



INTEGRA-TR™ WIRELESS MODEM FOR LICENSED SPECTRUM



USER MANUAL
PN 001-4008-000 REV 16

Revised December 2010

REVISION HISTORY

REV	DATE	DESCRIPTION
REV 0	Feb 2000	Initial Release as 001-4008-000.
REV 1	Mar 2000	Updated manual format.
REV 2	Jul 2000	Corrected FCC/IC numbers and added FM approval information.
REV 3	Sep 2000	Updated Channel information in General Specifications - Section 1.
REV 4	Nov 2000	Updated Typical Deviation in Section 4.
REV 5	Jan 2001	Added CE information to Section 1.
REV 6	Mar 2001	Updated Duty Cycle information in General Specifications - Section 1.
REV 7	Jul 2001	Updated manual to reflect Windows-based Field Programming Software to Section 2. Added Part Number breakdown to Section 1.
REV 8	Oct 2001	Added CSMA and CWID information to Section 2. Moved CD certificates to Appendix A.
REV 9	Nov 2001	Added Extended ID information to Section 2.
REV 10	Nov 2002	Added Splinter Channel, Digital I/O and note to LED table (1) to Section 2.
REV 11	Sep 2003	Added Packet Test and Array Test information to Section 2. Added product warranty statements in Appendix B. Updated General Specifications.
REV 12	Apr 2004	Removed references to Sleep and Suspend Mode in Section 1, 2 & 3. Removed International Warranty from Appendix B-replaced with revised warranty.
REV 13	Mar 2005	Added multi-channel information, replaced references to Sleep and Suspend Mode. Updated Accessories table.
REV 14	Jul 2006	Moved Revision level to 15 to sync with all formats.
REV 15	Jul 2006	Added pdf and hard copy part numbers for customer reference. Revised references to Band 1 UHF versions, frequencies were listed as 380-403 MHz.
REV 16	Dec 2010	

Important Notice

Because of the nature of wireless communication, transmission and reception of data can never be guaranteed. Data may be delayed, corrupted (i.e., have errors), or be totally lost. Significant delays or losses of data are rare when wireless devices such as the Integra-TR are used in a normal manner with a well-constructed network. Integra-TR should not be used in situations where failure to transmit or receive data could result in damage of any kind to the user or any other party, including but not limited to personal injury, death, or loss of property. CalAmp accepts no responsibility for damages of any kind resulting from delays or errors in data transmitted or received using Integra-TR, or for the failure of Integra-TR to transmit or receive such data.

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RF Exposure Compliance Requirements



The Integra-TR radio is intended for use in the Industrial Monitoring and Control and SCADA markets. The Integra-TR unit must be professionally installed and must ensure a minimum separation distance listed in the table below between the radiating structure and any person. An antenna mounted on a pole or tower is the typical installation and in rare instances, a 1/2-wave whip antenna is used.

Min Safety Distance (cm @max power)	Antenna Gain		
	5 dBi	10 dBi	15 dBi
VHF	79.3 cm	141.0 cm	250.8 cm
UHF	68.2 cm	121.4 cm	215.8 cm
900 MHz	45.0 cm	80.1 cm	142.5 cm

It is the responsibility of the user to guarantee compliance with the FCC MPE regulations when operating this device in a way other than described above.

Integra-TR uses a low power radio frequency transmitter. The concentrated energy from an antenna may pose a health hazard. People should not be in front of the antenna when the transmitter is operating.

The installer of this equipment must ensure the antenna is located or pointed such that it does not emit an RF field in excess of Health Canada limits for the general population. Recommended safety guidelines for the human exposure to radio frequency electromagnetic energy are contained in the Canadian Safety Code 6 (available from Health Canada) and the Federal Communications Commission (FCC) Bulletin 65.

Any changes or modifications not expressly approved by the party responsible for compliance (in the country where used) could void the user's authority to operate the equipment.

1 TABLE OF CONTENTS

1.1	Figures	6
1.2	Tables	7
2	<i>PRODUCT OVERVIEW</i>	8
2.1	Scope of Manual.....	8
2.2	General Description	8
2.2.1	Characteristics.....	8
2.3	Part Number Breakdown	9
2.3.1	Transceiver Identification	9
2.3.2	Accessories and Options	9
2.3.3	Factory Mutual NI Kit	10
2.3.4	Configuration	12
2.4	Factory Repair	12
2.5	Physical Description.....	12
2.6	Diagnostics.....	12
2.7	Firmware Updates	13
2.8	Network Application.....	13
2.8.1	RF Path and Communications Range	13
2.8.2	Basic Connections.....	13
2.8.3	Common Characteristics	14
2.8.4	Point-to-Point System	14
2.8.5	Point-to-Multipoint System.....	14
2.8.6	Extending a Landline (Tail Circuit)	15
2.9	Specifications.....	17
3	<i>FEATURES AND OPERATION</i>	20
3.1	Overview	20
3.2	Front Panel	20
3.2.1	Antenna Connector	20
3.2.2	Connection to DTE	20
3.2.3	LED Indicators.....	20
3.2.4	COM Port.....	21
3.2.5	Setup Port.....	22
3.3	Rear Panel	23
3.3.1	Heat Sink.....	23
3.3.2	Power	23
3.3.3	Power – I/O Connector	23
3.4	Integra-TR Field Programming Software	24
3.4.1	Introduction.....	24
3.4.2	Setup Modem/Radio Parameters.....	25
3.4.3	Version Request	38
3.4.4	List Information	39
3.4.5	Apply Integra Reset	39
3.4.6	Program Comment/ID.....	39
3.4.7	Program Parameters	40
3.4.8	Read Parameters.....	41
3.4.9	Copy Parameters	41

3.4.10	COM Port Settings	41
3.4.11	Swap COM Ports	44
3.4.12	Port Statistics	45
3.4.13	Offline Link Test	46
3.4.14	Offline Diagnostics	48
3.4.15	Online Diagnostics	50
3.4.16	Diagnostic IDs and Alarms	52
3.4.17	User Test	54
3.4.18	Packet Test	56
3.4.19	Array Test	58
3.4.20	Ping Test	60
3.4.21	ASCII / Hex Terminal	63
3.4.22	Program Code Menu	64
3.5	Integra-TR Help Files	65
3.6	Optimizing Your System	65
4	CONFIGURABLE PARAMETERS	67
4.1	Parameter Overview	67
5	DEFINITIONS	69

1.1 FIGURES

Figure 1-	FM Approved External Connections	10
Figure 2-	Installation Dimensions	11
Figure 3 -	Basic Required Connections	13
Figure 4 -	Point-to-Point System	14
Figure 5 -	Point-to-Multipoint System (simplex or half-duplex)	14
Figure 6 -	Point-to-Multipoint System (full-duplex)	15
Figure 7 -	Point-to-Multipoint System (full-duplex repeater)	15
Figure 8 -	Landline (Tail Circuit)	15
Figure 9 -	DCE Crossover Cable for RTS-CTS Mode	16
Figure 10 -	DCE Crossover Cable for DOX Mode	16
Figure 11 -	COM and Setup Port Connectors Pin Locations	22
Figure 12 -	3-wire Interface	22
Figure 13 -	Integra-TR Rear Panel	23
Figure 14 -	I/O Connector	23
Figure 15 -	Integra-TR Field Programming Software Startup Screen	24
Figure 16 -	Setup Modem/Radio Parameters Screen	25
Figure 17 -	Suspend Mode Timing	29
Figure 18 -	COM/Analog Setup Parameters Screen	29
Figure 19 -	Integra-TR Control Signal Timing	30
Figure 20 -	Digital I/O Circuit Diagram	32
Figure 21 -	Integra Power I/O Cable	32
Figure 22 -	Integra Field Programming Software Digital I/O Screens	34
Figure 23 -	Radio Setup Parameters Screen	35
Figure 24 -	Frequencies Tab	37
Figure 25 -	Version Request Screen	39
Figure 26 -	List Request Screen	39
Figure 27 -	Reset Screen	39
Figure 28 -	Program Comment/ID Screen	40
Figure 29 -	Program Parameters	40
Figure 30 -	Port Settings Screen	41

Figure 31 - Port Statistics Screen	45
Figure 32 - Offline Link Test Screen	46
Figure 33 - Offline Diagnostics Screen.....	48
Figure 34 - Online Diagnostics	51
Figure 35 - Diagnostic IDs and Alarms Screen.....	52
Figure 36 - User Test Screen	54
Figure 37 - Packet Test Screen	56
Figure 38 - Array Test Screen.....	58
Figure 39 - Ping Test Screen.....	60
Figure 40 - ASCII Terminal Screen	63
Figure 41 - Select Firmware File Window (for reference only).....	64
Figure 42 - Integra-TR Online Help Introductory Screen.....	65

1.2 TABLES

Table 1 - Integra-TR Part Number Breakdown.....	9
Table 2 - Accessories	9
Table 3 - LEDs Color Functions***	21
Table 4 - COM Port Signals.....	21
Table 5 - Setup Port Signals.....	22
Table 6 - Diagnostics Information	27
Table 7 - 4 Channel Select Mode.....	35
Table 8 - Communications Mode.....	43
Table 9 - Y-Cable Connections.....	57
Table 10 - SWR / Rev Pwr Interpretation	66
Table 11 - Normal Factory Settings (Units).....	67
Table 12 - Normal Factory Settings (Bases)	68

2 PRODUCT OVERVIEW

2.1 SCOPE OF MANUAL

This document provides the information required for the operation and preventive maintenance of the Integra-TR integrated wireless modem. This manual is intended for system designers, installers and maintenance technicians.

2.2 GENERAL DESCRIPTION

Integra-TR is a high-speed transparent integrated wireless modem. It is FCC refarming compliant and designed specifically to fit the needs of SCADA, telemetry and control applications. Integra-TR provides the communication links to data equipment for installations where wired communication is impractical.

Integra-TR works with most makes and models of remote terminal units (RTU) and programmable logic controllers (PLC) and their protocols. Configuration settings allow tailoring for a variety of applications. Integra-TR supports:

1. Point to point Master-Remote or Peer-to-Peer configurations in simplex or half-duplex modes.
2. Point to multipoint Master-Remote configuration in simplex or half-duplex modes and offers full-duplex in dual-unit configuration. These configurations are available as I-Base products. Contact your CalAmp Representative for details.

2.2.1 CHARACTERISTICS

Integra-TR has the following characteristics:

- Selectable network speeds of 2400 and 4800 b/s for quarter channel units, 4800 and 9600 b/s for half channel units as well as 4800, 9600 and 19200 b/s for full channel units
- Backward compatible with the Integra-T for bit rate of 4800 and 9600 b/s (full channel units only)
- One COM port for connection to DTE. Speed of 1200 - 19200 baud
- One Setup port for configuration and diagnostics (speed fixed to 9600 baud, 8 bit, no parity, 1 stop bit)
- Built-in 5-watt transceiver (adjustable 1-5 watts), operating in the VHF, UHF or 900 MHz communications bands. Half-duplex or simplex operation
- Fully transparent operation with error-free data delivery
- Allows transmission of "break" characters
- DOX (Data Operated Transmit) or RTS mode
- Stations may be set as "master" or "remote" to prevent remote stations from hearing each other in a simplex RF configuration
- Full local and remote diagnostics
- Two configurable I/O lines programmable as either 8-bit analog inputs or digital outputs
- "12 VDC, negative ground" device
- CWID provides the ability to program the unit to periodically identify itself on the air by sending the FCC Station ID in Morse code
- Disable Tx w/Carrier Present configures the unit to prevent transmission when the radio channel is busy
- Low power consumption modes: "sleep" and "suspend" modes (< 20 mA)
- Multi-channel capability under system PLC control provides advanced network monitoring

2.3 PART NUMBER BREAKDOWN

The following table provides a breakdown of the Integra-TR part number.

Table 1- Integra-TR Part Number Breakdown

242-40W8-XYZ*				
W	X		Y	Z (UHF Units)
1 VHF	0	406.1-422 MHz	0 6.25 kHz	0 406.1-422 MHz, or Dual Band
4 UHF	1	380-400 MHz	1 12.5 kHz	1 414-430 MHz
9 900 MHz	2	403-419 MHz	3 25 kHz	
	3	419-435 MHz (UHF), 406.1-440 MHz (UHF Dual Band)	5 Dual Band 12.5 & 25 kHz	
	4	132-150 MHz (VHF), 435-451 MHz (UHF)		
	5	450-470 MHz (UHF), 440-476 MHz (UHF Dual Band), 928-960 MHz (900 MHz)		
	6	150-174 MHz (VHF), 464-480 MHz (UHF)		
	7	480-496 MHz		
	8	496-512 MHz		

*An F should follow any part number to designate an Integra-TR with the cooling fan option.

2.3.1 TRANSCEIVER IDENTIFICATION

The transceiver identification is a random, unique serial number (SN) printed on the box label and model label on the side of the Integra-TR unit.

2.3.2 ACCESSORIES AND OPTIONS

Table 2 - Accessories

Accessory	DRL Part Number
Integra-TR Field Programming Kit includes software, technical manual on CD ROM with programming cable (DRL part number 697-4008-408)	250-4008-001
SMA to Type N-Male Adapter Cable	697-5000-101
Integra-TR Start-Up Disc includes Field Programming Software, Manual and Quick Start Guide	002-4008-100
*Cooling fan - factory option (For extended duty-cycle transmit applications)	Catalog number plus "F" suffix.
Power cable	697-4008-001
Factory Mutual NI Kit	023-1000-200
Switching Power Converter (SPC)	250-0300-133
Demo Power Kit	250-0300-175
Data Interface Kit	250-0045-103
Data Diagnostic Kit	250-0005-105

Integra-TR DIN-rail Mounting Kit	250-5800-408
*Full-duplex base station	Contact Technical Service
VHF Antenna Kit	Contact Sales Representative

*For extended-transmit applications, the “TX Time out” timer must be turned off (set to “disable”) via the Field Programming Software.

For information on accessories and options, contact your sales representative. In the United States phone 1-800-9927774 or 1-507-833-8819, for International inquiries phone 507-833-8819.

2.3.3 FACTORY MUTUAL NI KIT

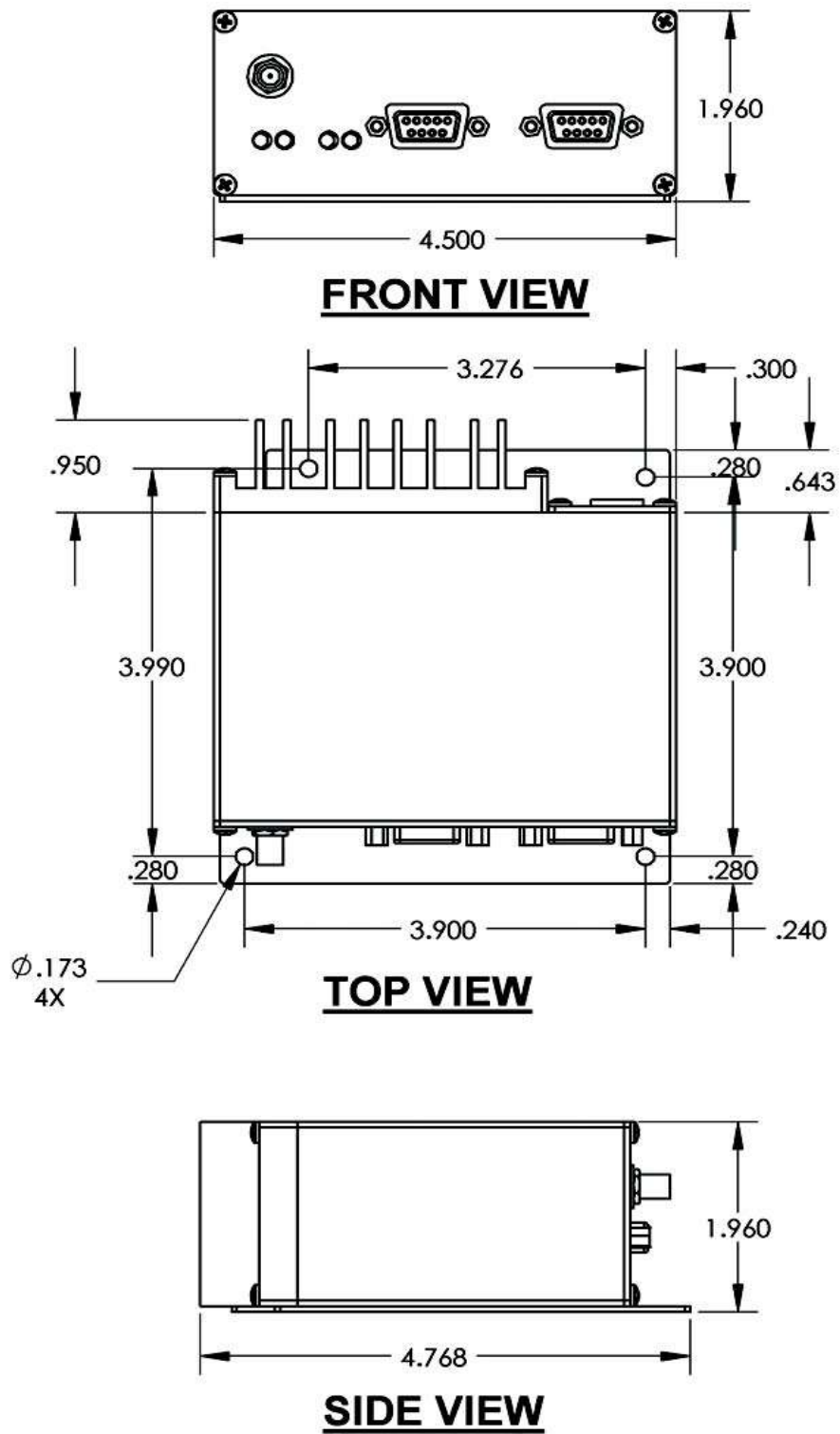
The Integra-TR with the Factory Mutual NI Kit (DRL part number 023-1000-200) is approved as non-incendive for Class I, Groups ABCD, Division 2, hazardous locations by Factory Mutual Research Corporation. This option includes approval for International Electrotechnical Commission (IEC) Class I, Zone 2.

Approved models are labeled with this rating. Only units with the Factory Mutual approved label carry the nonincendive rating. Installation, service, and repair of the FM approved units must be in accordance with the instructions found in this manual and the National Electrical Code (ANSI-NFPA 70) Division 2: Hazardous (classified) Location Incendive Wiring Techniques. Mount the unit in an enclosure or assembly. Route all interconnecting cables (DC power and coaxial) through conduit as specified in the National Electrical Code document referenced above. For further guidance on installation, see ANSI\ISA-RPI2.6: Installation of Intrinsically Safe Systems for Hazardous (Classified) locations.

Figure 1- FM Approved External Connections



Figure 2- Installation Dimensions



2.3.4 CONFIGURATION

Operating characteristics of the Integra-TR are configured by means of Integra-TR's Field Programming Software. The Field Programming Software is Windows based and requires a Windows® 98 or later operating system running the Integra-TR Field Programming Software for both configuration and adjustment.

2.4 FACTORY REPAIR

CalAmp guarantees that every Integra-TR module will be free from physical defects in material and workmanship for two (2) years from the date of purchase when used within the limits set forth in the Specifications section of this manual. The manufacturer's warranty statement for this product is available in Appendix 1. If the product proves defective during this warranty period, call CalAmp Customer Service to obtain a Return Material Authorization (RMA). **BE SURE TO HAVE THE EQUIPMENT MODEL AND SERIAL NUMBER, AND BILLING AND SHIPPING ADDRESSES ON HAND WHEN CALLING.** You may also request an RMA online at www.calamp.com.

When returning a product, mark the RMA clearly on the outside of the package. Include a complete description of the problem and the name and telephone number of a contact person. **RETURN REQUESTS WILL NOT BE PROCESSED WITHOUT THIS INFORMATION.**

For units in warranty, customers are responsible for shipping charges to CalAmp. For units returned out of warranty, customers are responsible for all shipping charges. Return shipping instructions are the responsibility of the customer.

CalAmp reserves the right to update its products, software, or documentation without obligation to notify any individual or entity. Please direct all inquiries to:

CalAmp, 299 Johnson Ave., Ste 110, Waseca, MN 56093 Telephone 507.833.8819 or Toll Free 800.992.7774

2.5 PHYSICAL DESCRIPTION

Integra-TR consists of a logic PCB (which includes modem circuitry) and a radio module. Each logic PCB and radio module are matched together and characterized in the factory to optimize performance as an intelligent unit. The two boards then slide into the rails of an extruded aluminum case.

DTE connection is made via a front panel connector. Power is applied through a rear panel 4-pin connector which includes two programmable analog connections usable as inputs or outputs.

The unit is not hermetically sealed and should be mounted in a suitable enclosure when dust and/or a corrosive atmosphere are anticipated. Physically, there are no external switches or adjustments. All operating parameters are set using the Field Programming Software.

2.6 DIAGNOSTICS

Integra-TR has sophisticated built-in diagnostics that may be transmitted automatically without interfering with normal network operation. In addition, commands to generate test transmissions, etc., may be issued either locally or remotely.

Diagnostic information takes one of two forms:

Online Diagnostics - Information is automatically sent by each unit at the beginning of every data transmission.

Offline Diagnostics - Information is sent by a specific unit in response to an inquiry made locally or from another station.

2.7 FIRMWARE UPDATES

The Integra-TR firmware resides in flash EPROM and is designed to allow field updates.

Updates are done using a PC connected to the Integra-TR but do not require opening the unit. Updates will be coordinated by DRL's Technical Service.

2.8 NETWORK APPLICATION

Integra-TR is suited to a variety of network applications. Its primary design goal was to satisfy the needs of SCADA systems using RTUs or PLCs in either point-to-point or point-to-multipoint service.

This section gives an overview of some common configurations. Selection of "master" or "remote" as well as data delivery conditions is done using the Integra-TR Field Programming Software.

2.8.1 RF PATH AND COMMUNICATIONS RANGE

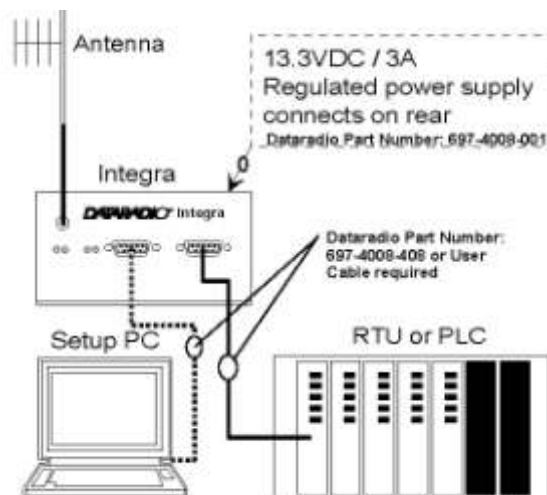
Integra-TR is designed for use over distances up to 30 miles + (50 km) depending on terrain and antenna system. To assure reliable communications, the RF (radio frequency) path between stations should be studied by a competent professional who can determine what antennas are required and whether or not a repeater is needed. Your CalAmp Sales Representative can assist you.

2.8.2 BASIC CONNECTIONS

The connections required are shown in Figure 3.

While an RTU or PLC is shown in the diagram, master stations often use a PC running an application designed to communicate with remote RTUs or PLCs. The Setup PC is used for both configuration and local and remote diagnostics. It may be left connected at all times but is not required for normal operation once the unit has been configured.

Figure 3 - Basic Required Connections



2.8.3 COMMON CHARACTERISTICS

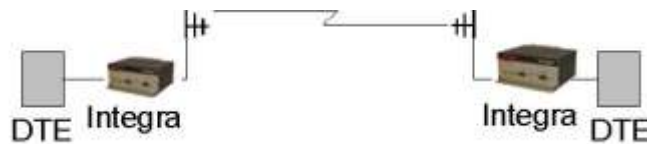
The networks described in this section share common characteristics:

1. The DTE (data terminal equipment) network speed (1200, 2400, 4800, 9600 and 19,200 b/s) must be the same for all stations in a network.
2. Transmission of online diagnostics may be enabled or disabled at any station or stations without affecting their ability to communicate with other stations.

2.8.4 POINT-TO-POINT SYSTEM

Simple point-to-point connection is shown in Figure 4.

Figure 4 - Point-to-Point System

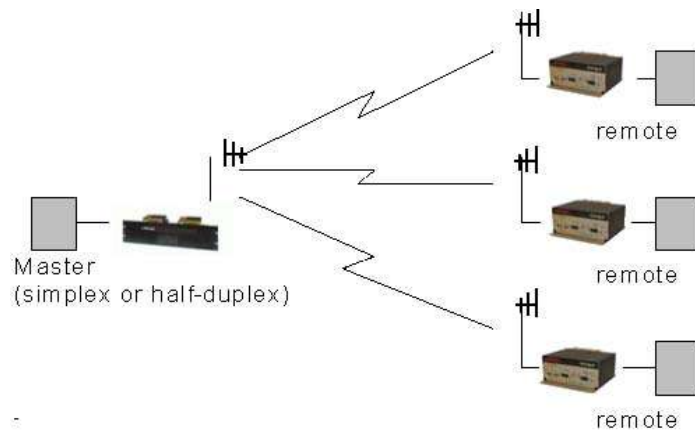


In this system, the user's equipment (DTE) may be set up in either a peer-to-peer or a Master-Remote configuration.

2.8.5 POINT-TO-MULTIPOINT SYSTEM

Basic point-to-multipoint systems are shown in Figure 5.

Figure 5 - Point-to-Multipoint System (simplex or half-duplex)



If a half-duplex radio network is used (i.e. two frequencies with the master station transmitting and receiving on the reverse pair from the remotes), the master station can be either full duplex or half-duplex.

If a simplex radio network is used (i.e. a single frequency for all stations), we recommend that the master Integra-TR be set to "master", the remotes to "remote" and all units to "selective" data delivery. This will prevent remote stations from hearing each other's responses. For full duplex configuration, set the receiving unit Rx/Tx Mode to Rx Only (using the Field Programming Software). Set the transmitting unit mode to Tx Only.

Figure 6 - Point-to-Multipoint System (full-duplex)

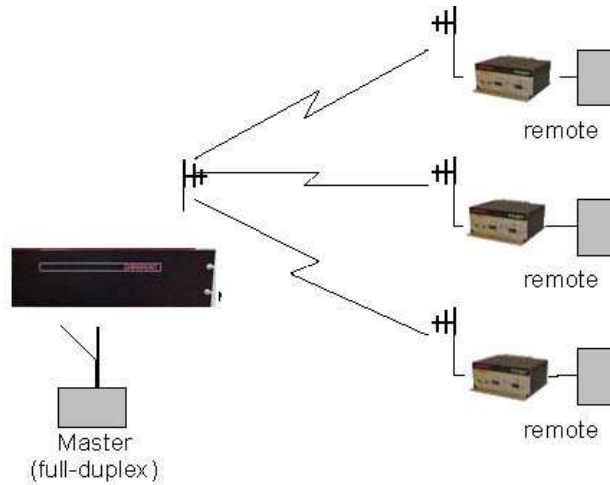
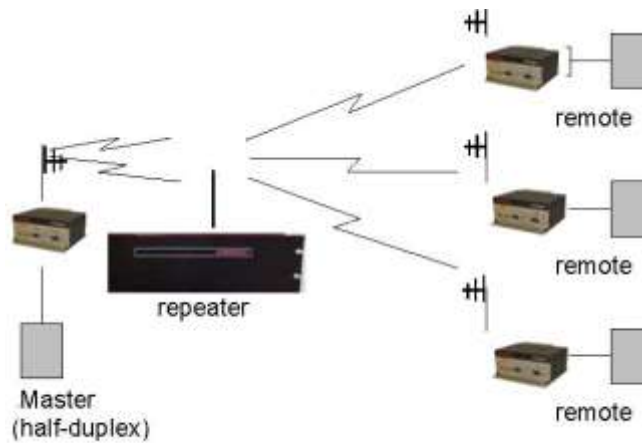


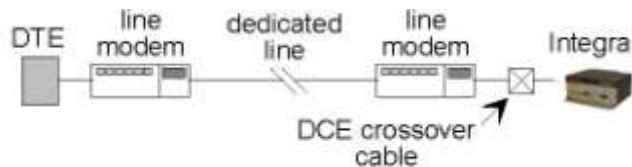
Figure 7 - Point-to-Multipoint System (full-duplex repeater)



2.8.6 EXTENDING A LANDLINE (TAIL CIRCUIT)

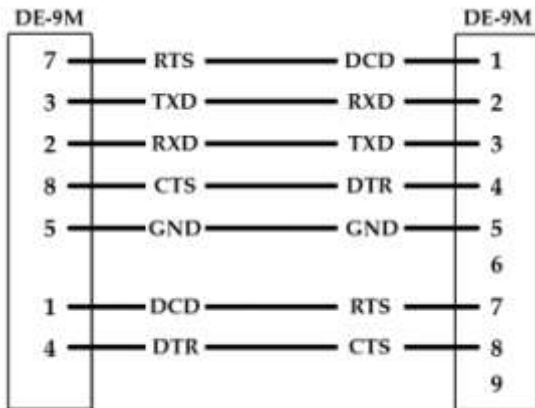
Integra-TR may be used to extend a landline circuit (giving access to difficult locations, etc.). This type of connection is called a “tail circuit” and is shown in Figure 8. The tail circuit assembly may be used in any of the network types described in the preceding sections.

Figure 8 - Landline (Tail Circuit)



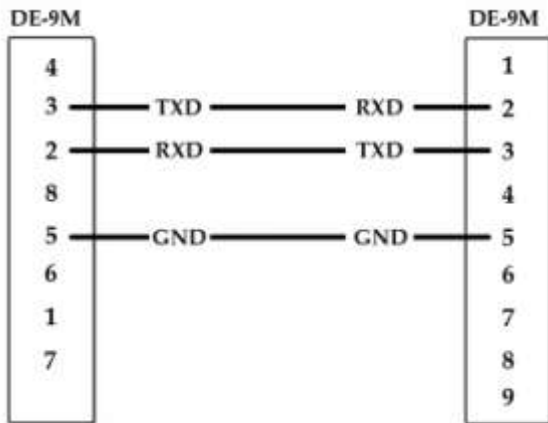
Note: The line modems should be full-duplex units.

Figure 9 - DCE Crossover Cable for RTS-CTS Mode



Some point-to-point FDX landline modems or line drivers may require the use of DOX mode and an alternate pinout for DTR, DCD, CTS and RTS as shown in Figure 10.

Figure 10 - DCE Crossover Cable for DOX Mode



2.9 SPECIFICATIONS

These specifications are subject to change without notice. RF specifications are measured per TIA/EIA-603 with a psophometric baseband filter.

General	VHF	UHF	900 MHz
Frequency	132-174 MHz	380-400 MHz*, 403-512 MHz, 406.1-476 MHz Dual Band	928-960 MHz
Channels	Multi-channel capability under system PLC control		
Channel Bandwidth	6.25, 12.5 or 25 kHz models		
Operating Temperature	-30° to + 60° C		
Supply Voltage	10 - 16 VDC maximum (nominal 13.3) Fuse protected against reverse voltage (internal surface mount 3A fuse: not field replaceable)		
RX Current Drain at 13.3 VDC	<220 mA (with a terminal connected to Integra-TR COM port)		
TX Current Drain at 13.3 VDC	<2.6 A		
Power Saving Mode Current Drain	<20 mA		
Cold Start¹	4 sec (typical)		
Warm Start Rx²	45 to 60 ms (depending on radio model and temperature)		
Warm Start Tx³	55 to 70 ms (depending on radio model and temperature)		
Tx Turn On Time⁴	15 ms (typical)		
RX/TX Bandwidth (without tuning)	18 MHz (132-150) 24 MHz (150-174)	16 MHz except 20 MHz (380-400, 450-470) 34 MHz (406.1-440 Dual) 36 MHz (440-476 Dual)	32 MHz

*380 to 400 MHz frequency band is not FCC or IC type approved

¹Includes 102 cm power cable

Receiver	VHF	UHF	900 MHz
Sensitivity	0.35 μ V for 12 dB SINAD		
Selectivity (25 kHz)	>70 dB minimum >65 dB Minimum UHF Dual Band		> 65 dB minimum
Selectivity (12.5 kHz)	>60 dB minimum >55 dB Minimum UHF Dual Band		>60 dB minimum
Intermodulation	>70 dB minimum		> 70 dB minimum
Spurious Rejection	>70 dB minimum		>70 dB minimum
FM Hum and Noise	<-45 dB max (25 kHz)		<-40 dB max (25 kHz)
Conducted Spurious	< -57 dBm		

¹ Cold Start: Time from DC power applied until unit is fully ready to receive or transmit data

² Warm Start Rx: In power saving modes (sleep or suspend), wake-up time for full receiver recovery

³ Warm Start Tx: In power saving modes (sleep or suspend), wake-up time for full transceiver operation

⁴ Tx Turn On Time: Typical Rx to Tx switching time for stable transmission

Transmitter	VHF	UHF	900 MHz
RF Power Output	1 to 5 Watts, software adjustable		
Spurious and Harmonics	<-57 dBc (-20 dBm)		
Frequency Tolerance	1.5 PPM		
FM Hum and Noise	<-45 dB (25 kHz)		<-40 dB (25 kHz)
Tx Duty Cycle	50%, max. Tx time 30 seconds, extended Tx time with the cooling fan option		

Modem / Logic	
Operation	Simplex / half duplex
Data Bit Rates	25 kHz channel: 4800 b/s, 9600 b/s, 19200 b/s 12.5 kHz channel: 4800 b/s, 9600 b/s 6.25 kHz channel: 2400 b/s, 4800 b/s
Modulation Type	DRCMSK (Differential Raise-Cosine Minimum Shift Keying)
RTS/CTS Delay (RTS mode)	4 ms
Addressing	10 bit station address, 1 bit station type (master / remote)
Bit Error Rate (BER)	12.5 kHz @ 9.6 kbps: -104 dBm, 1x10 ⁻⁶ @ 1.4 μV 25 kHz @ 4.8 or 9.6 kbps: -107 dBm, 1x10 ⁻⁶ @ 1.0 μV 25 kHz @ 19.2 kbps: -100 dBm, 1x10 ⁻⁶ @ 2.3 μV

COM Port	
Interface	EIA RS-232C
Data Rate	1200 - 19200 b/s
Protocol	Transparent, 7 or 8 data bits, 1 or 2 stop bits, even, odd or no parity
Transmit Control	RTS or DOX (data operated transmit)

Setup / Diag Port	
Data Format	Proprietary binary for setup, ASCII for diagnostics
Data Rate	9600 b/s, 8 bit, no parity, 1 stop bit

Analog Inputs	
Interface	Two inputs, 0-10 VDC, 8 bits. May be read only via Offline Diagnostics. Absolute maximum input voltage < 20 Vdc. Inputs are reverse-voltage protected.

Digital Outputs	
-----------------	--

Interface	Two outputs, requires external pull-up to 2 to 10 Vdc. Set via Offline Diagnostics
------------------	--

Display	
4 Bi-color status LEDs	RUN/PWR/ CS/SYN, RX/TX, RD/TD

Connectors	
RF	SMA Female
COM	DE-9F
SETUP/DIAG	DE-9F
Power - I/O	Snap & Lock 4-Pin DC Power Jack

Diagnostics	
Online	Short ID, temperature, B+ voltage, local RSSI, remote RSSI, fwd and rev power, Rx Quality
Offline	As for Online plus: Demodulated Signal Voltage, Analog Input Levels, Digital Outputs

Certifications			
	FCC (6.25 kHz)	FCC (12.5 & 25 kHz)	IC (DOC)
VHF	NP4MCUA5Q 6K00F1D	EOTMCUA5R 9K30F1D, 15K3F1D	773195562A 9K30F1D, 15K3F1D
UHF	NP4MCUB5Q 6K00F1D	EOTMCUB5R 9K30F1D, 15K3F1D	773195561A 9K30F1D, 15K3F1D
UHF Dual Band		NP44048350 9K30F1D, 15K3F1D	773B-4048350 9K30F1D, 15K3F1D
900 MHz	NA	EOTMCUC5R 9K30F1D, 15K3F1D	7731955611A 9K30F1D, 15K3F1D

3 FEATURES AND OPERATION

3.1 OVERVIEW

This chapter describes the connections, indicators, and operating characteristics of the Integra-TR. This chapter is intended for system application and installation personnel.

3.2 FRONT PANEL

The various front panel elements are described in the following sections.



3.2.1 ANTENNA CONNECTOR

Antenna connector is a female 50-ohm SMA- type. Units operated with a “rubber duck” antenna connected directly to the antenna connector may exhibit unusual operating characteristics and high levels of reverse power.

3.2.2 CONNECTION TO DTE

Integra-TR is configured as DCE. Most DTE devices should be connected using a nine-conductor pin-to-pin “straight” cable (CalAmp part number 697-4008-408). Some RTUs or PLCs may require a special cable to route the signals correctly. See the documentation for your data equipment for further information. Contact CalAmp for DTE interface information or review CalAmp’s Technical Services Application Notes available on our website at www.calamp.com.

3.2.3 LED INDICATORS

Integra-TR has four two-color LED indicators. Their functions are shown in Table 3.

Table 3 - LEDs Color Functions***

RUN/PWR	Green	Normal operation
	Flash Yellow and Green	Setup mode or loading new application or new bootloader
	Flash Red	Firmware error*
	Red	CPU or PROM failure*
CS/SYN	Off	No RF RX carrier
	Green	Receive carrier present
	Red	(Reserved)
RX/TX	Off	No RF RX carrier
	Green	Receiving network data
	Yellow	Synthesizer unlocked
	Red	Transmitter is on
RD/TD	Off	Idle
	Green	RX data outgoing from RS-232 port
	Red	TX data incoming at RS-232 port**

* Contact Technical Support

**or buffered in CSMA mode

***LED indicators may be different during startup

3.2.4 COM PORT

DTE baud rates from 1200 to 19200 are supported. Integra-TR's are factory set (default) for 2400 b/s (6.25 kHz) or 9600 b/s (12.5 & 25 kHz), 8 bits, no parity, and 1 stop bit. Unless required by your operating protocol, ***we advise restricting port speed to be equal to or less than the RF network speed.***

Table 4 - COM Port Signals

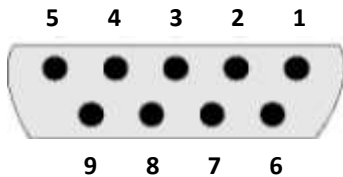
Pin	Name	Function
1	DCD	Output: Always asserted or asserted when receive RF carrier present (selectable via Field Programming Software)
2	RXD	Output: Data from Integra-TR to DTE
3	TXD	Input: Data from DTE to Integra-TR
4	DTR	Input: Ignored
5	GND	Signal and chassis ground
6	DSR	Output: always positive
7	RTS	Input: Used as a "begin transmission" signal in RTS mode
8	CTS	Output: Used for handshaking in RTS mode and used for flow control in DOX mode RTS mode: RTS

		to CTS delay in 4 ms DOX mode: CTS always asserted except when data overflow is detected
9	RI	Not internally connected, reserved

3.2.4.1 CONNECTOR PIN OUT

The DE-9F pin out is shown in Figure 11 for reference.

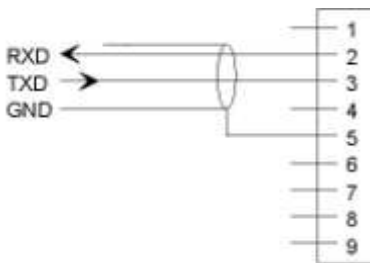
Figure 11 - COM and Setup Port Connectors Pin Locations



3.2.4.2 WIRE CONNECTION (DOX)

For DTE that lack RTS control, Integra-TR can operate in DOX mode (Data Operated Transmit) with only Transmit Data, Receive Data and Ground (“3-wire interface”).

Figure 12 - 3-wire Interface



3.2.5 SETUP PORT

The Setup port uses a DE-9 female connector configured as DCE. Signals are described in Table 5.

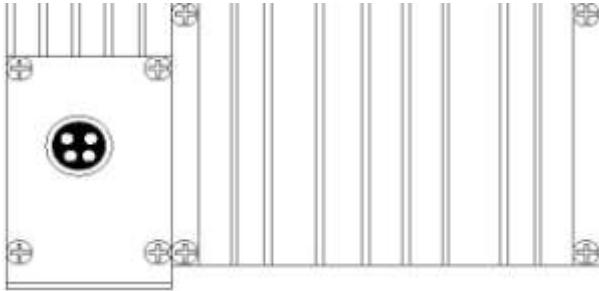
Table 5 - Setup Port Signals

Pin	Name	Function
1	DCD	Tied directly to DTR
2	RXD	Data from Integra-TR to setup PC
3	TXD	Data from setup PC to Integra-TR
4	DTR	Tied directly to DCD
5	GND	Signal and chassis ground
6	DSR	Output: always positive (asserted)
7	RTS	Tied to CTS
8	CTS	Tied to RTS
9	RI	Not internally connected, reserved

The Setup port uses a proprietary communications protocol designed to work with the Integra-TR Field Programming Software program. It is also designed to provide alpha numeric (ASCII) diagnostics information when connected to a PC terminal emulator.

3.3 REAR PANEL

Figure 13 - Integra-TR Rear Panel



The various elements are described in the following sections.

3.3.1 HEAT SINK

The rear panel heat sink is essential for proper operation of the Integra-TR transmitter. The unit must be mounted in a location that permits free air circulation past the heat sink. Cooling will be best if the fins are vertical.

3.3.2 POWER

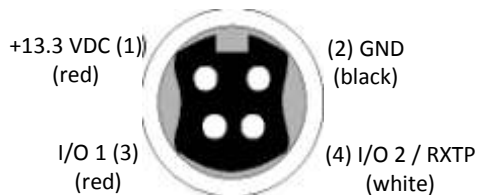
The Integra-TR power requires a regulated power source of 13.3 VDC nominal (10 - 16 VDC max.) negative ground with a 3.0 A rating. An internal surface-mount 3A fuse (not field-replaceable) and a crowbar diode protect the main RF power components from reverse polarity. Application of more than 16 VDC will damage the unit and is not covered by the warranty.

WARNING: Do not exceed 16 VDC.

3.3.3 POWER – I/O CONNECTOR

The 4-pin power/analog connector pin out is shown in Figure 14.

Figure 14 - I/O Connector



Note: The color of the power I/O cable wires are shown in parenthesis. If the I/O connections are not used the green and white wires should be cut back and/or taped to prevent contact (power I/O cable part number 697-4008001 see Table 2).

3.4 INTEGRA-TR FIELD PROGRAMMING SOFTWARE

Figure 15 - Integra-TR Field Programming Software Startup Screen



3.4.1 INTRODUCTION

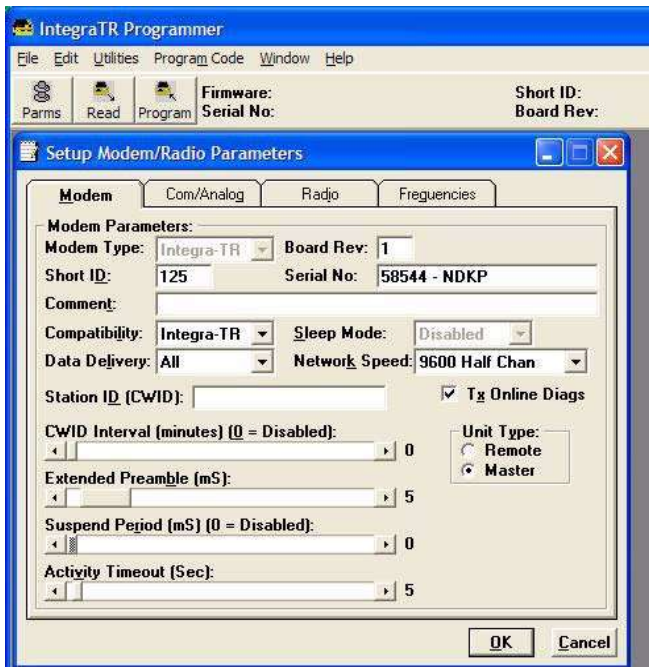
The Integra-TR Field Programming Software is the programming and diagnostics software for the Integra-TR wireless modem. The Field Programming Software allows the user to edit and program user programmable settings, interactively tune modem and RF parameters, and monitor diagnostic data from the Integra-TR. See Figure 15 for the Integra-TR Field Programming Software startup screen.

This manual assumes the Field Programming Software has been installed on the user’s PC with at least one operational serial COM Port available.

3.4.2 SETUP MODEM/RADIO PARAMETERS

The Setup Modem/Radio Parameters screen is accessed from the Edit menu pull-down or from the Parms icon when the tool bar is visible.

Figure 16 - Setup Modem/Radio Parameters Screen



3.4.2.1 MODEM OPERATING PARAMETERS

Setup Modem/Radio Parameters allows the user to view and edit Integra-TR’s programmable parameters. Programming parameters can be stored in a data file with the .DAT file extension. Programmable parameters are used by the Read/Program Parameters screen for programming into nonvolatile memory (see Figure 16). Parameter settings are modified from four screen tabs: the Modem tab, Com/Analog tab, Radio tab and Frequencies tab. When desired parameters in each tab window have been adjusted, select the OK button to store the parameter information into local PC memory and exit the parameter screen. Clicking the Default Parms button sets certain parameters back to factory default settings. Clicking Cancel exits the parameter screen without modifying any parameters currently stored in local PC memory.

Modem operating parameters include:

Modem Type

Modem type displays the type of modem (Integra-TR or Integra OIP). Modem type is a non-programmable parameter.

Board Rev

Board Rev displays the hardware revision of the modem board. Board rev is a non-programmable parameter.

Short ID

A user-defined number (from 1 to 254, 256 to 1023 - 255 is reserved) that identifies an individual unit in a network. *Note: Firmware versions 2.10 and earlier only allow short IDs of (from) 1-254.*

Serial No.

Serial No. displays the serial number for the modem board. Serial No. is a non-programmable parameter.

Comment

Integra-TR Field Programming Software supplies this field for user-convenient description(s): customer name, location, technical info...). Comments can be text up to 24 characters in length, including spaces.

Compatibility

This field selects the compatibility mode (for use with previous versions of Integras).

- Integra-TR - used for networks made up of Integra-TR wireless modems.
- Integra-T/TR - used for "on-air" backward compatibility with the Integra-T for bit rates of 4800 and 9600 b/s (full channel units only).

The Integra-TR is capable of selectable network speeds of 2400 & 4800 b/s for quarter-channel units (6.25 kHz), 4800 and 9600 b/s for half-channel units (12.5 kHz) or 4800, 9600, 19200 b/s for full-channel units (25 kHz). Use the Integra-TR mode whenever feasible.

Sleep Mode

One of the Integra-TR's two low power modes of operation, along with and "Suspend Mode". When Sleep Mode is enabled, the unit is in low power consumption (approximately 15 mA). In Sleep Mode, the Integra-TR cannot detect the presence of a carrier. Only asserting RTS on the COM or Setup ports will wake the unit. It is ready to receive and decode data within 45 to 65 mS (dependent on Integra model and temperature) after wake-up.

Data Delivery

This field determines if data should be delivered to the COM port. Designating a unit as Master or Remote sets a flag in the header identifying the Unit Type of the originating station:

- All - this option causes the unit to accept (on the receive side) all data transmissions.
- Selective - this option causes the unit to accept (on the receive side) data only if it originates from a unit of the opposite Unit Type (i.e., a Master will only accept data from a Remote and a Remote will only accept data from a Master).

Network Speed

Network Speed selects the bit rate of the RF link between units. This can be different from the COM Port baud rate. This setting must be the same for all units in a network.

- 2400 b/s - selectable for quarter channel models Integra-TR only.
- 4800 b/s - selectable for quarter, half- and full-channel models of the Integra-TR and for full-channel models of the Integra-T.
- 9600 b/s - selectable for half- and full-channel models of the Integra-TR and for full-channel models of the Integra-T.
- 19200 b/s - selectable for full-channel models of Integra-TR only.

Tx Online Diags

Transmission of online diagnostics may be enabled or disabled for any unit without affecting its ability to communicate with other units in a network. At the beginning of each data transmission from a unit, diagnostics are delivered locally to the unit's Setup Port regardless of the Tx Online Diags setting. Where continuous data transmissions are required from a Master unit, diagnostics are delivered at 20 second intervals.

Online Diagnostic String Format

In ASCII output mode, the setup port will output a one line diagnostic string each time the unit receives a transmission from another unit. No other data will be output. The string consists of a number of comma-delimited fields terminated by a carriage return. Each field within itself is a constant length, but the fields are not all uniform in length. Field definitions are shown in Table 6.

A typical diagnostic string (0003,+28,13.1,-093,-088,4.7,1,015,015) would be interpreted as: Remote station # 3 reports that:

- Its internal case temperature is +28°C
- Supply voltage is 13.1 VDC
- It is receiving a signal of -93 dBm from the master
- The master is receiving a signal of -88 dBm from station 003
- The forward power is 4.7 watts
- The reverse power is good
- 15 of the last 15 data blocks were received correctly

Table 6 - Diagnostics Information

Name	Length (in bytes)	Description
Short ID	4	1 -1023 (a number from 1 to 254, 256 to 1023)
Temperature	3	Signed value
B+	4	From 6.0 to 18.8 V
Remote RSSI	4	Signal strength received by remote station in dBm
Local RSSI	4	Signal strength for this remote as received by local station in dBm
FWD Power	4	From 0 to 7 watts
Rev Power	1	0 = good 1 = poor
Rx Quality	3	Number of good data blocks received in the last 15
	3	Number of total data blocks detected, maximum 15

Using an External Program for Online Diagnostics

The Setup port communicates with the field programming software using a proprietary protocol. However, if a terminal, or PC running terminal software is connected to the Setup port, online diagnostic information will be delivered in plain ASCII format.

Initialization

When powered on, the Integra will attempt to establish a link with the field programming software. If RTS is not exerted on the setup port, Integra-TR will immediately switch to ASCII mode.

Unit Type

This radio button selects unit type:

- Remote - Select this option to designate the unit as a Remote station
- Master - Select this option to designate the unit as a Master station

Station ID (CWID)

Station ID is used to set the Station ID (CWID) or FCC Call Sign for the system. It is sent out as Morse Code at predetermined intervals. Station ID is a combination of letters (upper-case) and numbers (0 - 9) up to 9 characters in length.

CWID Interval

CWID Interval is used to set the interval of time the unit will transmit the Station ID (CWID) or FCC Call Sign. The range is 1 to 255 minutes in 1 minute intervals, with 0 being disabled. To enable the transmissions of the Station ID (CWID) or FCC Call Sign, a non-zero value must be set for the CWID Interval. Only one unit in a system should be programmed to transmit the Station ID (CWID), typically the Master.

Extended Preamble

This field extends transmitted synchronization time when the unit is used in a network with repeaters. The default is 5 mS and the range is 0 to 100 mS in 5 mS intervals. Add 10 mS for each Repeater an Integra-TR communicates through in a network (dependent on user's protocol).

Note: Units supplied or updated prior to November of 2001 use a default value of 0 mS for Extended Preamble. Extensive testing has shown 5 mS to be the most robust setting. If timing is critical in your application, this value can be set back to 0 mS.

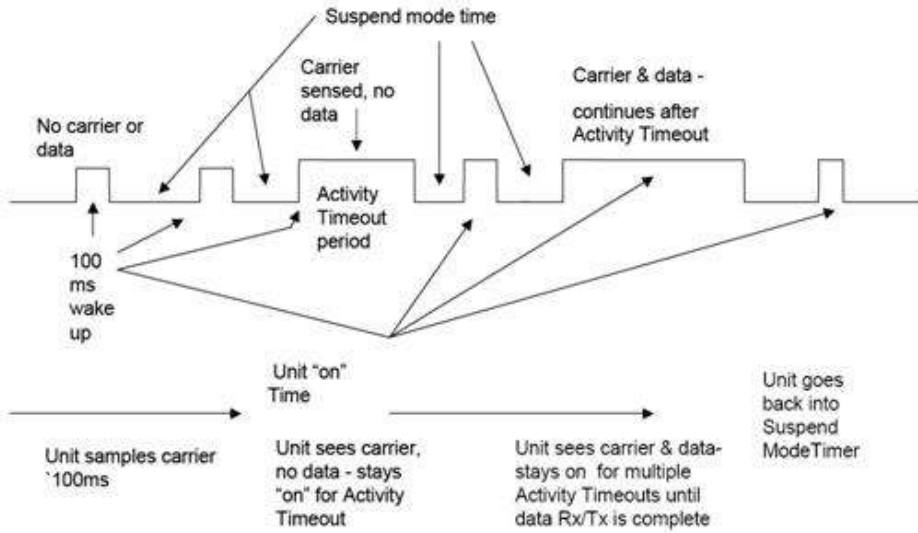
Suspend Period

Suspend Period allows the user to set the length of time the Integra-TR goes to cycled lower power mode. The range for Suspend Period is from 50 to 12,000 mS in 50 mS intervals. Setting this range to a value of 0 disables Suspend Period.

Activity Timeout

Activity Timeout is used to set the minimum length of time the unit will remain awake in the presence of a carrier - range is 1 to 255 seconds in 1 second intervals. This field is active only if Suspend Period is enabled. A non-zero value must be set to enable Suspend Period. The same Activity Timeout and Suspend Period values must be set for both Master and Remote units. See Figure 17 for a Suspend Mode Timing graphic.

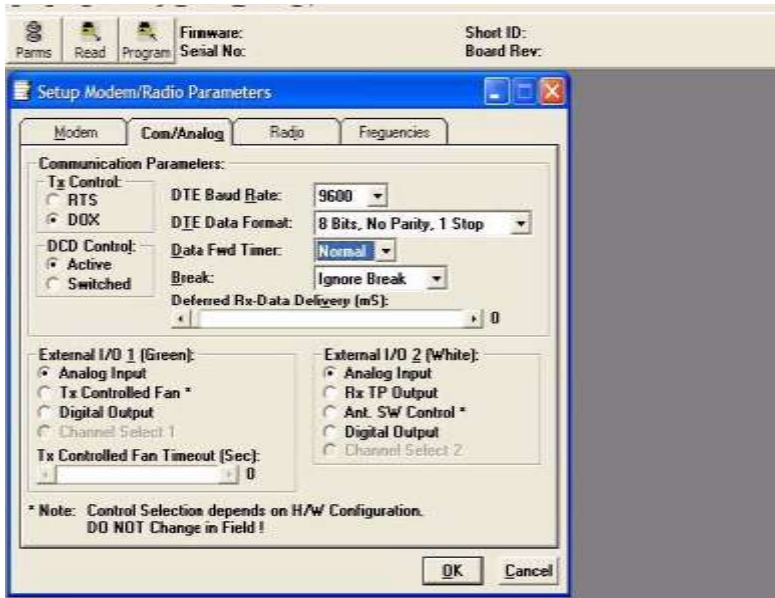
Figure 17 - Suspend Mode Timing



3.4.2.2 COM/ANALOG OPERATING PARAMETERS

The COM/Analog tab allows user programming of various COM Port and External input/output parameters (see Figure 18).

Figure 18 - COM/Analog Setup Parameters Screen



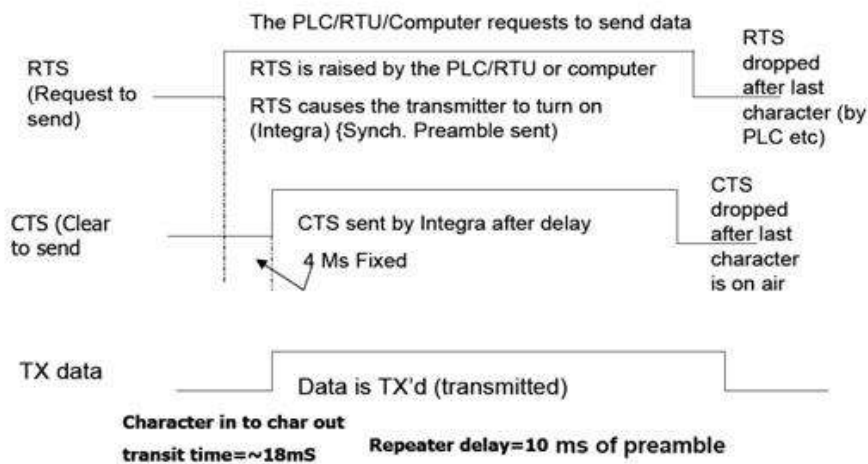
Tx Control

This radio button selects the unit's mode at the beginning of a transmission

- RTS – Request to Send
- DOX – Data Operated Transmit

The Transmit Control default mode is DOX in which the unit begins a transmission as soon as data is presented to the COM Port. The optional mode is RTS in which the unit begins transmission only when the RS-232 RTS input pin of the COM Port is raised and continues transmitting until the RTS is dropped. Selecting RTS also activates the switched option in DCD control (see Figure 18).

Figure 19 - Integra-TR Control Signal Timing



DCD Control

This field selects the mode of the RS-232 DCD (Data Carrier Detect)

- Active - always asserted
- Switched - follows the radio carrier and data sent to DTE

DTE Baud Rate

This field selects the port speed of the COM Port (independent of RF Network Speed)

- 1200
- 2400
- 4800
- 9600
- 19200

For best results, CalAmp recommends using the same rates for both the COM Port and RF Network Speeds. Always have RF network speed equal to or greater than COM Port speed.

DTE Data Format

8 bits, no parity, 1 stop (default)	7 bits, no parity, 1 stop
8 bits, no parity, 2 stop	7 bits, no parity, 2 stop
8 bits, odd parity, 1 stop	7 bits, odd parity, 1 stop
8 bits, odd parity, 2 stop	7 bits, odd parity, 2 stop
8 bits, even parity, 1 stop	7 bits, even parity, 1 stop
8 bits, even parity, 2 stop	7 bits, even parity, 2 stop

Data Fwd Timer

This field selects the timing between data blocks in a transmission to accommodate some RTU's special timing requirements:

- Normal - 15 ms option (default)
- Fast - 5 ms option (do not use for baud rates below 2400 b/s)

Break

This field selects the unit's response to break signals (protocol dependent) on the COM Port:

- Ignore break - unit does not transmit or receive break signals
- Transmit break - unit transmits and receives break signals

Deferred Rx-Data Delivery

This field sets the period of time the unit waits until delivering received data to the COM Port. Range is 0 to 255 ms in 1 ms intervals (keeps delays minimum for protocols susceptible to inter-character delays).

External I/O 1 (Green)

These radio buttons select configuration of Pin 3 on the Power - I/O Connector (green wire):

- Analog Input - Analog input is an option on units not equipped with the cooling fan option - can be used to monitor an external voltage (0 to 10 volts). Monitoring is from the Offline Diagnostics screen
- Tx Controlled Fan - Selecting this option will cause the unit to turn the fan ON at the start of a transmission and OFF after a predetermined timeout (TX Controlled Fan Timeout) at the completion of a transmission. The length of time the fan is on is the length of the transmission plus the timeout time. This option is displayed for versions of firmware that support fan control output based on transmissions (Ver 2.04 and later).
- Digital Output - Digital Output is an option for units not equipped with the cooling fan option. This connection can be used to control the open-collector transistor on the connector. The open-collector output can sink a maximum current of 100 mA when the modem board rev is 0 or 1. The output is controlled from the Offline Diagnostics screen. Figure 22 shows the Field Programming Software interface for Digital I/O.

Digital Output Circuit and Interface Parameters

Hardware setup for the Integra-TR utilizing Digital I/O should be completed following the circuit diagram in Figure 20 and the wire diagram in Figure 21.

Figure 20 - Digital I/O Circuit Diagram

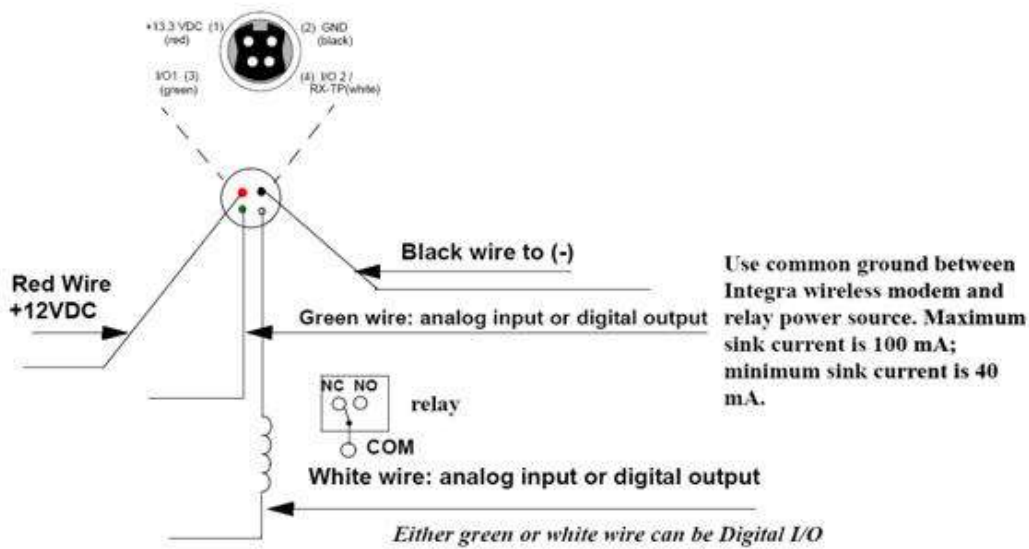
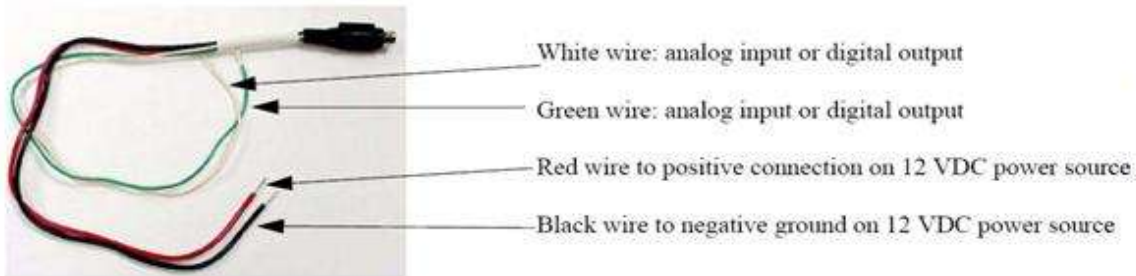


Figure 21 - Integra Power I/O Cable



From COM/Analog Operating Parameters screen (see Figure 18 and Figure 22), select **Digital Output** for the External I/O to be interfaced with user application. Figure 21 shows External I/O 2 (white wire) as chosen Digital Output. If desired, External I/O 1 (green wire) is utilized by choosing External I/O 1. Select **Utilities** from tool bar and select **Offline Diagnostics**. The Offline Diagnostics screen provides the interface to select the Modem ID for the desired Remote Unit. Figure 22 shows 28 as an example. Click **Get Diags** button. External I/O 1 diagnostics shows the output's status. Figure 22 shows External I/O 1 operating at 0.1 volt with External I/O 2 ON (grounded). The External I/O status changes as the selection box is checked. Selection boxes will show and affect changes to selected unit it Modem Select when **Get Diags** is clicked. If Local ID is selected, **Get Diags** will return the status of the local Integra.

Channel Select 1

For use in Integras not equipped with the cooling option - setting this option will configure the connection to be an analog input for 2 or 4 Channel Select Mode. If Channel Select 2 is NOT selected, this input and Channel Select 2 input selects between Channels 1, 2, 3 and 4. A low level (logic 0) is a voltage less than the Channel Select Voltage and a high level (logic 1) is a voltage greater than the Channel Select Voltage. The Channel Select Voltage is selected on the Radio Tab. For 2 Channel Select Mode, see Table 7 "4 Channel Select Mode".

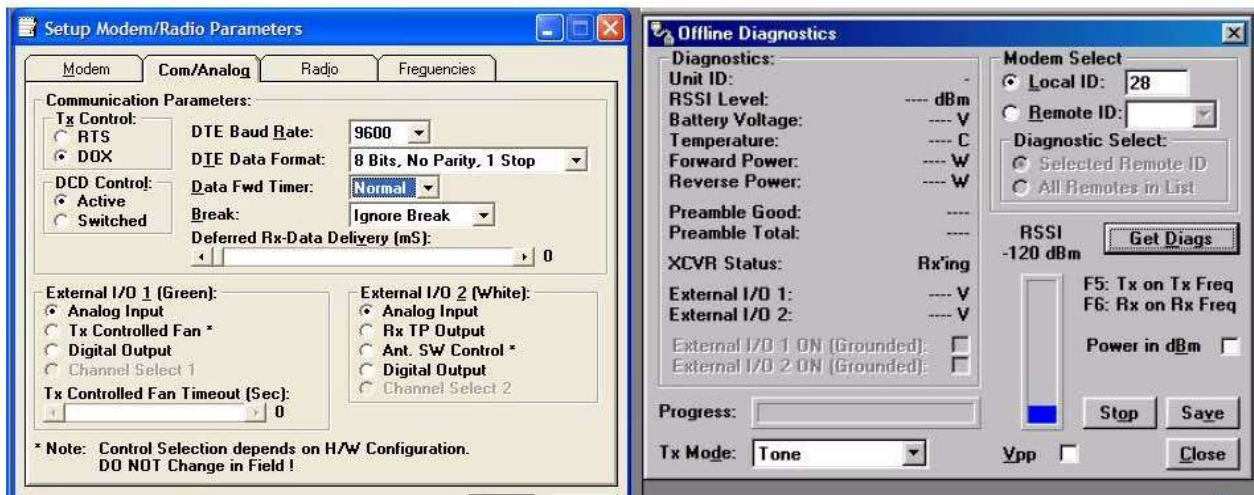
Note: If configured as a Digital Output, the open-collector transistor requires an external pull-up (i.e., resistor) to a voltage of 2 to 10 volts.

Note: Multi-Channel operation is available in modem firmware 2.20 or later.

Tx Controlled Fan Timeout

Tx Controlled Fan Timeout is used to set the interval of time the unit will keep the fan turned ON after a transmission is completed. The range is 5 to 255 seconds in 1 second intervals.

Figure 22 - Integra Field Programming Software Digital I/O Screens



External I/O 2 (White)

These radio buttons select configuration of Pin 4 of the Power - I/O Connector (white wire):

- Analog Input - for use on units not equipped with the cooling option - can be used to monitor an external voltage (0 to 10 volts).
- Rx TP Output - performs as the demodulated signal level test point. The Rx TP level is half of the internal Rx Test Point.
- Ant. SW Control - supports the use of a redundant base station. Ant. SW Control configuration is dependent on hardware configuration and should not be changed in the field.
- Digital Output - This connection can be used to control the open-collector transistor on the connector. The open-collector output can sink a maximum current of 40 mA when the modem board rev is 0 and 100 mA when the modem board rev is 1. The output is controlled from the Offline Diagnostics screen NOTE: When configured as a Digital Output, the open-collector transistor requires an external pull-up (i.e., resistor) to a voltage of 2 to 10 volts.

Channel Select 2

Selecting the Channel Select 2 option will configure the connection to be an analog input for 2 or 4 Channel Select Mode. If Channel Select 1 IS NOT selected, this input selects between Channels 1 and 2. If Channel Select 1 IS selected, this input and Channel Select 2 input selects between Channels 1,2,3 and 4. A low level input and Channel Select 2 input selects between channels 1,2,3 and 4. A low level (logic 0) is a voltage less than the Channel Select Voltage and a high level (logic 1) is a

voltage greater than the Channel Select Voltage. Channel Select Voltage is selected on the Radio Tab. For 2 Channel Select Mode, a low level input will select channel 1 and a high level will select Channel 2. For 4 Channel Select Mode, see Table 7.

Note: When configured as a Digital Output, the open collector transistor requires an external pull-up (i.e., resistor) to a voltage of 2 to 10 volts.

Note: Multi-Channel operation is available in modem firmware version 2.20 and later.

Table 7 - 4 Channel Select Mode

	Channel Select 2	Channel Select 1
Channel 1	low	low
Channel 2	low	high
Channel 3	high	low
Channel 4	high	high

3.4.2.3 RADIO OPERATING PARAMETERS

The Radio tab allows user programming of various radio operating parameters.

Radio

This field designates the radio model.

Range

This field designates radio frequency range.

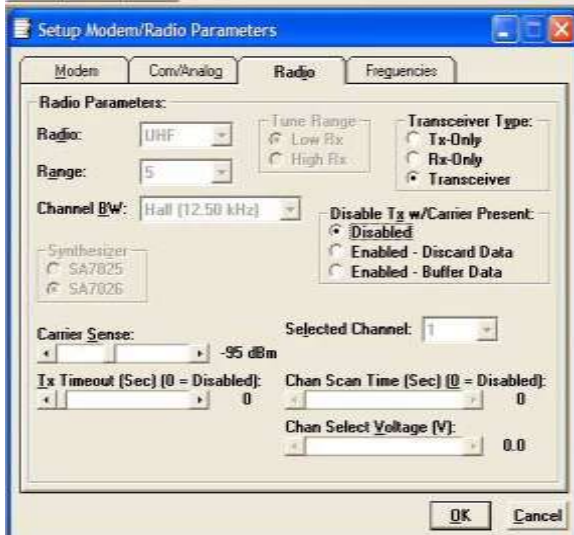
Channel Bandwidth

This field specifies whether the unit is half-channel (12.5 kHz) or full-channel (25 kHz).

Synthesizer

Synthesizer displays the type of synthesizer used on the RF circuit board (SA7025 or SA706).

Figure 23 - Radio Setup Parameters Screen



Tune Range

For UHF Range 0 25 kHz units only: Tune Range allows setting of the Integra-TR to the low or high end of the frequency (242-4048-030: 406.1-422 MHz Low Rx, 242-4048-031: 414-430 MHz High Rx).

Transceiver Type

These radio buttons configure the transmitting and receiving characteristics of the unit according to the type of network application:

- Tx Only - For use in a full-duplex application to disable receptions on the unit used as the transmitter. Tx Only designation pre-loads the synthesizer and allows faster attack time to speed up transmission response.
- Rx Only - For use in a full-duplex application to disable transmissions on the unit used as the receiver. Rx Only designation prevents accidental transmissions.
- Transceiver - For use in all other applications.

Disable Tx w/Carrier Present

The Disable Tx w/Carrier Present provides the following options to configure unit reaction to an RF carrier presence when a transmission is to begin:

- Disabled - Select this option to instruct the unit to **allow** a transmission when a carrier is present.
- Enabled (Discard data) - Select this option to instruct the unit **not to allow** a transmission if a carrier is present. Any user data the unit receives on the COM Port while a carrier is present, is ignored and discarded.
- Enabled (Buffer data) - Select this option to instruct the unit **not to allow** a transmission if a carrier is present. Any user data the unit receives on the COM Port while a carrier is present is buffered and sent when the carrier is no longer present.

Carrier Sense

Denotes the RSSI level when the unit senses a carrier. Carrier Sense is used for data recovery, in the interpretation of diagnostics, and to turn on the front panel CS LED. The threshold may be raised to prevent false Carrier Sense operation in

the presence of noise, inter-modulation, or other sources of interference (i.e. for ambient noise at -100 dBm, set the Carrier Sense for -95 dBm).

Tx Timeout

Tx Timeout is used to set maximum period of time the unit will allow in a transmission. The range is 0 to 120 seconds in 1 second intervals (0 being disabled). Tx Timeout is used to protect both the unit and the network in case a transmitter becomes stuck on the air. For Integra-TRs equipped with the cooling option for extended transmit applications, the Tx Timeout must be disabled. **Warning:** Disabling the timer may disrupt the network or damage the unit should it become stuck in transmit due to excessive user data received on the COM port or the if the RTS signal remains active.

Selected Channel

This field allows the user to choose a selected channel pair for receiving and transmitting. Allowable entries are 1 to 16. The selected channel will be used if Channel Select 1 and Channel Select 2 are NOT selected. (COM/Analog Tab). Note: This feature is disabled when a Channel Select Line is enabled (green or white wire).

Chan Scan Time

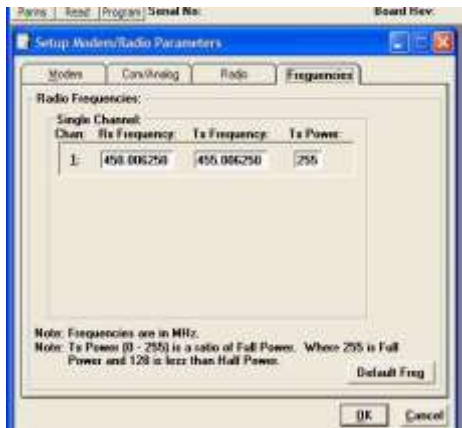
Channel Scan Time allows the user to configure the modem to switch (increment from the Selected Channel) to a new channel if it has not received a valid data packet for this programmable time. This is programmable in steps of 20 seconds (60 to 5000 seconds, or 1 to 83 minutes). Setting Chan Scan Time to zero disables channel scan operation and the modem remains on the selected channel. Note: This feature is disabled when Sleep/Suspend Period is enabled, when Master Mode is enabled or when a Channel Select Line is enabled (green or white wire).

Chan Select Voltage

Chan Select Voltage allows the user to determine voltage thresholds for Channel Select 1 (green) and Channel Select 2 (white) inputs (if programmed). A low level (logic 0) is a voltage less than the set voltage threshold and a high level (logic 1) is a voltage greater than the set voltage threshold. Note: Multi-Channel operation is available in modem firmware version 2.20 and later.

3.4.2.4 SETUP MODEM/RADIO PARAMETERS: FREQUENCIES TAB

Figure 24 - Frequencies Tab



The Frequencies Tab allows the user to program the radio channels (Frequency Pairs).

Rx Frequency

Rx Frequency designates channel receive frequency.

Tx Frequency

Tx Frequency designates channel transmit frequency. There are 6 VHF splinter channels available for quarter-channel VHF (6.25 kHz) Integras. The frequencies for these splinter channels are:

- 154.456250 MHz
- 154.463750 MHz
- 154.471250 MHz
- 154.478750 MHz
- 173.203750 MHz
- 173.396250 MHz

Caution: If an Integra-TR is programmed on a splinter channel, care must be taken not to perform a Read and a Program with Field Programming Software Version 2.05 or earlier. Users with splinter frequencies should confirm that they are using Version 2.06 or later. To download the newest version, visit our website at www.calamp.com.

Tx Power

This field designates the channel pair Power Output Adjust value. The default value is 255 (5 watts). This value should be left at the default value unless lower power is required to meet regulatory requirements, to increase the allowable transmit duty cycle or to reduce transmit power. As the output is adjusted downward (less RF output power) the overall current requirements of the Integra are lessened. When optimizing a system for operational parameters such as RF coverage and over all power (current) usage, the correct amount of RF power needed for coverage may actually be less than full (5 watts) output. This in turn can lower overall power (current) needs of the wireless modem.

NOTE: Power does not vary linearly with this parameter so some experimentation may be required to determine the correct power setting.

3.4.3 VERSION REQUEST

The Select Version Reset utility is accessed from the Edit pull-down menu. Selecting Version Request causes the Integra-TR Field Programming Software to display information about the version of the Integra-TR hardware and firmware (see Figure 25).

Figure 25 - Version Request Screen



3.4.4 LIST INFORMATION

The List Information utility is accessed from the Edit pull-down menu. List Request is a diagnostic tool for the modem's firmware. The information is used if interfacing with Technical Services is necessary (See Figure 26).

Figure 26 - List Request Screen



3.4.5 APPLY INTEGRA RESET

The Apply Integra Reset utility is accessed from the Edit pull-down menu. Integra Reset tells the Integra-TR to perform a software reset. Performing a Station Reset reacts the same as cycling power to the unit (see Figure 27).

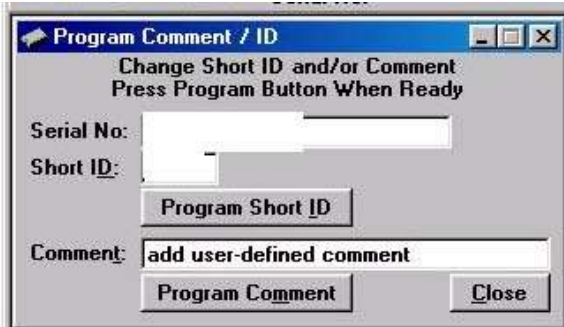
Figure 27 - Reset Screen



3.4.6 PROGRAM COMMENT/ID

The Program Comment/ID utility is accessed from the Edit pull-down menu. The Program Comment/ID field allows the user to program a Short ID and/or Comment. This function is used if the Integra-TR to be programmed was cloned from another unit (See Figure 28).

Figure 28 - Program Comment/ID Screen



Short ID

A number (from 1 to 254 and 256 to 1023 - 255 is reserved) that identifies an individual unit in a network.

Program Short ID

Clicking this button programs the new Short ID.

Comment

This field allows the user to give each unit a unique description (s), or add customer name, location, technical information, or other user desired information. Comments must be text and are limited to 24 characters, including spaces.

3.4.7 PROGRAM PARAMETERS

Figure 29 - Program Parameters



Program Parameters allows the user to program the currently loaded programmable parameters to the Integra-TR (the ID Number, Comment and Remote/Master settings are extracted from the fields on the screen). This option can be used for programming the same Data File (.DAT) into multiple modems (if .dat file is imported into the parameters field, the Short

ID, Comment and Remote/Master settings will be changed - verify correct ID, Comment and Remote/Master BEFORE clicking OK). At the completion of programming, the ID Number will automatically be incremented.

3.4.8 READ PARAMETERS

The Read Parameters function allows the user to view the programmable parameters that are currently programmed in the Integra-TR.

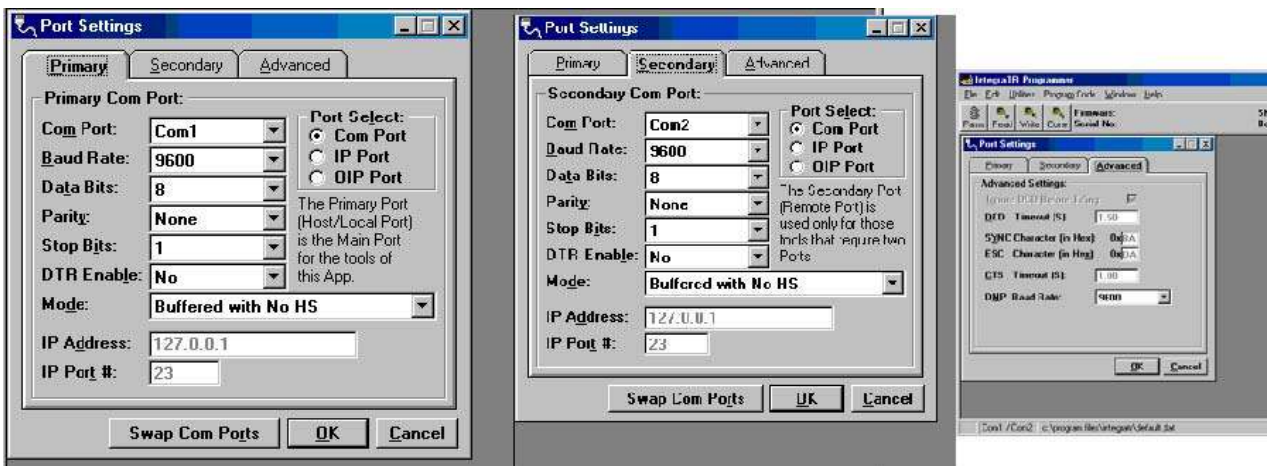
3.4.9 COPY PARAMETERS

The Copy Parameters function allows the user to write the currently loaded programmable parameters to the Integra-TR (including the ID Number, Comment and Remote/Master Settings).

3.4.10 COM PORT SETTINGS

Integra-TR programming is done through the PC's Primary COM Port. Primary and secondary COM ports are configured with the Field Programming Software. The programming cable (included in the Programming Kit - DRL part number 250-4008-001) is connected from the Setup Port on the Integra-TR to the PC's COM port configured as the Primary Port. The Port Settings screen of the Field Programming Software is accessed via the Utilities pull-down menu (see Figure 30). The Port Settings screens are used to configure the PC's serial COM Ports. COM Port parameters are defined in 2.4.2.1. COM Port assignments are displayed in the bottom status bar of the Integra-TR Field Programming Software screen.

Figure 30 - Port Settings Screen



3.4.10.1 PRIMARY COM PORT PARAMETERS

COM Port

Selects COM Port number (COM 1-4) for the Primary and Secondary COM ports (see Figure 30).

Baud Rate

Selects the communication speed for Primary and Secondary COM Ports.

Data Bits

Selects the number of data bits (7 or 8) transmitted or received for the Primary and Secondary COM Ports.

Parity

Selects transmission or reception of any Parity Bits for the Primary and Secondary COM Ports.

Stop Bits

Selects number of Stop Bits (1 or 2) transmitted or received for the Primary and Secondary COM Ports.

DTR Enable

Used to assert DTR (Data Terminal Ready) line of the RS232 Port when the port is open for the Primary and Secondary COM Ports.

Mode

See Section 3.4.2.2.

IP Address

IP Address allows selection of an IP Address when IP Port is selected.. The Ethernet-to-RS-232 converter with this IP Address must have a TCP (Telnet) server enabled.

IP Port

IP Port Number allows the user to select the IP Port number used if the Port Select has IP Port selected. This is the Port Number that will be used to make a TCP (Telnet) connection.

Port Select

Port Select allows the user to choose data transmissions and receptions on a specified RS-232 COM port or an Ethernet adapter via TCP (Telnet).

Com Port - System data will be transmitted and received using the specified RS-232 COM port.

IP Port - System data will be transmitted and received over the Ethernet to a specified IP address and port number using the TCP (Telnet) protocol. Select this option if an Ethernet to RS232 converter is implemented for the unit under test.

OIP Port - Feature not accessible with standard Integra-TR.

Swap COM Ports

Selecting the Swap Com Ports button moves the Secondary COM Port settings to the Primary COM Port (and moves the Primary COM Port to the Secondary settings). Since Integra-TR programming is done through the Primary COM Port, this is useful when two units are connected to the Primary and Secondary COM Ports. A Swap COM Ports allows the second unit to be programmed without switching programming cables. Swap COM Ports is also selectable from the Utilities drop-down menu.

3.4.10.2 PRIMARY AND SECONDARY PORT SETTINGS COMMUNICATIONS MODES

The Utilities drop down menu provides the tool to configure the communications mode for the Primary and Secondary PC Port. See Table 8 for Communication Mode configurations.

Table 8 - Communications Mode

Mode	Description
Sync/ESC with No HS	Sends data using Sync/byte-stuffing protocol without handshaking.
Buffered with No HS	Sends buffered data without handshaking (this mode required for DOX operation.)
Sync/Esc with RTS/CTS HS	Sends data using the Sync/Esc byte-stuffing protocol with RTS/CTS hardware handshaking.
Buffered with RTS/CTS HS	Sends buffered data with RTS/CTS hardware handshaking.
Sync/Esc with Flow Control HS	Sends data using the Sync/Esc byte-stuffing protocol with flow control handshaking.
Buffered with Flow Control HS	Sends buffered data with flow control hardware handshaking.

3.4.10.3 ADVANCED PORT SETTINGS

Ignore DCD Before Tx'ing

Ignore DCD before Tx'ing allows the user to check for an inactive DCD before transmitting. If selected, no data is sent until DCD becomes active.

DCD Timeout

If Ignore DCD Before Tx'ing is selected, DCD Timeout determines the length of time to wait for DCD to become inactive before data is sent. If the DCD does not become inactive during this time, the data is not sent.

SYNC Character SYNC Character allows the user to select the SYNC character when utilizing a Sync/Esc (Framing) Mode. The Sync Character is the first character of a frame to be sent. This character is a HEX character.

ESC Character

ESC Character allows the user to select the ESC character when utilizing a Sync/Esc (Framing) Mode. The ESC Character precedes any embedded SYNC or ESC characters that follow the initial SYNC character. This character is a HEX character.

CTS Timeout

CTS Timeout selects the RTS to CTS timeout when using an RTS/CTS hardware handshaking mode. This is the amount of time (in 50mS increments) the software will allow for the CTS line to become active after asserting the RTS line.

TCP/IP Response

The TCP/IP Response allows the user to select the Response Time (in seconds) to allow for the Unit to respond to Programming Commands over a TCP/IP Connection. The value of this may require the use of the About Utility. By pinging the destination IP Address, the utility will give back Minimum / Maximum / Average Times it takes to send and receive a packet over the TCP/IP Connection. A safe value will be to use the Maximum Time (in seconds).

DMP Baud Rate

DMP Baud Rate selects the communication speed for the Primary and Secondary COM Ports when using the DMP protocol. This protocol is used to talk to the Integra modems through the Setup Port.

SYNC/ESC Framing

A typical SYNC/ESC frame will look like the following character stream.

SYNC	ML	Data0	-----	DataN	Chksum
8 bits	8 bits	8 bits	-----	8 bits	8 bits

And the following definitions are made:

SYNC (8 bits)

Marks the start of a frame when not preceded by an ESC character. When using a Sync/Esc (Framing) Mode, the software will stuff this character automatically.

ML (8 bits)

The length of frame is given by ML. ML is the number of characters left to be received including the checksum but excluding any ESC characters added as part of the protocol. When using a SYNC/ESC (Framing) Mode, the software will stuff this character automatically (based on the number of data characters).

Data 0 - N (8 bits each)

Frame information.

Chksum (8 bits)

This is the 8 bit 2s complement of the sum of the frame less the SYNC character and any additional ESC characters added (ignoring the carry out of the high order bits. When using a SYNC/ESC (Framing) Mode, the software will stuff this character automatically.

3.4.11 SWAP COM PORTS

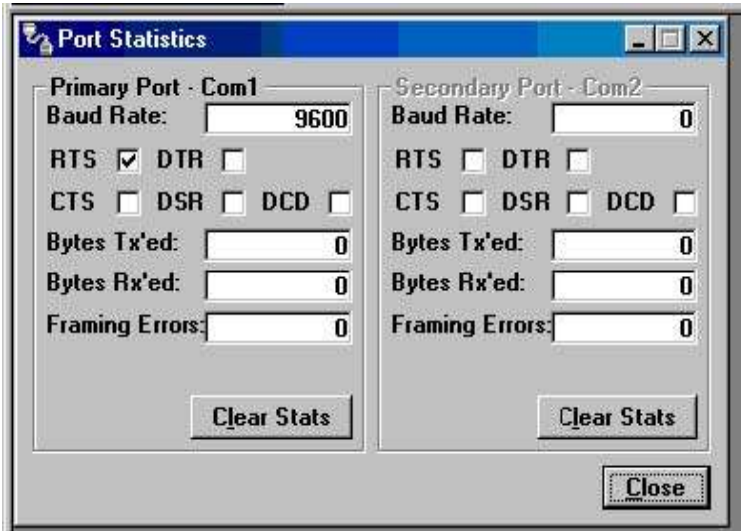
Selecting Swap Com Ports from the Utilities drop-down menu moves the Secondary COM Port settings to the Primary COM Port (and moves the Primary COM Port to the Secondary settings). Since Integra-TR programming is done through the Primary COM Port, this is useful when two units are connected to the Primary and Secondary COM Ports. A Swap COM

Ports allows the second unit to be programmed without switching programming cables. Swap COM Ports is also selectable from the Port Settings Primary and Secondary Port screens.

3.4.12 PORT STATISTICS

Port Statistics are accessed from the Utilities pull-down menu and show the current parameters of the PC's Primary and Secondary COM ports.

Figure 31 - Port Statistics Screen



Baud Rate

Baud Rate shows the current setting for the utilized COM port.

RTS

RTS shows the current state of the RTS (request to send) line. RTS is an output from the PC.

DTR

DTR shows the current state of the DTR (data terminal ready) line. DTR is an output from the PC.

CTS

CTS shows the current state of the CTS (clear to send) line. CTS is an input to the PC.

DSR

DSR shows the current state of the DSR (data set ready) line. DSR is an input to the PC.

DCD

DCD shows the current state of the DCD (data carrier detect) line. DCD is an input to the PC.

Bytes Tx'ed

Bytes Transmitted shows the number of bytes (characters) transmitted since the port was last opened.

Bytes Rx'ed

Bytes Received shows the number of bytes (characters) received since the port was last opened.

Framing Errors

Framing Errors shows the number of Framing Errors received since the port was last opened.

3.4.13 OFFLINE LINK TEST

The Offline Link Test utility is accessed from the Utilities pull-down menu. The Offline Link Test is used to test the link between two units: the local unit interfaced to the computer and a remote unit. Blocks of data are transmitted to the remote unit and the remote unit decodes and returns them. The transmitted and received blocks of data are compared and the ratio of the results is calculated. **NOTE: An Offline Link Test requires suspension of user network operation.**

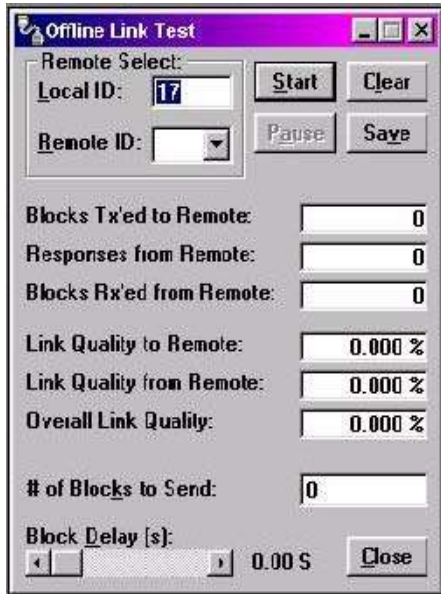
Local ID

The Local ID is the Short ID of the unit connected to the computer.

Remote ID

The Remote ID combo box allows selection of the unit (by choosing its Remote ID) from which the Link Test information is gathered. Remote IDs are set up in the Diagnostic IDs and Alarms Screen.

Figure 32 - Offline Link Test Screen



An Offline Link Test returns the following statistics:

Blocks Tx'ed to Remote

Blocks Tx'ed to Remote displays the number of data blocks transmitted to the remote unit.

Responses from Remote

Responses from Remote displays the number of responses heard from the remote unit.

Blocks Rx'ed from Remote

Blocks Rx'ed from Remote displays the number of data blocks received from the remote unit.

Link Quality to Remote

Link Quality to Remote displays the receive quality of the remote unit; the number of correctly decoded transmissions received by the remote divided by the number of total transmissions detected by the remote (in %).

Link Quality from Remote

Link Quality from Remote displays the ratio of data blocks received to data blocks transmitted (in %).

Overall Link Quality

Overall Link Quality displays the overall link quality by combining the Link Quality to Remote ratio with the Link Quality from Remote ratio (in %).

of Blocks to Send

of Blocks to Send allows the user to determine the number of blocks to send before stopping (with 0 being disabled).

Block Delay (s)

Block Delay (s) allows the user to determine the delay between the transmission of data blocks in 0.25 second intervals (0.00 to 10.00 seconds).

Clear

Clear allows the user to clear the display (blocks transmitted, responses received, blocks received and link quality).

Start

Start is used to begin the test.

Pause

Pause is used to pause the test and allows the user to resume the test at a later time.

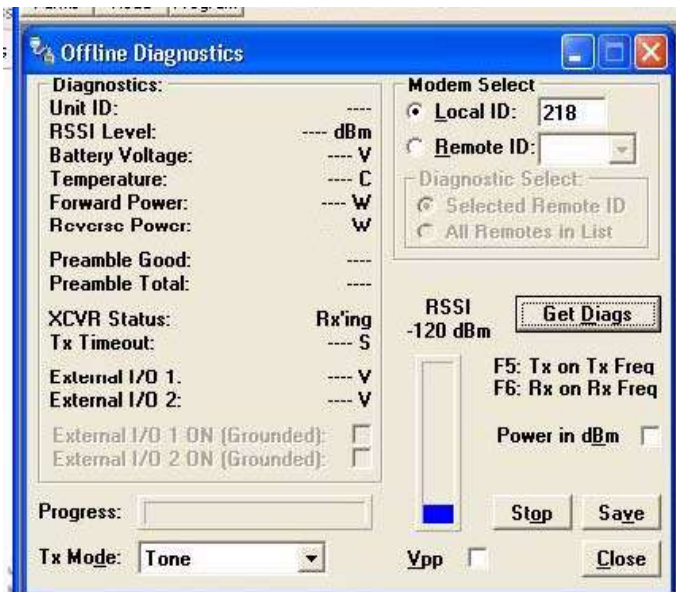
Save

The Save button allows the user to save the current Offline Link Test results to a file.

3.4.14 OFFLINE DIAGNOSTICS

Offline Diagnostics are accessed from the Utilities pull-down menu. Offline Diagnostics are returned from a local or remote unit in response to a Get Diags request (see Figure 33). An Offline Diagnostics request requires suspension of user network operation.

Figure 33 - Offline Diagnostics Screen



Offline Diagnostics parameters include the following:

- Unit ID: the Short ID of the unit sending diagnostics.
- RSSI Level: Received Signal Strength Indication (in dBm).
- Battery Voltage: supply voltage.
- Temperature: internal case temperature (in Celsius).
- Forward Power: Forward Power (in watts or dBm).
- Reverse Power: Reverse Power (in watts or dBm).
- Preamble Good: the number of correctly decoded transmissions received in the last 15. Used with Preamble Total, this serves as an indication of how well the unit is receiving data.
- Preamble Total: the number of total transmissions detected, maximum is 15. Used with Preamble Good, this serves as an indication of how well the unit is receiving data.
- XCVR Status: displays the status of the transceiver.
- Tx Timeout: A request for a remote unit to transmit causes the unit to transmit on the programmed transmit frequency until the Tx Timeout Timer expires. Program the Tx Timeout Timer in the Setup Modem/Radio Parameters/Radio Tab.
- Progress: The Progress panel shows the progress of the Get Diags request.
- Tx Mode: The Tx Mode combo box allows the user to select different transmit modes when the unit is told to transmit:
 - Tone: the unit will transmit a 1200 Hz tone.
 - Mod Balance: the unit will transmit a 100 Hz square wave.
 - Random Data: the unit will transmit random data.
 - No Modulation: the unit will transmit with no modulation.
- External I/O 1 (Pin 3 - Green Wire): When the I/O 1 connection of the Power - I/O Connector is configured as a Digital Output, External I/O displays the state of the open-collector transistor (ON-Grounded/OFF-Open). If configured as an Analog Input, External I/O displays the voltage on the connector (in volts). Programming of External I/O 1 is performed in the Setup Modem/Radio Parameters screen.
- External I/O 2 (Pin 4 - White Wire): When the I/O 2 connection of the Power - I/O Connector is configured as a Digital Output, this displays the state of the open-collector transistor (ON - Grounded / OFF - Open). If configured as Analog Input, External I/O 2 displays the voltage on the connector (in volts). Programming of the External I/O 2 is performed in the Setup Modem/Radio Parameters screen.
- External I/O 1 ON (Grounded): When the I/O 1 connection of the Power - I/O Connector is configured as a Digital Output, this checkbox is enabled to allow for the change of state of the open-collector output of Pin 3. Clicking on this check box causes immediate action to change the state of the output. This is true for local or a selected remote ID.
- External I/O 2 ON (Grounded): When the I/O 2 connection of the Power - I/O Connector is configured as a Digital Output, this checkbox is enabled to allow for the change of state of the open-collector output on Pin 4. Clicking on this check box causes immediate action to change the state of the output. This is true for local or a selected remote ID.

Modem Select

Local ID

The Local ID button allows the user to send commands to the local unit (the unit interfaced to the computer). The Short ID for this unit is shown.

Remote ID

The Remote ID button allows the user to send diagnostic commands to any specific remote unit and obtain its diagnostic information. The Remote ID is selected from the list of Remote IDs set up in the Diagnostic IDs and Alarms screen.

Diagnostic Select / Selected Remote ID

This button allows the user to gather Offline Diagnostics from the selected Remote ID only.

Diagnostic Select / Remote ID List

This button allows the user to gather Offline Diagnostics from all the IDs in the list of Remote IDs (including the local unit).

Get Diags

The Get Diags button allows the user to send the command for Offline Diagnostics. The command is sent to the unit connected to the computer if the Local ID button is selected. The command is sent to the selected Remote ID if the Remote ID and Selected Remote ID buttons are selected. The command is sent to the list of Remote IDs if the Remote ID and Remote ID List buttons are selected.

Stop

The Stop button allows the user to stop any commands for Offline Diagnostics from being sent.

Save

The Save button allows the user to save the current Offline Diagnostics to a text file.

RSSI/Pwr

The RSSI/Pwr panel shows the current RSSI level (in dBm) while the local unit is receiving and the current Power Level (in watts or dBm) while the local unit is transmitting.

Rev Pwr

The Rev Pwr check box allows the user to view the reverse power instead of forward power while the local unit is transmitting.

F5

Pressing the F5 key will cause the unit to transmit on the programmed transmit frequency.

F6

Pressing the F6 key will cause the unit to go to receive on the programmed receive frequency.

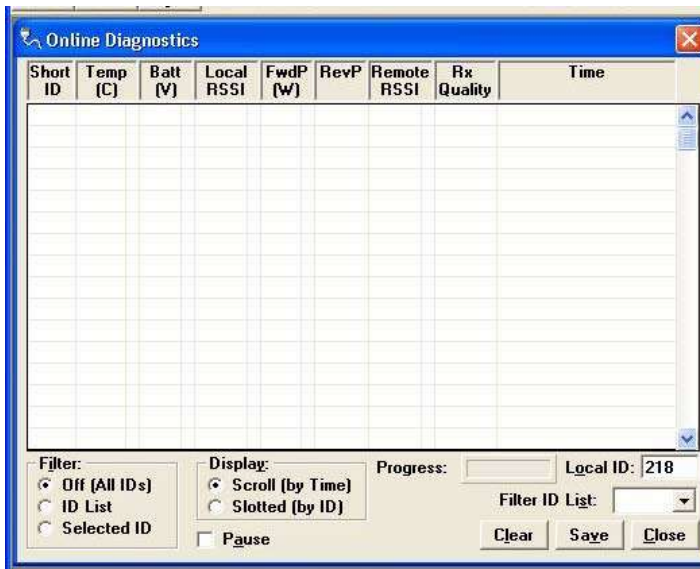
Note: Commanding a remote unit to transmit will cause the unit to transmit on the programmed transmit frequency until the Tx Timeout Timer expires. Be sure to program the Tx Timeout Timer in the Setup Modem/Radio Parameters Screen (see Figure 16).

3.4.15 ONLINE DIAGNOSTICS

Online Diagnostics are accessed from the Utilities pull-down menu. Online Diagnostics are transmitted by each unit in a network before the user’s data is transmitted. All units must be programmed with the Online Diagnostics parameter found on the Setup Modem/Radio Parameters screen to receive Diagnostics from a system. The unit that the computer is interfaced with will output Online Diagnostics as they are received. Using Online Diagnostics does not require suspension of network operation.

Online Diagnostics are subject to alarm conditions defined in the Diagnostic IDs and Alarms screen (see Figure 34). When Online Diagnostics are received and a diagnostic field falls outside the alarm limits, a “<” character will designate a value less than the low alarm and a “>” character will designate a value greater than the high alarm.

Figure 34 - Online Diagnostics



The following Online Diagnostics are gathered:

- **Short ID:** The Short ID displays the Short ID of the unit transmitting the diagnostics.
- **Temp:** Temp displays the internal case temperature (in Celsius) of the unit transmitting the diagnostics.
- **Batt:** Batt displays the supply voltage (in volts) of the unit transmitting the diagnostics.
- **Local RSSI:** If these are the diagnostics from a Remote Station, Local RSSI indicates the RSSI level of the Local Station obtained by the Remote Station transmitting these diagnostics. If these are the diagnostics from the Local Station, Local RSSI indicates the RSSI level of the Local Station from the last transmission of a Remote Station.
- **FwdP:** FwdP displays the forward power (in watts) of the unit transmitting the diagnostics.
- **RevP:** RevP displays the approximate measure of reverse (reflected) power of the unit transmitting the diagnostics. This is represented as “Good” if the reverse power is within acceptable limits and is represented as “Bad” if the reverse power is too high. The threshold is set to approximately 1/4 the forward power.
- **Remote RSSI:** If these are the diagnostics from a Remote Station, Remote RSSI indicates the RSSI level of the Remote Station from the last received transmission. If these are diagnostics from the Local Station, Remote RSSI indicates the RSSI level of the Remote Station last received at the local Station.
- **Rx Quality:** Rx Quality displays the receive quality (in %) of the remote unit. This is the number of correctly decoded transmissions received (in the last 15) divided by the number of total transmissions detected.

Time

Time is the time stamp when the diagnostics were received.

Filter

Filter allows the user to filter Short IDs. The following options are available:

- Off (All IDs): no IDs are filtered out.
- ID List: only the IDs in the Filter ID List are shown.
- Selected ID: only the selected ID in the Filter ID List is shown.

Display

Display allows the user to format on screen data. The following options are available:

- Scroll (by time): displays the diagnostics as they are received.
- Slotted (by ID): sorts the diagnostics by Short ID. Using this option, each Short ID will have one row of diagnostics, showing the most recent.

Progress

The Progress panel shows the sorting progress of the diagnostics if a filter was changed.

Local ID

The Local ID is the Short ID of the unit interfaced with the PC.

Filter ID List

Filter ID List is a listing of Remote IDs setup in the Diagnostic IDs and Alarms Screen. This list is used for selecting a filter.

Pause

The Pause button allows the user to pause the reception of the diagnostics for scrolling through the grid.

Clear

The Clear button allows the user to clear the display and current Online Diagnostics.

Save

The Save button allows the user to save the current Online Diagnostics to a file. A maximum of 4096 lines of data can be saved.

3.4.16 DIAGNOSTIC IDS AND ALARMS

The Diagnostics IDs and Alarms utility is accessed from the Utilities pull-down menu. The Diagnostics IDs and Alarms screen allows the user to set up the ID List for use with the Offline Link Test, and Offline and Online Diagnostics as well as Alarms for use with Online Diagnostics.

Figure 35 - Diagnostic IDs and Alarms Screen



ID Entry and List

ID Entry: Allows the user to add Short IDs to the ID List. The range of this field is 1 to 1023 (ID 255 is reserved). A Short ID is added to the ID list by hitting Enter or by pressing the Add ID button.

ID List: Allows the user to select a Short ID from the list to delete. A Short ID is deleted from the list by pressing the Delete ID button.

IP Address:

IP Address allows the user to receive diagnostics through a serial to Ethernet converter with this IP Address. Default allows the user to select a default unit for the diagnostics when received through a serial to Ethernet converter.

Alarms for Online Diagnostics

Alarm indications are available with Online Diagnostics. When Online Diagnostics are received and a diagnostic field falls outside the Alarm limits, a "<" character will designate a value less than the low Alarm and a ">" character will designate a value greater than the High Alarm (See Figure 35).

Low/High RSSI: Low/High RSSI represent the low and high limits for the RSSI diagnostics (in dBm).

Low/High Temp: The Low/High Temp represents the low and high limits for the temperature diagnostics (in degrees C).

Low/High Batt: Low/High Batt represents the low and high limits for the battery voltage diagnostics (in volts).

Low/High Fwd Pwr: Low/High Pwr represents the low and high limits for the forward power diagnostics (in watts).

Open

The Open button allows the user to load Diagnostic IDs and Alarms from a previously saved file.

Save

The Save button allows the user to save the current Diagnostic IDs and Alarms to the current file.

Save As

The Save As button allows the user to save the current Diagnostic IDs and Alarms to a name different than the current file.

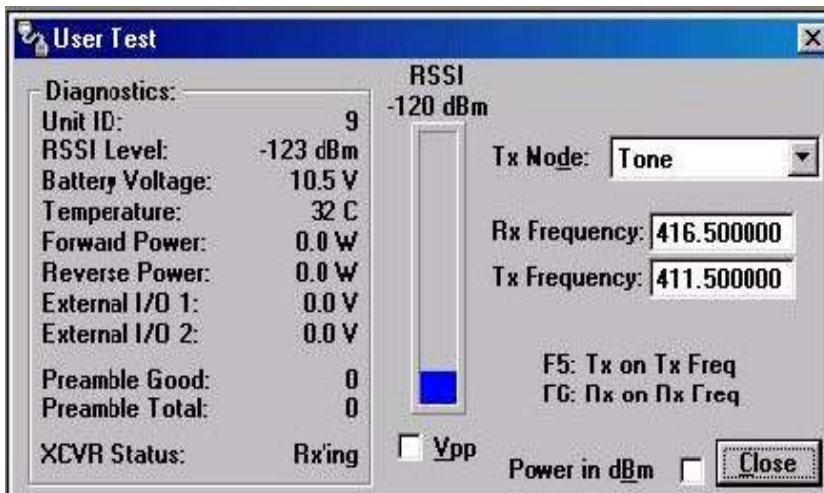
OK

Selecting OK closes the Diagnostic IDs and Alarms window.

3.4.17 USER TEST

The User Test Utility is accessed from the Utilities pull-down menu. The User Test utility is an Offline function and requires suspension of network operation.

Figure 36 - User Test Screen



A User Test's diagnostic parameters include:

Unit ID

The Unit ID is the Short ID of the unit from which the diagnostics were received.

RSSI Level

Received Signal Strength Indication (in dBm).

Battery Voltage

Supply voltage (in volts).

Temperature

Internal temperature (in degrees Celsius).

Forward Power

Forward power (in watts or dBm).

Reverse Power

Reverse power (in watts or dBm).

External I/O 1

Voltage on the External I/O 1 Input from the Power - I/O Connector (in volts).

External I/O 2

Voltage on the External I/O Input from the Power - I/O Connector (in volts).

Preamble Good

The number of correctly decoded transmissions received in the last 15. Used with Preamble Total, this serves as an indication of how well the unit is receiving data.

Preamble Total

The number of total transmissions detected, maximum is 15. Used with Preamble Good, this serves as an indication of how well the unit is receiving data.

RSSI /Pwr

This panel shows the current RSSI level (in dBm) while the local unit is receiving and the current power level (in watts or dBm) while the local unit is transmitting.

Rev Pwr

This check box changes forward power to reverse power on the Power Panel from while the local unit is transmitting.

Power in dBm

This check box allows the user to view Fwd/Rev Power in dBm (instead of watts).

Tx Mode

This box allows the user to select different transmit modes when the unit is told to transmit.

- Tone - the unit transmits a 1200 Hz tone
- Mod Balance - the unit transmits a 100 Hz square wave
- Random Data - the unit transmits random data
- No Modulation - the unit transmits a carrier with no modulation

Rx / Tx Frequency

Rx / Tx Frequency shows the current transmit frequencies.

F5

Pressing the F5 key will cause the unit to transmit on the programmed transmit frequency.

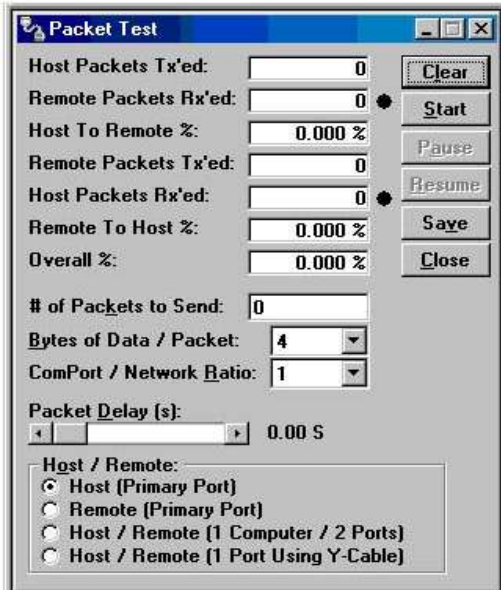
F6

Pressing the F6 key will cause the unit to go to receive on the programmed receive frequency.

3.4.18 PACKET TEST

The Packet Test allows the user to simulate a Host/Remote polling environment. The Host will send out a packet to the Remote and the Remote will reply to the Master with the same packet information. This test is useful for testing the modem link.

Figure 37 - Packet Test Screen



Host Packets Tx'ed

Host Packets Tx'ed shows the number of data packet the Host device sent to the Remote.

Remote Packets Rx'ed

Remote Packets Rx'ed shows the number of data packets the Remote device successfully received from the Host.

Host to Remote %

Host to Remote % shows the number of data packets the Remote device has successfully sent to the Remote.

Remote Packets Tx'ed

Remote Packets Tx'ed shows the number of data packets the Remote device sent back to the Host.

Host Packets Rx'ed

Host Packets Rx'ed shows the number of data packets the Host device successfully received from the Remote.

Remote to Host %

Remote to Host % shows the percentage of data packets the Remote device successfully sent to the Host.

Overall %

Overall % shows the percentage of Host received packets versus Host transmitted packets.

of Packets to Send

of Packets to Send is a programmable number to tell the Host how many data packets to send to the Remote. After the programmed number of data packets are sent, the transmission will automatically stop.

Bytes of Data/Packet

Bytes of Data/Packet is a programmable number to tell the Host the number of data bytes to send in each packet. The Remote will respond with the same number of data bytes received.

COM Port/ Network Radio

Com Port/Network Radio is the ratio of COM Port baud rate to network (over-the-air) baud rate of the modem. This is used if the network baud rate is slower than the COM Port baud rate. If the COM Port baud rate is 9600 and the network baud rate is 4800, set the ratio to 2. If the COM Port baud rate and the Network Baud Rate are the same, set the Ratio to 1.

Packet Delay (s)

Packet Delay (s) tells the Host the number of seconds to delay between sending each data packet (range is from 0.00 to 10.00 seconds in 0.25 second intervals).

Host/Remote

Host/Remote allows the user to choose the COM Port configuration.

Host (Primary Port) - Configure the Primary COM Port as the Host device (the device initiating packets to the Remote device).

Remote (Primary Port) - Configure the Primary COM Port as the Remote device (the device responding to the packets from the Host device).

Host/Remote (1 computer / 2 ports) - Configure the Primary COM Port as the Host device and the Secondary COM Port as the Remote device. A computer with 2 COM Ports is required for this option.

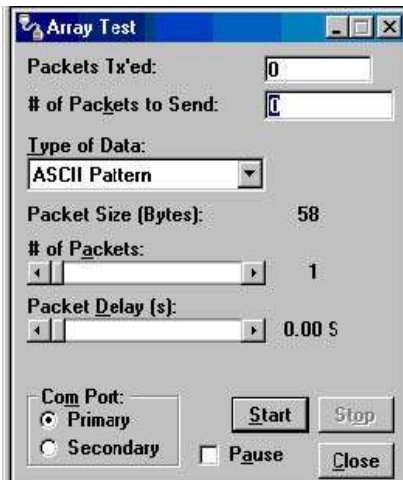
Host/Remote (1 Port using a Y-cable) - A computer with 1 COM Port is typical for this option (See Table 9). Configure the Primary COM Port as the Host and Remote device. A Y-cable is required for this option (where Tx connections are split out to the transmitting device and the Rx connections are split out to the receiving device).

Table 9 - Y-Cable Connections

Pin Name	DB-9	DB-25	Computer	Rx	Tx
DCD	1	8	X	X	-
RxD	2	3	X	X	-
TxD	3	2	X	-	X
DTR	4	20	-	-	-
GND	5	7	X	X	X
DSR	6	6	-	-	-
RTS	7	4	X	-	X
CTS	8	5	X	-	X
RI	9	22	-	-	-

3.4.19 ARRAY TEST

Figure 38 - Array Test Screen



The Array Test utility is used to send programmable length test packets. The packets are built using one of four possible patterns.

Packets Tx'ed

Packets Tx'ed shows the total number of data packets transmitted.

of Packets to Send

of Packets to Send shows the number of data packets to send before stopping (the range is 0 to unlimited).

Type of Data

Type of Data identifies the data pattern for each data packet. The size and format for each pattern is shown in the pattern descriptions.

Pattern Descriptions -

ASCII Pattern

The ASCII Pattern Packet are 58 characters in length and have a sequence number at the beginning of each string, starting at 000, incrementing to 999 and wrapping around to 000 again. The pattern used to build the packets should have the following format (in ASCII):

```
000 ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz
001 ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz
- - -
998 ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz
999 ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz
000 ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz
001 ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz
```

ASCII Number Pattern

The ASCII Number Pattern are 54 characters in length and have a sequence number at the beginning of each string, starting at 000, incrementing to 999 and wrapping around to 000 again. The pattern used to build the packets should have the following format (in ASCII):

```
000 00 11 22 33 44 55 66 77 88 99 AA BB CC DD EE FF
001 00 11 22 33 44 55 66 77 88 99 AA BB CC DD EE FF
- - -
998 00 11 22 33 44 55 66 77 88 99 AA BB CC DD EE FF
999 00 11 22 33 44 55 66 77 88 99 AA BB CC DD EE FF
000 00 11 22 33 44 55 66 77 88 99 AA BB CC DD EE FF
001 00 11 22 33 44 55 66 77 88 99 AA BB CC DD EE FF
```

Binary Pattern

Binary Pattern packets are 16 characters in length and have a sequence number every 16 characters, starting at 0x00, incrementing to 0xFF and wrapping around to 0x00 again. The pattern used to build the packets should have the following format (in Hex):

```
00 11 22 33 44 55 66 77 88 99 AA BB CC DD EE FF
01 11 22 33 44 55 66 77 88 99 AA BB CC DD EE FF
02 11 22 33 44 55 66 77 88 99 AA BB CC DD EE FF
-- 11 22 33 44 55 66 77 88 99 AA BB CC DD EE FF
FE 11 22 33 44 55 66 77 88 99 AA BB CC DD EE FF
FF 11 22 33 44 55 66 77 88 99 AA BB CC DD EE FF
00 11 22 33 44 55 66 77 88 99 AA BB CC DD EE FF
01 11 22 33 44 55 66 77 88 99 AA BB CC DD EE FF
02 11 22 33 44 55 66 77 88 99 AA BB CC DD EE FF
-- 11 22 33 44 55 66 77 88 99 AA BB CC DD EE FF
```

Random Binary Pattern

Random Binary Pattern is 16 characters in length and contain random binary data.

Packet Size

Packet Size shows the number of data bytes in each packet (described in Pattern Descriptions above).

of Packets

of Packets shows the number of packets in each transmission.

Packet Delay

Packet Delay shows the amount of time (in seconds) to delay between each packet transmission (range is from 0.00 to 30.00 seconds in 0.25 second intervals).

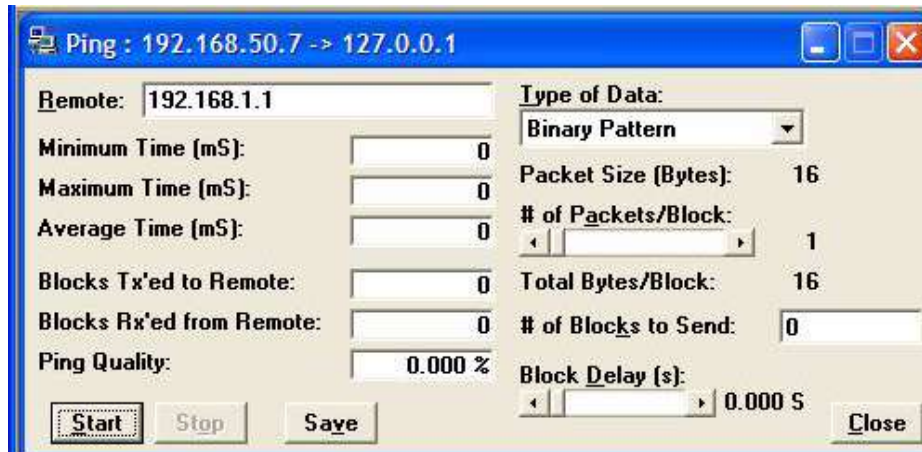
COM Port

COM Port allows the user to select which COM port (Primary or Secondary) is used for transmitting data.

3.4.20 PING TEST

For user convenience, the PING Test was added to the Integra FPS as a utility and is used to simulate a Host/Remote polling environment. The Master sends out a packet to the Remote and the Remote replies to the Master with the same packet information. This utility is useful for testing Ethernet and modem links.

Figure 39 - Ping Test Screen



Remote

Remote displays the IP Address of the device under test.

Minimum Time

Minimum Time displays the minimum amount of time taken for the Ping Packet to echo back from the Remote device (in milliseconds).

Maximum Time

Maximum Time displays the maximum amount of time taken for the Ping Packet to echo back from the Remote device (in milliseconds).

Average Time

Average Time displays the average amount of time taken for the Ping Packet to echo back from the Remote device (in milliseconds).

Blocks Tx'ed to Remote

Blocks Tx'ed to Remote displays the number of data packets sent to the Remote device.

Blocks Rx'ed from Remote

Blocks Rx'ed from Remote displays the number of data packets received from the Remote device.

Ping Quality

Ping Quality displays the overall percentage of data packets sent vs. data packets received during the Ping Test.

Type of Data

Type of Data displays the type of Data Pattern to be used for each packet. The size for each Data Pattern is shown below in Packet Size. The following lists the formats of the Data Patterns:

ASCII Pattern

The packets will be 52 characters in length. The pattern used to build the packets will have the following format (in ASCII):

```
ABCDEFGHIJKLMNPOQRSTUVWXYZabcdefghijklmnopqrstuvwxy  
ABCDEFGHIJKLMNPOQRSTUVWXYZabcdefghijklmnopqrstuvwxy  
---  
ABCDEFGHIJKLMNPOQRSTUVWXYZabcdefghijklmnopqrstuvwxy
```

ASCII Number Pattern

The packets will be 48 characters in length. The pattern used to build the packets will have the following format (in ASCII):

```
00 11 22 33 44 55 66 77 88 99 AA BB CC DD EE FF  
00 11 22 33 44 55 66 77 88 99 AA BB CC DD EE FF  
---  
00 11 22 33 44 55 66 77 88 99 AA BB CC DD EE FF
```

Binary Pattern

The packets will be 16 characters in length. The pattern used to build the packets will have the following format (in Hex):

```
00 11 22 33 44 55 66 77 88 99 AA BB CC DD EE FF
00 11 22 33 44 55 66 77 88 99 AA BB CC DD EE FF
---
00 11 22 33 44 55 66 77 88 99 AA BB CC DD EE FF
```

Random Binary Pattern

The packets will be 16 characters in length and contain random binary data.

Packet Size

Packet Size displays the number of bytes in each packet (described in Type of Data).

of Packets/Block

of Packets/Block displays the number of packets in each transmission block (described in Type of Data).

Total Bytes/Block

Total Bytes/Block displays the total number of blocks in each transmission block.

of Blocks to Send

of Blocks to Send displays the number of blocks to be sent to the Remote device (after selected number has been sent, transmission automatically stops).

Block Delay

Block Delay displays the amount of time (in seconds) of delay between each block transmission (range is from 0.000 to 5.000 seconds in 0.125 second intervals). Block Delay is user programmable.

Start

The Start button begins the Ping Test.

Stop

The Stop button stops the Ping Test.

Save

The Save button offers the user the option to save the information received from the test.

Close

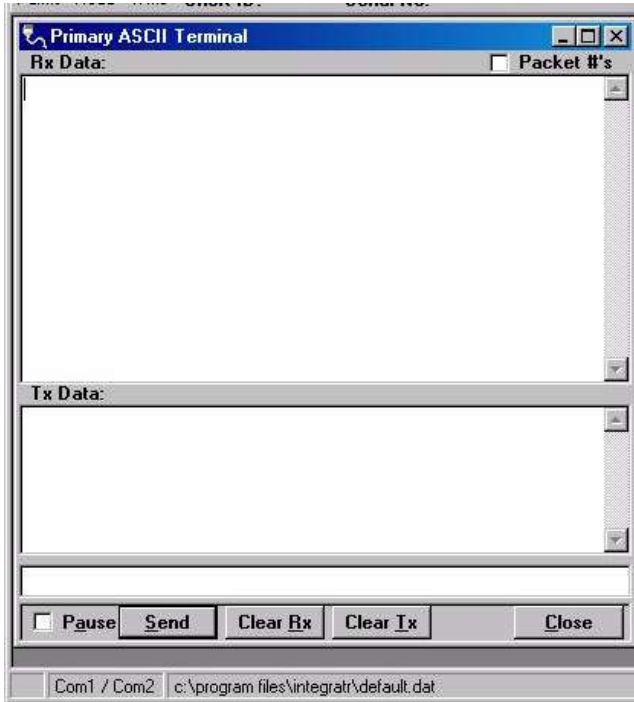
The Close button closes the Ping Test window.

3.4.21 ASCII / HEX TERMINAL

The ASCII Terminal Screens are accessed from the Utilities pull-down menu and allow the user to select an ASCII, Hexadecimal TCP Socket or UDP Socket Terminal Screen for the Primary and Secondary COM Ports (configured in the Port Settings screen - see Section 3.4.10) Data is sent according to the port configuration set up in the Port Settings screen.

3.4.21.1 ASCII TERMINAL

Figure 40 - ASCII Terminal Screen



ASCII Terminal (see Figure 40) configurations include:

Primary

The Primary ASCII Terminal screen allows the user to send and receive ASCII data on the Primary COM Port (setup in the Port Settings screen).

Secondary

The Secondary ASCII Terminal screen allows the user to send and receive ASCII data on the Secondary COM Port (set up in the Port Settings screen).

TCP Socket

The TCP Socket Terminal screen allows the user to send and receive ASCII data over a TCP connection.

UDP Socket

The UDP Socket Terminal screen allows the user to send and receive ASCII data over a UDP connection.

3.4.21.2 HEX TERMINAL

Hex Terminal configurations include:

Primary

The Primary Hex Terminal screen selects a Hexadecimal Terminal screen to send and receive Hexadecimal data on the Primary COM Port (set up in the Port Settings screen).

Secondary

The Secondary Hex Terminal screen selects a Hexadecimal Terminal screen to send and receive Hexadecimal data on the Secondary COM Port (set up in the Port Settings screen).

TCP Socket

The TCP Socket Terminal screen allows the user to send and receive Hexadecimal data over a TCP connection.

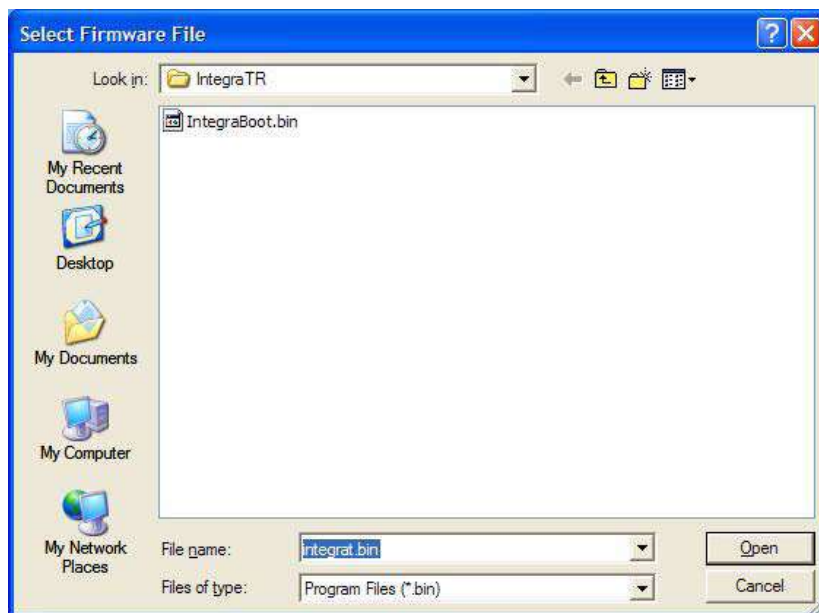
UDP Socket

The UDP Socket Terminal screen allows the user to send and receive Hexadecimal data over a UDP connection.

3.4.22 PROGRAM CODE MENU

The Program Code pull-down menu allows the user to update the Integra-TR firmware (*.bin) with the Program Firmware option, read Boot Code version, select Firmware File (allows the user to select the file to program the firmware in the Integra-TR) or upgrade the Boot Code file. Selecting one of these options opens a standard navigation window to select the desired file.

Figure 41 - Select Firmware File Window (for reference only)



3.5 INTEGRA-TR HELP FILES

Integra-TR Field Programming Software's online help files are accessed by the menu bar at the top of the Field Programming window.

Figure 42 - Integra-TR Online Help Introductory Screen



3.6 OPTIMIZING YOUR SYSTEM

Detailed system engineering is beyond the scope of this manual. However, there are some simple tips that can be used to optimize performance of a radio based SCADA or telemetry system.

Choose the best protocol Some SCADA devices allow a choice of more than one operating protocol. In some cases, performance can be improved by selecting a different protocol. Contact Technical Service for assistance.

Check timer settings Polling protocols issue a poll and wait a certain time for a response. Integra-TR adds a short amount of delay to each poll and response (typically in the order of 60 to 70 ms). Timer settings that are too short may cause erroneous indication of missed polls, in which case the application may retry or continue to cycle, ignoring the missed station. In this case, the response may collide with the next poll, further increasing errors. Setting an adequate timer margin will avoid problems and maximize performance.

Avoid flow control Set the COM port baud rate to a value less than or equal to the radio network speed (2400, 4800, 9600 or 19200 b/s). In a polling system, this will prevent buffer overflow with possible missed transmissions. If the port baud rate must be set higher than the radio network speed, you may have to limit message length to prevent possible buffer overflow. Integra-TR will exert a flow control signal (CTS dropped) if buffers are almost full, but not all DTE honor such signals.

Use the highest suitable port baud rate (without exceeding the radio network speed) Operating an RTU at 1200 b/s on a 9600 b/s network will increase data transmission delays and reduce system performance.

Evaluate the need for online diagnostics Enabling online diagnostics increases delays by 2.5 to 20 ms (depending on speed). In critical applications, this extra delay can be eliminated by disabling online diagnostics. Offline Diagnostics (diagnostics on request) remain available.

Interpreting RSSI Readings

Typical values of RSSI will be in the range of -110 to -60 dBm (depending on network speed), with higher values (i.e. less negative values) indicating a stronger signal.

Reliability of data reception depends largely on signal strength. Good design practice calls for a minimum 30 dB “fade margin”, based on a threshold reception level of -107 dBm (1 μ V) at speed of 9600 b/s. Experience indicates that this will give about 99.5% reliability.

Some representative performance values for 9600 b/s operation are given below. These values assume that the units are correctly aligned and installed in a quiet location. Environments with high electrical or RF noise levels will require an increase (less negative) in the numbers shown to achieve a given level of reliability.

-100 dBm Approximately 50% reliability. Fading may cause frequent data loss.

-90 dBm Approximately 90% reliability. Fading will cause occasional data loss.

-80 dBm Approximately 99% reliability. Reasonable tolerance to most fading.

-70 dBm Approximately 99.9% reliability with high tolerance to fading.

If RSSI values drops seasonally the most likely cause is tree foliage which can interfere with radio transmissions during the spring and summer.

Interpreting Power Readings

The values returned are approximate and should not be regarded as an absolute indicator of performance. For example, a unit that shows a forward power of 4.5 watts may actually measure at 5.0 watts on a lab quality wattmeter. For this reason, these values should not be used to indicate that a unit is out of spec or to compare one unit to another.

However, the values returned should be consistent for any given unit. If statistics are kept on a unit per unit basis, changes in forward or reflected power are significant. The following conditions are worthy of investigation.

1. Forward power output (in watts) drops or rises by more than 10% from its established value. Reflected power remains low. This indicates that the transmitter may need alignment or that a component may be in need of replacement.
2. Forward power output drops by more than 10% from its established value or reflected power shows an increase. This indicates a possible antenna or feedline problem that affects SWR (Standing Wave Ratio).

Reverse Power and SWR

A reverse power reading above zero is an indication that the antenna, feedline or connectors are damaged, corroded or improperly tuned. This creates standing waves that are reported as a Standing Wave Ratio (SWR). Table 10 is based on a forward power of 5 watts (it may be scaled for lower power settings) and gives guidelines to interpreting these figures:

Table 10 - SWR / Rev Pwr Interpretation

SWR	Rev Pwr	Significance
1:1	0	Ideal situation
1.5:1	0.2	Normal operation
2:1	0.6	Should be investigated
3:1 or greater	1.25 or greater	Defective antenna, feedline, or connectors

Should values returned by the built-in diagnostics seem to indicate a problem, verify using proper radio shop equipment.

4 CONFIGURABLE PARAMETERS

4.1 PARAMETER OVERVIEW

The parameters used to configure the Integra-TR units are described in the Field Programming Software help file. Section 4 summarizes the Integra-TR parameter settings and their variations when used within a network.

Table 11 - Normal Factory Settings (Units)

Fields	Integra-TR with other Integra-TR	Integra-T / TR	Integra-T
Network Settings			
Compatibility Mode	Integra-TR	Integra-T / TR	(N/A)
Tx/Rx Mode	Both Tx and Rx		(N/A)
Extended Preamble (ms)	5 mS	0 mS	0 mS
Network Speed	19200 Full Channel 9600 Half Channel 2400 Quarter Channel	9600 Full Channel	
Tx Online Diagnostics	Yes		
Unit Type	Master		
Data Delivery	All		
Suspend Period (ms)	0		
Activity Time-out (sec)	5		
Sleep Mode	Disable (N/A)		
COM Port			
Device Baud	19200	9600	
Data fwd timer	Normal		
Parity	8 bit, no parity, 1 stop bit		
Break	Ignore break		
Xmit Control	DOX		
DCD Control	Switched		
External I/O Connector			
I/O 1	Input or Fan Control (units with cooling fan option) Digital Output (units not equipped with cooling fan option when Modem Board Rev is 0 or 1)		Input
I/O 2	Input Digital Output to control open-collector transistor (when Modem Board Rev is 0 or 1)		
Frequency			
Transmit	User choice		
Receive	User choice		
Adjustments			
Carrier Sense (-dBm)	105 (116 for quarter-channel)	110	
Tx Time Out	30 sec ON		
Disable Tx w/ Carrier Present	Disabled (OFF)		
Power Out	255 (indicates 5 Watts nominal)		
Transceiver Type	Transceiver		

Refer to help files (See section 3.5) for descriptions of the above fields.

Table 12 - Normal Factory Settings (Bases)

Fields	Full Duplex Base Integra-TR with other Integra-TR		Redundant Integra-TR Full Duplex Base with Integra-TR/Integra-T			
	RX Unit	TX Unit	RX Units	TX Units		
Network Settings						
Station ID (CWID)	Disabled (OFF)					
Compatibility Mode	Integra-TR		Integra-T / TR			
Extended Preamble (ms)	5 mS		0 mS			
Network Speed	19200 Full Channel 9600 Half Channel 2400 Quarter Channel		9600 Full Channel			
Tx Online Diagnostics	Yes					
Unit Type	Master					
Data Delivery	All					
Activity Time-out (sec)	5					
COM Port						
Device Baud	19200 / 9600 / 2400		9600			
Data fwd timer	Normal					
Parity	8 bit, no parity, 1 stop bit					
Break	Ignore break					
Xmit Control	DOX					
DCD Control	Switched					
External I/O Connector						
I/O 1	Input	Output	Fan Control	Input	Output	Fan Control
I/O 2	RxTp		Input	RxTp		Ant. SW Control
Frequency						
Transmit	User Choice					
Receive	User Choice					
Adjustments						
Carrier Sense (-dBm)	105 (116 for quarter-channel)	(N/A)	110	(N/A)		
Tx Time Out	Disabled					
Disable Tx w/Carrier Present	Disabled (OFF)					
Tx Power	255 (indicates 5 watts nominal)					
Transceiver Type	Rx Only	Tx Only	Rx Only	Tx Only		

Refer to help files (See section 3.5) for descriptions of the above fields.

5 DEFINITIONS

Bit dribble	Extraneous bits delivered at the end of a data transmission. Equivalent to a “squelch tail” in voice systems. Integra-TR does not have bit dribble.
COM Port	The Communications Port of Integra-TR. This port is configured as DCE and is designed to connect directly to DTE.
CTS	Clear to Send. An RS-232 output signal from Integra-TR indicating that it is ready to accept data (used in RTS mode).
DCE	Data Communications Equipment. This designation is applied to equipment such as modems. DCE is designed to connect to DTE.
DOX	Data Operated Transmit. A mode of operation in which Integra-TR begins a transmission as soon as data is presented to the RS-232 port.
DTE	Data Terminal Equipment. This designation is applied to equipment such as terminals, PCs, RTUs, PLCs, etc. DTE is designed to connect to DCE.
Field Programming Software	This software allows configuration and testing of Integra-TR
Full Channel	Radio channel bandwidth equal to 25kHz.
Half Channel	Radio channel bandwidth equal to 12.5kHz.
Multi-Channel	The Integra-TR has multi-channel capability under system PLC control for advanced network monitoring .
Network speed	This is the bit rate on the RF link between units. Could be different from COM port baud rate.
PLC	Programmable Logic Controller. An intelligent device that can make decisions, gather and report information, and control other devices.
Refarming	Strategy for using the radio spectrum more efficiently to meet future communications requirements and the FCC's minimum bit rate requirements with speeds up to 19200 in Full Channel and 9600 in Half Channel.
RTS	Request to Send. RS-232 input signal to Integra-TR indicating that the DTE has data to send. RTS may optionally be used as a transmit switch for Integra-TR.
RTS mode	A mode of operation in which Integra-TR begins a transmission when RTS is raised and continues transmitting until RTS is dropped.
RTU	Remote Terminal Unit. A SCADA device used to gather information or control other devices.
SCADA	Supervisory Control And Data Acquisition. A general term referring to systems that gather data and/or perform control operations.
Setup Port	The configuration / diagnostic port of Integra-TR. This port is designed to be connected to a PC running the Integra Field Programming Software.
Transparent	A transparent unit transmits all data without regard to special characters, etc.

ABOUT CALAMP

CalAmp is a leading provider of wireless communications products that enable anytime/anywhere access to critical information, data and entertainment content. With comprehensive capabilities ranging from product design and development through volume production, CalAmp delivers cost-effective high quality solutions to a broad array of customers and end markets. CalAmp is the leading supplier of Direct Broadcast Satellite (DBS) outdoor customer premise equipment to the U.S. satellite television market. The Company also provides wireless data communication solutions for the

telemetry and asset tracking markets, private wireless networks, public safety communications and critical infrastructure and process control applications. For additional information, please visit the Company's website at www.calamp.com.