



243 Jubug-Ri, Yangji-Myeon, Yongin-Si, Gyeonggi-Do, Korea 449-822

Tel: +82-31-323-6008 Fax: +82-31-323-6010

<http://www.ltalab.com>

Dates of Tests : May 11~19, 2011

Test Report S/N : LR50011105F

Test Site : LTA CO., LTD.

CERTIFICATION OF COMPLIANCE

FCC ID.

VSOXM-4000A

APPLICANT

Yeonhwa M Tech Co., Ltd.

Device Category	:	VHF FM Transceiver
Manufacturing Description	:	FM TRANSCEIVER
Manufacturer	:	Yeonhwa M Tech Co., Ltd.
Trade mark	:	Xradio
Model name	:	XM-4000A
Variet model name	:	XM-4200A
Serial number	:	Identical prototype
FCC Rule Part(s)	:	§2, §22, §74, §90
Frequency Range	:	400 ~ 470MHz
RF Output Power	:	40W
Channel Separation	:	12.5kHz
Emission Designators:	:	10K4F3E
Data of issue	:	May 20, 2011

This test report is issued under the authority of:

The test was supervised by:

Hyun-Chae You, Manager

Il-Shin kim, Test Engineer

This test result only responds to the tested sample. It is not allowed to copy this report even partly without the allowance of the test laboratory. The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

NVLAP LAB Code.: 200723-0

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1. General information's

1-1 Test Performed

Company name : LTA Co., Ltd.
 Address : 243, Jubug-ri, Yangji-Myeon, Youngin-Si, Kyunggi-Do, Korea. 449-822
 Web site : <http://www.ltalab.com>
 E-mail : chahn@ltalab.com
 Telephone : +82-31-323-6008
 Facsimile : +82-31-323-6010

Quality control in the testing laboratory is implemented as per ISO/IEC 17025 which is the “General requirements for the competents of calibration and testing laboratory”.

1-2 Accredited agencies

LTA Co., Ltd. is approved to perform EMC testing by the following agencies:

Agency	Country	Accreditation No.	Validity	Reference
NVLAP	U.S.A	200723-0	2011-09-30	ECT accredited Lab.
KCC	KOREA	KR0049	2013-04-24	EMC accredited Lab.
FCC	U.S.A	610755	2014-04-27	FCC filing
FCC	U.S.A	649054	2011-05-26	FCC CAB
VCCI	JAPAN	R-2133, C-2307	2011-06-21	VCCI registration
VCCI	JAPAN	T-2009	2013-12-23	VCCI registration
IC	CANADA	5799A	2012-05-14	IC filing

2. Information's about test item

2-1 Client & Manufacturer

Company name : Yeonhwa M Tech Co., Ltd.
 Address : 3F, Yukyong B/D, 544-6, Gasan-dong, Geumcheon-gu, Seoul, Korea
 TEL / FAX : +82-70-7434-7274 / +82-2-3281-7271

2-2 Equipment Under Test (EUT)

Trade name : VHF FM Transceiver
 FCC ID : VSOXM-4000A
 Model name : XM-4000A
 Variant model name : XM-4200A
 Serial number : Identical prototype
 Date of receipt : May 11, 2011
 EUT condition : Pre-production, not damaged
 Frequency Range : 400 ~ 470 MHz
 RF output power : 40W
 Channel Separation : 12.5kHz
 Duty cycle TX power : 5(Tx) : 5(Rx) : 90(Stand-by)
 Speaker Impedance : 16 ohm
 Audio Output Power : 1.0Watt across an 16-ohm load
 Power Source : 13.8V DC

2-3 Tested frequency

	LOW	MID	HIGH
Frequency (MHz)	406.125	435.025	469.975

2-4 Ancillary Equipment

Equipment	Model No.	Serial No.	Manufacturer
MIC	MM-100	N/A	N/A
CAR BATTERY	BX40R	N/A	ATLASBX

3. Test Report

3.1 Summary of tests

FCC Part Section(s)	Parameter	Status (note 1)
2.1046 (a)	Carrier Output Power (Conducted)	C
2.1051	Unwanted Emissions (Transmitter Conducted)	C
2.1053 (a)	Field Strength of Spurious Radiation	C
2.1049 (c) (1)	Emission Masks (Occupied Bandwidth)	C
90.214	Transient Frequency Behavior	C
2.1047 (a)	Audio Low Pass Filter (Voice Input)	C
2.1047 (a)	Audio Frequency Response	C
2.1047 (b)	Modulation Limiting	C
2.1055 (a) (1)	Frequency Stability (Temperature Variation)	C
2.1055 (b) (1)	Frequency Stability (Voltage Variation)	C
2.202 (g)	Necessary Bandwidth and Emission Bandwidth	C

Note 1: C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable

The sample was tested according to the following specification:

*FCC Rules and Regulations, Volume II; Part 2, Sub-part J, Sections 2.947, 2.1033(c), 2.1046, 2.1047, 2.1079, 2.1051, 2.1053, 2.1055, 2.1057 and Part 22, Part 74 Subpart H, Part 90.

*ANSI C63.4

*TIA/EIA 603, Edition C

3.2 Transmitter requirements

3.2.1 Carrier Output Power (Conducted)

Definition:

- The carrier power output for a transmitter for this service is the power available at the output terminals of the transmitter when the output terminals are connected to the standard transmitter load.

Specification : 47 CFR 2.1046 (a)
 Test method : ANSI/TIA/EIA-603-C-2004

Measurement Procedure:

- The EUT was connected to a resistive coaxial attenuator of normal load impedance, and the unmodulated output power was measured by means of an R.F. Power Meter.

TEST CONDITIONS		Carrier power(W)		
Power level (W)	Channel Spacing (kHz)	406.125 MHz	435.025 MHz	469.975 MHz
40	12.5	40.11	40.17	40.05
Measurement uncertainty		± 0,45dB		

3.2.2 Unwanted Emissions (Transmitter Conducted)

Definition:

- Conducted spurious emissions are emissions at the antenna terminals on a frequency or frequencies which are outside a band sufficient to ensure transmission of information of required quality for the class of communication desired.

Specification	: 47 CFR 2.1051
Test method	: ANSI/TIA/EIA-603-C-2004

Measurement Procedure:

- The emissions were measured for the worst case as follows:
 - (1) Within a band of frequencies defined by the carrier frequency plus and minus one channel.
 - (2) From the lowest frequency generated in the EUT and to at least the 10th harmonic of the carrier frequency, or 40GHz, whichever is lower.
- The magnitude of spurious emissions that are attenuated more than 20dB below the permissible value need not be specified.

LIMIT

$$= 43 + 10 \log_{10} (P) \text{ dBc (or -13 dBm)}$$

Measurement Data: 12.5KHz

OPERATING FREQUENCY : 406.125 MHz
 MEASURED OUTPUT POWER : 46.03 dBm = 40.11 W
 MODULATION SIGNAL : FM
 LIMIT : $43 + 10 \log_{10} (W) =$ 59.03 dBc

Freq. (MHz)	Level (dBm)	Level (dBc)	Freq. (MHz)	Level (dBm)	Level (dBc)
812.25	-30.52	76.55			
1218.38	-36.34	82.37			

Remarks

No other emissions were detected at a level greater than 20dB below limit.

Measurement Data:

OPERATING FREQUENCY : 435.025 MHz
 MEASURED OUTPUT POWER : 46.04 dBm = 40.17 W
 MODULATION SIGNAL : FM
 LIMIT : $43 + 10 \log_{10} (W) =$ 59.04 dBc

Freq. (MHz)	Level (dBm)	Level (dBc)	Freq. (MHz)	Level (dBm)	Level (dBc)
870.05	-30.28	76.32			
1305.08	-37.34	83.38			

Remarks

No other emissions were detected at a level greater than 20dB below limit.

Measurement Data: 12.5KHzOPERATING FREQUENCY : 469.975 MHzMEASURED OUTPUT POWER : 46.03 dBm = 40.05 W

MODULATION SIGNAL : FM

LIMIT : $43 + 10 \log_{10} (W) =$ 59.03 dBc

Freq. (MHz)	Level (dBm)	Level (dBc)	Freq. (MHz)	Level (dBm)	Level (dBc)
939.95	-30.25	76.28			
1409.93	-36.38	82.41			

Remarks

No other emissions were detected at a level greater than 20dB below limit.

3.2.3 Field Strength of Spurious Radiation

Definition:

- Radiated spurious emissions are emissions from the equipment when transmitting into a non-radiating load on a frequency or frequencies which are outside an occupied band sufficient to ensure transmission of information of required quality for the class of communications desired.

Specification	:	47 CFR 2.1053(a)
Test method	:	ANSI/TIA/EIA-603-C-2004

Measurement Procedure:

- The test sample was set up at a distance of three meters from the test instrument. Valid spurious signals were determined by switching the power on and off.
- In the field, the test sample was placed on a wooden turntable above ground at three meters away from the search antenna.
- The cables were oriented in order to obtain the maximum response. At each emission frequency, the turntable was rotated and the search antennas were raised and lowered vertically.
- The emission was observed with both a vertically polarized and a horizontally polarized search antenna and the worst case was used.
- The field strength of each emission within 20dB of the limit was recorded and corrected with the appropriate cable and transducer factors.
- From the lowest frequency generated in the EUT and to at least the 10th harmonic of the carrier frequency, or 40GHz, whichever is lower.
- The worst case for all channels is shown.

LIMIT

$$= 43 + 10 \log_{10} (P) \text{ dBc (or -13 dBm)}$$

Measurement Data: Attached for Worst Case

Measurement Data:

OPERATING FREQUENCY : 469.975 MHz

MEASURED OUTPUT POWER :: 46.03 dBm = 40.05 W

MODULATION SIGNAL : FM

LIMIT : $43 + 10 \log_{10} (W) =$ 59.03 dBc

Freq. (MHz)	Pol. (H/V)	Reading (dBm/m)	C.F (dBm/m)	Level (dBm/m)	Level (dBc)
939.95	H	-40.50	4.16	-36.34	82.37
1409.93	H	-44.58	5.07	-39.51	85.54

Remarks

No emissions were detected at a level greater than 20dB below limit.

3.2.4 Emission Masks (Occupied Bandwidth)

Definition:

- The term transmitter Sideband Spectrum denotes the sideband energy produced at a discrete frequency separation from the carrier up to the test bandwidth due to all sources of unwanted noise within the transmitter in a modulated condition.

Specification	: 47 CFR 2.1049(c)(1)
Test method	: ANSI/TIA/EIA-603-C-2004

Measurement Procedure:

- The EUT and test equipment were set up as shown on the following page, with the Spectrum Analyzer connected.
- For EUTs supporting audio modulation, the audio signal generator was adjusted to the frequency of maximum response and with output level set for $\pm 2.5 / \pm 1.25$ kHz deviation (or 50% modulation). With level constant, the signal level was increased 16dB.
- For EUTs supporting digital modulation, the digital modulation mode was operated to its maximum extent.
- The Occupied Bandwidth was measured with the Spectrum Analyzer controls set as shown on the test results.

Measurement Data:

- Refer to the Appendix II.

3.2.5 Transient Frequency Behavior

Definition:

- The transient frequency behavior is a measure of the difference, as a function in time, of the actual transmitter frequency to the assigned transmitter frequency when the transmitted RF output power is switched on or off.

Specification	: 47 CFR 90.214
Test method	: ANSI/TIA/EIA-603-C-2004

Measurement Procedure:

- The EUT was set up as shown on the attached page, following TIA/EIA-603 steps a, b, and c as a guide.
- The transmitter was turned on.
- Sufficient attenuation was provided so that the transmitter carrier level measured at the output of the combiner was 40 dB below the maximum input level of the test receiver. This level was recorded as step f.
- The transmitter was turned off.
- An RF signal generator (1) modulated with a 1 kHz tone at either 25, 12.5, or 6.25 kHz deviation, and set to the same frequency as the assigned transmitter frequency, (2) was adjusted to a level -20 dB below the level recorded for step f, as measured at the output of the combiner. This level was then fixed for the remainder of the test and is recorded at step h.
- The oscilloscope was set up using TIA/EIA-603 steps j and k as a guide, and to either 10 ms/div (UHF) or 5ms/div (VHF).
- The 30 dB attenuator was removed, the transmitter was turned on, and the level of the carrier at the output of the combiner was recorded as step l.
- The carrier on-time as referenced in TIA/EIA-603 steps m, n, and o was captured and plotted. The carrier off-time as referenced in TIA/EIA-603 steps p, q, r, and s was captured and plotted.
- For EUTs supporting audio modulation, the audio signal generator was adjusted to the frequency of maximum response and with output level set for $\pm 2.5 / \pm 1.25$ kHz deviation (or 50% modulation). With level constant, the signal level was increased 16dB.
- For EUTs supporting digital modulation, the digital modulation mode was operated to its maximum extent.
- The Occupied Bandwidth was measured with the Spectrum Analyzer controls set as shown on the test results.

Measurement Data:

- Refer to the Appendix II.

3.2.6 Audio Low Pass Filter (Voice Input)

Definition:

- The Audio Low Pass Filter Response is the frequency response of the post limiter low pass filter circuit above 3000Hz.

Specification : 47 CFR 2.1047(a)
Test method : ANSI/TIA/EIA-603-C-2004

Measurement Procedure:

- The EUT and test equipment were set up such that the audio input was connected at the input to the modulation limiter, and the modulated stage.
- The audio output was connected at the output to the modulated stage.

Measurement Data:

- Refer to the Appendix II.

3.2.7 Audio Frequency Response

Definition:

- The audio frequency response is the degree of closeness to which the frequency deviation of the transmitter follows a prescribed characteristic.

Specification	: 47 CFR 2.1047(a)
Test method	: ANSI/TIA/EIA-603-C-2004

Measurement Procedure:

- The audio signal input was adjusted to obtain 20% modulation at 1kHz, and this point was taken as the 0dB reference level.
- With input levels held constant and below limiting at all frequencies, the audio signal generator was varied from 300 Hz to 30 kHz.
- The response in dB relative to 1 kHz was then measured, using the HP 8901A Modulation Analyzer.

Measurement Data:

- Refer to the Appendix II.

3.2.8 Modulation Limiting

Definition:

- Modulation limiting refers to the transmitter circuits ability to limit the transmitter from producing deviations due to modulation in excess of a rated system deviation.

Specification	:	47 CFR 2.1047(b)
Test method	:	ANSI/TIA/EIA-603-C-2004

Measurement Procedure:

- The signal generator was connected to the input of the EUT as for " Frequency Response of the Modulating Circuit."
- The modulation response was measured for each of three frequencies (one of which was the frequency of maximum response), and the input voltage was varied and was observed on an HP 8901A Modulation Analyzer.
- The input level was varied from 30% modulation (± 1.5 kHz deviation) to at least 20 dB higher than the saturation point.

Measurement Data:

- Refer to the Appendix II.

3.2.9 Frequency Stability

Definition:

- Modulation limiting refers to the transmitter circuits ability to limit the transmitter from producing deviations due to modulation in excess of a rated system deviation.

Specification	: 47 CFR 2.1055
Test method	: ANSI/TIA/EIA-603-C-2004

Measurement Procedure:

The frequency stability of the transmitter is measured by:

- a) Temperature: The temperature is varied from -30°C to +60°C using an environmental chamber.
- b) Primary Supply Voltage: The primary supply voltage is varied from 85% to 115% of the voltage normally at the input to the device or at the power supply terminals if cables are not normally supplied.

Specification- The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block. The frequency stability of the transmitter shall be maintained within $\pm 0.00025(\pm 2.5\text{ppm})$ of the center frequency.

Time Period and Procedure:

1. The carrier frequency of the transmitter and the individual oscillators is measured at room temperature (25°C to 27°C to provide a reference).
2. The equipment is subjected to an overnight “soak” at -30°C without power applied.
3. After the overnight “soak” at 30°C (usually 14-16 hours), the equipment is turned on in a “standby” condition for one minute before applying power to the transmitter. Measurement of the carrier frequency of the transmitter and the individual oscillators is made within a three minute interval after applying power to the transmitter.
4. Frequency measurements are made at 10°C interval up to room temperature. At least a period of one and one half-hour is provided to allow stabilization of the equipment at each temperature level.
5. Again the transmitter carrier frequency and the individual oscillators is measured at room temperature to begin measurement of the upper temperature levels.
6. Frequency measurements are at 10 intervals starting at -30°C up to +60°C allowing at least two hours at each temperature for stabilization. In all measurements the frequency is measured within three minutes after re-applying power to the transmitter.
7. The artificial load is mounted external to the temperature chamber.

NOTE: The EUT is tested down to the battery endpoint.

Measurement Data:

- Refer to the Appendix II.

3.2.10 Necessary Bandwidth and Emission Bandwidth

Specification : 47 CFR 2.202 (g)

MODULATION = 10K4F3E

NECESSARY BANDWIDTH CALCULATION:

MAXIMUM MODULATION (M), kHz	= 3
MAXIMUM DEVIATION (D), kHz	= 2.2
CONSTANT FACTOR (K)	= 1
NECESSARY BANDWIDTH (BN), kHz	= (2 * M) + (2 * D * K)
	= 10.4

APPENDIX I

TEST EQUIPMENT USED FOR TESTS

	Description	Model No.	Serial No.	Manufacturer	Interval	Last Cal. Date
1	Spectrum Analyzer (~30GHz)	FSV-30	100757	R&S	1 year	2011-01-24
2	Spectrum Analyzer (~2.9GHz)	8594E	3710A04074	HP	2 year	2009-10-12
3	Signal Generator (~3.2GHz)	8648C	3623A02597	HP	1 year	2011-03-30
4	Signal Generator (1~20GHz)	83711B	US34490456	HP	1 year	2011-03-30
5	Attenuator (3dB)	8491A	37822	HP	2 year	2010-10-08
6	Attenuator (10dB)	8491A	63196	HP	2 year	2010-10-08
7	Attenuator (30dB)	8498A	3318A10929	HP	2 year	2011-01-05
8	Test Receiver (~30MHz)	ESHS10	828404/009	R&S	1 year	2011-03-30
9	EMI Test Receiver (~1GHz)	ESCI7	100722	R&S	1 year	2010-10-08
10	RF Amplifier (~1.3GHz)	8447D	2439A09058	HP	2 year	2010-10-08
11	RF Amplifier (1~18GHz)	8449B	3008A02126	HP	2 year	2010-03-29
12	Horn Antenna (1~18GHz)	BBHA 9120D	9120D122	SCHWARZBECK	2 year	2010-12-24
13	Horn Antenna (18 ~ 40GHz)	SAS-574	154	Schwarzbeck	2 year	2010-11-25
14	Horn Antenna (18 ~ 40GHz)	SAS-574	155	Schwarzbeck	2 year	2010-11-25
15	TRILOG Antenna	VULB 9160	9160-3172	SCHWARZBECK	2 year	2010-10-07
16	Dipole Antenna	VHA9103	2116	SCHWARZBECK	2 year	2010-11-25
17	Dipole Antenna	VHA9103	2117	SCHWARZBECK	2 year	2010-11-25
18	Dipole Antenna	VHA9105	2261	SCHWARZBECK	2 year	2010-11-25
19	Dipole Antenna	VHA9105	2262	SCHWARZBECK	2 year	2010-11-25
20	Hygro-Thermograph	THB-36	0041557-01	ISUZU	2 year	2010-04-12
21	Splitter (SMA)	ZFSC-2-2500	SF617800326	Mini-Circuits	-	-
22	Power Divider	11636A	6243	HP	2 year	2010-10-08
23	DC Power Supply	6622A	3448A03079	HP	-	-
24	Frequency Counter	5342A	2826A12411	HP	1 year	2011-03-30
25	Power Meter	EPM-441A	GB32481702	HP	1 year	2011-03-30
26	Power Sensor	8481A	US41030291	HP	1 year	2010-10-08
27	Audio Analyzer	8903B	3729A18901	HP	1 year	2010-10-08
28	Modulation Analyzer	8901B	3749A05878	HP	1 year	2010-10-08
29	TEMP & HUMIDITY Chamber	YJ-500	LTAS06041	JinYoung Tech	1 year	2010-10-08
30	Stop Watch	HS-3	601Q09R	CASIO	2 year	2010-03-31
31	LISN	ENV216	100408	R&S	1 year	2010-10-08
32	UNIVERSAL RADIO COMMUNICATION TESTER	CMU200	106243	R&S	2 year	2010-05-13
33	Highpass Filter	WHKX1.5/15G-10SS	74	Wainwright Instruments	-	-
34	Highpass Filter	WHKX3.0/18G-10SS	118	Wainwright Instruments	-	-

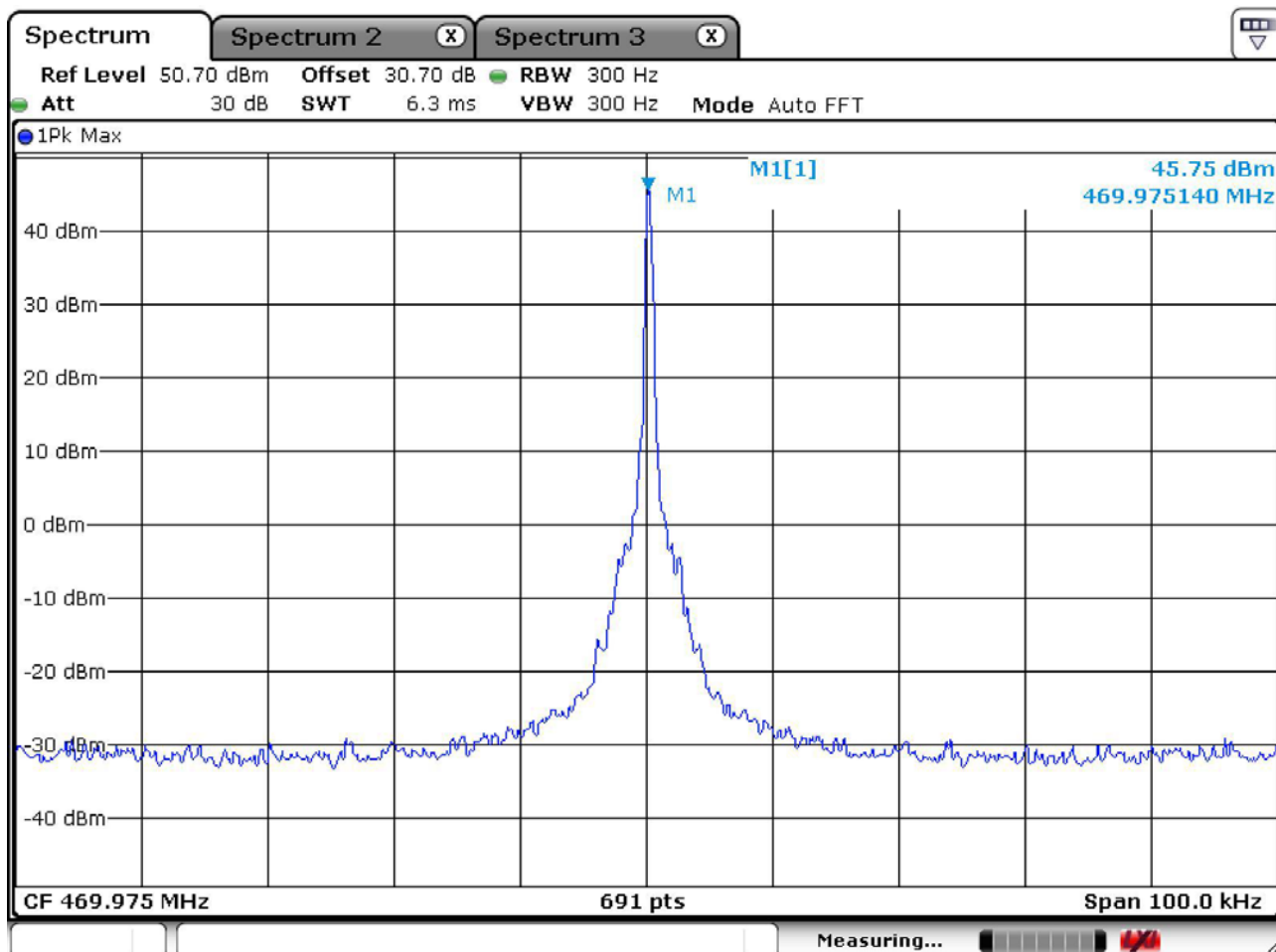
APPENDIX II

TEST PLOTS

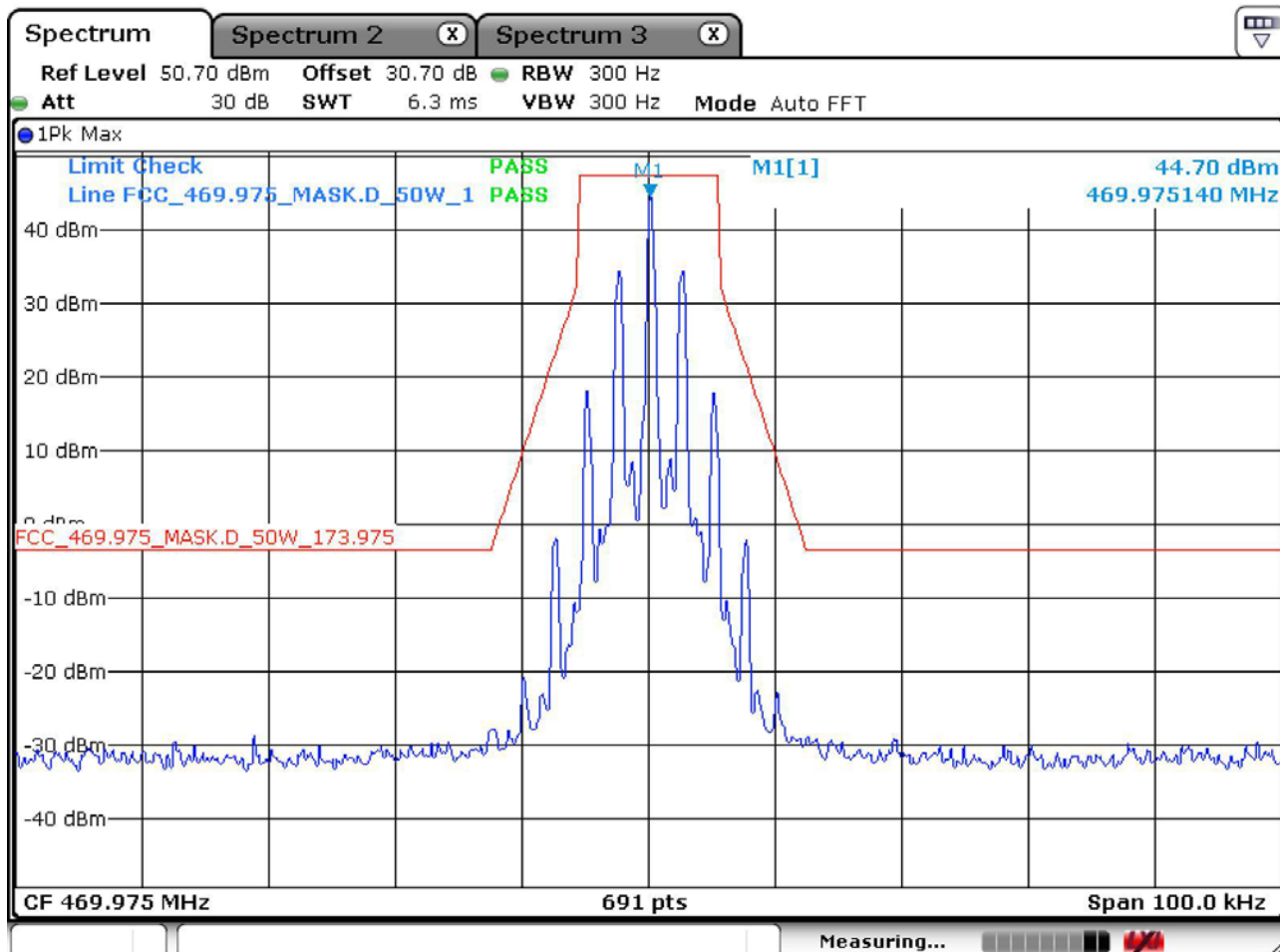
Emission Masks Measurement Data:

OPERATING FREQUENCY : 469.975 MHz

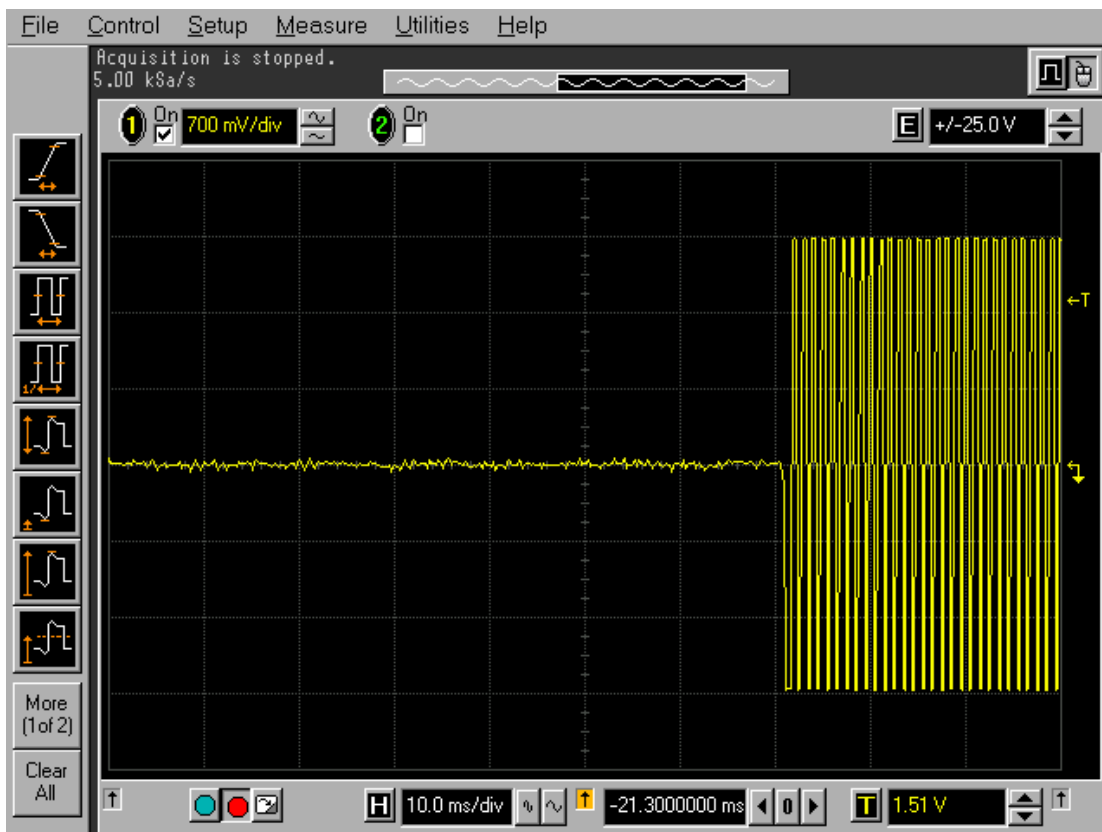
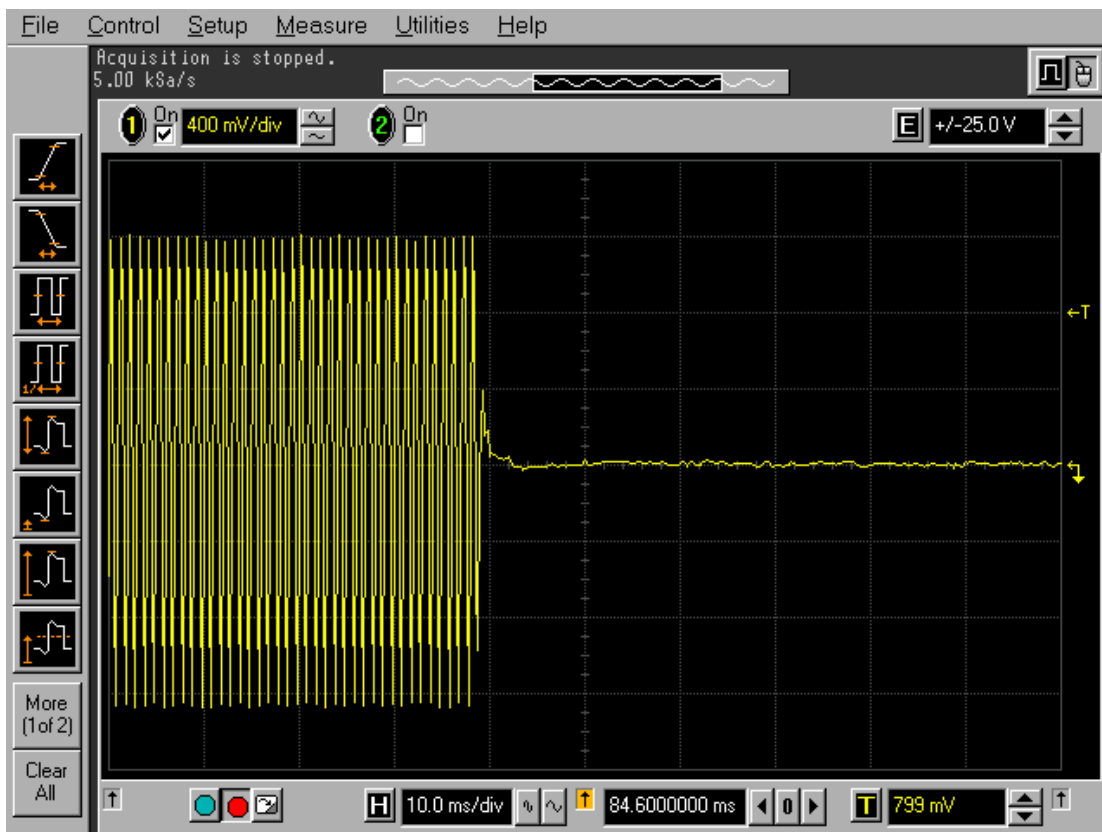
MODULATION : None



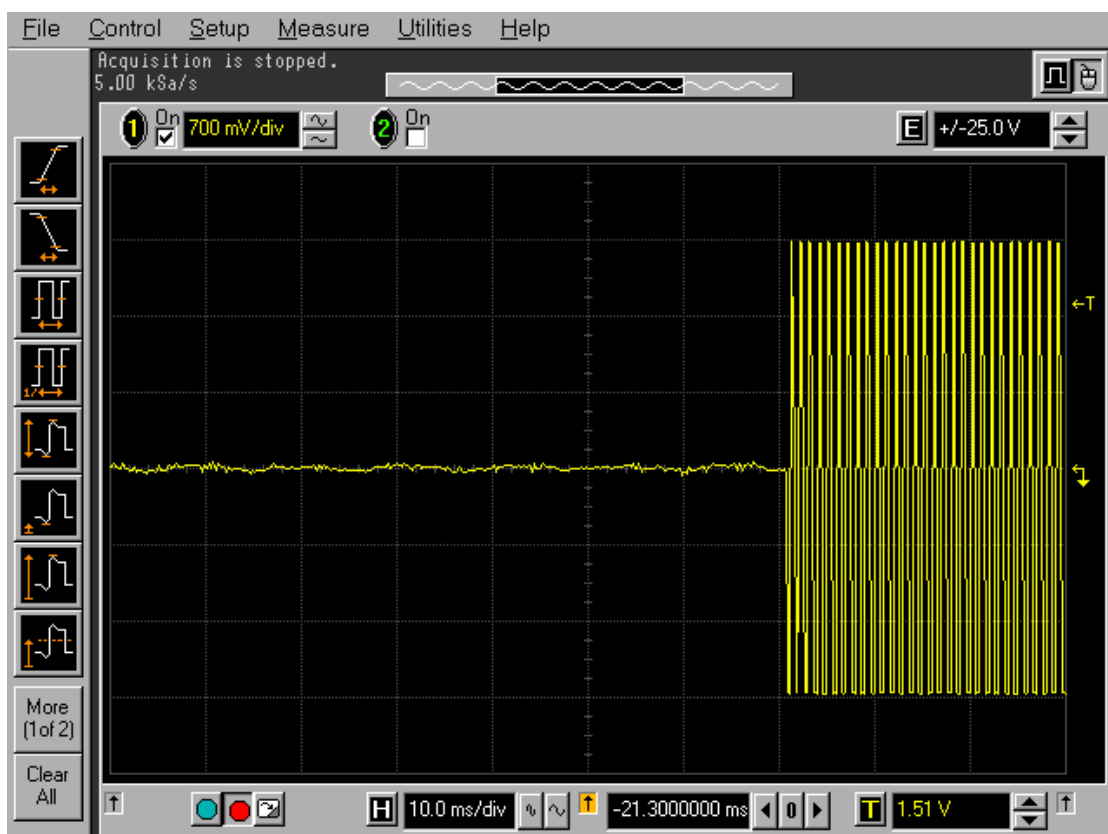
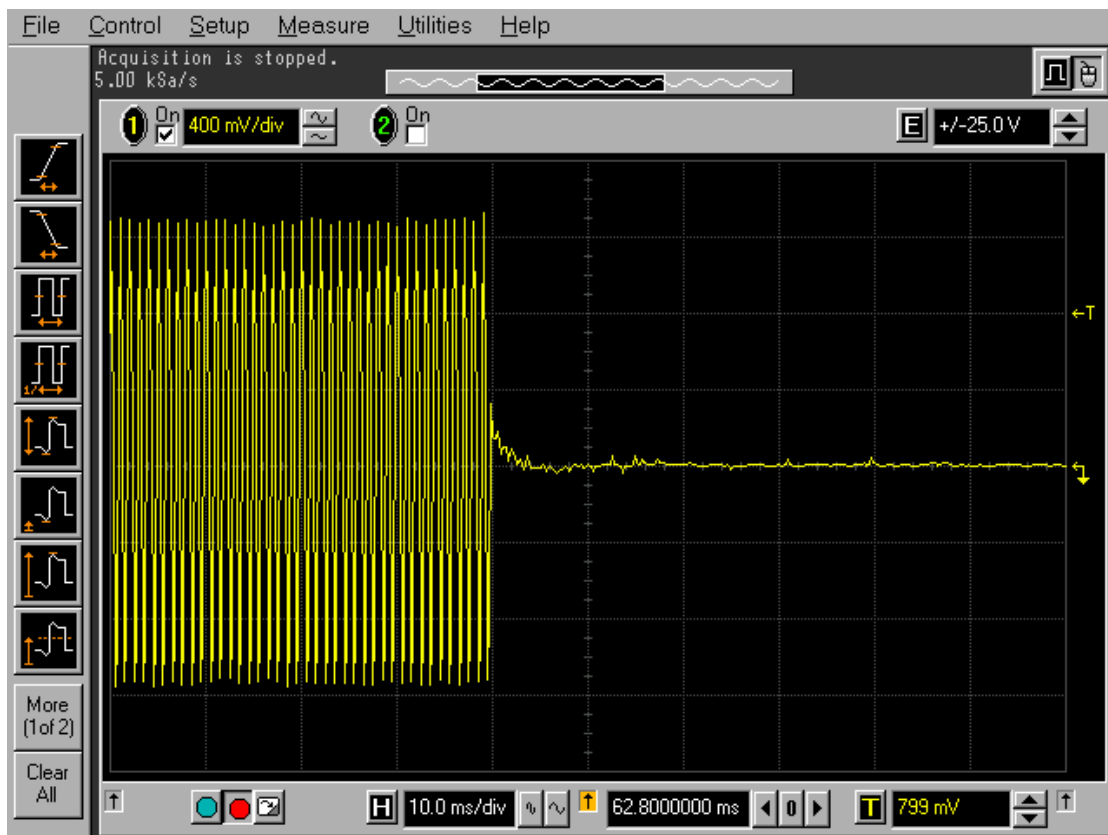
OPERATING FREQUENCY : 469.975 MHz
MODULATION : Voice: 2500 Hz, Sine Wave
MASK: D, VHF/UHF 12.5 kHz BW



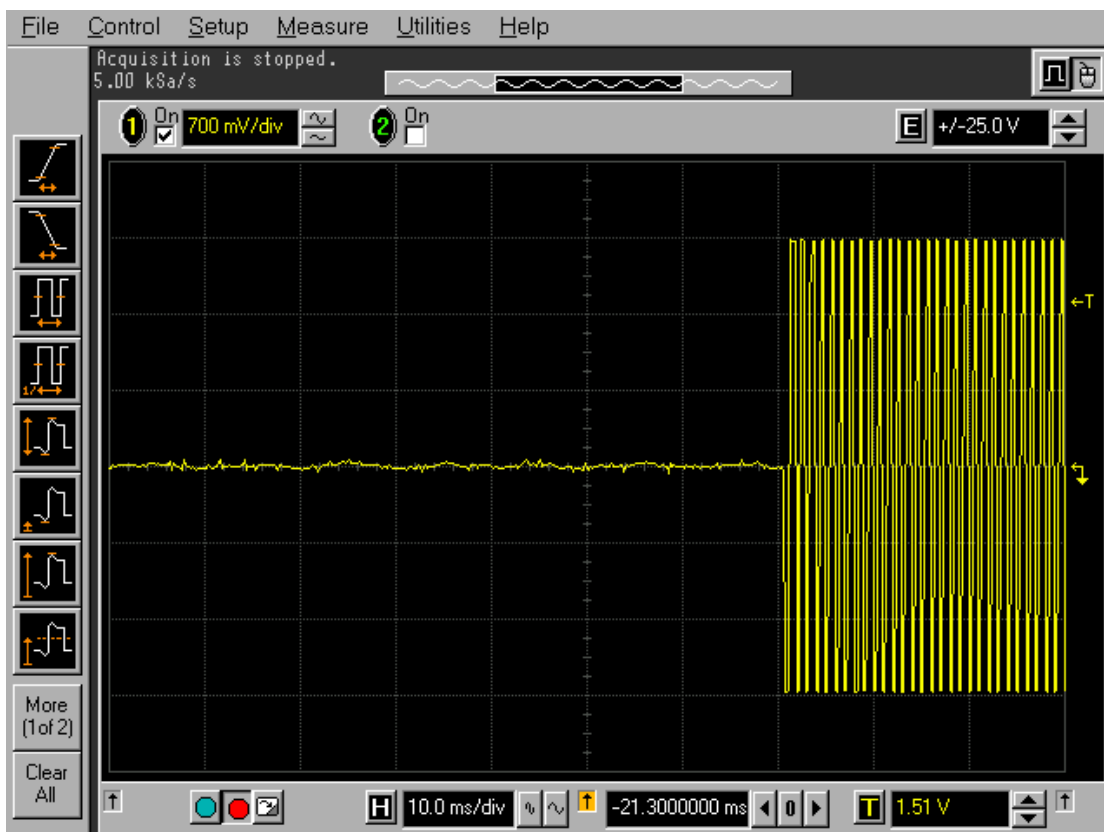
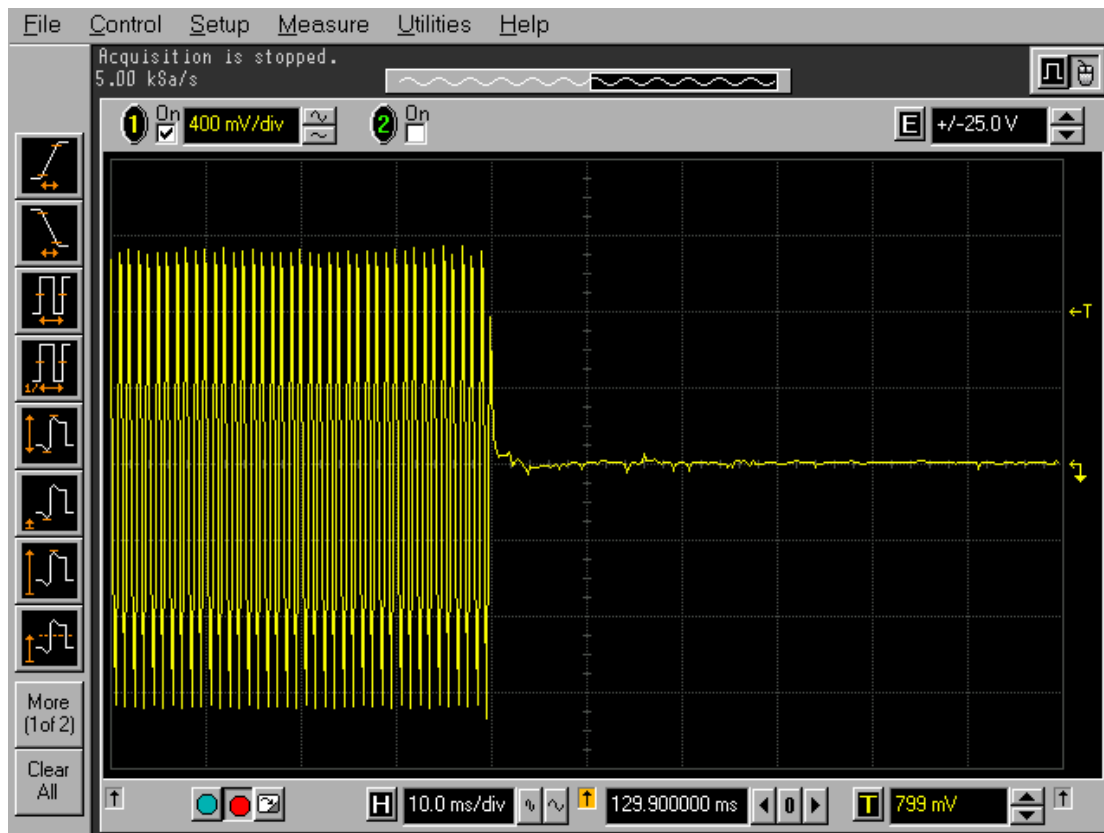
406.125MHz -12.5KHz



435.025MHz -12.5KHz



469.975MHz -12.5KHz

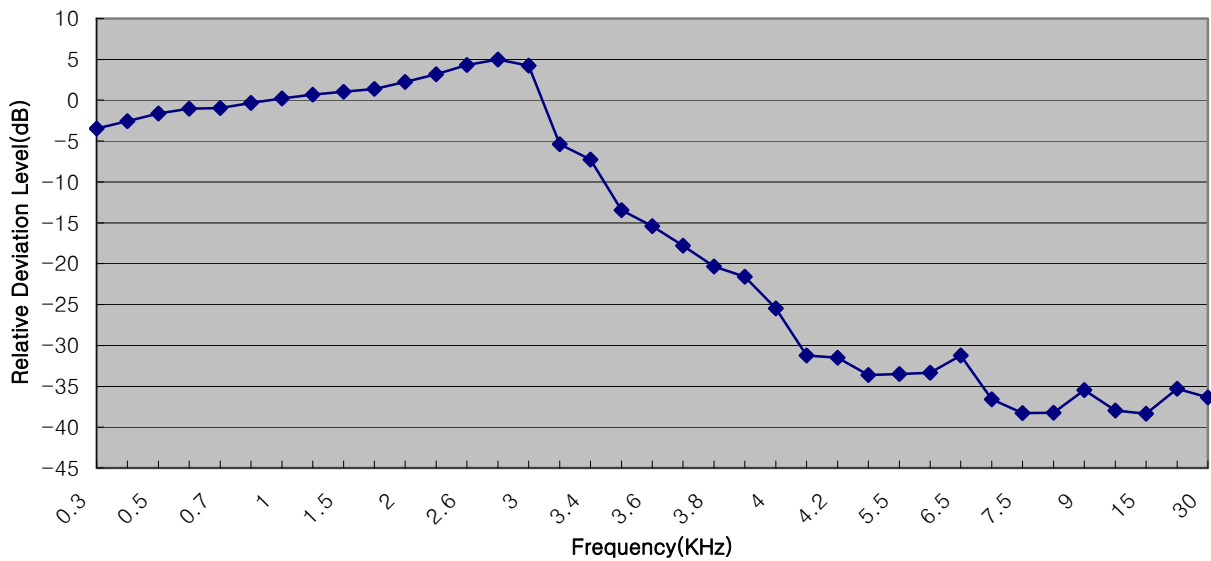


Audio Frequency Response Measurement Data:

OPERATING FREQUENCY : 469.975 MHz
 REFERENCE LEVEL : 0dB @ 1kHz

Audio Frequency Response					
Freq., kHz	Level, dB	Freq., kHz	Level, dB	Freq., kHz	Level, dB
0.3	-3.48	2.8	4.98	5.5	-33.5
0.4	-2.58	3.0	4.25	6.0	-33.34
0.5	-1.63	3.3	-5.38	6.5	-31.23
0.6	-1.05	3.4	-7.25	7.0	-36.58
0.7	-0.97	3.5	-13.44	7.5	-38.28
0.8	-0.34	3.6	-15.39	8.0	-38.23
1.0	0.23	3.7	-17.78	9.0	-35.43
1.2	0.68	3.8	-20.34	10.0	-37.95
1.5	1.04	3.9	-21.59	15.0	-38.33
1.7	1.38	4.0	-25.48	20.0	-35.28
2.0	2.24	4.1	-31.23	30.0	-36.33
2.3	3.17	4.2	-31.49		
2.6	4.33	4.8	-33.59		

Audio Frequency Response



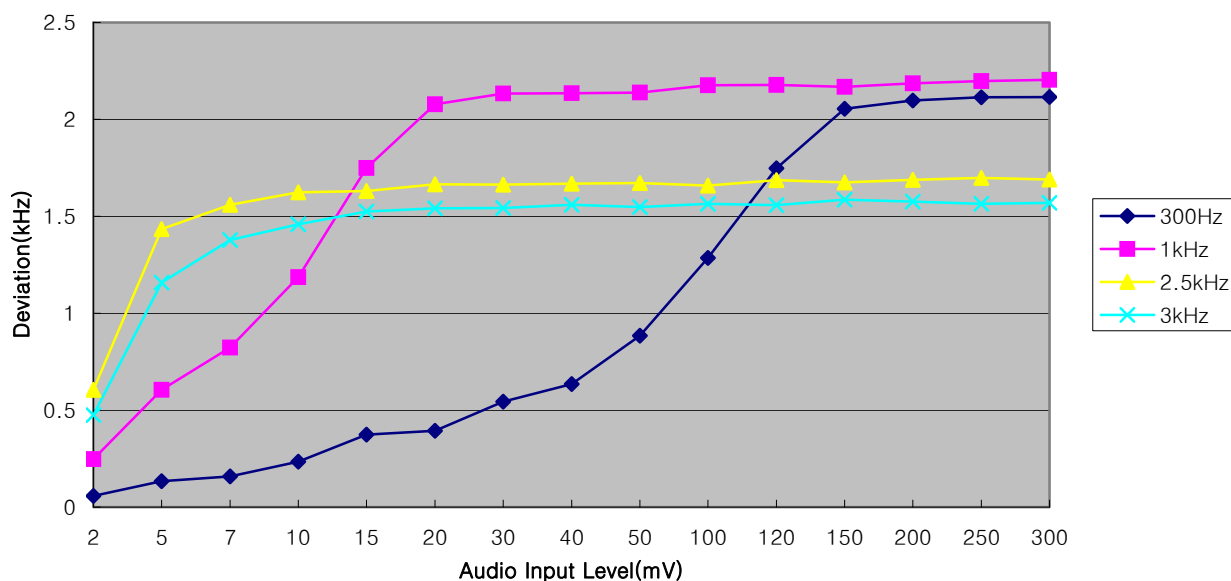
Modulation Limiting Measurement Data:

OPERATING FREQUENCY : 469.975 MHz

CHANNEL SPACING : 12.5 kHz

Input Level (mV)	FM Deviation in kHz at Indicated Modulating Frequency			
	300Hz	1KHz	2.5KHz	3KHz
2	0.058	0.248	0.605	0.476
5	0.134	0.605	1.434	1.158
7	0.158	0.824	1.559	1.378
10	0.234	1.186	1.624	1.459
15	0.375	1.749	1.631	1.525
20	0.394	2.078	1.665	1.541
30	0.545	2.134	1.663	1.543
40	0.635	2.136	1.669	1.559
50	0.885	2.139	1.672	1.548
100	1.286	2.177	1.659	1.564
120	1.748	2.178	1.687	1.558
150	2.054	2.168	1.675	1.586
200	2.098	2.187	1.688	1.576
250	2.114	2.198	1.698	1.564
300	2.115	2.204	1.689	1.569

Deviation Limiting



Frequency Stability Measurement Data:

OPERATING FREQUENCY : 469.975 MHz

REFERENCE VOLTAGE: 13.8 VDC CHANNEL SPACING: 12.5 kHz

DEVIATION LIMIT: ± 0.00025% or 2.5ppm

VOLTAGE (%)	POWER (VDC)	TEMP (dB)	FREQ (Hz)	Deviation (%)
100%	13.8	+20(Ref)	469,975,025	0.000000
100%		-30	469,975,145	-0.000026
100%		-20	469,975,137	-0.000024
100%		-10	469,975,114	-0.000019
100%		0	469,975,098	-0.000016
100%		+10	469,975,043	-0.000004
100%		+20	469,975,025	0.000000
100%		+25	469,975,011	0.000003
100%		+30	469,975,003	0.000005
100%		+40	469,974,999	0.000006
100%		+50	469,974,947	0.000017
100%		+60	469,974,934	0.000019
85%	11.73	+20	469,975,031	-0.000001
115%	15.87	+20	469,975,028	-0.000001
BATT.ENDPOINT	7.2	+20	469,975,025	0.000000

