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Cardinal Secure

Intelligent MDU Range

This handbook applies to models iMDU12B-S
iMDU12B-D

Handbook

Version 2.05

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- Added ***Security Features*** summary
- Added changes table in Document History
- Added Firmware History section
- Added notes on trap versions and multiple trap destinations in ***SNMP settings***
- Corrected relay pin names in GPIO jumper table in ***Hardware Setup***
- Updated ***Connecting to a unit for the first time***
- Expanded FAQ
- Aligned ***Installation*** text with Installation and Safety Information flyer supplied with unit

Changes in v2.00

- Comprehensively revised and updated for the **Cardinal Secure** product refresh
- Described new security features of firmware 1.1.0.x and their usage:
  + SNMPv3 authorization and encryption settings
  + Serial / web options to disable legacy SNMP versions (v1, v2c)
  + Serial-only option to disable entire Web UI
  + Web UI improvements
- Serial port protocol enhancements
- Described improvements to temperature and humidity reporting
  + Explicit reporting of temperature and humidity source
  + Dynamic detection of sensor connection state

Details on the device history (i.e. release notes) can be found in the ***Firmware History*** section at the rear of this handbook.

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Contents

INTRODUCTION **1**
MAIN FEATURES 2
SECURITY FEATURES 2
OVERVIEW 3
VARIANTS 5
iMDU12B-S *5*
iMDU12B-D *5*
Options *5*
Accessories *6*
INTERFACES 7
Front panel *7*
Rear panel *8*

INSTALLATION **9**
RACK MOUNTING AND VENTILATION 9
REAR I/O 10
RJ11 6-way serial / ext. temp & humidity port *10*
RJ45 8-way Ethernet port *10*
26-way GPIO port *11*
HARDWARE SETUP 12

GETTING STARTED **13**
FRONT PANEL CONTROLS AND LEDS 13
CONNECTING TO A UNIT FOR THE FIRST TIME 14
Using the serial port *15*
BASIC SECURITY SETUP 17

USING THE WEB UI **18**
INTRODUCTION 18
SECURITY OPTIONS 18
TAB SELECTION BANNER 19
SYSTEM STATUS TAB 21
Input *22*
Power Monitoring *22*
Output *22*
General Purpose Inputs *24*
General Purpose Outputs *24*
CONTROL MODES AND PASSWORDS 25

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IP CONFIG TAB 26
DHCP *27*
Static IP Settings *27*
NTP Settings *27*
SNMP Settings *27*
SNMPv3 Settings *28*
MDU CONFIG TAB 29
MDU *30*
Passwords *30*
Input *30*
Power Monitoring *30*
Output *31*
General Purpose Inputs *32*
General Purpose Relays *32*
Temperature and Humidity *33*
EVENT LOG TAB 34
POWER LOG TAB 35
ABOUT TAB 36
MDU *37*
IP Config *37*

SERIAL PROTOCOL REFERENCE 38
COMMANDS 38

TROUBLESHOOTING 39
FREQUENTLY ASKED QUESTIONS 39

ORDERING INFORMATION 41
MODEL VARIANTS 41
OPTIONS 41

FIRMWARE UPGRADES 42
WARNINGS 42

FIRMWARE HISTORY 47

SPECIFICATION 48

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Introduction

Cardinal is a range of **i**ntelligent **M**ains **D**istribution **U**nits from dB Broadcast designed to provide a.c. power to professional broadcast systems. Such power supplies are required to be **reliable**, **available** and **maintainable**. They must be able to withstand constant use, yet be controllable to save power. They must provide secure remote monitoring and control, and offer sensors to monitor their environment. Fuses must be easily accessible to enable rapid fault resolution. Excellent longevity, backed up by quality service and support is also a must.

The latest Cardinal iMDU12B models meet these aims in a 1RU rack format, with a choice of single or dual inputs, 12 separate outputs and a host of auxiliary interfaces (Web, SNMP, GPIO and Serial). Both internal and external environmental sensing options are also offered. The iMDU12B range replaces the iMDU12A range.

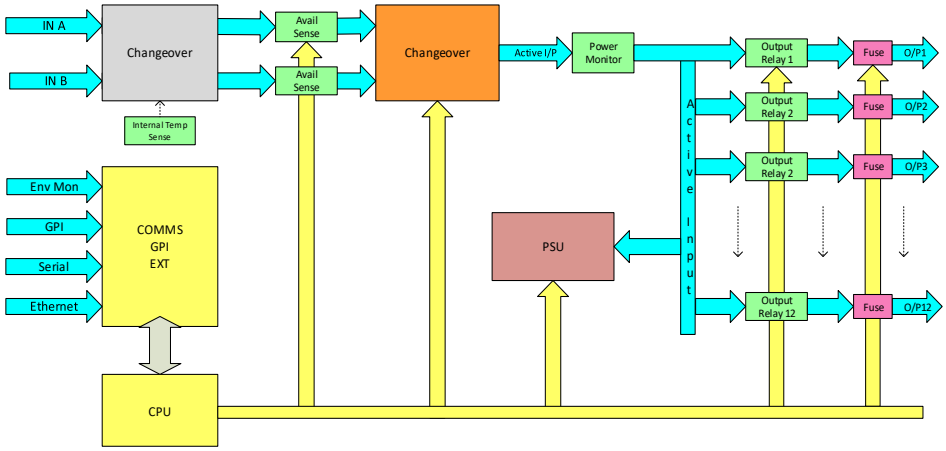


Figure 1: Cardinal iMDU block diagram (dual input version)

The dual input version enables main and back-up power sources to be connected to a single Cardinal unit.

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Main features

- Single or dual input versions with Neutrik powerCON® inlets
- 12 individually fused IEC outputs, each with fuse failure indication LED
- Easy access to each output fuse from the front panel
- Sequential or simultaneous power-on
- Input power monitoring
- Automatic, configurable power shedding
- Thermal breaker
- Network interface
- Configuration, monitoring and control via Web User Interface (browser)
- Configuration, monitoring and control via SNMP
- Serial interface for network and security configuration and optional external environmental monitoring (connecting remote temperature/humidity sensor)
- Simple Logging
- Sixteen General Purpose Inputs
- Two General Purpose Outputs (Relays)
- Fail-Safe (ON) variant available
- Cable tie bar included at rear
- Front panel label strip for identifying each output’s connected equipment

Security features

- Configuration, monitoring and control via SNMPv3 (authentication & encryption)
- Web interface can be disabled to lock unit down to a single secure attack surface
- BareMetal software architecture with OSless networking
- Zero chance of running malicious code in the background
- No unused protocols to maintain
- GPI interface allows integration of tamper switches

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Overview

Input switching

Cardinals are supplied as either single or dual input devices. The dual input variant enables main and back-up power sources to be connected to a single unit. Switching to back-up is automatic on failure of the main supply. The main supply is always preferred if available. The changeover system allows out of phase mains inputs to be switched.

Input power monitoring

Live monitoring statistics are provided on Voltage, Current, Active Power, Energy and Power Factor for the active input.

Automatic power shedding

If a backup power supply is selected, it may be necessary to switch off non-critical equipment by shedding several iMDU outputs. On dual input devices, power shedding may be configured for automatic operation on a per-output basis.

Network interfaces

A fully featured Web UI is provided for easy remote monitoring with any standard browser. This interface may also be used for configuration and control where security considerations allow. Access via the rear panel ethernet port.

SNMPv3 is supported to allow secure remote monitoring, configuration and control using third-party management software. Access via the rear panel ethernet port.

Scheduling and sustainability

SNMPv3 offers a way to script secure, scheduled outlet power switching to save energy, making the iMDU an excellent solution to help reach your sustainability goals.

Serial interface

A local serial interface is provided to facilitate initial setup of network and security settings. The serial protocol also supports configuration backup and factory calibration.

Power-off fault alerts

On loss of mains input, capacitors sustain the microcontroller sufficiently (approximately 10s) to log the fault, indicate it on the Web UI and send SNMP traps to alert a management system of the loss.

Logging

As well as error logging the iMDU records five days of the following:

- Peak input voltage per input
- Minimum input voltage per input

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Temperature and humidity sensing

Optional temperature and humidity sensors can be fitted - either integrated or added remotely for environmental monitoring at any position within the equipment bay.

Configurable alarms

Choose which events are considered errors to be reported in the log and externally. See SNMP alerts below.

GPIO

Each iMDU includes 16 General Purpose Inputs for collating discrete signals from other equipment for onward reporting. In addition, 2 General Purpose Output relays are offered. The GPIO provides an easy way to add Web UI / SNMP monitoring and control of extraneous elements to your system, such as intruder alarms, open door detection or an ON-AIR lamp for example.

Thermal breaker

The front panel on-off switch also acts as a thermal breaker, set to operate when a load of approximately 12A occurs (derated with temperature).

SNMP alerts

The Cardinal range can be configured to provide SNMP alerts (traps) for various conditions including; loss of input mains power, blown fuses or output status changing. Two separate trap destinations are supported.

Sequential power-on

The standard wiring for both single and dual devices is “Fail-OFF”. This means the internal controller is used to switch the a.c. outlets ON. In the case of a power failure in the control circuit, all outlets would remain OFF. The advantage of this configuration is that it supports sequential switch-on of the outlets at start up, which can help prevent current in-rush.

At power-on, outlets are enabled under software control according to a set of start-up delays specified in the configuration. By default, these are set up so that the outputs are switched on one at a time, with a delay delta of 1s between each switch. It is of course possible to modify the delays, or to remove them so that all outputs come on at once. Nevertheless, we refer to the standard Fail-OFF wiring as the “Sequential” variant since it facilitates this feature.

Non-sequential power-on (-F variants)

These ensure continuity of output. Details are given in the Variants section below. Take note of the safety warnings.

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Variants

iMDU12B-S

A **single** input iMDU with 12 independent outputs.

iMDU12B-D

A **dual** input iMDU with 12 independent outputs. If input 1 fails the unit automatically switches to input 2 to enable continuity of supply.

Options

The following additional options may be added to either single or dual devices:

-F

Fail-Safe. This is an alternative wiring that ensures all outlets come ON if d.c. power to the internal controller fails, rather than turning everything OFF. This provides an extra level of resilience to downstream services and prevents such a failure in the iMDU from cutting off supply to downstream equipment.



-F variants are designed to ensure continuity of supply when the controller fails. This is not a human safety feature.

If the configuration intent is that some outputs be OFF, turning them ON in response to such a failure is a change. Power appears on all outlets, including those that were previously unused. System designers should take this into account.

In particular the warning under “Master Switch and Supply LEDs” below should be heeded.

Failure of communications to an -F device should be investigated promptly as it could indicate a controller failure with associated “all outputs ON” condition (i.e. without front panel LED indication). Rectify the issue as soon as possible so that outlet power status will be indicated correctly.

The iMDU12B-DF includes additional hardware-based current inrush protection.

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-H

Integrated front panel humidity & temperature sensor. -H & -R are mutually exclusive.

-R

Front panel controller reset. -H & -R are mutually exclusive.

Accessories

IMDU12-O-H

External humidity & temperature sensor, requires cable iMDU12-O-C-x. Compatible with iMDU12A or iMDU12B models.

iMDU12-O-C-x

Cable (serial, screened) for IMDU12-O-H. Length x may be customised. Standard x=3 m.

iMDU12B-O-G

Front panel ON/OFF switch guard.

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Interfaces

An introduction to the interfaces is given below along with some important safety notes.

Front panel

Master switch

The front panel on-off switch doubles as a thermal breaker.

Supply LEDs

The front panel provides LED indication of the availability and connection status of the external a.c. input(s).

For **single** variants, the “SUPPLY” LED is green if an external supply is detected and the front panel hardware master switch is set to ‘1’, thereby powering up the unit. Otherwise, the LED will be off.

For **dual** variants, supply indication is achieved using four separate green LEDs. The two supplies are labelled A and B. The availability LEDs (“AVAIL.”) require the respective external supply to be present and the front panel hardware master switch set to ‘1’. The two selection LEDs (“ACTIVE”) indicate which supply has been selected. Input selection is automatic. Input A will always be chosen if it is available. Input B is for a backup supply.

Network LEDs

Separate yellow LEDs provide indication of ethernet LINK status and network ACTIVITY.

Output LEDs

Each of the 12 a.c. outputs features a red “FUSE” LED and a green “OUTPUT” LED.

Fuse holders

The fuses for the a.c. outlets are accessible via the front panel.



Fail-Safe variants (-F) allow a condition where all outlets are ON with all LEDs OFF if the master switch is set to ‘1’ and the controller fails. This is an emergency bypass condition intended to ensure continuity of supply. Do not rely on the supply or output LEDs when working on downstream equipment. Pay attention to the state of the master switch, and disconnect the relevant cables to ensure isolation.

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Rear panel

The a.c. inputs, a.c. outlets, serial, ethernet and GPIO connectors are available on the rear panel. Wiring details for the connectors are given in the ***Installation*** chapter.

Serial port

A single serial port is provided on the rear of the device supporting a text-based protocol that allows for initial setup of network and security settings. The protocol also supports configuration backup and factory calibration. Application firmware updates are also possible via the serial port.

When not in use for the above purposes, the serial port may be used to connect an optional external temperature and humidity sensor.

Details of operation are given in the ***Getting Started*** chapter and commands are listed in the ***Serial Protocol Reference***.

Ethernet port

A fully featured Web UI is provided for easy remote monitoring with any standard browser. This interface may also be used for remote configuration and control where appropriate. SNMPv3 is also supported to allow secure remote monitoring, configuration and control using third-party management software.

Details of operation are given in the ***Using the Web UI*** chapter.

A single ethernet port is provided on the rear of the device for interacting with both the web server and the SNMP agent. However, the serial port must be used first, to set up the basic network and security options.

The default IP address configured at the factory is 192.168.0.161. The first step in configuration is to ensure that each Cardinal unit has its own unique IP address.



Refer to the Getting Started chapter for further detail.

Installation

Rack mounting and ventilation



Warning, installation instructions are intended for competent personnel. To avoid electric shock do not attempt service or internal configuration unless competent. Always disconnect all mains supplies before removing any covers.

Install Cardinal iMDUs in a standard 19-inch rack as follows (apply power last):

- Install each unit on to its own angled equipment supports to help bear the combined weight of the unit and any cables attached to the rear tie-bar.
- Please contact Support on T: +44 (0)1353 661117 before installing multiple units without ventilation gaps.
- Ensure an adequate supply of forced cool air.
- Connect 2.5mm² input power cables(s) to the Neutrik powerCON® connectors at the rear of the frame and to suitable **switched-off** supply outlet(s).
- Test the unit is grounded through each input in turn BEFORE applying power to the input cables. **The front panel switch does not isolate the unit from its inputs.** It isolates the processor and the outputs. There is an input detection circuit before the switch, so grounding must be checked before the input cables are powered.
- If necessary, connect the earth screw terminal point to a technical earth.
- Connect the Network interface to a LAN or PC and optionally connect the 6-way RJ11 serial interface to the serial port of a PC (for initial configuration).
- If required, connect GPIO for external monitoring and control using the 26-way port.
- Connect up to 12 mains loads to the fused IEC connectors at the rear of the frame.
- Ensure that no single load will exceed the current rating for a single output (6A) or for the installed fuse in that output if lower (default 5A-slow-blow).
- Ensure that the inrush will not exceed 60A or permanent damage may occur.
- Ensure that the total current from all outputs will not exceed the total current specification for the unit (12A). It is not recommended that the unit be used continuously above 10A.
- On older units, if the **iMDU12-O-H** Temperature and Humidity sensor is required, it should be attached with the unit powered off for correct reporting of connection status. Since firmware 1.1.x.x hot-plugging of this device **is** supported.
- Power the unit when ready (externally and by setting the front panel switch to 1).
- Check status using the front panel LEDs, Web UI and SNMP.

Rear I/O



Figure 2: Single and Dual input version rear panel view

RJ11 6-way serial / ext. temp & humidity port

Pin	Signal	Destination (i.e. RS232 9 pin male)
1	0V	Pin 5 – GND
2	TXD	Pin 2 – RX
3	RXD	Pin 3 – TX
4	NC	
5	RC2	Use only for optional external temp & humidity sensor
6	+5V	Do not use as a supply

Use null modem wiring shown to connect to a PC serial port.

RJ45 8-way Ethernet port

Pin	Signal
1	TPOUT+
2	TPOUT-
3	TPIN+
4/5	NC
6	TPIN-
7/8	NC

Use a standard Ethernet cable to connect to a network.

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26-way GPIO port

Pin	Signal	Pin	Signal	Pin	
1	0V	**10**	+5V	**19**	GPI 1
2	GPI 2	**11**	GPI 3	**20**	GPI 4
3	GPI 5	**12**	GPI 6	**21**	GPI 7
4	GPI 8	**13**	GPO 1A	**22**	GPO 1B
5	GPO 2A	**14**	GPO 2B	**23**	Spare P1
6	Spare P2	**15**	0V	**24**	+5V
7	GPI 9	**16**	GPI 10	**25**	GPI 11
8	GPI 12	**17**	GPI 13	**26**	GPI 14
9	GPI 15	**18**	GPI 16		



GPIO logic is configured by internal jumpers as described in the next section: Hardware setup. Inputs may be configured as active-high or active-low and output contacts may be configured as normally-closed or normally-open.

Hardware setup

The only user-configurable settings inside the unit are jumpers to configure GP Inputs as active-low or active-high, and GP Output relay contacts as normally-closed or normally-open.

To avoid electric shock do not attempt service or internal configuration unless qualified to do so. Always disconnect all applicable mains supplies before removing any covers.

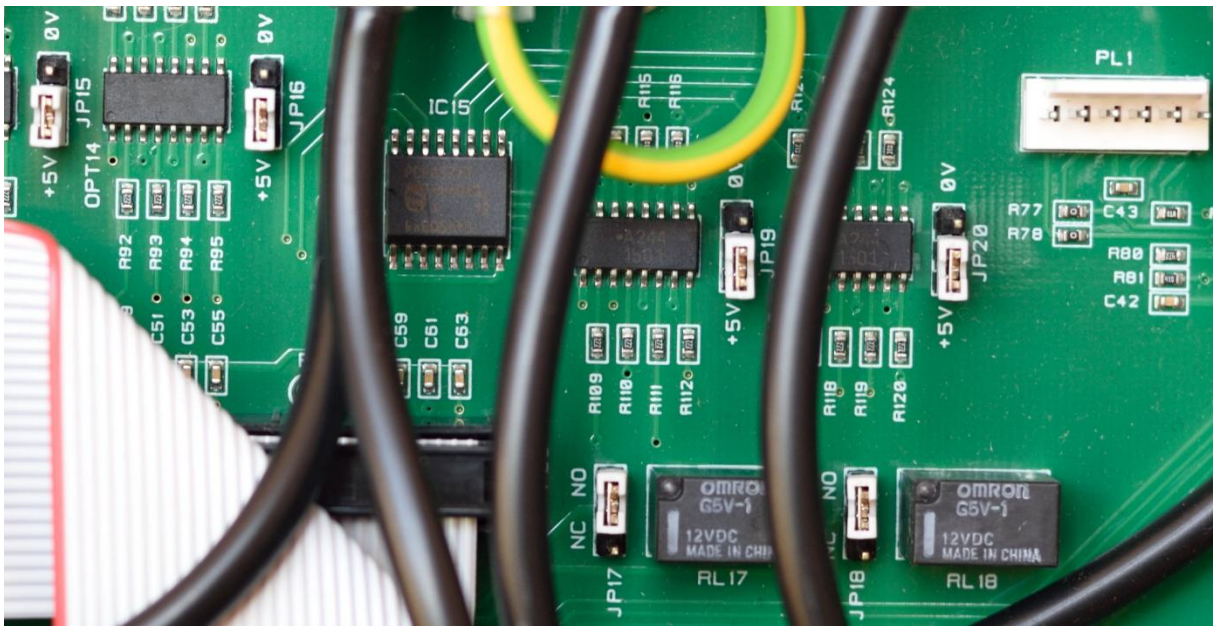


Figure 3: Cardinal iMDU with the top cover removed showing GPIO jumper links

GPIO function	Jumper	Comment
Inputs 1 to 4	JP15	For active high select 0V For active low select +5V
Inputs 5 to 8	JP16	For active high select 0V For active low select +5V
Inputs 9 to 12	JP19	For active high select 0V For active low select +5V
Inputs 13 to 16	JP20	For active high select 0V For active low select +5V
Output 1 (1A-1B)	JP17	For normally closed select NC For normally open select NO
Output 2 (2A-2B)	JP18	For normally closed select NC For normally open select NO

GPIO specifications are given in the Specification chapter.

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Getting Started

Front panel controls and LEDs

The front panel allows basic supply and output availability to be monitored.



The following parameters can be monitored using the front panel LEDs:

Function	LED	Comment
Supply (S)	Supply, Green	On single supply units, shows the unit is powered up.
Supply (D)	Active A/B, Green	On dual supply units, shows the unit is powered up and which input is in use.
	Available A/B, Green	On dual supply units, shows the unit is powered up and which inputs are available.
Network	Activity, Yellow	Shows network communications.
	Link, Yellow	Shows network datalink connected.
Fuse	Fuse, Red	Indicates blown fuse.
Output	Output, Green	Indicates numbered a.c. outlet is ON.

In circuit terms, the LEDs come after the front-panel breaker switch. Therefore, if the switch is set to '0', a supply may still be connected on the input side of the unit even though the supply LEDs are OFF.

LEDs are under software control. Therefore, if the master switch is set to '1' and the controller fails, Fail-Safe variants (-F) allow a condition where all a.c. outlets are ON with all LEDs OFF. This is an emergency bypass condition intended to ensure continuity of supply. Do not rely on the supply or output LEDs when working on downstream equipment. Pay attention to the state of the master switch, and disconnect the relevant cables to ensure isolation.

Connecting to a unit for the first time

Cardinal units are shipped with all interfaces enabled. The simplest way to get a feel for the device is to browse its Web-based User Interface.

To do this, first set up a network connection to the device:

Connect the iMDU ethernet port directly to a spare ethernet port on your computer using a standard network cable. Both iMDU and PC need an IPv4 address in the same subnet range. The factory default IP configuration of the iMDU is 192.168.0.161 / 24 (i.e. a static address at 192.168.0.161 using a subnet mask of 255.255.255.0).

There are two ways to establish a simple network connection. Either:

1. Temporarily change the IP details of the PC port to a spare value in the subnet of the iMDU - for example 192.168.0.100 / 24

OR

2. Use a serial command to change the IP settings of the Cardinal to match the PC subnet.

The second method requires a null-modem cable with an RJ11 connector at the Cardinal end (see next section).

You can verify the connection using **ping** as the iMDU will respond to ICMP message requests.

Once a network connection has been established, enter the IP address of the iMDU into a browser address bar.



When connecting for the first time you may have to explicitly include the http:// prefix before the IP address in the browser address bar, as your browser may assume https:// and therefore fail to connect.

The browser provides helpful indication that http is insecure, reminding you to disable the web UI when you have completed configuration, unless you have taken appropriate security measures elsewhere on your network and are not relying on the iMDU to provide security.

If the Cardinal *has* been configured since it left the factory, the Web UI may have been disabled. In this case, see the chapter on ***Basic security setup*** to find out how to re-enable it for easy configuration.

The iMDU can also be configured to accept an IP address from a DHCP server, however fixed addressing is often preferred as it offers an easy way for specific units to be permanently associated with specific addresses. The iMDU has no concept of a “hostname”, so for networking purposes it must be identified by its IP and MAC addresses. A unique name label may be assigned, but this is not a hostname in a networking sense.

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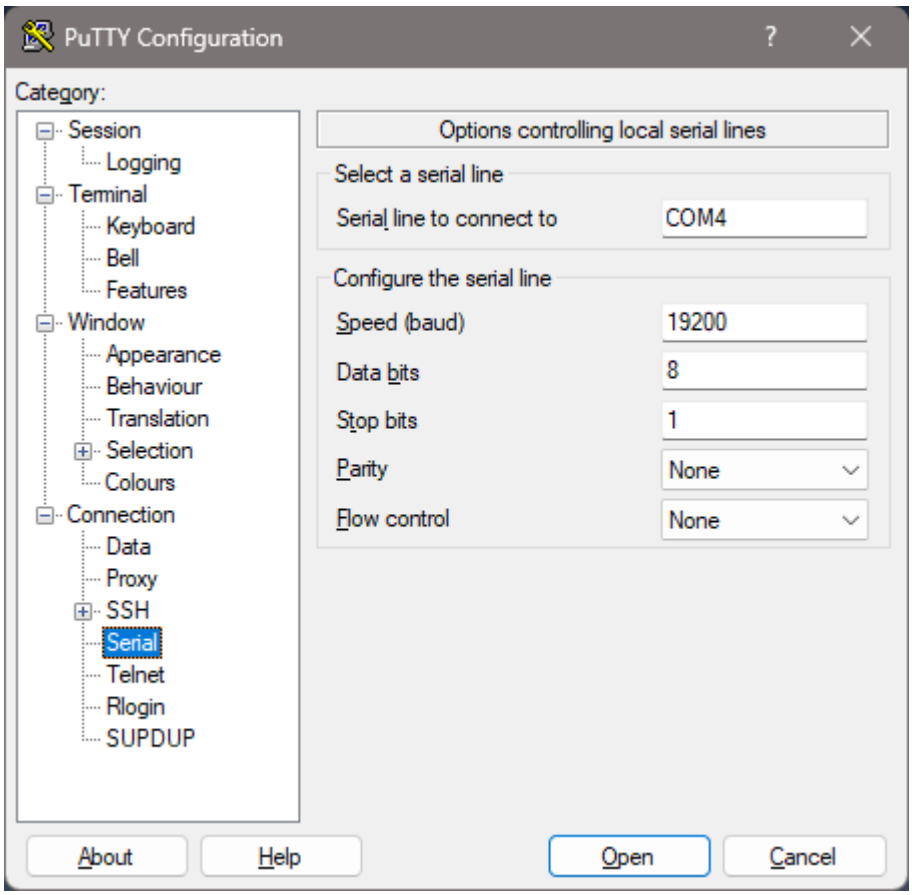
Using the serial port

To use the serial port, a null-modem cable is required with an RJ11 connector at the Cardinal end, wired according to the table in the Installation chapter.

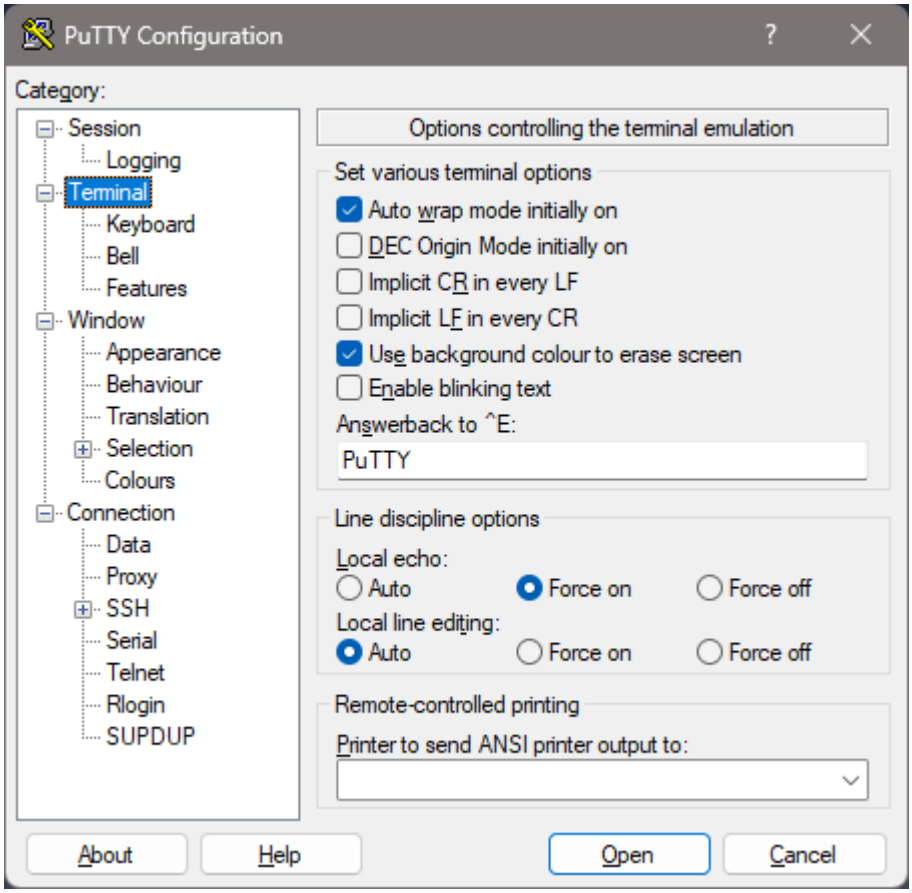
Start a terminal session using an emulator such as PuTTY.

PuTTY settings

1. Set connection type to “Serial”. Specify the COM port connected to your cable.
2. Category > Serial: Set speed 19,200 baud, 8 data bits, 1 stop bit, no parity and no flow control. In this example, we are using COM4.



3. Category > Terminal: Ensure Local echo is set to Force on.





Early firmware (pre 1.0.14.x) may also require "Implicit CR in every LF" and "Implicit LF in every CR" to be selected.

Save your settings and open a session with these settings. You may need to hit "Enter" on your keyboard to return a command prompt from the device. At this point you can start entering commands as per the serial protocol below.

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Using the serial protocol

A complete list of serial commands is given in the ***Serial Protocol Reference*** later in this handbook.

Example 1: to specify IP settings, type each command followed by its argument at the '>' prompt as shown:

> CLIENT 192.168.0.49
> NETMASK 255.255.255.0
> GATEWAY 192.168.0.1

Example 2: to enable DHCP:

> DHCP ENABLE

Example 3: to disable the Web UI:

> WEBSERVER 0

Commands should be entered in UPPER CASE. As of v1.1 of the protocol, selective support for lower case commands has been added as a convenience. For example, the "help" command.



A question mark turns a command into a query (where supported).

To display the current address type:

> CLIENT?

Basic security setup

Cardinal units are shipped with both Web UI and all SNMP interfaces enabled. This allows for easy configuration at install time. However, if your firmware does not support https, once configured you may wish to disable the Web UI for deployment, depending on your network configuration and application. In addition, it is recommended that legacy insecure versions of the SNMP protocol are disabled if your firmware supports SNMPv3 (1.1.0.x or later). To disable the Web UI, or to re-enable it once disabled, you will need access to the serial port.

Serial commands for basic security are listed in the ***Serial Protocol Reference***.

Using the Web UI is the easiest way to carry out configuration, even if you decide to disable it and use only SNMPv3 for operation in the final deployment.

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Using the Web UI

Introduction

The Web-based User Interface is designed to allow users to configure, monitor and control Cardinal units remotely over a TCP/IP network via a browser.

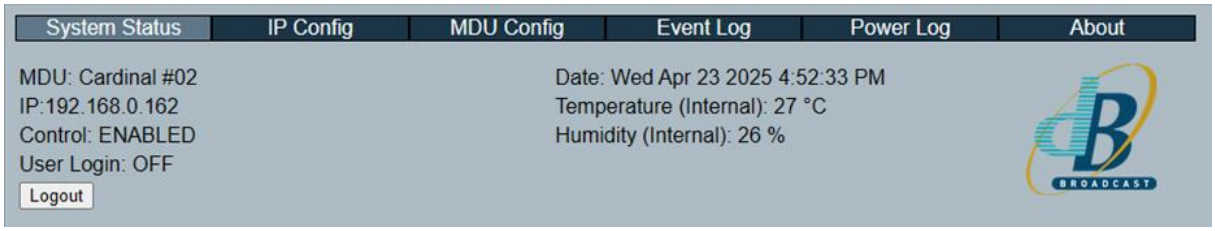
Security options

Various levels of Web UI protection are offered:

- Configuration pages (IP Config, MDU Config) are always password protected.
- Output status control can be password protected (via ***MDU Config*** tab).
- Monitoring can also be password protected (via ***MDU Config*** tab).
- If required, the entire Web UI can be disabled (see ***Basic security setup***). The secure SNMPv3 interface may then be used independently to provide remote access. This is the recommended mode for deployment where maximum security is required.
- The Web UI password may be reset using the serial interface if it becomes lost (see ***Basic security setup***).

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Tab selection banner



At the top of the Web UI is the tab selection banner, as shown in the figure above. This appears on all tabs. Tabs may be selected by clicking on the respective button in the selection bar. The button for the currently selected tab is highlighted in grey.

The banner also reports a high-level summary of settings and status as outlined below.

Banner Fields (left)

MDU – This is a user assigned name, configurable via ***MDU Config*** tab. Setting a unique name for each device helps to identify specific units on your network. This is simply a text label. The MDU has no concept of a host name.

IP – this field shows the IPv4 address specified for the unit. Again, this field promotes rapid identification of the device at hand. The IP address is configured on the ***IP Config*** tab. By default, it is set to 192.168.0.161/24 with DHCP off.

Control – this field is visible only when the ***System Status*** tab is selected. The System Status tab is where the output control buttons reside (for both ac outlets and GPO). This field indicates whether the buttons are clickable. For details on how to enable / disable control (and / or set up multiple browsers to use the tab in different roles) see the ***Control Modes*** section below.

User Login – This shows the (ON/OFF) status of the ***Password protect all web pages*** setting. This can be modified on the ***MDU Config*** tab (and is applied when all browsers are refreshed).

Logout – This button logs the current user out of the device. System Status, Event Log, Power Log and About tabs may still be used as a logged-out user provided the ***Password protect all web pages*** setting on the ***MDU Config*** is unchecked.

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Banner Fields (right)

Date – Displays the current date and time.



A valid date requires a connection to an NTP server. At first switch-on, the date may appear with the year 1970. Check the NTP server setup if this condition persists.

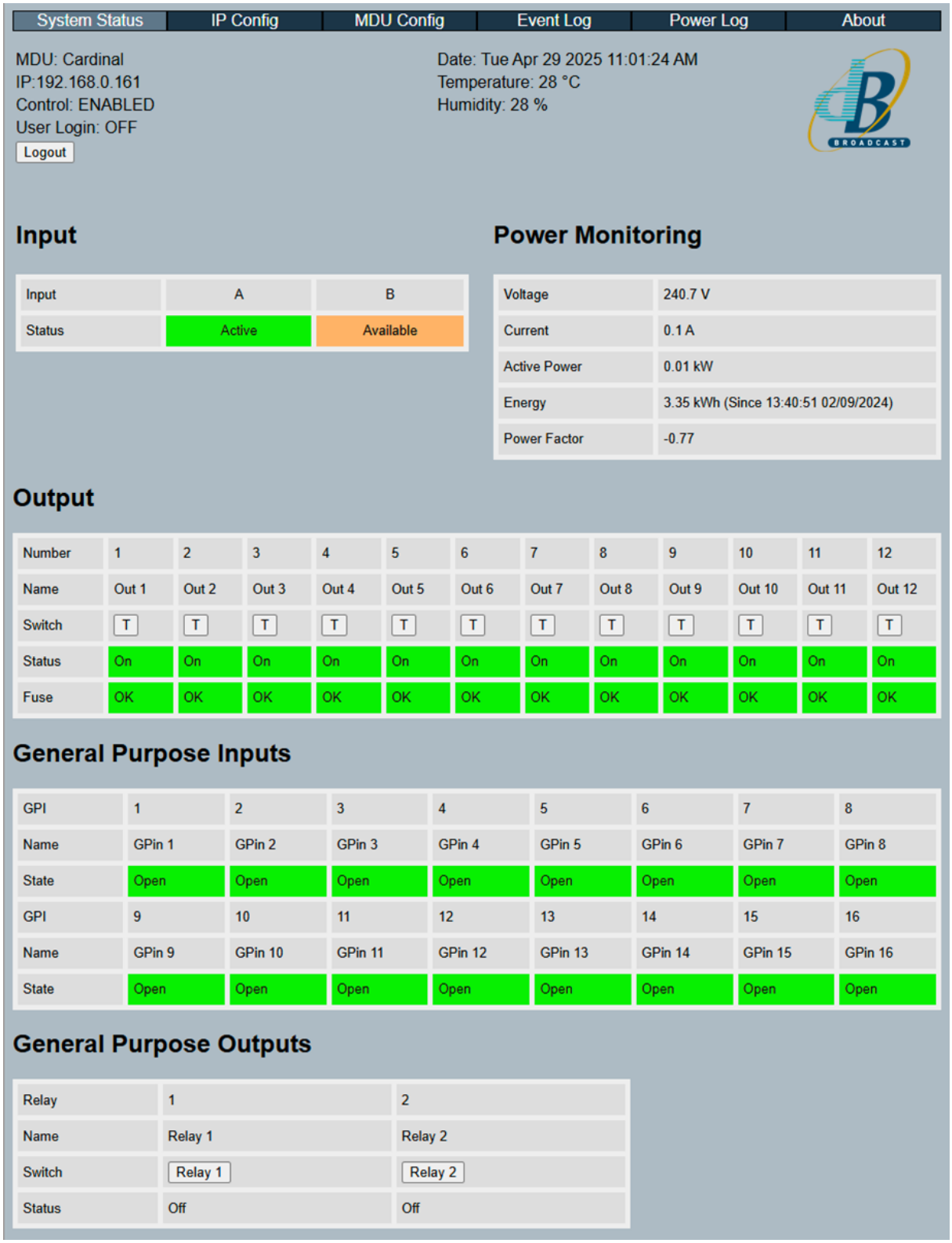
Temperature – Displays the output of the internal or external temperature sensor (where fitted). If both are fitted, the external one is used. In later firmware versions the words “Internal” and “External” are used in parentheses after the reading on -H variants to make this explicit.

Humidity – Displays the output of the internal or external humidity sensor (where fitted). If both are fitted, the external one is used. In later firmware versions the words “Internal” and “External” are used in parentheses after the reading on -H variants to make this explicit.

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System Status tab

The System Status tab is the “homepage” of the Web UI.



The System Status tab provides an at-a-glance view of the iMDU status, showing the active mains input, real-time power monitoring statistics, the ON/OFF status of the twelve a.c. outputs, the sixteen general purpose inputs and the two general purpose output relays. Manual control of the mains outlets and general-purpose outputs is also available from this tab when enabled.

Two alternative use cases are envisaged for the System Status tab:

i) as an OPERATOR interface providing the status information and push-button controls necessary for manual control

OR

ii) as a MONITORING-ONLY interface where the controls are password protected

Control is ENABLED by default, so by default the tab is an OPERATOR interface. The control features are:

- the ability to switch each a.c. Output ON and OFF by means of its toggle button.
- the ability to switch each GP Output Relay ON and OFF by means of its toggle button.

The various sections of the System Status tab are explained below.

Input

Status – Shows inputs as “Active” (green), “Fail” (red) or “Available” (amber). On single input devices, only input A is shown, which will be either green or red. On dual input variants the standby (B) input will be shown amber when powered ready for use, green when selected (due to a failure of A) and red when unavailable.

Power Monitoring

Real-time: **Input Voltage, Input Current, Active Power** and **Power Factor**.
Cumulative: **Energy** used (since last reset of the energy meter – see ***MDU Config***).

Output

Number – Output number 1-12 (non-editable field), provides an index to the table.

Name – Output name. Each can be edited on the ***MDU Config*** tab or via SNMP.

Switch – to toggle the ON/OFF status of an a.c. output, click on its **T** button icon in the “Switch” row. A pop-up box will be displayed, from the IP address assigned to the unit. For example:

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Click ‘OK to make the change or cancel.

A greyed-out T button icon indicates a particular output has been locked and cannot be switched, even if control is ENABLED for the System Status tab as a whole. Individual output locking status may be viewed / modified on the MDU Config tab or via SNMP.

Status – Output status is indicated using the following colours.

Status Indication	Description
Off	Indicates output is switched **off**.
On	Indicates output is switched **on**.
Shed	Indicates an output is switched **off** because it has been shed. This is a feature of dual input iMDUs, which can shed outputs when the primary input (A) fails and the unit has switched to input (B). Shedding occurs for each output with “Can shed” ticked after the Stop Delay for that output has elapsed.
Waiting	Indicates output is switched **off** because an initial Start Delay is active. Where a Start Delay has been configured, it occurs during power up and when recovering from a shed output when the mains power is restored. When the Start Delay ends that output will switch **on**.

Fuse – If a fuse blows, “Failed” will appear in black against a red background as shown:

Failed

General Purpose Inputs

GPI – Hard-coded reference number identifying each GP Input.

Name – User-editable label for each GP Input. Edit on the ***MDU Config*** tab or via SNMP.

State – Open or Closed.

General Purpose Outputs

Relay – Hard-coded reference number identifying each GP Output.

Name – User-editable label for each GP Output. Edit on the ***MDU Config*** tab or via SNMP.

Switch – To toggle a GP Output Relay, click on the relevant **Relay** button in this row.

Status – Off or On.

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Control Modes and Passwords

Two alternative use case are envisaged for the System Status tab:

i) as an OPERATOR interface providing the status information and controls necessary for manual control

OR

ii) as an MONITORING only interface where controls are password protected

Control may be DISABLED by password protecting the toggle buttons (via the ***Password protect System Status controls*** checkbox on the ***MDU Config*** tab), submitting the change and logging out (using the Logout button on the System Status tab). This will ensure that a password must be supplied before any control function is executed.

By this design, it is possible to connect to the iMDU from multiple browsers or machines concurrently and setup the role of the tab differently for each browser / machine. Simply specify that controls should be protected (i.e. for all clients) and then logout on the browser / machine that you want to use as monitoring-only. For this workflow, you must also uncheck ***Password protect all web pages*** on the MDU Config tab to allow viewing status without being logged in.



You may also wish to ensure that any monitoring-only browser isn't storing the password in its password manager. The password may be reset using the serial interface if it becomes lost.

The User Login field in the banner area shows the (ON/OFF) status of the ***Password protect all web pages*** setting. (Modify using the ***MDU Config*** tab and then refresh all browsers).



When switching this setting to ON, if a browser already has access to status and / or control, access will be preserved via that browser until it is refreshed. You may need a reboot to force any client you don't have control of to refresh. By design, reboots and fundamental security setup require use of the serial port (i.e. being physically present), so it's best to decide your policy for this setting at install time. To prevent unintended logging back in, ensure your browser isn't storing the password in its password manager.

Use of the maximum possible password length is recommended (currently 10 characters).

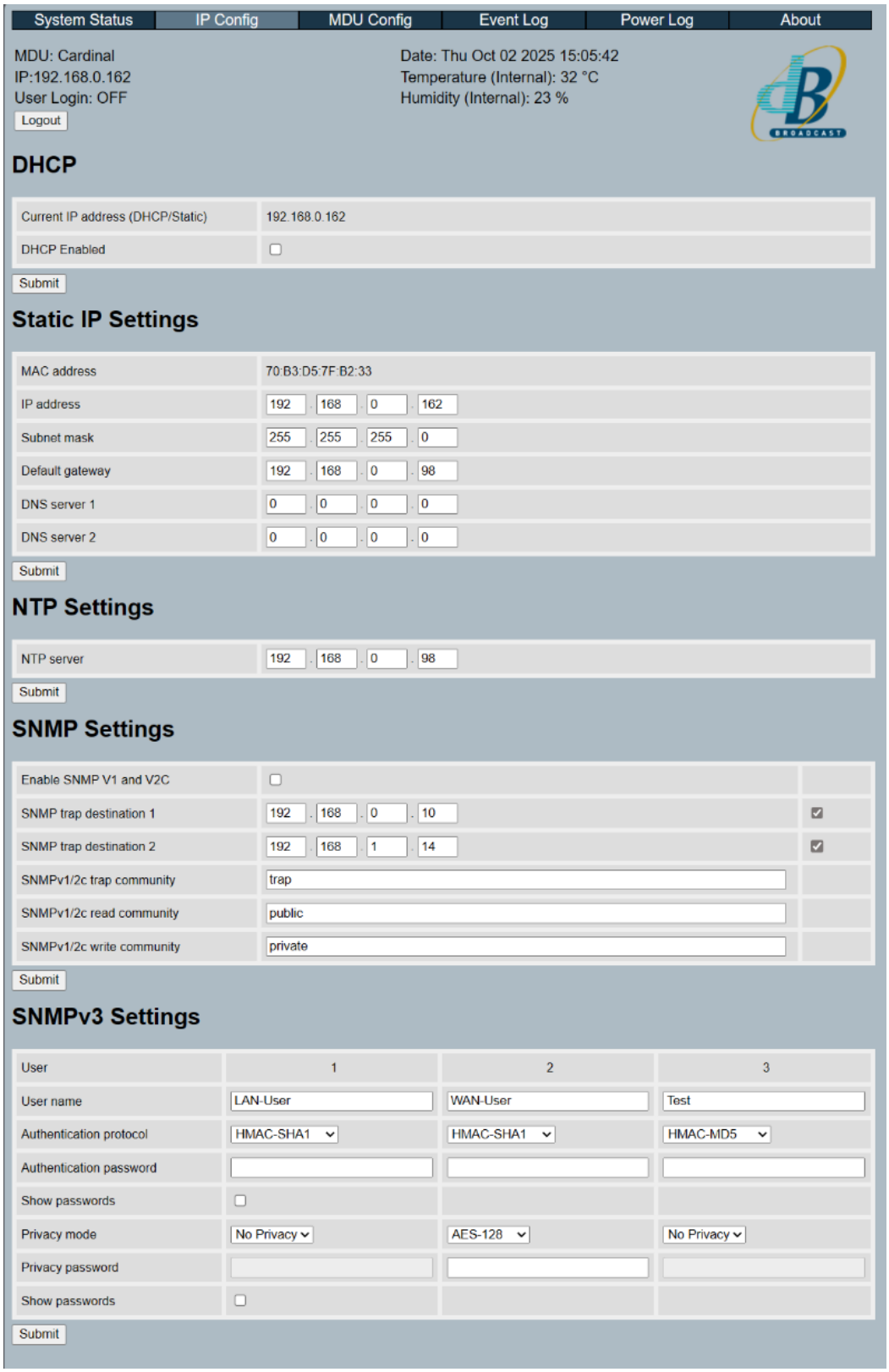
A confirmation dialogue will appear before any control function is executed, in all modes.



Individual outputs may also be locked on the MDU Config tab or via SNMP.

IP Config tab

Access to configuration screens requires a user name and password. The defaults are ‘admin’ and ‘admin’ respectively. Passwords are set up on the ***MDU Config*** tab.



DHCP

Current IP address (DHCP/Static) – A read-only field displaying the current IP Address.

DHCP Enabled – Enables or disables DHCP. A reboot is required to make a change.

Static IP Settings

MAC address – A read-only field displaying the Ethernet MAC address of the iMDU, grouped here with the IP settings for convenience. This is unique for each device and is configured at the factory.

IP address – Changing the address takes effect as soon as the submit button is pressed regardless of the DHCP configuration, but will be ignored at boot if DHCP is enabled.

Subnet mask – Changing the subnet mask takes effect as soon as the submit button is pressed regardless of the DHCP configuration, but will be ignored at boot if DHCP is enabled.

Default gateway – Changing the gateway address takes effect as soon as the submit button is pressed regardless of the DHCP configuration, but will be ignored at boot if DHCP is enabled.

DNS server – The DNS servers are required if any named addresses are used. When DHCP is used these are assigned by the DHCP server. Named addresses were used in older firmware in the deprecated unencrypted email feature.

NTP Settings

NTP Server – The IP address of the Network Time Protocol server used to set the time in the iMDU. There is no hardware real-time clock, so it is necessary to configure an NTP time server for date-stamped event logging.

SNMP Settings

Please contact support@dbbroadcast.co.uk to obtain the latest MIB. Some MIB browsers use a contact MIB for initial communications. In the case of the Cardinal iMDU, the “model” object in the infoGroup is recommended.

Enable SNMP V1 and V2C – If your firmware supports SNMPv3, it is recommended to disable these earlier versions for improved security. See ***Basic Security Setup***. This setting applies to reading and writing operations over SNMP (get, set, walk etc.). Traps are unaffected and will always use v2c.

SNMP trap destinations – You may specify up to two IP addresses as SNMP trap destinations. SNMP managers on these IP addresses should listen for traps on port 162. A separate enable checkbox exists for each destination. These addresses are used for all

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versions of SNMP and all versions of SNMP use v2c style traps. Therefore, authorization is not required to receive traps and they are not encrypted.

In general, any item on the ***MDU Config*** tab with an associated **alarm enable** checkbox will have changes in its state sent out as a trap to all enabled destinations when its alarm enable checkbox is ticked.



When using multiple trap destinations, at least one destination should lie outside the iMDU's subnet (i.e. on the other side of a router). This ensures that a gateway will be used to resolve ARP requests in the event that one of the destination machines has a problem. Otherwise, in the event of a failure, traps to the remaining good destination are likely to be paused as well. In the case where both destinations are on a different subnet, use a different router for each destination for maximum redundancy to ensure the router itself is not a single point of failure.

Communities – By default, the v2c trap community is set to "trap", the read community is set to "public" and the write community is set to "private" as convention dictates. Communities are about organisation rather than security. They are transferred in plain text and are not even required in SNMPv1 so they should **not** be viewed as passwords in the sense of providing security. If your system does not support SNMPv3, please note that additional security measures will be necessary to protect the system.

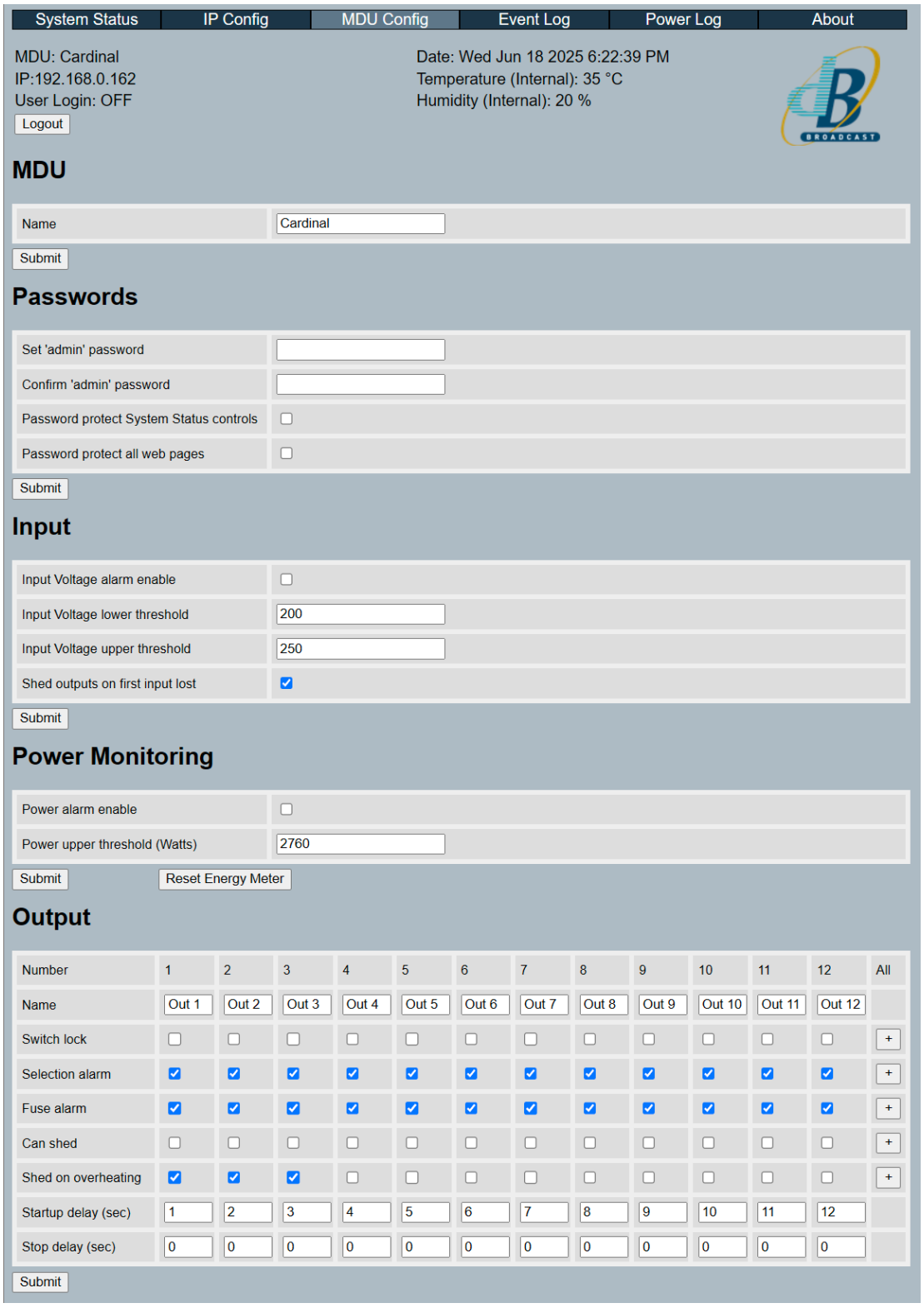
SNMPv3 Settings

These can also be configured via the ***Serial Protocol***. However, it is easier to use the Web UI for this task. The Web UI can be disabled afterwards if required.

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MDU Config tab

The iMDU configuration page is password protected, the default username and password is “admin”. The username is not configurable, but the password can be set using the *Set ‘admin’ password* box.



MDU

Name – A user assigned name for the iMDU. Setting a unique name for each device helps to identify specific units on your network. This is simply a text label. The iMDU has no concept of a host name. Up to 10 alpha-numeric characters / symbols may be used.

Passwords

See also ***Control Modes and Passwords.***

Set 'admin' password – This is used to set the configuration password. This password provides access to both the MDU config and IP config tabs. Up to 10 alpha-numeric characters / symbols may be used.



If the admin password is lost it may be reconfigured using the serial protocol command "PASSWORD" (for which no password is needed).

Password Protect System Status Controls – This protects the output and GPO switching buttons on the System Status tab.

Password protect all web pages – This protects all tabs, rather than simply the IP Config and MDU Config tabs.

Input

Input Voltage alarm enable – This is used to enable the input voltage alarm. Note that once an event is triggered, there is a hysteresis of 5V. The hysteresis is to prevent small voltage changes sending too many events to the Event Log. It is recommended that there is a minimum of 5V between the upper and lower voltage thresholds.

Input Voltage lower threshold – The input voltage below which an alarm is raised, sending a trap.

Input Voltage upper threshold – The input voltage above which an alarm is raised, sending a trap.

Shed outputs on first input lost – On dual input variants, if the first power supply is removed, outputs are shed for which shedding has been enabled.

Power Monitoring

Power alarm enable – Used to enable the power monitoring alarm.

Power upper threshold (Watts) – The input power wattage above which an alarm is raised, sending a trap.

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Output

Each of the following settings may be applied individually, per output. For checkboxes, you can apply a setting to all outputs at once using the plus button at the end of the table row.

Name – The user label for the output. Up to 7 alpha-numeric characters / symbols may be used per output.

Switch lock – Allows each output to be locked on or off, disabling its Toggle switch on the System Status tab.

Selection alarm – When enabled, a trap will be sent each time the output changes state.

Fuse alarm – When enabled, a trap will be sent if the output fuse fails.

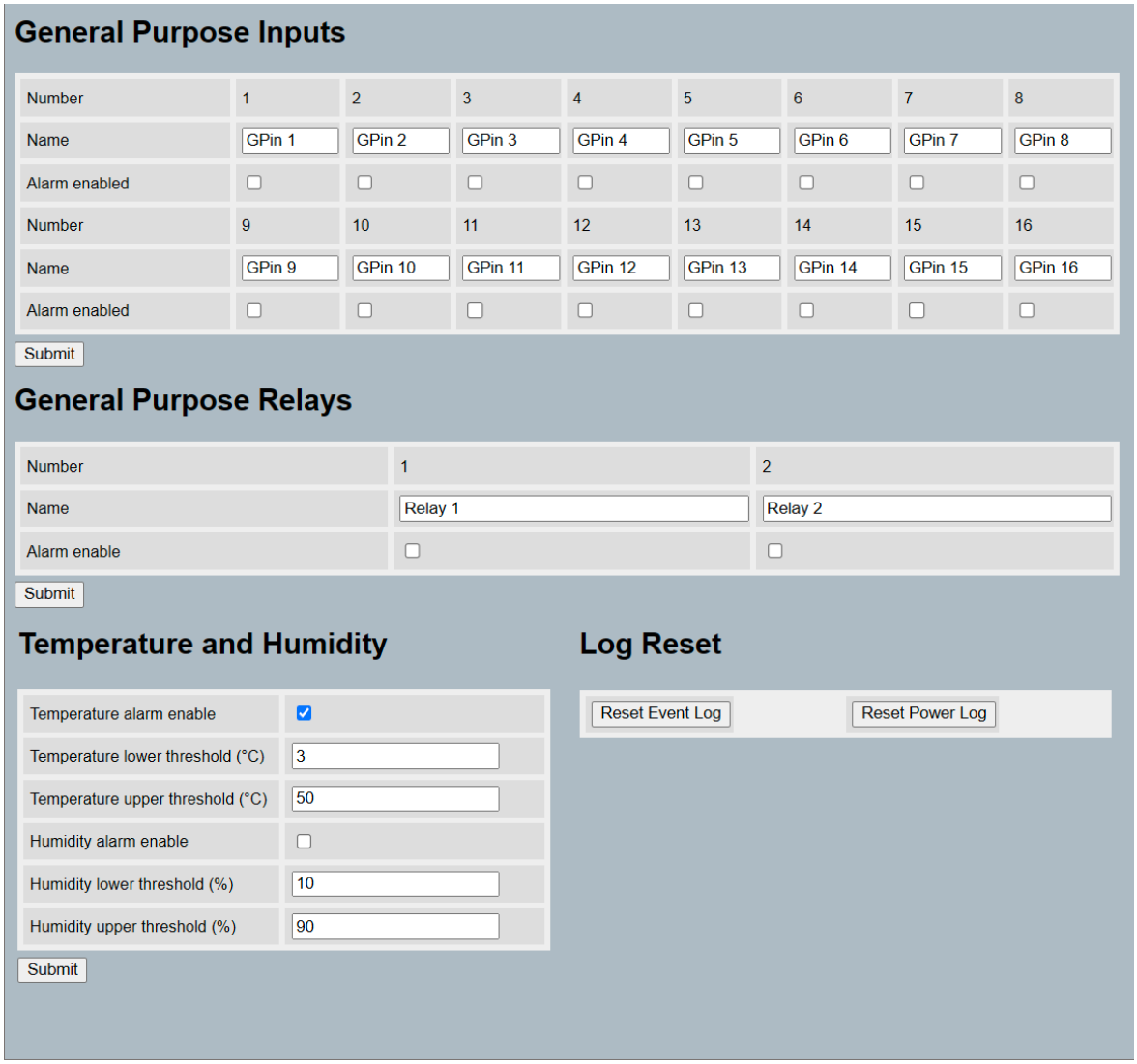
Can shed – In dual variants, for applications where the secondary input is limited in the current and / or total energy it can supply, the option exists to shed certain outputs when a switch to backup occurs. Enabling *Can shed* for an output indicates it can be shed when the main power supply is lost.

Shed on overheating – If an internal or external temperature sensor is fitted, enabling this will cause the output to shed when the upper temperature threshold is reached.

Startup delay (sec) – For standard, sequential variants, this is the time to wait before the output is switched on at startup or following a reset. This allows outputs to be turned on in a sequence reducing start up current surges. Valid times are between 0 to 15 seconds (9999 seconds with firmware 1.0.14 and above). This setting has no effect on -F variants (whose outputs come on as soon as input power is applied and during resets).

Stop delay (sec) – Sets the shedding delay. Allows outputs to be powered down in an orderly way. The permitted delay is 0 to 15 seconds (9999 seconds with firmware 1.0.14 and above).

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General Purpose Inputs

Name – the label for the GPI. Up to 7 alpha-numeric characters / symbols may be used.

Alarm enabled – When enabled, a trap will be sent when a change of GPI state is detected.

General Purpose Relays

Name – the label for the GPO. Up to 7 alpha-numeric characters / symbols may be used.

Alarm enabled – When enabled, a trap will be sent when a change of GPO state occurs.

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Temperature and Humidity

These settings have no effect unless an internal or external temperature / humidity sensor is present.

Temperature alarm enable – When enabled, a trap will be sent when a temperature threshold is breached.

Temperature lower threshold – Sets the lower temperature threshold for the alarm.

Temperature lower threshold – Sets the upper temperature threshold for the alarm.

Humidity alarm enable – When enabled, a trap will be sent when a humidity threshold is breached.

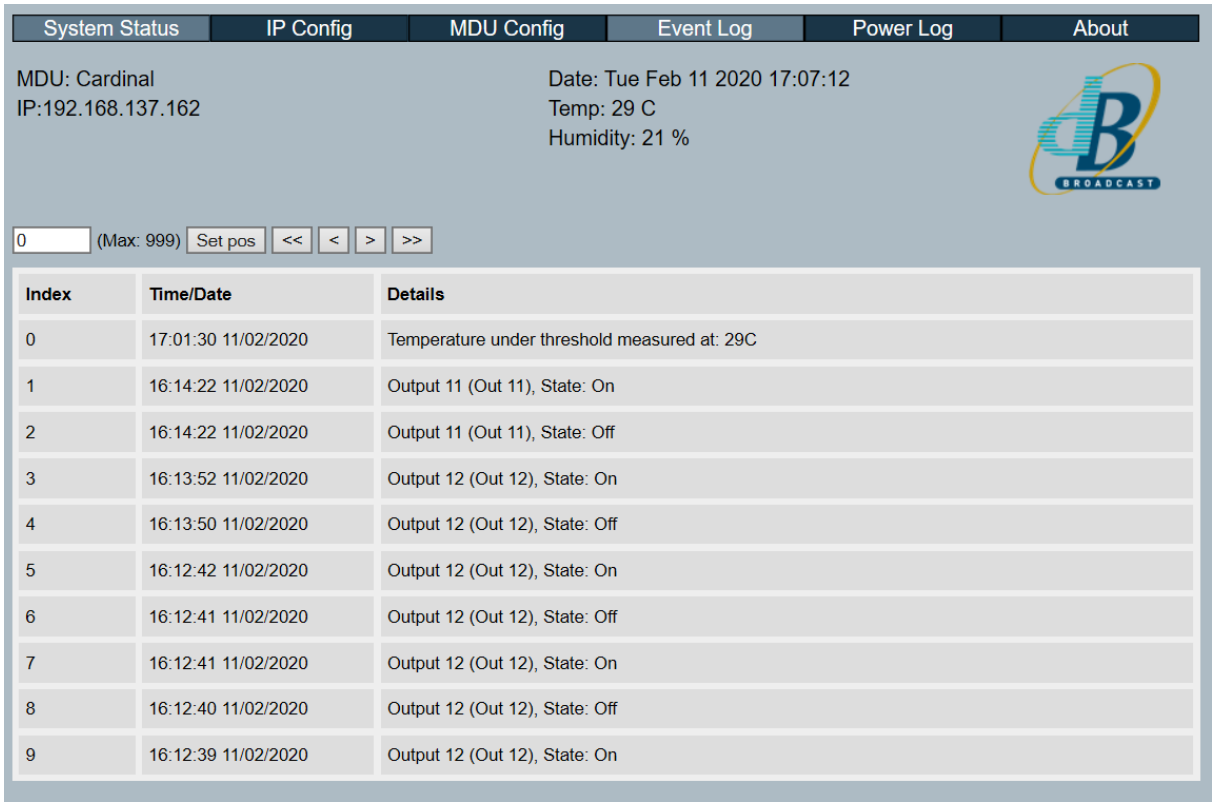
Humidity lower threshold – Sets the lower humidity threshold for the alarm.

Humidity lower threshold – Sets the upper humidity threshold for the alarm.

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Event Log tab

The event logs are read only and provide a list of events where event 0 is the most recent.



Index	Time/Date	Details
0	17:01:30 11/02/2020	Temperature under threshold measured at: 29C
1	16:14:22 11/02/2020	Output 11 (Out 11), State: On
2	16:14:22 11/02/2020	Output 11 (Out 11), State: Off
3	16:13:52 11/02/2020	Output 12 (Out 12), State: On
4	16:13:50 11/02/2020	Output 12 (Out 12), State: Off
5	16:12:42 11/02/2020	Output 12 (Out 12), State: On
6	16:12:41 11/02/2020	Output 12 (Out 12), State: Off
7	16:12:41 11/02/2020	Output 12 (Out 12), State: On
8	16:12:40 11/02/2020	Output 12 (Out 12), State: Off
9	16:12:39 11/02/2020	Output 12 (Out 12), State: On

Use the ‘Set pos’ (Set position) and fast-forward / forward / reverse / fast-reverse controls to move quickly through the logs.



Time stamping requires a valid connection to an NTP server. At first switch-on, time stamps may appear with the year 1970. Check the NTP server setup if this condition persists.

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Power Log tab

The power logs record the minimum and peak figures for voltage, current, power and power factor every hour along with temperature and humidity (if a sensor is fitted).



		Volts		Amps		kW		Power Factor		Temp (C)		Humidity (%)	
Index	Time/Date	Min	Peak	Min	Peak	Min	Peak	Min	Peak	Min	Peak	Min	Peak
0	17:07:40 11/02/2020	242	249	0.1	0.1	0.00	0.02	-0.70	-0.53	29	30	20	21
1	16:07:39 11/02/2020	243	249	0.1	0.3	0.00	0.01	-0.66	-0.51	30	30	21	22
2	15:07:37 11/02/2020	244	250	0.1	0.1	0.00	0.00	-0.63	-0.51	30	31	21	24
3	14:07:36 11/02/2020	0	249	0.0	0.1	0.00	0.00	-0.62	0.00	30	30	21	22
4	12:30:34 11/02/2020	0	252	0.0	0.1	0.00	0.00	-0.57	0.00	29	30	22	23
5	10:38:06 11/02/2020	246	251	0.1	0.1	0.00	0.00	-0.56	-0.53	28	29	22	24
6	09:38:09 11/02/2020	0	250	0.0	0.1	0.00	0.00	-0.63	0.00	28	28	23	25
7	17:13:37 01/01/1970	243	250	0.1	0.1	0.00	0.00	-0.55	-0.51	28	28	23	23
8	16:13:35 01/01/1970	243	253	0.1	0.1	0.00	0.00	-0.57	-0.51	28	28	23	23
9	15:13:33 01/01/1970	243	249	0.1	0.1	0.00	0.00	-0.55	-0.51	28	28	23	23

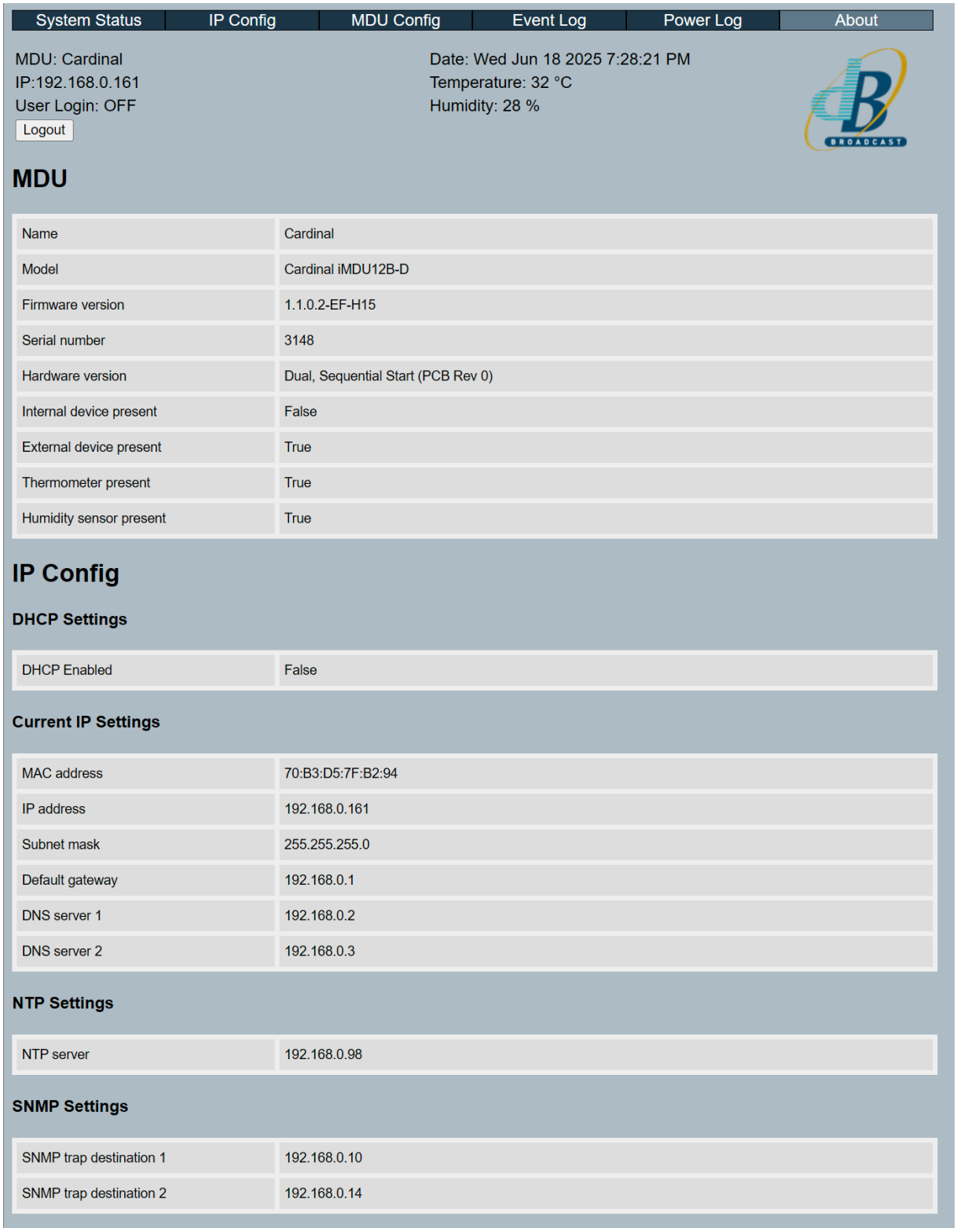


Time stamping requires a valid connection to an NTP server. At first switch-on, time stamps may appear with the year 1970. Check the NTP server setup if this condition persists.

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About tab

The *About* tab provides detailed, read-only information about the iMDU, its hardware, external devices, firmware and network configuration.



MDU

A read-only summary of key identifier data for the device, along with presence detection of internal and/or external temperature and humidity sensor options. Where both internal and external sensors are present, the external sensors are preferred. See ***Banner Fields*.**

IP Config

A read-only summary of network settings made using the *IP Config* tab. The *IP Config* tab requires the user to login. The MAC address is factory set and cannot be changed.

Serial Protocol Reference

Commands

The following table summarises the commands available at the serial interface in v1.1 of the protocol, first deployed in firmware 1.1.x.x. Additions from v1.0 are highlighted in blue.

Query Syntax	Command Syntax	Description
HELP	-	Usage & settings overview
CLIENT?	CLIENT <IP address>	Set iMDU IPv4 address
DHCP?	DHCP <ENABLE/DISABLE>	Configure DHCP client
FIRMWARE{?}	-	Query firmware version
GATEWAY?	GATEWAY <Gateway IP address>	Set gateway IP address
MACADDR?	-	Query MAC address of iMDU
NETMASK?	NETMASK <Subnet mask>	Set iMDU IPv4 network mask
-	PASSWORD <Password>	Set Web UI password
-	RESET	Reset iMDU
-	RESETENERGYMETER	Reset Energy Meter
-	RESETEVENTS	Reset Event Log
-	RESETPOWERLOG	Reset Power Log
SERNO?	-	Query iMDU serial number
SNMP?	-	Query SNMP settings
SNMPV1V2MODE?	SNMPV1V2MODE <0 = disable, 1 = enable (insecure)>	Configure legacy SNMP v1 & v2c support
SNMPV3CONF <0/1/2>	SNMPV3CONF <userindex> <'SET' or 'DELETE'> <username> <authmode> <auth key> <privmode> <priv key>	Configure SNMPv3 settings for user 0, user 1 or user 2.
-	STARTLOADER A	See Firmware Upgrades
UPTIME{?}	-	Query how long iMDU has been up
WEBSERVER?	WEBSERVER <0 = disable, 1 = enable>	Enable / Disable Web UI



The serial interface is used to specify basic network and security settings as explained in Connecting to a unit for the first time in the Getting Started chapter.

Troubleshooting

Frequently Asked Questions

How does shedding work?

The Cardinal iMDU allows for each output to be designated as a load that can be disconnected in the event of an automatic switchover to a backup supply.

In addition, a disconnection delay can be associated with each output to allow outputs to be disconnected in an orderly manner rather than simultaneously.

Can the default fuse value of 6.3 Amps slow-blow be changed?

Yes, the fuse value can be selected for each output's maximum load. For example, 10 outputs could be fitted with fuses to suit individual loads of 0.5A, one at 2.0A and one at 5.0 A for a total of 12.0A.



Take care that the total load does not exceed the total maximum safe load for the Cardinal iMDU of 12A. See the *Specification* chapter for maximum ratings.



With INRUSH LIMITED models the inrush current at power on is limited to 40A, through a current limiting circuit. When the unit is powered, the maximum inrush current should be limited to 60A.

What safeguards are there besides fuses that the Cardinal iMDU is not overloaded?

Besides output fuses, there are two mechanisms to prevent overload.

1) The unit is fitted with a combined ON/OFF switch and over current trip on the front panel. At room temperature, the current trip is at 12A to prevent overload.
2) The 12A over current switch derates with temperature, at an internal temperature of 60°C the trip current is 9.7A which prevents heat damage.

How do I find out what the IP address of a unit is?

Connect a terminal or terminal emulator to the 6-way RJ11 serial port and enter the command CLIENT? The current IP address will be displayed.



The MAC address is printed on a label near the tie bar at the rear of the unit.

Can units be stacked in a rack without vertical spacers?

Yes, provided that forced air cooling within the rack can reach all units. Note that when units are stacked, the internal temperature of the stacked units can reach 60°C when the current rating is reduced to 9.7A.

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Why is a rack tray recommended?

The unit itself weighs approximately 3 kilograms plus the weight of cable attached to the tie-bar at the rear of the unit.

Do both supply inputs on a dual input Cardinal iMDU need to be the same phase?

No, the input selector method employed allows non-phase inputs to be switched safely.

What safeguards are there to prevent unwanted alert chatter when configuration limits are momentarily breached?

A tag and re-test system is used so that after an event is created following the breach of a set parameter, an alert is only created after the re-test delay. This means that the breach must be persistent for an alert message to be created.



If necessary, re-configure MDU settings with slightly higher maximum parameters to prevent excessive alerts.

How can alerts be sent to inform a user of a power out?

The Cardinal PSU is designed to maintain internal power rails for 10 seconds after input power loss. This provides time for alerts to be sent following total loss of input mains power.



This also explains why LEDs remain lit for a while after switching off the unit.

The checkboxes on my Web UI are grey rather than blue, what's going on?

Newer versions of Google Chrome and Microsoft Edge have changed the default rendering of this item as part of a trend to better support dark mode. Checkbox backgrounds may be either grey or blue depending on your browser version. The colour has no functional meaning.

The checkboxes on my Web UI config pages do not dynamically update to reflect changes made on other browsers or the serial interface.

Hit refresh (Ctrl-F5) on the Web UI if you want to be sure you are seeing the latest settings when more than one interface is in use. Config pages allow you to curate a group of settings locally before hitting submit.

Traps are slow to arrive when monitoring on Linux.

Adding a dummy hostname for each iMDU into the /etc/hosts file on your Linux machine will speed this up considerably. For example, if your iMDU uses its factory default IP address, append the file with something like:

```
192.168.0.161    mdu161
```

The hostname should be unique but does not need to match the MDU name as the MDU itself has no concept of a host name.

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Ordering Information

Model variants

iMDU12B-S	Cardinal intelligent MDU with single input and 12 outputs, SNMP and sequential switch on of outputs
iMDU12B-D	Cardinal intelligent MDU with dual input and 12 outputs, SNMP and sequential switch on of outputs

Options

-F	Failsafe option – all outputs ON if boot fails (no sequential start)
-H	Integrated front panel temperature and humidity sensor
-R	Front panel controller reset (-H & R are mutually exclusive)
iMDU12-O-H	External temperature and humidity sensor
iMDU12-O-C-x	Cable for external sensor, serial screened. Standard length x=3 m (for custom lengths, specify on order in 0.5 m increments)
iMDU12B-O-G	Front panel ON/OFF switch guard

Firmware Upgrades

Warnings

Warning, “Fail-Safe” (i.e. variant ‘-F’) Cardinals will switch all outlets to “ON” during a firmware upgrade, even if the outlet had been set to “OFF” in the config.

dB recommends that all loads are physically removed from the outlets before a firmware upgrade takes place.

dB Broadcast cannot be held responsible for damage to the Cardinal iMDU12B, connected equipment or persons if this warning is ignored.

Following any firmware upgrade, it is important to refresh the browser (using ctrl-F5) on all client devices that use the iMDU Web UI to ensure the latest graphical elements and updates are used in place of previously cached versions.

Download procedure

Copy the iMDU12B_Serial_Loader.exe application (supplied on request) to the PC you will use to carry out the upgrade. This is a standalone executable. There is no need to install it.

Obtain the required firmware (.hex) file from dB Broadcast and store it on the PC.

Firmware files are specific to the target processor in the MDU and the upgrade method. You will need to know which processor is deployed your particular MDU and select the required file for a serial upgrade.

Connect a terminal emulator program as described in Using the Serial Port.

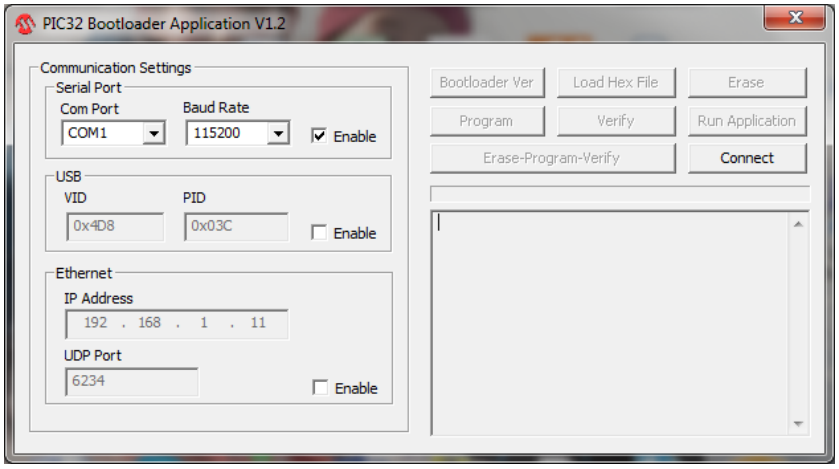
Set Cardinal into Boot Load mode as follows:

Using your terminal emulator (e.g. “PuTTY”), type “STARTLOADER A” followed by a Carriage Return. A message will be returned confirming that the unit is entering a new mode that will eventually time out if no further activity occurs.

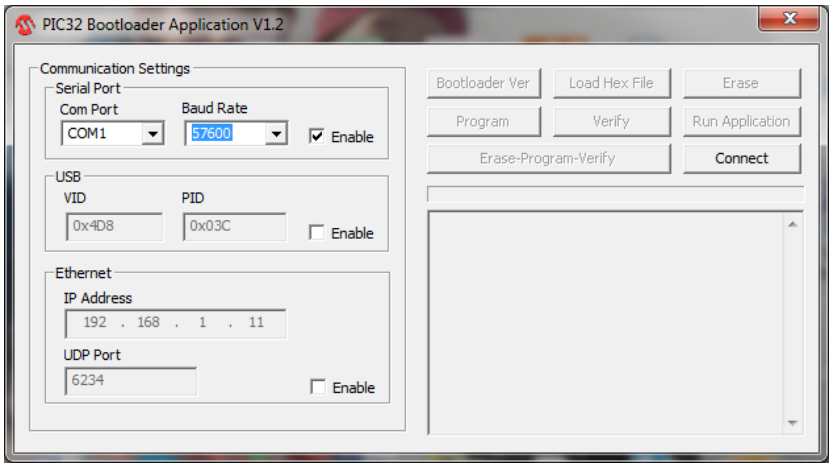
Close your terminal emulator so that the loader program can re-use the serial connection.

Open the application “iMDU12B_Serial_loader” and the screen below will appear.

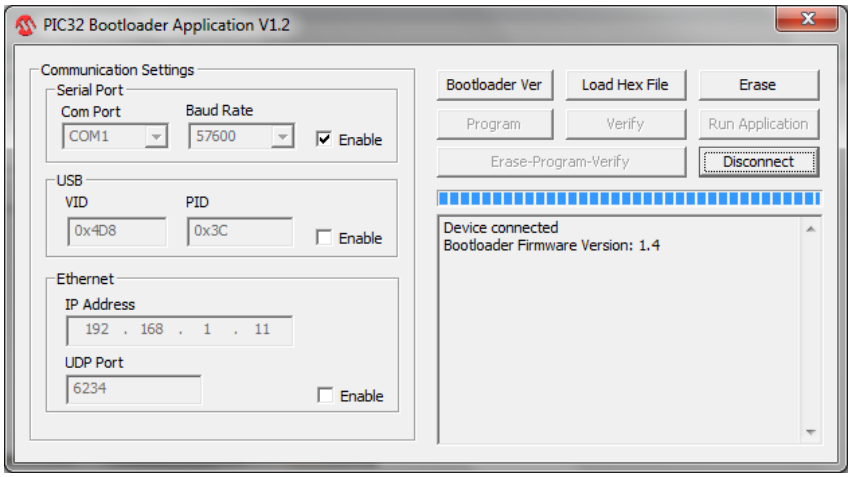
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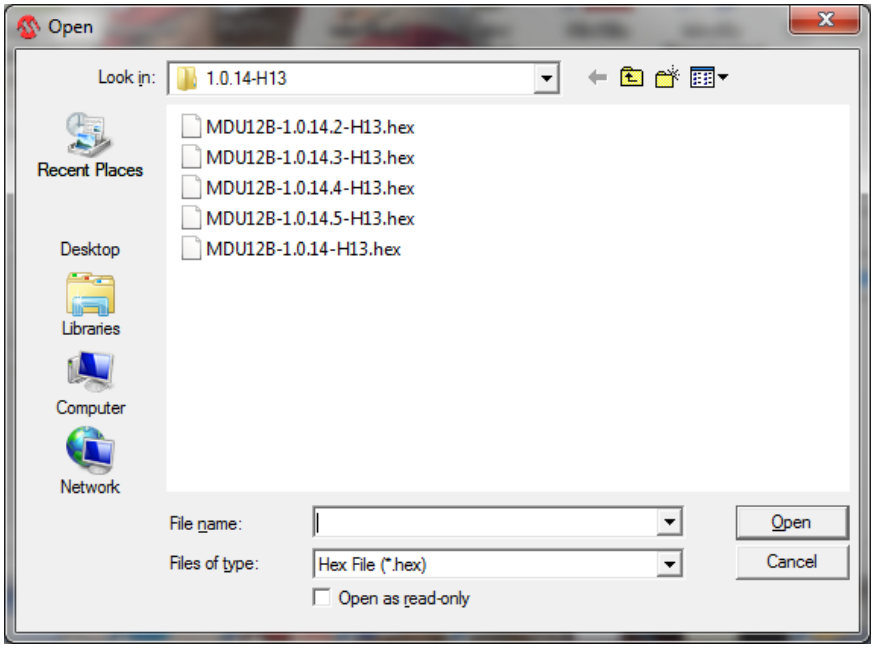
Select “57600” baud rate.



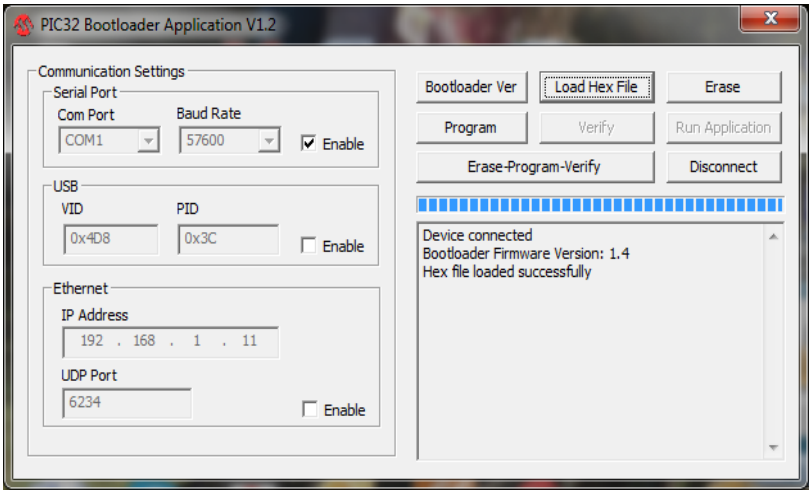
“Click” on “connect” and the message below is seen.



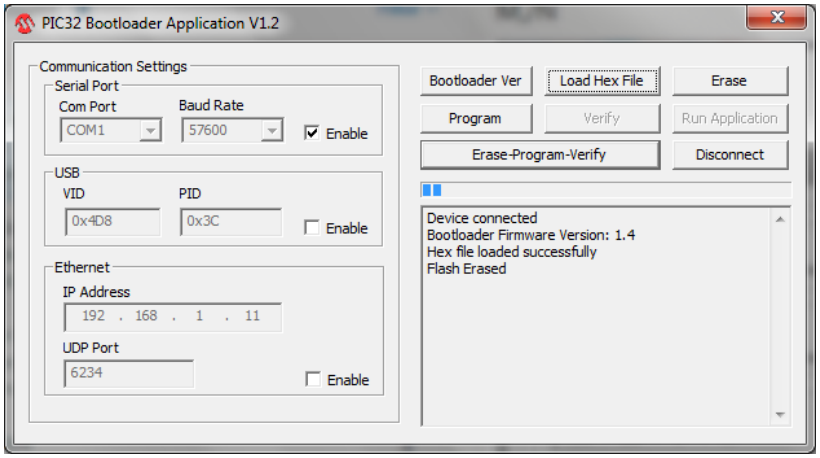
Click on “Load Hex File”, and the message below will pop up. Select the PC directory where the firmware is stored and then “Open” the required file.



The message below is seen.

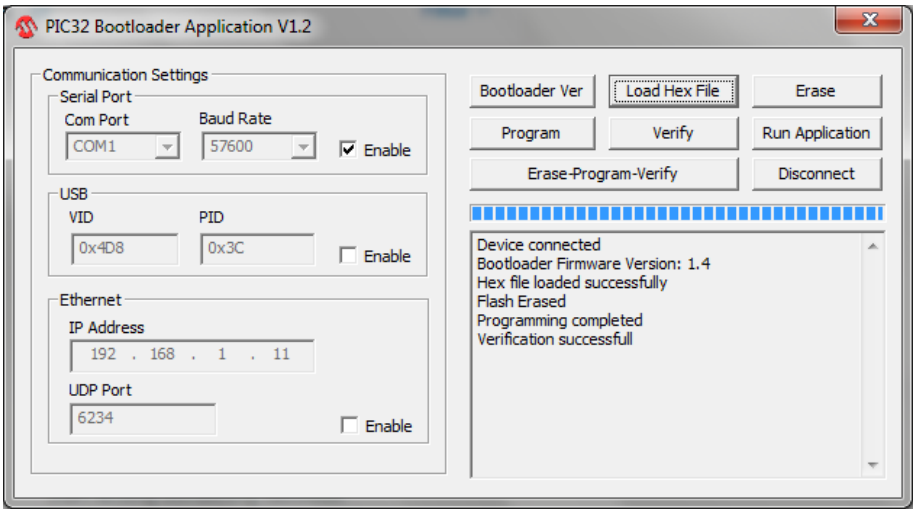


Click on “Erase-Program-Verify” and the message below is seen.

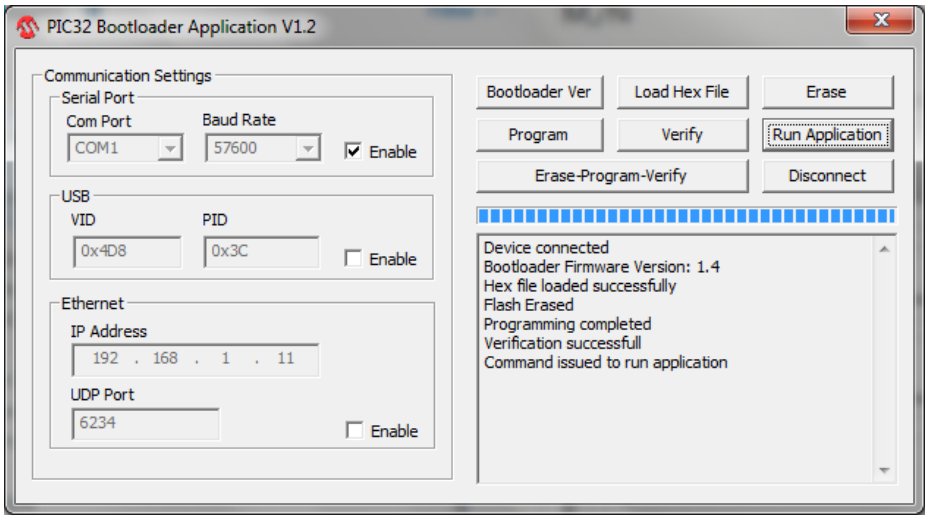


Programming typically takes several minutes.

The message below is seen when the erase, program and verification is complete.

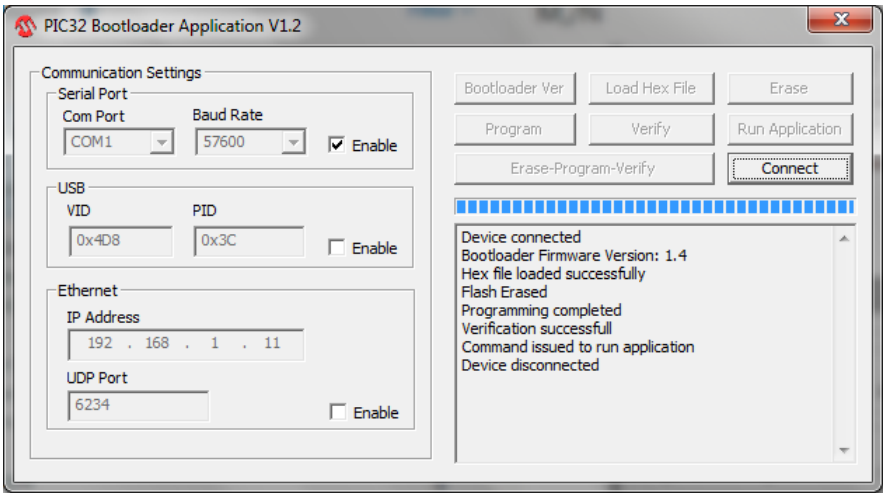


Click "Run Application". Cardinal will now be operating normally.

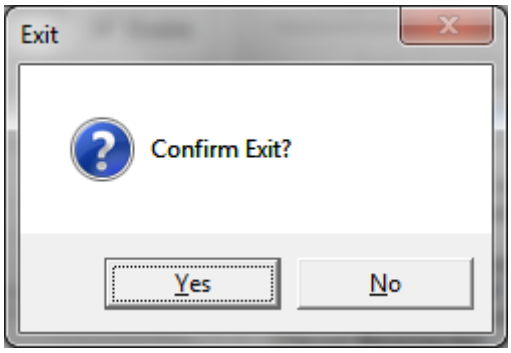


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Click “Disconnect” and the message below is seen.



Close application.



Click “Yes”

Check operation by re-opening your terminal program (e.g. “PuTTY”). You can use the FIRMWARE? Command to see the new firmware version. The download is now complete, and the serial lead may be disconnected.



The serial upgrade method upgrades all firmware except the Bootloader Firmware that supports the serial upgrade process itself. It is known that older Bootloader Firmware fails to respond to the Run Application button and holds the device in reset after a successful upgrade. In this case, you must wait for 2 minutes after verification is successful to allow the process to time out, whereupon MDU will then reboot on its own. This issue was fixed in later Bootloader Firmware without upgrading the version number (1.4) so it is not possible to tell if your bootloader is old by its version number. A full upgrade that includes a new bootloader requires a “unified” hex file for the correct target processor and is a “lid-off” procedure.



Following any firmware upgrade, it is important to refresh the browser (using ctrl-F5) on all client devices that use the iMDU Web UI to ensure the latest graphical elements and updates are used in place of previously cached versions.

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Firmware History

Release 1.1.0.10 - **Cardinal Secure** product refresh.

Date: 25/09/2025

Description:

* Added SNMPv3 and encrypted keys support
* Added Web UI option and serial command for enabling/disabling SNMPv1 and SNMPv2
* Added serial command for enabling/disabling entire Web UI
* Serial port protocol improvements
* Serial port resilience improvements
* Web UI improvements
* Improved reliability of traps when multiple destinations are configured
* Dynamic detection and reporting of temperature and humidity sensor connection state
* Explicit reporting of temperature and humidity source
* Disabled legacy unencrypted email support

Customers with security concerns may now switch off insecure access methods.

Release 1.0.14.7 - update for manufacturing.

Date: 15/11/2022

Description:

* Added support for sibling MCU to secure supply chain.
  Each release now has alternative firmware compiled from a common codebase.
  Be sure to select the correct hex file depending on which MCU you are targeting.

* Fixed response to Run Application button in Serial Loader App, to increase engineer confidence when performing future field upgrades. A factory firmware upgrade that includes the boot loader is required to see this benefit.

Specification

Input

Connector:	1 or 2 Neutrik powerCON® inlets (depending on model variant)
Voltage:	230V +/- 10%
LEDs:	Single I/P: Supply LED (green) Dual I/P: Supply Active/Available LEDs per I/P (green)

Outputs

Connector:	12 x IEC sockets on the rear panel
Fuse rating (max):	T6.3 A per output (5A fitted)
Total load:	Up to 12A at 230V
LEDs:	2 per output for “on/off” (green) and “fuse blown” (red)

Control/monitoring

Network:	Ethernet RJ45
Serial:	RS232 via 6-way RJ11 Modular Jack
GPIO:	26-way ‘D’ type: 16 inputs and 2 dry contact outputs
LEDs:	Network Activity and Link (yellow)

Physical

Height:	44mm (1RU) bay mounted unit
Width:	483mm (standard 19-inch rack) Depth: 380mm (including tie bar)
Switch:	Front panel switch is also an over-current circuit breaker
Tie Bar:	At the rear for cable retention
Weight:	2.9 Kg (single input version)

Environmental

Operating temperature:	5°C to 40°C non-condensing.
Operational humidity:	Up to 85% Relative Humidity
Storage temperature:	0°C to 80°C

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