Intuicom®

EB-6 PLUS™

HIGH-SPEED IP/ETHERNET DATALINK

User Guide

This manual is for use by purchasers and other authorized users of the Intuicom Products. No part of this document may be reproduced or transmitted in any form or by any means, electronic or mechanical, or for any purpose without the express written permission of Intuicom Inc.

FCC Notification

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 device must be operated as supplied by Intuicom, Inc. Any changes or modifications made to the device without the express written approval of Intuicom, Inc. may void the user's authority to operate the device.

CAUTION: The model number FIP1-900N2B-HE has a maximum transmitted output power of 871mW. It is recommended that the transmit antenna be kept at least 23 cm away from nearby persons to satisfy FCC RF exposure requirements.

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.

Note: Whenever any Intuicom, Inc. module is placed inside an enclosure a label must be placed on the outside of that enclosure which includes the module's FCC ID.

This product is licensed by The United States. Diversion contrary to U.S. law is prohibited. Shipment or re-export of this product outside of The United States may require authorization by the U.S. Bureau of Export Administration.

Please contact Intuicom, Inc. for further assistance and information.

Table of Contents

1 Product Overview

The Intuicom EB-6 Plus (Intuicom P/N: FIP1-900N2B-HE) combines the best-in-class overall wireless performance with a robust and secure communications interface.

Key Features Include:

- High-Speed 867Kbps Over-the-Air Data Rate
- Long Range Operation with High Sensitivity
- 10/100 Ethernet Interface with Auto-Crossover
- Dual RS232/RS422/RS485 Serial Interfaces with IP Terminal Servers
- 128-Bit AES Data Encryption
- Web Based Configuration and Diagnostics
- RADIUS Authentication
- Low Power Consumption
- Flexible Singe Unit Operation – each unit can be configured as a Gateway, Endpoint, Repeater/Endpoint
- Optional Embedded GPS

Physical Layout:
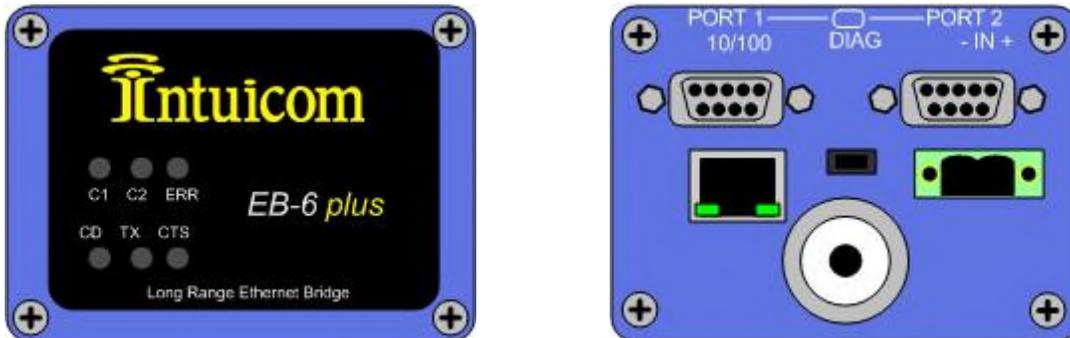
Figure 1-1: EB-6 Plus Front and Back Panels

The EB-6 Plus front panel has six status LEDs, three of which indicate radio status and three of which indicate overall unit status. See **Appendix D - Radio LEDs** for detailed information about LED status indicators. The back panel contains all of the connectors for wireless antenna, Ethernet, serial, and power

2 Configuration

An EB-6 Plus must be configured before it can be operated as part of a wireless or IP network. Configuration is performed in two steps. First, the unit must be given an initial IP address. This IP address can be the unit's final IP address – but the goal is to allow access to the Web-based configuration when the unit's Ethernet interface is plugged into a local LAN. The initial IP address configuration can be accomplished in two ways:

- by attaching to a serial port 1 and signaling the unit while it is booting or,
- attaching the unit to an Ethernet network and "discover" the unit with a utility running on a PC attached to the same network.

After access to the Web-based configuration pages is available – a complete configuration can be performed. The Web-based configuration interface is how the unit's configuration is maintained after it is deployed.

In order to begin configuration – make sure you have the following available:

- EB-6 Plus unit to be configured
- Power adapter
- Serial Cable (straight through serial cable)
- Ethernet Cable
- PC with available serial port and terminal application (such as HyperTerminal)
- PC with network adapter configured with an IP address and Web browser (can be same PC as above)
- Intuicom EB6plus Discovery Utility (included on CD shipped with unit or from Intuicom directly)

2.1 Initial IP Configuration - Serial

To set the unit's initial IP address, connect a serial cable between the PC's serial port and the unit's PORT-1. Start a terminal application on the PC such as HyperTerminal and configure it to use the serial port to which the unit is connected (likely COM1) using the following values:
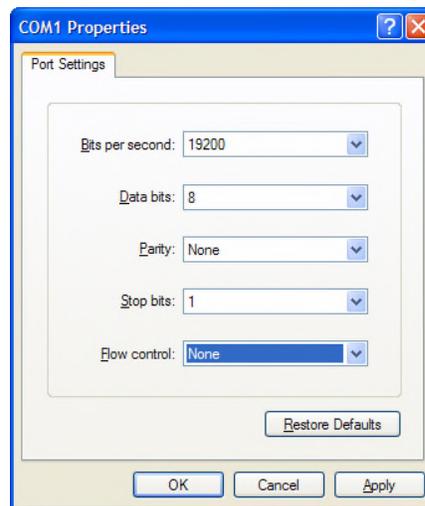
Note: Be sure HyperTerminal is indeed set as above and does **not** show "Autodetect" in the status bar for terminal type or serial port configuration.
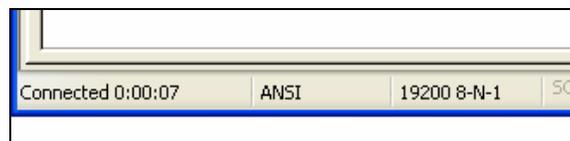
The next step must be performed while the unit is booting: Apply power to the unit and watch for a prompt asking if you would like to enter setup mode. Note that his prompt only waits a few seconds for a response before continuing with the boot. Respond with "Y" to be presented with the option to change the current IP configuration.
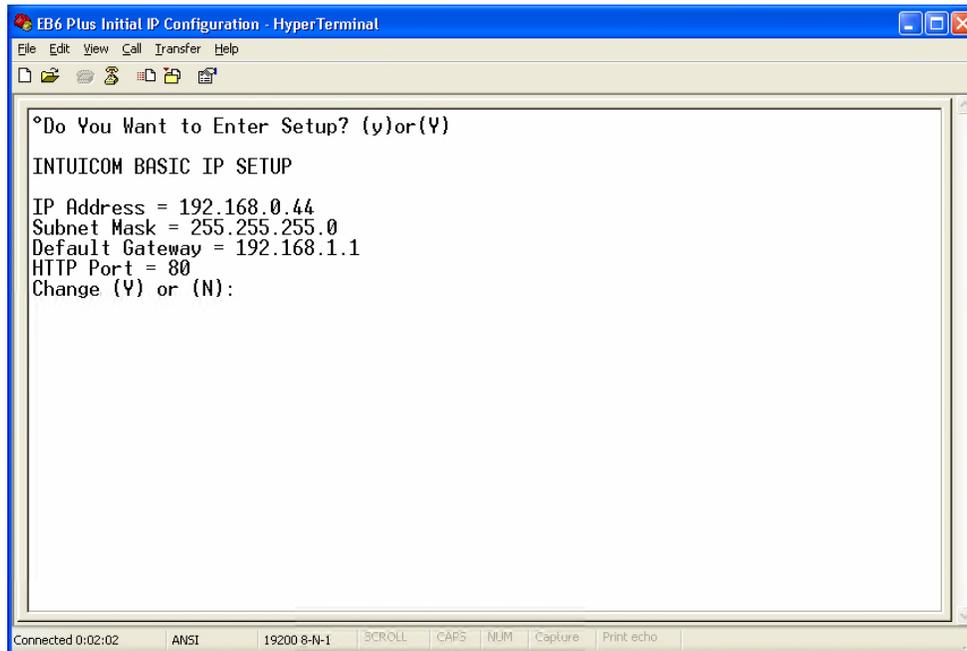
Type "Y" and enter an IP Address, Subnet Mask, and Default Gateway values valid for the LAN to which the unit will be connected. To keep the existing entry – type Enter. If you make a mistake, you will be prompted again if you would like to change the values. Enter "N" to confirm the IP Address configuration and allow the unit to continue to boot. You can now proceed with connecting to the unit using the Web-based configuration interface.

2.2 Initial IP Configuration – Discovery Tool/PC Utility

Using the Intuicom Discovery Tool utility to discover and set IP addresses of network connected EB-6 Plus units requires no serial connections. Simply connect both the unit to be configured and a PC to a common Ethernet network and execute the Intuicom Discovery Tool (included on CD shipped with units or available from Intuicom) "DiscoveryTool.exe".
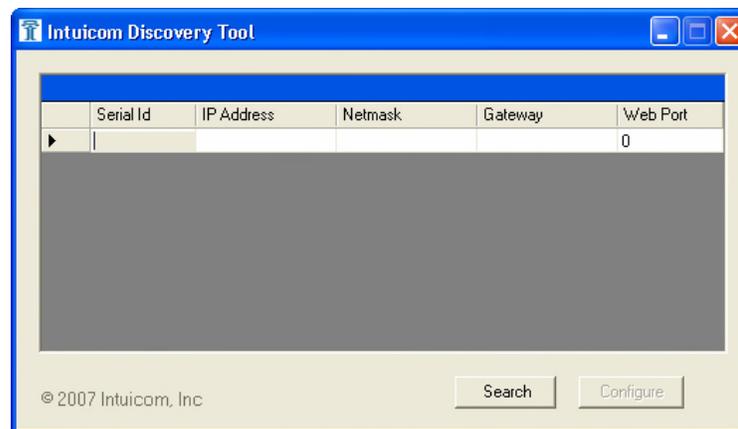
Next click the **Search** button on the tool to discover EB-6 Plus units available on the Ethernet network:
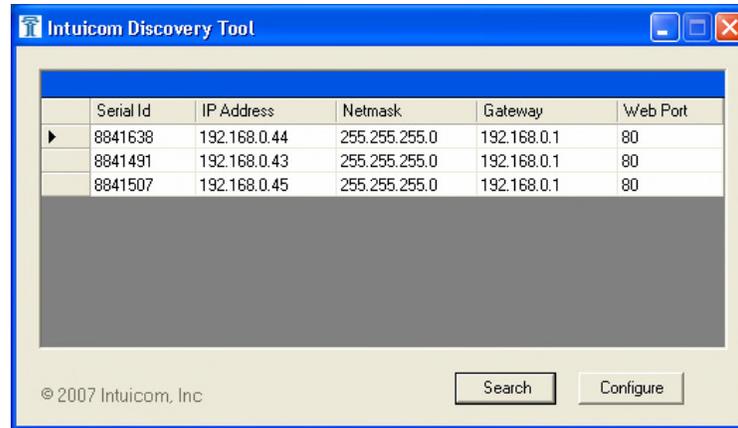
Select the unit to be configured and click the **Configure** button to display the unit's configuration dialog. Because this configuration can occur without physical access to the unit, a password is required. This password is the same as the Admin password for the Web-based configuration. The default password is: admin.
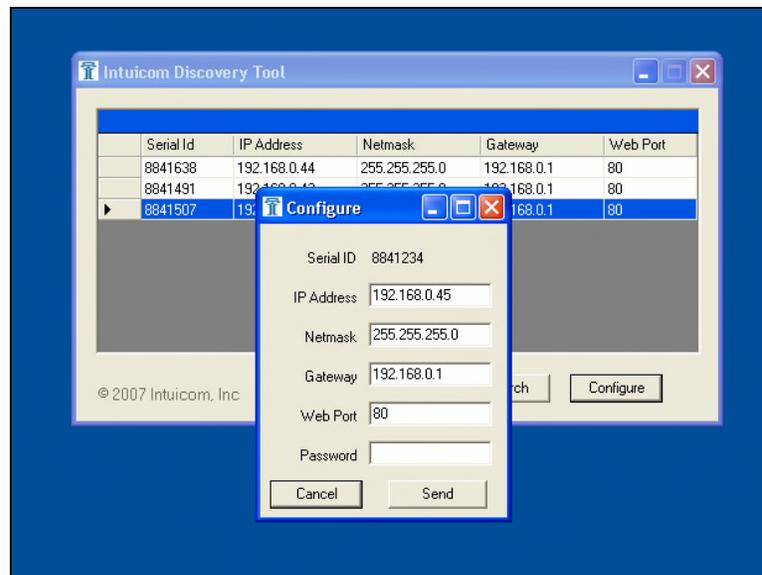
Configure the unit's IP address, Netmask, Gateway and web port as necessary, fill in the password and click send. The unit will receive the configuration change, and reboot. You can now proceed with connecting to the unit using the Web-based configuration interface.

2.3 Web Based Configuration Interface

Access the Web Based configuration by opening a web browser and entering in the IP address of the unit. This may be the IP address configured in the Initial IP Configuration.
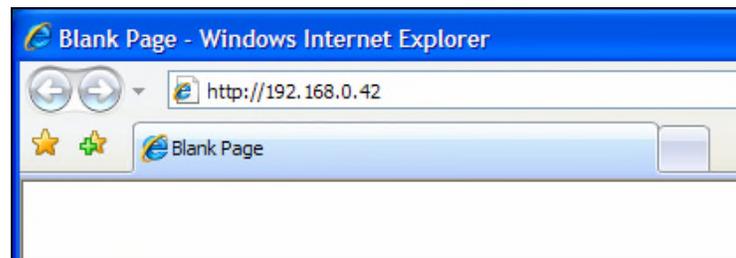
Network access to the unit's configuration requires a username and a password. An EB-6 Plus has two fixed usernames with different levels of access: **admin** and **guest**. The default factory passwords for the usernames are **admin** and **guest** respectively. Enter admin/admin to begin configuration.

After a username and password are successfully entered the unit's main Status Page will be displayed. This page refreshes itself automatically with up to date statistics. Click on the Hyperlinks in the left column to access the different configuration topics.
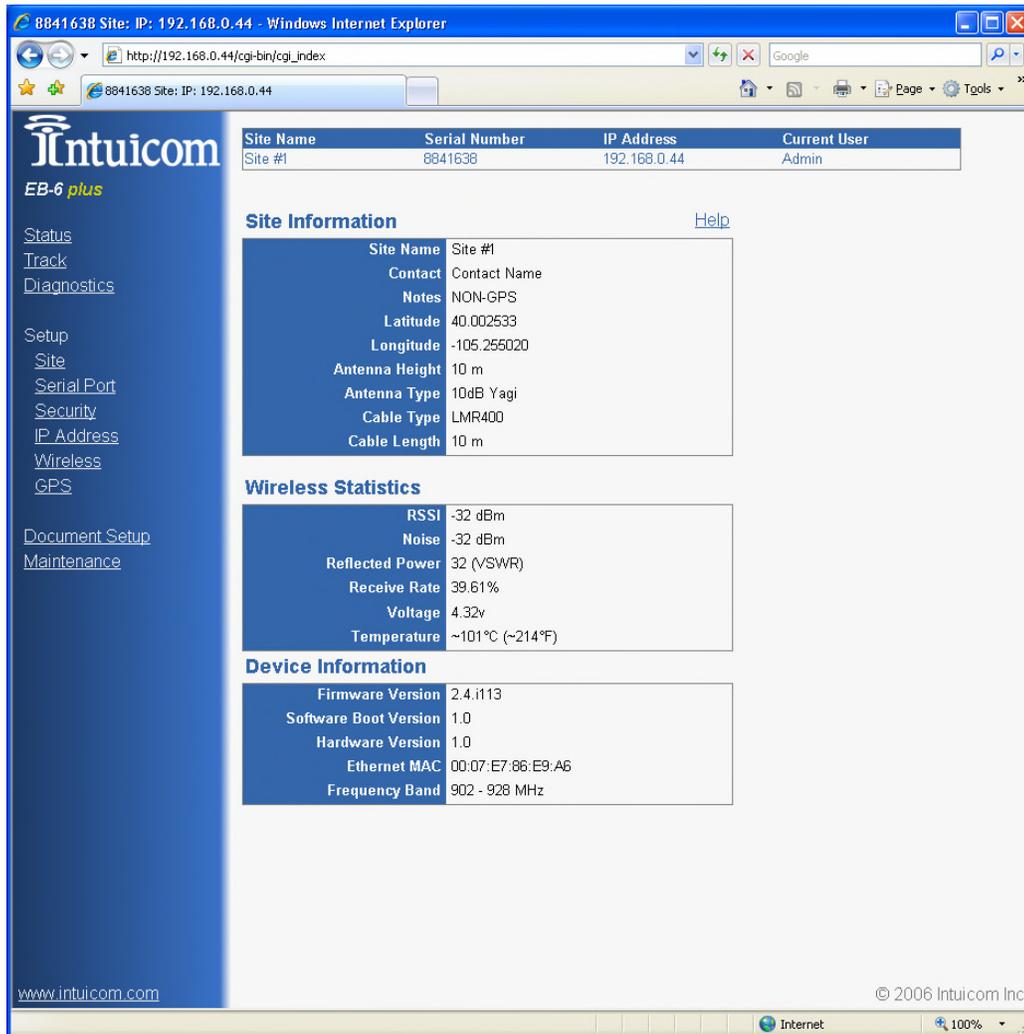
IMPORTANT: On each configuration page there is a button for SAVE and REBOOT. Configuration changes made to each page must be SAVED prior to moving on to another configuration page. Configuration changes will take effect after the unit is rebooted. It is suggested that the user make and save all necessary changes, then reboot the unit for changes to take effect.

2.4   Configuration Overview

Click the hyperlinks in the table on the left of the Web-based interface to access the different configuration/setup, maintenance, and status topics:

Status – This read-only page contains key fields for the unit's operational status

Track –This page provides a link for integration with Google Earth®. For non-GPS enabled units, it will provide a link with the user supplied position and other site data. For GPS units it provides a link allowing the user to track the position of the unit in real-time.

Diagnostics –This read-only page automatically refreshes real-time graphs for signal, noise and antenna reflected power.

Setup: Site –This setup page contains all fields for specifying site/unit specific data such as the site name, contact name, location, antenna setups, etc. This page is not critical for operation.

Setup: Serial Port –The setup page for configuring serial port/terminal server behavior.

Setup: Security –The setup page for specifying security relates parameter such as passwords, data encryption and RADIUS.

Setup: IP Address –The setup page for specifying the unit's IP address, netmask, and gateway, along with the TCP port for the Web-based configuration pages.

Setup: Wireless – The setup page for specifying all parameters related to the unit's wireless link.

Setup: GPS –For GPS enabled units, this page provides the interface to configure GPS data streams and applications.

Document Setup –This link launches a separate web page with a summary of the unit's configuration.

Maintenance – This page provides an interface for maintenance tasks such as upgrading the unit's firmware.

The amount of configuration necessary for a given unit depends upon your application, but at a minimum, the IP Address, and Wireless configurations must be completed to successfully operate the unit in a wireless network.

2.5 Status

The status page provides a summary of key operational and site data for the unit.
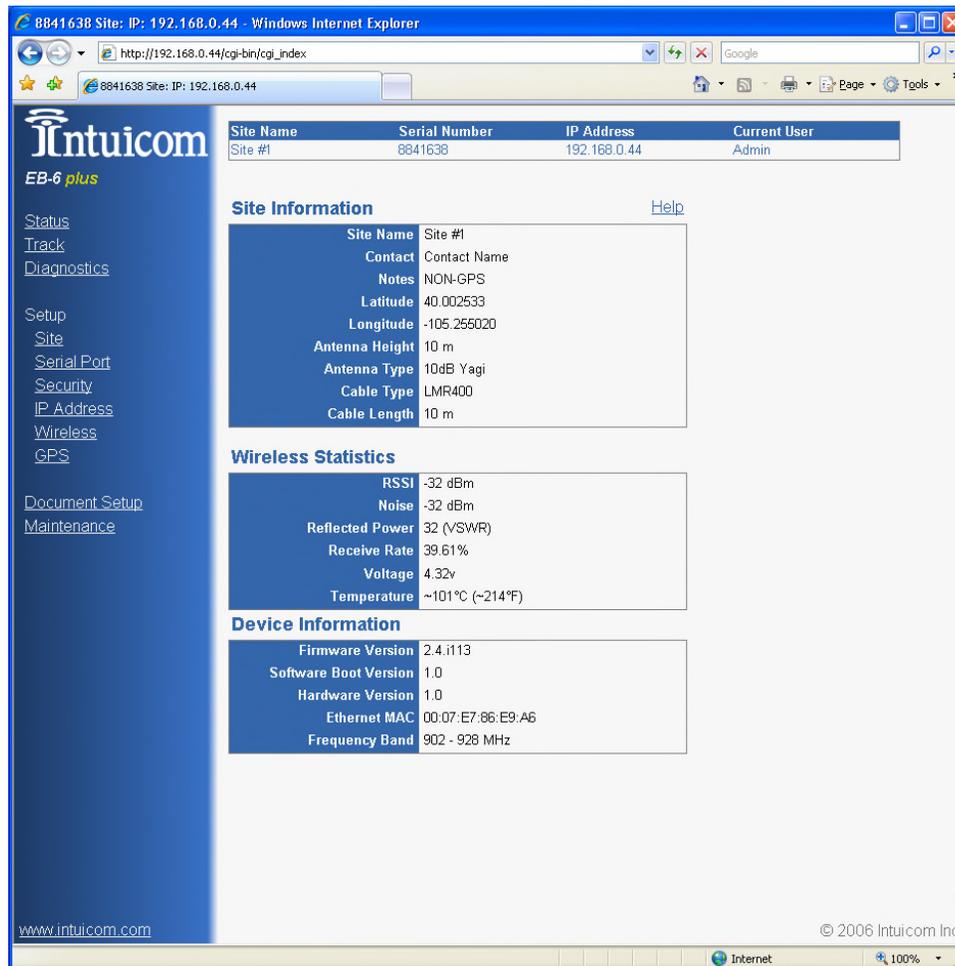
Site Information block contains user supplied/specified fields. These fields are for reference and documentation purposes and do not affect the unit's operation. Use the Setup: Site page to configure these parameters. It is generally very useful in troubleshooting to have key site information available. The Latitude and Longitude fields are user entered on a non-GPS page, but are dynamic and filled in by the GPS on a GPS enabled unit.

The **Wireless Statistics** block contains information about the wireless link. These fields are not valid unless the unit is currently linked to another unit(s) wirelessly. The reflected power field is an indication of the quality of the transmission line quality. A high reflected power (above 25) indicates that the antennas and/or the transmission line could be improved for better range/performance.

The Device Information block provides static information about the unit itself. While the firmware/software versions may change with upgrades, the MAC and frequency band will remain fixed.

See Section 3.2 for more information about the Status page.

2.6   Track

The EB-6 Plus has the ability to generate a KML file for use with Google Earth ©. This feature can be very helpful for troubleshooting and documentation. For GPS enabled units, this feature allows the unit's position to be tracked in real-time.
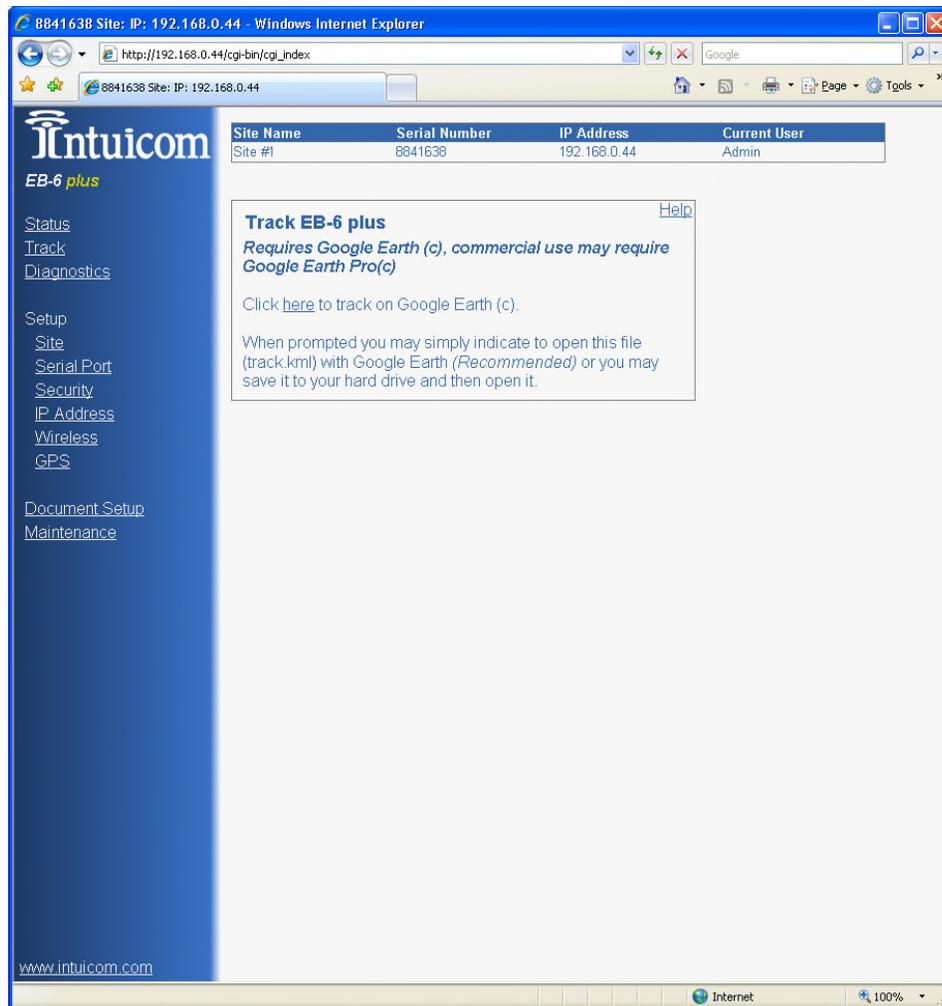
Clicking on the link on this page will launch Google Earth© with the necessary data to plot or track this unit. If you have filled out custom HTML text in the site page, that text or link will be present in the balloon connected with the plotted position.

Depending upon its use, this feature may require the Professional version of Google Earth©.

2.7 Diagnostics

This read-only page provides real-time wireless link statistics in the form of xy graphs. See Section 3.2 for more information.
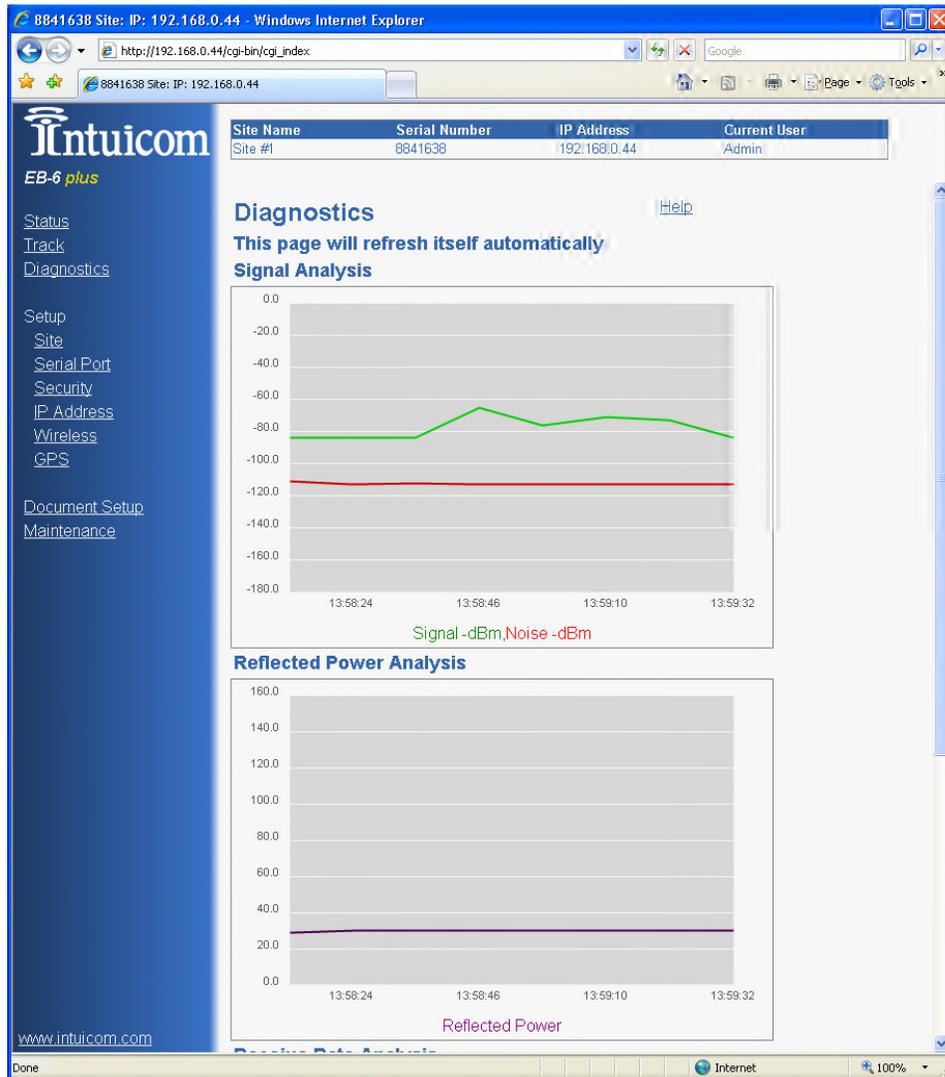
2.8 Setup: Site

The site page allows the user to enter site specific data about this unit's installation. Data from this page is utilized for a number of features including the Document Setup page, and for the Track page.

Completing these fields with accurate data can be very beneficial when it is necessary to troubleshoot a site.
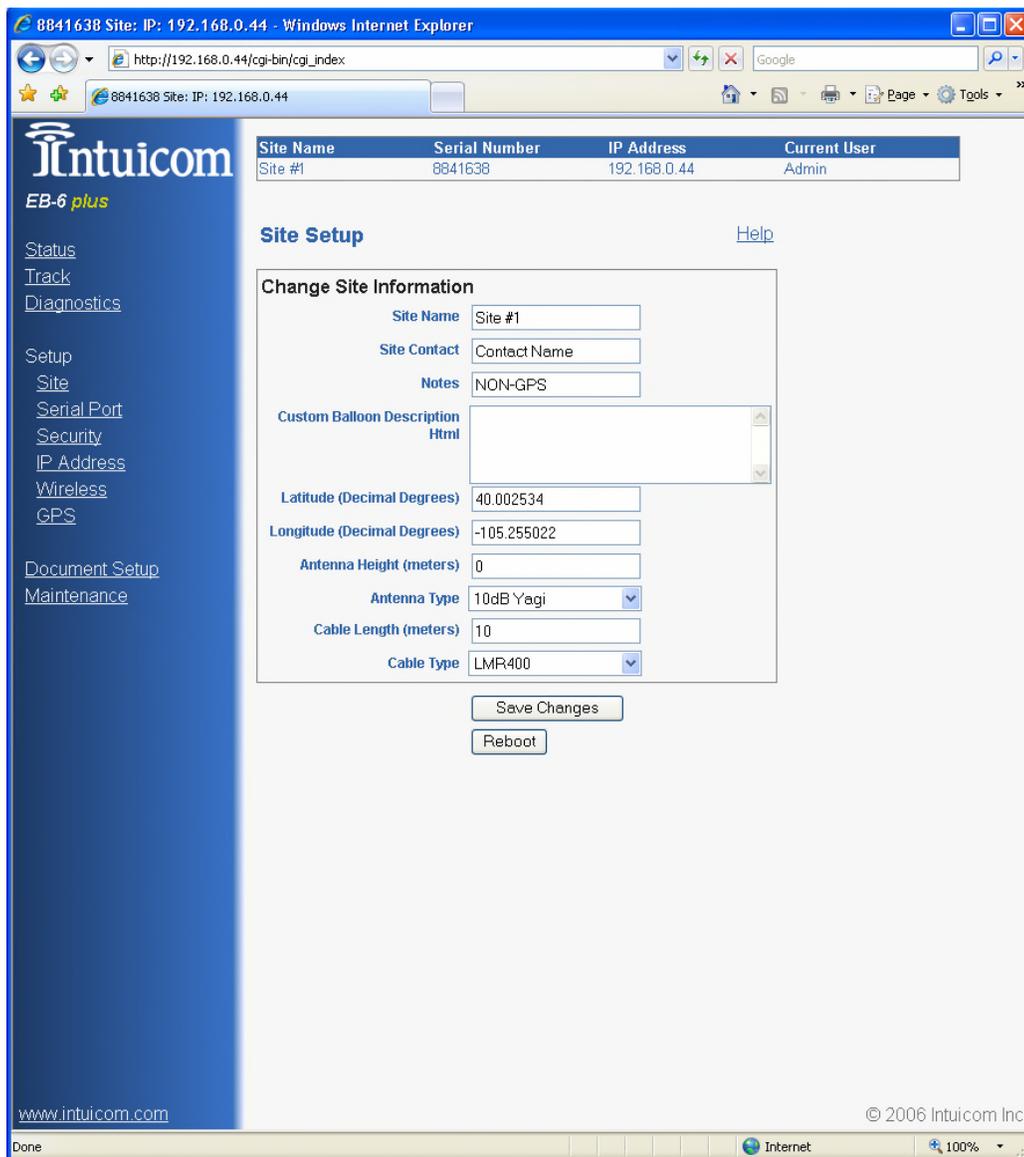
The **Site Name, Site Contact**, and **Notes** fields are user supplies free-text fields.

The **Custom Balloon Description HTML** field allows the user to supply HTML text that will be displayed in the balloon in Google Earth© when utilizing the Track feature. Text in this field (limited to 512 characters) could be a simple link:

`<a href="`http://www.intuicom.com`" target=_blank>Intuicom Home Page</a>`

Or an image:

`<img src=`http://....`/>`   **etc...**

Non GPS Units:

For Non-GPS units, the fields **Latitude**, **Longitude**, and **Antenna Height** will appear and allow the user to specify the unit's installation location and height of the antenna. Be sure to complete these fields in degrees i.e. -105.1897 longitude.

GPS-Enabled Units:

For GPS enabled units, the Latitude and Longitude are automatically filled in by the embedded GPS. The **Clamp to Ground** field specifies a behavior for the Google Earth© Track feature – whether the unit should be plotted at its reported altitude or whether it should be plotted at ground level.

For the Antenna Type, Cable Length, and Cable Type fields, specify the details to reflect the unit's installation.

Again, these fields do not affect core operation of the unit. An incorrect antenna type specification, for example, will not adversely affect the unit's operation.

2.9 Setup: Serial Port

The EB-6 Plus has two serial ports that can be enabled to operate as TCP Terminal Servers. Each serial port can operate in RS232, RS422 or RS485 mode. A unit with the embedded GPS option will only have a single serial port available.

The serial terminal server can operate in two different modes: either as a TCP server, where clients can connect and thus be connected to the serial port, or as a TCP client, where the unit establishes a TCP connection to some remote server, and then transmits data to and from the serial port. When operating as a TCP server, the unit has an alarm feature allowing it to temporarily act as a TCP client when data arrives on its serial port.

Terminal Server – select this checkbox to enable a TCP Terminal server for this serial port. Specify the TCP port number for this terminal server.

Terminal Client – select this checkbox to enable this serial port to operate as a TCP Client, connecting to a remote TCP server. Specify the OP address and TCP port for the remote TCP server. Note that Terminal Client and Terminal Server cannot be simultaneously selected.

Alarm – select this checkbox to enable the alarm feature. The alarm feature is only enabled when operating as a Terminal Server for this serial port. Specify the remote IP address and TCP port number for the alarm feature to connect to when data is present on the serial port.

Baud Rate, Data Bits, Stop Bits, Parity Flow Control - specify the serial parameters to match the serial interface for the connected device.

CD Mode – Controls the operation of the CD pin of the serial port. In Normal mode, the CD pin indicates link status, and in Keying mode, the CD state changes while data is transmitted out the serial port – the keying mode can be used to key the transmit of another radio system.

Interface – Selects there serial interface mode: RS232, RS485, or RS422.

Modbus RTU – Enables a Modbus packing algorithm that attempts to consolidate bytes of individual modbus packets, eliminating interbyte latency.
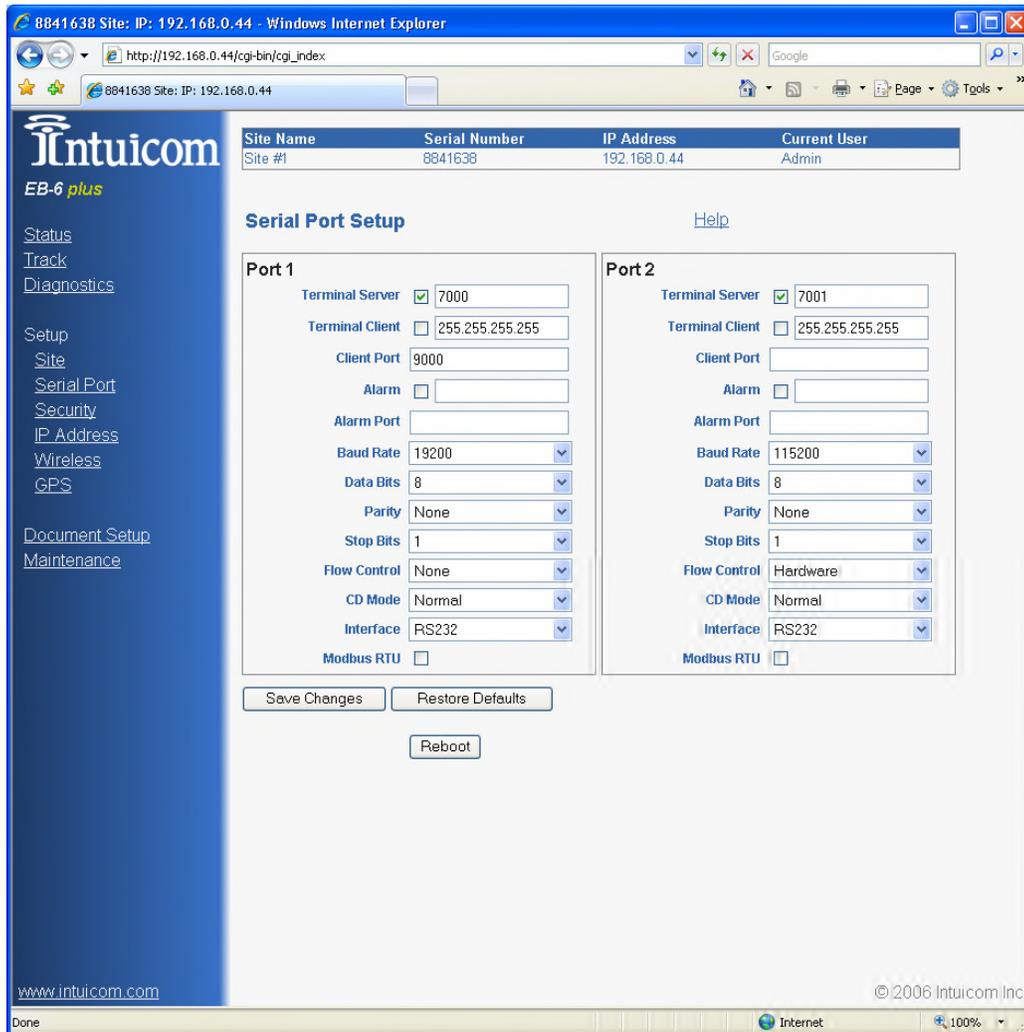
See **Appendix B – Serial Pinouts**– for more information about operating RS485 or RS422.

2.10 Setup: Security

The security page contains parameters for configuring the unit's security features including the Web-based configuration password, RADIUS Authentication and AES data encryption.

2.10.1 Password

Configure the Password for either the Admin or the Guest Web-based configuration user. The Admin user has permissions to modify configurations, while the Guest user can only view certain portions of the configuration.

2.10.2 AES Encryption

The EB-6 Plus protects all data communications over the air using 128 BIT AES encryption. When the encryption key field is blank, a default key is used. If desired, enter your unique encryption key. This key must be the same on all radios that will operate in a given wireless network. Units with different keys cannot communicate wirelessly.

2.10.3 RADIUS Authentication

The EB-6 Plus can optionally use RADIUS (RFC 2138) authentication standard to determine if a given radio (Endpoint/Repeater) has authorization to access the network. The RADIUS configuration differs if the unit is operating as an Endpoint/Repeater or a Gateway. You may need to seek assistance from your Network Administrator to obtain these values.

RADIUS Server Configuration

Your network administrator will need to configure the RADIUS server for each Endpoint that will authenticate. The IP Address of each Endpoint unit should be entered into the RADIUS server's "Clients" configuration/file. Additionally, the serial number of each unit (no hyphens) should be added to the RADIUS server's "Users" configuration/file.

Gateway Configuration

To require all Endpoint (See Wireless Configuration) radios to authenticate, check the ENABLE checkbox on the **Gateway** radio (there is only one Gateway radio per wireless network). Additionally configure the **IP Address** and **Port number** for the RADIUS server.

Endpoint/Repeater Configuration

For Endpoint or Repeater units, complete the **Shared Secret** and **Password** fields.

Shared Secret – Enter the appropriate secret for the RADIUS server this Endpoint will be using for authentication.

XXXXXXX Password – Enter the appropriate password that this Endpoint or Repeater will be using to authenticate.
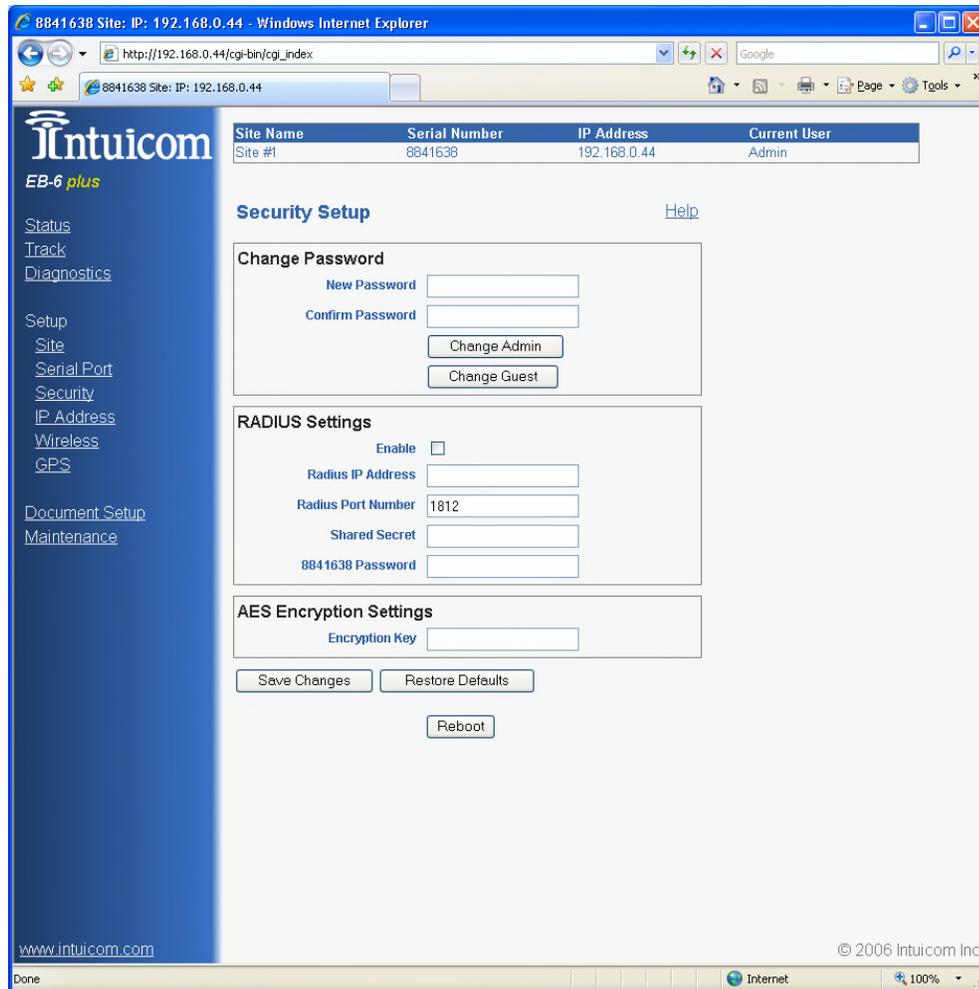
Be sure to save your configuration by clicking the "Save Changes" button. No changes will take effect until the unit is rebooted.

2.11 Setup: IP Configuration

The IP Address Setup page allows the user to modify the unit's current IP address, subnet mask, default gateway and HTTP port for the Web Based configuration. Coordinate with your Network Administrator to aid in configuration your wireless network so it will integrate with your existing LAN.

Be sure to save any changes using the "Save Changes" button.

Changes will take effect the next time the unit is rebooted.
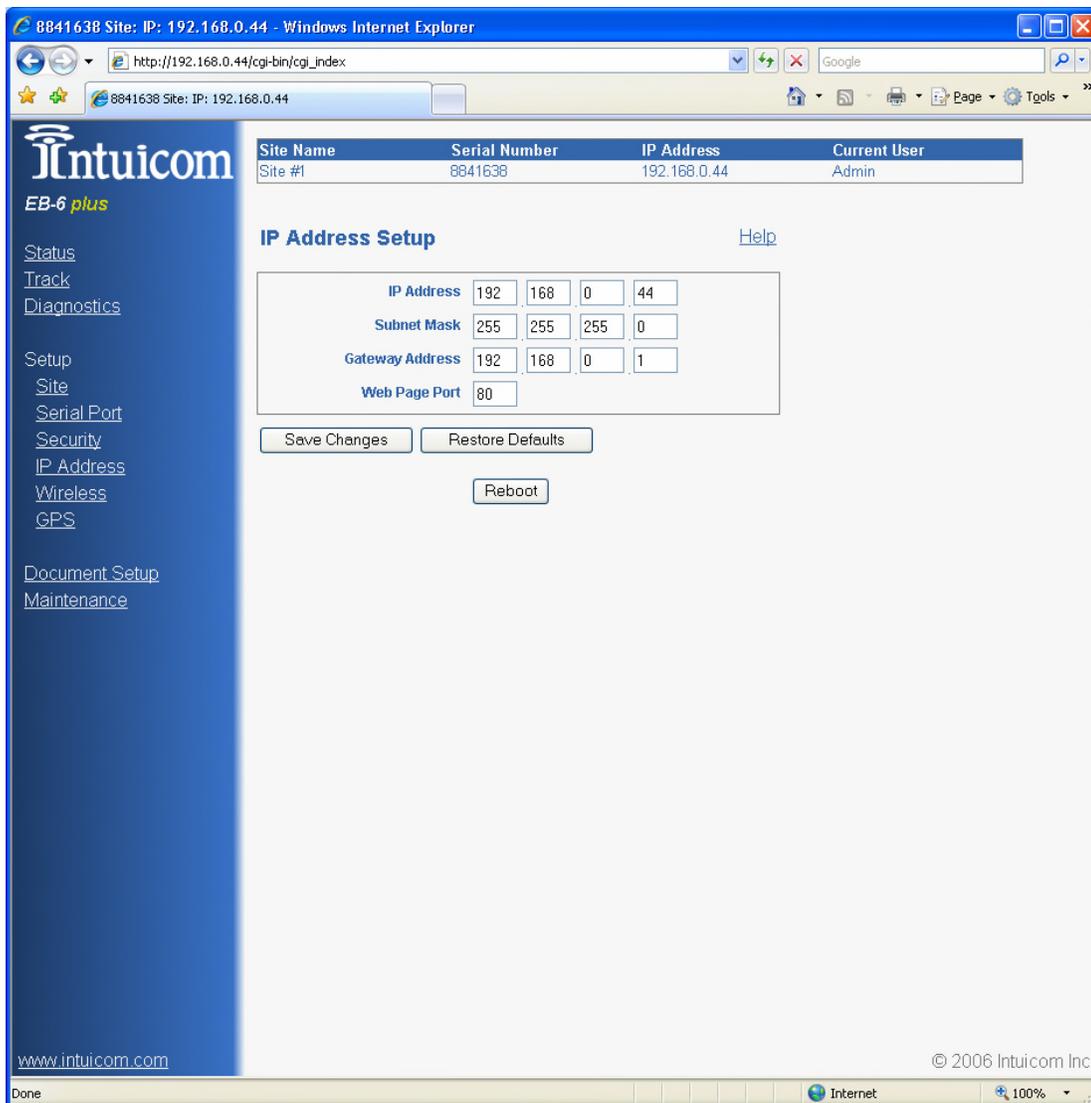
2.12 Setup: Wireless

For the unit to participate in a wireless network, the Wireless Setup must be completed correctly.
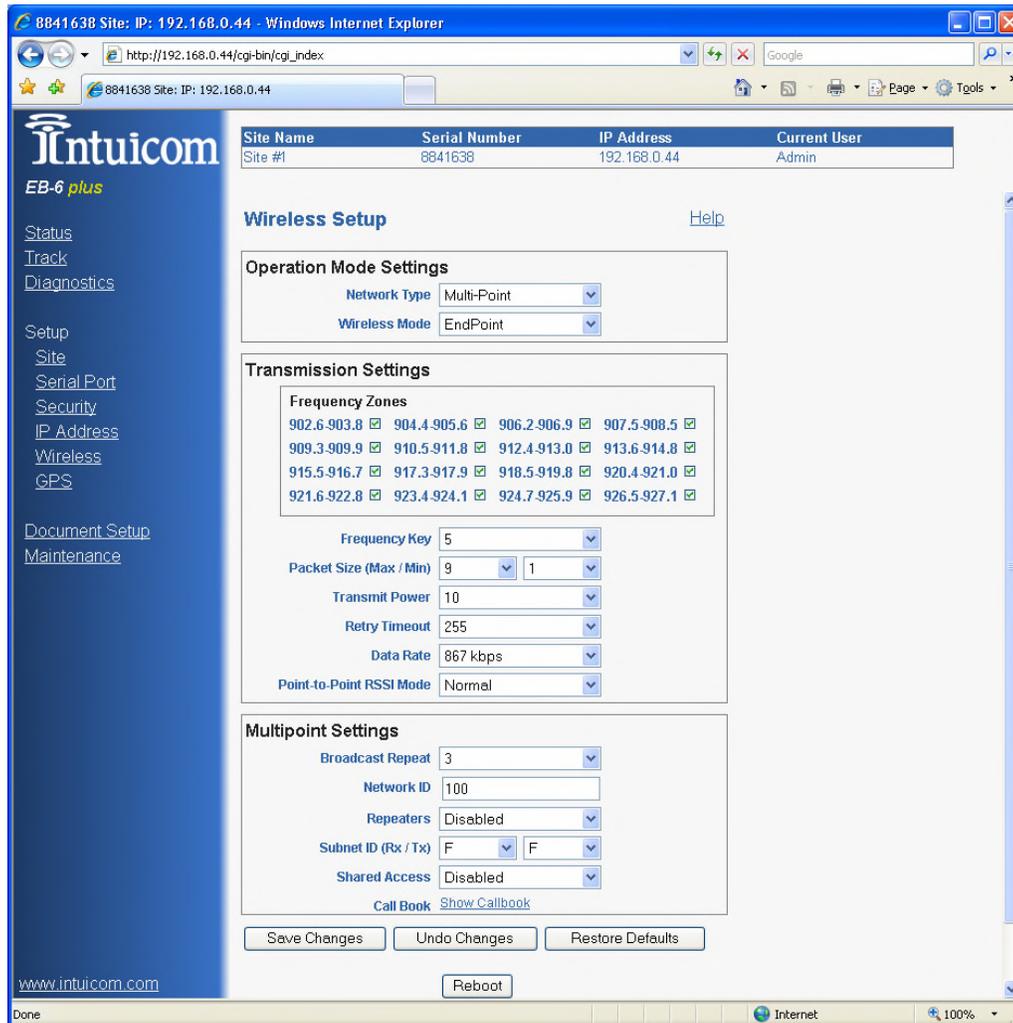
2.12.1   Operational Mode Settings

The first step in the Wireless Setup is to select the wireless **Network Type** and the role or **Wireless Mode** this unit will play in that **Network Type**.

There are two types of networks available: **Point-To-Point** (PTP) and **Point-To-Multipoint** (PTMP). Choose PTP if your network only consists of two stations communicating with each other (this can occur through up to four repeaters). Choose PTMP if your network will consist of multiple endpoints all communicating back to a central location (possibly through one or more repeaters).

The next step is to choose the **Wireless Mode** or role this unit will play in the selected **Network Type**. The available Wireless Modes are: **Gateway**, **Endpoint**, and **Repeater**. In a given wireless network there must be a single **Gateway**. In a PTP network, there is a single **Endpoint** and up to four **Repeaters**. In a PTMP network, there are an unlimited number of **Endpoints** and **Repeaters**. The most common configuration is a PTMP network with a Gateway, Endpoints and no Repeaters.

| Network Type/ Wireless Mode	Description
Point-to-Point/ Gateway	This mode designates the unit as the Gateway in Point-to-Point mode. The Gateway may call any or all Endpoints designated in its Call Book. A quick method of identifying a Gateway is to power the transceiver. Prior to establishing a communication link with an Endpoint or Repeater, all three of the Gateway's LEDs will be solid red.
Point-to-Point/ End-Point	This mode designates the transceiver as an Endpoint in Point-to-Point mode. The Endpoint communicates with any Gateway in its Call Book— either directly or through up to four Repeaters. When functioning as a Endpoint, the Entry to Call feature in the transceiver's Call Book is not operational.
Point–to-Multipoint/ Gateway	This mode designates the transceiver as a Gateway in Multipoint mode. This mode allows one Gateway transceiver to simultaneously be in communication with numerous Endpoints and Repeaters. A Point-to-Multipoint Gateway communicates only with other transceivers designated as Point-to-Multipoint Endpoints or Point-to-Multipoint Repeaters.
Point-to- Multipoint/ End-Point	This mode designates the transceiver as a Endpoint in Multipoint mode. This mode allows the Endpoint to communicate with a Multipoint Gateway. The Endpoint may communicate with its Gateway through one or more Repeaters.
Point-to-Point/ Repeater	The use of up to four Repeaters in a Point-to-Point communications link is allowed, significantly extending the operating range. When designated as a Repeater, a transceiver behaves as a pass-through link. All settings for the call book, baud rates and radio transmission characteristics are disabled. A Repeater will connect with any Gateway that calls it. The Repeater must be set up properly in the Gateway's call book.
Point-to-Multipoint/ Repeater	This option allows the transceiver to operate as an Endpoint/Repeater in a Multipoint network.

Keep in mind that enabling repeaters for a network has an impact on available bandwidth – reducing it by ~ 50%.

The following two diagrams are examples of PTP and PTMP networks:
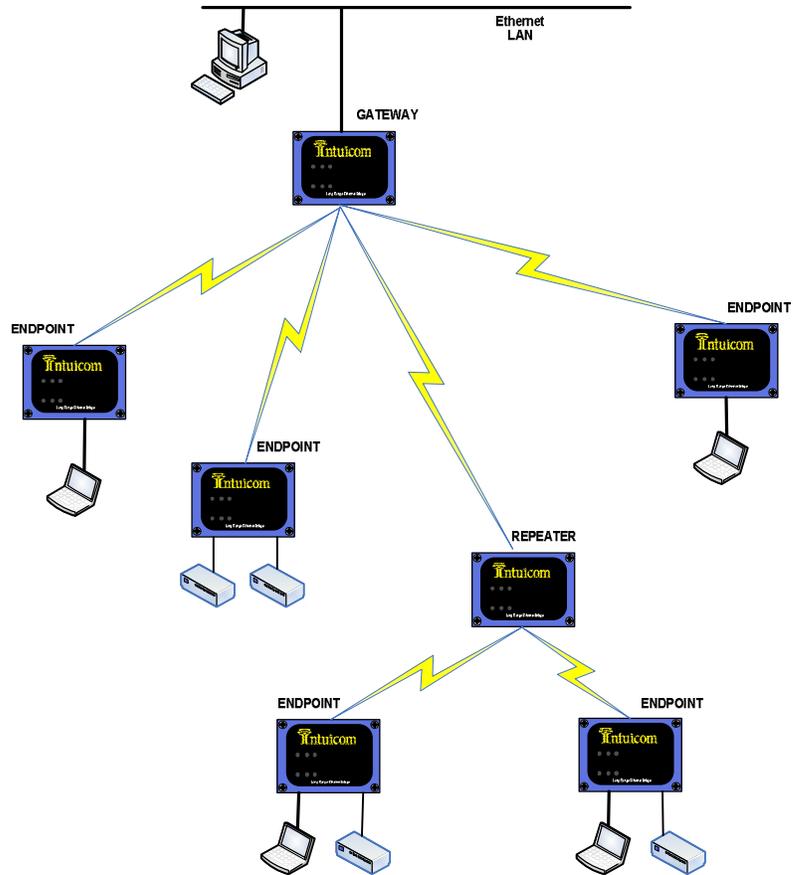
Figure 2-1: Example Point-To-Multipoint Network
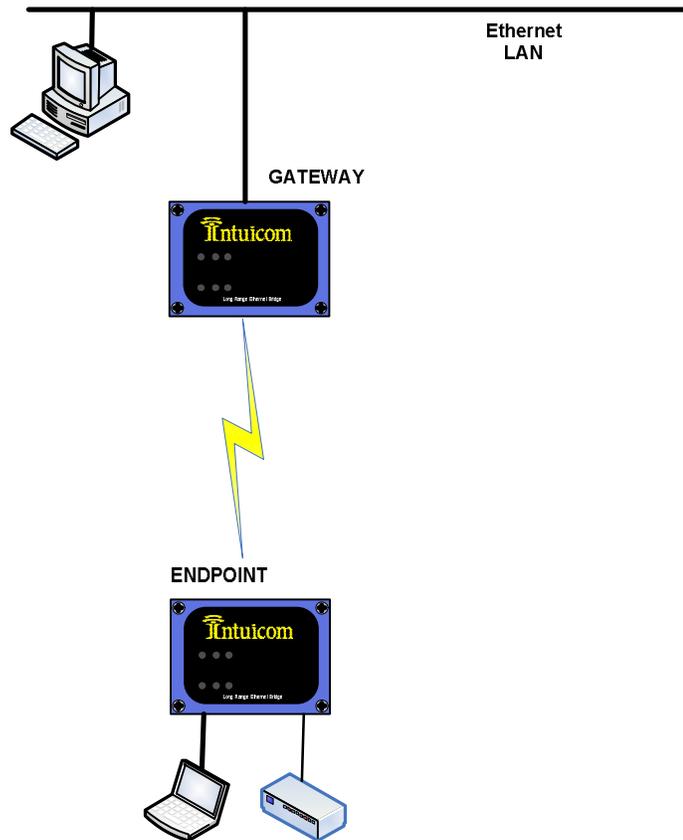
Figure 2-2: Example Point-To-Point Network

2.12.2   Transmission Settings

Frequency Zones

The Frequency Zones configuration allows the user to specify which portions of the wireless band can be utilized by the radio. In most cases it is best to leave all zones enabled. Custom band plans for compliance with different country's regulations can be configured be enabling or disabling portions of the band. In the US, at least 60% of the band must be utilized. All radios operating as a network must have the same Zones configuration.

Frequency Key

The Frequency Key controls the hopping pattern of the radio. All radios in a given network must have the same Frequency Key. To minimize interference choose a Frequency Key different than that of other nearby Intuicom EB-6 Plus networks.

Min/Max Packet Size

The Minimum and Maximum Packet Size parameters together control the size of the radio packets sent across the air. Different combinations of Min and Max Packet size, along with Data Rate, can optimize a given network for throughput or latency. The default values of nine (9) for Max and one (1) for Min are a good balance for bi-directional throughput in a PTMP network. Applications requiring low latency may consider smaller packet sizes. See **Appendix C – Max/Min Packet Sizes** for packet size table and other optimization information.

Transmit Power

This parameter controls the units transmit power. Values range from 0 to 10 with 10 being approximately 1 Watt of output power. See the EB-6 Plus Installation Guide for more information regarding legal combinations of power levels and antennas.

Retry Timeout

The Retry Timeout parameter controls the time an Endpoint or Repeater will delay before dropping a connection to a Gateway or Repeater. The factory default is set to the maximum of 255. The minimum value is eight (8). Setting a value less than the maximum is useful in networks where an Endpoint may be mobile and switching from one Repeater to another.

For a Gateway, the Retry Timeout parameter controls how long a Gateway will allow a slave to remain connected while re-trying data packets. It can be useful to lower the Retry Timeout on the Gateway if it is likely that Endpoints with weak links might monopolize access to the Gateway.

For PTP networks, the Retry Timeout should never be set to less than a value of 151.

Data Rate

This parameter sets the over-the-air data rate. There are two choices. All radios in a given network must have the same setting for Data Rate. The slower data rate will allow the wireless link to tolerate more RF noise and achieve greater range.

PTP RSSI Mode

Only active in PTP mode – setting this to "TEST" from "NORMAL" allows a user to evaluate RSSI in a PTP link by looking at the CTS LED. Be sure to set back to "NORMAL" when testing is complete.

2.12.3   Multipoint Settings

Broadcast Repeat

In a Point-To-Multipoint network, packets outbound from the Gateway to Endpoints are not acknowledged. Broadcast Repeat controls the number of times the outbound radio packets are transmitted. The more times outbound packets are repeated, the more robust the radio link from Gateway to Endpoint or Repeater – but at the cost of bandwidth. The minimum value is 0 and the maximum value is 9, while the default is 3. The Broadcast Repeat parameter can be different on each leg of a network with repeaters: For example, the Gateway may have its broadcast repeat set to 5, but a given Repeater may have it set lower, at 2 because the links between the Repeater and connected Endpoints are very solid.

Network ID

For Point-To-Multipoint networks, a unique Network ID is required. The ID must be the same of all units operating in the same network. Any value from 0 to 4095 with the exception of 255 is valid. A value of 255 indicates that the callbook should be used to specify the units in a Multipoint network.

Repeaters

Specifies whether repeaters are present in the Multipoint wireless network. All units in a given network must have the same setting for Repeaters – either Enabled or Disabled. When Repeaters are enabled – a physical repeater need not be present – however, enabling Repeaters diminishes the maximum bandwidth of a network by approximately 50%.

Subnet ID

Subnet ID is an Advanced Configuration for Multipoint networks allowing the user to specify exactly how a network's Endpoints and Repeater should form links. The use of Subnet IDs requires that the Multipoint network is using a Network ID rather than the callbook.

In a typical Multipoint network, a Repeater or Endpoint will connect to the first Repeater or Gateway it hears with the same Network ID (assuming other parameters correctly configured). Subnet IDs are very useful in networks where an Endpoint or Repeater might link to a Repeater (or the Gateway) with a weaker signal when one with a stronger signal is available.   Subnet ID contains two fields: **TX ID** and **RX ID**.

The **RX ID** specifies what ID a Repeater or Endpoint will listen to.

The **TX ID** specifies on which ID a Repeater will transmit on (the TX parameter only has meaning for Repeaters).

The Gateway always transmits and received on ID 0. No special action needs to be taken on the Gateway (the configuration page with show the Gateway with TX and RX IDs of F and F or "disabled").

If, on an Endpoint, both the **RX** and **TX ID**s are set to 0, the unit enters ROAMING mode, in this mode, a mobile Endpoint will be allowed to roam from subnet to subnet.

The following diagram shows an example Multipoint network configured with Subnet IDs – this network will always link in the architecture shown below.
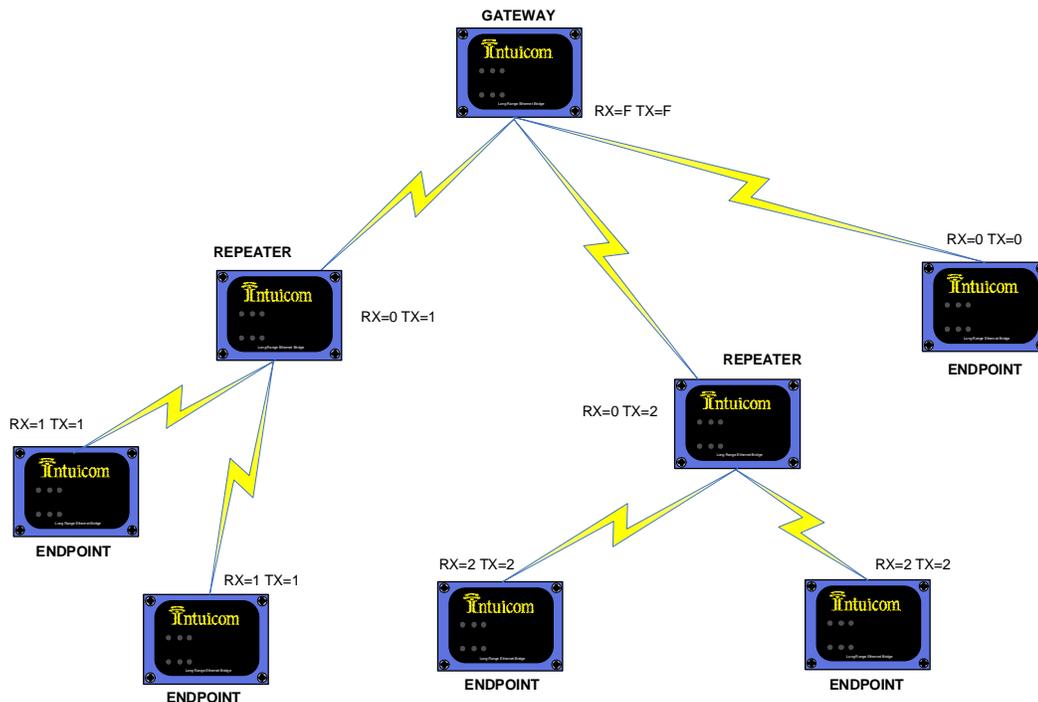
Figure 2-3: Example PTMP Network with Subnet ID

Shared Access

This feature is designed for better accommodating data streaming from Multiple Endpoints in a Multipoint network. Shared access causes each Endpoint to release its connection to the Gateway after transferring a segment of data, giving other units a chance to do the same. This parameter should always be set to Disabled on Gateways and on all units in a Point-To-Point network.

Callbook

The callbook is a table of unit IDs that allow the user to configure Point-To-Point networks. Typically, in a PTP network without repeaters, the Gateway contains the ID of the Endpoint and the Endpoint's callbook contains the ID of the Gateway – both in Entry 0 of the table. To specify a repeater path to the endpoint, the columns for repeaters are filled in on the Gateway in the order that the repeaters would be encountered from Gateway to Endpoint.

2.12.4 Example Wireless Configuration

The example below outlines a Point-To-Multipoint network with a Gateway and three Endpoints without any Repeaters.
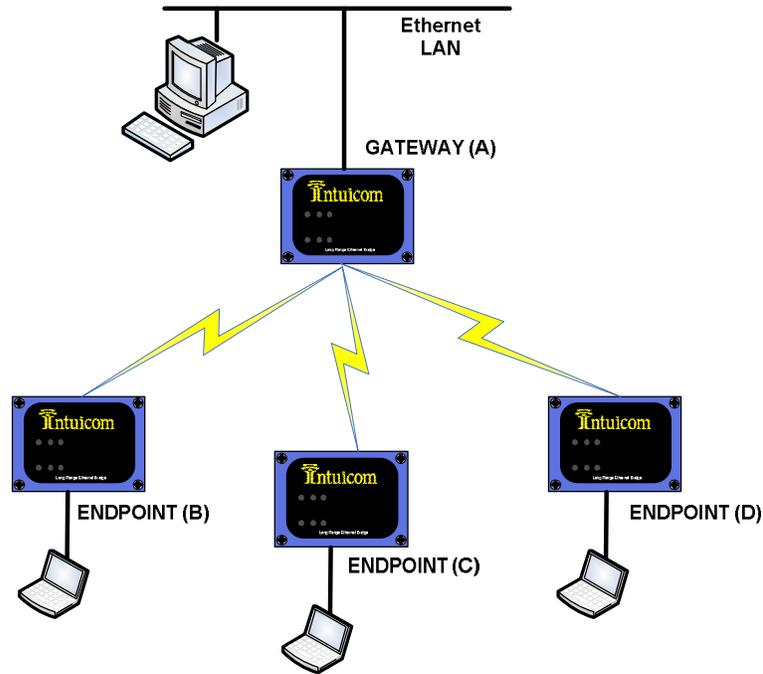
Parameter	A	B	C	D
IP Address	192.168.0.42	192.168.0.43	192.168.0.44	192.168.0.45
Subnet Mask	255.255.255.0	255.255.255.0	255.255.255.0	255.255.255.0
Default Gateway	192.168.0.1	192.168.0.1	192.168.0.1	192.168.0.1
Radius Enabled	False	False	False	False
AES Key	Default (blank)	Default (blank)	Default (blank)	Default (blank)
Network Type	PTMP	PTMP	PTMP	PTMP
Wireless Mode	Gateway	Endpoint	Endpoint	Endpoint
Frequency Key	1	1	1	1
Max/Min Packet	9/1	9/1	9/1	9/1
Transmit Power	10	10	10	10
Retry Timeout	255	255	255	255
Data Rate	867	867	867	867
PTP RSSI Mode	Normal	Normal	Normal	Normal
Broadcast Repeat	3	3	3	3
Network ID	1234	1234	1234	1234
Repeaters	Disabled	Disabled	Disabled	Disabled
Subnet ID RX /TX	F/F (Disabled)	F/F (Disabled)	F/F (Disabled)	F/F (Disabled)
Shared Access	Disabled	Disabled	Disabled	Disabled

2.13 Setup: GPS

An embedded GPS is an option available on the Intuicom EB-6 Plus Transceiver (Intuicom P/N FIP1-900N2B-HEU). The GPS option utilizes one of the unit's serial ports, Port 2.

Data from the embedded GPS can be processed and transmitted in a number of different ways.

Data Destination Settings

The unit's GPS data can be transmitted via UDP to a specified IP and UDP port. To enable this option, check the Enabled checkbox and enter the IP and UDP Port. Data from the GPS will be pre-pended with the unit's serial number.

Distance Based Update Settings

The unit can be configured to only send data when the unit has moved a specified distance or a specified number of seconds have elapsed. This feature cuts down on network traffic, especially for stationary targets. Enabled distance based updates by selecting Enabled, then specifying a trip distance and timeout values. The Data Destination feature must be enabled for the Distance Based Update feature to have any effect.

String Settings

The String Settings allow the rate and type of GPS strings communicated through Data Destination to be configured by the used. The PMIN1 string is a composite of the GGA and RMC eliminating duplicate fields. The Distance Based Update feature only utilized the PMIN1 string as the distance is calculated in 3D. Specify which NMEA strings are enabled and at what rate.

2.14 Document Setup

The Document Setup page create a static web page displaying a summary of the unit's current configuration.
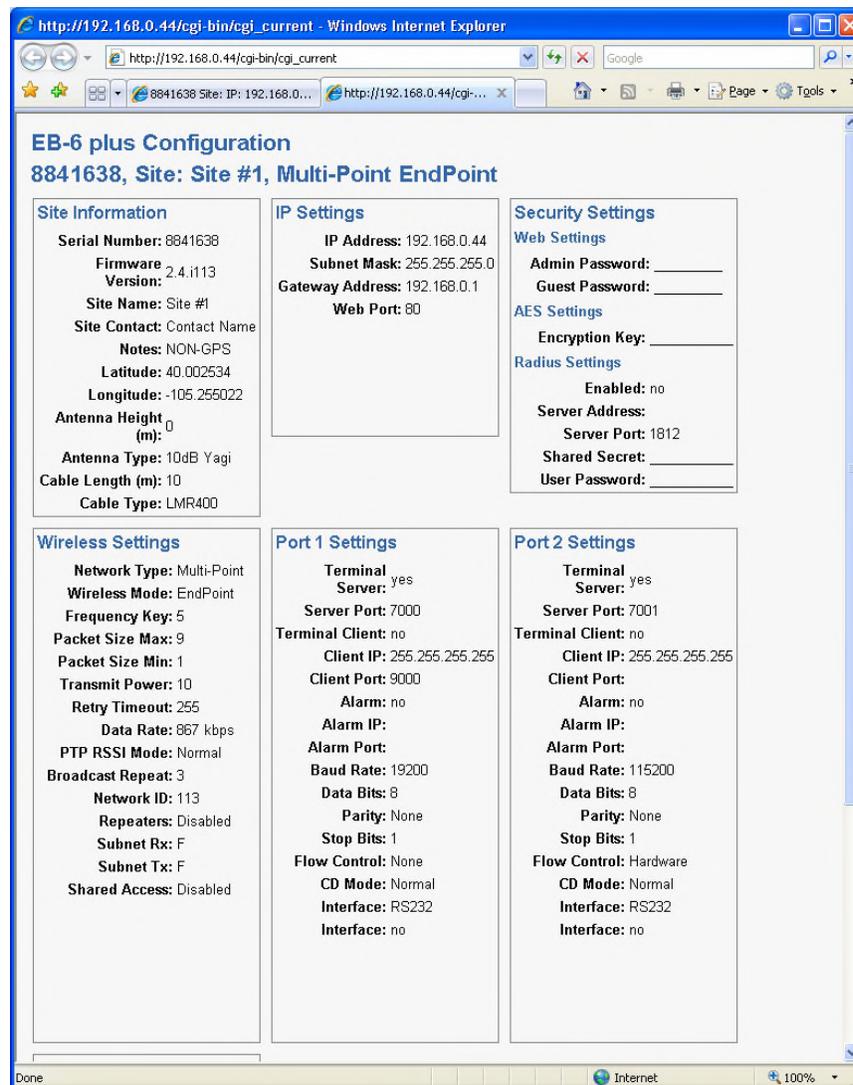
2.15 Maintenance

The Maintenance page allows the user upgrade the unit's firmware.
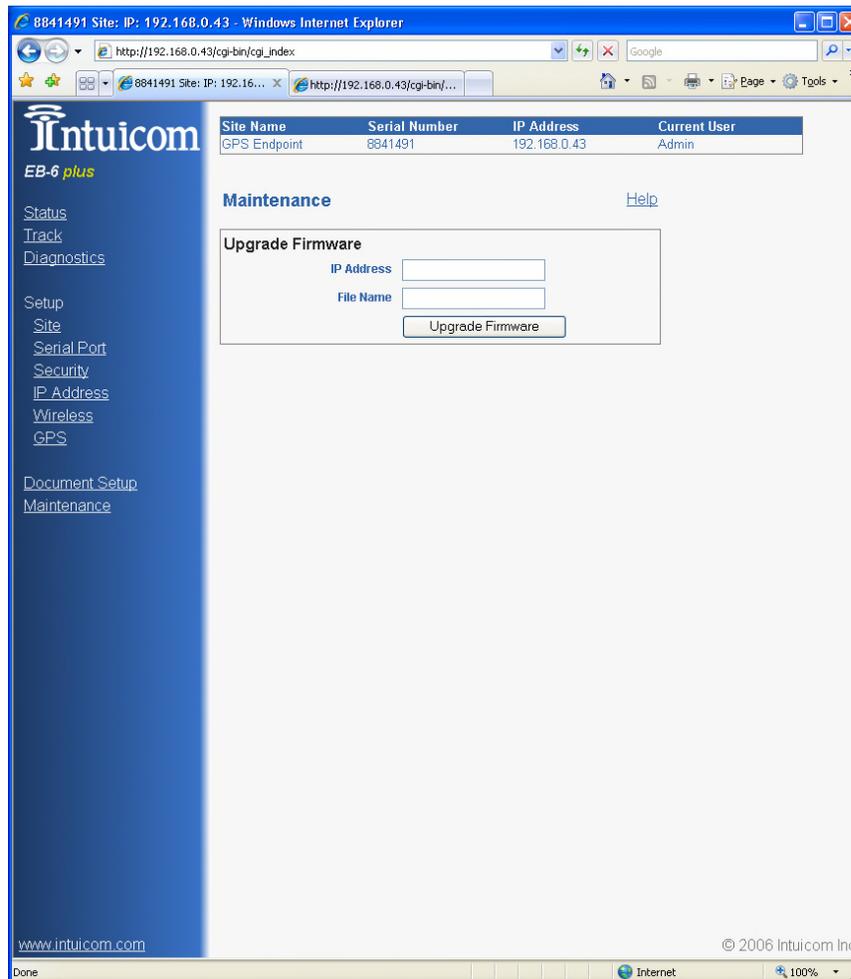
2.15.1 Upgrade Firmware

A firmware upgrade requires the following items:

- A new firmware image file
- The Intuicom TFTP server program (or any TFTP server)
- A network between the unit and the TFTP server.

Contact Intuicom to obtain the TFTP server application and the firmware image file.

To upgrade the firmware:

1. Place the image file so that it is available via the TFTP server
2. Log onto the unit to be upgraded, and go to the Maintenance page
3. Complete the fields for the IP address of the TFTP server and enter the name of the image file
4. Click the Upgrade Firmware Button
5. **! Important ! The upgrade process will progress from Retrieving, to Programming, to Rebooting. DO NOT POWER DOWN THE UNIT. Allow at least 2 minutes after seeing the REBOOTING message before attempting to access the unit.**

3 Operation

After units have been correctly configured, they are ready to be operated as a wireless network.
It is recommended to test configurations prior to deploying units to the field. The following
steps outline a simple test:

1. Connect the Gateway unit to the wired network, attach an antenna (duck antenna for
   testing) and connect to power.
2. For a Multipoint network with Endpoints that connect directly to the Gateway, connect an
   antenna to an Endpoint, and apply power. **Important: never connect the Ethernet
   interface of an Endpoint to the same LAN as the Gateway!**
3. Observe the LEDs on the Gateway and Endpoint units. For a PTP network, both units'
   CD LEDs should be green. For a PTMP network, the Endpoint's CD LED should be
   green.
4. Confirm the Gateway and Endpoint can be reached using a browser to connect to each
   unit's web interface.

3.1 LED Indications

Each unit has six bi-color (red 🔴/green 🟢) LED indicators on the front panel. The
indicators convey a unit's operational status.   Additionally there are two LED indicators for
the Ethernet Port on the unit's back panel.

Boot Sequence

During Boot, the C1, C2, and ERR LEDs on the front panel will sequence green. When the
unit is done booting, and no errors exist, the C1, C2 and ERR LEDs should be off.

Authentication / Encryption Errors

Condition	ERR LED
Endpoint has not linked with Gateway	Solid Red
Endpoint cannot contact RADIUS server	Solid Red
Endpoint was denied authentication from RADIUS server	Alternating Red and Green
Endpoint AES encryption key does not match Gateway encryption key	Alternating Red and Green

Data Buffering Errors

Condition	ERR LED
Buffer Overflow Locally	Solid Red
Buffer Overflow in Network	Solid Green

Radio Link Status and Quality

There three bi-color radio LED indicators: CD, TX, and CTS can indicate a wide variety of conditions, and the indications depend upon the configured operation mode and role of the unit (Point-to-Point, Point-to-Multipoint, Endpoint, Repeater, Gateway).

The following tables highlights the key indicators likely seen in the most common operation modes. See **Appendix D - Radio LEDs** for complete coverage of all conditions.

Point-to-Multipoint						
Condition	**Endpoint**			**Gateway**		
	CD	**TX**	**CTS**	**CD**	**TX**	**CTS**
Powered, No Link	Solid Red - Bright	Off	Blinking Red	Solid Red - Bright	Solid Red - Dim	Off
Endpoint Linked to Gateway – No Data	Solid Green	Off	Solid Red - Bright	Solid Red - Bright	Solid Red - Dim	Off
Endpoint linked to Gateway – Sending Data	Solid Green	Intermittent Red	Solid Red - Bright	Green when RCV data – otherwise Solid Red	Solid Red - Dim	Red while RCV data – otherwise Off

Point-to-Point						
Condition	**Endpoint**			**Gateway**		
	CD	**TX**	**CTS**	**CD**	**TX**	**CTS**
Powered, No Link	Solid Red - Bright	Off	Blinking Red	Solid Red - Bright	Solid Red - Bright	Solid Red - Bright
Endpoint Linked to Gateway – No Data	Solid Green	Intermittent Red	Intermittent Red	Solid Green	Intermittent Red	Intermittent Red
Endpoint linked to Gateway – Sending Data	Solid Green	Intermittent Red	Intermittent Red	Solid Green	Intermittent Red	Intermittent Red

Ethernet Port LEDs

Status	**Left LED (Link)**	**Right LED (Activity)**
Linked, Data Activity	Solid Green (100 Base-T) Solid Orange (10 Base-T)	Solid Green
Linked, Data Activity	Solid Green (100 Base-T) Solid Orange (10 Base-T)	Blinking Green
Linked, No Data Activity	Solid Green (100 Base-T) Solid Orange (10 Base-T)	Off
Not Linked. Check that cable is connected, in good condition, and connected to another device	Off	Off

3.2 Status and Diagnostics

A unit's current **Status** and **Diagnostic** data is available by simply connecting to the web interface. The Status page is displayed by default. The Status page automatically updates itself every five to ten seconds.
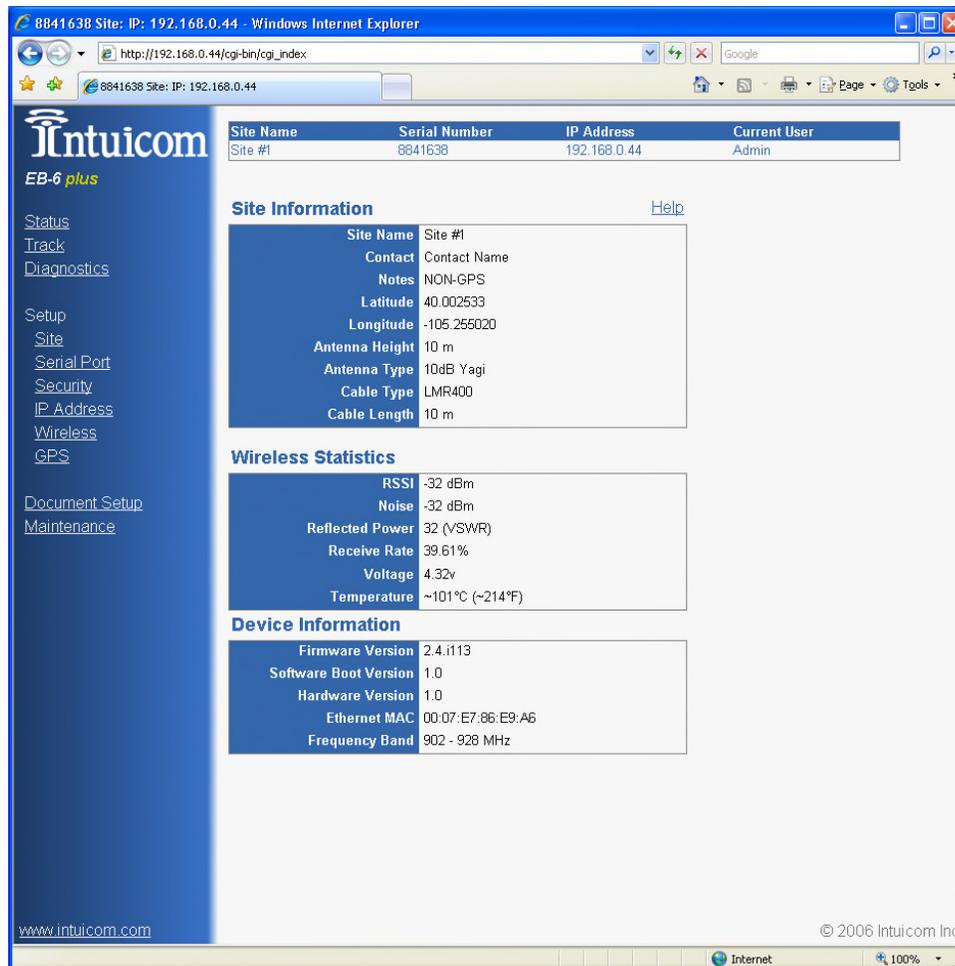
The **Status** page contains the following fields:

Site Name – Not a diagnostic field – user configurable for reference only.

Contact – Not a diagnostic field – user configurable for reference only.

Notes – Not a diagnostic field – user configurable for reference only.

Latitude - Not a diagnostic field – user configurable for reference only.

Longitude - Not a diagnostic field – user configurable for reference only.

Antenna Height - Not a diagnostic field – user configurable for reference only.

Antenna Type - Not a diagnostic field – user configurable for reference only.

Cable Type - Not a diagnostic field – user configurable for reference only.

Cable Length - Not a diagnostic field – user configurable for reference only.

RSSI – The current Received Signal Strength in dBm. This field is valid only for Endpoint and Repeater units. For a reliable wireless link, the RSSI should be 30 dB above the background Noise. Low average signal levels can often be corrected with higher gain antennas, better antenna placement, and/or additional repeaters. Please consult the EB-6 Plus Installation Manual for antenna and FCC requirements.

Noise – The current background RF noise at this unit's antenna in dBm. Typically the background RF noise level is approximately -80 dBm. Noise levels significantly higher indicate the presence of interference that may degrade the performance of the unit's wireless link. High noise levels can often be mitigated with band-pass filters, antenna placement, or antenna polarization.

Voltage – The current input voltage at the unit.

Receive Rate – this is a measure of how successful the wireless link between this unit and a Gateway or an upstream Repeater. This parameter is useful because the signal strength indicator may not give a complete picture of how the wireless link is operating. Ideally this value would be 100% for a strong wireless link.

Reflected Power – This field indicates the amount of power reflected back to the unit by its transmission line and antenna when transmitting. There are a number of factors to keep in mind when interpreting Reflected Power:

- The unit must be or have recently transmitted for this value to have meaning
- Because it shows a percentage of the power transmitted, if the TX power is set to a low value – the reflected power will be correspondingly lower.
- Long and/or high attenuation transmission lines may mask a problem by attenuating any reflected power – inhibiting the radio's ability to display a meaningful value.
- In general, for a reasonably short transmission link, and full TX power – the Reflected power should be less than approximately 25.

Temperature – The ambient temperature (as measured inside the unit).

Firmware Version, Software Boot Version, Hardware Version – these fields display the version numbers for the units hardware and software.

Ethernet MAC – the units unique Ethernet MAC (Media Access Control) number. This number may be needed for network security configuration in some systems – also to identify the unit and a PC's MAC/ARP table.

Frequency Band – the unit's operation frequency band.

The **Diagnostics** page provides a real-time graph of key wireless diagnostic values. To access the diagnostics trend data, click the link on the menu at the left of the page. The page begins to collect and graph data – it will refresh itself automatically approximately every ten seconds.

The Diagnostics page graphs RSSI, Noise, Receive Rate and Reflected Power.
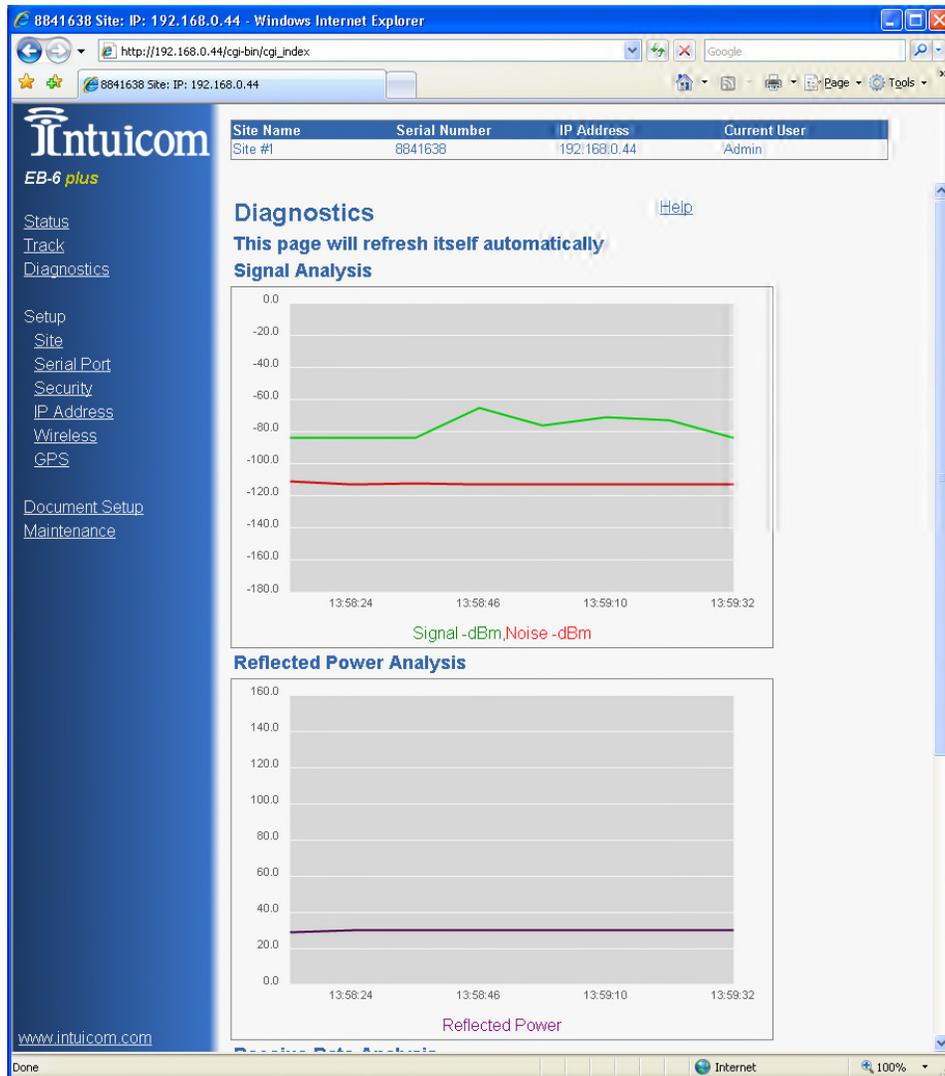
3.3 Track

The EB-6 Plus can export a KML file for use in plotting the unit's location using Google Earth ©. Be sure to complete all of the site information accurately. If Google Earth© is already installed, clicking the link will launch Google Earth© and plot the unit on the map.

For GPS enabled units, clicking on the link will not only plot the current position, but it will continue to update regularly allowing a moving target to be plotted.

Any custom HTML completed on the site information page will be available in the balloon pointing to the icon.
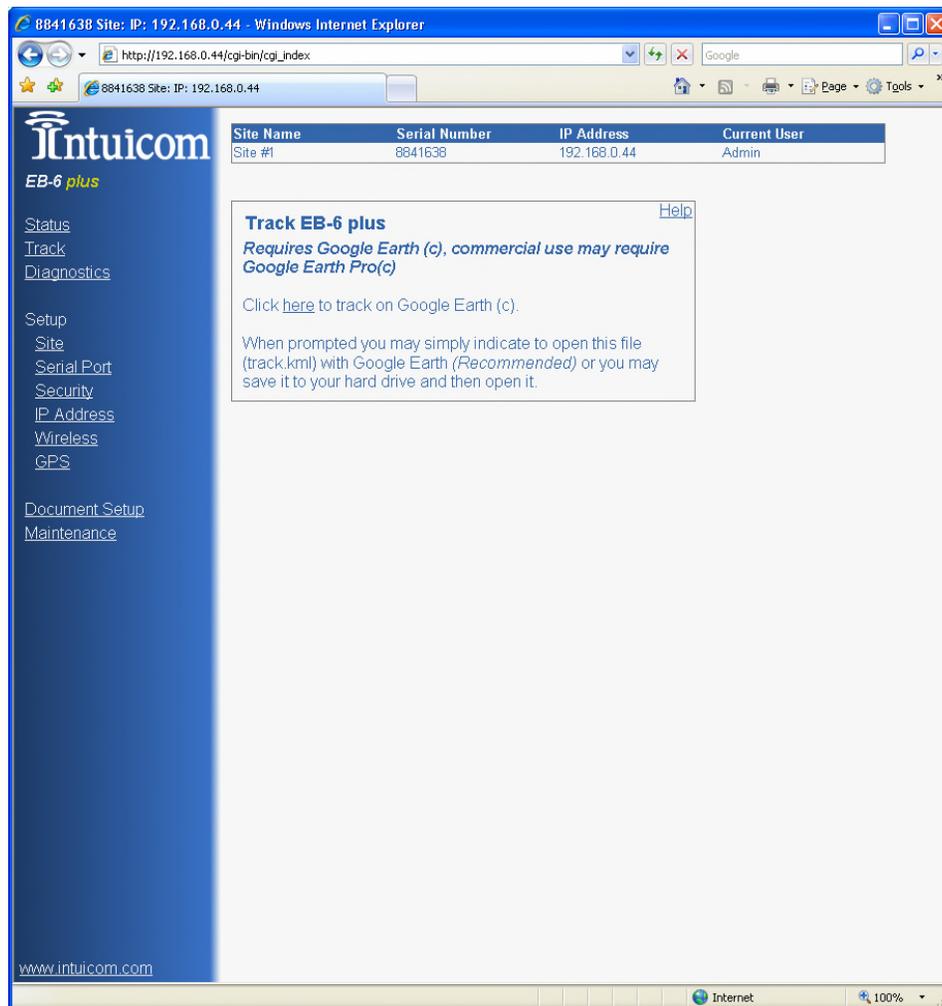
4 Appendix A – Technical Specifications

GENERAL SPECIFICATIONS

Enclosure	Ruggedized extruded aluminum
Size	H: 56.6 mm x W: 74.4 mm x L: 165.1 mm
Weight	463g.
Operating Temperature	-40º C to +60º C
Connectors/Signals	
External Antenna	TNC Type Female
Data	RJ-45 (Ethernet 10/100BaseT), DB-9 (RS-232/422/485)
Power (@ 12 VDC)	<140 mA Receive; <550 mA Transmit
Input Voltage	6-30 VDC
Operating Modes	
System Configurations	Point-to-Point, Point-to-Multipoint
Unit Operating Modes	Access Point, Repeater, End Point

WIRELESS TRANSCEIVER

Frequency Range	902 - 928 MHz
Transmitter	
Output Power	100 mW to 1 W (+30 dBm) ; Programmable
Range, Line of Sight	40+ Miles at 614 Kbps 15+ miles at 867 Kbps
Modulation	Spread Spectrum, GFSK
Occupied Bandwidth	611.2 KHz – Narrow Band
Spreading Method	Frequency Hopping / FCC DTS
Hopping Patterns	15 per band, 105 total, user selectable
Hopping Channels	41 - Narrow Band
Hopping Bands	7, user selectable
Receiver	@12 VDC
Sensitivity	-102 dBm at 10^{-6} BER at 614 Kbps -100 dBm at 10^{-6} BER at 867 Kbps
Data Transmission	
Error Detection	32 Bit CRC, retransmit on error
Data Encryption	128-bit AES, Substitution, dynamic key
Authentication	Central Authentication and RADIUS compliant
Data bit Rate	867 Kbps (point-to-point) 614 Kbps (point-to-multipoint)
Data Interface	10/100 BaseT; Serial: RS-232/422/485

NOTE: Specifications subject to change without notice

5 Appendix B – Serial Pinouts

The serial ports can be operated in one of three different modes: RS232, RS485 or RS422. The function of the port's pins change depending upon the mode.

RS232 Pin Assignments:

Pin #	Assignment	Direction	Notes
1	Carrier Detect (CD)	Output	*See Serial Setup*
2	Transmit Data (TXD)	Output	
3	Receive Data (RXD)	Input	
4	Data Terminal Ready (DTR)	Input	
5	Signal Ground (GND)	--	
6	Data Set Ready (DSR)	Output	
7	Request to Send (RTS)	Input	
8	Clear to Send (CTS)	Output	
9	Signal Ground (GND)	--	

RS422 and RS485 Full Duplex Pin Assignments:

Pin #	Assignment
2	TX +
3	RS +
5	Signal Ground
7	RX -
8	TX -

RS485 Half Duplex Pin Assignments:

Pin #'s	Assignment
2, 3	Wire to both pins for Bus+
7.8	Wire to both bins for Bus -
5	Signal Ground

For both RS-422 and RS-485, the EB-6 Plus can drive 32 standard unit loads and loads the bus with only 1/8 unit load. This means the user can tie up to 256 devices on the bus if all of the line receivers have 1/8 unit load.

RS-422 is used for 4-wire or full duplex communication with one Gateway and multiple Endpoints. The Gateway unit keeps the line driver asserted at all times. The maximum line length is 4,000 feet using 2, 120 ohm twisted pair cables with a 5th wire for data common. RS-485 full duplex using 4 wire plus common is the same as RS-422, except the system can have multiple Gateways on the bus.

The most common operation of RS-485 is a two-wire comprised of a 120 ohm impedance single twisted pair. In this system the loading of the port is as described above which allows up to 256 1/8 unit load units on the bus. Maximum line length is also 4,000 feet with a third wire required for data common. The EB-6 Plus will check the line to be certain no other device is transmitting before enabling the line driver for data transmission.

There is no provision for hand shaking in any of the above modes of operation, so data rates of 57.6 KBaud and above are not recommended without a protocol that can handle error detection properly.

6 Appendix C – Max/Min Packet Sizes

The Min and Max packet size configuration values (Wireless Setup) allow control over the internal radio's packet sizes. In a given wireless network, all Min and Max packet size values must be set identically – For Example: If the Gateway is configured for a Max Packet size of **9** and a Min Packet size of **1**, all units in that network must be configured for the same Max and Min packet size.

The default values for Max and Min packet size, **9** and **1** respectively, provide a good balance for bi-directional throughput. Some applications may have relatively low data rates, but require low latency. For these applications, lowering the Max and Min Packet size can favor latency over throughput.

Recommended settings for Max and Min packet size to achieve lower latency:

Max Packet Size: **3** Min Packet Size **3**

7 Appendix D - Radio LEDs

Point-to-Multipoint

Condition	Gateway			Endpoint			Repeater		
	Carrier Detect (CD)	Transmit (TX)	Clear to Send (CTS)	Carrier Detect (CD)	Transmit (TX)	Clear to Send (CTS)	Carrier Detect (CD)	Transmit (TX)	Clear to Send (CTS)
Powered, not linked	Solid red bright	Solid red dim	Off	Solid red bright	Off	Blinking red	Solid red bright	Off	Blinking red
Repeater and Endpoint linked to Gateway, no data	Solid red bright	Solid red dim	Off	Solid green	Off	* Solid red bright	Solid green	Solid red dim	* Solid red bright
Repeater and Endpoint linked to Gateway, Gateway sending data to Endpoint	Solid red bright	Solid red dim	Off	Solid green	Off	* Solid red bright	Solid green	Solid red dim	* Solid red bright
Repeater and Endpoint linked to Gateway, Endpoint sending data to Gateway	Solid green RCV data or Solid red bright	Solid red dim	Intermittent flash red »o«	Solid green	Intermittent flash red »o«	* Solid red bright	Solid green	Solid red bright	* Solid red bright

Point-to-Point

Condition	Gateway			Endpoint			Repeater		
	Carrier Detect (CD)	Transmit (TX)	Clear to Send (CTS)	Carrier Detect (CD)	Transmit (TX)	Clear to Send (CTS)	Carrier Detect (CD)	Transmit (TX)	Clear to Send (CTS)
Powered, no link	Solid red bright	Solid red bright	Solid red bright	Solid red bright	Off	Blinking red Θ	Solid red bright	Off	Blinking red Θ
Linked, no Repeater, sending sparse data	Solid green	Intermittent flash red »o«	Intermittent flash red »o«	Solid green	Intermittent flash red »o«	Intermittent flash red »o«	n/a	n/a	n/a
Gateway calling Endpoint through Repeater	Solid red bright	Solid red dim	Solid red bright	Solid red bright	Off	Blinking red Θ	Solid red bright	Off	Blinking red Θ
Gateway linked to Repeater, not to Endpoint	Flashing orange »o«	Solid red dim	Solid red bright	Solid red bright	Off	Blinking red Θ	Solid red bright	Solid red dim	Solid red bright
Repeater linked to Endpoint	Solid green	Intermittent flash red »o«	Intermittent flash red »o«	Solid green	Intermittent flash red »o«	Intermittent flash red »o«	Solid green	Intermittent flash red »o«	Intermittent flash red »o«

8 Technical Support

For technical support please email Intuicom at: support@intuicom.com or call 303-449-4330.

9 Warranty

LIMITED WARRANTY TO END-USERS
Intuicom, Inc.
1880 South Flatiron Ct., Suite R
BOULDER, CO 80301

A. <u>Standard Limited Warranty for Software Products</u>. For Products that include a software license, INTUICOM makes a limited warranty to the End User that the software will perform substantially in accordance with the accompanying written materials and that the transfer media on which the Product is provided will be free from defects in materials or workmanship under normal use and service for a period of ninety (90) days from the date of delivery (the "Limited Warranty") pursuant to the software license included with the Product. The software license specifically disclaims all other warranties relating to the Products, including any and all other warranties with respect to the performance of the Products.

B. <u>Hardware and Other Equipment Manufactured By Intuicom</u>. Hardware products manufactured by INTUICOM include a limited warranty for defects in materials or workmanship under normal use and service for a period of one (1) year from the date of delivery. Intuicom, at its sole discretion, will repair or replace hardware covered under this limited warranty. Cables, antennas or other accessories manufactured by INTUICOM include a limited warranty for defects in materials or workmanship under normal use and service for a period of ninety (90) days from the date of delivery.   Repairs not covered under this limited warranty will be billed as set forth in INTUICOM's current Hardware Service Policy and Instructions.

C. <u>Hardware Manufactured By Others</u>. INTUICOM makes no warranties whatsoever with respect to Hardware manufactured by third parties. Customers shall look only to the original manufacturer of the Hardware, pursuant to the terms of any manufacturer warranty for any alleged defects and indemnifies and holds INTUICOM harmless from and against any claims by any party related directly or indirectly to any defects in the Hardware, and functional failure, improper operation, failure to operate according to specifications or any other matter related to the Hardware. INTUICOM shall not be liable or responsible for the failure of the Manufacturer to perform under or honor any warranty with respect to the Hardware. Customer acknowledges and agrees that Customer shall have the risk of any loss, damage or functional failure related to the HARDWARE and shall have the responsibility for maintaining the proper operation of the HARDWARE and complying with all maintenance guidelines and specifications from the Manufacturer and all other conditions to receiving warranty coverage from the Manufacturer.

D. <u>No Other Warranty</u>.   EXCEPT FOR THE EXPRESS STANDARD LIMITED WARRANTY REFERENCED ABOVE, INTUICOM GRANTS NO OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING THE PRODUCTS, THEIR FITNESS FOR ANY PURPOSE, THEIR QUALITY, THEIR MERCHANTABILITY OR OTHERWISE. INTUICOM DOES NOT MAKE BY VIRTUE OF THIS AGREEMENT OR ANY PRODUCT ORDER, AND HEREBY EXPRESSLY DISCLAIMS, ANY OTHER REPRESENTATION OR WARRANTY OF ANY KIND WITH RESPECT TO THE PRODUCTS.

E. <u>Limitation of Liability</u>.   IN NO EVENT WILL INTUICOM BE LIABLE FOR ANY INDIRECT, SPECIAL, CONSEQUENTIAL, INCIDENTAL, BUSINESS INTERUPTION, CATESTROHPIC, PUNITIVE OR OTHER DAMAGES WHICH MAY BE CLAIMED TO ARISE IN CONECTION WITH ITS PRODUCTS, REGARDLESS OF THE LEGAL THEORY BEHIND SUCH CLAIMS, WHETHER IN TORT, CONTRACT OR UNDER ANY APPLICABLE STATUTORY OR REGULATORY LAWS, RULES, REGULATIONS, EXECUTIVE OR ADMINISTRATIVE ORDERS OR DECLARATIONS OR OTHERWISE, EVEN IF INTUICOM HAS BEEN ADVISED OR OTHERWISE HAS KNOWLEDGE OF THE POSSIBILITY OF SUCH DAMAGES AND TAKES NO ACTION TO PREVENT OR MINIMIZE SUCH DAMAGES. IN THE EVENT THAT REGARLDESS OF THE WARRANTY DISCLAIMERS AND HOLD HARMLESS PROVISIONS INCLUDED ABOVE INTUICOM IS SOMEHOW HELD LIABLE OR RESPONSIBLE FOR ANY DAMAGE OR INJURY, INTUICOM'S LIABILITY FOR ANY DAMAGES SHALL NOT EXCEED THE PROFIT REALIZED BY INTUICOM ON THE SALE OR PROVISION OF THE HARDWARE TO THE CUSTOMER.