

**NATIONAL CERTIFICATION LABORATORY**

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**FCC REPORT OF RADIO INTERFERENCE**

**for**

**Probotics, Inc.**  
**Suite 223, 700 River Ave.**  
**Pittsburgh, PA 15212**

**FCC ID: N4O-CYE2**

**October 5, 1998**

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## 1.0 Introduction

This report has been prepared on behalf of Probotics, Inc., to support the attached Application for Certification of a Part 15 Intentional Radiator. The Equipment Under Test was the Probotics, Inc. **CYE Robot Transceiver**.

This system consists of a Robot unit and a Base unit, both of which contain an identical transceiver. The units communicate on a single frequency via Half-Duplex operation. Both units incorporate identical wire antennas as well. The system will not operate with only one of the units turned on.

Radio-Noise Emissions tests were performed according to ANSI C63.4-1992 **"Methods of Measurement of RFI from Low-Voltage Electronic Equipment in the Range of 9 KHz - 40 GHz"**. The measuring equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

Testing was performed at National Certification Laboratory in Ellicott City, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch. FCC acceptance was granted on May 26, 1993.

## 1.1 Summary

The **CYE Robot Transceiver** complies with the Part 15.249 Radio Limits for operation within the band 902-928 MHz, of an Intentional Radiator. Both transmitters in the robot and base units are identical, and both were tested and shown to comply.

## 2.0 Description of Equipment Under Test (EUT)

The EUT Features:

FEATURES	FREQUENCY
Wire Antenna	903.4 MHz only
Crystal Stabilized	
FSK FM Modulated	
AC Adapter Powered in Base	
Battery Powered in Robot	
Half-Duplex @ 9600 BAUD Operation	

FCC ID #: N40-CYE2

### 3.0 Test Configuration

The EUT was setup on the test table in a manner which follows the general guidelines of ANSI C63.4, Section 6 "General Operating Conditions and Configurations".

A notebook computer was used to control the Base unit via RS-232 port during testing. The Robot unit was controlled from the Base unit's RF transmissions, which contain instructions from the computer. Since both the Robot and the Base units transmit on the same frequency, a Half-Duplex design is used which allows for only one unit to transmit at a time while the other receives. This allows for field strength measurements to be taken on individual units.

The EUT was configured in a horizontal axis only for testing, since this is the only axis in which it is intended to operate in, based on the mechanical housing and the function of the robot unit which is to roll along a floor.

### 4.0 Conducted Emissions Scheme

The Robot unit is powered by battery only. However the Base unit is powered by A.C. adapter, so A.C. line-conducted emissions measurements are required.

The EUT is placed on an 80 cm high 1 X 1.5 m non-conductive table. Power to the EUT is provided through a Solar Corporation 50  $\Omega$ /50  $\mu$ H Line Impedance Stabilization Network bonded to a 2.2 X 2 meter horizontal ground plane, and a 2.2 X 2 meter vertical ground plane. The LISN has its AC input supplied from a filtered AC power source. A separate LISN provides AC power to the peripheral equipment. I/O cables are moved about to obtain maximum emissions.

The 50  $\Omega$  output of the LISN is connected to the input of the spectrum analyzer and emissions in the frequency range of 450 kHz to 30 MHz are searched. The detector function is set to quasi-peak and the resolution bandwidth is set at 9 kHz, with all post-detector filtering no less than 10 times the resolution bandwidth for final measurements. All emissions within 20 dB of the limit are recorded in the data tables.

## 5.0 Radiated Emissions Scheme

The EUT was initially scanned in the frequency range 30 to 9040 MHz indoors, at a distance of 1 meter to determine its emissions profile. The EUT was then placed on an 80 cm high 1 X 1.5 meter non-conductive motorized turntable for radiated testing on the 3-meter open area test site. The emissions from the EUT are measured continuously at every azimuth by rotating the turntable. Waveguide horn and log periodic broadband antennas are mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna is varied between 1 and 4 meters. Both the horizontal and vertical field components are measured.

The output from the antenna is connected to the input of a preamplifier which is in turn connected to a spectrum analyzer. The detector function is set to Peak. The resolution bandwidth of the spectrum analyzer system is set at 100 kHz, for measurements in the range 30 MHz -1 GHz, and 1 MHz for measurements in the range of 1 - 9 GHz, with all post-detector filtering no less than 10 times the resolution bandwidth. All emissions within 20 dB of the limit are recorded in the data tables.

To convert the spectrum analyzer reading into a quantified E-field level to allow comparison with the FCC limits, it is necessary to account for various calibration factors. These factors include cable loss (CL) and antenna factors (AF). The AF/CL in dB/m is algebraically added to the Spectrum Analyzer Voltage in  $\text{dB}\mu\text{V}$  to obtain the Radiated Electric Field in  $\text{dB}\mu\text{V}/\text{m}$ . This level is then compared with the FCC limit.

### Example:

Spectrum Analyzer Volt:  $\text{VdBuV}$

Composite Factor:  $\text{AF/CLdB/m}$

Electric Field:  $\text{EdB}\mu\text{V}/\text{m} = \text{VdB}\mu\text{V} + \text{AF/CLdB/m}$

Linear Conversion:  $\text{EuV/m} = \text{Antilog}(\text{EdB}\mu\text{V}/\text{m}/20)$

FCC RADIATED EMISSIONS DATA

FCC ID: N4O-CYE2

CLIENT: PROBOTICS  
 EUT: CYE ROBOT  
 FREQ.: 903.43 MHZ

3-METER TEST			PEAK			PEAK			
FREQ MHz	POL ANT	EUT	SPEC A dBuV	AF/C dB/m	AMP GAIN	AVG. FACTOR	E-FIELD dBuV/m	LIMIT dBuV/m	MRG dB
903.43	H	H	66.0	24.0	0	0.0	90.0	94.0	-4.0
1806.86	H	H	48.0	30.0	-30	0.0	48.0	54.0	-6.0
2710.29	H	H	45.0	34.0	-30	0.0	49.0	54.0	-5.0
3613.72	V	H	40.0	36.0	-30	0.0	46.0	54.0	-8.0
4517.15	H	H	39.0	38.0	-30	0.0	47.0	54.0	-7.0
5420.58	H	H	38.0	35.0	-30	0.0	43.0	54.0	-11.0
6324.01	H	H	36.0	36.0	-30	0.0	42.0	54.0	-12.0
7227.44	V	H	34.0	37.0	-30	0.0	41.0	54.0	-13.0
8130.87	H	H	35.0	38.0	-30	0.0	43.0	54.0	-11.0
9034.30	H	H	31.0	38.0	-30	0.0	39.0	54.0	-15.0

TEST ENGINEER

  
 STEVE DAYHOFF

DATE 10/2/88

## FCC RADIATED EMISSIONS DATA

FCC ID: N4O-CYE2

CLIENT: PROBOTICS

EUT: CYE BASE

FREQ.: 903.43 MHZ

3-METER TEST			PEAK			PEAK			
FREQ MHz	POL ANT	EUT	SPEC A dBuV	AF/C dB/m	AMP GAIN	AVG. FACTOR	E-FIELD dBuV/m	LIMIT dBuV/m	MRG dB
903.43	H	H	65.0	24.0	0	0.0	89.0	94.0	-5.0
1806.86	H	H	49.0	30.0	-30	0.0	49.0	54.0	-5.0
2710.29	H	H	43.0	34.0	-30	0.0	47.0	54.0	-7.0
3613.72	V	H	41.0	36.0	-30	0.0	47.0	54.0	-7.0
4517.15	H	H	37.0	38.0	-30	0.0	45.0	54.0	-9.0
5420.58	H	H	36.0	35.0	-30	0.0	41.0	54.0	-13.0
6324.01	H	H	35.0	36.0	-30	0.0	41.0	54.0	-13.0
7227.44	H	H	35.0	37.0	-30	0.0	42.0	54.0	-12.0
8130.87	H	H	35.0	38.0	-30	0.0	43.0	54.0	-11.0
9034.30	V	H	32.0	38.0	-30	0.0	40.0	54.0	-14.0

TEST ENGINEER

SD DATE 10/2/88  
 STEVE DAYHOFF

## FCC CLASS B CONDUCTED EMISSIONS DATA

FCC ID: N4O-CYE1

CLIENT: PROBOTICS  
 EUT: BASE UNIT

## LINE 1 - NEUTRAL

FREQ MHz	VOLTAGE dBuV	QP LEVEL		MARGIN dB
		VOLTAGE uV	FCC LIMIT uV	
0.456	42	125.9	250	-6
0.637	37.4	74.1	250	-10.6
1.608	34.8	55.0	250	-13.2
12	25.8	19.5	250	-22.2

## LINE 2 - PHASE

FREQ MHz	VOLTAGE dBuV	QP LEVEL		MARGIN dB
		VOLTAGE uV	FCC LIMIT uV	
0.456	38.4	83.2	250	-9.6
0.637	35.1	56.9	250	-12.9
1.608	43.6	151.4	250	-4.4
12	26.8	21.9	250	-21.2

Conducted - L1

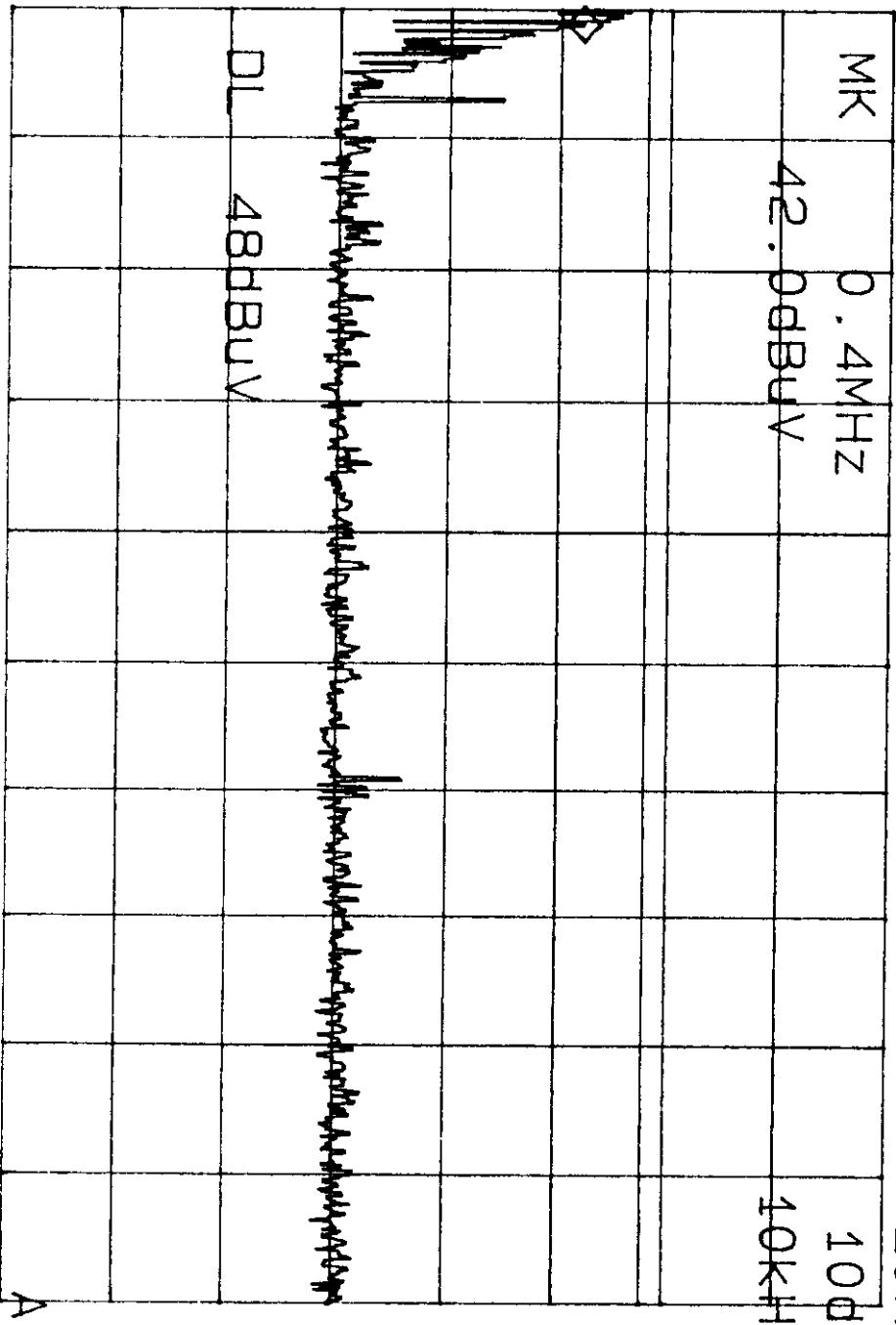
70dBuV

10.2MHz

20MHz

MK  
0.4MHz  
42.0dBuV

10dB/  
10kHzW



ST 50ms/

ATT 10dB

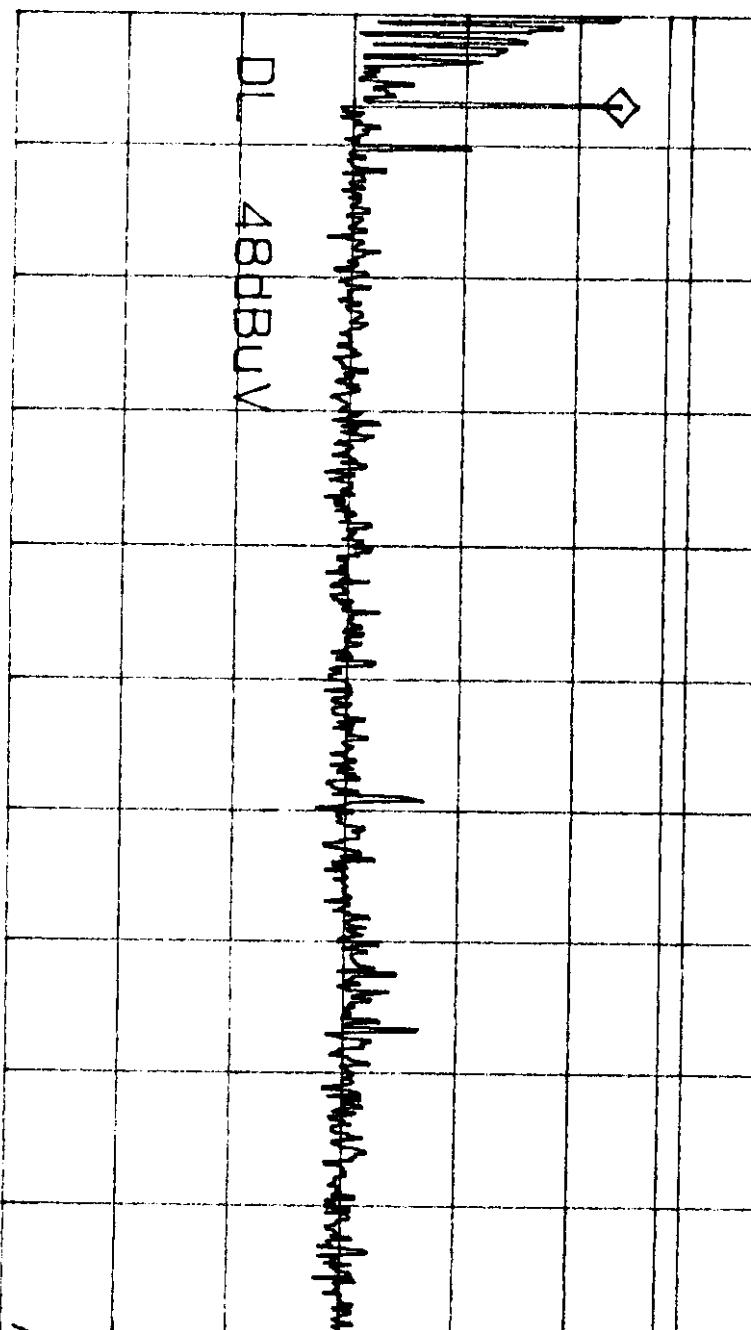
VF 100kHz

Conducted - L2  
70dBuV

10.2MHz

20MHz

MK 1.6MHz 10dB/  
43.6dBuV 10kHzW



ST 50ms / ATT 10dB VF 100kHz AFC

**Bandwidth Measurement:**

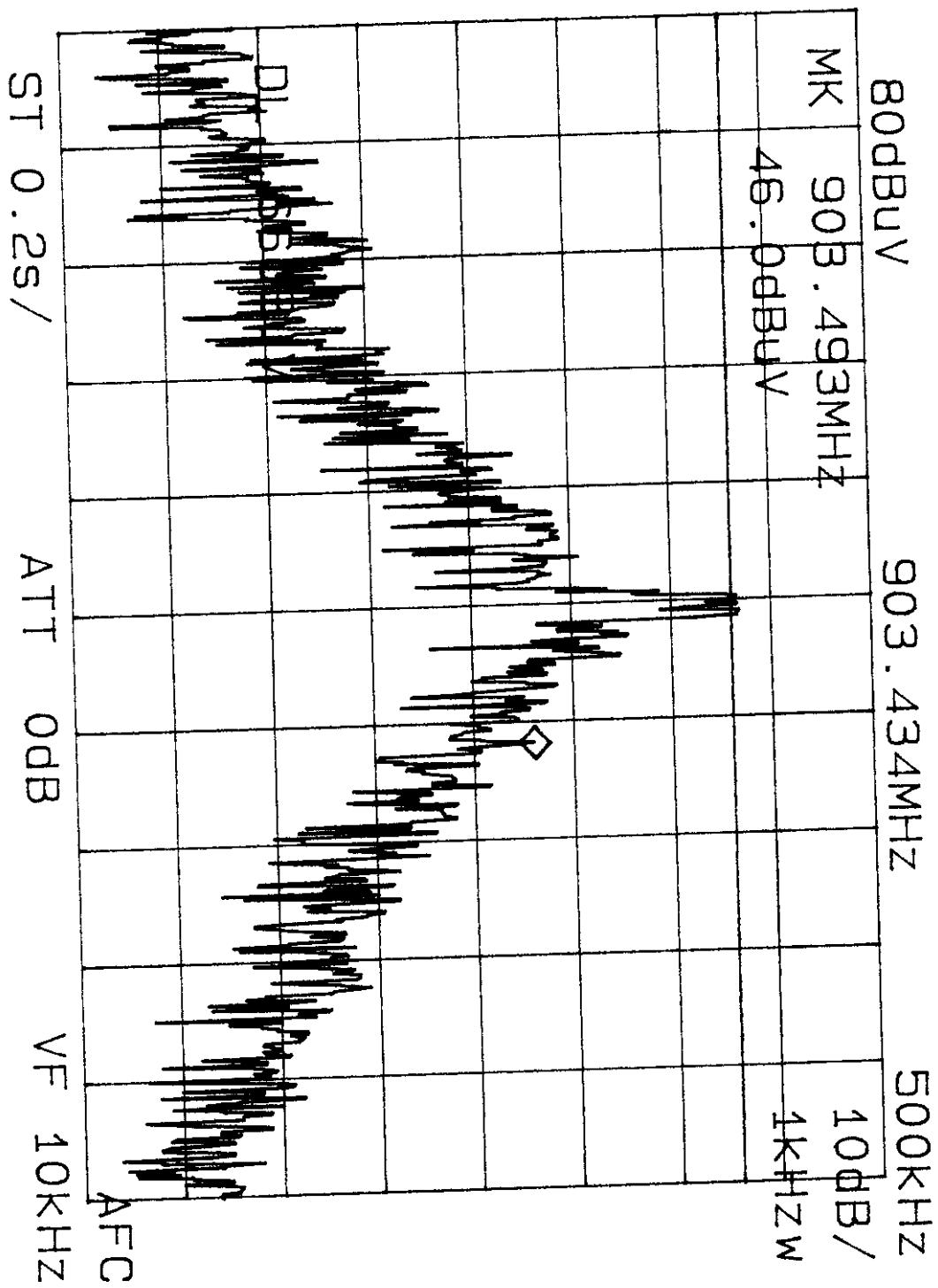
The following plot is a graph of the modulated carrier which demonstrates the Bandwidth at a 20 dB point down from peak.

## 20 dB BANDWIDTH PLOT - BANDWIDTH = 120 KHZ

MODIFIED

500 KHZ SPAN

1 KHZ RES. BW



**Table 1**  
**Support Equipment**

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MANUFACTURER	FCC ID #	SERIAL #
<b>SERIAL DEVICE:</b>  EUT Probotics RobotBase	N40-CYE1 (Pending)	None
<b>PARALLEL DEVICE:</b>  Epson T-1000 Printer	BKM9A8P70RA	0A0059174
<b>EUT:</b>  Probotics Robot	N40-CYE2	None
<b>HOST COMPUTER:</b>  Kapok Computers Notebook	L4PK5000T2	NISD617017853

*FCC ID #: N40-CYE2*

**Table 2**

**Interface Cables Used**

<b>HOST to Printer</b>	1.5 meters bundled to 1 meter in length - shielded
<b>HOST to EUT</b>	3.2 meters bundled to 1 meter in length - unshielded
<b>EUT Power</b>	Unshielded 15 VDC power cord from AC adapter
All other I/O cables such as monitor, keyboard are permanently attached to the peripherals - presume shielded.	
<b><u>Note:</u></b> There are no ferrite beads attached to any I/O cables for this test.	

**Table 3**  
**Measurement Equipment Used**

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The following equipment is used to perform measurements:

<b>EQUIPMENT</b>	<b>SERIAL NUMBER</b>
Wavetek 2410A 1100 MHz Signal Generator	1362016
HP Model 8449B Preamplifier	12A533-A
EMCO Model 3146 Log Periodic Antenna	1222
Solar 8012-50-R-24-BNC LISN	924867
Advantest Model R4131D Spectrum Analyzer	54378A
EMCO Model 3115 Ridge Horn Antenna	1238
4 Meter Antenna Mast	None
Motorized Turntable	None
RG-233U 50 ohm coax Cable	None