

MDS™ TransNEXT



Technical Manual

MDS TransNEXT Technical Manual, Rev. A
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RF Regulatory Information

RF Exposure Notice (English and French)

RF Exposure



Concentrated energy from a directional antenna may pose a health hazard to humans. Do not allow people to come closer to the antenna than the distances listed in the table below when the transmitter is operating. More information on RF exposure can be found online at the following website:
www.fcc.gov/oet/info/documents/bulletins

l'exposition aux RF



Concentré d'énergie à partir d'une antenne directionnelle peut poser un risque pour la santé humaine. Ne pas permettre aux gens de se rapprocher de l'antenne que les distances indiquées dans le tableau ci-dessous lorsque l'émetteur est en marche. Plus d'informations sur l'exposition aux RF peut être trouvé en ligne à l'adresse suivante:
www.fcc.gov/oet/info/documents/bulletins

Antennas must not be co-located. All transmission antennas must be at least 20 cm apart to comply with FCC co-location rules.

TransNEXT Minimum RF Safety Distance

TransNEXT Model	Minimum Safety Distance from Antenna <i>operating with a 10dBd (12.15dBi) antenna and so configured for the maximum allowable EIRP of +36dBm</i>
NET9L	34 cm
NET9S	34 cm

Approved Antennas

This product has been approved for use with the antennas listed in Table 1-1, below:

Manufacturer	Manufacturer's Part Number	Type	Gain (dBi)/per port	For use with (E5MDS- or 101D-)
Kathrein	OGB9-915N	Omni	11.0	NET9L
PCTEL	Z3336	Yagi	12.2	NET9L
Hana Wireless	HW-OD9-6D-NF	Dual-Polarized Omni	6.0	NET9S
PCTEL	BMYD890K-DP	Dual-Polarized Yagi	11.0	NET9S

Table 1-1. Approved Antennas for TransNEXT

Professional installation is required. The installation site must conform to 15.247/RSS-247 Conducted and Radiated Power limits. Proper feedline selection and/or radio power setpoints must be set accordingly for use with each antenna type as detailed in Table 1-2.

Radio Model	Antenna Model	Radio Power Setpoint (dBm)	Minimum Cable Loss required for this configuration (dB)	Conducted Power into antenna (dBm) <i>Note 1</i>	EIRP(dBm) <i>Note 2</i>
NET9L	OGB9-915N	30	5.0	25	36
		25	0	25	36
NET9L	Z3336	30	6.2	23.8	36
		24	0.2	23.8	36
NET9S	HW-OD9-6D-NF	30	3.0	30	36
		27	0	30	36
NET9S	BMYD890K-DP	30	8.0	25	36
		22	0	25	36

Note 1: Conducted Power into antenna is the sum of the power of both transmitter feedline outputs for NET9S
Note 2: EIRP is the sum of the radiated power of all polarizations for NET9S

Table 1-2. Feedline losses and radio power setpoints for ERP and Conducted Power compliance for TransNEXT installations.

FCC Part 15 Notice and Industry Canada RSS Notices

This device complies with Part 15 of the FCC rules for a Class A digital device. Operation of this device subject to the following two conditions:

- (1) this device may not cause harmful interference, and
 - (2) this device must accept any interference received, including interference that may cause undesired operation. Any unauthorized modification or changes to this device without the express approval of the manufacturer may void the user's authority to operate this device. Furthermore, this device is intended to be used only when installed in accordance with the instructions outlined in this guide. Failure to comply with these instructions may void the user's authority to operate this device.
- (a) Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.
 - (b) The radio transmitters described herein (IC ID: 101D-NET9L and 101D-NET9S) have been approved by Industry Canada to operate with the antenna types listed in Table 1-1 with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Cet appareil est conforme à la Partie 15 des règlements de la FCC et Industrie Canada exempts de licence standard RSS (s). Son utilisation est soumise à deux conditions:

- (1) ce dispositif ne peut causer des interférences,
 - (2) cet appareil doit accepter toute interférence pouvant causer un mauvais fonctionnement du dispositif.
- (a) En vertu des règlements d'Industrie Canada, cet émetteur radio ne peut fonctionner avec une antenne d'un type et un maximum (ou moins) approuvés pour gagner de l'émetteur par Industrie Canada. Pour réduire le risque d'interférence aux autres utilisateurs, le type d'antenne et son gain doivent être choisis de façon que la puissance isotrope rayonnée équivalente (PIRE) ne dépasse pas ce qui est nécessaire pour une communication réussie.
 - (b) Les émetteurs radio décrits ici (IC ID : 101D-NET9L et 101D-NET9S) ont été approuvés par Industrie Canada pour fonctionner avec les types d'antennes répertoriés dans le tableau (Table 1-1) avec le gain maximum autorisé et l'impédance d'antenne requise pour chaque type d'antenne indiqué. Les types d'antennes non inclus dans cette liste, ayant un gain supérieur au gain maximum indiqué pour ce type, sont strictement interdits pour une utilisation avec cet appareil.

IEEE-1613 Compliance

The TransNEXT is IEEE-1613 compliant provided that unshielded cables are ≤ 2 meters in length.

Operational Safety Notices

The TransNEXT may not be used in an environment where radio frequency equipment is prohibited or restricted in its use. This typically includes aircrafts, airports, hospitals, and other sensitive electronic areas.

Do not operate RF devices in an environment that may be susceptible to radio interference resulting in danger, specifically:

- **Areas where prohibited by law** - Follow any special rules and regulations and obey all signs and notices. Do not use the TransNEXT when you suspect that it may cause interference or danger.
- **Near Medical and life support equipment** - Do not use the TransNEXT in any area where medical equipment, or life support equipment may be located, or near any equipment that may be susceptible to any form of radio interference.
- **All cables and conductors making connections to the units need to be rated at 85 °C or higher.**
- **Use Copper Conductors Only**
- **Use 18 AWG wire**

NOTE The TransNEXT does not support Voice Communications.

Regulatory Limitations

Some product options including hardware and software configuration settings may be restricted based on applicable region-specific regulatory constraints.

FCC / IC IDs

As of the printing date, the following identifiers are assigned to the models listed below.

Model	FCC ID	IC ID
NET9L	E5MDS-NET9L	101D-NET9L
NET9S	E5MDS-NET9S	101D-NET9S

Country-Specific Installation Data

Refer to APPENDIX D – Country Specific Information at the back of this manual for important notices regarding installation in specific countries.

Servicing Precautions

No user-serviceable parts are contained inside this equipment. Opening of the unit by unauthorized personnel voids the warranty. All servicing must be performed by an authorized repair facility.



When servicing energized equipment, be sure to wear appropriate Personal Protective Equipment (PPE). During internal service, situations could arise where objects accidentally contact or short circuit components and the appropriate PPE would alleviate or decrease the severity of potential injury. When servicing equipment, all workplace regulations and other applicable standards for live electrical work should be followed to ensure personal safety.

Manual Revision and Accuracy

This manual was updated to cover a specific version of firmware code. Accordingly, some screens and features may differ from the actual unit you are working with. While every reasonable effort has been made to ensure the accuracy of this publication, product improvements may also result in minor differences between the manual and the product shipped to you. If you have additional questions or need an exact specification for a product, please contact GE MDS using the information at the back of this guide. In addition, manual updates can be found on our website at www.gemds.com.

Environmental Information

The manufacture of this equipment has required the extraction and use of natural resources. Improper disposal may contaminate the environment and present a health risk due to hazardous substances contained within. To avoid dissemination of these substances into our environment, and to limit the demand on natural resources, we encourage you to use the appropriate recycling systems for disposal. These systems will reuse or recycle most of the materials found in this equipment in a sound way. Please contact GE MDS or your supplier for more information on the proper disposal of this equipment.

Cyber Security Policy

As part of GE's commitment to product safety, quality and reliability and to reduce risk exposure for GE and our customers, the "GE Product Cyber Security Standard" (the Policy) outlines the requirements that GE Business Units must meet. The Policy, requires each GE Business Unit to implement reasonable, industry-specific measures designed to protect all GE products and services, including all relevant components and services sourced from third parties, from cyber security threats throughout their supported life cycle.

Safety Regulatory Information

CSA/us C1D2 Safety Notice

This product is approved for use in Class 1, Division 2, Groups A, B, C & D Hazardous Locations. Such locations are defined in Article 500 of the National Fire Protection Association (NFPA) publication NFPA 70, otherwise known as the National Electrical Code. The transceiver has been recognized for use in these hazardous locations by the Canadian Standards Association (CSA) which also issues the US mark of approval (CSA/US). The CSA Certification is in accordance with CSA STD C22.2 No. 213-M1987.

For Class I, Division 2, the product shall be installed in a tool secured enclosure providing a suitable degree of protection against deterioration of the equipment that would adversely affect its suitability for use in the hazardous locations area and to avoid USB-C diagnostic port /connectors from being accessible during normal operation. The antenna port shall be used with a passive antenna only. The final installation is subject to acceptance of CSA International or the local inspection authority having jurisdiction.



WARNING – EXPLOSION HAZARD. DO NOT REMOVE OR REPLACE WHILE CIRCUIT IS LIVE UNLESS THE AREA IS FREE OF IGNITIBLE CONCENTRATIONS



WARNING – EXPLOSION HAZARD. DO NOT CONNECT OR DISCONNECT WHEN ENERGIZED



AVERTISSEMENT – RISQUE D'EXPLOSION. NE PAS RETIRER OU REMPLACER LORSQUE LE CIRCUIT EST SOUS TENSION À MOINS QUE LA ZONE NE SOIT EXEMPTÉ DE CONCENTRATIONS INFLAMMABLES



AVERTISSEMENT – RISQUE D'EXPLOSION. NE PAS CONNECTER OU DÉCONNECTER LORSQU'IL EST SOUS TENSION



1.0 Product Overview and Applications

1.1 Introduction

This manual describes the MDS TransNEXT™. The TransNEXT is the successor to the MDS TransNET™ 900 MHz unlicensed radio. Setting the standard for reliable, long-range wireless serial data transmission utilizing proven Frequency Hopping Spread Spectrum (FHSS) technology, the next generation TransNEXT is backwards-compatible with its predecessor, TransNET. The TransNEXT's backwards compatibility enables the continued use of legacy serial networks while also adding new capabilities to migrate networks with secure Ethernet connectivity.



Figure 1-1. TransNET Lite
(model NXT9L)



Figure 1-2. Figure 1-3. TransNET Standard with Display
(model NXT9S)

Information on other GE MDS products can be found by visiting our website at www.gemds.com.

1.1.1 About This Manual

This manual is intended for systems engineers, network administrators and others responsible for planning, commissioning, installing, using and troubleshooting the wireless system. Electronic copies of all user documentation are available free of charge at www.gemds.com

Software Command Notations

The product is designed for software control via a connected PC. To show the names of software commands, keyboard entries, or other information displayed on a PC screen, a bolded font is used throughout the manual. In some cases italics or non-bolded sections may be used to distinguish fixed syntax from portions of a command where the user must supply specific data.

For example:

[1234567] Login: **admin**

NOTE The software commands and responses shown in this manual were obtained from a unit operating in a lab environment. The information displayed may differ from field service conditions.

2.0 Product Description

The TransNEXT is a rugged license-free wireless communication device well suited for a variety of SCADA and telemetry solutions using serial and IP/Ethernet.

2.1 Key Features

TransNEXT units include the following key features:

- **Backwards-Compatible** – Over-the-Air Compatible with TransNET, with similar or better RF performance in real-world field installations.
- **Over-the-air (OTA) reprogramming** – This facility provides a simple means to non-intrusively broadcast a firmware upgrade to an entire field of remotes, using a copy of the firmware image currently running in the TransNEXT master radio. This feature operates slowly to avoid conflicting with payload data and to allow interoperability through an existing TransNET network.
- **Optional E-ink display (*select models only*)** – This display provides a convenient tool for installation, local diagnostics, and troubleshooting. The E-ink display maintains the last screen image following a power failure.
- **IP Payload** – First introduced in the MDS SD™ this facility performs local ethernet to serial conversion, providing an efficient means to connect compatible ethernet devices.
- **Small Form Factor**—The unit is housed in a rugged enclosure suited for operation in harsh industrial environments. It requires only protection from direct exposure to the weather and may be easily mounted inside a NEMA enclosure for outdoor applications when required.
- **User Interface**—Multiple user interfaces are provided for configuration and monitoring of the unit. These include USB, web, SSH and local serial (*using “+++” to temporarily override the payload data interface*)

NOTE The TransNEXT is designed for secure environments. As such, management of the device does not support Telnet, but instead implements the more secure SSH protocol.



NOTE For units certified and installed in hazardous locations, use only the serial or Ethernet connections on the unit’s front panel. Do *not* use the USB port in hazardous locations.

- **Network Management System**— TransNEXT is supported by GE MDS PulseNET, a Network Management System (NMS), providing monitoring of small- and large-scale deployment of all GE MDS devices. (***) for interoperability, TransNEXT appears as a TransNET device)

2.2 Typical Applications

MDS TransNEXT is the successor to the MDS TransNET radio. It builds on the flexibility of the predecessor product and serves a wide variety of traditional applications.

Multiple Address Systems (MAS)

This is the most common application of the transceiver. It consists of a central control station (Master) and two or more associated Remote units. An MAS network provides communications between a central host computer and remote terminal units (RTUs) or other data collection devices. The operation of the radio system is transparent to the computer equipment. When used in this application, the transceiver provides an excellent alternative to traditional (licensed) MAS radio systems.

Point-to-Point System

A point-to-point configuration is a simple arrangement consisting of just two radios—a Master and a Remote. This provides a half-duplex communications link for the transfer of data between two locations.

Adding a Tail-End Link to an Existing Network

A tail-end link can be used to extend the range of a traditional (licensed) MAS system. This might be required if an outlying site is blocked from the MAS Master station by a natural or man-made obstruction. In this arrangement, a TransNEXT radio links the outlying Remote site into the rest of a licensed MAS system by sending data from that site to an associated TransNEXT installed at one of the licensed Remote sites.

As the data from the outlying site is received at the licensed Remote site, it is transferred to the licensed radio (via a local cable connection) and is then transmitted to the MAS Master station in the usual manner.

Extending a TransNEXT Network with a Network Repeater

Similar to a Tail-End Link, Store-and-Forward (SAF) offers a way to physically extend the network range, but in a simple and economical manner. SAF works by dividing a network into a vertical hierarchy of two or more sub-networks. Extension radios (designated in TransNEXT as radio.mode “x”) serve as single-radio repeaters that link adjacent sub-networks, and move data from one sub-network to the next one.

Interworking with a TransNET network

Each of the application types above can be supported by introducing a TransNEXT radio into an existing TransNET network, replacing older radios or extending communication and new features to new sites.

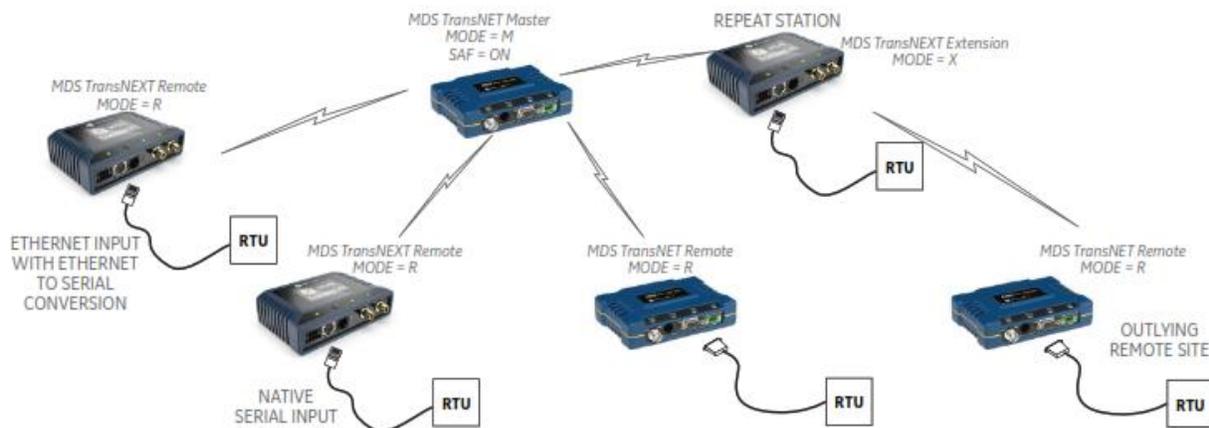


Figure 2-1. Mixed TransNEXT & TransNEXT Application

2.3 TransNEXT Connectors and Indicators

Figure 2-2 shows the unit's front panel connectors and indicators. These items are referenced in the text that follows. The unit's LED Indicator / Button Panel is described in Figure 2-6.



Figure 2-2. TransNEXT, Connectors and Indicators

PWR & I/O —Two-conductor DC input connection and I/O

- A latching 6-pin connector is used (Figure 2-3). It is keyed and can only be inserted one way.
- Pin 1 is GND, Pin 5 is Vin.
- Pins 2,4, and 6 are reserved for future I/O capability.
- Use Copper Conductors Only
- Use 18 AWG wire
- Tighten wire clamps to 5 lb-in. (0.6 Nm)

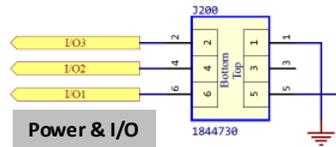


Figure 2-3. 6-pin Power & I/O Connector (P/N 73-1194A85)

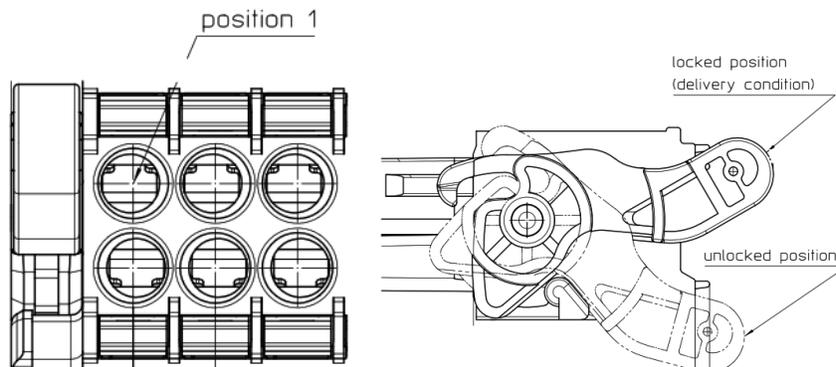


Figure 2-4. 6-pin Power & I/O Connector (Phoenix Contact part)

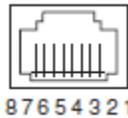
NOTE The unit is designed for use in negative ground DC power systems only. Only use the power supply provided by the manufacturer for the product or a certified LPS power supply rated for

nominal power 6-36 VDC, 1.6 A maximum must be used. Otherwise, safety of the product may be impaired. In case of doubt, please consult the local authorized suppliers.

Input voltage to the unit must be well filtered and within the nominal range of 6-36 VDC. The maximum rated power consumption of the device is 10 watts, but actual power is typically much less. The power supply must be capable of supplying the expected maximum power for the installation. For expected power requirements in common configurations, see “Technical Specifications on Page 53.

ETH— Ethernet connection port. These ports support both device management and payload data transport. This is a standard RJ-45 jack and features MDIX auto-sensing capability, allowing straight-through or crossover cables to be used.

Connecting to the unit via SSH supports device management and provides a similar user interface available using the unit’s serial COM port.



(As viewed from the outside the unit)

Table 2-1. ETH1/2 Pin Details

Pin	Function	Pin	Function
1	Transmit Data (TX) High	5	Unused
2	Transmit Data (TX) Low	6	Receive Data (RX) Low
3	Receive Data (RX) High	7	Unused
4	Unused	8	Unused

USB Port—This port provides a USB-C connection to a laptop or PC. The port provides a local console for management of the device. A standard host-to-USB-C cable may be used.

COM Port—This connector serves as the serial interface port for payload data. The COM port serves as the primary interface for connecting the unit to an external DTE serial device supporting RS-232 or RS-485. If necessary, an adapter may be used to convert the unit’s RJ-45 serial jack to a DB-9F type (GE MDS 73-2434A25).

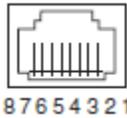
NOTE TransNEXT typically uses the unit’s USB port to access the device management interface (CLI). As an alternat access method typing “+++” on the COM port (at roughly half second intervals) will cause it to drop out of payload mode and present the CLI interface. Issuing a logout command will revert the unit to payload data mode.

The COM port supports a serial data rate of 1200-115200 bps (115200 default, asynchronous only). The unit is hardwired as a DCE device.

Supported data formats for the COM port are:

	com1.databits	com1.paritybits	com1.stopbits
8N1 - 8 char bits, no parity, 1 stop bit (<i>Default</i>)	8	“N”	1
8N2 - 8 char bits, no parity, 2 stop bits	8	“N”	2
8O1 - 8 char bits, odd parity, 1 stop	8	“O”	1
8O2 - 8 char bits, odd parity, 2 stop bits	8	“O”	2
8E1 - 8 char bits, even parity, 1 stop bit	8	“E”	1
8E2 - 8 char bits, even parity, 2 stop bits	8	“E”	2

The tables on the following page provide pin descriptions for the COM data port in RS-232 mode and RS-485 modes, respectively.



(As viewed from the outside the unit)

Table 2-2. COM Port Pin Details (RS-232)

Pin Number	Input / Output	Pin Description
1	OUT	ALARM Output
2	OUT	DCD (Data Carrier Detect)
3	Reserved	--
4	Ground	Connects to ground (negative supply potential) on chassis
5	OUT	RXD (Received Data)—Supplies received data to the connected device
6	IN	TXD (Transmitted Data)—Accepts TX data from the connected device
7	OUT	CTS (Clear to Send)
8	IN	RTS (Request to Send)

Table 2-3. COM1 Port Pin Details (RS-485)

Pin Number	Input/Output	Pin Description
1	OUT	ALARM Output
2	OUT	DCD (Data Carrier Detect)
3	Reserved	--
4	Ground	Connects to ground (negative supply potential) on chassis
5	OUT	TXD+/TXB (Transmitted Data +)—Non-inverting driver output. Supplies received payload data to the connected device.
6	IN	RXD+/RXB (Received Data +) — Non-inverting receiver input. Accepts payload data from the connected device.
7	OUT	TXD-/TXA (Transmitted Data -)—Inverting driver output. Supplies received payload data to the connected device.
8	IN	RXD-/RXA (Received Data -) — Inverting receiver input. Accepts payload data from the connected device.

COM1 Port notes and wiring arrangements (for RS-485)

- The COM1 port supports 4-wire and 2-wire RS-485 mode as follows:
 - RXD+ / RXB and RXD- / RXA are data sent *into* the unit
 - RXD+ / RXB is positive with respect to RXD- / RXA when the line input is a “0”
 - TXD+ / TXB and TXD- / TXA are data sent *out* by the unit
 - TXD+ / TXB is positive with respect to the TXD- / TXA when the line output is a “0”
- 2-wire RS-485 mode connections:
 - Connect pins 5&6 (TXD+/RXD+) together and connect to (TXD+/RXD+) tied together on connected device
 - Connect pins 7&8 (RXD-/TXD-) together and connect to (TXD-/RXD-) tied together on connected device
- 4-wire RS-485 mode connections:
 - Connect pin 5 (TXD+) to RXD+ of connected device
 - Connect pin 6 (RXD+) to TXD+ of connected device
 - Connect pin 7 (TXD-) to RXD- of connected device
 - Connect pin 8 (RXD-) to TXD- of connected device

Figure 2-5 illustrates the 2-wire and 4-wire connections described above.

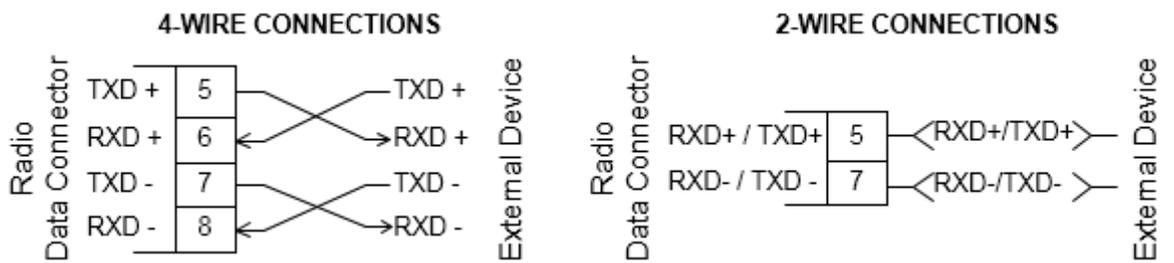
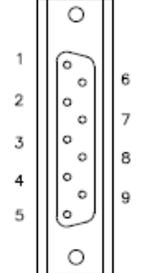


Figure 2-5. EIA-485 4-Wire/2-Wire Connections

NOTE GE MDS part number 73-2434A25 provides a custom RJ45 to DB9 Adapter for use with the TransNEXT and other GE MDS products. The chart below provides details for connections made using this adapter.

WIRING CHART

RJ-45 PIN	FUNCTION	DB9 PIN	
1	DSR	6	
2	DCD	1	
3	DTR	4	
4	GND	5	
5	RXD	2	
6	TXD	3	
7	CTS	8	
8	RTS	7	

LED / Button Panel —The LEDs on the top of the unit provide visual indications of device status. The push button (appearing like a thin white circle) is used for special functions like controlling the optional E-ink display screen.



Figure 2-6. LED Indicators & Push Button

The LEDs are multi-color to convey different types of status conditions as shown in the following chart:

Table 2-4. Description of LED Status Indicators

LED Name	LED State	Description
PWR (DC Power)	Off	No power to unit.
	Solid Green	Unit is powered, no problems detected.
	Flashing Red (0.5s ON/ 0.5s OFF)	Alarm indication.
	Flashing Green (0.5s ON/ 0.5s OFF)	Unit is being programmed.
	Fast Alternating (Red/Yellow/Green)	Unit is booting up.
RADIO-1 (master) (remote) (all)	Off	Interface disabled.
	Solid Green + flicker	Radio-1 will flicker on data.
	Solid Color + flicker on data [Color based on RSSI]	Radio-1 is synchronized to a master. LED will flicker on data.
	Flashing Red (1.0s ON/1.0s OFF)	Remote radio is not synchronized.
	Multi-Color (rotating) (1.0s ON per color)	Radio is in setup mode.
RADIO-2 (if equipped)	Off	Interface disabled.

2.4 Grounding Considerations

To minimize the chance of damage to the unit and its connected equipment, a safety ground (NEC Class 2 compliant) is recommended, which bonds the chassis, antenna system(s), power supply and connected data equipment to a *single-point* ground, keeping all ground leads as short as possible.

Normally, the unit is adequately grounded if mounted with the flat brackets to a well-grounded metal surface. If the unit is not mounted to a grounded surface, it is recommended that a safety ground wire be attached to the screw provided on the bottom corner of the enclosure, in the recessed flat area. Alternatively, a safety ground wire may be attached to one of the mounting bracket screws.

The use of a lightning protector is recommended where the antenna cable enters the building; Bond the protector to the tower ground, if possible. All grounds and cabling must comply with applicable codes and regulations. One source for lightning protection products may be found online at <http://www.protectiongroup.com/PolyPhaser>.

2.5 Mounting Options

The unit may be mounted with flat mounting brackets *or* an optional 35 mm DIN rail attachment.

NOTE To prevent moisture from entering the unit, do not mount the case with the cable connectors pointing up. Also, dress all cables to prevent moisture from running along the cables and into the unit.

2.5.1 Optional DIN Rail Mounting

If ordered with the DIN rail mounting option, two choices are available. For vertical mounting the unit is supplied with a DIN rail clip attached to an integrated bracket on the unit's case. For horizontal mounting a special bracket is used. In both cases the bracket allows for quick installation and removal from a DIN mounting rail. See Figure 2-7.



Figure 2-7. DIN Rail Attachment examples
(Pull down tab to release from rail)

2.6 Antenna Planning and Installation

Consideration must be taken to select appropriate antennas for optimal RF performance. The use of non-approved antennas may result in a violation of FCC rules and subject the user to FCC enforcement action. Note that with any installation, there needs to be a minimum 20 cm spacing between all transmit antennas to avoid co-location difficulties.

900 MHz ISM Antennas —Antenna connection is a TNC connector. Multiple options are available for this unlicensed operation.

NOTE Professional installation is required.

NOTE For regions governed by FCC/IC compliance the maximum EIRP must be limited to 36 dBm. If $((\text{antenna gain} - \text{feed line loss}) + \text{power output setting}) > 36$, then the power output of the TransNEXT must be reduced.

Table 2-5. Signal Loss in Coaxial Cables (at 900 MHz)

Cable Type	10 Feet (3 Meters)	50 Feet (15 Meters)	100 Feet (30.5 Meters)	500 Feet (152 Meters)
RG-214	0.76 dB	3.80 dB	7.60 dB	Unacceptable Loss
LMR-400	0.39 dB	1.95 dB	3.90 dB	Unacceptable Loss
1/2 inch HELIAX	0.23 dB	1.15 dB	2.29 dB	11.45 dB
7/8 inch HELIAX	0.13 dB	0.64 dB	1.28 dB	6.40 dB
1-1/4 inch HELIAX	0.10 dB	0.48 dB	0.95 dB	4.75 dB
1-5/8 inch HELIAX	0.08 dB	0.40 dB	0.80 dB	4.00 dB

Accessories and Spares

The table below lists common accessories and spare items for use with the TransNEXT. GE MDS also offers an *Accessories Selection Guide* listing an array of additional items that may be used with the product. Contact your factory representative or visit www.gemds.com to obtain a copy of the guide.

Table 2-6. Accessories & Ancillary Items

Item	Description	Part Number
DC Power Plug, 6-pin, polarized	Mates with power connector on the unit's case. Screw terminals are provided for wires, threaded locking screws to prevent accidental disconnect.	73-1194A85
COM Port Adapter	Converts the unit's RJ-45 serial jack to a DB-9F type.	73-2434A25
Ethernet Surge Suppressor	Surge suppressor for protection of the Ethernet port against lightning.	29-4018A01
Bandpass Filter	Antenna system filter that helps eliminate interference from nearby paging transmitters.	20-2822A02

2.7 Initial Settings Overview

2.7.1 Setting Basic Parameters—First Steps

Setup will vary based on the application. But these minimal tasks should always be performed after initial startup and connection to a PC:

1. Change the login passwords.
2. Configure the radio.addr (Network Address) for your system
3. Configure the Serial COM port and ETH port as needed

When Configuring a new network one radio will have to be designated as a master. On that radio

1. Configure the radio.mode ("m"=master)

Finally:

2. Make sure to save configuration

The Device Management section that follows provides more information on how to use the CLI.

3.0 Device Management

This section describes the steps for connecting a PC, logging in and setting unit parameters. The focus here is on the local serial console interface, but other methods of connection are available and offer similar capabilities. The key differences are with initial access and appearance of data.

TransNEXT offers several interfaces to allow device configuration and monitoring of status and performance. These include local serial console, USB, and Secure Shell (SSH) for local access via the WAN and LAN networks. The serial console, USB and SSH services offer a command line interface (CLI). There are three user accounts/roles for management access: admin, tech and oper.

NOTE The TransNEXT device is designed for high security environments. As such, management of the device does not support Telnet, but instead implements the more secure SSH protocol.

Configuring and managing the TransNEXT is done by changing configuration data via the Web User Interface (UI) or from the Command Line Interface (CLI). Either way requires two steps. The first step is to use a user interface to add, remove, or alter a piece of configuration data. The second step is to use the user interface to *save* the configuration change. Multiple changes can be made prior to committing them. This two-step process allows users to make multiple changes to the configuration and control when to apply.

3.1 Using the Web User Interface

The *Web User Interface* works with your PC's browser to provide an intuitive, web-style presentation of all unit information, settings, and diagnostics. Web management uses the unit's Ethernet RJ-45 connector

To connect to the unit and manage it via the Web, you will need the following:

- A PC with a web browser program installed.
- An Ethernet cable connected between the PC and the TransNEXT as shown in PC Connection for Web Management.
- The unit's IP address. Check with your Network Administrator, or determine the address via a command line interface connection. The default address for a factory supplied unit is 192.168.1.1.
- The user name and password for the unit. Check with your Network Administrator, or, if a username and password have not been set, login as **admin** using the default password unique to this unit. (For security, a new password should be established as soon as possible after login.)

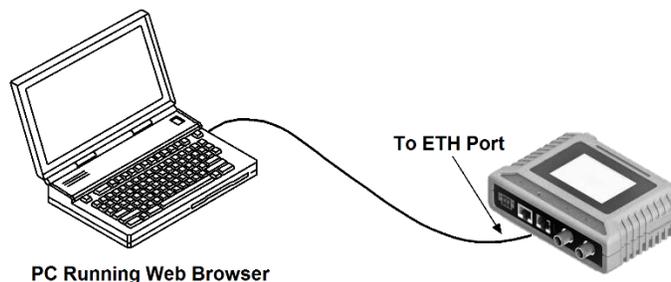


Figure 3-1. PC Connection for Web Management

Use of a current browser is highly recommended.

Logging On

3. Connect the unit to a PC via an Ethernet connection.
4. Configure your PC network settings to an IP address on the same subnet as the unit. The default subnet mask is 255.255.255.0.
5. Enter the unit's IP address in a web browser window, just as you would enter a website address. When the login screen appears (Figure 3-2. Login Screen), enter the User Name and Password for the unit. (The default entries for a new unit are Admin for username and a unique 10-character password printed on the unit.) Click the **Login** button.

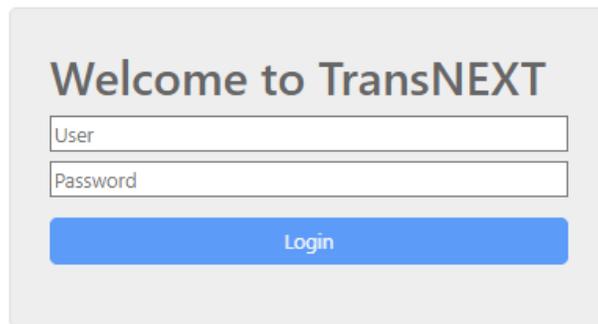


Figure 3-2. Login Screen

After successful login the initial web page is displayed. Every page includes a banner section at the top as shown in Figure 3-3 below:



Figure 3-3. Web UI / banner

The default page after login is the “Dashboard”. Other pages are available by clicking any of the selections to the right of the TransNEXT name.

Choices are:

- Dashboard
- Configuration
- Actions
- Logging

Clicking the “Logout” button on the far right terminates the current Web UI session and brings the device back to the Login Screen.

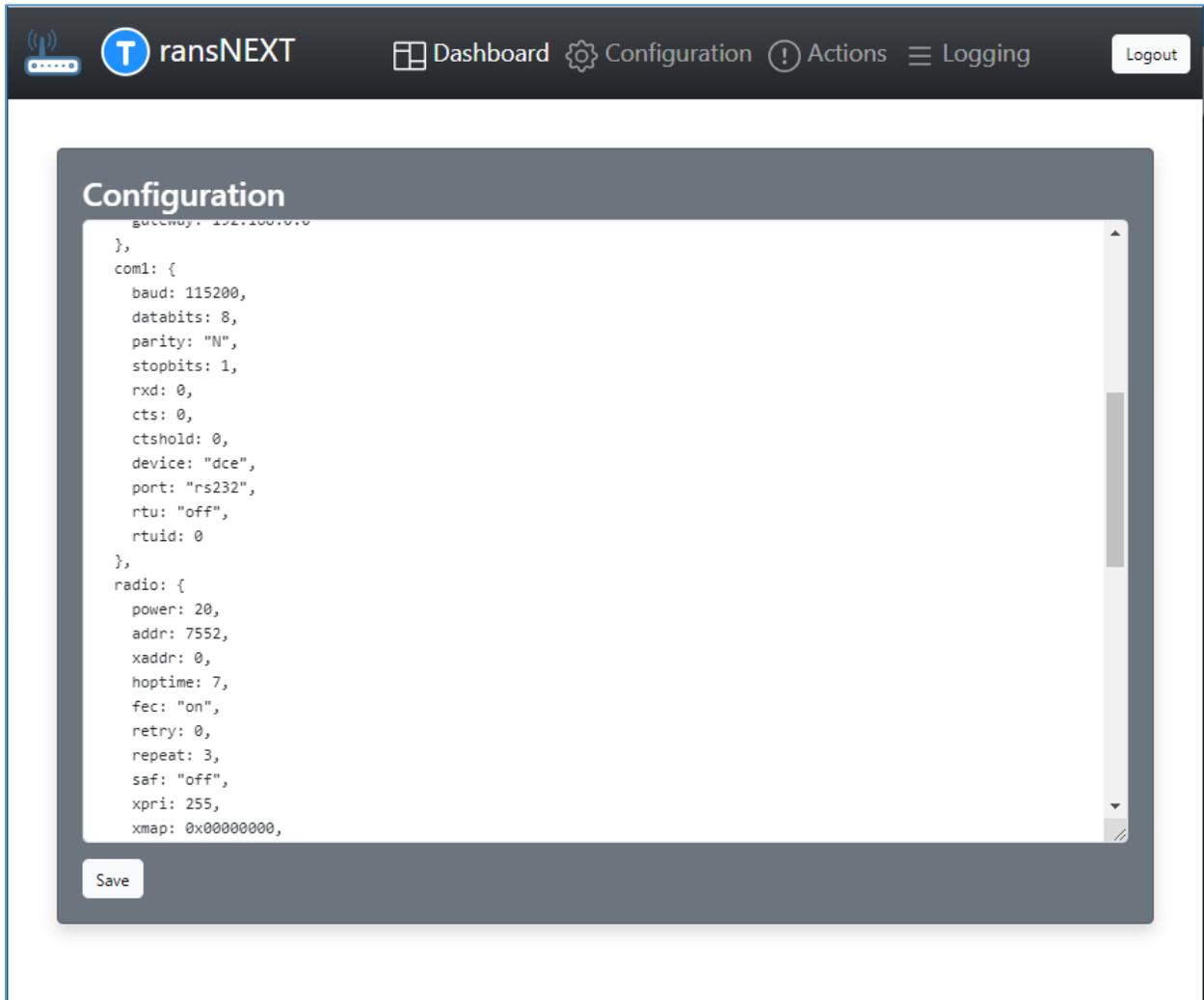
NOTE Using the browser's screen refresh button will behave like selecting “Logout”. Please avoid use of screen refresh unless a logout is intended.

Each of the main page selections is explained below.

Configuration

The “Configuration” page allows a Web UI user to change device configuration using the same parameter syntax visible in the CLI.

To effect a change, move the scrollbar on the right to the appropriate configuration group (com1, radio, etc.) Next, find the specific attribute in the group to modify. The attribute’s current value is shown immediately to the right of the colon. Click on the value after the colon to edit it. If multiple changes are desired, repeat the process above. To save the configuration and cause the new settings to go into effect, click the “Save” button on the bottom left.



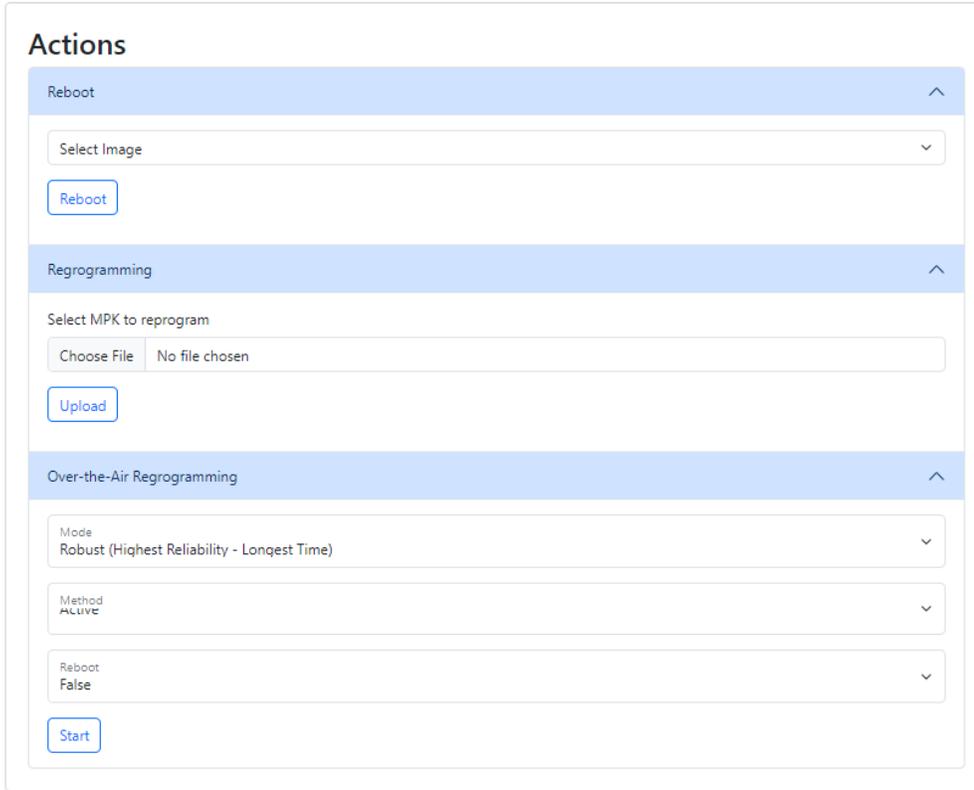
The screenshot shows the TransNEXT web interface. The top navigation bar includes the TransNEXT logo, a "Dashboard" button, a "Configuration" button (which is active), an "Actions" button with a warning icon, a "Logging" button with a menu icon, and a "Logout" button. The main content area is titled "Configuration" and displays a JSON configuration for a device. The configuration is as follows:

```
gateway: 192.168.0.10
},
com1: {
  baud: 115200,
  databits: 8,
  parity: "N",
  stopbits: 1,
  rxd: 0,
  cts: 0,
  ctshold: 0,
  device: "dce",
  port: "rs232",
  rtu: "off",
  rtuid: 0
},
radio: {
  power: 20,
  addr: 7552,
  xaddr: 0,
  hoptime: 7,
  fec: "on",
  retry: 0,
  repeat: 3,
  saf: "off",
  xpri: 255,
  xmap: 0x00000000,
```

A "Save" button is located at the bottom left of the configuration area.

Actions

The “Actions” page is used to control device reboot and reprogramming. Click the carrot symbol on the right to expand or collapse a section.



The screenshot shows the 'Actions' page with three main sections, each with a blue header and an expand/collapse arrow on the right:

- Reboot:** Contains a 'Select Image' dropdown menu and a 'Reboot' button.
- Reprogramming:** Contains a 'Select MPK to reprogram' section with a 'Choose File' button and 'No file chosen' text, and an 'Upload' button.
- Over-the-Air Reprogramming:** Contains three dropdown menus: 'Mode' (set to 'Robust (Highest Reliability - Longest Time)'), 'Method' (set to 'Active'), and 'Reboot' (set to 'False'). It also has a 'Start' button.

The Reboot section allows reboot to either the current image or the inactive image.

The Reprogramming section allows specification of an application MPK file. Selecting “upload” automatically loads the firmware to the current inactive image. This process protects against accidental corruption of the current image. After reprogramming is complete returning to the reboot section allows a reboot to the newly loaded image.

The Over-the-Air Reprogramming section allows the current firmware image running on a master radio to be broadcast over the air to the entire network of TransNEXT remotes. The operation relies on unacknowledged broadcast transmission with variable repeats. Choose the transmission mode setting based on the characteristics of the connected network. **Robust** mode may take several days to operate but it is the most reliable. Other choices include **Slow**, **Medium**, **Fast**, or **Turbo** (for lab testing only). Additional controls include Passive or Active transmission, to limit the affect on the polling operation. The Reboot control specifies whether remotes should automatically reboot to the new image once the reprogramming operation is complete.

NOTE Varying RF environmental conditions may prevent Over-the-Air Reprogramming from successfully updating all devices. The operation may be repeated as needed to attempt to pick up units missed during a prior session. If a remote unit has a particularly poor signal OTA reprogramming may be impractical and it may be necessary to reprogram the device locally.

Logging

The “Logging” page is used to display the non-volatile history of logged system events. Logs are displayed in reverse chronological order.

The log index is a relative indicator of time. The most recent log has index number “0” and is shown first. Each time you return to the Logging page the index is recalculated.

Index	Facility	Description	Parameter
0	Login	User logged in	admin
1	Firmware	Modem Reprog Complete	radio 1
2	Login	User logged in	admin
3	SET Alarms	No Sync	
4	Firmware	Modem Reprog Started	radio 1
5	Reset Source	SFT Reset	
6	Firmware	System Boot	radio 1
7	Login	User logged in	admin
8	Login	User logged out	admin
9	Login	User logged in	admin

Prev Next Clear

The “Prev” and “Next” buttons at the bottom of the page provide the ability to traverse the history of logged events. The “Clear” button clears the entire log history.

3.2 Using the Command Line Interface (CLI)

3.2.1 Differences between USB, Serial and SSH

USB, Serial and SSH each use different methods of access, but all require a login and will present an equivalent Command Line Interface after login is complete.

NOTE The login prompt will appear as “[0000000] Login: ” where 0000000 is the device serial number.

Any terminal emulator can be used, but Tera Term from the Open Source Development Network is recommended.

USB access requires connecting the USB port on a laptop or PC to the USB-C port on the radio. Recommended cable length is 2 meters or less. This is typically the simplest way to connect to the unit and is the recommended method for CLI operation.

Serial access uses an RS-232/RS-485 serial connection from a PC to the unit’s COM port. Maximum cable length for an IEEE-1613 compliant serial connection is 2 meters. The serial port defaults to operation as a payload data port, using a pre-configured baud rate (default is 115.2kbps). To temporarily enter into command line mode on the payload port it is necessary to type the escape sequence “+++”.

SSH access uses an Ethernet PC connection to the unit’s ETH port. SSH can be connected to the unit from any network point that has connectivity with the PC, including remotely over the Internet, or using other networks.

3.2.2 Establishing Communication— SSH

Follow these steps to configure the unit for SSH:

1. Connect to the unit with a PC that is in the same IP network as the TransNEXT. Launch an SSH client program (like PuTTY) and connect to the unit using its programmed IP address.

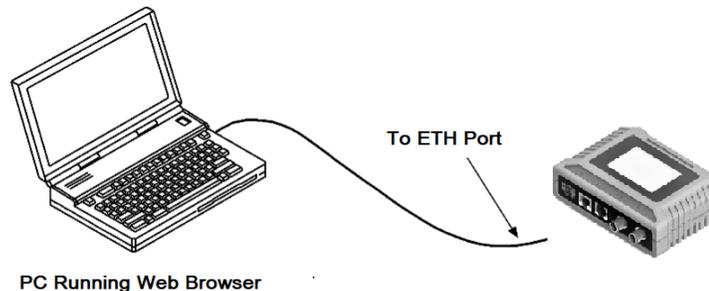


Figure 3-4. PC Connection for Programming/Management

2. The default IP address for the unit is 192.168.1.1. If you do not know the current IP address of the unit, follow the serial configuration instructions below, where you can determine the address and continue configuration, or check with your network administrator.
3. Login with the user name “**admin**” and default admin password for this unit.
4. The SSH connection will confirm with the message:
> You are connected to the TransNEXT SSH Server
>

3.2.3 Establishing Communication— USB

Follow these steps to configure the unit for USB:

1. Connect a PC to the unit's USB port as shown in Figure 3-6. Maximum recommended cable length is 6 ft/2 m.

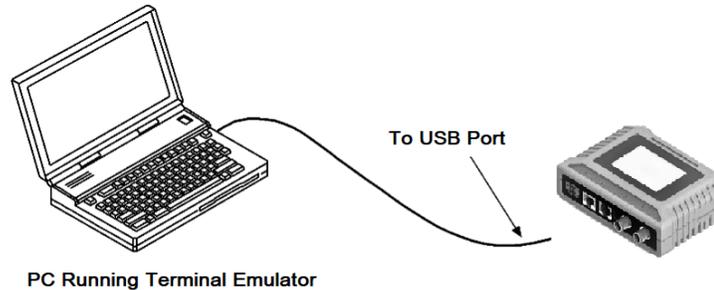


Figure 3-5. PC Connection for Programming/Management

2. The USB will instantiate a COM port to the PC
3. Launch a terminal communications program, such as Tera Term or PuTTY, with the COM port matching the USB port instantiated by the TransNEXT device.

NOTE If a message like the one below is displayed, that means that an SSH CLI session is already active. Pressing “D” will force the SSH connection to drop, freeing the USB port to continue with login

Remote SSH console session in progress.

Please press D to disconnect remote console user.

4. Login with the user name “admin” and default admin password for this unit.

3.2.4 Establishing Communication—Serial Interface

Follow these steps to configure the unit for its first use with serial console interface:

1. Connect a PC to the unit's COM port as shown in Figure 3-6. Maximum recommended cable length is 6 ft/2 m.
2. Launch a terminal communications program, such as Tera Term or PuTTY, with the following communication parameters: 115200 bps (default speed), 8 bits, no parity, one stop bit (8N1) and flow control disabled. Incorrect parameter settings are a frequent cause of connection difficulties. Double check to be sure they are correct.

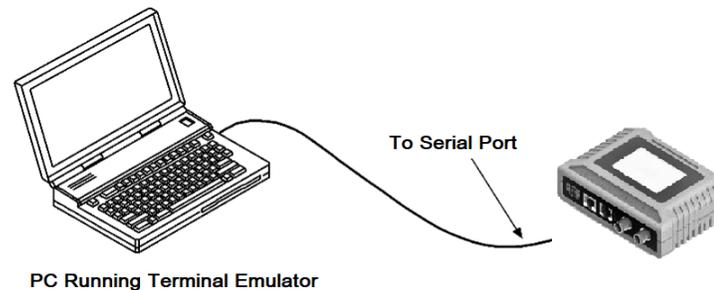


Figure 3-6. PC Connection for Programming/Management

6. Enter “+++” to cause the serial payload port to temporarily enter into command line mode.
7. At the Login: prompt, login with the user name “admin” and default admin password for this unit.

3.2.5 CLI Overview

NOTE For serial and USB operation, on timeout or logout, the TransNEXT will display an ASCII banner page followed by a new prompt for “Login:”

```

#####  #####  ###  ##  ##  #####  ##  ##  #####  ##  ##  #####
##  ##  ##  ##  ##  ###  ##  ##  ##  ##  ##  ##  ##  ##  ##  ##
##  ##  ##  ##  ##  ##  ###  ##  ##  ##  ##  ##  ##  ##  ##  ##
##  #####  ##  ##  ##  ##  ##  ##  ##  ##  ##  ##  ##  ##  ##
##  ##  ##  #####  ##  ##  ##  ##  ##  ##  ##  ##  ##  ##  ##
##  ##  ##  ##  ##  ##  ##  ##  ##  ##  ##  ##  ##  ##  ##  ##
#####  #####  ###  ##  ##  #####  ##  ##  #####  ##  ##  #####

[1234567] Login:
  
```

After successful login, the “>” command prompt appears where you may configure and manage unit settings. Help can be requested as follows:

```

>help
help <name> for help with a specific command
  
```

Available commands:

```

about          System information about this device
app            Show application image versions
app_ota       OTA App reprogramming
authcode      Enter device authorization code
bootloader    Show bootloader image versions
cfg           Configuration database
clear         Clear system logs or stats
clos         Enter DLINK mode
help         Help command
logout        Logout of active session
password      Change user password
ping         Ping a host
reboot       Reboot radio
serdump      Display serial payload history
setup        Disable hopping and enter radio setup mode
show         Show various system attributes
uptime       Radio uptime
  
```

Individual commands have their own help. Enter the command name followed by help as shown in the examples below:

```

>
>show help
show device      Show device information
show log <debug> Show event log, with optional debug points
show alarms     Show current system alarms
show status      Show radio status
show stats      Show radio and network statistics
show sync       Show radio synchronization status
show temp       Show system temperature
show vin        Show radio input voltage
show uptime     Show system uptime
show rssi       Show continuous radio RSSI
show rssi!      Show radio RSSI
  
```

```

>cfg help
cfg snapshot    Save a snapshot of the database
cfg restore     Restores saved database snapshot
cfg show        Show entire database
cfg load        Load database from flash
cfg save        Save database to flash
cfg replace     Replace database: prompts for multi-line value
cfg get <key>  Get value assigned to key
cfg set <key>.<value> Assign value to a key
  
```

```
cfg import          <Paste> in a configuration

>setup help
chan               Get/Set setup channel [0-127] f_MHz=902.2+(.2*chan)
key                Continuous TX key
burst              Burst TX key
dkey               Key down
rssi               Sample continuous RSSI
rssi!              Get last RSSI sample
quit               Exit radio setup mode

>app help
app <1|2>          Set active image
app update         Update app inactive image over Ymodem
app copy           Copy the active image to the inactive
>
```

When working with the CLI the up and down arrows can be used to navigate previously entered commands. For example, when testing for synchronization if the “show sync” command is issued, the command can be repeated by selecting up-arrow followed by carriage return.

3.3 Device Configuration

3.3.1 Overview

Non-volatile, user-configurable parameters are controlled with the “cfg” command.

```
>
>cfg help
cfg snapshot      Save a snapshot of the database
cfg restore       Restores saved database snapshot
cfg show          Show entire database
cfg load          Load database from flash
cfg save          Save database to flash
cfg replace       Replace database: prompts for multi-line value
cfg get <key>    Get value assigned to key
cfg set <key>.<value> Assign value to a key
cfg import        <Paste> in a configuration
```

Configuration items are organized into attribute groups, identified by a <key> as shown in the table below.

Table 3-1. Configuration Items (cfg)

Attribute Group <Key>	Items controlled
owner	Owner name and message
system	System operating characteristics
leds	<i>Reserved for future</i>
pushbtn	<i>Reserved for future</i>
display	Settings associated with E-ink display behavior <i>(only applicable for units equipped with an E-ink display)</i>
eth	IP address, netmask, and default gateway
com1	Settings associated with serial payload interface, including baud rate, RTS/CTS handshaking, and embedded RTU simulator controls.
radio	Settings associated with frequency hopping radio behavior
ippl	IP/Payload controls
dlink	Diagnostic Link controls (for use by an external NMS or configuration tool)
password	Settings associated with password complexity control.

To display all saved user configuration settings, enter **cfg show** as follows:

```
>cfg show
{
  owner: {
    message: "TransNEXT",
    name: ""
  },
  system: {
    mode: "TransNEXT",
    asense: "hi",
    amask: 0x00000000
  },
  leds: {
  },
  pushbtn: {
  },
  display: {
    enabled: "on",
    invert: "off",
    show_ip: "on"
  }
}
```

```
},
eth: {
  ipaddr: 192.168.1.1
  netmask: 255.255.255.0
  gateway: 192.168.0.0
},
com1: {
  baud: 115200,
  databits: 8,
  parity: "N",
  stopbits: 1,
  rxd: 0,
  cts: 0,
  ctshold: 0,
  device: "dce",
  port: "rs232",
  rtu: "off",
  rtuid: 0
},
radio: {
  power: 20,
  addr: 7552,
  xaddr: 0,
  hoptime: 7,
  fec: "on",
  retry: 0,
  repeat: 3,
  saf: "off",
  xpri: 255,
  xmap: 0x00000000,
  skip: [8,1,0,0,0,0,0,0],
  unit_addr: 4567,
  mode: "R"
},
ipp1: {
  enabled: "off",
  mode: "udp",
  talk_on_vrc: 1,
  listen_to_vrc: 1,
  local_ip_port: 30011,
  ip_peer_addr: 192.168.1.1
  ip_peer_port: 30011,
  connection_timeout: 0,
  keepAlive: "off"
},
dlink: {
  enabled: "on",
  type: "node",
  tcp_access: "off",
  connection_timeout: 0,
  tcp_port: 30020,
  trend_resp_win: 120
},
password: {
  min_chars: 1,
  max_chars: 64,
  min_lower_case: 1,
  min_capital_letters: 0,
  min_numbers: 0,
  min_non_alpha_numeric: 0,
  permit_username: "on"
}
}
```

To display configuration settings for a single Attribute Group, enter a command like the following:

```
>cfg get owner
{
  message: "TransNEXT",
  name: ""
}
```

To display a single attribute from a group, use dot notation as follows:

```
>cfg get owner.message
"TransNEXT"
```

NOTE The **cfg show** command displays only the last saved configuration. The **cfg get** command shows the scratchpad version of attributes that include changes that are not yet saved.

To change a parameter, use the **cfg set** command. An example is shown here:

```
>cfg set radio.addr 1234
Setting radio.addr to 1234
```

When using **cfg set** commands you are only creating a planned change. The change will be saved and activate only after **cfg save** is issued.

```
>cfg save
OK
```

NOTE Failure to issue a “**cfg save**” will cause prior unsaved “**cfg set**” values to be lost or ignored.

When using **cfg set** it is important to use the same parameter syntax shown by **cfg get** and **cfg show**. For example, in the case above, **radio.addr** is specified as a decimal number. Other radio attribute group settings behave differently. For example, **radio.mode** is set by entering a quoted “m”, “x”, or “r” (for master, extension, or remote, respectively). Failure to enter the quotes will cause the command to fail with a syntax error.

```
>cfg set radio.mode m
Syntax error

>cfg set radio.mode "m"
Setting radio.mode to "m"
```

Settings are explained in greater detail in the sections that follow.

3.3.2 Radio settings

The Radio attribute group contains settings that control TransNEXT radio operation. Items under the radio group typically use names similar to that of commands found in the GE MDS TransNET radio.

```
>cfg get radio
{
  power: 30,
  addr: 7552,
  xaddr: 0,
  hoptime: 7,
  fec: "on",
  retry: 0,
  repeat: 3,
  saf: "off",
  xpri: 255,
  xmap: 0x00000000,
  skip: [8,1,0,0,0,0,0,0],
  unit_addr: 4567,
  mode: "m"
}
```

3.3.2.1 *radio.power* [10-30]

Power can range from 10 to 30 dBm. Default is 30dbm which is equal to 1 watt. In the USA total Effective Isotropic Radiated Power must be <= 36dbm. This means that power must be turned down for systems with antenna gain greater than 6db.

NOTE Some countries may employ lower EIRP limits. Check the regulatory rules and turn down power as needed to ensure compliance.

3.3.2.2 *radio.addr* [1-65000]

This is the radio's Network Address. Valid network addresses range from 1 to 65000.

A Network Address must be programmed at the time of installation and must be common across each radio in a given network. Radios are typically shipped with network address set to 0. This is a special reserved value indicating address is not set. If the address is not set the system will be in an invalid state, preventing operation and generating an alarm.

NOTE We recommend that the last four digits of the Master radio's serial number be used for the network address. This helps avoid conflicts with other users.

3.3.2.3 *radio.xaddr* [0-31]

This is the radio's Extended Address. The item is only applicable for a Master or Extension radio. Valid extended addresses range from 0 to 31. Default is 0.

Extended Address serves as a common address for the sub-network synchronized to this Master or Extension. This value can be listed in the *radio.xpri* parameter of associated Extension or Remote radios to allow them to synchronize to this radio. Setting the Master to zero (0) is recommended. It is easy to remember, and works well with other radio default settings.

3.3.2.4 *radio.hoptime* [7 or 28]

This controls radio hop timing. The item is a value corresponding to the hop-time setting in milliseconds. 7 and 28 are the only choices. Default *radio.hoptime* is 7. A setting of 28 must be used when throughput exceeds 57,600 bps and is recommended when data transmission sizes exceed 256 bytes.

Changes to the *radio.hoptime* may only be made at the Master radio. (This is because the Master radio establishes the hop-time setting for the entire network.) At Remote radios, the hop-time setting may be read when the radio is in synchronization with the Master, but it cannot be changed.

3.3.2.5 *radio.fec* ["on" or "off"]

This item controls Forward Error Correction. The default setting is "on". (It needs to be turned off when throughput exceeds 57,600 bps.). The *radio.fec* value is set at the Master and is automatically passed on to all Remotes in a network.

3.3.2.6 *radio.retry* [0-10]

This item affects upstream data. The value represents the maximum number of times (0 to 10) that a Remote radio will re-transmit data. The default setting is 10.

This item is associated with ARQ (Automatic Repeat Request) operation of the radio and is intended for use in areas with heavy radio interference. A value of 0 represents no retries, while values of 1 or greater successively improve the chance of data delivery in spectrally harsh environments (at the expense of possibly increased latency). The *radio.retry* value is only settable at the Master. It is readable by a synchronized Remote.

3.3.2.7 *radio.repeat* [0-10]

This item affects downstream data. The setting causes a Master or Extension to unconditionally repeat transmissions for the specified number of times. Unlike the *radio.retry* behavior, there is no acknowledgment that a message has been received.

The value represents the maximum number of times (0 to 10) that a Master or Extension radio will re-transmit data. The default setting is 3.

3.3.2.8 *radio.saf* ["on" or "off"]

This item controls the operational state of Store-and-Forward (SAF) mode. The default setting is "off".

Store-and-Forward (SAF) offers a way to physically extend network range. Extension radios (designated as *radio.mode* "x") serve as single-radio repeaters that link adjacent sub-networks, and move data from one sub-network to the next one.

The *radio.saf* setting affects all radios in the associated network. When SAF is on, overall system throughput is halved but does not reduce further regardless of store-and-forward depth.

When SAF is off, units programmed as *radio.mode* "x" behave as standard remotes.

The *radio.saf* value is set at the Master and is automatically passed on to all Remotes in a network.

3.3.2.9 *radio.xpri* [0-31 or 255]

The *radio.xpri* value is only meaningful for a Remote or Extension radio.

This item establishes a Primary Extended Address, specifying the primary radio with which this radio will attempt to synchronize and communicate. Whenever the current radio attempts to establish sync, it will limit its choice to the *radio.xpri* value for the first 30 seconds before allowing synchronization to other units in the *radio.xmap* list.

NOTE After the first 30 seconds the *radio.xpri* value is still always an implicitly allowed synchronization source even if it is not called out in the *radio.xmap* list.

The default value for *radio.xpri* is 0 (matching the default *xaddr*). A setting of 255 represents "none" and allows the unit to synchronize with any Master or Extension in the *radio.xmap* list.

3.3.2.10 *radio.xmap* [0x00000000-0xFFFFFFFF]

The *radio.xmap* value is only meaningful for a Remote or Extension radio.

radio.xmap is a 32-bit hexadecimal entry where the least significant bit represents *xaddr* 0 and the most significant bit represents *xaddr* 31. The full 32-bit hex value represents the set of all 32 possible extension addresses with which the radio could be allowed to communicate. A set bit means that synchronization to that *xaddr* is allowed; a clear bit means not allowed.

This value defaults to 0x00000000 which means that the only allowed synchronization source is the one specified by *radio.xpri*.

3.3.2.11 *radio.skip* [<8-element-array>]

This attribute indicates which combination of 8 possible frequencies zones should be removed from the radio's hop sequence. Default is [0,0,0,0,0,0,0,0] meaning no zones are skipped.

Skipping zones is one way of dealing with constant interference on one or more frequencies in the radio's operating band. See A Word About Radio Interference on Page 50 for more information on dealing with interference. Consult "APPENDIX B – Operating Frequencies" to see the frequency range covered by each zone.

The `radio.skip` value is entered as an 8-element, comma-separated array, delimited by square braces. Each array element may specify a zone (1 through 8) to skip. Unused array elements should be filled with "0" such that there are always 8 items. Items in the list may be specified in any order.

The `radio.skip` value is set at the Master and is automatically passed on to all Remotes in a network.

3.3.2.12 *radio.unit_addr [1-65000]*

Unit address is used for network-wide diagnostics (used by PulseNET and Field Network Manager). Valid network addresses range from 1 to 65000. Default value is the last four digits of the radio's serial number. Values < 10000 must match the 4-digit default. Values >= 10000 can be arbitrary.

NOTE Keeping unit address set to the last 4 digits of serial number is recommended and should only be changed if a conflict is detected. This method helps minimize conflicts between radios.

3.3.2.13 *radio.mode ["m" or "r" or "x"]*

The `radio.mode` attribute sets the operating mode of the radio. A Master radio is set with `radio.mode = "m"`; a Remote set by `radio.mode = "r"` and an Extension is set by `radio.mode = "x"`.

All units default to Remotes; other modes must be specifically programmed with **cfg set radio.mode**.

If mode "x" is used, the mode "x" radio should be programmed with an Extended Address (XADDR). Units that need to hear this mode "x" radio must be programmed with an appropriate `radio.xpri` and/or `radio.xmap` value.

NOTE A mode "x" radio will behave like a mode "r" radio unless `radio.saf` is set to "on"

3.3.3 Owner settings

The Owner attribute group contains system identification info.

```
>cfg get owner
{
  message: "TransNEXT",
  name: ""
}
```

3.3.3.1 *owner.message [<63 character string>]*

Owner message is a 63-character string. For units equipped with a display this will appear as the text on status screen. Strings of 20 characters or less display best. Default is blank.

3.3.3.2 *owner.name [<63 character string>]*

Owner name is a 63-character string. Default is blank.

3.3.4 System settings

The System attribute group contains miscellaneous settings. Note that `system.mode` is not settable. `system.asense` and `system.amask` control alarm output functionality.

```
>cfg get system
```



```
{
  mode: "TransNEXT",
  asense: "hi",
  amask: 0x00000000
}
```

3.3.4.1 *system.asense* ["hi" or "low"]

This attribute is used to set the sense of the alarm output at Pin 1 of the RJ-45 COM1 connector. The default is active "hi" which means an unmasked alarm is present when the signal on pin 1 is asserted.

3.3.4.2 *system.amask* [0x00000000-0xFFFFFFFF]

This attribute controls the alarm mask associated with alarm output on Pin 1 of the RJ-45 COM1 connector. The value sets the alarm bits that cause the alarm output signal to be triggered. The PWR LED will still flash, and events will be logged for all alarms, but the alarm output signal will only be activated for those alarms that have the corresponding mask bit set. The hex value for the mask aligns with numbered value displayed by the "show alarms" command. The default is 0xFFFFFFFF. Adjusting *system.amask* allows the user to tailor the alarm response of the device.

3.3.5 Display settings

The Display attribute group contains settings associated with the optional E-ink display. Changing these items has no affect on a unit that is not equipped with a display.

```
>cfg get display
{
  enabled: "on",
  invert: "off",
  show_ip: "on"
}
```

3.3.5.1 *display.enabled* ["on" or "off"]

This attribute controls whether or not the display is on. Default is "on".

3.3.5.2 *display.invert* ["on" or "off"]

This attribute controls the background/foreground emphasis. When this is set to "off" the display will have a mostly a white background. Default is "off".

3.3.5.3 *display.show_ip* ["on" or "off"]

This attribute allows suppression of the device IP address on the display. The facility is included to help facilitate any physical device security concerns associated with displaying the IP address. Default is "on". When set to "off" the display will show literal xx.xx.xx.xx instead of the programmed IP.

3.3.6 Eth settings

The Eth attribute group contains settings associated with Ethernet. All items in this group use IPv4 dot-decimal format such as xxx.xxx.xxx.xxx.

```
>cfg get eth
{
  ipaddr: 192.168.1.1
  netmask: 255.255.255.0
  gateway: 192.168.1.254
}
```

3.3.6.1 *eth.ipaddr* [xxx.xxx.xxx.xxx]

This is the IP address for the radio. The radio requires a local IP address to support ssh and IP/Payload (terminal server) services. Default is “192.168.1.1”.

3.3.6.2 *eth.netmask* [xxx.xxx.xxx.xxx]

This attribute refers to the radio’s IPv4 local subnet mask. Default is “255.255.255.0”. This parameter is used when the radio attempts to send a locally initiated message.

3.3.6.3 *eth.gateway* [xxx.xxx.xxx.xxx]

This is the IPv4 address of the default gateway device, typically a router connected to the radio. Default is “192.168.1.254”.

3.3.7 COM1 settings

The COM1 attribute group contains settings associated with serial payload data including settings for baud, handshaking, RS232/RS485 mode, and embedded RTU simulator control

```
>cfg get com1
{
  baud: 115200,
  databits: 8,
  parity: "N",
  stopbits: 1,
  rxd: 0,
  cts: 0,
  ctshold: 0,
  device: "dce",
  port: "rs232",
  rtu: "off",
  rtuid: 0
}
```

3.3.7.1 *com1.baud* [<baud list choice>]

This is the serial port baud rate in bits per second. Valid baud settings are 300, 600, 1200, 1800, 2400, 3200, 4800, 9600, 19200, 38400, 57600, and 115200. Default is 115200bps.

3.3.7.2 *com1.databits* [8]

This is the number of databits. Currently 8 is the only valid choice.

3.3.7.3 *com1.parity* ["N", "O", or "E"]

This is the parity setting. N = None; O = Odd; E = Even. Default is “N” – none.

3.3.7.4 *com1.stopbits* [1 or 2]

This is the number of stopbits. Default is 1 stop bit.

3.3.7.5 *com1.rxd [0-255]*

This is the receive data delay in milliseconds. Default is 0.

This attribute sets a delay, in milliseconds to pause after data would normally be delivered to the port. The typical intent is to remove character gaps in data delivery. When set to a value sufficient to cover `radio.hoptime` and retransmissions this will emulate a seamless data delivery mode. This is useful for protocols such as Modbus. Use a delay of twice the value of the `radio.hoptime` period; if retries are used multiply that value by the typical retry count; if `radio.saf` is “on”, multiply by 2 again.

3.3.7.6 *com1.cts [0-255]*

This attribute sets a delay associated with CTS (clear-to-send) line response. Valid values are 0 to 255 milliseconds. Default is 0.

For DCE operation, the attribute specifies how long to wait after the RTS line goes high before asserting the CTS line. A timer value of zero means that the CTS line will be asserted immediately following the assertion of RTS.

For CTS Key operation (see the `com1.device` setting), the timer specifies how long to wait after asserting the CTS line before sending data out the COM port. A timer value of zero means that data will be sent out the com port without imposing a key-up delay. (Other delays may be in effect from other radio operating parameters.)

3.3.7.7 *com1.ctshold [0-65535]*

This attribute sets a delay associated with CTS (clear-to-send) hold time. Valid values are 0 to 65535 milliseconds. Default is 0.

Used when `com1.device` is “cts key”, this command sets the amount of time in milliseconds that CTS remains present following transmission of the last character out the RXD pin of the com port. This “hold time” can be used to prevent squelch tail data corruption when communicating with other radios.

The CTSHOLD setting can range from 0 to 65535 (i.e., over 65 seconds). The default value is 0, which means that CTS will drop immediately after the last character is transmitted.

3.3.7.8 *com1.device [“dce” or “cts key”]*

This attribute sets the device behavior of the com port. The default is “dce”.

In DCE mode, CTS will go high following RTS, subject to the `com1.cts` delay value. Keying is stimulated by the input of characters at the data port. Hardware flow control is implemented by dropping the CTS line if data arrives faster than it can be transmitted.

In CTS KEY mode, the radio is assumed to be controlling another radio, such as in a repeater or tail-end link system. The RTS line is ignored and the CTS line is used as a keyline control for the other radio. CTS is asserted immediately after the receipt of RF data, but data will not be sent out the DATA port until after the `com1.cts` delay time has expired. (This gives the other radio time to key.) Following transmission of the last byte of data, CTS will remain asserted for the duration specified by `com1.ctshold`. The `com1.ctshold` value should be set sufficiently high.

3.3.7.9 *com1.port [“rs232” or “rs485”]*

This attribute sets the electrical signaling behavior of the serial port. Default is “rs232”.

Pin descriptions for RS-232 are given in Table 2-2. COM Port Pin Details (RS-232).

Pin descriptions for RS-485 are given in Table 2-3. COM1 Port Pin Details (RS-485).

3.3.7.10 *com1.rtu* ["on" or "off"]

This attribute enables the embedded RTU simulator poll detection and response. Default is “off”.

When set to “on” this enables devices in a network to be polled using standard GE MDS polling utilities.

3.3.7.11 *com1.rtuid* [0-80]

This attribute assigns an address/ID to the local radios embedded RTU simulator. Default is “0”.

3.3.8 Ippl settings

The Ippl attribute group contains settings associated with IP/Payload. IP/Payload as originally introduced in the GE MDS SD licensed radio series. IP/Payload acts like a terminal server with the serial port side routed as over-the-air streaming traffic.

NOTE VRC fields for this attribute group are reserved for future application and not currently used.

```
>cfg get ippl
{
  enabled: "off",
  mode: "udp",
  talk_on_vrc: 1,
  listen_to_vrc: 1,
  local_ip_port: 30011,
  ip_peer_addr: 192.168.1.1
  ip_peer_port: 30011,
  connection_timeout: 0,
  keepAlive: "off"
}
```

3.3.8.1 *ippl.enabled* ["on" or "off"]

This attribute enables IP/Payload. Default is “off”.

3.3.8.2 *ippl.mode* ["udp", "tcp-client", or "tcp-server"]

This attribute enables the operational mode “udp” or “tcp” and for tcp indicates if the radio should act as a server or client.

3.3.8.3 *ippl.local_ip_port* [0-65000]

This attribute specifies the local_ip_port for TCP server use it. It is not used when ippl.mode is not equal to “tcp_server”. The corresponding IP address is the value from eth.ipaddr. The default port is 0.

3.3.8.4 *ippl.ip_peer_addr* [xxx.xxx.xxx.xxx]

This attribute specifies the IP peer address for UDP and TCP client use. It is not applicable for TCP server. The value is specific in IPv4 dot decimal format. The default is 192.168.1.1.

3.3.8.5 *ippl.ip_peer_port* [0-65000]

This attribute specifies the IP peer port for UDP and TCP client use. It is not applicable for TCP server. The default port is 30011.

3.3.8.6 *ippl.connection_timeout* [0-65535]

This attribute specifies the connection timeout in milliseconds for all modes. The timeout is the maximum time the connection can remain idle before dropping the connection. 0 is reserved as a special value to mean do not apply a connection timeout. Default is 0.

3.3.8.7 *ippl.keepAlive* ["on" or "off"]

This attribute enables connection keep alive. Default is "off".

3.3.9 Dlink settings

The Dlink attribute group contains settings associated with DLINK diagnostic. DLINK is used for Network Management (PulseNET, Field Network Manager, and similar tools). In TransNEXT DLINK operation is expected to occur via TCP on the Ethernet port.

```
>cfg get dlink
{
  enabled: "on",
  type: "node",
  tcp_access: "off",
  connection_timeout: 0,
  tcp_port: 30020,
  trend_resp_win: 120
}
```

NOTE Dlink.trend_resp_win is reserved for future use.

3.3.9.1 *dlink.enabled* ["on" or "off"]

This attribute enables dlink network-wide diagnostics transactions. Default is "off".

NOTE To address security concerns, TransNEXT normally ships with DLINK disabled. It is important to set dlink.enabled to "on" for each unit, prior to deployment if this operation is desired.

3.3.9.2 *dlink.type* [<dlink type choice>]

This attribute specifies the radio's operational characteristics for network-wide diagnostics. Valid dlink type choices include "node", "root", "repeater", "peer", and "gate". Default is "node"

NOTE Selections "repeater", "peer", and "gate" are reserved for special use.

NODE is the most common setting, and the default. This is the basic system radio device-type. Typically, the radio network is comprised of nodes and one root. Non-intrusive diagnostics can only be conducted from the root node.

ROOT is limited to one, and only one, per network (including units associated through Extension units.) The root is the focal point of network-wide diagnostics information. The root is the only radio through which non-intrusive diagnostics can be conducted. This value should be set on Master (radio.mode "m").

3.3.9.3 *dlink.tcp_access* ["on" or "off"]

This attribute enables dlink network-wide diagnostics transactions. Default is "off".

3.3.9.4 *dlink.connection_timeout* [0-65535]

This attribute specifies the connection timeout in milliseconds for TCP dlink operation. The timeout is the maximum time the connection can remain idle before dropping the connection. 0 is reserved as a special value to mean do not apply a connection timeout. Default is 0.

3.3.9.5 *dlink.tcp_port* [0-65000]

This attribute specifies the TCP port for the Dlink TCP server to use. It is not used when *dlink.tcp_access* is “off”. The default is 30020.

3.3.10 Password settings

The Password attribute group contains settings associated with password management. By default, TransNEXT units ship with a unique 10-character password per device. The password policy allows customer control of what password choices are acceptable.

```
>cfg get password
{
  min_chars: 1,
  max_chars: 64,
  min_lower_case: 1,
  min_capital_letters: 0,
  min_numbers: 0,
  min_non_alpha_numeric: 0,
  permit_username: "on"
}
```

NOTE For best security practice GE MDS recommends changing the password prior to deployment.

Passwords are changed with the **password** command.

```
>password help
password <user>          change password for specified user
  <user> [admin, tech, oper]
```

3.3.10.1 *password.min_chars* [0-255]

This item specifies the minimum number of characters for a new password. Default is 10.

3.3.10.2 *password.max_chars* [0-255]

This item specifies the maximum number of characters for a new password. Default is 64.

3.3.10.3 *password.min_lower_case* [0-255]

This item specifies the minimum number of lower-case characters for a new password. Default is 1.

3.3.10.4 *password.min_capital_letters* [0-255]

This item specifies the minimum number of capital letters for a new password. Default is 1.

3.3.10.5 *password.min_numbers* [0-255]

This item specifies the minimum number of numbers (0-9) for a new password. Default is 1.

3.3.10.6 *password.min_non_alpha_numeric [0-255]*

This item specifies the minimum number of special characters for a new password. Default is 0.

3.3.10.7 *password.permit_username ["on" or "off"]*

This attribute specifies whether any of the reserved user roll names can be used as the password. Default is "off".

3.4 System Health and Status

3.4.1 Show command

The CLI show commands provides a quick means to obtain various types of device status. Options include the following:

<code>show device</code>	Show device information
<code>show log</code>	Show event log
<code>show alarms</code>	Show current system alarms
<code>show status</code>	Show radio status
<code>show stats</code>	Show radio and network statistics
<code>show sync</code>	Show radio synchronization status
<code>show temp</code>	Show system temperature
<code>show vin</code>	Show radio input voltage
<code>show uptime</code>	Show system uptime
<code>show rssi</code>	Show continuous radio RSSI
<code>show rssi!</code>	Show radio RSSI
<code>show eth</code>	Show ethernet status

3.4.2 Event Logging

Key system status change conditions are stored as logged events in non-volatile memory. Examples of logged events include alarm changes, configuration changes, software updates, reboots, logins, etc.

NOTE Logs currently can only be retrieved or cleared via the CLI interface.

To display logs issue the show logs command as follows:

```
>show log
Event Log:
0. Configuration: Configuration Change - radio
1. Login: User logged in - admin
2. Login: User logged out - admin
3. Login: User logged in - admin
4. Login: User logged out - admin
5. Login: User logged in - admin
6. Login: User logged out - admin
7. !SET - Alarms: VSWR
8. !CLR - Alarms: No Sync
9. Configuration: Configuration Saved - Local Console
10. Configuration: Configuration Change - radio
11. Configuration: Configuration Change - radio
12. Login: User logged in - admin
```

```
13. Login: User logged out - admin
14. Firmware: Modem Reprog Complete - radio 1
15. Login: User logged in - admin
16. !SET - Alarms: No Sync
17. Firmware: Modem Reprog Started - radio 1
18. Reset Source: SFT Reset -
19. Firmware: System Boot - radio 2
-- Press a key to continue (Q to quit) -
```

The logs are retrieved in reverse chronological order. The most recent item will always be 0. Older items have a higher number and indicate a older events. The command will show 20 logged items and then pause asking for a key to continue or “Q” to quit.

To clear the log history issue the “clear logs” command as shown below. Answer “y” to the “clear entire log” prompt:

```
>clear log
Clear entire log? (y/n)

Clearing log...Done.
```

3.4.3 Snapshots and System Recovery

TransNEXT provides a means to take a “snapshot” copy of the current configuration database image (see **cfg show**) for later restoration. This can be handy to roll back the unit’s settings to a previous known good configuration. Note that restoring the unit to the snapshot will overwrite the current configuration, and that it cannot be undone.

To save a snapshot:

```
>cfg snapshot
OK
```

To restore a previous snapshot as the current configuration:

```
>cfg restore
OK
```

3.5 Firmware Reprogramming

NOTE Information on reprogramming in this section is limited to reprogramming of device/radio *application* firmware. Bootloader firmware updates are not considered.

TransNEXT provides for two saved firmware images. The purpose is to ensure that there is always one good image to run. One image is reserved as the active image, and the other is the inactive image. Firmware reprogramming always applies to the *inactive* image. With this method if there is a problem, the active image is preserved.

GE MDS provides signed TransNEXT firmware as proprietary .MPK files posted on our website. The CLI and Web Interface both offer facilities for local reprogramming of the saved firmware images. MPK files can be loaded directly by the Web UI. For Web reprogramming see page 32. The sections below focus on reprogramming using the CLI.

3.5.1 Local Device Reprogramming

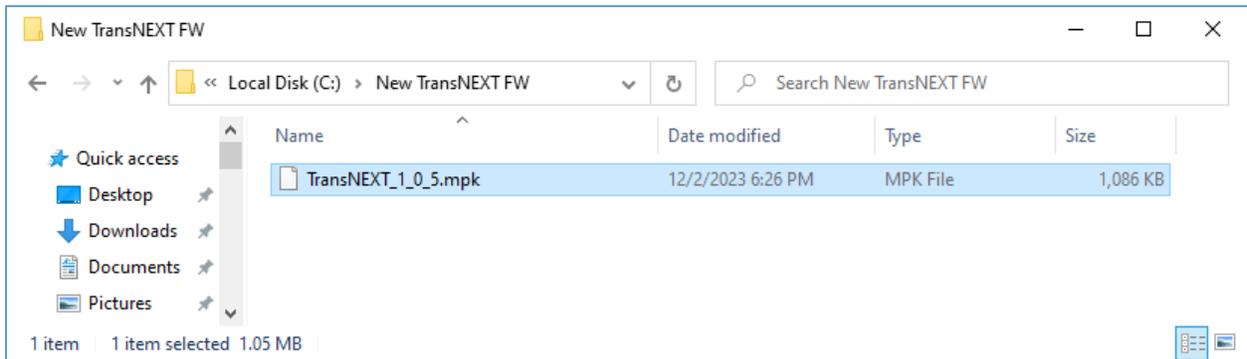
For the CLI a terminal emulator supporting YMODEM is required. Tera Term is as simple free terminal emulator that supports YMODEM. Tera Term is convenient because it will reestablish a USB/Serial connection following TransNEXT device reboot. Other terminal emulators may be used, but examples in the section are based on Tera Term.

Prior to upgrading firmware, it is good practice to confirm what firmware is currently loaded and active.

To check the current firmware, issue the **app** command as shown.

```
>app
Image 1 Version: 1.0.3 (active)
Image 2 Version: 1.0.3
```

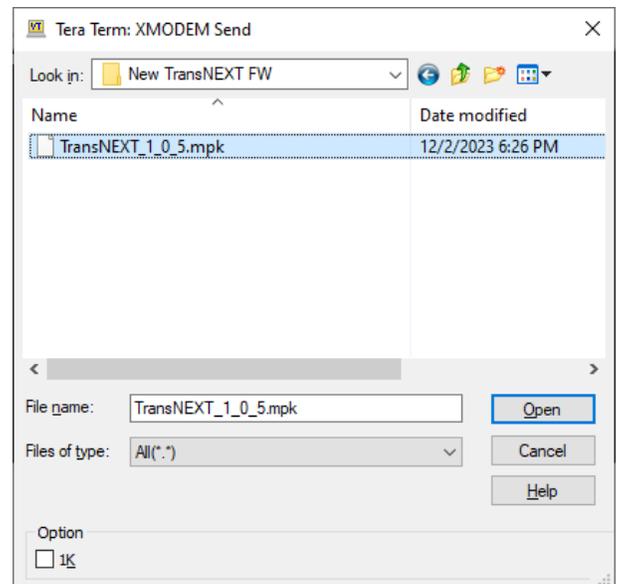
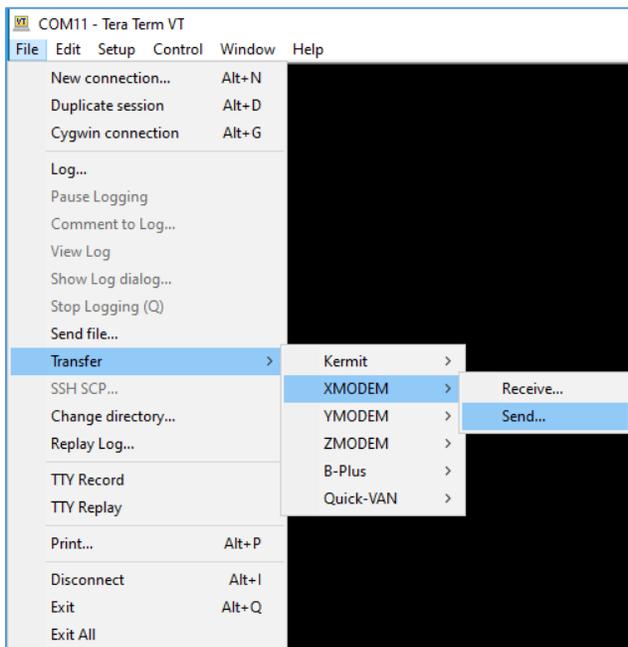
In this example we see that both the active and inactive image are 1.0.3. Next identify and locate which firmware you want to load.



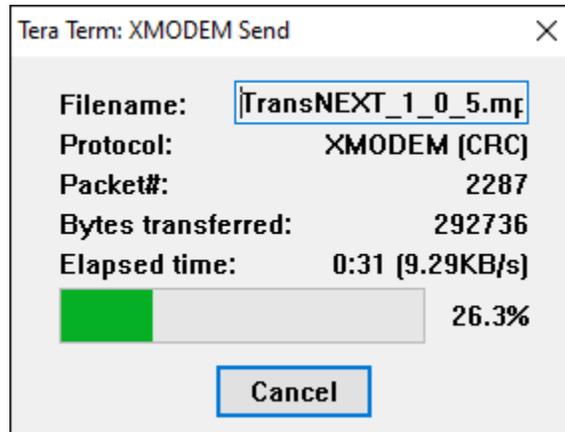
To update to FW 1.0.5 issue the **app update** command. The TransNEXT will prompt you to initiate a YMODEM transfer:

```
>app update
Start YMODEM transfer, send file now...
Hit Ctrl-X twice to cancel
C
```

Select the XMODEM transfer like the example here:



Progress is shown as follows:



At completion the display will show:

```
Transfer complete: 1111168 bytes
Validating MPK.....
Updating image...
|
OK
>
```

Now use the **app** command to verify that the new 1.0.5 firmware is now loaded as the inactive image.

```
>app
Image 1 Version: 1.0.3 (active)
Image 2 Version: 1.0.5
```

Finally use the **app 2** command to make image 2 the new active image.

```
>app 2
Confirm switch to Image 2? (y/n)
-
Reboot to APP image: 2 .....
```

NOTE The process of the **app 2** command above will take a few minutes to complete.

At the completion of this stage the TransNEXT will automatically switch to the new image and reboot. After reboot the UI connection will need to be reestablished. If using Tera Term, the TransNEXT device will have a small delay and finally return to the banner and login prompt.

Upon logging in the device may still be finishing programming on an internal radio processor. During this time the **app** command will show “unavailable”.

```
>app
Access Denied:
Modem FW Update in Progress
Command failed!
>
```

After a few minutes the internal operation is complete, and the **app** command will show the new active version.

```
>app
Image 1 Version: 1.0.3
Image 2 Version: 1.0.5 (active)
```

3.5.2 Over-the-Air Reprogramming

Over-the-Air Reprogramming section allows the current firmware image running on a master radio to be broadcast over the air to the entire network of TransNEXT remotes. The operation relies on unacknowledged broadcast transmission with variable repeats.

NOTE Varying RF environmental conditions may prevent Over-the-Air Reprogramming from successfully updating all devices. The operation may be repeated as needed to attempt to pick up units missed during a prior session. If a remote unit has a particularly poor signal OTA reprogramming may be impractical and it may be necessary to reprogram the device locally.

From the CLI the command is `app_ota`. Help is as follows:

```
>help app_ota
method <active|passive>  OTA App transfer mode
reboot <true|false>      OTA App reboot after update
start <speed>            Start OTA App reprogramming
                        <speed> [robust, slow, medium, fast, turbo]
stop                     Stop OTA reprogramming
```

The command can be used at the master or remote to query current status of over-the-air transfer.

```
>app_ota
Status: Inactive
```

The command can be used query default settings as follows:

```
>app_ota method
Passive

>app_ota reboot
True
```

Setting the method and reboot parameters are done as separate lines prior to kicking off a transfer.

Method indicates if the TransNEXT will send intrusively or non-intrusively. The **method** argument is “active” or “passive”. **Passive** is non-intrusive while **Active** may cause some interference with payload data polling.

```
>app_ota method passive
>OK
```

Reboot indicates if the remote TransNEXT units will automatically reboot at the end of a transmission sequence when the new firmware image has been properly received. The **reboot** argument is “true” or “false”.

```
>app_ota reboot true
>OK
```

Prior to initiating the Broadcast OTA session, determine the transmission mode setting based on the characteristics of the connected network.

For weak signal networks “robust” is recommended and provides the best chance of hitting all units, but it may take a week or more for the system to update. For smaller networks with excellent signal strength other options may work well and complete much faster.

Table 3-2. OTA broadcast speed controls:

Speed setting	Transmission Sequence Repeat Count	Inter-Message Delay
robust	20	5 ms
slow	10	50 ms
medium	5	100 ms
fast	2	150 ms
turbo	2	200 ms

The line below initiates the broadcast FW OTA operation from the master at the desired speed using previously set values for “method” and “reboot”. The parameter following start is the speed argument shown in the table below:

```
>app_ota start robust  
OK
```

Querying status at the Master will then show:

```
>app_ota  
Status: Active: 0%
```

To terminate a session at the Master use the “stop” argument on the command line:

```
>app_ota stop  
OK
```

Checking status will show the following:

```
>app_ota  
Status: Canceled
```

NOTE Avoid frequent queries on the UI during reprogramming – especially when using the faster transmission selections. It may interfere with successful transfer.

4.0 TECHNICAL REFERENCE

4.1 A Word About Radio Interference

All units must meet the basic requirements listed below for proper operation. Check these items first when troubleshooting a system problem:

The TransNEXT shares the frequency spectrum with other services and unlicensed devices. As such, near 100% error free communications may not be achieved in a given location, and some level of interference should be expected. However, the radio's flexible design and hopping techniques should allow adequate performance if care is taken in choosing station location, configuration of radio parameters and software/protocol techniques.

In general, keep the following points in mind when setting up your communications network:

1. Systems installed in rural areas are least likely to encounter interference; those in suburban and urban environments are more likely to be affected by other devices operating in the license-free frequency band and by adjacent licensed services.
2. If possible, use a directional antenna at Remote sites. Although these antennas may be more costly than omnidirectional types, they confine the transmission and reception pattern to a comparatively narrow lobe, which minimizes interference to (and from) stations located outside the pattern.
3. If interference is suspected from a nearby licensed system (such as a paging transmitter), it may be helpful to use horizontal polarization of all antennas in the network. Because most other services use vertical polarization in these bands, an additional 20 dB of attenuation to interference can be achieved by using horizontal polarization.
4. Multiple transceiver systems can co-exist in proximity to each other with only very minor interference if they are each assigned a unique network address. Each network address has a different hop pattern.

Additional RF isolation can be achieved by using separate directional antennas with as much vertical or horizontal separation as is practical. Vertical separation of antennas is more effective per foot/meter than horizontal.

5. If constant interference is present in a particular frequency zone, it may be necessary to "lock out" that zone from the radio's hopping pattern. The radio includes built-in tools to help users remove blocked frequency zones. Refer to the discussion of the `radio.skip` attribute for more information. In the USA, a maximum of four zones may be skipped, per FCC rules. Check the regulatory requirements for your region.
6. Interference can also come from out-of-band RF sources such as paging systems. Installation of a bandpass filter in the antenna system may bring relief. (Contact the GE CIC Customer Service Department for recommendations and sources of suitable filters.)
7. Proper use of the `radio.retry` and `radio.repeat` may be helpful in areas with heavy interference.

The `radio.retry` sets the maximum number of times (0 to 10) that a radio will re-transmit upstream data over the air. Values greater than 0 successively improve the chances of a message getting through when interference is a problem.

The `radio.repeat` sets a fixed number of unconditional retransmissions for downstream data.

8. The RF power output of all radios in a system should be set for the lowest level necessary for reliable communications. This lessens the chance of causing unnecessary interference to nearby systems.

4.2 Troubleshooting

All units must meet the basic requirements listed below for proper operation. Check these items first when troubleshooting a system problem:

- Adequate and stable primary power
- Secure cable connections (RF, data, and power)
- A clear transmission path between Master and each Remote
- An efficient and properly aligned antenna system providing adequate received signal strength.
- Proper programming of the transceiver's parameters
- The correct interface between the transceiver and the connected data equipment (correct cable wiring, proper data format, timing, etc.)

4.2.1 LED Status Indicators

The PWR LED typically provides the quickest field indication of a system problem. If the PWR LED is flashing Red, then an alarm condition is present. (Additional details on LED status are available in Section 2.3 TransNEXT Connectors and Indicators on page 18).

The “show alarms” command will indicate current active alarm conditions. An example is show below:

```
>show alarms
Current Alarms:
0.) No ADDR programmed
13.) No Sync
```

Alternatively, via the web UI click on the alarm icon on the far right of the status banner. A pop-up window will indicate current alarms.

4.2.2 Event Log

Event logs provide a history of alarm status and can help indicate if a recent change caused a problem. See section 3.4.2 Event Logging for more information.

4.2.3 Setup Mode

Setup mode can be useful for troubleshooting in bench top settings. Entering the command “**setup**” temporarily takes the TransNEXT out of normal hopping mode and allows for direct test of transmit and receive functions. Setup mode is confirmed when the command prompt changes from “>” to “**SETUP>**”.

In Setup mode, the transmit and receive frequencies are set by the “**chan**” (channel) command. Channel 0 corresponds to 902.2MHz and channel 128 corresponds to 927.6MHz. To key on channel type “key” for a continuous signal or “burst” for a burst operation. Use “dkey” to key down. To check RSSI use



the “**rss**” command for continuous sampling (until <CR> is entered); alternatively use “**rss!**” for a 1-shot sample that returns to the “**SETUP>**” prompt.

Note that the transmission functions of setup mode are not intended for field use. Setup mode can be terminated at any time by typing “**quit**” at the “**SETUP>**” prompt. Duration of Setup mode is timed and will expire after 10 minutes as a protection to keep a unit from accidentally being left in this state.

4.3 Technical Specifications

GENERAL

Input Power

6 to 36 VDC, 1.0 Amp max. 6.0 Watts maximum (NET9L)
 6 to 36 VDC, 1.6 Amp max. 9.6 Watts maximum (NET9S)

Below are power consumption estimates:

Table 4-1. TransNEXT Power Consumption:

Mode	NET9L	NET9S
Receive	760 mw	970 mw
Transmit	6.0 W	9.6 W

Ethernet Port

RJ-45 10/100 Mbps Auto-MDIX

Serial Port

RJ-45, supporting RS-232/RS-485

LAN Protocols

802.3 (Ethernet), TCP/IP, ICMP, ssh, http/https

Networking

N/A

Configuration

Serial console, SSH, HTTP/HTTPS

Security

Secure Boot, Signed Firmware, Roll-based Access Control

Physical

Size

5.3" long (13.46 cm), 3.8" wide (9.65 cm), 1.6" high (4.06 cm)

Housing

Die-cast Aluminum

Weight

1.25 lbs. (0.57kg). without mounting hardware

Environmental

Operating Temperature Range

-40°C to +70°C

NOTE Operating temperature range may be reduced based on model configuration. See product label for detail.



Caution: This device may exceed safe handling temperatures when operated in an ambient temperature above 55°.

Agency/Regulatory Approvals

FCC

NET9L (Lite) – E5MDS-NET9L



NET9S (Standrd) – E5MDS-NET9S

IC - Industry

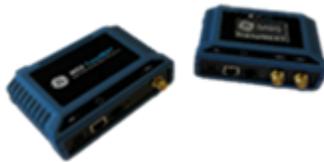
NET9L (Lite) – 101D-NET9L

NET9S (Standrd) – 101D-NET9S

900 MHz ISM - Unlicensed

Frequency Range	902 to 928 MHz
Power Output	10 dBm to 30 dBm in 1.0 dBm steps (DEFAULT = 30 dBm)
Output Impedance	50 Ohms
Permissible Antennas	Various options depending on local regulatory, including .. GE MDS 93-/97-3194A14, 10dBd (12.15dBi) YAGI Antenna GE MDS 93-/97-3194A23, 7dBd (9.15dBi) 5/8 wavelength OMNI
Antenna Connector	TNC female
Number of Frequency Channels	Selectable 64 to 128
Channel Separation	200.0 kHz minimum
Modulation Type	2-Level FSK
Data Rates	106kbps (uncompressed OTA)
Peak Frequency Deviation	1250 kbps / 4-level GFSK: 550 kHz
Dwell Time	7 or 28 ms (default = 7)

NOTE All specifications are subject to change without notice or obligation.



5.0 Glossary of Terms and Abbreviations

If you are new to wireless communications systems, some of the terms used in this guide may be unfamiliar. The following glossary explains many of these terms and will prove helpful in understanding the operation of the unit. While some of these terms may not appear in the text, they are included here to promote a more complete understanding of wireless technology.

Antenna System Gain: A figure, normally expressed in dB, representing the power increase resulting from the use of a gain-type antenna. System losses (from the feedline and coaxial connectors, for example) are subtracted from this figure to calculate the total antenna system gain.

Bit: The smallest unit of digital data, often represented by a one or a zero. Eight bits (plus start, stop, and parity bits) usually comprise a byte.

Bits-per-second: See *BPS*.

BPS (Bits-per-second): A measure of the information transfer rate of digital data across a communication channel.

Bridging: (see Ethernet Bridging)

Byte: A string of digital data usually made up of eight data bits and start, stop and parity bits.

CLI: Command Line Interface. A method of user control where commands are entered as character strings to set configuration and operating parameters.

CTS: Clear to Send

Decibel (dB): A measure computed from the ratio between two signal levels. Frequently used to express the gain (or loss) of a system.

Data Circuit-terminating Equipment: See *DCE*.

Data Communications Equipment: See *DCE*.

Data Terminal Equipment: See *DTE*.

dB_i: Decibels referenced to an “ideal” isotropic radiator in free space, frequently used to express antenna gain.

dB_d: Decibels referenced to a dipole antenna, used to express antenna gain.

dBm: Decibels referenced to one milliwatt. An absolute unit used to measure signal power, as in transmitter power output, or received signal strength.

DCE (Data Circuit-terminating Equipment) (or Data Communications Equipment): In data communications terminology, this is the “modem” side of a computer-to-modem connection. The unit described in this manual is hardwired as a DCE device.

DLINK: MDS Proprietary diagnostic link protocol

DTE (Data Terminal Equipment): A device that provides data in the form of digital signals at its output. DTE connects to the DCE device.

ETH: Ethernet

Ethernet Bridging: Involves combining an Ethernet interface with one or more other interfaces under a single interface.

Fade Margin: The greatest tolerable reduction in average received signal strength that will be anticipated under most conditions. It provides an allowance for reduced signal strength due to multipath, slight antenna movement or changing atmospheric losses. A fade margin of 10 dB is usually sufficient in most ISM systems.

FHSS: Frequency Hopping Spread Spectrum radio.

Hardware Flow Control: A feature used to prevent data buffer overruns when the unit is handling high-speed data from an RTU or PLC. When the buffer approaches overflow, the unit drops the clear-to-send (CTS) line, which instructs the RTU or PLC to delay further transmission until CTS again returns to the high state.

Host Computer: The computer installed at the master unit, which controls the collection of data from one or more remote sites.

IP: Internet Protocol

ISM: Abbreviation for “Industrial, Scientific, Medical” band. The 900MHz ISM band is where TransNEXT operates.

LAN: Local Area Network

LED: Light Emitting Diode

mA: Milliampere

Poll: A request for data issued from the host computer (or master PLC) to a Remote unit.

PLC (Programmable Logic Controller): A dedicated microprocessor configured for a specific application with discrete inputs and outputs. It can serve as a host or as an RTU.

PPM: Parts per Million

Programmable Logic Controller: See *PLC*.

Remote Terminal Unit: See *RTU*.

RTS: Request-to-send

RTU: Remote Terminal Unit. A data collection device installed at a Remote unit site.

RX: Abbreviation for “Receive.”

SAF (Store and Forward): An available feature of the unit whereby data is stored by a designated Remote, and then retransmitted to a station beyond the communication range of the Master.

SCADA (Supervisory Control And Data Acquisition): An overall term for the functions commonly provided through a multiple address radio system.

Signal-to-Noise Ratio: See *SNR*.

SNR (Signal-to-Noise ratio): A measure of how well the signal is being received at a radio relative to noise on the channel.

SSH: Secure Shell protocol for a network that allows users to open a window on a local PC and connect to a remote PC as if they were present at the remote.

Supervisory Control And Data Acquisition: See *SCADA*.

TX: Abbreviation for “Transmit.”

Unlicensed: Typically referring to unlicensed operation, whereby end users do not need to apply for license prior to installing or using certain classes of radios. TransNEXT is a FHSS radio designed for use in the unlicensed 900MHz ISM band.

YMODEM: This is a simple file transfer protocol originally introduced in 1985. TransNEXT uses YMODEM to support uploads of MPK firmware.



6.0 APPENDIX A –Electronic Ink Display

6.1 Introduction

Select TransNEXT models are equipped with an Electronic Ink display.

Electronic Ink is lower power technology ideally suited for a low power applications. It uses reflected light from the environment and provides a persistent display of the last image written even after power is removed.

NOTE Even though the display will hold a persistent image indefinitely, the TransNEXT software will periodically update the data. When an update cycle occurs, the display will flash momentarily as the screen is fully erased and a new set of data is written. This is normal operation.

The TransNEXT display provides three key functions organized into three screens: a status page, a spectrum analyzer, and an antenna alignment tool. Based on which screen is active the TransNEXT will use a different data update cycle.

Pressing the white circular button on the LED panel allows the user to force a screen update or advance to a different screen.

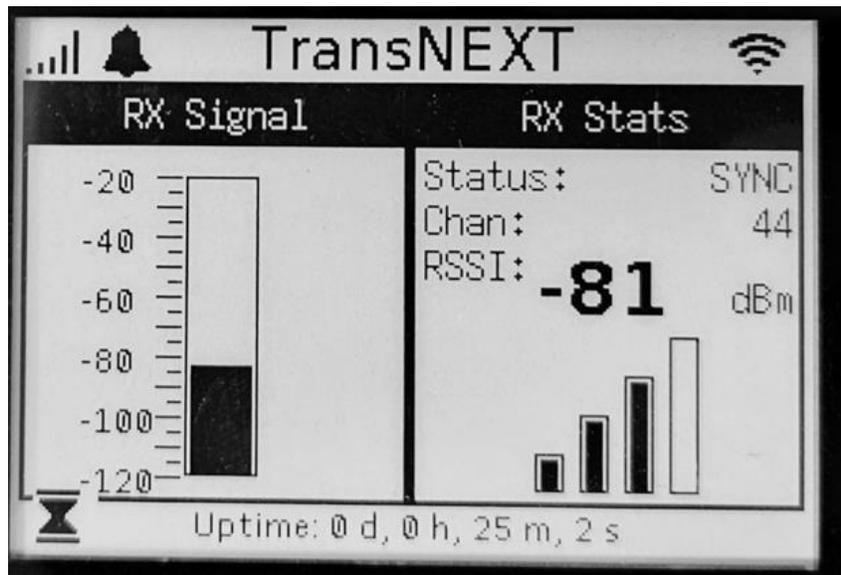
6.2 Status Page

The status page is the default. It includes the owner message, uptime, device data, and radio data. The data refresh rate defaults to 2 minutes. An example is shown below:



6.3 Antenna Alignment Page

The antenna alignment page uses a 10-sec refresh to see the effects of different antenna positions. This is intended as a simple tool to assist in initial installation.



6.4 Spectrum Analyzer Page

The page is intended to assist in initial installation and in field maintenance. The analyzer will plot data over the operating range (902-928MHz) providing a simple overview of the spectral environment in which the device is operating.

The upper line provides a sample of the system based on received TransNEXT and TransNET messages. The lower line provides a sample of the system based on times when the channel is not in use. The lower line represents the noise floor of the environment in which the TransNEXT is operating.



NOTE The Spectrum Analyzer Page is intended as a simple tool to detect easily identified blockers in the FHSS band. It is based on a simple collection of signal strength and only operates over the bands in which the radio operates. For advanced troubleshooting use of RF test equipment is still recommended.



7.0 APPENDIX B – Operating Frequencies

The TransNEXT is a Frequency-Hopping Spread Spectrum (FHSS) radio that can be configured to operate in a subset of all available frequencies in the 902-928MHz range.

TransNEXT divides the available frequencies into a set of 8 configurable zones with 16 discrete, 200KHz bandwidth channels per zone. The table below illustrates the 900MHz frequency ranges that apply to each zone. The “skip” parameter under radio settings defined which zones to skip. By default, no zones are skipped which provides a total of 128 different channels in the hop pattern.

NOTE The module may be configured by the factory to limit the number of skipped zones or disallow operation in specific frequency ranges (zones) in order to meet country specific regulatory requirements. These settings can NOT be changed or modified by the user.

ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5	ZONE 6	ZONE 7	ZONE 8
902.2	905.4	908.6	911.8	915.0	918.2	921.4	924.6
to							
905.2	908.4	911.6	914.8	918.0	921.2	924.4	927.6

8.0 APPENDIX C– Licenses

8.1 Open Source License Declaration

The MDS TransNEXT product includes Open Source Software. Usage is governed by the corresponding licenses which are listed on the GE MDS Industrial Wireless website, under TransNEXT Software/Firmware Downloads, Support Items and `license-declaration-n_n_n.txt`.

Upon request, in accordance with certain software license terms, GE will make available a copy of Open Source code contained in this product. This code is provided to you on an “as is” basis, and GE makes no representations or warranties for the use of this code by you independent of any GE provided software or services. For more information, contact gemds.techsupport@ge.com

9.0 APPENDIX D – Country Specific Information

The table below identifies any country-specific installation requirements or warning required by the country for the TransNEXT. Operation of the unit must be in full compliance with all country and regional requirements.

Table 9-1. Country-Specific Installation Data

Country	Applicable Symbol(s)	Installation/Operating Requirements
Australia		<p>For professional use only, not for sale to the general public.</p> <p>Hot surface—this product is only suitable for installation restricted access locations.</p>
Mexico		Certificate No.: NYC-2302CT1755

10.0 APPENDIX E – Alarm Codes

The TransNEXT has a facility to report alarm conditions and assert an external alarm signal based on configuration settings.

Alarm Codes include the following:

Table 18. Alarm Codes

Alarm Code	Alarm Type	Description
00	Major	The network address is not programmed. radio.addr = 0
01	Major	Improper firmware detected for this radio model.
04	Major	One or more of the programmable synthesizer loops is reporting an out-of-lock condition.
08	Major	The system is reporting that it has not been calibrated. Factory calibration is required for proper radio operation.
12	Major	Receiver time-out alarm.
16	Minor	The unit address is not programmed.
29	Minor	RF output power fault detected. (Power differs by more than 2 dB from set level.) Often caused by high antenna system SWR. Check antenna, feedline and connectors.
30	Minor	The system is reporting an RSSI reading below -105 dBm.
31	Minor	The transceiver's internal temperature is approaching an out-of-tolerance condition. If the temperature drifts outside of the recommended operating range and the transceiver may fail.



NOTES



IN CASE OF DIFFICULTY...

Our products are designed for long life and trouble-free operation. However, this equipment, as with all electronic equipment, may have an occasional component failure. The following information will assist you in the event that servicing becomes necessary.

TECHNICAL ASSISTANCE

Technical assistance for GE MDS products is available from our Technical Support Department during business hours (8:30 A.M.–6:00 P.M. Eastern Time). When calling, please give the complete model number of the product, along with a description of the trouble/symptom(s) that you are experiencing. In many cases, problems can be resolved over the telephone, without the need for returning the unit to the factory. Please use one of the following means for product assistance:

Phone: 585 241-5510 E-Mail: gemds.techsupport@ge.com
FAX: 585 242-8369 Web: www.gemds.com

REPAIR SERVICE

Component level repair of this equipment is not recommended in the field. Many components are installed using surface mount technology, which requires specialized training and equipment for proper servicing. For this reason, the equipment should be returned to the factory for any PC board repairs. The factory is best equipped to diagnose, repair and align your unit to its proper operating specifications.

If return of the equipment is necessary, you must obtain a return authorization number before shipment. This number helps expedite the repair so that the equipment can be returned to you as quickly as possible. Please be sure to include the number on the outside of the shipping box, and on any correspondence relating to the repair. No equipment will be accepted for repair without an authorization number.

Contact Technical Support in your region to obtain an authorization number:

The radio must be properly packed for return to the factory. The original shipping container and packaging materials should be used whenever possible. All factory returns should be addressed to:

**GE MDS LLC
Product Services Department
(Auth. No. XXXX)
175 Science Parkway
Rochester, NY 14620 USA**

When repairs have been completed, the equipment will be returned to you by the same shipping method used to send it to the factory. Please specify if you wish to make different shipping arrangements.

REPLACEMENT PARTS

Many spare and replacement items are available for purchase by contacting your factory sales representative, or by visiting our online store at <http://store.gedigitalenergy.com/front.asp>

