SMITH ELECTRONICS, INC.
ELECTROMAGNETIC COMPATIBILITY LABORATORIES

RADIO-FREQUENCY SPURIOUSE EMISSIONS TEST REPORT

FOR

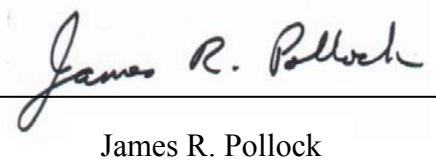
HEXAGRAM, INC.

"PIT-SET" TRANSMITTER
Model 6717B
FCC ID: LLB6717D

SIGNAL SUBSTITUTION METHOD

January 10, 2003

Prepared by:



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TEST REPORT

INTRODUCTION

The Hexagram "PIT-SET" transmitter is a battery operated transmitter designed to be electrically attached to an in ground utility meter. The transmitter would be mounted in the meter pit and provide a short, intermittent radio frequency transmission to provide a remote reading of the meter. A microprocessor provides timing, control and data processing functions. The built in antenna is inaccessible to the user and no provision is made for an external antenna. This report describes the tests performed on the transmitter for output power and spurious emissions

MEASUREMENTS PERFORMED

Measurements were made to determine the equivalent output power and the level of harmonic emissions in relation to the fundamental frequency using the substitution test method of TIA-603.

POWER OUTPUT AND SPURIOUS EMISSIONS

A series of measurements of the operating frequency and any harmonic emissions was made on the Smith Electronics, open field test site located at 8200 Snowville Road, Brecksville, OH. Data pertinent to this site is on file with the FCC.

Measurements below 1000 MHz were made at a three-meter test distance with frequencies above 1000 MHz being measured at one meter. A receiver and a tuned dipole were used for receiving below 1000 MHz and a spectrum analyzer and a wave guide antenna above 1000 MHz.

The transmitter was suspended from a Ford meter box cover (approx. 10.5" x 7") This steel cover was placed atop an open cardboard box so that the transmitter body was below the cover. The box and transmitter were placed on a remotely rotatable, non-conducting test stand. This general set up is shown in Pictorial 1. Because of the intermittent nature of the normally operating transmitter, an external battery pack was used and the transmitter was forced to continually transmit for the measurements.

With the test receiver tuned to the unmodulated signal, the transmitter was rotated to the position of maximum signal. The receiving antenna was then varied between 1 and 4 meters in height to again maximize the signal. Measurements were made with the antennas positioned both vertically and horizontally and the maximum signal recorded.

No differences were observed with different signal detectors, so a quasi-peak detector was used for the signals below 1000 MHz and average detection above 1000 MHz.

After the maximum received meter readings were obtained for each frequency and polarity, the meter under test was removed from the area and replaced by a signal generator and transmitting antenna. With the transmit antenna placed as close as possible to the position of the test unit, the signal generator was activated at a test frequency. With the signal detected, the transmit antenna was rotated slightly to maximize the reading. The receive antenna was also positioned for maximum reception. The signal generator output was then adjusted until the received signal was equal to the received signal from the unit

under test. These measurements were repeated for each frequency and antenna orientation and the maximum values obtained are noted in Table 1. Antenna gain and coax loss figures are also included in Table 1

In order to convert the signal generator output value to equivalent radiated power from a dipole, the following equation is used:

$$P_d = P_g - \text{cable loss(dB)} + \text{antenna gain(dB}_d\text{)}$$

where:

P_d is the dipole equivalent power, P_g is the generator output into the substitution antenna and "antenna gain" is the gain of the substitution antenna with respect to a dipole.

According to 90.210(d)(3) all emissions greater than 12.5 kHz from the center of the authorized band shall be attenuated below the unmodulated carrier by 50 + 10log(P). Using P = 0.050 W, the required attenuation is 37.0 dB. An examination of Table 1 shows that all emissions are 45.7 dB or more below the carrier level.

TABLE 1
HEXAGRAM PIT SET TRANSMITTER
SUBSTITUTION METHOD
per TIA-603

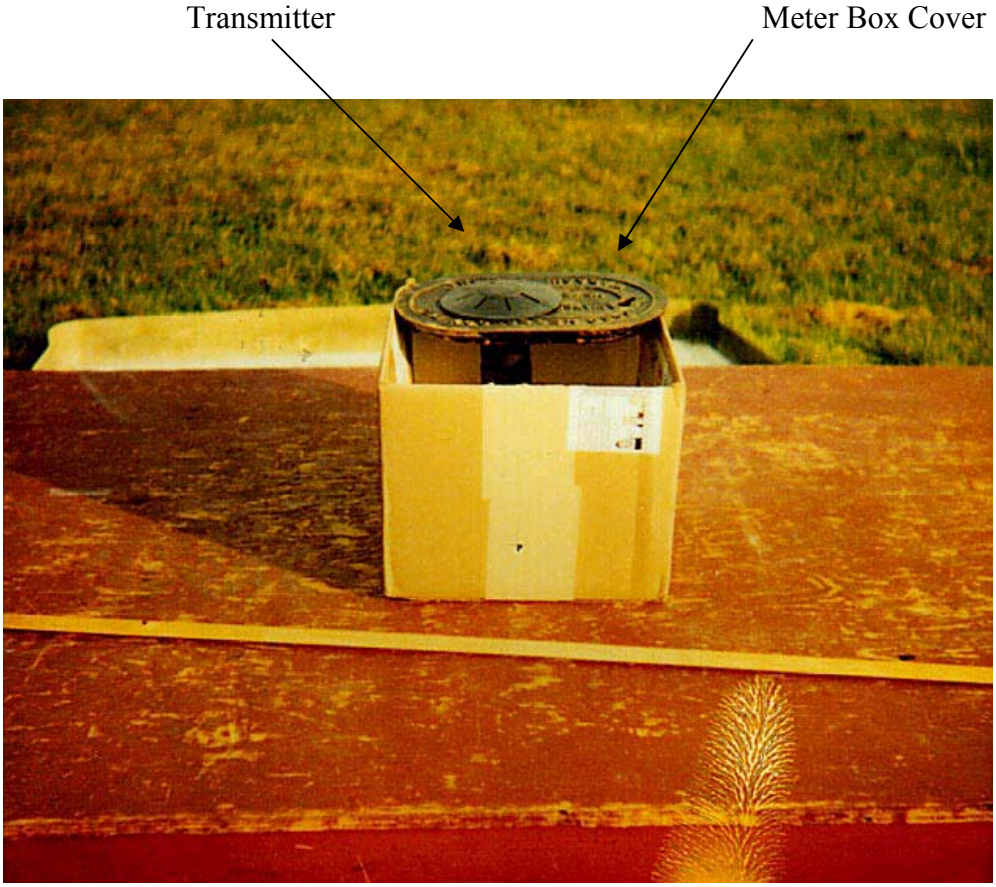
3 meter measurement using LPA antenna

Frequency (MHz)	Gen. Output (dB)	Coax Loss (dB)	Ant. Gain (dBd)	Dipole Eq. Power (dBm)	Difference (dB)
460	+14.5	0.3	2.8	17.0	--
920	-33.0	0.5	3.8	-29.7	-46.7

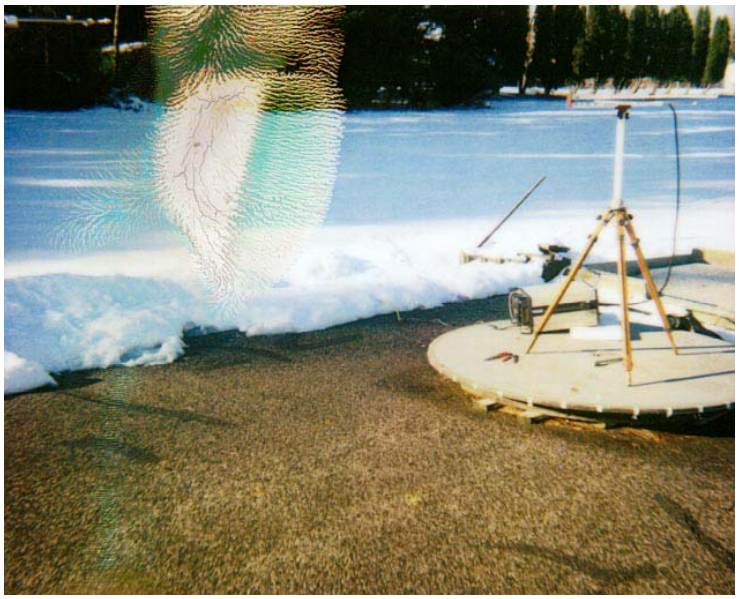
1 meter measurement using horn antenna

Frequency (MHz)	Gen. Output (dBm)	Coax Loss (dB)	Ant. Gain (dBd)	Dipole Eq. Power (dBm)	Difference (dB)
1380	-41.0	0.7	3.1	-38.6	-55.6
1840	-41.0	0.8	4.9	-36.9	-53.9
2300	-37.6	0.9	5.6	-32.9	-49.9
2760	-34.6	1.1	6.2	-29.5	-46.5
3220	-34.2	1.2	6.7	-28.7	-45.7
3680	-35.3	1.3	6.6	-30.0	-47.0
4140	-33.8	1.4	6.5	-28.7	-45.7
4600	-42.2	1.5	7.2	-36.5	-53.5

17 dBm = 50.1 mW or 0.050 W
Required attenuation for harmonics is 50 + log (.05) = 37.0 dB



PICTORIAL 1
HEXAGRAM PIT-SET
TEST SET UP



Below 1000 MHz

Above 1000 MHz

PICTORIAL 2
HEXAGRAM SUBSTITUTION METHOD
TEST SET UP

TEST INFORMATION

SUMMARY

The Hexagram "Pit-Set" transmitter, modified by changing the power amplifier and removing an RF shield, has been shown to be capable of complying with those requirements of the Federal Communications Commission for a Part 90 transmitter regarding output power and spurious emissions.

EQUIPMENT UNDER TEST	"Pit-Set" Transmitter, FCC ID: LLB6717D
MANUFACTURER	Hexagram, Inc. 23905 Mercantile Cleveland, OH 44122
TEST DATE	October 1 & 25, 2002 & January 8, 2003

TEST EQUIPMENT USED

RECEIVERS	Singer-Stoddart EMI Field Intensity Meter Model NM 37/57 S/N 0366-06168 Calibrated 6/02
	Hewlett-Packard Spectrum Analyzer Model 8593EM S/N 3536A00147 Calibrated 6/00
SIGNAL GENERATORS	Marconi Model 2955 S/N 1319281034 < 1 GHz Calibrated 10/02
	Agilent Model 83711B S/N US37101420 1 – 20 GHz Calibrated 12/02
RECEIVE ANTENNAS	Stoddart 91598-2 Tuned Dipole Frequency Range 400 – 1000 MHz
	EMCO 3115 Double Ridged Guide Horn S/N 2560 Frequency Range 1 – 18 GHz
TRANSMIT ANTENNAS	EMCO 3146 LPA < 1GHz S/N 1236 Frequency Range 200 – 1000 MHz
	Eaton 96001 Ridged Wave-Guide Horn S/N 2355 Frequency Range 1 – 18 GHz
MISCELLANEOUS	12.2 m RG-214/U coaxial cable
	2 x 1.8 m RG-214/U coaxial cable