Test Report for an Unlicensed Transmitter, Receiver, and Digital Device

Product Tested:

Name: Weathermate, Weathermate Remote Transmitter, & Weathermate Remote Receiver
Model #: WM12-x, WM-RT & WM-RR

Prepared for:

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Report Number: A0210-3A
Issue Date: 15 July, 1999

Accredited by the National Voluntary Laboratory Accreditation Program for the specific scope of accreditation under laboratory code 200245-0

EMC Engineering and Testing Services

Radiated & Conducted Emissions, Unlicensed Transmitter, and Receiver Conformance Statement

Report Number: A0210-3A
Product Name: Weathermate, Weathermate Remote Transmitter, and Weathermate Remote Receiver
Model Number: WM12-x, WM-RT, & WM-RR

We, the undersigned, hereby state that the proper standards and procedures were followed as detailed in this test record. Furthermore, we attest that the data contained within this report is accurate and concise within the bounds of the standards and our company procedures.

Daniel Wilkerson	Lonnie Smoots
Sr. EMC Technician	Sr. EMC Technician

I, the undersigned, hereby declare that the equipment tested and referenced in this report conforms to the identified standard(s) as described in this attached test record. There were no modifications made to the equipment in order to achieve compliance with these standards.

Furthermore, there was no deviation from, additions to or exclusions from the ANSI 63.4:1992 test methodology.

Signature:

Date: 15 July, 1999

Location: Plano, Texas

Full Name: Michael Cantwell, PE

Title: NARTE EMC Engineer (EMC-002019-NE) Signatory for NVLAP

Note: This report may not be used by the client to claim product endorsement by NVLAP or any agency of the U.S. Government.

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1. Executive Summary

The following report for EMC compliance of a Class B unlicensed transmitter, receiver, and digital device is prepared on behalf of Telsco Industries, Inc. in accordance with the rules of the Federal Communications Commission (47 CFR 15). The transmitter is operated under 47 CFR 15.231.

This report covers testing for the Weathermate, Weathermate Transmitter, and Weathermate Receiver and all testing was performed on the 28th, 29th and 30th of May and the 8th of June, 1999.

All equipment configurations and measurements contained in this report were performed in accordance with the revision of the standards listed in this report. Also, the instrumentation and facilities utilized for the measurements conform to all appropriate standards. Calibration checks are performed yearly on the instruments by a local calibration lab, with traceability to the National Institute of Standards and Technology (NIST).

All radiated and conducted emission measurements are performed manually at RheinTexas, Inc. The radiated emission measurements required by the rules were performed on a 10m open area test site (OATS) maintained by RheinTexas, Inc., 1701 East Plano Parkway, Suite 150, Plano, Texas 75074, USA. Complete site descriptions and site attenuation measurement data are maintained at the test facility and can be made available upon request. The Power Line Conducted Emission Measurements were performed in a shielded enclosure also located at the same facility. The radiated and conducted measurement sites have been listed with the Federal Communications Commission (FCC).

1.1 Modifications to EUT

There were no modifications made.

1.2 Special Accessories

There were no special accessories found necessary as a result of this testing.

1.3 Equivalent Models

Per the manufacturer, the following models are equivalent to the tested model:

Table 1 - Equivalent Models

Model Number	Description
WM6-O	Weathermate irrigation controller with 6 watering stations and metal encased power transformer for outdoor use
WM9-O	Weathermate irrigation controller with 9 watering stations and metal encased power transformer for outdoor use
WM12-O	Weathermate irrigation controller with 12 watering stations and metal encased power transformer for outdoor use
WM6-N	Weathermate irrigation controller with 6 watering stations and external plug-in power transformer for indoor use
WM9-N	Weathermate irrigation controller with 9 watering stations and external plug-in power transformer for indoor use
WM12-N	Weathermate irrigation controller with 12 watering stations and external plug-in power transformer for indoor use

The manufacturer provides, as an option for any of the models listed in Table 1:

Table 2 - Options

Model Number	Description
WM-RR	433.92 MHz Receiver
WM-RT	433.92 MHz Handheld Transmitter
WM-RC	Includes WM-RR & WM-RT Together

2. Test Facility

The open area test site used to collect the radiated emissions data and the shielded room used to collect the conducted emissions data has been listed by the Federal Communications Commission (FCC, per ANSI C63.4). It has also been accredited by NVLAP.

3. EUT Configuration

3.1 Technical Description

The product configuration tested consisted of a WM12-x Weathermate irrigation controller, 433.92 MHz receiver printed circuit board, and a handheld 433.92 MHz transmitter. The WM-RR receiver printed circuit board is mounted inside the Weathermate irrigation controller as shown in Figure 8. The WM-RT transmitter is a handheld device, which consists of a small printed circuit board moundted inside a plastic enclosure with a 9” wire antenna (22 AWG).

The Weathermate irrigation controller is a digital device, which hosted the receiver. The transmitter is used in conjunction with these devices.

3.1.1 General

Weathermate is an irrigation controller. It controls sprinklers. It's a microprocessor based system that can be programmed to water automatically (see Weathermate user manual).

The controller has a rain sensor contact input that may be used to prevent the controller from watering when it's raining.

The input power to the system is 110VAC for US models and 220/240VAC for export models. The US version has two transformers, one for indoor use and one for outdoor use. Both of these transformers were tested. The controller's transformer steps down the input power to 24VAC. The 24VAC is then rectified and regulated to 5VDC to power the controller's control logic. The 24VAC is also used to power the controller outputs. The output load is a group of wires connected to solenoids in the field. They are wired to the controller via the output terminal block. All the solenoids are wired together on the other end and connected to the common position at the output terminal block. The solenoids are 24VAC powered via triacs controlled by the system processor. When powered, the solenoid drives an actuator that opens the valve to water. The controller is also capable of solenoid short/over current detection. In case of an overcurrent the controller will skip the shorted station and activates the next one. The normal stations are numbered 1 to 12. A special station numbered MV for Master Valve and it's designed to control a pump if needed. This station has a longer short detection delay to mask the inrush current surges.

The remote control consists of a transmitter and a receiver. The receiver is connected to the main board and mounted in the same housing. It receives commands from the transmitter and sends them to the processor. The transmitter is a hand held device with two buttons. One button to turn ON and OFF a station. The second button to advance to the next station after a station was turned ON by the transmitter.

3.2 Test Configuration(s)

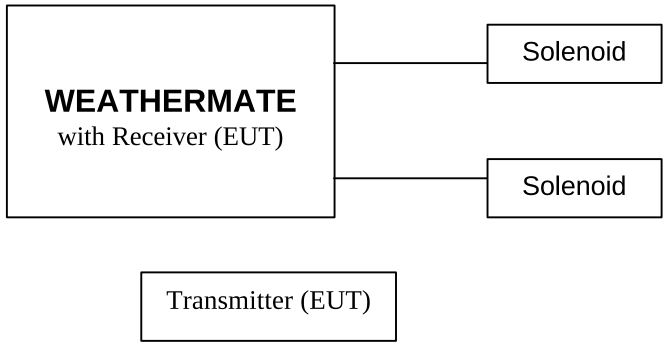

Figure 1 - Block Diagram of System Configuration

The system was configured for testing in a typical fashion (as a customer would normally use it). A list of the equipment under test (EUT) and its support equipment is found below.

Table 3 - Components in Block Diagram

Description	Manufacturer	Model	Serial No	FCC I.D.
Weathermate (EUT)	Telsco	WM12-x[1]	None	None
Solenoid	Telsco	M24ESA	None	None
Transmitter (EUT)	Telsco	WM-RT	None	OLPWM-RT

Table 4 – Internal to Weathermate

Description	Manufacturer	Model	Serial No	FCC I.D.
Receiver (EUT)	Telsco	WM-RR	None	OLPWM-RR

3.3 Exercise Software

The EUT exercise program used during radiated and conducted testing was contained in firmware in the weathermate's microcontroller, receiver, and transmitter.

3.4 Mode of Operation

The Weathermate was operated in a normal irrigation mode, occasionally changing watering stations and activating the atached solenoids.

[1] Radiated emsissions testing was performed with the WM12-O and conducted emissions testing was performed on the WM12-O and the WM12-N.

3.5 Photos of EUT

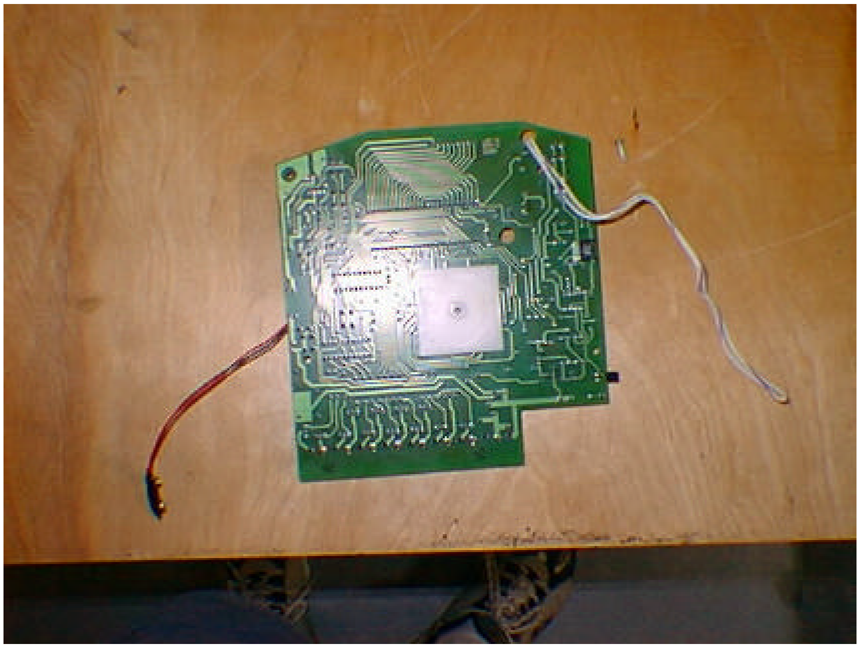

Figure 2 - Back Side of Weathermate (EUT)

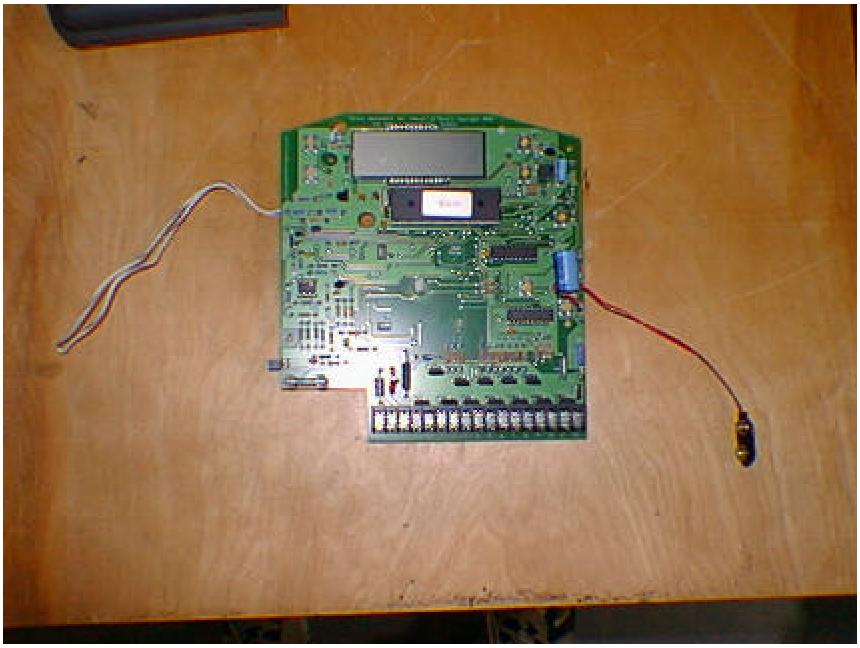

Figure 3 - Component Side of Weathermate (EUT)

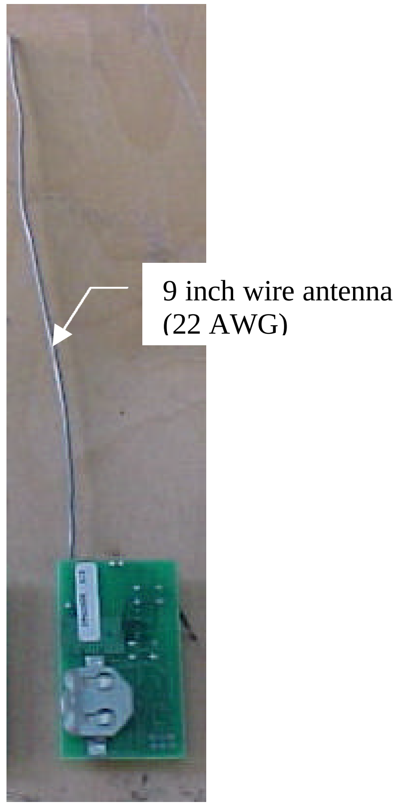

Figure 4 – Bottom Side of 433.92 MHz Transmitter (EUT)

Figure 5 - Top Side of 433.92 MHz Transmitter (EUT)

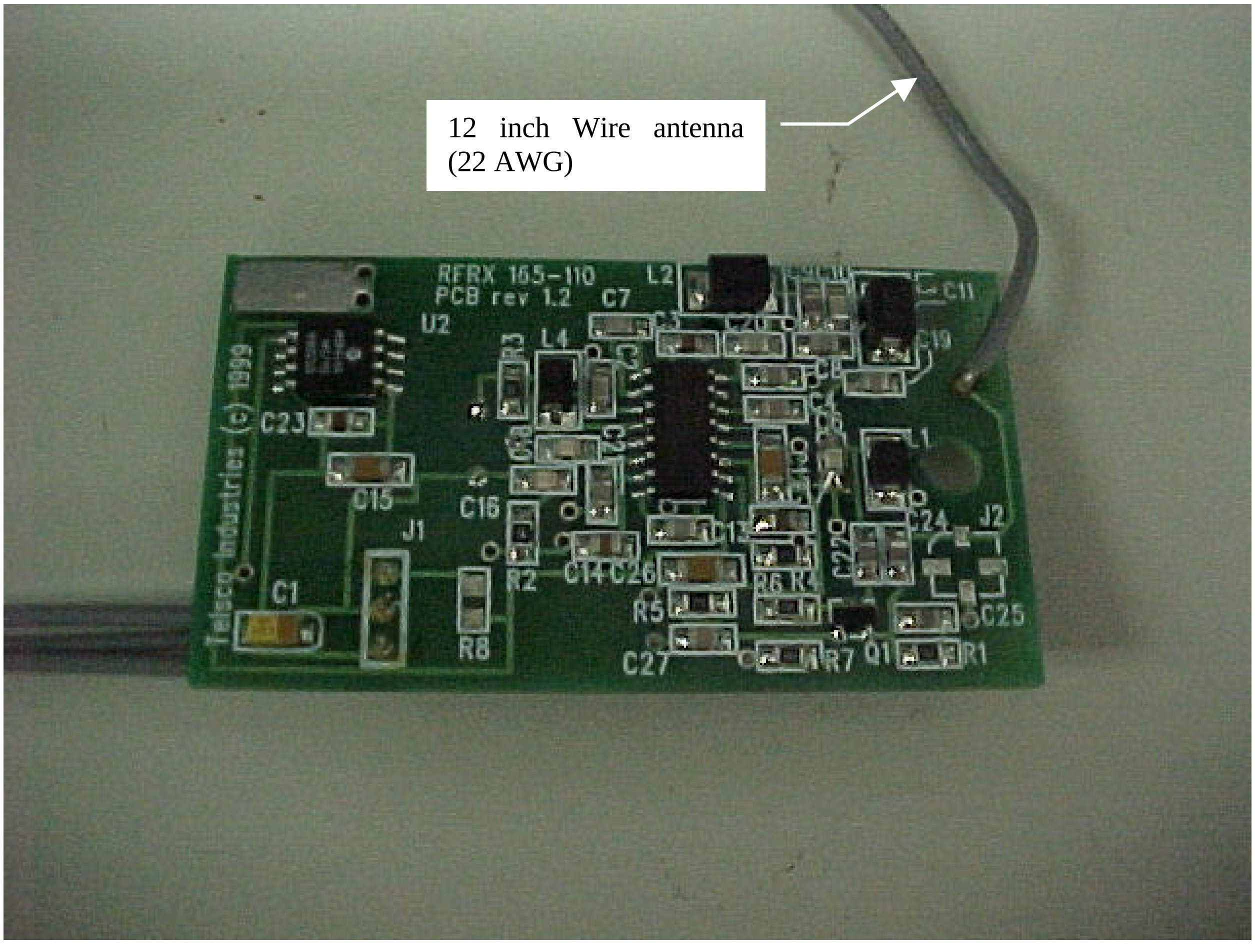

Figure 6 - Component Side of 433.92 MHz Receiver (EUT)

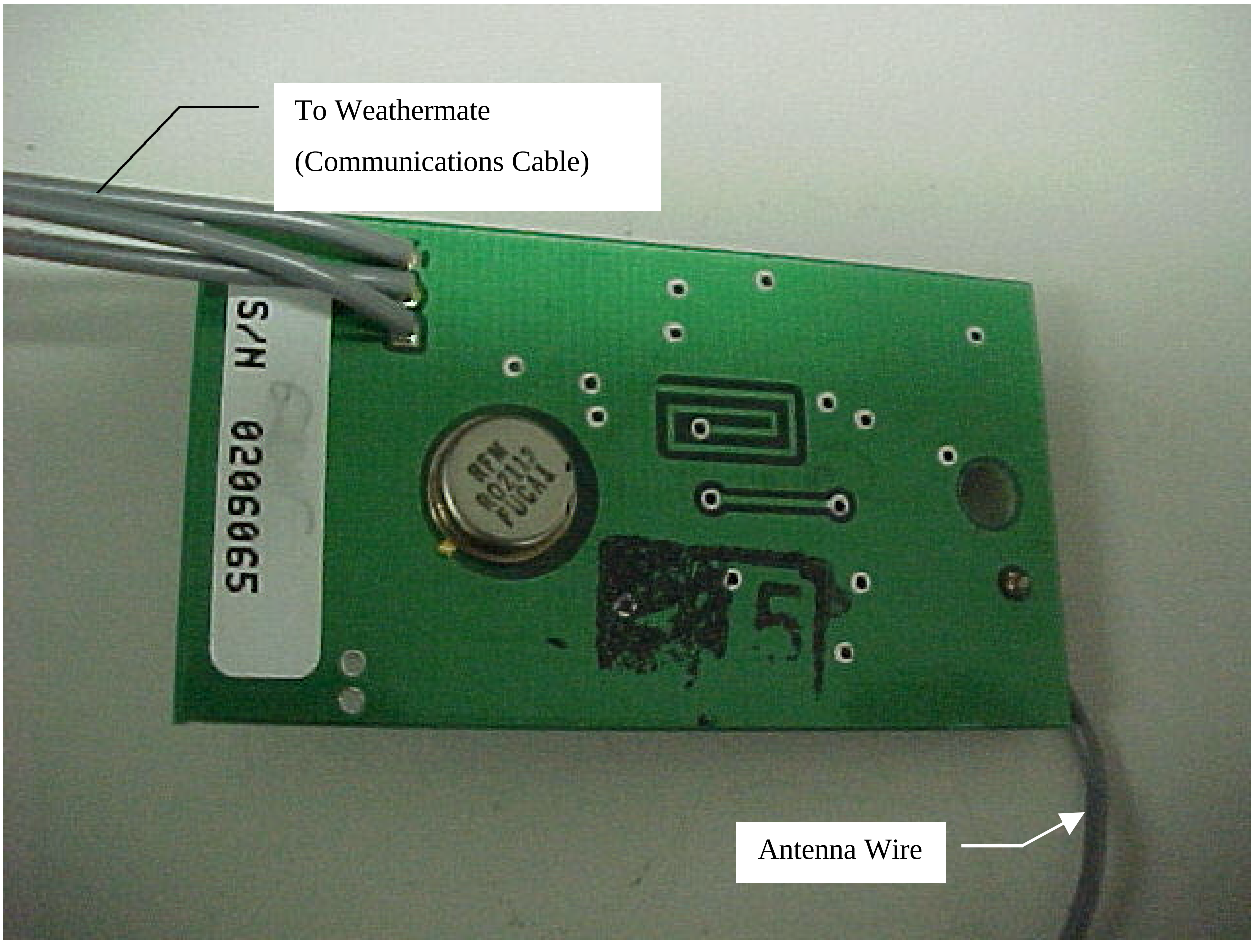

Figure 7 - Back Side of 433.92 MHz Receiver (EUT)

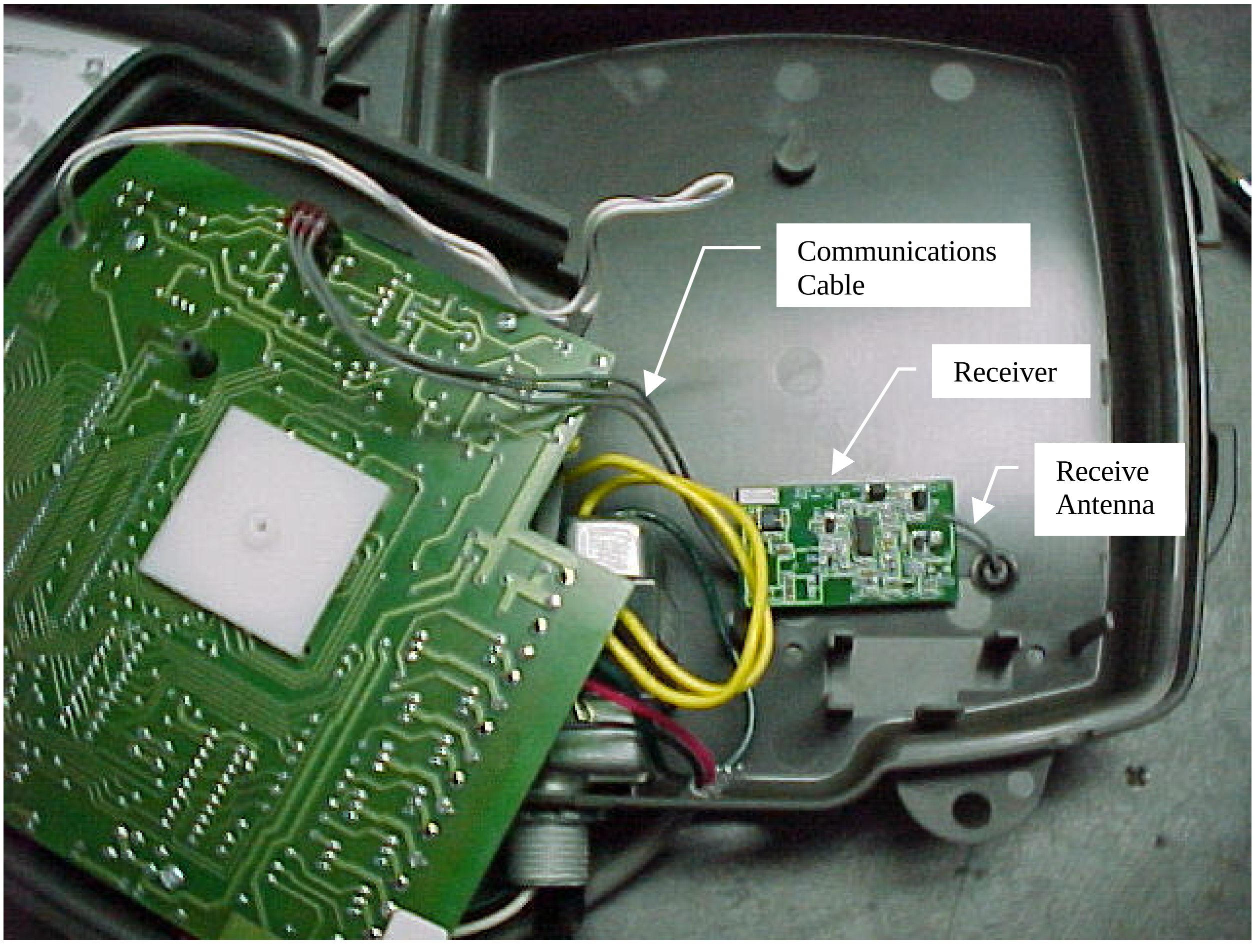

Figure 8 - Receiver Location

4. Test Results

4.1 Emissions Test Methodology

Both conducted and radiated testing were performed according to the procedures in ANSI C63.4 1992 and CISPR 22:1993. Radiated testing was performed at an antenna to EUT distance of 10 meters.

RheinTexas, Inc. has implemented procedures to minimize errors that occur from test instruments, calibration, procedures, and test setups. Test instrument and calibration errors are documented from the manufacturer or calibration lab. Other errors have been defined and calculated within the RheinTexas quality manual. RheinTexas implements these procedures to minimize errors that may occur: The highlights of the procedures are yearly as well as daily calibrations, technician training, and emphasis to employees on avoiding error.

4.1.1 Deviations from Test Methodology

There were no deviations from the test methodology during this test

4.2 Power Output

An oscilloscope probe was calibrated to determine it's loss at 433.92 MHz and was found to be 31.3 dB. The measured value of the output power at the antenna port was 80.5 dBμV. Correcting the measured value for the oscilloscope probe loss resulted in antenna output port power (where the wire was soldered) of 111.8 dBμV (4.8 dBm).

4.3 Occupied Bandwidth

The bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency. Once the reference level is established, the equipment is conditioned with typical modulating signals to produce the worst-case (i.e. the widest) bandwidth. If no specific bandwidth requirement is specified, then measure the bandwidth at –20dB with respect to the reference level.

In order to measure the modulated signal properly, a resolution bandwidth that is small compared to the bandwidth required by the regulations shall be used on the measuring instrument. However, the 6 dB resolution bandwidth ov the measuring instrument shall be set to a value greater than 5% of the bandwidth requirements. When no bandwidth requirements are specified, the minimum 6 dB resolution bandwidth of the measuring instrument is given below.

Table 5 - Minimum Resolution Bandwidth

Fundamental Frequency	**Minimum Resolution Bandwidth**
9 kHz to 30 MHz	1 kHz
30 MHz to 1 GHz	10 kHz
1 GHz to 40 GHz	100 kHz

The display line of the spectrum analyzer was set to 20 dB below the peak level of the transmitted emission. The delta marker was then utilized to measure the intersection of the displayed waveform with the display line with the change in frequency between the two markers recorded as the occupied bandwidth.

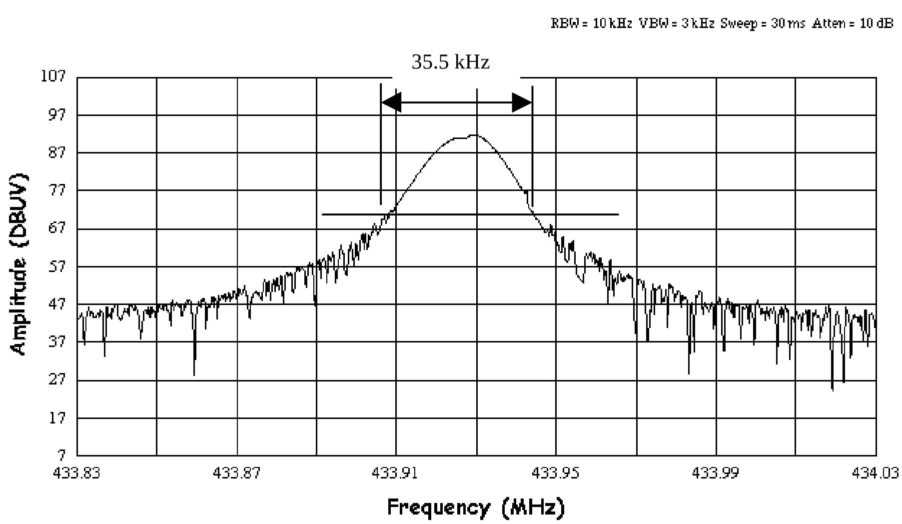

Figure 9 - Occupied Bandwidth

As noted in Figure 9, the occupied bandwidth is 35.5 kHz at –20 dBc with no modulation (this particular transmitter uses a keyed carrier to transmit data).

4.4 Transmitter Characteristics

4.4.1 Pulse Train Duration for Relaxation of Limit for Average Detector Measurements

The spectrum analyzer was used with a span of 0 Hz to provide a time domain display of the transmitted pulse-modulated data. The delta marker was used to measure the time difference between the begginning and end of the pulse train. This value was used to determine the duty cycle compared to a 100 msec period. Since the duration of the pulse was greater than 100 msec, no duty cycle correction factor was used.

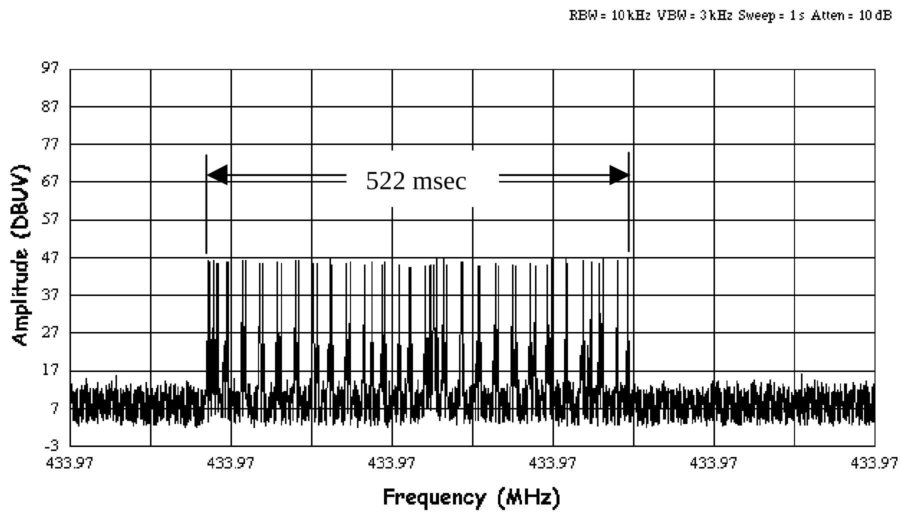

Figure 10 - Pulse Train Duration

4.5 Radiated Emissions Measurements

The limits utilized are from CISPR-22:1993/EN55022:1994.

4.5.1 Test Methodology

Whenever possible, and before final measurements of radiated emissions are made on the open-field three/ten meter range, the EUT is scanned indoors at a three meter distance (or one meter distance if necessary) in order to determine its emissions spectrum signature. The physical arrangement of the test system and associated cabling was varied in order to determine the effect on the EUT's emissions in amplitude, direction and frequency. This process is either repeated, or performed, during final radiated emissions measurements on the open-field range, at each frequency, in order to insure that maximum emission amplitudes are obtained. RheinTexas works diligently to ensure that worst case modes, physical arrangement of the test system and associated cabling produce maximum emission levels.

Final radiated emissions measurements were made on the 10 meter, open-field test site. The EUT was placed on a nonconductive turntable approximately 0.8 meters above the ground plane. The spectrum was examined from 30 MHz to 1000 MHz. When any clock exceeds 108 MHz but less than 500 MHz, the emissions of the EUT are also measured between 1 to 2 GHz using an average detector with the resolution bandwidth set at 1 MHz. For clocks greater than 500 MHz and less than 1 GHz, the emissions of the EUT are also measured between 1 and 5 GHz.

At each frequency, the EUT was rotated 360 degrees, and the antenna was raised and lowered from one to four meters in order to determine the maximum emission levels. Measurements were taken using both horizontal and vertical antenna polarizations. The spectrum analyzer's 6 dB bandwidth was set to 120 kHz, and the analyzer was operated in the CISPR quasi-peak detection mode. The highest emission amplitudes relative to the appropriate limit were measured and recorded in this report.

4.5.2 Test Limits

The tables below list the EN55022 / CISPR-22 radiated emission limits. The EUT to antenna distance used at RheinTexas is always 10m unless otherwise noted. In addition to the CISPR 22 requirements, limits have been imposed above 1 GHz for compliance with the limits found in Part 15 of the FCC rules (47CFR).

Table 6 - CISPR-22 Class A Radiated Emissions

Frequency	**Limit (dBμV/m)**		
(MHz)	**30m**	**10m**	**3 m**
30 to 230	30	40	50
230 to 1000	37	47	57
≥ 1000[1]	--	49.5	60

Table 7 - CISPR-22 Class B Radiated Emissions

Frequency	**Limit (dBμV/m)**	
(MHz)	**10m**	**3m**
30 to 230	30	40
230 to 1000	37	47
≥ 1000[1]	43.5	54

[1] This FCC Limit actually begins at 960 MHz. The lower limit is used from 960 to 1000 MHz to fully comply with the requirements of CISPR 22.

4.5.3 Radiated Emissions Data

All readings are quasi-peak unless stated otherwise. The pk notation in the receiver reading denotes that this measurement was taken using the peak detector.

The data provided for the digital device are measurements of the noise floor at various frequencies. The receiver frequency (433.92 MHz) and it's related harmonics could not be measured.

Table 8 - Radiated Emissions Data (Digital Device)

Emission Frequency (MHz)	Det	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Analyzer Reading (dBµV)	Site Correction Factor (dB/m)	Emission Level (dBµV/m)	EN55022 / CISPR22 Limit (dBµV/m)	EN55022 / CISPR22 Margin (dBµV/m)	Pass/ Fail	Comments
40.000	Qp	V	170	1.0	24.8	-8.8	16.0	30.0	-14.0	Pass	
75.570	Qp	V	225	1.0	34.0	-13.9	20.1	30.0	-9.9	Pass	
84.321	Qp	H	105	1.0	24.8	-12.8	12.0	30.0	-18.0	Pass	
171.914	Qp	H	130	1.0	25.0	-10.1	14.9	30.0	-15.1	Pass	
244.795	Qp	H	200	3.0	25.8	-8.1	17.7	37.0	-19.3	Pass	
320.547	Qp	V	180	1.0	24.5	-5.5	19.0	37.0	-18.0	Pass	
360.784	Qp	H	240	14.0	25.0	-4.5	20.5	37.0	-16.5	Pass	
520.126	Qp	H	250	4.0	24.5	-1.4	23.1	37.0	-13.9	Pass	
561.972	Qp	V	1401	1.0	24.6	0.4	25.0	37.0	-12.0	Pass	
603.335	Qp	H	130	1.0	24.9	-0.3	24.6	37.0	-12.4	Pass	
718.396	Qp	V	180	1.0	25.2	1.8	27.0	37.0	-10.0	Pass	
757.668	Qp	H	145	1.0	24.5	2.0	26.5	37.0	-10.5	Pass	
775.830	Qp	H	200	1.0	24.6	2.0	26.6	37.0	-10.4	Pass	
848.438	Qp	V	105	1.0	26.4	3.2	29.6	37.0	-7.4	Pass	
911.952	Qp	H	305	4.0	24.7	3.6	28.3	37.0	-8.7	Pass	

Table 9 - Radiated Emissions Data (Transmitter with 9” Antenna)

Emission Frequency (MHz)	Det	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Analyzer Reading (dBµV)	Site Correction Factor (dB/m)	Emission Level (dBµV/m)	EN55022 / CISPR22 Limit (dBµV/m)	EN55022 / CISPR22 Margin (dBµV/m)	Pass/ Fail	Comments
433.900	Av	H	0	2.0	50.8	-2.1	48.7	80.8	-32.1	Pass	
433.900	Av	V	10	1.0	42.6	-1.8	40.8	80.8	-40.0	Pass	
867.760	Av	V	35	1.5	34.4	3.1	37.5	60.8	-23.3	Pass	
867.817	Av	H	275	2.0	35.0	3.8	38.8	60.8	-22.0	Pass	
1301.600	Av	V	55	1.5	21.3	8.2	29.5	54.0	-24.5	Pass	
1301.730	Av	H	135	1.0	22.6	9.1	31.7	54.0	-22.3	Pass	
1735.400	Av	H	35	1.0	27.8	11.9	39.7	60.8	-21.1	Pass	
1735.700	Av	V	5	1.0	19.6	10.2	29.8	60.8	-31.0	Pass	
2169.300	Av	V	355	1.0	31.1	2.2	33.3	60.8	-27.5	Pass	
2169.700	Av	H	5	1.0	32.7	2.2	34.9	60.8	-25.9	Pass	
2603.500	Av	V	10	1.0	30.7	4.3	35.0	60.8	-25.8	Pass	
2603.800	Av	H	355	1.0	28.2	4.3	32.5	60.8	-28.3	Pass	
3037.400	Av	H	0	1.0	30.0	6.6	36.6	60.8	-24.2	Pass	
3037.800	Av	V	350	1.0	30.6	6.6	37.2	60.8	-23.6	Pass	
3471.478	Av	V	10	1.0	29.2	9.5	38.7	60.8	-22.1	Pass	
3471.550	Av	H	355	1.0	29.5	9.5	39.0	60.8	-21.8	Pass	
3905.560	Av	H	355	1.0	29.4	13.6	43.0	54.0	-11.0	Pass	
3905.800	Av	V	10	1.0	29.6	13.6	43.2	54.0	-10.8	Pass	
4339.300	Av	H	5	1.0	28.0	11.2	39.2	54.0	-14.8	Pass	
4339.412	Av	V	0	1.0	29.2	11.2	40.4	54.0	-13.6	Pass	

4.5.4 Radiated Test Configuration Photographs

Figure 11 - Radiated Setup (Front View)

4.6 Conducted Emissions

The limits utilized are from CISPR-22:1993/EN55022:1994.

4.6.1 Test Methodology

The power line conducted emission measurements were performed in a shielded enclosure. The EUT was assembled on a wooden table 80 centimeters high. Power was provided to the EUT through a 50 Ω / 50 μH Line Impedance Stabilization Network (EUT LISN). The EUT LISN was provided power through an AC filter box on the outside of the shielded enclosure. The filter box and EUT LISN housing are bonded to the ground plane of the shielded enclosure. A second LISN, the peripheral LISN, provides isolated power for the EUT test peripherals. A metal power outlet box, which is bonded to the ground plane and electrically connected to the peripheral LISN, powers the EUT host peripherals.

The spectrum analyzer was connected to the AC line, which is bonded to the exterior of the shielded room. The 50 Ω output of the EUT LISN was connected to a high pass filter (>8 kHz), which is then connected to the spectrum analyzer input. Conducted emission levels were measured on each current-carrying line with the spectrum analyzer operating in the CISPR quasi-peak mode (or peak mode if applicable). The analyzer's 6 dB bandwidth was set to 9 kHz. The emission spectrum was scanned from 150 kHz to 30 MHz. The highest emission amplitudes relative to the appropriate limit were measured and have been recorded in this report.

4.6.2 Test Limits

The tables below list the EN55022 / CISPR-22 conducted emissions limits.

Table 10 - CISPR-22 Class A Conducted Emissions Limits

	Limit (dBμV)	
Frequency (MHz)	**Quasi-Peak**	**Average**
0.15 to 0.5	79	66
0.5 to 30	73	60

Table 11 - CISPR-22 Class B Conducted Emissions Limits

	Limit (dBμV)	
Frequency (MHz)	**Quasi-Peak**	**Average**
0.15 to 0.5	66 to 56	56 to 46
0.5 to 5.0	56	46
5 to 30	60	50

4.6.3 Conducted Emissions Data

The initial step in collecting conducted data is a spectrum analyzer peak scan of the measurement range. All emission data is measured in peak mode. Any emissions within 4db of the average limit is then measured with a quasi-peak detector for final measurement. If the quasi-peak value exceeds the average limit but is below the quasi-peak limit, then the signal is re-measured using the average detector.

The quasi-peak measurement is then compared to the quasi-peak limit *and* the average measurement is compared to the average limit. In these instances, both readings must be below their appropriate limits to be considered compliant.

The conducted test was performed with the EUT exercise software running, and the emissions were scanned between 150 kHz to 30 MHz on the HOT SIDE and NEUTRAL SIDE, herein referred to as L2 and L1, respectively.

Table 12 - Conducted Emissions Data, WM12-N (EUT), Hot (L2)

Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV)	Site Correction Factor (dB)	Emission Level (dBuV)	EN55022 / CISPR22 QP Limit (dBuV)	EN55022 / CISPR22 QP Margin (dBuV)	EN55022 / CISPR22 AV Limit (dBuV)	EN55022 / CISPR22 AV Margin (dBuV)
0.150	Pk	34.4	10.7	45.1	66.0	-20.9	56.0	-10.9
0.220	Pk	27.2	10.3	37.5	62.8	-25.3	52.8	-15.3
0.569	Pk	26.4	9.2	35.6	56.0	-20.4	46.0	-10.4
13.150	Pk	26.6	9.8	36.4	60.0	-23.6	50.0	-13.6
18.140	Pk	26.4	10.3	36.7	60.0	-23.3	50.0	-13.3
28.728	Pk	24.2	10.8	35.0	60.0	-25.0	50.0	-15.0

Table 13 - Conducted Emissions Data, WM12-N (EUT), Neutral (L1)

Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV)	Site Correction Factor (dB)	Emission Level (dBuV)	EN55022 / CISPR22 QP Limit (dBuV)	EN55022 / CISPR22 QP Margin (dBuV)	EN55022 / CISPR22 AV Limit (dBuV)	EN55022 / CISPR22 AV Margin (dBuV)
0.151	Pk	33.9	10.7	44.6	65.9	-21.3	55.9	-11.3
0.204	Pk	29.0	10.4	39.4	63.4	-24.0	53.4	-14.0
0.536	Pk	23.8	9.3	33.1	56.0	-22.9	46.0	-12.9
8.680	Pk	26.2	9.7	35.9	60.0	-24.1	50.0	-14.1
21.180	Pk	27.6	10.5	38.1	60.0	-21.9	50.0	-11.9
29.376	Pk	24.5	10.9	35.4	60.0	-24.6	50.0	-14.6

Table 14 - Conducted Emissions Data, WM12-O (EUT), Hot (L2)

Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV)	Site Correction Factor (dB)	Emission Level (dBuV)	EN55022 / CISPR22 QP Limit (dBuV)	EN55022 / CISPR22 QP Margin (dBuV)	EN55022 / CISPR22 AV Limit (dBuV)	EN55022 / CISPR22 AV Margin (dBuV)
0.151	Pk	34.5	10.7	45.2	65.9	-20.7	55.9	-10.7
0.198	Pk	29.6	10.4	40.0	63.7	-23.7	53.7	-13.7
0.892	Pk	27.3	9.2	36.5	56.0	-19.5	46.0	-9.5
1.000	Pk	27.3	9.1	36.4	56.0	-19.6	46.0	-9.6
6.885	Pk	26.6	9.6	36.2	60.0	-23.8	50.0	-13.8
17.360	Pk	26.9	10.2	37.1	60.0	-22.9	50.0	-12.9
25.290	Pk	27.5	10.4	37.9	60.0	-22.1	50.0	-12.1

Table 15 - Conducted Emissions Data, WM12-O (EUT), Neutral (L1)

Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV)	Site Correction Factor (dB)	Emission Level (dBuV)	EN55022 / CISPR22 QP Limit (dBuV)	EN55022 / CISPR22 QP Margin (dBuV)	EN55022 / CISPR22 AV Limit (dBuV)	EN55022 / CISPR22 AV Margin (dBuV)
0.150	Pk	34.3	10.7	45.0	66.0	-21.0	56.0	-11.0
0.196	Pk	30.3	10.4	40.7	63.8	-23.1	53.8	-13.1
0.707	Pk	26.2	9.2	35.4	56.0	-20.6	46.0	-10.6
1.220	Pk	26.6	9.1	35.7	56.0	-20.3	46.0	-10.3
21.150	Pk	27.5	10.5	38.0	60.0	-22.0	50.0	-12.0
29.460	Pk	28.0	10.9	38.9	60.0	-21.1	50.0	-11.1

(1)Pk = Peak; QP = Quasi-Peak; Av = Average

(2)Average limit (QP limit is provided only when a QP measurement fails the Average limit.)

4.6.4 Conducted Test Configuration Photographs

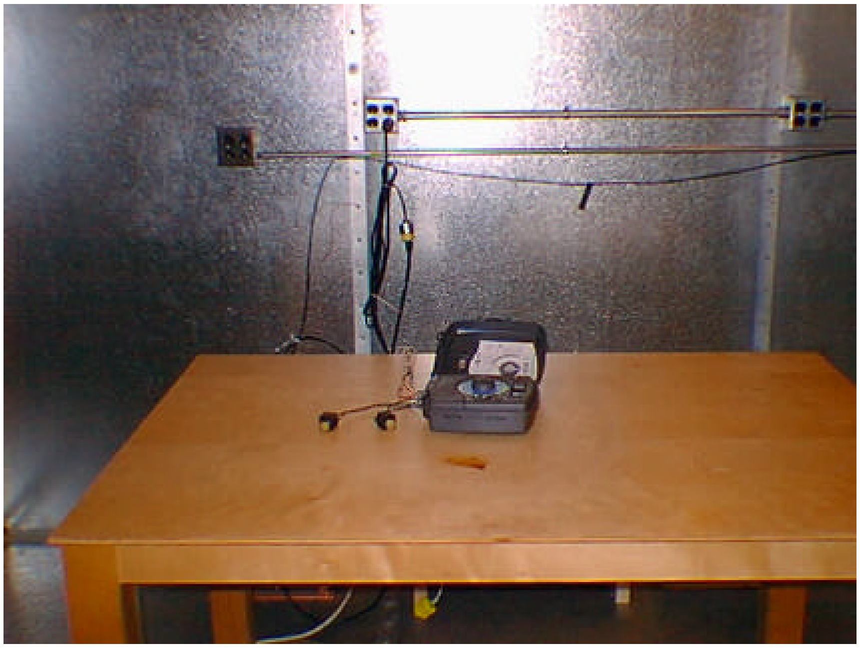

Figure 12 - Conducted Setup, Front View

5. Test Equipment

The following test equipment was used to perform the radiated and conducted emissions testing. All the equipment is calibrated by competent calibration laboratories traceable to NIST.

The Test column indicates which equipment was utilized to perform the radiated and conducted testing. An "R" in this column indicates that it was used for radiated emissions testing and a "C" in this column indicates that it was used for conducted emissions testing.

Table 16 - Test Equipment List

Test	Manufacturer	Model	Description	Serial Number	Last Cal	Next Cal
R	Hewlett Packard	8566B	Spectrum Analyzer	2816A16178 2747A05126	29-Dec-98	29-Dec-99
	Hewlett Packard	85650A	Quasi-Peak Adapter	3303A01859	29-Dec-98	29-Dec-99
R	Rhein Tech Labs	PR-1040	Amplifier	N/A	27-Mar-99	27-Mar-00
	RheinTexas	Radiated Cable	Site 1NE	R002	27-Mar-99	27-Mar-00
	Chase	CBL6112A	Bilog Antenna	2149	5-Nov-98	5-Nov-99
	Hewlett Packard	8546A	EMI Receiver	3265A00348 3448A00288	21-Dec-98	21-Dec-99
	RheinTexas	Radiated Cable	Site 2NW	R003	27-Mar-99	27-Mar-00
R	Chase	CBL6112A	Bilog Antenna	2150	7-May-98	7-May-99
R	EMCO	3115	Horn Antenna	9901-5672	25-Jun-99	25-Jun-00
R	Hewlett Packard	8449B	Amplifier	3008A00244	25-Feb-99	25-Feb-01
C	Hewlett Packard	8567A	Spectrum Analyzer	2602A00153 2542A11108	31-Jul-98	31-Jul-99
	Hewlett Packard	85650A	Quasi-Peak Adapter	3303A01832	31-Jul-98	31-Jul-99
C	Solar	9252-50-R-24-BNC	LISN	961023	19-Aug-98	19-Aug-99
C	RheinTexas	Conducted Cables	Coaxial Cables	C001	19-Aug-98	19-Aug-99