Emissions Testing
Performed
on the
Saar Associates
Narrow Band Transmitter
Model: WSI002

To

FCC Part 15 Subpart C, 15.249

Date of Test: February 27, 2002

Report Date: March 29, 2002

Report Number: 3019852

Contact: David Saar

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I – Introduction and Summary

TO: Mr. David Saar
FROM: Nicholas Abbondante, Compliance Engineer
DATE: February 27, 2002
PROJECT #: 3019852
RE: Emissions testing of the Narrow Band Transmitter, Model: WSI002

On February 27, 2002 we tested the Narrow Band Transmitter, Model: WSI002 to determine if it was in compliance with the FCC Part 15, Subpart C, 15.249, "Operation within the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5875 MHz, and 24.0-24.25 GHz" requirements.
A prototype version of the sample was received on 2/26/2002 in good condition. We found that the unit met the Part 15 requirements when tested as received.

The following table summarizes the results of testing.

Test	Pass/Fail	Section of FCC Rules	Section of Test Report
Fundamental Field Strength	Pass	15.249	Table 1
Harmonic Emissions	Pass	15.249	Table 1
Restricted Band & Spurious Emissions	Pass	15.249, 15.205 15.209	Table 1

In summary, this report confirms that the Narrow Band Transmitter, Model: WSI002 is compliant with the FCC Part 15, Subpart C, 15.249 requirements when production units conform to the initial sample. Please address all questions and comments concerning this report to Nicholas Abbondante, Compliance Engineer.

II – Technical Requirements

15.1 Scope

The EUT is a telemetry transmitter which measures the flow of water in a flow sensor as well as the temperature of the water. A prototype of the was received on 2/26/2002 in good condition.

15.27 Special Accessories

No special accessories are necessary for the Narrow Band Transmitter, Model: WSI002 to meet the compliance requirements.

15.31 Measurement Standards

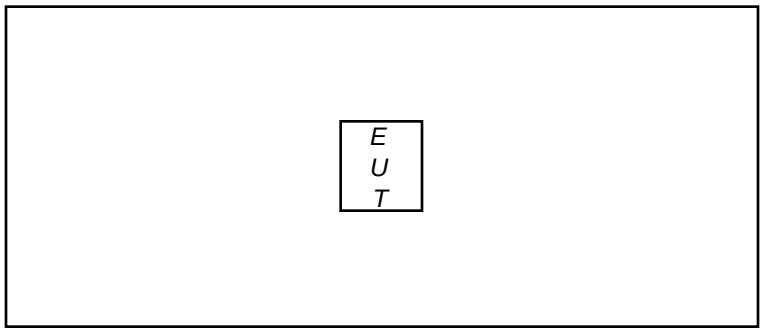
The measurement procedures as specified by ANSI C63.4:1992 were used to test this device. See Section IV of the test report for a detailed description of the test site and the measurement equipment.

Description of how the EUT was exercised during test

The EUT was activated using fresh batteries. The transmitter was set to transmit a modulated signal twice a second for 200 ms per pulse during testing. In normal usage, this 400 ms on time occurs once every 8 hours.

System Block Diagram

The diagram below details the interconnection of the EUT with the support equipment.



Justification

The system was configured for testing in a typical fashion (as a customer would normally use it), and in the confines as outlined in ANSI C63.4 (1992).

For maximizing emissions, the system was rotated through 360^{o}, the antenna height was varied from 1 meter to 4 meters above the ground plane, and the antenna polarization was changed. This step by step procedure for maximizing emissions led to the data reported.

The transmitter was configured for testing in a typical fashion (as a customer would normally use it). The device was mounted to a cardboard box, which enabled the engineer to maximize emissions through its placement in the three orthogonal axes.

15.33 Frequency range of measurement

The device was scanned for spurious and harmonic emissions from 30 MHz to the 10th harmonic of the fundamental emission. The 10th harmonic for this device is 9150 MHz.

15.35 Measurement detector functions and bandwidth

The following table illustrates the detector functions and bandwidth used to test the device.

Frequency Range	Measurement Detector	Measurement Bandwidth
450 kHz to 30 MHz	Quasi-Peak	9 kHz
30 MHz to 1000 MHz	Quasi-Peak Average	120 kHz 120 kHz
1000 MHz to 10th harmonic	Average	1 MHz

The quasi-peak detector meets the requirements of CISPR 16.

15.201 Certification

The device is required to be certified in accordance with Part 2 of the FCC rules, Subpart J.

15.203 Antenna Requirements

The antenna is part of the device chassis, and may not be removed without destroying the integrity of the device.

15.205 Restricted bands of operation

Section 15.249 requires that all spurious emissions excepting harmonics be compared to the general limits set forth in 15.209, or be attenuated by 50 dB below the fundamental, whichever is the lesser attenuation. The requirement of 15.205 is that any emissions falling within a restricted band be attenuated below the general emissions limits of 15.209. Therefore, the stricter limits of 15.209 were used when examining the spurious emissions levels, as it meets both requirements simultaneously. See section 15.35 for explanation of how detector bandwidth functions were used during testing.

15.207 Conducted limits

(a) For an intentional radiator designed to be connected to the AC mains network, the radio frequency voltage that is conducted back onto the AC power line between the frequencies 450 kHz and 30 MHz shall not exceed 250 uV, or 48 dBuV.
(b) If the proper measuring techniques are used, and the quasi-peak value of an emission exceeds its average value by 6 dB or more, that emission is broadband and the quasi-peak value may be reduced by 13 dB and compared to the limits.
(d) Devices powered from a battery are not subject to these limits unless there are provisions for connecting to a charger while the device is operating. Devices that obtain power through an AC adapter or through another device which is connected to the AC mains network are subject to these limits.

15.209 Radiated emission limits; general requirements

(a) Field Strength Requirements

Frequency Range (MHz)	Field Strength (μV/m)	Measurement Distance (m)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

(b) In the emission table above, the tighter limit applies at the band edges.
(c) The level of any spurious emissions must be lower than that of the fundamental emission of the intentional radiator. The limits in the above table are based on the frequency of the spurious emission, not the frequency of the fundamental frequency.
(d) See 15.35 for a description of measurement detector functions and bandwidth.
(e) See 15.33 for a description of the frequency range of measurement.
(f) If the frequency range of measurement must extend beyond the 10^{th} harmonic because of a digital device in the intentional radiator, the emissions found above the 10^{th} harmonic are to be compared with the general limits for radiated emissions from unintentional radiators set forth in 15.109.

15.249 Operation in the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5875 MHz, and 24.0-24.25 GHz

(a) Field Strength Requirements
Note: The requirements of Section 15.205 are in addition to the following requirements.

Fundamental Frequency (MHz)	Fundamental Field Strength at 3 meters (µV/m)	Harmonic Emissions at 3 meters (µV/m)
902-928	50000	500
2400-2483.5	50000	500
5725-5875	50000	500
24000-24250	250000	2500

(b) Field strength limits are specified at a distance of 3 meters
(c) All emissions other than the fundamental frequency and its harmonics shall be attenuated by 50 dB below the level of the fundamental emission or to the general radiated emission requirements of 15.209, whichever is the lesser attenuation.

III - Attestation

LABORATORY MEASUREMENTS

Pursuant To
Part 15, Subpart C
For
Intentional Radiators

Company Name:	Saar Associates, Inc.
Address:	37 Todd Ridge Road Titusville, NJ, 08560
Model:	WSI002
Date of Test(s):	February 27, 2002
Test Site Location:	INTERTEK TESTING SERVICES NA INC. 70 Codman Hill Road Boxborough, MA 01719
Site:	2

I attest to the accuracy of this report:

Signature	Signature
Nicholas Abbondante	Michael F. Murphy
Testing Performed By	Reviewer
Engineer	Staff Engineer/EMC
Title	Title

IV - Site Description and Measurement Equipment

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, General Requirements.

A. **Test Set-Up**: The test set-up and procedures described below are designed to meet the requirements of ANSI C63.4 (1992).

1. The test site is a Plastic/Fiberglass structure with a groundplane. The site has attenuation characteristics which meet the requirements of ANSI C63.4 (1992). Information on the site has been filed with the FCC as required by Rule 2.948. The address of the site is 70 Codman Hill Road, Boxborough, MA 01719.

2. Power to the site is nominal line voltage of 117 V_{AC} and 230 V_{AC}, 60 Hz.

3. The equipment under test (EUT) is placed on a wooden turntable which is four feet in diameter and approximately one meter in height above the groundplane. During the radiated emissions test, the turntable is rotated 360 degrees 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 search for maximum signal levels. The height of the antenna is varied from one meter to four meters. Body-worn, hand-held and small portable devices are mounted on a non-conductive box and emissions are investigated on three orthogonal axis.

4. Detector function for radiated emissions is in 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:

   Averaging Factor in dB = 20 LOG (duty cycle)

   The time period 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 data section. The duty cycle is measured by placing the spectrum analyzer in zero scan (receiver mode) and linear mode at maximum bandwidth (3 MHz at 3 dB down) and viewing the resulting time domain signal output from the analyzer on a Tektronix 465 Oscilloscope. The oscilloscope is used because of its superior time base and triggering facilities. Alternately an average detector can be employed when required.

5. Antennas used below 1000 MHz were EMCO Model 3142 Biconolog Antennas and Compliance Design Inc. Model A100 tuned Dipole Antennas. For measurements between 1000 MHz and 18000 MHz above 1 GHz, an EMCO Model: 3115 Horn Antenna is used. The Antennas used are listed in the Test Equipment Summary in Section 6.

6. The field strength measuring equipment used included:

Description	Manufacturer	Model	Serial #	Cal Due
Spectrum Analyzer	Agilent	E7405A	US40240205	11/02/2002
Super High Frequency Cable	Sucoflex	104PE	0555/4PEA	03/29/2003
RF Filter	Hewlett Packard	85420E	3427A00126	12/07/2002
Receiver Set w/RF Filter	Hewlett Packard	85422E	3520A00125	12/07/2002
Horn Antenna	EMCO	3115	9602-4675	5/29/2002
Preamplifier	MITEQ	NSP4000-NF	507145	9/22/2002
Antenna	EMCO	3142	9711-1223	10/08/2002

7. The frequency range to be 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.

8. The EUT is warmed up for 15 minutes prior to the test. If battery powered, a new battery is used.

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

10. The IF bandwidth used for measurement of radiated signal strength was 100 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 No. 150-2. Above 1000 MHz, a bandwidth of 1 MHz is generally used.

11. 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 (where no preamplifier is used), signals are 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.

12. For measurements made in the 9 kHz to 30 MHz range, a distance of 30 meters was used unless a good signal-to-noise ratio could not be obtained. In that case, a closer distance was used and that distance is so marked in the data table.

V – Summary of Equipment Under Test

1	**Manufacturer**:	Pro Circuits, Inc. 2059 Springdale Road Suite B Cherry Hill, NJ, 08003
2	**Grantee**:	Saar Associates, Inc. 37 Todd Ridge Road Titusville, NJ, 08560 (609) 818-0860 Contact: David Saar
3	**Trade Name**:	Narrow Band Transmitter
4	**Model No.**:	WSI002
5	**Serial No.**:	Proto1
6	**Intended FCC ID** (with preceding 3-character grantee code):	OV6WSI002
7	**Date of Test**:	February 27, 2002
8	**Frequencies to which device can be tuned**:	915 MHz
9	**Can customer tune device?**	No
10	**Applicable emissions limits**:	15.205, 15.207, 15.209, 15.249
11	**Antenna Characteristics:**	The antenna is a wire soldered to the PC board. It fits into a black plastic guide in the external casing which simultaneously holds it upright and separates it from the rest of the electronics.

VI - Configuration Information

Equipment Under Test:	Narrow Band Transmitter
Model:	WSI002
Serial No.:	Proto1
FCC Identifier:	None assigned as of this report; intended FCC ID is OV6WSI002

Support Equipment:

None, the EUT was operated in a standalone configuration.

Cables:

QTY	Description	Shield Description	Hood Description	Length (m)

None

VII - Configuration Photographs

Radiated Emissions Test Setup, Front and Back

Line Conducted Emissions Test Setup, Front and Back

Line-conducted emissions testing was not performed as the EUT derives power from a battery.

VIII - Sample Calculation

The following is how net field strength readings were determined:

NF = RF + AF + CF + PF + DF

Where,

NF = Net Reading in dBµV/m
RF = Reading from receiver in dBµV
AF = Antenna Correction Factor in dB(1/m)
CF = Cable Correction Factor in dB
AVF = Duty Cycle Correction Factor in dB
DF = Distance Factor in dB (using 20 dB/decade), from 3 to 1 meters 10.5 dB was added for measurements performed at 1 meter

To convert from dBµV/m to µV/m or mV/m the following was used:

$UF = 10^{(NF / 20)}$

Where,

UF = Net Reading in µV/m

Example:

For the fundamental field strength measurement at 8.4 (distance = 3 meters) see table [1].

NF = NF = RF + AF + CF + AVF + DF = 62.9 + 13.7 + 2.1 + (–10.0) + 0.0 = 68.7 dBµV/m

$UF = 10^{(68.7\ dB\mu V / 20)} = 2722.7\ \mu V/m$

IX - Data Tables

Radiated Emissions / Interference

Table: 1

Company:	Saar Associates, Inc.			Tested by:	Nicholas Abbondante		
Model #:	Narrow Band Transmitte	Serial #:	Proto1	Location:	EMI Site 2		
Project #:	3019852	Pressure:	N/A	Detector:	HP 8542E		
Date:	02/28/02	Temp:	16.4C	Antenna:	LOG2		
Standard:	FCC Part 15 C	Humidity:	42%	PreAmp:	None		
Class:	None	Group:	None	Cable(s):	2C, 10m Prime		None
Notes:				Distance:	3	meters	

Abbreviations: nb - narrow band, bb - broadband, pk - peak measurement

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	404.000	8.9	16.7	3.3	0.0	-10.5	39.4	46.0	-6.6
H	914.900	62.3	24.1	5.5	0.0	0.0	91.9	94.0	-2.1
H	1830.000	37.4	28.9	4.0	22.3	0.0	47.9	54.0	-6.1
V	2745.000	22.8	31.3	5.1	22.3	0.0	36.9	54.0	-17.1
V	3660.000	20.6	33.6	6.2	22.7	0.0	37.7	54.0	-16.3
V	4575.000	20.1	34.9	6.7	23.2	0.0	38.5	54.0	-15.5