



Acuity Edge Router ER-550
Hardware User Guide
(ER-550 Rev. C)

Version 1.0

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Revision History

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1. Scope

The present document describes the Acuity Edger Router ER-550 hardware features.

2. Introduction

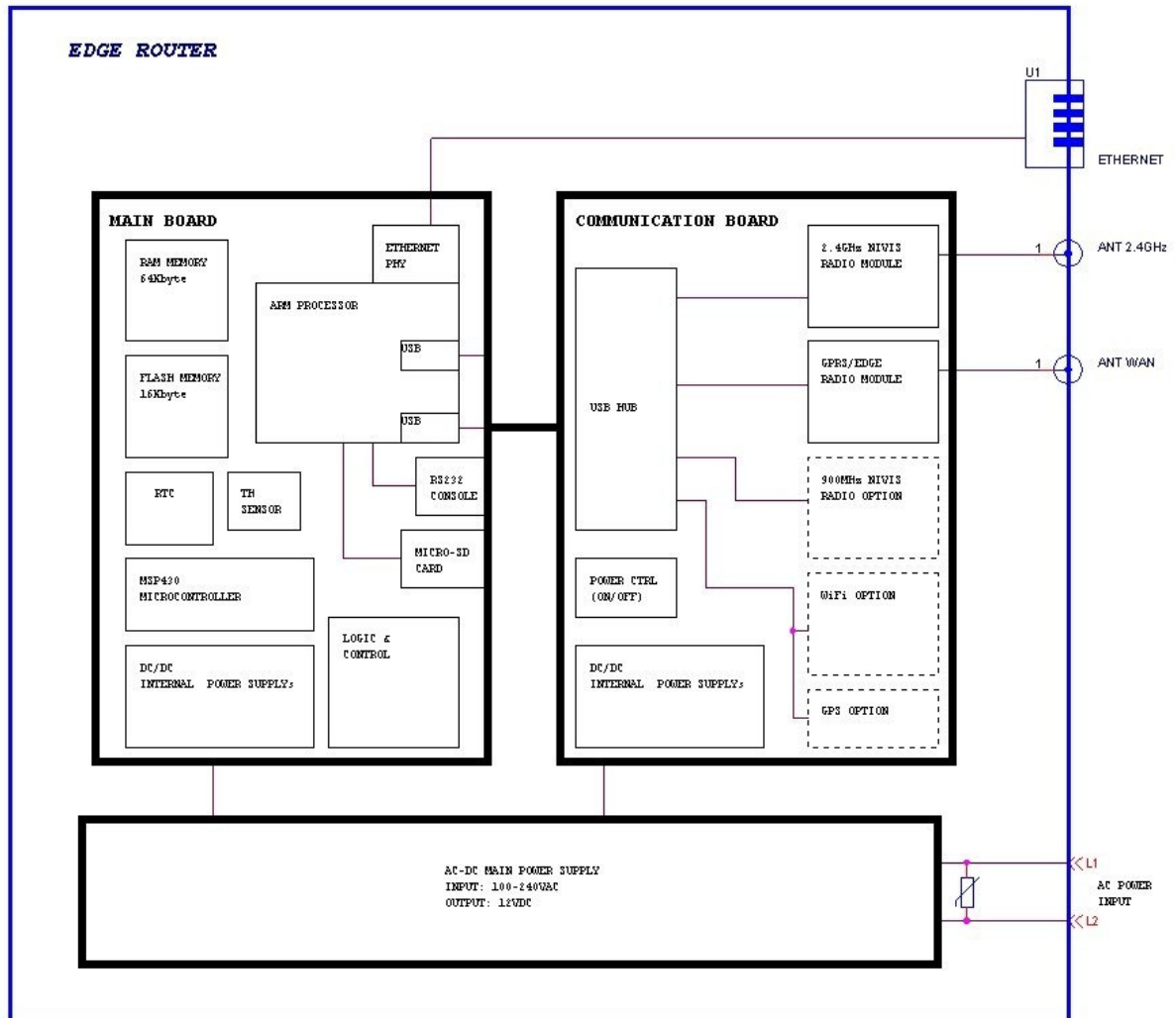
- The Acuity Edge Router ER-550 is designed to fulfill communications and data acquisition requirement and use multiple communication channels (GPRS/EDGE WAN + 10/100Base-T Ethernet port) and gather data via the 2.4GHz mesh network radio link.
- The board is configured as intelligent LAN to WAN gateway for mesh sensor networks applications. Data is stored and forwarded based on firmware application.
- Board is operated continuously powered and includes circuitry that allows control of power for sections of the board.
- Hardware includes a powerful ARM9 (@200MHz) and utilize a USB hub structure and internal USB to serial converters in order to achieve communication channels functionality
- Hardware includes a second MSP430 microcontroller that fulfills watchdog and wake-up and monitoring duties for different modes of operation available.
- Communication modules are installed on a pluggable communication board on top of the main board
- There are few connection available to user and include antenna connections, Ethernet port and AC power connection, all other connections are internal in the enclosure and are not directly accessible from outside.
- Design is AC powered and support an operating voltage range of 100-240VAC
- Hardware support operation temperatures range: -40C...+85C with up to 95% non condensing humidity

3. Mechanical View

- Mechanical outline was designed to fit requirements
- Dimensions are presented in Appendix 1

4. Block Diagram

Block diagram present the most important subsystems of the board.



The Edge Router includes an ARM9 processor as the main processing entity that controls most of the system features (some features are integrated internally into chip). Subsystems controlled by the ARM processor are:

- Two directly connected serial channels. First channel is used for serial console port used for factory programming and as debug console and is available on the as RS232 connection. Second channel is used for intercommunication (watchdog, commands, control and BSL mode) with the MSP430 microcontroller that ensure system level watchdog and low power modes of operation. Also the second channel is used for remote firmware upgrade of MSP430 code by using the BSL mode programming mode.
- Two directly connected USB host channels. First channel is used for uplink USB to a 4 port USB hub situated on the communication board in order to extend the number of channels to necessary slot ports. Second channel is used for providing the front panel USB user channel for administration via serial interface and configuration purposes or as general USB host port for further applications.
- One Ethernet port (twisted pair port - 10/100Base-T). ARM processor implements the Ethernet MAC internally and connects via the external PHY IC to RJ45 available connector on the main board.
- One 16-bit Data Address and Control bus for easy interfacing the memory subsystem. Multiple chip select signals allow simple interface and multiple methods for booting the system.
- Hardware SPI bus multiplexed for use with 2K Boot EEPROM option, micro-SD card slot on main board for boot or storage or optional installed LCD panel.
- A large number of I/O grouped for internal control of board subsystems, for control of power signals latch, for control of BSL programming mode of MSP430, for implementing the I2C buses on the board. Two signals drive the Red and Green on board LED's.

The ARM memory subsystem is situated on the main board and includes the FLASH memory (implemented 16Kbyte) and the two RAM memory chips (implement 2 x 32Kbyte). No buffering is included between memory and ARM processor. Boot of system is realized from FLASH image programmed at factory. Also FLASH accommodates the file system, application code and space for data storage. The RAM memory is used to run the live system after boot, as temporary storage file system and as memory allocated for system.

A set of 4 USB ports present on communication board are connected to USB-to-Serial converters (internally) and supplemental circuitry that allow creation of slots (communication slots) for the OEM installed communication modules. Slot powering is controlled internally via a latch. This ensure a lot of flexibility for available power on/off modes used in firmware.

The power supply subsystem include a 3.3V permanent power supply with low quiescent current for MSP430 low power modes, a set of two power supply for 3.3V and 1.8V for the ARM, a 5V power supply for the USB hub and serial to USB converters and level shifters of the communication board, one high current (up to 4A) switched power supply for powering the OEM radio modules installed. Some extra linear regulators are

present in order to efficiently provide the voltages for OEM modules and control the power. Power supply can be switched ON/OFF under ARM control (separate for each OEM module installed), the ARM power and USB hub power can be switched ON/OFF under MSP430 control in order to support fine power management and a large combination of modes of operation.

The main internal voltage is 12V and is provided by the AC-DC converter module installed together with the main and communication board into the internal metallic enclosure (for shielding purposes). Input voltage is AC through installed power cord and screw connections of the AC-DC power module.

Some auxiliary subsystems are present for internal management and include:

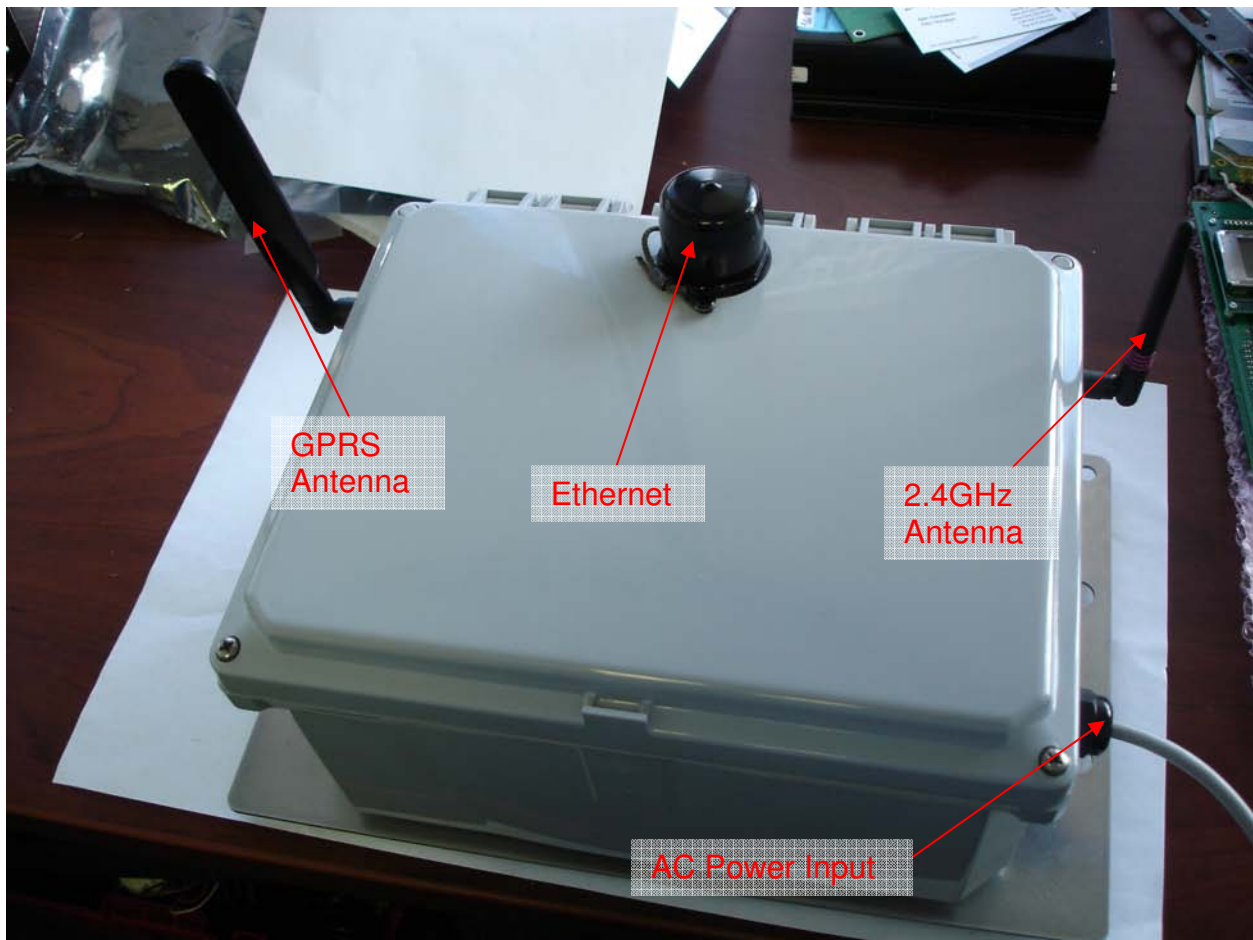
- Temperature and humidity sensor for environment management and alarms if unit is exposed to values outside the specified range
- Precision hardware RTC used for applications that need precise time keeping, also this is the 32KHz reference for the ARM processor internal RTC. The RTC selected should allow drifts of no more than 3-4 seconds/month under normal conditions and better if calibration trimmed at factory.
- Analog measurements via ARM analog input pins for on board voltages in order to allow alarms when on board circuitry present anomaly in usage or onboard components are faulty affecting the correct range for voltages.

Whole boards are installed stacked into the inside metallic enclosure and include the power supply (in order to minimize the RF emissions). The external connections for antennas and Ethernet are routed outside the metallic enclosure to proper connectors on the IP-65 certified external plastic enclosure.

5. User Configuration & Connections

5.1 Power Connection

- Power is connected through a connector situated on the right side of the unit
- Recommended connection via PVC or Teflon insulated power cable with minimal AWG #24 conductor size.
- Please check installation manual for other available connection types



5.2 External Ethernet Port Connection (10/100Base-T, RJ45)

- Ethernet port connects externally through an RJ-45 type water proof connection on top of the enclosure
- Proper cabling need to be used according to specifications for network cabling. (PC use cross cable, connection via Hub use straight cable, or as specified)
- Ethernet subsystem can be power down under firmware control using board internal control I/O pins in order to avoid extra consumption (when not used)



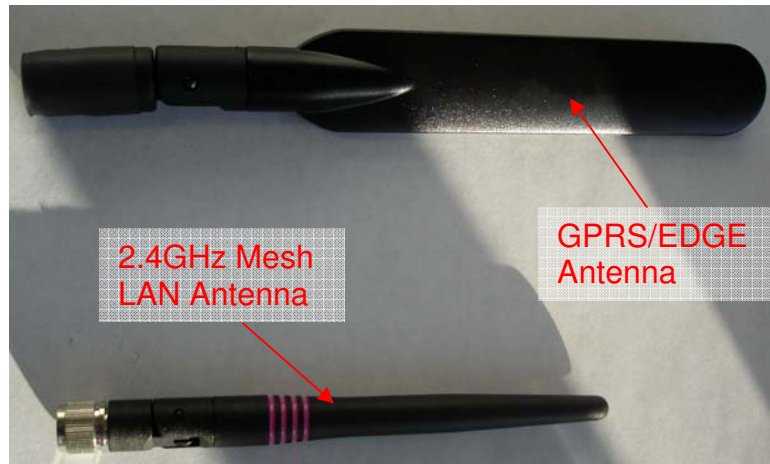
- Pin usage for Ethernet (10/100Base-T, RJ45 connection) are presented below:

Pin	Signal	Description	Direction
1	TD+	Transmit Data (+) Line	Output
2	TD-	Transmit Data (-) Line	Output
3	RD+	Receive Data (+) Line	Input
4	Not Used		
5	Not Used		
6	RD-	Receive Data (-) Line	Input
7	Not Used		
8	Not Used		

- Usage of a Lightning Protection device between Ethernet port and actual connection cable is recommended for exterior installations. We recommend usage of a device similar to <http://www.hyperlinktech.com/web/al-cat5w.php> .

5.4 Antenna Ports

- Antenna ports are situated on the sides of the enclosure.
- Antennas used have been specified in accordance to FCC certifications for the device.



- On the left side of enclosure (the pedal shaped antenna) is the WAN connection antenna. This is a quad band antenna specifically designed for GSM/GPRS operation.

GPRS/EDGE – WAN ANTENNA	
Description	ANTENNA RUBBER DUCK MULT-BAND SMA
Model	T6140AM-AGDPU-S
Manufacturer	Nearson Inc.
Vendor	Digi-Key Corporation
Vendor P/N	730-1016-ND
Gain [dBi]	2.0
Connection Type	SMA (Male), Swivel

- On the right side of enclosure (the ring marked) is the mesh LAN connection antenna. This is a 2.4GHz antenna specifically designed for ISM band operation.

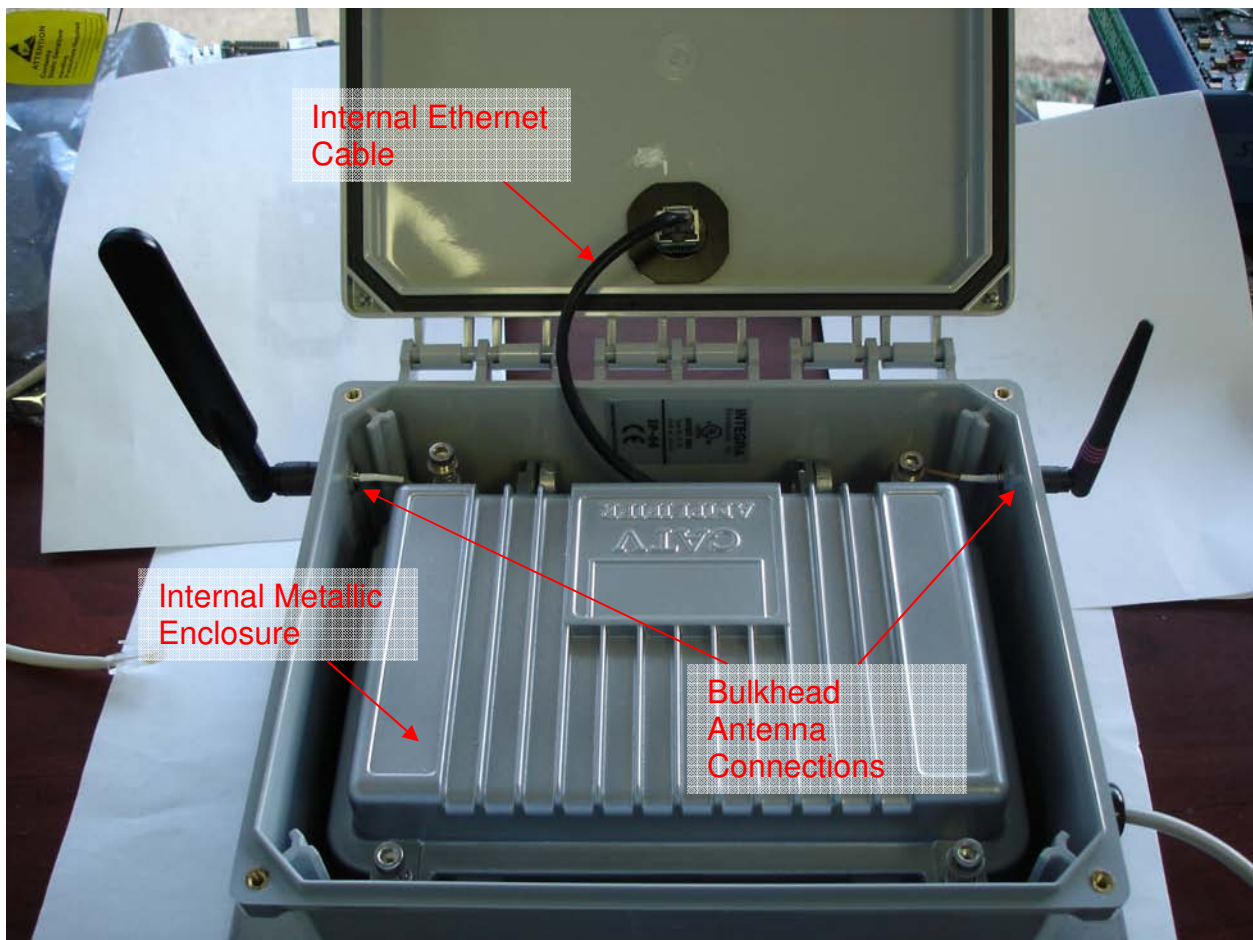
2.4GHz – MESH LAN ANTENNA	
Description	ANTENNA 2.4GHZ 1/2 WAVE RP/SMA
Model	ANT-2.4-CW-RCT-RP
Manufacturer	Antenna Factor
Vendor	Digi-Key Corporation
Vendor P/N	ANT-2.4-CW-RCT-RP-ND
Gain [dBi]	2.2
Connection Type	SMA Reverse (Female), Swivel

6. Internal Connections

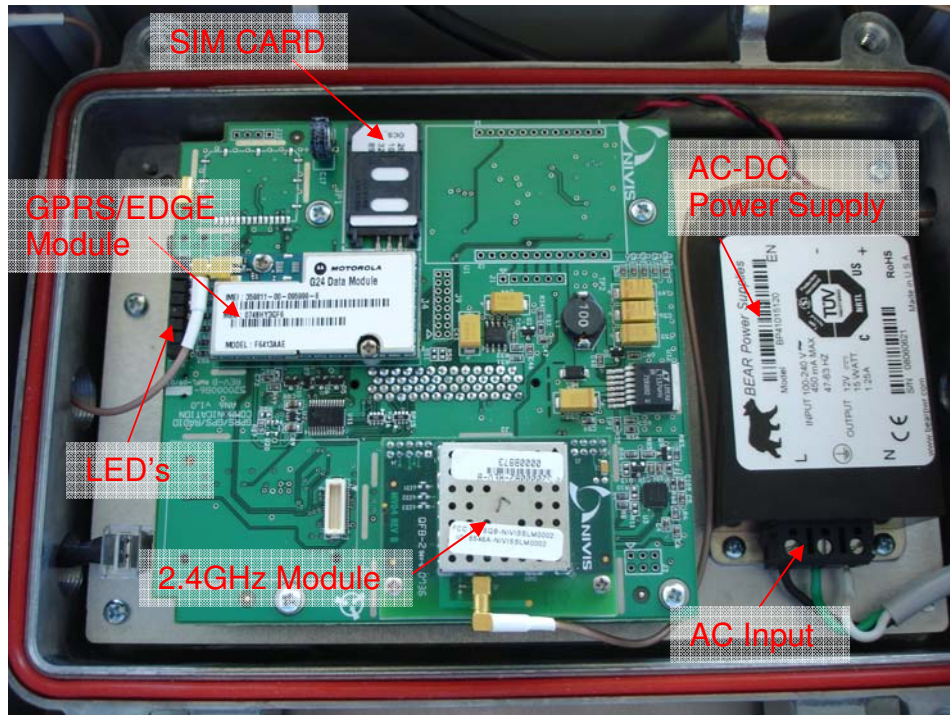
6.1 Connectors and cables

- Internal Connections are used for engineering diagnostics and factory configuration of the unit.
- Usage and access to those connection are described in separate documents
- Those connections are internal and accessible only if unit is opened
- WARNING: Unit can be damaged by improper use of internal connections

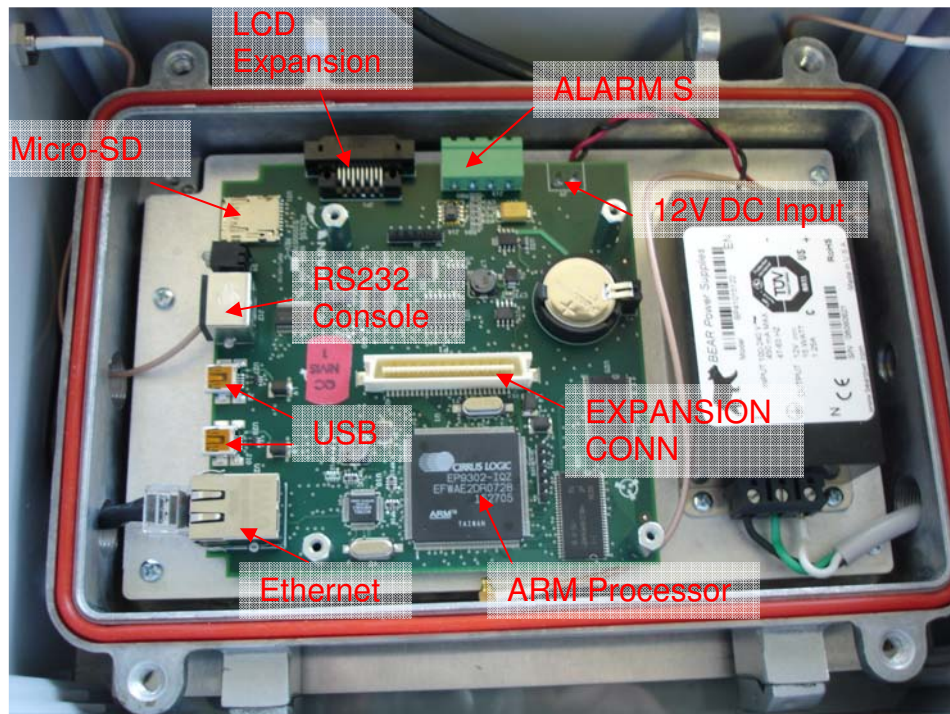
- Enclosure View



- Communication Board View

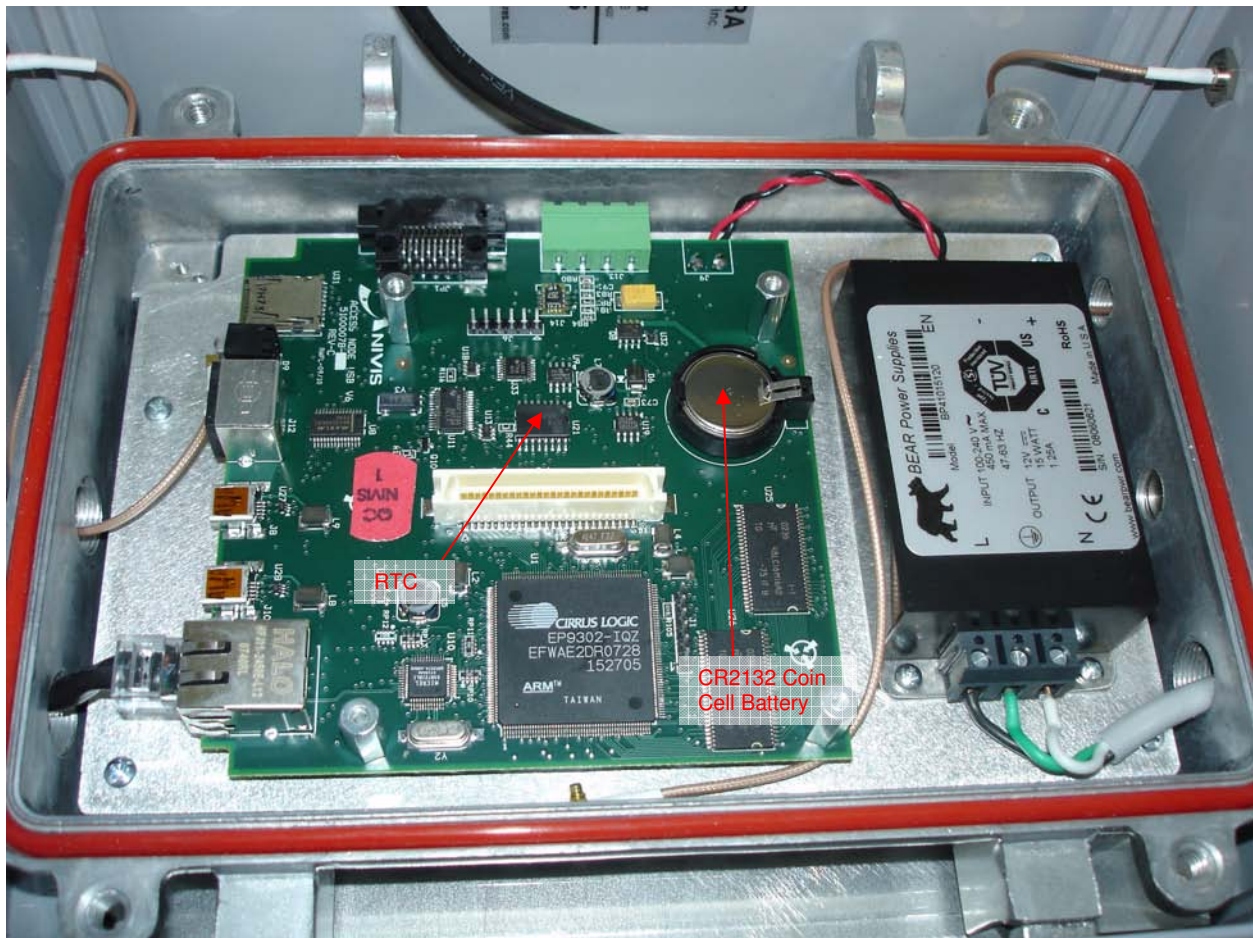


- Main Board View



6.2 RTC Back-up Battery

- The device contain a coin cell battery socket to accommodate battery for RTC
- Socket should be populated with a coin cell CR2032 battery type
- Follow indicated polarity for battery installation, (+) on bottom.
- Anticipated battery life based on theoretical calculations is 10 years.
- Battery should be replaced as needed based on unit usage
- Inspection for corrosion is recommended when battery change is done
- WARNING: Unit can be damaged by polarity reverse battery installation
- Default Factory Configuration: CR2032 Lithium Battery Installed (10 year life)



7. Start-Up Procedure

7.1 Quick Power-On

- System is factory preconfigured with firmware to support intended application
- First Install mechanically the Edge Router according to Installation Manual
- Verify proper installation and positioning of the external antennas.
- Install power connection and apply AC power to the system.
- Wait about 1-2 minutes for the system to boot and connect to NOC
- Verify with NOC specialists if system has registered and all subsystems are running properly
- Coordinate tests and actions with NOC personnel if issues appear at installation
- There are no field accessible configuration elements on the hardware of the device, configuration changes are solely achieved under firmware control

Note: The Ethernet port can be used for field configuration and debug according to documentation provided. For direct PC or PDA connection use appropriate crossed type cable.

8. RF and Compliance

8.1 RF Exposure Limits WARNING

To comply with FCC's RF exposure limits for general population / uncontrolled exposure, the antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20cm from all persons and must not be collocated or operating in conjunction with any other antenna or transmitter.

8.2 Compliance Statement (Part 15.19)

This Device complies with Part 15 of the FCC Rules.

Operation is subject to the following two conditions:

- This device may not cause harmful interference.
- This device must accept any interference received, including interference that may cause undesired operation.

8.3 Information to the user (Part 15.105)

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 in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

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

8.4 WARNING (Part 15.21)

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

Appendix 1

- Mechanical outline and dimensions:

