



Entranet 868

Gateway/Receiver



Data and Instruction Manual

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1. Introduction

1.1 - Copyright, Limitation of Liability and Revision Rights

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1.2 - Symbols



Indicates something to be noted by the user



Indicates important information



Indicates high voltage

1.3 - Conventions for Cautions and Warnings

CAUTION



Cautions advise the user to proceed with care.

They alert users to situations wherein there is potential that they might perform an action which could result in an unexpected outcome or the loss of data which could be permanent.

Cautions contain an explanation of why the action is potentially problematic.

WARNING!



Warnings advise the user to proceed with *extreme* care.

They alert users to situations wherein there is potential that they might perform an action which could result in personal injury or damage to equipment.

Warnings contain an explanation of why the action is potentially dangerous.

1.4 – Important Safety Information



Be sure to heed the following warnings to prevent personal injury or damage to equipment.

WARNING!



The circuit powering the **Entranet** is 5/24vdc depending on the power module being used. Disconnect power before installation or servicing to prevent electrical shock or damage to equipment. Make all connections in accordance with national and local electrical codes. Use copper conductors only. To reduce the risk of fire or electrical shock, install in a controlled environment relatively free of contaminants. The **Entranet** is only intended for use as a monitoring and communications device. To prevent loss of data or damage to equipment, **DO NOT USE IT FOR ANY OTHER PURPOSE.**



Static charges produce voltages high enough to damage electronic components. The microprocessors and associated circuitry within an **Entranet** device are sensitive to static discharge.

Follow these precautions when installing, servicing, or operating the system:

- Work in a static-free area.
- Discharge any static electricity you may have accumulated.
- Discharge static electricity by touching a known, securely grounded object.
- Do not handle the printed circuit board (PCB) without proper protection against static discharge.
- Use a wrist strap when handling PCBs. The wrist strap clamp must be secured to earth ground.

WARNING!



All electrical installation work must be undertaken by a suitably qualified and competent person and must be carried out in full accordance with all relevant Statutory Requirements and Regulations.

1.5 - Before Commencing Repair Work

WARNING!



1. Disconnect/Isolate the power supply, if connected.
2. Ensure that all safety and operational measures have been implemented.

1.6 – Risk Avoidance

To avoid the risk of personal injury and damage to equipment the **Entranet** must be operated in accordance with the guidelines and specifications detailed in this manual, as well as all statutory requirements and regulations. Take special heed to all Cautions and Warnings.

2. Introduction to the **Entranet**

2.1 – Device Overview

The **Entranet** 868 gateway/receiver is at the heart of our 868MHz mesh network. It collects data from nodes such as the **EnCompass** 868 and conveys it seamlessly and securely to the web via TCP/IP or 3G*. Installed on the **Entranet** is a data and device management hub which can be accessed locally or via the internet. Use it to manage the network and swiftly setup new devices, connect your data easily to any other software, system or server, or see it right there on the dashboards.

*This document refers to both variants of the **Entranet** 868. The TCP/IP variant connects via Ethernet only while the 3G variant can also connect to the internet via 3G/GPRS. Notification will be given where information does not apply to all variants and options.

2.2 – Features Overview

- Superior, seamless mesh network using protocol designed for high range and penetration in challenging environments without compromising power consumption.
- Connect to any software, system or server to/through CSV, Modbus, BACnet, LonWorks, SCADA/DCS and more.
- Powered by 24vdc PSU or 5v USB mains adapter.
- Simple setup and clear configuration, either locally or remotely via the device/data management hub installed onboard.
- Data can be reviewed on the local dashboards
- Firmware can be upgraded over-the-air.
- Modbus TCP/IP Slave and Master via Serial connection (option)
- Sampling and reporting fully customizable.
- Signal strength reported.
- Powerful system diagnostic tools.
- IP67 rated



2.3 – Network Overview

The C2i mesh network allows a large number of measurements to be taken over a large area and reported via radio frequency (RF) to a single gateway/receiver – the **Entranet** 868

C2i wireless data collectors operate with the **Entranet** in one of three configurable modes. When a device is in *node* setting it collects data and transmits it back to the **Entranet**. When in *repeater* setting it receives data from nodes too far from the **Entranet** and then retransmits the data, thus extending the range of the system. (To ensure that transmission, and therefore battery usage, is efficient, the maximum number of repeaters between a node and the **Entranet** is two). The third mode, *node/repeater*, combines the functionality of both.

The network works effectively with a handful of nodes (or even just one) in use, but comes into its own when used in large and perhaps complex scenarios as it conveys vast amounts of data to the **Entranet** rapidly, reliably and efficiently. This makes it ideal for comprehensive monitoring of plant, equipment, machinery and systems (PEMS).

The **Entranet** acts as an Ethernet device, providing web access to **GATEWAY**, the integrated device/data management hub. All devices on the network can be configured here as well as the onward data connections to other systems and platforms via protocols such as BACnet and oBIX. Data can also be downloaded directly or viewed right there on a dashboard.

The **Entranet** may also be accessed locally via the serial port connection to enable constant, high resolution reading of data from all inputs.

2.4 – Monitoring Capabilities

- **Digital Status and Logger** – Two (optional) digital inputs provide utility and/or maintenance data. Each can be configured to count pulses, regularly sample the status, or log the exact time of each change of status.
- **Serial Connection** - The serial connection enables constant, high resolution reading of data from all inputs, using an attached computer.
- **Modbus Slaves** - *(optional)*. If the device is set up as a Modbus RTU Master and/or a Modbus TCP/IP Master, data will be received for any coils or registers on Modbus slaves, based on user configuration.

2.5 – Input Connections



Input wiring must be installed in accordance with national and local regulations/requirements. All wiring types must be selected appropriately, according to their function and operating constraints.

The inputs for the **Entranet** require glands or conduit entries in the gland plate at the bottom of the **Entranet**. Care needs to be taken to ensure the IP rating remains intact. Each input can take a wide range of readily available sensor types. All inputs and outputs are protected against electrostatic discharge (ESD).

2.5.1 - Connection Details

The connections to the **Entranet** are via cable entry holes in the bottom of the case, where cables pass through glands and terminate into the spring loaded plug-in terminals mounted on the edge of the printed circuit board. The case has a detachable plate that is screwed, complete with seal. This plate can be replaced with a blank or with 4 or 8 holes. The cover over the terminal compartment is screwed complete with seal.

3. Deploying your **Entranet**

3.1 - Before Deploying the **Entranet**



Read this guide before installing. If the **Entranet** is installed incorrectly, Utilivista's guarantee obligations will no longer apply. If in doubt, contact us.

The **Entranet** must be mounted in a suitable environment in a position that allows safe access and good clearance for wiring, servicing, removal, and connection of all the I/O.



Environmental Considerations

- Do not operate outside the ambient temperature range (-20°C to +60°C).
- Do not cover. Allow air circulation.
- Protect from direct contact with steam or any other harmful substances.
- Where possible, protect from direct sunlight.



Where possible keep away from the following:

- Steel poles, pipes, RSJ's, cladding and other large metal surfaces.
- Electric motors or high frequency drives.
- Other strong wireless signalling systems, dishes or antenna's.
- High voltage electric cables or transmission lines.
- Any equipment that transmits high levels of interference (high EMC / RF).
- Areas where there is the potential for mechanical damage or obvious obstruction to normal operational behaviour.



To maximise signal strength:

- Mount the **Entranet** in its upright position (though it can be mounted in any orientation).
- Minimise the number of structural obstacles and the distance between the **Entranet** and its nodes.
- Fix the **Entranet** as high as practically possible.

For more detailed information and advice, see Appendix A.

3.2 - Fixing the **Entranet**

The **Entranet** should be fixed to a wall or other permanent structure by attaching a screw or bolt to the building or equipment framework, and hanging the node via the keyhole fixing on the back of the unit. Allow 300mm between the **Entranet** and any other fixed equipment or services that may cause mechanical / electrical damage or interference.



Take care not to drill materials that may be harmful. Also ensure that there are no hidden services etc. in or near the path of the drill.

To avoid any danger in fixing as described above, alternative fixings could be used such as cable strap, Velcro, "No-Nails" or similar.

3.3 – Connecting Cables



All cables and wiring must comply with national and local regulations and standards.

It may be more convenient to make all the connections before mounting the device, especially if it needs to be positioned at a higher level to gain good reception. In this case ensure long enough tails are provided to enable tidy clipping/fastening to the building fabric/cable tray.

Remove the front access cover and route the cables through the gland plate and connect to the appropriate terminals.

The installer must ensure that the cable glands or entry system is sealed to IP67 standard to maintain the IP protection category. If these necessary steps are not taken and an **Entranet** is damaged because of ingress of water or other particulates and corrosive vapours, Utilivista will not be obliged to replace the unit within the warranty period.



Ensure all cable entries are used or plugged with the appropriate gland/plug.

4. Configuring your **Entranet**

4.1 – Accessing the Device

Connect the **Entranet** to power via the 24v PSU or the USB adaptor.



The settings for IP networking can be changed, but the **Entranet must first be accessed using its default IP address: 192.168.1.130.**

To add to a LAN which allows a new device with static IP address 192.168.1.130:

- Connect the RJ45 Ethernet cable into a switch or router.
- You may need to wait for about 2 minutes for the device to be fully booted up and available via Ethernet cable. See the next section (4.3) for a guide to the LED indicator showing the Ethernet port status.

To connect directly to a computer (e.g. to change the IP address to suit your LAN):

- Ensure your computer is not connected to any other LAN, either wirelessly or through an Ethernet cable.
- Connect the RJ45 Ethernet cable into your computer's Ethernet port. You may need wait for about 2 minutes for the device to be fully booted up and available via Ethernet cable. See the next section (4.3) for a guide to the LED indicator showing the Ethernet port status.
- In the TCP / IP settings of the LAN connection for your computer, set the IP address manually within the range **192.168.1.1 – 192.168.1.254**, (but DO NOT use 192.168.1.130), and the subnet mask to **255.255.255.0**.
- Open Internet Explorer or another browser on a computer on the network, and type into the address bar: `http://192.168.1.130`.

4.2 – Logging In



You will need to log in with a username and password.

The username must be 'admin', 'manager' or 'user':

- Logging in as 'admin' allows you to change any settings.
 - The default password for admin is: C2iAdmin
- Logging in as 'manager' allows you to change configuration settings but not general settings.
 - The default password for manager is: C2iManager
- Logging in as 'user' means that no changes can be made.
 - The default password for user is: C2iUser

Passwords can be changed in the *Administration* settings. Each login type allows all settings to be viewed.

CAUTION



It is strongly advised to create a unique password at the earliest opportunity. This document, and thus the default passwords, are publicly available.

4.3 – Using the LED Indicator

When powered, the LED on your **Entronet** will indicate the status of the device with a series of flashes followed by a five second gap. The number of these flashes between each pause indicate the following:

	Device is Functioning	Ethernet Networking is Functioning	3G is Functioning
No Flashes	X	X	X
1 Flash*		X	X
2 Flashes			X
3 Flashes**		X	
4 Flashes**			

* When networking needs to be initiated (e.g. on inserting an Ethernet cable) this may continue for about 2mins.

** Only applicable to the 3G variant of the **Entronet**

4.4 – Settings and Tools

4.4.1 – Administration

To access these settings, open the *Settings* folder in the menu and then click *Administration*. You will see options for the following:

- *Label and Description for Device*: You can set values for these, for display purposes.
- *Location Info*: These settings describe the site on which the device is installed. If applicable, they synchronise with the online SiteConnect interface, with the following rule: The latest edit, whether on the device or online, takes precedence and overwrites previous values in both places, except for the customer name setting, which is always retrieved, if possible, from SiteConnect.
- *Update password*: This is the only field which can be edited by the non-admin usernames, and gives the opportunity to change the password for the username you are logged in as. If logged in as admin you can also set any of the usernames to revert back to their default password.
- *Internet Activity and Time Synchronisation*: The time will be kept accurate by regular synchronisation over the internet or with a local timeserver which you can specify here. If you need to be able to set the time manually then set *Only use NTP to set time* to **No**. This will not disable synchronisation but will allow you to click an icon on the front page next to the time and change it manually. To access the front page at any time, (where the current time is displayed) click the *Front Page* icon at the top right of the screen.
- *Internet Activity and Remote Access / Updates*: If the device is to be continuously online (which is not necessary for all functionality), you can choose to automatically apply updates (*Check for Updates*), and to allow remote access through SiteConnect (must be purchased).

- *User-Initiated Updates:* If you have an update from C2i that needs to be manually uploaded, e.g. because the device is not connected to the internet, you can use the *Drop upg file or click to upload* section of the page. You will see a message that the file is uploaded, and the update will then be applied.
- *System Boots:* This shows the latest boot timestamp, which will be based on the time settings at the time of booting up. There is a link to *Reboot now* which will perform a reboot; the device will be off for up to one minute, and network connectivity may take more than a minute to be restored.
 - *For 3G devices:* There is also a link to *Restart modules* which power cycles all peripheral modules including the modem.
- *Configuration Backup Files:* A configuration file contains all settings relating to the pages in the menu under 'Configuration', though no data history. Configuration files can be downloaded or uploaded and applied on the Administration page. All firmware versions to date use the same format for these files (version 1).

4.4.2 – System Info

To access these settings open the *Settings* folder in the menu and then click *System Info*. As well as seeing version information and technical information for the device, you will see options for the following:

Locale Settings: Time zone can set, with all the geographic options from any continent, or the option of always using Greenwich Mean Time. There are also settings for date format and the choice between temperature in °C or °F.

4.4.3 - Network Settings

To access these settings, open the *Settings* folder in the menu and then click *Network*.

- *Allow New Nodes:* Use this to allow new C2i wireless nodes to connect to the **Entranet** (when they are put into Learn Mode using a magnet. See **EnCompass** Manual).
- *IP Network:* Use these settings if you need to assign an IP address, subnet mask or default gateway (if using a gateway to the internet or to another network), as well as (excl. 3G devices) the DNS server (the Domain Name Server for internet use, often the same as the default gateway). Alternatively, you can specify that DHCP addressing should be used by your router to allocate the **Entranet**'s IP address, in which case you will need to find out the IP address from your router to be able to access the **Entranet**.
- *Mobile Network (For 3G devices):* For setting the APN, username and password specific to the Sim Card inserted for mobile internet. This information can be provided by the mobile internet company. This section also shows connection status, remote IP address, boot-time signal strength, and mobile network.

4.4.4 - TCP / UDP Ports

To use this page, open the *Settings* folder in the menu and then click *TCP / UDP Port Numbers*. It shows port numbers for all incoming and outgoing connections, with options to turn off activity on specific ports.

4.4.5 - Settings for Digital Inputs (applicable only to devices with digital inputs installed.)

These settings are located by opening the *Configuration* folder and then the *Onboard Inputs* folder in the menu.

There is a page called *Generic Settings* which allows you to set the sampling interval for both digital inputs. (The interval between any two consecutive data values, between 10 seconds and 4 hours.)

The page called *Status / Pulse* allows you to activate and set the mode for the digital inputs. The options for mode are: *Take regular snapshots* or *Keep pulse count*. See the sub-section on *Status / Pulse* in the *Settings for EnCompass Inputs & Outputs* section (5.7.6, P17) below. You are also able to give a custom label to each input.

4.5 – Diagnostics

The 6 sections below refer to pages that can be found by opening the *Diagnostics* folder from the menu and clicking on the relevant section.

4.5.1 - Error Log

- *Reports*: You will be able to see details of any problems with email or FTP operations, which may be due to an intermittent internet connection, incorrect server details, etc.
- *Modbus*: You will be able to see details of any problems with Modbus requests, which may be due to registers not being valid on a particular device, or failure to connect to the device. The presence of an error message indicates that a read request was attempted.

4.5.2 - Command Log

The *Command Log* shows all network commands processed by the wireless network receiver.

By default the page displays logs for today; Use the date option to select a different day. Each day should at least show some commands to synchronise time clocks. If there are no commands or all commands for a day have a status of 'Failed', this may indicate internal system problems, and a power cycle is recommended.

4.5.2 - Upgrade Log

This shows all upgrade activity for this gateway. A table shows the date and time, upgrade filename and status of all upgrades, most recent first.

To manually initiate upgrade, if you have a file for this, see Section 4.4.1, P10. Please note that it may take up to 2 minutes for an uploaded upgrade file to show in the Upgrade Log.

4.5.3 - Boot Log / GSM Log

This shows all instances of the device shutting down or booting up, and for 3G devices, all instances of the GSM connection status changing.

4.5.4 - System Power Log

This gives information about changes to powering mode (Mains or UPS), and hourly values for processor voltage and UPS battery voltage.

4.5.5 - Ping Tool

To access the *Ping Tool* open the *Diagnostics* folder from the menu and click on *Ping Tool*.

This allows you to ping IP addresses or domain names on the local area network or the internet and see responses.

For Network Diagnostics, see Section 5.9, P20.

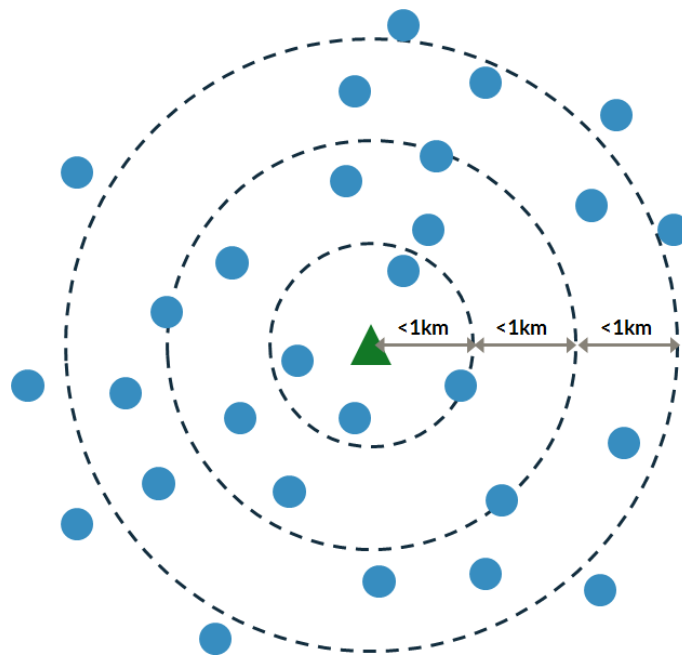
5. Configuring the Network

5.1 – Planning and Commissioning a Network

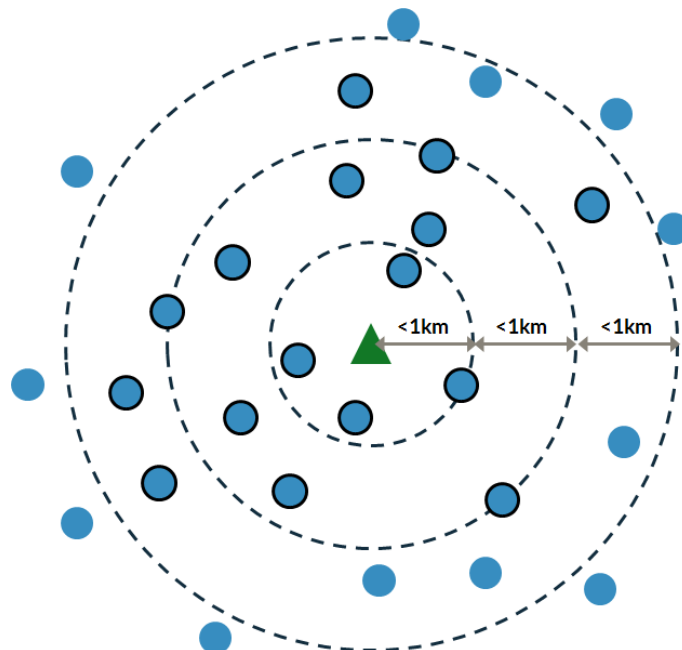
5.1.1 – Establishing your Requirements

The number of monitoring nodes such as the **EnCompass** should be easy to establish, based on your monitoring requirements. Estimating the number of repeaters necessitates a strategy as outlined below.

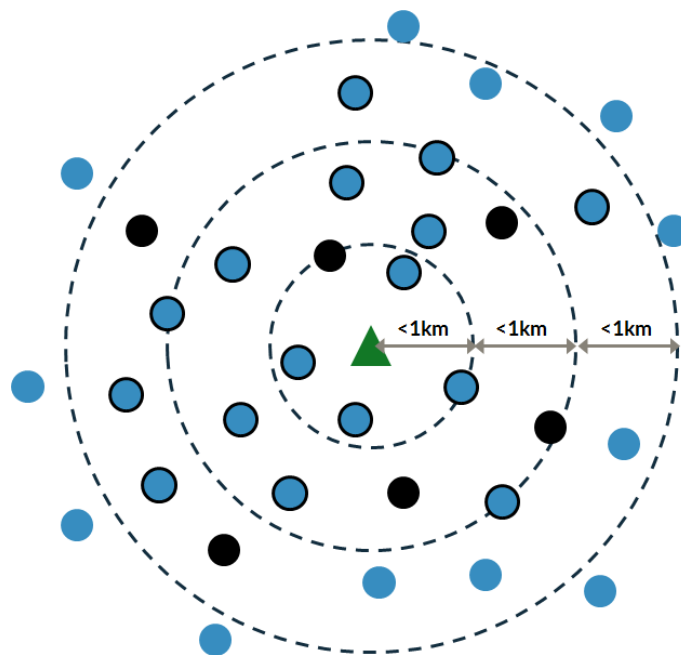
1. Mark the location of all nodes on a site or building plan. Draw rings up to 1000m apart to include all nodes, with the **Entranet** gateway/receiver at the centre.



2. Mark all nodes except the outermost as node/repeaters.



- Place repeaters where there are gaps in the network to ensure every node and node/receiver has at least one path to the **Entranet**.



The exact position of all nodes, node/repeaters and repeaters will always need to be fine-tuned in-situ using the range indicators. Detailed instructions for the positioning and fixing of devices can be found in Section 3 and Appendix A.

5.1.2. - Setting-Up the C2i Network

Step 1: Initial Setup

- Install the **Entranet** gateway/receiver in a suitable location.
- Access the local configuration pages (*Settings/Network/Allow New Nodes*) and set the **Entranet** to allow new nodes.

Step 2: Setup the nodes and repeaters

See **EnCompass** 868 Manual, Section 6 and 7

5.2 – Adding a new **EnCompass** to the network

- Go to *Settings* and then *Network*
- Set *Allow New Nodes* to **Yes**
- Click **Save and Apply** (This setting will last until 00:00 at the end of the day.)
- Use a magnet to put the **EnCompass** into Learn Mode. (See **EnCompass** 868 Manual)

If successful then after a refresh of the menu you should see the node serial number listed in the menu.

5.3 - General Settings and Status of an EnCompass



Applying changes to an **EnCompass** 868 can take up to 15 minutes, or longer if the reporting interval is set to a higher value than 15 minutes.

To find the general settings for an **EnCompass**, open *Configuration* and then *Node Status & Settings* in the menu and click on the text of the serial number or name for the relevant **EnCompass**. The settings in this section include:

- *Mode*: Indicates whether the **EnCompass** is acting as a sensor *node* (measuring inputs) or a *repeater* (forwarding data for other nodes) or both (*node / repeater*)
 - *Power Mode*: Indicates the current power source i.e. battery, or external power (either directly from a power adapter or from a computer). This must always be correctly set to prevent loss of functionality or fast battery loss.
 - *Battery*: See *Checking the Battery Life of an EnCompass*
 - *Name*: A name can be used to refer to this node instead of the serial number.
 - *Sampling Interval*: The interval between any two consecutive data values for any input, between 10 seconds and 4 hours. When more than 2 inputs are reporting, a sampling rate of 10 seconds is liable to cause a buffer overload, resulting in lost data. Likewise when more than 4 inputs are reporting, the same would be true of a sampling rate of 20 seconds. For sampling intervals over (and including) one minute, this issue is avoided, however many inputs are reporting.
 - *Reporting Interval*: The maximum amount of time that will pass between the **EnCompass** sending all the latest sampled values for any one input back to the gateway/receiver. Higher values are likely to result in improved battery life but also in delays to implement changes to node parameters.
- The firmware version number for the **EnCompass** is also shown.

5.4 - Default values for new nodes

You can set the default values for battery capacity, sampling interval and reporting interval, or change these settings for all nodes already on the network, using the *All Nodes* page which is found by opening the *Configuration* folder and then the *Node Status & Settings* folder in the menu and clicking *All Nodes*.

5.5 - Deleting an EnCompass

In the page for general settings for an **EnCompass** (see Section 5.3 above), there is a link at the bottom to delete the device. Clicking this will mean data for that device will be removed, but any new data sent, if the device is on and within range, will cause it to be shown again.

5.6 - Checking the Battery Life of an EnCompass

In the page for general settings for an **EnCompass** (see Section 5.3 above), if the **EnCompass** is battery powered, there are settings that relate to the capacity of the battery:

- *Battery Capacity*: Total capacity in mA. This must be correct to calculate remaining capacity.
- *Battery Changed / First Used*: Given as a date, so that the system knows when the battery was full. This must be correct to calculate remaining capacity. This will be populated automatically when an **EnCompass** is first used on the network. After a change of battery, you should enter the date of change. If you forget to do this at the time you can do it at a later date. (Hovering over the help box on this setting will show you dates when a restart of the **EnCompass** was detected, which may help to remind you of when the battery was changed.)
- *Remaining Battery Capacity*: Not known with high accuracy but can be taken as a guide. After 1% of battery capacity has been used you will be able to see an estimate of how much longer this battery will last, based on battery usage over the last month.



When it is calculated that an **EnCompass** has a low battery, a low battery icon will show next to the serial number or name of that device in the menu.

5.7 - Settings for EnCompass Inputs & Outputs



Applying changes to an **EnCompass** ⁸⁶⁸ can take up to 15 minutes, or longer if the reporting interval is set to a higher value than 15 minutes.

These settings are located by opening the *Configuration* folder, then the *Node Status & Settings* folder, and then the folder named as the serial number or label for the relevant **EnCompass** device in the menu. There are pages for each type of input as described below.

5.7.1 - Labels for all inputs

All the inputs can optionally be given a label with maximum length of 17 characters, which is used for display purposes on these pages and is also used as a column heading in CSV files. (See Section 6.4 - CSV Files and Reporting Schedules, P23)

5.7.2 - Voltage

A voltage input is automatically activated when physically connected. See the *Consumption* section for more information on setting up voltage inputs.

5.7.3 - Current

A current input is automatically activated when physically connected. A current input needs to be assigned a CT sensor, so that the value can be given in terms of Amps. Enter the manufacturer first, then the sensor category, then the sensor label. If the sensor is not available it needs to be added to the library and calibrated for use on an **EnCompass** (See Section 5.8 - Adding Sensors for **EnCompass** Inputs, P19).

If the sensor is changed for an activated input, and then the page saved, an option will appear asking if the change should be backdated to historical data or only apply from that point in time. See the consumption section for more information on setting up current inputs in relation to consumption calculations in kWh.

5.7.4 - Consumption

This is relevant if voltage and current inputs are connected, or if just current is connected on a mains powered node and an assumed voltage has been entered for that current input, to enable high frequency conversion of amps to watt.

The value in kWh can be overridden to a user entered value, relevant to a specified time (which must be a time near the actual time of entering it in these settings) so that the value will be synchronised with another counter.

5.7.5 - Thermistor

Thermistor inputs are automatically activated when physically connected. A thermistor input needs to be assigned a sensor, so that the value can be given in terms of your chosen temperature unit (see the general settings for the **Entronet: Administration Settings**). Enter the manufacturer first, then the sensor category, then the sensor label here. If the sensor is not available it needs to be added to the library (See Section 5.8 - Adding Sensors for **EnCompass** Inputs, P19).



If the sensor is changed for an activated input, and then the page saved, an option will appear asking if the change should be backdated to historical data or only apply from that point in time.

5.7.6 - Status / Pulse

Any digital input to be used needs to be assigned a mode:

- **Record All Changes** – This will ignore the sampling interval and give data values whenever the input changes between **On** and **Off**.
- **Take Regular Snapshots** – The state of the input will be recorded, using the sampling interval of the **EnCompass**.
- **Keep Pulse Count** – A running total will be recorded, using the sampling interval of the **EnCompass**. A unit can be specified, which will be appended when data is displayed. A conversion factor can be entered, such that the number of pulses multiplied by this factor is equal to the number of specified units. If the conversion factor is changed for an activated input, and then the page saved, an option will appear asking if the change should be backdated to historical data or only apply from that point in time. Once the conversion factor has been entered, the value (in specified units) can be overridden to a user entered value, relevant to a specified time (which must be a time near the actual time of entering it in these settings) so that the value will be synchronised with another counter.



If the unit is powered by mains power any of the thermistor inputs can be used as digital inputs, giving you up to five additional inputs for status / pulse. The mode of these inputs can be altered on this page.

5.7.7 - 4-20mA

A 4-20mA input needs to be activated here if it will be used, by setting the mode to **Sampling**, then when physically connected to a powered 4-20mA, sensor data will be sampled. A 4-20mA input needs to be assigned a sensor, so that the value can be given in the appropriate unit. First the manufacturer, then the sensor category, then the sensor label must be entered here. If the sensor is not available it needs to be added to the library (See Section 5.8 - Adding Sensors for **EnCompass** Inputs, P19).

5.7.8 - Digital Output

This can be switched **On** or **Off** here, or (for an **EnCompass** 868 which is measuring electrical consumption) set to **Pulse Meter Mode** which results in a 100ms active pulse occurring on every kWh consumed.

5.7.9 - Disabling Any Input



If the number or type of inputs in use on an **EnCompass** 868 has changed, such that any voltage, current or thermistor inputs that once were in use are no longer attached to an electrical circuit / sensor, it is likely that data will still be sent for these inputs.

To disable any input, go to the page for general settings for that **EnCompass**. This is found by opening the *Configuration* folder and then the *Node Status & Settings* folder in the menu and clicking on the text of the serial number or name for the relevant **EnCompass**. You will then be able to click the link to **Reset Active Inputs**, which will mean that for a few minutes no data at all is received by the **Entranet** for this device, after which, only data for voltage, current or thermistor inputs that are physically connected, and data for other input types which are configured to be 'enabled', is received.

There is a link on the page for *All Nodes* to reset active inputs for all **EnCompass** devices. This page is found by opening *Configuration* folder and then the *Node Status & Settings* folder in the menu and then clicking on *All Nodes*.

5.7.10 - Troubleshooting: Input Not Active

If there is no recent data for an input that you expect to see data for, check the following things:

1. Physical connection OK: For Voltage, Current, Consumption, Thermistor, 4-20mA inputs, there will be no data sent unless the input is physically connected properly.
2. Enabled in software: For Status/Pulse and 4-20mA inputs, the input must be enabled in the page for that input type for that **EnCompass** node. (See Sections 5.7.6 and 5.7.7 above). For consumption data, a current transformer must be assigned to the current input. (See 5.7.3 above)
3. Node communicating: If there is recent data for other inputs on this **EnCompass** node, or if the *Network Diagnostics* page shows that the time of the last communication from the node is within the last hour, this would suggest that there isn't a problem in this area.
4. Enough time elapsed: Check the reporting interval (See Section 5.3 - General Settings and Status of an **EnCompass**, P15), and be sure that you are waiting enough time for data to come in. Also, be aware that the following circumstances may mean that the time taken to receive data is 2 or more times more than usual:

- i. After the node is first added to the network
 - ii. After the input is first activated
 - iii. After active inputs are reset
 - iv. Signal strength problems on the network.
5. Re-enable: For Status/Pulse, 4-20mA and consumption data, If all the above has been checked, there is a slim possibility that a problem happened when enabling the input or in the case of consumption data, setting the current transformer. If this is the case, changing this setting, then saving, then changing back to the desired setting, will in almost all cases rectify that problem.

5.8 - Adding Sensors for **EnCompass** Inputs

In the *Libraries* folder of the menu there are folders for *Current Transformers*, *4-20mA sensors*, and *Thermistor sensors*. Opening any of these folders reveals a tree of manufacturers, then sensor categories (see below), then specific sensors.



Using any sensor that is not in this library requires adding it using these pages.

At the bottom of the list of manufacturers in the menu there is a page called *New Manufacturer*, which you should use if you are adding a sensor of an unlisted manufacturer.

At the bottom of the list of specific sensors for any category, there is a page called *New Sensor* which you should use for adding the sensor. See the sections below for what information is required on this page.

5.8.1 - Current Transformers

The only category of current transformers is 333mV CTs. A new CT needs to be calibrated for use on an **EnCompass**. To calibrate:

1. Set the conversion factor to 1.
2. Save the sensor and go to the page for current inputs (see Section 5.7 and 5.7.3) and select the newly added sensor for the appropriate input.
3. Have the CT connected to the input, with a known current on the circuit.



Please note that the manual for the CT may specify that the CT is not accurate below a certain current. The current you measure should exceed that threshold.

4. Note the time at which the known current is being measured.
5. When a value is available for that known time (see Section 6.3), calculate the conversion factor as follows: actual current (amps) / value read on the device (amps) = conversion factor.
6. Return to the page for the new Current Transformer, using the tree in the menu as described in this section; then update the conversion factor.
7. Save.

5.8.2 - 4-20mA Sensors

The categories are: *Temperature*, *Humidity*, *Pressure*, *Flow*, *Level*, *Air Quality* and *Other*.

A new sensor needs the following information entered: unit, and two values in terms of the specified unit, one for when the sensor outputs 4mA and the other for 20mA.

5.8.3 - Thermistor Sensors

The categories are: *10K Sensors*, *20K Sensors*, *PT100 Sensors*, *PT1000 Sensors*, and *Other*.

A new sensor needs the following information entered: Temperatures (in your chosen temperature unit, see Section 4.4.2, P10) and resistances (ohms) for any 3 calibration points.

Changes will be automatically applied within 60 seconds.

5.9 – Network Diagnostics



The network diagnostics page is especially useful if you are investigating time delays on receiving data, or if you see a warning symbol showing next to a node's label in the menu.

The network diagnostics page allows you to see the latest signal strengths and routes taken (via any repeaters) for all the **EnCompass** devices on the network, with historical records for these.

To access the page, open the *Diagnostics* folder from the menu and click on *Network*. There is a checkbox for each device. Check all that you are interested in and click **Refresh Data**. You will see a table showing the following fields for each device:

- Time of Last Comms: When the device last sent any information (Input data, status, etc.) to the **Entranet**. If a duration of time above the reporting interval has passed since a node communicated, this suggests network problems.
- 3rd Device: If this node is using 2 repeaters, the 3rd device from the **Entranet** will be the node itself. Signal Strength: Between the 3rd device and 2nd device, if applicable.
- 2nd Device: If this node is using 1 or more repeaters, the 2nd device away from the **Entranet**. Signal Strength: Between the 2nd device and nearest device.
- Nearest Device: Nearest repeater, or the node itself if no repeaters are used. Signal Strength: Between this device and the **Entranet**.

Signal Strengths are given as numbers with the band specified, as follows:

0-50 - Poor

50-55 - Fair

55-100 - Good.



Signal strengths for all communications are aggregated, averaged and reported at least once every hour. To see when the displayed signal strength was reported, hover over the value.

To see a table showing the log of signal strength values between two **EnCompass** devices or between the nearest device and the **Entranet**, click on the small **Expand** icon shown beneath the signal strength value.

To see a table showing the log of different routes an **EnCompass** device has taken to communicate with the **Entranet**, click the larger **Expand** icon in the 'Expand' column of the table. If no icon is displayed, this is because the route shown is the only route that this device has used.

6. Viewing and Exporting Data

6.1 – Summary of Interfaces for Monitoring/Export

6.1.1 – Graphics and Tables on Web Pages

Use your web browser to see dashboards and tables for latest data, and tables and graphs for historical data.

6.1.2 - CSV Files and Reporting Schedules

Comma Separated Variable (CSV) files can be requested for any combination of device and input type. These can be downloaded on request or scheduled for email and / or FTP upload at user definable regular intervals.

6.1.3 - Modbus Slave Functionality

Applicable only to devices with Modbus additional functionality.

If the device is set up as a Modbus TCP/IP Slave, any input for which data is being received can be assigned a register number so that the latest value can be read via Modbus at any time.

6.2 - Dashboards

To see a dashboard page for any **EnCompass** on the network, click on the serial number or name of the node in question, at the bottom of the left-hand menu.

The dashboard screen is split up into sections allocated to different input types. All inputs that are active will show in the appropriate section. If you see fewer inputs than you expect, see Section 5.7.10, P18.

Each input is labelled either with a generic name, e.g. 4-20mA Input 1, or the customised name if you have given a label to the input. (See Section 5.7, P16)

Clicking on the dial or displayed value for an input allows you to see more historical data and graphs for that input (see Section 6.3.2, P23).

The dashboard screen refreshes automatically when new data comes in for the inputs.

6.2.1 - Voltage and Current

7 dial graphics show the latest voltage and current for phase 1, 2, and 3 and the neutral current. A timestamp shows under the dial showing the exact time that this was sampled. Also displayed are the values of the minimum, average, and maximum voltage and current for the hour leading up to that timestamp, and a trend graph showing sampled values in that last hour.

You can click on one of the dials to see more historical data and graphs for a specific input, or click on one of the hourly trend graphs to see more graphs for a voltage / current pair.

6.2.2 - Status / Pulse / kWh Consumption

Up to 9 sections of the screen show either counters or ON / OFF status values, for each of this type of input / output, with timestamps showing the exact time that this was sampled.

6.2.3 - Temperature and Humidity

Up to 7 sections show values for each input in these categories, with timestamps showing the exact time that this was sampled. Also for thermistor inputs a trend graph shows sampled values in the last hour leading up to that timestamp.

6.2.4 - 4-20mA Inputs

Up to 3 sections show values for each 4-20mA input, displayed as described above for thermistor inputs.

6.3 - Graphs and Tables

6.3.1 - For All Inputs

To see a table of the latest data from any inputs of any devices, open the *Diagnostics* folder from menu, then click *Data*.

Use the check boxes for device and input type and use the filter checkboxes to select which combination of devices and input types you are interested in, then click **Refresh Data**, for a static table or **Auto Refresh**, for a table which will be refreshed automatically every 30 seconds.

There will be a row in the table for every active input that matches your filter options. If you see fewer rows than you expect, see Section 5.7.10 - Troubleshooting: Input Not Active in Settings, P18. Each row shows the Device ID, Input ID, Input Name, the latest value, when it was captured and when this data was reported over the wireless network to the **Entranet**.

For Modbus inputs, the Input ID means the absolute register address.

For C2i inputs, the input ID consists of one or two letters (input type) followed by a number (input number within that type, except that numbers are not used for SHT75 inputs), e.g. T1 for thermistor input 1. The input types are indicated as follows:

- V = Voltage**
- I = Current**
- C = Consumption**
- T = Thermistor**
- D = Status / Pulse**
- A = 4-20mA**
- ST = SHT75 temperature**
- SH = SHT75 humidity**

Also on each row is an expand link which allows you to see more historical data and graphs for that input (see Section 6.3.2, P22).

There is also a checkbox which you can select and then use the **Delete** button at the bottom of the table, if you wish to delete all stored data for that input. (Also see Section 5.7.9 - Disabling Any Input, P18).

6.3.2 - Historical Data

See above section(s) for how to access graphs and tables of historical data for a specific input. These pages have the following options for changing which data is shown:

- *Date*: The default setting is today's date, or latest date for which there is data.
- *Data Range*: The default setting is **24 hours** which shows 24 hours of data ending with the last known value for that date. The other options for this are:
 - 2 weeks ending on this date
 - 7 days ending on this date
 - 24 hours
 - 4 hours (beginning either at 0:00, 04:00, 08:00, 12:00, 16:00 or 20:00).

For the first two of these options, because of the larger amount of data, just a graph is shown with no accompanying table.

The graphs and tables show all the known data in the specified range; the frequency of data is determined by the settings for the input in question.

6.4 - CSV Files and Reporting Schedules

6.4.1 - Description of the CSV files

The **Entronet** provides data files in the Comma Separated Variable (CSV) file format. These can be opened in a variety of applications, including spreadsheet programs such as Excel, and also imported into many monitoring software offerings. An example of the first 3 lines of text from a CSV file for 2 different inputs is shown below:

```
Timestamp,Mod-meter 40001 K-counter,Node A211410-0136 V1 Ref-voltage,  
27/03/2015 00:00:00,237001,242.4,  
27/03/2015 00:05:00,237008,241.9,
```

The column names for an input (text on the top line, after the first column of 'Timestamp', are composed of the following information, appended together:

- If a C2i input:
 1. The label of the Modbus device or C2i device, or the serial number if there is no label (see Section 4.4.1, P9, and 5.3, P15).
 2. A code showing which input this is on the device. E.g. V1 for input input 1, I1 for current input 1, T1 for temperature input 1, D1 for digital input 1, A1 for 4-20mA input 1, ST for SHT75 temperature, SH for SHT75 humidity.)
 3. The label of this input, if it has been labelled (see Section 5.7, P16).
- If a Modbus input (*applicable only to devices with Modbus additional functionality*):
 1. The label of the Modbus device.
 2. The register address, e.g. 40001
 3. The label for this register address, if it has been labelled.

The first column of all rows of data is a timestamp, showing the date (in your chosen date format) and the time (HH:MM:SS).

Data in the columns after this is written as numbers (without any characters separating thousands), with the number of decimal places used being dependent on 1) the type of field this is measuring, if a C2i input, or 2) the specified number of decimal places for that register, if a Modbus input.

There will be one row in the CSV file for each timestamp for which data was sampled for any of the inputs that the CSV file is for. The CSV file will only apply to a specific range e.g. the latest 24 hours.

6.4.2 - Downloading a one-off CSV file

To download a CSV file:

1. Open the *Diagnostics* folder from the menu then click *Data*.
2. Use the check boxes for device and input type to select which combination of devices and input types you are interested in.
3. Click the **CSV Download** link below the checkboxes.
4. Select a start date and (inclusive) end date.
5. Use either the **Download CSV File** link or the **No Timeout Download** link. The first of these will take no longer than a few minutes but if you have requested lots of data (e.g. 100,000 values in total) the file may be incomplete. (In this case the filename will indicate that it is incomplete). The second of these can take an unlimited length of time and will always give a complete file with all the data you are requesting.

If your browser shows a security bar asking you to confirm download of the file, click to **Confirm**. You may then have to do the previous step again.

6.4.3 - Description of scheduled CSV reports

A report can be scheduled so that data relating to a user defined combination of devices and input types is emailed and / or uploaded via FTP, at a defined frequency.

The input types you can select from are:

- C2i Inputs:
 - Voltage** (If applicable you can select just Max, Min or Average. See Section 5.7.2, P16).
 - Current**
 - Temperature**
 - Status / Pulse**
 - 4-20 mA**
- Modbus Inputs (can be combined in the same report):
 - Discrete Coils**
 - Discrete Inputs**
 - Holding Registers**
 - Input Registers**

The frequencies you can select are:

5, 10, 15, or 30 minutes

1, 6, 12 or 24 hours

Weekly (with options for when the week starts), or monthly.

The scheduler will perform the following actions:

1. Wait until it is time for another report. (e.g. for 15 minute reports, wait until a little before 0, 15, 30, or 45 minutes past the hour. The report may be ready a little before these times, for example if the sampling interval for this data was 1 minute, the report for 12:00-12:15 would contain data for times up to 12:14, because the data for 12:15 would be included in the next report.)
2. Check that all the data for this report has been received by this device. For C2i data from **EnCompass** 868 devices, this may take another few minutes, or considerably longer if your network has communication problems, in which case keep checking until the data is ready. For data from Modbus devices, there is no need to keep waiting.
3. Build the CSV file, naming it as defined by the user, with a suffix in the filename to show the times it relates to, and check that it can be emailed to the specified address(es) and / or uploaded to the specified FTP server. If it can then do so. If it cannot due to problems with the internet connection, keep checking until the internet connection is OK.



As described immediately above, sometimes the scheduler has to wait until a report can be sent. If enough time elapses such that more reports of this definition would be ready to send, then it groups all the necessary reports as one longer one, rather than sending multiple reports at the same time.

6.4.4 - Scheduling CSV file reports

To schedule a report, open the *Configuration* folder and then the *CSV Reports* folder, then click **New**. Use the check boxes for device and input type to select which combination of devices and input types you are interested in. Then enter values for the following fields:



You can run an instant test of the settings once they are saved.

- *Report ID*: An ID to use to refer to these particular settings for automatic reporting.
- *Frequency*: See section above.
- *Filename*: Maximum 28 characters. It will be appended with the date and .csv file extension. As well as alphanumeric characters, you can use the underscore and dash characters.

Email Settings (If email is to be used):

- *Email to*: An email address, or more than one, separated with commas.
- *Email From*: An email address to appear as the sender address. To reduce risk of emails being put in a spam folder the domain name of this address should be that of your SMTP server (see below).
- *Email Subject*: Enter a subject if you want emails to be sent with a subject line different from the csv filename.
- *SMTP Server*: Server name for SMPT (Simple Mail Transport Protocol). The device does not function as a mail sending server so you must use an external one which this device must be able to access.

- *SMTP Port*: This is usually 25.
- *SMTP Username and Password*: Enter these if your server requires authentication.
- *SSL Security Required*: Select yes if your SMTP server requires SSL (Secure Sockets Layer) security.

FTP / SFTP Settings (If FTP uploads are to be used):

- *Connection Type*: 'FTP in active mode' is the default. 'FTP in passive mode' means that all connections to the server are initiated by the client. Often the reason for using this mode is to prevent a firewall blocking the connections. 'SFTP' can also be selected which is a different protocol with added security, using Secure Shell (SSH)
- *Server*: IP address or server name e.g. ftp.example.com.
- *Port*: TCP Port for this server. Usually this is 21 for FTP or 22 for SFTP.
- *Username and Password*: For FTP authentication.
- *Folder*: A folder found in the root folder of the FTP server, e.g. reports, or the path to a subfolder, e.g. reports/workshop. The folder entered here must exist on the server. Leave blank if just uploading to root folder.

Once you have entered the necessary settings click **Save**.

6.4.5 - Altering, Duplicating or deleting an existing scheduled report

To see the settings for an existing scheduled report, open the *Configuration* folder and then the *CSV Reports* folder, then click the appropriate report ID. Any settings can be altered and the report saved again. If the Report ID is altered, this will duplicate these settings and create a new report. Use the delete icon to remove this scheduled report.

6.5 - Modbus Slave Functionality

Applicable only to devices with Modbus additional functionality.

If the device is set up as a Modbus TCP/IP Slave, any input for which data is being received can be assigned a register number so that the latest value can be read via Modbus at any time.



The returned value for inputs from a C2i **EnCompass** on the network will always be the latest value known to the **EnCompass**, which is updated periodically when it sends data, typically every 15 minutes.

To access the page for the Modbus Server, open the *Configuration* folder and then the *Modbus Server Settings* folder, then click *Modbus Server Settings*.

The top section of this page gives options for the status of the Modbus Server (On/Off), and the TCP Port used for requests, which **cannot** be any of the following reserved ports:

20, 21, 25, 80, 102, 123, 5001, 32123, 34962, 34963, 32964

Once the status has been set to **On**, and the page saved for the first time, you are able to assign specific inputs to specific Modbus addresses. You can choose which addressing mode for registers, as follows:

Register Addresses (Absolute), in which the first input coil is displayed as 10001 and the first input register is displayed as 30001, or **Input Numbers Within Type**, in which the first input coil is displayed as 0 and the first input register is also displayed as 0.

To assign specific inputs to specific Modbus addresses, use the filter checkboxes to select the devices and input types you are interested in (see Section 6.4.1 - Description of the CSV Files, P23, for a list of input types), then click **Apply Filters**.

Then for each input that shows in the table you can set the following information:

- Input Register Type: The options are, **Input Register, 16 bit integer, Input Register, 32 bit float**, (these options are not available when assigning for a coil input being read from another Modbus RTU or Modbus TCP slave), or **Coil, Single bit 1/0**, (this option is available when assigning for a C2i digital input or a coil input being read from another Modbus RTU or Modbus TCP slave.)



If registers are assigned as 32 bit float input register, the byte order (strictly speaking, the word order or register order) is High -> Low.

- Modbus Address: This can be entered individually for each input, or if you wish to assign consecutive addresses to inputs in the table, enter the address for the first row in the table, and any others that will not simply take the next register address after the input above it in the table, then click on **Auto-Fill Empty Addresses**.

After saving any changes on this page, please allow a minute for these changes to take effect.

7. Specifications

7.1 - General Specifications

Ambient Limits	-20°C to +60°C.
Electrical Supply	24vdc PSU or 5vdc USB Mains Adapter

CONNECTIVITY

Communications Range	Up to 1000m Line-of-Sight
Operating Frequency	868Mhz
Channel Spacing	12.5kHz / 25kHz
Receiver Sensitivity	-115dbm
Maximum Link Budget	135dbm
Functionality	Bi-directional
Data Rate	2400 Baud
Bandwidth	Narrow Band FM
Transmit Power	+20dbm (100mW)
Firmware Upgrades	Transmitted over-the-air
Access to Interface	Local or Remote (www) if enabled
Connection to Internet	TCP/IP 3G (depending on variant)

CASING

Material	Acrylonitrile Butadiene Styrene (ABS)
Dimensions (H,W,D)	235.00 x 154.06 x 73.22 mm
Volume	3.5x10 ¹⁶ Ωcm
Weight	1.1kg approx.
Colour	Black
IP Rating	67
Impact Strength	240J/m
Ultimate Tensile Strength @ 20°C	40Mpa
Elongation at Break @ 20°C	50%
Instantaneous Flexural Modulus @20°C	2200Mpa
Compressive Strength @ 20°C	42Mpa
Specific Gravity	1.05x10 ³ kg/m ³
Poisson's Ratio	0.35
Surface Resistance	< 10 ⁹ Ω
Vicat Softening Point	95

Coefficient of Thermal Expansion 10.1x10⁻⁵ m/m°C

Maximum Operating Temperature 60°C

Temperature Range -20°C to +60°C

Thermal Conductivity 0.2W/m°C

Specific Heat 1.47kJ/kg°C

Thermal Ignition Resistance HB @ 1.5mm

DIGITAL INPUTS

Voltage Rating 5V DC

Input Logic Low Voltage (typical) <0.7V

Input Logic High Voltage (typical) >2.25V

Input Type Logic level

Operating Logic Open circuit = 1, Closed circuit = 0

Pulsed Input Fast Counter

Max 220ms

7.2 - Special Conditions

No testing has been carried out in any of the following environments:

- High altitudes.
- Pressurised cabins or containers.
- Explosive atmospheres.

7.3 - Approvals

- IP67 protection, where 6 means total protection against dust and 7 means protection against immersion between 15cm and 1m of water for 30 minutes.



C2i only recommends and sells approved sensors. It is the responsibility of the customer to ensure that all sensors used with the **Entranet** have the appropriate approvals.

7.4 - Safety Features

7.4.1 - Cage Clamp Terminals

Cage clamp type terminals ensure the wires are secure and held reliably, thus the connections have an increased durability and stability.

Power terminals conductor size is equal to 0.75mm² and low voltage terminals conductor size is equal to 0.5mm². Recommend using 0.5mm² pin ferrule crimps for easier termination.

7.4.2 - ABS Casing Material

The casing material used for the **Entranet** is acrylonitrile butadiene styrene (ABS) a compound which has been formulated to meet the static dissipative requirements of the ATEX Directive, thus meeting specific safety requirements. The Casing has high impact strength and ductility, good chemical resistance and abrasion resistance. The material is nontoxic, thus handling of the node has no inherent safety risks. The casing material has high strain tolerance and good resistance to ultraviolet light.

7.4.3 – Electrical Static Discharge (ESD)

All inputs and outputs are protected against ESD.

7.5 – Flammability Ratings

The ratings are as follows:

5VA: burning stops within 60 seconds on a vertical specimen with no drips; specimens do not develop a hole.

5VB: burning stops within 60 seconds on a vertical specimen with no drips; specimens may develop a hole.

V-0: burning stops within 10 seconds on a vertical specimen; non-inflamed particles may drip.

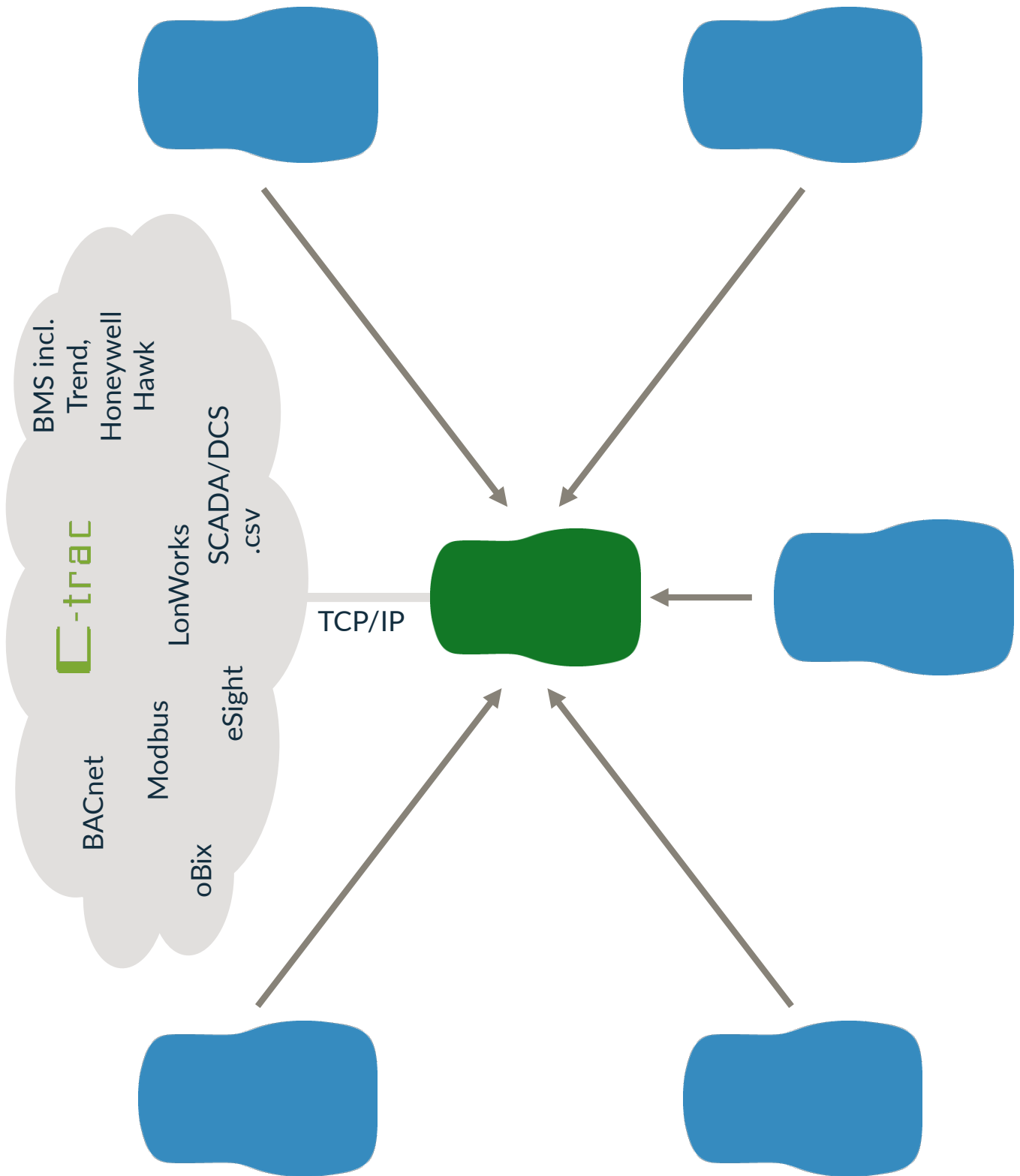
V-1: burning stops within 30 seconds on a vertical specimen; non-inflamed particles may drip.

V-2: burning stops within 30 seconds on a vertical specimen; flaming particles may drip.

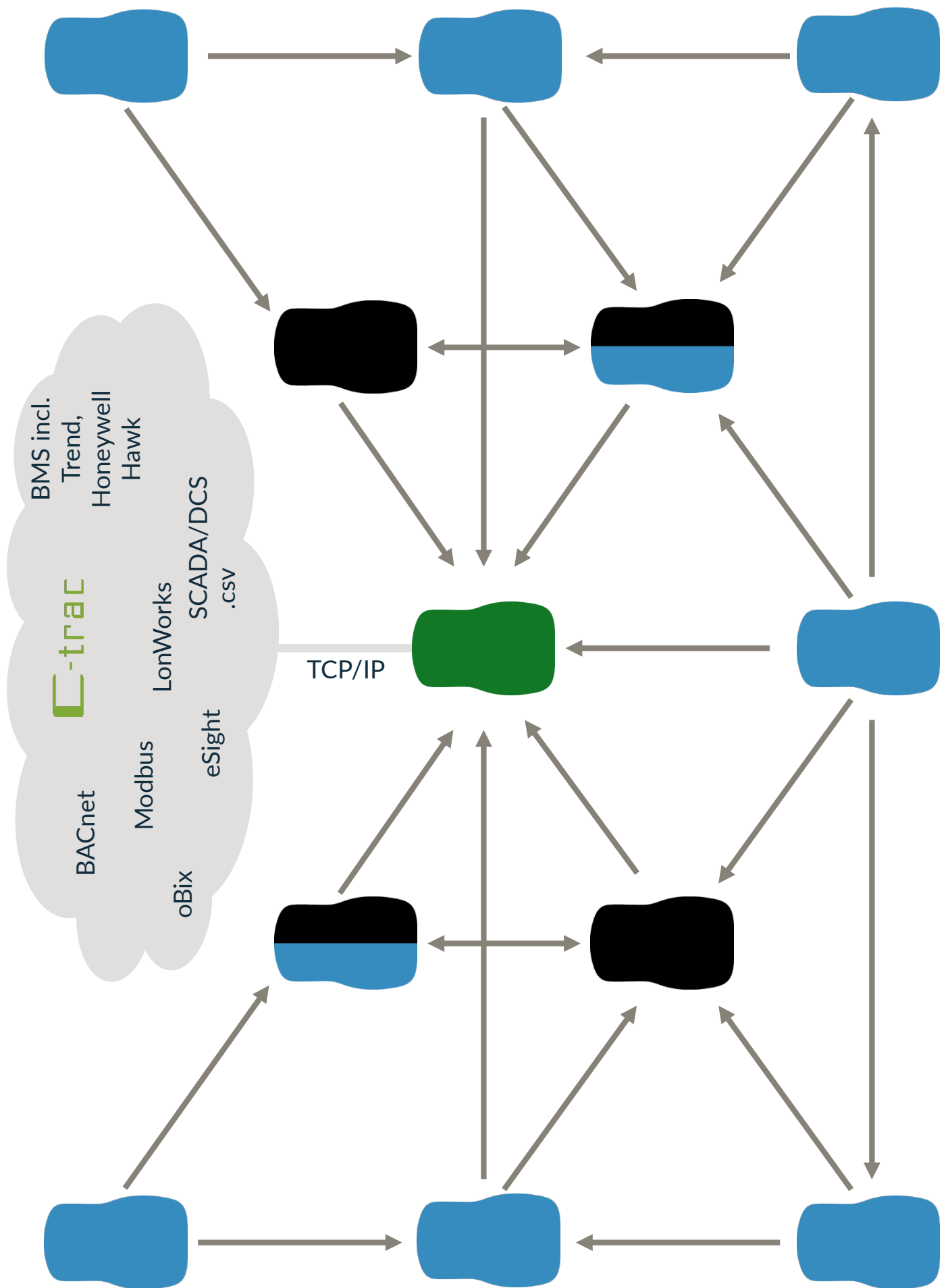
Enclosure Material (UL-94 1.5mm)	V-0
Enclosure Material (UL-94 2.0mm)	5VB
Enclosure Material (UL-94 3.0mm)	5VA
Resin (UL-94 6.0mm)	V-0

8. Network Examples

8.1 - Simple Network



8.2 - Network Including Repeaters and Node/Repeaters



Appendix A - Positioning to Maximise Range

A.1 - Signal Propagation and Penetration



Use this Appendix as a guide to maximising the range and efficiency by careful positioning of the **EnCompass** nodes and **Entranet** gateway/receiver.

Wireless data is transmitted via radio waves. As a radio wave propagates from transmitter to receiver its strength/magnitude/amplitude decreases proportionally to the inverse of the distance and its intensity decreases proportionally to the inverse of the distance squared. Therefore, for every doubling of the distance between transmitter and receiver, intensity reduces to a quarter and strength is halved, thus limiting the effective range.

$$A \propto \frac{1}{d} \quad I \propto \frac{1}{d^2}$$

Moreover, radio waves receive many losses in typical situations due to obstructions which reduce the effective range even further. The common solution is to increase power; however, using the latest technology to extend the range and improve the link budget, the **EnCompass** and **Entranet** have excellent penetration and range without the limitations of poor battery life.

A.2 - Typical Range-Reducing Obstructions



Position the signal path to avoid the following where possible:

- Reinforced Concrete.
- Steel Cladding.
- Thermal insulation with metallised foil.
- Treated Glass.
- Equipment prone to emit radio interference.
- High Power and overhead power lines.

TYPICAL MATERIAL DATA

	Description	Penetration
	Wood, Uncoated Glass, Gypsum	90 - 100%
	Brick, Pressboard	65 - 95%
	Reinforced Concrete (depending on the density or rebar)	10 - 90%
	Metal, Metal Coated Insulation	0 - 10%





TYPICAL RANGE DATA

	Description	Range
	Line of Sight	Up to 1000m
	Wood, Uncoated Glass, Gypsum (through 4 walls)	250m
	Brick, Pressboard (through 2 walls)	150m
	Reinforced Concrete (through 1 wall or ceiling)	100m
	Metal, Metal Coated Insulation (through 1 wall)	Up to 30m

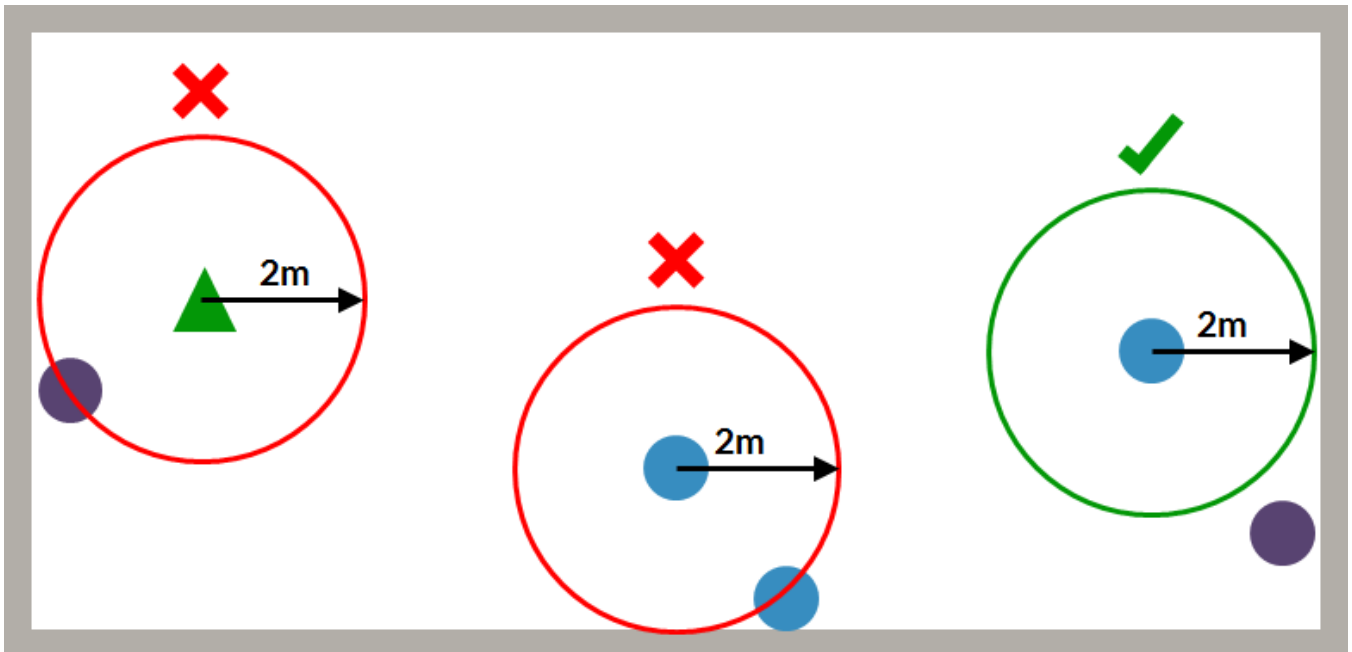
A.3 - Examples

Placement of the **Entranet** needs to be planned to ensure a system with maximum efficiency and effectiveness.

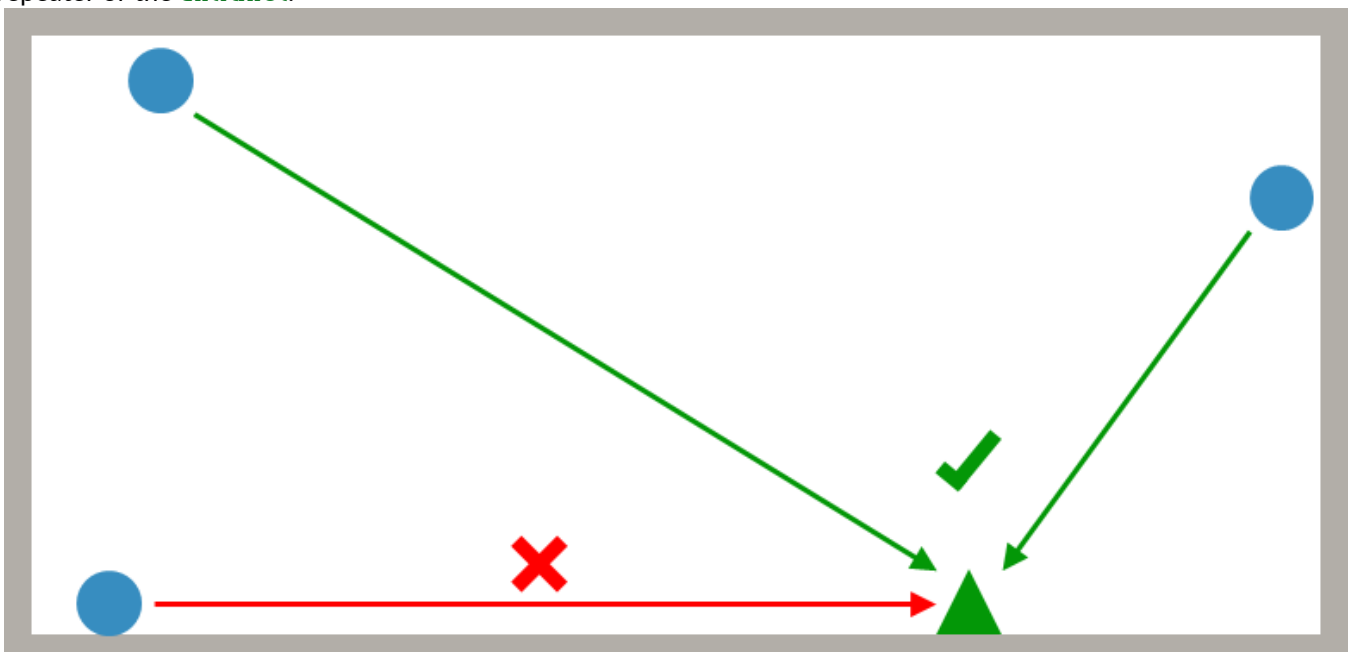
KEY:

-  **Entranet** receiver
-  **EnCompass** node
-  **EnCompass** node/repeater
-  Other transmitter

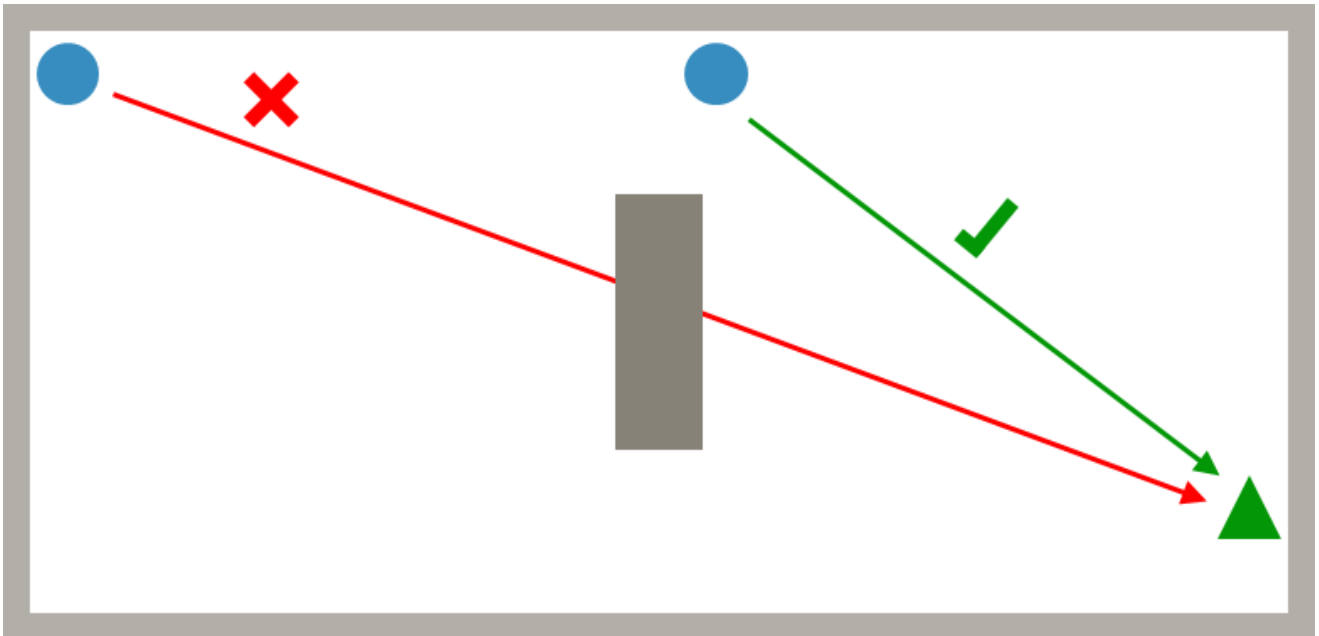
No **EnCompass** or **Entranet** must be less than 2 metres from each other or another transmitter.



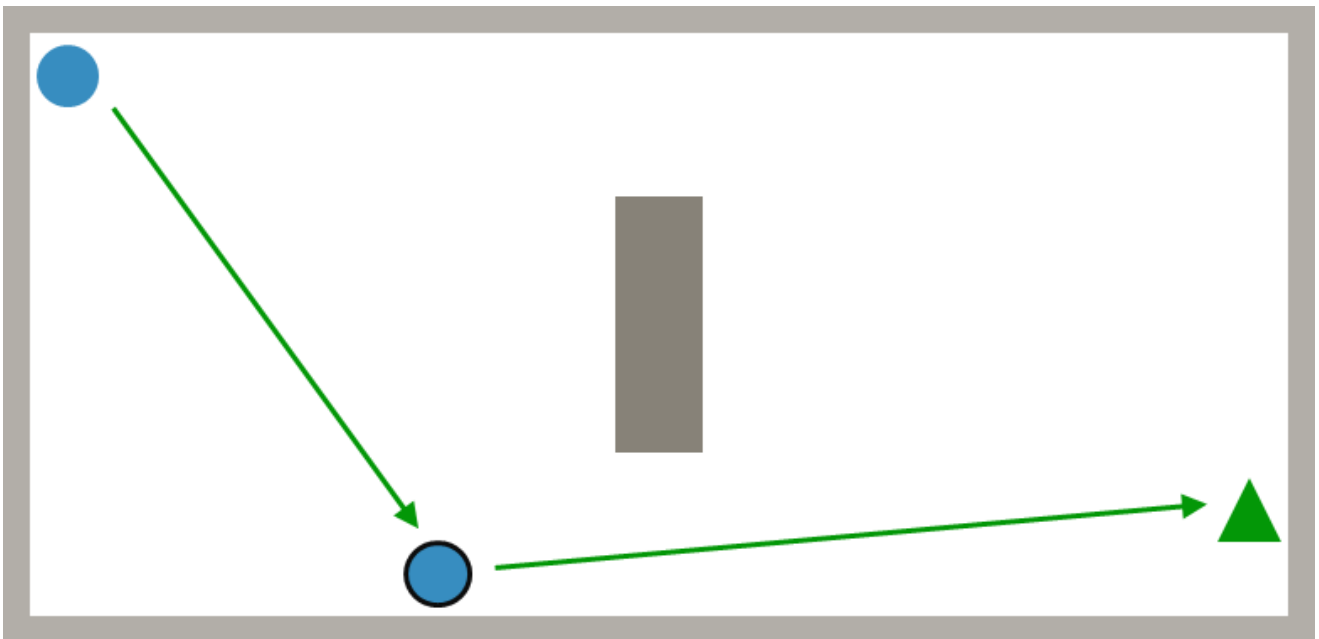
When mounting an **EnCompass** within the same internal vicinity as the **Entranet** or a repeater (with no obstructions), the **EnCompass** should be mounted on the opposite or adjacent wall, not on the same wall as a repeater or the **Entranet**.



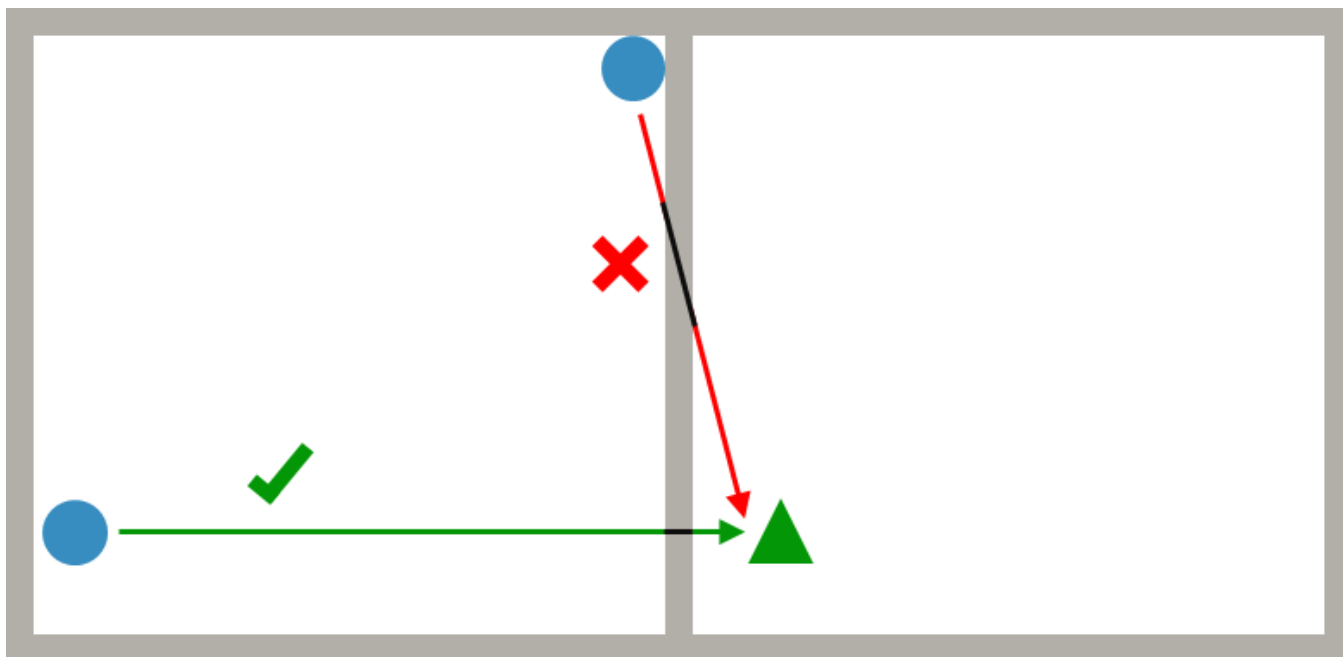
If possible, obstructions should be avoided.



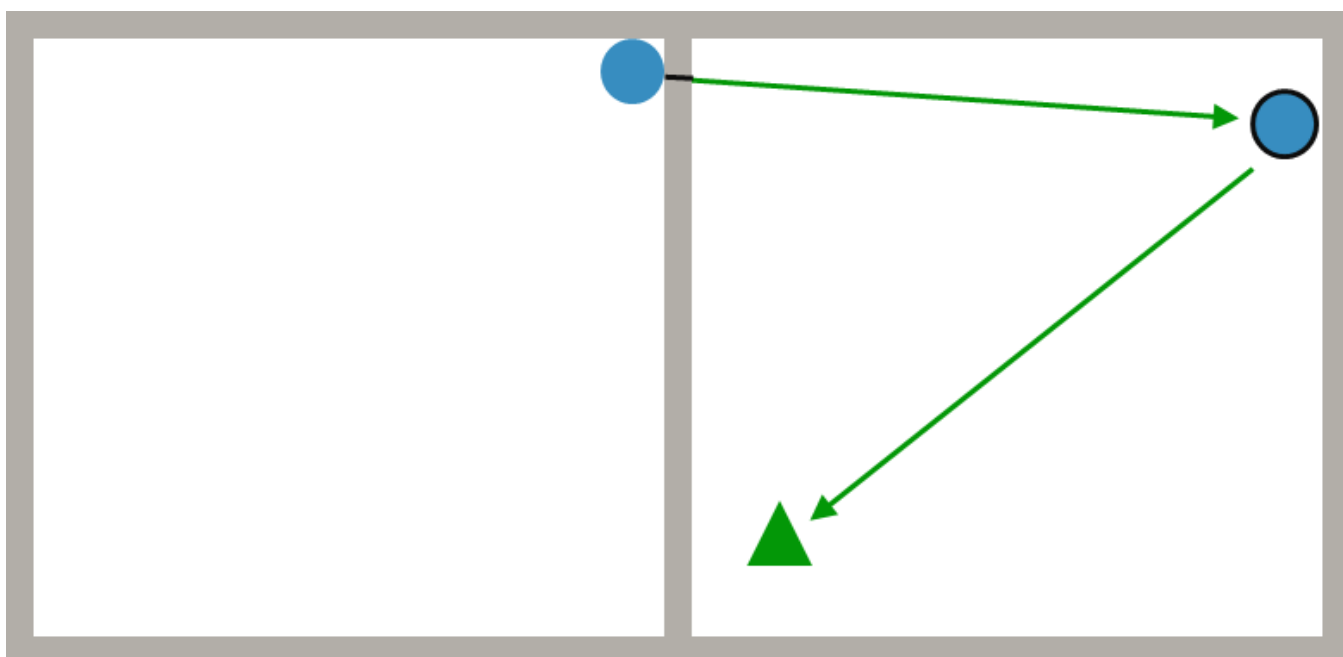
Repeaters can also be used to avoid obstacles, as well as to extend range.



To minimise signal losses when passing through an obstruction such as a wall, position **EnCompass** nodes and repeaters and **Entranet** gateway/receivers such that the signal passes through as close to 90° as possible, reducing the distance through it.



Alternatively, to avoid passing through a wall or other obstruction at a poor angle use a repeater.



Appendix B – Network Protocol Information

B.1 - Method Used for Optimal Repeater Efficiency

For every logged input a node has an opportunity to transmit its sampled values every 15 minutes, which it will do if the setting for reporting interval demands it to be sent, or if the buffer is approaching maximum capacity. A repeater operates by remembering when a node may wake up to perform transmission and ensuring that it wakes up momentarily beforehand in order to repeat the packets. Repeaters can be at one of two logical levels. Level 1 is a repeater that is within direct range of the **Entranet**, while Level 2 means the path to the **Entranet** is via a Level 1 repeater. Each repeater therefore stores a list of nodes for which it is repeating packets. Normally the repeater is completely powered down and waiting for the correct time to wake up for the next node transmission. At all times where possible, the repeater will completely power down when it can. For example, if a Level 2 repeater forwards a packet, then based on the packet size and the transmission bit-rate there is a physical minimum time at which a response can possibly arrive back. During this time the repeater will power down.

In order for a node to register itself with a repeater, it is necessary to communicate with it outside of a predetermined time window. To allow this, each repeater wakes up every 5 seconds and checks for 2 milliseconds for the presence of a preamble signal of alternating 1's and 0's. If this is detected the **Entranet** is left on until either a valid packet is received, or the preamble ends and no packet is received immediately afterwards. For a node to transmit a packet at any time to a repeater, it simply has to transmit preamble for 5 seconds followed immediately by the packet. This uses a large amount of power on the node, but is something that would not occur very often, possibly no more than once. The repeater can operate this way continuously even from battery due to the very low average power consumption this requires.

In Learn Mode (or when rerouting due to loss of communications), a node attempts to talk directly to the **Entranet** first. If this isn't possible then it attempts to register with a Level 1 repeater. Again, if this fails then it attempts to register with a Level 2 repeater. Once communications are established, the acknowledgement from the **Entranet** will have the list of repeater IDs inserted into it. The node then remembers this path (in reverse) and inserts this into the header of each packet it subsequently transmits in order to have the packet follow the learned route.

B.2 - Method Used for Mesh Routing

Each packet transmitted contains an optional 'required route'. This is a list of 24-bit serial numbers of all the repeaters that are required to pass the packet. Currently the list is two elements long, meaning that there can be at most two repeaters between any node and the **Entranet**.

If no repeaters are required, then all the addresses in the list should be set to 0. If only one is required, then the first element should be set to the required address and the remaining elements set to 0 and so on. The actual route address is used to record the route a packet has actually taken, rather than its desired route.

The process of automatically learning a route between a node and the **Entranet**, or of bypassing a faulty repeater, uses a combination of these tables along with the retry counter. When a node is first installed, it doesn't have any routing information and will always transmit the required and actual routes as zero. When the node sends a report, if the **Entranet** is within range it will send a response as normal. However, each time the node sends a report and doesn't receive a response, the retry counter is incremented. There is a maximum number of retries that will be attempted before the node gives up, which is programmable and would normally be 10.

Assuming the node and the **Entranet** are out of range, the node will transmit a packet and fail to hear any response. However, if there is a repeater in range then the repeater will monitor these packets and wait until the retry counter reaches 3. At that point it assumes that the node is unable to communicate with the **Entranet** and it should

therefore step in to assist. So, the repeater adds its own address into the unused actual route address and re-transmits the packet.

If the **Entranet** then receives this packet, it sees that the actual route taken was different to the required route. The **Entranet** then remembers that in order to send a packet to this node, it must send it via the repeater specified in the actual route list, but in reverse order.

The ACK packet will then be received back at the node, and upon inspection the node will see the route taken by the ACK and will remember the reverse pattern for next time. So, the next packet it sends will have the required route table set.

When a repeater receives a packet that has its own serial number in the required route table, it must repeat it, but only if it hasn't already repeated it before. So, if the repeater's own address appears in the actual route table then it does NOT repeat the packet. But, if its address does not appear then it adds its address to the actual route table and then retransmits it. This is done regardless of the retry count to ensure that packets following the required route are sent first time.

Appendix C – Additional Information

C.1 - Data Intervals and Storage

C.1.1 - Sampling Intervals

The data logs will acquire new values at regular intervals, according to which sampling rate is set. The options are:

- 10, 20, or 30 seconds
- 1, 2, 3, 5, 6, 10, 15, or 30 minutes
- 1, 2, 3 or 4 hours

C.1.2 - Storage and Capacity

Data on **EnCompass** 868 devices is temporarily stored on the device until wireless transmission to the **Entranet** takes place. Transmission occurs every 15 minutes, or less often if the reporting interval is changed from the default.

The limitations of the temporary storage on the **EnCompass** collector can affect higher frequency collection in the following ways:

- When more than 2 inputs are reporting, a sampling rate of 10 seconds is liable to cause a buffer overload, resulting in lost data.
- Likewise when more than 4 inputs are reporting, the same would be true of a sampling rate of 20 seconds.
- For sampling intervals over (and including) one minute, this issue is avoided, however many inputs are reporting.

The **Entranet** receives data from wireless nodes at 15 minute intervals, and data from Modbus registers according to the set sampling rates. The device is able to store data until its buffer of 32 million values is full, at which point new values will overwrite the oldest values. Here are some examples of how long this might take:

Total Number of Inputs/Registers	Sampling Interval (mins)	Duration that data is kept on Entranet
500	5	7 months +
1000	3	2 months
1500	1	2 weeks

C.2 - Required TCP or UDP Ports

 They may need to be unblocked by a firewall.

The following TCP or UDP ports will be required, if the specified functionality is used. Port numbers shown with an asterisk can be changed in the settings for that functionality.

Functionality	TCP Ports	UDP Ports
WAN, Inbound		
FTP of CSV files (unless passive mode)	20	
WAN, Outbound		
Internet Time (NTP)		123
Email of CSV files	25*	
FTP / SFTP of CSV files	21 or 22	
Automatic Firmware Upgrades	80 or 443	
Remote Access	80 or 443, 22	
LAN, Inbound		
All configuration pages	80	
Modbus TCP, gateway as Slave	1502*	
LAN, Outbound		
Local Time Server (NTP)		123
Modbus TCP, gateway as Master	502*	

C.3 – Resin Fill Information

A large part of the circuitry is resin potted. This provides structural and thermal stability to the internal workings of the node. The components are protected from any physical and most chemical risks. The resin also provides UV absorption.

Robnor Resins EL171H A semi rigid, room temperature curing, flame retardant polyurethane resin system.

DESCRIPTION

Basic	Two-component polyurethane system
Resin	RL171H
Hardener	HL171H
Application	Key Properties
Encapsulation of Transformers	Non-toxic
Cable Joints	UL94-V0 @ 6mm
Wide range of substrates	Excellent adhesion
Low to medium voltage electrical and electronic applications	High thermal conductivity
	Economical

PHYSICAL DATA (APPROX. VALUES)

Description	Resin	Hardener	Mixed
Colour	Black	Amber	Black
Colour	Beige	Amber	Beige
Specific Gravity	1.72	1.24	1.65
Viscosity (mPas) @ 25°C	19000	200	6000

CURE SCHEDULE (150ML SAMPLE)

Temperature	Working Life (minutes)	Gel Time (minutes)	Light Handling (hours)	Full Cure (hours)
RT (20-25°C)	20	40	24	48
60°C	-	-	2	4
80°C	-	-	1	2

TYPICAL PROPERTIES

	Test	Result	Unit
	Operating Temperature	-40 - +125	°C (application & geometry dependant)
	Flammability	6mm	UL94-V0
Peak Exotherm	(250g @ 20°C)	40	°C
	Shrinkage	0.5	%
	Volume Resistivity	12 ¹⁰	Ohm.cm
	Surface Resistivity	12 - 14 ¹⁰	Ohm.cm
	Dielectric Strength	16	kV/mm
	Permittivity (ε)	4.6	50Hz
	Loss Tangent (Tanδ)	0.04	50Hz
	Hardness	90	Shore A
	Heat Deflection Temperature	Flexible	
	Water Absorption (30 days @ 25°C)	0.54	%
	Thermal Conductivity	0.75	W/mK
	Coefficient of Linear Expansion	60 - 80	Ppm/°C
	Elongation at Break	~30	%
	Comparative Tracking Index	>600	v

APPROVALS

	RoHS Compliant	Yes
	UL94-V0	6mm
	REACH (SVHC Concentration)	0%