

A. INTRODUCTION

The TransPondITV4 is a low powered, battery operated transmitter designed for reading water, gas and electric meters. It operates at a nominal 919.89 MHz frequency. The transmitter, constructed on an etched circuit card, is powered from a 3.6 volt lithium battery. An integral, loop antenna is used.

B. OPERATIONAL DESCRIPTION

Subject to Request for Confidentiality, see Exhibit marked Operational Description.

C. DESCRIPTION OF MEASUREMENT PROCEDURE: RADIATED MEASUREMENTS

Measurements of transmitter radiated emissions were made using ANSI 63.4 (1992) as the test procedure. Measurements were made with 3 meter spacing between the transmitter under test and the test equipment antenna.

The transmitter was placed on a rotatable table approximately 80 cm in height.

A fresh battery was installed.

Measurement of field strength was made through use of an HP 8568B spectrum analyzer with HP 85650A quasi-peak adapter or a Tektronix 494P spectrum analyzer.

The device had a period of 47×10^{-3} seconds (see Figure 3) corresponding to a PRF of 21.3 Hz. Accordingly, the HP quasi-peak detector was used for emissions below 1 GHz.

Above 1 GHz, the Tektronix 494P spectrum analyzer, a peak responding device, was used. Test distance was 1 meter; data were extrapolated to 3 meters.

An Eaton 94455 biconical antenna was used to 200 MHz; and a Eaton log periodic antenna P/N 96005, S/N 1243, was used from 200 to 1 GHz. (Calibration data for the LPA is included in Appendix A.) Above 1 GHz an ARA LPD-210 log periodic antenna was used.

An analysis of time domain measurements (see plot in Figure 3) was made to determine average field intensity of above 1 GHz harmonics. Sample calculations are included in Figure 4.

Based on time domain observations, a correction factor for emissions above 1 GHz, based on a nominal 100 mS averaging interval was computed and is included in Table 1 data.

C. DESCRIPTION OF MEASUREMENT PROCEDURE: RADIATED MEASUREMENTS
(Continued)

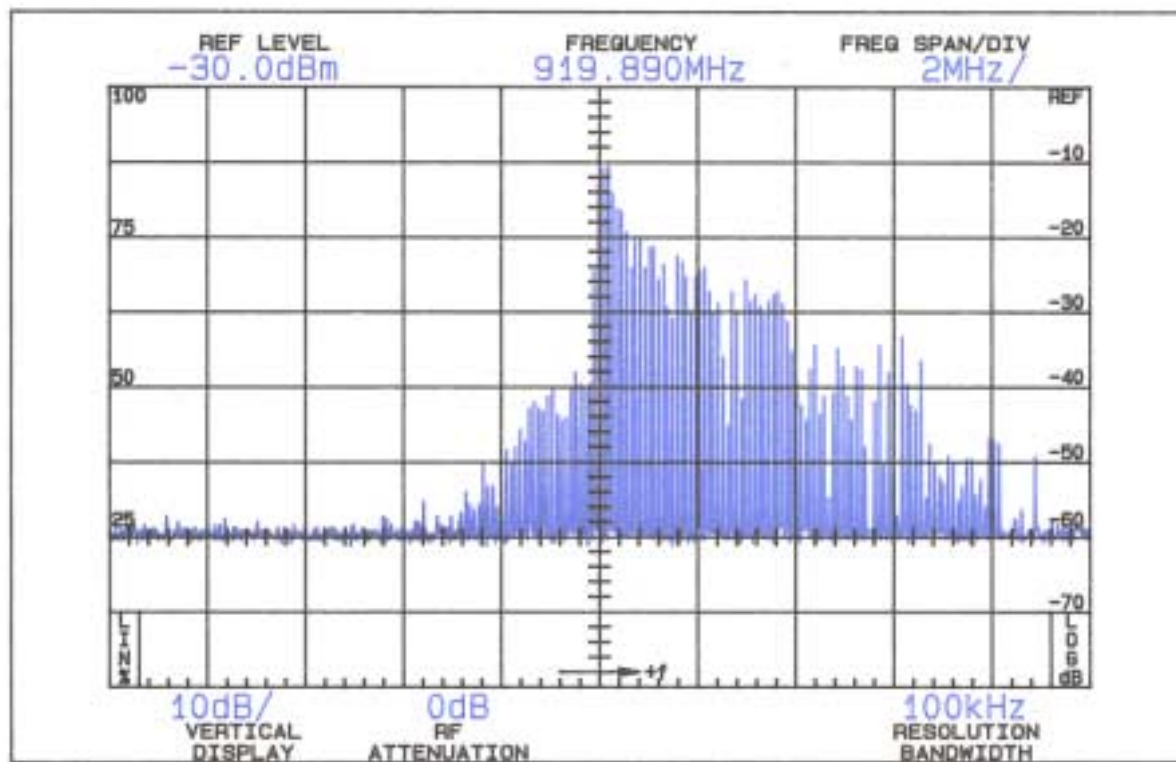
For each spurious emission identified between 30 to the tenth harmonic the test assembly was rotated for maximum pickup, the test antenna varied in elevation and the test antenna polarization shifted between horizontal to vertical in order to maximize observed signals.

The measurement procedure included recording the worst-case field strength for receiving antenna polarization, test antenna height variation from 100 cm to 400 cm, test sample rotation, and placing the test sample on each of its major planes.

The spectrum was checked from 30 to 9200 MHz. All emissions not reported were more than 20 dB below the permitted level or below FCC limits but in the ambient/system noise floor. Tabulation of the measurements are shown in Table 1.

Specific forbidden band scans were made per Paragraph 15.205 and 15.209.

FIGURE 1



Nominal Center Frequency

Horizontal Span: 2 MHz/Div

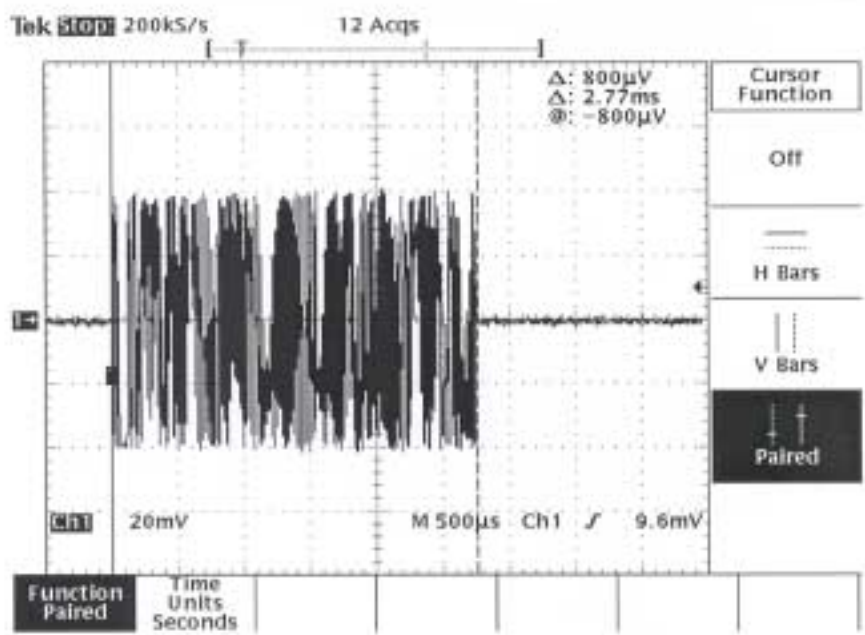
Vertical: 10 dB/Div.

Resolution: 100 Hz

OCCUPIED BANDWIDTH
FCC ID: MS8-TRANSPONDITV4

FIGURE 1

FIGURE 2



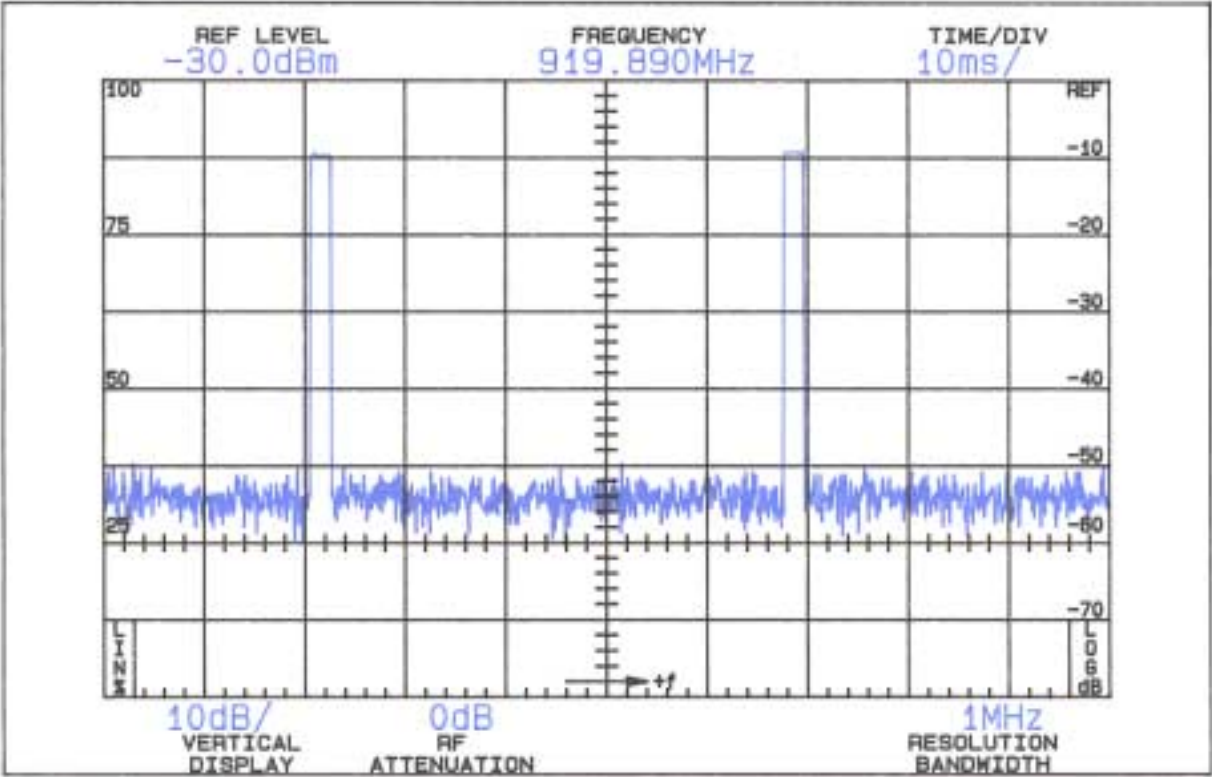
TRANSMISSION DURATION

Horizontal: 500 microseconds/Div
(Time domain)

TRANSMISSION CHARACTERISTICS
FCC ID: MS8-TRANSPONDITV4

FIGURE 2

FIGURE 3



TRANSMISSION PULSE REPETITION RATE

Horizontal: 10 milliseconds/Division
(Time Domain)

TRANSMISSION CHARACTERISTICS
FCC ID: MS8-TRANSPONDITV4

FIGURE 3

SAMPLE COMPUTATIONS

Using the time domain plots of Figures 2 and 3, maximum "on" time over any 100 mS interval is:

"On" Pulses:

2.77 millisecond

Duty Cycle: $2.77/100 = 0.028$

$20 \text{ Log } 0.028 = -31.2^* \text{ dB}$

*Maximum of -20 dB was used in Table 1 peak/average computations, per Para. 15.249(d).

SAMPLE COMPUTATIONS
FCC ID: MS8-TRANSPONDITV4

FIGURE 4

6
TABLE 1

RADIATED FIELD INTENSITY
Measured at 3 meters
15.249

Frequency (MHz)	**	Meter ¹ Reading (dBm)	Antenna ⁴ Factor (dB)	Field ² Intensity uV/m @ 3m	PZ	Calc. Field ³ Intensity uV/m @ 3m	FCC Limit uV/m @ 3m	dB to Limit
919.845	Q	-44.37	30.9	47,479	V	n/a	50000.0	- 0.45
1839.685	P	-93.94	32.8	196	V	19.6	500.0	-28.1
2759.528	P	-97.32	36.9	213.3	H	21.3	500.0*	-27.4
3679.370	P	-99.49	38.1	190.7	H	19.0	500.0*	-28.4

Note 1: Peak detector reading without averaging.

Note 2: $\text{uV/m} = \text{Log}^{-1} \frac{\text{dBu/m}}{20}$

dBu = dBm + antenna factor + 107

Note 3: Field Intensity calculated from peak value and -20 dB peak/average factor.

Note 4: Includes cable attenuation

*Forbidden Band

** Q = quasi-peak detector

** P = peak detector

PZ = test antenna polarization

All other emissions to the tenth harmonic were below FCC limits.

(Unit was measured on 3 major planes)

VBW 1 MHz, RBW 1 MHz, with CISPR 120 kHz detector; RBW > 1 GHz: 1 MHz

RADIATED FIELD INTENSITY
FCC ID: MS8-TRANSPONDITV4

TABLE 1

D. FORBIDDEN BAND MEASUREMENTS

Any spurious signals from the transmitter that fell in a forbidden band are identified in Table 1. All forbidden bands, per Paragraph 15.205, from 73 MHz to 10 GHz were searched and any applicable emissions above noise or interference levels are shown in Table 1.

E. POWER LINE CONDUCTED MEASUREMENTS

AC line conducted spurious measurements were not made since the device does not use the public power supply system.

F. COMPLIANCE WITH SECTION 15.249 OF PART 15

15.249(a,b) The field strength of the radiation emission was measured and found to comply with the limits established by 15.249(a) and 15.209. (See data of Table 1.)

15.249(c) Emissions radiated outside of the specified frequency bands, except for harmonics, were attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in 15.209, (whichever is the lesser attenuation). See Figure 1.

APPENDIX A

CERTIFICATE OF CALIBRATION CONFORMANCE

LIBERTY LABS, INC.
P.O. BOX 230
Kimballton, IA 51543
TEL: (712) 773-2199
FAX: (712) 773-2299
EMAIL: mhoward@netins.net

THIS ANTENNA HAS BEEN INDIVIDUALLY CALIBRATED USING ANSI C63.5,
AMERICAN NATIONAL STANDARD FOR CALIBRATION OF ANTENNAS USED FOR
RADIATED EMISSION MEASUREMENTS IN EMI CONTROL.

CALIBRATION ACCURACY: +- 1dB

CALIBRATION TRACEABILITY:

ALL MEASUREMENT INSTRUMENTATION IS TRACEABLE TO THE
UNITED STATES NATIONAL INSTITUTE OF STANDARDS AND
TECHNOLOGY (NIST). Supporting Documentation relative to traceability
is on file and is available for examination upon request

MEASUREMENT PROCEDURE PER MILITARY HANDBOOK-52A AS
GUIDANCE FOR MILITARY STANDARD (MIL-STD) 45662 AND ISO
GUIDE 25.

TEMPERATURE: 15 Deg C

RELATIVE HUMIDITY: 55%

CERTIFICATE NO.: 1016
CLIENT: Hyak Associates
MANUFACTURER: Eaton LPA
MODEL NUMBER: 96005
SERIAL NUMBER: 1243
DATE OF CALIBRATION: 3/13/96 (MM/DD/YY)
NOTES:

RE-CERTIFICATION DATE: 2 YEARS FROM CALIBRATION DATE



ENGINEER IN CHARGE
MICHAEL W. HOWARD
NARTE CERTIFIED EMC ENGINEER, NO. EMC-000102-NE



Cable Loss File Name

LIBERTY LABS, INC: ACF Plot

Wednesday, March 13, 1996 09:54

c:\anthold\cable01.txt

Measurement Set #1 File

c:\anthold\set04.txt

Measurement Set #2 File

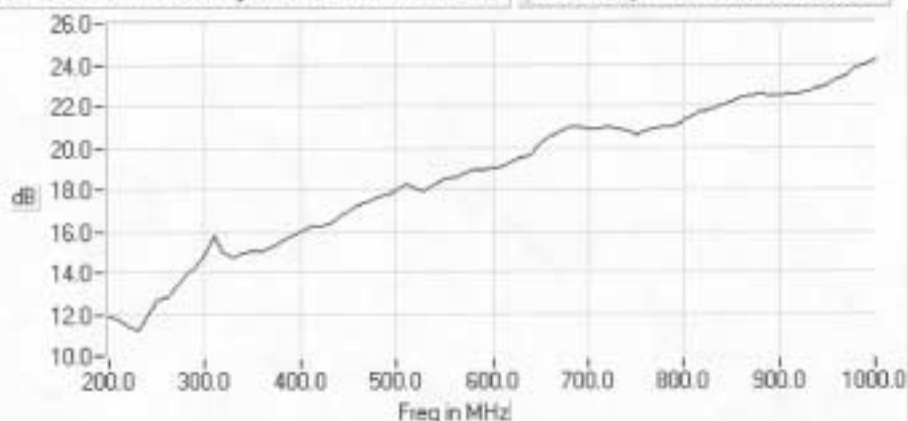
c:\anthold\set05.txt

Measurement Set #3 File

c:\anthold\set06.txt

Measurement Dist (Meters)

3



Ant. Polarization

Vert

Ht (Meters)

2.0

Hr min (Meters)

1.0

Hr max (Meters)

4.0

Cal Data for Ant Set ?



Customer Name

Hyak Associates

Temp (Deg C)

15

Humidity (%)

55

Ant. Mfr.

EATON

Ant. Model

96005

Ant. Serial #

1243

Storage File Name

c:\anthold\ant02.txt

		ANT02.DAT	
FREQ	ACF	Gain	NUM
MHz	dB/m	dB	Gain
200.0000	11.8	4.4	2.75
210.0000	11.7	4.9	3.09
220.0000	11.4	5.7	3.70
230.0000	11.3	6.2	4.15
240.0000	12.0	5.8	3.81
250.0000	12.7	5.5	3.53
260.0000	12.8	5.7	3.71
270.0000	13.4	5.4	3.50
280.0000	13.9	5.2	3.33
290.0000	14.2	5.3	3.35
300.0000	14.8	4.9	3.11
310.0000	15.8	4.3	2.68
320.0000	14.9	5.4	3.44
330.0000	14.8	5.8	3.81
340.0000	14.9	5.9	3.93
350.0000	15.0	6.0	4.02
360.0000	15.1	6.3	4.23
370.0000	15.2	6.4	4.34
380.0000	15.5	6.3	4.27
390.0000	15.7	6.3	4.27
400.0000	16.0	6.2	4.21
410.0000	16.2	6.3	4.23
420.0000	16.2	6.4	4.41
430.0000	16.4	6.5	4.47
440.0000	16.7	6.4	4.37
450.0000	16.8	6.4	4.39
460.0000	17.2	6.2	4.21
470.0000	17.4	6.3	4.23
480.0000	17.6	6.2	4.21
490.0000	17.8	6.3	4.22
500.0000	17.9	6.3	4.28
510.0000	18.2	6.1	4.09
520.0000	18.0	6.5	4.49
530.0000	17.9	6.8	4.78
540.0000	18.2	6.6	4.58
550.0000	18.4	6.6	4.56
560.0000	18.5	6.6	4.62
570.0000	18.8	6.6	4.52
580.0000	18.9	6.6	4.54
590.0000	18.9	6.7	4.71
600.0000	19.0	6.8	4.76
610.0000	19.0	6.9	4.90
620.0000	19.3	6.7	4.72
630.0000	19.5	6.7	4.71

		ANT02.DAT	
640.0000	19.6	6.7	4.67
650.0000	20.1	6.3	4.29
660.0000	20.5	6.0	4.02
670.0000	20.7	6.0	3.97
680.0000	21.0	5.9	3.87
690.0000	21.0	6.0	4.00
700.0000	20.9	6.2	4.17
710.0000	20.9	6.4	4.34
720.0000	21.0	6.4	4.34
730.0000	20.9	6.6	4.58
740.0000	20.8	6.8	4.82
750.0000	20.7	7.1	5.07
760.0000	20.8	7.0	5.03
770.0000	20.9	7.0	5.02
780.0000	21.0	7.0	5.05
790.0000	21.0	7.1	5.16
800.0000	21.2	7.0	5.04
810.0000	21.5	6.9	4.84
820.0000	21.7	6.8	4.77
830.0000	21.8	6.8	4.77
840.0000	22.0	6.7	4.64
850.0000	22.2	6.6	4.54
860.0000	22.4	6.5	4.45
870.0000	22.5	6.5	4.45
880.0000	22.5	6.5	4.51
890.0000	22.5	6.7	4.66
900.0000	22.4	6.9	4.84
910.0000	22.5	6.8	4.84
920.0000	22.5	6.9	4.95
930.0000	22.6	6.9	4.94
940.0000	22.8	6.9	4.86
950.0000	22.9	6.8	4.79
960.0000	23.3	6.5	4.48
970.0000	23.4	6.5	4.52
980.0000	23.8	6.2	4.16
990.0000	24.0	6.1	4.11
1000.0000	24.2	6.0	3.94