Electromagnetic Emission

FCC MEASUREMENT REPORT

CERTIFICATION OF COMPLIANCE
FCC PART80 CERTIFICATION

PRODUCT	:	**MARINE DSC VHF RADIO TELEPHONE**
MODEL/TYPE NO	:	**STR-6000A**
FCC ID	:	**RN6STR-6000A**
TRADE NAME	:	**SAMYUNG ENC**
APPLICANT	:	**SAMYUNG ENC Co., Ltd.** **1123-17, Dongsam-Dong, Youngdo-gu, Busan, 606-083, Korea** **Attn. : In-Joon, Choi / Managing Director**
FCC CLASSIFICATION	:	**GVH Part 80 VHF Transmitter (GMDSS)**
FCC RULE PART(S)	:	**FCC Part 80 Stations in the Maritime Services**
FCC PROCEDURE	:	**Certification**
DATES OF TEST	:	**March 27, 2006 ~ April 11, 2006**
DATES OF ISSUE	:	**April 14, 2006**
TEST REPORT No.	:	**BWS-06-RF-0010**
TEST LAB.	:	**BWS TECH Inc.(FCC Registration Number : 553281)**

This MARINE DSC VHF RADIO TELEPHONE STR-6000A has been tested in accordance with the measurement procedures specified in ANSI C63.4-2002 at the BWS TECH/EMC Test Laboratory and has been shown to be complied with the electromagnetic radiated emission limits specified in FCC Rule Part80.
I attest to the accuracy of data. All measurement herein was performed by me or were made under my supervision. 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 may not necessarily produce the same results due to production tolerance and measurement uncertainties.

2006/4/14
(Date)

Tested by **Choi, Chang-Young**

2006/4/14
(Date)

Reviewed by **TaeHyun, Nam**

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FCC TEST REPORT

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)*

1. General Information

Applicant

Company Name : SAMYUNG ENC Co., Ltd.
Company Address : 1123-17, Dongsam-Dong, Youngdo-gu, Busan, 606-083, Korea
Phone/Fax : Phone : +82-51-601-6600 Fax : +82-51-412-6616

Manufacturer

Company Name : SAMYUNG ENC Co., Ltd.
Company Address : 1123-17, Dongsam-Dong, Youngdo-gu, Busan, 606-083, Korea
Phone/Fax : Phone : +82-51-601-6600 Fax : +82-51-412-6616

- **EUT Type :** MARINE DSC VHF RADIO TELEPHONE
- **Model Number :** STR-6000A
- **FCC Identifier :** RN6STR-6000A
- **S/N :** Prototype
- **FCC Rule Part(s) :** FCC Part 80 Stations in the Maritime Services
- **FCC Classification :** GVH : Part 80 VHF Transmitter (GMDSS)
- **Freq. Range :** 156.025 MHz ~ 157.425 MHz
- **Channel :** 178
ITU Channel: 55
USA Channel: 53
CANADA Channel: 60
WEATHER Channel: 10
- **Modulation Method :** FM, FSK
- **Emission Designator :** FM(16K0G3E), DSC(16K0G2B)
- **RF Power Output :** 25W / 1W
- **Test Procedure :** ANSI C63.4-2002
- **Dates of Tests :** March 30, 2006
- **Place of Tests :** BWS TECH Inc.
#611-1 Maesan-Ri, Mohyeon-Myeon, Cheoin-Gu, Yongin-Si,
Gyeonggi-Do 449-853, Korea
(FCC Registration Number : 553281)
TEL: +82 31 333 5997 FAX: +82 31 333 0017
- **Test Report No. :** BWS-06-RF-0010

2. Description of Test Facility

The measurement for radiated and conducted emission test were conducted at the open area test site of BWS TECH Inc. facility located at #611-1 Maesan-Ri, Mohyeon-Myeon, Cheoin-Gu, Yongin-Si, Gyeonggi-Do, 449-853 Korea. The site is constructed in conformance with the requirements of the ANSI C63.4-2002 and CISPR Publication 16. The BWS TECH measurement facility has been filed to the Commission 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 C63.4-2002 and registered to the Federal Communications Commission (Registration Number : 553281).

The measurement procedure described in American National Standard for Method of Measurement of Radio-Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40GHz (ANSI C.63.4-2002) was used in determining radiated and conducted emissions from the SAMYUNG ENC Co., Ltd. Marine DSC VHF Radio Telephone Model : STR-6000A.

3. Product Information

The Equipment Under Test (EUT) is SAMYUNG ENC Co., Ltd. Marine DSC VHF Radio Telephone Model : STR-6000A. (FCC ID: RN6STR-6000A).

STR-6000A includes DSC/VHF radio telephone and DSC receiver required by the Global Maritime Distress and Safety System(GMDSS) and is designed to be compact and lightweight for easy installation in any vessels engaged in international voyages and near-going vessels.
In addition to the conventional voice communication, STR-6000A is equipped with Digital Selective Calling(DSC) functions for distress calls and routine calls as well. It also incorporates all the necessary units for DSC services such as DSC unit, CH70 DSC receiver.

3.1 DC Voltage abd Currents

The DC voltages applied to and DC currents into the several elements of the final radio frequency amplifying stage for normal operation over power range were;

Standby : 13.6 Volts, 0.5 Ampare
Low Power : 13.6 Volts, 1.5 Ampare
High Power : 13.6 Volts, 5.5 Ampare

3.2 Emission Designator

Type of Emission : G3E

Necessary Bandwidth and Emission Bandwidth :
FM : Bn = 16K0G3E
DSC : Bn = 16K0G2B

Calculation:

Maximum Modulation(M) in kHz : 3
Maximum Deviation(D) in kHz : 2.5(NB) and 5(WB)
Constant Factor(k) : 1
Bn = 2M + 2DK

3.3 General Specification

3.3.1 STR-6000A Standards

TX Frequency	156.025MHz ~ 157.425MHz
RX Frequency	156.050MHz ~ 163.275MHz
Number of Channels	178 ITU Channel: 55 USA Channel: 53 CANADA Channel: 60 WEATHER Channel: 10
Radio Wave Mode	FM(16K0G3E), DSC(16K0G2B)
Channel Interval	25kHz
Communication Mode	Simplex and Semi-Duplex
Antenna impedance	50Ω(SO-239)
Audio Output Impedance	4Ω
Frequency Stability	±10 PPM(-20℃ to +60℃)
Voltage Supply	13.6V DC±10%(Negative Ground)
Consumption Currency (13.6V)	TX High 5.5A max Maximum Audio 1.5A max
Operating Temperature	-15℃ ~ +55℃
Dimensions	85×172×170
Weight	1.1kg

3.3.2 Transmitting Unit

Output Power (ⓐ 13.8 V DC)	25W / 1W
Frequency Deviation	Within ±5ppm
Oscillation Mode	Synthesizer Mode
Modulation	Variable Reactance Frequency Modulation
Maximum Frequency Deviation	±5.0kHz
Occupied Bandwidth	Within 16kHz
MIC Input Impedance	2kΩ
Audio Frequency Response	300Hz~3kHz 6dB/octave(+1 ~ -3dB)
Spurious Emissions	Less than 70dB
Adjacent Channel Power	Less than -70dBc
Audio Harmonic Distortion	Less than 10%
Residual Modulation (S/N Ratio)	Over 40dB

3.3.3 Receiving Unit

Receive System	Double Conversation Super Heterodyne
Intermediate Frequencies	1st 21.7MHz
	2nd 450kHz
Local Oscillation Frequency	Receiving Frequency - 21.7MHz
Local Oscillation Mode	SYNTHESIZER Mode
Sensitivity	32uV (20dB SINAD) 0.22uV (12dB SINAD)
Audio Frequency Response	-6dB/octave
Squelch Sensitivity	0.22uV
Co-Channel Rejection	-10dB ~ 0dB
Adjacent Channel Selectivity	Over 70dB
Spurious Response Rejection Ratio	Over 70dB
Inter-modulation Rejection Ratio	Over 68dB
Spurious Emission	Less than 2nW(-56.9dBm)
Hum and Noise	Less than -40dB
Audio Output Power (at 13.6 V DC)	4.5W / 4Ω(Distortion Rate: Less 10%)

3.3.4 Dedicated Receiving Unit

Operating Frequency	156.525MHz
Mode	16K0G2B
Receive System	Double-Conversion Super Heterodyne
Intermediate Frequencies	1st 10.70 MHz 2nd 450 kHz
Inter-modulation Rejection Ratio	Over 68dB
Adjacent Channel Selectivity	Over 70dB
Spurious Response Rejection Ratio	Over 70dB
Spurious Emission	Less than 2nW(-56.9dBm)
DSC Modulation Speed	1200baud (±30ppm)
DSC Modulation Mode	FSK
DSC Modulation Rate	Within m=2±10%
MARK Frequency	Within 1300Hz±10Hz
SPACE Frequency	Within 2100Hz±10Hz
Maximum Sensitivity Available	Bit Error Rate: Less than 10^{-2} in 0.25uv
DSC Operation	ITU-R M.541-9 ITU-R M.689-2
DSC Protocol	ITU-R M.493-11 class-A
DSC FILE Memory	DISTRESS-Related Message Reception: 20 OTHERS-Related Message Reception : 20

3.4 EUT operating conditions & test configuration

3.4.1 Client Condition

Temperature : -30 ℃ ~ +50 ℃
Humidity : 95 %

3.4.2 EUT Operating Condition

Operating Mode : Transmitter was operated in a continues transmission mode with the carrier modulated as specified in the test data.
Special test Software : Not Used.
Special test Hardware : Not Used.
TX Frequency Band : 156.025 MHz ~ 157.425 MHz
Test Frequencies : Low Channel (Ch. 60) 156.025 MHz
Middle Channel (Ch. 18) 156.900 MHz
High Channel (Ch. 88) 157.425 MHz
Modulation : FM Modulation
Modulation Signal Source : External Source

4. Summary of Test Results

TEST REQUIREMENTS	FCC Paragraph	Spec.	Meas.	Result
RF Power Output (Conducted)	§2.1046 §80.215	25 / 1 Watt	25 / 1	Pass
RF Power Output (ERP)	§80.215	18 Watt	16.6	Pass
Audio Frequency Response	§2.1047	N/A	Graph	Pass
Audio Low pass Filter Response	§2.1047	N/A	Graph	Pass
Modulation Limiting	§2.1047	5 kHz	Graph	Pass
Occupied Bandwidth	§80.211	Emission Mask	Plot	Pass
Spurious Emissions at Antenna Terminals	§2.1053 §80.211	$43+10\log_{10}P$	Plot	Pass
Field Strength of Spurious Radiation	§2.1053 §80.211	$43+10\log_{10}P$	80.3	Pass
Frequency Stability/Temperature Variation	§2.1053 §80.209	5×10^{-6}	Graph	Pass
Maximum Usable Sensitivity for the Receiver	§80.874	0.5 uV		Pass

5. TEST DATA

5.1 RF Power Output (Conducted)

5.1.1 Definition

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

5.1.2 Specification

FCC Rules Part 2, Section 2.1046
FCC Rules Part 80, Section 80.215

5.1.3 Method of Measurement

ANSI/TIA-603-B-2002 Section 2.2.1

5.1.4 Measurement Set-Up

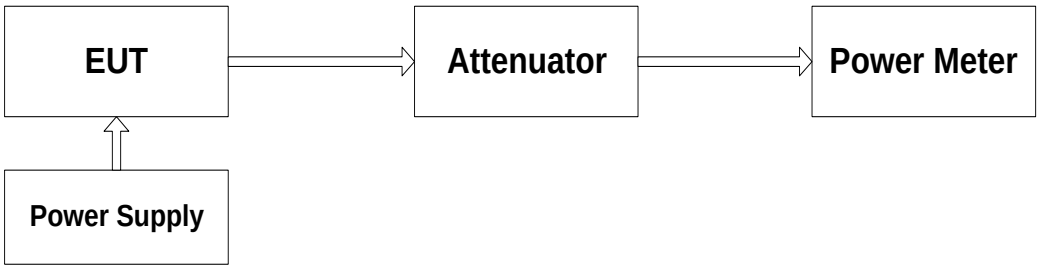


Fig-1

5.1.5 Test Equipment List

Equipment	Model Name	Manufacture
EUT	STR-6000A	SAMYUNG ENC
Power Supply	6034	AGILENT
Audio Analyzer	8903B	AGILENT
Attenuator	RFA500NMF30	RES-NET
Power Sensor	8481A	AGILENT
Power Meter	E4418A	AGILENT

5.1.6 Test Procedure

① Connect the equipment as Fig-1.
② Measure the transmitter output power during the defined duty cycle.
Correct for all losses in the RF path.
③ The value recorded in step ② is the conducted carrier output power rating.

5.1.7 Limit

① FCC Limits (According to part 80.215): High (25Watt) and Low (1 Watt).

5.1.8 Test Result

5.1.8.1. High Power

Transmitter Channel Setting	Frequency Tuned (MHz)	Measured Power (Watts)	Rated Power (Watts)
Low	156.025	24.98	25.0
Middle	156.900	24.15	
High	157.425	24.95	

5.1.8.2. Low Power

Transmitter Channel Setting	Frequency Tuned (MHz)	Measured Power (Watts)	Rated Power (Watts)
Low	156.025	0.891	1.0
Middle	156.900	0.826	
High	157.425	0.891	

5.2 RF Power Output (ERP)

5.2.1 Definition

The Effective Radiated Power is defined as the product of the power applied to an antenna and its gain relative to an ideal half wave dipole in a given direction. Maximum ERP is the maximum ERP in any direction.

For equipment using an antenna with known radiation characteristics ERP is a characteristic that can be calculated as well as measured,

(Note: Effective Isotropic Radiated Power (EIRP) can be computed using the following:

EIRP (dBm) = *ERP* (dBm) + 2.15 (dB.)

5.2.2 Specification

FCC Rules Part 80, Section 80.215

5.2.3 Method of Measurement

ANSI/TIA-603-B-2002 Section 2.2.17

5.2.4 Measurement Set-Up

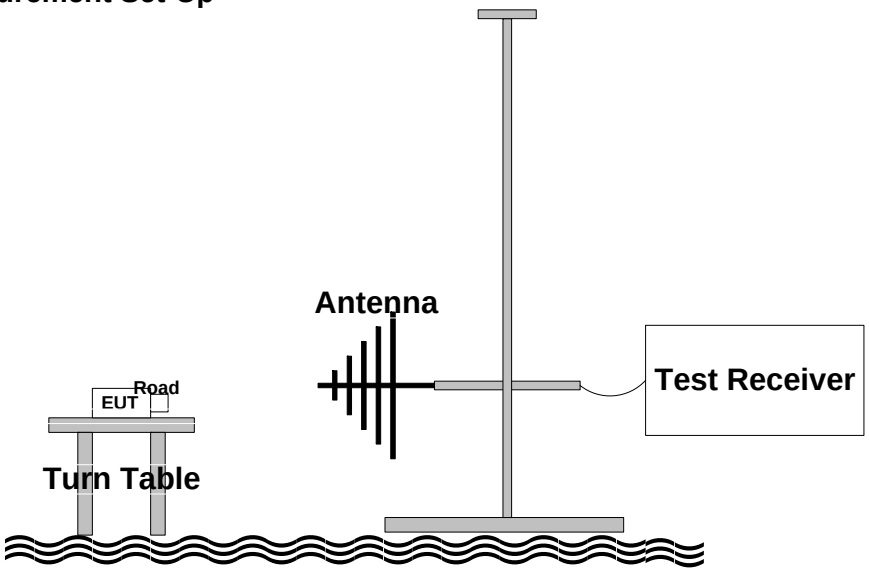


Fig-2.1 (Step 1)

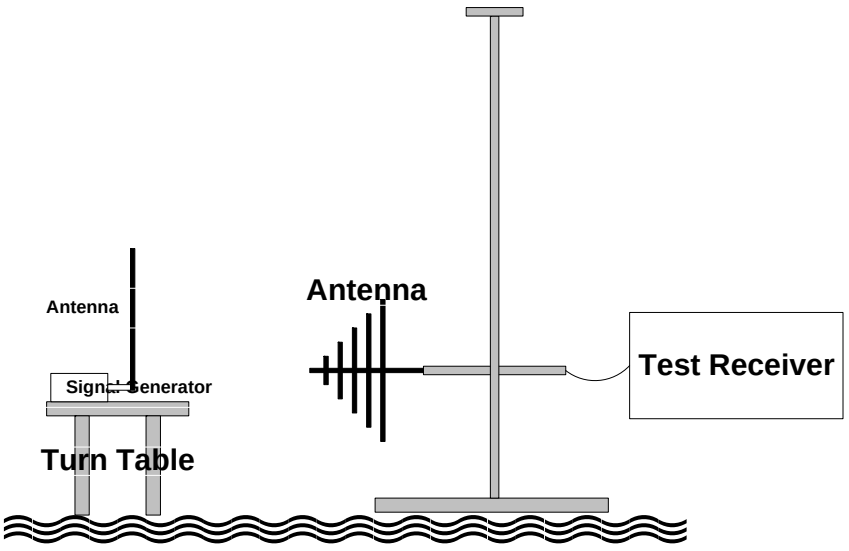


Fig-2.2 (Step 2)

5.2.5 Test Equipment List

Equipment	Model Name	Manufacture
EUT	STR-6000A	SAMYUNG ENC
EUT's Antenna	SAN-150	SAMYUNG ENC
Power Supply	6034	AGILENT
Audio Analyzer	8903B	AGILENT
Attenuator	33-30-33	WEINSCHEL
RF Power Amplifier	5127R	ORHIR RF
Dipole Antenna	VDA6116A / UHA9105	SCHAFFNER
Test Receiver	ESVS 10	ROHDE & SCHWARZ
Signal Generator	E4432B	AGILENT

5.2.6 Test Procedure

① Connect the equipment as Fig-2.1. Mount the equipment with the manufacturer specified antenna in a vertical orientation on a manufacturer specified mounting surface located on a non-conducting rotating platform of a RF anechoic chamber (preferred) or a standard radiation site.

② Key the transmitter, then rotate the EUT 360° azimuthally and record spectrum analyzer power level (LVL) measurements at angular increments that are sufficiently small to permit resolution of all peaks. If a standard radiation test site is used, raise and lower the test antenna to obtain a maximum reading at each angular increment. (Note: several batteries may be needed to offset the effect of battery voltage droop, which should not exceed 5% of the manufactured specified battery voltage during transmission).

③ Replace the transmitter under test with a vertically polarized half-wave dipole (or an antenna whose gain is known relative to an ideal half-wave dipole). The center of the antenna should be at the same location as the center of the antenna under test.

④ Connect the antenna to a signal generator with a known output power and record the path loss (in dB) as *LOSS*. If a standard radiation test site is used, raise and lower the test antenna to obtain a maximum reading.

LOSS = *Generator Output Power* (dBm) – *Analyzer reading* (dBm)

⑤ Determine the effective radiated output power at each angular position from the readings in steps ② and ④ using the following equation:

ERP (dBm) = *LVL* (dBm) + *LOSS* (dB)

⑥ The maximum ERP is the maximum value determined in the preceding step.

5.2.7 Method of Calculation

① When calculating ERP, in addition to knowing characteristics, it is necessary to know the loss transmission line attenuation, mismatches, filters, the point where transmitter output power is measured, is applied to the antenna. ERP can then be calculated

ERP (dBm) = *Output Power* (dBm) - *Losses* (dB)

where: dBd refers to gain relative to an ideal dipole.

5.2.8 Limit

① FCC Limits (According to part 80.215): 18 Watt

5.2.9 Test Result

ERP Power Frequency Tuned (MHz)	Max. E-Field of EUT (dBuV/m)	Antenna Polarization (V/H)	Signal GEN. Power (dBm)	Isotropic Gain (dBd)	Measured ERP Power (dBm)	Measured ERP Power (Watts)	Limit (Watts)
156.025	126.16	V	44.2	-2.0	42.2	16.6	18
156.900	125.65	V	43.6	-2.0	41.6	16.2	
157.425	126.09	V	44.1	-2.0	42.1	16.5	

5.3 Modulation Characteristics – Audio Frequency Response

5.3.1 Definition

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

5.3.2 Specification

FCC Rules Part 2, Section 2.1047(a)

5.3.3 Method of Measurement

ANSI/TIA-603-B-2002 Section 2.2.6

5.3.4 Measurement Set-Up

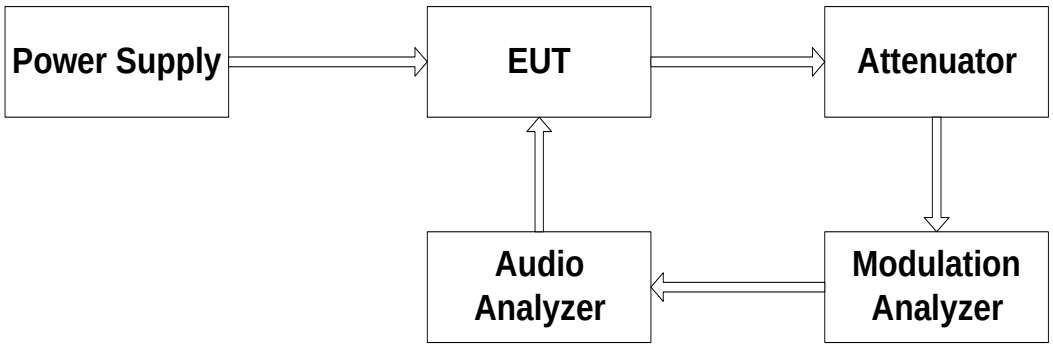


Fig-3

5.3.5 Test Equipment List

Equipment	Model Name	Manufacture
EUT	STR-6000A	SAMYUNG ENC
Power Supply	6034	AGILENT
Audio Analyzer	8903B	AGILENT
Modulation Analyzer	8901B	AGILENT
Attenuator	RFA500NMF30	RES-NET

5.3.6 Test Procedure

① The unit was turn-up in accordance with the alignment procedure stated in the Fig-3 and was loaded into a 50 Ω resistive termination.
② The audio analyzer was connected to the audio input circuit/microphone of the EUT.
③ The audio signal input was adjusted to obtain 20% modulation at 1 kHz, and this point was taken as the 0 dB reference level.
④ With input levels held constant and below limiting at all frequencies, the audio signal generator was varied from 100 Hz to 10 kHz.
⑤ The response in dB relative to 1 kHz was then measured, using the HP 8901A Modulation Analyzer.

5.3.7 Limit

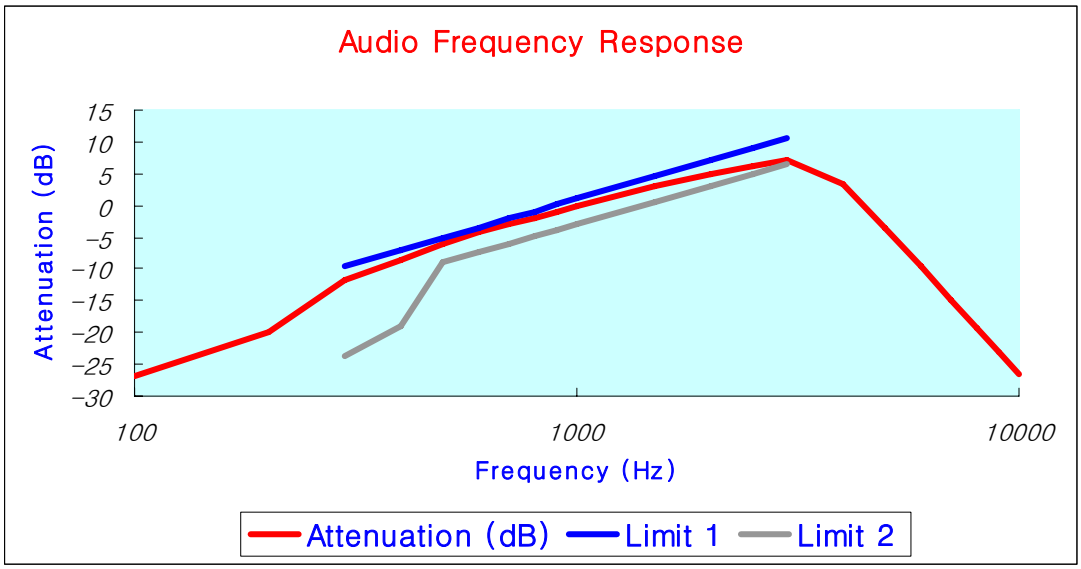
① The audio frequency response from 300 Hz to 3000 Hz shall not vary more than +1 dB or -3 dB from a true 6 dB per octave pre-emphasis characteristic as referenced to the 1000 Hz level. The exception is from 500 Hz to 300 Hz, where an additional 6 dB per octave roll-off is allowed.

5.3.8 Test Result / Channel 18 (156.900 MHz)

5.3.8.1 Data

Audio Input Frequency (Hz)	Attenuation (dB)
100	-26.8
200	-19.8
300	-11.9
400	-8.6
500	-6.1
600	-4.1
700	-3.0
800	-1.9
900	-0.9
1000	0
1500	3.1
2000	4.8
2500	6.2
3000	7.0
4000	3.2
5000	-3.7
6000	-9.7
7000	-14.8
8000	-19.2
9000	-23.2
10000	-26.6

5.3.8.2 Graph



5.4 Modulation Characteristics – Audio Low pass Filter Response

5.4.1 Definition

The audio low pass filter response is the frequency response of the post limiter low pass filter circuit above 3000 Hz.

5.4.2 Specification

FCC Rules Part 2, Section 2.1047(a)

5.4.3 Method of Measurement

ANSI/TIA-603-B-2002 Section 2.2.15

5.4.4 Measurement Set-Up

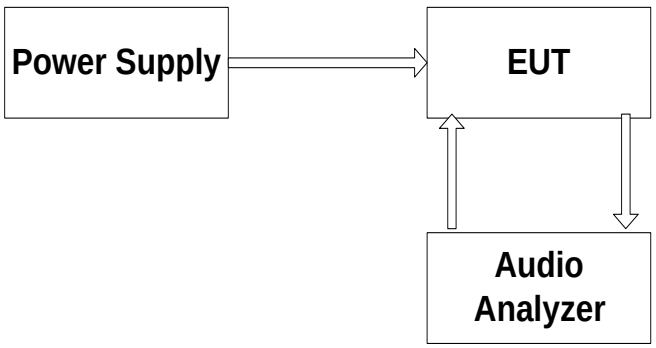


Fig-4

5.4.5 Test Equipment List

Equipment	Model Name	Manufacture
EUT	STR-6000A	SAMYUNG ENC
Power Supply	6034	AGILENT
Audio Analyzer	8903B	AGILENT

5.4.6 Test Procedure

① The unit was turn-up in accordance with the alignment procedure stated in the Fig-4, and was loaded into a 50 Ω resistive termination.
② To measure the audio low pass filter response, an audio analyzer were connected to the actual Printed Circuit Board of the transmitter.
③ Audio analyzer monitored the output of the audio filter.
④ An AF input level was maintained constant at least 10 dB below the saturation level at 1 kHz tone.
⑤ Record the dB level of the 1 kHz tone of the audio analyzer.
⑥ Set the audio input frequency to desired test frequency between 3 kHz and upper LPF limit.
⑦ Record dB level on the audio analyzer.
⑧ Calculate the audio frequency response as
LPF response = LEVFREQ - LEVREF

5.4.7 Limit

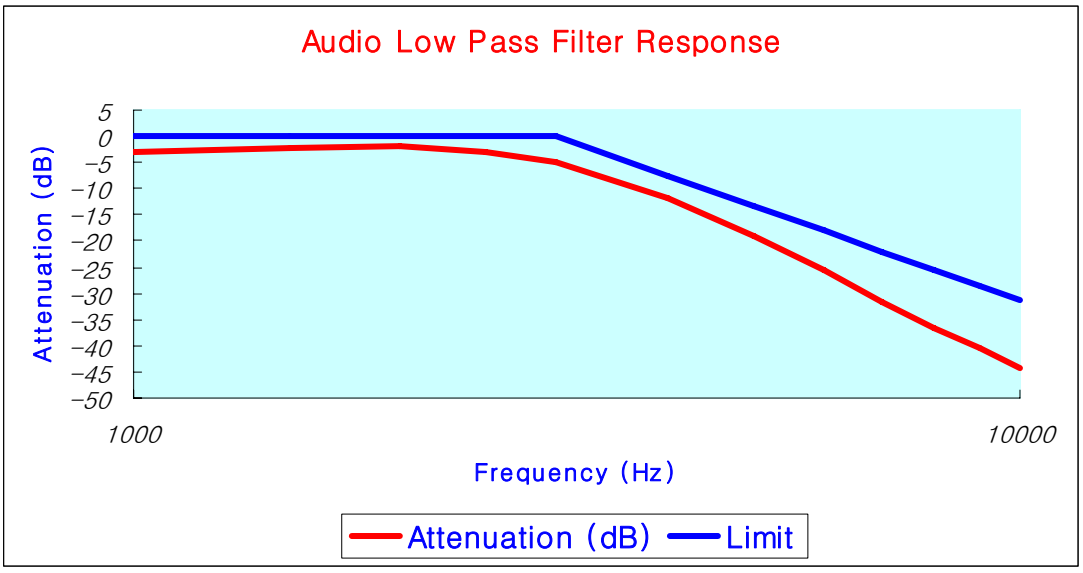
① At frequencies from 3000 Hz through 20,000 Hz, the attenuation shall be greater than the attenuation at 1000 Hz by at least: 60 log10 (f / 3000) dB
where: f is the audio frequency in Hz.
At frequencies above 20,000 Hz the attenuation shall be greater than the attenuation at 1000 Hz by at least: 50 dB.

5.4.8 Test Result / Channel 18 (156.900 MHz)

5.4.8.1 Data

Audio Input Frequency (Hz)	Attenuation (dB)
100	-3.0
200	-2.8
300	-2.9
400	-2.8
500	-2.9
600	-2.9
700	-2.9
800	-2.9
900	-2.9
1000	-2.9
1500	-2.4
2000	-2.0
2500	-3.2
3000	-4.8
4000	-11.7
5000	-19.2
6000	-25.7
7000	-31.5
8000	-36.5
9000	-40.5
10000	-44.2

5.4.8.2 Graph



5.5 Modulation Characteristics – Modulation Limiting

5.5.1 Definition

Modulation limiting is the transmitter circuit's ability to limit the transmitter from producing deviations in excess of a rated system deviation.

5.5.2 Specification

FCC Rules Part 2, Section 2.1047(b)

5.5.3 Method of Measurement

ANSI/TIA-603-B-2002 Section 2.2.3

5.5.4 Measurement Set-Up

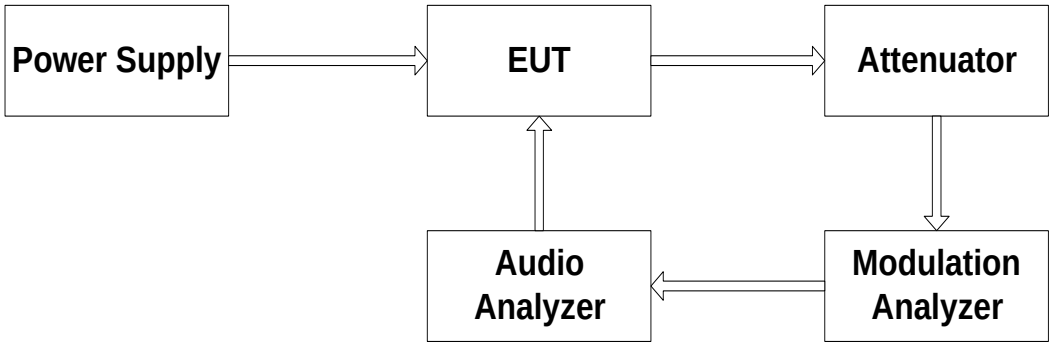


Fig-5

5.5.5 Test Equipment List

Equipment	Model Name	Manufacture
EUT	SP 6402	MAXON CIC CO LTD
Power Supply	IPS-30B03DD	INTERACT
Audio Analyzer	8903B	Agilent
Modulation Analyzer	8901B	Agilent
Attenuator	33-30-33	WEINSCHEL
Directional Coupler	778D	Agilent
Termination	8173	Bird

5.5.6 Test Procedure

① The unit was turn-up in accordance with the alignment procedure stated in the Fig-4, and was loaded into a 50 Ω resistive termination.
② Apply an 1 kHz modulating signal to EUT from the audio frequency analyzer, and adjust the level to obtain 60% of full rated system deviation.
③ Increase the level from the AF generator by ±20 dB in one step.
④ Measure the steady-state deviation.
⑤ With the AF generator level hold constant, vary the audio frequency from 300 Hz to 3000 Hz. Record the maximum deviation.
⑥ Set the modulation analyzer to measure the peak negative deviation and repeat the test above.

5.5.7 Limit

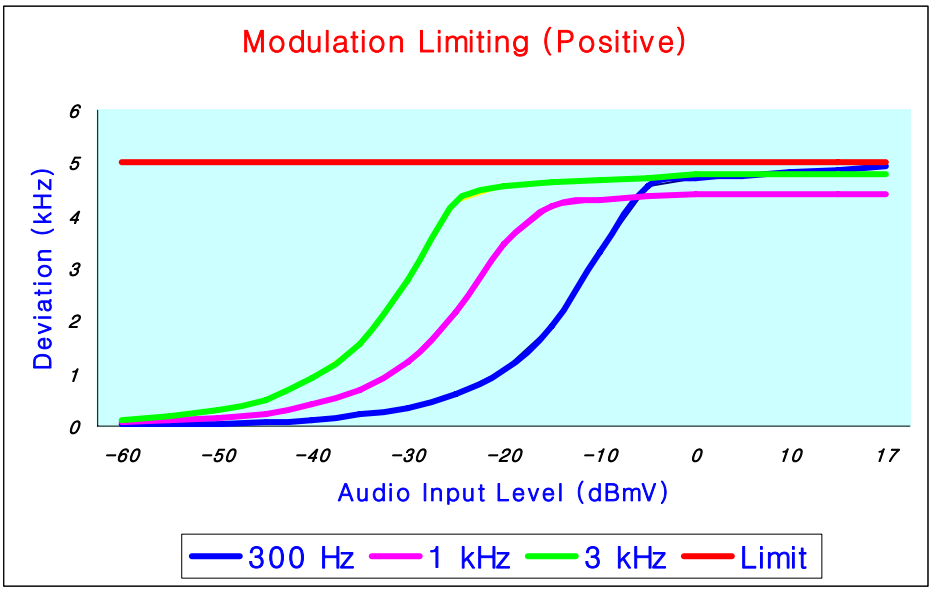
① 5 kHz

5.5.8 Test Result (Data) / Channel 18 (156.900 MHz)

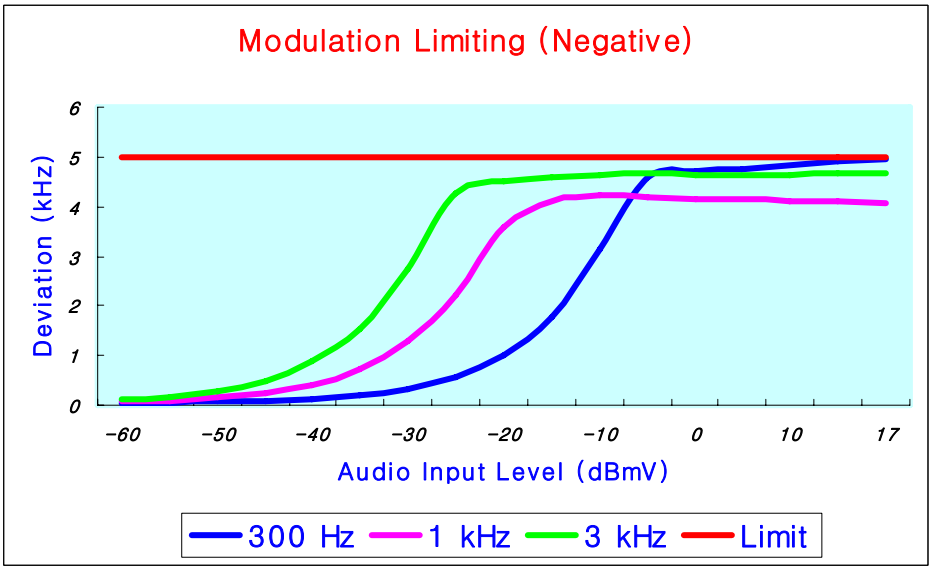
Audio Input Level (dBmV)	Positive Peak Deviation (kHz)			Negative Peak Deviation (kHz)		
	300 Hz	1 kHz	3 kHz	300 Hz	1 kHz	3 kHz
-60	0.04	0.07	0.12	0.04	0.07	0.12
-55	0.04	0.10	0.19	0.05	0.10	0.18
-50	0.05	0.15	0.31	0.07	0.15	0.30
-45	0.08	0.24	0.51	0.09	0.25	0.50
-40	0.13	0.41	0.90	0.13	0.41	0.88
-35	0.23	0.70	1.57	0.21	0.73	1.55
-30	0.34	1.23	2.78	0.34	1.27	2.74
-25	0.60	2.17	4.26	0.58	2.23	4.25
-20	1.06	3.44	4.55	1.01	3.59	4.52
-15	1.88	4.18	4.64	1.77	4.11	4.61
-10	3.30	4.30	4.68	3.13	4.23	4.64
-5	4.54	4.35	4.70	4.59	4.20	4.67
0	4.70	4.40	4.78	4.70	4.16	4.64
5	4.73	4.41	4.78	4.76	4.16	4.63
10	4.82	4.42	4.78	4.85	4.12	4.63
15	4.86	4.40	4.78	4.90	4.10	4.66
17	4.92	4.40	4.80	4.96	4.08	4.67

5.5.9 Test Result (Graph) / Channel 18 (156.900 MHz)

5.5.9.1 Positive



5.5.9.2 Negative



5.6 Occupied Bandwidth

5.6.1 Definition

The transmitter sideband spectrum denotes the sideband power 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.

5.6.2 Specification

FCC Rules Part 2, Section 2.1049
FCC Rules Part 80, Section 80.211

5.6.3 Method of Measurement

ANSI/TIA-603-B-2002 Section 2.2.11

5.6.4 Measurement Set-Up

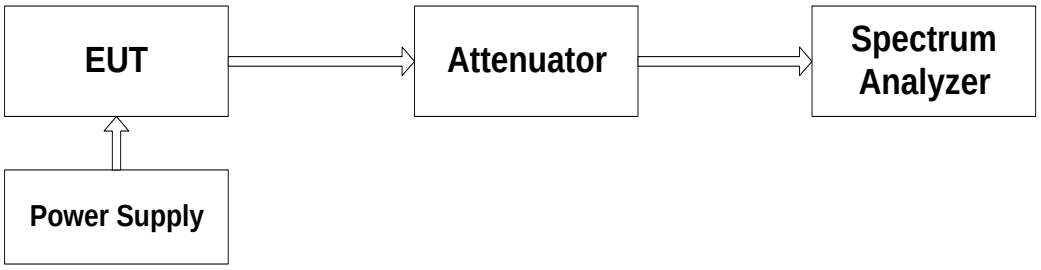


Fig-6

5.6.5 Test Equipment List

Equipment	Model Name	Manufacture
EUT	STR-6000A	SAMYUNG ENC
Power Supply	6034	AGILENT
Audio Analyzer	8903B	AGILENT
Attenuator	RFA500NMF30	RES-NET
Spectrum Analyzer	8563EC	AGILENT

5.6.6 Test Procedure

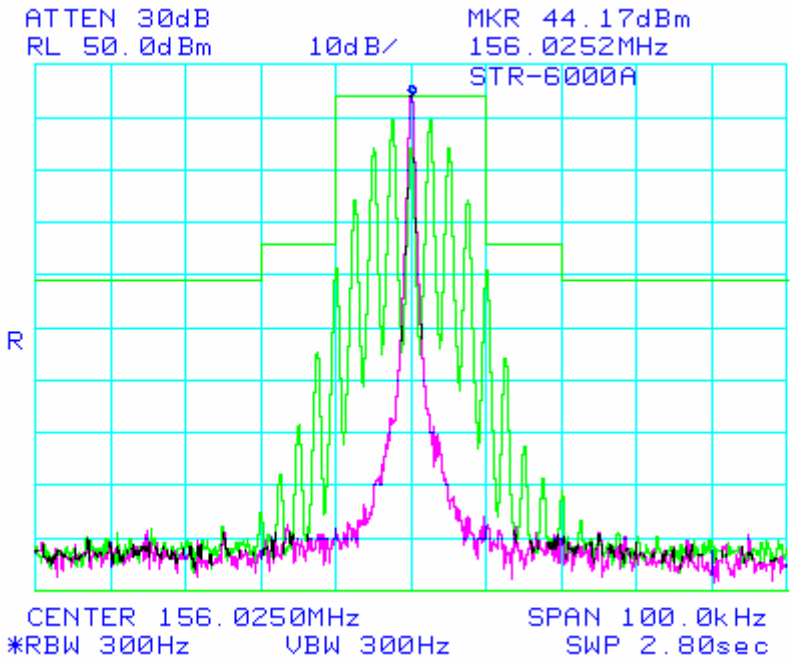
① The unit was turn-up in accordance with the alignment procedure stated in the Fig-6 , and was loaded into a 50 Ω resistive termination.
② For EUTs supporting audio modulation, the audio signal generator was adjusted to the frequency of maximum response and with output level set for maximum deviation (or 50% modulation). With level constant, the signal level was increased 16 dB.
③ For EUTs supporting digital modulation, the digital modulation mode was operated to its maximum extent.
④ The Occupied Bandwidth was measured with the Spectrum Analyzer controls set as shown on the test results.

5.6.7 Limit

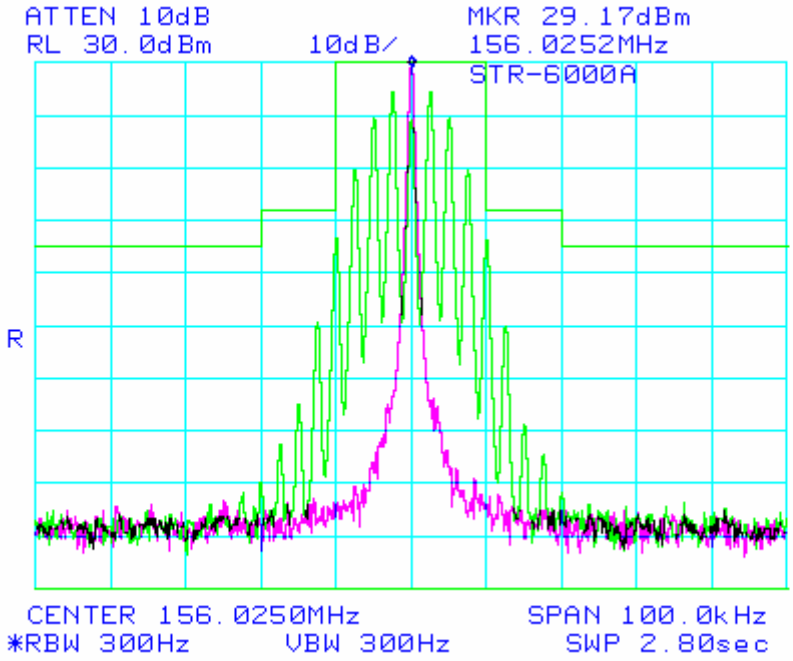
⑤ FCC 80.211
50~100% (10~20kHz) of assigned frequency : 28 dB
100~250% (20~50kHz) of assigned frequency : 35 dB
Above 250% (50kHz) of assigned frequency : $43+10\log_{10}$ (P) dB dB

5.6.8 Test Plot

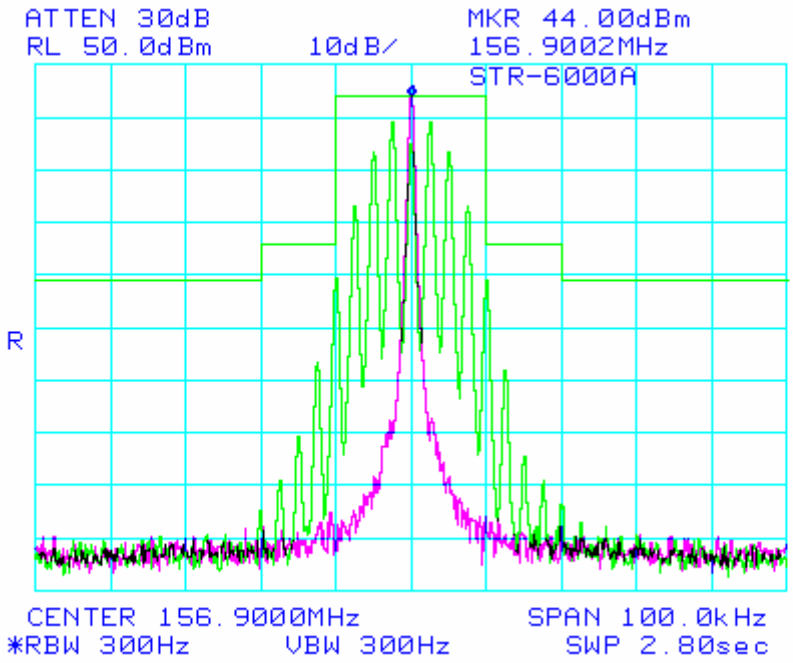
5.6.8.1 Channel 60 (156.025 MHz) / High Power (25 Watts)



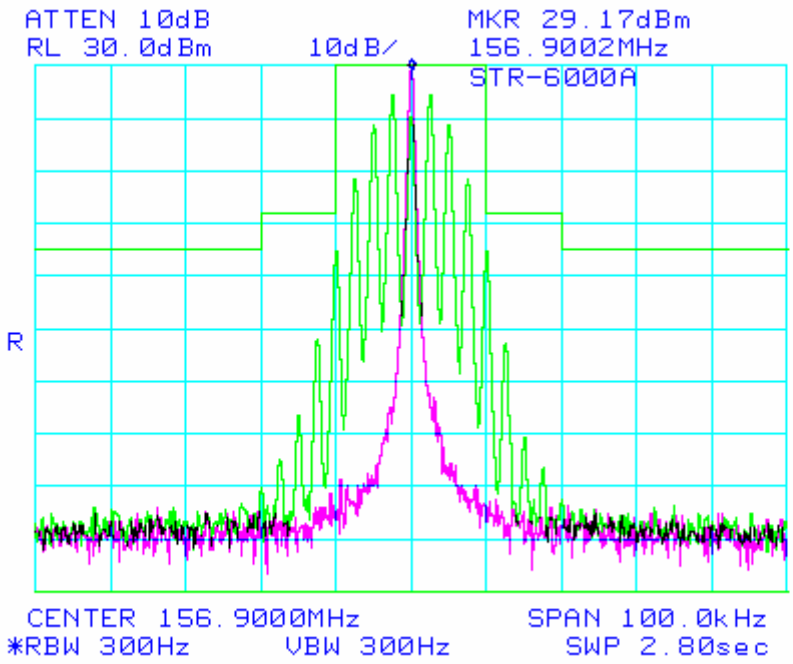
5.6.8.2 Channel 60 (156.025 MHz) / Low Power (1 Watt)



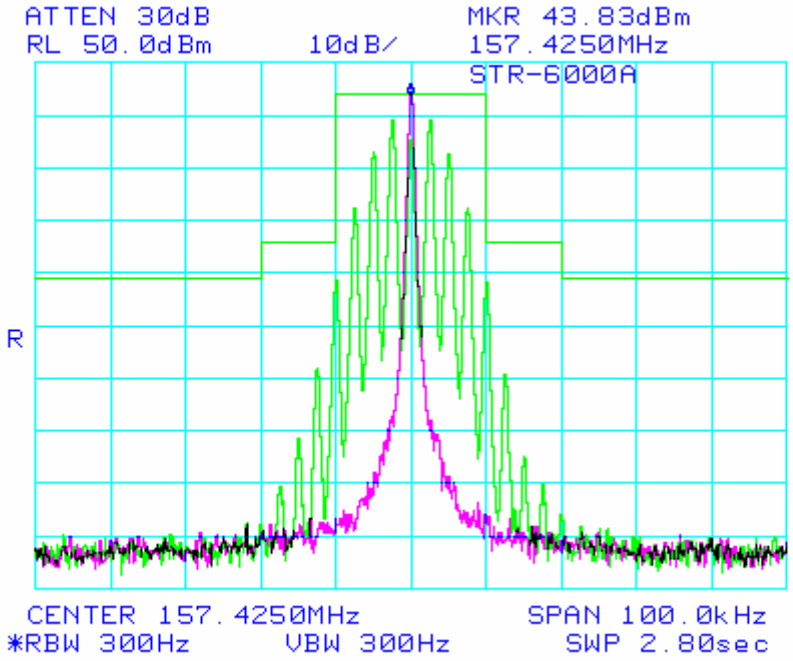
5.6.8.3 Channel 18 (156.900 MHz) / High Power (25 Watts)



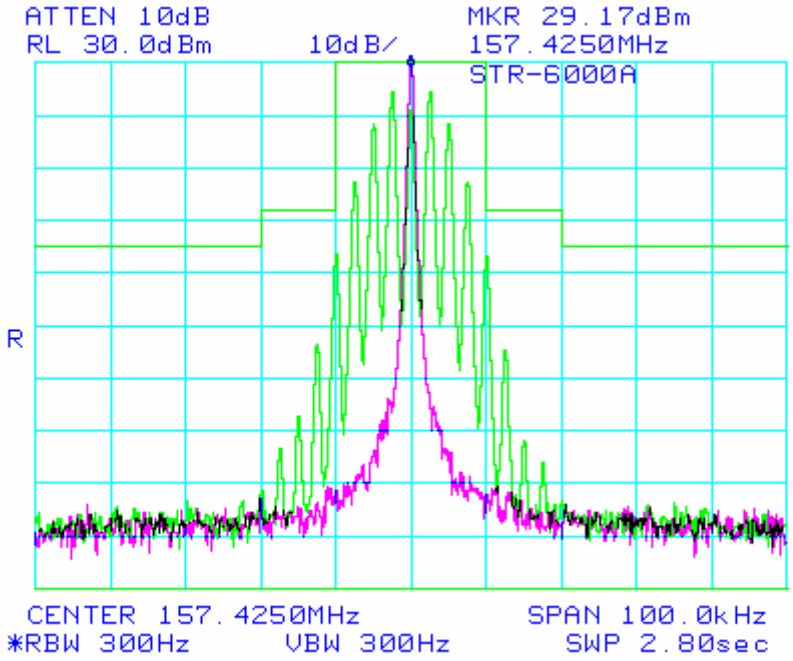
5.6.8.4 Channel 18 (156.900 MHz) / Low Power (1 Watt)



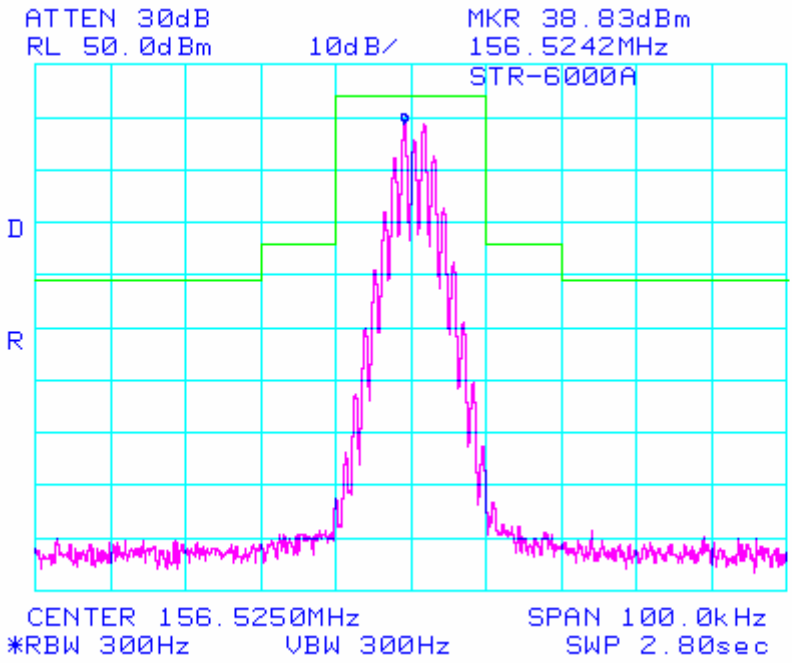
5.6.8.5 Channel 88 (157.425 MHz) / High Power (25 Watts)



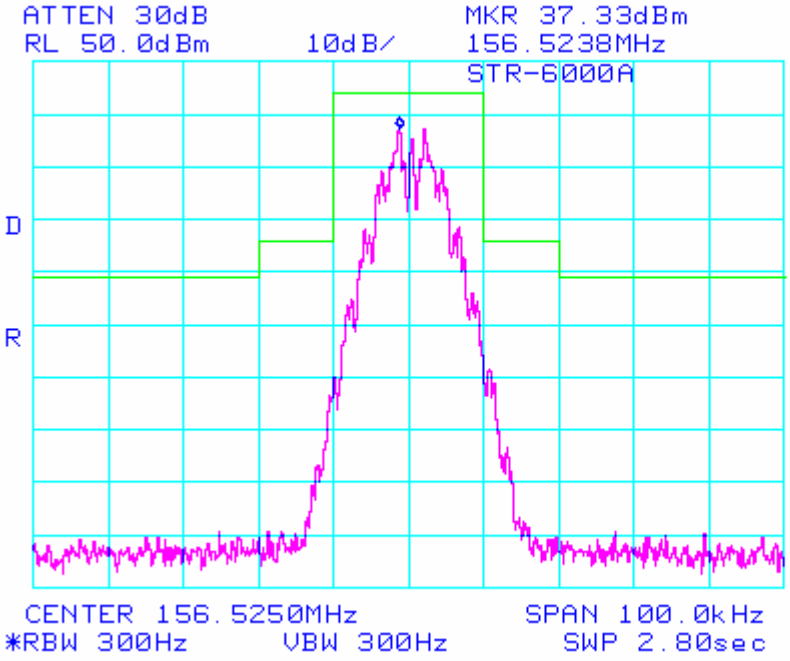
5.6.8.6 Channel 88 (157.425 MHz) / Low Power (1 Watt)



5.6.8.7 Channel 70 (156.525 MHz) / High Power (25 Watts) DSC / 1300 Hz



5.6.8.8 Channel 70 (156.525 MHz) / High Power (25 Watts) DSC / 2100 Hz



5.7 Spurious Emissions at Antenna Terminals

5.7.1 Definition

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

5.7.2 Specification

FCC Rules Part 2, Section 2.1051
FCC Rules Part 80, Section 80.211

5.7.3 Method of Measurement

ANSI/TIA-603-B-2002 Section 2.2.13

5.7.4 Measurement Set-Up

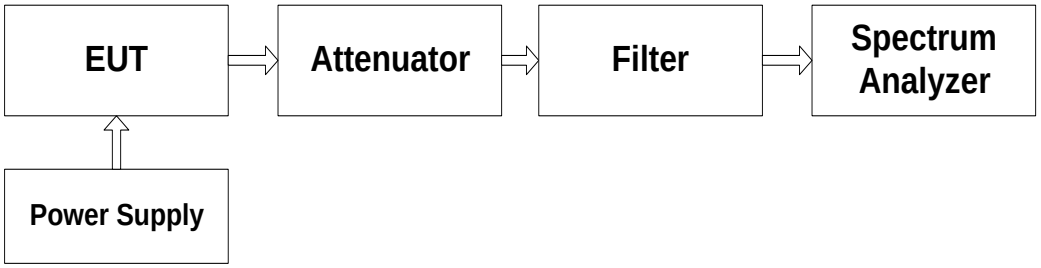


Fig-7

5.7.5 Test Equipment List

Equipment	Model Name	Manufacture
EUT	STR-6000A	SAMYUNG ENC
Power Supply	6034	AGILENT
Audio Analyzer	8903B	AGILENT
Attenuator	RFA500NMF30	RES-NET
Filter	MEP-294	TAKEDA RIKEN
Spectrum Analyzer	8563EC	AGILENT

5.7.6 Test Procedure

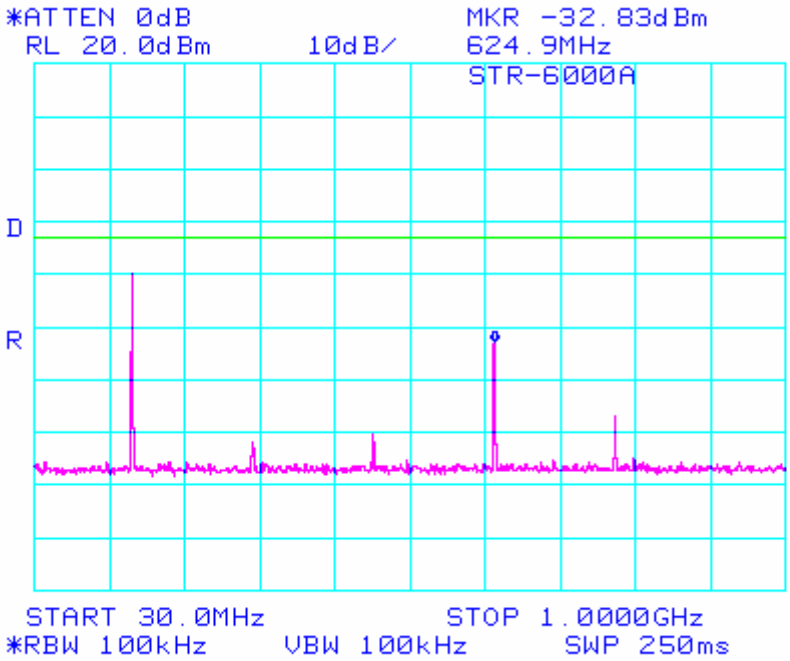
① The unit was turn-up in accordance with the alignment procedure stated in the Fig-7, and was loaded into a 50 Ω resistive termination.
② The unit of conducted spurious emission levels shall be the power.
③ Transmitter was set to the high power output condition.
④ The unit was modulated with an audio tone at an input level 16dB greater than that required 50% modulation. The spectrum was scanned from the lowest frequency generated in the equipment to the 10^{th} harmonic of the carrier.

5.7.7 Limit

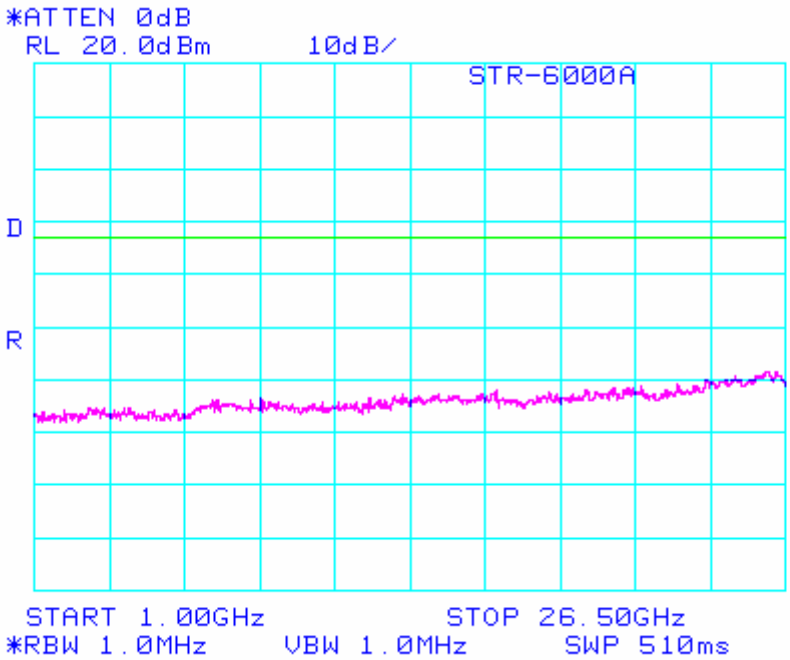
⑤ The limit was applied according the $43+10\log_{10}$(P: mean power in Watts) dB.
⑥ 43 + 10 log (P) dBc, 56.98 dBc, -13 dBm

5.7.8 Test Plot

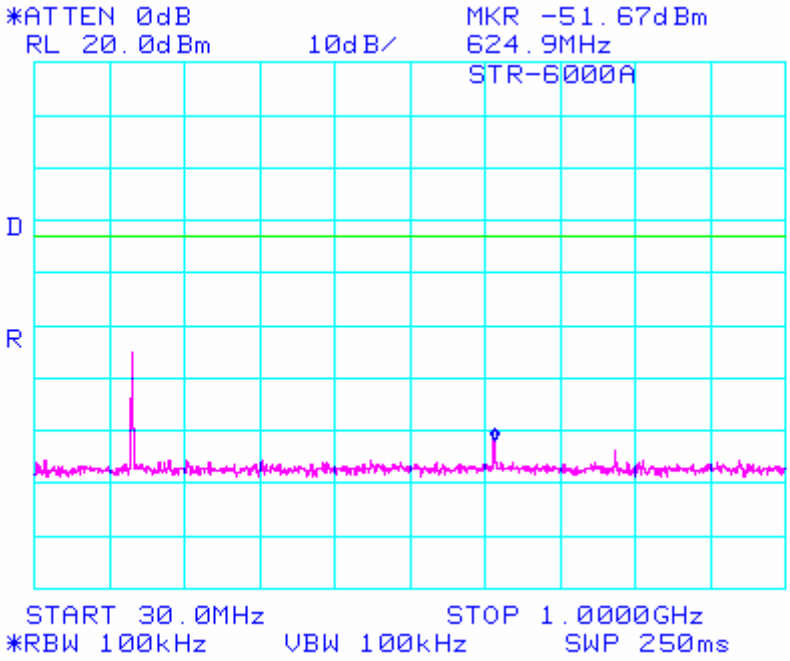
5.7.8.1 Channel 60 (156.025 MHz) / High Power (25 Watts) / 30 MHz ~ 1 GHz



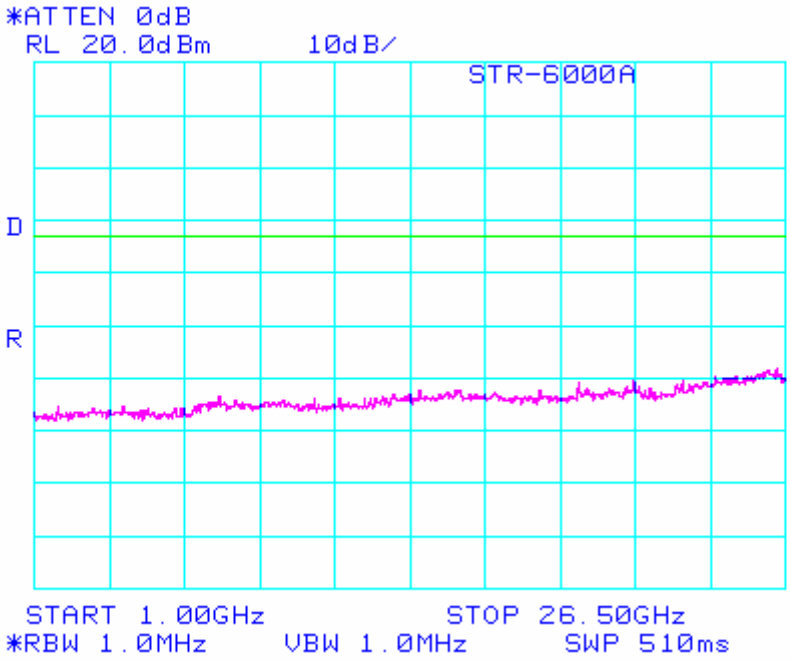
5.7.8.2 Channel 60 (156.025 MHz) / High Power (25 Watts) / 1 GHz ~ 2 GHz



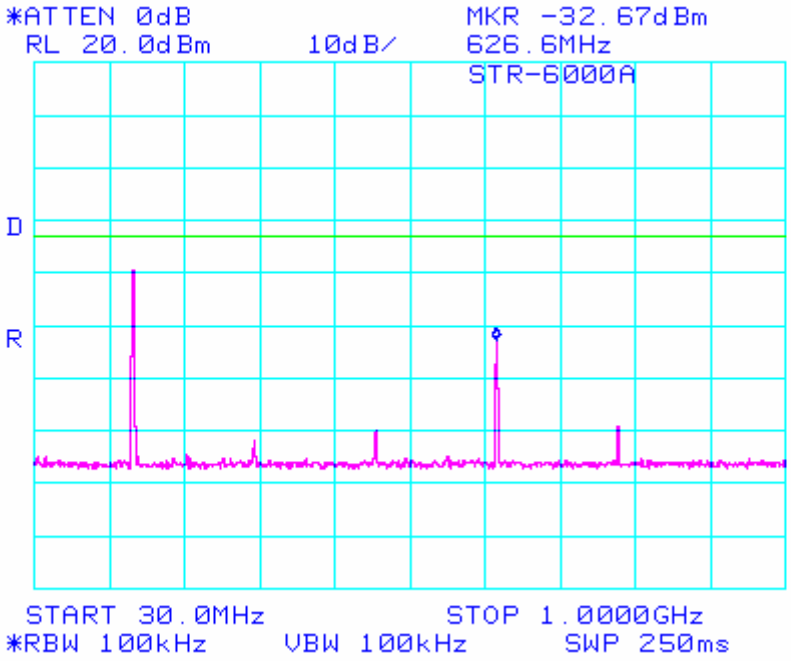
5.7.8.3 Channel 60 (156.025 MHz) / Low Power (1 Watt) / 30 MHz ~ 1 GHz



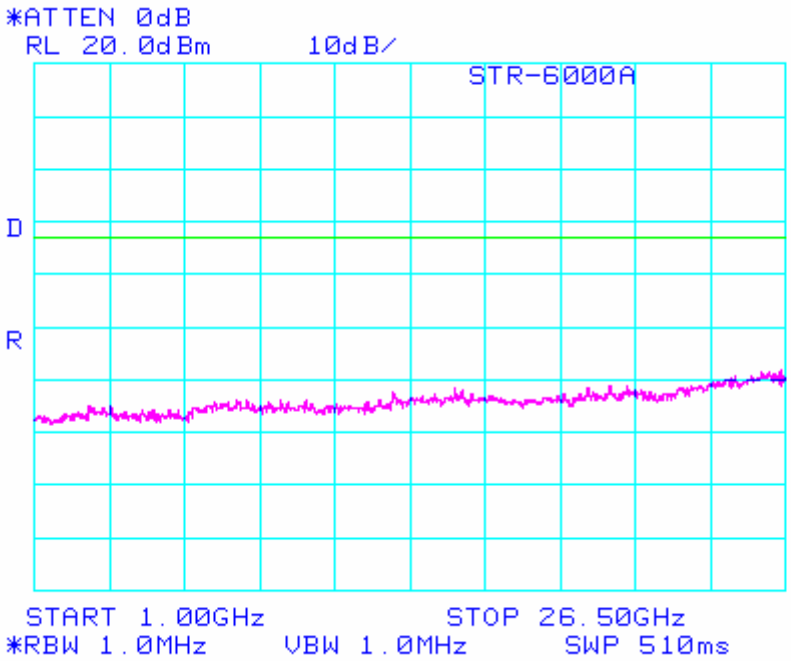
5.7.8.4 Channel 60 (156.025 MHz) / Low Power (1 Watt) / 1 GHz ~ 2 GHz



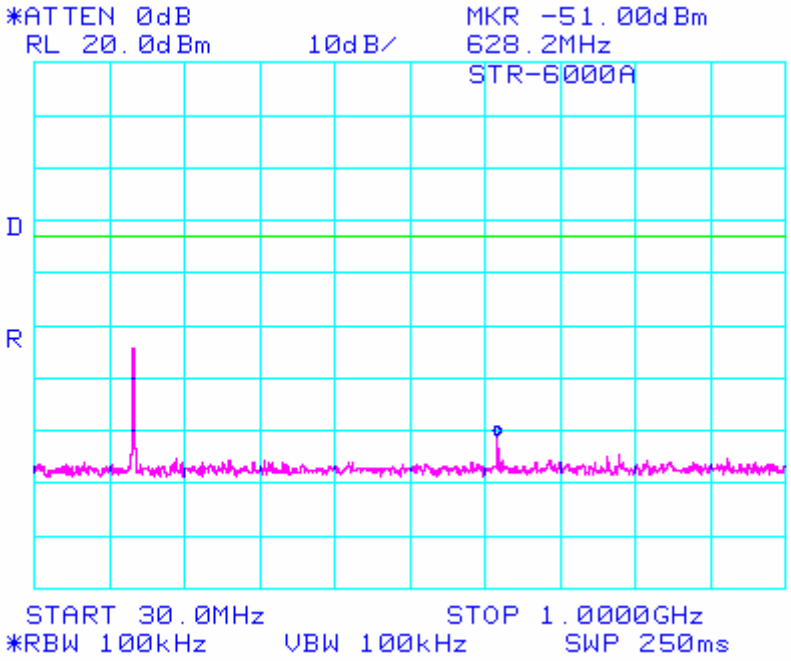
5.7.8.5 Channel 18 (156.900 MHz) / High Power (25 Watts) / 30 MHz ~ 1 GHz



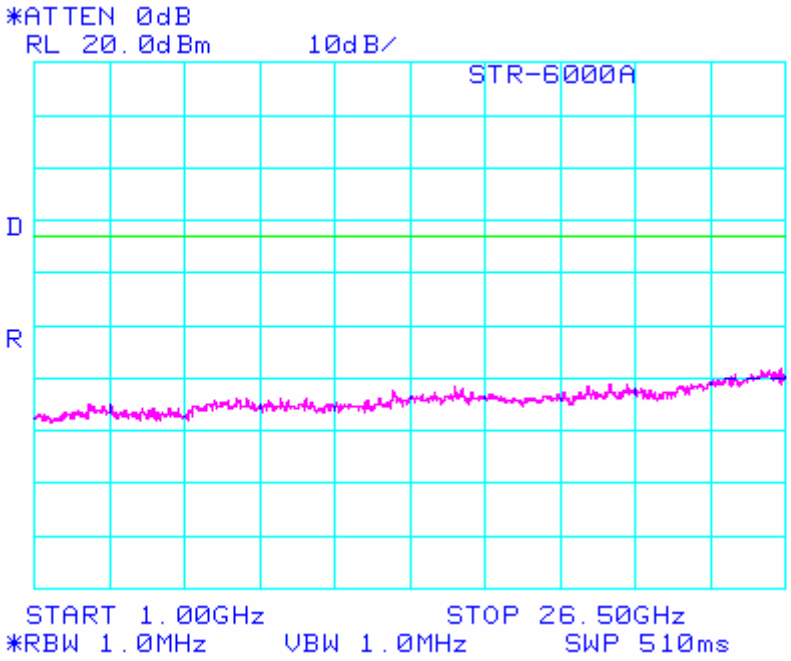
5.7.8.6 Channel 18 (156.900 MHz) / High Power (25 Watts) / 1 GHz ~ 2 GHz



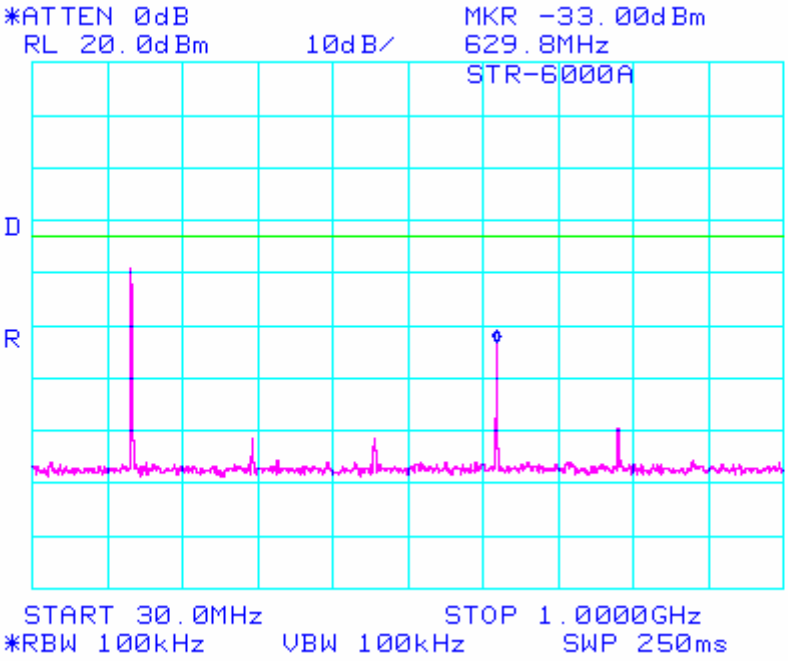
5.7.8.7 Channel 18 (156.900 MHz) / Low Power (1 Watt) / 30 MHz ~ 1 GHz



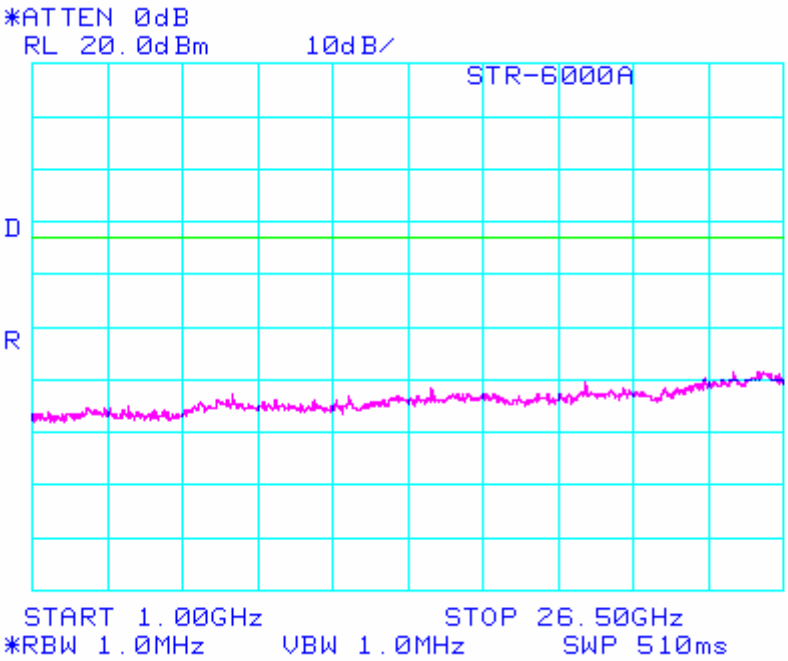
5.7.8.8 Channel 18 (156.900 MHz) / Low Power (1 Watt) / 1 GHz ~ 2 GHz



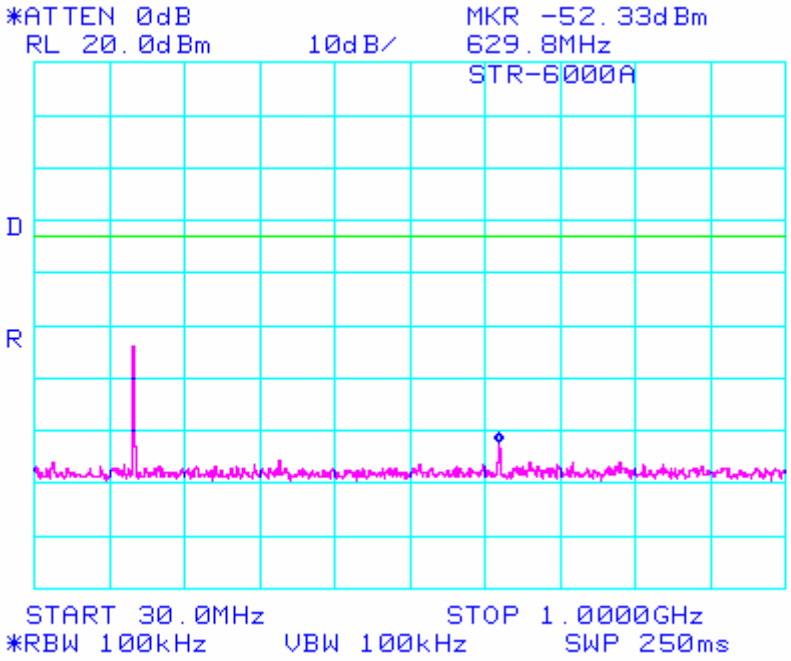
5.7.8.9 Channel 88 (157.425 MHz) / High Power (25 Watts) / 30 MHz ~ 1 GHz



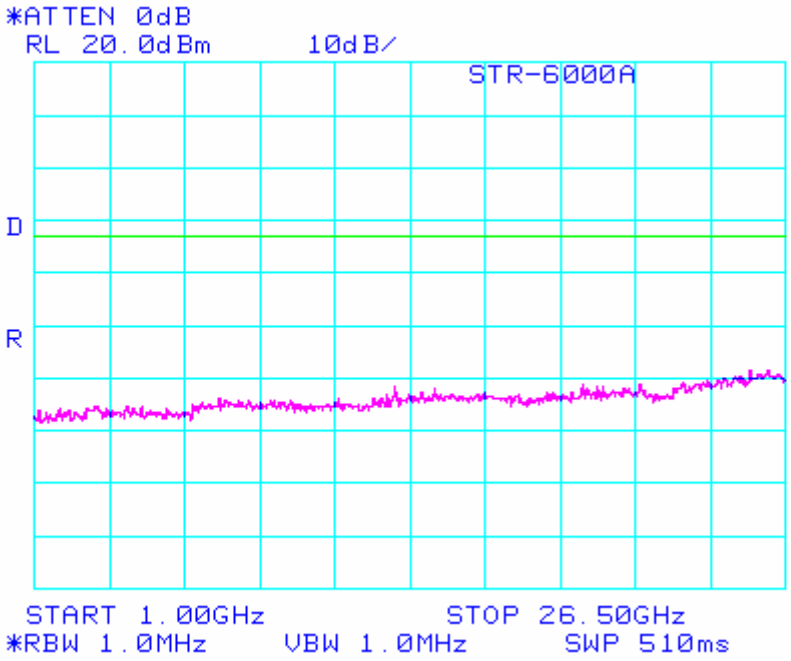
5.7.8.10 Channel 88 (157.425 MHz) / High Power (25 Watts) / 1 GHz ~ 2 GHz



5.7.8.11 Channel 88 (157.425 MHz) / Low Power (1 Watt) / 30 MHz ~ 1 GHz



5.7.8.12 Channel 88 (157.425 MHz) / Low Power (1 Watt) / 1 GHz ~ 2 GHz



5.8 Field Strength of Spurious Radiation

5.8.1 Definition

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

5.8.2 Specification

FCC Rules Part 2, Section 2.1051
FCC Rules Part 80, Section 80.211

5.8.3 Method of Measurement

ANSI/TIA-603-B-2002 Section 2.2.12

5.8.4 Measurement Set-Up

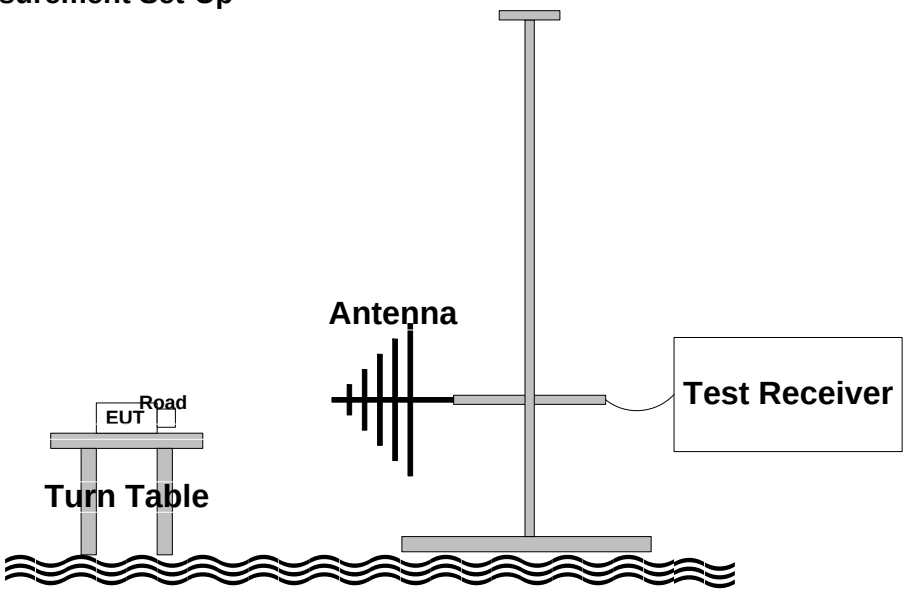


Fig-8.1

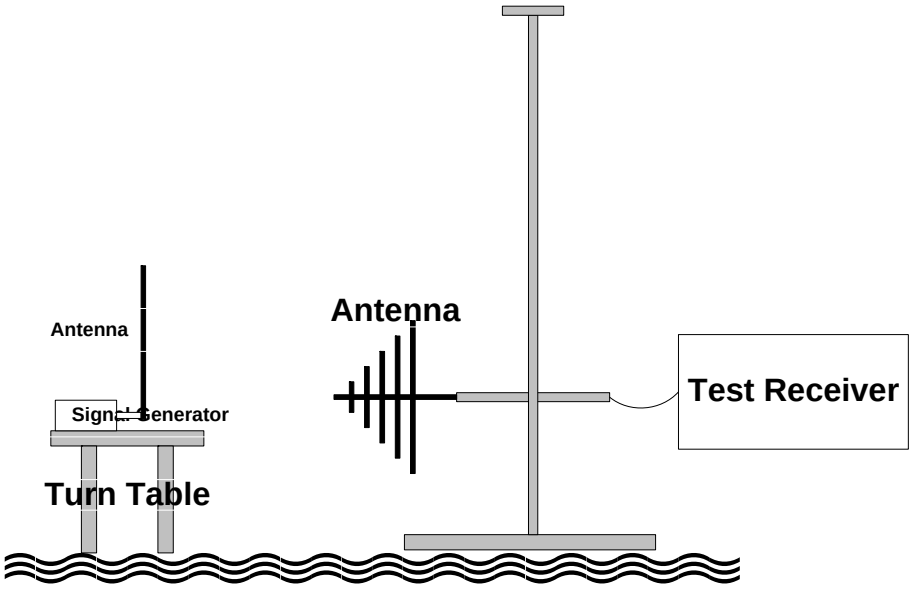


Fig-8.2

5.8.5 Test Equipment List

Equipment	Model Name	Manufacture
EUT	STR-6000A	SAMYUNG ENC
Power Supply	6034	AGILENT
Road	8173	BIRD
Dipole Antenna	VDA6116A / UHA9105	SCHAFFNER
Horn Antenna	BBHA 9120	SCHWARZBECK
Bilog Antenna	VULB 9160	SCHWARZBECK
Receiver	ESVS 10	ROHDE & SCHWARZ
Signal Generator	E4432B	AGILENT

5.8.6 Test Procedure

① Connect the equipment as Fig-8.1.
② Place the transmitter to be tested on the turntable in the standard test site
③ The transmitter is transmitting into a nonradiating load that is placed on the turntable. The RF cable to this load should be of minimum length. For transmitters with integral antennas, the tests are to be run with the unit operating into the integral antenna.
④ For each spurious measurement the test antenna should be adjusted to the correct length for the frequency involved. This length may be determined from a calibration ruler supplied with the equipment. Measurements shall be made from the lowest radio frequency generated in the equipment to the tenth harmonic of the carrier, except for the region close to the carrier equal to ± the test bandwidth.
⑤ Key the transmitter.
⑥ For each spurious frequency, raise and lower the test antenna from 1 m to 4m to obtain a maximum reading on the spectrum analyzer with the test antenna at horizontal polarity. Then the turntable should be rotated 360° to determine the maximum reading. Repeat this procedure to obtain the highest possible reading. Record this maximum reading.
⑦ Repeat step ⑥ for each spurious frequency with the test antenna polarized vertically.
⑧ Reconnect the equipment as Fig-8.2.
⑨ Remove the transmitter and replace it with a substitution antenna (the antenna should be half-wavelength for each frequency involved). The center of the substitution antenna should be approximately at the same location as the center of the transmitter. At the lower frequencies, where the substitution antenna is very long, this will be impossible to achieve when the antenna is polarized vertically. In such case the lower end of the antenna should be 0.3 m above the ground.
⑩ Feed the substitution antenna at the transmitter end with a signal generator connected to the antenna by means of a nonradiating cable. With the antennas at both ends horizontally polarized, and with the signal generator tuned to a particular spurious frequency, raise and lower the test antenna to obtain a maximum reading at the spectrum analyzer. Adjust the level of the signal generator output until the previously recorded maximum reading for this set of conditions is obtained. This should be done carefully repeating the adjustment of the test antenna and generator output.
⑪ Repeat step ⑩ with both antennas vertically polarized for each spurious frequency.
⑫ Calculate power in dBm into a reference ideal half-wave dipole antenna by reducing the readings obtained in steps ⑩ and ⑪ 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 half-wave dipole antenna by the following formula :

Pd(dBm) = Pg(dBm) − cable loss (dB) + antenna gain (dB)

where: Pd is the dipole equivalent power and
Pg is the generator output power into the substitution antenna.

5.8.7 Limit

① 43 + 10 log (P) dBc, 56.98 dBc, -13 dBm

5.8.8 Test Result

ERP Power Frequency Tuned (MHz)	Max. E-Field of EUT (dBuV/m)	Antenna Polarization (V/H)	Signal GEN. Power (dBm)	Dipole Gain (dBd)	Measured ERP Power (dBm)	Attenuation (dBc)	Limit (dBc)	Margin (dB)
Channel 60 / 156.025 MHz / 25 Watts								
156.025	140.2	V	+44.0	0	+44.0	-	-	-
312.050	41.8	V	-54.4	0	-54.4	98.4	57.0	41.4
468.075	38.5	V	-57.4	0	-57.4	101.4		44.4
624.100	57.6	V	-37.6	0	-37.6	81.6		24.6
780.125	44.7	V	-51.5	0	-51.5	95.5		38.5
936.150	Not Found							
1092.175								
1248.200								
1404.225								
1560.250								
1716.275								
1872.300								
Channel 18 / 156.900 MHz / 25 Watts								
156.900	140.1	V	+43.9	0	+43.9	-	-	-
313.800	41.5	V	-54.7	0	-54.1	98.0	57.0	41.0
470.700	38.9	V	-57.0	0	-57.0	100.9		43.9
427.600	58.0	V	-37.2	0	-37.2	81.1		24.1
784.500	45.0	V	-51.2	0	-51.2	95.1		38.1
941.400	Not Found							
1098.300								
1255.200								
1412.100								
1569.000								
1725.900								
1882.800								
Channel 88 / 157.425 MHz / 25 Watts								
157.425	140.0	V	+43.8	0	+43.8	-	-	-
314.850	40.8	V	-55.5	0	-55.5	99.3	57.0	42.3
472.275	39.2	V	-56.8	0	-56.8	100.6		43.6
629.700	58.3	V	-36.5	0	-36.5	80.3		23.3
787.125	44.8	V	-50.9	0	-50.9	94.7		37.7
944.550	Not Found							
1101.975								
1259.400								
1416.825								
1574.250								
1731.675								
1889.100								

5.9 Frequency Stability / Temperature Variation

5.9.1 Definition

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

5.9.2 Specification

FCC Rules Part 2, Section 2.1055
FCC Rules Part 80, Section 80.209(a)

5.9.3 Method of Measurement

ANSI/TIA-603-B-2002 Section 2.2.2

5.9.4 Measurement Set-Up

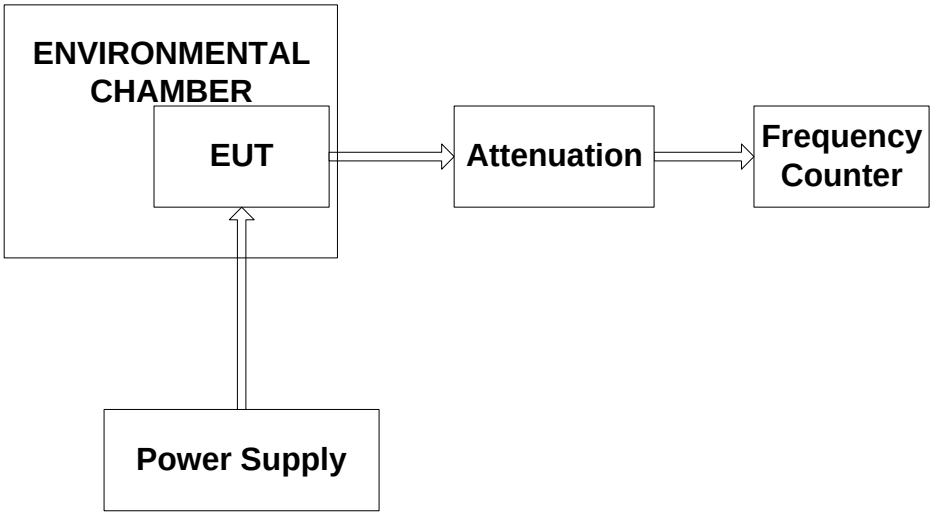


Fig-9

5.9.5 Test Equipment List

Equipment	Model Name	Manufacture
EUT	STR-6000A	SAMYUNG ENC
Power Supply	6034	AGILENT
Attenuator	RFA500NMF30	RES-NET
Frequency Counter	R5372	ADVENTEST
Environmental Chamber	EN-GLMP-54	ENEX

5.9.6 Test Procedure

① Connect the equipment as Fig-9.
② Operate the equipment in standby conditions for 15 minutes before proceeding.
③ Record the carrier frequency of the transmitter as *MCF*MHz.
④ Calculate the ppm frequency error.

5.9.7 Limit

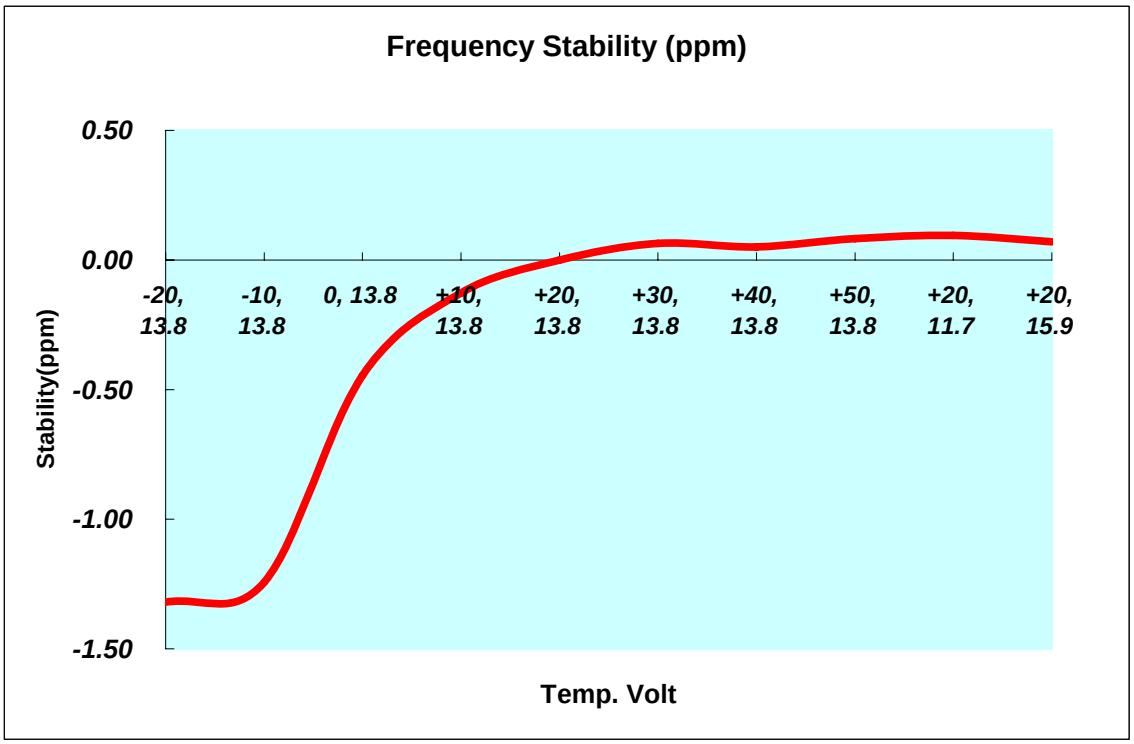
① 5 ppm

5.9.8 Test Result / Channel 18 (156.900 MHz)

5.9.8.1 Data Table

Voltage (%)	Power Supply (Vdc)	Temperature (ºC)	Frequency (Hz)	Deviation (ppm)	Limit (ppm)
100%	13.8	-30	156899753	-0.73	5.00
		-20	156899660	-1.32	
		-10	156899672	-1.24	
		0	156899797	-0.45	
		+10	156899847	-0.13	
		+20 (Ref.)	156899867	0	
		+30	156899877	+0.06	
		+40	156899875	+0.05	
		+50	156899880	+0.08	
85%	11.7	+20	156899882	+0.10	
115%	15.9		156899878	+0.07	

5.9.8.2 Graph



5.10 Maximum Usable Sensitivity for the Receiver

5.10.1 Definition

The reference sensitivity is the level of receiver input signal at a specified frequency with specified modulation that will result in the standard SINAD at the output of the receiver.

5.10.2 Specification

FCC Rules Part 80, Section 80.874

5.10.3 Method of Measurement

ANSI/TIA-603-B-2002 Section 2.1.4

5.10.4 Measurement Set-Up

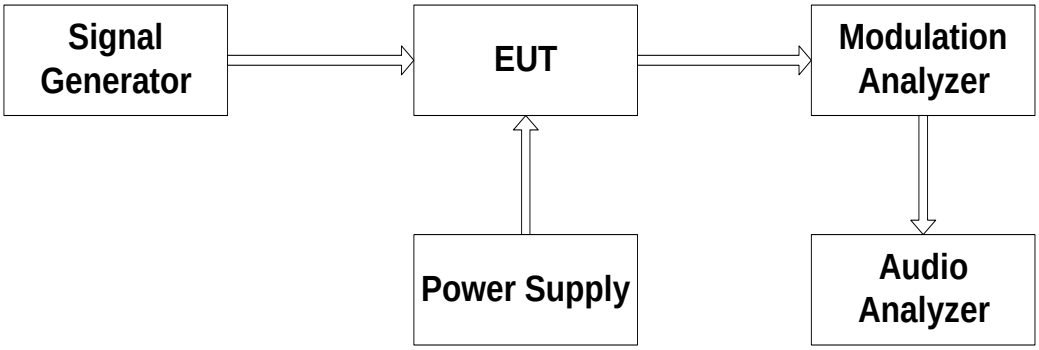


Fig-10

5.10.5 Test Equipment List

Equipment	Model Name	Manufacture
EUT	STR-6000A	SAMYUNG ENC
Power Supply	6034	AGILENT
Signal Generator	E4432B	AGILENT
Modulation Analyzer	8901B	AGILENT
Audio Analyzer	8903B	AGILENT

5.10.6 Test Procedure

① Connect the equipment as Fig-10.
② Apply a standard input signal to the receiver input terminals.
③ Adjust the receiver volume control to obtain rated output power.
④ Adjust the receiver input signal level to produce the standard SINAD(12 dB). Record this level.
⑤ If the output power obtained in step ④ is more than 3 dB below the level obtained in step ③, the input signal level at which the output has fallen by 3dB should be recorded.
⑥The reference sensitivity is the larger of the input signal levels that were obtained in steps ④ and ⑤.

5.10.7 Limit

① 0.5 uV

5.10.8 Test Result

Channel	Frequency	Input Power		
		11.7 Vdc	13.8 Vdc	15.9Vdc
60	156.025 MHz	0.30	0.30	0.31
18	156.900 MHz	0.33	0.35	0.33
88	157.425 MHz	0.38	0.38	0.36
70 (DSC)	156.525 MHz	0.29	0.29	0.30

6. RF Exposure Requirements

6.1 Specification

FCC Rules Part 1 §1.1310, §2.1091

6.2 Method of Measurement

Maritime Services operating under section Part 80 are categorically from routine environmental evaluation to demonstrating RF exposure compliance with respect to MPE and/or SAR limits. These devices are not exempted from compliance does not exceed the Commission's RF exposure guidelines. Unless a device operates at substantially low power levels, with a low gain antenna(s), supporting information is generally needed to establish the various potential operating configurations and exposure conditions of a transmitter and its antenna(s) in order to determine compliance with the RF exposure guidelines.

In order to demonstrate compliance with MPE requirements (see Section 2.1091), the following information is typically needed:

Calculation that estimates the minimum separation distance (20 cm or more) between an antenna and persons required to satisfy power density limits defined for free space.

Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement Any caution statements and/or warning labels that are necessary in order to comply with the exposure limits Any other RF exposure related issues that may affect MPE compliance.

6.3 Limit

FCC 1.1310:- The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b).

LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm2)	Average Time (minutes)
(A) Limits for Occupational/Control Exposures				
30-300	61.4	0.163	1.0	6
(B) Limits for General Population/Uncontrolled Exposure				
30-300	**27.5**	**0.073**	**0.2**	**30**

6.4 Result

Frequency (MHz)	Measured ERP Power (dBm)	Antenna Gain (dBi)	Calculated EIRP (Watt)	Duty cycle (%)	The time averaged power over 30 minutes (Watt)	Laboratory's Recommended Minimum RF Safety Distance (r) (meters)
156.025	44.00	2.14	41.11	50	20.56	0.90
156.900	43.90	2.14	40.18	50	20.09	0.89
157.425	43.80	2.14	39.26	50	19.63	0.88

Calculation Method of RF Safety Distance:

$$S = \frac{PG}{4\pi r^2} = \frac{EIRP}{4\pi r^2}$$

P : power input to the antenna in mW
EIRP : Equivalent (effective) isotropic radiated power.
S : power density mW/cm^2
G : numeric gain of antenna relative to isotropic radiator
R : distance to centre of radiation in cm

FCC radio frequency exposure limits may be exceeded at distances closer than r cm from the antenna of this device

$$r = \sqrt{\frac{PG}{4\pi S}} = \sqrt{\frac{EIRP}{4\pi S}}$$

Note :

1. S = 0.2 mW/cm^2 for Limits for General Population/Uncontrolled Exposures.
2. This Equipment assume a typical transceiver duty cycle with 50% transmit time.
3. The time averaged power over 30 minutes will be calculated from 15 minutes TX on time and 15 minutes TX off time .
4. Minimum calculated separation distance between antenna and persons required : 0.90 m

7. TEST EQUIPMENTS LIST

List of Test Equipments Used for Measurements

EQUIPMENT	MODEL	MANUFACTURE	SERIAL NUMBER	Calibration Due date
EMI Receiver	ESVS 10	ROHDE & SCHWARZ	863247/019	05.25.2006
Dipole Antenna	VDA6116A / UHA9105	SCHAFFNER	1277/2168	03.23.2006
Dipole Antenna	VDA6116A / UHA9105	SCHAFFNER	1277/2168	03.23.2006
Horn Antenna	BBHA 9120	SCHWARZBECK	BBHA 9120 D234	02.07.2007
Horn Antenna	BBHA 9120	SCHWARZBECK	BBHA 9120 D517	02.07.2007
Bilog Antenna	VULB 9160	SCHWARZBECK	9160-3145	12.16.2006
Signal Generator	E4432B	AGILENT	US40053157	07.11.2006
Frequency Counter	R5372	ADVANTEST	41855204	02.17.2007
Power Meter	E4418A	AGILENT	GB38272621	02.22.2007
Power Sensor	E9301B	AGILENT	US40010238	12.15.2006
Audio Analyzer	8903B	AGILENT	3011A09344	02.23.2007
Modulation Analyzer	8901B	AGILENT	3028A03124	02.22.2007
Spectrum Analyzer	8563EC	AGILENT	3946A00348	11.15.2006
Road	8173	BIRD	2501	N/A
Attenuator	RFA500NMF30	BIRD	9522	11.14.2006
Filter	MEP-294	TAKEDA RIKEN	30520019	N/A
Environmental Chamber	EN-GLMP-54	ENEX	-	03.22.2007
Message Measuring Set	AITS	SINE QUA NON	-	N/A