APPLICATION SUBMITTAL

FOR
FCC GRANT OF CERTIFICATION
Per Part 87

FOR

MODEL: KXP2290
1090 MHz
Multi-Mode S Aviation Transponder with Diversity capability
FCC ID: ASYKXP2290

FOR

Honeywell International Inc.

One Technology Center
23500 West 105th Street
Olathe, KS 66061
Test Report Number 060613

ROGERS LABS, INC.
4405 West 259th Terrace
Louisburg, KS 66053
Phone / Fax (913) 837-3214

Test Report

For

Application of Certification

For

Honeywell International Inc.

One Technology Center
23500 West 105th Street
Olathe, KS 66061
Phone: (913) 712-2352

Jack Glecier
FCC Coordinator

MULTI-MODE S, AVIATION TRANSPONDER WITH DIVERSITY CAPABILITY
Model: KXP2290
Part Number: 066-01198-0101
Frequency Range: 1090 MHz

FCC ID: ASYKXP2290

Test Date: June 13, 2006

Certifying Engineer: Scot D Rogers

Scot D. Rogers
ROGERS LABS, INC.
4405 West 259th Terrace
Louisburg, KS 66053
Phone: (913) 837-3214
FAX: (913) 837-3214

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FORWARD

In accordance with the Federal Communications, Code of Federal Regulations, dated October 1, 2005, Part 2 Subpart J, Paragraphs 2.907, 2.911, 2.913, 2.915, 2.925, 2.926, 2.1031 through 2.1057, and Part 87, Subchapter D, Paragraphs 87.131 through 87.147 the following is submitted.

List of Test Equipment

A Hewlett Packard 8591EM and or 8562A Spectrum Analyzer was used as the measuring device for the emissions testing. The analyzer settings used are described in the following table. Refer to the Appendix for a complete list of Test Equipment.

HP 8591EM SPECTRUM ANALYZER SETTINGS		
CONDUCTED EMISSIONS		
RBW	AVG. BW	DETECTOR FUNCTION
9 kHz	30 kHz	Peak/Quasi Peak
RADIATED EMISSIONS (30 – 1000 MHz)		
RBW	AVG. BW	DETECTOR FUNCTION
120 kHz	300 kHz	Peak/Quasi Peak
HP 8562A SPECTRUM ANALYZER SETTINGS		
RADIATED EMISSIONS (1 – 40 GHz)		
RBW	AVG. BW	DETECTOR FUNCTION
1 MHz	1 MHz	Peak/Average
ANTENNA CONDUCTED EMISSIONS		
RBW	AVG. BW	DETECTOR FUNCTION
100 kHz	100 kHz	Peak

2.1033(c) Application for Certification

(1) Manufacturer: Honeywell International Inc.
One Technology Center
23500 West 105th Street
Olathe, KS 66061

(2) Identification: FCC I.D.: ASYKXP2290

(3) Instruction Book: Refer to exhibit for Draft Instruction Manual.

(4) Emission Type: Emissions designator 12M6V1D

(5) Frequency Range: 1090 MHz

(6) Operating Power Level: 251-Watts peak, 2.5 Watts (Average Power) delivered from this EUT.

(7) Maximum P_o: 251 Watts (nominal peak power) and 2.5 watts average delivered from this EUT. Maximum power output as determined by appropriate standards during certification per CFR 47 paragraph 87.131. The specifications of RTCA/DO-181C stipulate 125W peak minimum and 500W maximum RF peak output power.

(8) Power into final amplifying circuitry: Final amplifier 50.0 volts @ 10.00 amps (500 watts peak power).

(9) Tune Up Procedure for Output Power: Refer to Exhibit for Transceiver Alignment Procedure.

(10) Circuit Diagrams; description of circuits, frequency stability, spurious suppression, and power and modulation limiting:
Refer to Exhibit for Circuit Diagrams.
Refer to Exhibit for Theory of Operation.

(11) Photograph or drawing of the Identification Plate:
Refer to Exhibit for Photograph or Drawing.

(12) Drawings of Construction and Layout: Refer to Exhibit for Drawings of Components Layout and Chassis Drawings.

(13) Detail Description of Digital Modulation:
The unit employs pulse modulation prescribed by FAA TSOC112. This requires pulses of 0.450±0.100 microseconds for ATCRBS and 0.500 ±0.050 microseconds for Mode S with rise times of 0.100-microsecond maximum and fall-times of 0.200 microseconds maximum for both. The KXP2290 transmitter includes a 1090 MHz frequency synthesizer signal source, a 60 W class AB power amplifier provides the drive power needed for the 450 W class C final power amplifier. A low pass filter between the transmitter and the RF I/O port with a 3 dB corner frequency of 1.3 GHz attenuates the transmitter's carrier harmonics. The maximum rated condition, Mode S reply, has a 120 microsecond length with four pulses in the first eight microseconds, which is called the preamble, and pulses of 0.5 or 1.0 microsecond length filling in the next 112 microseconds, which is called the data block. Binary data is coded by the pulse position in the one-microsecond frames.

(14) Data required by 47 CFR paragraphs 2.1046 through 2.1057 are contained in the report.

(15) External power amplifier requirements do not apply to this device or application.

(16) AM broadcast requirements do not apply to this device or application.

(17) Requirements of 47 CFR paragraph 25.129 do not apply to this device or application.

(18) The device is not a software-defined radio and requirements of 2.944 do not apply to this application.

System Description

The KXP 2290 is a Mode S Transponder capable of non-diversity or diversity operation. It is a member of the APEX system family. The KXP 2290 part number is 066-01198-0101. The KXP 2290 Mode S Transponder is designed to meet TSO-C112 for a Class 2A ATCRBS/Mode Select Airborne Transponder System. It is a blind-mount transponder that replies to ATCRBS Mode A and C, Intermode, and Mode S interrogations.

Since the KXP 2290 is a Class 2A transponder, it can handle Comm A & Comm B Mode S data link protocols. The KXP 2290 is compliant with TSO-C112 Class 2A and ETSO-2C112a requirements. The EUROCAE ED-73B transponder functionality is Level 2 (Surveillance and Comm A/B) and the marking is *level 2s.* Additionally the ED-73B defined class is "CLASS 1". The KXP 2290 is also designed to meet the Enhanced Surveillance mandated in Europe.

The KXP 2290 has the ability to receive an 8-digit alphanumeric Flight ID code. The flight crew enters the Flight ID information via the APEX control panel.

The KXP 2290 will work with any conventional ATCRBS blade or quarter-wave monopole type antenna that meets the requirements of TSO-C112.

The KXP 2290 uses ARINC 735A TCAS interface protocol to interface with TCAS II. As a peripheral to the TCAS II processor, the transponder receives and replies to short and long Air-to-Air surveillance and TCAS Coordination interrogations. In addition, it receives and replies to Ground-to-Air surveillance and Comm-A interrogations directed to TCAS.

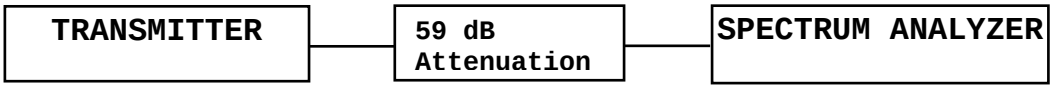
The KXP 2290 contains BITE (Built In Test Equipment) so the operational health of the unit is constantly monitored. When a critical fault is detected, the unit will notify the APEX system. The unit stores detected failures in non-volatile memory for later review. The unit also has a temperature sensor and a timer so that faults can be time stamped and temperature data can be collected and stored.

2.1046 RF Power Output

Measurements Required

Measurements shall be made to establish the radio frequency power delivered by the transmitter into the standard output termination. The power output shall be monitored and recorded and no adjustment shall be made to the transmitter after the test has begun, except as noted below:
If the power output is adjustable, measurements shall be made for the highest and lowest power levels.

Test Arrangement



The radio frequency power output was measured at the antenna terminal by placing of 59 dB attenuation in the antenna line and observing the emission with the spectrum analyzer. The spectrum analyzer had an impedance of 50Ω to match the impedance of the standard antenna. A HP 8591EM Spectrum Analyzer was used to measure the radio frequency power at the antenna port. The data was taken in dBm and converted to watts as shown in the following Table. Refer to Figure 1 showing the maximum output power of the transmitter. Data was taken per 47 CFR Paragraph 2.1046(a) and applicable paragraphs of Part 87.

P_{dBm} = power in dB above 1 milliwatt.
Milliwatts = $10^{(PdBm/10)}$
Watts = (Milliwatts)(0.001)(W/mW)

milliwatts = $10^{(53.997/10)}$
= 251,000 mW
= 251 Watts Peak power

Results

FREQUENCY	P_{dBm}	P_{mw}	P_{w}
1090	53.99	251,000	251

The specifications of 47 CFR Paragraph 2.1046(a) and applicable Parts of 2 and 87.131 are met. There are no deviations to the specifications.

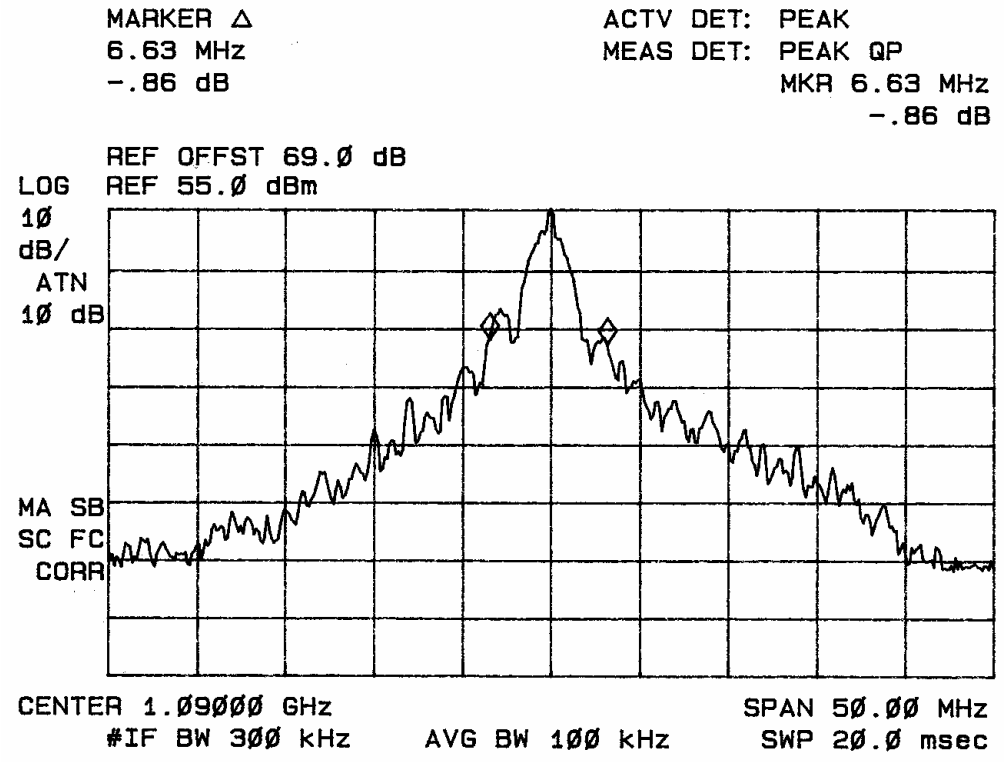


Figure 1 Maximum Power Output

2.1047 Modulation Characteristics

Measurements Required

A curve or equivalent data, which shows that the equipment will meet the modulation requirements of the rules, under which the equipment is to be licensed, shall be submitted. The modulation specifications are defined by the FAA TSO-C112 standard for use in the ATCRBS, Mode A, Mode C, Intermode, and Mode S interrogations. This requires pulses of 0.450±0.100 microseconds for ATCRBS and 0.500 ±0.050 microseconds for Mode S with rise times of 0.100-microsecond maximum and fall-times of 0.200 microseconds maximum for both. The KXP2290 transmitter includes a 1090 MHz frequency synthesizer signal source, a 60 W class AB power amplifier provides the drive power needed for the 350 W final power amplifier. A low pass filter between the transmitter and the RF I/O port with a 3 dB corner frequency of 1.3 GHz attenuates the transmitter's carrier harmonics. The maximum rated condition, Mode S reply, has a 120 microsecond length with four pulses in the first eight microseconds, which is called the preamble, and pulses of 0.5 or 1.0 microsecond length filling in the next 112 microseconds, which is called the data block. Binary data is coded by the pulse position in the one-microsecond frames.

Results

Figures 2 and 3 display photographs of the oscilloscope screen display taken while the equipment was operating in a normal mode. The requirements of 47 CFR 2.1049(c)(1) and applicable paragraphs of Part 87.141 are met. There are no deviations to the specifications.

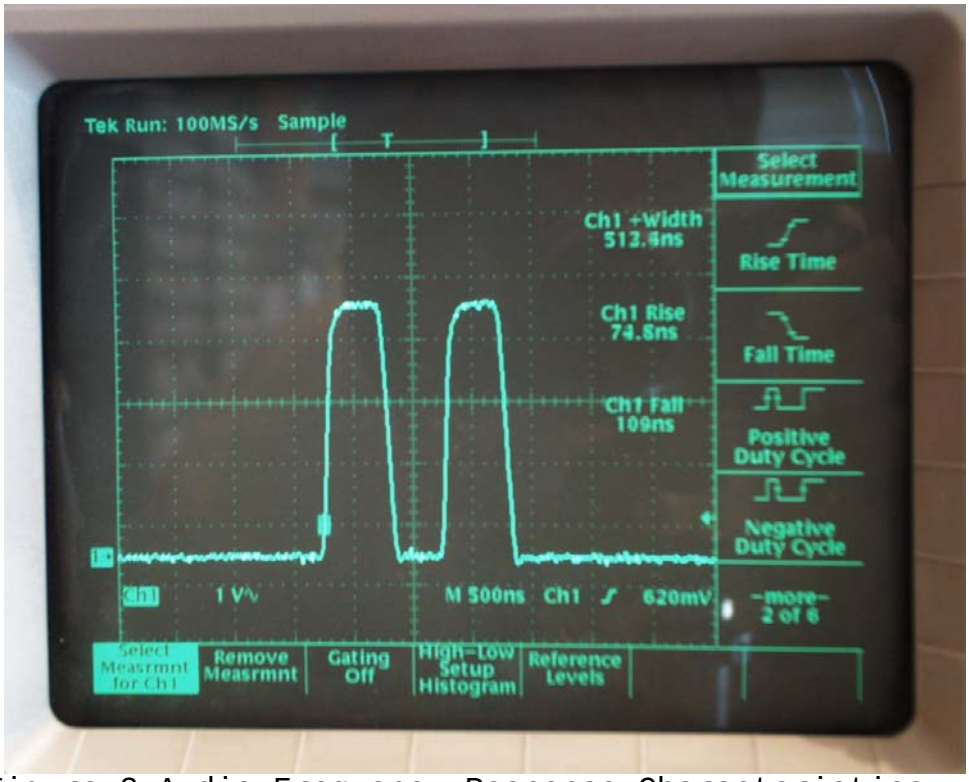


Figure 2 Audio Frequency Response Characteristics

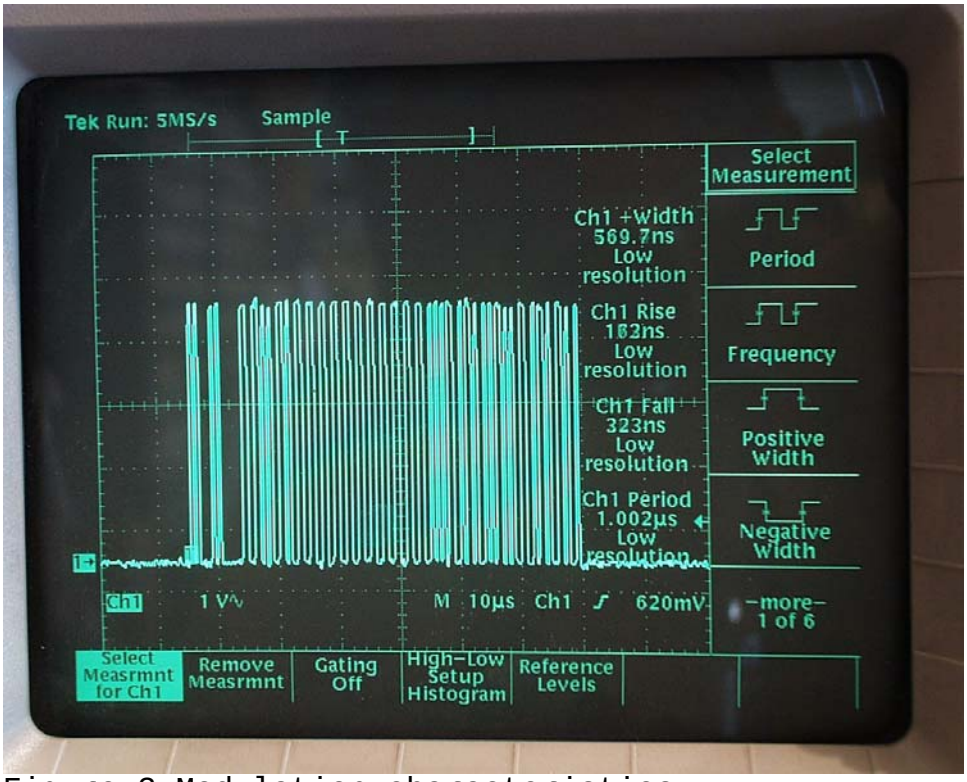


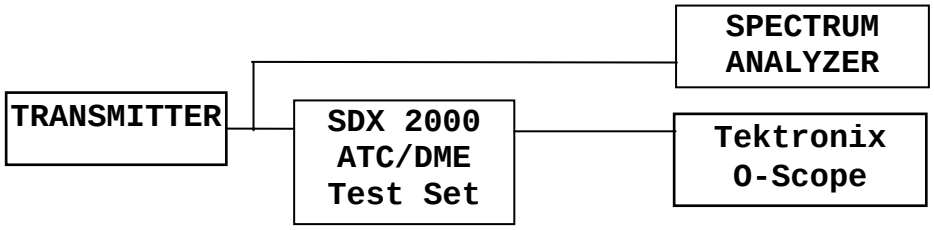
Figure 3 Modulation characteristics

2.1049 Occupied Bandwidth

Measurements Required

The occupied bandwidth, that is the frequency bandwidth such that below its lower and above its upper frequency limits, the mean powers radiated are equal to 0.5 percent of the total mean power radiated by a given emission.

Test Arrangement



A spectrum analyzer was used to observe the radio frequency spectrum with the transmitter operating in all normal modes. The SDX2000 Test Set continuously interrogated the transponder while measurements were made.

Results

Frequency (MHz)	Occupied bandwidth(MHz)
1090.00	7.63 (Worst-case Mode S)
1090.00	12.00 (Worst-case Mode C)

The power ratio in dB representing 99.5% of the total mean power was recorded from the spectrum analyzer. Refer to figures 4 and 5 showing plots of the occupied bandwidth of the 99.5% power.

The requirements of 47 CFR 2.1049(c)(1) and applicable paragraphs of Part 87.135 are met. There are no deviations to the specifications.

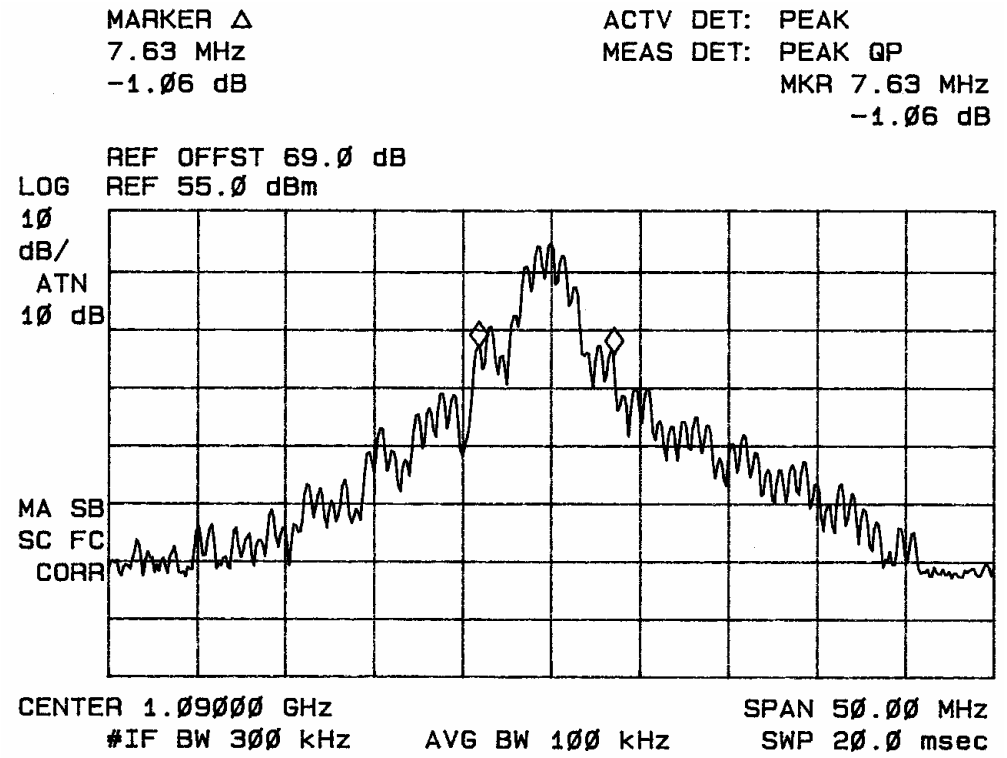


Figure 4 Mode S Occupied Band Width, Carrier frequency 1090.00 MHz

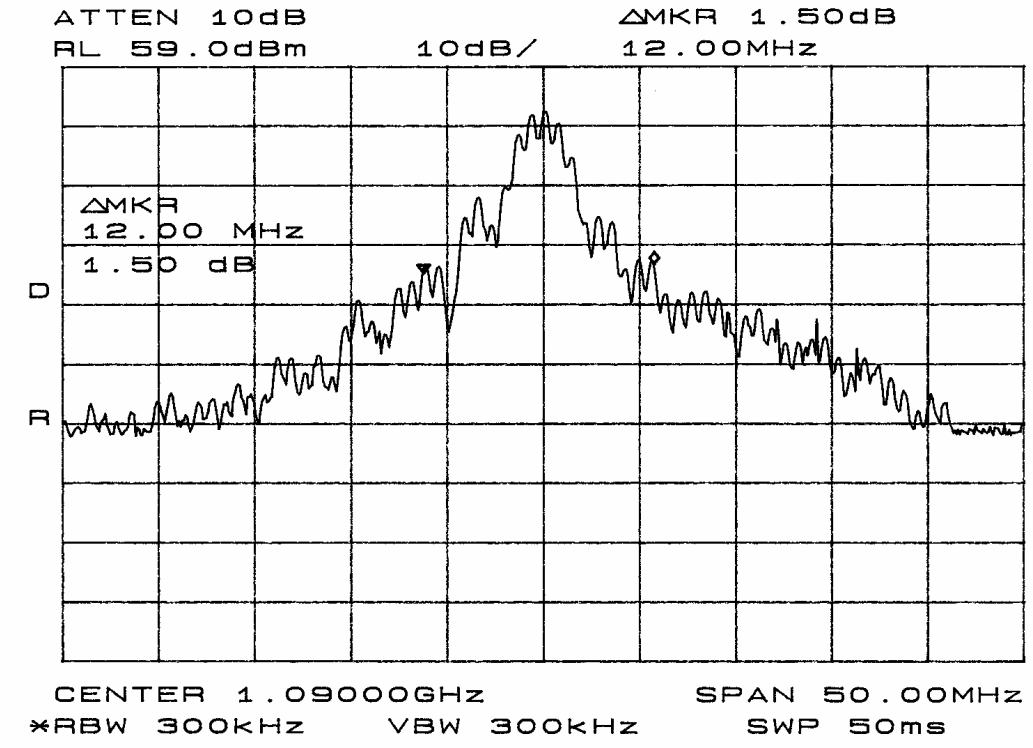


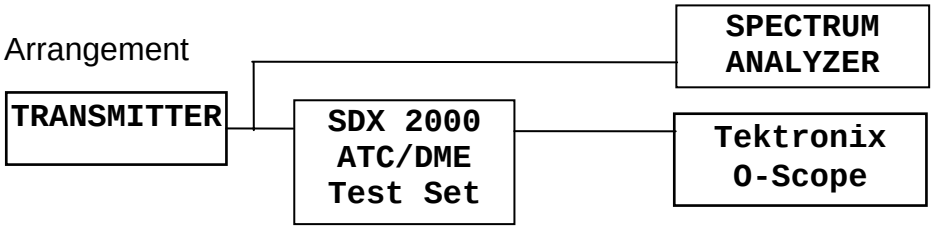
Figure 5 Mode C Occupied Band Width, Carrier frequency 1090.00 MHz

2.1051 Spurious Emissions at Antenna Terminals

Measurements Required

The radio frequency voltage or power generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna.

Test Arrangement



The radio frequency output was coupled to a HP 8562A Spectrum Analyzer. The spectrum analyzer was used to observe the radio frequency spectrum with the transmitter modulated per section 2.1049 and operated in all normal modes. The frequency spectrum from 30 MHz to 12,900 MHz was observed and plots produced of the frequency spectrum. Figures 6 through 8 represent data for the antenna spurious emissions of the KXP2290. Data was taken per 47 CFR 2.1051, 2.1057, and applicable paragraphs of Part 87.139.

Results

The output of the unit was coupled to a HP Spectrum Analyzer and the frequency emissions were measured. Data was taken as per 47 CFR 2.1051 and applicable paragraphs of Part 87. Specifications of Paragraphs 2.1051, 2.1057 and applicable paragraphs of part 87.139 are met. There are no deviations to the specifications.

CHANNEL MHz	SPURIOUS FREQ. (MHz)	MEASURED LEVEL (dBm)	LEVEL BELOW CARRIER (dB)
1090.00	2180.0	-7.6	-62.6
	3270.0	-7.5	-62.5
	4360.0	-7.2	-62.2
	5450.0	-7.6	-62.6

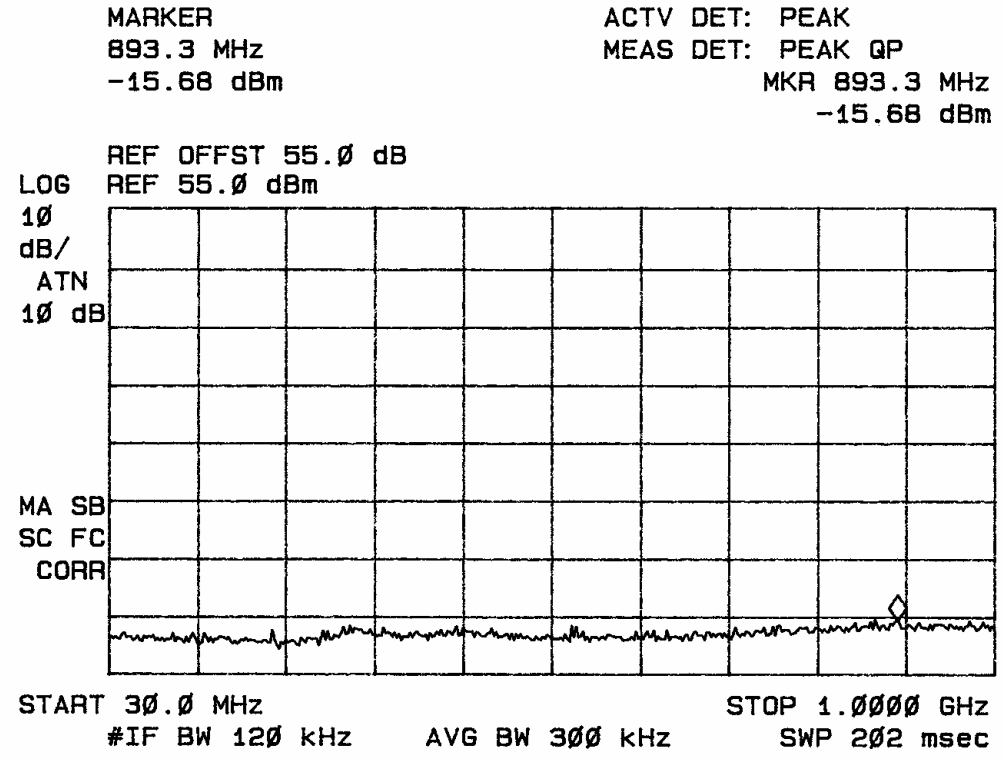


Figure 6 Spurious Emissions at Antenna Terminal.

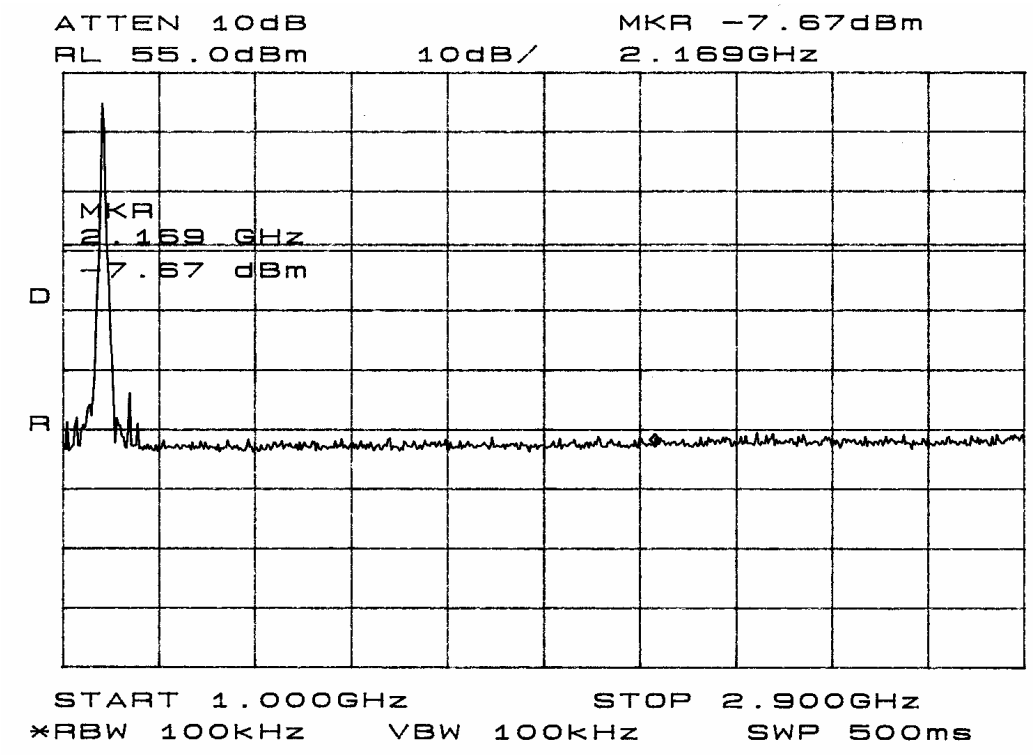


Figure 7 Spurious Emissions at Antenna Terminal.

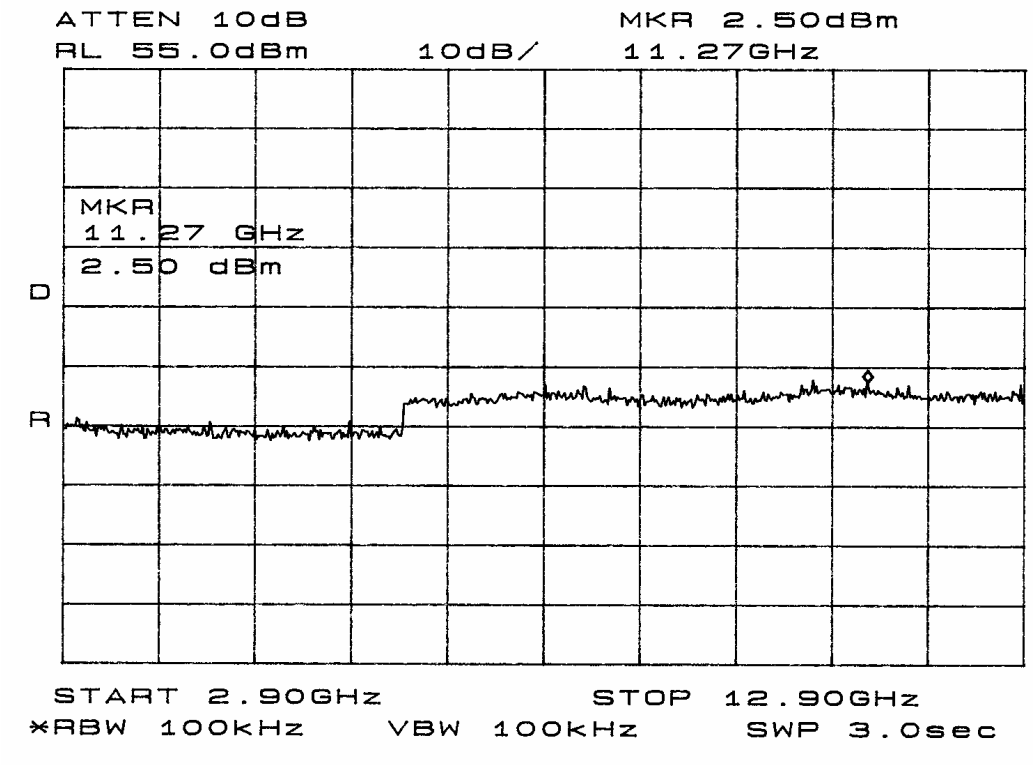


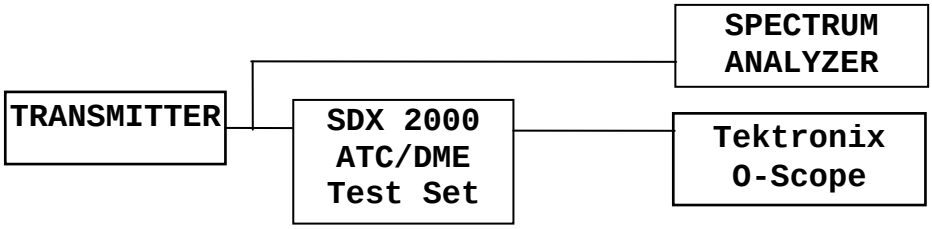
Figure 8 Spurious Emissions at Antenna Terminal.

2.1053 Field Strength of Spurious Radiation

Measurements Required

Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. This equipment is typically incorporated into a rack of equipment, cabling attached to the cabinet. A test box was constructed to interface with the equipment for testing purposes. The test box offered transmitter control for power and the SDX2000 test set continuously interrogated the unit during all testing. The SDX2000 test set supplied the 50-ohm load for the antenna connections.

Test Arrangement



The test setup was assembled in a screen room for preliminary screening. The transmitter was placed on a wooden turntable 0.8 meters above the ground plane and at a distance of 1 meter from the receive antenna, plots were made of the radiated emissions. Refer to figures 9 through 12 showing plots of the spectrum analyzer display of the frequency spectrum taken in the screen room.

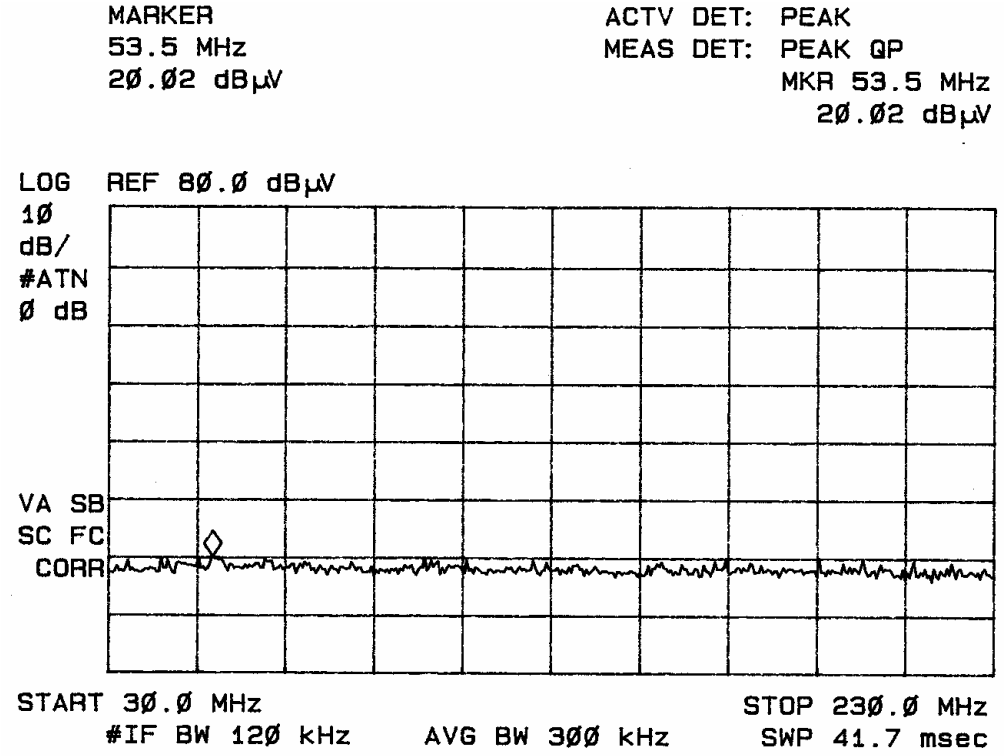


Figure 9 Radiated emissions taken at 1 meter in screen room.

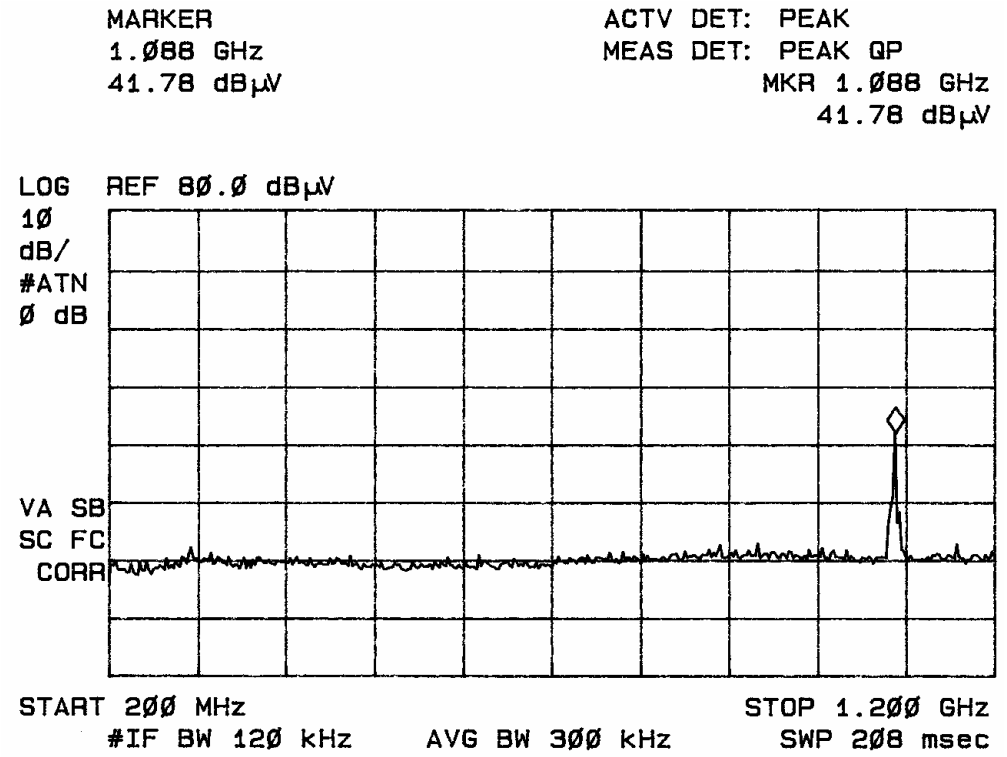


Figure 10 Radiated emissions taken at 1 meter in screen room.

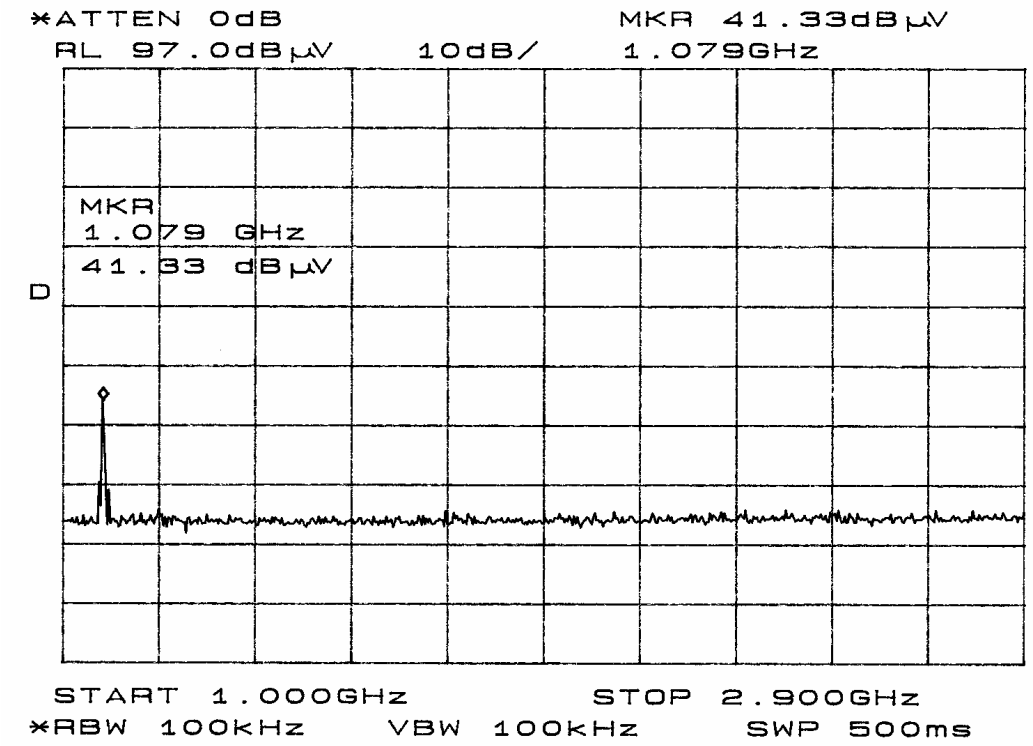


Figure 11 Radiated emissions taken at 1 meter in screen room.

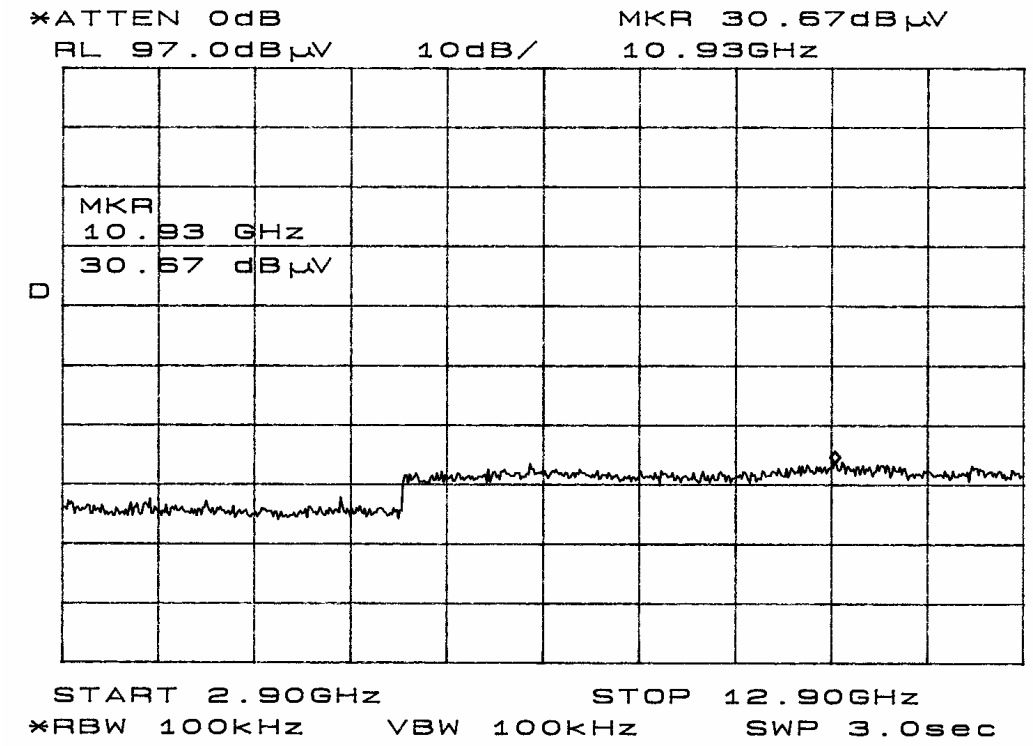


Figure 12 Radiated emissions taken at 1 meter in screen room.

The transmitter was placed on a wooden turntable 0.8 meters above the ground plane and at a distance of 3 meters from the Field Strength Measuring (FSM) antenna. With the EUT modulated and radiating into a 50Ω load. The receiving antenna was raised and lowered from 1m to 4m in height to obtain the maximum reading of spurious radiation from the EUT, cabinet, and interface cabling. The turntable was rotated though 360 degrees to locate the position registering the highest amplitude of emission. The frequency spectrum was then searched for spurious emissions generated from the transmitter and test setup. The amplitude of each spurious emission was maximized by raising and lowering the FSM antenna, and rotating the turntable before final data was recorded. A biconilog antenna was used for frequency measurements of 30 to 1000 MHz. A log periodic antenna was used for frequencies of 1000 MHz to 5000 MHz. A double-ridge horn antenna was used for frequencies of 5000 MHz to 12,900 MHz. Emission levels were measured and recorded from the spectrum analyzer in dBµV. Data was taken at the ROGERS LABS, INC. 3 meters open area test site (OATS). A description of the test facility is on file with the FCC, Reference 90910, and dated May 16, 2006.

Results

The EUT was connected to the SDX2000 Test Set and operated in all available normal modes while radiated emissions testing were performed. The amplitude of each spurious emission was maximized and amplitude levels recorded while operating at the open area test site at a distance of 3-meters.

Channel frequency 1090.00 MHz

Frequency In MHz	FSM Hor. (dBµV) Quasi-Peak	FSM Vert. (dBµV) Quasi-Peak	Ant. Fact. (dB)	Amp. Gain (dB)	Comp. Hor. (dBµV/m) @ 3m	Comp. Vert. (dBµV/m) @ 3 m	FCC Limit (dBµV)
53.0	40.7	44.5	6.6	30	17.3	21.1	40.0
209.8	46.8	31.6	11.0	30	27.8	12.6	43.5
300.0	48.9	45.8	14.3	30	33.2	30.1	43.5
2180.0	16.5	14.3	31.1	35	12.6	10.4	54.0
3270.0	16.3	15.3	36.4	35	17.7	16.7	54.0
4360.0	16.6	14.3	32.5	35	14.1	11.8	54.0
5450.0	16.3	14.1	33.1	35	14.4	12.2	54.0
6540.0	18.8	16.8	34.2	35	18.0	16.0	54.0
7630.0	17.5	19.0	36.7	35	19.2	20.7	54.0
8720.0	17.0	16.5	36.8	35	18.8	18.3	54.0
9810.0	17.5	16.8	38.1	35	20.6	19.9	54.0
10900.0	16.8	17.3	39.1	35	20.9	21.4	54.0

Other Emissions present with amplitudes at least 20 dB below limit.

Specifications of 47 CFR Paragraph 2.1053, 2.1057, applicable paragraphs of part 87.139 are met. There are no deviations or exceptions to the specifications.

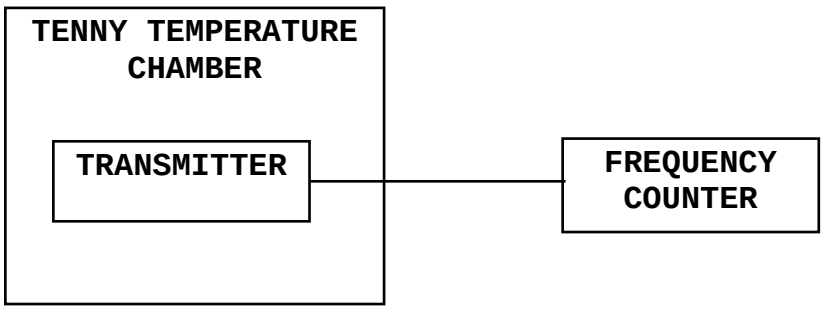
2.1055 Frequency Stability

Measurements Required

The frequency stability shall be measured with variations of ambient temperature from -30° to +50° centigrade. Measurements shall be made at the extremes of the temperature range and at intervals of not more than 10° centigrade through the range. A period sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. In addition to temperature stability, the frequency stability shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value.
(2) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided.

Test Arrangement



The measurement procedure outlined below shall be followed.

Step 1: The transmitter shall be installed in an environmental test chamber whose temperature is

controllable. Provision shall be made to measure the frequency of the transmitter.
Step 2: With the transmitter inoperative (power switched "OFF"), the temperature of the test chamber shall be adjusted to +25°C. After a temperature stabilization period of one hour at +25°C, the transmitter shall be switched "ON" with standard test voltage applied.
Step 3: The carrier shall be keyed "ON", and the transmitter shall be operated unmodulated at full radio frequency power output at the duty cycle, for which it is rated, for duration of at least 5 minutes. The radio frequency carrier frequency shall be monitored and measurements shall be recorded.

Step 4: The test procedures outlined in Steps 2 and 3, shall be repeated after stabilizing the transmitter at the environmental temperatures specified, -30°C to +50°C in 10-degree increments.

The frequency stability was measured with variations in the power supply voltage from 85 to 115 percent of the nominal value. A Sorensen DC Power Supply was used to vary the dc voltage for the power input from 23.80 Vdc to 32.20 Vdc. The frequency was measured and the variation in parts per million was calculated. Data was taken per 47 CFR Paragraphs 2.1055 and applicable paragraphs of part 87.133.

Results

Frequency 1090.00 (MHz)	FREQUENCY STABILITY VS TEMPERATURE IN PARTS PER MILLION (PPM)								
	Temperature in °C								
	-30	-20	-10	0	+10	+20	+30	+40	+50
Change (Hz)	-3000	-2000	-1000	0	0	0	0	0	0
PPM	-0.3	-0.2	-0.09	0	0	0	0	0	0
%	-0.0027	-0.0018	-0.0009	0	0	0	0	0	0
Limit (PPM)	20	20	20	20	20	20	20	20	20

FREQUENCY (1090 MHz)	FREQUENCY STABILITY VS VOLTAGE VARIATION 28.0 volts nominal; RESULTS IN PPM INPUT VOLTAGE		
	23.80 V_{dc}	28.00 V_{dc}	32.20 V_{dc}
Change (Hz)	0.0	0.0	0.0

Specifications of 47 CFR Paragraphs 2.1055 and applicable paragraphs of part 87.133 are met. There are no deviations or exceptions to the specifications.

APPENDIX

Model: KXP2290

1. Test Equipment List
2. Rogers Qualifications
3. FCC Site Approval Letter

TEST EQUIPMENT LIST FOR ROGERS LABS, INC.

The test equipment used is maintained in calibration and good operating condition. Use of this calibrated equipment ensures measurements are traceable to national standards.

List of Test Equipment:	Calibration Date:
Scope: Tektronix 2230	2/06
Wattmeter: Bird 43 with Load Bird 8085	2/06
Power Supplies: Sorensen SRL 20-25, SRL 40-25, DCR 150, DCR 140	2/06
H/V Power Supply: Fluke Model: 408B (SN: 573)	2/06
R.F. Generator: HP 606A	2/06
R.F. Generator: HP 8614A	2/06
R.F. Generator: HP 8640B	2/06
Spectrum Analyzer: HP 8562A, Mixers: 11517A, 11970A, 11970K, 11970U, 11970V, 11970W HP Adapters: 11518, 11519, 11520	2/06
Spectrum Analyzer: HP 8591 EM	5/06
Frequency Counter: Leader LDC 825	2/06
Antenna: EMCO Biconilog Model: 3143	5/06
Antenna: EMCO Log Periodic Model: 3147	10/05
Antenna: Antenna Research Biconical Model: BCD 235	10/05
Antenna: EMCO Dipole Set 3121C	2/06
Antenna: C.D. B-101	2/06
Antenna: Solar 9229-1 & 9230-1	2/06
Antenna: EMCO 6509	2/06
Audio Oscillator: H.P. 201CD	2/06
R.F. Power Amp 65W Model: 470-A-1010	2/06
R.F. Power Amp 50W M185- 10-501	2/06
R.F. PreAmp CPPA-102	2/06
LISN 50 µHy/50 ohm/0.1 µf	10/05
LISN Compliance Eng. 240/20	2/06
LISN Fischer Custom Communications FCC-LISN-50-16-2-08	6/05
Peavey Power Amp Model: IPS 801	2/06
Power Amp A.R. Model: 10W 1010M7	2/06
Power Amp EIN Model: A301	2/06
ELGAR Model: 1751	2/06
ELGAR Model: TG 704A-3D	2/06
ESD Test Set 2010i	2/06
Fast Transient Burst Generator Model: EFT/B-101	2/06
Current Probe: Singer CP-105	2/06
Current Probe: Solar 9108-1N	2/06
Field Intensity Meter: EFM-018	2/06
KEYTEK Ecat Surge Generator	2/06
Shielded Room 5 M x 3 M x 3.0 M (101 dB Integrity)	

5/2/2006

QUALIFICATIONS

Of

SCOT D. ROGERS, ENGINEER

ROGERS LABS, INC.

Mr. Rogers has approximately 17 years experience in the field of electronics. Mr. Rogers has worked for six years in the automated controls industry and the remaining years working with the design, development and testing of radio communications and electronic equipment.

POSITIONS HELD:

Systems Engineer:	A/C Controls Mfg. Co., Inc. 6 Years
Electrical Engineer:	Rogers Consulting Labs, Inc. 5 Years
Electrical Engineer:	Rogers Labs, Inc. Current

EDUCATIONAL BACKGROUND:

1) Bachelor of Science Degree in Electrical Engineering from Kansas State University.

2) Bachelor of Science Degree in Business Administration Kansas State University.

3) Several Specialized Training courses and seminars pertaining to Microprocessors and Software programming.

Scot D Rogers
Scot D. Rogers

June 13, 2006
Date

FEDERAL COMMUNICATIONS COMMISSION

Laboratory Division
7435 Oakland Mills Road
Columbia, MD 21046

May 16, 2006

Registration Number: 90910

Rogers Labs, Inc.
4405 West 259th Terrace
Louisburg, KS 66053

Attention: Scot Rogers

Re: Measurement facility located at Louisburg
3 & 10 meter site
Date of Renewal: May 16, 2006

Dear Sir or Madam:

Your request for renewal of the registration of the subject measurement facility has been received. The information submitted has been placed in your file and the registration has been renewed. The name of your organization will remain on the list of facilities whose measurement data will be accepted in conjunction with applications for Certification under Parts 15 or 18 of the Commission's Rules. Please note that the file must be updated for any changes made to the facility and the registration must be renewed at least every three years.

Measurement facilities that have indicated that they are available to the public to perform measurement services on a fee basis may be found on the FCC website www.fcc.gov under E-Filing, OET Equipment Authorization Electronic Filing, Test Firms.

Sincerely,

Phyllis Parrish
Information Technician