ELECTROMAGNETIC INTERFERENCE TEST REPORT

FOR

GARLAND RODESCHÉ & ASSOCIATES, INC.

SILENTHORN™ / SILENTSIREN™ vehicle warning device
TRANSCEIVER

NI7-SILENTHORN-A1

July 5, 2000

Prepared for: Garland Rodesché & Associates, Inc.
920 Holbron Road
Streetsboro, OH 44241

Measurements made
and report prepared by: James R. Pollock
James R. Pollock

SMITH ELECTRONICS, INC.
8200 SNOWVILLE RD.
CLEVELAND, OH 44141
440/526-4386

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CERTIFICATE OF COMPLIANCE

1. Applicant:	Garland Rodesché & Associates, Inc. 920 Holbron Road Streetsboro, OH 44241
2. Manufacturer:	Pulsar Systems, Inc. 650 Nashville Pike, Building #5 Gallatin, TN 37066
3. Contact:	Carl Garesché Garland Rodesché & Assoc., Inc. Tel. & Fax 330/653-5370
4. Regulation:	CFR47-Part 15C 15.231
5. Measurement Method:	ANSI C63.4-1992
6. Type:	SILENTHORN™/SILENTSIREN™ Radio Control Transceiver
7. Frequency:	418 MHz
8. Dates of Test:	June 5 - 27, 2000
9. Place of Test:	Smith Electronics, Inc., Lab, 8200 Snowville Rd., Brecksville, OH. Open Field Site at 8200 Snowville Rd., Brecksville, OH

10. Statement of Compliance:

I hereby certify that measurements of radio frequency emissions from the Garland Rodesché & Associates, Inc., SILENTHORN™ / SILENTSIREN™ vehicle warning device transceiver were performed by me between June 5 and 27, 2000, and that the results of the measurements confirmed that the unit tested is capable of compliance with the above regulations.

July 07, 2000
Date

James R. Pollock, President
Signature, Title

INTRODUCTION:

The device tested is a 418 MHz transceiver intended to be installed in a majority of vehicles in a given area. When installed in a typical vehicle, the transmitter is activated along with the warning horn. In an emergency vehicle (police, fire, ambulance, etc.) the siren operation would activate the transmitter. The receivers in equipped vehicles would detect the presence of nearby warning horns or sirens and indicate visually the proximity of such warning signals. The transmitter portion is to be certified to the requirements of Part 15.231 of the FCC rules. As a digital device, the unit is exempt under 15.103(a) by virtue of being installed in transportation vehicles, and the receiver portion is to be verified per 15.101(b). One sample of the transceiver was tested. The receiver verification is covered in a separate report.

RADIATED EMISSIONS BELOW 2000 MHZ:

An initial scan of the emissions profile of the transmitter was made in a shielded room and verified that between 30 MHz and 1500 MHz no significant emissions other than the fundamental frequency and its harmonics were present.

Measurements of the emissions below 2000 MHz were made on the Smith Electronics 3 m open field test site located at 8200 Snowville Road, Brecksville, OH. Data on this test site is on file with the FCC.

The transmitter, with its coding set as provided by the manufacturer, and the switch held on, was placed flat on a rotatable, non-conductive platform at a 3 m test distance. The transmit dipole antenna was oriented horizontally, displaced laterally by about 0.8 m and at a height about 0.35 m above the unit with the approximately 2 m antenna cable placed on the platform. (See Pictorial 1, upper photo)

The NM 37/57 receiver was tuned to the fundamental frequency and the transmitter was then rotated and the horizontally polarized test antenna (tuned dipole) varied in height between 1 & 4 meters to obtain the maximum reading. The maximum level, using peak detection, was recorded. The transmitter was also examined with its antenna oriented vertically and with the test antenna vertically polarized. All measured values were recorded. The same procedure was used to obtain the maximum level of the second through fourth harmonics with a Hewlett Packard Model HP8593EM spectrum analyzer and a horn antenna used above 1000 MHz. The maximum values at each frequency are recorded in Table 1. Below 1000 MHz, the instrument bandwidth was 120 kHz; above 1000 MHz, a 1 MHz bandwidth was used.

RADIATED EMISSIONS ABOVE 2000 MHZ:

The measurement of radiated emissions above 2000 MHz was performed in an open area at a test distance of 1.5 meter. A manually operated rotating platform was used and the same procedure followed except for the variation in antenna height. Because of the shorter test distance the transmitters antenna was positioned about 0.2 m above the transmitter with little lateral displacement (See Pictorial 1, lower photo). Peak readings were made using a HP 8593EM spectrum analyzer. Maximum measured levels are also recorded in Table 1.

AVERAGE DETERMINATION:

To determine the average value of the emissions from the peak values, the pulse information shown in Fig. 1 was used. Figure 1 shows a complete pulse train as well as the timing between trains. Using distance measurements from the plots, it was determined that each pulse train is about 20.5 mS long and the interval between trains is about 96.6 mS for a period of 117.1 mS. Only one pulse train is therefore in any one period of 100 mS. The pulse train then comprises 20.5 mS of the 100 mS interval. Each pulse train operates at a 50% duty cycle and is, therefore, "on" for 10.25 mS.

Hence, within the 100 mS period of interest, the pulses are "on" for 10.25 mS or 10.25% for a ratio of -19.7 dB. This is within the allowable peak/avg. ratio of 20 dB as seen in Part 15.35.

As a result, each peak value measured is reduced by 19.7 dB to give the average value desired by Para. 15.231.

OCCUPIED BANDWIDTH:

Paragraph 15.231(c) restricts the occupied bandwidth of these transmitters to 0.25% of the fundamental frequency. With a fundamental of 418 MHz, this allows an occupied bandwidth of 1.04 MHz. The approximate 20 dB down points as shown in Fig. 2, indicate a bandwidth of about 65 kHz. This is well below the requirement.

CALCULATIONS:

A.) Field Strength.

Peak readings were made at all frequencies in dBuV. The 19.7 dB peak to average factor was subtracted from the peak reading to produce an average value. To these values were added the antenna factor and a coax loss factor in dB to arrive at field strength in dBuV/m. This value was then converted to microvolts per meter by dividing dBuV/m by 20 and finding the anti-log of the quotient.

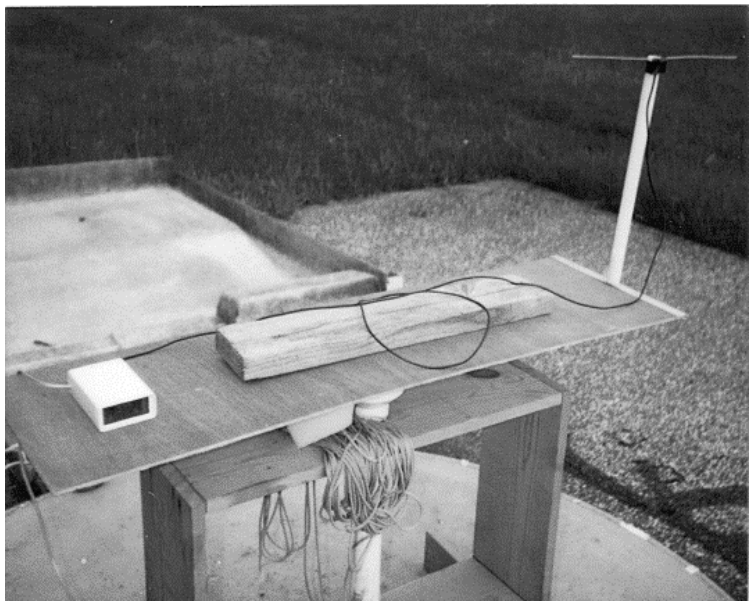
For the measurements above 2000 MHz which were made at a 1.5 m distance, the field strength in uV/m was divided by 2 (6dB) to allow for an inverse distance correction.

B.) Occupied Bandwidth.

With the transmitter operating, a scan was made as shown in Fig. 2. The marker was set to the peak level, and using the "delta" capability moved to the left until it was at least 20 dB below the peak. The marker was reset, the "delta" engaged and the marker relocated to the right of the peak to approximately the same level as the left marker. The distance between the markers, indicated on the analyzer display was read directly.

CONCLUSIONS:

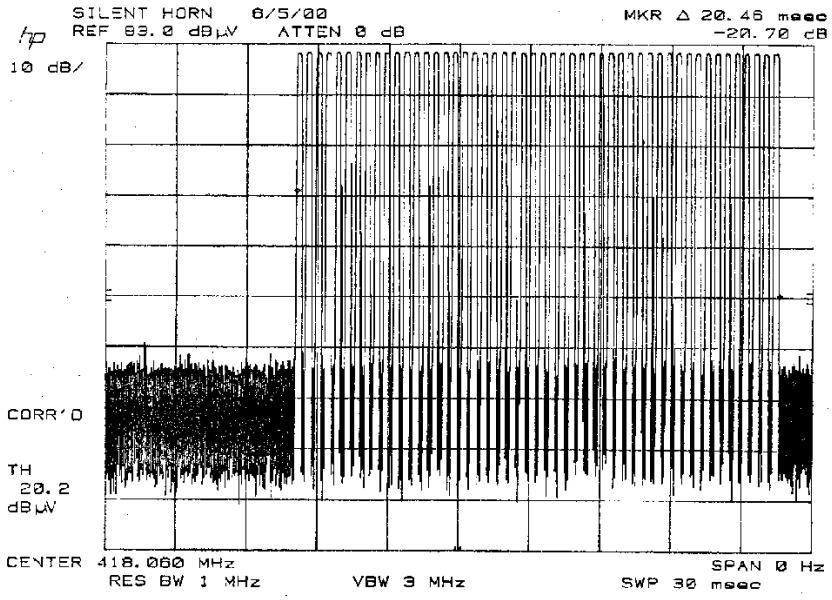
The transmitter portion of the Garland Rodesché & Associates, Inc., SILENTHORN™ / SILENTSIREN™ vehicle warning device transceiver, when tested as described, has been shown to be capable of compliance with the FCC Rules and Regulations under Part 15.231 for control of transmitters.



MEASUREMENTS BELOW 2000 MHZ

MEASUREMENTS ABOVE 2000 MHZ

PICTORIAL 1
FIELD STRENGTH MEASUREMENT TEST SET UPS
SILENTHORN™/SILENTSIREN™ VWD



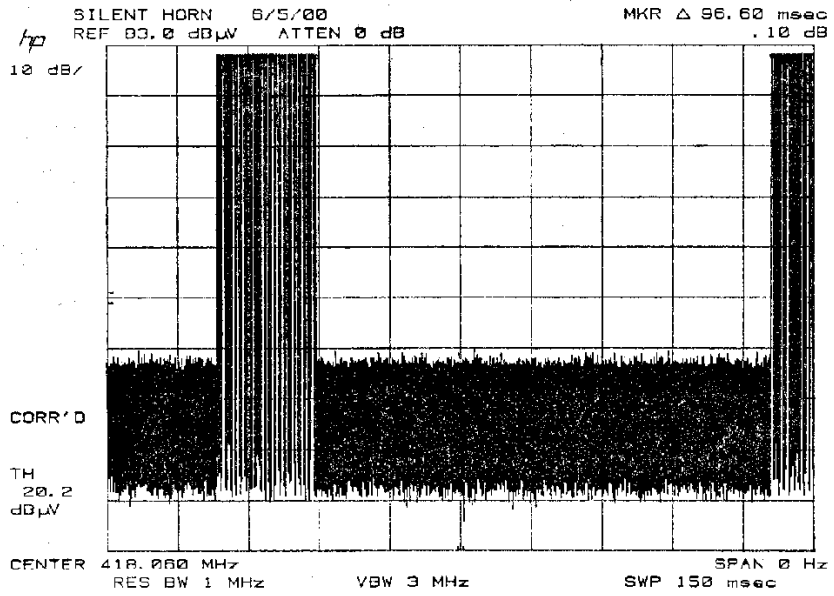


Fig. 1
PULSE TRAIN DATA
SILENT HORN/SILENT SIREN
TRANSMITTER

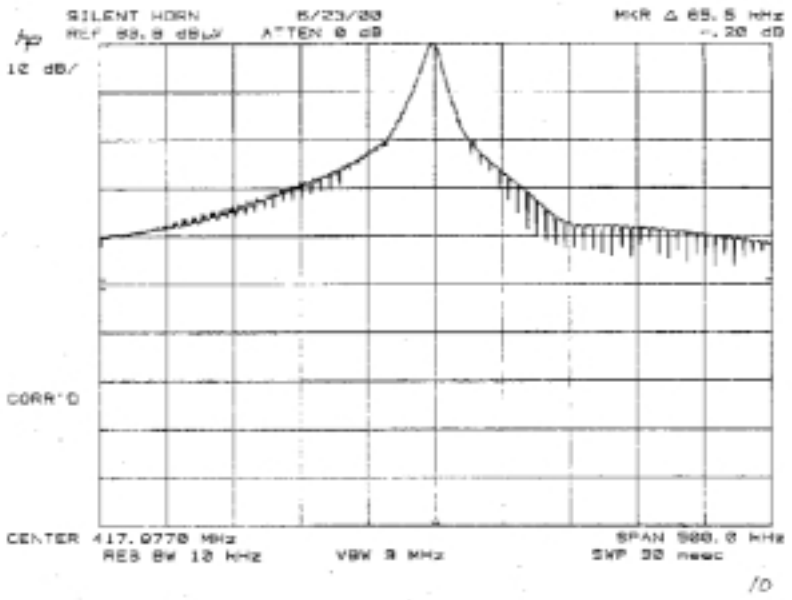


Fig. 2
OCCUPIED BANDWIDTH DATA
SILENT HORN/SILENT SIREN

TABLE 1
GARLAND RODESCHÉ & ASSOCIATES, INC.
SILENTHORN™ / SILENTSIREN™
RADIO CONTROL TRANSCEIVER

TRANSMITTER EMISSIONS

Freq. (MHz)	Meter dBuV	AF dB	Coax dB	Field Strength @ Dist. dBuV/m	Field Strength @ Dist. uV/m	Field Strength @3m uV/m	Limit uV/m	Diff. dB
@ 3 m								
418	72.0 pk 52.3 avg	21.6	1.0	74.9	5559	5559	10,333	- 5.4
836	24.0 pk 4.3 avg	28.3	1.6	34.2	51	51	1,033	-26.1
1254	36.5 pk 16.8 avg	25.0	4.2	46.0	199	199	1,033	-14.3
1672	29.8 pk 10.1.avg	26.2	0.4	36.7	68	68	500	-17.3
---------- @ 1.5 m ----------								
2090	42.7 pk 23.0 avg	29.0	0.4	52.4	417	208	1,033	-13.9
2508	31.5 pk 11.8 avg	29.5	0.5	41.8	123	62	1,033	-24.5
2926	30.2 pk 10.5 avg	30.8	0.6	41.9	124	62	1,033	-24.5
3344	30.0 pk 10.3 avg	32.0	0.6	42.9	140	70	1,033	-23.4
3762	32.8 pk 13.1 avg	33.0	0.7	46.8	219	109	500	-13.2
4180	30.4 pk 10.7 avg	33.0	0.7	44.4	166	83	500	-15.6

Average values are calculated by subtracting 19.7 dB from the peak value.

EQUATIONS USED IN CALCULATIONS

$$E = R + A + C \qquad \text{EQ. 1}$$

Where: E = Field strength in dBuV/m

R = Meter reading in dBuV

A = Antenna factor in dB

C = Coax loss in dB

$$FS = 10^{(E/20)} \qquad \text{EQ. 2}$$

Where: FS = Field strength in uV/m

E = Field strength in dBuV/m

$$E_{Avg.} = E_{Pk} - 19.7 \qquad \text{EQ. 3}$$

Where: $E_{Avg.}$ = Average field strength in dBuV/m

E_{Pk} = Peak field strength in dBuV/m

19.7 = Peak to average ratio in dB

Sample Calculation: At 2090 MHz, using EQ. 3 and data from Table 1,

$E_{Avg.}$ = 42.7 dBuV(Pk) - 19.7 (Pk/Avg. ratio) = 23.0 dBuV(Avg.)

Using EQ. 1, E = 23.0(dBuV) + 29.0(A) + 0.4(C) = 52.4 dBuV/m

Using EQ. 2, $FS = 10^{(52.4/20)}$

$= 10^{2.62}$

FS = 417 uV/m (Avg. at 1.5 m)

417/2 = 208 uV/m (Avg. at 3 m)

LIST OF TEST EQUIPMENT

RECEIVERS:	Hewlett-Packard Spectrum Analyzer Type 8568B with 8560A RF Section S/N 2216A02120 85662A Display Section S/N 2152A03686 85650A Quasi-Peak Adapter S/N 2043A003450 Calibrated 6/00
	Singer Stoddart EMI Field Intensity Meter Model NM 37/57 S/N 0366-06068 Calibrated 6/00
	Hewlett-Packard Spectrum Analyzer Model 8593EM, S/N 3536A00147 Calibrated 6/00
ANTENNAS;	EMCO Biconical Antenna Model 3104 Freq. Range 20 - 200 MHz
	EMCO Log-Periodic Antenna Model 3146 Freq. Range 200 - 1000 MHz
	Stoddart Tuned Dipole Antenna Model 91598-2 Freq. Range 400 - 1000 MHz
	EMCO Double Ridged Guide Horn Model 3115 Freq. Range 1 - 18 GHz
MISCELLANEOUS:	Hewlett-Packard Preamplifier Model 8447D S/N 1725A01282
	12.2 m RG-214/U coaxial cable
	1.0 m RG-214/U coaxial cable

ELECTROMAGNETIC INTERFERENCE TEST REPORT

FOR

GARLAND RODESCHÉ & ASSOCIATES, INC.

SILENTHORN(TM)/SILENTSIREN(TM) vehicle warning devices
RECEIVER/DIGITAL DEVICE

July 3, 2000

Prepared for: Garland Rodesché & Associates, Inc.
920 Holbron Road
Streetsboro, OH 44241

Measurements made
and report prepared by: James R. Pollock
James R. Pollock

SMITH ELECTRONICS, INC.

8200 SNOWVILLE RD.
CLEVELAND, OH 44141
440/526-4386

VERIFICATION OF COMPLIANCE

1.	Applicant:	Garland Rodesché & Ass., Inc. 920 Holbron Road Streetsboro, OH 44241
2.	Contact:	Carl Garesché Garland Rodesché & Ass., Inc. Tel. 330/653-5370
3.	Regulation:	CFR47-Part 15B; 15.109
4.	Measurement Method:	ANSI C63.4-1992
5.	Type:	SILENTHORN(TM)/SILENTSIREN(TM) VWD Radio Control Receiver/Digital Device
6.	Frequency:	418 MHz
7.	Dates of Test:	June 5 - 27, 2000
8.	Place of Test:	Smith Electronics, Inc. Test Lab, 8200 Snowville Rd., Brecksville, OH. Open Field Sites at 8200 Snowville Rd., Brecksville, OH.

9. Statement of Compliance:

I hereby verify that measurements of radio frequency emissions from the SILENTHORN(TM)/SILENTSIREN(TM) transceiver were performed by me between June 3 and 27, 2000, and that the results of the measurement confirmed that the unit tested is capable of compliance with the abo regulations, both as a transmitter and as a receiver/digital device. This report covers only the digital device and receiver portions of the transceiver.

July 03, 2000
Date

James R. Pollock, President
Signature, Title

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INTRODUCTION:

The device tested is intended for use in a motor vehicle and will receive power from the vehicle electrical supply. The transmitter portion is similar to the typical radio control transmitter and wil operate at 418 MHz under Part 15.231. The receiver portion is a su heterodyne circuit tuned to the same frequency, with its SAW oscillator operating at 407.3 MHz. A 4 MHz crystal oscillator is included in the circuit and generates emissions that are also examined. One sample of the transceiver was tested.

Part 15.103(a) exempts the digital device portion of the unit by virtue of its being installed in transportation vehicles. Even so, the emissions were examined and found to be well within the requirements of 15.109.

RECEIVER/DIGITAL DEVICE MEASUREMENTS

All emissions other than those generated by the transmitter portion of the transceiver were generated by connecting the DC power lea to the power supply but not activating the transmitter itself. An unintentional radiator such as a receiver or digital device is required comply with the limits of Part 15.109(a).

The dipole antenna is installed with coax permanently connected ins the receiver housing and can not readily be replaced. The system is powered from the 12 VDC supply from the vehicle on which it is mounted. adjustments are readily accessible to the user. The receiver, as part o Certified transceiver is to be authorized by Verification. The receiver radiated emissions measurements were performed with the receiver detecti a 418 MHz signal, although no change in local oscillator emissions were observed with the received signal.

RADIATED EMISSIONS BELOW 1000 MHZ:

An initial scan of the emissions profile of the receiver was made i shielded room and is shown in Fig. 1. The emissions below about 200 MHz appear to be produced by the 4 MHz clock, while the emissions above 200 are those produced by the local oscillator of the receiver circuit. The appropriate limit is drawn on each figure for reference.

Final measurements of the receiver emissions below 1000 MHz were ma on the Smith Electronics 3 m open field test site located at 8200 Snowvi Road, Brecksville, OH. Data on this test site is on file with the FCC.

The transceiver was placed on the turntable in a typical installed position with the antenna placed a short distance away, also on the turntable. A small loop probe connected to a signal generator was place near the system to produce the 418 MHz signal for the receiver.

The NM 37/57 receiver was tuned to a signal produced by the system the receiver was then rotated and the vertical, biconical test antenna varied in height between 1 & 4 meters to obtain the maximum reading. Th maximum level, using quasi-peak detection, was recorded. The procedure repeated with the test antenna in the horizontal position and the result again recorded. The spectrum was scanned between 30 MHz and 1000 MHz, wi each significant signal recorded. The maximum levels are recorded in Ta 1.

RADIATED EMISSIONS ABOVE 1000 MHZ:

A scan of frequencies from 1000 MHz to 2000 MHz was performed in th shielded room at a test distance of 0.1 m. A double- ridged-guide horn antenna was used with a HP 8593EM spectrum analyzer. The measured value obtained are also found in Table 1.

CONCLUSIONS:

All radiated emissions generated by the digital and receiver circui of the SILENTHORN(TM)/SILENTSIREN(TM) transceivers were determined to be in compliance with the FCC requirements for unintentional radiators as foun in 15.109.

TABLE 1

RECEIVER/DIGITAL DEVICE EMISSIONS
SILENTHORN(TM)/SILENTSIREN(TM) VWD

Freq. (MHz)	Meter (dBuV)	AF (dB)	Coax (dB)	Field Strength @ Dist. (dBuV/m)	@3m (uV/m)	Limit (uV/m)	Diff. (dB)
DIGITAL DEVICE EMISSIONS							
				@ 3 m			
76	11.0	9.8	0.8	21.6	12	12	100	-18.4
116	2.0	11.9	1.0	14.9	5.6	5.6	150	-28.6
RECEIVER EMISSIONS							
				@ 3 m			
407.3	6.0	15.7	2.1	23.8	15.5	15.5	200	-22.2
814.6	3.0	20.8	3.2	27.0	22.4	22.4	200	-19.0
				@ 0.1 m			
>1000	<34.0	28.5	0.4	<62.9	1400	47	300	-16.1
Sweep between 1 & 2 GHz with 1 MHz BW Maximum Antenna factor and coax loss								
1221.9	12.7	25.0	0.3	38.0	80	2.6	300	-41.1
Sweep between 1 & 2 GHz with 10 kHz BW Bandwidth should not be critical as measured signal is narrowband.								

Measurements below 1000 MHz are quasi-peak. Above 1000 MHz, peak measurements were used.

EQUATIONS USED IN CALCULATIONS

$$E = R + A + C \qquad \text{EQ. 1}$$

Where: E = Field strength in dBuV/m

R = Meter reading in dBuV

A = Antenna factor in dB

C = Coax loss in dB

$$FS = 10^{(E/20)} \qquad \text{EQ. 2}$$

Where: FS = Field strength in uV/m

E = Field strength in dBuV/m

Sample Calculation:

At 407.3 MHz, using EQ. 1 and data from Table 1,

$$E = 6.0 + 15.7 + 2.1 = 23.8 \text{ dBuV/m}$$

Using EQ. 2, $FS = 10^{(23.8/20)}$

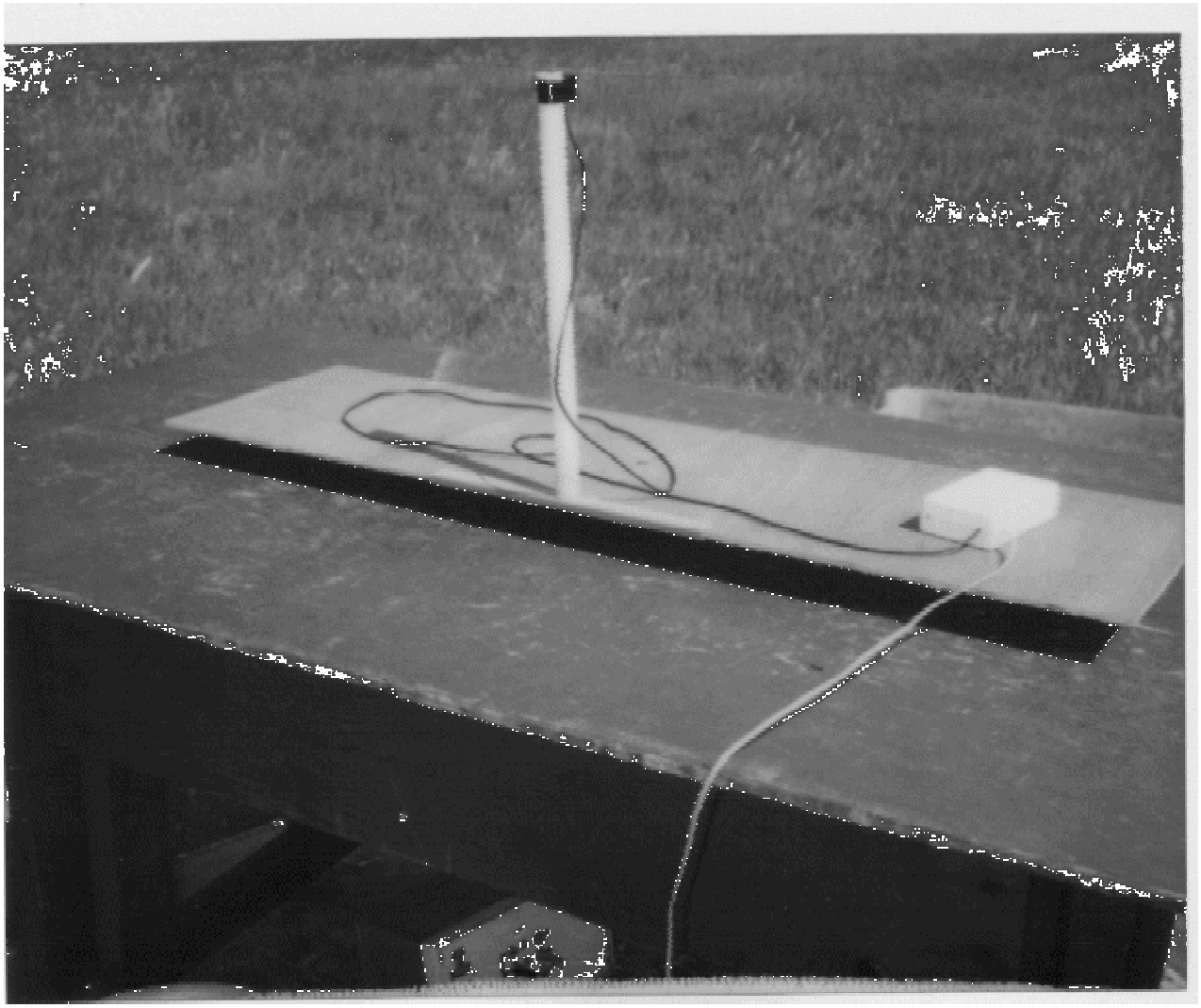
$$= 10^{1.19}$$

$$FS = 15.5 \text{ uV/m} \quad (\text{at } 3 \text{ m})$$

For measurements made at less than 3 m, the field strength is multiplied the quotient of the measurement distance and 3 meters.

LIST OF TEST EQUIPMENT

RECEIVERS:	Hewlett-Packard Spectrum Analyzer Type 856 with 8560A RF Section S/N 2216A02120 85662A Display Section S/N 2152A03686 85650A Quasi-Peak Adapter S/N 2043A00350 Calibrated 6/00
	Singer Stoddart EMI Field Intensity Meter Model NM 37/57 S/N 0366-06168 Calibrated 6/00
	Hewlett-Packard Spectrum Analyzer Model 8593EM, S/N 3536A00147 Calibrated 6/00
ANTENNAS;	EMCO Biconical Antenna Model 3104 Freq. Range 20 - 200 MHz
	EMCO Log-Periodic Antenna Model 3146 Freq. Range 200 - 1000 MHz
	EMCO Double Ridged Guide Horn Model 3115 Freq. Range 1 - 18 GHz
MISCELLANEOUS:	Hewlett-Packard Preamplifier Model 8447D S/N 1725A01282
	Marconi Signal Generator Model 2019
	12.2 m RG-214/U coaxial cable 1.0 m RG-214/U coaxial cable



PICTORIAL 1
FIELD STRENGTH MEASUREMENT
TEST SET UP
SILENTHORN™/SILENTSIREN™
RECEIVER/DIGITAL DEVICE

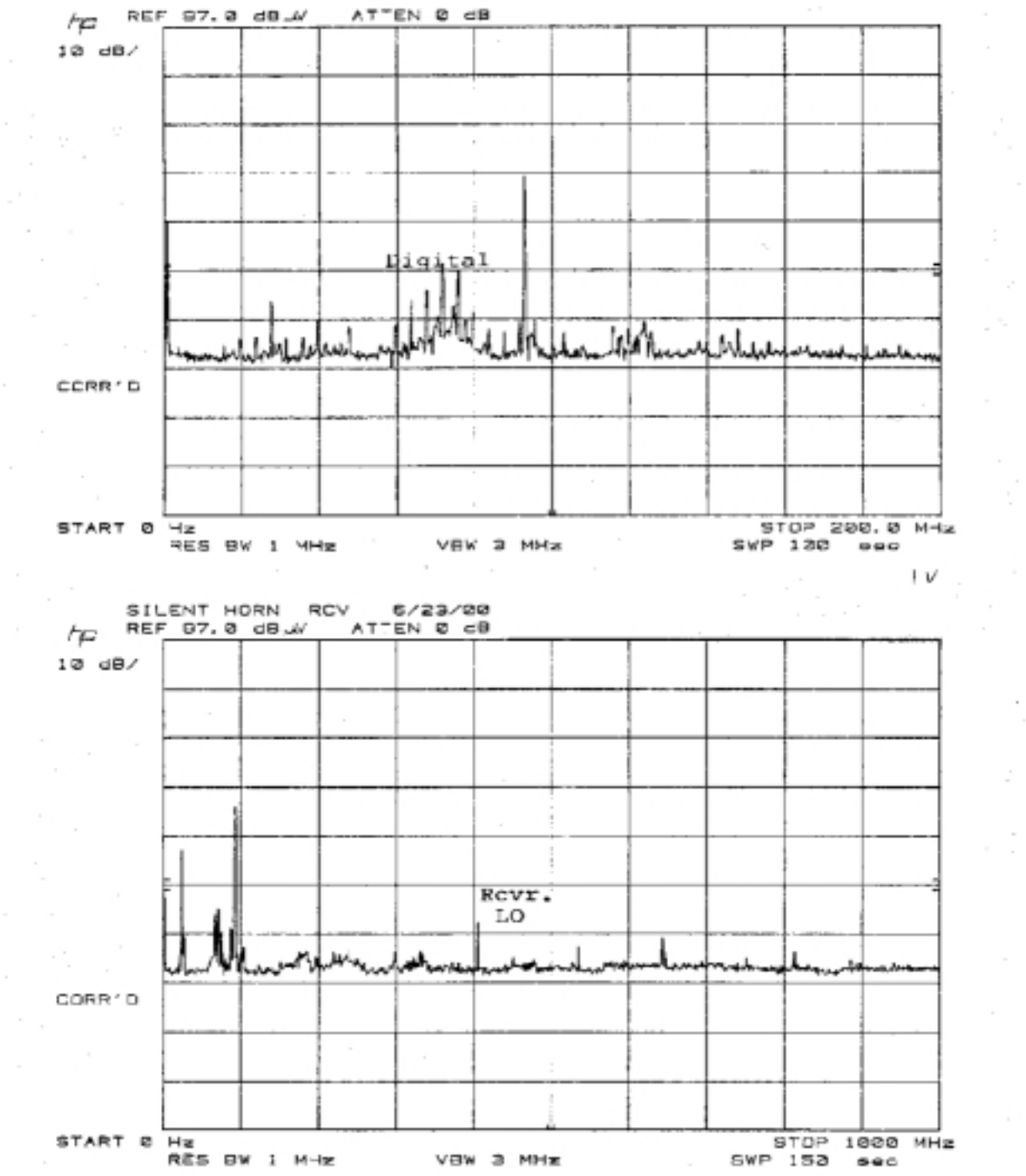


Fig. 1
EMISSIONS PROFILE
GARLAND RODESCHÉ & ASSOCIATES
SILENTHORN™/SILENTSIREN™
RECEIVER/DIGITAL DEVICE