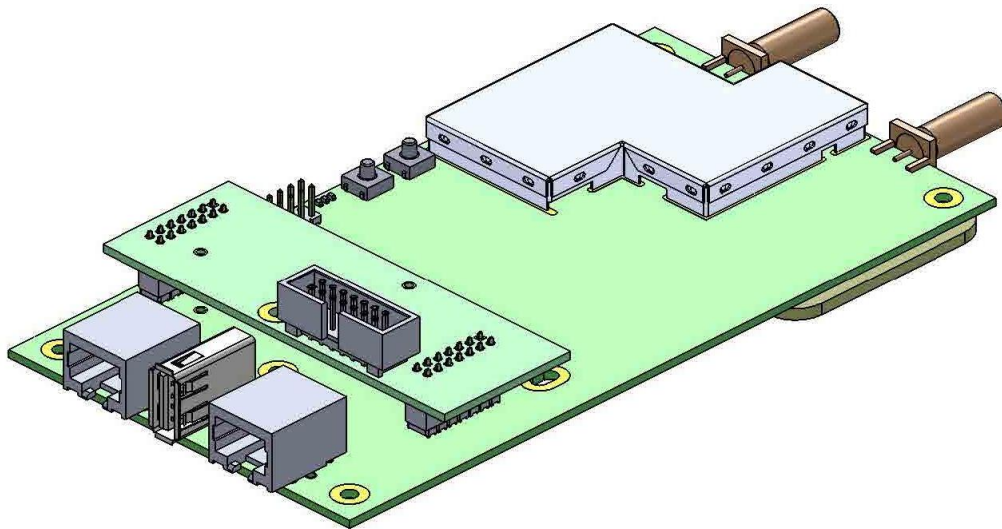


Tropos 1410-B Integration Guide

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Revision 1.7



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Notices

Copyright Notice

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This product includes technology protected by U.S. Patents 6,704,301; 6,965,575; 7,016,328; 7,031,293; 7,058,021; 7,362,737; 7,376,087; 7,382,778; 7,397,789; 7,450,552; 7,460,489; 7,489,932; 7,499,409; 7,505,426; 7,542,421; 7,551,562; 7,564,781; 7,564,862; 7,580,393; 7,580,705; 7,586,879.

FCC Notice to Users and Operators

This device complies with Part 15 of the FCC Rules. Operation is 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.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to correct the interference by using one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase separation between the equipment and receiver.
- Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician.

This Part 15 radio device operates on a non-interference basis with other devices operating at this frequency. Any changes or modification to said product not expressly approved by Tropos Networks could void the user's authority to operate this device.

Industry Canada Notice to users and operators:

This Class B digital apparatus meets all requirements of the Canadian Interference Causing Equipment Regulations. Operation is 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.

Cet appareillage numérique de la classe B répond à toutes les exigences de l'interférence canadienne causant des règlements d'équipement. L'opération est sujette aux deux conditions suivantes : (1) cet dispositif peut ne pas causer l'interférence nocive, et (2) ce dispositif doit accepter n'importe quelle interférence reçue, y compris l'interférence qui peut causer l'opération peu désirée.

This device has been designed to operate with the antennas listed. Antennas not included or having a gain greater than 7.4 dBi in the 2.4 GHz band are strictly prohibited for use with this device. The required antenna impedance is 50 Ohms.

Operation is subject to the following two conditions:

1. This device may not cause interference, and
2. This device must accept any interference, including interference that may cause undesired operation of the device.

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (EIRP) is not more than that permitted for successful communication.

Required labeling

The Federal Communications Commission (FCC) and Industry Canada (IC) require equipment that contains a Tropo 1410-B to have a label on the outside of the product that shows the FCC and IC ID numbers. The label should say the following:

Contains:

FCC ID P9J-142401

IC ID 4751A-142401

Introduction

The Tropos 1410-B is a compact, single-radio board designed to be integrated into devices that participate in a Tropos mesh network. The 1410-B allows large mesh networks to be built economically, delivering mesh coverage and wireless- or wired-client connectivity for Smart Grid and other multi-use applications. The 1410-B can be configured to operate in either of two modes:

- As an endpoint: A 1401-B can act as a wireless-to-Ethernet or wireless-to-serial bridge to connect any Ethernet- or serial-enabled device to a Tropos mesh network. Endpoint operation requires Tropos Software Release 7.9 or higher.
- As a full-functioned mesh node: In mesh mode, a 1410-B can provide endpoint functions as well as support wireless clients and downstream mesh links. Mesh operation requires Tropos Software Release 8.1 or higher.

The 1410-B is optimized for embedded applications. While other Tropos routers are stand-alone devices, the Tropos 1410-B is designed to be integrated into other devices. For example, a Tropos 1410-B can be integrated into a pole-mounted transformer, enabling the transformer to communicate health and power quality data as well as function as a node in the mesh network.

Examples of devices that can use a 1410-B for communications into a Smart Grid or Smart City infrastructure are:

- transformers
- fuel cell control units
- thermal energy storage units
- control units for reclosers, regulators, switch gear and capacitor banks
- electric vehicle chargers
- solar power inverters and controls
- intelligent traffic signals
- parking kiosks

Connectivity to wired and wireless clients

The Tropos 1410-B supports both Ethernet and serial communications (RS-232 or RS-485, configurable) for client devices. The serial interfaces support the DNP3 protocol. Connection to these ports is through RJ-45 connectors. One RJ-45 connector supports the Ethernet port and power, and the second RJ-45 connector supports the serial interfaces and power (wiring diagrams for the RJ-45 connectors are shown in Figure 1).

When operating in mesh mode the 1410-B can support wireless clients. A wireless client can be any device that supports 802.11b/g/n communications, including electric power distribution devices such as reclosers, capacitor banks, and voltage regulators, and video cameras used for security or traffic monitoring. Virtually any communicating device can be connected to the Tropos 1410-B.

Security

The Tropos 1410-B supports a high level of network security, including the following functions:

- Authentication: WPA, WPA2, 802.11i, RADIUS, 802.1x (includes EAP-TLS, EAP-TTLS, PEAP)
- Hardware-assisted encryption
- Multiple BSSIDs & ESSIDs (ESSID suppression)
- Password and Certificate-based HTTPS and SSH Remote Access
- Denial of Service Attack Detection
- IPSEC tunneling to wired clients with AES-128 encryption
- Packet Filtering & Forwarding
- Peer-to-Peer Blocking
- Client Access Control Lists
- Router Access Control
- Evil Twin Detection and Reporting

Tropos Control network management

The 1410-B is managed by Tropos' industry leading network management, monitoring and control application, Tropos Control. Tropos Control allows the network operator to monitor network performance in real time and perform complex tasks such as network reconfiguration. It can function in a stand-alone configuration or as part of a larger network management system using SNMP.

Integrating the 1410-B

Integration of the 1410-B requires physically mounting the unit in a safe and reliable manner, powering the unit, connecting the data interfaces and connecting the antennas. The following sections describe these steps. Figure 1 is an outline drawing of the 1410-B showing the location of components referred to in the following sections.

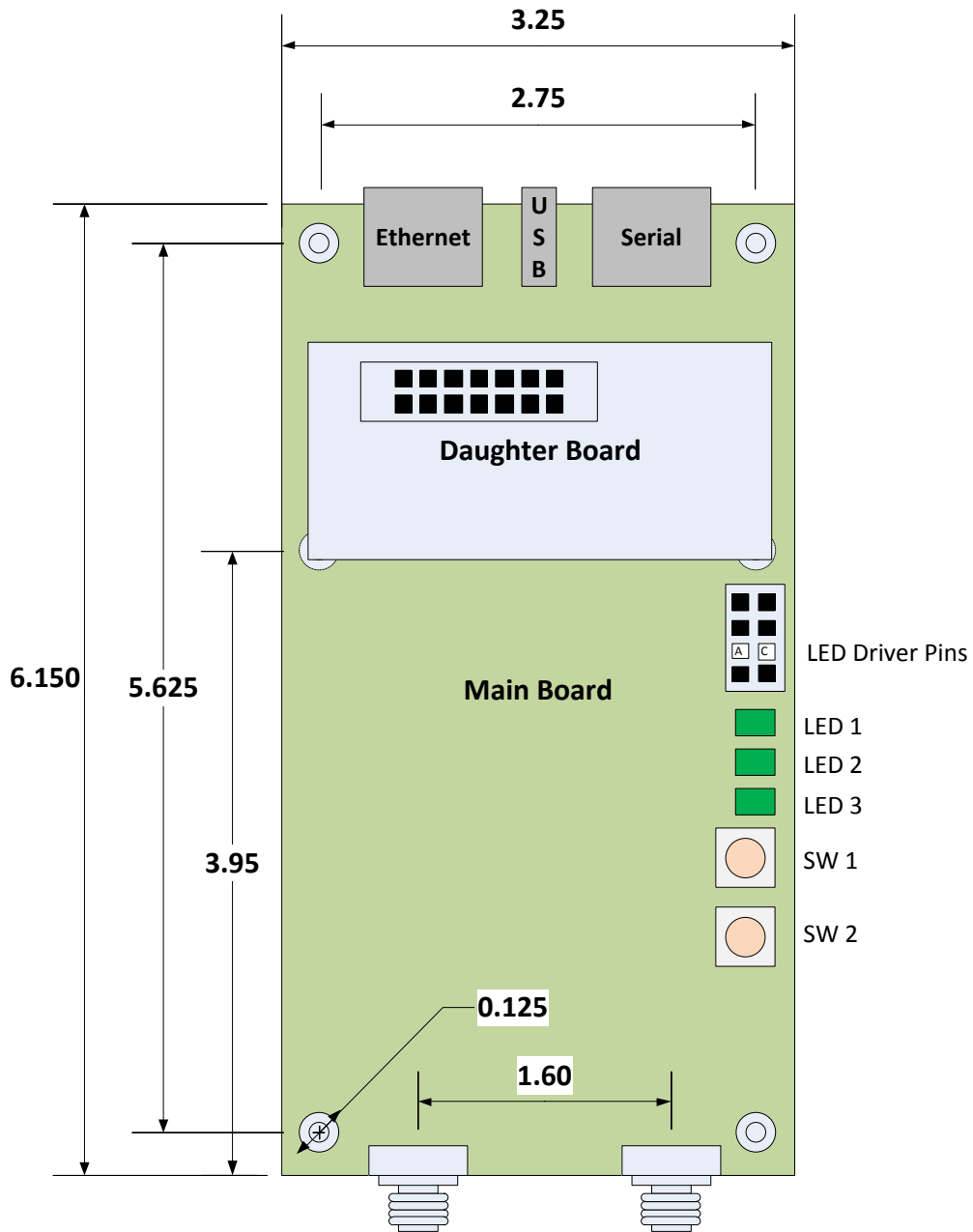


Figure 1
1410-B Components and Dimensions

Handling the 1410-B circuit board

Certain components used in the 1410-B are sensitive to static electricity and can be damaged by its discharge. The 1410-B should be handled only in an ESD safe work area. The purpose of an ESD safe work area is to prevent damage to sensitive components from spikes and static discharges. These areas must be designed and maintained to prevent ESD damage.

1410-B circuit board assemblies must always be handled at properly designated work areas.

Stacking of 1410-B circuit boards and assemblies should be avoided to prevent physical damage.

Work areas should be kept clean and neat. 1410-B circuit board assemblies should be handled by the edges. Avoid touching the circuits or components.

Physical installation

The 1410-B is a two board assembly. The main board contains the processor, radio and connectors. The daughter board contains components for conditioning and monitoring power, and a 14-pin ribbon-cable connector.

The 1410-B main board is 6.150" long x 3.250" wide. With the daughter board installed the 1410-B is approximately 1" high. There are six mounting holes on the 1410-B main board designed for 4-40 screws (see Figure 1). The 1410-B should be mounted on stand-offs or bosses so that there is a minimum of 0.5" of clearance on all sides of the unit.

Tropos recommends that mounting the 1410-B with four screws through the holes at the corners of the main board. Alternatively, the 1410-B can be mounted using the two SMA antenna connectors and the two holes located under the daughter board.

Power

The 1410-B can be powered in two ways:

1. The integrator can provide 10-28 VDC power to the 1410-B. This power is then regulated by the 1410-B. This is the preferred method of powering. Power can be applied to the either the Ethernet or serial RJ-45 connector (see Figure 1). The pin assignments for these ports are shown in Tables 1 and 2.

The 1410-B does not use 802.3af or 802.3at signaling.

2. Regulated 5 VDC can be applied to the 14-pin connector on the daughter board. This will not be regulated by the 1410-B. Therefore the following specifications apply:
 - 5 VDC \pm 0.5%
 - Ripple < 25 mV
 - Transient response < 50 mV

Communications interfaces

The 1410-B supports Ethernet, serial and USB connections. There are two RJ-45 connectors on the main board. One is used for the Ethernet port. The other is used for the serial ports. There is one USB Type A receptacle on the main board.

Ethernet

The Ethernet port supports the Ethernet signals and power, as shown in table 1, below.

pin	assignment	pin	assignment
1	TX +	5	Power +
2	TX -	6	RX -
3	RX +	7	Power -
4	Power +	8	Power -

Table 1: Ethernet Port Pin Assignments

Serial

The 1410-B provides a dual serial interface on RJ-45 port 2. The integrator needs to configure the 1410-B for either RS-232 or RS-485 operation as follows:

(Configuration instructions to be added)

The serial interface can support multiple serial connections. The following configurations are supported:

- One RS-232 connection (option 1 in Table 2)
- One RS-485 connection (option 1 in Table 2)
- One RS-232 connection and one RS-485 connections (option 2 in Table 2)
- Two RS-232 connections (option 2 in Table 2)

The RJ-45 connector used for the serial ports has the pin assignments shown in Table 2, below:

pin	option 1 (one serial port)	option 2 (two serial ports)
1	RS232 TX or RS485 TXRX +	RS232 (port 1) TX or RS485 TXRX +
2	GND	GND
3	RS232 RX or RS485 TXRX -	RS232 (port 1) RX or RS485 TXRX -
4	Power +	not used
5	Power +	RS-232 (port 2) RX
6	not used	RS-232 (port 2) TX
7	Power -	not used
8	Power -	not used

Table 2: Serial Port Pin Assignments

Note: when the connector is used to support two serial ports (option 2) the connector cannot support the power connections. In these cases power must be applied to the Ethernet port as shown in Table 1.

The integrator must ensure that all cables have appropriate strain relief and do not place any stress on the 1410-B's connectors.

14-Pin Interface

There is a 14-pin ribbon cable interface on the daughter board that can be used to power the 1410-B with a regulated 5 VDC supply (see "Power" above) and for direct TTL-level serial communications. The connector is a Digi-Key A33161-ND. The mating cable connector is a Digi-Key ASC14B-ND. The pin assignments are shown in Table 3.

pin	assignment	pin	Assignment
1	+5 VDC	8	
2		9	
3		10	
4		11	
5		12	UART TX 2.5 V
6	Ground	13	UART RX 2.5 V
7	Ground	14	

USB port

The 1410-B is equipped with a USB interface accessible through a Type A receptacle on the main board. Future software releases may provide support for devices such as GPS receivers.

Pushbutton Switches

Two pushbutton switches are mounted on the 1410-B (see Figures 1 and 2). Their function is:

SW 1 – Software safe mode start. When SW 1 is depressed and held during the power on sequence the 1410-B software will start in safe mode.

SW 2 – Software reset. When SW 2 is depressed the 1410-B software will restart.

LEDs

Three LEDs are installed on the 1410-B (see Figures 1 and 2). Their function is:

LED 1 blinks green when the radio is on.

LED 2 is solid green when the 1410-B is connected to a network

LED 3 is not used at this time.

The 1410-B can drive an external LED (for example, an LED mounted on the OEM product and visible from the outside of the package). Figure 1 shows the LED Driver Pins marked A (anode) and C (cathode).

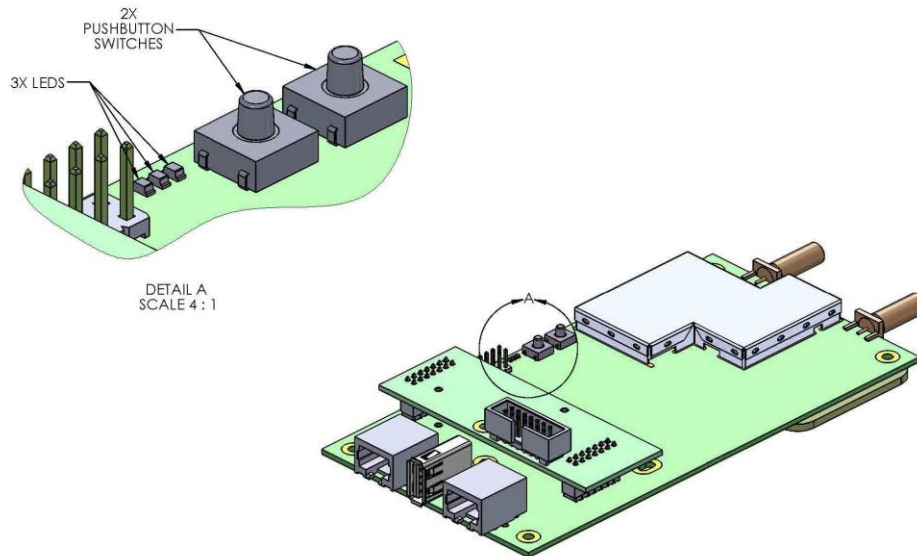


Figure 2

LED and Switch Detail

Antennas

Antennas for the 1410-B can be purchased from Tropos or sourced by the integrator. The 1410-B is designed for use with two 7.4 dBi monopole antennas.

Note: The 1410-B is FCC and Industry Canada approved for use with monopole antennas with a gain of 7.4 dBi or less. Please consult Tropos for any applications requiring other antennas.

It is preferable to mount the antennas outside of the device enclosure, but antennas can be located inside of an enclosure if the enclosure is non-metallic. Antennas should be mounted as high as possible and can be mounted remotely from the device.

The standard antenna connectors on the 1410-B main board are SMA connectors.

The connection from the antenna connectors on the 1410-B and any antenna connectors on the device should be made with low-loss coaxial cable. Tropos recommends LMR-240 or better cable.

Configuration

Configuration of the 1410-B is covered in the current version of the Tropos User Guide for Release 7.9 or higher.

Recommended Testing

Tropos recommends that the OEM integrator perform the following tests to validate the integration of the 1410-B into their product. These are provided as guidelines to the OEM. Actual testing is the responsibility of the OEM.

Physical Installation and Packaging

1. Verify that the 1410-B is installed in the enclosure in accordance with the assembly drawings and the installation guidelines and specifications provided in this document.
2. Verify that the antennas are properly connected to the SMA-antenna connectors.
3. Verify that the cable connecting the 1410-B to the OEM equipment is properly installed.
4. Verify that the 1410-B is powered when power is provided to the power supply board.
5. Verify that the external LED (if used) is properly wired and operates correctly.

Figure 3 shows a typical test configuration

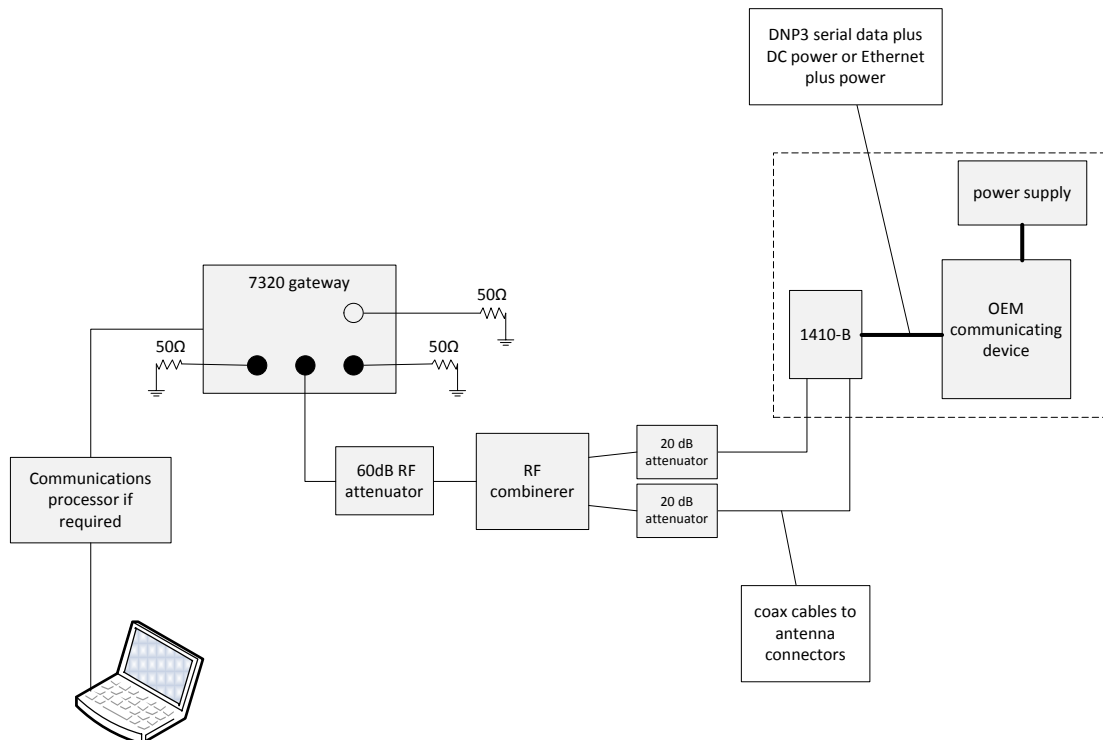


Figure 3
Typical Test Configuration

Communications and Connectivity Testing

Install an RF combiner and an attenuator as shown. Connect the attenuator to the center N-connector on the 7320 router that will function as the gateway.

Using the configuration shown in Figure 3, perform the following tests:

- Conduct a ping flood test from the computer to the 1410-B. Verify operation up to 25% duty cycle.
- Conduct tests from a communications controller (for example, a DNP3 master station) to the OEM equipment to for all supported commands.
- Verify that the console messages during 1410B boot up do not affect OEM equipment (reboot 1410B multiple times consecutively).
- If serial communications is used verify that all the serial speeds (i.e. baud-rates 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200) on 1410B work correctly with the OEM equipment.
- Verify that communications functionality does not get disrupted for extended period of time when 1410B roams to a different Tropos router (in the same subnet when 1410B retains the same IP address).
- Verify that 1410B reboots and upgrades do not disrupt the communications functionality and end-to-end connectivity. Communications should resume automatically after a reboot.
- Verify the 1410B status page in the Configurator displays valid DNP3 local/remote address and Tx/Rx packet information.
- Verify that 1410B can be rebooted using the configurator (remotely) and with the reset button (locally).
- Verify 1410B can be reached via its rescue interfaces (wireless wlan0 and Ethernet eth1) during standalone mode when it is not connected to any Tropos router.
- Verify 1410B and its wired clients can be configured in static and DHCP modes.

Environmental Tests

1. High and low temperature tests
 - The OEM equipment should be temperature tested, but within the specified temperature range of the 1410-B
2. Cold start tests
 - Start up tests at the low rated operating temperature
3. Humidity tests
 - The OEM equipment should be humidity tested to its specifications, but within the specified humidity range of the 1410-B
4. Temperature cycle tests per OEM requirements
5. Vibration tests per OEM requirements
6. Line voltage test
 - Operation between the specified input power range of the OEM equipment
7. Surge test per OEM specifications
 - Voltage transient test per OEM specifications

Safety and Servicing Information

The Federal Communications Commission (FCC) with its action in ET Docket 96-8 has adopted a safety standard for human exposure to RF electromagnetic energy emitted by FCC certified equipment. The Tropos 1410 meets the uncontrolled environmental limits found in OET-65 and ANSI C95.1, 1991. Proper operation of this device according to the instructions found in this manual will result in user exposure that is substantially below the FCC recommended limits.

To comply with FCC, Industry Canada and other national RF exposure safety requirements the antennas for this device must be installed to provide a separation distance of at least 20 cm from persons and shall not be co-located with other transmitting antennas except as shown in FCC/IC multi-transmitter guidelines.

Safety Guidelines

- Follow these guidelines to ensure safe operation of the router:
- Do not touch or move the antennas while the unit is transmitting or receiving.
- Do not hold any component containing a radio such that the antenna is very close to or touching any exposed parts of the body, especially the face or eyes, while transmitting.
- Do not operate the radio or attempt to transmit data unless the antenna is connected; otherwise, the radio may be damaged.
- Use in specific environments:
 - Do not operate a portable transmitter near unshielded blasting caps or in an explosive environment unless it is a type especially qualified for such use.
 - The use of wireless devices in hazardous locations is limited to the constraints posed by the safety directors of such environments.
 - The use of wireless devices on airplanes is governed by the Federal Aviation Administration (FAA).
 - The use of wireless devices in hospitals is restricted to the limits set forth by each hospital.

Servicing the 1410-B

The 1410-B has no user serviceable parts. For any service-related issues, contact Tropos Customer Support (support@tropos.com).

Specifications

Wireless

protocols supported	802.11 b/g/n
frequency band	2.400-2.483 GHz
modulation (802.11b)	DSSS (DBPSK, DQPSK, CCK)
modulation (802.11g/n)	OFDM (64-QAM, 16-QAM, QPSK, BPSK)
media access protocol	CSMA/CA with ACK
TX power	12-27 dBm set in 1 dB units
RX sensitivity	-97 dBm at 1 Mbps
multi-antenna system	2 TX, 2 RX MIMO
Radio ID	FCC: P9J-142401 IC: 4751A-142401

Wired Interfaces

Ethernet	one 10/100Base-T
Serial	<ul style="list-style-type: none"> one RS-232 or two RS-232 or one RS-485 or one RS232 and one RS485 DNP3
USB	one USB
connectors	<ul style="list-style-type: none"> two RJ-45(Ethernet and serial) one USB Type A one Digi-Key A33161-ND

Security

authentication	WPA, WPA2, 802.11i, RADIUS, 802.1x (includes EAP-TLS, EAP-TTLS, PEAP)
encryption	AES-128 (FIPS 140-2 compliant)

Networking

compatibility	802.11b/g/n
VLAN support	802q, ESSID and IP based tagging
addressing	static and dynamic addressing for wireless and wired clients
quality of service (QoS)	<ul style="list-style-type: none"> 802.11e WMM 802.p/q with 4 queues per VLAN and ESSID 802.p and DSCP

Power

unregulated input	10-28 VDC
regulated input	5 VDC \pm 0.5% ripple < 25 mV transient response < 50 mV
power consumption	3 W typical

Physical

operating temperature	-40 °C to +75 °C / -40 °F to +167 °F
storage temperature	-40 °C to +85 °C / -40 °F to +185 °F
shock / vibration	ETSI 300-19-2-4; T41.E class 4M3
dimensions	6.15" L x 3.25" W
weight	8 oz
antenna connectors	2 SMA
antenna protection	integrated
electrical fast transient immunity	EN61000-4-3 level 2
EMC field immunity	EN61000-4-2 level 2
ESD immunity	EN61000-4-2 (contact); level 3 (air)