

FCC Test Report

Product Name : Repeater
Model No. : ST-9116C
FCC ID. : M38-ST-9116C

Applicant : RANGER COMMUNICATIONS (M) SDN , BHD.
Address : NO.8716, BATU BERENDAM FTZⅢ, 75350 BATU
BERENDAM, MELAKA, MALAYSIA

Date of Receipt : 2014/09/26
Issued Date : 2016/01/13
Report No. : 14A0006R-RFUSP22V00-A
Report Version : V1.0

The test results relate only to the samples tested.
The test report shall not be reproduced except in full without the written approval of Corporation.

Test Report Certification

Issued Date : 2016/01/13

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Product Name : Repeater

Applicant : RANGER COMMUNICATIONS (M) SDN , BHD.

Address : NO.8716, BATU BERENDAM FTZ III, 75350 BATU
BERENDAM, MELAKA, MALAYSIA

Manufacturer : RANGER COMMUNICATIONS (M) SDN , BHD.

Model No. : ST-9116C

FCC ID. : M38-ST-9116C

EUT Voltage : DC 13.8V

Trade Name : SMAR TRUNK

Applicable Standard : ANSI/TIA 603-C: 2004, FCC CFR 47 Part 90,
ANSI C63.4: 2009

Test Result : Complied

The test results relate only to the samples tested.

The test report shall not be reproduced except in full without the written approval of Corporation.

Documented By :

(Carol Tsai / Engineering Adm. Assistant)

Reviewed By :

(Bruno Tsai / Engineer)

Approved By :

(Roy Wang / Director)

Laboratory Information

We, **QuieTek Corporation**, are an independent RF consultancy that was established the whole facility in our laboratories. The test facility has been accredited/accepted (audited or listed) by the following related bodies in compliance with ISO 17025 specified testing scopes:

Taiwan R.O.C.	: TAF, Accreditation Number: 3024
USA	: FCC, Registration Number: 365520
Canada	: IC, Submission No: 181665 / IC Registration Number: 4075C-4

The related certificate for our laboratories about the test site and management system can be downloaded from QuieTek Corporation's Web Site:<http://www.quietek.com/chinese/about/certificates.aspx?bval=5>

The address and introduction of QuieTek Corporation's laboratories can be founded in our Web site :

<http://www.quietek.com/>

If you have any comments, Please don't hesitate to contact us. Our contact information is as below:

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E-Mail : service@quietek.com

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1. General Information

1.1. EUT Description

Product Name	Repeater
Trade Name	SMAR TRUNK
Model No.	ST-9116C
Frequency Range	421-470MHz
Channel Spacing	12.5kHz, 6.25kHz
Type of Modulation	FM, FDMA, TDMA
Antenna Gain	N/A
Antenna Type	N/A (by Terminator)

Component

N/A

Note:

1. This device is a Repeater, which including 421-470MHz transmitting and receiving function.
2. Regards to the frequency band operation; the lowest 、middle and highest frequency of channel were selected to perform the test, and then shown on this report.
3. This device is a composite device in accordance with Part 15 regulations. The receiving function receiving was tested and its test report number is 14A0006R-RFUSP01V00 under Declaration of Conformity.

1.2. Test Mode

has verified the construction and function in typical operation. The preliminary tests were performed in different data rate, and to find the worst condition, which was shown in this test report. The following table is the final test mode.

TX	Mode 1: Transmit
----	------------------

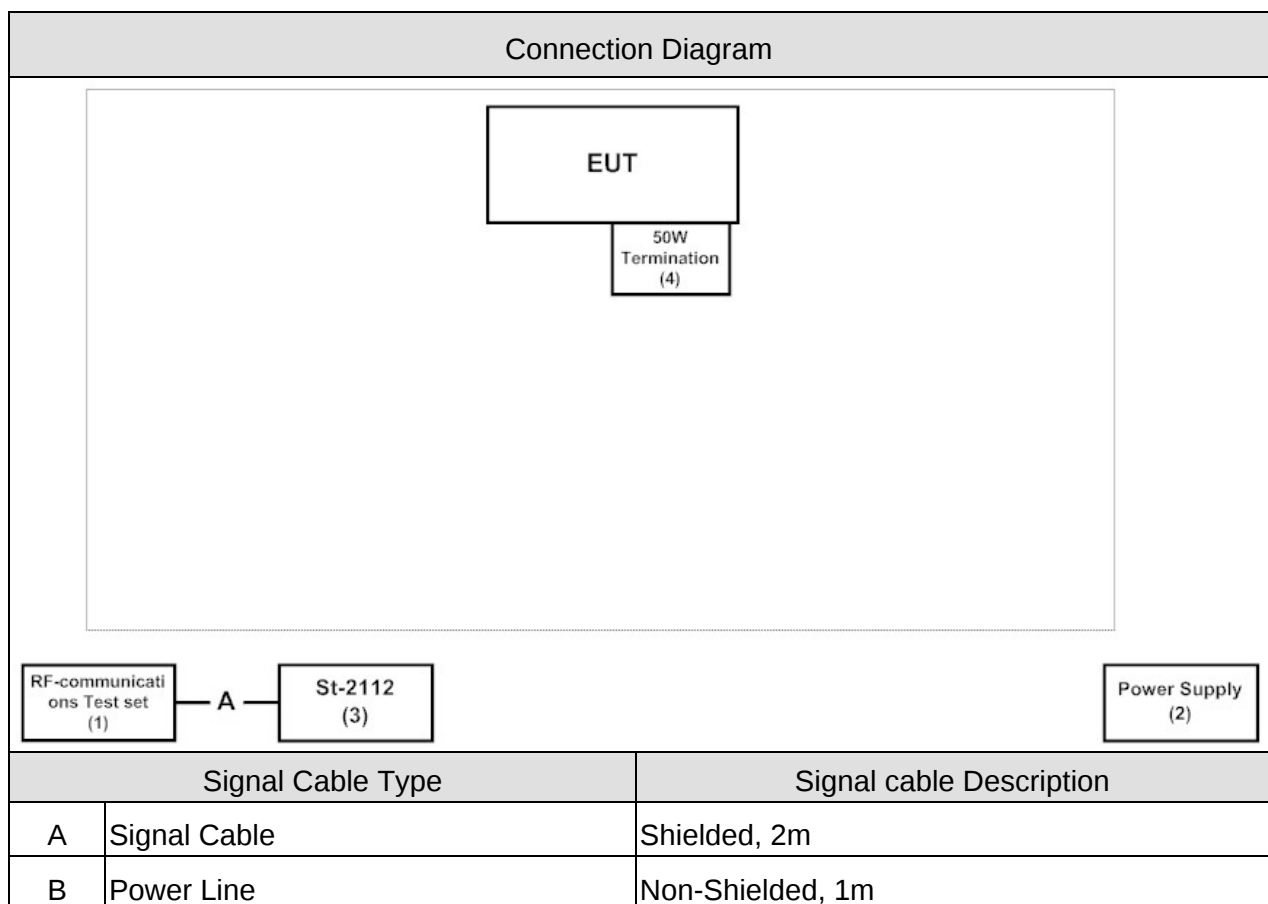
Test Items	Section	Frequency (MHz)	Mode	Result
RF Power Output	90.205	421/450/470	1	Complies
Modulation Characteristics	90.242(b)	421/450/470	1	Complies
Modulation Limiting	90.210	421/450/470	1	Complies
Occupied Bandwidth	90.209 & 90.210	421/450/470	1	Complies
Spurious Emissions at Antenna Terminals (Conducted)	90.210	421/450/470	1	Complies
Field Strength of Spurious Emissions	90.210	421/450/470	1	Complies
Frequency Stability	90.213	421/450/470	1	Complies
Transient Frequency Behavior	90.214	421/450/470	1	Complies

1.3. Tested System Details

The types for all equipments, plus descriptions of all cables used in the tested system (including inserted cards) are:

Product	Manufacturer	Model No.	Serial No.	Power Cord
1 RF-communications Test set	HP	8920A	3614A08091	Non-Shielded, 1m
2 Power Supply	Chroma	62024P-80-60	A01034	--
3 St-2112	RANGER	2112	N/A	--
4 50Ω Termination	N/A	Mini-Circuits	N/A	--

1.4. Configuration of tested System



1.5. EUT Exercise Software

1	Setup the EUT as shown in Section 1.4.
2	Use the Audio Generator input modulation tone
3	Configure the test channel
4	Verify that the EUT works properly.

1.6. Test Facility

Ambient conditions in the laboratory:

Items	Test Item	Required (IEC 68-1)	Actual
Temperature (°C)	RF Power Output	15 - 35	25
Humidity (%RH)		25 - 75	45
Barometric pressure (mbar)		860 - 1060	950-1000
Temperature (°C)	Modulation Characteristics	15 - 35	25
Humidity (%RH)		25 - 75	45
Barometric pressure (mbar)		860 - 1060	950-1000
Temperature (°C)	Occupied Bandwidth	15 - 35	25
Humidity (%RH)		25 - 75	45
Barometric pressure (mbar)		860 - 1060	950-1000
Temperature (°C)	Spurious Emissions at Antenna Terminals (Conducted)	15 - 35	25
Humidity (%RH)		25 - 75	45
Barometric pressure (mbar)		860 - 1060	950-1000
Temperature (°C)	Field Strength of Spurious Emissions	15 - 35	25
Humidity (%RH)		25 - 75	65
Barometric pressure (mbar)		860 - 1060	950-1000
Temperature (°C)	Frequency Stability	15 - 35	25
Humidity (%RH)		25 - 75	45
Barometric pressure (mbar)		860 - 1060	950-1000
Temperature (°C)	Transient Frequency Behavior	15 - 35	25
Humidity (%RH)		25 - 75	45
Barometric pressure (mbar)		860 - 1060	950-1000

2. RF Power Output

2.1. Test Equipment

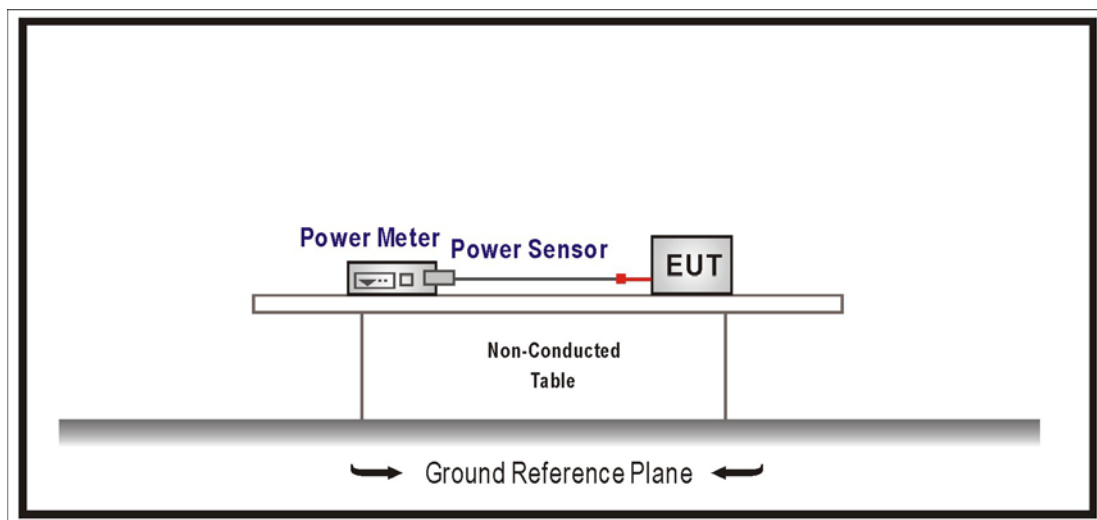
The following test equipments are used during the test:

RF Power Output / SR7

Instrument	Manufacturer	Model No.	Serial No	Next Cal. Date
Power Meter	Agilent	N1911A	MY45101353	2015/10/31
Power Sensor	Agilent	N1921A	MY45241670	2015/10/31

Note: 1. All equipments that need to calibrate are with calibration period of 1 year.

2.2. Test Setup



2.3. Limits

Please refer to FCC 47 CFR 90.205 for specification details.

2.4. Test Procedure

The RF power output was measured at the antenna feed point using a peak power meter. A 50-ohm, resistive wattmeter was connected to the RF output connector.

2.5. Uncertainty

The measurement uncertainty is defined as ± 1.27 dB.

2.6. Test Result

Product	Repeater		
Test Item	RF Power Output		
Test Mode	Mode 1: Transmit		
Date of Test	2016/01/12	Test Site	SR7

12.5KHz

Channel No.	Frequency (MHz)	Measure Level (dBm)	Measure Level (W)	Limit
Low	421	46.180	41.495	Reference 90.205
Mid	450	46.180	41.495	Reference 90.205
High	470	46.050	40.272	Reference 90.205

6.25KHz

Channel No.	Frequency (MHz)	Measure Level (dBm)	Measure Level (W)	Limit
Low	421	40.290	10.691	Reference 90.205
Mid	450	40.360	10.871	Reference 90.205
High	470	40.550	11.358	Reference 90.205

3. Modulation Characteristics

3.1. Test Equipment

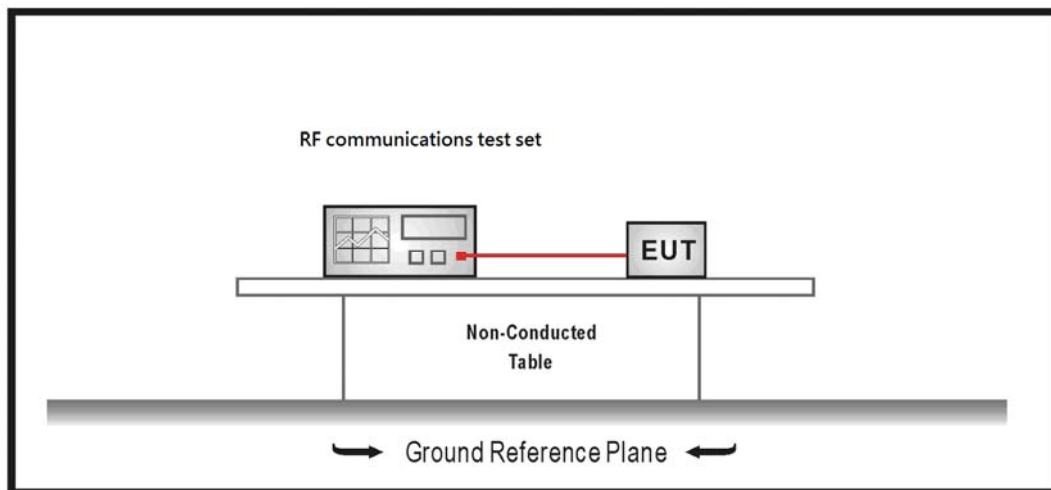
The following test equipments are used during the radiated emission tests:

Modulation Characteristics / SR7

Instrument	Manufacturer	Model No.	Serial No	Next Cal. Date
RF-communications Test set	HP	8920A	3614A08091	2015/04/27
Receiver	Agilent	N9038A	MY53220121	2015/07/26

Note: 1. All equipments that need to calibrate are with calibration period of 1 year.

3.2. Test Setup



3.3. Limits

§ **90.242(b)**: Recommended audio filter attenuation characteristics are given below:

Audio band	Minimum Attenuation Rel. to 1 kHz Attenuation
3 – 20 KHz 20 – 30 KHz	$60 \log_{10}(f/3)$ dB where f is in kHz 50dB

Note: Audit Freq Response and Modulation limiting tests were performed only for 12.5 & 25 kHz channel spacing.

These tests were not performed for 6.25 kHz ch spacing as there is no FM voice capability for this device.

3.4. Test Procedure

Audio frequency response

The audio frequency response was measured in accordance with ANSI/TIA 603-C: 2004.

Audio Low Pass Filter

The audio low pass filter for voice-modulated equipment was measured in accordance with ANSI/TIA 603-C: 2004.

Audio Input versus modulation

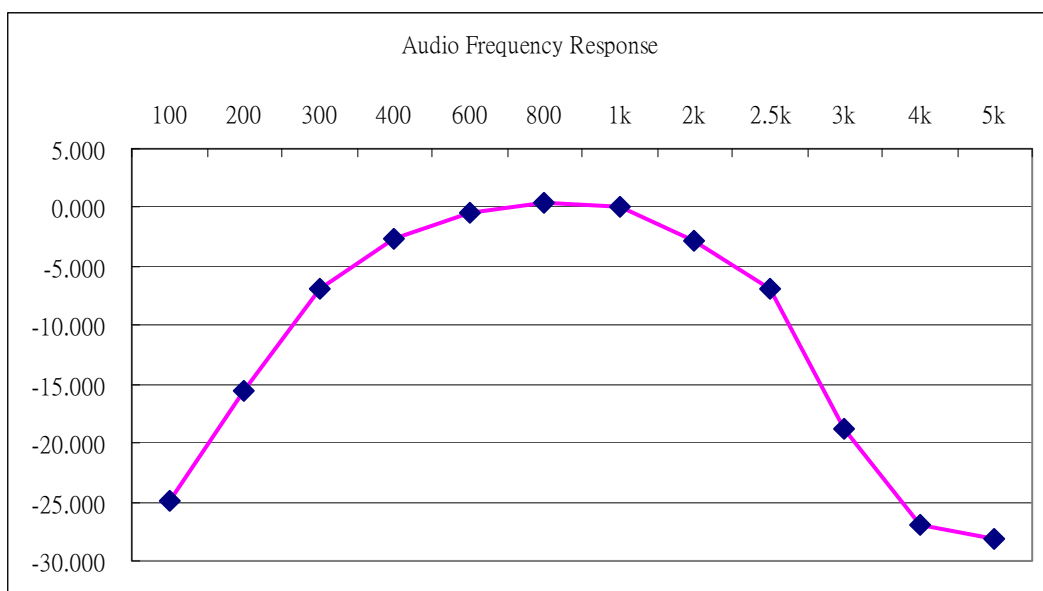
The audio input level needed for a particular percentage of modulation was measured in accordance with ANSI/TIA 603-C: 2004.

3.5. Test Result

Product	Repeater		
Test Item	Audio Frequency Response		
Test Mode	Mode 1: Transmit		
Date of Test	2015/01/04	Test Site	SR7

12.5KHz

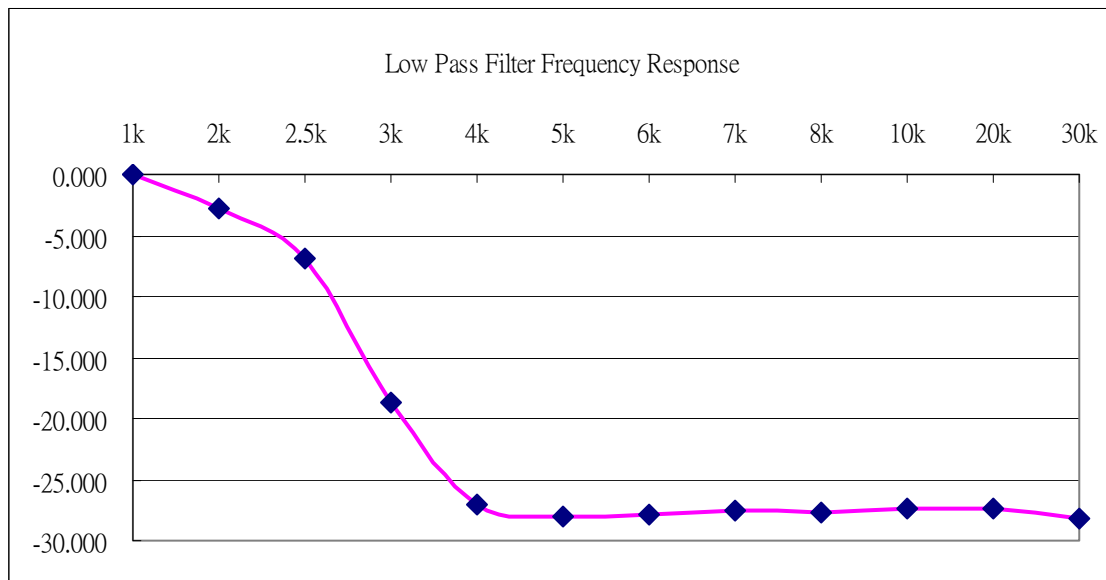
Audio Frequency (Hz)	Deviation	dB
100	0.149	-24.876
200	0.433	-15.610
300	1.185	-6.865
400	1.938	-2.592
600	2.485	-0.433
800	2.725	0.368
1k	2.612	0.000
2k	1.884	-2.838
2.5k	1.191	-6.821
3k	0.303	-18.711
4k	0.117	-26.976
5k	0.103	-28.083



Product	Repeater		
Test Item	Low Pass Filter Frequency Response		
Test Mode	Mode 1: Transmit		
Date of Test	2015/01/04	Test Site	SR7

12.5KHz

Audio Frequency (Hz)	Deviation	dB
1k	2.612	0.000
2k	1.884	-2.838
2.5k	1.191	-6.821
3k	0.303	-18.711
4k	0.117	-26.976
5k	0.103	-28.083
6k	0.106	-27.833
7k	0.109	-27.591
8k	0.107	-27.752
10k	0.112	-27.355
20k	0.111	-27.433
30k	0.101	-28.253



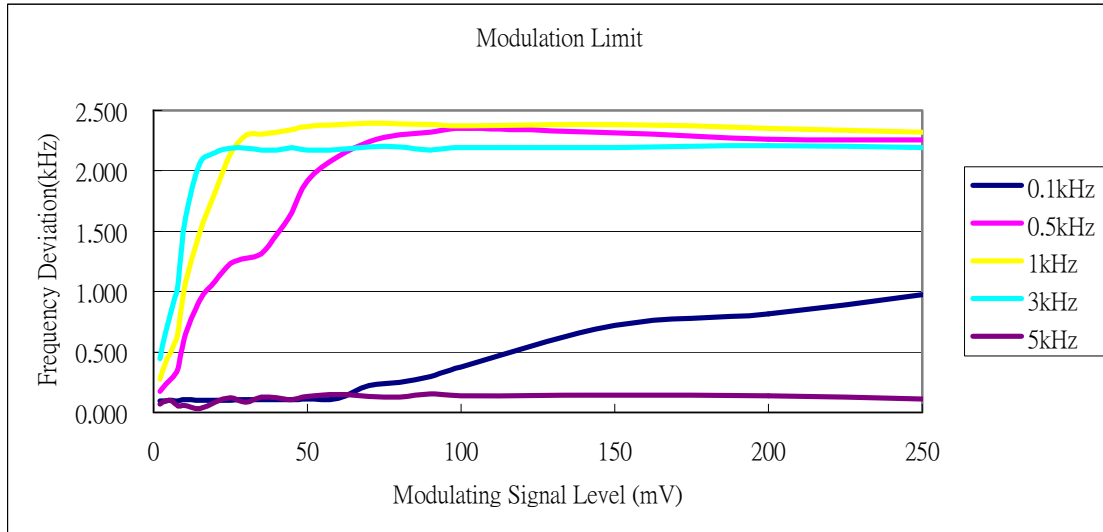
Product	Repeater		
Test Item	Voice Modulation Limiting for 12.5KHz Channel Spacing		
Test Mode	Mode 1: Transmit		
Date of Test	2015/01/04	Test Site	SR7

12.5KHz

Modulating Signal Level	Peak Frequency Deviation (kHz) at the following modulating frequency:					Maximum Limit
	0.1kHz	0.5kHz	1kHz	3kHz	5kHz	
mV						kHz
2	0.103	0.173	0.277	0.446	0.054	2.5
4	0.098	0.227	0.406	0.670	0.056	2.5
6	0.104	0.281	0.538	0.873	0.079	2.5
8	0.102	0.361	0.655	1.066	0.057	2.5
10	0.104	0.620	1.021	1.546	0.070	2.5
15	0.104	0.925	1.492	2.055	0.101	2.5
20	0.101	1.082	1.825	2.170	0.087	2.5
25	0.101	1.236	2.128	2.176	0.088	2.5
30	0.106	1.274	2.298	2.195	0.110	2.5
35	0.106	1.323	2.316	2.173	0.118	2.5
40	0.107	1.473	2.319	2.191	0.125	2.5
45	0.109	1.668	2.339	2.182	0.124	2.5
50	0.111	1.916	2.354	2.194	0.106	2.5
60	0.114	2.123	2.379	2.196	0.143	2.5
70	0.212	2.248	2.399	2.197	0.154	2.5
80	0.250	2.298	2.394	2.192	0.143	2.5
90	0.300	2.322	2.401	2.174	0.131	2.5
100	0.375	2.351	2.378	2.199	0.110	2.5
150	0.715	2.310	2.389	2.199	0.149	2.5
200	0.824	2.260	2.352	2.203	0.132	2.5
250	0.975	2.255	2.316	2.197	0.140	2.5

Product	Repeater		
Test Item	Voice Modulation Limiting for 12.5KHz Channel Spacing		
Test Mode	Mode 1: Transmit		
Date of Test	2015/01/04	Test Site	SR7

12.5KHz



Product	Repeater		
Test Item	Voice Modulation Limiting for 12.5KHz Channel Spacing		
Test Mode	Mode 1: Transmit		
Date of Test	2015/01/04	Test Site	SR7

12.5KHz

Modulation Frequency (kHz)	Peak Deviation (kHz)	Maximum Limit (kHz)
100	0.149	2.5
200	0.433	2.5
300	1.185	2.5
400	1.938	2.5
600	2.485	2.5
800	2.725	2.5
1k	2.612	2.5
2k	1.884	2.5
2.5k	1.191	2.5
3k	0.303	2.5
4k	0.117	2.5
5k	0.103	2.5
6k	0.106	2.5
7k	0.109	2.5
8k	0.107	2.5
10k	0.112	2.5
20k	0.111	2.5
30k	0.101	2.5

3.6. Digital Modulation

Max Deviation measured for 6.25KHz Channel Spacing F1E&F1D = 823Hz

4. Occupied Bandwidth

4.1. Test Equipment

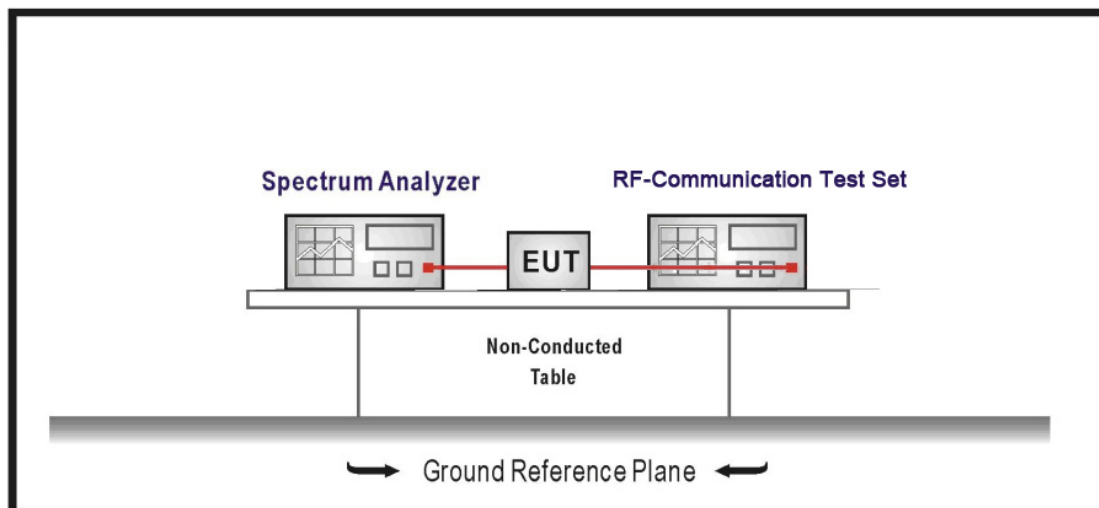
The following test equipments are used during the radiated emission tests:

Occupied Bandwidth / SR7

Instrument	Manufacturer	Model No.	Serial No	Next Cal. Date
Spectrum Analyzer	R&S	FSV 40	101049	2015/07/14
RF-communications Test set	HP	8920A	3614A08091	2016/04/15
Receiver	Agilent	N9038A	MY53220121	2015/07/26

Note: 1. All equipments that need to calibrate are with calibration period of 1 year.

4.2. Test Setup



4.3. Limits

Emissions shall be attenuated below the mean output power of the transmitter as follows:

Frequency Range (MHz)	Maximum Authorized BW (KHz)	Channel Spacing (KHz)	Recommended Frequency Deviation (KHz)	FCC Applicable Mask
156-174, 421-512	11.25	12.5	2.5	Mask D – Voice & Data
150-174, 421-512	6	6.25	1.25	Mask E – Voice & Data

4.4. Test Procedure

The test procedure used was ANSI/TIA 603-C: 2004

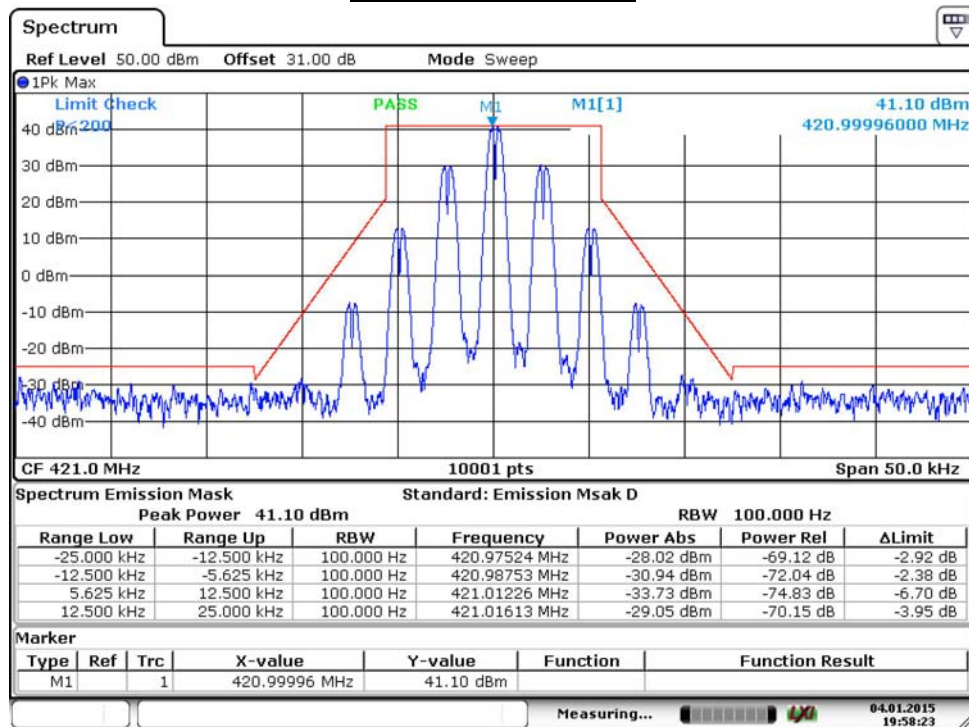
4.5. Uncertainty

The measurement uncertainty is defined as ± 150 Hz

4.6. Test Result

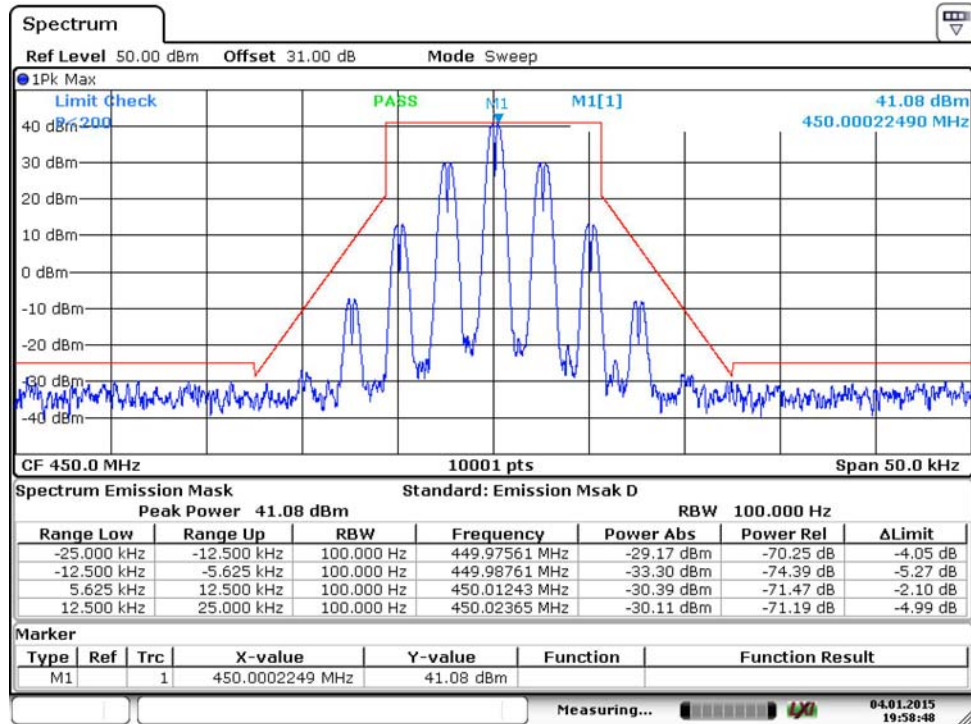
Product	Repeater		
Test Item	Occupied Bandwidth		
Test Mode	Mode 1: Transmit		
Date of Test	2015/05/16	Test Site	SR7

421MHz(Modulation)



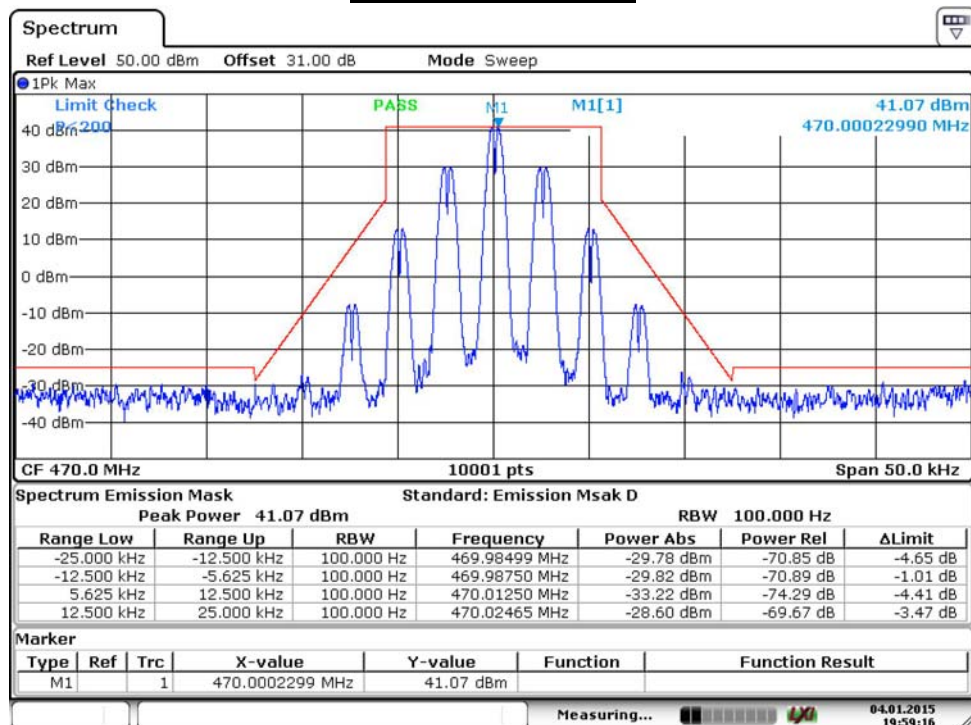
Date: 4.JAN.2015 19:58:23

450MHz(Modulation)



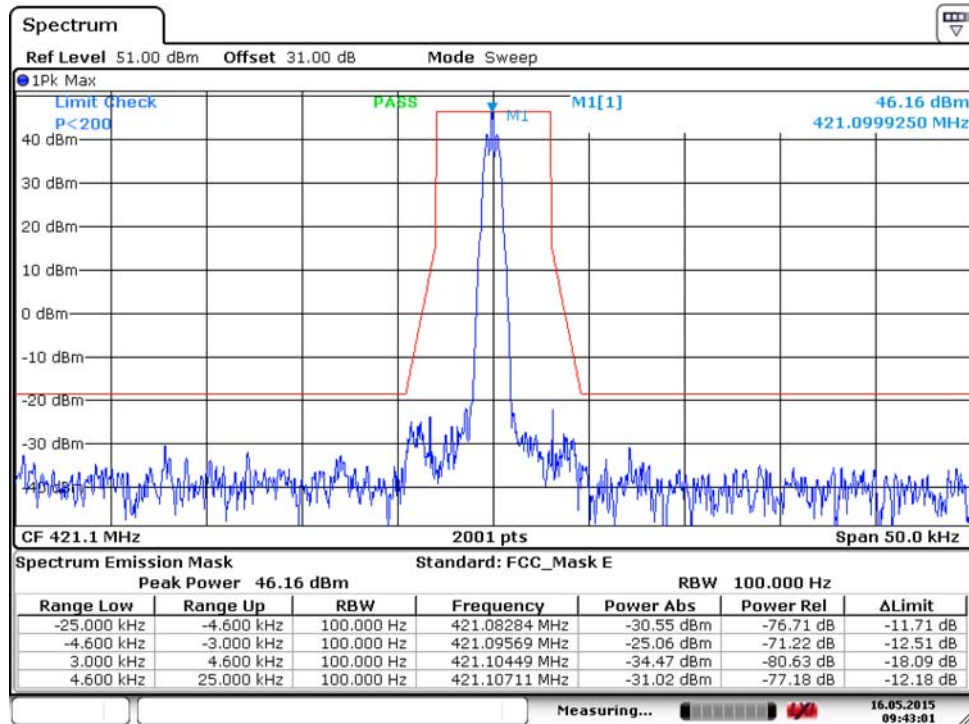
Date: 4.JAN.2015 19:58:48

470MHz(Modulation)



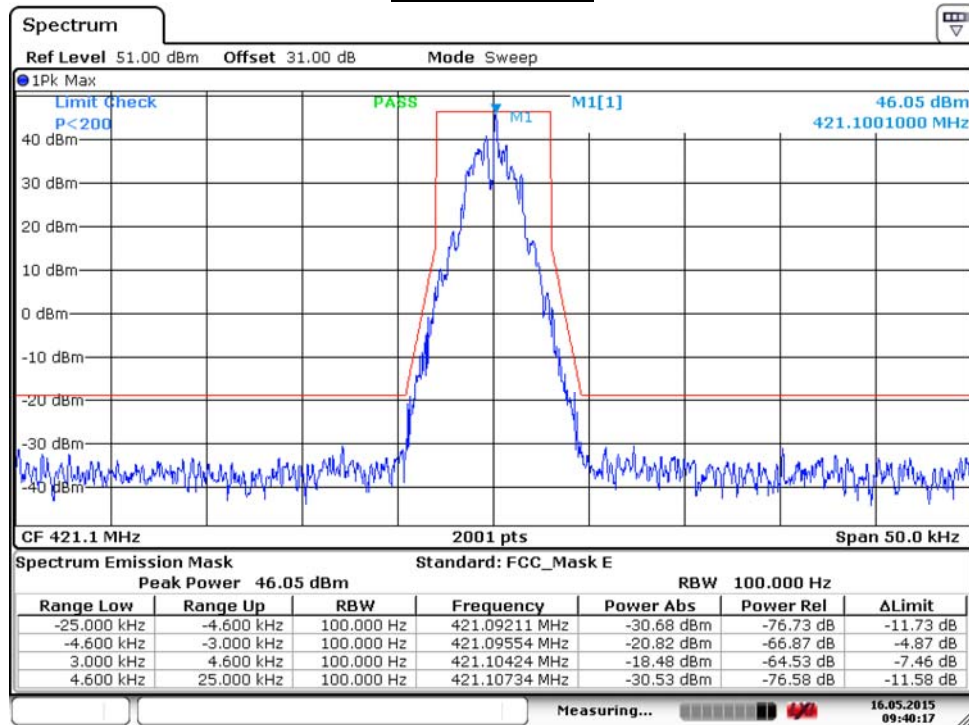
Date: 4.JAN.2015 19:59:16

421MHz(Carr Mask)



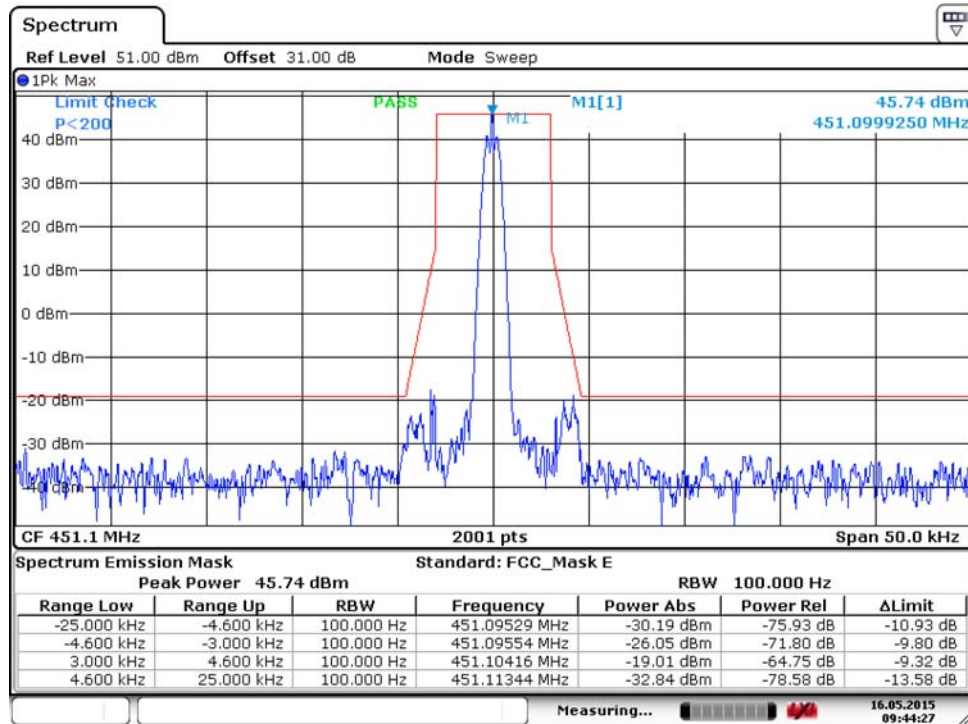
Date: 16.MAY.2015 09:43:01

421MHz(Mask)



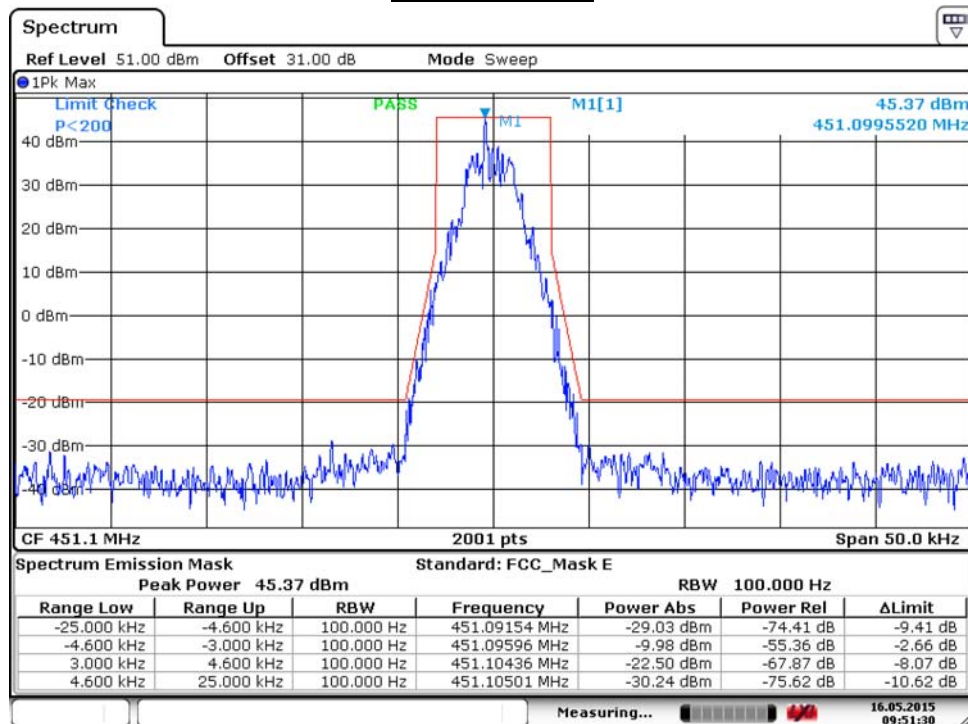
Date: 16.MAY.2015 09:40:17

450MHz(Carr Mask)



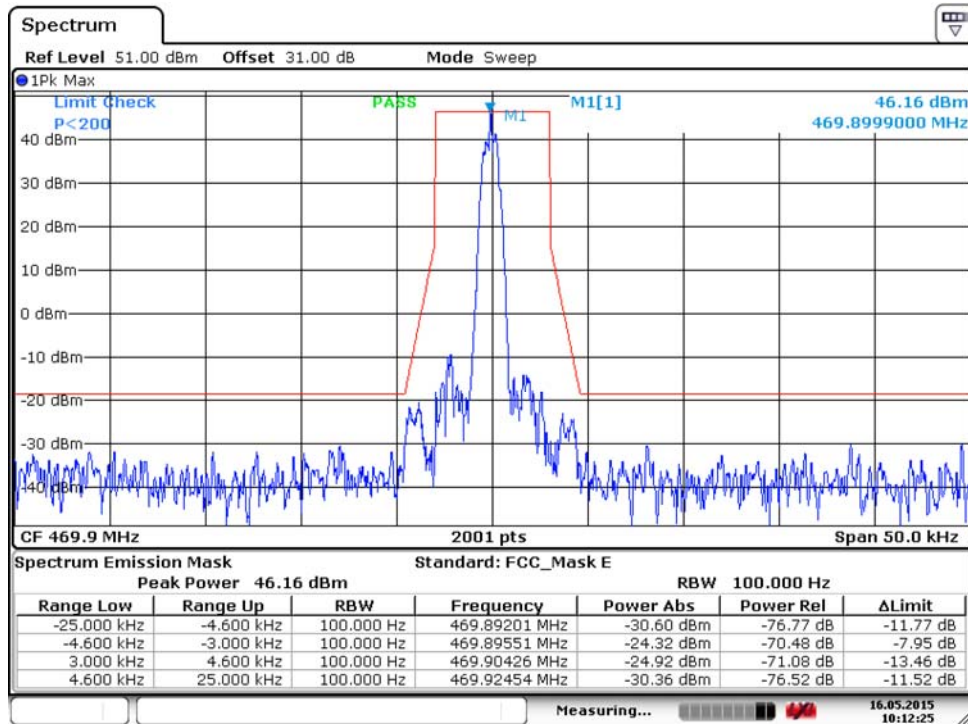
Date: 16.MAY.2015 09:44:28

450MHz(Mask)



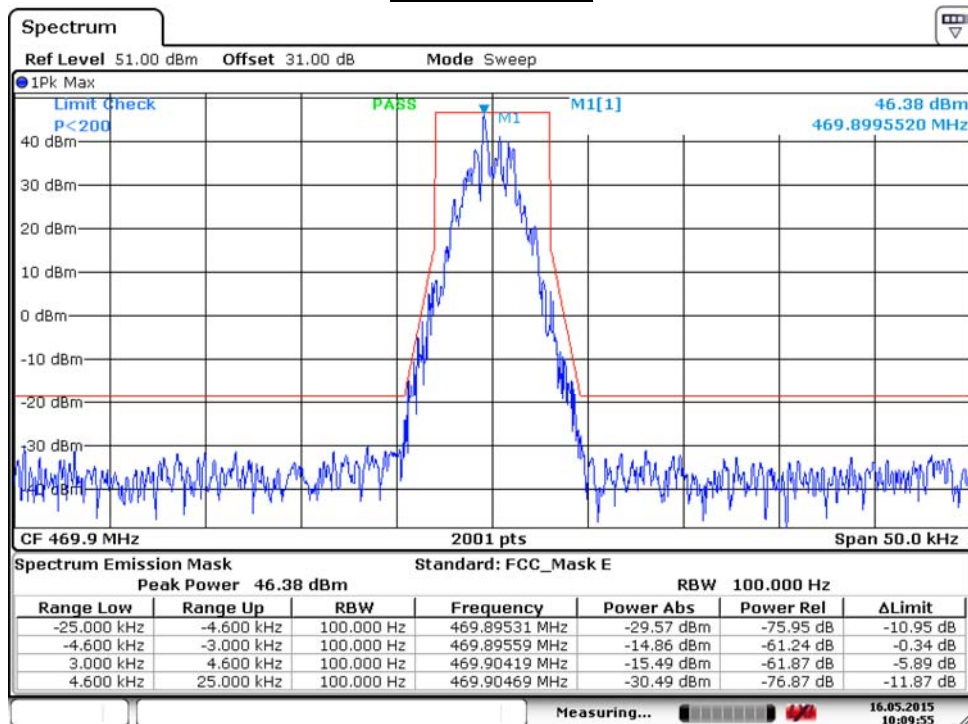
Date: 16.MAY.2015 09:51:30

470MHz(Carr Mask)



Date: 16.MAY.2015 10:12:24

470MHz(Mask)



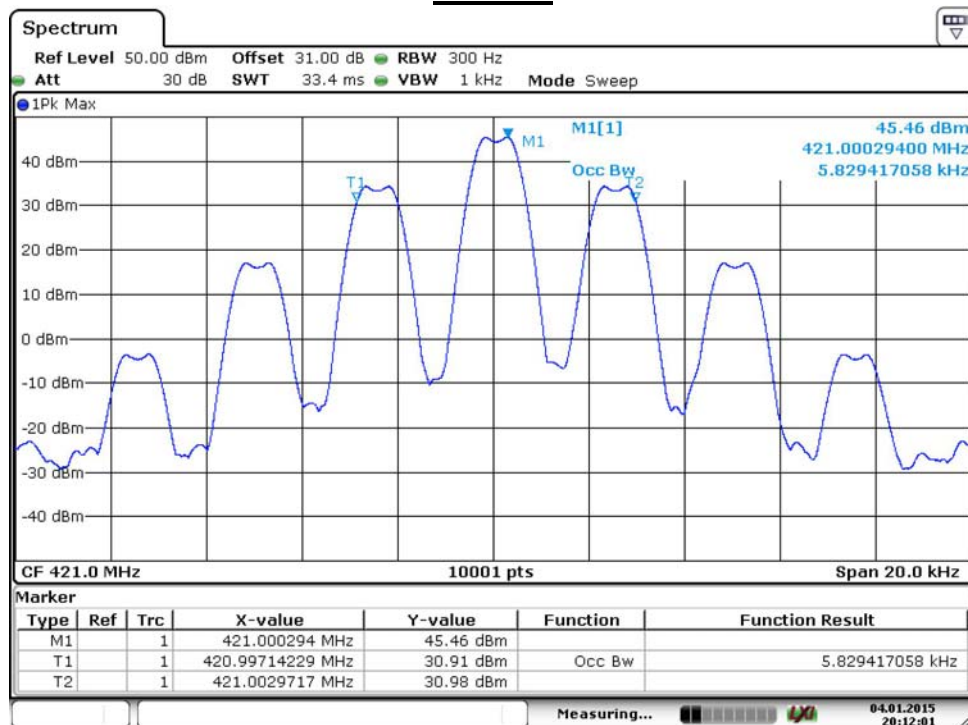
Date: 16.MAY.2015 10:09:55

Product	Repeater		
Test Item	Occupied Bandwidth		
Test Mode	Mode 1: Transmit		
Date of Test	2015/01/04	Test Site	SR7

Analog

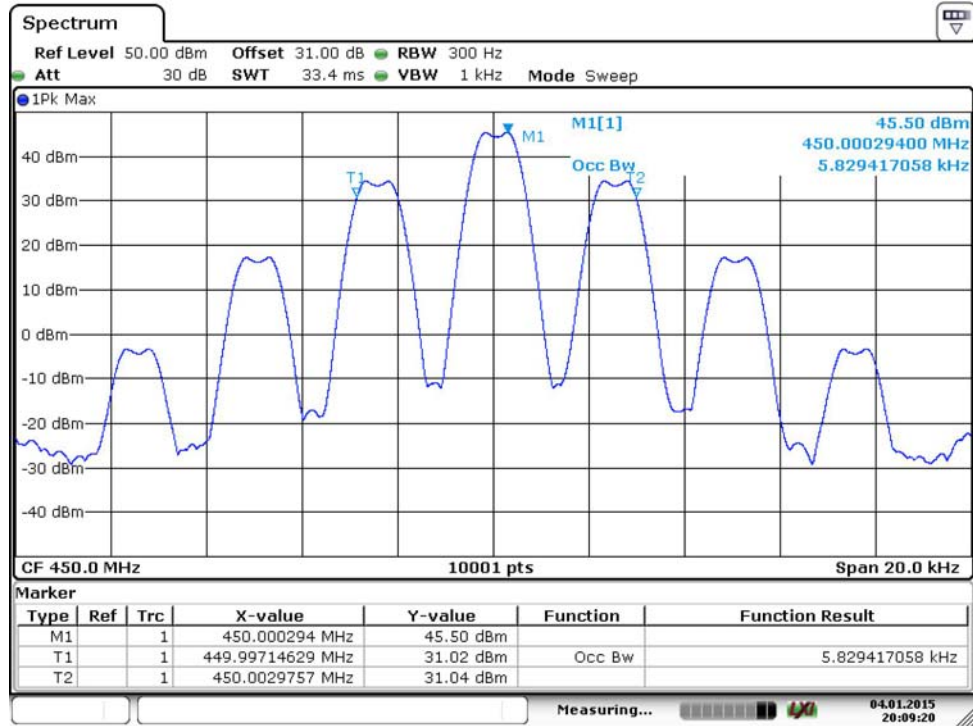
Channel	Frequency (MHz)	Measure Level(kHz)	Limit (kHz)	Result
Low	421	5.829	--	Pass
Mid	450	5.829	--	Pass
High	470	5.831	--	Pass

421MHz



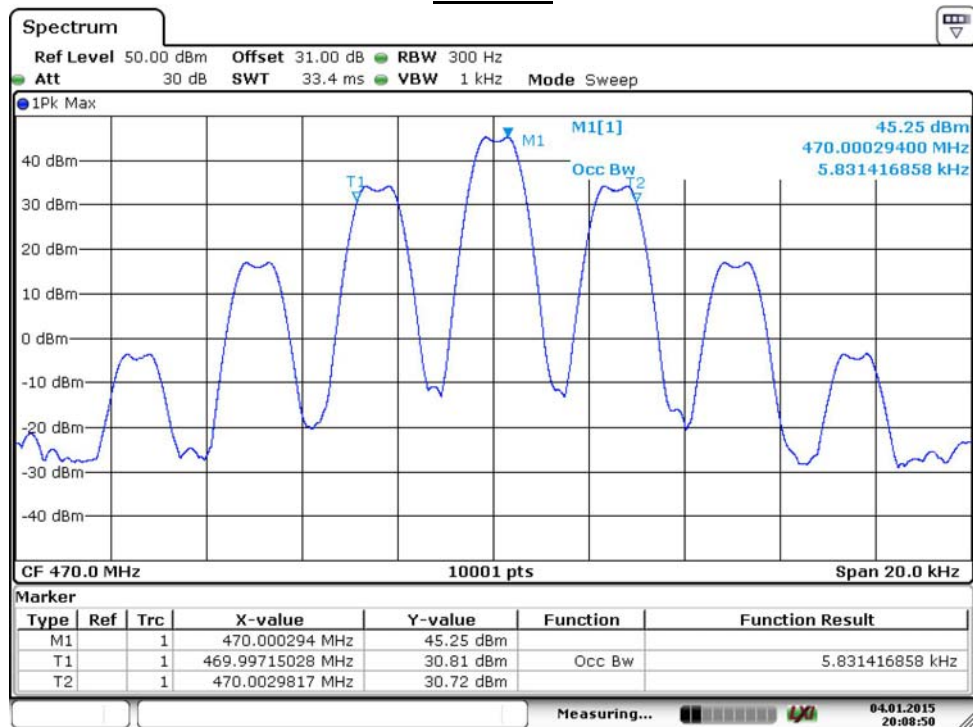
Date: 4.JAN.2015 20:12:01

450MHz



Date: 4.JAN.2015 20:09:20

470MHz



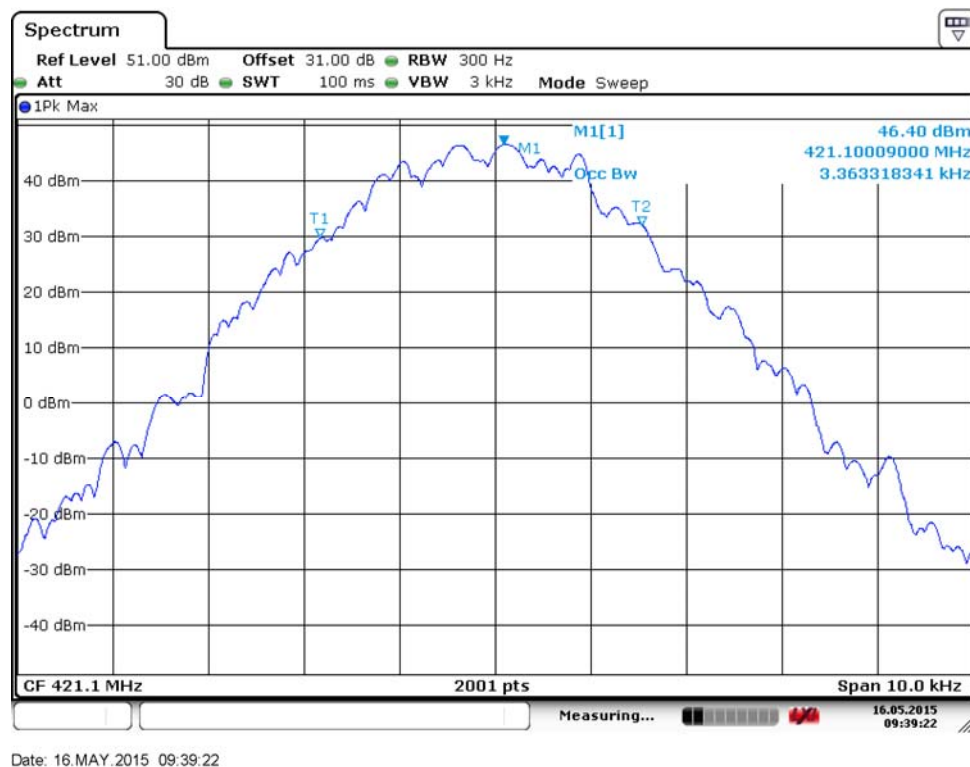
Date: 4.JAN.2015 20:08:50

Product	Repeater		
Test Item	Occupied Bandwidth		
Test Mode	Mode 1: Transmit		
Date of Test	2015/05/16	Test Site	SR7

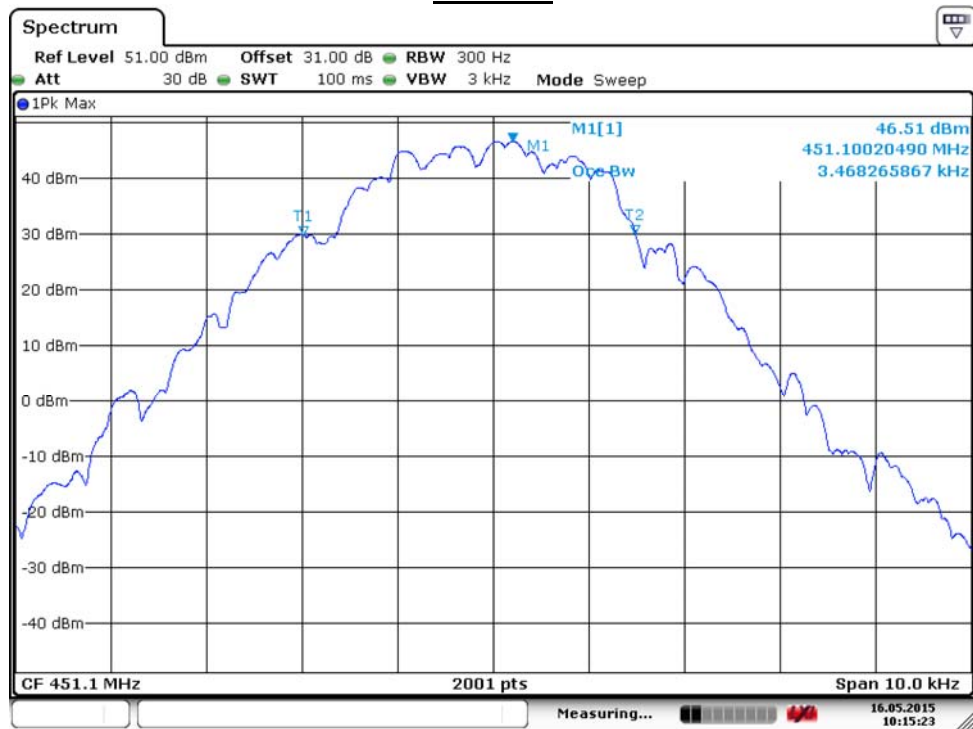
Analog

Channel	Frequency (MHz)	Measure Level(kHz)	Limit (kHz)	Result
Low	421	3.363	--	Pass
Mid	450	3.468	--	Pass
High	470	3.528	--	Pass

421MHz

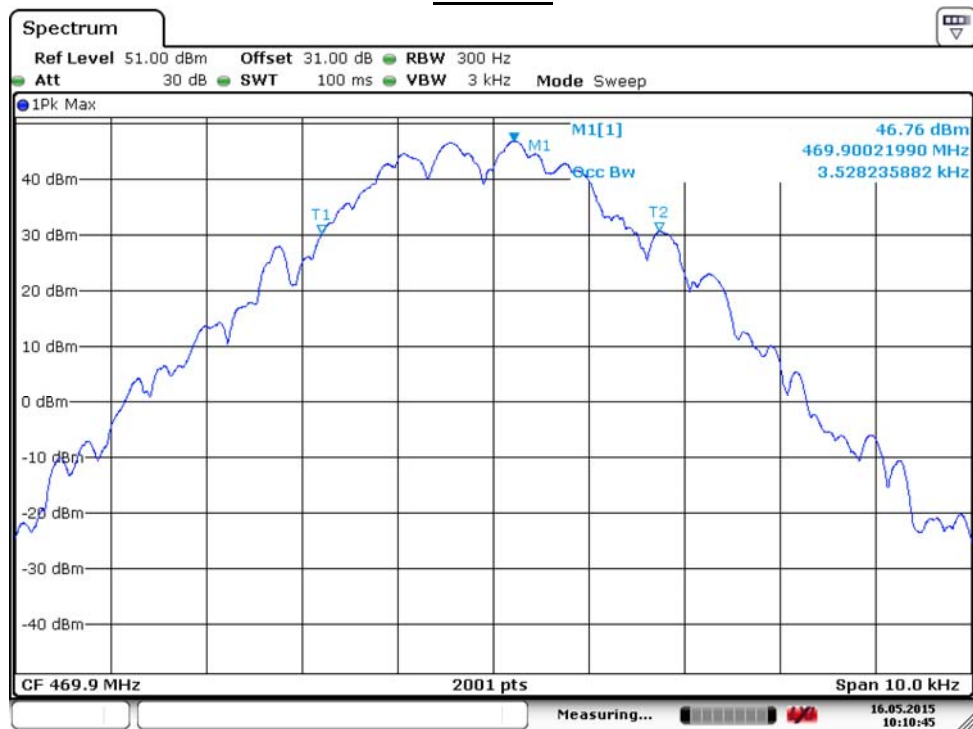


450MHz



Date: 16.MAY.2015 10:15:23

470MHz



Date: 16.MAY.2015 10:10:45

5. Spurious Emissions at Antenna Terminals (Conducted)

5.1. Test Equipment

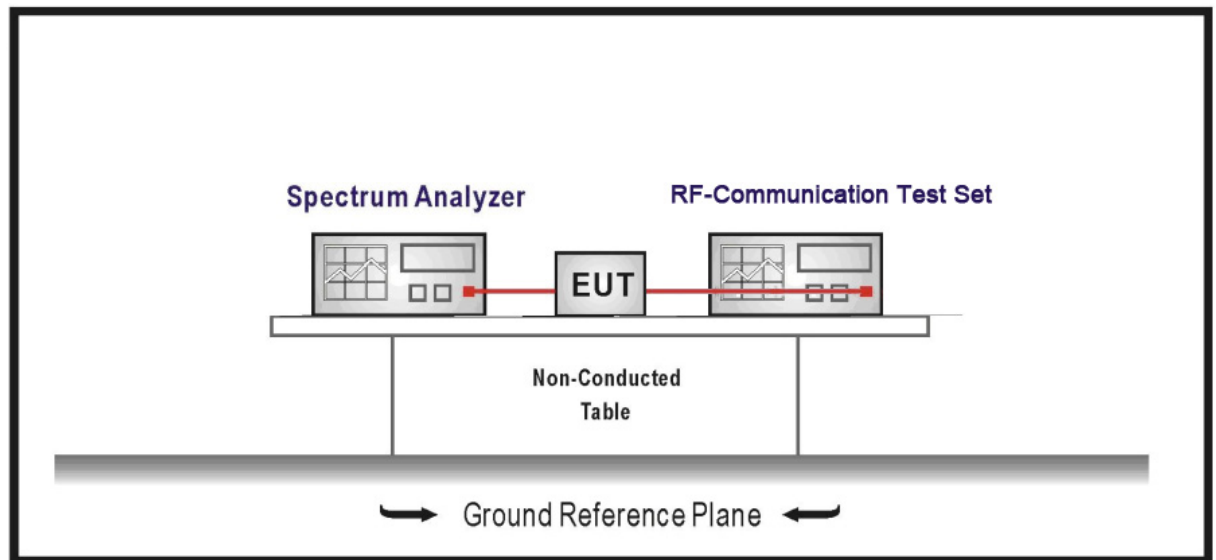
The following test equipments are used during the radiated emission test:

Spurious Emissions at Antenna Terminals (Conducted) / SR7

Instrument	Manufacturer	Model No.	Serial No	Next Cal. Date
Spectrum Analyzer	R&S	FSV 40	101049	2015/07/14
RF-communications Test set	HP	8920A	3614A08091	2016/04/15
Receiver	Agilent	N9038A	MY53220121	2015/07/26

Note: 1. All equipments that need to calibrate are with calibration period of 1 year.

5.2. Test Setup



5.3. Limits

Emissions shall be attenuated below the mean output power of the transmitter as follows:

FCC Rules	Attenuation Limit (dBc)
§ 90.210(b)	At least $43 + 10 \log (P)$ dB
§ 90.210(d)	At least $50 + 10 \log (P)$ dB or 70 dB, whichever is the lesser attenuation.
§ 90.210(e)	At least $55 + 10 \log (P)$ or 65 dB, whichever is the lesser attenuation.

5.4. Test Procedure

The carrier was modulated 100%. The spectrum was scanned from 0.4 to at least the 10th harmonic of the fundamental. Above 1 GHz the resolution bandwidth was 1 MHz and the VBW = 1MHz. The measurements were made in accordance with standard ANSI/TIA-603-C: 2004

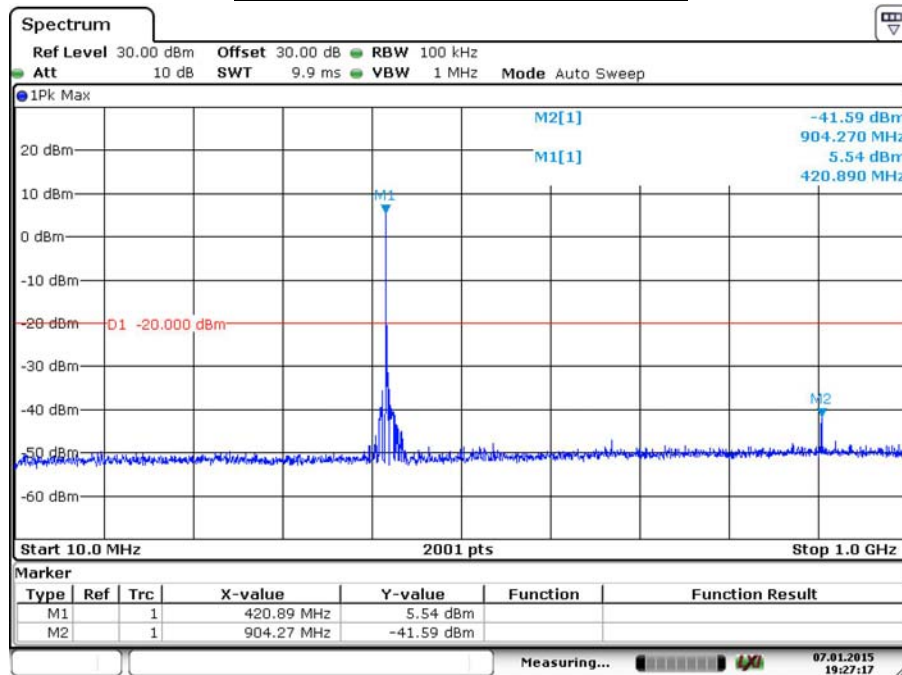
5.5. Uncertainty

The measurement uncertainty is defined as ± 1.27 dB

5.6. Test Result

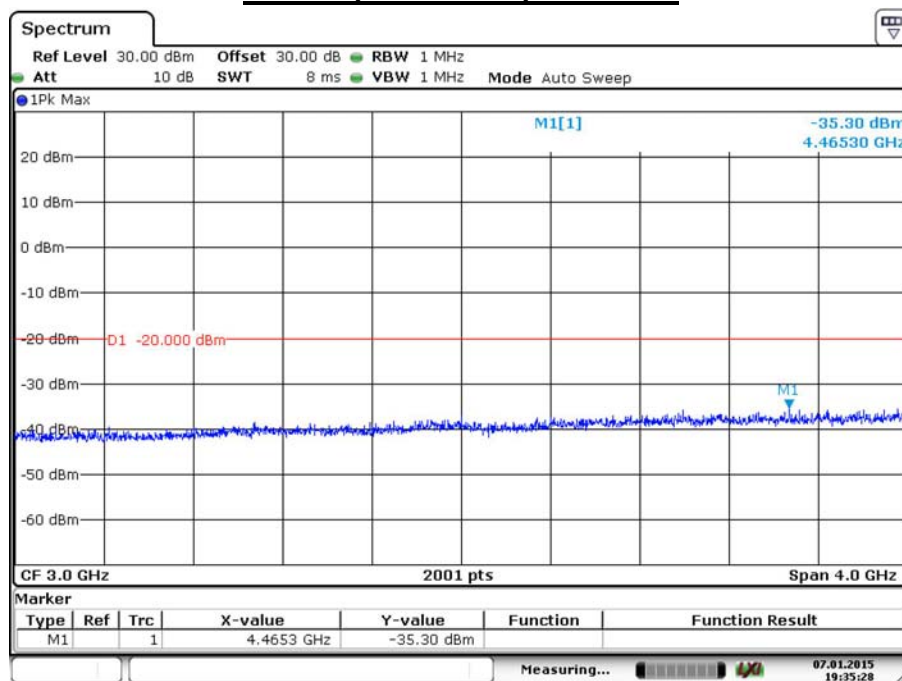
Product	Repeater		
Test Item	Spurious Emissions at Antenna Terminals (Conducted)		
Test Mode	Mode 1: Transmit		
Date of Test	2015/05/25	Test Site	SR7

421MHz(10MHz-1GHz) – 12.5KHz



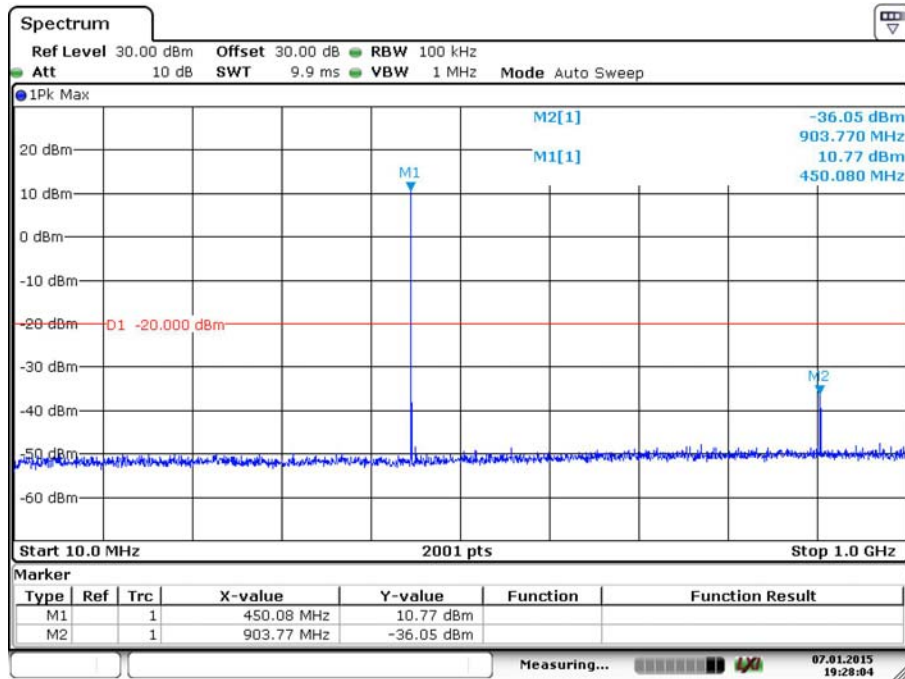
Date: 7.JAN.2015 19:27:17

421MHz(1GHz-5GHz) – 12.5KHz



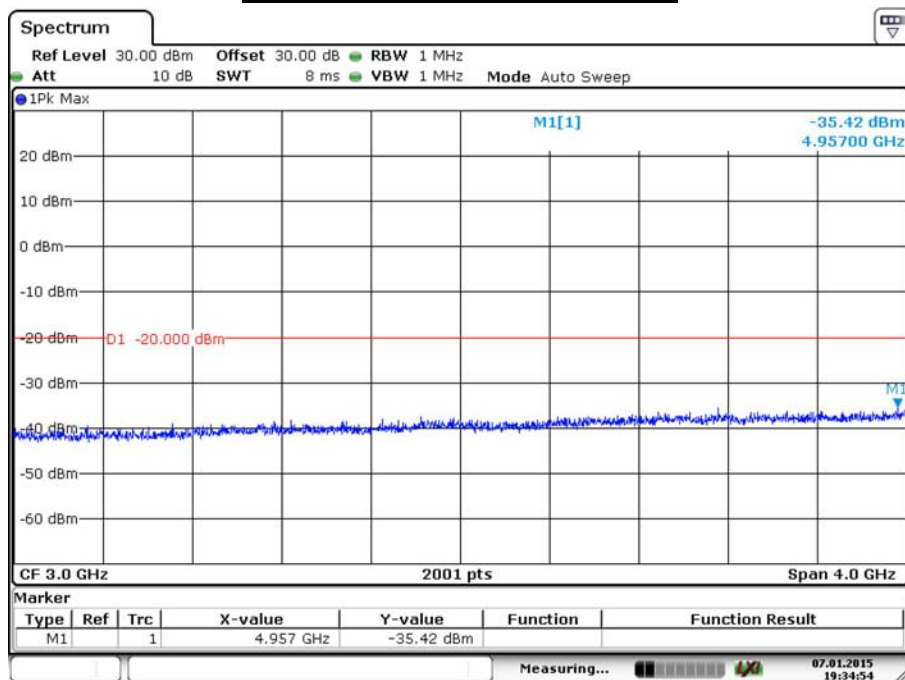
Date: 7.JAN.2015 19:35:29

450MHz(10MHz-1GHz) – 12.5KHz



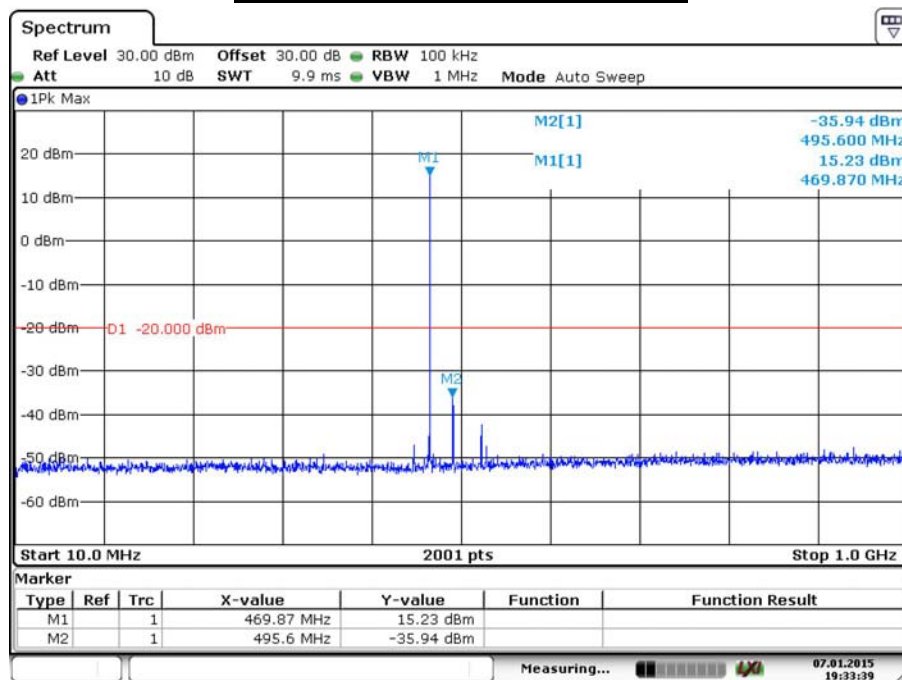
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450MHz(1GHz-5GHz) – 12.5KHz



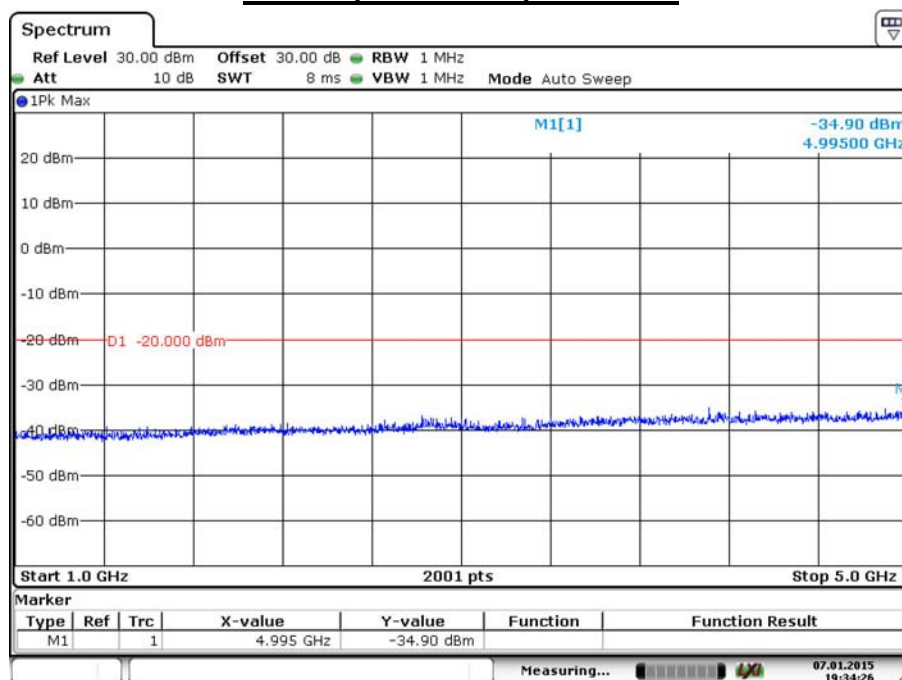
Date: 7.JAN.2015 19:34:54

470MHz(10MHz-1GHz) – 12.5KHz



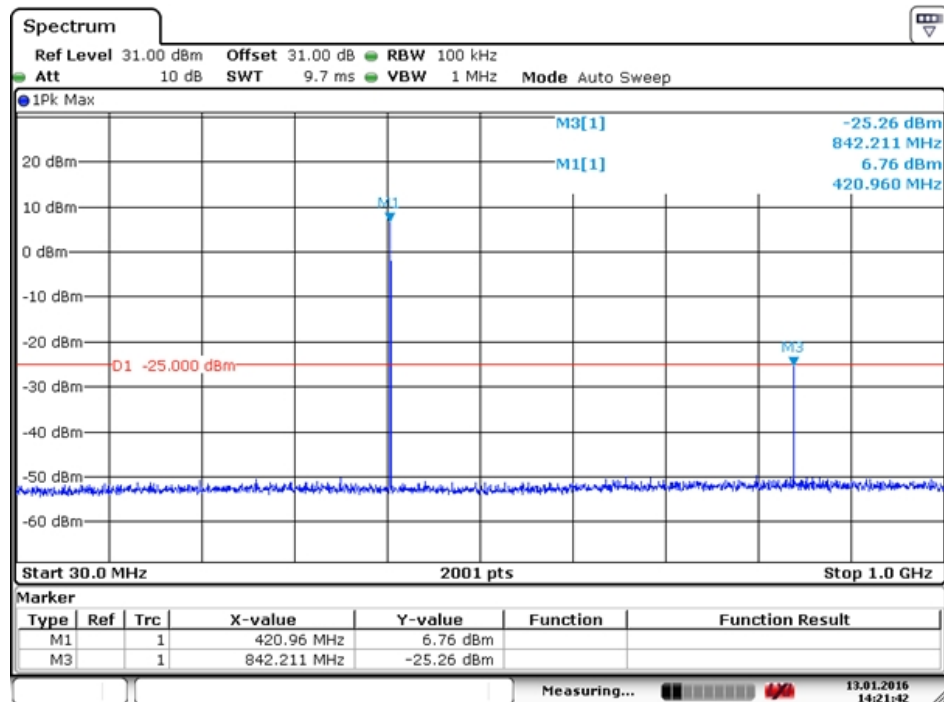
Date: 7.JAN.2015 19:33:39

470MHz(1GHz-5GHz) – 12.5KHz



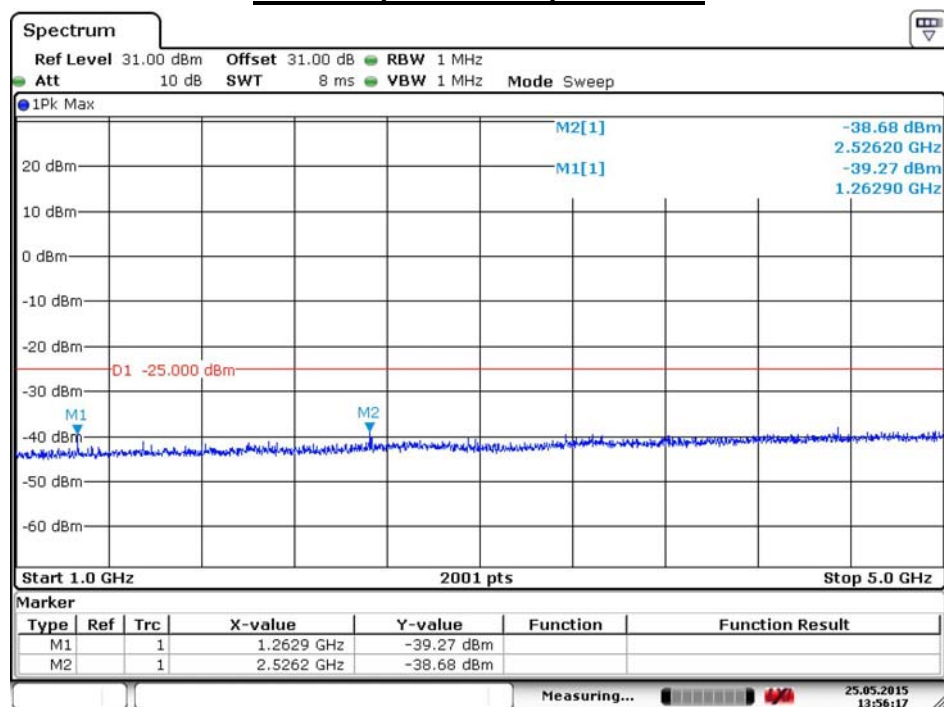
Date: 7.JAN.2015 19:34:27

421 MHz (30MHz-1GHz) – 6.25KHz



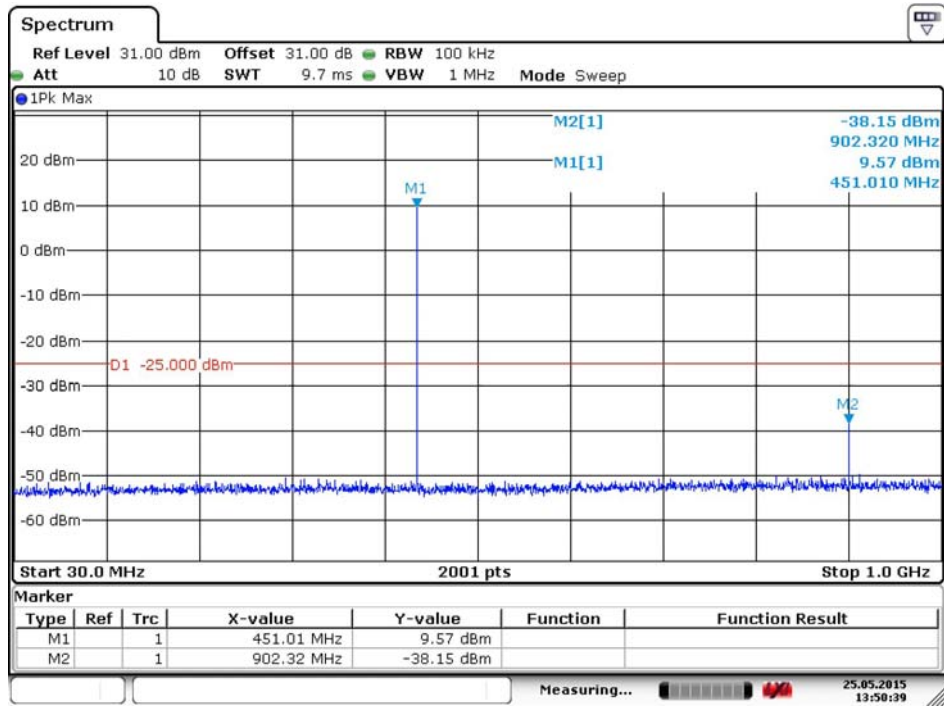
Date: 13.JAN.2016 14:21:42

421 MHz (1GHz-5GHz) – 6.25KHz



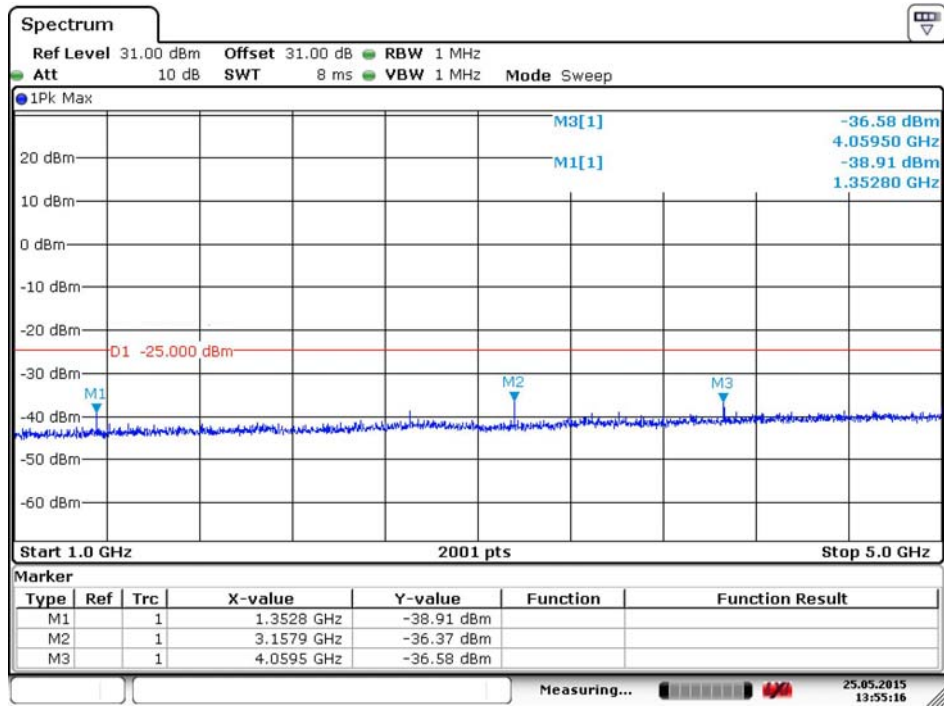
Date: 25.MAY.2015 13:56:17

450 MHz (30MHz-1GHz) – 6.25KHz



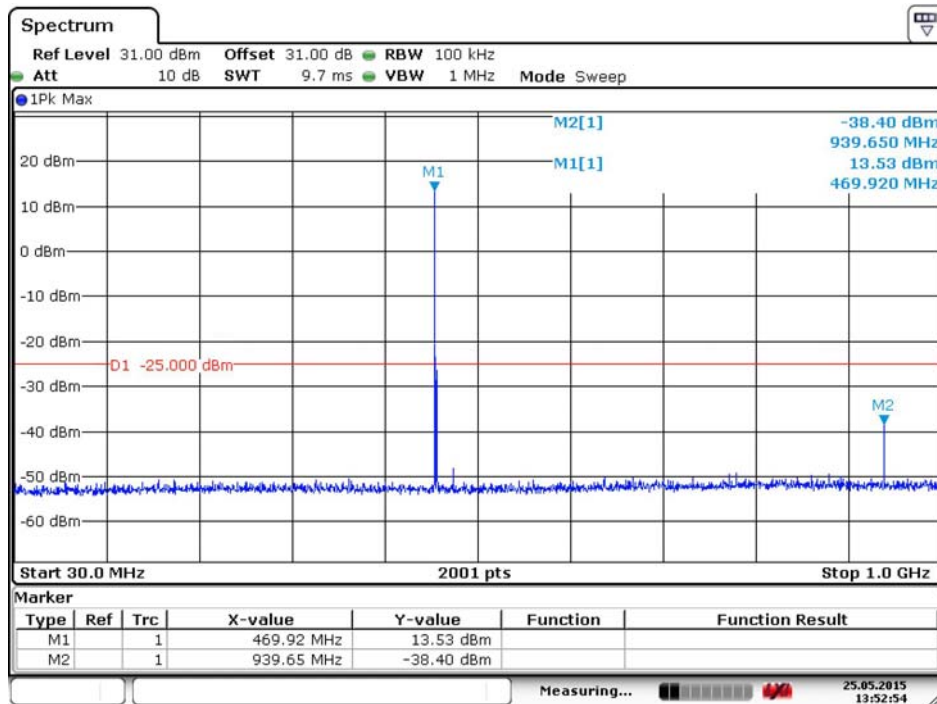
Date: 25.MAY.2015 13:50:39

450 MHz (1GHz-5GHz) – 6.25KHz



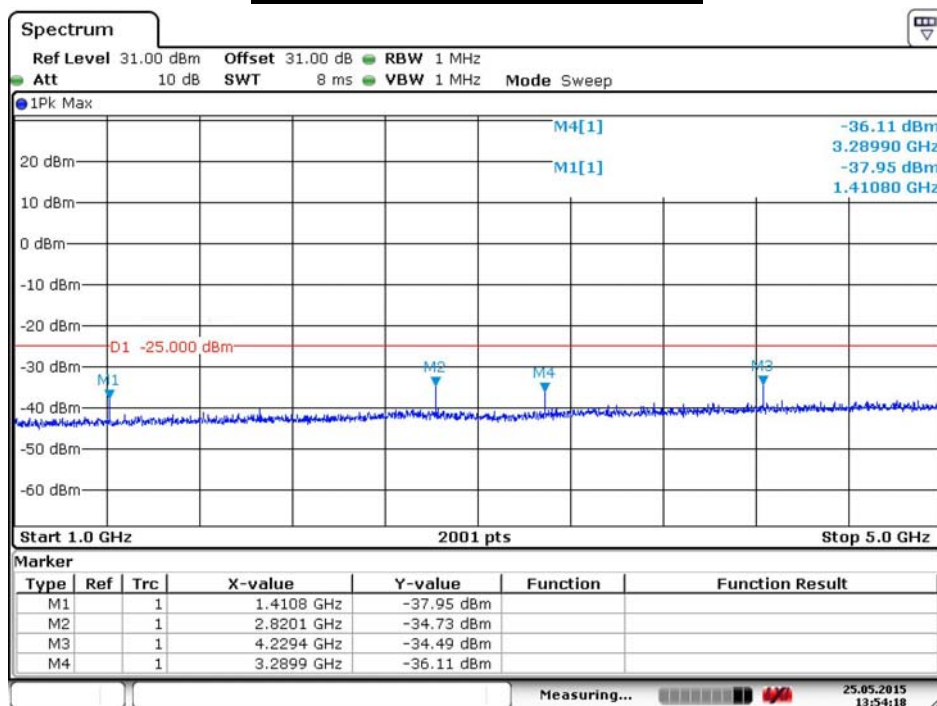
Date: 25.MAY.2015 13:55:17

470MHz (30MHz-1GHz) – 6.25KHz



Date: 25.MAY.2015 13:52:55

470 MHz (1GHz-5GHz) – 6.25KHz



Date: 25.MAY.2015 13:54:19

6. Field Strength of Spurious Emissions

6.1. Test Equipment

The following test equipments are used during the band edge tests:

Field Strength of Spurious Emissions / CB1

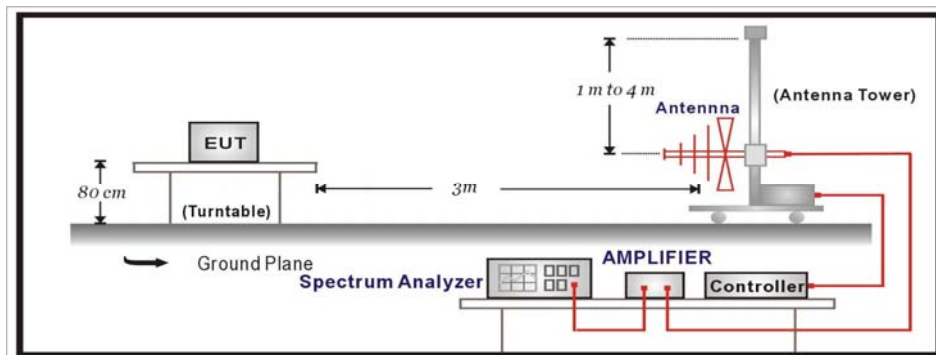
Instrument	Manufacturer	Model No.	Serial No	Next Cal. Date
Bilog Antenna	SCHAFFNER	CBL6112B	2895	2015/08/14
Double Ridged Guide Horn Antenna	Schwarzback	BBHA 9120	D743	2015/02/12
Pre-Amplifier	Quietek	AMF-4D.	888003	2015/06/02
Pre-Amplifier	QuieTek	AP-025C	CHM-0706049	2015/02/06
k Type Cable	Huber Suhner	Sucoflex 102	25623/2	2015/02/10
Signal & Spectrum Analyzer	R&S	FSV 40	101049	2015/07/14
RF-communications Test set	HP	8920A	3614A08091	2015/04/27

Note: 1. All equipments that need to calibrate are with calibration period of 1 year.

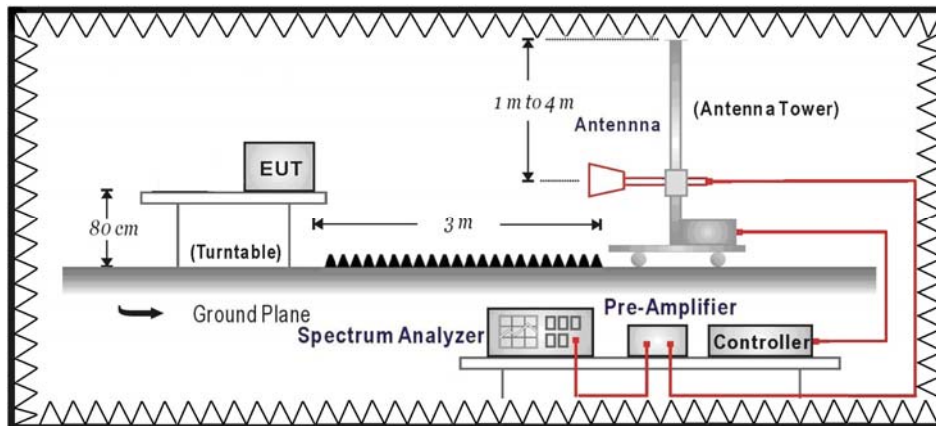
6.2. Test Setup

RF Radiated Measurement:

Under 1GHz Test Setup:



Above 1GHz Test Setup:



6.3. Limits

Emissions shall be attenuated below the mean output power of the transmitter as follows:

FCC Rules	Attenuation Limit (dBc)
§ 90.210(b)	At least $43 + 10 \log (P)$ dB
§ 90.210(d)	At least $50 + 10 \log (P)$ dB or 70 dB, whichever is the lesser attenuation.
§ 90.210(e)	At least $55 + 10 \log (P)$ or 65 dB, whichever is the lesser attenuation.

6.4. Test Procedure

The spectrum was scanned from 30 MHz to at least the tenth harmonic of the fundamental.

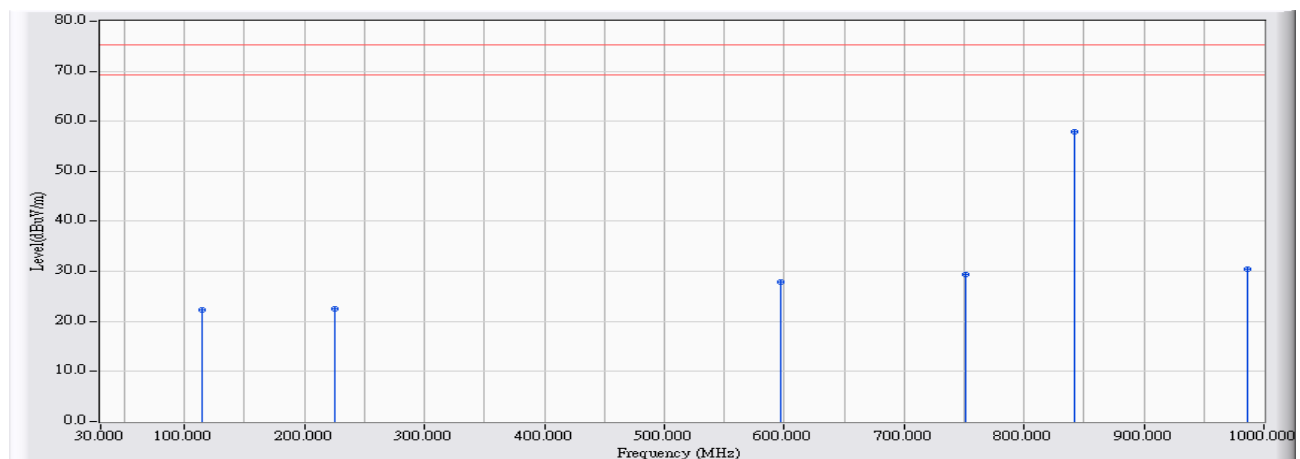
6.5. Uncertainty

The measurement uncertainty is defined as ± 3.65 dB

6.6. Test Result

30MHz-1GHz Spurious

Site : CB1	Time : 2015/01/06 - 16:08
Limit : FCC_PART90_03M_PK	Margin : 6
Probe : CB1_FCC_EFS_30-1G-1_0901 - HORIZONTAL	Power : DC 13.8V
EUT : Repeater	Note : 421MHz

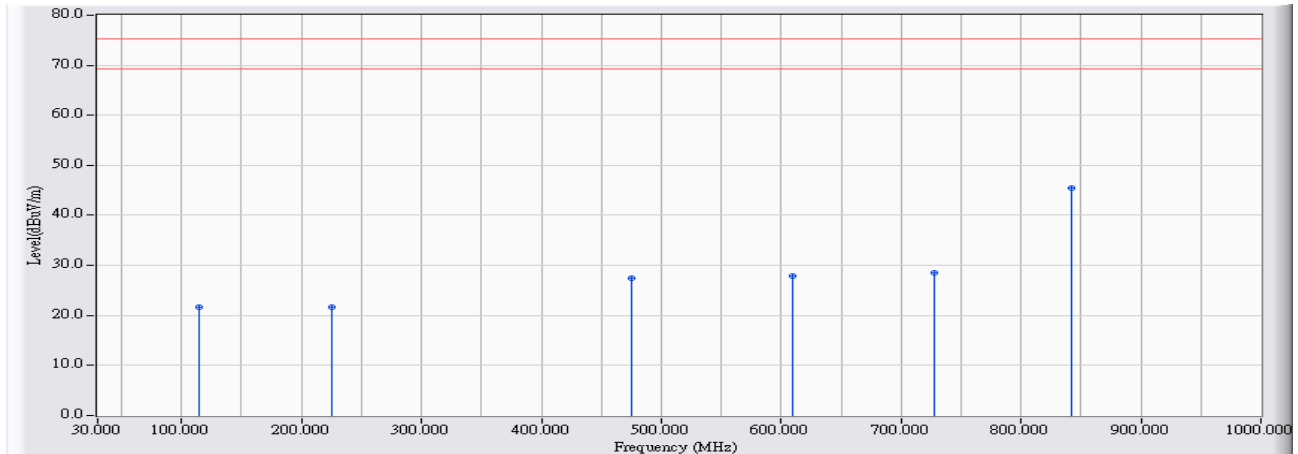


		Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Measure Level (dBuV/m)	Margin (dB)	Limit (dBuV/m)	Detector Type
1		114.348	10.700	11.532	22.232	-52.968	75.200	PEAK
2		224.873	9.945	12.553	22.498	-52.702	75.200	PEAK
3		597.651	17.921	9.983	27.903	-47.297	75.200	PEAK
4		751.804	18.823	10.476	29.299	-45.901	75.200	PEAK
5	*	841.969	19.542	38.332	57.874	-17.326	75.200	PEAK
6		985.942	20.556	9.903	30.459	-44.741	75.200	PEAK

Note:

1. All Reading Levels are Peak value.
2. “ * ”, means this data is the worst emission level.
3. Measurement Level = Reading Level + Correct Factor.

Site : CB1	Time : 2015/01/06 - 16:12
Limit : FCC_PART90_03M_PK	Margin : 6
Probe : CB1_FCC_EFS_30-1G-1_0901 - VERTICAL	Power : DC 13.8V
EUT : Repeater	Note : 421MHz

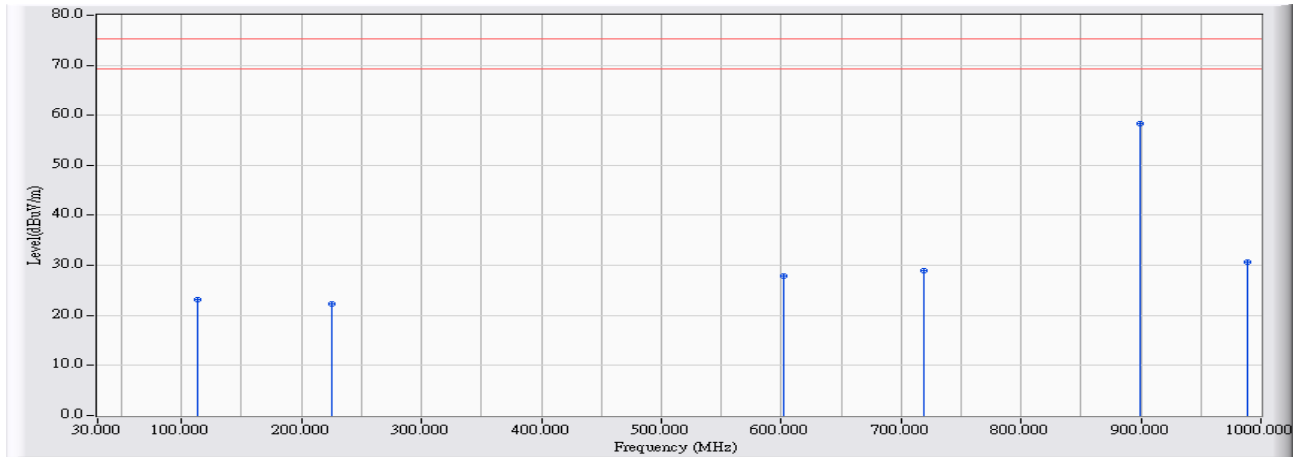


		Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Measure Level (dBuV/m)	Margin (dB)	Limit (dBuV/m)	Detector Type
1		114.348	10.700	11.059	21.759	-53.441	75.200	PEAK
2		224.873	9.945	11.674	21.619	-53.581	75.200	PEAK
3		475.492	16.547	10.894	27.441	-47.759	75.200	PEAK
4		609.285	17.972	9.994	27.966	-47.234	75.200	PEAK
5		727.566	18.556	10.006	28.562	-46.638	75.200	PEAK
6	*	841.484	19.540	25.850	45.390	-29.810	75.200	PEAK

Note:

1. All Reading Levels are Peak value.
2. " * ", means this data is the worst emission level.
3. Measurement Level = Reading Level + Correct Factor.

Site : CB1	Time : 2015/01/06 - 16:26
Limit : FCC_PART90_03M_PK	Margin : 6
Probe : CB1_FCC_EFS_30-1G-1_0901 - HORIZONTAL	Power : DC 13.8V
EUT : Repeater	Note : 450MHz

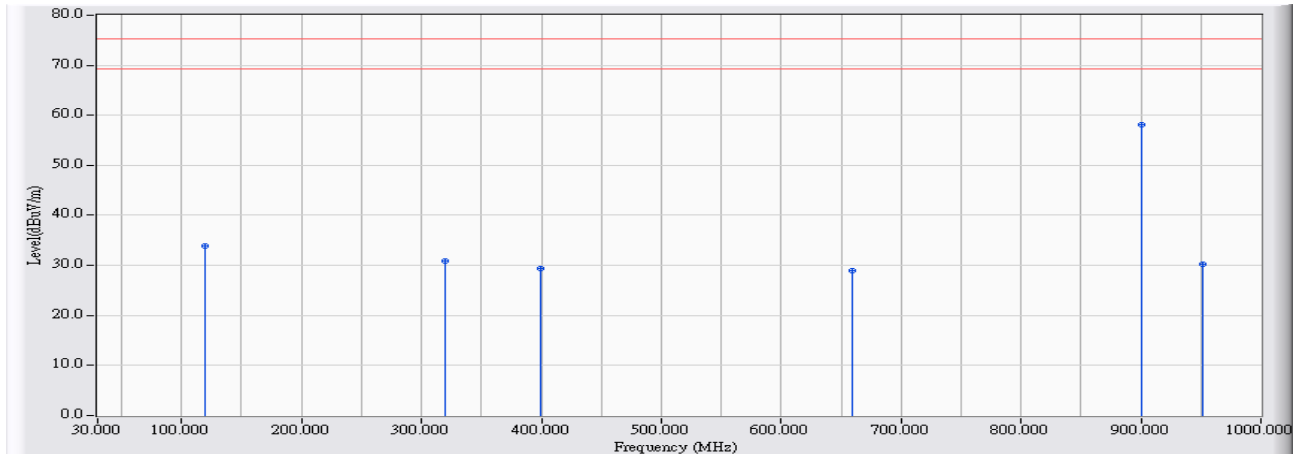


		Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Measure Level (dBuV/m)	Margin (dB)	Limit (dBuV/m)	Detector Type
1		113.863	10.658	12.593	23.251	-51.949	75.200	PEAK
2		224.873	9.945	12.437	22.382	-52.818	75.200	PEAK
3		602.499	17.951	10.038	27.989	-47.211	75.200	PEAK
4		718.356	18.455	10.401	28.856	-46.344	75.200	PEAK
5	*	899.655	19.801	38.610	58.411	-16.789	75.200	PEAK
6		988.366	20.577	10.086	30.663	-44.537	75.200	PEAK

Note:

1. All Reading Levels are Peak value.
2. " * ", means this data is the worst emission level.
3. Measurement Level = Reading Level + Correct Factor.

Site : CB1	Time : 2015/01/06 - 16:28
Limit : FCC_PART90_03M_PK	Margin : 6
Probe : CB1_FCC_EFS_30-1G-1_0901 - VERTICAL	Power : DC 13.8V
EUT : Repeater	Note : 450MHz

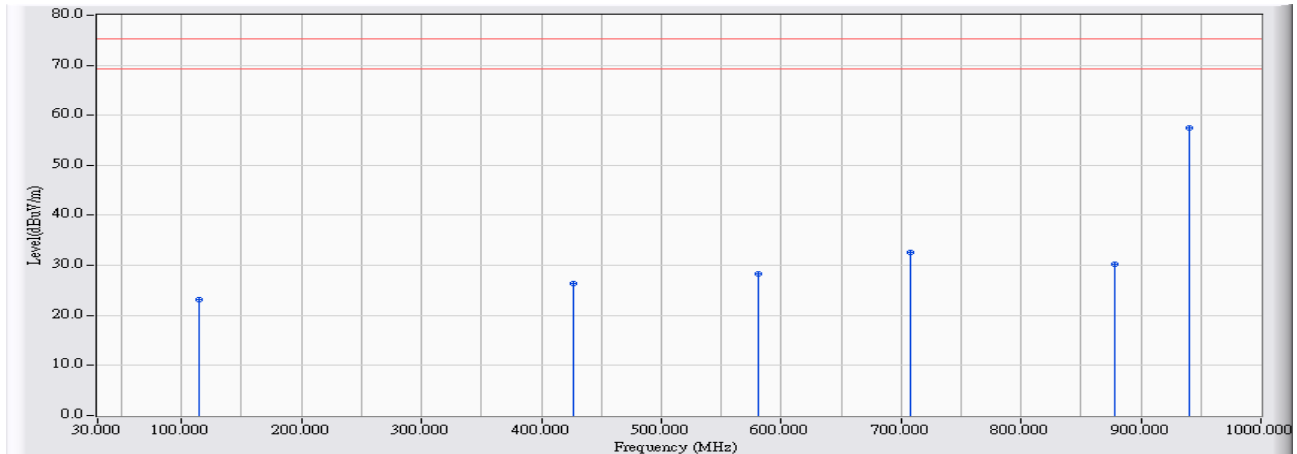


		Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Measure Level (dBuV/m)	Margin (dB)	Limit (dBuV/m)	Detector Type
1		119.680	11.146	22.768	33.914	-41.286	75.200	PEAK
2		319.885	13.061	17.771	30.832	-44.368	75.200	PEAK
3		399.870	15.229	14.137	29.366	-45.834	75.200	PEAK
4		659.700	18.128	10.813	28.941	-46.259	75.200	PEAK
5	*	900.000	19.802	38.310	58.113	-17.087	75.200	PEAK
6		951.039	20.249	10.095	30.345	-44.855	75.200	PEAK

Note:

1. All Reading Levels are Peak value.
2. " * ", means this data is the worst emission level.
3. Measurement Level = Reading Level + Correct Factor.

Site : CB1	Time : 2015/01/06 - 16:33
Limit : FCC_PART90_03M_PK	Margin : 6
Probe : CB1_FCC_EFS_30-1G-1_0901 - HORIZONTAL	Power : DC 13.8V
EUT : Repeater	Note : 470MHz

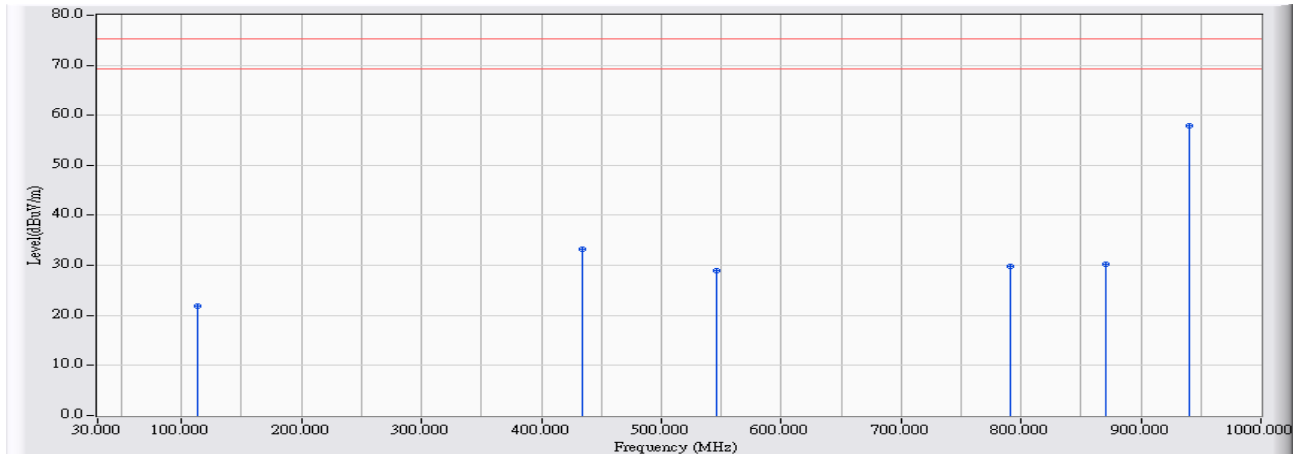


		Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Measure Level (dBuV/m)	Margin (dB)	Limit (dBuV/m)	Detector Type
1		114.348	10.700	12.534	23.234	-51.966	75.200	PEAK
2		427.016	15.704	10.759	26.463	-48.737	75.200	PEAK
3		580.685	17.756	10.604	28.360	-46.840	75.200	PEAK
4		707.206	18.332	14.246	32.578	-42.622	75.200	PEAK
5		878.326	19.705	10.616	30.321	-44.879	75.200	PEAK
6	*	940.030	20.153	37.230	57.383	-17.817	75.200	PEAK

Note:

1. All Reading Levels are Peak value.
2. " * ", means this data is the worst emission level.
3. Measurement Level = Reading Level + Correct Factor.

Site : CB1	Time : 2015/01/06 - 16:40
Limit : FCC_PART90_03M_PK	Margin : 6
Probe : CB1_FCC_EFS_30-1G-1_0901 - VERTICAL	Power : DC 13.8V
EUT : Repeater	Note : 470MHz



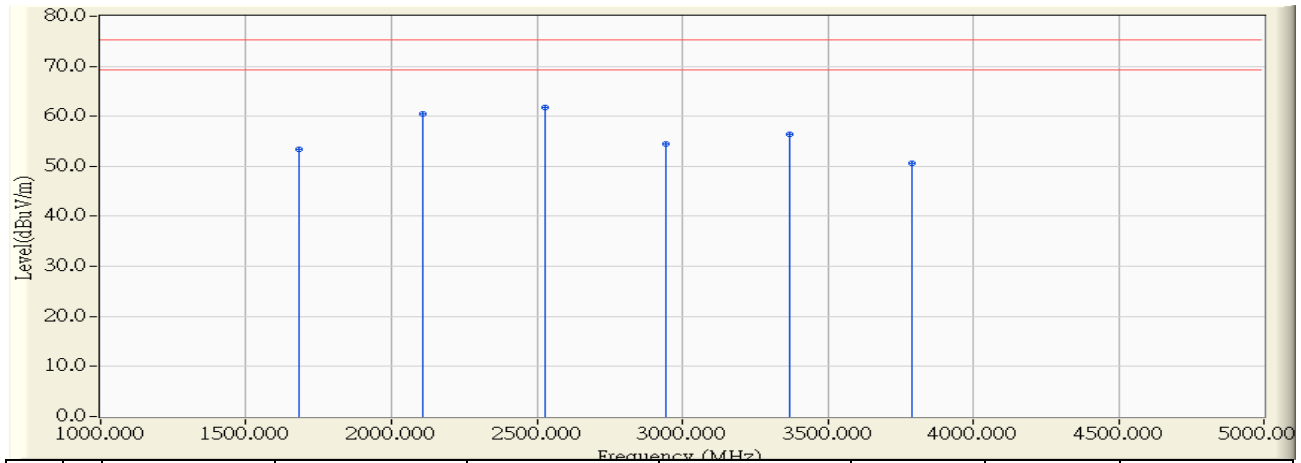
		Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Measure Level (dBuV/m)	Margin (dB)	Limit (dBuV/m)	Detector Type
1		113.863	10.658	11.294	21.952	-53.248	75.200	PEAK
2		434.773	15.839	17.339	33.178	-42.022	75.200	PEAK
3		546.267	17.421	11.529	28.951	-46.249	75.200	PEAK
4		790.585	19.250	10.659	29.909	-45.291	75.200	PEAK
5		871.054	19.673	10.642	30.314	-44.886	75.200	PEAK
6	*	940.130	20.154	37.790	57.944	-17.256	75.200	PEAK

Note:

1. All Reading Levels are Peak value.
2. " * ", means this data is the worst emission level.
3. Measurement Level = Reading Level + Correct Factor.

Harmonic & Spurious:

Site : CB1	Time : 2015/01/07 - 00:36
Limit : FCC_Part90_H_03M_PK	Margin : 6
Probe : CB1_FCC_EFS_1-18G-1_0901 - HORIZONTAL	Power : DC 13.8V
EUT : Repeater	Note : 421MHz

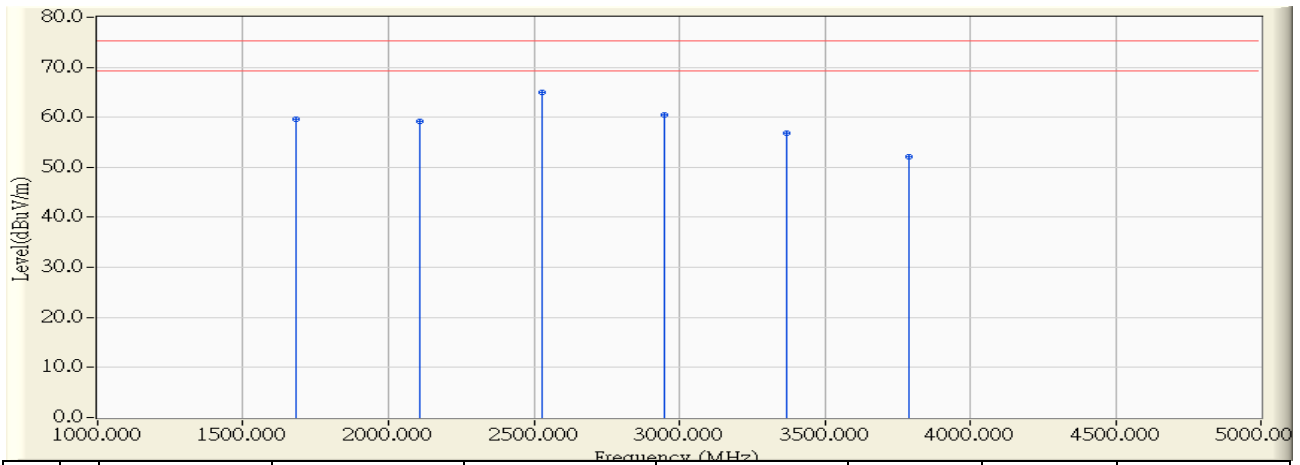


	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Measure Level (dBuV/m)	Margin (dB)	Limit (dBuV/m)	Detector Type
1	1684.009	-21.717	75.098	53.381	-21.819	75.200	PEAK
2	2106.012	-19.144	79.665	60.521	-14.679	75.200	PEAK
3	* 2525.979	-15.073	76.809	61.736	-13.464	75.200	PEAK
4	2946.009	-16.122	70.528	54.405	-20.795	75.200	PEAK
5	3368.004	-15.709	72.123	56.413	-18.787	75.200	PEAK
6	3788.019	-14.943	65.558	50.614	-24.586	75.200	PEAK

Note:

1. All Reading Levels are Peak value.
2. “ * ”, means this data is the worst emission level.
3. Measurement Level = Reading Level + Correct Factor.

Site : CB1	Time : 2015/01/07 - 00:43
Limit : FCC_Part90_H_03M_PK	Margin : 6
Probe : CB1_FCC_EFS_1-18G-1_0901 - VERTICAL	Power : DC 13.8V
EUT : Repeater	Note : 421MHz

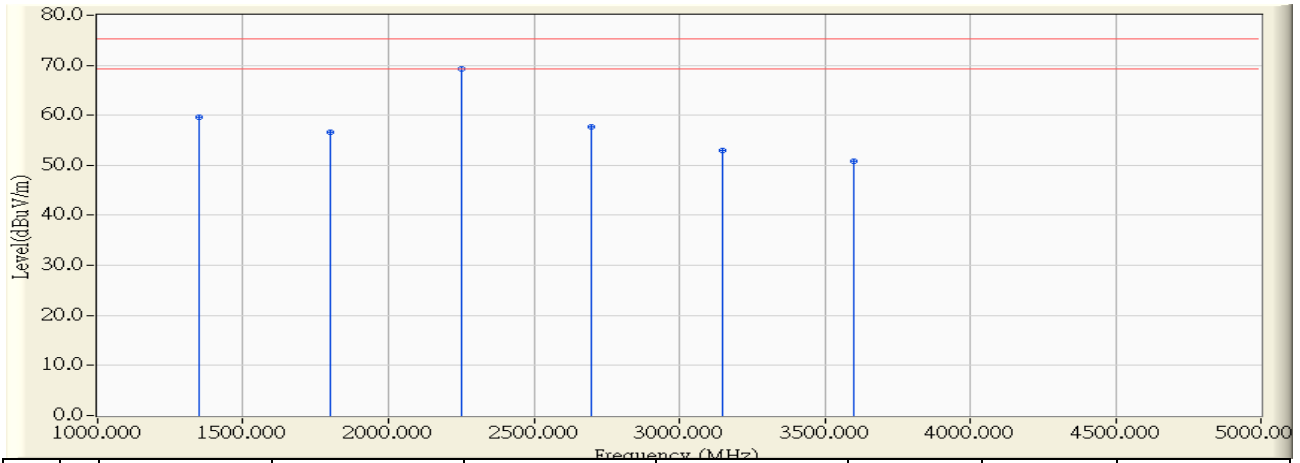


	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Measure Level (dBuV/m)	Margin (dB)	Limit (dBuV/m)	Detector Type
1	1684.009	-21.717	81.395	59.678	-15.522	75.200	PEAK
2	2105.964	-19.144	78.239	59.095	-16.105	75.200	PEAK
3	* 2526.013	-15.073	80.141	65.068	-10.132	75.200	PEAK
4	2948.000	-16.128	76.685	60.557	-14.643	75.200	PEAK
5	3367.979	-15.709	72.492	56.783	-18.417	75.200	PEAK
6	3788.006	-14.943	67.126	52.183	-23.017	75.200	PEAK

Note:

1. All Reading Levels are Peak value.
2. " * ", means this data is the worst emission level.
3. Measurement Level = Reading Level + Correct Factor.

Site : CB1	Time : 2015/01/07 - 00:49
Limit : FCC_Part90_H_03M_PK	Margin : 6
Probe : CB1_FCC_EFS_1-18G-1_0901 - HORIZONTAL	Power : DC 13.8V
EUT : Repeater	Note : 450MHz

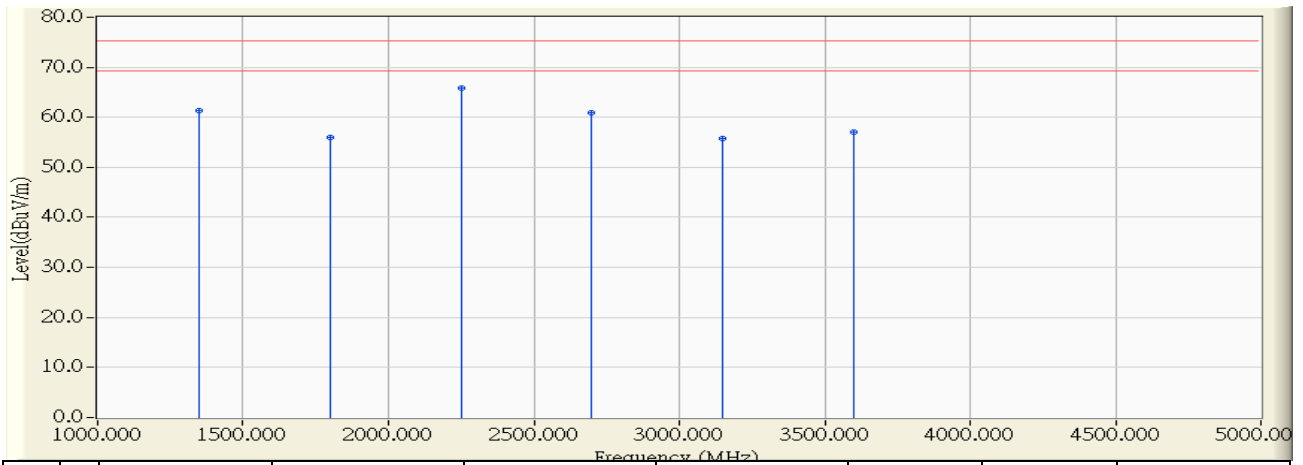


	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Measure Level (dBuV/m)	Margin (dB)	Limit (dBuV/m)	Detector Type
1	1350.017	-22.882	82.424	59.542	-15.658	75.200	PEAK
2	1799.979	-21.334	77.950	56.616	-18.584	75.200	PEAK
3	* 2249.964	-17.456	86.823	69.368	-5.832	75.200	PEAK
4	2699.972	-15.508	73.114	57.606	-17.594	75.200	PEAK
5	3149.960	-15.961	68.869	52.908	-22.292	75.200	PEAK
6	3599.967	-15.325	66.192	50.867	-24.333	75.200	PEAK

Note:

1. All Reading Levels are Peak value.
2. " * ", means this data is the worst emission level.
3. Measurement Level = Reading Level + Correct Factor.

Site : CB1	Time : 2015/01/07 - 00:57
Limit : FCC_Part90_H_03M_PK	Margin : 6
Probe : CB1_FCC_EFS_1-18G-1_0901 - VERTICAL	Power : DC 13.8V
EUT : Repeater	Note : 450MHz

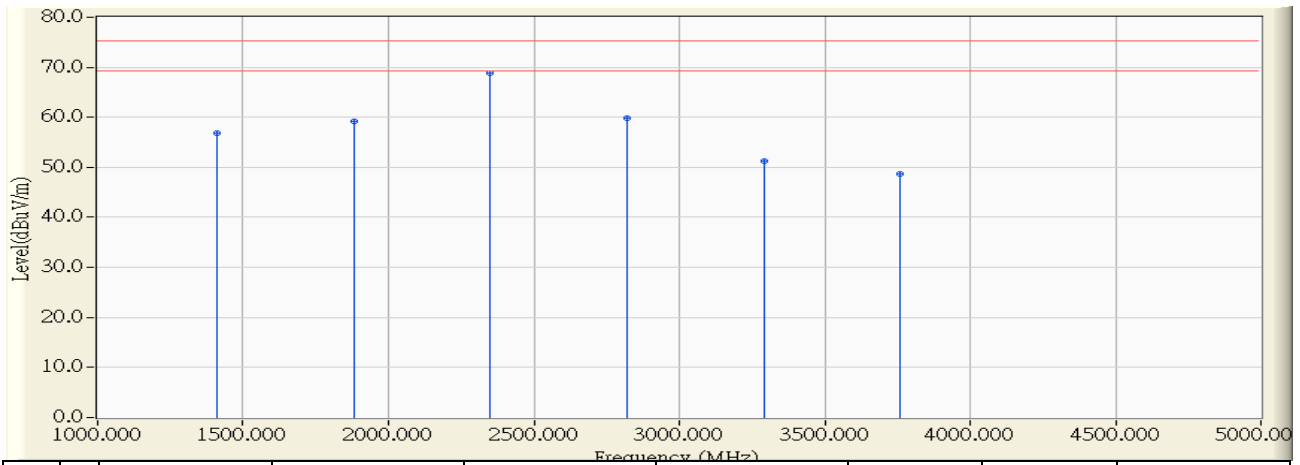


	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Measure Level (dBuV/m)	Margin (dB)	Limit (dBuV/m)	Detector Type
1	1350.003	-22.882	84.155	61.273	-13.927	75.200	PEAK
2	1799.960	-21.334	77.370	56.036	-19.164	75.200	PEAK
3	* 2250.017	-17.455	83.367	65.912	-9.288	75.200	PEAK
4	2699.967	-15.508	76.498	60.990	-14.210	75.200	PEAK
5	3149.969	-15.961	71.821	55.860	-19.340	75.200	PEAK
6	3599.975	-15.325	72.364	57.039	-18.161	75.200	PEAK

Note:

1. All Reading Levels are Peak value.
2. " * ", means this data is the worst emission level.
3. Measurement Level = Reading Level + Correct Factor.

Site : CB1	Time : 2015/01/07 - 01:08
Limit : FCC_Part90_H_03M_PK	Margin : 6
Probe : CB1_FCC_EFS_1-18G-1_0901 - HORIZONTAL	Power : DC 13.8V
EUT : Repeater	Note : 470MHz

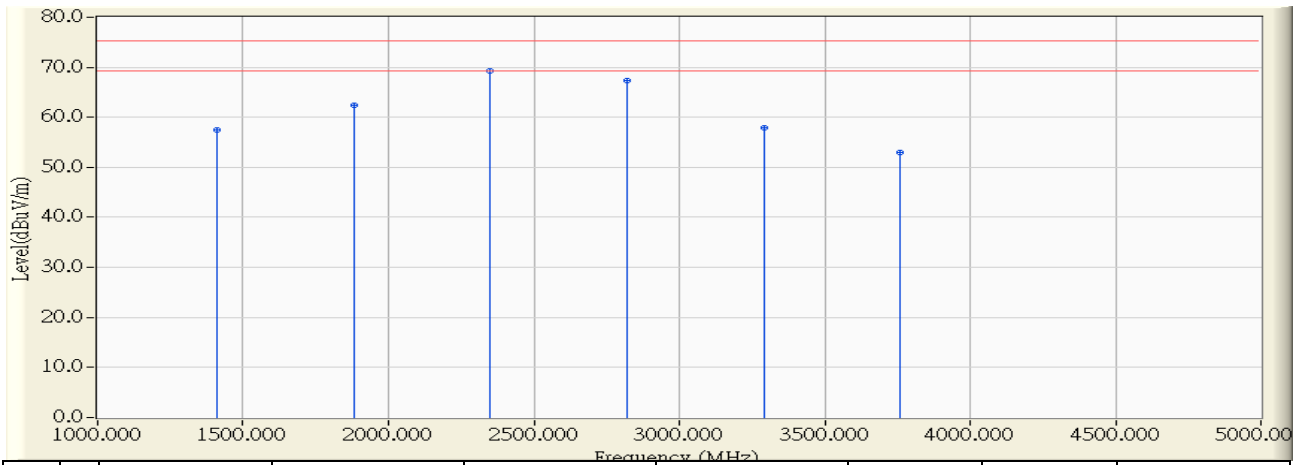


	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Measure Level (dBuV/m)	Margin (dB)	Limit (dBuV/m)	Detector Type
1	1409.963	-22.652	79.576	56.924	-18.276	75.200	PEAK
2	1880.001	-21.070	80.228	59.158	-16.042	75.200	PEAK
3	* 2349.971	-16.282	85.090	68.808	-6.392	75.200	PEAK
4	2819.966	-15.808	75.714	59.906	-15.294	75.200	PEAK
5	3290.013	-15.800	67.120	51.320	-23.880	75.200	PEAK
6	3759.964	-15.001	63.674	48.673	-26.527	75.200	PEAK

Note:

1. All Reading Levels are Peak value.
2. " * ", means this data is the worst emission level.
3. Measurement Level = Reading Level + Correct Factor.

Site : CB1	Time : 2015/01/07 - 01:17
Limit : FCC_Part90_H_03M_PK	Margin : 6
Probe : CB1_FCC_EFS_1-18G-1_0901 - VERTICAL	Power : DC 13.8V
EUT : Repeater	Note : 470MHz



	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Measure Level (dBuV/m)	Margin (dB)	Limit (dBuV/m)	Detector Type
1	1409.977	-22.652	80.037	57.385	-17.815	75.200	PEAK
2	1879.966	-21.070	83.454	62.384	-12.816	75.200	PEAK
3	* 2350.015	-16.282	85.515	69.233	-5.967	75.200	PEAK
4	2820.018	-15.808	83.247	67.439	-7.761	75.200	PEAK
5	3289.975	-15.800	73.691	57.891	-17.309	75.200	PEAK
6	3760.018	-15.001	67.991	52.990	-22.210	75.200	PEAK

Note:

1. All Reading Levels are Peak value.
2. " * ", means this data is the worst emission level.
3. Measurement Level = Reading Level + Correct Factor.

7. Frequency Stability

7.1. Test Equipment

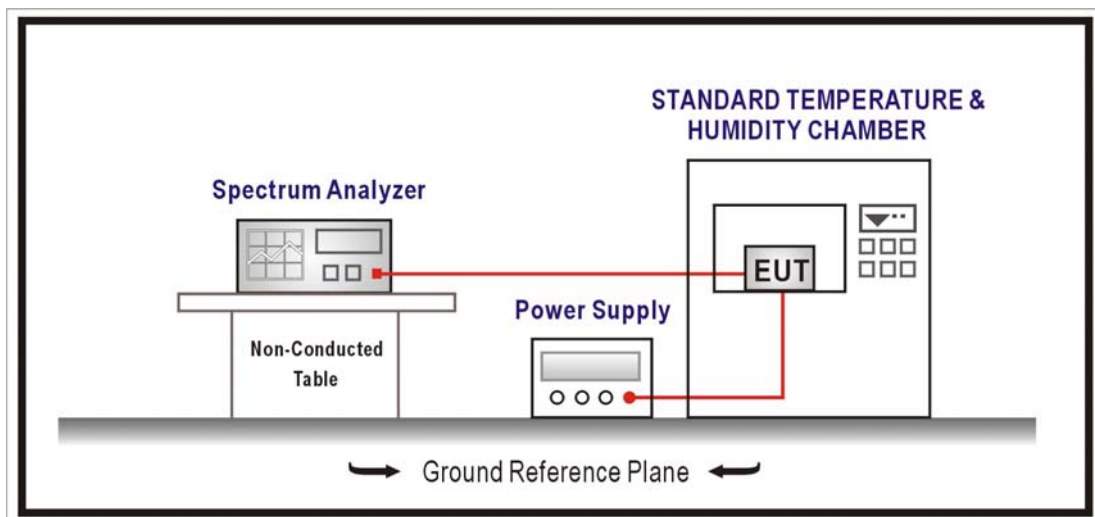
The following test equipments are used during the radiated emission tests:

Frequency Stability / SR7

Instrument	Manufacturer	Model No.	Serial No	Next Cal. Date
Spectrum Analyzer	Agilent	N9010A-EXA	US47140172	2015/07/14
Temperature & Humidity Chamber	WIT	TH-1S-B	1082101	2015/01/22

Note: 1. All equipments that need to calibrate are with calibration period of 1 year.

7.2. Test Setup



7.3. Limits

§Transmitters used must have minimum frequency stability as specified in the following table.

Frequency Range (MHz)	Channel Bandwidth (KHz)	Frequency Tolerance (ppm)		
		Fixed and Base Stations	Mobile Stations	
			> 2 W	≤ 2 W
150-174 MHz	6.25	1.0	2.0	2.0
	12.5	2.5	5.0	5.0
	25	5.0	5.0	50.0*
421-512 MHz	6.25	0.5	1.0	1.0
	12.5	1.5	2.5	2.5
	25	2.5	5.0	5.0

• Stations operating in the 154.45 to 154.49 MHz or the 173.2 to 173.4 MHz bands must have a frequency stability of 5 ppm.
 • Paging transmitters operating on paging-only frequencies must operate with frequency stability of 5 ppm in the 150-174 MHz band and 2.5 ppm in the 421-512 MHz band.

7.4. Test Procedure

The frequency stability was measured per ANSI/TIA 603-C: 2004

7.5. Uncertainty

The measurement uncertainty is defined as ± 150 Hz

7.6. Test Result

Product	Repeater		
Test Item	Frequency Stability		
Test Mode	Mode 1: Transmit-421MHz		
Date of Test	2015/05/27	Test Site	SR7

Temperature Interval (°C)	DC Voltage (V)	Frequency (MHz)	Deviation (ppm)	Result
-30	13.80	421.000045	0.1069	PASS
-20		421.000022	0.0523	PASS
-10		421.000000	0.0000	PASS
0		420.999989	-0.0261	PASS
10		420.999991	-0.0214	PASS
20		420.999992	-0.0190	PASS
30		420.999977	-0.0546	PASS
40		420.999967	-0.0784	PASS
50		420.999960	-0.0950	PASS

Temperature Interval (°C)	DC Voltage (V)	Frequency (MHz)	Deviation (ppm)	Result
25	15.87	420.999995	-0.0119	PASS
	13.80	420.999998	-0.0048	PASS
	11.73	420.999995	-0.0119	PASS

Product	Repeater		
Test Item	Frequency Stability		
Test Mode	Mode 1: Transmit-450MHz		
Date of Test	2015/05/27	Test Site	SR7

Temperature Interval (°C)	DC Voltage (V)	Frequency (MHz)	Deviation (ppm)	Result
-30	13.80	450.000043	0.0956	PASS
-20		450.000020	0.0444	PASS
-10		450.000011	0.0244	PASS
0		449.999986	-0.0311	PASS
10		449.999990	-0.0222	PASS
20		449.999976	-0.0533	PASS
30		449.999963	-0.0822	PASS
40		449.999963	-0.0822	PASS
50		449.999948	-0.1156	PASS

Temperature Interval (°C)	DC Voltage (V)	Frequency (MHz)	Deviation (ppm)	Result
25	15.87	449.999997	-0.0067	PASS
	13.80	449.999999	-0.0022	PASS
	11.73	449.999997	-0.0067	PASS

Product	Repeater		
Test Item	Frequency Stability		
Test Mode	Mode 1: Transmit-470MHz		
Date of Test	2015/05/27	Test Site	SR7

Temperature Interval (°C)	DC Voltage (V)	Frequency (MHz)	Deviation (ppm)	Result
-30	13.80	470.000041	0.0872	PASS
-20		470.000015	0.0319	PASS
-10		470.000011	0.0234	PASS
0		469.999997	-0.0064	PASS
10		469.999997	-0.0064	PASS
20		469.999990	-0.0213	PASS
30		469.999967	-0.0702	PASS
40		469.999951	-0.1043	PASS
50		469.999888	-0.2383	PASS

Temperature Interval (°C)	DC Voltage (V)	Frequency (MHz)	Deviation (ppm)	Result
25	15.87	469.999999	-0.0021	PASS
	13.80	469.999997	-0.0064	PASS
	11.73	469.999998	-0.0043	PASS

8. Transient Frequency Behavior

8.1. Test Equipment

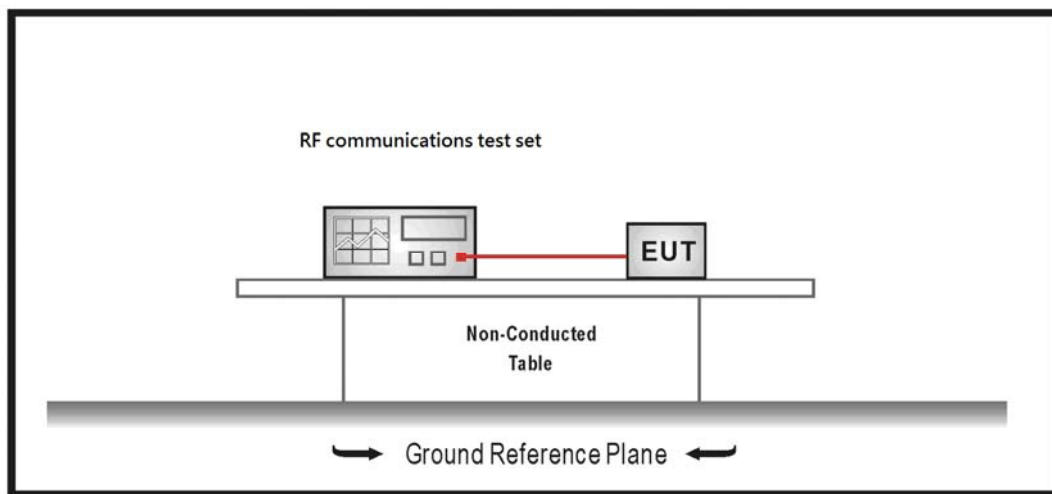
The following test equipments are used during the radiated emission tests:

Transient Frequency Behavior / SR7

Instrument	Manufacturer	Model No.	Serial No	Next Cal. Date
RF-communications Test set	HP	8920A	3614A08091	2015/04/27
Receiver	Agilent	N9038A	MY53220121	2015/07/26

Note: 1. All equipments that need to calibrate are with calibration period of 1 year.

8.2. Test Setup



8.3. Limits

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

Time Intervals	Maximum frequency difference	All Equipment	
		150-174 MHz	421-512 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

- (1) t_{on} is the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.
 t_1 is the time period immediately following t_{on} .
 t_2 is the time period immediately following t_1 .
 t_3 is the time period from the instant when the transmitter is turned off until t_{off} .
 t_{off} is the instant when the 1kHz 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 6watts or less, the frequency difference during this time may exceed the maximum frequency difference for this period.

8.4. Test Procedure

The test procedure was ANSI/TIA 603-C: 2004. Using the variable attenuator. The transmitter level was set to 40 dB below the test receivers maximum input level. Then the transmitter was turned off. With the transmitter off the signal generator was set 20dB below the level of the transmitter in the above step, this level will be maintained with the signal generator through-out the test.

Reduce the attenuation between the transmitter and the RF detector by 30 dB.

With the levels set as above the transient frequency behavior was observed

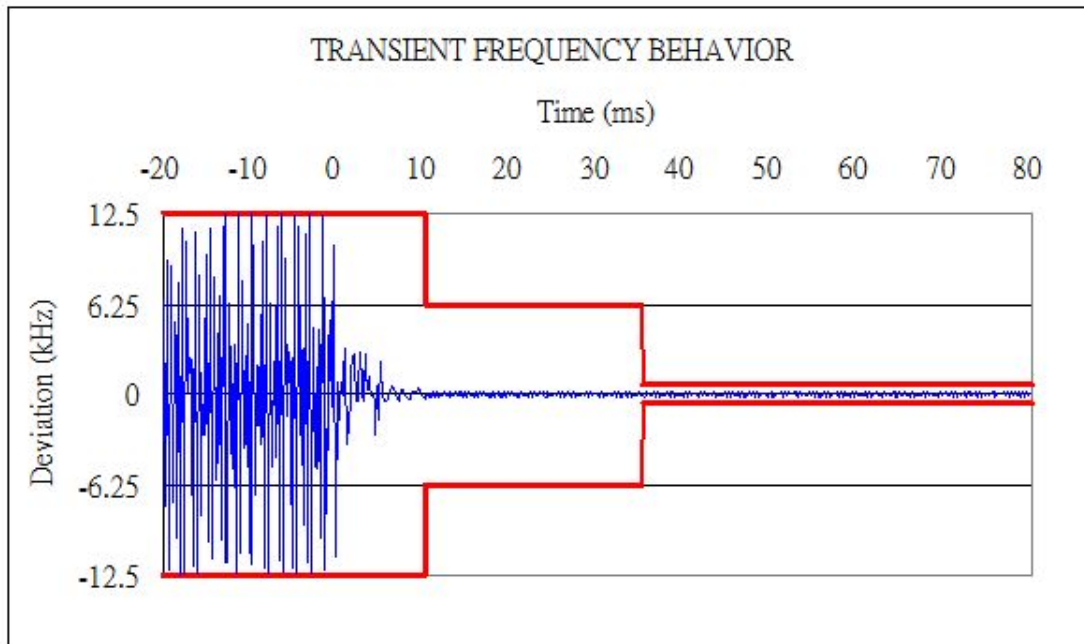
8.5. Uncertainty

The measurement uncertainty is defined as ± 150 Hz

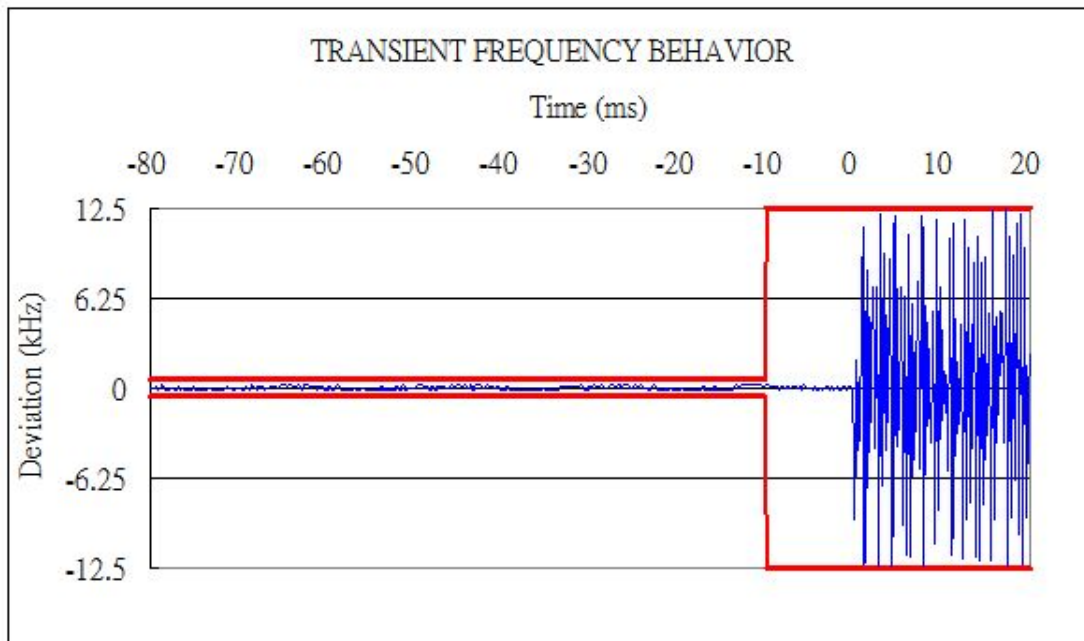
8.6. Test Result

Product	Repeater		
Test Item	Transient Frequency Behavior		
Test Mode	Mode 1: Transmit		
Date of Test	2015/01/04	Test Site	SR7

Channel Spacing 12.5 kHz Bandwidth On

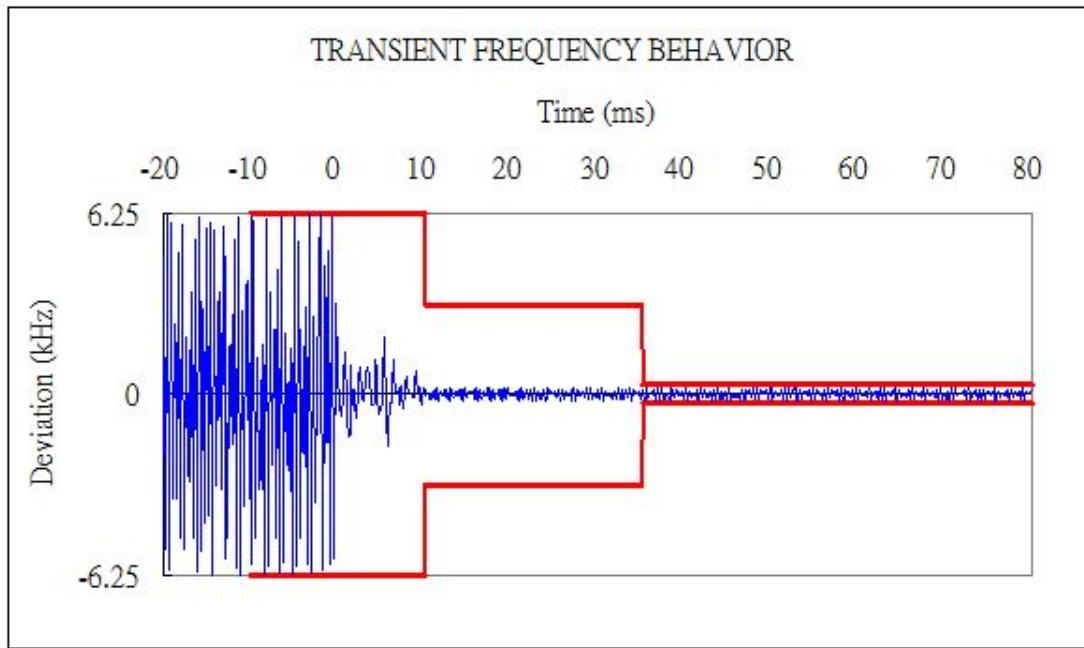


Channel Spacing 12.5 kHz Bandwidth Off



Product	Repeater		
Test Item	Transient Frequency Behavior		
Test Mode	Mode 1: Transmit		
Date of Test	2015/01/04	Test Site	SR7

Channel Spacing 6.25 kHz Bandwidth On



Channel Spacing 6.25 kHz Bandwidth Off

