TIMCO ENGINEERING INC.
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Newberry, Florida 32669
http://www.timcoengr.com
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Test Report

FCC RULES PART 87 AND PART 90

Product Name: PORTABLE TRANSCEIVER

FCC ID: K6610623X20

Applicant:

VERTEX STANDARD CO., LTD.
4-8-8 NAKAMEGURO, MEGURO-KU
TOKYO, 153-8644
JAPAN

Date Receipt: AUGUST 25, 2004

Date Tested: SEPTEMBER 17, 2004

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APPLICANT: VERTEX STANDARD CO., LTD.

FCC ID: K6610623X20

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TEST REPORT:

EXHIBITS CONTAINING:

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GENERAL INFORMATION REQUIRED
FOR TYPE ACCEPTANCE

2.1033(c)(1)(2) VERTEX STANDARD CO., LTD. will manufacture the FCCID: K6610623X20 VHF TRANSCEIVER in quantity, for use under FCC RULES PART 90 and FCC RULES PART 87, AERONAUTICAL GROUND STATION.

VERTEX STANDARD CO., LTD.
4-8-8 NAKAMEGURO, MEGURO-KU
TOKYO, 153-8644 JAPAN

2.1033(c) **TECHNICAL DESCRIPTION**

2.1033(c)(3) Instruction book. A draft copy of the instruction manual is included in the exhibits.

Necessary Bandwidth Calculations:

2.1033(c)(4) 87.137 Type of Emission: 6K00A3E (amplitude modulation)

Bn = 2M + 2DK
M = 3000
D = 0
Bn = 2(3000) + 2(0) = 6k

Authorized Bandwidth = 6.25 kHz.

2.1033(c) (4) 90.209 Type of Emission: 11K0F3E

Bn = 2M + 2DK
M = 3000
D = 2500
Bn = 2(3000) + 2(2500) = 11 kHz

90.217 (b) Authorized Bandwidth 12.5 kHz

2.1033(c) (4) 90.209 Type of Emission: 16K0F3E

Bn = 2M + 2DK
M = 3000
D = 5000
Bn = 2(3000) + 2(5000) = 16 kHz

90.217 (b) Authorized Bandwidth 25 kHz

2.1033(c)(5) Frequency Range: 118-136.975 MHz
151.5125-158.4 MHz

2.1033(c)(6)(7) 90.205 Power Output shall not exceed 59 Watts into a 50 ohm resistive load. There are no user power controls.

2.1033(c)(8) DC Voltages and Current into Final Amplifier:
POWER INPUT:

FINAL AMPLIFIER ONLY

High	Low
Vce = 7.2 VDC	Vce = 7.2 VDC
Ice = .890 A.	Ice = .410 A.
Pin = 6.408 Watts	Pin = 2.952 Watts

2.1033(c)(9) Tune-up procedure. The tune-up procedure is included in the exhibits.

2.1033(c)(10) Complete Circuit Diagrams: The circuit diagram and block diagram are included in the exhibits.

(11) Function of each electron tube or semiconductor device or other active circuit device are included in the exhibits.

(12) Description of all circuitry and devices provided for determining and stabilizing frequency is included in the circuit description in the instruction manual.

2.1033(c)(13) A photograph or drawing of the equipment identification label is shown in the exhibits.

2.1033(c)(14) Photographs of the equipment of sufficient clarity to reveal equipment construction and layout and label location are shown in the exhibits.

2.1033(c)(15) Digital Modulation is not allowed

2.1033(c)(16) The data required for 2.1046 through 2.1057 is submitted below.

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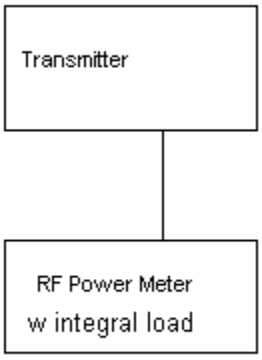
2.1046(a) **RF POWER OUTPUT**

RF power is measured by connecting a 50-ohm, resistive wattmeter to the RF output connector. With a nominal battery voltage of 7.2 VDC, and the transmitter properly adjusted the RF output measures:

OUTPUT POWER: HIGH – 2.0 Watts (FM)
LOW - 0.3 Watts (FM)
- 1.5 Watts (AM)



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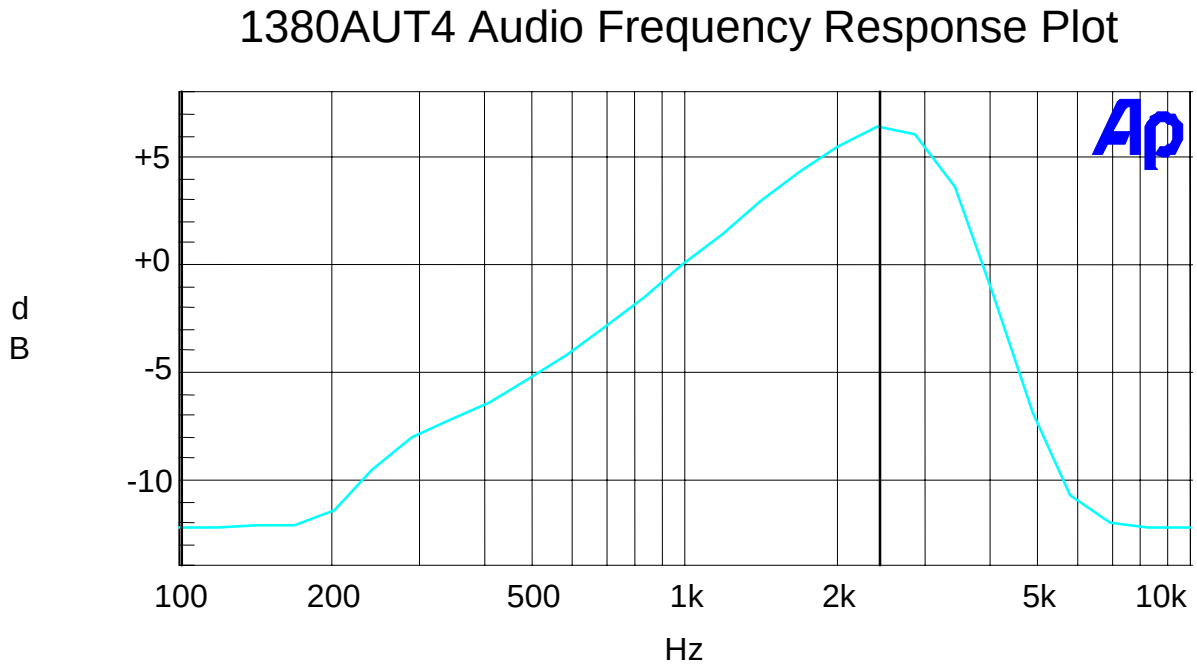
2.1047(a)(b) **Modulation characteristics:**

AUDIO FREQUENCY RESPONSE

The audio frequency response was measured in accordance with TIA/EIA Specification 603. The audio frequency response curve is shown below. The audio signal was fed into a dummy microphone circuit and into the microphone connector. The input required to produce 30 percent modulation level was measured.



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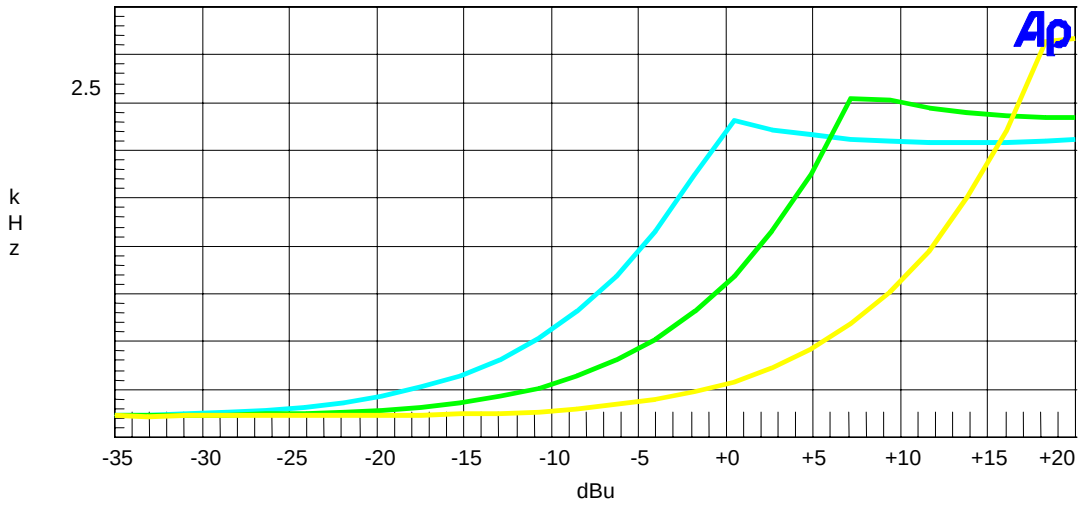
2.1047(b) **Audio input versus modulation**

The audio input level needed for a particular percentage of modulation was measured in accordance with TIA/EIA Specification 603. The audio input curves versus modulation are shown below. Curves are provided for audio input frequencies of 300, 1000, and 2500 Hz.

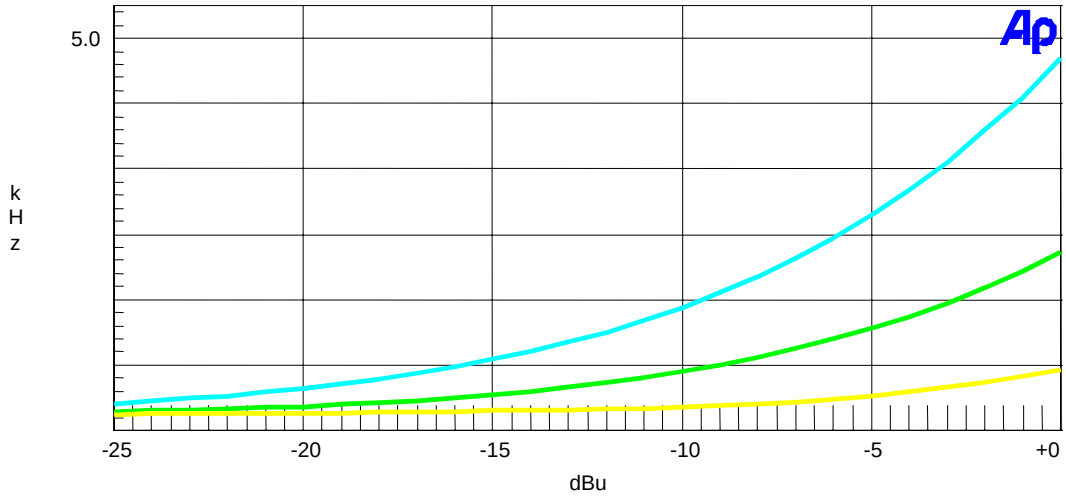
blue2.5k green1k yellow300hz

1380AUT4 Modulation Limiting Plot Narrow 12.5k



Blue 2.5k, green 1k, yellow 300hz

1380AUT4 Modulation Limiting plot Wide 25k



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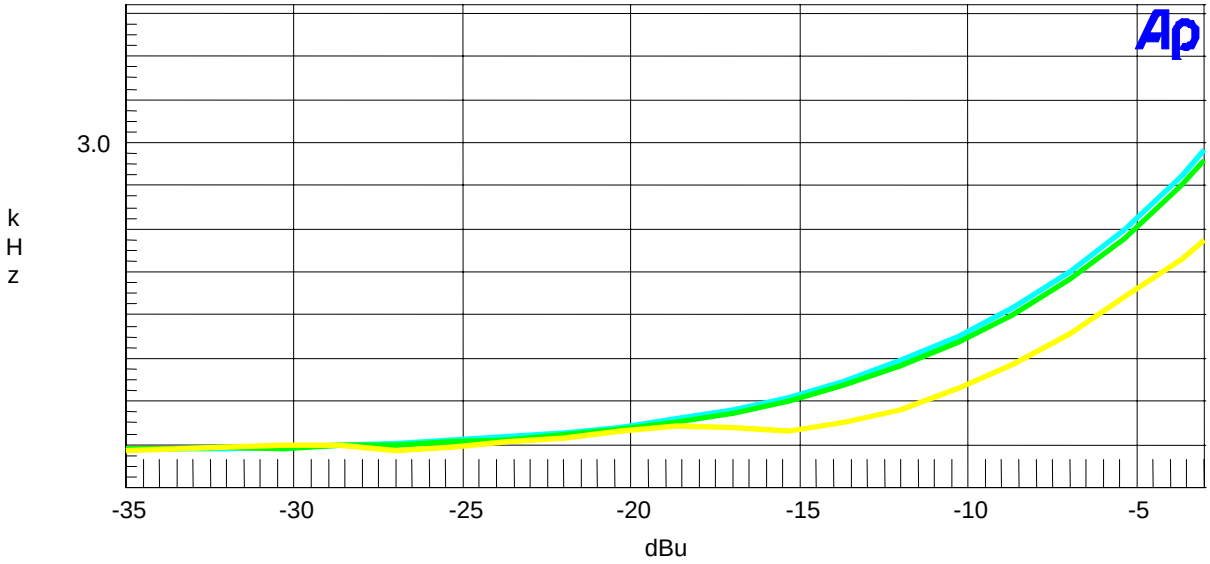
2.1047
87.141

Modulation Characteristics:

The transmitter audio circuitry is contained in the audio processing board and is controlled by that assembly dependent upon which combination of modulation. The audio frequency response was measured in accordance with TIA/EIA Specification 603 Paragraph 2.2.6.

blue2.5k green1k yellow300hz

1380BUT4 Modulation Limiting AM



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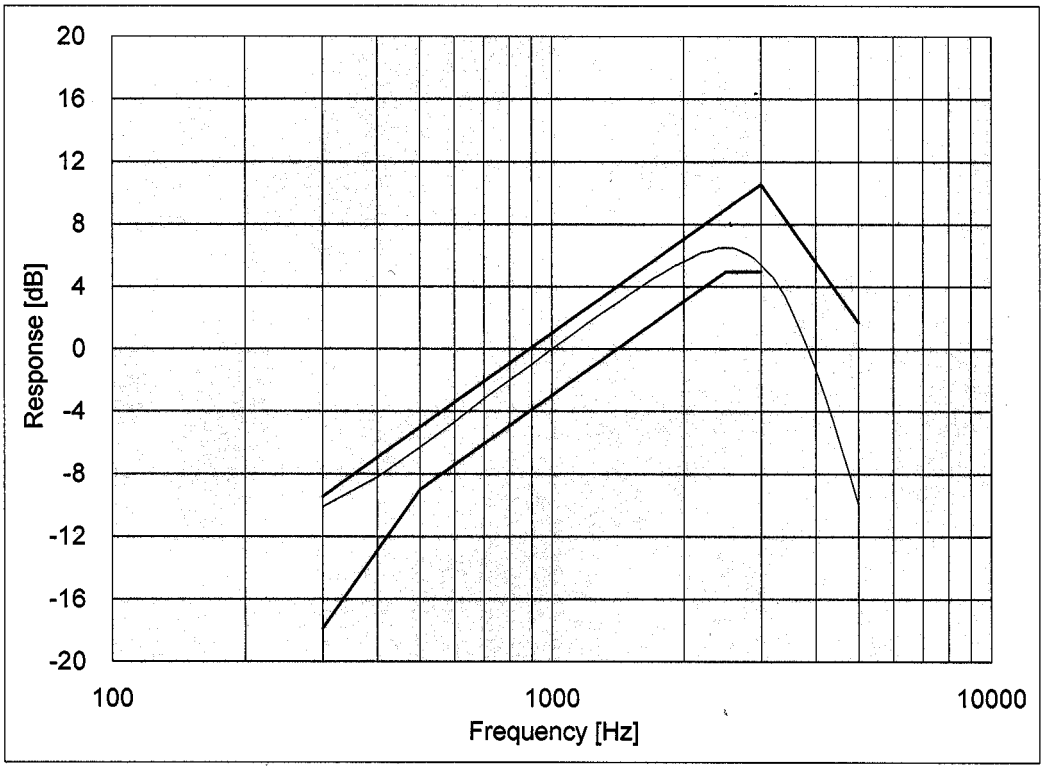
2.1047(a) **Post Limiter Filter**

The filter must be between the modulation limiter and the modulated stage. At any frequency between 3 & 20 kHz the filter must have an attenuation of 60log (f/3) greater that the attenuation at 1KHz. See the plot below.

AUDIO LOW PASS FILTER

NAME OF TEST: Audio Frequency Response

STATE: 0 : General



2.1049 Occupied bandwidth:

90.210(b) Emission Mask B – 20 kHz channel bandwidth equipment. Data in the plots show that on any frequency removed from the assigned frequency by more than 50%, but not more than 100%: At least 25dB. On any frequency removed from the assigned frequency by more than 100%, but not more than 250%: At least 35 dB. On any frequency removed from the assigned frequency by more than 250%, of the authorized bandwidth: At least 43 + 10log(P)dB.

90.210(d) Emission Mask D - 12.5 kHz channel bandwidth equipment. For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

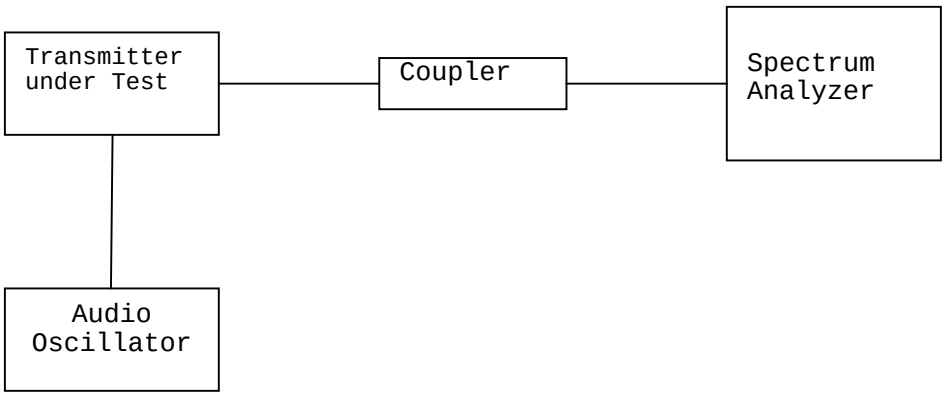
(1) On any frequency from the center of the authorized bandwidth f0 to 5.625 kHz removed from f0: Zero dB.
(2) On any frequency from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least 7.27 (fd - 2.88 kHz) dB.
(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 12.5 kHz: At least 50 + 10log(P) dB or 70 dB, whichever is the lesser attenuation.

Radiotelephone Transmitter with Modulation Limiter

Test procedure: TIA/EIA-603 para 2.2.11, with the exception that various tones were used.

Test procedure diagram

OCCUPIED BANDWIDTH MEASUREMENT



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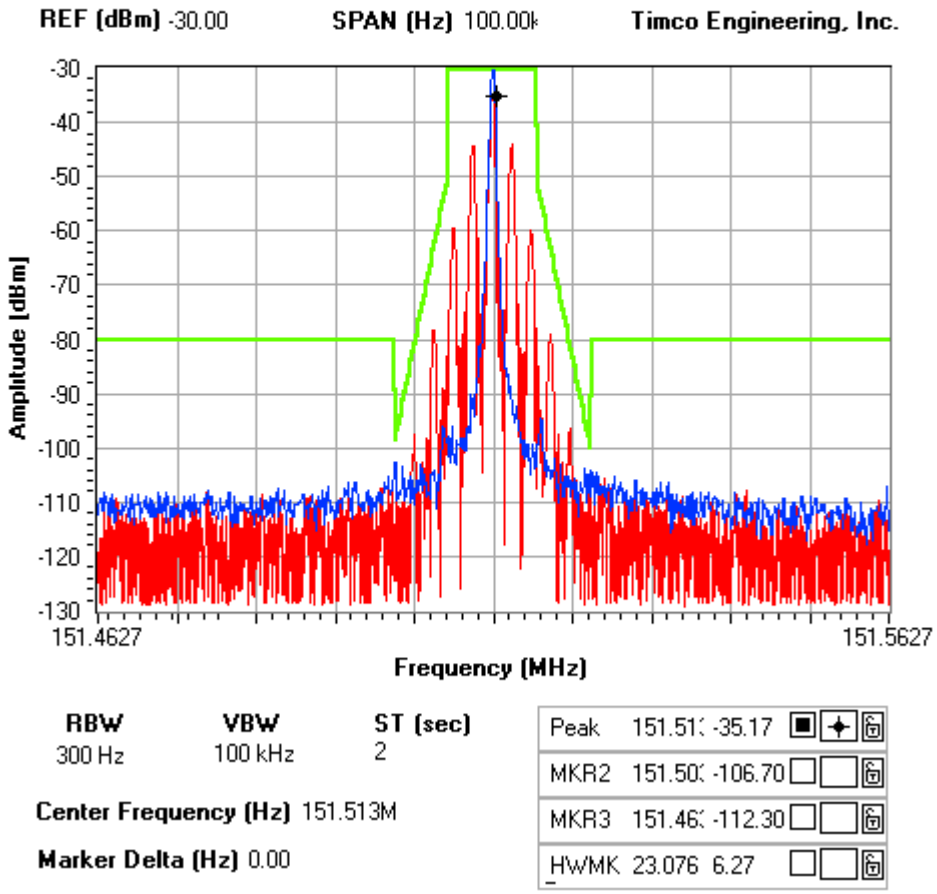
OCCUPIED BANDWIDTH PLOT
NARROW BAND

NOTES:
1380aut4 occupied bw 12.5k

FCC 90.210 Mask D



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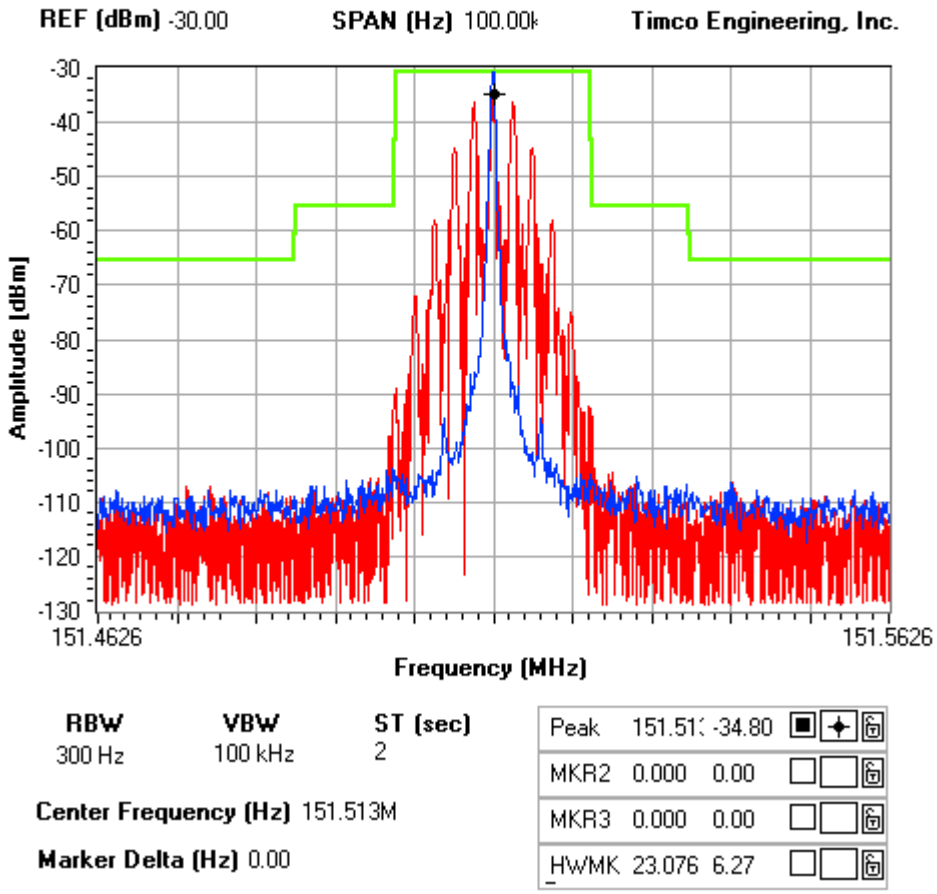
OCCUPIED BANDWIDTH
WIDE BAND

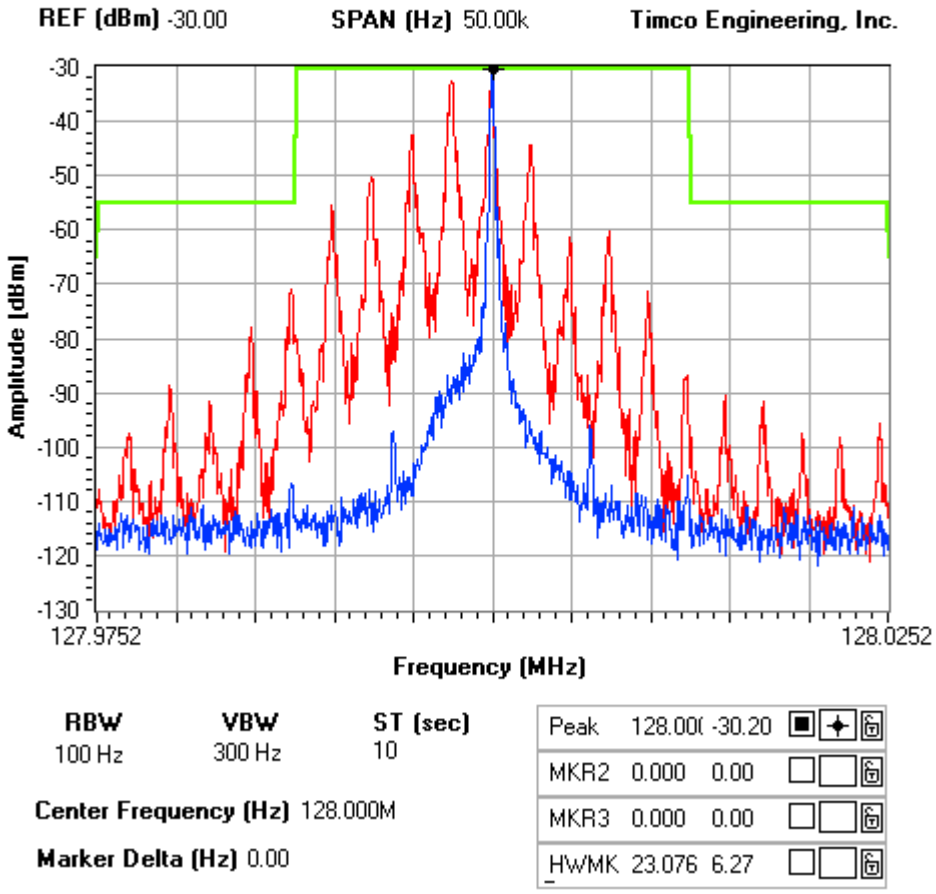
NOTES:
1380aut4 occupied bw 25k

FCC 90.210 Mask B



NOTES:
1380aut4 occupied bandwidth am

FCC 90.210 Mask B



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2.1051 **Spurious emissions at antenna terminals (conducted):**

Data below shows the level of conducted spurious responses. The carrier was modulated 100% using a 2500 Hz tone. The spectrum was scanned from 0.4 to at least the 10th harmonic of the fundamental. The measurements were made in accordance with standard TIA/EIA-603.

HIGH: 50 + 10log(2.0) = 53.01
LOW: 50 + 10log(0.3) = 44.77

TF HIGH POWER	EF	dB below carrier	TF LOW POWER	EF	dB below carrier
151.5	151.5	0.0	151.5	151.5	0.0
	303.0	74.0		303.0	73.3
	454.5	77.4		454.5	78.5
	606.0	98.1		606.0	104.8
	757.5	92.6		757.5	90.7
	909.0	102.5		909.0	105.8
	1060.5	105.0		1060.5	99.2
	1212.0	112.6		1212.0	108.0
	1363.5	114.2		1363.5	106.7
	1515.0	114.9		1515.0	107.1

TF HIGH POWER	EF	dB below carrier	TF LOW POWER	EF	dB below carrier
158.4	158.4	0.0	158.4	158.4	0.0
	316.8	71.8		316.8	71.5
	475.2	76.7		475.2	79.2
	633.6	102.6		633.6	92.2
	792.0	94.9		792.0	93.5
	950.4	103.6		950.4	107.1
	1108.8	105.7		1108.8	104.4
	1267.2	111.6		1267.2	108.4
	1425.6	113.5		1425.6	107.9
	1584.0	108.5		1584.0	108.5

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2.1052 **Spurious emissions at antenna terminals (conducted):**

Data below shows the level of conducted spurious responses. The carrier was modulated 100% using a 2500 Hz tone. The spectrum was scanned from 0.4 to at least the 10th harmonic of the fundamental. The measurements were made in accordance with standard TIA/EIA-603.

REQUIREMENTS: Emissions must be 43 + 10log(Po) dB below the mean power output of the transmitter.

43 + 10 log(1.5) = 44.76 dB

TF	EF	dB below carrier	TF	EF	dB below carrier
118	118	0.0	136.9	136.9	0.0
	236	73.3		273.8	72.1
	354	75.8		410.7	80.9
	472	83.7		547.6	92.2
	590	96.6		684.5	91.5
	708	92.5		821.4	100.4
	826	97.2		958.3	109.6
	944	101.7		1095.2	104.8
	1062	100.4		1232.1	118.3
	1180	111.4		1369.0	118.2

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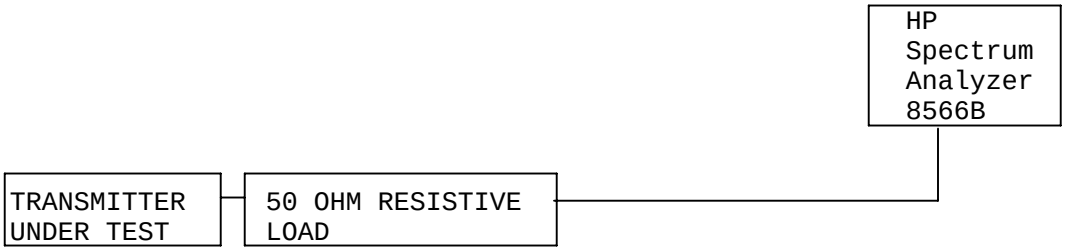
Method of Measuring Conducted Spurious Emissions



METHOD OF MEASUREMENT: The procedure used was TIA/EIA-603 STANDARD without any exceptions. An audio generator was connected to the UUT through a dummy microphone circuit and the output of the transmitter connected to a standard load and from the standard load through a pre-selector filter of the spectrum analyzer. The spectrum was scanned from 400 kHz to at least the tenth harmonic of the fundamental using a HP model 8566B spectrum analyzer. The measurements were made using the shielded room located at TIMCO ENGINEERING INC. 849 N.W. State Road 45, Newberry, Florida 32669.

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2.1053 **Field strength of spurious emissions:**

NAME OF TEST: **RADIATED SPURIOUS EMISSIONS (151.5 MHz)**

REQUIREMENTS: Emissions must be 50 + 10log(Po) dB below the mean power output of the transmitter.

HIGH: 50 + 10log(2.0) = 53.01
LOW: 50 + 10log(0.3) = 44.77

TEST DATA (HIGH):

Emission Frequency MHz	Ant. Polarity	Corrected EUT Signal Reading	Coax Loss (dB)	Substitution Antenna (dBd)	dB Below Carrier (dBc)
151.50	V	23.70	0	-0.39	0
303.00	V	-41.10	0	-1.32	65.73
454.50	H	-48.70	0	-0.47	72.48
606.00	H	-65.90	0	-0.4	89.61
757.50	V	-53.90	0	-0.67	77.88
909.00	V	-60.70	0	-0.66	84.67
1060.50	V	-62.50	1.01	3.19	83.63
1212.00	V	-58.30	1.04	3.8	78.85
1363.50	V	-52.90	1.07	4.4	72.88
1515.00	V	-61.60	1.1	4.96	81.05

TEST DATA (LOW):

Emission Frequency MHz	Ant. Polarity	Corrected EUT Signal Reading	Coax Loss (dB)	Substitution Antenna (dBd)	dB Below Carrier (dBc)
151.50	V	15.90	0	-0.39	0
303.00	V	-52.90	0	-1.32	69.73
454.50	H	-57.10	0	-0.47	73.08
606.00	H	-71.80	0	-0.4	87.71
757.50	V	-61.10	0	-0.67	77.28
1060.50	V	-63.70	1.01	3.19	77.03
1363.50	V	-54.80	1.07	4.4	66.98
1515.00	V	-64.60	1.1	4.96	76.25

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2.1053 **Field strength of spurious emissions:**

NAME OF TEST: **RADIATED SPURIOUS EMISSIONS (158.4 MHz)**

REQUIREMENTS: Emissions must be 50 + 10log(Po) dB below the mean power output of the transmitter.

HIGH: 50 + 10log(2.0) = 53.01
LOW: 50 + 10log(0.3) = 44.77

TEST DATA (HIGH):

Emission Frequency MHz	Ant. Polarity	Corrected EUT Signal Reading	Coax Loss (dB)	Substitution Antenna (dBd)	dB Below Carrier (dBc)
158.40	V	24.20	0	-0.18	0
316.80	V	-32.80	0	-1.25	58.07
475.20	H	-50.70	0	-0.55	75.27
633.60	H	-55.30	0	-0.22	79.54
792.00	H	-61.30	0	-1.22	86.54
950.40	V	-57.30	0	-1.15	82.47
1108.80	V	-65.20	1.02	3.39	86.85
1425.60	V	-56.40	1.09	4.65	76.86

TEST DATA (LOW):

Emission Frequency MHz	Ant. Polarity	Corrected EUT Signal Reading	Coax Loss (dB)	Substitution Antenna (dBd)	dB Below Carrier (dBc)
158.40	V	14.70	0	-0.18	0
316.80	H	-47.00	0	-1.25	62.77
475.20	V	-56.90	0	-0.55	71.97
633.60	H	-63.70	0	-0.22	78.44
950.40	V	-57.70	0	-1.15	73.37

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2.1053 **Field strength of spurious emissions:**

NAME OF TEST: **RADIATED SPURIOUS EMISSIONS (118.00 MHz)**

REQUIREMENTS: Emissions must be 43 + 10log(Po) dB below the mean power output of the transmitter.

43 + 10 log(1.5) = 44.76 dB

TEST DATA:

Emission Frequency MHz	Ant. Polarity	Corrected EUT Signal Reading	Coax Loss (dB)	Substitution Antenna (dBd)	dB Below Carrier (dBc)
118.00	V	23.70	0	-0.41	0
236.00	H	-52.50	0	-1.15	76.94
354.00	V	-54.50	0	-1.15	78.94
472.00	H	-49.90	0	-0.54	73.73
590.00	V	-65.70	0	-0.45	89.44
708.00	H	-58.40	0	0.05	81.64
826.00	H	-62.80	0	-1.14	87.23

TEST DATA:

Emission Frequency MHz	Ant. Polarity	Corrected EUT Signal Reading	Coax Loss (dB)	Substitution Antenna (dBd)	dB Below Carrier (dBc)
136.90	V	14.10	0	-0.55	0
274.00	V	-46.40	0	-1.15	61.1
410.90	V	-45.30	0	-0.39	59.24
547.90	H	-50.40	0	-0.55	64.5
684.90	V	-55.30	0	-0.09	68.94
821.90	V	-58.70	0	-1.17	73.42
958.90	V	-56.60	0	-1.26	71.41
1095.90	V	-60.60	1.02	3.33	71.84
1232.90	V	-60.60	1.05	3.88	71.32
1369.90	H	-53.00	1.07	4.43	63.19

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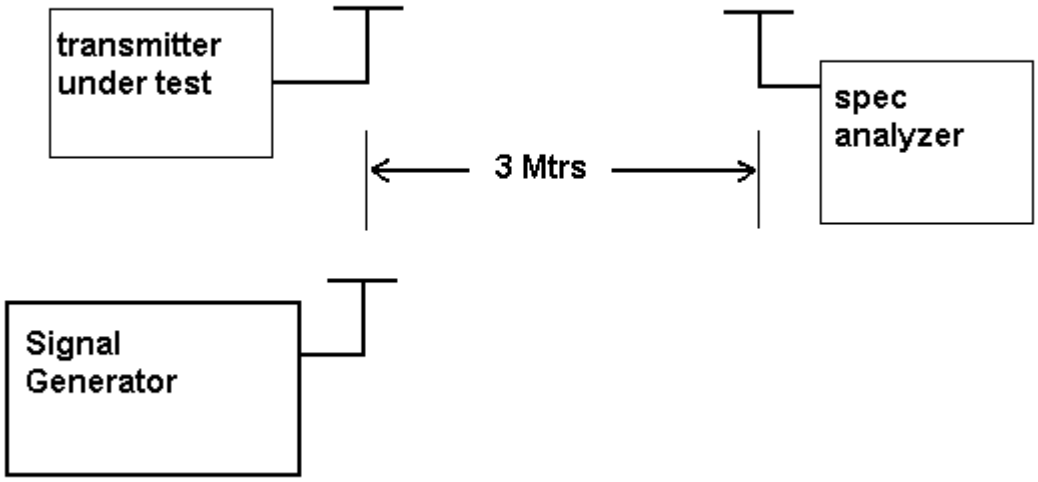
Method of Measuring Radiated Spurious Emissions



METHOD OF MEASUREMENTS: The tabulated data shows the results of the radiated field strength emissions test. The spectrum was scanned from 30 MHz to at least the tenth harmonic of the fundamental. This test was conducted per TIA/EIA STANDARD 603 using the substitution method. Measurements were made at the open field test site of TIMCO ENGINEERING, INC. located at 849 NW State Road 45, Newberry, FL 32669.

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2.1055 90.213(a)(1) Frequency stability:

Temperature and voltage tests were performed to verify that the frequency remains within the .0005%, 5-ppm specification limit. The EUT was placed in the temperature chamber at 25º C and allowed to stabilize for one hour. The transmitter was keyed ON for one minute during which four frequency readings were recorded at 15-second intervals. The worse case number was taken for temperature plotting. The assigned channel frequency was considered to be the reference frequency. The temperature was then reduced to -30º C after which the transmitter was again allowed to stabilize for one hour. The transmitter was keyed ON for one minute, and again frequency readings were noted at 15-second intervals. The worst-case number was recorded for temperature plotting. This procedure was repeated in 10 degree increments up to + 50º C.

Readings were also taken at minus 15% of the battery voltage of 7.2 VDC, which we estimate to be the battery endpoint.

MEASUREMENT DATA:

Assigned Frequency (Ref. Frequency): 154.600 147 MHz

TEMPERATURE_°C	FREQUENCY_MHz	PPM
REFERENCE	154.600 147	0.00
-30	154.600 09	- 0.37
-20	154.600 165	+ 0.12
-10	154.600 374	+ 1.47
0	154.600 321	+ 1.13
+10	154.600 295	+ 0.96
+20	154.600 147	0.00
+30	154.599 973	- 1.13
+40	154.599 858	- 1.87
+50	154.599 902	- 1.58

BATT	%BATT. DATA	VOLTS	BATT. PPM
-15%	154.600 142	6.12	- 0.03

RESULTS OF MEASUREMENTS: The test results indicates that the EUT meets the requirements.

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2.1055
87.133

Frequency stability:

Temperature and voltage tests were performed to verify that the frequency remains within the .0020%,(20 ppm)(87.133) specification limit.

The test was conducted as follows: The transmitter was placed in the temperature chamber at 25° C and allowed to stabilize for one hour. The transmitter was keyed ON for one minute during which four frequency readings were recorded at 15 second intervals. The worse case number was taken for temperature plotting. The assigned channel frequency was considered to be the reference frequency. The temperature was then reduced to -30° C after which the transmitter was again allowed to stabilize for one hour. The transmitter was keyed ON for one minute, and again frequency readings were noted at 15 second intervals. The worst case number was recorded for temperature plotting. This procedure was repeated in 10° increments up to + 50 degrees C.

MEASUREMENT DATA:

Assigned Frequency (Ref. Frequency): 128.000 121 MHz

TEMPERATURE°C	FREQUENCY MHz	PPM
REFERENCE	128.000 121	00.00
-30	127.999 988	- 1.04
-20	128.000 113	- 0.06
-10	128.000 311	+ 1.48
0	128.000 271	+ 1.17
+10	128.000 251	+ 1.02
+20	128.000 121	0.00
+30	128.999 981	- 1.09
+40	128.999 892	- 1.79
+50	128.999 918	- 1.59

BATT	VOLTS	%BATT. DATA	BATT. PPM
-15%	6.29	128.000 115	- 0.05

RESULTS OF MEASUREMENTS: The test results indicates that the EUT meets the requirements.

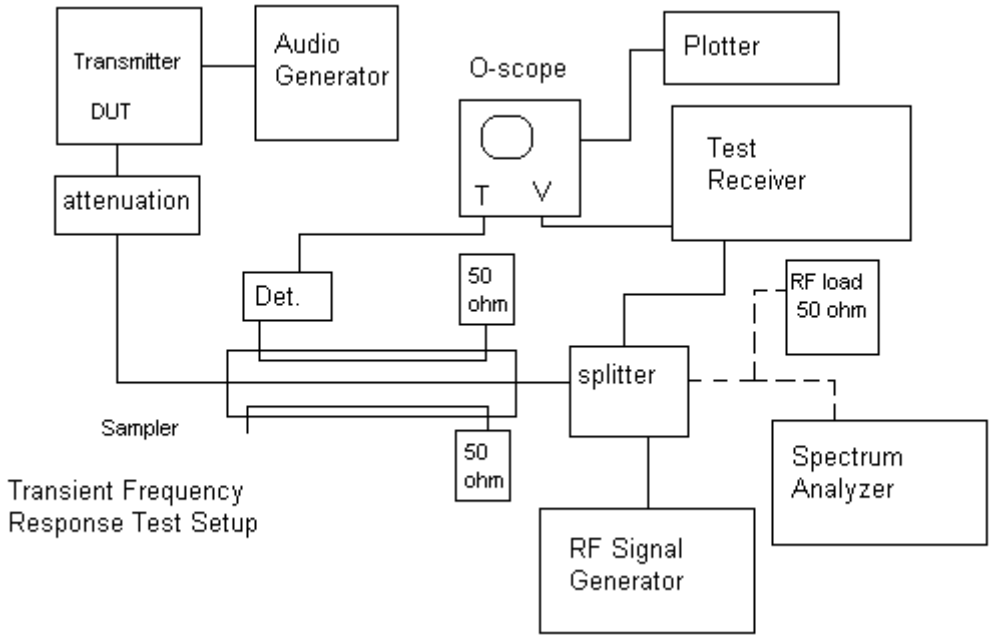
2.1055(a)(1) Frequency stability:
90.214 Transient Frequency Behavior

REQUIREMENTS: Transmitters designed to operate in the 150-174 MHz and 421-512 MHz frequency bands must maintain transient frequencies within the maximum transient frequencies within the maximum frequency difference limits during the time intervals indicated:

Time Intervals	Maximum frequency difference	All Equipment	
		150-174 MHz	421-512 MHz
Transient Frequency Behavior for Equipment Designed to Operate on 25 kHz Channels			
t_1[4]	±25.0 kHz	5.0 mS	10.0 mS
t_2	±12.5 kHz	20.0 mS	25.0 mS
t_3[4]	±25.0 kHz	5.0 mS	10.0 mS
Transient Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels			
t_1[4]	±12.5 kHz	5.0 mS	10.0 mS
t_2	±6.25 kHz	20.0 mS	25.0 mS
t_3[4]	±12.5 kHz	5.0 mS	10.0 mS
Transient Frequency Behavior for Equipment Designed to Operate on 6.25 kHz Channels			
t_1[4]	±6.25 kHz	5.0 mS	10.0 mS
t_2	±3.125 kHz	20.0 mS	25.0 mS
t_3[4]	±6.25 kHz	5.0 mS	10.0 mS

TEST PROCEEDURE: TIA/EIA TS603 PARA 2.2.19, the levels were set as follows;

1. Using the variable attenuator the transmitter level was set to 40 dB below the test receivers maximum input level, then the transmitter was turned off.
2. With the transmitter off the signal generator was set 20dB below the level of the transmitter in the above step, this level will be maintained with the signal generator through-out the test.
3. Reduce the attenuation between the transmitter and the RF detector by 30 dB.
4. With the levels set as above the transient frequency behavior was observed & recorded.



Transient Frequency Response Test Setup

TIMCO ENGINEERING INC.
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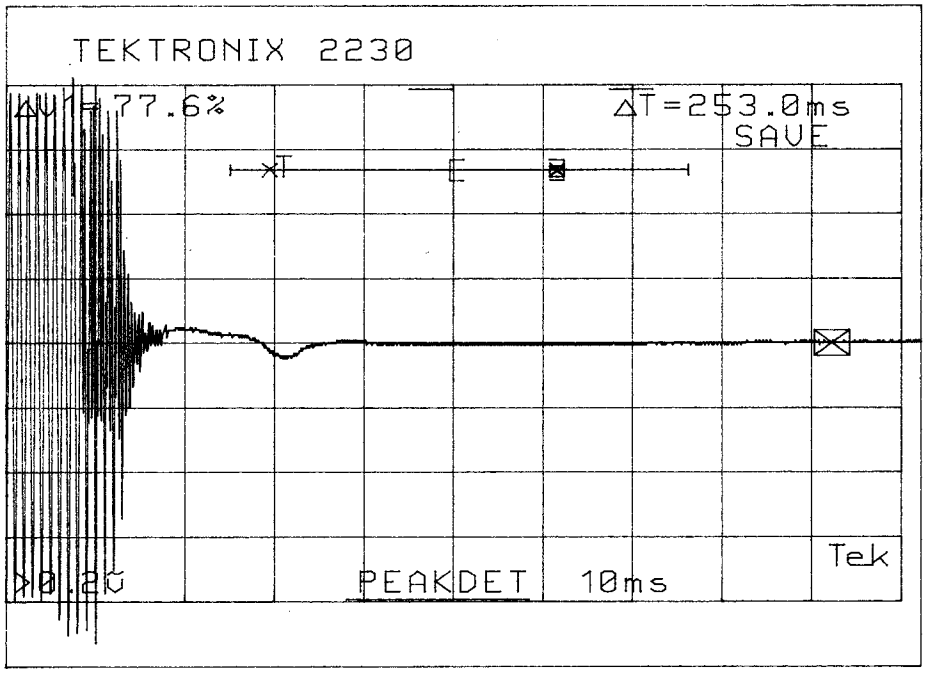
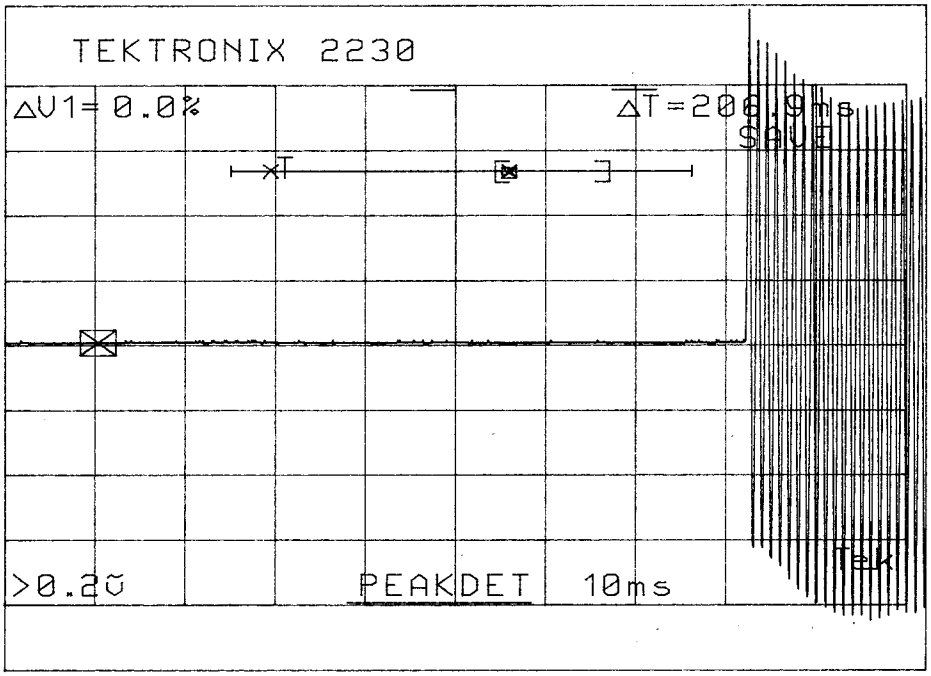
Newberry, Florida 32669
http://www.timcoengr.com
888.472.2424 F 352.472.2030 email: tei@timcoengr.com

TRANSIENT FREQUENCY RESPONSE
12.5 kHz – NARROW BAND
HIGH POWER





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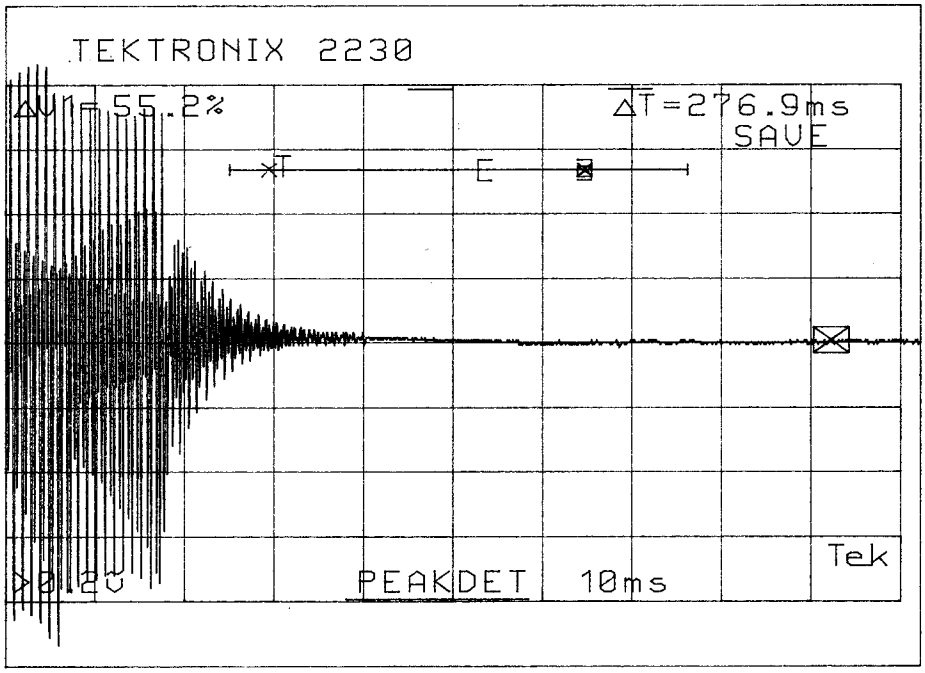
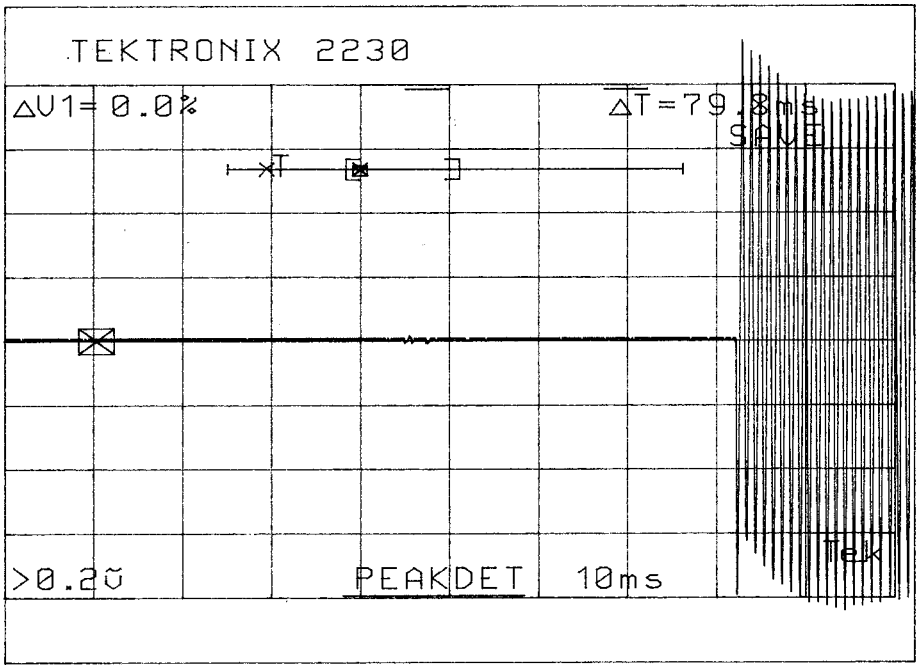
TRANSIENT FREQUENCY RESPONSE
12.5 kHz – NARROW BAND
LOW POWER





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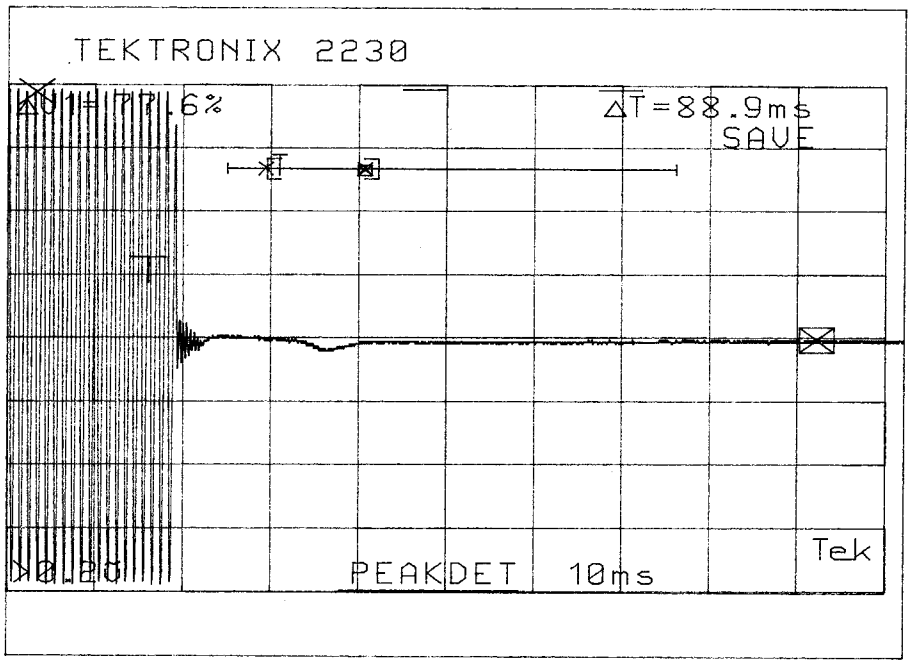
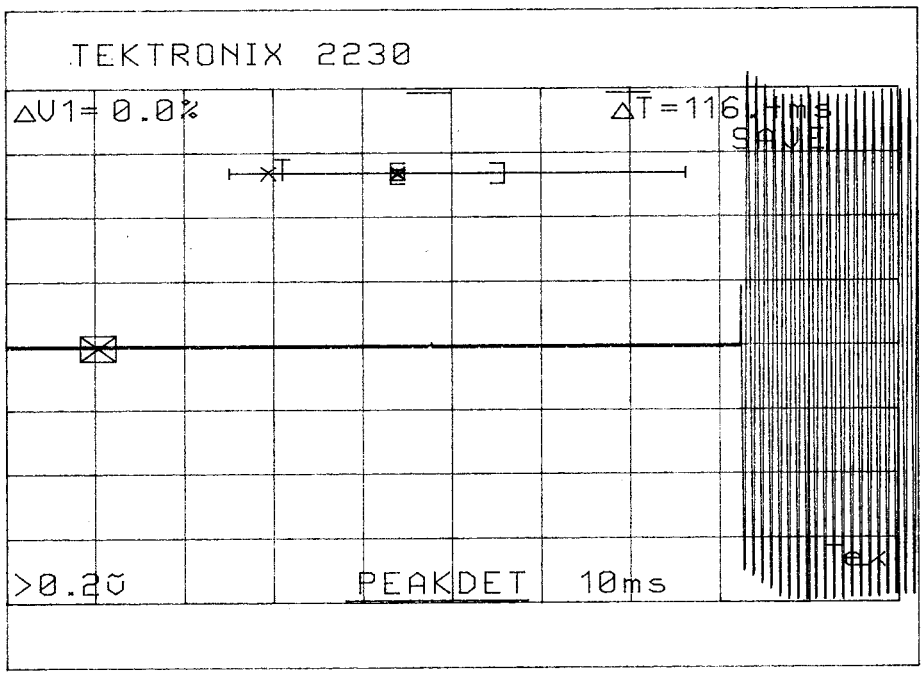
TRANSIENT FREQUENCY RESPONSE
25 kHz – WIDE BAND
HIGH POWER





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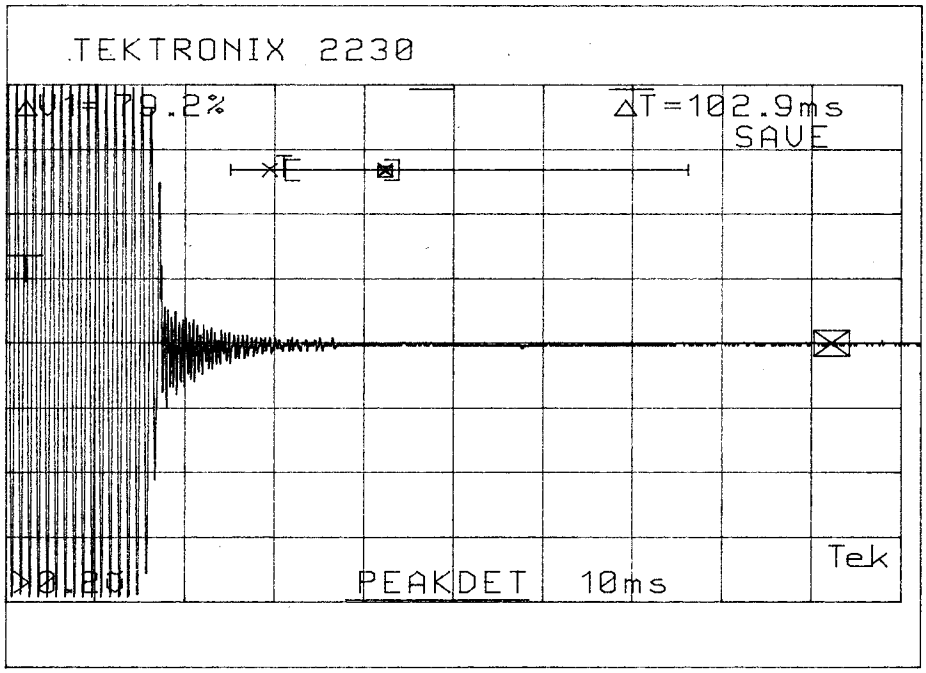
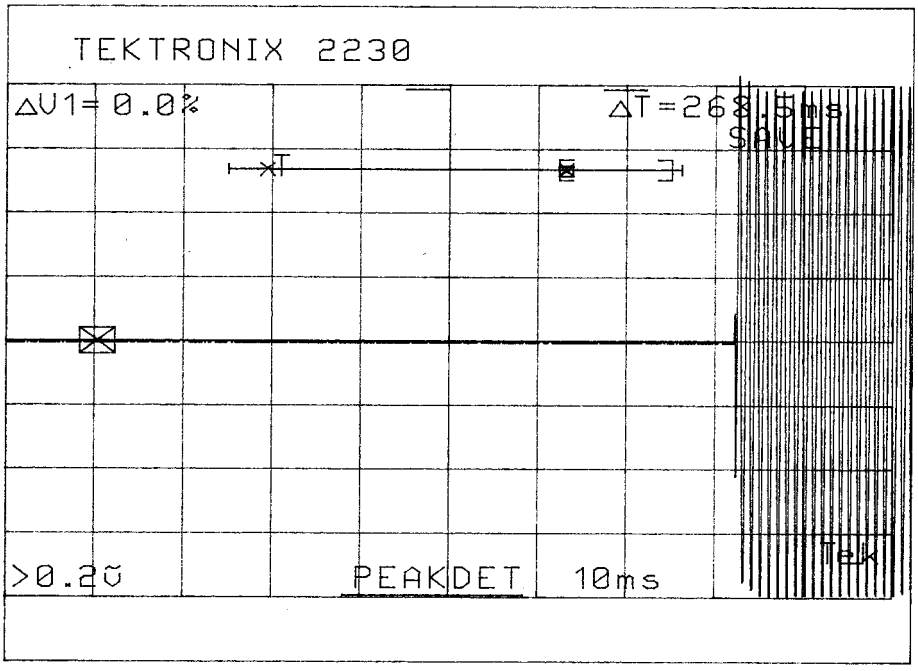
TRANSIENT FREQUENCY RESPONSE
25 kHz – WIDE BAND
LOW POWER





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EMC Equipment List

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
Tan Tower Spectrum Analyzer	HP	8566B Opt 462	3138A07786 3144A20661	CAL 9/23/03	9/23/05
Tan Tower RF Preselector	HP	85685A	3221A01400	CAL 9/23/03	9/23/05
Tan Tower Quasi-Peak Adapter	HP	85650A	3303A01690	CAL 9/23/03	9/23/05
Tan Tower Preamplifier	HP	8449B-H02	3008A00372	CAL 9/23/03	9/23/05
Biconnical Antenna	Electro-Metrics	BIA-25	1171	CAL 4/26/01	4/26/03
Log-Periodic Antenna	Electro-Metrics	LPA-25	1122	CAL 10/2/01	10/2/03
Double-Ridged Horn Antenna	Electro-Metrics	RGA-180	2319	CAL 2/17/03	2/17/05
LISN	Electro-Metrics	ANS-25/2	2604	CAL 10/9/01	10/9/03
Termaline Wattmeter	Bird Electronic Corporation	611	16405	out for cal	
Oscilloscope	Tektronix	2230	300572	CAL 7/3/03	7/3/05
System One	Audio Precision	System One	SYS1-45868	CHAR 4/25/02	4/25/04
Temperature Chamber	Tenney Engineering	TTRC	11717-7	CHAR 1/22/02	1/22/04
Digital Multimeter	Fluke	77	35053830	CHAR 1/8/02	1/8/04
Peak Power Meter	HP	8900C	2131A00545	CAL 7/2/03	7/2/05
Power Sensor	Agilent Technologies	84811A	2551A02705	CAL 7/2/03	7/2/05
Power Meter	HP	432A	1141A07655	CAL 4/15/03	4/15/05
Digital Thermometer	Fluke	2166A	42032	out for cal	
Frequency Counter	HP	5352B	2632A00165	CAL 8/3/04	8/3/06
Service Monitor	IFR	FM/AM 500A	5182	CAL 11/22/00	Out of Service
Signal Generator	HP	8640B	2308A21464	CAL 2/15/02	2/15/04
Modulation Analyzer	HP	8901A	3435A06868	CAL 9/5/01	9/5/03
Egg Timer	Unk			CHAR 2/1/02	2/1/04
Measuring Tape-20M	Kraftixx	0631-20		CHAR 2/1/02	2/1/04