



HUGHES9502

Inmarsat BGAN Satellite
IP Terminal Kit



Guarantee

This equipment is guaranteed against defects in materials and workmanship. We will repair or replace products which prove to be defective during the guarantee period as detailed on your invoice, provided they are returned to us prepaid. The guarantee will not apply to:

- Equipment which has been modified or altered in any way without the written permission of Campbell Scientific
- Batteries
- Any product which has been subjected to misuse, neglect, acts of God or damage in transit.

Campbell Scientific will return guaranteed equipment by surface carrier prepaid. Campbell Scientific will not reimburse the claimant for costs incurred in removing and/or reinstalling equipment. This guarantee and the Company's obligation thereunder is in lieu of all other guarantees, expressed or implied, including those of suitability and fitness for a particular purpose. Campbell Scientific is not liable for consequential damage.

Please inform us before returning equipment and obtain a Repair Reference Number whether the repair is under guarantee or not. Please state the faults as clearly as possible, and if the product is out of the guarantee period it should be accompanied by a purchase order. Quotations for repairs can be given on request. It is the policy of Campbell Scientific to protect the health of its employees and provide a safe working environment, in support of this policy a "Declaration of Hazardous Material and Decontamination" form will be issued for completion.

When returning equipment, the Repair Reference Number must be clearly marked on the outside of the package. Complete the "Declaration of Hazardous Material and Decontamination" form and ensure a completed copy is returned with your goods. Please note your Repair may not be processed if you do not include a copy of this form and Campbell Scientific Ltd reserves the right to return goods at the customers' expense.

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PLEASE READ FIRST

About this manual

Please note that this manual was originally produced by Campbell Scientific Inc. primarily for the North American market. Some spellings, weights and measures may reflect this origin.

Some useful conversion factors:

Area: 1 in² (square inch) = 645 mm²

Length: 1 in. (inch) = 25.4 mm
1 ft (foot) = 304.8 mm
1 yard = 0.914 m
1 mile = 1.609 km

Mass: 1 oz. (ounce) = 28.35 g
1 lb (pound weight) = 0.454 kg

Pressure: 1 psi (lb/in²) = 68.95 mb

Volume: 1 UK pint = 568.3 ml
1 UK gallon = 4.546 litres
1 US gallon = 3.785 litres

In addition, while most of the information in the manual is correct for all countries, certain information is specific to the North American market and so may not be applicable to European users.

Differences include the U.S standard external power supply details where some information (for example the AC transformer input voltage) will not be applicable for British/European use. *Please note, however, that when a power supply adapter is ordered it will be suitable for use in your country.*

Reference to some radio transmitters, digital cell phones and aerials may also not be applicable according to your locality.

Some brackets, shields and enclosure options, including wiring, are not sold as standard items in the European market; in some cases alternatives are offered. Details of the alternatives will be covered in separate manuals.

Part numbers prefixed with a “#” symbol are special order parts for use with non-EU variants or for special installations. Please quote the full part number with the # when ordering.

Recycling information



At the end of this product's life it should not be put in commercial or domestic refuse but sent for recycling. Any batteries contained within the product or used during the products life should be removed from the product and also be sent to an appropriate recycling facility.

Campbell Scientific Ltd can advise on the recycling of the equipment and in some cases arrange collection and the correct disposal of it, although charges may apply for some items or territories.

For further advice or support, please contact Campbell Scientific Ltd, or your local agent.



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Safety

DANGER — MANY HAZARDS ARE ASSOCIATED WITH INSTALLING, USING, MAINTAINING, AND WORKING ON OR AROUND **TRIPODS, TOWERS, AND ANY ATTACHMENTS TO TRIPODS AND TOWERS SUCH AS SENSORS, CROSSARMS, ENCLOSURES, ANTENNAS, ETC.** FAILURE TO PROPERLY AND COMPLETELY ASSEMBLE, INSTALL, OPERATE, USE, AND MAINTAIN TRIPODS, TOWERS, AND ATTACHMENTS, AND FAILURE TO HEED WARNINGS, INCREASES THE RISK OF DEATH, ACCIDENT, SERIOUS INJURY, PROPERTY DAMAGE, AND PRODUCT FAILURE. TAKE ALL REASONABLE PRECAUTIONS TO AVOID THESE HAZARDS. CHECK WITH YOUR ORGANIZATION'S SAFETY COORDINATOR (OR POLICY) FOR PROCEDURES AND REQUIRED PROTECTIVE EQUIPMENT PRIOR TO PERFORMING ANY WORK.

Use tripods, towers, and attachments to tripods and towers only for purposes for which they are designed. Do not exceed design limits. Be familiar and comply with all instructions provided in product manuals. Manuals are available at www.campbellsci.eu or by telephoning +44(0) 1509 828 888 (UK). You are responsible for conformance with governing codes and regulations, including safety regulations, and the integrity and location of structures or land to which towers, tripods, and any attachments are attached. Installation sites should be evaluated and approved by a qualified engineer. If questions or concerns arise regarding installation, use, or maintenance of tripods, towers, attachments, or electrical connections, consult with a licensed and qualified engineer or electrician.

General

- Prior to performing site or installation work, obtain required approvals and permits. Comply with all governing structure-height regulations, such as those of the FAA in the USA.
- Use only qualified personnel for installation, use, and maintenance of tripods and towers, and any attachments to tripods and towers. The use of licensed and qualified contractors is highly recommended.
- Read all applicable instructions carefully and understand procedures thoroughly before beginning work.
- Wear a **hardhat** and **eye protection**, and take **other appropriate safety precautions** while working on or around tripods and towers.
- **Do not climb** tripods or towers at any time, and prohibit climbing by other persons. Take reasonable precautions to secure tripod and tower sites from trespassers.
- Use only manufacturer recommended parts, materials, and tools.

Utility and Electrical

- **You can be killed** or sustain serious bodily injury if the tripod, tower, or attachments you are installing, constructing, using, or maintaining, or a tool, stake, or anchor, come in **contact with overhead or underground utility lines**.
- Maintain a distance of at least one-and-one-half times structure height, or 20 feet, or the distance required by applicable law, **whichever is greater**, between overhead utility lines and the structure (tripod, tower, attachments, or tools).
- Prior to performing site or installation work, inform all utility companies and have all underground utilities marked.
- Comply with all electrical codes. Electrical equipment and related grounding devices should be installed by a licensed and qualified electrician.

Elevated Work and Weather

- Exercise extreme caution when performing elevated work.
- Use appropriate equipment and safety practices.
- During installation and maintenance, keep tower and tripod sites clear of un-trained or non-essential personnel. Take precautions to prevent elevated tools and objects from dropping.
- Do not perform any work in inclement weather, including wind, rain, snow, lightning, etc.

Maintenance

- Periodically (at least yearly) check for wear and damage, including corrosion, stress cracks, frayed cables, loose cable clamps, cable tightness, etc. and take necessary corrective actions.
- Periodically (at least yearly) check electrical ground connections.

WHILE EVERY ATTEMPT IS MADE TO EMBODY THE HIGHEST DEGREE OF SAFETY IN ALL CAMPBELL SCIENTIFIC PRODUCTS, THE CUSTOMER ASSUMES ALL RISK FROM ANY INJURY RESULTING FROM IMPROPER INSTALLATION, USE, OR MAINTENANCE OF TRIPODS, TOWERS, OR ATTACHMENTS TO TRIPODS AND TOWERS SUCH AS SENSORS, CROSSARMS, ENCLOSURES, ANTENNAS, ETC.

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HUGHES9502 Inmarsat BGAN Satellite IP Terminal Kit

1. Introduction

The HUGHES9502 terminal kit uses the Inmarsat Broadband Global Area Network (BGAN) to provide reliable end-to-end IP connectivity. It connects to a remote station with Campbell Scientific software or with the many IP protocols supported by our hardware. The HUGHES9502 kit includes the HUGHES9502 terminal, directional antenna, antenna cable, mounting hardware, and cables needed to connect the terminal to the data logger and power supply. The HUGHES9502 is an ideal solution for remote sites outside of cellular coverage.

NOTE

This manual provides information only for CRBasic data loggers. For retired Edlog data logger support, contact Campbell Scientific.

2. Precautions

- People using pacemakers or hearing aids should consult a physician first before interacting with the satellite terminal within one metre.
- Do not install the satellite terminal during electrical storms, which could result in severe personal injury or death.
- Never use the satellite terminal where blasting work is in progress. Observe all restrictions and follow any regulations or rules. Areas with a potentially explosive environment are often, but not always, clearly marked.
- Do not stand in front of the antenna. This device emits radio frequency energy. To avoid injury, do not place head or other body parts in front of the satellite outdoor unit (ODU) when system is operational. Maintain a distance of 1 m or more from the front of the satellite terminal ODU.
- Do not disassemble your satellite terminal. The unit does not contain consumer-serviceable components. Changes or modifications to the terminal not expressly approved by Hughes Network Systems will void the warranty and could void your authority to operate this equipment.
- Consult your Inmarsat service provider to ensure that you obtain a Subscriber Identity Module (SIM) and a service plan appropriate for your application and intended location of use.
- Properly connect the protective earth ground to help minimize chance of damage.
- Leaving a computer connected to the unit may result in excessive data usage and overage charges.

- Ensure the HUGHES9502 terminal is connected to an appropriate power supply. Connecting the HUGHES9502 to the **12V** or **SW12V** terminals of a Campbell Scientific data logger can damage the data logger.
- Handle the HUGHES9502 terminal with care.
- Avoid exposing your satellite terminal to extreme hot or cold temperatures outside the range –40 to 75 °C.
- To avoid impaired terminal performance, ensure the unit antenna is not damaged or covered with foreign material such as paint or labelling.
- When inserting the SIM, do not bend it or damage the contacts in any way.
- When connecting the interface cables, do not use excessive force.
- Use only a soft, damp cloth to clean the terminal and antenna.

3. Initial Inspection

Upon receipt of the HUGHES9502, inspect the package and contents for damage. File any damage claims with the shipping company.

Immediately check package contents against the shipping documentation (see Section 3.1, *Ships with List* (p. 2)). Contact Campbell Scientific about any discrepancies.

3.1 Ships with List

The HUGHES9502 Inmarsat BGAN Satellite IP Terminal Kit includes:

- (1) HUGHES9502 Modem with SIM
 - (1) Antenna
 - (1) 10 m antenna cable
 - (1) Type N-to-TNC coaxial adapter
 - (1) HUGHES9502 Terminal Mounting Kit
 - (1) HUGHES9502 Antenna Mounting Kit
- HUGHES9502 Parts Included Kit consisting of:
- (1) Red Power Wire, 0.6 m (2 ft)
 - (1) Black Power Wire, 0.6 m (2 ft)
 - (1) CAT 6 Ethernet Unshielded Cable, 0.6 m (2 ft)
 - (1) Serial Cable, DB9-Female-to-Pigtail, 0.6 m (2 ft)
 - (1) USB Cable, Type-A-Male-to-Type-B-Male, 1.8 m (6 ft)

4. Overview

The HUGHES9502 IP satellite terminal provides reliable connectivity over the Inmarsat BGAN for low power, remote monitoring applications. For additional information on the HUGHES9502 satellite terminal, see www.hughes.com.

Use of the HUGHES9502 requires a BGAN/M2M service agreement with an Inmarsat service provider.

5. Specifications

Nominal Input Voltage:	+12 Vdc or +24 Vdc
SIM Card Type:	USIM
Water and Dust Ingress Protection Rating:	IP-40 Compliant
Operating Temperature Range:	–40 to 75 °C
Storage Temperature Range:	–55 to 75 °C
Humidity Tolerance:	95% RH (at 40 °C)
Dimensions:	150 x 200 x 45 mm (5.9 x 7.87 x 1.77 in)
Weight:	1.12 kg (2.47 lb)
Frequency	
Satellite Transmit:	1626.5 to 1675 MHz
Satellite Receive:	1518 to 1559 MHz
GPS:	1574.42 to 1576.42 MHz
Power Consumption @ 12 Vdc	
Transmit:	< 1.7 A peak
Narrow Beam without Transmit:	333 mA
Idle (Regional Beam):	< 84 mA
Sleep (Controlling the Ethernet Packet):	< 0.8 mA
Off, GPIO Sleep Pin Control:	< 0.3 mA
Interfaces	
Power Input:	Screw terminal, reverse polarity protected
Antenna Connector:	TNC jack
Ethernet:	10BaseT, RJ45 connector (used for data logger or computer communications)
USB Connector:	Type B (used for computer communications)
RS-232 Connector:	GNSS DB9 (used for GPIO sleep pin control)
Antenna	
Wind Loading:	Survival wind loading up to 160.93 kph (100 mph)
Water and Dust Ingress Protection Rating:	IP-65 Compliant

Cable Connectors:	Type N male-to-type N male (Type N-to-TNC adapter included for antenna-to-terminal connection)
Cable Length:	10 m (30 ft)
Dimensions:	38.5 x 38.5 x 3.3 cm (15.2 x 15.2 x 1.3 in.) without mount
Weight:	1.85 kg (4.08 lb) without mount

6. Installation

6.1 Service Activation

Contact local Inmarsat service provider to activate SIM card. Choose either a static (fixed) IP or a dynamic IP. This is an M2M system, and the ports you plan on using will need to be opened by the provider.

Ports you may need active:

- 6783 - 6786 – Various *LoggerNet* Functions
- 80 - HTTP
- 21 - FTP

Galaxy 1 is recommended for USA sites:

Galaxy 1 USA
4611 S. University Dr. #454
Fort Lauderdale FL 33328
USA
Tel: +1 954 472 9599
sales@gl1sat.com

Submit completed document to Galaxy 1 to enable satellite service. Rates given are only as reference and are estimates. Other fees may apply and all prices are subject to change. Check with your service provider for pricing.

6.2 HUGHES9502 Configuration

1. Connect the power supply, such as the PS150, to ac power using the power jack, then use the supplied red and black wires to connect the HUGHES9502 to the power supply. The HUGHES9502 draws too much current to be powered by the data logger **12V** or **SW12V** terminals.

CAUTION

Connecting the HUGHES9502 to the data logger **12V** or **SW12V** terminals can damage the data logger.

2. Use an Ethernet cable to connect the HUGHES9502 to your computer. With DHCP enabled on your computer, it will be assigned an IP address that will allow you to connect to the modem. The default IP of the HUGHES9502 is 192.168.128.100.

- Open a web browser and type **192.168.128.100** in the address bar. You should see a screen similar to this:

The screenshot shows the HUGHES 9502 Home page. The top navigation bar includes Home, Connections, Settings, M2M, Security, and SMS. The main content area is divided into several sections:

- STATUS Connection:** Shows 'Registering...' with a signal strength bar at 0/40.
- GPS:** Shows 'Acquiring' with location 'Waiting' and last fix '24-Nov-2014, 20:27 UTC'.
- Pointing Info:** Shows 'I-4 Americas' with a signal strength bar at 216.1° and 53.6°.
- Terminal Information:** A table with the following data:

Model	BGAN USER TERMINAL, Hughes 9502
IMEI	353938-03-007940-8
Software Version	5.9.4.1
- SIM Information:** A table with the following data:

IMSI	901112112809485
APN	STRATOS.BGAN.INMARSAT.COM
Subscriber Phone Number	Not configured by Service Provider.
- Troubleshooting:** Includes 'Terminal Logs' with links for 'Download Current' and 'Reset Log', and 'Reset Terminal to Factory Defaults' with a 'Restore to Defaults' button.
- Reboot Terminal:** Includes a 'Reboot Terminal' button.

6.2.1 M2M Configuration

Configure the HUGHES9502 so all incoming packets from the satellite will be forwarded to the data logger:

- Go to the **M2M** tab of the HUGHES9502 user interface.
- Under **Always ON Context**, change the **Static ACA IP Address** to **192.168.128.240**. Now all incoming packets will be forwarded to this IP address.

The screenshot shows the HUGHES 9502 M2M Setup page. The top navigation bar includes Home, Connections, Settings, M2M, Security, and SMS. The main content area is divided into several sections:

- Ping Configuration:** Includes 'Context Watchdog' (On/Off), 'Primary Ping IP Address' (0.0.0.0), 'Secondary Ping IP Address' (0.0.0.0), 'Tertiary Ping IP Address' (0.0.0.0), 'Time between Pings' (0 minutes), and 'Ping Required' (Yes/No). An 'Apply Changes' button is at the bottom.
- Always ON Context:** Includes 'Always On Context' (On/Off), 'Static ACA IP Address' (192.168.128.240), 'QoS' (Standard), and 'APN Config' (STRATOS.BGAN.INMARSAT.COM). An 'Apply Changes' button is at the bottom.

- Click **Apply Changes** when you are done. A window will appear indicating you need to reboot to save this change. Click **Reboot**.

6.3 Data Logger Configuration

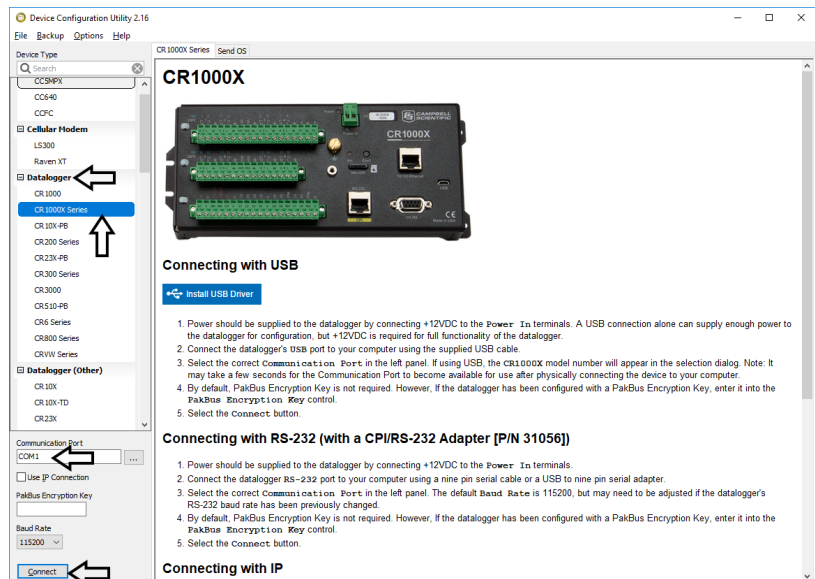
Configure the data logger with a static IP address that matches the IP used in the **Static ACA IP Address** setting in the HUGHES9502. The data logger may require an Ethernet interface (Section 6.6, *Wiring and Connections (p. 14)*).

Device Configuration Utility (DevConfig) is used to configure the data logger. *DevConfig* comes with *PC200W*, *PC400*, *LoggerNet*, and *LoggerNetAdmin*. It is also available for download free of charge at www.campbellsci.eu/downloads.

The following example uses a CR1000X. See appropriate data logger manual for individual needs.

To connect to your data logger, follow these steps:

- If this is the first time connecting to the data logger, install the drivers.
- Connect your computer to the data logger.
- Open *Device Configuration Utility*.
- Select the **Communication Port** on your computer that is connected to the data logger.
- Expand the **Datalogger** list and select your data logger.
- Click **Connect**.



7. Once you are connected, select the **Ethernet** tab.

The screenshot shows the configuration window for the Hughes9502 Inmarsat BGAN Satellite IP Terminal Kit. The 'Ethernet' tab is active, displaying the following settings:

- Ethernet Power:** Always On
- IP Address:** 192.168.128.240
- Subnet Mask:** 255.255.255.0
- IP Gateway:** 192.168.128.100
- DNS Server 1:** 8.8.8.8
- DNS Server 2:** 172.30.66.7

The 'Ethernet Domain Name Servers' section contains the following text:

This setting specifies the addresses of up to two domain name servers that the datalogger can use to resolve domain names to IP addresses. Note that if DHCP is used to resolve IP information, the addresses obtained via DHCP will be appended to this list.

Buttons at the bottom include 'Apply', 'Cancel', 'Factory Defaults', 'Read File', and 'Summary'.

8. Type the values shown in TABLE 6-1.

TABLE 6-1. Ethernet Settings		
Setting	Value	Description
IP Address	192.168.128.240	We configured the modem to automatically connect to a device with this IP address.
Subnet Mask	255.255.255.0	The modem and data logger will be on a local area network with this subnet mask.
IP Gateway	192.168.128.100	This is the IP address assigned to the satellite modem. This tells the data logger to direct its IP traffic to this destination to be forwarded on to the Internet.
DNS Server 1	8.8.8.8	DNS (Domain Name System) is a server used to translate domain names to IP addresses. 8.8.8.8 is a Google public DNS server.
DNS Server 2	172.30.66.7	172.30.66.7 is a DNS server hosted by Inmarsat for their own customers.

9. If using a static IP, data logger configuration is now complete. Click **Apply** to save the setting changes. If using a dynamic IP, another setting must be configured as described in the next section.

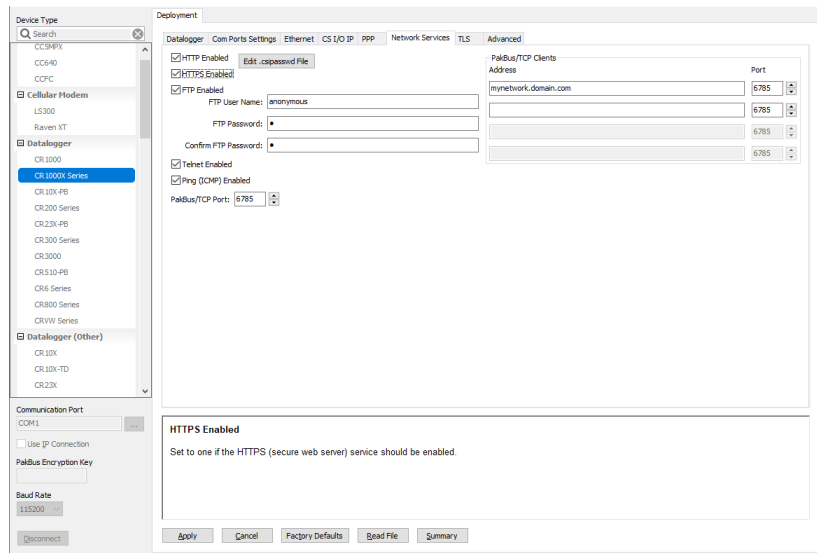
6.3.1 Dynamic IP

One simple method for establishing connection with a dynamic IP is to have the data logger actively attempt to establish communication with *LoggerNet*. *LoggerNet* needs to be addressable and accessible by a public IP address. The

data logger connects to the public IP address. Communications are routed to *LoggerNet* through port forwarding. See your network administrator for help with obtaining a public IP address and configuring port forwarding.

Use the following steps to set up the data logger to actively attempt to establish communication with *LoggerNet*:

1. While connected to your data logger in *DevConfig*, go to the **Network Services** tab.
2. Type the IP Address you want your data logger to connect to in the **PakBus/TCP Client Connections** field.



3. Click **Apply** to save the setting changes.

6.4 LoggerNet

The *LoggerNet* **Network Map** is configured from the *LoggerNet* **Setup** screen. The **Setup** screen needs to be in the **Standard** view:

1. From the *LoggerNet* toolbar, click **Main | Setup**
2. Click the **View** menu at the top of the **Setup** screen.
3. Click **Standard** view.

There are many different ways to set up *LoggerNet* to communicate with your data logger depending on the plan you have selected with your provider and the nature of your local network. The simplest connection is a Static, Public IP.

6.4.1 Static, Public IP

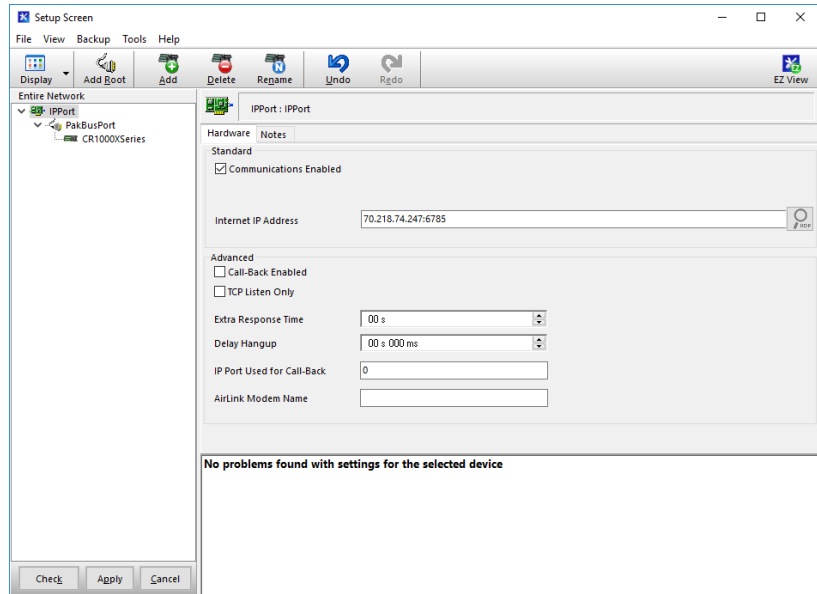
From the *LoggerNet* **Setup** screen:

1. Select **Add Root | IPPort**.
2. Add a **PakBusPort** to the **IPPort**.

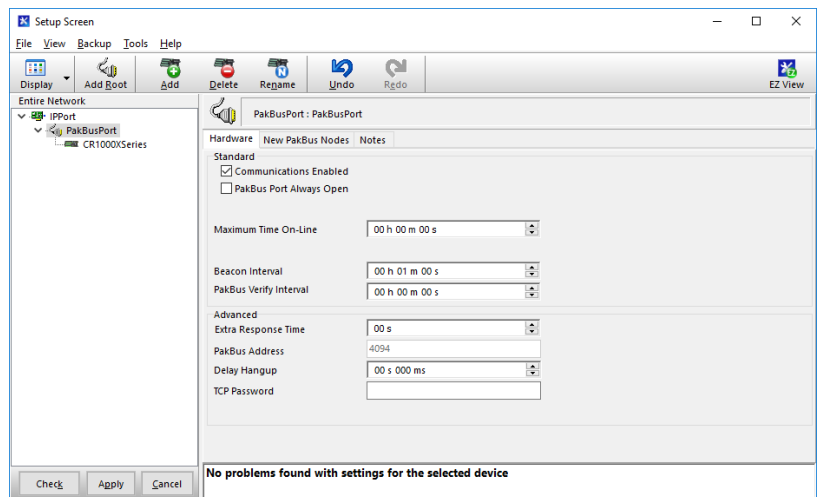
3. Add a data logger to the **PakBusPort**.
4. Select the **IPPort** in the **Network Map**. Type the HUGHES9502 IP address or domain name (WAN address) and port number. The IP address and port number are entered in the **Internet IP Address** field separated by a colon.

NOTE

Do not type the preceding zeroes in the IP address; for example, 070.218.074.247 is typed as 70.218.74.247. Default port number is 6785.

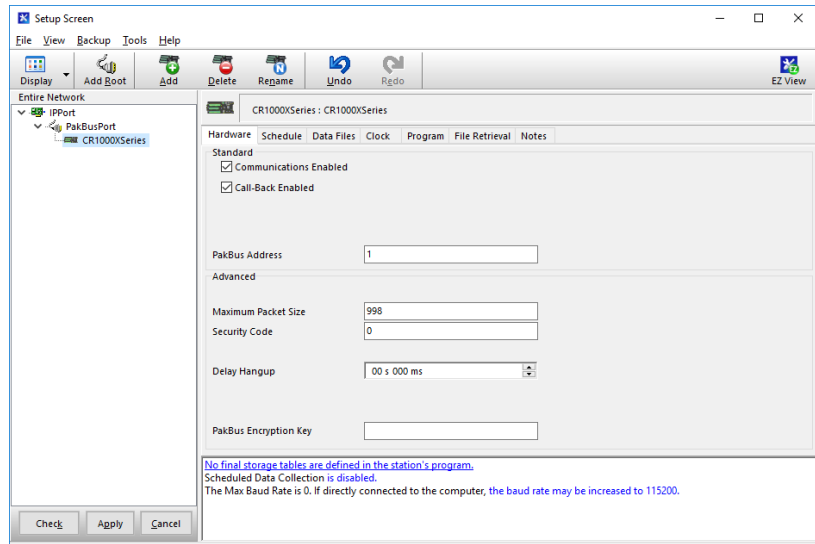


5. Use the default settings for the **PakBusPort**. Do not check **PakBus Port Always Open**.



6. Set the **PakBus Address** to match the data logger address (default address is 1).

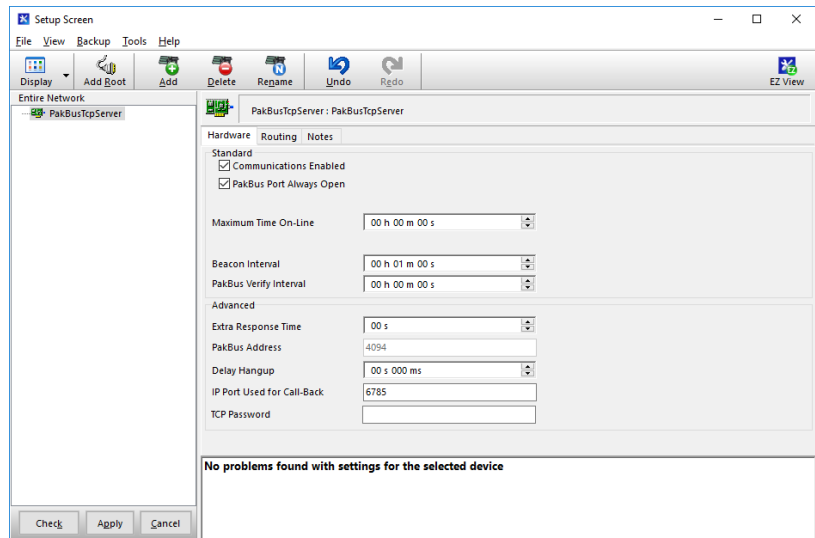
7. Apply the changes.



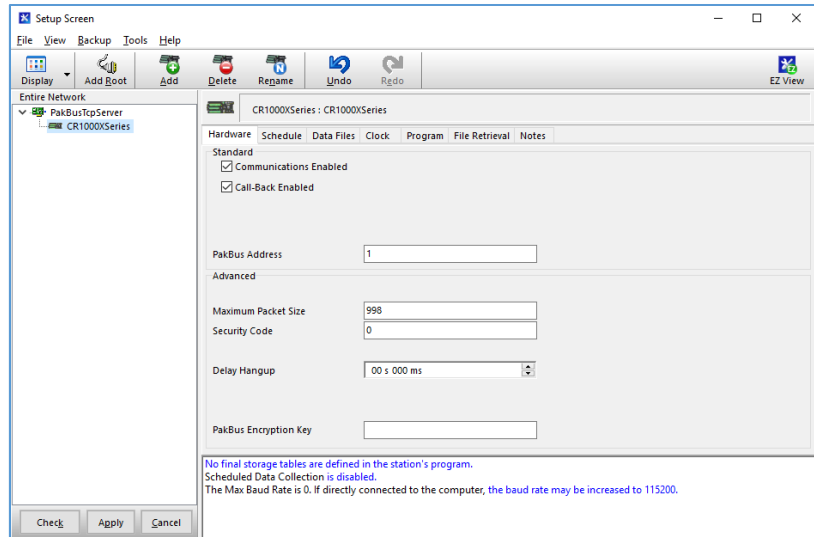
6.4.2 Dynamic IP

From the *LoggerNet* Setup screen:

1. Select **Add Root | PakBusTcpServer**.
2. Add your data logger to the **PakBusTcpServer**
3. Select the **PakBusTCPServer** on the network map, and check **PakBus Port Always Open**.



4. Select your data logger on the network map, and make sure the **PakBus Address** matches what you have set up in your data logger.



5. Apply the changes.

6.5 Antenna Installation

CAUTION

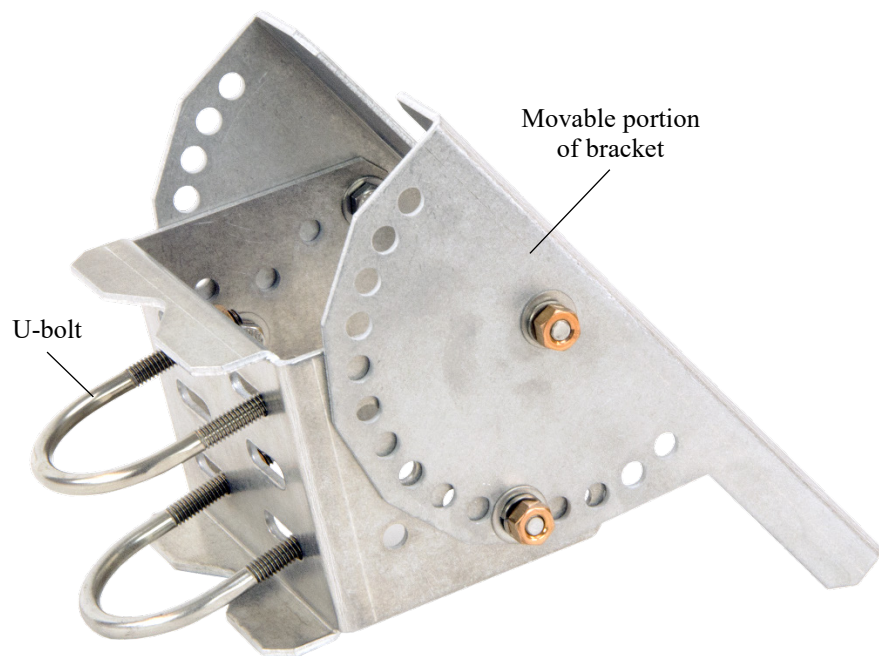
Do not stand in front of the antenna when the modem is powered because it produces radio frequency (RF) radiation.

A laptop and tools are required to aim the antenna in the field. Test everything at your office before going to the field. Because the Inmarsat BGAN satellites are geostationary, the antenna only needs to be aimed once.

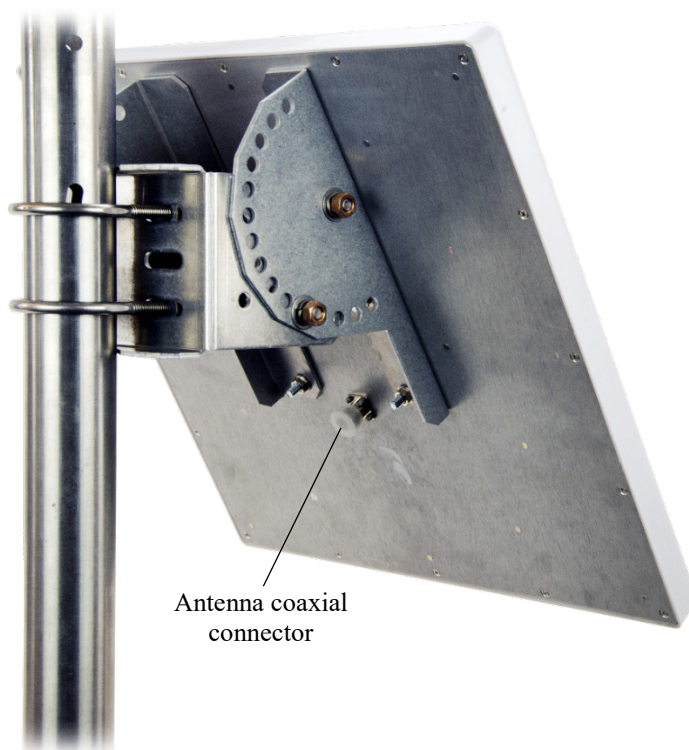
6.5.1 Antenna Siting Considerations

Stations using the HUGHES9502 must provide the flat, directional antenna with a good view of the southern (Northern Hemisphere) or northern (Southern Hemisphere) sky. Locate the stations between $+75^{\circ}$ and -75° latitude. Stations located at the extreme latitudes will need a better view of the horizon at low angles and are more susceptible to line-of-sight issues introduced by nearby buildings or mountains.

6.5.2 Mounting Antenna to a Pole



1. Secure the antenna mounting bracket to the pole using the provided U-bolts and nuts.
2. Mount the antenna to the movable portion of the mounting bracket using the bolts and nuts on the antenna. Ensure that the coaxial connector on the antenna lines up with the large hole in the mounting bracket.



3. Connect the N-type end of the antenna cable (larger end with no adapter) to the antenna.
4. Connect the TNC end (smaller end with adapter attached) of the cable to the satellite modem unit.



5. Follow procedure in Section 6.5.3, *Aiming the Antenna* (p. 13).

6.5.3 Aiming the Antenna

Correctly aiming the antenna is important because the SAT-Inmarsat-BGAN-kit uses a directional antenna.

1. Connect your laptop to the modem using an Ethernet cable.
2. Access the HUGHES9502 user interface (UI) by typing **192.168.128.100** in a browser. After getting a GPS fix, use the elevation and azimuth displayed in the **Pointing Info** (lower left corner of the UI) to aim the antenna.

The screenshot displays the HUGHES9502 web interface. The top navigation bar includes links for Home, Connections, Settings, M2M, Security, and SMS. The main content area is divided into several sections:

- STATUS Connection:** Shows 'Connected' status with a signal strength indicator.
- GPS:** Displays '3D GPS Fix' with location coordinates (41.71577° N, 111.80965° W) and the last fix time (21-Mar-2015, 23:01 UTC).
- Pointing Info:** Shows the current pointing information, including 'I-4 Americas' and coordinates '159.7°' and '39.8°'.
- Terminal Information:** Provides details about the terminal, including Model (BGAN USER TERMINAL, Hughes 9502), IMEI, Software Version (5.9.3.1), IMSI, APN (STRATOS.BGAN.INMARSAT.COM), and Subscriber Phone Number.
- Troubleshooting:** Includes a section for 'Terminal Logs' with links to download current and archived logs, and buttons to reset event and packet logs.
- Reset Terminal to Factory Defaults:** A section with a button to restore the terminal to its original default values.
- Reboot Terminal:** A section with a button to reboot the terminal software.

NOTE

As the antenna is pointed in the correct direction, the **Signal Strength** should increase (top left of the UI). The **Signal Strength** value must be above 53 for a successful connection. When the **Signal Strength** reaches 53, the status bar will be entirely green and the **Connection Status** will show **Connected**.

3. Tighten nuts to secure the antenna at the proper angle.

6.5.4 Verify Connection

Once the connection is made, open another tab in your browser and verify that you can connect to a website (for example, www.google.com).

6.6 Wiring and Connections

The HUGHES9502 connects directly to the data logger onboard Ethernet port (FIGURE 6-1) or connects to the data logger by using an interface (FIGURE 6-2, FIGURE 6-3). TABLE 6-2 shows data logger compatibility for the various Ethernet interface options. Wiring of the HUGHES9502 is shown in TABLE 6-3.

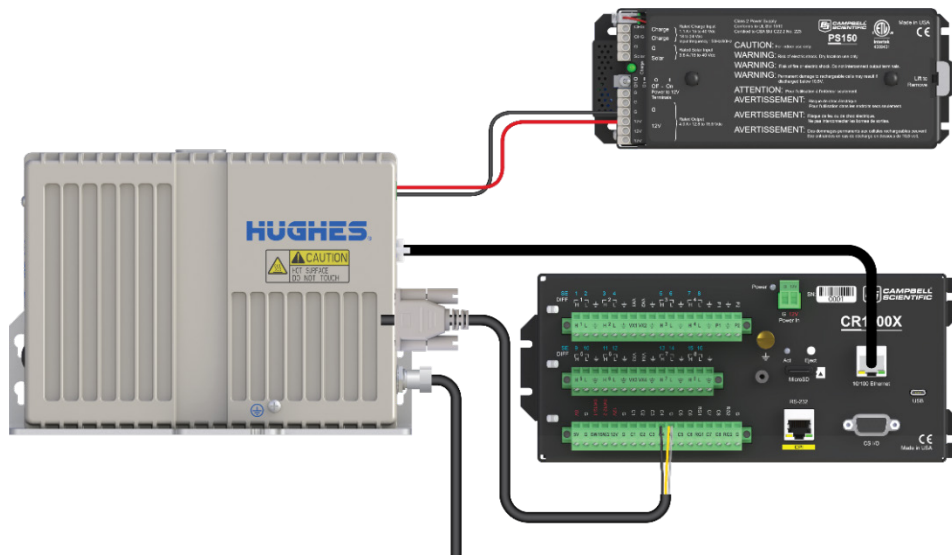


FIGURE 6-1. HUGHES9502 connected to CR1000X on-board Ethernet port

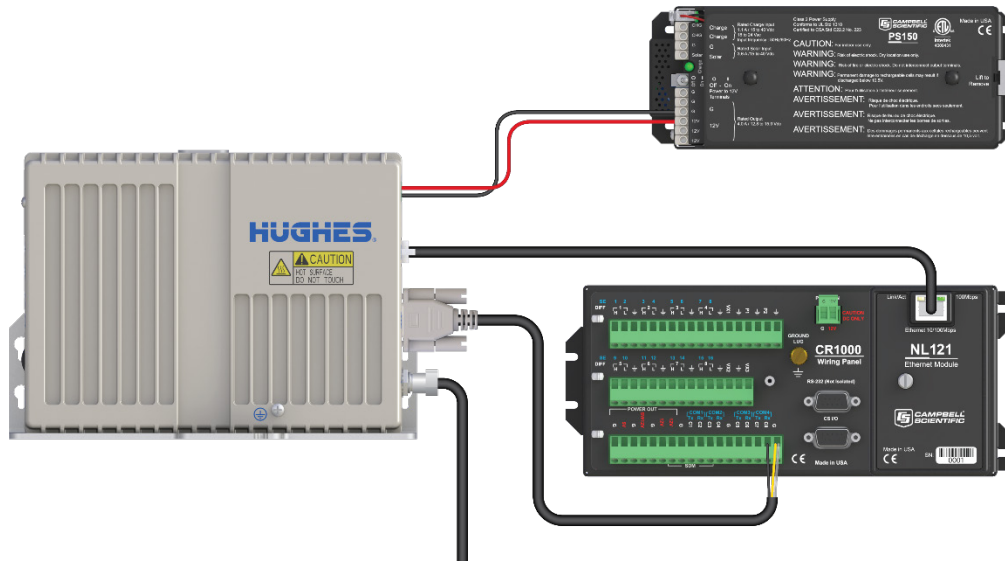


FIGURE 6-2. HUGHES9502 connected to the NL121 on a CR1000

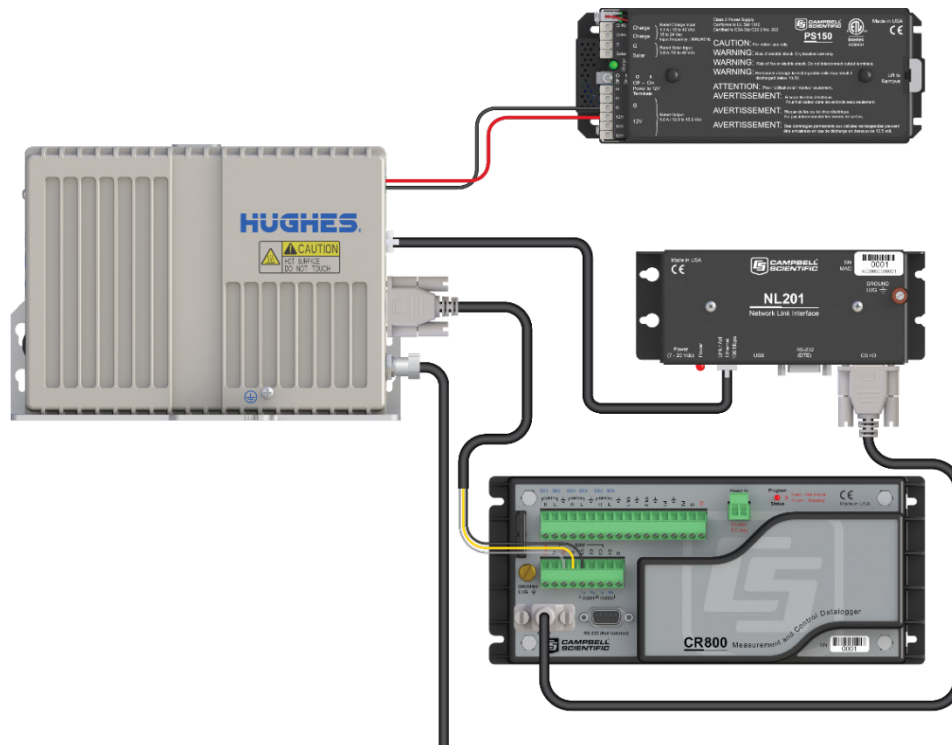


FIGURE 6-3. HUGHES9502 connected to the NL201 and CR800

TABLE 6-2. Ethernet Connection Options and Data Logger Compatibility			
	Data Logger Onboard Ethernet Port	NL121 or NL116	NL201
Compatible Data Loggers	CR310, CR1000X, CR6, CR9000X	CR1000, CR3000	CR200(X) Series, CR300, CR310, CR800 Series, CR1000, CR1000X, CR3000, CR6, CR5000, CR9000X

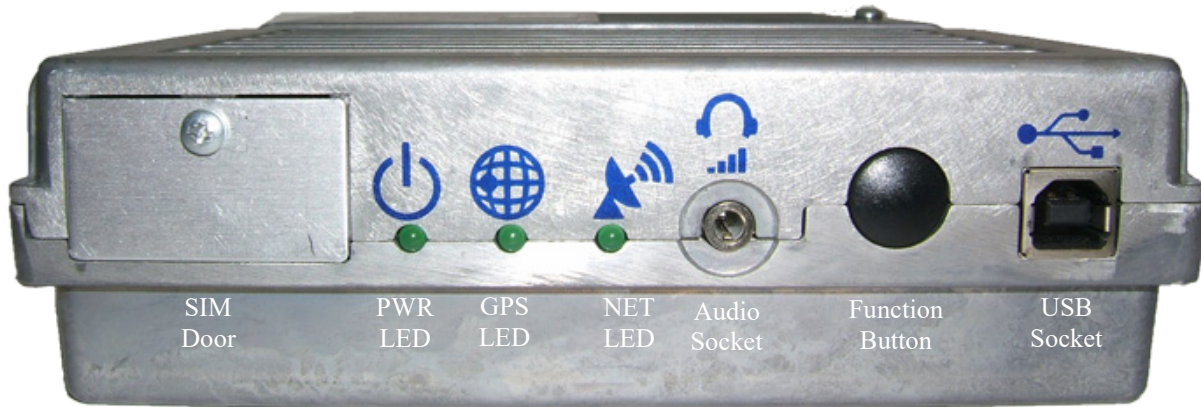
TABLE 6-3. HUGHES9502 Connections to Data Logger, Interfaces, and Power Supply		
HUGHES9502 Connector Label or Type	Cable or Wire	Connection
+	Red 18 AWG wire	12V, + or equivalent terminal on the power supply
–	Black 18 AWG wire	G, –, $\frac{1}{2}$ or equivalent terminal on power supply
RJ45	CAT6 Ethernet unshielded cable	Ethernet port on data logger, NL121, NL116, or NL201 ¹
DB9 ²	DB9 female-to-pigtail serial cable	See TABLE 6-4
¹ The NL201 CS I/O port connects to the data logger CS I/O port by using an SC12 cable (shipped with the NL201); refer to the NL201 manual for more information. ² The DB9 port is used for sleep control (optional). Appendix B, <i>General Purpose Input Output (GPIO) (p. B-1)</i> , provides more information.		

TABLE 6-4. Serial Cable-to-Data-Logger Connection for Sleep Control		
Pin Number	Wire Colour	Data Logger Terminal
9	Grey	C (control terminal)
5	Yellow	$\frac{1}{2}$ (analogue ground)
--	Clear (Shield)	$\frac{1}{2}$ (analogue ground)
--	Other Colours	Not used

7. Operation

7.1 HUGHES9502 Satellite Terminal

The satellite modem supplied with the SAT-Inmarsat-BGAN-Kit has the following interfaces and controls on the exterior of the unit:



Sim Door: Remove this to insert or replace the modem Inmarsat SIM card. A Phillips head screwdriver is supplied with the modem kit for this purpose.

PWR, GPS and NET LEDs: See Appendix A, *Status LEDs (p. A-1)*, for details.

Audio Socket: Connect headphones to this 3.5 mm audio socket when the modem is in the **Pointing Mode** to hear tones that increase their pitch as the received signal strength increases.

Function Button: Used for placing the modem in **Pointing Mode** as well as resetting the modem.

USB Socket: Used for Ethernet over USB, allowing a computer to access the modem web UI, AT commands, and upgrade the modem operating system.



Antenna Connector: The antenna cable will connect to the modem TNC antenna connector with the supplied N-TNC adapter.

GPIO DB9: Used in Campbell Scientific systems to place the modem in sleep mode. See Appendix B, *General Purpose Input Output (GPIO)* (p. B-1).

Ethernet: The main data interface for the modem. The data logger connects to the modem on this port over Ethernet.

Power Supply: Suitable for either 12 Vdc or 24 Vdc nominal power sources. Due to its current drain, the unit should be powered directly from a battery or regulator instead of a data logger **12V** or **SW12** terminal.

7.2 Satellite Coverage

The Inmarsat Broadband Global Area Network (BGAN) satellite network consists of three geostationary satellites: I-4 Asia Pacific, I-4 EMEA and I-4 Americas, which provide satellite data services around the world (FIGURE 7-1). A geostationary satellite does not change its position in the sky, allowing terminals to use much lower transmission power combined with a directional antenna, making low-power satellite services feasible. Because it uses L-band frequencies (1518 to 1675 MHz), the BGAN service is largely unaffected by rain fade, which causes signal degradation in some satellite systems.

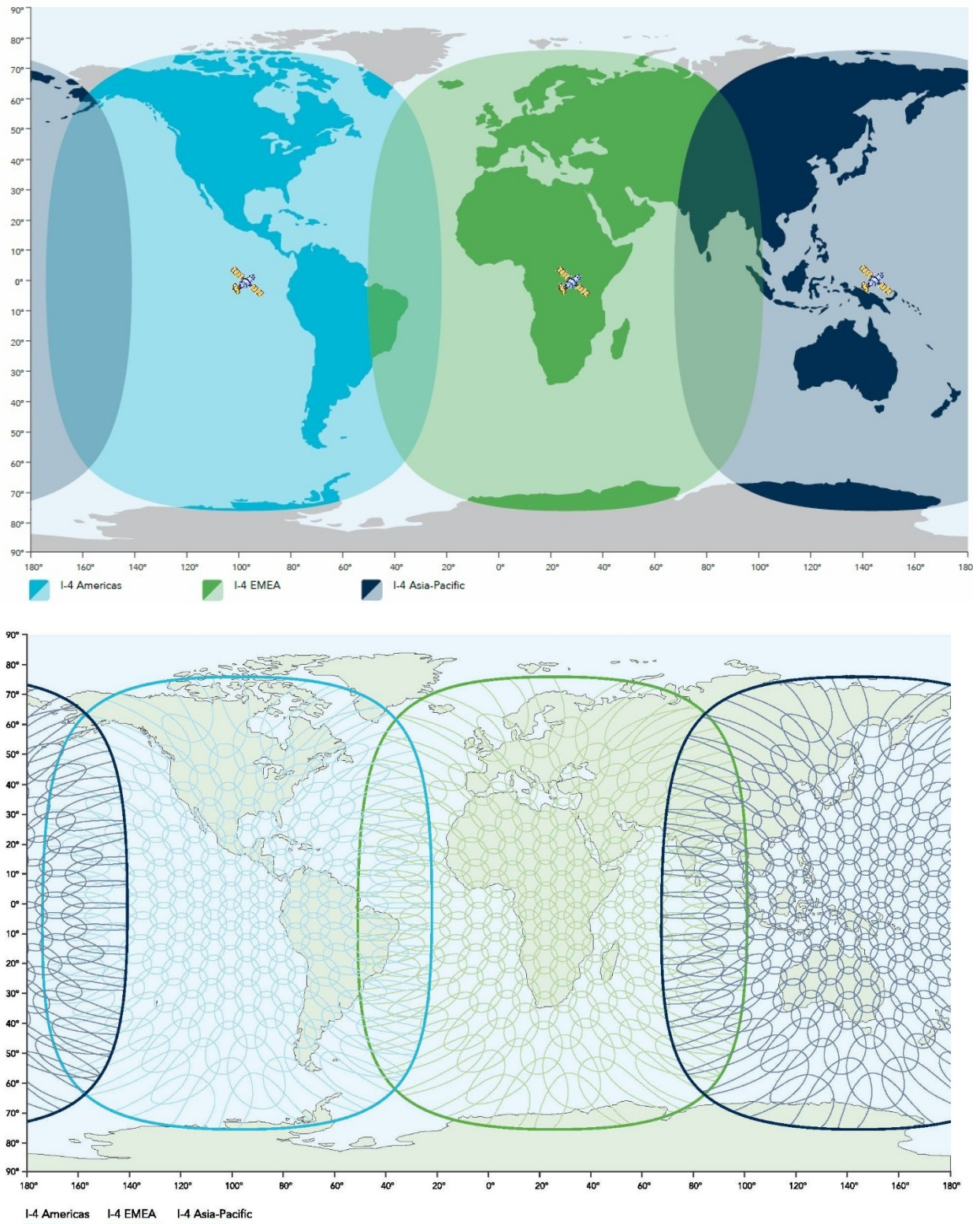


FIGURE 7-1. Inmarsat BGAN satellites and their coverage

7.3 Power Considerations

There are multiple methods for addressing average power consumption. The unit can idle in a low-power state or be put to sleep under data logger control. Therefore, the HUGHES9502 can be a good fit for stations with a sensitive power budget. Download the power budget spreadsheet to determine your power budget requirements (www.campbellsci.eu/downloads).

If power usage is a concern, use the general purpose input output (GPIO) to put the HUGHES9502 in sleep mode and use the CRBasic **IPNetPower()** instruction to turn off your network peripheral. Before transmission, power the network peripheral then the HUGHES9502. For more information, see Appendix B, *General Purpose Input Output (GPIO)* (p. B-1).

7.4 Communication Performance

Information provided by Inmarsat: “Send data using BGAN Standard IP at a rate of up to 448 kbps with a low latency from 800 milliseconds, assuring real-time visibility of critical data.” Latency is dependent on the end-to-end.

Campbell Scientific has observed the following:

- Raw upload (data logger to Internet) speeds: 100 kbps typical
- PakBus payload upload speeds: typically greater than 12 kbps
- ICMP ping time: 1 second typical
- PakBus ping of 1000 bytes: 2.5 seconds typical

Data transfer speeds can vary depending on location, signal strength, and the protocol used.

8. Troubleshooting

NOTE

All factory repairs require a returned material authorization (RMA) and completion of the “Declaration of Hazardous Material and Decontamination” form. Refer to the [Read 1st](#) page at the beginning of this manual for more information.

Symptoms and possible solutions are provided in TABLE 8-1.

TABLE 8-1. Symptoms and Possible Solutions

Symptom	Solution
No lights are visible on the modem unit.	Ensure that power is connected to the modem and that your battery has sufficient voltage.
No power light on the NL201 interface.	Ensure power is connected to the NL201.
Modem Web UI does not appear in browser.	Try a different browser. Default IP address is 192.168.128.100
Cannot get signal strength above 53.	Check coarse pointing information in modem UI and ensure that obstructions do not obscure the antenna view of the sky.
Connection Status window in Web UI shows Registering... and never connects despite signal strength being above 53.	Check that your SIM card has been configured and activated. For Inmarsat SIM services in USA contact: Galaxy 1 USA 4611 S. University Dr. #454 Fort Lauderdale, FL 33328 USA Tel: +1 954 472 9599
No Ethernet activity lights on the NL116 or NL121 when it is connected to the modem.	Ensure that the data logger settings match those in Section 6.3, <i>Data Logger Configuration (p. 6)</i> .
Modem periodically powers down or stops responding.	Check the data logger program and ensure that it's not causing this situation.
Global IP never appears in Manage Contexts window.	Check that your SIM card has been activated by the plan vendor and check that credit is available if it is a pre-paid SIM card.

Appendix A. Status LEDs

The M2M unit has three green LEDs:

- **PWR (Power) LED:**
 - Turn unit on—LED turns on
- **GPS LED**
 - Flashes while acquiring fix
 - Turns solid when unit has a 2D or 3D fix
- **NET (Network) LED:**
 - Flashes when registered
 - Turns solid when unit establishes a PDP context

Each LED will either be:

- Off
- On
- Flashing: 1 Hz, 50% duty cycle
- Short flash: 1 Hz, 1/8th duty cycle – this indicates a fault.

All three LEDs flash in install mode and short flash if there is a fault detected that prevents normal operation.

The basic operation of the LEDs is according to the following rules and is shown in [FIGURE A-1](#):

1. At power on, the LEDs will be active until one minute after the PDP context is established. If the context does not get established, they will turn off after 5 minutes.
2. Once off, if the user presses the function button they will toggle active for 1 minute.
3. In install mode, the LEDs will always be active.

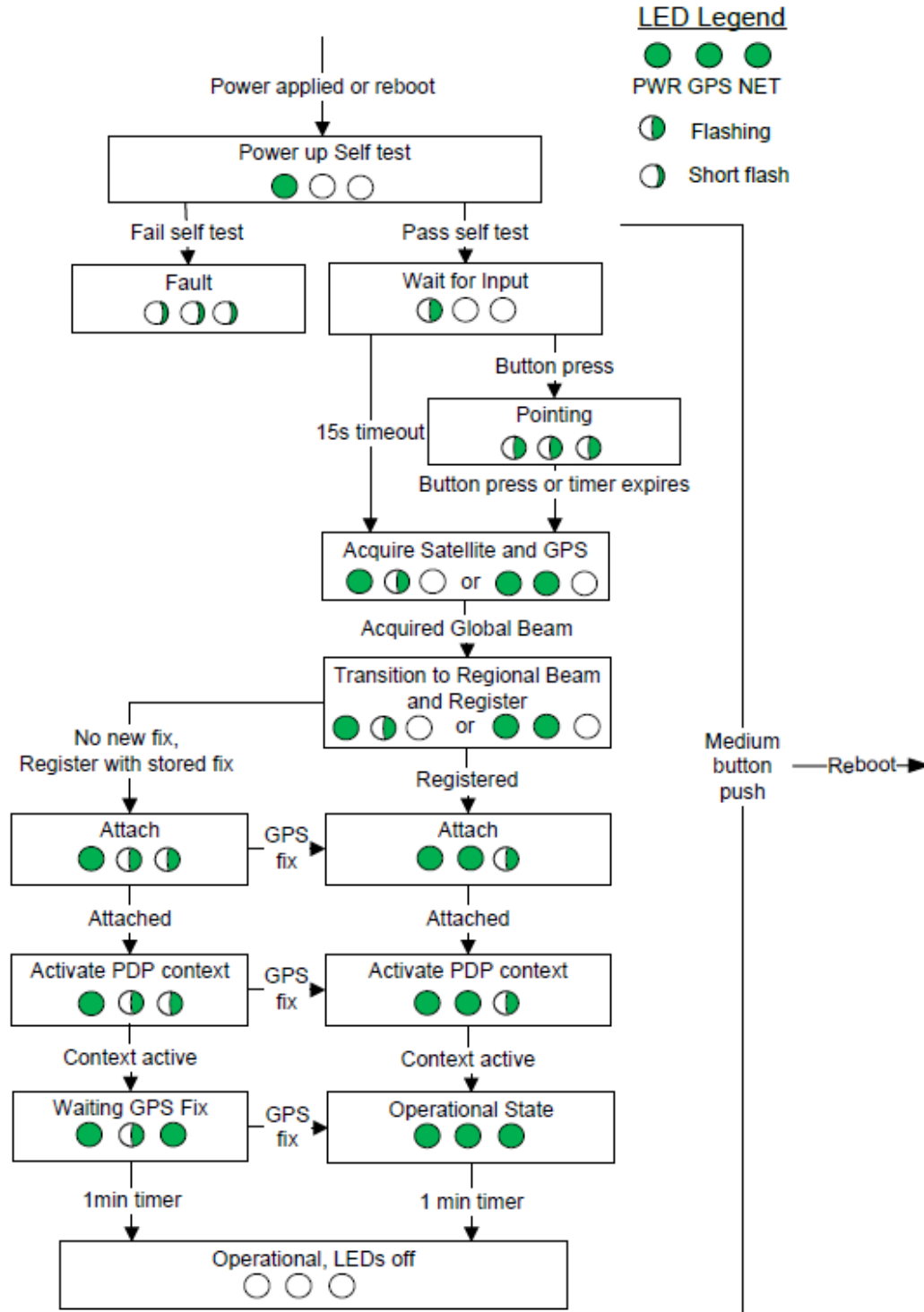


FIGURE A-1. Flowchart of Status LEDs

Appendix B. General Purpose Input Output (GPIO)

The general purpose input output (GPIO) control line on the DB9 GNSS serial port can power the HUGHES9502. If a voltage is applied to pin 9 of the serial port and pin 5 as ground, the HUGHES9502 will power down. It will power up when the voltage is removed. The voltage can be 2.5 Vdc to 50 Vdc. The recommended value is 12 Vdc. In GPIO sleep, it uses approximately 0.25 mA.

To use the GPIO control line, connect the data logger to the HUGHES9502 with the DB9-female-to-pigtail serial cable shipped with the HUGHES9502. The **PortSet()** CRBasic instruction sets the control terminal high and the **IPNetPower()** CRBasic instruction turns on the Ethernet interface. CRBasic Example B-1 is a CR1000X program; other data loggers are programmed similarly.

CRBasic Example B-1. CR1000X Program to Controlling the GPIO

```
Public PTemp, batt_volt

DataTable (FifteenSec,1,-1)
  DataInterval (0,15,Sec,10)
  Minimum (1,batt_volt,FP2,0,False)
  Sample (1,PTemp,FP2)
EndTable

BeginProg
  Scan (1,Sec,0,0)
    PanelTemp (PTemp,250)
    Battery (batt_volt)

    CallTable FifteenSec

    If TimeIsBetween (0,15,60,min) Then
      'for the first 15 minutes of every hour
      PortSet(C1,0) 'set the control terminal low allowing the unit to power up
      IPNetPower(1,-1) 'turn on the Ethernet interface
    Else
      IPNetPower(1,0) 'turn off the Ethernet interface
      PortSet(C1,1 )
    EndIf

  NextScan
EndProg
```

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