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### FCC PART 90 Test Report

**FCC ID: UU3FC301DU1**

**Report Reference No.....: CTL120503385-WF**

Compiled by

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Name of the organization performing the tests

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Approved by

( position+printed name+signature)...: Manager Tracy Qi

*Tracy Qi*

Date of issue.....: June 01, 2012

**Testing Laboratory Name .....: Shenzhen CTL Electromagnetic Technology Co., Ltd.**

Address.....: Zone B, 4/F, Block 20, Guangqian Industrial Park, Longzhu Road, Nanshan, Shenzhen 518055 China.

**Test Firm.....: Bontek Compliance Testing Laboratory Ltd**

Address.....: 1/F, Block East H-3, OCT Eastern Ind. Zone, Qiaocheng East Road, Nanshan, Shenzhen, China

**Applicant's name.....: Shenzhen Friendcom Technology Development Co., Ltd.**

Address.....: 6/F, 17 Building, Guangqian Industrial Park, Longzhu Road, Xili Town, Nanshan District, Shenzhen City, China

**Test specification:**

Standard .....: **FCC Part 90: PRIVATE LAND MOBILE RADIO SERVICES**

TRF Originator.....: Shenzhen CTL Electromagnetic Technology Co., Ltd.

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

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**Test item description ..... : Data Radio**

Trade Mark .....: Friendcom

Model/Type reference.....: FC-301/D

Modulation.....: GMSK

Emission Type.....: 7K60FXD

Channel Separation.....: 12.5KHz

Power Supply.....: DC 12.5V

Rated Power.....: 5W

Operating Frequency Range.....: From 400 MHz to 470 MHz

Result.....: **Positive**

# TEST REPORT

<b>Test Report No. :</b> CTL120503385-WF	June 01, 2012
	Date of issue

Equipment under Test : Data Radio

Model /Type : FC-301/D

Listed Models : /

**Applicant** : Shenzhen Friendcom Technology Development Co., Ltd.

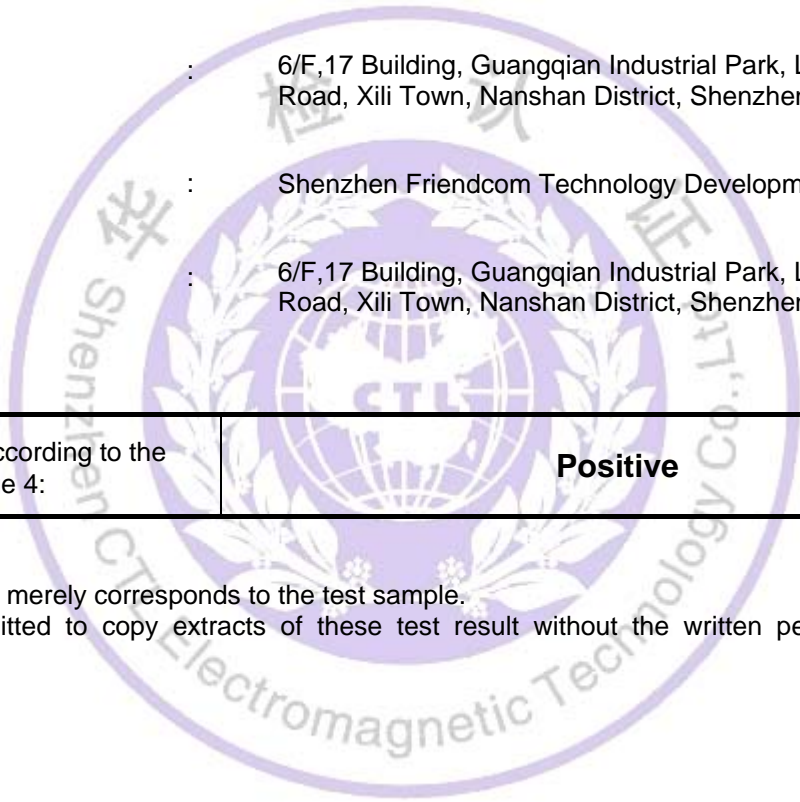
Address : 6/F,17 Building, Guangqian Industrial Park, Longzhu Road, Xili Town, Nanshan District, Shenzhen City, China

**Manufacture** : Shenzhen Friendcom Technology Development Co., Ltd.

Address : 6/F,17 Building, Guangqian Industrial Park, Longzhu Road, Xili Town, Nanshan District, Shenzhen City, China

<b>Test Result</b> according to the standards on page 4:	<b>Positive</b>
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The test report merely corresponds to the test sample.  
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.



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## 1. TEST STANDARDS

The tests were performed according to following standards:

[FCC Part 90:](#) PRIVATE LAND MOBILE RADIO SERVICES

[ANSI/TIA-603-C-2004 :](#) Land Mobile FM or PM Communications Equipment Measurement and Performance Standards.

[47 CFR FCC Part 15 Subpart B](#) - Unintentional Radiators

[FCC Part 2:](#) FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS



## 2. SUMMARY

### 2.1. General Remarks

Date of receipt of test sample	:	May 01, 2012
Testing commenced on	:	May 01, 2012
Testing concluded on	:	May 27, 2012

### 2.2. Equipment Under Test

#### Power supply system utilised

Power supply voltage	:	<input type="radio"/> 120V / 60 Hz	<input type="radio"/> 115V / 60Hz
		<input type="radio"/> 12 V DC	<input type="radio"/> 24 V DC
		<input checked="" type="radio"/> Other (specified in blank below)	

DC 12.5V

### 2.3. Short description of the Equipment under Test (EUT)

The Friendcom's Model: FC-301/D or the "EUT" as referred to in this report; more general information as follows, for more details, refer to the user's manual of the EUT.

Name of EUT	Data Radio	
Model Number	FC-301/D	
FCC ID	UU3FC301DU1	
Rated Output Power	5 Watts(36.99dBm)	
Support data rate	9.6kbps	
Modulation Type	GMSK for Digital Data	
	Digital	7K60FXD for Digital Data only
Channel Separation	Digital Data	12.5KHz
Antenna Type	External	
Frequency Range	400MHz-470MHz	
Maximum Output Power	Digital	<u>5.96 W</u> for 12.5 KHz Channel Separation

#### Test frequency list

Frequency Range (MHz)	Modulation Type	Channel Separation (KHz)	Test Channel	Test Frequency (MHz)	
				TX	RX
400-470	Digital/GMSK	12.5	Low	406.5000	406.5000
			Middle	435.0000	435.0000
			High	469.5000	469.5000

### 2.4. Short description of the Equipment under Test (EUT)

400-470MHz Data Radio (FC-301/D).

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

Serial number: Prototype

## 2.5. EUT operation mode

The EUT has been tested under typical operating condition.

## 2.6. EUT configuration

The following peripheral devices and interface cables were connected during the measurement:

- - supplied by the manufacturer
- - supplied by the lab

<input type="radio"/>	Power Cable	Length (m) :	/
		Shield :	/
		Detachable :	/
<input type="radio"/>	Multimeter	Manufacturer :	/
		Model No. :	/

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

This submittal(s) (test report) is intended for FCC ID: **UU3FC301DU1** filing to comply with the FCC Part 90 Rules.

## 2.8. Modifications

No modifications were implemented to meet testing criteria.

## 2.9. Note

The EUT is is a U frequency band (400-470MHz) Data Radio, The functions of the EUT listed as below:

	Test Standards	Reference Report
Radio	FCC Part 90	CTL120503385-WF
MPE	OET 65	CTL120503385-WM

### **3. TEST ENVIRONMENT**

#### **3.1. Address of the test laboratory**

Bontek Compliance Testing Laboratory Ltd  
1/F, Block East H-3, OCT Eastern Ind. Zone, Qiaocheng East Road, Nanshan, Shenzhen, China

The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 (2003) and CISPR Publication 22.

#### **3.2. Test Facility**

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

##### **FCC-Registration No.: 338263**

Bontek Compliance Testing Laboratory Ltd EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 338263, March 24, 2008.

##### **IC Registration No.: 7631A**

The 3m alternate test site of Bontek Compliance Testing Laboratory Ltd EMC Laboratory has been registered by Certification and Engineer Bureau of Industry Canada for the performance of with Registration NO.: 7631A on March, 2011.

#### **3.3. Environmental conditions**

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

Temperature: 15-35 ° C

Humidity: 30-60 %

Atmospheric pressure: 950-1050mbar

#### **3.4. Configuration of Tested System**

**Fig. 2-1 Configuration of Tested System**



**Table 2-1 Equipment Used in Tested System**

### 3.5. Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16 - 4 „Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements“ and is documented in the Bontek Compliance Testing Laboratory Ltd quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for Bontek laboratory is reported:

Test	Range	Measurement Uncertainty	Notes
Radiated Emission	30~1000MHz	4.10dB	(1)
Radiated Emission	1~12.75GHz	4.32dB	(1)
Conducted Disturbance	0.15~30MHz	3.20dB	(1)

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

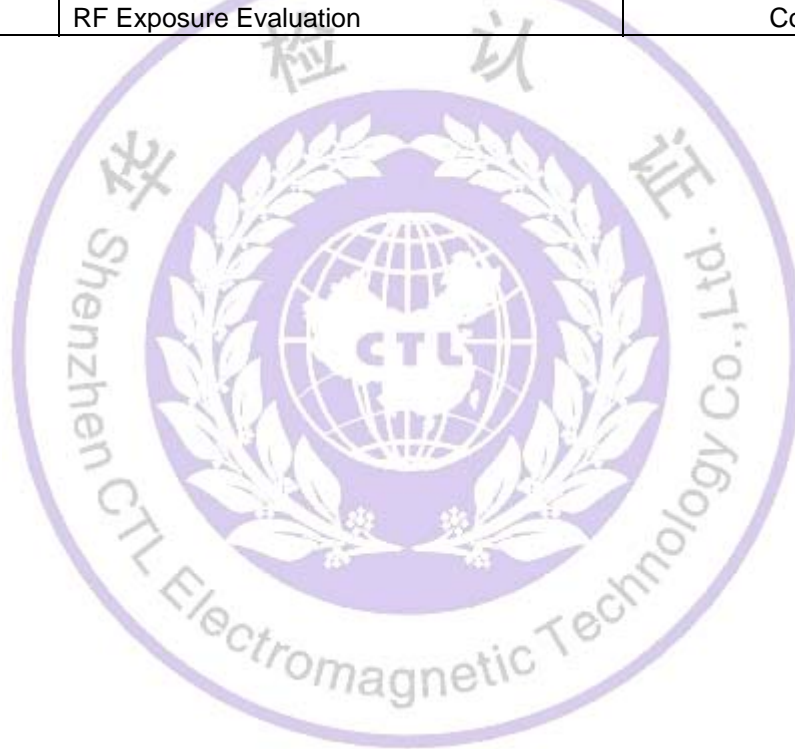
### 3.6. Equipments Used during the Test

Item	Test Equipment	Manufacturer	Model No.	Last Cal.	Due. Date
1	EMI Test Receiver	ROHDE & SCHWARZ	ESCI	2012/04/14	2013/04/13
2	Radio Communication Tester	ROHDE & SCHWARZ	CMU200	2012/04/14	2013/04/13
3	Dual Directional Coupler	Agilent	778D	2012/04/14	2013/04/13
4	10dB attenuator	SCHWARZBECK	MTAIMP-136	2012/04/14	2013/04/13
5	Tunable Bandreject filter	K&L	3TNF-800	2012/04/14	2013/04/13
6	Tunable Bandreject filter	K&L	5TNF-1700	2012/04/14	2013/04/13
7	High-Pass Filter	K&L	9SH10-2700/X12750-O/O	2012/04/14	2013/04/13
8	High-Pass Filter	K&L	41H10-1375/U12750-O/O	2012/04/14	2013/04/13
9	Coaxial Cable	Huber+Suhner	AC4-RF-H	2012/04/14	2013/04/13
10	AC Power Supply	IDRC	CF-500TP	2012/04/14	2013/04/13
11	DC Power Supply	IDRC	CD-035-020PR	2012/04/14	2013/04/13
12	RF Current Probe	FCC	F-33-4	2012/04/14	2013/04/13
13	Temperature /Humidity Meter	zhicheng	ZC1-2	2012/04/14	2013/04/13
14	MICROWAVE AMPLIFIER	HP	8349B	2012/04/14	2013/04/13
15	Amplifier	HP	8447D	2012/04/14	2013/04/13
16	SIGNAL GENERATOR	HP	8647A	2012/04/14	2013/04/13
17	Log Periodic Antenna	ELECTRO-METRICS	EM-6950	2012/04/14	2013/04/13
18	Horn Antenna	Schwarzbeck	BBHA9120A	2012/04/14	2013/04/13
19	EMI Test Receiver	R&S	ESPI	2012/04/14	2013/04/13
20	Loop Antenna	ZHINAN	ZN30900A	2012/04/14	2013/04/13
21	Horn Antenna	Schwarzbeck	ZN30900A	2012/04/14	2013/04/13
22	Horn Antenna	Schwarzbeck	ZN30900A	2012/04/14	2013/04/13



### 3.7. General Technical Requirements and Summary of Test Results

FCC Rules	Description of Test	Test Result
§ 15.107	Conducted Emission	Complies
§ 15.109	Receiver Radiated Spurious Emission	Complies
§ 15.109	Receiver Conducted Spurious Emission	Complies
§ 90.205	Maximum Transmitter Power	Complies
§ 90.207	Modulation Characteristic	N/A
§ 90.209	Occupied Bandwidth	Complies
§ 90.210	Emission Mask	Complies
§ 90.213	Frequency Stability	Complies
§ 90.214	Transmitter Frequency Behavior	Complies
§ 90.210	Transmitter Radiated Spurious Emission	Complies
§ 90.210	Spurious Emission On Antenna Port	Complies
§ 2.1091	RF Exposure Evaluation	Complies



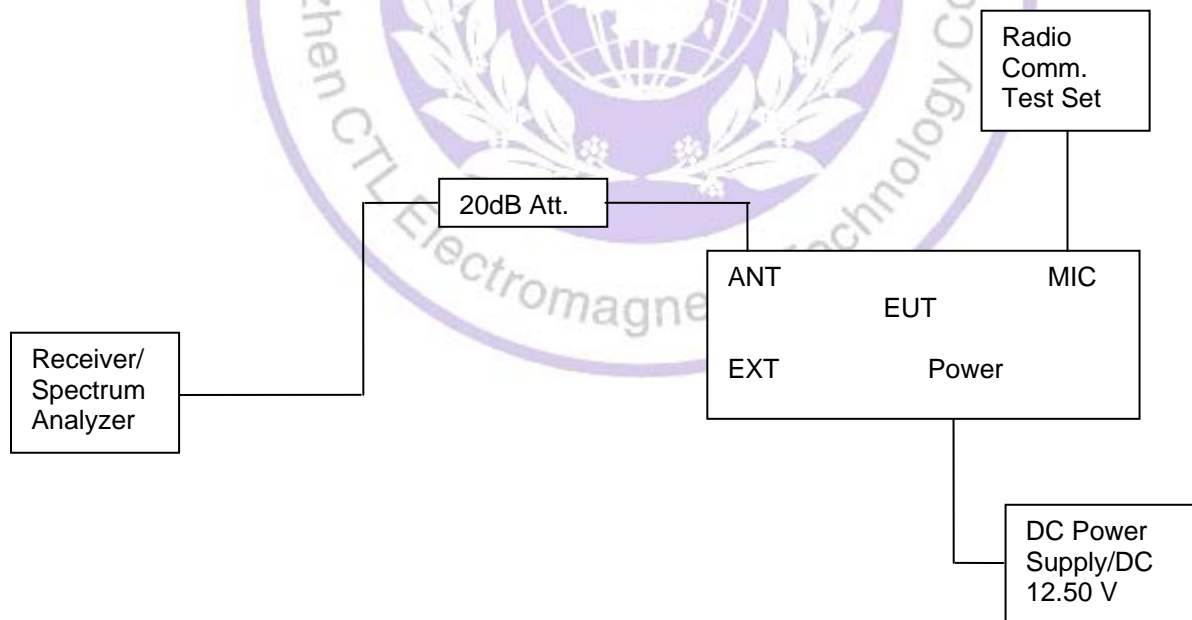
## 4. TEST CONDITIONS AND RESULTS

### 4.1. Occupied Bandwidth and Emission Mask

#### PROVISIONS APPLICABLE

- (a). Occupied Bandwidth: The EUT was connected to the audio signal generator and the spectrum analyzer via the main RF connector, and through an appropriate attenuator. The EUT was controlled to transmit its maximum power. Then the bandwidth of 99% power can be measured by the spectrum analyzer.
- (b). Emission Mask B: For transmitters that are equipped with an audio low-pass filter pursuant to §90.211(a), the power of any emission must be below the unmodulated carrier power (P) as follows:
- (1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.
  - (2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.
  - (3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least  $43 + 10 \log (P)$  dB.
- (c). Emission Mask D, 12.5 kHz channel bandwidth equipment: For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:
- (1) On any frequency from the center of the authorized bandwidth  $f_0$  to 5.625 kHz removed from  $f_0$ : Zero dB.
  - (2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency ( $f_d$  in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least  $7.27(f_d - 2.88 \text{ kHz})$  dB.
  - (3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency ( $f_d$  in kHz) of more than 12.5 kHz: At least  $50 + 10 \log (P)$  dB or 70 dB, whichever is the lesser attenuation.

#### TEST CONFIGURATION



#### TEST PROCEDURE

- 1 The EUT was placed on a turn table which is 0.8m above ground plane.
- 2 The EUT was modulated by 2.5 KHz Sine wave audio signal; the level of the audio signal employed is 16 dB greater than that necessary to produce 50% of rated system deviation for FM modulation devices. Rated system deviation is 2.5 kHz (12.5 kHz channel spacing) and 5 kHz (25 kHz channel spacing).
- 3 Set EUT as normal operation.
- 4 Set SPA Center Frequency = fundamental frequency, RBW=300Hz, VBW= 3 KHz, span =50 KHz.
- 5 Set SPA Max hold. Mark peak, Set 99% Occupied Bandwidth.

- 6 Set SPA Center Frequency=fundamental frequency, RBW=300Hz, VBW=3 KHz span=50 KHz for 25 KHz channel spacing, while RBW=100Hz, VBW=1 KHz, span=50 KHz for 12.5 channel spacing.

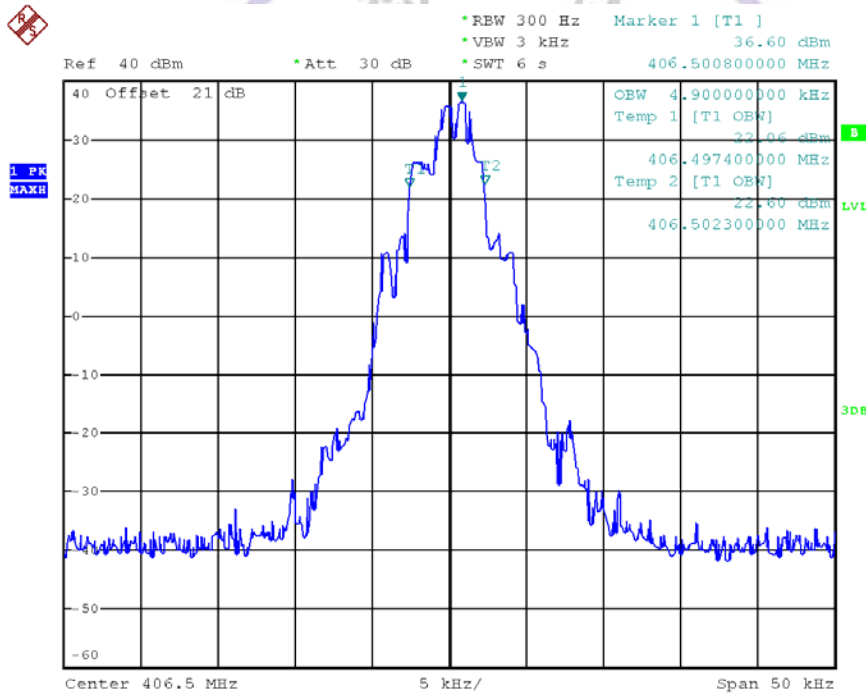
**TEST RESULTS:**

**4.2.1 Occupied Bandwidth**

Modulation Type	Channel Separation	Test Channel	Test Frequency	99% Occupied Bandwidth
GMSK	12.5KHz	Low	406.5000 MHz	4.90 KHz
		Middle	450.5000 MHz	4.80 KHz
		High	469.5000 MHz	4.80 KHz
Limit		11.25KHz for 12.5KHz Channel Separation		
Test Results		Compliance		

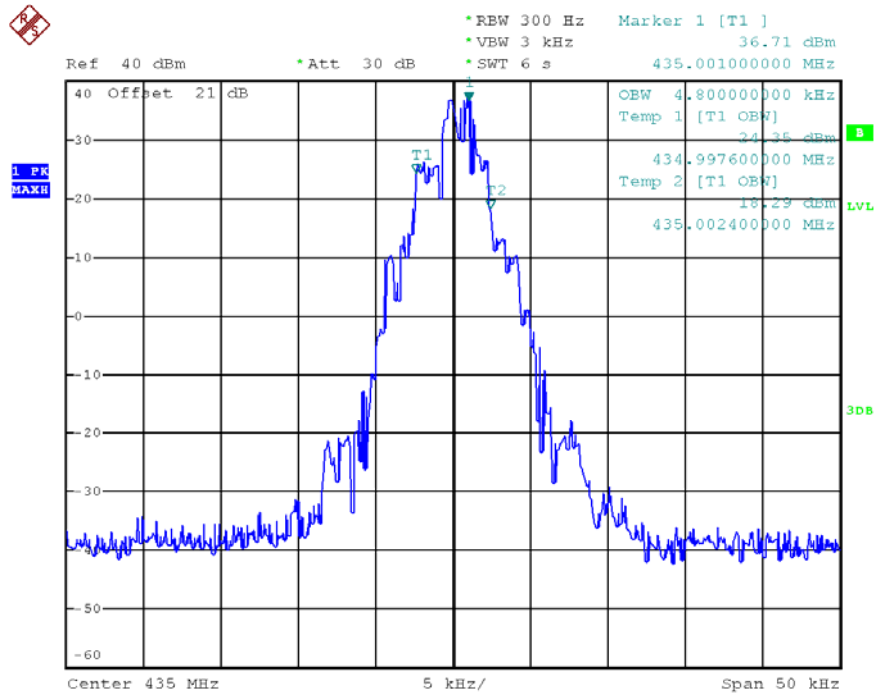
**Plots of 99% and 26dB Bandwidth Measurement**

Modulation Type	Channel Separation	Freq.(MHz)	99% Bandwidth (KHz)	FCC Limit (KHz)	Results
GMSK	12.5 KHz	406.5000	4.90	11.25	Compliance



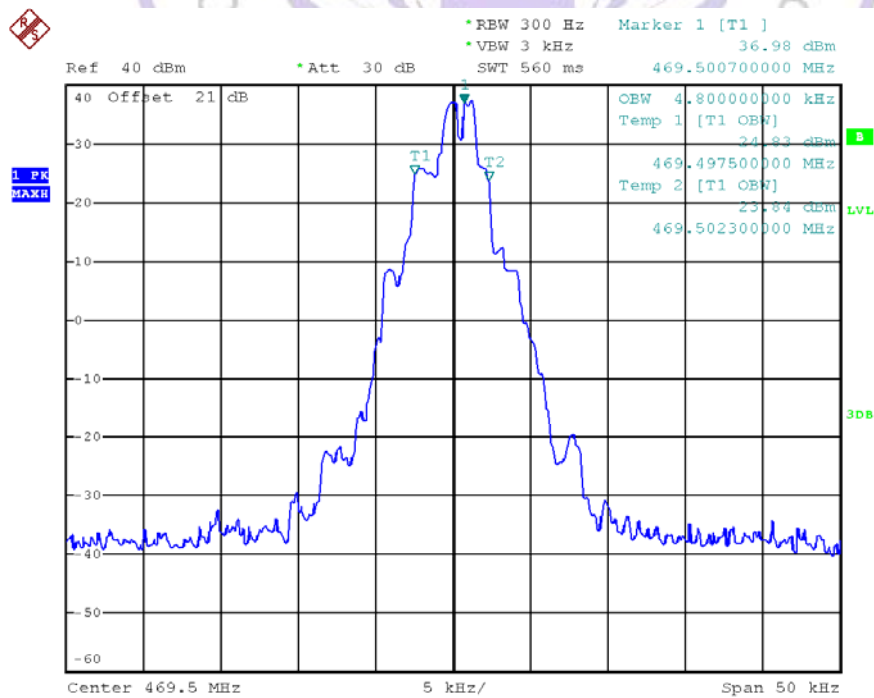
Date: 1.MAY.2012 15:30:04

Modulation Type	Channel Separation	Freq.(MHz)	99% Bandwidth (KHz)	FCC Limit (KHz)	Results
GMSK	12.5 KHz	435.0000	4.80	11.25	Compliance



Date: 1.MAY.2012 15:23:45

Modulation Type	Channel Separation	Freq.(MHz)	99% Bandwidth (KHz)	FCC Limit (KHz)	Results
GMSK	12.5 KHz	469.5000	4.80	11.25	Compliance



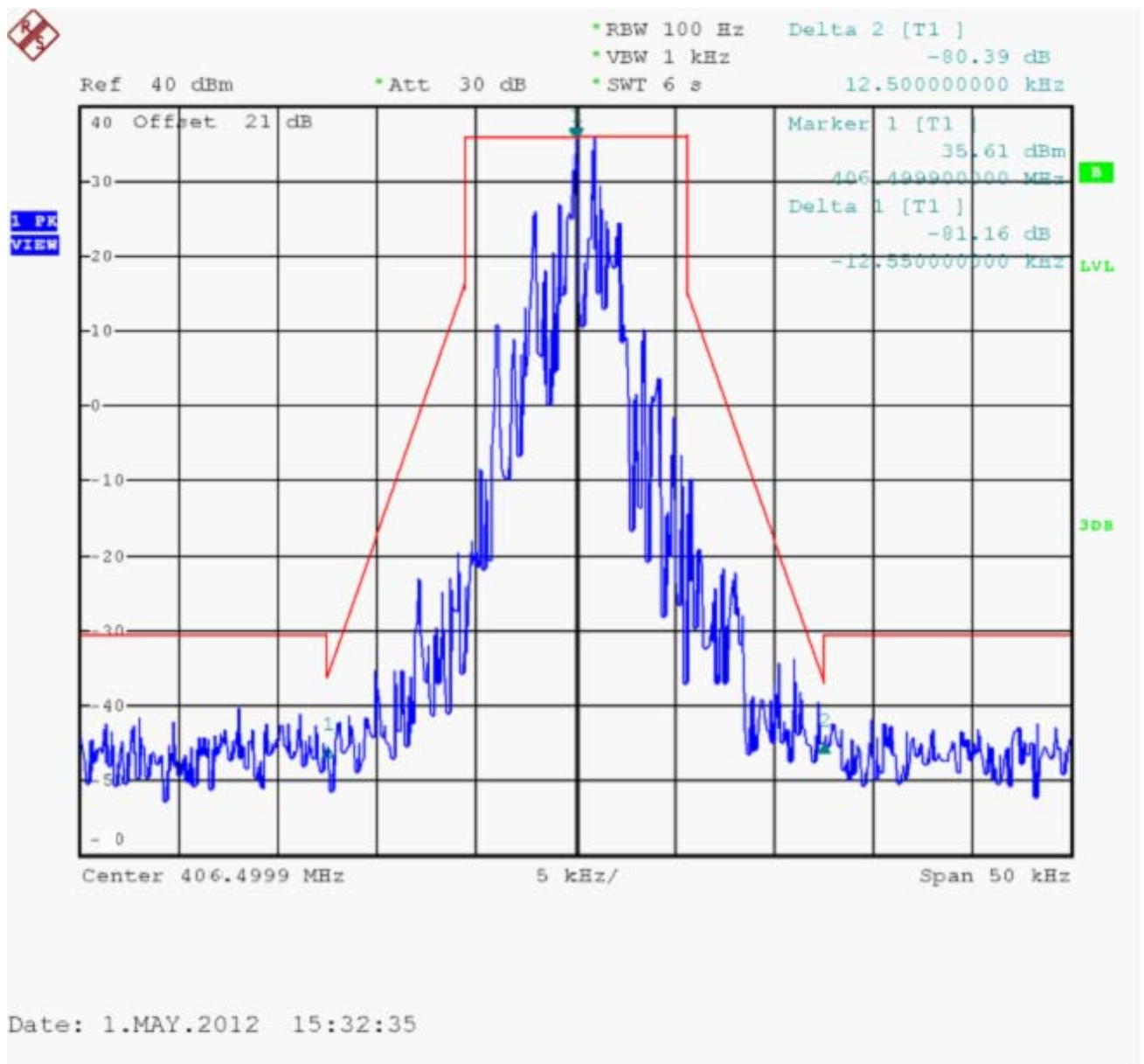
Date: 1.MAY.2012 15:10:18

### 4.2.2 Emission Mask

Modulation Type	Channel Separation	Test Channel	Test Frequency	FCC Applicable Mask	RBW
GMSK	12.5KHz	Low	406.5000 MHz	D	100 Hz
		Middle	435.0000 MHz	D	100 Hz
		High	469.5000 MHz	D	100 Hz
Test Results		Compliance			

Referred as the attached plot hereinafter  
 Note: The yellow curve represents unmodulated signal.  
 The green curve represents modulated signal.

Modulation Type	Channel Separation	Freq.(MHz)	FCC Applicable Mask	RBW	Audio Freq. (KHz)	Results
GMSK	12.5 KHz	406.5000	D	100Hz	/	Compliance



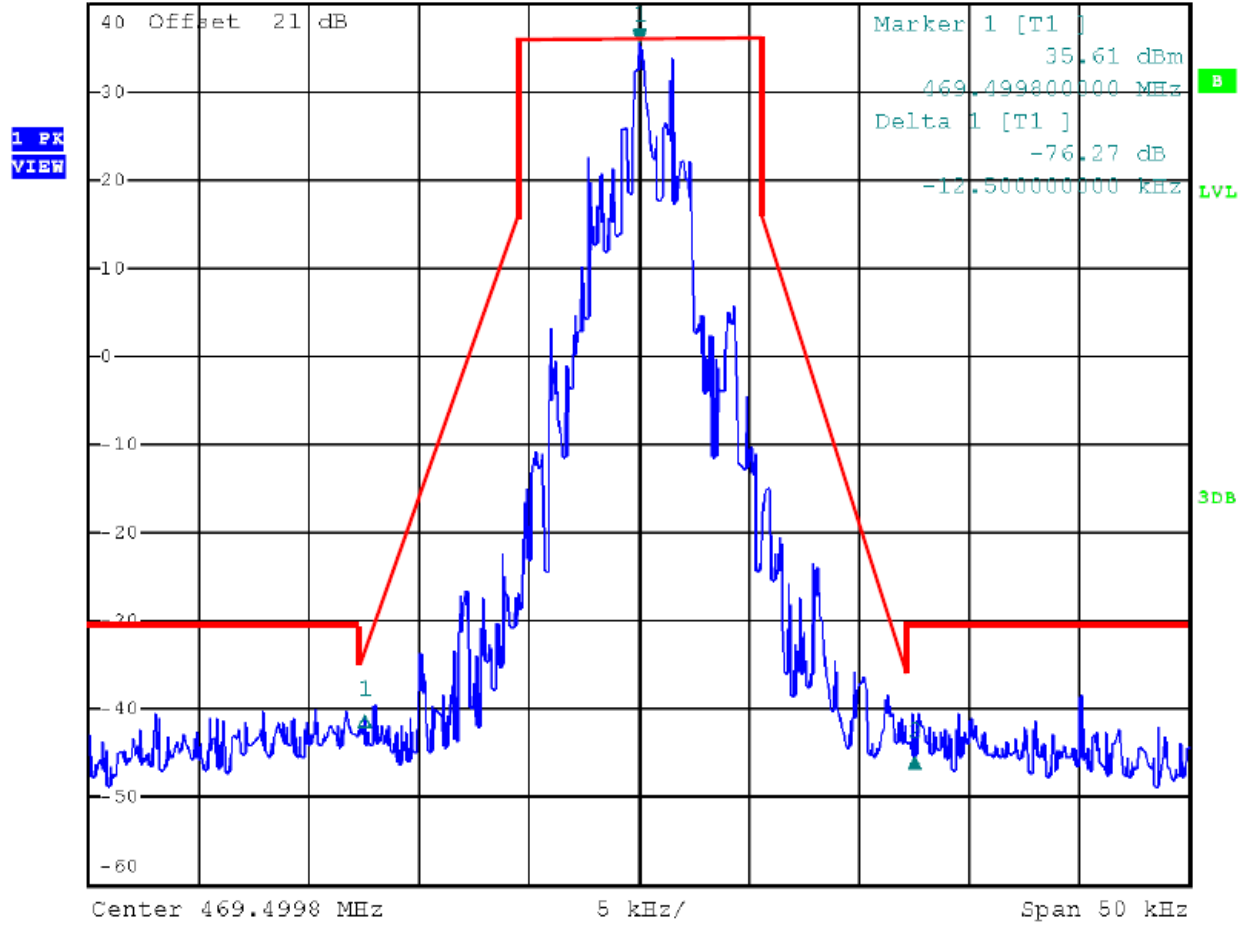
12.5 kHz Channel Spacing, 406.5000 MHz, GMSK Modulation Only



Modulation Type	Channel Separation	Freq.(MHz)	FCC Applicable Mask	RBW	Audio Freq. (KHz)	Results
GMSK	12.5 KHz	469.5000	D	100Hz	/	Compliance



Ref 40 dBm      \*Att 30 dB      \*RBW 100 Hz      Delta 2 [T1]      -80.91 dB  
\*VBW 1 kHz      12.500000000 kHz  
\*SWT 6 s



Date: 1.MAY.2012 15:11:47

12.5 kHz Channel Spacing, 469.5000 MHz, GMSK Modulation Only

## 4.2. Radiated Spurious Emission Test

### TEST APPLICABLE

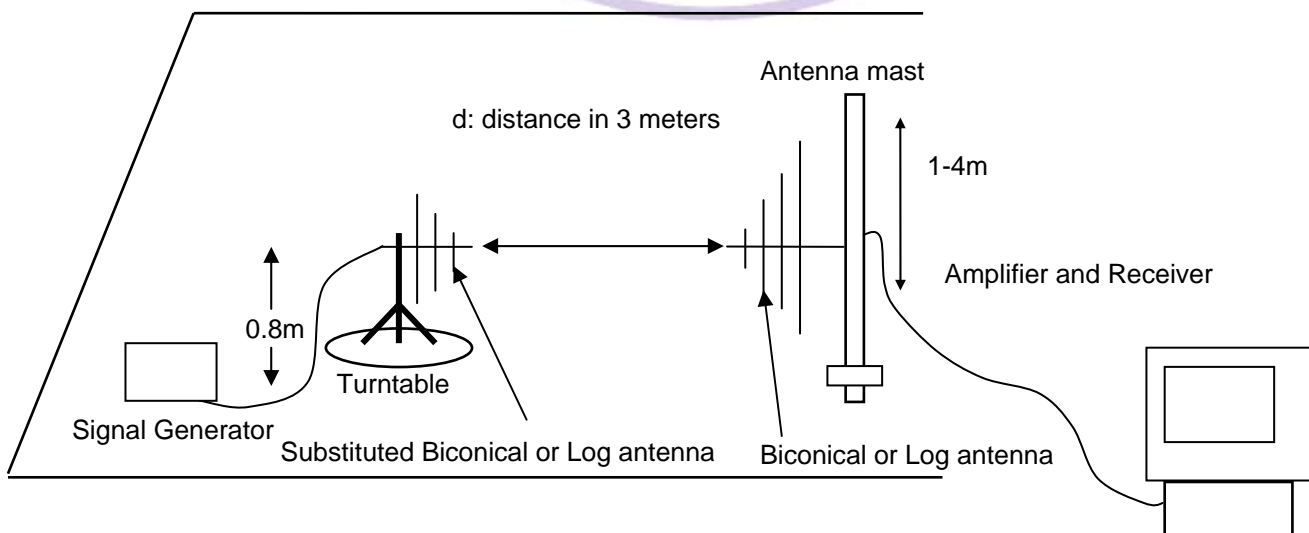
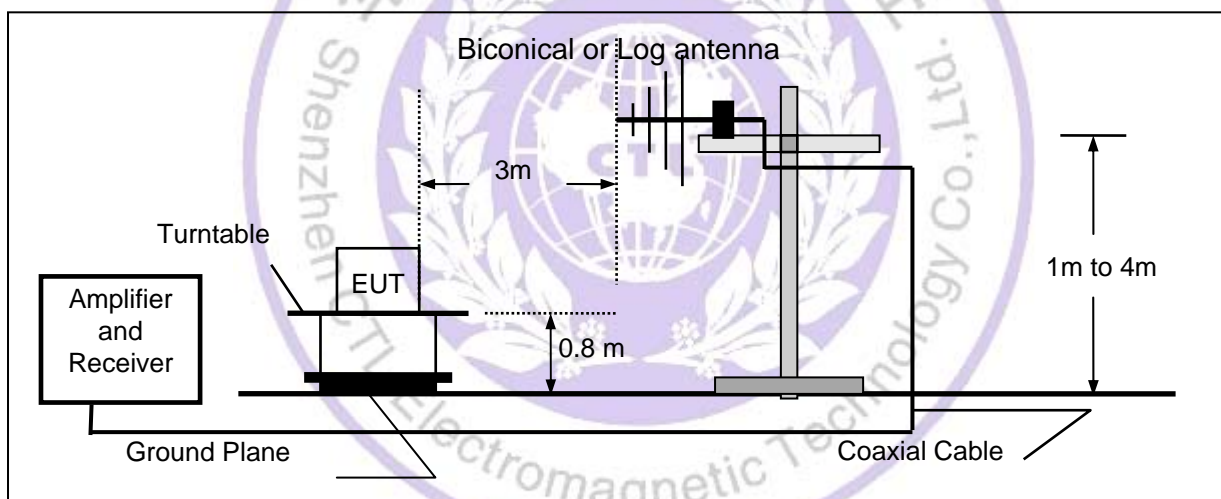
According to the TIA/EIA 603 test method, and according to Section 90.210, the power of each unwanted emission shall be less than Transmitted Power as specified below for transmitters designed to operate with 12.5 KHz channel bandwidth:

- 1 On any frequency removed from the center of the authorized bandwidth  $f_0$  to 5.625 KHz removed from  $f_0$ : Zero dB
  - 2 On any frequency removed from the center of the authorized bandwidth by a displacement frequency ( $f_d$  in KHz)  $f_0$  of more than 5.625 KHz but no more than 12.5 KHz: At least 7.27dB
  - 3 On any frequency removed from the center of the authorized bandwidth by a displacement frequency ( $f_d$  in KHz)  $f_0$  of more than 12.5 KHz: At least  $50+10 \log (P)$  dB or 70 dB, which ever is lesser attenuation.
- For transmitters designed to transmit with 25 KHz channel separation and equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as following:

- 1 On any frequency removed from the assigned frequency by more than 50 percent, but no more than 100 percent of the authorized bandwidth: At least 25 dB.
- 2 On any frequency removed from the assigned frequency by more than 100 percent, but no more than 250 percent of the authorized bandwidth: At least 35 dB.
- 3 On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least  $43+10\log (P)$  dB.

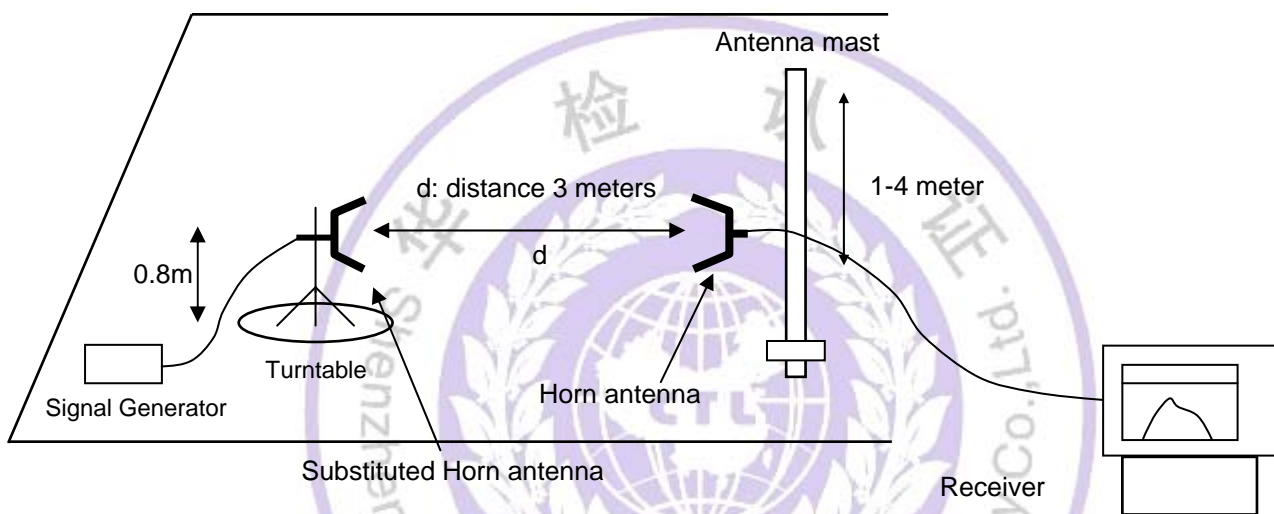
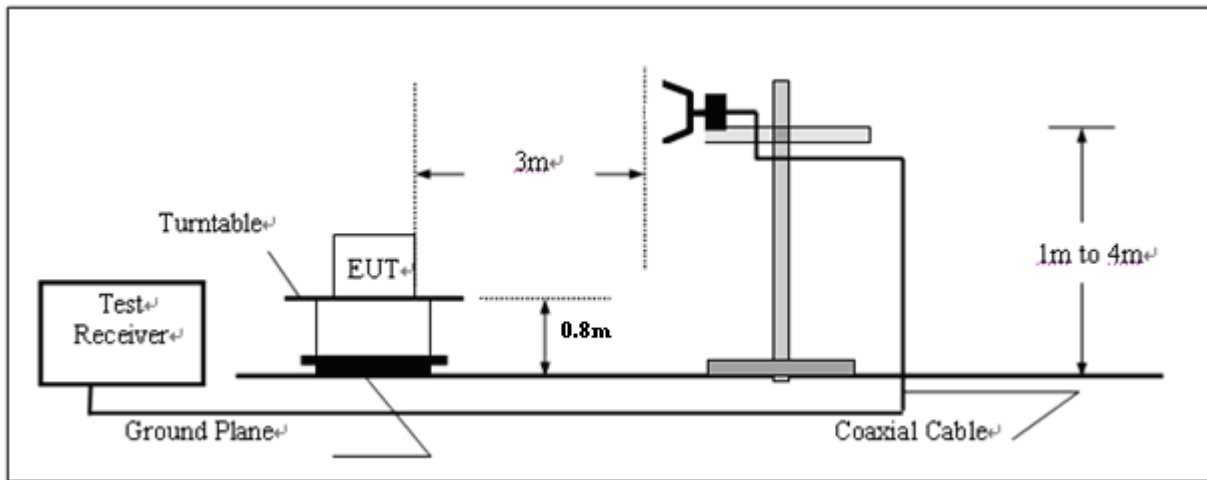
### TEST CONFIGURATION

Below 1GHz





## Above 1GHz

**TEST PROCEDURE**

- 1 Set the EMI Receiver (for measuring E-Field) and Receiver (for measuring EIRP) as follows:  
Center Frequency: equal to the signal source  
Resolution BW: 100 KHz  
Video BW: VBW > RBW  
Detector Mode: positive  
Average: off  
Span: 3 x the signal bandwidth
- 2 Load an appropriate correction factors file in EMI Receiver for correcting the field strength reading level  
Total Correction Factor recorded in the EMI Receiver = Cable Loss + Antenna Factor + Amplifier Gain  
 $E \text{ (dBuV/m)} = \text{Reading (dBuV)} + \text{Total Correction Factor (dB)}$
- 3 The transmitter under test was placed at the specified height on a non-conducting turntable (80 cm height)
- 4 Substitute the EUT by a signal generator and one of the following transmitting antenna (substitution antenna):  
DIPOLE antenna for frequency from 30-1000 MHz or  
HORN antenna for frequency above 1 GHz}.
- 5 Mount the transmitting antenna at 1.0 meter high from the ground plane.
- 6 Use one of the following antenna as a receiving antenna:  
DIPOLE antenna for frequency from 30-1000 MHz or  
HORN antenna for frequency above 1 GHz}.
- 7 If the DIPOLE antenna is used, tune it's elements to the frequency as specified in the calibration manual.
- 8 Adjust both transmitting and receiving antenna in a VERTICAL polarization.
- 9 Tune the EMI Receivers to the test frequency.
- 10 Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.
- 11 The transmitter was rotated through 360° about a vertical axis until a higher maximum signal was received.
- 12 Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.

- 13 Adjust input signal to the substitution antenna until an equal or a known related level to that detected from the transmitter was obtained in the test receiver.
- 14 Record the power level read from the Average Power Meter and calculate the ERP/EIRP as follows:  

$$P = P_1 - L_1 = (P_2 + L_2) - L_1 = P_3 + A + L_2 - L_1$$

$$EIRP = P + G_1 = P_3 + L_2 - L_1 + A + G_1$$

$$ERP = EIRP - 2.15 \text{ dB}$$
 Total Correction factor in EMI Receiver =  $L_2 - L_1 + G_1$
- Where:  
 P: Actual RF Power fed into the substitution antenna port after corrected.  
 P<sub>1</sub>: Power output from the signal generator  
 P<sub>2</sub>: Power measured at attenuator A input  
 P<sub>3</sub>: Power reading on the Average Power Meter  
 EIRP: EIRP after correction  
 ERP: ERP after correction
- 15 Adjust both transmitting and receiving antenna in a Horizontal polarization, then repeat step (11) to (14).
- 16 Repeat step (4) to (16) for different test frequency
- 17 Repeat steps (3) to (12) with the substitution antenna oriented in horizontal polarization.
- 18 Actual gain of the EUT's antenna is the difference of the measured EIRP and measured RF power at the RF port. Correct the antenna gain if necessary.

**TEST RESULTS**

**Modulation Type: GMSK**

FCC Part 22.359, 74.462, 80.211 and 90.210 and RSS Gen, RSS 119 Issue 11 (12.5 kHz Bandwidth only):  
 On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f d in kHz) of more than 12.5 kHz at least:

Low:  $50 + 10 \log (P_{\text{watts}}) = 50 + 10 \log (5.87) = 57.69 \text{ dB}$

High:  $50 + 10 \log (P_{\text{watts}}) = 50 + 10 \log (5.96) = 57.75 \text{ dB}$

Note: In general, the worse case attenuation requirement shown above was applied.

Calculation: Limit (dBm) = EL-50-10log10 (TP)

Notes: EL is the emission level of the Output Power expressed in dBm,  
 In this application, the EL is 36.99 dBm.  
 Limit (dBm) = 36.99-50-10log10 (5.96) = -20 dBm

Note: 1. In general, the worse case attenuation requirement shown above was applied.

2. The measurement frequency range from 30 MHz to 5 GHz.

3. \*\*\* means that the emission level is too low to be measured or at least 20 dB down than the limit.

Modulation		GMSK		Channel Separation		12.5KHz		
Test Channel		Low Channel		Test Frequency		406.5000 MHz		
Frequency (MHz)	E-Field Level (dBuv/m)	EMI Detector (Peak/QP)	Antenna Polarization	Antenna Height (cm)	Table Angle (Degree)	ERP measured by Substitution Method (dBm)	Limit (dBm)	Margin (dB)
813.000	52.34	Peak	H	333	356	-44.22	-20	24.22
3658.500	57.11	Peak	H	200	177	-38.96	-20	18.96
4065.000	66.81	Peak	H	100	134	-29.43	-20	9.43
...	...		H					
813.000	53.16	Peak	V	128	299	-43.76	-20	23.76
3658.500	58.38	Peak	V	124	122	-38.13	-20	18.13
4065.000	64.68	Peak	V	124	89	-31.76	-20	11.76
...	...		V					

Modulation		GMSK		Channel Separation		12.5KHz		
Test Channel		Middle Channel		Test Frequency		435.0000 MHz		
Frequency (MHz)	E-Field Level (dBuV/m)	EMI Detector (Peak/QP)	Antenna Polarization	Antenna Height (cm)	Table Angle (Degree)	ERP measured by Substitution Method (dBm)	Limit (dBm)	Margin (dB)
870.000	60.99	Peak	H	108	0	-35.54	-20	15.54
1740.000	58.12	Peak	H	155	341	-37.87	-20	17.87
2610.000	58.28	Peak	H	300	204	-38.14	-20	8.14
...	...		H					
870.000	57.24	Peak	V	100	73	-39.50	-20	19.50
1740.000	62.55	Peak	V	128	169	-34.42	-20	14.42
2610.000	61.11	Peak	V	150	254	-35.65	-20	15.65
...	...		V					

Modulation		GMSK		Channel Separation		12.5KHz		
Test Channel		High Channel		Test Frequency		469.5000 MHz		
Frequency (MHz)	E-Field Level (dBuV/m)	EMI Detector (Peak/QP)	Antenna Polarization	Antenna Height (cm)	Table Angle (Degree)	ERP measured by Substitution Method (dBm)	Limit (dBm)	Margin (dB)
939.000	55.95	Peak	H	100	307	-40.46	-20	20.46
4225.500	65.53	Peak	H	200	88	-30.68	-20	10.68
4695.000	67.44	Peak	H	159	144	-28.96	-20	8.96
...	...		H					
939.000	53.98	Peak	V	100	273	-42.47	-20	22.47
4225.500	67.11	Peak	V	150	100	-29.32	-20	9.32
4695.000	69.06	Peak	V	150	56	-27.36	-20	7.36
...	...		V					

### 4.3. Spurious Emission On Antenna Port

#### TEST APPLICABLE

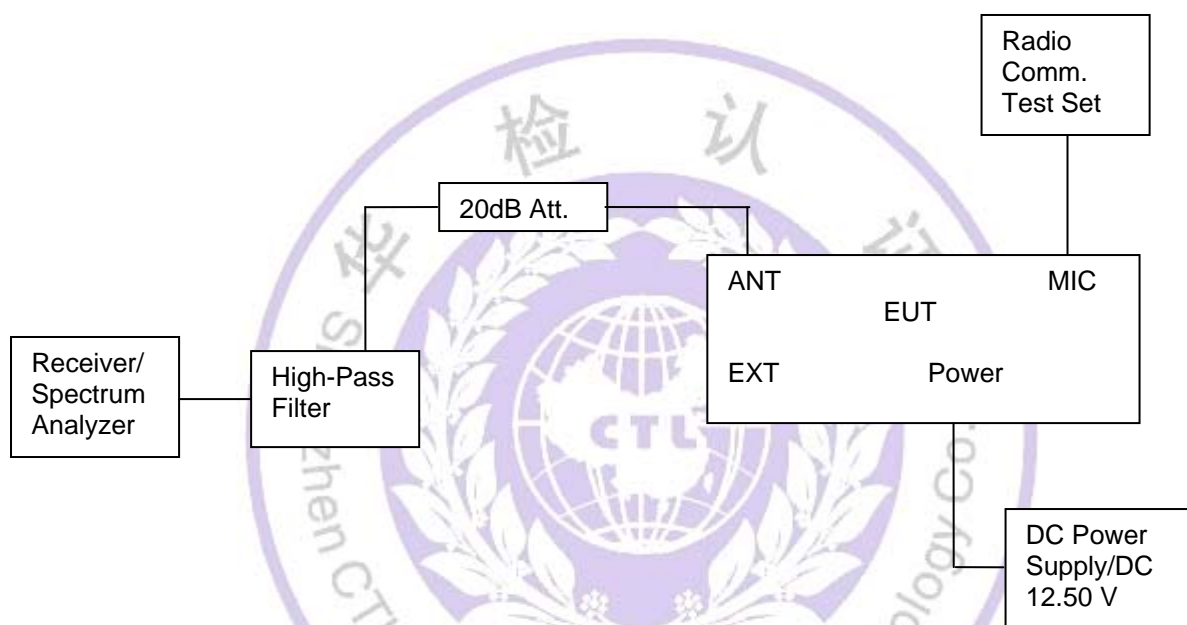
The same as Section 4.3

#### TEST PROCEDURE

The RF output of the EUT was connected to a spectrum analyzer through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set to 100 kHz. Sufficient scans were taken to show any out of band emission up to 10th. Harmonic for the lower and the highest frequency range. Set RBW 100 kHz, VBW 300 kHz in the frequency band 30MHz to 1GHz, while set RBW=1MHz.VBW=3MHz from the 1GHz to 10<sup>th</sup> Harmonic.

The audio input was set to 0 to get the unmodulated carrier, the resulting picture is print out for each channel separation.

#### TEST CONFIGURATION



#### TEST RESULTS:

##### **Modulation Type: GMSK**

FCC Part 22.359, 74.462, 80.211 and 90.210 and RSS Gen, RSS 119 Issue 11 (12.5 kHz Bandwidth only):  
 On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f d in kHz) of more than 12.5 kHz at least:

Low:  $50 + 10 \log (P_{\text{watts}}) = 50 + 10 \log (5.87) = 57.69 \text{ dB}$

High:  $50 + 10 \log (P_{\text{watts}}) = 50 + 10 \log (5.96) = 57.75 \text{ dB}$

Note: In general, the worse case attenuation requirement shown above was applied.

Calculation:  $\text{Limit (dBm)} = \text{EL} - 50 - 10 \log_{10} (\text{TP})$

Notes: EL is the emission level of the Output Power expressed in dBm,  
 In this application, the EL is 36.99 dBm.

$\text{Limit (dBm)} = 36.99 - 50 - 10 \log_{10} (5.96) = -20 \text{ dBm}$

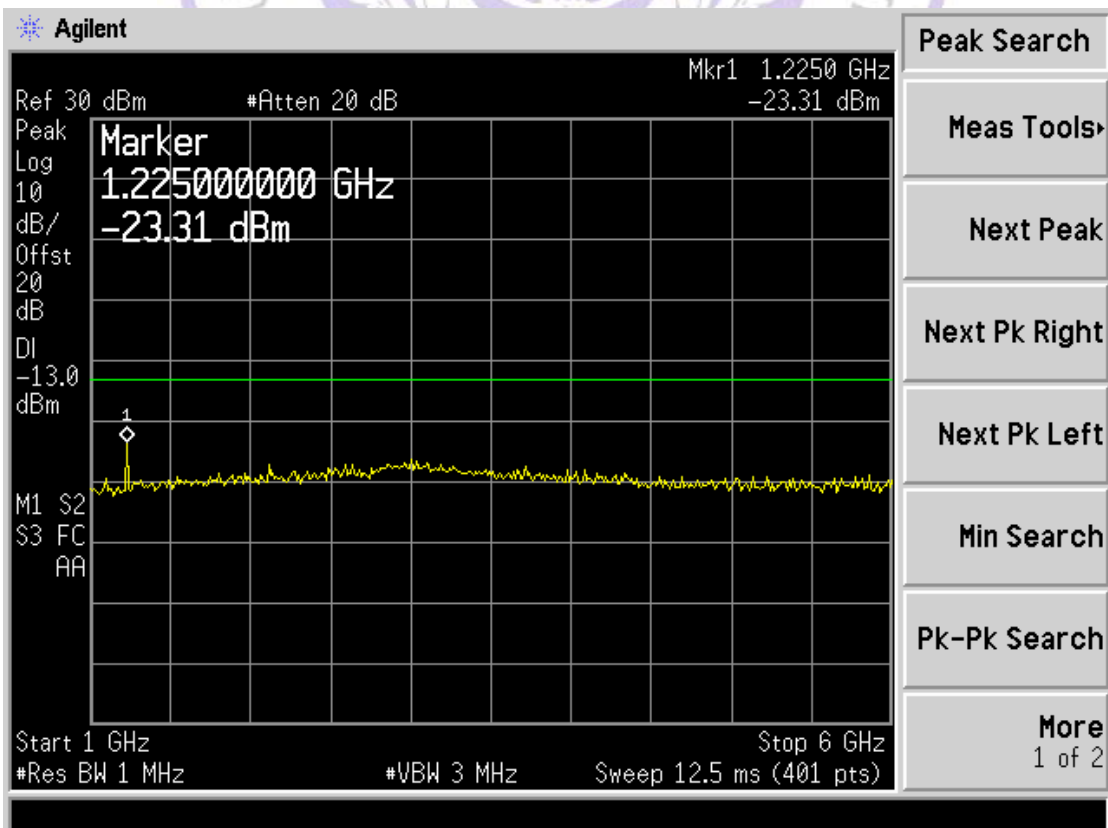
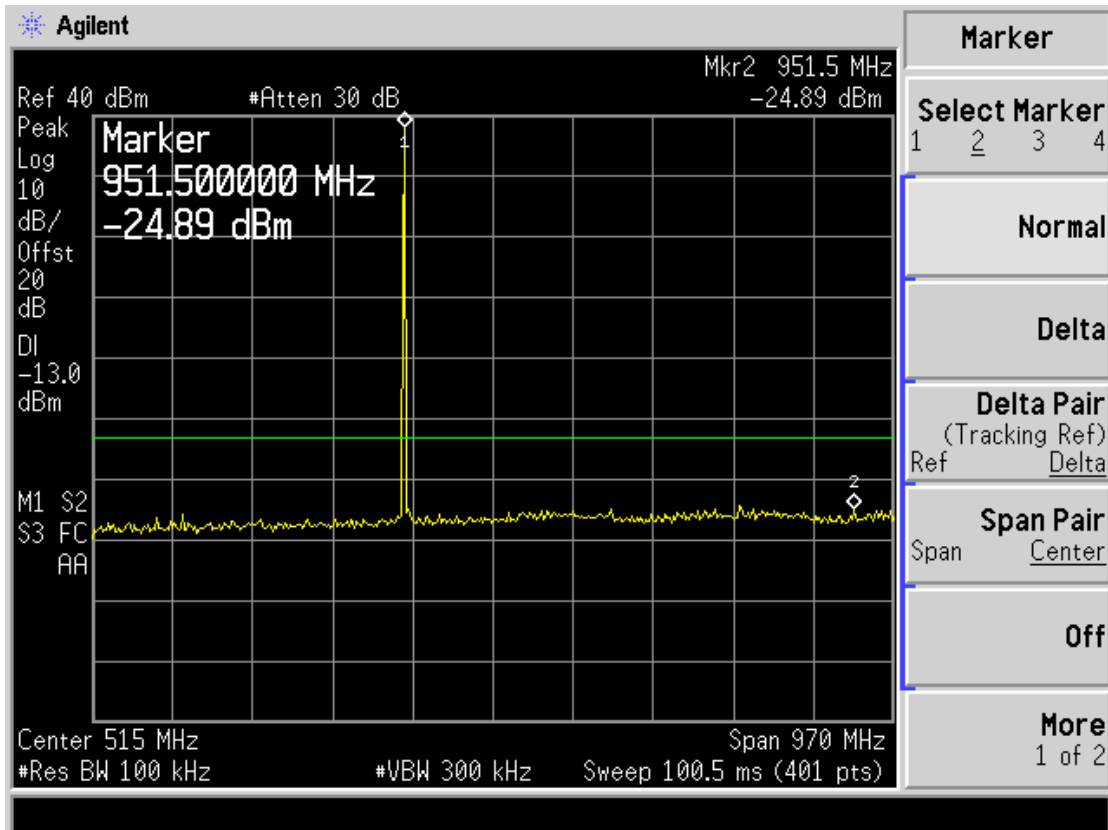
- Note: 1. In general, the worse case attenuation requirement shown above was applied.  
 2. The measurement frequency range from 30 MHz to 5 GHz.

Modulation Type	Channel Separation	Test Channel	Test Frequency (MHz)	Maximum Conducted Spurious Emissions Below 1GHz		Maximum Conducted Spurious Emissions Above 1GHz	
				Frequency (MHz)	Datum (dBm)	Frequency (MHz)	Datum (dBm)
GMSK	12.5KHz	Low	406.5000	951.50	-24.89	1225.00	-23.31
		Middle	435.0000	801.20	-23.95	1300.50	-23.34
		High	469.5000	946.70	-24.95	1412.50	-24.38
Limit		-20dBm for 12.5KHz Channel Separation					
Test Results		Compliance					

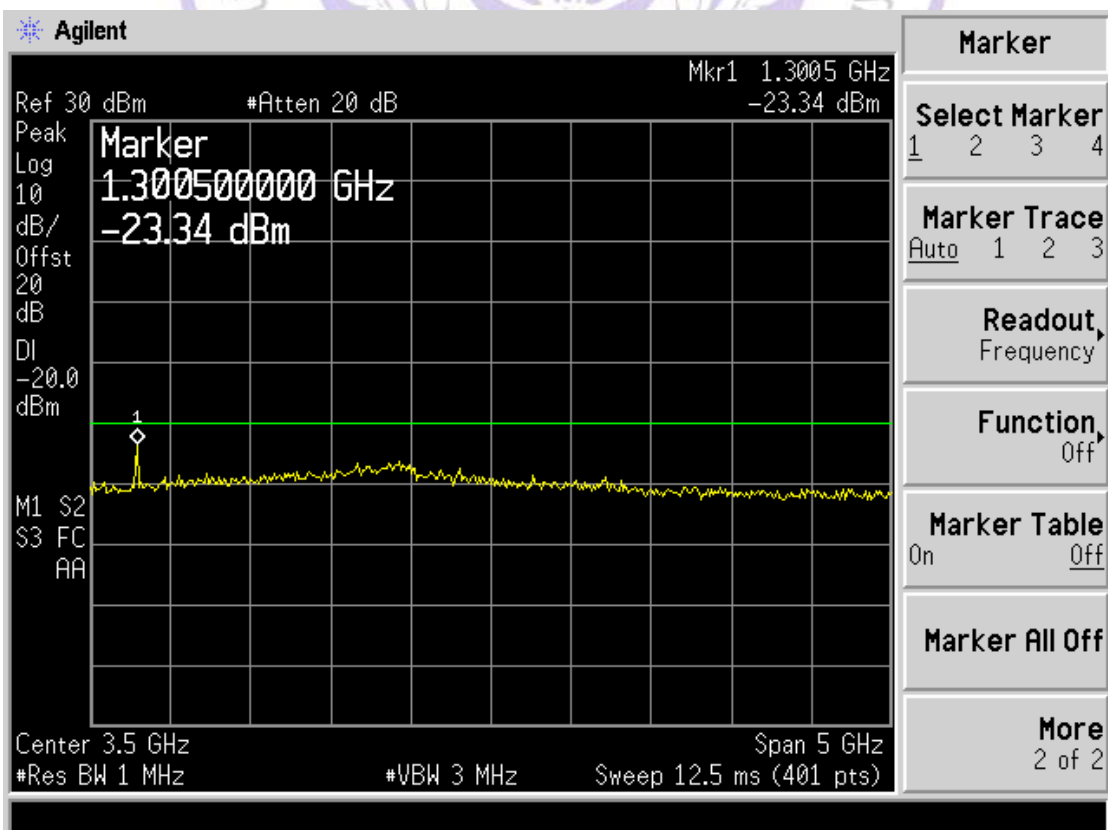
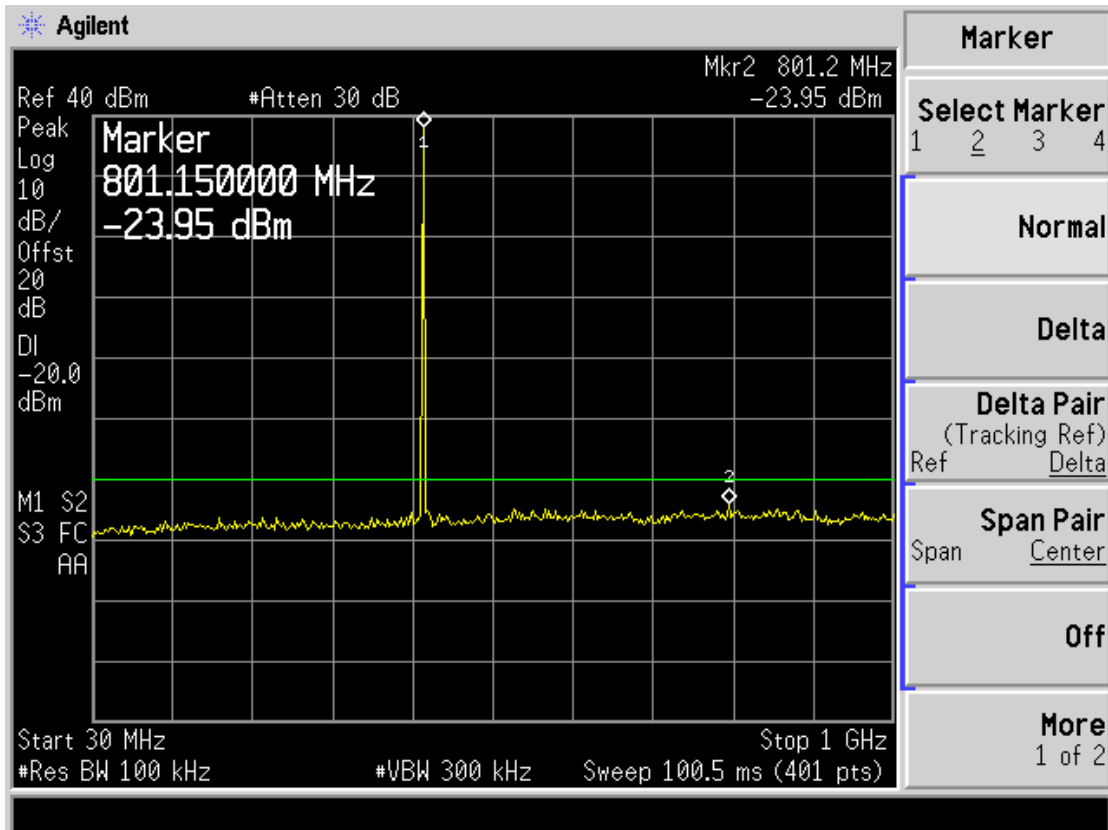
**Plots of Spurious Emission on Antenna Port Measurement**



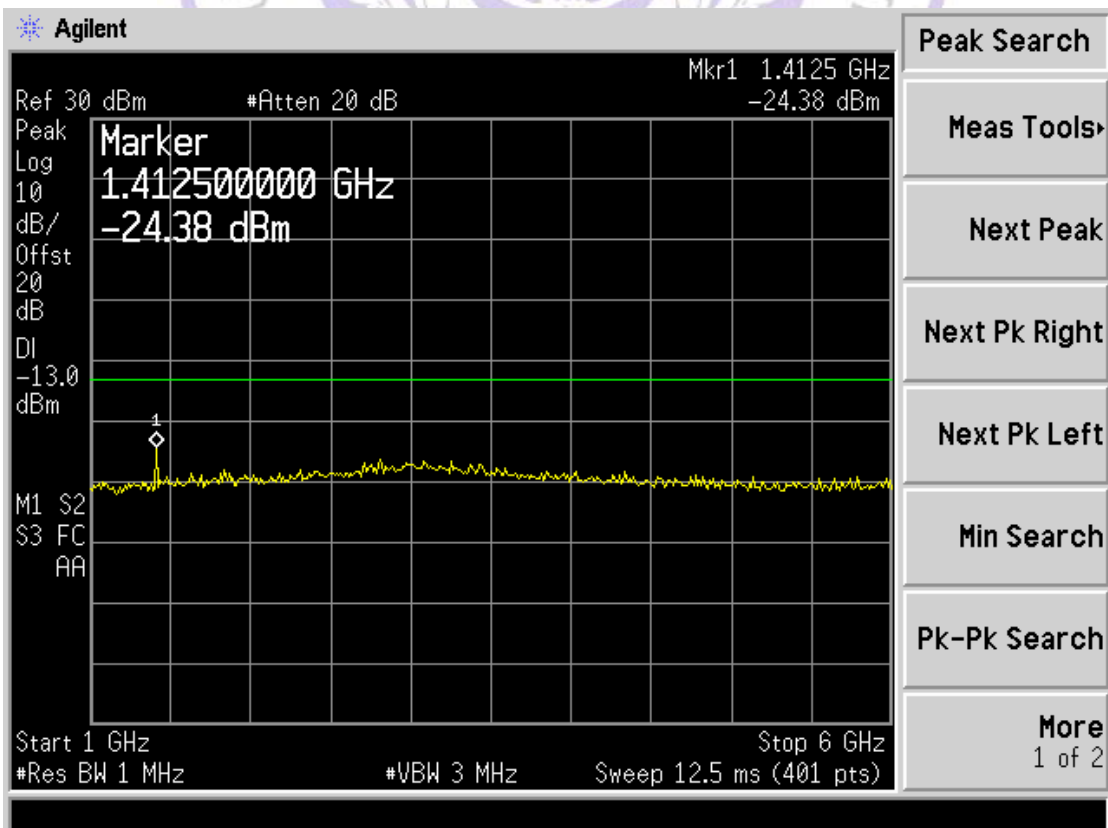
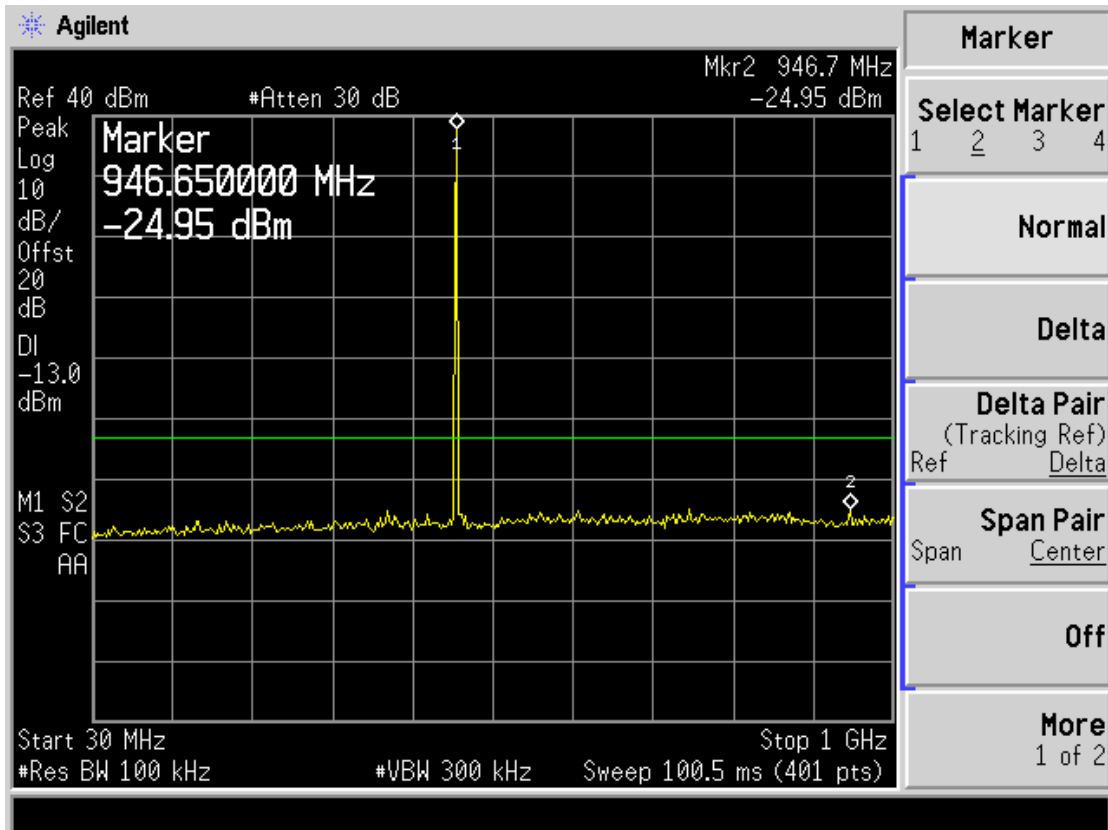
Modulation Type	Channel Separation	Test Channel	Test Frequency (MHz)	Maximum Conducted Spurious Emissions Below 1GHz		Maximum Conducted Spurious Emissions Above 1GHz		FCC Limit
				Frequency (MHz)	Datum (dBm)	Frequency (MHz)	Datum (dBm)	
GMSK	12.5KHz	Low	406.5000	951.50	-24.89	1225.00	-23.31	-20dBm
Test Results				Compliance				



Modulation Type	Channel Separation	Test Channel	Test Frequency (MHz)	Maximum Conducted Spurious Emissions Below 1GHz		Maximum Conducted Spurious Emissions Above 1GHz		FCC Limit
				Frequency (MHz)	Datum (dBm)	Frequency (MHz)	Datum (dBm)	
GMSK	12.5KHz	Middle	435.0000	801.20	-23.95	1300.50	-23.34	-20dBm
Test Results				Compliance				



Modulation Type	Channel Separation	Test Channel	Test Frequency (MHz)	Maximum Conducted Spurious Emissions Below 1GHz		Maximum Conducted Spurious Emissions Above 1GHz		FCC Limit
				Frequency (MHz)	Datum (dBm)	Frequency (MHz)	Datum (dBm)	
GMSK	12.5KHz	High	469.5000	946.70	-24.95	1412.50	-24.38	-20dBm
Test Results				Compliance				





## 4.4. Modulation Characteristics

### TEST APPLICABLE

According to CFR47 section 2.1047(a), for Voice Modulation Communication Equipment, the frequency response of the audio modulation circuit over a range of 100 to 5000Hz shall be measured.

### TEST PROCEDURE

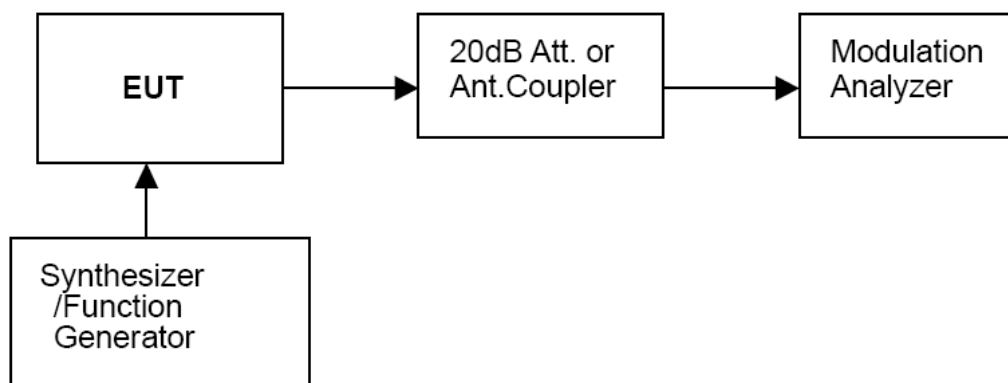
#### Modulation Limit

- 1 Configure the EUT as shown in figure 1, adjust the audio input for 60% of rated system deviation at 1 KHz using this level as a reference (0dB) and vary the input level from -20 to +20dB. Record the frequency deviation obtained as a function of the input level.
- 2 Repeat step 1 with input frequency changing to 300, 1004, 1500 and 2500Hz in sequence.

#### Audio Frequency Response

- 1 Configure the EUT as shown in figure 1.
- 2 Adjust the audio input for 20% of rated system deviation at 1 KHz using this level as a reference (0dB).
- 3 Vary the Audio frequency from 100 Hz to 3 KHz and record the frequency deviation.
- 4 Audio Frequency Response =  $20 \log_{10} (\text{Deviation of test frequency} / \text{Deviation of 1 KHz reference})$ .

### TEST CONFIGURATION



### TEST RESULTS

#### Modulation type: GMSK

Channel bandwidth: 12.5 kHz

It is not applicable for devices which operate with the digitized data modulation type.

#### b). Audio Frequency Response:

Rule Part No.: Part 2.1407(a) (b)

#### Method of Measurement:

The audio frequency response was measured in accordance with TIA/EIA Specification 603 with no exception. A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 300-3000Hz shall be submitted and Audio Post Limiter Low Pass Filter Response from 3.0 KHz to 50KHz. However, the audio frequency response should test from 100Hz to 5.0 KHz according to FCC Part 90.

#### Modulation type: GMSK

Channel bandwidth: 12.5 kHz

It is not applicable for devices which operate with the digitized data modulation type.

### 4.5. Frequency Stability Measurement

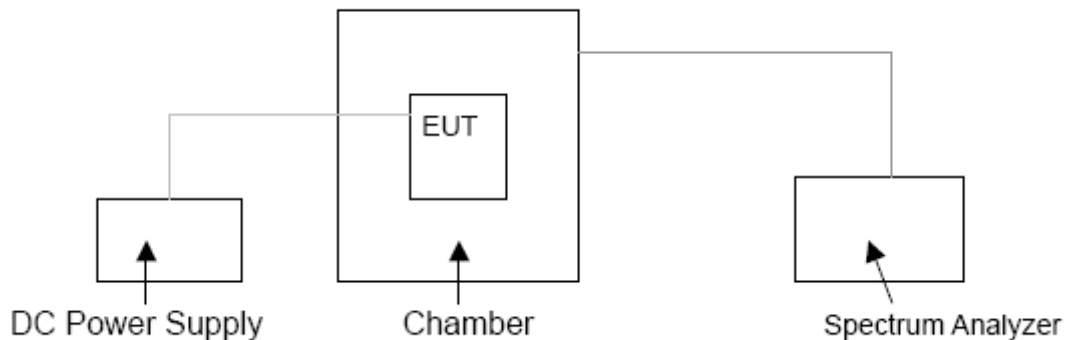
#### TEST APPLICABLE

- 1 According to FCC Part 2 Section 2.1055 (a)(1), the frequency stability shall be measured with variation of ambient temperature from -30°C to +50°C centigrade.
- 2 According to FCC Part 2 Section 2.1055 (a) (2), for battery powered equipment, the frequency stability shall be measured with reducing primary supply voltage to the battery operating end point, which is specified by the manufacture.
- 3 Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.
- 4 According to §90.213, the frequency stability limit is 1.5 ppm for 12.5 KHz channel separation.

#### TEST PROCEDURE

The EUT was set in the climate chamber and connected to an external DC power supply. The RF output was directly connected to Spectrum Analyzer ESI 26. The coupling loss of the additional cables was recorded and taken in account for all the measurements. After temperature stabilization (approx. 20 min for each stage), the frequency for the lower, the middle and the highest frequency range was recorded. For Frequency stability Vs. Voltage the EUT was connected to a DC power supply and the voltage was adjusted in the required ranges. The result was recorded.

#### TEST SETUP BLOCK DIAGRAM



#### TEST LIMITS

According to 90.213, Transmitters used must have minimum frequency stability as specified in the following table.

Frequency range (MHz)	Fixed and base stations	Mobile stations	
		Over 2 watts output power	2 watts or less output power
Below 25 .....	1,2,3 100	100	200
25-50 .....	20	20	50
72-76 .....	5	-----	50
150-174 .....	5,11 5	6 5	4,6 50
216-220 .....	1.0	-----	1.0
220-222 <sup>12</sup> .....	0.1	1.5	1.5
421-512 .....	7,11,14 2.5	8 5	8 5
806-809 .....	<sup>14</sup> 1.0	1.5	1.5
809-824 .....	<sup>14</sup> 1.5	2.5	2.5
851-854 .....	1.0	1.5	1.5
854-869 .....	1.5	2.5	2.5
896-901 .....	<sup>14</sup> 0.1	1.5	1.5
902-928 .....	2.5	2.5	2.5
902-928 <sup>13</sup> .....	2.5	2.5	2.5
929-930 .....	1.5	-----	-----
935-940 .....	0.1	1.5	1.5
1427-1435 .....	9 300	300	300
Above 2450 <sup>10</sup> .....	-----	-----	-----

Modulation Type	Channel Separation	Test conditions		Frequency error (ppm)		
		Voltage(V)	Temp(°C)	406.5000 (MHz)	435.0000 (MHz)	469.5000 (MHz)
Digital/GMSK	12.5KHz	12.50	-30	-1.05	-1.03	-1.01
			-20	-0.95	-0.85	-0.91
			-10	-0.66	-0.77	-0.77
			0	-0.61	-0.63	-0.61
			10	-0.54	-0.54	-0.50
			20	-0.54	-0.51	-0.50
			30	-0.52	-0.51	-0.50
			40	-0.52	-0.43	-0.46
			50	-0.49	-0.41	-0.43
		10.63 (85% Rated)	20	-0.91	-0.87	-0.84
		14.38 (115% Rated)	20	-0.47	-0.55	-0.53
Limit				1.50	1.50	1.50
Conclusion			Complies			



### 4.6. Conducted Output Power

#### TEST APPLICABLE

Per FCC «2.1046 and «90.205: Maximum ERP is dependent upon the station’s antenna HAAT and required service area.

#### TEST PROCEDURE

Measurements shall be made to establish the radio frequency power delivered by the transmitter the standard output termination. The power output shall be monitored and recorded and no adjustment shall be made to the transmitter after the test has begun, except as noted bellow:  
 If the power output is adjustable, measurements shall be made for the highest and lowest power levels. The EUT connect to the Receiver through 40 dB attenuator.  
 Measurement with Spectrum Analyzer FSP40 or Aglient E4407B conducted, external power supply with 12.50 V stabilized supply voltage.

#### TEST CONFIGURATION

EUT		Attenuator		Spectrum Analyzer/Receiver
-----	--	------------	--	----------------------------

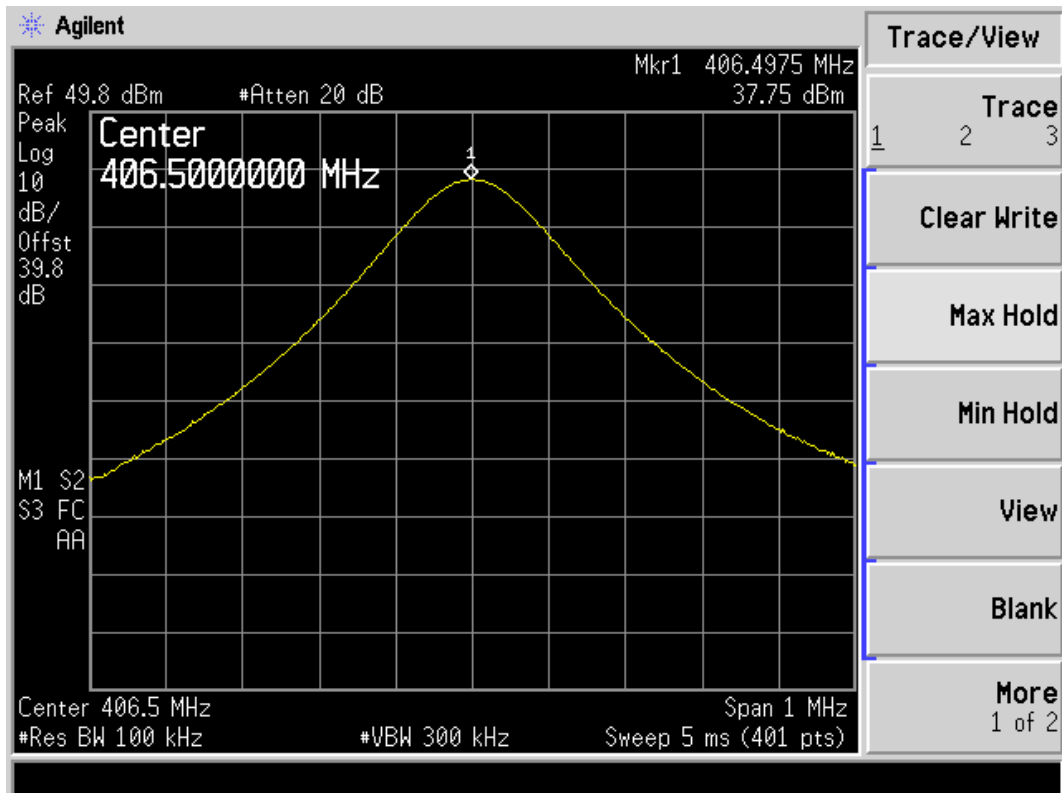
The EUT was directly connected to a RF Communication Test set by a 40 dB attenuator

#### TEST RESULTS

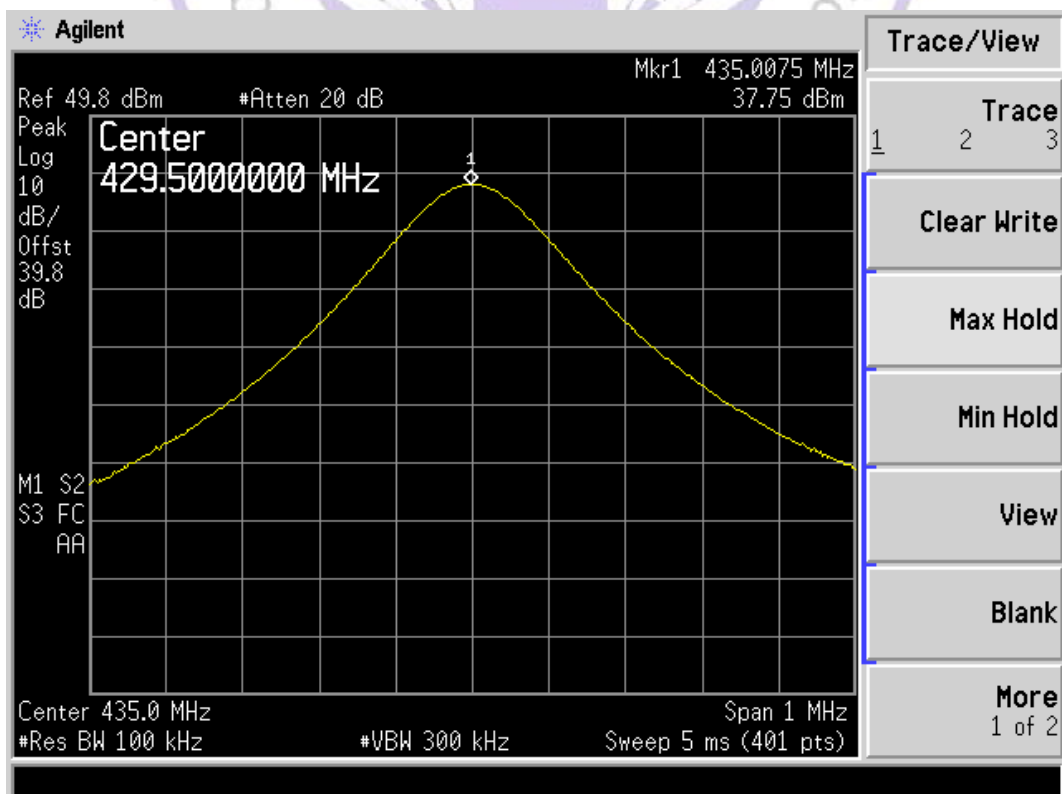
Frequency Range (MHz)	Modulation Type	Channel Separation (KHz)	Test Channel	Maximum Output Power Test Results (dBm)
400-470	Digital/GMSK	12.5	Low	37.75
			Middle	37.75
			High	37.69
Limit	The limit is dependent upon the station’s antenna HAAT and required service area.			
Test Results	Compliance			

#### Plots of Maximum Transmitter Power Measurement

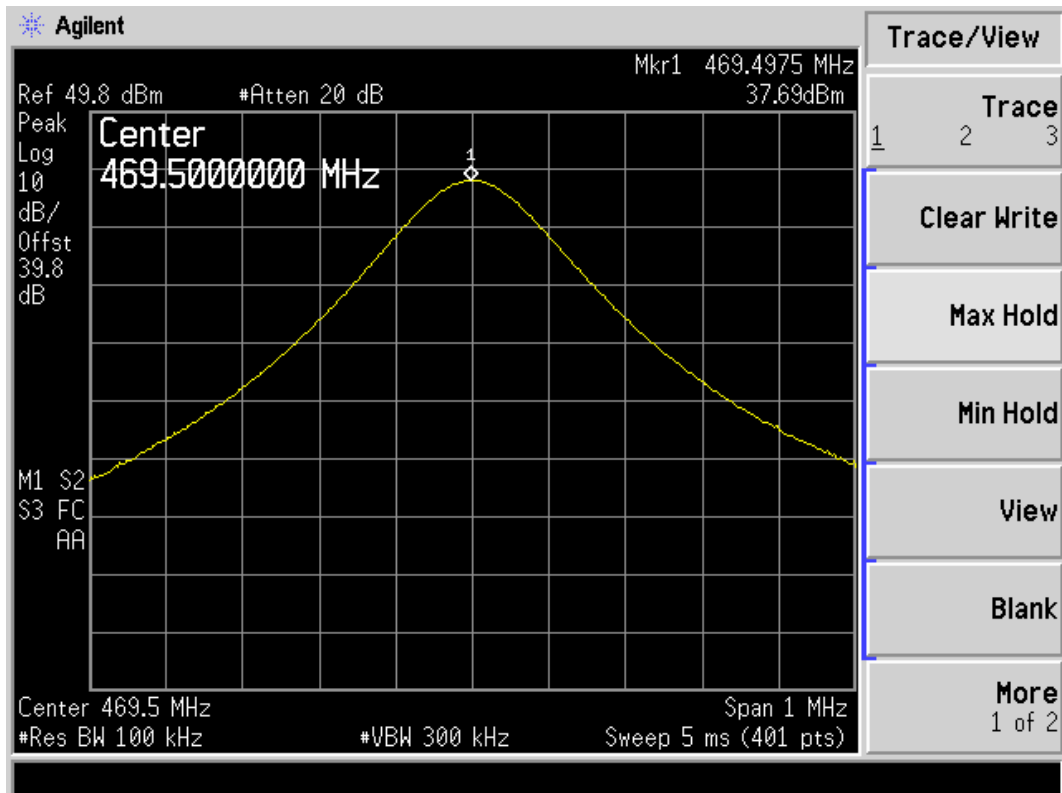
Modulation Type	Channel Separation	Freq.(MHz)	Rated Power (Watt)	Measurement (dBm)	FCC Limit	Results
GMSK	12.5 KHz	406.5000	5.0	37.75	Varies	Complicance



Modulation Type	Channel Separation	Freq.(MHz)	Rated Power (Watt)	Measurement (dBm)	FCC Limit	Results
GMSK	12.5 KHz	435.0000	5.0	37.75	Varies	Complicance



Modulation Type	Channel Separation	Freq.(MHz)	Rated Power (Watt)	Measurement (dBm)	FCC Limit	Results
GMSK	12.5 KHz	469.5000	5.0	37.69	Varies	Compliance



### 4.7. Transmitter Frequency Behavior

#### TEST APPLICABLE

Section 90.214

Transient frequencies must be within the maximum frequency difference limits during the time intervals indicated:

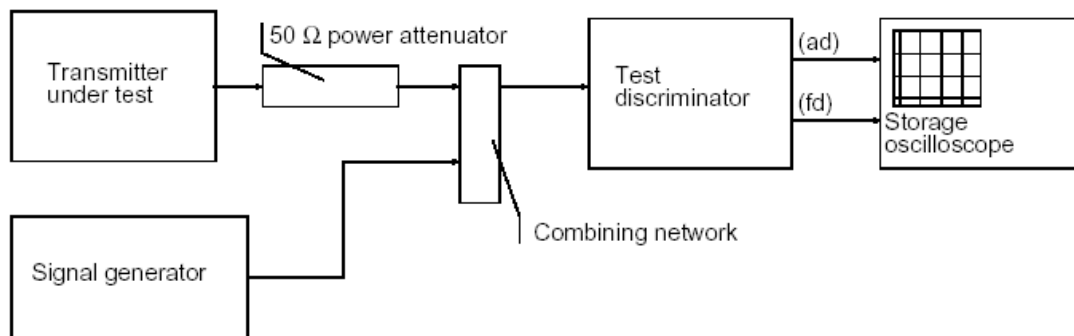
Time intervals <sup>1, 2</sup>	Maximum frequency difference <sup>3</sup>	All equipment	
		150 to 174 MHz	421 to 512MHz
Transient Frequency Behavior for Equipment Designed to Operate on 25 KHz Channels			
t <sub>1</sub> <sup>4</sup> .....	± 25.0 KHz	5.0 ms	10.0 ms
t <sub>2</sub> <sup>4</sup> .....	± 12.5 KHz	20.0 ms	25.0 ms
t <sub>3</sub> <sup>4</sup> .....	± 25.0 KHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 12.5 KHz Channels			
t <sub>1</sub> <sup>4</sup> .....	± 12.5 KHz	5.0 ms	10.0 ms
t <sub>2</sub> <sup>4</sup> .....	± 6.25 KHz	20.0 ms	25.0 ms
t <sub>3</sub> <sup>4</sup> .....	± 12.5 KHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 6.25 KHz Channels			
t <sub>1</sub> <sup>4</sup> .....	±6.25 KHz	5.0 ms	10.0 ms
t <sub>2</sub> <sup>4</sup> .....	±3.125 KHz	20.0 ms	25.0 ms
t <sub>3</sub> <sup>4</sup> .....	±6.25 KHz	5.0 ms	10.0 ms

- t<sub>on</sub> is the instant when a 1 KHz test signal is completely suppressed, including any capture time due to phasing.  
 t<sub>1</sub> is the time period immediately following t<sub>on</sub>.  
 t<sub>2</sub> is the time period immediately following t<sub>1</sub>.  
 t<sub>3</sub> is the time period from the instant when the transmitter is turned off until t<sub>off</sub>.  
 t<sub>off</sub> is the instant when the 1 KHz test signal starts to rise.
- During the time from the end of t<sub>2</sub> to the beginning of t<sub>3</sub>, the frequency difference must not exceed the limits specified in § 90.213.
- Difference between the actual transmitter frequency and the assigned transmitter frequency.
- If the transmitter carrier output power rating is 6 watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

#### TEST PROCEDURE

TIA/EIA-603 2.2.19

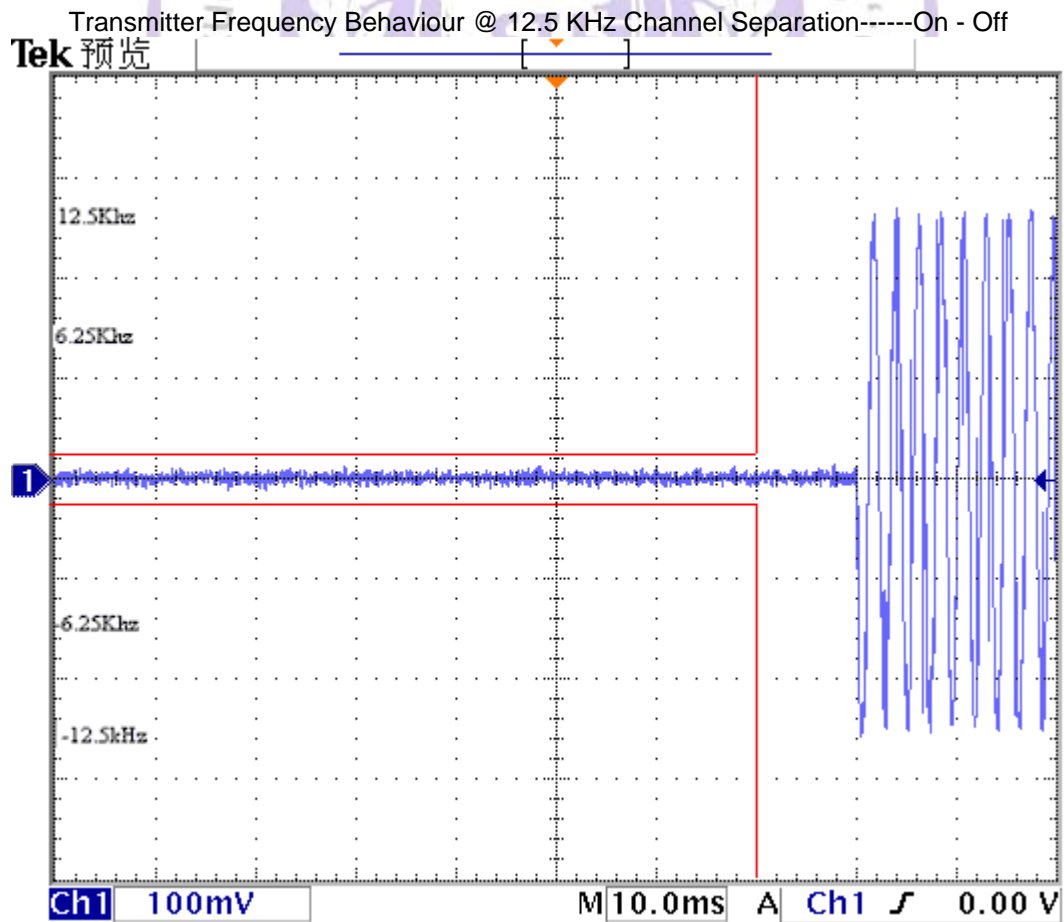
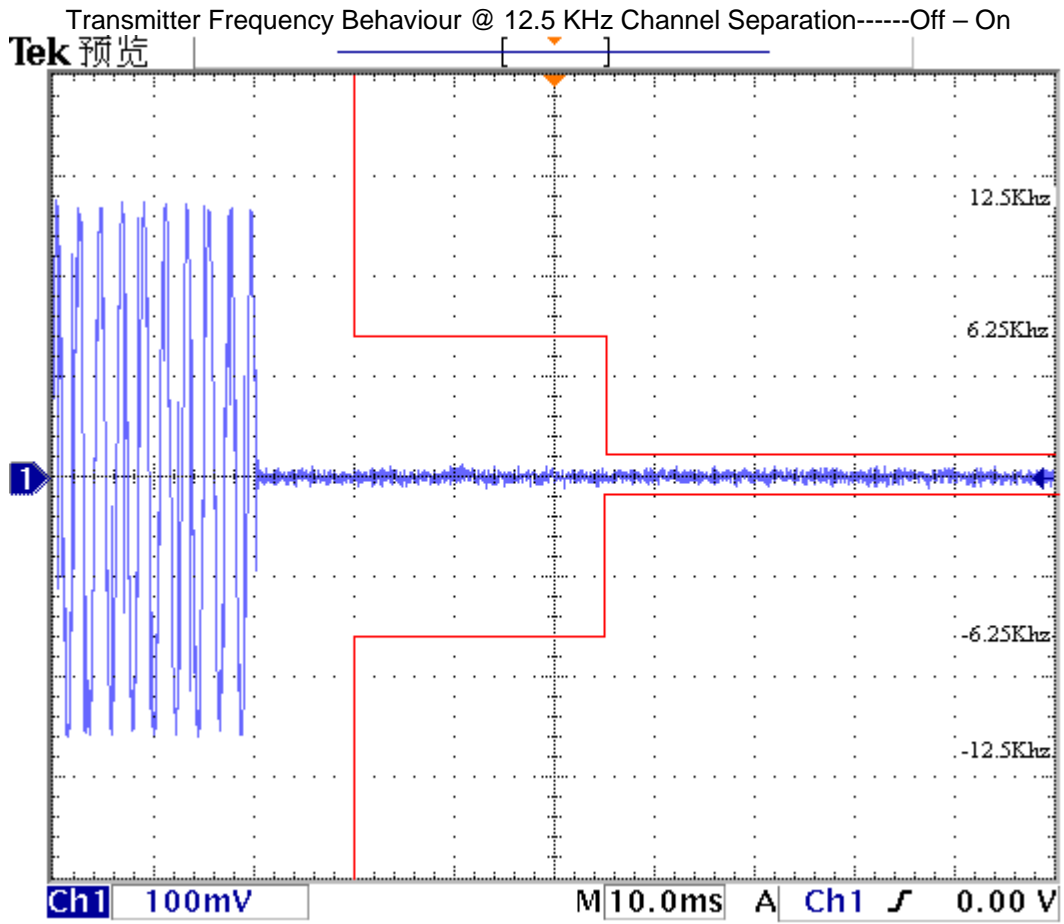
#### TEST CONFIGURATION



#### TEST RESULTS

Please refer to the following plots.

Modulation Type: GMSK





## 5. Test Setup Photos of the EUT



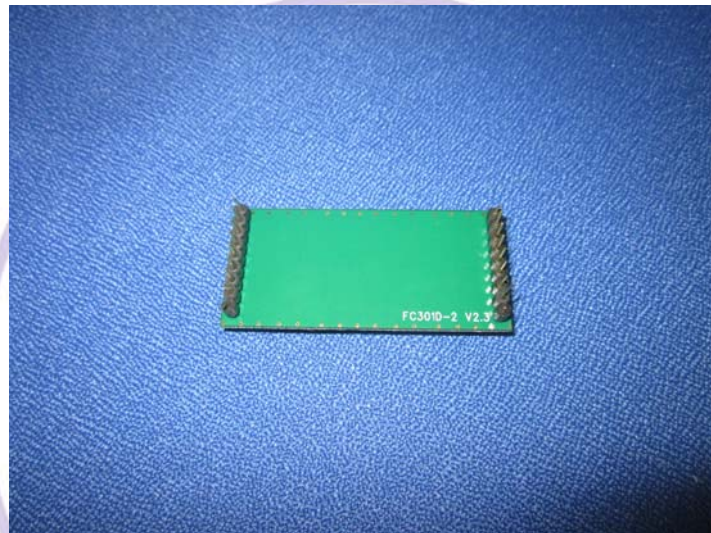
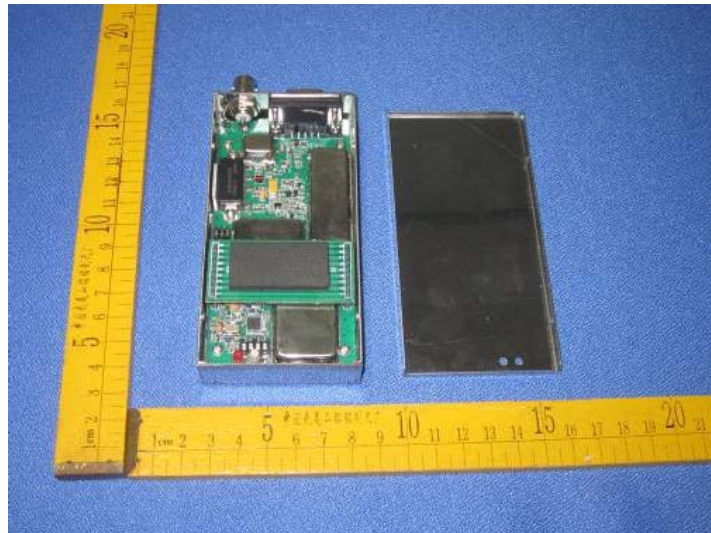
## 6. External and Internal Photos of the EUT

### External Photos





Internal Photos





.....End of Report.....