Electromagnetic Compatibility Test Report

Tests Performed on an ISC Technologies, Inc

Paging Transmitter, Model ISC-T5540

Radiometrics Document RP-5511

Product Detail:
FCC ID: SS6ISC-T5540
Equipment type: 406-430 & 445 to 470 paging Transmitter

Test Standards:
US CFR Title 47, Chapter I, FCC Part 22 and 90
FCC Part 90 CFR Title 47: 2004
Industry Canada RSS-119, Issue 6

This report concerns: Original Grant for Certification
FCC Parts 2, 22 and 90

Tests Performed For:	*Test Facility:*
ISC Technologies, Inc PO Box 43 Quincy, IL 62306	**Radiometrics Midwest Corporation** 12 East Devonwood Romeoville, IL 60446 Phone: (815) 293-0772 e-mail: info@radiomet.com

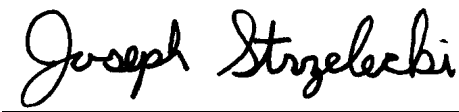
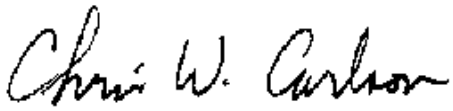
Test Date(s): (Month-Day-Year)
March 1 to 10, 2005

Document RP-5511 Revisions:

Rev.	Issue Date	Affected Pages	Revised By	Authorized Signature for Revision
0	March 25, 2005			
1	April 25, 2005	3	Joseph Strzelecki	Joseph Strzelecki

Table of Contents

1 ADMINISTRATIVE DATA

Equipment Under Test: A ISC Technologies, Inc, Paging Transmitter Model: ISC-T5540 Serial Number: None This will be referred to as the EUT in this Report	
Date EUT Received at Radiometrics: (Month-Day-Year) March 1, 2005	*Test Date(s): (Month-Day-Year)* March 1 to 10, 2005
Test Report Written By: Joseph Strzelecki Senior EMC Engineer	*Test Witnessed By:* Dan Pease ISC Technologies, Inc
Radiometrics' Personnel Responsible for Test:  Joseph Strzelecki Senior EMC Engineer NARTE EMC-000877-NE Joseph Foster ISC Technologies, Inc.	*Test Report Approved By*  Chris W. Carlson Director of Engineering NARTE EMC-000921-NE

2 TEST SUMMARY AND RESULTS

The EUT (Equipment Under Test) is a Paging Transmitter, Model ISC-T5540, manufactured by ISC Technologies, Inc. The detailed test results are presented in a separate section. The following is a summary of the test results.

Transmitter Requirements

Environmental Phenomena	Frequency Range	FCC Section	RSS-119 Section	Test Result
RF Power Output	406 to 470 MHz	2.1046	6.2	Pass
Modulation Characteristics	406 to 470 MHz	2.1047	6.6	Pass
Occupied Bandwidth Test; Emissions Masks	406 to 470 MHz	2.1049	6.4	Pass
Spurious RF Conducted Emissions	1-4700 MHz	2.1051	6.4	Pass
Field Strength of Spurious Radiation	30-4700 MHz	2.1053	6.3	Pass
Frequency Vs. Temperature	406 to 470 MHz	2.1055	5.3	Pass
Frequency Vs. Voltage	406 to 470 MHz	2.1055	2.3	Pass
Transient Frequency Behavior	406 to 470 MHz	90.214	6.5	Pass

3 EQUIPMENT UNDER TEST (EUT) DETAILS

3.1 EUT Description

The EUT is a Paging Transmitter, Model ISC-T5540, manufactured by ISC Technologies, Inc. The EUT was in good working condition during the tests, with no known defects.

3.2 Related Submittals

ISC Technologies, Inc is not submitting any other products simultaneously for equipment authorization related to the EUT.

4 TESTED SYSTEM DETAILS

4.1 Tested System Configuration

The system was configured for testing in a typical fashion. The EUT was placed in an equipment rack as in a normal installation. The testing was performed in conditions as close as possible to installed conditions. Wiring was consistent with manufacturer's recommendations. Power was supplied at 115 VAC, 60 Hz single-phase. The identification for all equipment, used in the tested system, is:

Tested System Configuration List

Item	Description	Type*	Manufacturer	Model Number	Serial Number
1	Paging Transmitter System	E	ISC Technologies	ISC-T5540	None
2	Exciter	E	ISC Technologies	DSP Exciter	Q94390023E4875
3	Exciter	E	ISC Technologies	DSP Exciter	21725470
4	Power Amplifier	E	ISC Technologies	97 Series	Q96350084E10725
5	Power Amplifier	E	ISC Technologies	97 Series	20329839
6	Power Supply	E	ISC Technologies	2728	20289430
7	Power Supply	E	ISC Technologies	2728	10185095

* Type: E = EUT, P = Peripheral, S = Support Equipment;

4.2 Special Accessories

No special accessories were used during the tests in order to achieve compliance.

4.3 Equipment Modifications

No modifications were made to the EUT at Radiometrics' test facility in order to comply with the standards listed in this report.

5 TEST SPECIFICATIONS AND RELATED DOCUMENTS

Document	Date	Title
FCC CFR Title 47	2004	Code of Federal Regulations Title 47, Chapter 1, Federal Communications Commission, Parts 22 and 90
ANSI C63.4-2001	2001	Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
IC RSS-119 Issue 5	2000	Land Mobile and Fixed Radio Transmitters and Receivers, 27.41 to 960.0 MHz
IC RSS-212 Issue 1	1998	Test Methods For Radio Equipment
TIA-603-C	2004	Land Mobile FM or PM Communications Equipment – Measurement and Performance Standards

6 RADIOMETRICS' TEST FACILITIES

The results of these tests were obtained at Radiometrics Midwest Corp. in Romeoville, Illinois, USA. Radiometrics is accredited by A2LA (American Association for Laboratory Accreditation) to conform to ISO/IEC 17025: 1999 "General Requirements for the Competence of Calibration and Testing Laboratories". Radiometrics' Lab Code is 121191 and Certification Number is 1495.01. A copy of the accreditation can be accessed on our web site (www.radiomet.com). Radiometrics accreditation status can be verified at A2LA's web site (www.a2la2.org).

The following is a list of the facilities used during the tests:

Chamber E: Is a custom made anechoic chamber that measures 52' L X 30' W X 18' H. The walls and ceiling are fully lined with RF absorber. Pro-shield of Collinsville, Oklahoma manufactured the chamber.

A separate ten-foot long, brass plated, steel ground rod attached via a 6 inch copper braid grounds each of the above chambers. Each enclosure is also equipped with low-pass power line filters.

Open Area Test Site (OATS): Is located on 8625 Helmar Road in Newark, Illinois, USA and measures 56' L X 24' W X 17' H. The entire open field test site has a metal ground screen. The FCC has accepted these sites as test site number 31040/SIT 1300F2. The FCC test site Registration Number is 90897. Details of the site characteristics are on file with the Industry Canada as file number IC3124.

A complete list of the test equipment is provided herein. The calibration due dates are indicated on the equipment list. The equipment is calibrated in accordance to ANSI/NCSL Z540-1 with traceability to the National Institute of Standards and Technology (NIST).

7 DEVIATIONS AND EXCLUSIONS FROM THE TEST SPECIFICATIONS

There were no deviations or exclusions from the test specifications.

8 CERTIFICATION

Radiometrics Midwest Corporation certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specification. The results relate only to the EUT listed herein. Any modifications made to the EUT subsequent to the indicated test date will invalidate the data and void this certification.

9 TEST EQUIPMENT TABLE

RMC ID	Manufacturer	Description	Model No.	Serial No.	Frequency Range	Cal Period	Cal Date
ANT-06	EMCO	Log-Periodic Ant.	3146	1248	200-1000MHz	24 mo	11/17/03
ANT-13	EMCO	Horn Antenna	3115	2502	1.0-18GHz	24 Mo.	10/13/04
ANT-42	EMCO	Bicon Antenna	3104C	9512-4713	25-300MHz	24 Mo.	12/02/03
ANT-44	Impossible Machine	Super Log Antenna	SL-20M2G	1002	20-2000MHz	24 Mo.	06/15/04
ATT-02	KDI	Attenuator	A710N	RMC1	DC-10GHz	24 Mo.	02/04/05
ATT-22	Bird Elect.	Attenuator	8327-300	2049	DC-2GHz	12 Mo.	02/04/05
ATT-03	KDI	Attenuator	A710N	RMC3	DC-10GHz	24 Mo.	01/12/03
DIR-07	Werlatone	Directional Coupler	C3908	6929	80-1000MHz	24 Mo.	12/29/04
DIR-10	Narda	Directional Coupler	27443	0018-85-39	1-18 GHz	24 Mo.	12/31/03
MOD-01	HP / Agilent	Modulation Analyzer	8901B	3005A02631	0.15-1300MHz	12 Mo.	02/25/05
PRE-01	HP / Agilent	Preselector	85685A	2510A00143	20 Hz-2GHz	12 Mo.	01/20/05
PWM-01	Boonton	Power Meter	4230	22503	50kHz-18GHz	24 Mo.	06/13/03
REC-08	HP / Agilent	Spectrum Analyzer	8566B	2648A13481 2209A01436	30Hz-22GHz	12 Mo.	05/26/04
SCP-01	Tektronix	Oscilloscope	TDS724A	B010117	DC-500MHz	18 Mo.	06/02/04
SIG-09	Gigatronics	RF Synthesizer	6061A	5130174	0.01-1050MHz	12 Mo.	12/29/04
THM-01	Extech Inst.	Temp/Humid Meter	4465CF	001106557	N/A	24 Mo.	01/28/04

Note: All calibrated equipment is subject to periodic checks.

10 TEST SECTIONS

In all modes, the transmitter was terminated with a 50 W load.

In analog modes, the transmitter was modulated with a 2,500 Hz sine wave at an input level 16 dB greater than that required to produce 50% of the rated system deviation at 1000 Hz. I the Digital modes, the transmitter was modulated with a 4800 Hz square wave.

Mask B and D were used in this Report:

Limits: Mask B (dBm): P(dBm) – (43+10xLOG P(W)) = -13 dBm

Mask D (dBm): P(dBm) – (50+10xLOG P(W)) or 70 dB which ever is lessor attenuation
Mask D = -20 dBm for 50 Watts and -16 dBm for 250 Watts

10.1 Peak Output Power

An HP 8901B Modulation Analyzer/Power meter was used for this test.

2.1046	**Peak Power**				
TX freq MHz	Atten & Cable	Reading dBm	Total dBm	Watts	Power Setting
406	40.2	13.6	53.8	239.88	250
413.25	40.2	13.7	53.9	245.47	250
420	40.2	13.5	53.7	234.42	250
406	40.2	6.5	46.7	46.77	50
413.25	40.2	6.7	46.9	48.98	50
420	40.2	6.9	47.1	51.29	50
445	40.2	13.7	53.9	242.66	250
457	40.3	13.6	53.9	245.47	250
470	40.3	13.6	53.9	246.60	250
445	40.2	6.6	46.8	47.86	50
457	40.3	6.5	46.8	47.86	50
470	40.3	6.5	46.8	47.86	50

Test Date: March 2, 2005
Judgement: Pass
Tested by: Joseph Strzelecki

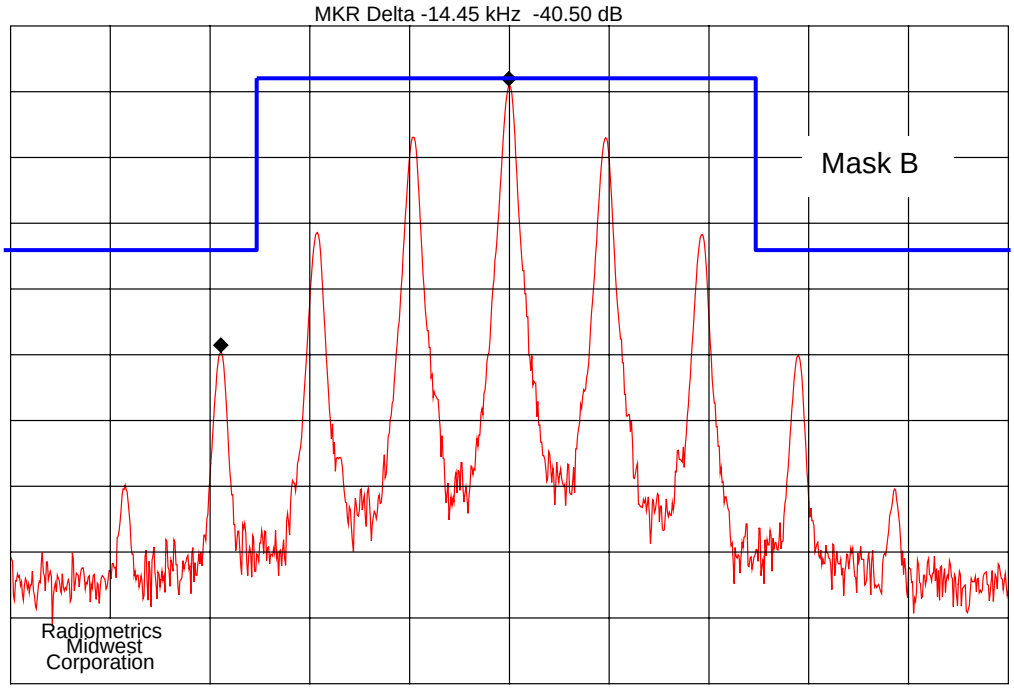
10.2 Occupied Bandwidth; Emissions Masks

The spectrum analyzer was set to the MAX HOLD mode to record the worst case of the modulation. The EUT was transmitting at its maximum data rate. The trace was allowed to stabilize.

The marker-to-peak function was set to the peak of the emission. Then the marker-delta function was used to measure 20 dB down one side of the emission. The marker-delta function was reset and then moved to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission.

The emissions Masks are from FCC part 90.210.
last entry in the table in 90.210 shows mask B as being appropriate for all other bands not previously listed.

420 MHz; 50 Watts; 25 kHz Channel; Digital Modulation; File BW2

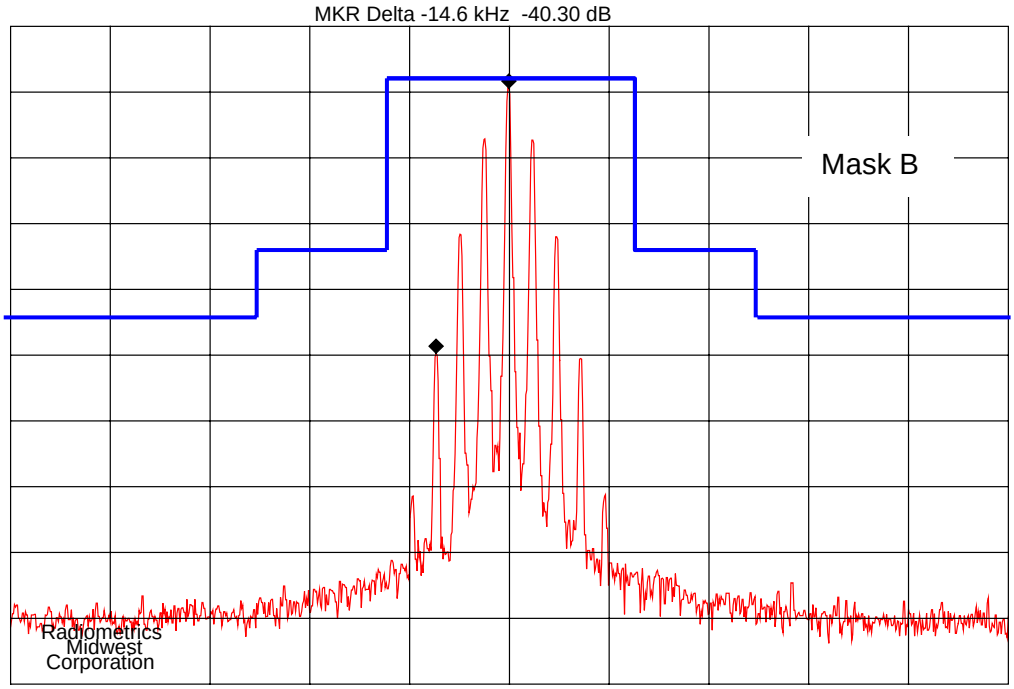


COMPANY : ISC Technologies
CENTER 419.999 9 MHz
RES BW 300 Hz
10 dB/
NOTES : Occupied Bandwidth, 4.8 kHz Deviation; 50 Watts

ITEM : GL-T5540
REF 14.0 dBm
VBW 1 kHz
TIME : 10:44

DATE : 03-01-2005
SPAN 50.0 kHz
ATTEN 30 dB
SWP 1.50 sec

420 MHz; 50 Watts; 25 kHz Channel; Digital Modulation; File BW3

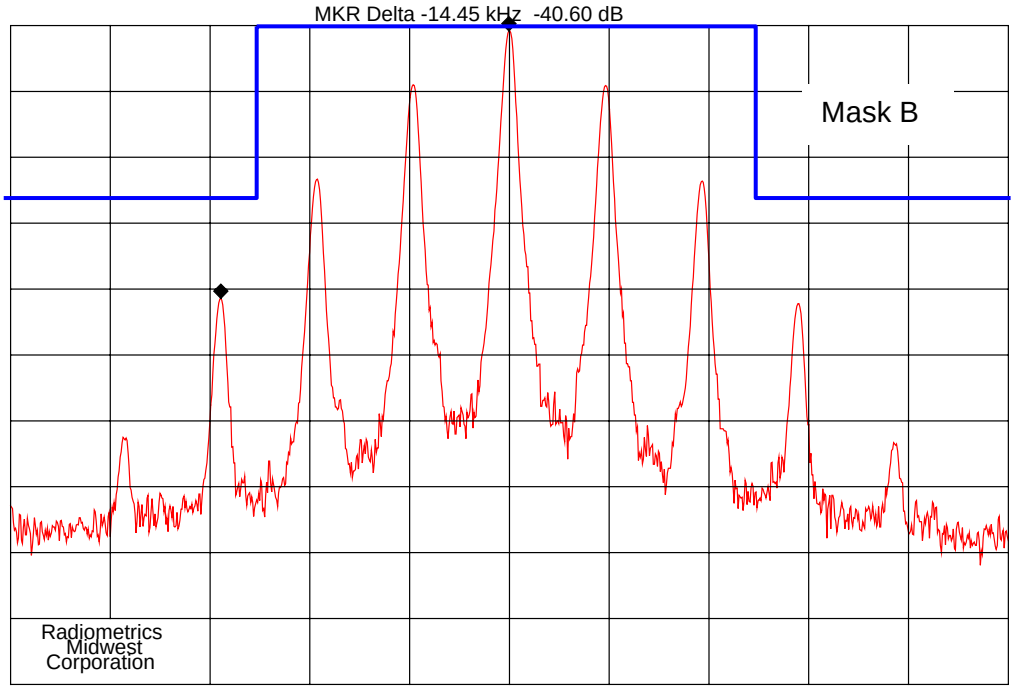


COMPANY : ISC Technologies
CENTER 419.999 MHz
RES BW 300 Hz
10 dB/
NOTES : Occupied Bandwidth, 4.8 kHz Deviation; 50 Watts

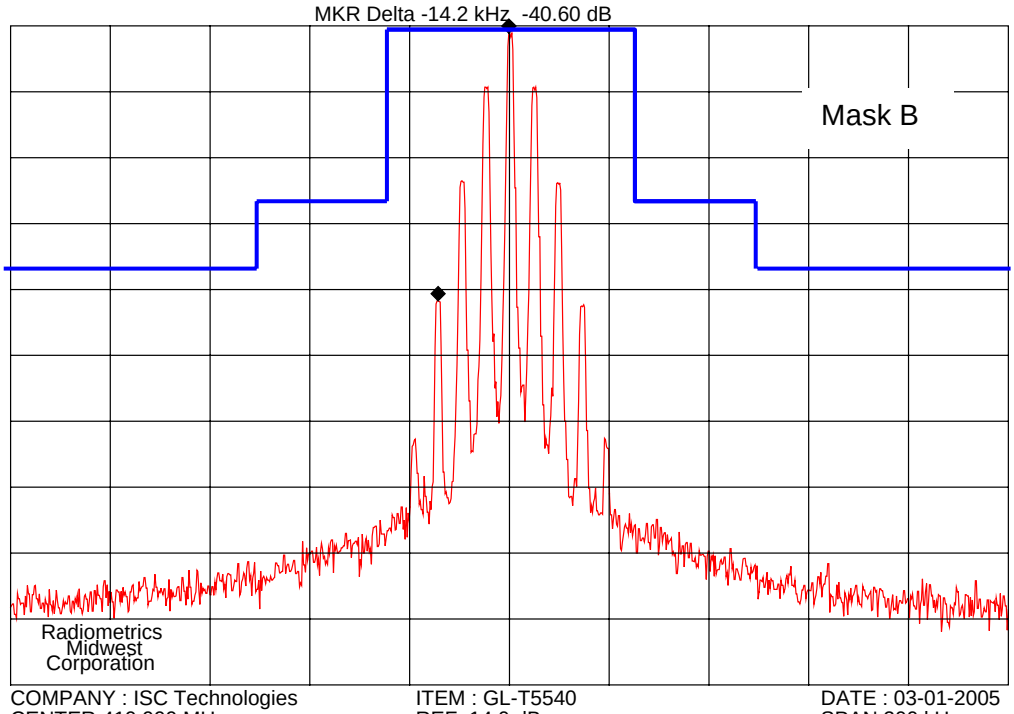
ITEM : GL-T5540
REF 14.0 dBm
VBW 1 kHz
TIME : 10:55

DATE : 03-01-2005
SPAN 200 kHz
ATTEN 30 dB
SWP 6.00 sec

420 MHz; 250 Watts; 25 kHz Channel; Digital Modulation; File BW1



420 MHz; 250 Watts; 25 kHz Channel; Digital Modulation; File BW4

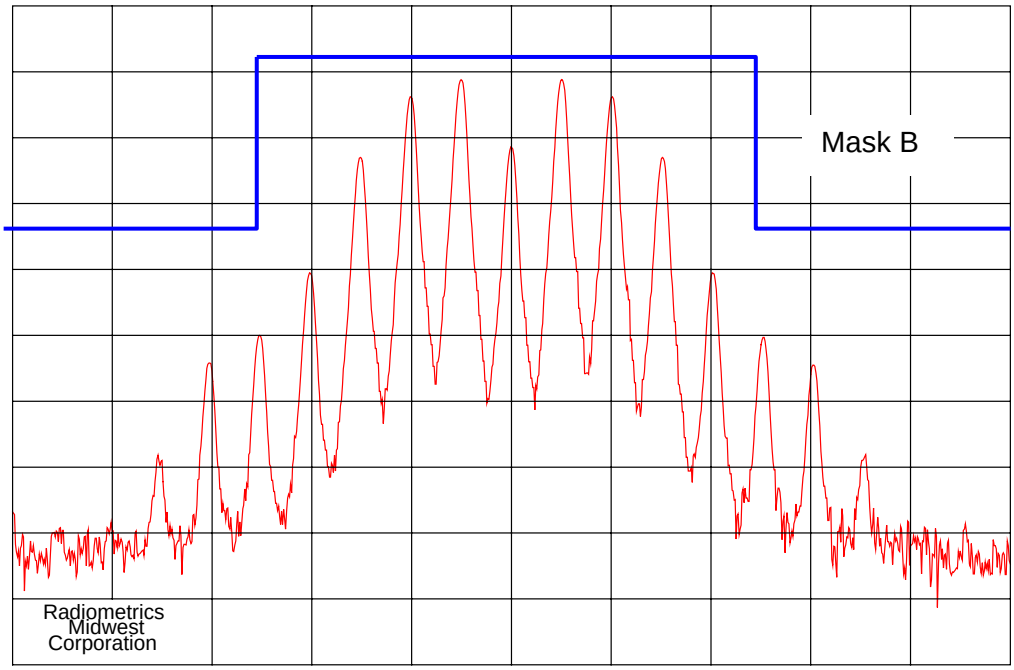


COMPANY : ISC Technologies
CENTER 419.999 MHz
RES BW 300 Hz
10 dB/
NOTES : Occupied Bandwidth, 4.8 kHz Deviation; 250 Watts

ITEM : GL-T5540
REF 14.0 dBm
VBW 1 kHz
TIME : 10:59

DATE : 03-01-2005
SPAN 200 kHz
ATTEN 30 dB
SWP 6.00 sec

445 MHz; 50 Watts; 25 kHz Channel; Analog Modulation; File BW26

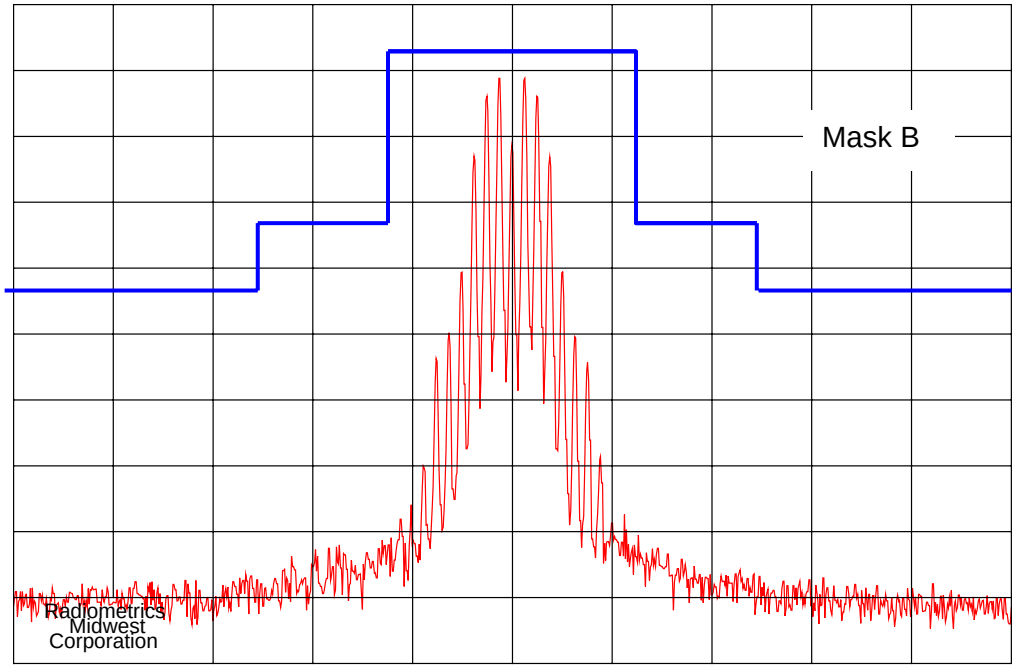


COMPANY : ISC Technologies
CENTER 445.000 0 MHz
RES BW 300 Hz
10 dB/
NOTES : Bandwidth, Analog; 25kHz

ITEM : GL-T5540
REF 14.0 dBm
VBW 1 kHz
TIME : 09:28

DATE : 03-02-2005
SPAN 50.0 kHz
ATTEN 30 dB
SWP 1.50 sec

445 MHz; 50 Watts; 25 kHz Channel; Analog Modulation; File BW25

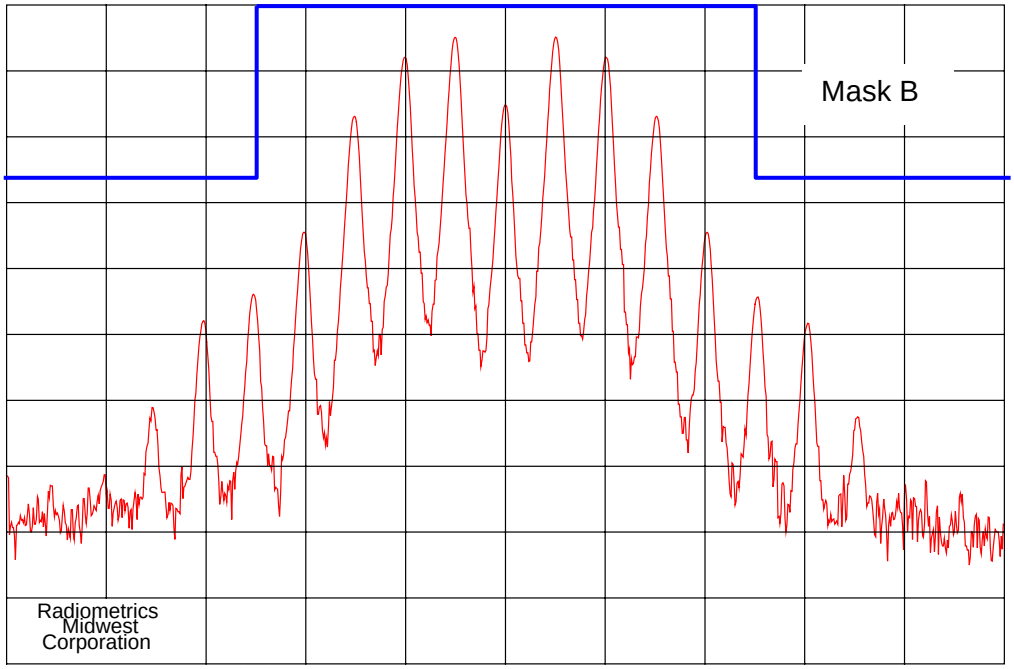


COMPANY : ISC Technologies
CENTER 445.000 MHz
RES BW 300 Hz
10 dB/
NOTES : Bandwidth, Analog; 25kHz

ITEM : GL-T5540
REF 14.0 dBm
VBW 1 kHz
TIME : 09:27

DATE : 03-02-2005
SPAN 200 kHz
ATTEN 30 dB
SWP 6.00 sec

445 MHz; 250 Watts; 25 kHz Channel; Analog Modulation; File BW24

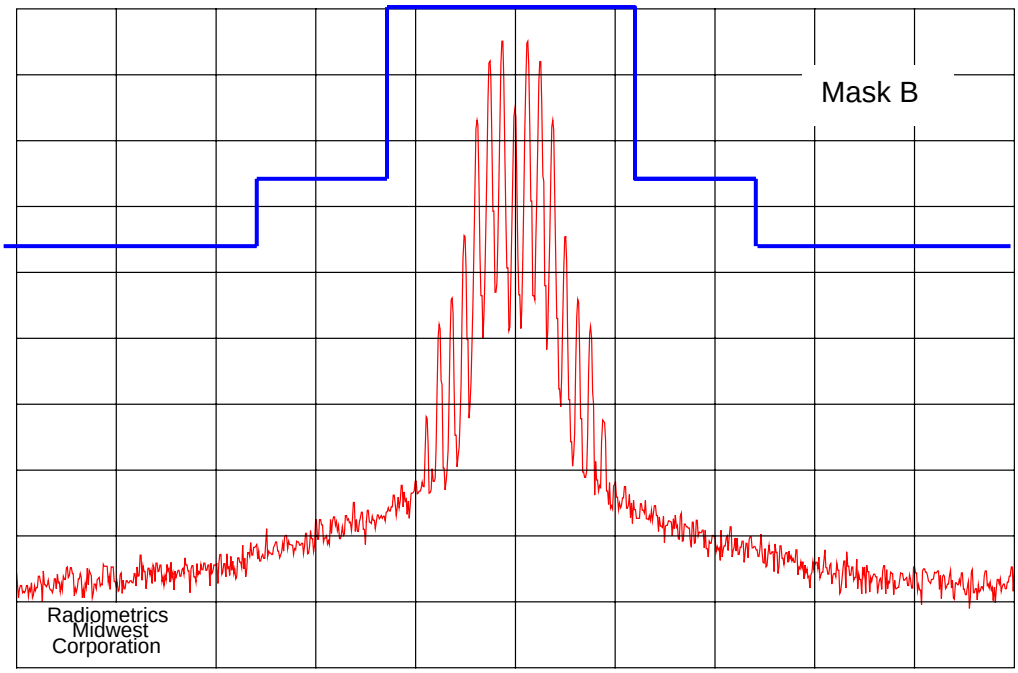


COMPANY : ISC Technologies
CENTER 445.000 0 MHz
RES BW 300 Hz
10 dB/
NOTES : Bandwidth, Analog; 25kHz

ITEM : GL-T5540
REF 14.0 dBm
VBW 1 kHz
TIME : 09:21

DATE : 03-02-2005
SPAN 50.0 kHz
ATTEN 30 dB
SWP 1.50 sec

445 MHz; 250 Watts; 25 kHz Channel; Analog Modulation; File BW23

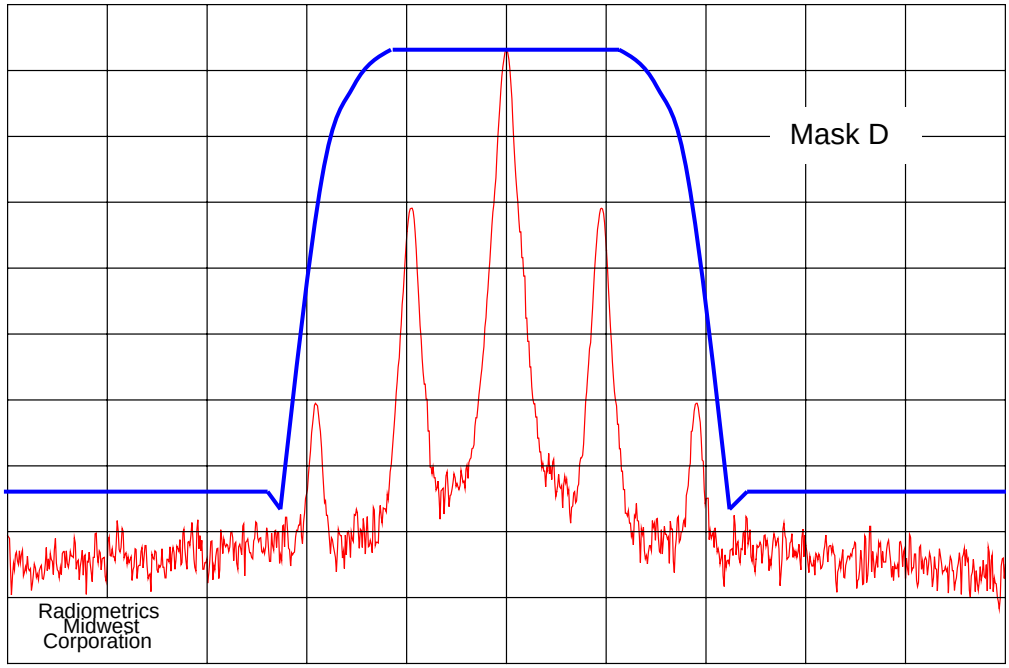


COMPANY : ISC Technologies
CENTER 445.000 MHz
RES BW 300 Hz
10 dB/
NOTES : Bandwidth, Analog; 25kHz

ITEM : GL-T5540
REF 14.0 dBm
VBW 1 kHz
TIME : 09:20

DATE : 03-02-2005
SPAN 200 kHz
ATTEN 30 dB
SWP 6.00 sec

470 MHz; 50 Watts; 12.5 kHz Channel; Digital Modulation; File BW20

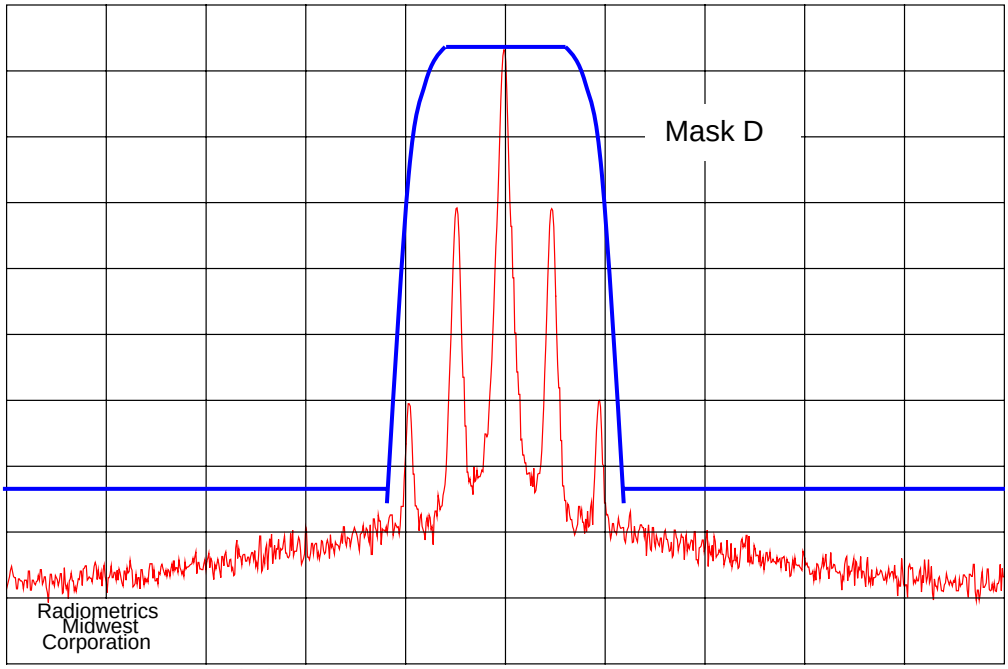


COMPANY : ISC Technologies
CENTER 470.000 0 MHz
RES BW 300 Hz
10 dB/
NOTES : Bandwidth, Digital; 12.5kHz

ITEM : GL-T5540
REF 14.0 dBm
VBW 1 kHz
TIME : 08:46

DATE : 03-02-2005
SPAN 50.0 kHz
ATTEN 30 dB
SWP 1.50 sec

470 MHz; 50 Watts; 12.5 kHz Channel; Digital Modulation; File BW19

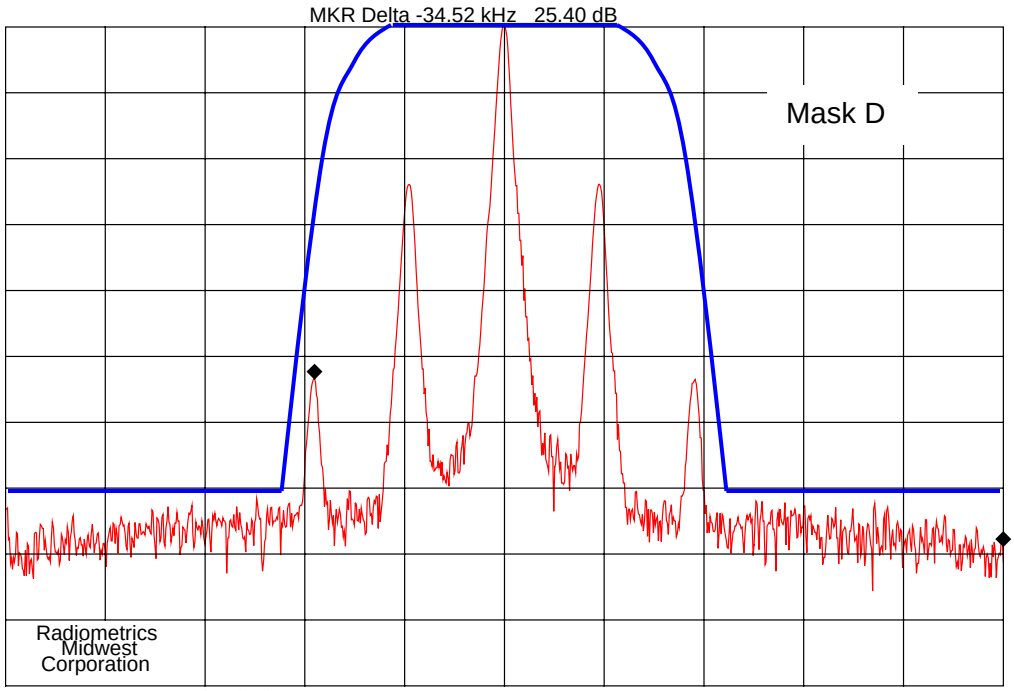


COMPANY : ISC Technologies
CENTER 470.000 MHz
RES BW 300 Hz
10 dB/
NOTES : Bandwidth, Digital; 12.5kHz

ITEM : GL-T5540
REF 14.0 dBm
VBW 1 kHz
TIME : 08:44

DATE : 03-02-2005
SPAN 100 kHz
ATTEN 30 dB
SWP 3.00 sec

470 MHz; 250 Watts; 12.5 kHz Channel; Digital Modulation; File BW17

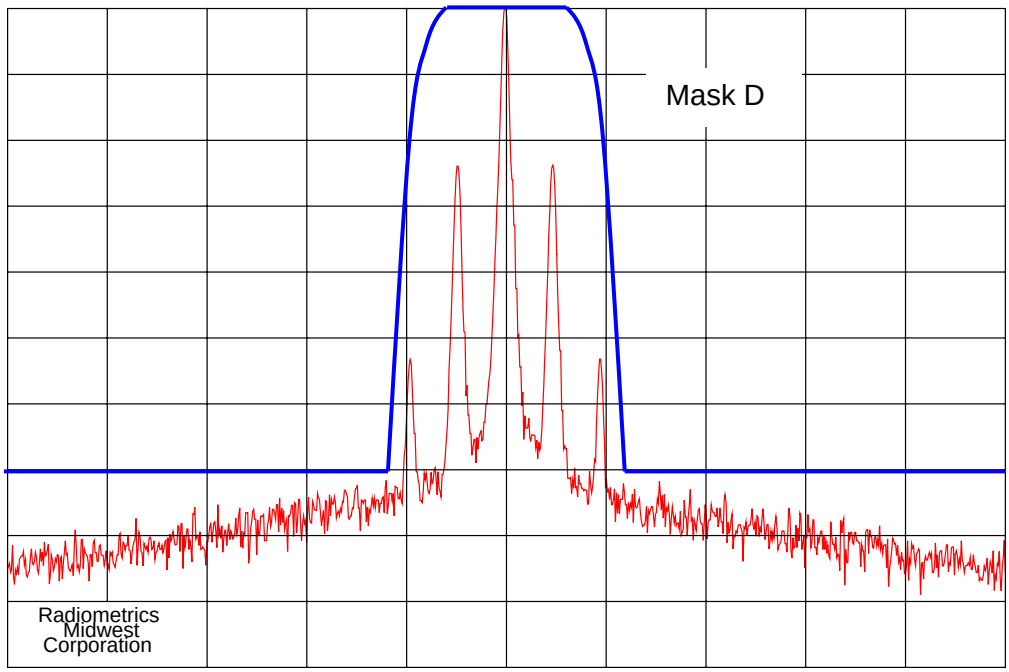


COMPANY : ISC Technologies
CENTER 470.000 0 MHz
RES BW 300 Hz
10 dB/
NOTES : Bandwidth, Digital; 12.5kHz

ITEM : GL-T5540
REF 14.0 dBm
VBW 1 kHz
TIME : 08:41

DATE : 03-02-2005
SPAN 50.0 kHz
ATTEN 30 dB
SWP 1.50 sec

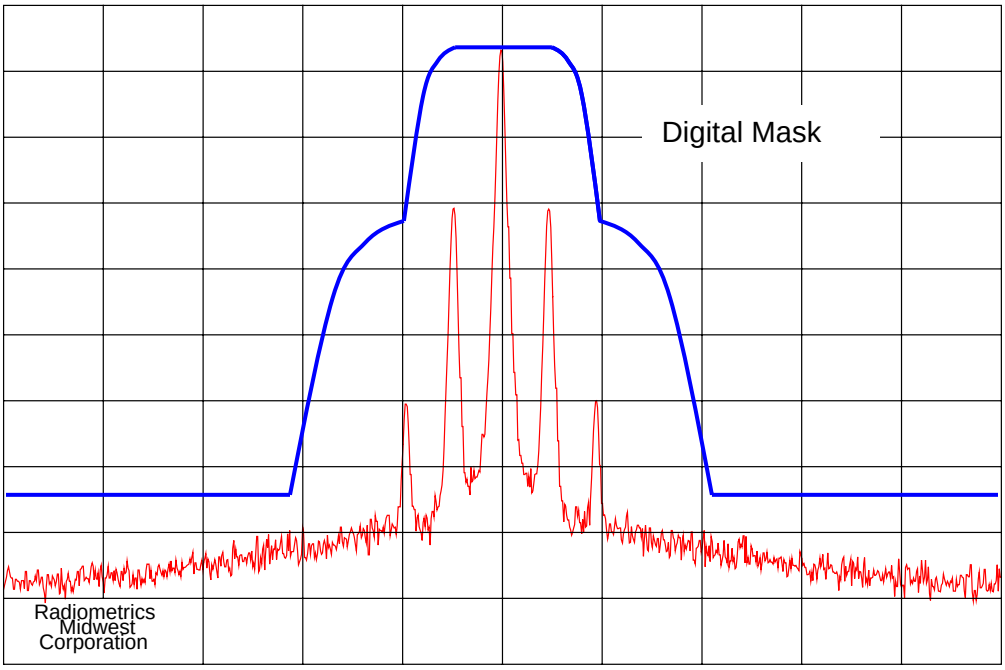
470 MHz; 250 Watts; 12.5 kHz Channel; Digital Modulation; File BW18



Judgement: Pass
Tested by: Joseph Strzelecki

The following emission masks are from FCC part 22.359.

470 MHz; 50 Watts; 12.5 kHz Channel; Digital Modulation; File BW19

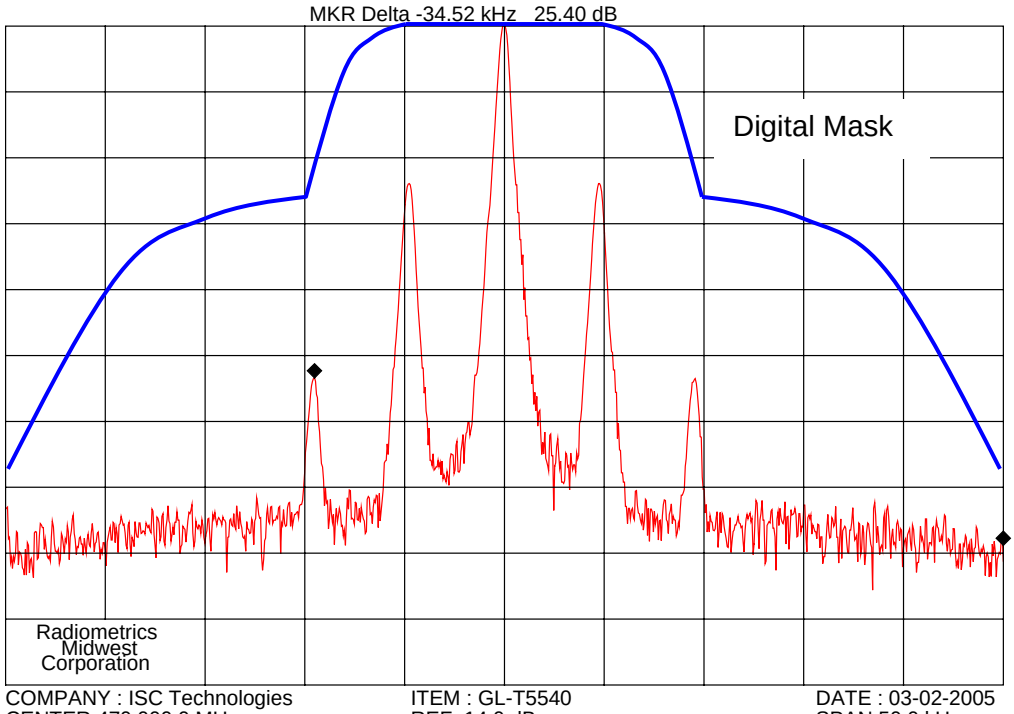


COMPANY : ISC Technologies
CENTER 470.000 MHz
RES BW 300 Hz
10 dB/
NOTES : Bandwidth, Digital; 12.5kHz

ITEM : GL-T5540
REF 14.0 dBm
VBW 1 kHz
TIME : 08:44

DATE : 03-02-2005
SPAN 100 kHz
ATTEN 30 dB
SWP 3.00 sec

470 MHz; 250 Watts; 12.5 kHz Channel; Digital Modulation; File BW17

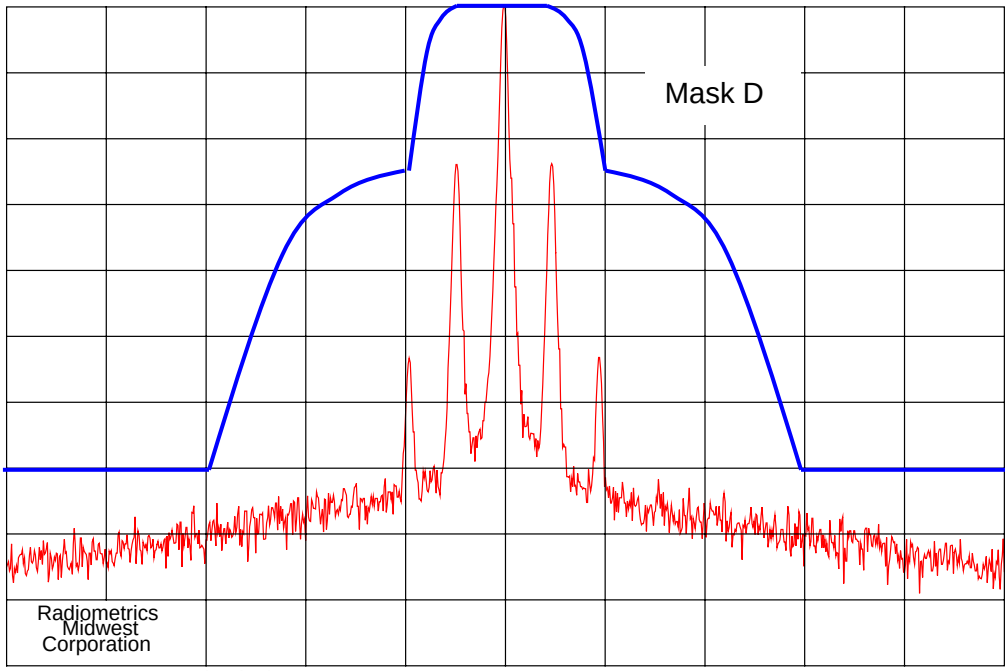


COMPANY : ISC Technologies
CENTER 470.000 0 MHz
RES BW 300 Hz
10 dB/
NOTES : Bandwidth, Digital; 12.5kHz

ITEM : GL-T5540
REF 14.0 dBm
VBW 1 kHz
TIME : 08:41

DATE : 03-02-2005
SPAN 50.0 kHz
ATTEN 30 dB
SWP 1.50 sec

470 MHz; 250 Watts; 12.5 kHz Channel; Digital Modulation; File BW18

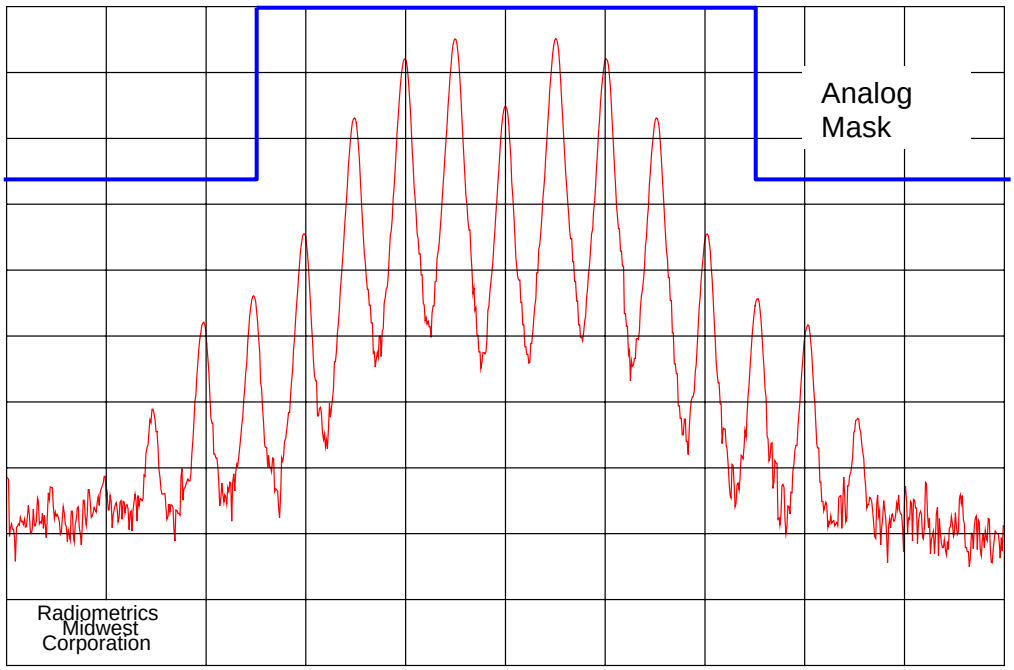


COMPANY : ISC Technologies
CENTER 470.000 MHz
RES BW 300 Hz
10 dB/
NOTES : Bandwidth, Digital; 12.5kHz

ITEM : GL-T5540
REF 14.0 dBm
VBW 1 kHz
TIME : 08:43

DATE : 03-02-2005
SPAN 100 kHz
ATTEN 30 dB
SWP 3.00 sec

445 MHz; 250 Watts; 25 kHz Channel; Analog Modulation; File BW24

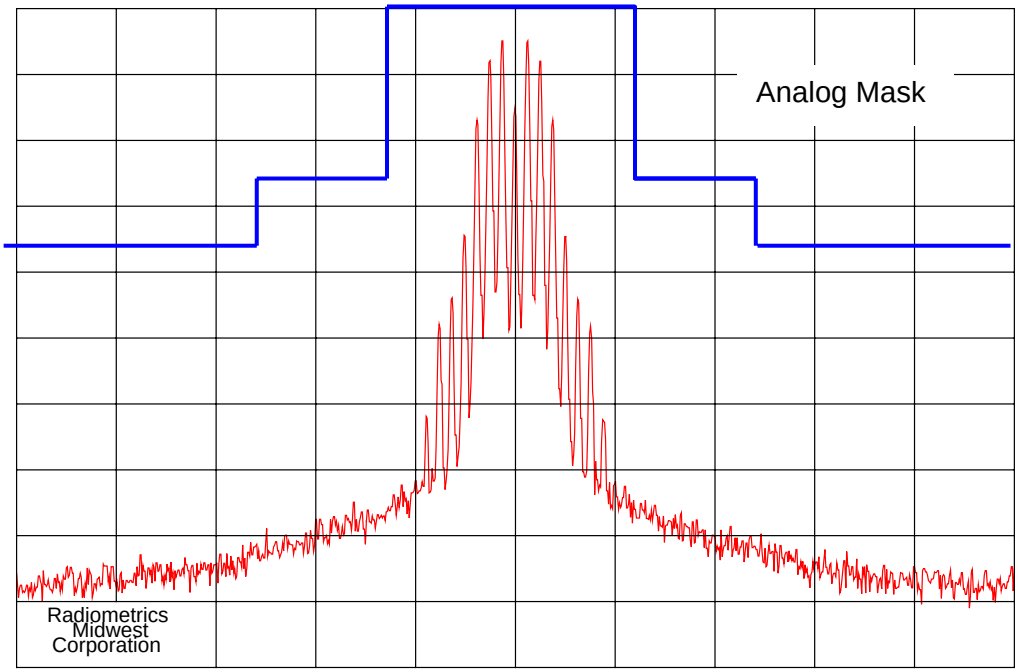


COMPANY : ISC Technologies
CENTER 445.000 0 MHz
RES BW 300 Hz
10 dB/
NOTES : Bandwidth, Analog; 25kHz

ITEM : GL-T5540
REF 14.0 dBm
VBW 1 kHz
TIME : 09:21

DATE : 03-02-2005
SPAN 50.0 kHz
ATTEN 30 dB
SWP 1.50 sec

445 MHz; 250 Watts; 25 kHz Channel; Analog Modulation; File BW23



Judgement: Pass
Tested by: Joseph Strzelecki

10.2.1 Spurious RF Conducted Emissions

The spectrum analyzer was set to the MAX HOLD mode to record all spurious emissions from the lowest frequency generated in the EUT up through the 10th harmonic. The transmitter is terminated with a 50 W load and interfaced with a spectrum analyzer using a directional coupler.

Limits: Mask B (dBm): P(dBm) – (43+10xLOG P(W)) = -13 dBm
Mask D (dBm): P(dBm) – (50+10xLOG P(W)) or 70 dB which ever is lessor attenuation
Mask D = -20 dBm for 50 Watts and -16 dBm for 250 Watts

Tx MHz	Watts	Channel kHz	Modulation		Spurious Emissions		Noise floor dBm
			Hz	Type	Limit dBm	EUT dBm	
420	250	25	4800	Digital	-13	-20	-20
420	50	25	4800	Digital	-13	-26	-26
445	250	25	2500	Analog	-13	-20	-20
445	50	25	2500	Analog	-13	-26	-26
470	250	12.5	4800	Digital	-16	-20	-20
470	50	12.5	4800	Digital	-20	-26	-26

Judgement: Pass
Tested by: Joseph Strzelecki

10.3 Modulation Characteristics

10.3.1 Audio Frequency Response

Procedures

Voice (6dB/octave Pre-emphasized) Input:

1. The transmitter was set for 1.5 kHz deviation using a 1 kHz test tone. A measurement was then taken and set as the 0dB reference.
2. The test signal amplitude was then held constant and the frequency varied over the range shown in the following chart and measurements taken.

Flat Input:

1. The transmitter was set for 1.5 kHz deviation using a 1 kHz test tone. A measurement was then taken and set as the 0dB reference.
2. The test signal amplitude was then held constant and the frequency varied over the range shown in the following chart and measurements taken.

	Audio Output Level	
Audio Frequency (Hz)	Voice Input (dB)	Flat Input (dB)
100	-28.5	-0.2
200	-15.5	-0.15
300	-10.4	-0.1
500	-6.0	-0.05
1000	0	0
2000	+5.9	-0.3
2500	+8.0	-0.3
3000	+9.0	-0.8
3500	+6.5	-3.2
4000	-4.0	-8.5
4500	-28.2	-19.5
5000	-38	-40

Judgment: Pass
Tested by: Joseph Foster

10.3.2 Analog Deviation Limiter

Procedure:

1. A 1 kHz test tone producing 50% modulation (2.5 kHz) was applied to the EUT.
2. The audio generator amplitude was then changed to the values shown in the following charts and plus and minus peak deviations observed. The peak absolute value for each measurement point is recorded in the following chart.
3. The test was conducted on both the flat and Pre-emphasized inputs as shown in the following charts.

Audio Input Level	Frequency Deviation (kHz) Pre-emphasized input			
	300 Hz	600 Hz	1000 Hz	2500 Hz
-6 dB	0.42	0.8	1.3	3.2
0 dB	0.8	1.57	2.5	4.8
+3 dB	1.1	2.2	3.6	4.8
+6 dB	1.58	3.0	4.8	4.8
+10 dB	2.5	4.8	4.8	4.8
+16 dB	4.8	4.8	4.8	4.8
+20 dB	4.85	4.85	4.84	3.6

FCC 2.1047 (b)

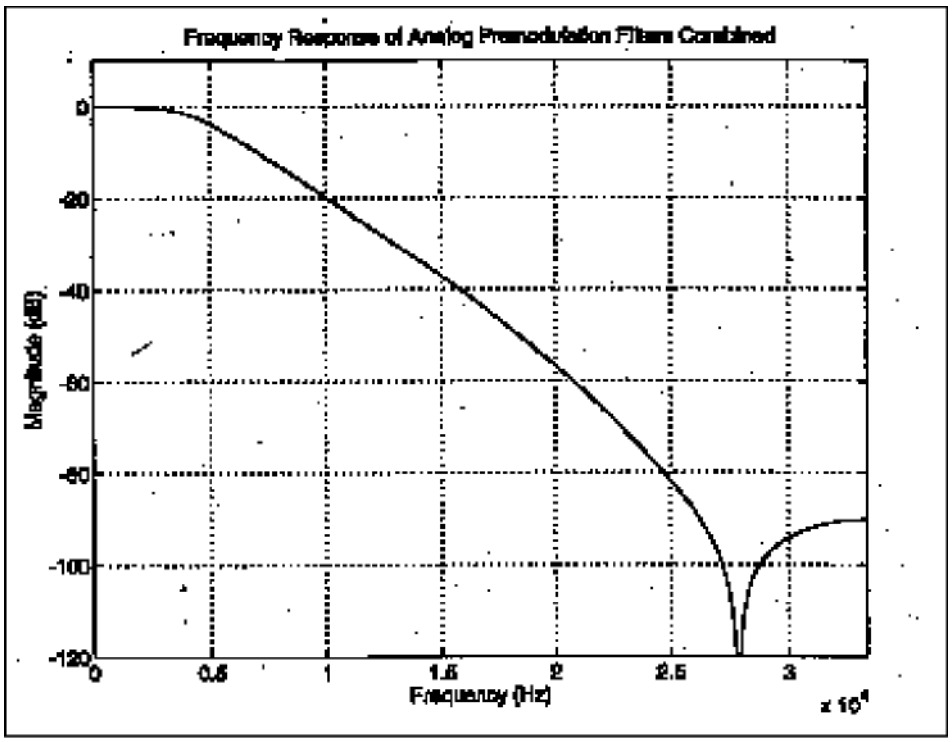
Audio Input Level	Frequency Deviation (kHz) Flat input			
	300 Hz	600 Hz	1000 Hz	2500 Hz
-6 dB	1.3	1.3	1.3	1.3
0 dB	2.5	2.5	2.5	2.5
+3 dB	3.6	3.6	3.6	3.53
+6 dB	4.8	4.8	4.8	4.69
+10 dB	4.85	4.8	4.8	4.8
+16 dB	4.85	4.85	4.85	4.8
+20 dB	4.85	4.85	4.85	4.84

Judgment: Pass
Tested by: Joseph Foster

10.3.3 Analog Modulation Filter (2.1047)

Analog modulation is generated and shaped by digital-signal processing techniques (DSP). The filter does not exist in a conventional analog sense that would allow measurement of the filter alone. The frequency response plot for the analog filter (Figure 1) is a graphical representation of the filter, as it exists in the product firmware.

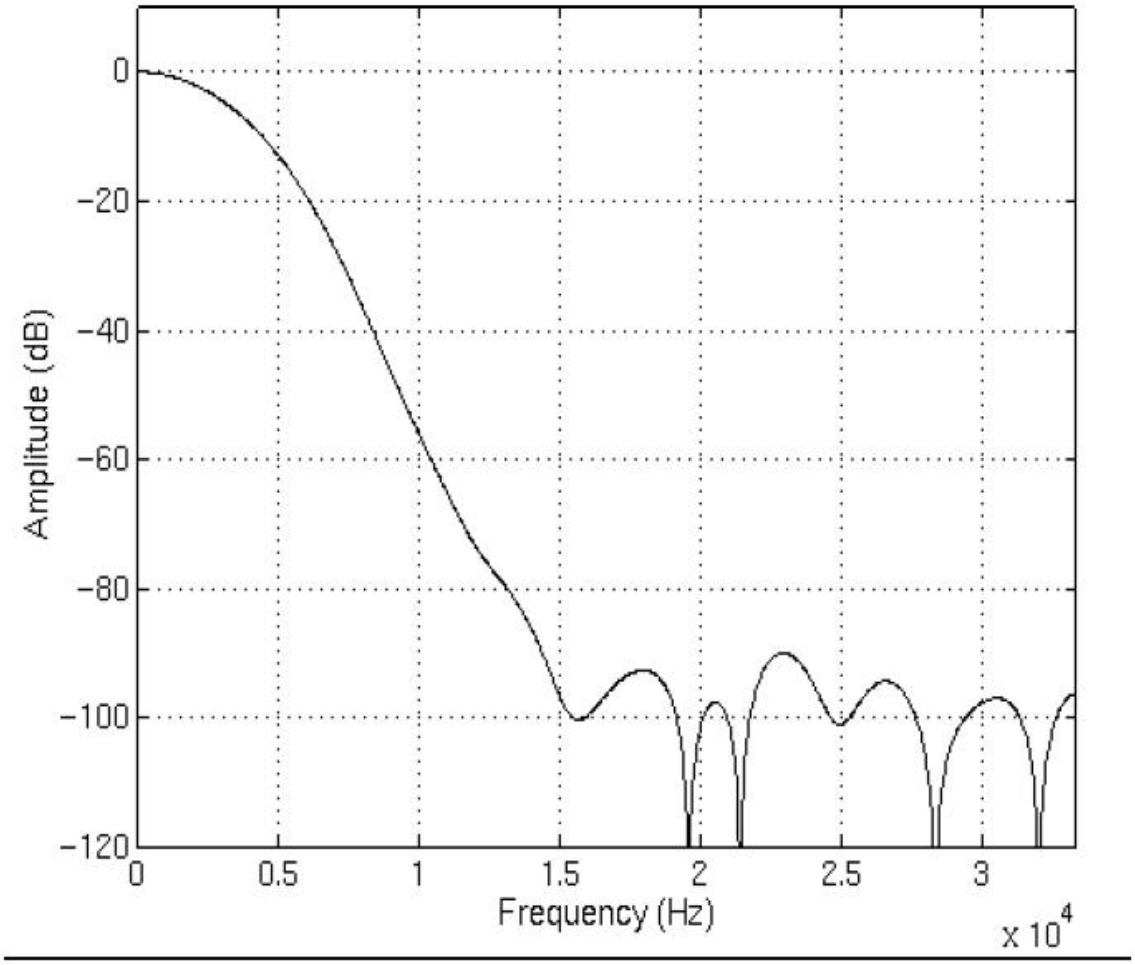
Figure 1. Frequency Response



MODULATION FILTER – DIGITAL (FCC 2.1047)

Digital modulation is generated and shaped by digital signal processing techniques (DSP). The filter does not exist in a conventional analog sense that would allow measurement of the filter characteristics alone. The frequency response plot for the digital filter shown in Figure 2 is a graphical representation of the filter, as it exists in the product firmware.

Figure 2. Modulation Filter



10.4 Frequency Tolerance

10.4.1 Frequency Vs. Temperature

Procedure:

1. The EUT was operated at 25°C and allowed to stabilize for 20 minutes and a reference measurement taken. The chamber was then set to 20° and allowed to stabilize for 20 minutes before the measurement was recorded.
2. The chamber was then decremented in 10°C steps with a 20 minute stabilization period prior to each measurement.
3. After the -30° C measurement was taken the chamber was set to 30° C and allowed to stabilize for one hour prior to recording the measurement.

4. The temperature was then incremented in 10° C steps with a 20 minute stabilization period for each measurement.

Temperature (Centigrade)	Frequency (Hz)	Delta Frequency (Hz)	Delta in Parts Per Billion (ppb)
-30	450,000,007.7	-0.6	-1.33
-20	450,000,007.7	-0.6	-1.33
-10	450,000,007.7	-0.6	-1.33
0	450,000,007.8	-0.5	-1.11
+10	450,000,008.2	-0.1	-0.222
+20	450,000,008.3	0	0
+25	450,000,008.3	Reference	Reference
+30	450,000,008.3	0	0
+40	450,000,008.3	0	0
+50	450,000,008.4	+0.1	+0.222

10.4.2 Frequency Stability Vs. Supply Voltage

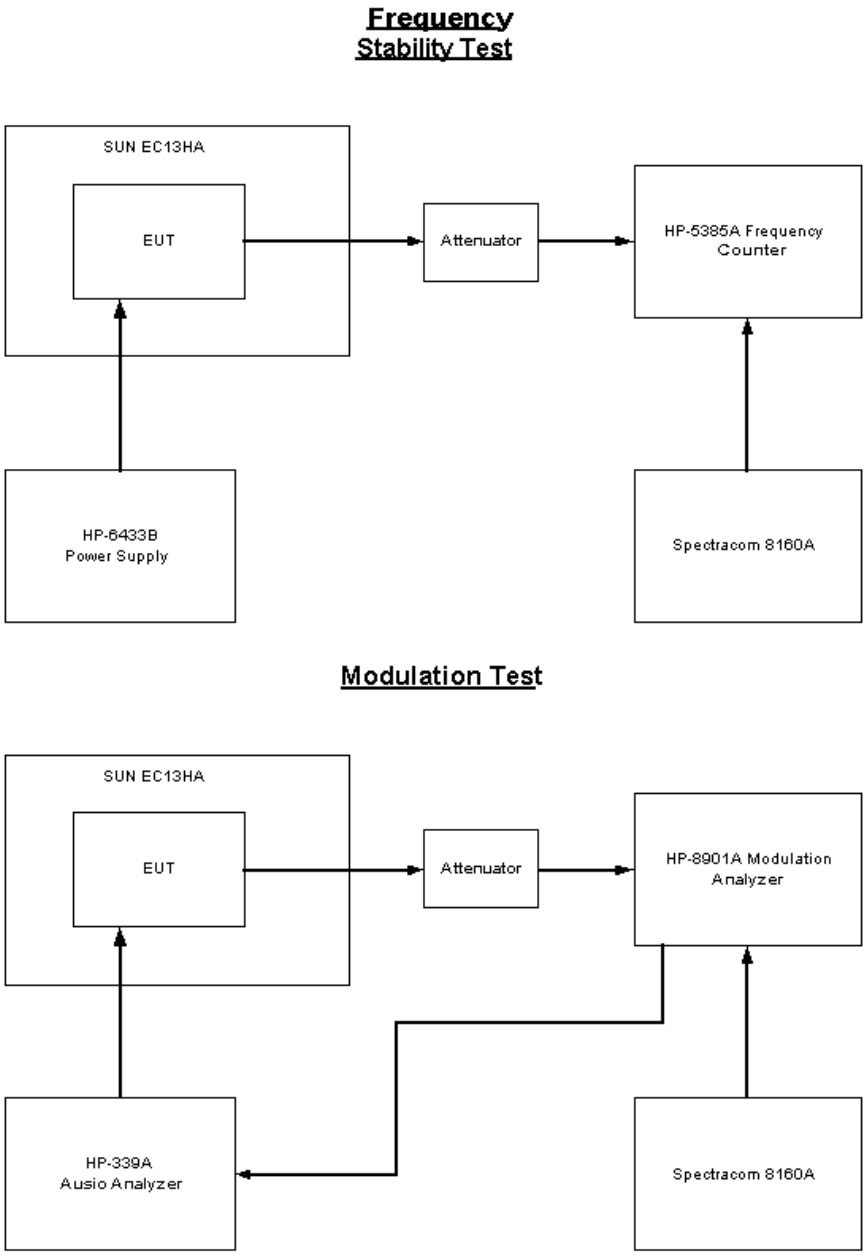
Procedure:

1. The EUT was allowed to stabilize in a 25° C ambient with the nominal primary power supply voltage of 26VDC applied.
2. The primary power supply was then set to 85% of the nominal value and the measurement recorded.
3. The primary power was then set to 115% of the nominal value and the frequency measurement recorded.

Supply Voltage (%)	Supply Voltage	Frequency (Hz)	Delta Frequency (Hz)	Delta in Parts Per Billion (ppb)
85	22.1	450,000,008.3	0	0
100	26.0	450,000,008.3	0	0
115	29.9	450,000,008.3	0	0

Judgment: Pass
Tested by: Joseph Foster

Figure 3. Test Setup for Frequency Stability and Modulation Characteristics



Test equipment used:

- 10 MHz Reference: Spectracom NBS Frequency Standard Receiver model 8160A (TE-R6)
- 10 MHz Distribution Amplifier: Spectracom Frequency Distribution Amplifier model 8140 (TE-R9MM)
- Adjustable DC Power supply: HP-6433B (TE-S22)
- Modulation Analyzer: HP-8901A (TE-A453)
- Frequency Counter: HP-5385A (TE-C97)
- Audio Analyzer: HP-339A (TE-M78)
- Temperature Chamber. Sun Systems Model EC13HA.

10.5 Field Strength of Unwanted Spurious Radiation

10.5.1 Test Procedures

Radiated emission measurements in the Restricted bands were performed with linearly polarized broadband antennas. The results obtained with these antennas can be correlated with results obtained with a tuned dipole antenna. A 10 dB linearity check is performed prior to start of testing in order to determine if an overload condition exists. From 30 to 4700 MHz, an HP8566B spectrum analyzer with a preselector was used for measurement.

Final radiated emissions measurements were performed at the anechoic chamber at a test distance of 3 meters. The entire frequency range from 30 to 4700 MHz was slowly scanned and the emissions in the restricted frequency bands were recorded. Measurements were performed using the peak detector function. For each frequency, the test antenna was raised and lowered from 1 to 4 meters in order to obtain maximum reading on the spectrum analyzer. The turntable was then rotated 360 degrees to determine the maximum reading. The procedure was repeated in order to obtain the highest possible reading, which was recorded.

Radiated emission measurements are performed with linearly polarized broadband antennas. Measurements were performed using two antenna polarizations, (vertical and horizontal). The worst case emissions were recorded.

The EUT was placed on the turntable at the test site. The EUT was transmitting to a non-radiating load that was placed on the turntable. The RF cable to the load was 1 meter in length. The transmitter was keyed during the tests.

The EUT was removed and replaced with a substitution antenna. The center of the substitution was approximately at the same location as the center of the EUT.

The substitution antenna was fed at the EUT end with a signal generator connected to the antenna by means of a non-radiating cable. With the antennas horizontally polarized at both ends, and with the signal generator tuned to a particular spurious frequency, the test antenna was raised and lowered in order to obtain a maximum reading on the spectrum analyzer. The output level of the signal generator was adjusted until the previously recorded maximum reading for this set of conditions was obtained. The procedures were then repeated in with the antennas vertically polarized at both ends.

The power in dBm was calculated into a reference ideal half-wave antenna by reducing the readings obtained by the power loss in the cable between the generator and the antenna, and further corrected for the gain of the substitution antenna used relative to an ideal half-wave dipole antenna by the following formula:

Pd(dBm) = Pg(dBm) – cable loss (dB) + antenna gain (dB)

Where:
Pd is the dipole equivalent power and
Pg is the generator output power into the substitution antenna

Since –20 dBm is the lowest limit, it was used for all tests.

10.5.2 Radiated Field Strength Sample Calculation

The following was used for reference only. The final determination of compliance was the substitution method as described in the previous section

The field strength is calculated by adding the Antenna Factor and Cable Loss, to the measured reading. The basic equation is as follows:

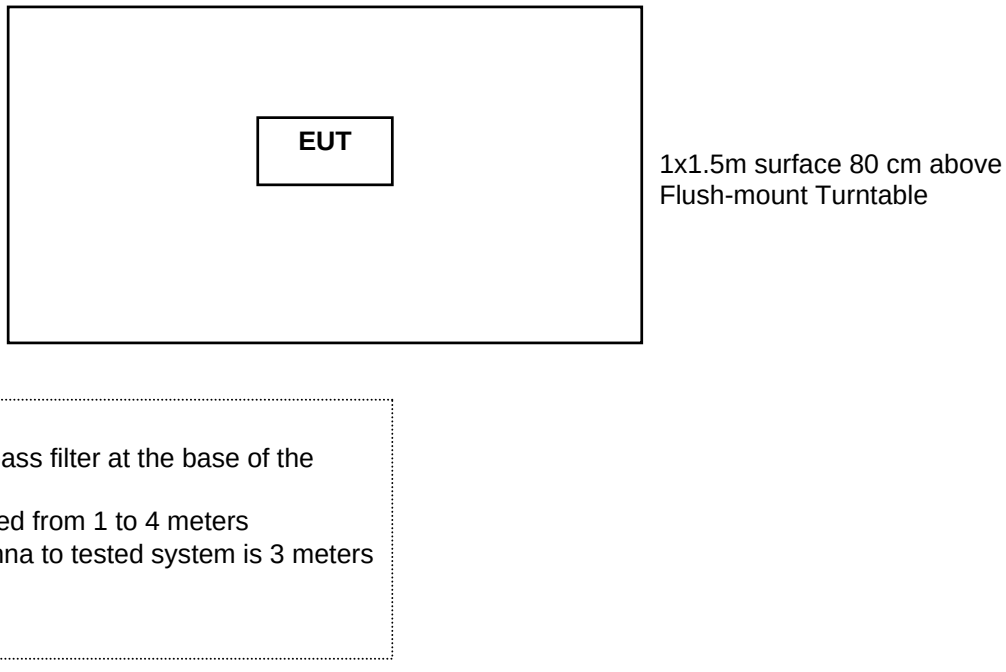
FS = RA + AF + CF

Where: FS = Field Strength
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Attenuation Factor

The limit was calculated using the following formula:
Power (Watts) $P = (VxD)^2/30$
Where: V=Volts/meter & D = Antenna Distance in meters

For P= -20 dBm, V = 75.2 dBuV/m

Figure 4. Drawing of Radiated Emissions Setup



10.5.3 Spurious Radiated Emissions Test Results

The following spectrum analyzer settings were used.

Span = wide enough to fully capture the emission being measured
RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz
VBW > RBW; Sweep = auto; Detector function = peak; Trace = max hold
The Tests were performed with the 250 Watt power setting. This was found to be the worst case. The 250 Watt setting also complied with the 50 Watt, 12.5 kHz limit.

Manufacturer	ISC Technologies, Inc	Specification	FCC Part 22 & 90 & RSS-119
Model	ISC-T5540	Test Date	March 2, 2005
Serial Number	None	Test Distance	3 Meters
Abbreviations	Pol = Antenna Polarization; V = Vertical; H = Horizontal;		

EUT Freq MHz	Emission Freq MHz	Pol	Ant #	Analyzer Rdg from EUT	Generator Pwr into Subs Ant	Subs. Ant Gain dB	Dipole Equivalent dBm	Limit dBm	Margin dB

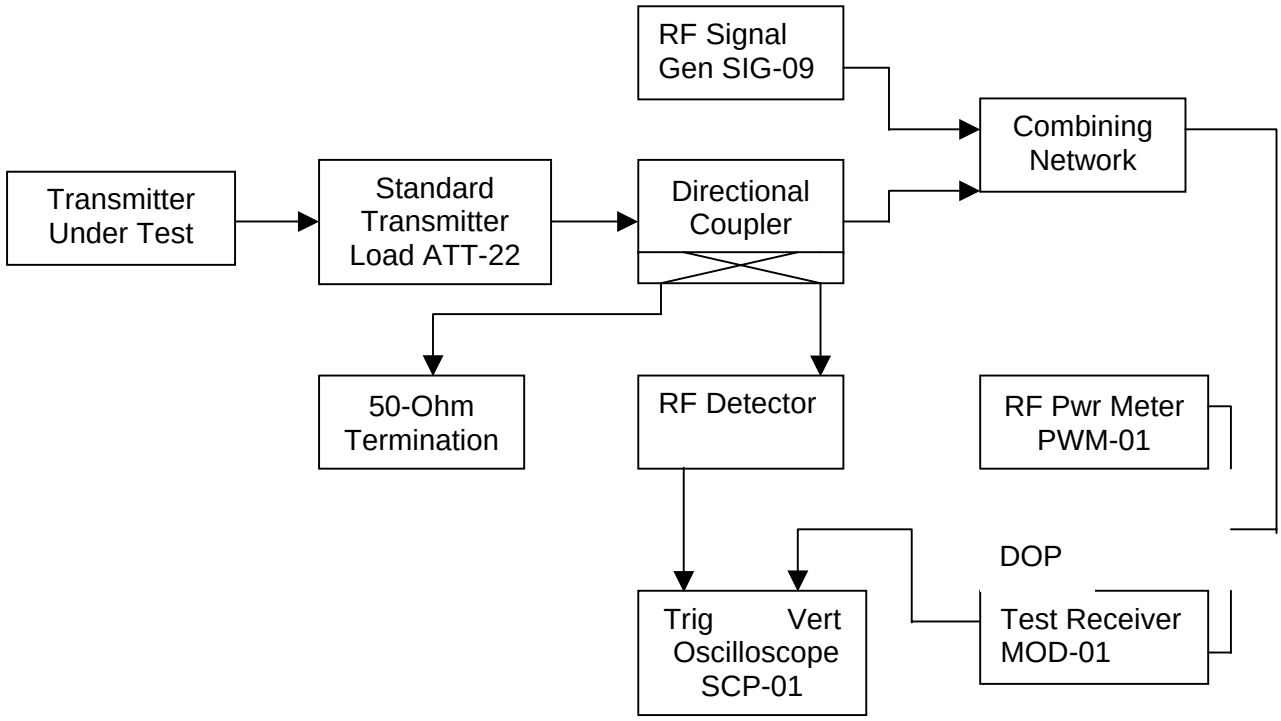
EUT Freq MHz	Emission Freq MHz	Pol	Ant #	Analyzer Rdg from EUT	Generator Pwr into Subs Ant	Subs. Ant Gain dB	Dipole Equivalent dBm	Limit dBm	Margin dB
406	812	V	44	37.3	-37.2	5.9	-31.3	-20	11.3
406	812	H	44	43.6	-33.2	5.9	-27.3	-20	7.3
457	914	H	44	25.2	-49.0	6.2	-42.8	-20	22.8
457	914	V	44	22.3	-49.8	6.2	-43.6	-20	23.6
470	940	V	44	24.9	-46.6	5.6	-41.0	-20	21.0
470	940	H	44	26.6	-47.0	5.6	-41.4	-20	21.4
406	1218	H	13	40.3	-36.5	7.3	-29.2	-20	9.2
406	1624	H	13	43.4	-33.7	8.6	-25.1	-20	5.1
406	2842	H	13	33.9	-40.1	9.6	-30.5	-20	10.5
406	3654	H	13	24.6	-46.3	9.7	-36.6	-20	16.6
406	1218	V	13	38.6	-37.8	7.3	-30.5	-20	10.5
406	1624	V	13	38.3	-39.1	8.6	-30.5	-20	10.5
406	2842	V	13	27.9	-43.9	9.6	-34.3	-20	14.3
406	4060	V	13	23.6	-44.8	9.4	-35.4	-20	15.4
457	1371	H	13	38.1	-39.0	7.7	-31.3	-20	11.3
457	1828	H	13	20.6	-54.6	8.6	-46.0	-20	26.0
457	2742	H	13	21	-52.4	9.6	-42.8	-20	22.8
457	4113	H	13	21.2	-47.2	9.5	-37.7	-20	17.7
457	1371	V	13	40.4	-36.4	7.7	-28.7	-20	8.7
457	1828	V	13	21.6	-53.5	8.6	-44.9	-20	24.9
457	3656	V	13	26.7	-43.3	9.7	-33.6	-20	13.6
457	4113	V	13	25.3	-43.1	9.5	-33.6	-20	13.6
457	4570	V	13	21.7	-46.9	10.1	-36.8	-20	16.8
470	1410	H	13	39.7	-37.5	8.1	-29.4	-20	9.4
470	1880	H	13	22.6	-51.5	8.6	-42.9	-20	22.9
470	4230	H	13	24.5	-44.1	9.6	-34.5	-20	14.5
470	1408	V	13	37	-40.2	8.1	-32.1	-20	12.1
470	1870	V	13	37.4	-36.0	8.6	-27.4	-20	7.4
470	2350	V	13	20.2	-53.2	9.2	-44.0	-20	24.0
470	2820	V	13	20.2	-52.4	9.6	-42.8	-20	22.8
470	3285	V	13	27.4	-42.5	9.8	-32.7	-20	12.7
470	3753	V	13	29.2	-39.5	9.7	-29.8	-20	9.8
470	4700	V	13	24.7	-43.7	10.5	-33.2	-20	13.2

Judgment: Passed by 5.1 dB
Tested by: Joseph Strzelecki

10.6 Transient Frequency Behavior

10.6.1 Test method

The test was performed in accordance to TIA-603-C Section 2.2.19.3 Alternate Method of Measurement (Using a Test Receiver). The equipment was connected as shown below.

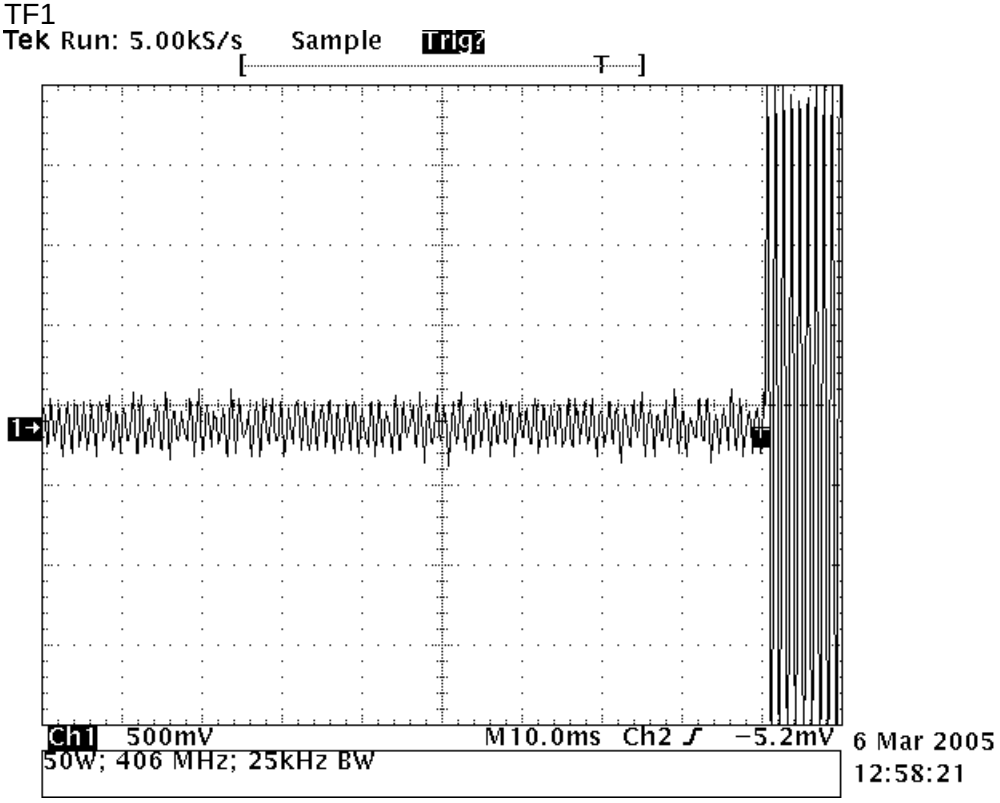


10.6.2 Test Results

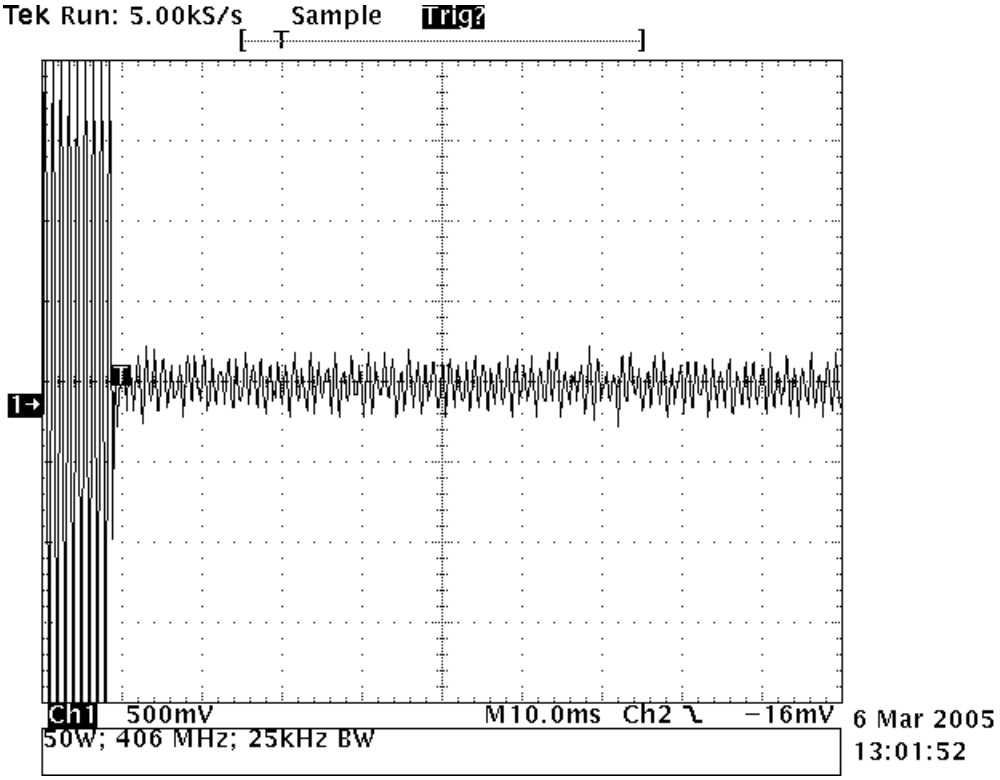
Freq MHz	Power Watts	Channel BW	On Plot	Off Plot	Limits for Time interval/Freq difference						Test Result
					t1		t2		t3		
					mSec	kHz	mSec	kHz	mSec	kHz	
406	50	25	TF2	TF1	10	25	25	12.5	10	25	Pass
406	250	25	TF3	TF4	10	25	25	12.5	10	25	Pass
406	50	12.5	TF7	TF6	10	12.5	25	6.25	10	12.5	Pass
406	250	12.5	TF8	TF5	10	12.5	25	6.25	10	12.5	Pass
470	50	25	TF10	TF16	10	25	25	12.5	10	25	Pass
470	250	25	TF9	TF15	10	25	25	12.5	10	25	Pass
470	50	12.5	TF11	TF14	10	12.5	25	6.25	10	12.5	Pass
470	250	12.5	TF12	TF13	10	12.5	25	6.25	10	12.5	Pass
445	50	25	TF19	TF18	10	25	25	12.5	10	25	Pass
445	250	25	TF20	TF17	10	25	25	12.5	10	25	Pass
445	50	12.5	TF22	TF23	10	12.5	25	6.25	10	12.5	Pass
445	250	12.5	TF21	TF24	10	12.5	25	6.25	10	12.5	Pass

Probe 1.000:1
Judgement: Pass
Tested by: Joseph Strzelecki
Probe 1.000:1
Vertical scale: +/- 4 div. corresponds to +/- 12.5 kHz

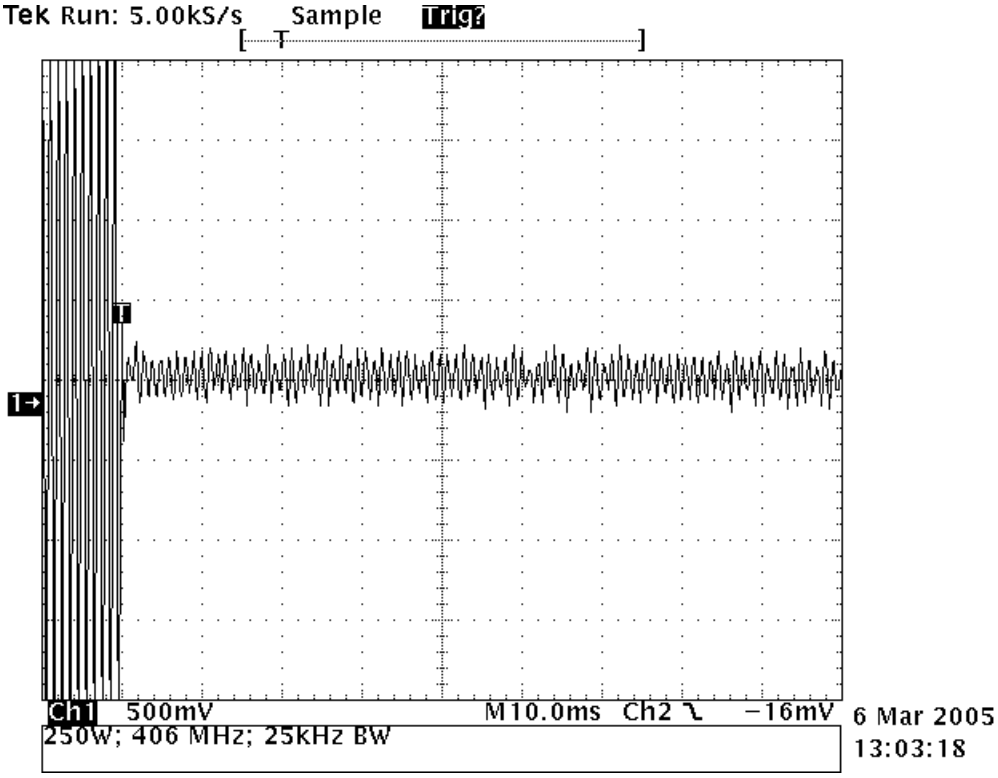
TF1


Tek Run: 5.00kS/s Sample Trig?
Ch1 500mV M10.0ms Ch2 ƒ −5.2mV
50W; 406 MHz; 25kHz BW
6 Mar 2005
12:58:21

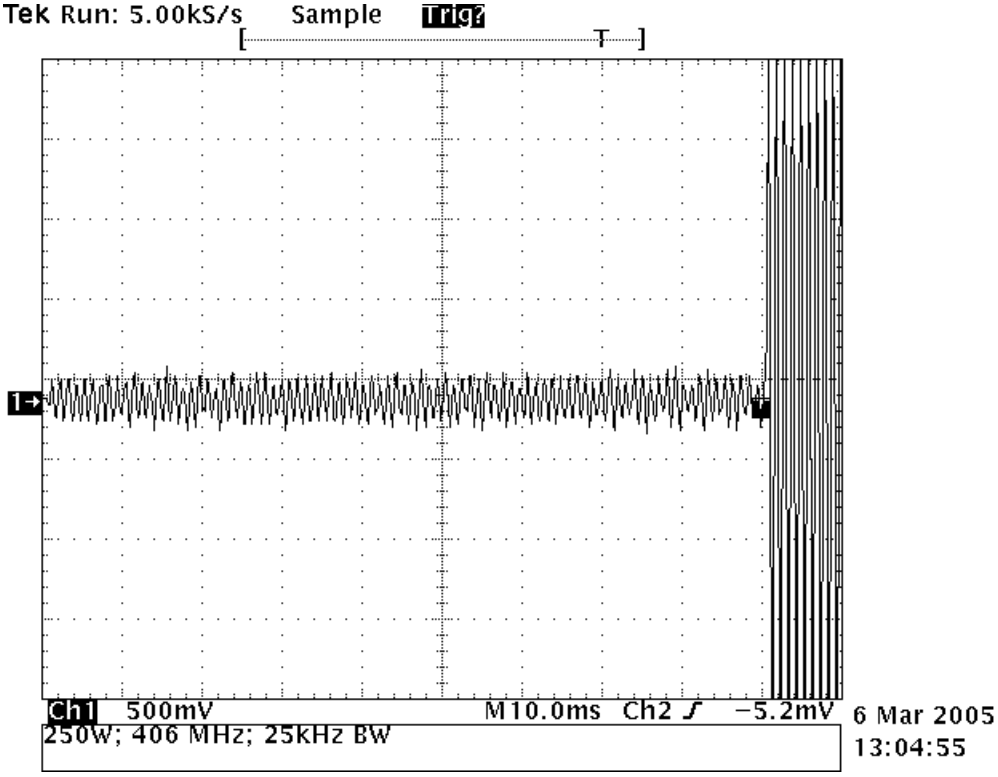
TF2


Tek Run: 5.00kS/s Sample Trig?
Ch1 500mV M10.0ms Ch2 ƒ −16mV
50W; 406 MHz; 25kHz BW
6 Mar 2005
13:01:52

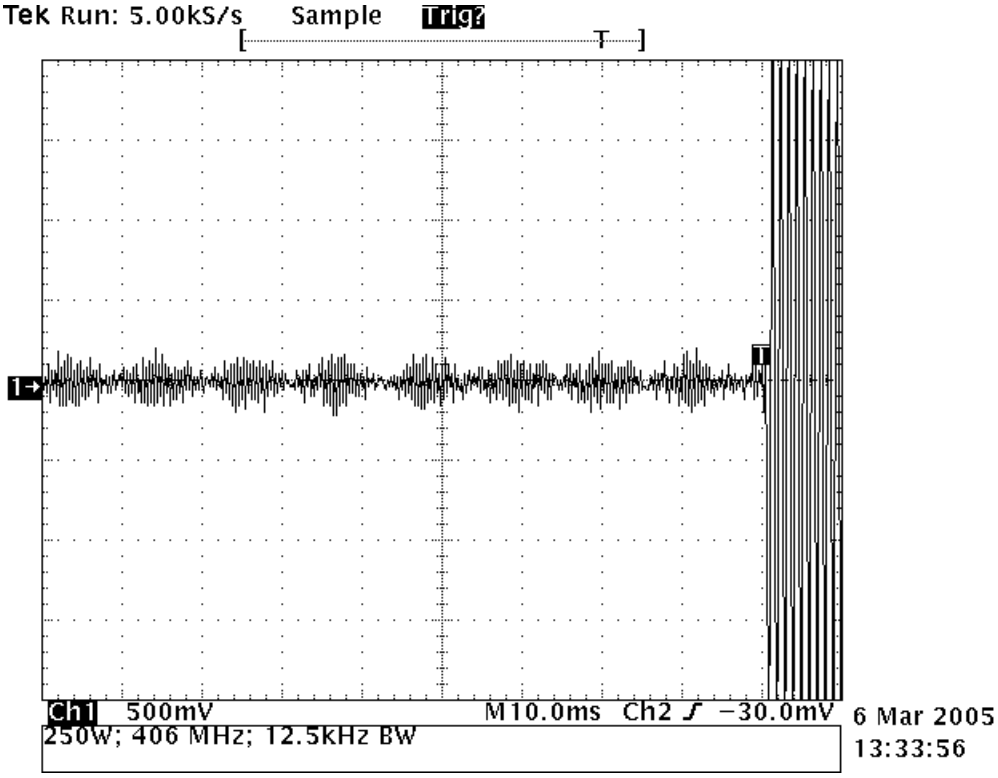
TF3


Tek Run: 5.00kS/s Sample Trig?
Ch1 500mV M10.0ms Ch2 ∖ −16mV
250W; 406 MHz; 25kHz BW
6 Mar 2005
13:03:18

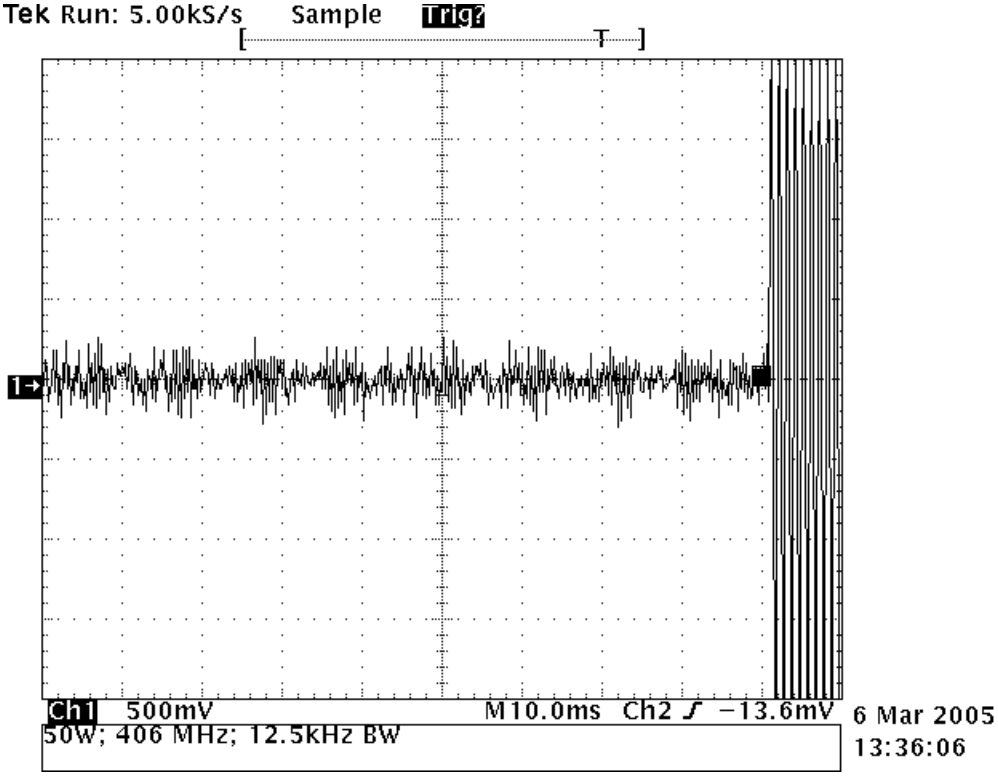
TF4


Tek Run: 5.00kS/s Sample Trig?
Ch1 500mV M10.0ms Ch2 ∫ −5.2mV
250W; 406 MHz; 25kHz BW
6 Mar 2005
13:04:55

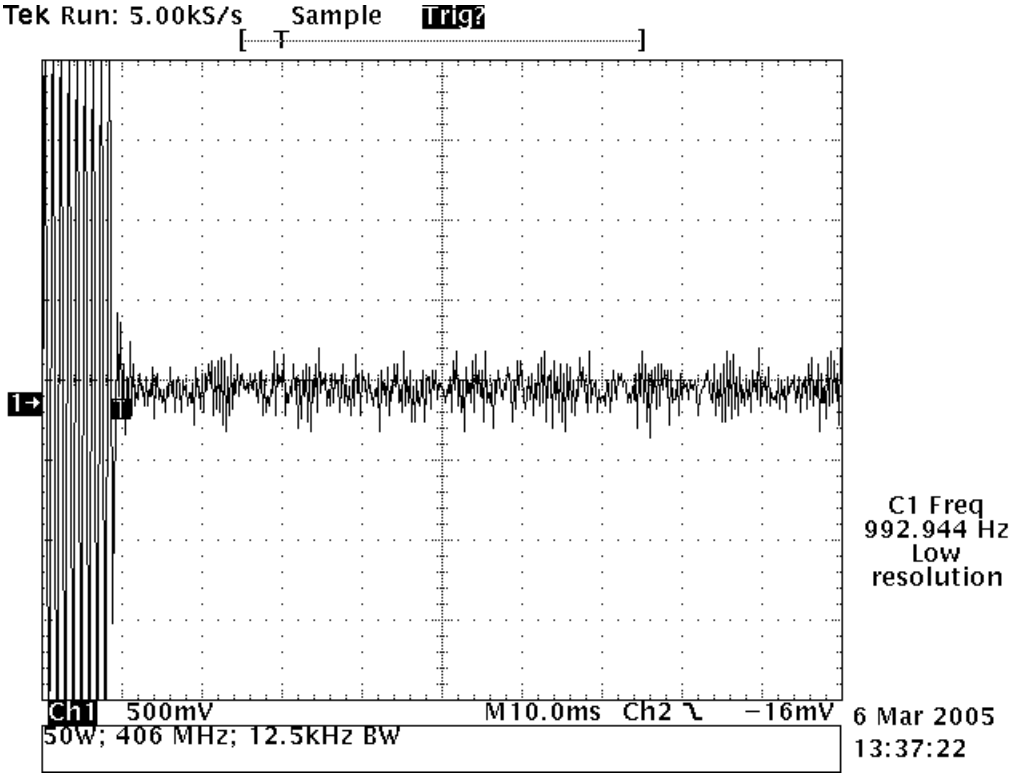
TF5


Tek Run: 5.00kS/s Sample Trig?
Ch1 500mV M10.0ms Ch2 ƒ −30.0mV
250W; 406 MHz; 12.5kHz BW
6 Mar 2005
13:33:56

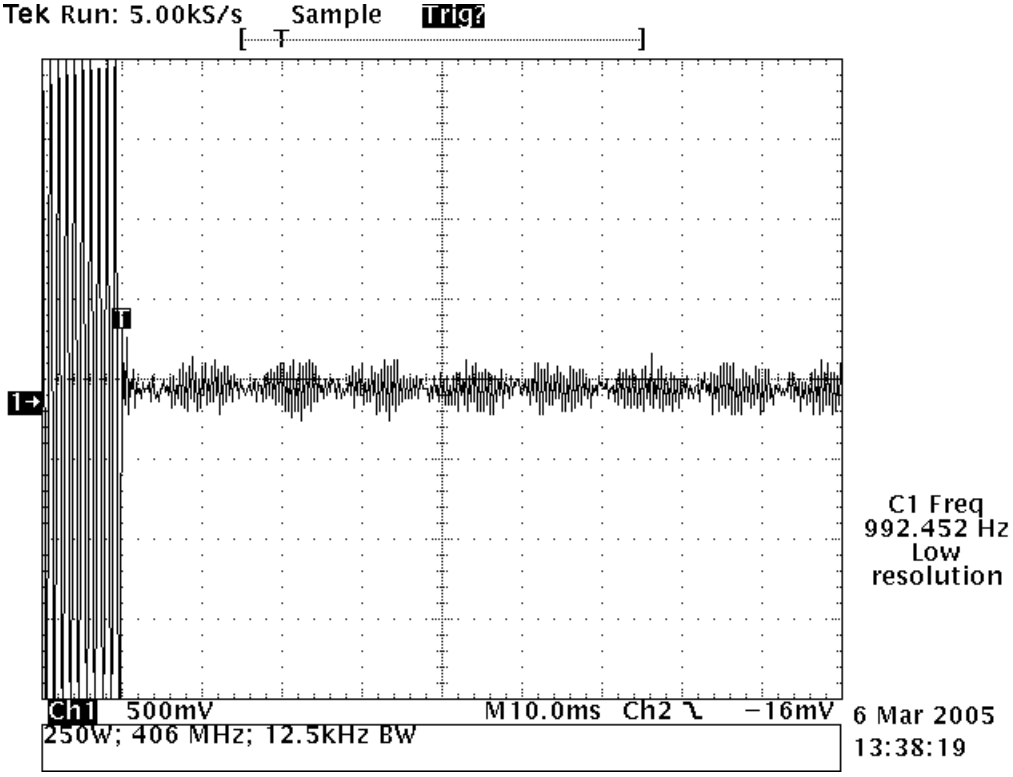
TF6


Tek Run: 5.00kS/s Sample Trig?
Ch1 500mV M10.0ms Ch2 ƒ −13.6mV
50W; 406 MHz; 12.5kHz BW
6 Mar 2005
13:36:06

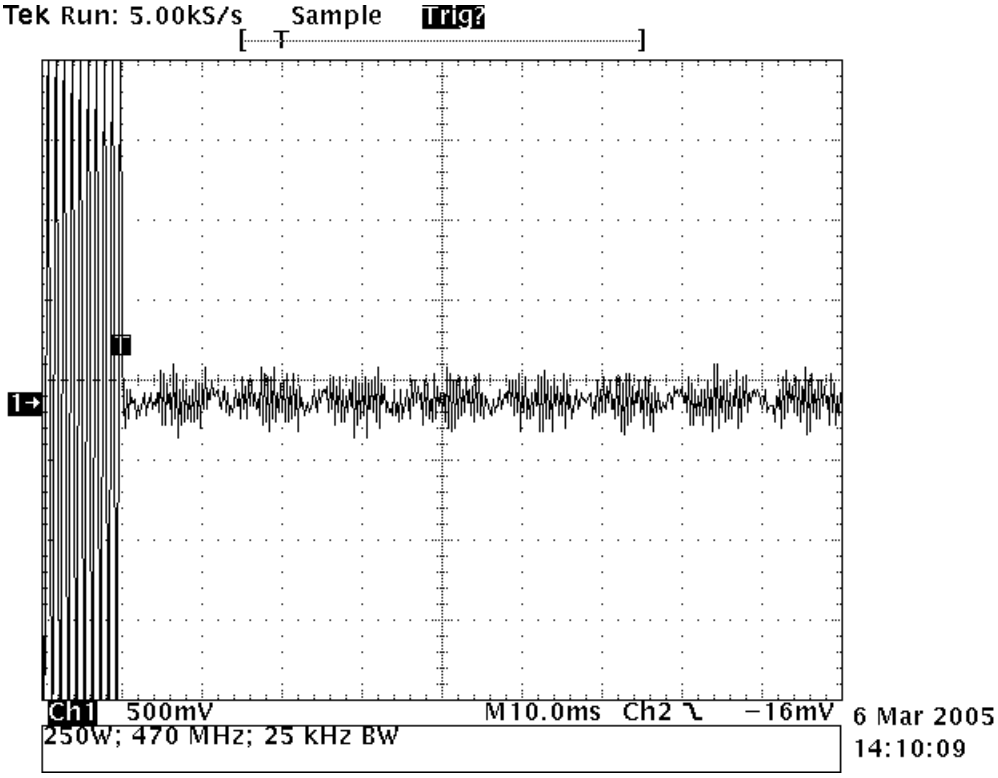
TF7


Tek Run: 5.00kS/s Sample Trig?
Ch1 500mV M10.0ms Ch2 ∖ −16mV
50W; 406 MHz; 12.5kHz BW
C1 Freq
992.944 Hz
Low
resolution
6 Mar 2005
13:37:22

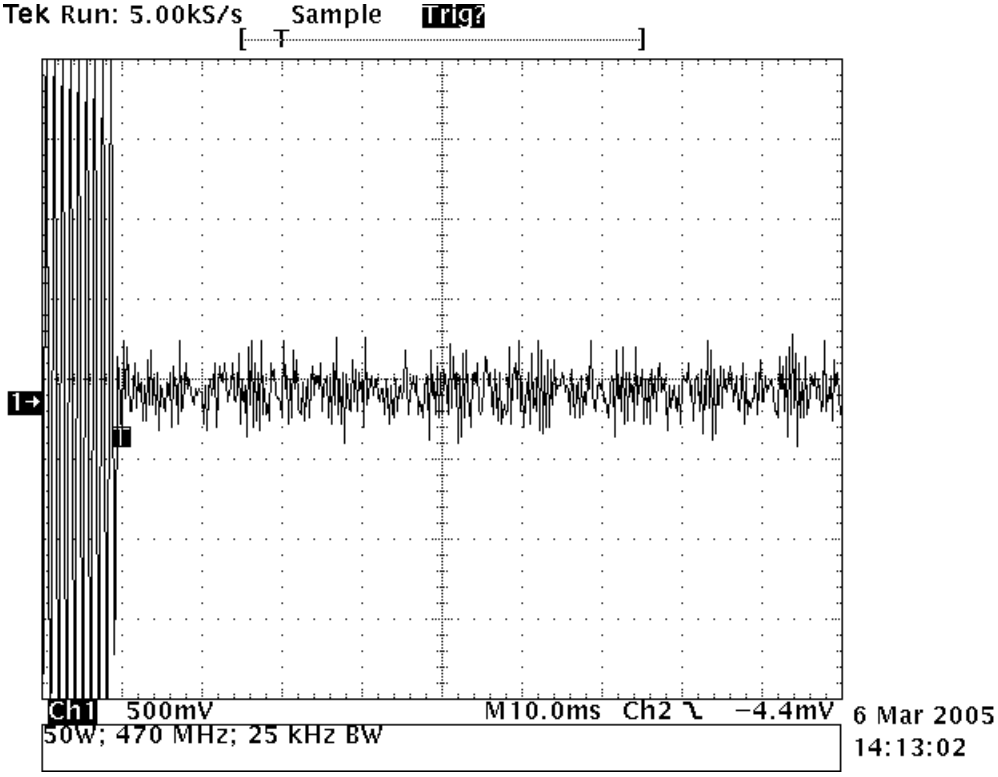
TF8


Tek Run: 5.00kS/s Sample Trig?
Ch1 500mV M10.0ms Ch2 ∖ −16mV
250W; 406 MHz; 12.5kHz BW
C1 Freq
992.452 Hz
Low
resolution
6 Mar 2005
13:38:19

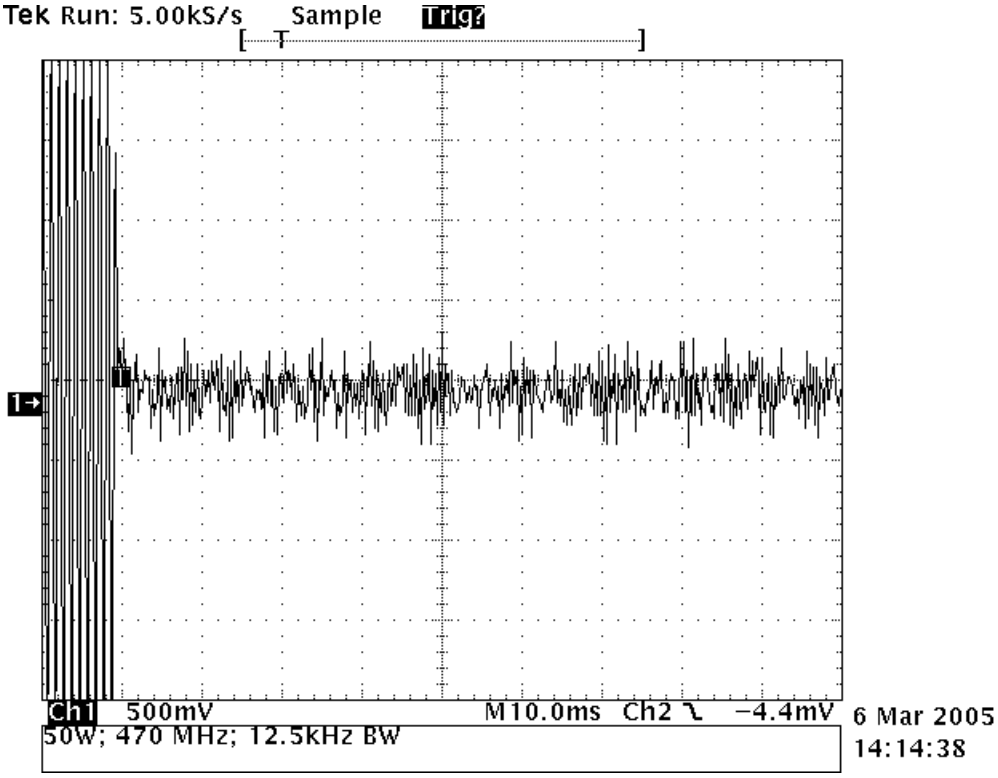
TF9


Tek Run: 5.00kS/s Sample Trig?
Ch1 500mV M10.0ms Ch2 ∖ −16mV
250W; 470 MHz; 25 kHz BW
6 Mar 2005
14:10:09

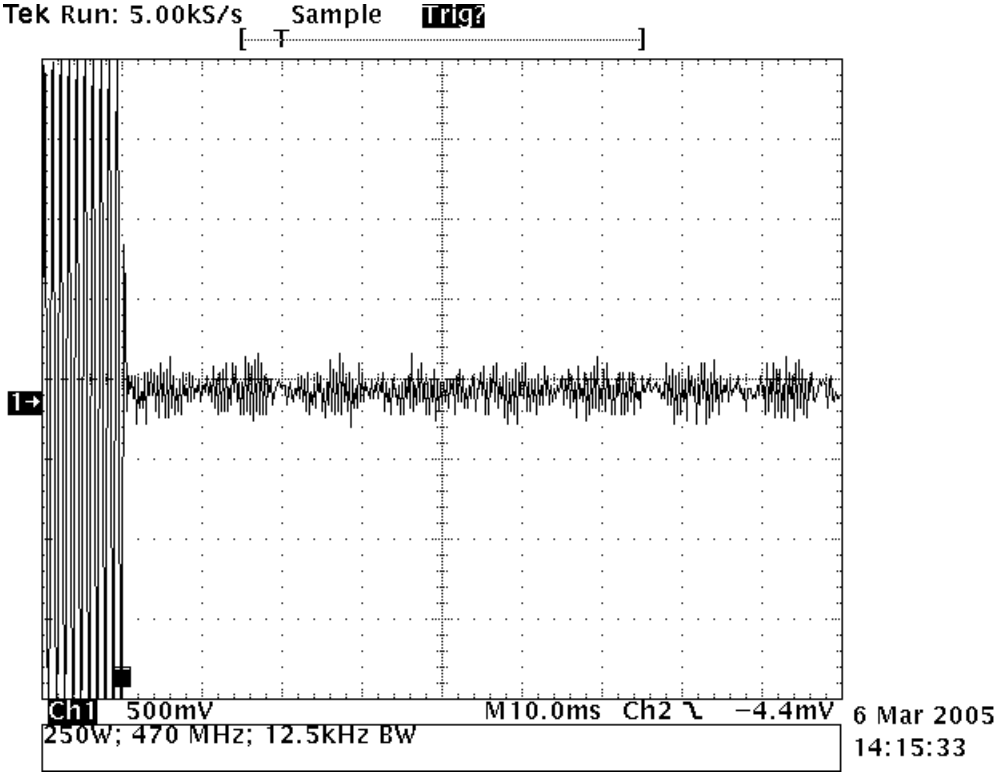
TF10


Tek Run: 5.00kS/s Sample Trig?
Ch1 500mV M10.0ms Ch2 ∖ −4.4mV
50W; 470 MHz; 25 kHz BW
6 Mar 2005
14:13:02

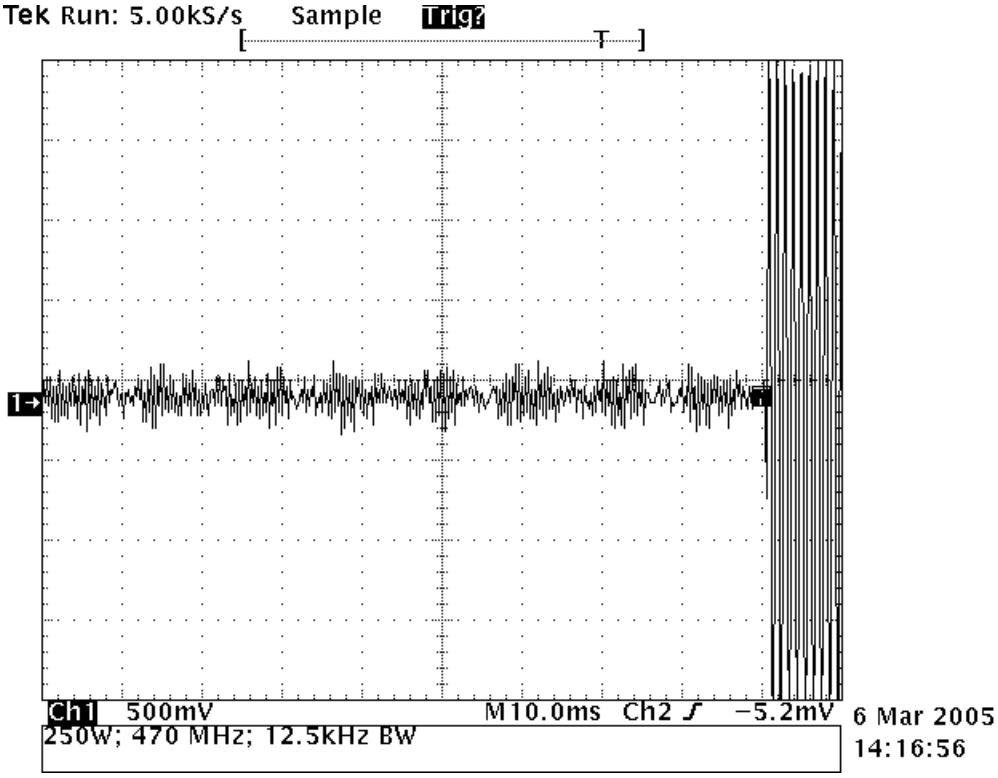
TF11


Tek Run: 5.00kS/s Sample Trig?
Ch1 500mV M10.0ms Ch2 ∖ −4.4mV
50W; 470 MHz; 12.5kHz BW
6 Mar 2005
14:14:38

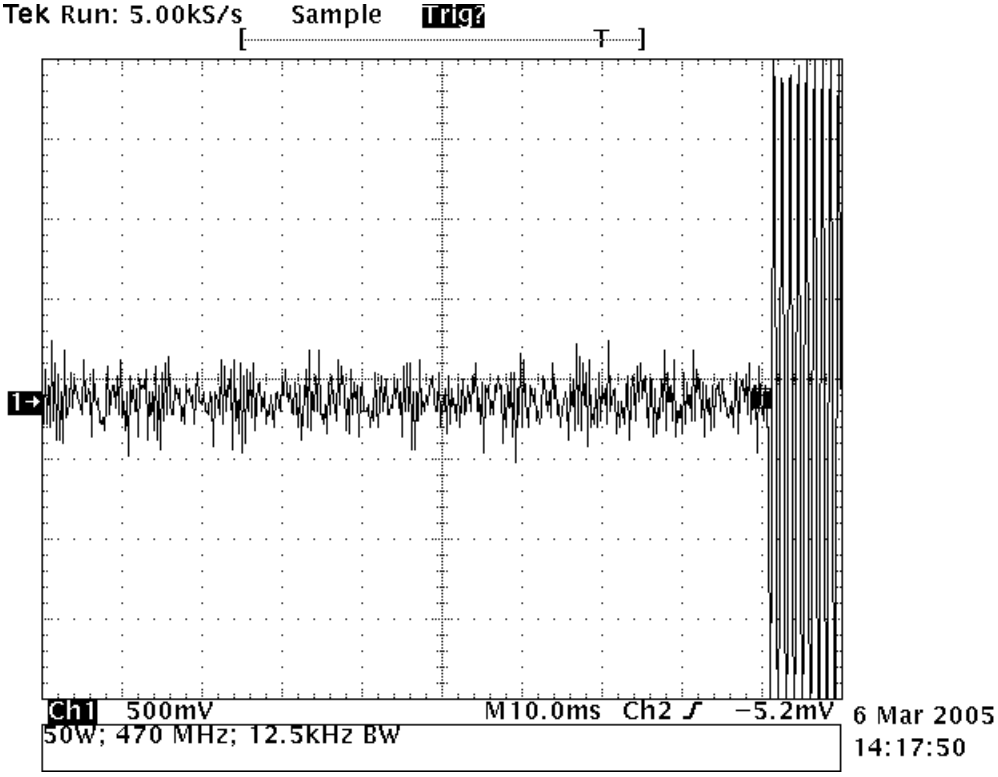
TF12


Tek Run: 5.00kS/s Sample Trig?
Ch1 500mV M10.0ms Ch2 ∖ −4.4mV
250W; 470 MHz; 12.5kHz BW
6 Mar 2005
14:15:33

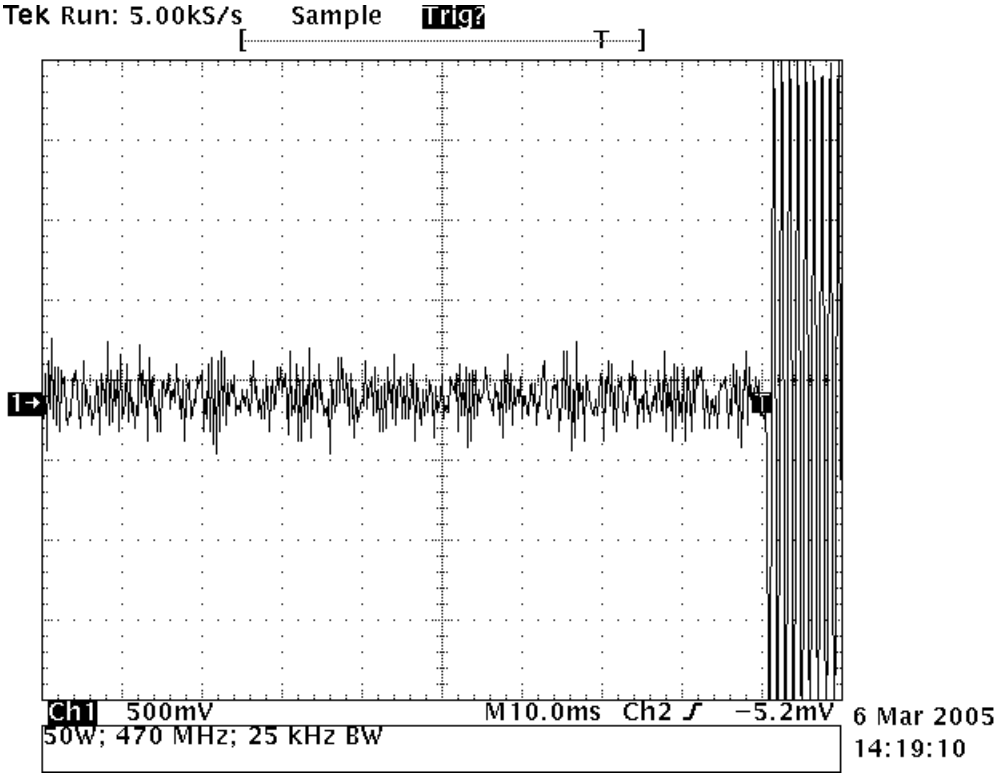
TF13


Tek Run: 5.00kS/s Sample Trig?
Ch1 500mV M10.0ms Ch2 ƒ −5.2mV
250W; 470 MHz; 12.5kHz BW
6 Mar 2005
14:16:56

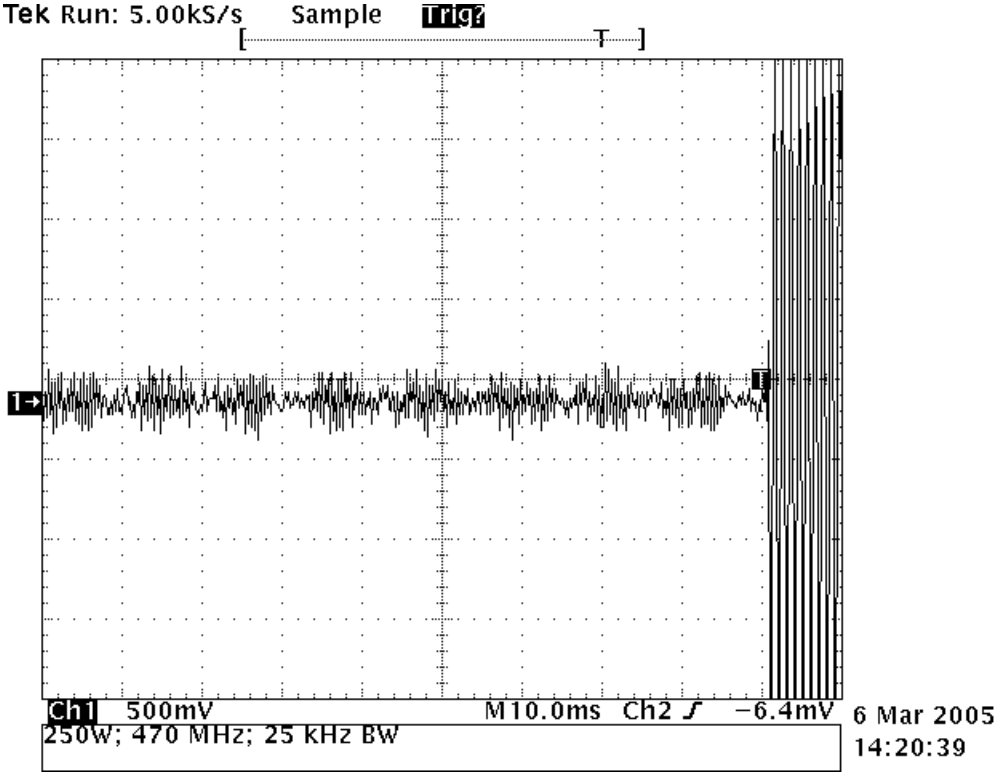
TF14


Tek Run: 5.00kS/s Sample Trig?
Ch1 500mV M10.0ms Ch2 ƒ −5.2mV
50W; 470 MHz; 12.5kHz BW
6 Mar 2005
14:17:50

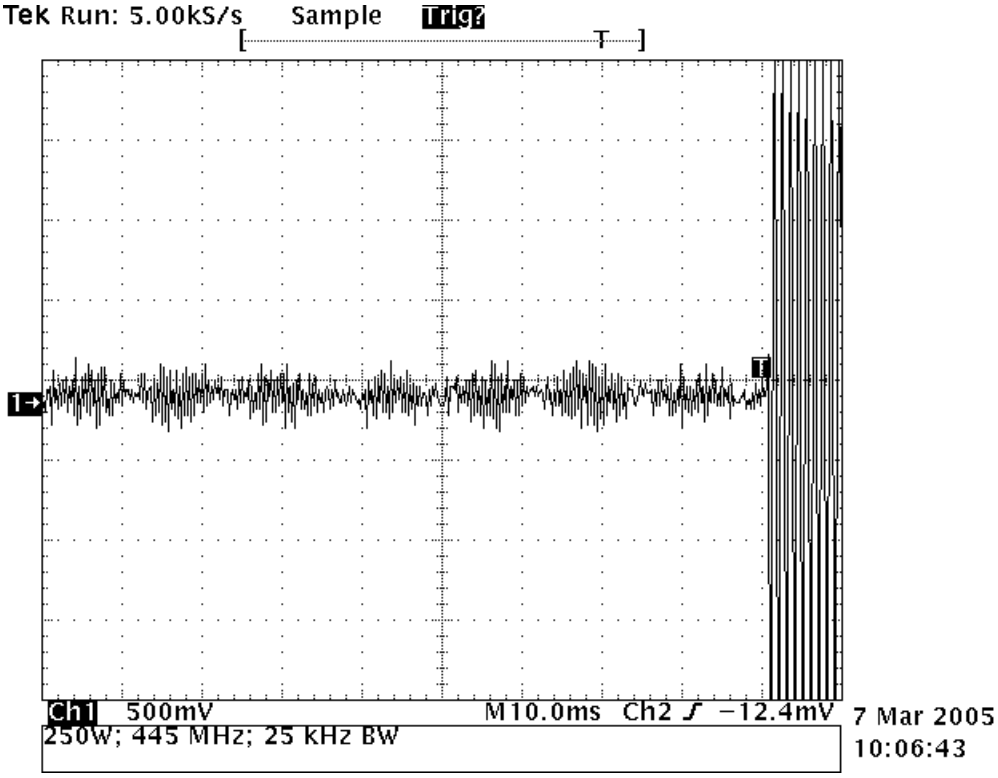
TF15


Tek Run: 5.00kS/s Sample Trig?
Ch1 500mV M10.0ms Ch2 ƒ −5.2mV
50W; 470 MHz; 25 kHz BW
6 Mar 2005
14:19:10

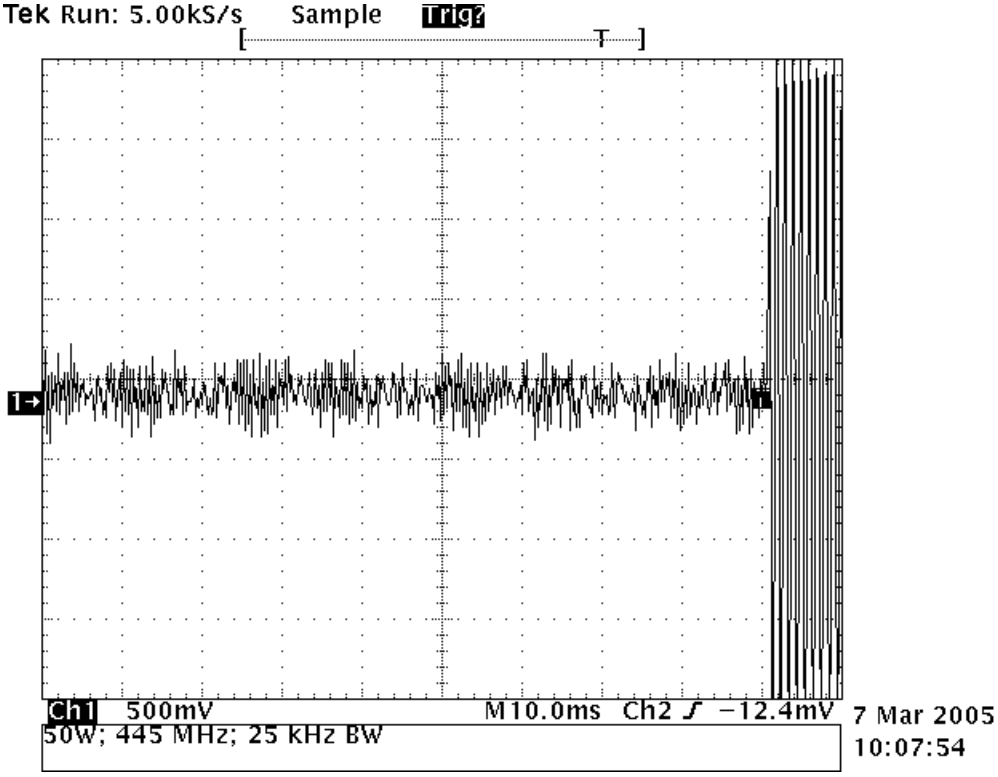
TF16


Tek Run: 5.00kS/s Sample Trig?
Ch1 500mV M10.0ms Ch2 ƒ −6.4mV
250W; 470 MHz; 25 kHz BW
6 Mar 2005
14:20:39

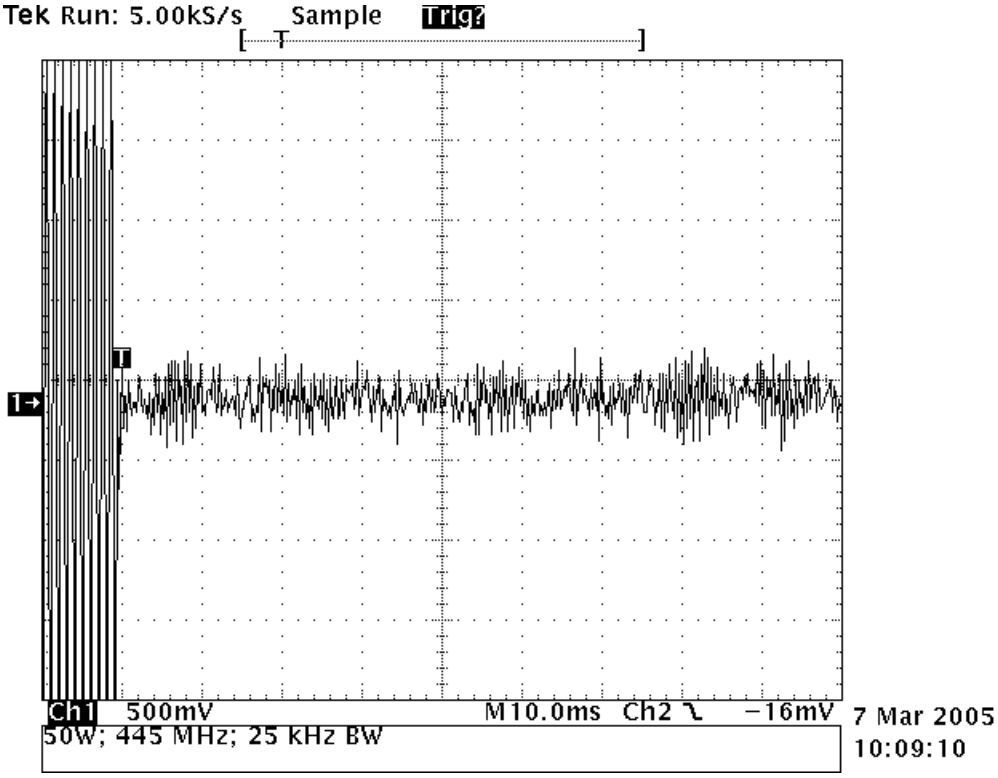
TF17


Tek Run: 5.00kS/s Sample Trig?
Ch1 500mV M10.0ms Ch2 ƒ −12.4mV
250W; 445 MHz; 25 kHz BW
7 Mar 2005
10:06:43

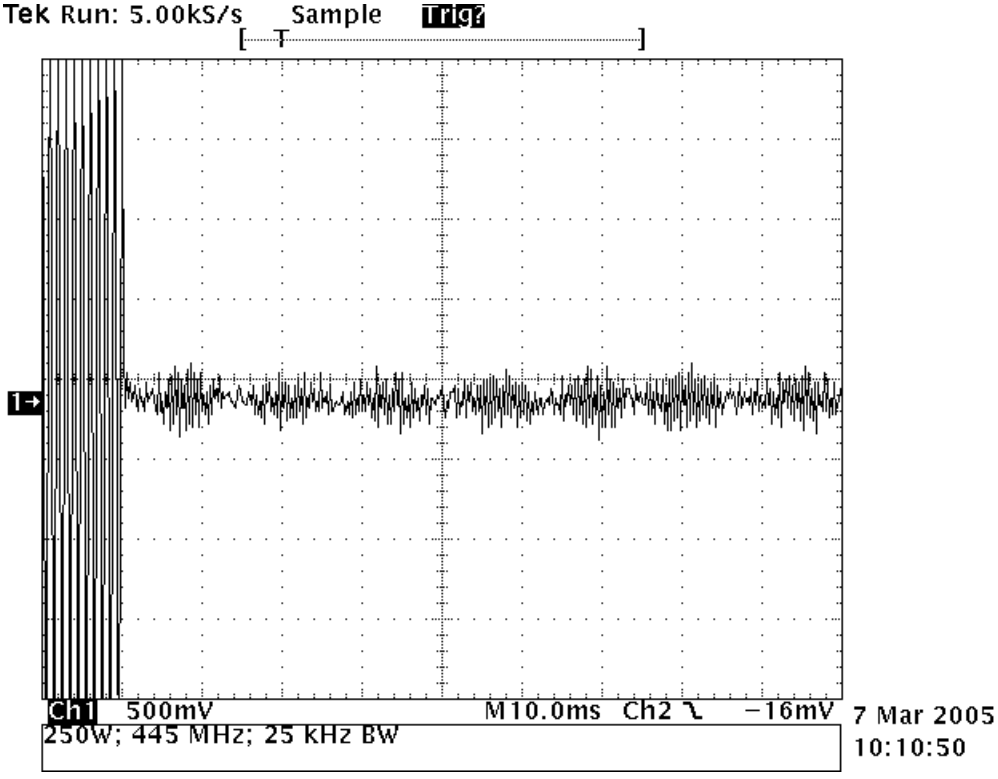
TF18


Tek Run: 5.00kS/s Sample Trig?
Ch1 500mV M10.0ms Ch2 ƒ −12.4mV
50W; 445 MHz; 25 kHz BW
7 Mar 2005
10:07:54

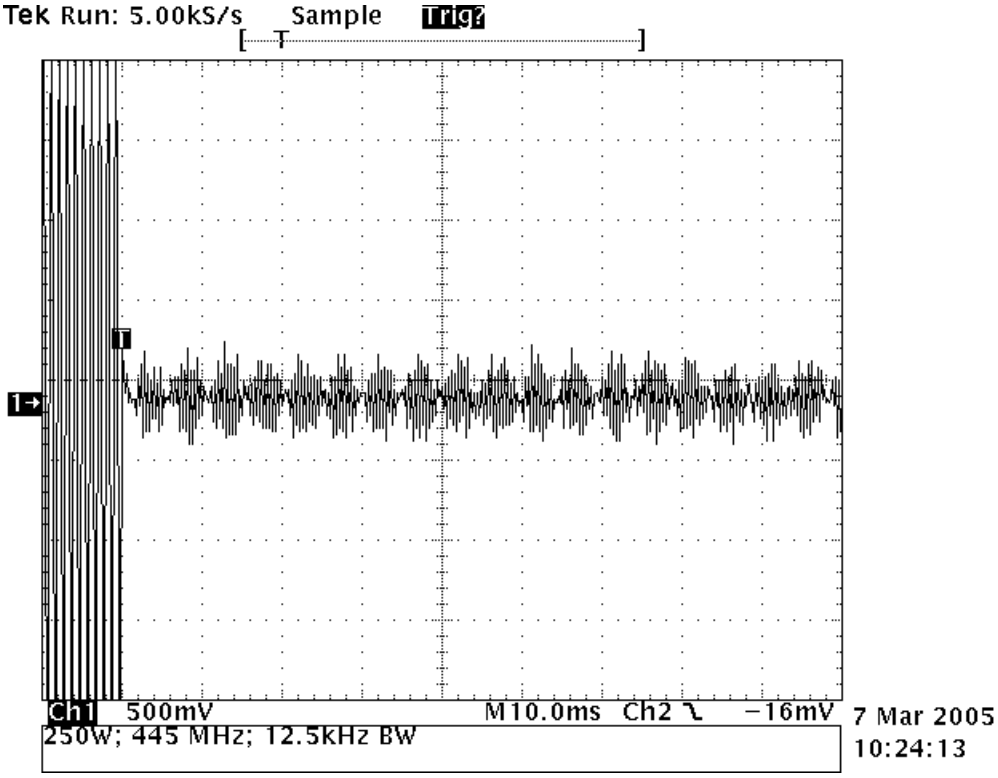
TF19



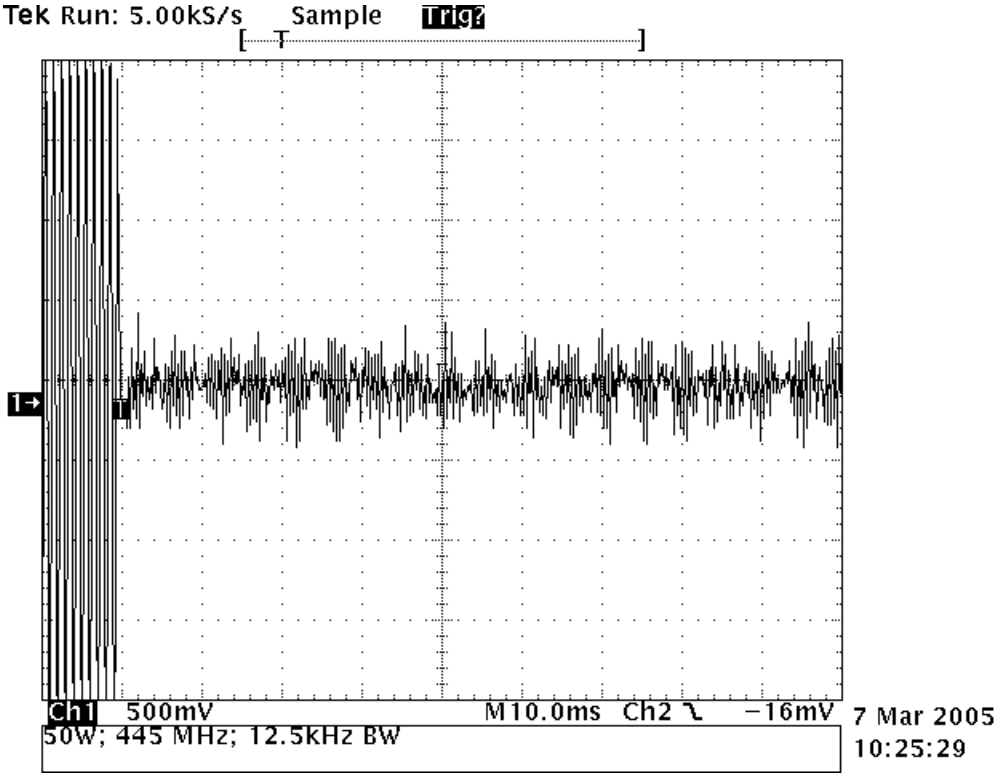
TF20



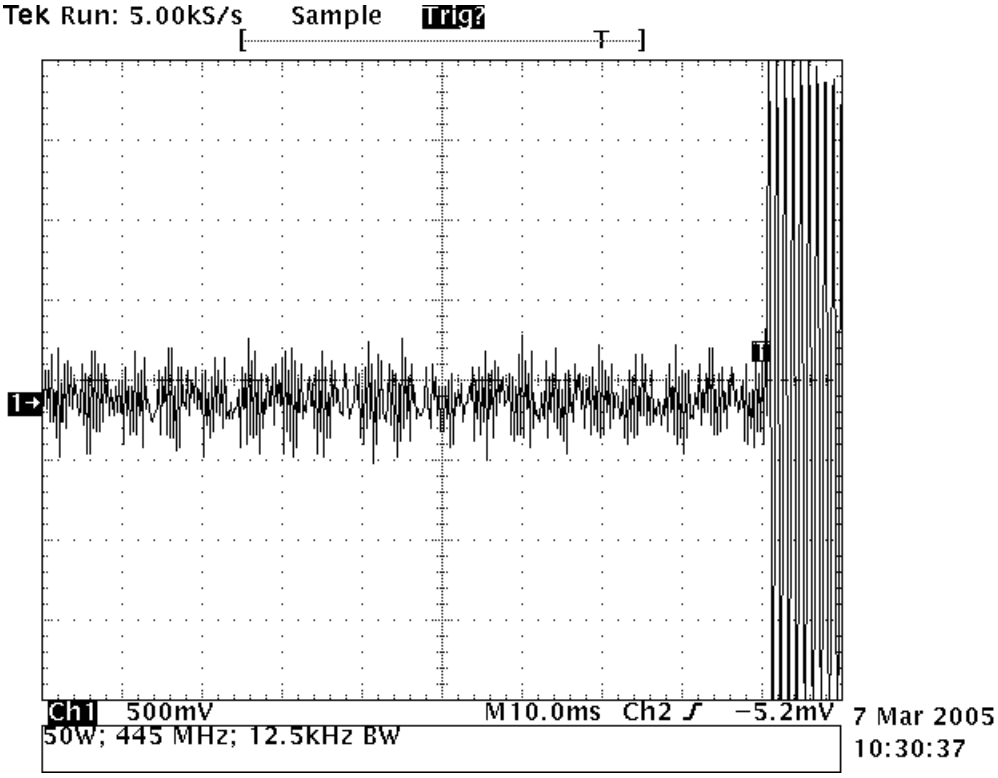
TF21


Tek Run: 5.00kS/s Sample Trig?
Ch1 500mV M10.0ms Ch2 ∖ −16mV
250W; 445 MHz; 12.5kHz BW
7 Mar 2005
10:24:13

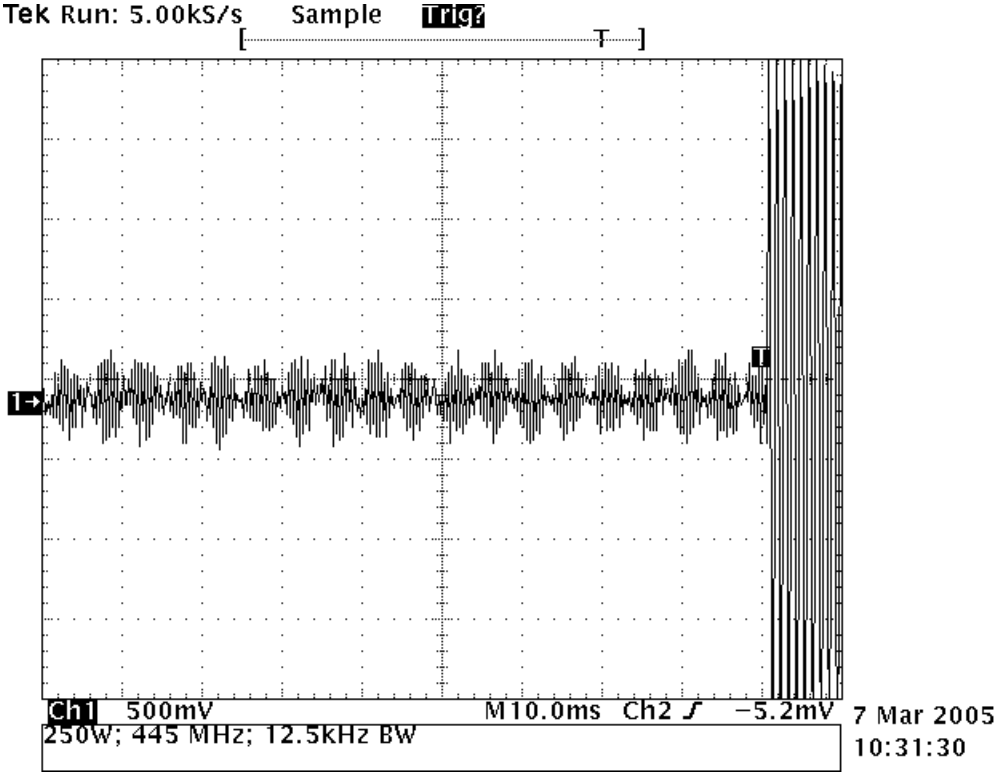
TF22


Tek Run: 5.00kS/s Sample Trig?
Ch1 500mV M10.0ms Ch2 ∖ −16mV
50W; 445 MHz; 12.5kHz BW
7 Mar 2005
10:25:29

TF23


Tek Run: 5.00kS/s Sample Trig?
Ch1 500mV M10.0ms Ch2 ƒ −5.2mV
50W; 445 MHz; 12.5kHz BW
7 Mar 2005
10:30:37

TF24


Tek Run: 5.00kS/s Sample Trig?
Ch1 500mV M10.0ms Ch2 ƒ −5.2mV
250W; 445 MHz; 12.5kHz BW
7 Mar 2005
10:31:30