Electromagnetic Compatibility Test Report

Tests Performed on an ISC Technologies, Inc

Paging Transmitter, Model ISC-T8411E

Radiometrics Document RP-5577-FCC

Product Detail:
FCC ID: SS6ISC-T8411E
Equipment type: 150 to 174 paging Transmitter

Test Standards:
US CFR Title 47, Chapter I, FCC Part 22 and 90
FCC Part 90 CFR Title 47: 2004

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

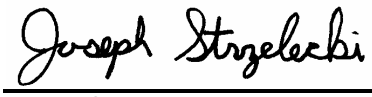
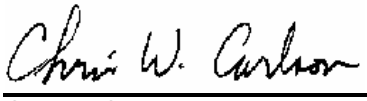
Test Date(s): (Month-Day-Year)
May 20 to 26 and September 26 to 30, 2005

Document RP-5577-FCC Revisions:

Rev.	Issue Date	Affected Pages	Revised By
0	December 2, 2005		

Table of Contents

1 ADMINISTRATIVE DATA

Equipment Under Test: A ISC Technologies, Inc, Paging Transmitter Model: ISC-T8411E Serial Number: None This will be referred to as the EUT in this Report	
Date EUT Received at Radiometrics: (Month-Day-Year) May 19, 2005	*Test Date(s): (Month-Day-Year)* May 20 to 26 and September 26 to 30, 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-T8411E, 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	150 to 174 MHz	2.1046	6.2	Pass
Modulation Characteristics	150 to 174 MHz	2.1047	6.6	Pass
Occupied Bandwidth Test; Emissions Masks	150 to 174 MHz	2.1049	6.4	Pass
Spurious RF Conducted Emissions	1-2000 MHz	2.1051	6.4	Pass
Field Strength of Spurious Radiation	30-2000 MHz	2.1053	6.3	Pass
Frequency Vs. Temperature	150 to 174 MHz	2.1055	5.3	Pass
Frequency Vs. Voltage	150 to 174 MHz	2.1055	2.3	Pass
Transient Frequency Behavior	150 to 174 MHz	90.214	6.5	Pass

The transmitter may be equipped with an internal isolator option, which limits the output power from 225 to 200 watts. The following tests were performed with and without the isolator:

1. The RF power output
2. Spurious RF Conducted Emissions

3. Field Strength of Spurious Radiation

All other tests were performed with the isolator. In our opinion, other than three tests listed above, the isolator would not affect the test results.

3 EQUIPMENT UNDER TEST (EUT) DETAILS

3.1 EUT Description

The EUT is a Paging Transmitter, Model ISC-T8411E, 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-T8411E	260316632
2	Exciter	E	ISC Technologies	DSP Exciter	Q98170382E12578
3	Exciter	E	ISC Technologies	90692	20487328
4	Power Amplifier	E	ISC Technologies	T8411E	1000.02285
5	Power Supply	E	ISC Technologies	GL2835	20620007

* 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
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.	04/20/05
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.	06/21/05
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 Watt 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**				
EUT Condition	TX freq MHz	Atten & Cable	Reading dBm	Total dBm	Watts	Power Setting
With Isolator	156	50.1	2.8	52.9	195.0	100 W
With Isolator	156	50.1	-0.1	50.0	100.0	200 W
With Isolator	173	50.1	2.9	53.0	199.5	200 W
With Isolator	173	50.1	-0.2	49.9	97.7	200 W
No Isolator	156	50.1	3.2	53.3	213.8	225 W
No Isolator	173	50.1	3.1	53.2	208.9	225 W

Test Date: May 25 and September 29, 2005
Judgement: Pass
Tested by: Joseph Strzelecki

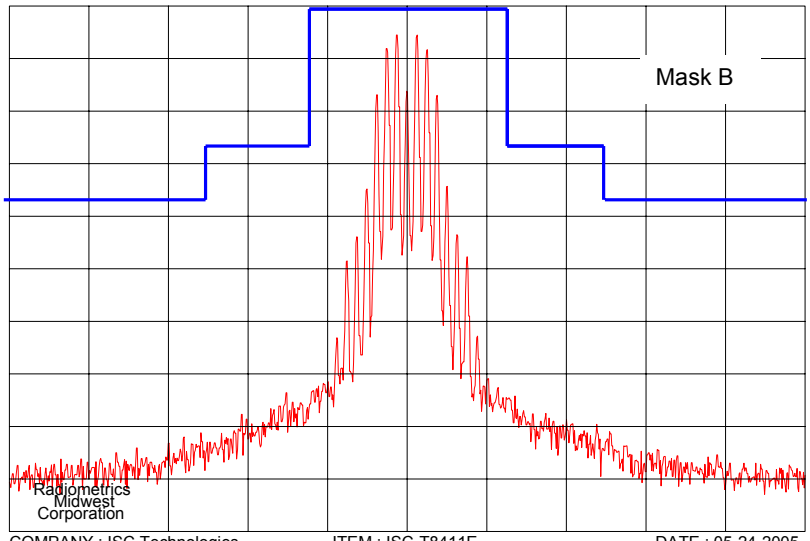
10.2 Occupied Bandwidth; Emissions Masks

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 and 22.359 andRSS-119. The last entry in the table in 90.210 shows mask B as being appropriate for all other bands not previously listed.

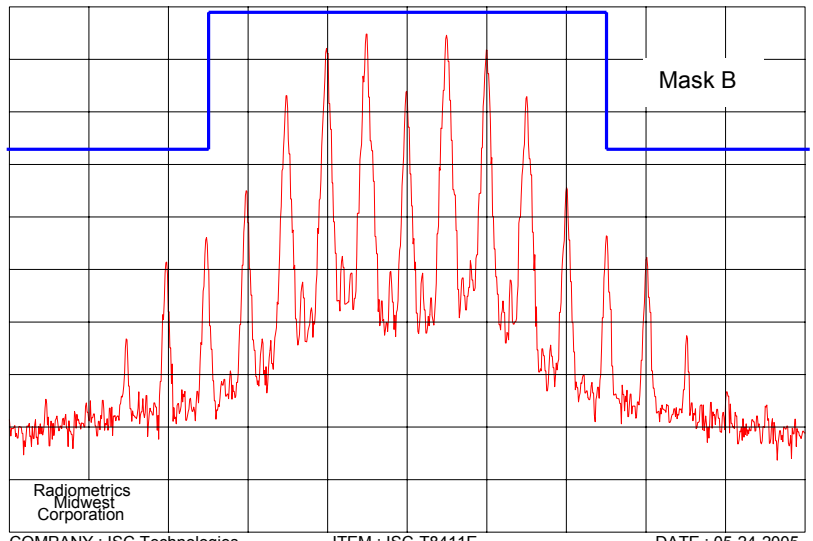
10.2.1 Emission MASK B



COMPANY : ISC Technologies
CENTER 156.000 MHz
RES BW 300 Hz
10 dB/
NOTES : Bandwidth; Analog, 25.0 kHz; 100W

ITEM : ISC-T8411E
REF 0.0 dBm
VBW 1 kHz
TIME : 13:52

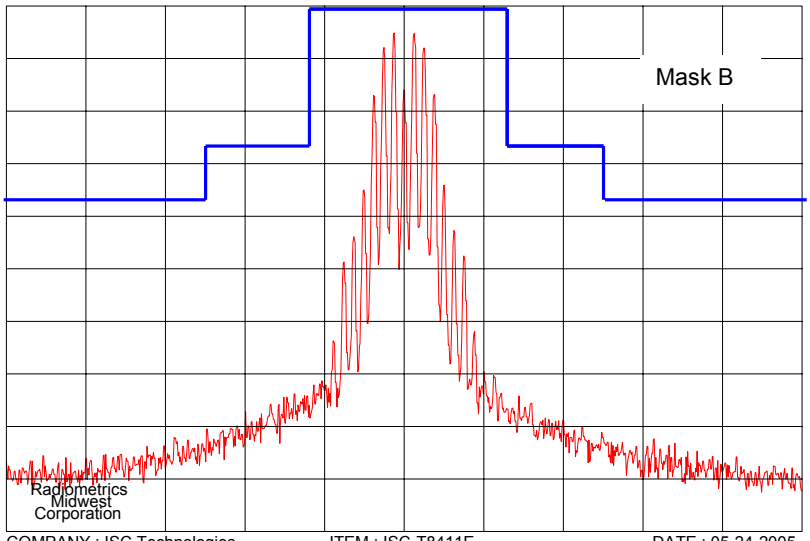
DATE : 05-24-2005
SPAN 200 kHz
ATTEN 0 dB
SWP 6.00 sec



COMPANY : ISC Technologies
CENTER 156.000 0 MHz
RES BW 100 Hz
10 dB/
NOTES : Bandwidth; Analog, 25.0 kHz; 100W

ITEM : ISC-T8411E
REF 0.0 dBm
VBW 300 Hz
TIME : 13:53

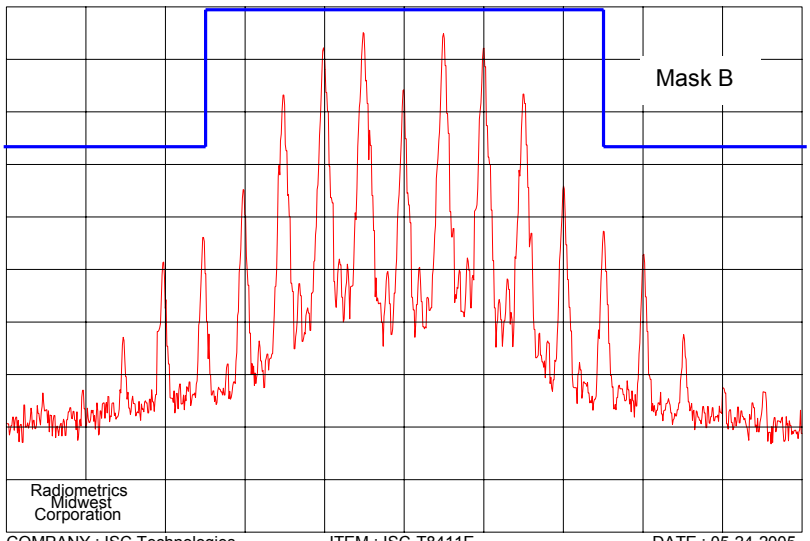
DATE : 05-24-2005
SPAN 50.0 kHz
ATTEN 0 dB
SWP 15.0 sec



COMPANY : ISC Technologies
CENTER 156.000 MHz
RES BW 300 Hz
10 dB/
NOTES : Bandwidth; Analog, 25.0 kHz; 200W

ITEM : ISC-T8411E
REF 3.0 dBm
VBW 1 kHz
TIME : 13:51

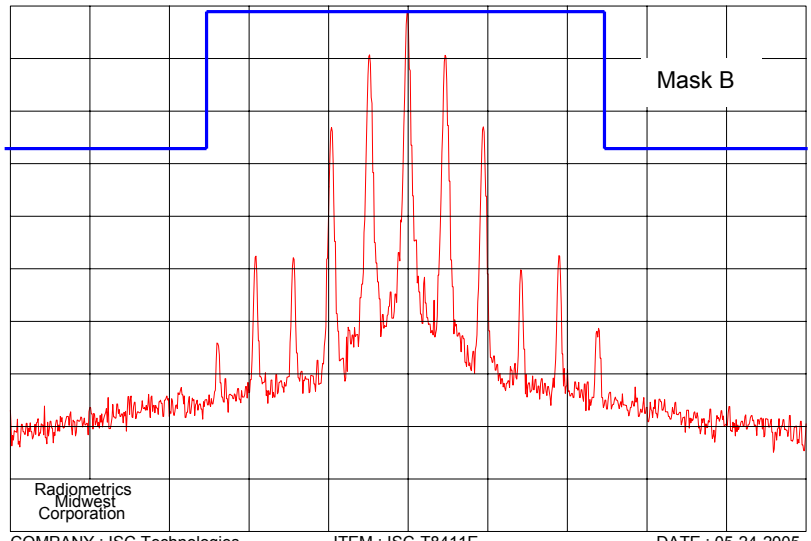
DATE : 05-24-2005
SPAN 200 kHz
ATTEN 0 dB
SWP 6.00 sec



COMPANY : ISC Technologies
CENTER 156.000 0 MHz
RES BW 100 Hz
10 dB/
NOTES : Bandwidth; Analog, 25.0 kHz; 200W

ITEM : ISC-T8411E
REF 3.0 dBm
VBW 300 Hz
TIME : 13:44

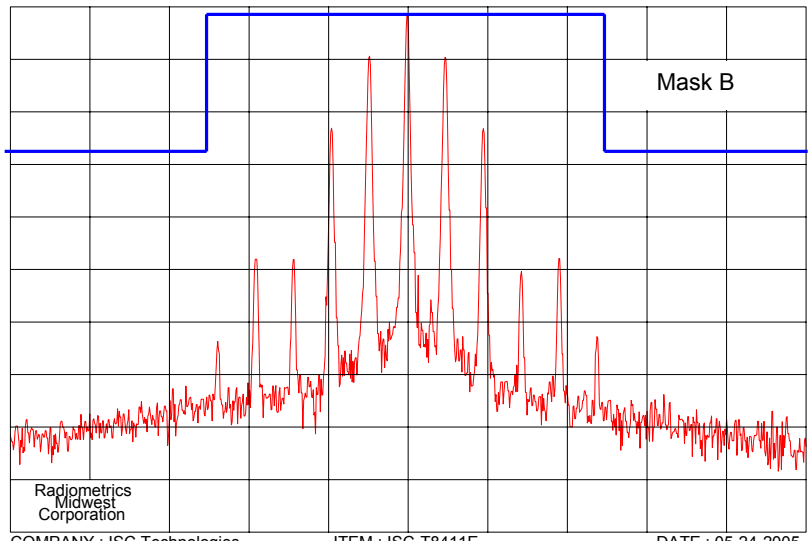
DATE : 05-24-2005
SPAN 50.0 kHz
ATTEN 0 dB
SWP 15.0 sec



COMPANY : ISC Technologies
CENTER 173.000 0 MHz
RES BW 100 Hz
10 dB/
NOTES : Bandwidth; Digital, 25.0 kHz; 200W

ITEM : ISC-T8411E
REF 3.0 dBm
VBW 300 Hz
TIME : 15:00

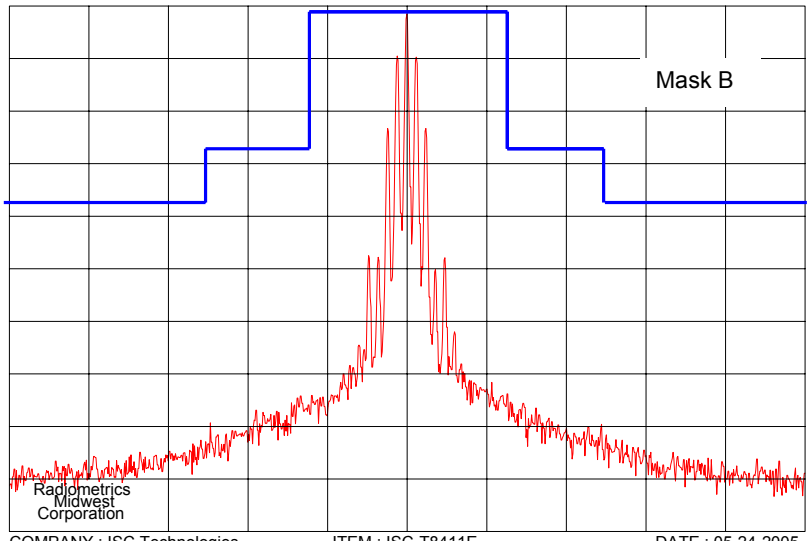
DATE : 05-24-2005
SPAN 50.0 kHz
ATTEN 0 dB
SWP 15.0 sec



COMPANY : ISC Technologies
CENTER 173.000 0 MHz
RES BW 100 Hz
10 dB/
NOTES : Bandwidth; Digital, 25.0 kHz; 100W

ITEM : ISC-T8411E
REF 0.0 dBm
VBW 300 Hz
TIME : 14:50

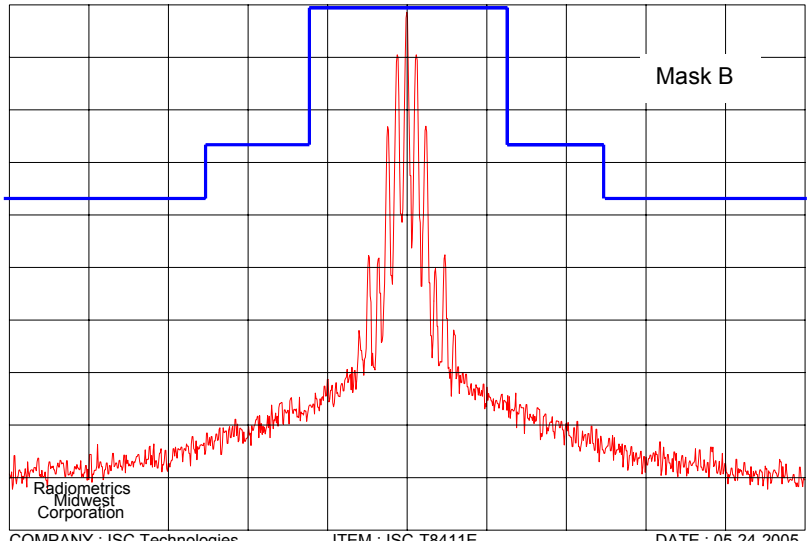
DATE : 05-24-2005
SPAN 50.0 kHz
ATTEN 0 dB
SWP 15.0 sec



COMPANY : ISC Technologies
CENTER 173.000 MHz
RES BW 300 Hz
10 dB/
NOTES : Bandwidth; Digital, 25.0 kHz; 100W

ITEM : ISC-T8411E
REF 0.0 dBm
VBW 1 kHz
TIME : 14:45

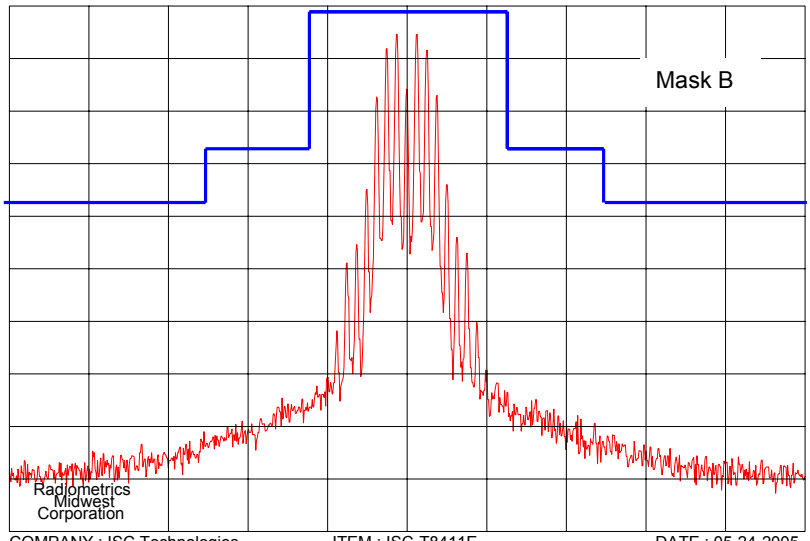
DATE : 05-24-2005
SPAN 200 kHz
ATTEN 0 dB
SWP 6.00 sec



COMPANY : ISC Technologies
CENTER 173.000 MHz
RES BW 300 Hz
10 dB/
NOTES : Bandwidth; Digital, 25.0 kHz; 200W

ITEM : ISC-T8411E
REF 3.0 dBm
VBW 1 kHz
TIME : 14:44

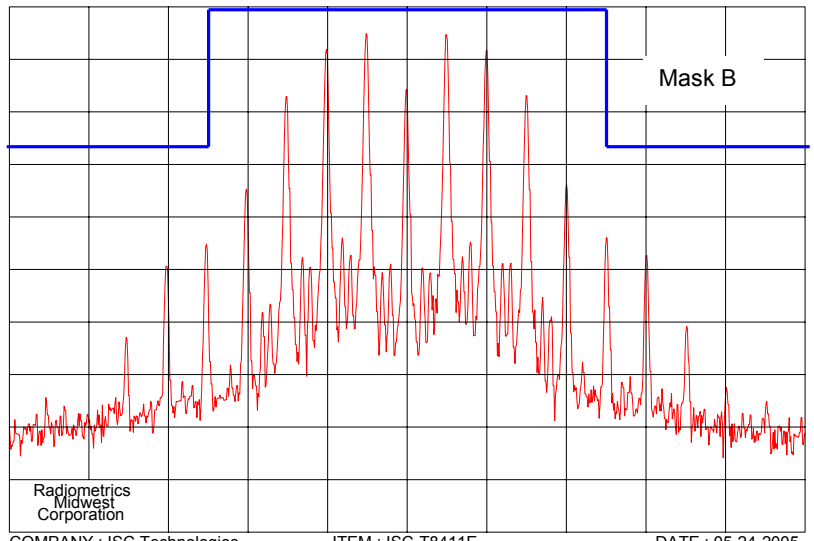
DATE : 05-24-2005
SPAN 200 kHz
ATTEN 0 dB
SWP 6.00 sec



COMPANY : ISC Technologies
CENTER 173.000 MHz
RES BW 300 Hz
10 dB/
NOTES : Bandwidth; Analog, 25.0 kHz; 200W

ITEM : ISC-T8411E
REF 3.0 dBm
VBW 1 kHz
TIME : 14:37

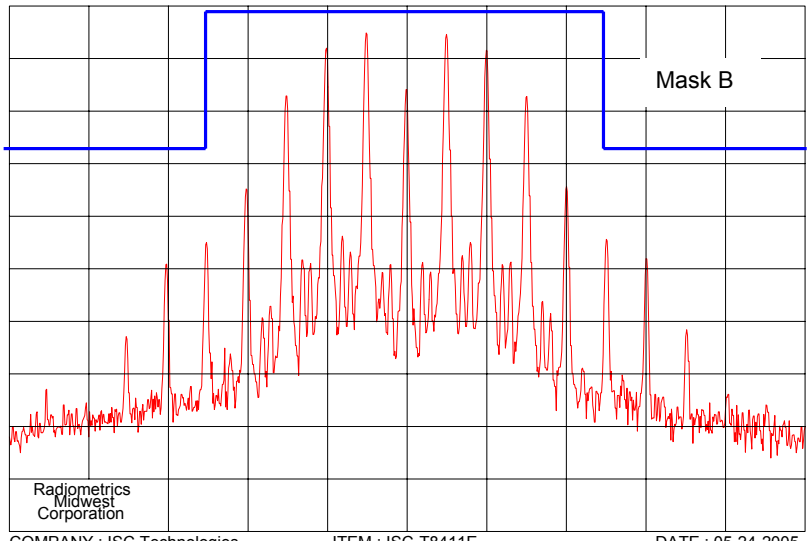
DATE : 05-24-2005
SPAN 200 kHz
ATTEN 0 dB
SWP 6.00 sec



COMPANY : ISC Technologies
CENTER 173.000 0 MHz
RES BW 100 Hz
10 dB/
NOTES : Bandwidth; Analog, 25.0 kHz; 200W

ITEM : ISC-T8411E
REF 3.0 dBm
VBW 300 Hz
TIME : 14:36

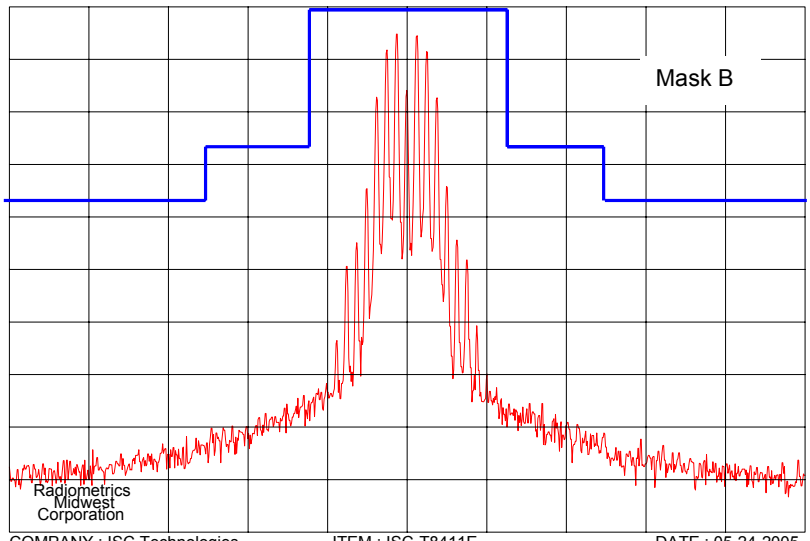
DATE : 05-24-2005
SPAN 50.0 kHz
ATTEN 0 dB
SWP 15.0 sec



COMPANY : ISC Technologies
CENTER 173.000 0 MHz
RES BW 100 Hz
10 dB/
NOTES : Bandwidth; Analog, 25.0 kHz; 100W

ITEM : ISC-T8411E
REF 0.0 dBm
VBW 300 Hz
TIME : 14:31

DATE : 05-24-2005
SPAN 50.0 kHz
ATTEN 0 dB
SWP 15.0 sec

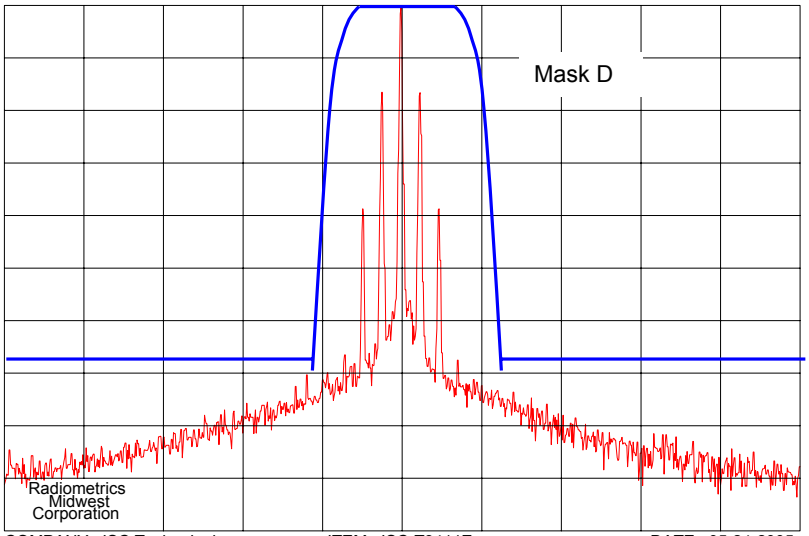


COMPANY : ISC Technologies
CENTER 173.000 MHz
RES BW 300 Hz
10 dB/
NOTES : Bandwidth; Analog, 25.0 kHz; 100W

ITEM : ISC-T8411E
REF 0.0 dBm
VBW 1 kHz
TIME : 14:27

DATE : 05-24-2005
SPAN 200 kHz
ATTEN 10 dB
SWP 6.00 sec

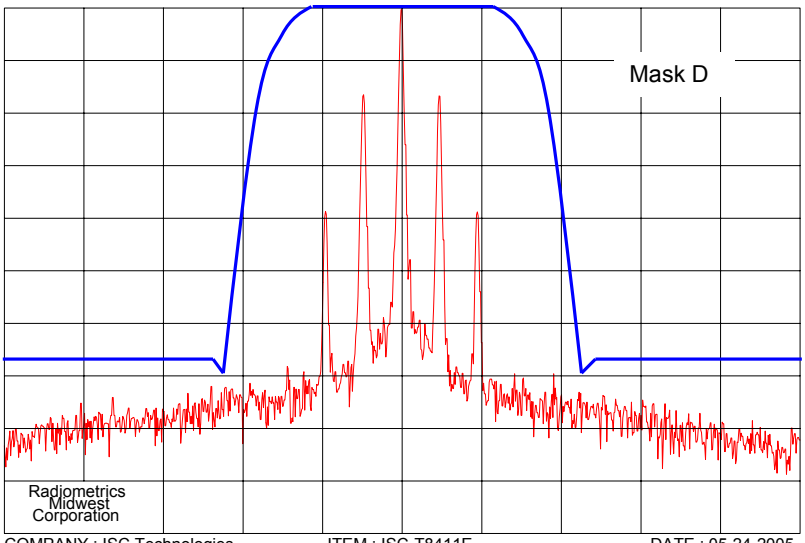
10.2.2 Emission MASK D



COMPANY : ISC Technologies
CENTER 173.000 MHz
RES BW 100 Hz
10 dB/
NOTES : Bandwidth; Digital, 12.5 kHz; 100W

ITEM : ISC-T8411E
REF 0.0 dBm
VBW 300 Hz
TIME : 15:23

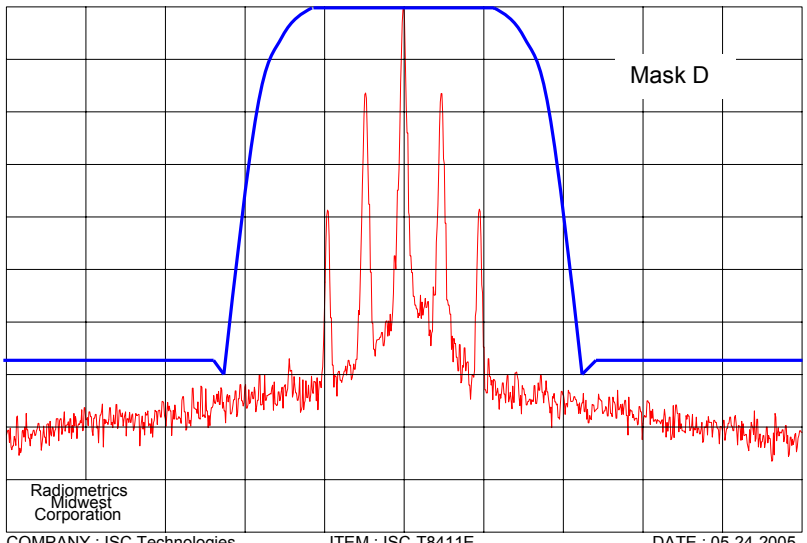
DATE : 05-24-2005
SPAN 100 kHz
ATTEN 0 dB
SWP 30.0 sec



COMPANY : ISC Technologies
CENTER 173.000 0 MHz
RES BW 100 Hz
10 dB/
NOTES : Bandwidth; Digital, 12.5 kHz; 100W

ITEM : ISC-T8411E
REF 0.0 dBm
VBW 300 Hz
TIME : 15:22

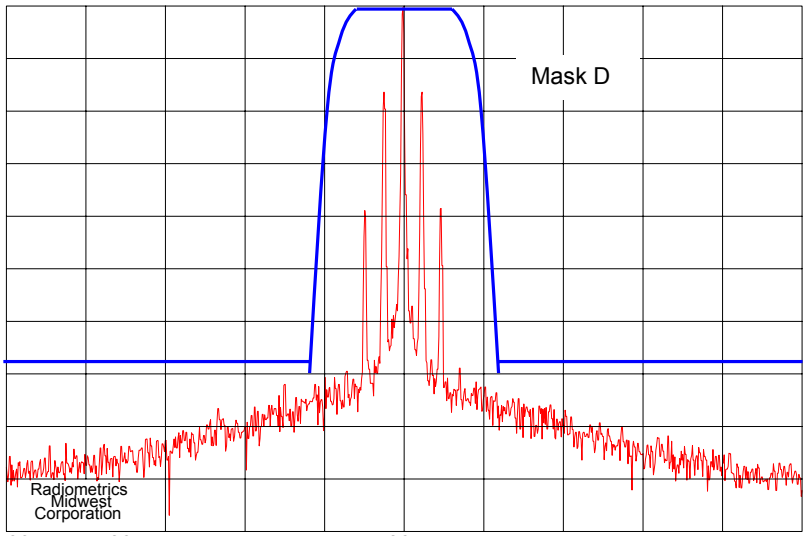
DATE : 05-24-2005
SPAN 50.0 kHz
ATTEN 0 dB
SWP 15.0 sec



COMPANY : ISC Technologies
CENTER 173.000 0 MHz
RES BW 100 Hz
10 dB/
NOTES : Bandwidth; Digital, 12.5 kHz; 200W

ITEM : ISC-T8411E
REF 3.0 dBm
VBW 300 Hz
TIME : 15:11

DATE : 05-24-2005
SPAN 50.0 kHz
ATTEN 0 dB
SWP 15.0 sec

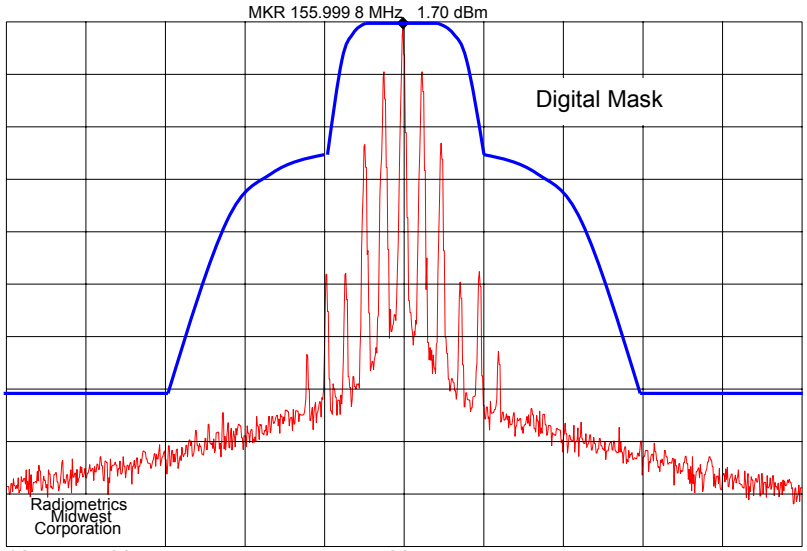


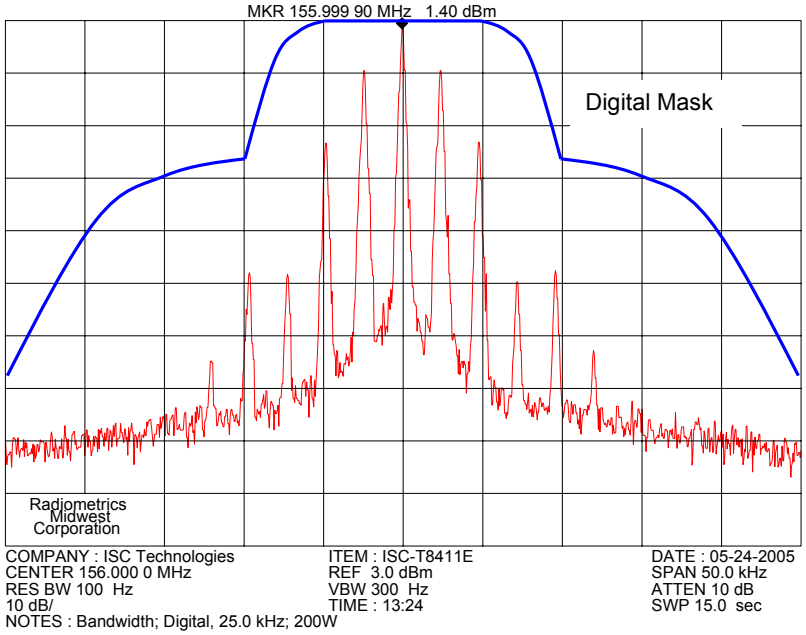
COMPANY : ISC Technologies
CENTER 173.000 MHz
RES BW 100 Hz
10 dB/
NOTES : Bandwidth; Digital, 12.5 kHz; 200W

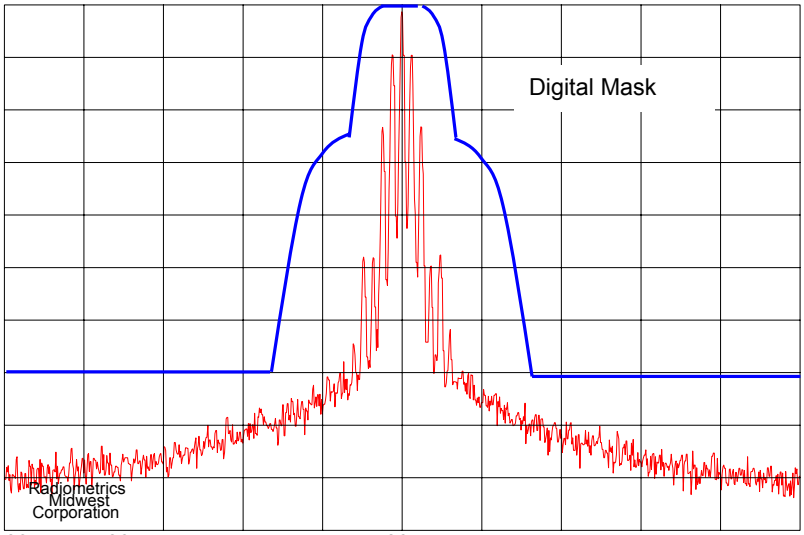
ITEM : ISC-T8411E
REF 3.0 dBm
VBW 300 Hz
TIME : 15:08

DATE : 05-24-2005
SPAN 100 kHz
ATTEN 0 dB
SWP 30.0 sec

10.2.3 Emissions MASK from FCC Section 22.359



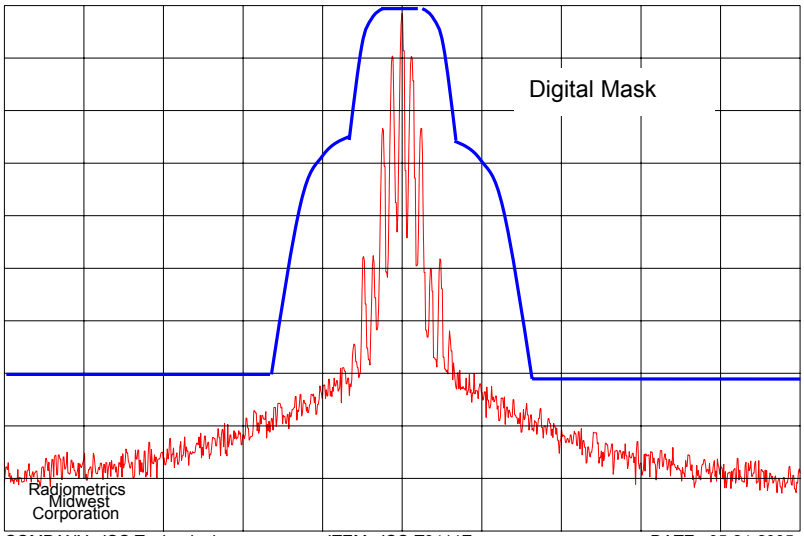




COMPANY : ISC Technologie
CENTER 156.000 MHz
RES BW 300 Hz
10 dB/
NOTES : Bandwidth; Digital, 25.0 kHz; 200W

ITEM : ISC-T8411E
REF 3.0 dBm
VBW 1 kHz
TIME : 13:22

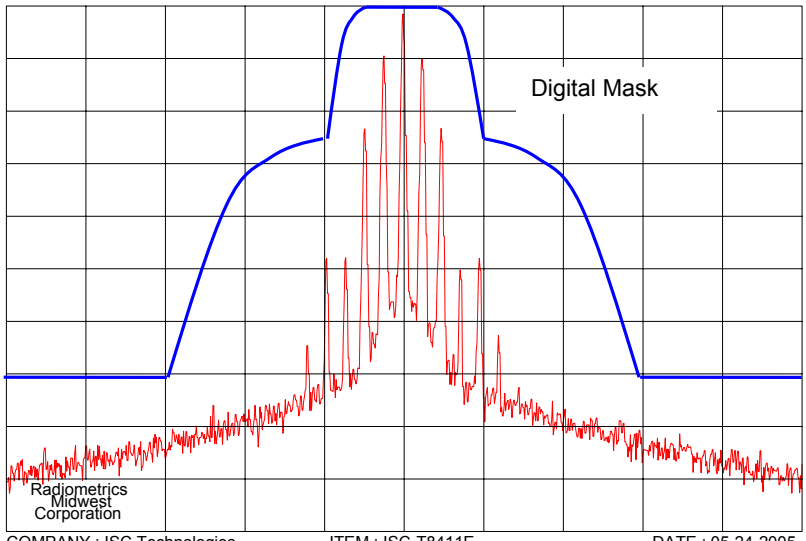
DATE : 05-24-2005
SPAN 200 kHz
ATTEN 10 dB
SWP 6.00 sec



COMPANY : ISC Technologies
CENTER 156.000 MHz
RES BW 300 Hz
10 dB/
NOTES : Bandwidth; Digital, 25.0 kHz; 100W

ITEM : ISC-T8411E
REF 0.0 dBm
VBW 1 kHz
TIME : 13:21

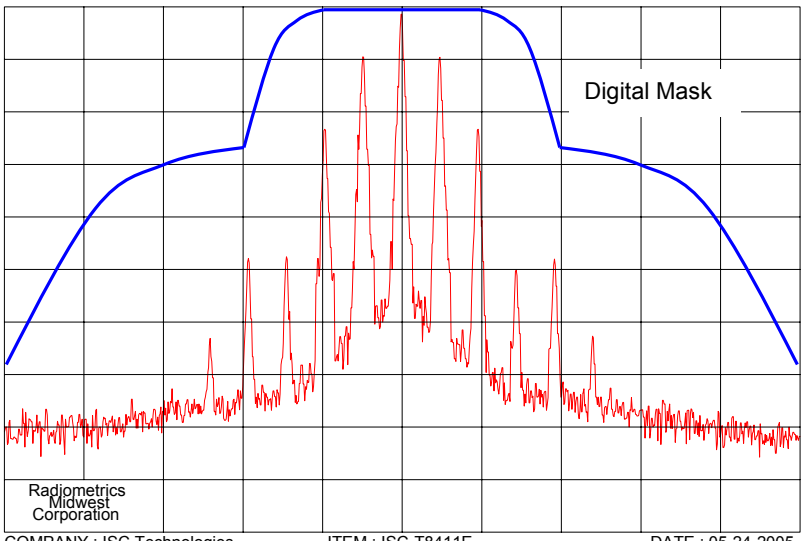
DATE : 05-24-2005
SPAN 200 kHz
ATTEN 10 dB
SWP 6.00 sec



COMPANY : ISC Technologies
CENTER 156.000 MHz
RES BW 100 Hz
10 dB/
NOTES : Bandwidth; Digital, 25.0 kHz; 100W

ITEM : ISC-T8411E
REF 0.0 dBm
VBW 300 Hz
TIME : 13:21

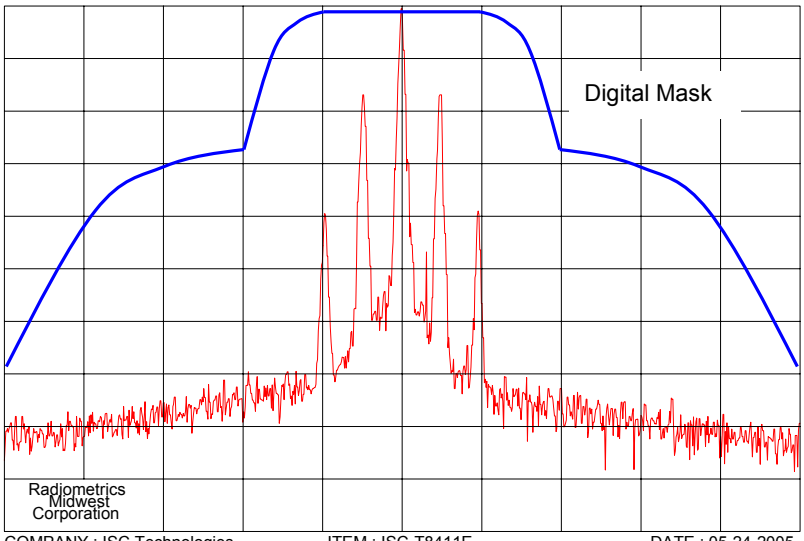
DATE : 05-24-2005
SPAN 100 kHz
ATTEN 10 dB
SWP 30.0 sec



COMPANY : ISC Technologies
CENTER 156.000 0 MHz
RES BW 100 Hz
10 dB/
NOTES : Bandwidth; Digital, 25.0 kHz; 100W

ITEM : ISC-T8411E
REF 0.0 dBm
VBW 300 Hz
TIME : 13:18

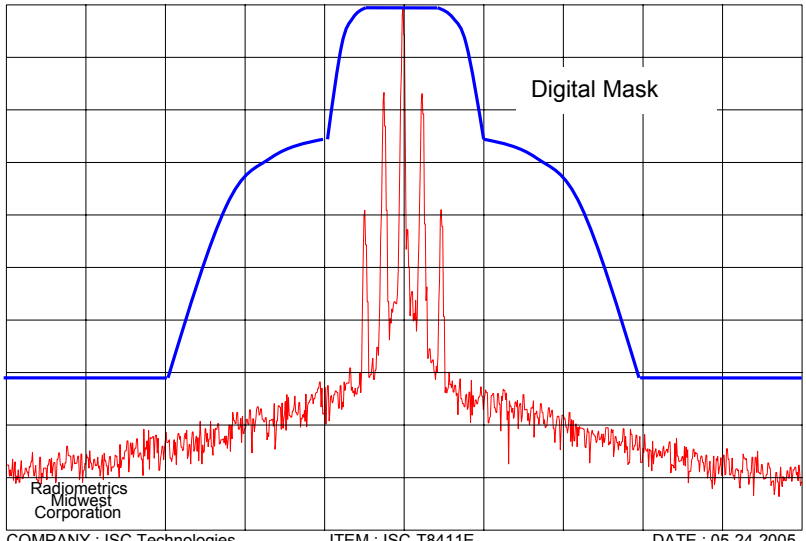
DATE : 05-24-2005
SPAN 50.0 kHz
ATTEN 10 dB
SWP 15.0 sec



COMPANY : ISC Technologies
CENTER 156.000 0 MHz
RES BW 100 Hz
10 dB/
NOTES : Bandwidth; Digital, 12.5 kHz; 100W

ITEM : ISC-T8411E
REF 0.0 dBm
VBW 300 Hz
TIME : 13:15

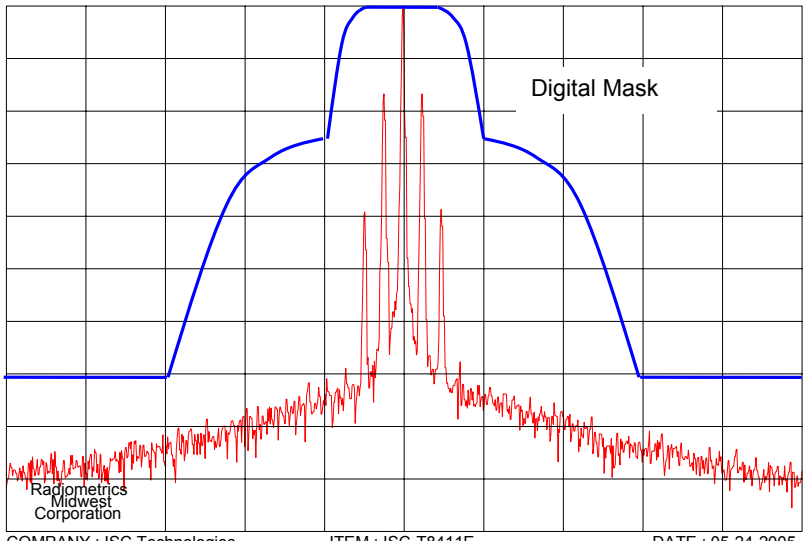
DATE : 05-24-2005
SPAN 50.0 kHz
ATTEN 10 dB
SWP 15.0 sec



COMPANY : ISC Technologies
CENTER 156.000 MHz
RES BW 100 Hz
10 dB/
NOTES : Bandwidth; Digital, 12.5 kHz; 100W

ITEM : ISC-T8411E
REF 0.0 dBm
VBW 300 Hz
TIME : 13:14

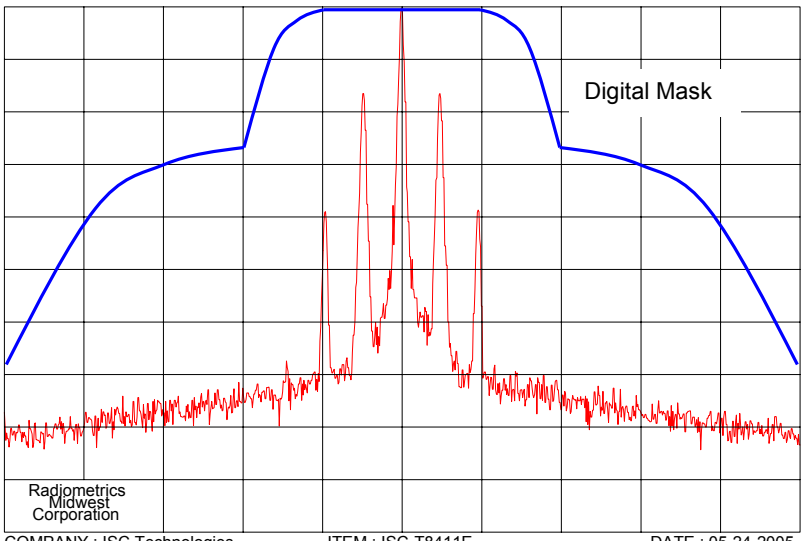
DATE : 05-24-2005
SPAN 100 kHz
ATTEN 10 dB
SWP 30.0 sec



COMPANY : ISC Technologies
CENTER 156.000 MHz
RES BW 100 Hz
10 dB/
NOTES : Bandwidth; Digital, 12.5 kHz; 200W

ITEM : ISC-T8411E
REF 3.0 dBm
VBW 300 Hz
TIME : 13:12

DATE : 05-24-2005
SPAN 100 kHz
ATTEN 10 dB
SWP 30.0 sec

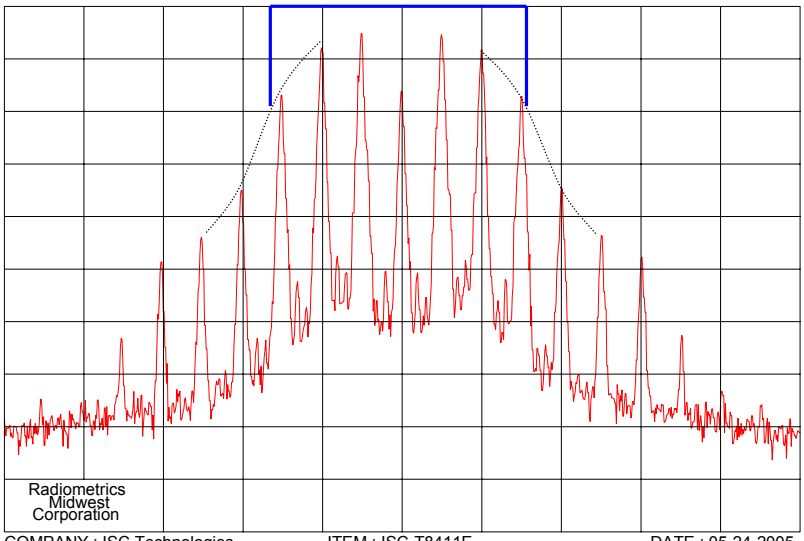


COMPANY : ISC Technologies
CENTER 156.000 0 MHz
RES BW 100 Hz
10 dB/
NOTES : Bandwidth; Digital, 12.5 kHz; 200W

ITEM : ISC-T8411E
REF 3.0 dBm
VBW 300 Hz
TIME : 13:08

DATE : 05-24-2005
SPAN 50.0 kHz
ATTEN 10 dB
SWP 15.0 sec

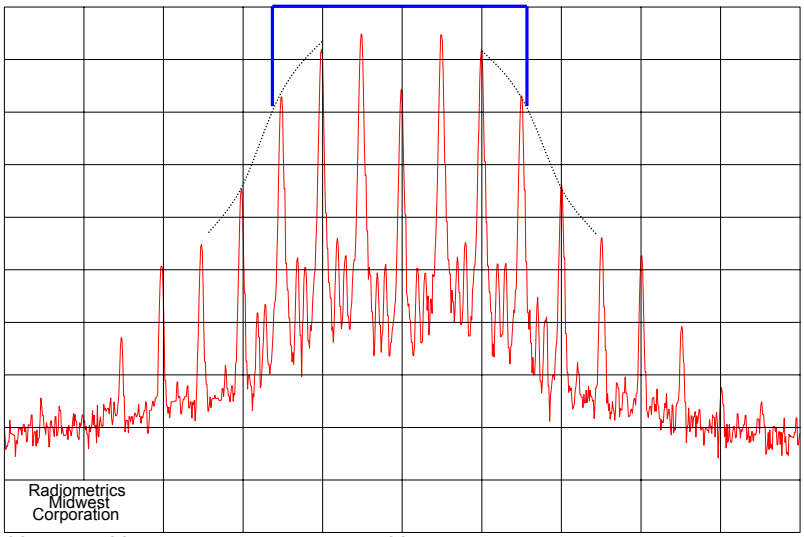
10.2.4 99% Bandwidth measurement



COMPANY : ISC Technologies
CENTER 156.000 0 MHz
RES BW 100 Hz
10 dB/
NOTES : Bandwidth; Analog, 25.0 kHz; 100W

ITEM : ISC-T8411E
REF 0.0 dBm
VBW 300 Hz
TIME : 13:53

DATE : 05-24-2005
SPAN 50.0 kHz
ATTEN 0 dB
SWP 15.0 sec



16 KHz 99% bandwidth

Judgement: Pass
Tested by: Joseph Strzelecki

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10.2.5 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 with a preselector. A 50 dB attenuator was connected between the EUT and the spectrum analyzer.

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 100 Watts, -17.0 dBm for 200 Watts and -16.5 dBm for 225 Watts

The frequencies tested were from 1 to 1800 MHz with the exception of frequencies within 100 kHz of the center frequency. The limits are worst case limits from RSS-119, and FCC part 90.210 and 22.359 are shown below.

Tx		Channel	Modulation		Spurious Emissions		Noise	
MHz	Watts	kHz	Hz	Type	Limit dBm	EUT dBm	floor dBm	Mask
156	200	25	4800	Digital	-13.0	-27.0	-27.0	B
156	100	25	4800	Digital	-13.0	-27.0	-27.0	B
156	200	12.5	4800	Digital	-17.0	-27.0	-27.0	D
156	100	12.5	4800	Digital	-20.0	-27.0	-27.0	D
156	200	25	2500	Analog	-13.0	-27.0	-27.0	B
156	100	25	2500	Analog	-13.0	-27.0	-27.0	B
156	225	25	4800	Digital	-13.0	-27.0	-27.0	B
156	225	12.5	4800	Digital	-16.5	-27.0	-27.0	D
156	225	25	2500	Analog	-13.0	-27.0	-27.0	B
173	200	25	4800	Digital	-13.0	-27.0	-27.0	B
173	100	25	4800	Digital	-13.0	-27.0	-27.0	B
173	200	12.5	4800	Digital	-17.0	-27.0	-27.0	D
173	100	12.5	4800	Digital	-20.0	-27.0	-27.0	D
173	200	25	2500	Analog	-13.0	-27.0	-27.0	B
173	100	25	2500	Analog	-13.0	-27.0	-27.0	B
173	225	25	4800	Digital	-13.0	-27.0	-27.0	B
173	225	12.5	4800	Digital	-16.5	-27.0	-27.0	D
173	225	25	2500	Analog	-13.0	-27.0	-27.0	B

Judgement: Pass
Tested by: Joseph Strzelecki

10.3 Modulation Characteristics

10.3.1 Audio Frequency Response

Test Procedures:

FCC 2.1047 (a)

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

1. The transmitter was set for 1.5kHz. deviation using a 1kHz. 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 1.5kHz. deviation using a 1kHz. 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.

Test Results:

Audio Frequency (Hz)	Audio Output Level	
	Voice Input (dB)	Flat Input (dB)
100	-29	-0.2
200	-15.5	-0.15
300	-10.4	-0.1
500	-5.7	-0.8
1000	0	0
2000	+6.0	-0.3
2500	+8.1	-0.25
3000	+9.2	-0.75
3500	+6.7	-3.0
4000	-3.4	-8.1
4500	-28	-18
5000	-40	-43

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.

Deleted: 1kHz
Deleted: 2.5kHz

Audio Input Level	Frequency Deviation (kHz) Pre-emphasized input			
	300 Hz	600 Hz	1000 Hz	2500 Hz
-6 dB	0.40	0.78	1.30	3.20
0 dB	0.80	1.52	2.50	4.80
+3 dB	1.10	2.15	3.54	4.83
+6 dB	1.54	3.00	4.82	4.83
+10 dB	2.43	4.78	4.82	4.83
+16 dB	4.78	4.83	4.83	4.83
+20 dB	4.84	4.84	4.84	4.10

FCC 2.1047 (b)

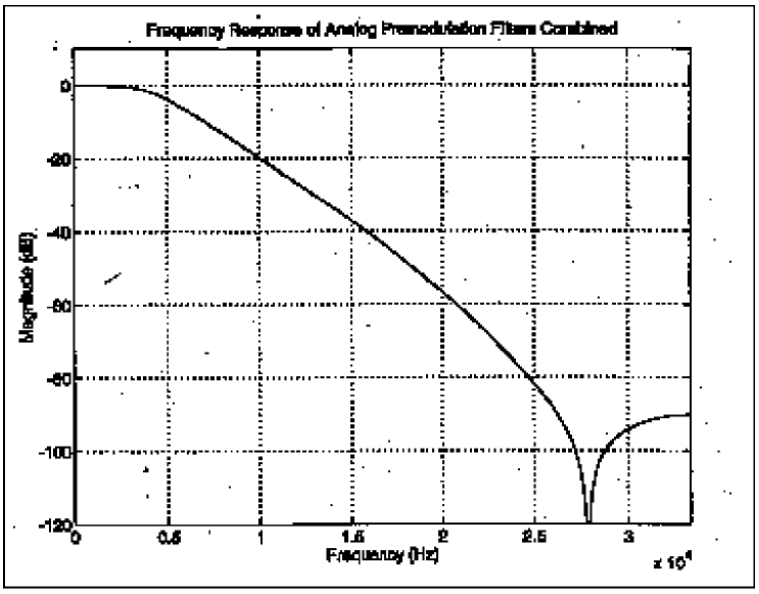
Audio Input Level	Frequency Deviation (kHz) Flat input			
	300 Hz	600 Hz	1000 Hz	2500 Hz
-6 dB	1.24	1.26	1.26	1.24
0 dB	2.45	2.48	2.50	2.44
+3 dB	3.50	3.53	3.56	3.48
+6 dB	4.78	4.80	4.81	4.68
+10 dB	4.83	4.82	4.82	4.82
+16 dB	4.85	4.84	4.84	4.84
+20 dB	4.85	4.84	4.84	4.83

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.

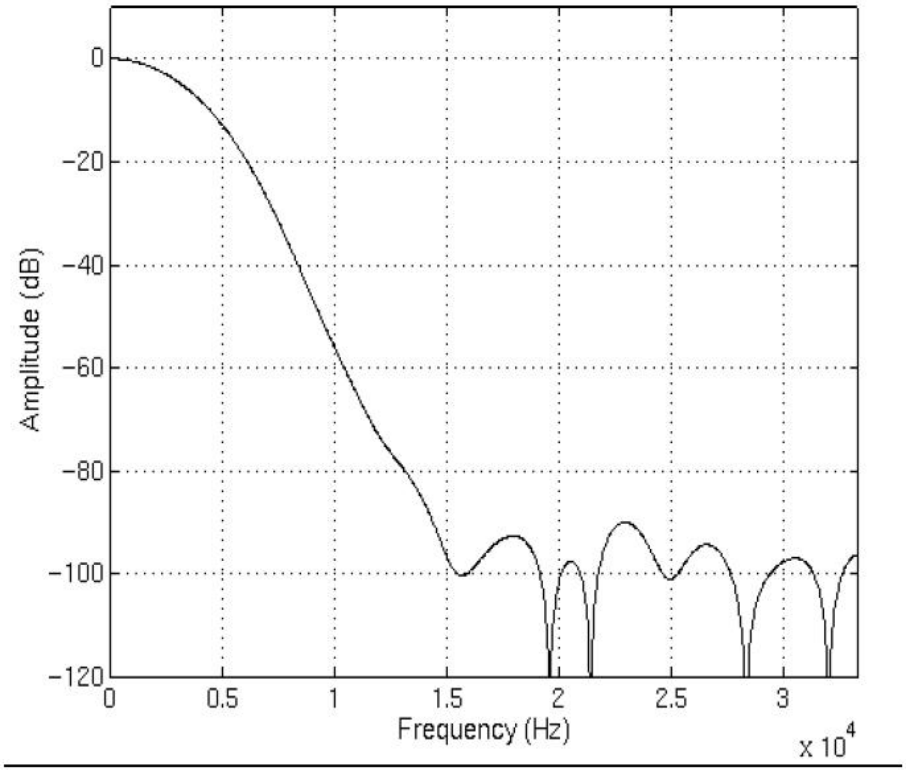
Figure 1. Frequency Response



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	150,000,000.9	-0.2	-1.33
-20	150,000,000.9	-0.2	-1.33
-10	150,000,000.9	-0.2	-1.33
0	150,000,001.0	-0.1	-0.667
+10	150,000,001.0	-0.1	-0.667
+20	150,000,001.1	0	0
+25	150,000,001.1	Reference	Reference
+30	150,000,001.1	0	0
+40	150,000,001.1	0	0
+50	150,000,001.2	+0.1	+0.667

10.4.2 Frequency Stability vs. Supply Voltage

FCC 2.1055 (d)
Two sets of measurements were performed; one with a 26 VDC nominal Voltage and one with 28 VDC nominal voltage.

Procedure:

1. The EUT was allowed to stabilize in a 25° C ambient with the nominal primary power supply voltage 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.

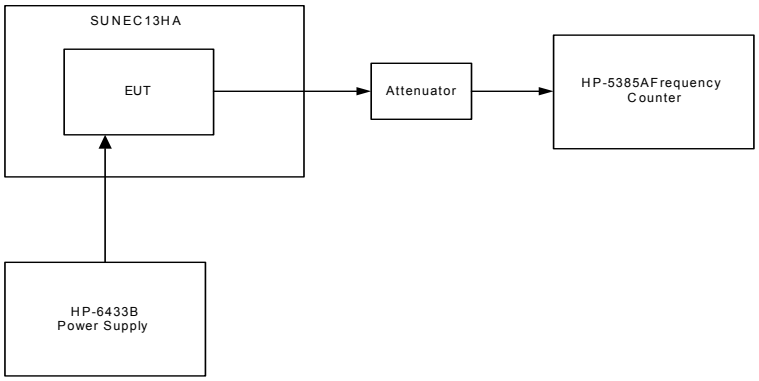
Supply Voltage (%)	Supply Voltage	Frequency (Hz)	Delta Frequency (Hz)	Delta in Parts Per Billion (ppb)
85	22.1	150,000,001.1	0	0
100	26.0	150,000,001.1	0	0
115	29.9	150,000,001.1	0	0

Supply Voltage (%)	Supply Voltage	Frequency (Hz)	Delta Frequency (Hz)	Delta in Parts Per Billion (ppb)
85	23.8	150,000,000.1	+0.2	+1.33
100	28.0	149,999,999.9	0	0
115	32.2	149,999,999.9	0	0

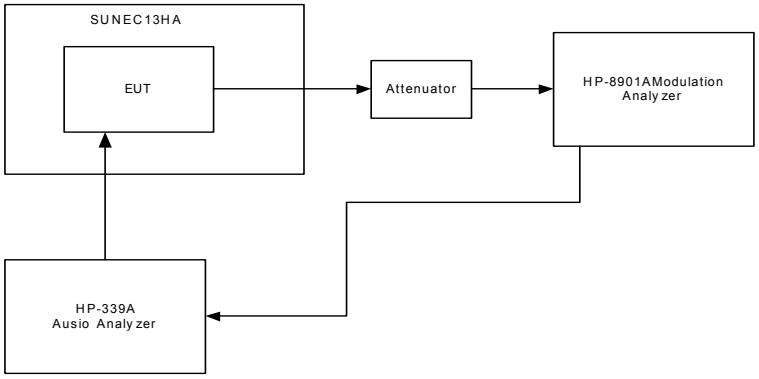
Judgment: Pass
Tested by: Joseph Foster

Figure 3. Test Setup for Frequency Stability and Modulation Characteristics

Frequency Stability Test



Modulation Test



Test equipment used:

- Adjustable DC Power supply: HP-6433B (TE-S22). Cal. not required.
- Modulation Analyzer: HP-8901A (TE-A453) Cal. 4/6/05, Due 4/6/06.
- Frequency Counter: HP-5385A (TE-C97) Cal. 4/6/05, Due 4/6/06
- Audio Analyzer: HP-339A (TE-M78) Cal. 4/6/05, Due 4/6/06
- Temperature Chamber. Sun Systems Model EC13HA. Cal. not required.

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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.

Deleted: 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.¶

Deleted: The detected emission levels were maximized by rotating the EUT, and by scanning the measurement antenna from 1 to 4 meters above the ground.

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.

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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:

Deleted: and by subtracting the Amplifier Gain from

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) $P = (VxD)^2/30$

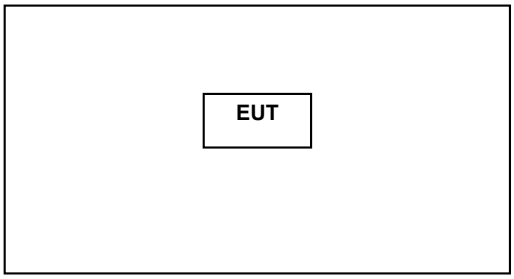
Where: V=Volts/meter & D = Antenna Distance in meters

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

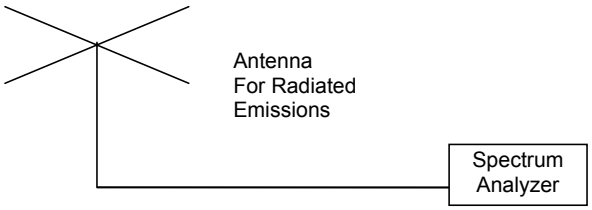
Deleted: For P= -13 dBm, V = 82.2 dBuV/m¶

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

Figure 4. Drawing of Radiated Emissions Setup



Notes:
- AC outlet with low-pass filter at the base of the turntable
- Antenna height varied from 1 to 4 meters
- Distance from antenna to tested system is 3 meters
- Not to Scale



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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 200 and the 225 Watt power setting. The worst case readings are shown below. The 225 Watt setting also complied with the 100 Watt, 12.5 kHz limit.

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Manufacturer	ISC Technologies, Inc	Specification	FCC Part 22 & 90 & RSS-119
Model	ISC-T8411E	Test Date	March 2, 2005
Serial Number	None	Test Distance	3 Meters
Abbreviations	Pol = Antenna Polarization; V = Vertical; H = Horizontal;		

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EUT Freq MHz	Emission Freq MHz	Pol	ANT #	Analyzer rdg dBuV from EUT	Tx Ant Gain dB	Generator pwr into subs Ant	Dipole equivalent dBm	Limit dBm	Margin dB

EUT Freq MHz	Emission Freq MHz	Pol	ANT #	Analyzer rdg dBuV from EUT	Tx Ant Gain dB	Generator pwr into subs Ant	Dipole equivalent dBm	Limit dBm	Margin dB
156	156	H	44	33.3	5.3	-55.4	-50.1	-20.0	30.1
156	312	H	44	27.9	6.3	-54.5	-48.2	-20.0	28.2
156	468	H	44	23.6	6.4	-54.4	-48.0	-20.0	28.0
156	624	H	44	23.6	6.8	-52.5	-45.7	-20.0	25.7
156	780	H	44	23.6	7.5	-51.3	-43.8	-20.0	23.8
156	936	H	44	23.6	7.1	-47.3	-40.2	-20.0	20.2
156	1092	H	13	27.9	7.7	-42.5	-34.8	-20.0	14.8
156	1248	H	13	27.9	8.7	-43.2	-34.5	-20.0	14.5
156	1404	H	13	28.2	9.7	-43.1	-33.4	-20.0	13.4
156	1560	H	13	29.4	9.0	-38.2	-29.2	-20.0	9.2
156	156	V	44	39.0	5.3	-48.7	-43.4	-20.0	23.4
156	312.4	V	44	30.6	6.3	-52.9	-46.6	-20.0	26.6
156	467.9	V	44	28.2	6.3	-50.7	-44.4	-20.0	24.4
156	623.9	V	44	27.1	6.7	-49.4	-42.7	-20.0	22.7
156	779.9	V	44	27.6	7.6	-47.0	-39.4	-20.0	19.4
156	935.9	V	44	30.6	7.1	-39.8	-32.7	-20.0	12.7
156	1092	V	13	29.4	7.7	-41.9	-34.2	-20.0	14.2
156	1248	V	13	32.4	8.7	-37.2	-28.6	-20.0	8.6
156	1404	V	13	28.2	9.7	-42.7	-33.0	-20.0	13.0
156	1560	V	13	29.3	9.0	-37.7	-28.6	-20.0	8.6
173	173	H	44	39.8	6.0	-49.1	-43.1	-20.0	23.1
173	346	H	44	30.2	5.9	-51.0	-45.1	-20.0	25.1
173	519	H	44	28.7	6.7	-48.9	-42.2	-20.0	22.2
173	692.1	H	44	22.3	6.5	-52.2	-45.6	-20.0	25.6
173	865.1	H	44	22.2	6.5	-49.4	-42.9	-20.0	22.9
173	1038.1	H	13	23.7	6.7	-44.9	-38.2	-20.0	18.2
173	1211.2	H	13	23.3	8.8	-47.5	-38.7	-20.0	18.7
173	1380	H	13	22.7	9.5	-47.3	-37.8	-20.0	17.8
173	1384.2	H	13	23.3	9.6	-47.3	-37.7	-20.0	17.7
173	1557.3	H	13	19.0	9.0	-48.1	-39.1	-20.0	19.1
173	1730	H	13	25.0	9.1	-42.0	-32.9	-20.0	12.9
173	173	V	44	43.2	6.0	-45.9	-39.9	-20.0	19.9
173	346	V	44	27.8	5.9	-52.2	-46.3	-20.0	26.3
173	518.9	V	44	24.0	6.7	-54.9	-48.1	-20.0	28.1
173	691.9	V	44	23.5	6.5	-49.7	-43.2	-20.0	23.2
173	865.1	V	44	22	6.5	-50.0	-43.5	-20.0	23.5
173	1037.8	V	13	24.9	6.7	-43.5	-36.8	-20.0	16.8
173	1211.2	V	13	23.3	8.8	-47.3	-38.5	-20.0	18.5
173	1384.2	V	13	23.0	9.6	-47.2	-37.6	-20.0	17.6
173	1730.3	V	13	21.2	9.1	-45.9	-36.8	-20.0	16.8

Judgment: Passed by 8.7 dB
Tested by: Joseph Strzelecki

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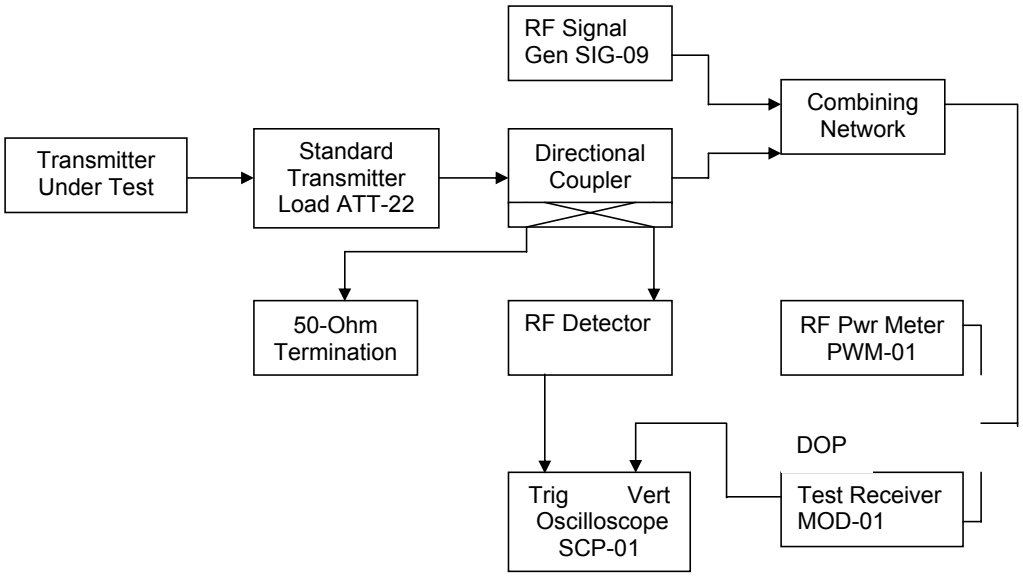
10.6 Transient Frequency Behavior

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.

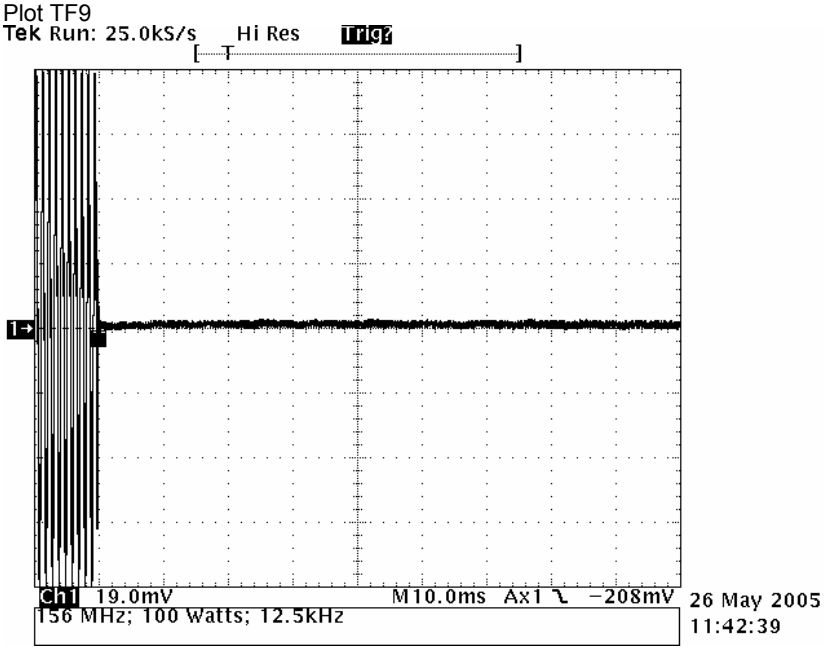


10.6.2 Test Results

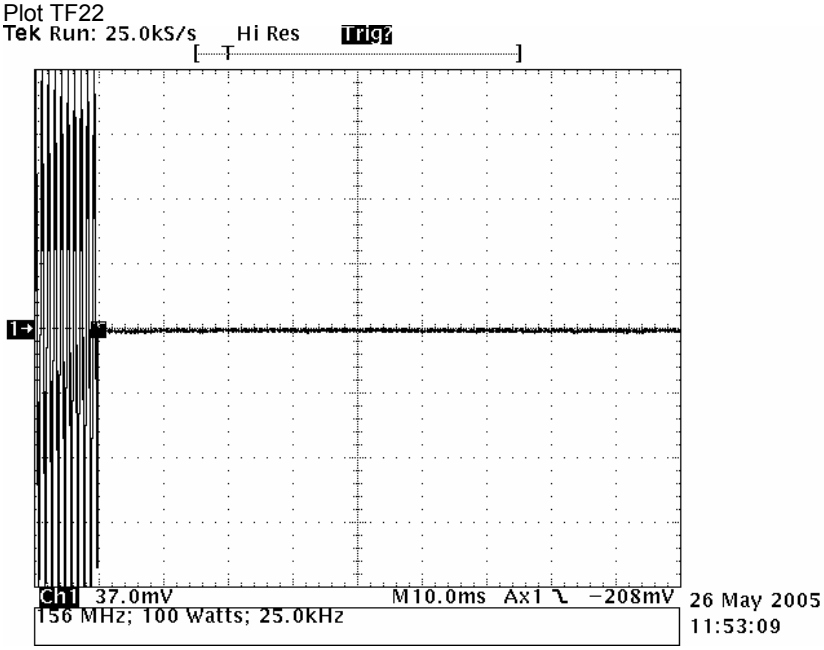
Freq MHz	Power Watts	Channel BW	On Plot	Off Plot	Limits for Time interval/Freq difference						Test Result
					t1		t2		t3		
					mSec	kHz	mSec	kHz	mSec	kHz	
156	100	25	TF22	TF23	10	25	25	12.5	10	25	Pass
156	200	25	TF21	TF24	10	25	25	12.5	10	25	Pass
156	100	12.5	TF19	TF18	10	12.5	25	6.25	10	12.5	Pass
156	200	12.5	TF20	TF17	10	12.5	25	6.25	10	12.5	Pass
173	100	25	TF1	TF25	10	25	25	12.5	10	25	Pass
173	200	25	TF4	TF26	10	25	25	12.5	10	25	Pass
173	100	12.5	TF6	TF27	10	12.5	25	6.25	10	12.5	Pass
173	200	12.5	TF5	TF28	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

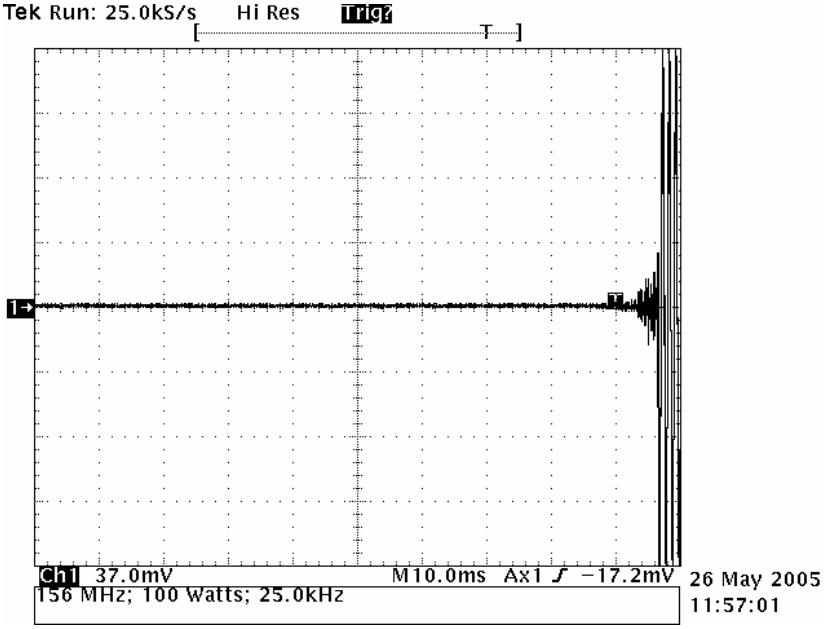
Plot TF9


Tek Run: 25.0kS/s Hi Res
Trig?
Ch1 19.0mV
M10.0ms Ax1 ↘ −208mV
156 MHz; 100 Watts; 12.5kHz
26 May 2005
11:42:39

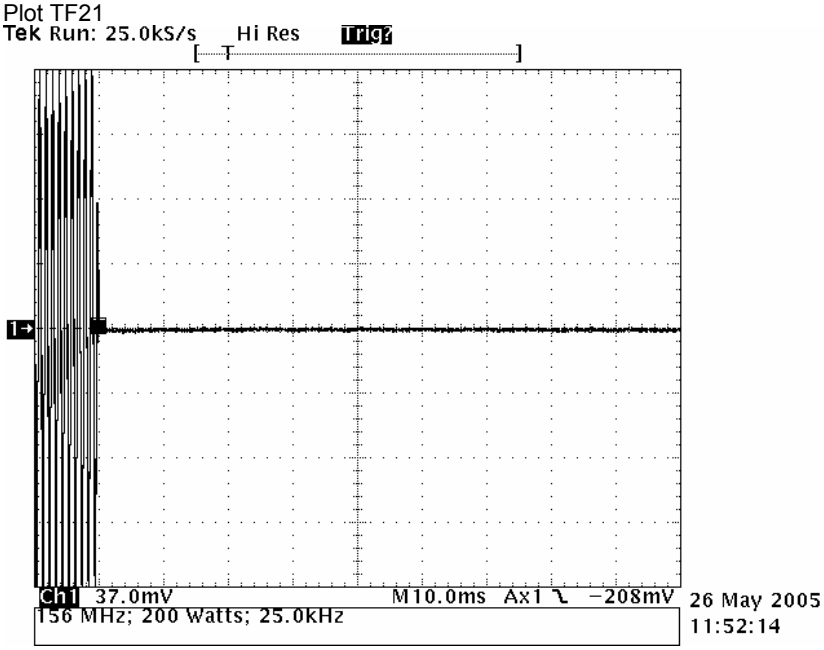
Plot TF22



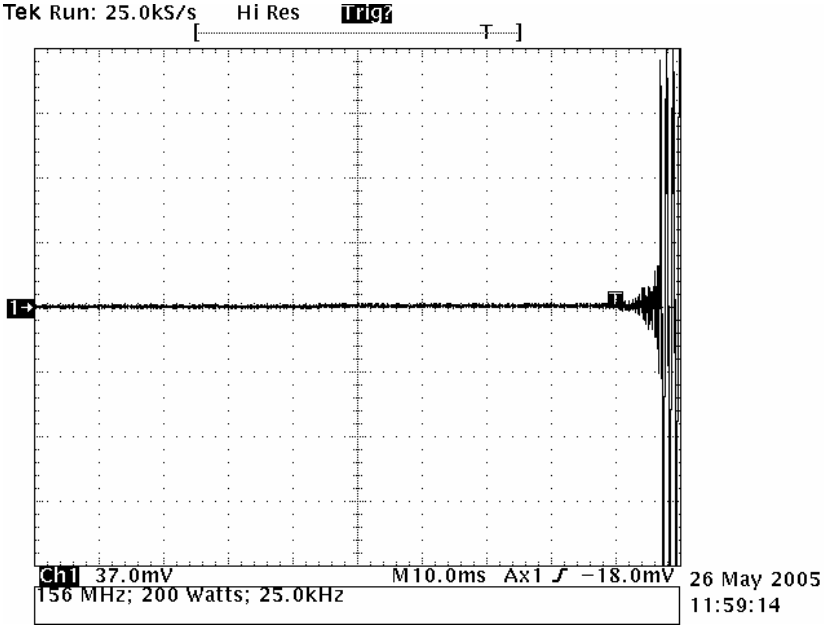
Plot TF23



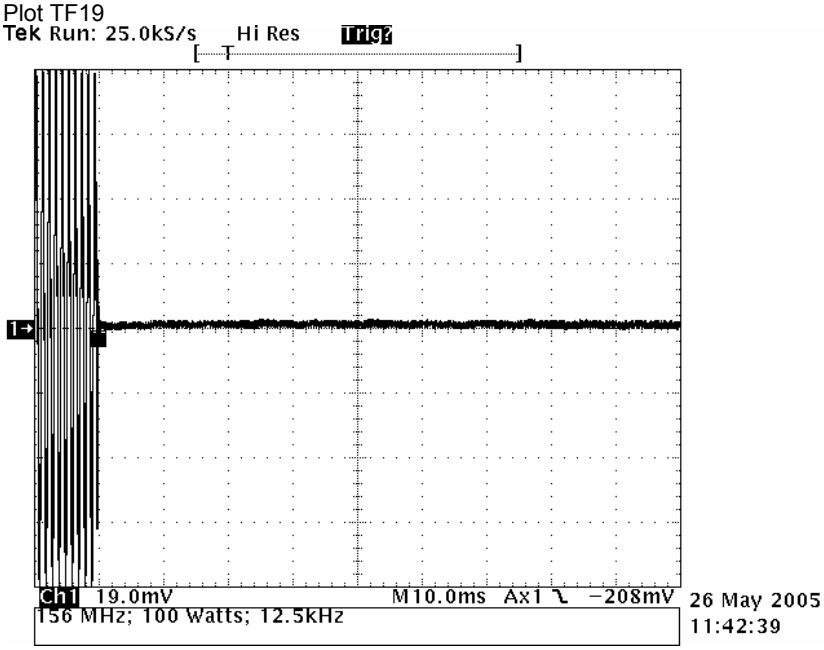
Plot TF21



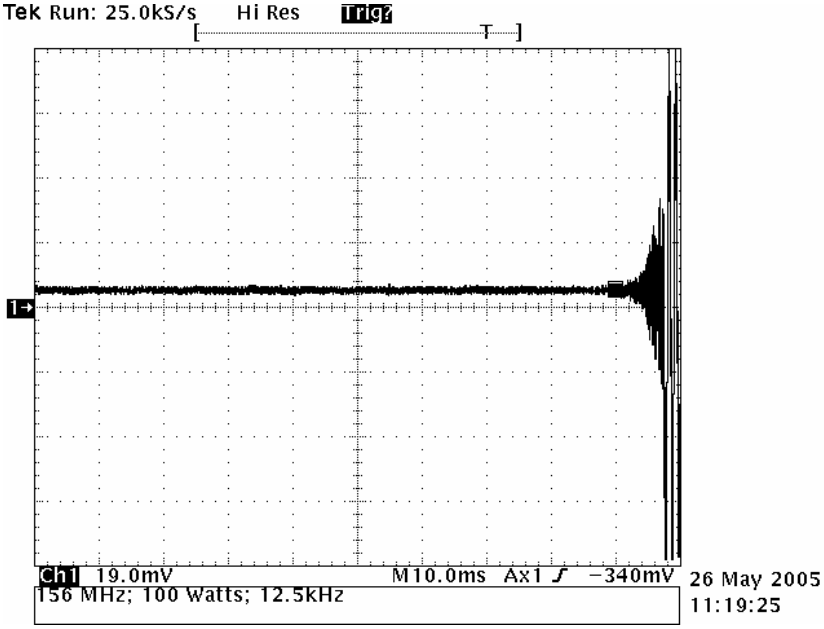
Plot TF24



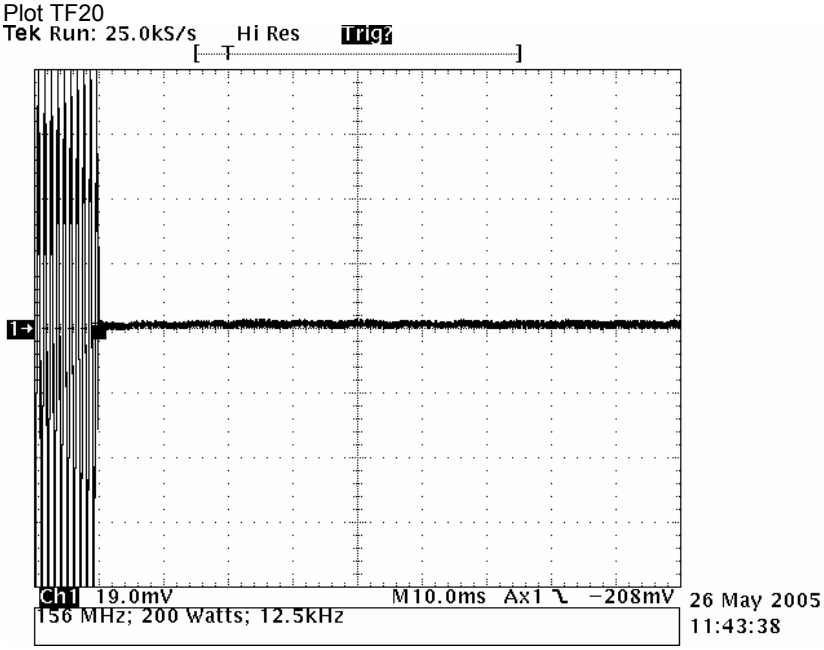
Plot TF19



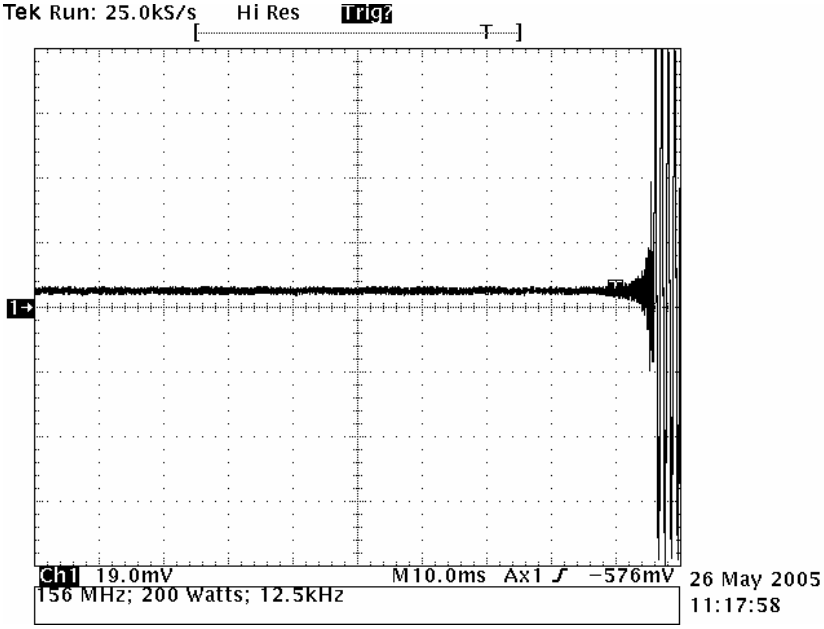
Plot TF18



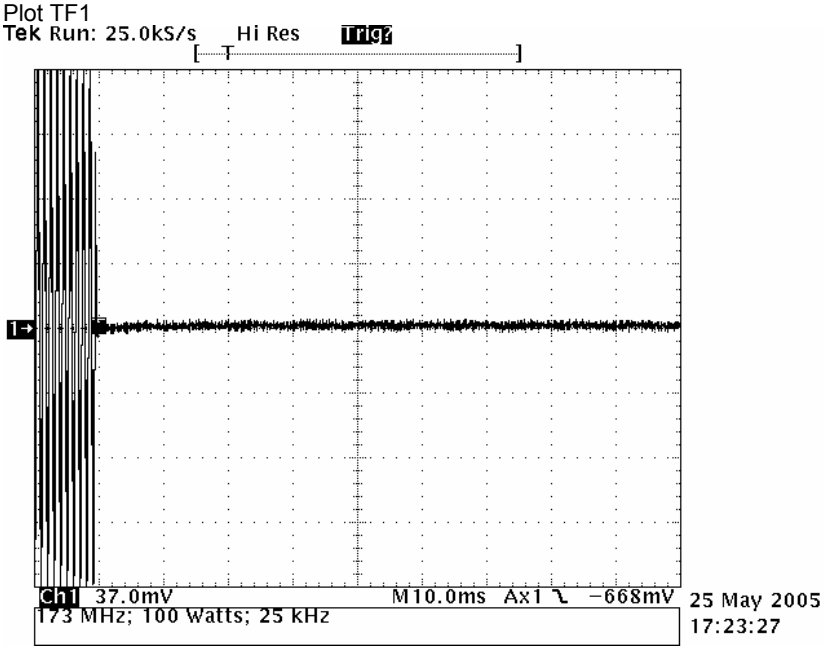
Plot TF20



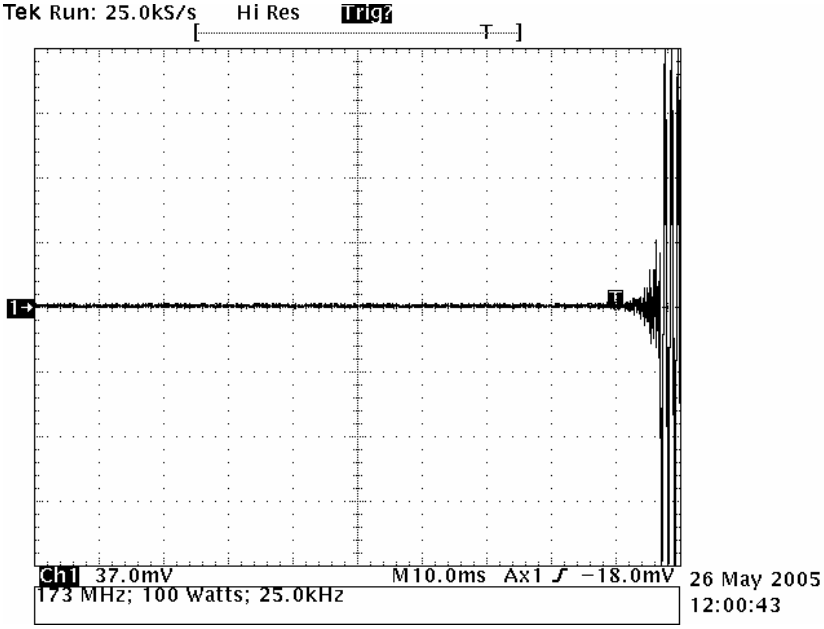
Plot TF17



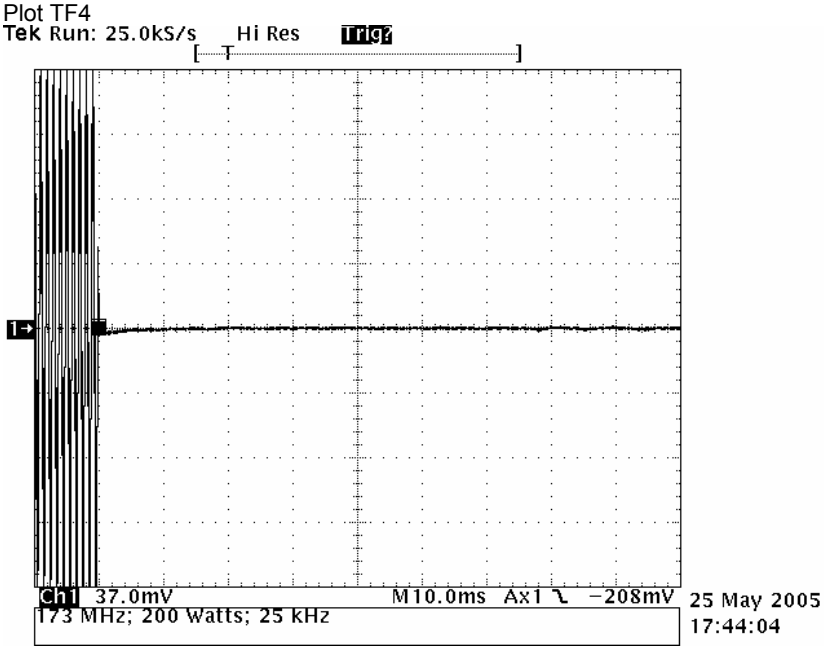
Plot TF1



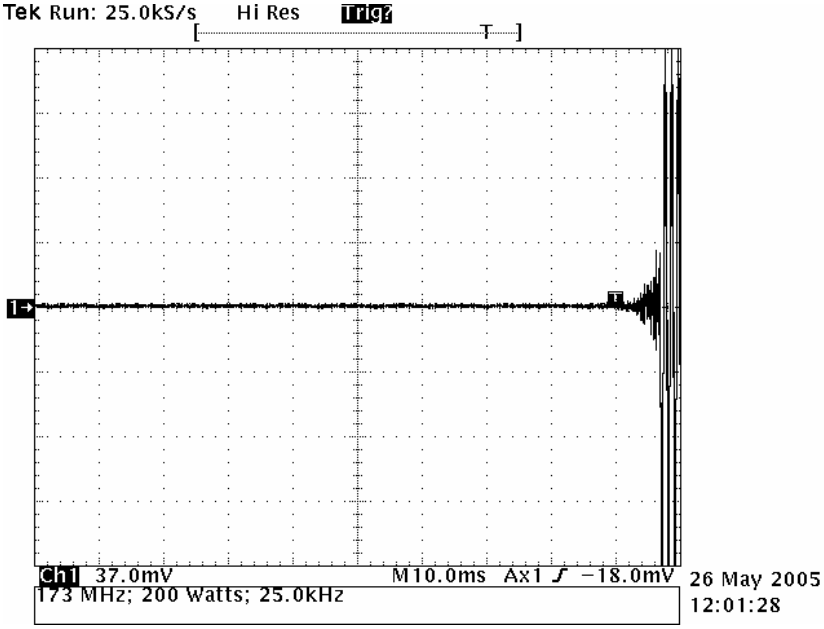
Plot TF25



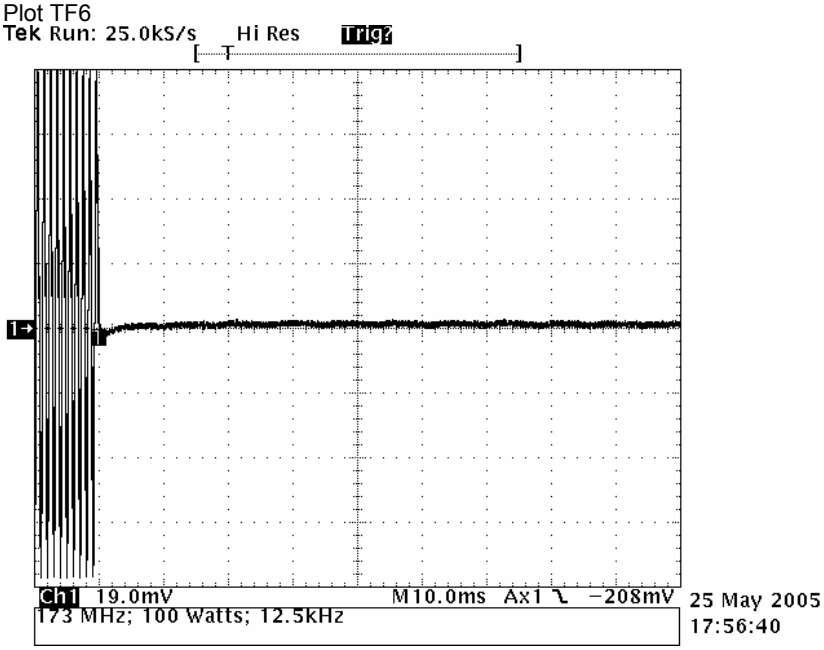
Plot TF4



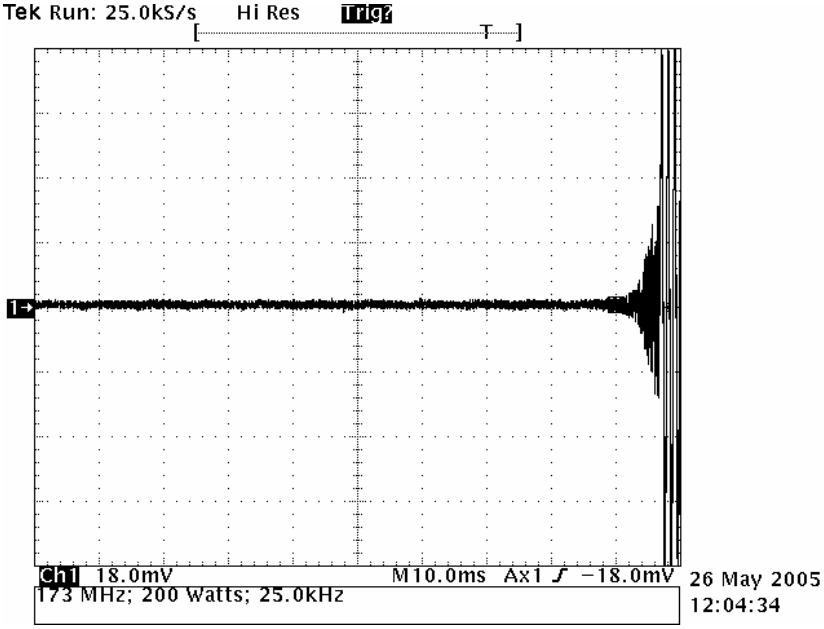
Plot TF26



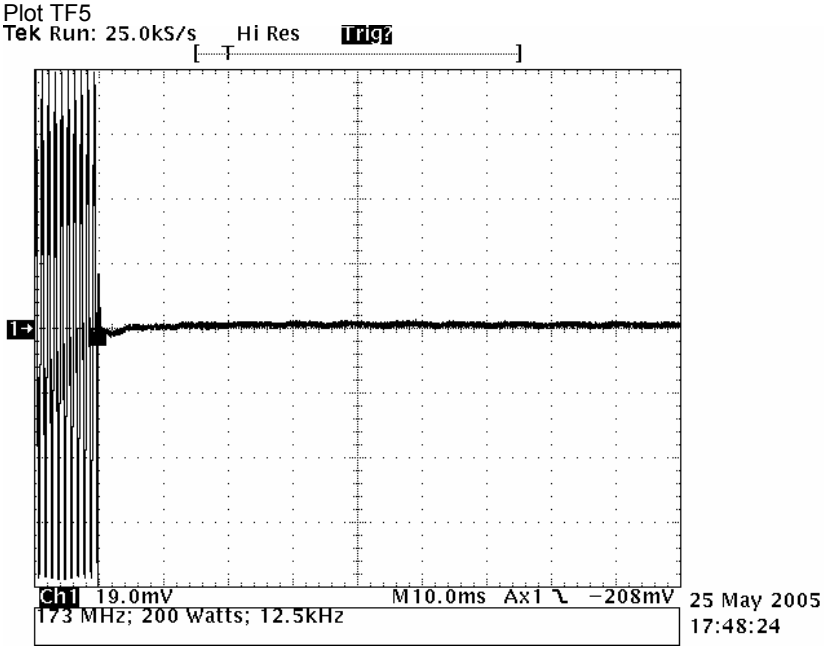
Plot TF6



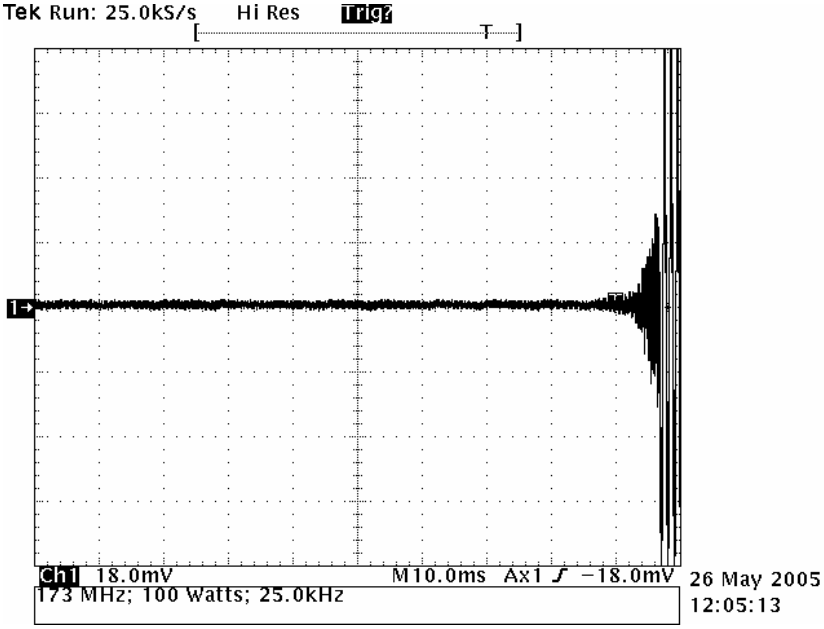
Plot TF27



Plot TF5



Plot TF28



EUT Freq MHz	Emission Freq. MHz	Meter Reading dBuV	Antenna		Cable Loss dB	Field Strength dBuV/m		Margin Under Limit dB
			Factor dB	Pol/ Type		EUT	Limit	
406	812	43.6	21.5	H/44	7.0	72.1	75.2	3.1
406	812	37.3	21.3	V/44	7.0	65.6	75.2	9.6
406	1218	40.3	24.6	H/13	2.7	67.6	75.2	7.6
406	1624	43.4	25.8	H/13	3.1	72.3	75.2	2.9
406	2842	33.9	29.6	H/13	4.2	67.7	75.2	7.5
406	3654	24.6	31.7	H/13	4.9	61.2	75.2	14.0
406	1218	38.6	24.6	V/13	2.7	65.9	75.2	9.3
406	1624	38.3	25.8	V/13	3.1	67.2	75.2	8.0
406	2842	27.9	29.6	V/13	4.2	61.7	75.2	13.5
406	4060	23.6	32.8	V/13	5.1	61.5	75.2	13.7
457	914	25.2	23	H/44	7.4	55.6	75.2	19.6
457	914	22.3	22.7	V/44	7.4	52.4	75.2	22.8
457	1371	38.1	24.9	H/13	2.8	65.8	75.2	9.4
457	1828	20.6	26.7	H/13	3.4	50.7	75.2	24.5
457	2742	21	29.3	H/13	4.2	54.5	75.2	20.7
457	4113	21.2	32.9	H/13	5.2	59.3	75.2	15.9
457	1371	40.4	24.9	V/13	2.8	68.1	75.2	7.1
457	1828	21.6	26.7	V/13	3.4	51.7	75.2	23.5
457	3656	26.7	31.7	V/13	4.9	63.3	75.2	11.9
457	4113	25.3	32.9	V/13	5.2	63.4	75.2	11.8
457	4570	21.7	33.2	V/13	5.6	60.5	75.2	14.7
470	230.1	24	11.9	H/44	3.4	39.3	75.2	35.9
470	258.8	26.5	12.7	H/44	3.6	42.8	75.2	32.4
470	940	26.6	23	H/44	7.6	57.2	75.2	18.0
470	82.8	22.8	6.9	V/44	2.0	31.7	75.2	43.5
470	940	24.9	22.2	V/44	7.6	54.7	75.2	20.5
470	1410	39.7	25	H/13	2.9	67.6	75.2	7.6
470	1880	22.6	26.9	H/13	3.4	52.9	75.2	22.3
470	4230	24.5	33	H/13	5.3	62.8	75.2	12.4
470	1408	37	25	V/13	2.9	64.9	75.2	10.3
470	1870	37.4	26.9	V/13	3.4	67.7	75.2	7.5
470	2350	20.2	28.3	V/13	3.8	52.3	75.2	22.9
470	2820	20.2	29.5	V/13	4.2	53.9	75.2	21.3
470	3285	27.4	30.7	V/13	4.6	62.7	75.2	12.5
470	3753	29.2	32	V/13	4.9	66.1	75.2	9.1
470	4700	24.7	33.3	V/13	5.5	63.5	75.2	11.7