SE 250 SYSTEM TEST REPORT

Below is the data required by 47CFR2.1046 through 47CFR2.1057

List of Measurement Equipment Used

Equipment	Serial Number	Calibration Date
HP8591E Spectrum Analyzer	3543A04924	11JUL14
Tektronix TDS3012C	TDS3012C C015007	26FEB14
Fluke 87V Digital Multimeter	22960173	19APR14
Agilent U8903A Audio Analyzer	MY51090010	19APR14
HP5335A Universal Counter	2548A08843	22JUL14
1007C Environmental Chamber	11086	18JUL14

47CFR2.1046 Measurements required: RF output power.

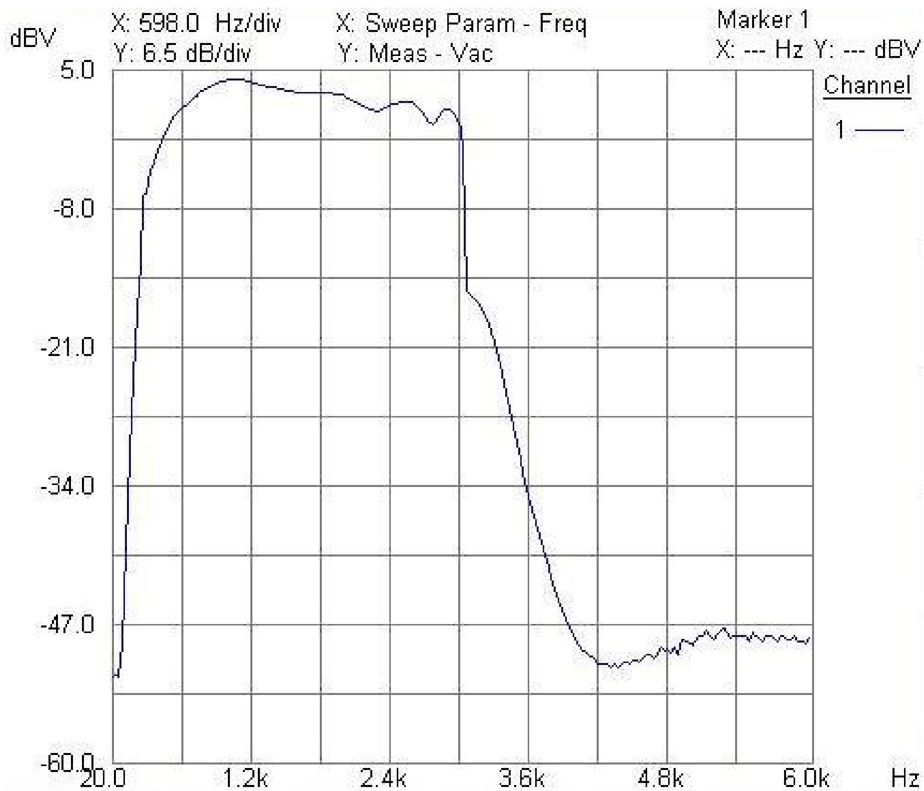
A Tektronix TDS3012C oscilloscope was used to verify the proper RF Power at the transmitter's output terminals terminated into a 50 Ohm Non Inductive dummy load. Power was calculated using the formula Watts = $(Vpp/(2 \cdot \sqrt{2}))^2 / 50$. The system's operating frequency was 320 KHz.

Description of below chart column headers:
Watts = Calculated output power at 50 Ohm non inductive load
Vpp = Peak to Peak Voltage read across an external 50 Ohm non inductive load

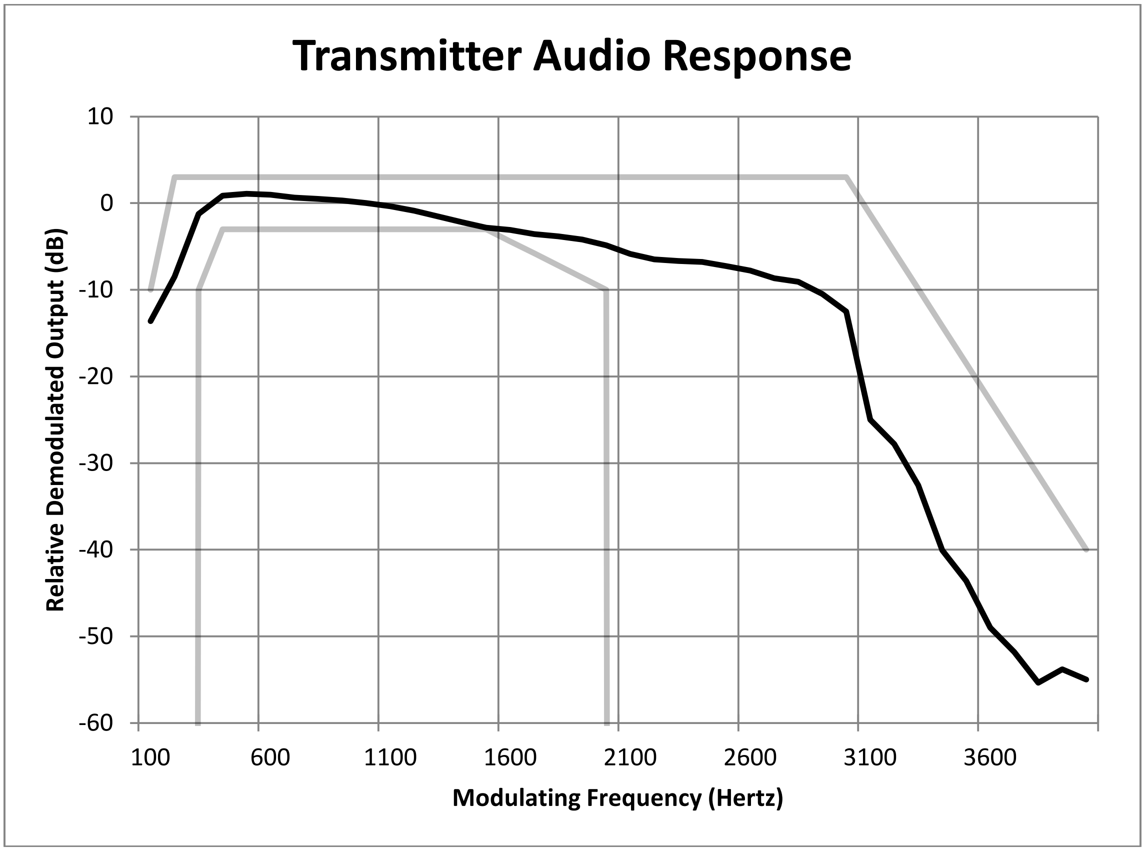
Transmitter Power Meter Reading	Voltage Across 50 Ohm Load (Vpp)	Calculated Power (Watts)
10	63	9.92
15	77	14.82
20	89	19.80
25	100	25.00
50	142	50.41
75	173	74.82
100	200	100.00
125	224	125.44
150	244	148.8
175	266	176.9
200	282	198.8
225	300	225.0
250	315	248.1

47CFR2.1047 Measurements required: Modulation characteristics.

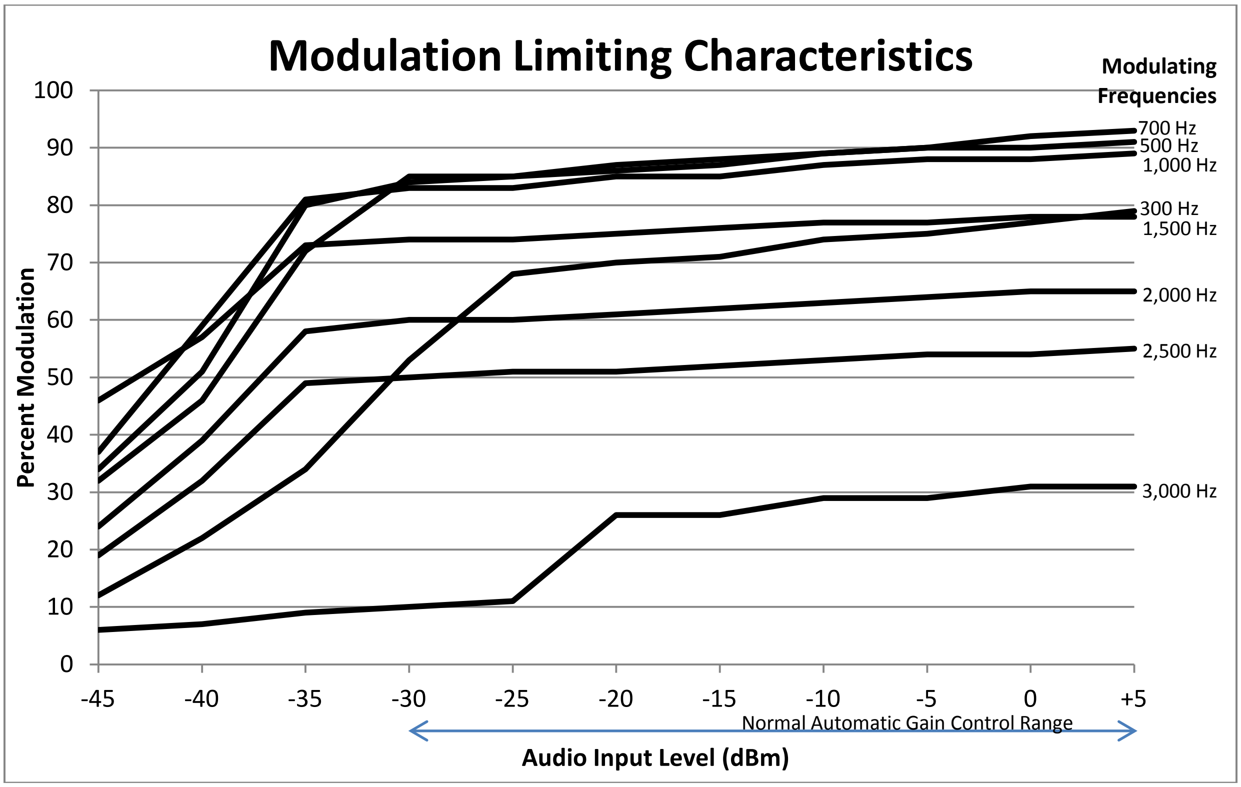
(a) An Agilent U8903A Audio Analyzer was connected to the input of the pulse width modulator on the TX1 board. The tracking generator output was connected to the audio input terminals. The system was setup per the manual and the frequency was swept from 0 to 6000 Hz. The below image shows the output response.



The below image shows the response of the audio band-pass filter.

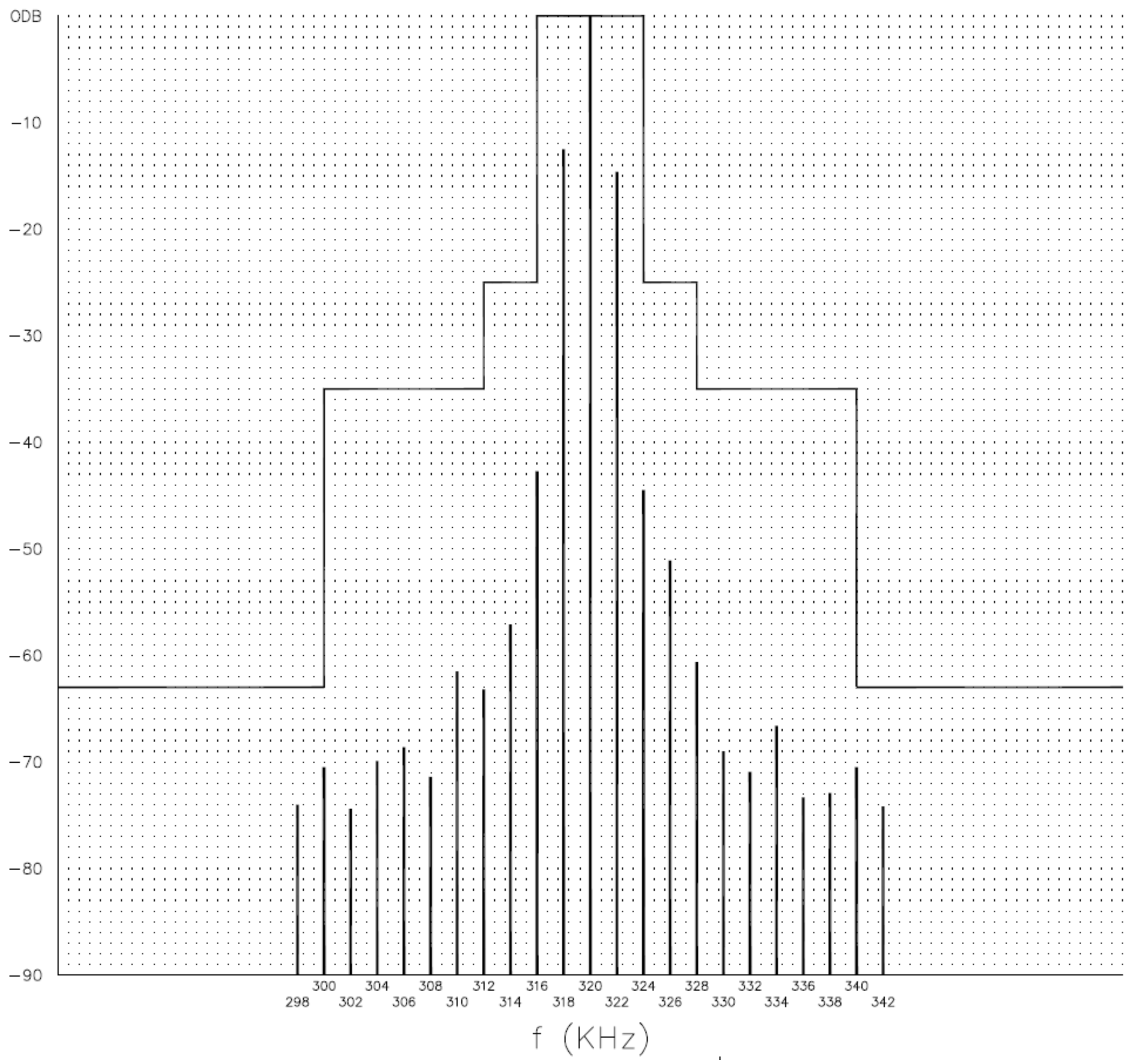


(b) A typical transmitter was set up for 250 Watts into a 50 Ohm dummy load. The voice circuitry was adjusted for an 85% modulated signal at 1,000 Hz with an input level of -17 dBm. The frequency was adjusted from 300 Hz to 3000 Hz while adjusting the audio input level from –45dBm to +5dBm. The "Modulation Limiting Characteristics" graph below shows the modulating limiting capability of the Automatic Gain Control circuit. The roll off in percent modulation at the different frequencies is due to the in line band-pass filter.



47CFR2.1049 Measurements required: Occupied bandwidth.

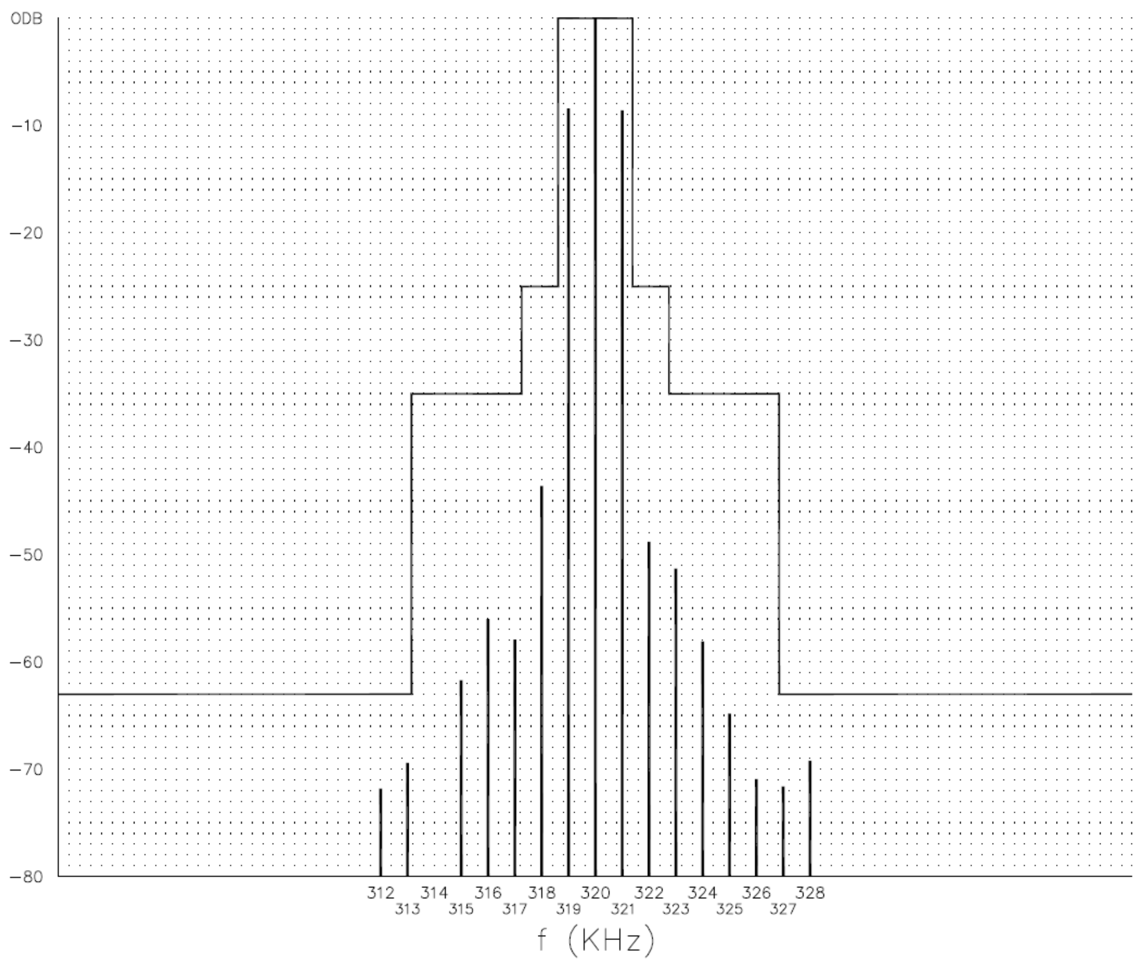
A3E emission - The transmitter was set to 250 Watts into a 50 Ohm non inductive dummy load. The system was adjusted for 50% modulation with an input of (-17dBm) 2500Hz using a Wavetek 136 Signal Generator, verifying the frequency with a HP5335A Universal Counter. The input was increased by 16 dBm with the Automatic Gain Control (AGC) circuit adjusted to limit at 95% modulation. The measurements for the spectrum shown below were made using an HP8591E Spectrum Analyzer.



NOTES: 1. THIS DWG NO. SD733002 REV. 1.
2. TITLE: TYPE CERTIFICATION SE250 OCCUPIED BANDWIDTH (250 WATTS) A3E DIAGRAM.

47CFR2.1049 Measurements required: Occupied bandwidth.

A2A emission - The transmitter was set to 250 Watts into a 50 Ohm dummy load. The system was adjusted for 95% modulation with an internally produced identifier tone of 1020 Hz. The measurements for the spectrum shown below were made using an HP8591E Spectrum Analyzer.

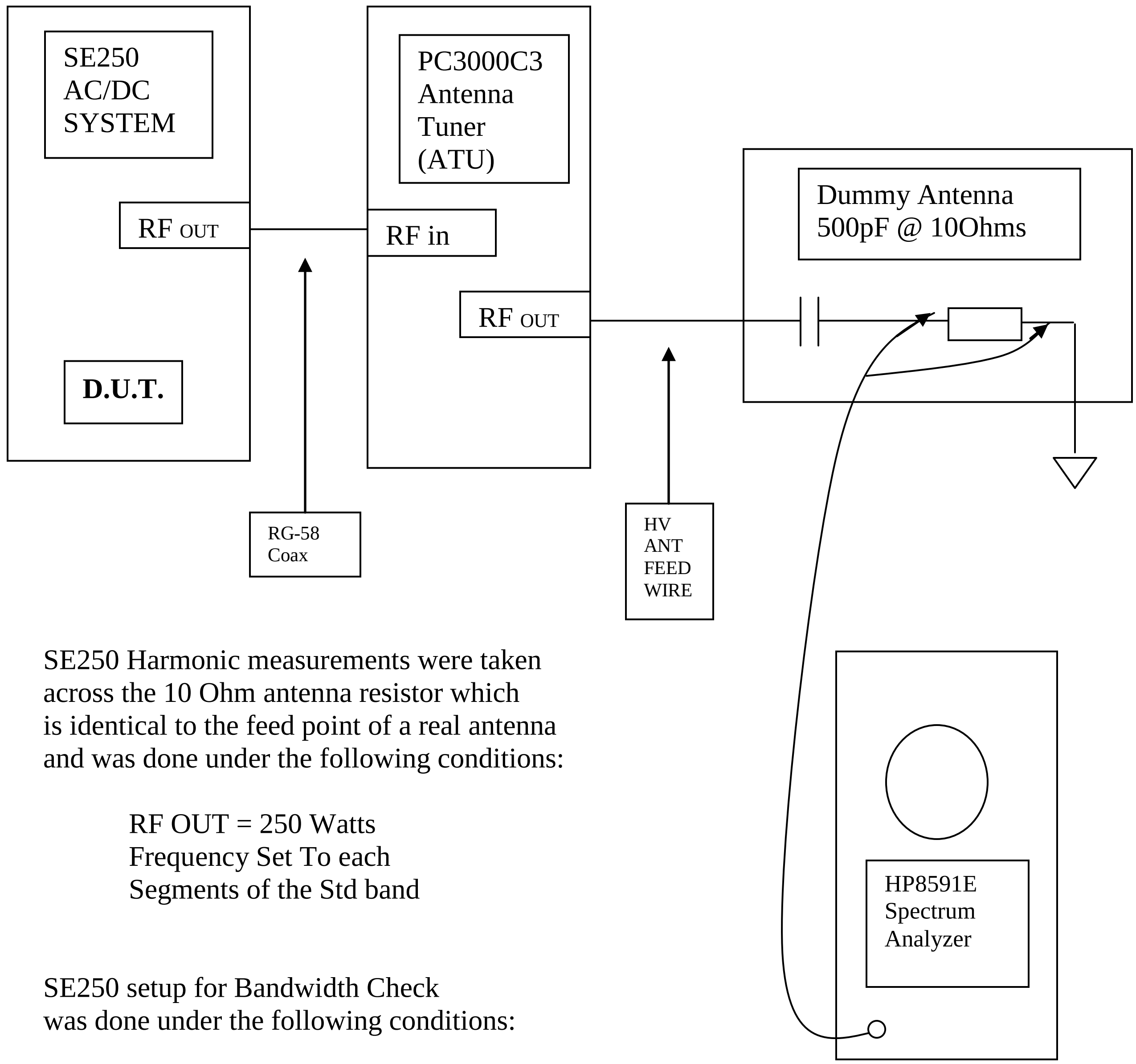


NOTES: 1. THIS DWG NO. SD733003 REV. 1.
2. TITLE: TYPE CERTIFICATION SE250 OCCUPIED BANDWIDTH (250 WATTS) A2A DIAGRAM.

TEST RATIONALE

Occupied bandwidth was tested and documented in the Standard Band. This is because internal transmitter operation (specifically the modulator section) is virtually identical across all its bands. The only difference between the Standard, M and H bands is the final RF filter section. However, this section has no effect on occupied bandwidth, since they are virtually flat with no more than 1dB loss from 100 kHz to the top end of the band it is strapped for. For this reason testing at different RF frequencies was deemed redundant and unnecessary. A cursory test bore this assumption out.

Spurious Harmonics and Occupied Bandwidth Test Set-Up



SE250 Harmonic measurements were taken across the 10 Ohm antenna resistor which is identical to the feed point of a real antenna and was done under the following conditions:

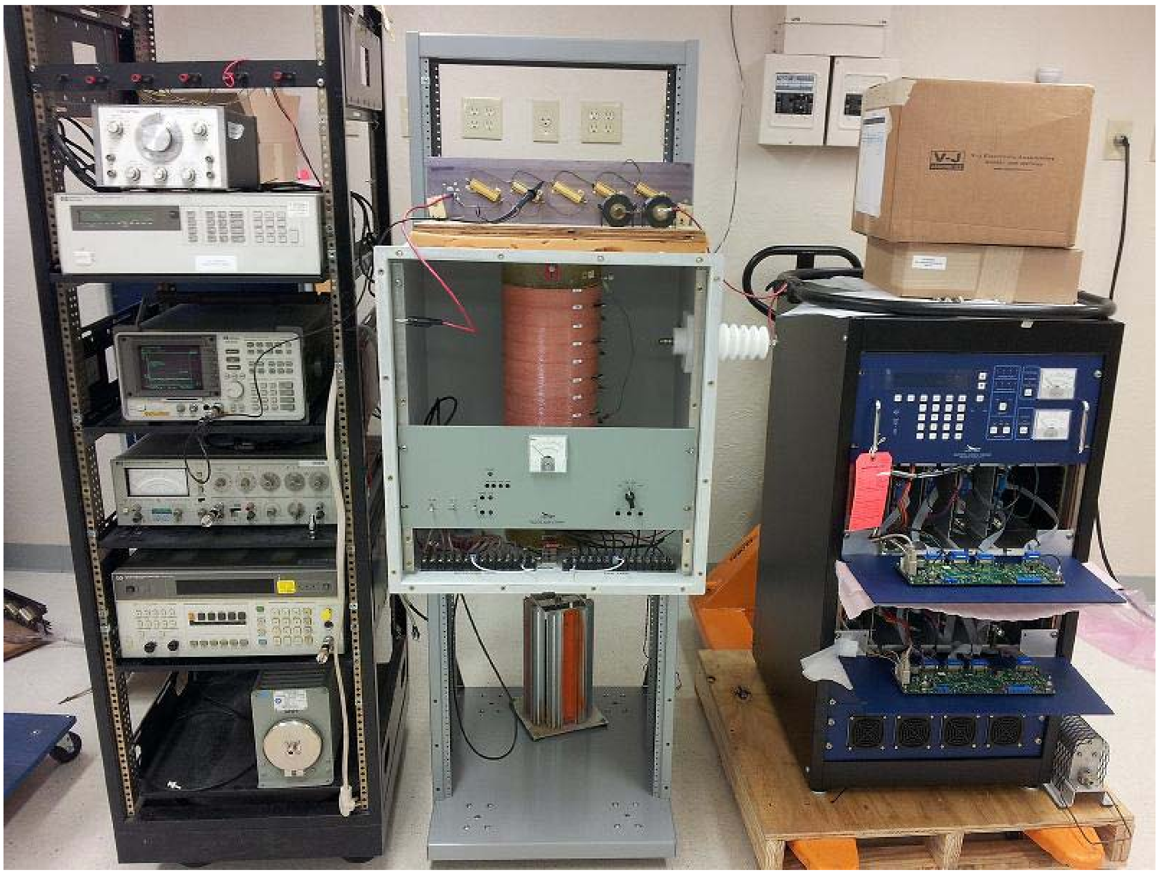
RF OUT = 250 Watts
Frequency Set To each
Segments of the Std band

SE250 setup for Bandwidth Check was done under the following conditions:

RF OUT = 250 Watts
Frequency Set To 320kHz

Image of equipment under test

Front view showing the Transmitter, ATU, Spectrum analyzer, and Antenna Simulator on top of ATU. Spectrum Analyzer is attached across dummy antenna 10 Ohm resistor. White Insulator is the antenna feed-point which is connected to the Dummy Antenna.



47CFR2.1051 Measurements required: Spurious emissions at antenna terminals.

The transmitter was connected to a dummy antenna through the PC-3000C3 antenna tuning unit. The dummy antenna was 10 Ohms in series with 500 pF. The equipment was operated at 250 Watts in each of the STD band filter segments. The spectrum was observed for each case with an HP8591E Spectrum Analyzer. Results are tabulated below. All spurious emissions are dB relative to carrier.
Measurements made 11JUN2013.

Frequency (KHz)	2 x Freq	3 x Freq	4 x Freq	5 x Freq	All Other Frequencies
190	-67.2	-71.4	< -75	< -75	< -75
200	-73.5	-73.7	< -75	< -75	< -75
210	-72.6	-73.1	< -75	< -75	< -75
220	-72.5	-73.1	< -75	< -75	< -75
230	-72.3	-72.6	< -75	< -75	< -75
240	-72.7	-74.2	< -75	< -75	< -75
250	-73.6	-74.1	< -75	< -75	< -75
260	< -75	< -75	< -75	< -75	< -75
270	-74.8	-74.8	< -75	< -75	< -75
280	< -75	< -75	< -75	< -75	< -75
290	< -75	< -75	< -75	< -75	< -75
300	< -75	< -75	< -75	< -75	< -75
310	< -75	< -75	< -75	< -75	< -75
320	< -75	< -75	< -75	< -75	< -75
330	< -75	< -75	< -75	< -75	< -75
340	< -75	< -75	< -75	< -75	< -75
350	< -75	< -75	< -75	< -75	< -75
360	< -75	< -75	< -75	< -75	< -75
370	< -75	< -75	< -75	< -75	< -75
380	< -75	< -75	< -75	< -75	< -75
390	< -75	< -75	< -75	< -75	< -75
400	-73.6	-67.4	< -75	< -75	< -75
410	-69.3	-67.1	-74.8	< -75	< -75
420	-67.9	-69.2	-74.6	< -75	< -75
430	-67.8	-68.1	< -75	< -75	< -75
440	-68.3	-72.7	< -75	< -75	< -75
450	-68.6	-70.6	< -75	< -75	< -75
460	-69.1	-71.1	< -75	< -75	< -75
470	-69.7	-70.8	< -75	< -75	< -75
480	-69.5	-71.9	< -75	< -75	< -75
490	-70.0	-72.3	< -75	< -75	< -75
500	-70.2	-72.1	< -75	< -75	< -75
510	-67.2	< -75	< -75	< -75	< -75
520	-67.7	< -75	< -75	< -75	< -75
530	-68.1	< -75	< -75	< -75	< -75
535	-67.5	< -75	< -75	< -75	< -75

TEST RATIONALE

Harmonic testing was performed at the antenna input terminal for the full range of each band segment requiring a different passive filter module. These filter modules almost exclusively determine the final harmonic and spurious signal content and therefore the system needed to be tested in each major band segment involving a different filter.

The test was done at maximum normal transmitter output of 250 Watts. The SE Series is designed to operate smoothly and continuously from 10 to 250 Watts. Therefore harmonic testing was accomplished at maximum power output where worst case stress on the final Power Amplifier FETs and subsequent filter components occurs and maximum harmonic and spurious energy content exists.

47CFR2.1053 Measurements required: Field strength of spurious radiation

Testing was done for compliance of Article 3.1(b) of European Community Council Directive. Testing showed conformance to emission requirements of EN 61000-6-4, with radiated emissions test CISPR 16-2-3 Edition 3.0:2010

Testing was done by RETLIF Laboratories, Test Report R-1743P-2.

Relevant information regarding these emissions tests, including a certificate of compliance, is shown in an excerpt from the test document below. The full report is available upon request.

CERTIFICATE OF CONFORMANCE
EUROPEAN COMMUNITY
COUNCIL DIRECTIVE 1999/5/EC
Article 3.1(b)

Date of Issue:	January, 2012
Issued By:	Retlif Testing Laboratories 3131 Detwiler Road Harleysville, PA 19438
Issued To:	Southern Avionics Company 5055 Belmont Street Beaumont, TX 77707
Reference:	Retlif Report Number R-1743P-2, Rev. A

Retlif Testing Laboratories hereby acknowledges that compliance testing in accordance with the below listed standards was performed on a representative sample of the equipment listed below. Retlif Testing Laboratories further acknowledges that the test sample listed below was found to be in compliance with these standards.
This certificate is hereby issued to the above named grantee and is valid only for the equipment identified below.

Manufacturer:	Southern Avionics Company 5055 Belmont Street Beaumont, TX 77707
Equipment Tested:	Non-Directional Beacon AM Transmitter
Model Number:	SE250
Serial Number:	33030XX0D0001
Brand Name:	Southern Avionics
Product Type:	Maritime Navigation and Radio-communication Equipment and Systems

Notes:

1) See attached report R-1743P-2, Rev. A for details and/or conditions pertaining to this certificate.
2) Conforms to the emissions requirements of EN 60945: 2002:

CISPR 16-1: 1999	Conducted Emissions
CISPR 16-1: 1999	Radiated Emissions

3) Conforms to the immunity requirements of EN 60945: 2002:

IEC 61000-4-2:1995	Electrostatic Discharge
IEC 61000-4-3:1995	Radiated Disturbance
IEC 61000-4-4:1995	Fast Transients (Bursts), Power and I/O Leads
IEC 61000-4-5:1995	Slow Transients (Surge), Power Leads
IEC 61000-4-6:1996	Conducted Radio Frequency Disturbance, Power Leads
IEC 61000-4-11:1994	Power Supply Short Term Variation
IEC 61000-4-11:1994	Power Supply Failure

4.0 General Requirements

4.1 Test Environment

All testing was performed at the Retlif Testing Laboratories Harleysville, Pennsylvania facility. Each test method was performed in the environment specified within the test standard. Where the test environment deviated from that specified, it is noted in the applicable test method.

4.1.1 Shielded Enclosures

All testing which required the use of a shielded enclosure was performed in a solid steel, double wall, modular type. The attenuation characteristics of the enclosure were in accordance with IEEE-Std-299. All input power lines to the enclosure were filtered utilizing filters manufactured in accordance with MIL-PRF-15733H and tested in accordance with MIL-STD-220B. The walls of the enclosure were treated with a combination of carbon impregnated foam and ferrite tile. For IEC 61000-4-3, the floor between the EUT and test antenna was treated with ferrite tile. The enclosure met the field uniformity requirements contained therein.

4.1.2 Conducted Emissions

All conducted emissions testing described herein was performed on a conducting ground plane. The conducting ground plane for measuring AC power line conducted emissions consisted of a floor-earth grounded conducting surface. The conducting surface was a minimum of 2.0 meters x 2.0 meters in size and extended at least 0.5 meters beyond the vertical projection (footprint) of the EUT. The ground plane was covered by insulating material 10 millimeters thick.

4.1.3 Radiated Emissions

4.1.3.1 Preliminary

Preliminary radiated emissions measurements were performed in a shielded enclosure.

4.1.3.2 Formal

Formal radiated emissions testing was performed on an OATS. The test site was covered with a conducting ground plane. The equipment under test was placed in an RF transparent enclosure, on top of an 80 cm high non-metallic table which was mounted to the flush mounted, metallic turntable. The test site met the test site attenuation requirements specified in CISPR 11 throughout the frequency range of test.

4.2 Test Instrumentation

A listing of all test instrumentation utilized is contained within each applicable test method. These listings indicate the model, manufacturer, frequency range, last calibration date and calibration due date of all instrumentation utilized. All instrumentation utilized was calibrated prior to use in accordance with the procedures set forth in Retlif Testing Laboratories standard manuals RCM-001 and RQM-001 which are in accordance with the requirements of ANSI/NCSL Z-540.1.

4.2.1 Measurement Uncertainty

In accordance with ISO/IEC 17025, Retlif Testing Laboratories has produced an estimate of the uncertainty of its measurements using accepted methods of analysis, through the production and application of suitable uncertainty of measurement procedures. For emissions testing, measurement uncertainty has been calculated in order to provide a confidence level of 95% (K=2.0). For immunity/susceptibility testing, measurement uncertainty has been calculated to provide a minimum confidence level of 90% (K=1.64). The results of these calculations are shown in the table below:

Table 2 - Measurement Uncertainty

Test Method	Confidence Level	Probability Distribution	K	Expanded Uncertainty
Conducted Emissions	95 %	Normal	2.00	3.72 dB
Radiated Emissions	95 %	Normal	2.00	6.10 dB
Radiated Immunity	90 %	Normal	1.64	1.80 dB
Conducted Immunity	95 %	Normal	2.00	2.21 dB

For Electrostatic Discharge (ESD), Electrical Fast Transient/Burst (EFT/B) and Surge immunity testing, the test methods specify the limits to the values of the major sources of uncertainty of measurement. The test equipment utilized to perform these tests has been determined to meet the requirements of the relevant standards and the results have been reported in accordance with the relevant standards. Therefore, the requirements for measurement uncertainty are deemed to have been satisfied.

4.3 Detector Function

For the conducted emissions testing described herein Peak, Quasi-Peak and Average detector functions in accordance with CISPR 16 were utilized.

For the radiated emissions testing described herein a Quasi-Peak detector function in accordance with CISPR 16 was utilized.

5.0 Description of Equipment Under Test

5.1 EUT Description

The SE series Non-Directional Beacon (NDB) takes advantage of the Renesas M16C/29 microprocessor. There are three of these powerful processors operating within the SE Transmitter. This form of distributed processing allows each processor to operate within a specialized domain.

These processors communicate with each other via an I^2C bus. This highly efficient bus handles all critical communications between the processors and other critical elements of the transmitter. One of the M16C/29 processors is located on the Master Controller printed circuit board (PCB) and is the heart of the system, generally controlling all system operations either directly or via the I^2C bus. Each transmitter has a M16C/29 to communicate with the various parts of the transmitter with an analog and digital input/output (I/O) multiplexing interface.

The following are all controlled by embedded firmware: Direct Digital Synthesis (DDS) of RF frequency and AF tone frequency, Identifier Morse code dot, dash and space intervals, customer IDENT sequence, standard alarms, any additional fault handling based on multipoint voltage, current, transfer criteria and power and modulation limiting.

The frequency of operation, RF output power and modulation percentage of the system's RF signal is dictated by the Master Controller section to the transmitter controller via the I^2C bus. The RF signal from the Transmitter Controller is routed to the RF section which consists of the RF Power Controller/Modulator, RF Power Amplifier and Filter Bridge PCB's. The base signal is amplified and filtered in the RF section, then sent to the antenna coupler, and ultimately to the antenna for broadcast. Additionally, various operational information is relayed between the two sections.

Control and monitoring operations are communicated via Ethernet protocol.

5.1.1 Designations

Table 3 details the equipment nomenclature, Part Number, Model Number and Serial Number, where applicable, of all EUT system components, if applicable.

Table 3 - EUT Designations

Description	Manufacturer	Model Number	Serial Number
EUT	Southern Avionics Company	SE250	33030XX0D0001

5.1.2 Physical Characteristics

Table 4 details the physical characteristics of all EUT components, if applicable.

Table 4 - Physical Characteristics

Description	Depth (cm)	Width (cm)	Height (cm)	Weight (kg)
EUT	64.0	55.0	105.0	71.37

5.2 Electrical Characteristics

5.2.1 Power Input

Table 5 details the electrical power requirements of all EUT components:

Table 5 - Power Input

Description	Input Voltage	Frequency	Current	Phase
EUT	230 VAC	50 Hz	2 Amps	Single

5.2.2 Highest Clock Frequency

The highest clock frequency generated or used by the EUT was 32 MHz.

5.3 EUT Configuration

For all test methods, the EUT was configured as shown in the General Test Setup drawing, Figure 1.

5.3.1 Power Leads and Interconnecting Cables

All power and interconnecting cables, including cable length, routing and type were as specified in Table 6:

Table 6 - EUT Interconnecting Cable Configurations

Connector Designation	EUT Port	Cable Length (Meters)	Signal Description	Cable Description	Routed To
EUT	RF Output	2.3	RF	Shielded / Coaxial RG58	50 Ω Load
EUT	Ground Stud	2.0	Ground	Unshielded / Braid	Room Ground
EUT	AC Power	1.75	230 VAC, 50 Hz Input	Unshielded / 14 AWG, 3 Wire Twisted (MFG: Alpha, 1942/3F BK003)	AC Mains
EUT	Ethernet	5.85	Ethernet Communications	Unshielded / CAT5E	Laptop
ATU Cable	ATU Control / Option Strip	2.0	Analog	Shielded / 8 Conductor (Beldon 9613)	Unterminated

5.4 Modifications

The following modifications were made to the EUT during the course of this testing program in order to demonstrate compliance with the specified requirements:

5.4.1 CISPR 16-1, Conducted Emissions

October 27, 2011

- Installed one 10 uf 440V capacitor, Manufactured By: GE, Part Number: 97F53005, between the Hot and Neutral leads on the output of the Corcom line filter.

November 9, 2011

Due to the following modifications to the hardware during the course of Safety testing, the customer requested Conducted Emissions and Fast Transients be retested:

Removed two 4.7uf 275V capacitors:

- One capacitor from between the Hot and Ground leads on the line power input port.
- One capacitor from between the Neutral and Ground leads on the line power input port.

5.4.2 CISPR 16-1, Radiated Emissions

October 28, 2011

- Removed the paint from the back of the front and rear panels in order to make a better ground connection to the chassis.
- Added EMI gasket material, Manufacturer: Intermark, Part Number: NLCG-050100, to the entire length of the (vertical) right and left front panel mounting rails.

5.5 Mode of Operation

During the performance of all testing specified herein, the EUT was operated as follows:

System:

- Operated at an RF frequency of 320 kHz
- Transmitted RF power, SE250 at 155 watts
- RF modulated at 0% modulation
- Ethernet was connected to a laptop monitoring all transmitter parameters
- PA voltmeter read 44 volts
- TX1 indicator ON
- TX2 indicator OFF
- Select TX1 indicator ON
- Select TX2 indicator OFF
- Monitor PRI indicator ON
- FWD PWR indicator ON
- PA volts indicator ON
- All other indicators OFF

Mode of Operation (con't)

System Display:

- SE series (Dual)
- Fault None
- RF frequency 320000 Hz
- Tone frequency setting 1020 Hz
- Call sign: SAC
- TX mode: CARR

The EUT was running the following installed software:

Master Controller:

- SLG33003 Keyboard Encoder Programmable IC code
- SLG33004 Master Microcontroller Program
- SLG33005 Ethernet Server Program

Transmitter Controller:

- SLG33000 TX Microcontroller Program
- SLG33001 Frequency Counter Programmable IC Code
- SLG33002 Power and Modulation Monitor Programmable IC Code

Laptop:
Running Windows XP, using Google to view "Netburner" generated EUT info screen

5.5.1 Support Equipment
All equipment that was utilized to achieve the EUT operating state specified in paragraph 5.5 is listed in Table 7:

Table 7 - Support Equipment

Description	Manufacturer	Model Number	Serial Number
RF Load	Bird	8325	5079

5.6 Susceptibility Criteria

The following were considered indications of EUT susceptibility:

- Any change greater than +/- 100 Hz of the operating frequency
- If transmitter changes from ON to OFF
- If preset modulation changes
- If TX1 indicator turns OFF
- If TX2 indicator turns ON
- If Select TX1 indicator turns OFF
- If Select TX2 indicator turns ON
- If Monitor PRI indicator turns OFF
- If FWD PWR indicator turns OFF
- If PA volts indicator turns OFF
- If all other indicators turn ON

The following performance criteria, as outlined in EN 60945, were used to determine compliance with the requirements:

IEC 61000-4-2	- Performance Criteria B
IEC 61000-4-3	- Performance Criteria A
IEC 61000-4-4	- Performance Criteria B
IEC 61000-4-5	- Performance Criteria B
IEC 61000-4-6	- Performance Criteria A
IEC 61000-4-11	- Performance Criteria B and C

Performance Criteria A: The apparatus shall continue to operate as intended. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended. In some cases the performance level may be replaced by a permissible loss of performance. If the minimum performance level or the permissible performance loss is not specified by the manufacturer then either of these may be derived from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.

Performance Criteria B: The apparatus shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended. In some cases the performance level may be replaced by a permissible loss of performance. During the test, degradation of performance is however allowed. No change of actual operating state or stored data is allowed. If the minimum performance level or the permissible performance loss is not specified by the manufacturer then either of these may be derived from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.

Performance Criteria C: Temporary loss of function is allowed, provided the function is self recoverable or can be restored by the operation of the controls.

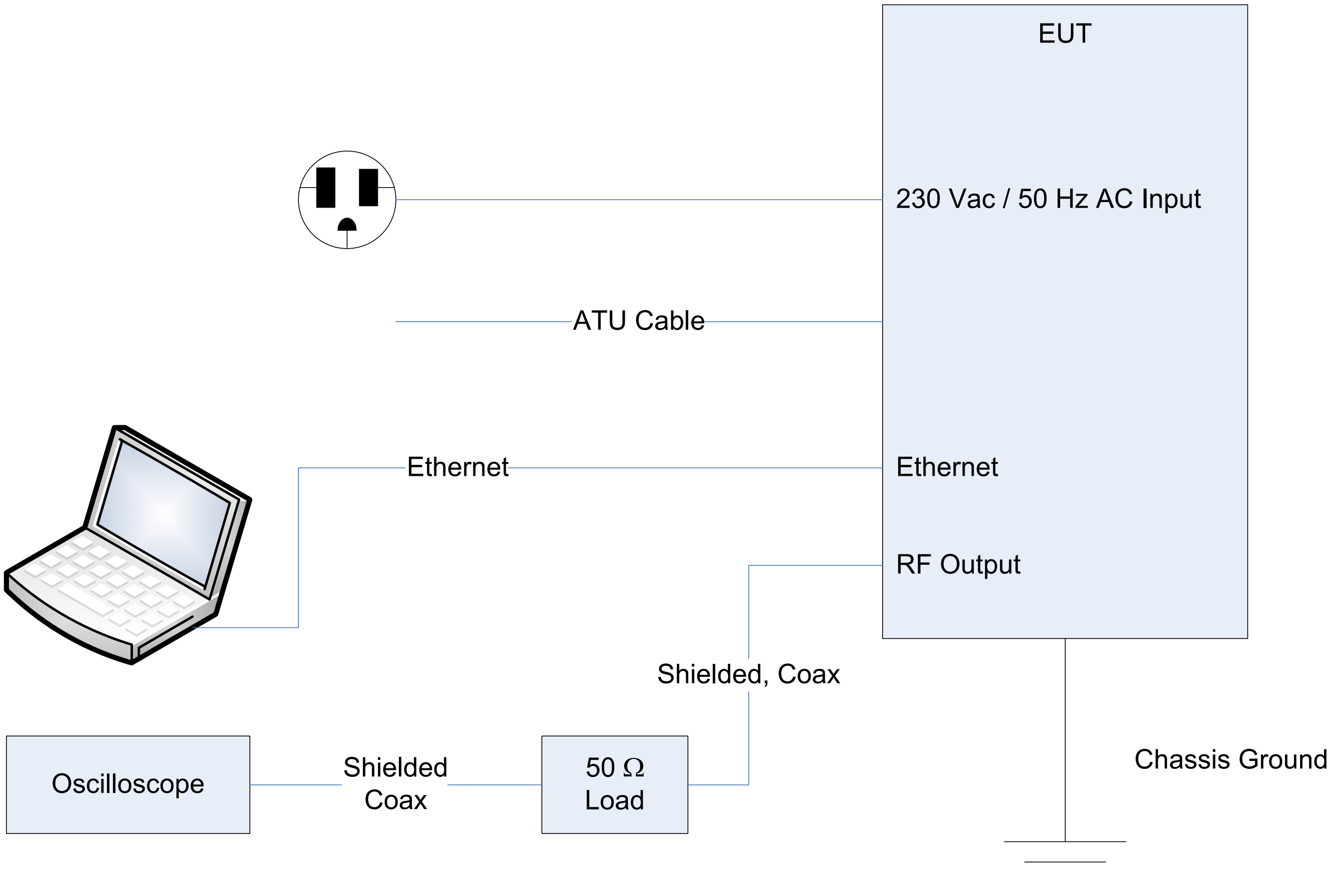
5.6.1 Monitoring Equipment

All equipment that was utilized to monitor the EUT for indications of degradation or malfunction (susceptibility), as detailed in paragraph 5.6, is listed in Table 8:

Table 8 - Monitoring Equipment

Description	Manufacturer	Model Number	Serial Number
Oscilloscope	Tektronix	TAS250	TW10318

Figure 1 - General Test Setup



6.0 Test Methods Performed and Test Results

The following test methods were performed on the Non-Directional Beacon AM Transmitter. All testing documented herein was performed in the sequence shown in Table 9:

Table 9 - Test Sequence and Results

Testing Dates	Para.	Test Method	Results
October 24-25, 2011	6.4	IEC 61000-4-3, Radiated Disturbance	Complied
October 26, 2011	6.1	CISPR 16-1, Conducted Emissions	Did Not Comply
October 26, 2011	6.2	CISPR 16-1, Radiated Emissions	Did Not Comply
October 27, 2011	See Paragraph 5.4.1 herein for a detailed description of the modifications performed prior to the continuation of testing.		
October 27, 2011	6.1	Continue testing - CISPR 16-1, Conducted Emissions	Complied
October 27, 2011	6.5	IEC 61000-4-4, Fast Transients (Burst), Power Leads	Complied
October 27, 2011	6.6	IEC 61000-4-4, Fast Transients (Burst), I/O Leads	Complied
October 27, 2011	6.8	IEC 61000-4-6, Conducted Radio Frequency Disturbance, Power Leads	Complied
October 27, 2011	6.3	IEC 61000-4-2, Electrostatic Discharge	Complied
October 27, 2011	6.10	IEC 61000-4-11, Power Supply Failure	Complied
October 28, 2011	6.9	Power Supply Short Term Variations	Complied
October 28, 2011	See Paragraph 5.4.2 herein for a detailed description of the modifications performed.		
October 28-31, 2011	6.2	Retest - CISPR 16-1, Radiated Emissions	Complied
October 29, 2011	6.7	IEC 61000-4-5, Slow Transients (Surge), Power Leads	Complied
November 9, 2011	See Paragraph 5.4.2 herein for a detailed description of the modifications performed.		
November 9-10, 2011	6.1	Retest - CISPR 16-1, Conducted Emissions	Complied
November 10, 2011	6.5	Retest - IEC 61000-4-4, Fast Transients (Burst), Power Leads	Complied

See individual test methods contained in paragraphs 6.1 through 6.10 of this test report for a full description of the test procedures utilized and the results obtained.

6.2 Section 9.3, Radiated Emissions, 150 kHz to 2 GHz

6.2.1 Normative References
CISPR 16-1: 1999

6.2.2 Purpose
The purpose of this test was to measure and signals radiated by the EUT other than through an antenna which can potentially disturb other equipment on the ship, such as radio receivers.

6.2.3 Test Limits
The limits shown in Table 11 were used to determine compliance of the EUT to the radiated emissions requirements of EN 60945.

Table 11 - Radiated Emissions, Test Limits

Frequency Range	Quasi-Peak Limit [dBμV/M], at 3.0 Meters	Measuring Receiver Bandwidth
150 kHz to 300 kHz	80.0 to 52.0	9 kHz
300 kHz to 30 MHz	52.0 to 34.0	9 kHz
30 MHz to 2 GHz	54.0	120 kHz
156 MHz to 165 MHz	24.0 (30.0 Peak)	9 kHz

6.2.4 Test Setup
The EUT and associated cabling, configured as detailed in paragraph 5.0 herein, was placed on a 0.8 m non-conductive test stand on the flush mounted turntable, in its normal plane of operation. The turntable positions were relative to the EUT as follows:

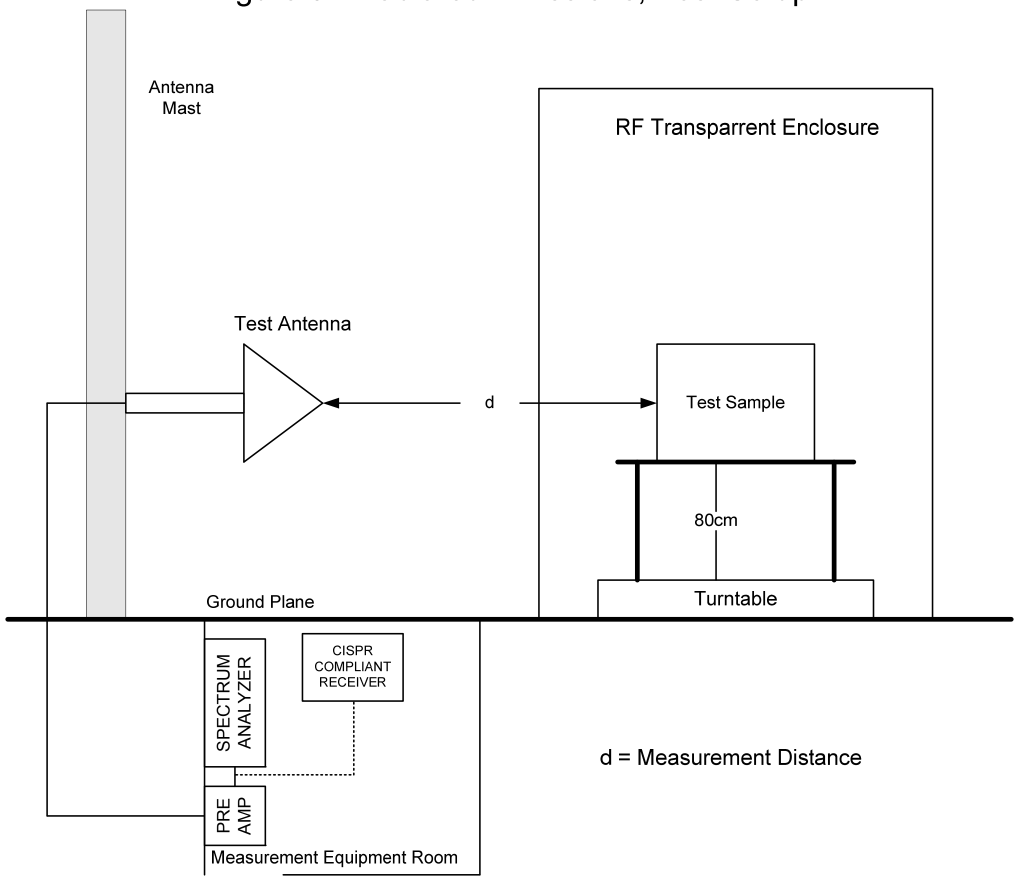
When facing the EUT the front is at 0^o, the rear is at 180^o and the left side is at 270^o. The test stand was situated such that the nearest part of the boundary of the EUT was located 3.0 m from the measuring antenna.

The power cables were routed to the power mains outlet located on top of the turntable. Excess power cable length was left on the surface of the turntable. Earth connections, where required for safety purposes, were connected to a ground reference point on the turntable. Where not otherwise provided or specified by the manufacturer, they were 1.0 m long and run parallel to the mains connection at a distance of not more than 0.1 m.

The power and signal cables were oriented in relation to the ground plane in a manner equivalent to actual use. Excess length of interconnecting cables was bundled at the approximate center of the cable with bundles 30 to 40 cm in length, running in the horizontal plane from the port to which they were connected. Care was taken during testing to relocate all system components and cabling in an effort to maximize the emissions from the EUT.

Test Setup (con't.)
The antenna was connected via coaxial cable to a CISPR compliant receiver for final readings and to a broadband pre-amplifier, which in turn was connected to a spectrum analyzer in order to maximize emissions.

Figure 3 - Radiated Emissions, Test Setup



6.2.5 Test Equipment
The details of the test equipment utilized during the performance of this test method are shown below:

EN	Manufacturer	Description	Range	Model No.	Cal Date	Due Date
3207	EMCO	ACTIVE LOOP	10 KHZ - 30 MHZ	6502	6/9/2011	6/9/2012
8071	AGILENT / HP	SPECTRUM ANALYZER	100Hz-2.5 GHz/2-22GH	8566B	6/10/2011	6/10/2012
8072	AGILENT / HP	SPECTRUM ANALYZER DISPLAY		85662A	6/10/2011	6/10/2012
8079	ROHDE & SCHWARZ	EMI TEST RECEIVER		ESH3	6/9/2011	6/9/2012
8080	ROHDE & SCHWARZ	EMI TEST RECEIVER	20-1300 MHz	ESVP	7/18/2011	7/18/2012
8300C	UNKNOWN	3/10 METER CABLE	3/10 METER	3 METER CABLE	8/23/2011	8/23/2012
8411	SONOMA INSTRUMENT	PRE-AMPLIFIER	9 kHz - 1 GHz	310N	8/11/2011	8/11/2012
8433	ETS LINDGREN	BICONILOG	20 - 6000 MHz	3142D	8/31/2011	8/31/2012

6.2.6 Test Procedure

With the test instrumentation and the EUT configured as stated above, the following steps were performed:

1. The EUT was operated as detailed in paragraph 5.5 herein.
2. The spectrum analyzer was configured to display the frequency range of test.
3. With the test antenna both horizontally and vertically polarized, the EUT cabling was relocated in order to maximize the radiated emissions.
4. The operating mode of the EUT was varied in order to determine the operating mode which produced maximum radiated emissions with respect to the limit.
5. The EUT configuration which produced maximum radiated emissions with respect to the limit was maintained for the duration of testing.
6. The frequency of test was scanned to determine the frequency of all emissions from the EUT.
7. At each frequency upon which an emission was determined to be from the EUT the following steps were performed in order to further maximize the observed emissions:
    a. The test antenna height was
        i. At a fixed height of 1.5 m for frequencies between 150 kHz and 30 MHz.
        ii. Varied from 1.5 to 4.0 m for frequencies above 30 MHz.
    b. The test antenna polarization was varied from vertical to horizontal for frequencies above 30 MHz.
    c. The EUT was rotated 360° about its vertical axis.
8. The RF cable from the test antenna was connected to the CISPR compliant receiver.
9. For all emissions found to be within 20 dB of the specified limit, the following was recorded:
    a. Frequency of emission.
    b. Quasi-Peak detector receiver meter reading.
    c. Correction factor consisting of antenna factor and cable loss.
    d. Test antenna height and polarization where applicable.
    e. Turntable position.

6.2.7 Sample Calculations

Shown below is a sample showing calculations used, either manually or under software control, to derive the final corrected reading.

$R_C = M_R + C_{IL} + A_F$

Where:
R_C = Corrected Reading in dBµV/M
M_R = Meter Reading in dBµV
C_{IL} = Insertion Loss of Cable in dB
A_F = Antenna Factor in dB

Example:
M_R = 25.3 dBµV
C_{IL} = 3.6 dB
A_F = 12.4dB

R_C = 25.3 + 3.6 + 12.4
= 41.3 dBµV/M

6.2.8 Test Results

October 26, 2011

The EUT produced a single discrete emission above the specified limit at a frequency of 163.18 MHz in the Horizontal polarization. This emission was 37.4 dBµV/m, 13.4 dB above the limit of 24.0 dBuV/m.

October 28-31, 2011

After the modifications detailed in Paragraph 5.4.1 herein were performed, the EUT was retested and found to comply with requirements specified for this method. No emissions were observed which exceeded the CISPR 16-1 limits specified by EN 60945.

See the following photographs and test data for a full presentation of the test setup and results obtained.

Test Photographs
Radiated Emissions

Test Photographs
Radiated Emissions

Test Setup

Perpendicular, 150 kHz to 30 MHz

Test Photographs
Radiated Emissions

Parallel, 150 kHz to 30 MHz

Biconical, Horizontal, 30 MHz to 2 GHz

Test Photographs
Radiated Emissions

Biconical, Vertical, 30 MHz to 2 GHz

CISPR 16-1, Radiated Emissions
150 kHz to 2 GHz
Test Data

Test Method:	**CISPR 16-1, Radiated Emissions, 150 kHz to 2 GHz**		
Customer:	Southern Avionics Company	**Job No.**	R-1743P-2
Test Sample:	Non directional Beacon AM Transmitter		
Part Number:	N/A	**Serial No.**	33030XX0D0001
Model Number	SE250		
Operating Mode	Half RF power output at 320 KHz		
Test Specification	EN 60945; Maritime navigation and radio communication equipment and systems – General Requirements – Methods of testing an required test results		
Technician:	Brent Mortimer	**Date:**	10/28/11
Notes:	Test Distance: 3 Meters Detector: Quasi-Peak Temp: 15 ºC RH: 37 %		

Test Freq.	Antenna Orientation /Height	EUT Orientation	Meter Reading	Correction Factor	Corrected Reading	Limit
MHz	Meters	Degrees	dBuV	dB	dBuV/M	dBuV/M
.150						80
|						|
.300						52
|						|
**0.32	Parallel 1.0	0	63.6	10.2	73.82	51.75
**0.32	Perpendicular 1.0	200	68.1	10.2	78.32	51.75
|						|
19.98	Parallel 1.0	200	16.1	7.4	23.5	35.59
19.98	Perpendicular 1.0	140	19.9	7.4	27.38	35.59
|						|
21.66	Parallel 1.0	171	20.4	7.4	27.8	34.93
21.66	Perpendicular 1.0	214	14.7	7.4	22.1	34.93
|						|
23.67	Parallel 1.0	0	5.0	7.4	12.4	34.93
23.67	Perpendicular 1.0	360	3.4	7.4	10.8	34.93
|						|
26.23	Parallel 1.0	0	6.9	7.4	14.3	34.52
26.23	Perpendicular 1.0	185	10.3	7.4	17.7	34.52
|						|
30.00						34

NOTES: The frequency range was scanned from 150.0 kHz to 2 GHz. All emissions not recorded were more than 20dB below the specified limit.
**This is the fundamental operating frequency, it is exempt as per EN 60945 Section 9.3.1

Test Method:	**CISPR 16-1, Radiated Emissions, 150 kHz to 2 GHz**		
Customer:	Southern Avionics Company	**Job No.**	R-1743P-2
Test Sample:	Non directional Beacon AM Transmitter		
Part Number:	N/A	**Serial No.**	33030XX0D0001
Model Number	SE250		
Operating Mode	Half RF power output at 320 KHz		
Test Specification	EN 60945; Maritime navigation and radio communication equipment and systems – General Requirements – Methods of testing an required test results		
Technician:	Brent Mortimer	**Date:**	10/28/11

Notes: Test Distance: 3 Meters

Detector: Quasi-Peak Temp: 15 ºC RH: 37 %

Test Freq.	**Antenna Pol /Height**	**EUT Orientation**	**Meter Reading**	**Correction Factor**	**Corrected Reading**	**Limit**
MHz	(V/H) / Meters	Degrees	dBuV	dB	dBuV/M	dBuV/M
30.00						54
|						|
46.07	V / 1.0	180	27.0	11.7	38.74	|
46.07	H / 1.8	180	15.5	11.7	27.24	|
|						|
139.43	V / 1.0	320	16.3	10.1	26.4	|
139.43	H / 1.7	230	15.3	10.1	25.4	|
|						|
156.00						54
156.00						30
|						|
*163.18	V / 1.8	360	7.4	10.7	18.1	|
*163.18	H / 1.5	85	9.3	10.7	20.0	|
|						|
165.00						30
165.00						54
|						|
169.90	V / 2.0	360	15.1	11.3	26.4	|
169.90	H / 1.2	360	30.3	11.3	41.6	|
|						|
255.96	V / 1.6	360	27.3	16.0	43.3	|
255.96	H / 1.5	45	15.4	16.0	31.4	|
						|
287.97	V / 1.4	360	23.9	16.1	40.0	|
287.97	H / 2.0	360	24.9	16.1	41.0	|
						|
319.99	V / 1.1	360	22.4	17.2	39.6	|
319.99	H / 1.7	360	11.4	17.2	28.6	|
|						|
2000.00						54

NOTES: The frequency range was scanned from 150.0 kHz to 2 GHz. All emissions not recorded were more than 20dB below the specified limit.
*This is a peak measurement. The receiver bandwidth was 9kHz IAW EN 60945, Section 9.3.2, part b.

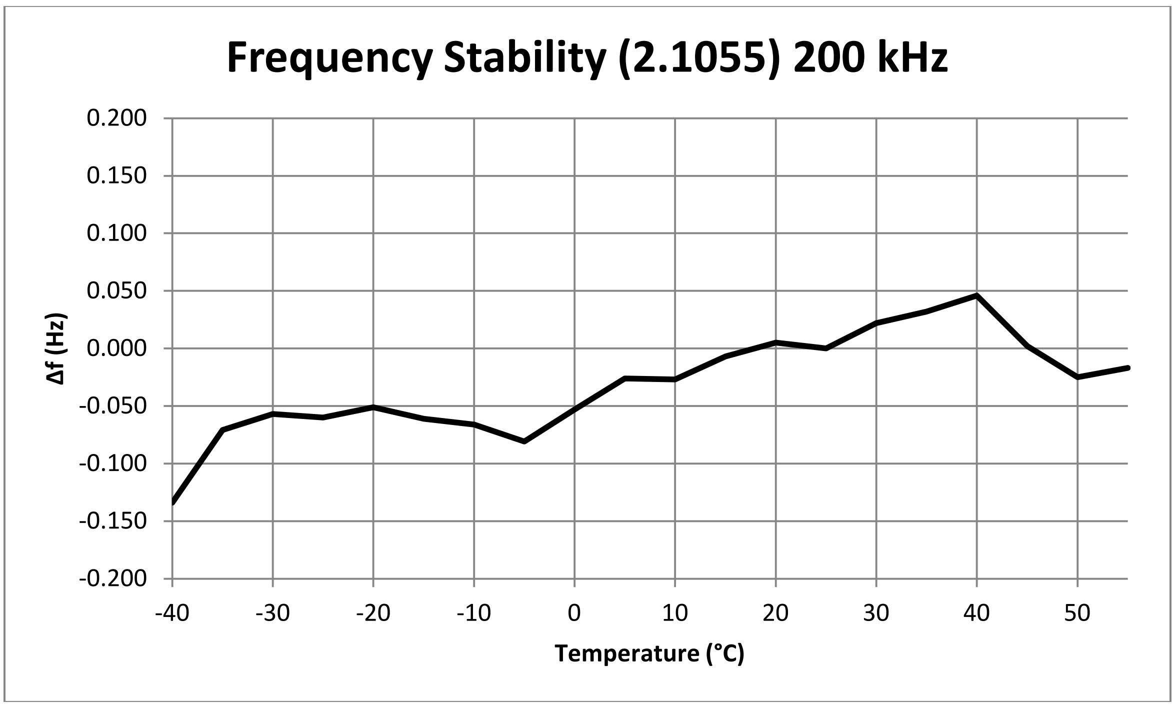
Page 2 of 2

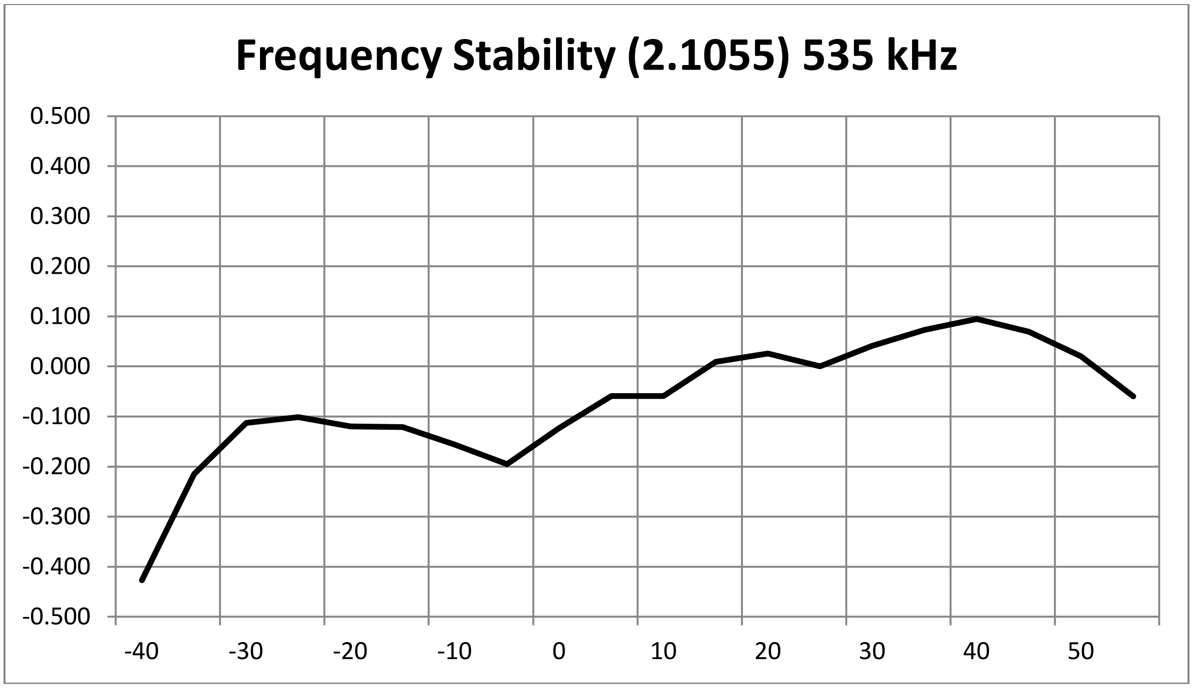
47CFR2.1055 Measurement required: Frequency stability.

a.) Frequency stability based on temperature fluctuations

Oscillator chip used is Suntsu STGJ527-32.000MHZ, SAC Part Number 1YD32001. The Manufacturers Specifications is listed in the datasheet on the next page.

All components related to frequency generation and control, including all transmitter drawer modules, and master control board, were placed inside a temperature chamber. Frequency was measured externally at the output using an HP5335A Universal Counter. Frequency was recorded for two separate tests, at 200kHz and 535kHz. Tests began at an ambient room temperature of 25°C. Frequency readings are in respect to the starting frequency, initially measured at room temperature.




Frequency Stability (2.1055) 535 kHz
0.500
0.400
0.300
0.200
0.100
0.000
-0.100
-0.200
-0.300
-0.400
-0.500
-40
-30
-20
-10
0
10
20
30
40
50

STG SERIES

14 PIN DIP TCXO

STG SERIES FEATURES

- AVAILABLE TO ±1.0ppm
- STANDARD FULL-SIZE PACKAGE
- HCMOS/TTL COMPATIBLE
- RoHS COMPLIANT
- 3.3±0.3V OR 5.0±0.5V

PART NUMBERING GUIDE

STG F 3 27 - 15.000MHz

FREQUENCY STABILITY
F: ±5.0ppm
G: ±2.5ppm
H: ±2.0ppm
I: ±1.5ppm
J: ±1.0ppm

SUPPLY VOLTAGE
3: 3.3±0.3 V
5: 5.0±0.5 V

OPERATING TEMPERATURE RANGE
BLANK: 0°C to + 70°C
16: -10°C to + 60°C
27: -20°C to + 70°C
37: -30°C to + 75°C
48: -40°C to + 85°C

FREQUENCY

*FOR CUSTOM PARAMETERS CONTACT YOUR SUNTSU REPRESENTATIVE.
CAGE CODE: 4GUT4

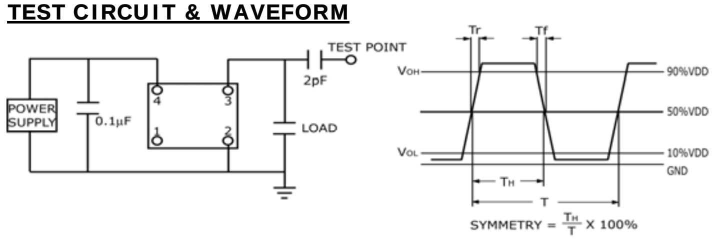
ELECTRICAL SPECIFICATIONS

FREQUENCY RANGE:	2.000MHz-150.000MHz
STABILITY (VS. AGING):	±1.0ppm/FIRST YEAR MAX
STABILITY (VS. VOLTAGE):	±0.5ppm MAX
FREQUENCY ADJUSTMENT (INTERNAL TRIMMER):	±3.0ppm MIN
STORAGE TEMPERATURE:	-55°C TO 125°C
HCMOS - 50% OF WAVEFORM	40%/60%
CURRENT CONSUMPTION:	
5.0V:	40mA MAX
3.3V:	30mA MAX
LOAD:	
CMOS:	15pF MAX
TTL:	2 TTL GATES
RISE/FALL TIME:	10nS MAX
PHASE NOISE (TYPICAL):	
10Hz OFFSET:	-70dBc/Hz
100Hz OFFSET:	-95dBc/Hz
1kHz OFFSET:	-110dBc/Hz
10kHz OFFSET:	-120dBc/Hz

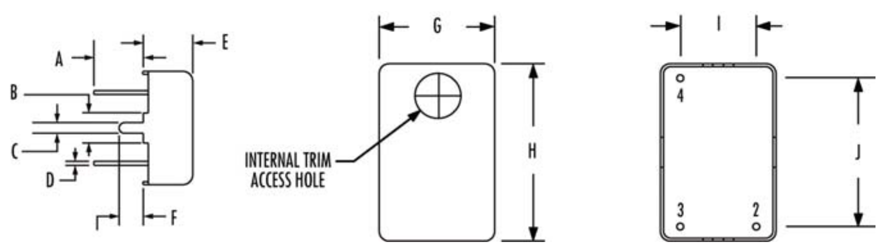
ENVIRONMENTAL & MECHANICAL SPECIFICATIONS

DROP TEST:	30cm ONTO 2mm STEEL PLATE (3 TIMES)
MECHANICAL SHOCK:	MIL-STD-883, METHOD 2002, CONDITION B
VIBRATION:	MIL-STD-883, METHOD 2007, CONDITION A

TEST CIRCUIT & WAVEFORM



PRODUCT SCHEMATIC



PIN	FUNCTION
1	NO PIN
2	CASE GROUND
3	OUTPUT
4	SUPPLY VOLTAGE
	DIMENSIONS
A	9.00 MAX
B	4.00±0.1
C	1.00±0.1
D	0.50
E	9.20 MAX
F	2.50±0.1
G	11.85
H	18.45
I	7.62
J	15.24

NOTE: DIMENSIONS IN MILLIMETERS (mm); DRAWING NOT TO SCALE

47CFR2.1055 Measurement required: Frequency stability.

c.) The transmitter was connected to a variable transformer (PowerStat 226U), to vary the input AC power from 85% to 115% while monitoring frequency stability. Supply voltage was measured at the input terminals using a Fluke 87V Digital Multimeter. Frequency was measured over a 50 Ohm dummy load, using a HP5335A Universal Counter.

The transmitter was set for 320 kHz. Frequency measurements are shown as read from the external meter, not the internal displayed frequency.

220V AC, 320 kHz		
Input Voltage	% of nominal voltage	Output frequency
187	85%	320,000 Hz
198	90%	320,000 Hz
209	95%	320,000 Hz
220	100%	320,000 Hz
231	105%	320,000 Hz
241	110%	320,000 Hz
253	115%	320,000 Hz

115V AC, 320 kHz		
Input Voltage	% of nominal voltage	Output frequency
97.75	85%	320,000 Hz
103.5	90%	320,000 Hz
109.25	95%	320,000 Hz
115.0	100%	320,000 Hz
120.75	105%	320,000 Hz
126.5	110%	320,000 Hz
132.25	115%	320,000 Hz

It can be noted that frequency did not change until input voltage was reduced to 70V, at which point the transmitter shut down on an AC Failure.