Integra
Technical Manual

Version: Integra-TR

DATARADIO ®

INTEGRA-TR WIRELESS MODEM
Part No. 242-40V8-XYZ

Dataradio COR Ltd. designs and manufactures radios and wireless modems to serve a wide variety of data communication needs. Dataradio produces equipment for the fixed data market including SCADA systems for utilities, petrochemical, waste and fresh water management markets and RF boards for OEM applications in the Radio Frequency Data Capture market.

PRODUCT WARRANTY

The manufacturer's warranty statement for this product is available from Dataradio COR, Ltd. 299 Johnson Avenue, Box 1733, Waseca, MN 56093-0833. Phone (507) 833-8819.

The information in this document is subject to change without notice.

DATARADIO ® is a trademark of DATARADIO, Inc.

PRODUCT OVERVIEW

1.1 SCOPE OF MANUAL

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

1.2 GENERAL DESCRIPTION

 Integra-TR is a high-speed transparent 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.

Settings and connections for these configurations are given later in this manual

1.2.1 CHARACTERISTICS

 Integra-TR has the following characteristics:
  ● Selectable network speeds of 4800 and 9600 b/s for half channel units as well as 4800, 9600 and 19.200
    b/s for full channel units. 2400 or 4800 b/s for quarter 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 300 - 19200 bauds
  ● One Setup port, for configuration and diagnostics (speed fixed to 9600 baud, 8 bit, no parity, 1 stop bit)
  ● Built-in 5-watt transceiver, 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 8-bit analog inputs (0 - 10V)
  ● Low power consumption modes: "sleep" and "suspend" modes (< 20 mA).
  ● "12 VDC, negative ground" device.

1.2.2 ACCESSORIES AND OPTIONS

Accessory	DRL Part Number
Integra-TR Field Programming Kit (includes software and technical manual on CD ROM, and programming cable - DRL part number 697-4008-408)	250-4008-001
SMA Male - BNC Female adapter cable	023-3410-098
*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
*Full-duplex base station - Y-cable option	Contact Technical Service

* 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 1-800-992-7774. For international sales, phone 1-952-882-5529 or 1-305-829-4030.

1.2.3 FACTORY MUTUAL NI KIT

The Integra-TR with the Factory Mutual NI Kit (DRL part number 023-1000-200) is approved as nonincendive 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.
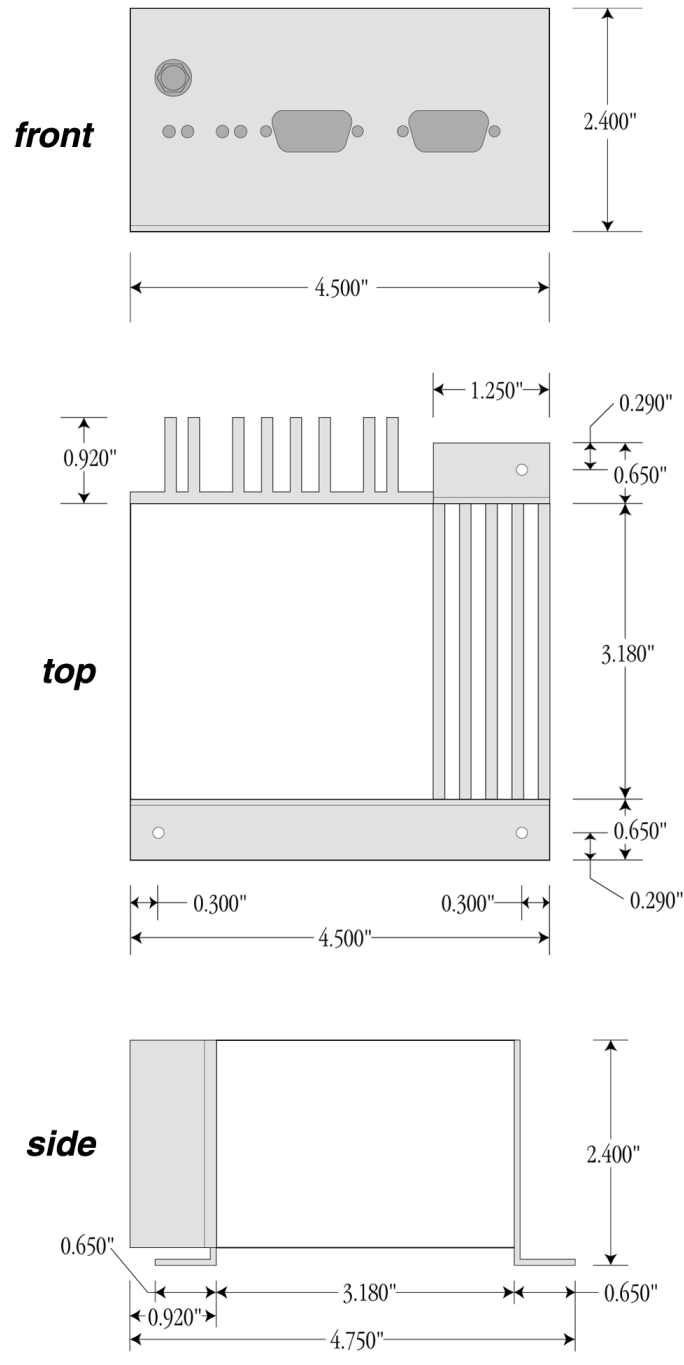

Figure 1-1   FM Approved External Connections

Figure 1-2   Installation Dimensions

1.2.4 INTEGRA-TR CE

$C\epsilon$ 0122 ①

Important Notice/Warning on restrictive use in all EU and EFTA member states:
This device is a VHF/UHF Radio data transmitter intended for indoor and outdoor use. Operation of this device is subject to end-user licence. The end user is strongly advised to contact the local frequency management authorities to obtain such an end-user licence according to local legislations and frequency allocations. The manufacturer takes no responsibility for any unauthorized use of this device.

Avis important/Avertissement au sujet de restrictions d'utilisation applicables à l'intérieur d'un pays membre de l'UE ou de l'AELE :
Cet appareil est un émetteur radio opérant en VHF/UHF, d'usage intérieur ou extérieur, utilisé pour la transmission de données. L'opération de cet appareil est assujettie aux termes et conditions de la licence émise à l'utilisateur final. Il est fortement conseillé à l'utilisateur final de contacter les autorités locales légalement responsables de la gestion et de l'allocation des fréquences radios et d'obtenir auprès d'eux toute licence d'opération requise. Le manufacturier n'assume aucune responsabilité pour l'usage non réglementaire de cet appareil.

Avvertenza importante per l'uso limitato ai paesi della Comunita' Europea ed EFTA. Questo dispositivo e' un trasmettitore radiofonico di dati di VHF/UHF per uso interno ed esterno. Bisogna avere una licenza per ultilizzare questo dispositivo. Consigliamo fortemente a chi usera' questo trasmettitore di contattare le autorita' locali che amministrano la gestione delle frequenze per ottenere un'autorizzazione che sia conforme alle leggi locali, e, con questa ottenere l'assegnamento della frequenza. Il fornitore di questo dispositivo non e' responsabile per l'uso non autorizzato.

O aviso/advertir importante no uso restritivo estados de todo o membro do EU e do EFTA: Este dispositivo é um transmissor de rádio dos dados de VHF/UHF pretendido para o uso indoor e ao ar livre. A operação deste dispositivo é sujeita à licença do end-user. O usuário da extremidade é recomendado fortemente contatar as autoridades locais da gerência da freqüência para obter tal licença do end-user de acordo com legislações e alocamentos locais da freqüência. O fabricante das tomadas nenhuma responsabilidade para algum uso desautorizado deste dispositivo.

Advertencia/Noticia: Importante uso restrictivo en Estados miembros de toda la Unión Europea y de Aelc: Este equipo es un radio transmisor de datos en las bandas de VHF y UHF previsto para uso en interiores y exteriores. La operación de este equipo es conforme a licencia obtenida por el usuario final.   Se aconseja al usurario final que entre en contacto con las autoridades locales que aprueban el uso de frecuencias, para obtener su propia asignación de frecuencia de acuerdo a la legislacion de cada pais. El fabricante no se hace responsable del uso de los equipos sin la aprobación de frecuencia por las autoridades locales.

Wichtige Information/Warnung hinsichtlich Gebrauch in allen EU- und EFTA-Mitgliederstaaten:
Dieses Gerät ist ein VHF/UHF Daten – Funkgerät, daß sowohl innen als auch im Freien betrieben werden kann. Die Inbetriebnahme dieses Gerätes ist abhängig von einer Nutzerlizenz. Wir empfehlen dem Gerätebetreiber sich mit den zuständigen Frequenz – Regulierungsbehörden in Verbindung zu setzen, um die entsprechenden Lizenzen, gemäß gültiger Gesetzgebung, zu beantragen. Der Hersteller dieses Daten – Funkgerätes kann keine Haftung für nicht ordnungsgemäßen (gesetzeskonformen) Betrieb des Gerätes übernehmen.

Part No. 001-4008-101/102

CERTIFICATE *(vertical title on left margin)*

CERTIFICATE OF CONFORMITY OF A PRODUCT WITH THE ESSENTIAL
REQUIREMENTS OF DIRECTIVE 1999/5/EC, ACCORDING TO THE CONFORMITY
ASSESSMENT PROCEDURE REFERRED TO IN ARTICLE 10(5) AND ANNEX IV

DESCRIPTION OF THE PRODUCT

Manufacturer	:	Dataradio COR Ltd.
Address	:	299 Johnson Avenue, Waseca, Minnesota
		United States of America
Product Brand name	:	Dataradio
Product type/model	:	242-4018-xxx [Integra TR VHF]
Intended use	:	Transmission of data acquisition and control messages
		in the frequency range 132 – 174 MHz
Type of equipment	:	High-Speed Transparant Radiomodem Transceiver

TECHNICAL CONSTRUCTION FILE

Issued by	:	Dataradio COR Ltd.
Address	:	299 Johnson Avenue, Waseca, Minnesota
		United States of America
Signed By	:	M. Christensen
Date	:	October 16, 2000
File number	:	242-4018.0

NMi CERTIFICATE

Issued by	:	Notified Body 0122, NMi Certin B.V.
Date	:	October 17, 2000
Certificate number	:	9310125372
On behalf of	:	The Director of NMi Certin B.V.
Signature	:	
Name:		P. de Beer

Based on the evidence presented in the Technical Construction File, NMi Certin BV, as
appointed Notified Body (number 0122), has given a positive opinion that the product
described is in conformity with the essential requirements of R&TTE Directive 1999/5/EC.

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Part No. 001-4008-101/102

CERTIFICATE

CERTIFICATE OF CONFORMITY OF A PRODUCT WITH THE ESSENTIAL REQUIREMENTS OF DIRECTIVE 1999/5/EC, ACCORDING TO THE CONFORMITY ASSESSMENT PROCEDURE REFERRED TO IN ARTICLE 10(5) AND ANNEX IV

DESCRIPTION OF THE PRODUCT

Manufacturer	:	Dataradio COR Ltd.
Address	:	299 Johnson Avenue, Waseca, Minnesota United States of America
Product Brand name	:	Dataradio
Product type/model	:	242-4048-xxx [Integra TR UHF]
Intended use	:	Transmission of data acquisition and control messages in the frequency range 403 - 470 MHz
Type of equipment	:	High-Speed Transparant Radiomodem Transceiver

TECHNICAL CONSTRUCTION FILE

Issued by	:	Dataradio COR Ltd.
Address	:	299 Johnson Avenue, Waseca, Minnesota United States of America
Signed By	:	M. Christensen
Date	:	October 16, 2000
File number	:	242-4048.0

NMi CERTIFICATE

Issued by	:	**Notified Body 0122,** NMi Certin B.V.
Date	:	October 17, 2000
Certificate number	:	9310125375
On behalf of	:	The Director of NMi Certin B.V.
Signature	:	
Name:		P. de Beer

Based on the evidence presented in the Technical Construction File, NMi Certin BV, as appointed Notified Body (number 0122), has given a positive opinion that the product described is in conformity with the essential requirements of R&TTE Directive 1999/5/EC.

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DATARADIO COR Ltd.
299 Johnson Avenue, P.O. Box 1733
Waseca, MN 56093-0833 USA
Phone: 1-800-772-7774; 507-835-8819
Fax: 507-835-6648
Website: www.dataradio.com

DATARADIO ®

Declaration of Conformity

We, the undersigned,

Company	Dataradio COR Ltd.
Address, City	299 Johnson Avenue, Waseca, Minnesota
Country	United States of America
Phone number	+1 507 835 63 48
Fax number	+1 507 835 69 99

certify and declare under our sole responsibility that the following equipment:

Product description / Intended use	Transmission of data acquisition and control messages in the frequency range 132 – 174 MHz
EU /EFTA memberstates Intended for use	**EU**: Austria, Belgium, Denmark, Finland, France, Germany Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, United Kingdom **EFTA**: Switzerland, Iceland, Lichtenstein, Norway
Restrictive use	-none-
Manufacturer	Dataradio COR Ltd.
Brand	Dataradio
Types	242-4018-xxx [Integra TR VHF]

is tested to and conforms with the essential radio test suites included in following standards:

Standard	Issue date
EN 300 113 v1.3.1	February 2000
EN 300 279 v1.2.1	February 1999
EN 60950	(1992), incl. A1(1993), A2(1993),A3(1995), A4(1997)

and therefore complies with the essential requirements and provisions of the **Directive 1999/5/EC** of the European Parliament and of the council of 9 march 1999 on Radio equipment and Telecommunications Terminal Equipment and the mutual recognition of their conformity and Annex IV (Conformity Assessment procedure referred to in article 10(4)).

The following Notified Bodies have been consulted in the Conformity Assessment procedure:

Notified Body number	Name and address
0122	NMi Certin B.V., POB 15, 9822 ZG Niekerk, The Netherlands

The technical documentation as required by the Conformity Assessment procedure is kept at the following address:

Company	Dataradio COR Ltd.
Address, City	299 Johnson Avenue, Waseca, Minnesota
Country	United States of America
Phone number	+1 507 835 63 48
Fax number	+1 507 835 69 99

C E

Drawn up in	Niekerk, The Netherlands
Date	October 16, 2000

Part No. 001-4008-101/102

DATARADIO COR Ltd.
299 Johnson Avenue, P.O. Box 1733
Waseca, MN 56093-0833 USA
Phone: 1-800-772-7774; 507-835-8819
Fax: 507-835-6648
Website: www.dataradio.com

DATARADIO®

Declaration of Conformity

We, the undersigned,

Company	Dataradio COR Ltd.
Address, City	299 Johnson Avenue, Waseca, Minnesota
Country	United States of America
Phone number	+1 507 835 63 48
Fax number	+1 507 835 69 99

certify and declare under our sole responsibility that the following equipment:

Product description / Intended use	Transmission of data acquisition and control messages in the frequency range 403 - 470 MHz
EU /EFTA memberstates intended for use	**EU**: Austria, Belgium, Denmark, Finland, France, Germany Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, United Kingdom **EFTA**: Switzerland, Iceland, Lichtenstein, Norway
Restrictive use	-none-
Manufacturer	Dataradio COR Ltd.
Brand	Dataradio
Types	242-4048-xxx [Integra TR UHF]

is tested to and conforms with the essential radio test suites included in following standards:

Standard	Issue date
EN 300 113 v1.3.1	February 2000
EN 300 279 v1.2.1	February 1999
EN 60950	(1992), incl. A1(1993), A2(1993),A3(1995), A4(1997)

and therefore complies with the essential requirements and provisions of the **Directive 1999/5/EC** of the European Parliament and of the council of 9 march 1999 on Radio equipment and Telecommunications Terminal Equipment and the mutual recognition of their conformity and Annex IV (Conformity Assessment procedure referred to in article 10(4)).

The following Notified Bodies have been consulted in the Conformity Assessment procedure:

Notified Body number	Name and address
0122	NMi Certin B.V., POB 15, 9822 ZG Niekerk, The Netherlands

The technical documentation as required by the Conformity Assessment procedure is kept at the following address:

Company	Dataradio COR Ltd.
Address, City	299 Johnson Avenue, Waseca, Minnesota
Country	United States of America
Phone number	+1 507 835 63 48
Fax number	+1 507 835 69 99

Drawn up in	Niekerk, The Netherlands
Date	October 16, 2000

CE

Part No. 001-4008-101/102

DATARADIO COR Ltd
299 Johnson Ave, P.O. Box 1733
Waseca, MN 56093-0833 USA
Phone: 1-800-992-7774; 507-835-8819
Fax: 507-835-6648
Website: www.dataradio.com

DATARADIO ®

Declaration of Product Quality Assurance.

In accordance with the Conformity Assessment procedure referred to in article 10(3) of **Directive 1999/5/EC of the European Parliament and of the Council of 9 march 1999**Radio equipment and Telecommunication Terminal Equipment and their mutual recognition of their conformity (R&TTE directive), We, the undersigned,

Company	DATARADIO COR Ltd.
Address, City	299 Johnson Avenue, Waseca, Minnesota
Country	United States of America
Phone number	+1 507 835 88 19
Fax number	+1 507 835 66 48

certify and declare under our sole responsibility that for the following equipment:

Description	High-Speed Transparent Radiomodem Transceiver Series
Brand / Trademark	DATARADIO®
Model numbers	242-4016-xxx [T-96SR VHF] 242-4018-xxx [Integra TR VHF] 242-4046-xxx [T-96SR UHF] 242-4048-xxx [Integra TR UHF]

manufactured by:

Company	Dataradio COR Ltd.
Address, City	299 Johnson Avenue, Waseca, Minnesota
Country	United States of America
Phone number	+1 507 835 88 19
Fax number	+1 507 835 66 48

the QA Manual on the following pages describes the philosophy, processes and procedures that are currently in place to confirm that the manufacturing process ensures compliance of the manufactured products with the technical documentation as established by DATARADIO COR Ltd. under the requirements of the R&TTE directive and with the requirements of the R&TTE directive that apply to them.

$C\epsilon$

Drawn up in	Niekerk, The Netherlands
Date	16 October 2000
	Mark a. Christensen

1.2.5 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 Windows95 or later operating system. Integra-TR requires the use of the Integra-TR Field Programming Software for both configuration and adjustment.

1.3 FACTORY TECHNICAL SERVICE

 The Technical Service Department provides customer assistance on technical problems and serves as an interface with factory repair facilities. They can be reached in the following ways:

DATARADIO COR Ltd.
299 Johnson Avenue, P.O. Box 1733
Waseca, MN 56093-0833

Technical Service hours are: Monday to Friday 7:30 AM to 4:30 PM, Central Time

Phone: 1-800-992-7774
1-507-833-6701 or 1-507-833-8819
Fax:1-507-833-6748
Email address: support@dataradio-cor.com

1.4 PRODUCT WARRANTY

The warranty statement for the Integra-TR is available by contacting your sales representative. DRL warranties are included in .pdf format on CD versions of DATARADIO technical manuals.

1.5 REPLACEMENT PARTS

This product is normally not field-serviceable, except by the replacement of complete units. Specialized equipment and training is required to repair logic boards and radio modules.

Contact Technical Service for information before returning equipment. A Technical Service representative may suggest a solution eliminating the need to return equipment.

1.6 IF A PROBLEM ARISES...

Component level repair is not recommended on the Integra-TR. DRL's factory is best equipped to diagnose problems and make component level repairs. Contact Technical Service before returning equipment. A technician may suggest a solution eliminating the need to return equipment.

1.6.1 FACTORY REPAIR

 Dataradio products are designed for long life and failure-free operation. If a problem arises, factory service is available. Contact the Technical Service Department before returning equipment. A service representative may suggest a solution eliminating the need to return equipment.

A Return Material Authorization (RMA) is required when returning equipment to Dataradio for repair. Contact the Technical Service Department at 800-992-7774 (extension 6707) or send an email (rma@dataradio-cor.com) to request an RMA number. Be prepared to give the equipment model and serial number, your account number (if known), a detailed reason for return, a "ship to" address (with return shipping instructions), a "bill to" address, and a contact name. No equipment will be accepted without an RMA number.

Include the RMA number, a complete description of the problem, and the name and phone number of a contact person with the returned units. This information is important. The technician may have questions that need to be answered to identify the problem and repair the equipment. The RMA number helps locate your equipment in the repair lab if there is a need to contact Dataradio concerning the equipment. Units sent in for repair will be returned to the customer re-tuned to the current Dataradio Test and Tune Procedure and will conform to all specifications noted in this section

Customers are responsible for shipping charges (to Dataradio) for returned units in warranty. Units in warranty are repaired free of charge unless there is evidence of abuse or damage beyond the terms of the warranty. Dataradio covers return shipping costs for equipment repaired while under warranty.

Units out of warranty are subject to repair service charges. *NOTE: All requests for out of warranty repairs require a purchase order and are subject to credit approval.* Customers are responsible for shipping charges (to and from Dataradio) on units out of warranty. Return shipping instructions are the responsibility of the customer.

1.7 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 where dust and/or a corrosive atmosphere are anticipated. Physically, there are no external switches or adjustments. All operating parameters are set using the Field Software Program.

1.8 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.

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1.9 FIRMWARE UPGRADES

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

Upgrades are done using a PC connected to the Integra-TR but do not require opening the unit. Upgrades require intervention with DRL's Technical Service.

1.10 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.

1.10.1 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.

1.10.2 BASIC CONNECTIONS

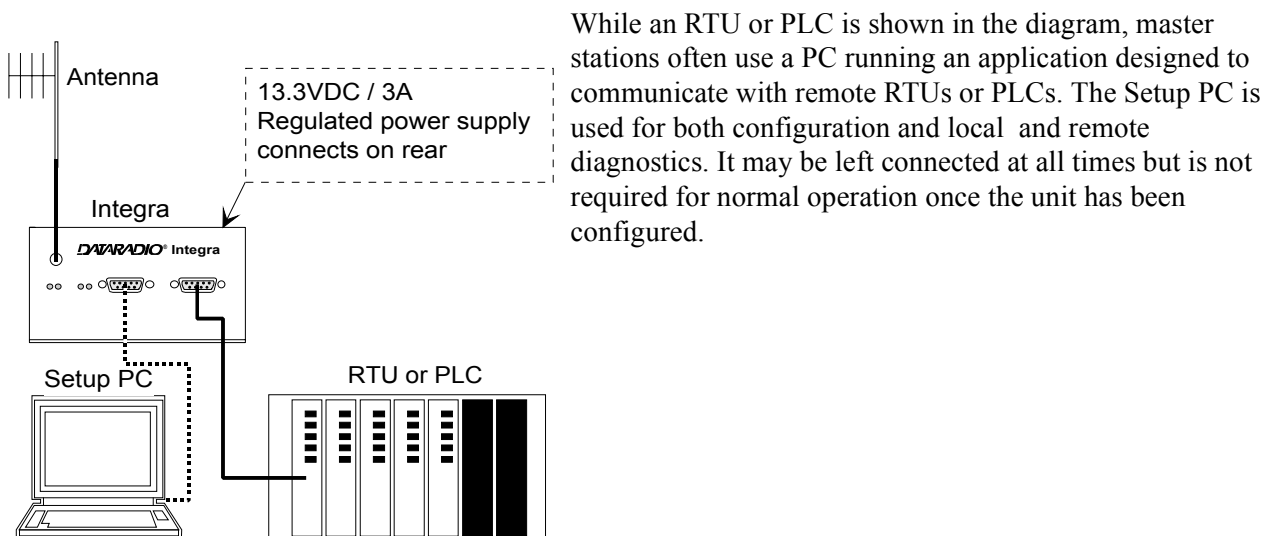The connections required are shown in Figure 1-3.

Antenna

13.3VDC / 3A
Regulated power supply
connects on rear

Integra

DATARADIO® Integra

Setup PC

RTU or PLC

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 1-3   Basic Required Connections

1.10.3 COMMON CHARACTERISTICS

The networks described in this section share common characteristics:

1. The network speed (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.

1.10.4 POINT-TO-POINT SYSTEM

A simple point-to-point connection is shown in Figure 1-4.

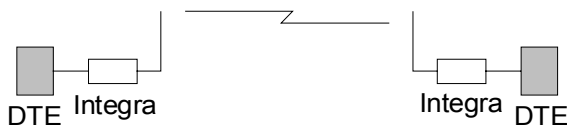DTE Integra   Integra DTE

Figure 1-4   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.

1.10.5 POINT-MULTIPOINT SYSTEM

Basic point-multipoint systems are shown in Figure 1-5:

remote

Master
(simplex or half-duplex)   remote
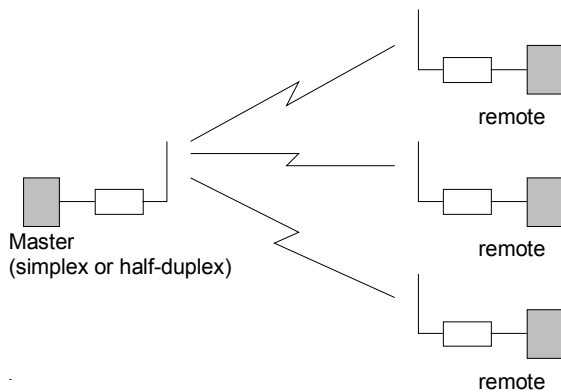
remote

Figure 1-5   Point-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.
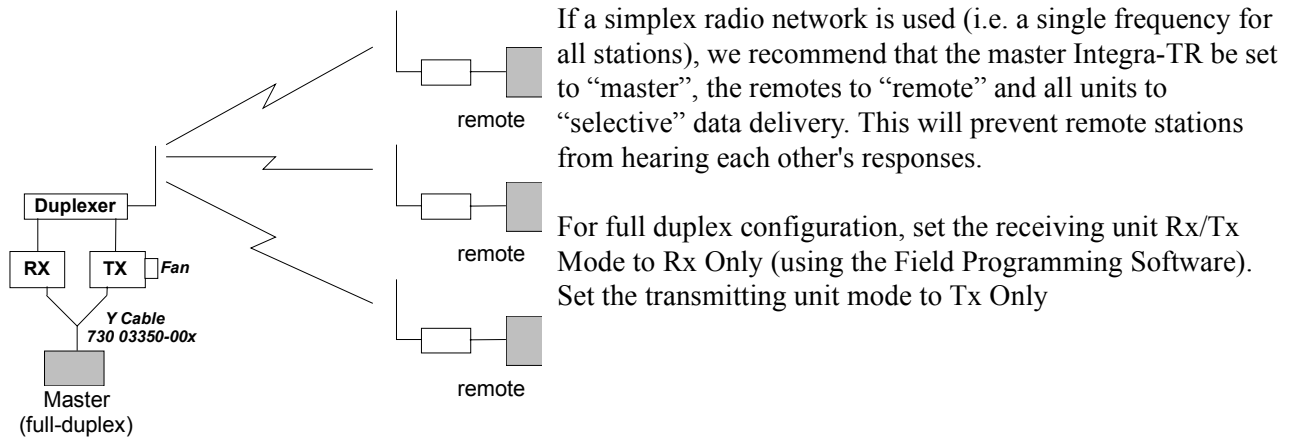
If a simplex radio network is used (i.e. a single frequency for all stations), we recommend that the master Integra-TR be set to "master", the remotes to "remote" and all units to "selective" data delivery. This will prevent remote stations from hearing each other's responses.

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 1-6   Point-Multipoint System (Full-duplex)
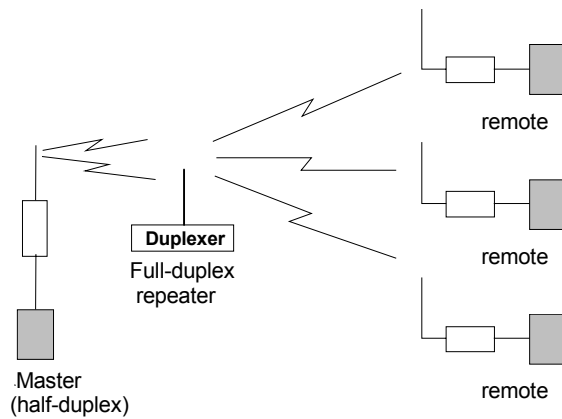
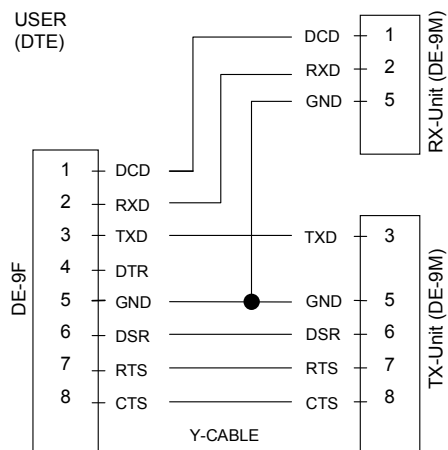**Figure 1-7   Point-Multipoint System (Full-duplex Repeater)**

Figure 1-8   Integra-TR Full-duplex Base Station Pinout

1.10.6 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 1-9. The tail circuit assembly may be used in any of the network types described in the preceding sections.
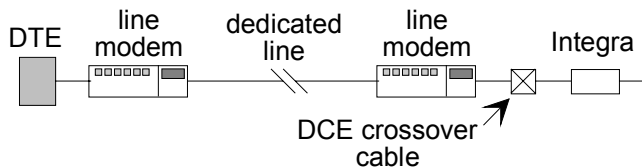

Figure 1-9   Landline (Tail Circuit)

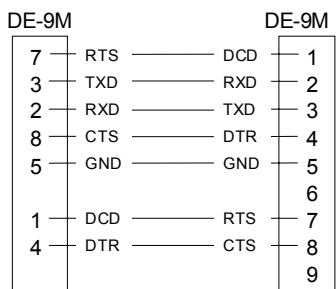Note: The line modems should be full duplex units.

Figure 1-10   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 1-11.

DE-9M   DE-9M

```
4 ─── DTR ─────── DCD ─── 1
3 ─── TXD ─────── RXD ─── 2
2 ─── RXD ─────── TXD ─── 3
8 ─── CTS ─────── RTS ─── 7
5 ─── GND ─────── GND ─── 5
                         6
1 ─── DCD ─────── DTR ─── 4
7 ─── RTS ─────── CTS ─── 8
                         9
```
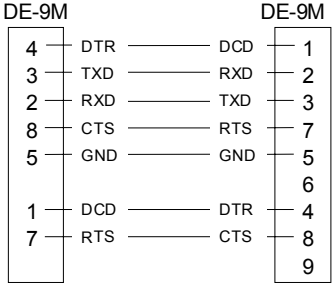
Figure 1-11   DCE Crossover Cable for DOX Mode

GENERAL SPECIFICATIONS

These specifications are subject to change without notice.

GENERAL	VHF	UHF	900 MHz
Frequency	132-174 MHz	380-403 MHz* 403-512 MHz	928-960 MHz
Channels	One channel		
Channel Bandwidth	6.25 (VHF and UHF only), 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	<170 mA (with a terminal connected to Integra-TR COM port)		
Tx Current Drain at 13.3 VDC	<2.0 A		<2.5 A
Low Power Mode Current Drain	20 mA		
Cold start [1]	4 sec (typical)		
Warm Start Rx [2]	45 to 60 msec (depending on radio model and temperature)		
Warm Start Tx [3]	55 to 70 msec (depending on radio model and temperature)		
Tx Turnon Time [4]	15 ms (typical)		
Rx/Tx Bandwidth, without tuning	18 MHz (132-150) 24 MHz (150-174)	16 MHz except 20 MHz (450-470)	32 MHz
Nominal Dimensions	4.5" W x 2.2" H x 4.75" D (11.4 x 5.6 x 12.1 cm)		

*380 to 403 MHz frequency band is not FCC or IC type approved

RECEIVER	VHF	UHF	900 MHz
Sensitivity	0.35 µV for 12 dB SINAD*		
Selectivity (25 kHz)	75 dB typical, 70 dB minimum		72 dB typical, 65 dB minimum
Selectivity (12.5 kHz)	65 dB typical, 60 dB minimum		63 dB typical, 60 dB minimum
Selectivity (6.25 kHz)	TBD	TBD	N/A
Intermodulation	75 dB typical, 70 dB minimum		72 dB typical, 70 dB minimum
Spurious Rejection	75 dB typical, 70 dB minimum		75 dB typical, 70 dB minimum
FM Hum and Noise	-48 dB typical -45 dB max (25 kHz)	-48 dB typical -45 dB max (25 kHz)	-43 dB typical -40 dB max (25 kHz)
Conducted Spurious	< -57 dBm		

*psophometrically weighted

TRANSMITTER	VHF	UHF	900 MHz
RF Power Output	1 to 5 Watts, software adjustable		
Spurious and Harmonics	-63 dBc (-26 dBm) typical -57 dBc (-20 dBm) max.	-75 dBc (-38 dBm) typical -63 dBc (-26 dBm) max.	-75 dBc (-38 dBm) typical -57 dBc (-20 dBm) max.

Frequency Stability
    12.5 and 25 kHz
    6.25 kHz
	
	2.5 PPM
	1 PPM
		
		1.5 PPM
		1 PPM
			
			1.5 PPM

FM Hum and Noise	-50 dB typical (25 kHz) -45 dB max (25 kHz)	-50 dB typical (25 kHz) -45 dB max (25 kHz)	-50 dB typical (25 kHz) -40 dB max (25 kHz)
Attack Time	< 7 ms		
Tx Duty Cycle	50%, max. Tx time 30 seconds, extended Tx time with the cooling fan option		

[1] Cold Start: time from DC power applied until unit is fully ready to receive or transmit data
[2] Warm Start Rx: in low power modes (sleep or suspend), wake-up time for full receiver recovery
[3] Warm Start Tx: in low power modes (sleep or suspend), wake-up time for full transceiver operation
[4] Tx Turnon Time: typical Rx to Tx switching time for stable transmission

Part No. 001-4008-101/102

Modem / Logic	
Operation	Simplex / half duplex
Data Bit Rates	25 kHz channel: 4800 b/s, 9600 b/s, 19200 b/s
Modulation Type	DRCMSK (Differential Raise-Cosine Minimum Shift Keying)
RTS/CTS Delay (RTS mode)	4 ms
Addressing	8 bit station address, 1 bit station type (master / remote)
Bit Error Rate (BER) 2400 b/s 6.25 kHz 4800 b/s 6.25 kHz 9600 b/s, 12.5 kHz 9600 and 4800 b/s, 25 kHz 19200 b/s, 25 kHz	 TBD TBD 1 x 10 -6 at 1.4 µV minimum /-104 dBm 1 x 10 -6 at 1.0 µV minimum / -107 dBm 1 x 10 -6 at 2.3 µV minimum / -100 dBm

COM Port	
Interface	EIA RS-232C
Data Rate	300 - 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.

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/Analog	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

FCC / IC Certifications			
	FCC 6.25 kHz	**FCC 12.5 & 25 kHz**	**IC (DOC)**
VHF	NP4MCUA5Q 3K75F1D, 3K42F1D	EOTMCUA5R 9K30F1D, 15K3F1D	773195562A 9K30F1D, 15K3F1D
UHF	NP4MCUB5Q 3K75F1D, 3K42F1D	EOTMCUB5R 9K30F1D, 15K3F1D	773195561A 9K30F1D, 15K3F1D
900 MHz	-	EOTMCUC5R 9K30F1D, 15K3F1D	7731955611A 9K30F1D, 15K3F1D

2.1 OVERVIEW

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

2.2 FRONT PANEL

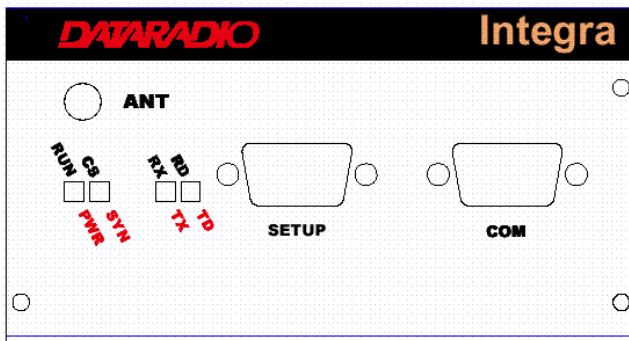The various front panel elements are described in the following sections.

Figure 2-1   Integra-TR Front Panel

2.2.1 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.

2.2.2 Connection to DTE

Integra-TR is configured as DCE. Most DTE should be connected using a nine-conductor pin-to-pin "straight" cable. Some RTUs or PLCs may require a special cable to route the signals correctly. See the documentation for your data equipment for further information.

2.2.3 LED Indicators

Integra-TR has four two-color LED indicators. Their functions are shown in Table 2-1.

Table 2-1 LEDs Color Functions

RUN/PWR	Green	Normal operation
	Flash green	Sleep mode (flashes during wakeup)
	Flash red & 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.

2.2.4 COM Port

Baud rates from 300 to 19200 are supported. Integra-TR's are factory set (default) for 9600 b/s, 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 2-2   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 Will "wake up" unit in sleep 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

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2.2.4.1 Connector Pin Out

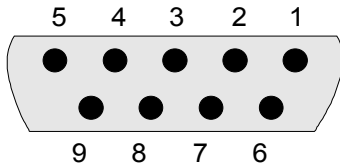The DE-9F pin out is shown in Figure 2.2 for reference.

Figure 2-2   COM and Setup Port Connectors Pin Locations

2.2.4.2 Wire Connection (DOX) Field Programming Software

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").
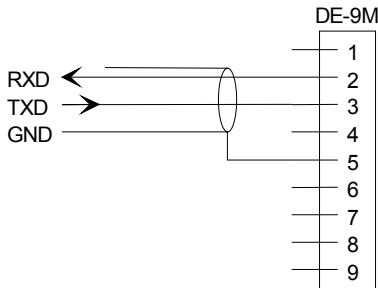

Figure 2-3   3-Wire Interface

2.2.5 Setup Port

The Setup port uses a DE-9 female connector configured as DCE. Signals are described Table 2-4.

Table 2-3   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. Also monitored to "wake up" unit from sleep mode
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 numeric diagnostics information when connected to a PC terminal emulator.

Part No. 001-4008-101/102
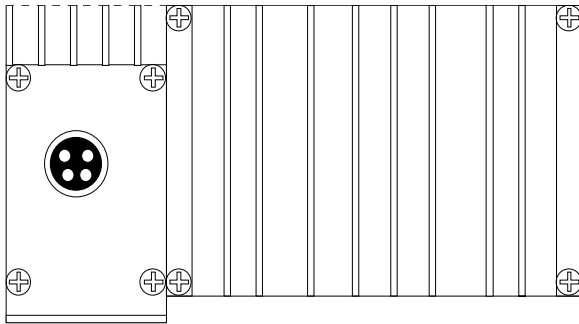
2.3 REAR PANEL

Figure 2-4   Integra-TR rear panel

The various elements are described in the following sections.

2.3.1 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.

2.3.2 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 16Vdc.

2.3.3 Power / Analog Connector

The 4-pin power / analog connector pin out is shown in Figure 2-5.

+13.3 VDC (1)   (2) GND
   (red)   (black)

Analog 1 (3)   (4) Analog 2 /
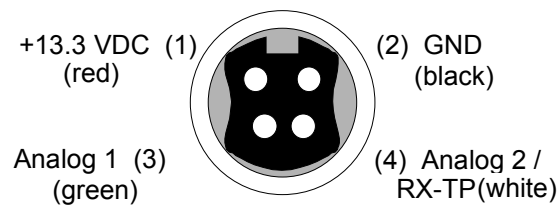   (green)   RX-TP(white)

Figure 2-5   Analog Connector

Note: The color of the power cable wires are shown in parenthesis. If the analog connections are not used the green and white wires should be cut back and/or taped to prevent contact. (See Table 1-1 for power cable part number.)
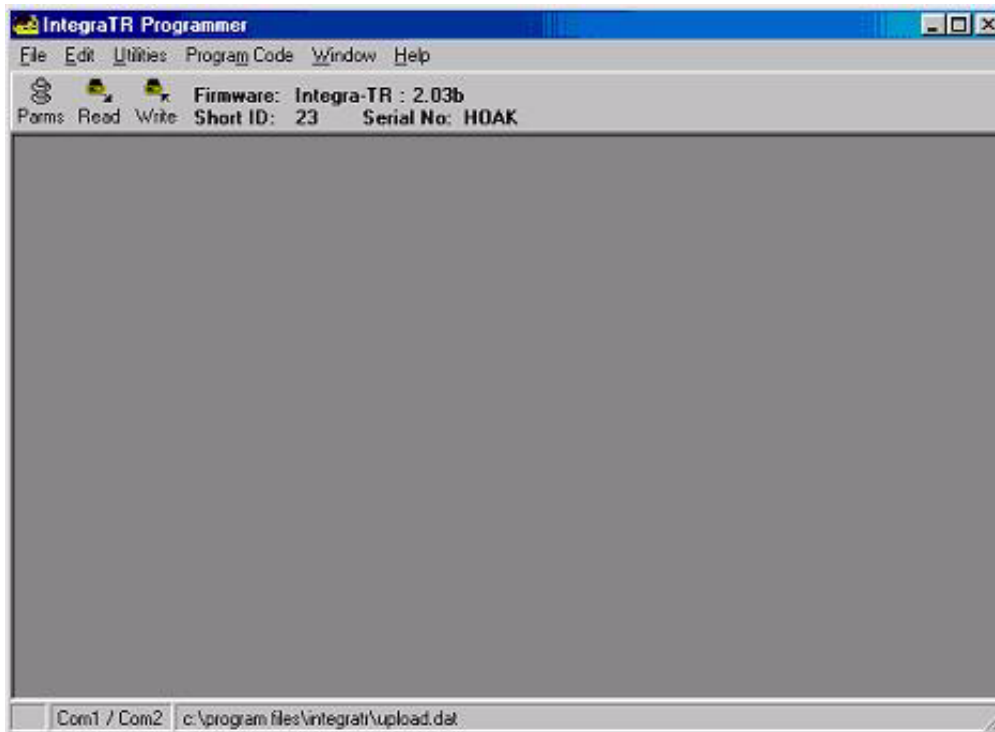
Figure 2-6 Integra-TR Field Programming Software Startup Screen

2.4 INTEGRA-TR FIELD PROGRAMMING SOFTWARE

2.4.1 Introduction

The Integra-TR Field Programming Software is the programming and diagnostics software for the Dataradio 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 2-6 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.

2.4.2 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 2-7). 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.

2.4.2.1 COM Port Parameters

COM Port

Selects COM Port number (COM 1-4) for Primary and Secondary COM Ports (see Figure 2-7).
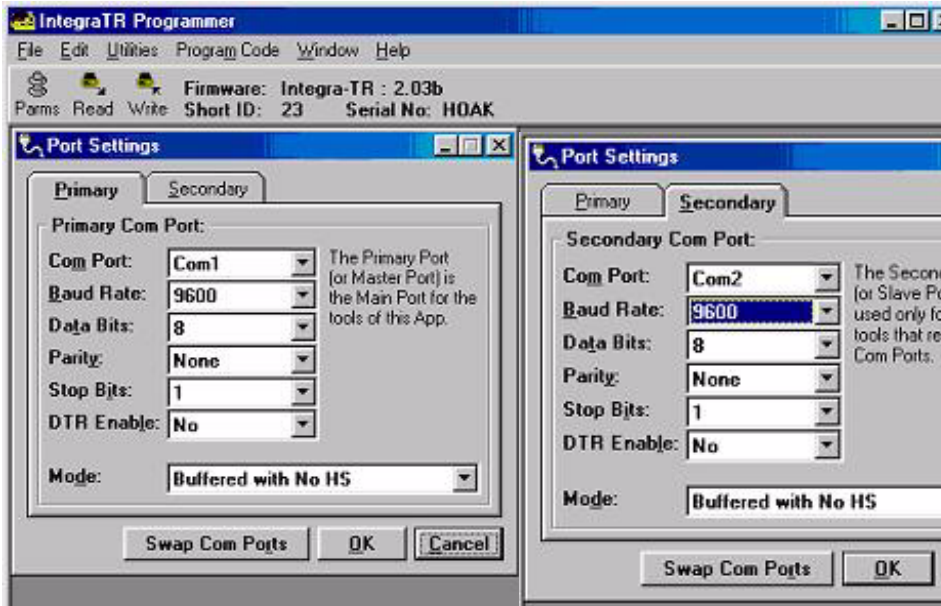
Figure 2-7   Port Settings Screens

Baud Rate
Selects the communication speed for Primary and Secondary COM Ports.

Data Bits

Selects the number of data bits (4-8) 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.

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.

2.4.2.2 Primary and Secondary Port Settings Communications Modes

The Mode drop down menu configures the communications mode for the Primary and Secondary PC Port.

See Table 2-4 for Communication Modes configurations.

Table 2-4   Communication Modes

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.
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.

2.4.3 Port Statistics

Port Statistics show current parameters of the PC's Primary and Secondary COM Ports.

Figure 2-8   Port Statistics Screen

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.

2-7

<u>DCD</u>

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

<u>Bytes Tx'ed</u>

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

<u>Bytes Rx'ed</u>

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

<u>Framing Errors</u>

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

<u>Dribble Bytes</u>

Dribble Bytes shows the number of extra (not expected) bytes (characters) received since the port was last opened.

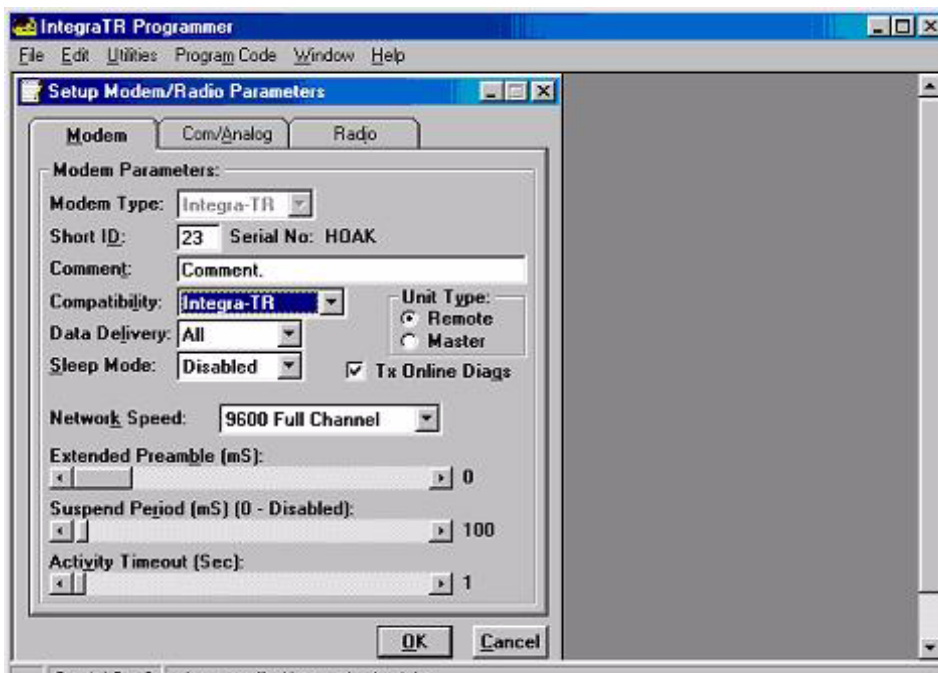## 2.4.4 Setup Modem/Radio Parameters

Figure 2-9   Setup Modem/Radio Screen

The Setup Modem/Radio Parameters screen is accessed from the Edit menu pull-down (see Figure 3-1) or from the Parms icon when the tool bar is visible.

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2.4.3.1 Modem Operating Parameters

The 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/Write Parameters screen for programming into nonvolatile memory.

Parameter settings are modified from three screen tabs: the Modem tab, Com/Analog tab, and Radio tab. When desired parameters in each tab window have been adjusted, select the OK button to store the parameter information into local 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 memory.

Modem operating parameters include:

Short ID

The user-defined number (1 to 254) that identifies an individual unit in a network.

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 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 and 4800 b/s quarter-channel units, 4800 and 9600 b/s for half-channel units, and 4800, 9600, 19200 b/s for full-channel units. Use the Integra-TR mode whenever feasible.

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

Sleep Mode

Sleep Mode is one of Integra-TR's three low power modes of operation (along with "Reduced Transmit Power" and "Suspend Mode"). When Sleep Mode is enabled, the unit is in low power consumption (approximately 7 mA). The unit cannot detect the presence of carrier in sleep mode. Asserting RTS on the COM or Setup Ports wakes the unit. The unit will receive and decode data within 45 to 65 ms (dependent on model and temperature) after wake-up.

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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

Designating a unit as Master or Remote sets a flag in the header identifying Unit Type of originating station. This function is used in conjunction with "Data Delivery" when running certain user protocols.

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 units Setup Port regardless of the Tx Online Diags settings. Where continuous data transmissions are required from a Master unit, diagnostics are sent at 20 second intervals.

Diagnostics information includes:

- Short ID,
- Internal case temperature (in Celsius),
- Battery voltage (in volts),
- RSSI (in dBm),
- Forward Power (in watts),
- Reverse Power Indicator,
- Remote RSSI
- Receive quality.

Network Speed

This field selects the network speed (bit rate) of the RF link between units. The can vary from the COM Port baud rate but must be the same for all units in a network:
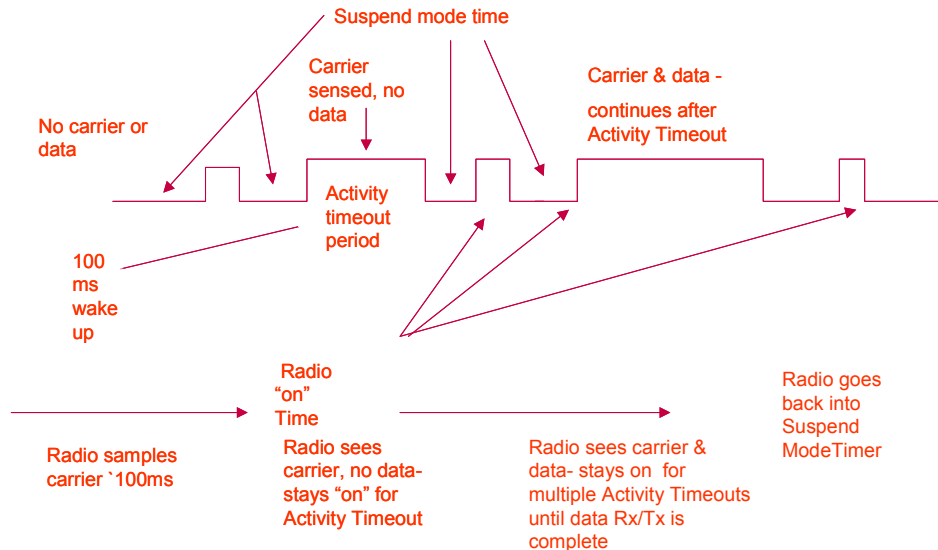
- 2400 b/s for one-quarter channel models of Integra-TR
- 4800 b/s - selectable for quarter-, half- and full-channel models of Integra-TR and for full-channel models of Integra-T
- 9600 b/s - selectable for half- and full-channel models of Integra-TR and for full-channel models of Integra-T
- 19200 b/s - selectable for full channel models of Integra-TR only

Extended Preamble

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

Integra-TR

Suspend Mode Time Graphic (not to scale)

Suspend mode time

Carrier sensed, no data

Carrier & data - continues after Activity Timeout

No carrier or data

Activity timeout period

100 ms wake up

Radio "on" Time

Radio goes back into Suspend ModeTimer

Radio samples carrier `100ms

Radio sees carrier, no data- stays "on" for Activity Timeout

Radio sees carrier & data- stays on for multiple Activity Timeouts until data Rx/Tx is complete

Note: Graphic uses 100 ms timing parameter as required by Suspend Mode.

Figure 2-9   Suspend Mode Timing Graphic

Suspend Period

This field is used to set the period of time until a unit goes to cycled low power mode - range is 50 to 12,000 mS in 50 mS intervals. Setting to a value of 0 disables Suspend Mode.

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 Mode is enabled. A non-zero value must be set to enable Suspend Mode. The same Activity Timeout and Suspend Period values must be set for both Master and Remote units. See Figure 2-10 for a Suspend Mode Timing graphic.

2.4.3.2 Com/Analog Operating Parameters

The Com/Analog tab allows user programming of various COM Port and External input/output parameters see Figure 2-11).

Tx Control

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

- RTS - Request to Send
- DOX - Data Operated Transmit
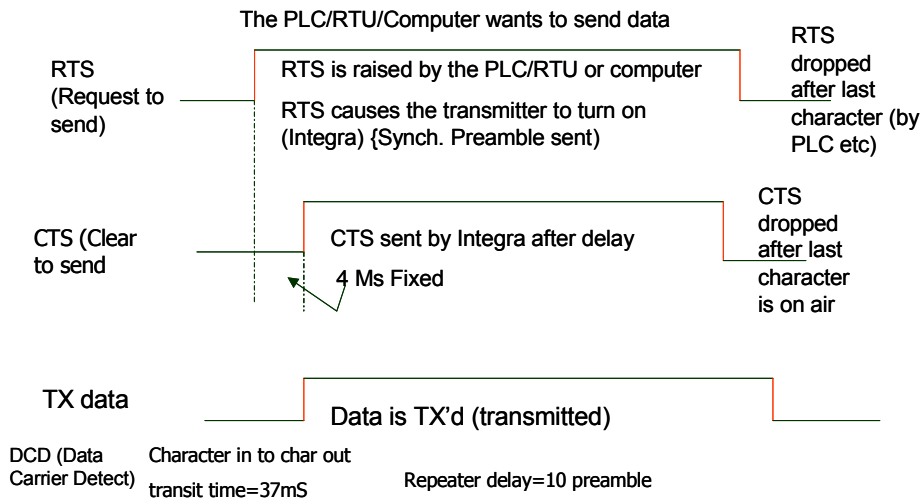
2-11

Integra-TR Control Signal Timing

Figure 2-10   Transmit Control Signal Timing Graphic

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 2-10).

Figure 2-11   Com/Analog Setup Parameters Screen

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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 Network Speed)

- 300
- 1200
- 2400
- 4800
- 9600
- 19200

For best results, Dataradio recommends using the same rates for both the COM Port and Network Speeds.

DTE Data Format

This field selects the format for the COM Port. All units in a network must use the same DTE data format:

8 bits, no parity, 1 stop	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
- 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 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.)

<u>Analog 1</u>

Analog 1 selects configuration of Pin 3 of the Power/Analog connector (green wire):

- Input - for use on units not equipped with the cooling option - can be used to monitor an external voltage (0 to 10 volts)
- Fan Control - regulates an external fan. Factory set (enabled) and the default for all units equipped with the cooling option. The temperature-controlled open-collector transistor is rated for 100 mA max. The unit's internal thresholds are set for ON at 48 degrees C and OFF at 38 degrees C. This selection is dependent on hardware configuration and should not be changed in the field.

<u>Analog 2</u>

This field selects configuration of Pin 4 of the Power/Analog connector (white wire):

- 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 - 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.

2.4.3.3 Radio Operating Parameters

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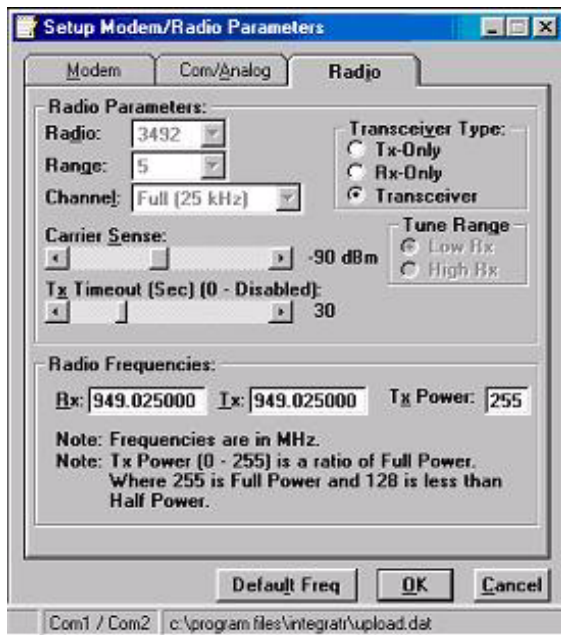

Figure 2-12   Radio Setup Parameters Screen

<u>Radio</u>
This field designates the radio model.

Range

This field designates radio frequency range.

Channel

This field specifies whether the unit is quarter-, full-, or half-channel (6.25, 12.5, or 25 kHz).

Transceiver Type

This field configures the transmitting and receiving characteristics of the unit according to 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

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.

Rx Frequency

Rx Frequency designates channel pair transmit frequency.

Tx Frequency

Tx Frequency designates channel pair receive frequency

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 or to increase the allowable transmit duty cycle.

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

2.4.4 Apply Station Reset

Station Reset tells the Integra-TR to perform a software reset. Performing a Station Reset reacts the same as cycling power to the unit.

Figure 2-13   Station Reset Screen

2.4.5 Version Request

Selecting Version Request causes the Integra-TR Field Programming Software to display information about the version of the Integra-TR hardware and firmware.

Figure 2-14   Version Request Screen

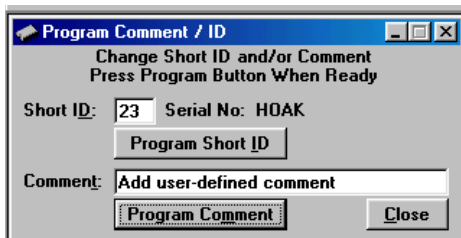## 2.4.6 Program Comment / ID

Figure 2-15   Program Comment / ID Screen

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 2-15)

Short ID

The number (1 to 254) 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.

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2.4.7 Radio Parameter Cloning

Figure 2-16   Clone Programmable Parameters Screens

After the initial Integra-TR parameters are programmed, saved, and stored in local memory, other Integras in the system can be quickly programmed using the cloning option under the Edit pull-down menu. Clone Programmable Parameters will program the radio with all of the currently loaded parameters except the Short ID and Comment. The cloning option is useful if there is a need to change the DTE Baud Rate for a number of radios in a system.

2.4.8 Writing / Reading Integra-TR Parameters

After all radio parameters are setup, select the OK button to store the information into the PC's memory. To load parameters into the Integra-TR, initiate a Write Programmable Settings from the Edit menu or select the Write icon from the Tool Bar. After the programmable parameters are loaded into the Integra-TR, save the parameter information using the Save Data As option in the File pull-down menu. The name and location of the file (*.dat extension) will appear on the status bar at the bottom of the screen.

The Read Programmable Settings command will read parameters from the current Integra-TR and store the information in local memory. The parameters can be viewed and/or edited with the Setup Modem/Radio Parameters screens.

Note: Dataradio recommends a Read be done anytime an initial connection is made to the Integra-TR Setup Port before accessing the Setup Modem/Radio Parameters screen. This will help avoid writing erroneous parameters to the connected unit.

2.4.9 Offline Link Test

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 are calculated. *NOTE: An Offline Link Test requires suspension of network operation.*

An Offline Link Test returns the following statistics (see Figure 2-17):

Local ID

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

Remote ID

The Remote ID combo box allows selection of the unit (by choosing it's Remote ID) from which the Link Test information is gathered. Remote IDs are set up in the Diagnostic IDs and Alarms Screen.
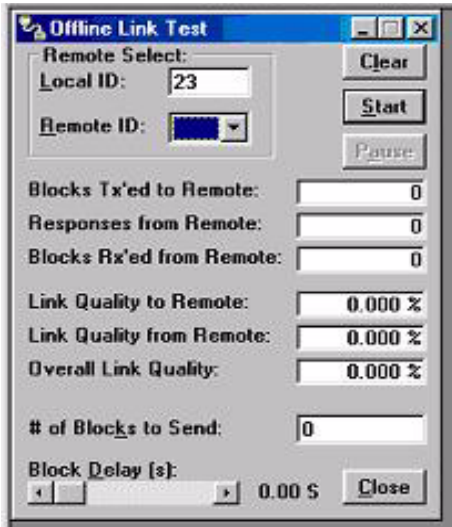
Figure 2-17   Offline Link Test Screen

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 (in the last 15) 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).

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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.

2.4.10 Offline Diagnostics

Offline Diagnostics are returned from a local or remote unit in response to a Get Diags request (see Figure 2-18). An Offline Diagnostics request requires suspension of network operation. 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)
- Reverse Power: Reverse Power (in watts)
- Analog Input 1: voltage on the External Analog 1 Input from the Power/Analog connector (in volts)
- Analog Input 2: voltage on the External Analog 2 Input from the Power/Analog 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.

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 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.

Figure 2-18   Offline Diagnostics 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 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) while the local unit is transmitting.

Rev Pwr

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

<u>Progress</u>

The Progress panel shows the progress of the Get Diags request.

<u>Tx Mode</u>

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.

<u>F5</u>

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

<u>F6</u>

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

Note: Telling 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 2-9).

2.4.11 Online Diagnostics

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. 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 2-20). 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.
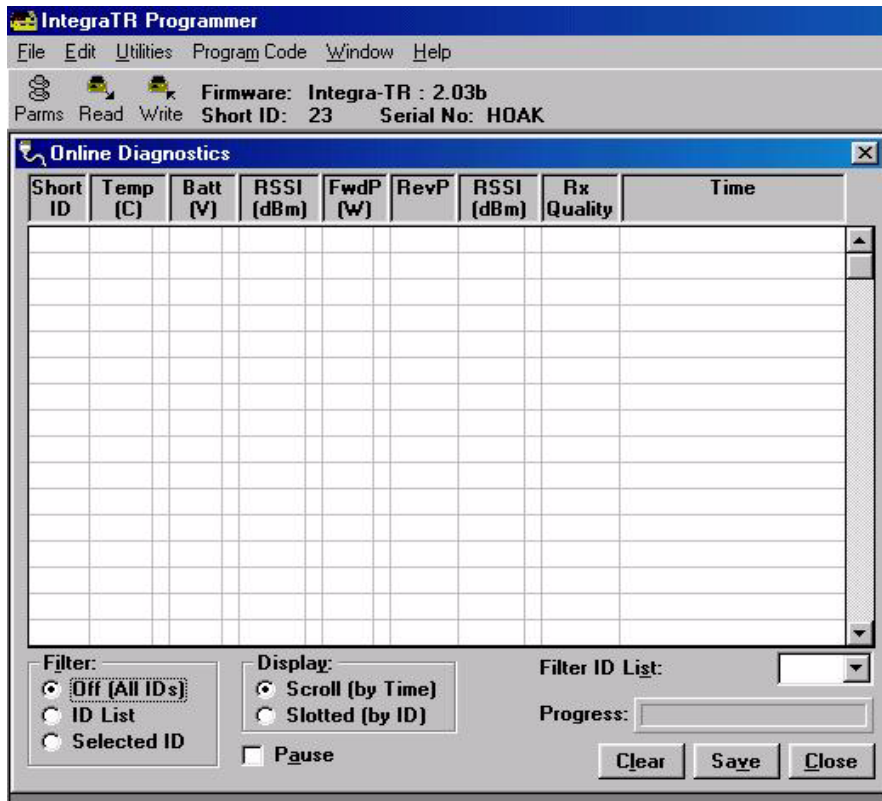
Figure 2-19   Online Diagnostics

The following Online Diagnostics are available:

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.

RSSI

RSSI displays the RSSI (in dBm) ID of the unit transmitting the diagnostics. This is the RSSI sampled during the last transmission the unit received.

FwdP

FwdP displays the forward power (in watts) of the unit transmitting the diagnostics.

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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.

RSSI

RSSI displays the Remote RSSI (in dBm) of the unit last transmitting the diagnostics. This is the RSSI found in the Online Diagnostics of the last transmission received by the unit.

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

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.

Progress

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

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.

<u>Save</u>

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

2.4.12 Diagnostic IDs and Alarms

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.
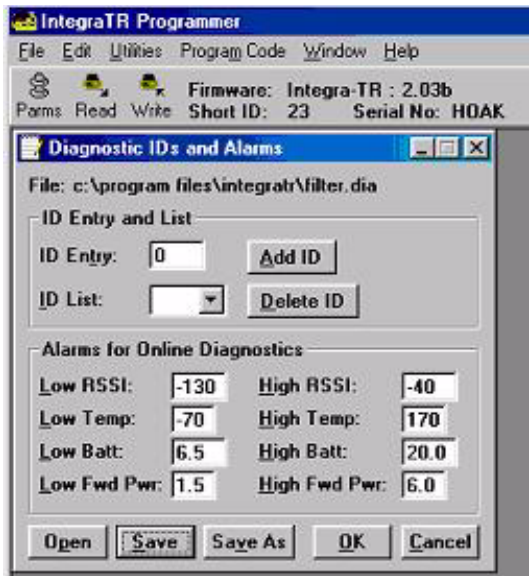

Figure 2-20   Diagnostic IDs and Alarms Screen

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 255. 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.

Alarms

Alarms are used 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.

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

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

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

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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 restore 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.

2.4.13 User Test

Figure 2-21   User Test Screen

The User Test utility is an offline function and requires suspension of network operation. 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)

<u>Temperature</u>

Internal temperature (in degrees Celsius)

<u>Forward Power</u>

Forward power (in watts)

<u>Reverse Power</u>

Reverse power (in watts)

<u>Analog Input 1</u>

Voltage on the External Analog 1 Input from the Power / Analog Connector (in volts)

<u>Analog Input 2</u>

Voltage on the External Analog 2 Input from the Power / Analog Connector (in volts)

<u>Preamble Good</u>

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.

<u>Preamble Total</u>

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.

<u>RSSI /Pwr</u>

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

<u>Rev Pwr</u>

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

<u>Tx Mode</u>

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 square wave
● Random Data - the unit transmits random data
● No Modulation - the unit transmits with no modulation

<u>Rx / Tx Frequency</u>

Rx / Tx Frequency shows the current transmit frequencies.

<u>F5</u>

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

<u>F6</u>

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

2.4.14 ASCII / Hex Terminal

Terminal Screens allow the user to select an ASCII or Hexadecimal Terminal Screen for the Primary and Secondary COM Ports (configured in the Port Settings screen - see Section 2.4.3) Data is sent according to the port configuration set up in the Port Settings screen.
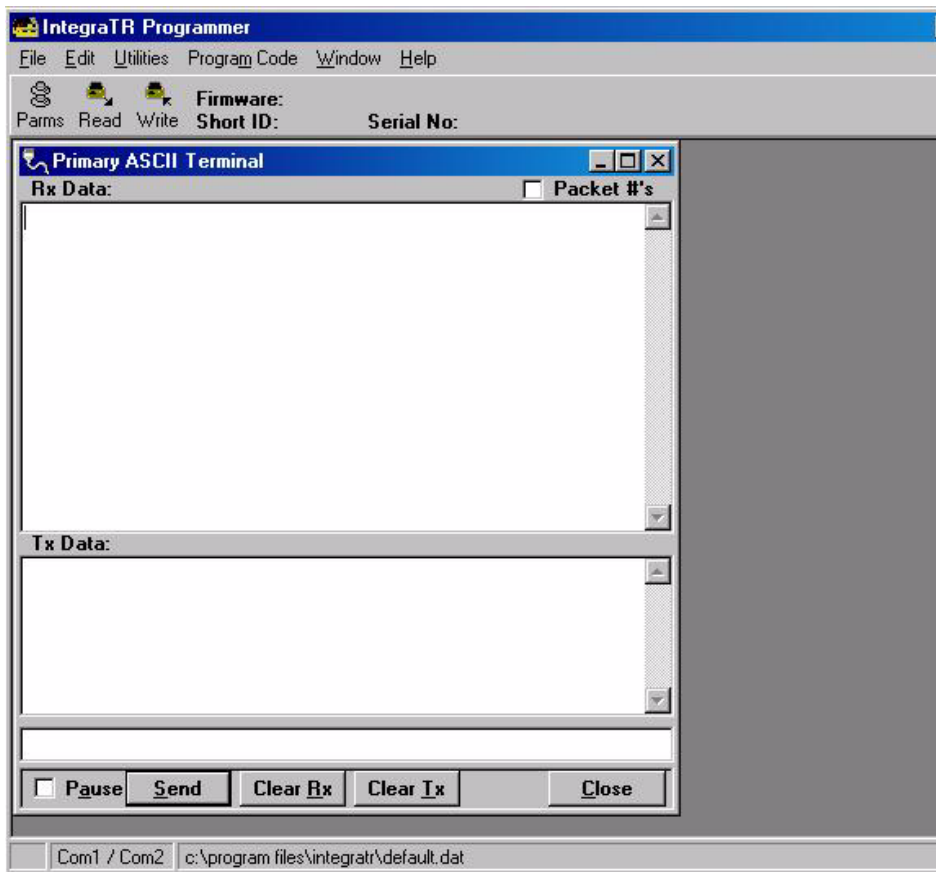

Figure 2-22   ASCII Terminal Screen

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2.4.14.1 ASCII Terminal

ASCII Terminal configurations include:

<u>Primary</u>

The Primary ASCII Terminal screen sends and receives ASCII data on the Primary COM Port (set up in the Port Settings screen).

<u>Secondary</u>

The Secondary ASCII Terminal screen sends and receives ASCII data on the Secondary COM Port (set up in the Port Settings screen).

2.4.14.2 HEX Terminal

Hex Terminal configurations include:

<u>Primary</u>

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).

<u>Secondary</u>

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).

2.4.15 Program Code

The Program Code pull-down menu allows the user to update the Integra-TR firmware (*.bin) with the Program Firmware option. Select Modem Code File allows the user to select the file to program the firmware in the Integra-TR.
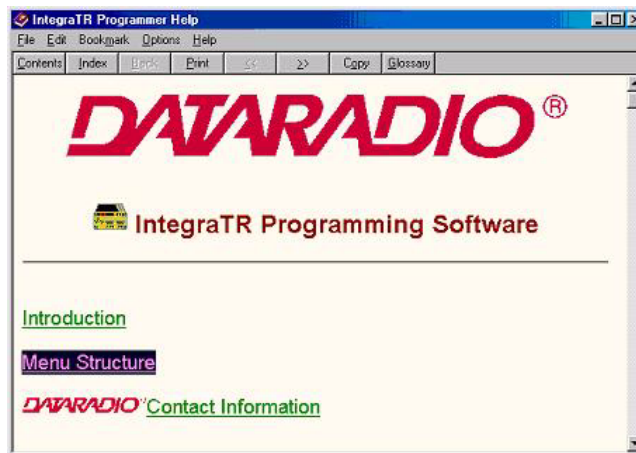
2.5 INTEGRA-TR HELP FILES

Figure 2-23   Integra-TR Online Help Introductory Screen

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

2.6 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 10 ms (depending on speed). In critical applications, this extra delay can be eliminated by disabling online diagnostics. Offline diagnostics (diagnostics on request) remain available.

MAINTENANCE AND ADJUSTMENTS

3.1 OVERVIEW AND MAINTENANCE INTERVALS

This chapter outlines the basic tests and adjustments required upon initial installation and thereafter at annual maintenance intervals or whenever deterioration in performance indicates that adjustment may be required. Units are delivered from the factory properly aligned and tested on the frequency range specified at time of order. Adjustment beyond that described in this chapter is not required unless radio modules have been tampered with or repaired. In such cases, we recommend complete factory re-alignment as special test equipment is required. This chapter is intended for use by installation and maintenance personnel.

3.2 EQUIPMENT REQUIRED

The adjustments described below require the following equipment:

1. 13.3 VDC / 5A regulated power supply.
2. Radio service monitor (IFR1200 or equiv.).
3. Cable with SMA male connector to connect Integra-TR to the service monitor.
4. Integra Field Programming Software kit.
5. A PC with Windows 95 or later operating system to run the Field Programming Software.
6. Normal radio shop tools.

3.3 TEST POINT

For trouble shooting aid, there is one test point available at pin 4 of the power/analog connector (white wire). This demodulated signal measurement is half the voltage read at the RSSI bar graph (found in the Field Programming Software).

Note: the RX-TP mode must be selected (*Analog Connector* window) using the Integra Field Programming Software.

3.4 BASIC TESTS / ADJUSTMENTS

Basic tests and adjustments to be performed are:

1. Transmitter power output
2. Transmitter frequency
3. Transmitter deviation
4. Carrier Sense
5. Demodulated signal level
6. 12 dB Sinad
7. Distortion

3.5 PRELIMINARY STEPS

Important Note: Before proceeding make sure that the service monitor has been calibrated recently and has warmed up for at least the time specified by its manufacturer. Some reported frequency and deviation problems have actually been erroneous indications from service monitors that have not adequately warmed up. This is particularly likely when field service is done during winter months.

1. Connect the Integra-TR antenna connector to the radio service monitor RF input using a 023-3410-118 or equivalent 50-ohm cable. That input should be able to support at least 5 watts.
2. Connect Integra-TR to the power supply and adjust the supply voltage to 13.3 volts.
   WARNING: Do not exceed 16 VDC during setting-up for tests and adjustments.
3. Using a 9-conductor straight RS-232 cable, connect the unit's Setup port to the RS-232 port of a PC and run the Integra Field Programming Software on the PC.
4. Press GET for the unit configuration.
5. From the Settings menu command, click on Radio Settings, set the frequency to be used for testing. Leave this window open and on top.
6. Follow the steps in Table 7.

3.5.1 AFTER ADJUSTMENTS ARE COMPLETED

Adjustments made using the Field Programming Software are temporary and must be made permanent as follows:

1. After all adjustments are completed satisfactorily, press "PUT" to save the changes permanently to the unit.
2. Press Station Reset to activate all configuration changes.

WARNING: The frequency band 406 to 406.1 MHz is reserved for use by distress beacons and should not be programmed into the unit.

Table 3-1   Tests and Adjustments for One-quarter, Half, and Full Channel Units

Step	Action	Expected Results	Measure With	If Not?
1	**Output Power**	5 W [1] + 10%, -20%	Service monitor set to read power	Adjust using the Field Programming Software *Power Out* setting (255 is the maximum) or refer to Factory Tech support
2	**Frequency Error** Press TX *Unmod*	Within ± 300 Hz	Service monitor set to read frequency	Adjust using the Field Programming Software *Freq Warp* setting. (Typical adjustment range is 1.5kHz) If found outside limits, call factory technical support.
3	**Deviation** Press TX tone For any bit rate speeds selected	Tol. +5%, -10% For Full channel: ±4.0 kHz For Half channel: ±2.5 kHz For One-quarter channel:	Service monitor set to read deviation with mid(15-30 kHz) IF filter	Adjust using the Field Programming Software *Deviation* setting (if required)
4	**Carrier Sense** Inject a non-modulated carrier at -120 dBm to the Integra-TR RF input; Raise the service monitor RF output until the CS LED comes on	The CS LED should be off The CS LED should come on within 2 dB from the value set by the Field Programming Software: Default: approx. -105 dBm (-110 in non-refarmed mode)		The threshold may be raised to prevent false CS operation in the presence of noise, intermodulation, or other sources of radio interference (e.g., for ambient noise at -100 dBm (measured with a spectrum analyzer), set the CS threshold for -95 dBm)
5	Set the service monitor to generate a -80 dBm signal on the selected receive frequency. The signal should be modulated with a 1.0 kHz tone at deviation specified below. Set service monitor IF filter to mid (15-30 kHz), no audio filter. *Note: Use test audio (pin 4) of the power/analog connector (white lead) for SINAD and distortion*			
6	**Demodulated Audio** Press *CHK* For any bit rate speeds selected: For Full channel unit: set deviation to ±4 kHz For Half channel unit: set deviation to ± 2.5 kHz For Quarter channel unit:	1 Vpp ± 0.1 If read at Test audio pin 4 of PWR analog connector		Adjust using *RXA adjust setting* (if required)
7	**12 dB SINAD** Set service monitor IF filter to mid (15-30 kHz) For Full channel unit: set deviation to ±3 kHz For Half channel unit: set deviation to ± 1.5 kHz For Quarter channel unit:	≤ 0.5 µV [2]	Service monitor set for **SINAD**	Refer to Factory Technical Support
8	Distortion Set service monitor IF filter to mid (15-30 kHz) *Deviation level as per SINAD above*	< 3%	Service monitor set for **DISTORTION**	Refer to Factory Technical Support

[1] (Unless you set a lower value). Note that readings less than 5 watts may be due to losses in the cables used for testing. Check your wattmeter frequency calibration curve.

[2]If a psophometrically weighted filter is available on the service monitor, use 0.35 µV.

NETWORK TROUBLESHOOTING

4.1 TROUBLESHOOTING OVERVIEW

The Field Programming Software provides help for the user to find problems on individual units within a network. This program runs (only) from the Integra Setup port.

Here is a list of tests that a user (having network communication problems) can try while using this software utility:

With user network application's running:

● Monitor the current network activity by using online diagnostics monitoring feature
● Gather diagnostics (i.e. local GET Status) from the unit connected to and check that they are within tolerances

With user network application offline:

● Check communication link between two units (i.e. Link test)
● Gather remote diagnostics (i.e. Remote GET Status) from a "suspect" remote unit and check that they are within tolerances
● Check RF signal strength of a particular remote unit transmitting a continuous unmodulated test carrier (i.e. Remote Carrier button)
● Check RF power output from the connected unit by using the Carrier test button. The RSSI bar graph will turn to a divided wattmeter (Forward and Reflected power)
● Check carrier frequency from the unit connected by using the Carrier button and a RF communication test set
● Check transmit deviation from the unit connected by using TX Tone button and a RF communication test set

4.2 INTDIAG

The Field Programming Software is divided into two distinct parts: the *Online* and *Offline* diagnostics.

4.2.1 ONLINE DIAGNOSTICS

Online diagnostics may be used for monitoring an operating network with the user's applications running. The diagnostics are piggy-backed (carried along with user data transmissions) and do not interfere with day-to-day operations. Refer to Table 4-1 for diagnostics, descriptions, and tolerances.
Maintaining a registry listing typical diagnostic readings for a network is an effective tool for comparing test readings and trend monitoring (system history). Variances in the data displayed can alert technicians to changes in network status. Earlier detection leads to earlier intervention.

4.2.2 OFFLINE DIAGNOSTICS

Offline diagnostics are used for trouble-shooting and test transmissions to remote units or to a local connected unit. Offline diagnostics are intrusive as they take control of radio channels. User applications must be offline.

4.3 GET STATUS

The Get Status function allows the user suspecting network communications problems to gather diagnostics and check tolerances as follows:

● Local GET Status: gathers diagnostics from the unit connected to the network
● Remote GET Status: gathers diagnostics from a suspect remote unit connected to the network

Values displayed are taken at the moment the GET Status button is pressed. The GET Status does not continuously update. Press the Clear button and press GET Status again to update the information.

Table 4-1 Diagnostic Information

Field Name	Description	Tolerance
Unit ID	Identifies the unit whose diagnostics are displayed	Between 1 & 254
FPWR	Approximate measure of transmit RF power If power read from Bar graph or from reported diagnostics *Note: If power read from an external wattmeter*	Normally 3.5 to 6.0W Normally 4.0 to 5.5W
RPWR	Approximate measure of reflected power. Online Diagnostics:	0 if reflected power is within limits, 1 if reflected power is too high. The threshold is set to approximately 1/4 of FPWR
	Offline Diagnostics:	Value is in watts, ideally close to zero, but values up to about 15% of FPWR may be encountered in properly operating systems. If a dummy load is used to test a unit, expect reflected power to be less than 0.2W
RSSI and Remote RSSI	If "Radio Source" is in "Remote" mode: ● the RSSI reading indicates local station signal strength in dBm as heard by the remote ● the Remote RSSI indicates how well the local unit receives the remote signal measured in dBm If "Radio Source" is in "Local" mode: ● the RSSI reading indicates how well the local unit receives the remote signal measured in dBm. ● the Remote RSSI reading indicates local station signal strength in dBm as heard by the remote	Normally +/- 3dB accuracy A good received signal level should be higher than -90dBm

<div align="right">table continued one 4-3</div>

4-2

Field Name	Description	Tolerance
Temp	Internal case temperature	Operating limits: -30 degrees C to +75 degrees C
SWB+	Selected unit main DC power measured in tenths of a volt from 6.0 to 18.8 volts, **WARNING: Do not exceed 16Vdc**. Application of more than 16 VDC will damage the unit and is not covered by the warranty.	Should nominally be close to 13.3VDC Operating limits: 10.0 to 16.0 V
Peak	Demodulated signal voltage: peak-to-peak (Available only for Offline Get Stats)	See transmit deviation tables
Ext1	User-specified "Analog 1" input as a voltage be-tween 0 and 10 volts DC in tenths, at 8 bits of resolution. (Available only for Offline Get Stats) If the "Fan Control" (Analog 1) box is checked in the RSS program, the value displayed will be 00.0 Volt	0 to 10.0 VDC
Ext2	User-specified "Analog 2" input as a voltage be-tween 0 and 10 volts DC in tenths, at 8 bits of resolution. (Available only for Offline Get Stats) If the "Rx/Tp (Analog 2) box is checked in the RSS program, the value displayed will be 00.0 Volt	0 to 10.0 VDC
Good	Number of correctly decoded transmissions in the last 15 received In multiple frequency networks (duplex), this ratio will be an aggregate of all stations heard. In single frequency networks (simplex), this ratio usually represents receptions from the master station.	15/15 equals 100% Lower values (8/15), coupled with strong received signals (Remote RSSI), usually mean local interference at the remote site.
Total	Used with the number in the field "Good" to establish a percentage indicative of reception quality.	

4.4 OFFLINE LINK TEST

Tests the network data link status by sending a number of transmissions to a remote unit, back from the remote, computing a ratio of good to bad signals received and displaying the result as a link quality for both individual links as well as the overall link.

Caution: Shut down your application before pressing "Link Test".

Before starting a Link Test:

1. Ensure that the Radio Source selected is "Remote".
2. Click in the active Short ID field and enter the address of the desired remote unit.
3.   Press the "Link Test" button to start transmitting blocks of data.

The selected remote decodes and returns data blocks. Transmission will continue until the link test button is pressed again or after 100 data blocks are transmitted. The sent and received data are compared and the ratio of good to bad blocks are calculated. The error rate is calculated separately for each direction and for the link as a whole. The results are displayed on the message screen in the format detailed in Table 4-2.

Table 4-2   Link Test Display Format

Action	Format	Results	Relation
Blocks Sent	0-100	Records the total number of blocks transmitted to the remote	A
Blocks Received by remote	0-100	Indicates recorded total number of blocks received by the remote	B
Link Quality to remote	0.0% to 100.0%	Ratio (percentage) of blocks received by the remote compared to blocks transmitted. Value is indicative of link quality to remote	B over A
Responses from remote	0-100	Indicates recorded total of response-blocks received from the remote	C
Link Quality from remote	0.0% to 100.0%	Ratio (percentage) of blocks received from the remote compared to the recorded total of blocks received by the remote. Value is indicative of link quality from remote	C over B
Overall Link Quality	0.0% to 100.0%	Ratio (percentage) of blocks received from the remote compared to the recorded total of blocks first transmitted to the remote. Value is indicative of overall link quality to and from remote	C over A

4.5 BAR GRAPH

A Received Signal Strength Indicator (RSSI) bar graph is available during continuous test transmissions (i.e., remote "Tx Tone" and "Carrier"). The appearance of the "Local RSSI" indicator is a single vertical graph bar with indicated values in "dBm". The accuracy of the reading is normally better than +/- 3db. The bar graph changes during user maintenance local test transmissions of "Tx Tone" and "Carrier". A split screen of two parallel vertical bars is seen. The "Local TX Pwr" measurements of "Forward power" and "Reflected power" are in "Watts" (see Figure 4-1).

4.6 CARRIER

To send an unmodulated carrier, press the "Carrier" button. Used mainly to check carrier frequency, RF power level (local unit) and received signal strength from a remote unit.
Warning: Care must be taken while reading transmit deviation remotely. Over-the-air service monitor readings may give higher results than expected because of RF noise and interference that superimpose on the received signal.

- If Source is "Local", pressing Carrier transmits until the button is pressed again
- If Source is "Remote", the selected unit will send for 30 seconds. Remote transmissions cannot be interrupted

All buttons are inactive during test transmissions.

4.7 TX TONE

The TX Tone is used mainly to check transmit deviation. To send a modulated carrier, press the "TX Tone" button (see Figure 4-1).

- If Source is Local, sends a 1200 Hz sine wave for 30 seconds or until the button is pressed again
- If Source is Remote, causes the selected ID remote to send a tone for 30 seconds. Remote transmissions cannot be interrupted. All buttons are inactive during test transmissions. Typical transmit deviation are network speed dependant and are shown in Table 4-3.

Table 4-3   Typical Transmit Deviation

Connected to an Integra-TR, Full Channel, Part Number 242-40X8-Y30, Native Compatibility Mode		
Network Speed (in b/s)	Typical Deviation (kHz)	Voltage at Pin 4 when receiving that deviation from other units (white wire of analog/power connector) (Vpp)
19200	$\pm$ 4.0	1.5
9600	$\pm$ 4.0	1.5
4800	$\pm$ 4.0	1.5
Connected to an Integra-TR, Quarter Channel, Part Number 242-40X8-XXX, Native Compatibility Mode		
Connected to an Integra-TR, Half Channel, Part Number 242-40X8-Y10, Native Compatibility Mode		
9600	$\pm$ 2.5	1.5
4800	$\pm$ 2.5	1.5
Connected to an Integra-TR, Full Channel, Part Number 242-40X8-Y30, Integra-T/Integra-TR Compatibility Mode		
9600	$\pm$ 3.0	1.5
4800	$\pm$ 3.0	1.5
Connected to an Integra-TR, Quarter Channel, Part Number 242-40X8-XXX, Native Compatibility Mode		
4800	$\pm$ .05	1.5
2400	$\pm$ 1.64	1.5
Connected to an Integra-T, Full Channel, Part Number 242-40X7-Y30		
9600	$\pm$ 3.0	1.5
4800	$\pm$ 4.0	1.5

CONFIGURABLE PARAMETERS

5.1 PARAMETER OVERVIEW

The parameters used to configure the Integra-TR units are described in the Field Programming Software help file. Section 5 summarizes the Integra-TR parameter settings and their variations when used within a network.

Table 5-1   Normal Factory Settings (Units)

Fields	Integra-TR with other Integra-TR	Integra-TR with Integra-T	Integra T
Network Settings			
Compatibility Mode	Integra-TR	Integra-TR & Integra-T	(N/A)
Tx/Rx Mode	Both Tx and Rx		(N/A)
Extended Preamble (ms)	0		
Network Speed	19200 Full Channel, 9600 Half Channel, or 2400 Quarter Channel	9600 Full Channel	
Tx Time Out	30 sec ON		
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	Active		
Analog Connector			
Analog 1	Input or Fan Control (Units with cooling option)		Input
Analog 2	Input		
Frequency			
Transmit	User choice		
Receive	User choice		
Adjustments			
Carrier Sense (-dBm)	105	110	
Power Out	255 (indicates 5 Watts nominal)		
Frequency Warp	Grayed out (radio dependent)		
Deviation	Values set at factory can be changed, if required; hit related test button to enable field		
RXA Adjust			

Refer to help files for descriptions of the above fields.

Table 5-2   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				
Compatibility Mode	Integra-TR		Integra-TR and Integra-T	
Tx/Rx Mode	Rx Only	Tx Only	Rx Only	Tx Only
Extended Preamble (ms)	0			
Network Speed	19200 Full Channel, 9600 Half Channel, or 2400 Quarter Channel		9600 Full Channel	
Tx Time Out	Disable			
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	Active			
Analog Connector				
Analog 1	Input	Fan Control	Input	Fan Control
Analog 2	RxTp	Input	RxTp	Ant. SW Control
Frequency				
Transmit	User Choice			
Receive	User Choice			
Adjustments				
Carrier Sense (-dBm)	105	(N/A)	110	(N/A)
Power Out	255 (indicates 5 Watts nominal)			
Frequency Warp	Grayed out (radio dependant) Values are set at factory; can be changed if required; hit release test button to enable field			
Deviation				

Refer to help files for descriptions of the above fields.

Part No. 001-4008-101/102

CIRCUIT DESCRIPTION

6.1 OVERVIEW

Section 6 describes the circuit operation of the logic board. This section is intended for use by engineering and service personnel.

6.2 CIRCUIT DESCRIPTION

Refer to Figure 6-1 for the block diagram of the Integra-TR Logic Board.

6.2.1 MICROPROCESSOR CIRCUIT

The microprocessor contains two Z84015 CMOS low power Intelligent Peripheral Controllers (IPC). Each IPC is an 8-bit microprocessor integrated with CTC, SIO, PIO Clock Generator Controller and Watch Dog Timer.

One of the Z84015s (U17) is used in the normal mode. The other Z84015 (U21) is used in the evaluation mode and only the CTC, SIO and PIO sections are used. The CPU section is disabled.

The first Z84015 Clock Generator uses a 19.6608 MHz crystal that provides a CPU clock rate of 9.8304 MHz for both Z84015s. The 9.8304 MHz clock is further divided by 2 to feed all 8 CTC (4 in each Z84015).

The 64K-memory space of the Z84015 is divided into two blocks of 32k each. The lower 32K are used for the firmware program and the upper 32K by the CMOS RAM (U18). The memory IC used for the program is a CMOS FLASH (U22) with 1024 sectors of 128 bytes each.

The dual Z84015 circuit provides up to 8 Counter Timer Channels (CTC), 4 Serial Input/Output (SIO) and 32 Parallel In-put/Output (PIO) lines.

The CPU also provides the clock for the CPLD modem.

6.2.2 RS232

The RS232 IC (U15) is used to interface the application DE-9 connector to the SIO_B section of U17, and the set-up DE-9 connector to the SIO_A section of U21. Two receivers remain enabled in sleep mode to ensure fast wakeup.

6.2.3 MODEM

The modem section is used to interface the serial digital data to the transceiver.

The CPLD modem IC (U16) with a programmable Raise-Cosine filter (U10) operates in DRCMSK mode at 2400, 4800, 9600, and 19200 bits/sec. It incorporates a 7-bit hardware scrambler and uses Differential (NRZI) encoding in DRCMSK mode to minimize data pattern-sensitivity. An electronic potentiometer U5B

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(E-Pot), controlled by CPU U17, is used to set the transmitter deviation by amplitude adjustment of the baseband signal. Electronic potentiometer U5C is also provided to fine adjust the RF carrier frequency.

6.2.4 TRANSMIT & RECEIVE DATA

Transmit Data from the RS-232 port is level-shifted to TTL by U15 and passed through the CPU for further processing and conversion from asynchronous to synchronous format.   The CPLD modem, U16, takes the digital data stream from SIO-A of the CPU and synthesizes to the constant-amplitude analog baseband signal. The synthesized data stream is filtered by U10, buffered by U9B, and applied to radio module TXA at P1-6.

Received signals are applied to the RXA pin on P1-13 and amplified by U3A. U3A gain is set by the electronic potentiometer, U5D, and filtered by U10. The same filter circuit is used for transmission and reception. Two analog multiplexer/demultiplexer gates (U8A and B) controlled by TX_EN line are used for sharing. The filter U10 cut-off frequency is programmable by the CPLD, based on the data rate. The analog signal is buffered by U1D and fed to Peak Detectors U3C, U3D, and U3B, and to slicer circuit U1C via U1B. The raw data is passed to the CPLD modem (U16) for de-scrambling and receive clock recovery. The resulting synchronous bit stream is fed to CPU SIO-A for further processing and conversion to asynchronous format before delivery to the RS-232 driver and to the user port.

6.2.5 INTEGRA-TR A/D AND DIGIPOT

An 8 channel, 8-bit successive approximation A/D converter, type ADC0838 (U4), is interfaced to CPU (U17) and Peripheral (U21).

CH0 and CH1 are connected to the positive and negative peak detector of the modem section. The software can read the positive or negative value of an RX signal, or using the differential mode, the actual peak-to-peak RX signal value.

CH3 is used to measure the radio RSSI signal which was amplified by U7A.

CH4 is connected to the radio diagnostic signal (P3-14). This pin is used to output an analog signal corresponding to the power output and the reflected signal.

CH5 is connected to U6 (LM50), a temperature sensor with a -40 to +125°C range.

CH6 is used to read the SWB+ voltage after proper scaling into the 0-5 V range.

CH7 and CH8 are connected to EXT SIGNAL 1 and 2. A 2:1 divider and protection circuit is inserted between both external signals and the A/D.

The External Signal (pins 1 and 2) is also connected to U21 at PB6 and PB7 through transistors Q3 and Q4 and can be used for Analog Input or Digital Output.

EXT_SIGNAL 2 is also connected to the Rx test point RX-TP through U8A (74HC4066). Under software control, the RX-TP (scaled down by 2) is available on the power connector for trouble-shooting purposes.

A 4-channel digital potentiometer type (U5) is used to adjust the RX Signal, TX Modulation, Carrier Frequency and Carrier Detect Threshold.

An 8 channel, 8-bit successive approximation A/D converter, type AD0838 (U9), is interfaced to CPU (U18) and Peripheral (U20).

U19 generates a power-on reset for the CPU and U6 is a temperature sensor used by the firmware to compensate for variations in RSSI.

The RSSI signal from the transceiver is amplified and filtered by U7A. The signal is compared to a threshold value set by digital potentiometer (U5A). The output of the comparator (U7B) is used to change the hold time of both peak detectors at the beginning of the receive packet.

6.2.6 WAKE-UP CIRCUIT

The wake-up circuit for the Integra-TR consists of a 50 ms monostable circuit that is triggered by the rising edge of a Sleep signal from CPU (U17). The falling edge of this 50 ms pulse (end of pulse) is connected to the NMI of the CPU and will wake up the CPU from Sleep mode after 50 ms.

When exiting SLEEP mode on a \NMI, the CPU firmware will increment a counter, then return to Sleep until it reaches a limit set by a software parameter. When the programmed count is reached the CPU will wake up the radio and the RS232 driver, program the synthesizer, and watch for channel activity.

While in sleep mode (during the 50 ms pulse), an active RTS from either communication port will reset (terminate) the 50 ms pulse so that its falling edge will restart the CPU immediately.

The CPU will check to see if either RTS signal is valid each time it is restarted by the \NMI. The firmware will only start the sleep timer after checking that all "wakeup" inputs are inactive.

6.2.7 POWER SUPPLY

The 13.3-volt DC power input is protected by a 3-amp fuse and reverse-protected by a diode.

A 5 volt, low voltage regulator (U12) is used to power all digital functions and another 5 volt, low voltage regulator is used to control the analog +5V_SW voltage in the sleep mode.
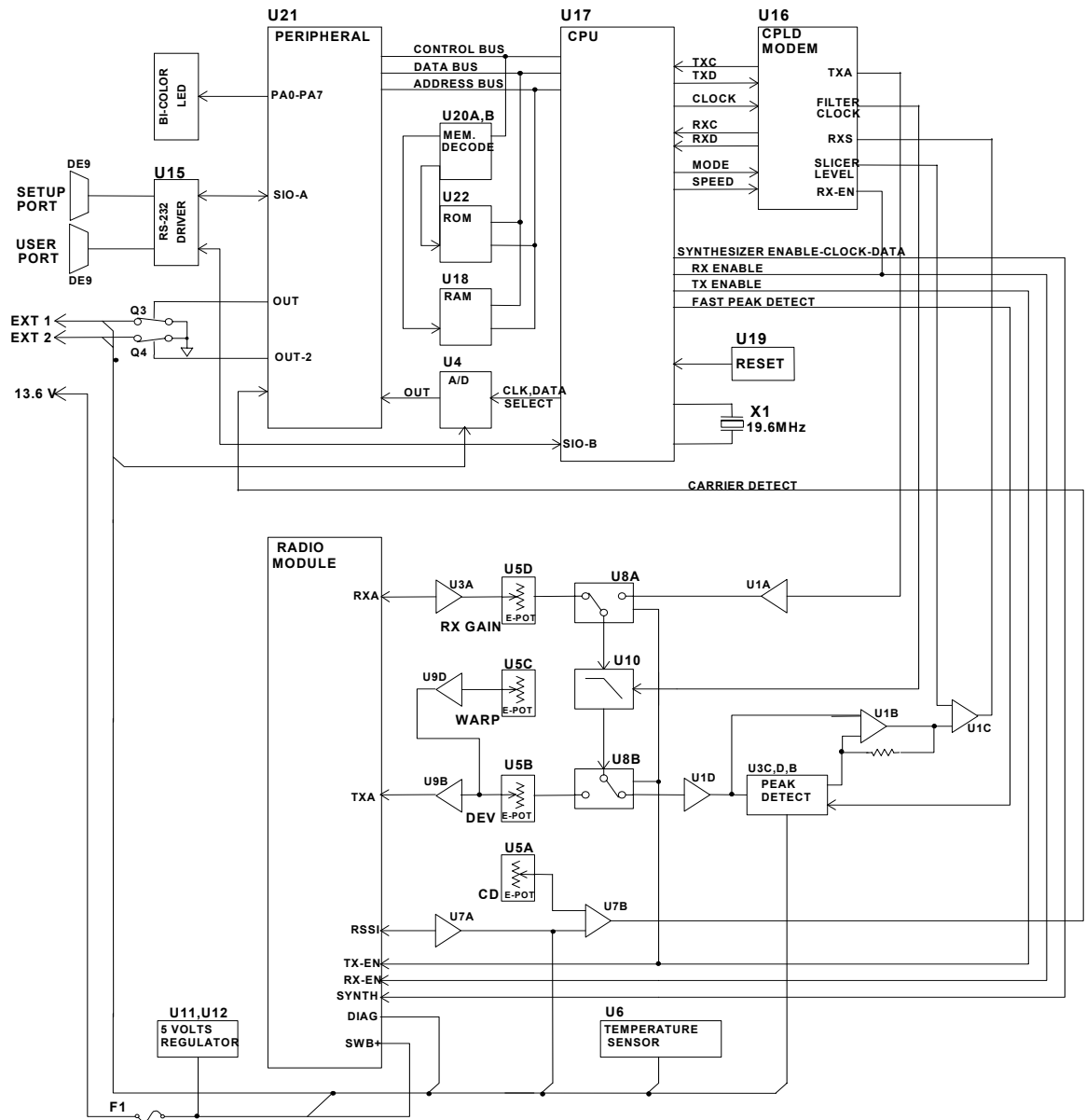
Figure 6-1   Logic Board Block Diagram

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The External Signal (pins 1 and 2) is also connected to U21 at PB6 and PB7 through transistors Q3 and Q4 and can be used for Analog Input or Digital Output.

EXT_SIGNAL 2 is also connected to the Rx test point RX-TP through U8A (74HC4066). Under software control, the RX-TP (scaled down by 2) is available on the power connector for trouble-shooting purposes.

A 4-channel digital potentiometer type (U5) is used to adjust the RX Signal, TX Modulation, Carrier Frequency and Carrier Detect Threshold.

An 8 channel, 8-bit successive approximation A/D converter, type AD0838 (U9), is interfaced to CPU (U18) and Peripheral (U20).

U19 generates a power-on reset for the CPU and U6 is a temperature sensor used by the firmware to compensate for variations in RSSI.

The RSSI signal from the transceiver is amplified and filtered by U7A. The signal is compared to a threshold value set by digital potentiometer (U5A). The output of the comparator (U7B) is used to change the hold time of both peak detectors at the beginning of the receive packet.

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When exiting SLEEP mode on a \NMI, the CPU firmware will increment a counter, then return to Sleep until it reaches a limit set by a software parameter. When the programmed count is reached the CPU will wake up the radio and the RS232 driver, program the synthesizer, and watch for channel activity.

While in sleep mode (during the 50 ms pulse), an active RTS from either communication port will reset (terminate) the 50 ms pulse so that its falling edge will restart the CPU immediately.

The CPU will check to see if either RTS signal is valid each time it is restarted by the \NMI. The firmware will only start the sleep timer after checking that all "wakeup" inputs are inactive.

6.2.7 POWER SUPPLY

The 13.3-volt DC power input is protected by a 3-amp fuse and reverse-protected by a diode.

A 5 volt, low voltage regulator (U12) is used to power all digital functions and another 5 volt, low voltage regulator is used to control the analog +5V_SW voltage in the sleep mode.
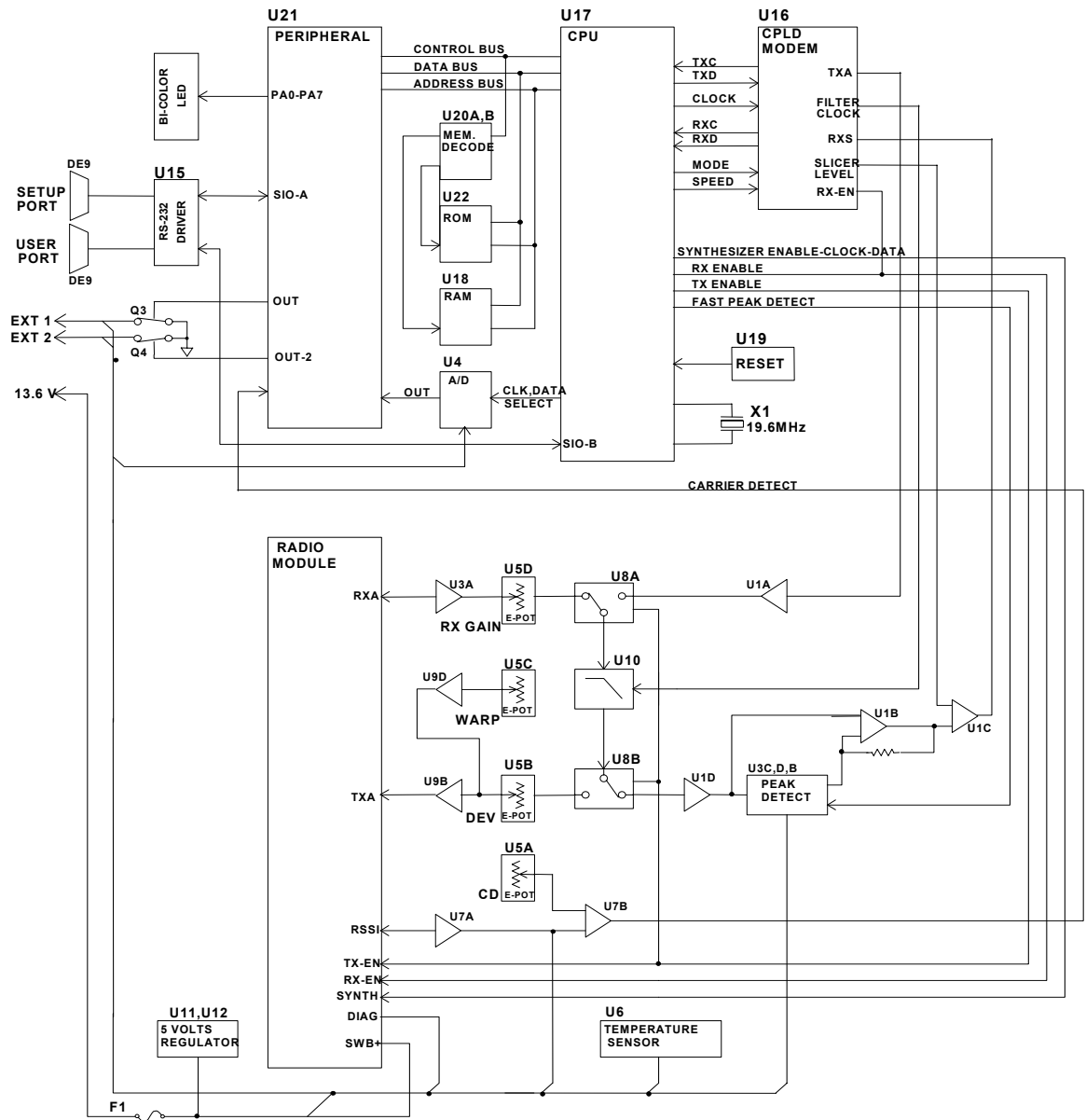
Figure 6-1   Logic Board Block Diagram

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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.
Quarter Channel	Radio channel bandwidth equal to 6.25 kHz.
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.