Shenzhen Huatongwei International Inspection Co., Ltd.
1/F,Bldg 3,Hongfa Hi-tech Industrial Park,Genyu Road,Tianliao,Gongming,Shenzhen,China
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TEST REPORT

Report Reference No. ..... :	**TRE15090106** **R/C……..: 90939**
FCC ID ..... :	**P6NDH-9100**
Applicant's name ..... :	**Shenzhen HQT Science&Technology Co., Ltd.**
Address..... :	5/F, East of Building M-8, Central Zone, Hi-tech Industrial Park, Nanshan District, Shenzhen,China
Manufacturer.....:	**Shenzhen HQT Science&Technology Co., Ltd.**
Address..... :	5/F, East of Building M-8, Central Zone, Hi-tech Industrial Park, Nanshan District, Shenzhen,China
Test item description ..... :	**Digital portable Radio**
Trade Mark ..... :	HQT
Model/Type reference..... :	DH-9100
Listed Model(s) ..... :	-
Standard ..... :	**FCC Part 90/FCC Part 2/ FCC Part 15B**
Date of receipt of test sample…….. :	Oct 26, 2015
Date of testing…… :	Oct 27, 2015- Nov 10, 2015
Date of issue……... :	Nov 10, 2015
Result..... ……..:	**PASS**

Compiled by (position+printed name+signature)..:	File administrators Shayne Zhu	Shayne Zhu
Supervised by (position+printed name+signature)..:	Project Engineer Cary Luo	Cary Luo
Approved by (position+printed name+signature)..:	RF Manager Hans Hu	Hans Hu

Testing Laboratory Name ..... :	**Shenzhen Huatongwei International Inspection Co., Ltd.**
Address..... :	1/F, Bldg 3, Hongfa Hi-tech Industrial Park, Genyu Road, Tianliao, Gongming, Shenzhen, China

Contents

1. TEST STANDARDS AND TEST DESCRIPTION

1.1. Test Standards

The tests were performed according to following standards:
FCC Rules Part 90: 2014 Private land mobile radio services.
TIA/EIA 603 D: June 2010 Land Mobile FM or PM Communications Equipment Measurement and Performance Standards.
FCC Part 15 Subpart B: 2014 Unintentional Radiators
FCC Part 2: 2014 Frequency allocations and radio treaty matters, general rules and regulations.
KDB579009 D01 v03r01: Questions and Answers on Re-farming Part 90 frequencies
KDB 579009 D02 v01r02: Transition Summary Table

1.2. Test Description

Transmitter Requirement			
Test item	Standards requirement	Result	
		Pass	N/A
Maximum Transmitter Power	FCC Part 90.205	☒	
Modulation Characteristic	FCC Part 90.207	☒	
Occupied Bandwidth	FCC Part 90.209	☒	
Emission Mask	FCC Part 90.210	☒	
Frequency Stability	FCC Part 90.213	☒	
Transmitter Frequency Behavior	FCC Part 90.214	☒	
Transmitter Radiated Spurious Emission	FCC Part 90.210	☒	
Spurious Emission On Antenna Port	FCC Part 90.210	☒	
Receiver Requirement			
Test item	Standards requirement	Result	
		Pass	N/A
Conducted Emission	FCC Part 15.207	☒	
Radiated Spurious Emission	FCC Part 15.109	☒	

2. SUMMARY

2.1. Client Information

Applicant:	Shenzhen HQT Science&Technology Co., Ltd.
Address:	5/F, East of Building M-8, Central Zone, Hi-tech Industrial Park, Nanshan District, Shenzhen,China
Manufacturer:	Shenzhen HQT Science&Technology Co., Ltd.
Address:	5/F, East of Building M-8, Central Zone, Hi-tech Industrial Park, Nanshan District, Shenzhen,China

2.2. Product Description

Name of EUT:	Digital portable Radio	
Trade mark:	HQT	
Model/Type reference:	DH-9100	
Listed Model(s):	-	
Power supply:	DC 7.40V	
Battery information:	Model:BL2002 7.4Vd.c., 2000mAh/14.8Wh	
Charger information:	Model:CL1000 Input:12Vd.c.,1000mA Output:1000mA	
Adapter information:	Model: NLB100120W1A Input: 100-240Va.c., 50/60Hz, 0.4A Max Output:12.0Vd.c., 1A	
Operation Frequency Range:	From 400MHz to 470 MHz	
Rated Output Power:	High Power:4 Watts(36.02dBm)/Low Power:1 Watts(30dBm)	
Modulation Type:	Analog Voice:	FM
	Digital Voice /Digital Data:	4FSK
Digital Type:	DMR	
Channel Separation:	Analog Voice:	☒ 12.5kHz
	Digital Voice /Digital Data:	☒ 12.5kHz ☐ 6.25kHz
Emission Designator:	Analog Voice:	☒12.5kHz Channel Separation: 9K85F3E ☐25kHz Channel Separation: ---
	Digital Voice& Data:	☒12.5kHz Channel Separation: 8K04FXW ☐6.25kHz Channel Separation: ---
	Digital Data:	☒12.5kHz Channel Separation: 8K04FXD ☐6.25kHz Channel Separation: ---
Support data rate:	9.6kbps	
Antenna Type:	External	
Maximum Transmitter Power:	Analog	3.78W for 12.5kHz Channel Separation
	Digital	3.83W for 12.5kHz Channel Separation

Note:

1)The product has the same digital working characters when operating in both two digitized voice/data mode. So only one set of test results for digital modulation modes are provided in this test report.

2)This equipment is capable of supporting a minimum data rate of 4800 bits per second per 6.25 kHz of channel bandwidth. DMR interphone's bandwidth is 12.5 kHz, and it has a double time slot, one is the speech time slot, one is the data time slot, just language sequence is satisfied with 4800 bps/6.25 kHz BW.

2.3. Test frequency list

Mode	Modulation	Operation Frequency Range	Test Frequency (MHz)	
Digital	4FSK	406.1MHz~420MHz	CH_L	406.1125
			CH_M	413.0500
			CH_H	419.9875
		421MHz~470MHz	CH_L	421.0125
			CH_M	455.0000
			CH_H	469.9875
Analog	FM	406.1MHz~420MHz	CH_L	406.1125
			CH_M	413.0500
			CH_H	419.9875
		421MHz~470MHz	CH_L	421.0125
			CH_M	455.0000
			CH_H	469.9875

Note:

In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, please see the above listed frequency for testing.

2.4. EUT operation mode

Test mode	Transmitting	Power level		Digital	Analog	AC Adapter
		High	Low	12.5kHz	12.5kHz	
TX1	√	√		√		
TX2	√		√	√		
TX3	√	√			√	
TX4	√		√		√	
Charging						√

√: is operation mode.

2.5. EUT configuration

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

● - supplied by the manufacturer

○ - supplied by the lab

○	Power Cable	Length (m) :	/
		Shield :	Unshielded
		Detachable :	Undetachable
○	Multimeter	Manufacturer :	/
		Model No. :	/

3. TEST ENVIRONMENT

3.1. Address of the test laboratory

Laboratory:Shenzhen Huatongwei International Inspection Co., Ltd.
Address: 1/F, Bldg 3, Hongfa Hi-tech Industrial Park, Genyu Road, Tianliao, Gongming, Shenzhen, China
Phone: 86-755-26748019 Fax: 86-755-26748089

3.2. Test Facility

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

CNAS-Lab Code: L1225
Shenzhen Huatongwei International Inspection Co., Ltd. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC17025: 2005 General Requirements) for the Competence of Testing and Calibration Laboratories, Date of Registration: February 28, 2015. Valid time is until February 27, 2018.

A2LA-Lab Cert. No. 3902.01
Shenzhen Huatongwei International Inspection Co., Ltd. EMC Laboratory has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2005 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing. Valid time is until December 31, 2016.

FCC-Registration No.: 317478
Shenzhen Huatongwei International Inspection Co., 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 317478, Renewal date Jul. 18, 2014, valid time is until Jul. 18, 2017.

IC-Registration No.: 5377A&5377B
The 3m Alternate Test Site of Shenzhen Huatongwei International Inspection Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for the performance of radiated measurements with Registration No. 5377A on Dec. 31, 2013, valid time is until Dec. 31, 2016.
Two 3m Alternate Test Site of Shenzhen Huatongwei International Inspection Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for the performance of radiated measurements with Registration No. 5377B on Dec.03, 2014, valid time is until Dec.03, 2017.

ACA
Shenzhen Huatongwei International Inspection Co., Ltd. EMC Laboratory can also perform testing for the Australian C-Tick mark as a result of our A2LA accreditation.

VCCI
The 3m Semi-anechoic chamber (12.2m×7.95m×6.7m) of Shenzhen Huatongwei International Inspection Co., Ltd. has been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-2484. Date of Registration: Dec. 20, 2012. Valid time is until Dec. 29, 2015.
Radiated disturbance above 1GHz measurement of Shenzhen Huatongwei International Inspection Co., Ltd. has been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: G-292. Date of Registration: Dec. 24, 2013. Valid time is until Dec. 23, 2016.
Main Ports Conducted Interference Measurement of Shenzhen Huatongwei International Inspection Co., Ltd. has been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: C-2726. Date of Registration: Dec. 20, 2012. Valid time is until Dec. 19, 2015.
Telecommunication Ports Conducted Interference Measurement of Shenzhen Huatongwei International Inspection Co., Ltd. has been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: T-1837. Date of Registration: May 07, 2013. Valid time is until May 06, 2016.

DNV
Shenzhen Huatongwei International Inspection Co., Ltd. has been found to comply with the requirements of DNV towards subcontractor of EMC and safety testing services in conjunction with the EMC and Low voltage Directives and in the voluntary field. The acceptance is based on a formal quality Audit and follow-ups according to relevant parts of ISO/IEC Guide 17025 (2005), in accordance with the requirements of the DNV Laboratory Quality Manual towards subcontractors. Valid time is until Aug. 24, 2016.

3.3. Environmental conditions

Normal Conditon	
Relative humidity:	20 % to 75 %.
Air Pressure:	950~1050mba
Voltage:	DC 7.4V

3.4. 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 Shenzhen Huatongwei International Inspection Co., 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 Shenzhen Huatongwei laboratory is reported:

Test Items	Measurement Uncertainty	Notes
Frequency stability	25 Hz	(1)
Transmitter power conducted	0.57 dB	(1)
Transmitter power Radiated	2.20 dB	(1)
Conducted spurious emission 9KHz-40 GHz	1.60 dB	(1)
Conducted Emission 9KHz-30MHz	3.39 dB	(1)
Radiated Emission 30~1000MHz	4.65 dB	(1)
Radiated Emission 1~18GHz	5.16 dB	(1)
Radiated Emission 18-40GHz	5.54 dB	(1)
Occupied Bandwidth	---------	(1)
Emission Mask	---------	(1)
Modulation Characteristic	---------	(1)
Transmitter Frequency Behavior	---------	(1)

(1) This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=1.96.

3.5. Equipments Used during the Test

Conducted Emission				
Name of Equipment	Manufacturer	Model	Serial Number	Last Cal.
Artificial Mains	Rohde&Schwarz	ESH2-Z5	100028	2015/11/2
EMI Test Receiver	Rohde&Schwarz	ESCS 30	100038	2015/11/2
Pulse Limiter	Rohde&Schwarz	ESHSZ2	100044	2015/11/2
EMI Test Software	Rohde&Schwarz	ES-K1 V1.71	N/A	N/A
RF COMMUNICATION TEST SET	HP	8920A	3813A10206	2015/11/2
Artificial Mains	Rohde&Schwarz	ESH3-Z6	100210	2015/11/2
Artificial Mains	Rohde&Schwarz	ESH3-Z6	100211	2015/11/2

Modulation Characteristic				
Name of Equipment	Manufacturer	Model	Serial Number	Last Cal.
RF COMMUNICATION TEST SET	HP	8920A	3813A10206	2015/11/2

Frequency Stability				
Name of Equipment	Manufacturer	Model	Serial Number	Last Cal.
RF COMMUNICATION TEST SET	HP	8920A	3813A10206	2015/11/2
Signal Generator	Rohde&Schwarz	SMT03	100059	2015/11/2
Climate Chamber	ESPEC	EL-10KA	05107008	2015/11/2

Transmitter Radiated Spurious Emission				
Name of Equipment	Manufacturer	Model	Serial Number	Last Cal.
Ultra-Broadband Antenna	Rohde&Schwarz	HL562	100015	2015/11/2
EMI Test Receiver	Rohde&Schwarz	ESI 26	100009	2015/11/2
RF Test Panel	Rohde&Schwarz	TS / RSP	335015/ 0017	N/A
HORN ANTENNA	Rohde&Schwarz	HF906	100039	2015/12/2
Turntable	ETS	2088	2149	N/A
Antenna Mast	ETS	2075	2346	N/A
EMI Test Software	Rohde&Schwarz	ES-K1 V1.71	N/A	N/A
RF COMMUNICATION TEST SET	HP	8920A	3813A10206	2015/11/2
Ultra-Broadband Antenna	ShwarzBeck	VULB9163	538	2015/11/2
Ultra-Broadband Antenna	ShwarzBeck	VULB9163	539	2015/11/2
HORN ANTENNA	ShwarzBeck	9120D	1012	2015/11/2
HORN ANTENNA	ShwarzBeck	9120D	1011	2015/11/2
TURNTABLE	MATURO	TT2.0	----	N/A
ANTENNA MAST	MATURO	TAM-4.0-P	----	N/A

Maximum Transmitter Power & Spurious Emission On Antenna Port & Occupied Bandwidth & Emission Mask				
Name of Equipment	Manufacturer	Model	Serial Number	Last Cal.
Receiver	Rohde&Schwarz	ESI 26	100009	2015/11/2
Attenuator	R&S	ESH3-22	100449	2015/11/2
RF COMMUNICATION TEST SET	HP	8920A	3813A10206	2015/11/2
High-Pass Filter	Anritsu	MP526B	6220875256	2015/11/2
High-Pass Filter	Anritsu	MP526D	6220878392	2015/11/2
Spectrum Analzyer	Aglient	E4407B	MY44210775	2015/11/2
Spectrum Analzyer	Rohde&Schwarz	FSP40	1164.4391.40	2015/11/2
SPECTRUM ANALYZER	Agilent	E4407B	MY44210775	2015/11/2

Transient Frequency Behavior				
Name of Equipment	Manufacturer	Model	Serial Number	Last Cal.
Signal Generator	Rohde&Schwarz	SMT03	100059	2015/11/2
Storage Oscilloscope	Tektronix	TDS3054B	B033027	2015/11/2
RF COMMUNICATION TEST SET	HP	8920A	3813A10206	2015/11/2

The calibration interval was one year.

4. TEST CONDITIONS AND RESULTS

4.1. Maximum Transmitter Power

Applicants for licenses must request and use no more power than the actual power necessary for satisfactory operation.

LIMIT

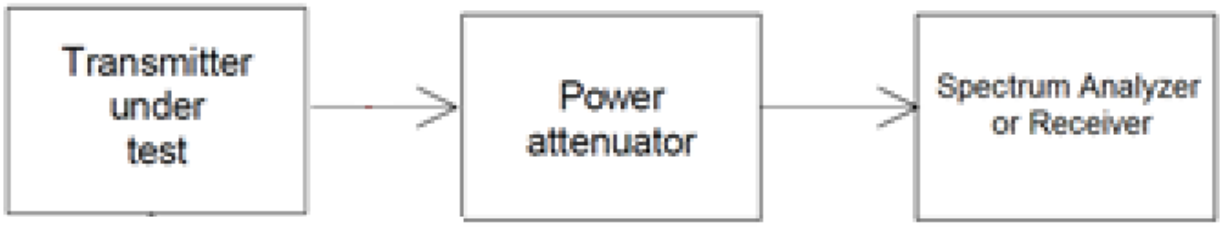
FCC Part 2.1046 and Part 90.205

Maximum ERP is dependent upon the station's antenna HAAT and required service area. The output power shall be within ±1 dB of the manufacturer's rated power listed in the equipment specifications.

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.
Connect the equipment as illustrated.

TEST CONFIGURATION



TEST MODE:

Please reference to the section 2.4

TEST RESULTS

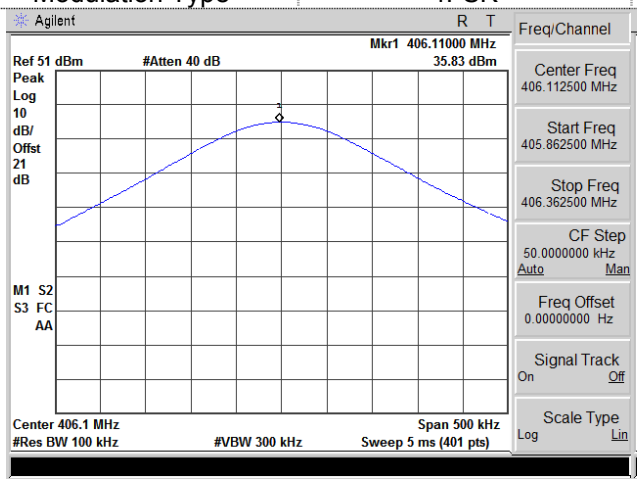
☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

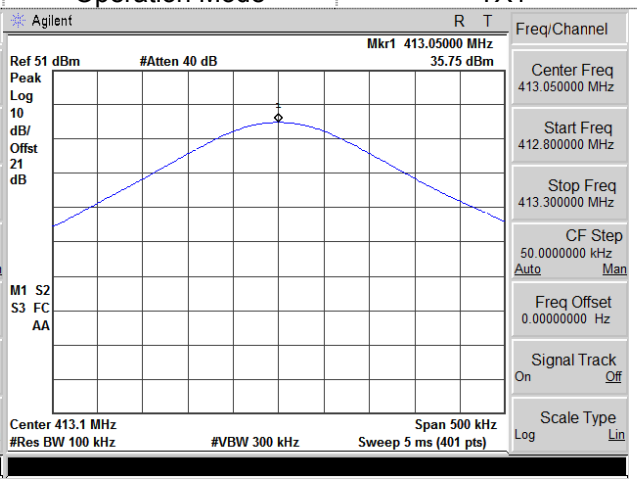
Operation Mode	Test Frequency (MHz)	Measured power (dBm)	Rated Output Power (dBm)	Difference (dB)	Limit (dB)	Result
TX1	406.1125	35.83	36.02	-0.19	-1 ~ +1	Pass
	413.0500	35.75	36.02	-0.27		
	419.9875	35.76	36.02	-0.26		
	421.0125	35.72	36.02	-0.30		
	455.0000	35.75	36.02	-0.27		
	469.9875	35.67	36.02	-0.35		
TX2	406.1125	30.70	30.00	0.70	-1 ~ +1	Pass
	413.0500	30.33	30.00	0.33		
	419.9875	30.19	30.00	0.19		
	421.0125	30.94	30.00	0.94		
	455.0000	30.97	30.00	0.97		
	469.9875	30.76	30.00	0.76		
TX3	406.1125	35.83	36.02	-0.19	-1 ~ +1	Pass
	413.0500	35.77	36.02	-0.25		
	419.9875	35.73	36.02	-0.29		
	421.0125	35.70	36.02	-0.32		
	455.0000	35.68	36.02	-0.34		
	469.9875	35.66	36.02	-0.36		
TX4	406.1125	30.64	30.00	0.64	-1 ~ +1	Pass
	413.0500	30.36	30.00	0.36		
	419.9875	30.25	30.00	0.25		
	421.0125	30.98	30.00	0.98		
	455.0000	30.96	30.00	0.96		
	469.9875	30.78	30.00	0.78		

Test plot as follows:

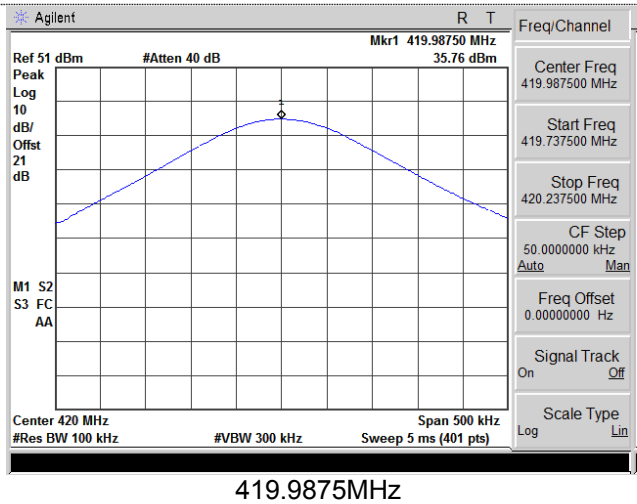
Modulation Type	4FSK	Operation Mode	TX1



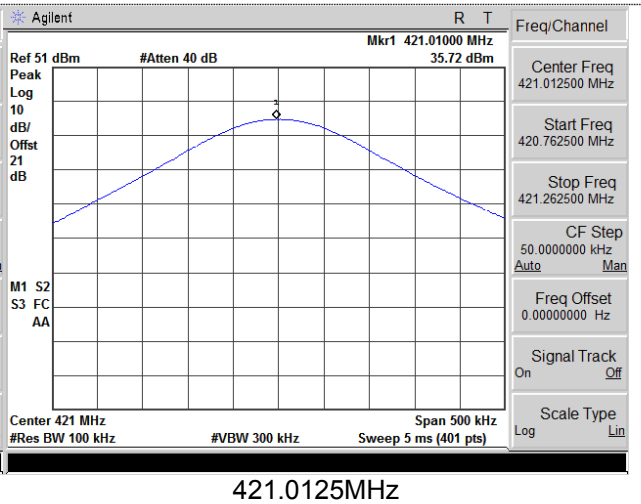
406.1125MHz



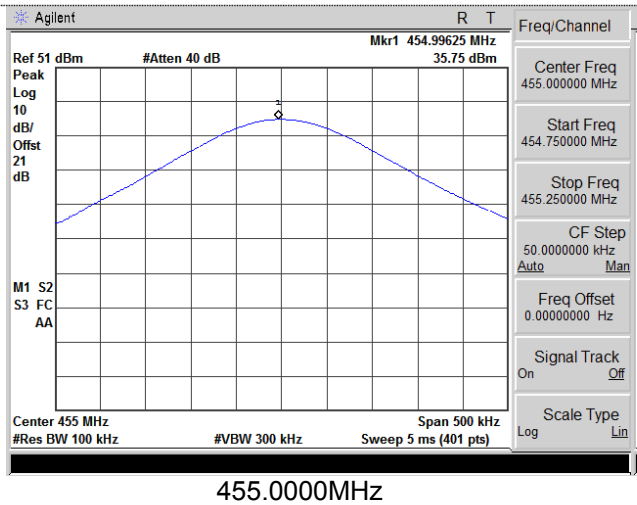
413.0500MHz



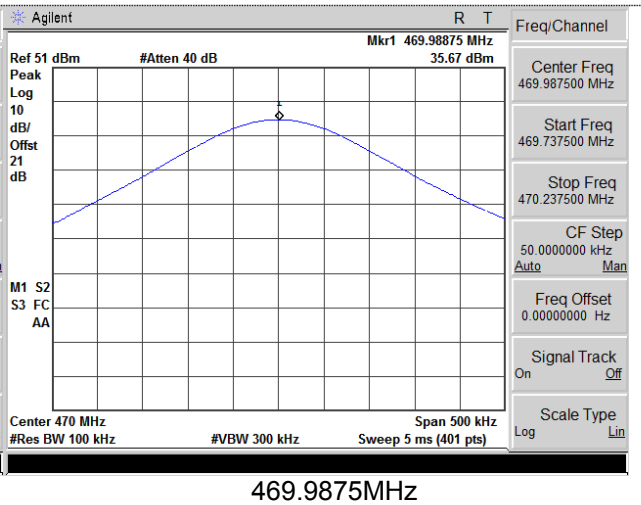
419.9875MHz



421.0125MHz

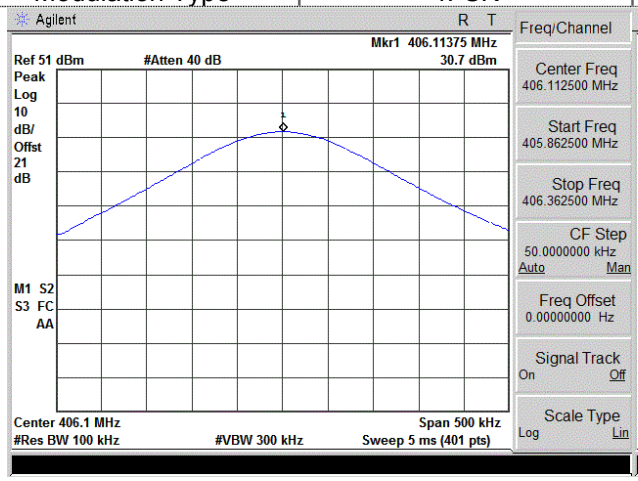


455.0000MHz

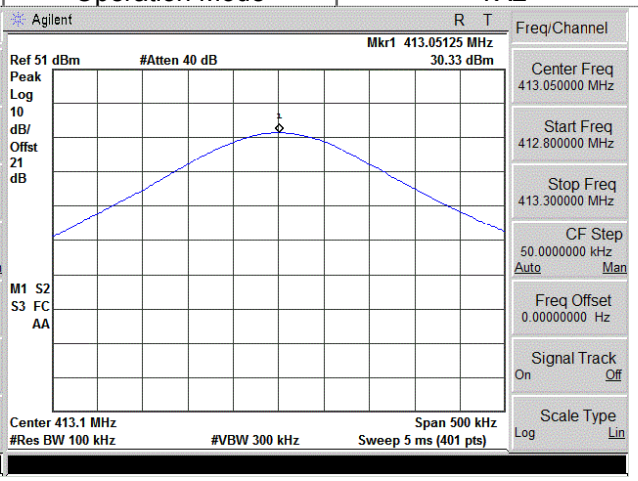


469.9875MHz

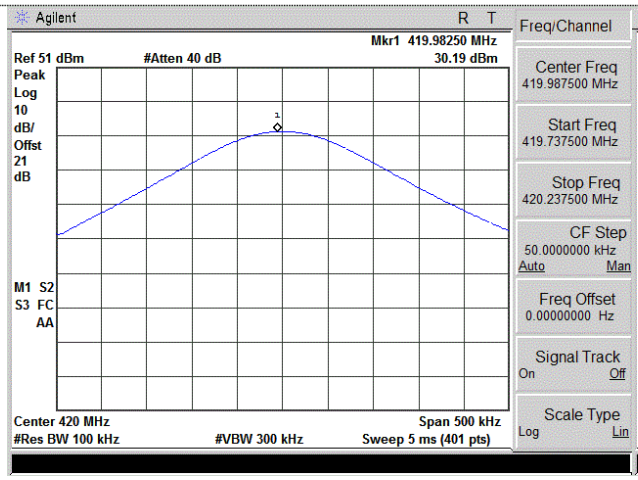
Modulation Type	4FSK	Operation Mode	TX2



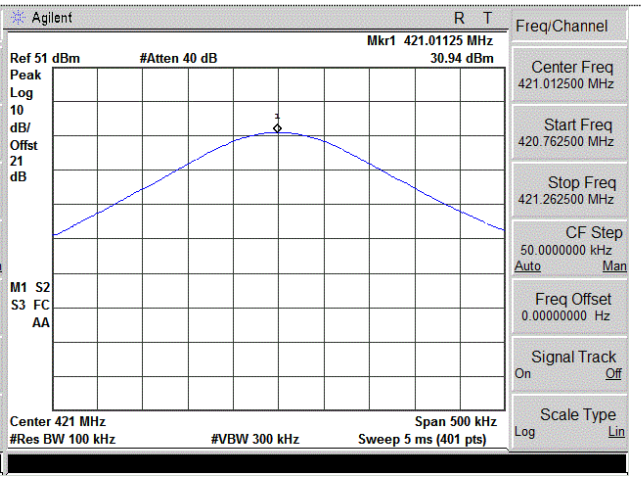
406.1125MHz



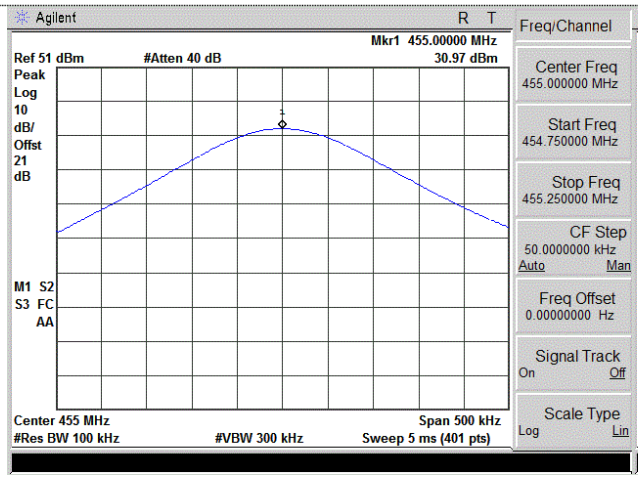
413.0500MHz



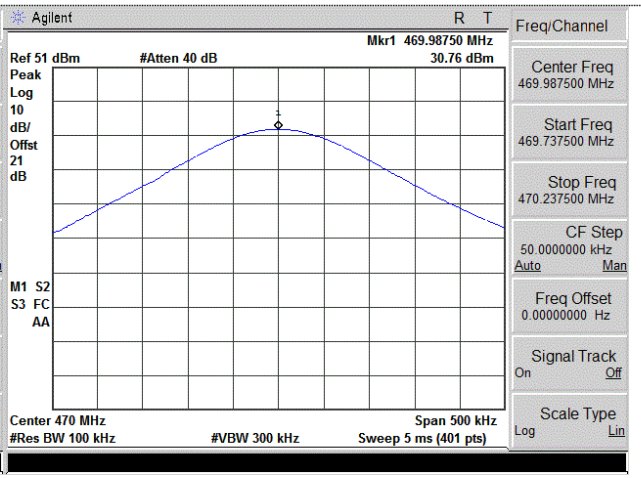
419.9875MHz



421.0125MHz

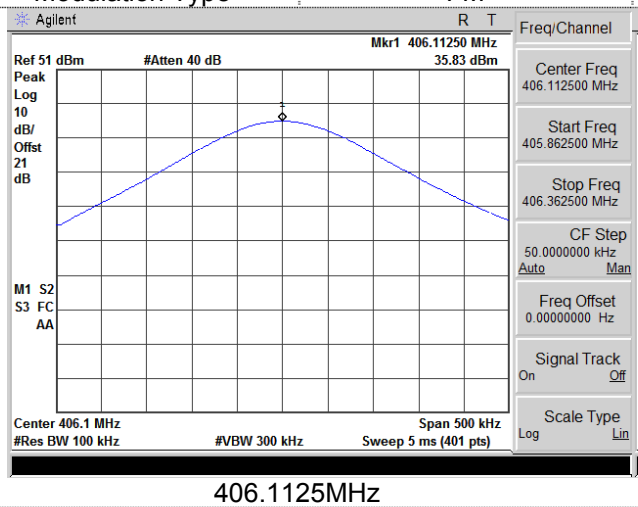


455.0000MHz

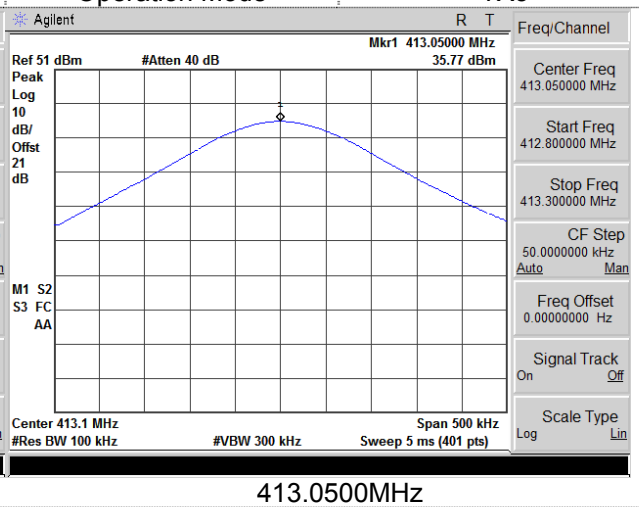


469.9875MHz

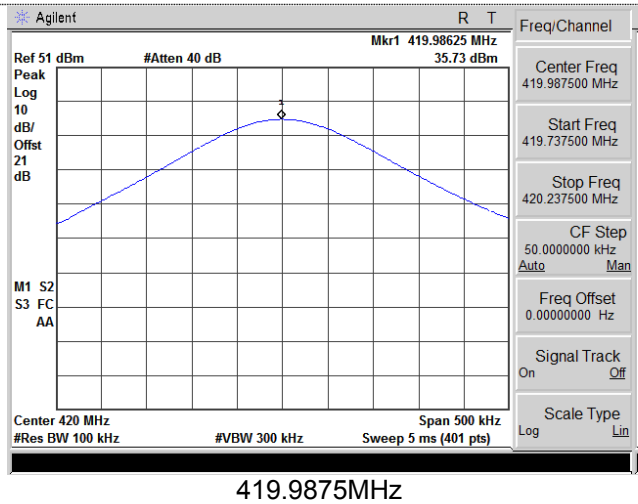
Modulation Type	FM	Operation Mode	TX3



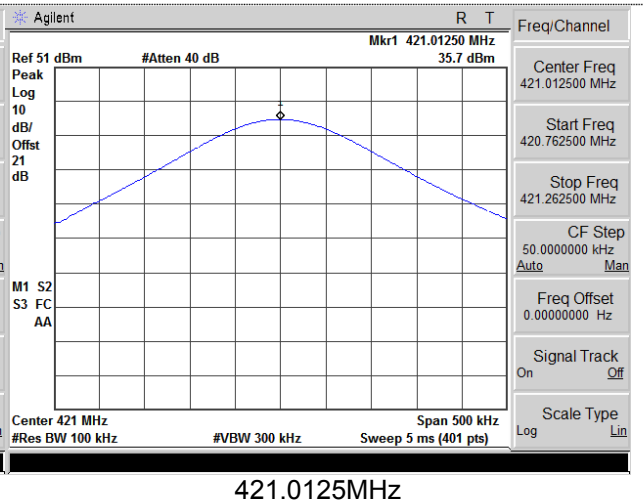
406.1125MHz



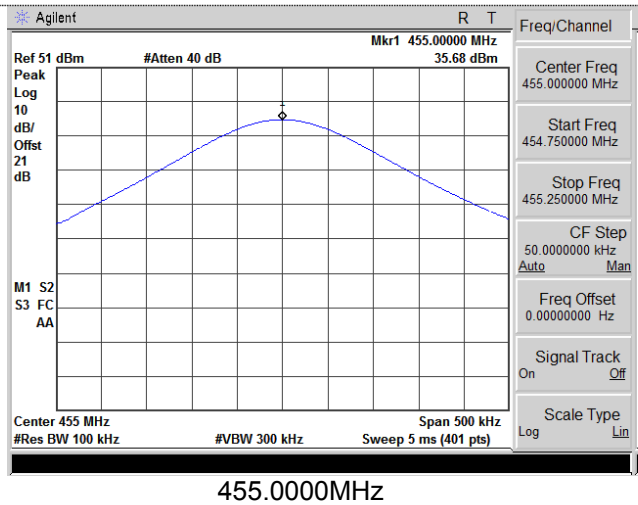
413.0500MHz



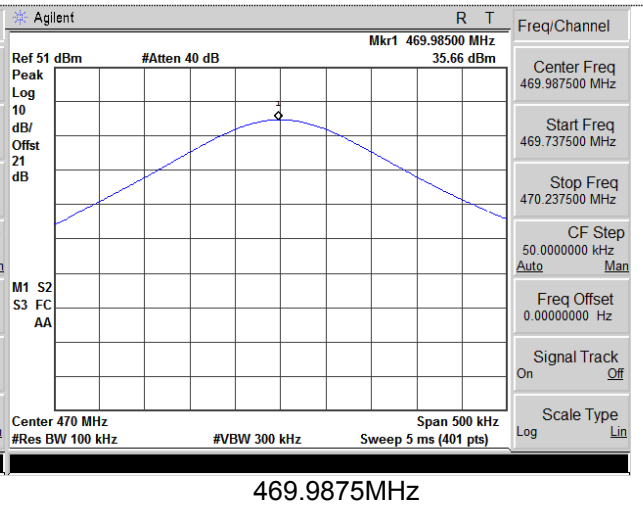
419.9875MHz



421.0125MHz

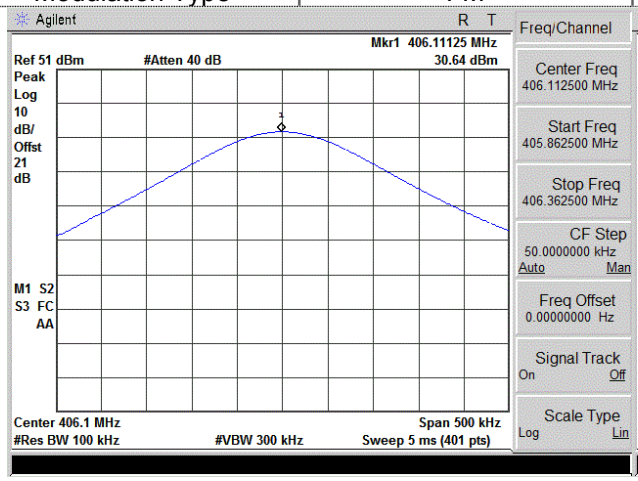


455.0000MHz

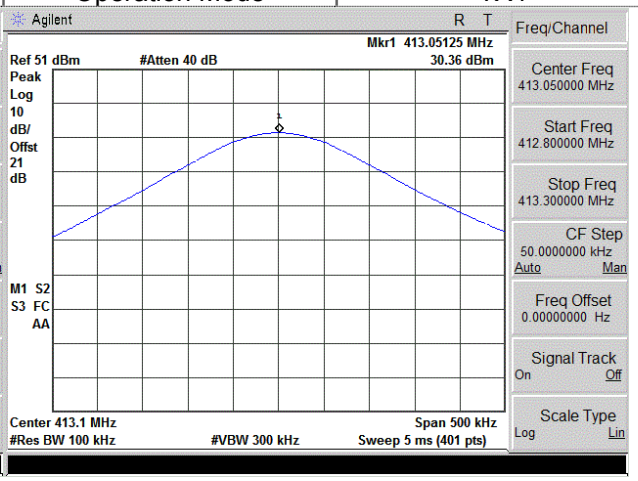


469.9875MHz

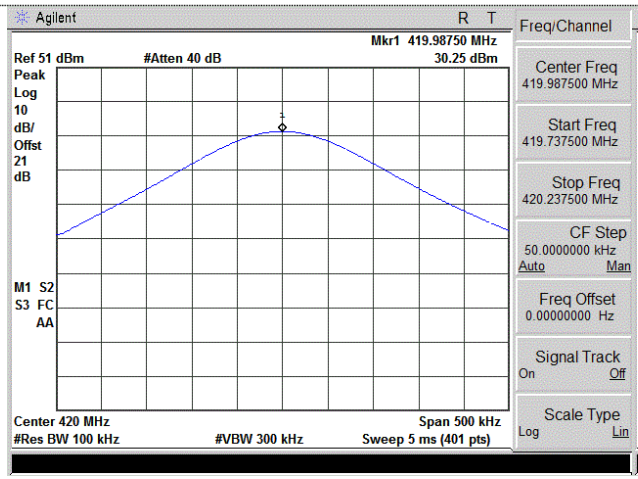
Modulation Type	FM	Operation Mode	TX4



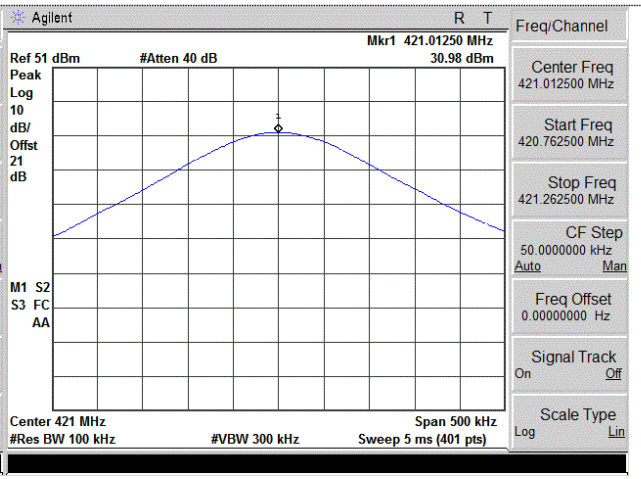
406.1125MHz



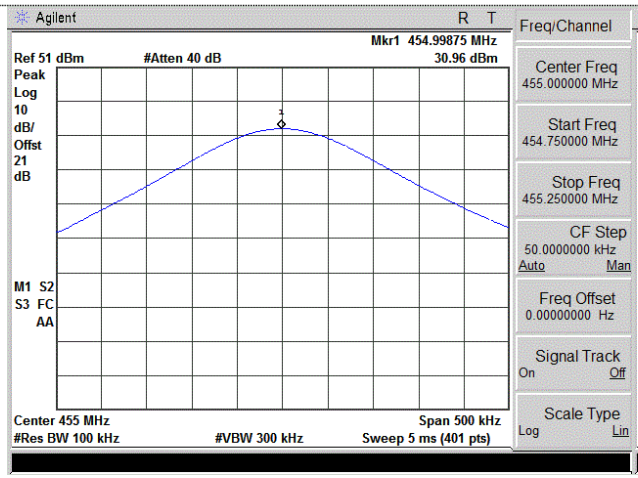
413.0500MHz



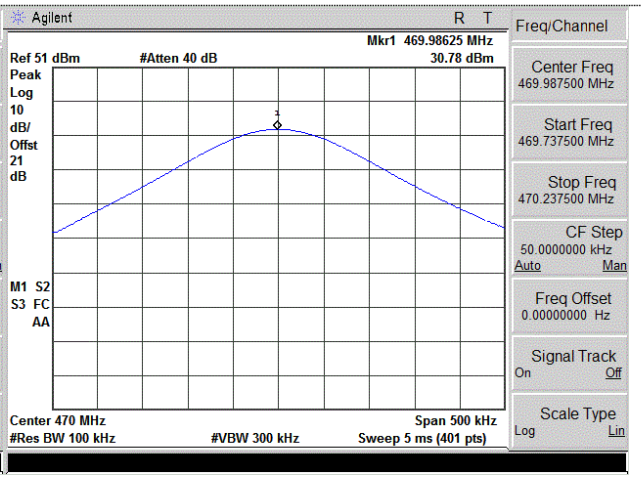
419.9875MHz



421.0125MHz



455.0000MHz



469.9875MHz

4.2. Occupied Bandwidth

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits.

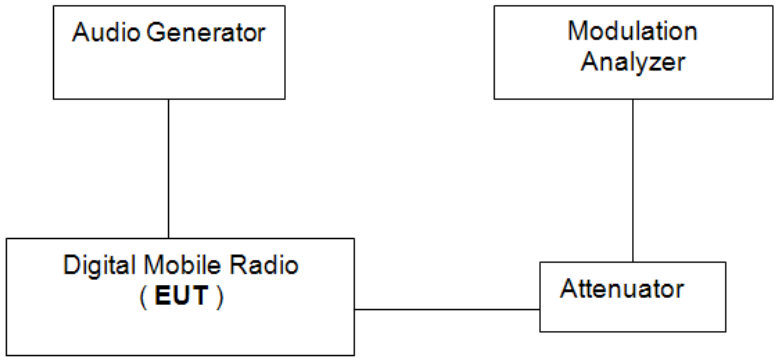
LIMIT

FCC part 90.209

Bandwidth limitations:

Frequency band (MHz)	Channel spacing (kHz)	Authorized bandwidth (kHz)
Below 252		
25-50	20	20
72-76	20	20
150-174	17.5	1 320/11.25/6
216-2205	6.25	20/11.25/6
220-222	5	4
406-5122	16.25	1 320/11.25/6
806-809/851-854	12.5	20
809-824/854-869	25	20
896-901/935-940	12.5	13.6
902-9284		
929-930	25	20
1427-14325	12.5	12.5
32450-2483.52		
Above 25002		

TEST CONFIGURATION



TEST PROCEDURE

1 The EUT was modulated by 2.5kHz 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. Rated system deviation is 2.5 kHz (12.5kHz channel spacing).
2 Set EUT as normal operation.
Set SPA Center Frequency = fundamental frequency, RBW=100Hz, VBW=300Hz, span=50kHz for 12.5kHz channel spacing.
3 Set SPA Max hold. Mark peak, Set 99% Occupied Bandwidth and 26dB Occupied Bandwidth.
4 Set SPA Center Frequency=fundamental frequency, set =100Hz, VBW=300Hz, span=50kHz for 12.5kHz channel spacing.

TEST MODE:

Please reference to the section 2.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

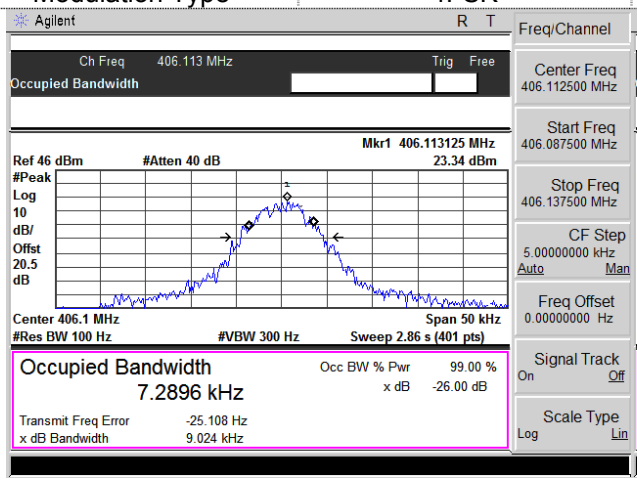
Please refer to the below test data:

Operation Mode	Test Frequency (MHz)	Occupied Bandwidth (kHz)		Limit (kHz)	Result
		99%	26dB		
TX1	406.1125	7.29	9.02	⩽11.25	Pass
	413.05	6.97	9.69		
	419.9875	7.52	8.91		
	421.0125	6.93	9.34		
	455	7.65	9.37		
	469.9875	7.02	9.12		
TX2	406.1125	6.80	9.19	⩽11.25	Pass
	413.05	7.00	9.75		
	419.9875	7.04	9.30		
	421.0125	7.28	9.41		
	455	7.32	8.86		
	469.9875	8.04	10.57		
TX3	406.1125	9.78	10.27	⩽11.25	Pass
	413.05	9.74	10.18		
	419.9875	9.80	10.23		
	421.0125	9.81	10.23		
	455	9.77	10.18		
	469.9875	9.82	10.20		
TX4	406.1125	9.79	10.27	⩽11.25	Pass
	413.05	9.73	10.17		
	419.9875	9.82	10.22		
	421.0125	9.82	10.24		
	455	9.78	10.18		
	469.9875	9.85	10.19		

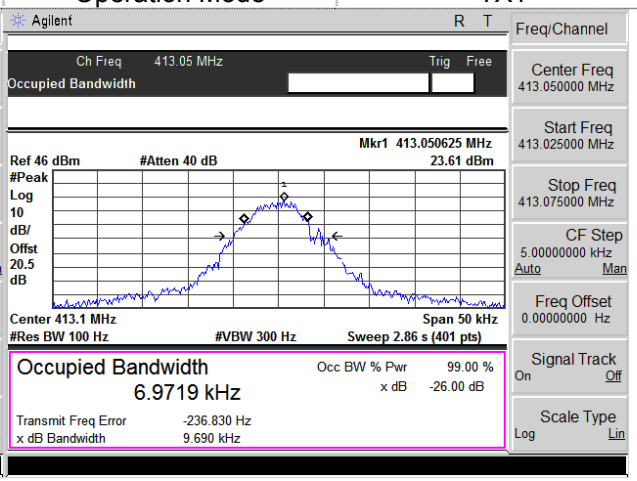
The equipment applicable to 12.5kHz Channel Bandwidth.

Test plot as follows:

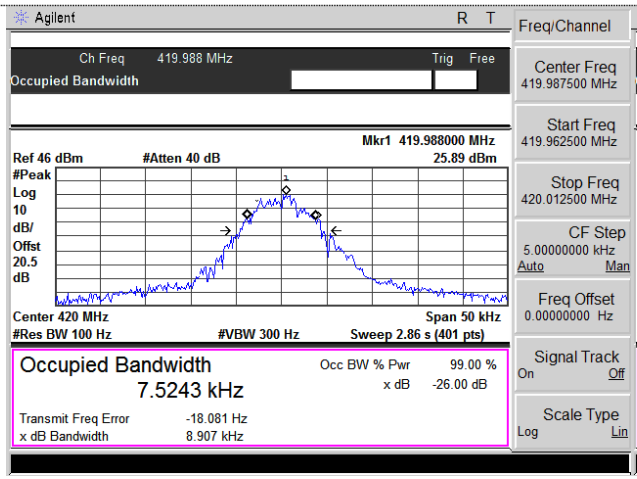
Modulation Type	4FSK	Operation Mode	TX1



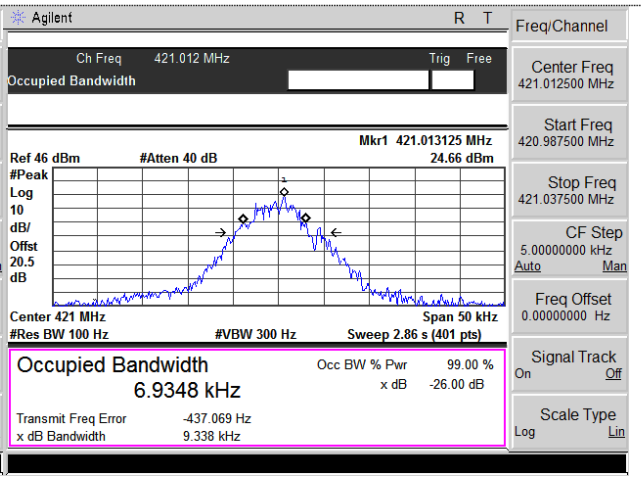
406.1125MHz



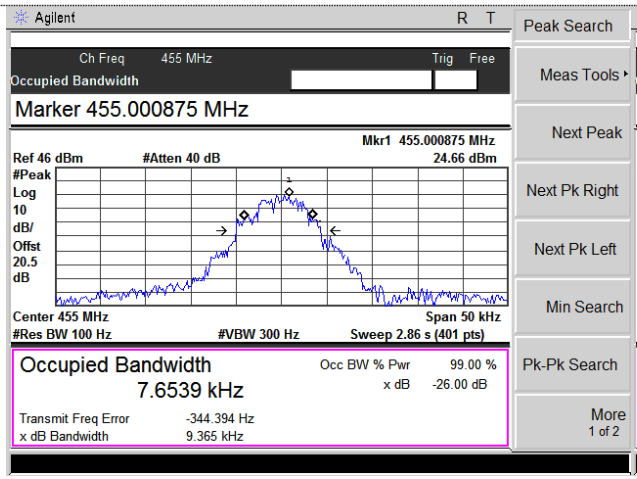
413.0500MHz



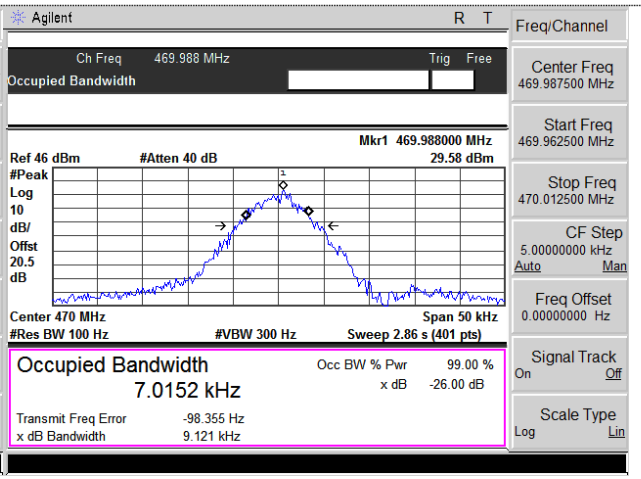
419.9875MHz



421.0125MHz

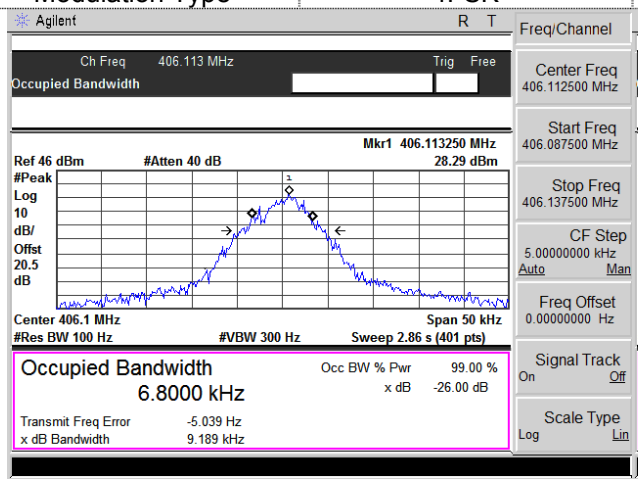


455.0000MHz

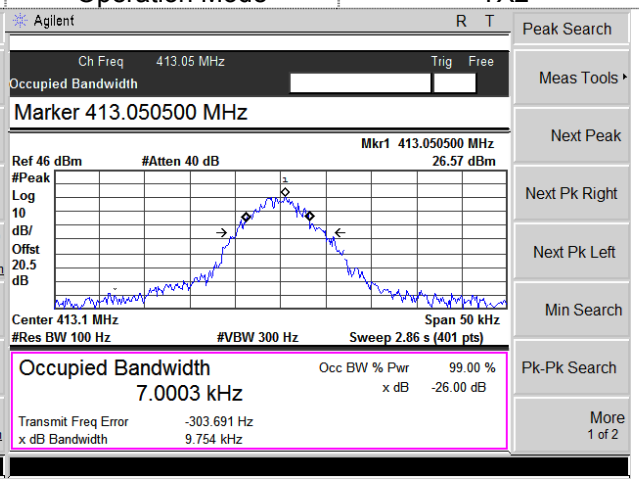


469.9875MHz

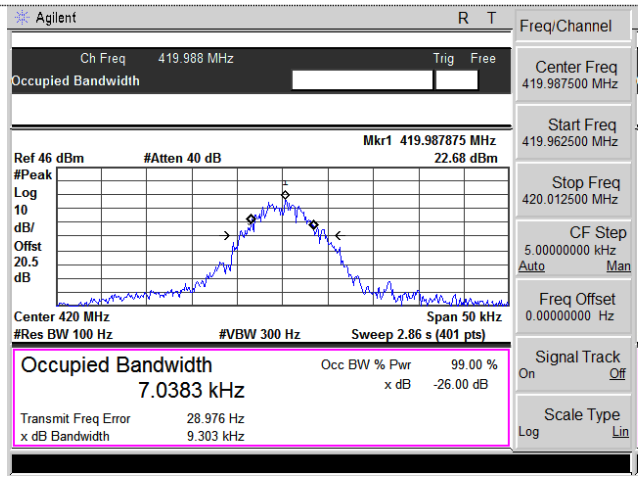
Modulation Type	4FSK	Operation Mode	TX2



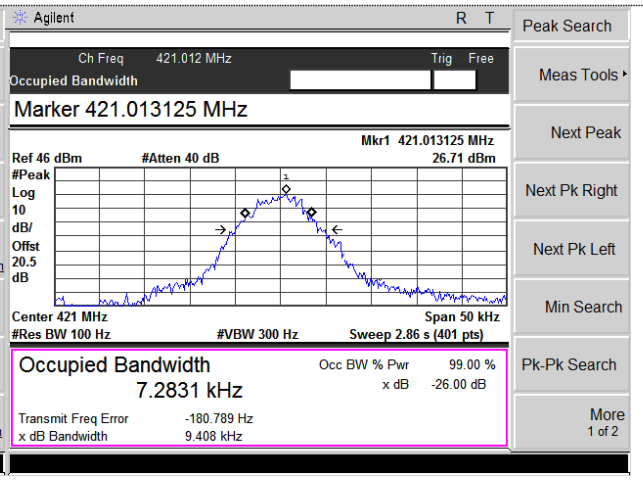
406.1125MHz



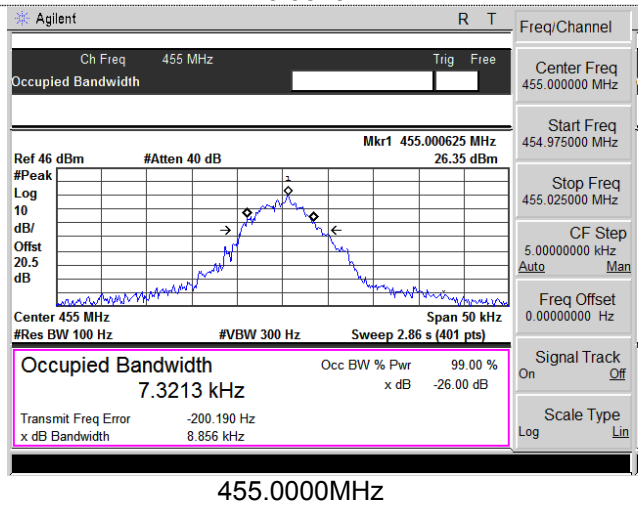
413.0500MHz



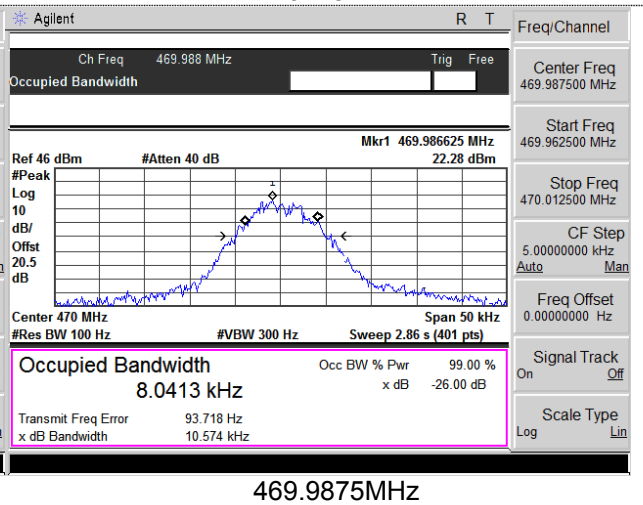
419.9875MHz



421.0125MHz

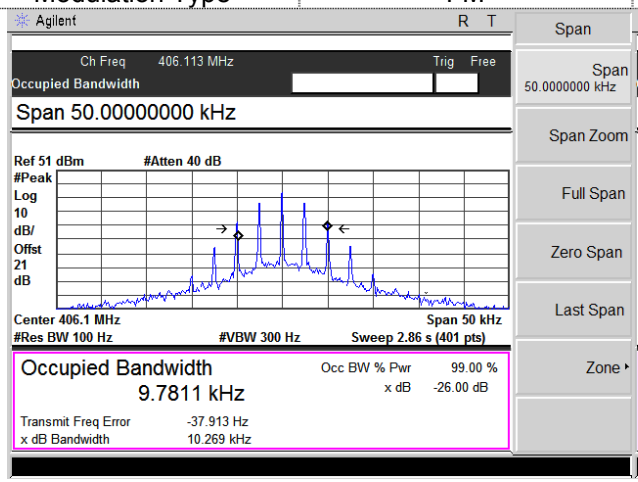


455.0000MHz

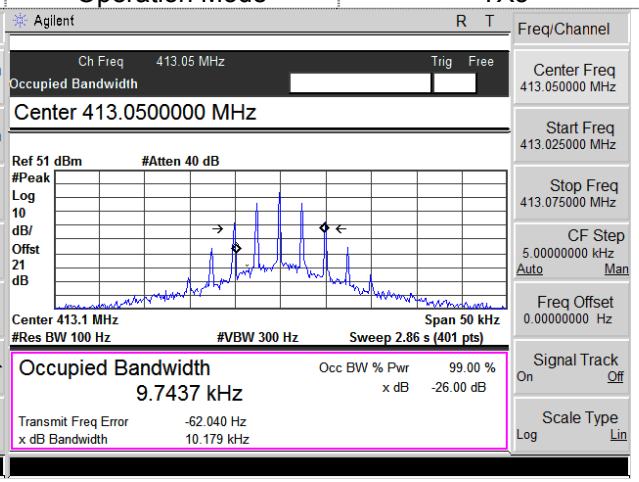


469.9875MHz

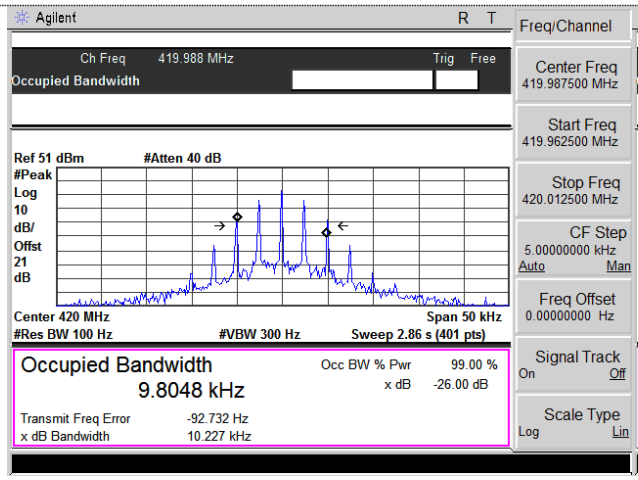
Modulation Type	FM	Operation Mode	TX3



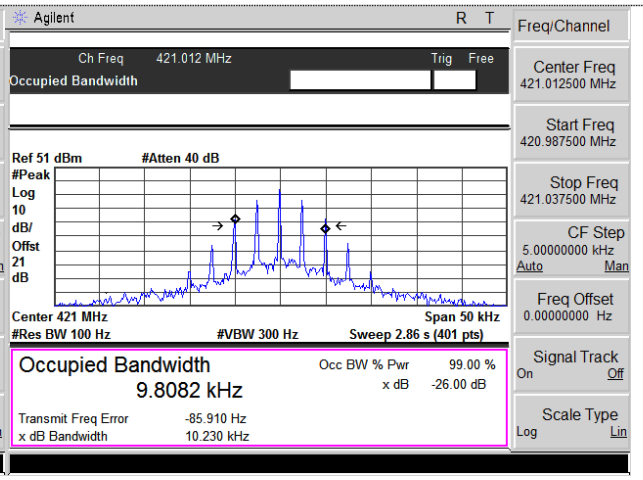
406.1125MHz



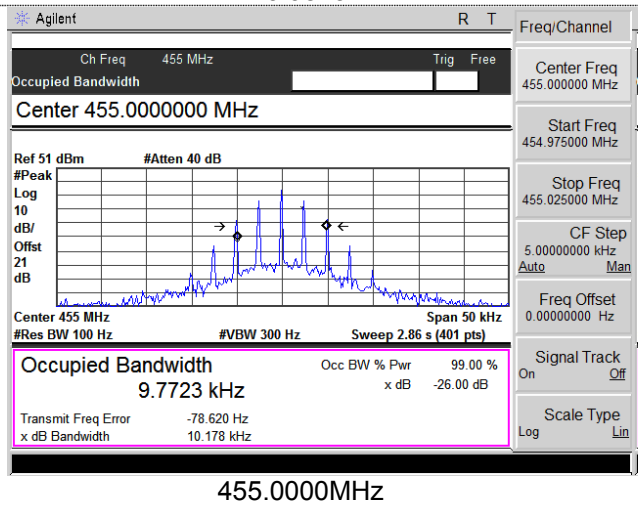
413.0500MHz



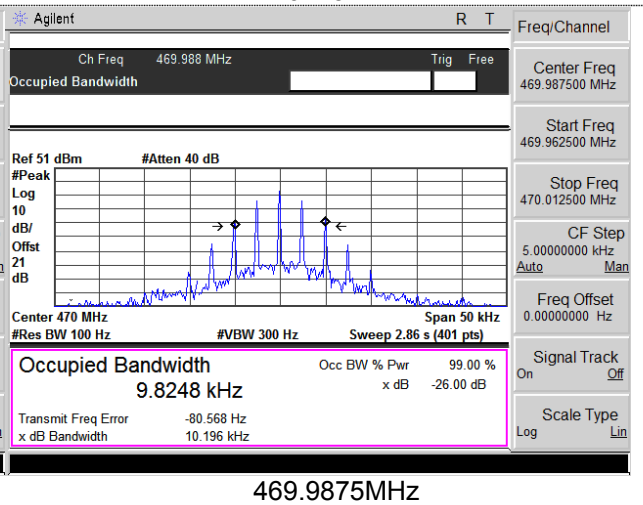
419.9875MHz



421.0125MHz

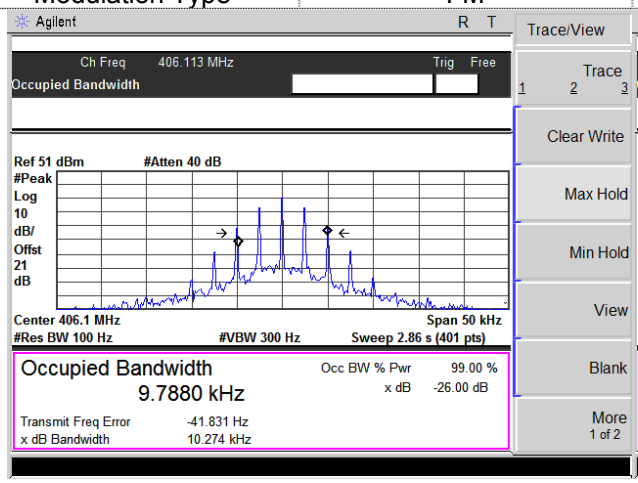


455.0000MHz

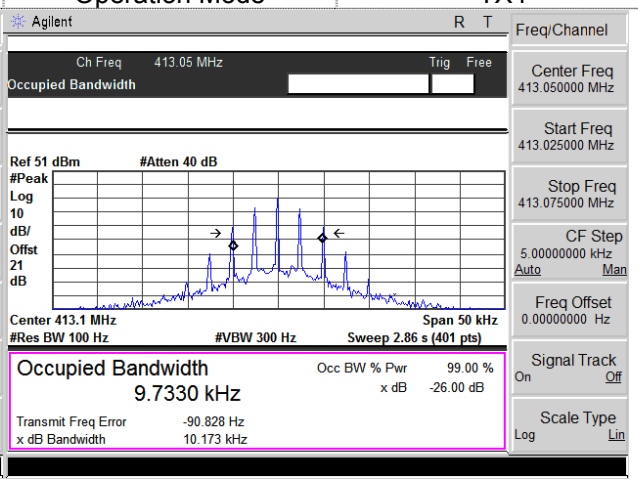


469.9875MHz

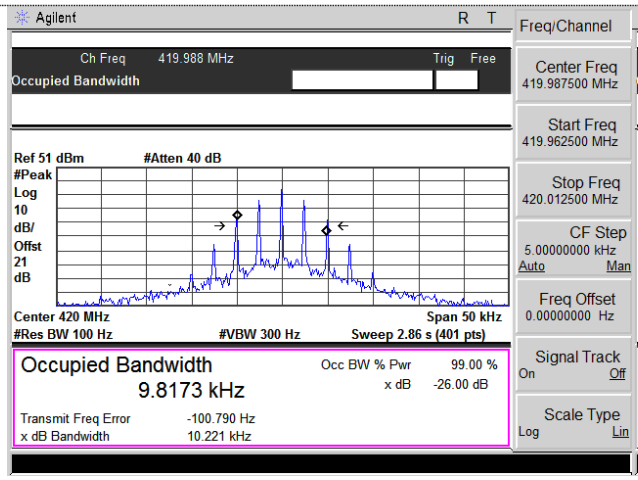
Modulation Type	FM	Operation Mode	TX4



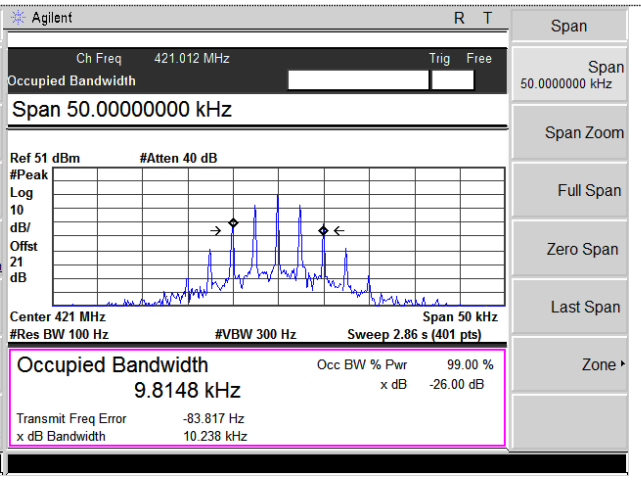
406.1125MHz



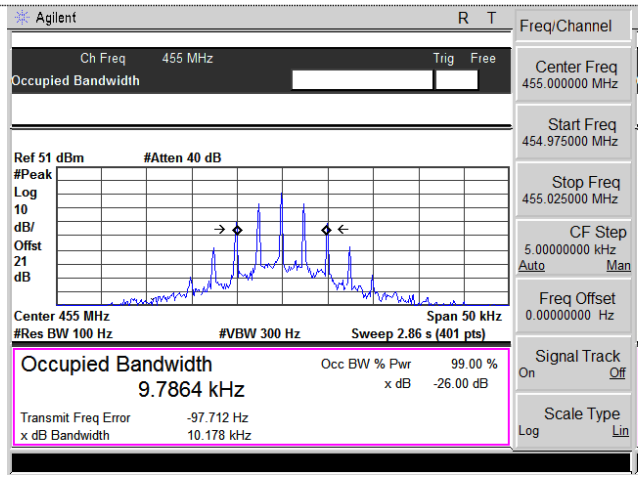
413.0500MHz



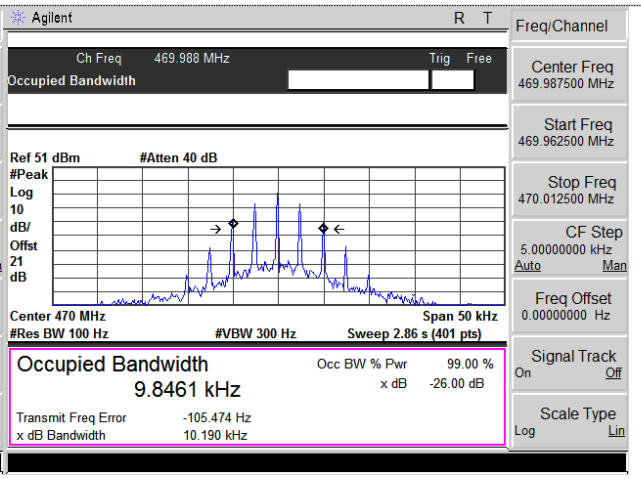
419.9875MHz



421.0125MHz



455.0000MHz



469.9875MHz

4.3. Emission Mask

Transmitters used in the radio services governed by this part must comply with the emission masks outlined in this section.

LIMIT

FCC part 90.210

Frequency band (MHz)	Mask for equipment with audio low pass filter	Mask for equipment without audio low pass filter
Below 251	A or B	A or C
25-50	B	C
72-76	B	C
150-1742	B, D, or E	C, D or E
150 paging only	B	C
220-222	F	F
421-5122 5	B, D, or E	C, D, or E
450 paging only	B	G
806-809/851-854	B	H
809-824/854-8693 5	B	G
896-901/935-940	I	J
902-928	K	K
929-930	B	G
4940-4990 MHz	L or M	L or M
5850-59254		
All other bands	B	C

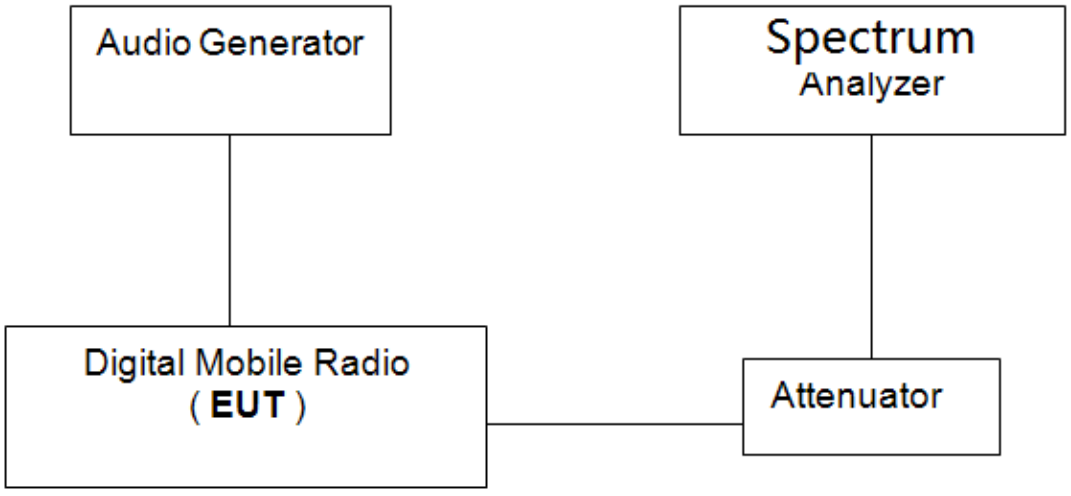
(d) Emission Mask D—12.5 kHz channel bandwidth equipment. For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

(1) On any frequency from the center of the authorized bandwidth f0 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 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 modulated by 2.5kHz 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. Rated system deviation is 2.5 kHz (12.5kHz channel spacing) .
2. Set EUT as normal operation.
   Set SPA Center Frequency = fundamental frequency, RBW=100Hz, VBW=300Hz,span=50kHz for 12.5KHz channel spacing.

TEST MODE:

Please reference to the section 2.4

TEST RESULTS

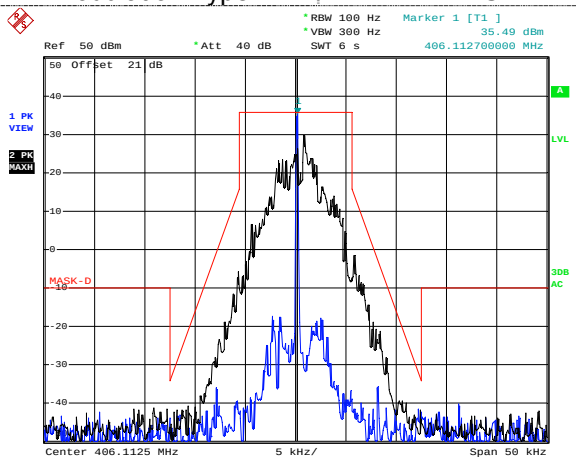
☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

Note:
The equipment applicable to Emission Mask D.

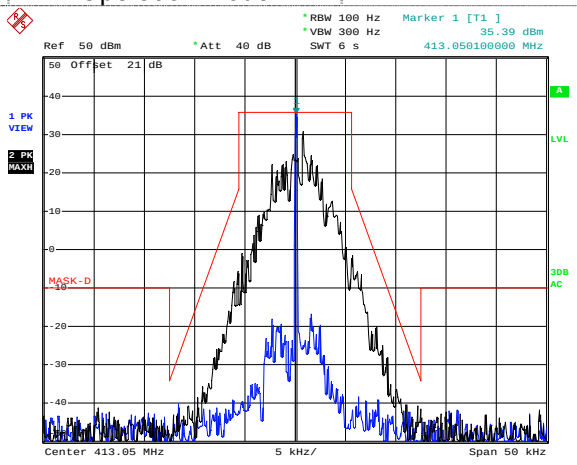
Test plot as follows:

Modulation Type	4FSK	Operation Mode	TX1



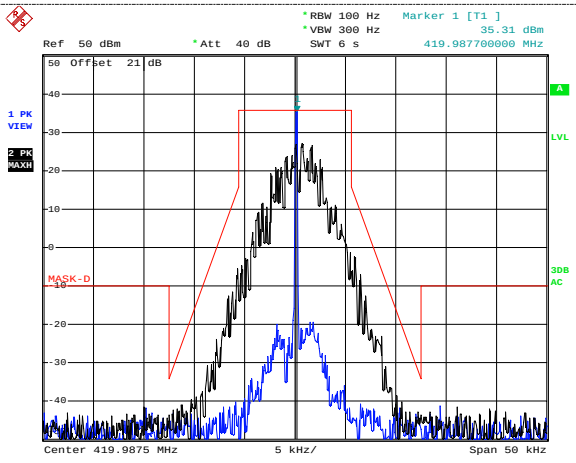
Date: 6.NOV.2015 21:41:40

406.1125MHz



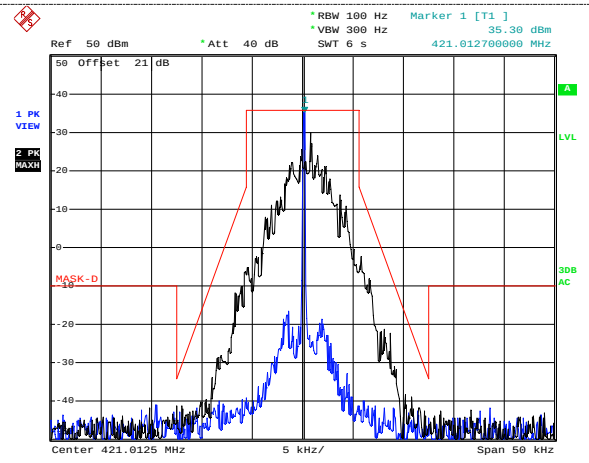
Date: 6.NOV.2015 21:43:05

413.0500MHz



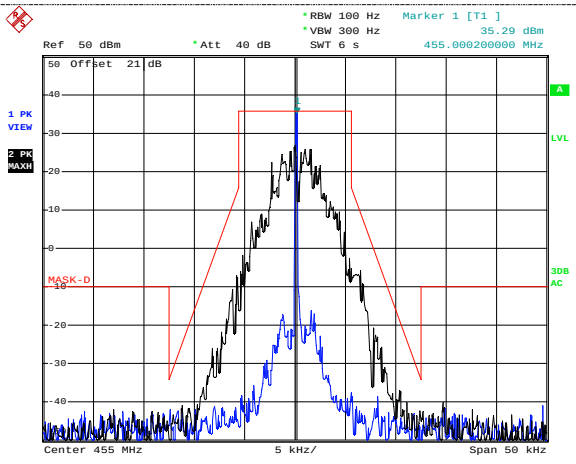
Date: 6.NOV.2015 21:45:08

419.9875MHz



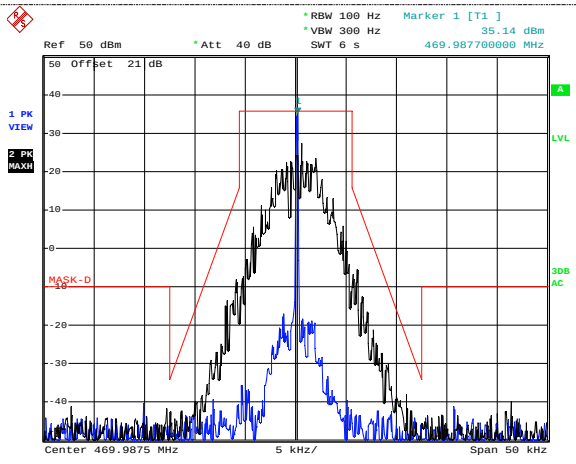
Date: 6.NOV.2015 21:46:21

421.0125MHz



Date: 6.NOV.2015 21:47:26

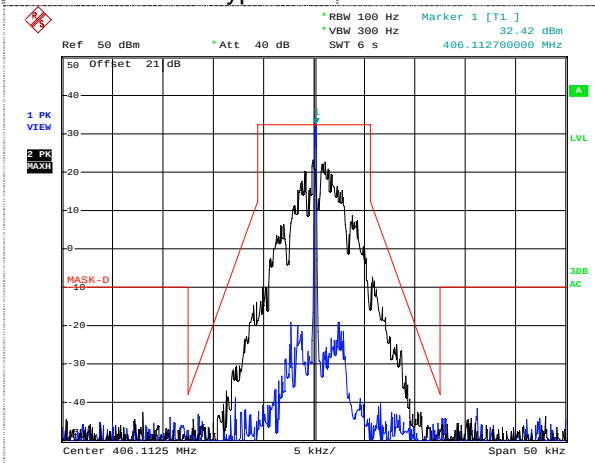
455.0000MHz



Date: 6.NOV.2015 21:48:32

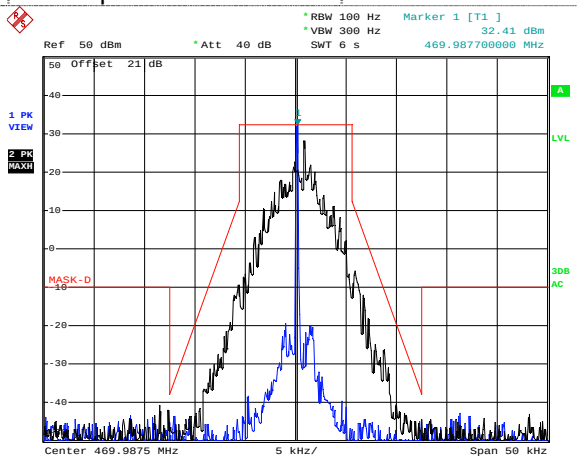
469.9875MHz

Modulation Type	4FSK	Operation Mode	TX2



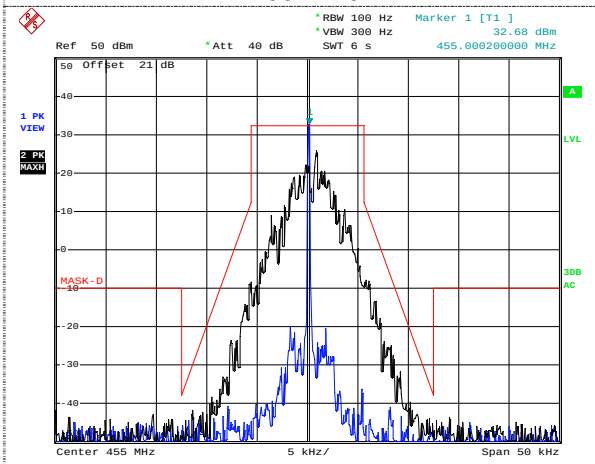
Date: 6.NOV.2015 21:39:44

406.1125MHz



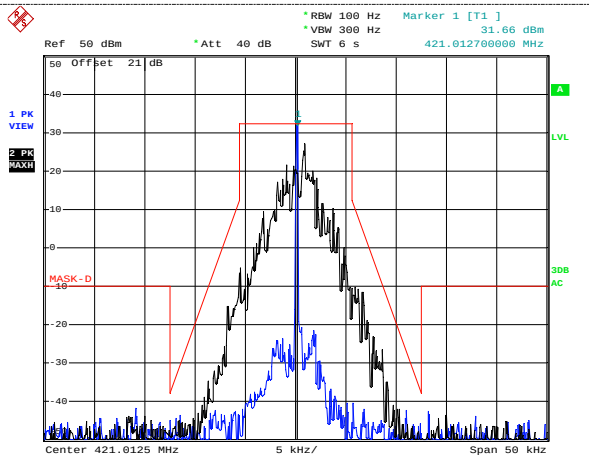
Date: 6.NOV.2015 21:50:30

413.0500MHz



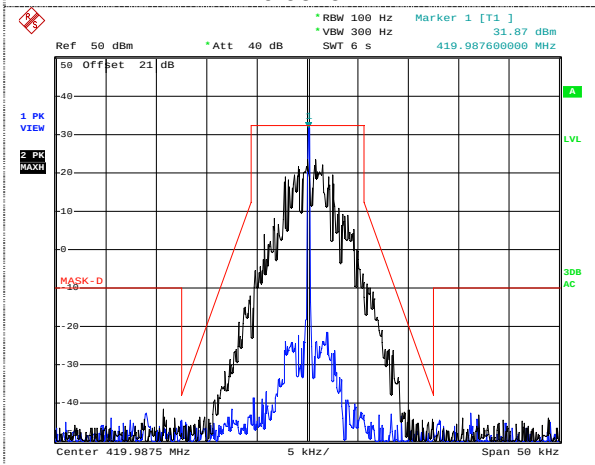
Date: 6.NOV.2015 21:51:47

419.9875MHz



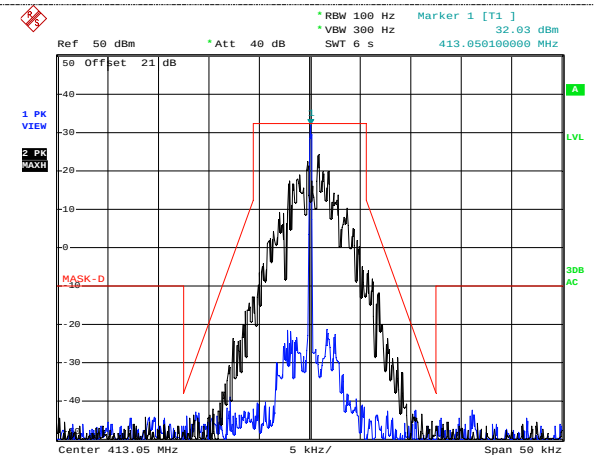
Date: 6.NOV.2015 21:53:33

421.0125MHz



Date: 6.NOV.2015 21:55:28

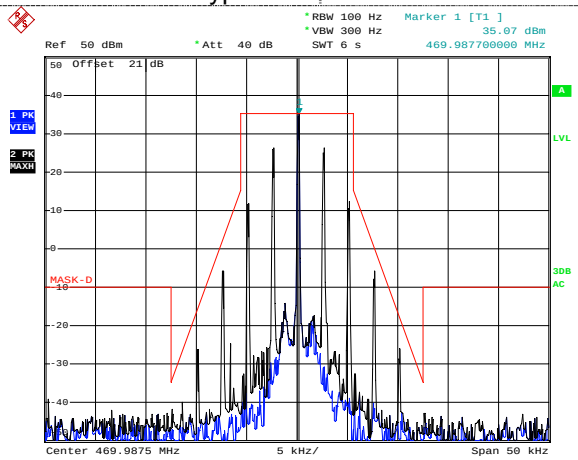
455.0000MHz



Date: 6.NOV.2015 21:56:55

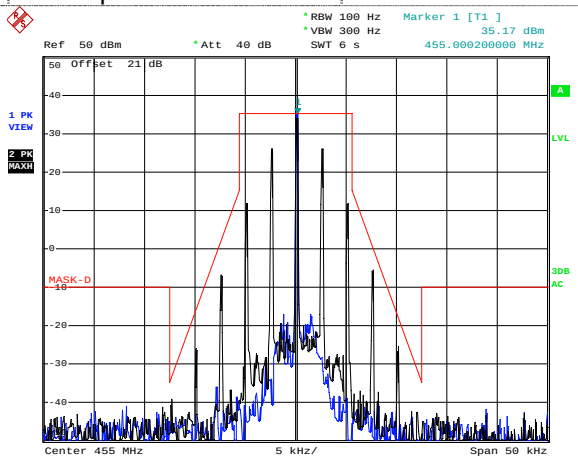
469.9875MHz

Modulation Type	FM	Operation Mode	TX3



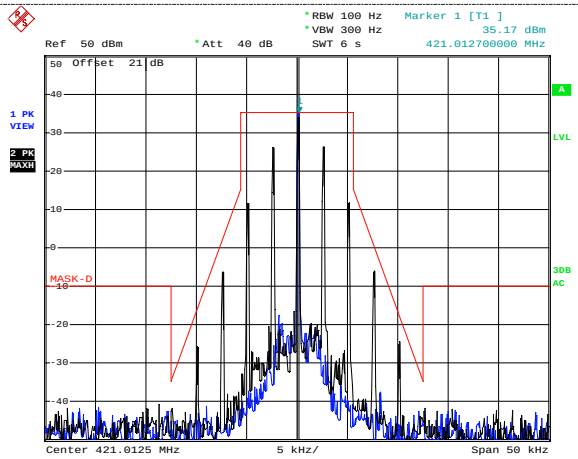
Date: 6.NOV.2015 22:08:33

406.1125MHz



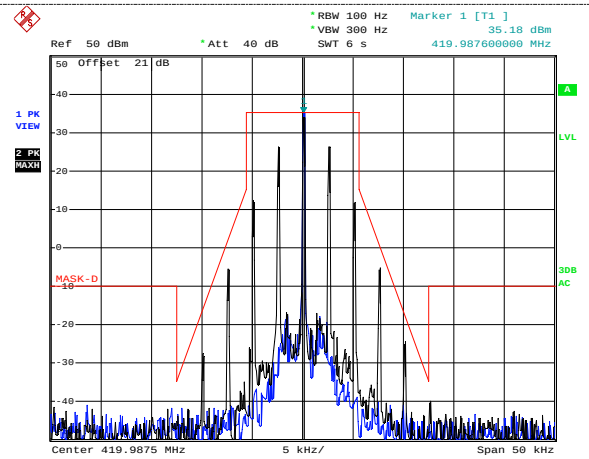
Date: 6.NOV.2015 22:09:27

413.0500MHz



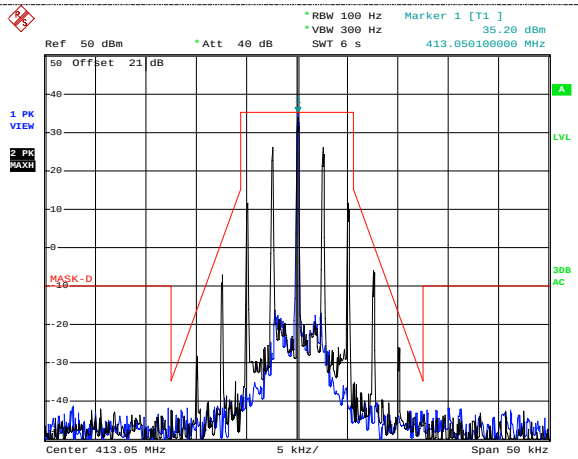
Date: 6.NOV.2015 22:11:34

419.9875MHz



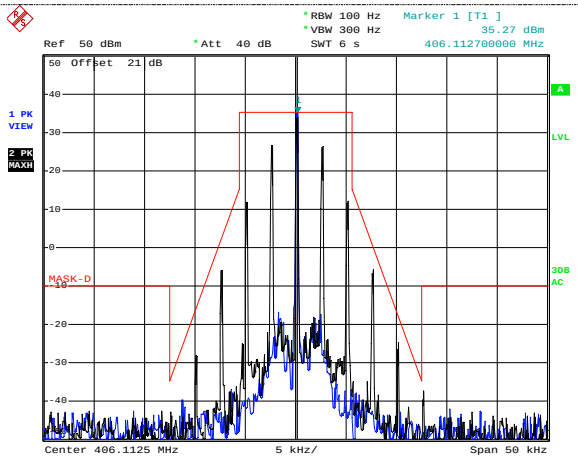
Date: 6.NOV.2015 22:12:27

421.0125MHz



Date: 6.NOV.2015 22:13:28

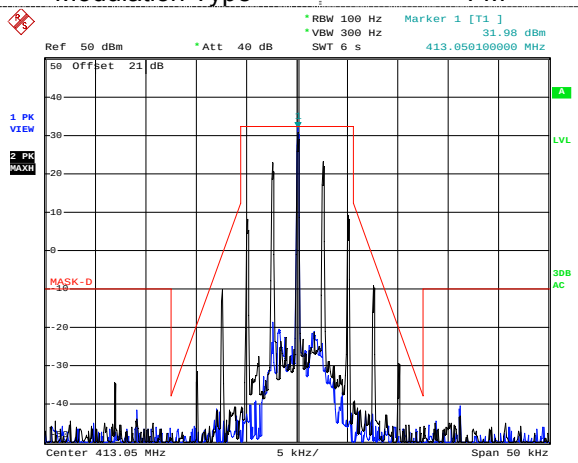
455.0000MHz



Date: 6.NOV.2015 22:14:11

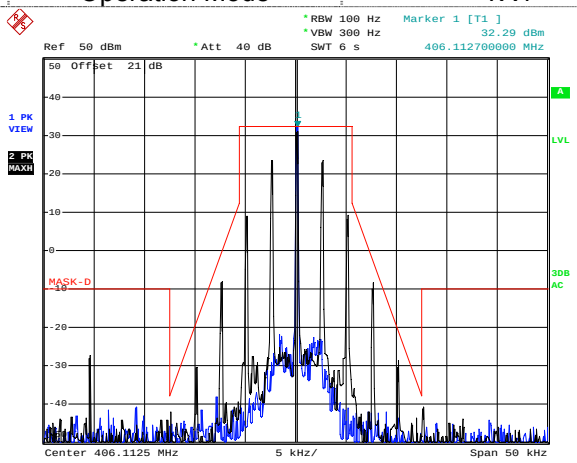
469.9875MHz

Modulation Type	FM	Operation Mode	TX4



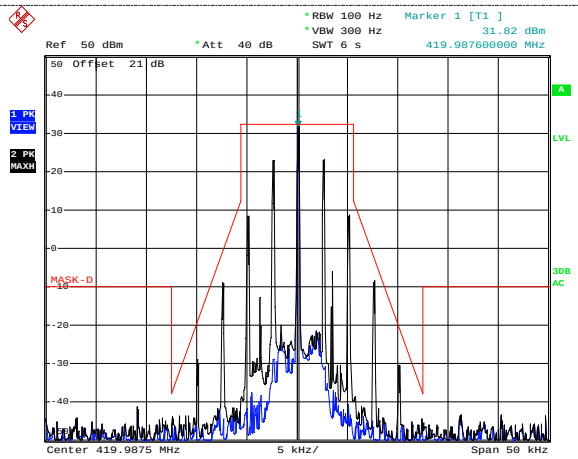
Date: 6.NOV.2015 22:01:58

406.1125MHz



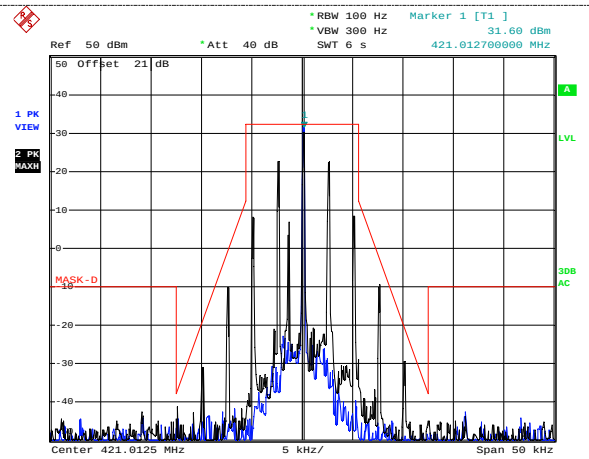
Date: 6.NOV.2015 22:03:14

413.0500MHz



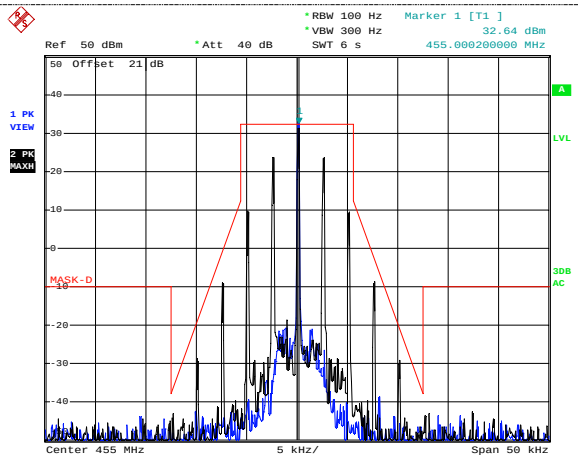
Date: 6.NOV.2015 22:04:06

419.9875MHz



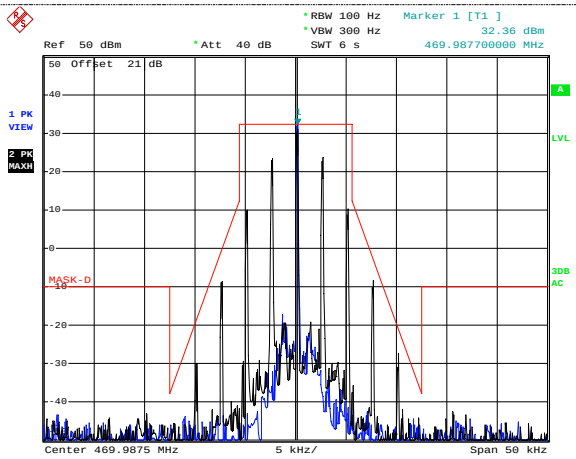
Date: 6.NOV.2015 22:05:13

421.0125MHz



Date: 6.NOV.2015 22:06:20

455.0000MHz



Date: 6.NOV.2015 22:07:02

469.9875MHz

4.4. Modulation Charcateristics

Voice modulated communication equipment. A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz shall be submitted.

LIMIT

FCC part 2.1047(a)

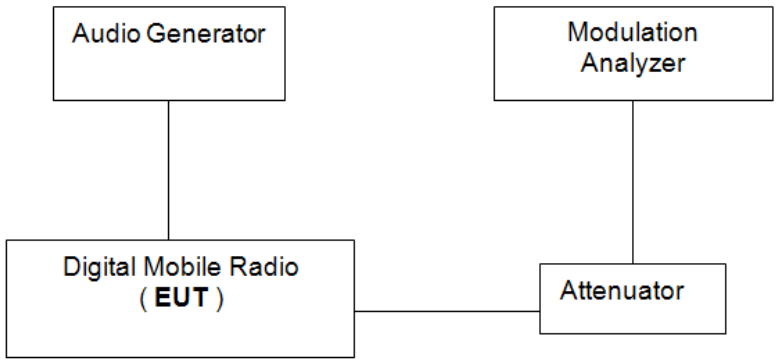
1. Modulation Limit:

1) Configure the EUT as shown in figure, adjust the audio input for 60% of rated system deviation at 1kHz 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.

2. Audio Frequency Response:

1) Configure the EUT as shown in figure .
2) Adjust the audio input for 20% of rated system deviation at 1kHz 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 =20log10 (Deviation of test frequency/Deviation of 1kHz reference).

TEST CONFIGURATION



TEST MODE:

Please reference to the section 2.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

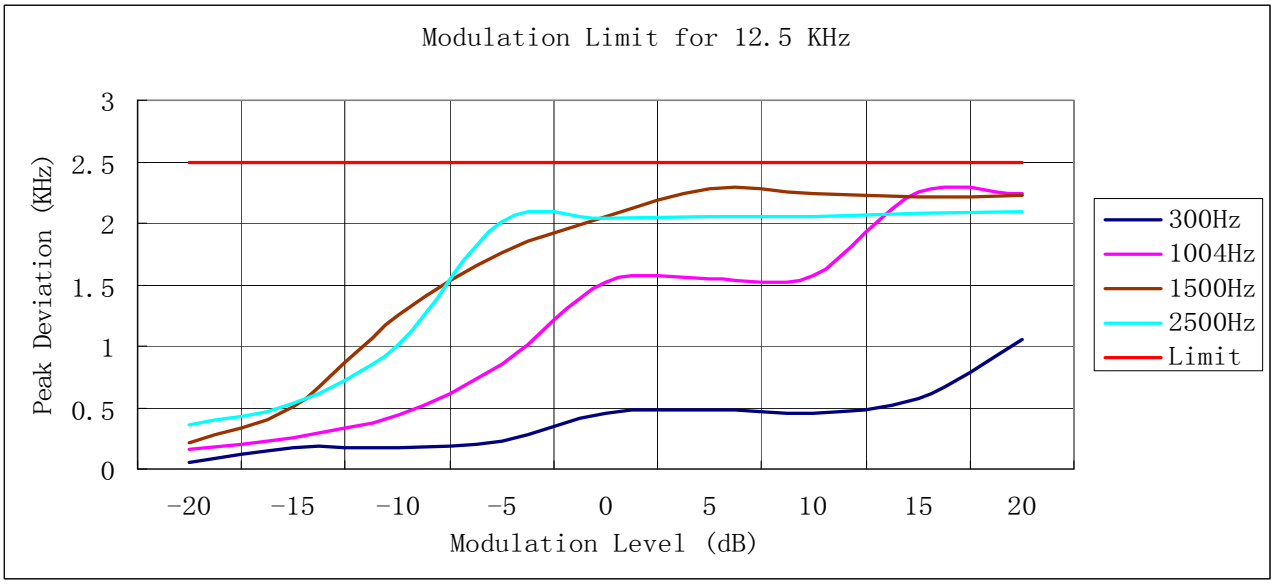
Remark:We tested TX3 to TX4.recorded worst case at TX3 for 455MHz.

Please refer to the below test data:

a).Modulation Limit:

TX3: 455MHz						
Modulation Level (dB)	Peak Freq. Deviation At 300Hz (kHz)	Peak Freq. Deviation At 1004Hz (kHz)	Peak Freq. Deviation At 1500Hz (kHz)	Peak Freq. Deviation At 2500 Hz (kHz)	Limit (kHz)	Result
-20	0.12	0.13	0.28	0.36	2.5	Pass
-15	0.14	0.15	0.47	0.52		
-10	0.13	0.48	1.34	1.06		
-5	0.21	0.91	1.64	2.04		
0	0.42	1.62	2.11	2.07		
5	0.48	1.53	2.32	2.06		
10	0.45	1.55	2.27	2.11		
15	0.57	2.23	2.12	2.15		
20	1.04	2.23	2.24	2.19		

Test plot as follows:



b). Audio Frequency Response:

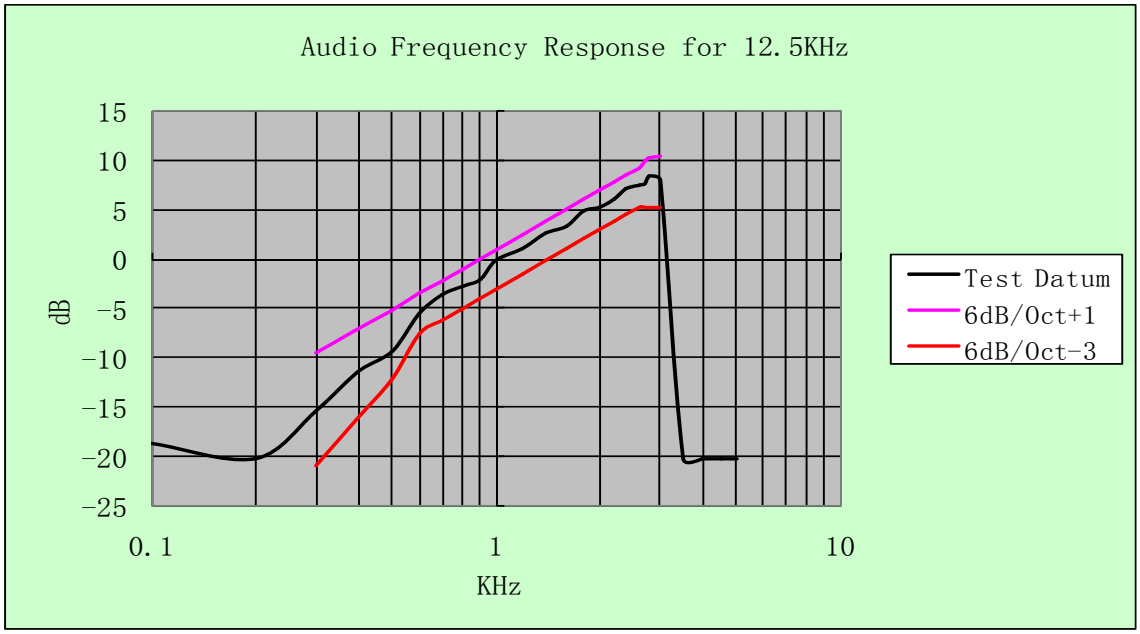
Method of Measurement:

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 3.0kHz to 50kHz.However, the audio frequency response should test from 100Hz to 5.0 kHz according to FCC Part 2.1047(a).

Note: The Audio Frequency Response is identical for 12.5 kHz channel separation

TX3:455MHz			
Frequency (kHz)	Frequency Deviation (kHz)	1KHz Refenerce Deviation (kHz)	Audio Frequency Response (dB)
0.1	0.07	0.63	-19.08
0.2	0.06	0.63	-20.42
0.3	0.1	0.63	-15.99
0.4	0.18	0.63	-10.88
0.5	0.25	0.63	-8.03
0.6	0.35	0.63	-5.11
0.7	0.46	0.63	-2.73
0.8	0.48	0.63	-2.36
0.9	0.51	0.63	-1.84
1	0.63	0.63	0.00
1.2	0.74	0.63	1.40
1.4	0.85	0.63	2.60
1.6	0.94	0.63	3.48
1.8	1.11	0.63	4.92
2	1.13	0.63	5.07
2.2	1.19	0.63	5.52
2.4	1.28	0.63	6.16
2.6	1.37	0.63	6.75
2.7	1.39	0.63	6.87
2.8	1.47	0.63	7.36
3	1.61	0.63	8.15
3.5	0.05	0.63	-22.01
4	0.06	0.63	-20.42
4.5	0.06	0.63	-20.42
5	0.06	0.63	-20.42

Test plot as follows:


Audio Frequency Response for 12.5KHz
15
10
5
0
-5
-10
-15
-20
-25
dB
0.1
1
10
KHz
Test Datum
6dB/Oct+1
6dB/Oct-3

4.5. Frequency Stability Test

LIMIT

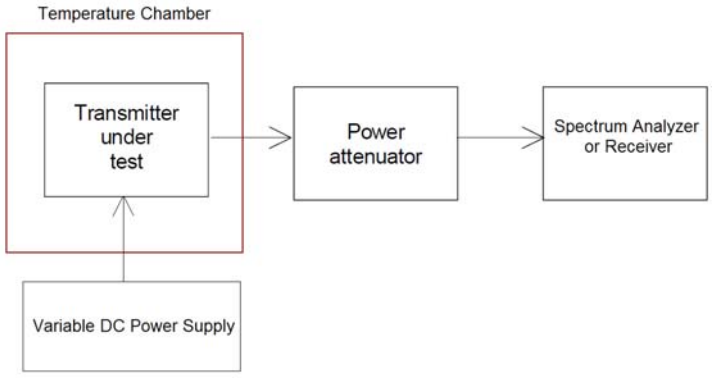
FCC part 90.213

Frequency range (MHz)	Fixed and base stations	Mobile stations	
		Over 2 watts output power	2 watts or less output power
Below 25	1 2 3100	100	200
25-50	20	20	50
72-76	5		50
150-174	5 115	65	4 650
216-220	1.0		1.0
220-22212	0.1	1.5	1.5
421-512	7 11 142.5	85	85
806-809	141.0	1.5	1.5
809-824	141.5	2.5	2.5
851-854	1.0	1.5	1.5
854-869	1.5	2.5	2.5
896-901	140.1	1.5	1.5
902-928	2.5	2.5	2.5
902-92813	2.5	2.5	2.5
929-930	1.5		
935-940	0.1	1.5	1.5
1427-1435	9300	300	300
Above 245010			

TEST PROCEDURE

1. According to FCC Part 2 Section 2.1055 (a)(1), the frequency stability shall be measured with variation of ambient temperature from -30℃ to +50℃ centigrade.
2. According to FCC Part 2 Section 2.1055 (d) (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.
4. 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 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 CONFIGURATION



TEST MODE:

Please reference to the section 2.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

Please refer to the below test data:

TX1									
Test conditions		Frequency error (ppm)						Limit (ppm)	Result
Voltage (V)	Temp (℃)	406.1125 MHz	413.05 MHz	419.9875 MHz	421.0125 MHz	455 MHz	469.9875 MHz		
7.4	-30	0.32	-0.65	0.56	-0.57	0.32	0.59	±2.5	Pass
	-20	0.69	0.48	0.43	0.74	0.73	-0.65		
	-10	0.52	0.56	0.55	0.35	0.29	0.73		
	0	-0.36	0.48	0.68	-0.62	0.57	0.46		
	10	0.74	-0.38	0.72	-0.42	-0.69	0.39		
	20	0.58	0.45	0.69	0.69	0.48	0.26		
	30	0.44	0.43	0.75	0.68	-0.46	0.32		
	40	0.82	0.35	0.82	0.59	0.33	0.41		
	50	0.66	0.74	0.48	0.81	-0.48	0.64		
6.29 (85% Rated)	20	-0.42	0.38	-0.54	0.88	0.67	0.58		
8.51 (115% Rated)	20	0.72	0.81	0.39	-0.62	0.57	-0.48		

TX2									
Test conditions		Frequency error (ppm)						Limit (ppm)	Result
Voltage(V)	Temp (℃)	406.1125 MHz	413.05 MHz	419.9875 MHz	421.0125 MHz	455 MHz	469.9875 MHz		
7.4	-30	0.68	0.68	0.44	0.57	0.63	0.89	±2.5	Pass
	-20	0.54	0.78	-0.56	0.53	0.57	0.67		
	-10	0.52	0.56	0.54	0.39	0.42	0.38		
	0	0.74	0.47	-0.81	-0.54	0.38	0.44		
	10	-0.52	0.41	0.47	0.64	0.44	-0.57		
	20	0.29	-0.55	0.63	0.61	0.38	0.37		
	30	0.82	0.63	0.57	0.48	0.71	0.59		
	40	0.46	0.59	0.36	0.42	0.52	0.67		
	50	-0.57	0.64	0.55	0.69	0.39	0.39		
6.29 (85% Rated)	20	0.78	0.76	0.57	-0.52	0.66	-0.58		
8.51 (115% Rated)	20	-0.69	0.66	0.62	0.75	0.55	0.62		

TX3									
Test conditions		Frequency error (ppm)						Limit (ppm)	Result
Voltage(V)	Temp (℃)	406.1125 MHz	413.05 MHz	419.9875 MHz	421.0125 MHz	455 MHz	469.9875 MHz		
7.4	-30	-0.63	0.45	-0.53	0.88	0.45	0.42	±2.5	Pass
	-20	0.42	0.36	-0.46	0.72	0.42	-0.68		
	-10	0.57	0.42	0.56	0.64	0.49	0.48		
	0	0.27	0.53	0.55	0.54	0.65	0.55		
	10	0.73	0.47	0.68	0.56	0.59	0.69		
	20	0.52	0.55	0.74	-0.53	-0.47	0.42		
	30	0.49	-0.68	0.36	0.62	0.85	-0.61		
	40	0.78	0.57	0.46	0.54	-0.66	0.54		
	50	-0.52	0.47	0.52	0.72	0.51	-0.58		
6.29 (85% Rated)	20	0.46	-0.56	0.62	0.56	0.47	0.71		
8.51 (115% Rated)	20	0.73	-0.72	0.73	-0.66	0.57	0.39		

TX4									
Test conditions		Frequency error (ppm)						Limit (ppm)	Result
Voltage(V)	Temp (℃)	406.1125 MHz	413.05 MHz	419.9875 MHz	421.0125 MHz	455 MHz	469.9875 MHz		
7.4	-30	0.45	0.39	0.66	-0.53	0.74	0.93	±2.5	Pass
	-20	0.26	0.42	-0.59	0.55	0.63	-0.58		
	-10	-0.47	0.68	-0.74	0.54	-0.48	0.54		
	0	0.69	0.55	0.47	0.63	0.56	0.52		
	10	0.52	-0.45	0.67	0.59	0.59	0.36		
	20	0.57	0.52	0.59	0.55	0.74	0.22		
	30	0.85	0.39	0.51	0.64	0.83	0.81		
	40	0.69	-0.47	0.55	0.51	0.85	0.46		
	50	-0.63	0.49	0.57	-0.67	-0.55	-0.27		
6.29 (85% Rated)	20	0.92	0.68	0.83	0.64	0.65	0.84		
8.51 (115% Rated)	20	-0.45	-0.58	-0.57	0.72	-0.57	0.63		

4.6. Transmitter Frequency Behavior

LIMIT

FCC part 90.214

Transmitters designed to operate in the 150-174 MHz and 421-512 MHz frequency bands must maintain transient frequencies within the maximum frequency difference limits during the time intervals indicated:

Time intervals[1 2]	Maximum frequency difference[3]	All equipment	
		150 to 174 MHz	421 to 512 MHz
Transient Frequency Behavior for Equipment Designed to Operate on 25 kHz Channels			
t_1[4]	±25.0 kHz	5.0 ms	10.0 ms
t_2	±12.5 kHz	20.0 ms	25.0 ms
t_3[4]	±25.0 kHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels			
t_1[4]	±12.5 kHz	5.0 ms	10.0 ms
t_2	±6.25 kHz	20.0 ms	25.0 ms
t_3[4]	±12.5 kHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 6.25 kHz Channels			
t_1[4]	±6.25 kHz	5.0 ms	10.0 ms
t_2	±3.125 kHz	20.0 ms	25.0 ms
t_3[4]	±6.25 kHz	5.0 ms	10.0 ms

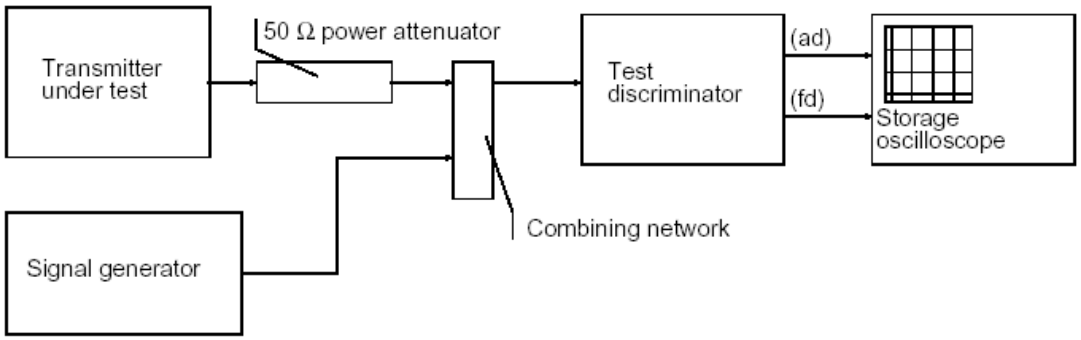
Note:

1. On is the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.

1) t_1 is the time period immediately following ton.
2) t_2 is the time period immediately following t_1.
3) t_3 is the time period from the instant when the transmitter is turned off until toff.
4) t_{off} is the instant when the 1 kHz test signal starts to rise.

2. During the time from the end of t_2 to the beginning of t_3, the frequency difference must not exceed the limits specified in § 90.213.
3. Difference between the actual transmitter frequency and the assigned transmitter frequency.
4. 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 CONFIGURATION



TEST PROCEDURE

According to TIA/EIA-603 2.2.19 requirement.As for the product different from PTT,we use test steps as follows:

1. Connect DUT into Test discriminator and Storage Oscilloscope and keep DUT stats ON;
2. Input 1kHz signal into DUT;
3. Set the modulation domain analyzer to trigger on the rising edge of the waveform in order to capture a single-shot turn-on of the transmitter signals;
4. Keep DUT in OFF state and Key the PTT;
5. Observe the stored oscilloscope of modulation domain analyzer.The signal trace shall be maintained within the allowable limits during the periods t_1 and t_2,and shall also remain within limits following t_2;
6. Adjust the modulation domain anzlyzer to trigger on the falling edge of the transmitter waveform in order to capture a single-shot turn-off transmitter of the transmitter signal.
7. Keep the digital portable radio in ON state and Unkey the PTT;
8. Observe the stored oscilloscope of modulation domain analyzer.The signal trace shall be maintained within the allowable limits during the period t_3.

TEST MODE:

Please reference to the section 2.4

TEST RESULTS

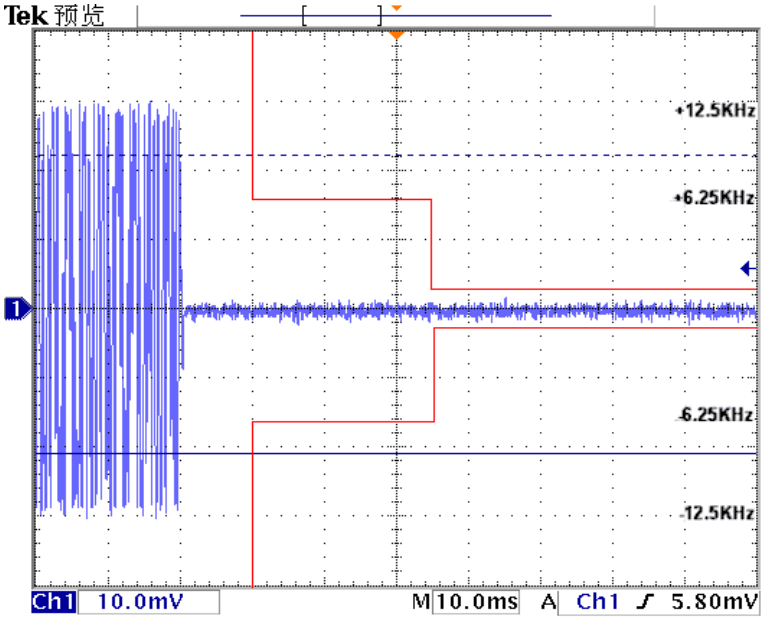
☒ **Passed** ☐ **Not Applicable**

Remark:We tested TX3 to TX4,recorded worst case at TX3 for 455MHz.

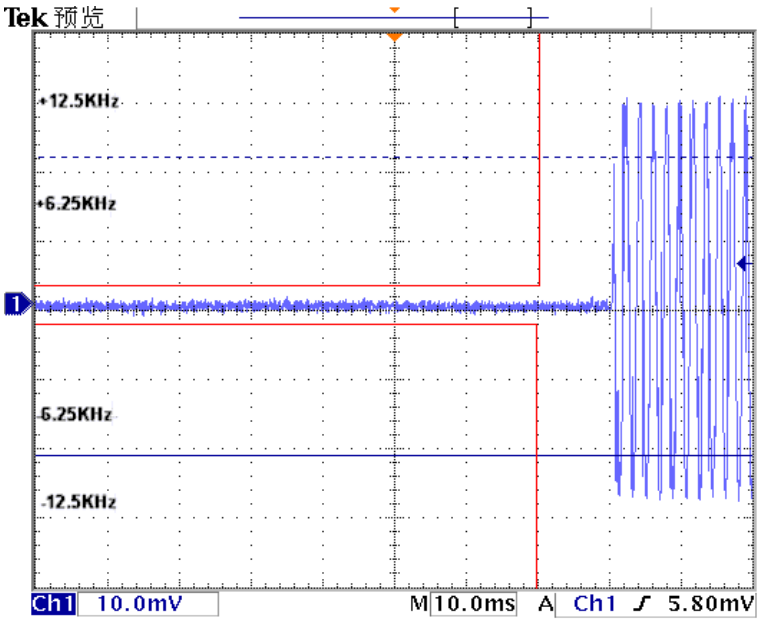
Please refer to the following plots:

Modulation Type: FM(TX3)

Transmitter Frequency Behaviour @ 12.5kHz Channel Separation------Off – On



Transmitter Frequency Behaviour @ 12.5kHz Channel Separation------On – Off



4.7. Spurious Emission on Antenna Port

LIMIT

Modulation Type: 4FSK

FCC Part 22.359, 74.462, 80.211 and 90.210 (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 (Pwatts) = 50 + 10 log (3.83) =55.83dB
High: 50 + 10 log (Pwatts) = 50 + 10 log (1.25) = 50.97dB

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 36.63 dBm.
Limit (dBm) =36.63-50-10log$_{10}$ (3.83) = -20 dBm

Modulation Type: FM

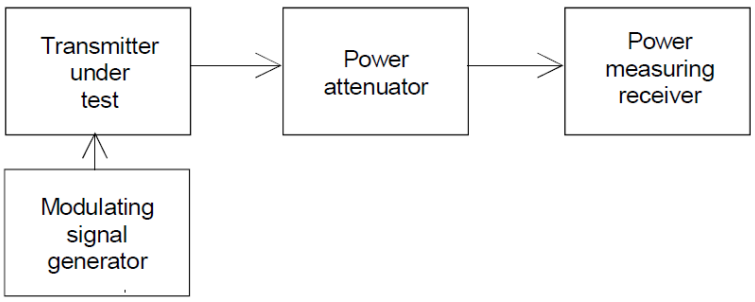
FCC Part 22.359, 74.462, 80.211 and 90.210 (12.5 kHz bandwidth only): On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz at least:
Low: 50 + 10 log (Pwatts) = 50 + 10 log (3.83) =55.83dB
High: 50 + 10 log (Pwatts) = 50 + 10 log (1.25) =50.97dB
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 36.63 dBm.
Limit (dBm) =36.63-50-10log$_{10}$ (3.83) = -20 dBm

TEST PROCEDURE

1. The RF output of the EUT was connected to a spectrum analyzer through appropriate attenuation.
2. 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 10th Harmonic.
3. 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 MODE:

Please reference to the section 2.4

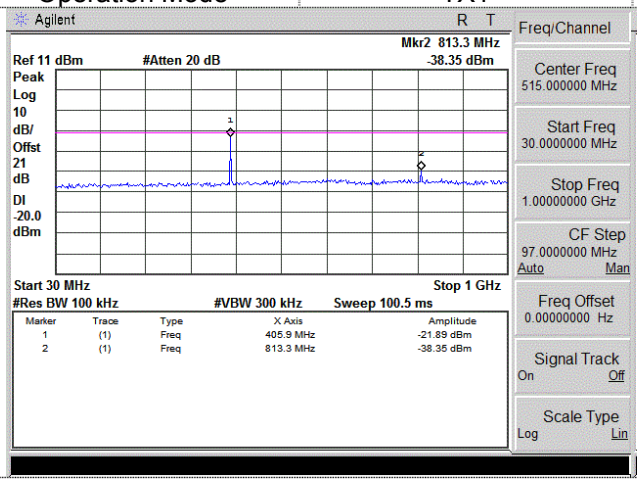
TEST RESULTS

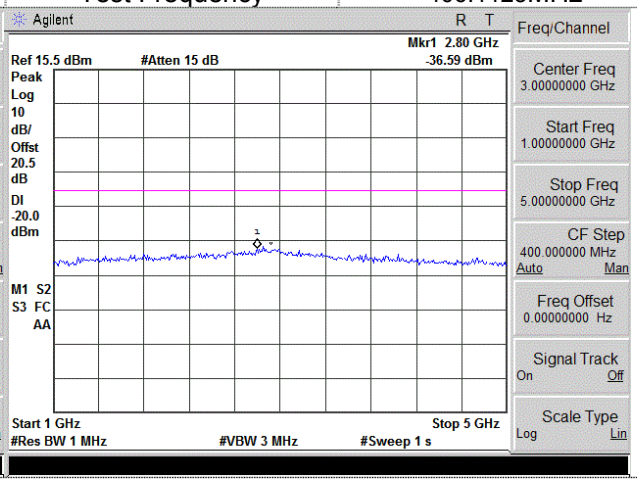
☒ **Passed** ☐ **Not Applicable**

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

Test plot as follows:

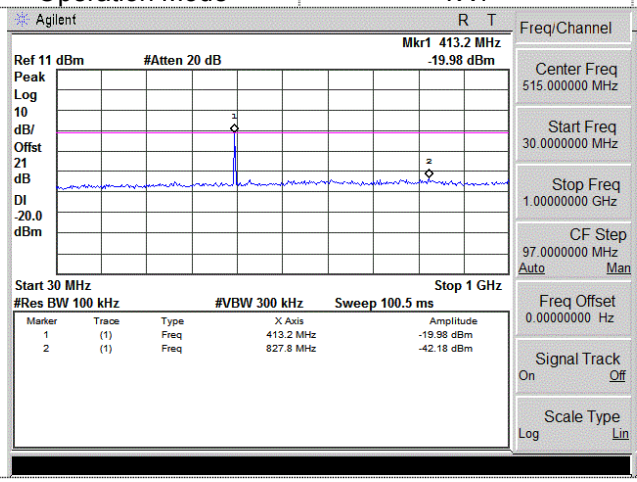
Operation Mode	TX1	Test Frequency	406.1125MHz

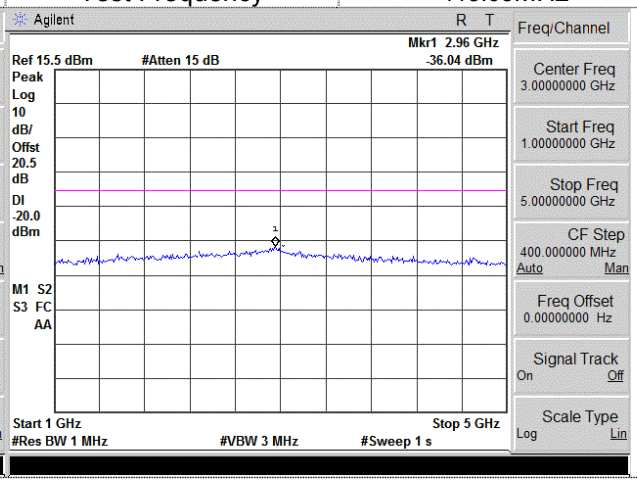




30MHz-1GHz 1GHz-5GHz

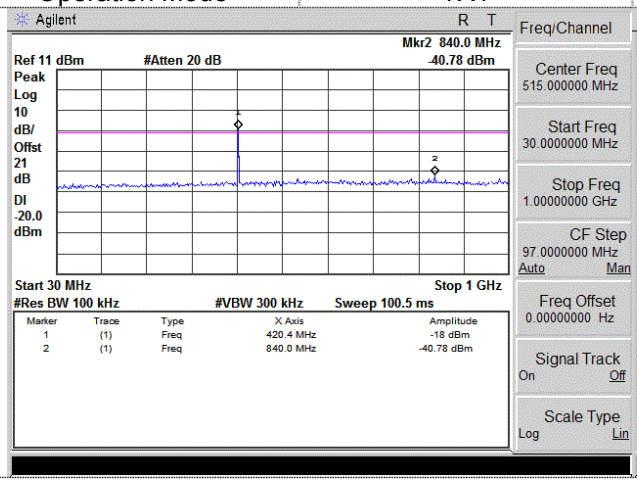
Operation Mode	TX1	Test Frequency	413.05MHz

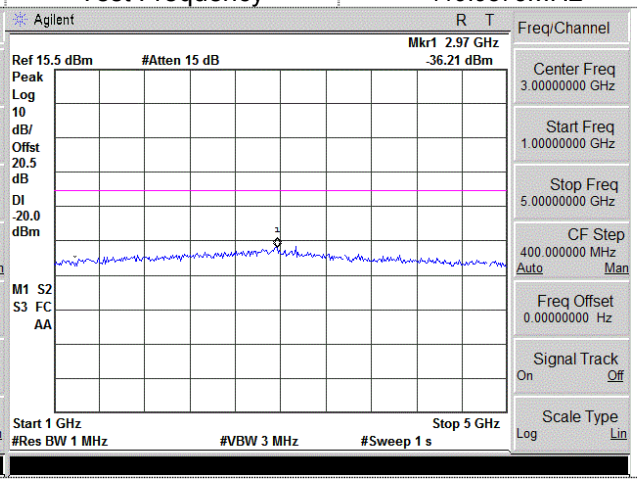




30MHz-1GHz 1GHz-5GHz

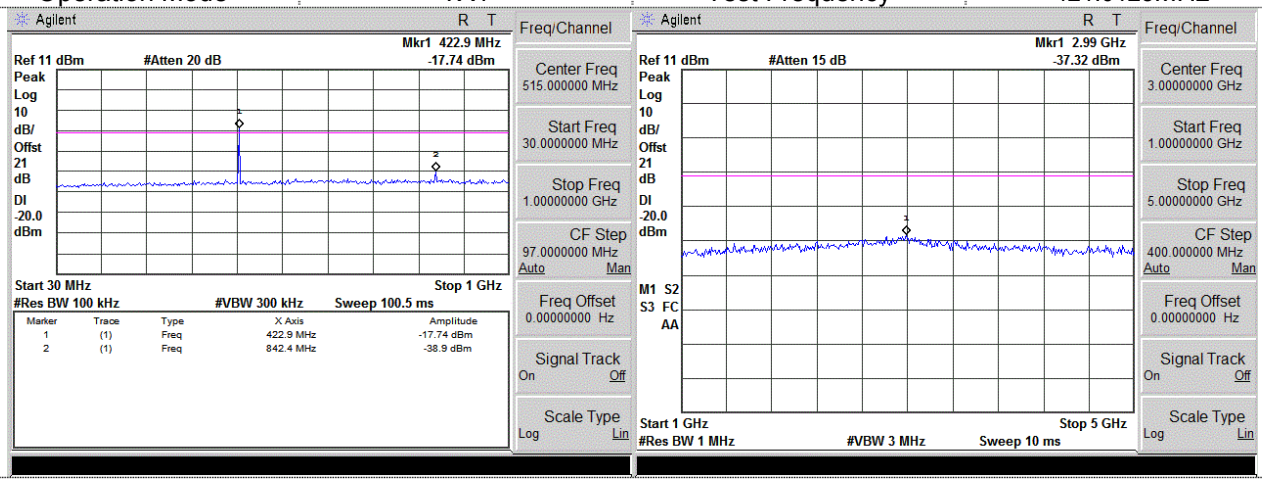
Operation Mode	TX1	Test Frequency	419.9875MHz





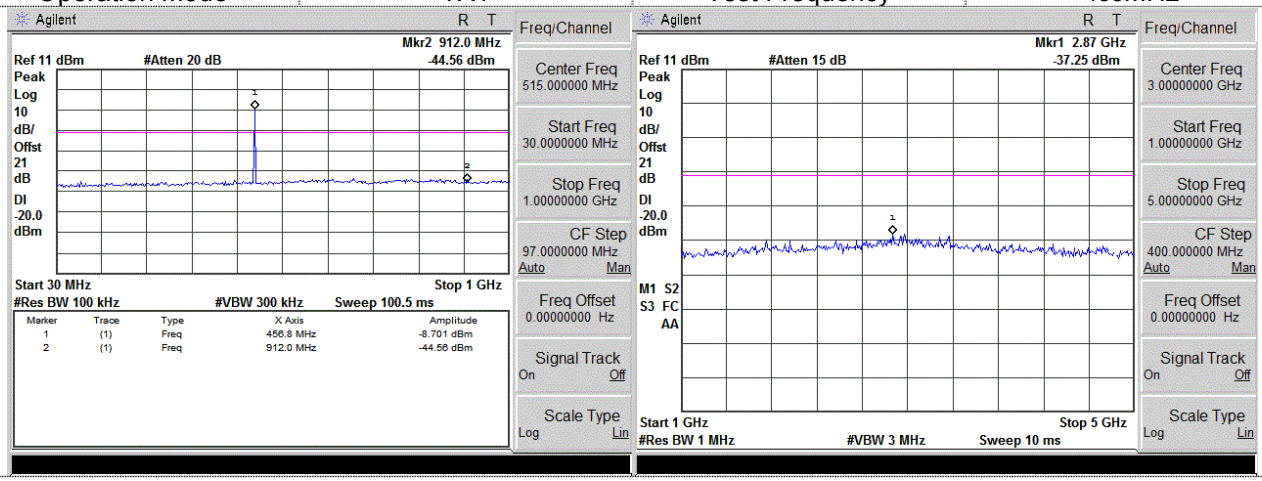
30MHz-1GHz 1GHz-5GHz

Operation Mode	TX1	Test Frequency	421.0125MHz



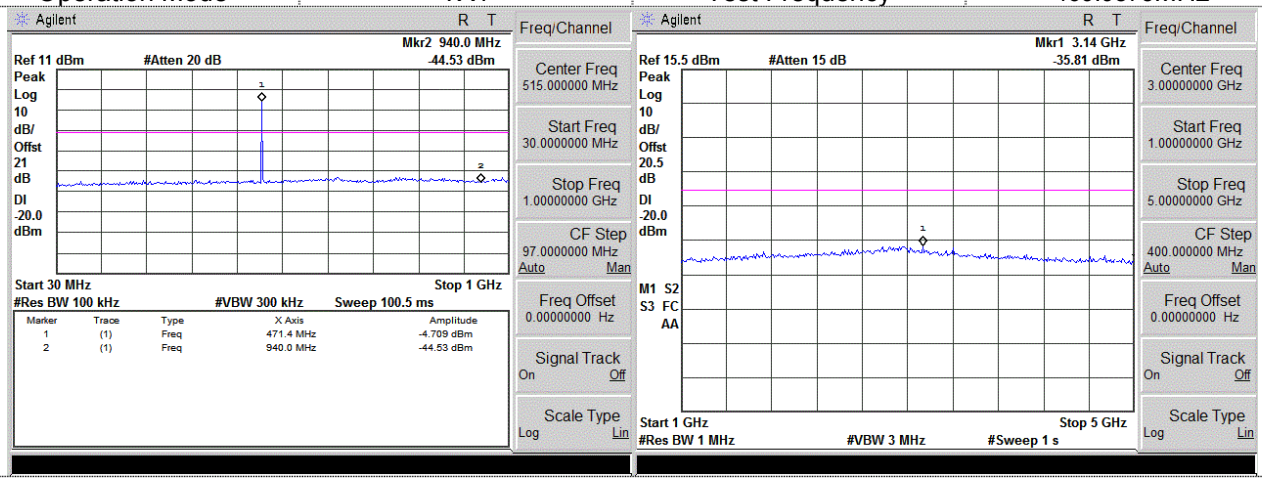
30MHz-1GHz 1GHz-5GHz

Operation Mode	TX1	Test Frequency	455MHz



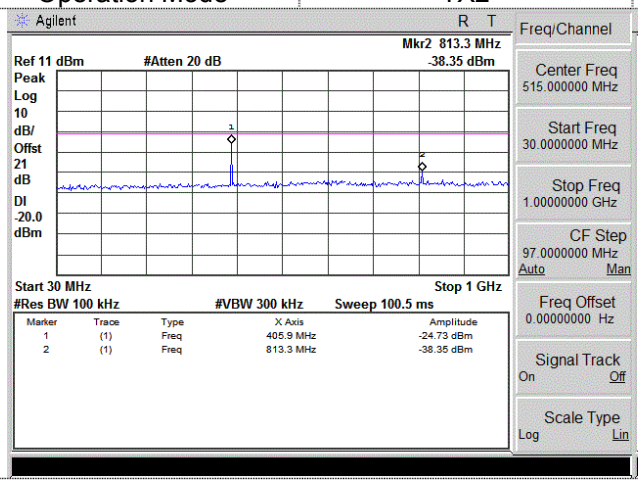
30MHz-1GHz 1GHz-5GHz

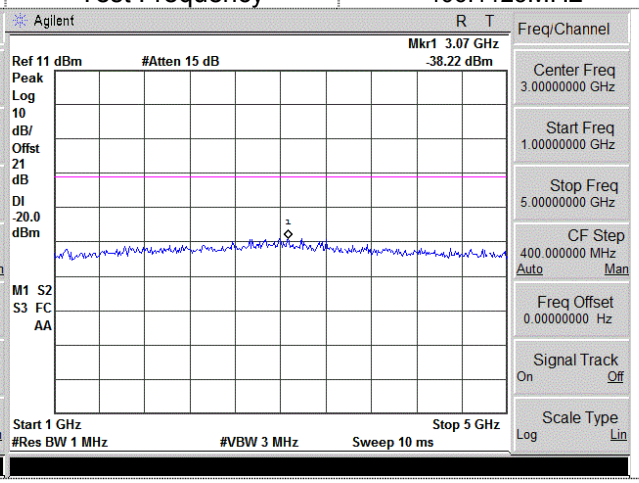
Operation Mode	TX1	Test Frequency	469.9875MHz



30MHz-1GHz 1GHz-5GHz

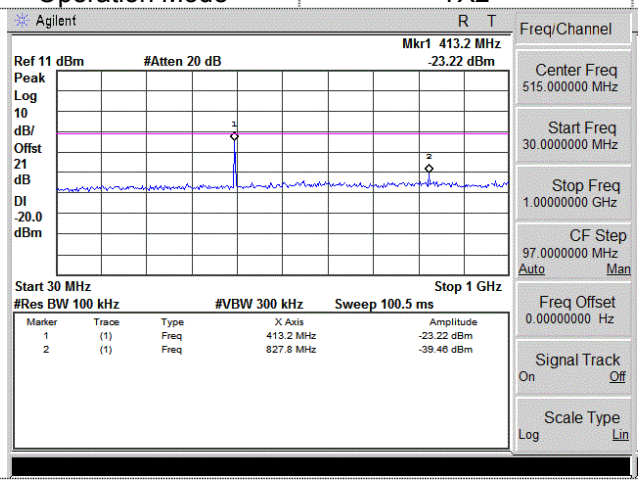
Operation Mode	TX2	Test Frequency	406.1125MHz

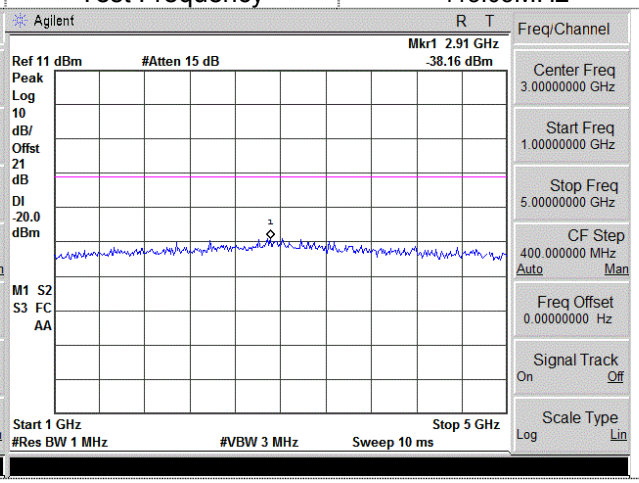




30MHz-1GHz 1GHz-5GHz

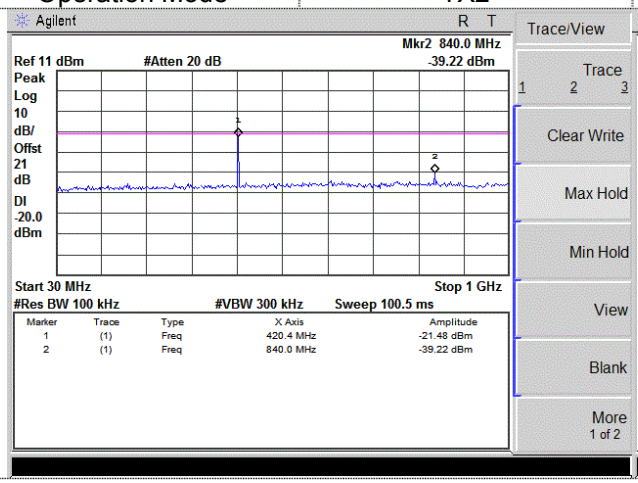
Operation Mode	TX2	Test Frequency	413.05MHz

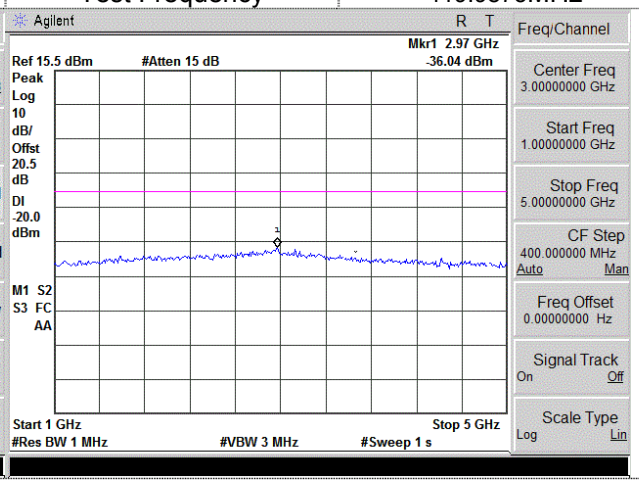




30MHz-1GHz 1GHz-5GHz

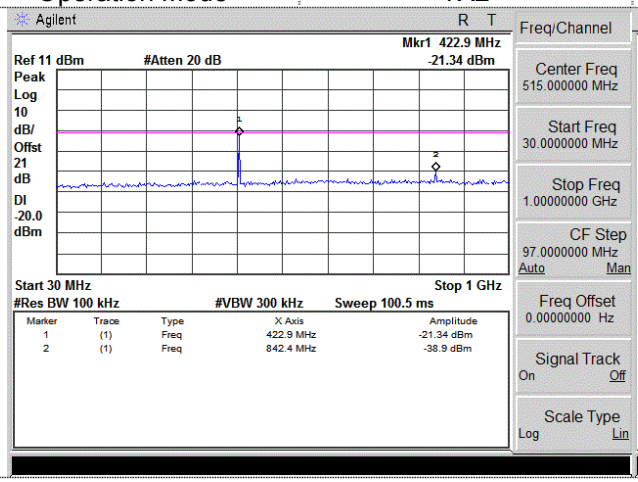
Operation Mode	TX2	Test Frequency	419.9875MHz



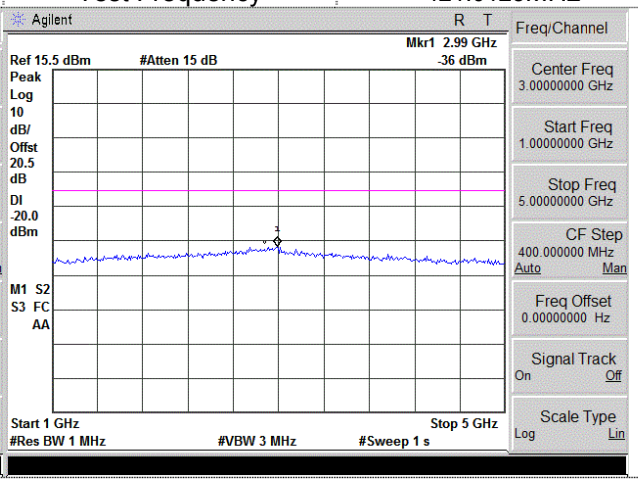


30MHz-1GHz 1GHz-5GHz

Operation Mode	TX2	Test Frequency	421.0125MHz

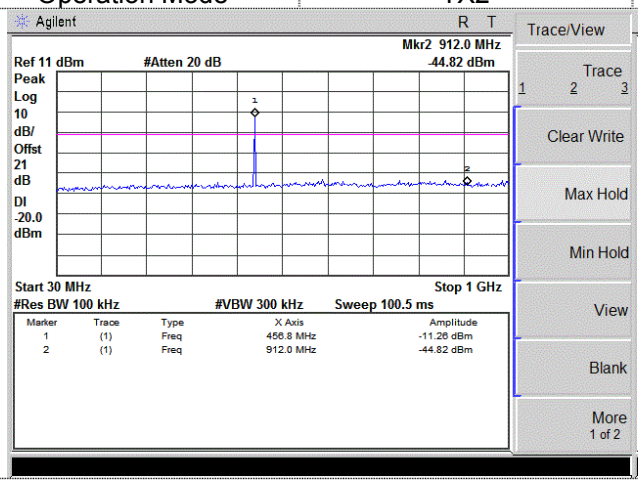


30MHz-1GHz

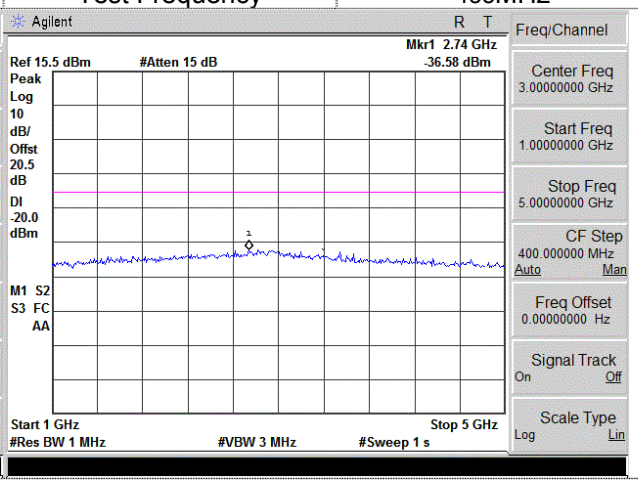


1GHz-5GHz

Operation Mode	TX2	Test Frequency	455MHz

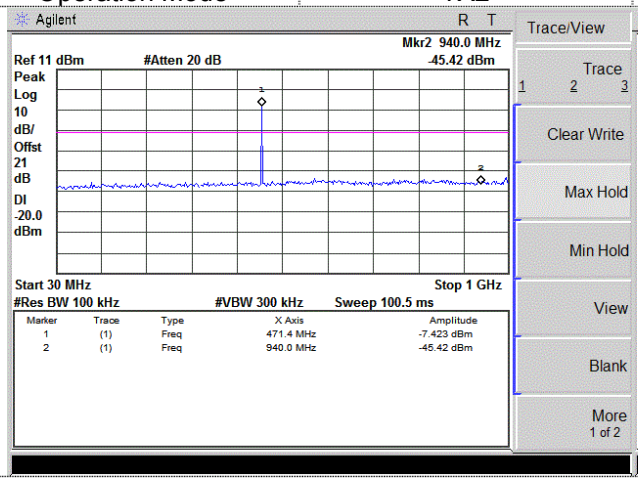


30MHz-1GHz

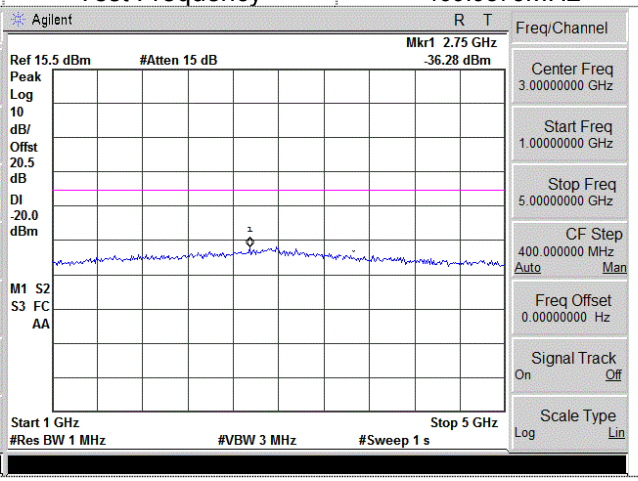


1GHz-5GHz

Operation Mode	TX2	Test Frequency	469.9875MHz

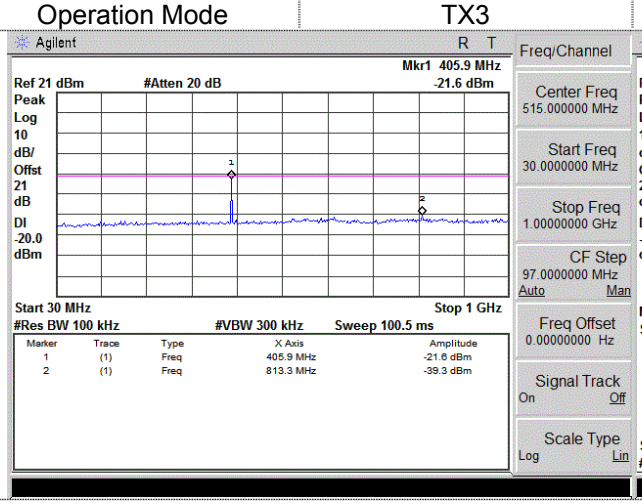


30MHz-1GHz

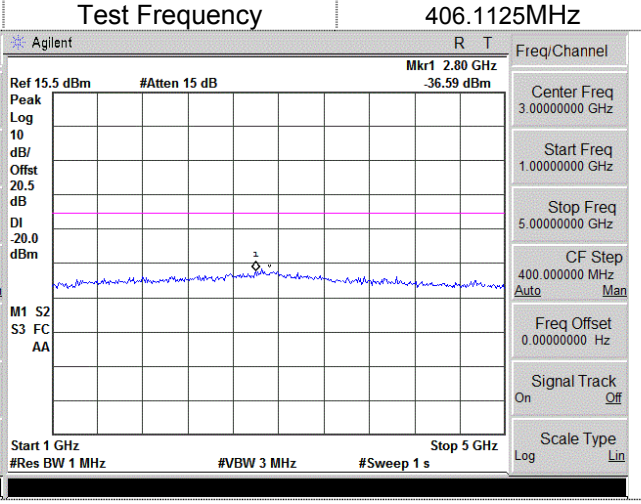


1GHz-5GHz

Operation Mode	TX3	Test Frequency	406.1125MHz

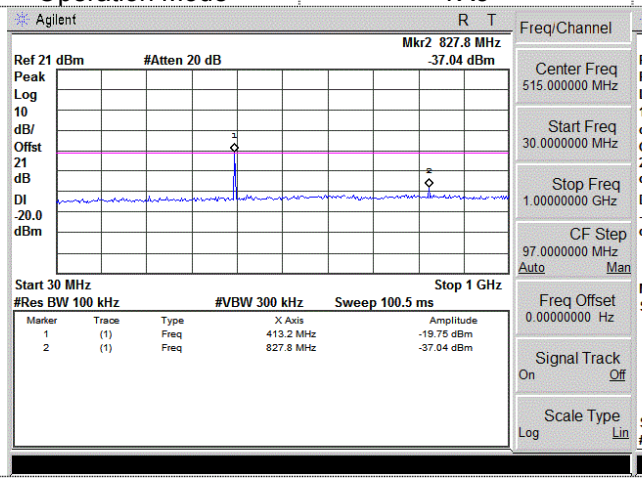


30MHz-1GHz

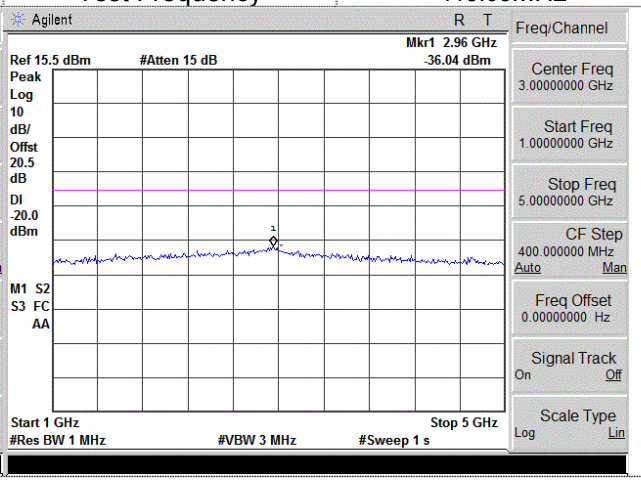


1GHz-5GHz

Operation Mode	TX3	Test Frequency	413.05MHz

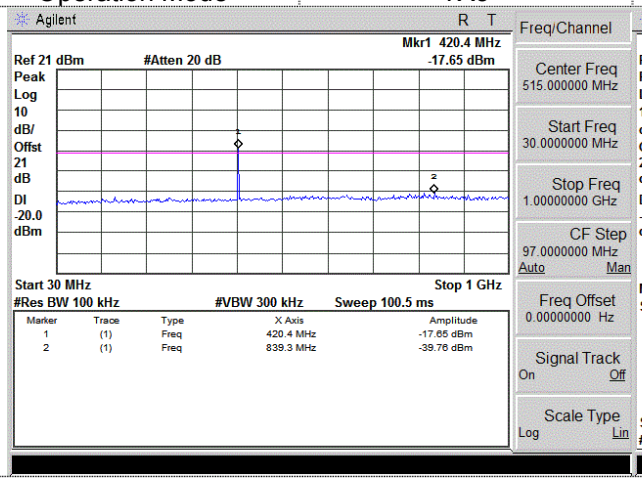


30MHz-1GHz

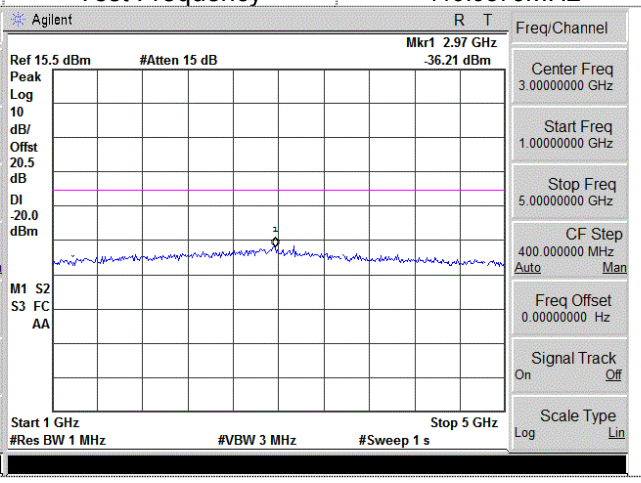


1GHz-5GHz

Operation Mode	TX3	Test Frequency	419.9875MHz

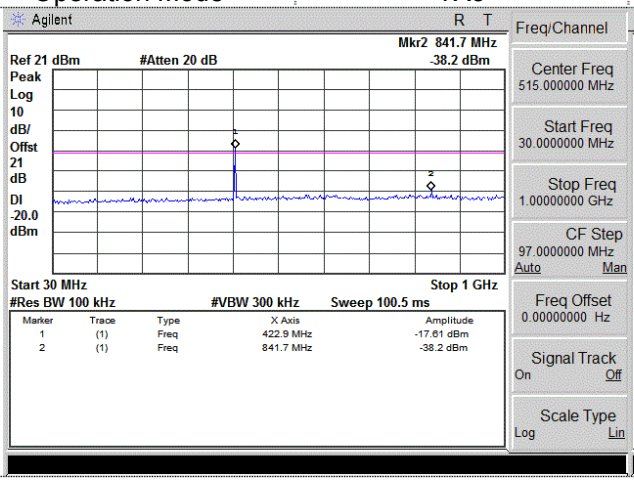


30MHz-1GHz

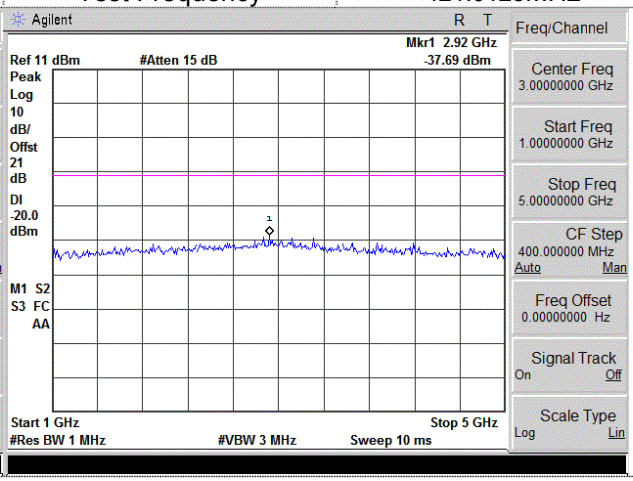


1GHz-5GHz

Operation Mode	TX3	Test Frequency	421.0125MHz

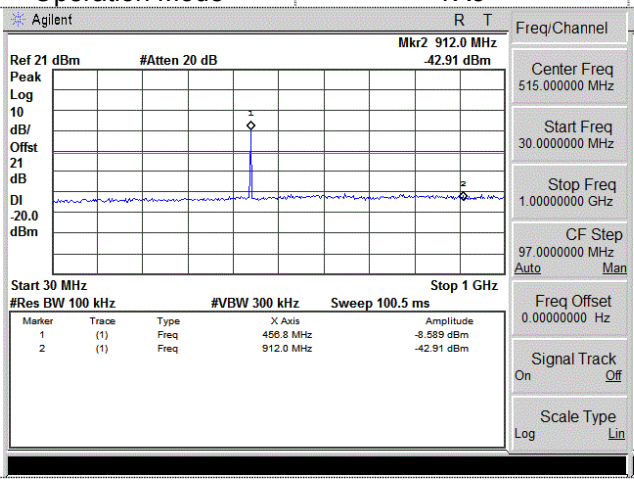


30MHz-1GHz

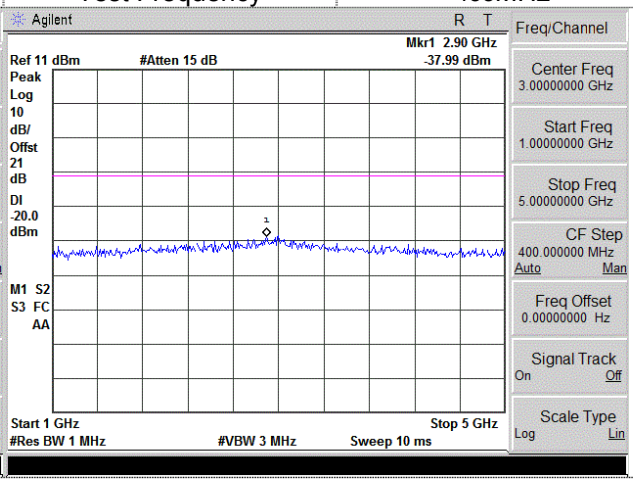


1GHz-5GHz

Operation Mode	TX3	Test Frequency	455MHz

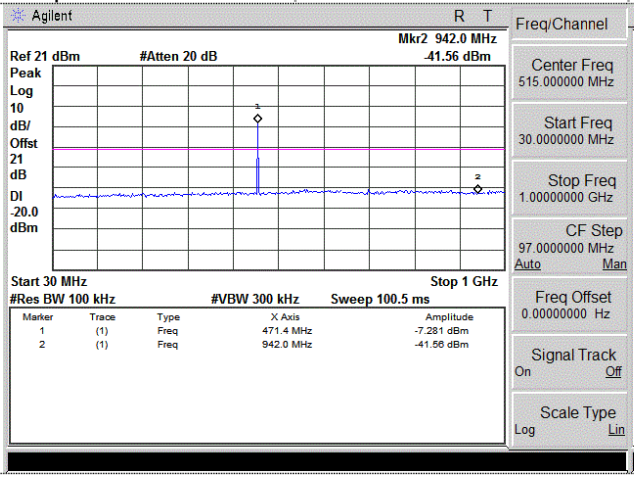


30MHz-1GHz

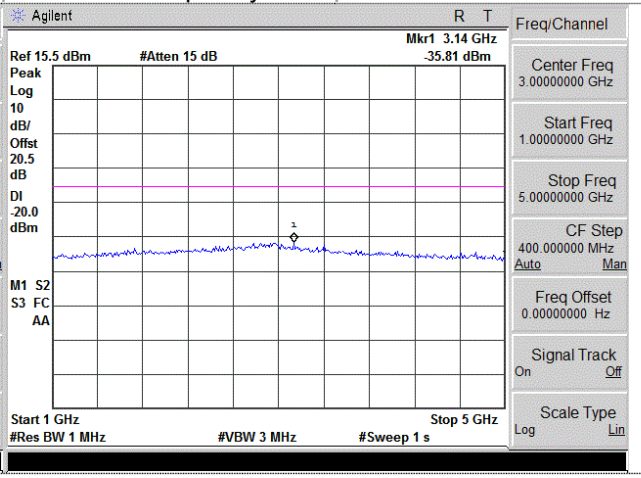


1GHz-5GHz

Operation Mode	TX3	Test Frequency	469.9875MHz

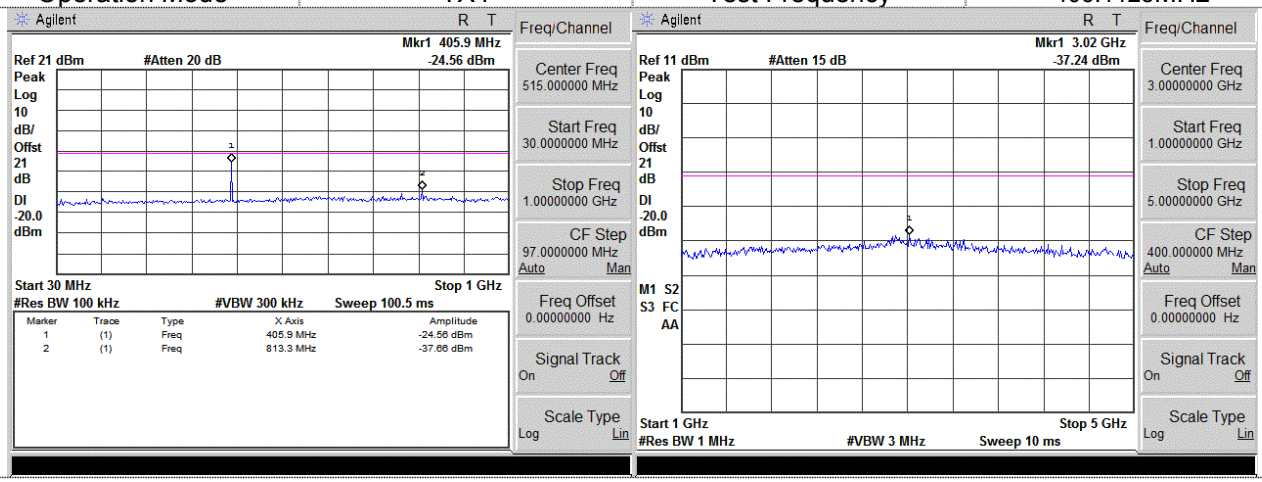


30MHz-1GHz



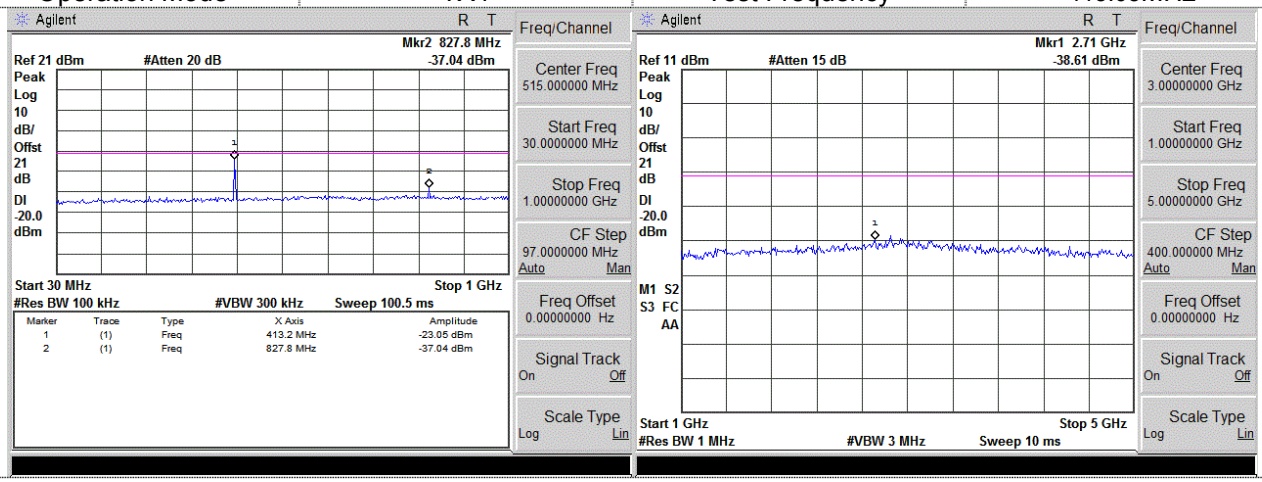
1GHz-5GHz

Operation Mode	TX4	Test Frequency	406.1125MHz



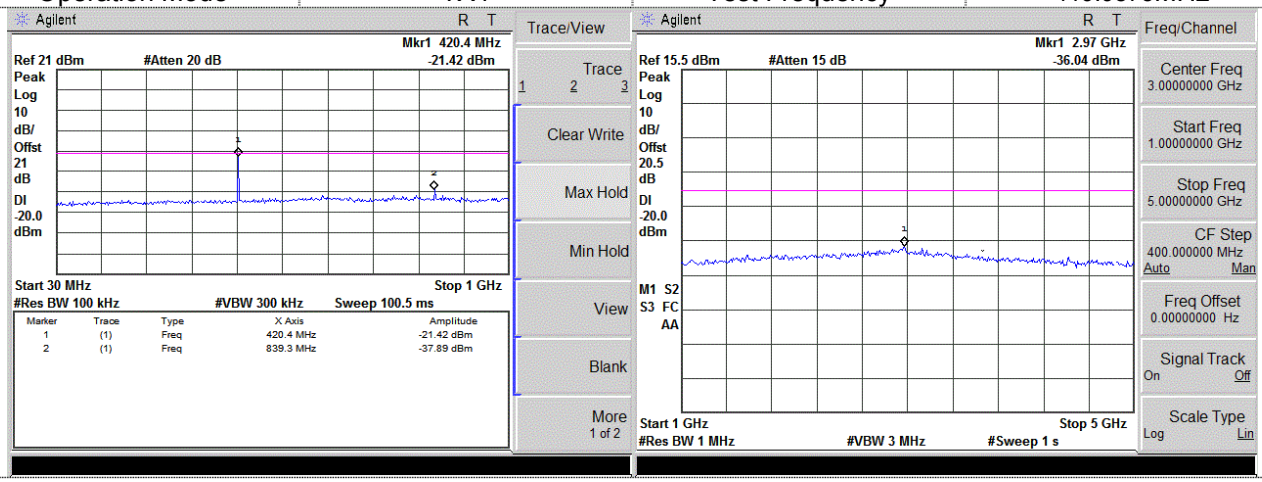
30MHz-1GHz 1GHz-5GHz

Operation Mode	TX4	Test Frequency	413.05MHz



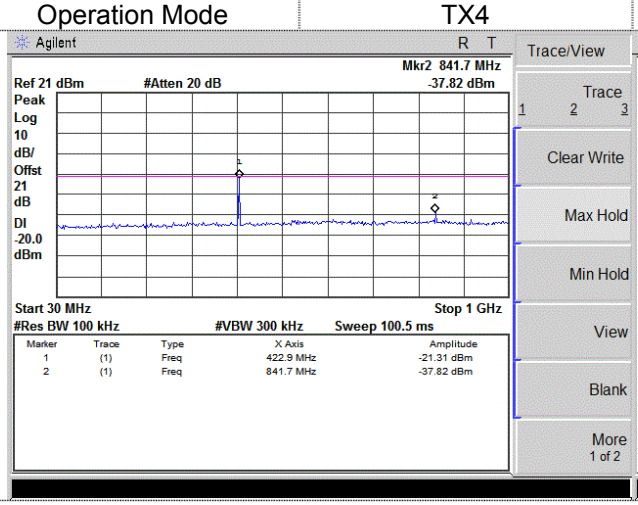
30MHz-1GHz 1GHz-5GHz

Operation Mode	TX4	Test Frequency	419.9875MHz

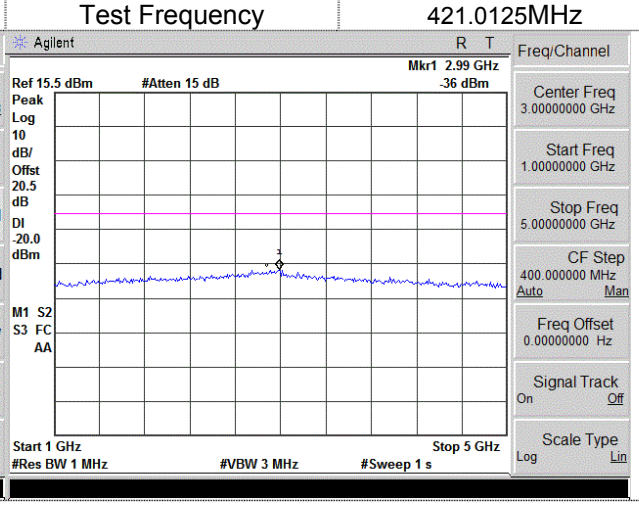


30MHz-1GHz 1GHz-5GHz

Operation Mode	TX4	Test Frequency	421.0125MHz

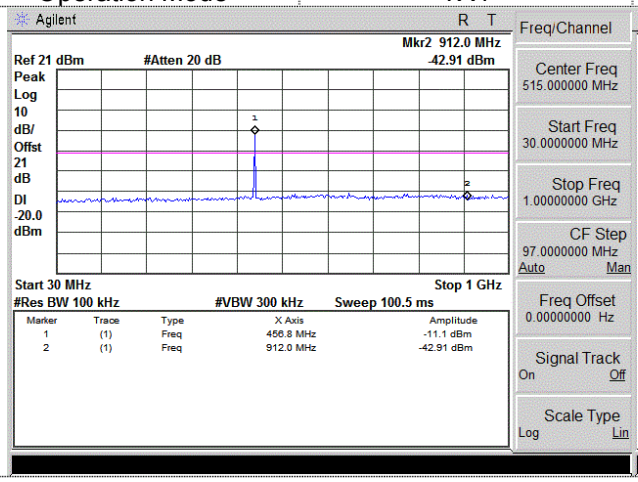


30MHz-1GHz

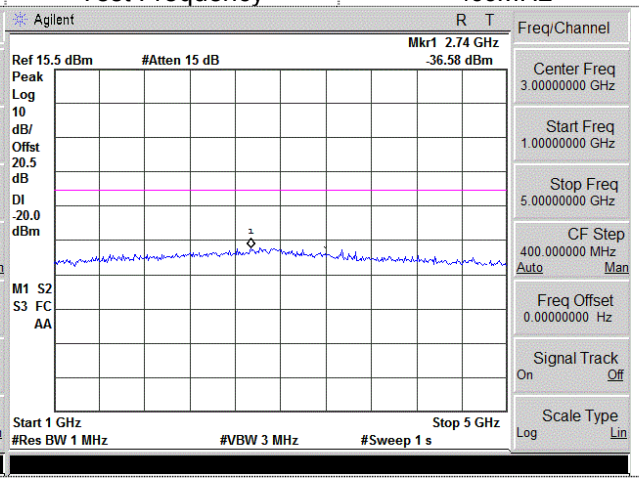


1GHz-5GHz

Operation Mode	TX4	Test Frequency	455MHz

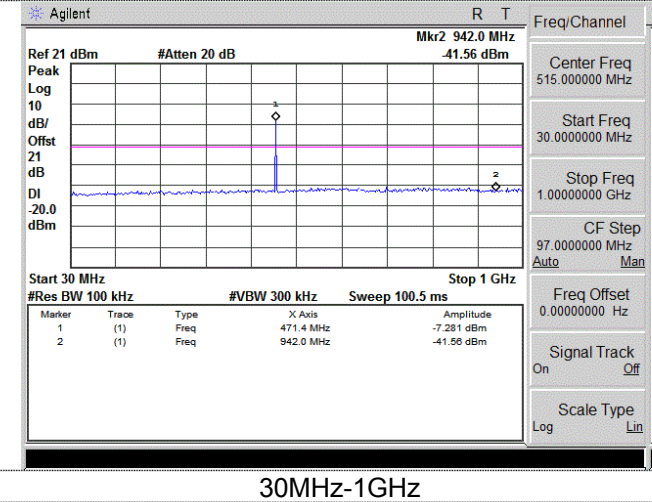


30MHz-1GHz

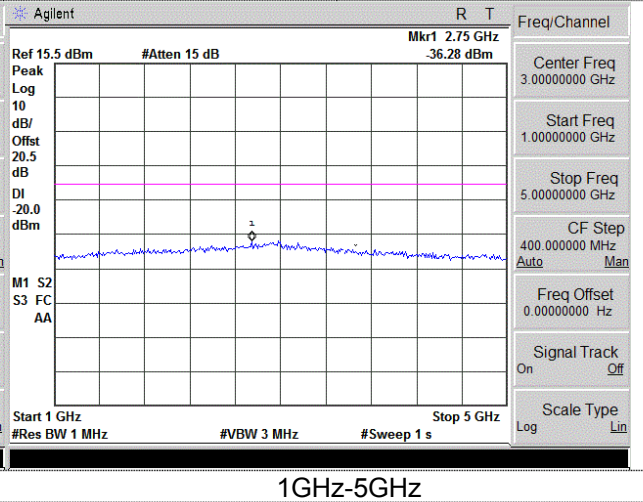


1GHz-5GHz

Operation Mode	TX4	Test Frequency	469.9875MHz



30MHz-1GHz



1GHz-5GHz

4.8. Transmitter Radiated Spurious Emission

LIMIT

Modulation Type: 4FSK

FCC Part 22.359, 74.462, 80.211 and 90.210 (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 (Pwatts) = 50 + 10 log (3.83) =55.83dB
High: 50 + 10 log (Pwatts) = 50 + 10 log (1.25) = 50.97dB

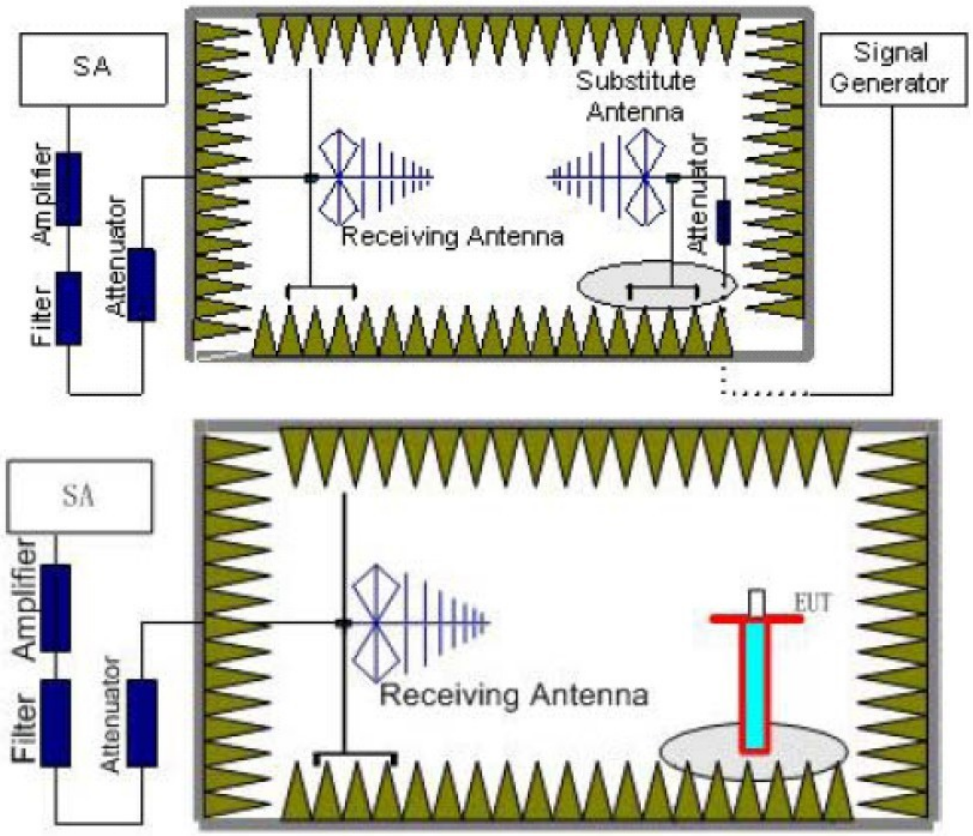
Note: In general, the worse case attenuation requirement shown above was applied.
Calculation: Limit (dBm) =EL-50-10log10 (TP)
Notes: EL is the emission level of the Output Power expressed in dBm,
In this application, the EL is 36.63 dBm.
Limit (dBm) =36.63-50-10$\log_{10}$ (3.83) = -20 dBm

Modulation Type: FM

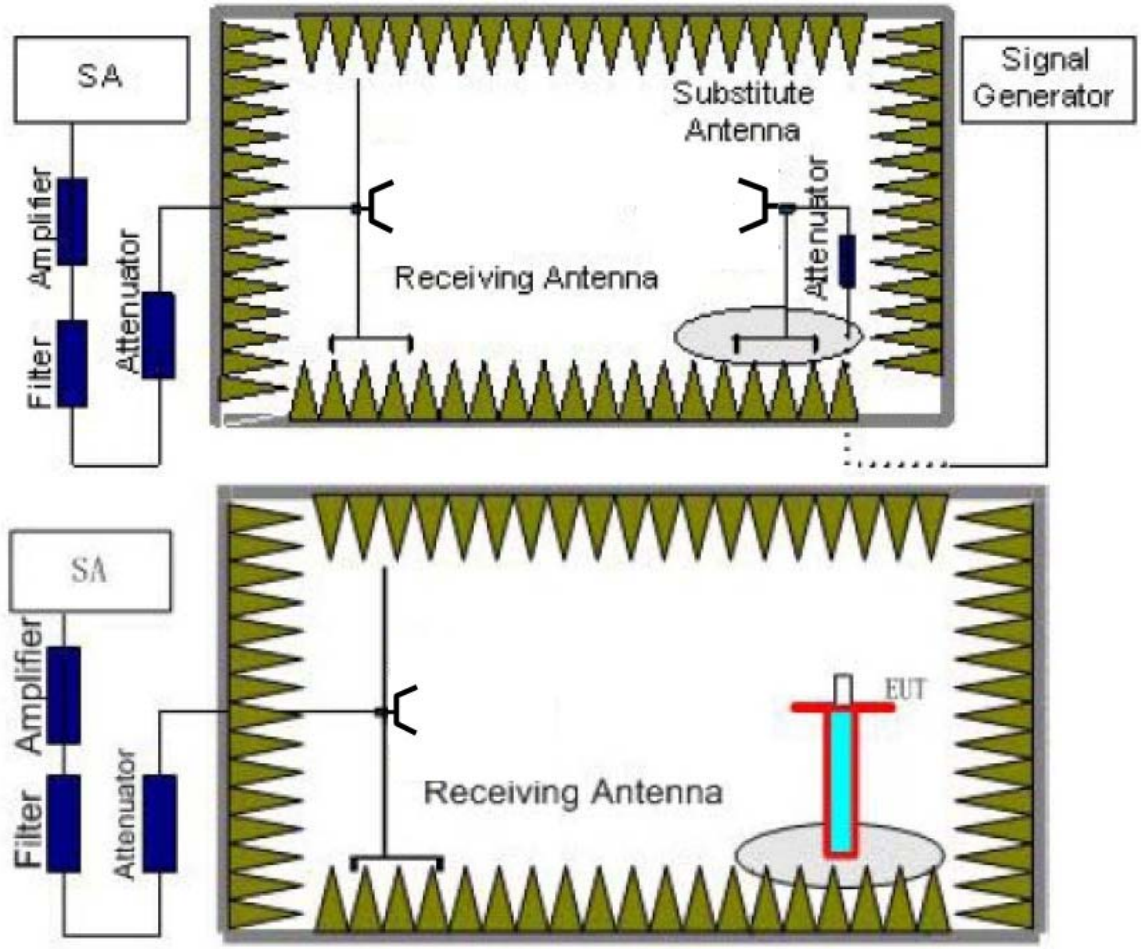
FCC Part 22.359, 74.462, 80.211 and 90.210 (12.5 kHz bandwidth only): On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz at least:
Low: 50 + 10 log (Pwatts) = 50 + 10 log (3.83) =55.83dB
High: 50 + 10 log (Pwatts) = 50 + 10 log (1.25) =50.97dB
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 36.63 dBm.
Limit (dBm) =36.63-50-10$\log_{10}$ (3.83) = -20 dBm

TEST CONFIGURATION

Below 1GHz:



Above 1GHz:



TEST PROCEDURE

1. EUT was placed on a 0.8 meter high non-conductive stand at a 3 meter test distance from the receive antenna. A receiving antenna was placed on the antenna mast 3 meters from the EUT for emission measurements. The height of receiving antenna is 1. 0 m. Detected emissions were maximized at each frequency by rotating the EUT through 360° and adjusting the receiving antenna polarization. The radiated emission measurements of all transmit frequencies in six channels were measured with peak detector.
2. A log-periodic antenna or double-ridged waveguide horn antenna shall be substituted in place of the EUT. The log-periodic antenna will be driven by a signal generator and the level will be adjusted till the same power value on the spectrum analyzer or receiver. The level of the spurious emissions can be calculated through the level of the signal generator, cable loss, the gain of the substitution antenna and the reading of the spectrum analyzer or receiver.
3. The EUT is then put into continuously transmitting mode at its maximum power level during the test.Set Test Receiver or Spectrum RBW=1MHz,VBW=3MHz for above 1GHz and RBW=100kHz,VBW=300kHz for 30MHz to 1GHz, And the maximum value of the receiver should be recorded as (P_r).
4. The EUT shall be replaced by a substitution antenna. In the chamber, an substitution antenna for the frequency band of interest is placed at the reference point of the chamber. An RF Signal source for the frequency band of interest is connected to the substitution antenna with a cable that has been constructed to not interfere with the radiation pattern of the antenna. A power (P_{Mea}) is applied to the input of the substitution antenna, and adjust the level of the signal generator output until the value of the receiver reach the previously recorded (P_r). The power of signal source (P_{Mea}) is recorded. The test should be performed by rotating the test item and adjusting the receiving antenna polarization.
5. A amplifier should be connected to the Signal Source output port. And the cable should be connect between the Amplifier and the Substitution Antenna. The cable loss (P_{cl}) ,the Substitution Antenna Gain (G_a) and the Amplifier Gain (P_{Ag}) should be recorded after test.
   The measurement results are obtained as described below:
   Power(EIRP)=P_{Mea}- P_{Ag} - P_{cl} - G_a
   We used SMF100A micowave signal generator which signal level can up to 33dBm,so we not used power Amplifier for substituation test; The measurement results are amend as described below:
   Power(EIRP)=P_{Mea}- P_{cl} - G_a

6. This value is EIRP since the measurement is calibrated using an antenna of known gain (2.15 dBi) and known input power.
7. ERP can be calculated from EIRP by subtracting the gain of the dipole, ERP = EIRP-2.15dBi.

TEST MODE:

Please reference to the section 2.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

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. We tested TX1to TX4.recorded worst case at TX1 and TX3.
4. Absolute Level=SG Level-Cable loss+Antenna Gain, Margin=Limit-Absulute Level

Frequency (MHz)	Polar (H/V)	Receiver Reading (dBμV)	Substituted Method			Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			S.G.Level (dBm)	Antenna Gain (dBd/dBi)	Cable Loss (dB)			
TX1:406.1125 MHz								
812.225	H	52.94	-44.6	0	3.34	-47.94	-20	27.94
812.225	V	53.77	-45.43	0	3.34	-48.77	-20	28.77
1217.32	H	71.21	-55.65	9	4.17	-50.82	-20	30.82
1217.32	V	67.23	-52.12	9	4.17	-47.29	-20	27.29
1941.7	H	62.64	-44.22	12.1	5.5	-37.62	-20	17.62
1941.7	V	64.67	-46.25	12.1	5.5	-39.65	-20	19.65
TX1:413.0500 MHz								
826.1	H	67.15	-53.67	0	3.66	-57.33	-20	37.33
826.1	V	68.99	-55.51	0	3.66	-59.17	-20	39.17
1064.78	H	56.62	-50.18	8.5	4.19	-45.87	-20	25.87
1064.78	V	58.19	-51.75	8.5	4.19	-47.44	-20	27.44
1753.64	H	60.45	-51.21	11.3	5.71	-45.62	-20	25.62
1753.64	V	60.49	-51.25	11.3	5.71	-45.66	-20	25.66
TX1:419.9875 MHz								
839.975	H	58.72	-49.68	0	3.44	-53.12	-20	33.12
839.975	V	58.04	-49	0	3.44	-52.44	-20	32.44
2100.03	H	62.32	-50.57	8.7	6.33	-48.2	-20	28.2
2100.03	V	57.48	-47.17	8.7	6.33	-44.8	-20	24.8
2939.75	H	56.13	-42.85	11.56	8.04	-39.33	-20	19.33
2939.75	V	60.49	-51.25	11.56	8.04	-47.73	-20	27.73
TX1:421.0125 MHz								
842.025	H	56.12	-46.97	0	3.44	-50.41	-20	30.41
842.025	V	57.9	-48.75	0	3.44	-52.19	-20	32.19
1684.48	H	58.51	-49.49	8.2	5.57	-46.86	-20	26.86
1684.48	V	59.58	-49.22	8.2	5.57	-46.59	-20	26.59
2949.23	H	52.92	-39.63	11.1	8.06	-36.59	-20	16.59
2949.23	V	56.25	-42.96	11.1	8.06	-39.92	-20	19.92
TX1:455.0000 MHz								
910	H	58.07	-47.15	0	3.62	-50.77	-20	30.77
910	V	61.61	-49.7	0	3.66	-53.36	-20	33.36
2350.46	H	47.05	-41.83	9.6	6.62	-38.85	-20	18.85
2350.46	V	50.63	-39.41	9.6	6.62	-36.43	-20	16.43
3186.09	H	48.23	-34.32	11.5	5.71	-28.53	-20	8.53
3186.09	V	49.24	-35.1	11.5	5.71	-29.31	-20	9.31
TX1:469.9875MHz								
939.975	H	61.61	-49.7	0	3.02	-52.72	-20	32.72
939.975	V	64.5	-52.59	0	3.66	-56.25	-20	36.25
2350.46	H	50.63	-39.41	8.7	6.75	-37.46	-20	17.46
2350.46	V	53.53	-42.31	8.7	6.75	-40.36	-20	20.36
3290.32	H	49.24	-35.1	11.5	8.55	-32.15	-20	12.15
3290.32	V	46.89	-32.75	11.5	8.55	-29.8	-20	9.8

Frequency (MHz)	Polar (H/V)	Receiver Reading (dBμV)	Substituted Method			Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			S.G.Level (dBm)	Antenna Gain (dBd/dBi)	Cable Loss (dB)			
TX3:406.1125 MHz								
812.225	H	64.89	-56.41	0	3.37	-59.78	-20	39.78
812.225	V	62.06	-53.58	0	3.37	-56.95	-20	36.95
1508.15	H	69.86	-53.2	9.1	4.75	-48.85	-20	28.85
1508.15	V	65.43	-48.77	9.1	4.75	-44.42	-20	24.42
2033.39	H	63.63	-44.81	12.2	5.68	-38.29	-20	18.29
2033.39	V	63.81	-44.93	12.1	5.68	-38.51	-20	18.51
TX3:413.0500 MHz								
826.1	H	76.88	-68.4	0	3.44	-71.84	-20	51.84
826.1	V	62.76	-53.68	0	3.44	-57.12	-20	37.12
1676.37	H	62.51	-53.52	8.6	5.56	-50.48	-20	30.48
1676.37	V	50.54	-41.55	8.6	5.56	-38.51	-20	18.51
3797.05	H	57.58	-42.56	11	8.69	-40.25	-20	20.25
3797.05	V	54.83	-39.81	11	8.69	-37.5	-20	17.5
TX3:419.9875 MHz								
839.975	H	67.04	-69.12	0	3.44	-72.56	-20	52.56
839.975	V	67.12	-57.97	0	3.44	-61.41	-20	41.41
1679.07	H	51.46	-42.47	8.7	5.56	-39.33	-20	19.33
1679.07	V	56..51	-47.49	8.7	5.56	-44.35	-20	24.35
2939.75	H	52.92	-39.64	11.23	8.04	-36.45	-20	16.45
2939.75	V	55.56	-45.2	11.23	8.04	-42.01	-20	22.01
TX3:421.0125 MHz								
842.025	H	70.9	-61.75	0	3.44	-65.19	-20	45.19
842.025	V	64.05	-53.13	0	3.44	-56.57	-20	36.57
1819.77	H	52.11	-41.75	8.5	5.35	-38.6	-20	18.6
1819.77	V	52.01	-42.56	8.5	5.35	-39.41	-20	19.41
2729.97	H	56.25	-42.96	11.1	7.55	-39.41	-20	19.41
2729.97	V	52.1	-39.57	11.1	7.55	-36.02	-20	16.02
TX3:455.0000 MHz								
910	H	66.07	-52.37	0	3.62	-55.99	-20	35.99
910	V	65.26	-55.15	0	3.66	-58.81	-20	38.81
1829.46	H	57.16	-47.71	9.8	5.97	-43.88	-20	23.88
1829.46	V	55.38	-42.89	9.8	5.97	-39.06	-20	19.06
2276.01	H	50.05	-39.09	11.5	6.62	-34.21	-20	14.21
2276.01	V	51.32	-40.28	11.5	6.62	-35.4	-20	15.4
TX3:469.9875MHz								
939.975	H	64.61	-52.7	0	3.64	-56.34	-20	36.34
939.975	V	69.59	-58.59	0	3.64	-62.23	-20	42.23
2350.46	H	55.63	-44.41	8.7	6.75	-42.46	-20	22.46
2350.46	V	56.72	-47.1	8.7	6.75	-45.15	-20	25.15
2819.27	H	51.89	-39.04	11.5	7.77	-35.31	-20	15.31
2819.27	V	55.57	-42.72	11.5	7.77	-38.99	-20	18.99

4.9. **Conducted Emissions Test**

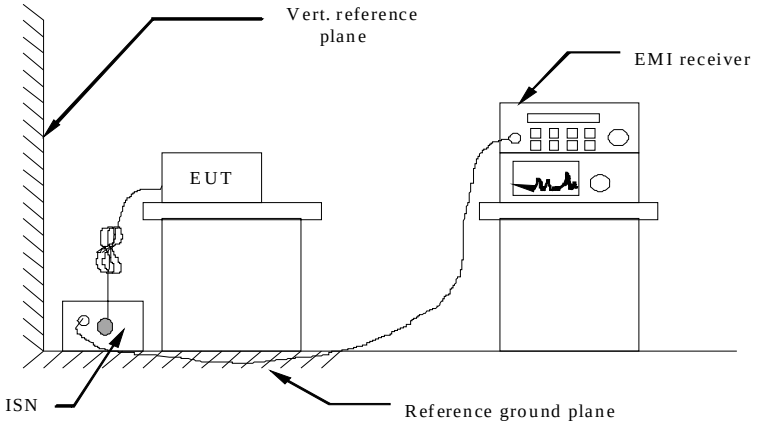
The frequency spectrum from 0.15 MHz to 30 MHz was investigated. The LISN used was 50 ohm / 50 u Henry as specified by section 5.1 of ANSI C63.4 - 2009. Cables and peripherals were moved to find the maximum emission levels for each frequency.

Limit

FCC part 15.107(a)

Frequency of Emission (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

TEST CONFIGURATION



TEST PROCEDURE

1 The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system; a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.4-2009.
2 Support equipment, if needed, was placed as per ANSI C63.4-2009.
3 All I/O cables were positioned to simulate typical actual usage as per ANSI C63.4-2009.
4 If a EUT received AC120V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
5 All support equipments received AC power from a second LISN, if any
6 The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
7 Analyzer / Receiver scanned from 150 kHz to 30MHz for emissions in each of the test modes.
8 During the above scans, the emissions were maximized by cable manipulation.

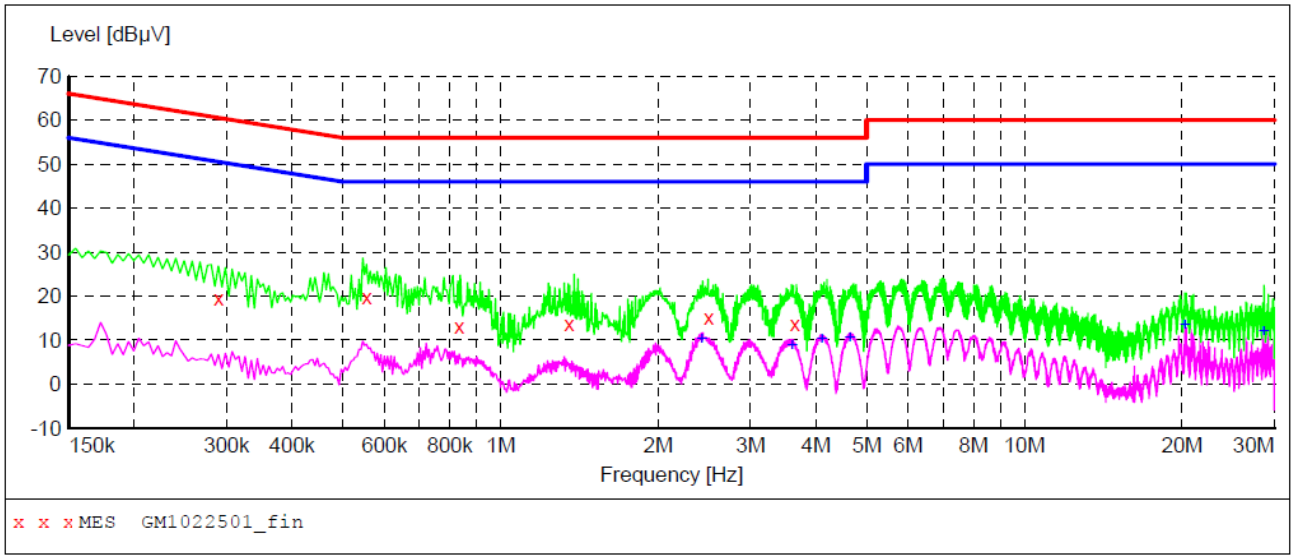
TEST MODE:

Please reference to the section 2.4

TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

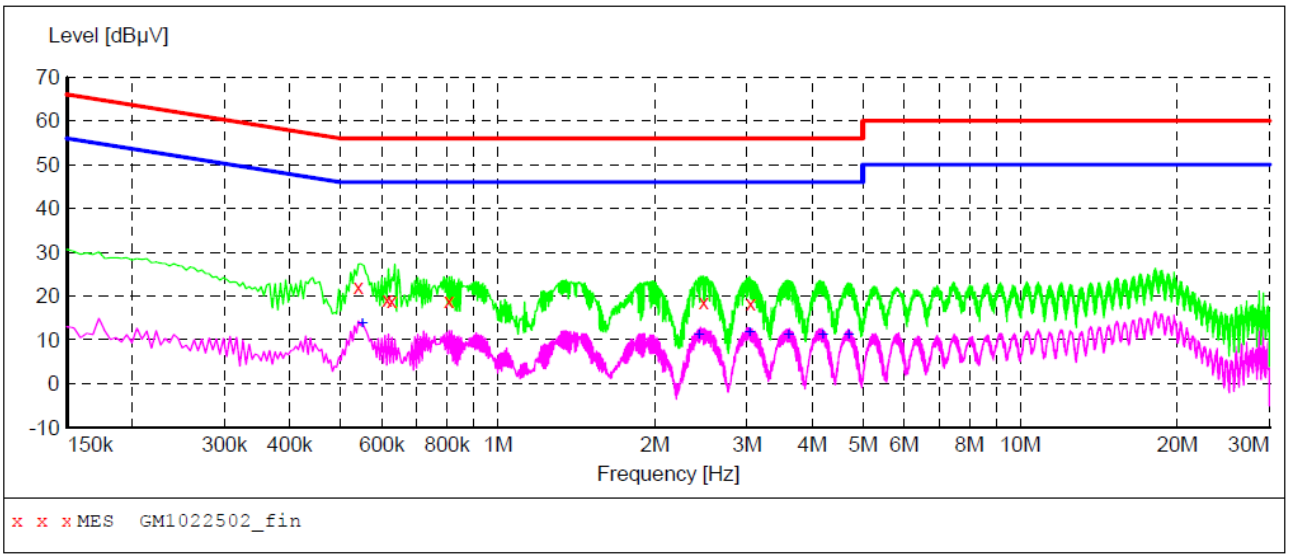
Test mode:	Charging	Polarization	N



Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.289500	19.60	10.2	61	40.9	QP	N	GND
0.555000	19.70	10.2	56	36.3	QP	N	GND
0.834000	13.20	10.2	56	42.8	QP	N	GND
1.351500	13.60	10.2	56	42.4	QP	N	GND
2.499000	15.10	10.3	56	40.9	QP	N	GND
3.646500	13.60	10.3	56	42.4	QP	N	GND

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
2.422500	10.30	10.3	46	35.7	AV	N	GND
3.597000	8.80	10.3	46	37.2	AV	N	GND
4.105500	10.10	10.3	46	35.9	AV	N	GND
4.641000	10.40	10.4	46	35.6	AV	N	GND
20.260500	13.50	11.0	50	36.5	AV	N	GND
28.689000	11.90	11.1	50	38.1	AV	N	GND

Test mode:	Charging	Polarization	L1



Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.541500	22.00	10.2	56	34.0	QP	L1	GND
0.613500	19.10	10.2	56	36.9	QP	L1	GND
0.627000	18.90	10.2	56	37.1	QP	L1	GND
0.807000	19.00	10.2	56	37.0	QP	L1	GND
2.476500	18.70	10.3	56	37.3	QP	L1	GND
3.052500	18.40	10.3	56	37.6	QP	L1	GND

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.550500	13.70	10.2	46	32.3	AV	L1	GND
2.427000	10.90	10.3	46	35.1	AV	L1	GND
3.034500	11.50	10.3	46	34.5	AV	L1	GND
3.597000	11.10	10.3	46	34.9	AV	L1	GND
4.191000	11.10	10.3	46	34.9	AV	L1	GND
4.690500	11.10	10.4	46	34.9	AV	L1	GND

4.10. Radiated Spurious Emission

LIMIT

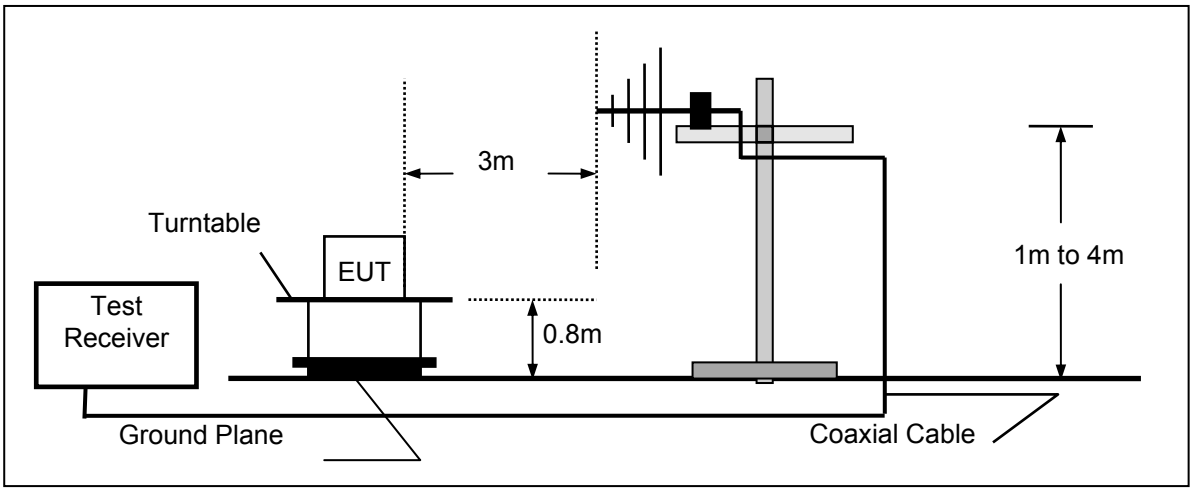
For unintentional device, according to § 15.109(a) except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values：

Frequency (MHz)	Distance (Meters)	Radiated (dBμV/m)	Radiated (μV/m)
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

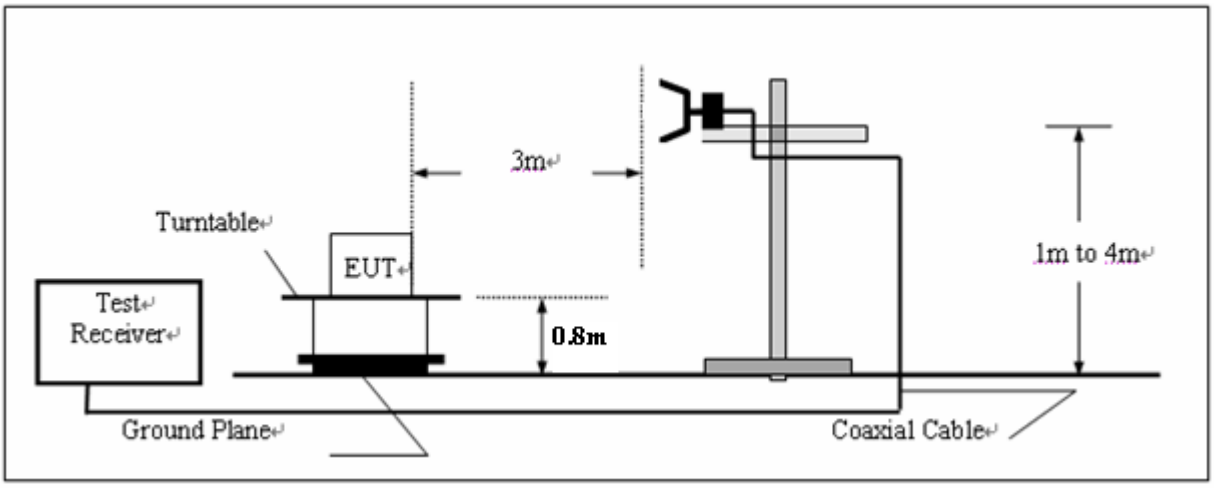
For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the above table.

TEST CONFIGURATION

(A) Radiated Emission Test Set-Up, Frequency below 1000MHz



(B) Radiated Emission Test Set-Up, Frequency above 1000MHz



TEST PROCEDURE

1 The EUT was placed on a turn table which is 0.8m above ground plane.
2 Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0℃ to 360℃ to acquire the highest emissions from EUT
3 And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4 Repeat above procedures until all frequency measurements have been completed.

TEST MODE:

Please reference to the section 2.4

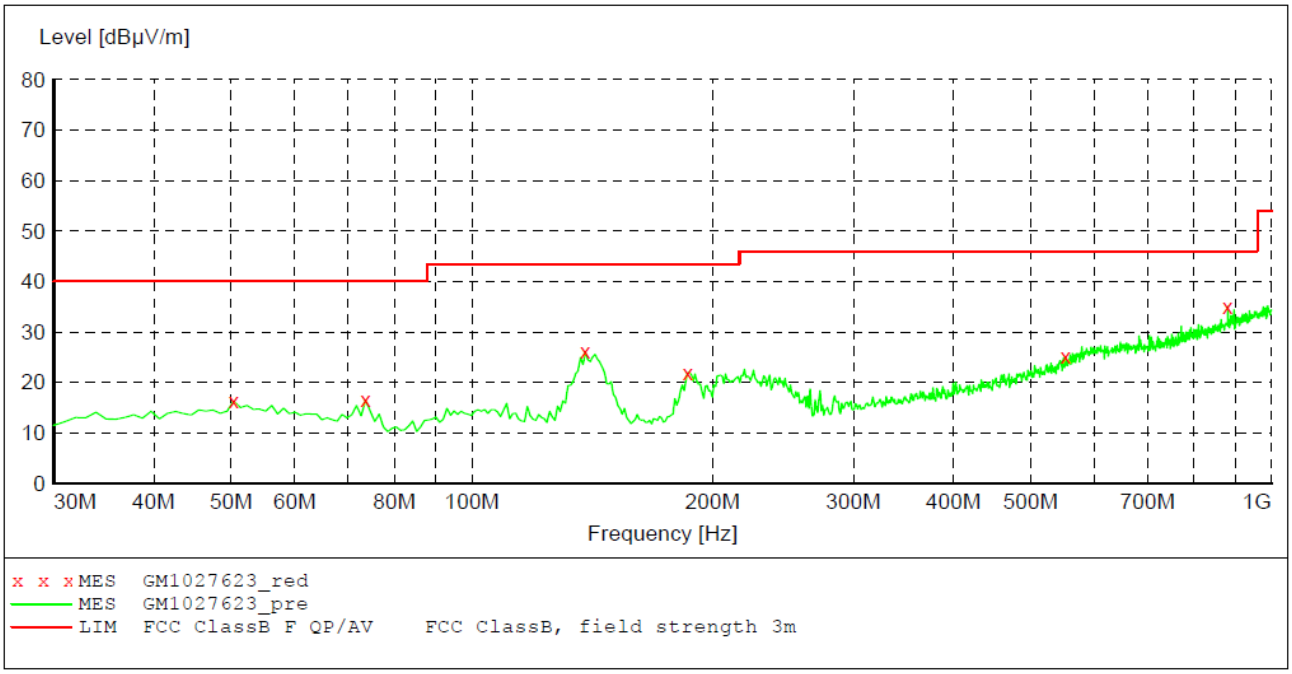
TEST RESULTS

☒ **Passed** ☐ **Not Applicable**

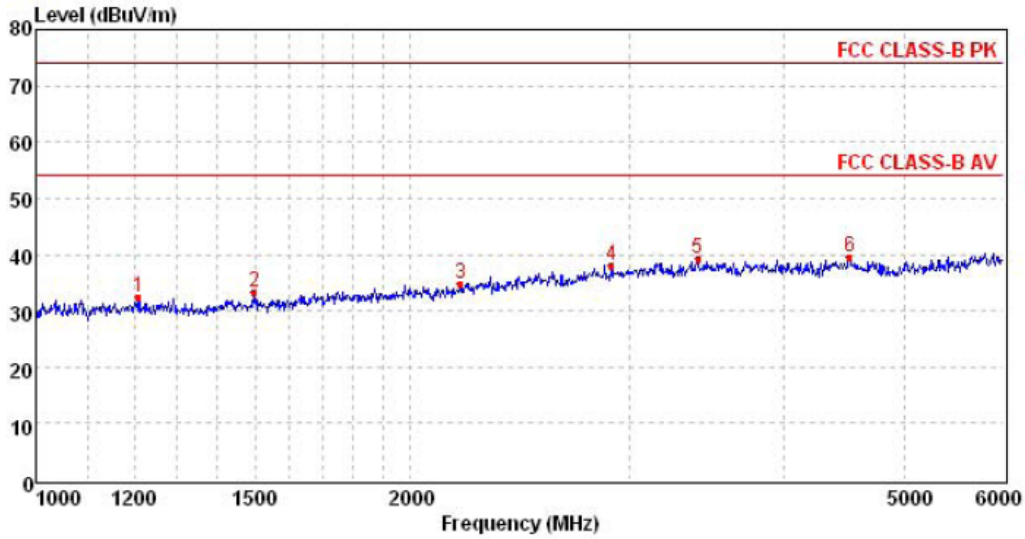
Note:
The EUT shall be scanned from 30 MHz to the 5th harmonic of the highest oscillator frequency in the digital devices or 1 GHz whichever is higher.

Please refer to the below test data:

Test mode:	Charging	Polarity:	*Horizontal*

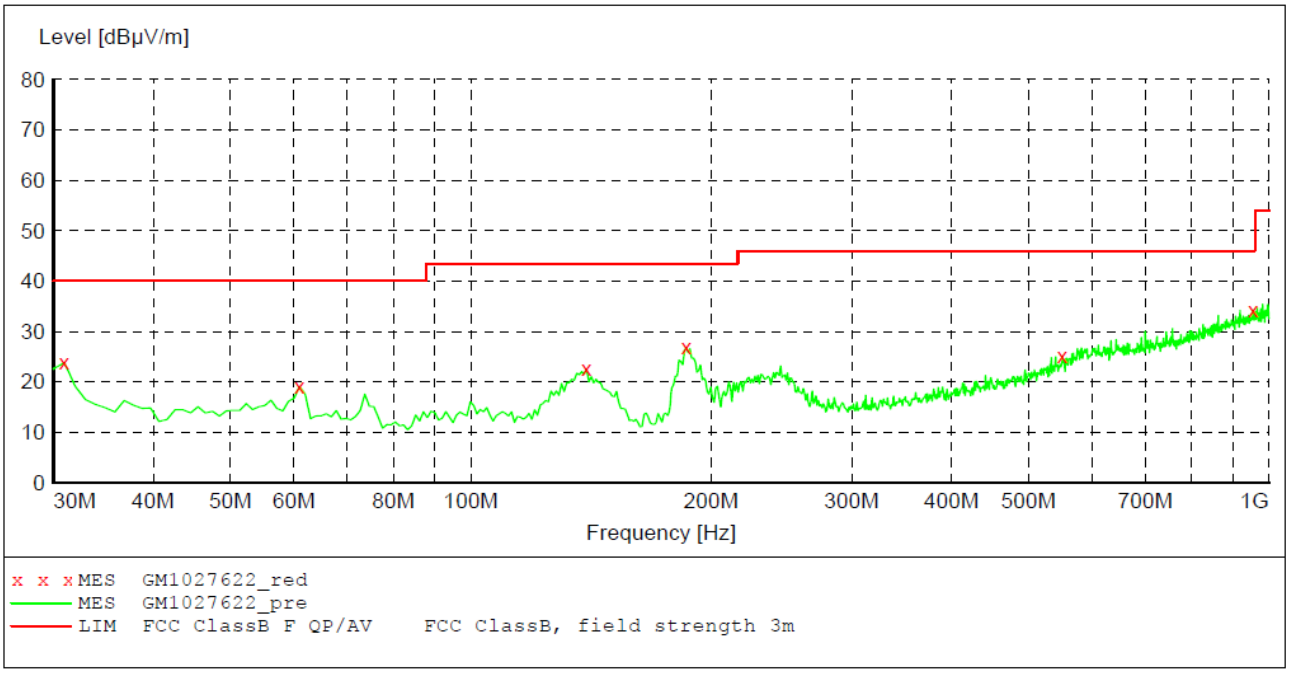


Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization
50.370000	16.30	-14.3	40.0	23.7	QP	100.0	242.00	HORIZONTAL
73.650000	16.50	-17.6	40.0	23.5	QP	300.0	126.00	HORIZONTAL
138.640000	26.10	-18.1	43.5	17.4	QP	300.0	360.00	HORIZONTAL
186.170000	21.90	-15.1	43.5	21.6	QP	300.0	154.00	HORIZONTAL
552.830000	25.10	-4.7	46.0	20.9	QP	300.0	217.00	HORIZONTAL
881.660000	35.10	2.3	46.0	10.9	QP	300.0	360.00	HORIZONTAL

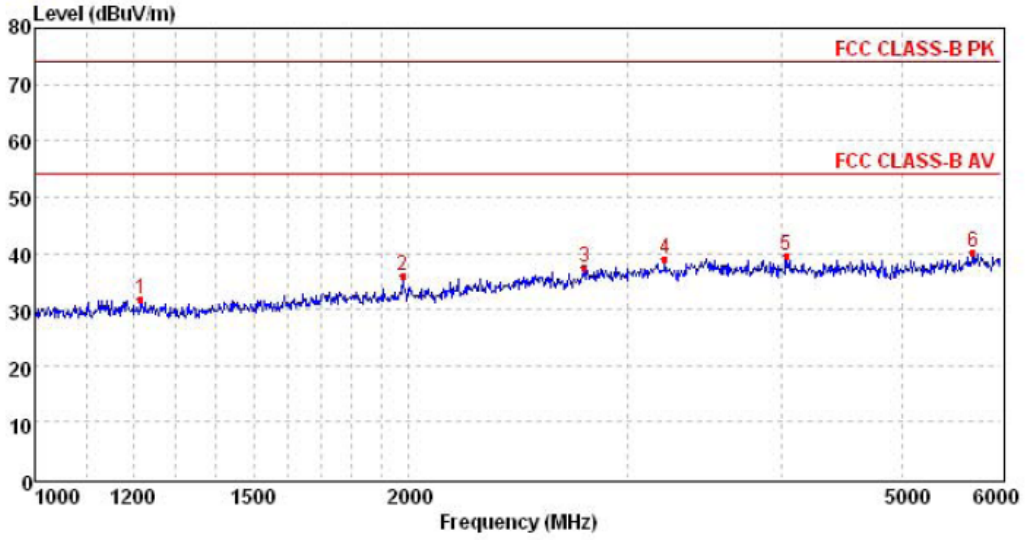


Mark	Frequency MHz	Reading dBuV/m	Antenna dB	Cable dB	Preamp dB	Level dBuV/m	Limit dBuV/m	Over limit	Remark
1	1209.16	39.89	24.44	4.55	36.53	32.35	74.00	-41.65	Peak
2	1499.21	40.26	24.70	5.18	36.83	33.31	74.00	-40.69	Peak
3	2195.88	38.96	26.85	6.49	37.42	34.88	74.00	-39.12	Peak
4	2904.02	39.68	28.40	7.96	37.93	38.11	74.00	-35.89	Peak
5	3406.09	39.99	28.67	8.69	37.99	39.36	74.00	-34.64	Peak
6	4512.58	37.94	30.91	8.99	38.34	39.50	74.00	-34.50	Peak

Test mode:	Charging	Polarity:	Vertical

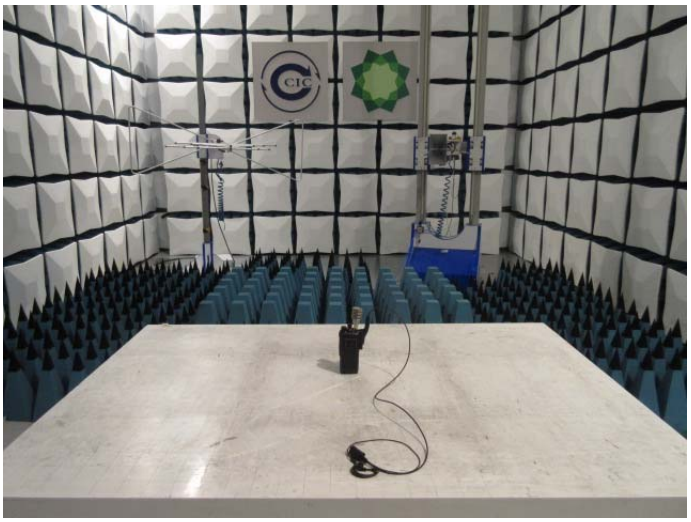


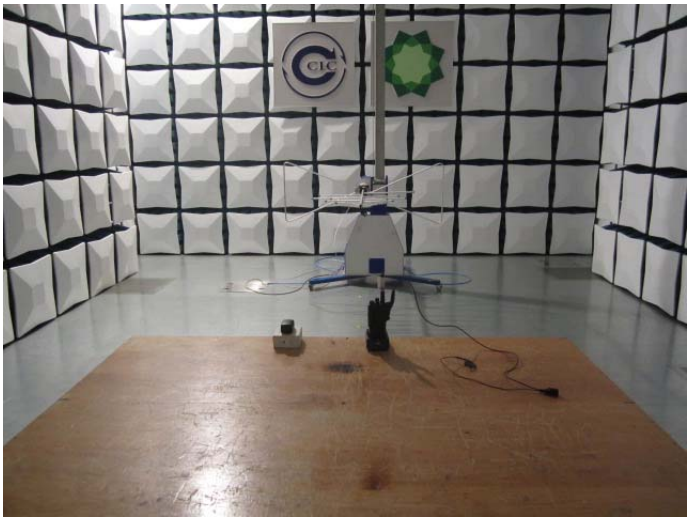
Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization
30.970000	23.80	-16.7	40.0	16.2	QP	100.0	235.00	VERTICAL
61.040000	19.10	-15.1	40.0	20.9	QP	100.0	358.00	VERTICAL
139.610000	22.50	-18.2	43.5	21.0	QP	100.0	310.00	VERTICAL
186.170000	26.80	-15.1	43.5	16.7	QP	100.0	40.00	VERTICAL
550.890000	25.20	-4.8	46.0	20.8	QP	100.0	14.00	VERTICAL
955.380000	34.30	3.8	46.0	11.7	QP	100.0	158.00	VERTICAL

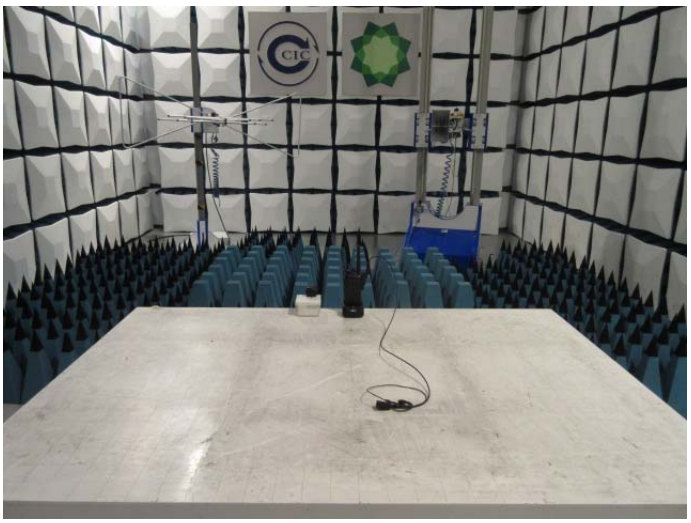


Mark	Frequency MHz	Reading dBuV/m	Antenna dB	Cable dB	Preamp dB	Level dBuV/m	Limit dBuV/m	Over limit	Remark
1	1217.86	39.22	24.44	4.57	36.53	31.70	74.00	-42.30	Peak
2	1979.14	40.97	26.04	6.12	37.23	35.90	74.00	-38.10	Peak
3	2771.84	39.49	28.24	7.66	37.85	37.54	74.00	-36.46	Peak
4	3216.29	40.01	28.59	8.46	37.99	39.07	74.00	-34.93	Peak
5	4030.90	39.49	29.57	8.63	38.01	39.68	74.00	-34.32	Peak
6	5696.20	35.95	32.72	9.68	38.11	40.24	74.00	-33.76	Peak

5. Test Setup Photos of the EUT





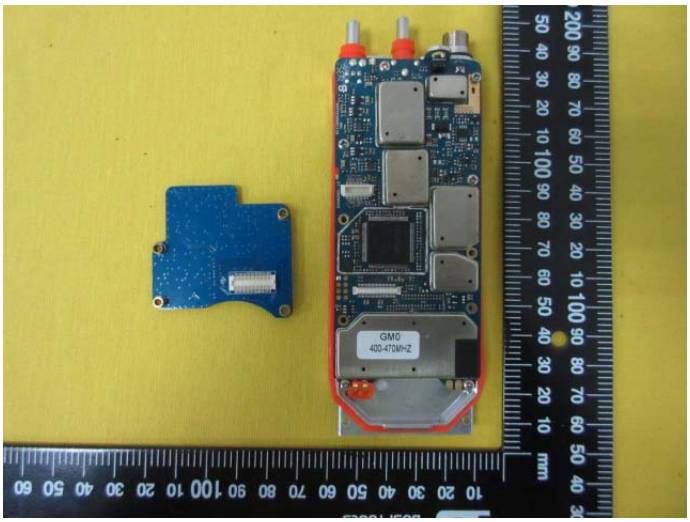


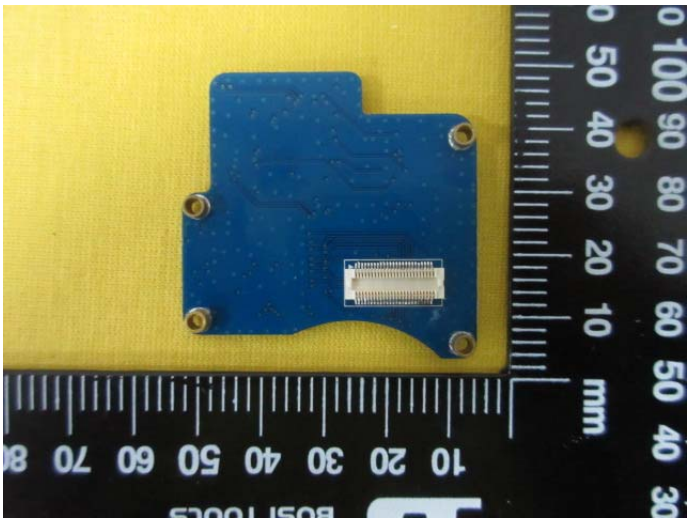
6. External and Internal Photos of the EUT

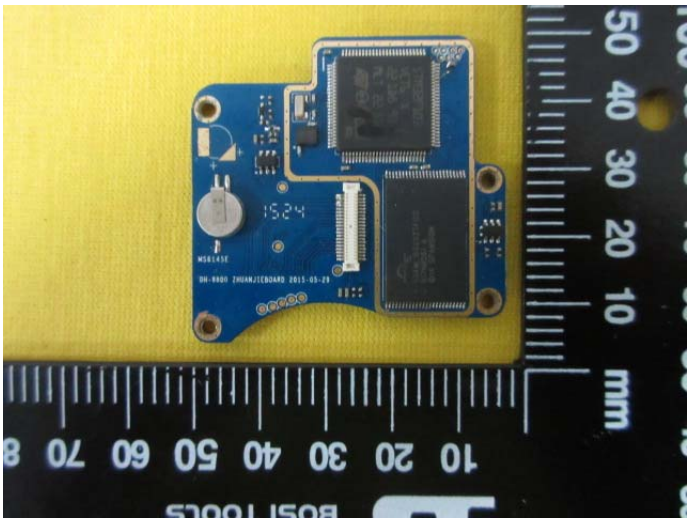
External photos of the EUT

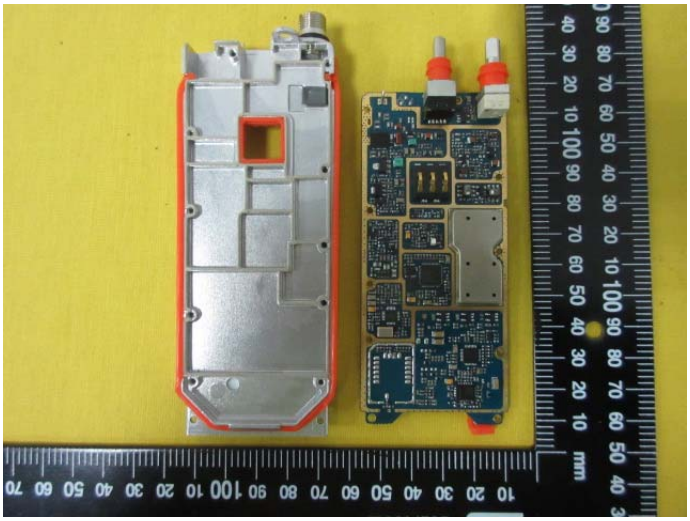

BOSI TOOLS

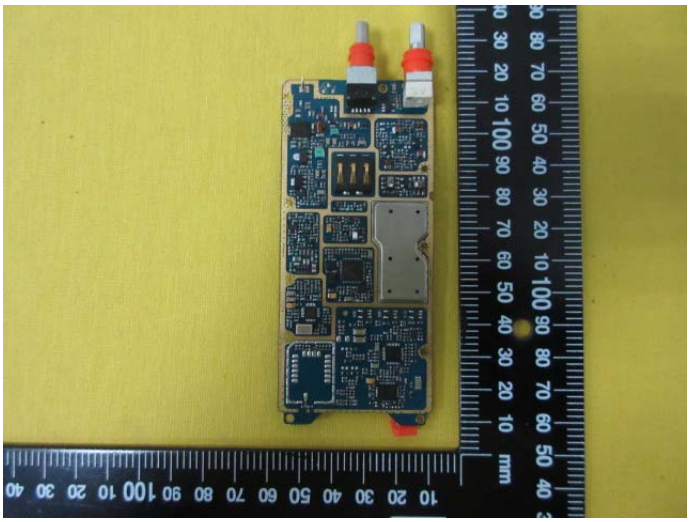
Internal photos of the EUT

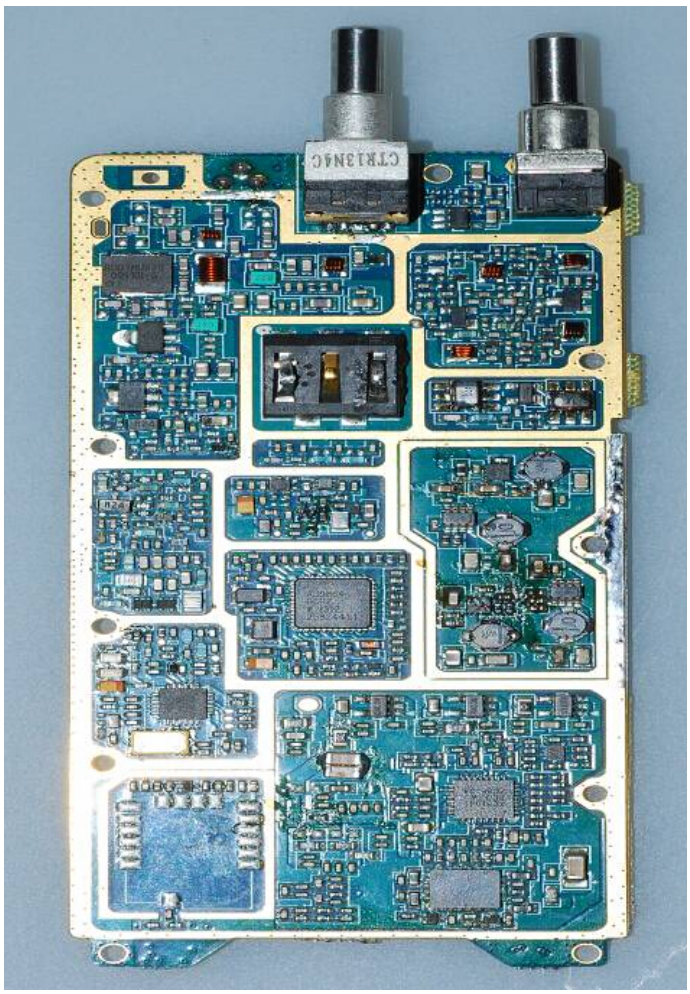


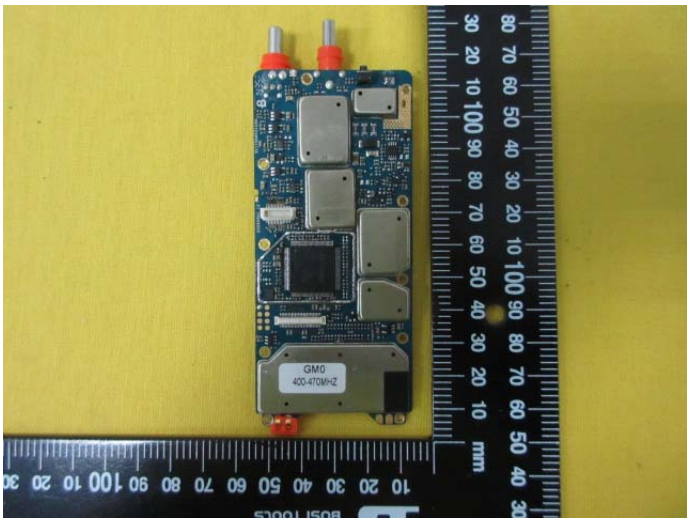









CTR13N4C



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