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FCC Part 90 Certification Application

FCC Form 731

For The

JSLM²

UHF ANALOG TELEMETRY RADIO MODEM

FCC ID: NP4-2422140510



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Test 9: Frequency Stability with Variation in Supply Voltage

Test 10: Transient Frequency Behavior

NAME OF TEST: Transmitter Rated Power Output

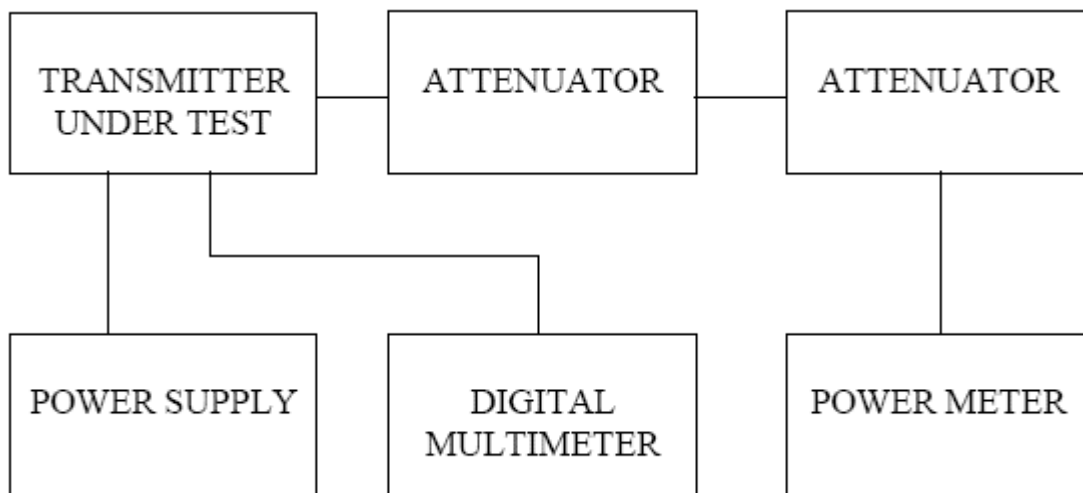
RULE PART NUMBER: 2.1046 (a) (c)

TEST RESULTS: See results below

TEST CONDITIONS: Standard Test Conditions

TEST EQUIPMENT: 50-Ohm Attenuator, Tenuline Model 8340 / 20 dB / 25 Watt
 50-Ohm Attenuator, Tenuline Model 8340 / 10dB / 25 Watt
 Power Supply, Instek Model GPS-2303
 Power Meter, Model HP-436A

TEST SET-UP:



TEST RESULTS:

Frequency (MHz)	DC Voltage at Final (Vdc)	DC Current into Final (Adc)	DC Power into Final (W)	RF Power Output (W)
450	12.50	1.17	14.63	5.0
450	7.2	0.65	4.68	0.1

NAME OF TEST: Frequency Response of Transmitter Audio Low pass Filter

RULE PART NUMBER: 2.1047(a)

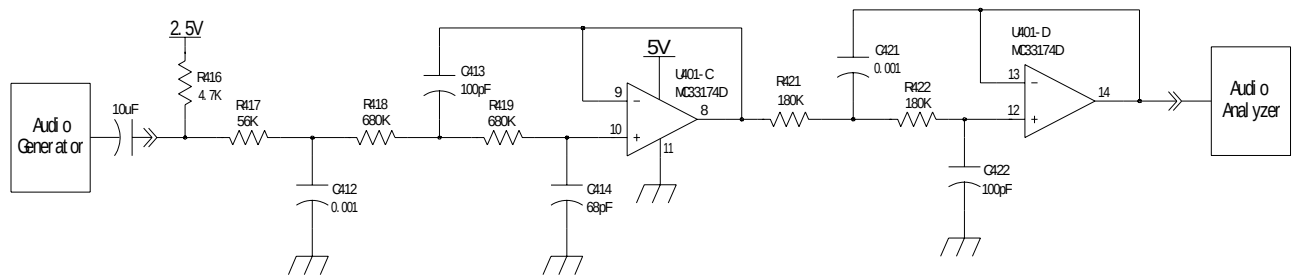
TEST RESULTS: See Graph On Following Page

TEST CONDITIONS: Standard Test Conditions, 25 C

TEST PROCEDURE: TIA/EIA – 603-B, 2.2.15

TEST EQUIPMENT: Audio Generator, Model HP8903A
Audio Analyzer, Model HP8903A

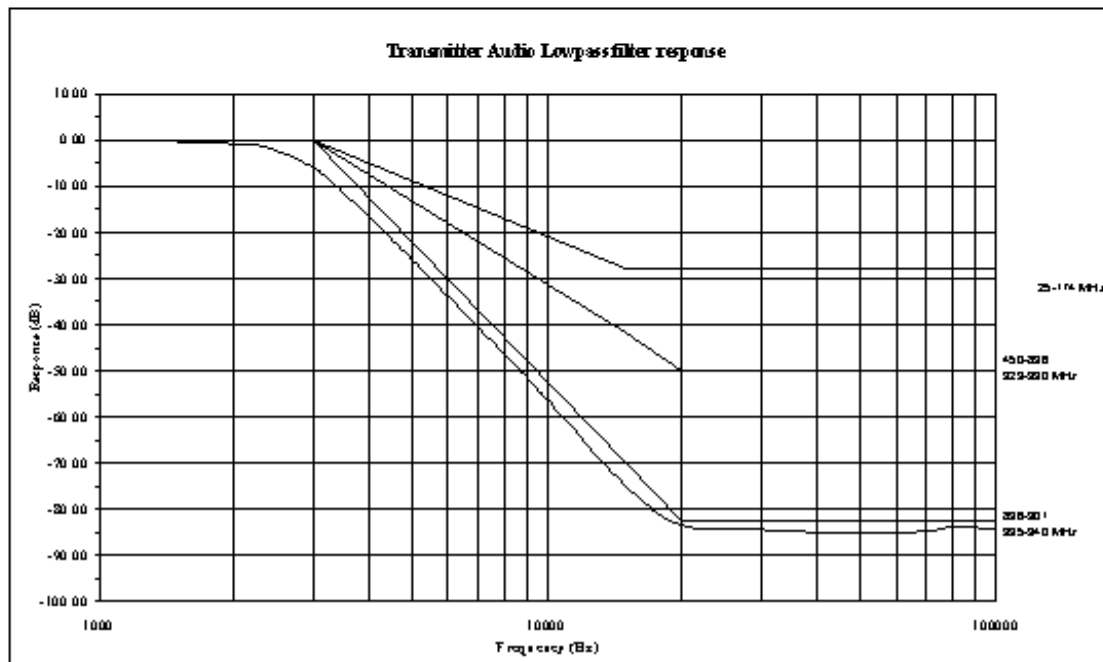
TEST SET-UP: TRANSMIT AUDIO SPLATTER FILTER



TEST RESULTS:

Performance Relative To 1000 Hz, 0 dB

Frequency (Hz)	Response (dB)
100	0.30
500	0.24
700	0.16
1000	0.00
1400	-0.25
2000	-0.82
2400	-1.80
3000	-5.96
3400	-10.20
4000	-16.65
4400	-20.60
5000	-26.00
7000	-40.50
9000	-51.50
10000	-56.30
15000	-75.00
20000	-83.40
30000	-84.40
50000	-85.30
70000	-84.70
80000	-83.90
100000	-84.20



NAME OF TEST: Audio Frequency Response of Transmitter Modulating Circuit

RULE PART NUMBER: 2.1047 (a)

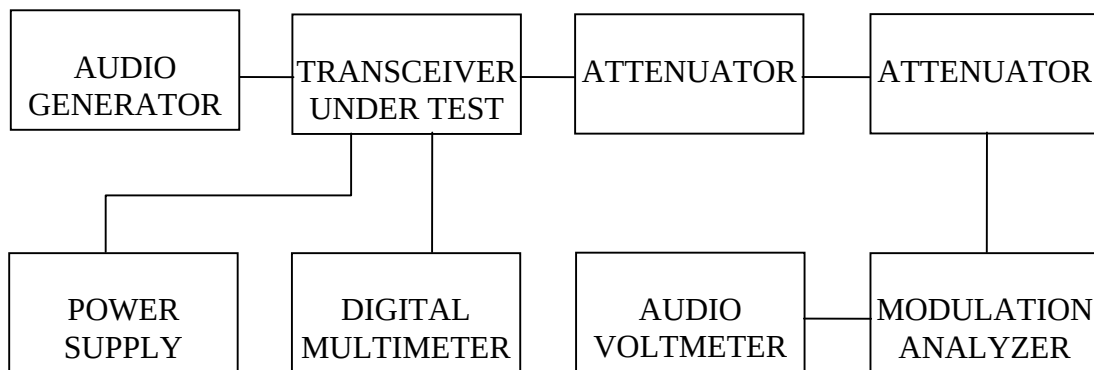
TEST RESULTS: Conforms to minimum standards, see following pages

TEST CONDITIONS: Standard Test Conditions, 25 C

TEST PROCEDURE: TIA/EIA – 603-B, 2.2.6.2.2

TEST EQUIPMENT: 50-Ohm Attenuator, Tenuline Model 8340 / 20 dB / 25 Watt
 50-Ohm Attenuator, Tenuline Model 8340 / 10 dB / 25 Watt
 Modulation Analyzer, Model HP8901A
 Power Supply, Model Instek GPS-2303
 Digital Voltmeter, Fluke Model 8000A
 Audio Generator, Model HP8903A
 Audio Voltmeter, Model HP8903A

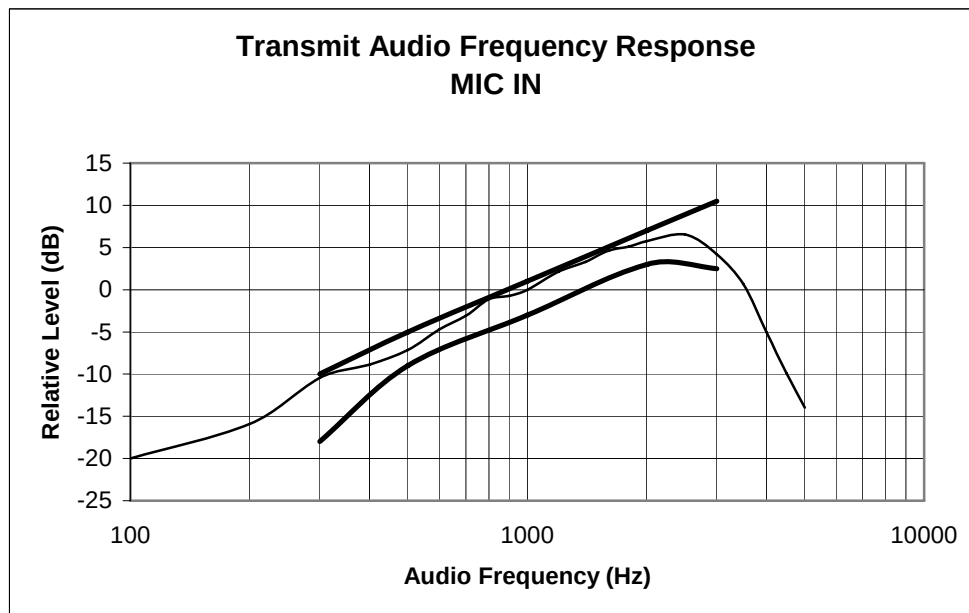
TEST SET-UP:



Reference level (0 dB) = 1.0 kHz deviation with 1000 Hz tone at audio input of loader board.

MIC IN

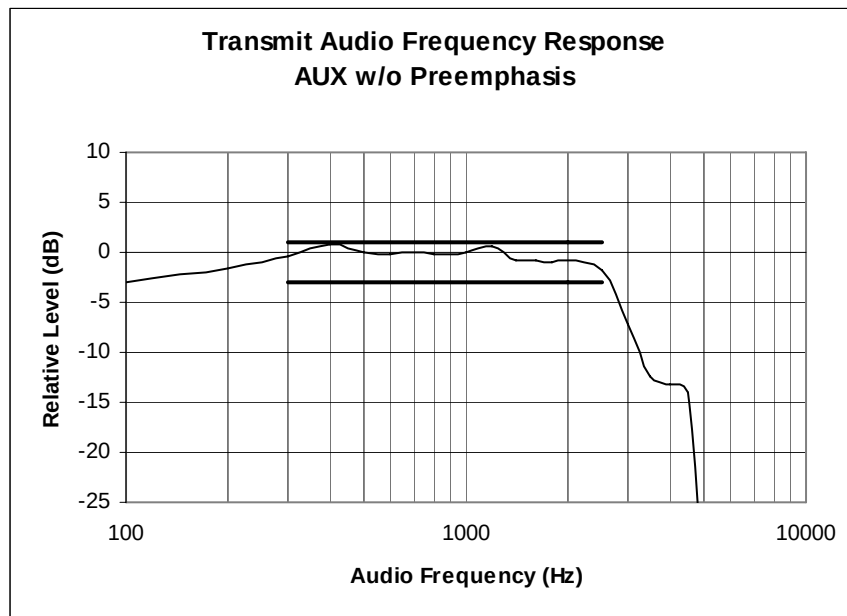
Frequency (Hz)	Relative Level (dB)
100	-20.00
200	-15.92
300	-10.46
400	-8.87
500	-7.13
600	-4.73
700	-3.10
800	-1.11
900	-0.72
1000	0.00
1200	2.14
1400	3.29
1600	4.61
1800	5.11
2000	5.76
2500	6.53
3000	4.19
3500	0.67
4000	-5.04
4500	-9.90
5000	-13.98



Reference level (0 dB) = 1.0 kHz deviation with 1000 Hz tone at audio input of loader board.

AUX w/o Pre-emphasis

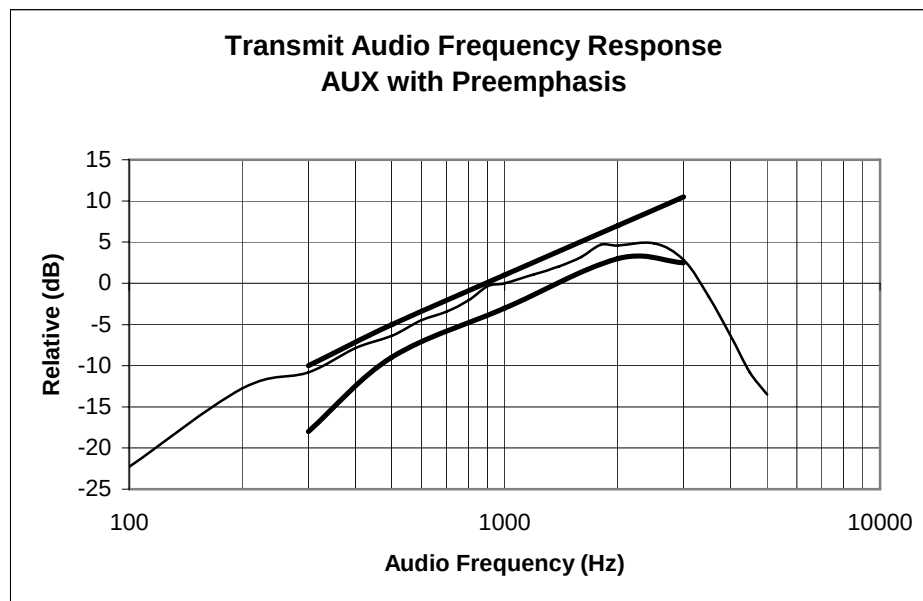
Frequency (Hz)	Relative Level (dB)
100	-3.10
200	-1.51
300	-0.35
400	0.83
500	0.00
600	-0.18
700	0.00
800	-0.18
900	-0.18
1000	0.00
1200	0.51
1400	-0.72
1600	-0.72
1800	-0.92
2000	-0.72
2500	-1.72
3000	-7.13
3500	-12.40
4000	-13.15
4500	-13.98
5000	-33.98



Reference level (0 dB) = 1.0 kHz deviation with 1000 Hz tone at audio input of loader board.

AUX with Pre-emphasis

Frequency (Hz)	Relative Level (dB)
100	-22.28
200	-12.74
300	-10.80
400	-7.88
500	-6.36
600	-4.49
700	-3.44
800	-2.06
900	-0.34
1000	0.00
1200	1.10
1400	2.07
1600	3.18
1800	4.67
2000	4.57
2500	4.86
3000	2.83
3500	-1.65
4000	-6.36
4500	-10.80
5000	-13.49



NAME OF TEST: Modulation Limiting

RULE PART NUMBER: 2.1047(b)

MINIMUM STANDARD: Shall not exceed 2.5 kHz deviation from 300 Hz to 3000 Hz

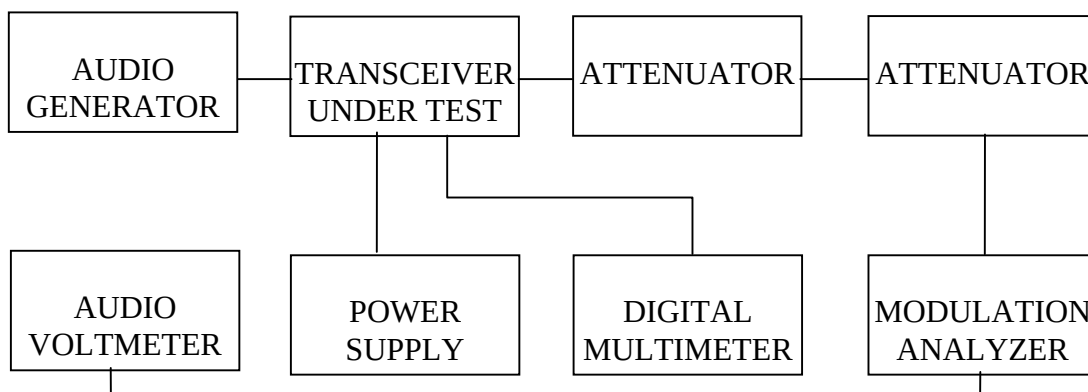
TEST RESULTS: Conforms to minimum standards

TEST CONDITIONS: Standard Test Conditions, 25 C

TEST PROCEDURE: TIA/EIA – 603-B, 2.2.3

TEST EQUIPMENT: 50-Ohm Attenuator, Tenuline Model 8340 / 20 dB / 25 Watt
 50-Ohm Attenuator, Tenuline Model 8340 / 10 dB / 25 Watt
 Modulation Analyzer, Model HP8901A
 Power Supply, Model Instek GPS-2303
 Digital Voltmeter, Fluke Model 8000A
 Audio Generator, Model HP8903A
 Audio Voltmeter, Model HP8903A

TEST SET-UP:

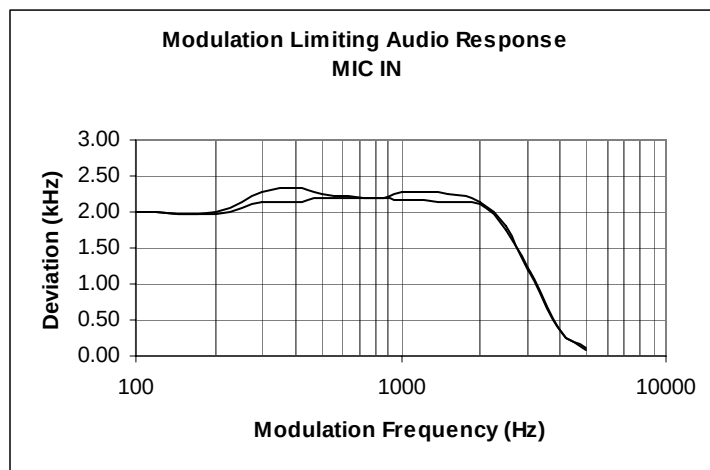


DEVIATION LIMITING WITH INPUT VOLTAGE
20 dB ABOVE 60% RATED DEVIATION AT 300 Hz

For 11K0F3E

MIC IN

Mod. Freq	Pos Dev	Neg Dev
Hz	(kHz)	(kHz)
100	1.99	1.99
200	1.99	1.97
300	2.29	2.13
400	2.32	2.14
500	2.26	2.19
800	2.20	2.19
1000	2.29	2.18
1500	2.24	2.13
2000	2.13	2.11
2500	1.81	1.76
3000	1.20	1.22
4000	0.35	0.36
5000	0.12	0.09

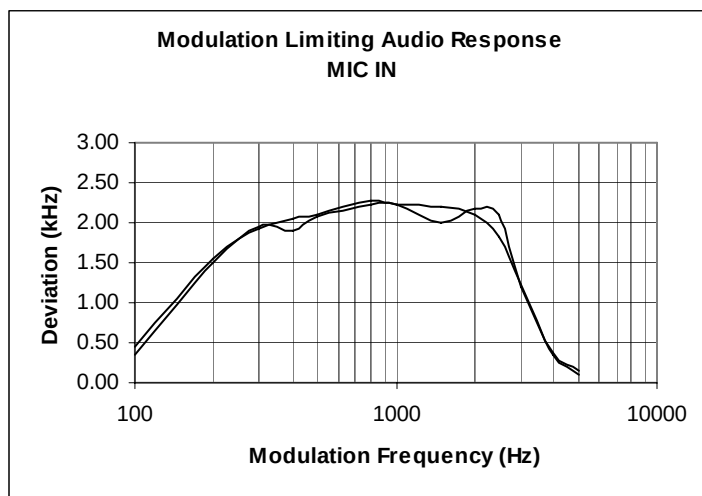


DEVIATION LIMITING WITH INPUT VOLTAGE
20 dB ABOVE 60% RATED DEVIATION AT 1000 Hz

For 11K0F3E

MIC IN

Mod. Freq	Pos Dev	Neg Dev
Hz	(kHz)	(kHz)
100	0.45	0.35
200	1.55	1.50
300	1.92	1.95
400	2.04	1.91
500	2.11	2.07
800	2.27	2.22
1000	2.22	2.22
1500	2.20	2.00
2000	2.11	2.18
2500	1.83	2.10
3000	1.22	1.19
4000	0.34	0.37
5000	0.10	0.16

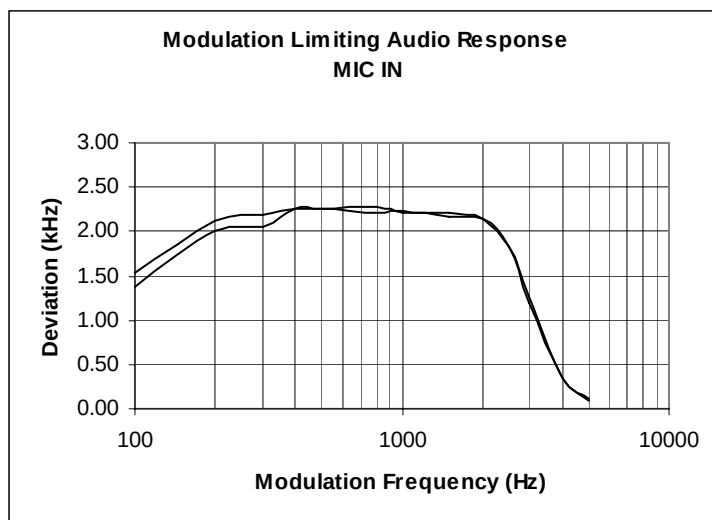


DEVIATION LIMITING WITH INPUT VOLTAGE
20 dB ABOVE 60% RATED DEVIATION AT 3000 Hz

For 11K0F3E

MIC IN

Mod. Freq	Pos Dev	Neg Dev
Hz	(kHz)	(kHz)
100	1.53	1.37
200	2.12	2.01
300	2.19	2.05
400	2.26	2.26
500	2.25	2.26
800	2.28	2.22
1000	2.22	2.23
1500	2.20	2.16
2000	2.15	2.14
2500	1.82	1.82
3000	1.26	1.19
4000	0.33	0.34
5000	0.12	0.09

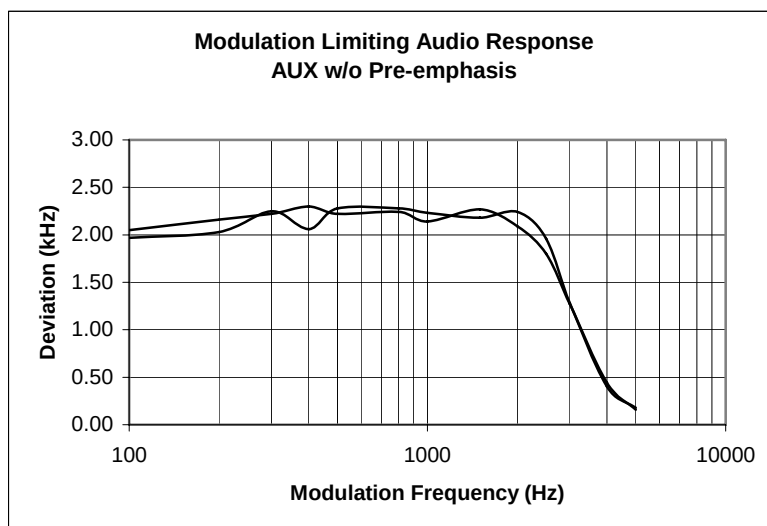


DEVIATION LIMITING WITH INPUT VOLTAGE
20 dB ABOVE 60% RATED DEVIATION AT 300 Hz

For 11K0F3E

AUX w/o Pre-emphasis

Mod. Freq	Pos Dev	Neg Dev
Hz	(kHz)	(kHz)
100	1.97	2.05
200	2.03	2.16
300	2.25	2.22
400	2.06	2.30
500	2.28	2.22
800	2.28	2.24
1000	2.23	2.14
1500	2.18	2.27
2000	2.24	2.09
2500	1.96	1.80
3000	1.28	1.27
4000	0.40	0.44
5000	0.18	0.16

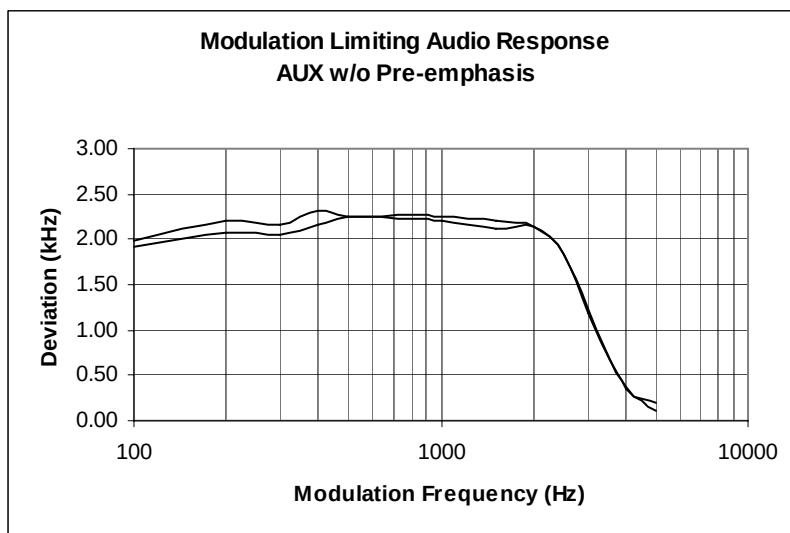


DEVIATION LIMITING WITH INPUT VOLTAGE
20 dB ABOVE 60% RATED DEVIATION AT 1000 Hz

For 11K0F3E

AUX w/o Pre-emphasis

Mod. Freq	Pos Dev	Neg Dev
Hz	(kHz)	(kHz)
100	1.92	1.98
200	2.08	2.20
300	2.05	2.16
400	2.16	2.31
500	2.26	2.25
800	2.22	2.27
1000	2.20	2.26
1500	2.12	2.20
2000	2.15	2.15
2500	1.82	1.83
3000	1.20	1.23
4000	0.38	0.35
5000	0.10	0.20

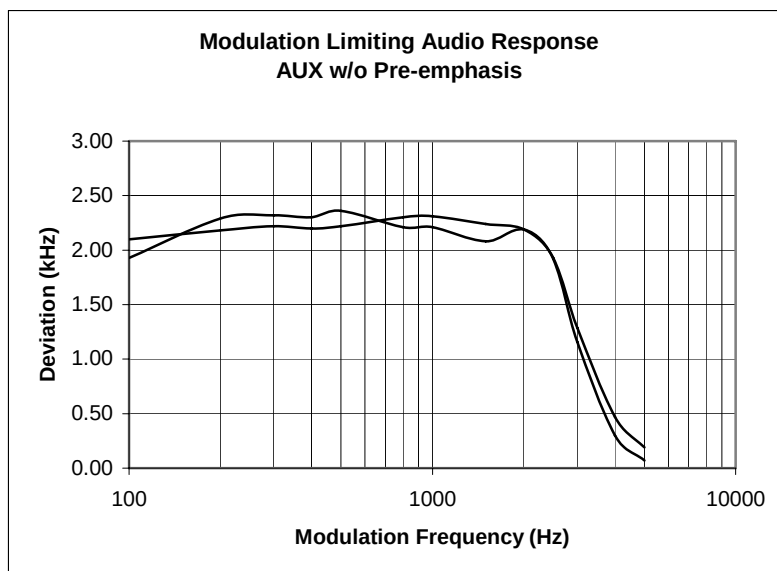


DEVIATION LIMITING WITH INPUT VOLTAGE
20 dB ABOVE 60% RATED DEVIATION AT 3000 Hz

For 11K0F3E

AUX w/o Pre-emphasis

Mod. Freq	Pos Dev	Neg Dev
Hz	(kHz)	(kHz)
100	2.10	1.93
200	2.18	2.29
300	2.22	2.32
400	2.20	2.30
500	2.22	2.36
800	2.30	2.21
1000	2.31	2.21
1500	2.24	2.08
2000	2.19	2.19
2500	1.93	1.92
3000	1.29	1.16
4000	0.47	0.30
5000	0.19	0.07

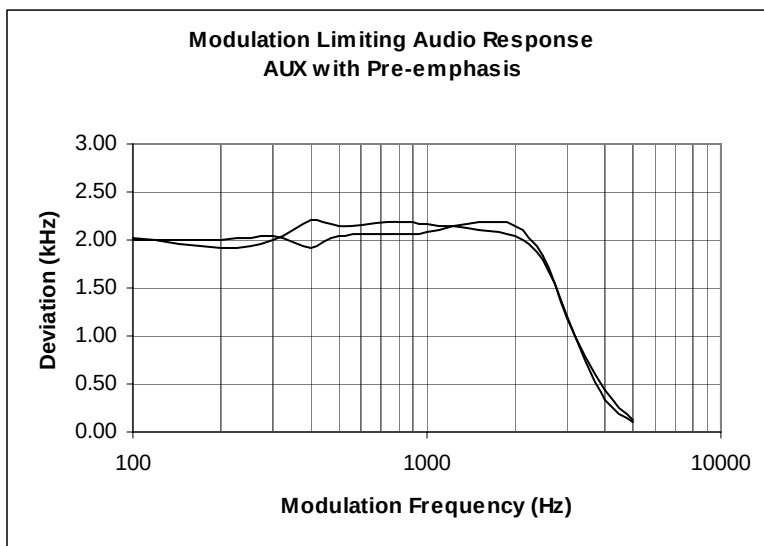


DEVIATION LIMITING WITH INPUT VOLTAGE
20 dB ABOVE 60% RATED DEVIATION AT 300 Hz

For 11K0F3E

AUX with Pre-emphasis

Mod. Freq	Pos Dev	Neg Dev
Hz	(kHz)	(kHz)
100	1.99	2.02
200	2.00	1.91
300	2.05	1.99
400	1.92	2.21
500	2.05	2.15
800	2.07	2.19
1000	2.08	2.17
1500	2.19	2.10
2000	2.14	2.05
2500	1.84	1.79
3000	1.19	1.21
4000	0.43	0.34
5000	0.12	0.10

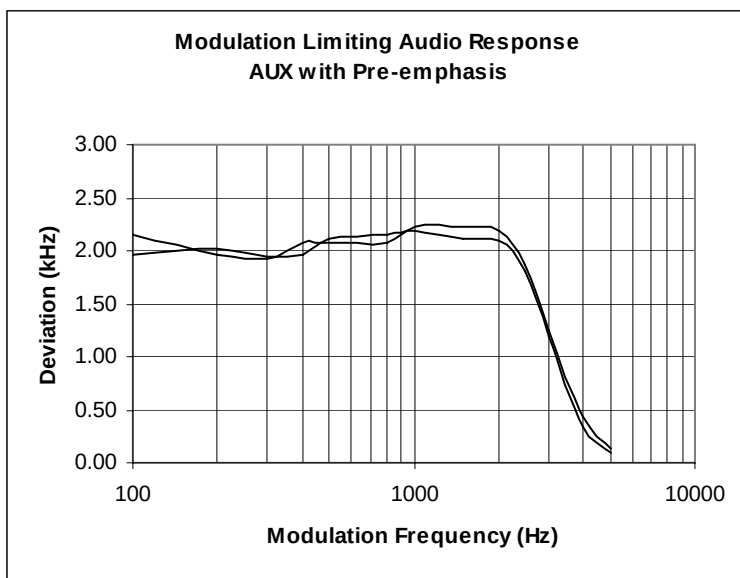


DEVIATION LIMITING WITH INPUT VOLTAGE
20 dB ABOVE 60% RATED DEVIATION AT 1000 Hz

For 11K0F3E

AUX with Pre-emphasis

Mod. Freq	Pos Dev	Neg Dev
Hz	(kHz)	(kHz)
100	2.15	1.96
200	1.97	2.02
300	1.92	1.94
400	2.08	1.97
500	2.08	2.12
800	2.08	2.16
1000	2.22	2.18
1500	2.22	2.12
2000	2.18	2.10
2500	1.86	1.82
3000	1.24	1.18
4000	0.44	0.34
5000	0.14	0.10

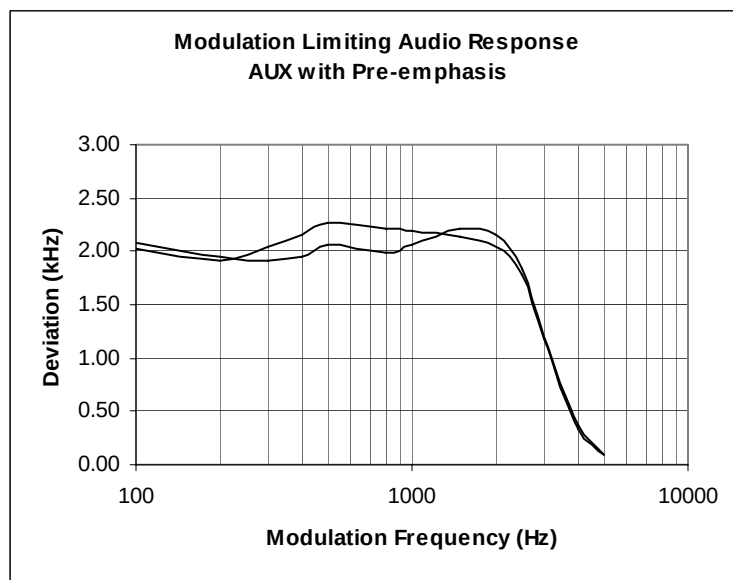


DEVIATION LIMITING WITH INPUT VOLTAGE
20 dB ABOVE 60% RATED DEVIATION AT 3000 Hz

For 11K0F3E

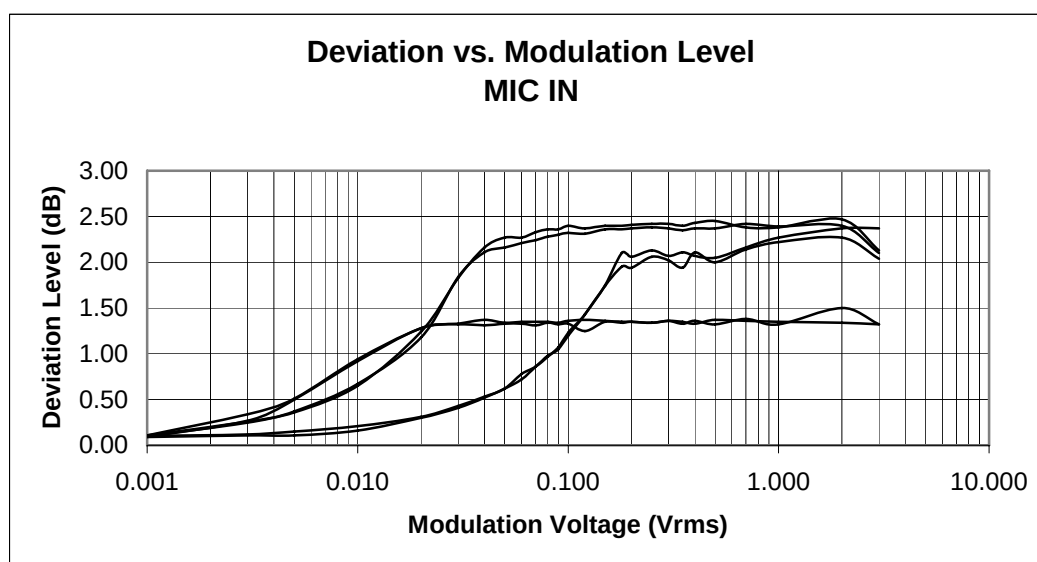
AUX with Pre-emphasis

Mod. Freq	Pos Dev	Neg Dev
Hz	(kHz)	(kHz)
100	2.09	2.03
200	1.95	1.92
300	1.91	2.04
400	1.95	2.16
500	2.06	2.26
800	1.98	2.21
1000	2.06	2.20
1500	2.22	2.14
2000	2.15	2.05
2500	1.83	1.78
3000	1.20	1.18
4000	0.38	0.33
5000	0.10	0.09



Modulation Versus Input Voltage for
11K0F3E
MIC IN

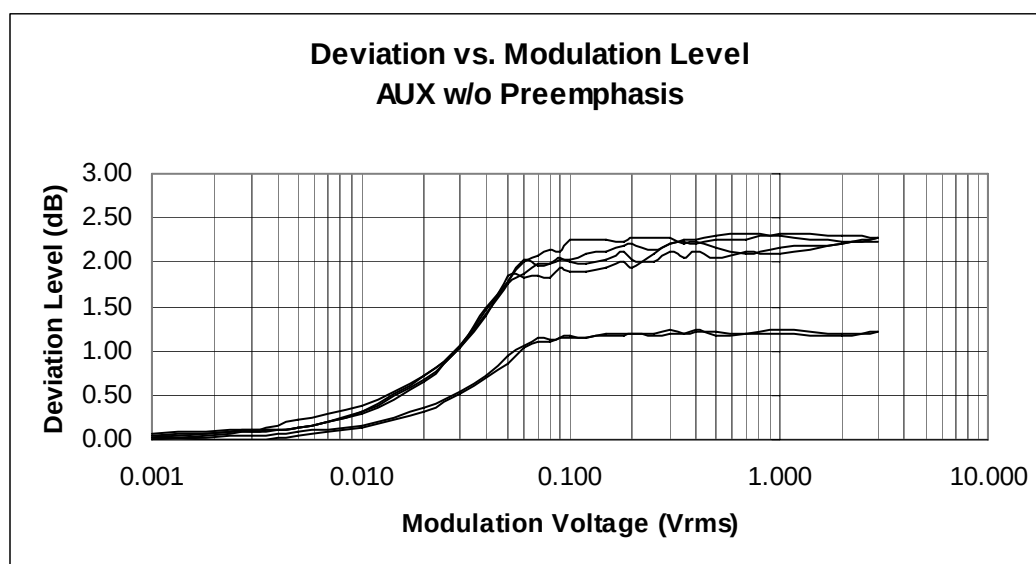
Input Voltage (Vrms)	FM=300 Hz		FM=1000 Hz		FM=3000 Hz	
	Pos Dev	Neg Dev	Pos Dev	Neg Dev	Pos Dev	Neg Dev
0.000	0.10	0.09	0.11	0.10	0.11	0.09
0.003	0.12	0.11	0.26	0.25	0.34	0.27
0.005	0.15	0.11	0.36	0.37	0.51	0.50
0.010	0.21	0.16	0.65	0.67	0.94	0.92
0.020	0.31	0.30	1.24	1.18	1.28	1.28
0.030	0.43	0.41	1.83	1.84	1.33	1.32
0.040	0.53	0.52	2.16	2.11	1.37	1.31
0.050	0.62	0.62	2.27	2.16	1.34	1.33
0.060	0.78	0.72	2.27	2.21	1.35	1.33
0.070	0.86	0.86	2.33	2.24	1.35	1.31
0.080	0.97	0.98	2.36	2.28	1.35	1.34
0.090	1.07	1.05	2.36	2.30	1.34	1.32
0.100	1.23	1.20	2.40	2.32	1.36	1.33
0.120	1.43	1.43	2.37	2.31	1.37	1.25
0.150	1.75	1.74	2.40	2.36	1.36	1.35
0.180	2.10	1.95	2.40	2.36	1.35	1.34
0.200	2.06	1.94	2.41	2.37	1.35	1.35
0.250	2.13	2.06	2.42	2.38	1.34	1.34
0.300	2.07	2.02	2.42	2.37	1.36	1.36
0.350	2.11	1.94	2.40	2.35	1.35	1.33
0.400	2.07	2.11	2.43	2.37	1.33	1.36
0.500	2.05	2.00	2.45	2.37	1.37	1.32
0.700	2.16	2.14	2.38	2.42	1.36	1.38
1.000	2.27	2.22	2.38	2.39	1.35	1.32
2.000	2.37	2.27	2.47	2.40	1.34	1.50
3.000	2.37	2.04	2.13	2.10	1.32	1.32



Modulation Versus Input Voltage for
11K0F3E

AUX w/o Pre-emphasis

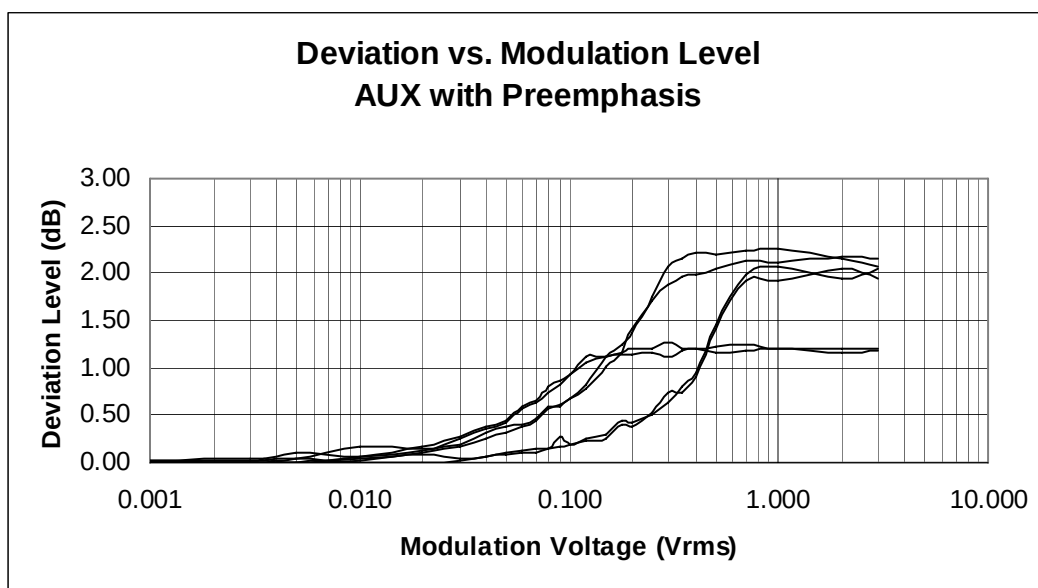
Input Voltage (Vrms)	FM=300 Hz		FM=1000 Hz		FM=3000 Hz	
	Pos Dev	Neg Dev	Pos Dev	Neg Dev	Pos Dev	Neg Dev
0.000	0.06	0.01	0.05	0.04	0.02	0.03
0.003	0.11	0.08	0.11	0.09	0.04	0.00
0.005	0.14	0.13	0.22	0.14	0.08	0.04
0.010	0.32	0.30	0.38	0.32	0.16	0.14
0.020	0.72	0.65	0.72	0.68	0.36	0.32
0.030	1.06	1.03	1.06	1.03	0.55	0.51
0.040	1.49	1.39	1.47	1.43	0.72	0.71
0.050	1.79	1.85	1.79	1.76	0.94	0.85
0.060	2.04	1.82	2.00	1.88	1.05	1.04
0.070	1.96	1.85	2.08	1.99	1.15	1.11
0.080	1.98	1.83	2.14	1.98	1.12	1.11
0.090	2.05	1.95	2.13	2.04	1.15	1.15
0.100	2.00	1.90	2.25	2.03	1.18	1.14
0.120	1.99	1.89	2.26	2.10	1.16	1.14
0.150	2.03	1.93	2.26	2.13	1.20	1.17
0.180	2.11	2.00	2.24	2.18	1.20	1.17
0.200	2.04	1.94	2.27	2.20	1.20	1.20
0.250	2.00	2.10	2.27	2.15	1.20	1.18
0.300	2.13	2.20	2.28	2.22	1.24	1.19
0.350	2.06	2.24	2.20	2.26	1.20	1.20
0.400	2.13	2.20	2.23	2.26	1.21	1.25
0.500	2.06	2.26	2.16	2.30	1.21	1.17
0.700	2.11	2.25	2.10	2.33	1.20	1.20
1.000	2.09	2.32	2.17	2.31	1.23	1.20
2.000	2.20	2.30	2.22	2.23	1.19	1.17
3.000	2.28	2.27	2.27	2.23	1.21	1.22



Modulation Versus Input Voltage for
11K0F3E

AUX with Pre-emphasis

Input Voltage (Vrms)	FM=300 Hz		FM=1000 Hz		FM=3000 Hz	
	Pos Dev	Neg Dev	Pos Dev	Neg Dev	Pos Dev	Neg Dev
0.000	0.02	0.00	0.01	0.03	0.03	0.01
0.003	0.04	0.03	0.01	0.00	0.03	0.01
0.005	0.00	0.04	0.04	0.01	0.10	0.01
0.010	0.04	0.01	0.16	0.02	0.07	0.06
0.020	0.08	0.00	0.14	0.10	0.17	0.12
0.030	0.05	0.02	0.19	0.16	0.28	0.26
0.040	0.07	0.07	0.32	0.25	0.37	0.35
0.050	0.10	0.08	0.39	0.32	0.45	0.43
0.060	0.13	0.10	0.40	0.37	0.59	0.56
0.070	0.15	0.10	0.47	0.45	0.66	0.63
0.080	0.14	0.14	0.59	0.57	0.80	0.73
0.090	0.27	0.16	0.60	0.61	0.87	0.82
0.100	0.19	0.18	0.68	0.67	0.94	0.94
0.120	0.25	0.24	0.83	0.79	1.12	1.05
0.150	0.30	0.25	1.12	1.01	1.13	1.11
0.180	0.44	0.40	1.25	1.16	1.17	1.14
0.200	0.43	0.38	1.37	1.41	1.20	1.14
0.250	0.50	0.52	1.75	1.71	1.21	1.17
0.300	0.64	0.74	2.08	1.87	1.27	1.12
0.350	0.80	0.75	2.16	1.97	1.21	1.18
0.400	0.96	0.90	2.21	1.98	1.20	1.21
0.500	1.46	1.42	2.19	2.04	1.22	1.17
0.700	1.98	1.92	2.24	2.14	1.25	1.19
1.000	2.08	1.93	2.26	2.12	1.21	1.21
2.000	1.94	2.04	2.16	2.17	1.20	1.17
3.000	2.05	1.94	2.07	2.16	1.20	1.19



NAME OF TEST: Transmitter Occupied Bandwidth for Emission Designator

RULE PART NUMBER: 2.202, 90.209 (b)(5), 90.210(d), 2.1049 (c) (1)

MINIMUM STANDARDS: **Mask D**
 Sidebands and Spurious [Rule 90.210 (d), P = 5 Watts and P=0.1 Watt]
 Authorized Bandwidth = 11.25 kHz [Rule 90.209(b) (5)]
 From Fo to 5.625 kHz, down 0 dB.
 Greater than 5.625 kHz to 12.5 kHz, down 7.27($f_d - 2.88\text{kHz}$) dB.
 Greater than 12.5 kHz, at least $50 + 10\log_{10}(P)$ or 70 dB, which ever is the lesser attenuation

Attenuation = 0 dB at Fo to 5.625 kHz
 Attenuation = 20 dB at 5.625 kHz and 70 dB at 12.5 kHz
 Attenuation = 57 dB at greater than 12.5 kHz @ 5 Watts
 Attenuation = 40 dB at greater than 12.5 kHz @ 0.1 Watt

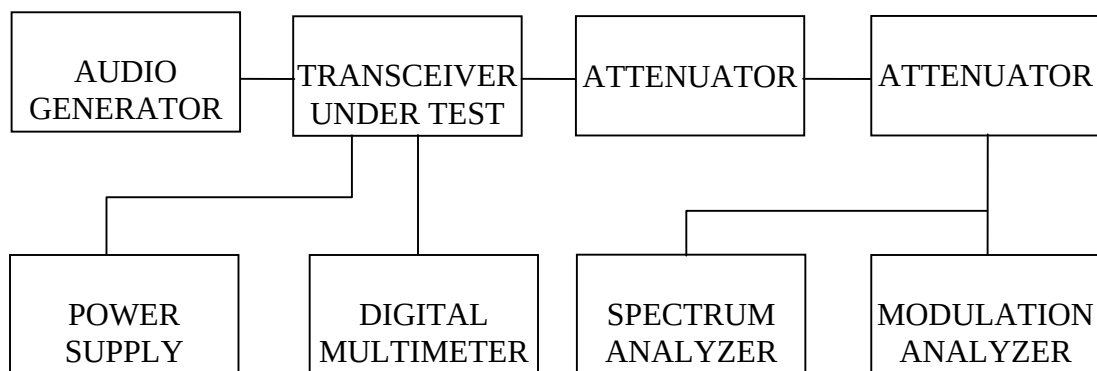
TEST RESULTS: Meets minimum standards (see data on following page)
 With 2.5 kHz deviation

TEST CONDITIONS: Standard Test Conditions, 25 C

TEST PROCEDURE: TIA/EIA – 603-B, 2.2.13, 3.2.11.2

TEST EQUIPMENT: 50-Ohm Attenuators, Pasternack Model PE4131 / 10 dB / 20 Watt
 50-Ohm Attenuators, MCL Model 5W-S20 / 20 dB / 5 Watt
 50-Ohm Attenuators, Inmet Model 6B-10W / 20 dB / 10 Watt
 Power Supply, Instek Model GPS-2303
 Spectrum Analyzer, Agilent Model E4404B
 Audio Generator, Model HP 8903A
 Modulation Analyzer, Model HP8901A

TEST SET-UP:



MODULATION SOURCE DESCRIPTION:

HP-8903A was used to provide modulation at 2.5 kHz. The audio signal was applied to the audio input of the DL-3232 loader board. Deviation was set via the loader board

NECESSARY BANDWIDTH CALCULATION

$$B_n = 2M + 2DK$$

M= 3000 Hz. This is the highest modulating frequency widely recognized by the industry as a standard for voice.

D = 2500 Hz. This is the maximum deviation.

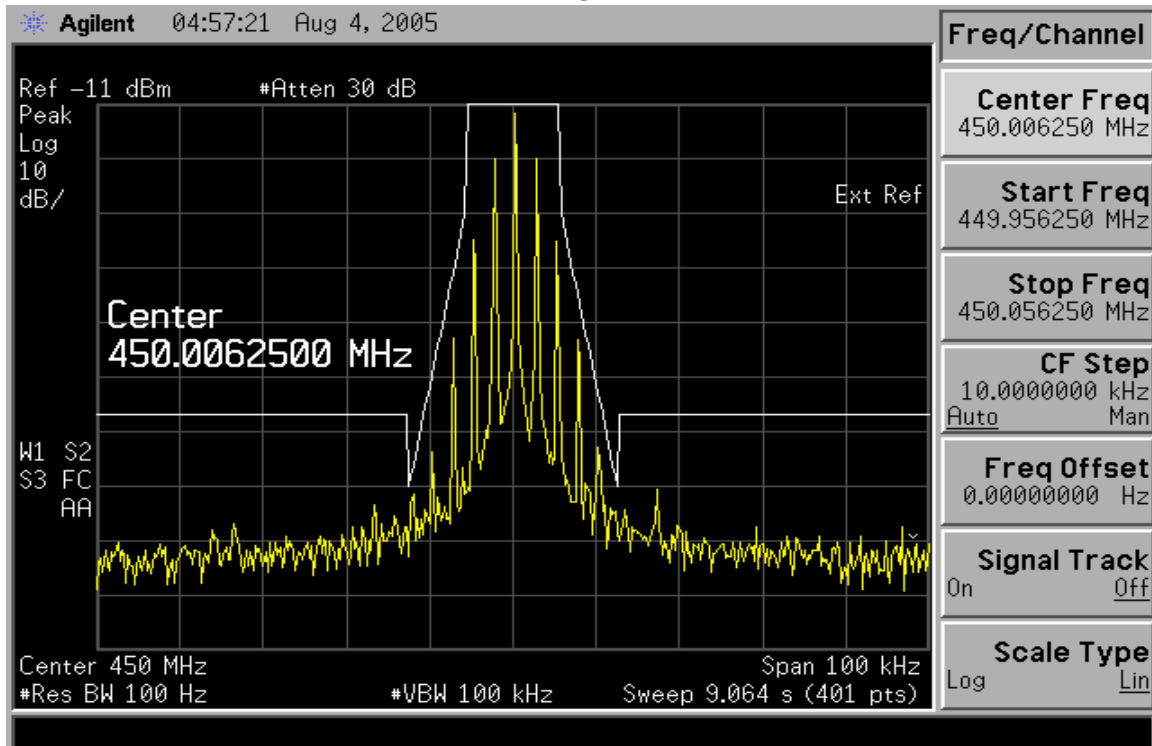
$$K = 1$$

$$B_n = 2(3000) + 2(2500)(1) = 11,000 \text{ Hz.}$$

The corresponding emission designator prefix for necessary bandwidth = **11K0**.

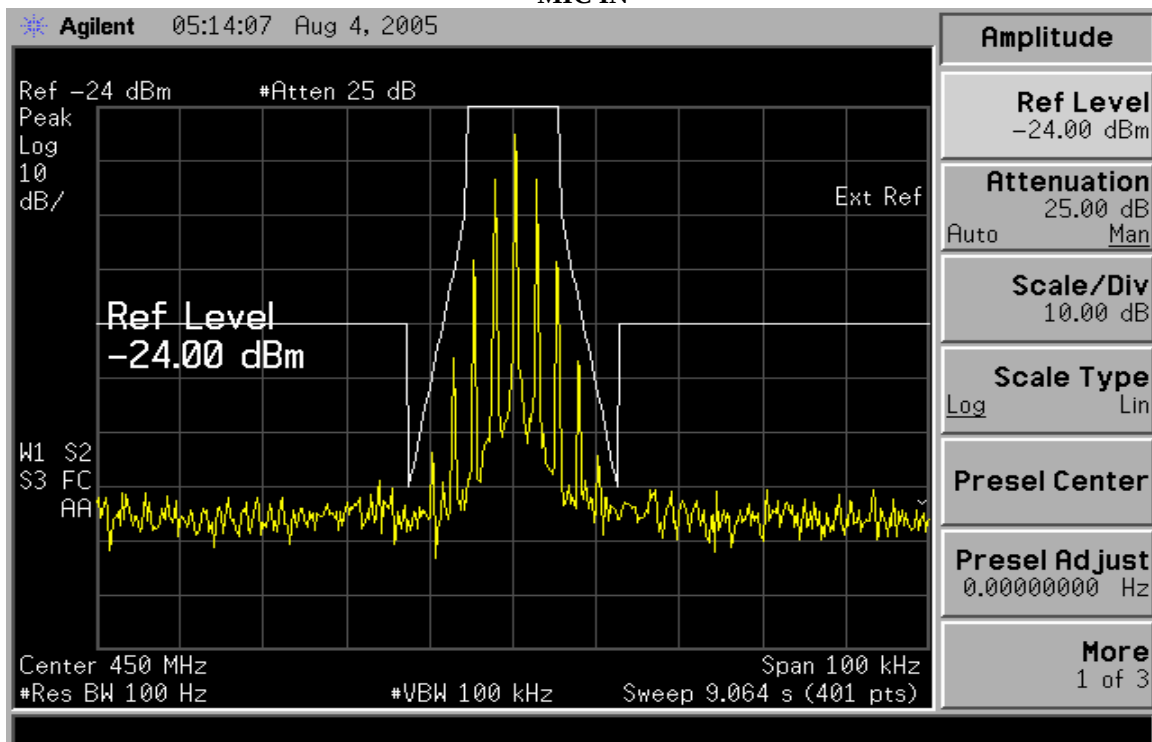
Frequency: 450.00625 MHz
Power: 5 W

MIC IN



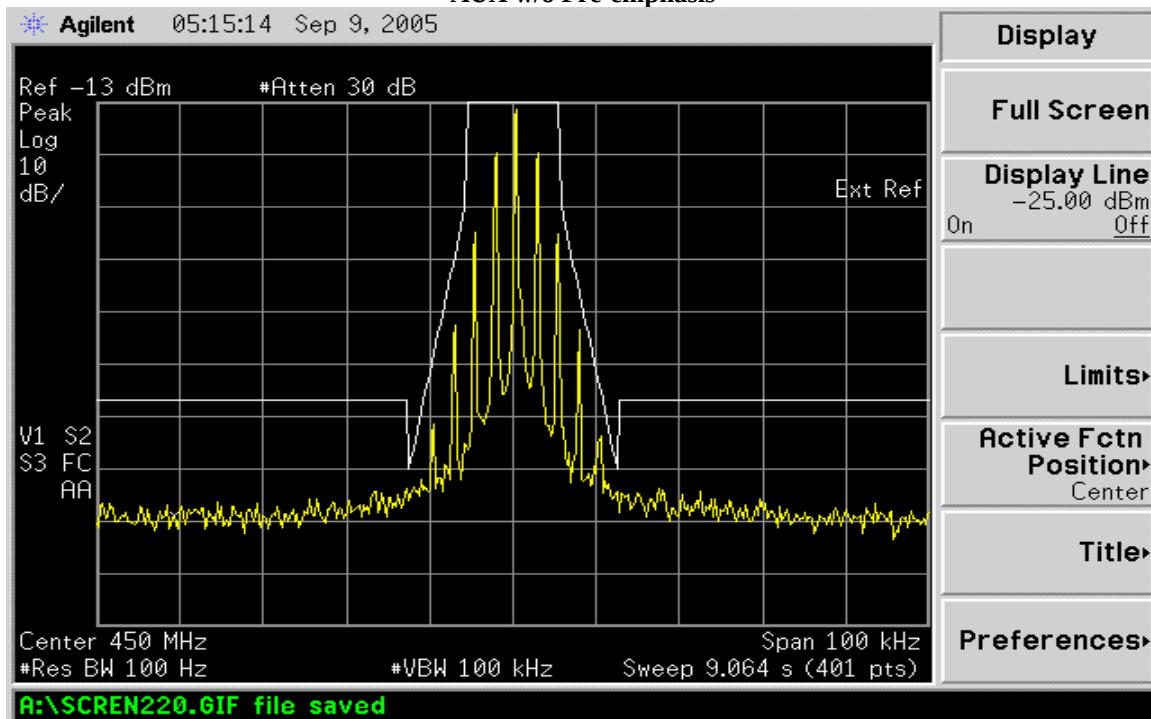
Frequency: 450.00625 MHz
Power: 0.1 W

MIC IN



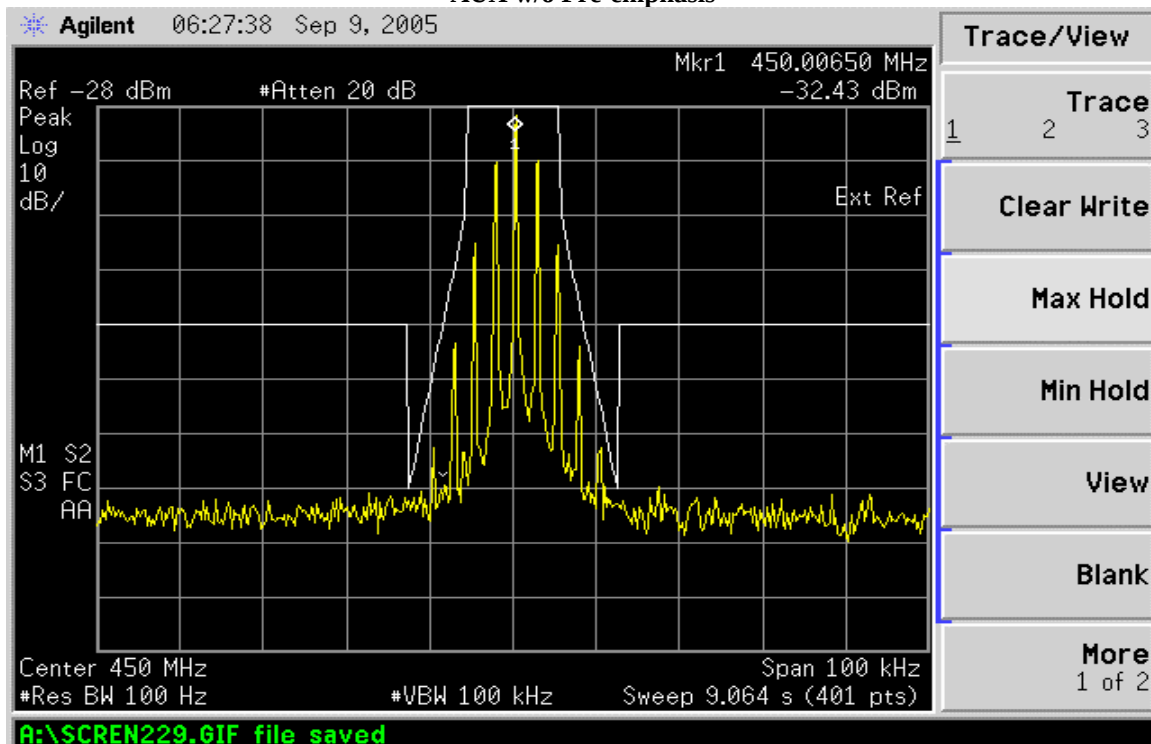
Frequency: 450.00625 MHz
Power: 5W

AUX w/o Pre-emphasis

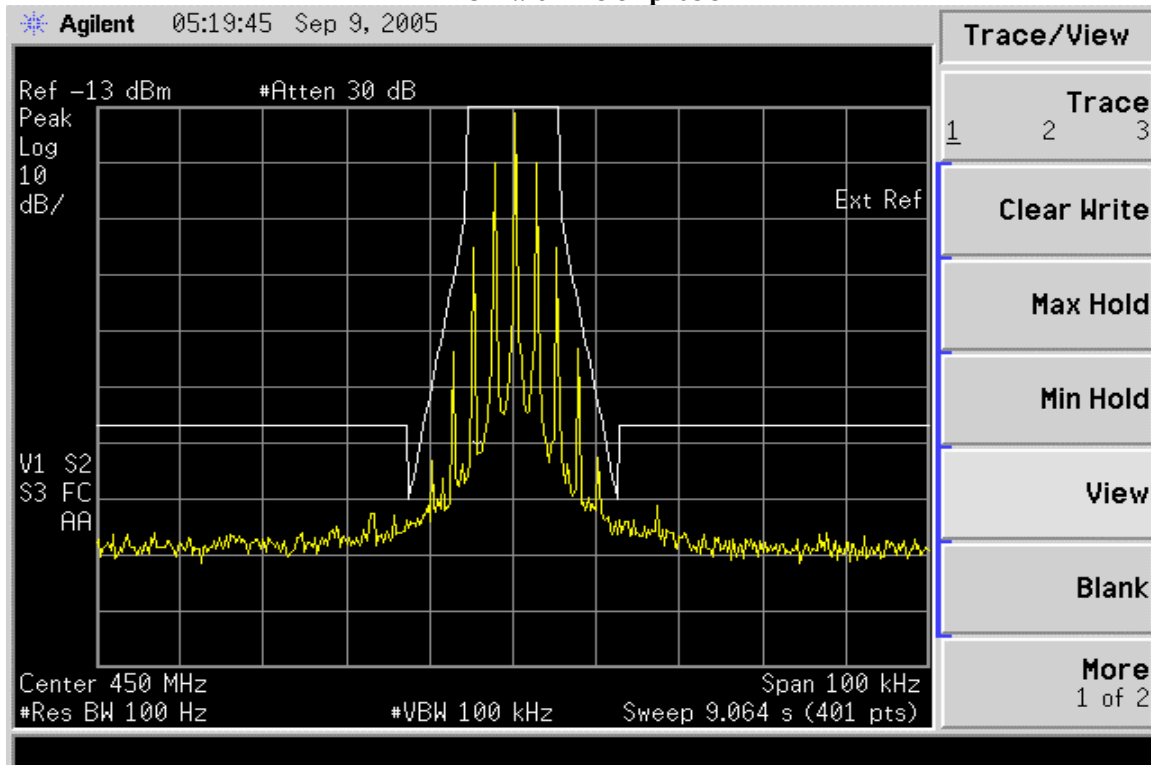


Frequency: 450.00625 MHz
Power: 0.1W

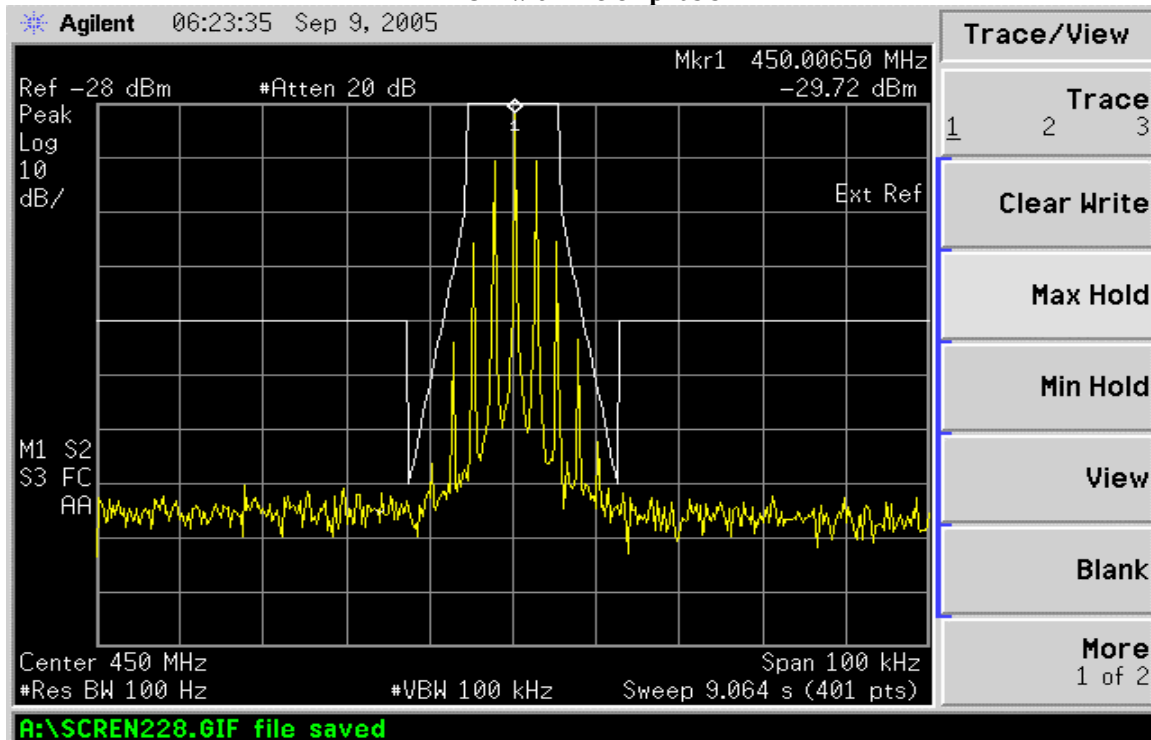
AUX w/o Pre-emphasis



Frequency: 450.00625 MHz
Power: 5W

AUX with Pre-emphasis

Frequency: 450.00625 MHz
Power: 0.1W

AUX with Pre-emphasis

NAME OF TEST: Transmitter Spurious and Harmonic Outputs

RULE PART NUMBER: 2.1051, 90.210 (d)(3)

MINIMUM STANDARDS: For 5 Watts; $50+10\log_{10}(5 \text{ Watts}) = -57 \text{ dBc}$
 For 0.1 Watts; $50+10\log_{10}(0.1 \text{ Watts}) = -40 \text{ dBc}$
 or -70 dBc whichever is the lesser attenuation.

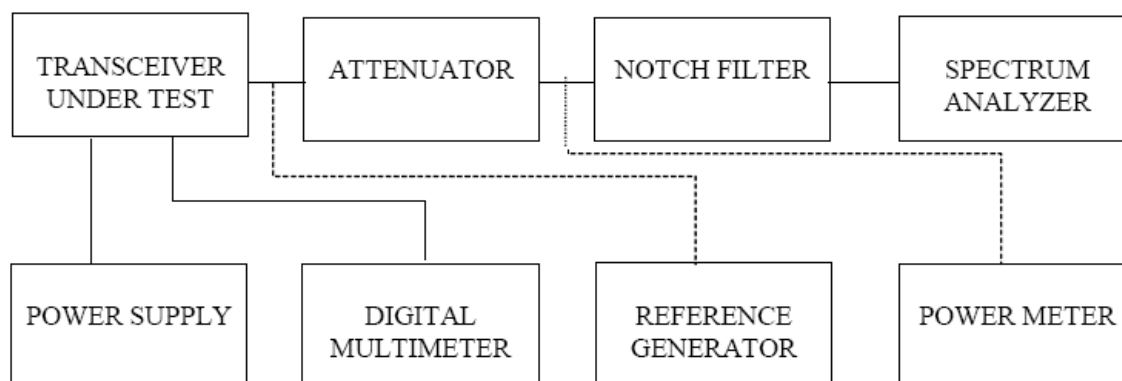
TEST RESULTS: Meets minimum standards (see data on following page)

TEST CONDITIONS: Standard Test Conditions, 25 C
 RF Voltage measured at antenna terminals

TEST PROCEDURE: TIA/EIA – 603-B, 2.2.13

TEST EQUIPMENT: 50-Ohm Attenuators, Pasternack Model PE4131 / 10 dB / 20 Watt
 50-Ohm Attenuators, MCL Model 5W-S20 / 20 dB / 5 Watt
 50-Ohm Attenuators, Inmet Model 6B-10W / 20 dB / 10 Watt
 Power Supply, Instek Model GPS-2303
 Spectrum Analyzer, Advantest Model R3265A
 Reference Generator, Agilent Model E82570
 Notch Filter

TEST SET-UP:



MEASUREMENT PROCEDURE:

1. The transmitter carrier output frequency is 406.000, 430.000, 450.000, and 470.000. The reference oscillator frequency is 17.5000 MHz. The transmitter has voltage levels at 12.5 Volts and 7.2 Volts.
2. After the carrier reference was established on the spectrum analyzer, the notch filter was adjusted to null the carrier fundamental to extend the range of the spectrum analyzer for harmonic measurements.
3. At each spurious frequency, generation substitution was used to establish the true spurious level.
4. The spectrum was scanned to the 10th harmonic

TEST DATA:

$F_o = 406.000$ MHz

12.5 Volts @ 5 Watts = 37.0 dBm

Spec = -57 dBc

Harmonic	Frequency (MHz)	Level Relative to Carrier (dBc)	Passed by (dB)
2	812	-66.01	-9.01
3	1218	-71.52	-14.52
4	1624	-86.20	-29.20
5	2030	-86.69	-29.69
6	2436	-76.98	-19.98
7	2842	-89.78	-32.78
8	3248	-92.19	-35.19
9	3654	-93.12	-36.12
10	4060	-97.34	-40.34

$F_o = 430.000$ MHz

12.5 Volts @ 5 Watts = 37.0 dBm

Spec = -57 dBc

Harmonic	Frequency (MHz)	Level Relative to Carrier (dBc)	Passed by (dB)
2	860	-66.22	-9.22
3	1290	-70.01	-13.01
4	1720	-88.17	-31.17
5	2150	-88.51	-31.51
6	2580	-77.41	-20.41
7	3010	-93.39	-36.39
8	3440	-92.37	-35.37
9	3870	-92.09	-35.09
10	4300	-92.08	-35.08

$F_o = 450.000 \text{ MHz}$

12.5 Volts @ 5 Watts = 37.0 dBm

Spec = -57 dBc

Harmonic	Frequency (MHz)	Level (dBc)	Passed by (dB)
2	900	-62.50	-5.50
3	1350	-68.30	-11.30
4	1800	-90.40	-33.40
5	2250	-91.50	-34.50
6	2700	-84.30	-27.30
7	3150	-95.00	-38.00
8	3600	-94.70	-37.70
9	4050	-98.20	-41.20
10	4500	-93.40	-36.40

$F_o = 470.000 \text{ MHz}$

12.5 Volts @ 5 Watts = 37.0 dBm

Spec = -57 dBc

Harmonic	Frequency (MHz)	Level (dBc)	Passed by (dB)
2	940	-62.10	-5.10
3	1410	-67.90	-10.90
4	1880	-89.70	-32.70
5	2350	-87.70	-30.70
6	2820	-86.90	-29.90
7	3290	-89.50	-32.50
8	3760	-92.60	-35.60
9	4230	-97.40	-40.40
10	4700	-92.80	-35.80

$F_o = 406.000 \text{ MHz}$

7.2 Volts @ 0.1 Watts = 20.0 dBm

Spec = -40 dBc

Harmonic	Frequency (MHz)	Level Relative to Carrier (dBc)	Passed by (dB)
2	812	-63.88	-23.88
3	1218	-63.41	-23.41
4	1624	-82.15	-42.15
5	2030	-81.98	-41.98
6	2436	-66.68	-26.68
7	2842	-80.34	-40.34
8	3248	-79.55	-39.55
9	3654	-80.56	-40.56
10	4060	-80.17	-40.17

$F_o = 430.000 \text{ MHz}$

7.2 Volts @ 0.1 Watts = 20.0 dBm

Spec = -40 dBc

Harmonic	Frequency (MHz)	Level Relative to Carrier (dBc)	Passed by (dB)
2	860	-64.61	-24.61
3	1290	-65.44	-25.44
4	1720	-80.25	-40.25
5	2150	-79.67	-39.67
6	2580	-77.14	-37.14
7	3010	-79.61	-39.61
8	3440	-79.09	-39.09
9	3870	-80.35	-40.35
10	4300	-80.07	-40.07

$F_o = 450.000 \text{ MHz}$

7.2 Volts @ 0.1 Watts = 20.0 dBm

Spec = -40 dBc

Harmonic	Frequency (MHz)	Level (dBc)	Passed by (dB)
2	900	-55.40	-15.40
3	1350	-73.80	-33.80
4	1800	-76.80	-36.80
5	2250	-70.50	-30.50
6	2700	-72.70	-32.70
7	3150	-76.20	-36.20
8	3600	-73.90	-33.90
9	4050	-77.10	-37.10
10	4500	-72.10	-32.10

$F_o = 470.000 \text{ MHz}$

7.2 Volts @ 0.1 Watts = 20.0 dBm

Spec = -40 dBc

Harmonic	Frequency (MHz)	Level (dBc)	Passed by (dB)
2	940	-55.40	-15.40
3	1410	-70.50	-30.50
4	1880	-73.60	-33.60
5	2350	-71.10	-31.10
6	2820	-73.90	-33.90
7	3290	-73.00	-33.00
8	3760	-75.30	-35.30
9	4230	-76.10	-36.10
10	4700	-71.80	-31.80

NAME OF TEST: Frequency Stability with Variation in Ambient Temperature

RULE PART NUMBER: 2.1055 (a) (b), 90.213 (a)

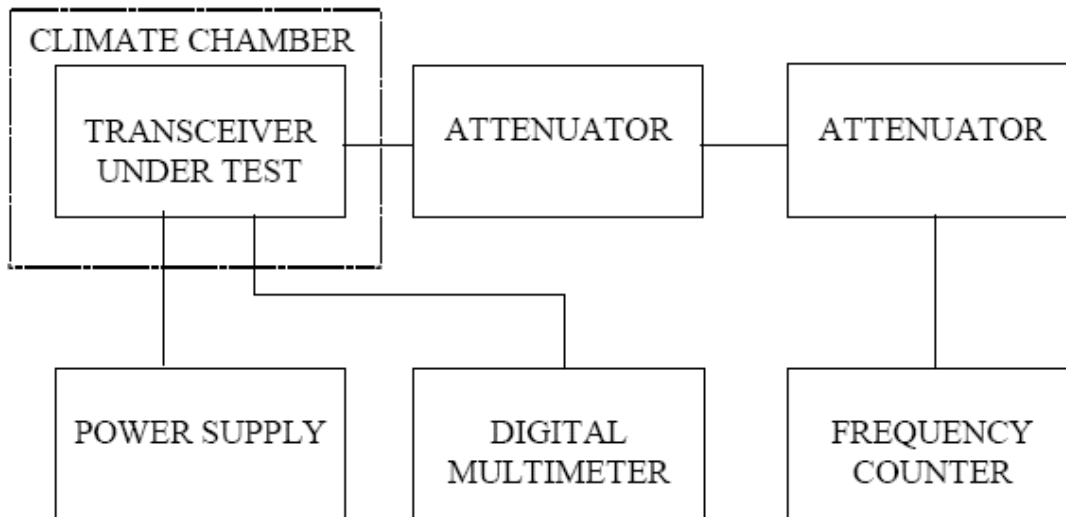
MINIMUM STANDARD: Shall not exceed ± 0.000250 % form test frequency, or 2.50 ppm

TEST RESULTS: Meets minimum standard, see data on following page

TEST CONDITIONS: Standard Test Conditions

TEST EQUIPMENT: Attenuator, Tenuline Model 8340 / 20dB / 25 Watt
 Attenuator, Tenuline Model 8340 / 10 dB / 25 Watt
 Frequency Counter, Fluke Model 1920A
 Power Supply, Model HP-6284A
 Digital Voltmeter, Fluke 8840A
 Climate Chamber, Tenney Jr. Model R-404

TEST SET-UP:



Channel Frequency: 450.00625 MHz
 Voltage & Power Level: 12.5 Volts @ 5 Watts
 Highest Variation: 1.00

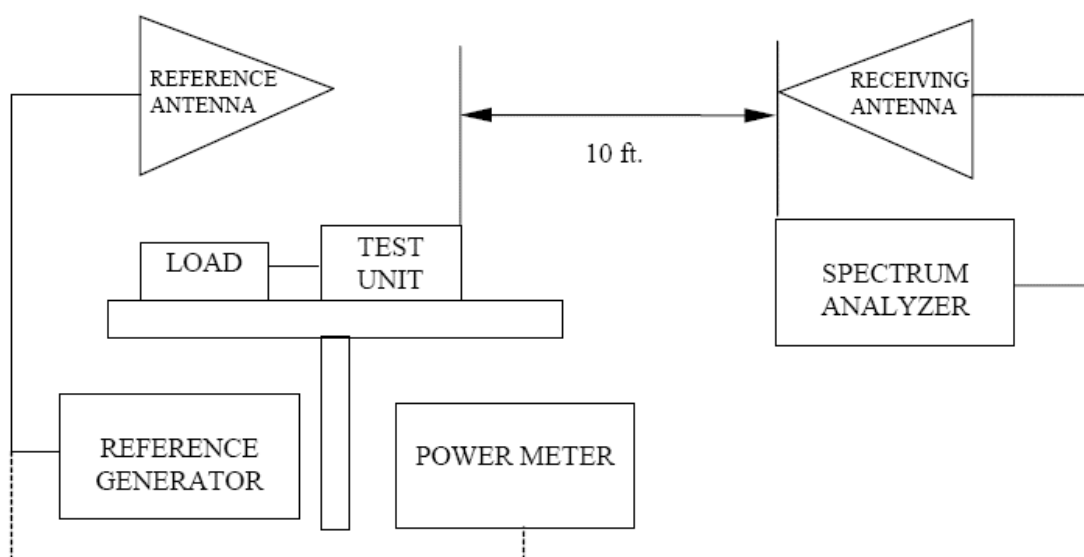
Temperature (Deg C)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)
-30	450.006710	460	1.00
-20	450.006620	370	0.82
-10	450.006640	390	0.87
0	450.006530	280	0.62
10	450.006460	210	0.47
20	450.006210	-40	-0.09
30	450.006300	50	0.11
40	450.006280	30	0.07
50	450.006310	60	0.13
60	450.006350	100	0.22

Channel Frequency: 450.00625 MHz
 Voltage & Power Level: 7.2 Volts @ 0.1 Watts
 Highest Variation: 0.96

Temperature (Deg C)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)
-30	450.006670	420	0.93
-20	450.006680	430	0.96
-10	450.006610	360	0.80
0	450.006490	240	0.53
10	450.006430	180	0.40
20	450.006280	30	0.07
30	450.006300	50	0.11
40	450.006330	80	0.18
50	450.006350	100	0.22
60	450.006400	150	0.33

NAME OF TEST:	Field Strength of Spurious Radiation
RULE PART NUMBER:	2.1053, 90.210 (d)(3)
MINIMUM STANDARDS:	For 5 Watts; $50+10\log_{10}(5 \text{ Watts}) = -57 \text{ dBc}$ For 0.1 Watts; $50+10\log_{10}(0.1 \text{ Watts}) = -40 \text{ dBc}$ Or -70 dBc whichever is the lesser attenuation.
TEST RESULTS:	Meets minimum standards (see data on following page)
TEST CONDITIONS:	Standard Test Conditions, 25 C
TEST PROCEDURE:	TIA/EIA – 603-B, 2.2.12
TEST EQUIPMENT:	Waveguide Horn Antenna, EMCO Model 3115 Bilog Antenna, Chase Model CBL6111B Log Periodic Linear Polarization Antenna, AILTECH Model 94612-1 Dipole Antenna, Electro-Metrics Model EM-6924 Power Supply, Model HP-6284A Spectrum Analyzer, Model Hp-8561B Reference Generator, Agilent Model E82570 Power Meter, Model HP436A 50-Ohm Load, Lucas Weinschel 58-30-43
MEASUREMENT PROCEDURE:	Radiated spurious attenuation was measured according to TIA/EIA Standard 603-B Section 2.2.12

TEST SET-UP:



Frequency: 406 MHz
Power: 5 Watts @ 12.5 Volts

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Spurious Attenuation dBc
812	H	-83.00	-44.7	2.67	-0.47	-84.8
	V	-84.67	-46.5	2.67	-0.47	-86.6
1218	H	-89.17	-50.7	3.50	4.40	-86.8
	V	-90.50	-52.0	3.50	4.40	-88.1
1624	H	-91.00	-53.7	4.00	3.65	-91.0
	V	-90.17	-54.2	4.00	3.65	-91.5
2030	H	-95.17	-51.7	4.50	5.00	-88.2
	V	-90.50	-48.8	4.50	5.00	-85.3
2436	H	-94.67	-51.7	5.17	3.20	-90.6
	V	-91.33	-45.7	5.17	3.20	-84.6
2842	H	-93.50	-47.3	6.00	4.50	-85.8
	V	-90.00	-43.0	6.00	4.50	-81.5
3248	H	-90.00	-39.5	6.67	3.20	-80.0
	V	-90.00	-41.8	6.67	3.20	-82.3
3654	H	-96.00	-43.8	7.00	4.40	-83.4
	V	-92.33	-40.2	7.00	4.40	-79.8
4060	H	-94.17	-42.0	7.50	3.60	-82.9
	V	-93.00	-40.5	7.50	3.60	-81.4

Frequency: 430 MHz
Power: 5 Watts @ 12.5 Volts

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Spurious Attenuation dBc
860	H	-85.17	-40.3	2.50	-0.47	-80.3
	V	-84.00	-47.3	2.50	-0.47	-87.3
1290	H	-89.17	-51.8	3.67	4.60	-87.9
	V	-88.00	-52.0	3.67	4.60	-88.1
1720	H	-95.17	-55.3	4.00	3.20	-93.1
	V	-93.00	-54.3	4.00	3.20	-92.1
2150	H	-95.27	-54.4	5.00	4.80	-91.6
	V	-92.50	-48.8	5.00	4.80	-86.0
2580	H	-96.00	-48.8	5.33	3.20	-88.0
	V	-93.00	-48.2	5.33	3.20	-87.3
3010	H	-90.50	-43.3	5.83	4.55	-81.6
	V	-84.00	-36.8	5.83	4.55	-75.1
3440	H	-90.83	-42.2	6.50	3.20	-82.5
	V	-90.33	-40.3	6.50	3.20	-80.6
3870	H	-96.00	-42.3	6.50	4.60	-81.2
	V	-96.00	-43.5	6.50	4.60	-82.4
4300	H	-96.00	-43.3	8.17	3.10	-85.4
	V	-96.00	-42.5	8.17	3.10	-84.6

Frequency: 450 MHz
 Power: 5 Watts @ 12.5 Volts

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Spurious Attenuation dBc
900	H	-83.50	-38.7	3.00	-0.47	-79.1
	V	-84.83	-46.8	3.00	-0.47	-87.3
1350	H	-92.33	-57.0	3.83	4.45	-93.4
	V	-92.33	-58.2	3.83	4.45	-94.5
1800	H	-93.33	-53.5	4.33	3.50	-91.3
	V	-94.17	-52.7	4.33	3.50	-90.5
2250	H	-92.00	-46.8	5.17	4.47	-84.5
	V	-93.17	-50.7	5.17	4.47	-88.4
2700	H	-94.17	-50.3	5.50	4.00	-88.8
	V	-94.17	-49.7	5.50	4.00	-88.2
3150	H	-97.00	-49.0	6.17	4.00	-88.2
	V	-95.33	-45.8	6.17	4.00	-85.0
3600	H	-92.83	-40.5	7.00	4.00	-80.5
	V	-91.67	-40.5	7.00	4.00	-80.5
4050	H	-97.00	-45.2	7.33	3.60	-85.9
	V	-95.00	-42.3	7.33	3.60	-83.1
4500	H	-97.00	-41.0	7.83	3.93	-81.9
	V	-94.67	-40.2	7.83	3.93	-81.1

Frequency: 470 MHz
 Power: 5 Watts @ 12.5 Volts

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Spurious Attenuation dBc
940	H	-84.00	-46.5	3.00	-0.47	-87.0
	V	-88.67	-47.5	3.00	-0.47	-88.0
1410	H	-97.00	-59.8	3.83	4.30	-96.4
	V	-92.33	-56.0	3.83	4.30	-92.5
1880	H	-97.00	-54.8	4.33	4.30	-91.9
	V	-97.00	-54.3	4.33	4.30	-91.4
2350	H	-94.67	-48.2	4.83	4.00	-86.0
	V	-93.33	-47.3	4.83	4.00	-85.2
2820	H	-96.17	-51.0	5.67	4.50	-89.2
	V	-94.33	-47.8	5.67	4.50	-86.0
3290	H	-97.00	-47.8	6.50	3.20	-88.1
	V	-92.67	-44.5	6.50	3.20	-84.8
3760	H	-97.00	-46.7	6.67	5.15	-85.2
	V	-95.50	-44.0	6.67	5.15	-82.5
4230	H	-97.00	-42.3	8.50	3.00	-84.8
	V	-94.83	-40.5	8.50	3.00	-83.0
4700	H	-97.00	-44.0	8.33	3.90	-85.4
	V	-95.83	-41.7	8.33	3.90	-83.1

Frequency: 406 MHz
 Power: 0.1 Watts @ 7.2 Volts

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Spurious Attenuation dBc
812	H	-96.6	-58.3	2.67	-0.47	-81.4
	V	-95.5	-57.3	2.67	-0.47	-80.5
1218	H	-96.3	-57.8	3.50	4.40	-76.9
	V	-96.7	-58.2	3.50	4.40	-77.3
1624	H	-97.0	-59.7	4.00	3.65	-80.0
	V	-97.0	-61.0	4.00	3.65	-81.4
2030	H	-97.0	-53.5	4.50	5.00	-73.0
	V	-97.0	-55.3	4.50	5.00	-74.8
2436	H	-97.0	-54.0	5.17	3.20	-76.0
	V	-96.3	-50.7	5.17	3.20	-72.6
2842	H	-97.0	-50.8	6.00	4.50	-72.3
	V	-97.0	-50.0	6.00	4.50	-71.5
3248	H	-97.0	-46.5	6.67	3.20	-70.0
	V	-97.0	-48.8	6.67	3.20	-72.3
3654	H	-97.0	-44.8	7.00	4.40	-67.4
	V	-97.0	-44.8	7.00	4.40	-67.4
4060	H	-97.0	-44.8	7.50	3.60	-68.7
	V	-97.0	-44.5	7.50	3.60	-68.4

Frequency: 430 MHz
 Power: 0.1 Watts @ 7.2 Volts

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Spurious Attenuation dBc
860	H	-96.5	-51.7	2.50	-0.47	-74.6
	V	-95.8	-59.2	2.50	-0.47	-82.1
1290	H	-97.0	-59.7	3.67	4.60	-78.7
	V	-96.0	-60.0	3.67	4.60	-79.1
1720	H	-97.0	-57.2	4.00	3.20	-78.0
	V	-97.0	-58.3	4.00	3.20	-79.1
2150	H	-97.0	-56.2	5.00	4.80	-76.4
	V	-97.0	-53.3	5.00	4.80	-73.5
2580	H	-97.0	-49.8	5.33	3.20	-72.0
	V	-97.0	-52.2	5.33	3.20	-74.3
3010	H	-96.6	-49.5	5.83	4.55	-70.7
	V	-96.5	-49.3	5.83	4.55	-70.6
3440	H	-97.0	-48.3	6.50	3.20	-71.6
	V	-97.0	-47.0	6.50	3.20	-70.3
3870	H	-97.0	-43.3	6.50	4.60	-65.2
	V	-97.0	-44.5	6.50	4.60	-66.4
4300	H	-97.0	-44.3	8.17	3.10	-69.4
	V	-97.0	-43.5	8.17	3.10	-68.6

Frequency: 450 MHz
 Power: 0.1 Watts @ 7.2 Volts

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Spurious Attenuation dBc
900	H	-96.0	-51.2	3.00	-0.47	-74.6
	V	-95.7	-57.7	3.00	-0.47	-81.2
1350	H	-96.0	-60.7	3.83	4.45	-80.1
	V	-95.2	-61.0	3.83	4.45	-80.4
1800	H	-96.0	-56.2	4.33	3.50	-77.0
	V	-96.0	-54.5	4.33	3.50	-75.3
2250	H	-97.0	-51.8	5.17	4.47	-72.5
	V	-93.7	-51.2	5.17	4.47	-71.9
2700	H	-97.0	-53.2	5.50	4.00	-74.7
	V	-97.0	-52.5	5.50	4.00	-74.0
3150	H	-97.0	-49.0	6.17	4.00	-71.2
	V	-97.0	-47.5	6.17	4.00	-69.7
3600	H	-97.0	-44.7	7.00	4.00	-67.7
	V	-97.0	-45.8	7.00	4.00	-68.8
4050	H	-97.0	-45.2	7.33	3.60	-68.9
	V	-97.0	-44.3	7.33	3.60	-68.1
4500	H	-97.0	-41.0	7.83	3.93	-64.9
	V	-97.0	-42.5	7.83	3.93	-66.4

Frequency: 470 MHz
 Power: 0.1 Watts @ 7.2 Volts

Spurious Frequency (MHz)	Polarization (Horz/Vert)	Spurious Level (dBm)	Substitution Generator (dBm)	Cable Loss (dB)	Antenna Gain (dBd)	Spurious Attenuation dBc
940	H	-97.0	-59.5	3.00	-0.47	-83.0
	V	-96.3	-55.2	3.00	-0.47	-78.6
1410	H	-95.8	-58.6	3.83	4.30	-78.2
	V	-97.0	-60.7	3.83	4.30	-80.2
1880	H	-96.0	-53.8	4.33	4.30	-73.9
	V	-97.0	-54.3	4.33	4.30	-74.4
2350	H	-97.0	-50.5	4.83	4.00	-71.3
	V	-97.0	-51.0	4.83	4.00	-71.8
2820	H	-97.0	-51.8	5.67	4.50	-73.0
	V	-97.0	-50.5	5.67	4.50	-71.7
3290	H	-97.0	-47.8	6.50	3.20	-71.1
	V	-97.0	-48.8	6.50	3.20	-72.1
3760	H	-97.0	-46.7	6.67	5.15	-68.2
	V	-97.0	-45.5	6.67	5.15	-67.0
4230	H	-97.0	-42.3	8.50	3.00	-67.8
	V	-97.0	-42.7	8.50	3.00	-68.2
4700	H	-97.0	-44.0	8.33	3.90	-68.4
	V	-97.0	-42.8	8.33	3.90	-67.3

NAME OF TEST: Frequency Stability with Variation in Supply Voltage

RULE PART NUMBER: 2.1055 (d)(1), 90.213 (a)

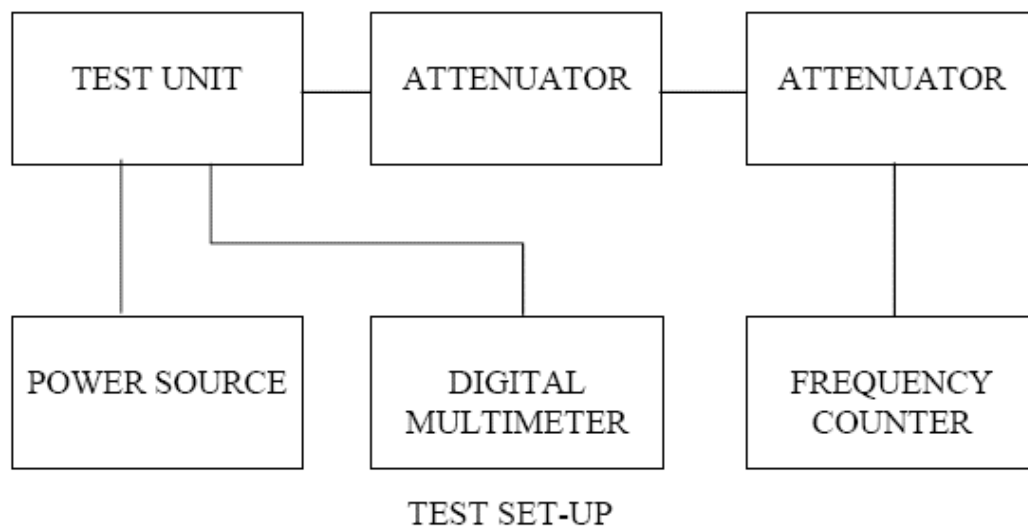
MINIMUM STANDARD: Shall not exceed ± 0.000250 % from the test frequency, 2.50 ppm for $\pm 15\%$ change in supply voltage.

TEST RESULTS: Meets minimum standard, see data on following page

TEST CONDITIONS: Standard Test Conditions, 25 C

TEST EQUIPMENT: 50-Ohm Attenuator, Tenuline Model 8340 / 20dB / 25 Watt
50-Ohm Attenuator, Tenuline Model 8340 / 10dB / 25 Watt
Frequency Counter, Fluke Model 1920A
Digital Voltmeter, Fluke Model 8012A
DC Power Supply, Instek Model GPS-2303

TEST SET-UP:



Channel Frequency: 430.000 MHz
 Tolerance Requirements: 0.00025%
 Highest Variation: 0.00

Input Voltage (Vdc)	Frequency (MHz)	Delta Freq (% of assigned Freq)	Ppm from assigned Frequency
6.0	430.000	0.00	0.00
12.5	430.000	0.00	0.00
15.0	430.000	0.00	0.00

Channel Frequency: 450.000 MHz
 Tolerance Requirements: 0.00025%
 Highest Variation: 0.00

Input Voltage (Vdc)	Frequency (MHz)	Delta Freq (% of assigned Freq)	Ppm from assigned Frequency
6.0	450.000	0.00	0.00
12.5	450.000	0.00	0.00
15.0	450.000	0.00	0.00

NAME OF TEST: Transient Frequency Behavior

RULE PART NUMBER: 90.214

TEST CONDITIONS: Transient tests were conducted by modulating a 1 kHz tone with 1.5 kHz deviation through the loader audio input.

MINIMUM STANDARD: 12.5 kHz channel (used worst case numbers from 406 to 470 MHz)

<u>TIME INTERVAL</u>	<u>MAXIMUM FREQUENCY DIFFERENCE (kHz)</u>	<u>TIME (ms)</u>
T1	+/- 12.5	10
T2	+/- 6.25	25
T3	+/- 12.5	10

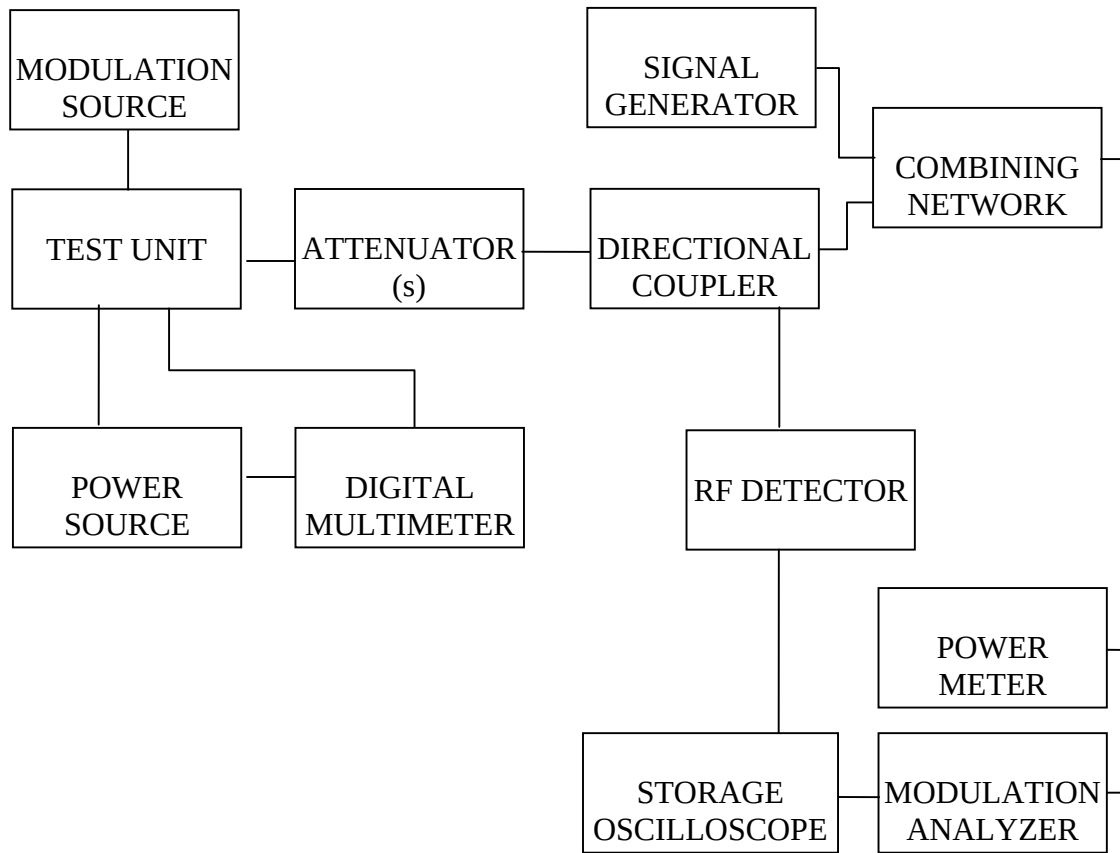
TEST RESULTS: Meets minimum standards, see data on following pages

TEST CONDITIONS: RF Power Level = 5 Watts and 0.1 Watt
Standard Test Conditions, 25 C

TEST PROCEDURE: TIA/EIA – 603-B, 2.2.19

TEST EQUIPMENT: 50-Ohm Attenuator, Tenuline Model 8340 / 20 dB / 25 Watt
50-Ohm Attenuator, Tenuline Model 8340 / 10 dB / 25 Watt
Power Supply, Instek Model GPS-2303
Digital Voltmeter, Fluke Model 8012A
Power Combiner, Model MCL ZFSC-4-1
Modulation Analyzer, Model HP8901A
Power Meter, Model HP436
Oscilloscope, Tektronix Model TDS 3014B
Power Detector, Model JDT lab made
Directional Coupler, Model HP778D
Signal Generator, Model HP8657B
Audio Analyzer, Model HP8903A

TEST SET-UP:

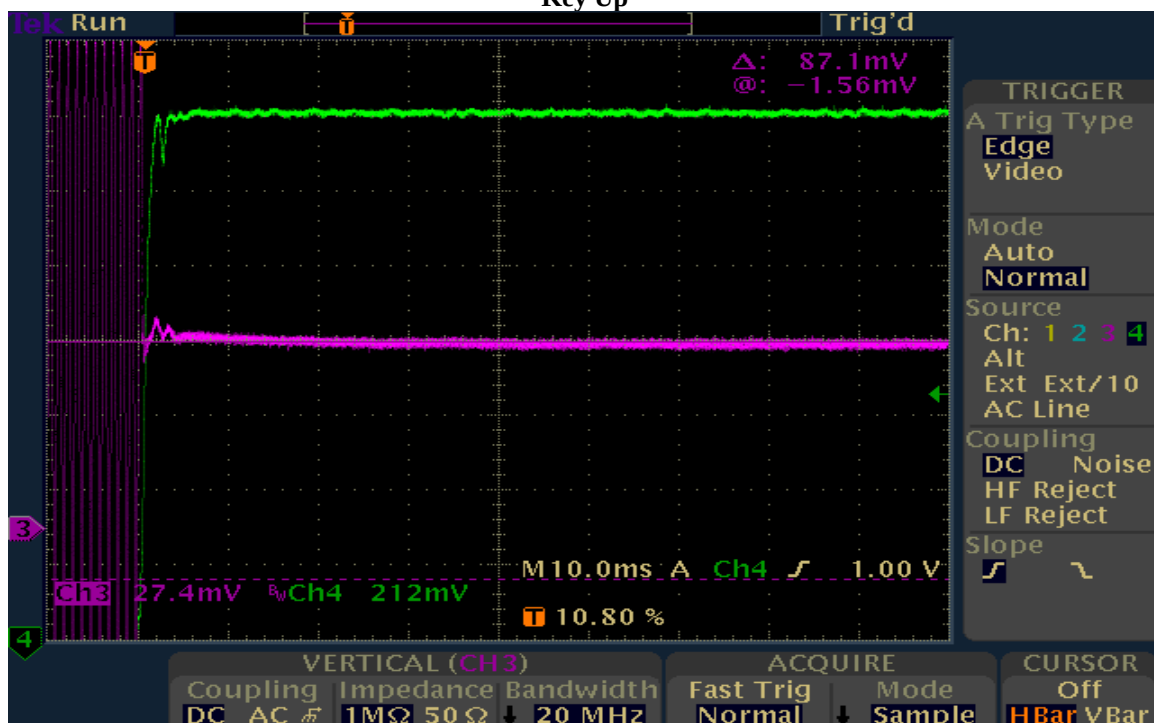


Transient Frequency Response

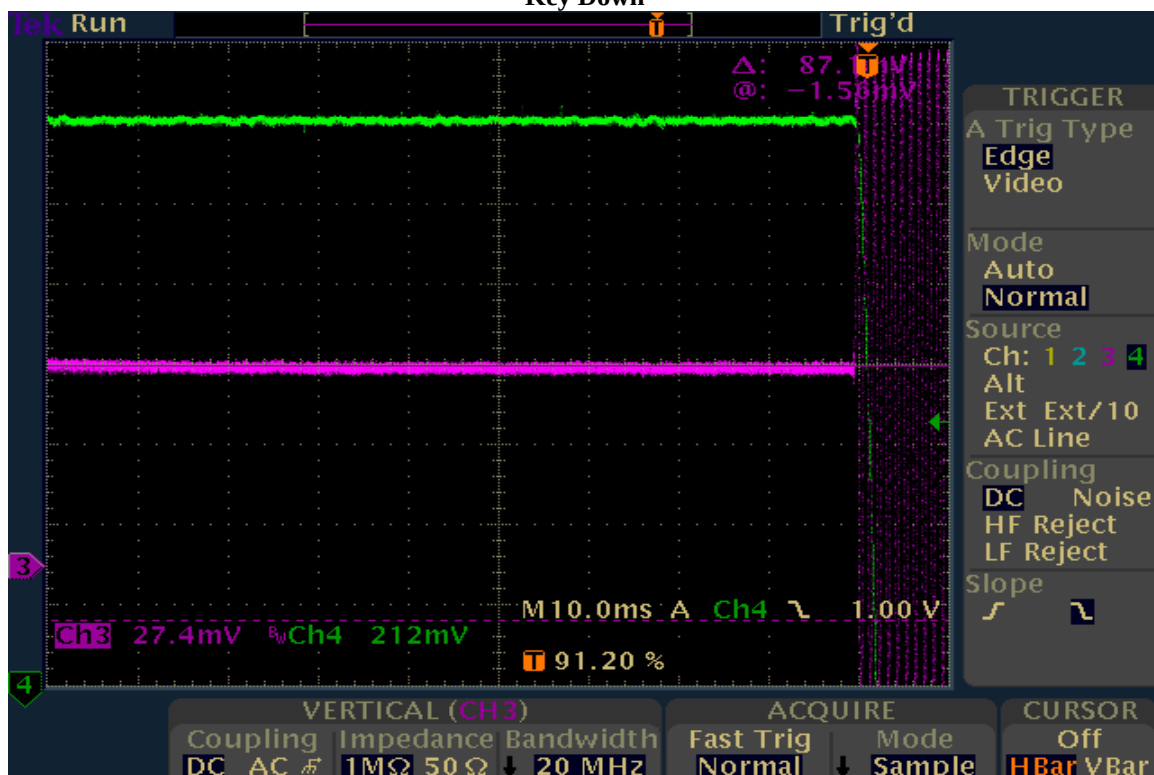
Frequency : 450.000000 MHz

Power: 5 W

Key Up

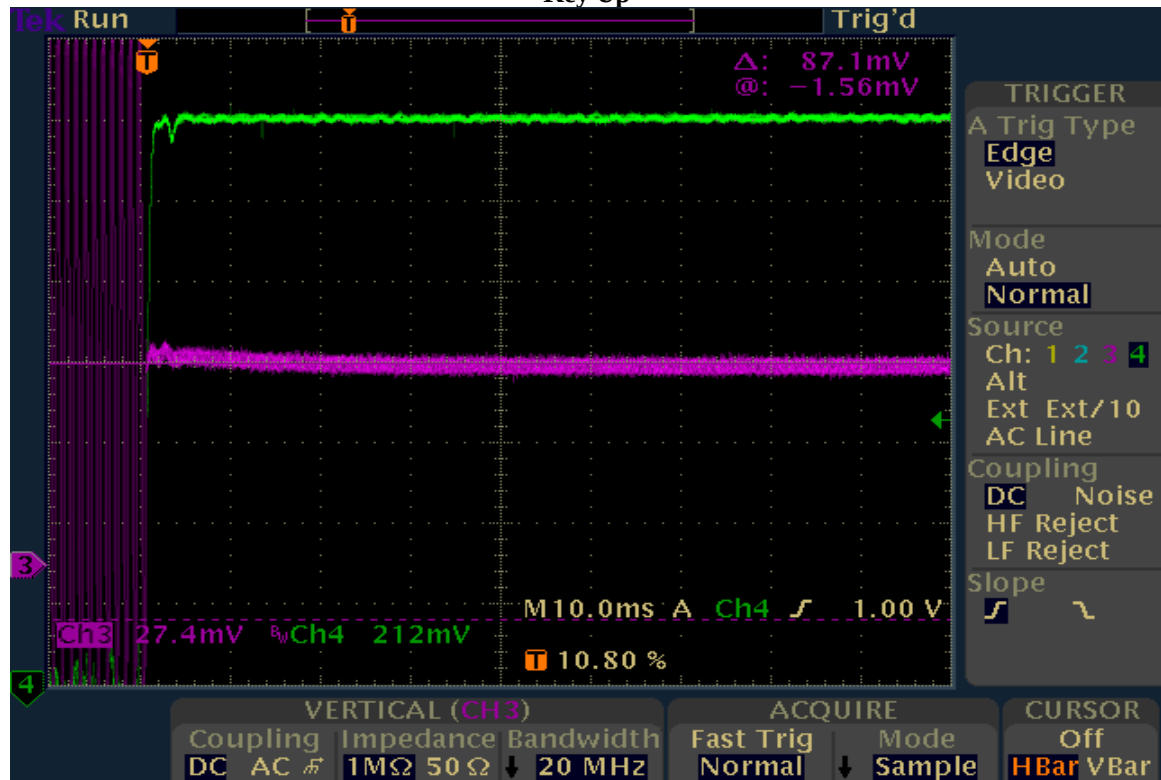


Key Down



Frequency: 450.000000 MHz
Power: 0.1 W

Key Up



Key Down

