ENGINEERING TEST REPORT

MOBEXCOM DVR Vehicular Repeater
Model No.: MOBEXCOM DVR 700

FCC ID: LO6-DVRS700

Applicant:

Futurecom Systems Group Inc
3277 Langstaff Road
Concord, Ontario
Canada, L4K 5P8

Tested in Accordance With

Federal Communications Commission (FCC)
47 CFR, PARTS 2 and 90 (Subpart R)

UltraTech's File No.: FSG-042F90R

This Test report is Issued under the Authority of Tri M. Luu, Professional Engineer, Vice President of Engineering UltraTech Group of Labs Date: June 28, 2005	
Report Prepared by: Dan Huynh Issued Date: June 28, 2005	Tested by: Mr. Hung Trinh, RFI/EMC Technician Test Dates: January 29 - February 13, 2005

- *The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.*
- *This report must not be used by the client to claim product endorsement by NVLAP or any agency of the US Government.*

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EXHIBIT 1. SUBMITTAL CHECK LIST

Annex No.	Exhibit Type	Description of Contents	Quality Check (OK)
--	Test Report	▪ Exhibit 1: Submittal Check lists ▪ Exhibit 2: Introduction ▪ Exhibit 3: Performance Assessment ▪ Exhibit 4: EUT Operation and Configuration during Tests ▪ Exhibit 5: Summary of Test Results ▪ Exhibit 6: Measurement Data ▪ Exhibit 7: Measurement Uncertainty ▪ Exhibit 8: Measurement Methods	OK
1	Test Setup Photos	Test Setup Photos	OK
2	External Photos of EUT	External Photos	OK
3	Internal Photos of EUT	External Photos	OK
4	Cover Letters	▪ Letter from Ultratech Requesting for Certification ▪ Letter from the Applicant to Appoint Ultratech to Act as an Agent ▪ Letter from the Applicant to Request for Confidentiality Filing	OK
5	Attestation Statements	Applicant Part 90 Attestation	OK
6	ID Label/Location Info	▪ ID Label ▪ Location of ID Label	OK
7	Block Diagrams	Block Diagram	OK
8	Schematic Diagrams	Schematics	OK
9	Parts List/Tune Up Info	▪ Parts List ▪ MOBEXCOM DVR Repeater Adjustment and Programming	OK
10	Operational Description	MOBEXCOM DVR Operational Description	OK
11	RF Exposure Info	See Section 6.6 in this test report for MPE evaluation	OK
12	Users Manual	MOBEXCOM DVRS 700MHz Vehicular Repeater User's Manual	OK

EXHIBIT 2. INTRODUCTION

2.1. SCOPE

Reference:	FCC Parts 2 and 90 (Subpart R)
Title:	Code of Federal Regulations (CFR) Title 47 Telecommunication, Parts 2 & 90
Purpose of Test:	To obtain FCC Certification Authorization for Radio operating in the frequency bands 764-776 MHz and 794-806MHz.
Test Procedures:	Both conducted and radiated emissions measurements were conducted in accordance with American National Standards Institute ANSI C63.4 - American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

2.2. RELATED SUBMITTAL(S)/GRANT(S)

None.

2.3. NORMATIVE REFERENCES

Publication	Year	Title
FCC CFR Parts 0-19, 80-End	2004	Code of Federal Regulations – Telecommunication
ANSI C63.4	2003	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
TIA/EIA 603, Edition B	01-Nov-2002	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards

EXHIBIT 3. PERFORMANCE ASSESSMENT

3.1. CLIENT INFORMATION

APPLICANT	
Name:	Futurecom Systems Group Inc.
Address:	3277 Langstaff Road Concord, Ontario Canada L4K 5P8
Contact Person:	Mr. Mike Wyrzykowski Phone #: 905-660-5548 Fax #: 905-660-1380 Email Address: mikew@futurecom.com

MANUFACTURER	
Name:	Futurecom Systems Group Inc.
Address:	3277 Langstaff Road Concord, Ontario Canada, L4K 5P8
Contact Person:	Mr. Mike Wyrzykowski Phone #: 905-660-5548 Fax #: 905-660-1380 Email Address: mikew@futurecom.com

3.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

Brand Name:	Futurecom Systems Group Inc.
Product Name:	MOBEXCOM DVR Vehicular Repeater
Model Name or Number:	MOBEXCOM DVR 700
Serial Number:	Preproduction
Type of Equipment:	Non-broadcast Radio Communication Equipment
External Power Supply:	None
Transmitting/Receiving Antenna Type:	Non-integral
Operational Description:	The Futurecom MOBEXCOM DVR Vehicular Repeater is designed to interface to a range of mobile radios. It permits expanded operation of portable radios. The MOBEXCOM DVR Vehicular Repeater communicates with the mobile radio using a serial data protocol.

3.3. EUT'S TECHNICAL SPECIFICATIONS

Transmitter	
Equipment Type:	Mobile
Intended Operating Environment:	[x] Commercial [x] Light Industry & Heavy Industry
Power Supply Requirement:	13.8 Vdc
RF Output Power Rating:	1 to 20 W
Operating Frequency Range:	764-776 MHz, 794-806 MHz
RF Output Impedance:	50 Ohms
Channel Spacing:	12.5 kHz & 25.0 kHz
Occupied Bandwidth (99%):	▪ 10.10 kHz for 12.5 kHz channel spacing ▪ 15.15 kHz for 25 kHz channel spacing ▪ 7.25 kHz for 12.5 kHz channel spacing (digital)
Emission Designation*:	▪ 11K0F3E for 12.5 kHz channel spacing ▪ 16K0F3E for 25 kHz channel spacing ▪ 7K30F1E for 12.5 / 25 kHz channel spacing (digital)
Oscillator Frequencies:	Digital signal frequencies: 32.768 kHz, 16.0 MHz, 29.4912 MHz, 144.0 MHz and 120 MHz Analogue signal frequency: LO1: Rx Freq - 109.65 MHz (Rx), LO2: 107.85 MHz & LO3: Tx Freq + 110.51875 MHz Reference Oscillator: 14.4 MHz
Antenna Connector Type:	TNC female

* For an average case of commercial telephony, the Necessary Bandwidth is calculated as follows:

For FM Voice Modulation:

Channel Spacing = 12.5 KHz, D = 2.5 KHz max., K = 1, M = 3 KHz
B_n = 2M + 2DK = 2(3) + 2(2.5)(1) = **11 KHz**
emission designation: 11K0F3E

Channel Spacing = 25 KHz, D = 5 KHz max., K = 1, M = 3 KHz
B_n = 2M + 2DK = 2(3) + 2(5)(1) = **16 KHz**
emission designation: 11K0F3E

For FM Digital Modulation:

Channel Spacing = 12.5 KHz, D = 2.5 KHz max., K = 1, M = Data Rate in kb/s / Level of FM,
Level of FM = 4
M = 9.6/4 kb/s
B_n = 2M + 2DK = 2(9.6/4) + 2(2.5)(1) = **7.3 KHz**
emission designation: 7K30F1D

3.4. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	DC Input Port	1	Jack	Non-shielded
2	RF IN/OUT Port	2	TNC	Shielded
3	RS-232 Port	1	9 pin male circular	Non-shielded
4	Mobile Radio Port	1	20 pin male circular	Non-shielded
5	USB	1	USB	Non-shielded

3.5. ANCILLARY EQUIPMENT

The EUT was tested while connected to the following representative configuration of ancillary equipment necessary to exercise the ports during tests:

Ancillary Equipment # 1	
Description:	Laptop Computer
Brand name:	IBM
Model Name or Number:	2625
Serial Number:	78-WWM48
Cable Length & Type:	6 feet shielded cable
Connected to EUT's Port:	RS-232

3.6. TEST ARRANGEMENT

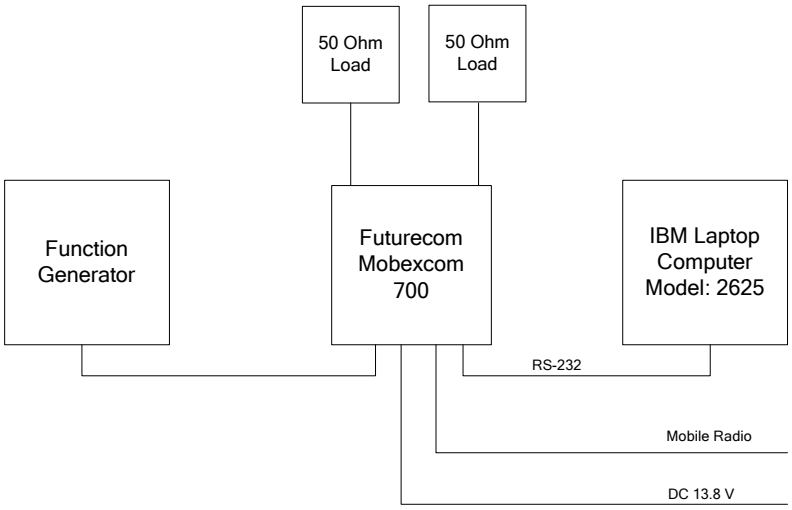


EXHIBIT 4. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

4.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21°C
Humidity:	51%
Pressure:	102 kPa
Power input source:	13.8 Vdc

4.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TEST SIGNALS

Operating Modes:	The transmitter was operated in a continuous transmission mode with the carrier modulated as specified in the Test Data.
Special Test Software:	Operating software provided by Futurecom for selecting operating channel frequency and power
Special Hardware Used:	N/A
Transmitter Test Antenna:	The EUT is tested with the transmitter antenna port terminated to a 50 Ohms RF Load.

Transmitter Test Signals	
Frequency Band(s):	▪ 764-776 MHz ▪ 794-806 MHz
Frequency(ies) Tested: (near top, near middle and near bottom in the frequency range of operation.)	▪ 764 MHz, 770 MHz and 776 MHz ▪ 794 MHz, 800 MHz and 806 MHz
Transmitter Wanted Output Test Signals:	
▪ RF Power Output (measured maximum output power):	20 W
▪ Normal Test Modulation:	FM Data & Voice
▪ Modulating signal source:	external

EXHIBIT 5. SUMMARY OF TEST RESULTS

5.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

- AC Power Line Conducted Emissions were performed in UltraTech's shielded room, 24'(L) by 16'(W) by 8'(H).
- Radiated Emissions were performed at the Ultratech's 3 Meter Open Field Test Site (OFTS) situated in the Town of Oakville, province of Ontario.

The above sites have been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville Open Field Test Site has been filed with FCC office (FCC File No.: 31040/SIT 1300B3) and Industry Canada office (Industry Canada File No.: IC2049). Last Date of Site Calibration: January 10, 2005.

5.2. APPLICABILITY & SUMMARY OF EMISSION TEST RESULTS

FCC Section(s)	Test Requirements	Applicability (Yes/No)
90.541 & 2.1046	RF Power Output	Yes
1.1307, 1.1310, 2.1091 & 2.1093	RF Exposure Limit	Yes
90.539 & 2.1055	Frequency Stability	Yes
2.1047(a)	Audio Frequency Response	Yes
2.1047(b)	Modulation Limiting	Yes
90.543 & 2.1049	99% OBW & Adjacent Channel Coupled Power	Yes
90.543(c), 2.1057 & 2.1051	Emission Limits - Spurious Emissions at Antenna Terminal	Yes
90.543(c), 2.1057 & 2.1053	Emission Limits - Field Strength of Spurious Emissions	Yes
MOBEXCOM DVR Vehicular Repeater, Model No.: MOBEXCOM DVR 700, by Futurecom Systems Group Inc. has been tested and found to comply with FCC Part 15, Subpart B - Radio Receivers and Class A Digital Devices. The engineering test report is kept in file and it is available upon request.		

5.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.

5.4. DEVIATION OF STANDARD TEST PROCEDURES

None.

EXHIBIT 6. MEASUREMENTS, EXAMINATIONS & TEST DATA FOR EMC EMISSIONS

6.1. TEST PROCEDURES

This section contains test results only. Details of test methods and procedures can be found in Exhibit 8 of this report.

6.2. MEASUREMENT UNCERTAINTIES

The measurement uncertainties stated were calculated in accordance with requirements of UKAS Document NIS 81 with a confidence level of 95%. Please refer to Exhibit 7 for Measurement Uncertainties.

6.3. MEASUREMENT EQUIPMENT USED

The measurement equipment used complied with the requirements of the Standards referenced in the Methods & Procedures ANSI C63.4 and CISPR 16-1.

6.4. ESSENTIAL/PRIMARY FUNCTIONS AS DECLARED BY THE MANUFACTURER

The essential function of the EUT is to correctly communicate data/voice to and from radios over RF link.

6.5. RF POWER OUTPUT [§§ 2.1046 & 90.541]

6.5.1. Limits

§ 90.541 Transmitting power limits: The transmitting power of base, mobile, portable and control stations operating in the 764-776 MHz and 794-806 MHz frequency band must not exceed the maximum limits in this section, and must also comply with any applicable effective radiated power limits in § 90.545.

(a) The transmitting power of base transmitters must not exceed the limits given in paragraphs (a), (b) and (c) of § 90.635.
(b) The transmitter output power of mobile and control transmitters must not exceed 30 Watts.
(c) The transmitter output power of portable (hand-held) transmitters must not exceed 3 Watts.
(d) Transmitters operating on the narrowband low power channels listed in §§ 90.531(b)(3), 90.531(b)(4), must not exceed 2 watts (ERP).

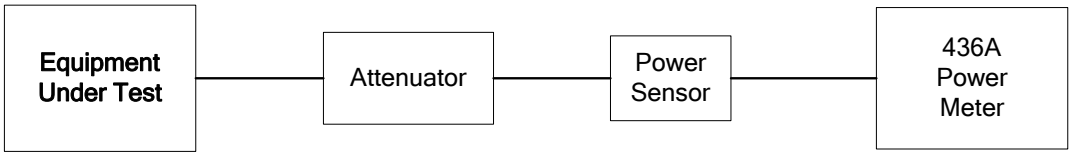
6.5.2. Method of Measurements

Refer to Exhibit 8, Sections 8.1 (Conducted) and 8.2 (Radiated) of this report for measurement details

6.5.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Attenuator(s)	Weinschel Corp	48-30-34	Bm5354	DC – 8.5 GHz
Power Meter	Hewlett Packard	436A	1725A02249	10 kHz – 50 GHz, sensor dependent
Power Sensor	Hewlett Packard	8481A	2702A68983	10 MHz – 18 GHz

6.5.4. Test Arrangement



6.5.5. Test Data

Fundamental Frequency (MHz)	Channel Spacing (kHz)	Measured Power in Tx Mode (Watts)	Measured Power in Repeater Mode, 0 dBm Input (Watts)
RF Output Power Setting: 20 W (Maximum)			
764	12.5	20.00	20.14
770	12.5	20.04	20.14
776	12.5	20.00	20.09
764	25.0	20.00	20.09
770	25.0	20.00	20.14
776	25.0	20.00	20.00
794	12.5	20.00	20.04
800	12.5	20.00	20.04
806	12.5	20.46	20.04
794	25.0	20.04	20.00
800	25.0	20.00	20.00
806	25.0	20.46	20.51
RF Output Power Setting: 1W Minimum			
764	12.5	1.00	1.00
770	12.5	1.00	1.00
776	12.5	1.00	1.00
764	25.0	1.00	1.00
770	25.0	1.00	1.00
776	25.0	1.00	1.00
794	12.5	1.04	1.00
800	12.5	1.03	1.16
806	12.5	1.05	1.00
794	25.0	1.04	1.00
800	25.0	1.02	1.00
806	25.0	1.04	1.04

6.6. RF EXPOSURE REQUIREMENT [§§ 1.1310 & 2.1091]

The criteria listed in table 1 shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in RSS-102

FCC 47 CFR 1.1310:

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*($900/f^2$)	6
30–300	61.4	0.163	1.0	6
300–1500			f/300	6
1500–100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*($180/f^2$)	30
30–300	27.5	0.073	0.2	30
300–1500			f/1500	30
1500–100,000			1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density
NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.
NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

Calculation Method of RF Safety Distance:

$S = PG/4\Pi r^2 = EIRP/4\Pi r^2 \Rightarrow r = \sqrt{PG/4\Pi S} = \sqrt{EIRP/4\Pi S}$

Where: P: power input to the antenna in mW
EIRP: Equivalent (effective) isotropic radiated power.
S: power density mW/cm^2
G: numeric gain of antenna relative to isotropic radiator
r: distance to center of radiation in cm

MPE Evaluation

Antenna gain limit specified by manufacturer: 0 dBd or 2.15 dBi

Lowest Frequency (MHz)	Highest Measured RF Conducted Power (dBm)	Calculated EIRP (dBm)	Exposure Condition	Calculated Minimum RF Safety Distance r (cm)
764	43.11	45.26	Occupational	33
764	43.11	45.26	Bystanders	73

Note 1: RF EXPOSURE DISTANCE LIMITS: $r = (PG/4\Pi S)^{1/2} = (EIRP/4\Pi S)^{1/2}$

Occupational/Control Exposures: $S = f/300 = 764/300$ mW/cm^2
$EIRP = 45.26$ dBm $= 10^{(45.26/10)}$ mW

$r = (EIRP/4\Pi S)^{1/2} = (10^{(45.26/10)}/ 4\Pi(764/300))^{1/2} = 32.39$ cm ≈ 33 cm

For bystanders: $S = f/1500 = 764/1500$ mW/cm^2
$EIRP = 45.26$ dBm $= 10^{(45.26/10)}$ mW

$r = (EIRP/4\Pi S)^{1/2} = (10^{(45.26/10)} / 4\Pi(764/1500)^{1/2} = 72.43$ cm ≈ 73 cm

Evaluation of RF Exposure Compliance Requirements	
RF Exposure Requirements	**Compliance with FCC Rules**
Minimum calculated separation distance between antenna and persons required: Occupational: 33 cm Bystanders: 73	Manufacturer' instruction for separation distance between antenna and persons required: 73 cm. See user's manual for details
Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement	See user's manual for details
Caution statements and/or warning labels that are necessary in order to comply with the exposure limits	See user's manual for details
Any other RF exposure related issues that may affect MPE compliance	N/A

6.7. FREQUENCY STABILITY [§§ 2.1055 & 90.539]

6.7.1. Limits

§ 90.539 Frequency Stability:- Transmitters designed to operate in 764-776 MHz and 794-806 MHz frequency band must meet the frequency stability requirements in this section.

(a) Mobile, portable and control transmitters must normally use automatic frequency control (AFC) to lock on to the base station signal.
(b) The frequency stability of base transmitters operating in the narrowband segment must be 100 parts per billion or better.
(c) The frequency stability of mobile, portable, and control transmitters operating in the narrowband segment must be 400 parts per billion or better when AFC is locked to the base station. When AFC is not locked to the base station, the frequency stability must be at least 1.0 ppm for 6.25 kHz, 1.5 ppm for 12.5 kHz (2 channel aggregate), and 2.5 ppm for 25 kHz (4 channel aggregate).
(d) The frequency stability of base transmitters operating in the wideband segment must be 1 part per million or better.
(e) The frequency stability of mobile, portable and control transmitters operating in the wideband segment must be 1.25 parts per million or better when AFC is locked to a base station, and 5 parts per million or better when AFC is not locked.

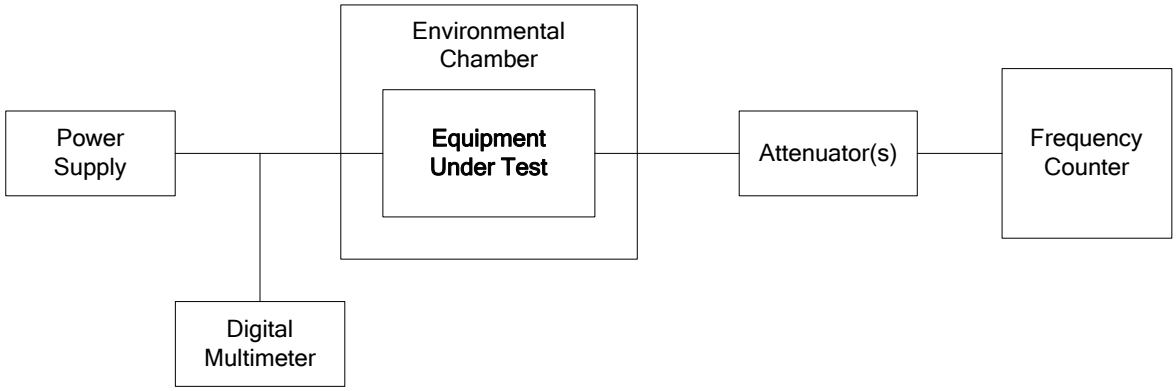
6.7.2. Method of Measurements

Refer to Exhibit 8, Section 8.3 of this report for measurement details

6.7.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Frequency Counter	EIP	545A	2683	10 Hz-18 GHz
Attenuator	Weinschel Corp	48-30-34	BM5354	DC-18 GHz
Temperature & Humidity Chamber	Tenney	T5	9723B	-40°C to +60 °C range
Digital Multimeter	Tenma	72-6202	2080027	DC-100 kHz
Power Supply	Tenma	72-6153	--	DC 0-20 V, 0-10A.

6.7.4. Test Arrangement



6.7.5. Test Data

Product Name: Model No.:	MOBEXCOM DVR Vehicular Repeater MOBEXCOM DVR 700
Center Frequency:	764 MHz
Full Power Level:	20 W
Frequency Tolerance Limit:	1.5 ppm
Max. Frequency Tolerance Measured:	+158 Hz (0.2 ppm)
Input Voltage Rating:	13.8 Vdc

CENTER FREQUENCY & RF POWER OUTPUT VARIATION			
Ambient Temperature (^{o}C)	**Supply Voltage (Nominal) 13.8 Volts**	**Supply Voltage (85% of Nominal) 11.73 Volts**	**Supply Voltage (115% of Nominal) 15.87 Volts**
	Hz	**Hz**	**Hz**
-30	-130	n/a	n/a
-20	-40	n/a	n/a
-10	+109	n/a	n/a
0	+158	n/a	n/a
+10	+95	n/a	n/a
+20	0	-9	+30
+30	+127	n/a	n/a
+40	-97	n/a	n/a
+50	+36	n/a	n/a
+60	+33	n/a	n/a

6.8. AUDIO FREQUENCY RESPONSE [§ 2.1047(a)]

6.8.1. Limits @ FCC 2.1047(a)

Recommended audio filter attenuation characteristics are given below:

RF Band	Audio band	Minimum Attenuation Rel. to 1 kHz Attenuation
406.1 – 960 MHz	3 –20 kHz 20 – 30 kHz	60 $\log_{10}$(f/3) dB where f is in kHz 50dB

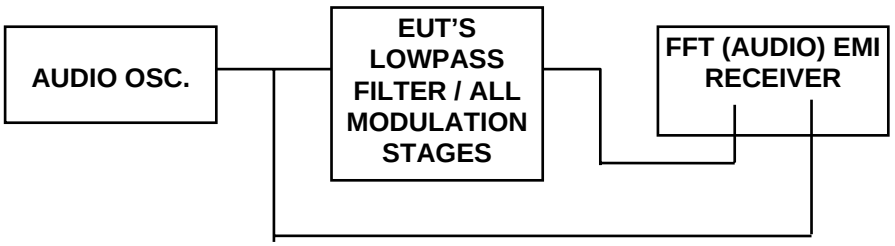
6.8.2. Method of Measurements

The rated audio input signal was applied to the input of the audio lowpass filter (or of all modulation stages) using an audio oscillator, this input signal level and its corresponding output signal were then measured and recorded using the FFT (Audio) EMI Receiver. Tests were repeated at different audio signal frequencies from 0 to 50 kHz.

6.8.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
FFT (audio) EMI Receiver	Advantest	R9211E	…	10 mHz – 100 kHz, 1 MHz Input Impedance
Audio Oscillator	Hewlett Packard	HP 204C	0989A08798	DC to 1.2 MHz

6.8.4. Test Arrangement



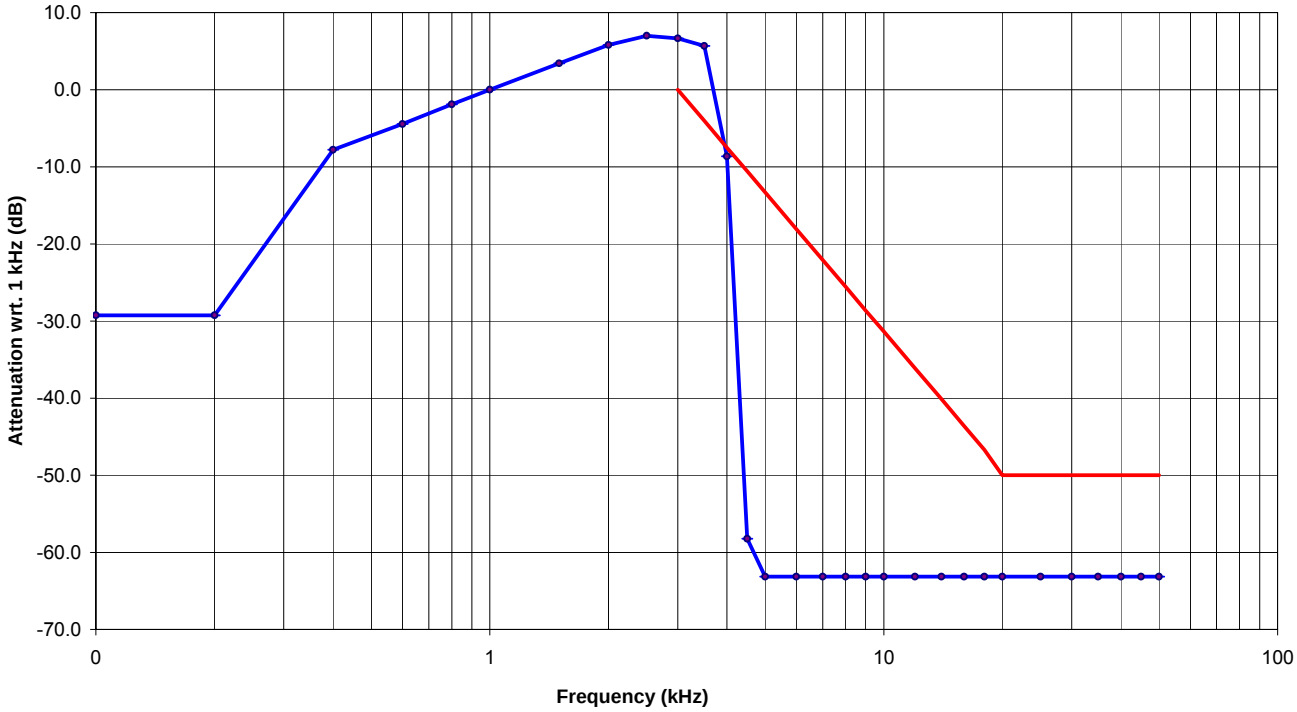
6.8.5. Test Data

*6.8.5.1. 12.5 kHz Channel Spacing, F3E, Frequency of All Modulation States**

Note: Because of the difficulty of measuring the Frequency Response of the internal lowpass filter, the Frequency Response of All Modulation States are performed to show the roll-off at 3 kHz in comparison with FCC Limit for audio lowpass filter.

Frequency (kHz)	Audio IN (dBV)	Audio OUT (dBV)	Attenuation (OUT - IN) (dB)	Attenuation Rel. 1 kHz (dB)	Recommended Attenuation (dB)
0.1	-25.86	<-32.84	<-7.0	<-29.3	--
0.2	-25.86	<-32.84	<-7.0	<-29.3	--
0.4	-25.86	-11.36	14.5	-7.8	--
0.6	-25.86	-8.04	17.8	-4.5	--
0.8	-25.86	-5.47	20.4	-1.9	--
1.0	-25.86	-3.59	22.3	0.0	--
1.5	-25.86	-0.15	25.7	3.4	--
2.0	-25.86	2.21	28.1	5.8	--
2.5	-25.86	3.41	29.3	7.0	--
3.0	-25.86	3.08	28.9	6.7	0
3.5	-25.86	2.09	28.0	5.7	-4
4.0	-25.86	-12.22	13.6	-8.6	-7
4.5	-25.86	-61.82	-36.0	-58.2	-11
5.0	-25.86	<-66.76	<-40.9	<-63.2	-13
6.0	-25.86	<-66.76	<-40.9	<-63.2	-18
7.0	-25.86	<-66.76	<-40.9	<-63.2	-22
8.0	-25.86	<-66.76	<-40.9	<-63.2	-26
9.0	-25.86	<-66.76	<-40.9	<-63.2	-29
10.0	-25.86	<-66.76	<-40.9	<-63.2	-31
12.0	-25.86	<-66.76	<-40.9	<-63.2	-36
14.0	-25.86	<-66.76	<-40.9	<-63.2	-40
16.0	-25.86	<-66.76	<-40.9	<-63.2	-44
18.0	-25.86	<-66.76	<-40.9	<-63.2	-47
20.0	-25.86	<-66.76	<-40.9	<-63.2	-50
25.0	-25.86	<-66.76	<-40.9	<-63.2	-50
30.0	-25.86	<-66.76	<-40.9	<-63.2	-50
35.0	-25.86	<-66.76	<-40.9	<-63.2	-50
40.0	-25.86	<-66.76	<-40.9	<-63.2	-50
45.0	-25.86	<-66.76	<-40.9	<-63.2	-50
50.0	-25.86	<-66.76	<-40.9	<-63.2	-50

Audio Frequency Response
12.5 kHz Channel Spacing

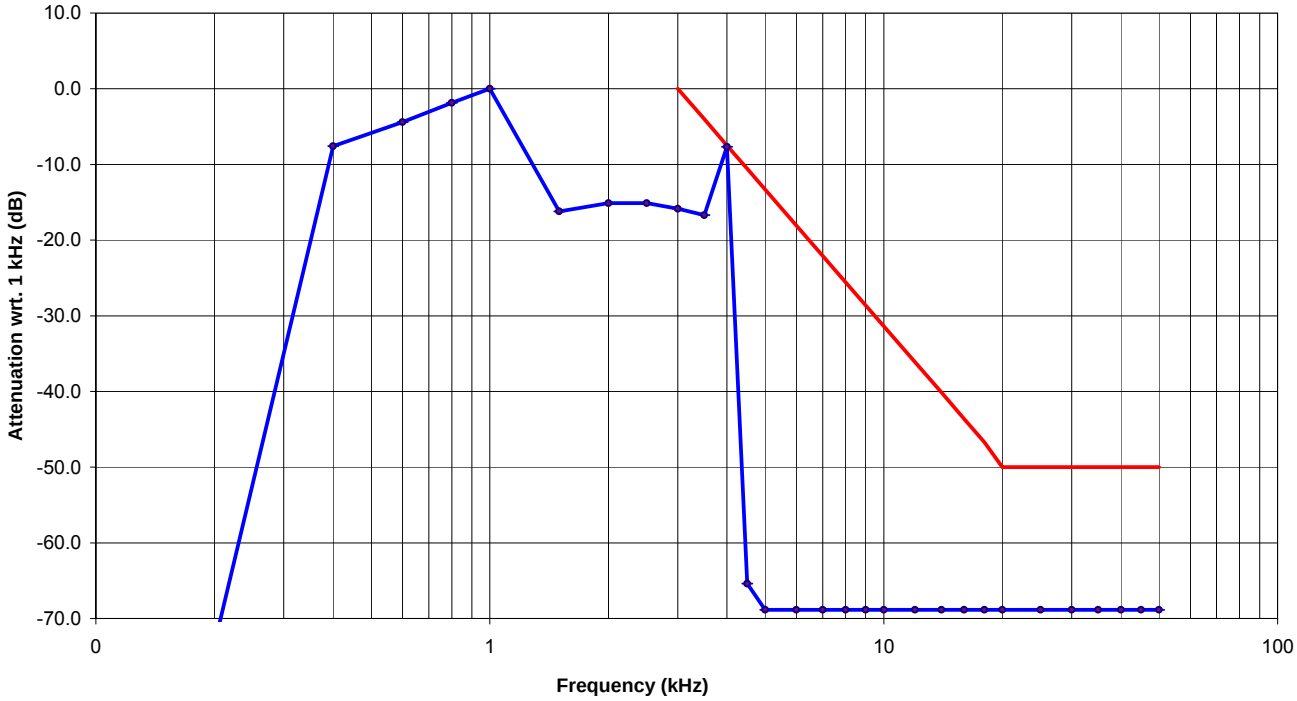


*6.8.5.2. 25 kHz Channel Spacing, F3E, Frequency of All Modulation States**

Note: Because of the difficulty of measuring the Frequency Response of the internal lowpass filter, the Frequency Response of All Modulation States are performed to show the roll-off at 3 kHz in comparison with FCC Limit for audio lowpass filter.

Frequency (kHz)	Audio IN (dBV)	Audio OUT (dBV)	Attenuation (OUT - IN) (dB)	Attenuation Rel. 1 kHz (dB)	Recommended Attenuation (dB)
0.1	-22.96	<-68.20	<-45.2	<-73.3	--
0.2	-22.96	-68.20	-45.2	-73.3	--
0.4	-22.96	-2.46	20.5	-7.6	--
0.6	-22.96	0.72	23.7	-4.4	--
0.8	-22.96	3.29	26.3	-1.8	--
1.0	-22.96	5.13	28.1	0.0	--
1.5	-22.96	-11.07	11.9	-16.2	--
2.0	-22.96	-9.97	13.0	-15.1	--
2.5	-22.96	-9.97	13.0	-15.1	--
3.0	-22.96	-10.73	12.2	-15.9	0
3.5	-22.96	-11.56	11.4	-16.7	-4
4.0	-22.96	-2.53	20.4	-7.7	-7
4.5	-22.96	-60.28	-37.3	-65.4	-11
5.0	-22.96	<-63.72	<-40.8	<-68.9	-13
6.0	-22.96	<-63.72	<-40.8	<-68.9	-18
7.0	-22.96	<-63.72	<-40.8	<-68.9	-22
8.0	-22.96	<-63.72	<-40.8	<-68.9	-26
9.0	-22.96	<-63.72	<-40.8	<-68.9	-29
10.0	-22.96	<-63.72	<-40.8	<-68.9	-31
12.0	-22.96	<-63.72	<-40.8	<-68.9	-36
14.0	-22.96	<-63.72	<-40.8	<-68.9	-40
16.0	-22.96	<-63.72	<-40.8	<-68.9	-44
18.0	-22.96	<-63.72	<-40.8	<-68.9	-47
20.0	-22.96	<-63.72	<-40.8	<-68.9	-50
25.0	-22.96	<-63.72	<-40.8	<-68.9	-50
30.0	-22.96	<-63.72	<-40.8	<-68.9	-50
35.0	-22.96	<-63.72	<-40.8	<-68.9	-50
40.0	-22.96	<-63.72	<-40.8	<-68.9	-50
45.0	-22.96	<-63.72	<-40.8	<-68.9	-50
50.0	-22.96	<-63.72	<-40.8	<-68.9	-50

Audio Frequency Response
25 kHz Channel Spacing



6.9. MODULATION LIMITING [§ 2.1047(b)]

6.9.1. Limits

Recommended frequency deviation characteristics are given below:

- 2.5 kHz for 12.5 kHz Channel Spacing
- 5 kHz for 25 kHz Channel Spacing System

6.9.2. Method of Measurements

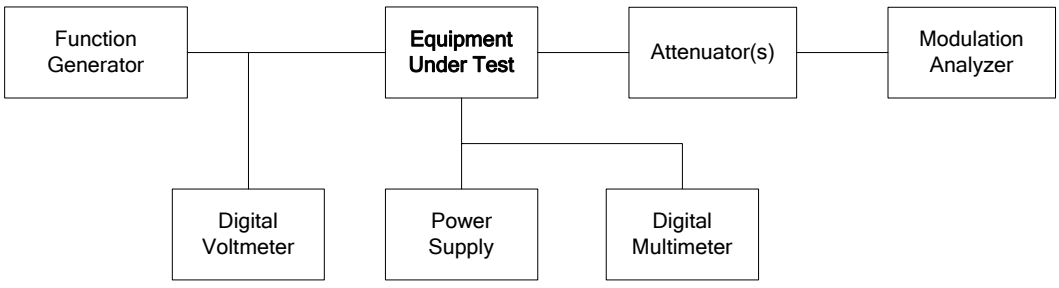
For Audio Transmitter:- The carrier frequency deviation was measured with the tone input signal level varied from 0 Vp to audio input rating level plus 16 dB at frequencies 0.1, 0.5, 1.0, 3.0 and 5.0 kHz. The maximum deviation was recorded at each test condition.

For Data Transmitter with Maximum Frequency Deviation set by Factory:- The EUT was set at maximum frequency deviation, and its peak frequency deviation was then measured using EUT's internal random data source.

6.9.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Function Generator	Stanford Research Systems	DS345	34591	1 μHz – 30.2 MHz
Digital Voltmeter	Hewlett-Packard	3456A	2015A04523	DC-250 KHz
Modulation Analyzer	Hewlett Packard	8901B	3226A04606	150 kHz-1.3 GHz
Attenuator	Weinschel Corp	48-30-34	BM5354	DC-18 GHz
Digital Multimeter	Tenma	72-6202	2080027	DC-100 kHz
Power Supply	Tenma	72-6153	--	DC 0-20 V, 0-10A.

6.9.4. Test Arrangement



6.9.5. Test Data

6.9.5.1. Voice Modulation Limiting – 12.5 kHz Channel Spacing

MODULATING SIGNAL LEVEL	PEAK FREQUENCY DEVIATION (kHz) at the following modulating frequency:					MAXIMUM LIMIT
(mVrms)	0.1 kHz	0.5 kHz	1.0 kHz	3.0 kHz	5.0 kHz	(kHz)
20	0.71	0.78	0.96	1.57	0.72	2.5
40	0.71	1.13	1.31	2.50	0.72	2.5
60	0.71	1.13	1.66	2.50	0.72	2.5
80	0.71	1.29	2.01	2.50	0.72	2.5
100	0.71	1.48	2.38	2.50	0.72	2.5
150	0.71	1.91	2.50	2.50	0.72	2.5
200	0.71	2.37	2.50	2.50	0.72	2.5
250	0.71	2.50	2.50	2.50	0.72	2.5
300	0.71	2.50	2.50	2.50	0.72	2.5
350	0.74	2.50	2.50	2.50	0.72	2.5
400	0.79	2.50	2.50	2.50	0.72	2.5
450	0.81	2.50	2.50	2.50	0.72	2.5
500	0.85	2.50	2.50	2.50	0.72	2.5
550	0.91	2.50	2.50	2.50	0.72	2.5
600	0.96	2.50	2.50	2.50	0.72	2.5
650	0.98	2.50	2.50	2.50	0.72	2.5
700	0.99	2.50	2.50	2.50	0.72	2.5
750	1.03	2.50	2.50	2.50	0.72	2.5
800	1.03	2.50	2.50	2.50	0.72	2.5
850	1.06	2.50	2.50	2.50	0.72	2.5
900	1.11	2.50	2.50	2.50	0.72	2.5
950	1.18	2.50	2.50	2.50	0.72	2.5
1000	1.27	2.50	2.50	2.50	0.72	2.5

Voice Signal Input Level = STD MOD Level + 16 dB
= 33.98 dBmVrms + 16
= 49.98 dBmVrms
= 316 mVrms

MODULATING FREQUENCY (KHz)	PEAK FREQUENCY DEVIATION (KHz)	MAXIMUM LIMIT (KHz)
0.1	0.7	2.5
0.2	0.7	2.5
0.4	2.5	2.5
0.6	2.5	2.5
0.8	2.5	2.5
1.0	2.5	2.5
1.2	2.5	2.5
1.4	2.5	2.5
1.6	2.5	2.5
1.8	2.5	2.5
2.0	2.5	2.5
2.5	2.5	2.5
3.0	2.5	2.5
3.5	2.5	2.5
4.0	2.0	2.5
4.5	0.7	2.5
5.0	0.7	2.5
6.0	0.7	2.5
7.0	0.7	2.5
8.0	0.7	2.5
9.0	0.7	2.5
10.0	0.7	2.5

6.9.5.2. Voice Modulation Limiting – 25 kHz Channel Spacing

MODULATING SIGNAL LEVEL	PEAK FREQUENCY DEVIATION (kHz) at the following modulating frequency:					MAXIMUM LIMIT
(mVrms)	0.1 kHz	0.5 kHz	1.0 kHz	3.0 kHz	5.0 kHz	(kHz)
20	0.71	0.95	1.29	2.61	0.71	5.0
40	0.71	1.30	2.00	4.72	0.71	5.0
60	0.71	1.66	2.73	4.93	0.71	5.0
80	0.71	2.01	3.63	4.93	0.71	5.0
100	0.71	2.38	4.38	4.93	0.71	5.0
150	0.71	3.29	4.98	5.00	0.71	5.0
200	0.71	4.39	4.98	5.00	0.71	5.0
250	0.71	4.93	4.98	5.00	0.71	5.0
300	0.71	4.93	4.98	5.00	0.71	5.0
350	0.81	4.93	4.98	5.00	0.71	5.0
400	0.97	4.93	4.98	5.00	0.71	5.0
450	1.05	4.93	4.98	5.00	0.71	5.0
500	1.17	4.93	4.98	5.00	0.71	5.0
550	1.34	4.93	4.98	5.00	0.71	5.0
600	1.45	4.93	4.98	5.00	0.71	5.0
650	1.48	4.93	4.98	5.00	0.71	5.0
700	1.48	4.93	4.98	5.00	0.71	5.0
750	1.48	4.93	4.98	5.00	0.71	5.0
800	1.48	4.93	4.98	5.00	0.71	5.0
850	1.57	4.93	4.98	5.00	0.71	5.0
900	1.69	4.93	4.98	5.00	0.71	5.0
950	1.88	4.93	4.98	5.00	0.71	5.0
1000	2.06	4.93	4.98	5.00	0.71	5.0

Voice Signal Input Level = STD MOD Level + 16 dB
= 36.90 dBmVrms + 16
= 52.90 dBmVrms
= 442 mVrms

MODULATING FREQUENCY (KHz)	PEAK FREQUENCY DEVIATION (KHz)	MAXIMUM LIMIT (KHz)
0.1	1.04	5.0
0.2	1.83	5.0
0.4	4.92	5.0
0.6	4.95	5.0
0.8	4.97	5.0
1.0	5.00	5.0
1.2	5.00	5.0
1.4	5.00	5.0
1.6	5.00	5.0
1.8	5.00	5.0
2.0	5.00	5.0
2.5	5.00	5.0
3.0	5.00	5.0
3.5	4.84	5.0
4.0	3.63	5.0
4.5	1.32	5.0
5.0	0.77	5.0
6.0	0.94	5.0
7.0	1.31	5.0
8.0	1.91	5.0
9.0	1.63	5.0
10.0	0.71	5.0

6.10. 99% OBW & ADJACENT CHANNEL COUPLED POWER (ACCP) [§§ 2.1049, 90.209 & 90.543]

6.10.1. Limits

§ 90.543 Emission limitations: Transmitters designed to operate in 764-776 MHz and 794-806 MHz frequency band must meet the emission limitations in this section.

(a) The adjacent channel coupled power (ACCP) requirements for transmitters designed for various channel sizes are shown in the following tables. Mobile station requirements apply to handheld, car mounted and control station units. The tables specify a maximum value for the ACCP relative to maximum output power as a function of the displacement from the channel center frequency. In addition, the ACCP for a mobile station transmitter at the specified frequency displacement must not exceed the value shown in the tables. For transmitters that have power control, the latter ACCP requirement can be met at maximum power reduction. In the following charts, "(s)" means a swept measurement is to be used.

12.5 kHz MOBILE TRANSMITTER ACCP REQUIREMENTS

Offset from center frequency (kHz)	Measurement bandwidth (kHz)	Maximum ACCP relative (dBc)	Maximum ACCP absolute (dBm)
9.375	6.25	-40	([1])
15.625.....	6.25	-60	45
21.875	6.25	-60	45
37.5	25	-65	50
62.5	25	-65	50
87.5	25	-65	50
150	100	-65	50
250	100	-65	50
>400 to receive band	30(s)	-75	55
in the receive band	30(s)	-100	70

[1] Not specified.

25 kHz MOBILE TRANSMITTER ACCP REQUIREMENTS

Offset from center Frequency (kHz)	Measurement Bandwidth (kHz)	Maximum ACCP Relative (dBc)	Maximum ACCP Absolute (dBm)
15.625	6.25	40	([1])
21.875	6.25	60	45
37.5	25	65	50
62.5	25	65	50
87.5	25	65	50
150	100	65	50
250	100	65	50
> 400 to receive band	30(s)	75	55
in the receive band	30(s)	100	70

[1] Not specified.

6.10.2. Method of Measurements

(b) *ACCP measurement procedure.* The following are procedures for making transmitter measurements. For time division multiple access (TDMA) systems, the measurements are to be made under TDMA operation only during time slots when the transmitter is on. All measurements must be made at the input to the transmitter's antenna. Measurement bandwidth used below implies an instrument that measures the power in many narrow bandwidths (e.g. 300 Hz) and integrates these powers across a larger band to determine power in the measurement bandwidth.

(1) *Setting reference level.* Using a spectrum analyzer capable of ACCP measurements, set the measurement bandwidth to the channel size. For example, for a 6.25 kHz transmitter, set the measurement bandwidth to 6.25 kHz; for a 150 kHz transmitter, set the measurement bandwidth to 150 kHz. Set the frequency offset of the measurement bandwidth to zero and adjust the center frequency of the spectrum analyzer to give the power level in the measurement bandwidth. Record this power level in dBm as the ''reference power level''.

(2) *Measuring the power level at frequency offsets <600kHz.* Using a spectrum analyzer capable of ACCP measurements, set the measurement bandwidth as shown in the tables above. Measure the ACCP in dBm. These measurements should be made at maximum power. Calculate the coupled power by subtracting the measurements made in this step from the reference power measured in the previous step. The absolute ACCP values must be less than the values given in the table for each condition above.

(3) *Measuring the power level at frequency offsets >600kHz.* Set a spectrum analyzer to 30 kHz resolution bandwidth, 1 MHz video bandwidth and sample mode detection. Sweep ± 6 MHz from the carrier frequency. Set the reference level to the RMS value of the transmitter power and note the absolute power. The response at frequencies greater than 600 kHz must be less than the values in the tables above.

(4) *Upper power limit measurement.* The absolute coupled power in dBm measured above must be compared to the table entry for each given frequency offset. For those mobile stations with power control, these measurements should be repeated with power control at maximum power reduction. The absolute ACCP at maximum power reduction must be less than the values in the tables above.

(c) *Out-of-band emission limit.* On any frequency outside of the frequency ranges covered by the ACCP tables in this section, the power of any emission must be reduced below the unmodulated carrier power (P) by at least 43 + 10 log (P) dB.

(d) *Authorized bandwidth.* Provided that the ACCP requirements of this section are met, applicants may request any authorized bandwidth that does not exceed the channel size.

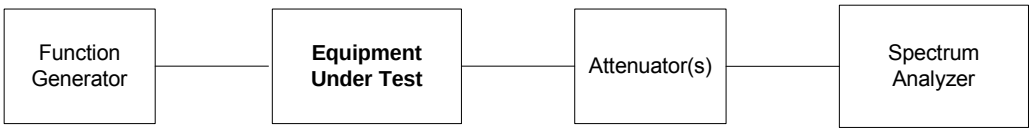
(e) For operations in the 764 to 776 MHz and 794 to 806 MHz bands, all emissions including harmonics in the band 1559–1610 MHz shall be limited to -70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and -80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

(f) When an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in this section.

6.10.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Rhode & Schwarz	FSEK20/B4/B21	834157/005	9 kHz- 40 GHz
Attenuator	Weinschel Corp	48-30-34	BM5354	DC-18 GHz
Function Generator	Stanford Research Systems	DS345	34591	1 μHz – 30.2 MHz

6.10.4. Test Arrangement



6.10.5. Test Data

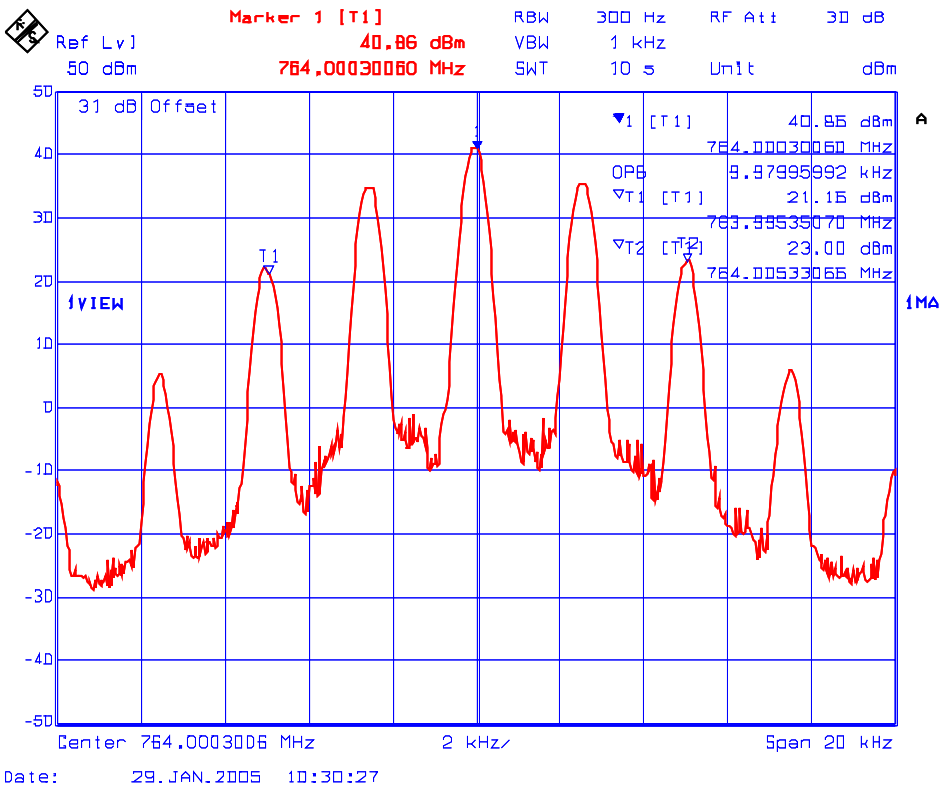
6.10.5.1. 99% Occupied Bandwidth

Frequency (MHz)	Channel Spacing (kHz)	*Measured 99% OBW (kHz)	Recommended 99% OBW (kHz)
Modulation: FM with 2.5 kHz sine wave signal			
764	12.5	9.98	< 12.5
770	12.5	9.98	< 12.5
776	12.5	9.98	< 12.5
794	12.5	10.06	< 12.5
800	12.5	10.10	< 12.5
806	12.5	10.06	< 12.5
764	25	14.91	< 25.0
770	25	14.97	< 25.0
776	25	15.03	< 25.0
794	25	14.97	< 25.0
800	25	15.15	< 25.0
806	25	15.03	< 25.0

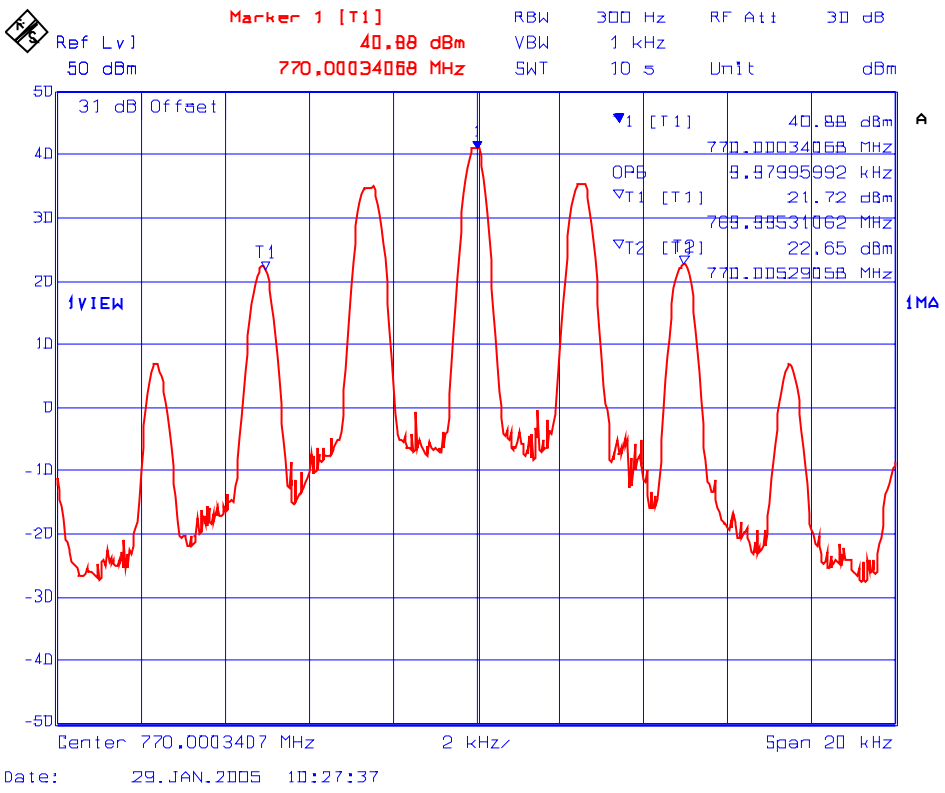
Frequency (MHz)	Channel Spacing (kHz)	*Measured 99% OBW (kHz)	Recommended 99% OBW (kHz)
Modulation: C4FM			
764	12.5	7.25	< 12.5
770	12.5	6.97	< 12.5
776	12.5	6.97	< 12.5
794	12.5	6.89	< 12.5
800	12.5	6.93	< 12.5
806	12.5	7.05	< 12.5

* See the following plots (1 to 18) for detailed measurements.

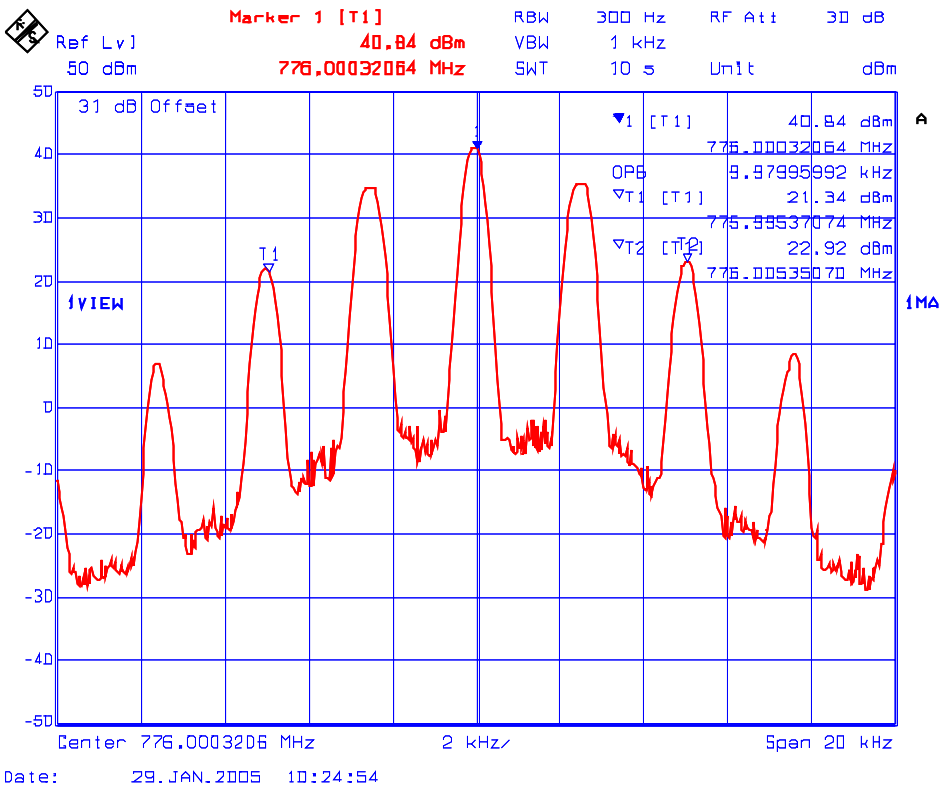
Plot 1: 99% Occupied Bandwidth
Test Frequency: 764 MHz, 12.5 kHz Channel Spacing
Modulation: FM modulation with 2.5 kHz sine wave signal



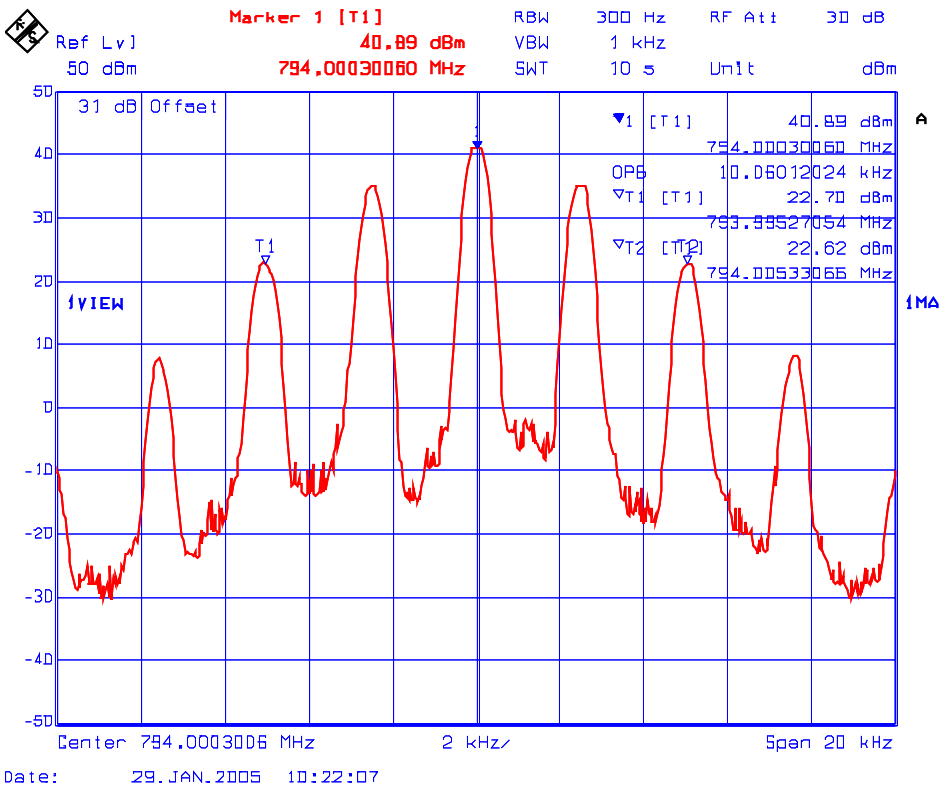
Plot 2: 99% Occupied Bandwidth
Fc: 770 MHz, 12.5 kHz Channel Spacing
Modulation: FM modulation with 2.5 kHz Sine wave signal



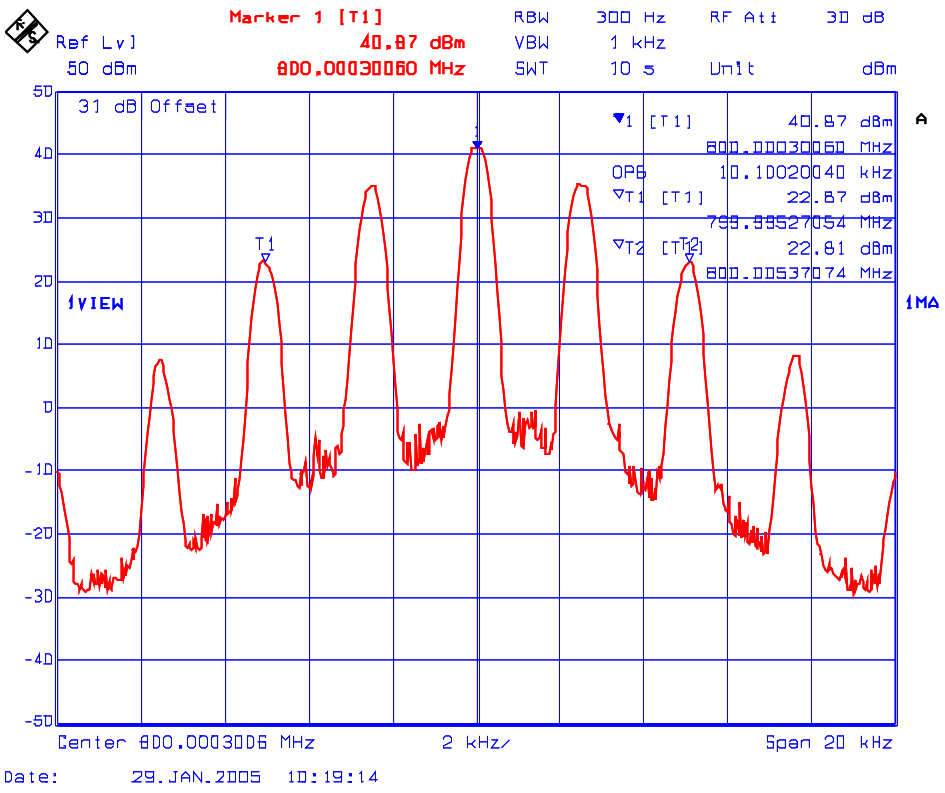
Plot 3: 99% Occupied Bandwidth
Fc: 776 MHz, 12.5 kHz Channel Spacing
Modulation: FM modulation with 2.5 kHz Sine wave signal



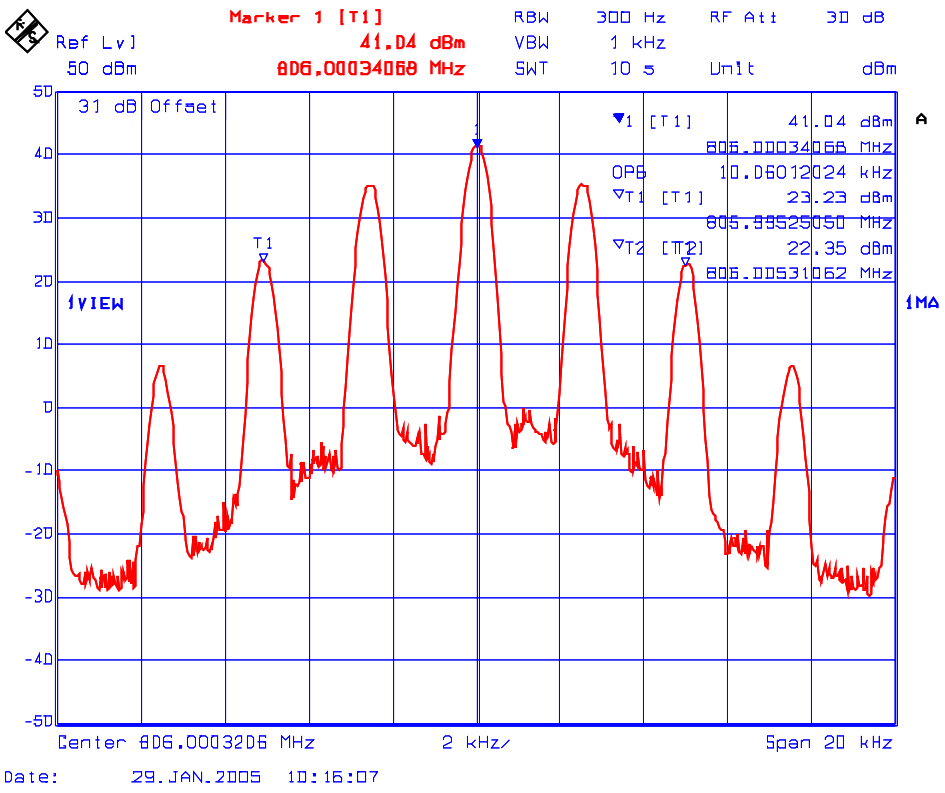
Plot 4: 99% Occupied Bandwidth
Fc: 794 MHz, 12.5 kHz Channel Spacing
Modulation: FM modulation with 2.5 kHz Sine wave signal



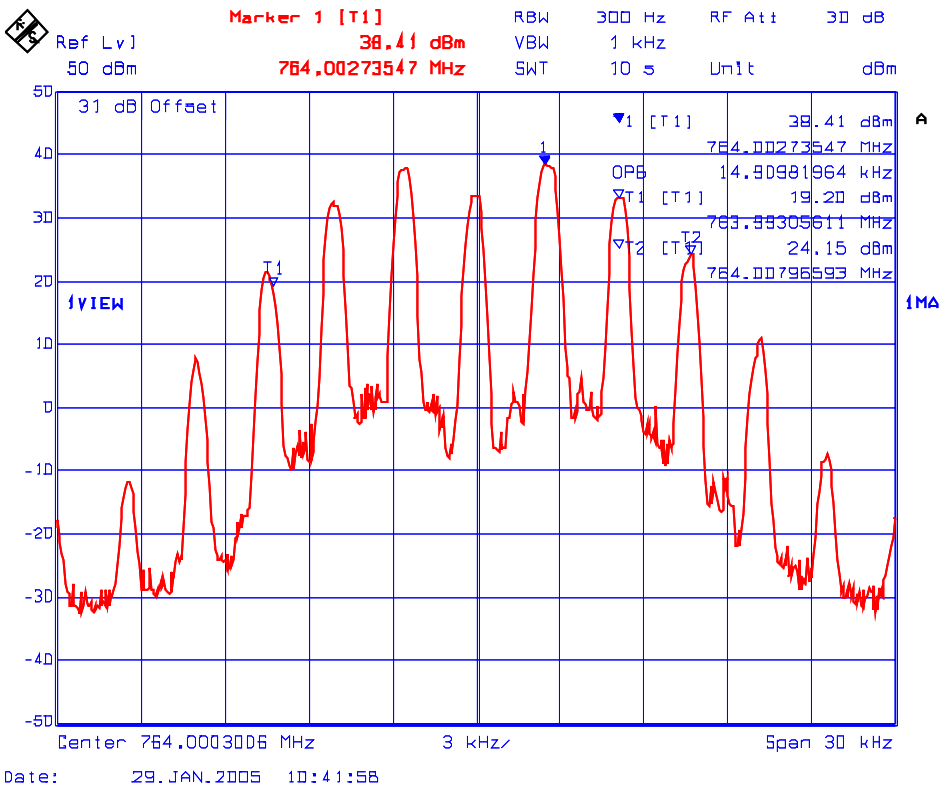
Plot 5: 99% Occupied Bandwidth
Fc: 800 MHz, 12.5 kHz Channel Spacing
Modulation: FM modulation with 2.5 kHz sine wave signal



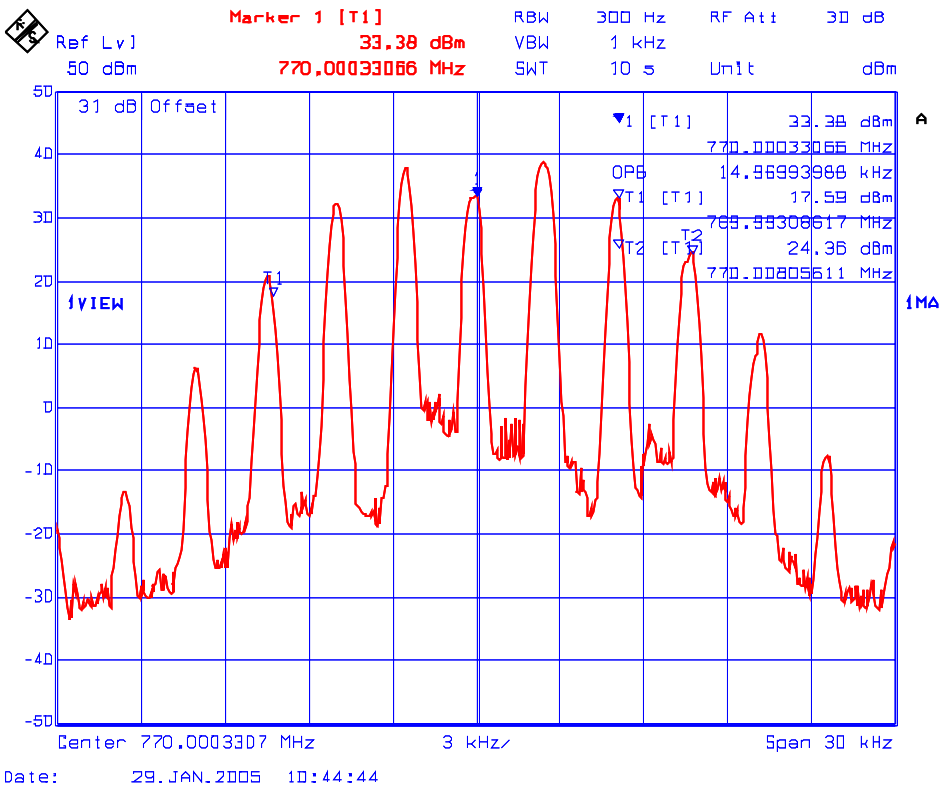
Plot 6: 99% Occupied Bandwidth
Fc: 806 MHz, 12.5 kHz Channel Spacing
Modulation: FM modulation with 2.5 kHz sine wave signal



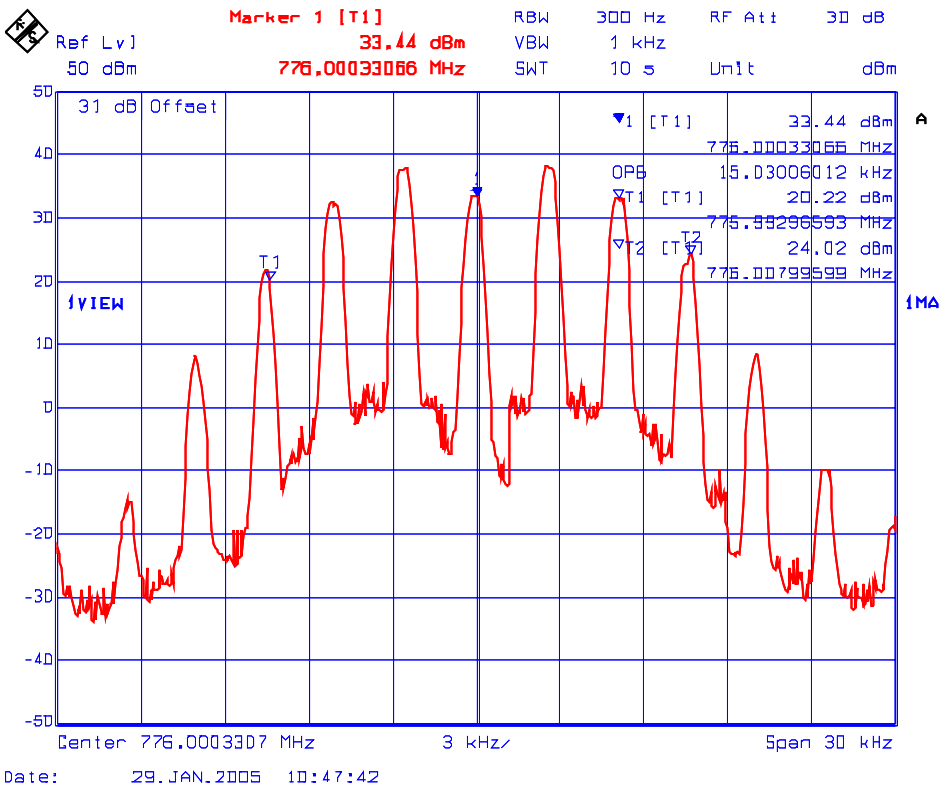
Plot 7: 99% Occupied Bandwidth
Frequency: 764 MHz, 25 kHz Channel Spacing
Modulation: FM Modulation with 2.5 kHz sine wave signal



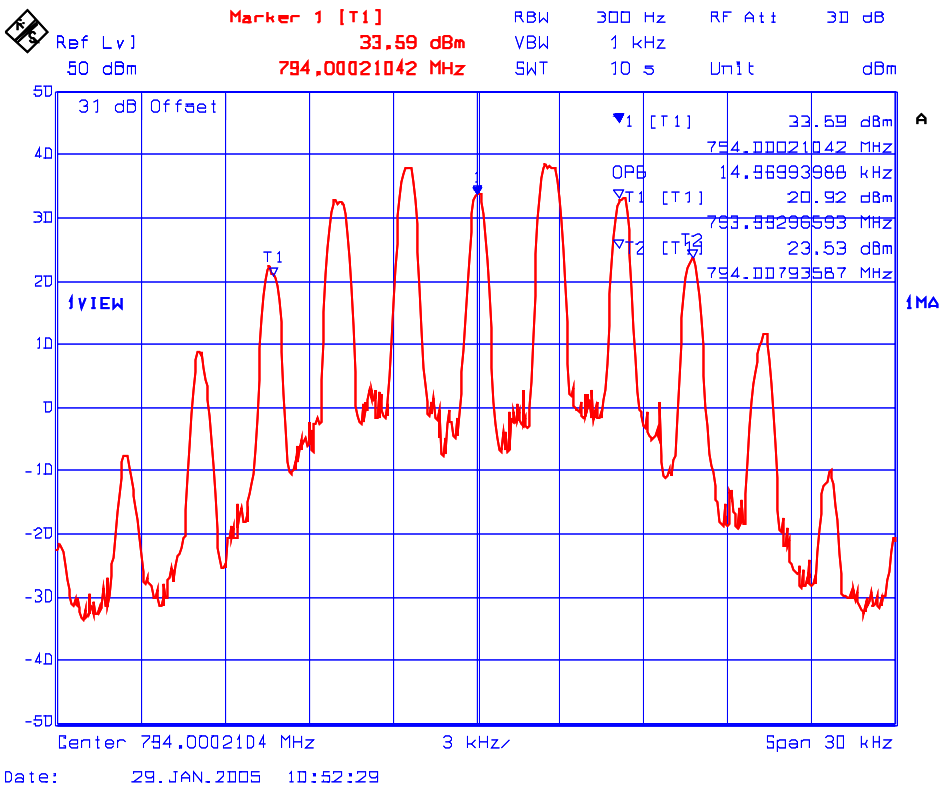
Plot 8: 99% Occupied Bandwidth
Fc: 770 MHz, 25 kHz Channel Spacing
Modulation: FM Modulation with 2.5 kHz Sine Wave signal



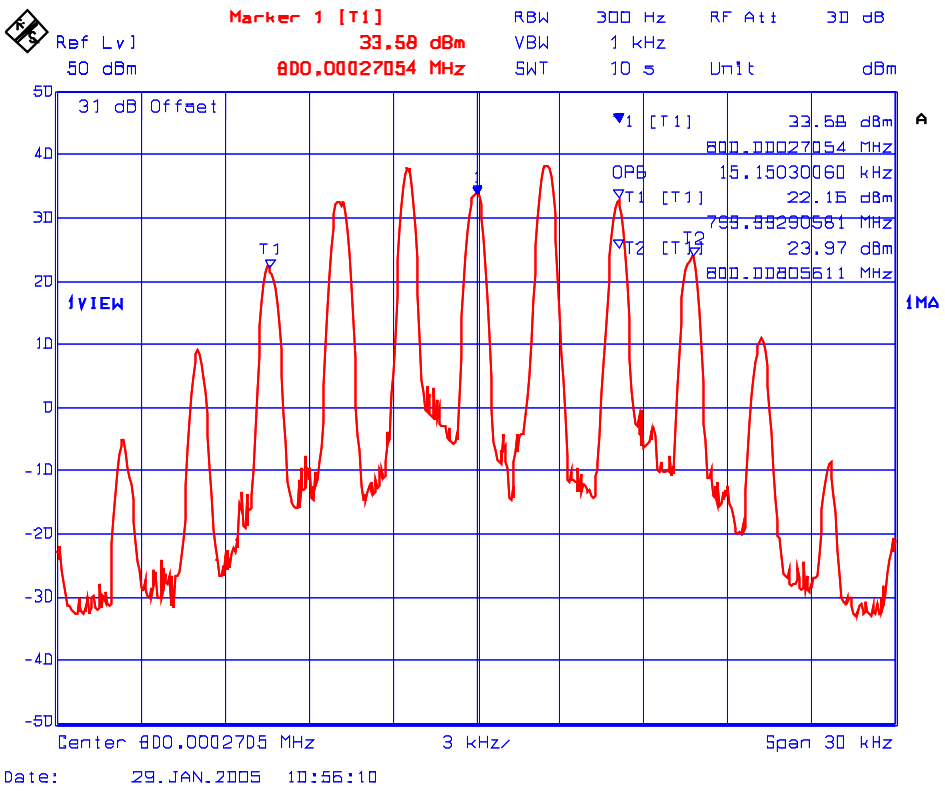
Plot 9: 99% Occupied Bandwidth
Fc: 776 MHz, 25 kHz Channel Spacing
Modulation: FM Modulation with 2.5 kHz sine wave signal



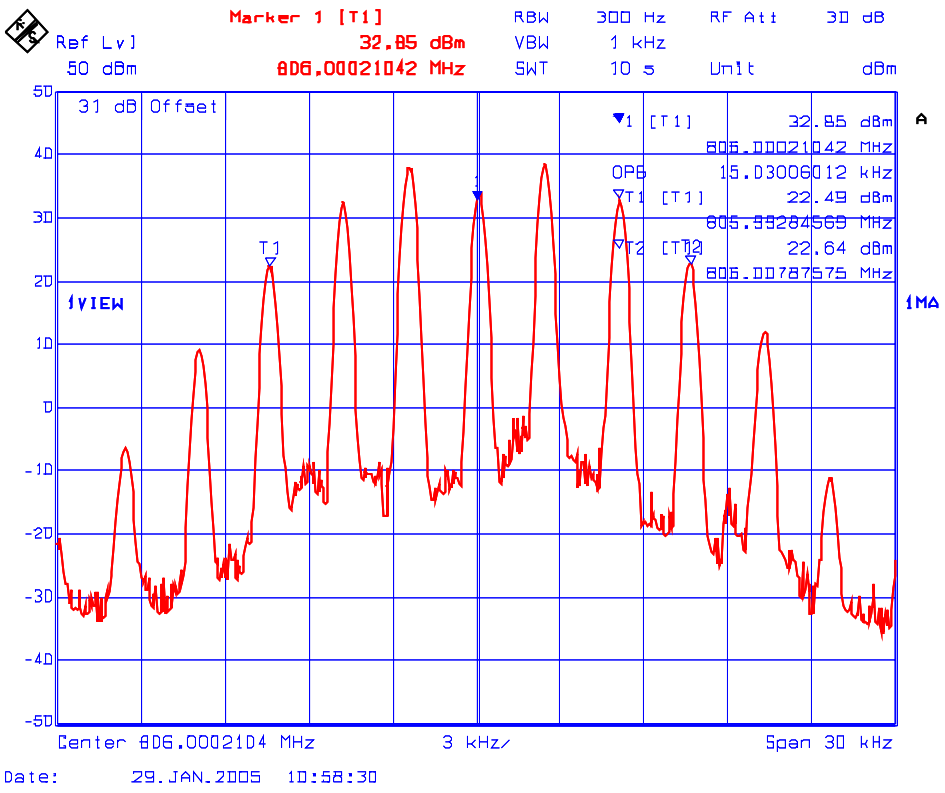
Plot 10: 99% Occupied Bandwidth
Fc: 794 MHz, 25 kHz Channel Spacing
Modulation: FM Modulation with 2.5 kHz sine wave signal



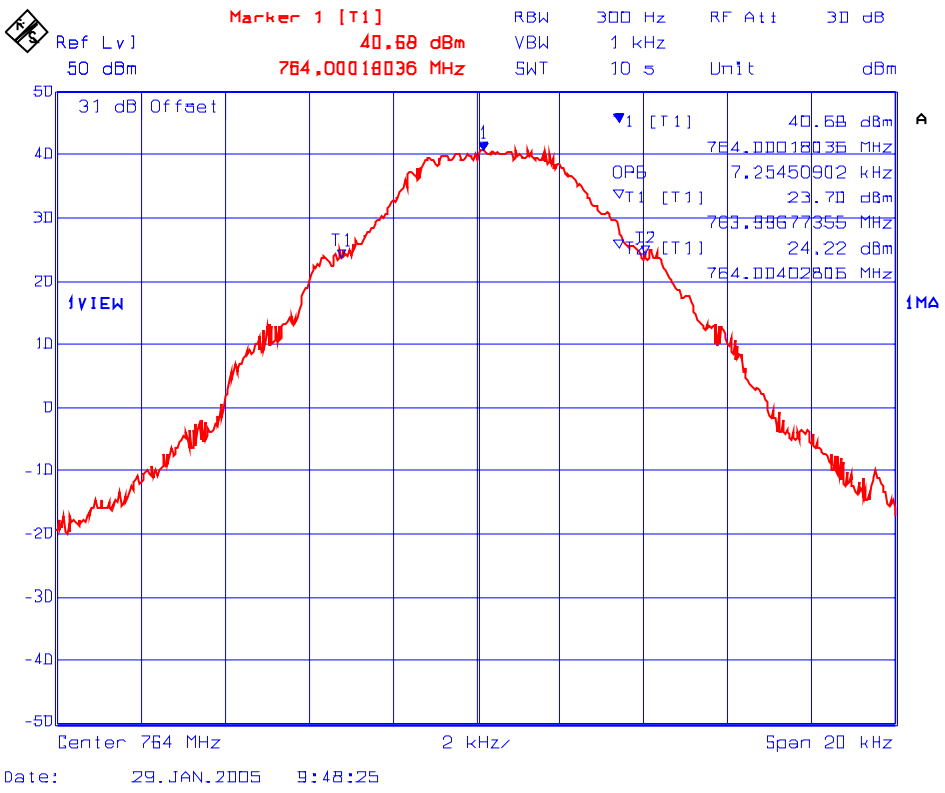
Plot 11: 99% Occupied Bandwidth
Fc: 800 MHz, 25 kHz Channel Spacing
Modulation: FM Modulation with 2.5 kHz sine wave signal



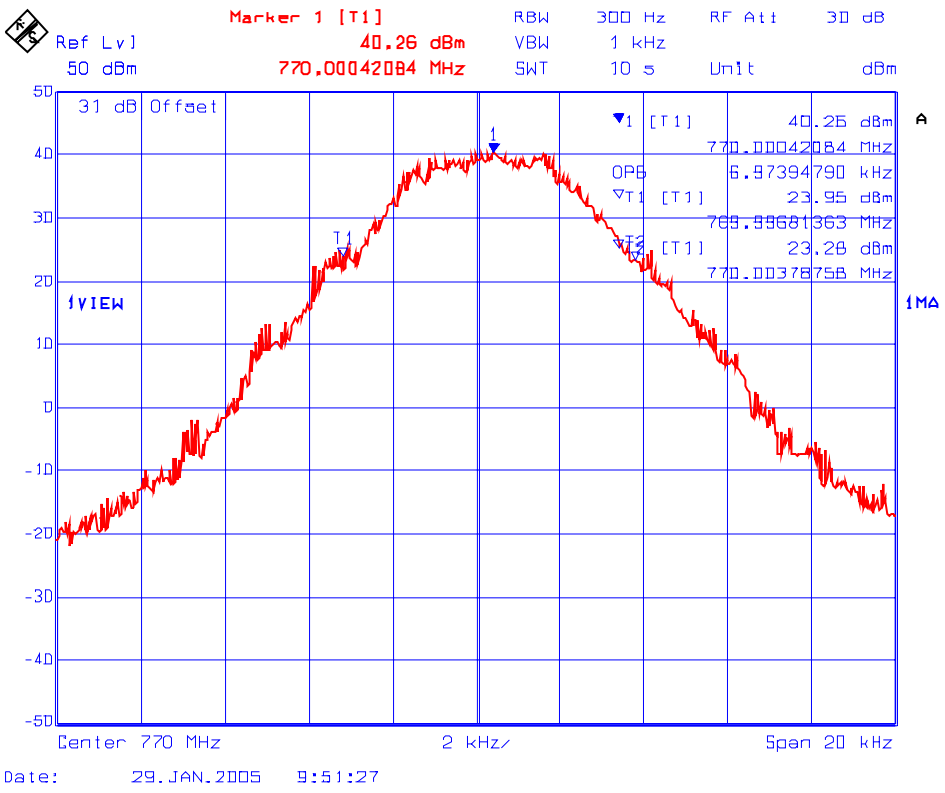
Plot 12: 99% Occupied Bandwidth
Fc: 806 MHz, 25 kHz Channel Spacing
Modulation: FM Modulation with 2.5 kHz sine wave signal



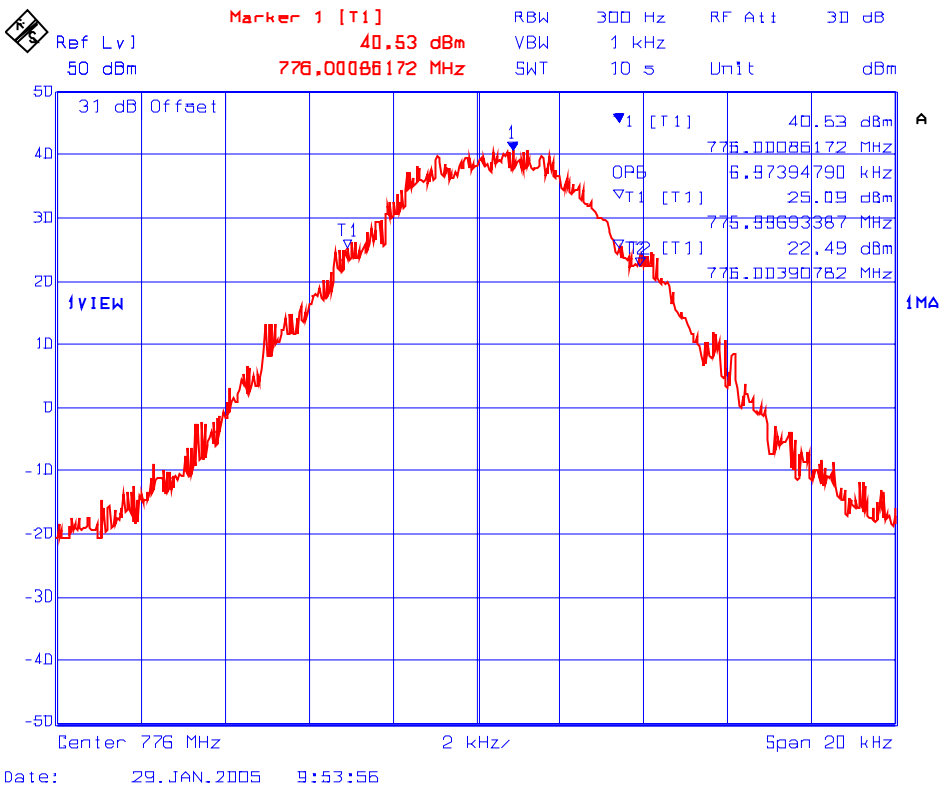
Plot 13: 99% Occupied Bandwidth
Fc: 764 MHz
Modulation: C4FM



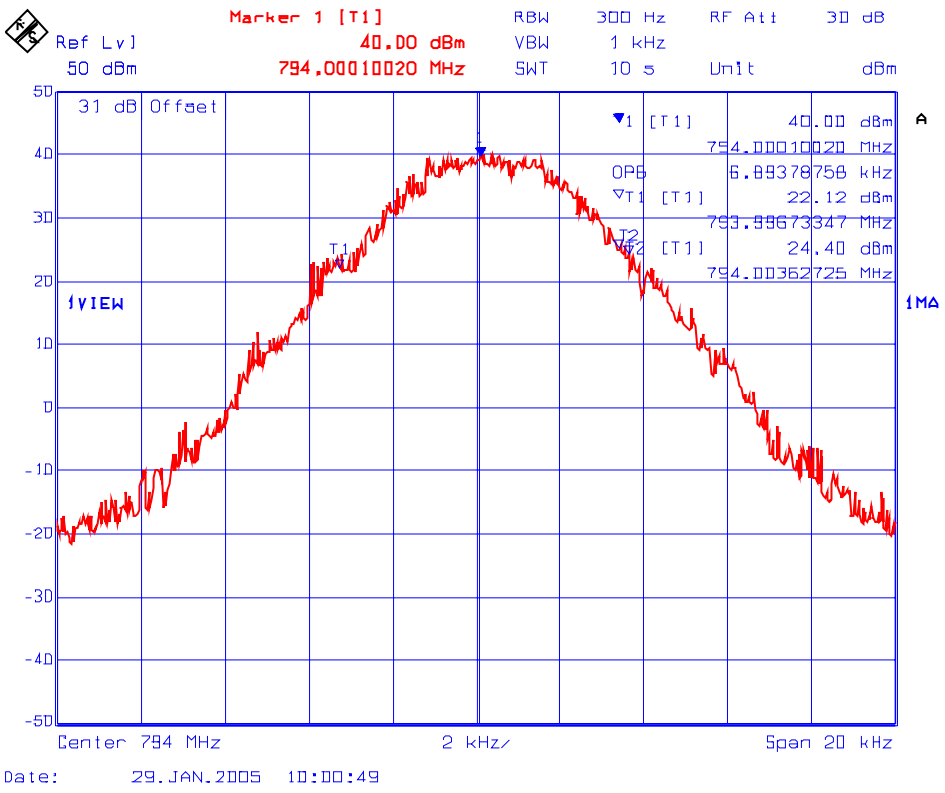
Plot 14: 99% Occupied Bandwidth
Fc: 770 MHz
Modulation: C4FM



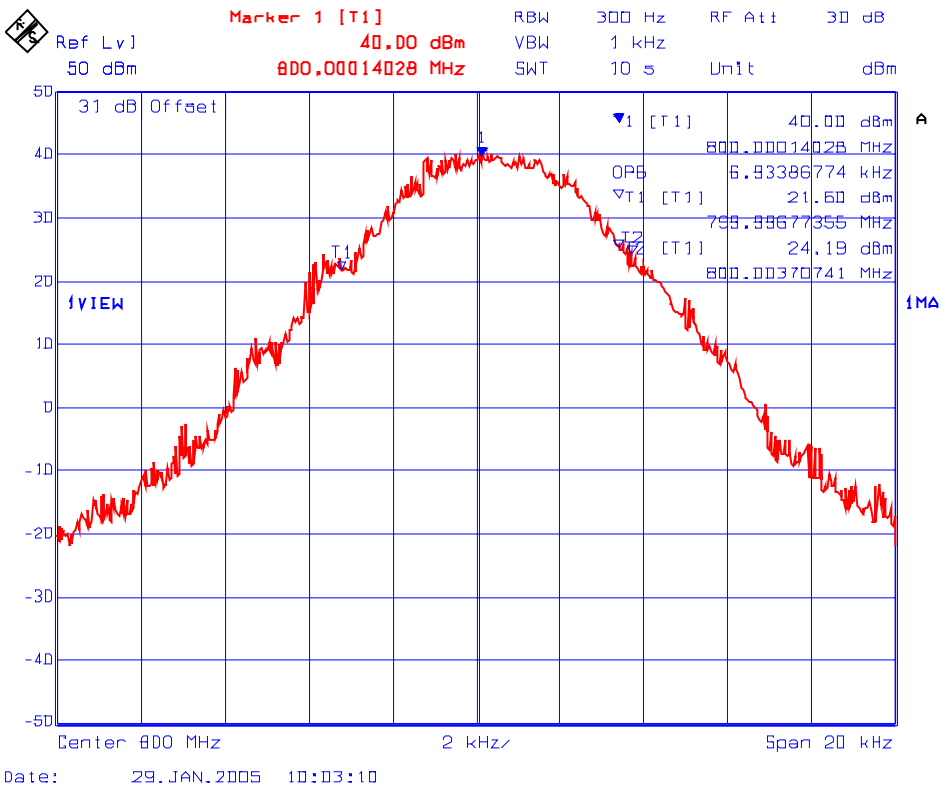
Plot 15: 99% Occupied Bandwidth
Fc: 776 MHz
Modulation: C4FM



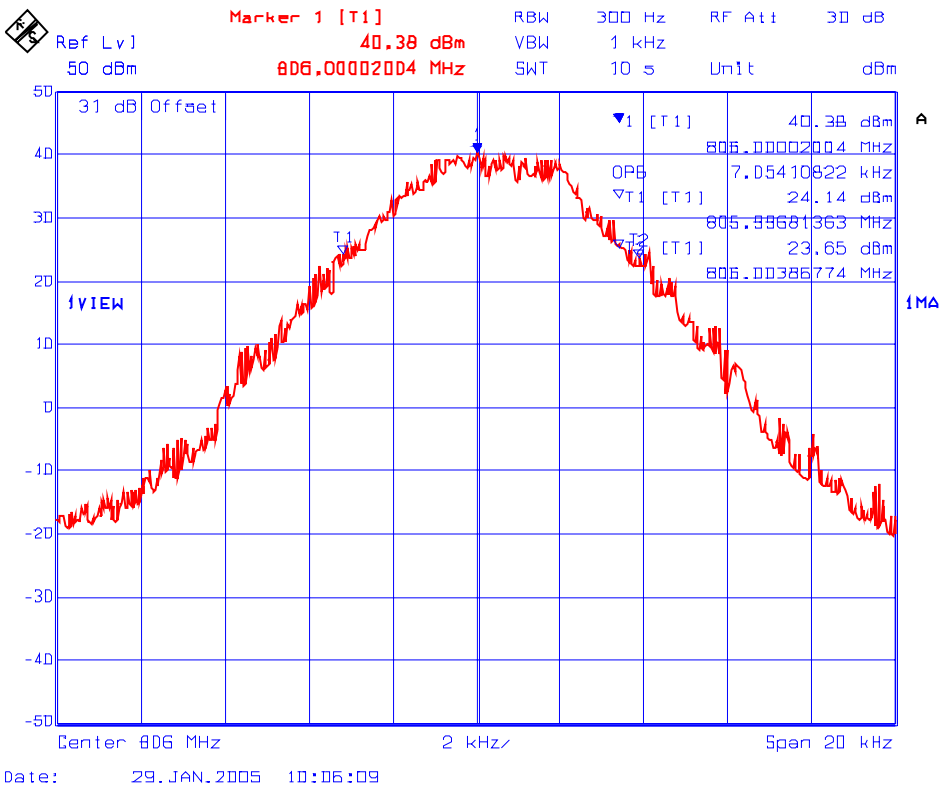
Plot 16: 99% Occupied Bandwidth
Fc: 794 MHz
Modulation: C4FM



Plot 17: 99% Occupied Bandwidth
Fc: 800 MHz
Modulation: C4FM



Plot 18: 99% Occupied Bandwidth
Fc: 806 MHz
Modulation: C4FM



6.10.5.2. Emission Limitations – Adjacent Channel Coupled Power (ACCP)

6.10.5.2.1. Test Configuration #1: 764 MHz, Ref. Power Level: 43 dBm, 12.5 kHz Channel Spacing, Analog Voice

Offset (kHz)	Measurement BW (kHz)	Measured ACCP at Fc – Offset (dBc)	Measured ACCP at Fc + Offset (dBc)	Maximum ACCP Relative (dBc)
9.375	6.25	-63.15	-63.50	-40
15.625	6.25	-68.51	-67.88	-60
21.875	6.25	-71.34	-70.22	-60
37.5	25	-67.82	-67.56	-65
62.5	25	-68.84	-68.37	-65
87.5	25	-67.02	-67.80	-65
150	100	-71.19	-71.14	-65
250	100	-72.19	-72.82	-65
>400 to receive band	30 (Swept)	<-75	<-75	-75
in the receive band	30 (Swept)	<-100	<-100	-100

6.10.5.2.2. Test Configuration #2: 764 MHz, Ref. Power Level: 43 dBm, 25 kHz Channel Spacing, Analog Voice

Offset (kHz)	Measurement BW (kHz)	Measured ACCP at Fc – Offset (dBc)	Measured ACCP at Fc + Offset (dBc)	Maximum ACCP Relative (dBc)
15.625	6.25	-68.49	-67.75	-40
21.875	6.25	-71.99	-70.81	-60
37.5	25	-68.88	-67.45	-65
62.5	25	-69.07	-68.28	-65
87.5	25	-66.58	-67.56	-65
150	100	-68.25	-68.62	-65
250	100	-69.60	-70.57	-65
>400 to receive band	30 (Swept)	<-75	<-75	-75
in the receive band	30 (Swept)	<-100	<-100	-100

6.10.5.2.3. Test Configuration #3: 770 MHz, Ref. Power Level: 43 dBm, 12.5 kHz Channel Spacing, Analog Voice)

Offset (kHz)	Measurement BW (kHz)	Measured ACCP at Fc – Offset (dBc)	Measured ACCP at Fc + Offset (dBc)	Maximum ACCP Relative (dBc)
9.375	6.25	-62.56	-62.29	-40
15.625	6.25	-67.50	-67.36	-60
21.875	6.25	-71.80	-69.16	-60
37.5	25	-67.70	-67.11	-65
62.5	25	-68.29	-68.68	-65
87.5	25	-66.37	-66.98	-65
150	100	-68.75	-69.28	-65
250	100	-70.24	-70.41	-65
>400 to receive band	30 (Swept)	<-75	<-75	-75
in the receive band	30 (Swept)	<-100	<-100	-100

6.10.5.2.4. Test Configuration #4: 770 MHz, Ref. Power Level: 43 dBm, 25 kHz Channel Spacing, Analog Voice)

Offset (kHz)	Measurement BW (kHz)	Measured ACCP at Fc – Offset (dBc)	Measured ACCP at Fc + Offset (dBc)	Maximum ACCP Relative (dBc)
15.625	6.25	-68.85	-64.99	-40
21.875	6.25	-70.54	-69.17	-60
37.5	25	-67.58	-66.91	-65
62.5	25	-68.16	-68.03	-65
87.5	25	-67.02	-67.10	-65
150	100	-67.65	-67.74	-65
250	100	-69.80	-69.90	-65
>400 to receive band	30 (Swept)	<-75	<-75	-75
in the receive band	30 (Swept)	<-100	<-100	-100

6.10.5.2.5. Test Configuration #5: 776 MHz, Ref. Power Level: 43 dBm, 12.5 kHz Channel Spacing, Analog Voice

Offset (kHz)	Measurement BW (kHz)	Measured ACCP at Fc – Offset (dBc)	Measured ACCP at Fc + Offset (dBc)	Maximum ACCP Relative (dBc)
9.375	6.25	-63.12	-63.02	-40
15.625	6.25	-67.75	-66.85	-60
21.875	6.25	-71.97	-69.98	-60
37.5	25	-66.32	-65.74	-65
62.5	25	-65.95	-66.30	-65
87.5	25	-65.65	-65.42	-65
150	100	-68.98	-69.22	-65
250	100	-71.99	-71.56	-65
>400 to receive band	30 (Swept)	<-75	<-75	-75
in the receive band	30 (Swept)	<-100	<-100	-100

6.10.5.2.6. Test Configuration #6: 776 MHz, Ref. Power Level: 43 dBm, 25 kHz Channel Spacing, Analog Voice

Offset (kHz)	Measurement BW (kHz)	Measured ACCP at Fc – Offset (dBc)	Measured ACCP at Fc + Offset (dBc)	Maximum ACCP Relative (dBc)
15.625	6.25	-68.04	-66.59	-40
21.875	6.25	-70.39	-70.70	-60
37.5	25	-66.42	-66.04	-65
62.5	25	-67.11	-67.31	-65
87.5	25	-65.68	-66.23	-65
150	100	-67.54	-67.60	-65
250	100	-69.91	-71.16	-65
>400 to receive band	30 (Swept)	<-75	<-75	-75
in the receive band	30 (Swept)	<-100	<-100	-100

6.10.5.2.7. Test Configuration #7: 794 MHz, Ref. Power Level: 43 dBm, 12.5 kHz Channel Spacing, Analog Voice

Offset (kHz)	Measurement BW (kHz)	Measured ACCP at Fc – Offset (dBc)	Measured ACCP at Fc + Offset (dBc)	Maximum ACCP Relative (dBc)
9.375	6.25	-63.37	-63.64	-40
15.625	6.25	-68.33	-67.95	-60
21.875	6.25	-72.06	-71.36	-60
37.5	25	-68.75	-69.72	-65
62.5	25	-69.39	-69.39	-65
87.5	25	-68.08	-68.20	-65
150	100	-70.69	-70.64	-65
250	100	-72.88	-72.88	-65
>400 to receive band	30 (Swept)	<-75	<-75	-75
in the receive band	30 (Swept)	<-100	<-100	-100

6.10.5.2.8. Test Configuration #8: 794 MHz, Ref. Power Level: 43 dBm, 25 kHz Channel Spacing, Analog Voice

Offset (kHz)	Measurement BW (kHz)	Measured ACCP at Fc – Offset (dBc)	Measured ACCP at Fc + Offset (dBc)	Maximum ACCP Relative (dBc)
15.625	6.25	-67.93	-67.46	-40
21.875	6.25	-71.91	-70.74	-60
37.5	25	-68.20	-69.06	-65
62.5	25	-69.18	-69.54	-65
87.5	25	-68.49	-69.17	-65
150	100	-68.50	-67.40	-65
250	100	-70.07	-70.39	-65
>400 to receive band	30 (Swept)	<-75	<-75	-75
in the receive band	30 (Swept)	<-100	<-100	-100

6.10.5.2.9. Test Configuration #9: 800 MHz, Ref. Power Level: 43 dBm, 12.5 kHz Channel Spacing, Analog Voice)

Offset (kHz)	Measurement BW (kHz)	Measured ACCP at Fc – Offset (dBc)	Measured ACCP at Fc + Offset (dBc)	Maximum ACCP Relative (dBc)
9.375	6.25	-63.61	-64.49	-40
15.625	6.25	-69.79	-68.29	-60
21.875	6.25	-71.87	-71.76	-60
37.5	25	-69.28	-68.51	-65
62.5	25	-69.96	-69.71	-65
87.5	25	-68.10	-69.11	-65
150	100	-70.38	-71.22	-65
250	100	-73.26	-73.06	-65
>400 to receive band	30 (Swept)	<-75	<-75	-75
in the receive band	30 (Swept)	<-100	<-100	-100

6.10.5.2.10. Test Configuration #10: 800 MHz, Ref. Power Level: 43 dBm, 25 kHz Channel Spacing, Analog Voice)

Offset (kHz)	Measurement BW (kHz)	Measured ACCP at Fc – Offset (dBc)	Measured ACCP at Fc + Offset (dBc)	Maximum ACCP Relative (dBc)
15.625	6.25	-67.69	-68.60	-40
21.875	6.25	-70.68	-72.09	-60
37.5	25	-68.79	-68.37	-65
62.5	25	-69.83	-68.86	-65
87.5	25	-68.36	-68.14	-65
150	100	-66.06	-66.61	-65
250	100	-68.13	-68.42	-65
>400 to receive band	30 (Swept)	<-75	<-75	-75
in the receive band	30 (Swept)	<-100	<-100	-100

6.10.5.2.11. Test Configuration #11: 806 MHz, Ref. Power Level: 43 dBm, 12.5 kHz Channel Spacing, Analog Voice

Offset (kHz)	Measurement BW (kHz)	Measured ACCP at Fc – Offset (dBc)	Measured ACCP at Fc + Offset (dBc)	Maximum ACCP Relative (dBc)
9.375	6.25	-64.96	-65.55	-40
15.625	6.25	-68.35	-68.97	-60
21.875	6.25	-71.47	-70.88	-60
37.5	25	-66.86	-68.00	-65
62.5	25	-67.50	-68.42	-65
87.5	25	-66.74	-66.32	-65
150	100	-71.19	-71.21	-65
250	100	-73.01	-72.55	-65
>400 to receive band	30 (Swept)	<-75	<-75	-75
in the receive band	30 (Swept)	<-100	<-100	-100

6.10.5.2.12. Test Configuration #12: 806 MHz, Ref. Power Level: 43 dBm, 25 kHz Channel Spacing, Analog Voice

Offset (kHz)	Measurement BW (kHz)	Measured ACCP at Fc – Offset (dBc)	Measured ACCP at Fc + Offset (dBc)	Maximum ACCP Relative (dBc)
15.625	6.25	-69.16	-68.43	-40
21.875	6.25	-71.01	-71.03	-60
37.5	25	-67.87	-67.77	-65
62.5	25	-66.67	-67.76	-65
87.5	25	-66.37	-65.45	-65
150	100	-65.78	-66.03	-65
250	100	-68.03	-68.20	-65
>400 to receive band	30 (Swept)	<-75	<-75	-75
in the receive band	30 (Swept)	<-100	<-100	-100

6.10.5.2.13. Test Configuration #13: 764 MHz, Ref Power Level: 43 dBm, 12.5 kHz Channel Spacing, Digital Voice

Offset (kHz)	Measurement BW (kHz)	Measured ACCP at Fc – Offset (dBc)	Measured ACCP at Fc + Offset (dBc)	Maximum ACCP Relative (dBc)
9.375	6.25	-51.60	-42.83	-40
15.625	6.25	-65.42	-62.85	-60
21.875	6.25	-69.38	-68.53	-60
37.5	25	-69.40	-69.00	-65
62.5	25	-69.86	-70.07	-65
87.5	25	-67.83	-67.96	-65
150	100	-68.82	-68.95	-65
250	100	-72.74	-71.74	-65
>400 to receive band	30 (Swept)	<-75	<-75	-75
in the receive band	30 (Swept)	<-100	<-100	-100

6.10.5.2.14. Test Configuration #14: 770 MHz, Ref Power Level: 43 dBm, 12.5 kHz Channel Spacing, Digital Voice

Offset (kHz)	Measurement BW (kHz)	Measured ACCP at Fc – Offset (dBc)	Measured ACCP at Fc + Offset (dBc)	Maximum ACCP Relative (dBc)
9.375	6.25	-52.61	-48.11	-40
15.625	6.25	-65.21	-61.91	-60
21.875	6.25	-70.56	-68.08	-60
37.5	25	-66.01	-65.49	-65
62.5	25	-66.20	-67.15	-65
87.5	25	-66.17	-66.94	-65
150	100	-69.98	-70.21	-65
250	100	-72.73	-73.17	-65
>400 to receive band	30 (Swept)	<-75	<-75	-75
in the receive band	30 (Swept)	<-100	<-100	-100

6.10.5.2.15. Test Configuration #15: 776 MHz, Ref Power Level: 43 dBm, 12.5 kHz Channel Spacing, Digital Voice

Offset (kHz)	Measurement BW (kHz)	Measured ACCP at Fc – Offset (dBc)	Measured ACCP at Fc + Offset (dBc)	Maximum ACCP Relative (dBc)
9.375	6.25	-52.28	-41.26	-40
15.625	6.25	-65.39	-61.83	-60
21.875	6.25	-71.10	-67.32	-60
37.5	25	-68.16	-67.21	-65
62.5	25	-68.33	-68.06	-65
87.5	25	-67.07	-67.08	-65
150	100	-71.40	-70.58	-65
250	100	-72.61	-73.40	-65
>400 to receive band	30 (Swept)	<-75	<-75	-75
in the receive band	30 (Swept)	<-100	<-100	-100

6.10.5.2.16. Test Configuration #16: 794 MHz, Ref. Power Level: 43 dBm, 12.5 kHz Channel Spacing, Digital Voice

Offset (kHz)	Measurement BW (kHz)	Measured ACCP at Fc – Offset (dBc)	Measured ACCP at Fc + Offset (dBc)	Maximum ACCP Relative (dBc)
9.375	6.25	-51.30	-42.45	-40
15.625	6.25	-65.07	-63.05	-60
21.875	6.25	-71.43	-70.62	-60
37.5	25	-68.76	-68.16	-65
62.5	25	-69.15	-69.31	-65
87.5	25	-69.29	-68.41	-65
150	100	-69.61	-69.58	-65
250	100	-72.49	-72.14	-65
>400 to receive band	30 (Swept)	<-75	<-75	-75
in the receive band	30 (Swept)	<-100	<-100	-100

6.10.5.2.17. Test Configuration #17: 800 MHz, Ref Power Level: 43 dBm, 12.5 kHz Channel Spacing, Digital Voice

Offset (kHz)	Measurement BW (kHz)	Measured ACCP at Fc – Offset (dBc)	Measured ACCP at Fc + Offset (dBc)	Maximum ACCP Relative (dBc)
9.375	6.25	-51.29	-43.02	-40
15.625	6.25	-64.64	-63.61	-60
21.875	6.25	-71.77	-70.06	-60
37.5	25	-67.44	-68.35	-65
62.5	25	-70.47	-69.32	-65
87.5	25	-69.01	-68.45	-65
150	100	-66.63	-67.19	-65
250	100	-70.52	-70.27	-65
>400 to receive band	30 (Swept)	<-75	<-75	-75
in the receive band	30 (Swept)	<-100	<-100	-100

6.10.5.2.18. Test Configuration #18: 806 MHz, Ref Power Level: 43 dBm, 12.5 kHz Channel Spacing, Digital Voice

Offset (kHz)	Measurement BW (kHz)	Measured ACCP at Fc – Offset (dBc)	Measured ACCP at Fc + Offset (dBc)	Maximum ACCP Relative (dBc)
9.375	6.25	-48.76	-45.26	-40
15.625	6.25	-65.08	-62.84	-60
21.875	6.25	-70.43	-69.99	-60
37.5	25	-65.66	-66.72	-65
62.5	25	-67.87	-67.05	-65
87.5	25	-66.82	-67.22	-65
150	100	-68.73	-69.24	-65
250	100	-70.83	-71.06	-65
>400 to receive band	30 (Swept)	<-75	<-75	-75
in the receive band	30 (Swept)	<-100	<-100	-100

6.11. TRANSMITTER ANTENNA POWER SPURIOUS/HARMONIC CONDUCTED EMISSIONS [§ 90.543(c)]

6.11.1. Limits

Out-of-band emission limit. On any frequency outside of the frequency ranges covered by the ACCP tables in this section, the power of any emission must be reduced below the unmodulated carrier power (P) by at least 43 + 10 log (P) dB

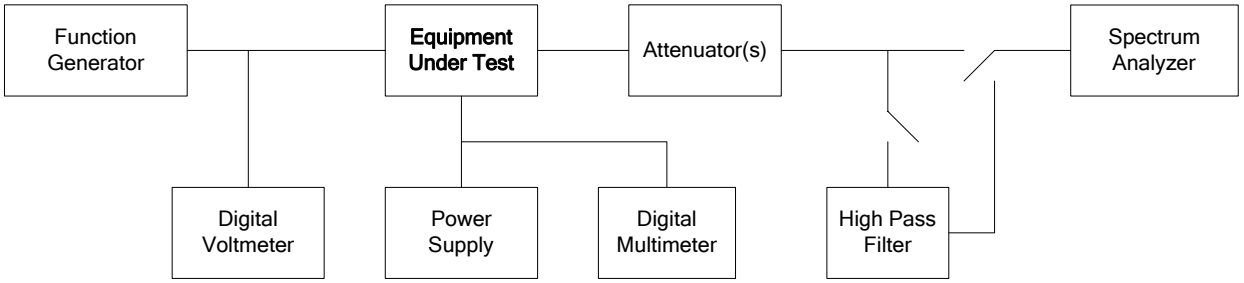
6.11.2. Method of Measurements

Refer to Exhibit 8 Section 8.4 of this report for measurement details

6.11.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Function Generator	Stanford Research Systems	DS345	34591	1 μHz – 30.2 MHz
Digital Voltmeter	Hewlett-Packard	3456A	2015A04523	DC-250 KHz
Spectrum Analyzer	Rhode & Schwarz	FSEK20/B4/B21	834157/005	9 kHz- 40 GHz
Attenuator	Weinschel Corp	48-30-34	BM5354	DC-18 GHz
Digital Multimeter	Tenma	72-6202	2080027	DC-100 kHz
Power Supply	Tenma	72-6153	--	DC 0-20 V, 0-10A.
High Pass Filter	Mini-Circuits	SHP-800	10425	Cut-off Frequency at 750 MHz

6.11.4. Test Arrangement



6.11.5. Test Data

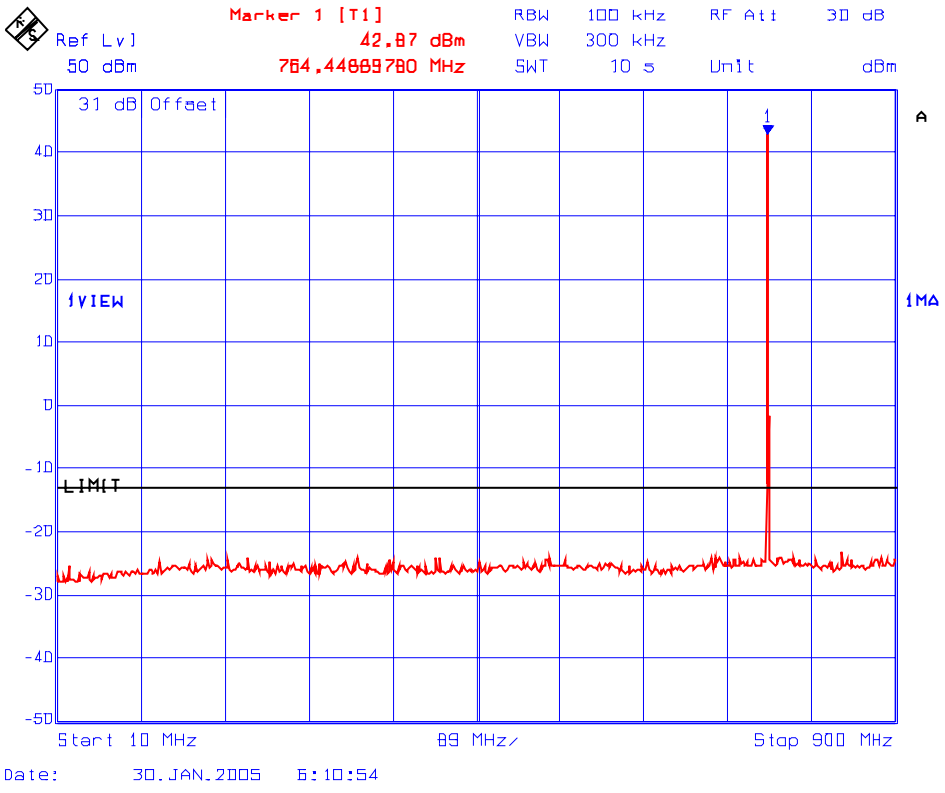
Remark:

Pre-scans performed on 12.5 kHz/ 25 kHz channel spacing with analog and digital modulations, no significant differences were observed. Therefore, the final conducted emissions tests are performed with 12.5 kHz channel spacing operation with 2.5 kHz sine wave modulation.

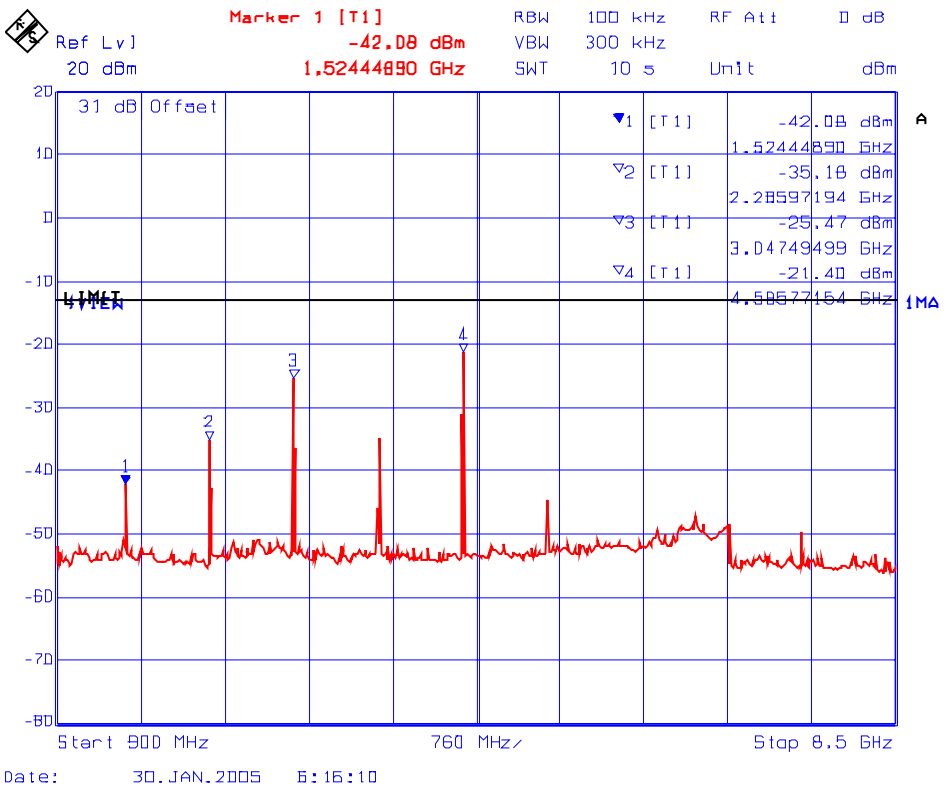
6.11.5.1. 764 – 776 MHz Band

6.11.5.1.1. Lowest Frequency (764 MHz)

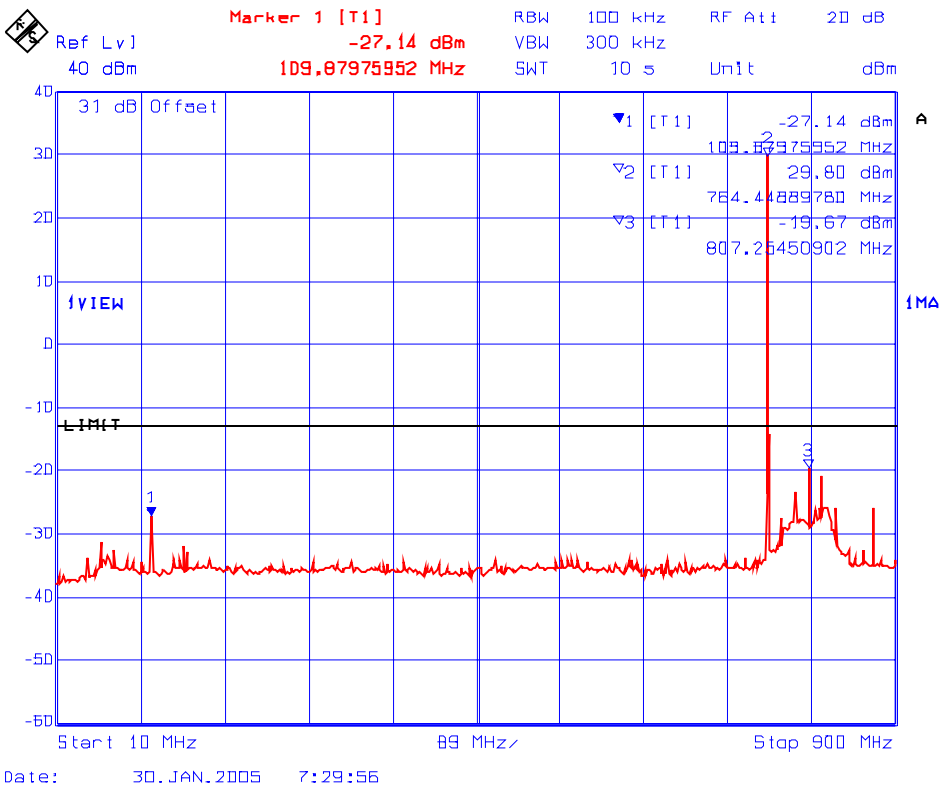
Plot 19: Spurious Emissions at Antenna Terminals
Fc: 764 MHz; Power: 20 W



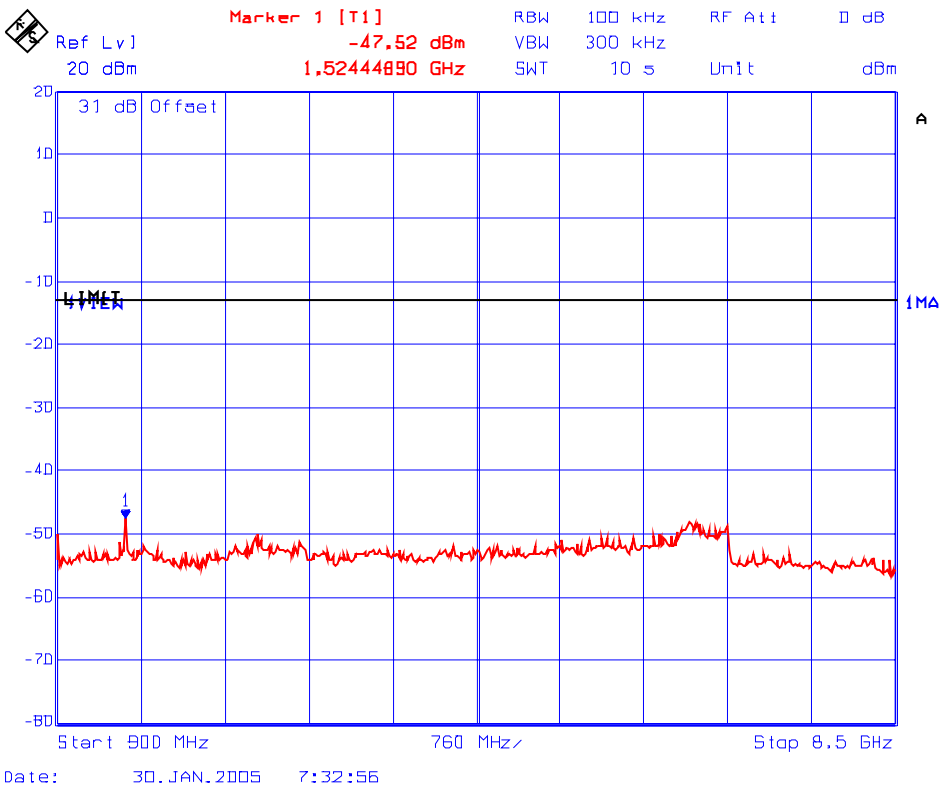
Plot 20: Spurious Emissions at Antenna Terminals
Fc: 764 MHz; Power: 20 W



Plot 21: Spurious Emissions at Antenna Terminals
Fc: 764 MHz; Power: 1 W

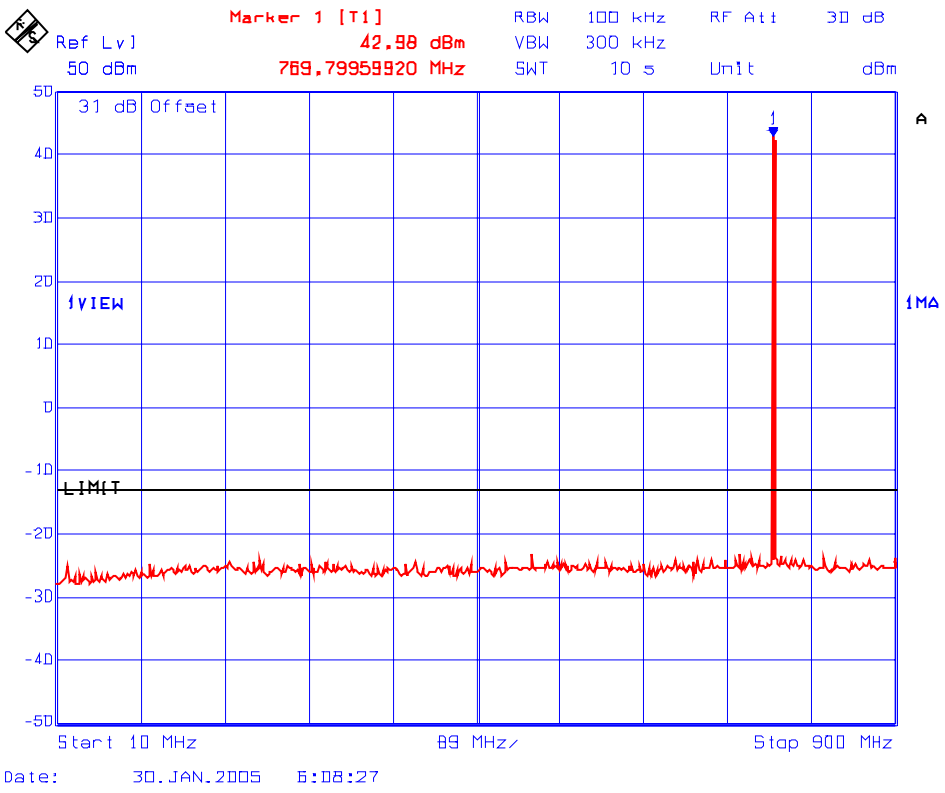


Plot 22: Spurious Emissions at Antenna Terminals
Fc: 764 MHz; Power: 1 W

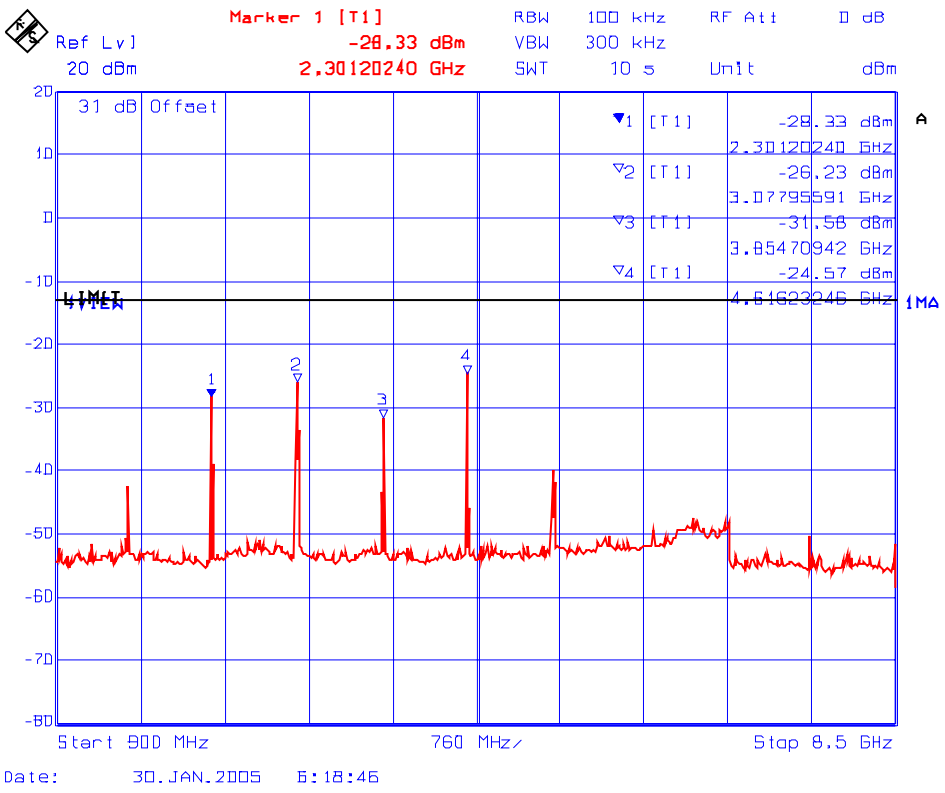


6.11.5.1.2. Middle Frequency (770 MHz)

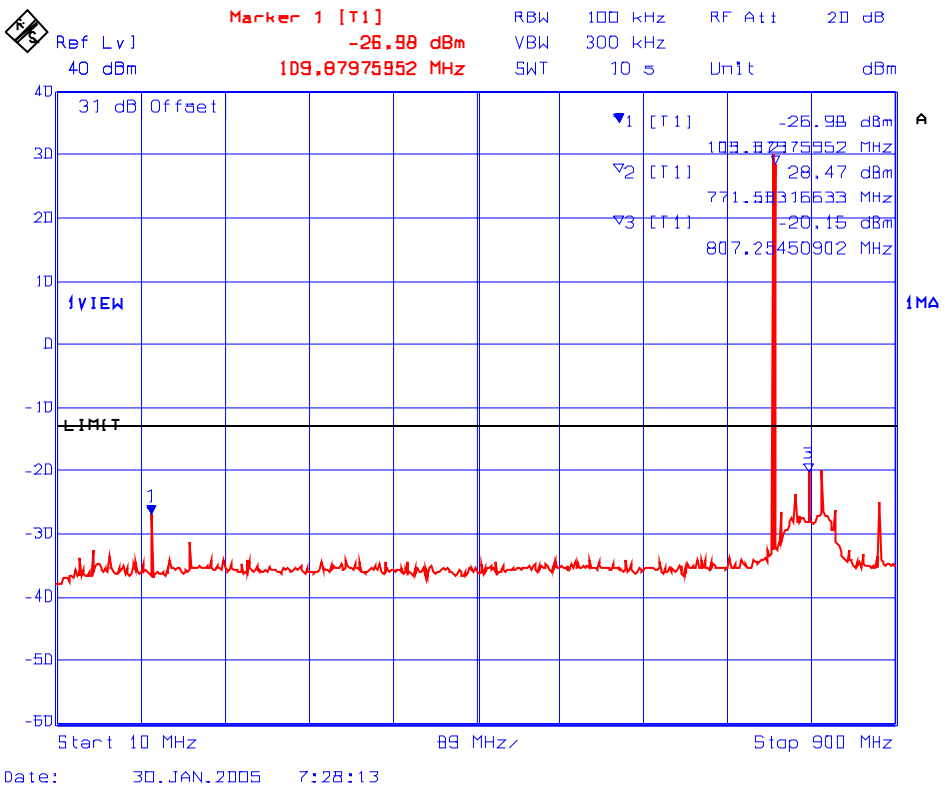
Plot 23: Spurious Emissions at Antenna Terminals
Fc: 770 MHz Power: 20 W



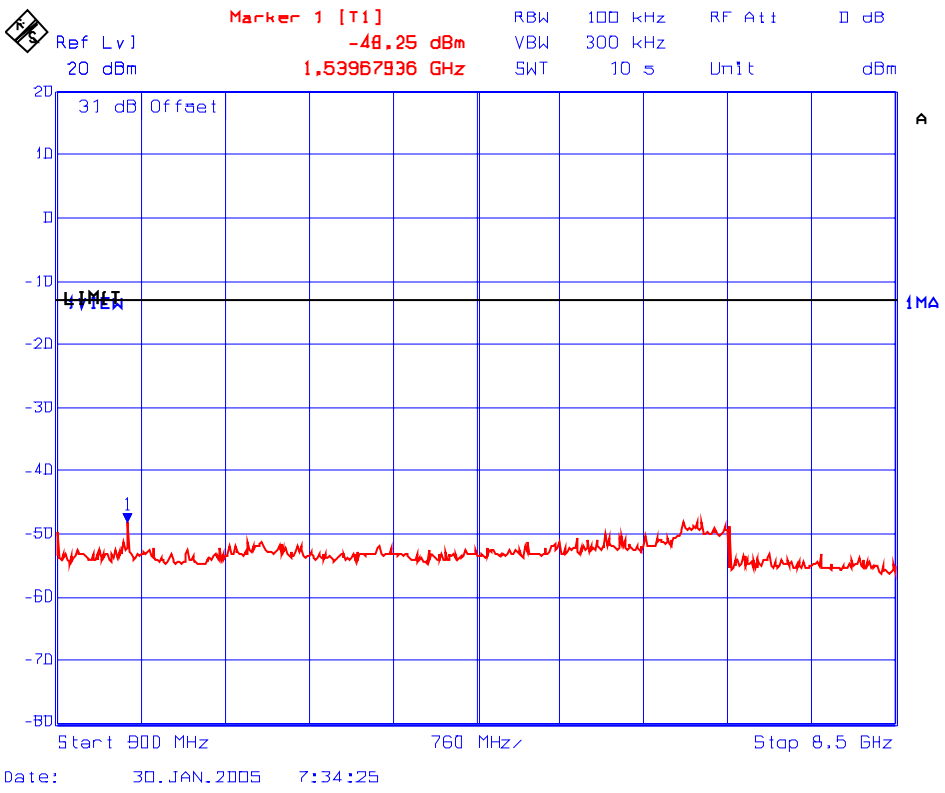
Plot 24: Spurious Emissions at Antenna Terminals
Fc: 770 MHz; Power: 20 W



Plot 25: Spurious Emissions at Antenna Terminals
Fc: 770 MHz; Power: 1 W

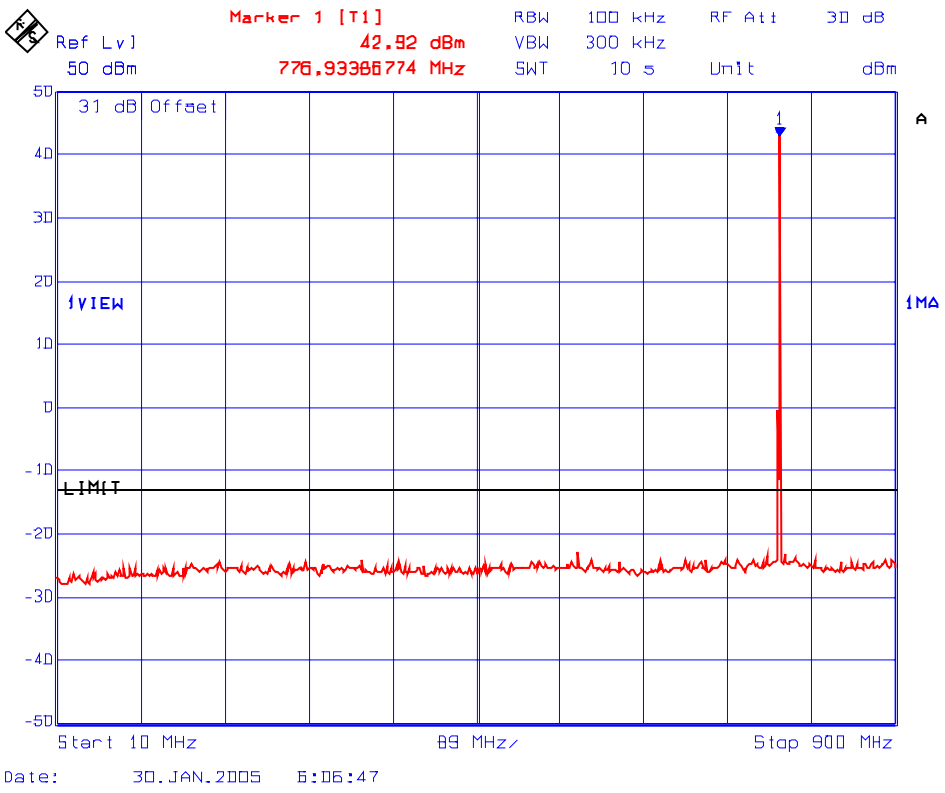


Plot 26: Spurious Emissions at Antenna Terminals
Fc: 770 MHz; Power: 1 W

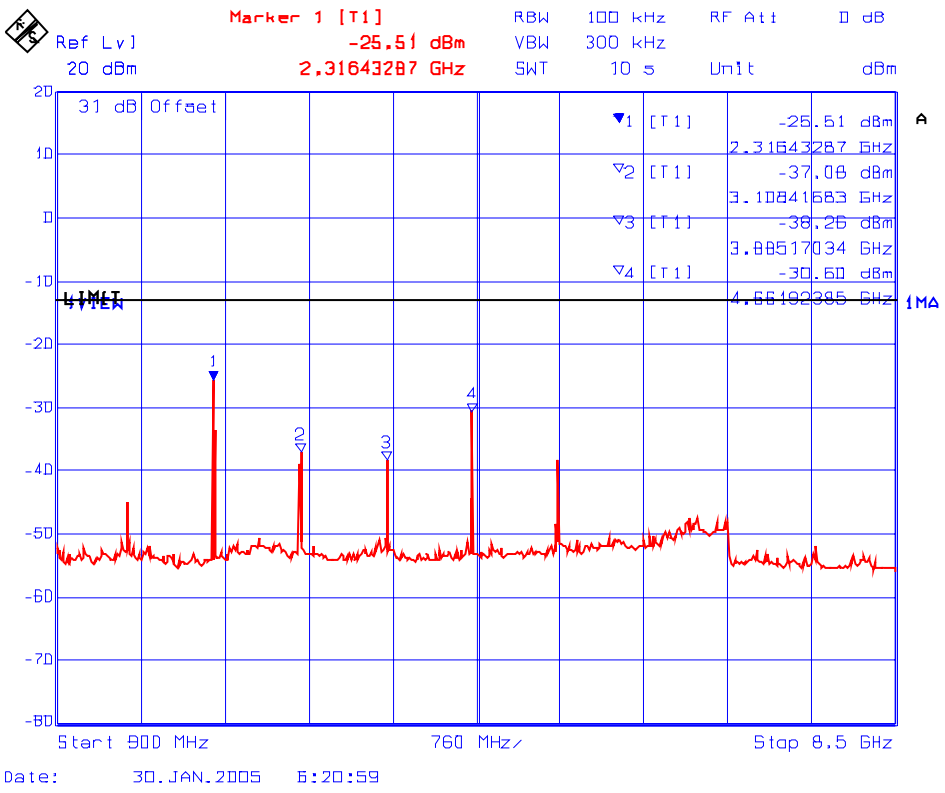


6.11.5.2. Highest Frequency (776 MHz)

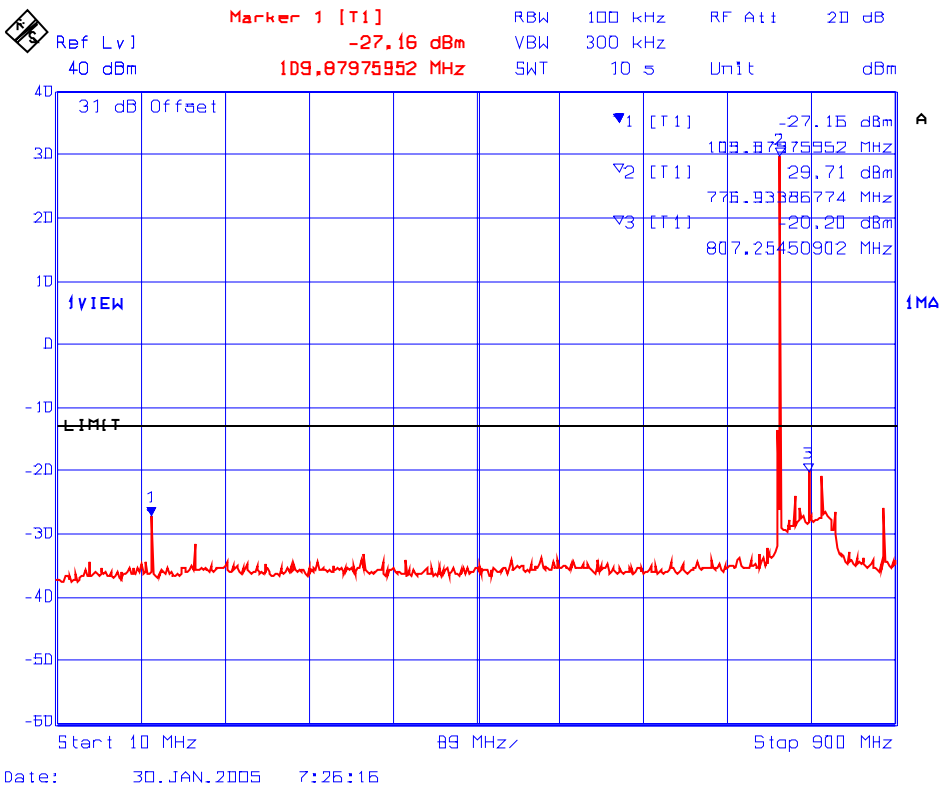
Plot 27: Spurious Emissions at Antenna Terminals
Fc: 776 MHz; Power: 20 W



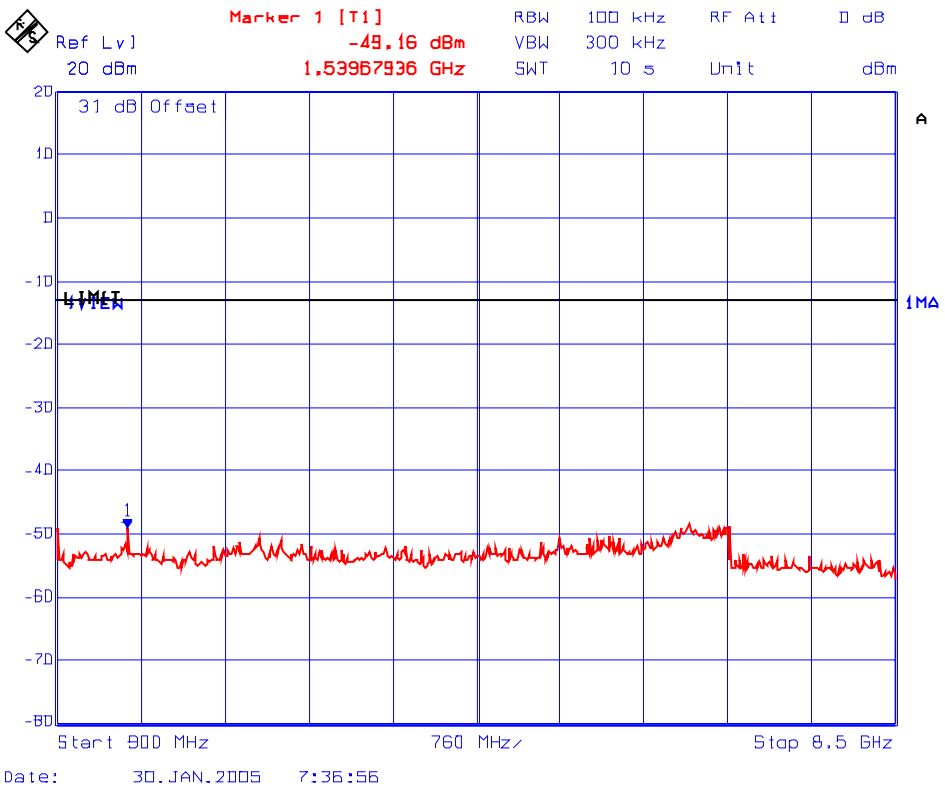
Plot 28: Spurious Emissions at Antenna Terminals
Fc: 776 MHz; Power: 20 W



Plot 29: Spurious Emissions at Antenna Terminals
Fc: 776 MHz; Power: 1 W



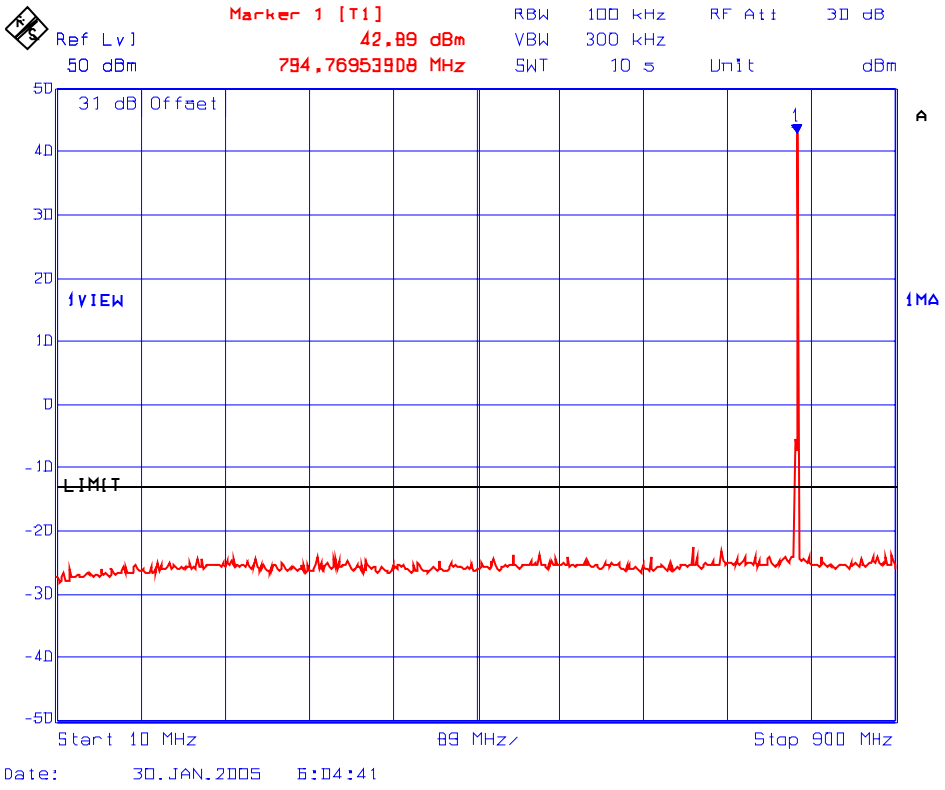
Plot 30: Spurious Emissions at Antenna Terminals
Fc: 776 MHz; Power: 1 W



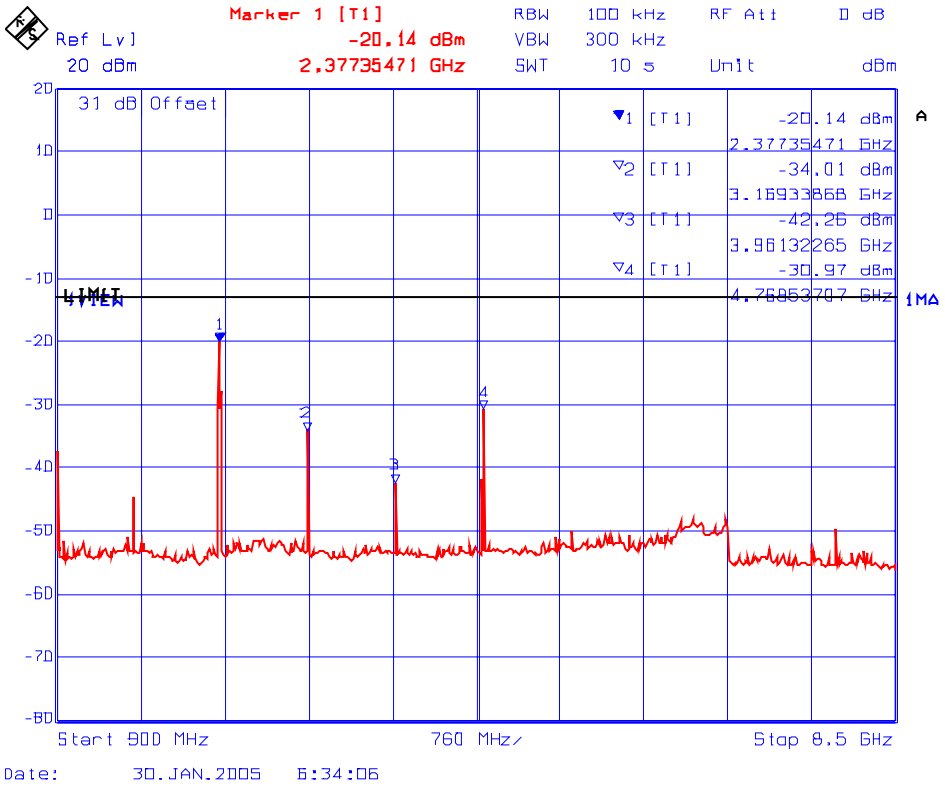
6.11.5.3. 794 – 806 MHz Band

6.11.5.4. Lowest Frequency (794 MHz)

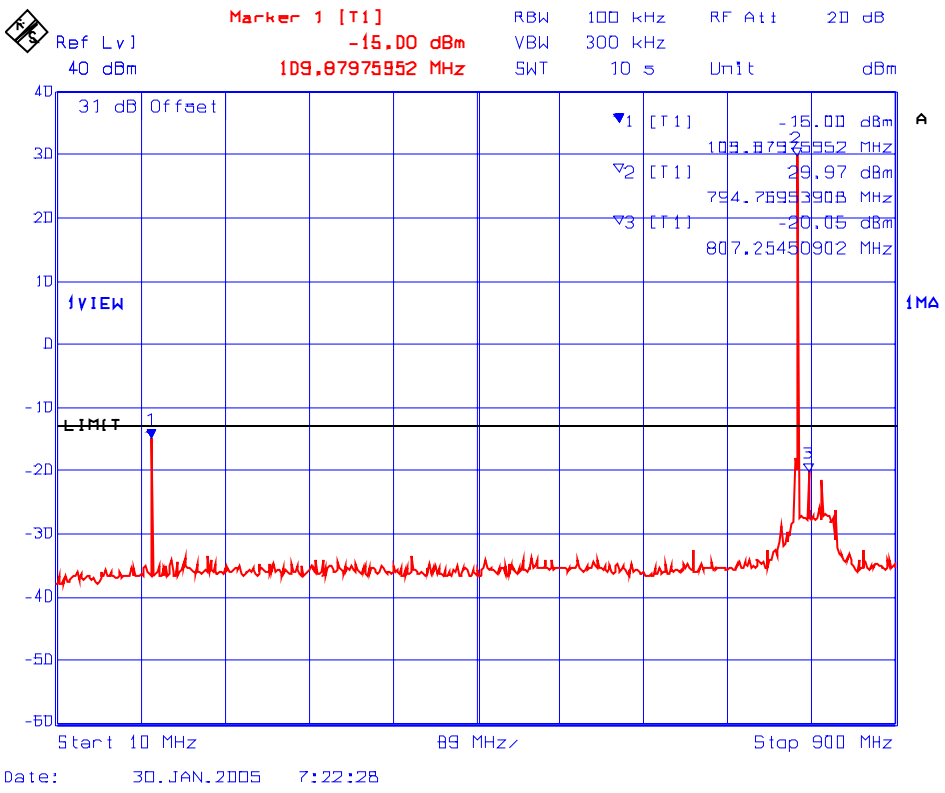
Plot 31: Spurious Emissions at Antenna Terminals
Fc: 794 MHz; Power: 20 W



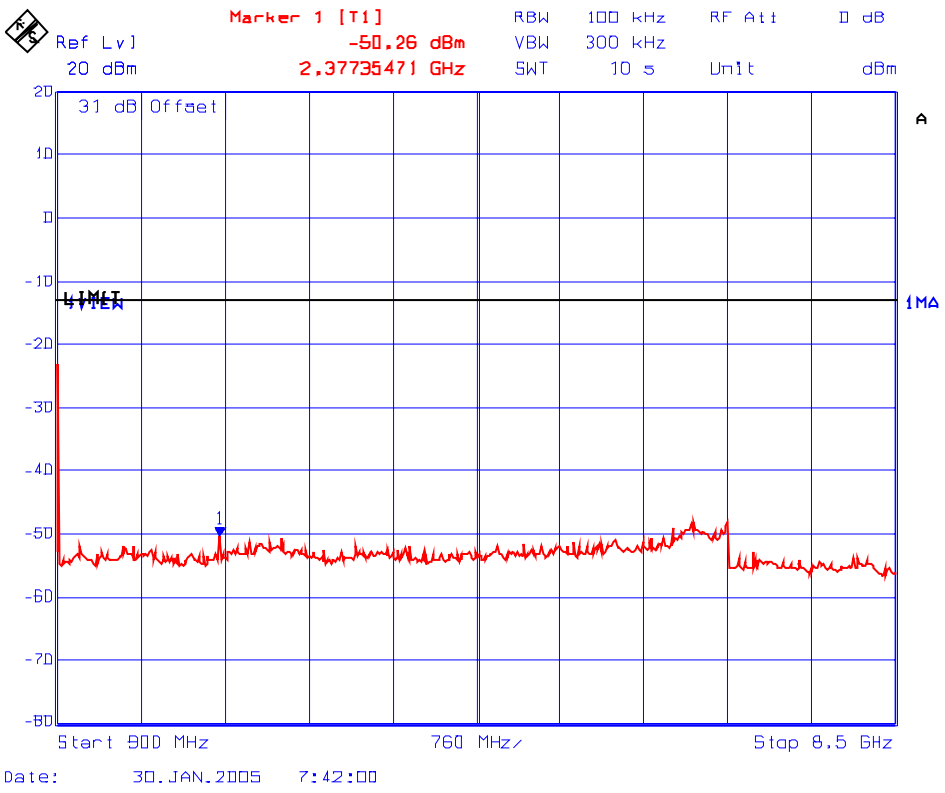
Plot 32: Spurious Emissions at Antenna Terminals
Fc: 794 MHz; Power: 20 W



Plot 33: Spurious Emissions at Antenna Terminals
Fc: 794 MHz; Power: 1 W

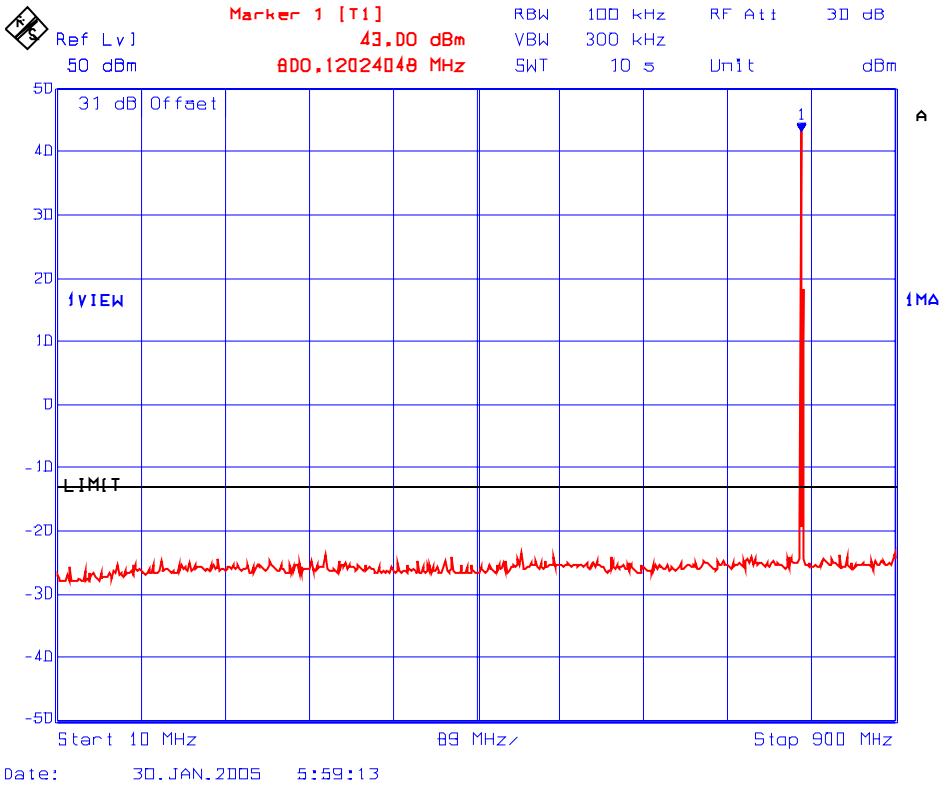


Plot 34: Spurious Emissions at Antenna Terminals
Fc: 794 MHz; Power: 1 W

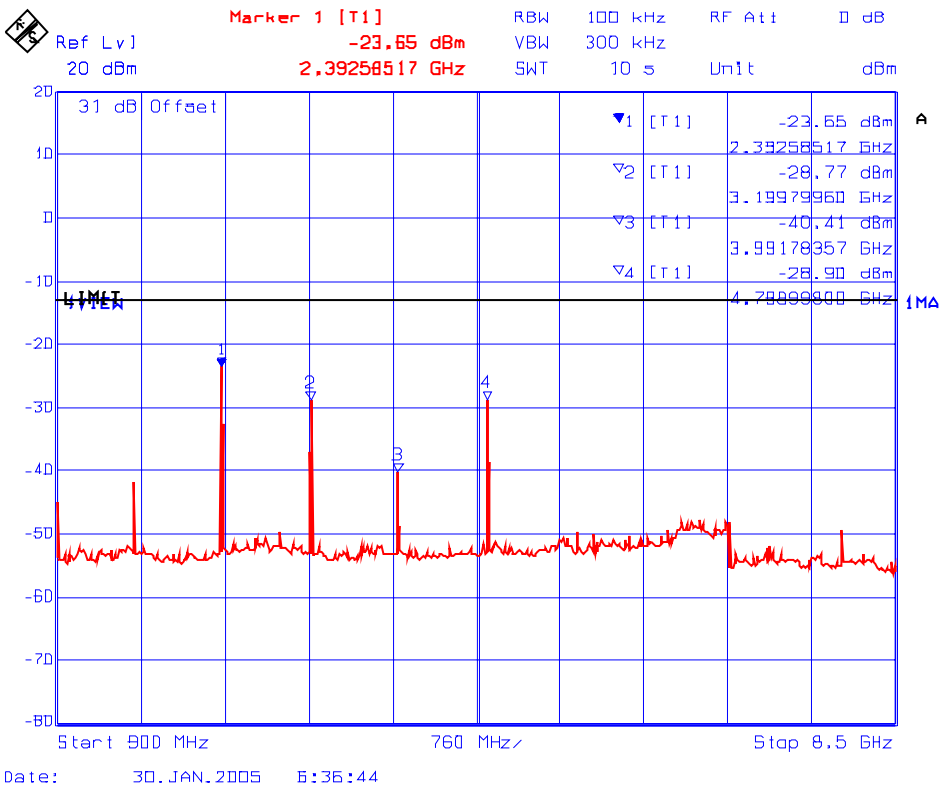


6.11.5.5. Middle Frequency (800 MHz)

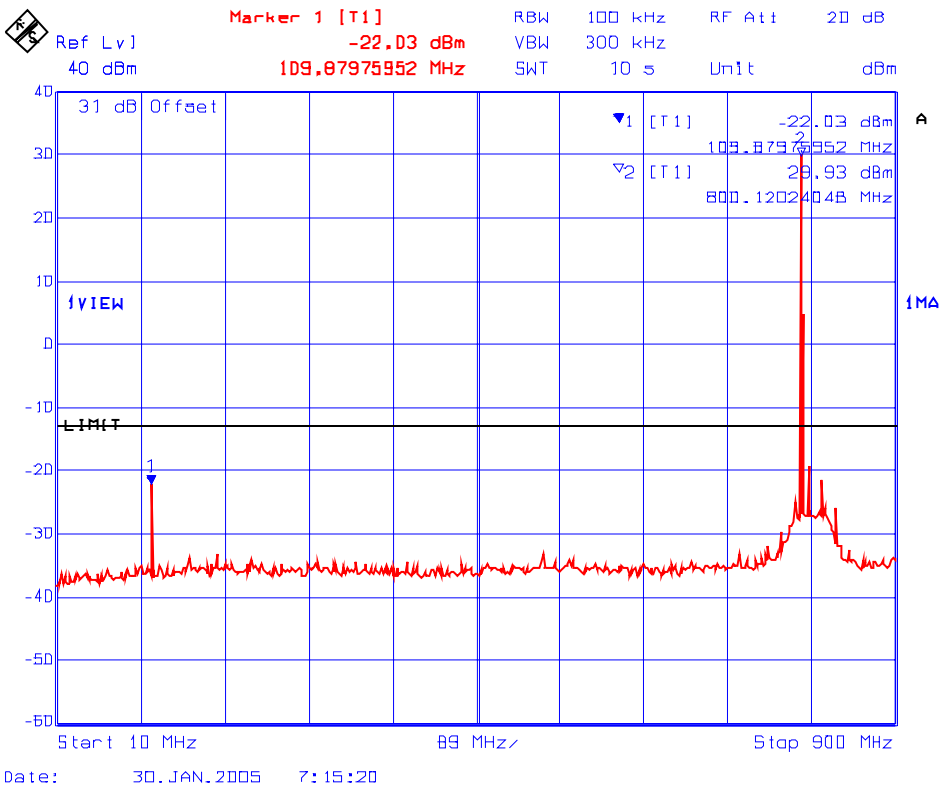
Plot 35: Spurious Emissions at Antenna Terminals
Fc: 800 MHz; Power: 20 W



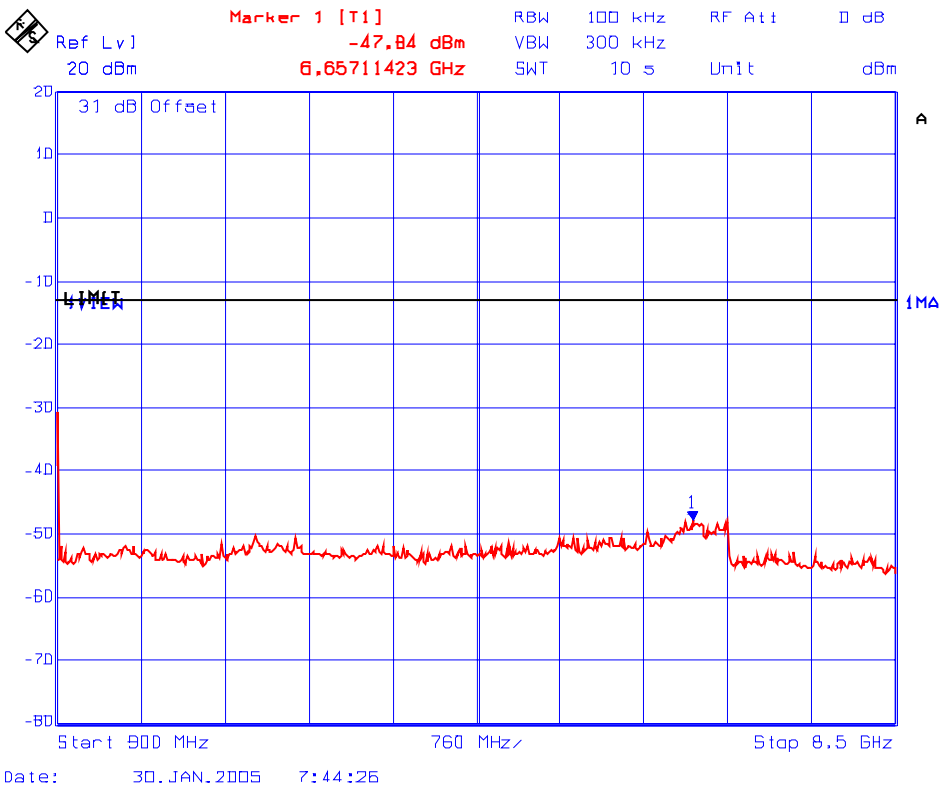
Plot 36: Spurious Emissions at Antenna Terminals
Fc: 800 MHz; Power: 20 W



Plot 37: Spurious Emissions at Antenna Terminals
Fc: 800 MHz; Power: 1 W

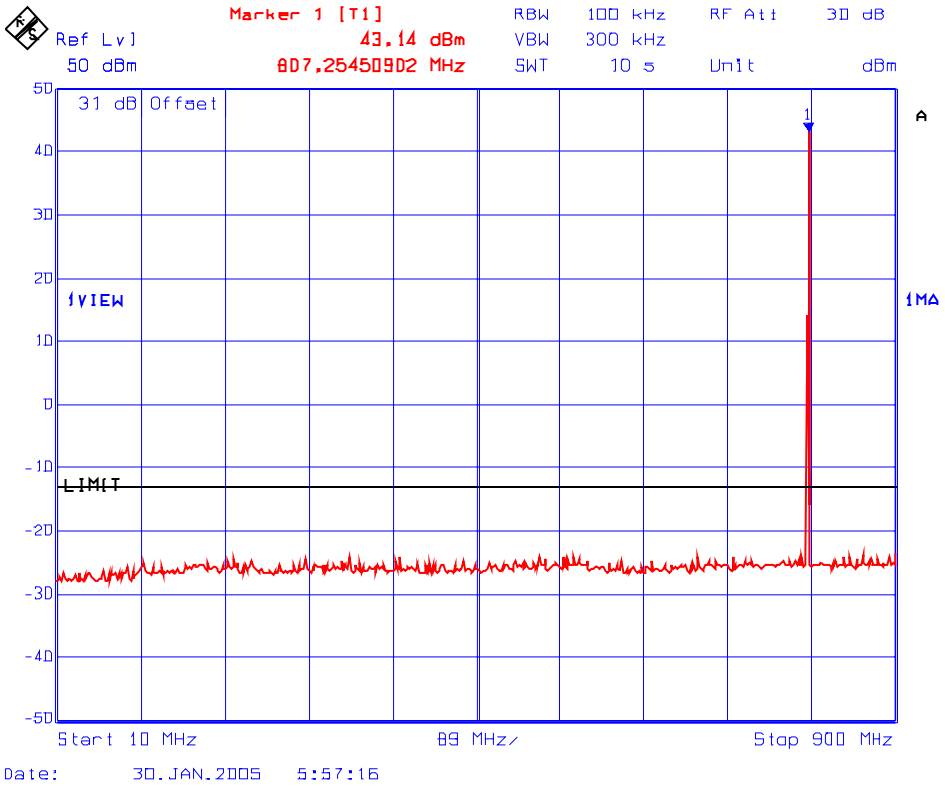


Plot 38: Spurious Emissions at Antenna Terminals
Fc: 800 MHz; Power: 1 W

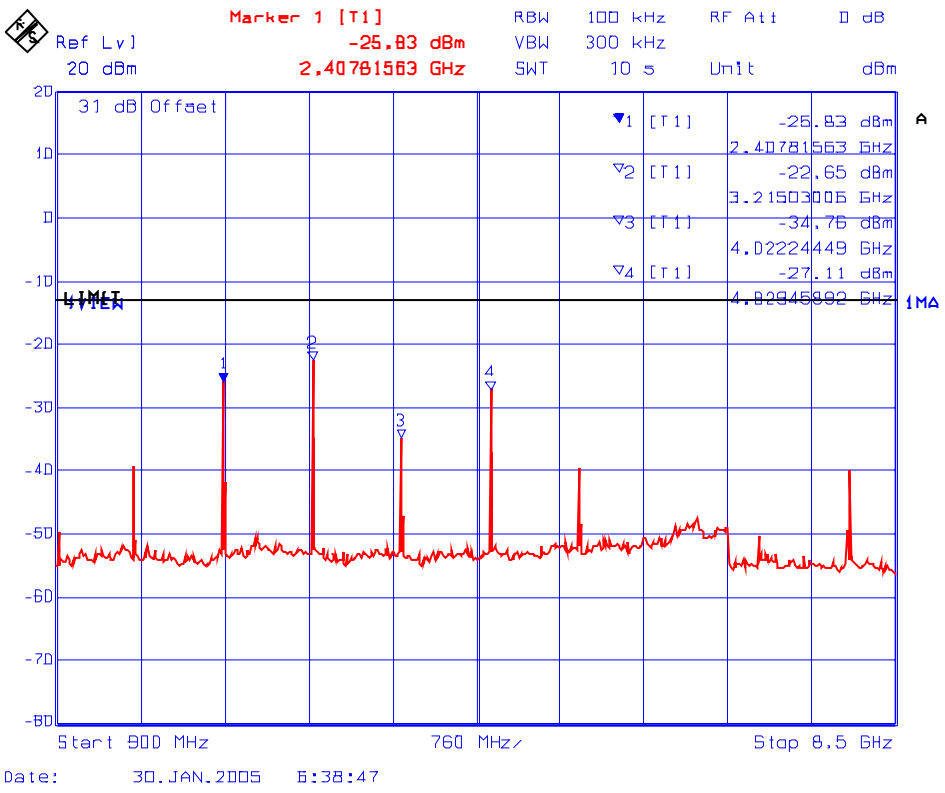


6.11.5.6. Highest Frequency (806 MHz)

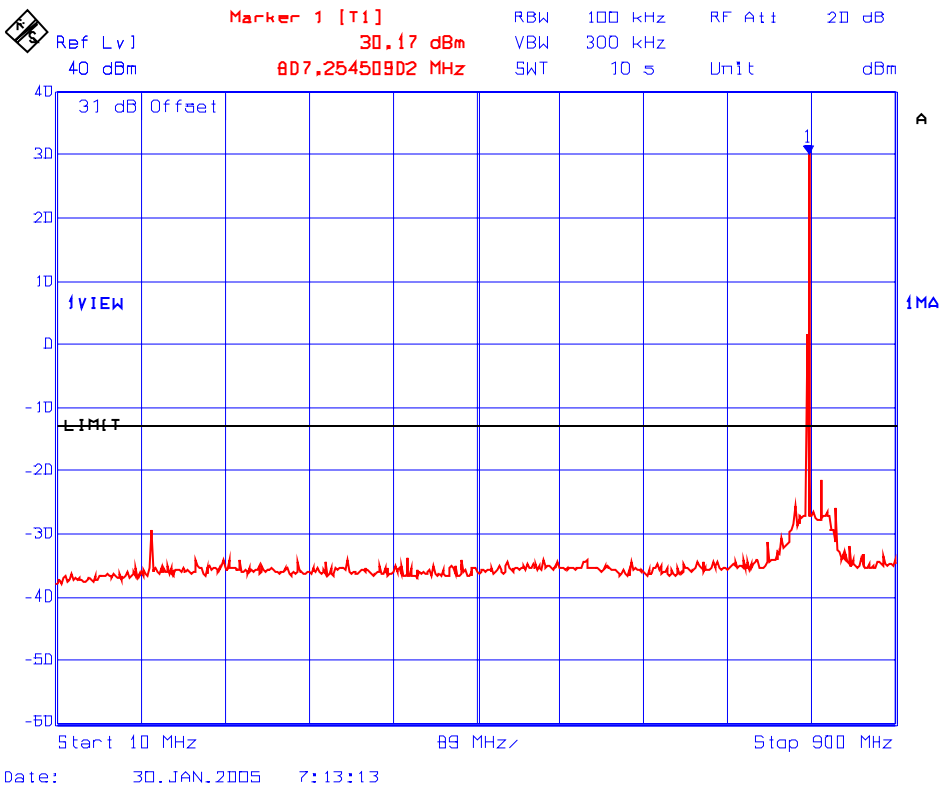
Plot 39: Spurious Emissions at Antenna Terminals
Fc: 806 MHz; Power: 20 W



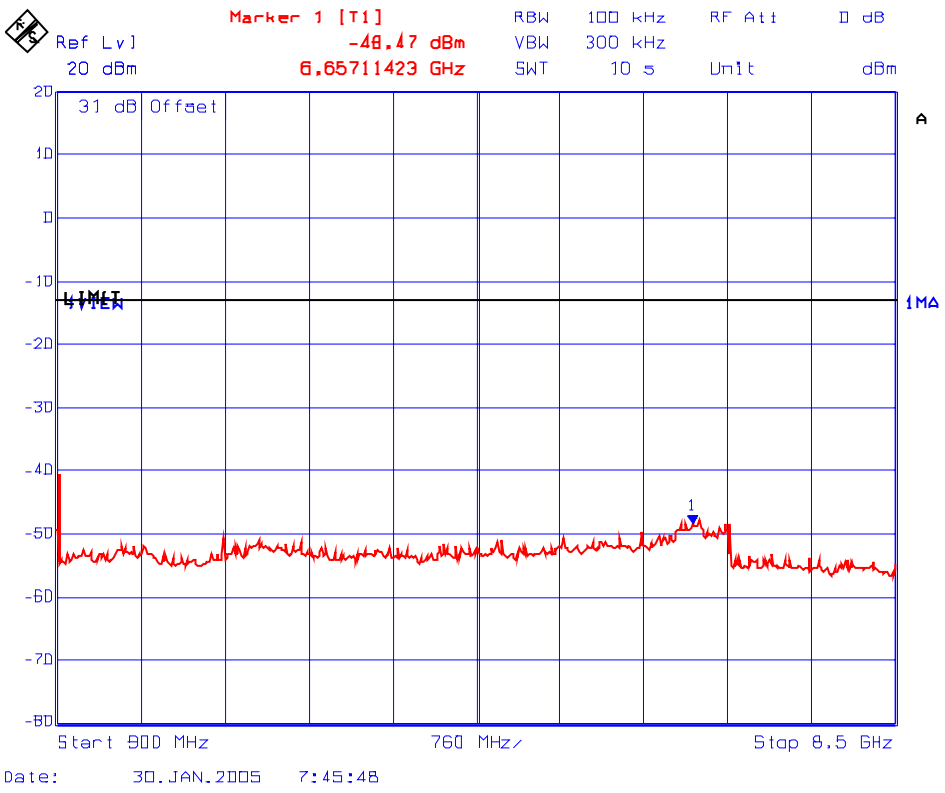
Plot 40: Spurious Emissions at Antenna Terminals
Fc: 806 MHz; Power: 20 W



Plot 41: Spurious Emissions at Antenna Terminals
Fc: 806 MHz; Power: 1 W



Plot 42: Spurious Emissions at Antenna Terminals
Fc: 806 MHz; Power: 1 W



6.12. TRANSMITTER SPURIOUS/HARMONIC RADIATED EMISSIONS [§ 90.543(c) & (e)]

6.12.1. Limits

Out-of-band emission limit. On any frequency outside of the frequency ranges covered by the ACCP tables in this section, the power of any emission must be reduced below the unmodulated carrier power (P) by at least 43 + 10 log (P) dB.

90.543(e) - For operations in the 764 to 776 MHz and 794 to 806 MHz bands, all emissions including harmonics in the band 1559-1610 MHz shall be limited to -70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and -80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

6.12.2. Method of Measurements

The spurious/harmonic ERP measurements are using substitution method specified in Exhibit 8, Section 8.2 of this report and its value in dBc is calculated as follows:

(1) If the transmitter's antenna is an integral part of the EUT, the ERP is measured using substitution method.
(2) If the transmitter's antenna is non-integral and diverse, the lowest ERP of the carrier with 0 dBi antenna gain is used for calculation of the spurious/harmonic emissions in dBc:
Lowest ERP of the carrier = EIRP – 2.15 dB = Pc + G - 2.15 dB = xxx dBm (conducted) + 0 dBi – 2.15 dB
(3) Spurious /harmonic emissions levels expressed in dBc (dB below carrier) are as follows:

ERP of spurious/harmonic (dBc) = ERP of carrier (dBm) – ERP of spurious/harmonic emission (dBm)

6.12.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Hewlett Packard	HP 8546A	…	9 kHz to 5.6 GHz with built-in 30 dB Gain Pre-selector, QP, Average & Peak Detectors.
RF Amplifier	Com-Power	PA-102		1 MHz to 1 GHz, 30 dB gain nomimal
Microwave Amplifier	Hewlett Packard	HP 83017A		1 GHz to 26.5 GHz, 30 dB nominal
Biconilog Antenna	EMCO	3142	10005	30 MHz to 2 GHz
Dipole Antenna	EMCO	3121C	8907-434	30 GHz – 1 GHz
Dipole Antenna	EMCO	3121C	8907-440	30 GHz – 1 GHz
Horn Antenna	EMCO	3155	9701-5061	1 GHz – 18 GHz
Horn Antenna	EMCO	3155	9911-5955	1 GHz – 18 GHz
RF Signal Generator	Hewlett Packard	HP 83752B	3610A00457	0.01 – 20 GHz

6.12.4. Test Data

Remarks:

- FCC 90.543(e) is not applicable for this device, transmit signals are not wideband or discrete signals.
- The rf spurious/harmonic emission characteristics between 2 different channel spacing operations and different modulations (voice/digital) are identical. Therefore, the following radiated emissions were performed on the radio set with 12.5 kHz channel spacing operation.
- The radiated emissions were performed at 3 meters distance. At its maximum power for worst case.
- The emissions were scanned from 10 MHz to 10 GHz; all emissions that are within 20 dB below the limit are recorded.

6.12.4.1. 764-776 MHz Band

6.12.4.1.1. Lowest Frequency (764 MHz)

Carrier Frequency (MHz):	764
Power (dBm):	43
Limit (dBc):	-56

All emissions are more than 20 dB below the limit.

6.12.4.1.2. Middle Frequency (770 MHz)

Carrier Frequency (MHz):	770
Power (dBm):	43
Limit (dBc):	-56

Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP measured by Substitution Method (dBm)	(dBc)	Limit (dBc)	Margin (dB)
2310	73.28	Peak	V	-28.85	-71.9	-56	-15.9
2310	71.64	Peak	H	-31.17	-74.2	-56	-18.2

6.12.4.1.3. Highest Frequency (776 MHz)

Carrier Frequency (MHz):	776
Power (dBm):	43
Limit (dBc):	-56

Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP measured by Substitution Method (dBm)	(dBc)	Limit (dBc)	Margin (dB)
2328	75.08	Peak	V	-25.53	-68.5	-56	-12.5
2328	75.41	Peak	H	-26.98	-70.0	-56	-14.0

6.12.4.2. 794-806 MHz Band

6.12.4.2.1. Highest Frequency (794 MHz)

Carrier Frequency (MHz): 794
Power (dBm): 43
Limit (dBc): -56

Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP measured by Substitution Method (dBm)	(dBc)	Limit (dBc)	Margin (dB)
2382	77.06	Peak	V	-24.07	-67.1	-56	-11.1
2382	77.41	Peak	H	-24.76	-67.8	-56	-11.8

6.12.4.2.2. Highest Frequency (800 MHz)

Carrier Frequency (MHz): 800
Power (dBm): 43
Limit (dBc): -56

Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP measured by Substitution Method (dBm)	(dBc)	Limit (dBc)	Margin (dB)
2400	72.95	Peak	V	-27.85	-70.9	-56	-14.9
2400	70.97	Peak	H	-31.84	-74.8	-56	-18.8

6.12.4.2.3. Highest Frequency (806 MHz)

Carrier Frequency (MHz): 806
Power (dBm): 43
Limit (dBc): -56

Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP measured by Substitution Method (dBm)	(dBc)	Limit (dBc)	Margin (dB)
2418	69.53	Peak	V	-32.81	-75.8	-56	-19.8
3224	77.96	Peak	V	-24.63	-67.6	-56	-11.6
3224	77.35	Peak	H	-25.71	-68.7	-56	-12.7

EXHIBIT 7. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of NIST Technical Note 1297 and NIS 81 (1994)

7.1. Radiated Emission Measurement Uncertainty

CONTRIBUTION (Radiated Emissions)	PROBABILITY DISTRIBUTION	UNCERTAINTY (± dB)	
		3 m	10 m
Antenna Factor Calibration	Normal (k=2)	±1.0	±1.0
Cable Loss Calibration	Normal (k=2)	±0.3	±0.5
EMI Receiver specification	Rectangular	±1.5	±1.5
Antenna Directivit	Rectangular	+0.5	+0.5
Antenna factor variation with height	Rectangular	±2.0	±0.5
Antenna phase center variation	Rectangular	0.0	±0.2
Antenna factor frequency interpolation	Rectangular	±0.25	±0.25
Measurement distance variation	Rectangular	±0.6	±0.4
Site imperfections	Rectangular	±2.0	±2.0
Mismatch: Receiver VRC Γ_1 = 0.2 Antenna VRC Γ_R = 0.67(Bi) 0.3 (Lp) Uncertainty limits 20Log(1±$\Gamma_1\Gamma_R$)	U-Shaped	+1.1 -1.25	±0.5
System repeatability	Std. Deviation	±0.5	±0.5
Repeatability of EUT		-	-
Combined standard uncertainty	Normal	+2.19 / -2.21	+1.74 / -1.72
Expanded uncertainty U	Normal (k=2)	+4.38 / -4.42	+3.48 / -3.44

Calculation for maximum uncertainty when 3m biconical antenna including a factor of k = 2 is used:

$U = 2u_c(y) = 2x(+2.19) = +4.38$ dB And $U = 2u_c(y) = 2x(-2.21) = -4.42$ dB

EXHIBIT 8. MEASUREMENT METHODS

8.1. CONDUCTED POWER MEASUREMENTS

- The following shall be applied to the combination(s) of the radio device and its intended antenna(e).
- I f the RF level is user adjustable, all measurements shall be made with the highest power level available to the user for that combination.
- The following method of measurement shall apply to both conducted and radiated measurements.
- The radiated measurements are performed at the Ultratech Calibrated Open Field Test Site.
- The measurement shall be performed using normal operation of the equipment with modulation.

Test procedure shall be as follows:

Step 1: Duty Cycle measurements if the transmitter's transmission is transient

- Using a EMI Receiver with the frequency span set to 0 Hz and the sweep time set at a suitable value to capture the envelope peaks and the duty cycle of the transmitter output signal;
- The duty cycle of the transmitter, x = Tx on / (Tx on + Tx off) with 0<x<1, is measure and recorded in the test report. For the purpose of testing, the equipment shall be operated with a duty cycle that is equal or more than 0.1.

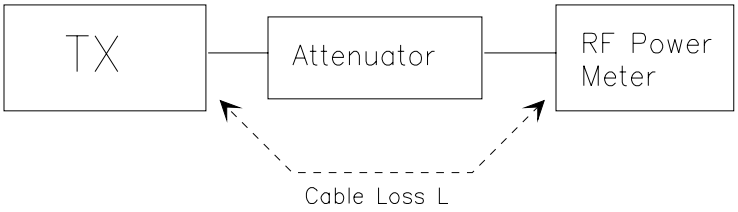
Step 2: Calculation of Average EIRP. See Figure 1

- The average output power of the transmitter shall be determined using a wideband, calibrated RF average power meter with the power sensor with an integration period that exceeds the repetition period of the transmitter by a factor 5 or more. The observed value shall be recorded as "A" (in dBm);
- The e.i.r.p. shall be calculated from the above measured power output "A", the observed duty cycle x, and the applicable antenna assembly gain "G" in dBi, according to the formula:

EIRP = A + G + 10log(1/x)

{ X = 1 for continuous transmission => 10log(1/x) = 0 dB }

Figure 1.



8.2. RADIATED POWER MEASUREMENTS (ERP & EIRP) USING SUBSTITUTION METHOD

8.2.1. Maximizing RF Emission Level (E-Field)

(a) The measurements were performed with full rf output power and modulation.
(b) Test was performed at listed 3m open area test site (listed with FCC, IC, ITI, NVLAP, ACA & VCCI).
(c) The transmitter under test was placed at the specified height on a non-conducting turntable (80 cm height)
(d) The BICONILOG antenna (20 MHz to 1 GHz) or HORN antenna (1 GHz to 18 GHz) was used for measuring.
(e) Load an appropriate correction factors file in EMI Receiver for correcting the field strength reading level

Total Correction Factor recorded in the EMI Receiver = Cable Loss + Antenna Factor
E (dBμV/m) = Reading (dBμV) + Total Correction Factor (dB/m)

(f) Set the EMI Receiver and #2 as follows:

Center Frequency:	test frequency
Resolution BW:	100 kHz
Video BW:	same
Detector Mode:	positive
Average:	off
Span:	3 x the signal bandwidth

(g) The test antenna was lowered or raised from 1 to 4 meters until the maximum signal level was detected.
(h) The transmitter was rotated through 360° about a vertical axis until a higher maximum signal was received.
(i) The test antenna was lowered or raised again from 1 to 4 meters until a maximum was obtained. This level was recorded.
(j) The recorded reading was corrected to the true field strength level by adding the antenna factor, cable loss and subtracting the pre-amplifier gain.
(k) The above steps were repeated with both transmitters' antenna and test receiving antenna placed in vertical and horizontal polarization. Both readings with the antennas placed in vertical and horizontal polarization shall be recorded.
(l) Repeat for all different test signal frequencies.

8.2.2. Measuring the EIRP of Spurious/Harmonic Emissions using Substitution Method

(a) Set the EMI Receiver (for measuring E-Field) and Receiver #2 (for measuring EIRP) as follows:

Center Frequency:	equal to the signal source
Resolution BW:	10 kHz
Video BW:	same
Detector Mode:	positive
Average:	off
Span:	3 x the signal bandwidth

(b) Load an appropriate correction factors file in EMI Receiver for correcting the field strength reading level

Total Correction Factor recorded in the EMI Receiver = Cable Loss + Antenna Factor
E (dBuV/m) = Reading (dBuV) + Total Correction Factor (dB/m)

(c) Select the frequency and E-field levels obtained in the Section 8.2.1 for ERP/EIRP measurements.
(d) Substitute the EUT by a signal generator and one of the following transmitting antenna (substitution antenna):
- ♦ DIPOLE antenna for frequency from 30-1000 MHz or
- ♦ HORN antenna for frequency above 1 GHz }.

(e) Mount the transmitting antenna at 1.5 meter high from the ground plane.
(f) Use one of the following antenna as a receiving antenna:
- ♦ DIPOLE antenna for frequency from 30-1000 MHz or
- ♦ HORN antenna for frequency above 1 GHz }.

(g) If the DIPOLE antenna is used, tune it's elements to the frequency as specified in the calibration manual.
(h) Adjust both transmitting and receiving antenna in a VERTICAL polarization.
(i) Tune the EMI Receivers to the test frequency.
(j) Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.
(k) The transmitter was rotated through 360^{o} about a vertical axis until a higher maximum signal was received.
(l) Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.
(m) Adjust input signal to the substitution antenna until an equal or a known related level to that detected from the transmitter was obtained in the test receiver.
(n) Record the power level read from the Average Power Meter and calculate the ERP/EIRP as follows:

P = P1 - L1 = (P2 + L2) – L1 = P3 + A + L2 - L1
EIRP = P + G1 = P3 + L2 - L1 + A + G1
ERP = EIRP – 2.15 dB
Total Correction factor in EMI Receiver # 2 = L2 – L1 + G1

Where:	P:	Actual RF Power fed into the substitution antenna port after corrected.
	P1:	Power output from the signal generator
	P2:	Power measured at attenuator A input
	P3:	Power reading on the Average Power Meter
	EIRP:	EIRP after correction
	ERP:	ERP after correction

(o) Adjust both transmitting and receiving antenna in a HORIZONTAL polarization, then repeat step (k) to (o)
(p) Repeat step (d) to (o) for different test frequency
(q) Repeat steps (c) to (j) with the substitution antenna oriented in horizontal polarization.
(r) Actual gain of the EUT's antenna is the difference of the measured EIRP and measured RF power at the RF port. Correct the antenna gain if necessary.

Figure 2

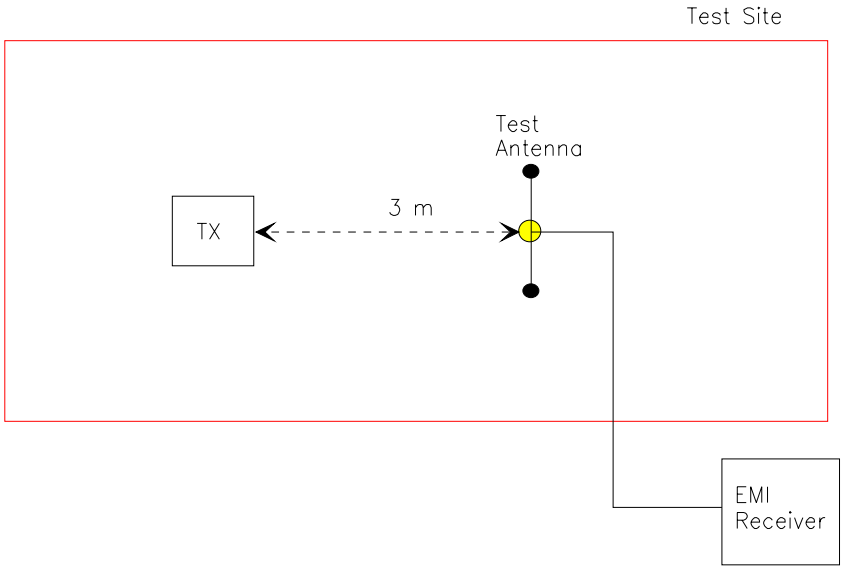
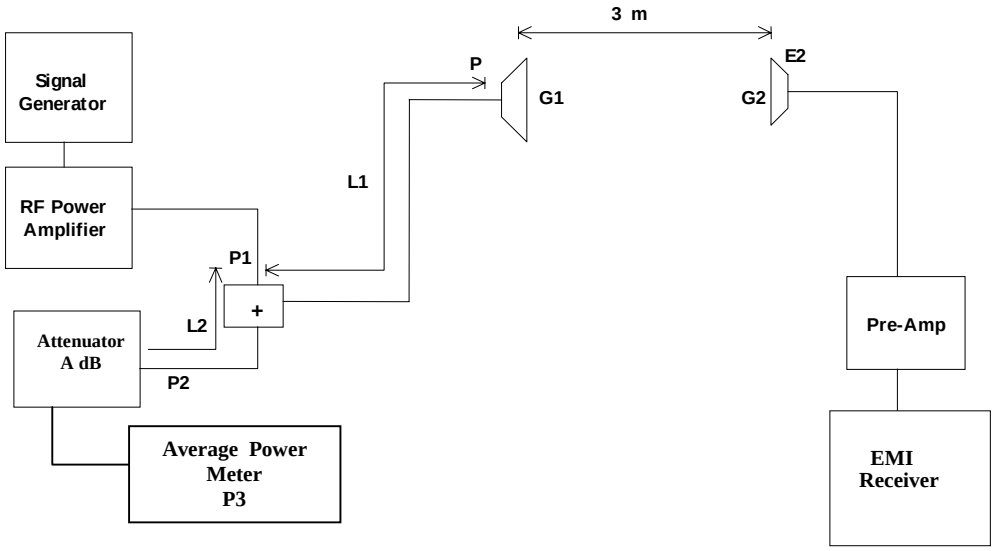


Figure 3



8.3. FREQUENCY STABILITY

Refer to FCC @ 2.1055.

(a) The frequency stability shall be measured with variation of ambient temperature as follows: From -30 to +50 centigrade except that specified in subparagraph (2) & (3) of this paragraph.

(b) Frequency measurements shall be made at extremes of the specified temperature range and at intervals of not more than 10 centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short-term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stability circuitry need be subjected to the temperature variation test.

(d) The frequency stability supply shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

(2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

(3) The supply voltage shall be measured at the input to the cable normally provide with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

(e) When deemed necessary, the Commission may require tests of frequency stability under conditions in addition to those specifically set out in paragraphs (a), (b), (c) and (d) of this section. (For example, measurements showing the effect of proximity to large metal objects, or of various types of antennas, may be required for portable equipment).

8.4. SPURIOUS EMISSIONS (CONDUCTED)

With transmitter modulation characteristics described in Out-of-Band Emissions measurements @ 2.1049, the transmitter spurious and harmonic emissions were scanned. The spurious and harmonic emissions were measured with the EMI Receiver controls set as RBW = 30 kHz minimum , VBW ≥ RBW and SWEEP TIME = AUTO). The transmitter was operated at a full rated power output, and modulated as follows:

FCC CFR 47, Para. 2.1057 - Frequency spectrum to be investigated:- The spectrum was investigated from the lowest radio generated in the equipment up to at least the 10^{th} harmonic of the carrier frequency or to the highest frequency practicable in the present state of the art of measuring techniques, whichever is lower. Particular attention should be paid to harmonics and subharmonics of the carrier frequency. Radiation at the frequencies of multiplier stages should be checked. The
amplitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be reported.

FCC CFR 47, Para. 2.1051 - Spurious Emissions at Antenna Terminal:- The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of the harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.