) was added to the reading to obtain power at the EUT antenna terminals. The test was performed at 3 channels (lowest, middle and highest channel).

5.3 Measured data of Maximum Output Power test results

Mode	Channel	Frequency (MHz)	Output Power (PK) (dBm)	Total Power (PK) (mW)	Limit (dBm)	Margin (dB)
GFSK	37	2402	-4.64	0.34	30	-34.64
	17	2440	-2.87	0.52	30	-32.87
	39	2480	-1.03	0.79	30	-31.03

6. RF Antenna Conducted Spurious test

6.1 Operating environment

Temperature:	24	℃
Relative Humidity:	55	%

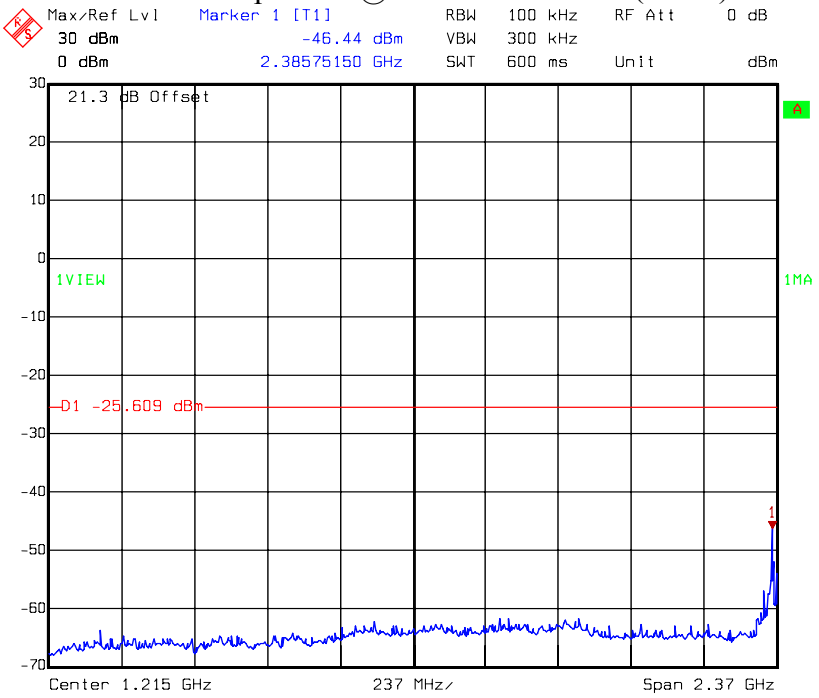
6.2 Test setup & procedure

The test procedure was according to FCC measurement guidelines KDB558074.
The measurements were performed from lowest generated frequency to 10th fundamental frequency RF antenna conducted per FCC 15.247 (c) was measured from the EUT antenna port using a 50ohm spectrum analyzer with the resolution bandwidth set at 100 kHz, and the video bandwidth set at 300 kHz.
Harmonics and spurious noise must be at least 20dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW. The table below is the results from the highest emission for each channel within the authorized band. This table was used to determine the spurious limits for each channel.

6.3 Measured data of the highest RF Antenna Conducted Spurious test result

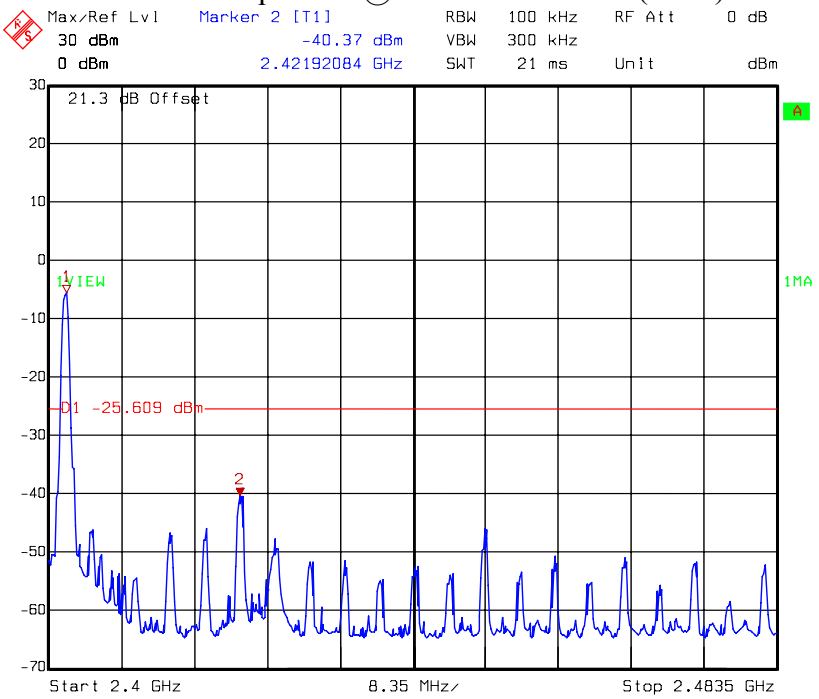
The test results please see the plot below.

Conducted spurious @ GFSK channel 37 (1 of 3)



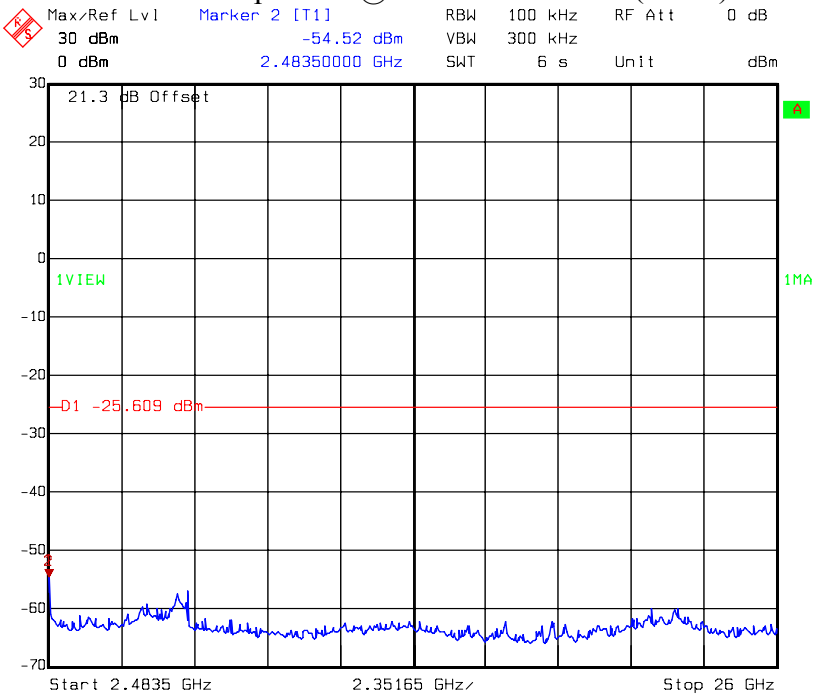
Title: Conducted Spurious (Vencer , VK-5000)
Comment A: FHSS_Chain0_Ch37_2402
Date: 01.NOV.2012 11:49:46

Conducted spurious @ GFSK channel 37 (2of 3)



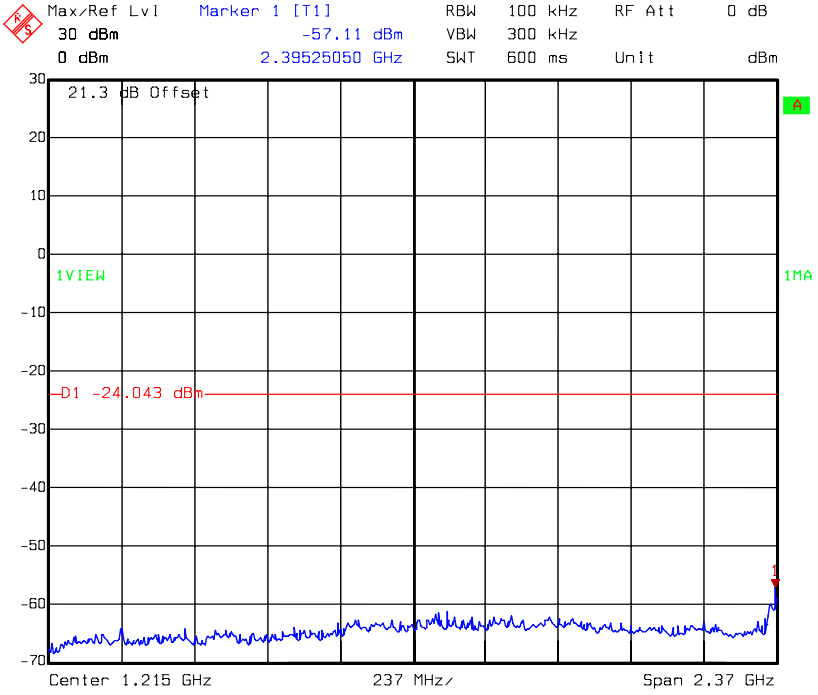
Title: Conducted Spurious (Vencer , VK-5000)
Comment A: FHSS_Chain0_Ch37_2402
Date: 01.NOV.2012 11:50:00

Conducted spurious @ GFSK channel 37 (3 of 3)



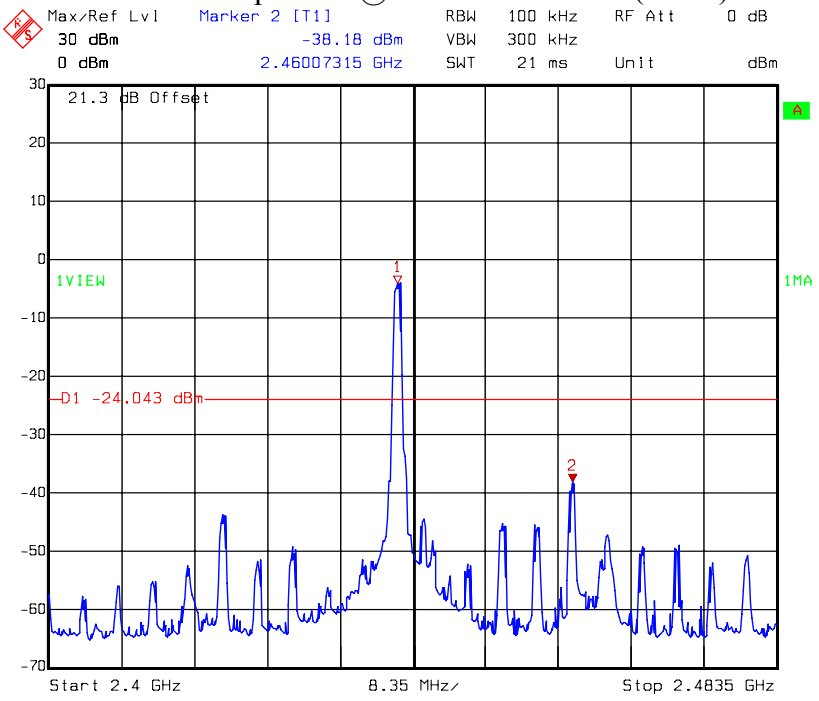
Title: Conducted Spurious (Vencer , VK-5000)
Comment A: FHSS_Chain0_Ch37_2402
Date: 01.NOV.2012 11:50:27

Conducted spurious @ GFSK channel 17 (1 of 3)



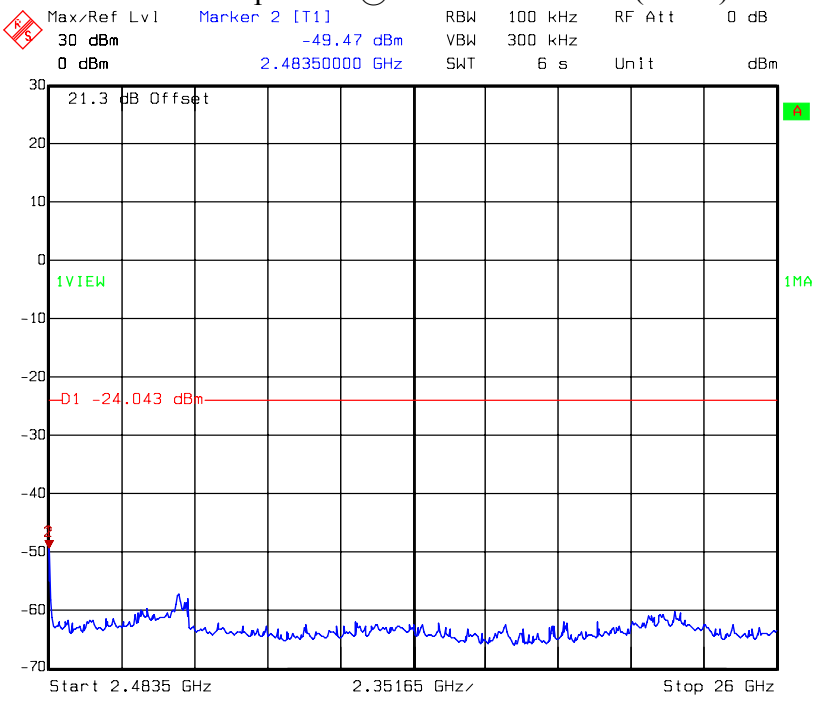
Title: Conducted Spurious (Vencer , VK-5000)
Comment A: FHSS_Chain0_Ch17_2440
Date: 01.NOV.2012 11:56:52

Conducted spurious @ GFSK channel 17 (2 of 3)



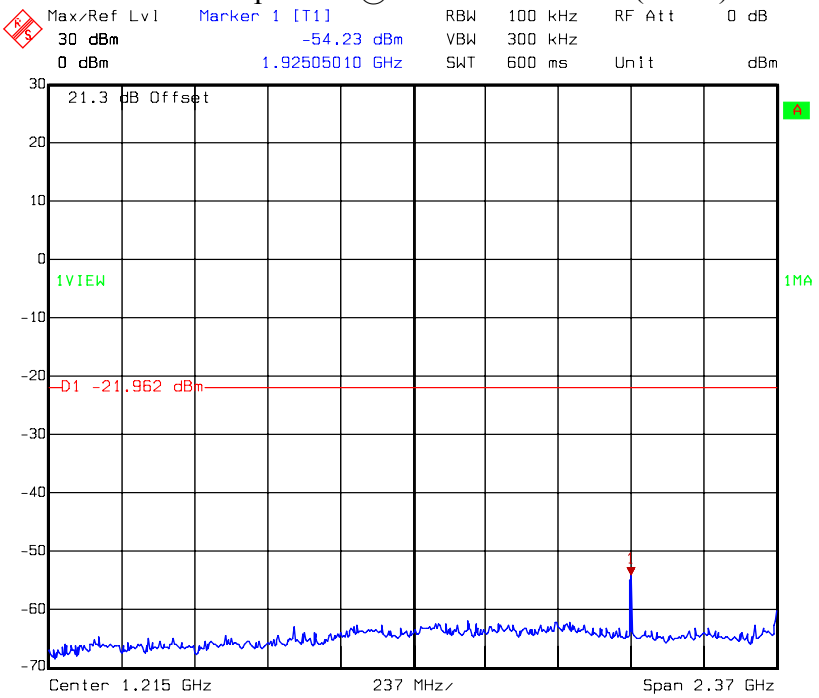
Title: Conducted Spurious (Vencer , VK-5000)
Comment A: FHSS_Chain0_Ch17_2440
Date: 01.NOV.2012 11:57:06

Conducted spurious @ GFSK channel 17 (3 of 3)



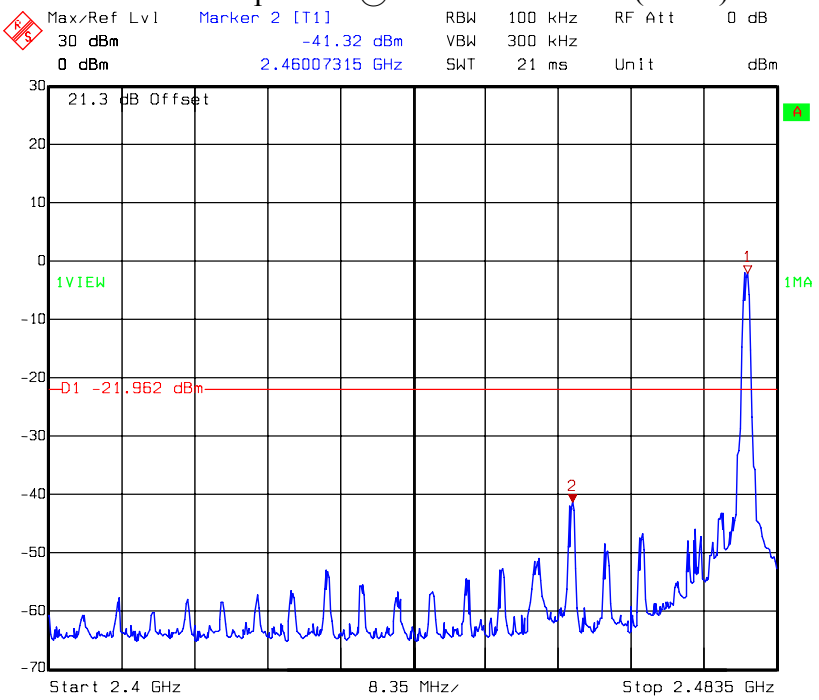
Title: Conducted Spurious (Vencer , VK-5000)
Comment A: FHSS_Chain0_Ch17_2440
Date: 01.NOV.2012 11:57:32

Conducted spurious @ GFSK channel 39 (1 of 3)



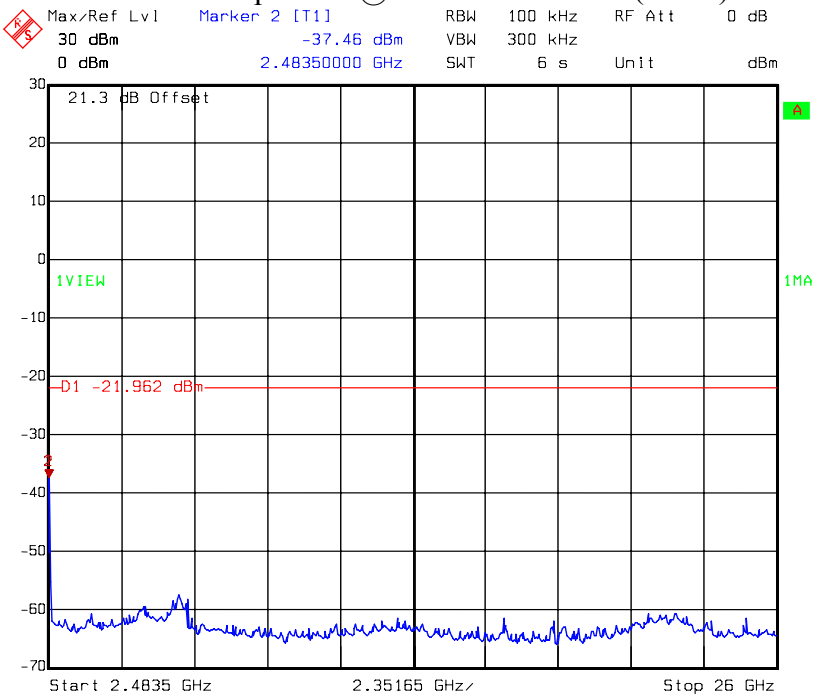
Title: Conducted Spurious (Vencer , VK-5000)
Comment A: FHSS_Chain0_Ch39_2480
Date: 01.NOV.2012 12:21:36

Conducted spurious @ GFSK channel 39 (2 of 3)



Title: Conducted Spurious (Vencer , VK-5000)
Comment A: FHSS_Chain0_Ch39_2480
Date: 01.NOV.2012 12:21:50

Conducted spurious @ GFSK channel 17 (3 of 3)



Title: Conducted Spurious (Vencer , VK-5000)
Comment A: FHSS_Chain0_Ch39_2480
Date: 01.NOV.2012 12:22:16

7. Radiated Emission test

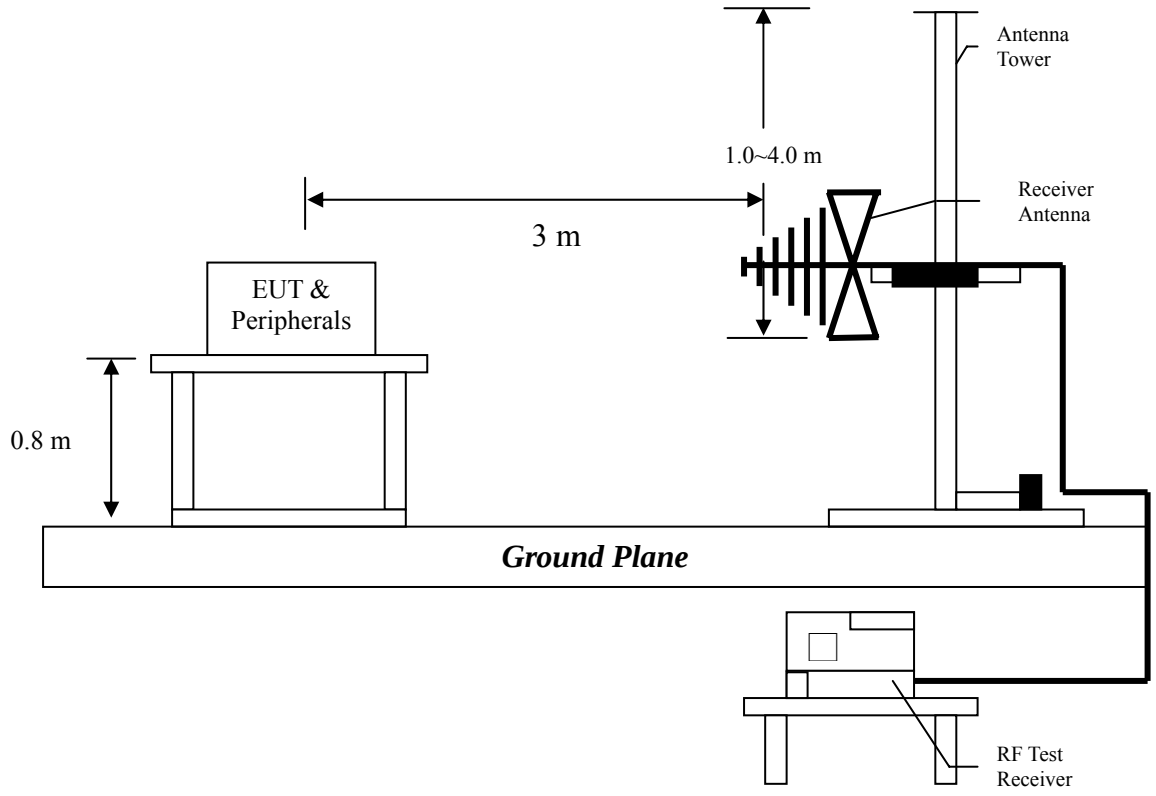
7.1 Operating environment

Temperature:	22	℃
Relative Humidity:	52	%
Atmospheric Pressure:	1008	hPa

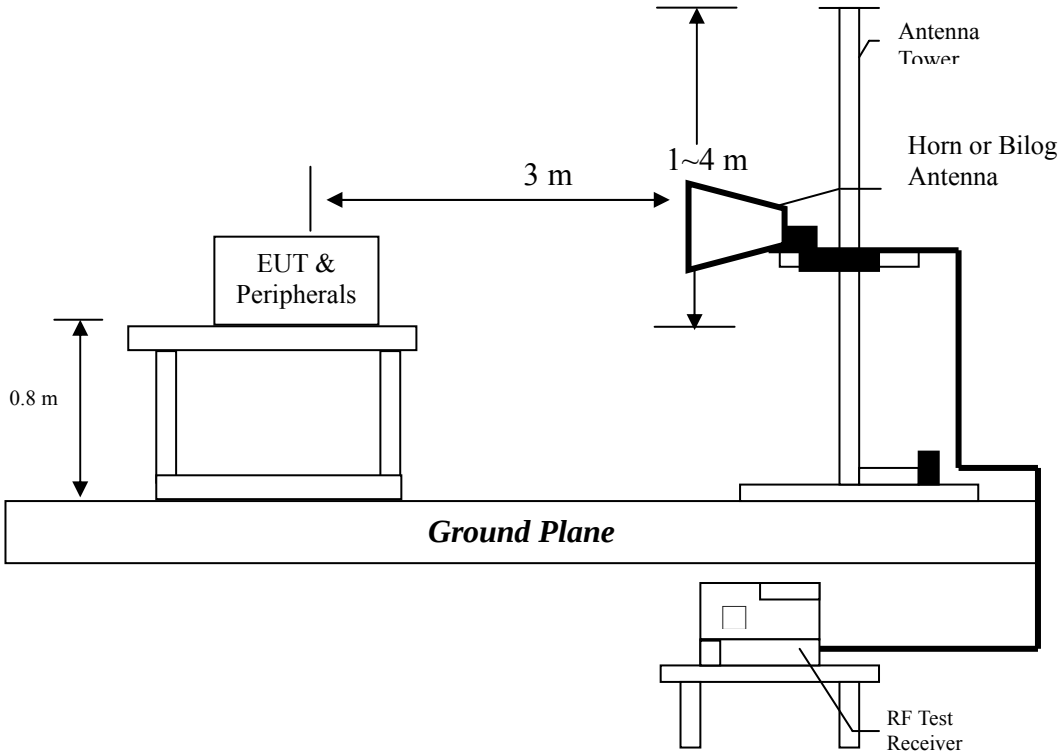
7.2 Test setup & procedure

The test procedure was according to FCC measurement guidelines KDB558074 and ANSI C63.4/2003.
The Diagram below shows the test setup, which is utilized to make these measurements.

The frequency spectrum from 30MHz to 1000MHz was investigated.



The frequency spectrum above 1GHz was investigated.

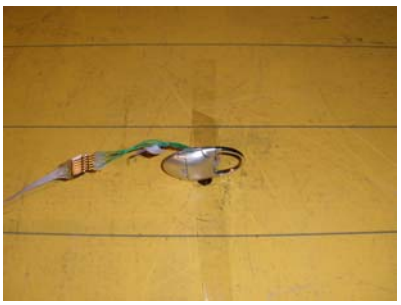


The signal is maximized through rotation and placement in the three orthogonal axes.
Radiated emission measurements were performed from lowest generated frequency to 10th fundamental frequency. Spectrum Analyzer Resolution Bandwidth is 100kHz or greater for frequencies 30MHz to 1GHz, 1MHz – for frequencies above 1GHz.
The EUT for testing is arranged on a wooden turntable. If some peripherals apply to the EUT, the peripherals will be connected to EUT and the whole system. During the test, all cables were arranged to produce worst-case emissions. The signal is maximized through rotation. The height of antenna and polarization is changing constantly for exploring for maximum signal level. The height of antenna can be up to 4 meters and down to 1 meter.

The measurement for radiated emission will be done at the distance of three meters unless the signal level is too low to measure at that distance. In the case of the reading under noise floor, a pre-amplifier is used and/or the test is conducted at a closer distance. And then all readings are extrapolated back to the equivalent 3 meter reading using inverse scaling with distance.

The signal is maximized through rotation and placement in the three orthogonal axes.

x plane



y plane

z plane

After verifying three axes, we found the maximum electromagnetic field was occurred at z-plane configuration. The final test data was executed under this configuration.

The EUT configuration, please refer to the "Spurious set-up photo.pdf".

7.3 Emission limits

The spurious Emission shall test through the 10th harmonic. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

Frequency (MHz)	Limits (dB μ V/m@3m)
30-88	40
88-216	43.5
216-960	46
Above 960	54

Remark:
1. In the above table, the tighter limit applies at the band edges.
2. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system

Measurement uncertainty was calculated in accordance with TR 100 028-1.

Parameter	Uncertainty
Radiated Emission	±5.056 dB

7.4 Radiated spurious emission test data

7.4.1 Measurement results: frequencies equal to or less than 1 GHz

The test was performed on EUT under continuously transmitting mode. Channel 17, 37, 39 were verified. The worst case occurred at Tx channel 39.

EUT : VK-5000
Test Condition : TX at channel 39

Antenna Polarization	Freq. (MHz)	Receiver Detector	Corr. Factor (dB/m)	Reading (dBuV)	Corrected Level (dBuV/m)	Limit @ 3 m (dBuV/m)	Margin (dB)
Vertical	31.94	QP	12.60	22.32	34.91	40.00	-5.09
Vertical	156.10	QP	15.83	20.90	36.73	43.50	-6.77
Vertical	181.32	QP	13.10	21.08	34.17	43.50	-9.33
Vertical	191.02	QP	12.00	22.83	34.83	43.50	-8.67
Vertical	466.50	QP	17.68	19.86	37.54	46.00	-8.46
Vertical	617.82	QP	20.75	18.38	39.13	46.00	-6.87
Horizontal	140.58	QP	13.24	26.40	39.63	43.50	-3.87
Horizontal	202.66	QP	10.78	25.89	36.66	43.50	-6.84
Horizontal	220.12	QP	11.63	26.10	37.72	46.00	-8.28
Horizontal	249.22	QP	12.36	31.28	43.64	46.00	-2.36
Horizontal	264.74	QP	12.88	24.83	37.71	46.00	-8.29
Horizontal	272.50	QP	13.21	23.26	36.46	46.00	-9.54

Remark:

1. Corr. Factor = Antenna Factor + Cable Loss
2. Corrected Level = Reading + Corr. Factor

7.4.2 Measurement results: frequency above 1GHz

EUT : VK-5000
Test Condition : GFSK at channel 37

Frequency (MHz)	Spectrum Analyzer Detector	Ant. Pol. (H/V)	Preamp. Gain (dB)	Correction Factor (dB/m)	Reading (dBuV)	Corrected Reading (dBuV/m)	Limit @ 3 m (dBuV/m)	Margin (dB)
4804.00	PK	V	35.1	38.54	41.59	45.03	54	-8.97
4804.00	PK	H	35.1	38.54	40.08	43.52	54	-10.48

Remark:
1. Corr. Factor = Antenna Factor + Cable Loss
2. Corrected Level = Reading + Corr. Factor + Duty Cycle Correction Factor
3. The frequency measured ranges from 1GHz to 25GHz.

EUT : VK-5000
Test Condition : GFSK at channel 17

Frequency (MHz)	Spectrum Analyzer Detector	Ant. Pol. (H/V)	Preamp. Gain (dB)	Correction Factor (dB/m)	Reading (dBuV)	Corrected Reading (dBuV/m)	Limit @ 3 m (dBuV/m)	Margin (dB)
4880.00	PK	V	35.1	38.54	42.02	45.46	54	-8.54
4880.00	PK	H	35.1	38.54	40.62	44.06	54	-9.94

Remark:
1. Corr. Factor = Antenna Factor + Cable Loss
2. Corrected Level = Reading + Corr. Factor + Duty Cycle Correction Factor
3. The frequency measured ranges from 1GHz to 25GHz.

EUT : VK-5000
Test Condition : GFSK at channel 39

Frequency (MHz)	Spectrum Analyzer Detector	Ant. Pol. (H/V)	Preamp. Gain (dB)	Correction Factor (dB/m)	Reading (dBuV)	Corrected Reading (dBuV/m)	Limit @ 3 m (dBuV/m)	Margin (dB)
4960.00	PK	V	35.1	38.54	43.93	47.37	54	-6.63
4960.00	PK	H	35.1	38.54	42.37	45.81	54	-8.19

Remark:

1. Corr. Factor = Antenna Factor + Cable Loss
2. Corrected Level = Reading + Corr. Factor + Duty Cycle Correction Factor
3. The frequency measured ranges from 1GHz to 25GHz.

8. Duty Cycle Correction Factor test

8.1 Operating environment

Temperature: 23 ℃
Relative Humidity: 55 %
Atmospheric Pressure: 1023 hPa

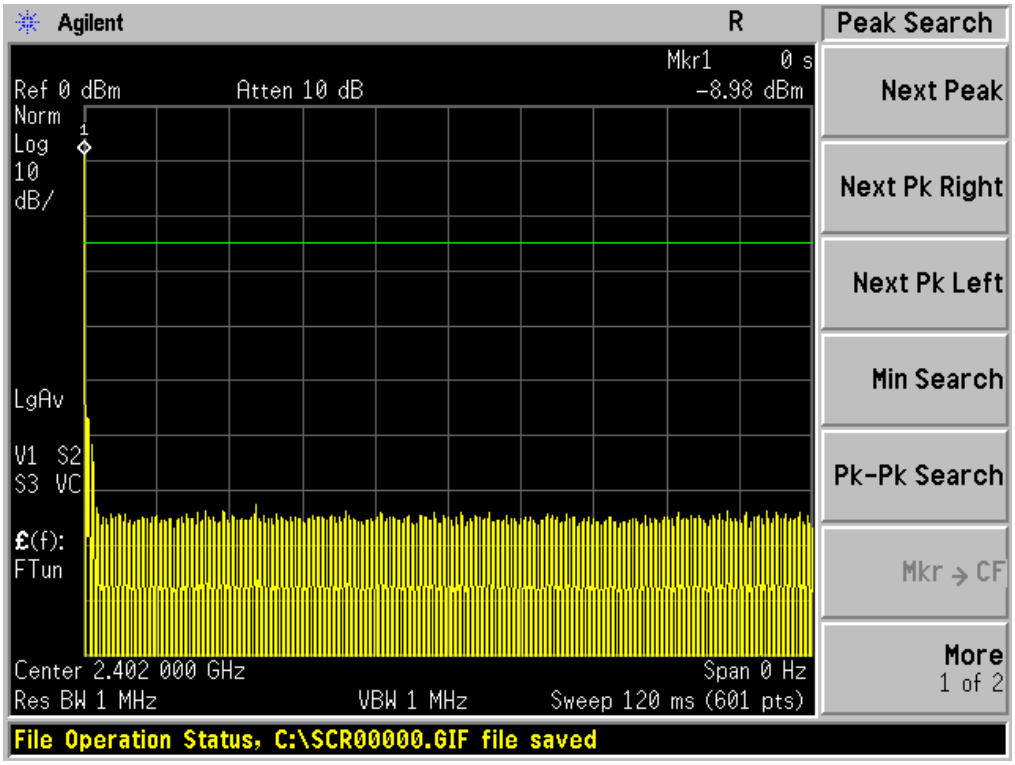
Duty Cycle Correction Factor

Channel	Frequency	Pulse time (ms)	Number of pulse during time period	Time period (ms)	Duty cycle %	Duty cycle correction factor
37	2402	0.36	1	100	0.36%	-48.8739
17	2440	0.105	1	100	0.11%	-59.5762
39	2480	0.36	1	100	0.36%	-48.8739

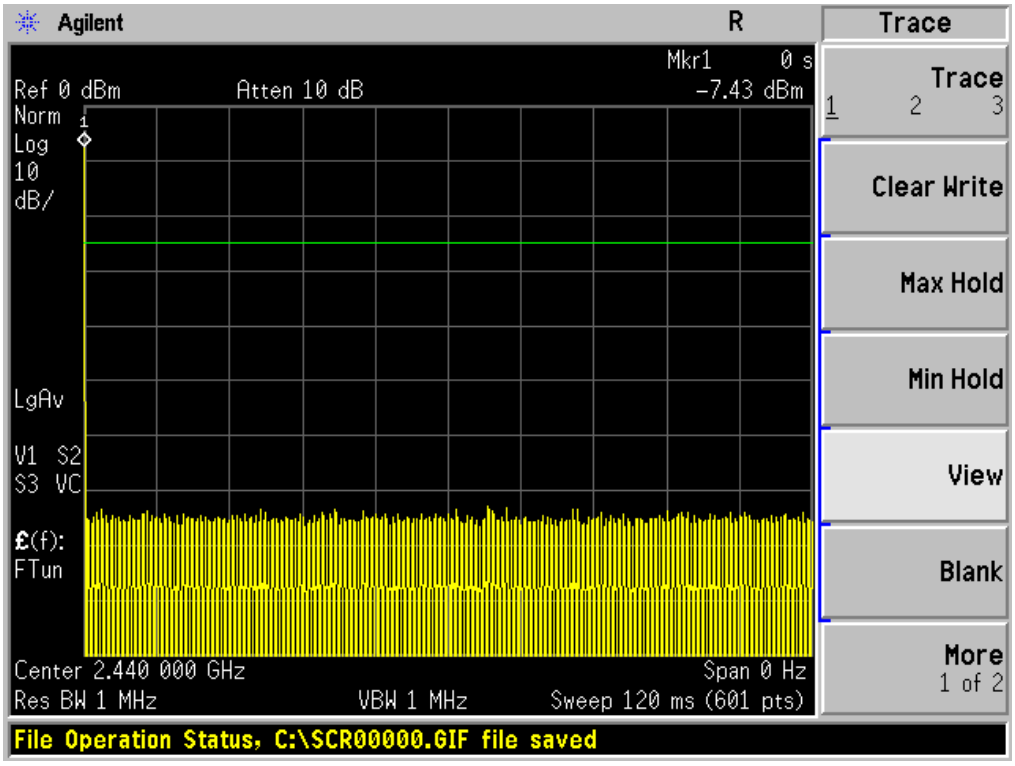
Remark:
1. Duty Cycle Correction Factor = 20 log (duty cycle/100%)
2. The worst case of GFSK mode is –48.8739

Please see the plot below.

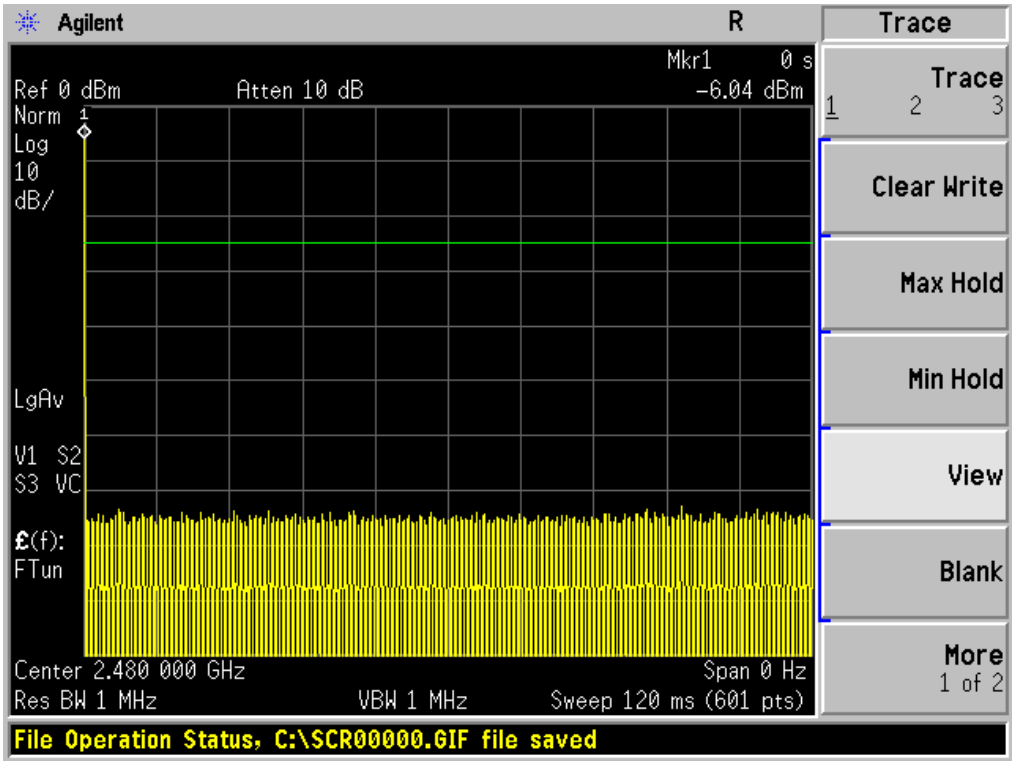
100ms @ GFSK mode Channel 37



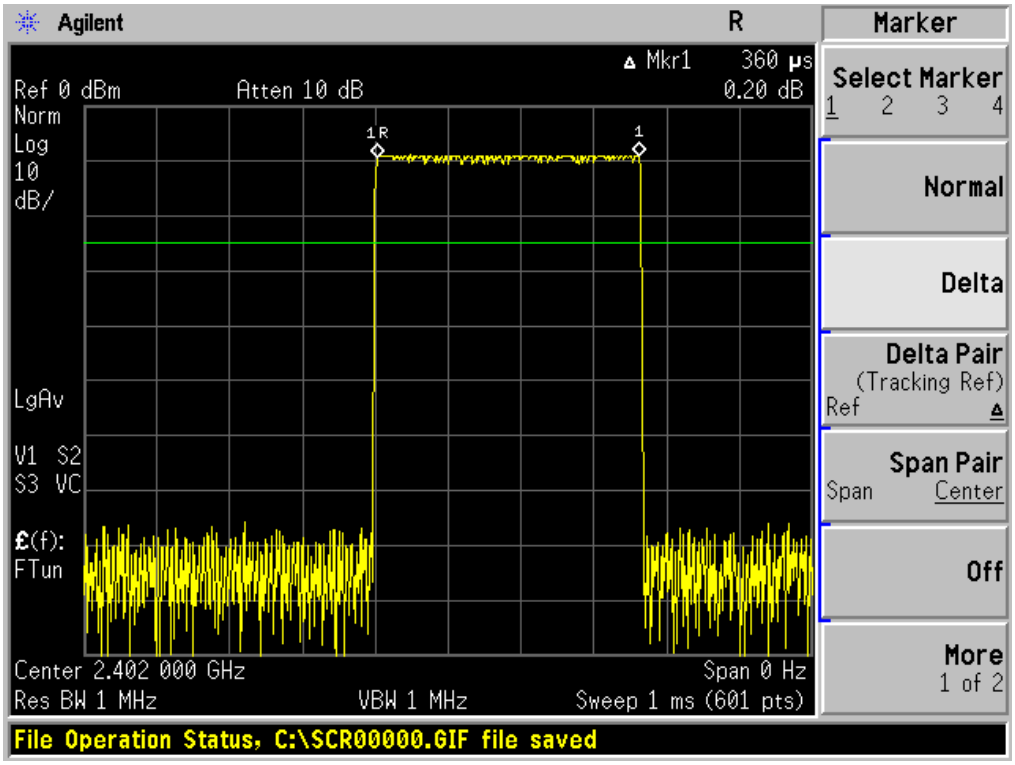
100ms @ GFSK mode Channel 17



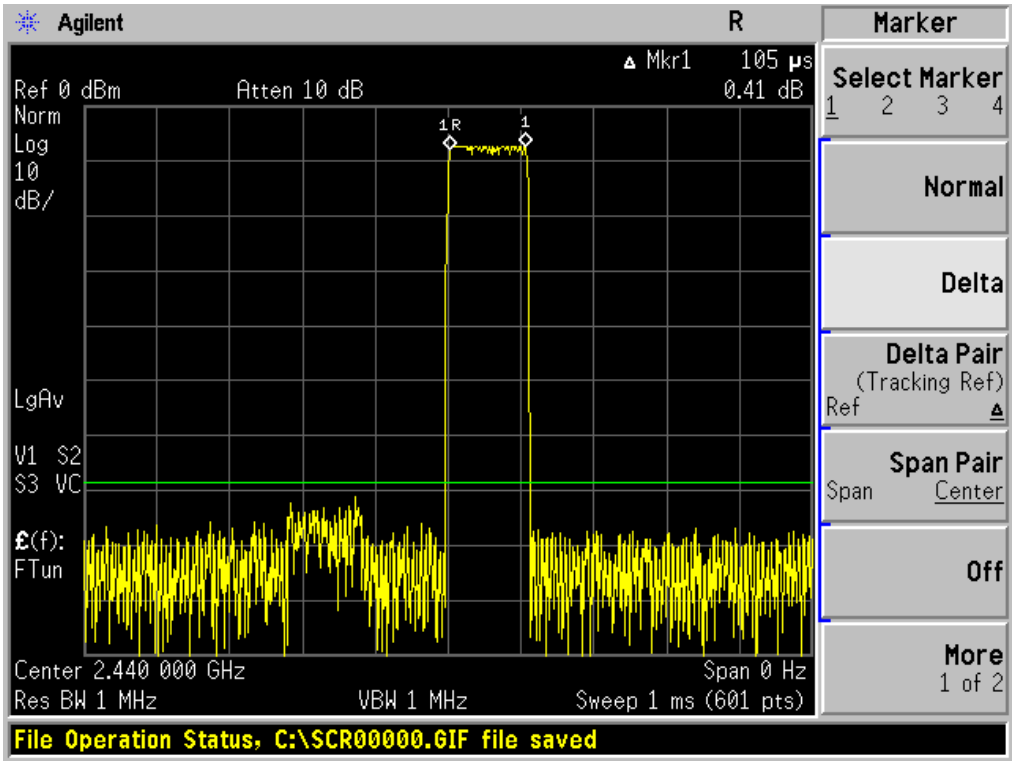
100ms @ GFSK mode Channel 39



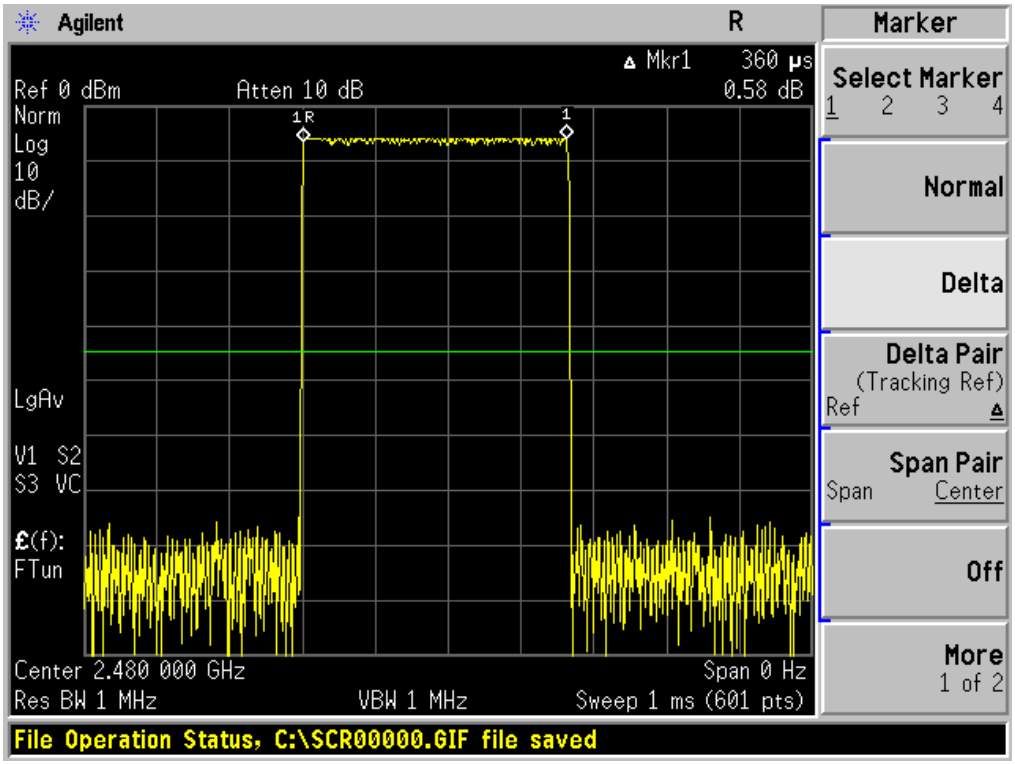
Single pulse @ GFSK mode Channel 37



Single pulse @ GFSK mode Channel 17



Single pulse @ GFSK mode Channel 39



9. Emission on the band edge §FCC 15.247(d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

9.1 Test setup & procedure

Please refer to the clause 7.2 of this report.

Please see the plot below.

9.2 Test Result

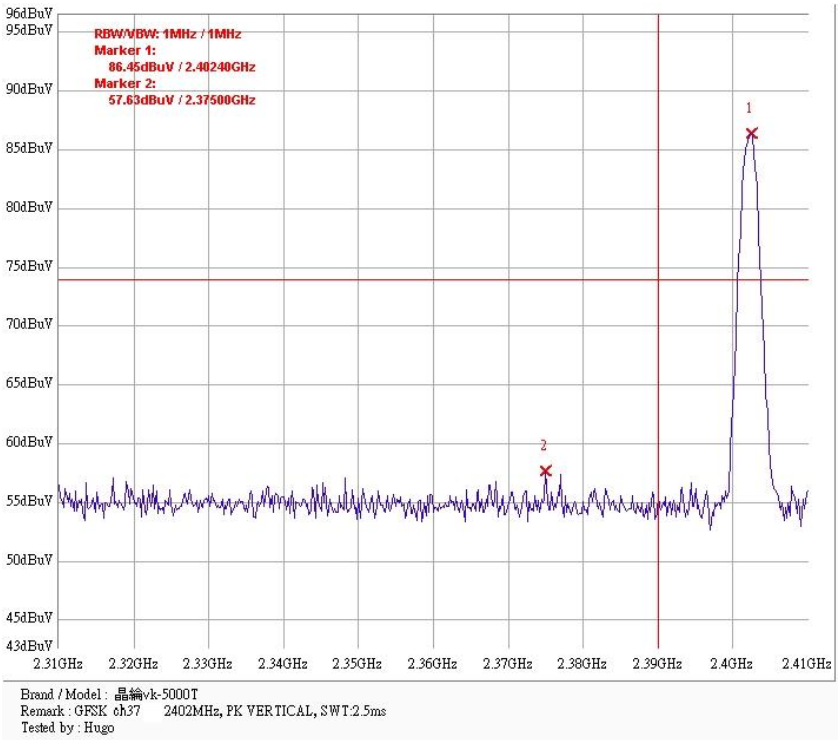
Test Mode: GFSK mode

Channel	Measurement Freq. Band (MHz)	Detector	The Max. Field Strength in Restrict Band (dBuV/m)	Limit @ 3 m (dBuV/m)	Margin (dB)
37 (lowest)	2310-2390	PK	57.63	74	-16.37
		AV	8.761	54	-45.239
39 (highest)	2483.5-2500	PK	58.66	74	-15.34
		AV	9.761	54	-44.239

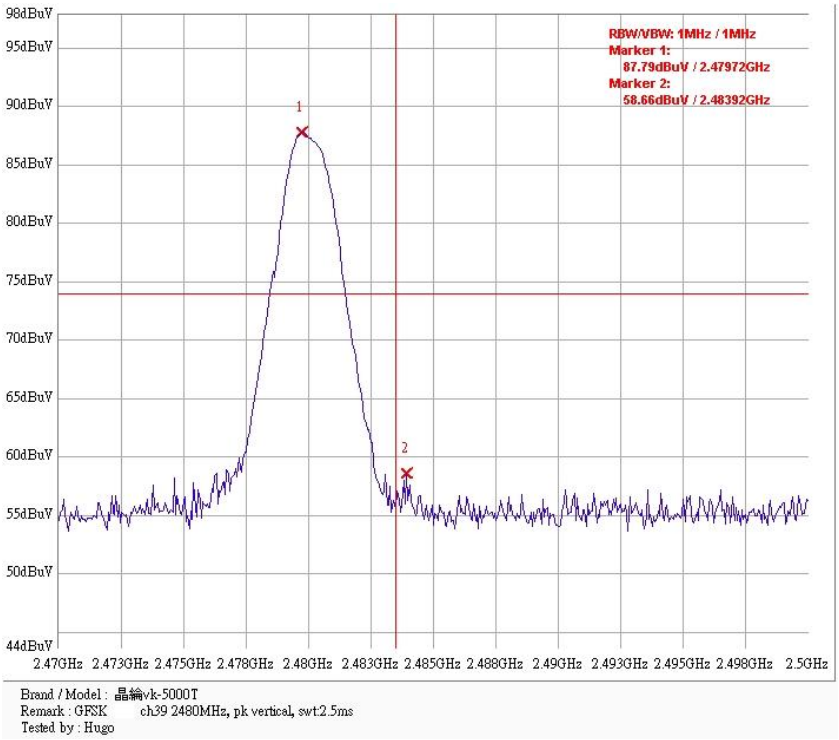
Remark: Duty Cycle Correction Factor = -48.8739 dB

9.2.1 Band edge

Band edge @ GFSK mode channel 37 PK



Band edge @ GFSK mode channel 39 PK



10. Power Line Conducted Emission test §FCC 15.207

According to FCC 15.207, the EUT only employs battery power for operation and does not operate from the AC power lines. Therefore, the test can be exempted.