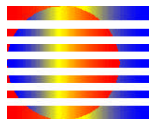


# *SPIDER-650*

## *Short Pulse Digital RADAR*

### User's Guide



***MULTISPECTRAL SOLUTIONS, INC.***

*A Tradition of Excellence in Innovation*

**Note 1: General Conditions of operation (FCC 15.5)**

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

**Note 2: Modifications (FCC 15.21)**

Changes or modifications to this equipment not expressly approved by Multispectral Solutions, Inc. may void the user's authority to operate this equipment.

**Note 3: Fields of Use (FCC 15.511 and 15.513)**

**Operation of this device is restricted to law enforcement, fire and rescue officials, scientific research institutes, public utilities, commercial mining companies, construction companies and industrial entities. Operation by any other party is a violation of 47 U.S.C. 301 and could subject the operator to serious legal penalties.**

# Chapter 1 – INTRODUCTION

## Overview

The SPIDER-650 is intended for determining the presence of objects that are within a 50-foot line-of-sight of the unit. The unit has a resolution of 1 foot with a maximum range of 50 feet.

## Installation

The SPIDER-650 unit can be placed anywhere as long as the antennae are facing outward towards the open space of detection. The antennae are located on the side with the elevated plastic facing. The only components required are an external cable (see Figure 1) and power supply.

The cable should be 9-pin female on both ends with one end having two terminals for distributing power to the SPIDER-650 unit. Figure 1 below shows banana leads as an example of a way to use an external power supply as the source. Battery terminal leads may also be used to power the unit as long as the battery can supply about 1 watt of power at its operating voltage (see Table 1).



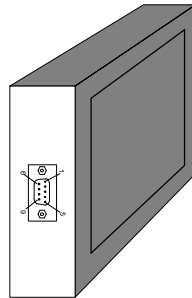
Figure 1 - Communication / Power Cable

Table 1 - Pin Description of Terminal-Side 9-Pin Female

Pin Number	Pin Name	Description
1	GND	Grounded
2	RD	Received Data
3	TD	Transmitted Data
4	N.C.	No Connect
5	GND	Grounded
6	Power	Input DC Power – Approximately 200mA @ +5V. Input DC Voltage can range from +3V to +30V.
7	N.C.	No Connect
8	N.C.	No Connect
9	Power	Input DC Power – Approximately 200mA @ +5V. Input DC Voltage can range from +3V to +30V.

**Table 2 - Pin Description of RADAR-Side 9-Pin Female**

<b>Pin Number</b>	<b>Pin Name</b>	<b>Description</b>
1	GND	Ground
2	Serial_Out	RS-232 Output
3	Serial_In	RS-232 Input
4	GND	Ground
5	GND	Ground
6	POWER_IN	Input DC Power – Approximately 200mA @ +5V. Input DC Voltage can range from +3V to +30V.
7	Loop	Connected to Pin 8
8	Loop	Connected to Pin 7
9	POWER_IN	Input DC Power – Approximately 200mA @ +5V. Input DC Voltage can range from +3V to +30V.



**Figure 2 – Communication Port Location**

## **Chapter 2 – BASIC SETUP**

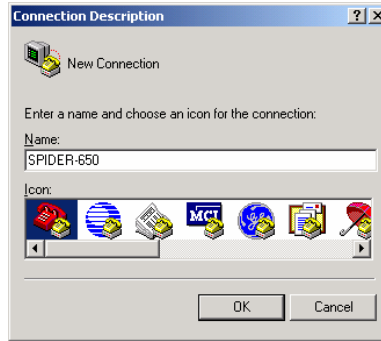
This chapter describes the process for setting up a terminal window on a user's computer. The below procedure assumes the user is running Windows 2000. Since other versions of Windows may deviate slightly from the following procedure, the user should check the operating system user's manual for proper terminal setup procedures.

### **HyperTerminal Setup**

To setup a HyperTerminal window under Windows 2000, adhere to the following procedure.

#### **STEP 1:**

Navigate to the **Programs -> Accessories -> Communications** folder and select the **HyperTerminal** icon. You should see a window similar to the one shown in Figure 3. Type a name for your HyperTerminal Session. The example below uses the "SPIDER-650" name. Once you have typed a name, click the OK button.



**Figure 3 - Connection Description Window**

**STEP 2:**

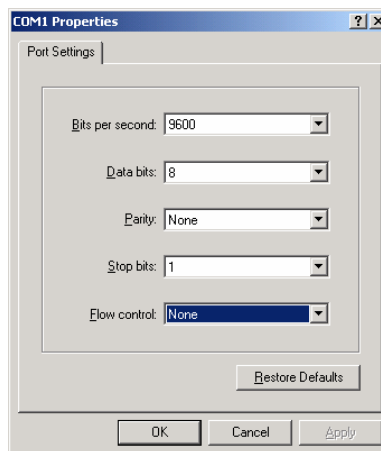
Determine which serial port the SPIDER-650 unit is attached to and enter it in the “**Connect To**” box shown below. Then click the OK button.



**Figure 4 - Serial Port Selection**

**STEP 3:**

You should see the **Port Settings** dialog box come up next. Enter the settings exactly as they appear in Figure 5. Click the OK button when you are finished.



**Figure 5 - Serial Port Settings**

#### STEP 4:

Check the terminal settings window by navigating to the **File -> Properties** window and clicking the **Settings** tab. Make sure the properties are exactly as they appear in Figure 6.

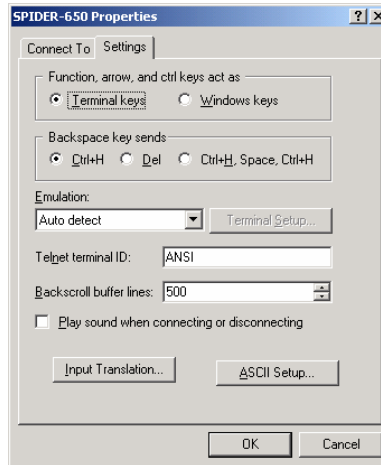


Figure 6 - Terminal Properties

### Powering the Unit

Once the HyperTerminal setup is complete, applying power to the terminals will activate the unit. The HyperTerminal window should appear similar to Figure 7. This figure shows what the user will see in the HyperTerminal window on cycling power.

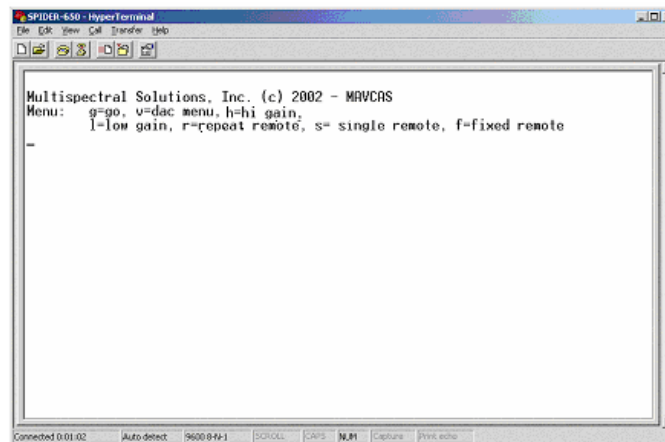


Figure 7 - Initial Terminal Screen after Applied Power

The screen displays the eight options available to the user. The most common option is the 'g' option. This will force the SPIDER-650 to transmit 5 consecutive pulses and recover and display the respective returns. Each of the 5 series of 50 returns is captured using a different sensitivity level on the receiver. Therefore, each row of asterisks on the HyperTerminal window displays a set of 50 returns received at a certain sensitivity level. The rows are arranged such that the first row of returns is captured at the least sensitive levels, while the last row of 50 returns is the most sensitive of the set. This display is illustrated in Figure 8 showing a target found at bin 13 at the

most sensitive setting. Typing the character 'g' on the terminal's keyboard will place the user in this mode.

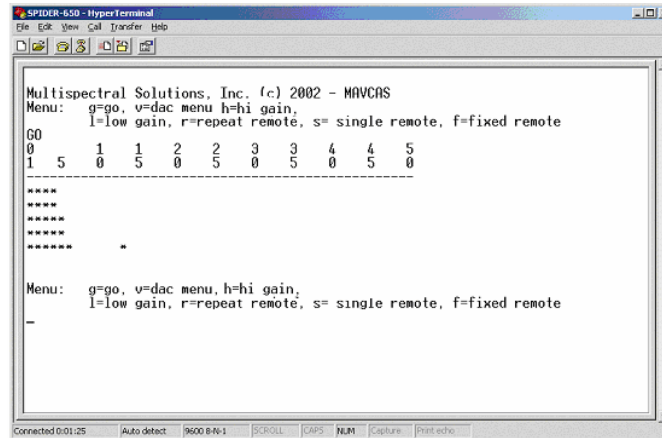


Figure 8 - Terminal Screen after Executing 'g' Menu Item

## Aiming the Unit

For best results, the unit should be aimed so that the white-faced plastic front is perpendicular to the line-of-sight between the unit and the target.

## Chapter 3 – ADVANCED MENU OPTIONS

There are seven other advanced options available to the user if a custom software interface is to be used.

### DAC Menu Item

The DAC Menu is the menu that allows the user to change sensitivity levels on the SPIDER-650's internal DAC (digital-to-analog converter). If the user wishes to change one of the 5 bias voltage values, he/she must first enter the 'v' key followed by the number corresponding to the appropriate run number. For example, if the user wants to change the bias value for the third transceiver run, a 'v' will be typed. This will bring up the following display:

```
select run number 1-5 , d = display voltages , q=end
```

```
enter voltage as 2 digit hex
```

Then the user hits the '3' key and will see:

```
V3= 0x
```

show up on the terminal to indicate that the DAC value for the third run should be entered. This is prompting the user to enter a 2 digit hex value between 0x00 and 0xFF. Only values after the 'x' should be entered.

Once the values have been entered, the user must press the ‘q’ key to quit the menu and force the current value to be set. If the programmed voltage levels need to be obtained, the user may enter the ‘d’ key to display the currently programmed voltages (before hitting the ‘q’ key). After typing the ‘d’ key, the user should expect to see a display similar to the following:

```
v1=10 v2=30 v3=60 v4=50 v5=90
done
```

An example DAC value modification terminal screen is shown in Figure 9.

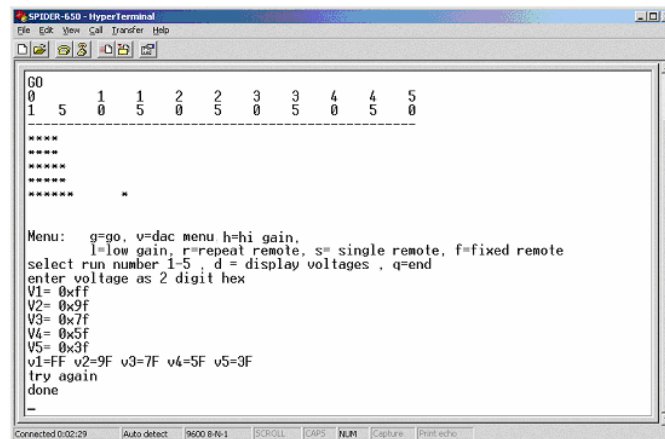


Figure 9 - Terminal Screen After Entering the DAC Menu

### Repeat Remote Mode Menu Item

To enter the Repeat Remote Mode, the user enters an ‘r’ at the terminal’s keyboard in the main menu. When the user enters Repeat Remote Mode, he will see a terminal similar to the following (also shown in Figure 10):

```
The receiver is now in Remote Repeat Mode.....
FC000000000000
FC000000000000
FC000000000000
FC000000000000
FE000000000000
FC000000000000
FC000000000000
FC000000000000
FC000000000000
FC000000000000
.
```

This mode will start by setting the DAC to a decimal value of 127 (0x7f). To increase the sensitivity on the receiver, the user will strike the ‘i’ key until the desired response is seen. The ‘i’ key has the effect of decreasing the DAC value by 1 LSB each time the key is struck.



To decrease sensitivity, the user will strike the 'd' key until the desired response is seen. The 'd' key has the effect of increasing the DAC value by 1 LSB each time the key is struck.

To leave this mode and return to the main menu, the user must press the escape key. When the Escape key is hit, the following message will appear on the terminal indicating that the user should enter one of the menu items:

Try Again

The display seen on the terminal in Figure 10 is in Packed Binary Target Format which is described in APPENDIX B - PACKED BINARY TARGET RETURN FORMAT.

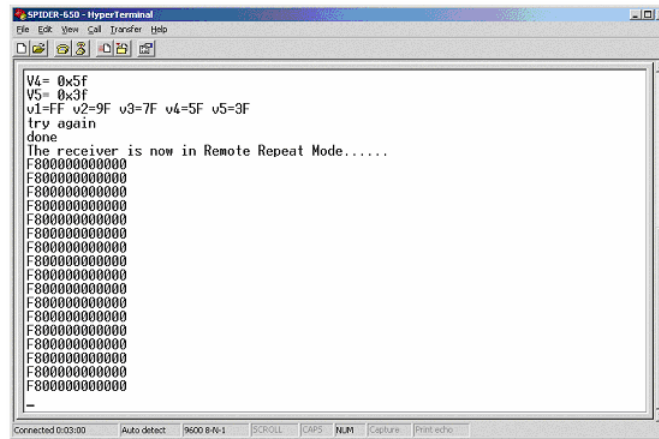


Figure 10 - Terminal Screen After Entering Repeat Remote Mode

## Fixed Remote Mode Menu Item

To enter the Fixed Remote Mode, the user enters an 'f' at the terminal's keyboard in the main menu. The Fixed Remote Mode allows the user to make decisions on where a target may be based on a summation of five returns each at different sensitivity levels. When the SPIDER-650 enters Fixed Remote Mode, the user will see a terminal similar to what is shown in Figure 11.

The ASCII data seen at the terminal is in Packed BCD Target Return Format, which is described in APPENDIX C - PACKED BCD TARGET RETURN FORMAT.

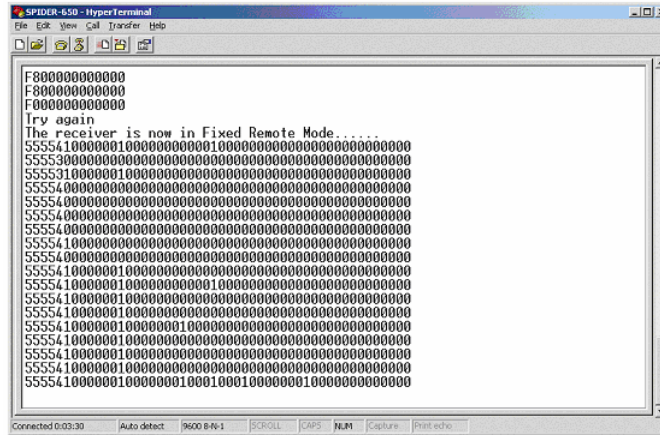


Figure 11 - Terminal Screen After Entering Fixed Remote Mode

## Single Remote Mode Menu Item

To enter the Single Remote Mode, the user enters an 's' at the terminal's keyboard in the main menu. A response of "The receiver is now in Remote Single Mode..." will verify the user is in this mode on the terminal (see Figure 12). The Single Remote Mode allows the user to find the appropriate bias setting by entering a single DAC bias value and analyzing the return associated with the bias setting. The return will be a single line of ASCII characters in Packed Binary Target Format representing the target returns accumulated at the set bias level. In this mode, the SPIDER-650 will remain idle until a 'b' is typed indicating to the SPIDER-650 that the user is about to enter a bias value. At this point, the SPIDER-650 will prompt the user to enter two digits by displaying the '=0x' combination of characters. Once the two hexadecimal digits are entered, the SPIDER-650 will send a single line of 13 ASCII characters representing the target return in a packed binary format as described in APPENDIX B - PACKED BINARY TARGET RETURN FORMAT.

The Escape key must be pressed **twice** to exit this mode. Once a return occurs, the user can then exit this mode. Upon exiting the Single Remote Mode, the following message will appear on the terminal indicating that the user should enter one of the menu items:

Try Again

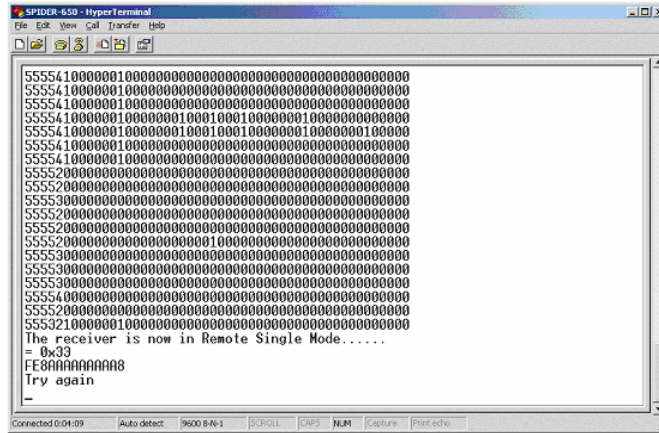


Figure 12 – Sample Terminal Screen After Entering Single Remote Mode

### Lo Gain Mode Menu Item

To place the SPIDER-650 in Lo Gain Mode, the user enters an ‘l’ at the terminal’s keyboard in the main menu. The Lo Gain Mode allows the user to desensitize the receiver for environments where the output transmit power is more than adequate for object detection. In this mode, the user will see a message similar to the one at the bottom of Figure 13. The user will remain in LO Gain Mode until HI Gain mode is entered (see next section).

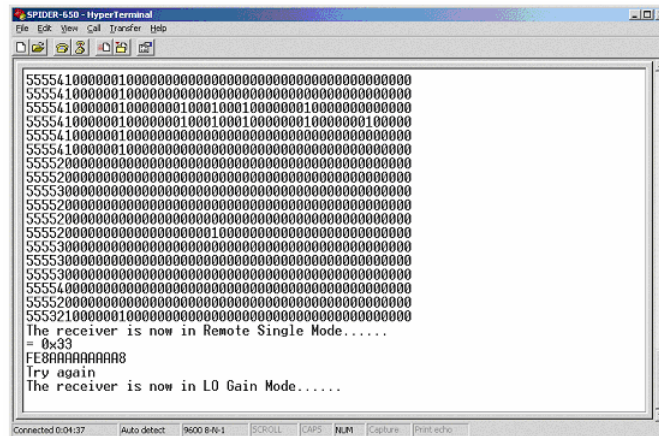


Figure 13 – Sample Terminal Screen After Entering Lo Gain Mode

### Hi Gain Mode Menu Item

To place the SPIDER-650 in Hi Gain Mode, the user enters an ‘h’ at the terminal’s keyboard in the main menu. The Hi Gain Mode allows the user to use the full capability of the receiver for environments where the targets have a limited radar cross section. In this mode, the user will see a message similar to the one at the bottom of Figure 14. The user will remain in HI Gain Mode until LO Gain mode is entered (see previous section).

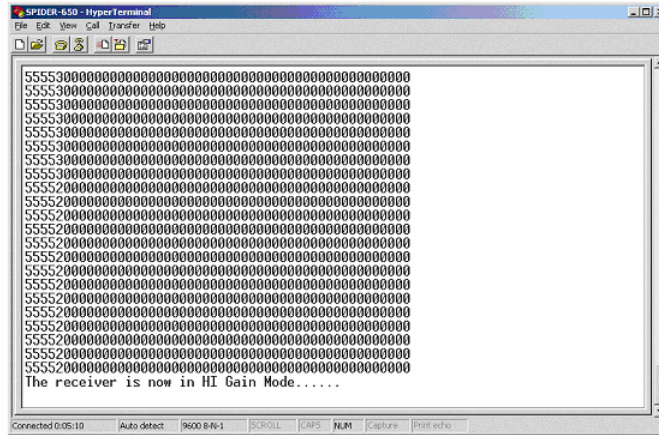


Figure 14 – Sample Terminal Screen After Entering Hi Gain Mode

## APPENDIX A -SPECIFICATIONS

### *Physical Characteristics:*

**Dimensions:** 6.375 x 3.625 x 3.5 in (161.9 x 92.1 x 88.9 mm)

**Weight:** 16 oz.

**Operating Temperature:** 32 to 158 °F (0 to 70 °C)

### *Power Consumption (+5V Supply):*

**Normal Operation:** 250 mA

### *Interface Standards:*

RS-232/RS-485

### *Output Power:*

FCC Part 15.511 and 15.513 Compliant

### *Sample Rate:*

30 Hz

### *Frequency Range:*

Centered at 6.35 GHz

### *Bandwidth:*

500 MHz

### *Range:*

50 feet

### *Resolution:*

1 foot

### *Software Compatibility*

Windows COM Port

## APPENDIX B - PACKED BINARY TARGET RETURN FORMAT

The following sequence of numbers `FC0000000000` characterizes target returns from 50 1-foot range bins represented in a packed binary format. This format allows a simple form of data compression to be processed in the SPIDER-650 unit while reducing the bottleneck of RS-232 data transfer. Each ASCII hexadecimal digit represents returns from four contiguous, 1-foot range bins. The last ASCII hexadecimal digit will only represent the last two contiguous, 1-foot range bins and will always be either 0, 8, 4, or C.

The most significant hexadecimal digits represent targets that are closer to the radar unit. For example, let's assume the following sequence of hexadecimal digits `FC00000080000` were sent over the RS-232 link and displayed on the terminal. The first hexadecimal digit 'F' (binary 1111) designates that there were target returns at 1, 2, 3, and 4-foot intervals from the receiver since each of the four bits were set in the respective range locations. The second hexadecimal digit 'C' (binary 1100) denotes there were target returns at 5 and 6 foot intervals from the receiver but none were detected at the 7 and 8 foot intervals since these range locations have cleared bits. The only other range location to be detected was at 33 feet since the 33<sup>rd</sup> bit from the left is the only other one set (the hexadecimal 8 digit).

## **APPENDIX C - PACKED BCD TARGET RETURN FORMAT**

The following sequence of numbers:

```
552200000000000000000000000000000000000000000000000000000000
```

characterize a sample target return from 50, 1-foot range bins represented in a packed BCD format. This format is a compact way of displaying the summation of returns at different sensitivity levels from 5 consecutive target illuminations. Each ASCII digit represents a return from a single 1-foot range bin. The most significant digit represents targets that are closer to the radar unit. For example, let's assume the above sequence of digits were sent over the RS-232 link and displayed on the terminal.

The first digit '5' designates that there were target returns in the closest range bin at 1 foot away for each of the 5 sensitivity settings. Range bins with a value of 5 are most likely target locations. The third digit '2' designates there were target returns at the 3-foot range bin for two of the 5 sensitivity settings. The user software will accumulate these returns over time and formulate enough information to determine target locations.