



MODULUS TECHNOLOGY

Engineering Services

An AAE Technologies Group Company

MiniPod GPS Receiver Operation Manual

Revision History

Issue	Change No.	Reason for change	Date
1	n/a	First Issue	09/05/2019
2	2242	Internal switch image added to page 17	09/03/2020
3	2365	Update to specification and wireless correction protocols	08/06/2020

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Thank you for choosing Modulus Technology as one of your subsea equipment suppliers. We hope you experience many years of reliable operational use from our products.

If you do encounter any technical issues with any of our products then please don't hesitate to contact our Technical Team via the following methods.

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Modulus Technology Ltd has made every effort to ensure that the information contained in this manual is correct at time of print. However our policy of continual product improvement means that we cannot assume liability for any errors which may occur.



These written instructions must be followed fully for reliable and safe operation of the equipment that this manual refers to. Modulus Technology Ltd cannot be held responsible for any issues arising from the improper use or maintenance of equipment referred to in this manual or failure of the operator to adhere to the instructions laid out in this manual. The user must be familiar with the contents of this manual before use or operation.

1. Introduction to the BCN-101G MiniPod Series

This manual provides the user with information on the installation, operation and maintenance of the MiniPod series and peripherals.

The MiniPod series is a lightweight, ruggedized GPS receiver / AHRS, it's designed to survive 50m immersion for use in harsh marine applications where surface positioning is required. The MiniPod provides options for wired and wireless communications.

The interconnect flexibility of the MiniPod allows for wired RS232, RS485 4-wire and RS485 2-wire or alternatively an internal RF module allows for wireless data transfer back to a RFR-101G receiver.

The vessel has a PC application interface which allows for received data to be fed via Ethernet or serial interface to the client navigation / logging application.

Variants

Model	GPS Receiver	AHRS	External RF Antenna	RF Directional Range
BCN-101G	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	800m
BCN-101GA	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	800m
BCN-101A	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	800m
BCN-101G-EXT	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	2000m
BCN-101GA-EXT	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	2000m



Note: The above variations are standard models currently manufactured by Modulus Technology, if there is any functionality not listed that is desired please contact Technical Support who will be happy to discuss any requirements for your project. The RF Range is a guide only and may vary.

Supplied Parts

Standard MiniPod

BCN-101G MiniPod

BCN-101G-2002 Mounting Bracket & Hardware

Modulus Support Disc

External RF MiniPod

BCN-101G-EXT MiniPod

BCN-101G-2005 Mounting Bracket & Hardware

BCN-101G-4002 External Antenna

Modulus Support Disc

2. MiniPod System Information

The MiniPod is supplied configured ready to go straight out of the box, upon power up the MiniPod will start transmitting a standard \$GPGGA NMEA string at 5Hz (default) through both the Primary Port A RS232 (115200,8,N,1) on the bottom end and over the RF link. The GPS will initiate <60s and the AHRS (when applicable) will start to transmit straight away although will take approximately 120s to settle and provide a stable reading.



Where possible a compass calibration should be performed prior to first operation after installation to compensate for magnetic interferences. (Applicable to AHRS versions only)

The MiniPod can be configured to output GPS data up to 10Hz transmission rate as standard.



Due to continual product development and improvement enhanced speed capabilities and data transfer may become available over RF link and this specification is subject to change. For further information and to discuss specific system applications please contact technical support.

The MiniPod is configured using the 'MiniPod Editor App'. Providing options for update rates, NMEA formats, and serial protocols.



Changing communication settings will immediately change the port configuration. Setting the MiniPod incorrectly may result in having to open the MiniPod for mechanical reset.



Recommended RS485 to RS232 converters - MOXA UPort 1150I/ 1250I/ 1450I Series.

For High Voltage applications using Applied Acoustic Equipment an optional Cable [HVC-3501] and Interface Box [BCN-101G-7024] can be purchased to provide a safe and reliable isolated power supply and RS485 communications from the MiniPod to user interface.

Integrated GPS Receiver

The integrated GPS receiver is an OEM Hemisphere P326 unit, configured for dual band L1 and L2 reception plus Multi GNSS providing worldwide reliable positioning coverage utilising the full constellation of positioning satellites.

The receiver can be configured directly using Port C RS232 using the defined interface configuration with PocketMax application from Hemisphere. Link below:-

<https://hemispheregnss.com/Resources-Support/Software>



Do not change the com port settings of Port A directly on the GPS Receiver, otherwise communications may be lost with the internal micro controller.

Port C is also available for External Corrections to be input through a wired connection and configurable using PocketMax.

GPS PPS Sync Pulse

The internal hardware supports an optional 1PPS +3.3V sync pulse output from the GPS module. This can be configured through additional internal hardware to output on the bulkhead connector to synchronise the MiniPod with other user equipment for easy integration and operational control. Please contact technical support for more information.

RF Interface

As standard the MiniPod is fitted with an internal RF antenna, the operating range of the standard internal antenna is typically 800m directional. The MiniPod has been developed to support bi-directional communications via RF link, this allows for RTCM (V3.2) or CMR corrections to be sent over RF for accurate positioning.

Refer to the 'MiniPod Receiver Operation Manual' [RFR-101G-8000] for further information.

External Antenna Option

An external RF Antenna can be fitted to increase the maximum wireless range back to the receiver without an External RF Antenna the maximum range expected would be approximately 800m fitting the external antenna will increase this to 2000m. Directional and Omni Directional Options available.



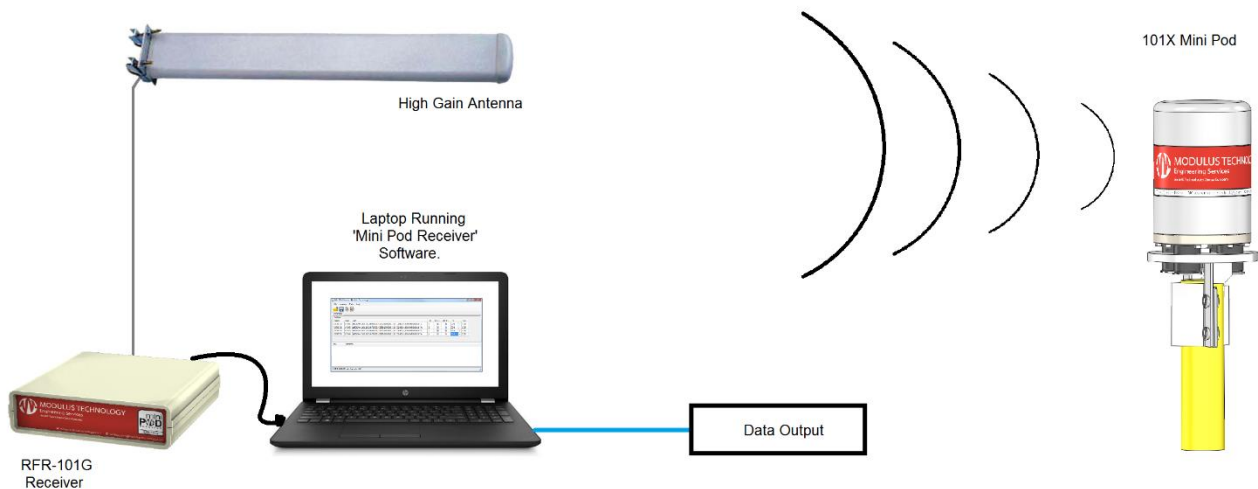
Recommended maximum operation is up to 4 GPS Pods operating at 10Hz with a single NMEA string output. It is not recommended to exceed 10Hz data rate for receiving reliable data. Ensure only a single NMEA string is enabled or bandwidth may be exceeded.

3. MiniPod Installation & Operation

Positioning of the MiniPod

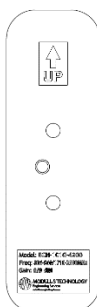
The unit must have a clear unobstructed view of the sky. In particular, large vertical surfaces in proximity above the antenna may cause problems with accurate position determination, due to the signal(s) taking an indirect path.

The RF Antenna is indicated by a notch on the MiniPod Endcap and by an antenna sticker as show with the MAC address of the MiniPod attached this is directional and for the best results this should be aligned with the receiver.




Ensure the BCN-101G MiniPod internal antenna is in alignment with directional RFR receiver antenna

The External RF Antenna is directional and must also be mounted facing aligned to the receiver please take note of the UP↑ Arrow indicating orientation of the mounting.



The External RF antennas are not pressure rated and should only be used on permanent above surface applications.

Connections

<div style="display: flex; align-items: center; justify-content: space-between;">  <div style="text-align: center;"> Configuration of MC-BH-8M </div> </div>			
Pin	<u>RS232</u>	<u>RS485 Full Duplex</u>	<u>RS485 Half Duplex</u>
1	24V DC	24V DC	24V DC
2	GND	GND	GND
3	Port A, RS232, TX. 115200 Baud 8,n,1.	Port A Line 1 +, TX 115200 Baud 8,n,1.	Port A RS485+, Rx/TX 115200 Baud 8,n,1.
4	N/C	Port A Line 1 -, TX 115200 Baud 8,n,1.	Port A RS485-, Rx/TX 115200 Baud 8,n,1.
5	Port A, RS232 Rx 115200 Baud 8,n,1.	Port A Line 2 +, Rx 115200 Baud 8,n,1.	N/C
6	N/C	Port A Line 2 -, Rx 115200 Baud 8,n,1.	N/C
7	Port C, RS232, (Tx). 19200 Baud 8,n,1	Port C, RS232, (Tx). 19200 Baud 8,n,1	Port C, RS232, (Tx). 19200 Baud 8,n,1
8	Port C, RS232, (Rx) 19200 Baud 8,n,1	Port C, RS232, (Rx) 19200 Baud 8,n,1	Port C, RS232, (Rx) 19200 Baud 8,n,1

The MiniPod requires a constant 18V-36V DC (nominal 24V) and has no ON / OFF switch, connecting power via the bulkhead connector will switch the unit on. Ensure power lines are protected by suitable fuse and electrical interference.

Port A is the primary data out port and can be configured for RS232, RS485 4 wire and RS485 2 wire communication protocols.

Port C is primarily a diagnostic communication port to the GPS receiver for direct connection for configuration and diagnostics. Port C can also be configured as a differential correction input.



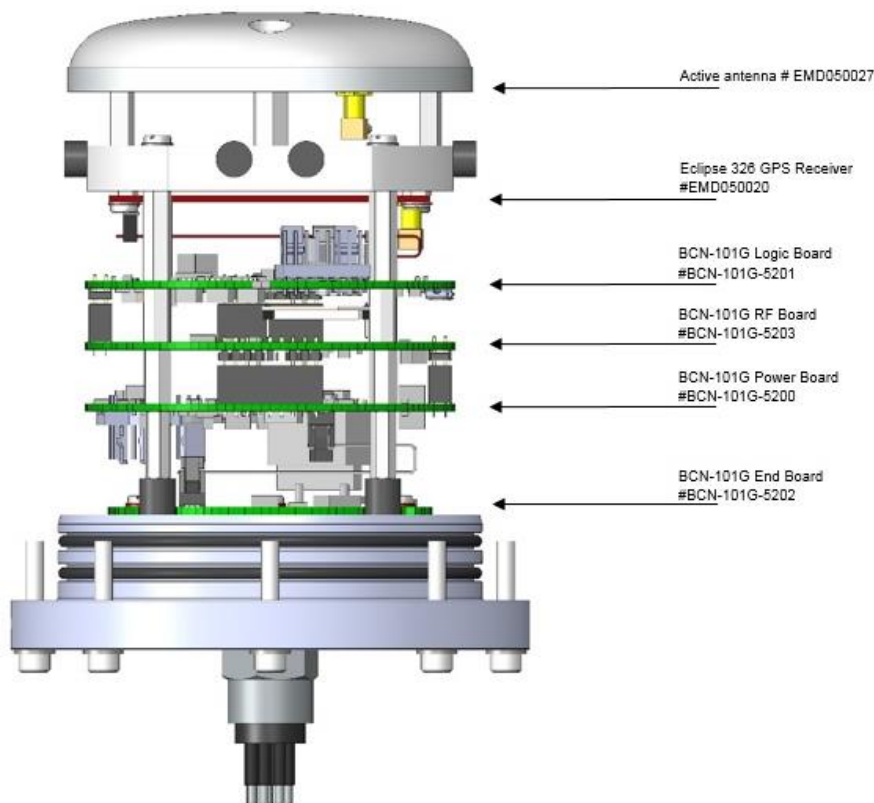
Make electrical connections before attaching mounting bracket. Connection to the unit must be lubricated with silicone gel, otherwise corrosion of the connector will occur, and the MC-IL-8F and locking collar is the compatible connector type to mate to this unit.

If the application has no means of wired power, an external battery pack [BPK-101G] can be interfaced to provide a stable 18V DC power supply to the MiniPod.

MiniPod Configuration.

The default configuration of the MiniPod will be delivered as follows:

PORT A, RS232 + RF ENABLED

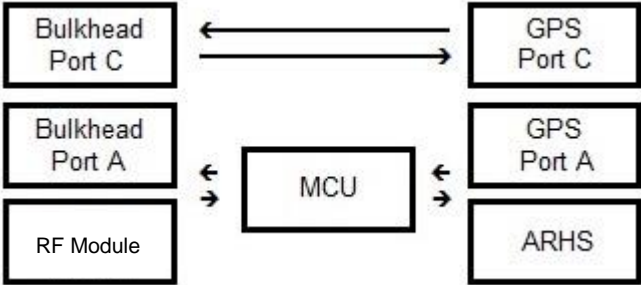


Pin	Configuration of Bulkhead Connector (MC-BH-8M)	RS232 Port A	RF
1	18V-36V DC	Default: 5Hz GGA NMEA	Default: 5Hz GGA NMEA
2	GND		
3	Port A, RS232, (Tx). 115200 Baud 8,n,1		
4	N/C		
5	Port A, RS232, (Rx). 115200 Baud 8,n,1		
6	N/C		
7	Port C, RS232, (Tx). 19200 Baud 8,n,1		
8	Port C, RS232, (Rx). 19200 Baud 8,n,1		



Any internal switches should not be changed without instruction from Modulus Technology or outside the contents of this manual. The switches are installed for fault finding and test purposes only.

The control of the MiniPod system is set by the on board micro controller using the 'MiniPod Editor'.

Device	Connected	System Diagram
Micro Controller (MCU)	<input checked="" type="checkbox"/>	 <pre> graph LR MCU[MCU] <--> BP_C[Bulkhead Port C] MCU <--> BP_A[Bulkhead Port A] MCU <--> RF[RF Module] MCU <--> GP_C[GPS Port C] MCU <--> GP_A[GPS Port A] MCU <--> ARHS[ARHS] </pre>
GPS (If Installed)	<input checked="" type="checkbox"/>	
RF Module	<input checked="" type="checkbox"/>	
AHRS (If Installed)	<input checked="" type="checkbox"/>	

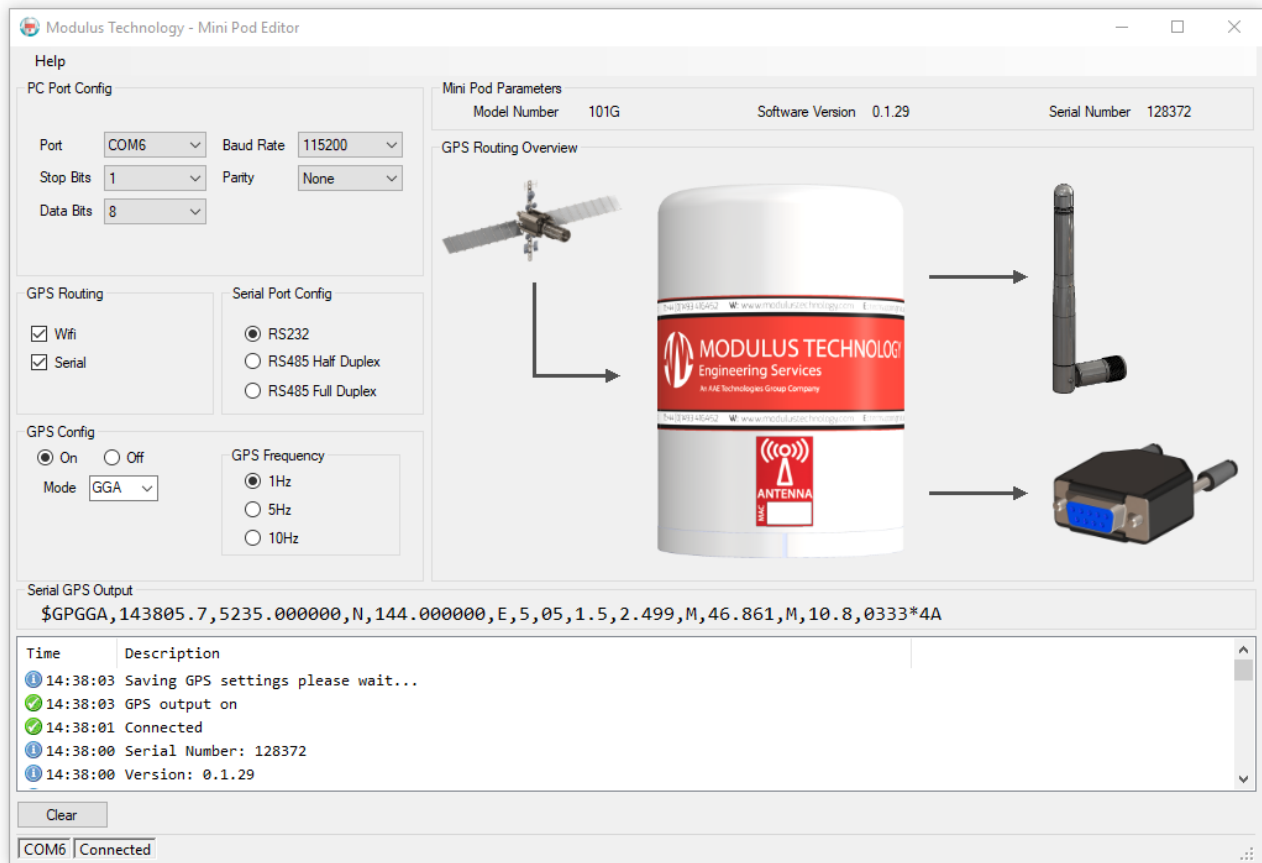


When the MCU is fitted all other devices are controlled via the micro controller and the outputs to the bulkhead connector and to the RF ZigBee module can be toggled On/Off via software using the 'MiniPod Editor' application through Port A.

4. Introduction to the MiniPod Editor

Overview

The MiniPod Editor is a software solution to configure MiniPod's.



MiniPod Editor Software

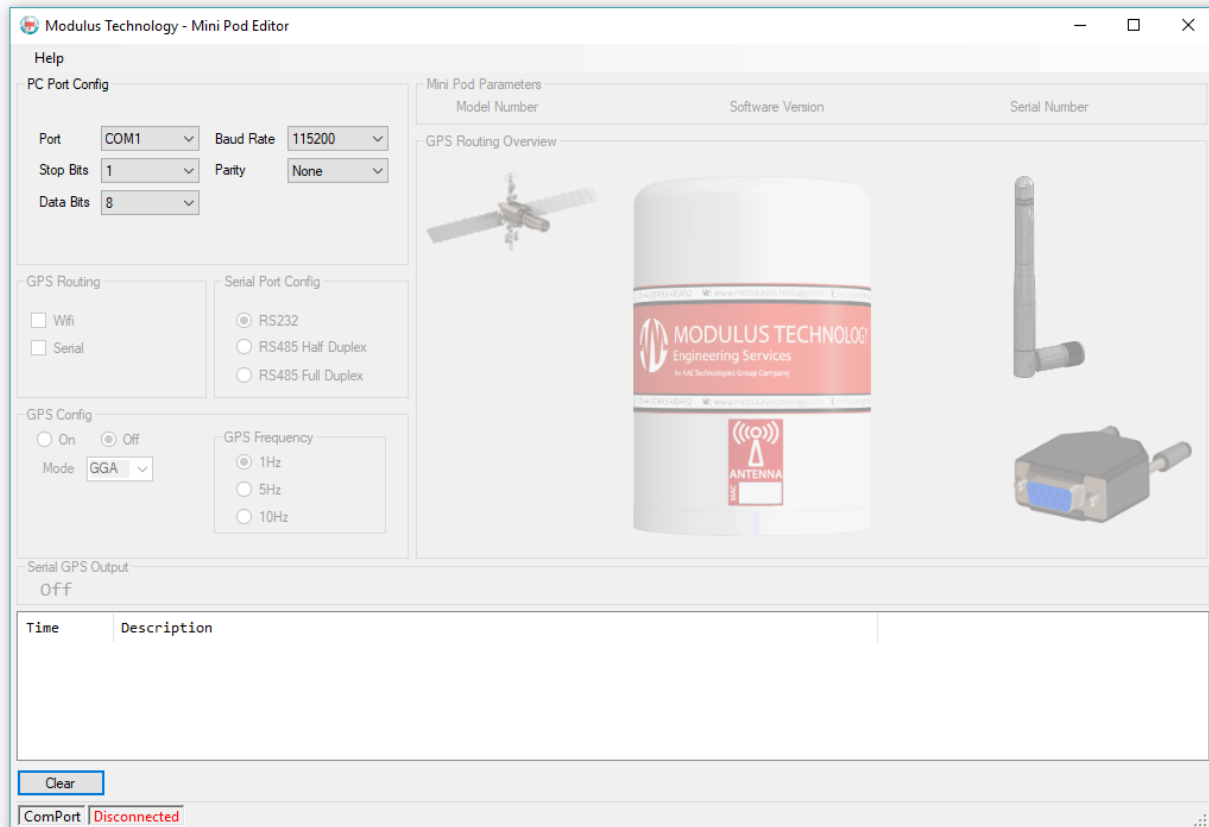
The MiniPod Editor is a Windows based software that connects to a MiniPod via a serial interface and allows configuration of interface and GPS output.

Software Installation

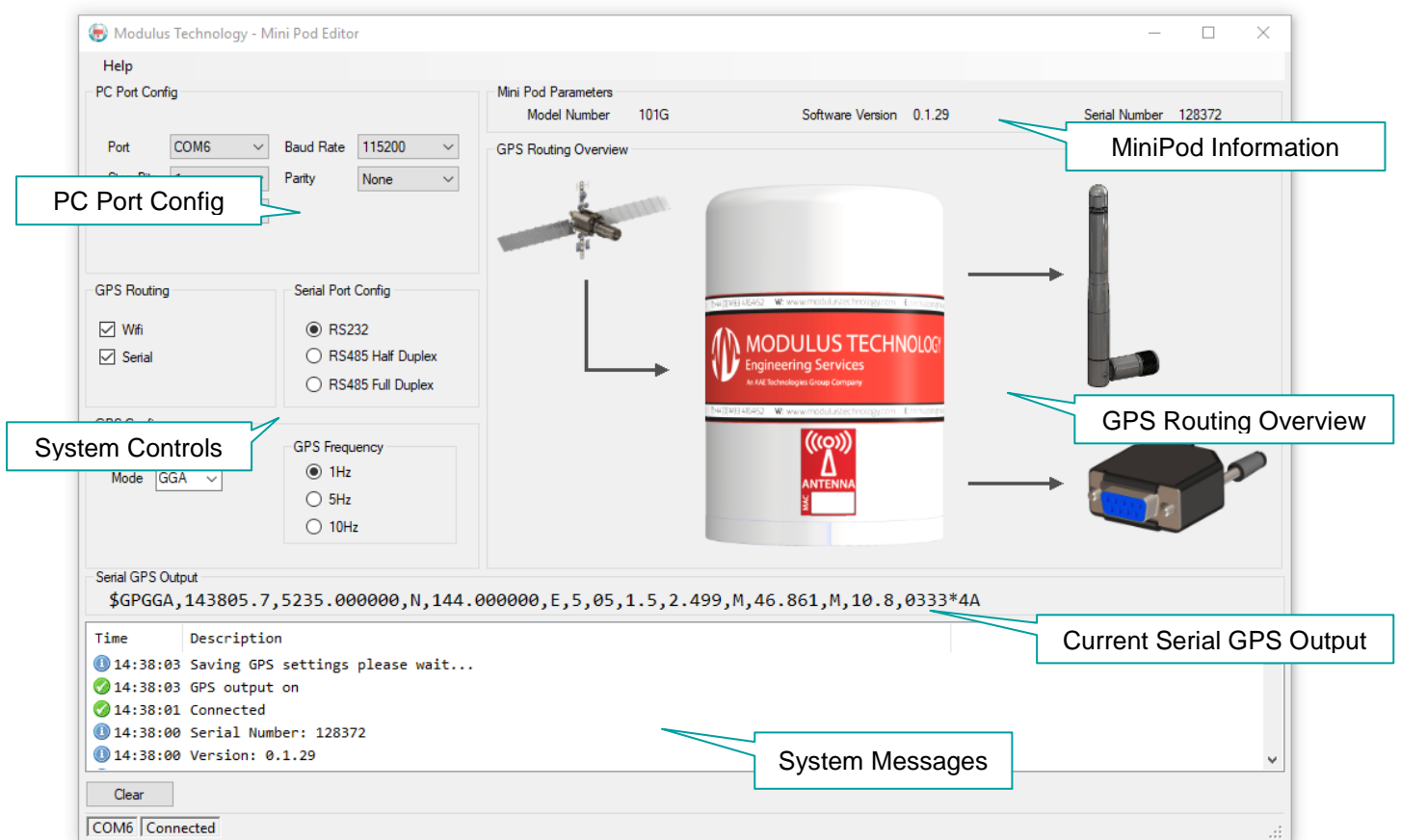
Install the MiniPod Editor Software by running the 'Setup.exe' package supplied.

Software Operation & Initial Configuration

When the 'MiniPod Editor' software is run it will attempt to connect to a MiniPod on the selected port. If no connection is made then the controls will remain transparent to indicate that they are not in use.



When a connection to the MiniPod is made the controls will activate and information will be displayed.

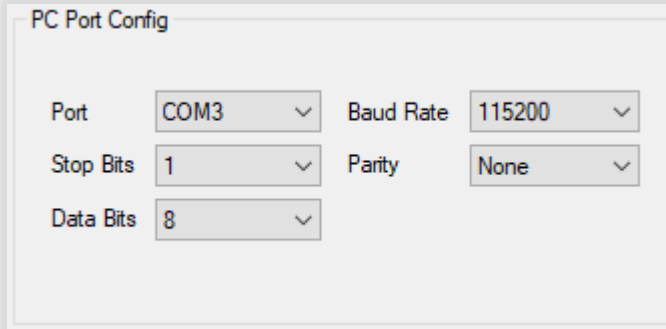


The window contains six areas.

- **MiniPod Information:** This area will display the model number, serial number and software version currently installed in the Mini Pod.
- **PC Port Config:** This area is used to specify the port settings for communication from PC to MiniPod.
- **System Controls:** This area is used to configure the MiniPod.
- **GPS Routing Overview:** This diagram will show the route that GPS messages will take.
- **Current Serial GPS Output:** This area shows the current GPS message that is output via the serial interface.
- **System Messages:** This area displays system messages including information, warnings, errors and progress messages. The window may be cleared at any time by pressing the 'Clear' button.

PC Port Configuration

To initiate communications, specify the correct serial port configuration. The 'MiniPod Editor' will continually scan the chosen port for a response from the MiniPod. Once a response is received full functionality will be available.

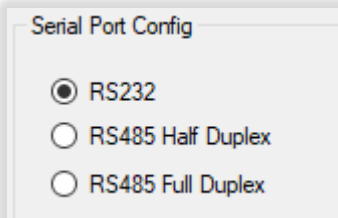


The 'PC Port Config' dialog box contains the following settings:

Parameter	Value
Port	COM3
Baud Rate	115200
Stop Bits	1
Parity	None
Data Bits	8

Serial Port Configuration

By default, the serial port is configured to use RS232, this can be changed to support RS485 Half Duplex or RS485 Full Duplex.



The 'Serial Port Config' dialog box contains the following options:

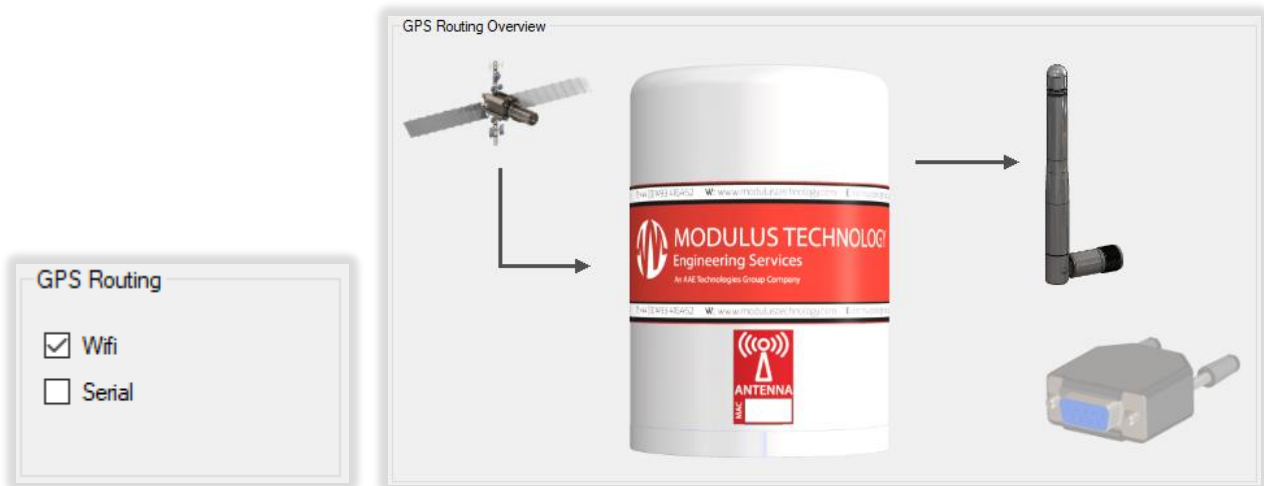
- ☒ RS232
- ☐ RS485 Half Duplex
- ☐ RS485 Full Duplex



Please note, once the serial port configuration is changed communication will stop working until the correct hardware is used.

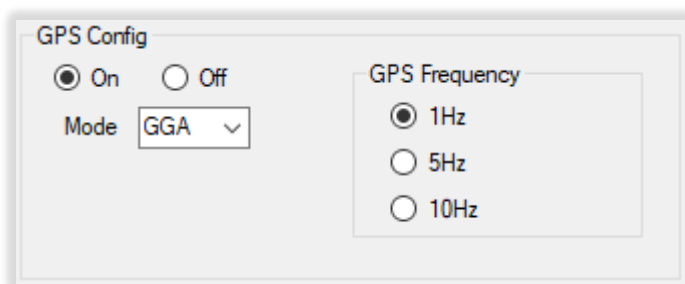
GPS Routing

The current GPS output path will be selected by the GPS Routing checkboxes and indicated by the GPS Routing Overview. The GPS output can be configured to use both WiFi and serial, WiFi only, serial only or no output.



GPS Configuration

Setting the GPS control to 'on' will enable the GPS string to output from the currently selected interface via the GPS routing control. The GPS string mode can be either GGA, GLL or RMC sent at a frequency of 1Hz, 5Hz or 10Hz. The GPS string will be output to the interface(s) indicated by the GPS Routing Overview.

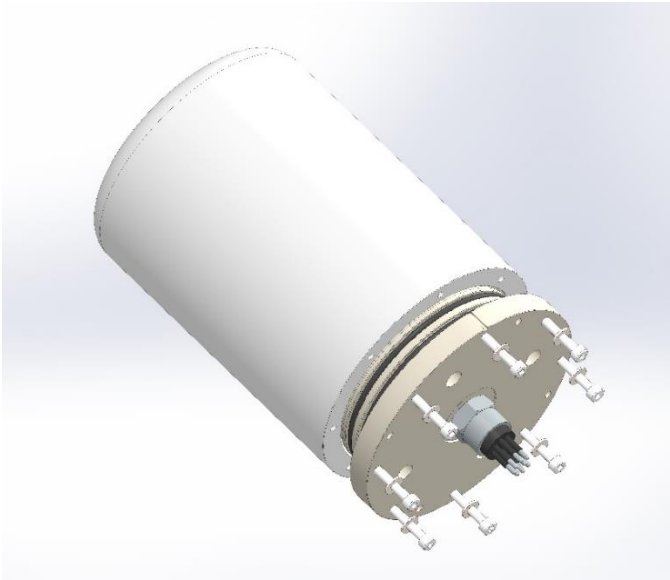


Please note, when a GPS command is sent to the MiniPod it will require a moment to save the GPS settings. If power is removed from the MiniPod during this time the GPS setting will not be saved. A system message will be displayed once saving is complete.

5. Fault Finding

Internal Switch Configuration

To force the unit into RS232 communications for fault finding purposes, or if communications have been changed by mistake, the unit must be removed from its subsea housing. There are 8 screws that should be removed as shown, 4 jack off screw locations are positioned to aide removal of the housing.

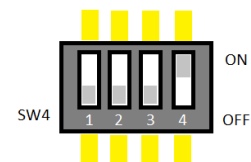


Once open the switches on the logic PCB need to be configured to bypass the initial Micro controller setup.

SW3-4 and SW4-4 are the only ones used.

At power on these switches are scanned and if set to 'ON' will override the internal settings.

SW3-4	SW4-4	Function
Off ↓	Off ↓	USE INTERNAL SETTINGS
Off ↓	On ↑	SET RS485 115200
On ↑	Off ↓	SET RS232 115200
On ↑	On ↑	Factory Reset



- To reset the configuration to factory default, with power removed, set both switches to 'ON' and power up the unit. All settings will be set to default. (see MiniPod Configuration)
- Wait >60s.
- Remove power and change switches both to 'OFF'
- Power on the unit and factory default communications will be set.
- Resume using 'MiniPod Editor' Application.
- If only certain hardware is available RS232 or RS485 may be set by using the other switch configurations.
The following commands will then be required to be sent to set the MiniPod to the desired communications before changing the switches to enable use with the 'MiniPod Editor' again.

Configuration Command \$MP,SPS

To configure the MiniPod bulkhead Port A in RS232 / RS485 (Full Duplex) / RS485 (Half Duplex) the \$MP,SPS command can be sent to the micro controller.

Bulkhead Port A configuration	Command Data String
RS232	\$MP,SPS,1110001000110000:?
RS485 4-wire (Full Duplex)	\$MP,SPS,1111101000110000:?
RS485 2-wire (Half Duplex)	\$MP,SPS,0011101000110000:?

Configuration Command \$MP,SPC

The MiniPod bulkhead Port A parameters can be user configured by sending the \$MP,SPC string and is terminated by a carriage return and line feed.

Command: (Eg. \$MP,SPC,ON,RS485,1,19200,8,None,1:?)

\$MP,SPC,ON,RS485,x,nnnnn,l,p,b:?CL

String code	Description	User Configuration
\$MP,SPC	String Header Identifying the Mini Pod followed by setup port configuration	N/A
ON	Telling the MCU this is active.	DO NOT CHANGE
RS485	Identifying Bulkhead Port A	N/A
x	Not Used	Default 1
nnnnn	Baud Rate	Set between 9600 to 115200
l	Character length	Set 7 or 8
p	Parity	Set 'None' or 'Even' or 'Odd'
b	Stop Bits	Set Value 1 or 2
C	Carriage return (CR)	N/A
L	Line Feed (LF)	N/A

Configuration Command \$MP,RVN

Once the correct port settings have been changed sending the \$MP,RVN:?CL command will read back the software revision, confirming bi-directional communication to the MCU has been achieved.

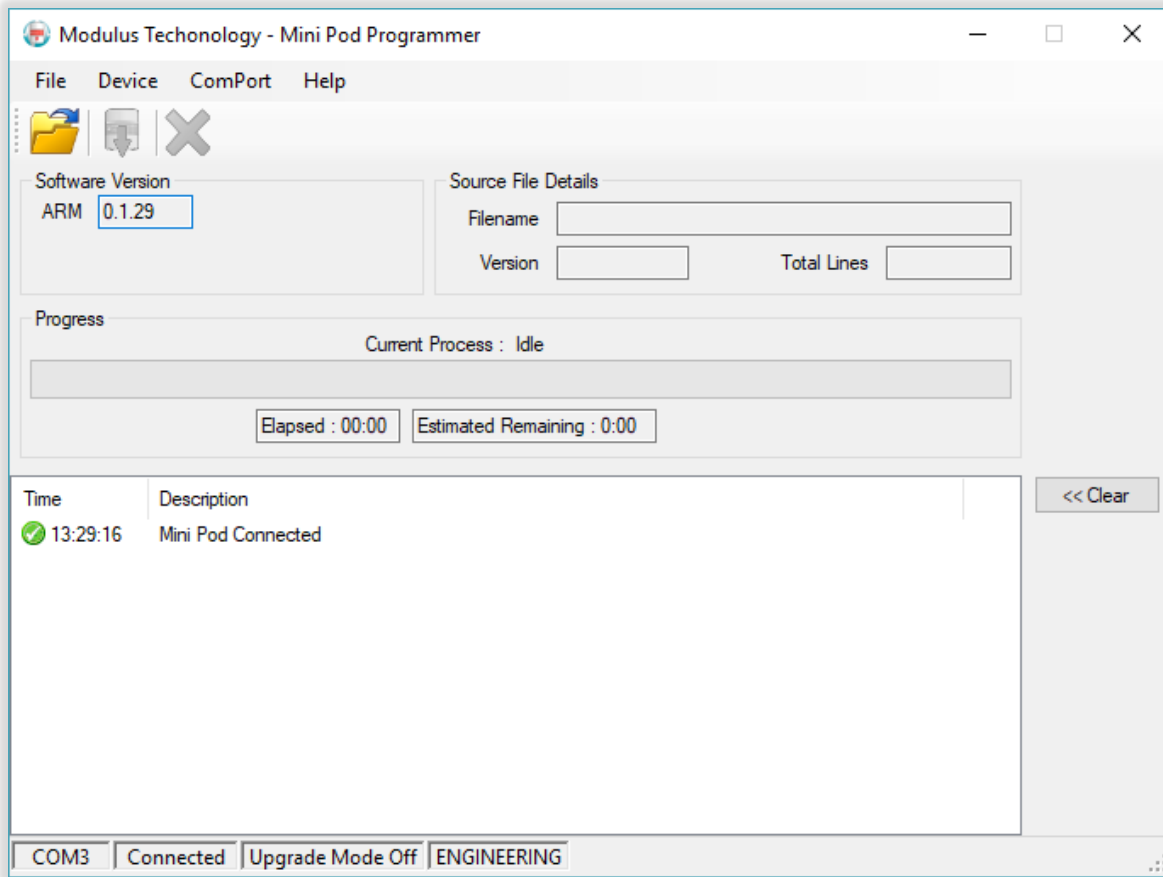
A reply similar to the below example will be given:

\$MP,00000010,RVN,0.1.05,101G,Nov 27 2018,15-27-33,0C9D,00063649,000:1DE8

6. Updating Firmware Using the MiniPod Programmer

Overview

The 'MiniPod Programmer' is a software solution created to allow MiniPod firmware upgrades.



The 'MiniPod Programmer' is a Windows based software that connects to a MiniPod via serial interface and allows firmware updates.

Software Installation

Install the 'MiniPod Programmer' software by running the 'Setup.exe' package supplied.

Software Operation

The 'MiniPod Programmer' software can be used to update the MiniPod software.

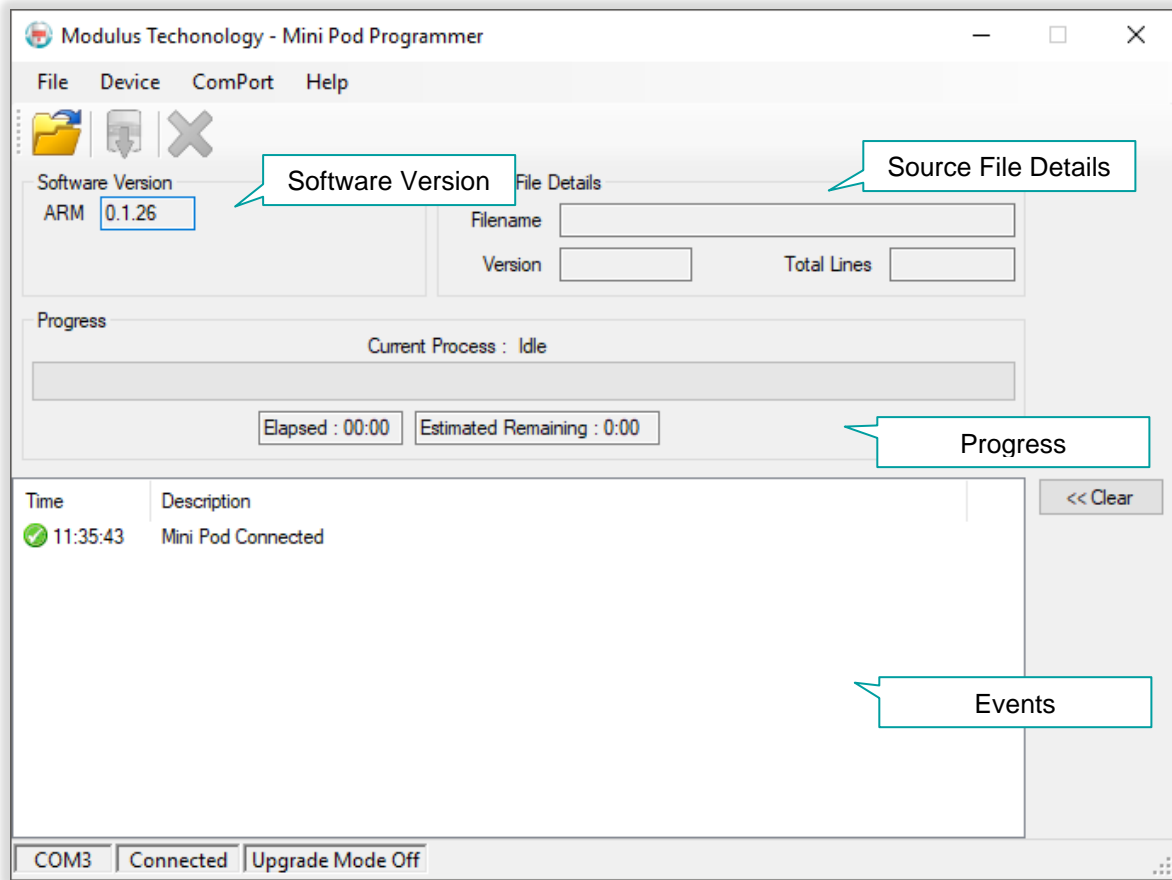
The software communicates with the MiniPod via a serial interface.

When the application is launched it will attempt to establish communication with the connected MiniPod.



Note: If the MiniPod is not detected please ensure the correct serial port is selected. To change the serial port, select 'Com Port' from the main menu and select the correct COM port. Note that the selected port will be automatically saved and used when the software is next launched.

Initial Configuration

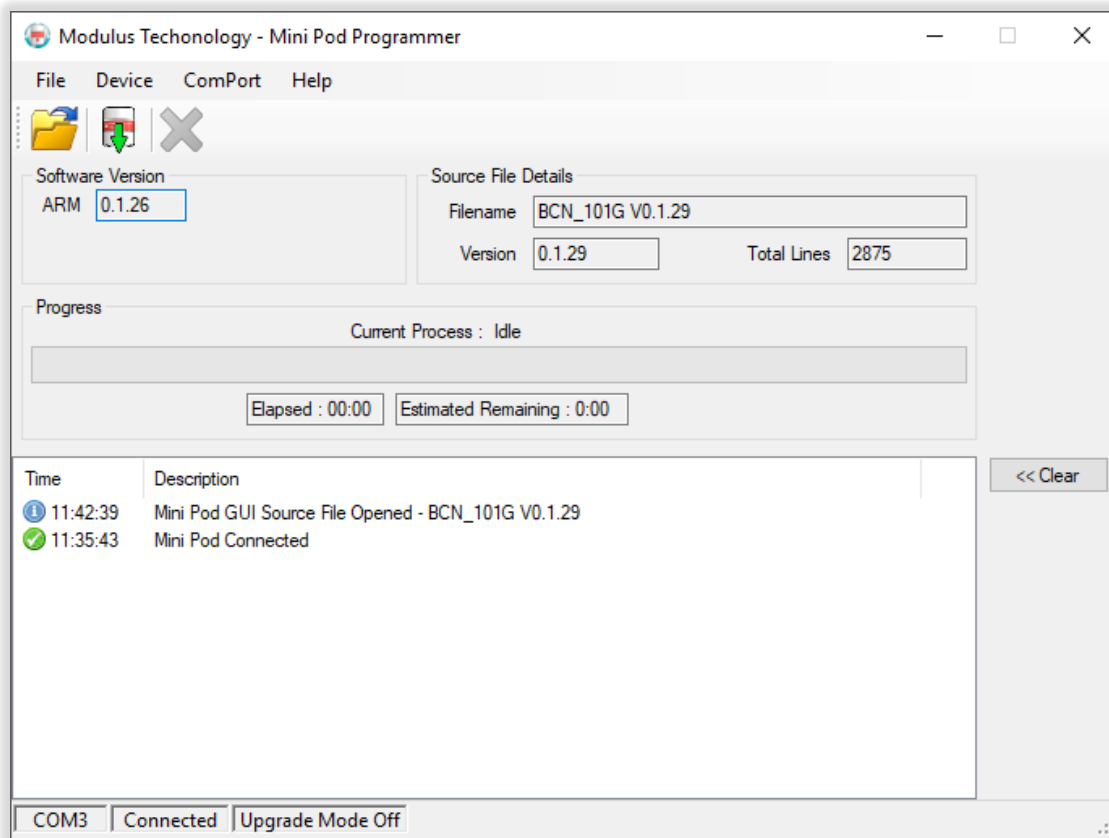


The window contains four areas.

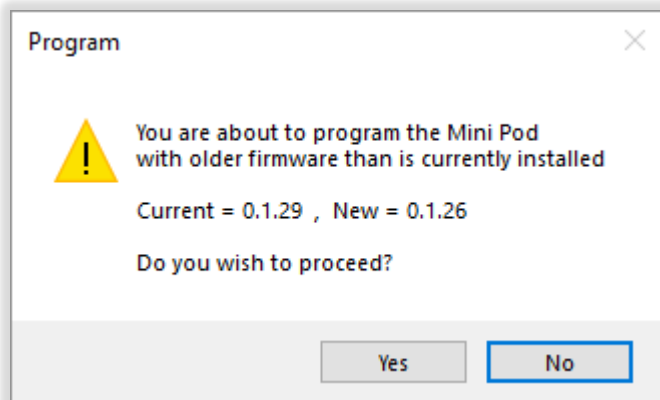
- **Software Version:** This area will display the version of software currently installed in the unit.
- **Source File Details:** This area will display information about the file that has been selected to update the MiniPod.
- **Progress:** This area will display information about the current progress of any operation selected.
- **Events:** This area displays system messages including information, warnings, errors and progress messages. The window may be cleared at any time by pressing the 'Clear' button.

Programming Procedure

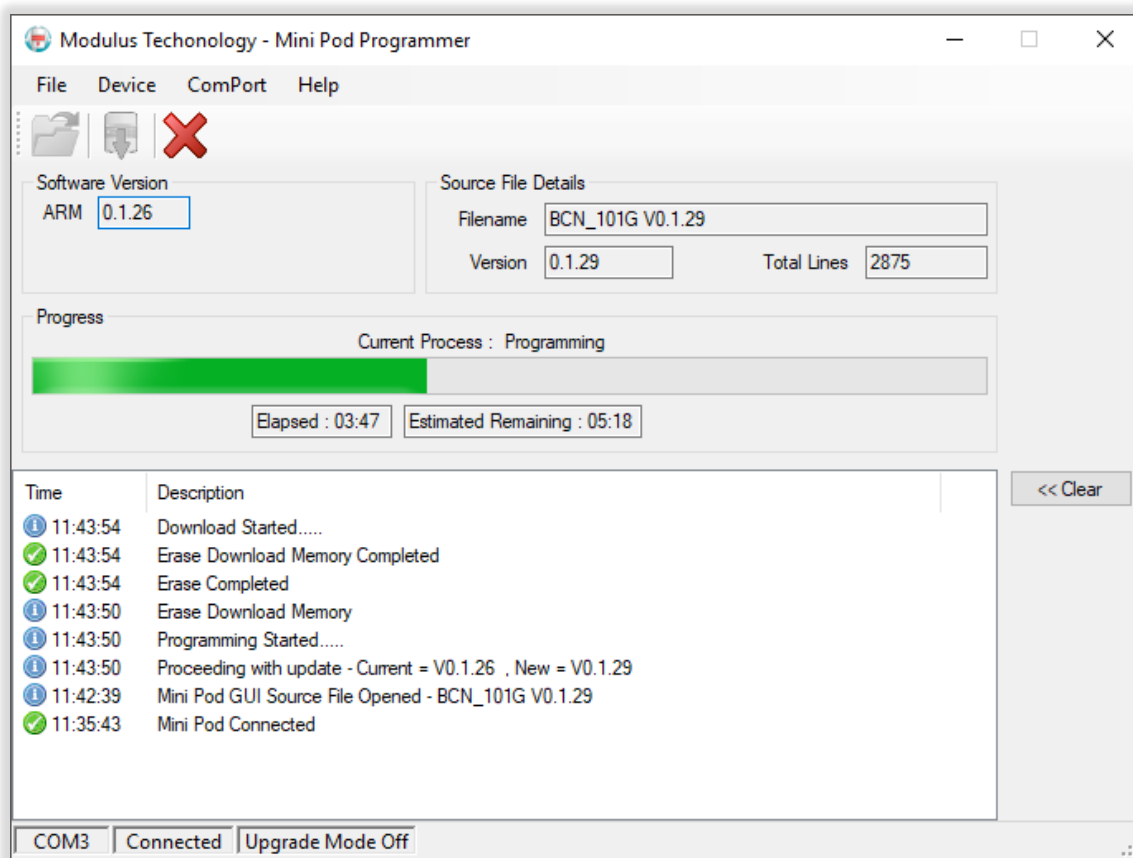
Open the source file of the software you wish to update by pressing the open file button on the toolbar. The open file window will show only the files relevant to the source file type selected. Once selected the information about the file selected will be displayed in the 'Source File Details' area as below



To proceed with the programming press the 'Program MiniPod' button on the toolbar. Confirm you wish to program at the next confirmation prompt. If you are programming a version of software that is either older or the same as the currently installed version you will be presented with an extra confirmation as below.



If confirmed, programming will proceed with the following screen displayed.

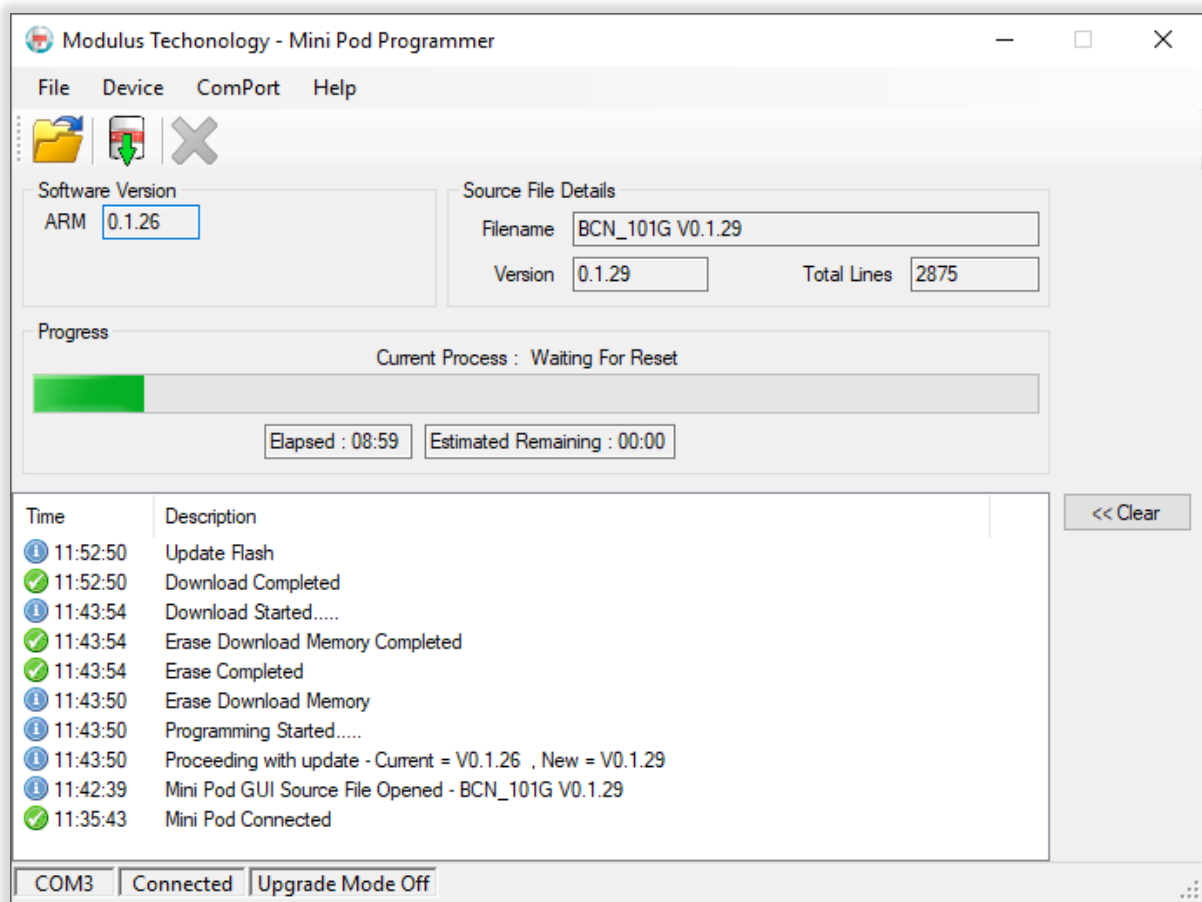


The progress and an estimated time to complete will be displayed along with various messages in the event window to show current progress.



Note: During this phase, the programming may be aborted if required.

When the programming phase is complete the MiniPod will carry out an internal re-flash process and then automatically reset. During this phase the following screen will be displayed

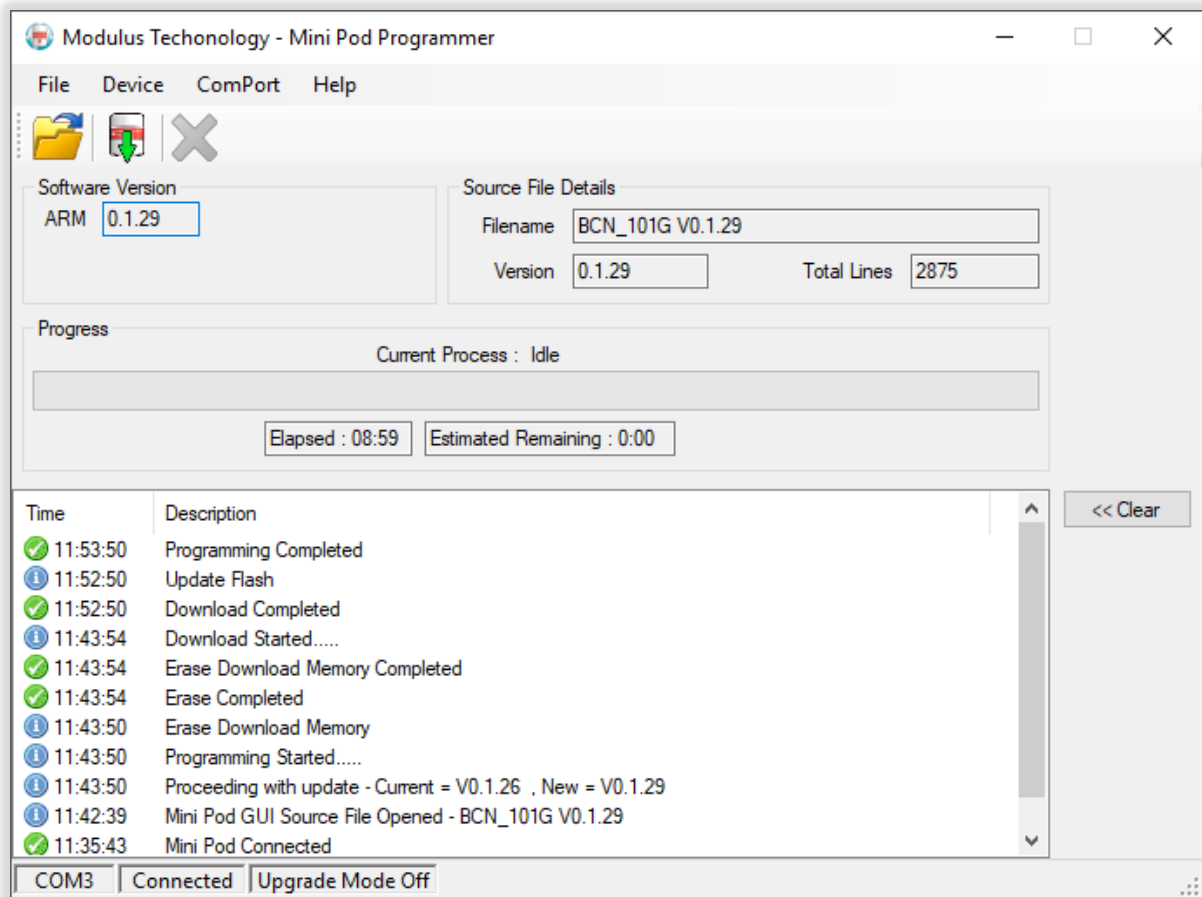


- **This phase can take up to 90 seconds to complete**



It is critical that during this phase the unit must not be powered down or tampered with in any way. Failure to comply may result in the unit becoming unserviceable and would have to be returned to the factory for repair.

After the unit is reset the MiniPod will automatically restart to complete the programming, as shown in the screen below.



Confirm that the software version is correct.

This completes the programming process.



Remember to disconnect the serial cable after confirming software revision.

7. Introduction to the RFR-101G Receiver

The hardware and software provides the operator with the tools to manage a network of RF enabled MiniPods using the hardware interface RFR-101G-7000. The RFR-101G Receiver is supplied with a RF High Gain Directional Antenna, a standard 20m RF Receiver Cable (customer specific lengths optional), and a custom build software package. Enabling the user to fully interface with the MiniPods and set up an RF Network. With the network configured the software allows the received GPS data to be fed via Ethernet or serial interface to the client navigation / logging application.



The RFR-101G-6000 MiniPod receiver application is a windows .net application compatible with Windows 7, 10. Ensure .net v4 or above is installed.

Each system is capable of running 4 MiniPods, each outputting at 10Hz.

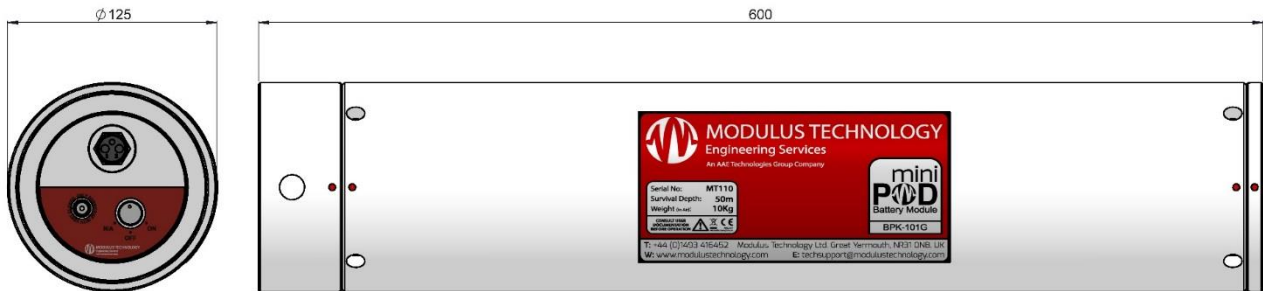
Refer to RFR-101G-8000 for more information.



Due to continual product development and improvement enhanced speed capabilities and data transfer may become available over RF link and this specification is subject to change. For further information and to discuss specific system applications please contact technical support.

8. Introduction to the BPK-101G Battery Pack

Modulus technology has designed the BPK-101G to supply a stable 18V DC Voltage to subsea equipment. This external battery pack has a mechanical ON/OFF switch for ease of storage and transportation and runs off 24 industrial grade alkaline D cells which can provide 10-days operational life and can be replaced easily by the user in the field.



Refer to BPK-101G-8000 for more information.

9. End of Life Recycling / Disposal



Within the EU all electronic components and batteries must be taken for separate collection at the end of their working life under EU WEEE directives. Modulus Technology Ltd as a manufacturer within the EU will responsibly dispose of any returned end of life Modulus Technology Ltd components / batteries through a registered WEEE scheme. In order to prevent uncontrolled waste disposal and promote re-cycling please return any end of life Modulus Technology Ltd components postage paid by sender to our UK head office. Please contact Technical Support for a RMA number prior to shipping.

10. Spares

Details to follow.

11. Transportation by Air

All equipment should be switched off prior to air transportation. Switching off is achieved by rotating the battery pack (BPK-101G) selector switch to the OFF position.

NiMH and Alkaline Battery Packs

These battery packs are **not** classified as dangerous goods for transportation by air. Any paperwork accompanying equipment that use these battery types should state this clearly.

12. Specifications

BCN-101G

Environmental

Survival Depth Rating:	50m
Temperature:	85°C Antenna Limit
Dimensions	170.0mm x 115.0mm OD
Weight	1.95Kg Air 101G 3.00Kg Air 101G + Bracket

Configuration

Receiver type:	GNSS Multi-frequency L1 & L2, RTK with carrier phase
GNSS compatibility:	GPS, GLONASS, BeiDou, QZSS & GALILEO
Channels:	372
SBAS tracking:	3 channel parallel tracking
Differential options:	SBAS, Autonomous, External RTCM (V3.2) or CMR, RTK, L-Band (Atlas) DGPS

Accuracy (dependant on correction):

RMS 67%:	Horizontal	Vertical	
RTK:	8mm + 1 ppm	15mm + 2ppm	
SBAS (WAAS):	0.3m	0.6m	<i>Accuracies dependent on multipath environment, number of satellites in view, geometry and ionospheric conditions.</i>
Unaided:	1.2m	2.4m	
Atlas H10:	0.04m		
Atlas H30:	0.15m		
Atlas H100:	0.50m		

Warm up time (Typical):

From cold:	<60s	(No almanac or real time clock)
Warm start:	<30s	(Almanac & RTC, no position)
Hot start:	<10s	

Connectivity

Connector:	8 pin MCBH connector (male)
Power:	18-36VDC
24v 160mA nominal	
Communication:	RS232 (2 bi-directional ports)
RS485 (2 wire bi-directional)	
RS485 (4-wire)	
Position protocol:	NMEA 0183 protocols supported, (GPGGA, GPRMC & GPGLL standard)
Refresh rate:	10Hz standard, 20Hz optional
Correction I/O protocol:	Hemisphere GNSS proprietary, ROX Format, RTCM v2.3 (wired only), RTCM (v3.2), CMR, CMR+
1pps	3.3V, 1ms pulse width, 20mA optional

Integrated AHRS

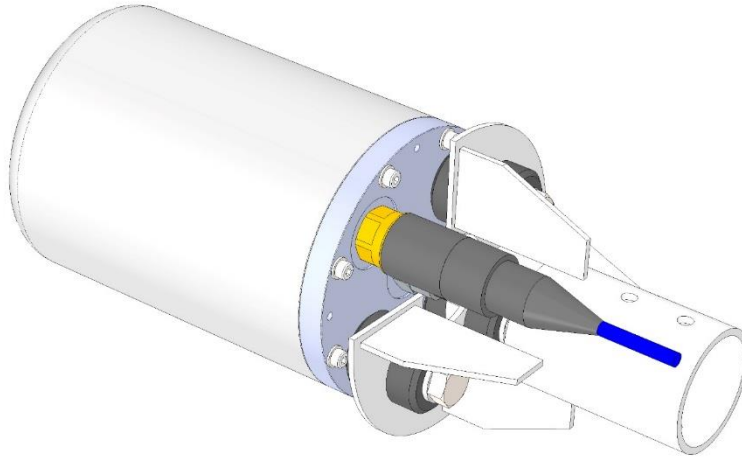
Bearing resolution:	0.1° displayed. Internally calculated to 0.01°
Heading sensor accuracy:	0.5° RMS standard; ±0.1° resolution/repeatability
Pitch/Roll sensor accuracy:	±0.10° RMS ±0.1° resolution/repeatability

OPTIONS

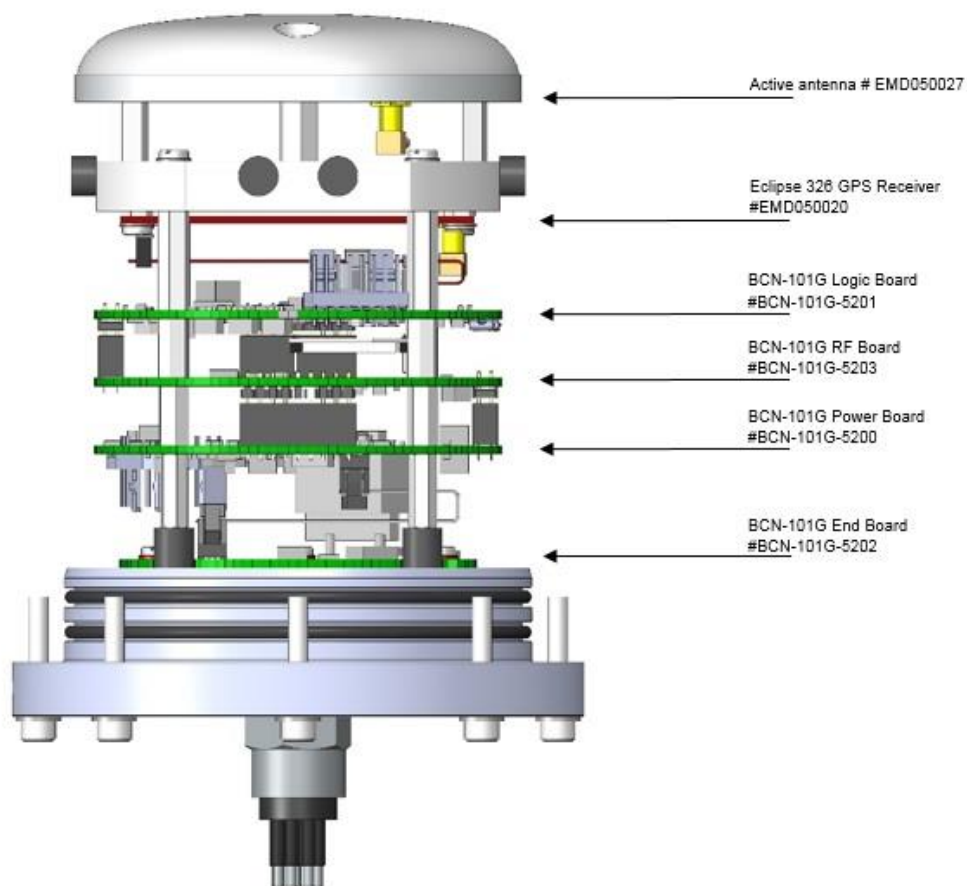
- Wireless modem with optional external antenna: Part number # RFR-101G, RFR wireless data receiver.
- External Battery: Part number # BPK-101G-10 (10 days).
- External Omni-Directional RF Antenna. Part number # BCN-101G-4003.

13. General Arrangement

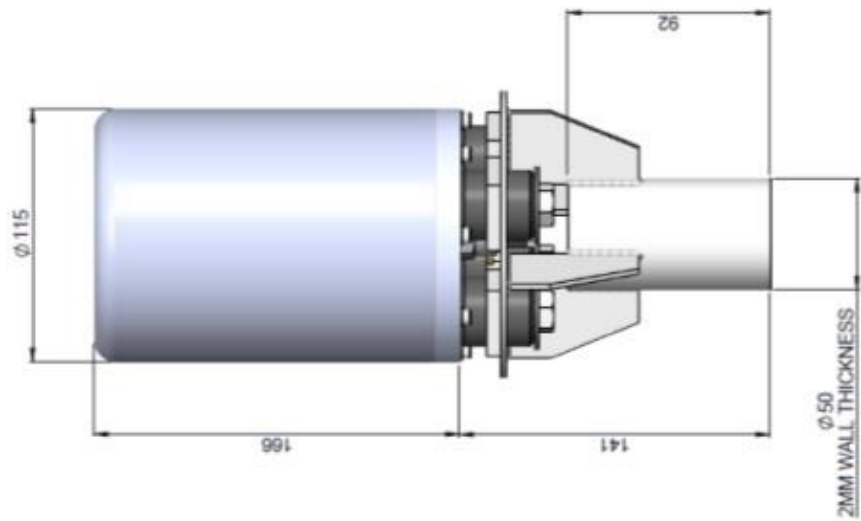
BCN-101G-EXT External Antenna Option



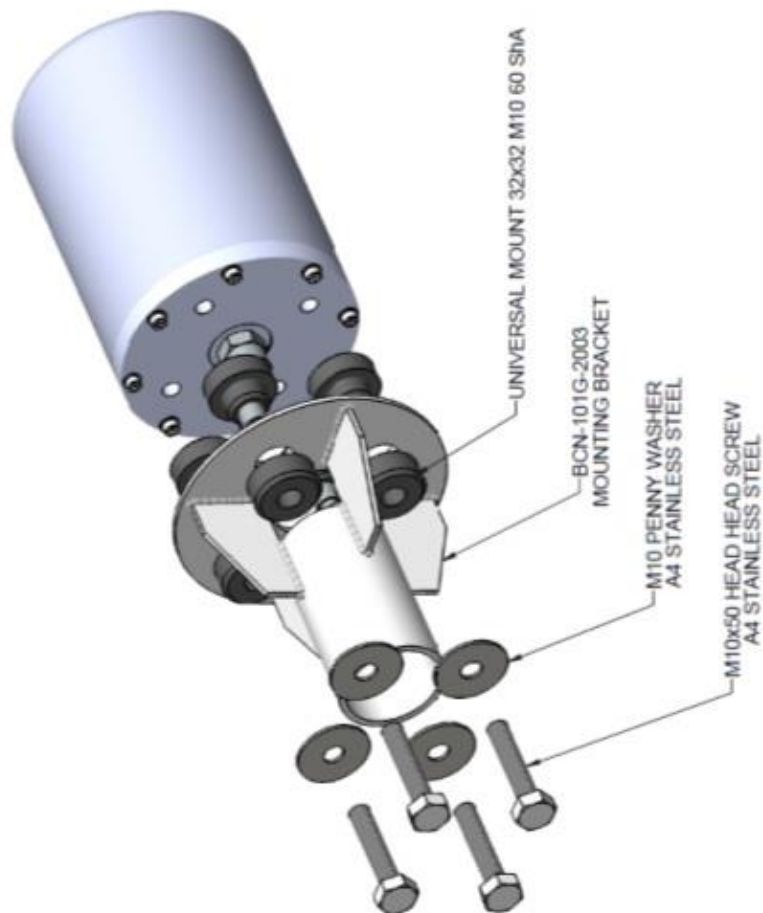
BCN-101G Internal Configuration



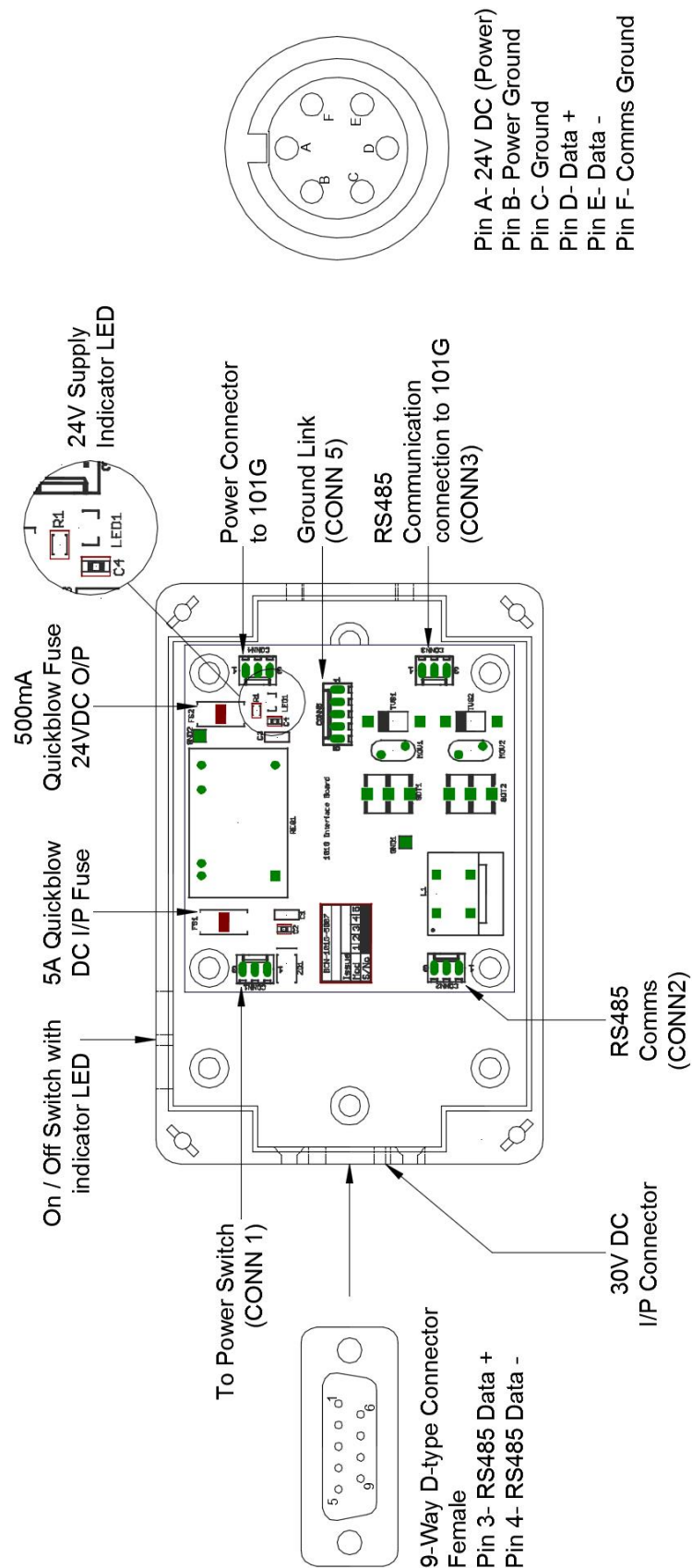
General External Dimensions & Hardware Configuration



USE THREADLOCK ON FASTENERS



BCN-101G-7024 HV RS485 Interface Box



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Although closely associated with the offshore energy sector having undertaken many projects within the marine oil, gas and renewable energy industries, Modulus Technology has also successfully completed supply contracts that include land survey, research, academic and defence related programmes.

Able to call upon its specialised resources of acoustic, mechanical and electronic engineering, software design, CAD capability and fabrication Modulus Technology fulfils projects from concept to completion in close collaboration with its clients. Beyond manufacture, service and support contracts or planned maintenance programmes complete the offer.



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