TEST REPORT

K-TECH TELECOMMUNICATIONS XTREME-2000 DTV TRANSMITTER

TECHNICAL REPORT

INTRODUCTION

The following information is provided to support the technical performance of the K-TECH Telecommunications XTREME-2000 TV Transmitter. The information is supplied for DTV broadcast service according to applicable portions of FCC rules contained in Part 2, Part 73, and Part 74.

1. Power Output Measurements as indicated by FCC Rule 74.795.
2. Frequency Measurements as identified by FCC Rule 74.795.
3. Emission mask compliance as defined in FCC Rule 74.794.
4. Attenuation to harmonics produced in the RNSS bands as defined in FCC Rule 74.794
5. Measurement of cabinet radiation of spurs and harmonics as specified in FCC Rule 2.1053 and 2.1057.
6. Demonstration of transmission and reception of 8-VSB ATSC signal.
7. Measurements of voltage and current to final amp stage as outlined in FCC Rule 74.795.

Measurements were conducted at transmitter power output levels of 100 watts average and 25 watts average and constitute the range of power for which type certification is sought. Measurements were taken on a unit with operating on UHF TV channel 20.

All test equipment was calibrated prior to the use of the equipment by the supplier of the test equipment. The list of test equipment is provided on the last page of the test report.

RF POWER OUTPUT

The equipment was configured as shown on the next page. The loss through the RF output cable, and attenuator was calibrated at the frequency of 506 MHz. The transmitter was energized and the power was increased to the desired output power. The average power was measured on the Agilent E4418 wattmeter equipped with an Agilent E4412A power sensor. The following pictures also indicate the power meter reading on the transmitter front panel.

POWER OUTPUT MEASUREMENTS

Power Meter Reading
at high power =105 watts

Power Meter Reading
at low power= 23 watts

TEST EQUIPMENT CONFIGURATION

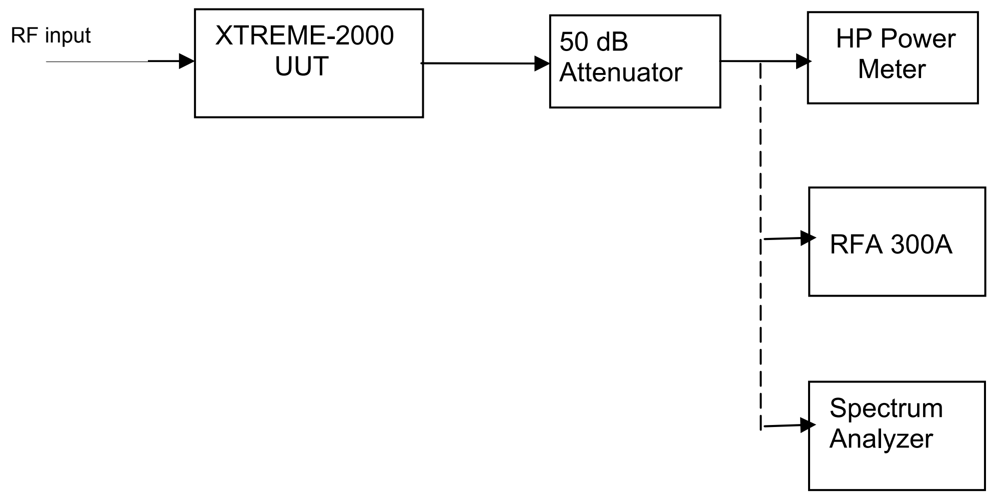


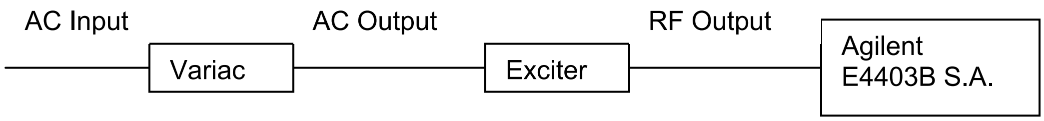
FIGURE 1

Dashed line indicates only one instrument connected at a time.

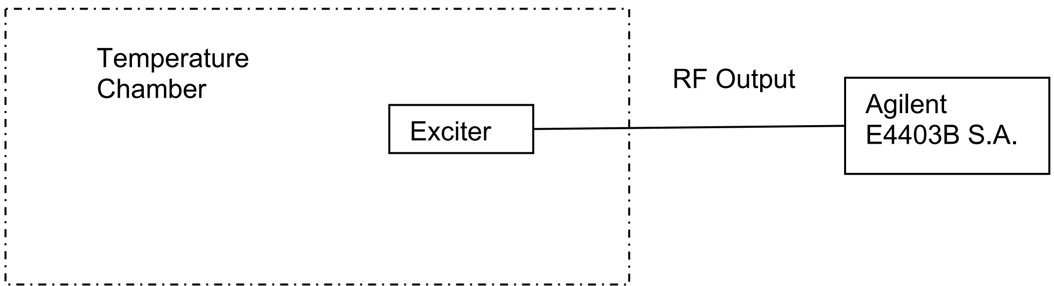
FREQUENCY STABILITY MEASUREMENTS

Frequency stability versus temperature and line voltage was measured in a controlled environment. For these tests the exciter RF output was fed to an Agilent E4403B spectrum analyzer with built-in frequency counter that has better than a 1ppm accuracy. The test equipment configuration is shown below.

Frequency Stability versus line voltage variation



Frequency Stability versus temperature



The Variac was adjusted for nominal voltage and the frequency was recorded. Then the variac was adjusted to 85% and 115% of the nominal voltage and the frequency was recorded at each voltage level. The results are tabulated below.

LINE VOLTAGE (Volts)	Pilot Frequency (MHz)
180 (85%)	506.309197
212 (nominal)	506.309200
244 (115%)	506.309204

For the temperature stability measurements the exciter was placed inside a Wedco Model 22-17MM temperature chamber equipped with a temperature controller. The exciter frequency was measured on the spectrum analyzer. Measurements were first recorded at room temperature (23 °C). The temperature in the chamber was raised to a maximum of 40 °C. Then the temperature was lowered to the minimum temperature of 0 °C. The temperature in the chamber was changed to each of the points identified in the table below and measured at the times indicated. The chamber followed a prescribed rate of change to reach each temperature and was then allowed to stabilize at the desired temperature for 10-15 minutes at which time frequency measurements were made.

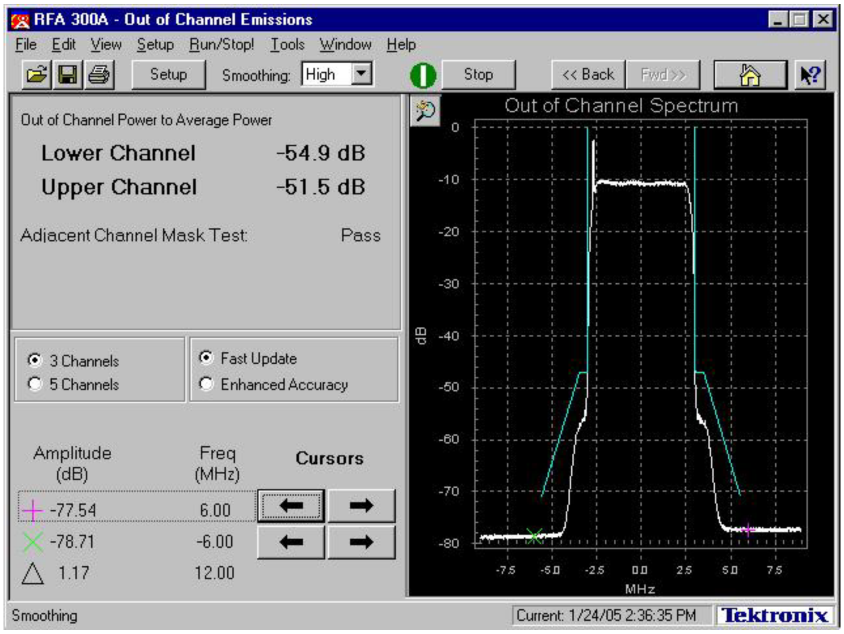
Temperature °C	Time	Pilot Frequency (MHz)
23	11:00	506.309125
30	11:25	506.309124
40	11:50	506.309107
20	12:30	506.309184
10	12:45	506.309288
0	1:00	506.309340

The recorded data indicates that the total frequency shift was 233 Hz which meets the FCC stability requirements.

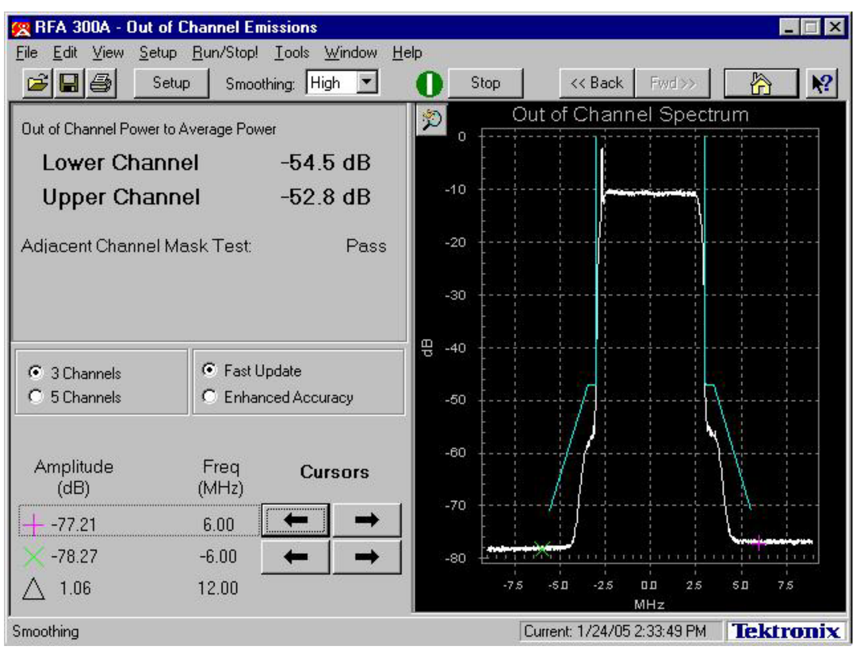
EMISSION MASK

The transmitter was tested to determine compliance with the “stringent” emission mask as defined in the FCC rules. The test equipment was configured as shown in Figure 1. The transmitter was energized on channel 20 and the emissions from the transmitter were measured at 100 watts output power and at 25 watts output power using a Tektronix RFA 300A and graphs of each performance measurement were made and are recorded below.

RF POWER OUTPUT AT 100 WATTS



RF POWER OUTPUT AT 25 WATTS

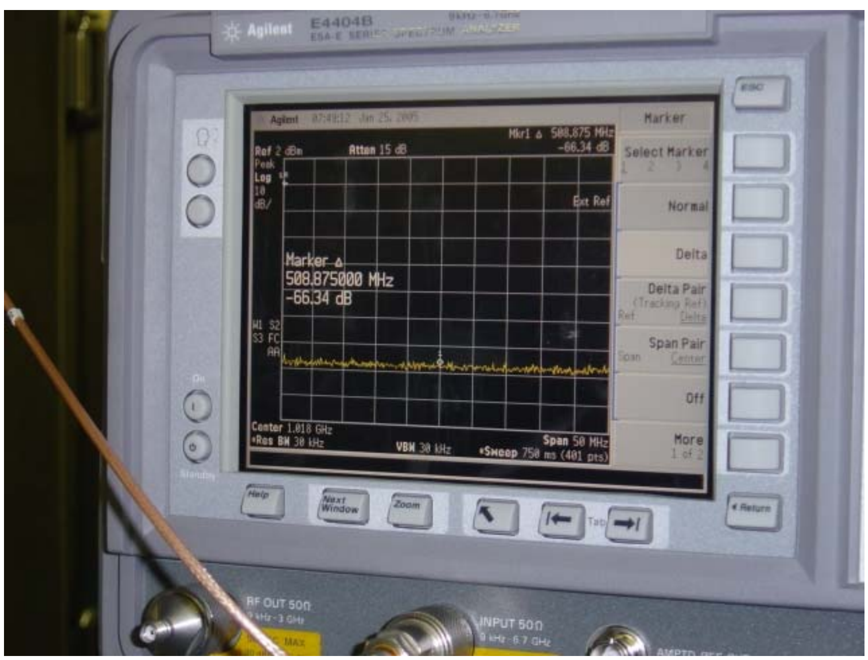


HARMONIC AND SPURIOUS MEASUREMENTS

The equipment configuration of Figure 1 was used to measure the harmonics. A photograph of the spectrum analyzer screen and the measurement method follows. The FCC rule specifies that all harmonics and spurious shall be -76 dB with respect to the total power in the authorized channel.

In a 500 kHz resolution bandwidth, the flat part of the spectrum will be 10.6 dB lower than the total power within the channel and therefore any harmonic energy will need to be 76-10.6 = 65.4 dB below the flat portion of the spectrum. Because of the “noiselike” characteristic of the DTV waveform both fundamental and harmonic/spurious energy will be reduced by an equal amount when adjusting the resolution bandwidth function of a spectrum analyzer. So the measurement can be made in different resolution bandwidth than 500 kHz and as long as the energy is below -65.4 dB, this will meet the FCC specification.

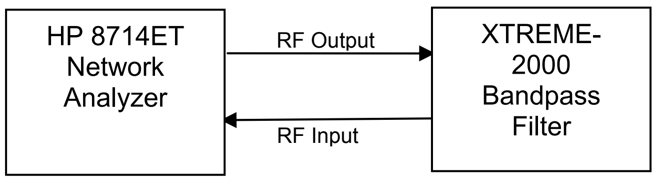
Using that information, the spectrum analyzer was configured for a resolution bandwidth of 30 kHz and the flat portion of the DTV waveform in the authorized channel was set at 10 dB below the top of the screen to prevent the spectrum analyzer from being overloaded. The spectrum through the 10^{th} harmonic was scanned to see if there was any harmonic or spurious energy present. No energy was found above the level of -66.3 dB which was the limitation of the spectrum analyzer in this configuration. The photograph below illustrates the concept and shows the area of the second harmonic frequency spectrum.



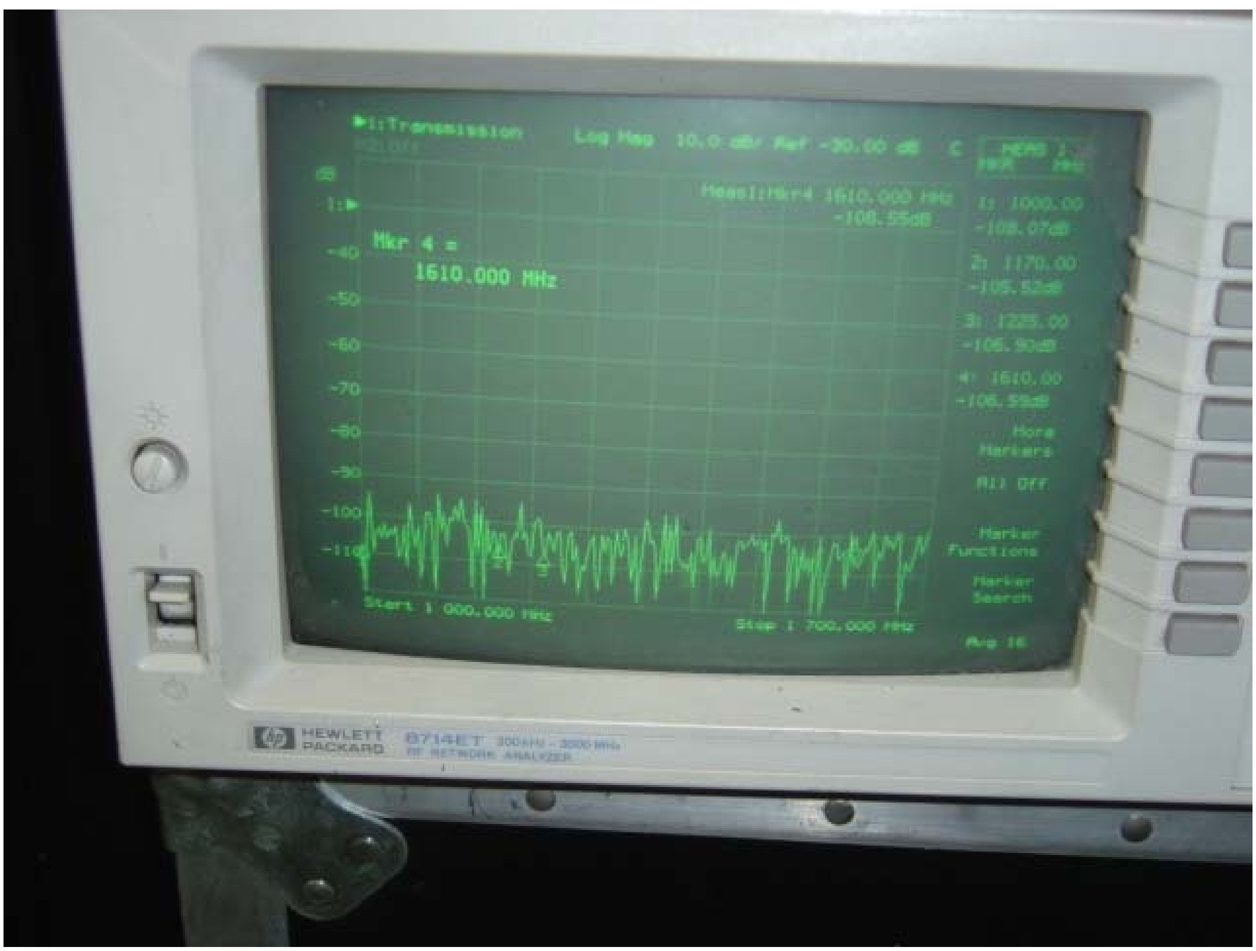
HARMONICS IN THE RNSS FREQUENCY BAND

The FCC rules stipulate 85 dB of filter attenuation to RNSS spectrum be provided for transmitters operating on channels that are harmonically related to the RNSS bands. The 85 dB filter attenuation for those frequencies can be shown be using a signal source and sweeping the spectrum in question.

To demonstrate this, a Hewlett Packard 8714ET network analyzer was connected the filter provided as part of the XTREME-2000 transmitter and the attenuation to the specific frequency bands was measured. The test equipment configuration is shown below. The RF output level was set at +0 dBm and the spectrum from 1.0 GHz to 1.7 GHz was examined.



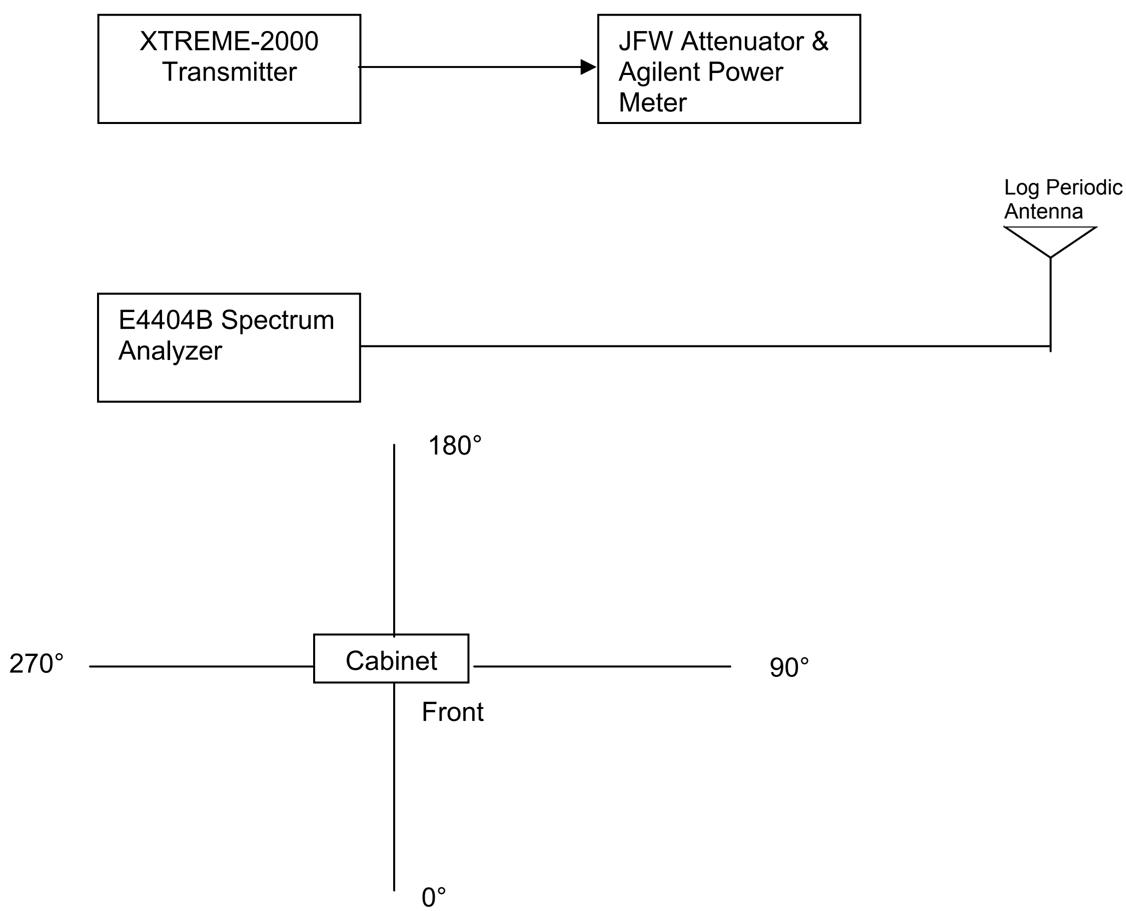
The following photograph below indicates all energy in the RNSS frequency bands is at least 95 dB down with respect to the input signal. Markers for the various RNSS frequency bands were set and can be located on the right hand side of the screen.



CABINET RADIATION

The transmitter and test equipment were configured as shown below including the angles of measurement with respect to the transmitter cabinet. The photo on the subsequent page also shows one view of the physical set-up of the test equipment and equipment under test. The transmitter was operated at 100 watts average power. The free space path loss and antenna gain characteristics were obtained at the fundamental frequency and at each of the harmonics of the visual carrier frequency in order to accurately assess the level of the signal radiated from the cabinet. Radiation from the cabinet was measured at a distance of 40 feet in 4 different physical rotation angles: 0, 90, 180, and 270 degrees (0 degrees being the front of the cabinet). All spectral components above -80 dB referenced to the total average power radiated from the cabinet were recorded. The values are tabulated in the table on the next page following the photos. An A.H. Systems Log Periodic antenna was used for the receiving antenna and its gains at the various harmonic frequencies are listed in the following tables.

TEST EQUIPMENT CONFIGURATION



PHYSICAL CABINET RADIATION TEST CONFIGURATION

This photograph shows the actual laboratory environment where the cabinet radiation tests were conducted. The log periodic antenna and cable connected to the spectrum analyzer are shown in the foreground and the XTREME-2000 is shown in the background. The transmitter was rotated 90 degrees for each of the measurement orientations. The antenna was rotated from horizontal to vertical polarization at each measurement point.

As indicated in the spreadsheet data on the following page, the worst case measurement was 62 dB at the second harmonic. The measurement tables for the all views of the transmitter at each frequency are shown below. The results indicate that all radiated harmonics meet the FCC requirement of 60 dB as outlined in FCC rule 2.1053 and 2.1057.

CABINET RADIATION DATA

FRONT VIEW

CABINET RADIATION SPREADSHEET

Front View

100 W= 50 dBm

Corrected level must be less than -10 dBm

Distance is 40 feet

Harmonic	Frequency MHz	Measured Level dBm	Cable Loss dB	Antenna Gain dB	Path Loss dB	Corrected Level dBm	Required Level	Comparison to transmit level dB
Xmit freq.	509	-40	0.4	4.6	48.4	4.2	-10 dBm	45.8
2nd	1018	-62	0.8	5	54.4	-11.8	-10 dBm	61.8
3rd	1527	-77	1.2	4.1	57.9	-22	-10 dBm	72
4th	2036	-77	1.6	5	60.4	-20	-10 dBm	70
5th	2545	-77	1.7	4.9	62.3	-17.9	-10 dBm	67.9
6th	3054	-77	1.8	4.7	63.9	-16	-10 dBm	66
7th	3563	-77	1.9	4.5	65.3	-14.3	-10 dBm	64.3
8th	4072	-77	2	4.5	66.4	-13.1	-10 dBm	63.1
9th	4581	-77	2.8	4.8	67.4	-11.6	-10 dBm	61.6
10th	5090	-77	3.2	4.9	68.4	-10.3	-10 dBm	60.3

Note: -77 dB was the noise floor of the spectrum analyzer. All harmonics above the 3rd harmonic were not visible

LEFT SIDE VIEW

CABINET RADIATION SPREADSHEET

Left side

100 W= 50 dBm

Corrected level must be less than -10 dBm

Distance is 40 feet

Harmonic	Frequency MHz	Measured Level dBm	Cable Loss dB	Antenna Gain dB	Path Loss dB	Corrected Level dBm	Required Level	Comparison to transmit level dB
Xmit freq.	509	-45	0.4	4.6	48.4	-0.8	-10 dBm	50.8
2nd	1018	-64	0.8	5	54.4	-13.8	-10 dBm	63.8
3rd	1527	-77	1.2	4.1	57.9	-22	-10 dBm	72
4th	2036	-77	1.6	5	60.4	-20	-10 dBm	70
5th	2545	-77	1.7	4.9	62.3	-17.9	-10 dBm	67.9
6th	3054	-77	1.8	4.7	63.9	-16	-10 dBm	66
7th	3563	-77	1.9	4.5	65.3	-14.3	-10 dBm	64.3
8th	4072	-77	2	4.5	66.4	-13.1	-10 dBm	63.1
9th	4581	-77	2.8	4.8	67.4	-11.6	-10 dBm	61.6
10th	5090	-77	3.2	4.9	68.4	-10.3	-10 dBm	60.3

Note: -77 dB was the noise floor of the spectrum analyzer. All harmonics above the 3rd harmonic were not visible

RIGHT SIDE VIEW

CABINET RADIATION SPREADSHEET

Right Side View

100 W= 50 dBm

Corrected level must be less than -10 dBm

Distance is 40 feet

Harmonic	Frequency MHz	Measured Level dBm	Cable Loss dB	Antenna Gain dB	Path Loss dB	Corrected Level dBm	Required Level	Comparison to transmit level dB
Xmit freq.	509	-46	0.4	4.6	48.4	-1.8	-10 dBm	51.8
2nd	1018	-63	0.8	5	54.4	-12.8	-10 dBm	62.8
3rd	1527	-77	1.2	4.1	57.9	-22	-10 dBm	72
4th	2036	-77	1.6	5	60.4	-20	-10 dBm	70
5th	2545	-77	1.7	4.9	62.3	-17.9	-10 dBm	67.9
6th	3054	-77	1.8	4.7	63.9	-16	-10 dBm	66
7th	3563	-77	1.9	4.5	65.3	-14.3	-10 dBm	64.3
8th	4072	-77	2	4.5	66.4	-13.1	-10 dBm	63.1
9th	4581	-77	2.8	4.8	67.4	-11.6	-10 dBm	61.6
10th	5090	-77	3.2	4.9	68.4	-10.3	-10 dBm	60.3

Note: -77 dB was the noise floor of the spectrum analyzer. All harmonics above the 3rd harmonic were not visible

BACK VIEW

CABINET RADIATION SPREADSHEET

Back View

100 W= 50 dBm

Corrected level must be less than -10 dBm

Distance is 40 feet

Harmonic	Frequency MHz	Measured Level dBm	Cable Loss dB	Antenna Gain dB	Path Loss dB	Corrected Level dBm	Required Level	Comparison to transmit level dB
Xmit freq.	509	-47	0.4	4.6	48.4	-2.8	-10 dBm	52.8
2nd	1018	-68	0.8	5	54.4	-17.8	-10 dBm	67.8
3rd	1527	-77	1.2	4.1	57.9	-22	-10 dBm	72
4th	2036	-77	1.6	5	60.4	-20	-10 dBm	70
5th	2545	-77	1.7	4.9	62.3	-17.9	-10 dBm	67.9
6th	3054	-77	1.8	4.7	63.9	-16	-10 dBm	66
7th	3563	-77	1.9	4.5	65.3	-14.3	-10 dBm	64.3
8th	4072	-77	2	4.5	66.4	-13.1	-10 dBm	63.1
9th	4581	-77	2.8	4.8	67.4	-11.6	-10 dBm	61.6
10th	5090	-77	3.2	4.9	68.4	-10.3	-10 dBm	60.3

Note: -77 dB was the noise floor of the spectrum analyzer. All harmonics above the 3rd harmonic were not visible

DEMONSTRATION OF 8-VSB TRANSMISSION & RECEPTION

The test equipment was configured as shown in Figure 1. The input signal to the XTREME-2000 transmitter was provided by an over-the-air KCET DTV signal. An 8-VSB receiver was mounted physically close to the transmitter and a small amount of signal was directly coupled to the 8-VSB receiver. A photograph of the 8-VSB receiver screen was taken to demonstrate that the XTREME-2000 transmits an 8-VSB signal capable of being received by a standard ATSC 8-VSB receiver.

VOLTAGES AND CURRENTS TO FINAL AMPLIFIERS

Final amplifier DC voltage and current measurements were made with the transmitter operating at 100 watts output power and at 23 watts output power. Voltage measurements were made using a Fluke 77 meter at each power level. Current measurements were made using the transmitter meter. The power supply voltage was measured as 31 volts for each operational point.

Output Power = 100 Watts
Voltage = 31 volts
Total DC Current = 48.3 amps
Final amplifier DC power input = 31 x 48.3 = 1497 watts

Output Power = 23 Watts
Voltage = 31 volts
Total DC Current = 35.2 amps
Final amplifier DC power input = 31 x 35.2 = 1091 watts

TEST EQUIPMENT USED FOR TYPE CERTIFICATION

The following list of test equipment was used for measurements taken for type certification or used to calibrate specific test instruments for type certification.

Manufacturer	Model	Description	Serial Number
TEKTRONIX	RFA-300A	8VSB MEASUREMENT SET	B010102
AGILENT	E4404B	ESA-E SERIES SPECTRUM ANALYZER	MY44211595
A.H.SYSTEM	SAS-512-7	LOG PERIODIC ANTENNA	105
PASTERNACK	RG393/U	6FT COAXIAL CABLE TO E4404B	
HP	8648A	SIGNAL GENERATOR (REF OSC)	3636A02732
JFW	50FH-030-300-2	300W 30dB LOAD ATTENUATOR	
HP	E4418	EPM SERIES POWER METER	US38470752
AGILENT	E4412A	E SERIES POWER SENSOR	MY41498607
WEDCO	E2-17MM	TEMPERATURE CHAMBER	21441275
SAMSUNG	SIR-T165	DIGITAL RECEIVER	31CTC000431F
VIEWSONIC	VLCDS21434-1	VIDEO MONITOR	E800671707
HP	8714ET	RF NETWORK ANALYZER	US39451252
POWERSTAT	1256-2P-B	VARIABLE AUTOTRANSFORMER	3206