TIMCO ENGINEERING INC.
849 NW State Road 45
Newberry, Florida 32669
http://www.timcoengr.com
888.472.2424 F 352.472.2030 email: sid@timcoengr.com

Test Report

Product Name: UHF TRANSCEIVER

FCC ID: MMA7150610D

Applicant:

MIDLAND RADIO CORPORATION
5900 PARRETTA DRIVE
KANSAS CITY MO 64120
USA

Date Receipt: 7/17/2006

Date Tested:8/14/2006

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APPLICANT: MIDLAND RADIO CORPORATION

FCC ID: MMA7150610D

TEST REPORT:

EXHIBITS CONTAING:

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GENERAL INFORMATION REQUIRED
FOR CERTIFICATION OF A LICENSED TRANSMITTER

Part 2.1033(c)(1)(2) MIDLAND RADIO CORPORATION will manufacture the FCCID: MMA7150610D UHF TRANSCEIVER in quantity, for use under FCC RULES PART 90.

Part 2.1033(c) TECHNICAL DESCRIPTION

Part 2.1033(c)(3) Instruction book. A draft copy of the instruction manual is included as an exhibit.

Part 2.1033(c) (4) Type of Emission: 10K6F3E
Part 90.209
Part 90.207

Bn = 2M + 2DK
M = 3000
D = 2300
Bn = 2(3000)+2(2300) = 10.6k narrow 12.5 kHz

Part 2.1033(c) (4) Type of Emission: 14K8F3E

Part 90.207

Bn = 2M + 2DK
M = 3000
D = 4400
Bn = 2(3000)+2(4400) = 14.8k wide 25 kHz

Part 2.1033(c)(5) Frequency Range: 440 - 475 MHz
Part 90.209 (b)(5)

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

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

FINAL AMPLIFIER ONLY
INPUT POWER – (13.6V)(4A) = 54 Watts

Part 2.1033(c)(9) **Tune-up procedure.** The tune-up procedure is included as an exhibit.

Part 2.1033(c)(10) **Complete Circuit Diagrams:** Circuit and block diagrams are included as exhibits.

Part 2.1033(c)(10): Description of all circuitry and devices provided for determining and stabilizing frequency is included in the circuit description.

Part 2.1033(c)(11): A photograph or drawing of the equipment identification label is included as an exhibit.

Part 2.1033(c)(12): Photographs of the equipment of sufficient clarity to reveal equipment construction and layout and label location are included as an exhibit.

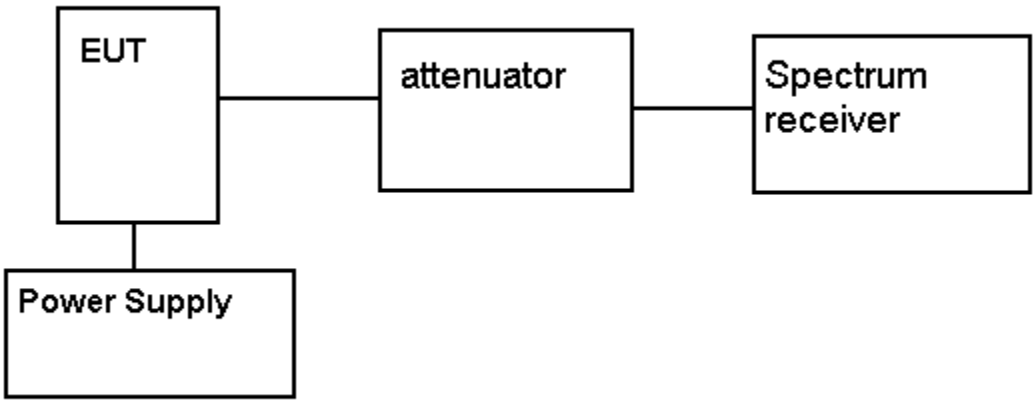
Part 2.1033(c)(13): For equipment employing digital modulation, a detailed description of the modulation technique. This UUT uses FSK to modulate the transmitter.

Part 2.1033(c)(14): The data required for 2.1046 through 2.1057 is submitted below.

Part 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, and the transmitter properly adjusted the RF output measures:

OUTPUT POWER: HIGH – 11 Watts
LOW - 6.5 Watts



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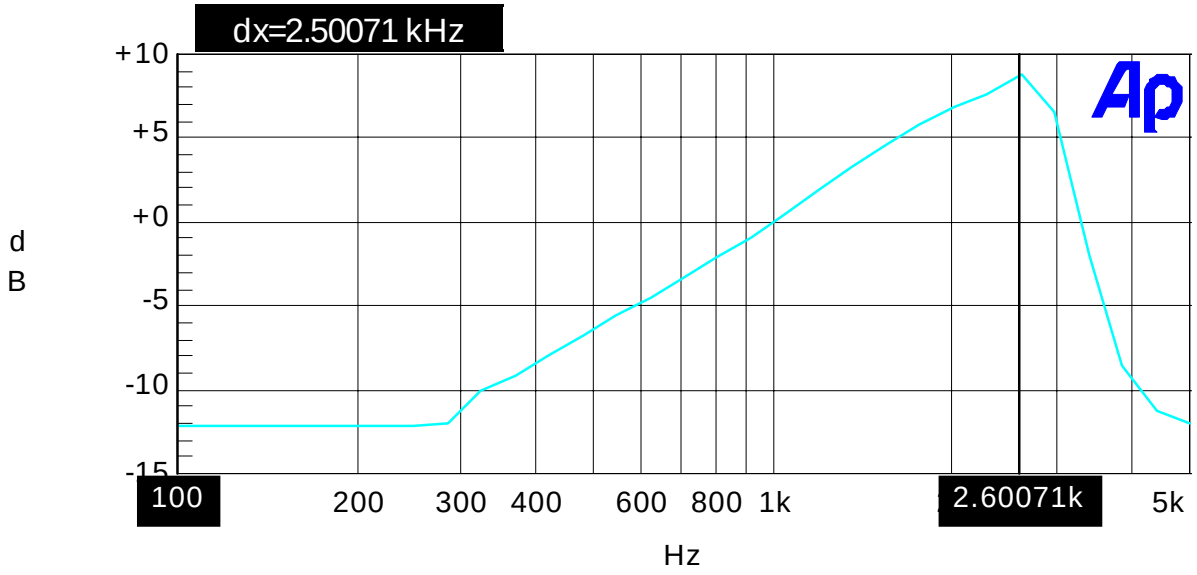
Part 2.1047(a)(b) **Modulation characteristics:**

AUDIO FREQUENCY RESPONSE

The audio frequency response was measured in accordance with TIA/EIA Specification 603. A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 – 5000Hz shall be submitted. The audio frequency response curve is shown below.

AUDIO FREQUENCY RESPONSE PLOT

2123AUT6 AUDIO FREQ RESPONCE PLOT 08/09/06 14:28:27



Color	Line Style	Thick	Data	Axis	Cursor1
Cyan	Solid	1	Anlr.Level A!Normalize	Left	..

MaxFreq.at1

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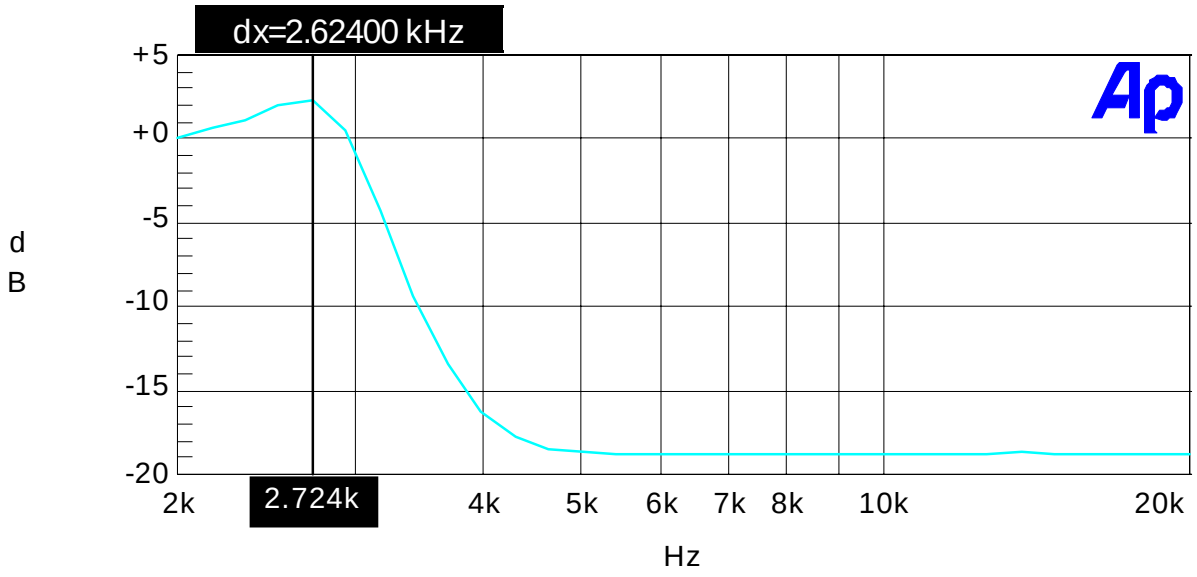
Part 2.1047(a) Voice modulated communication equipment: For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter, or of all the circuitry installed between the modulation limiter and the modulated stage shall be submitted.

AUDIO LOW PASS FILTER

2123AUT6 AUDIO LOW PASS FILTER PLOT 08/09/06 14:40:18



Color	Line Style	Thick	Data	Axis	Cursor1	Cursor2
Cyan	Solid	1	Anlr.Level A	Left	..	..

MaxFreq.at1

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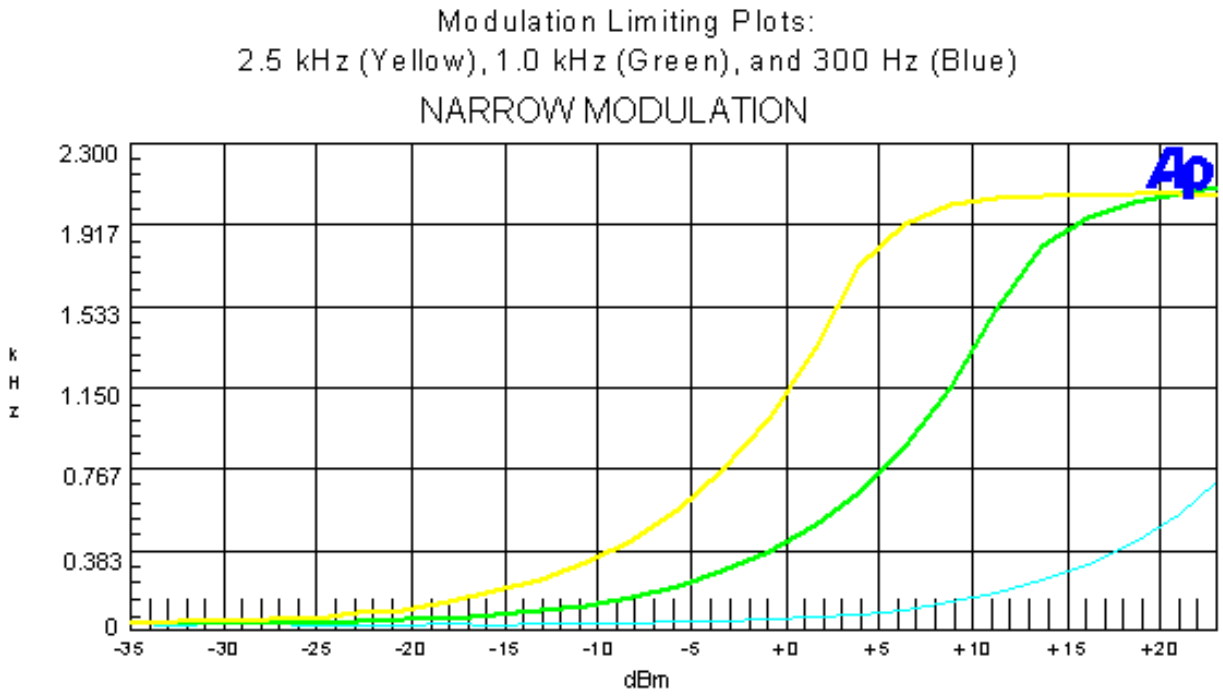
Part 2.1047(b) Audio input versus modulation

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.

MODULATION LIMITING PLOT



Color	Line Style	Thick	Data	Axis
Cyan	Solid	1	Anlr.Level A	Left
Green	Solid	3	Anlr.Level A	Left
Yellow	Solid	3	Anlr.Level A	Left

modulation limiting.at1

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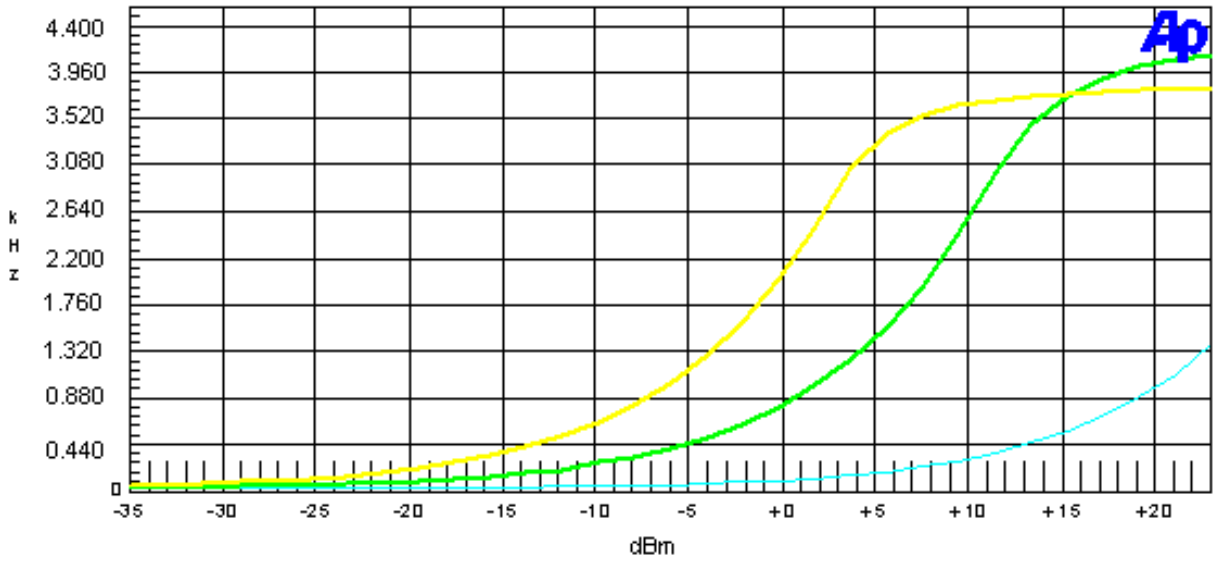
Modulation Limiting Plots:
2.5 kHz (Yellow), 1.0 kHz (Green), and 300 Hz (Blue)
WIDE MODULATION



Color	Line Style	Thick	Data	Axis
Cyan	Solid	1	Aud.Level A	Left
Green	Solid	3	Aud.Level A	Left
Yellow	Solid	3	Aud.Level A	Left

modulation limiting.at1

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Part 2.1049 Occupied bandwidth:

Part 2.1049(c) EMISSION BANDWIDTH:
Part 90.210(b) 25kHz Channel Spacing

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.

Part 90.210(c) 12.5kHz Channel Spacing Not Equipped with a Low Pass Filter

For transmitters that are not equipped with an audio low pass filter pursuant to S90.211 (b), the power of any emission must be attenuated below the un-modulated carrier output power as follows; (1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5 kHz but not more than10 kHz: At least 83 log (fd/5) dB; (2) ON any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 10 kHz, but not more than 250% of the authorized bandwidth: At least 29 log(fd2/11)dB or 50 dB, whichever is the lesser attenuation; (3) On any frequency removed from the center of the authorized bandwidth by more than 250% of the authorized bandwidth: At least 43+10 log(Po)dB.

Part 90.210(d) Emission Mask D - 12.5 kHz channel BW 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.

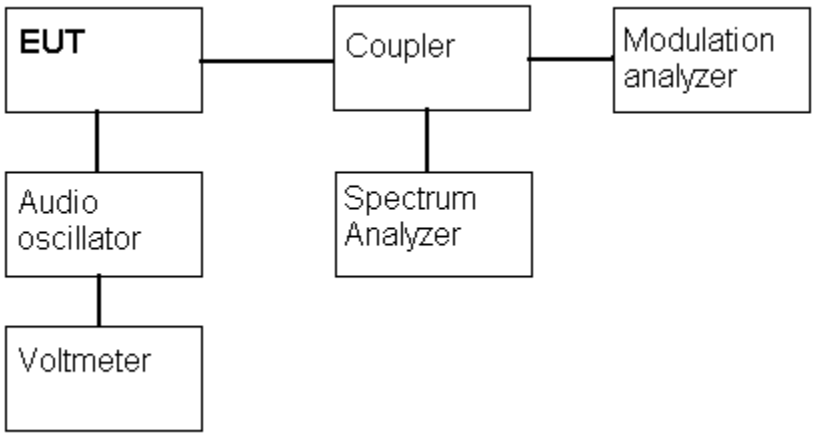
Part 90.210(e) Emission Mask E – 6.25 kHz channel BW equipment.
For transmitters designed to operate with a 6.25 kHz bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

(1) On any frequency from the center of the authorized bandwidth f0 to 3.0 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 3.0 kHz but no more than 4.6 kHz: At least 30 + 16.67(fd – 3.0 kHz) or 55 + 10 Log(P) or 65, whichever us the lesser attenuation.
(3) On any frequency removed from the center of the authorized
(4) bandwidth by more than 4.6kHz: At least 55 + 10log(P) dB or 65 dB, whichever is the lesser attenuation.

Test procedure: TIA/EIA-603 Para 2.2.11.

Test procedure diagram

OCCUPIED BANDWIDTH MEASUREMENT



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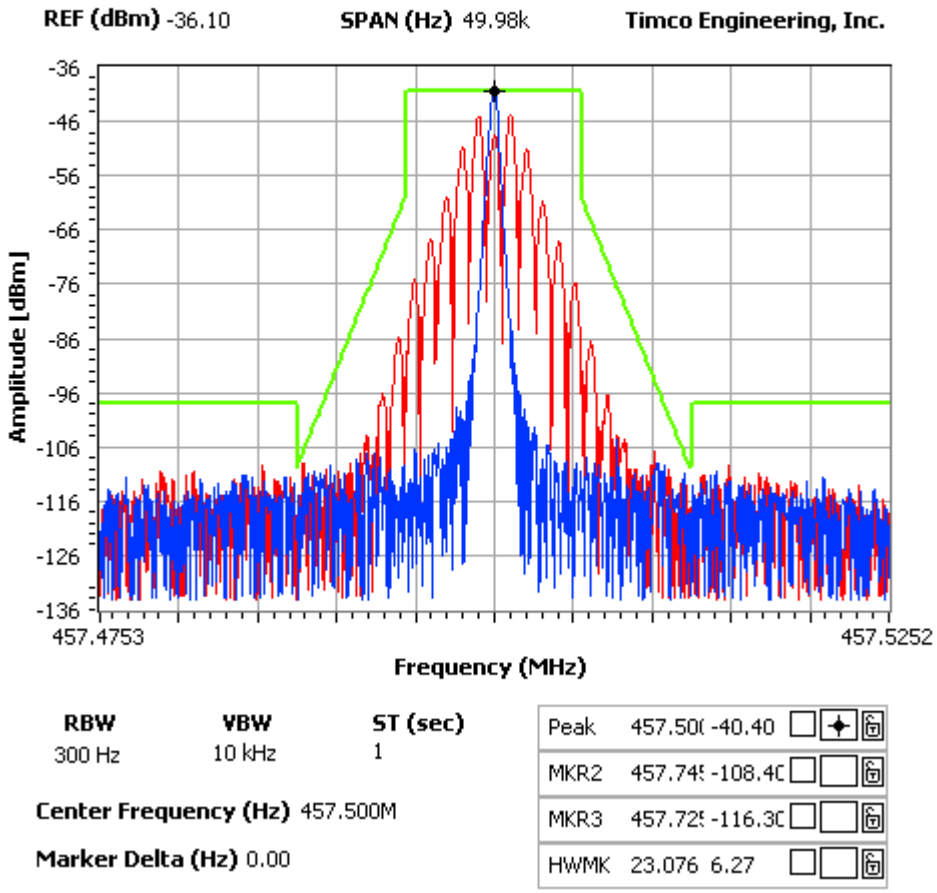
OCCUPIED BANDWIDTH PLOT

NOTES:
OCCUPIED BANDWIDTH -- 12.5kHz
MIDLAND RADIO CORP
FCC ID: MMA 7150610D

FCC 90.210 Mask D



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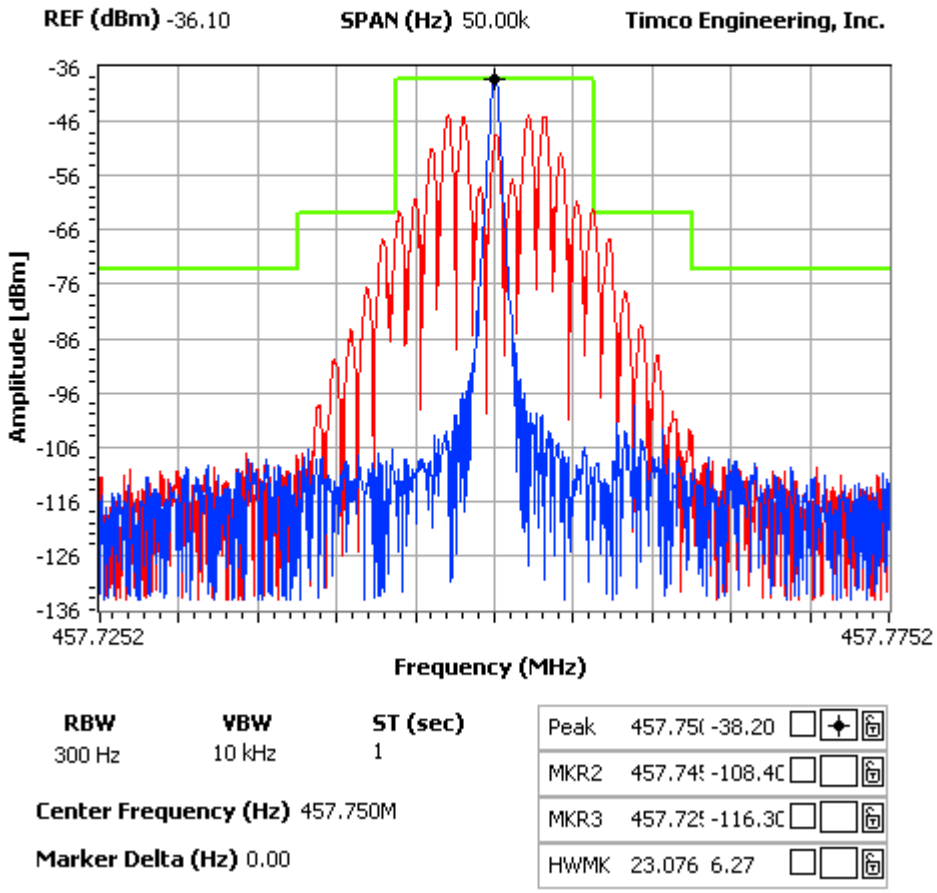
OCCUPIED BANDWIDTH PLOT

NOTES:
OCCUPIED BANDWIDTH -- 25kHz
MIDLAND RADIO CORP
FCC ID: MMA 7150610D

FCC 90.210 Mask B



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Part 2.1051(a) 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.

FCC Limit: Low Power: 43+10log(6.5) = 51.10 dB
High Power: 43+10log(11)= 53.40 dB

71-506-10D (duplex)

TF HIGH POWER	dB below carrier	TF LOW POWER	dB below carrier
440.025	0	440.0125	0
880.050	74.8	880.0250	70.4
457.750	0	457.500	0
915.500	80.6	915.000	78.2
473.975	0	474.950	0
947.950	86.4	949.900	85.1

71-506-10S (simplex)

TF HIGH POWER	dB below carrier	TF LOW POWER	dB below carrier
440.025	0	440.0125	0
880.050	82.5	880.0250	82.9
457.750	0	457.500	0
915.500	87.4	915.000	86.3
473.975	0	474.950	0
947.950	86.6	949.900	89.4

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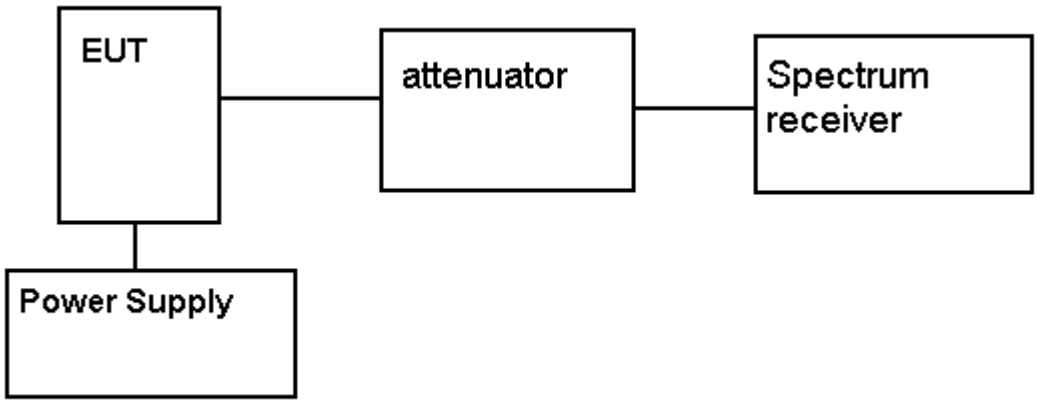
Method of Measuring Conducted Spurious Emissions



METHOD OF MEASUREMENT: The procedure used was TIA/EIA-603 STANDARD without any exceptions. The measurements were made at TIMCO ENGINEERING INC. 849 N.W. State Road 45, Newberry, Florida 32669.

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Part 2.1053 **Field strength of spurious emissions:**

NAME OF TEST: RADIATED SPURIOUS EMISSIONS

REQUIREMENTS: Low Power: 43+10log(6.5) = 51.10 dB
High Power: 43+10log(11)= 53.40 dB

LOW POWER

71-506-10D (duplex)

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
440.025	0	0
880.050	V	80.11
1320.075	V	89.23
1760.100	H	89.99
2200.125	H	100.53
2640.150	V	89.95
3080.175	V	87.95
3520.200	V	95.35
3960.225	V	86.61
4400.250	V	86.96

71-506-10S (simplex)

Emission Frequency MHz	Substitution Antenna (dBd)	dB Below Carrier (dBc)
440.025	0	0
880.050	-0.71	87.31
1320.075	4.23	87.33
1760.100	5.16	87.29
2200.125	5.91	98.83
2640.150	6.86	85.65
3080.175	7.21	87.85
3520.200	7.55	91.75
3960.225	7.64	93.91
4400.250	8.13	91.26

71-506-10D (duplex)

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
457.750	0	0
915.500	V	88.97
1373.250	V	85.06
1831.000	V	81.35
2288.750	V	91.94
2746.500	V	86.59
3204.250	V	84.77
3662.000	V	96.13
4119.750	V	91.00
4577.500	V	94.12

71-506-10S (simplex)

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
457.750	0	0
915.500	H	100.57
1373.250	V	77.36
1831.000	V	78.15
2288.750	V	93.24
2746.500	V	77.99
3204.250	V	85.47
3662.000	V	93.73
4119.750	V	93.30
4577.500	V	89.42

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Part 2.1053 Field strength of spurious emissions:

LOW POWER

71-506-10D (duplex)

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
473.975	0	0
947.950	V	87.73
1421.925	V	90.19
1895.900	H	80.43
2369.875	V	91.64
2843.850	V	82.82
3317.825	H	94.9
3791.800	H	99.03
4265.775	V	90.34
4739.750	V	89.53

71-506-10S (simplex)

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
473.975	0	0
947.950	H	85.83
1421.925	H	75.69
1895.900	H	81.43
2369.875	V	92.54
2843.850	H	88.42
3317.825	V	88.4
3791.800	V	94.63
4265.775	V	89.34
4739.750	V	91.73

HIGH POWER

71-506-10D (duplex)

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
440.0125	0	0
880.0250	V	77.41
1320.0375	H	91.23
1760.0500	V	83.69
2200.0625	V	90.53
2640.0750	V	90.55
3080.0875	V	86.65
3520.1000	V	94.85
3960.1125	V	92.21
4400.1250	V	90.86

71-506-10S (simplex)

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
440.0125	0	0
880.0250	V	87.91
1320.0375	H	89.23
1760.0500	H	86.79
2200.0625	H	98.73
2640.0750	V	86.95
3080.0875	V	89.25
3520.1000	V	94.45
3960.1125	V	92.31
4400.1250	V	91.66

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Part 2.1053 FIELD STRENGTH OF SPURIOUS EMISSIONS

HIGH POWER

71-506-10D (duplex)

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
457.500	0	0
915.000	V	89.27
1372.500	V	87.16
1830.000	V	78.95
2287.500	V	91.24
2745.000	V	86.69
3202.500	V	85.37
3660.000	V	94.33
4117.500	V	93.8
4575.000	V	90.02

71-506-10S (simplex)

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
457.500	0	0
915.000	H	87.87
1372.500	H	79.36
1830.000	H	86.05
2287.500	V	93.84
2745.000	V	79.49
3202.500	V	85.47
3660.000	V	91.13
4117.500	V	92.7
4575.000	V	89.42

71-506-10D (duplex)

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
474.950	0	0
949.900	V	86.93
1424.850	H	90.99
1899.800	V	77.63
2374.750	V	90.74
2849.700	V	84.32
3324.650	V	88.8
3799.600	V	94.13
4274.550	V	90.34
4749.500	H	94.03

71-506-10S (simplex)

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
474.950	0	0
949.900	H	84.53
1424.850	V	75.39
1899.800	H	84.53
2374.750	V	92.24
2849.700	H	92.62
3324.650	V	87.8
3799.600	H	98.63
4274.550	V	89.14
4749.500	V	91.13

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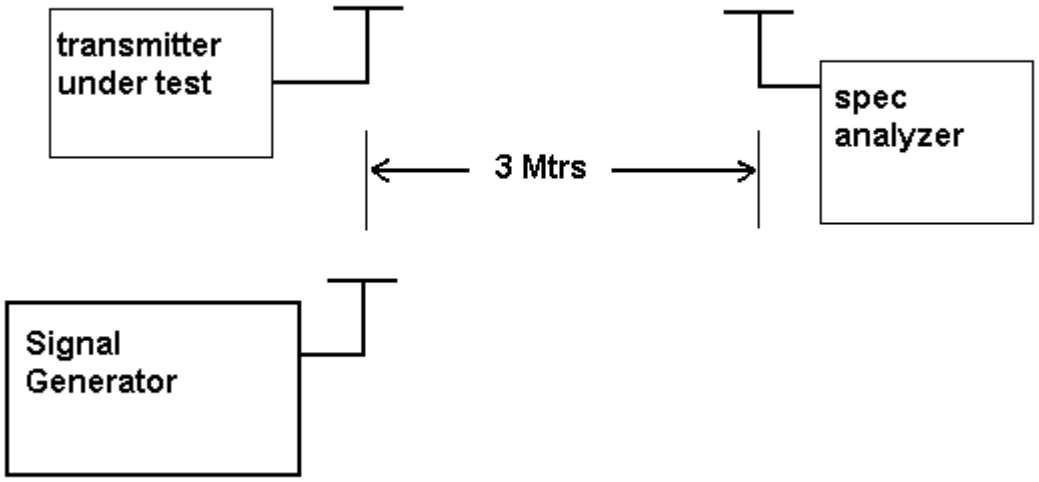
Method of Measuring Radiated Spurious Emissions



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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Part 2.1055 Frequency stability:
Part 90.213(a)(1) 90.266(b)(3)

MEASUREMENT DATA:

Temperature and voltage tests were performed to verify that the frequency remains within the .00015%, 1.5 ppm specification limit, for 25 kHz spacing & 0.00025% for 12.5 kHz spacing and 0.0001% for 6.25KHz spacing. 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 degree increments up to + 50° C.

MEASUREMENT DATA:

Assigned Frequency (Ref. Frequency): 465.000 000 MHz

TEMPERATURE_°C	FREQUENCY_MHz	PPM
REFERENCE	457.500 361	0.0
-30	457.500 377	0.03
-20	457.500 424	0.14
-10	457.500 398	0.08
0	457.500 417	0.12
+10	457.500 351	-0.02
+20	457.500 303	-0.13
+30	457.500 323	-0.18
+40	457.500 276	-0.19
+50	457.500 249	-0.24

BATT	%BATT. DATA	VOLTS	BATT. PPM
-15%	457.500 355	11.56	-0.01
+15%	457.500 354	15.64	-0.02

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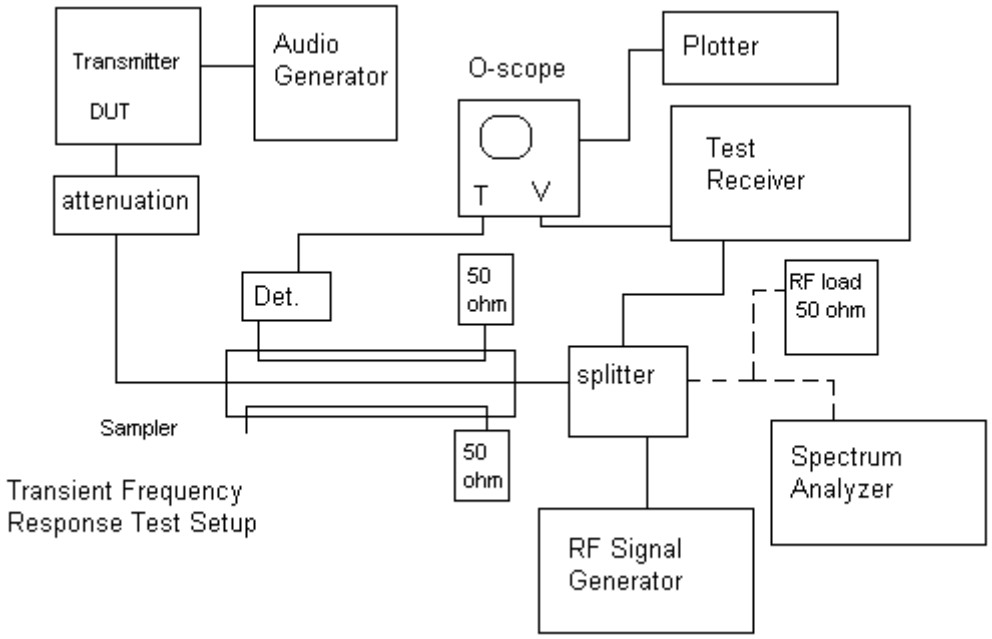
Part 2.1055(a)(1) **Frequency stability:**
Part 90.214 Transient Frequency Behavior

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

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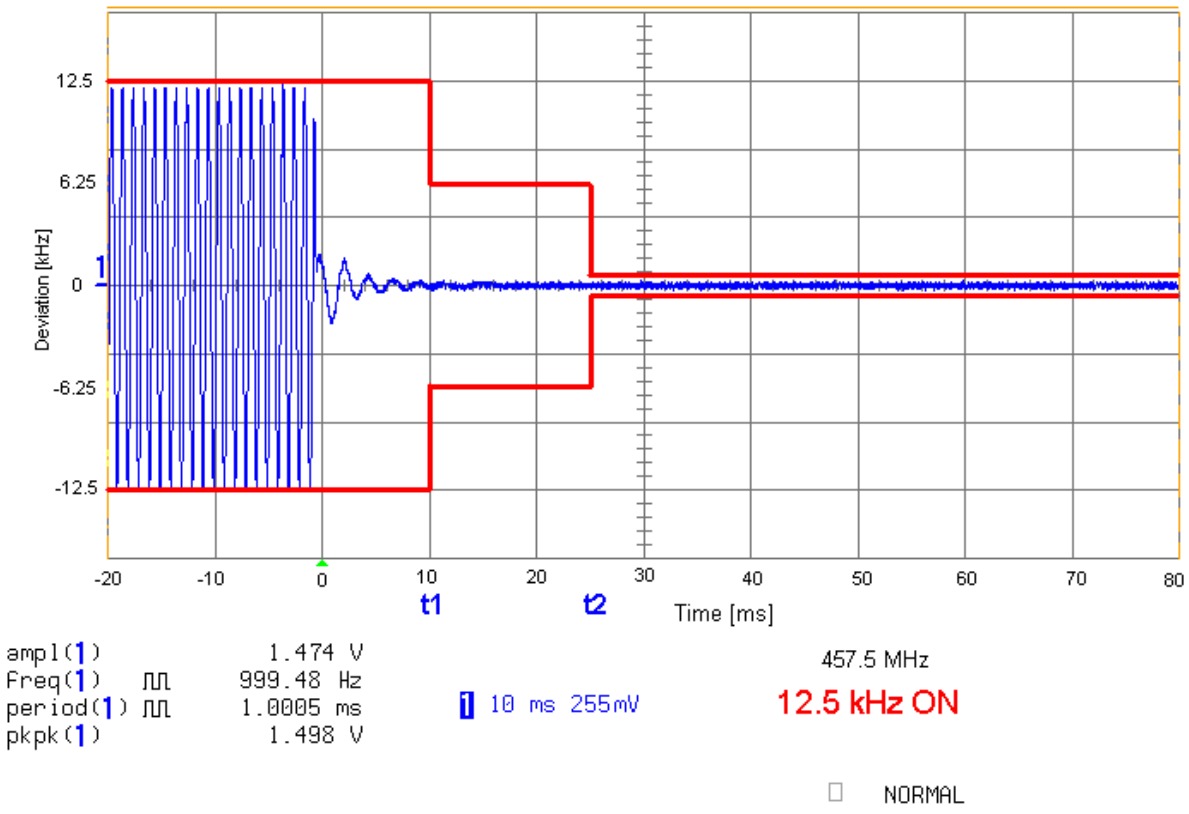
849 NW State Road 45
Newberry, Florida 32669
http://www.timcoengr.com
888.472.2424 F 352.472.2030 email: sid@timcoengr.com



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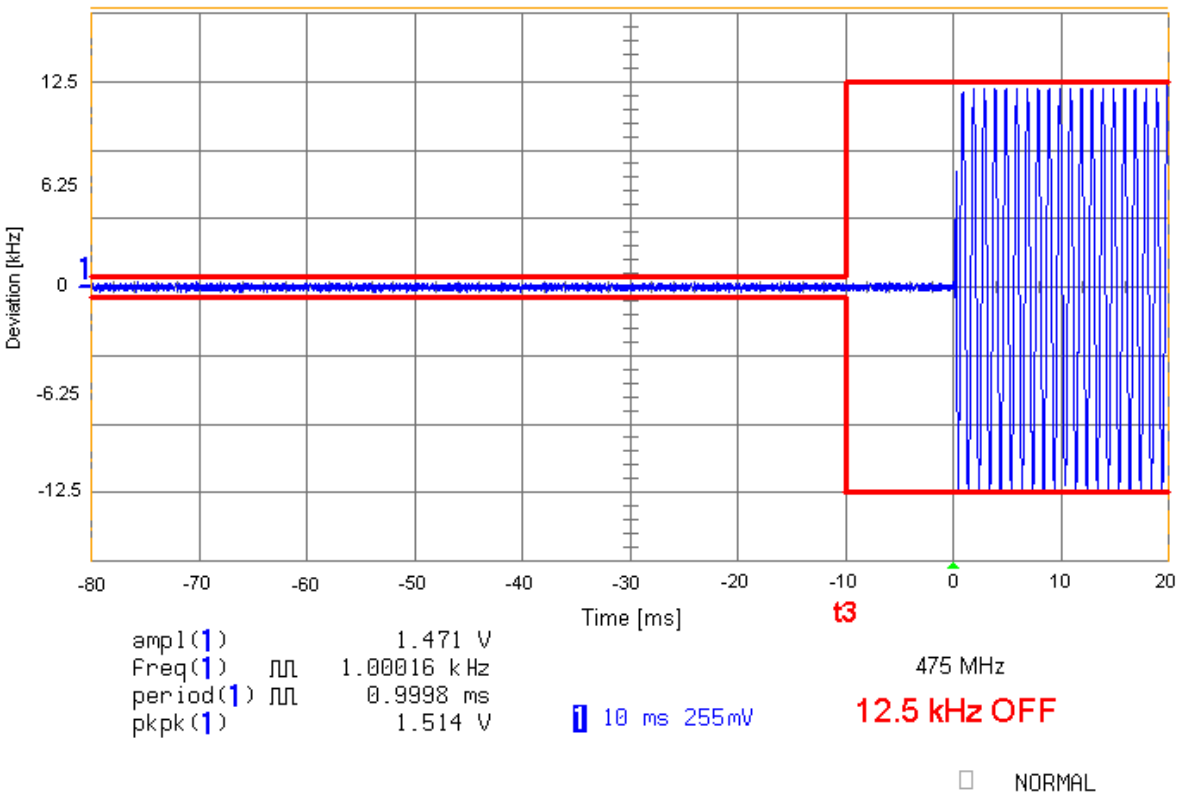

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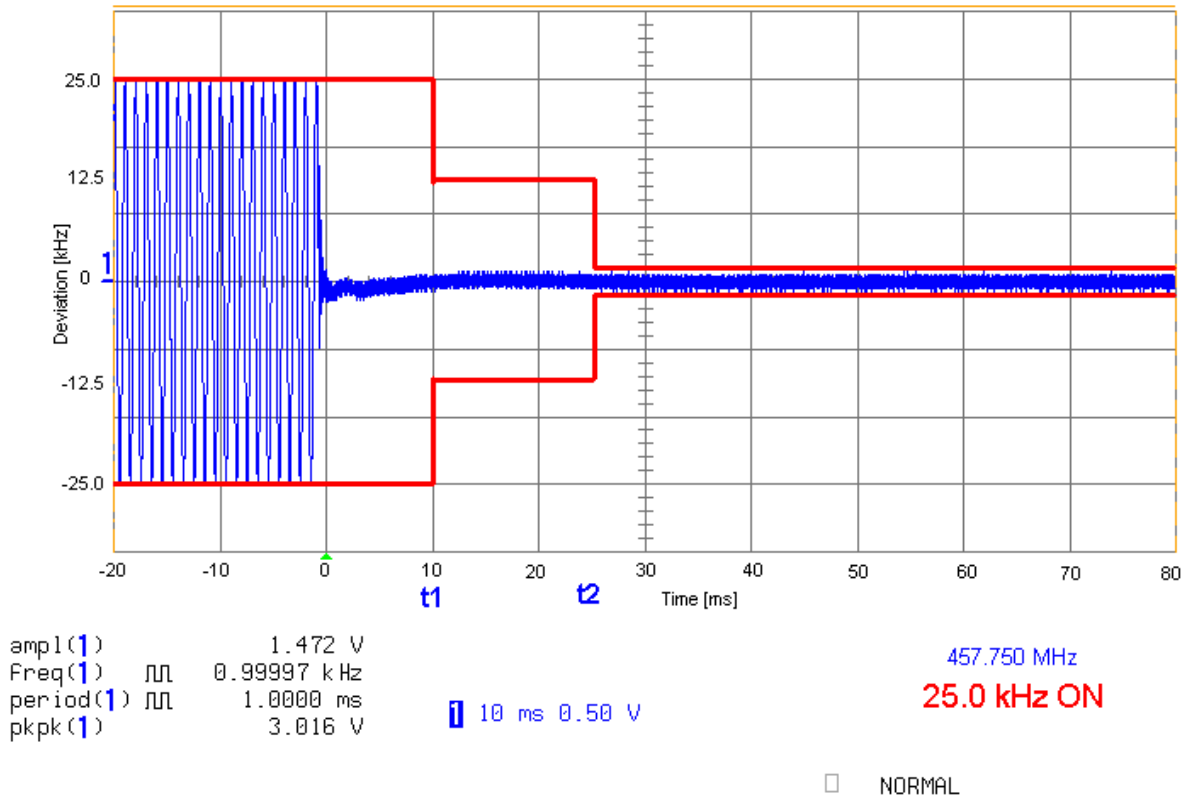

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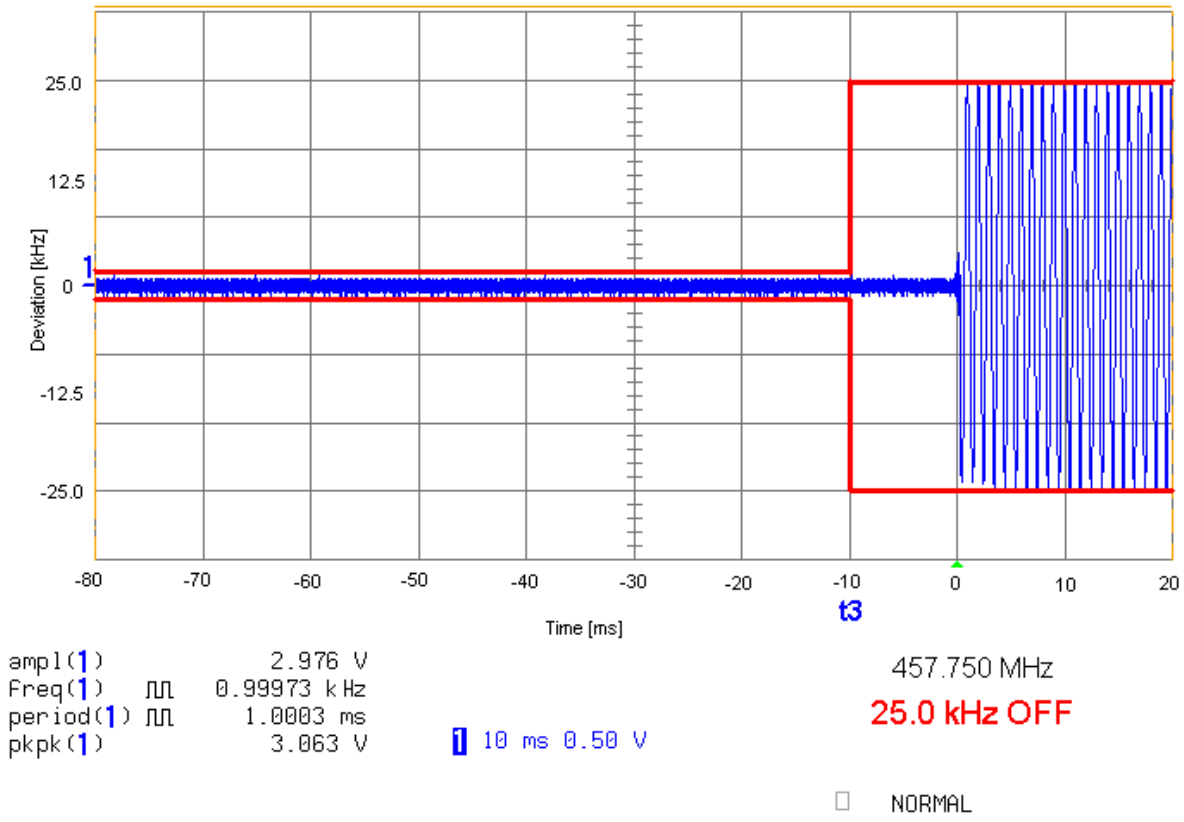

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71-506-10D (duplex)

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71-506-10S (simplex)

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EMC Equipment List

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
Analyzer Tan Tower Spectrum Analyzer	HP	8566B Opt 462	3138A07786 3144A20661	CAL 12/7/05	12/7/07
Analyzer Tan Tower RF Preselector	HP	85685A	3221A01400	CAL 12/7/05	12/7/07
Analyzer Tan Tower Quasi-Peak Adapter	HP	85650A	3303A01690	CAL 12/8/05	12/8/07
Analyzer Tan Tower Preamplifier	HP	8449B-H02	3008A00372	CAL 12/8/05	12/8/07
Antenna: Biconnical	Electro-Metrics	BIA-25	1171	CAL 4/29/05	4/29/07
Antenna: Log-Periodic	Electro-Metrics	LPA-25	1122	CAL 8/26/04	8/26/06
Antenna: Double-Ridged Horn	Electro-Metrics	RGA-180	2319	CAL 12/29/04	12/29/06
LISN	Electro-Metrics	ANS-25/2	2604	CAL 8/27/04	8/27/06
Termaline Wattmeter	Bird Electronic Corporation	611	16405	CAL 7/16/04	7/16/06