GUARDIAN AND T-96SR INTEROPERABILITY

PN 009-5006-001
Revision 1
June 2012

CalAmp®

TECHNICAL SERVICE APPLICATION NOTE

OVERVIEW

The following document is designed to provide information for the implementation of the Guardian Wireless Modem into an existing T-96SR wireless data system.

PRODUCT

T-96SR Wireless Modem, Guardian-X00 Wireless Modem

APPLICATION

The T-96SR is a wireless modem that operates in the VHF, UHF and 900 MHz frequency bands. The radio will operate at 25 KHz or 12.5 KHz bandwidth depending on the part number that is ordered.

The Guardian wireless modem can operate in the VHF, 200 MHz, UHF and 900 MHz frequency bands. The radio will operate at 25 KHz or 12.5 KHz of bandwidth. The user can select the operating mode by using the Guardian FPS (Field Programming Software) and selecting the proper bandwidth. Reference User Manual part number 001-5006-000 for additional information on Guardian frequency ranges and bandwidth selection.

The Guardian and T-96SR are over-the-air compatible (OTA). The Guardian will be configured through the FPS to match the parameters of the existing T-96SR system.

HARDWARE

Although the Guardian and T-96SR are OTA compatible, there are physical differences between the two product lines.

- Antenna connector
  - T-96SR – Female SMA connector
  - Guardian – Female TNC connector
  - The following coaxial adapter cables are available for the Guardian:
    - 250-0697-103 18” TNC – Male to Type N – Male RG-400
    - 250-0697-104 48” TNC – Male to Type N – Male RG-400
    - 250-0697-105 72” TNC – Male to Type N – Male RG-400
    - 250-0697-106 18” TNC – Male to Type N – Female RG-400
- Power connection
  - T-96SR utilizes a red and black wire from the data cable
    - Power Input: 10-15 VDC @ 3 amps maximum
  - Guardian uses a 4 pin power connector
    - 3 wire connection. The ‘White’ wire must be connected to B+
    - Power cable is included with the radio
    - Power cable PN# 897-5008-010
    - Power Input: 10-30 VDC @ 60 Watts maximum
- Data connection
  - T-96SR uses a DE-15 connector
  - T-96SR application cable goes from a DE-15 to a DB-9 standard serial connection, PN# 697-0000-001
  - Guardian uses a DB-9 standard serial connection and can use standard DB-9 to DB-9 cable, PN# 697-4008-408
  - Guardian does not require special application cables like the T-96SR
    - If the T-96SR currently in place is being replaced, there is likely a 697-0000-001 cable going from the radio to the PLC/RTU equipment.

        - The 697-0000-001 cable could be removed and the PLC/RTU can be connected directly to the radio.
        - If cable length is an issue, a short DB-9 to DB-9 cable can be added between the PLC/RTU and the Guardian radio.
- Mechanical footprint
    - The T-96SR and the Guardian do not use the same mechanical footprint.
    - Reference Guardian Technical Manual 001-5006-000 which shows the mechanical layout of the radio
    - See page 13 Section 1.4.7 fig. 1-2 for chassis dimensions
- Programming
    - The Guardian uses programming software unique to the Guardian
    - The Guardian programming cable is simply a standard DB-9 to DB-9 serial cable and no longer requires unique cabling.
    - Programming cable PN# 697-4008-408

PROGRAMMING AND SETUP

Programming of the T-96SR and Guardian is done using unique FPS for each wireless modem. Since both wireless modems are transparent in their operation with the RTU/PLC there is no need to be concerned about Master and Remote configurations.

The first step in adding a Guardian into an existing system is to read the parameters of the T-96SR. Log parameter settings so that a thorough record is available for programming the Guardian. See Figures 1-3.

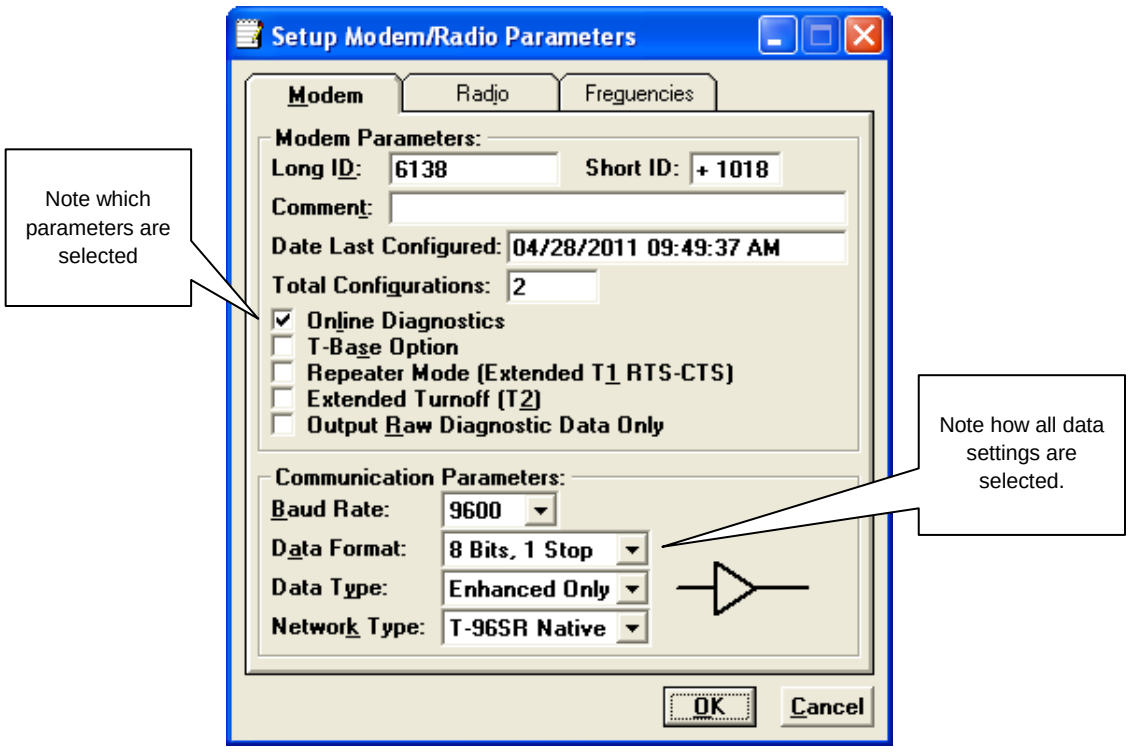

Fig. 1

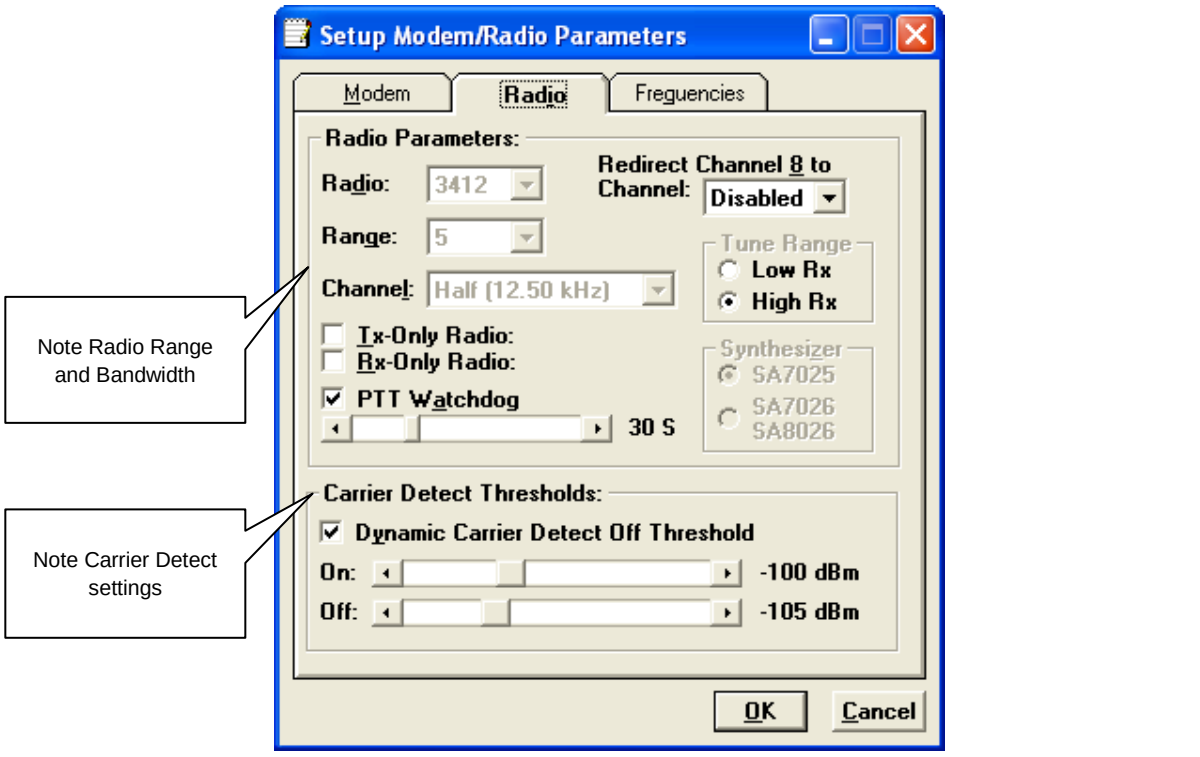
Setup Modem/Radio Parameters
Modem
Radio
Frequencies
Radio Parameters:
Radio:
3412
Redirect Channel 8 to Channel:
Disabled
Range:
5
Tune Range
Low Rx
High Rx
Channel:
Half (12.50 kHz)
Tx-Only Radio:
Rx-Only Radio:
PTT Watchdog
30 S
Synthesizer
SA7025
SA7026
SA8026
Carrier Detect Thresholds:
Dynamic Carrier Detect Off Threshold
On:
-100 dBm
Off:
-105 dBm
OK
Cancel
Note Radio Range and Bandwidth
Note Carrier Detect settings

Fig. 2

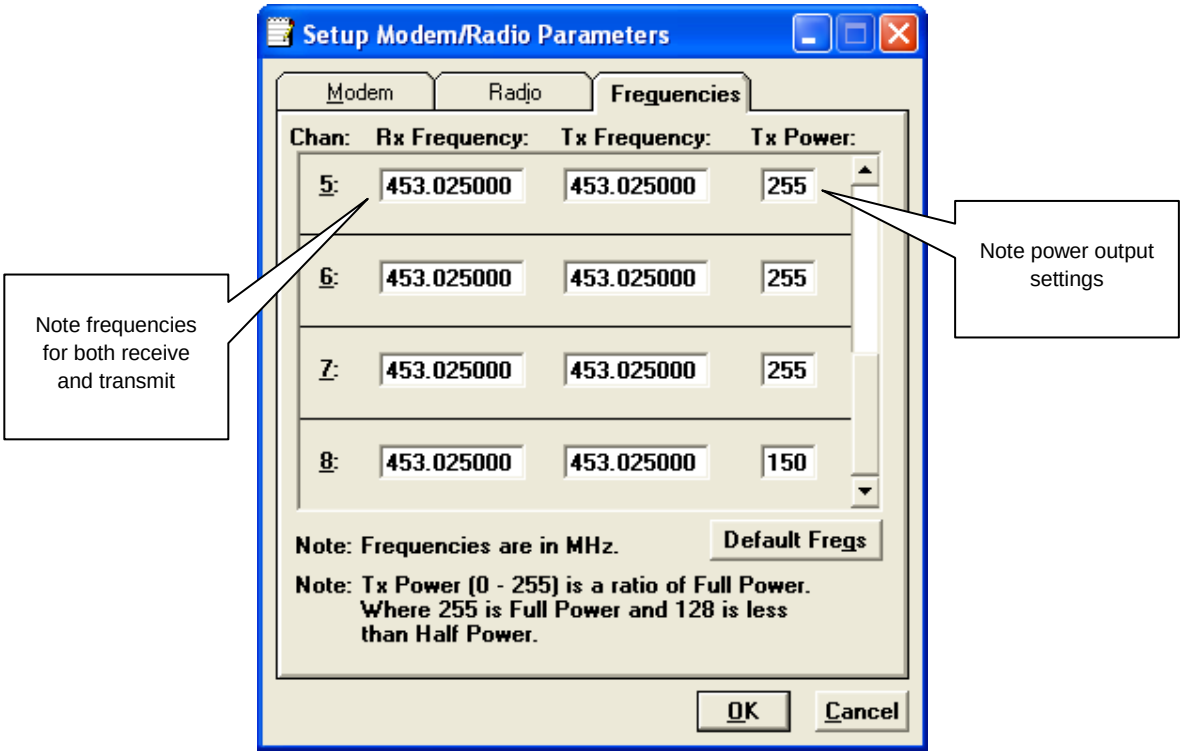
Setup Modem/Radio Parameters
Modem
Radio
Frequencies
Chan:
Rx Frequency:
Tx Frequency:
Tx Power:
5:
453.025000
453.025000
255
6:
453.025000
453.025000
255
7:
453.025000
453.025000
255
8:
453.025000
453.025000
150
Note: Frequencies are in MHz.
Default Freqs
Note: Tx Power (0 - 255) is a ratio of Full Power. Where 255 is Full Power and 128 is less than Half Power.
OK
Cancel
Note frequencies for both receive and transmit
Note power output settings

Fig. 3

SET GUARDIAN PARAMETERS

Once the parameters for the existing T-96SR system are logged, connect the Guardian to proper power supply voltage (10-30 VDC 60 Watt maximum at 10 watt RF power). Connect the antenna port to 50 ohm termination. Connect DB-9 to DB-9 data cable (PN# 697-4008-408 or equivalent) to Guardian "Setup" port.

- Note: Guardian FPS is defaulted to COM 1. Change if necessary.
- Programming parameters are 57,600 8, N, 1, DTR – None
- Handshaking should be set to "Buffered with no HS"

With the Guardian connected to proper power source, antenna terminated and programming cable connected to the "Setup" port of the radio/modem, press the "Config" button in the upper left corner as shown in Fig. 4.

Fig. 4

The Guardian FPS will read and display the current configuration of the radio/modem connected to the computer. The configuration screen will display the Long and Short ID numbers of the modem. The Long ID number will typically be a 6 digit number. This number can be changed to suit the application's needs (Fig. 5).

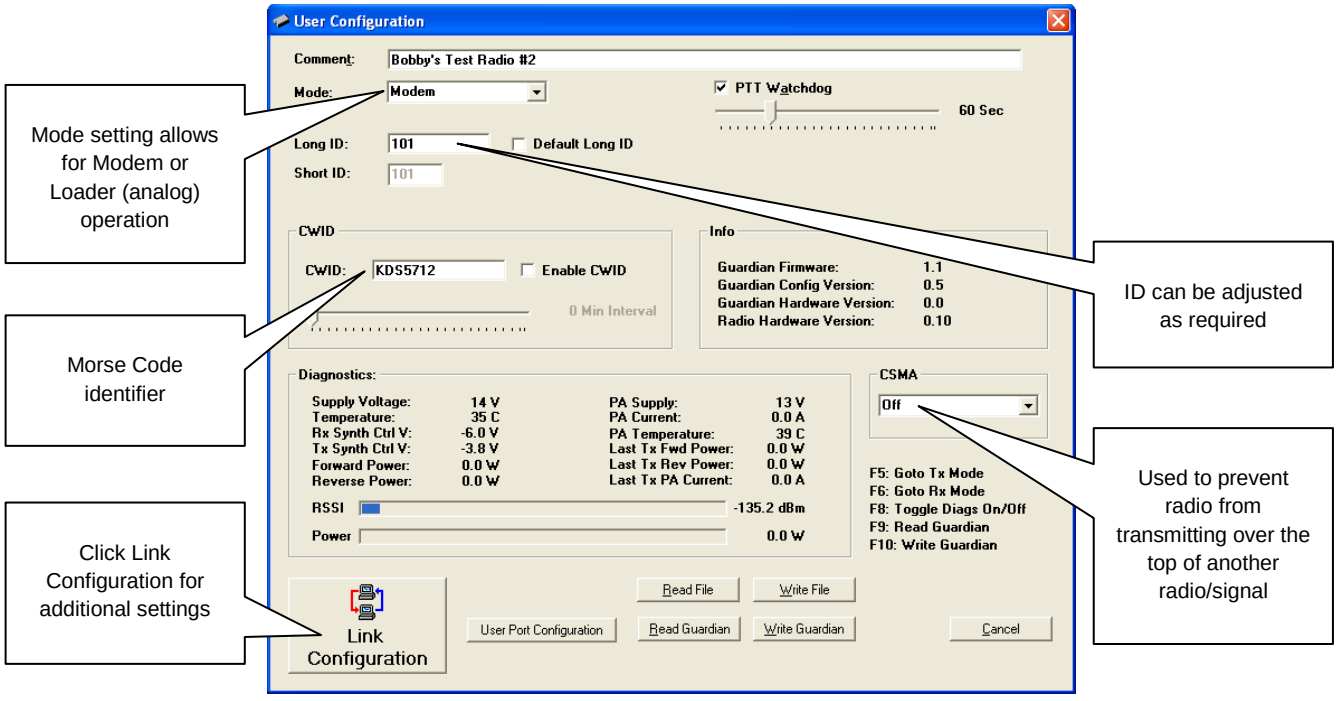

Fig. 5

- The "PTT Watchdog" performs the same function as in the T-96SR. This can be adjusted or left at factory default.
- Information and real-time diagnostics are available on this screen.

- CWID is a new feature not available on the T-96SR. Station /License call signs can be transmitted at selected intervals. This feature is used when the SCADA system shares a 'Voice Channel' with another system and is required to identify itself using Morse code. (Fig. 5)
- CSMA (Carrier Sense Multiple Access) is a feature added to the Guardian that is not available on the T-96SR.
    - This feature allows the radio to monitor the RF channel for activity
    - There are two modes to select from:
        - No TX when the radio/modem is receiving valid data
        - No TX when the radio/modem is receiving an RF carrier
        - See Fig. 5
- There is a new feature added to the Guardian that allows the radio to be used as a modem (T-96SR compatible) or be used as an analog radio (DL3400 compatible). For this application, only the 'Modem' mode will be used. (Fig. 5)

LINK CONFIGURATION

Press the "Link Configuration" button shown in Fig. 5 to advance to the modem settings. This is the screen that sets the RF channel frequencies and modem settings. See Fig. 6.

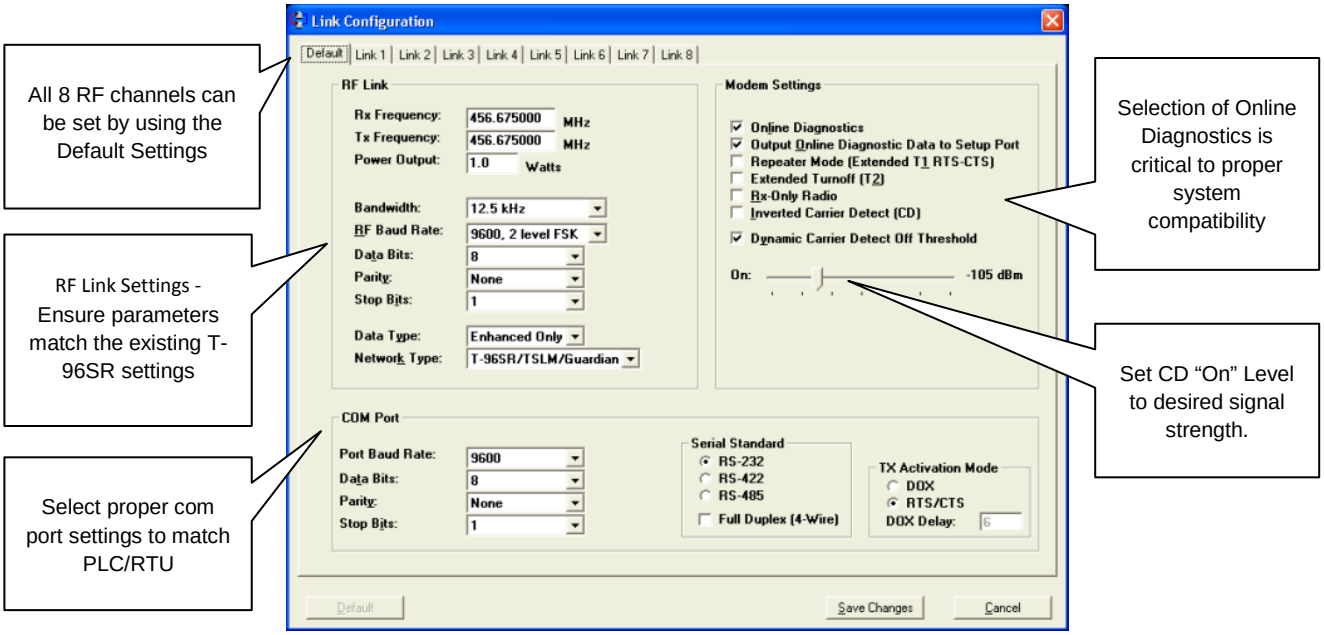

Fig. 6

Unlike the T-96SR where all 8 channels were programmed one channel at a time, the Guardian has a "Default" setting that will set all 8 channels simultaneously. (Fig. 6)

- Using the information collected from the T-96SR programming, set the RF Link information to match the system parameters.
- Channel bandwidth is now selectable for either 25 KHz or 12.5 KHz
- Set Power Output to the desired power level; 1-10Watts
- The Guardian allows for the OTA data settings to be different from the user comm port settings. Care must be taken to ensure the OTA settings are the same as the T-96SR system settings. (Fig. 6)
    - Channel Bandwidth must match the existing system
    - Data rate (Baud Rate) must be the same as the T-96SR
    - Data bits, Parity and Stop Bits must be the same

- The Guardian uses a slightly different yet compatible modulation scheme as the T-96SR
    - T-96SR uses DRCMSK modulation
    - Guardian uses 2 Level FSK

Refer to the parameters collected from the T-96SR programming to set the "Modem Settings". Pay close attention to the "Online Diags" settings. If Online Diagnostics are selected in the T-96SR system, they MUST be enabled in the Guardian. Whether or not the Online Diagnostics are output to the Setup Port is left to the discretion of the customer.

By selecting "Output Online Diagnostic Data to Setup Port", the end user can view Online Diagnostics the same as a T-Base Diagnostic Port would show them. (Fig. 6)

The remainder of the Modem Settings should match the T-96SR system. Dynamic Carrier Detect acts the same as the T-96SR. The Carrier Sense level is set by selecting the "On" level. This is the RSSI (Receive Signal Strength Indication) or signal strength required to open the squelch setting in the receiver. The Carrier Sense "Off" level is set automatically to 5 dBm below the "On" level. (Fig. 6)

The comm port settings must match the RTU/PLC equipment used in the system. Typically these settings will be the same as the RF Link Settings but can be set differently. When used in an existing T-96SR system, these will be the same as the RF Link Settings.

- Select the correct Baud rate, Parity bit and Stop bit values.
- Transmit control mode can be either RTS/CTS handshaking mode or DOX (Data Operated Transmit) mode.
- The Guardian also offers the choice of RS422 and RS485 serial connections.

When all parameters are selected and verified, press the "Save Changes" button at the bottom of the Link Configuration screen. The Link Configuration screen will close. There are two options for programming the Guardian: Press the "Write Guardian" button or press F10 on the programming keyboard. See Fig. 7.

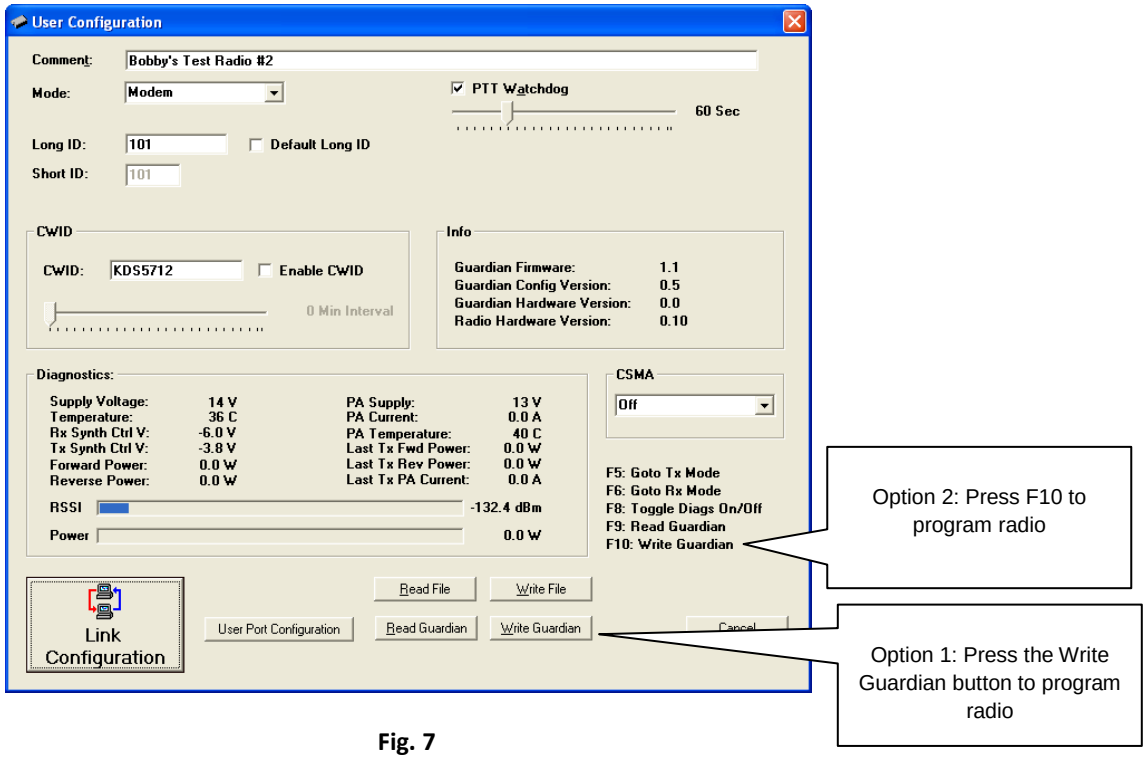

Fig. 7

Fig. 8

Programming of the Guardian is very fast. When complete click “OK” as shown in Fig. 8

The Guardian has now been configured and is ready for installation.

INSTALLATION

As noted on page 1 and page 2, the Guardian footprint is different than the T-96SR.

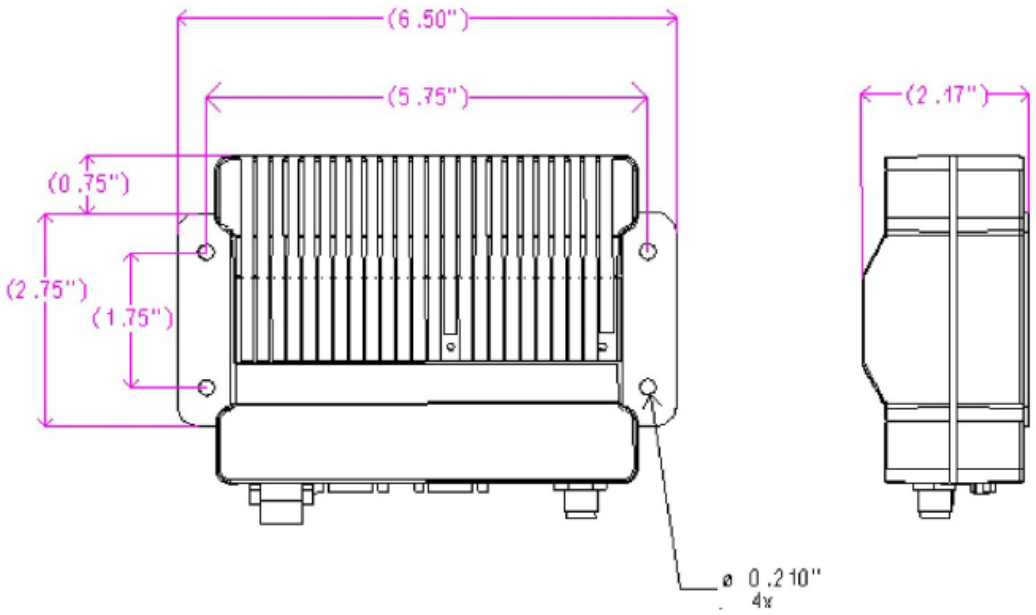

Fig. 9

Figure 9 shows the mechanical dimensions for the Guardian. When mounting the radio, orientation should allow unrestricted airflow from the heat sink fins. If radio location, heat dissipation or duty cycle are a concern, the addition of the Guardian Fan Kit should be considered. The following part numbers are available:

- 150-5008-001 Factory Installed Fan Kit
- 150-5008-002 Field Installed Fan Kit

Contact you sales representative for further information.

The antenna connection of the Guardian is a TNC-Female 50 ohm connector. See page 2 for available cables from CalAmp Corp.

Serial connection is a DB-9 Female. This is a DCE connection. The RTU/PLC control equipment may be DTE or DCE equipment. If the RS232 serial connection is DTE, a 'straight through' serial cable should be used. If the equipment has a DCE connection, a 'null modem' serial cable will be required.

For RTS/CTS handshaking flow control, 5 wires will be required for operation. These are as follows: (see Table 1)

Contact	EIA-232F Function	Signal Direction
1	Data Carrier Detect (DCD)	DTE ← DCE
2	Receive Data (RXD)	DTE ← DCE
3	Transmit Data (TXD)	DTE → DCE
4	Data Terminal Ready (DTR)	DTE → DCE
5	Signal Ground (GND)	DTE --- DCE
6	Data Set Ready (DSR)	DTE ← DCE
7	Ready To Send (RTS)	DTE → DCE
8	Clear To Send (CTS)	DTE ← DCE
9	Ring Indicator (RI)	DTE --- DCE

Table 1

- Pin 2 Receive Data – Data received by radio and output to a RTU/PLC
- Pin 3 Transmit Data – Data sent to modem to be transmitted by the radio
- Pin 5 Signal Ground – RS232 ground and also radio/modem chassis ground potential
- Pin 7 Request to Send – RTS raised to RS232 'High' to start transmit mode and prepare mode to receive data
- Pin 8 Clear to Send – CTS return RS232 'High' to RTU/PLC 30 mSec after RTS is raised. Modem is ready to receive data

DOX mode operation does not require RTS/CTS handshake control. When data is received on Pin 3 (TXD), data is buffered and the radio is set to transmit mode. Data is transmitted when the radio/modem is ready to send it.

DOX mode requires 3 wire connections for operation. These are as follows: (see Table 1)

- Pin 2 Receive Data – Data received by the radio and output to a RTU/PLC
- Pin 3 Transmit Data – Data sent to modem to be transmitted by the radio
- Pin 5 Signal Ground – RS232 ground and also radio/modem chassis ground potential

Summary:

Further information is available in the Guardian Technical Manual part number 001-5006-000. This manual is available for download at:

http://www.calamp.com/support/download-library

For technical assistance please contact CalAmp Corp. Technical Service at:

wngsupport@calamp.com or call 1-507-833-6701 option 1 for Fixed and Legacy products.