Electromagnetic Emission

F C C M E A S U R E M E N T R E P O R T

VERIFICATION OF COMPLIANCE

FCC Part 90 Certification Measurement

PRODUCT	:	UHF FM Transceiver
MODEL/TYPE NO	:	AT-400B
FCC ID	:	ONKAT-400B
APPLICANT	:	Airtech Information & Communicatons Co.,Ltd. #101-807, Techno Park Complex. , 364, Samjung-dong, Ojung-ku, Buchon-si, Kyungki-do, 421-809, Korea Attn. : T.H. Myung / General Manager
FCC CLASSIFICATION	:	Non-Broadcast Transmitter Held to Face(TNF)
FCC RULE PART(S)	:	FCC Part 90 Private Land Mobile Radio Services
FCC PROCEDURE	:	Certification
TRADE NAME	:	Airtech
TEST REPORT No.	:	E01.0625.FCC.237-1
DATES OF TEST	:	August 24, 2001
DATES OF ISSUE	:	August 27, 2001
TEST LAB.		ETL Inc 371-51, Gasan-Dong, Geumcheon-Gu, Seoul, Korea Tel : (031) 885-0072 Fax : (031) 885-0074

This UHF hand held FM transceiver has been tested in accordance with the measurement procedures specified in ANSI/TIA/EIA-603-1992 and Part 2(refer to the test report) at the ETL/EMC Test Laboratory and has been shown to be complied with the electromagnetic radiated emission limits specified in FCC Rule Part 2 & 90 requirement.
I attest to the accuracy of data. All measurement herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.
The results of testing in this report apply to the product/system which was tested only. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Name : Kayoung Kim
Title Chief Engineer & Lab.Manager

E-RAE Testing Laboratory Inc.
371-51, Gasan-Dong, Geumcheon-Gu,
Seoul, 153-023, Korea

Table of Contents

FCC MEASUREMENT REPORT

1.Scope – *Measurement and determination of electromagnetic emission(EME) of radio frequency devices including intentional radiators and/or unintentional radiators for compliance with the technical rules and regulations of the U.S Federal Communications Commission(FCC)*

General Information

Applicant Name : Airtech Information & Communicatons Co.,Ltd.

Address : #101-807, Techno Park Complex. , 364, Samjung-dong, Ojung-ku, Buchon-si, Kyungki-do, 421-809, Korea

Attention : T.H. Myung / General Manager

- **EUT Type :** UHF-FM Handheld Transceiver
- **Trade Name :** AIRTECH
- **Model Number :** AT-400B
- **FCC Identifier :** ONKAT-400B
- **S/N :** Prototype
- **Emission Designator :** 11K0F3E, 16K0F3E
- **Freq. Range :** 440 MHz – 470 MHz
- **FCC Rule Part(s) :** Part 90.210
- **EquipmentClass :** Non-Broadcast Transmitter Held to Face(TNF)
- **Modulation :** FM
- **Channel Spacing :** 12.5kHz / 25 kHz
- **Max. RF Power :** ERP 4 watts / 2 watts
- **Frequency Tolerance :** 2.5 ppm / 5.0 ppm
- **Battery Pack :** 7.5 VDC Ni-Mh Battery
- **Dates of Tests :** August 20 ~ 24, 2001
- **Place of Tests :** ETL(E-RAE Testing Laboratory) Inc.
  584, Sangwhal-Ri, Kanam-Myun, Yoju-Kun,
  Kyounggi-Do, Korea
  Tel : (031) 885-0072 Fax : (031) 885-0074
- **Test Report No. :** E01.0625.FCC.237-1

2. INTRODUCTION

The measurement tests were conducted at the open area test site of E-RAE Testing Laboratiry Inc. facility located at 584, Sangwhal-ri, Ganam-myun, Youju-kun, Kyoungki-do, Korea. The measurement facilities were constructed in conformance with the requirements of the ANSI C63.4-1992 and CISPR Publication 16. The ETL has site descriptions on file with the FCC for 3 and 10 meter site configurations. Detailed description of test facility was found to be in compliance with the requirements of Section 2.948 FCC Rules according to the ANSI C63.4-1992 and registered to the Federal Communications Commission(Registration Number : 95422).

All measurements contained in this application were conducted in accordance with FCC Rules and regulations CFR 47and American National Standard Method of Measurement of Radio-Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40GHz (ANSI C.63.4-1992).

Measurement Procedure

The radiated and spurious measurements were made outdoors at a 3-meter test range (see Figure2).
The equipment under testing was placed on a wooden turntable, 3-meters from the receive antenna. The receive antenna height and turntable rotations was adjusted for the highest reading on the receive spectrum analyzer. A half-wave dipole was substituted in place of the EUT. This dipole antenna was driven by a signal generator and the level of the signal generator was adjusted to obtain the same receive spectrum analyzer reading. This level was recorded.
For readings above 1 GHZ, the above procedure would be repeated using horn antennas and the difference between the gain of the horn and an isotropic antenna are taken into consideration.

3. DESCRIPTION OF ATTACHMENTS

Attachment A. Cover Letters
-. Application request letter
-. Agency Authorization letter

Attachment B. Attestation Statements
-. Part 90 attestation statement

Attachment C. Test Report
-. EMC Measurement report

Attachment D. FCC ID Label and Location
-. Sample FCC ID Label and location information is shown

Attachment E. Test Setup Photos
-. Radiated Emission Test setup photos are shown

Attachment F. External Photos
-. External photos of AT-400B are shown

Attachment G. Internal Photos
-. Internal photos of AT-400B are shown

Attachment H. Block Diagram
-. The block diagram is shown

Attachment I. Schematics
-. The circuit diagrams are shown

Attachment J. Operational Instruction
-. Explanation of operational instruction for circuit is shown.

Attachment K. Part List / Tune up Procedure
-. The part lists and alignment procedure are shown.

Attachment L. User Manual
-. The user operating manual is shown.

Attachment M. SAR Measurement report
-. The block diagram is shown

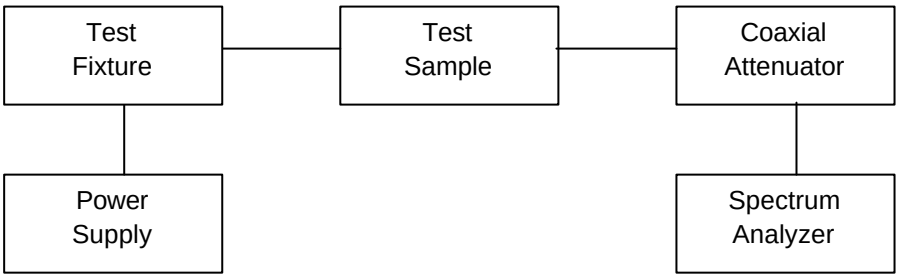
4. DESCRIPTION OF TESTS

4.1 RF Power Output - Conducted Power Output - §2.1046

Test Procedure : ANSI/TIA/EIA-603-1992, section 2.2.1

The EUT was connected to a resistive coaxial attenuator having a 50 ohm load impedance, and the unmodulated RF output power(carrier) was measured by means of an R. F. Spectrum Analyzer.

The EUT was aligned for transmitter operation on three frequencies(Fo) at full rated power per the tune-up procedure outlined in the Product Specification. This represents frequencies at the low, middle and high end of the EUT operating frequency band.



4.2 RF Power Output – ERP Measurement by Substitution Method - §2.1046

The EUT was setup at an antenna to EUT distance of 3 meters on an open area test site. The EUT was placed on a nonconductive turntable approximately 0.8 meters above the ground plane.
The physical arrangement of the EUT and associated cabling was varied in order to determine the effect on the EUT' s emissions in amplitude, direction and frequency. At each frequency, the EUT was rotated 360 degrees, and the antenna was raised and lowered from one to four meters in order to determine the maximum emission levels.
Measurements were taken using both horizontal and vertical antenna polarizations.
The worst-case, maximum radiated emission was recorded and used as reference for the ERP measurement. The EUT was then replaced by an ½wave dipole antenna and polarized in accordance with the EUT' s antenna polarization. The ½wave dipole antenna was connected to a RF signal generator with a coaxial cable.
The search antenna height, and search antenna polarity was set to levels that produced the maximum reading obtained in step 3. The signal generator was adjusted to a level that produced the radiated emission level obtained in step 3.
The signal generator level was recorded and corrected by the power loss in the cable between the generator and the antenna and further corrected for the gain of the substitution antenna used relative to an ideal ½wave dipole antenna. The signal generator corrected level is the ERP level

4. DESCRIPTION OF TESTS

4.3 Transmitter Audio Frequency Response - §2.1047(a)

Test Procedure : ANSI/TIA/EIA-603-1992, section 2.2.6

The audio frequency response is the degree of closeness to which the frequency deviation of the transmitter follows a prescribed characteristic.The frequency response of the audio modulating circuit over the frequency range 100 - 5000 Hz is measured. The audio signal generator is connected to the audio input circuit/microphone of the EUT. The audio signal input is adjusted to obtain 20% modulation at 1kHz and this point is taken as the 0dB reference level. With the input held constant and below the limit at all frequencies, the audio signal generator is varied from 100 Hz to 50 kHz. The deviation in kHz was recorded using a modulation analyzer. The response in dB relative to 1 kHz was calculated as follows:
Audio Frequency Response = 20 LOG (DEV_{freq}/DEV_{ref})

4.4 Audio Low Pass Filter Frequency Response - §2.1047(a)

Test Procedure : ANSI/TIA/EIA-603-1992, Section 2.2.15

The Audio Low Pass Filter Response is the frequency response of the post limiter low pass filter circuit above 3000 Hz. The response in dB relative to 1kHz is measured using the HP8901 Modulation Analyzer. For the frequency response of the audio low-pass filter, The EUT and test equipment were set up such that the audio input is connected at the input to the modulation limiter and the modulated stage. The audio output is connected at the output of the modulated stage.

4.5 Modulation Limiting - §2.1047(b) & §22.915(b)

Test Procedure : ANSI/TIA/EIA-603-1992, section 2.2.3

The audio signal generator is connected to the audio input circuit/microphone of the EUT.
The transmitter is adjusted its full rating. The modulation response is measured for each of the three modulating frequencies, one of them is the frequency of maximum response(300Hz, 1000 Hz, and 3000Hz), and the input signal voltage is varied from 30% modulation to at least 20dB higher than the saturation point. The system maximum deviation was recorded at each test condition.
Measurements of modulation and test plots are attached. Measurements were performed for both negative and positive modulation and respective results were recorded.

4. DESCRIPTION OF TESTS

4.6 Occupied Bandwidth : §2.1049 & §90.210

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission.
The antenna output terminal of the EUT was connected to the input of a 50ohm spectrum analyzer through a matched 30dB attenuator. The radio transmitter was modulated by a 2500 Hz tone at an input level 16 dB greater than that necessary to produce 50 percent modulation. The input level shall be established at the frequency of maximum response of the audio modulating circuit. The occupied bandwidth data is obtained for 25kHz and 12.5 kHz channel bandwidth. The results are shown on the attached graphs.

Specified limits according to the emission mask per section 90.210 is as below.

Emission Mask B. The power of any emission must be below the unmodulated carrier power (P) as follows:

(1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.

(2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 per-cent of the authorized bandwidth: At least 35 dB.

(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized band-width: At least 43 + 10 log (P) dB.

Emission Mask D. 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 removed 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.

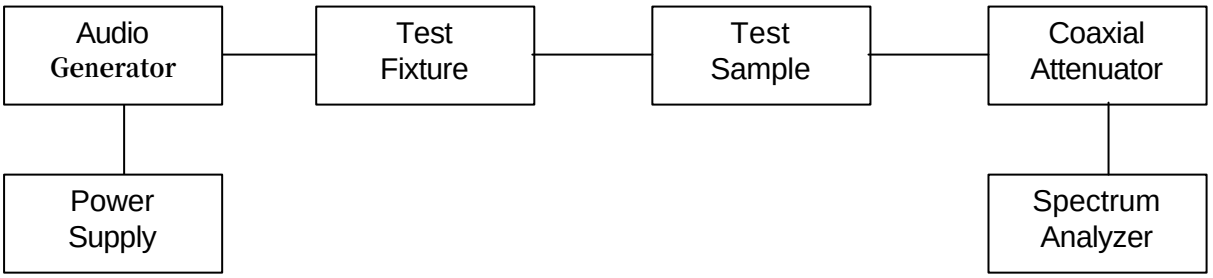
(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 12.5 kHz: At least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.

4. DESCRIPTION OF TESTS

4.7 Spurious and Harmonic Emissions at Antenna Terminal : §2.1051

The level of the carrier and the various conducted spurious and harmonic frequencies is measured by means of a calibrated spectrum analyzer. The spectrum is scanned from the lowest frequency generated in the equipment up to 10 GHz. The transmitter is modulated with a 2500Hz tone at a level of 16dB greater than that required to provide 50% modulation of the rated system deviation at 1000 Hz.

The antenna output terminal of the EUT was connected to the input of 50 ohm spectrum analyzer through a matched 30dB RF attenuator and coaxial cable.The transmitter was operating at maximum power with modulation.



4.8 Radiated Spurious and Harmonic Emissions : §2.1053

Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet,
control circuits, power leads, or inter-mediate circuit elements under normal conditions of installation and operation.
Radiation and harmonic emissions above 1 GHz is measured outdoors at our 3-meter test range. The equipment under test is placed on a wooden turn-table 3-meters fom the receive antenna. The receive antenna height and turntable rotations were adjusted for the highest reading on the receive spectrum analyzer. A half-wave dipole was substituted in place of the EUT. This dipole antenna was driven by a signal generator with the level of the signal generator being adjusted to obtain the same receive spectrum analyzer reading. This level is recorded. For readings above 1GHz, the above procedure is repeated using horn antennas and the difference between the gain of the horn and an isotropic antenna are taken into consideration.

4. DESCRIPTION OF TESTS

4.9 Frequency Stability / Temperature Variation - §2.1055(b) & §90.213

Test Procedure : ANSI/TIA/EIA-603-1992, section 2.2.2

The carrier frequency stability is the ability of the transmitter to maintain an assigned carrier frequency. The frequency stability of the transmitter is measured by:

a) **Temperature:** The temperature is varied from -30°C to +50°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 minimum frequency stability shall be +/- 2.5ppm for 12.5kHz channel bandwidth and 5ppm for 25kHz channel bandwidth at any time during normal operation.

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 any 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 is 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 were made at 10 intervals starting at 30°C up to +50°C allowing at least two hours at each
temperature for stabilization. In all measurements the frequency is measured within three minutes after
applying power to the transmitter.
7. The artificial load is mounted external to the temperature chamber.

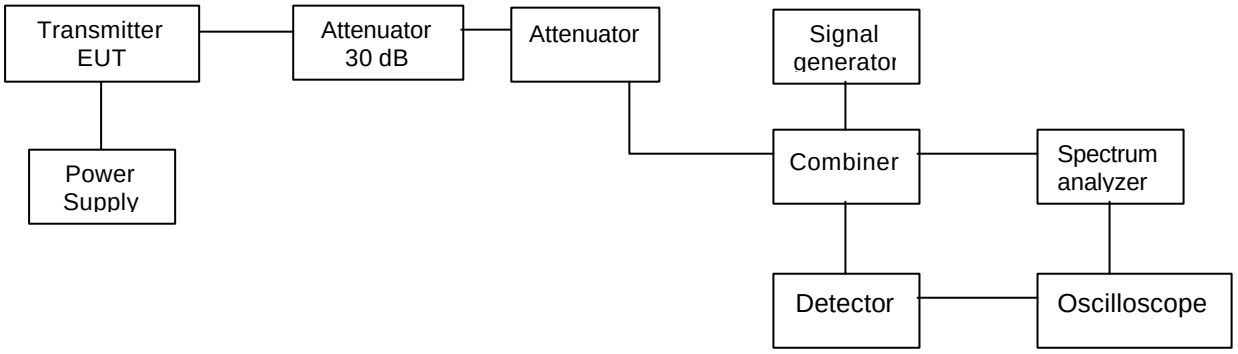
NOTE: The EUT is tested down to the battery endpoint.

4. DESCRIPTION OF TESTS

4.10 Transient Frequency Behavior - § 90.214

Test Procedure : ANSI/TIA/EIA-603-1992, section 2.2.19

1. The EUT was setup as shown on the following configuration.
2. The transmitter was turned on.
3. 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 , then the transmitter was turned off.
4. With the transmitter off, an RF signal generator (1) modulated with a 1 kHz tone at 25kHz and 12.5 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 3, as measured at the output of the combiner. This level was then maintained through out the test and was recorded.
6. The oscilloscope was setup using TIA/EIA-603 steps j and k as a guide, and to either 10 ms/div (UHF) or 5 ms/div (VHF).
7. 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.
8. The carrier on-time and the carrier off-time as referenced in TIA/EIA-603 steps were captured and plotted.



5. TEST DATA

5.1 RF Power Output : FCC Rules Part 2 §2.1046(a) , §90.205

A. Conducted Power Output

Transmitter Channel Setting	Frequency Tuned (MHz)	Measured Power (Peak) (dBm)	Rated Power (Watts)
Lowest	440.025	36.5	4.5
Middle	455.025	36.7	4.7
Highest	469.975	36.3	4.3

B. ERP Measurement by Substitution Method

Frequency Tuned (MHz)	EUT Conducted Power (dBm)	Max. E-Field of EUT (dBm)	Antenna Polarization (V/H)	Signal GEN. Power (dBm)	Dipole Gain (dBd)	Measured ERP Power	
						(dBm)	Watts
440.025	36.5	9.0	V	36.6	-0.85	35.75	3.8
455.025	36.7	10.2	V	36.9	-0.95	35.95	3.9
469.975	36.3	10.4	V	36.8	-0.65	36.15	4.1

Note :

1. *Transmitter was set to the high power output(5 watts) condition.*
2. *The EUT antenna as specified by the manufacturer was used(unity gain).*
3. *The maximum measured ERP is 36.15 dBm(4.1 Watts), as recorded in the above table.*
4. *ERP measurements were performed using the standard battery with full charged condition.*

5. TEST DATA

5.3 Modulation Characteristics – Audio Frequency Response

FCC Rules :	Part 2 §2.1047(a) & §90.242(b)(8)
Operating Frequency :	455.025 MHz
Channel :	Middle
Referency Voltage :	7.2 VDC
Power Output :	4 Watts

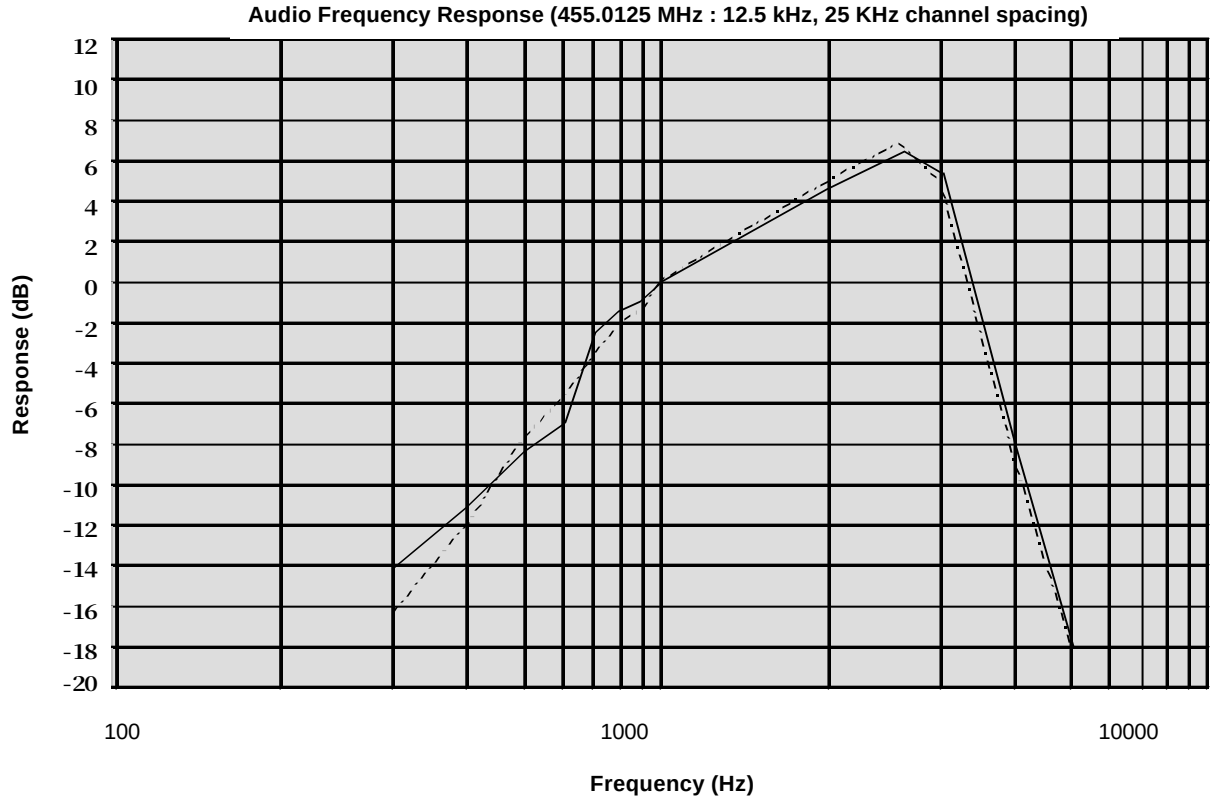
Audio Frequecy (Hz)	Response dB Measured	
	(Channel spacing : 12.5kHz)	(Channel spacing : 12.5kHz)
300	-14.0	-16.2
400	-11.2	-12.0
500	-8.2	-7.8
600	-6.8	-5.8
700	-2.4	-3.8
800	-1.4	-2.0
900	-0.8	-1.2
1000	0.0	0.0
2000	4.6	5.2
2500	6.4	6.8
3000	5.5	5.0
4000	-8.0	-8.6
5000	-18.0	-18.0

NOTE :

1. *No limit is required by the FCC for audio frequency response. The mrasured audio response data shows the role-off curve at 3 kHz.*

5. TEST DATA

5.3 Modulation Characteristics – Audio Frequency Response (continued)



5. TEST DATA

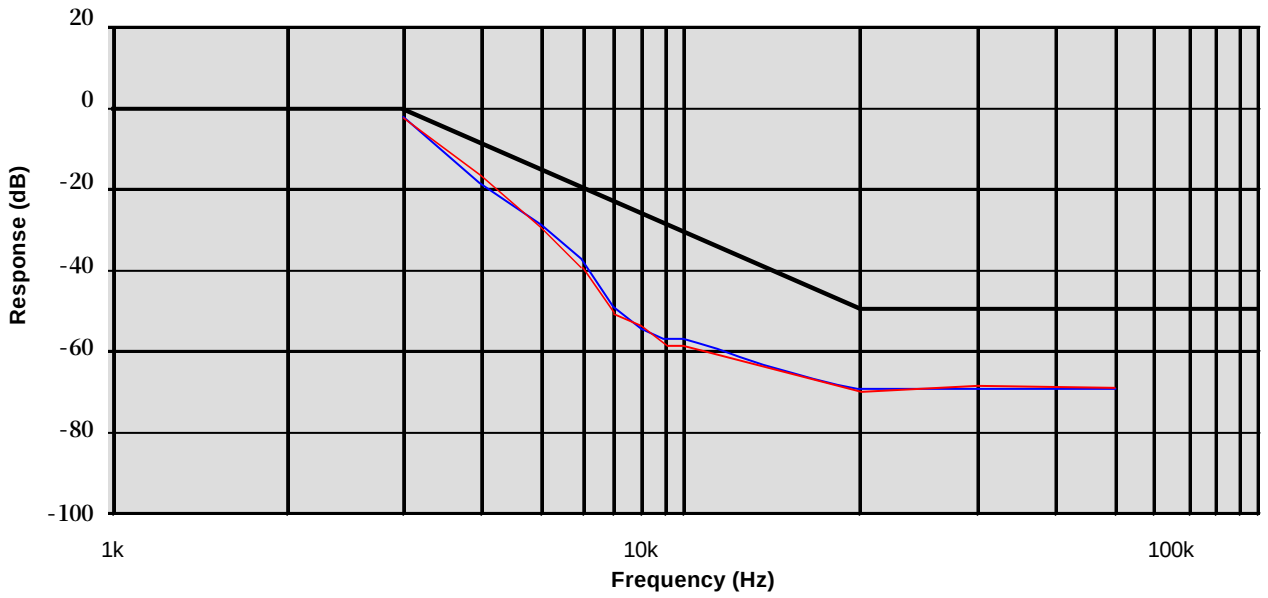
5.4 Modulation Characteristics – Audio Lowpass Filter Response

FCC Rules :	Part 2 §2.1047(a) , §90.242(b)(8)
Operating Frequency :	455.025 MHz
Channel :	Middle
Referency Voltage :	7.2 VDC
Power Output :	5 Watts

Audio Frequecy (KHz)	Response dB Measured	
	(Channel spacing : 12.5kHz)	(Channel spacing : 25kHz)
1	0.0	0.0
2	1.2	1.0
3	-3.7	-3.5
4	-19.2	-18.6
5	-28.2	-28.6
6	-37.4	-38.0
7	-48.0	-49.0
8	-54.6	-54.2
9	-56.8	-57.0
10	-56.0	-56.4
20	-68.4	-68.0
30	-68.0	-68.0
50	-68.0	-68.0

NOTE :

1. No limit is required by the FCC for audio frequency response. The mrasured audio response data shows the role-off curve at 3 kHz.



5. TEST DATA

5.5 Modulation Characteristics – Modulation Limiting

FCC Rules :	Part 2 §2.1047(b) , §90.210
Operating Frequency :	455.025 MHz
Channel :	Middle
Referency Voltage :	7.2 VDC
Power Output :	4 Watts

12.5 KHz Channel Spacing

Audio Input	Positive Peak Deviation (dB)			Negative Peak Deviation (dB)		
	300 Hz	1 KHz	3 KHz	300 Hz	1 KHz	3 KHz
-20	0.34	0.40	0.40	0.34	0.40	0.40
-15	0.34	0.60	0.70	0.34	0.60	0.70
-10	0.37	0.80	1.20	0.37	0.80	1.12
-5	0.40	1.20	1.50	0.40	1.20	1.56
0	0.45	1.60	1.70	0.45	1.62	1.74
5	0.60	1.90	1.68	0.60	1.90	1.72
10	0.80	2.10	1.70	0.80	2.10	1.70
15	1.20	2.20	1.70	1.20	2.20	1.70
20	1.60	2.20	1.70	1.66	2.20	1.70

25 KHz Channel Spacing

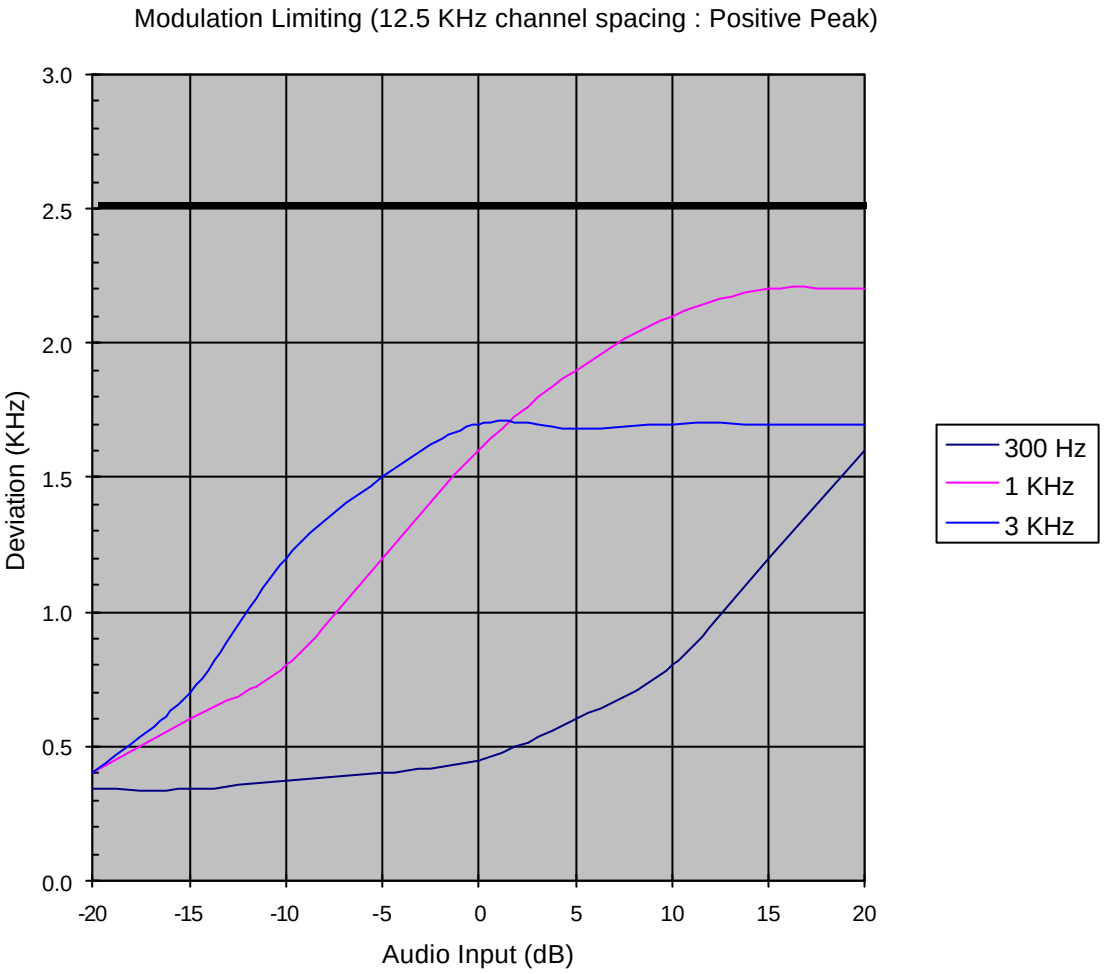
Audio Input	Positive Peak Deviation (dB)			Negative Peak Deviation (dB)		
	300 Hz	1 KHz	3 KHz	300 Hz	1 KHz	3 KHz
-20	0.50	0.70	1.15	0.50	0.70	1.15
-15	0.48	0.90	1.80	0.48	0.90	1.80
-10	0.50	1.25	2.50	0.50	1.25	2.50
-5	0.60	2.30	3.15	0.60	2.30	3.15
0	0.70	3.20	3.60	0.70	3.10	3.40
5	1.20	3.80	3.60	1.20	3.50	3.50
10	1.70	4.20	3.65	1.70	3.80	3.40
15	2.40	4.17	3.64	2.40	3.78	3.38
20	3.70	4.20	3.64	3.70	3.65	3.35

NOTE :

1. *The modulation limits was applied 5 KHz for 25 KHz channel spacing and 2.5 KHz for 12.5 KHz channel spacing system.*

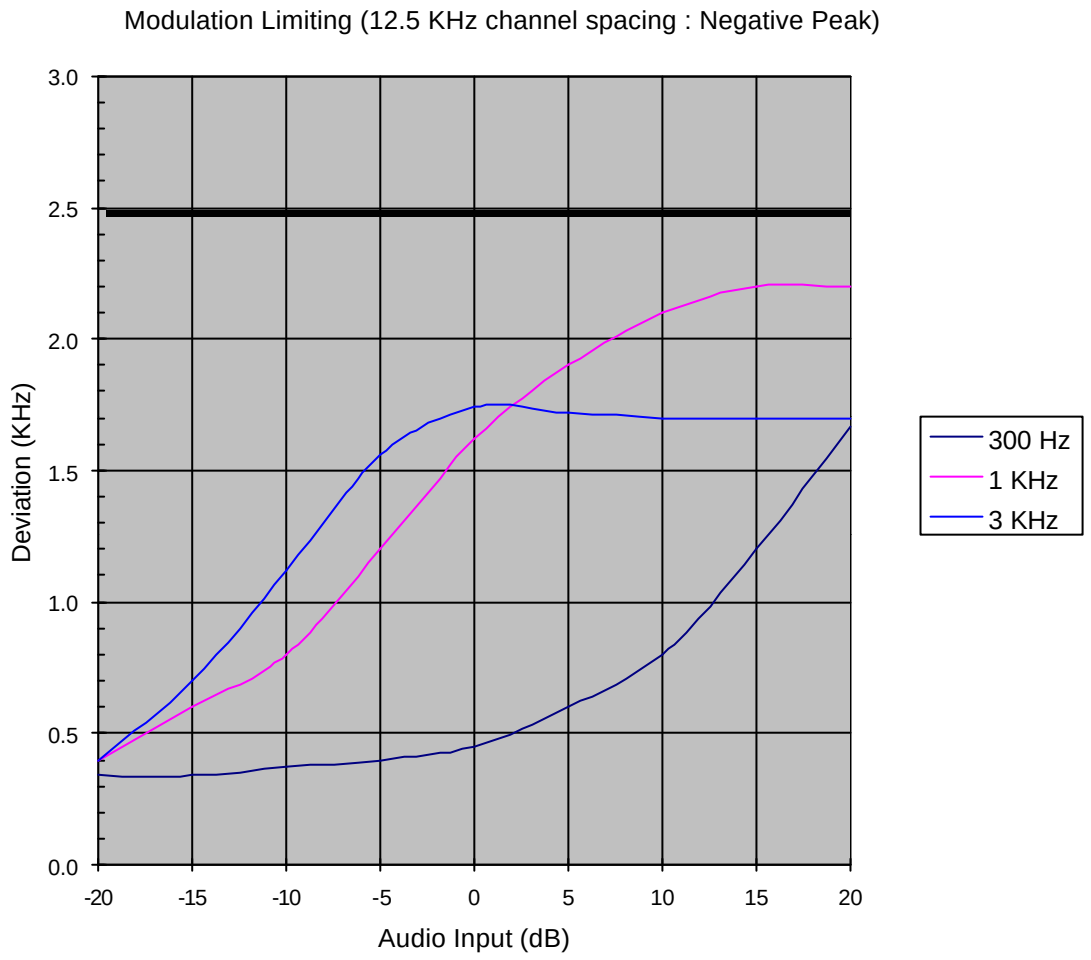
5. TEST DATA

5.5 Modulation Characteristics – Modulation Limiting (continued)



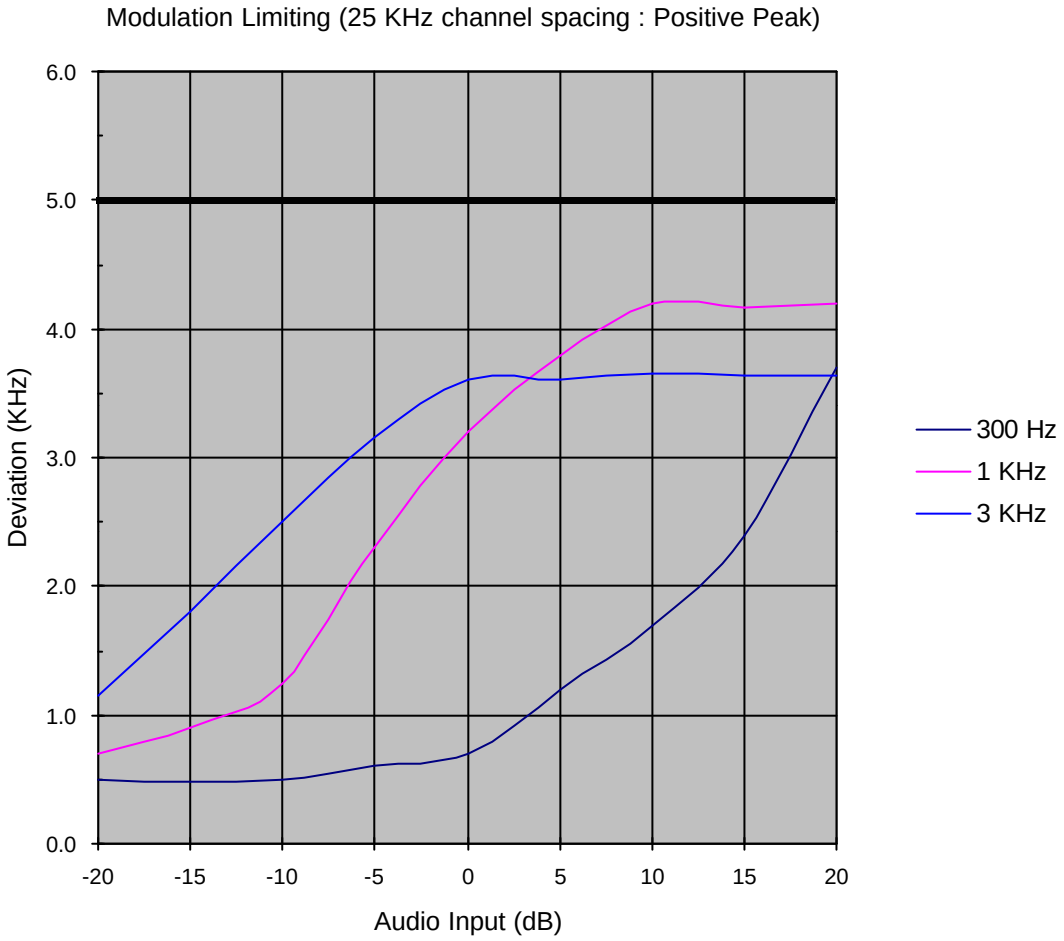
5. TEST DATA

5.5 Modulation Characteristics – Modulation Limiting (continued)



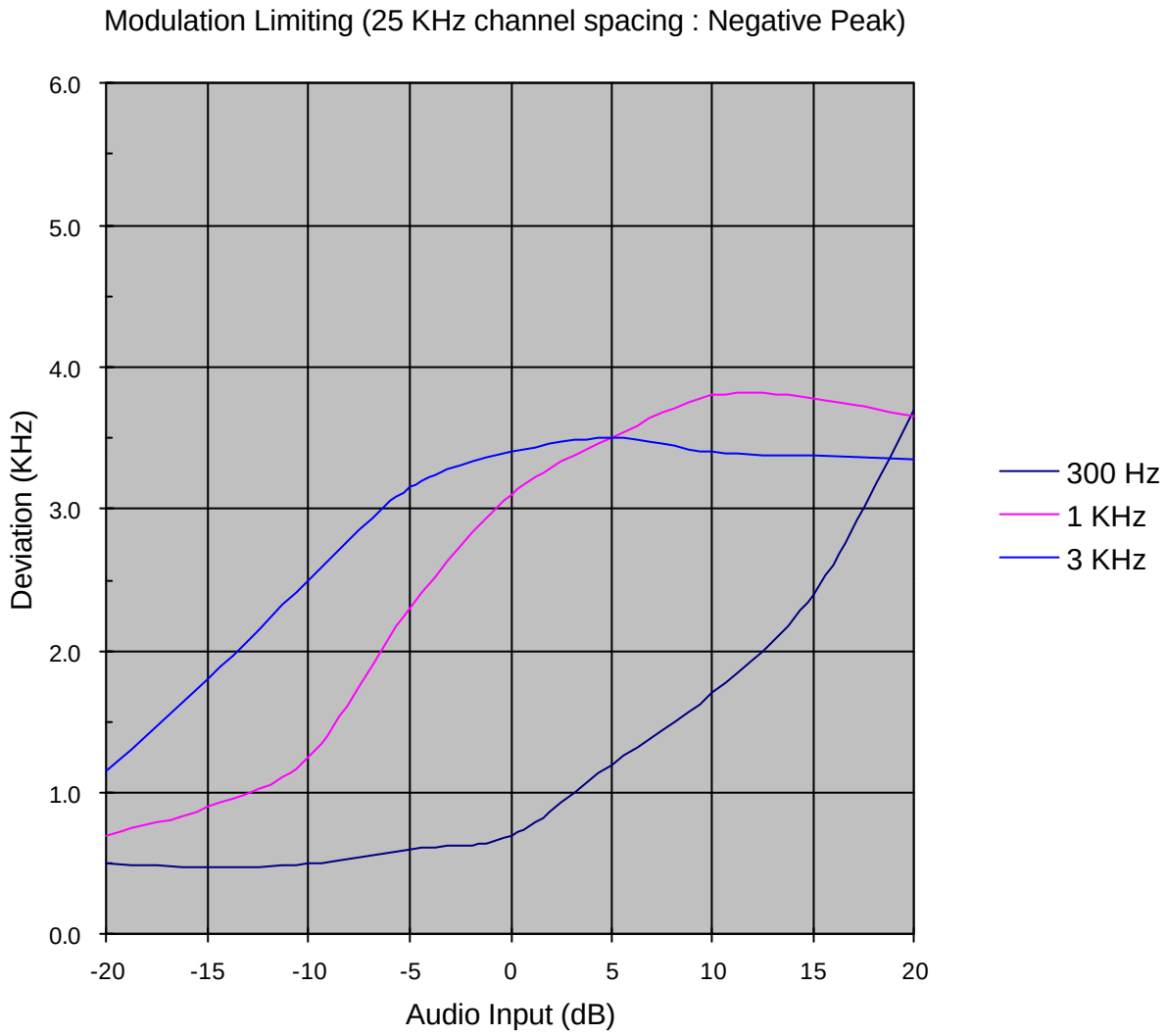
5. TEST DATA

5.5 Modulation Characteristics – Modulation Limiting (continued)



5. TEST DATA

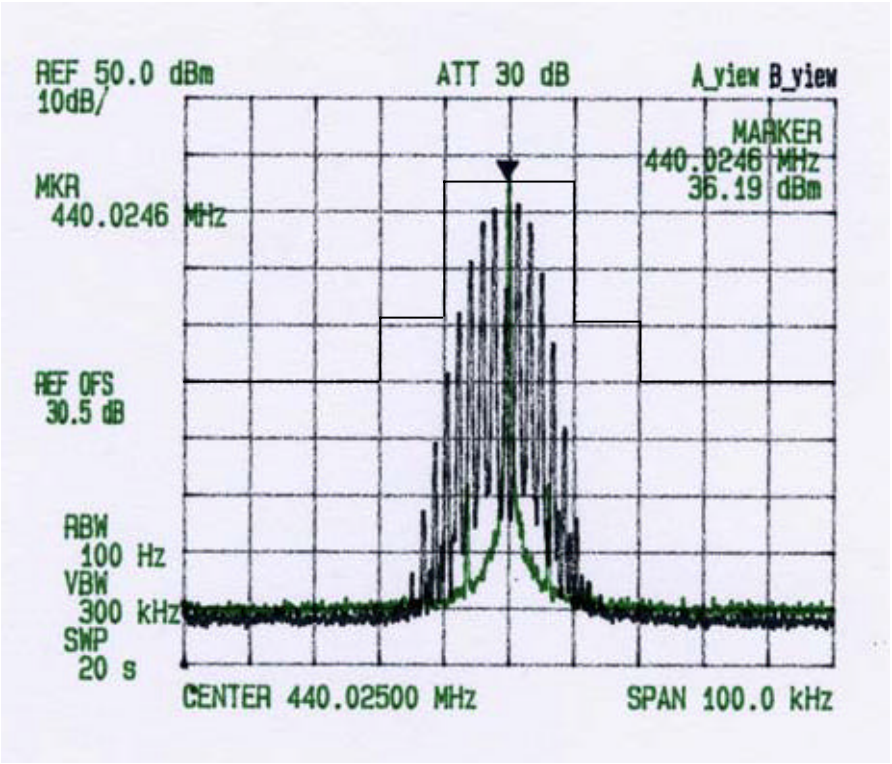
5.5 Modulation Characteristics – Modulation Limiting (continued)



5. TEST DATA

5.6 Occupied Bandwidth

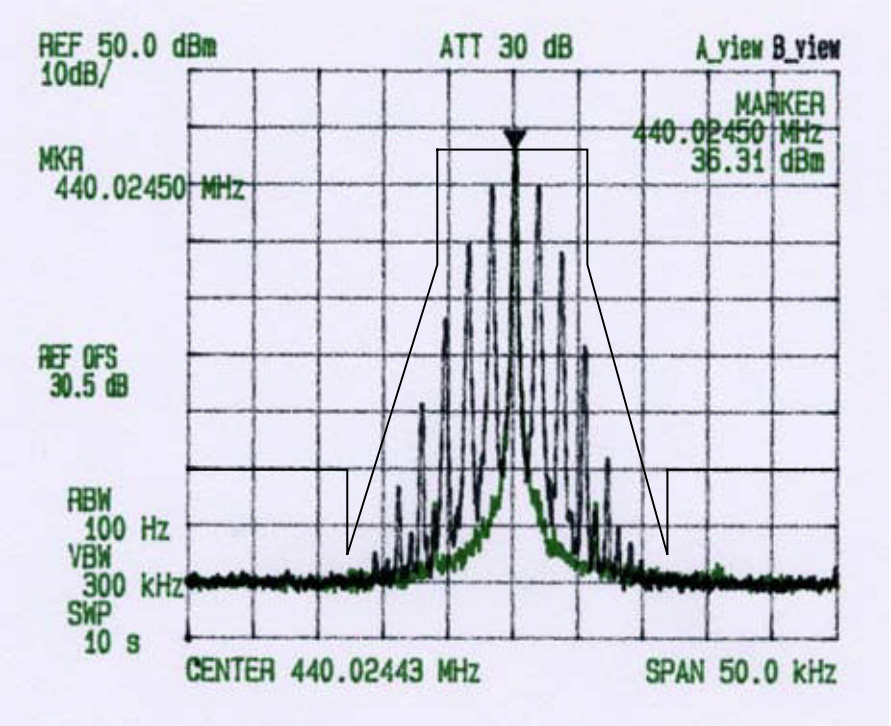
FCC Rules :	Part 2 §2.1053(a) , §90.210
Operating Frequency :	440.025 MHz
Channel :	Lowest
Measured Output Power :	36.9 dBm
Modulation Signal :	FM modulation with 2.5kHz sine wave signal
Emission Mask :	Mask B



5. TEST DATA

5.6 Occupied Bandwidth (continued)

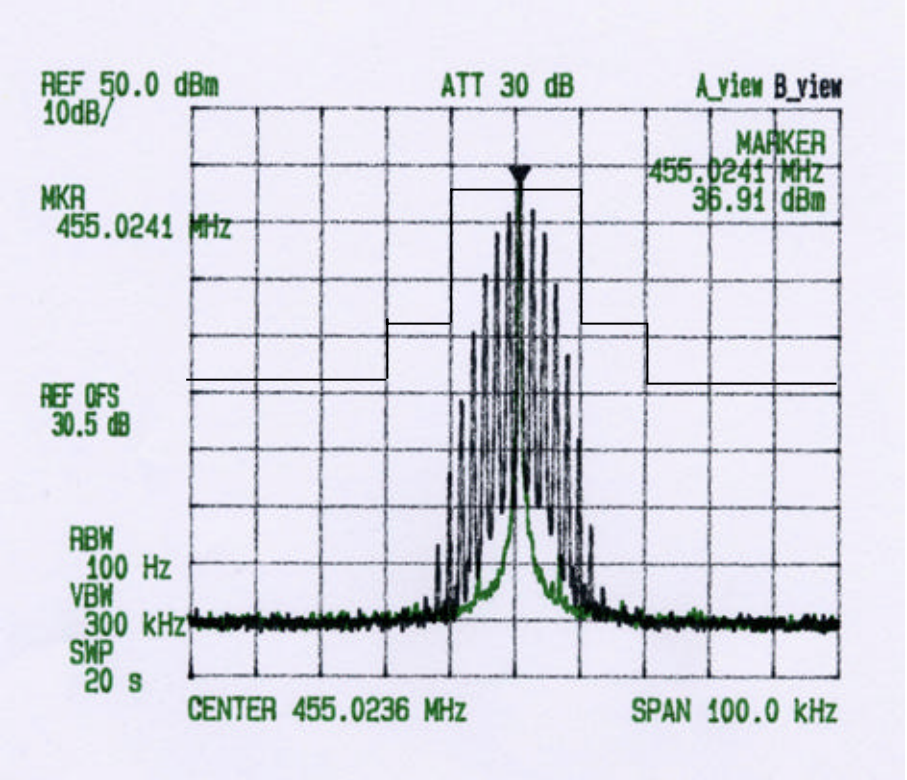
FCC Rules :	Part 2 §2.1053(a) , §90.210
Operating Frequency :	440.025 MHz
Channel :	Lowest
Measured Output Power :	36.3 dBm
Modulation Signal :	FM modulation with 2.5kHz sine wave signal
Emission Mask :	Mask D



5. TEST DATA

5.6 Occupied Bandwidth (continued)

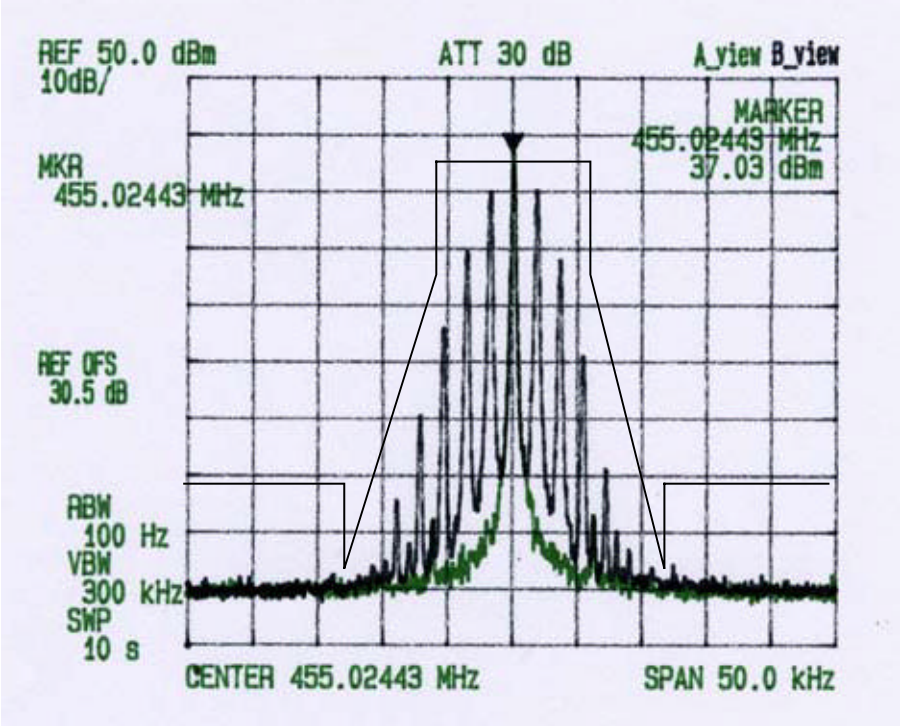
FCC Rules :	Part 2 §2.1053(a) , §90.210
Operating Frequency :	455.025 MHz
Channel :	Middle
Measured Output Power :	36.9 dBm
Modulation Signal :	FM modulation with 2.5kHz sine wave signal
Emission Mask :	Mask B



5. TEST DATA

5.6 Occupied Bandwidth (continued)

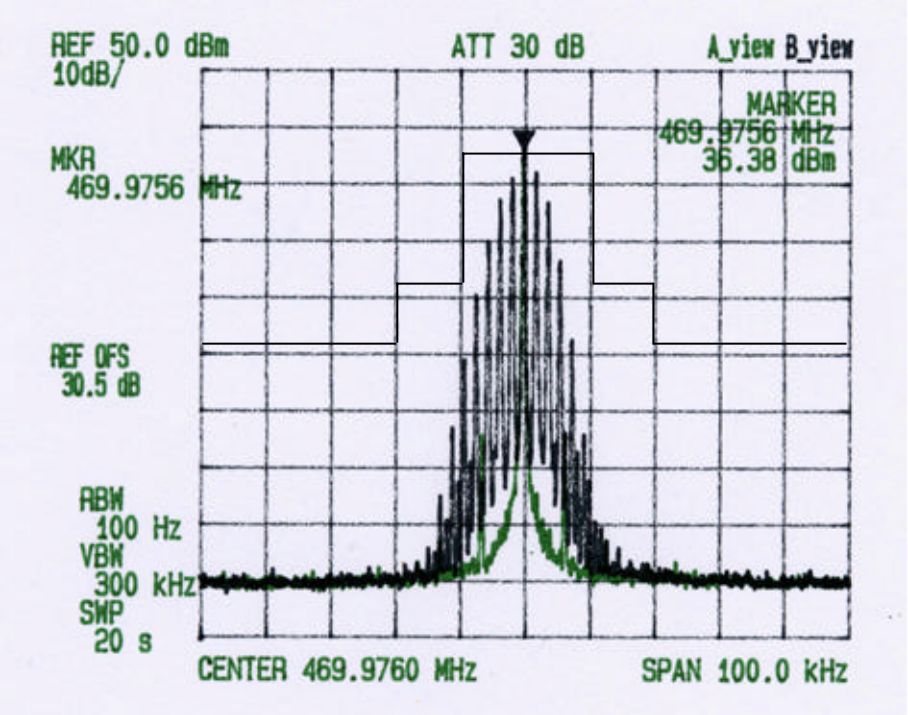
FCC Rules :	Part 2 §2.1053(a) , §90.210
Operating Frequency :	455.025 MHz
Channel :	Middle
Measured Output Power :	36.3 dBm
Modulation Signal :	FM modulation with 2.5kHz sine wave signal
Emission Mask :	Mask D



5. TEST DATA

5.6 Occupied Bandwidth (continued)

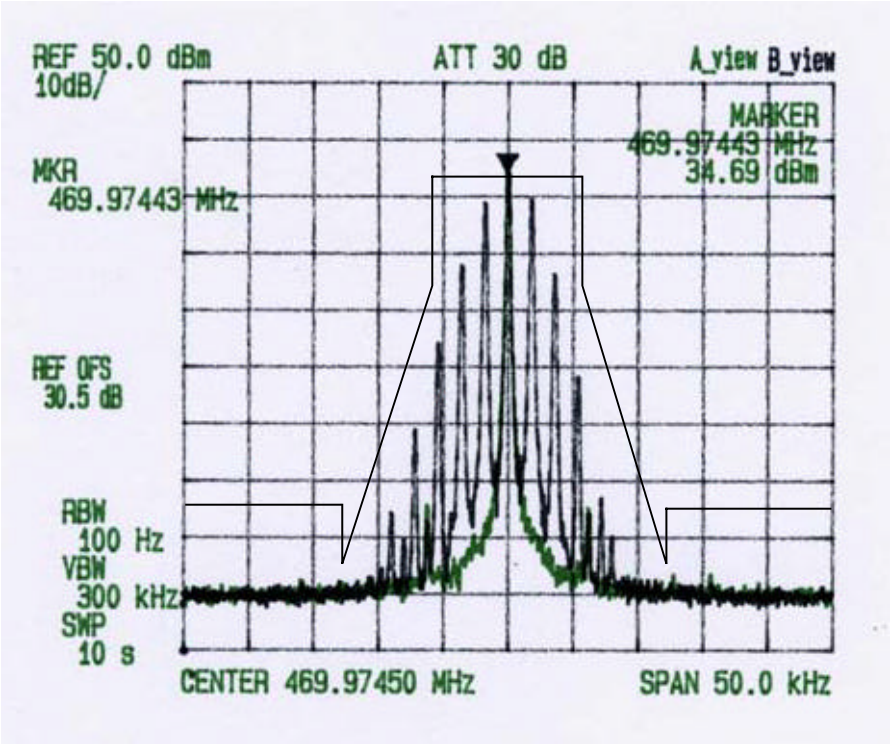
FCC Rules :	Part 2 §2.1053(a) , §90.210
Operating Frequency :	469.975 MHz
Channel :	Highest
Measured Output Power :	36.9 dBm
Modulation Signal :	FM modulation with 2.5kHz sine wave signal
Emission Mask :	Mask B



5. TEST DATA

5.6 Occupied Bandwidth (continued)

FCC Rules :	Part 2 §2.1053(a) , §90.210
Operating Frequency :	469.975 MHz
Channel :	Highest
Measured Output Power :	34.69 dBm
Modulation Signal :	FM modulation with 2.5kHz sine wave signal
Emission Mask :	Mask D



5. TEST DATA

5.7 Field Strength of Spurious Radiation

FCC Rules : Part 2 §2.1053(a) , §90.210
Operating Frequency : 440.025 MHz
Channel : Lowest
Measured Output Power : 36.5dBm
Modulation Signal : FM modulation with 2.5kHz sine wave signal
Distance : 3 meters

Frequency Tuned (MHz)	Antenna Polarization (V/H)	Signal GEN. Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)
880.05	V	-33.1	4.6	-28.5	-20.0	-8.5
1320.07	V	-38.1	5.3	-32.8	-20.0	-12.8
1760.10	H	-45.3	7.3	-38.0	-20.0	-18.0
2200.10	H	-47.8	6.8	-41.0	-20.0	-21.0
2640.15	V	-46.9	8.4	-38.5	-20.0	-18.5
3080.17	H	-55.3	8.9	-46.4	-20.0	-26.4
3520.20	H	-50.2	10.2	-40.0	-20.0	-20.0
3960.20	H	-58.8	10.4	-48.4	-20.0	-28.4
4400.25	H	-64.9	10.3	-54.6	-20.0	-34.6

Note :

1. *The spectrum bandwidth was set to RBW 100 kHz (freq. up to 1GHz) and RBW 1 MHz(freq above 1GHz).*
2. *Transmitter was set to the high power output(5 watts) condition.*
3. *The spectrum was checked from 30 MHz up to the 10th harmonic of the carrier frequency.*
4. *All emission not reported were found to be more than 20dB below the limit.*
5. *The EUT was positioned through 3 orthogonal axis and worst-case are reported.*
6. *ERP measurements were performed using the standard battery with full charged condition.*
7. *The limit was applied according to the section 90.210(d) 50 +10log(P) or –20dBm or 70dBc whichever is less.*

5. TEST DATA

5.8 Spurious Emissions at Antenna Terminals

FCC Rules : Part 2 §2.1051 , §90.210(b)(d)
Operating Frequency : 440.025 MHz
Channel : Low
Measured Output Power : 36.5 dBm (4.5Watts)
Modulation Signal : FM modulation with 2.5kHz sine wave signal
Channel Bandwidth : 12.5 kHz : Mask D

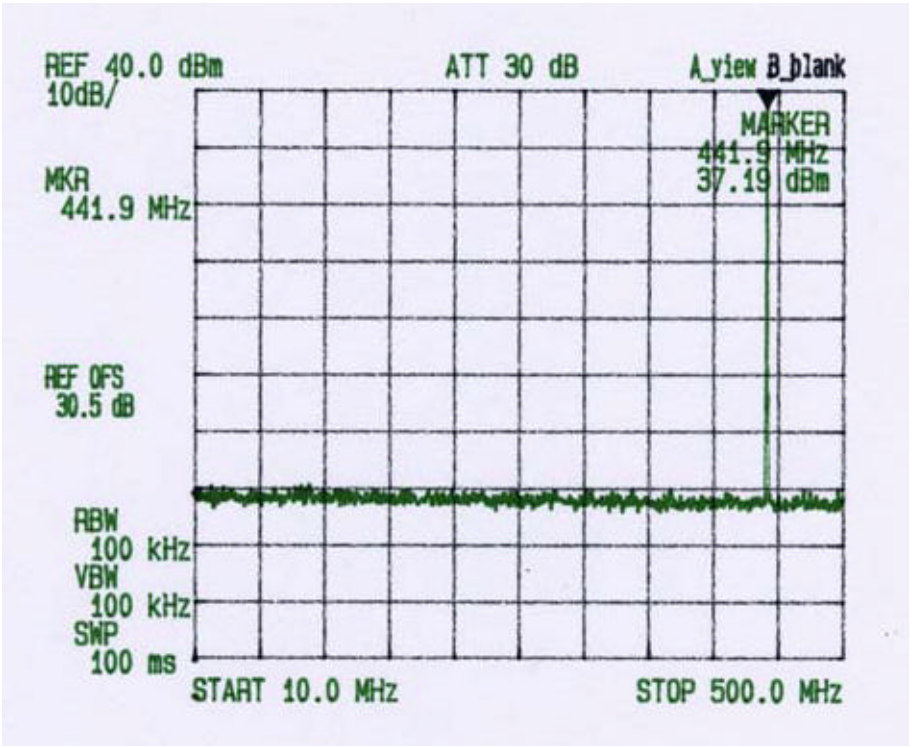
Frequency Tuned (MHz)	Ref.Level (dBm)	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Remarks
440.025	40.0	36.5			Fundmental
880.050		-30.0	-20.0	-10	Pass

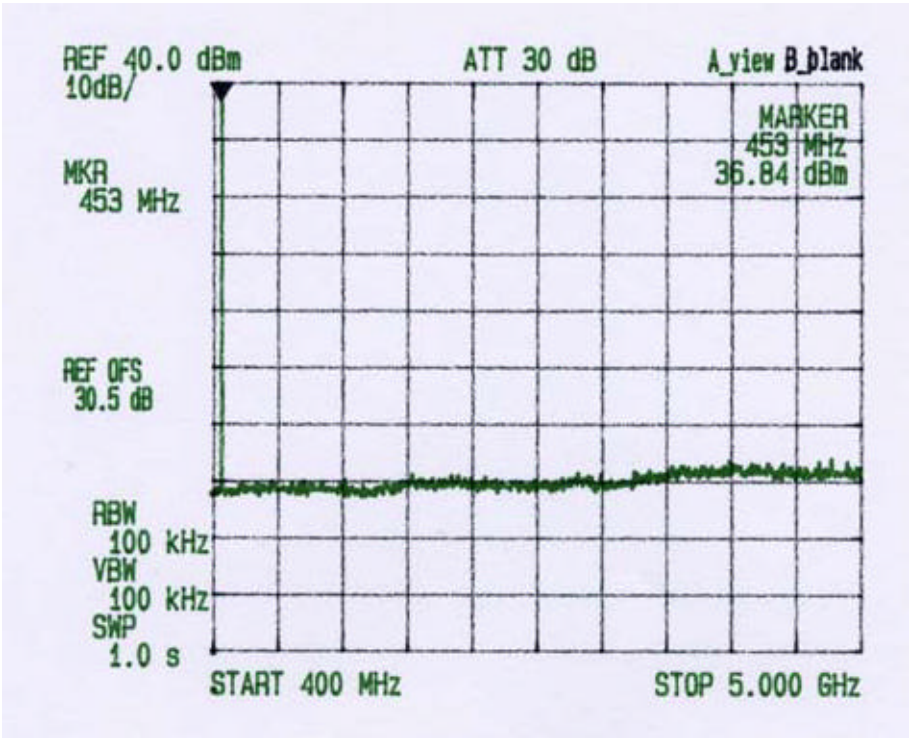
Frequency Tuned (MHz)	Ref.Level (dBm)	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Remarks
455.025	40.0	36.9			Fundmental
910.050		-30.0	-20.0	-10	Pass

Frequency Tuned (MHz)	Ref.Level (dBm)	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Remarks
469.975	40.0	36.3			Fundmental
939.950		-30.0	-20.0	-10	Pass

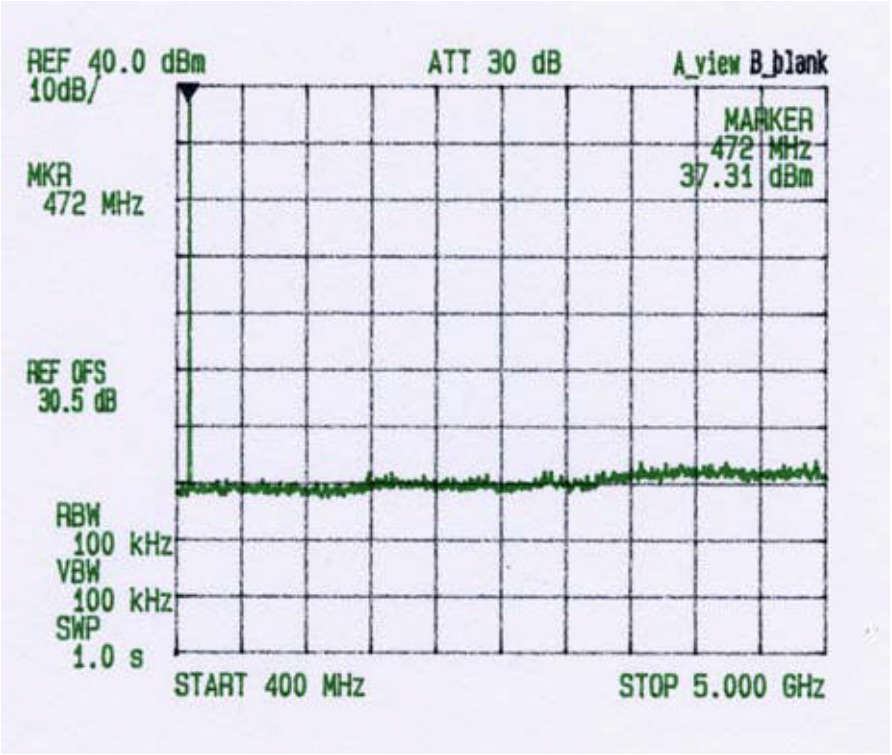
Note :
1. *The spectrum was checked from 10 MHz up to the 10th harmonic(5GHz) of the carrier frequency.*
2. *All emission not reported were found to be more than 20dB below the limit.*
3. *The spectrum bandwidth was set to RBW 100 kHz (freq. up to 1GHz) and RBW 1 MHz(freq above 1GHz).*
4. *Transmitter was set to the high power output(4 watts) condition.*
5. *The limit was applied according to the section 90.210(d) 50 +10log(P) or –20dBm or 70dBc whichever is less.*
6. *Please refer to the plots for details.*

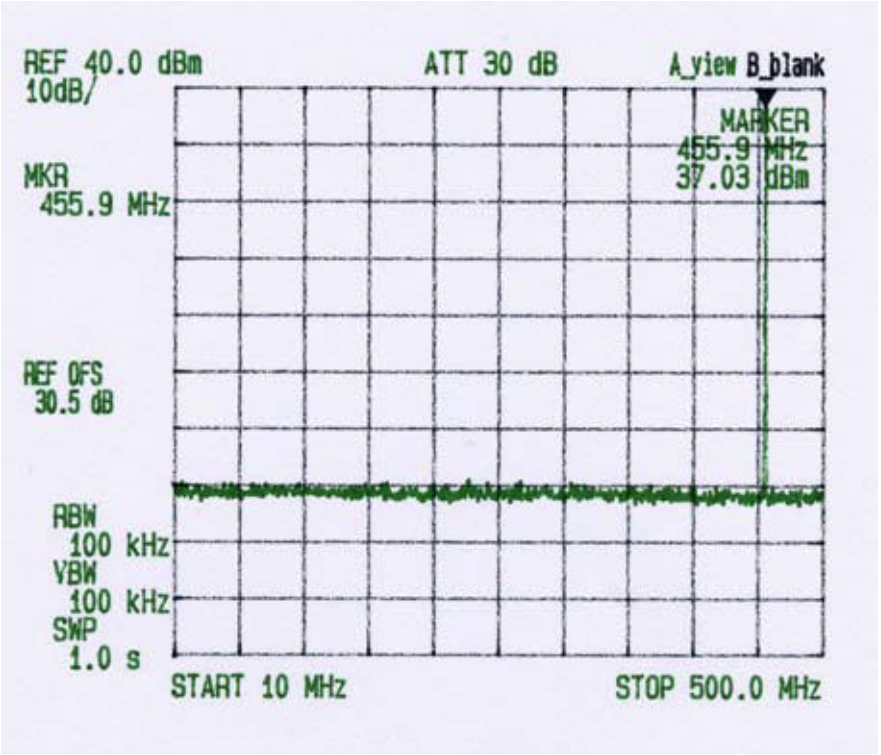
5. TEST DATA


REF 40.0 dBm
10dB/
ATT 30 dB
A_view B_blank
MARKER
441.9 MHz
37.19 dBm
MKR
441.9 MHz
REF OFS
30.5 dB
RBW
100 kHz
VBW
100 kHz
SWP
100 ms
START 10.0 MHz
STOP 500.0 MHz

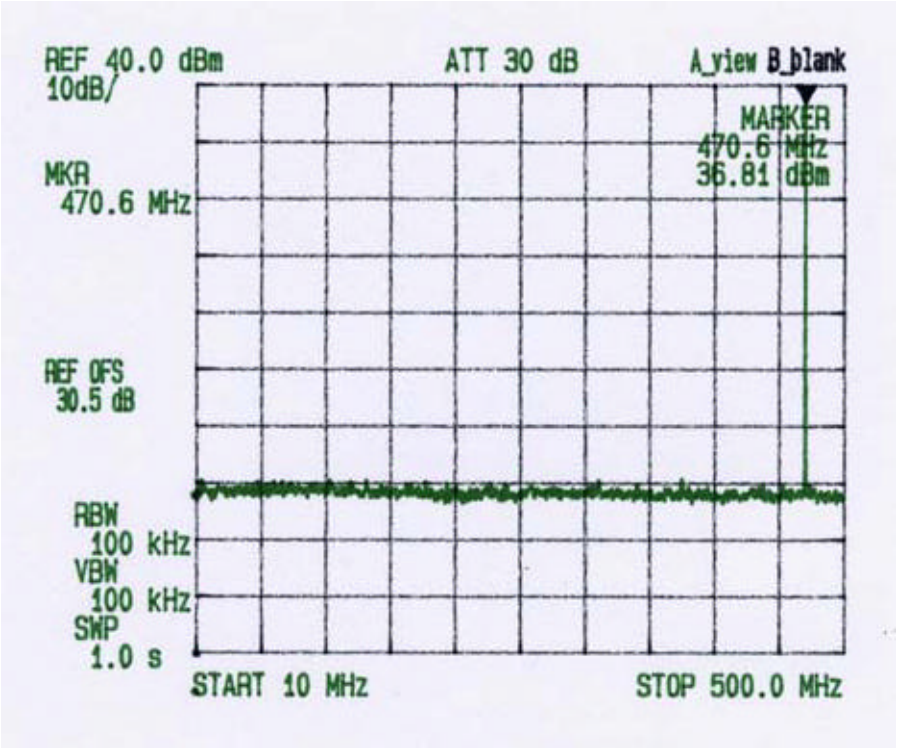

REF 40.0 dBm
10dB/
ATT 30 dB
A_view B_blank
MARKER
453 MHz
36.84 dBm
MKR
453 MHz
REF OFS
30.5 dB
RBW
100 kHz
VBW
100 kHz
SWP
1.0 s
START 400 MHz
STOP 5.000 GHz

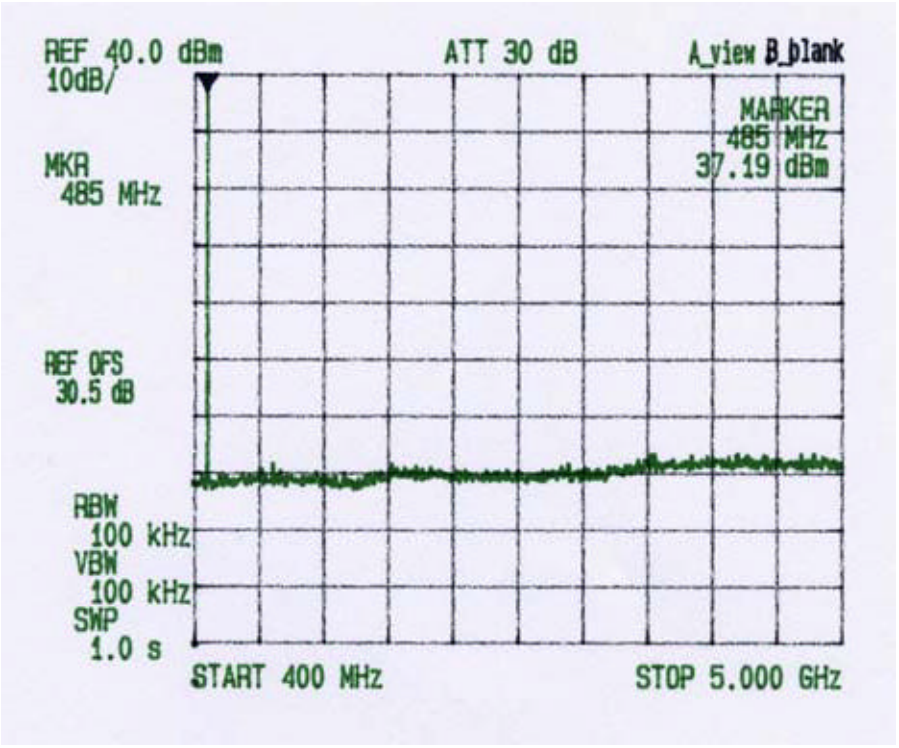
5. TEST DATA


REF 40.0 dBm
10dB/
ATT 30 dB
A_view B_blank
MARKER
472 MHz
37.31 dBm
MKR
472 MHz
REF OFS
30.5 dB
RBW
100 kHz
VBW
100 kHz
SWP
1.0 s
START 400 MHz
STOP 5.000 GHz


REF 40.0 dBm
10dB/
ATT 30 dB
A_view B_blank
MARKER
455.9 MHz
37.03 dBm
MKR
455.9 MHz
REF OFS
30.5 dB
RBW
100 kHz
VBW
100 kHz
SWP
1.0 s
START 10 MHz
STOP 500.0 MHz

5. TEST DATA


REF 40.0 dBm
10dB/
ATT 30 dB
A_view B_blank
MARKER
470.6 MHz
36.81 dBm
MKR
470.6 MHz
REF OFS
30.5 dB
RBW
100 kHz
VBW
100 kHz
SWP
1.0 s
START 10 MHz
STOP 500.0 MHz


REF 40.0 dBm
10dB/
ATT 30 dB
A_view B_blank
MARKER
485 MHz
37.19 dBm
MKR
485 MHz
REF OFS
30.5 dB
RBW
100 kHz
VBW
100 kHz
SWP
1.0 s
START 400 MHz
STOP 5.000 GHz

5. TEST DATA

5.9 Frequency Stability/Temperature Variation

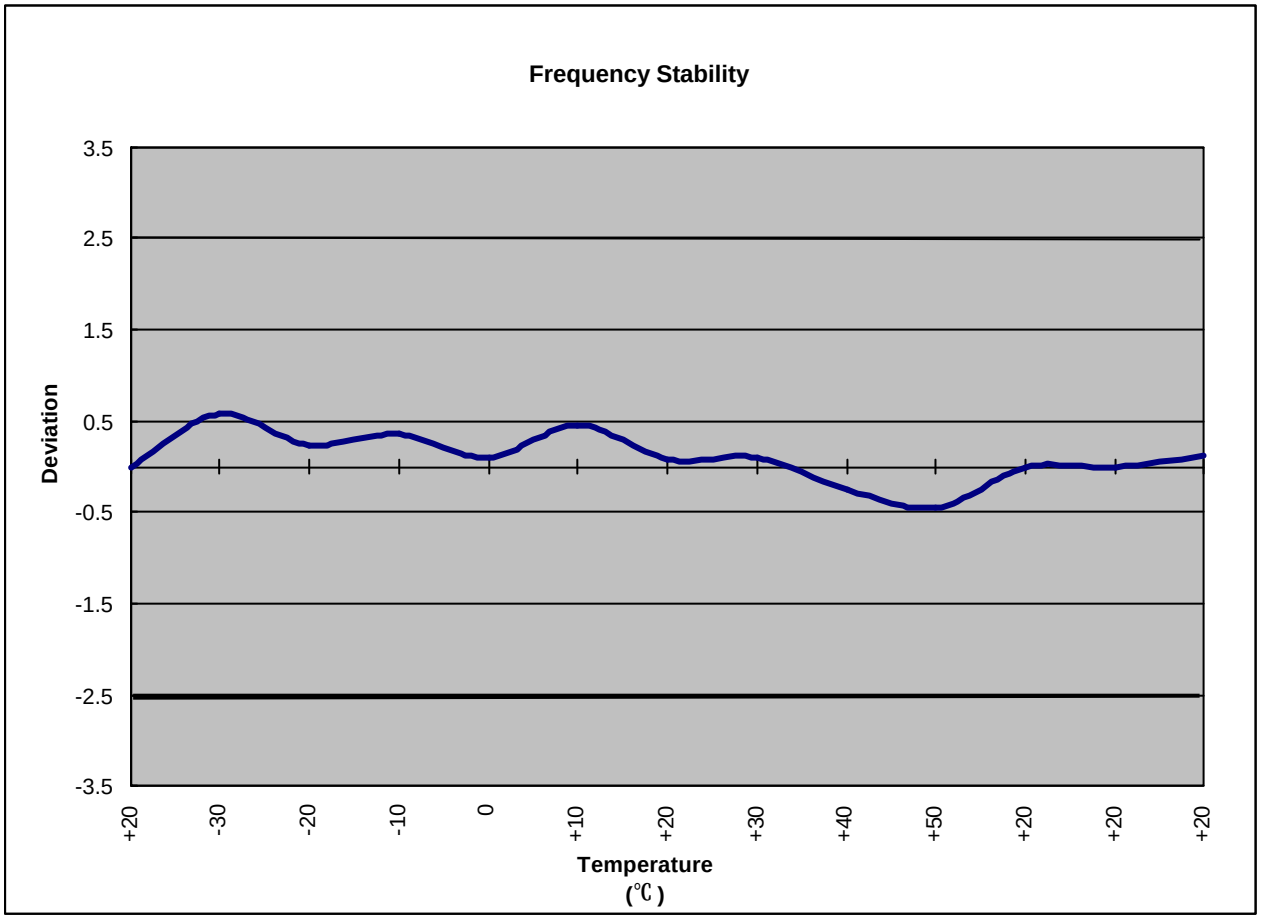
FCC Rules : Part 2 §2.1055 , §90.213
Operating Frequency : 455.0125 MHz
Channel : Middle
Referency Voltage : 7.2 VDC
Power Output : 5 Watts
Deviation Limit : 2.5ppm or 0.00025% for 12.5 kHz bandwidth

Voltage (%)	Power Supply (VDC)	Temperature (°C)	Frequency (Hz)	Deviation (%)
100 %	7.20	+20(Ref)	455,012,500	0.000000
100 %		- 30	455,012,245	0.000058
100 %		- 20	455,012,394	0.000024
100 %		- 10	455,012,342	0.000036
100 %		0	455,012,456	0.000010
100 %		+ 10	455,012,298	0.000046
100 %		+ 20	455,012,465	0.000008
100 %		+ 30	455,012,456	0.000010
100 %		+40	455,012,610	-0.000025
100 %		+50	455,012,698	-0.000045
85 %	6.12	+ 20	455,012,500	0.000002
115 %	8.28	+ 20	455,012,500	0.000000
BATT. Endpoint	5.4	+ 20	455,012,447	0.000012

Note :
1. The AT-400B was tested with 5 watts RF output , 12.5kHz and 25 kHz channel bandwidth. The worst-case temperature deviation was recorded.

5. TEST DATA

5.4 Frequency Stability (continued)



5. TEST DATA

5.9 Frequency Stability (continued)

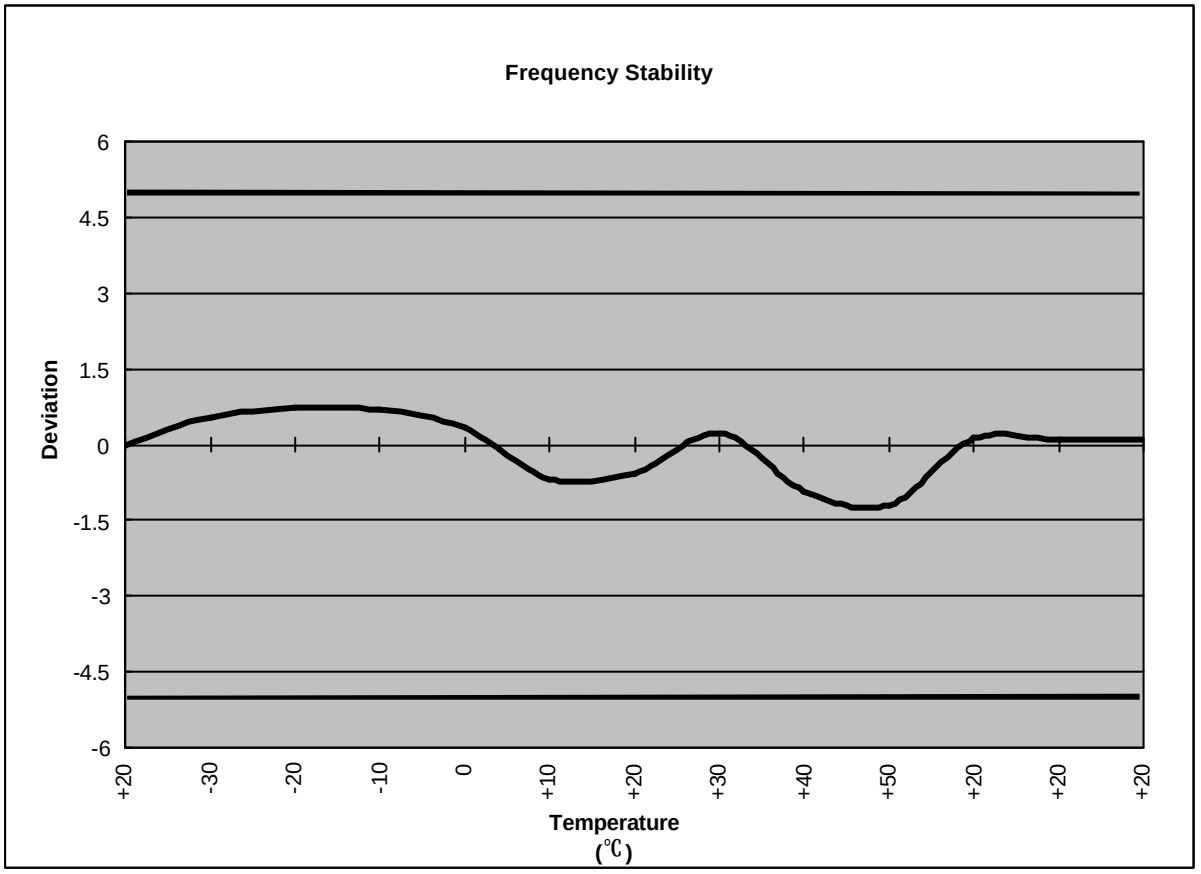
Operating Frequency : 455.0125 MHz
Channel : Middle
Referency Voltage : 7.2 VDC
Power Output : 5 Watts
Deviation Limit : 5.0ppm or 0.0005% for 25 kHz bandwidth

Voltage (%)	Power Supply (VDC)	Temperature (°C)	Frequency (Hz)	Deviation (%)
100 %	7.20	+20(Ref)	455,012,500	0.000000
100 %		- 30	455,012,254	0.000054
100 %		- 20	455,012,172	0.000072
100 %		- 10	455,012,191	0.000068
100 %		0	455,012,354	0.000032
100 %		+ 10	455,012,809	-0.000068
100 %		+ 20	455,012,755	-0.000056
100 %		+ 30	455,012,395	0.000023
100 %		+40	455,012,919	-0.000092
100 %		+50	455,012,046	-0.000120
85 %	6.12	+ 20	455,012,445	0.000012
115 %	8.28	+ 20	455,012,536	-0.000008
BATT. Endpoint	5.4	+ 20	455,012,464	0.000008

Note :
2. The AT-400B was tested with 5 watts RF output , 12.5kHz and 25 kHz channel bandwidth. The worst-case temperature deviation was recorded.

5. TEST DATA

5.9 Frequency Stability (continued)



5. TEST DATA

5.10 Transient Frequency Behavior

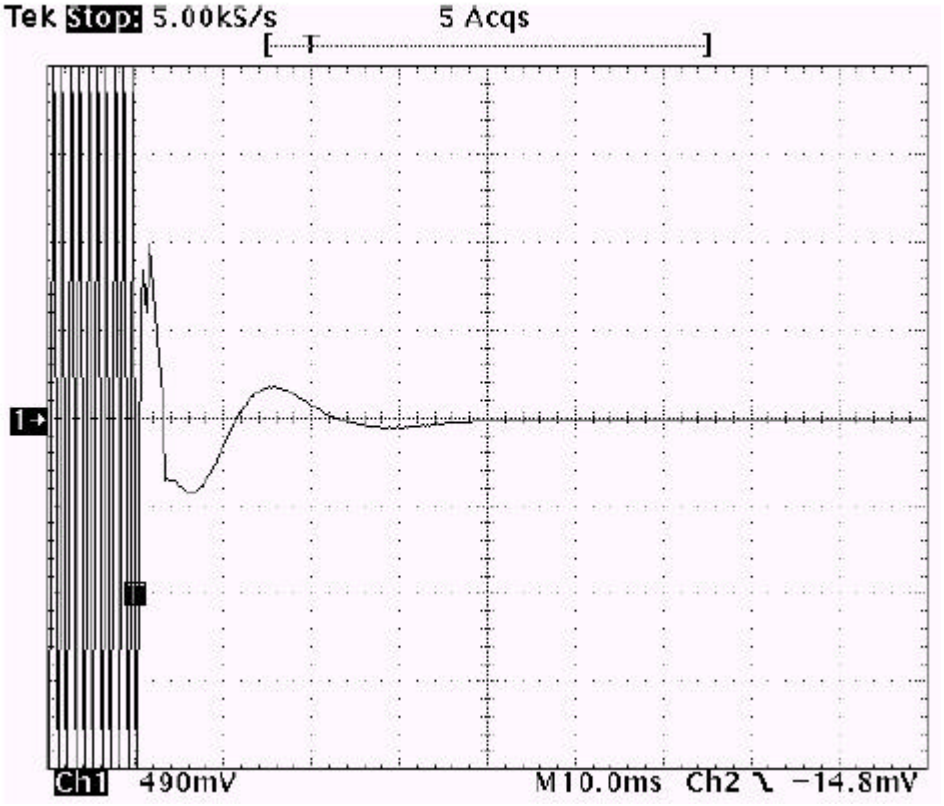
FCC Rules :	Part 90 §90.214
Operating Frequency :	455.025 MHz (WB:25KHz)
Channel :	Middle
Reference Voltage :	7.2 VDC
Power Output :	4 Watts
Ref. Signal Generator :	1kHz tone modulation with 25kHz dev.

FCC Limit @25KHz Channels

Time period	Time Intervals	Max. Frequency Difference(KHz)
t_1	10 ms	± 25
t_2	25 ms	± 12.5
t_3	10 ms	± 25

Note : After t_2 and before t_3(switch off condition), the transient frequency difference shall not exceed the limit specified in §90.213 (5ppm @ operating frequency).

25KHz channel spacing Carrier Switch on time @ 455.525 MHz



Note :

1. *The oscilloscope setting condition is as follows ;*
   Time base : 10 ms/div.
   Trigger : On negative edge of Ch 2, level –14.8 mV
   Ch 1 : 490 mv/div. , Probe : 1:1
   Vertical Scale : ±4 div. / correspond to ±25 KHz

5. TEST DATA

5.10 Transient Frequency Behavior (continued)

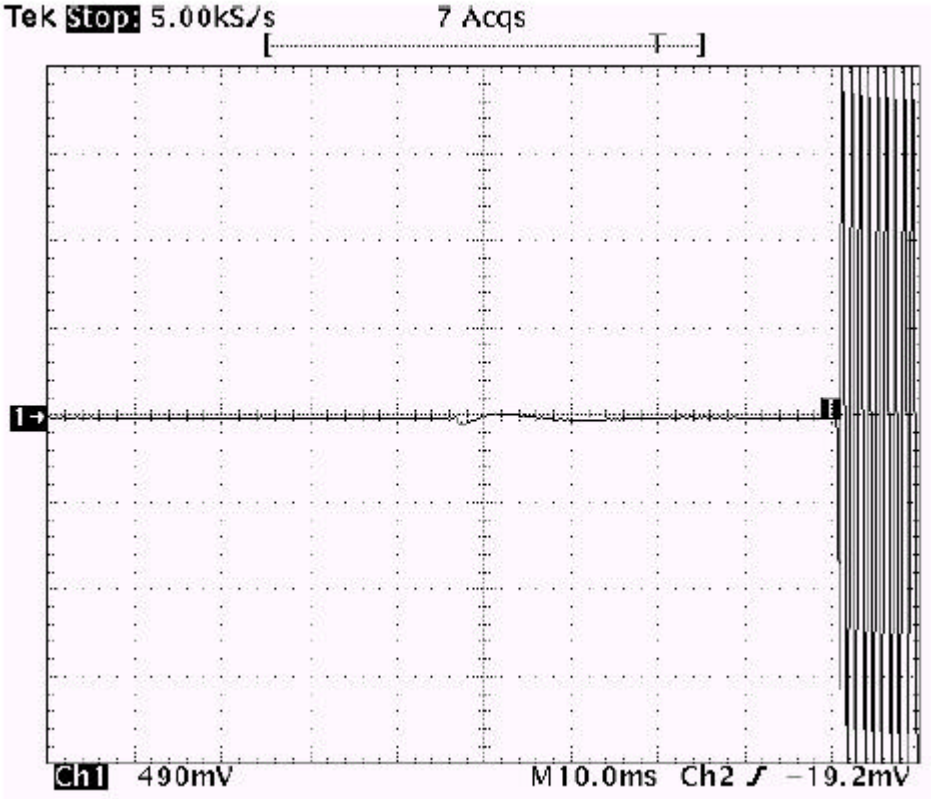
FCC Rules :	Part 90 §90.214
Operating Frequency :	455.025 MHz (WB:25KHz)
Channel :	Middle
Reference Voltage :	7.2 VDC
Power Output :	4 Watts
Ref. Signal Generator :	1kHz tone modulation with 25kHz dev.

FCC Limit @25KHz Channels

Time period	Time Intervals	Max. Frequency Difference(KHz)
t_1	10 ms	± 25
t_2	25 ms	± 12.5
t_3	10 ms	± 25

Note : After t_2 and before t_3(switch off condition), the transient frequency difference shall not exceed the limit specified in §90.213 (5ppm @ operating frequency).

25KHz channel spacing Carrier Switch off time @ 455.525 MHz



Note :

1. *The oscilloscope setting condition is as follows ;*
   Time base : 10 ms/div.
   Trigger : On negative edge of Ch 2, level –14.8 mV
   Ch 1 : 490 mv/div. , Probe : 1:1
   Vertical Scale : ±4 div. / correspond to ±25 KHz

5. TEST DATA

5.10 Transient Frequency Behavior (continued)

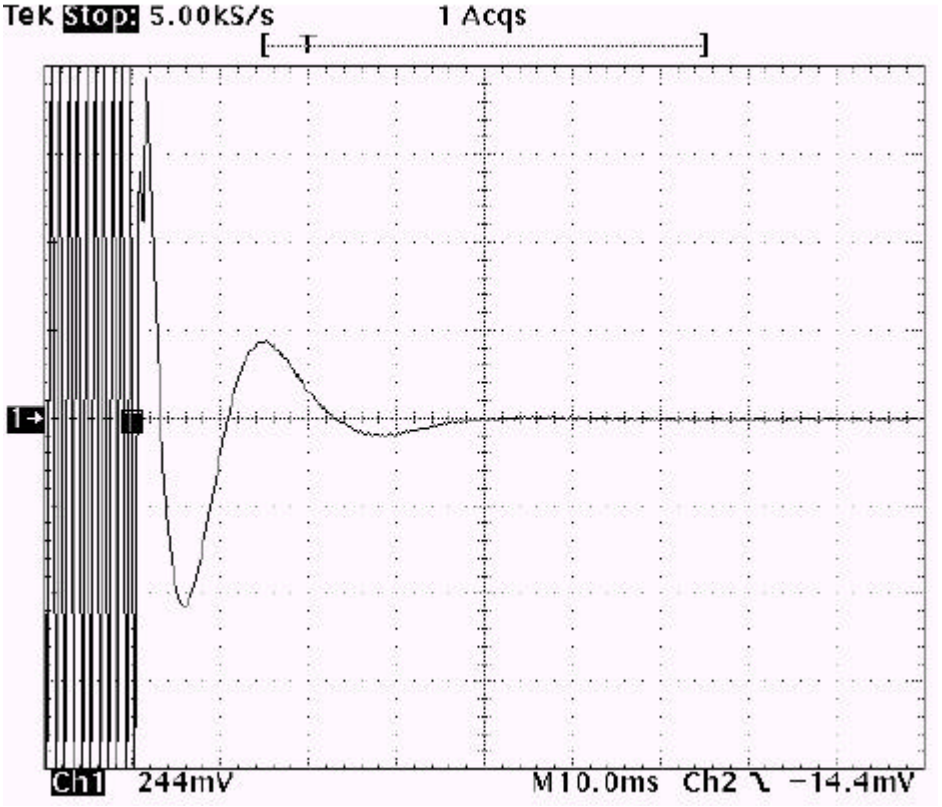
FCC Rules :	Part 90 §90.214
Operating Frequency :	455.025 MHz (NB:12.5KHz)
Channel :	Middle
Reference Voltage :	7.2 VDC
Power Output :	4 Watts
Ref. Signal Generator :	1kHz tone modulation with 25kHz dev.

FCC Limit @12.5KHz Channels

Time period	Time Intervals	Max. Frequency Difference(KHz)
t_1	10 ms	± 12.5
t_2	25 ms	± 6.25
t_3	10 ms	± 12.5

Note : After t_2 and before t_3(switch off condition), the transient frequency difference shall not exceed the limit specified in §90.213 (2.5ppm @ operating frequency).

12.5KHz channel spacing Carrier Switch on time @ 455.525 MHz



Note :
1. *The oscilloscope setting condition is as follows ;*
   Time base : 10 ms/div.
   Trigger : On negative edge of Ch 2, level –14.4 mV
   Ch 1 : 244 mv/div. , Probe : 1:1
   Vertical Scale : ±4 div. / correspond to ±12.5 KHz

5. TEST DATA

5.10 Transient Frequency Behavior (continued)

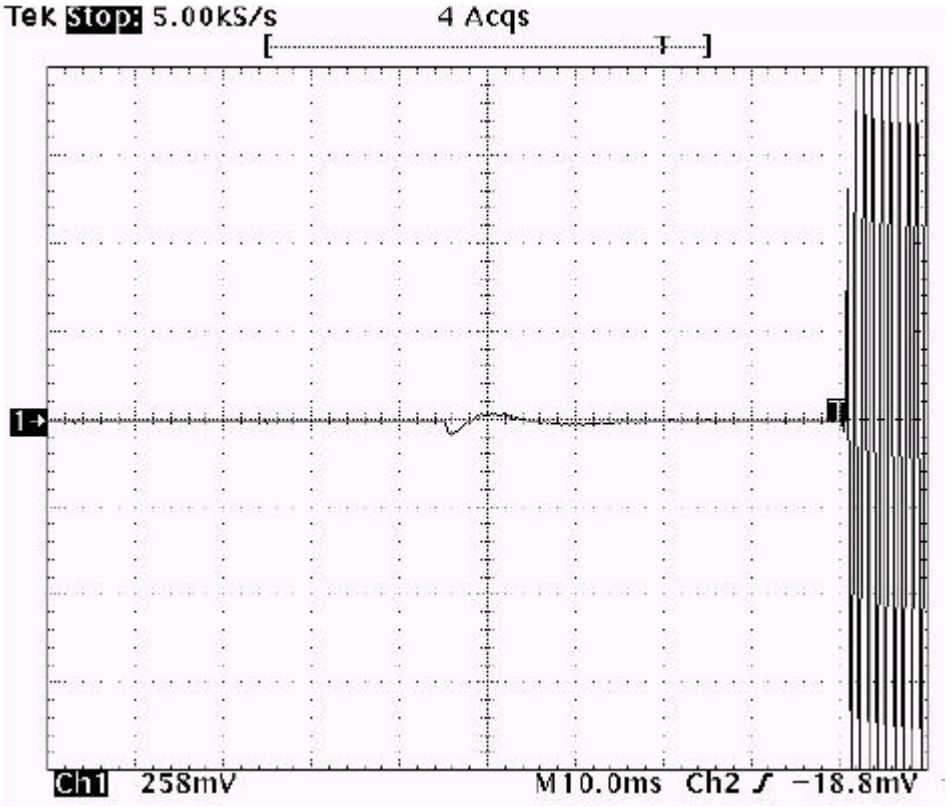
FCC Rules :	Part 90 §90.214
Operating Frequency :	455.025 MHz (NB:12.5KHz)
Channel :	Middle
Reference Voltage :	7.2 VDC
Power Output :	4 Watts
Ref. Signal Generator :	1kHz tone modulation with 12.5kHz dev.

FCC Limit @12.5KHz Channels

Time period	Time Intervals	Max. Frequency Difference(KHz)
t_1	10 ms	± 12.5
t_2	25 ms	± 6.25
t_3	10 ms	± 12.5

Note : After t_2 and before t_3(switch off condition), the transient frequency difference shall not exceed the limit specified in §90.213 (2.5ppm @ operating frequency).

12.5KHz channel spacing Carrier Switch off time @ 455.525 MHz



Note :
2. *The oscilloscope setting condition is as follows ;*
   Time base : 10 ms/div.
   Trigger : On negative edge of Ch 2, level –18.8 mV
   Ch 1 : 258 mv/div. , Probe : 1:1
   Vertical Scale : ±4 div. / correspond to ±12.5 KHz

6. SAMPLE CALCULATION

Emission Bandwidth

Type of Emission : F3E

Necessary Bandwidth and Emission Bandwidth :
12.5 kHz (Narrow Band Channel) : Bn = 11K0F3E
25 kHz (Wide Band Channel) : Bn = 16K0F3E

Calculation :

Max. modulation(M) in kHz : 3
Max. deviation(D) in kHz : 2.5(NB) and 5(WB)
Constant Factor(k) : 1
Bn = 2M + 2DK

7. TEST EQUIPMENT LIST

List of Test Equipments Used for Measurements

Test Equipment	Model	Mfg.	Serial No.	Cal. Due Date
Spectrum Analyzer	R3261A	Advantest	21720033	01-10-08
Spectrum Analyzer	R3265A	Advantest	45060321	02-02-28
Spectrum Analyzer	L1500A	H.P	US37360920	01-10-20
Receiver	ESVS 10	R & S	835165/001	02-04-06
Signal Generator	SMT-03	Rohde & Schwarz	831676/029	01-09-26
Signal Generator	SMT-03	Rohde & Schwarz	831676/030	01-09-27
Signal Generator	2025	IFR	202301/933	01-11-01
Power Meter	4232A	Boonton	42001	02-04-11
Power Meter	NRVS	Rohde & Schwarz	834053/060	02-04-17
Power Meter	URV35	Rohde & Schwarz	831688/004	02-04-25
Power Sensor	51011	Boonton	31619/32620	02-04-11
Audio Analyzer	8903B	HP	3120A07501	01-10-25
Audio Analyzer	UPL	Rohde & Schwarz	836421/028	01-09-07
Modulation Analyzer	8901B	HP	2525A03952	01-10-25
Power Sensor	11722A	HP	2501A02085	01-10-25
Synthesized Function Generator	33120A	Agilent	US36042014	02-01-07
Broadband Power Amplifier	AR75A250	Amplifier Research	27568	02-02-23
Broadband Power Amplifier	GRF5066	Ophir	1011	02-01-25
Preamplifier	HP8447D	HP	2944A07626	02-03-05
Preamplifier	HP 8347A	HP	2834A00544	01-05-23
TriLog Antenna	VULB9160	Schwarz Beck	3082	02-05-08
LogBicon	VULB9165	Schwarz Beck	2023	02-05-08
Dipole Antenna	VHAP	Schwarz Beck	964	02-05-03
Dipole Antenna	VHAP	Schwarz Beck	965	02-05-03
Dipole Antenna	UHAP	Schwarz Beck	949	02-05-03
Dipole Antenna	UHAP	Schwarz Beck	950	02-05-03
Dipole Antenna	3121C	EMCO	9807-2104	01-09-20
Double Ridged Horn	3115	EMCO	9809-2334	01-09-20
Double Ridged Horn	3115	EMCO	9809-2335	01-09-20
Attenuator	33-20-34	Weinschel	BH3583/2997	01-08-26
Attenuator	33-30-34	Weinschel	BG9477/9487	01-09-15
Dual directional coupler	C5571	Werlatone	7860	02-01-26
Dual directional coupler	C3653	Werlatone	7825	02-01-26
LISN	3825/2	EMCO	9208-1995 9006-1669	01-12-27
RF Detector	8471D	HP	3012A	01-10-12
Digital Oscilloscope	TDS540B	Tektronix	B020115	02-04-20
Digital Oscilloscope	2430A	Tektronix	B015319	02-03-15
Turn-Table	DETT-03	Daeil EMC	-	
Antenna Master	DEAM-03	Daeil EMC	-	
Plotter	7440A	H.P	2725A 75722	
EMC Anechoic Chamber	DTEC01	DAETONG	-	
Temp/Humidity Chamber	DSTH 702	DAESUNG	-	02-01-03
Impedance Matching Pad	6001.01.A	SUNNER	3252	01-09-22
Thermo Hygrograph	3-3122	ISUZU	3312201	01-12-20
BaroMeter	Regulus	Aneroid	-	02-03-08