TEST REPORT For FCC

Test Report No.	: TK-FR10039
Date of Issue	: 10/15/2010
FCC ID	: XTZRCL-T800
Description of Product	: Boomerang Transmitter
Model No.	: RCL-T800
Applicant	: **RCL KOREA** 1566 Joong San-dong Ilsang dong-gu, Goyang City Gyeonggi-do Korea
Manufacturer	: **RCL KOREA** 1566 Joong San-dong Ilsang dong-gu, Goyang City Gyeonggi-do Korea
Standards	: FCC Part90
Test Date	: 10/07/2010 - 10/15/2010
Test Results	: ☒ PASS ☐ FAIL

The test results relate only to the items tested.

Tested by:
Kyu-Chul Shin
Test Engineer
Date:10/15/2010

Reviewed by:
KT Kang
Technical Manager
Date: 10/15/2010

THRU-KES CO.,LTD.
477-6, Hager-Ri, Yoju-Up, Yoju-Gun Kyunggi-Do,469-803, Korea
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TABLE OF CONTENTS

1.0 General Product Description

EUT Type	:	Boomerang TX
FCC Rule Part(s)	:	§2; §15; §90
Model name	:	RCL-T800
Serial number	:	Identical prototype
Tx Freq. Range	:	450.0250 ~ 469.965 MHz
Channel Space Bandwidth		12.5kHz
Type of Modulation	:	10K2F1D
Frequency Tolerance:	:	± 0.00025 % (2.5ppm)
Maximum Output Power	:	Conducted: 1.92W
Power Source	:	12 Vdc
Antenna type	:	Whip antenna Gain: 0.33dBi

1.1 Tested Frequency

	LOW	MID	HIGH
Frequency (MHz)	450.025	457.575	469.965

1.2 Power Input into the Final Amplifier

DC Voltages and currents info the final amplifier :
Vce : 12 volts

1.3 Model Differences

None

1.4 Device Modifications

The following modifications were necessary for compliance:
Not applicable

1.5 Peripheral Devices

Device	Manufacturer	Model No.	Serial No.
E U T	R C L K O R E A	RCL-T800	-

1.6 Calibration Details of Equipment Used for Measurement

Test equipment and test accessories are calibrated on regular basis. The maximum time between calibrations is one year or what is recommended by the manufacturer, whichever is less. All test equipment calibrations are traceable to RRA & HCT, therefore, all test data recorded in this report is traceable to RRA & HCT.

1.7 Test Facility

The measurement facility is located at 477-6, Hager-Ri, Yoju-Up, Yoju-Gun Kyunggi-Do,469-803, Korea. Tel: +82-31-883-5092/Fax: +82-31-883-5169. The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.

1.8 Laboratory Accreditations and Listings

Country	Agency	Scope of Accreditation	Logo
USA	**FCC**	3 & 10 meter Open Area Test Sites and one conducted site to perform FCC Part 15/18 measurements.	343818
KOREA	**KCC**	EMI (10 meter Open Area Test Site and two conducted sites) Radio(3 & 10 meter Open Area Test Sites and one conducted site)	KR100
Canada	**IC**	3 & 10 meter Open Area Test Sites and one conducted site	4769B-1

2.0 Summary of tests

FCC Part Section(s)	Parameter	Test Condition	Status (note 1)
90.205	Power Limit	Conducted	C
90.207	Type of Emission		C
90.209	Bandwidth Limitation		C
90.210	Emissions Mask		C
2.1057	Transmitter Spurious Conducted Emission		C
90.213	Frequency Stability		C
90.214	Transient Frequency Behavior		C
90.210	Field Strength of Spurious Radiation	Radiated	C

Note 1: C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable

Note 2: The data in this test report are traceable to the national or international standards.

The sample was tested according to the following specification:

2.1 Technical Characteristic Test

2.1.1 Power Limit

90.205(h) 450–470 MHz:
The maximum allowable station effective radiated power(ERP) is dependent upon the station's antenna HAAT and required service area and will be authorized in accordance with table 2. (I.e. 2W for service area less than 3 km.)
Table 2-450-470 MHz-Maximum ERP/Reference HAAT for a Specific Service Area Radius

Service area radius (km)										
	3	8	13	16	24	32	40	48	64	80
Max. ERP(W)1	2	100	500	500	500	500	500	500	500	500
Up to reference HAAT (m)3	15	15	15	27	63	125	250	410	950	2700

1 Maximum ERP indicated provides for a 39 dBu signal strength at the edge of the service area per FCCReport R-6602, Fig. 29 (See Sec. 73.699, Fig. 10 b).
3 When the actual antenna HAAT is greater than the reference HAAT, the allowable ERP will be reducedin accordance with the following equation:
ERP allow = ERPmax X (HAATref / HAATactual)

Test Setup Layout

CONDUCTED OUTPUT POWER

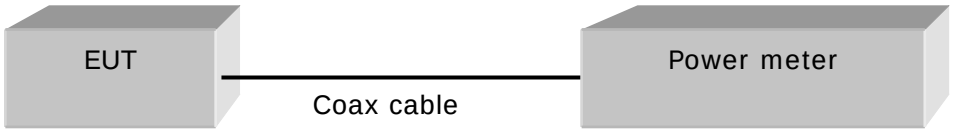


Figure 1 : Measurement setup for the carrier frequency seperation

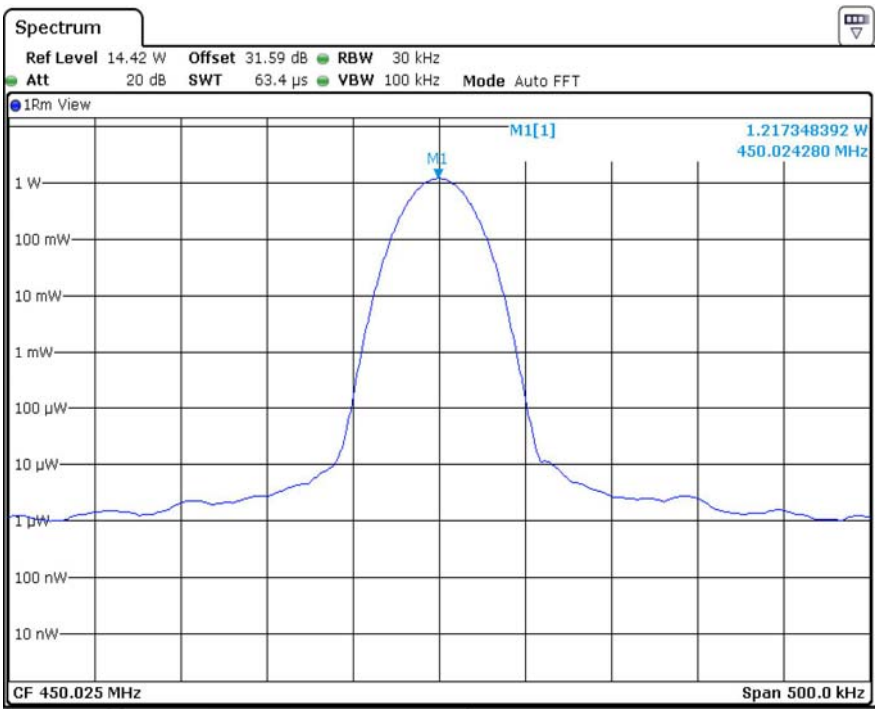
Limit : 2Watts

Test Results

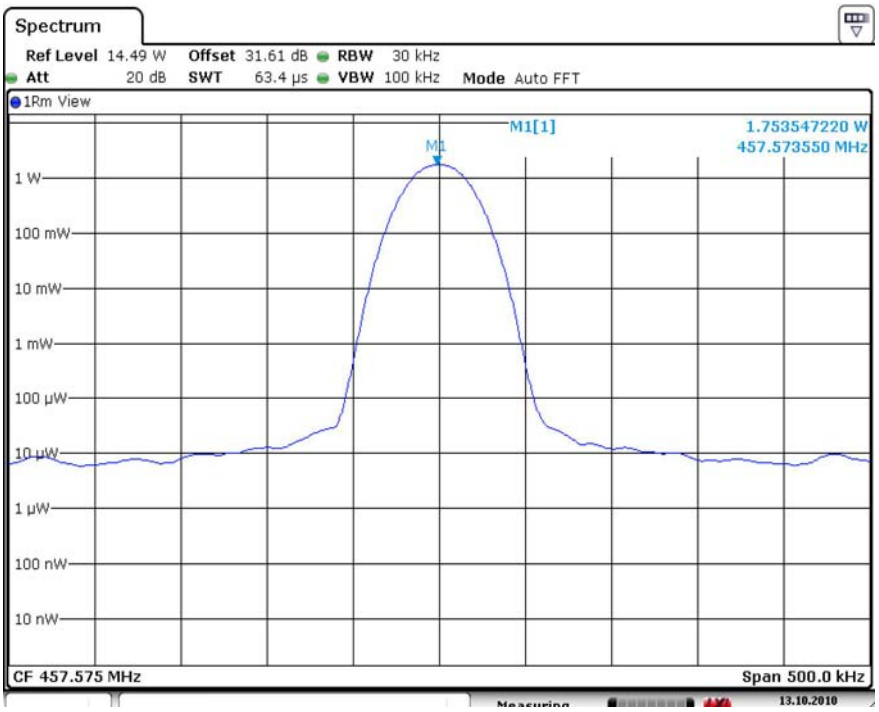
CONDUCTED OUTPUT POWER

Frequency (MHz)	Peak output power(dBm)	Peak output power(W)	Result
450.025	32.15	1.21	Complies
457.575	32.38	1.75	Complies
469.965	32.28	1.92	Complies

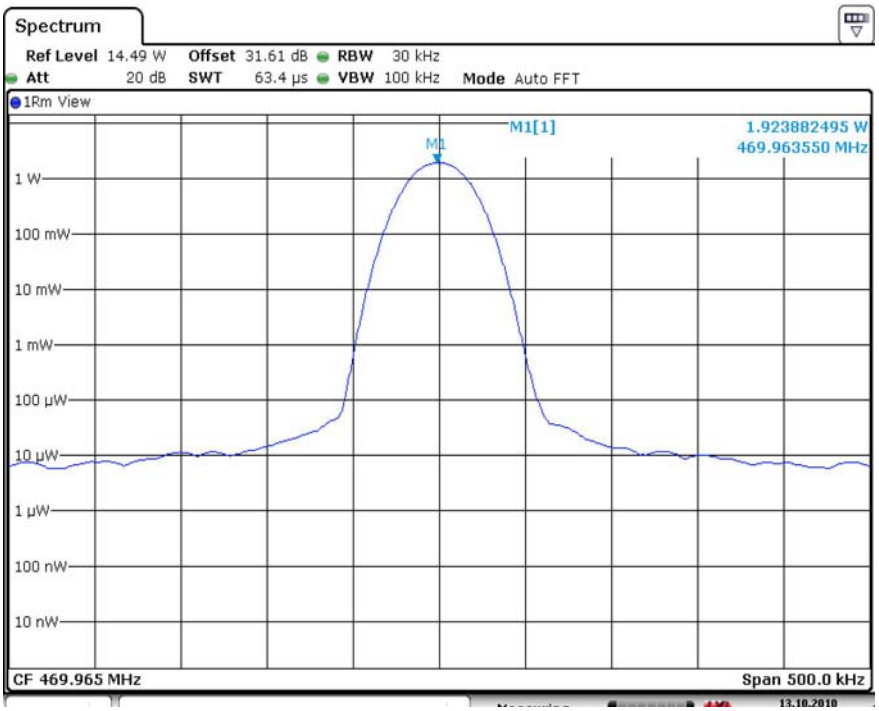
Low Frequency



Mid Frequency



High Frequency



2.1.2 Type of Emission

90.207(e):
For non-voice paging operations, only A1A, A1D, A2B, A2D, F1B, F1D,F2B, F2D, G1B, G1D, G2B, or G2D emissions will be authorized.

RCL-T800 : F1D

This equipment is a non-voice only paging operations

This equipment does not have audio low pass filter

2.1003 (4) Type of Emission : 10K2F1D

Bn =2M +2DK
M = 1200 bits per second
D = 4.5 KHz (Peak Deviation)
K = 1
Bn = 2(1200bps/2) + 2(4500) = 10.2k

2.1.3 Banddwidth Limitation

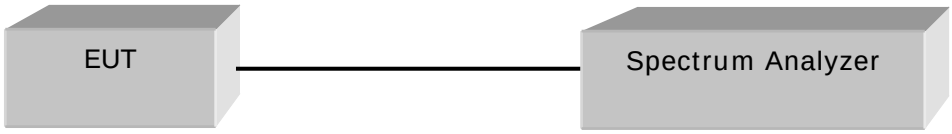
90.209.b.(3):
For all other types of emissions, the maximum authorized bandwidth shall not be more than that normally authorized for voice operations.
According to 90.209.b.(5), unless specified elsewhere, channel spacings and bandwidths that willbe authorized in the following frequency bands are given in the following "STANDARDCHANNEL SPACING/BANDWIDTH" table.

Standard Channel Spacing/Bandwidth

Frequency band (MHz)	Channel spacing (kHz)	Authorized bandwidth (kHz)
Below 25		
25-50.	20	20
72-76	20	20
150-174	17.5	1,320/11.25/6
220-222	5	4
406-512	6.25	20/11.25/6
806-809/851-854	12.5	20
809-824/854-869	25	20
896-901/935-940	12.5	13.6
902-928		
929-930	25	20
1427-1432.....12.5		12.5
2450-2483.5.....		
Above 2500.....		

1) For stations authorized on or after August 18, 1995.
3) Operations using equipment designed to operate with a 25 kHz channel bandwidth will be authorized a20 kHz bandwidth. Operations using equipment designed to operate with a 12.5 kHz channel bandwidth will be authorized an 11.25 kHz bandwidth. Operations using equipment designed to operate with a 6.25kHz channel bandwidth will be authorized a 6 kHz bandwidth. All stations must operate on channels with a band-width of 1.5KHz or less beginning January 1,2013, unless the operations meet the efficiency standard of 90.203(j)(3).

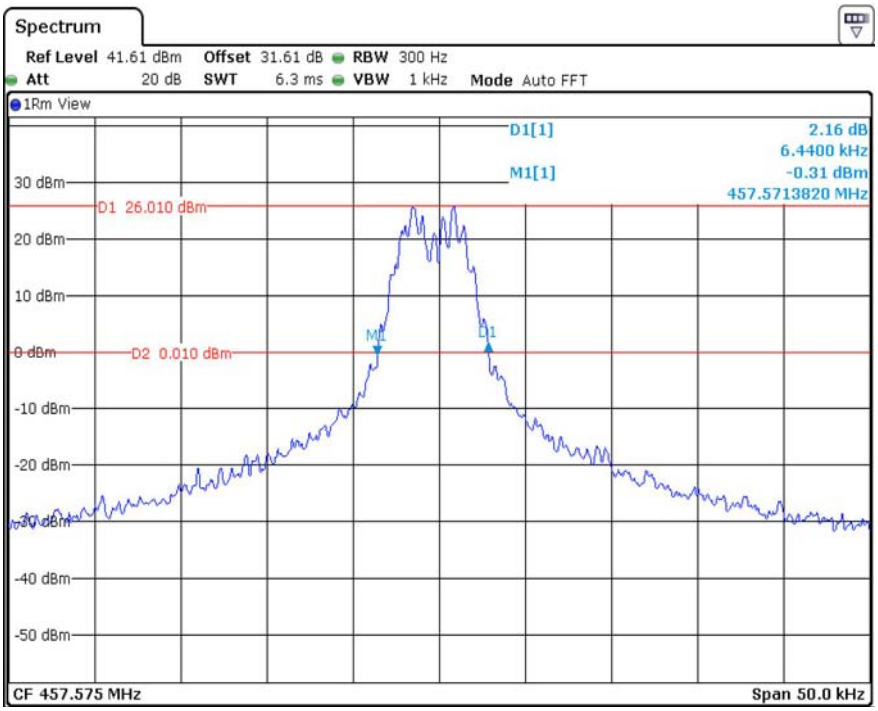
Test Setup Layout



Limit

11.25kHz

Mid Frequency



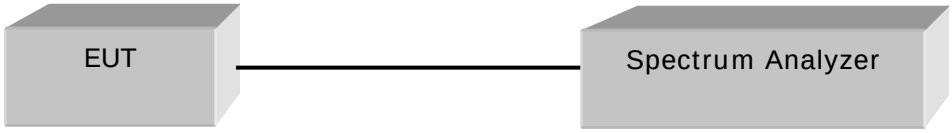
2.1.4 Emissions Mask

* This equipment without audio low pass filter
* This equipment Paging-only

90.210(g) Emission Mask G.

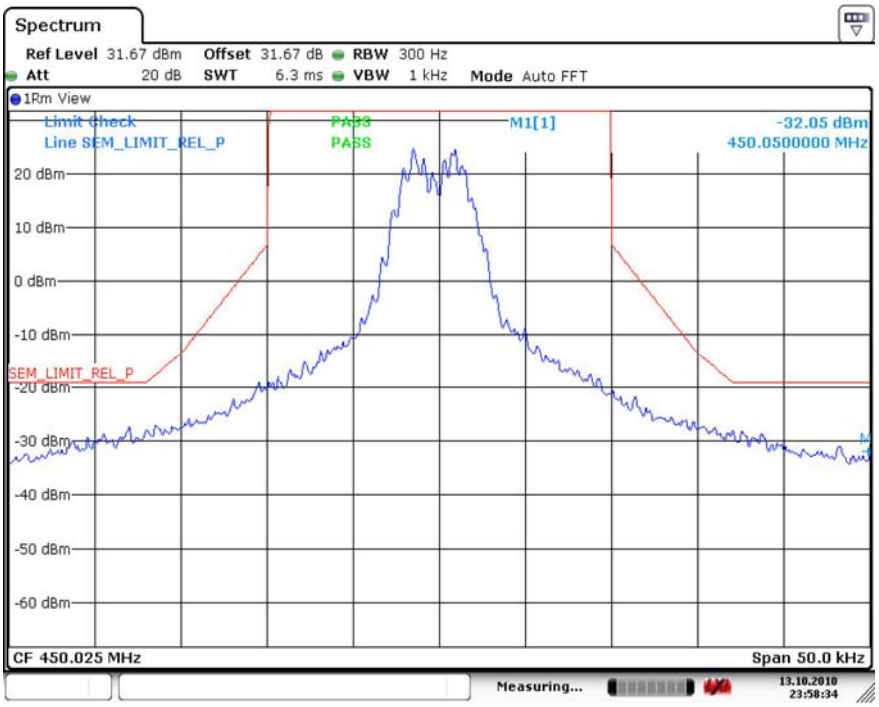
(g)Emission Mask G For transmitters that are not equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:
(1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in KHz) of more than 10 kHz, but no more than 250 percent of the authorized band-width: At least 116log (fd /6.1) dB or 50+10log(P) dB or 70dB, whichever is the lesser attenuation;
(2) On any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

Test Setup Layout

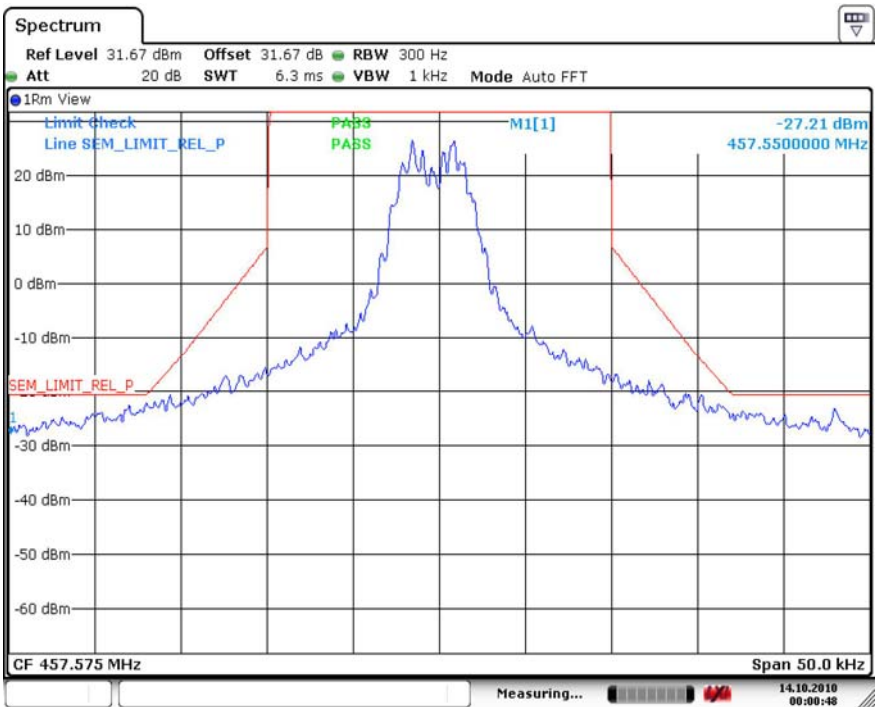


See next pages for actual measured spectrum plots.

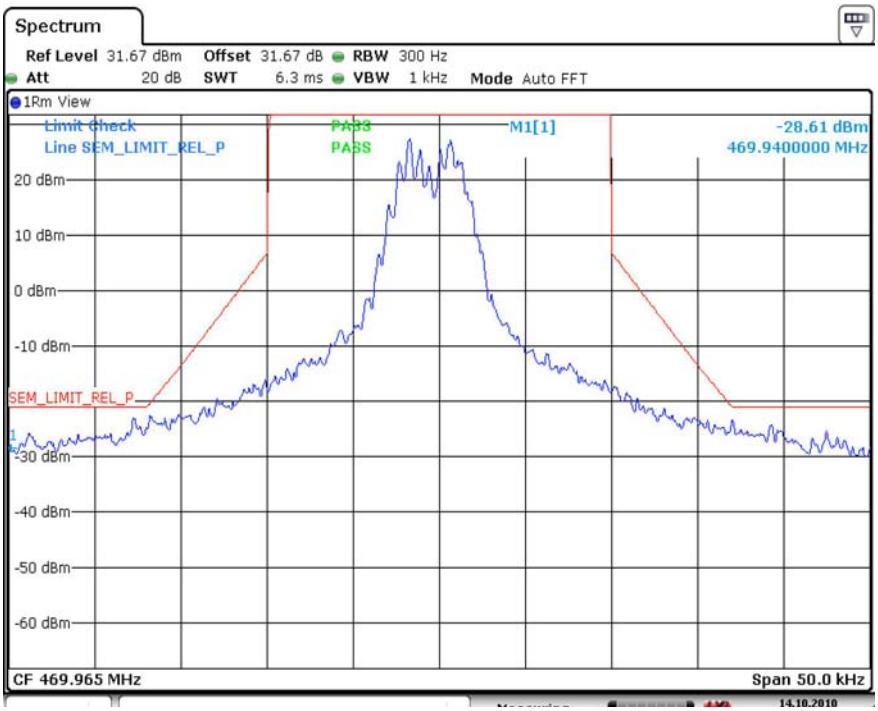
Low Frequency



Mid Frequency



High Frequency

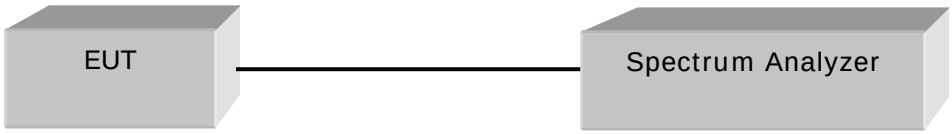


2.1.5 Transmitter Spurious Conducted Emission

2.1057 Frequency spectrum to be investigated.
(a) In all of the measurements set forth in 2.1051 and 2.1053, the spectrum shall be investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz, up to at least the frequency shown below:
(1) If the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

The spectrum analyzer is set to:
Center frequency = the highest, middle, and the lowest channels
RBW = 100 kHz
VBW = 100 kHz (≥ RBW)
Span = 100 MHz
Trace = max hold
Detector function = peak
Sweep = auto

Test Setup Layout

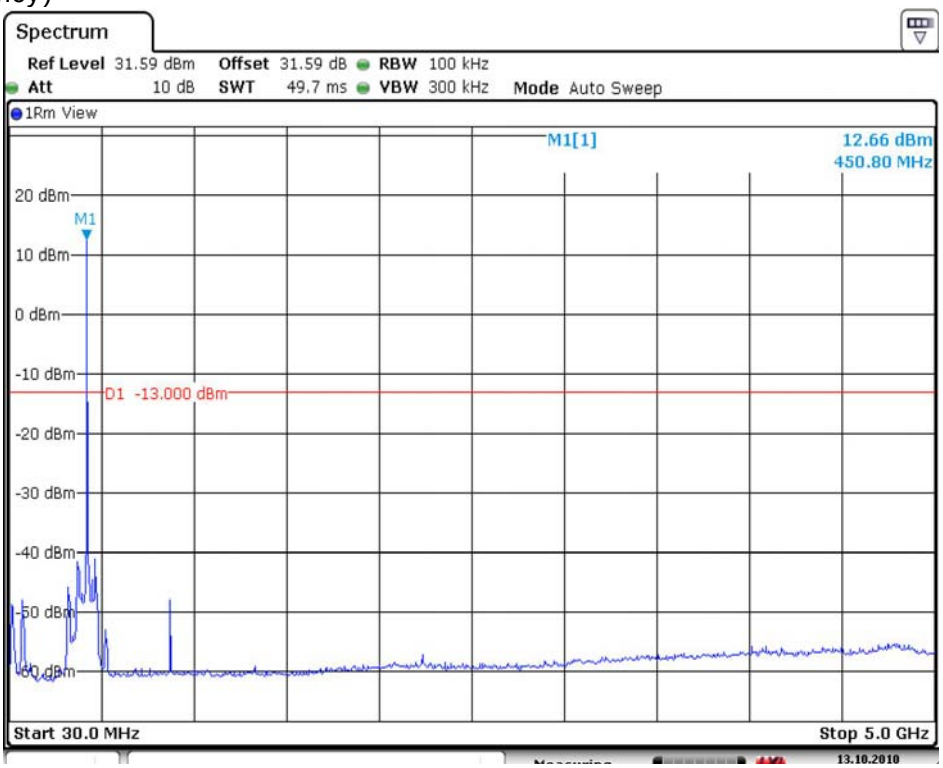


Limit

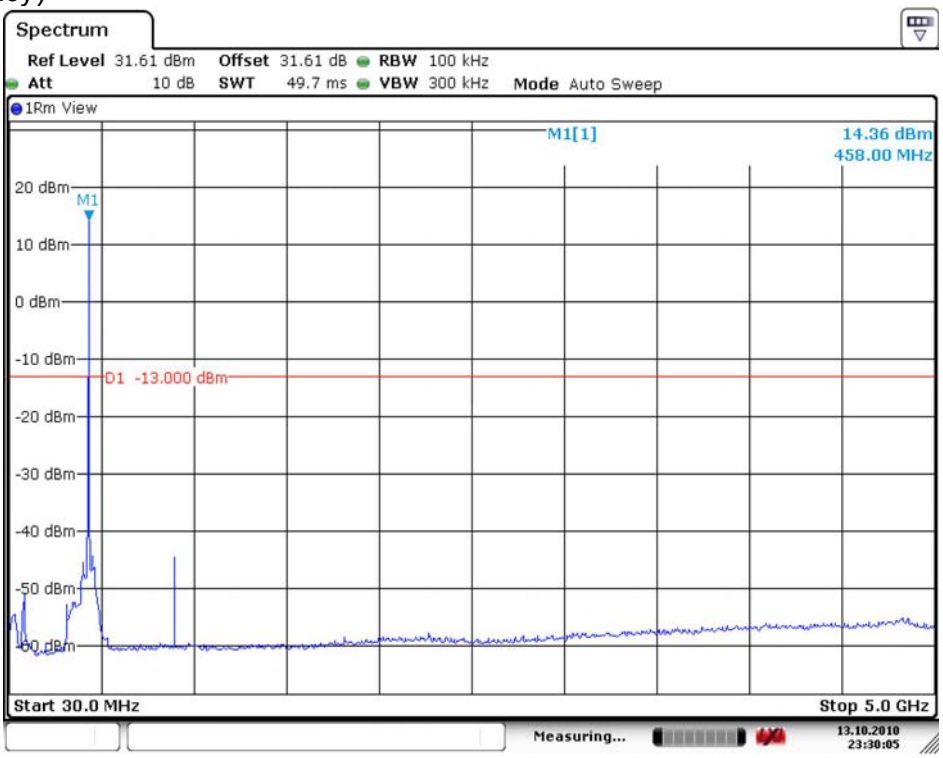
-13dBm

See next pages for actual measured spectrum plots.

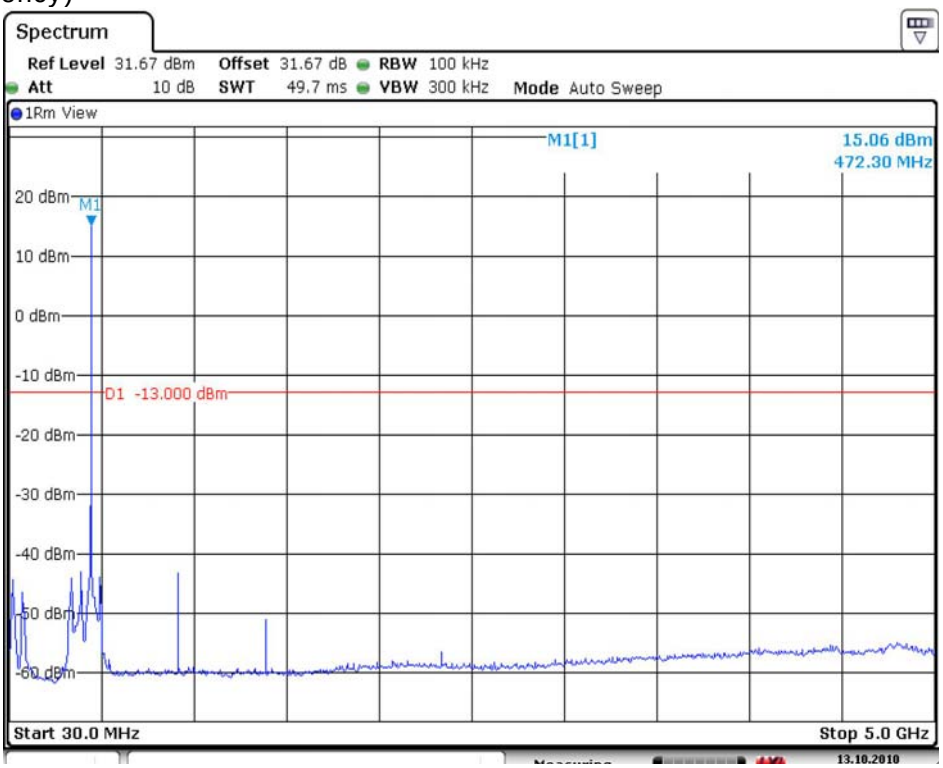
(Low Frequency)



(Mid Frequency)



(High Frequency)



2.1.6 Frequency Stability

90.213 : Frequency Stability

Minimum Frequency Stability[Parts per million (ppm)

Frequency range (MHz)	Fixed and base Stations	Mobile Stations	
		Over 2W output power	2 watts or less output power
Below 25	[1,13]100	100	100
25-50	20	20	50
72-76	5	-	50
150-174	[5,11,]5	[6,]5	[5,6]50
220-222	0.1	1.5	1.5
421-512	[7,11,15]2.5	[8]5	[8]5
806-821	[15]1.5	2.5	2.5
821-824	[15]1.0	1.5	1.5
851-866	1.5	2.5	2.5
866-869	1.0	1.5	1.5
896-901	[15]0.1	1.5	1.5
902-928	2.5	2.5	2.5
902-928	2.5	2.5	2.5
929-930	1.5	-	-
935-940	0.1	1.5	1.5
1427-1435	[9]300	300	300
Above 2450	-	-	-

1 Fixed and base stations with over 200 watts transmitter power must have a frequency stability of 50 ppm except for equipment used in the Public Safety Pool where the frequency stability is 100 ppm.
2 For single sideband operations below 25 MHz, the carrier frequency must be maintained within 50 Hz of the authorized carrier frequency.
3 Travelers information station transmitters operating from 530–1700 kHz and transmitters exceeding 200 watts peak envelope power used for disaster communications and long distance circuit operations pursuant to §§ 90.242 and 90.264must maintain the carrier frequency to within 20 Hz of the authorized frequency.
4 Stations operating in the 154.45 to 154.49 MHz or the 173.2 to 173.4 MHz bands must have a frequency stability of5 ppm.
5 In the 150–174 MHz band, fixed and base stations with a 12.5 kHz channel bandwidth must have a frequency stability of 2.5 ppm. Fixed and base stations with a 6.25 kHz channel bandwidth must have a frequency stability of 1.0 ppm.
6 In the 150–174 MHz band, mobile stations designed to operate with a 12.5 kHz channel bandwidth or designed to operate on a frequency specifically designated for itinerant use or designed for low-power operation of two watts or less, must have a frequency stability of 5.0 ppm. Mobile stations de-signed to operate with a 6.25 kHz channel bandwidth must have a frequency stability of 2.0 ppm.
7 In the 421–512 MHz band, fixed and base stations with a 12.5 kHz channel bandwidth must have a frequency stability of 1.5 ppm. Fixed and base stations with a 6.25 kHz channel bandwidth must have a frequency stability of 0.5 ppm.
8 In the 421–512 MHz band, mobile stations designed to operate with a 12.5 kHz channel bandwidth must have a frequency stability of 2.5 ppm. Mobile stations designed to operate with a 6.25 kHz channel bandwidth must have afrequency stability of 1.0 ppm.
9 Fixed stations with output powers above 120 watts and necessary bandwidth less than 3 kHz must operate with a frequency stability of 100 ppm. Fixed stations with output powers less than 120 watts and using time-division multiplex, must operate with a frequency stability of 500 ppm.

10 Frequency stability to be specified in the station authorization.
11 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.
12 Mobile units may utilize synchronizing signals from associated base stations to achieve the specified carrier stability.

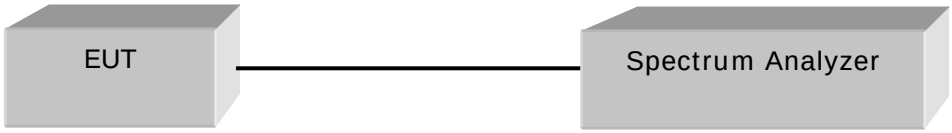
13 Fixed non-multilateration transmitters with an authorized bandwidth that is more than 40 kHz from the band edge, intermittently operated hand-held readers, and mobile transponders are not subject to frequency tolerance restrictions.
14 Control stations may operate with the frequency tolerance specified for associated mobile frequencies.

(a) Unless noted elsewhere, transmitters used in the services governed by this part must have minimum frequency stability as specified in the following table.

8 In the 421-512 MHz band, mobile stations designed to operate with a 12.5 kHz channel bandwidth must have a frequency stability of 2.5 ppm. Mobile stations designed to operate with a 6.25 kHz channel bandwidth must have a frequency stability of 1.0 ppm.

(b) For the purpose of determining the frequency stability limits, the power of a transmitter is considered to be the maximum rated output power as specified by the manufacturer.

Test Setup Layout



TEST Results:

Assigned Frequency (Ref. Frequency) : 450.025MHz

TEMPERATURE	FREQUENCY(MHz)	PPM	LIMIT(ppm)	비 고
-30	457.574341	1.44	2.5	**pass**
-20	457.574355	1.41	2.5	**pass**
-10	457.574355	1.41	2.5	**pass**
0	457.574442	1.22	2.5	**pass**
10	457.574457	1.19	2.5	**pass**
20	457.574522	1.04	2.5	**pass**
30	457.574536	1.01	2.5	**pass**
40	457.574565	0.95	2.5	**pass**
50	457.574544	1.00	2.5	**pass**
+15% Battery : 13.8V	457.574459	1.18	2.5	**pass**
-15% Battery : 10.2V	457.574459	1.18	2.5	**pass**

Limit
2.5ppm

2.1.7 TRANSIENT FREQUENCY BEHAVIOR

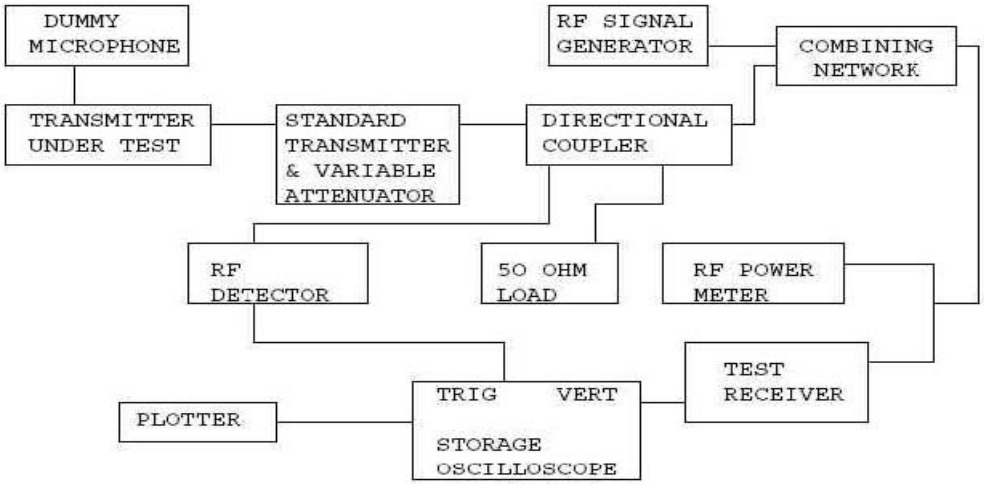
90.214 : Transient Frequency Behavior

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	Maximum Frequency Difference	All Equipment	
		150 to 174MHz	421 to 512MHz
Transient frequency Behavior for Equipment Designed to Operate on 25kHz 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 12.5kHz 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 6.25kHz 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 ton is the instant when a 1 kHz test signal is completely suppressed, including any capture time due tophasing.
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
t1. is the time period immediately following ton
t2 is the time period immediately following
t3 is the time period immediately before to ff

Test Setup Layout

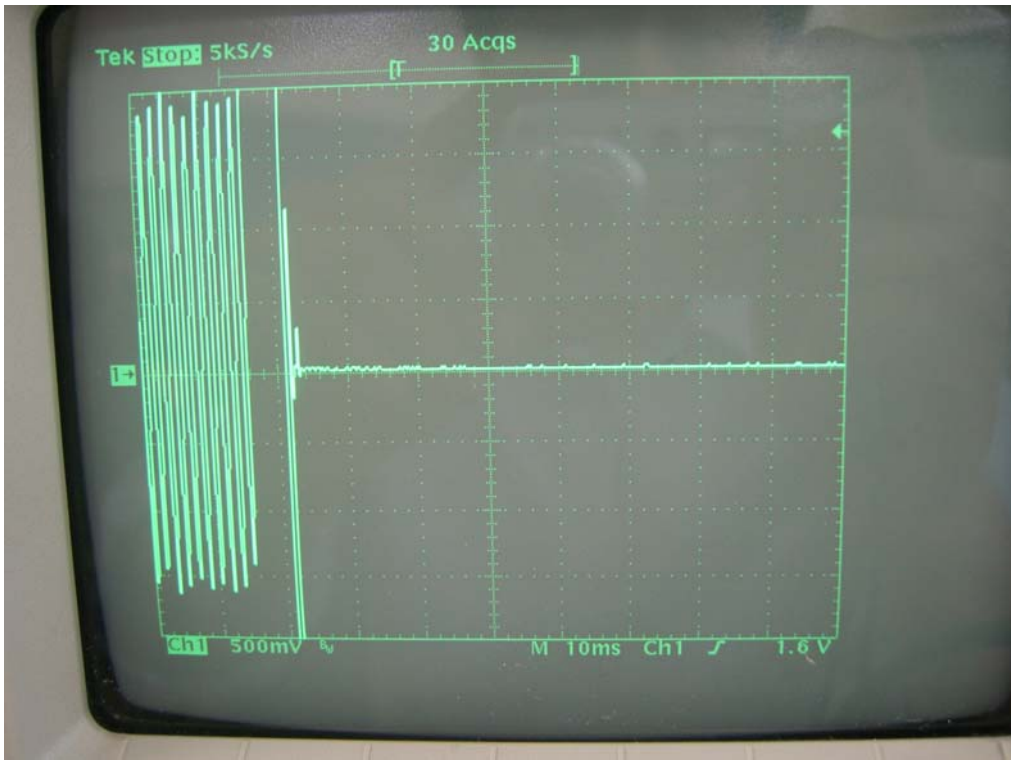


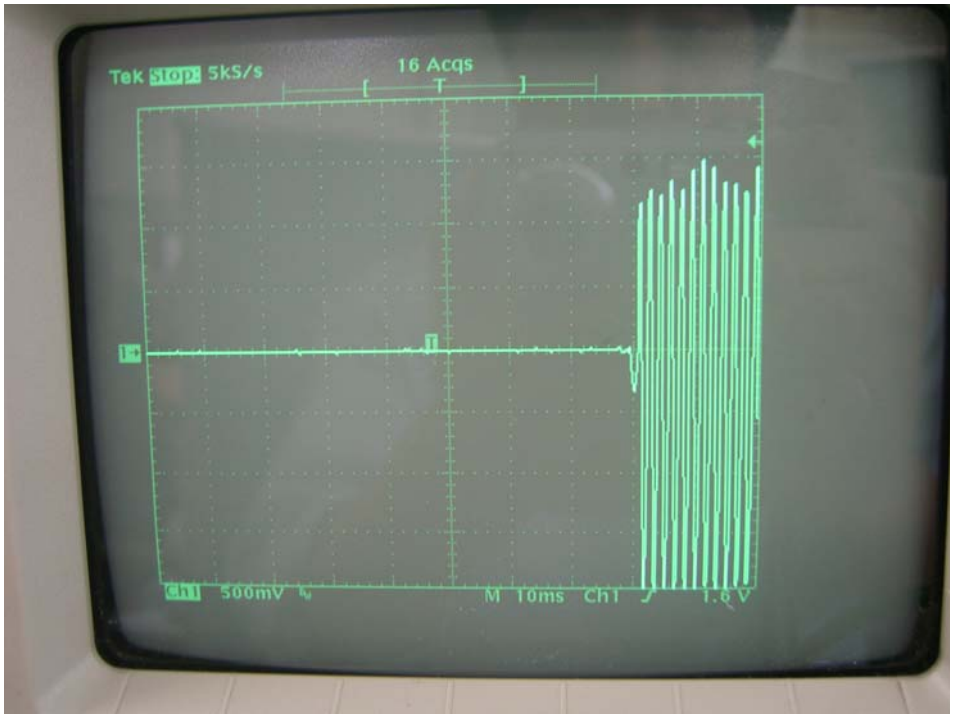
Limit

t2=25ms; during time interval t2 the maximum frequency different=±6.25KHz

See next pages for actual measured spectrum plots.

TRANSIENT FREQUENCY BEHAVIOR





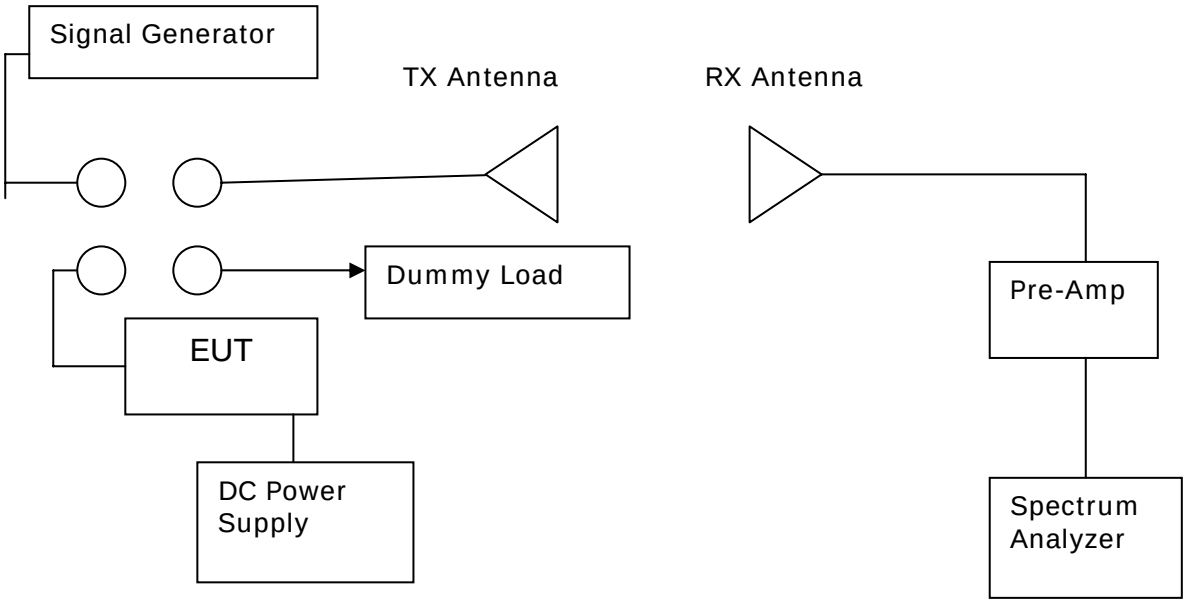
2.1.8 Field Strength of Surious Radiation

REGULATIONS : 2.1053 , 90.210
TEST METHOD/GUIDE : ANSI/TIA-603-C

Test Procedure

1. Adjust the spectrum analyzer for the following Setting:
   a) WBW : 10kHz(<1GHz), 1MHz(>1GHz).
   b) VBW : 300kHz(<1GHz), 3MHz(>1GHz).
   C) Sweep Speed : 50mS
   d) Detector mode : Positive Peak
2. The transmitter was placed on a wooden turntable, and it was transmitting into non-radiation load which was also placed on the turntable.
3. The measurement antenna was placed at a distance of 3meters from the EUT. During test, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT The test was performed by placing the EUT on 3-orthogonal axis.
4. The frequency range up to tenth harmonic of the fundamental frequency was investigated.
5. Remove the EUT and replace it with substitution antenna A signal generator was connected to the substitution antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution.

Measuring Equipment Configuration



Test result : Low Frequency : **43 +10LOG(1.21)=43.82 dB**

Frequency (MHz)	Pol	Reading (dBm)	ERP measured (dBm)	Limit (dBc)
900.036	V	-28.49	-27.67	43.82
1350.069	V	-22.18	-18.09	43.82
1800.109	V	-42.91	-28.91	43.82
2250.116	V	-43.75	-26.31	43.82
3150.173	V	-42.33	-23.68	43.82
3600.196	V	-51.70	-34.52	43.82

Test result : mid Frequency : **43 +10LOG(1.75)=45.43 dB**

Frequency (MHz)	Pol	Reading (dBm)	ERP measured (dBm)	Limit (dBc)
915.149	V	-28.12	-27.62	45.43
1372.720	V	-24.02	-18.58	45.43
1830.300	V	-43.52	-30.21	45.43
2287.891	V	-43.41	-26.92	45.43
2745.464	V	-50.06	-33.53	45.43
3203.018	V	-48.74	-30.81	45.43
3660.591	V	-52.57	-34.49	45.43

Test result : High Frequency : **43 +10LOG(1.92)=45.83 dB**

Frequency (MHz)	Pol	Reading (dBm)	ERP measured (dBm)	Limit (dBc)
939.936	V	-32.17	-30.99	45.83
1.409902	V	-24.07	-19.00	45.83
1.879873	V	-40.04	-26.80	45.83
2.349818	V	-39.18	-22.19	45.83
2.819782	V	-53.09	-45.15	45.83
3.289745	V	-49.48	-31.14	45.83
939.936	V	-58.13	-40.37	45.83

APPENDIX A – Test Equipment Used For Tests

c	Description	Manufacturer	Model No.	Serial No.	Due Cal.
1	Test Receiver	Rohde & Schwarz	ESHS 10	862970/018	2011.05.06
2	Test Receiver	Rohde & Schwarz	ESVS 10	826008/014	2011.05.06
3	Spectrum Analyzer	Hewlett Packard	8566B	2311A02394	2011.05.06
4	Spectrum Analyzer	Rohde & Schwarz	FSV30	100736	2010.12.01
5	Modulation Analyzer	Hewlett Packard	8901B	3438A05094	2011.05.06
6	Audio analyzer	Hewlett Packard	8903B	3011A12915	2011.05.06
7	Preamplifer	Hewlett Packard	8447F	2805A02570	2011.05.06
8	Preamplifer	A.H. Systems	PAM-0118	164	2011.05.06
9	Signal Generator	Hewlett Packard	8673D	2708A00448	2011.05.06
10	Power Meter	Hewlett Packard	437B	312U24787	2011.05.06
11	Power Sensor	Hewlett Packard	8482B	3318A06943	2011.05.06
12	Loop Antenna	Rohde & Schwarz	HFH2-Z2.335.4711.52	826532/006	2011.02.06
13	Dipole Antenna	Rohde & Schwarz	VHAP	574	2011.07.07
14	Dipole Antenna	Rohde & Schwarz	VHAP	575	2011.07.17
15	Dipole Antenna	Rohde & Schwarz	UHAP	545	2011.07.17
16	Dipole Antenna	Rohde & Schwarz	UHAP	546	2011.07.07
17	Biconical Antenna	Eaton Corp.	94455-1	0977	2011.07.03
18	Biconical Antenna	EMCO	3104C	9111-2468	2011.07.03
19	Log Periodic Antenna	EMCO	3146	2051	2011.06.05
20	Log Periodic Antenna	EMCO	3146	8901-2320	2011.07.03
21	Horn Antenna	A.H. Systems	SAS-571	414	2011.03.16
22	Waveform Generator	Hewlett Packard	33120A	US34001190	2011.05.06
23	Digital Oscilloscope	Tektronix	TDS 340A	B012287	2011.05.06
24	Dummy Load	Bird Electronics	8251	11511	2011.05.06

Test Setup Photo and Configurationb-(Part 90)