Application for Certification

Utiliman Systems, Inc.

Model: MIU

47 CFR, Part 15, Subpart C, §15.247

Spread Spectrum Transmitters

FCC ID: ORCMIU50W

August 26, 1999

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1.0 General Description

1.1 Product Description

The Screamer meter interface unit (MIU) is a direct sequence spread spectrum transmitter operating in the unlicensed 902-928 MHz band. The transmitter delivers 50 mW of RF power into a printed antenna.

The transmitter has two interface ports for connections to two utility meters. The microprocessor on the transmitter board accumulates pulses from the two-meter ports and transmits the pulse counts, along with a unique I.D. in a 13 ms burst. The interval between bursts is programmable. Typical operation would require transmission intervals between 1 per hour and one per 8 hours.

In addition to pulse counts and a unique I.D., the transmitter sends a vendor code, a property code, and a status byte. The status byte indicates repeat level, battery status, and tamper for each meter.

The data is spread using a 63-bit PN code, providing 18 dB of processing gain.

1.2 Related Submittal(s) Grants

This is a single Application for Certification.

1.3 Test Methodology

Radiated emission measurements were performed according to the procedures in ANSI C63.4 (1992). All measurements were performed in Open Area Test Sites. Preliminary scans were performed in the Open Area Test Sites only to determine worst case modes. For each scan, the procedures for maximizing emissions in Section 4.3 were followed. All radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "**Justification Section**" of this Application.

1.4 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is located at 4317-A Park Drive NW, Norcross, Georgia. This test facility has been fully described in a report dated Jan. 8, 1993 submitted to your office. Please reference the site filing number: 31040/SIT 1300F2, dated April 26, 1996. The NVLAP program accredits this facility (NVLAP Code: 100409-0).

2.0 System Test Configuration

2.1 Justification

The system was configured for testing in a typical fashion (as a customer would normally use it). The transmitter was placed on a non-conductive table 80 cm above a ground plane. The support equipment also placed on the tabletop. During testing, all cables were manipulated to produce the worst case emissions.

For small, battery powered transmitters, the transmitter is attached to a cardboard box and placed in each of it orthogonal axis during the procedure described above.

For simplicity of testing, the EUT was configured to transmit continuously. The EUT was configured to transmit a typical maximum data stream during testing. The EUT contains only one channel (923.580MHz) which was the only channel tested.

2.2 EUT Exercising Software

Special software to exercise the device was provided by Utiliman Systems, Inc. For simplicity of testing, the unit was configured to transmit continuously.

2.3 Special Accessories

There are no special accessories for compliance of this product.

Confirmed by:

David J. Schramm
EMC Team Leader
Intertek Testing Services
Agent for Utiliman Systems, Inc.

____ Signature

____ Date

2.4 Equipment Modifications

Any modifications installed previous to testing by Utiliman Systems, Inc. will be incorporated in each production model sold/leased in United States.

Intertek Testing Services installed no modifications.

Confirmed by:

David J. Schramm
EMC Team Leader
Intertek Testing Services
Agent for Utiliman Systems, Inc.

____ Signature

____ Date

2.5 Support Equipment List and Description

The FCC ID's for all equipment, plus descriptions of all cables used in the tested system (including inserted cards, which have grants) are:

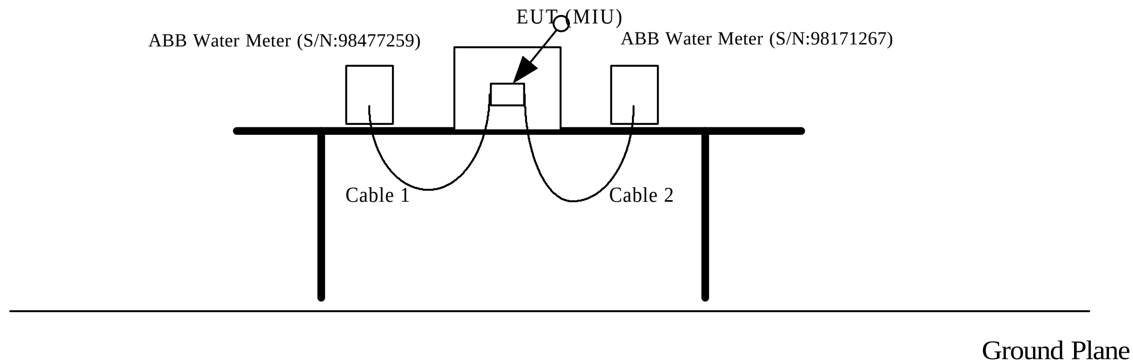
Water Meter	ABB
Model Number:	C-700 (5/8”)
Serial number:	98171267
FCC ID:	None

Water Meter	ABB
Model Number:	C-700 (5/8”)
Serial number:	98477259
FCC ID:	None

Cables:

1 Twisted three (conductor), 1m, unshielded (Cable 2 in Figure 2.6)
1 Twisted three (conductor), 2m, unshielded (Cable 1 in Figure 2.6)

2.6 Test Configuration Block Diagram



Configuration of Tested System

3.0 Test Results

Data is included of the worst case configuration (the configuration which resulted in the highest emission levels). A sample calculation, configuration photographs, data tables and plots of the emissions are included.

3.1 Emission Bandwidth (One Channel)

§15.247(a)(2) specifies that direct sequence systems shall have a 6-dB bandwidth of at least 500 kHz. The following plots show the bandwidth measurements for the only channel (923.580MHz). The bandwidth measurement for the single channels (923.580 MHz) was measured to be approximately 1420 kHz. The following plot was taken with a resolution bandwidth (RBW) of 100 kHz and a video bandwidth (VBW) of 1 MHz. Markers were displayed 6 dB down from the peak of the fundamental.

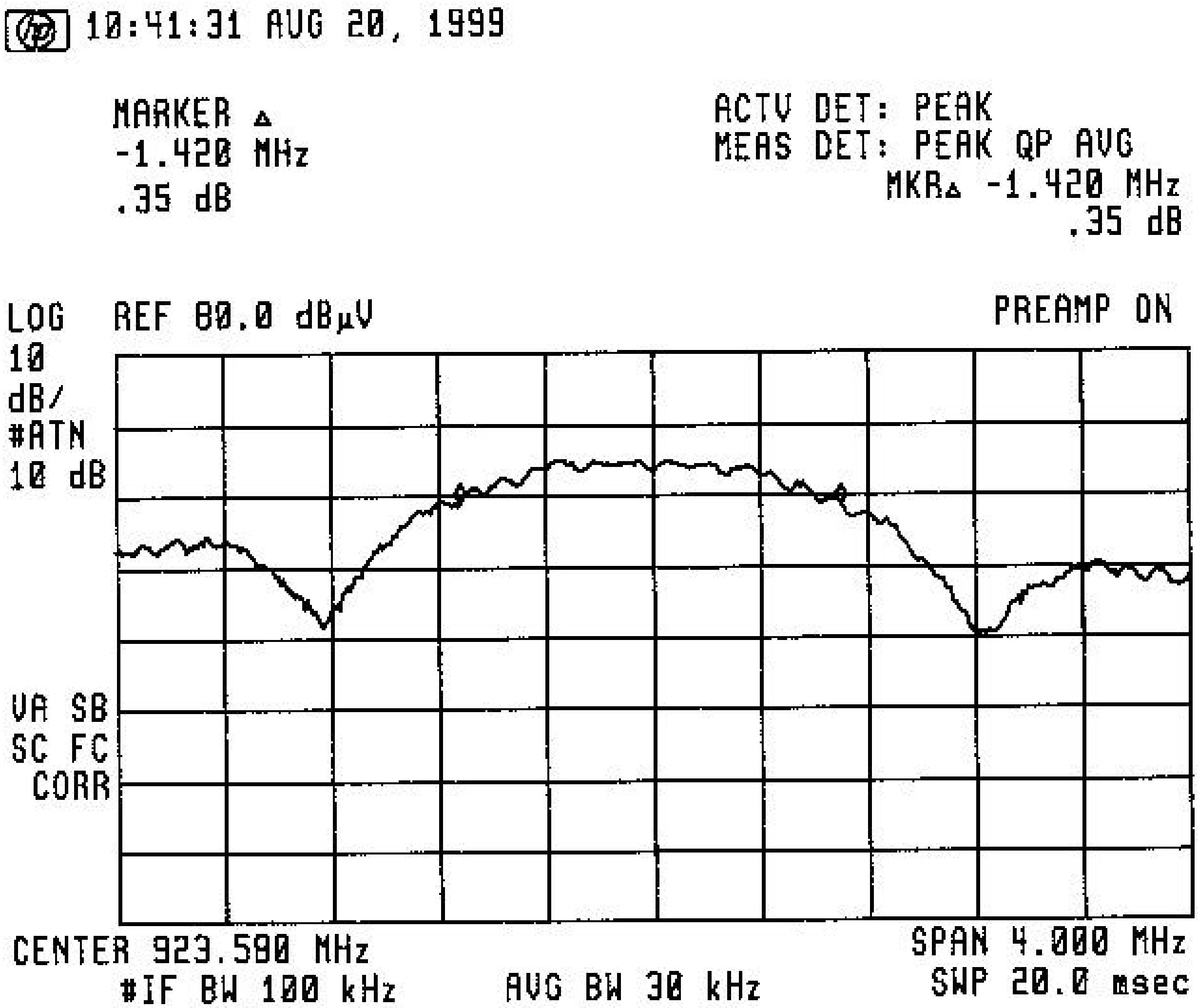


Figure 3.1 - 1: Emission Bandwidth Plot

3.2 Power Output

§15.247(b)(1) specifies power output requirements for direct sequence spread spectrum transmitters. The maximum peak output power for these devices shall not exceed one watt. If transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by one dB for every three dB that the directional gain of the antenna exceeds 6 dBi.

The peak output power for the only channel (923.580 MHz) was measured to be **16.36-dBm** (43.25 mW) as measured directly from a test point of the transmitter. A known good SMA connector was soldered to the bottom of the board and connected directly to the spectrum analyzer. On the analyzer, the following settings were used: Center frequency 923.58 MHz, Span 5 MHz, Resolution BW 3 MHz, Auto VBW (1 MHz), Auto Sweep (20 ms), Peak Hold, Peak Search.

3.2.1 Specific Absorption Rate and Maximum Permissible Exposure

The calculations for maximum transmitted power to be compared to the MPE limits are based on OET 65 (97-01). The MIU is designed for a maximum transmitter power of 17 dBm (50 mW). Assume the highest gain antenna of 0-dBi (1) for the integral antenna.

Using the equation for power density $S=PG/4\pi R^2$

Where S = power density in mW/cm^2

P = transmit power in milliwatts

G = numeric gain of transmit antenna

R = distance (cm)

$S = \{(50)(1)\}/\{4\pi(2)^2\}$

$S = 1.0\ mW/cm^2$ at a distance of 1 meter.

This power density is for the worst case. This level is below the 2.5 mW/cm^2 MPE for non-Occupational Controlled Access.

3.3 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG

Where FS = Field Strength in dB(uV/m)
RA = Receiver Amplitude (including preamplifier) in dB(uV)
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB(1/m)
AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows:

Assume a receiver reading of 52.0 dB (uV) is obtained. The antenna factor of 7.4 dB(1/m) and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dB(uV/m). This value in dB(uV/m) was converted to its corresponding level in uV/m.

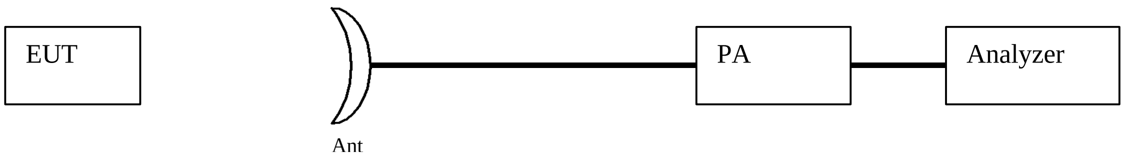
RA = 52.0 dB(uV)
AF = 7.4 dB(1/m)
CF = 1.6 dB
AG = 29.0 dB

FS = 52.0 + 7.4 + 1.6 - 29.0 = 32 dB(uV/m)

Level in uV/m = Common Antilogarithm [(32 dB(uV/m))/20] = 39.8 uV/m

3.4 *Transmitter Spurious Emissions*

§15.247(c) specifies requirements for spurious emissions from direct sequence spread spectrum transmitters. In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in the §15.209(a) is not required. In addition, radiated emissions that fall within the restricted bands, as defined in §15.205(a), must also comply with the radiates emissions limits specified in §15.209(a).



3.5 Transmitter Spurious Emission Data:

Table 3.5 - 1: Antenna Conducted Emissions

Note: The antenna is permanently attached wire antenna. This test was not performed

3.5 Transmitter Spurious Emission Data:

Radiated Emission

The data shown below lists the significant emission frequencies, the limit and the margin of compliance. Numbers with a minus sign are below the limit.

Table 3.5 - 2: Radiated Spurious Emissions, 30 – 10000 MHz

Radiated Emissions / Interference

Table: 1

Company:	Utiliman Systems	Tested by:	Jeffrey D. Hiday
Model:	MIU	Location:	Norcross
Job No.:	J99021325	Detector:	HP 8566
Date:	08/21/99	Antenna:	AHSYS571
Standard:	FCC Part 15.247	PreAmp:	HP-26G
Class:	Group: None	Cable(s):	cable-N2 cable-N1
Notes:		Distance:	3
		Signature:	

Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB
V	1847.000	65.0	28.5	2.0	26.9	0.0	68.6	85.0	-16.4
H	2770.000	40.5	32.1	3.7	26.7	0.0	49.6	54.0	-4.4
H	3694.000	45.0	32.2	3.8	36.4	0.0	44.6	54.0	-9.4
V	4617.000	38.2	34.0	4.3	36.2	0.0	40.3	54.0	-13.7
V	5541.000	34.2	34.9	4.3	35.9	0.0	37.5	85.0	-47.5
V	6465.000	38.9	37.4	4.5	36.4	0.0	44.4	85.0	-40.6
H	7388.000	34.1	37.9	4.6	36.5	0.0	40.1	54.0	-13.9
V	8312.000	36.1	38.1	4.7	36.8	0.0	42.1	54.0	-11.9
V	9235.000	34.1	39.5	5.1	37.0	0.0	41.7	85.0	-43.3

3.6 AC Power Line-Conducted Emissions

For AC powered devices, line-conducted emissions testing is performed based on the requirements in §15.207.

Table 3.6 - 1: Power Line Conducted Emissions

Note: The EUT is DC powered this test is not required.

3.7 Power Spectral Density, §15.247(d)

For direct sequence systems, the peak power spectral density conducted from the intentional radiator shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

The following plots show the power spectral density for the single channel (923.580). This measurement was made with the antenna port of the transmitter directly connected to the spectrum analyzer.

The resolution bandwidth is set to 3 kHz, the span is set to 300 kHz, and the sweep time is 100 seconds. The highest peak measurement for the only channel (923.58 MHz) was 75.24 dBuV (-20 dBm). See Figure 3.7-1 for plot.

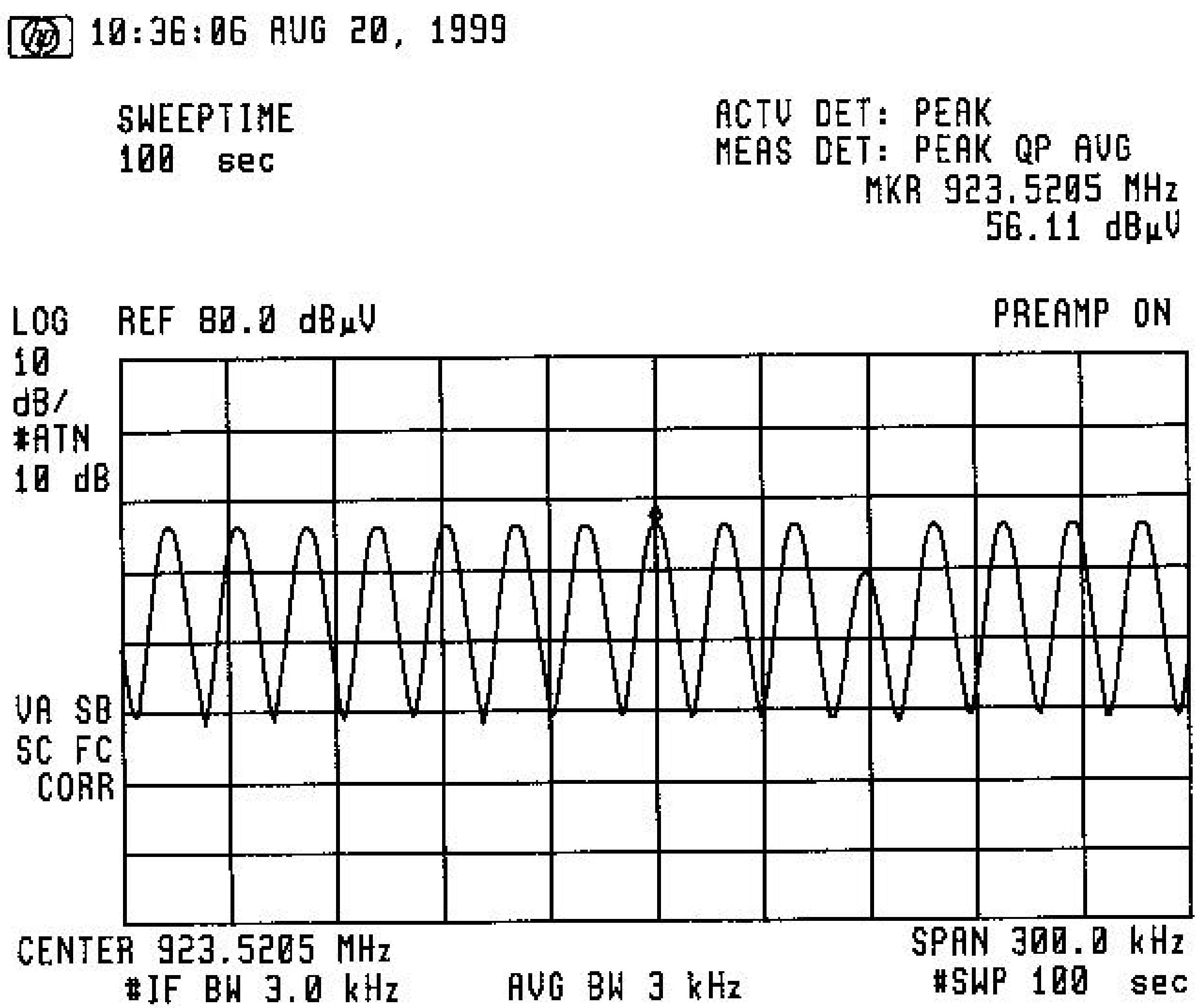


Figure 3.7 - 1: Power Spectral Density – Single (923.580 MHz) Channel

3.9 Radiated Emission Configuration Photographs

Figure 3.9 - 1: Worst Case Radiated Emission, Front View

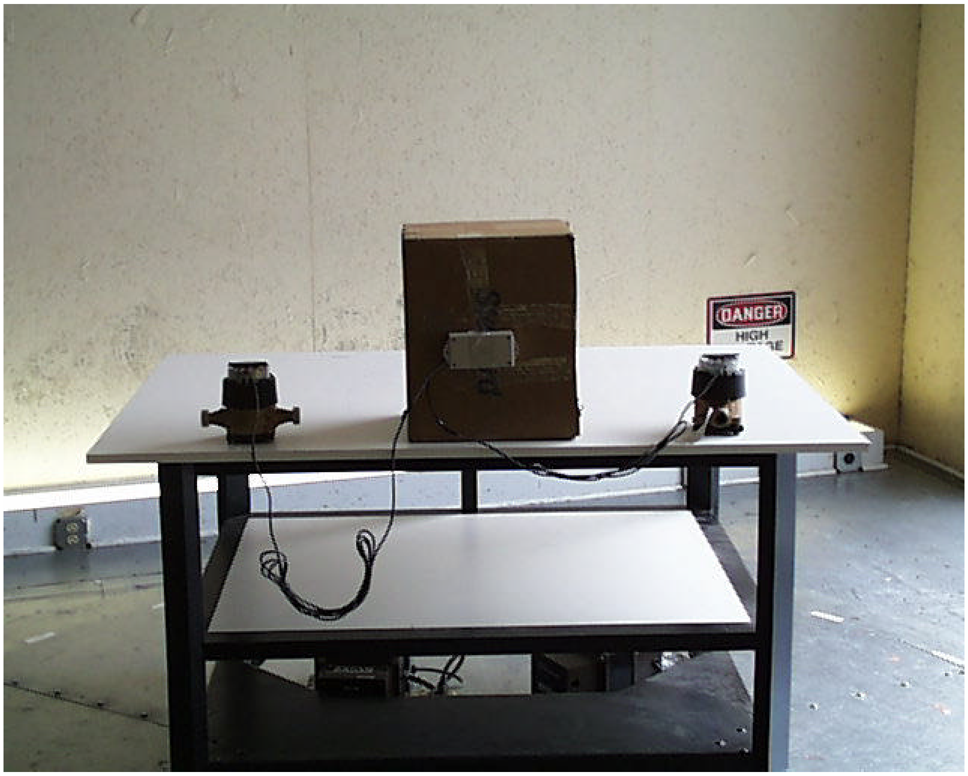


Figure 3.9 - 2: Worst Case Radiated Emission, Rear View

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Figure 3.9 - 3: Worst Case Line-Conducted Emission, Front View

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Figure 3.9 - 4: Worst Case Line-Conducted Emission, Rear View

4.0 Miscellaneous Information

This miscellaneous information includes details of the measured bandwidth, the test procedure and calculation of factors such as pulse desensitization and averaging factor.

4.1 Discussion of Pulse Desensitization

The determination of pulse desensitivity was made in accordance with Hewlett Packard Application Note 150-2, *Spectrum Analysis ... Pulsed RF.*

4.2 Calculation of Average Factor

Detector function for radiated emission measurements is peak or quasi-peak mode. Average readings, when required, are taken by measuring the duty cycle of the equipment under test and subtracting the corresponding amount in dB from the measured peak readings according to the following formula:

Average Factor in dB = 20 LOG (duty cycle)

The time over which the duty cycle is measured is 100 msec. The worst-case (highest percentage on) duty cycle is used and described specifically in the calculation contained in this section. A plot of the worst case duty cycle, if applicable, is also provided in this report.

Note: This EUT has a 100% duty cycle, therefore no correction applies.

Figure 4.2 - 1: Duty Cycle Plot

4.3 Emissions Test Procedures

The following is a description of the test procedure used by Intertek Testing Services in the measurements of transmitters operating under Part 15, Subpart C rules. The test setup and procedures described below are designed to meet the requirements of ANSI C63.4: 1992.

The transmitter was placed on a non-conductive table 80 cm above a ground plane. During testing, all cables were manipulated to produce the worst case emissions. During the radiated emissions test, the turntable is rotated and any cables leaving the EUT are manipulated to find the configuration resulting in maximum emissions. The antenna height and polarization are also varied during the testing to search for maximum signal levels. The height of the antenna is varied from one to four meters.

For small, battery powered transmitters, the transmitter is attached to a cardboard box and placed in each of it orthogonal axis during the procedure described above.

Detector function for radiated emissions is in quasi-peak mode. Average readings, when required, are taken by measuring the duty cycle of the equipment under test and subtracting the corresponding amount in dB from the measured peak readings. A detailed description for the calculation of the average factor can be found in Exhibit 8.2. Alternatively, the average detector of the receiver may be used. The method of measurement is indicated in the data tables.

The frequency range scanned is from the lowest radio frequency signal generated in the device, which is greater than 9 kHz, to the tenth harmonic of the highest fundamental frequency or 40 GHz, whichever is lower. For line conducted emissions, the range scanned is 450 kHz to 30 MHz.

The EUT is warmed up for 15 minutes prior to the test. AC power to the unit is varied from 85% to 115% nominal and variation in the fundamental emission field strength is recorded. If battery powered, a new, fully charged battery is used.

Conducted measurements were made as described in ANSI C63.4: 1992. An IF bandwidth of 9 kHz is used, and quasi-peak detection is employed.

The IF bandwidth used for measurement of radiated signal strength was 120 kHz or greater below 1000 MHz. Where pulsed transmissions of short enough pulse duration warrant, a greater bandwidth is selected according to the recommendations of Hewlett Packard Application Note 150-2. A discussion of whether pulse desensitivity is applicable to this unit is included in this report (See Exhibit 8.1). Above 1000 MHz, a resolution bandwidth of 1 MHz is used.

Transmitter measurements are normally conducted at a measurement distance of three meters. However, to assure low enough noise-floor in the forbidden bands and above 1 GHz, signals may be acquired at a distance of one meter or less. All measurements are extrapolated to three meters using inverse scaling, but those measurements taken at a closer distance are so marked.