



Application Note #5424

Using the FGR-115MB Radio with Schweitzer Engineering Labs Mirrored Bits Communications September 16, 2004

The FreeWave Technologies FGR-115MB Spread Spectrum transceivers is a special version of the FGR series product family which have 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 FGR-115MB contains all of the functionality of the standard FreeWave 900 MHz spread spectrum transceiver with the exception of TDMA mode. However, to be used in Mirror-Bit applications specific settings must be used as described below, the numbering follows the numbering format in the Free-Wave setup menu. Included at the back are the settings for the DGR-115RU for reference.

0) Set Operation Mode

Invoke the setup menu as you would to program the FreeWave FGR-115RC. Programming must be done through the diagnostics port using the ASC0409DC programming/diagnostics cable. The programming menu will not be displayed through the radio's RS-232 port. Enter 0 to open the Set Operation Mode menu. The menu will be displayed as shown below. A point-to-point Mirror-Bit communication link requires two radios. One radio must be set to be the Mirror-Bit Master (an entry of A in the operation mode menu, displayed as 10). The other must be the Mirror-Bit Slave (an entry of B, displayed as 11).

```
                SET MODEM MODE
          Modem Mode is  10

(0)  Point to Point Master
(1)  Point to Point Slave
(2)  Point to MultiPoint Master
(3)  Point to MultiPoint Slave
(4)  Point to Point Slave/Repeater
(5)  Point to Point Repeater
(6)  Point to Point Slave/Master Switchable
(7)  Point to Multipoint Repeater
(A)  Mirrorbit Master
(B)  Mirrorbit Slave
(Esc) Exit to Main Menu
```



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.

```

                                SET BAUD RATE
                                Modem Baud is 038400

(0) 230,400
(1) 115,200
(2) 76,800
(3) 57,600
(4) 38,400
(5) 19,200
(6) 9,600
(7) 4,800
(8) 2,400
(9) 1,200
(A) Data, Parity 0
(B) MODBus RTU 0
(C) RS232/485 0
(D) Setup Port 2
(E) TurnOffDelay 0 TurnOnDelay 0
(E) TurnOffDelay 0
(F) FlowControl 0
(Esc) Exit to Main Menu
```



2) Edit Call Book

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

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

MODEM CALL BOOK			
Entry to Call is 00			
Entry	Number	Repeater1	Repeater2
(0)	898-0001		
(1)	000-0000		
(2)	000-0000		
(3)	000-0000		
(4)	000-0000		
(5)	000-0000		
(6)	000-0000		
(7)	000-0000		
(8)	000-0000		
(9)	000-0000		
(C)	Change Entry to Use (0-9) or A(ALL)		
(Esc)	Exit to Main Menu		
Enter all zeros (000-0000) as your last number in list			



3) Edit Radio Transmission Characteristics

All values in the radio transmission characteristics section of the setup menu must be identical between the Mirrored-Bit master and the Mirrored Bit slave radios. MCU Speed (menu item B) must be set to 1. If more than one pair of FreeWave 900MHz transceivers is operating in close proximity they must be set to different Frequency Keys (menu item 0). This is also necessary if the radios are to be configured as Mirrored Bit repeaters.

```
RADIO PARAMETERS

WARNING: Do not change parameters without reading manual

(0)  FreqKey          5
(1)  Max Packet Size  8
(2)  Min Packet Size  9
(3)  Xmit Rate        1
(4)  RF Data Rate     3
(5)  RF Xmit Power    10
(6)  Slave Security   0
(7)  RTS to CTS       0
(8)  Retry Time Out  255
(9)  Lowpower Mode    0
(A)  High Noise       0
(B)  MCU Speed        1
(C)  RemoteLED        0
(Esc) Exit to Main Menu

Enter Choice  0
Enter New Frequency Key (0-E) (F for more)F

(0)  Hop Table Version  0
(1)  Hop Table Size    112
(2)  Hop Freq Offset    0
(Esc) Exit to Radio Menu
```



Other Notes

1. The FGR-115MB may be used with a number of different SEL devices, please contact SEL at www.selinc.com for a complete list of supported devices.
2. When the FGR-115MB is used for Mirror-Bit communication, one repeater configuration may be used in the link. Refer to Application note 5424B for repeater configuration instructions.
3. When the FGR-115MB is used for Mirror-Bit communication, it is not compatible with the models DGR-115RU or DGR-115RXU Mirror-Bit radios if these radios are also being used for Mirror-Bit communications. Otherwise, the FGR-115MB is compatible with any DGR or FGR-Series radios when used in standard point-to-point or point-to-multipoint modes.

Troubleshooting

The front panel LEDs are very useful in diagnosing the current condition of the FGR-115MB.

	Master			Slave		
Condition	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

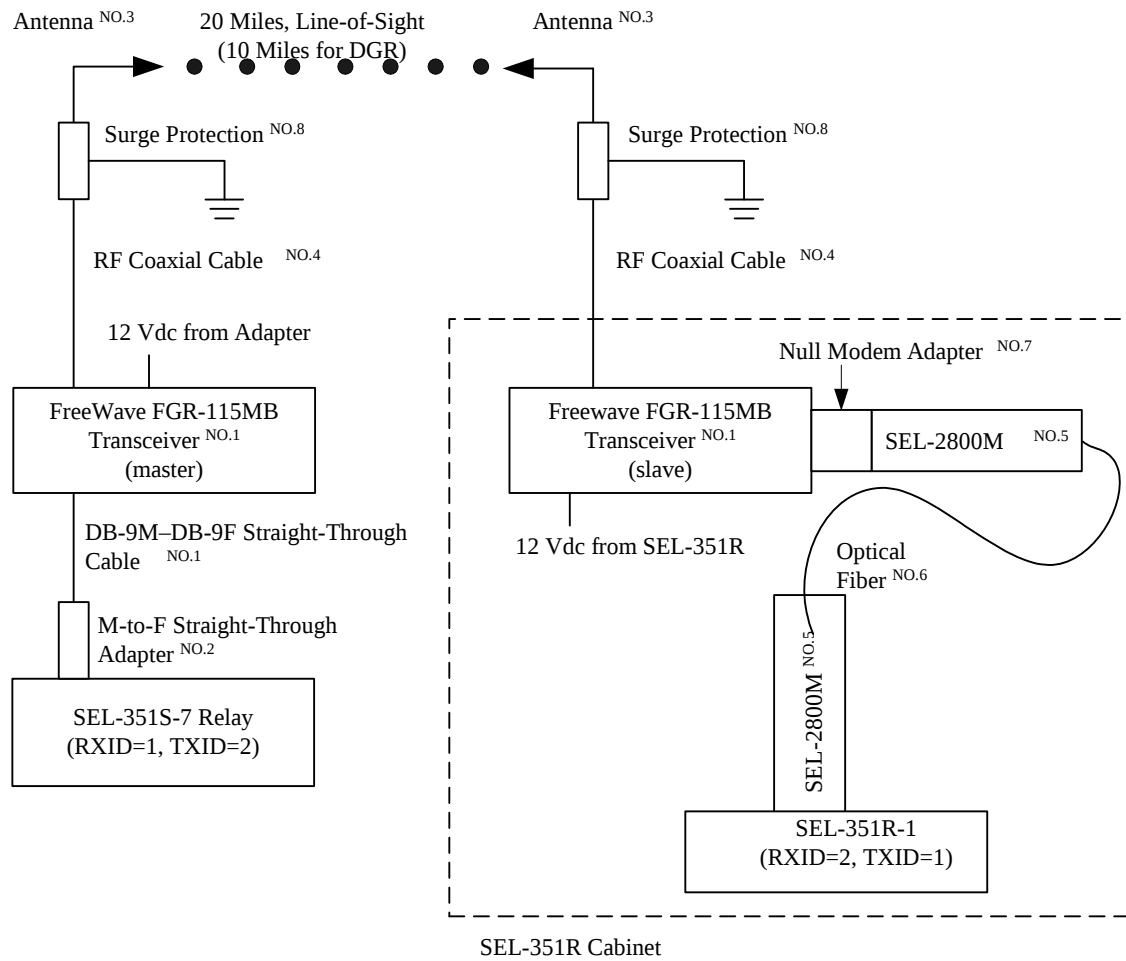


Figure 1: Example Installation



Equipment List

The following equipment list details the required components and connections, as shown in Figure 1. A pole, a tower, and/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 FGR-115MB, 12 VDC power, 1 W output, 20 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	\$1350
2	DB-9 Gender Changer	FreeWave Technologies, Inc. Model ECD0009MM, DB-9M-to-DB-9M converter or equivalent (each end of connector is male)	\$6
3	Yagi Antenna	FreeWave Technologies, Inc ¹ Model EAN0900YC. 10 dB directional, 26" long	\$194
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 1/4 shorting stub coaxial protector tuned for 870-970 MHz. www.northern-tech.com (800) 727-9119	\$135



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.



DGR-115RU and DGR-115RXU SEL Transceiver Radio Setup

```
                SET MODEM MODE
            Modem Mode is  10

(0)  Point to Point Master
(1)  Point to Point Slave
(2)  Point to MultiPoint Master
(3)  Point to MultiPoint Slave
(4)  Point to Point Slave/Repeater
(5)  Point to Point Repeater
(6)  Point to Point Slave/Master Switchable
(7)  Point to Multipoint Repeater
(A)  SEL Master(10)
(B)  SEL Slave(11)
(Esc) Exit to Main Menu
```

```
                SET BAUD RATE
            Modem Baud is  038400

(1)  115,200
(2)  76,800
(3)  57,600
(4)  38,400
(5)  19,200
(6)  9,600
(7)  4,800
(8)  2,400
(9)  1,200
(A)  Data, Parity  0
(B)  MODBus RTU    0
(Esc) Exit to Main Menu
```

Note:

DGR-115RU & DGR-115RXU transceivers are not compatible with FGR-115MB transceivers.



DGR-115RU and DGR-115RXU SEL Transceiver Radio Setup (cont.)

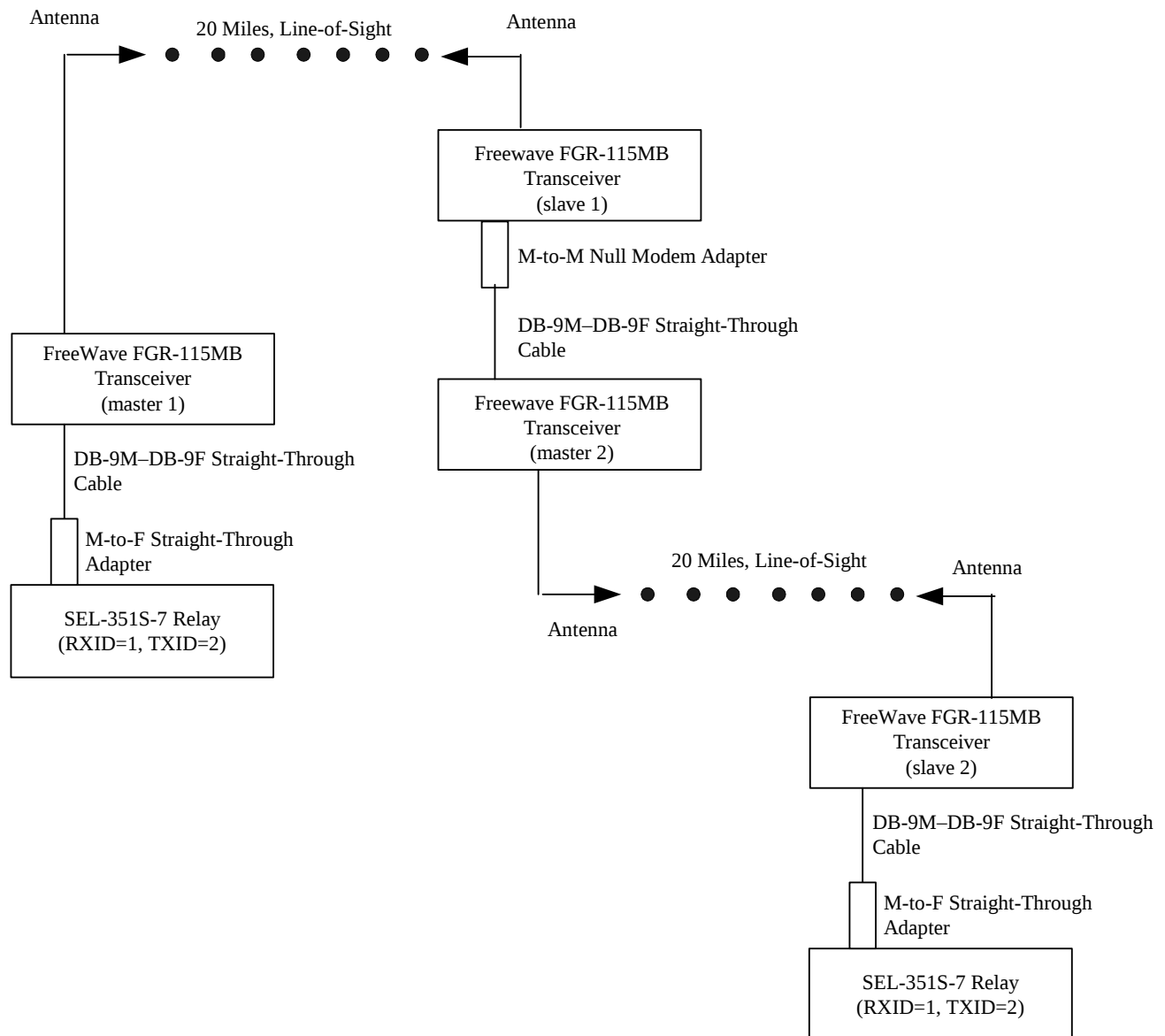
```
MODEM CALL BOOK
Entry to Call is 00
Entry      Number      Repeater1      Repeater2
(0)        898-0001
(1)        000-0000
(2)        000-0000
(3)        000-0000
(4)        000-0000
(5)        000-0000
(6)        000-0000
(7)        000-0000
(8)        000-0000
(9)        000-0000
(C)        Change Entry to Use (0-9) or A(ALL)
(Esc)      Exit to Main Menu
Enter all zeros (000-0000) as your last number in list
```

```
RADIO PARAMETERS
WARNING: Do not change parameters without reading manual
(0)  FreqKey      5
(1)  Max Packet Size  8
(2)  Min Packet Size  9
(3)  Xmit Rate     1
(4)  RF Data Rate   3
(5)  RF Xmit Power  10
(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

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

FGR-115MB Transceiver Radio Setup with Repeaters.





FGR-115MB Transceiver Radio Setup with Repeaters (cont.)

To use the FGR-115MB transceivers as repeaters in a Mirror-Bit link, the settings of the radios should be modified as shown below. A block diagram on the previous page shows the generic setup, while lacking the details as shown on page 5.

	Master 1	Slave 1	Master 2	Slave 2
Modem Mode	10 (A)	11 (B)	10 (A)	11 (B)
Baud Rate	38400	230400	230400	38400
Call Book Location 0	(slave 1)	(master 1)	(slave 2)	(master 2)

**FOR MORE DETAILED INFORMATION, REFER TO THE FGR-115MB USER MANUAL
ADDENDUM WHICH MAY BE FOUND ON THE USER CD OR CALL OUR TECH SUPPORT AT
(303) 444-3862**