

THRU Lab & Engineering.

477-6, Hager-Ri, Yoju-Up, Yoju-Gun

Kyunggi-Do, 469-803, Korea

T820318835092F820318835169 email thrukang@kornet.net



Test Report

Product Name: 4CH land mobile transceiver

FCC ID: MMABR777

Applicant:

Midland Radio Corporation

5900 Parretta Drive, Kansas City,

M064120

Date Receipt: 2006/04/26

Date Tested: 2006/05/29

APPLICANT: Midland Radio Corporation

FCC ID: MMABR777

REPORT #: THRU-606001

COVER SHEET

THRU Lab & Engineering.

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EXHIBITS CONTAINING:

CONFIDENTIALITY LETTER
BLOCK DIAGRAM
SCHEMATIC
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LABEL LOCATION
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OPERATIONAL DESCRIPTION
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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: MMABR777 UHF TRANSCEIVER in quantity, for use
under FCC RULES PART 90.

Midland Radio Corporation
5900 Parretta Drive,
Kansas City, MO 64120

Part 2.1033(c) TECHNICAL DESCRIPTION

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

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

Part 90.209

Part 90.207 Bn = 2M + 2DK

M = 3000

D = 1900

Bn = 2(3000) + 2(2300) = 10.6k

Part 2.1033(c)(5) Frequency Range: 421-512 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 - HIGH: (3.7V)(740mA) = 2.74 Watts

INPUT POWER - LOW: (3.7V)(370mA) = 1.37 Watts

Part 2.1033(c)(9) Tune-up procedure. The tune-up procedure is included.

Part 2.1033(c)(10) Complete Circuit Diagrams: The circuit diagram is
included. The block diagram is included.

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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.

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

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. (FOR VOICE REPORTS USE "Digital Modulation is not allowed")

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 as ERP as the antenna is permanently attached. The substitution method was used. With a nominal battery voltage, and the transmitter properly adjusted the RF output measures:

MAX OUTPUT POWER: HIGH - 0.4375 Watts
LOW - 0.1560 Watts

ERP Power (W)					
1ch(461.0338MHz)		2ch(464.4936MHz)		4ch(469.5621MHz)	
High	Low	High	Low	High	Low
0.3656	0.1560	0.4375	0.1552	0.4365	0.1549

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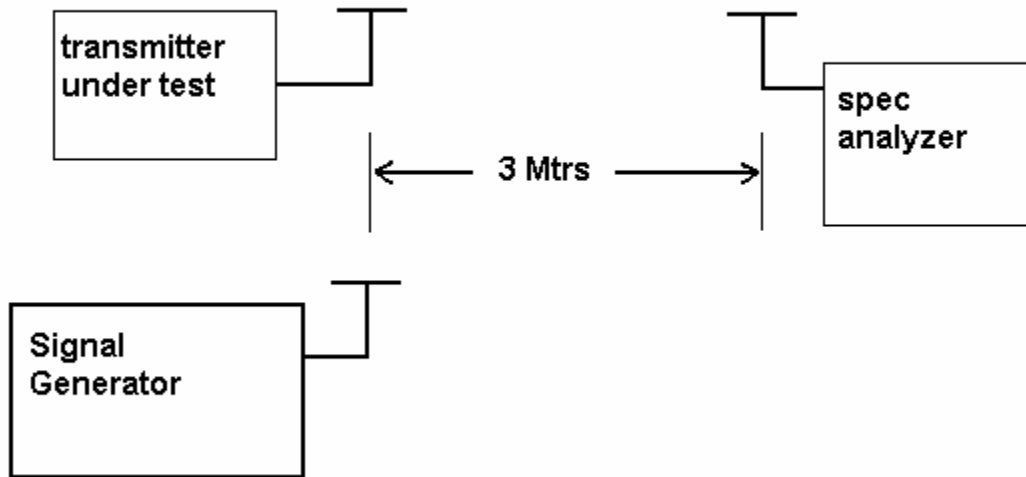
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Method of Measuring Radiated Emissions Power



METHOD OF MEASUREMENTS: The tabulated data shows the results of the radiated field strength emissions test. The spectrum was scanned from 400 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 ThruLab & ENGINEERING. located at 477-6, Hager-Ri, Yoju-Up, Yoju-Gun, Kyunggi-Do, 469-803, Korea

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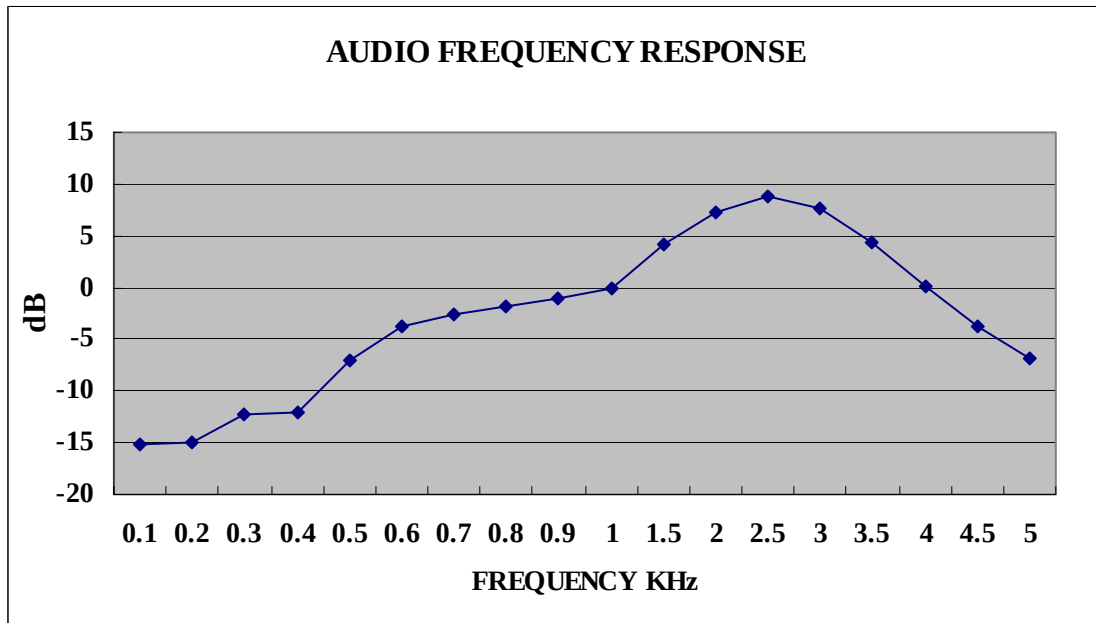
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Part 2.1047(a)(b) Modulation characteristics:

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



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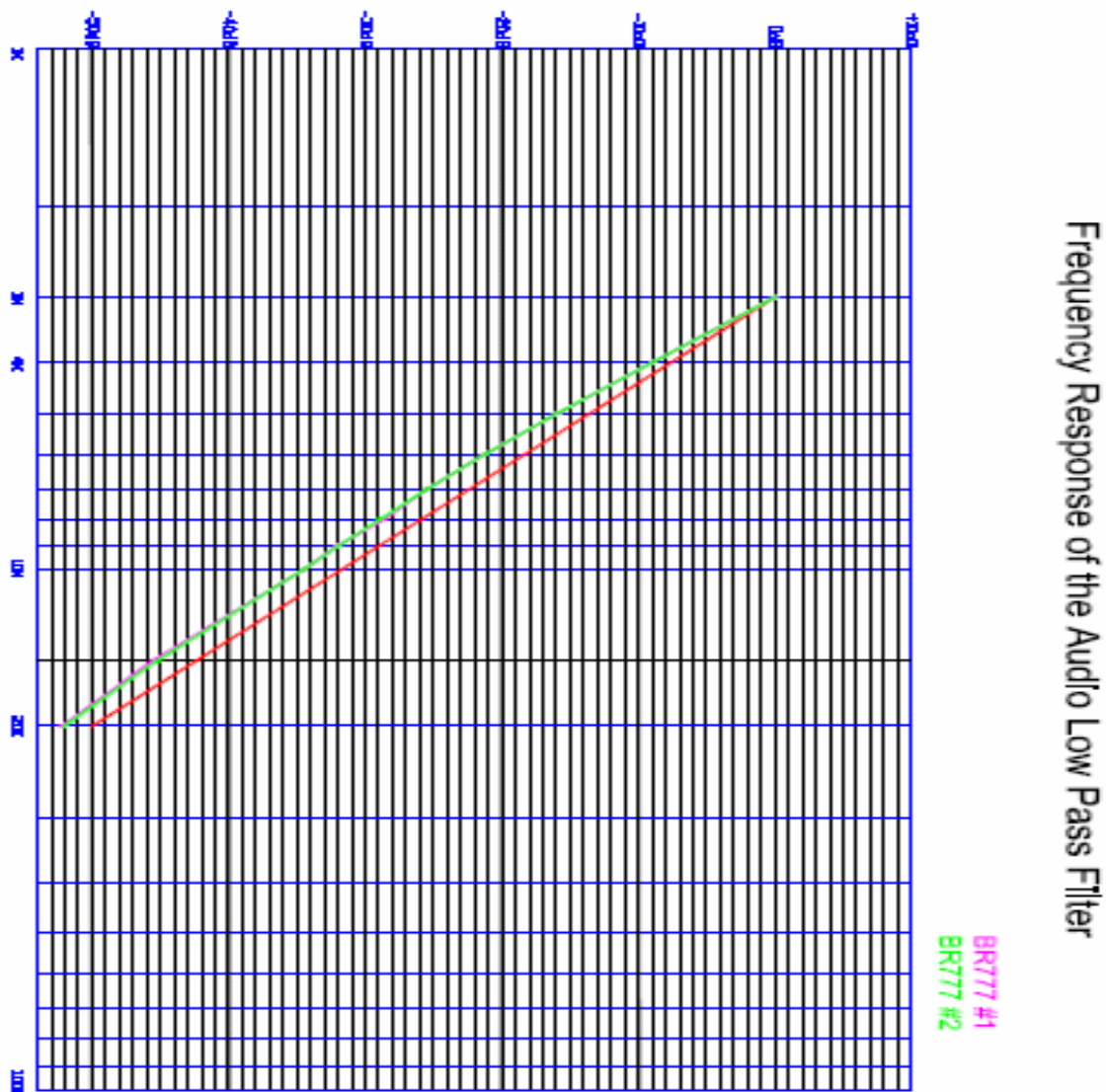
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Part 2.1047(a) Voice modulated communication equipment: For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter, or of all the circuitry installed between the modulation limiter and the modulated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

AUDIO LOW PASS FILTER



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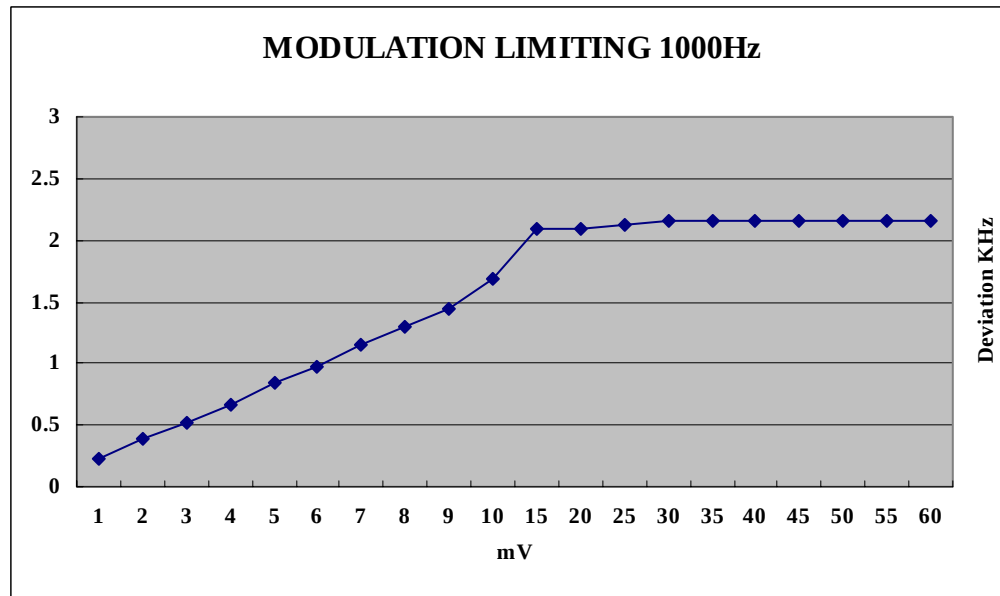
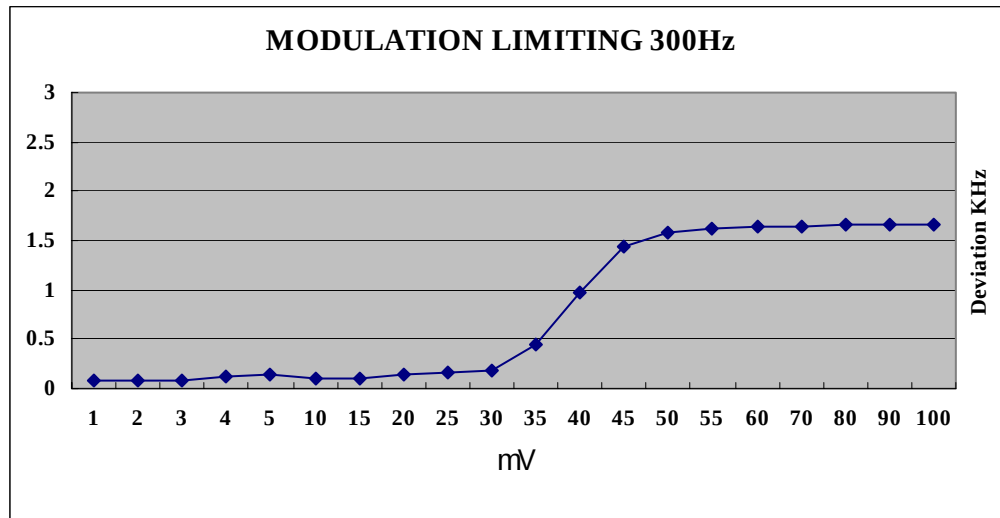
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Part 2.1047(b) Audio input versus modulation

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 3000 Hz.

MODULATION LIMITING PLOT



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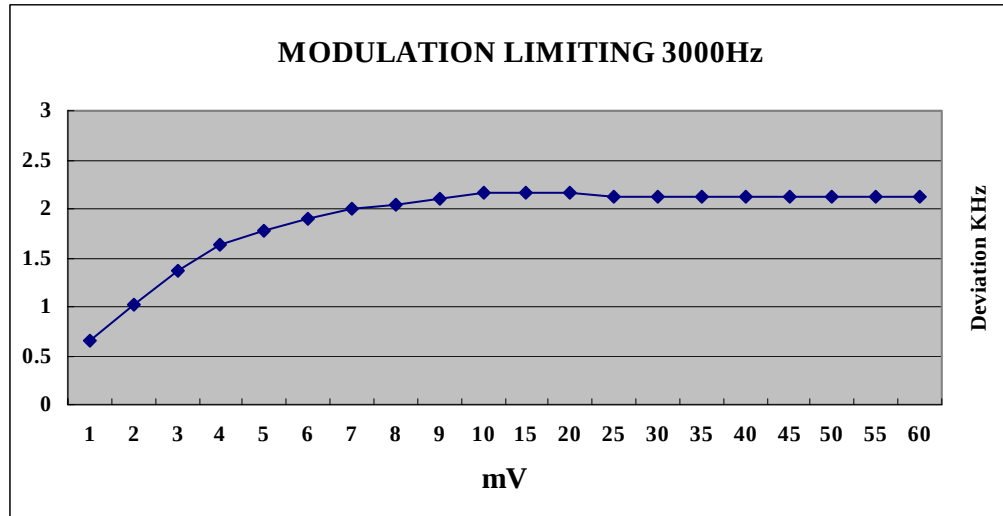
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Part 2.1049 Occupied bandwidth:

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 $43 + 10\log(P)$ 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 unmodulated carrier output power as follows; (1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5 kHz but not more than 10 kHz: At least $83 \log(f_d/5)$ dB; (2) ON any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 10 kHz, but not more than 250% of the authorized bandwidth: At least $29 \log(f_d^2/11)$ 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 $43 + 10 \log(P)$ 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 f_0 to 5.625 kHz removed from f_0 : Zero dB.
- (2) On any frequency from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least $7.27 (f_d - 2.88 \text{ kHz})$ dB.
- (3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz: At least $50 + 10\log(P)$ 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 f_0 to 3.0 kHz removed from f_0 : Zero dB.
- (2) On any frequency from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 3.0 kHz but no more

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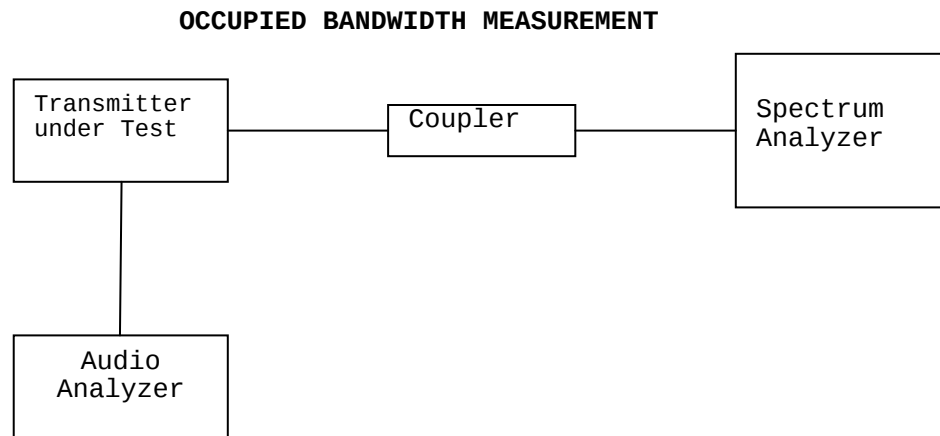
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- than 4.6 kHz: At least $30 + 16.67(f_d - 3.0 \text{ kHz})$ or $55 + 10 \log(P)$ or 65, whichever is the lesser attenuation.
- (3) On any frequency removed from the center of the authorized bandwidth by more than 4.6 kHz: At least $55 + 10 \log(P)$ dB or 65 dB, whichever is the lesser attenuation.

Test procedure: TIA/EIA-603 para 2.2.11.

Test procedure diagram



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OCCUPIED BANDWIDTH PLOT

Part 90.210(c) 12.5kHz Channel Spacing

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

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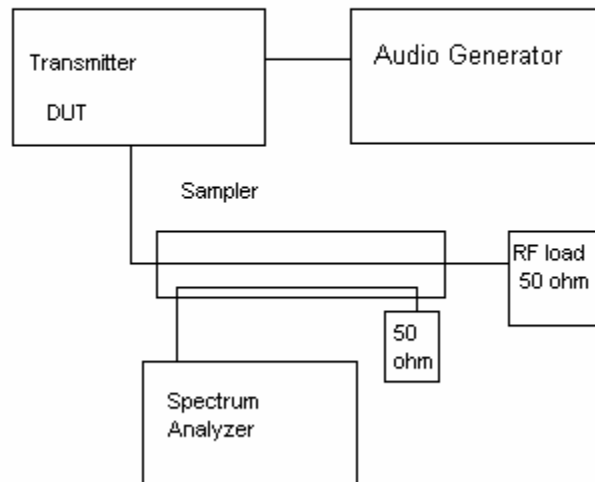
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Radiotelephone transmitter with modulation limiter:

Test procedure diagram

OCCUPIED BANDWIDTH MEASUREMENT

Occupied BW Test Equipment Setup



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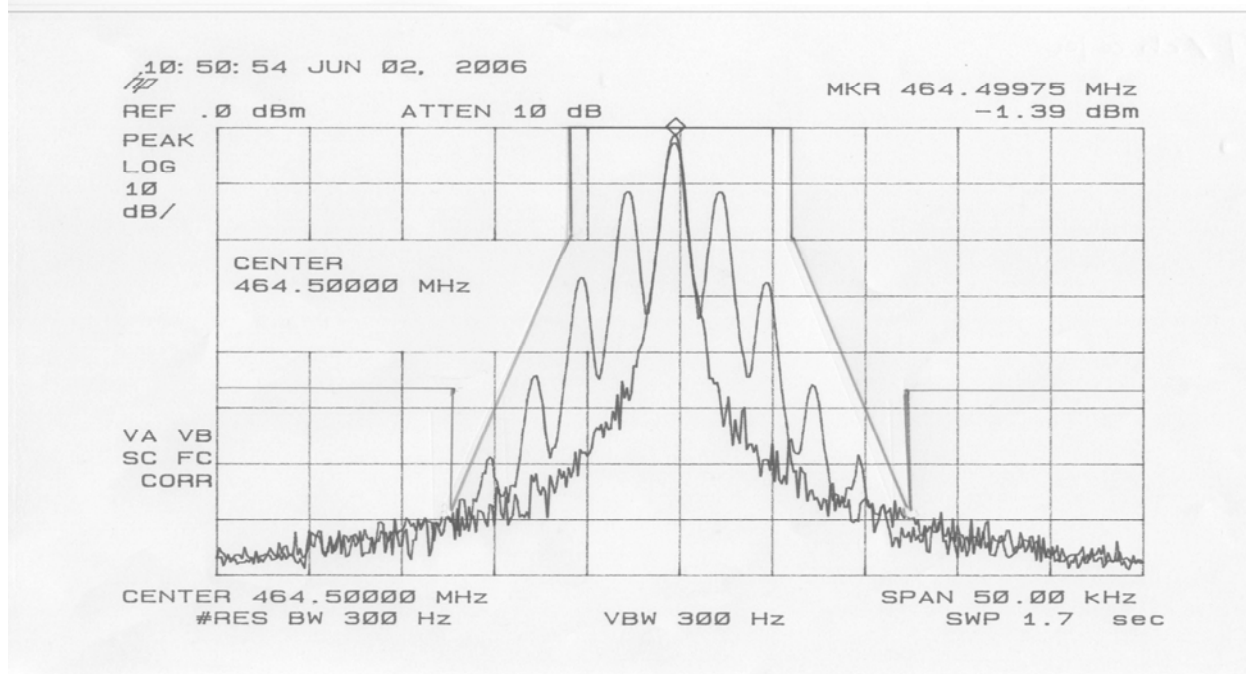
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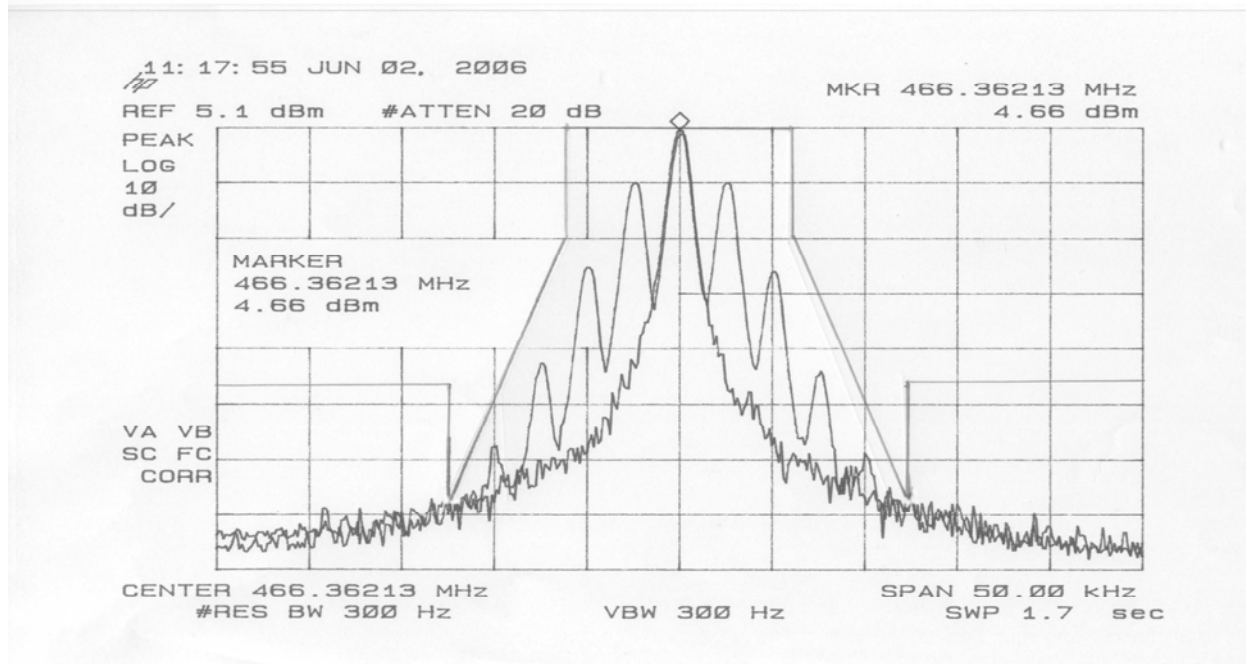
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1ch



2ch



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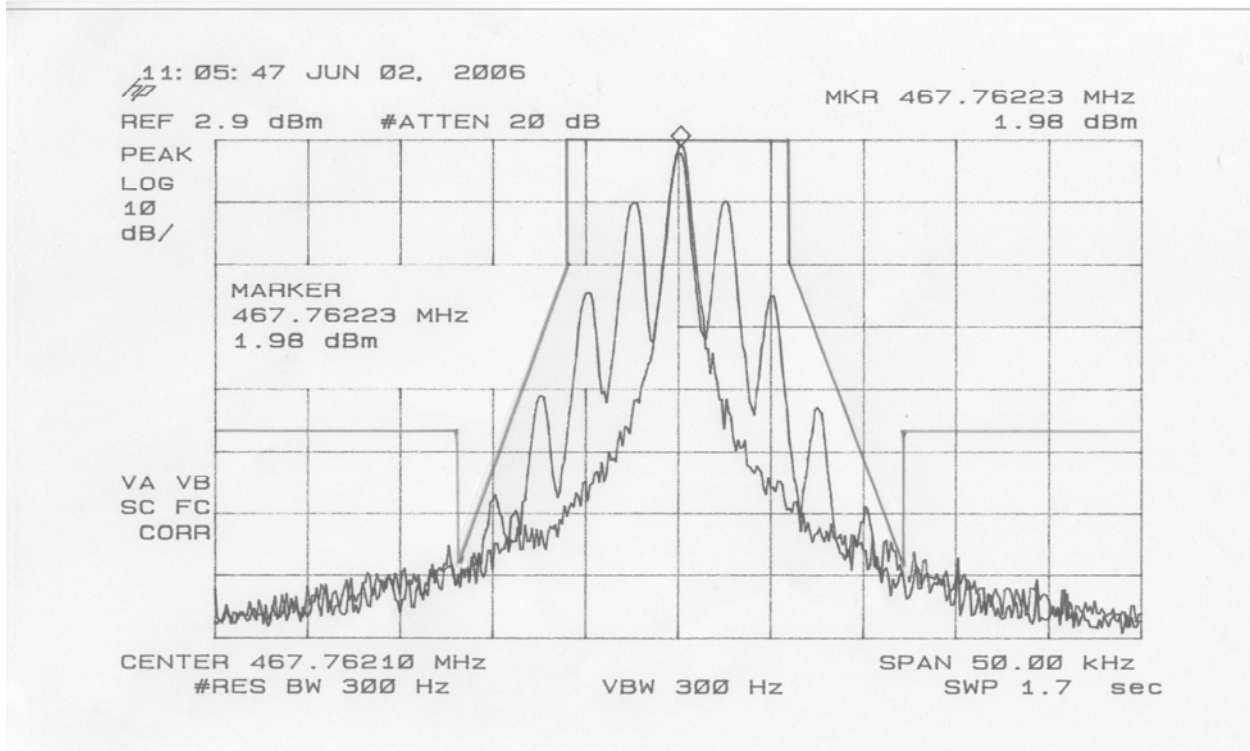
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4ch



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Part 2.1053 Field strength of spurious emissions:

NAME OF TEST: RADIATED SPURIOUS EMISSIONS

REQUIREMENTS: The spectrum was scanned from 400M to at least the 10th harmonic of the fundamental. The measurements were made in accordance with standard TIA/EIA-603.

TEST DATA:

1ch					
High	50+10log(	0.3656	)=	45.63	
Low	50+10log(	0.1560	)=	41.93	

1CH-High

1CH-Low

	dBc	Margin	dBm		dBc	Margin	dBm
461.0338	0	0		461.0338	0	0	
922.0680	64.91	19.28	-39.28	922.0680	54.41	12.48	-32.48
1383.1022	65.62	19.99	-39.99	1383.1022	61.02	19.09	-39.09
1844.1364	63.16	17.53	-37.53	1844.1364	58.76	16.83	-36.83
2305.1706	60.94	15.31	-35.31	2305.1706	56.54	14.61	-34.61
2766.2048	57.58	11.95	-31.95	2766.2048	54.78	12.85	-32.85

2ch					
High	50+10log(	0.4375	)=	46.41	
Low	50+10log(	0.1552	)=	41.91	

2CH-High

2CH-Low

	dBc	Margin	dBm		dBc	Margin	dBm
464.4936	0	0		464.4936	0	0	
928.9870	57.99	11.58	-31.58	928.9870	60.29	18.38	-38.38
1393.4804	66.83	20.42	-40.42	1393.4804	59.03	17.12	-37.12
1857.9738	66.97	20.56	-40.56	1857.9738	62.87	20.96	-40.96
2322.4672	62.05	15.64	-35.64	2322.4672	59.85	17.94	-37.94
2786.9606	65.70	19.29	-39.29	2786.9606	60.60	18.69	-38.69

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4ch

High $50+10\log(0.4365)$ = 46.40

Low $50+10\log(0.1549)$ = 41.90

4CH-High

4CH-Low

	dBc	Margin	dBm		dBc	Margin	dBm
469.5621	0	0		469.5621	0	0	
939.1242	65.09	18.69	-38.69	939.1242	55.39	13.49	-33.49
1408.6863	57.73	11.33	-31.33	1408.6863	55.63	13.73	-33.73
1878.2484	65.42	19.02	-39.02	1878.2484	58.52	16.62	-36.62
2347.8105	65.84	19.44	-39.44	2347.8105	60.24	18.34	-38.34
2817.3726	62.49	16.09	-36.09	2817.3726	58.59	16.69	-36.69

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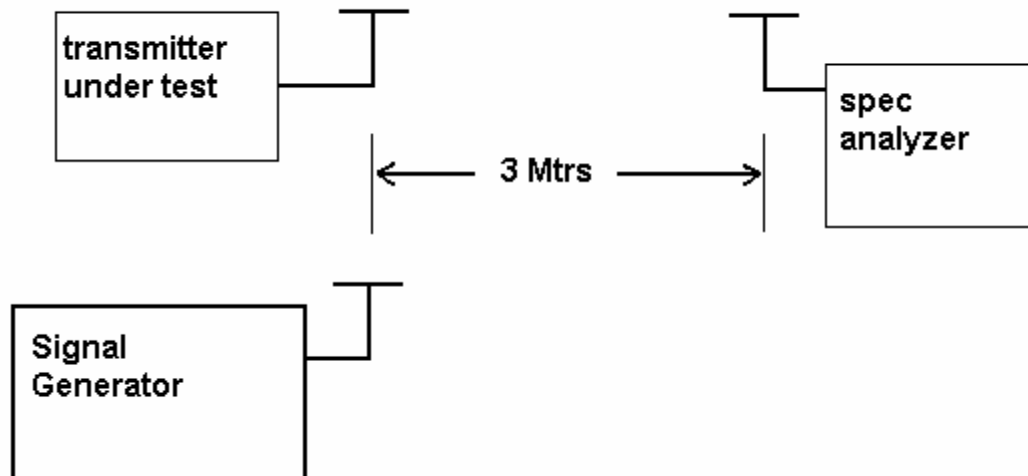
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Method of Measuring Radiated Spurious Emissions



METHOD OF MEASUREMENTS: The tabulated data shows the results of the radiated field strength emissions test. The spectrum was scanned from 400 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 ThruLab & ENGINEERING. located at 477-6, Hager-Ri, Yoju-Up, Yoju-Gun, Kyunggi-Do, 469-803, Korea

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FOR PART 90 UHF & VHF REPORTS USE THE FREQUENCY STABILITY PAGE BELOW

Part 2.1055 Frequency stability:

Part 90.213(a)(1) 90.266(b)(3)

Frequency Stability Requirement:

Temperature range requirements: -30 to +50° C.

Measurement procedure per TIA/EIA 603.

MEASUREMENT DATA:

TEMPERATURE	FREQUENCY (MHz)	ppm	LIMIT (ppm)
REFERENCE	464.5	0	
-30	464.50027	0.58	2.5
-20	464.50041	0.88	2.5
-10	464.50036	0.78	2.5
0	464.50030	0.65	2.5
10	464.49992	-0.17	2.5
20	464.50008	0.17	2.5
30	464.49976	-0.52	2.5
40	464.49973	-0.58	2.5
50	464.50020	0.43	2.5
END POINT OF BATTERY: 2.4V	464.49971	-0.62	2.5

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

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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

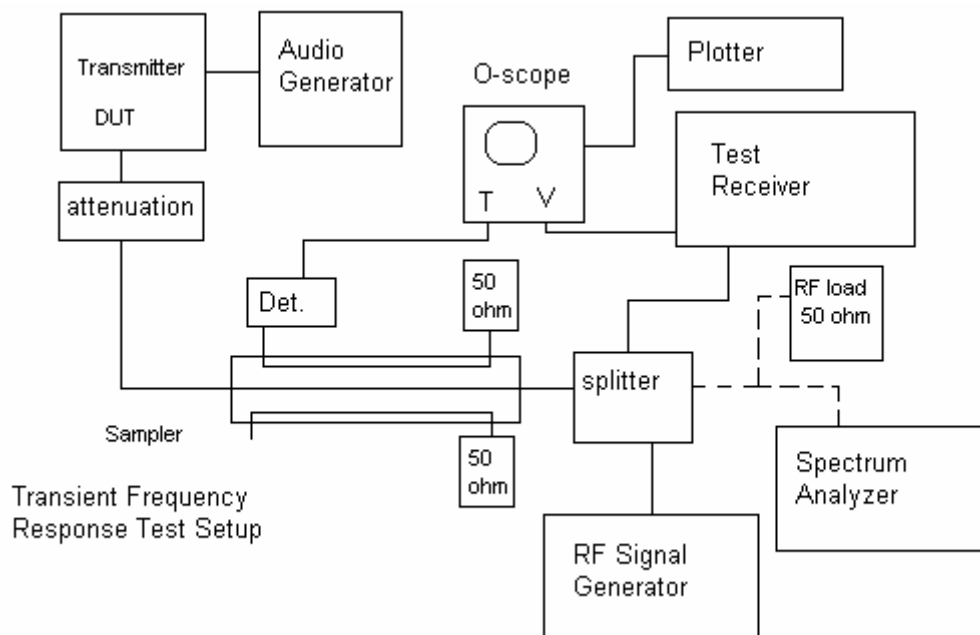
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1. Using the variable attenuator the transmitter level was set to 40 dB below the test receivers maximum input level, then the transmitter was turned off.
2. With the transmitter off the signal generator was set 20dB below the level of the transmitter 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.



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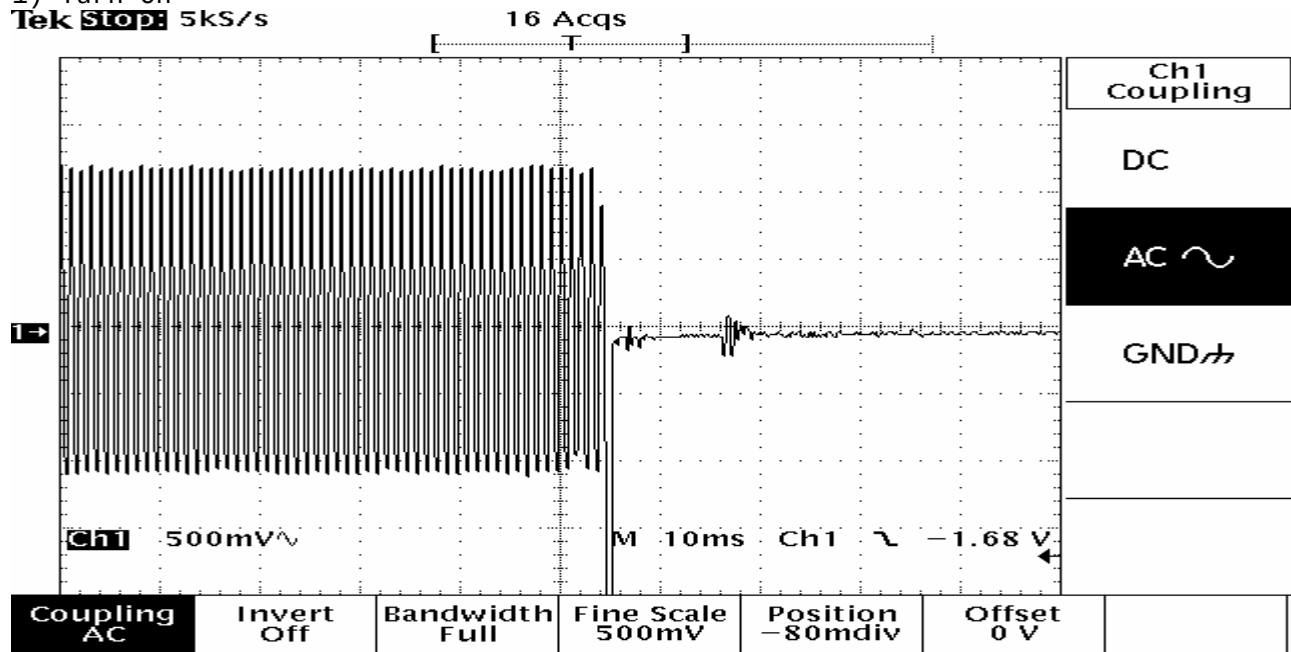
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1) Turn On

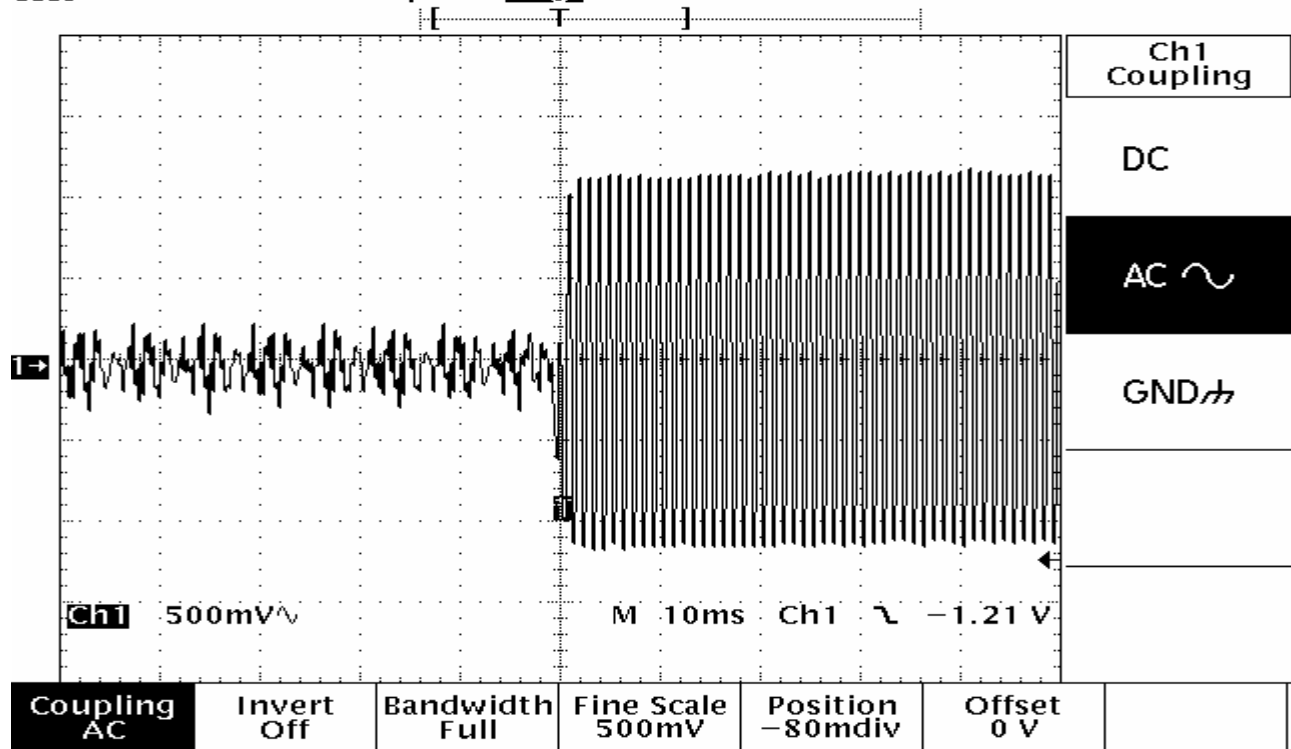
Tek Stop: 5kS/s



2) Turn Off

Tek Run: 5kS/s

Sample **Trig?**



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EMC Equipment List

No	Description	Manufacturer	Model No.	Serial No.	Due Cal.
1	Test Receiver	Rohde & Schwarz	ESVS10	830489/001	2006.04.23
2	Test Receiver	Rohde & Schwarz	ESHS 10	825832/014	2006.08.25
3	Test Receiver	Rohde & Schwarz	ESVS 10	826008/014	2006.05.24
4	Spectrum Analyzer	Hewlett Packard	8566B	2311A02394	2006.04.23
5	Spectrum Display	Hewlett Packard	85662A	2542A12429	2006.04.23
6	Quasi-peak Adapter	Hewlett Packard	85650A	2521A00887	2006.04.23
7	RF Preselector	Hewlett Packard	85685A	2648A00504	2006.04.23
8	Preamplifier	Hewlett Packard	8449B	3008A00375	2006.04.23
9	Preamplifier	Hewlett Packard	8447F	3113A05367	2007.05.09
10	Preamplifier	Hewlett Packard	8447F	2805A02570	2005.12.12
11	Preamplifier	A.H. Systems	PAM-0118	164	2007.04.01
12	Biconical Antenna	Eaton Corp.	94455-1	0977	2007.04.01
13	Biconical Antenna	EMCO	3104C	9111-2468	2006.06.07
14	Log Periodic Antenna	EMCO	3146	2051	2007.05.11
15	Log Periodic Antenna	EMCO	3146	8901-2320	2006.03.28
16	Horn Antenna	A.H. Systems	SAS-571	414	2006.03.17
17	Horn Antenna	A.H. Systems	SAS-571	781	2006.01.07
18	Loop Antenna	Rohde & Schwarz	HFH2- Z2.335.4711.52	826532/006	2006.01.31
19	Dipole Antenna	Rohde & Schwarz	VHAP	574	2006.12.12
20	Dipole Antenna	Rohde & Schwarz	VHAP	575	2006.12.12
21	Dipole Antenna	Rohde & Schwarz	UHAP	546	2006.12.12
22	Dipole Antenna	Rohde & Schwarz	UHAP	547	2006.12.12
23	Signal Generator	Rohde & Schwarz	SMS	872165/100	2006.04.23
24	Signal Generator	Rohde & Schwarz	SMX	825459/030	2006.05.20
25	Spectrum Monitor	Rohde & Schwarz	EZM	862304/007	None

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26	Panorama Monitor	Rohde & Schwarz	EPN	883707/207	None
27	Spectrum Analyzer	Advantest Corp.	R3261C	61720208	2006.04.23
28	Spcetrum Analyzer	Hewlett Packard	8591A	3205A02641	2005.12.12
29	LISN	EMCO	3825/2	9111-1912	2005.12.12
30	LISN	Solar	8012-50-R-24	8379121	2007.04.25
31	LISN	Kyoritsu	KNW-242	8-923-2	2007.05.28
32	Plotter	Hewlett Packard	7475A	2210A02802	None
33	Modulation Analyzer	Hewlett Packard	8901B	3438A05094	2007.05.19
34	Waveform Generator	Hewlett Packard	33120A	US34001190	2007.05.23
35	Audio analyzer	Hewlett Packard	8903B	3011A12915	2007.05.23
36	Universal counter	Hewlett Packard	5343A	3020A02978	2007.05.23
37	Frequency Counter	Tektronic	CMC251	TW52489	2007.04.23
38	Temperature & Humidity Chamber	TABAI EZPEC CORP.	MC711P	112000492	2006.08.27
39	Antenna Mast	EMCO	1070-3	9109-1617	None
40	Turn Table	EMCO	1080-1,2	9203-1762	None
41	Positioning Controller	EMCO	1090	9111-1054	
42	Antenna Power Supply	Rohde & Schwarz	HZ-9	920127	None
43	Pulse Limiter	Rohde & Schwarz	ESH3-Z2	881052	None
44	Coaxial Take-up Reel	EMCO	100817	9109-1684	None

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