RF Power Output Measurements

The equipment was configured as shown in Figure 1. The attenuation factor through the attenuators was calibrated at the channel center frequency of the channel 258 FM signal of 99.5 MHz. Average power was read on the Rohde Schwarz Power Meter.

Measurement Of Nominal Transmitter Power

The transmitter was energized at nominal power in the test configuration and the power was read on the R & S Power Meter through a calibrated 56.11 dB directional coupler. The indicated reading is shown below.

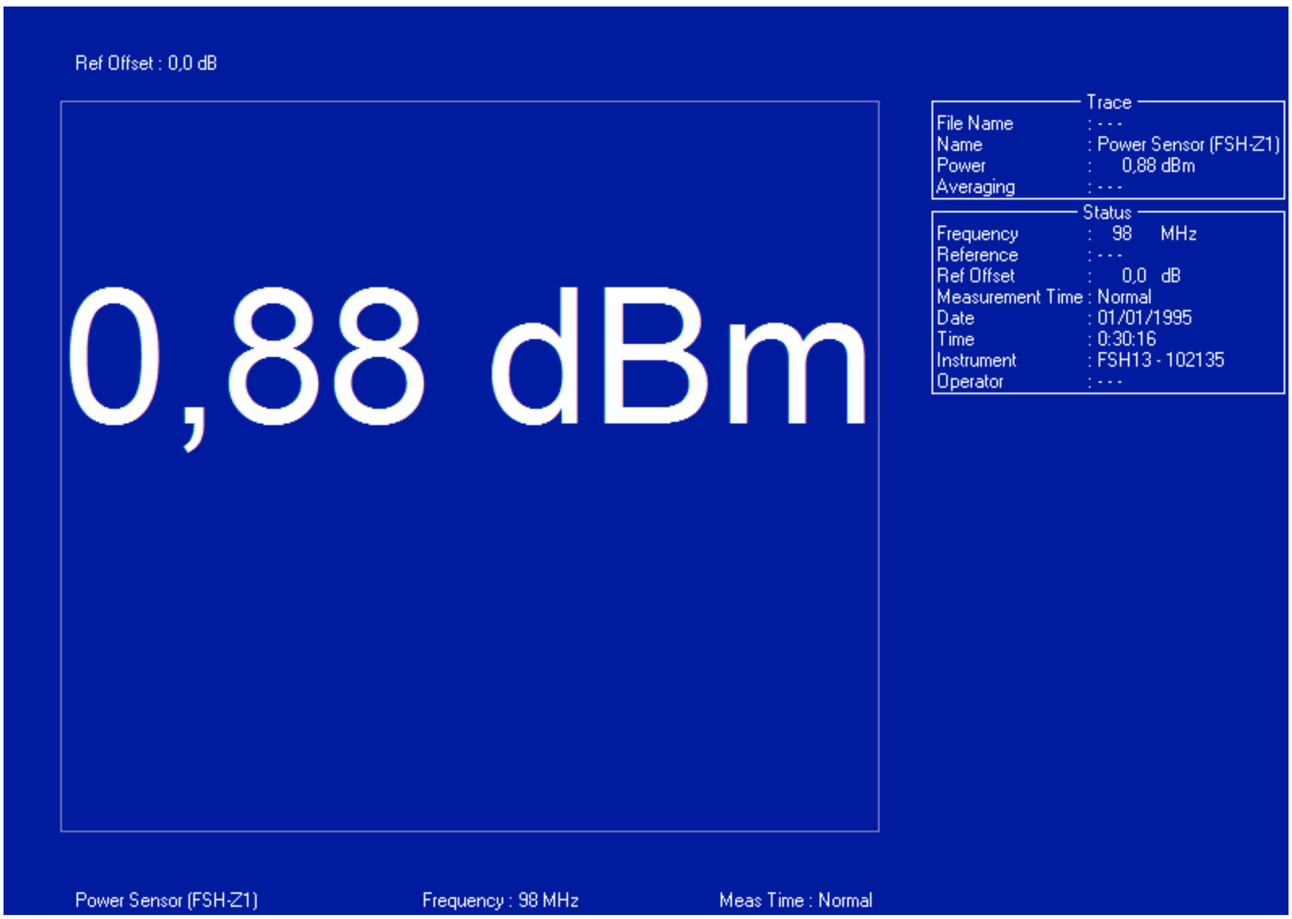


Figure 2—Power Meter Reading at Nominal Transmitter Power

Calculation of Output Power: The measured output power of 0.88 dBm, read with the FSH-Z1 power sensor plus the directional coupler factor of 56.11 dB yields a power output of 56.99 dBm or 500 watts. With this operational condition, measured transmitter final amplifier voltage is 44.8 VDC and final amplifier current is 15.0 Amps.

Emission Mask Compliance

To determine emission mask compliance, the test equipment configuration shown in Figure 1 was used. A Rohde & Schwarz ETL spectrum analyzer was used The transmitter tested for compliance with the emission mask as specified in FCC rule 73.317. Measurements were conducted in the monophonic and the stereophonic modes. The first part of the tests measured the adjacent channel emission and the second part of the tests measured the harmonic and spurious energy.

The transmitter was energized at 500 watts at a center frequency of 99.5 MHz as measured by the power meter used in the above exhibit. The first set of tests was done in the monophonic mode and a reference was established on the spectrum analyzer using an unmodulated carrier. After the reference value with the unmodulated carrier was established, modulation was inititated with a 15 kHz signal at 85% modulation (.85 x 75 kHz) for 63.75 kHz deviation as measured on the spectrum analyzer using the demodulation mode and zero span. Screen shots were taken with markers set up at the 120 kHz, 240 kHz and 600 kHz points to demonstrate that the power at those points was less than the 25 dBc, 35 dBc, points. The power beyond +/- 600 kHz was required to be:

43 + 10 log Po or 43+10 log (500) = 70 dB below the unmodulated carrier output power.

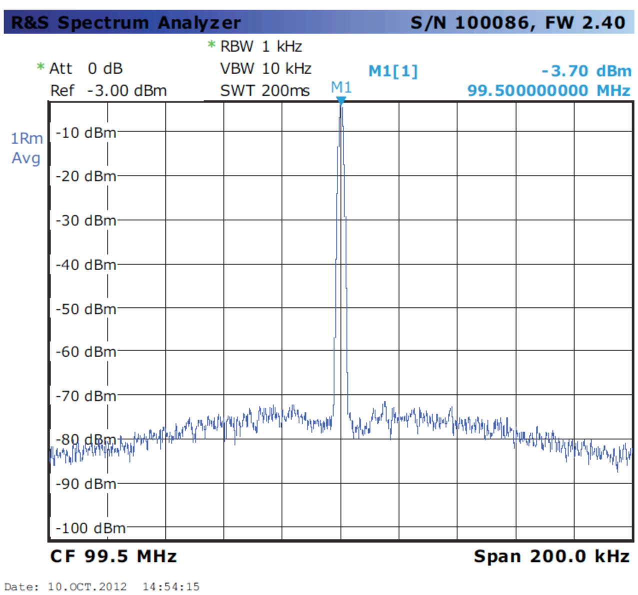


Figure 3 Unmodulated Carrier Reference

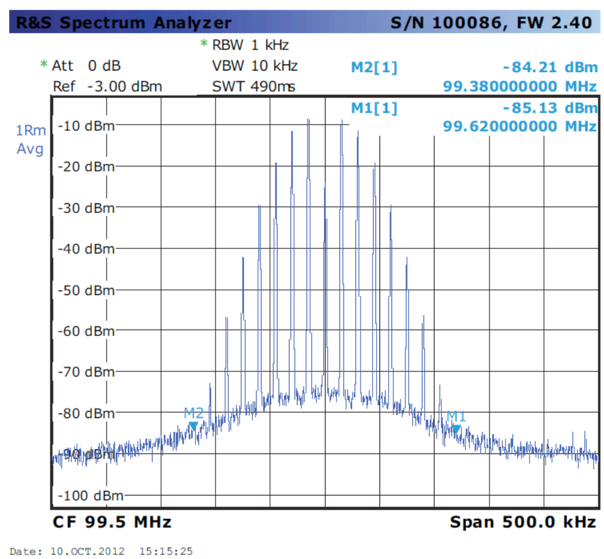
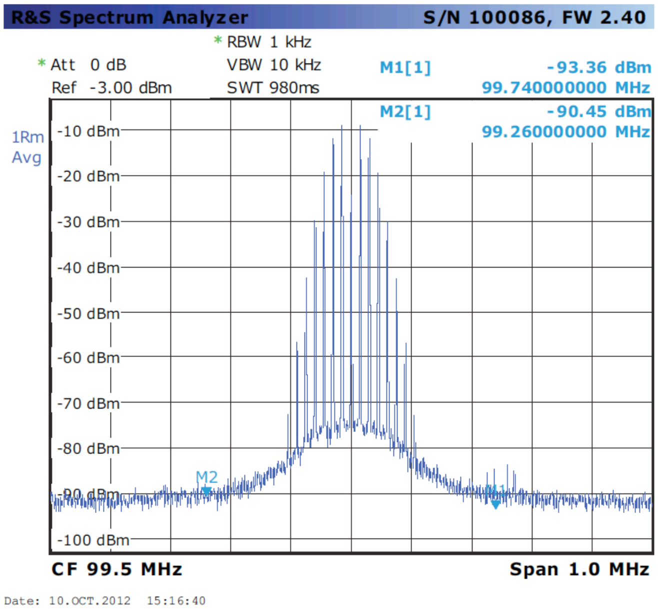


Figure 4 Deviation @ 63.75 kHz
Markers set at +/- 120kHz
RBW setting = 10 kHz



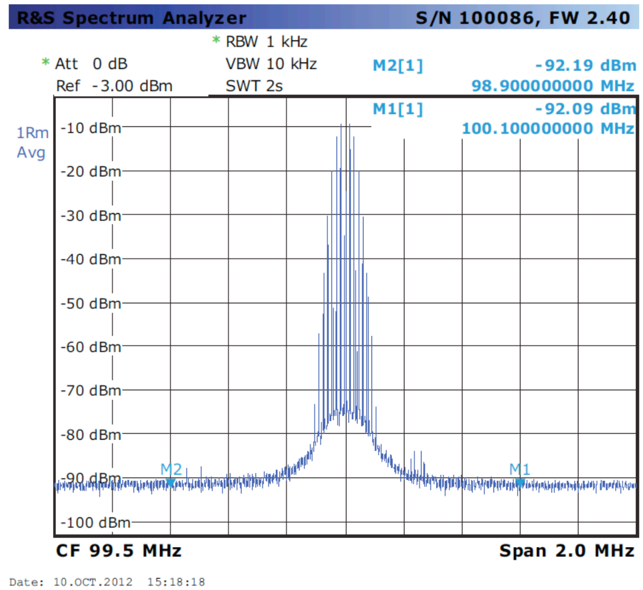


Figure 5 Deviation @ 63.75 kHz
Markers set at +/- 240 kHz
RBW setting = 10 kHz

Figure 6 Deviation @ 63.75 kHz
Markers set at +/- 600 kHz
RBW setting = 10 kHz

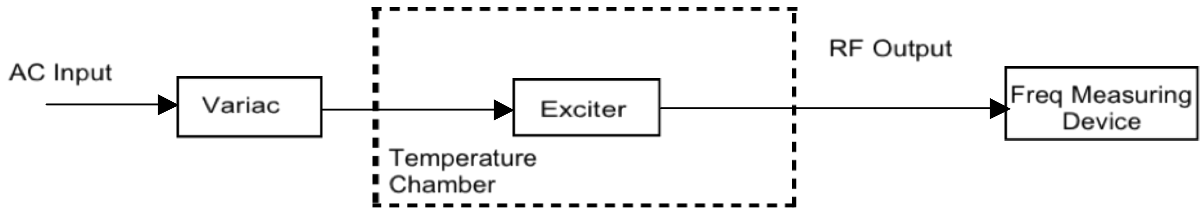
It is clear by examining the screen shots that the energy the markers identify is below 25 dBc at 120 kHz offset, 35 dBc offset at 240 kHz, and 70 dBc at 600 kHz offset from the carrier. Assuming a RBW correction factor of 30, (300 kHz/10 kHz), or 14.8 dB, is used, the marker values would still be significantly less power than -25 dBc, -35 dBc, or -70 dBc.

The second part of the emission mask compliance test was executed for harmonic and spurious frequencies up to the 10th harmonic of the transmitter frequency. For this test, the same reference level with an unmodulated carrier was used. A notch filter to eliminate the fundamental frequency was used at the input to the spectrum analyzer to prevent overload or harmonic responses from the spectrum analyzer itself. The notch filter was verified to have no attenuation at frequencies in the range of interest except for the fundamental channel. The table below indicates if harmonic or spurious energy was present and the correction values along with the pass-fail criterion.

Harmonic Number	Freq. [MHz]	Coupler+ Cable Correction [dB]	HPF Filter Correction [dB]	Measured Value	Corrected Value	Result dBc	Pass/Fail
1	98	-56.58		N/A	N/A		
2	196	-57.133	-0.1223	-82	-24.9893	81.5693	Pass
3	294	-57.474	-0.1672	-79	-21.6932	78.2732	Pass
4	392	-57.997	-0.2456	-100	-42.2486	98.8286	Pass
5	490	-58.948	-0.2647	-98	-39.3167	95.8967	Pass
6	588	-58.253	-0.2882	-100	-42.0352	98.6152	Pass
7	686	-59.959	-0.3719	-89	-29.4129	85.9929	Pass
8	784	-58.475	-0.4093	-98	-39.9343	96.5143	Pass
9	882	-60.157	-0.4523	-100	-40.2953	96.8753	Pass
10	980	-57.978	-0.5061	-100	-42.5281	99.1081	Pass

FREQUENCY STABILITY

The frequency stability of the transmitter is determined solely by the exciter used. The frequency stability was measured versus temperature and versus line voltage. The unmodulated carrier frequency was used as the frequency reference. Frequency stability versus temperature and line voltage was measured in a controlled environment. For these tests, the exciter RF output was fed to a calibrated Rohde & Schwarz ETL that has better than 0.1 ppm accuracy. 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:



TEST EQUIPMENT CONFIGURATION

Line Voltage (Volts)	**Frequency Shift (Hz)**
(85%)	99.50003078
(Nominal)	99.50003083
(115%)	99.50003099

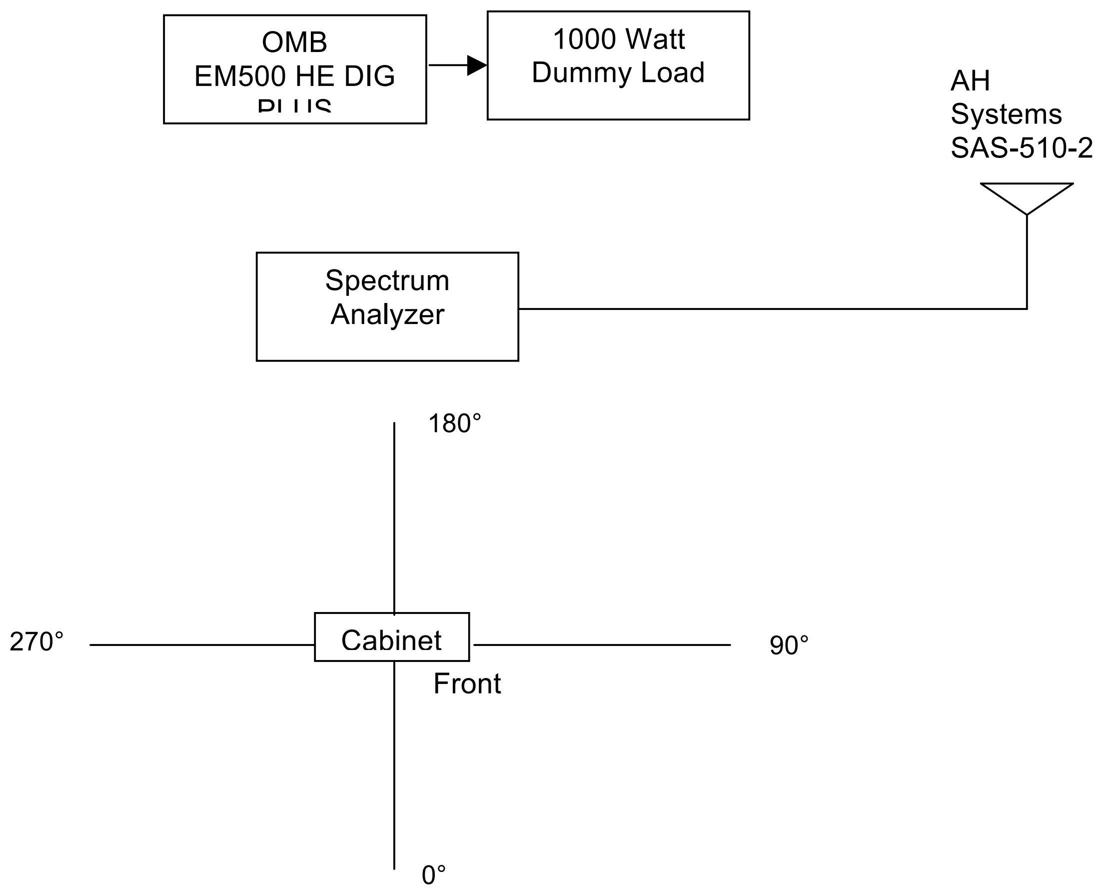
For the temperature stability measurements, the transmitter was placed inside a Tenney temperature chamber model T10C equipped with a Watlow EZ Zone temperature controller. The transmitter was energized and the carrier frequency was measured on the Rohde and Schwarz ETL test set. The temperature was then lowered to -10°C, allowed to stabilize for 15 minutes and then cycled to each warmer temperature where it was allowed to stabilize for 10 minutes before recording the measured frequency and moving on to the next higher temperature. The recorded data below indicates that the frequency stability requirements of FCC Rules were met.

Temperature °C	Time	Frequency (Hz)	Difference (Hz)
25	10:50	99500041.43	Reference
-10	11:15	99500030.03	-11.4
0	11:30	99500025.03	-16.4
10	11:45	99500028.03	-13.4
20	12:00	99500023.03	-18.4
30	12:15	99500016.00	-25.43
40	12:30	99500017.04	-24.39
50	13:50	99500024.04	-17.39
55	14:05	99500027.03	-14.4

CABINET RADIATION

The transmitter and test equipment were configured as shown below including the angles of measurement with respect to the transmitter cabinet. The transmitter was operated at 500 Watts average power. The free space path loss, cable loss and antenna gain characteristics were obtained at the fundamental frequency and at each of the harmonics of the transmitter 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 50 feet in 4 different physical rotation angles: 0, 90, 180 and 270 degrees (0 degrees being the front of the cabinet). The cabinet was rotated in four directions 90 degrees apart so that all angles of the transmitter were evaluated. The measured value for each spectrum emission emanating from the cabinet was recorded in the tables beginning on the next page.

Test Equipment Configuration for Cabinet Radiation



Cabinet Radiation Test Results

As calculated from the spreadsheet data on the following pages, the worst case measurement was -82.6 dB relative to the unmodulated carrier power. The measurement tables for all views of the transmitter are shown on the following pages.

CABINET RADIATION TEST

TEST INPUTS ***CONDITIONS & PARAMETERS***

TEST DATE:	**10/11/12**		
TEST ENGINEER:	**Greg Best**		
TRASMITTER MODEL NO:	EM500 HE Dig Plus		
OPERATING POWER OUTPUT LEVEL	**57.0 dBm**	**500**	**Power in Watts**
OPERATING FREQUENCY IN GHz	**99.5 MHz**	**258**	**Channel**
ANTENNA MODEL NUMBER	**SAS-510-2, SAS-542**		
SPECTRUM ANALYZER MODEL	**R& S ETL**		
DISTANCE TO TRANSMITTER	**18 meters**		

			FRONT	**VIEW**				
HARMONIC	FREQUENCY	MEASURED	CABLE	ANTENNA	PATH	CORRECTED	MAXIMUM	STATUS
		LEVEL	LOSS	GAIN	LOSS	LEVEL	LEVEL	P=PASS
	GHz	dBm	dB	dB	dB	dBm	dBm	
Fc	0.0995	-49	0.4	N/A	37.56	#VALUE!	-3.0	N/A
2	0.199	-80	0.6	2.5	43.58	-38.32	-3.0	P
3	0.2985	-84	0.7	6.8	47.10	-43.00	-3.0	P
4	0.398	-87	0.9	6.6	49.60	-43.10	-3.0	P
5	0.4975	-80	0.9	6.7	51.54	-34.24	-3.0	P
6	0.597	-85	1.0	6.7	53.12	-37.63	-3.0	P
7	0.6965	-82	1.0	7.2	54.46	-33.74	-3.0	P
8	0.796	-85	1.0	7.1	55.62	-35.48	-3.0	P
9	0.8955	-103	1.0	7.3	56.65	-52.65	-3.0	P
10	0.995	-105	1.0	7.0	57.56	-53.44	-3.0	P

			RIGHT	**VIEW**				
HARMONIC	FREQUENCY	MEASURED	CABLE	ANTENNA	PATH	CORRECTED	MAXIMUM	STATUS
	GHz	LEVEL	LOSS	GAIN	LOSS	LEVEL	LEVEL	
		dBm	dB	dB	dB	dBm	dBm	
Fc	0.0995	N/A	0.4	N/A	37.56	N/A	-3.0	N/A
2	0.199	-94	0.6	2.5	43.58	-52.32	-3.0	P
3	0.2985	-73	0.7	6.8	47.10	-32.00	-3.0	P
4	0.398	-93	0.9	6.6	49.60	-49.10	-3.0	P
5	0.4975	-75	0.9	6.7	51.54	-29.24	-3.0	P
6	0.597	-86	1.0	6.7	53.12	-38.63	-3.0	P
7	0.6965	-87	1.0	7.2	54.46	-38.74	-3.0	P
8	0.796	-85	1.0	7.1	55.62	-35.48	-3.0	P
9	0.8955	-99	1.0	7.3	56.65	-48.65	-3.0	P
10	0.995	-102	1.0	7.0	57.56	-50.44	-3.0	P

			REAR	VIEW				
HARMONIC	FREQUENCY	MEASURED	CABLE	ANTENNA	PATH	CORRECTED	MAXIMUM	STATUS
	GHz	LEVEL	LOSS	GAIN	LOSS	LEVEL	LEVEL	
		dBm	dB	dB	dB	dBm	dBm	
Fc	0.0995	N/A	0.4	N/A	37.56	N/A	-3.0	N/A
2	0.199	-90	0.6	2.5	43.58	-48.32	-3.0	P
3	0.2985	-83	0.7	6.8	47.10	-42.00	-3.0	P
4	0.398	-88	0.9	6.6	49.60	-44.10	-3.0	P
5	0.4975	-77	0.9	6.7	51.54	-31.24	-3.0	P
6	0.597	-90	1.0	6.7	53.12	-42.63	-3.0	P
7	0.6965	-81	1.0	7.2	54.46	-32.74	-3.0	P
8	0.796	-79	1.0	7.1	55.62	-29.48	-3.0	P
9	0.8955	-76	1.0	7.3	56.65	-25.65	-3.0	P
10	0.995	-95	1.0	7.0	57.56	-43.44	-3.0	P

			LEFT	VIEW				
HARMONIC	FREQUENCY	MEASURED	CABLE	ANTENNA	PATH	CORRECTED	MAXIMUM	STATUS
	GHz	LEVEL	LOSS dB	GAIN dB	LOSS	LEVEL	LEVEL	
		dBm	dB	dB	dB	dBm	dBm	
Fc	0.0995	N/A	0.4	N/A	37.56	N/A	-3.0	N/A
2	0.199	-89	0.6	2.5	43.58	-47.32	-3.0	P
3	0.2985	-75	0.7	6.8	47.10	-34.00	-3.0	P
4	0.398	-95	0.9	6.6	49.60	-51.10	-3.0	P
5	0.4975	-79	0.9	6.7	51.54	-33.24	-3.0	P
6	0.597	-85	1.0	6.7	53.12	-37.63	-3.0	P
7	0.6965	-82	1.0	7.2	54.46	-33.74	-3.0	P
8	0.796	-84	1.0	7.1	55.62	-34.48	-3.0	P
9	0.8955	-97	1.0	7.3	56.65	-46.65	-3.0	P
10	0.995	-96	1.0	7.0	57.56	-44.44	-3.0	P

PRE-EMPHASIS AND STEREOPHONIC PARAMETERS

The transmitter was energized at 500 watts in the configuration shown in Figure 1 and an Agilent 4402 with FM demodulation option was used as the spectrum analyzer. A variable audio oscillator signal was fed to the monophonic input of the transmitter and adjusted to obtain 100% modulation or 75 kHz at the reference frequency of 400 Hz. The spectrum analyzer was set to zero span, calibrated and the deviation output screen readout was used to measure the deviation of the transmitter. The audio signal generator amplitude was varied from 50 Hz to 15 kHz while keeping the deviation of the transmitter constant. The audio amplitude was compared to the reference frequency and then recorded and plotted to determine if the data met the response curve identified on the attached graph from FCC.

Pre-Emphasis Test Results—EM500 HE Dig Plus Compact

Frequency (Hz)	Amplitude (Normalized)	Pass/Fail
50	-0.2	Pass
100	0.0	Pass
200	-0.1	Pass
400	Ref	Pass
500	+0.1	Pass
1000	0.57	Pass
2000	2.45	Pass
4000	6.30	Pass
8000	11.6	Pass
10000	13.5	Pass
12000	15.0	Pass
15000	16.9	Pass

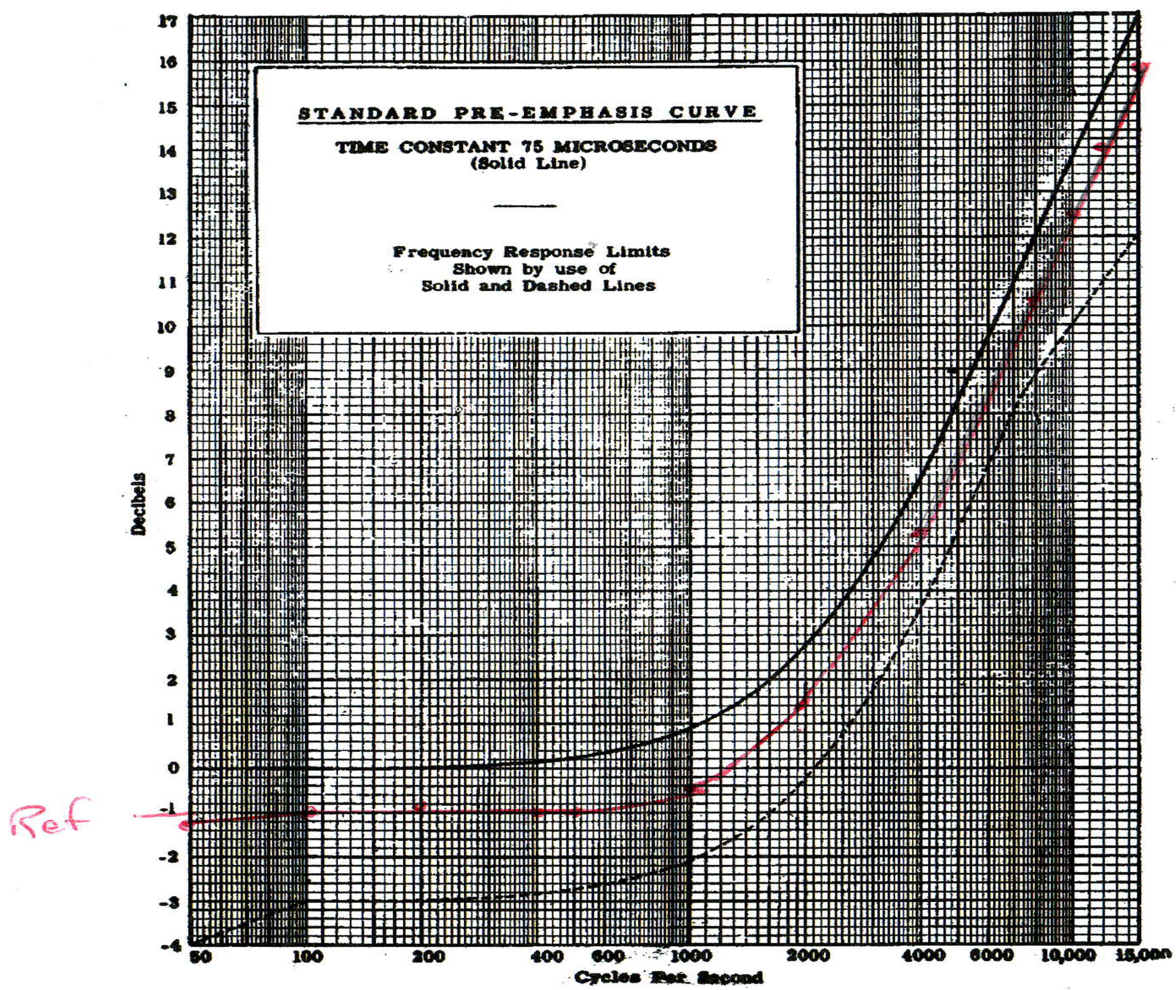
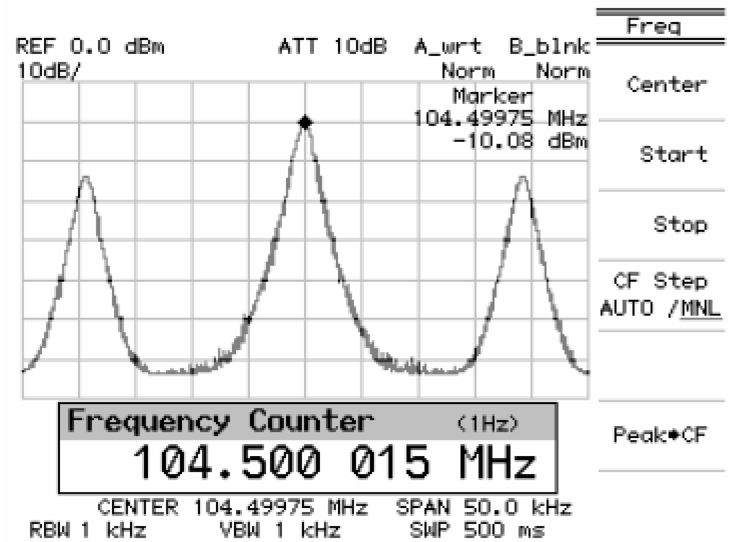


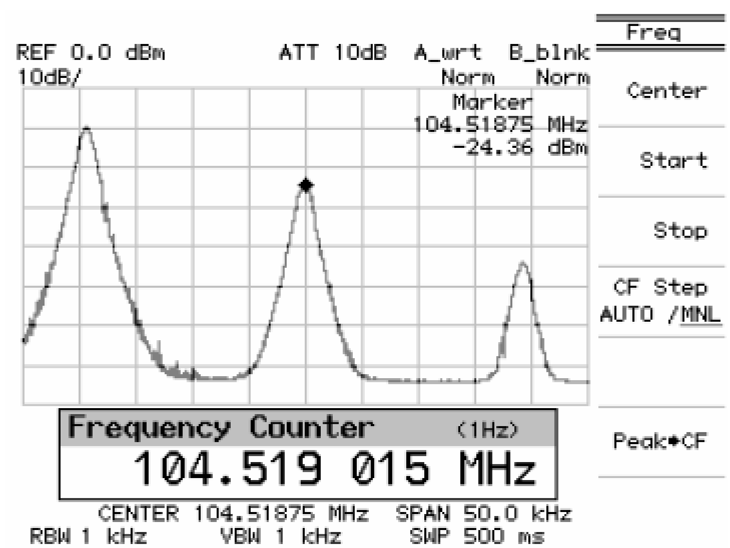
FIGURE 12

Stereophonic Operation Compliance

Other than the occupied bandwidth performance as previously demonstrated, the pilot subcarrier must be 19.000 kHz +/- 2 Hz with a deviation of between 8 and 10 kHz, and the suppressed 38 kHz subcarrier modulation must be less than 1 % of the main carrier according to FCC Rule 73.322. To demonstrate compliance, the transmitter was energized in the stereo mode but without any modulation and an RF sample was applied to the Advantest spectrum analyzer. After calibration, the pilot frequency and the transmitter carrier reference frequency were both measured and are shown in the plots below verifying that the frequency tolerance of +/- 2 Hz is met.



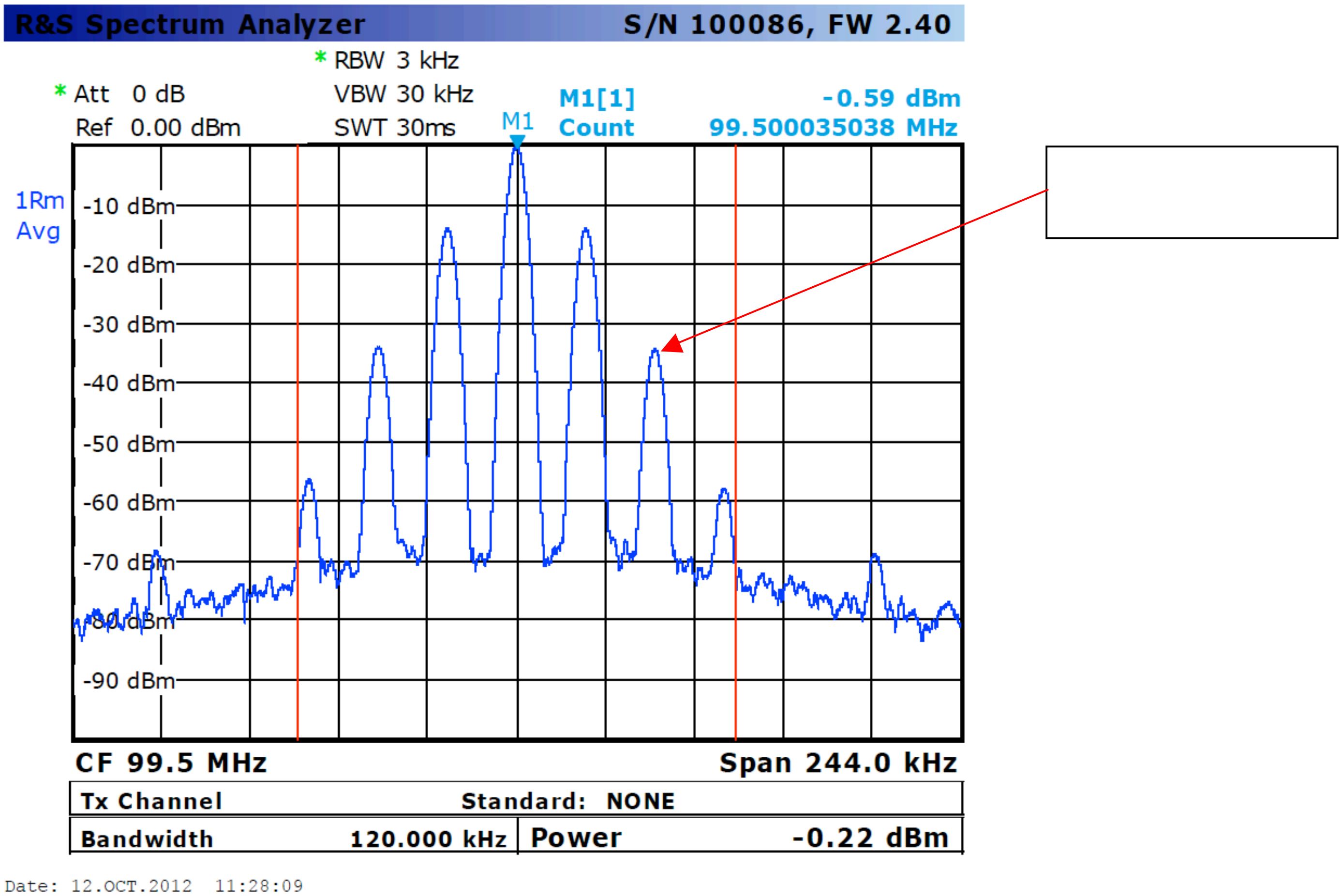
Main carrier



Main carrier +19KHz

38 kHz suppressed subcarrier sideband

The 38 kHz suppressed subcarrier was measured as -30 dB (two sidebands at -33 dB) as shown below relative to the unmodulated carrier power reference using the ETL spectrum analyzer. The low modulation index of the suppressed subcarrier results in only a single pair of sidebands relative to the main carrier. FCC Rule 73.322 requires 1% modulation or less. This would correspond to two sidebands at -23 dB so the 38 kHz suppressed subcarrier more than adequately meets this requirement.



Test Equipment List

The following test equipment was used in the various test equipment configurations or to create calibration of equipment at various frequencies. All equipment was within its calibration period.

VENDOR	MODEL NUMBER	DESCRIPTION	SERIAL NUMBER
Madell Corp.	Unknown	Variac	N/A
Tenney	T10C	Temperature Chamber	N/A
Watlow	EZ Zone	Temperature Controller/Monitor	N/A
Agilent	33220A	Audio Oscillator	1093309
Microwave Filter Co.	6367	Notch Filter	5/95
RF Power Sensor	Rohde&Schwarz	FSH-Z1	100021
Agilent	4402B	Spectrum Analyzer	1072066
BIRD	8890-300	3000 Watt Dummy Load	N/A
BIRD	8251	1000 Watt Dummy Load	N/A
Rohde & Schwarz	ETL	ETL Spectrum Analyzer	100086
A H Systems	SAS-510-2	Log Periodic Antenna	N/A
A H Systems	SAS-542	Biconical Antenna	N/A
Advantest	R3131	Spectrum Analyzer	J003753

SUMMARY

The equipment has been tested according to good engineering practice and FCC rules governing type certification and found to be in compliance with all appropriate FCC rules and regulations.