TRACER 4106/4206
System Manual

12804106L1A TRACER 4106 System (Plan A)
12804106L1B TRACER 4106 System (Plan B)
12804206L1A TRACER 4206 System (Plan A)
12804206L1B TRACER 4206 System (Plan B)

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About this Manual

This manual provides a complete description of the TRACER 4106/4206 system and system software. The purpose of this manual is to provide the technician, system administrator, and manager with general and specific information related to the planning, installation, operation, and maintenance of the TRACER 4106/4206. This manual is arranged so that needed information can be quickly and easily found. The following is an overview of the contents.

Section 1 System Description 11

Provides managers with an overview of the TRACER 4106/4206 system.

Section 2 Microwave Path Engineering Basics 13

Explains the basics of analyzing a wireless microwave link, or path. The significant parameters are defined, and several recommendations are offered.

Section 3 Engineering Guidelines 23

Provides information to assist network designers with incorporating the TRACER 4106/4206 system into their networks.

Section 4 Network Turnup Procedure 33

Provides step-by-step instructions on how to install the TRACER 4106/4206 unit, determine the parameters for the system, install the network and option modules, and power up the system.

Section 5 User Interface Guide 39

Explains the terminal interface and provides a description for each of the menus available for the TRACER 4106/4206 system.

Section 6 Troubleshooting Guide 61

Provides helpful information for troubleshooting common configuration problems for the TRACER 4106/4206 system.

Revision History

This is the second issue of this manual.

NOTE *Notes provide additional useful information.*

CAUTION *Cautions signify information that could prevent service interruption.*

WARNING *Warnings provide information that could prevent damage to the equipment or endangerment to human life.*

Safety Instructions

When using your telephone equipment, please follow these basic safety precautions to reduce the risk of fire, electrical shock, or personal injury:

1. Do not use this product near water, such as a bathtub, wash bowl, kitchen sink, laundry tub, in a wet basement, or near a swimming pool.
2. Avoid using a telephone (other than a cordless-type) during an electrical storm. There is a remote risk of shock from lightning.
3. Do not use the telephone to report a gas leak in the vicinity of the leak.
4. Use only the power cord, power supply, and/or batteries indicated in the manual. Do not dispose of batteries in a fire. They may explode. Check with local codes for special disposal instructions.

Save These Important Safety Instructions

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Federal Communications Commission Radio Frequency Interference Statement

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio frequencies. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

NOTE *Shielded cables must be used with this unit to ensure compliance with Class A FCC limits.*

WARNING *Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.*

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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.

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

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FCC Output Power Restrictions

The FCC does not require licensing to implement this device. License-free operation in the industrial, scientific, and medical band is documented in FCC Rules Part 15.247. It is the responsibility of the individuals designing and implementing the radio system to assure compliance with any pertinent FCC Rules and Regulations. **This device must be professionally installed**.

Exposure to Radio Frequency Fields

The TRACER 4106 is designed to operate at 2.4 GHz with 100 mW maximum transmit power. The TRACER 4206 is designed to operate at 5.8 GHz with 100 mW maximum transmit power.

This level of RF energy is 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 15 feet (4.6 meter) 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 15 feet (4.6 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 15 feet (4.6 meter) 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 TRACER 4106/4206 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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CAPS Department (256) 963-8722

Identify the RMA number clearly on the package (below address), and return to the following address:

ADTRAN Customer and Product Service
901 Explorer Blvd. (East Tower)
Huntsville, Alabama 35806

RMA # _____

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http://support.adtran.com

When needed, further pre-sales assistance is available by calling our Applications Engineering Department.

Applications Engineering (800) 615-1176

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http://support.adtran.com

When needed, further post-sales assistance is available by calling our Technical Support Center. Please have your unit serial number available when you call.

Technical Support	(888) 4ADTRAN

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The ADTRAN Custom Extended Services (ACES) program offers multiple types and levels of installation and maintenance services which allow you to choose the kind of assistance you need. This support is available at:

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For questions, call the ACES Help Desk.

ACES Help Desk	(888) 874-ACES (2237)

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Training Fax	(256) 963-6700
Training Email	training@adtran.com

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SYSTEM DESCRIPTION

This section of ADTRAN's TRACER 4106/4206 System manual is designed for use by network engineers, planners, and designers for overview information about the TRACER 4106/4206.

It contains general information and describes physical and operational concepts, network relationships, provisioning, testing, alarm status, and system monitoring. This section should be used in conjunction with Section 3, *Engineering Guidelines*, of the system manual.

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1. SYSTEM OVERVIEW

The ADTRAN TRACER® 4106 and 4206 wireless systems provide four independent T1 circuits over a wireless link for up to 30 miles (line-of-sight path required). As authorized under Part 15.247 of the FCC Rules, the TRACER 4106 and 4206 operate license-free in the 2.4 GHz and 5.8 GHz Industrial, Scientific, and Medical (ISM) bands, respectively. These bands require no frequency coordination or licensing of end users.

For configuration and testing, the TRACER 4106/4206 provide the capability to control the remote system through a separate maintenance channel. The TRACER 4106/4206 has several built-in test capabilities including remote loopback. Complete configuration and performance data is available through menus accessed using a standard RS-232 terminal interface.

2. FEATURES AND BENEFITS

The following is a brief list of TRACER 4106/4206 features and benefits:

Configuration and Management

- Easy to use VT100 control port (RS-232 interface) for configuration and monitoring
- Remote configuration

Operational

- Four independent transparent T1 transmission paths, over digital microwave link
- No license required per FCC Rules Part 15.247
- Frequency: 2.400 to 2.4835 GHz (TRACER 4106) 5.725 to 5.850 GHz (TRACER 4206)
- Point-to-point, up to 30 miles
- 1-U high unit for easy rack-mounting

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MICROWAVE PATH ENGINEERING BASICS

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1. LINE-OF-SITE

The TRACER 4106 and 4206 systems are designed for operation in the license free 2.400 to 2.4835 GHz and 5.725 to 5.850 GHz Industrial, Scientific, and Medical (ISM) bands. Radio wave propagation in these bands exhibit microwave characteristics, which are ideally suited for point-to-point, line-of-sight communications. Line-of-sight essentially requires that the transmitting antenna and receiving antenna are able to "see" each other, and that the straight-line path between the two antennas is free of any obstructions, such as buildings, trees, mountains, and, in longer paths, even the curvature of the earth.

Point-to-Point	Wireless communication from a single site to another individual site. Contrast with point-to-multipoint
Line-of-Sight	An unobstructed, direct path exists between the transmitting and the receiving antennas.

2. DECIBELS

The received signal power equation is often expressed in a decibel (dB) format, which turns the power multiplication and division operations into addition and subtraction operations. In general, any quantity can be expressed in decibels. If the quantity (x) is a power level, the decibel equivalent is defined as

$$x_{dB} = 10 \cdot log_{10}(x) \qquad \text{(dB)}$$

If the quantity x is referenced to a milliwatt (mW), then the decibel-milliwatt (dBm) is used instead of a generic decibel.

$$x_{dBm} = 10 \cdot log_{10}\left(\frac{x}{1mW}\right) \qquad \text{(dBm)}$$

3. RECEIVER POWER

The radio frequency (RF) signal power that is available at the input to the receiving TRACER 4106/4206 system is the next parameter of interest in analyzing a wireless path. The TRACER 4106/4206 has a maximum output power level of 100 mW, which is equivalent to 20 dBm. This output signal will be attenuated and distorted by various factors, all of which will degrade the original signal and affect the signal strength and quality as sensed by the receiving unit. A simplified power budget analysis is beneficial to perform after verifying a suitable line-of-sight path to determine if the microwave path is suitable, even for ideal, non-distorted signals.

The equation relating received signal power to the other microwave parameters is

$$P_R = \frac{P_T G_T G_R \lambda^2}{(4\pi)^2 d^2 L} \qquad \text{(watts, W)}$$

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where the variables in the equation are defined as

P_R	received power (Watts)
P_T	transmitted power (100 mW maximum for TRACER 4106/4206 - adjustable)
G_T	transmit antenna gain
G_R	receive antenna gain
λ	carrier wavelength (c / f) (meters)
d	path distance (meters)
L	other losses (RF coaxial cable, etc.)

The actual transmit and receive antenna gain values are strictly dependent upon the physical characteristics of the antennas installed for each link. Typical gains are between 20 and 40 dB. For example, a 4 foot diameter Parabolic dish has 34.2 dB of gain at 5.8 GHz. The carrier wavelength is the physical wavelength of the main RF carrier being used for communication, and is usually approximated at the center frequency of the band, which is 2441.75 or 5787.5 MHz. This gives a wavelength of 12.29 cm at 2441.75 MHz and 5.18 cm at 5787.5 MHz.

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 (30 dBm) into antennae of a gain less than or equal to 6 dBi. At 2.4 GHz (TRACER 4106), 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 4106 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 4206), there is no reduction in transmitter output power required for antennae gains greater than 6 dBi.

The path distance is simply the physical distance between the transmit and receive antennas. For the TRACER 4106/4206 these distances can range up to 30 miles. The final parameter L incorporates all other signal power losses in the microwave link, most of which are caused by antenna feed.

4. 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 features detailed below. Dish manufacturers will be able to supply gains for other types of antennas.

Table 1. Antenna Gain for Given Dish Diameters

Dish Diameter (in feet)	Gain at 2.4 GHz (in dBi) (TRACER 4106)	Gain at 5.8 GHz (in dBi) (TRACER 4206)
2	21	28.5
4	27	34.2
6	31	37.5
8	33	40.7
10	35	42.5
12	37	44.2

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5. PATH LOSS

The expression

$$L_P = \left(\frac{4\pi d}{\lambda}\right)^2 = \left(\frac{4\pi df}{c}\right)^2 \qquad \text{(dB)}$$

where

f	carrier frequency (Hz)
λ	carrier wavelength (c / f) (meters)
d	path distance (meters)
c	speed of light, free-space (meters)

is called the path loss, and increases rapidly as either path length increases or carrier wavelength decreases (which happens as the carrier frequency increases). So, longer microwave paths will naturally experience more path loss than shorter paths. Likewise, higher frequency microwave communication will experience more path loss than lower frequency microwave communication.

Table 2, tabulates path loss values for various path lengths for both 2.4 GHz and 5.8 GHz systems. Values not listed in the table can be interpolated from those listed.

Table 2. Path Loss for Given Path Lengths

Path Length (miles)	Path Loss 2.4 GHz (dB)	Path Loss 5.8 GHz (dB)
1	104	112
2	110	118
3	114	121
4	116	124
5	118	126
10	124	132
15	128	135
20	130	138
25	132	140
30	134	141
35	135	143

When using decibel notation, the received power equation becomes

$$P_R = P_T + G_T + G_R - L - 20 \cdot log_{10}\left(\frac{4\pi df}{c}\right) \qquad \text{(dBm)}$$

or

$$P_R = P_T + G_T + G_R - L - L_P \qquad \text{(dBm)}$$

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Where, in the second equation the path loss has been lumped into a single quantity, L_P, as discussed previously. When using decibel notation, it is necessary that all quantities are individually converted to decibels prior to performing addition and subtraction.

When d is expressed in miles and f in GHz, the path loss expression in decibels becomes

$$L_P = 96.6 + 20 \cdot log_{10}(d) + 20 \cdot log_{10}(f) \qquad \text{(dB)}$$

Figure 1 illustrates a wireless link containing all of the parameters previously discussed.

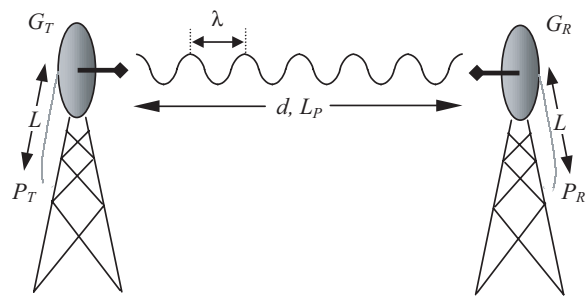

Figure 1. Example Microwave Path with Parameters

6. ANTENNA ALIGNMENT

With line-of-sight microwave communications, optimum system performance requires that the transmitting and receiving antennas are properly aligned. This will ensure maximum received signal power at each receiver. Antenna alignment must be achieved in both azimuth (along a horizontal plane) and elevation (along a vertical plane). A received signal strength indicator (RSSI) is used to aid the equipment installer in determining when alignment is maximized, by simply ensuring maximum RSSI. The RSSI indicator for the TRACER 4106/4206 system is provided through the VT100 terminal menus accessed through the RS-232 interface, and is presented as a series of bars indicating signal strength. More bars means more RSSI, which ensures more received signal strength and better link performance.

If the local system has acquired a useful signal from the remote system, then the remote TRACER 4106/4206 RSSI can also be viewed from the local TRACER 4106/4206 VT100 terminal menu interface.

An RSSI Test point is also provided on the front panel. The voltage (relative to the gnd test point) present on this test point represents a relative signal level of receive strength from the far end. The voltage at this test point can vary from approximatly 0 to greater than 4 Volts DC, with 0 Volts corresponding to no signal and 4 Volts or better to full signal strength.

Antenna Beam Patterns

Directly related to the subject of antenna alignment is the topic of antenna beam patterns. Antennas being used with the TRACER 4106/4206 system will have a particular beam shape determined in part by the physical construction and geometry of the antenna. The antenna beam patterns are characterized by a dominant main lobe, which is the preferred lobe to use for point-to-point communications, and several side

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lobes, as shown in Figure 2 on page 18. The antenna alignment step to setting up a microwave link is in fact steering the main lobes of both antennas until the main lobe of one transmitter is centered on the receiving element of the receiving antenna.

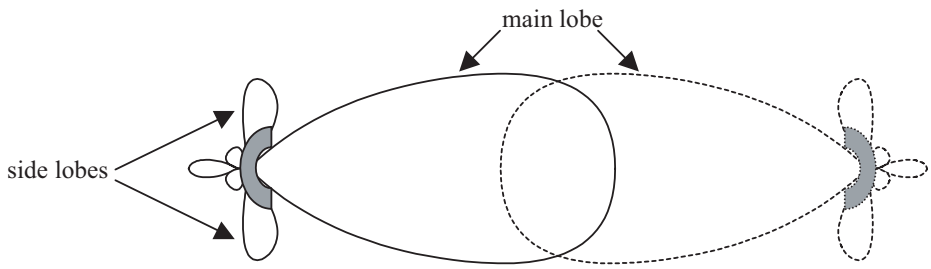

Figure 2. Typical Antenna Beam Pattern

Antennas are also designed to radiate RF energy efficiently for a specific range of frequencies. Please consult the data sheet for your particular antenna make and model to ensure that it is specified to operate in the 2400 MHz to 2483.5 MHz frequency band for TRACER 4106 models, and the 5725 MHz to 5850 MHz frequency band for TRACER 4206 models.

Fresnel Zones, Earth Curvature, & Antenna Heights

The Fresnel zones correspond to regions in the microwave path where reflections of the intended signal occur and combine in both constructive and destructive manners with the main signal, thereby either enhancing or reducing the net power at the receiver.

In general, the odd numbered Fresnel zones (1, 3, 5, ...) add constructively at the receiver, while the even numbered Fresnel zones (2, 4, 6, ...) add destructively at the receiver.

The first Fresnel zone corresponds to the main lobe, and must be at least 60% free of physical obstructions for the path calculations to be valid. Since the main lobe contains the vast majority of the microwave energy, this zone is typically used to determine proper antenna heights when placing antennas on towers or buildings.

The curvature of the Earth becomes a legitimate obstruction for path lengths of 7 miles or greater, and must also be accounted for when determining minimum antenna heights.

The aggregate expression for minimum antenna height that incorporates both the 60% first Fresnel zone and the Earth curvature is given by

$$h = 72.1\sqrt{\frac{d}{4f}} + 0.125d^2 \qquad \text{(feet)}$$

where f is in GHz and d is in miles.

Table 3 tabulates minimum antenna heights for given path lengths.

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Table 3. Minimum Antenna Height for Given Path Lengths

Path Length (miles)	Min. Antenna Height (ft)
2	22
4	32
6	41
8	50
10	60
14	81
16	92
18	104
20	117
22	131
24	145
26	161
28	177
30	194
32	213
34	232
36	252

7. COAXIAL CABLE

Coaxial cable will be required to attach the TRACER 4106/4206 to the antenna. The length of the cable will vary from a few feet to several feet, depending upon your application and the proximity of the TRACER 4106/4206 to the antenna.

Various grades of coaxial cable will work sufficiently well for connecting the TRACER 4106/4206 unit to the antenna. A low-loss coaxial cable is suggested to minimize cable losses. One end of the cable will require an N-type male connector (plug) to mate with the TRACER 4106/4206 unit. The other end of the coax will require a connector compatible with the antenna chosen for the installation, which is usually also an N-type male connector (plug). Additionally, it is recommended that both connectors on the coaxial cable be weatherproofed from the elements to prevent corrosion and electrical shorting.

Table 3 gives typical loss figures for some of the more common coaxial cable types, per 100 feet.

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Table 4. Typical Coaxial Loss for Common Cable Types, per 100 ft.

Cable Type	2.4 GHz Loss/100 ft. (in dB) (TRACER 4106)	5.8 GHz Loss/100 ft. (in dB) (TRACER 4206)
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

In certain areas where lightning strikes are frequent, a lightning arrestor should be installed directly on the antenna coax. This will help protect the RF electronics in the downstream path from damaging voltages and currents, including the TRACER 4106/4206 unit.

8. RECEIVER SENSITIVITY

Receiver sensitivity is a value expressed in decibels referenced to one milliwatt (dBm) that corresponds to the minimum amount of signal power needed at the receiver to achieve a given bit error rate (BER). Receiver sensitivity is usually a negative number of decibels, and as such smaller receiver sensitivity (higher quantity negative numbers) is better for a given BER. Several factors affect receiver sensitivity, including the data bandwidth of the wireless link, and the amount of additional signal degradation introduced in the receiver electronics. The receiver sensitivity of the TRACER 4106 is -93 dBm at 10^{-6} bit error rate, while the receiver sensitivity of the TRACER 4206 is -90 dBm at 10^{-6} bit error rate.

Three software selectable band plans are provided for frequency agility, should an interferer be present nearby. Changing the 4106/4206 bandplan does not require additional components, or opening of the radio. See >*TRACER System Configuration* > *RF Bandplan* on page 47 for additional details.

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9. FADE MARGIN

Fade margin is a value indicating the amount of extra signal power available to the receiver to operate at a maximum bit error rate (BER). Higher levels of fade margin are better, and will protect the viability of the microwave link against signal fading. For most applications, 20 to 30 dB of fade margin should ensure a reliable link. Fade margin is simply the difference between the available signal power at the receiver and the receiver sensitivity, discussed previously:

$$F = P_R - P_{sens} = P_R + G_T + G_R - L - L_P - P_{sens} \qquad \text{(dB)}$$

10. PATH AVAILABILITY

The path availability of a wireless link is a metric that expresses the fractional amount of time a link is available over some fixed amount of time, and depends on several factors. Path availability is expressed as

$$A = [1 - (2.5 \times 10^{-6}) abfd^3 (10^{-F/10})] \times 100\% \qquad \text{(dB)}$$

where the parameters are

a	terrain factor
b	climate factor
f	carrier frequency (GHz)
d	path length (miles)
F	fade margin (dB)

The terrain factor is a quantity that compensates the link availability for different types of terrain. Generally speaking, the more smooth an area's terrain is, the less availability a wireless link running over that terrain will have, primarily due to multipath reflections. In contrast, secondary microwave signals will be randomly dispersed over rough terrain, and will not interfere with the main signal lobe as badly as in the smooth terrain case. The terrain factor values normally used are listed below:

Terrain	Terrain Factor	Description
Smooth	4	water, flat desert
Average	1	moderate roughness
Mountainous	1/4	very rough, mountainous

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The climate factor is a quantity that compensates the link availability for different types of climates (weather). In general, microwave links operating in areas with high humidity will have less availability than those in arid areas, primarily because water is a dispersive mechanism to microwave energy, and causes the main signal lobe to refract and disperse away from the receiver location. The climate factor values normally used are listed below.

Climate	Climate Factor	Description
Very Dry	1/8	desert regions
Temperate	1/4	mainland, interior region
Humid	1/2	humid and coastal regions

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ENGINEERING GUIDELINES

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1. EQUIPMENT DIMENSIONS

The TRACER 4106/4206 unit is 17.12” W, 9.34” D, and 1.72” H, weighs 7 lbs, and can be used in rack-mount configurations.

2. POWER REQUIREMENTS

The TRACER 4106/4206 system has a maximum power consumption of 20W and a maximum current draw of 0.95A (at 21 VDC).

3. REVIEWING THE FRONT PANEL DESIGN

The front panel contains RSSI and TX PWR monitoring interfaces, a GND interface for reference with the monitoring interfaces, and status LEDs to provide visual information about the TRACER 4106/4206 system. Figure 1 identifies the various bantam interfaces and the LEDs.

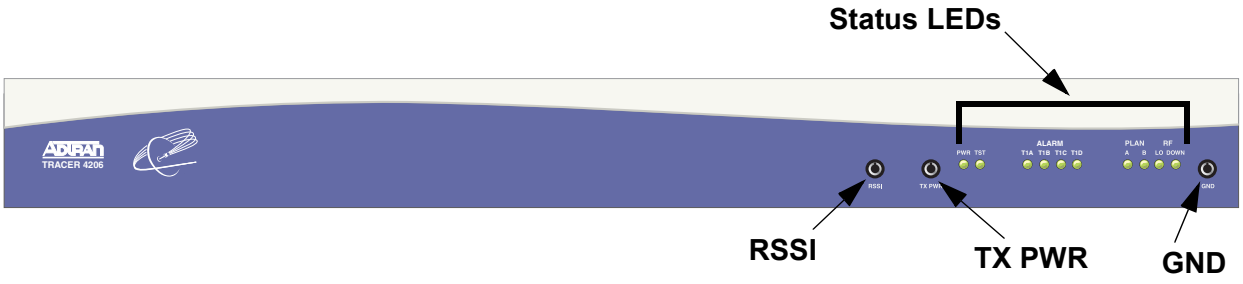

Figure 1. TRACER 4206 Front Panel Layout

RSSI Monitoring Interface

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 (V), with 0V corresponding to a weaker received signal and 4V or better corresponding to a stronger received signal.

NOTE	*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 levels and actual receive levels in dBm. This test point is provided to assess relative signal level for alignment of antennas.*

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TX PWR Monitoring Interface

The TX PWR voltage is a function of the selected transmit power level. This voltage ranges approximately from 0 to 5V, with 0V corresponding to +5 dBm (3 milliwatts) and 5V corresponding to +20 dBm (100 milliwatts).

Front Panel LEDs

With the TRACER 4106/4206 powered-on, the front panel LEDs provide visual information about the status of the TRACER 4106/4206 system. Table 1 provides a brief description of the front panel features, and Table 2 (continued on page 27) provides detailed information about the LEDs.

Table 1. TRACER 4106/4206 Front Panel Description

Feature	Description
RSSI Interface	DC voltage indicating strength of the received signal at the antenna
TX PWR Interface	DC voltage indicating strength of transmitted signal
GND Interface	Ground reference for RSSI and TX PWR interfaces
Status LEDs	Provides status information about the system

Table 2. TRACER 4106/4206 LEDs

For these LEDs...		This color light...	Indicates that...
PWR		Green (solid)	the TRACER 4106/4206 is connected to a power source.
		Off	the TRACER 4106/4206 is not currently powered up.
PLAN A		Green (solid)	the TRACER 4106/4206 is transmitting on Frequency Plan A.
		Off	the TRACER 4106/4206 is not transmitting on Frequency Plan A.
PLAN B		Green (solid)	the TRACER 4106/4206 is transmitting on Frequency Plan B.
		Off	the TRACER 4106/4206 is not transmitting on Frequency Plan B.
RF DOWN		Red (solid)	there is a communication problem between the local and remote TRACER 4106/4206 systems.
T1 Alarms	**T1A** **T1B** **T1C** **T1D**	Red (solid)	an Alarm Condition on a T1 Interface. Check the respective T1 status page to identify the active alarm.
		Red (blinking)	the respective T1 is in a loopback mode.
RF LOW		Red (solid)	the RSSI level is below suggested minimum threshold.
TST		Amber (solid)	there is an active test being performed by the system or there is an active loopback.

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4. REVIEWING THE TRACER 4106/4206 REAR PANEL DESIGN

The TRACER 4106/4206 rear panel contains the following interfaces:

- **ALARM** interface (terminal block) for connecting to an external alarm monitoring system
- **DC POWER** (terminal block) for connecting to a proper 21-60 VDC power source
- **T1A, T1B, T1C** and **T1D** (RJ-48C jacks) for connecting to a T1 device
- **ANTENNA** (N-Type connector) for the antenna feedline cable
- **TEST** (1/4" stereo jack) for QPSK constellation test point
- Ground lug for connecting to earth ground
- **RS-232** (DB-25 female) for connecting to a VT100 terminal or PC with terminal emulation software

Figure 2 on page 26 identifies the various features of the TRACER 4106/4206 rear panel. A detailed discussion of all interfaces (including pinouts, where applicable) follows the figure.

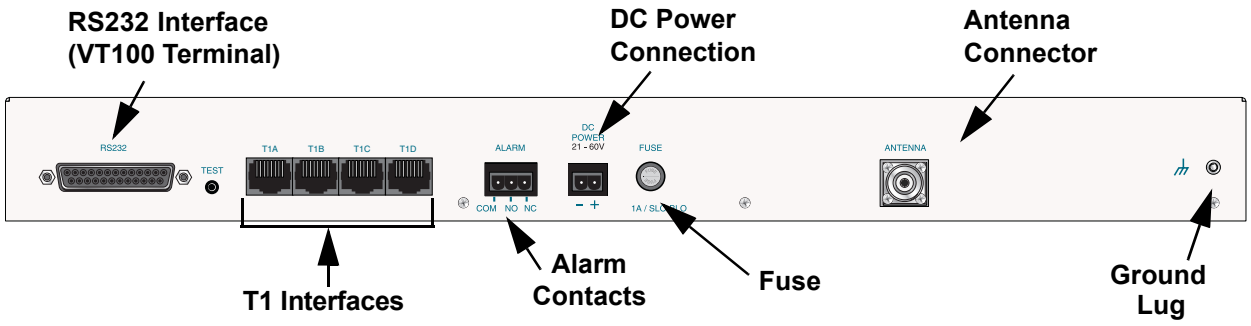

Figure 2. TRACER 4106/4206 Rear Panel Layout

Antenna Interface

The **ANTENNA** interface (N-Type connector) connects to the antenna (customer supplied) using standard antenna feedline cable. When determining the cable specifications for your application, refer to Section 2, *Microwave Path Engineering Basics* (*Coaxial Cable* on page 19) for a discussion on cable length and loss factors.

Fuse

The fuse holder, accessible from the rear panel of the TRACER 4106/4206, accepts a generic 1 Amp, 250 Volt, 2-inch slow-blo fuse.

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DC Power Connection

The TRACER 4106/4206 can operate from a supply between 21 and 60 VDC, with either polarity referenced to ground, and consumes less than 20 Watts (W). Power supplies should be able to provide up to 30 W at the selected voltage. Current required (in amps) is determined by dividing the power consumed (in watts) by the applied voltage (in volts). For example, at 48 V, TRACER 4106/4206 would draw approximately 0.42 A (25 W/48 V).

Connector type Plug-in Terminal Block

Table 3. DC Power Connector Pinout

PIN	NAME	DESCRIPTION
1	+	POSITIVE LEAD (referenced to ground)
2	-	NEGATIVE LEAD (referenced to ground)

Alarm Contacts

Normally open (NO) and normally closed (NC) alarm contacts are provided on the rear panel of the TRACER 4106/4206 system. In normal operation, the NC contact is electrically connected to the common contact (COM) and the NO contact is isolated. During an alarm condition, the NC contact becomes isolated and the NO is electrically connected to COM. This allows alarm conditions to be reported to external alarm monitoring systems.

Connector type Plug-in Terminal Block

Table 4. Alarm Contact Connector Pinout

PIN	NAME	DESCRIPTION
1	COM	COMMON CONTACT
2	NO	NORMALLY-OPEN CONTACT
3	NC	NORMALLY-CLOSED CONTACT

T1 Connections

The physical T1 interfaces are provided by 4 RJ-48C jacks that comply with the applicable ANSI and AT&T® standards.

Connector type RJ-48C

Table 5. T1 Interface Connector Pinout

PIN	NAME	DESCRIPTION
1	R	Transmit data (ring) towards the network
2	T	Transmit data (tip) towards the network
3, 6-8	UNUSED	——
4	R1	Receive data (ring) toward the network
5	T1	Transmit data (tip) from the network

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RS-232 Connection (Terminal Use)

The RS-232 connector provides a female DB-25 terminal connection (wired as a DCE interface), which is used for terminal access to the TRACER 4106/4206 system. The RS-232 port provides the following functions:

- Accepts EIA-232 input from a PC or terminal for controlling the TRACER 4106/4206 system
- Operates at 9600 bps

Table 6 on page 28 shows the pinout. Wiring diagrams for connecting to the RS-232 connector (for various applications) are provided following the pinout.

Connector type DB-25

Table 6. RS-232 Connection Pinout

PIN	NAME	DESCRIPTION
1, 7	GND	GROUND
2	TX	TRANSMIT
3	RX	RECEIVE
4	RTS	REQUEST TO SEND
5	CTS	CLEAR TO SEND
6	DSR	DATA SET READY (MODEM CONTROL ONLY)
8	CD	CARRIER DETECT
9-19	—	UNUSED
20	DTR	DATA TERMINAL READY (MODEM CONTROL ONLY)
21	—	UNUSED
22	RI	RING INDICATOR
23-25	—	UNUSED

Table 7. TRACER 4106/4206 (DCE) to Terminal (DTE) Diagram (DB-25)

PIN	NAME		PIN	NAME
2	TX	◄——►	2	TX
3	RX	◄——►	3	RX
4	RTS	◄——►	4	RTS
5	CTS	◄——►	5	CTS
6	DSR	◄——►	6	DSR
7	GND	◄——►	7	GND

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Table 8. TRACER 4106/4206 (DCE) to Personal Computer (DB-9)

PIN	NAME		PIN	NAME
2	TX	◄——►	2	TX
3	RX	◄——►	3	RX
4	RTS	◄——►	7	RTS
5	CTS	◄——►	8	CTS
6	DSR	◄——►	6	DSR
7	GND	◄——►	5	GND

RS-232 Connection (Modem Use)

Modem controls, discussed in Section 5, *User Interface Guide*, of this manual, will enable or disable modem control through the RS-232 interface. 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 4106/4206 and the data modem. The data modem should be configured for AUTO ANSWER and 9600 bps. When the user connects via modem to the TRACER 4106/4206 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 (until the system is reset) and access the system configuration to disable modem control.

The TRACER 4106/4206 must be interfaced to a modem via an RS-232 null modem adapter or cable. The null modem will convert Clear To Send (CTS) and Data Set Ready (DSR) into Ready To Send (RTS) and Data Terminal Ready (DTR), respectively. These signals will indicate (to most modems) that a valid DTE terminal device is present. The null modem interface must route Carrier Detect (CD) on pin 8 directly from the modem, and the modem must source CD only when actually connected to a carrier when using the RS-232 interface for modem control.

When **MODEM CONNECTION** (logout) is selected in the menu system, the TRACER 4106/4206 will de-assert DTR and DSR for a time greater than 20 ms. The null modem will consequently drop DTR and RTS at the modem interface, signaling the modem to hang up the line. If password functionality is enabled in the TRACER 4106/4206, selecting **MODEM CONNECTION** (logout) will reset the TRACER 4106/4206 to the password entry screen.

> **NOTE** *Hangup-on-DTR-drop may need to be explicitly enabled on some modems.*

Table 9 on page 30 contains the wiring diagram needed for connecting the TRACER 4106/4206 RS-232 interface to a modem using the null modem adapter.

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Table 9. TRACER 4106/4206 (DCE) to Modem (DCE)

PIN	NAME		PIN	NAME
2	TX	◄──►	3	RX
3	RX	◄──►	2	TX
4	RTS	◄──►	5	CTS
5	CTS	◄──►	4	RTS
6	DSR	◄──►	20	DTR
7	GND	◄──►	7	GND
8	CD	◄──►	8	CD

5. AT-A-GLANCE SPECIFICATIONS

The following is a list of specifications for the TRACER 4106/4206 system.

Hardware	Description		Specification
Transmitter			
	Output Power		+20 dBm, max
	Frequency Range		2400 to 2483.5 MHz (4106) 5725 to 5850 MHz (4206)
Receiver			
	Receive Level, Minimum		-93 dBm (TRACER 4106) -90 dBm (TRACER 4206)
	Receive Level, Maximum		-30 dBm
	Receive Level, Nominal		-55 dBm
Frequency Plan			
		Band Plan	
	Plan A	1	Tx 2.416 GHz, Rx 2.456 GHz (4106) Tx 5.734 GHz, Rx 5.814 GHz (4206)
		2	Tx 2.422 GHz, Rx 2.462 GHz (4106) Tx 5.744 GHz, Rx 5.824 GHz (4206)
		3	Tx 2.428 GHz, Rx 2.468 GHz (4106) Tx 5.753 GHz, Rx 5.833 GHz (4206)

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Hardware	Description		Specification
Frequency Plan (continued			
	Plan B	**Band Plan**	
		1	Tx 2.456 GHz, Rx 2.416 GHz (4106) Tx 5.814 GHz, Rx 5.734 GHz (4206)
		2	Tx 2.462 GHz, Rx 2.422 GHz (4106) Tx 5.824 GHz, Rx 5.744 GHz (4206)
		3	Tx 2.468 GHz, Rx 2.428 GHz (4106) Tx 5.833 GHz, Rx 5.753 GHz (4206)
T1 Interface			
	Capacity		1.544 Mbps (each)
	Connection		RJ-48C jacks
	Line Code		B8ZS, AMI
	Framing		ESF, D4
	Alarms		AIS, Red, Yellow, BPVs, LOS
	Loopbacks		Local and remote (line and link)
User Interface			
	Panel		Alarm LEDs
	Diagnostics		Line and Link Loopbacks
	Test Points		QPSK Constellation, RSSI, Tx PWR
	Alarms		Normally Open (NO) and Normally Closed (NC)
	VT100 Terminal		Menu Driven User Interface, Control of the Remote End, Loopback Test, Optional Password Protection, Event History
VT100 Terminal Interface			
	Data Rate		9600 bps
	Data Bits		8
	Parity		None
	Stop Bits		1
	Terminal Emulation		VT100
Mechanical and Environmental			
	Operating Temperature		-25° C to 65° C
	Size		17.12” W x 9.34” D x 1.72” H
	Humidity		95%, Non-condensing

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Hardware	Description	Specification
Mechanical and Environmental (continued)		
	Weight	7 lbs
Power		
	Input Voltage	21 to 60 VDC, either polarity referenced to ground
	Power Consumption	≤ 20 Watts
	Connector	2 pin terminal block (DC)
	Fuse	1 amp, 250 Volt slow-blo fuse (2-inch)

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NETWORK TURNUP PROCEDURE

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Figure 2. 5.8 GHz Bandwidth Division (TRACER 4206) 35

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1. INTRODUCTION

This section discusses the installation process of the TRACER 4106/4206 system.

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

2. TOOLS REQUIRED

The tools required for the installation of the TRACER 4106/4206 are:

- VT100 terminal or PC with terminal emulation software
- RS-232 (DB-25 male for TRACER 4106/4206 end) cable for connecting to terminal

CAUTION *To prevent electrical shock, do not install equipment in a wet location or during a lightning storm.*

3. UNPACK AND INSPECT THE SYSTEM

Each TRACER 4106/4206 is shipped in its own cardboard shipping carton. Open each carton carefully and avoid deep penetration into the carton with sharp objects.

After unpacking the unit, inspect it for possible shipping damage. If the equipment has been damaged in transit, immediately file a claim with the carrier, then contact ADTRAN Customer Service (see *Customer Service, Product Support Information, and Training* information in the front of this manual).

Contents of ADTRAN Shipment

Your ADTRAN shipment includes the following items:

- TRACER 4102 or TRACER 4206 unit
- TRACER 4106/4206 Documentation CD
- 4 T1 Interconnect Cables (RJ-48C Straight-Through)

Customer Provides

The following items are necessary for the installation of the TRACER 4106/4206 system and are not provided by ADTRAN:

- 21 to 60 VDC power source (or AC adapter available from ADTRAN P/N 1280650L1), either polarity referenced to ground
- Antenna and mounting hardware
- Antenna feedline cable

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4. CHANNEL SELECTION

The FCC has allocated 83.5 MHz of spectrum in the 2.4 GHz band where the TRACER 4106 operates, and 125 MHz of spectrum in the 5.8 GHz band where the TRACER 4206 operates. **Figure 1** and **Figure 2** illustrate the bandwidth division.

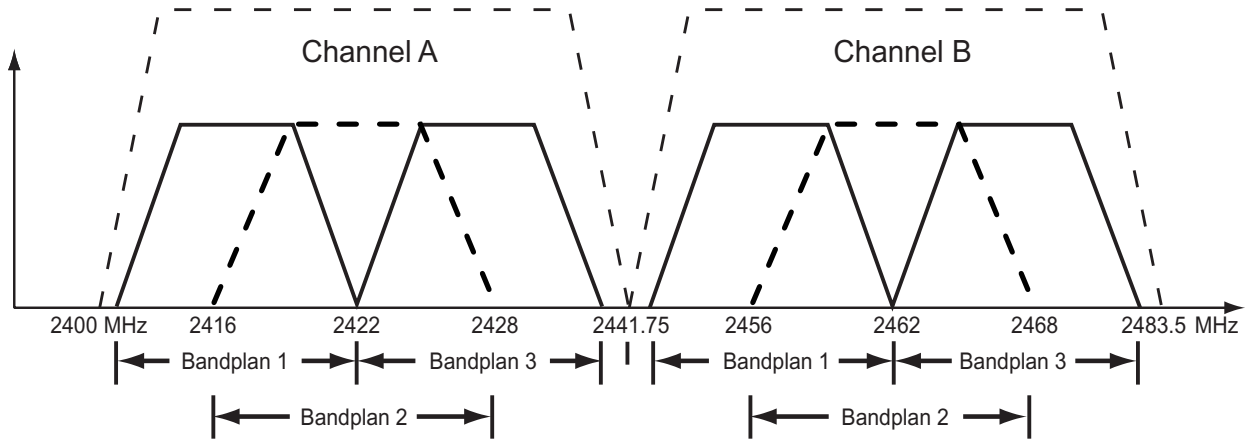

Figure 1. 2.4 GHz Bandwidth Division (TRACER 4106)

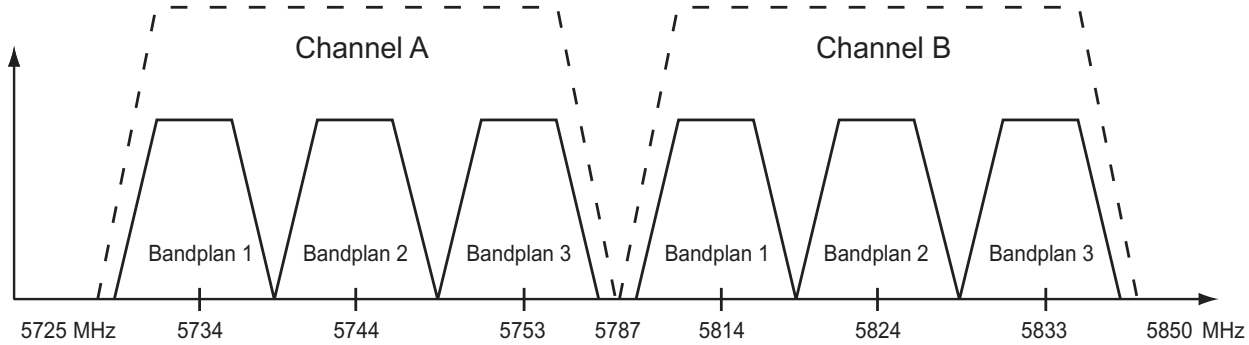

Figure 2. 5.8 GHz Bandwidth Division (TRACER 4206)

To designate the utilization of the ISM bandwidth, there are two different channel plans, labeled A and B. The letter of each channel plan setting is preset by the factory and refers to the physical configuration of the diplexer filter inside the environmental housing. Each channel is then divided into three bandplans (1, 2 or 3). The bandplans must be the same for the local and remote TRACER 4106/4206. For example, the transmitter at one end of the link will transmit in bandplan 1 of channel A (the lower portion of the spectrum) and receive in bandplan 1 of channel B (the upper portion). Consequently, the receiver at the other end should receive in bandplan 1 of channel A (the lower portion) and transmit in bandplan 1 of channel B (the upper portion).

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The letter of the channel plan (A or B) must be different on both ends and the number of the bandplan (1, 2, or 3) must be the same on both ends. The default bandplan configuration for the TRACER 4106/4206 is bandplan 1.

The channel plan (A or B) of the unit may be changed in the field if necessary by rewiring the internal diplexer. Contact ADTRAN Technical Support for more information on this procedure.

5. GROUNDING INSTRUCTIONS

The following provides grounding instruction information from the Underwriters' Laboratory UL 60950 Standard for Safety of Information Technology Equipment Including Electrical Business Equipment, of December, 2000.

An equipment grounding conductor that is not 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 ungrounded 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.

The supplemental grounding conductor shall be connected to the equipment using a number 8 ring terminal and should be fastened to the grounding lug provided on the rear panel of the equipment. The ring terminal should be installed using the appropriate crimping tool (AMP P/N 59250 T-EAD Crimping Tool or equivalent.)

NOTE

The supplemental equipment grounding terminal is located on the rear panel of the TRACER 4106/4206.

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CAUTION

- *This unit shall be installed in accordance with Article 400 and 364.8 of the NEC NFPA 70 when installed outside of a Restricted Access Location (i.e., central office, behind a locked door, service personnel only area).*
- *Power to the TRACER 4106/4206 DC system must be from a reliably grounded 21-60 VDC source which is electrically isolated from the AC source.*
- *The branch circuit overcurrent protection shall be a fuse or circuit breaker rated minimum 60 VDC, maximum 10A.*
- *A readily accessible disconnect device that is suitably approved and rated shall be incorporated in the field wiring.*

6. SUPPLYING POWER TO THE UNIT

The TRACER 4106/4206 can operate from a supply between 21 and 60 VDC, with either polarity referenced to ground. Power supplies should be able to provide up to 30 watts at the selected voltage. A dual pin terminal plug accepts power at the rear panel of the unit, providing a + and - polarity reference point. Adapters for this plug are available (P/N 1175043L2) and are furnished with the unit and optional power supply (P/N 1280650L1).

7. MOUNTING OPTIONS

Install the TRACER 4106/4206 in a location that requires minimal antenna feedline length (the loss in this cable directly affects overall system performance). The TRACER 4106/4206 is designed to be mounted in a rack. If multiple units are installed in one location, one half inch of spacing is recommended above and below the unit.

8. CONNECTING THE T1 INTERFACE

The physical T1 interface is provided using 4 RJ-48C jacks for transmit and receive. The provided straight through T1 interface cables can be used to interface to any standard T1 DTE device.

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USER INTERFACE GUIDE

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TABLES

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1. NAVIGATING THE TERMINAL MENU

The TRACER 4106/4206 menu system can be accessed with a VT100 compatible terminal set to 9600 bits per second, 8 data bits, 1 stop bit, and no parity, connected to the RS-232 port located 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 refresh the current screen. If password access has been enabled, the **ENTER PASSWORD** message will be displayed at the bottom of the TRACER 4106/4206 system status menu.

> NOTE
> *TRACER 4106 and 4206 menu screens are functionally identical, and vary only by displaying either "TRACER 4106" or "TRACER 4206" on various screens. Only the TRACER 4206 menus are illustrated in this manual for ease of explanation.*

> NOTE
> *All TRACER 4106/4206 systems are shipped factory default with password protection disabled.*

Terminal Menu Window

The TRACER 4106/4206 uses 11 (eleven) menu pages and a single main menu page to access its many features. The main menu page (see **Figure 1**) provides a link to all available configuration/status pages.

> NOTE
> *After connecting a VT100 terminal to the TRACER 4106/4206, press <**Ctrl + L**> to redraw the current screen.*

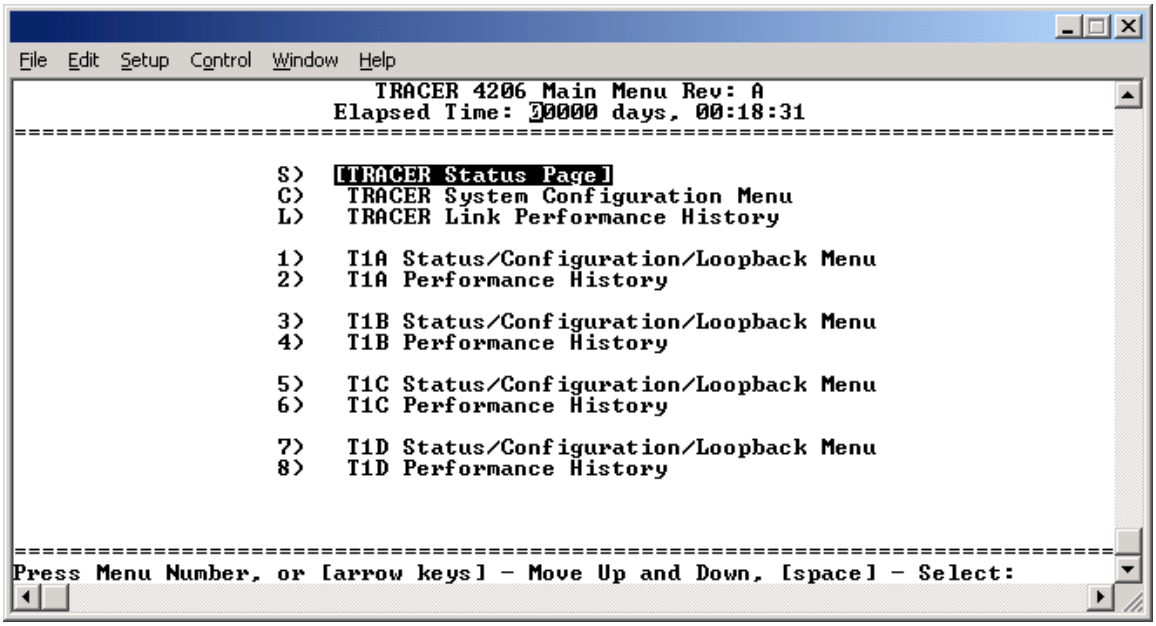

Figure 1. Main Menu Screen

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Navigating using the Keyboard Keys

You can use various keystrokes to move through the terminal menu, to manage a terminal menu session, and to configure the system.

Moving through the Menus

To do this...	Press this key...
Move up to select items	Up Arrow
Move down to select items	Down Arrow
Edit a selected menu item	Enter
Scroll through configuration parameters for a menu item	Spacebar Left/Right Arrows P or N (Prev/Next)
Cancel an edit	Escape
Return to Main Menu page	M

Session Management Keystrokes

To do this...	Press this key...
Log into a session	Spacebar
Refresh the screen To save time, only the portion of the screen that has changed is refreshed.	<Ctrl + L>

2. TERMINAL MENU AND SYSTEM CONTROL

Password Protection

The TRACER 4106/4206 provides optional password protection of the terminal interface. If enabled, a password prompt is presented at power-up, reboot, modem logout, or after ten minutes of inactivity on the terminal. Password protection is enabled and a password is defined via the system configuration menu.

> NOTE *All TRACER 4106/4206 systems are shipped factory default with password protection disabled.*

3. MENU DESCRIPTIONS

The remainder of this section describes the TRACER 4106/4206 menus and submenus.

> *The menu structure of the TRACER 4106/4206 system is depicted below as follows:*
> > MENU PAGE
> > > MENU PAGE > MENU SELECTION
> > > > MENU PAGE > MENU SELECTION > SUB-MENU

>TRACER SYSTEM STATUS

Figure 2 shows the TRACER System Status menu page. Status of major system components for both sides of the TRACER link are displayed, but no configuration can be performed from this view.

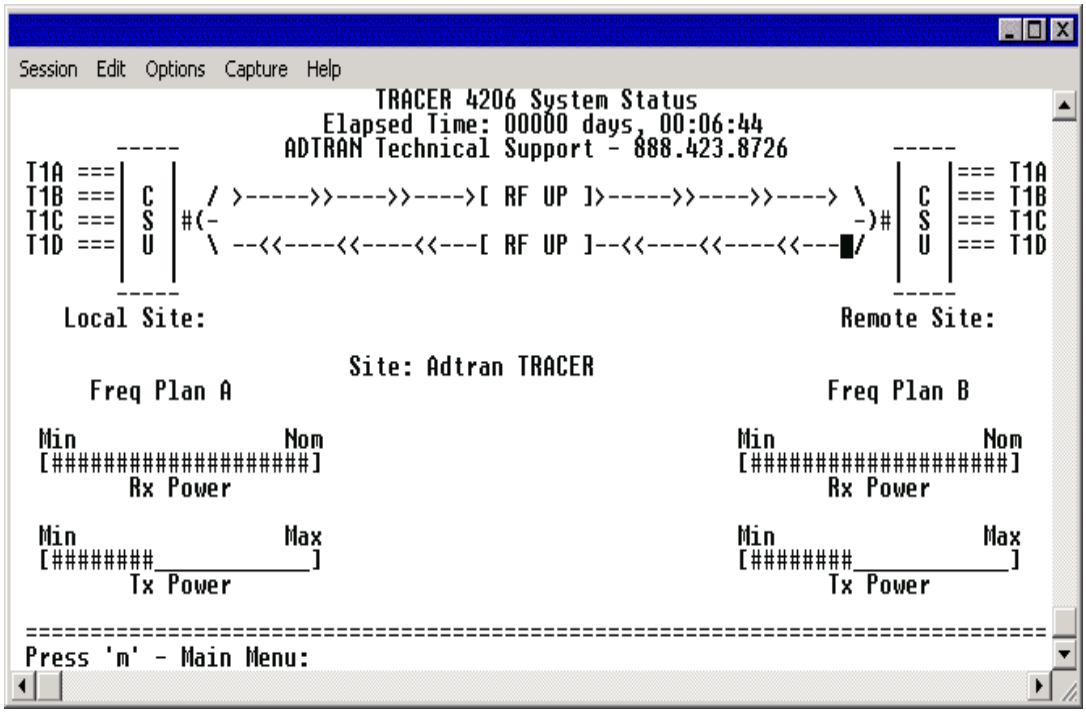

Figure 2. TRACER System Status

The top of the TRACER System Status menu page displays the elapsed time the TRACER 4106/4206 system has been operational since the last power reset. Located directly beneath the ADTRAN Technical Support phone number is a graphical indicator of the status of the TRACER 4106/4206 T1 and RF links (as reported by both the local and remote units). The **T1** labels will be reverse highlighted if any error conditions exist on that T1 interface.

The status of the received radio link is indicated as **RF UP** or **RF DOWN** for each direction. The left portion of the menu page reports the status of the local TRACER 4106/4206 (the system where the active terminal is attached). The right portion of the screen reports the status of the remote system. If the RF link is down, **DATA NOT AVAILABLE** will be displayed in place of the remote system status.

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To enter the TRACER main menu, press <M>.

> **NOTE** *Press <0> from any menu in the TRACER 4106/4206 VT100 menu structure to access the TRACER System Status page.*

>TRACER SYSTEM STATUS > FREQUENCY PLAN

Displays the frequency plan (A or B) for the TRACER 4106/4206 unit. For an operational TRACER 4106/4206 system, the local and remote units should display opposite frequency plans.

>TRACER SYSTEM STATUS > SITE

Displays the site name configured from the TRACER System Configuration page.

>TRACER SYSTEM STATUS > RX POWER

Displays the approximate receiver levels (for both the local and remote units) using a series of symbols (**#**). The more symbols (**#**) displayed, the stronger the signal. If the link is down and remote end data is unavailable, **DATA NOT AVAILABLE** is displayed in place of the symbols (**#**).

>TRACER SYSTEM STATUS > TX POWER

Displays the approximate transmitter levels (for both the local and remote units) using a series of symbols (**#**). The more symbols (**#**) displayed, the stronger the signal. If the link is down and remote end data is unavailable, **DATA NOT AVAILABLE** is displayed in place of the symbols (**#**).

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>MAIN MENU

The TRACER 4106/4206 Main Menu page provides access to all other configuration/status pages. **Figure 3** shows the TRACER Main Menu page.

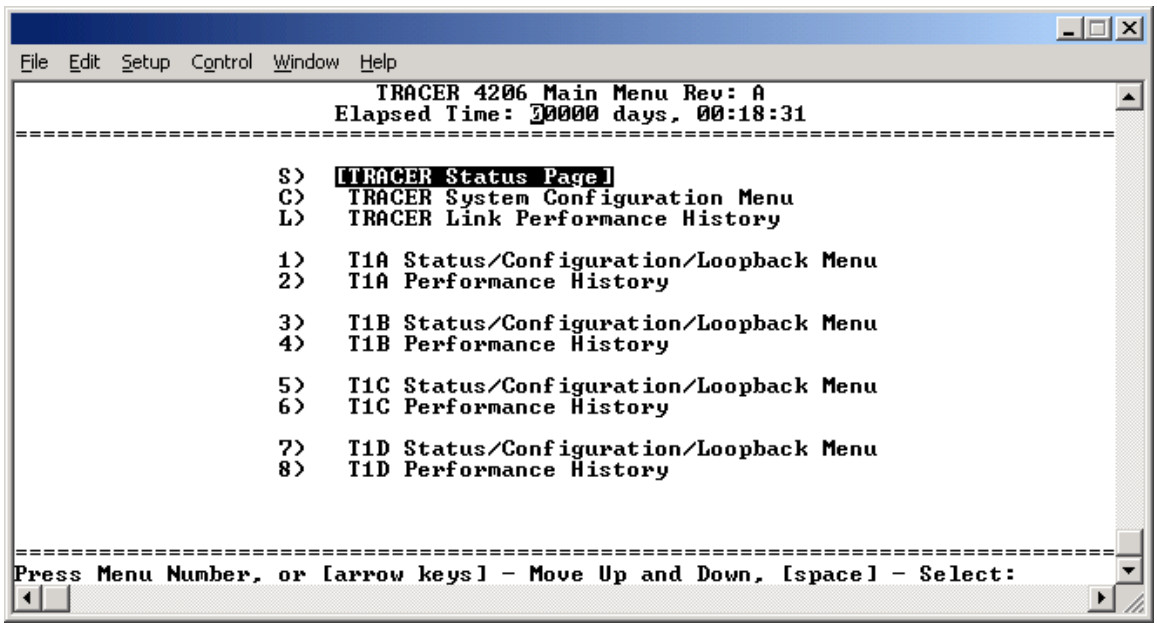

Figure 3. Main Menu

Use the up and down arrow keys to scroll through the available pages, or enter the number or letter of the selected page (to highlight the menu page) and press <**Enter**>.

> NOTE
> *Press <**M**> from any menu in the TRACER 4106/4206 VT100 menu structure to access the TRACER Main Menu page.*

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>TRACER SYSTEM CONFIGURATION

Figure 4 shows the TRACER System Configuration menu page. System configuration parameters for both the local and remote TRACER 4106/4206 units are available through this menu page.

```
Session  Edit  Options  Capture  Help
                    TRACER 4206 System Configuration
                   Elapsed Time: 00000 days, 00:20:28
==============================================================================

                     Local  Tracer                  Remote Tracer
                     -------------                  -------------
                  Min                  Nom        Min                  Nom
   Rx Power:      [#####################]         [#####################]

                  Min                  Max        Min                  Max
   Tx Power:      [########____________]         [########____________]

   Site Name:     [Adtran TRACER                ]   Adtran TRACER
   RF Bandplan:    Bandplan 1                      Bandplan 1
   Modem Control:  Disabled                        Disabled
   Modem Connection: Logout
   Password Enable: Disabled                       Disabled
   Password:       ******                          ******

   Performance Stats: Clear                        Clear

==============================================================================
Press 'm' - Main menu, [arrow keys] - Move Up and Down, [space] - Select:
```

Figure 4. TRACER System Configuration

> NOTE
> *Press <**C**> from any menu in the TRACER 4106/4206 VT100 menu structure to access the TRACER System Configuration menu page.*

>TRACER SYSTEM CONFIGURATION > RX POWER

Displays the approximate receiver levels (for both the local and remote units) using a series of symbols (**#**). The more symbols (**#**) displayed, the stronger the signal. If the link is down and remote end data is unavailable, **DATA NOT AVAILABLE** is displayed in place of the symbols (**#**). This parameter is display only.

>TRACER SYSTEM CONFIGURATION > TX POWER

Allows the transmitter levels (for both the local and remote units) to be adjusted. The current transmitter level is displayed using a series of symbols (**#**). The more symbols (**#**) displayed, the stronger the signal. If the link is down and remote end data is unavailable, **DATA NOT AVAILABLE** is displayed in place of the symbols (**#**).

> CAUTION
> *Reducing the transmitter power of the remote TRACER 4106/4206 could negatively impact the TRACER RF link.*

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>TRACER SYSTEM CONFIGURATION > SITE NAME

Enter up to 25 alphanumeric characters to be displayed for identification of the TRACER 4106/4206 system.

>TRACER SYSTEM CONFIGURATION > RF BANDPLAN

Sets the bandplan for the TRACER 4106/4206. Each channel is divided into three bandplans (1, 2, or 3). Both local and remote TRACER 4106/4206 must be configured with the same bandplan (1, 2, or 3) but different channel plans (Plan A or Plan B). For example, the transmitter at one end of the link will transmit in bandplan 1 of channel A (the lower portion of the spectrum) and receive in bandplan 1 of channel B (the upper portion). Consequently, the receiver at the other end should receive in bandplan 1 of channel A (the lower portion) and transmit in bandplan 1 of channel B (the upper portion). (Refer to **Figure 5** and **Figure 6.**). The TRACER 4106/4206 comes factory programmed with RF bandplan set to Band 1.

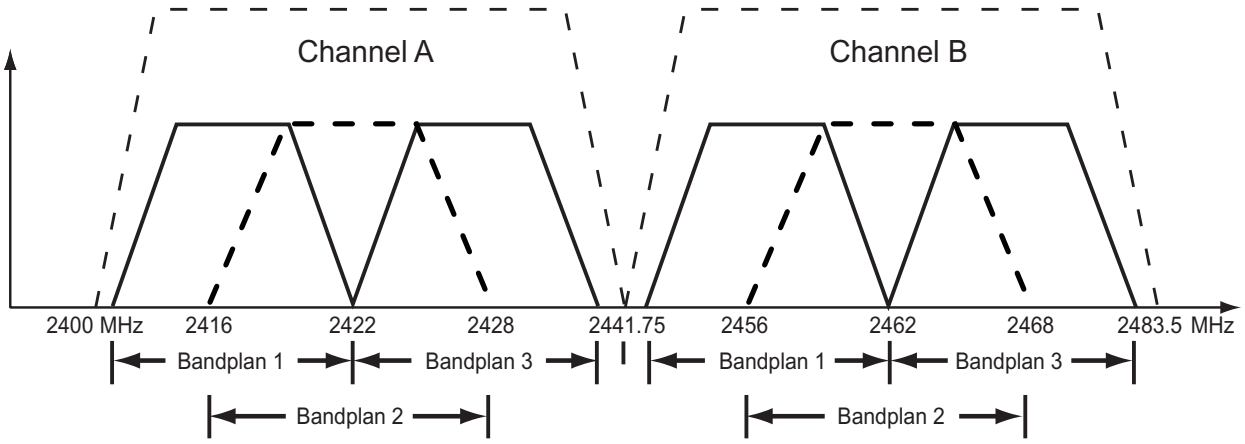

Figure 5. 2.4 GHz Bandwidth Division (TRACER 4106)

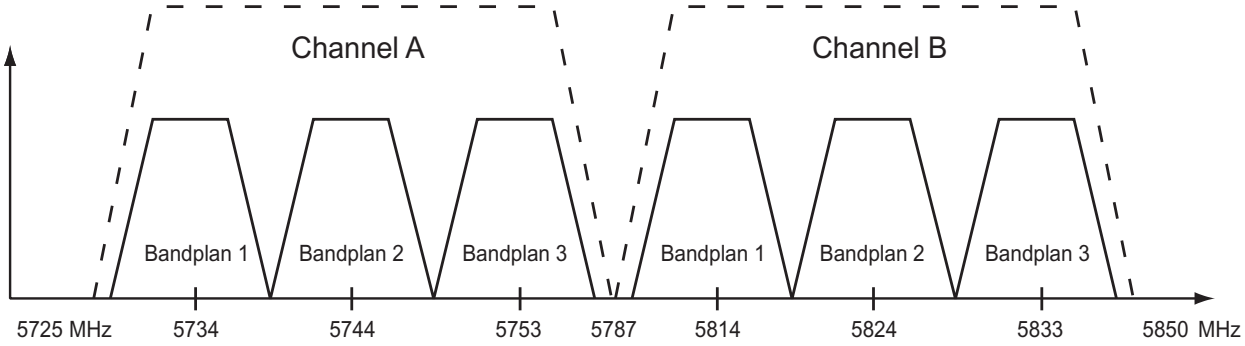

Figure 6. 5.8 GHz Bandwidth Division (TRACER 4206)

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>TRACER SYSTEM CONFIGURATION > MODEM CONTROL

Configures the modem control leads on the RS-232 port (terminal interface located on the rear panel of the unit). Set **MODEM CONTROL** to **ENABLED** when connecting the unit to a modem (using a null modem adapter). Setting **MODEM CONTROL** to **DISABLED** prevents the TRACER 4106/4206 from monitoring DCD and enables data to be sent to the VT 100 continuously. **MODEM CONTROL** must be set to **DISABLED** when the VT100 terminal is in use. The TRACER 4106/4206 comes factory programmed with **MODEM CONTROL** set to **DISABLED**.

> NOTE *Press <Ctrl+Z> three times from the terminal interface to temporarily disable **MODEM CONTROL** when the modem control leads are active.*

>TRACER SYSTEM CONFIGURATION > MODEM CONNECTION (LOGOUT)

Activator to cause the TRACER 4106/4206 to de-assert Clear To Send (CTS) and DSR for a time greater than 20 milliseconds. This signals the modem to disconnect the analog connection. Hangup-On-DTR-Drop may need to be explicitly enabled on some modems. If **PASSWORD PROTECTION** is **ENABLED**, this menu also causes the unit to close the current session and return to the TRACER System Status menu page and wait for password input.

>TRACER SYSTEM CONFIGURATION > PASSWORD ENABLE

Configures password protection for the VT100 terminal interface. Password protection for the TRACER 4106/4206 requires password input from the TRACER System Status menu page when connecting to the unit. When configured for Password protection, the TRACER 4106/4206 closes any terminal session that remains inactive for more than 10 minutes. The TRACER 4106/4206 comes factory programmed with **PASSWORD ENABLE** set to **DISABLED**.

>TRACER SYSTEM CONFIGURATION > PASSWORD

Sets the password for password protection of the TRACER 4106/4206 VT100 terminal interface. Enter up to 8 alphanumeric characters. The system password is case sensitive.

> NOTE *The default password for the TRACER 4106/4206 is **tracer**.*

>TRACER SYSTEM CONFIGURATION > PERFORMANCE STATS (CLEAR)

Activator to reset all system error counters for the TRACER 4106/4206.

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>TRACER LINK PERFORMANCE HISTORY

Figure 7 shows the TRACER Link Performance History menu page. The TRACER Link Performance History menu page displays detailed error statistics and received signal level for the RF link (from both the local and remote TRACER 4106/4206 units) in 15-minute increments.

```
File  Edit  Setup  Control  Window  Help
                          Link Performance History
        24 Hour Registers                          15 Minute Registers
            MIN          MIN                 MIN      MIN            MIN      MIN
    --LNK---RSL----LNK---RSL--          -LNK-RSL--LNK-RSL--------LNK-RSL--LNK-RSL-
     00074 00024  00074 00024  <-->  000 159  000 159
  -1: ----- -----  ----- -----   - 1: 895 895  895 895   -17: --- ---  --- ---
  -2: ----- -----  ----- -----   - 2: --- ---  --- ---   -18: --- ---  --- ---
  -3: ----- -----  ----- -----   - 3: --- ---  --- ---   -19: --- ---  --- ---
  -4: ----- -----  ----- -----   - 4: --- ---  --- ---   -20: --- ---  --- ---
  -5: ----- -----  ----- -----   - 5: --- ---  --- ---   -21: --- ---  --- ---
  -6: ----- -----  ----- -----   - 6: --- ---  --- ---   -22: --- ---  --- ---
  -7: ----- -----  ----- -----   - 7: --- ---  --- ---   -23: --- ---  --- ---
        Local        Remote      - 8: --- ---  --- ---   -24: --- ---  --- ---
                                 - 9: --- ---  --- ---   -25: --- ---  --- ---
                                -10: --- ---  --- ---   -26: --- ---  --- ---
                                -11: --- ---  --- ---   -27: --- ---  --- ---
                                -12: --- ---  --- ---   -28: --- ---  --- ---
                                -13: --- ---  --- ---   -29: --- ---  --- ---
                                -14: --- ---  --- ---   -30: --- ---  --- ---
                                -15: --- ---  --- ---   -31: --- ---  --- ---
                                -16: --- ---  --- ---   -32: --- ---  --- ---
                                       Local    Remote          Local    Remote
================================================================================
Press 'm' - Main Menu, 'p' - Previous Page, 'n' - Next Page:
```

Figure 7. TRACER Link Performance History

The minimum received signal level (**MIN RSL**) is represented as a numerical value from 0 to 255 with 0 corresponding to no receive power and 255 corresponding to an extremely strong signal. The minimum received signal level is directly related to RSSI.

The error count and received signal level for the most recent 24 hours are recorded and displayed on the right side of the page. The left side of the page displays the 24 hour totals for the most recent 7 days.

> NOTE
> *Press <N> to view the next 8 hours worth of 15-minute totals and <P> to view the previous 8 hours.*

> NOTE
> *Press <L> from any menu in the TRACER 4106/4206 VT100 menu structure to access the TRACER Link Performance History menu page.*

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>T1A STATUS/CONFIGURATION/LOOPBACK

Figure 8 shows the T1A Status/Configuration/Loopback menu page. Real-time graphical representation for the T1A link (using data from both the local and remote TRACER 4106/4206 units) is displayed on this page. T1A operational configuration parameters and testing functions are configured from this menu.

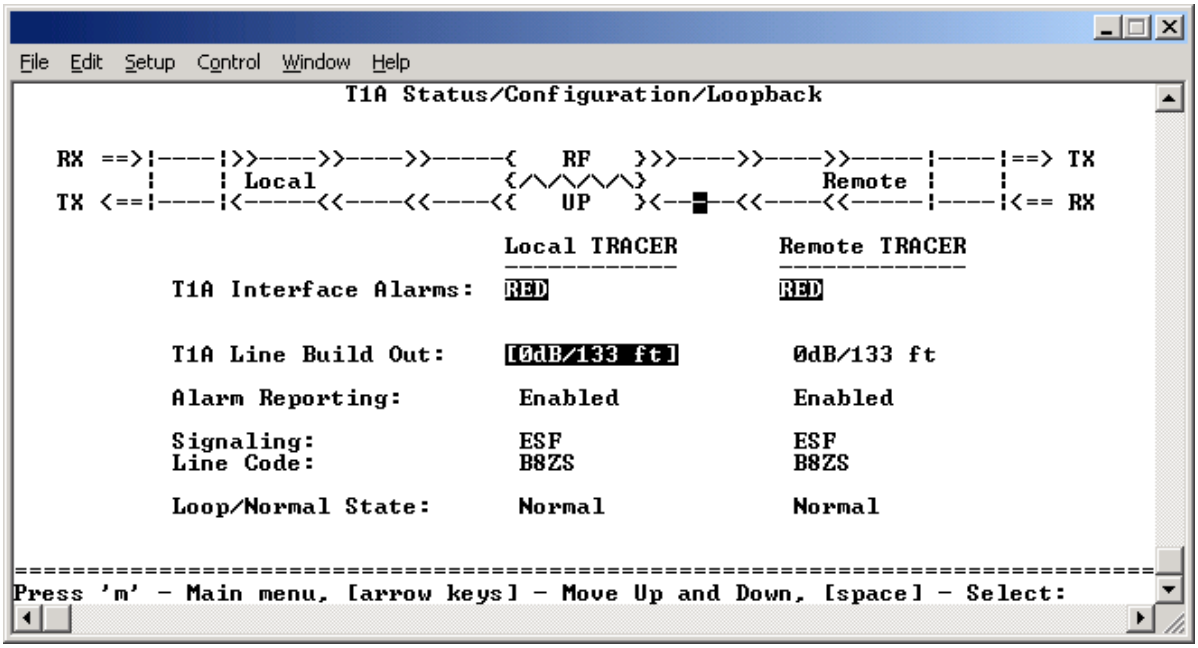

Figure 8. T1A Status/Configuration/Loopback

> *Press <**1**> from any menu in the TRACER 4106/4206 VT100 menu structure to access the T1A Status/Configuration/Loopback menu page.*

>T1A STATUS/CONFIGURATION/LOOPBACK > T1A INTERFACE ALARMS

Displays any active alarms on the T1A link (reported from both the local and remote TRACER 4106/4206 units). These alarms include Red, Blue, Yellow, AIS, and bipolar violations (**BPV**). See Section 6, *Troubleshooting Guide*, for more information on these alarms.

Table 1. T1 Interface Alarms

RED	Activates when a local facility failure occurs.
BPV	Activates when the incoming T1 stream presents bipolar violations (BPVs).
AIS	Activates when an incoming remote alarm is received from a connected T1 device. An AIS signal is an unframed All One signal that replaces the normal traffic signal
YEL	Activates when an incoming remote alarm is received from the T1 device indicating that a failure has occurred in the received direction.
LOS	Activates when no T1 signal is present from the connected T1 equipment. LOS is activated after receiving 192 consecutive zeros.

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>T1A STATUS/CONFIGURATION/LOOPBACK > T1A LINE BUILD OUT

Configures the T1A for the appropriate line buildout, based on the distance to the T1A equipment.

>T1A STATUS/CONFIGURATION/LOOPBACK > ALARM REPORTING

Determines whether the TRACER 4106/4206 unit will report active alarms. If **DISABLED**, no alarms will be displayed on this menu page. The **ALARM REPORTING** parameter is independently configured for the local and remote TRACER 4106/4206 units. When **DISABLED**, the front panel LED alarms will also be disabled (OFF).

>T1A STATUS/CONFIGURATION/LOOPBACK > SIGNALING

Configures the framing format for the T1A link for both the local and remote TRACER 4106/4206 units. The TRACER 4106/4206 transports T1A data across the link (as long as the T1A signal is properly timed). Configure the framing format (using the **SIGNALING** menu) to enable the TRACER 4106/4206 to monitor incoming framing error events and indicate problems with the attached metallic service. The TRACER 4106/4206 supports both **ESF** and **D4** framing formats.

>T1A STATUS/CONFIGURATION/LOOPBACK > LINE CODE

Sets the line coding for the T1A link. The TRACER 4106/4206 supports **B8ZS** and **AMI** line coding.

>T1A STATUS/CONFIGURATION/LOOPBACK > LOOP/NORMAL STATE

Controls the loop status of the T1A link. Activates/deactivates loopback conditions for testing purposes.

>T1A STATUS/CONFIGURATION/LOOPBACK > LOOP/NORMAL STATE > NORMAL

The T1A link is in normal data transport mode - there are no active loopbacks.

>T1A STATUS/CONFIGURATION/LOOPBACK > LOOP/NORMAL STATE > LINK

Activates a loopback at the TRACER 4106/4206 T1A framer towards the wireless link (see **Figure 9**). Use the **LINK** loopback to test data path integrity from one unit across the wireless link.

```
RX ==>|  +-|->>----->>----->>----{   RF   }->>----->>----->>----->>--  |==> TX
      |  | | Local             {/\/\/\/\}            Remote       |
TX <==|  +-|-----<<----<<----<<{   UP   }-----<<----<<----<<----  |<== RX
```

Figure 9. T1A Link Loopback

>T1A STATUS/CONFIGURATION/LOOPBACK > LOOP/NORMAL STATE > LINE

Activates a loopback at the TRACER 4106/4206 T1A framer towards the locally connected T1A equipment (see **Figure 10**). Use the **LINE** loopback to test data path integrity from the TRACER 4106/4206 unit to the T1A equipment.

```
RX ==>|-+--|---->>----->>----->>-{   RF   }---->>----->>----->>-|==> TX
      | |  | Local             {/\/\/\/\}            Remote |
TX <==|-+  |--<<----<<----<<---{   UP   }--<<----<<----<<--  |<== RX
```

Figure 10. T1A Line Loopback

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>T1A PERFORMANCE HISTORY

Figure 11 shows the T1A Performance History menu page. The T1A Performance History menu page displays detailed error statistics for the T1A link (from both the local and remote TRACER 4106/4206 units) in 15-minute increments.

```
File  Edit  Setup  Control  Window  Help
                         T1A Performance History
        24 Hour Registers                          15 Minute Registers

    ---ES---SES-----ES---SES--        --ES-SES---ES-SES---------ES-SES---ES-SES-
     01444 01444  01443 01443  <-->  549 549 548 548
  -1: ----- -----  ----- -----   - 1: 895 895 895 895   -17: --- ---  --- ---
  -2: ----- -----  ----- -----   - 2: --- --- --- ---   -18: --- ---  --- ---
  -3: ----- -----  ----- -----   - 3: --- --- --- ---   -19: --- ---  --- ---
  -4: ----- -----  ----- -----   - 4: --- --- --- ---   -20: --- ---  --- ---
  -5: ----- -----  ----- -----   - 5: --- --- --- ---   -21: --- ---  --- ---
  -6: ----- -----  ----- -----   - 6: --- --- --- ---   -22: --- ---  --- ---
  -7: ----- -----  ----- -----   - 7: --- --- --- ---   -23: --- ---  --- ---
        Local        Remote      - 8: --- --- --- ---   -24: --- ---  --- ---
                                 - 9: --- --- --- ---   -25: --- ---  --- ---
                                -10: --- --- --- ---   -26: --- ---  --- ---
                                -11: --- --- --- ---   -27: --- ---  --- ---
                                -12: --- --- --- ---   -28: --- ---  --- ---
                                -13: --- --- --- ---   -29: --- ---  --- ---
                                -14: --- --- --- ---   -30: --- ---  --- ---
                                -15: --- --- --- ---   -31: --- ---  --- ---
                                -16: --- --- --- ---   -32: --- ---  --- ---
                                       Local    Remote          Local    Remote
=================================================================================
Press 'm' - Main Menu, 'p' - Previous Page, 'n' - Next Page:
```

Figure 11. T1A Link Performance History

T1A performance data is presented as Errored Seconds (ES) and Severely Errored Seconds (SES) on the T1A link. The following events qualify as an ES–AIS, LOS or LOF Alarm Second, a single BPV or excessive zero event, or a single parity bit. An SES is caused by an AIS, LOS or LOF Alarm Second, or excessive Bipolar Violations (BPVs) or framed Parity Bit errors causing a line Bit Error Rate (BER) of 10^{-6}.

The error count for the most recent 24 hours are recorded and displayed on the right side of the page. The left side of the page displays the 24 hour totals for the most recent 7 days.

> NOTE
> *Press <**N**> to view the next 8 hours worth of 15-minute totals and <**P**> to view the previous 8 hours.*

> NOTE
> *Press <**2**> from any menu in the TRACER 4106/4206 VT100 menu structure to access the T1A Link Performance History menu page.*

>T1B STATUS/CONFIGURATION/LOOPBACK

Figure 12 shows the T1B Status/Configuration/Loopback menu page. Real-time graphical representation for the T1B link (using data from both the local and remote TRACER 4106/4206 units) is displayed on this page. T1B operational configuration parameters and testing functions are configured from this menu.

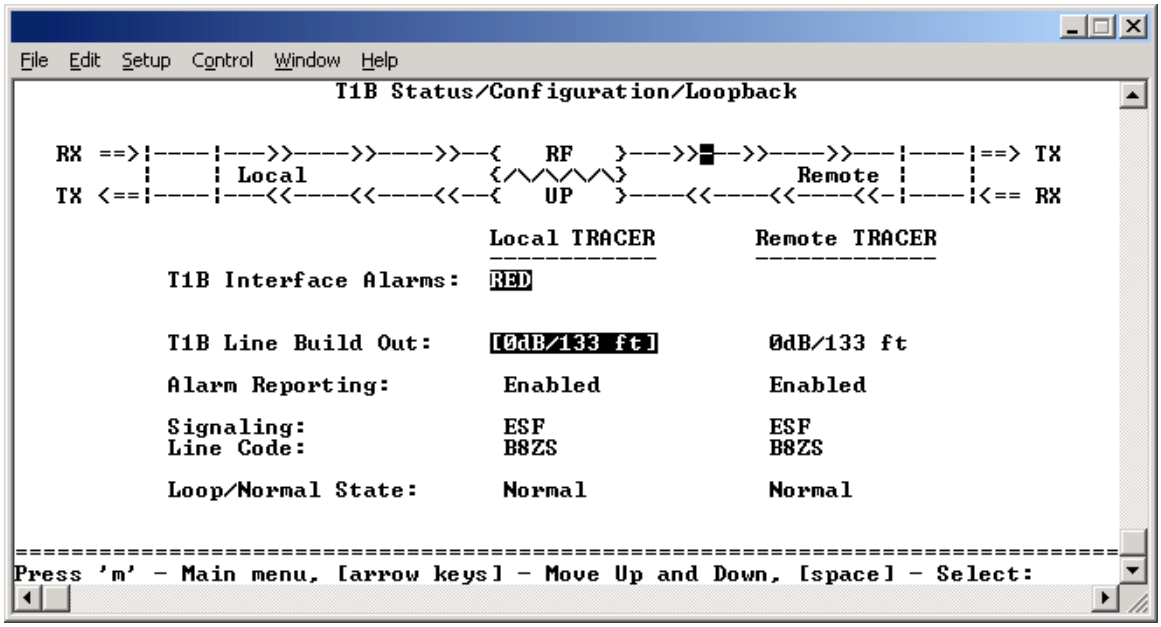

Figure 12. T1B Status/Configuration/Loopback

> NOTE
> *Press <**3**> from any menu in the TRACER 4106/4206 VT100 menu structure to access the T1B Status/Configuration/Loopback menu page.*

>T1B STATUS/CONFIGURATION/LOOPBACK > T1B INTERFACE ALARMS

Displays active alarms on the T1B link reported from both the local and remote TRACER 4106/4206 units. These alarms include Red, Blue, Yellow, AIS, and bipolar violations (BPV). See **Table 1** on page 50 for more information on these alarms.

>T1B STATUS/CONFIGURATION/LOOPBACK > T1B LINE BUILD OUT

Configures the T1B for the appropriate line buildout, based on the distance to the T1B equipment.

>T1B STATUS/CONFIGURATION/LOOPBACK > ALARM REPORTING

Determines whether the TRACER 4106/4206 unit will report active alarms. If **DISABLED**, no alarms will be displayed on this menu page. The Alarm Reporting parameter is independently configured for local and remote TRACER 4106/4206 units. When **DISABLED**, the front panel LED alarms will also be disabled (off).

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>T1B STATUS/CONFIGURATION/LOOPBACK > SIGNALING

Configure the framing format for the T1B link for both the local and remote TRACER 4106/4206 units. The TRACER 4106/4206 transports T1B data across the link (as long as the T1B signal is properly timed). Configure the framing format (using the **SIGNALING** menu) to enable the TRACER 4106/4206 to monitor the incoming framing error events and indicate problems with the attached metallic service. The TRACER 4106/4206 supports both **ESF** and **D4** framing formats.

>T1B STATUS/CONFIGURATION/LOOPBACK > LINE CODE

Sets the line coding for the T1B link. The TRACER 4106/4206 supports **B8ZS** and **AMI** line coding.

>T1B STATUS/CONFIGURATION/LOOPBACK > LOOP/NORMAL STATE

Controls the loop status of the T1B link. Activates/deactivates loopback conditions for testing purposes.

>T1B STATUS/CONFIGURATION/LOOPBACK >LOOP/NORMAL STATE > NORMAL

The T1B link is in normal data transport mode - there are no active loopbacks.

>T1B STATUS/CONFIGURATION/LOOPBACK >LOOP/NORMAL STATE > LINK

Activates a loopback at the TRACER 4106/4206 T1B framer towards the wireless link (see **Figure 13**). Use the **LINK** loopback to test data path integrity from one unit across the wireless link.

```
RX ==>|  +-|->>----->>----->>----{   RF   }->>----->>----->>----->>--  |==> TX
      |  | | Local              {/\/\/\/\}            Remote       |
TX <==|  +-|-----<<-----<<-----<<{   UP   }-----<<-----<<-----<<-----  |<== RX
```

Figure 13. T1B Link Loopback

>T1B STATUS/CONFIGURATION/LOOPBACK >LOOP/NORMAL STATE > LINE

Activates a loopback at the TRACER 4106/4206 T1B framer towards the wireless link (see **Figure 14**). Use the **LINE** loopback to test data path integrity from the TRACER 4106/4206 unit to the T1 equipment.

```
RX ==>|-+--|----->>----->>----->>-{   RF   }----->>----->>----->>-|==> TX
      | | | Local              {/\/\/\/\}            Remote |
TX <==|-+  |--<<-----<<-----<<---{   UP   }--<<-----<<-----<<---|<== RX
```

Figure 14. T1B Line Loopback

>T1B PERFORMANCE HISTORY

Figure 15 shows the T1B Performance History menu page. The T1B Performance History menu page displays detailed error statistics for the T1B link (from both the local and remote TRACER 4106/4206 units) in 15 minute increments.

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```
File  Edit  Setup  Control  Window  Help
                          T1B Performance History
        24 Hour Registers                          15 Minute Registers

    ---ES---SES-----ES---SES--        --ES-SES---ES-SES---------ES-SES---ES-SES-
     01519 01519  01519 01519  <-->  624 624  624 624
 -1: ----- -----  ----- -----   - 1: 895 895  895 895   -17: --- ---  --- ---
 -2: ----- -----  ----- -----   - 2: --- ---  --- ---   -18: --- ---  --- ---
 -3: ----- -----  ----- -----   - 3: --- ---  --- ---   -19: --- ---  --- ---
 -4: ----- -----  ----- -----   - 4: --- ---  --- ---   -20: --- ---  --- ---
 -5: ----- -----  ----- -----   - 5: --- ---  --- ---   -21: --- ---  --- ---
 -6: ----- -----  ----- -----   - 6: --- ---  --- ---   -22: --- ---  --- ---
 -7: ----- -----  ----- -----   - 7: --- ---  --- ---   -23: --- ---  --- ---
        Local        Remote     - 8: --- ---  --- ---   -24: --- ---  --- ---
                                - 9: --- ---  --- ---   -25: --- ---  --- ---
                               -10: --- ---  --- ---   -26: --- ---  --- ---
                               -11: --- ---  --- ---   -27: --- ---  --- ---
                               -12: --- ---  --- ---   -28: --- ---  --- ---
                               -13: --- ---  --- ---   -29: --- ---  --- ---
                               -14: --- ---  --- ---   -30: --- ---  --- ---
                               -15: --- ---  --- ---   -31: --- ---  --- ---
                               -16: --- ---  --- ---   -32: --- ---  --- ---
                                       Local    Remote         Local    Remote
==============================================================================
Press 'm' - Main Menu, 'p' - Previous Page, 'n' - Next Page:
```

Figure 15. T1B Link Performance History

T1B performance data is presented as Errored Seconds (ES) and Severely Errored Seconds (SES) on the T1B link. The following events qualify as an ES–AIS, LOS or LOF Alarm Second, a single BPV or excessive zero event, or a single parity bit. An SES is caused by an AIS, LOS or LOF Alarm Second, or excessive Bipolar Violations (BPVs) or framed Parity Bit errors causing a line Bit Error Rate (BER) of 10^{-6}.

The error count for the most recent 24 hours are recorded and displayed on the right side of the page. The left side of the page displays the 24 hour totals for the most recent 7 days.

> NOTE *Press <**N**> to view the next 8 hours worth of 15 minute totals and <**P**> to view the previous 8 hours.*

> NOTE *Press <**4**> from any menu in the TRACER 4106/4206 VT100 menu structure to access the T1B Link Performance History page.*

>T1C STATUS/CONFIGURATION/LOOPBACK

Figure 16 shows the T1C Status/Configuration/Loopback menu page. Real-time graphical representation for the T1C link using data from both the local and remote TRACER 4106/4206 units) is displayed on this page. T1C operational configuration parameters and testing functions are configured from this menu.

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```
File  Edit  Setup  Control  Window  Help
                    T1C Status/Configuration/Loopback

RX ==>|----|---->>---[>]---->>--{   RF   }--->>---->>---->>--|----|==> TX
      |    | Local            {/\/\/\/\}            Remote |    |
TX <==|----|---<<----<<----<<--{   UP   }---<<----<<----<<--|----|<== RX

                              Local TRACER       Remote TRACER
                              ------------       -------------
        T1C Interface Alarms:  RED                RED

        T1C Line Build Out:    [0dB/133 ft]        0dB/133 ft

        Alarm Reporting:        Enabled            Enabled

        Signaling:              ESF                ESF
        Line Code:              B8ZS               B8ZS

        Loop/Normal State:      Normal             Normal

==============================================================================
Press 'm' - Main menu, [arrow keys] - Move Up and Down, [space] - Select:
```

Figure 16. T1C Status/Configuration/Loopback

> *Press <**5**> from any menu in the TRACER 4106/4206 VT100 menu structure to access the T1C Status/Configuration/Loopback menu page.*

>T1C STATUS/CONFIGURATION/LOOPBACK > T1C INTERFACE ALARMS

Displays and active alarms on the T1C link reported from both the local and remote TRACER 4106/4206 units. These alarms include Red, Blue, Yellow, AIS, and bipolar violations (BPV). See **Table 1** on page 50, for more information on these alarms.

>T1C STATUS/CONFIGURATION/LOOPBACK > T1C LINE BUILD OUT

Configures the T1C for the appropriate line buildout, based on the distance to the T1C equipment.

>T1C STATUS/CONFIGURATION/LOOPBACK > ALARM REPORTING

Determines whether the TRACER 4106/4206 unit will report active alarms. If **DISABLED**, no alarms will be displayed on this menu page. The Alarm Reporting parameter is independently configured for local and remote TRACER 4106/4206 units. When **DISABLED**, the front panel LED alarms will also be disabled (off).

>T1C STATUS/CONFIGURATION/LOOPBACK > SIGNALING

Configure the framing format for the T1C link for both the local and remote TRACER 4106/4206 units. The TRACER 4106/4206 transports T1C data across the link (as long as the T1C signal is properly timed). Configure the framing format (using the **SIGNALING** menu) to enable the TRACER 4106/4206 to monitor the incoming framing error events and indicate problems with the attached metallic service. The TRACER 4106/4206 supports both **ESF** and **D4** framing formats.

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>T1C STATUS/CONFIGURATION/LOOPBACK > LINE CODE

Sets the line coding for the T1C link. The TRACER 4106/4206 supports **B8ZS** and **AMI** line coding.

>T1C STATUS/CONFIGURATION/LOOPBACK > LOOP/NORMAL STATE

Controls the loop status of the T1C link. Activates/deactivates loopback conditions for testing purposes.

>T1C STATUS/CONFIGURATION/LOOPBACK > LOOP/NORMAL STATE > NORMAL

The T1C link is in normal data transport mode - there are no active loopbacks.

>T1C STATUS/CONFIGURATION/LOOPBACK > LOOP/NORMAL STATE > LINK

Activates a loopback at the TRACER 4106/4206 T1C framer towards the wireless link (see **Figure 17**). Use the **LINK** loopback to test data path integrity from one unit across the wireless link.

```
RX ==>|  +-|->>---->>---->>----{   RF   }->>---->>---->>----->>--  |==> TX
      |  |C| Local             {/\/\/\/\}            Remote      |
TX <==|  +-|----<<----<<----<<{   UP   }-----<<----<<----<<----  |<== RX
```

Figure 17. T1C Link Loopback

>T1C STATUS/CONFIGURATION/LOOPBACK > LOOP/NORMAL STATE > LINE

Activates a loopback at the TRACER 4106/4206 T1C framer towards the wireless link (see **Figure 18**). Use the **LINE** loopback to test data path integrity from the TRACER 4106/4206 unit to the T1 equipment.

```
RX ==>|-+--|---->>---->>---->>-{   RF   }---->>---->>---->>-|==> TX
      |C|  | Local             {/\/\/\/\}            Remote |
TX <==|-+  |--<<----<<----<<---{   UP   }--<<----<<----<<---|<== RX
```

Figure 18. T1C Line Loopback

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>T1C PERFORMANCE HISTORY

Figure 19 shows the T1C Performance History menu page. The T1C Performance History menu page displays detailed error statistics for the T1C link (from both the local and remote TRACER 4106/4206 units) in 15 minute increments.

```
File  Edit  Setup  Control  Window  Help
                         T1C Performance History
        24 Hour Registers                          15 Minute Registers

    ---ES---SES-----ES---SES--        --ES-SES---ES-SES---------ES-SES---ES-SES-
     01572 01572  01571 01571   <-->  677 677  676 676
 -1: ----- -----  ----- -----    - 1: 895 895  895 895    -17: --- ---  --- ---
 -2: ----- -----  ----- -----    - 2: --- ---  --- ---    -18: --- ---  --- ---
 -3: ----- -----  ----- -----    - 3: --- ---  --- ---    -19: --- ---  --- ---
 -4: ----- -----  ----- -----    - 4: --- ---  --- ---    -20: --- ---  --- ---
 -5: ----- -----  ----- -----    - 5: --- ---  --- ---    -21: --- ---  --- ---
 -6: ----- -----  ----- -----    - 6: --- ---  --- ---    -22: --- ---  --- ---
 -7: ----- -----  ----- -----    - 7: --- ---  --- ---    -23: --- ---  --- ---
        Local        Remote      - 8: --- ---  --- ---    -24: --- ---  --- ---
                                 - 9: --- ---  --- ---    -25: --- ---  --- ---
                                -10: --- ---  --- ---    -26: --- ---  --- ---
                                -11: --- ---  --- ---    -27: --- ---  --- ---
                                -12: --- ---  --- ---    -28: --- ---  --- ---
                                -13: --- ---  --- ---    -29: --- ---  --- ---
                                -14: --- ---  --- ---    -30: --- ---  --- ---
                                -15: --- ---  --- ---    -31: --- ---  --- ---
                                -16: --- ---  --- ---    -32: --- ---  --- ---
                                       Local    Remote          Local    Remote
================================================================================
Press 'm' - Main Menu, 'p' - Previous Page, 'n' - Next Page:
```

Figure 19. T1C Performance History

T1C performance data is presented as Errored Seconds (ES) and Severely Errored Seconds (SES) on the T1C link. The following events qualify as an ES–AIS, LOS or LOF Alarm Second, a single BPV or excessive zero event, or a single parity bit. An SES is caused by an AIS, LOS or LOF Alarm Second, or excessive Bipolar Violations (BPVs) or framed Parity Bit errors causing a line Bit Error Rate (BER) of 10^{-6}.

The error count for the most recent 24 hours are recorded and displayed on the right side of the page. The left side of the page displays the 24 hour totals for the most recent 7 days.

> NOTE
> *Press <**N**> to view the next 8 hours worth of 15 minute totals and <**P**> to view the previous 8 hours.*

> NOTE
> *Press <**6**> from any menu in the TRACER 4106/4206 VT100 menu structure to access the T1C Link Performance History page.*

>T1D STATUS/CONFIGURATION/LOOPBACK

Figure 20 shows the T1D Status/Configuration/Loopback menu page. Real-time graphical representation for the T1D link (using data from both the local and remote TRACER 4106/4206 units) is displayed on this page. T1D operational configuration parameters and testing functions are configured from this menu.

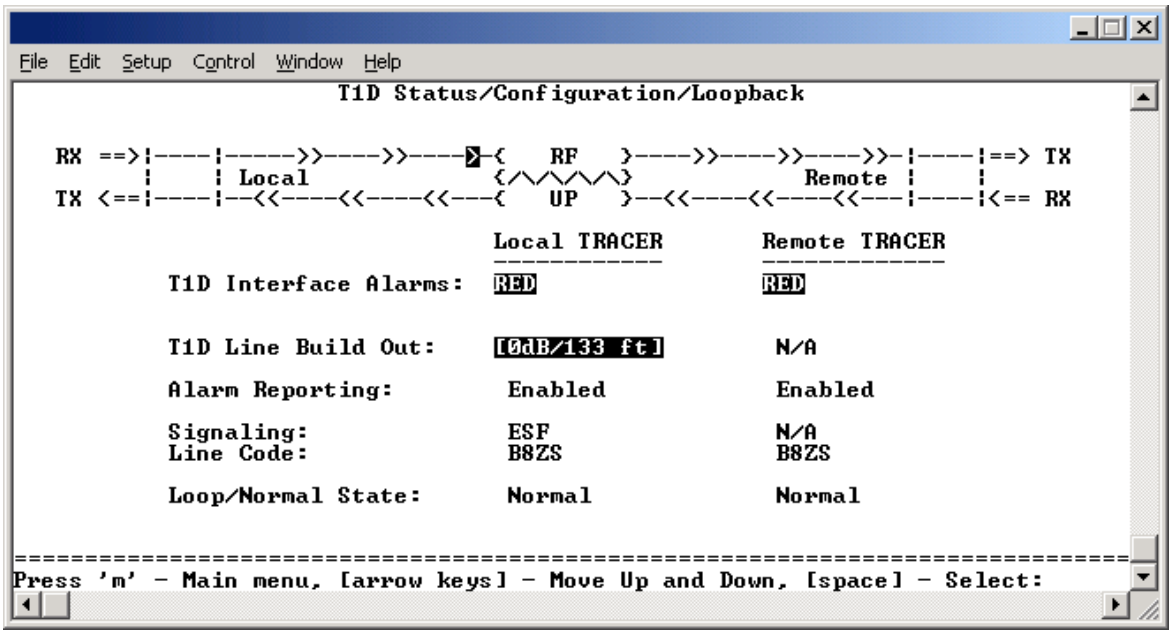

Figure 20. T1D Status/Configuration/Loopback

> **NOTE** Press <**7**> from any menu in the *TRACER 4106/4206* VT100 menu structure to access the T1D Status/Configuration/Loopback menu page.

>T1D STATUS/CONFIGURATION/LOOPBACK > T1D INTERFACE ALARMS

Displays and active alarms on the T1D link reported from both the local and remote TRACER 4106/4206 units. These alarms include Red, Blue, Yellow, AIS, and bipolar violations (BPV). See **Table 1** on page 50, for more information on these alarms.

>T1D STATUS/CONFIGURATION/LOOPBACK > T1D LINE BUILD OUT

Configures the T1D for the appropriate line buildout, based on the distance to the T1D equipment.

>T1D STATUS/CONFIGURATION/LOOPBACK > ALARM REPORTING

Determines whether the TRACER 4106/4206 unit will report active alarms. If **DISABLED**, no alarms will be displayed on this menu page. The Alarm Reporting parameter is independently configured for local and remote TRACER 4106/4206 units. When **DISABLED**, the front panel LED alarms will also be disabled (off).

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>T1D STATUS/CONFIGURATION/LOOPBACK > SIGNALING

Configure the framing format for the T1D link for both the local and remote TRACER 4106/4206 units. The TRACER 4106/4206 transports T1D data across the link (as long as the T1D signal is properly timed). Configure the framing format (using the **SIGNALING** menu) to enable the TRACER 4106/4206 to monitor the incoming framing error events and indicate problems with the attached metallic service. The TRACER 4106/4206 supports both **ESF** and **D4** framing formats.

>T1D STATUS/CONFIGURATION/LOOPBACK > LINE CODE

Sets the line coding for the T1D link. The TRACER 4106/4206 supports **B8ZS** and **AMI** line coding.

>T1D STATUS/CONFIGURATION/LOOPBACK > LOOP/NORMAL STATE

Controls the loop status of the T1D link. Activates/deactivates loopback conditions for testing purposes.

>T1D STATUS/CONFIGURATION/LOOPBACK > LOOP/NORMAL STATE > NORMAL

The T1D link is in normal data transport mode - there are no active loopbacks.

>T1D STATUS/CONFIGURATION/LOOPBACK > LOOP/NORMAL STATE > LINK

Activates a loopback at the TRACER 4106/4206 T1D framer towards the wireless link (see **Figure 21**). Use the **LINK** loopback to test data path integrity from one unit across the wireless link.

```
RX ==>|  +-|->>---->>---->>----{   RF   }->>---->>---->>----->>--  |==> TX
      |  | | Local             {/\/\/\/\}            Remote      |
TX <==|  +-|-----<<----<<----<<{   UP   }-----<<----<<----<<----  |<== RX
```

Figure 21. T1D Link Loopback

>T1D STATUS/CONFIGURATION/LOOPBACK > LOOP/NORMAL STATE > LINE

Activates a loopback at the TRACER 4106/4206 T1D framer towards the wireless link (see **Figure 22**). Use the **LINE** loopback to test data path integrity from the TRACER 4106/4206 unit to the T1 equipment.

```
RX ==>|-+--|---->>---->>---->>-{   RF   }---->>---->>---->>-|==> TX
      | |  | Local             {/\/\/\/\}            Remote |
TX <==|-+  |--<<----<<----<<---{   UP   }--<<----<<----<<---|<== RX
```

Figure 22. T1D Line Loopback

>T1D PERFORMANCE HISTORY

Figure 23 shows the T1D Performance History menu page. The T1D Performance History menu page displays detailed error statistics for the T1D link (from both the local and remote TRACER 4106/4206 units) in 15 minute increments.

```
File  Edit  Setup  Control  Window  Help
                         T1D Performance History
        24 Hour Registers                          15 Minute Registers

    ---ES---SES-----ES---SES--        --ES-SES---ES-SES---------ES-SES---ES-SES-
     01687 01687  01686 01686  <-->  792 792  791 791
 -1: ----- -----  ----- -----   - 1: 895 895  895 895   -17: --- ---  --- ---
 -2: ----- -----  ----- -----   - 2: --- ---  --- ---   -18: --- ---  --- ---
 -3: ----- -----  ----- -----   - 3: --- ---  --- ---   -19: --- ---  --- ---
 -4: ----- -----  ----- -----   - 4: --- ---  --- ---   -20: --- ---  --- ---
 -5: ----- -----  ----- -----   - 5: --- ---  --- ---   -21: --- ---  --- ---
 -6: ----- -----  ----- -----   - 6: --- ---  --- ---   -22: --- ---  --- ---
 -7: ----- -----  ----- -----   - 7: --- ---  --- ---   -23: --- ---  --- ---
        Local        Remote     - 8: --- ---  --- ---   -24: --- ---  --- ---
                                - 9: --- ---  --- ---   -25: --- ---  --- ---
                               -10: --- ---  --- ---   -26: --- ---  --- ---
                               -11: --- ---  --- ---   -27: --- ---  --- ---
                               -12: --- ---  --- ---   -28: --- ---  --- ---
                               -13: --- ---  --- ---   -29: --- ---  --- ---
                               -14: --- ---  --- ---   -30: --- ---  --- ---
                               -15: --- ---  --- ---   -31: --- ---  --- ---
                               -16: --- ---  --- ---   -32: --- ---  --- ---
                                      Local    Remote         Local    Remote
=================================================================================
Press 'm' - Main Menu, 'p' - Previous Page, 'n' - Next Page:
```

Figure 23. T1D Performance History

T1D performance data is presented as Errored Seconds (ES) and Severely Errored Seconds (SES) on the T1D link. The following events qualify as an ES–AIS, LOS or LOF Alarm Second, a single BPV or excessive zero event, or a single parity bit. An SES is caused by an AIS, LOS or LOF Alarm Second, or excessive Bipolar Violations (BPVs) or framed Parity Bit errors causing a line Bit Error Rate (BER) of 10^{-6}.

The error count for the most recent 24 hours are recorded and displayed on the right side of the page. The left side of the page displays the 24 hour totals for the most recent 7 days.

> NOTE
> *Press <**N**> to view the next 8 hours worth of 15 minute totals and <**P**> to view the previous 8 hours.*

> NOTE
> *Press <**8**> from any menu in the TRACER 4106/4206 VT100 menu structure to access the T1D Link Performance History page.*

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TROUBLESHOOTING GUIDE

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1. OVERVIEW

This troubleshooting guide provides recommended actions for various conditions of the TRACER 4106/4206 system. The status LEDs (located on the front panel of the unit) provide information to help determine the necessary troubleshooting action. Recommended actions for resolving possible status LED indicators are contained in this guide.

2. LED INDICATORS

PWR LED

If the **PWR** LED is not **ON** and solid green, it is an indicator that the TRACER 4106/4206 is not receiving adequate DC power.

Recommended Actions:

1. Verify that the power source is delivering between 21 and 60 VDC.
2. Check the polarity of the power connection (referenced to ground) of both the TRACER 4106/4206 unit and the power source.
3. Check the internal fuse. The fuse is accessed from the rear panel of the unit. If this fuse is open, replace with a 1Amp, 250 Volt (2-inch) slow-blo fuse.

TST LED

The **TST** will remain **ON** (solid Amber) during power-up to indicate a self-test is in progress. If the **TST** LED is blinking or remains **ON** after 10 seconds, this indicates that the TRACER 4106/4206 unit has failed self-test. This is an internal failure, and ADTRAN technical support should be contacted.

RF DOWN LED

If the **RF DOWN** LED is **ON** (solid Red), it is an indicator that there is a problem with the RF link to the TRACER 4106/4206.

Recommended Actions:

1. Check the RF coaxial cable connection.
2. Measure the RSSI voltage. If the signal is acceptable (> 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 Plan B and that both ends have the same Band Plan Number (ex. A1 and B1).
4. Verify that the antenna polarization is the same at both ends of the RF signal transmit and receive path.
5. Verify the RF signal path is clear.
6. Check for possible interference at both ends of the link. If necessary, change polarization and/or Band Plans at both ends.

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RF LOW LED

If the **RF LOW** LED is **ON** (solid Red), it is an indicator that the received signal is within 10 dB (approximately) 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. If water is apparent in the coax connectors, replace the coax.
3. Verify the RF signal path by verifying the antenna alignment.
4. Check the integrity of the cable plant.
5. Check the integrity of lightning arrestors.

T1 Alarm LEDs

If the **ALARM** LED is **ON** (solid red), it is an indication that the TRACER 4106/4206 is detecting an active T1 alarm. To identify the T1 interface in alarm and the specific alarm present, display the T1(x) Status Screens and check the **T1(X) INTERFACE ALARMS** field.

Recommended Actions:

1. Display the T1(X) Status Screen and Check the T1(X) Interface Alarm field to identify the active alarm.
2. Follow the steps below for the appropriate alarm.

LOS Alarm (Red Alarm)

LOS ALARM is an indication that the TRACER 4106/4206 may be unable to detect a viable T1 received signal from the connected T1 equipment. This error may be due to a degraded signal or no signal, or is may be caused by improper framing.

Recommended Actions:

1. Verify that the T1 cable is connected to the T1 interface on the TRACER 4106/4206.
2. Verify the connections at the opposite end of the T1 cable.
3. Verify that the framing mode (D4 or ESF) is the same for both the TRACER 4106/4206 and the T1 equipment.

Yellow Alarm

A Yellow Alarm 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 4106/4206 unit.

Recommended Actions:

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

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Blue Alarm

A remote alarm (alarm indication signal or AIS) 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 Actions:

1. Verify the input to any attached data equipment.

BPV

Bipolar violations (BPVs) indicate an improper configuration or faulty wiring.

Recommended Actions:

1. Verify the TRACER 4106/4206 unit and the attached equipment are configured for the same line coding (**B8ZS** or **AMI**).
2. Verify the cable connections for the T1 interface are solid.

3. RF ERRORS

RF errors can range anywhere from a non-viable microwave path to loose RF connectors.

Non-viable path conditions could be caused by physical obstructions such as buildings, moutainous terrain, trees, etc., as well as other physical limitations such as excessive path distances and in-band RF interference. These types of errors are remedied by performing a detailed line-of-sight microwave path study to determine whether or not a microwave link is feasible for the terrain and environment under consideration.

If after performing a microwave path study the system is still not operational, ensure that the antennas are properly aligned. Note that alignment must be achieved in both elevation and azimuth for optimal link performance. The TRACER 4106/4206 can be used to aid in antenna alignment by looking at the RSSI submenu. Optimal antenna alignment will correspond to the maximum number of RSSI bars on the TRACER 4106/4206 terminal display.

4. STEP-BY-STEP TROUBLESHOOTING

The logical troubleshooting flow presented in this section can be used to set up your TRACER 4106/4206 system, and also to diagnose a previously installed system. Please contact ADTRAN Technical support at any stage during installation and/or troubleshooting if you require assistance.

5. INSTALLING/TROUBLESHOOTING THE TRACER HARDWARE

1. Perform a detailed path profile for each TRACER 4106/4206 microwave link. A thorough path study can be used to estimate signal power budgets, fade margins at each receiver, identity potential line-of-site obstacles, properly size antenna dishes, and determine minimum antenna dish heights above the earth.
2. Setup all of the TRACER hardware on a work bench. It is also recommended that the actual cables to be used in the permanent installation be used in the work bench setup. A rigorous work bench “simulation” of the link will help you alleviate and avoid time-consuming errors.

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3. Examine the PLAN A and PLAN B lights on the front panel of each unit. These LEDs indicate the frequency plan for each TRACER 4106/4206 unit. The frequency plan (PLAN A, PLAN B) LED should be the opposite on both TRACER 4106/4206 units.
4. Attach the RF coaxial cables to be used in the permanent installation to the N-type connectors on the base of the TRACER 4106/4206 unit. Attach the other end of the coaxial cable(s) to an RF power meter or spectrum analyzer if either is available. The power measured by the meter/analyzer will be the RF power available at the input of the antenna. The TRACER 4106/4206 unit is programmed at the factory to output approximately 100 mW (20 dBm) of RF power. The actual power level measured by the meter/analyzer will be less than 100 mW due to RF losses through the coaxial cable, and is a function of cable type and length of cable being used. In any event, the power level at the output of the coaxial cable should be a significant fraction of 100 mW. A power meter/analyzer reading that is not on the order of at least tens-of-milliwatts could be an indication of any combination of either unsuitable RF, faulty, or unreasonably long coaxial cable.
5. Resolve all RF coaxial cabling errors before proceeding.
6. Attach the RF coaxial cables to a high-quality attenuator, if possible. If you do not have an attenuator, attach the coaxial cables to the antennas to be used in the permanent installation. If the installation antennas are not available, small, inexpensive dipole or patch antennas can be used for verification purposes. If an adjustable attenuator is being used, dial in the amount of attenuation that corresponds to the path loss value expected for the microwave link in which the TRACER hardware will be installed. The path loss value can be calculated from a knowledge of the path length, or provided by a path study. Remember to subtract both antenna gain values from the attenuator level if these values have not already be accounted for.
7. After setting up the RF pieces, examine the **RF DOWN** LED on the front panel of each TRACER 4106/4206 unit. If the **RF DOWN** LED is illuminated (red), the corresponding TRACER 4106/4206 is not receiving a suitable RF signal from the other TRACER 4106/4206 unit. In this case, the receiving TRACER 4106/4206 is either receiving a very weak signal, or no signal at all. If the **RF DOWN** LED is not illuminated, then the TRACER 4106/4206 units are receiving a suitable RF signal. Suitable RF power levels for low error rate communication will range from -30 dBm to -100 dBm for the 4106 and -30 dBm to -96 dBm for the 4206 measured at the N-type connector input on the TRACER unit.
8. Resolve any signal level issues before proceeding.
9. Examine the **RF LOW** LED on the front panel of each TRACER 4106/4206. If this LED is illuminated, then the TRACER 4106/4206 is receiving a relatively weak signal, however if the **RF DOWN** LED is not illuminated, the received signal is being suitably processed by the TRACER system. If you are receiving a weak signal (**RF LOW** is **ON**), please verify that the weak signal is not being caused by a faulty cable, an insufficiently tightened cable, or some other installation-related problem. Also, make sure an unreasonably large attenuation value has not been selected if you are using an attenuator on a work bench setup.

   Use the tables in Section 2, *Microwave Path Engineering Basics*, of this manual to select the proper free-space attenuation value (in dB) based on the estimated length of the microwave path. Remember to subtract out both antenna gains (local and remote) from the attenuator setting.
10. Command a link loopback in one TRACER 4106/4206 unit and run pattern from the connected T1 equipment. This will verify data path between the T1 equipment and the TRACER 4106/4206 unit.

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> **NOTE** *External pattern generators are required to test data path integrity. A T1 BERT tester is suggested.*

Installing/Configuring T1 Hardware

1. If possible, attach any or all of the intended T1 hardware to the TRACER 4106/4206 units using the same work bench setup. This step offers the perfect opportunity to configure your T1 hardware for proper functioning with the TRACER hardware.
2. Resolve any remaining T1 equipment-to-TRACER 4106/4206 configuration issues before field installation, if possible. This will significantly reduce the probability of unsuccessful field installation.

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