ENGINEERING TEST REPORT

Signal Booster II
Model No.: 61-65-50
FCC ID: EZZ5PI616550

Applicant:

TX RX Systems, Inc.
8625 Industrial Parkway
Angola, NY 14006
USA

Tested in Accordance With

Federal Communications Commission (FCC)
47 CFR Parts 2 and 90 (Subpart I)

UltraTech's File No.: TXRX-017F90

This Test report is Issued under the Authority of Tri M. Luu, Professional Engineer, Vice President of Engineering UltraTech Group of Labs Date: August 28, 2006	
Report Prepared by: Dan Huynh Issued Date: August 28, 2006	Tested by: Hung Trinh, EMI/RFI Technician Test Dates: June 22 - August 8, 2006

- *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	OK
1	Test Setup Photos	Radiated Emission Setup Photos	OK
2	External Photos of EUT	External Photos	OK
3	Internal Photos of EUT	Internal Photos	OK
4	Cover Letters	• Letter from Ultratech for Certification Request • 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	--	--
6	ID Label/Location Info	ID Label and Location of ID Label	OK
7	Block Diagrams	Block Diagram	OK
8	Schematic Diagrams	Schematics	OK
9	Parts List/Tune Up Info	Parts List/ Tuning Procedures	OK
10	Operational Description	Operational Description	OK
11	RF Exposure Info	See Section 6.6 of this test report for MPE evaluation	OK
12	User's Manual	Installation and Operation Manual for the Two-Way Signal Booster System	OK

EXHIBIT 2. INTRODUCTION

2.1. SCOPE

Reference:	FCC Parts 2 and 90
Title:	Code of Federal Regulations (CFR), Title 47 - Telecommunication, Parts 2 and 90 (Subpart I).
Purpose of Test:	To gain FCC Certification Authorization for Radio operating in the frequency band 406-430 MHz
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.
Environmental Classification:	Commercial, industrial or business

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

None.

2.3. NORMATIVE REFERENCES

Publication	Year	Title
FCC CFR Parts 0-19, 80-End	2005	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
CISPR 22 & EN 55022	2003 2003	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
CISPR 16-1	2003	Specification for Radio Disturbance and Immunity measuring apparatus and methods
TIA-603-C	2004	Land Mobile FM or PM – Communications Equipment – Measurement and Performance Standards.

EXHIBIT 3. PERFORMANCE ASSESSMENT

3.1. CLIENT INFORMATION

APPLICANT	
Name:	TX RX Systems, Inc.
Address:	8625 Industrial Parkway Angola, NY 14006 USA
Contact Person:	William J. Aquino Phone #: 716-549-4700 ext 5019 Fax #: 716-549-4772 Email Address: baquino@birdtechnologies.com

MANUFACTURER	
Name:	TX RX Systems, Inc.
Address:	8625 Industrial Parkway Angola, NY 14006 USA
Contact Person:	William J. Aquino Phone #: 716-549-4700 ext 5019 Fax #: 716-549-4772 Email Address: baquino@birdtechnologies.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:	TX RX Systems, Inc.
Product Name:	Signal Booster II
Model Name or Number:	61-65-50
Type of Equipment:	Non-broadcast Radio Communication Equipment
External Power Supply:	N/A
Primary User functions of EUT:	Signal Booster II extends radio coverage into areas where abrupt propagation losses prevent reliable communication.
Transmitting/Receiving Antenna Type:	Non-Integral

3.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type:	Base station (fixed use)
Intended Operating Environment:	Commercial, industrial or business environment
Power Supply Requirement:	100 to 240 VAC; 50 / 60 Hz or +24 to +27 VDC (Backup DC Power)
RF Input Power Rating:	0 dBm for single channel input
RF Output Power Rating:	32 dBm (1.6 W)
Operating Frequency Range:	406-430 MHz
RF Output Impedance:	50 Ohms
Occupied Bandwidth (99%):	Booster (The 99% OBW of the rf output signal is the same as that of the rf input signal from a FCC certified transmitter)
Emission Designation:	• F1D • F3E • G3E
Antenna Connector Type:	N Female
Antenna Description:	• Outdoor antenna: The antenna gain limit is 10 dB • In-building antenna: radiating coaxial cable or a network ¼ wave whip antenna (gain not exceed 0 dB)

RECEIVER	
Equipment Type:	Base station (fixed use)
Intended Operating Environment:	Commercial, industrial or business environment
Power Supply Requirement:	100 to 240 VAC; 50 / 60 Hz or +24 to +27 VDC (Backup DC Power)
Operating Frequency Range:	406-430 MHz

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	Downlink In / Uplink out	1	N female	Shielded
2	Uplink In / Downlink out	1	N female	Shielded
3	Backup DC power	1	2 term barrier	Non-shielded
4	Alarm contacts	1	6 term barrier	Non-shielded
5	AC Line Filter	1	Spade Lugs	--
6	Accessory AC outlet	2	AC duplex receptacles	--

3.5. ANCILLARY EQUIPMENT

None.

3.6. GENERAL TEST SETUP

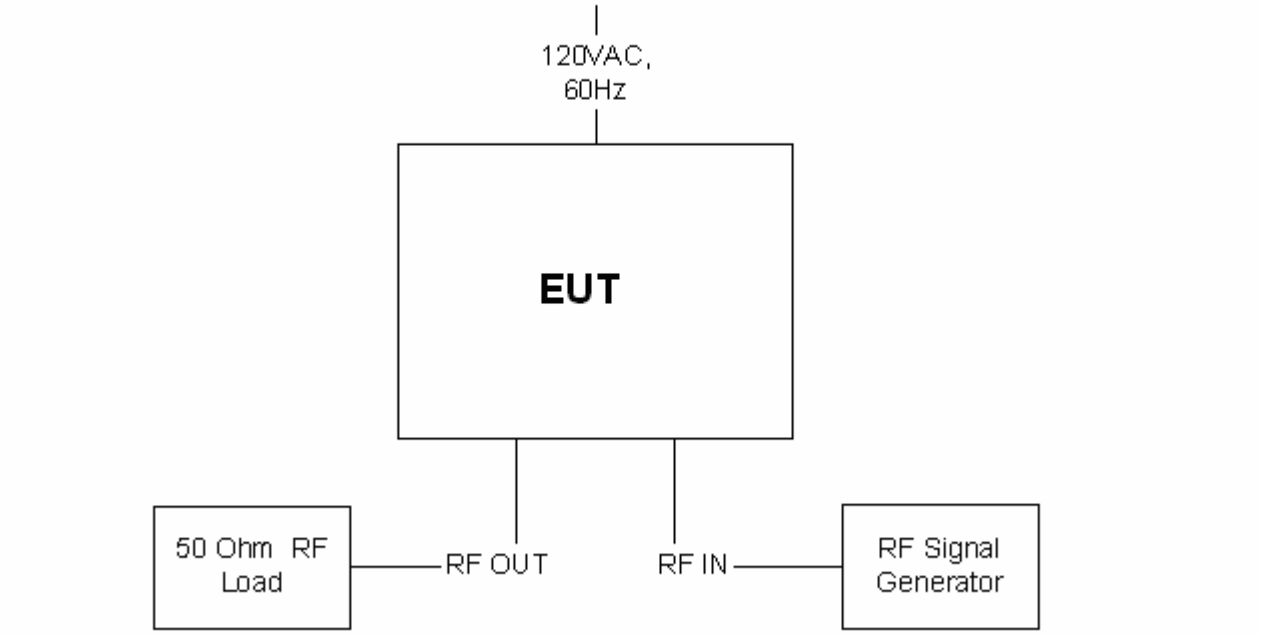


EXHIBIT 4. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

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:	120 VAC 60 Hz or +24 (Backup DC Power)

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:	N/A
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):	406-430 MHz
Frequency(ies) Tested: (Near lowest, near middle and near highest frequencies in the frequency range of operation.)	406.1 MHz, 418.0 MHz and 430.0 MHz
RF Power Output (measured maximum output power):	1.8 Watts
Normal Test Modulation:	Unmodulated, F1D, F3E & G3E
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 3-10 TDK Semi-Anechoic Chamber situated in the Town of Oakville, province of Ontario. This test site 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 3-10 TDK Semi-Anechoic Chamber has been filed with FCC office (FCC File No.: 31040/SIT 1300B3) and Industry Canada office (Industry Canada File No.: IC2049-1). Last Date of Site Calibration: June 20, 2006.

5.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC Section(s)	Test Requirements	Applicability (Yes/No)
2.1046 & 90.205	RF Power Output & Intermodulation	Yes
1.1307, 1.1310, 2.1091 & 2.1093	RF Exposure Limit	Yes
2.1055 & 90.213	Frequency Stability	(1)Not applicable for amplifier
2.1047(a) & 90.242(b)(8)	Audio Frequency Response	(2)Not applicable for amplifier
2.1047(b) & 90.210	Modulation Limiting	(2)Not applicable for amplifier
2.1049 & 90.210	Occupied Bandwidth, Emission Limitation & Emission Mask	Yes
2.1051, 2.1057 & 90.210	Emission Limits - Spurious Emissions at Antenna Terminal	Yes
2.1053, 2.1057 & 90.210	Emission Limits - Field Strength of Spurious Emissions	Yes
Signal Booster II, **Model No.: 61-65-50** by **TX RX Systems, Inc.** has also been tested and found to comply with **FCC Part 15, Subpart B - Radio Receivers and Class A Digital Devices**. The engineering test report has been documented and it is available upon request.		

Notes:

(1) Test is not applicable, the EUT is not designed to generate or translate frequencies, it only amplifies the signal it receives.
(2) Test is not applicable, the EUT does not contain modulation circuitry.

5.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

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 ULTRATECH Test Procedures, File # ULTR P001-2004, ANSI C63.4 and TIA-603-C.

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, TIA-603-C and CISPR 16-1.

6.4. ESSENTIAL/PRIMARY FUNCTIONS AS DECLARED BY THE MANUFACTURER

Signal boosters extend radio coverage into areas where abrupt propagation losses prevent reliable communication. This system receives an RF signal, raises its power level, and couples it to an antenna or leaky (radiating) coaxial cable system so that it can be re-radiated. No frequency translation (conversion) occurs with this device.

6.5. RF POWER OUTPUT & INTERMODULATION [§§ 2.1046 & 90.205]

6.5.1. Limits

See FCC 47 CFR 90.205 for specification details.

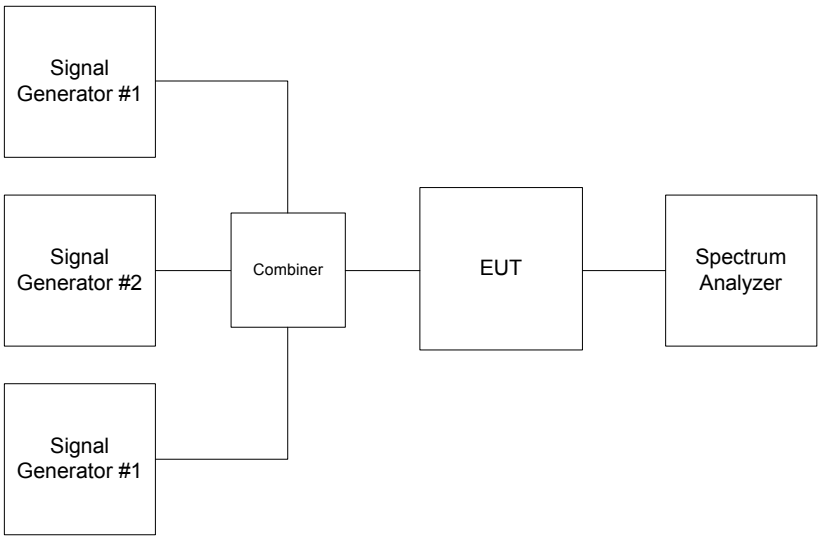
6.5.2. Method of Measurements

Refer to ULTRATECH Test Procedures, File # ULTR P001-2004 and TIA-603-C

6.5.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Signal Generator	Gigatronic	6061A	5130586	10 kHz - 1050 MHz
Signal Generator	Fluke	6061A	4770301	10 kHz - 1050 MHz
Signal Generator	Gigatronic	6061A	5130408	10 kHz - 1050 MHz
Combiner	Mini-Circuit	15542	0105	1 MHz – 1 GHz
Spectrum Analyzer	Rohde & Schwarz	FSEK20/B4/B21	834157/005	9 kHz – 40 GHz

6.5.4. Test Arrangement



6.5.5. Test Data

6.5.5.1. RF POWER OUTPUT with MODULATION, SINGLE CHANNEL, MAXIMUM RF IN = 0 dBm

6.5.5.1.1. 120 VAC Input

Test Frequency (MHz)	Modulation	Total RF Output Powerat Antenna Port (dBm)	RF Output Power Ratings at Antenna Port (dBm)
406.1	F1D/F3E/G3E	32.48	32
418.0	F1D/F3E/G3E	31.61	32
430.0	F1D/F3E/G3E	31.30	32

6.5.5.1.2. 27 VDC Input

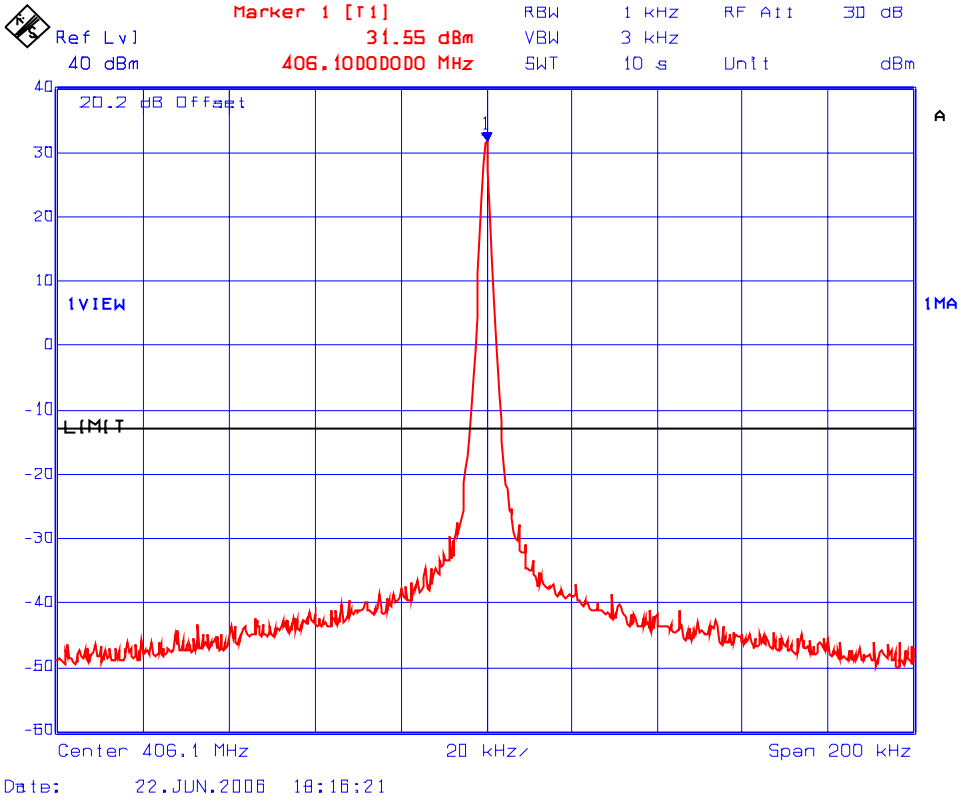
Test Frequency (MHz)	Modulation	Total RF Output Powerat Antenna Port (dBm)	RF Output Power Ratings at Antenna Port (dBm)
406.1	F1D/F3E/G3E	32.48	32
418.0	F1D/F3E/G3E	31.61	32
430.0	F1D/F3E/G3E	31.30	32

6.5.5.2. INTERMODULATION & PEAK POWERS IN 406.1-430 MHz BAND – NO MODULATION

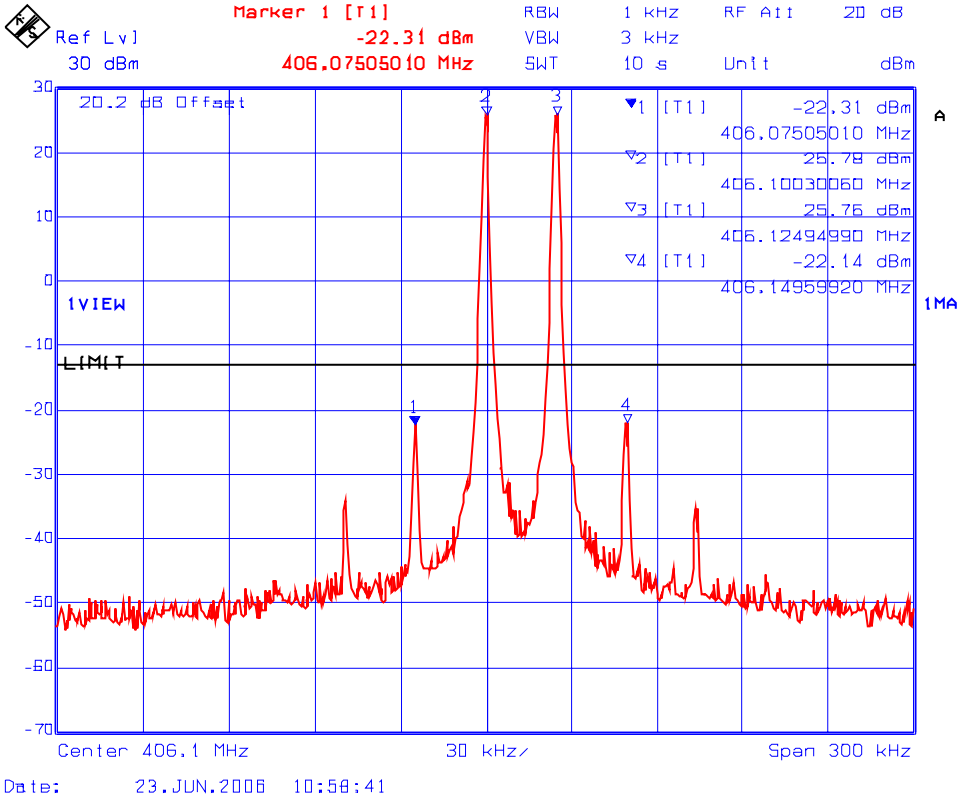
Frequency (MHz)	Number of In/Out Channels	Modulation	Maximum RF Input (conducted) (dBm)	Maximum RF Output (conducted) (dBm)
4061	1	unmodulated	0	31.55
406.1 406.125	2	unmodulated	-54.17	25.78
406.1 406.125 406.150	3	unmodulated	-55.14	24.78
418	1	unmodulated	0	31.75
418 418.025	2	unmodulated	-53.82	25.25
418 418.025 418.050	3	unmodulated	-55.21	24.08
430	1	unmodulated	0	30.65
430 429.975	2	unmodulated	-52.79	24.54
430 429.975 429.950	3	unmodulated	-53.98	23.34

See the following plots for intermodulation in the 406-430 MHz band.

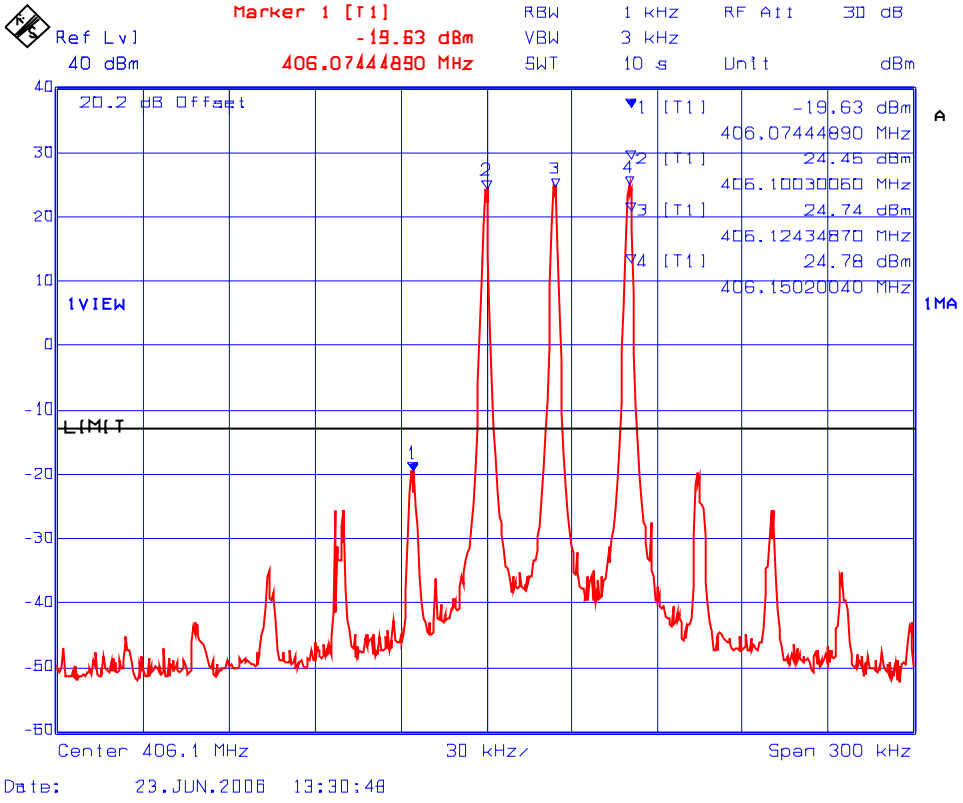
Plot 6.5.5.2.1 Intermodulation with 1 RF Input 406.1 - 430 MHz
Fc: 406.1 MHz; RF Input: 0dBm



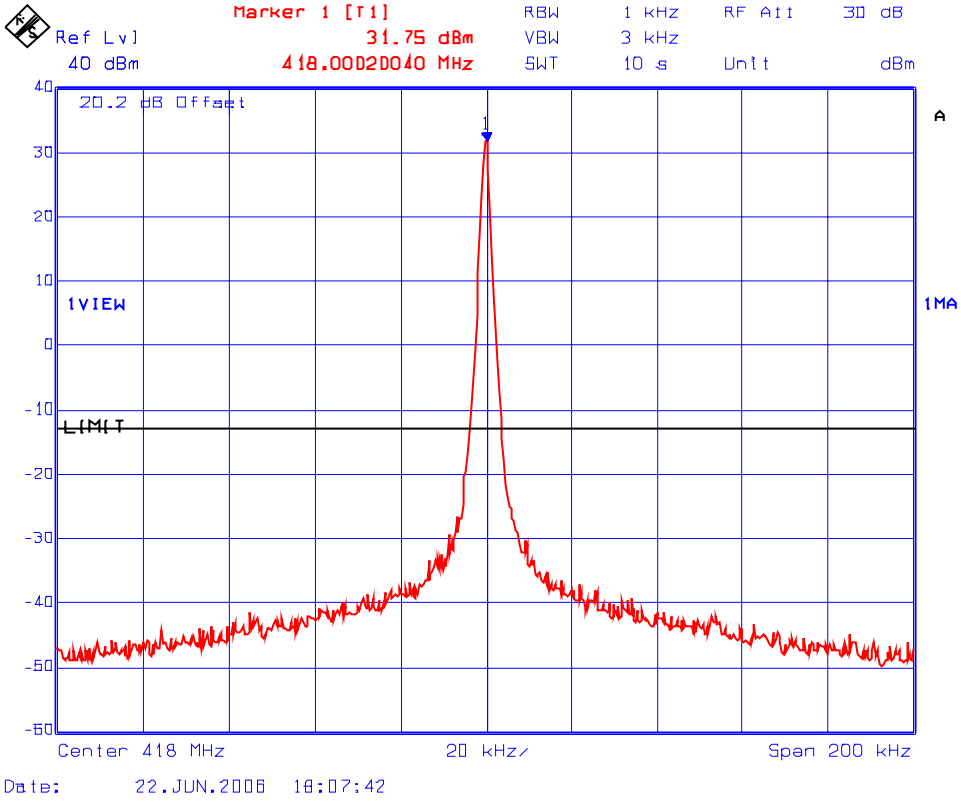
Plot 6.5.5.2.2 Intermodulation with 2 RF signals input/output in 406.1 – 430 MHz
Fc: 406.1 MHz & Fc + 25 kHz
RF Input 1: -54.17dBm, RF Input 2: -54.17dBm



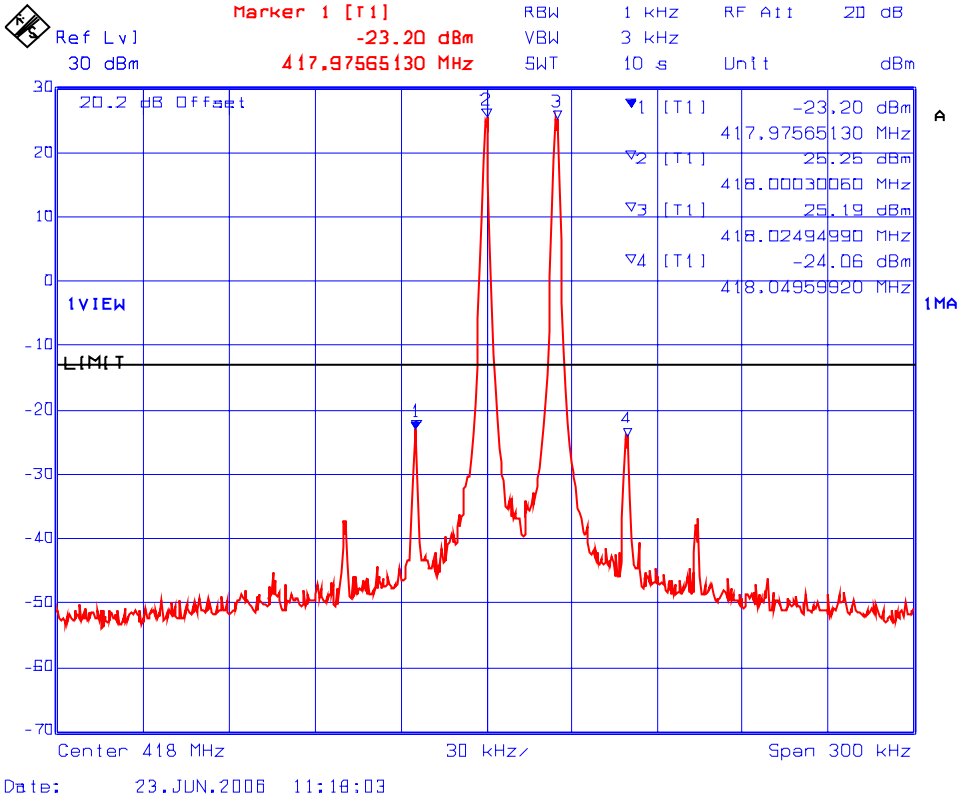
Plot 6.5.5.2.3 Intermodulation with 3 RF signal inputs/outputs in 406.1 – 430 MHz
Fc: 406.1 MHz, Fc + 25 kHz, & Fc + 50 kHz
RF Input 1: -55.14dBm, RF Input 2: -55.14dBm, RF Input 3: -55.14dBm



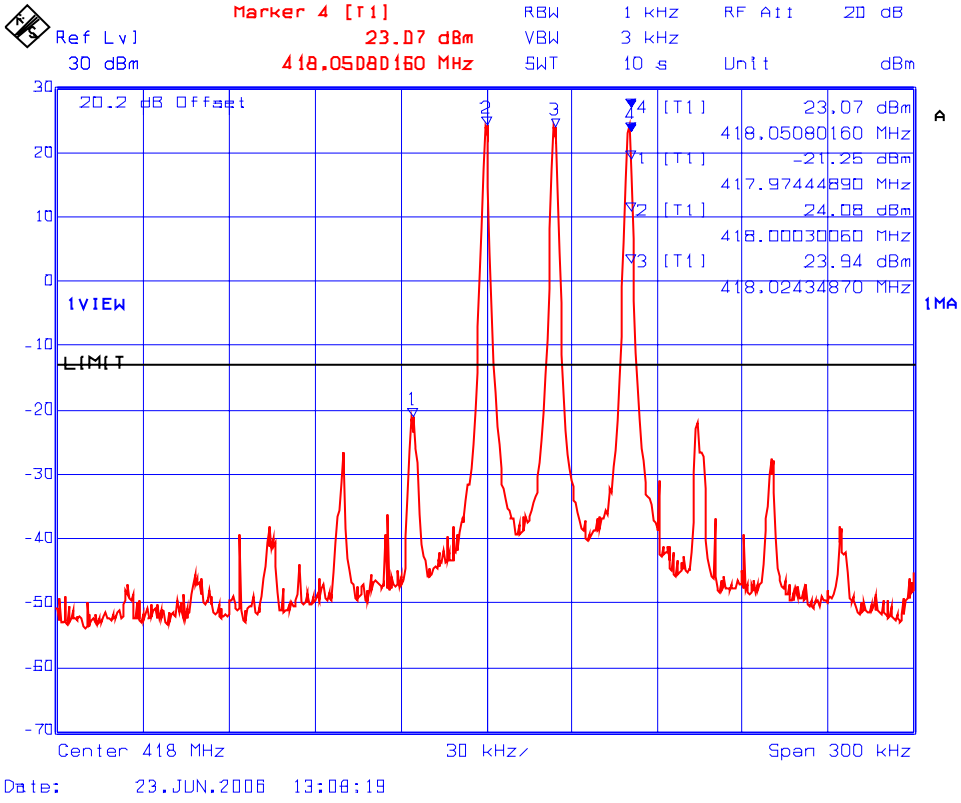
Plot 6.5.5.2.4 Intermodulation with 1 RF Input 406.1 - 430 MHz
Fc= 418 MHz; RF Input: 0dBm



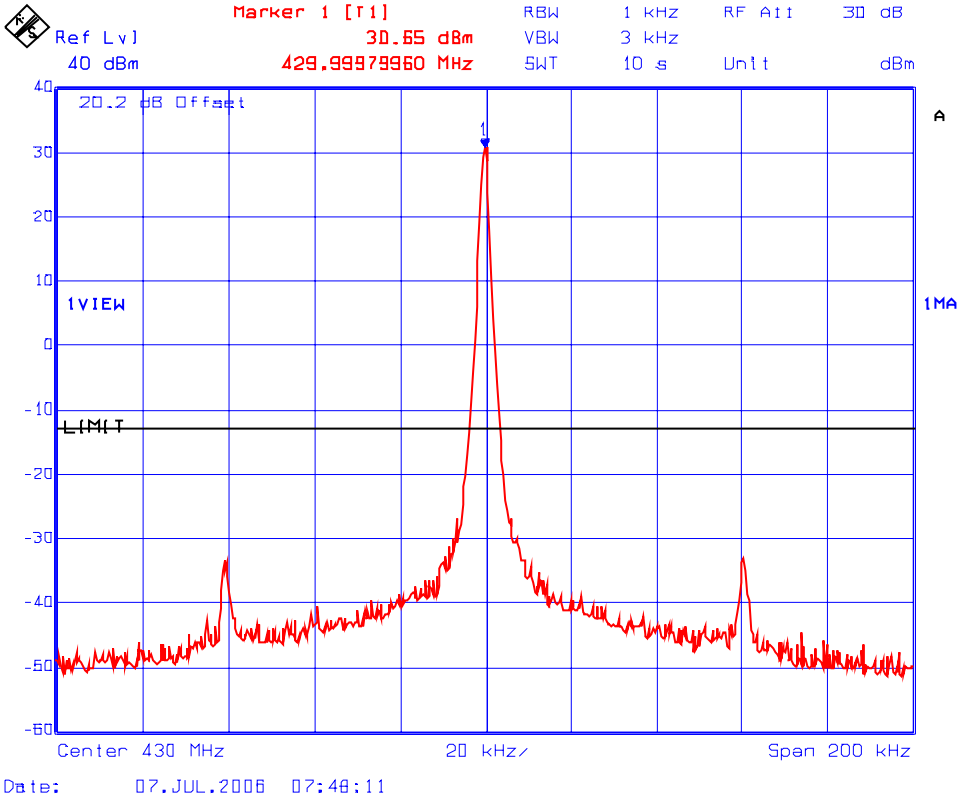
Plot 6.5.5.2.5 Intermodulation with 2 RF signal inputs/outputs in 406.1 – 430 MHz
Fc: 418 MHz & Fc + 25 kHz
RF Input 1: -53.82dBm, RF Input 2: -53.82dBm



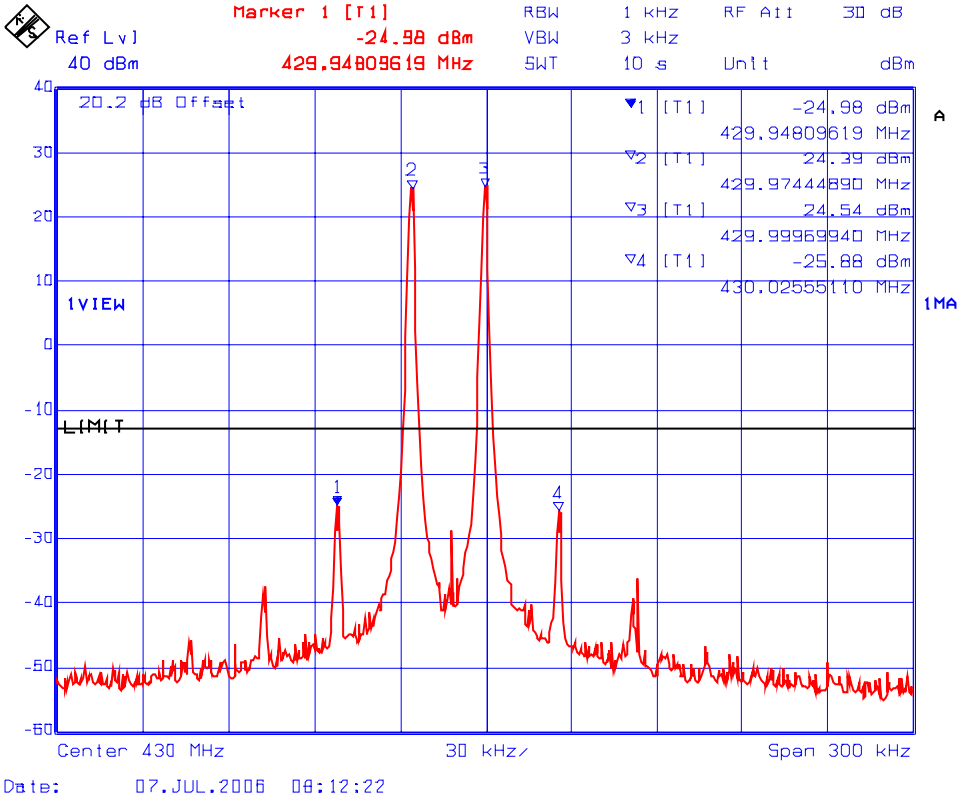
Plot 6.5.5.2.6 Intermodulation with 3 RF signal inputs/outputs in 406.1 – 430 MHz
Fc: 418 MHz, Fc + 25 kHz, & Fc + 50 kHz
RF Input 1: -55.21dBm, RF Input 2: -55.21dBm, RF Input 3: -55.21dBm



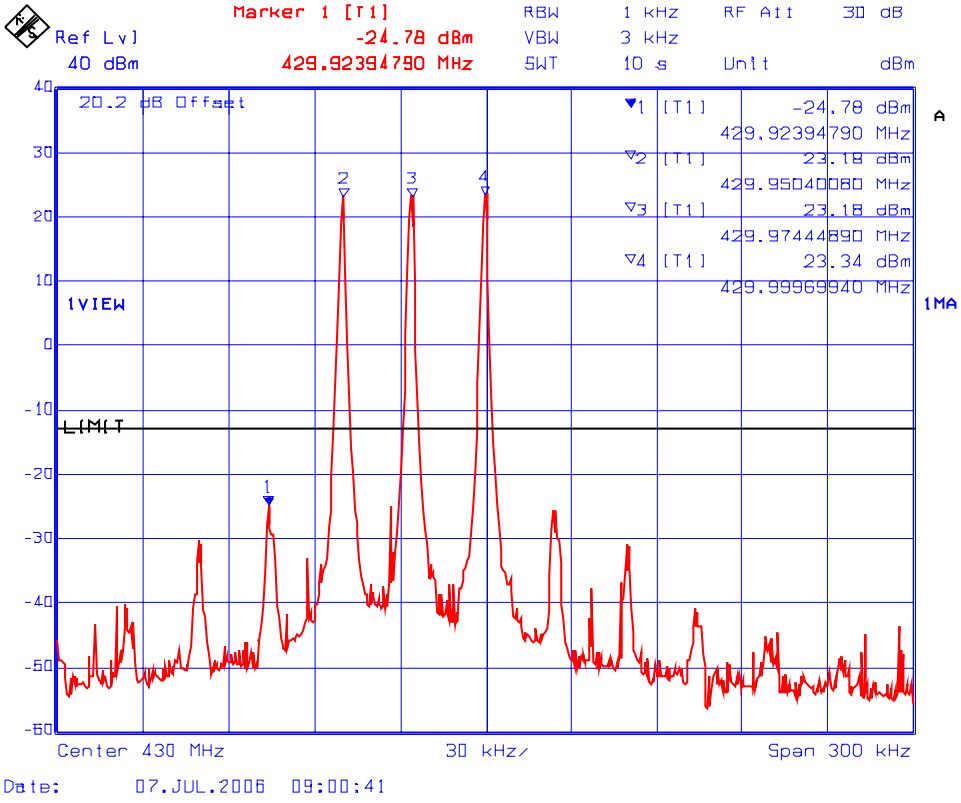
Plot 6.5.5.2.7 Intermodulation with 1 RF Input 406.1 – 430 MHz
Fc= 430 MHz; RF Input: 0dBm



Plot 6.5.5.2.8 Intermodulation with 2 RF signal inputs/outputs in 406.1 – 430 MHz
Fc: 430 MHz & Fc - 25 kHz
RF Input 1: -52.79dBm, RF Input 2: -52.97dBm



Plot 6.5.5.2.9 Intermodulation with 3 RF signal inputs/outputs in 406.1 – 430 MHz
Fc: 430 MHz, Fc - 25 kHz, & Fc - 50 kHz
RF Input 1: -53.98dBm, RF Input 2: -54.15dBm, RF Input 3: -54.24dBm



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

6.6.1. Limits

FCC 1.1310:- The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b).

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.

6.6.2. Method of Measurements

Refer to FCC @ 1.1310 and 2.1091

- In order to demonstrate compliance with MPE requirements (see Section 2.1091), the following information is typically needed:

(1) Calculation that estimates the minimum separation distance (20 cm or more) between an antenna and persons required to satisfy power density limits defined for free space.
(2) Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement.
(3) Any caution statements and/or warning labels that are necessary in order to comply with the exposure limits.
(4) Any other RF exposure related issues that may affect MPE compliance.

Calculation Method of RF Safety Distance:

$S = PG/4\Pi r^2 = EIRP/4\Pi r^2$

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 centre of radiation in cm

$r = \sqrt{PG/4\Pi S}$

- For portable transmitters (see Section 2.1093), or devices designed to operate next to a person's body, compliance is determined with respect to the SAR limit (define in the body tissues) for near-field exposure conditions. If the maximum average output power, operating condition configurations and exposure conditions are comparable to those of existing cellular and PCS phones, SAR evaluation may be required in order to determine if such a device complies with SAR limit. When SAR evaluation data is not available, and the additional supporting information cannot assure compliance, the Commission may request that an SAR evaluation be performed, as provided for in Section 1.1307(d).

6.6.3. Test Data

Antenna Gain Limit specified by Manufacturer: 0 dB (In-building Antenna) & 10 dB (Outdoor Antenna)

[(1)] Lowest Frequency (MHz)	Measured RF Conducted Power (dBm)	Calculated EIRP (dBm)	[(2)]Calculated Minimum RF Safety Distance r (cm)	Manufacturer's Specified Separation Distance (cm)
In-building Antenna (≤0 dB)				
406.1	32.48	34.63	29	30
Outdoor Mounted Antenna (≤10 dB)				
406.1	32.48	44.63	92	100

(1) The calculation is based on the lowest frequency (406.1 MHz) and the highest conducted power (32.48 dBm) for the worst case.
(2) The minimum separation distance between the antenna and bodies of users are calculated using the following equation:

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

In-building Antenna (≤ 0 dB gain):

EIRP = 34.63 dBm = $10^{(34.63/10)}$ mW
S = f/1500 = 406.1/1500 mW/cm^2 (General Population/ Uncontrolled Exposure)

$r = (EIRP/4\Pi S)^{1/2} = (10^{(34.63/10)}) / (4\Pi(406.1/1500))^{1/2}$ = 29.4 cm

Outdoor Mounted Antenna (≤ 10 dB gain):

EIRP = 44.63 dBm = $10^{(44.63/10)}$ mW
S = f/1500 = 406.1/1500 mW/cm^2 (General Population/ Uncontrolled Exposure)

$r = (EIRP/4\Pi S)^{1/2} = (10^{(44.63/10)}) / (4\Pi(406.1/1500))^{1/2}$ = 92.4 cm

Evaluation of RF Exposure Compliance Requirements	
RF Exposure Requirements	**Compliance with FCC Rules**
Minimum calculated separation distance between antenna and persons required: ▪ Indoor Antenna: 29.4 cm ▪ Outdoor Antenna: 92.6 cm	Manufacturer' instruction for separation distance between antenna and persons required: Indoor Antenna: 30 cm Outdoor Antenna: 100 cm
Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement	Please refer to User's Manual for details.
Caution statements and/or warning labels that are necessary in order to comply with the exposure limits	Refer to User's Manual for RF Exposure Information.
Any other RF exposure related issues that may affect MPE compliance	None.

6.7. OCCUPIED BANDWIDTH [§ 2.1049]

6.7.1. Limits

The spectral shape of the output should look similar to input for all modulations.

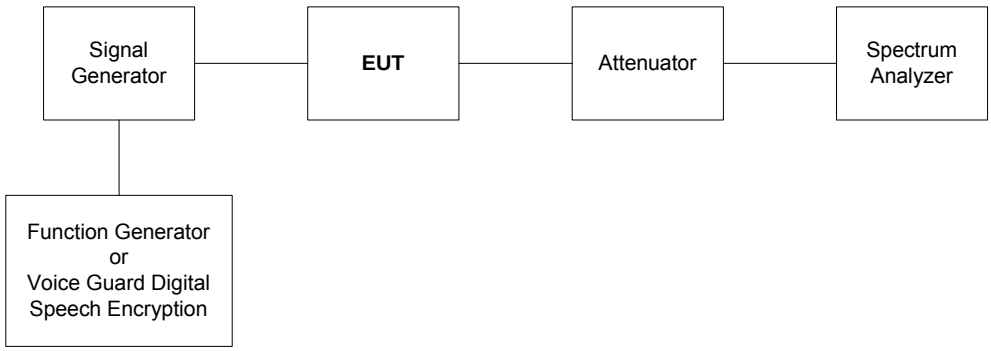
6.7.2. Method of Measurements

Refer to ULTRATECH Test Procedures, File # ULTR P001-2004 for measurement details.

6.7.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Rohde & Schwarz	FSEK20/B4/B21	834157/005	9 kHz – 40 GHz
Function Generator	Stanford Research Systems	DS345	34591	1Hz -30.2 MHz
Voice Guard Digital Speech Encryption	General Electric	9600-SW	9614517	--
Attenuator	Weinschel Corp	48-30-34	BM5354	DC - 18 GHz

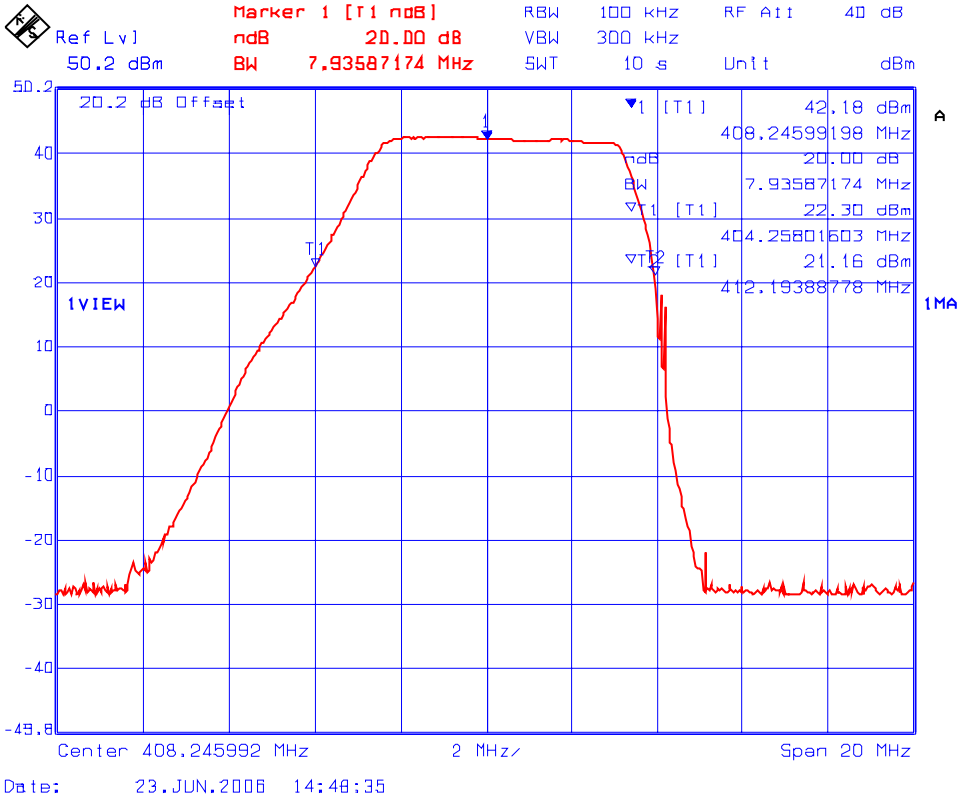
6.7.4. Test Arrangement



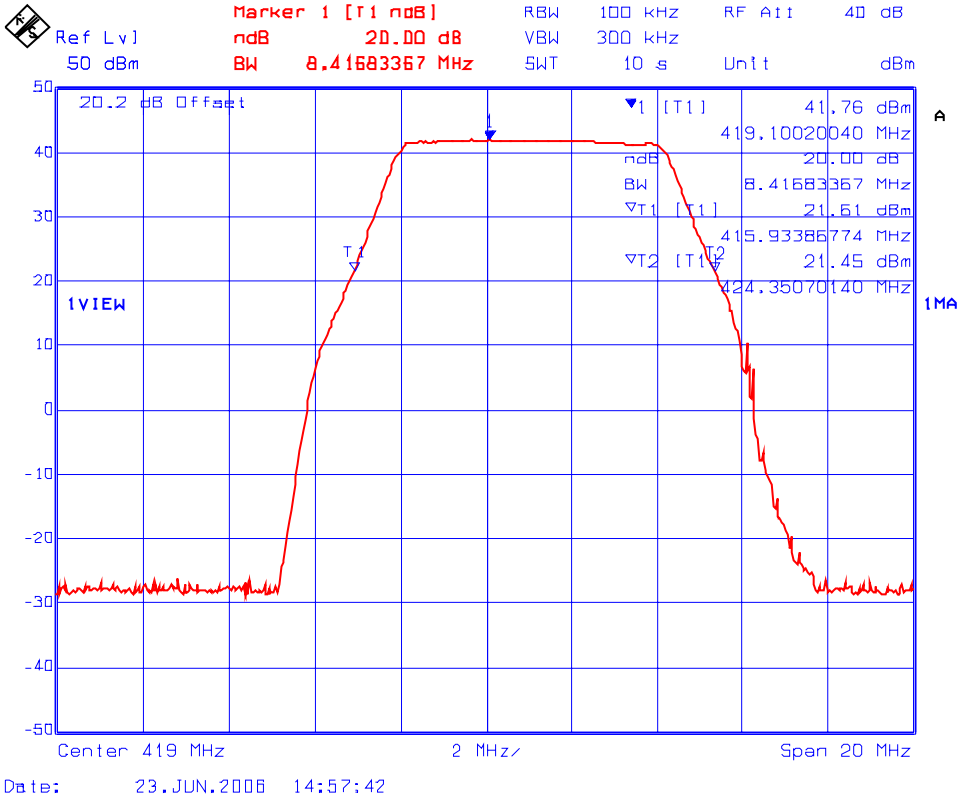
6.7.5. Test Data

6.7.5.1. Passband Gain

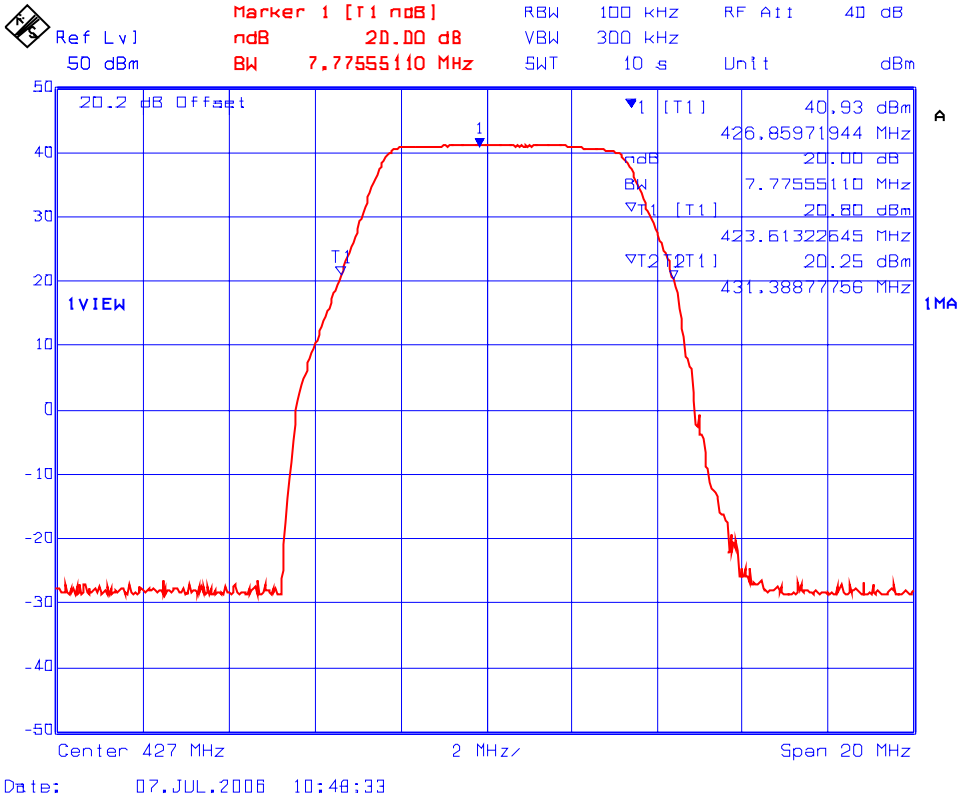
Plot 6.7.5.1.1 20dB Passband Gain of the 406.1 – 411.1 MHz Band
RF Input: 0dBm, Tracking from 400 – 450 MHz, Max Gain: 42.10 dB



Plot 6.7.5.1.2 20dB Passband Gain of the 417.1 – 423.1 MHz Band
RF Input: 0dBm, Tracking from 400 – 450 MHz, Max Gain: 41.76 dB

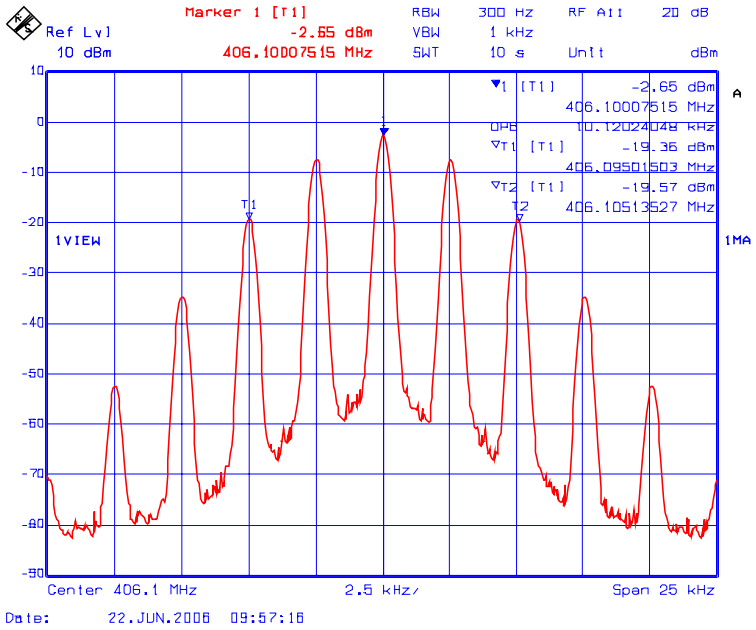


Plot 6.7.5.1.3 20dB Passband Gain of the 425 – 430 MHz Band
RF Input: 0dBm, Tracking from 400 – 450 MHz, Max Gain: 40.93 dB

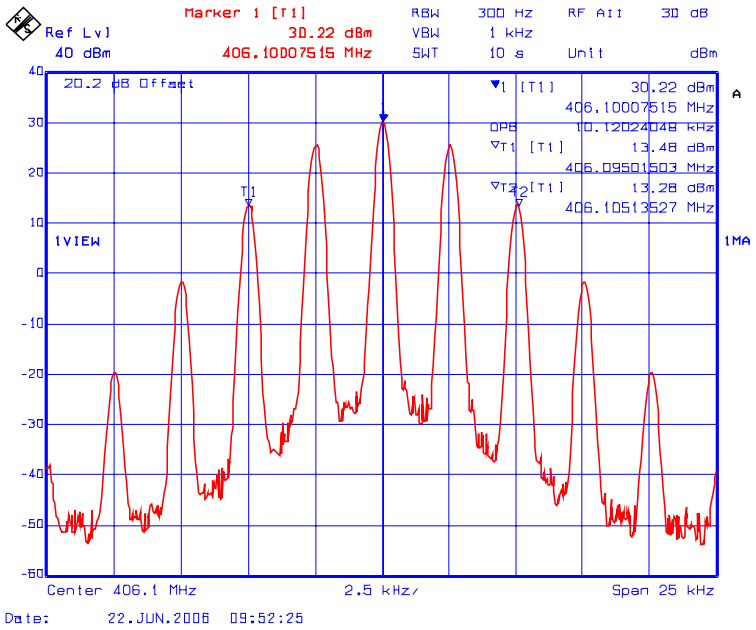


6.7.5.2. Occupied Bandwidth

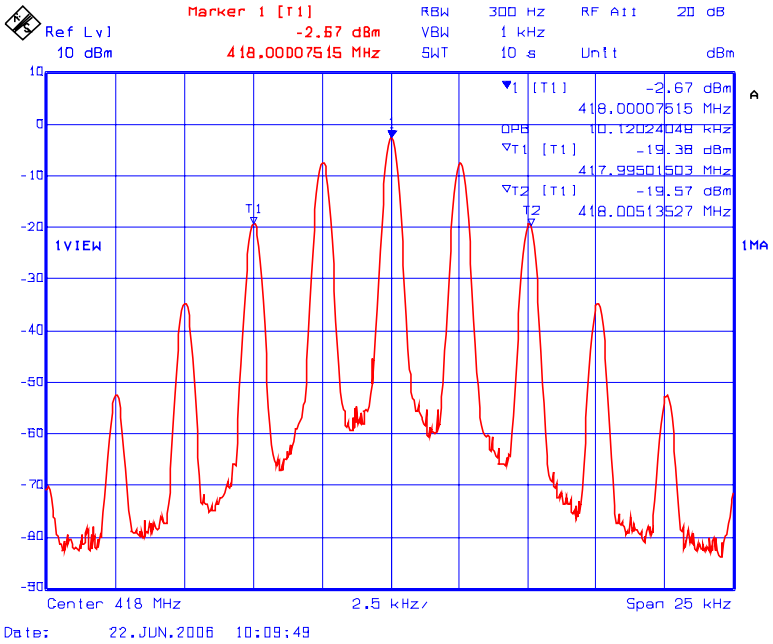
Plot 6.7.5.2.1 99% Occupied Bandwidth – RF Input
Fc: 406.1 MHz, 12.5 kHz Channel Spacing; Modulation: FM modulation with 2.5 kHz Sine wave signal



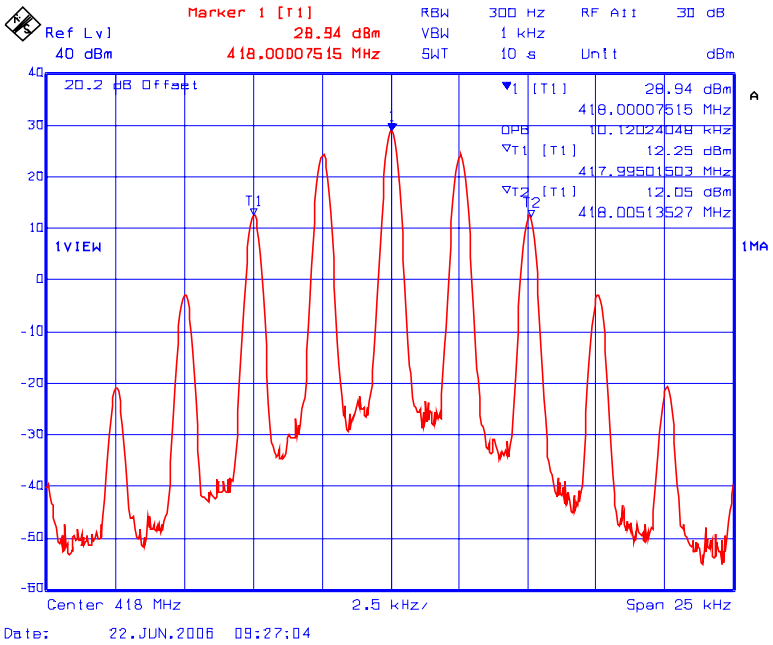
Plot 6.7.5.2.2 99% Occupied Bandwidth – RF Output
Fc: 406.1 MHz, 12.5 kHz Channel Spacing; Modulation: FM modulation with 2.5 kHz Sine wave signal



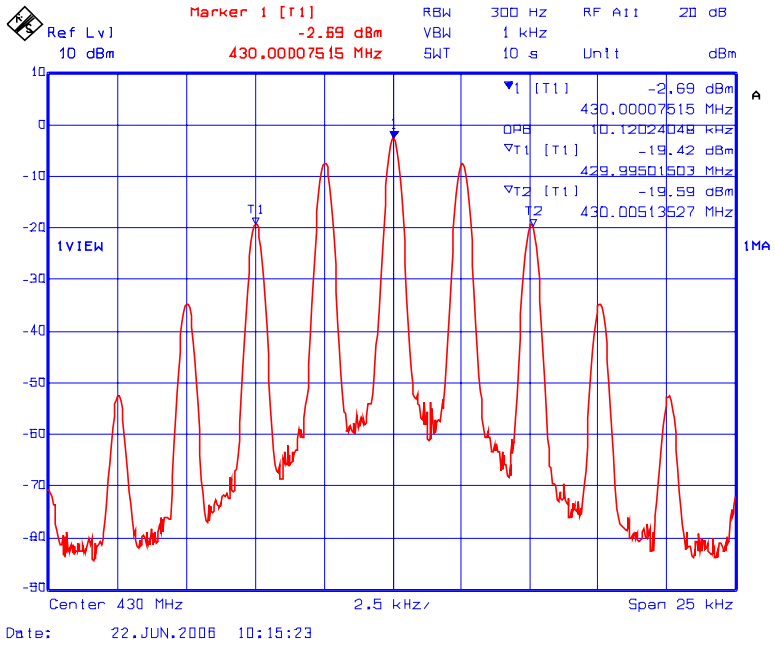
Plot 6.7.5.2.3 99% Occupied Bandwidth – RF Input
Fc: 418 MHz, 12.5 kHz Channel Spacing; Modulation: FM modulation with 2.5 kHz Sine wave signal



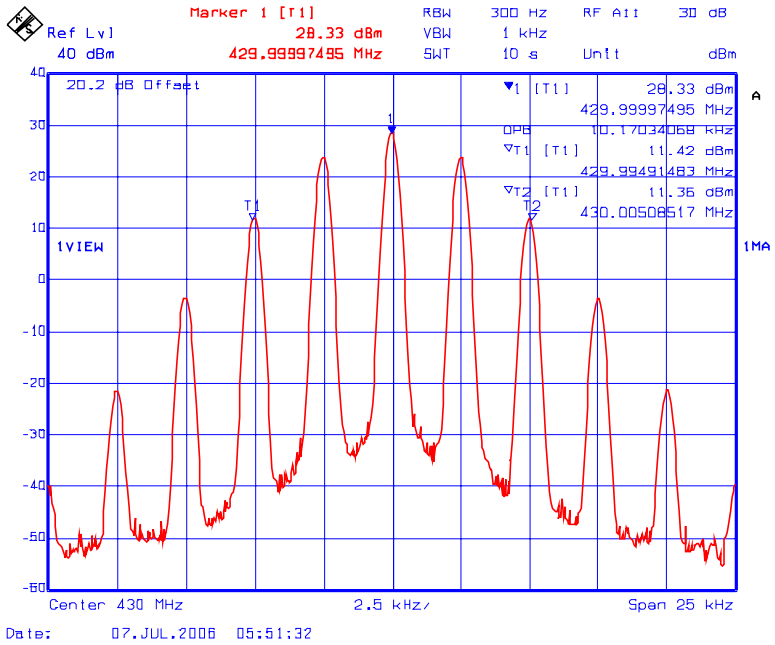
Plot 6.7.5.2.4 99% Occupied Bandwidth – RF Output
Fc: 418 MHz, 12.5 kHz Channel Spacing; Modulation: FM modulation with 2.5 kHz Sine wave signal



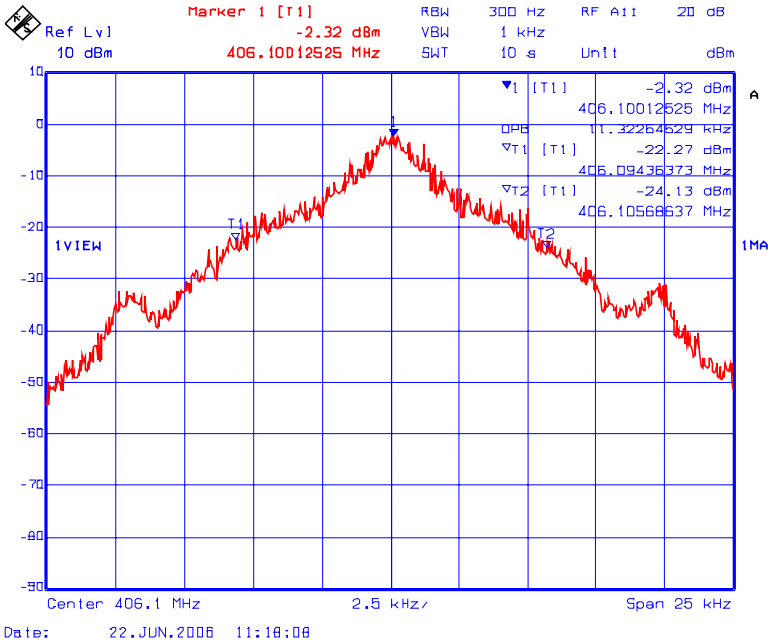
Plot 6.7.5.2.5 99% Occupied Bandwidth – RF Input
Fc: 430 MHz, 12.5 kHz Channel Spacing; Modulation: FM modulation with 2.5 kHz Sine wave signal



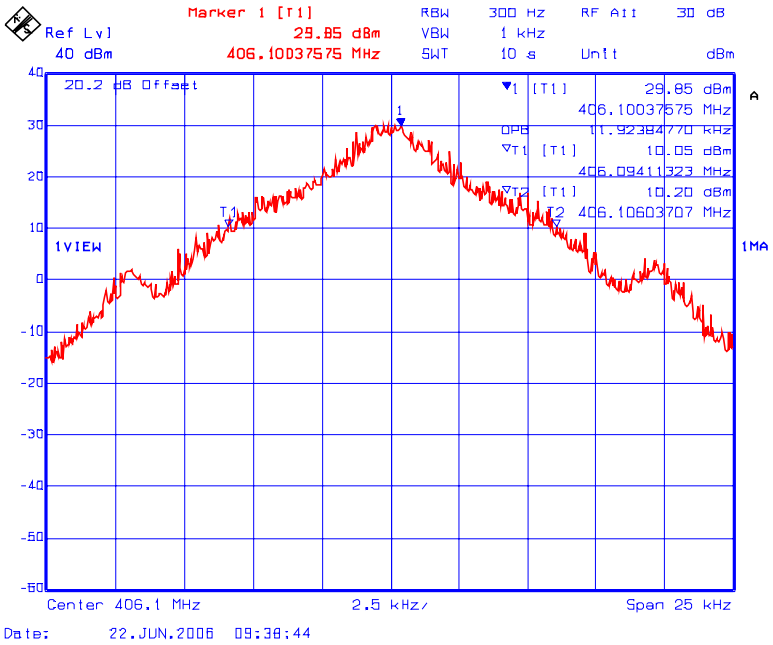
Plot 6.7.5.2.6 99% Occupied Bandwidth – RF Output
Fc: 430 MHz, 12.5 kHz Channel Spacing; Modulation: FM modulation with 2.5 kHz Sine wave signal



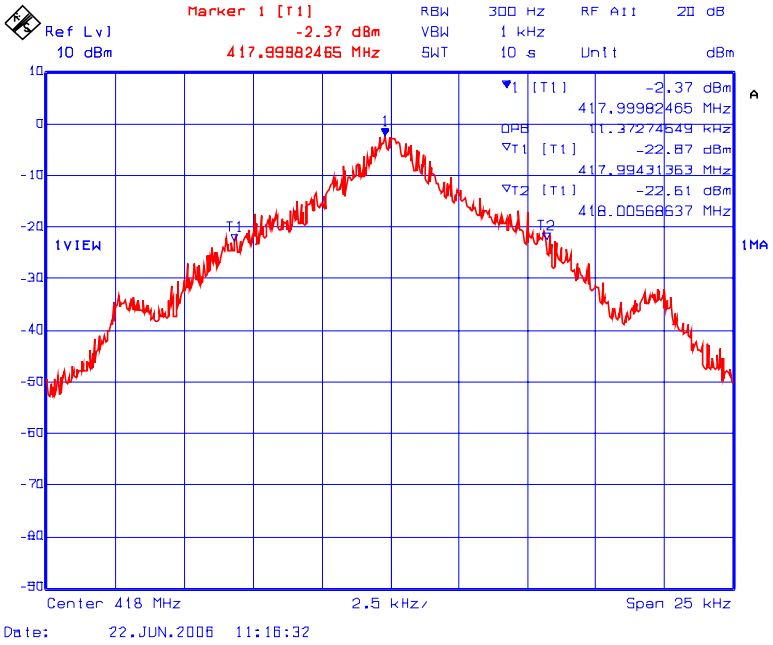
Plot 6.7.5.2.7 99% Occupied Bandwidth – RF Input
Fc: 406.1 MHz, 12.5 kHz Channel Spacing; Modulation: FM modulation with an external 9600 b/s random data source



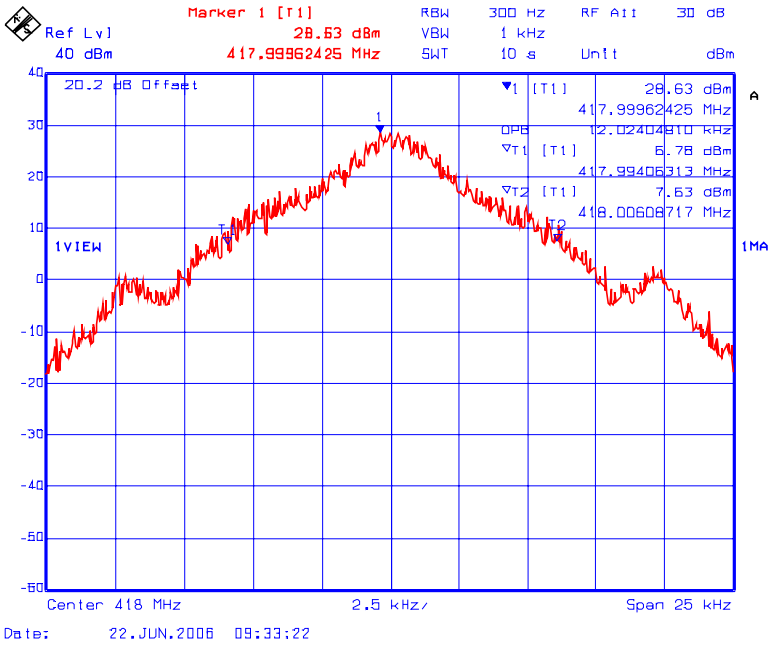
Plot 6.7.5.2.8 99% Occupied Bandwidth – RF Output
Fc: 406.1 MHz, 12.5 kHz Channel Spacing; Modulation: FM modulation with an external 9600 b/s random data source



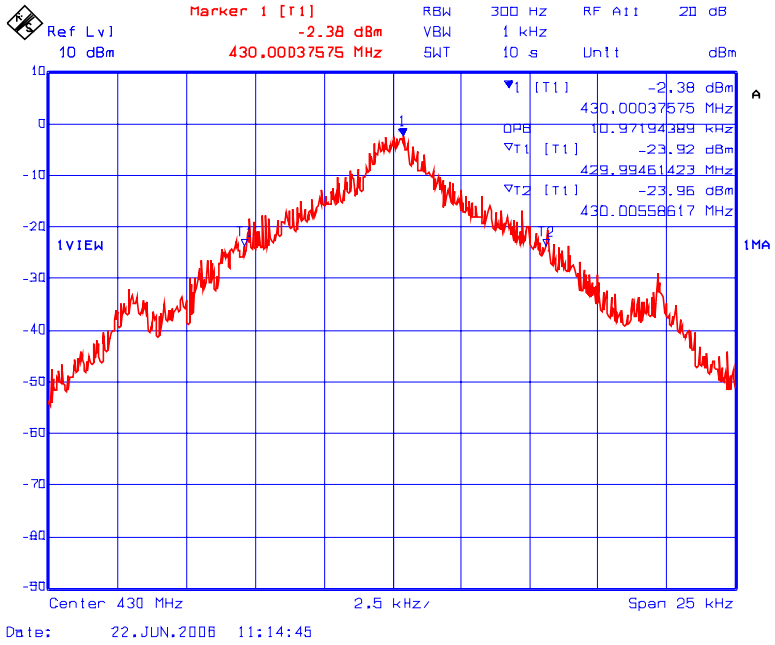
Plot 6.7.5.2.9 99% Occupied Bandwidth – RF Input
Fc: 418 MHz, 12.5 kHz Channel Spacing; Modulation: FM modulation with an external 9600 b/s random data source



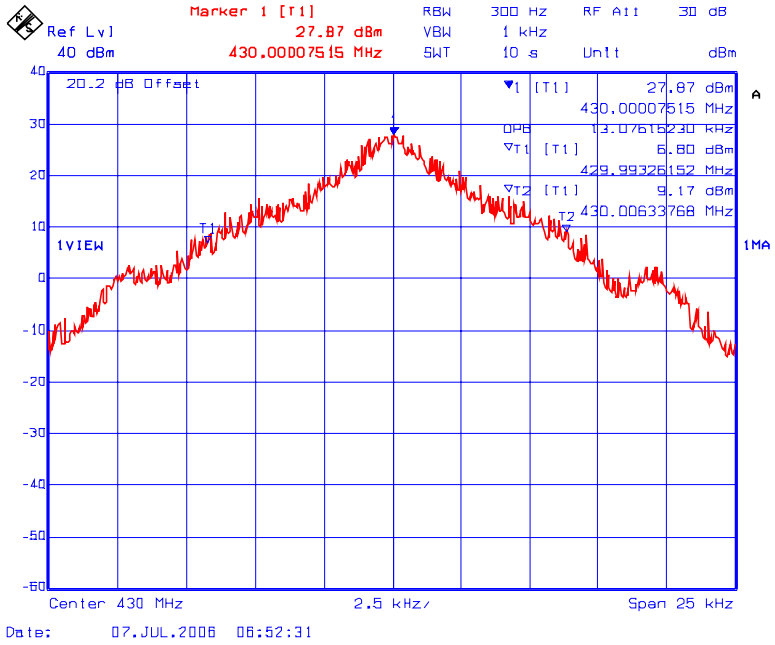
Plot 6.7.5.2.10 99% Occupied Bandwidth – RF Output
Fc: 418 MHz, 12.5 kHz Channel Spacing; Modulation: FM modulation with an external 9600 b/s random data source



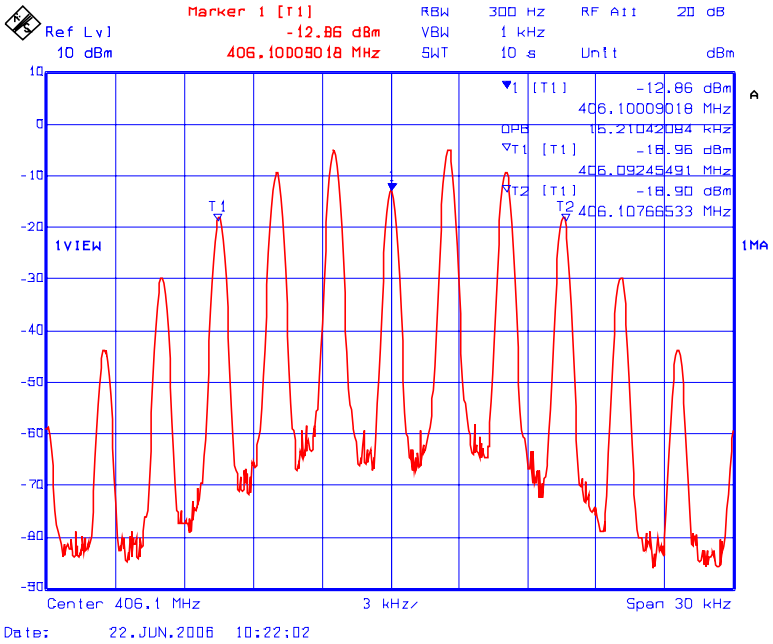
Plot 6.7.5.2.11 99% Occupied Bandwidth – RF Input
Fc: 430 MHz, 12.5 kHz Channel Spacing; Modulation: FM modulation with an external 9600 b/s random data source



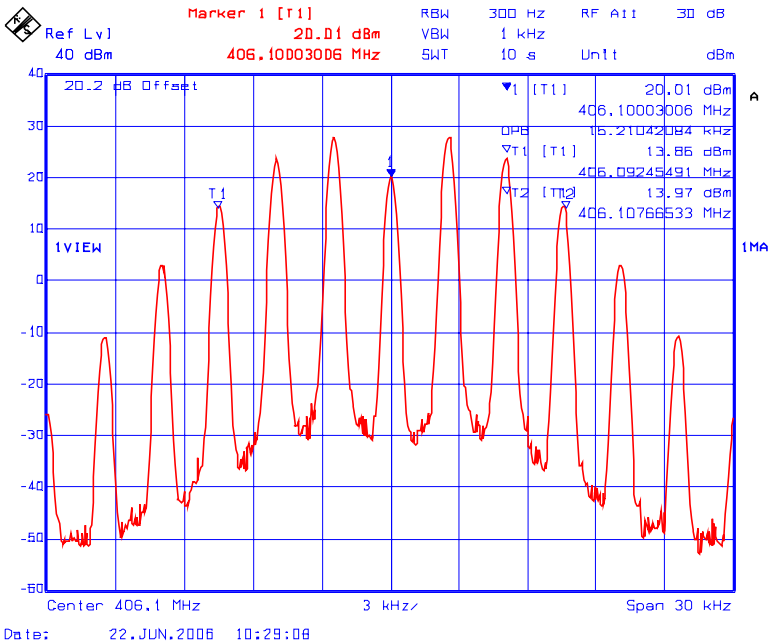
Plot 6.7.5.2.12 99% Occupied Bandwidth – RF Output
Fc: 430 MHz, 12.5 kHz Channel Spacing; Modulation: FM modulation with an external 9600 b/s random data source



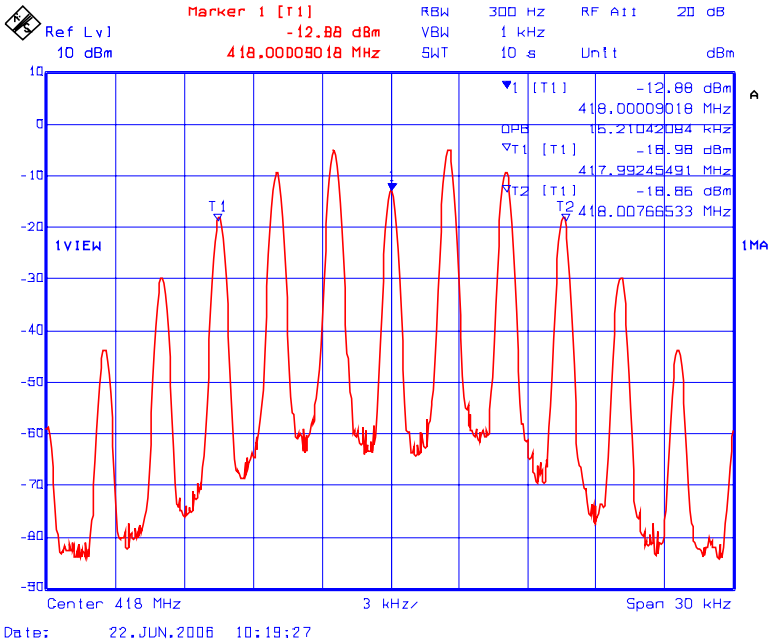
Plot 6.7.5.2.13 99% Occupied Bandwidth – RF Input
Fc: 406.1 MHz, 25 kHz Channel Spacing; Modulation: FM modulation with 2.5 kHz Sine wave signal



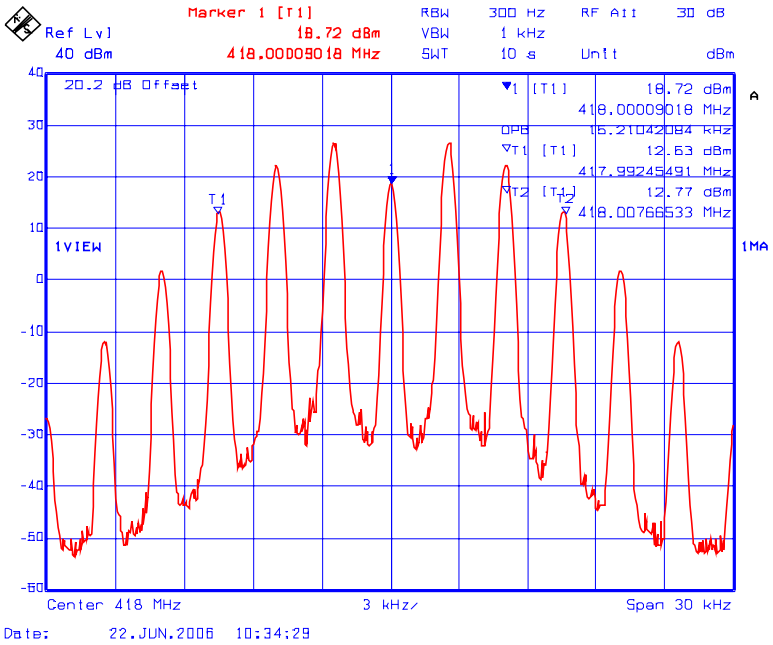
Plot 6.7.5.2.14 99% Occupied Bandwidth – RF Output
Fc: 406.1 MHz, 25 kHz Channel Spacing; Modulation: FM modulation with 2.5 kHz Sine wave signal



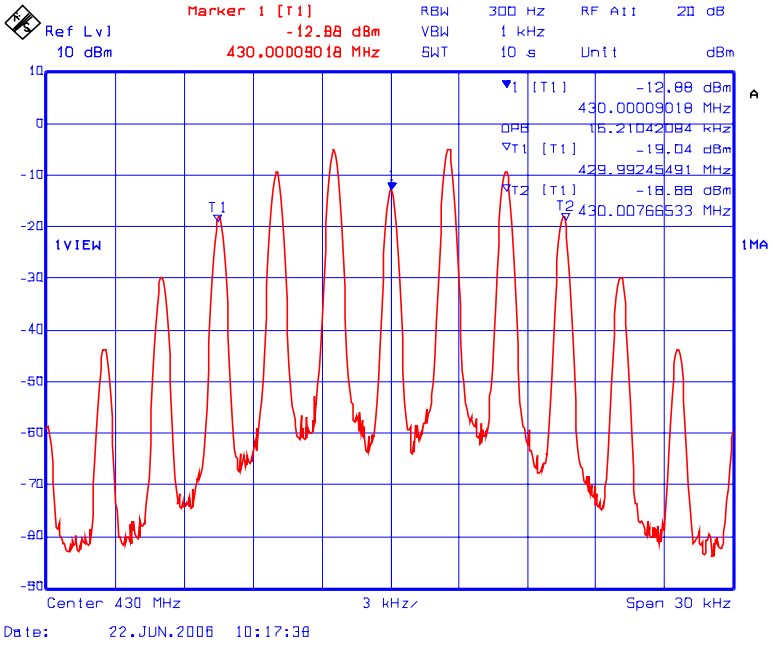
Plot 6.7.5.2.15 99% Occupied Bandwidth – RF Input
Fc: 418 MHz, 25 kHz Channel Spacing; Modulation: FM modulation with 2.5 kHz Sine wave signal



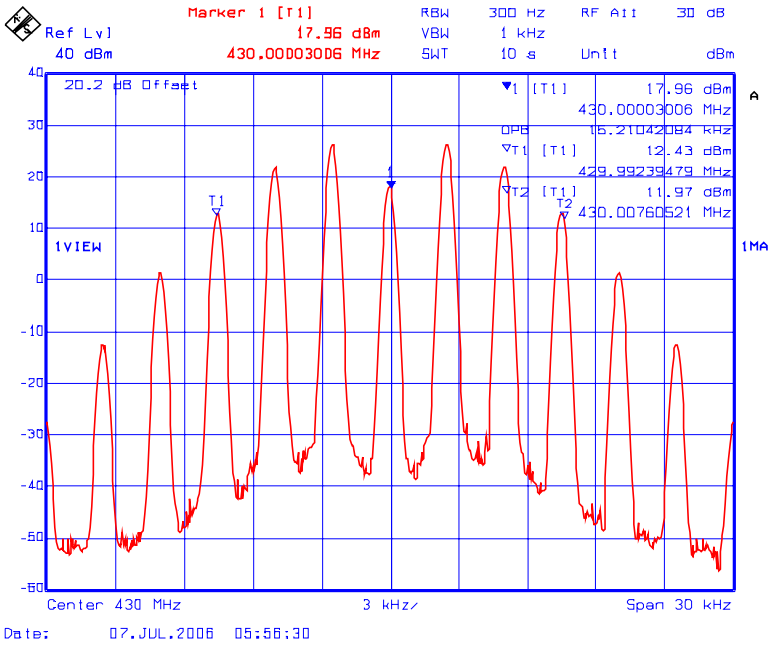
Plot 6.7.5.2.16 99% Occupied Bandwidth – RF Output
Fc: 418 MHz, 25 kHz Channel Spacing; Modulation: FM modulation with 2.5 kHz Sine wave signal



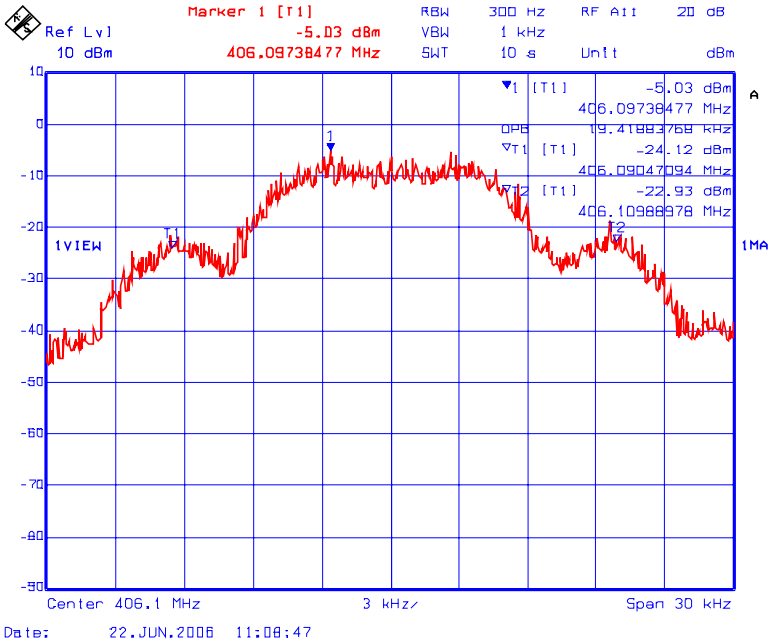
Plot 6.7.5.2.17 99% Occupied Bandwidth – RF Input
Fc: 430 MHz, 25 kHz Channel Spacing; Modulation: FM modulation with 2.5 kHz Sine wave signal



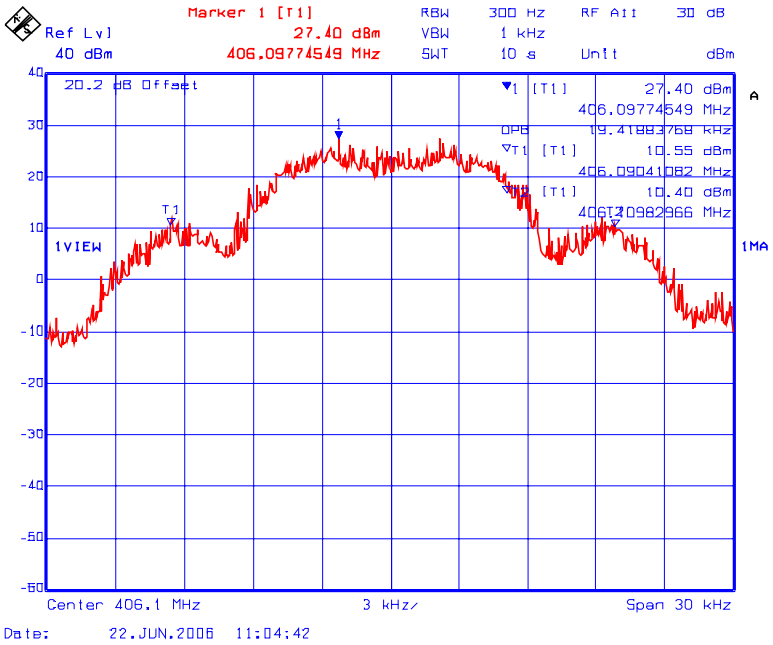
Plot 6.7.5.2.18 99% Occupied Bandwidth – RF Output
Fc: 430 MHz, 25 kHz Channel Spacing; Modulation: FM modulation with 2.5 kHz Sine wave signal



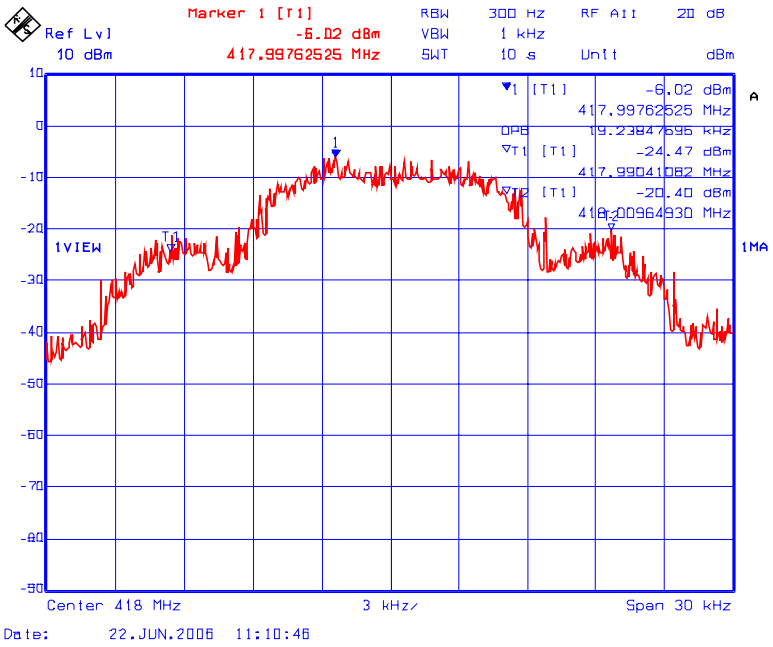
Plot 6.7.5.2.19 99% Occupied Bandwidth – RF Input
Fc: 406.1 MHz, 25 kHz Channel Spacing; Modulation: FM modulation with an external 9600 b/s random data source



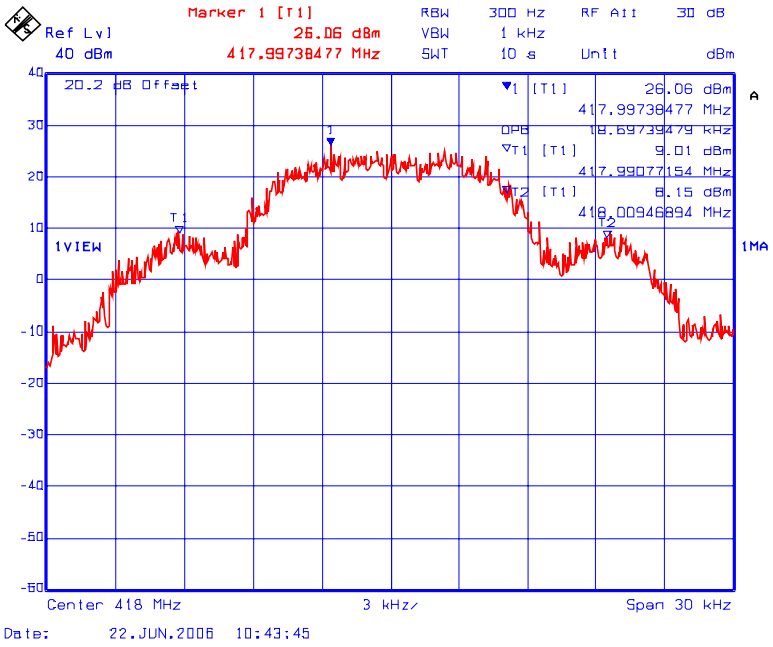
Plot 6.7.5.2.20 99% Occupied Bandwidth – RF Output
Fc: 406.1 MHz, 25 kHz Channel Spacing; Modulation: FM modulation with an external 9600 b/s random data source



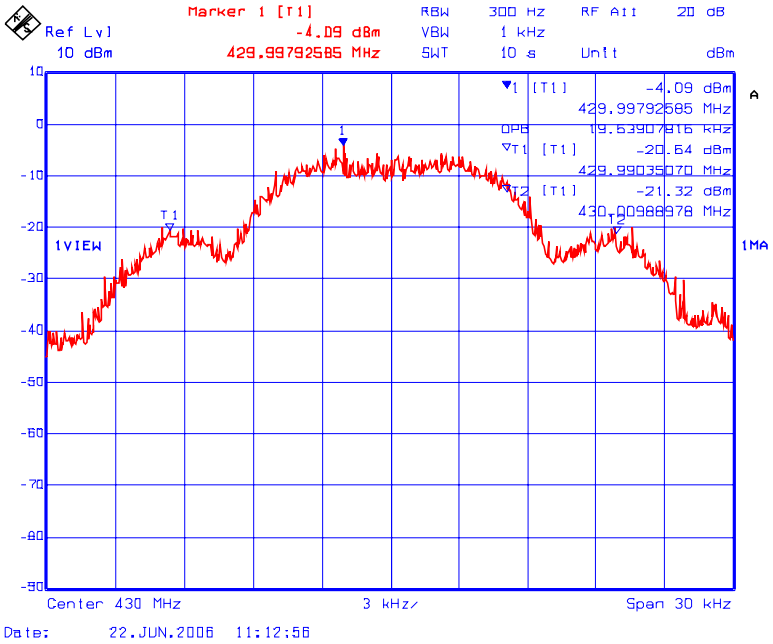
Plot 6.7.5.2.21 99% Occupied Bandwidth – RF Input
Fc: 418 MHz, 25 kHz Channel Spacing; Modulation: FM modulation with an external 9600 b/s random data source



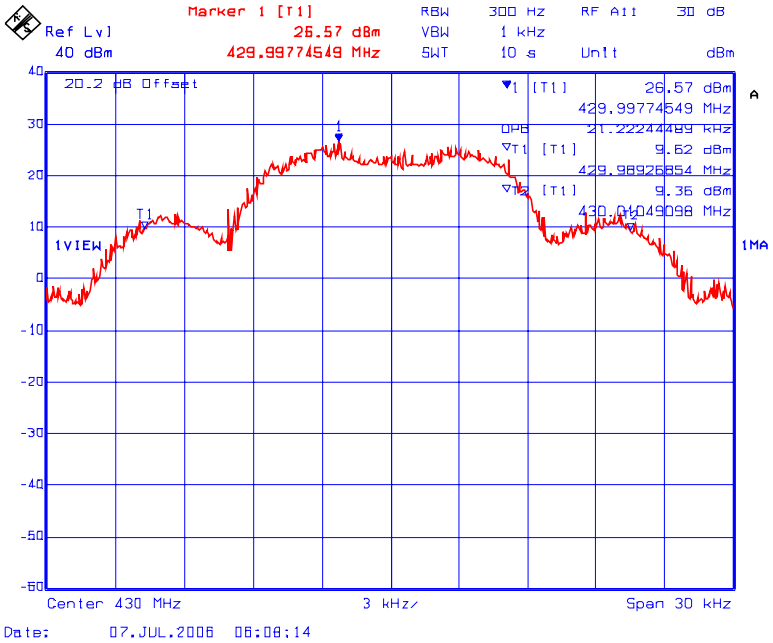
Plot 6.7.5.2.22 99% Occupied Bandwidth – RF Output
Fc: 418 MHz, 25 kHz Channel Spacing; Modulation: FM modulation with an external 9600 b/s random data source



Plot 6.7.5.2.23 99% Occupied Bandwidth – RF Input
Fc: 430 MHz, 25 kHz Channel Spacing; Modulation: FM modulation with an external 9600 b/s random data source



Plot 6.7.5.2.24 99% Occupied Bandwidth – RF Output
Fc: 430 MHz, 25 kHz Channel Spacing; Modulation: FM modulation with an external 9600 b/s random data source



6.8. TRANSMITTER ANTENNA POWER SPURIOUS/HARMONIC CONDUCTED EMISSIONS [§§ 2.1051 & 90.210]

6.8.1. Limits

At least 50 + 10*log(P in Watts) dBc.

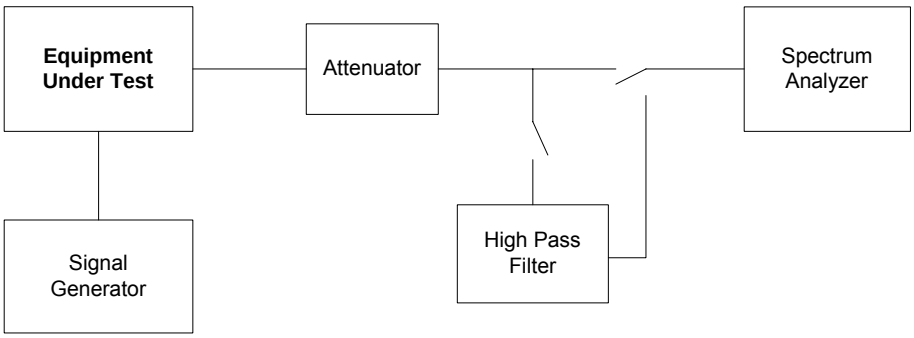
6.8.2. Method of Measurements

Refer to ULTRATECH Test Procedures, File # ULTR P001-2004 and TIA-603-C.

6.8.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Rohde & Schwarz	FSEK20/B4/B21	834157/005	9 kHz – 40 GHz
Attenuator	Weinschel Corp	46-20-34	BM1347	DC - 18 GHz
High Pass Filter	K & L	11SH10-1500/T8000-O/O	2	2 - 18 GHz
Signal Generator	Gigatronic	6061A	5130586	10 kHz - 1050 MHz

6.8.4. Test Arrangement



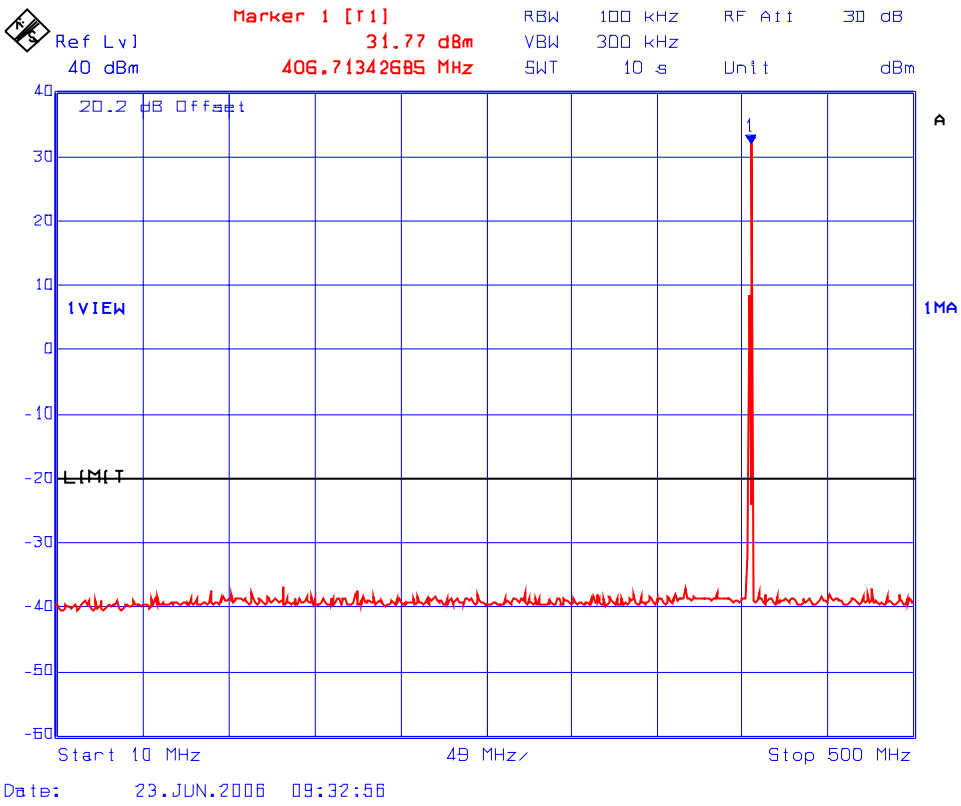
6.8.5. Test Data

Remarks:

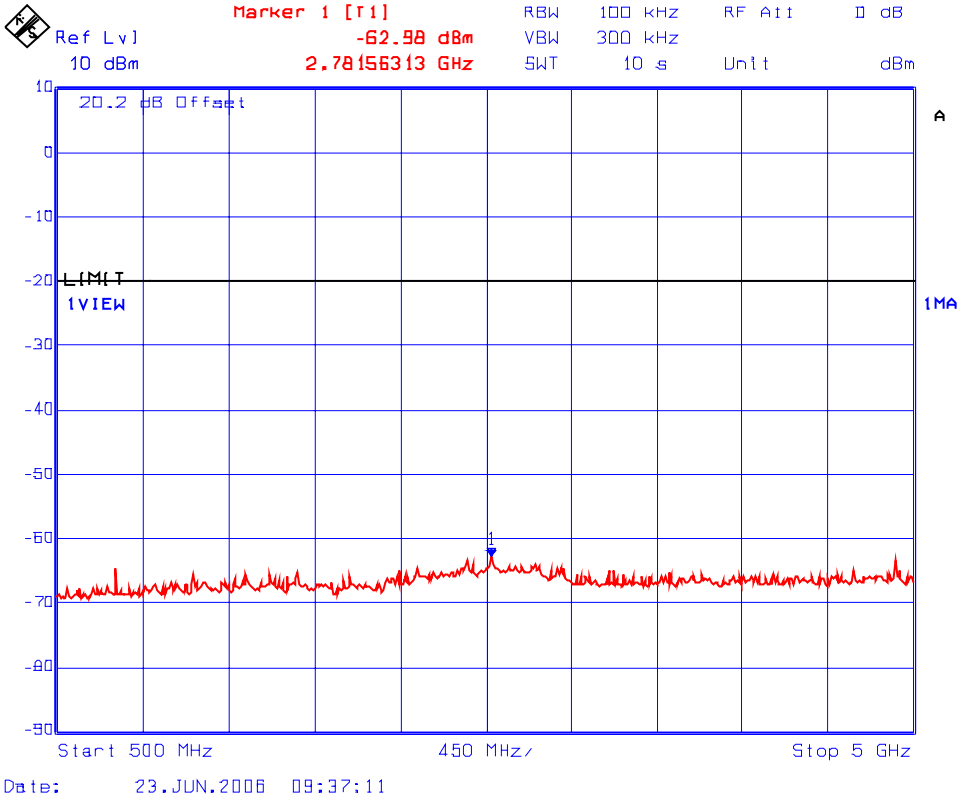
(1) There was no difference in spurious/harmonic emissions on pre-scans for all different modulations. Therefore, the rf spurious/harmonic emissions in this section would be performed without modulation and it shall represent for all different modulations required.
(2) The emissions were scanned from 10 MHz to 5 GHz.

Fundamental Frequency:	406.1 (1 channel input/output)
Modulation:	Unmodulated

Plot 6.8.5.1 Conducted Spurious Emission with 1 RF Signal Input/Output
Fc: 406.1 MHz

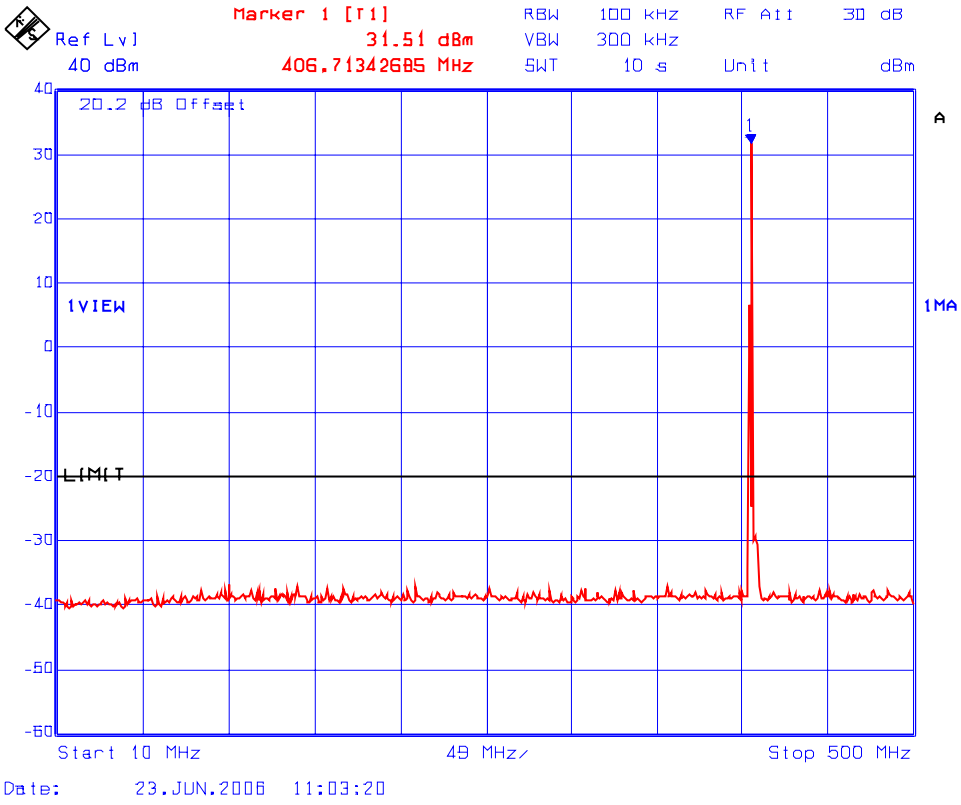


Plot 6.8.5.2 Conducted Spurious Emission with 1 RF Signal Input/Output
Fc: 406.1 MHz

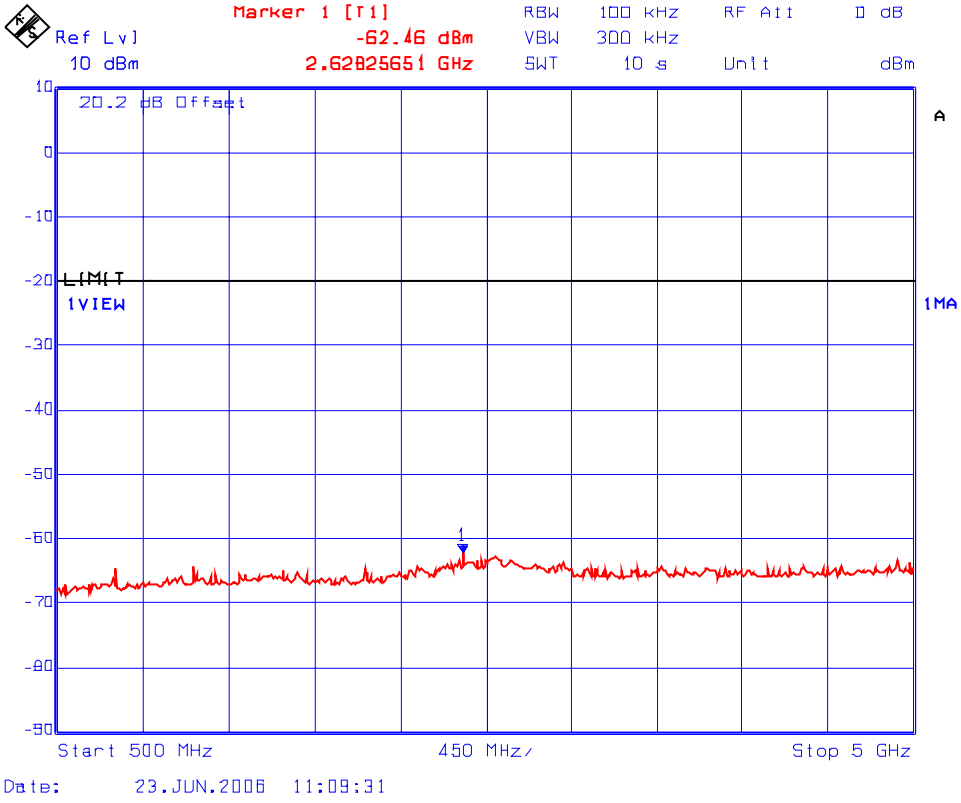


Fundamental Frequency:	406.1 MHz and 406.125 MHz (2 channels input/output)
Modulation:	Unmodulated

Plot 6.8.5.3 Conducted Spurious Emission with 2 RF Signals Input/Output
Fc: 406.1 MHz & Fc + 25 kHz;

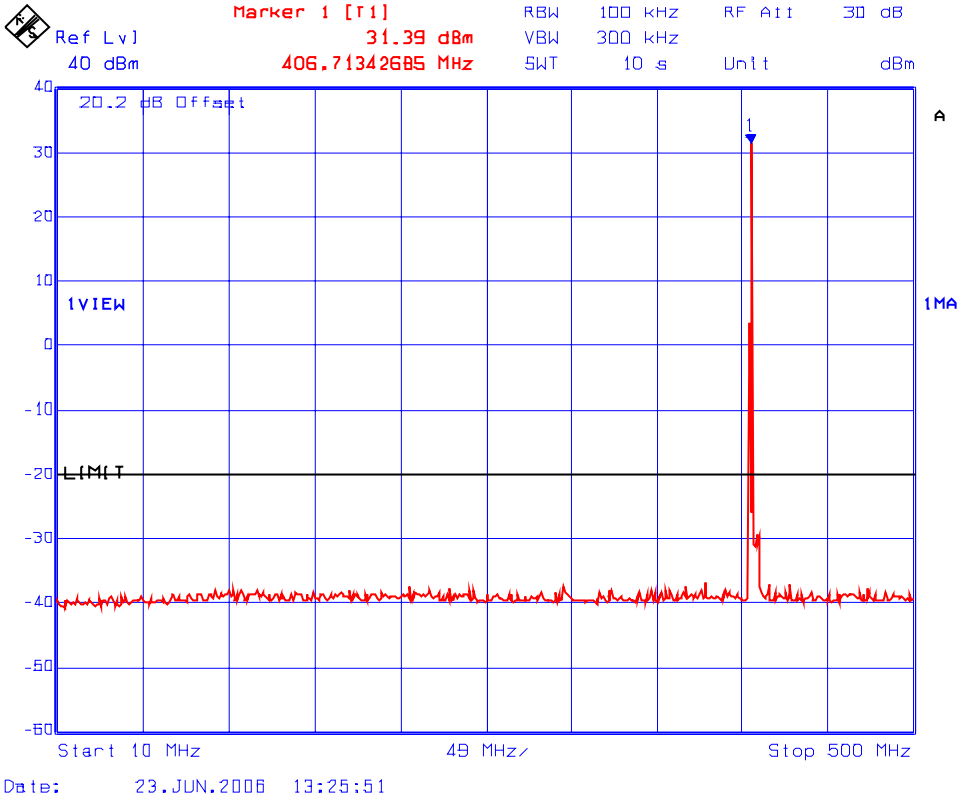


Plot 6.8.5.4 Conducted Spurious Emission with 2 RF Signals Input/Output
Fc: 406.1 MHz & Fc + 25 kHz

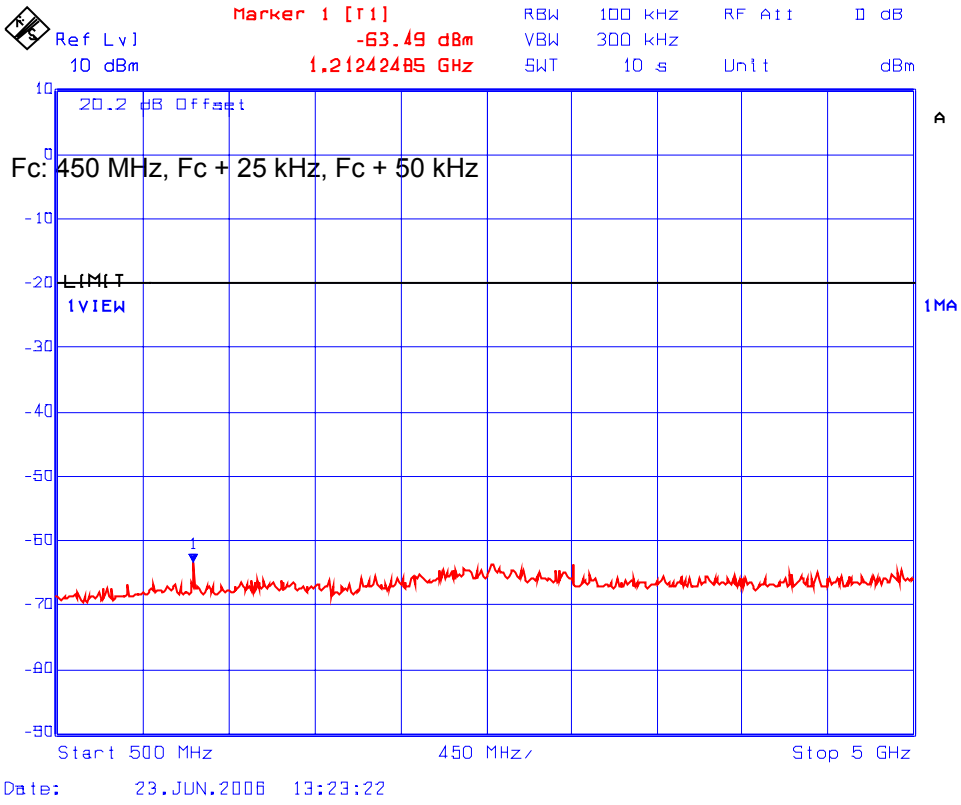


Fundamental Frequency:	406.1 MHz, 406.125 MHz, 406.150 MHz (3 channel inputs/outputs)
Modulation:	Unmodulated

Plot 6.8.5.5 Conducted Spurious Emission with 3 RF Signals Input/Output
Fc: 406.1 MHz, Fc + 25 kHz, Fc + 50 kHz

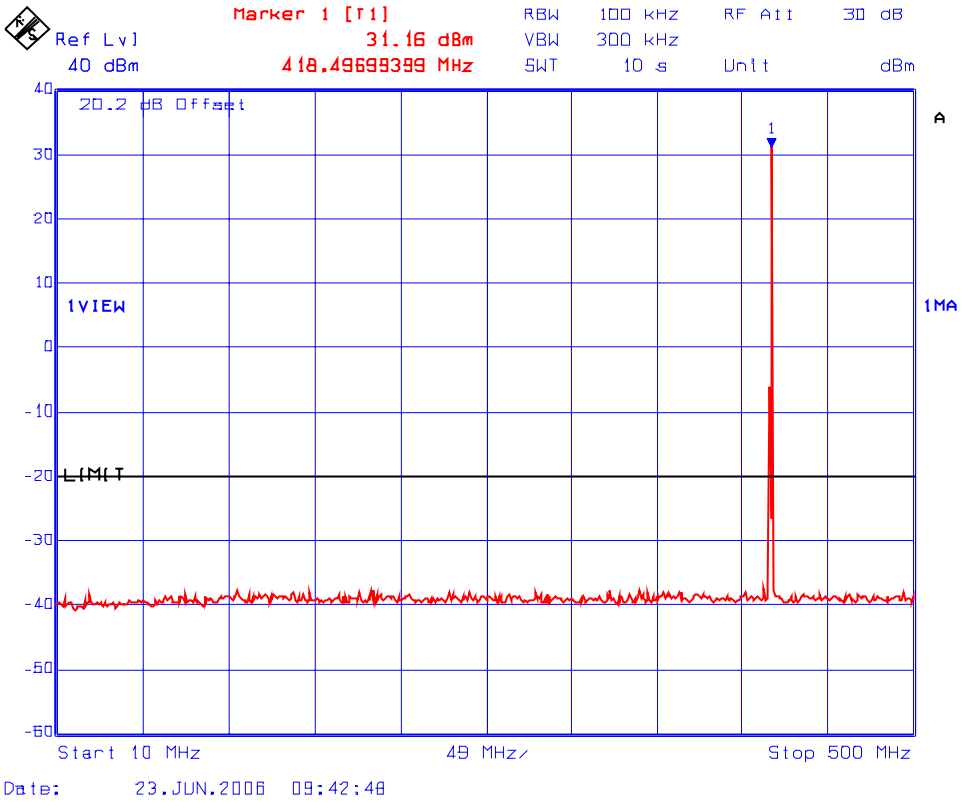


Plot 6.8.5.6 Conducted Spurious Emission with 3 RF Signals Input/Output
Fc: 406.1 MHz, Fc + 25 kHz, Fc + 50 kHz

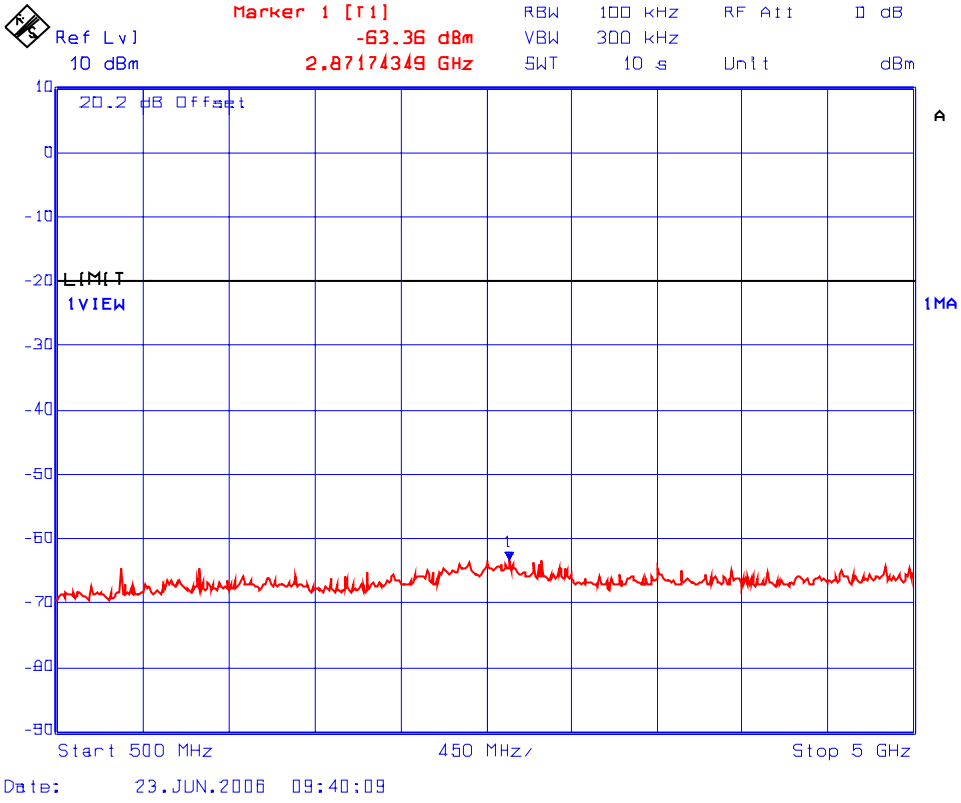


Fundamental Frequency:	418 MHz, 1 RF Signal input/output
Modulation:	Unmodulated

Plot 6.8.5.7 Conducted Spurious Emission with 1 RF Signal Input/Output
Fc: 418 MHz

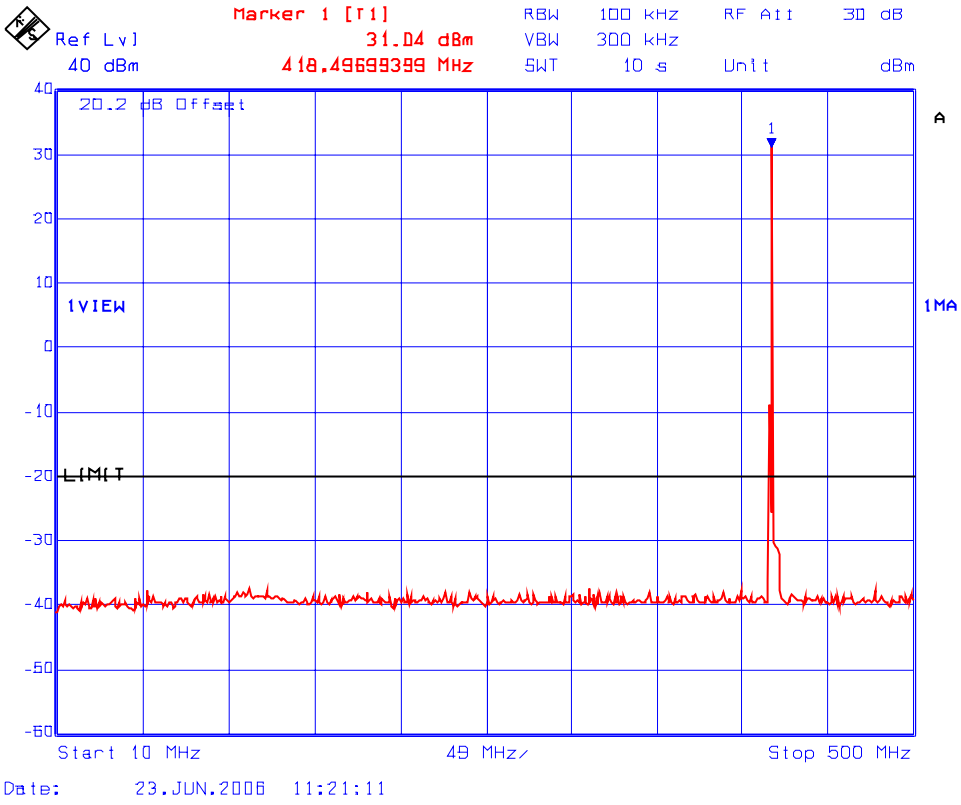


Plot 6.8.5.8 Conducted Spurious Emission with 1 RF Signal Input/Output
Fc: 418 MHz

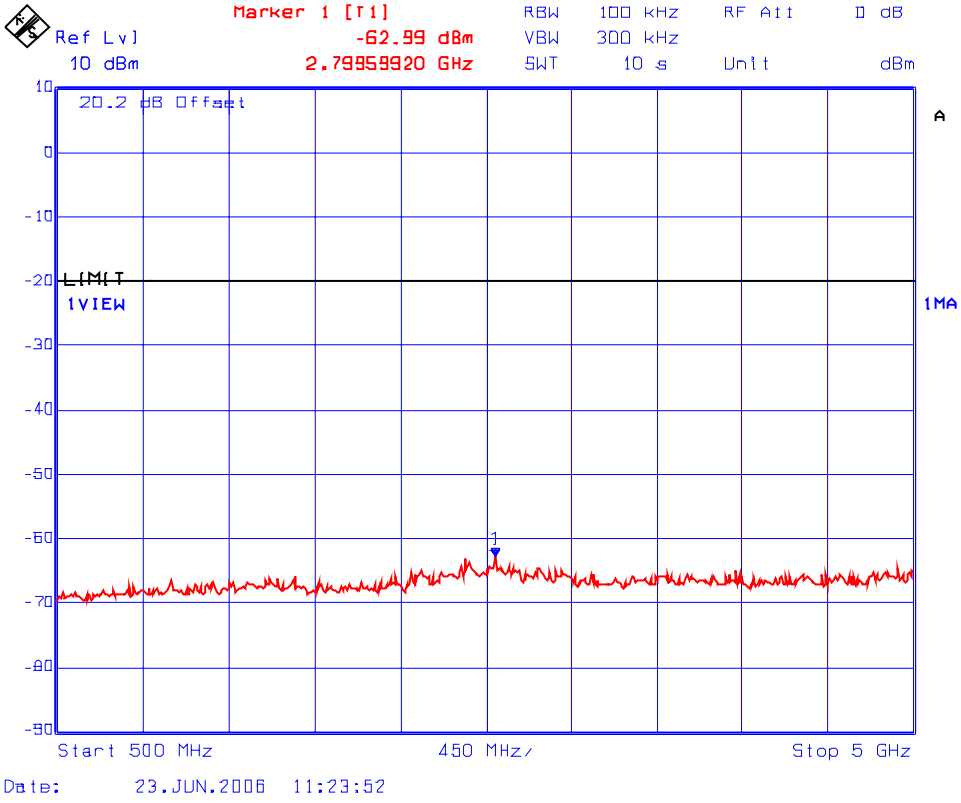


Fundamental Frequency:	418 MHz, 418.025 (2 channels input/output)
Modulation:	Unmodulated

Plot 6.8.5.9 Conducted Spurious Emission with 2 RF Signals Input/Output
Fc: 418 MHz, Fc + 25 kHz

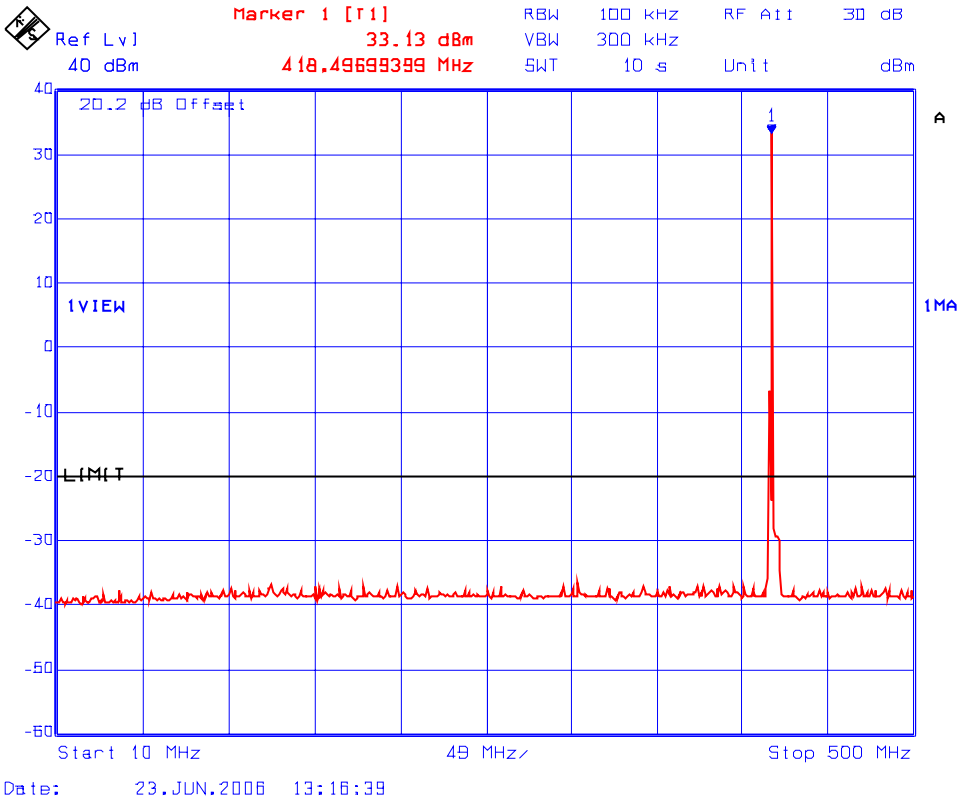


Plot 6.8.5.10 Conducted Spurious Emission with 2 RF Signals Input/Output
Fc: 418 MHz, Fc + 25 kHz

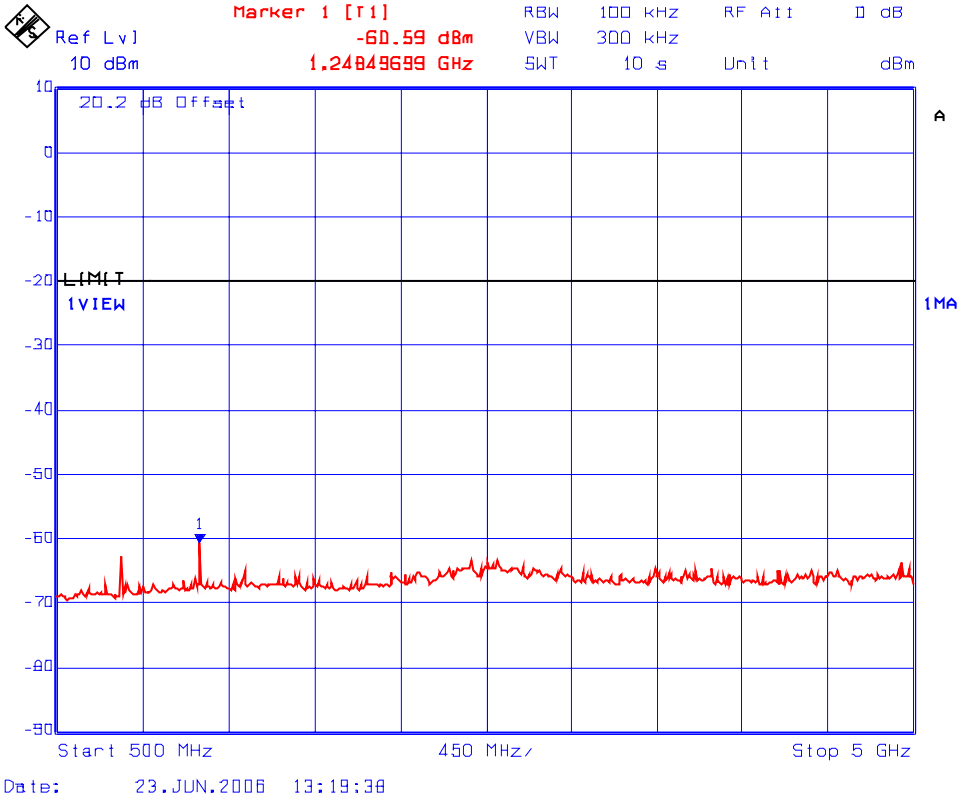


Fundamental Frequency:	418 MHz, 418.025, 418.050 (3 channels input/output)
Modulation:	Unmodulated

Plot 6.8.5.11 Conducted Spurious Emission with 3 RF Signals Input/Output
Fc: 418 MHz, Fc + 25 kHz, Fc + 50 kHz

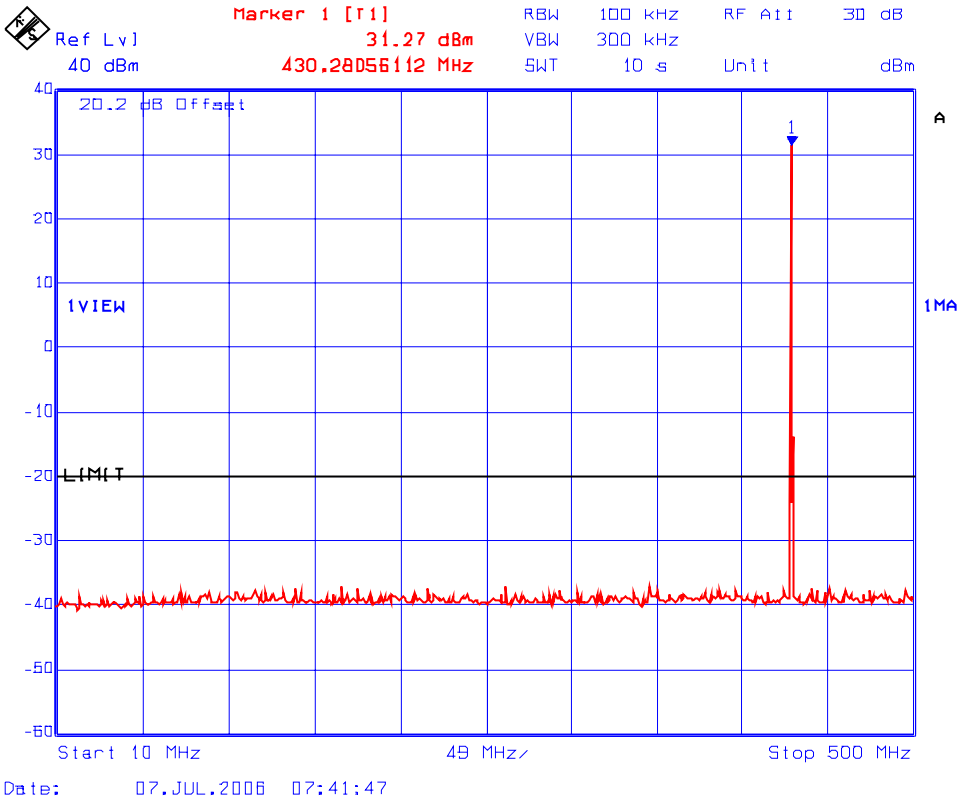


Plot 6.8.5.12 Conducted Spurious Emission with 3 RF Signals Input/Output
Fc: 418 MHz, Fc + 25 kHz, Fc + 50 kHz

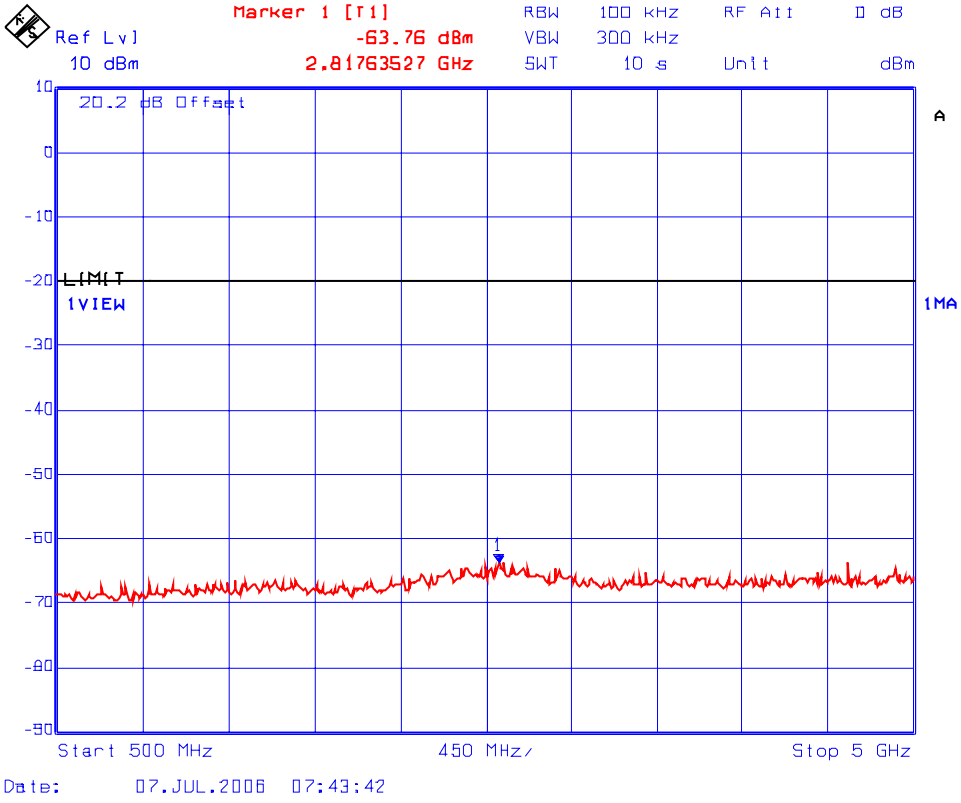


Fundamental Frequency: 430 MHz, 1 RF Signal input/output
Modulation: Unmodulated

Plot 6.8.5.13 Conducted Spurious Emission with 1 RF Signal Input/Output
Fc: 430 MHz

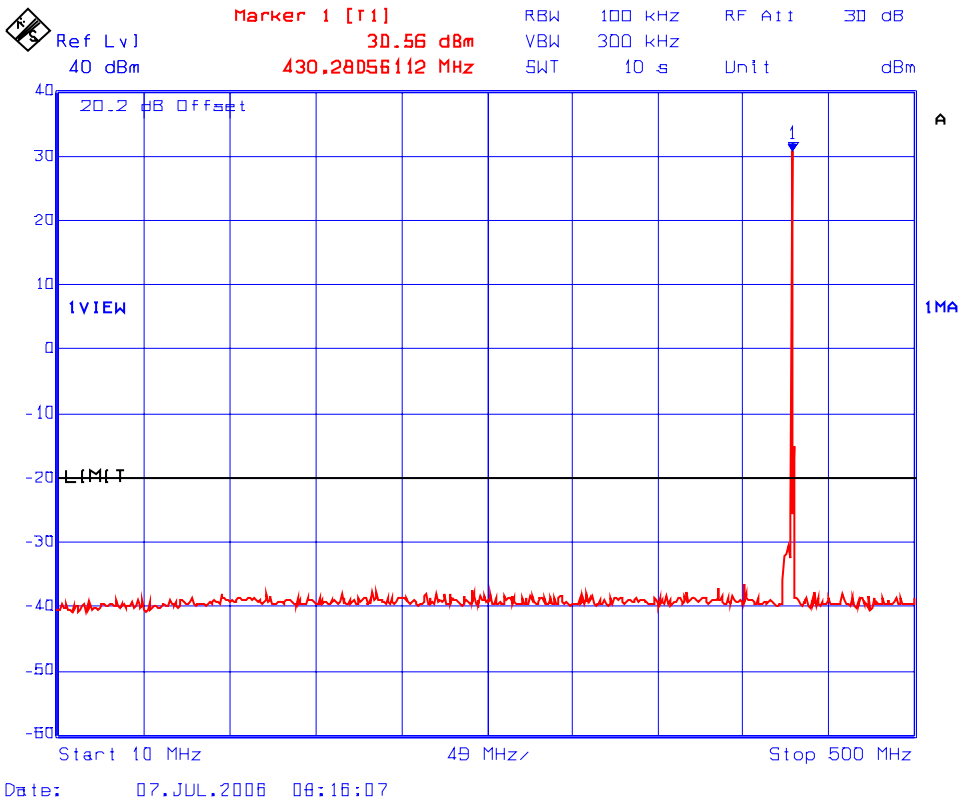


Plot 6.8.5.14 Conducted Spurious Emission with 1 RF Signal Input/Output
Fc: 430 MHz

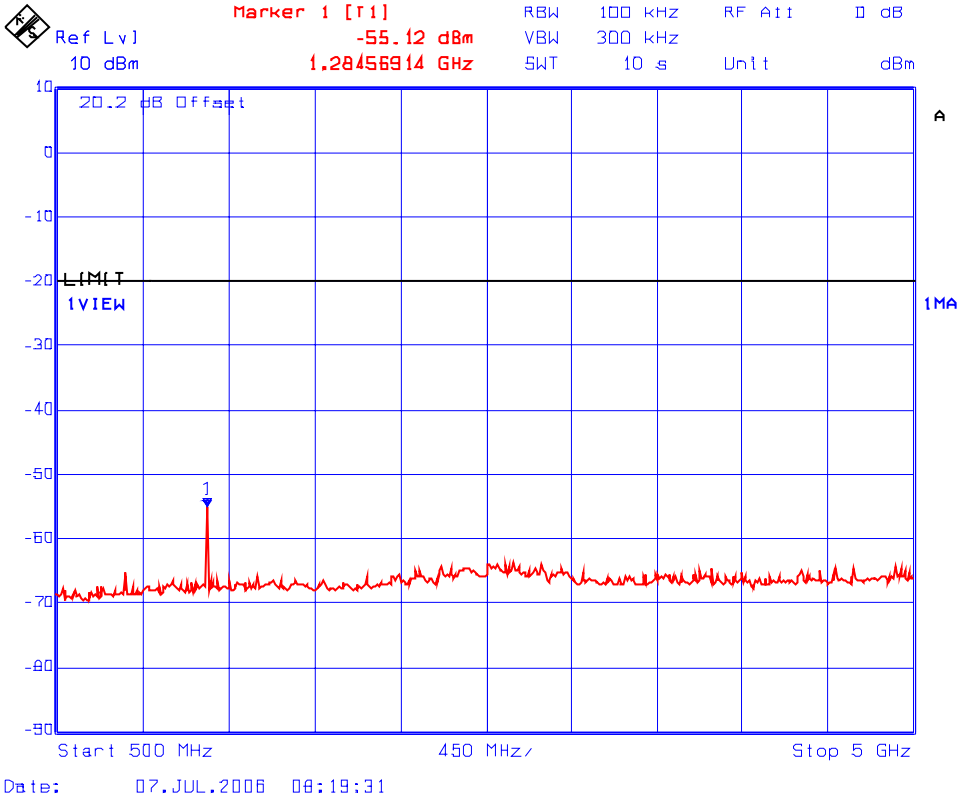


Fundamental Frequency:	430 MHz, 429.975 MHz (2 channels input/output)
Modulation:	Unmodulated

Plot 6.8.5.15 Conducted Spurious Emission with 2 RF Signals Input/Output
Fc: 430 MHz, Fc - 25 kHz

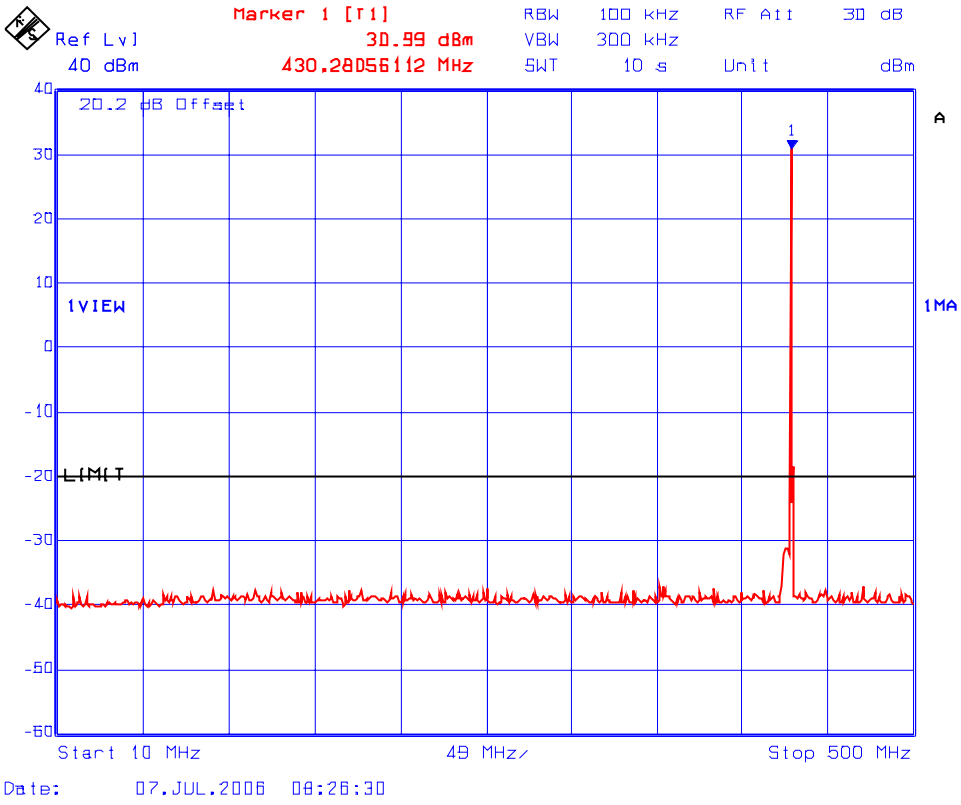


Plot 6.8.5.16 Conducted Spurious Emission with 2 RF Signals Input/Output
Fc: 430 MHz, Fc - 25 kHz

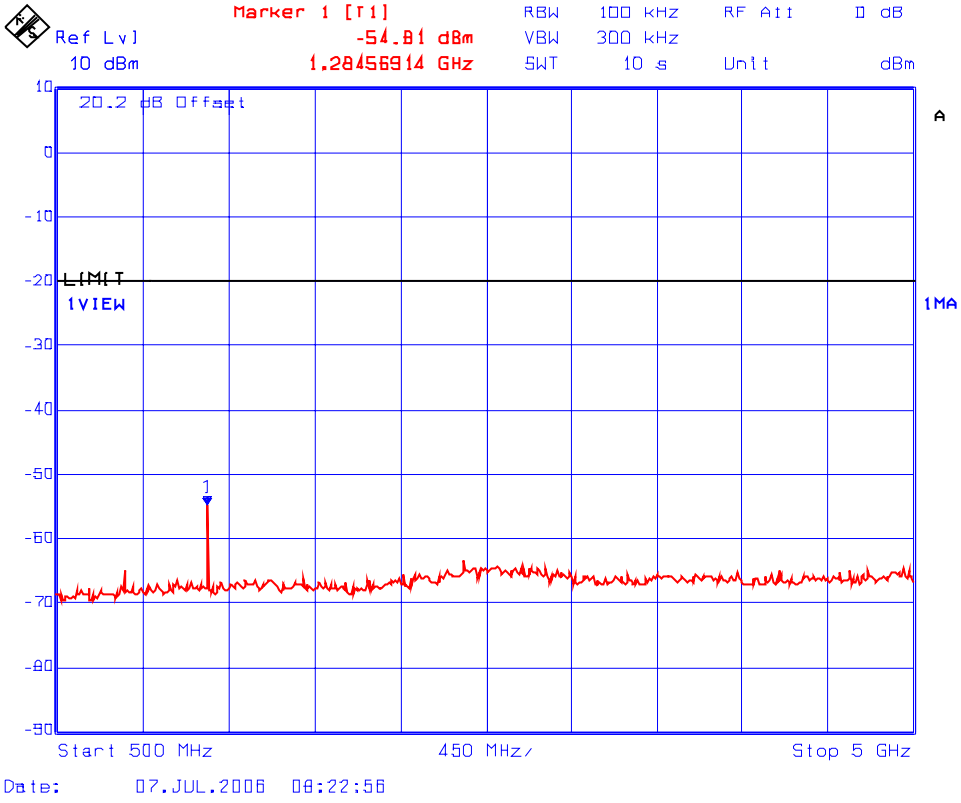


Fundamental Frequency:	430 MHz, 429.975 MHz, 429.95 MHz (3 channels input/output)
Modulation:	Unmodulated

Plot 6.8.5.17 Conducted Spurious Emission with 2 RF Signals Input/Output
Fc: 430 MHz, Fc - 25 kHz, Fc – 50 kHz



Plot 6.8.5.18 Conducted Spurious Emission with 2 RF Signals Input/Output
Fc: 430 MHz, Fc - 25 kHz, Fc – 50 kHz



6.9. TRANSMITTER SPURIOUS/HARMONIC RADIATED EMISSIONS [§§ 2.1053 & 90.210]

6.9.1. Limits

At least 50+10*log(P in Watts) dBc.

6.9.2. 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 = Pc 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)

6.9.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Rohde & Schwarz	FSEK20/B4/B21	834157/005	9 kHz – 40 GHz
RF Amplifier	Com-Power	PA-102		1 MHz to 1 GHz, 30 dB gain nominal
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

6.9.4. Test Data

Remarks:

(1) There was no difference in spurious/harmonic emissions on pre-scans for all different modulations. Therefore, the rf spurious/harmonic emissions in this section would be performed without modulation and it shall represent for all different modulations required.
(2) The RF spurious/harmonic emission characteristics for narrow band and wide band operation are indistinguishable. Therefore, the following radiated emissions were performed at 12.5 kHz channel spacing (narrow band) operation, and the results were compared with the more stringent limit of 50+10*log (P in watts) for the worst case.

6.9.4.1. Lowest Frequency (406.1 MHz)

Carrier Frequency(MHz):	406.1
Power(dBm):	32.48
Limit(dBc):	52.48

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)
The emissions were scanned from 30 MHz to 5 GHz at 3 meters distance and all spurious emissions and harmonics were more than 20 dB below the permissible limits.							

6.9.4.2. Middle Frequency (418 MHz)

Carrier Frequency(MHz):	418
Power(dBm):	31.61
Limit(dBc):	51.61

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)
The emissions were scanned from 30 MHz to 5 GHz at 3 meters distance and all spurious emissions and harmonics were more than 20 dB below the permissible limits.							

6.9.4.3. Highest Frequency (430 MHz)

Carrier Frequency(MHz):	430
Power(dBm):	31.30
Limit(dBc):	51.30

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)
The emissions were scanned from 30 MHz to 5 GHz at 3 meters distance and all spurious emissions and harmonics were more than 20 dB below the permissible limits.							

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

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)