

# EMC TEST REPORT

**Report No.:** TS13070085-EME**Model No.:** T647**Issued Date:** Jul. 22, 2013

**Applicant:** Kobo Inc.  
135 Liberty Street, Suite 101 Toronto, Ontario, M6K1A7  
Canada

**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

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**The test report was prepared by:**

  
Sunny Liu / Senior officer

**These measurements were taken by:**

  
Arthur Tsai / Engineer

**The test report was reviewed by:**

**Name** Jimmy Yang  
**Title** Engineer

## Table of Contents

Summary of Tests.....	4
1. General information .....	5
1.1 Identification of the EUT .....	5
1.2 Additional information about the EUT.....	6
1.3 Antenna description.....	6
1.2 Adapter information .....	6
2. Test specifications .....	7
2.1 Test standard.....	7
2.2 Operation mode .....	7
2.3 Peripherals equipment .....	7
2.3 Test equipment .....	8
3. Maximum 6 dB Bandwidth .....	9
3.1 Operating environment.....	9
3.2 Test setup & procedure.....	9
3.3 Measured data of Maximum 6 dB Bandwidth test results.....	9
4. Power Spectral Density .....	12
4.1 Operating environment.....	12
4.2 Test setup & procedure.....	12
4.3 Measured data of Power Spectral Density test results.....	12
5. Maximum Output Power test .....	15
5.1 Operating environment.....	15
5.2 Test setup & procedure.....	15
5.3 Measured data of Maximum Output Power test results .....	15
6. RF Antenna Conducted Spurious test.....	16
6.1 Operating environment.....	16
6.2 Test setup & procedure.....	16
6.3 Measured data of the highest RF Antenna Conducted Spurious test result .....	16
7. Radiated Emission test .....	22
7.1 Operating environment.....	22
7.2 Test setup & procedure.....	22
7.3 Emission limits.....	25
7.4 Radiated spurious emission test data.....	26
7.4.1 Measurement results: frequencies equal to or less than 1 GHz.....	26
7.4.2 Measurement results: frequency above 1GHz .....	27



8. Emission on the band edge §FCC 15.247(d).....	29
8.1 Test setup & procedure.....	29
8.2 Test Result .....	29
9. Power Line Conducted Emission test §FCC 15.207 .....	30
9.1 Operating environment.....	30
9.2 Test setup & procedure.....	30
9.3 Emission limit .....	30
9.5 Power Line Conducted Emission test data .....	31

### 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
Emission on the Band Edge test	15.247(d)	Pass
AC Power Line Conducted Emission test	15.207	Pass

## 1. General information

### 1.1 Identification of the EUT

Product: Tablet  
Model No.: T647  
FCC ID.: ZJLKOBOT647  
Frequency Range: 2402 MHz ~ 2480 MHz  
Channel Number: 40 channels  
Frequency of Each Channel: 2402 + 2k MHz; k = 0~39  
Channel Bandwidth: 2 MHz  
Type of Modulation: GFSK  
Rated Power: 1. DC 3.7 V from battery  
2. DC 5.35 V from adapter  
Power Cord: N/A  
Sample Received: Jul. 10, 2013  
Test Date(s): Jul. 11, 2013 ~ Jul. 18, 2013  
Note 1:

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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 Tablet(BT4.0), and was defined as information technology equipment.

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 : 1.79 dBi max  
Antenna Type : Chip antenna  
Connector Type : N/A

## 1.2 Adapter information

The EUT will be supplied with a power supply from below list:

No.	Brand	Model no.	Specification
Adapter	Kobo	PSAI10R-050Q	I/P: 100-240Vac, 50-60Hz, 0.3A O/P: 5.35 Vdc, 2.0 A

## 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 is supplied with DC 3.7 V from battery for all test items except for conducted emission test.

The EUT is supplied with DC 5.35 V from adapter (Test voltage: 120VAC, 60Hz) for conducted emission test.

The EUT executes test by “MS-DOS” and key-in commands provided by Wistron.

### 2.3 Peripherals equipment

Peripherals	Brand	Model No.	Serial No.	Description of Data Cable
Notebook PC	DELL	ECL089	E5420	USB shielded cable 1 meter × 1

## 2.3 Test equipment

Equipment	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
EMI Test Receiver	Rohde & Schwarz	ESCI	100018	2012/11/30	2013/11/29
Spectrum Analyzer	Rohde&schwarz	FSP30	100137	2013/06/21	2014/06/21
Spectrum Analyzer	Rohde&schwarz	FSEK30	100186	2013/01/23	2014/01/23
Horn Antenna (1-18G)	Schwarzbeck	BBHA 9120 D	9120D-456	2012/9/3	2014/9/3
Horn Antenna (14-42G)	SHWARZBECK	BBHA 9170	BBHA9170159	2012/9/5	2014/09/05
Broadband Antenna	SCHWARZBECK	VULB 9168	9168-172	2011/7/26	2013/07/25
Loop Antenna	RolfHeine	LA-285	02/10033	2012/03/20	2014/03/20
Pre-Amplifier	MITEQ	AFS44-00102650--42-10P-44	1495287	2011/10/27	2013/10/26
Pre-Amplifier	MITEQ	JS4-26004000--27-8A	828825	2012/9/8	2014/09/07
Power Meter	Anritsu	ML2495A	0844001	2012/10/9	2013/10/09
Power Sensor	Anritsu	MA2411B	0738452	2012/10/9	2013/10/09
WiMAX PSA Spectrum Analyzer	Agilent	E4440A	MY46186191	2013/06/05	2014/06/05

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



### 3. Maximum 6 dB Bandwidth

#### 3.1 Operating environment

Temperature: 23 °C  
 Relative Humidity: 50 %  
 Atmospheric Pressure: 1008 hPa

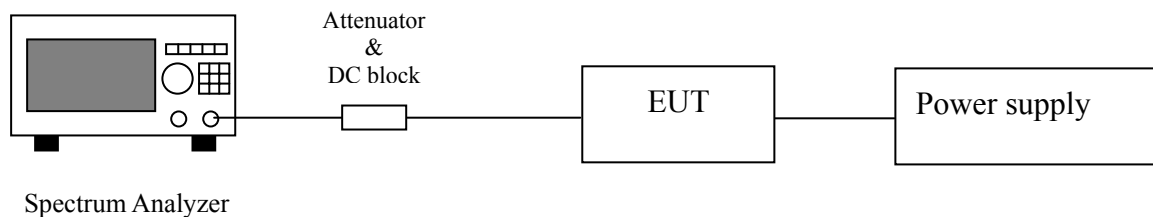
#### 3.2 Test setup & procedure

##### 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.

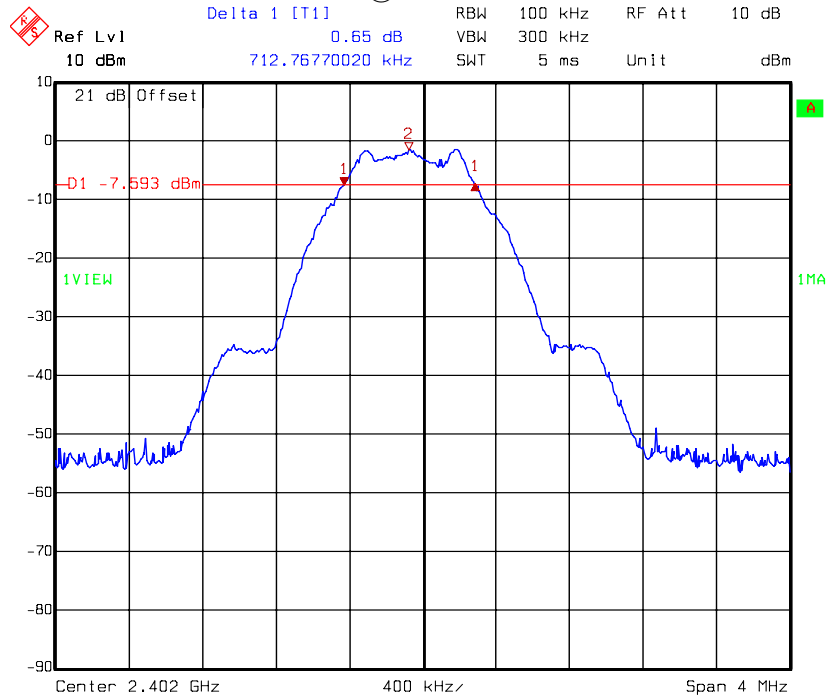
##### Test Diagram:



#### 3.3 Measured data of Maximum 6 dB Bandwidth test results

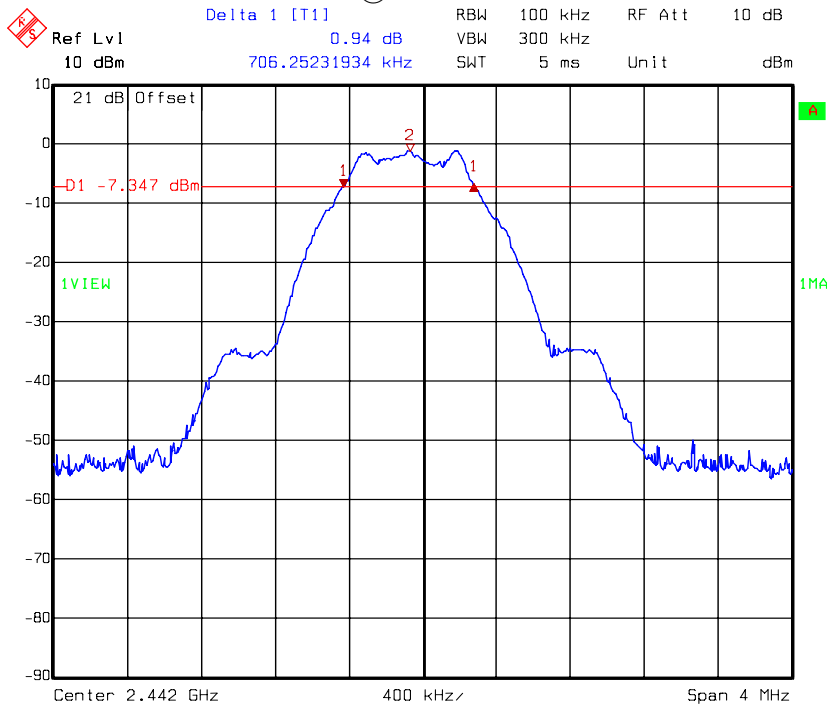
Mode	Channel	Frequency (MHz)	Bandwidth (MHz)	Min. Limit (MHz)	Pass/Fail
GFSK LE-1Mbps	0	2402	0.7127	0.5	Pass
	20	2442	0.7062	0.5	Pass
	39	2480	0.7101	0.5	Pass

### 6 dB Bandwidth @ GFSK mode channel 0



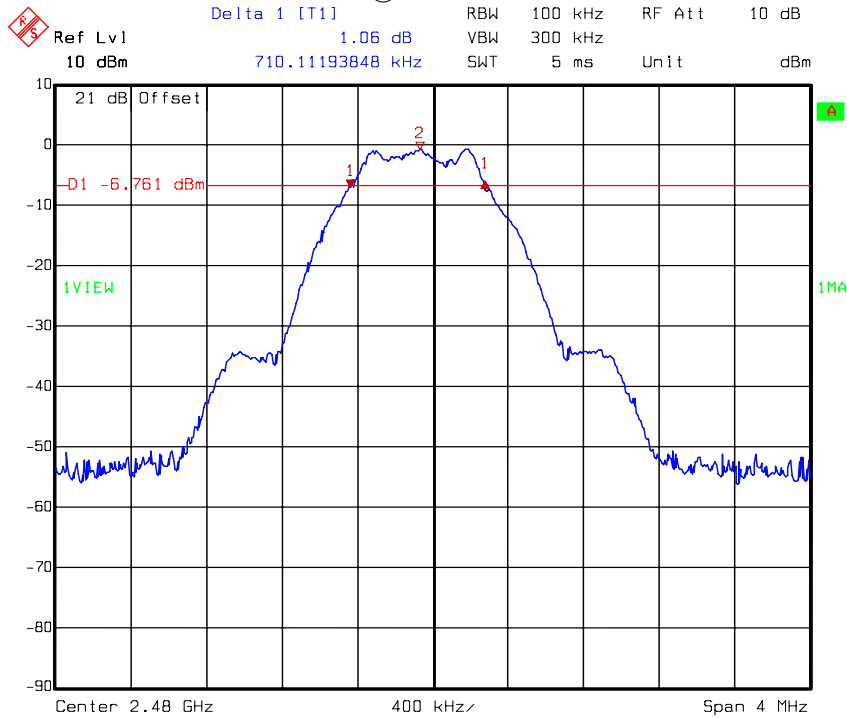
Title: 6dB Occupied Bandwidth ( KOB0 , T647 )  
Comment A: BT4.0\_Chain0\_Ch00\_2402  
Date: 17.JUL.2013 12:16:44

### 6 dB Bandwidth @ GFSK mode channel 20



Title: 6dB Occupied Bandwidth ( KOB0 , T647 )  
Comment A: BT4.0\_Chain0\_Ch20\_2442  
Date: 17.JUL.2013 12:15:37

# 6 dB Bandwidth @ GFSK mode channel 39



Title: 6dB Occupied Bandwidth ( KOB0 , T647 )  
 Comment A: BT4.0\_Chain0\_Ch39\_2480  
 Date: 17.JUL.2013 12:09:24

## 4. Power Spectral Density

### 4.1 Operating environment

Temperature: 23 °C  
Relative Humidity: 50 %  
Atmospheric Pressure: 1008 hPa

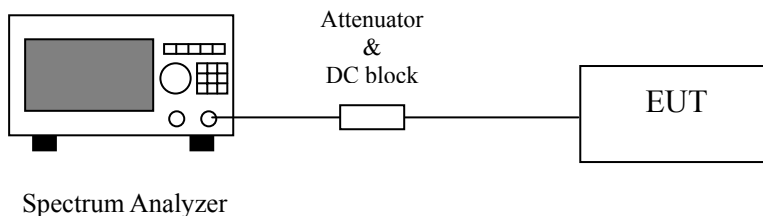
### 4.2 Test setup & procedure

#### 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  $\geq$  3 kHz, VBW  $\geq$  3 $\times$ 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.

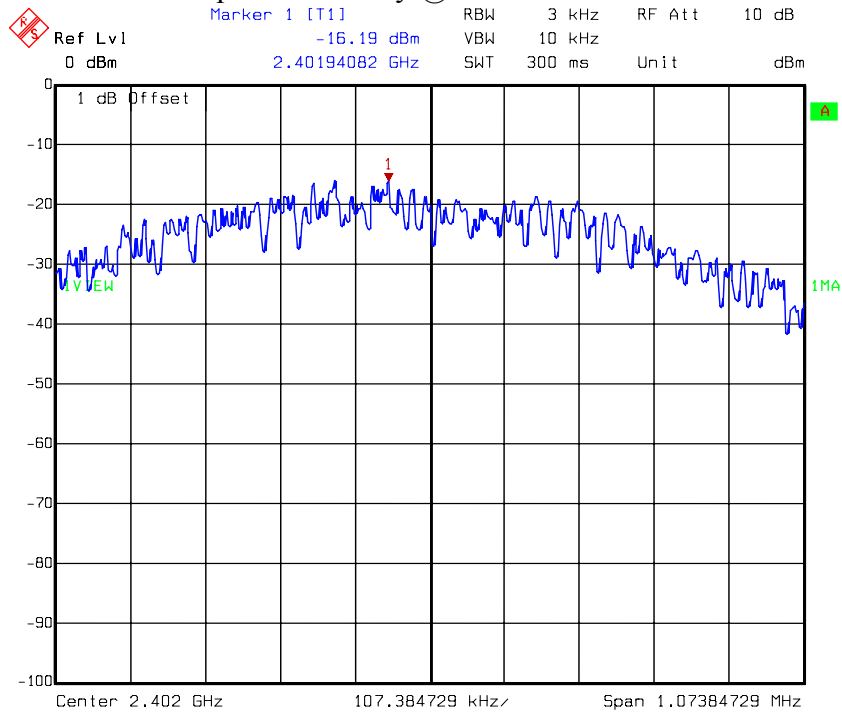
#### Test Diagram:



### 4.3 Measured data of Power Spectral Density test results

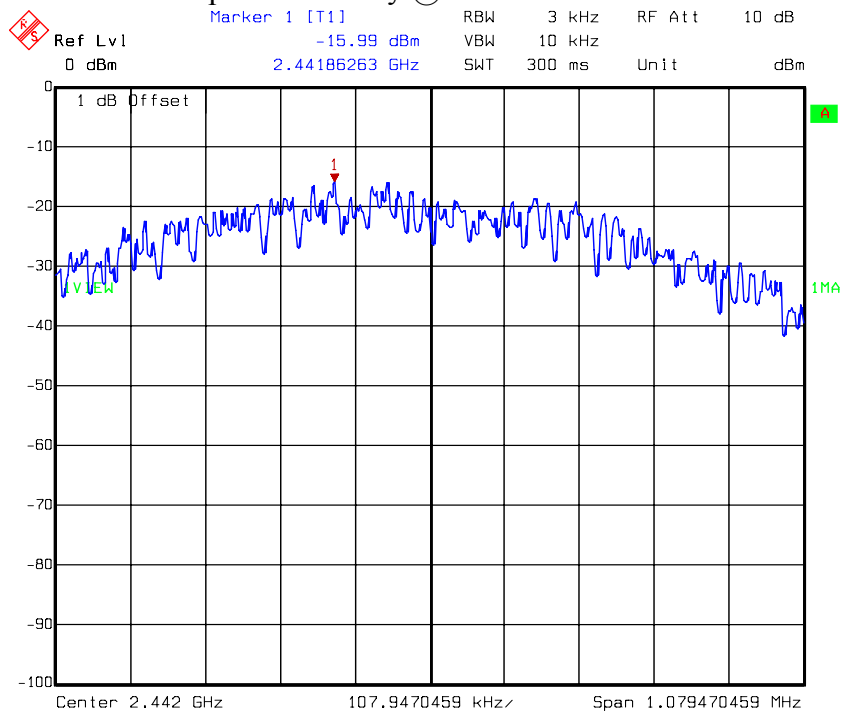
Mode	Channel	Frequency (MHz)	Power spectrum density (dBm)	Limit (dBm)
GFSK LE-1Mbps	0	2402	-16.19	8
	20	2442	-15.99	8
	39	2480	-15.70	8

### Power Spectral Density @ GFSK mode channel 0

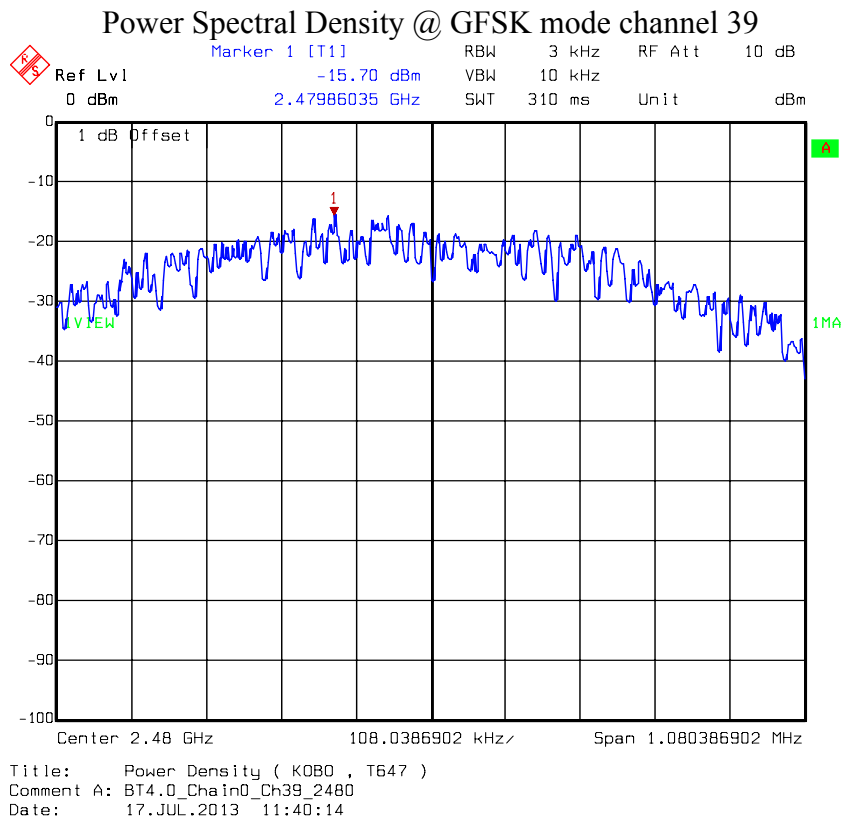


Title: Power Density ( KOB0 , T647 )  
Comment A: BT4.0\_Chain0\_Ch00\_2402  
Date: 17.JUL.2013 11:31:14

### Power Spectral Density @ GFSK mode channel 20



Title: Power Density ( KOB0 , T647 )  
Comment A: BT4.0\_Chain0\_Ch20\_2442  
Date: 17.JUL.2013 11:38:06



## 5. Maximum Output Power test

### 5.1 Operating environment

Temperature: 23 °C  
 Relative Humidity: 55 %  
 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	Frequency (MHz)	Output Power(dBm) (AV)	Output Power (mw)	Antenna Gain	EIRP Power	Limit (dBm)	Margin (dB)
				(dBi)	(dBm)		
GFSK LE-1Mbps	2402	-0.27	0.94	3.0	2.73	20	-17.27
	2442	0.42	1.10	3.0	3.42	20	-16.58
	2480	0.74	1.19	3.0	3.74	20	-16.26

## 6. RF Antenna Conducted Spurious test

### 6.1 Operating environment

Temperature:	24	°C
Relative Humidity:	55	%
Atmospheric Pressure:	1008	hPa

### 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.

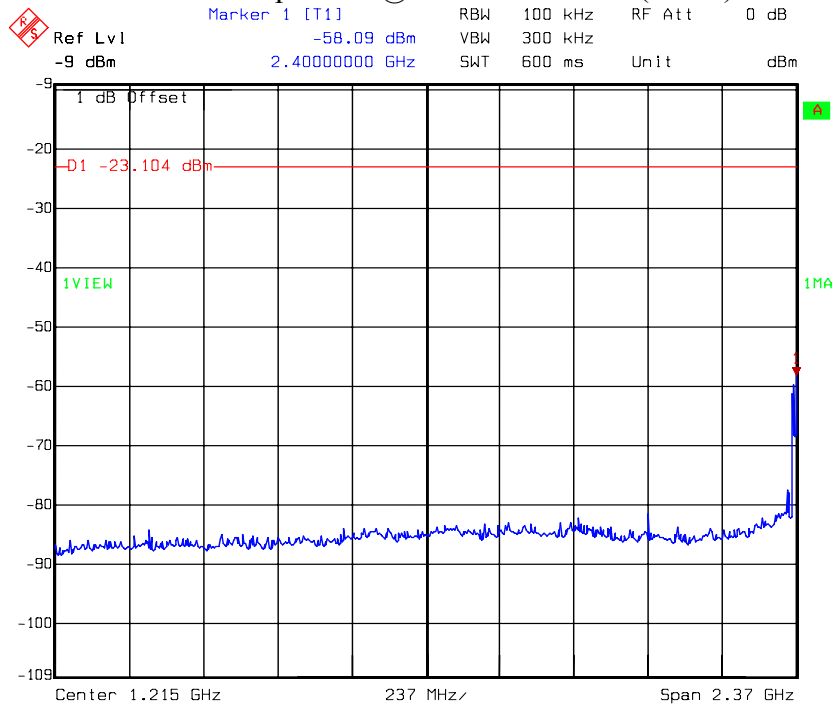
Harmonics and spurious noise must be at least 20dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW. The table below is the results from the highest emission for each channel within the authorized band. This table was used to determine the spurious limits for each channel.

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

The test results please see the plot below.

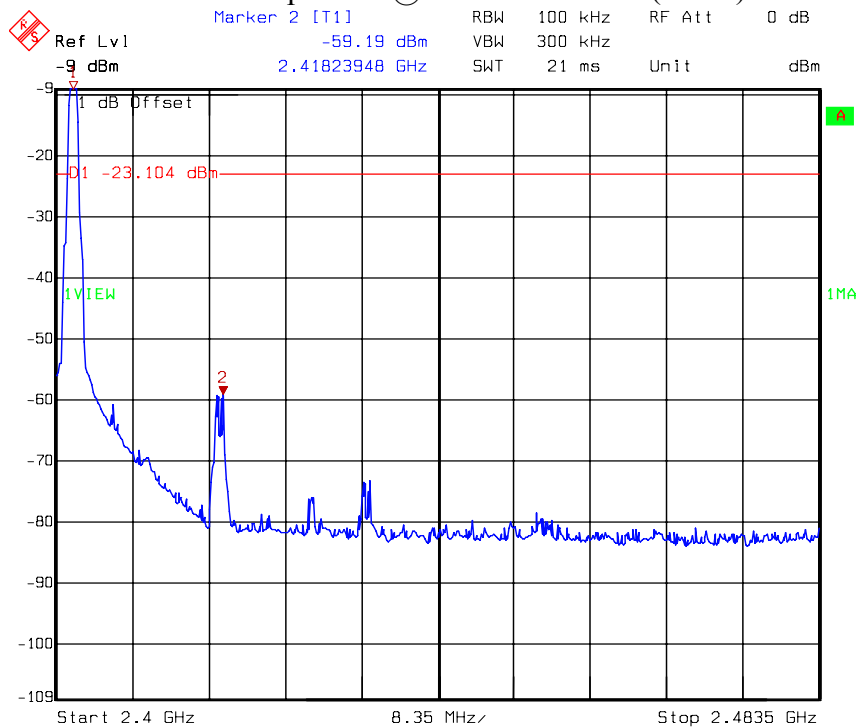


### Conducted spurious @ GFSK channel 0 (1 of 3)



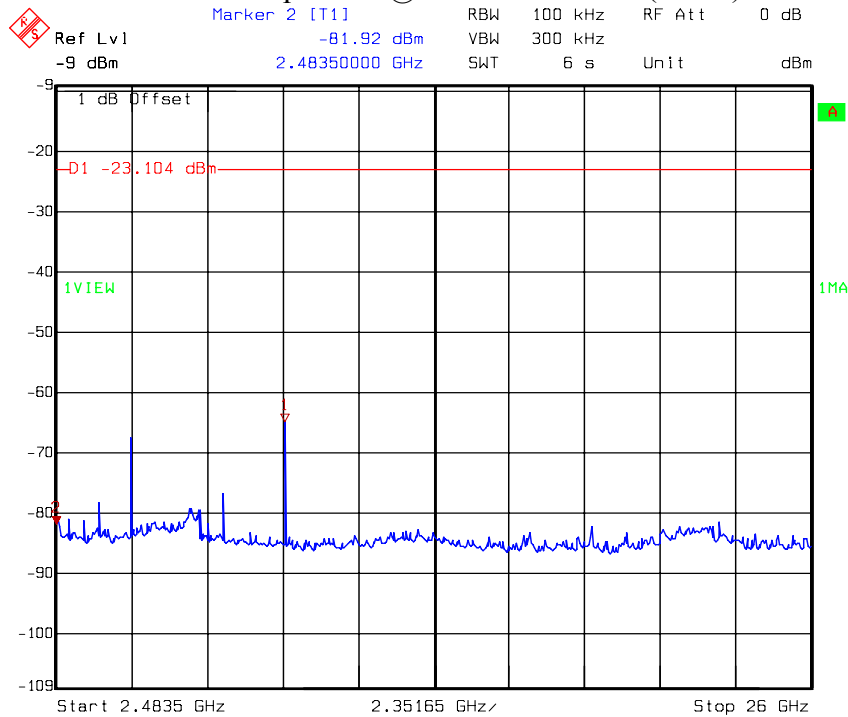
Title: Conducted Spurious ( KOB0 , T647 )  
Comment A: BT4.0\_Chain0\_Ch00\_2402  
Date: 17.JUL.2013 11:30:24

### Conducted spurious @ GFSK channel 0 (2 of 3)



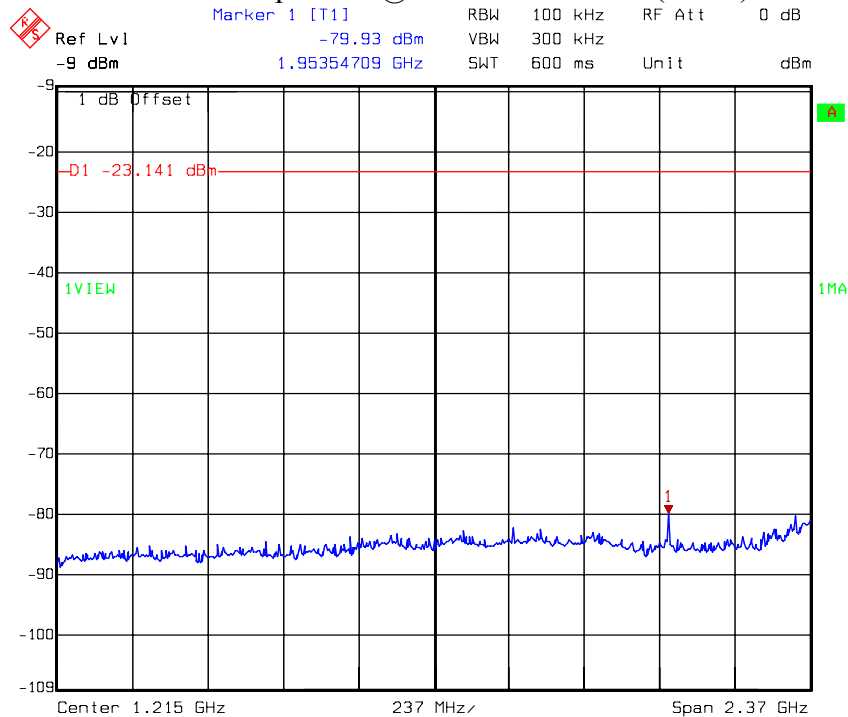
Title: Conducted Spurious ( KOB0 , T647 )  
Comment A: BT4.0\_Chain0\_Ch00\_2402  
Date: 17.JUL.2013 11:30:33

### Conducted spurious @ GFSK channel 0 (3 of 3)



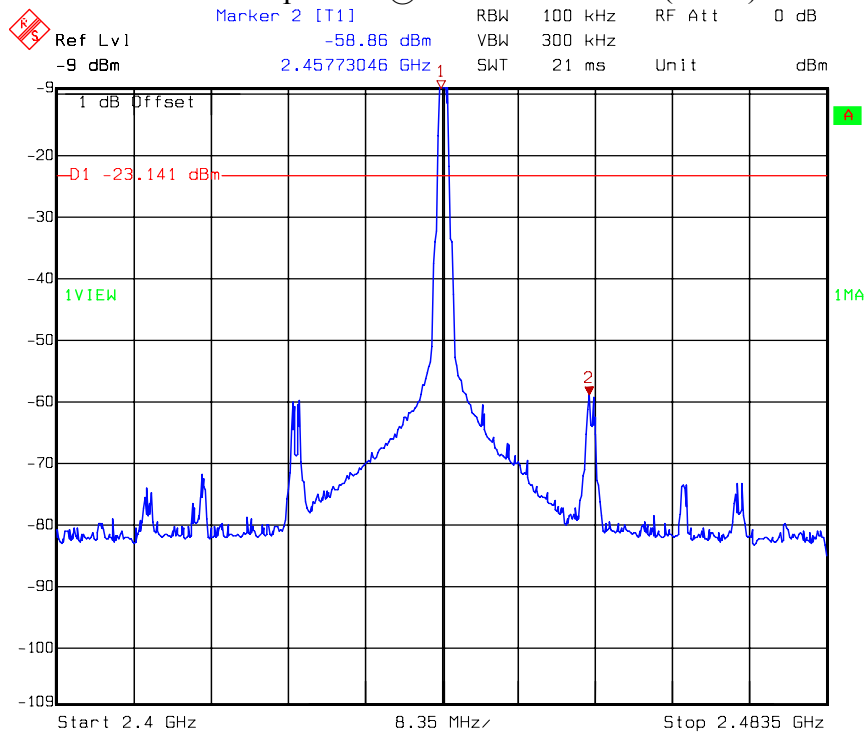
Title: Conducted Spurious ( KOB0 , T647 )  
Comment A: BT4.0\_Chain0\_Ch00\_2402  
Date: 17.JUL.2013 11:30:48

### Conducted spurious @ GFSK channel 20 (1 of 3)



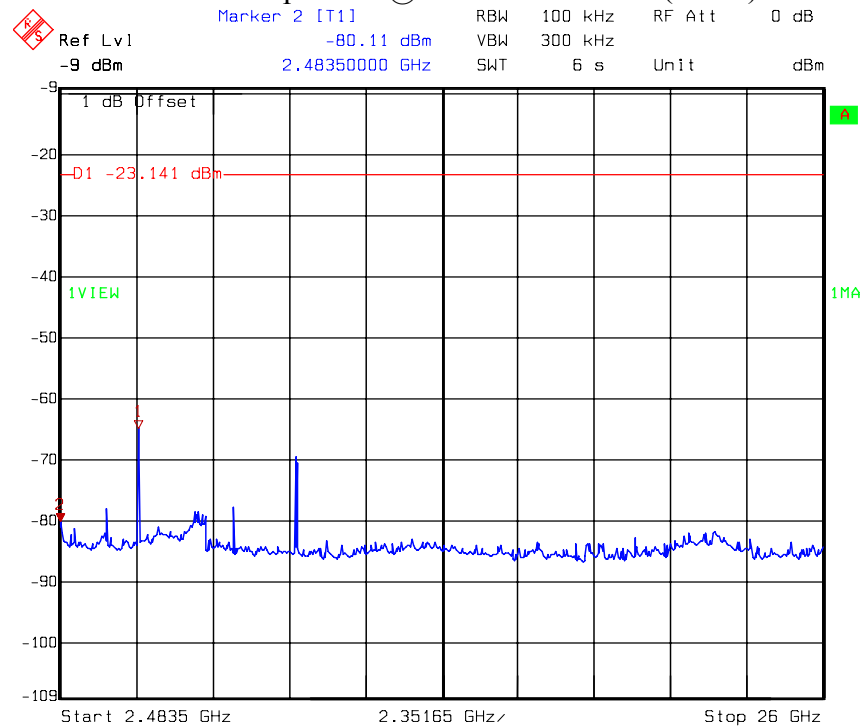
Title: Conducted Spurious ( KOB0 , T647 )  
Comment A: BT4.0\_Chain0\_Ch20\_2442  
Date: 17.JUL.2013 11:37:15

### Conducted spurious @ GFSK channel 20 (2 of 3)



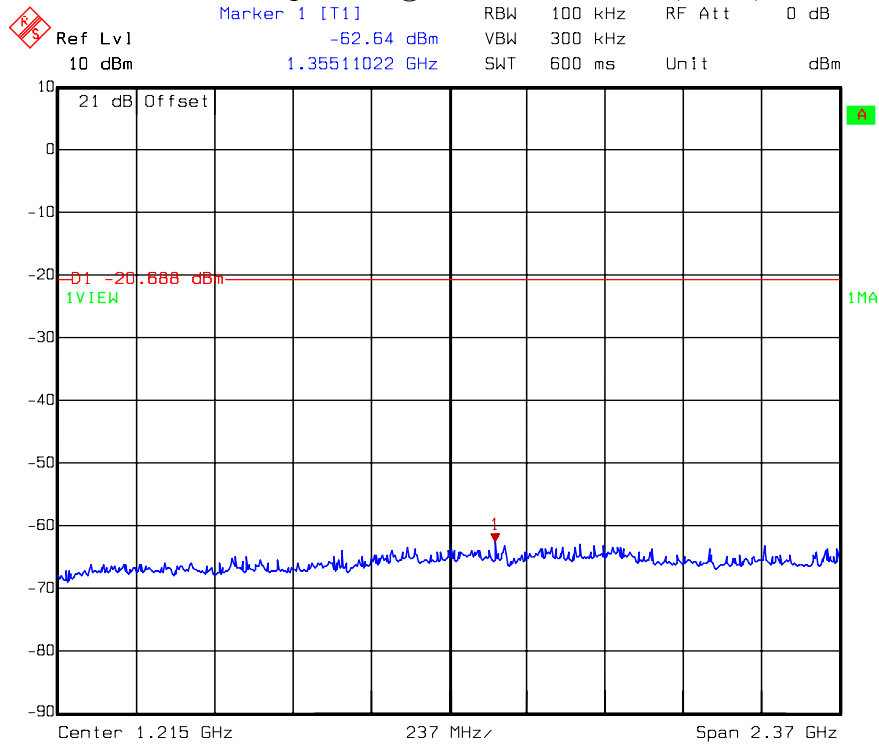
Title: Conducted Spurious ( KOB0 , T647 )  
Comment A: BT4.0\_Chain0\_Ch20\_2442  
Date: 17.JUL.2013 11:37:24

### Conducted spurious @ GFSK channel 20 (3 of 3)



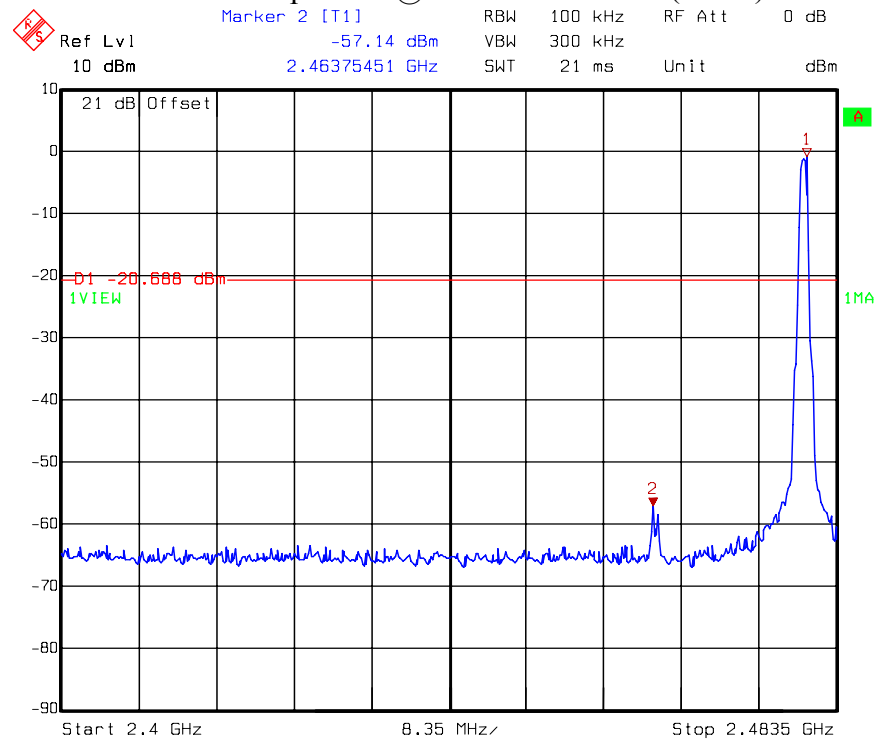
Title: Conducted Spurious ( KOB0 , T647 )  
Comment A: BT4.0\_Chain0\_Ch20\_2442  
Date: 17.JUL.2013 11:37:39

### Conducted spurious @ GFSK channel 39 (1 of 3)



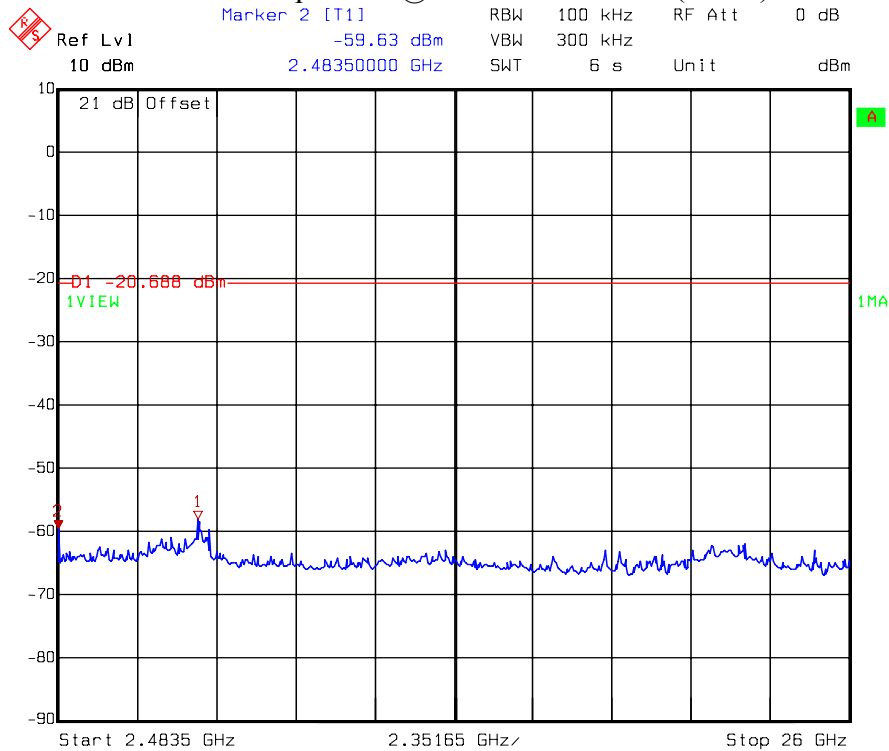
Title: Conducted Spurious ( KOB0 , T647 )  
Comment A: BT4.0\_Chain0\_Ch39\_2480  
Date: 17.JUL.2013 12:08:09

### Conducted spurious @ GFSK channel 39 (2 of 3)



Title: Conducted Spurious ( KOB0 , T647 )  
Comment A: BT4.0\_Chain0\_Ch39\_2480  
Date: 17.JUL.2013 12:08:18

### Conducted spurious @ GFSK channel 39 (3 of 3)



Title: Conducted Spurious ( KOB0 , T647 )  
 Comment A: BT4.0\_Chain0\_Ch39\_2480  
 Date: 17.JUL.2013 12:08:34

## 7. Radiated Emission test

### 7.1 Operating environment

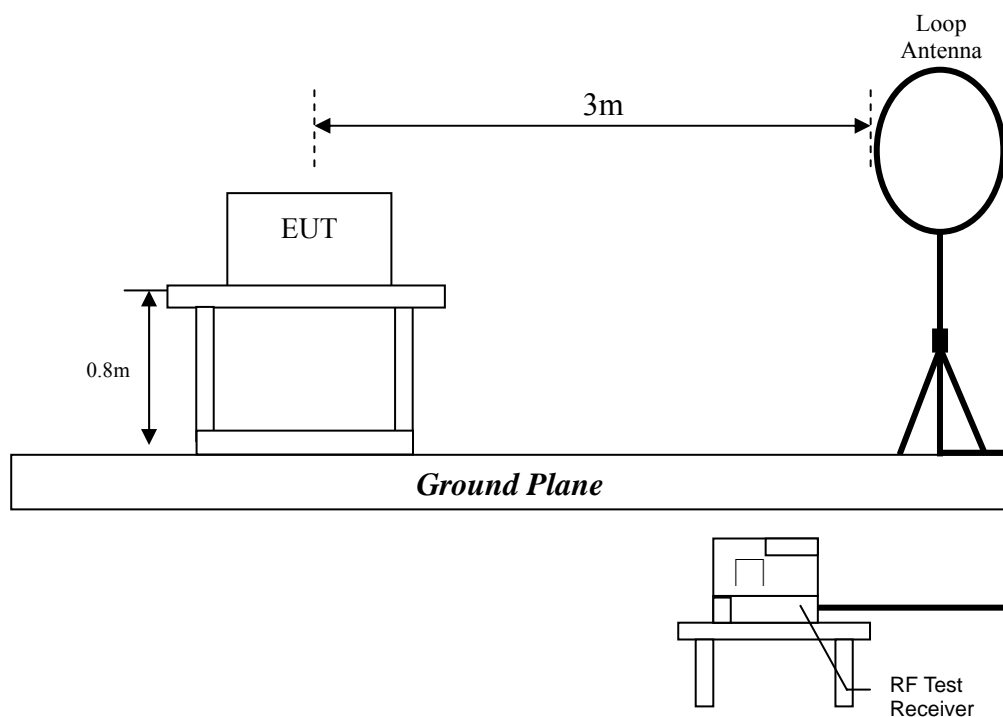
Temperature: 25 °C  
Relative Humidity: 55 %  
Atmospheric Pressure: 1008 hPa

### 7.2 Test setup & procedure

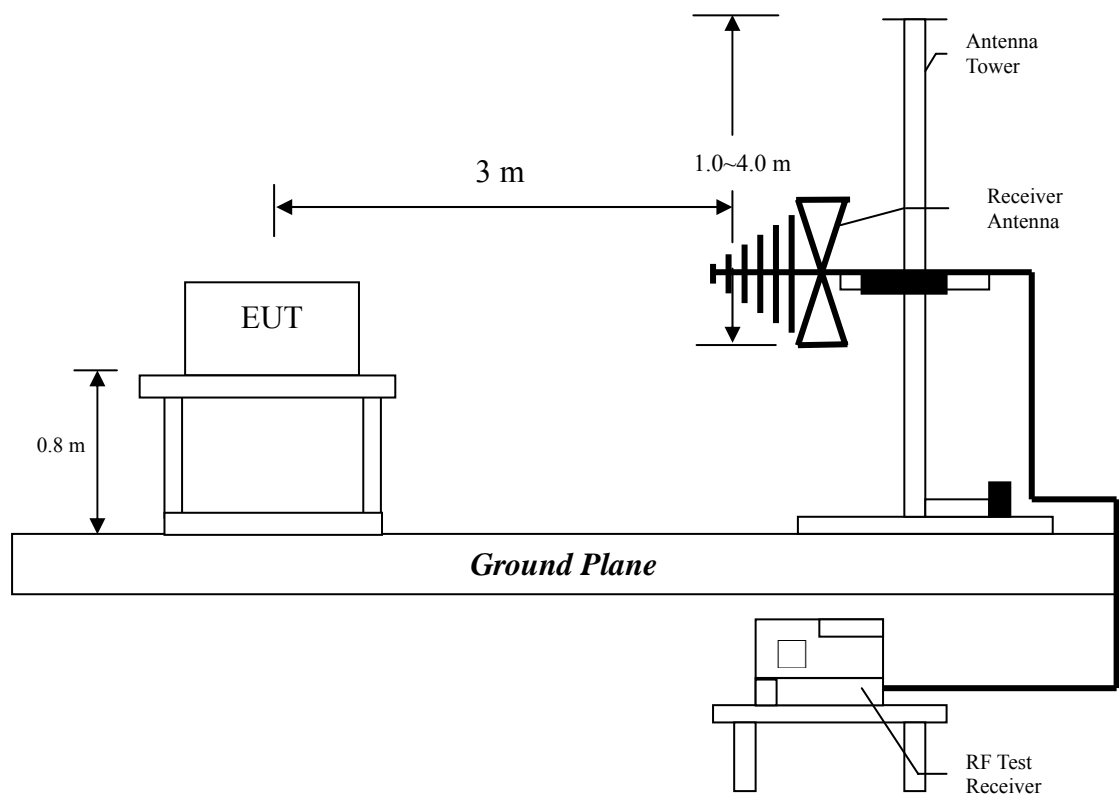
The test procedure was according to FCC measurement guidelines KDB558074 and ANSI C63.4/2003.

The Diagram below shows the test setup, which is utilized to make these measurements.

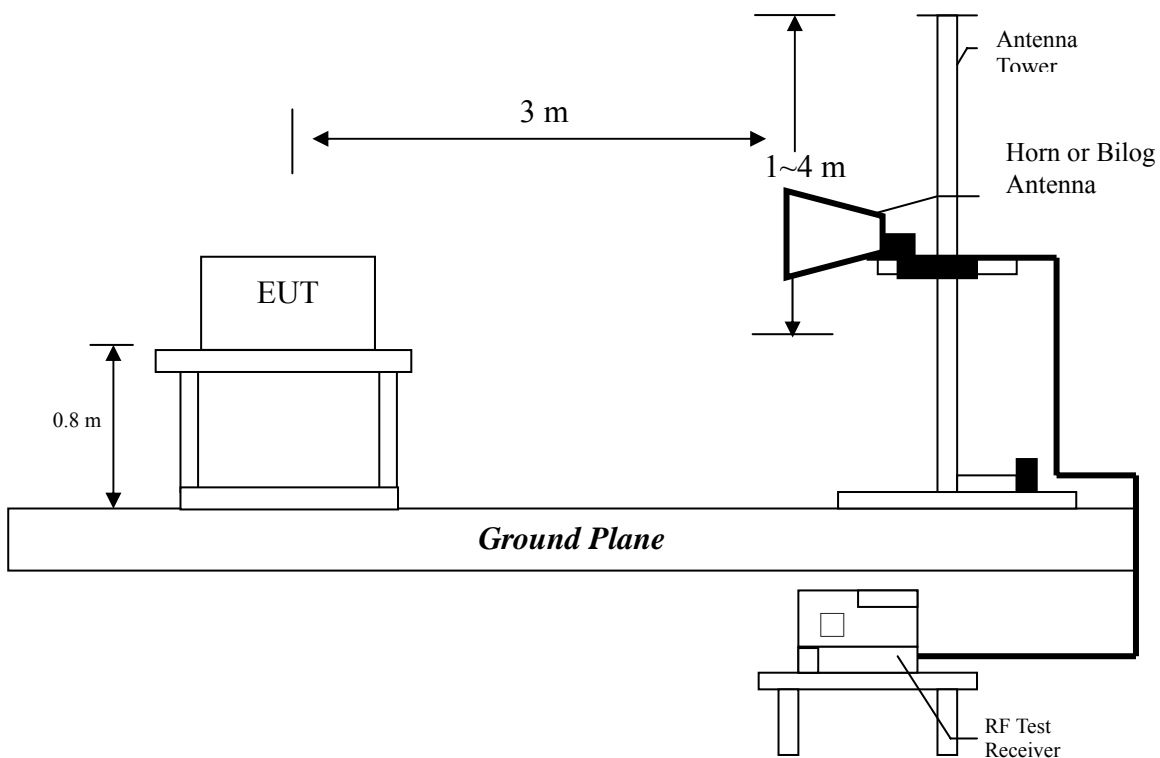
**Radiated emission from 9kHz to 30MHz uses Loop Antenna:**



**Radiated emission from 30MHz to 1GHz uses Bilog Antenna:**



**Radiated emission above 1GHz uses Horn Antenna:**

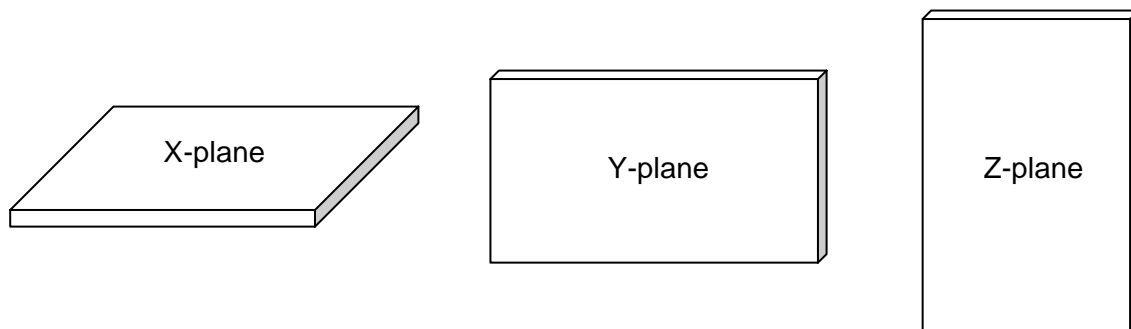


According to §15.33(a), the spectrum shall be investigated from the lowest radio frequency signal generated in the device, to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower. Spectrum Analyzer Resolution Bandwidth is 100kHz or greater for frequencies 30MHz to 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.



After verifying three axes, we found the maximum electromagnetic field was occurred at X-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)	Field Strength (microvolts/meter)
0.009~0.490	2400/F(kHz)
0.490~1.705	2400/F(kHz)
1.705~30	30
30-88	100
88-216	150
216-960	200
Above 960	500

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:

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

Parameter	Uncertainty		
Radiated Emission	Below 1 GHz	Vertical	3.90 dB
		Horizontal	3.86 dB
	Above 1 GHz	Vertical	5.74 dB
		Horizontal	5.55 dB
Conducted Emission	2.08 dB		

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

## 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 0, 20, 39 were verified. The worst case occurred at Tx channel 20.

EUT : T647  
Test Condition : GFSK at channel 20

Antenna Polarization	Freq. (MHz)	Receiver Detector	Corr. Factor (dB/m)	Reading (dBuV)	Corrected Level (dBuV/m)	Limit @ 3 m (dBuV/m)	Margin (dB)
Vertical	276.38	QP	13.24	19.57	32.80	46.00	-13.20
Vertical	350.10	QP	15.06	15.55	30.61	46.00	-15.39
Vertical	404.42	QP	16.47	18.46	34.93	46.00	-11.07
Vertical	511.12	QP	18.56	12.22	30.77	46.00	-15.23
Vertical	621.70	QP	20.75	12.72	33.47	46.00	-12.53
Vertical	666.32	QP	21.50	11.14	32.64	46.00	-13.36
Horizontal	276.38	QP	13.21	23.86	37.06	46.00	-8.94
Horizontal	350.10	QP	15.48	19.91	35.38	46.00	-10.62
Horizontal	404.42	QP	16.81	19.06	35.87	46.00	-10.13
Horizontal	511.12	QP	18.77	11.22	29.99	46.00	-16.01
Horizontal	664.38	QP	21.52	12.10	33.61	46.00	-12.39
Horizontal	714.82	QP	22.44	13.51	35.95	46.00	-10.05

Remark:

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

Note: The amplitude of spurious emissions that are attenuated by more than 20dB below the permissible value has no need to be reported.

#### 7.4.2 Measurement results: frequency above 1GHz

EUT : T647  
Test Condition : GFSK at channel 0

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	36.36	39.80	54	-14.20
4980.00	PK	V	35.1	38.54	42.79	46.23	55	-8.77
4804.00	PK	H	35.1	38.54	35.62	39.06	54	-14.94
4980.00	PK	H	35.1	38.54	40.2	43.64	55	-11.36

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 : T647  
Test Condition : GFSK at channel 20

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)
4884.00	PK	V	35.1	38.54	36.44	39.88	54	-14.12
4980.00	PK	V	35.1	38.54	45.18	48.62	55	-6.38
4884.00	PK	H	35.1	38.54	36.47	39.91	54	-14.09
4980.00	PK	H	35.1	38.54	41.88	45.32	55	-9.68

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 : T647  
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	H	35.1	38.54	37.76	41.20	54	-12.80
4980.00	PK	H	35.1	38.54	40.07	43.51	55	-11.49
4960.00	PK	V	35.1	38.54	43.45	46.89	54	-7.11

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. 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.

### 8.1 Test setup & procedure

Please refer to the clause 7.2 of this report.

Please see the plot below.

### 8.2 Test Result

#### Test Mode: GFSK mode

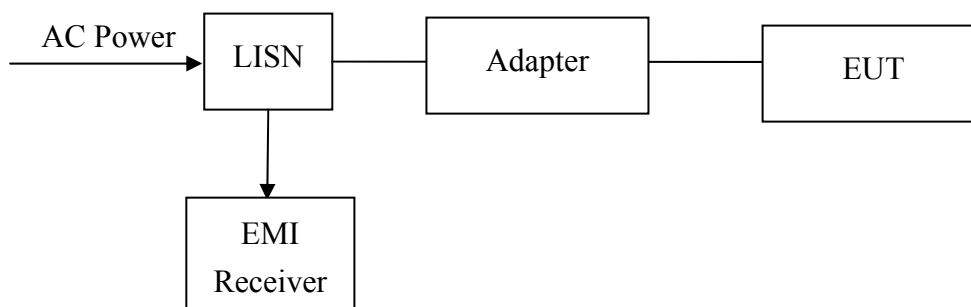
Frequency (MHz)	Spectrum Analyzer Detector	Ant. Pol. (H/V)	Preamp. Gain (dB)	Correction Factor (dB/m)	Reading (dBuV)	Corrected Reading (dBuV/m)	Limit @ 3 m (dBuV/m)	Margin (dB)	Restricted band (MHz)
2339.60	PK	H	38.01	31.61	64.32	57.92	74	-16.08	2310~2390
2339.60	AV	H	38.01	31.61	51.29	44.89	54	-9.11	
2402.00	PK	H	38.02	31.91	101.84	95.72	-	95.72	-
2402.00	AV	H	38.02	31.91	82.15	76.03	-	76.03	-
2480.00	PK	H	38.04	32.28	103.16	97.39	-	97.39	-
2480.00	AV	H	38.04	32.28	83.02	77.25	-	77.25	-
2483.50	PK	H	38.05	32.29	65.60	59.85	74	-14.15	2483.5~2500
2483.50	AV	H	38.05	32.29	56.53	50.78	54	-3.22	

## 9. Power Line Conducted Emission test §FCC 15.207

### 9.1 Operating environment

Temperature: 25 °C  
 Relative Humidity: 55 %  
 Atmospheric Pressure 1008 hPa

### 9.2 Test setup & procedure



**The test procedure was according to ANSI C63.4/2003.**

The EUT are connected to the main power through a line impedance stabilization network (LISN). This provides a 50 ohm/50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50 ohm/50uH coupling impedance with 50 ohm termination.

Both sides (Line and Neutral) of AC line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.4/2003 on conducted measurement. The bandwidth of the field strength meter (R & S Test Receiver ESCS 30) is set at 9 kHz.

The EUT configuration please refer to the “Conducted set-up photo.pdf”.

### 9.3 Emission limit

Freq. (MHz)	Conducted Limit (dBuV)	
	Q.P.	Ave.
0.15~0.50	66 – 56*	56 – 46*
0.50~5.00	56	46
5.00~30.0	60	50

\*Decreases with the logarithm of the frequency.

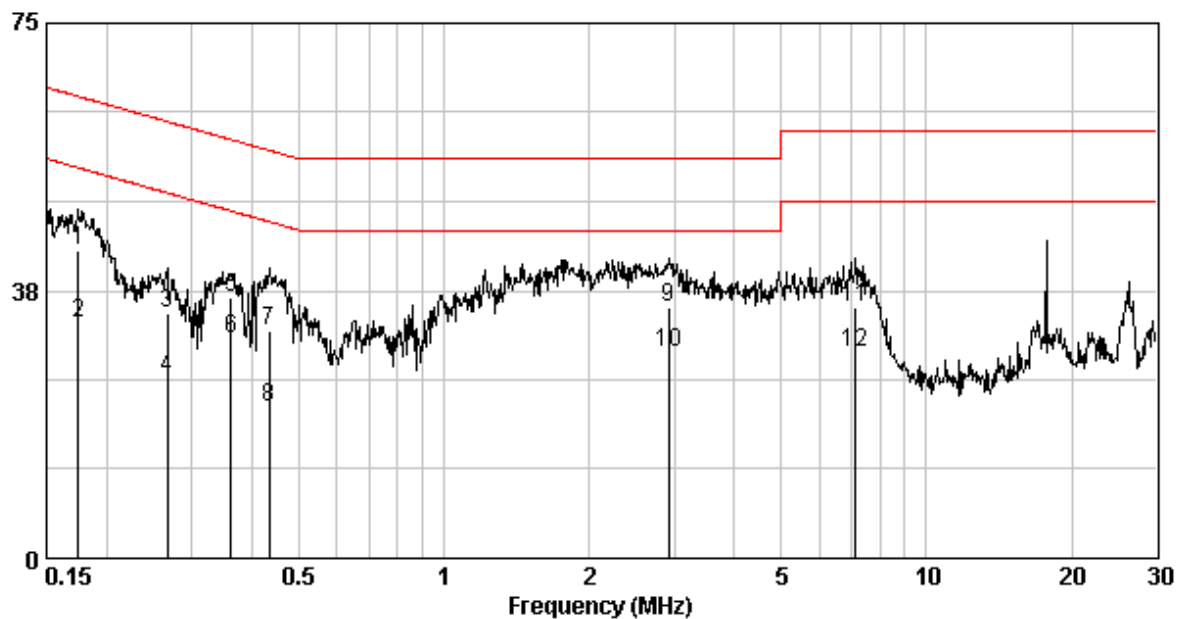
## 9.5 Power Line Conducted Emission test data

Phase: Line  
Model No.: T647  
Operating mode: Adapter mode

Frequency (MHz)	Corr. Factor (dB)	Level Qp (dBuV)	Limit Qp (dBuV)	Level Av (dBuV)	Limit Av (dBuV)	Margin (dB)	
						Qp	Av
0.175	0.13	43.13	64.72	32.95	54.72	-21.59	-21.77
0.267	0.15	34.43	61.20	25.17	51.20	-26.78	-26.04
0.361	0.16	36.48	58.69	30.74	48.69	-22.22	-17.96
0.435	0.16	31.90	57.15	21.19	47.15	-25.25	-25.96
2.915	0.31	35.16	56.00	28.98	46.00	-20.84	-17.02
7.137	0.51	35.14	60.00	28.86	50.00	-24.87	-21.15

Remark:

1. Corr. Factor (dB) = LISN Factor (dB) + Cable Loss (dB)
2. Margin (dB) = Level (dBuV) – Limit (dBuV)



Phase: Neutral  
Model No.: T647  
Operating mode: Adapter mode

Frequency (MHz)	Corr. Factor (dB)	Level Qp (dBuV)	Limit Qp (dBuV)	Level Av (dBuV)	Limit Av (dBuV)	Margin (dB)	
						Qp	Av
0.186	0.10	41.48	64.20	34.50	54.20	-22.71	-19.69
0.274	0.11	40.46	60.98	35.36	50.98	-20.52	-15.62
0.456	0.13	43.14	56.76	36.13	46.76	-13.62	-10.63
0.532	0.13	31.25	56.00	22.72	46.00	-24.75	-23.28
0.974	0.16	35.28	56.00	28.23	46.00	-20.72	-17.77
6.805	0.41	35.72	60.00	29.81	50.00	-24.28	-20.19

Remark:

1. Corr. Factor (dB)= LISN Factor (dB) + Cable Loss (dB)
2. Margin (dB) = Level (dBuV) – Limit (dBuV)

