

Application Note

#5424

July 26, 2001

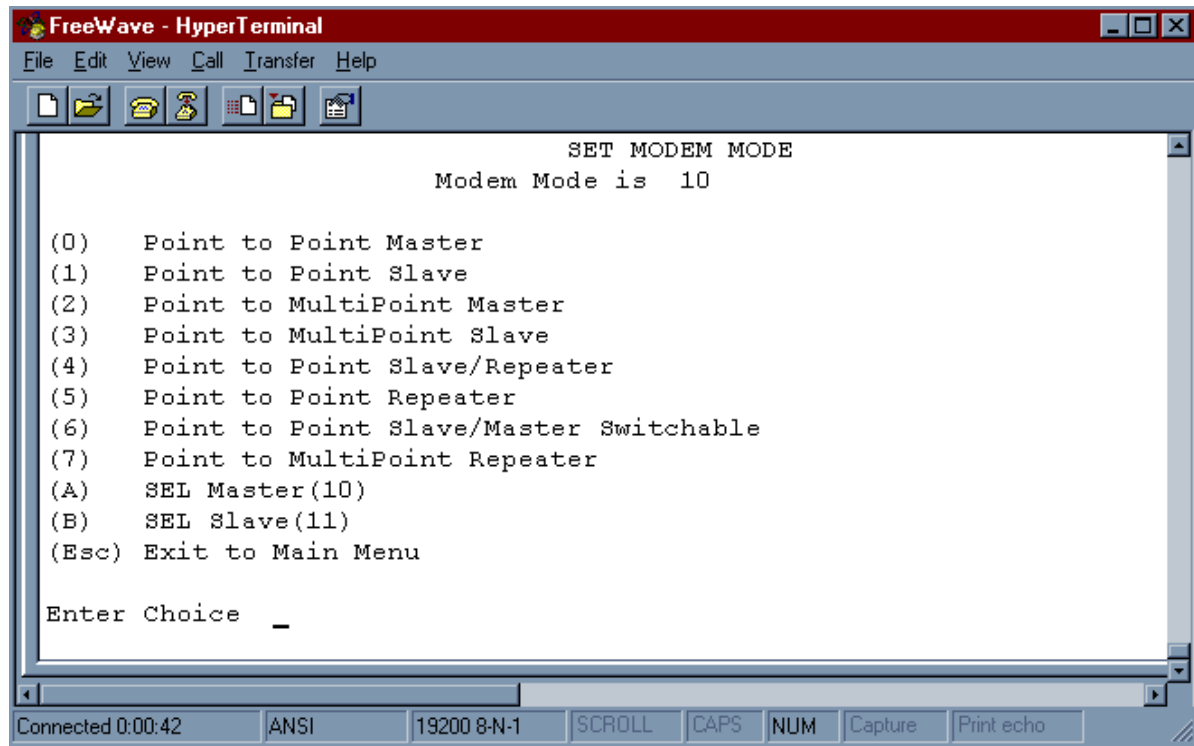
Using FreeWave DGR-115RU 900MHz Spread Spectrum transceiver with Schweitzer Engineering Labs Mirrored Bits Communications.

The FreeWave Technologies DGR-115RU Spread Spectrum transceiver is a special version of the DGR-115R which has been optimized for use with Schweitzer Engineering Labs Mirrored Bits Communications. In certain applications this provides a much more cost effective solution for mirrored bits communication than running fiber or using other communications equipment which may incur significant time and expense in set up or recurring fees.

The DGR-115RU contains all of the functionality of the DGR-115R 900 MHz spread spectrum transceiver with the exception of TDMA mode. However, to be used in Mirrored Bits applications specific settings must be used as described below, the numbering follows the numbering format in the FreeWave setup menu.

0) Set Operation Mode

Invoke the setup menu as you would typically to program the FreeWave DGR-115R. Enter 0 to set the operation mode, a screen similar to that shown below should appear. For a communications link one unit must be set to be the SEL Master (an entry of A in the Operation Mode menu) and the other must be the SEL Slave (an entry of B).



FreeWave Technologies, 1880 S. Flatiron Ct., Boulder, CO 80301
Phone: (303) 444-3862, Fax: (303) 786-9948, www.freewave.com

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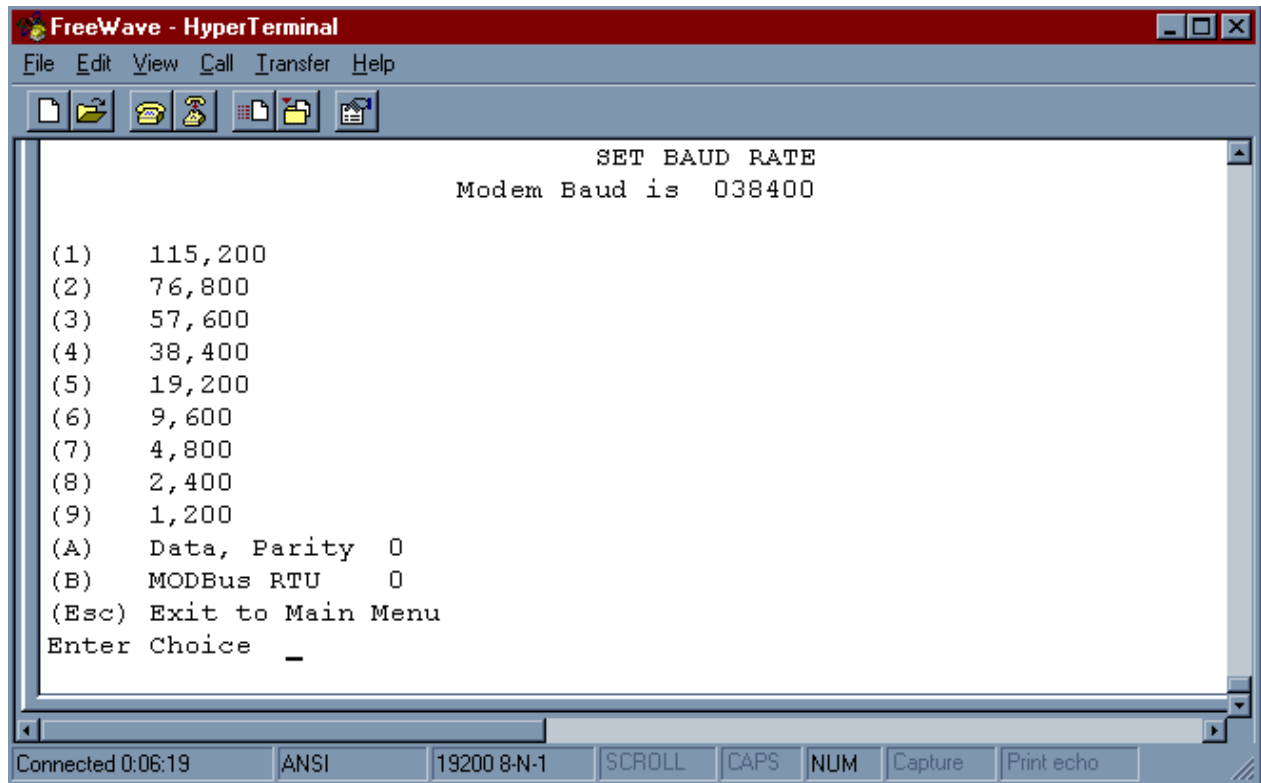
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1) Set Baud Rate

The Baud Rate on each transceiver must be set to 38,400 (entry 4 in the Baud Rate menu), Data and Parity must be set to 0 (8, N, 1), and Modbus RTU must be set to 0.



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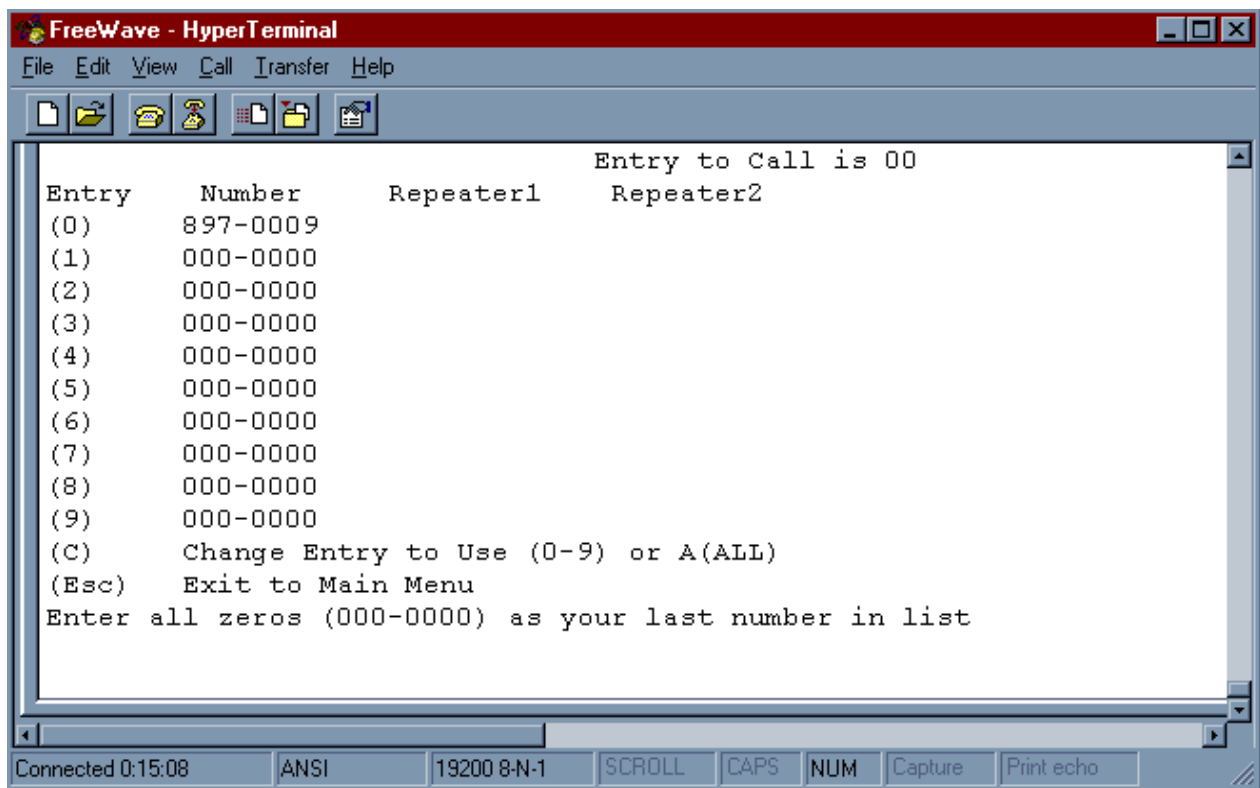
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2) Edit Call Book

When using the DGR-115RU in a Mirrored Bits application each radio **must** have the other radio's serial number as the first entry (Entry 0) in its Call Book with no entries in the Repeater1 and Repeater2 columns, as shown below. In addition, the SEL Master must be programmed to call the first entry in its Call Book.

Unlike the standard point to point operating mode, the SEL Slave will not establish communication with the master by turning Slave Security off. The Slave must have the SEL Master's serial number as its first entry (Entry 0) in the Call Book as well.



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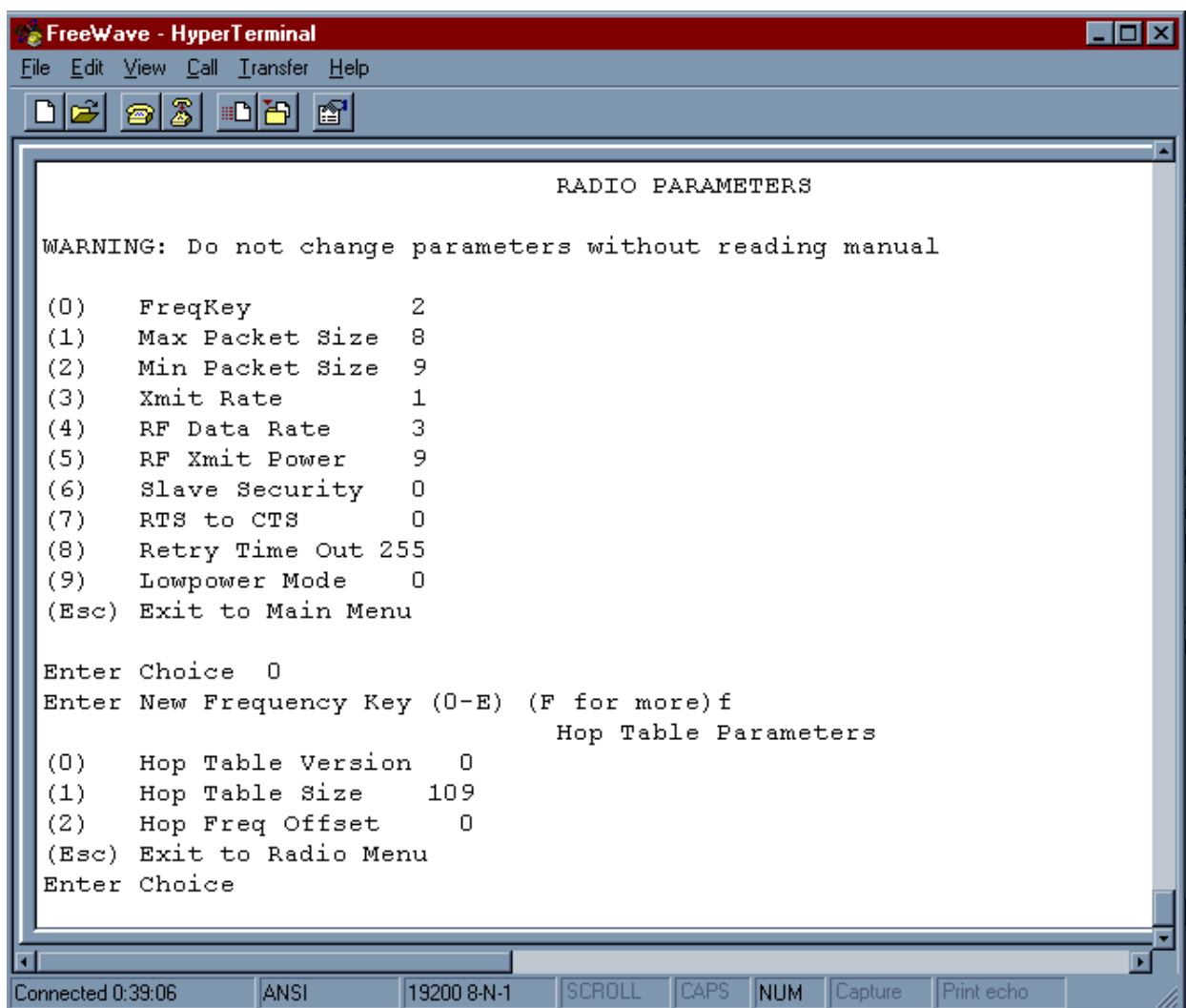
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3) Edit Radio Transmission Characteristics

All values in the radio transmission characteristics section of the setup menu must be identical between the 2 radios. In addition, RF Data Rate must be set to 3. If more than one pair of FreeWave 900MHz transceivers is operating in close vicinity they must be set to different Frequency Keys.

After setting the radio transmission characteristics enter a 0 from that same menu, followed by an f to set the hop table size to 109 and hop freq offset to 0.



```
FreeWave - HyperTerminal
File Edit View Call Transfer Help

RADIO PARAMETERS

WARNING: Do not change parameters without reading manual

(0) FreqKey 2
(1) Max Packet Size 8
(2) Min Packet Size 9
(3) Xmit Rate 1
(4) RF Data Rate 3
(5) RF Xmit Power 9
(6) Slave Security 0
(7) RTS to CTS 0
(8) Retry Time Out 255
(9) Lowpower Mode 0
(Esc) Exit to Main Menu

Enter Choice 0
Enter New Frequency Key (0-E) (F for more)f
Hop Table Parameters

(0) Hop Table Version 0
(1) Hop Table Size 109
(2) Hop Freq Offset 0
(Esc) Exit to Radio Menu
Enter Choice
```

Connected 0:39:06 ANSI 19200 8-N-1 SCROLL CAPS NUM Capture Print echo



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Other Notes

1. The DGR-115RU may be used with a number of SEL devices, please contact SEL at www.selinc.com for a complete list of supported devices.
2. When used for Mirrored Bits communication no repeaters may be used in the link. This is for direct point to point communications only.

Troubleshooting

The front panel LEDs are very useful in diagnosing the current condition of the DGR-115RU. The table below shows the most common conditions.

Condition	Master			Slave		
	CD	TR	CTS	CD	TR	CTS
Powered and connected	SG	SR	SR	SG	SR	SR
Powered, disconnected	SR	SR	O	SR	O	IF
Powered and connected but on different Freq Keys	SG/ SR (alternating)	SR (on and off)	IF	SG	IF	SR

Legend:

BR	Blinking Red
IF	Intermittent Flash Red
O	Off
SG	Solid Green
SR	Solid Red, Bright



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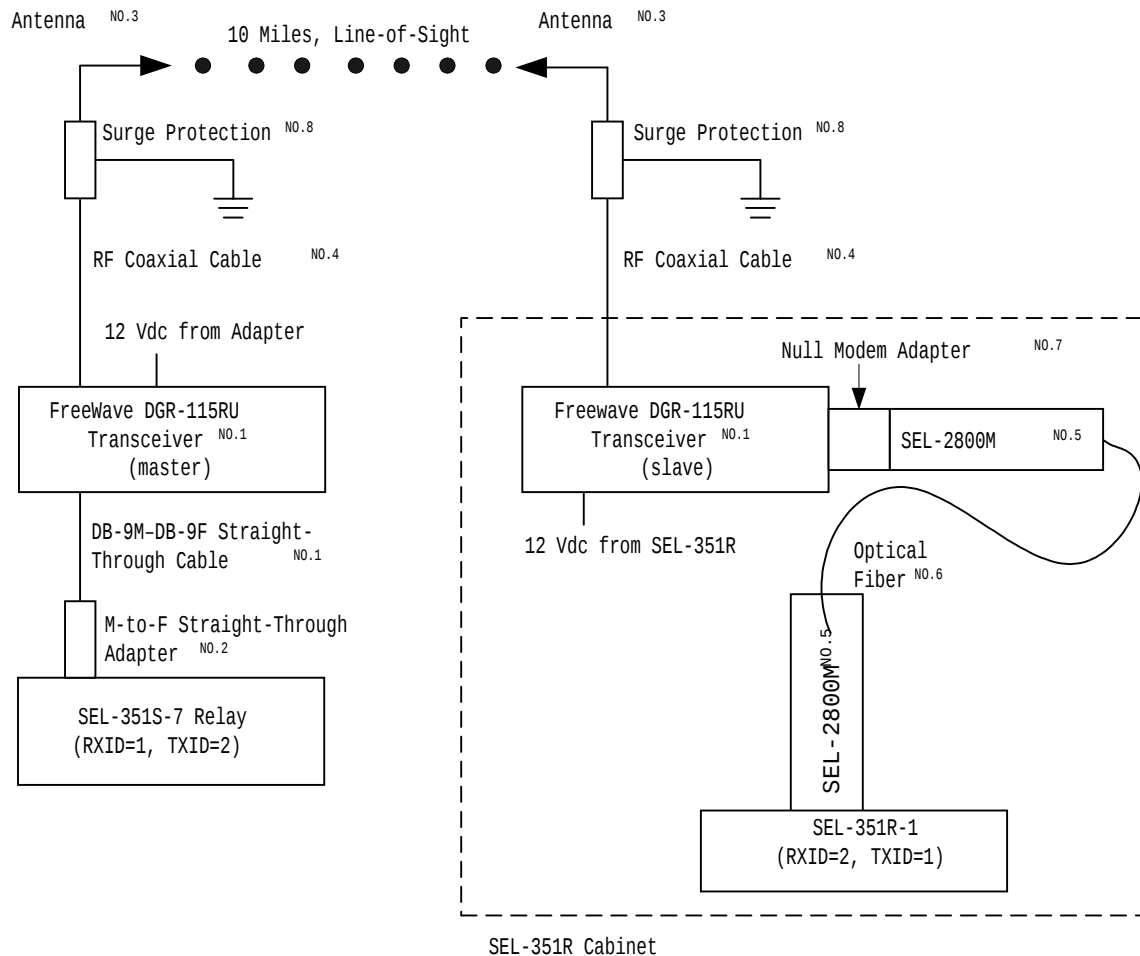


Figure 1: Example Installation



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Equipment List

The following equipment list details the required components and connections, as shown in Figure 1. A pole, tower, or other means of elevating the antenna is not shown.

Table 1: Equipment List

No.	Item	Description	Approx. Cost
1	900 MHz Spread-Spectrum Transceiver	FreeWave Technologies, Inc. Model DGR-115RU. 12 Vdc power, 1 W output, 10 mile line-of-sight, 120 Vac-to-12 Vdc adapter and 6' DB-9M-to-DB-9F straight-through cable included. (an SEL C285 cable can be used directly without adaptors if desired.) www.freewave.com (303) 444-3862	\$1300
2	DB-9 Gender Changer	FreeWave Technologies, Inc. Model ECD0009MM DB-9M-to-DB-9M converter, or equivalent (each end of the connector is male)	\$6
3	Yagi Antenna	FreeWave Technologies, Inc. ¹ Model EAN0900YB. 10 dB, directional, 26" long.	\$95
4	Low-Loss RF Cable	FreeWave Technologies, Inc. ² Model ASC0504NN. 50' length (other lengths available).	\$140
5	Fiber-Optic Transceiver	SEL ³ Model SEL-2800M. EIA-232 DB-9M-to-Fiber-Optic Transceiver.	\$102
6	Fiber-Optic Cable	SEL ³ Model C800FZ. Terminated Cable, 25' or less (other lengths available)	\$60
7	DB-9 Null Modem Adapter	FreeWave Technologies, Inc Model ECD0009NM 9 pin male to 9 pin female Null Modem Adapter , or equivalent (one end is male, one end is female)	\$7
8	Surge Protection	Northern Technologies, Model QWS-920N ⁴ . N Type M-to-F ¼ shorting stub coaxial protector tuned for 870 - 970 MHz. www.northern-tech.com (800) 727-9119	\$135



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Notes:

1. Other antennas may also be used.
2. Other low-loss RF cable may be used.
3. Other fiber-optic transceivers and cable may be used. Note, the fiber-optic transceivers are not required, but provide complete isolation between the radio and antenna and the relay.
4. Other surge protection may be used (PolyPhaser, etc.). This unit is recommended by FreeWave for use with their radios.



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