TRACER® 4103/4203
User Manual

RADIO FREQUENCY INTERFACE STATEMENT

This equipment has been tested and found to comply with the limits for an intentional radiator, pursuant to Part 15, Subpart C of the FCC Rules. This equipment generates, uses, and can radiate radio frequency energy. If not installed and used in accordance with the instructions, it may cause interference to radio communications.

The limits are designed to provide reasonable protection against such interference in a residential situation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment on and off, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna of the affected radio or television.
- Increase the separation between the equipment and the affected receiver.
- Connect the equipment and the affected receiver to power outlets on separate circuits.
- Consult the dealer or an experienced radio/TV technician for help.

W A R N I N G

Changes or modifications not expressly approved by ADTRAN could void the user's authority to operate the equipment.

Shielded Cables

A shielded-type power cord is required in order to meet FCC emission limits and also to prevent interference with nearby radio and television reception when using the AC voltage adapter. It is essential that only the ADTRAN-provided power cord be used.

FCC Output Power Restrictions

The FCC does not require licensing to implement this device. However, the FCC has established restrictions regarding maximum output power and the adjustments required when employing directional gain antennas. (Refer to *"Setting the Transmitter Power"* in Section 2 of this manual). These restrictions are detailed in FCC Part 15.247 (b)(1), (b)(3)(i), and (3)(iii). It is the responsibility of the individuals designing and implementing the radio system to assure compliance with these and any other pertinent FCC Rules and Regulations. This device must be professionally installed.

Exposure to Radio Frequency Fields

The TRACER 4103 operates in the 2.4 GHz Industrial, Scientific, and Medical (ISM) band with 100 mW power output, while the TRACER 4203 operates in the 5.8 GHz ISM band with 100 mW power output.

These levels of RF energy in are below the Maximum Permissible Exposure (MPE) levels specified in FCC OET 65:97-01. The installation of high gain antenna equipment in the system configuration may create the opportunity for exposure to levels higher than recommended for the general population at a distance less than 16.5 feet (5 meters) from the center of the antenna. **The following precautions must be taken during installation of this equipment**:

- The installed antenna must not be located in a manner that allows exposure of the general population to the direct beam path of the antenna at a distance less than 16.5 feet (5 meters). Installation on towers, masts, or rooftops not accessible to the general population is recommended; or
- Mount the antenna in a manner that prevents any personnel from entering the area within 16.5 feet (5 meters) from the front of the antenna.
- It is recommended that the installer place radio frequency hazard warnings signs on the barrier that prevents access to the antenna.
- Prior to installing the antenna to the RF output, make sure the power is adjusted to the settings specified in Section 2 of this manual.
- During antenna installation, be sure that power to the TRACER equipment is turned off in order to prevent any energy presence on the coaxial connector.
- During installation and alignment of the antenna, do not stand in front of the antenna assembly.
- During installation and alignment of the antenna, do not handle or touch the front of the antenna.

These simple precautions must be taken to prevent general population and installation personnel from exposure to RF energy in excess of specified MPE levels.

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INTRODUCTION

The TRACER 4103 and 4203 provide dual T1 transport by way of a spread spectrum microwave link for distances of 30 miles or more depending on path engineering. System performance is determined, in part, by the engineering of the microwave link. Each end of a TRACER 4103/4203 link is composed of a single rackmount unit. Two DS1/DSX-1 (T1) interfaces are provided on the rear of the TRACER 4103/4203, which can be mounted in a 19 or 23 inch rack. The DS1/DSX-1 interface provides connections up to 6000 feet from T1 equipment. A single coaxial cable connects the TRACER 4103/4203 to the antenna.

ISM BAND SPREAD SPECTRUM

The Federal Communications Commission (FCC) has established several portions of the radio frequency (RF) spectrum for use in Industrial, Scientific, and Medical (ISM) applications. Part 15.247 of the FCC rules describes the requirements of systems that operate in these bands. The three bands set aside, 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz, are designated for use by spread spectrum transmitters, either frequency hopping or direct sequence. Spread spectrum is a form of communication in which the bandwidth of a message signal is intentionally increased or “spread.” The TRACER 4103/4203 employs direct sequence spread spectrum (DSSS) transmission while operating in the 2400 to 2483.5 MHz and 5725-5850 MHz bands, respectively.

Direct Sequence

A direct sequence transmitter spreads the signal by mixing the data with the output of a pseudorandom number generator which changes state at a rate higher than the data rate. This rate is called the “chipping” rate. The TRACER 4103/4203 chipping rate is twelve times the data rate.

Coding

Many different pseudorandom sequences exist. The sequences are called pseudorandom because, although they appear noise-like, they are determinant and repeat after a specific number of chips. The longer a code is, the better correlation characteristics it possesses. These traits allow multiple spread spectrum systems to operate in the presence of one another with minimal interference if they are operating with different sequences. The TRACER 4103/4203 provides ten different 120-bit long sequences to help ensure minimal interference operation in high traffic areas.

APPLICATIONS

Any application that would typically use metallic T1 as a transport can use the TRACER 4103 or TRACER 4203 instead. **Figure 1-1** illustrates a typical application.

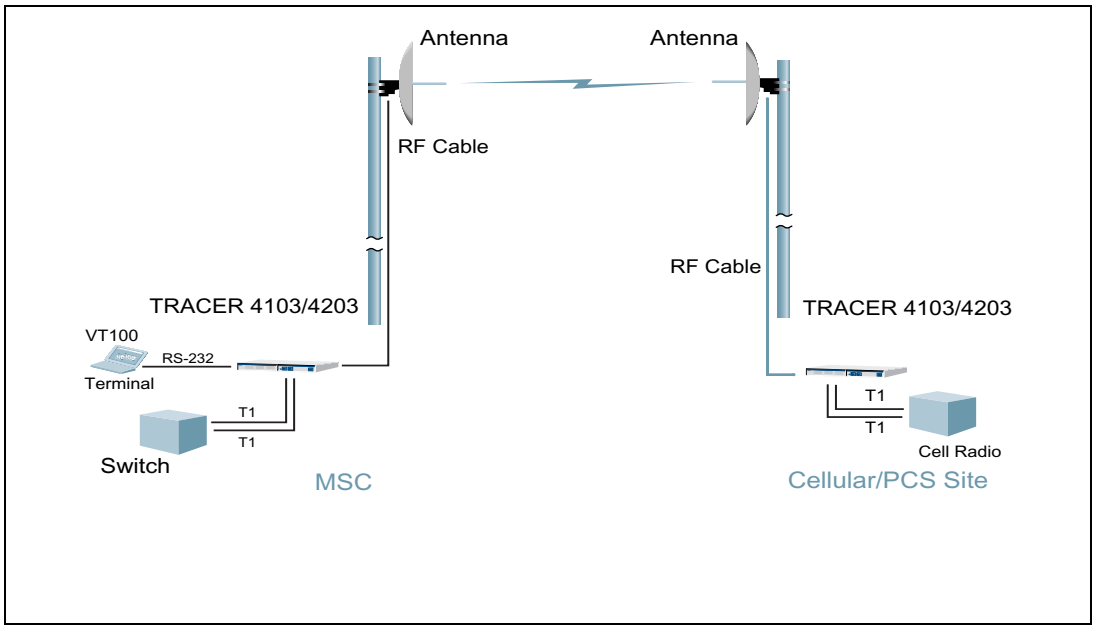

Figure 1-1. Typical Application

The TRACER 4103 or 4203 can be used in any application requiring that data be shared at a high rate of speed. In addition to telephony applications, TRACER 4103 or 4203 can be used in data communications such as internet networking, video conferencing, and telemetry.

CHANNEL SELECTION

The FCC has allocated 83.5 MHz of spectrum in the 2.4 GHz band (where the TRACER 4103 operates) and 125 MHz in the 5.8 GHz band (where the TRACER 4203 operates). A TRACER system divides the band into two portions - transmitting in one and receiving in the other. **Figure 1-2** illustrates the bandwidth division.

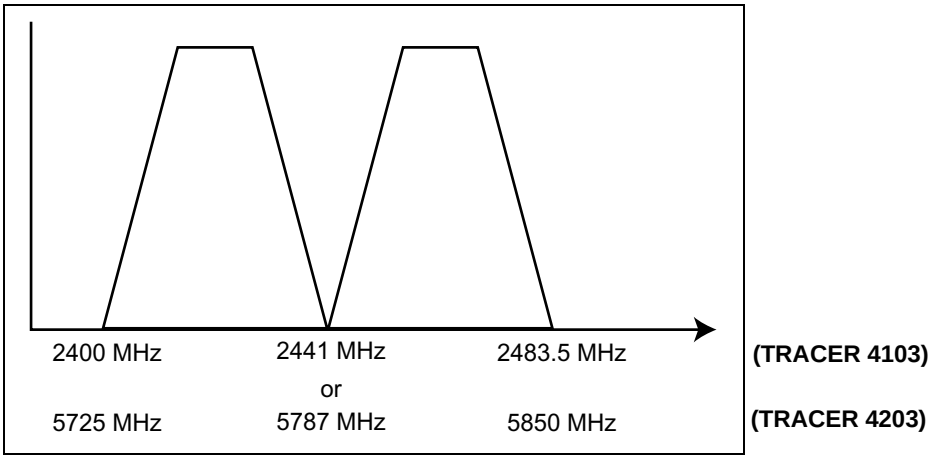

Figure 1-2. Bandwidth Division

The transmitter at one end of a link will transmit in the lower portion of the spectrum. Consequently the receiver at the other end will receive in the lower portion of the band and transmit in the upper portion. Thus, a system will operate in one of two frequency plans - transmit in the upper and receive in the lower or vice versa. These two plans are called Plan A and Plan B. One end of a path will be on Plan A and the other will be on Plan B. Shipment of a link will consist of an A and a B unless otherwise specified.

FORWARD ERROR CORRECTION

With the addition of overhead data, error detection and correction capability can be added to a data stream. Error correction can be accomplished by allowing the receiver to request the retransmission of a detected errored block. The TRACER 4103 and TRACER 4203, on the other hand, implement forward error correction (FEC) which adds enough overhead data for the receiver to detect and correct errors in the data stream without the need for retransmission. The addition of FEC decreases the required signal-to-noise (S/N) ratio by approximately 5.5 dB to achieve a given bit error rate (BER).

T1 Operation

Framing

The data in a T1 stream is delimited by framing bits. The pattern of the framing bits follows one of two formats – extended superframe (ESF) or superframe (SF or D4). The T1 interface must be prepared for the format that will be used.

Line Code

A mark in the data stream is coded as a pulse on the T1 line. A space is coded as “no activity” on the T1 line. As a form of error detection, subsequent marks in the data stream are coded as pulses of alternating polarity, either positive going or negative going. This type of line coding is called alternate mark inversion (AMI).

For the T1 receiver to operate correctly, a minimum number of “1s” must exist on the T1 facility. If the data cannot be guaranteed to meet this requirement, then another line coding format is used. In the bipolar 8 zero substitution (B8ZS) scheme, a string of eight “0s” is replaced by a special sequence of eight bits that contains a bipolar violation. The receiver, upon recognizing this sequence, reinserts the eight “0s” and the data is recovered intact.

DS1/DSX-1 Interface

When connecting the interface to the public switched network, an ADTRAN-provided cross-over cable (part number 3125M011) is required to meet FCC part 68 and IC CS03 requirements. This cable is required to cross-over the Tx and Rx pairs to meet the connecting arrangement of a network interface device. This cable is included with the unit and is labelled “T1 Crossover.”

Line Buildout or LBO

The DS1/DSX-1 interface provides two different types of line buildouts (LBOs), respectively. When set for DS1, LBOs for 0 dB, -7.5 dB, -15 dB, and -22 dB are available. The DS1 interface can operate on line lengths up to 6,000 feet. When set for DSX-1 interface, LBOs for 0-133 feet, 266-399 feet, 399-533 feet, and 533-655 feet are available.

TRACER 4103/4203 SYSTEM CONFIGURATION

The following section describes the TRACER 4103/4203 system components.

TRACER 4103/4203 Rear Panel

The rear panel provides all of the electrical interface points – DS1/DSX-1 interface, DS1/DSX-1 monitor, VT 100 terminal, alarm contacts, RF signal to the antenna, and DC power. The TRACER 4103/4203 rear panel is illustrated in **Figure 1-3**.

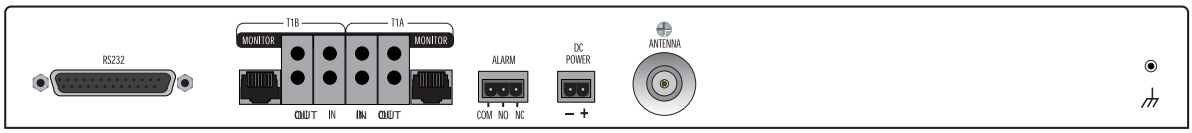

Figure 1-3. TRACER 4103/4203 Rear Panel

DS1/DSX-1 Interface

Two DS1/DSX-1 interfaces, labelled “T1A” and “T1B,” are provided for connecting to the T1 equipment. Two types of physical interfaces are provided – RJ-48C and bantam jacks. The DS1/DSX-1 interfaces provided for each channel are the same. The upper bantam connectors, labeled “Monitor,” provide isolated monitor points for testing. The lower bantam jacks provide signal insertion points. The insertion of a bantam jack disconnects the RJ-48C connector from the circuit. The DS1/DSX-1 interface can operate on line lengths up to 6000 feet.

When connecting the T1 interface to the public switched network, an ADTRAN-provided cross-over cable (part number 3125M011) is required to meet FCC part 68 and IC CS03 requirements. This cable is included with the TRACER 4103/4203 and is labeled “T1 Crossover.” This cable is required to cross-over the TX and RX pairs to meet the connecting arrangement of a network interface device.

For connections to other CPE-type equipment, such as an ADTRAN TSU-100, a straight-through T1 cable is provided by ADTRAN (P/N 3127004) and is included with the TRACER 4103/4203.

VT 100 RS-232 Interface

A serial interface port using RS-232C signal levels is provided for attaching a VT 100-compatible terminal. The connection is made via a DB-25 connector on the rear panel. The data rate is configured for 9600 bps, 8 data bits, no parity, and 1 stop bit. Flow control on the serial interface should be configured for none.

A 7-day error history of the T1 interfaces and radio link is also provided. Fifteen-minute histories are provided for the most recent 24 hours of operation.

Alarm Contacts

Major alarm contacts are provided on the rear panel. An alarm indicates the radio link is not operational. Normally-open and Normally-closed contacts are provided. Under normal operating conditions there is no continuity between the Normally-open and Common contacts. Under an alarm condition, continuity between those contacts exists. The Normally-closed and Common contacts normally have continuity, while under alarm conditions, these contacts are open.

Power

The unit receives power via a screw-type modular connector. The TRACER 4103/4203 operates on 21 to 63 Vdc, either polarity referenced to ground. The power consumption of the unit is 30 watts. An optional desktop AC adapter is available (ADTRAN P/N 1280650L1).

TRACER 4103/4203 Front Panel

The TRACER 4103 front panel is illustrated in **Figure 1-4**. The 4203 front panel is identical except for the model number.

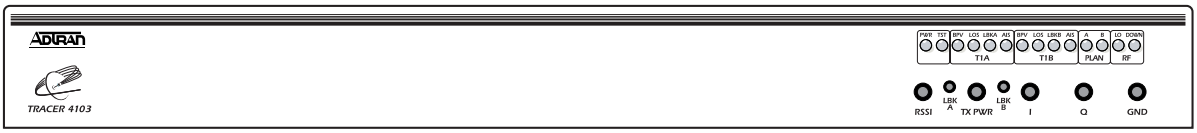

Figure 1-4. TRACER 4103 Front Panel

Options are set from the VT 100 terminal interface. As a rule, a *green* LED indicates a normal situation, a *red* LED indicates an error situation, and a *yellow* LED indicates a configuration option. LEDs indicating overall system integrity are listed below.

TEST	*Red* indicates that the self-test has completed and failed
PWR	*Green* indicates that DC voltage is applied

The LEDs associated with the DS1/DSX-1 interfaces are listed below. There are two sections of identical indicators – one for each DS1/DSX-1 interface.

BPV	*Red* if the incoming T1 stream contains bipolar violations
LOS	*Red* if there is no signal present at the T1 interface
LBKA/LBKB	*Yellow* if the T1 interface is in loopback
AIS	Flashes to indicate a T1 Yellow Alarm; remains *On* (solid) to indicate an AIS alarm (when the DS1/DSX-1 is receiving a Blue code)

The LEDs indicating RF Link Status are listed below.

RF LO	*Red* indicates the received RF carrier level within approximately 10 dB of the minimum receive level
RF DOWN	*Red* indicates the radio path is down

The front panel controls are listed below.

LBKA	Toggles T1A between no loopback and line loopback
LBKB	Toggles T1B between no loopback and line loopback

Non-volatile Memory

The TRACER 4103/4203 system contains non-volatile memory to retain certain configuration settings. These settings include:

Frequency plan
Chipping code
Password
Password enabling
Site name
T1 line coding
T1 framing

Built-In Tests

The TRACER 4103/4203 has several T1 loopbacks to aid in site setup and later debugging.

The monitor points provided on the front panel of the system are listed on the next page.

I	Demodulated received baseband output
Q	Demodulated received baseband output
RSSI	DC voltage indicating strength of the received signal at the antenna
GND	System ground
TX PWR	DC voltage indicating strength of transmitted signal

The RSSI voltage is a function of the signal strength at the receiver and is used to measure the received signal strength. RSSI varies approximately from 0 to greater than 4 volts, with 0 volts corresponding to a weaker received signal and 4 volts corresponding to a stronger received signal.

The TX PWR voltage is a function of the selected transmit power level. This voltage ranges approximately from 0 to 5 volts, with 0 volts corresponding to 0 dBm (1 milliwatt) and 5 volts corresponding to +20 dBm (100 milliwatts).

I M P O R T A N T

The voltage level present at the RSSI test point represents only a relative signal level of receive strength from the far end. No direct correlation can be made between RSSI voltage level and actual receive level in dBm. This test point is provided to assess relative signal level for alignment of antennas.

Antenna

TRACER 4103/4203 is intended to be coupled with an antenna that is directional and provides signal gain. There are several reasons for this requirement:

- TRACER 4103/4203 operates in point-to-point applications; therefore, an omnidirectional antenna is not needed.
- The FCC provides no recourse in this band in the event of nearby interference, so a directional antenna reduces the likelihood of interference in the antenna pattern.
- The low power transmitter is intended to be used with a high-gain antenna for long links.

The antenna requirements are listed below.

Minimum gain	15 dBi
Minimum return loss	15 dB
Connector	N-type
Impedance	50Ω

UNPACK, INSPECT

Carefully inspect the TRACER 4103/4203 for any damage. If damage is suspected, file a claim with the carrier, then contact ADTRAN Customer Service. If possible, keep the original shipping container for use in shipping the TRACER 4103/4203 back for repair or for verification of damage during shipment.

Before beginning installation, verify that all of the following components are present.

Configuration

Provided by ADTRAN
- TRACER 4103/4203 unit
- DS1/DSX-1 interface cables, straight-through and crossover (RJ-4C8 to RJ-48C)

Provided by customer
- Antenna feedline cable
- Antenna and mounting hardware
- VT 100 terminal and RS-232 interface cable
- 21 to 63 Vdc power source (available from ADTRAN), either polarity referenced to ground

INSTALLATION

Location and Mounting

Install the TRACER 4103/4203 in a location that requires minimal antenna feedline length (the loss in this cable directly affects overall system performance). The TRACER 4103/4203 is designed to be mounted in a rack. If multiple units are installed in one location, no space is needed between units, but certain regulations may require at least 0.75 inches of space above and below each unit.

Power Requirements

The TRACER 4103/4203 can operate from a supply between 21 and 63 Vdc, with either polarity referenced to ground, and consumes 16 watts. Current required (in amps) is determined by dividing the power consumed (in watts) by the applied voltage (in volts). For example, at 48 volts, TRACER 4103/4203 would draw approximately 16 watts/48 volts = 0.33 amps.

Grounding

The following grounding instructions are derived from the Underwriters' Laboratory *UL 1459 Standard for Safety: Telephone Equipment* dated September 20, 1993.

An equipment grounding conductor that is no smaller in size than the ungrounded branch-circuit supply conductors is to be installed as part of the circuit that supplies the product or system. Bare, covered, or insulated grounding conductors are acceptable. Individually covered or insulated equipment grounding conductors shall have a continuous outer finish that is either green, or green with one or more yellow stripes. The equipment grounding conductor is to be connected to ground at the service equipment.

The attachment-plug receptacles in the vicinity of the product or system are all to be of a grounding type, and the equipment grounding conductors serving these receptacles are to be connected to earth ground at the service equipment.

A supplementary equipment grounding conductor shall be installed between the product or system and ground that is in addition to the equipment grounding conductor in the power supply cord.

The supplementary equipment grounding conductor shall not be smaller in size than the undergrounded branch-circuit supply conductors. The supplementary equipment grounding conductor shall be connected to the product at the terminal provided, and shall be connected to ground in a manner that will retain the ground connection when the product is unplugged from the receptacle. The connection to ground of the supplementary equipment grounding conductor shall be in compliance with the rules for terminating bonding jumpers at Part K or Article 250 of the National Electrical Code, ANSI/NFPA 70. Termination of the supplementary equipment grounding conductor is permitted to be made to building steel, to a metal electrical raceway system, or to any grounded item that is permanently and reliably connected to the electrical service equipment ground.

Bare, covered, or insulated grounding conductors are acceptable. A covered or insulated grounding conductor shall have a continuous outer finish that is either green, or green with one or more yellow stripes.

The supplemental equipment grounding terminal is located on the rear panel of the TRACER 4103/4203.

DS1/DSX-1 Interface

The rear panel of the TRACER 4103/4203 has two sets of jacks labeled T1A and T1B which provide the same functionality. The pin assignments for the eight-position modular jack are listed below.

Pin	Name	Function
1	R	Send data (ring)
2	T	Send data (tip)
3		Not Used
4	R1	Receive data (ring)
5	T1	Receive data (tip)
6		Not Used
7		Not Used
8		Not Used

Bantam jack connections are provided for test equipment access. Data is received on the jack labeled “IN” and is transmitted on the jack labeled “OUT.” Bantam jacks are provided for both inserting and monitoring the interfaces. When a plug is placed in the insert jack, the connection between the modular jack and the interface circuitry is broken. The monitor jacks provide access to monitor the transmitted and received signals without interference.

When connecting the T1 interface to the public switched network, an ADTRAN-provided crossover cable (P/N 3125M011) is required to meet FCC part 68 and IC CS03 requirements. This cable is required to cross-over the Tx and Rx pairs to meet the connecting arrangement of a network interface device. This cable, labeled "T1 Crossover," is included with the TRACER 4103/4203.

For connections to other CPE-type equipment, such as an ADTRAN TSU, a straight-through T1 cable (ADTRAN P/N 3127004) is included with the TRACER 4103/4203.

Each DS1/DSX-1 interface must be configured for line code and framing via the VT 100 terminal. The choices for line code are AMI and B8ZS. The options for framing are D4 and ESF. Each channel can be configured independently of the other and should be configured to match the attached T1 equipment.

The line buildout (LBO) must be set for each DS1/DSX-1 interface. The LBO setting allows each DS1/DSX-1 interface transmitter to drive the interface with the correct signal strength and equalization based on the line attenuation between TRACER 4103/4203 and the attached equipment. The LBO is independently set for each interface via the VT 100 terminal. Two sets of configurations are provided – DSX-1 for short-haul interface (less than 655 feet) and DS1 for long-haul interfaces (655-6000 feet). The settings are detailed below.

Interface Type	LBO
DSX-1	0-133 feet
DSX-1	133-266 feet
DSX-1	266-399 feet
DSX-1	399-533 feet
DSX-1	533-655 feet
DS1	0 dB
DS1	-7.5 dB
DS1	-15 dB
DS1	-22.5 dB

LINK PLANNING

I M P O R T A N T

The appropriate transmitter power must be calculated as part of the link planning.

The factors that must be taken into account when planning a link are optimal received signal level, transmitter power, antenna feedline loss (each end), antenna gain (each end), free space path loss, and required fade margin.

I M P O R T A N T

The optimal signal level for the receiver is -60dBm.

Antenna Feedline Loss

Feedline loss is a function of feedline type and length. Feedline loss per 100 feet for several types of coax at RF frequencies is detailed in the table below. The RF loss applies to TRACER 4103/4203 to antenna interconnection. Antenna manufacturers' specifications may vary.

Cable	2.4 GHz Loss/100 ft (in dB) (TRACER 4103)	5.7 GHz Loss/100 ft (in dB) (TRACER 4203)
RG58	80	N/A
RG8 (air)	20	N/A
RG8 (foam)	9	N/A
1/4” Coax	5.91	11.36
3/8” Coax	5.76	9.65
1/2” Coax	3.83	6.49
5/8” Coax	2.98	4.90
7/8” Coax	2.2	N/A
1 1/4” Coax	1.62	N/A
1 5/8” Coax	1.41	N/A
5.8 GHz Elliptical Waveguide	N/A	1.23

Antenna Gain

Best performance will result from the use of a parabolic dish antenna. Antenna gain is determined by the size of the dish, with typical figures detailed below. Dish manufacturers will be able to supply gains for other types of antenna.

Antenna Diameter (in feet)	Gain at 2.4 GHz (in dB) (TRACER 4103)	Gain at 5.8 GHz (in dB) (TRACER 4203)
2	21	28.5
4	27	34.2
6	31	37.5
8	33	40.7
10	35	42.5
12	37	44.2

Path Loss

The free space path loss is given by

$$Loss(dB) = 96.6 + 20 \log_{10} f + 20 \log_{10} D$$

where D is distance in miles
f is operating frequency in GHz

A tabulation of various path loss is given below.

Link Distance **(in miles)**	2.4 GHz Path Loss **(in dB)**	Link Distance **(in miles)**	2.4 GHz Path Loss **(in dB)**	Link Distance **(in miles)**	5.8 GHz Path Loss **(in dB)**	Link Distance **(in miles)**	5.8 GHz Path Loss **(in dB)**
1	104	13	126	1	112	13	134
2	110	14	127	2	118	14	135
3	114	15	128	3	121	15	135
4	116	16	128	4	124	16	136
5	118	17	129	5	126	17	136
6	120	18	129	6	127	18	137
7	121	19	129	7	129	19	137
8	122	20	130	8	130	20	138
9	123	21	130	9	131	21	138
10	124	22	131	10	132	22	139
11	125	23	131	11	133	23	139
12	126	24	132	12	133	24	139

Path Availability

The availability of a path can be expressed by:

$$availability = (1 - C \times T \times 2.5 \times 10^{-6} \times f \times D^3 \times 10^{-F/10}) \times 100\%$$

where C is the climate factor
T is the terrain factor
f is the frequency in GHz
D is the path length in miles
F is the fade margin in dB

Climate factors are given below.

Climate	**Climate Factor**
Very Dry	1/8
Temperate	1/4
Humid	1/2

Terrain factors are listed below.

Terrain	Terrain Factor
Smooth	4
Average	1
Mountainous	1/4

The nominal received signal level is -60 dBm. For help in link planning, use the path loss calculation worksheet below.

-91 dBm (TRACER 4103) -90 dBm (TRACER 4203)	Minimum Signal Power
+_____	Transmitter Feedline Loss
- _____	Transmitter Antenna Gain
+_____	Path Loss
- _____	Receiver Antenna Gain
+_____	Receiver Feedline Loss
+_____	Required Fade Margin
=_____	(dBm) Transmitter Power Setting

SETTING THE TRANSMITTER POWER

The FCC specifies the maximum transmitter power that may be used for antennae of a given gain. FCC rules Part 15, Subpart 247 allow for a maximum power of 1 watt into antennae of a gain less than or equal to 6 dBi. At 2.4 GHz (TRACER 4103), the 1 watt maximum transmitter power must be reduced by 1 dB for every 3 dB of antenna gain over 6 dBi. Since the TRACER 4103 maximum transmit power is 100 milliwatts, only antennas with gains above 36 dBi (12 foot diameter parabolic dishes) require any reduction in transmit power. For the 5.8 GHz band (TRACER 4203), there is no reduction in transmitter output power required for antennae gains greater than 6 dBi.

The transmitter power is set via the TRACER system configuration page of the VT 100 interface. Attach a power meter to the N-type antenna connector on the rear panel of the TRACER 4103/4203, and adjust the power by the VT 100 until the desired transmitter power is obtained.

APPLYING POWER

If a source of 21 to 63 Vdc (16 watts) is available, it may be attached to the rear panel of the TRACER 4103/4203. The positive lead should be attached to the “+” screw terminal, and the negative lead should be attached to the “-” screw terminal.

AUTOMATIC FREQUENCY PLAN

Upon the initial application of power, the unit will default to the factory-preset Frequency Plan. The LED will indicate which frequency plan is active.

The Frequency Plan designates the frequencies on which the TRACER 4103/4203 transmits and receives. On the TRACER 4103/4203, plan A corresponds to a TX center frequency of 2422 MHz and an RX center frequency of 2462 MHz. Plan B on the TRACER 4103/4203 corresponds to a TX center frequency of 2462 MHz and an RX center frequency of 2422 MHz. On the TRACER 4203, plan A corresponds to a TX center frequency of 5747 MHz and an RX center frequency of 5827 MHz. Plan B on the TRACER 4203 corresponds to a TX center frequency of 5827 MHz and an RX center frequency of 5747 MHz. Shipment of a link consists of one unit set for plan A and the other unit set for plan B, unless specified otherwise. The Frequency Plan can be changed in the field if necessary. Contact ADTRAN Technical Support for more information on this procedure.

CHIPPING CODE

The chipping code for each end must be the same. The choice of code is selectable by the operator or the installer through the VT 100 terminal. TRACER 4103/4203 is shipped in a matched (default) configuration (code 0). Chipping code is set in the TRACER system configuration menu.

W A R N I N G

Chipping code can be set through the VT 100 interface from the other end of the link. If the remote end chipping code is accidentally changed, the link will be lost. If the new chipping is unknown, step the local end of the link through all the other chipping codes until the link is re-established.

CO-LOCATING MULTIPLE SYSTEMS

When multiple transmitters are to be co-located (installed in the same equipment room or on the same tower), it is advised to set all systems as follows:

1. If more than one system is transmitting from the same location, set the antenna polarity of one system *horizontal* and the other system(s) *vertical* if the systems are operating in the same frequency bands. (The antennas should be marked as to which mounting position is vertical or horizontal.) This will provide approximately 30 dB of isolation between the different antennas.
2. If more than one TRACER 4103/4203 system is installed, set the co-located transmitters to the same frequency plan (example: Plan A, Tx=2422 or 5747 MHz; or Plan B, Tx=2462 or 5827 MHz) and set each to a different spreading code. This keeps the transmitters on the additional system(s) from interfering with the co-located receiver(s).
3. If the systems are from different manufacturers, set the transmit frequencies as close as possible with different spreading codes. Other manufacturers may not use the exact frequency plans as the TRACER 4103/4203 system, but keeping the frequencies close will reduce the probability of the transmitter(s) interfering with the co-located receiver(s).

This equipment is authorized under FCC Part 15.247. With this authorization by the FCC, this equipment shall not be co-located with a similar transmitter that transmits identical information.

ANTENNA ALIGNMENT

After the transmitter power for each end has been adjusted and the TRACER 4103/4203 has been installed and connected, the antenna should be connected to the TRACER 4103/4203 via the feedline.

Verify that both antennas are arranged on the same polarity: vertical or horizontal. The antennas should be aimed toward one another as precisely as possible and the received signal strength indicator (RSSI) voltage measured. The RSSI voltage is a function of the signal strength at the receiver and is used to measure the received signal strength. RSSI varies approximately from 0 to greater than 4 volts, with 0 volts corresponding to a weaker received signal and 4 volts or better corresponding to a stronger received signal.

I M P O R T A N T

The voltage level present at the RSSI test point represents only a relative signal level of receive strength from the far end. No direct correlation can be made between RSSI voltage level and actual receive level in dBm. This test point is provided to assess relative signal level for alignment of antennas.

RF LOW

The “RF LO” LED indicates that the received signal is within 10dB of the minimum received signal strength (approximately -80 dBm). If this indicator is on, the link performance may be marginal. The antennas should be peaked in azimuth and elevation until the desired signal level is achieved. RSSI may be monitored on the front of the TRACER 4103/4203. If the received signal is too strong and RSSI reaches a maximum such that the peak cannot be discerned, then the transmitter power on the far end should be turned down.

At this point the radio link should be operational. Proper operation can be determined by the status of the “RF DOWN” LED. If this LED is *on*, the link is *not* operational. If this LED is *not on*, the link *is* operating. Certain types of interference can cause one end of a path to operate and the other end to fail. In some instances, this may be corrected by swapping the frequency plan at each end, thus avoiding the interference if it is stronger at one end than the other. Changing the spreading code at each end may also allow interference to be mitigated.

ALARM CONTACTS

Normally open and normally closed alarm contacts are provided on the rear of the TRACER 4103/4203. The alarm contacts are energized when the RF link goes down. Under normal operating conditions there is no continuity between the Normally-open and Common contacts. Under an alarm condition, continuity between those contacts exists. The Normally-closed and Common contacts normally have continuity, while under alarm conditions, these contacts are open.

VT 100 USER INTERFACE

The TRACER 4103/4203 may be accessed with a VT 100 compatible terminal set to 9600 bits per second, 8 data bits, and no parity, connected to the RS-232 port on the back of the unit. Flow control on the serial interface should be configured to none for proper operation. Once a terminal is connected, pressing CTRL-L will redraw the current screen. If password access has been enabled, the “Enter Password:” message will be displayed at the bottom of the TRACER system status menu. TRACER 4103/4203 is shipped with password protection disabled.

RS-232 INTERFACE

The TRACER 4103/4203 has an RS-232 interface for system management via an attached VT 100 terminal, personal computer, or modem. The RS-232 port is configured as a DCE with the following pin assignments:

Signal Name	Pin Number	Direction
TXD	2	To TRACER 4103/4203
RXD	3	From TRACER 4103/4203
RTS	4	To TRACER 4103/4203
CTS	5	From TRACER 4103/4203
DSR	6	From TRACER 4103/4203
Ground	7	
DCD	8	To TRACER 4103/4203
DTR	20	To TRACER 4103/4203

MODEM CONNECTION

Modem controls, discussed in the TRACER system configuration menu section, will enable or disable modem control. When this option is enabled from a standard terminal connection, all RS-232 communications will cease until a modem is attached with a Null-Modem adapter between the TRACER 4103/4203 and data modem. The data modem will need to be configured for AUTO ANSWER and 9600 BPS. When the user connects via modem to the TRACER 4103/4203 unit, communications via the RS-232 port will resume. If a user accidentally enables modem control from a terminal and disrupts the RS-232 communication, pressing [CTRL Z] three times, will temporarily disable the modem control option. This will allow the user to access the system configuration page to disable modem control.

When modem control is enabled, the RS-232 port is inactive until DTR and DCD are active. This prohibits data being sent to the modem or received from the modem while idle. The required Null-Modem adapter may be obtained at any computer hardware supplier. A straight-through serial cable should be used between the adapter and the modem or TRACER 4103/4203 unit. The modem must be configured to drop the connection on loss of DTR in order to disconnect.

CABLE CONNECTIONS

The cable connections required for various configurations are detailed in Appendix A of this manual.

PASSWORD

TRACER 4103/4203 provides optional password protection of the terminal interface. If enabled, a password prompt is presented at power-up, reboot, or after thirty minutes of inactivity on the terminal. The default configuration is “Disabled.” Password protection is enabled via the system configuration menu. The password is also set via the system configuration menu.

If the password is forgotten, physical access to TRACER 4103/4203 is required to access the terminal interface. The password may be bypassed by holding in the LBK A button while the system is rebooted. This disables the password and will bring up the TRACER system status menu to allow the password to be changed via the configuration screen.

C A U T I O N

This procedure is service-affecting.

MENU SELECTIONS

TRACER System Status

The Screen in **Figure 3-1** displays the status of major system components. System status is displayed for both sides of the link. This is a status screen only; no configuration can be performed from this view.

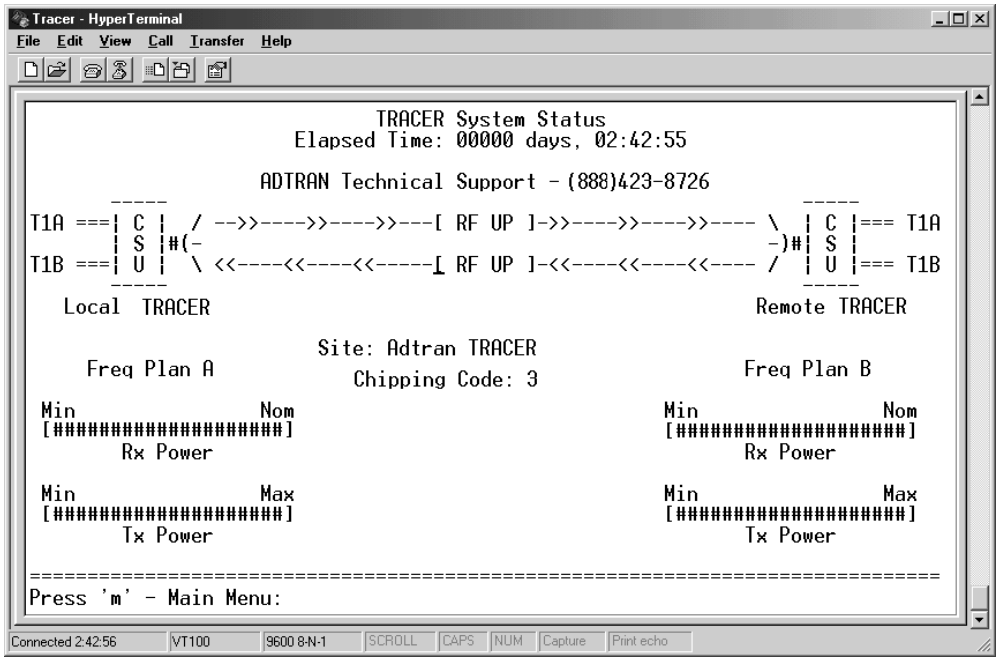

Figure 3-1. TRACER System Status

The upper portion of the screen indicates how long the system has been running since the last reset operation. The “T1A” and “T1B” labels will be highlighted if any error conditions exist on that T1 interface.

The status of the radio link is indicated as RF UP or RF DOWN. The left portion of the screen reports the status of the local system (the system to which the terminal is attached). The right portion of the screen reports the status of the remote system. During RF DOWN situations, remote status cannot be obtained and the message “RF Connection Down” will be displayed below the chipping code display. The approximate transmitter and receiver signal levels are shown via the “fuel gauges” on the left and right sides of the screen. If the link is down and remote end data is unavailable, the remote side fuel gauges will be replaced with a “Data Not Available” message. Chipping code indicates the code to which the system is set. From any menu in the VT 100 menu structure, pressing the 0 (zero) key will bring the operator back to this screen. Pressing M from this or any other menu will take the user to the TRACER main menu.

Main Menu

Pressing M on any screen will take the user to the TRACER main menu, from which all other menus are accessed. **Figure 3-2** shows the TRACER main menu screen.

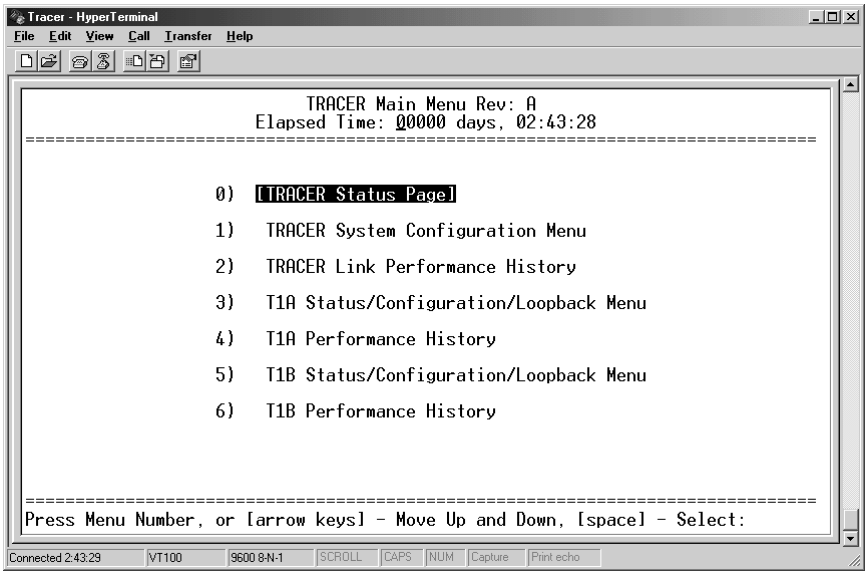

Figure 3-2. TRACER Main Menu

To return to the TRACER status page, press 0 from any menu or use the arrow keys to move to option 0 and then press Enter.

TRACER System Configuration

Pressing 1 from the TRACER main menu or using the arrow keys to move to option 1 and then pressing Enter will select the TRACER system configuration menu. The upper portion of this screen shows transmit and receive power on both ends of the link. Local and remote transmit power levels can be adjusted from this menu, while the receive power levels are a function of the link characteristics and cannot be changed. Selections are made by highlighting the option with the up or down arrow keys and

then pressing Enter. The option is changed by using the left or right arrow keys and the pressing Enter to enable the current selection.

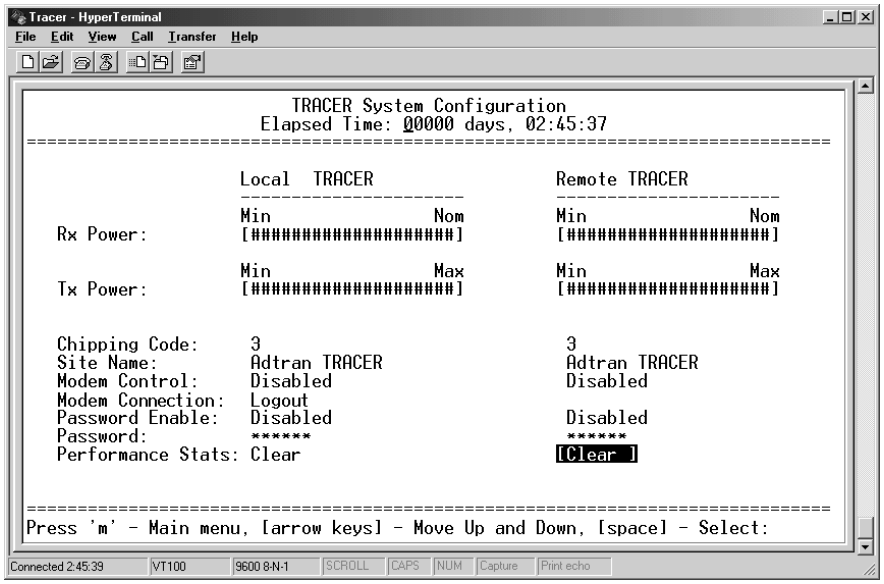

Figure 3-3. TRACER System Configuration

Rx Power shows a relative receive signal level and is for display only.

Tx Power allows the transmitter power to be adjusted.

Chipping Code allows the chipping code to be selected. Each end of the link must be configured for the same chipping code.

Site Name allows a string of up to 32 characters to be entered as a site identifier.

Modem Control configures the modem control leads on the RS 232 port. Disabling modem control lowers the DSR signal, which becomes DTR after passing through the null modem adapter. Configure the modem to disconnect on loss of DTR so the dialup connection will automatically drop. The default setting is Disabled.

Modem Connection causes the unit to de-assert CTS and DSR for a time greater than 20 milliseconds. This signals the modem to hang up the line. Hangup-on-DTR-Drop may need to be explicitly enabled on some modems. If password protection is enabled, this option also causes the unit to log out to the system status menu and await password input.

Password Enable allows password protection to be enabled or disabled. The default setting is Disabled. If password protection is enabled, the unit will automatically log out to the system status menu after 15 minutes and await password input.

Password allows the password to be set or changed. The default password is tracer.

Clear Performance Stats resets all the error counters.

I M P O R T A N T

If the remote end chipping code is accidentally changed from this menu, the link will be lost. If the new chipping code is unknown, step the local end of the link through all the other chipping codes until the link is re-established.

TRACER Link Performance History

Pressing 2 from the TRACER main menu or using the arrow keys to move to option 2 and then pressing Enter will select the TRACER link performance history menu. The screen in **Figure 3-4** presents detailed error statistics for the RF link. The data is presented as link (LNK) errors representing errored seconds received on the wireless link. This is generally an indication of path or interference problems. The counts for the most recent 24 hours are recorded in 15-minute increments. Twenty-four-hour totals are recorded for the most recent days. To view the next eight hours (32 15-minute intervals) of performance history, press N. To view the previous eight hours, press P. This information is available for both ends of the link. To return to the TRACER main menu, press M.

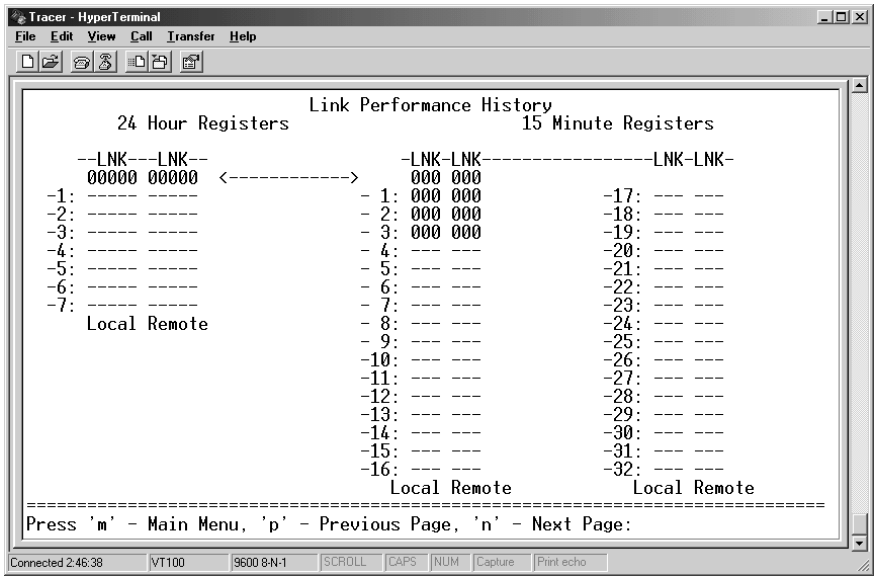

Figure 3-4. TRACER Link Performance History

T1A and T1B Status/Configuration/Loopback

Pressing 3 from the TRACER main menu or using the arrow keys to move to option 3 and then pressing Enter will select the T1A status/configuration/loopback menu. Option 5 selects the T1B status/ configuration/loopback menu.

The upper portion of this screen shows a real-time representation of the T1 link.

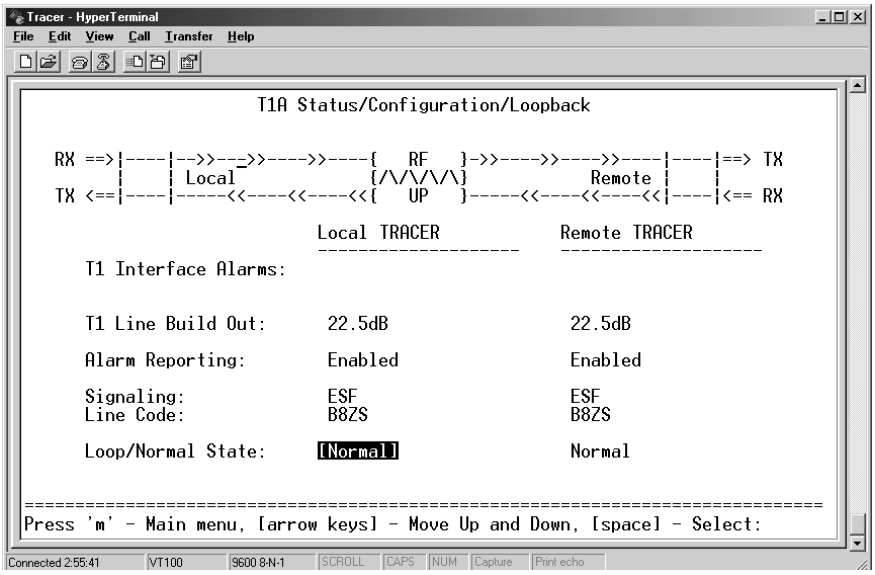

Figure 3-5. T1A Status/Configuration/Loopback

T1 Interface Alarms - Any active T1 alarms will be displayed for both ends of the link immediately below the link status, if both ends of the link have alarm reporting enabled. These alarms include red, blue, yellow, AIS, and bipolar variations (BPV). See *Troubleshooting* on page 37 for more information on these alarms.

Line Buildout allows each T1 to be configured for the appropriate line buildout, based on the distance to the T1 equipment.

Alarm Reporting can be enabled or disabled at either end of the link. If it is disabled, no alarms will be registered on this page. Each end of the link operates independently with regard to alarm reporting. Therefore, it is possible to have alarms enabled on the remote side and disabled locally, or vice-versa.

Signaling allows each T1 to be configured independently for D4 or ESF framing.

Line Code allows each T1 to be configured for AMI or B8ZS.

Loop/Normal State controls the loop status of the T1 link. Supported loopbacks include:

Link - The local unit is looped at the T1 framer so that data is looped back to the far end.

Line - The local unit is looped at the T1 interface so that data is looped back locally to the device attached to the T1 port.

Normal - No loopback present.

Table 3-1 describes the T1 interface alarms.

Table 3-1. T1 Interface Alarms

BPV	This alarm will activate when the incoming T1 stream presents bipolar violations (BPVs).
AIS	Alarm Indication Signal - This alarm will activate when the DS1/DSX-1 input receives a “blue code” (a string of 2316 1s with no more than one zero).
YEL	This alarm will activate when a Yellow alarm is received on the T1.
RED	Red Alarm - This alarm will activate when there is no signal present on the T1 interface.
LOS	This alarm (loss of signal) will activate when there is no signal present at the T1 interface.

T1A and T1B Performance History

Pressing 4 from the TRACER main menu or using the arrow keys to move to option 4 and then pressing Enter will select the T1A performance history menu. Option 6 selects the T1B performance history menu.The screen in **Figure 3-6** presents detailed error statistics for T1A. The data is presented as Errored Seconds and Severely Errored Seconds. The counts for the most recent 24 hours are recorded in 15-minute increments. Twenty-four-hour totals are recorded for the most recent days. To view the next eight hours (32 15-minute intervals) of performance history, press N. To view the previous eight hours, press P. This information is available for both ends of the link. To return to the TRACER main menu, press M.

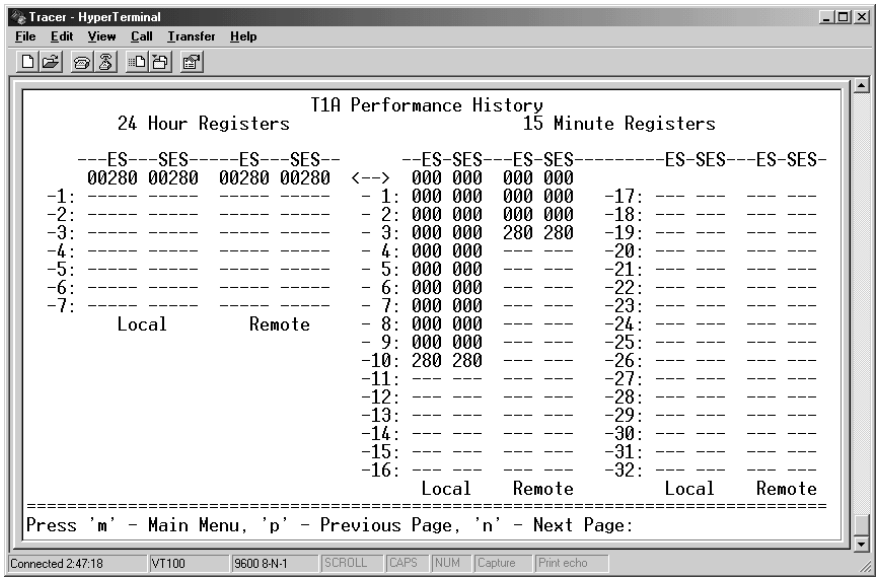

Figure 3-6. T1A Performance History

I M P O R T A N T

If problems persist after you have followed the Recommended Actions, contact ADTRAN Technical Support at (888) 423-8726.

Power LED is not Lit

If the power LED is not lit, it is an indicator that the TRACER 4103/4203 is not receiving adequate DC power.

Recommended Actions:

1. Verify that the power source is delivering between and 21- 63 VDC.
2. Check the polarity of the power connection by verifying that the positive voltage is applied to the terminal labeled "+" and the negative voltage is applied to the terminal labeled "-."
3. Check the internal fuse. The fuse is accessed by removing the top of the unit, and is located on the left side of the chassis when facing the front panel. If this fuse is open, replace with a 1 Amp, 250 Volt slow blow type fuse.

Test LED is Blinking or On (solid)

The test LED will remain *On (solid)* during power-up indicating a self-test is in progress. If the test LED is *Blinking* or remains *On (solid)* after 10 seconds, this indicates that TRACER 4103/4203 unit has failed a self test. This is an internal failure, and ADTRAN technical support should be contacted.

Link Down LED is Lit (RF Link is Down)

Recommended Actions:

1. Check the RF coaxial cable connection.
2. Measure the RSSI voltage. If the signal is good ($\geq$ 2.0 Vdc at RSSI Test Point), go to step 6.
3. Verify that one end of the link is configured as plan A and the other end is configured as plan B.
4. Verify that the antenna polarization is the same at both ends of the RF signal transmit and receive path.
5. Verify that the RF signal path is clear.
6. Verify that the chipping codes are the same on both ends of the link.
7. Check for possible interference at both ends of the link. If necessary, change polarization and/or PN code at both ends.

I M P O R T A N T

If problems persist after you have followed the Recommended Actions, contact ADTRAN Technical Support at (888) 423-8726.

RF Low LED is Lit

This indicates that the received signal is within approximately 10 dB of the minimum operable signal. This condition is typically indicative of a path problem.

Recommended Actions:

1. Verify the far-end transmitter power setting is the value that the link planning budget allows.
2. Check all coaxial cable connectors for solid connections. Check for water and corrosion around any of the connectors.
3. Verify the RF signal path by verifying the antenna alignment.
4. Check integrity of the cable plant.
5. Check integrity of lightning arrestors.

LOS LED is Lit (Red Alarm)

A Red Alarm (loss of signal) is generated at the TRACER 4103/4203 T1 interface when that interface cannot find the T1 framing information. This error may be due to a degraded signal or no signal, or it may be caused by improper framing.

Recommended Actions:

1. Verify that the T1 cable is connected to the T1 interface on the TRACER 4103/4203 unit.
2. If the RJ-45 connection is used, verify that the connector is wired correctly. If the bantam jacks are used, verify that they are inserted into the correct sockets.
3. Verify the connections at the opposite end of the T1 cable.
4. Verify that the framing mode (ESF or D4) is on the same setting for both the TRACER 4103/4203 unit and the connected equipment.

AIS LED is Lit (Yellow Alarm)

A Yellow Alarm, when indicated at TRACER 4103/4203, is generated by the attached equipment. When the attached equipment's T1 interface is in Red Alarm, a Yellow Alarm will be generated at the TRACER 4103/4203 unit.

Recommended Action:

1. Follow the troubleshooting steps for Red Alarm, but do so at the attached equipment.

I M P O R T A N T

If problems persist after you have followed the Recommended Actions, contact ADTRAN Technical Support at (888) 423-8726.

AIS LED is Blinking (Alarm Indication Signal or Blue Alarm)

A Blue Alarm (also called AIS, keep alive, and all-ones), when indicated at TRACER 4103/4203, is generated by the attached equipment. The root cause must be determined at the attached equipment. A typical cause of a blue alarm is a lack of input to a CSU.

Recommended Action:

1. Verify the input to any attached data equipment.

BPV LED is Lit (Bipolar Violations)

This alarm will activate when the incoming T1 stream presents Bipolar Violations (BPV). BPVs indicate an improper configuration or a faulty cable plant.

Recommended Actions:

1. Verify the TRACER 4103/4203 unit and the attached equipment are configured for the same line coding (AMI or B8ZS).
2. Verify that the Line Buildout (LBO) of the attached equipment is correct.
3. Inspect the cable plant for split pairs. A split pair is a condition in which the T1 interface is incorrectly wired into the cable plant. Each interface direction, transmit and receive, is carried on two signals - tip and ring. Normally, tip and ring for the transmit signal comprise the two wires for a single twisted pair in the bundle. It is not uncommon for one connection from the transmit interface and one connection from the receive interface to comprise another twisted pair. This condition is referred to as a split pair, and it can cause signal degradation.

This section lists the specifications for the TRACER 4103 and TRACER 4203 systems.

Transmitter

Output Power ..... +20 dBm, max
Frequency Range ..... 2400 to 2483.5 MHz (TRACER 4103); 5725 to 5850 MHz (TRACER 4203)
Channel Bandwidth .....40 MHz (TRACER 4103); 62 MHz (TRACER 4203)
Intermediate Frequency .....280 MHz

Receiver

Receive Level, range .....-30 to -91 dBm (TRACER 4103); -30 to -90 dBm (TRACER 4203)
Receive Level, maximum .....-30 dBm
Receive Level, nominal .....-60 dBm
Intermediate Frequency .....140 MHz

Frequency Plan

Plan A 2.4 GHz (TRACER 4103) .....Tx 2.422 GHz, Rx 2.462 GHz
Plan B 2.4 GHz (TRACER 4103) .....Tx 2.462 GHz, Rx 2.422 GHz
Plan A 5.8 GHz (TRACER 4203) .....Tx 5.747 GHz, Rx 5.827 GHz
Plan B 5.8 GHz (TRACER 4203) .....Tx 5.827 GHz, Rx 5.747 GHz

Spread Spectrum Data Pump

Modulation .....QPSK
Spreading Method ..... Direct sequence
Code Length ..... 120 bits
Processing Gain .....>12 dB
Number of Codes..... 10
Chipping Rate ..... 12 times

T1 Interface Specifications

Capacity .....2 x T1
Connection..... RJ-48C, bantam
Line Code .....AMI, B8ZS
Framing..... D4, ESF
Alarms ..... AIS, Red, Yellow, BPVs
Loopbacks.....Local and remote

User Interface

Front Panel ..... Alarm LEDs, Monitor Jacks
Diagnostics ..... T1 Loopback
Test Points ..... RSSI, QPSK Constellation, TX PWR
VT 100 Terminal ..... Menu-Driven User Interface, Control of the Remote End, Password Protected (Optional), Event History

VT 100 Terminal Interface

Data Rate ..... 9600 bps
Data Bits 8
Parity ..... None
Stop Bits 1
Terminal Emulation ..... VT 100

Mechanical & Environmental

TRACER 4103/4203
Operating Temperature ..... -25°C to 65°C
Size ..... 19" x 1.75" x 10.5"
Humidity ..... 95%, Non-condensing
Weight ..... 6 lbs

Power

Input Voltage ..... 21 to 63 Vdc, either polarity referenced to ground
Power Consumption ..... 16 watts
Connector ..... 2 pin terminal block (DC)
Fuse ..... 1 amp, 250 Volt slo-blow

WARRANTY

ADTRAN will replace or repair this product within five years from the date of shipment if it does not meet its published specifications or fails due to defects in materials and workmanship.

For detailed warranty, repair, and return information, refer to the ADTRAN Equipment Warranty, Repair, and Return Policy and Procedure located on the ADTRAN web site at http://www.adtran.com.

SALES

For TRACER 4103/4203 sales information, contact ADTRAN Sales at:

(888) 3ADTRAN or http://www.adtranwireless.com

TECHNICAL SUPPORT

Standard support hours are 7 a.m. to 7 p.m. CST, Monday through Friday. Emergency technical support is available 24 hours a day, seven days a week.

For technical support at any time, contact ADTRAN at:

(888) 423-8726

REPAIRS AND RETURNS

Return Material Authorization (RMA) is required prior to returning equipment to ADTRAN.

For RMA information, contact ADTRAN at:

(800) 726-8663

or ADTRAN, Inc.
Customer Service Department
P.O. Box 140000 / 901 Explorer Boulevard
Huntsville, Alabama 35814-4000

When returning faulty equipment, please include the RMA number on the shipping label.

ACRONYMS USED IN THIS MANUAL

AMI	Alternate Mark Inversion
B8ZS	Bipolar 8 zero substitution
BER	Bit error rate
CRC	Cyclic Redundancy Check
DCE	Data Communications Equipment
DTE	Data Terminal Equipment
ESF	Extended superframe
FCC	Federal Communications Commission
FEC	Forward error correction
IF	Intermediate Frequency
ISM	Industrial, Scientific, and Medical
LBK	Loopback
QPSK	Quadrature Phase Shift Keying
RF	Radio frequency
RSSI	Received signal strength indicator
Rx	Receive
SF	Superframe
Tx	Transmit

Glossary

The cable connections required for various configurations are detailed below.

Terminal Connection (DB25)

TRACER 4103 (DCE)			Terminal (DTE)	
Number	**Name**		**Number**	**Name**
2	TXD	⟷	2	TXD
3	RXD	⟷	3	RXD
4	RTS	⟷	4	RTS
5	CTS	⟷	5	CTS
6	DSR	⟷	6	DSR
7	Ground	⟷	7	Ground

Personal Computer Connection (DB9)

TRACER 4103 (DCE)			Computer (DTE)	
Number	**Name**		**Number**	**Name**
2	TXD	⟷	3	TXD
3	RXD	⟷	2	RXD
4	RTS	⟷	7	RTS
5	CTS	⟷	8	CTS
6	DSR	⟷	6	DSR
7	Ground	⟷	5	Ground

Modem Connection (DB25)

TRACER 4103 (DCE)			Modem (DCE)	
Number	**Name**		**Number**	**Name**
2	TXD	⟷	3	RXD
3	RXD	⟷	2	TXD
4	RTS	⟷	5	CTS
5	CTS	⟷	4	RTS
6	DSR	⟷	20	DTR
7	Ground	⟷	7	Ground

Appendix A Cable Connections