ENISCOPE®

Hybrid User Manual

[SWITCH ON TO EFFICIENCY]

best.energy

Table of Contents

Note: The word Eniscope throughout the document refers to the Eniscope Hybrid.

Important Safety Information

This manual may not be altered or reproduced in whole or in part by any means without the express written consent of Best Energy Saving Technology Ltd.

The information contained in this document is believed to be accurate at the time of publication, however, Best Energy Saving Technology Ltd assumes no responsibility for any errors which may appear here and reserves the right to make changes without notice.

Please read this manual carefully before installation, operation and maintenance of the Eniscope meter. The following symbols in this manual and on the Eniscope meter are used to provide warning of danger or risk during the installation and operation of the meters.

Electric Shock Symbol:
Carries information about procedures which must be followed to reduce the risk of electric shock and danger to personal health.

Safety Alert Symbol:
Carries information about circumstances which if not considered may result in injury or death.

Installation and maintenance of the Eniscope should only be performed by qualified, competent professionals who have received training and should have experience with high voltage and current devices.

Best Energy Saving Technology Ltd shall not be responsible or liable for any damages caused by improper installation.

Manufacturers Declaration of Conformity

This is to certify that the products described in this manual conform to the requirements of the following standards in respect of the low voltage directive, 2006/95/EC.

IEC/UL/EN61010-1, 3rd Edition
Safety requirements for electrical equipment for measurement, control, and laboratory use.

The products described in this manual conform to the requirements in respect of the EuropeanEMC directive, EN61326-1:2013.

Electrical equipment for measurement, control, and laboratory use.

Signed:

Troy Wrigley, CEO

Best.Energy
Southview House
St Austell Enterprise Park
Carclaze
St Austell
PL25 4EJ

Considerations When Installing the Eniscope Hybrid

Installation of the Eniscope must be performed by qualified personnel only, who follow standard safety precautions through the installation procedures. Those personnel should have appropriate training and experience of high voltage devices. Appropriate safety gloves, safety glasses and protective clothing are highly recommended.

During normal operation, dangerous voltage may appear on many parts of the Eniscope, including terminals, CT's (Current Transformers), PT's (Potential Transformers) and I/O (Inputs and Outputs) modules. All primary and secondary circuits can produce lethal voltages and currents. AVOID contact with any current-carrying surfaces.

The Eniscope and its I/O output channels are NOT designed as primary protection devices and shall NOT be used as primary circuit protection or in an energy-limiting capacity. The Eniscope and its I/O output channels can only be used as secondary protection. AVOID using under situations where failure of the Eniscope may cause injury or death. AVOID using the Eniscope for any application where risk of fire may occur.

All terminals should be inaccessible after installation. All wiring to auxiliary supply, voltage sensing inputs, CT inputs and any conduction paths must be inaccessible after installation. This should be achieved by enclosing the wiring in conduit, or by installing the entire unit in an inaccessible enclosure.

Do NOT perform Dielectric (HIPOT) test to any inputs, outputs or communication terminals. High voltage testing may damage electronic components of the Eniscope.
Applying more than the maximum voltage to the Eniscope and/or its modules will permanently damage the Eniscope and/or its modules. Please refer to the specifications for all devices before applying voltages.

IMPORTANT

Note: if the equipment is used in a manner not specified by the Manufacturer, the protection provided by the equipment may be impaired.

Note: There are no serviceable parts within the equipment. The equipment must be returned to the manufacturer for servicing.

Eniscope Hybrid Description

Eniscope Hybrid is a multi-channel, three phase energy meter and sensing system combined with a processing facility designed to gather, summarize, store and transmit energy related information to Web based servers for presentation and analysis.

The Eniscope offers the world's first truly integrated ecosystem for energy monitoring and efficiency, identifying waste and eliminating costs.

The best in class energy metering system combines up to 8 three-phase metering points and up to 8 pulse inputs, which can be arranged to monitor total gas and water consumption.

The compact, plug and play system can be easily installed by an electrician, instantly providing real-time data on energy consumption patterns by individual piece of equipment, circuit, building or property portfolio.

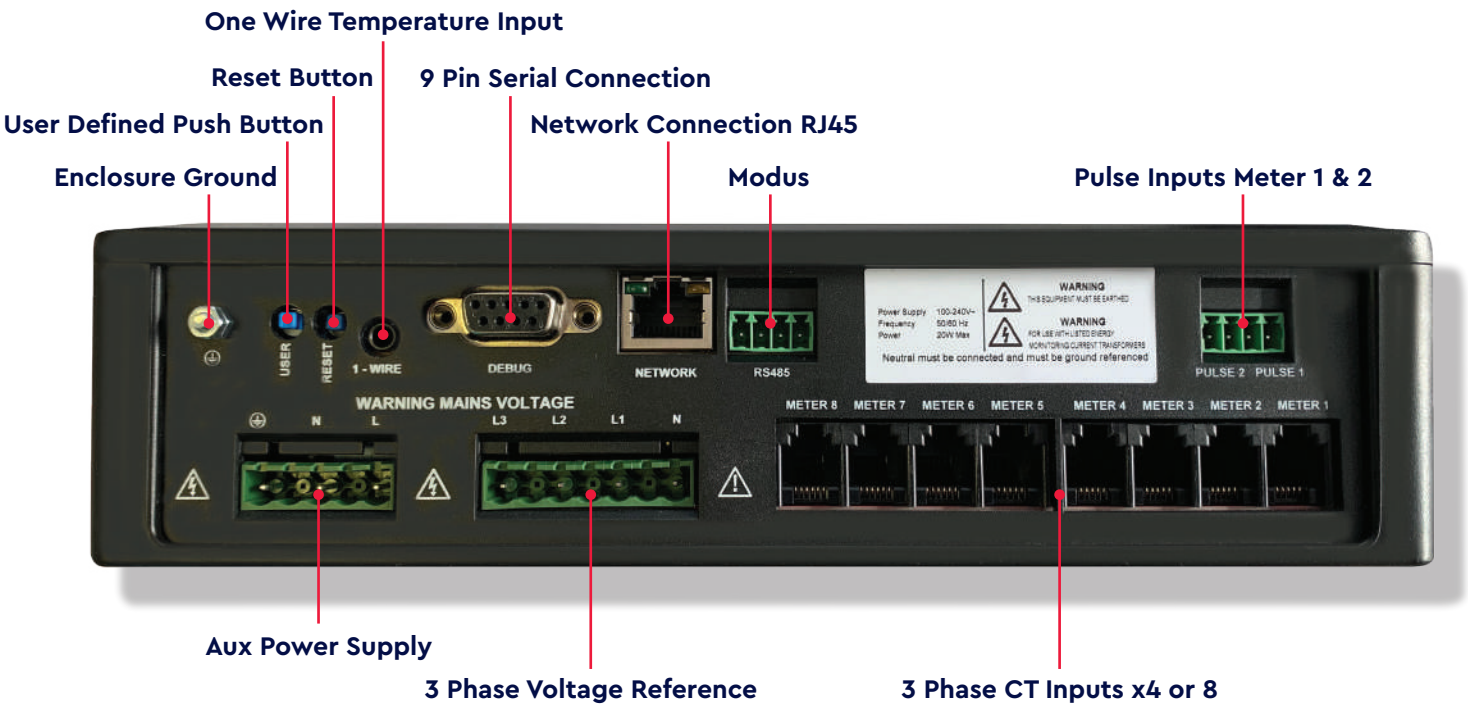
For those generating their own power, the Eniscope records minute-by-minute data. Information can be displayed to building occupants, or included on websites, via an attractive range of public displays.

Data can be viewed in real-time on any computer, or across a range of portable devices from anywhere in the world. Historical data can be accessed and analysed, at one-minute resolution via the Best.Energy Analytics system.

The Eniscope has been engineered to allow continuous, remote improvements and upgrades via the cloud, making this the world's most durable and future proof solution to energy monitoring and efficiency.

Contact your Best.Energy Distributor today to learn how your organisation can benefit from advanced real-time energy management.

Eniscope Hybrid Identification

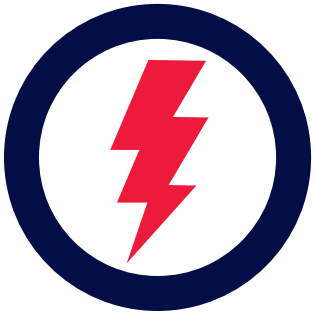


INSTALLATION

Please follow the ‘First Installation Guide’ under ‘Eniscope > Eniscope Hybrid (2018)’ headings at the support desk, for full guide before any installation.

http://help.bestsupportdesk.com/

SAFETY AT WORK



The owner, installer and user of this Eniscope measurement device are responsible for its correct installation and use, and must ensure that;

A **Only qualified persons install the unit.**

B **Isolate AC equipment before installation.**

C **The installation complies with the information contained in this publication.**

D **All units must be installed in accordance with the current National Electrical Code.**

Best.Energy or their agents do not assume any liability, expressed or implied, for any consequences resulting from inappropriate, negligent or incorrect installation, application, use or adjustment of this device.

A Mounting the Eniscope

Environmental

There are no specific ventilation requirements however, please check the environment, temperature and humidity to ensure the Eniscope is within the correct operating conditions. Also before you begin to mount the Eniscope ensure that there is nothing that will hinder or restrict the multiple ports on the bottom and left hand side.

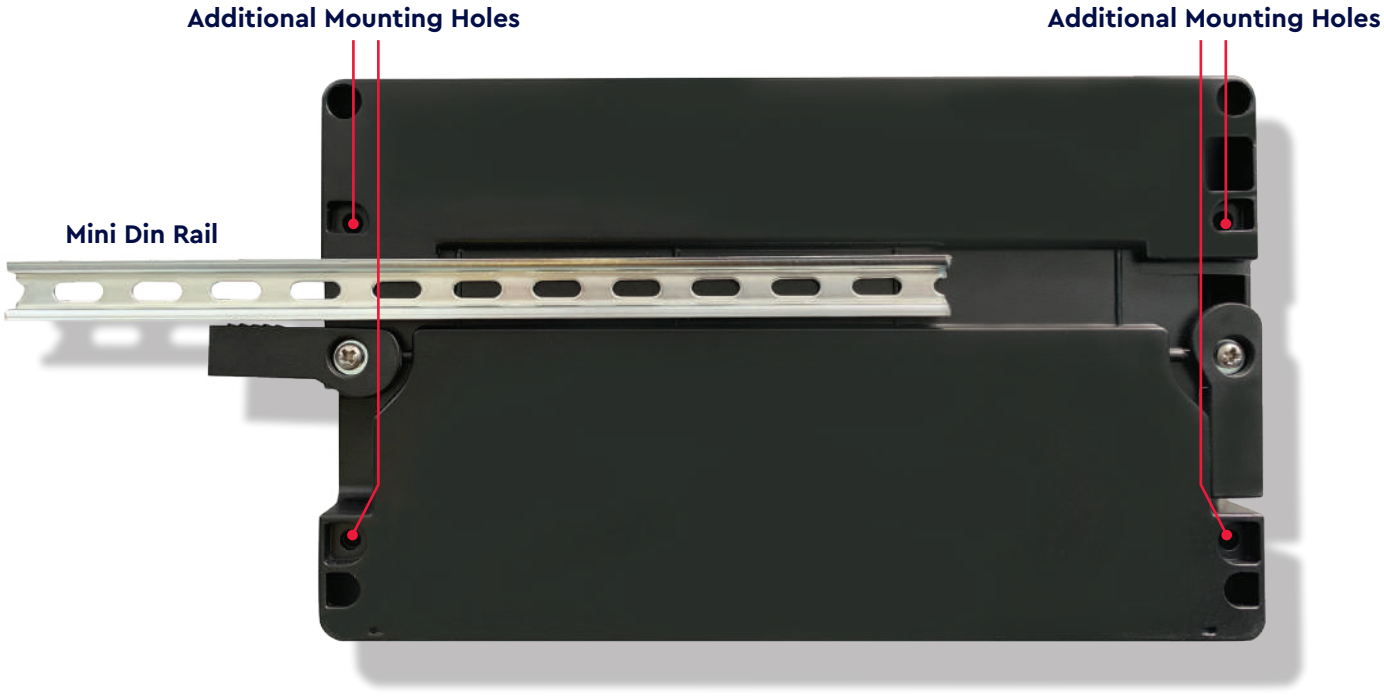
The Eniscope is Type 1, for indoor use only.

The Eniscope is designed to be mounted on a vertical surface within an electrical cabinet or wall mount, using the Eniscope Gland Box or suitably mounted trunking for incoming cables. Eniscope can be mounted using the corner mounting holes or the mini din rail provided.

There is a mounting hole template provided for both the Eniscope and the Gland Box.

Dimensions:

Height	**144mm**
Width	**236mm**
Depth	**60mm**
Weight	**0.80kg**



B The Auxiliary Supply

The Eniscope requires an Aux power supply to energise the processor and metering elements. The typical power consumption is very low (20W) and can be supplied by an independent source (or by the measured voltage line). A regulator or an uninterrupted power supply (UPS) must be used under high voltage fluctuation conditions or frequent power failures (1 per day).

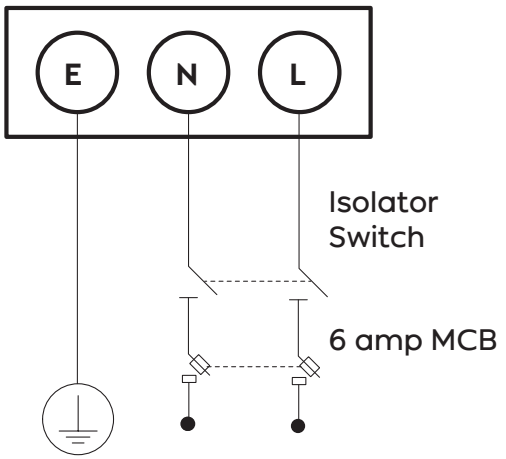
Please ensure an Isolator (disconnect) switch is installed no more than 1 meter from the Eniscope and within easy reach of the operator, and shall be clearly labelled as the disconnecting/isolating device for the equipment. A suitably rated MCB supply must be included in the installation.

Aux supply requirements:

- **100 to 240 V~ Nominal, Over Voltage Category II**
- **50 /60 Hz Nominal**
- **6 amp double pole MCB 'B' trip curve to IEC 60898 should be used on the auxiliary supply. A similar specified RCD/ELCB device can also be used.**
- **Alternatively 6 amp medium time delay fuses can be used.**

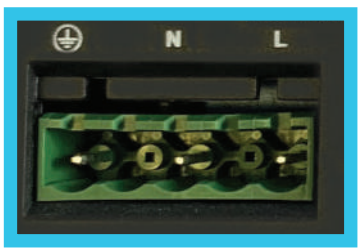
Cable Requirements

- **Conductor AWG:18 AWG, NFPA70 "National Electrical Code"**
- **Voltage Rating: 600 V~**
- **Conductor Area CSA: 1 mm2 Min**
- **Conductor Material: Copper**
- **Operating Temperature -20°C to +105°C**
- **Flame Rating VW-1**



Note: 100 to 240 V~ Nominal. This is lower than can be sensed, be sure the maximum 260V is not exceeded.

Instructions: Connect the AUX supply to the Eniscope, as shown in the wiring diagram.



i) Voltage Sensing Installation

To provide all of the required electrical parameters, the Eniscope Hybrid needs to monitor your Voltage and Current supply. This section should be closely followed and the previous safety page should be read before proceeding.

Voltage Input

Maximum sensing input voltage for the Eniscope Meter shall not exceed 346LN/600LL V~ rms for three phase or 346LN V~ rms for single phase.

A Neutral must be connected and should be ground referenced (PME). There shouldn't be a voltage difference between Neutral and Earth.

Cable Requirements

- Conductor AWG: 18 AWG, NFPA70 " National Electrical Code"
- Voltage Rating: 600 V~
- Conductor Area CSA: 1 mm2
- Conductor Material: Copper
- Operating Temperature -20°C to +105°C
- Flame Rating VW-1

6 amp MCB

A 6 amp triple pole MCB ''B' trip curve to IE C 60898 should be used on the voltage measurement input terminals. A similar specified RCD/ELCB device can also be used.

Instructions

1. **Identify a Distribution board that can supply a three phase (or Single) reference supply via a MCB.**
2. **Remove the protective cover to expose the Voltage sensing connections on the Eniscope.**
3. **Connect the voltage reference cables to the connectors using the correct wiring configuration, as shown on next page (Single Phase, Single Phase Two Wire or Three phase).**

Isolator – Disconnect Switch

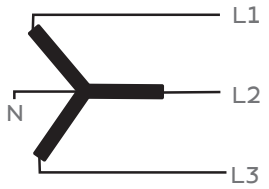
A 16 amp four-pole Isolator/Disconnect switch rated at a minimum of 600V~ must be included in the installation. The switch needs to be in close proximity to the equipment and within easy reach of the operator. The switch must be marked as the disconnecting device for the equipment.

Neutral Generator

For Eniscope to function correctly a neutral conductor needs to be connected to the voltage sensing circuit on the Eniscope. In some territories, primarily the United States of America, some supply systems for historical reasons have no neutral conductor. See Figures 1, 2, 3, 4 and 5 below. In order for Eniscope to measure such systems we must create a neutral reference conductor using the Best.Energy supplied neutral generator.

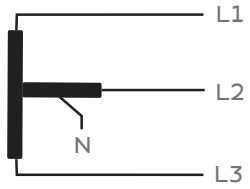
Note: In Delta system ensure, Neutral-line voltage does not exceed the maximum voltage limit.

Figure 1



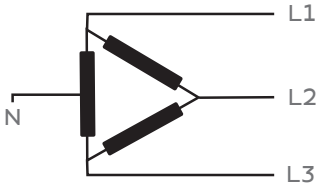
For Star or Wye connection with the star point grounded.

Figure 2



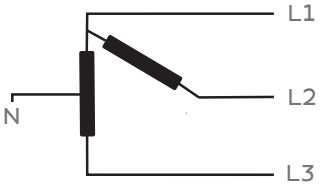
Tee connection with phase mid point grounded.

Figure 3



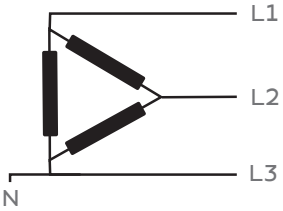
Delta connection with phase mid point grounded. (High Leg Delta)

Figure 4



Open Delta connection with phase mid point grounded.

Figure 5



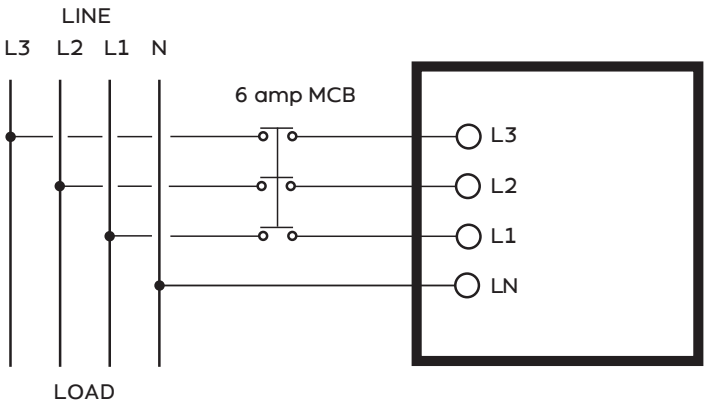
Delta connection with one phase grounded. (Corner Delta)

Best.Energy Neutral Generator

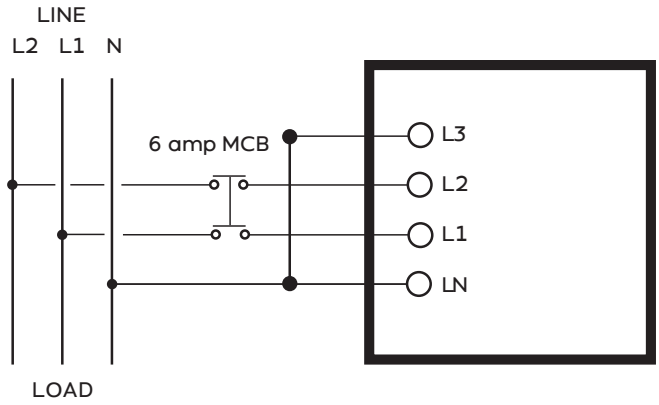
In territories where no neutral is available Best.Energy can supply a neutral generator module which ban be mounted inside the Best.Energy supplied gland box or within the same enclosure as the Eniscope. Contact Best.Energy for installation and wiring details.

Voltage Sensing Configurations

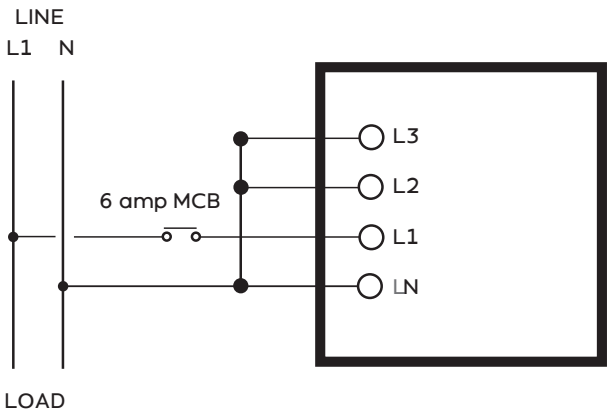
Three Phase Connection (3LN)
3-Phase 4-Line (Most common connection)



Single Phase Connection (2LN)
3-Line (mainly used North America)



Single Phase Connection (LN)
2-Line



Note: Multiple Single Phase Circuit Monitoring (2-Line Only)

On 2-Line systems, up to 3 CTs can be fitted to one Eniscope 3-phase CT Input connector. Potentially allowing you to monitor up to twenty four 2-Line Single Phase Inputs.

For this configuration L2 and L3 must be connected to L1 instead of LN (to be given a voltage reference).

ii CT Installation

Current Transformer Installation Overview

A current transformer (CT) produces a voltage output signal directly proportional to the current flowing in the conductor around which it is positioned. The output signal from the CT is sent to the meter and the current flow in the primary circuit calculated. A CT is required for each phase.

- **Only CT's listed by the manufacturer should be used. Under NO CIRCUMSTANCES use any other type of CT as severe damage or injury may result.**

- Current transformers are marked with the ratio between the maximum primary current and the maximum secondary signal. For example a 200 A:333 mV CT produces a 333 mV output signal when the maximum rated 200 A is flowing through the primary.

- It is best to match the CT primary as closely as possible to the maximum expected current to get the best accuracy. This is because CT's are less accurate at low loads than they are at full load.

- If using a 200 A CT you will need to input a figure of 200 into the Eniscope meter settings menu. Information on how to complete this, can be found in the commissioning section, under meter setup.

Polarity

- CT's are direction sensitive and must be fitted the correct way around. CT's are marked with an arrow on the body to indicate which direction they should face around the cable or buss-bar. The arrow must point towards the load or in the direction of normal power flow.

- The CT outputs must be connected to the meter the correct way round, otherwise the meter will not register correctly (i.e. negative readings). Current transformers are supplied with secondary leads black and white in colour which must be connected to the correct terminals on RJ12 adaptor.

- The CT's must be connected to the correct phase inputs on the meter. The meter will not register correctly if the CT for L1 is connected to the inputs for L3 current, for example.

- Unused CT inputs should be shorted together to avoid spurious readings.

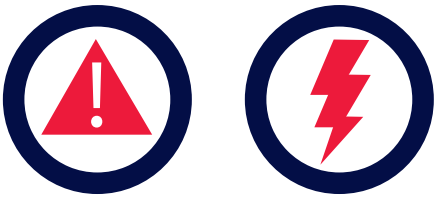
Please follow the instructions on the next pages for a successful installation

Caution, risk of electric shock

Ignoring this warning can lead to serious injury or death.

Only listed CT types should be used with the equipment. Failure to adhere to this requirement will invalidate the warranty.

Please check the Support Desk Current Transformers section, regarding range of available CT sizes and ratings:
http://help.bestsupportdesk.com



At the time of printing, the CT range includes:

25mm Aperture 30 Amp
CT/BCF30/30A/25

25mm Aperture 60 Amp
CT/BCF60/60A/25

25mm Aperture 120 Amp
CT/BCF120/120A/25

25mm Aperture 300 Amp
CT/BCF300/300A/25

50 x 50mm Aperture 500 Amp
BCT/4LSF500A/50/50

50 x 88mm Aperture 1000 Amp
BCT/4LSF1000A/50/88

63 x 100mm Aperture 2000 Amp
BCT/4LSF2000A/63/100

63 x 138mm Aperture 3000 Amp
BCT/4LSF3000A/63/138

75 x 175mm Aperture 4000 Amp
BCT/4LSF4000A/75/175

75 x 225mm Aperture 6000 Amp
BCT/4LSF6000A/75/225

Installation Instructions for Current Transformers

Important Safety Information

Caution, risk of electric shock

Important Safety Information Warning

Read all documentation prior to service or installation

Important: Must be certified to UL2808, XOBA for field installation.

Only to be installed in a ambient temperatures between -40C and +55C. Maximum altitude 2000 meters.

1. **The recommended current transformer types are intended for field installation within distribution and control equipment to measure electrical current.**

2. **Always disconnect the circuit from the power distribution system before service or installation.**

3. **Do not install the current transformers in an area blocking ventilation or in an area of breaker arc venting.**

4. **These current transformers are not suit able for Class II wiring methods or connecting to Class II equipment.**

5. **Do not allow the current transformer or cables to come into direct contact with live terminals or buss that exceeds voltages of 600V~.**

6. **The CT may not be installed in equipment where they exceed 75% of the wiring space of any cross-sectional area within the equipment.**

Method of Installation

1. Locate and isolate power to distribution panel where installation is to take place.

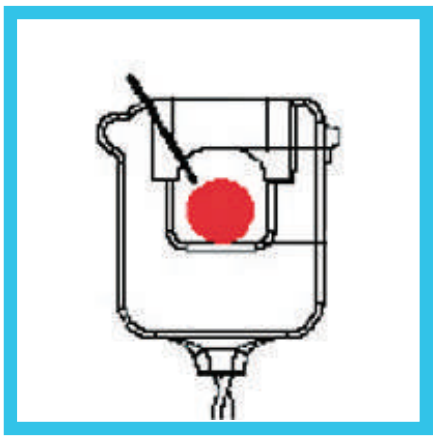
2. Identify the single conductor wire to be monitored and direction of flow/load.

3. Attach the current transformer around the conductor to be monitored without placing excessive strain or pressure. Do not route the leads over sharp edges and take care to fit the CT with the arrow in direction of flow/load.

Notes: If you placed the wire in the wrong terminal, gently press plastic clip with a screwdriver to release (as seen in picture above).

If the Analytics platform shows a negative kW trace, either reverse the black and white leads or reverse the direction of current flow through the CT's.

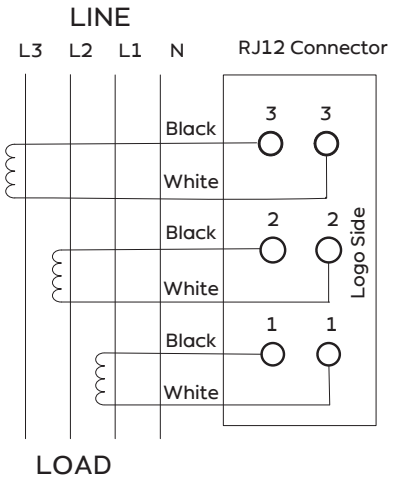
4. For greater accuracy of measurement it is advisable to cable tie the conductor to the CT body so the conductor passes through the centre of the CT.



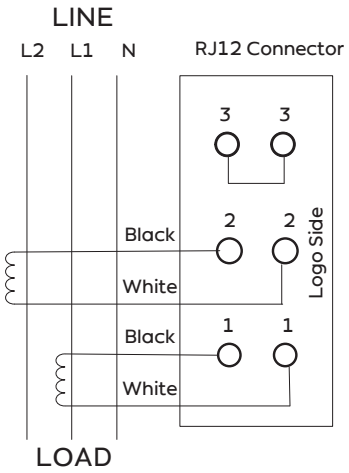
5. Repeat steps 2 to 4 for the other phases to be measured.

6. Now push the CT secondary leads into the RJ12 adaptor terminals for your phase type as shown on the next page. The white cable of each CT connects to either terminals 1, 2 and 3 of the side showing the Best.Energy logo. The corresponding black cable of each CT connects to terminal of same number on the opposite side of the terminal block.

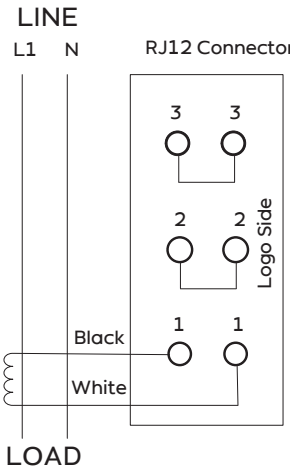
Three Phase



Two Phase



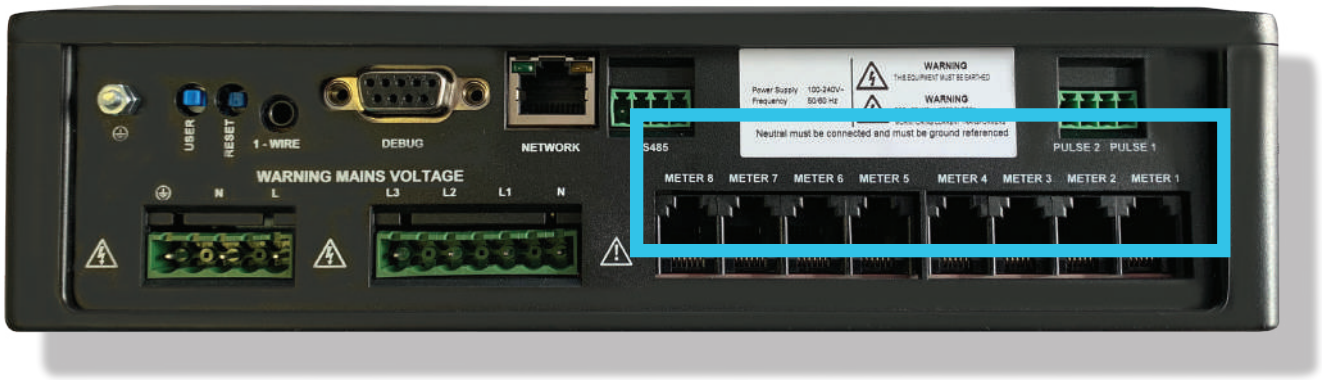
Single Phase



Note: Multiple Single Phase Circuit Monitoring (2-Line Only).

On 2-Line systems, up to 3 CTs can be fitted to one Eniscope 3-phase CT Input connector. Potentially allowing you to monitor up to twenty four 2-Line Single Phase Inputs.

For this configuration, fit the second CT to terminals 2 and the third CT to terminals 3 and in meter setup select 3 phase type.



Method of Installation

7. Once all the required CT's have been connected to the RJ12 adaptor, plug the RJ12 into the correct CT point on the Eniscope.

8. You can now turn the power on to the distribution panel.

Notes: If you need to extend the CT lead this can be done up to 10 meters using a 600V 1mm2 18 AWG, single core wire to VW-1 fame rating. Route CT cables away from mains voltage current carrying cables.

You have now completed the Electricity monitoring section. Please review the commissioning section to ensure the Real-time display and Analytics is receiving the recorded data.

D Pulse Inputs

The pulse inputs are designed to interface the pulse outputs of existing mechanical gas and water meters to the Eniscope. These types of pulse outputs are usually mechanically generated using switches that periodically connect the two contacts together. They are commonly called 'dry' contacts as they do not have any voltage or current on them.

Only non-powered circuits should be connected. Typical input would be from the reed-relay switch (pulse output) of a water meter conforming to IEC62053-31 or DIN43864 (S0).

So that the Eniscope can 'read' the pulse it supplies a very small, current limited, to the pulse input, and via the wiring to the pulse output of the water/gas meter. This is called 'wetting' the contacts. When the 'pulse' is present, this voltage is 'sunk' by pulse source. To prevent 'contact bounce' and hence multiple spurious counts, short pulses are ignored.

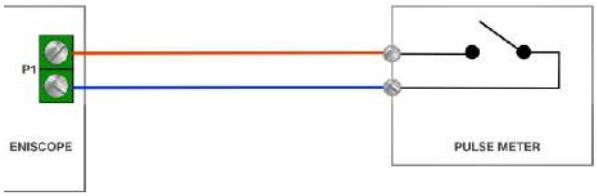
Operating Parameters

Typical open circuit voltage 4.6 V
Typical short circuit current 1.1 mA

To register a pulse the following must be met during the pulse:

- **Maximum short circuit resistance 3k ohms •**
- **Minimum pulse duration 100 ms**
- **Maximum pulse duration indefinite**
- **Max distance 100m**

Notes: The Modbus and Pulse inputs share a common floating isolated 5V bias supply. If required by local regulation, they can be connected to local ground via the common pins on the Modbus connectors. The isolation provided is for ground loop breaking only. Do not assume elevated voltage isolation.



Important

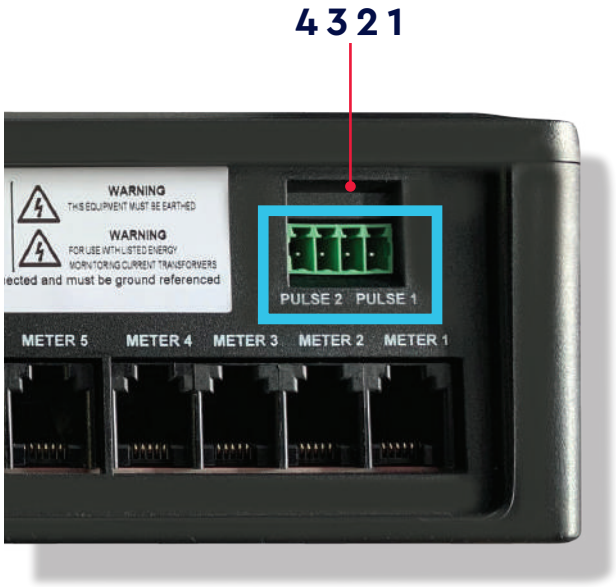
1. Pulse inputs must only be connected to galvanically isolated, voltage free pulse outputs.

2. All pulse inputs (and the modbus) share a common 0V connection and a common 5V bias supply. The supply is isolated from ground/earth and all other inputs. Be careful when connecting to multiple pulse sources from multiple locations. Additional protection or isolation may be required by some Authorities - please consult a competent local expert.

3. To ensure reliable operation over long wired connections and in noisy environments, the short circuit resistance should be as low as possible and ideally less than 100 ohms.

4. For pulse outputs that are polarity sensitive (eg open collector pulse sources), the left hand input is positive and the right hand input negative. Please note the minimum pulse duration.

Setting up the Pulse input

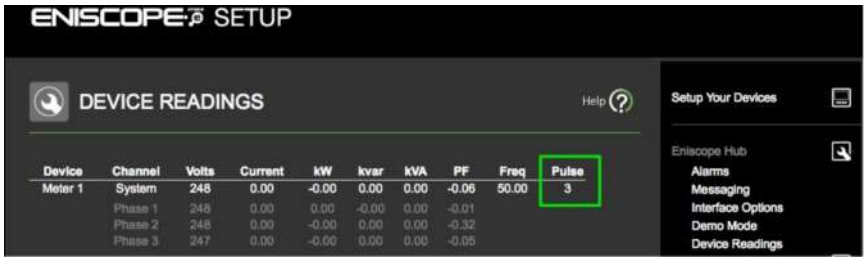


Please ensure you consult and comply with local regulations before connecting any pulse inputs and that your meter output dry contacts, meet the requirements on previous page.

Wire your meter outputs to the Eniscope's pulse input connectors, the Inputs are in Pairs (i.e. Two Pulse inputs per 4-way connector).

Pin 1 and 2 = Pulse Input 1
Pin 3 and 4 = Pulse Input 2

Each Pulse input is linked to a Meter and you must have the corresponding Meter Enabled and operational, to ensure data uploads to the server. You can also set up a meter under 'Setup Your Devices' for a CT input that has no physical CTs connected, by just setting dummy values (CT value =1, 3 phase type, etc).



Note: You can test if the Eniscope receives Input Pulses by wiring in a mechanical push switch.

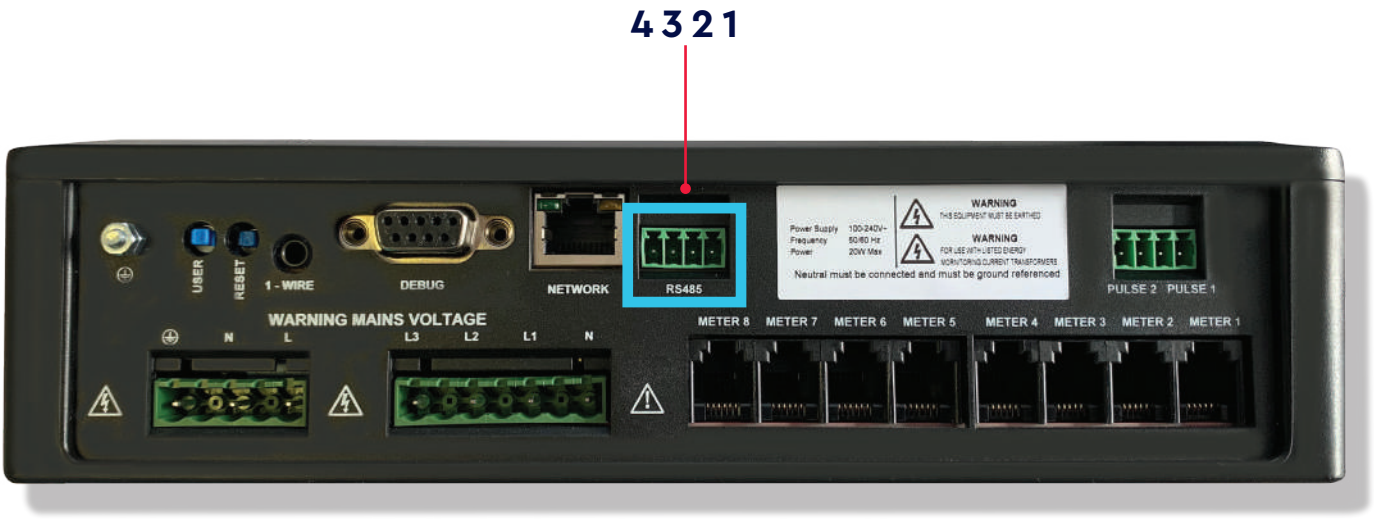
So 'pulse input 1' counted pulses will appear at the end of the Meter assigned with 'CT 1 input' (Meter 1 in Setup your devices). "Pulse input 2 is linked with CT 2 input".

Your next step is to set up your Pulse Meter at http://admin.eniscope.com. But please fully complete the installation and commissioning sections in this manual (including activation and Analytics setup) for your regular CT based meters first. Once the rest of your Eniscope system is fully setup, follow the 'Setting up the Pulse input' instructions at the support desk under Eniscope section.
http://help.bestsupportdesk.com/

(RS485 Serial Connection)

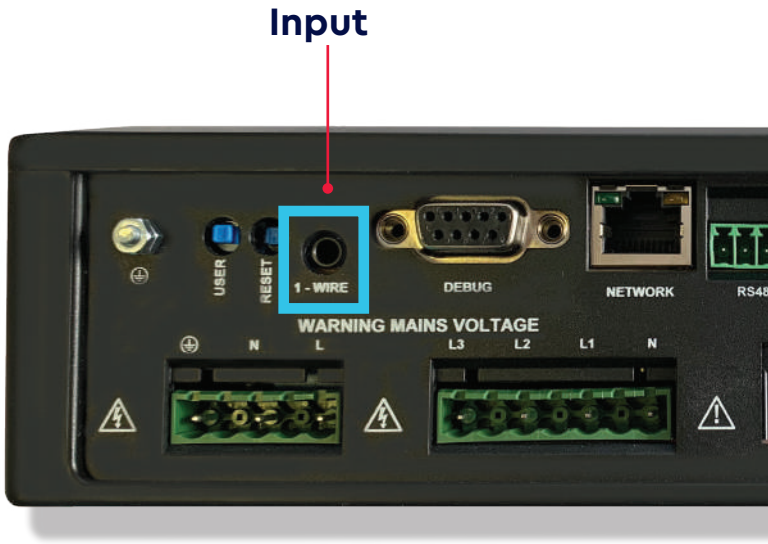
These inputs will provide for separate RS485 connections to control and monitor other meters or load-side products.

If you require the RS485 connection, please contact us via the Support Desk.
http://help.bestsupportdesk.com



F Temperature Sensing 1 Wire Input

(3.5mm Stereo Jack)



Temperature Probes

Temperature probes are connected to the Eniscope via the 1 wire 3.5mm stereo jack socket. Temperature probes can be obtained from Best.Energy. They come as a complete unit with a metal clad water-proof sensor wired to a standard 3.5mm stereo plug.

For a single temperature sensor, simply plug your temperature probe into this socket. After a few seconds the Ensicope will recognise the temperature probes presence and you will be able to add it to a metering point.

For multiple temperature sensing, the probes can be daisy-chained. The easiest way to accomplish this is to use a standard 3.5mm stereo jack socket doublers (picture above and to the right). These can be purchased from us, or you can easily source them from your local electronics outlet. Simply plug the doubler into the 1 Wire socket on the Eniscope to give you two sockets. This can be repeated as Eniscope supports up to 8 sensors.

The leads may be extended using standard 3.5mm stereo jack extender cables, again purchased from us or you can easily source them from your local electronics outlet. These come in various lengths, so choose one that meets your needs.

Configuration

As each temperature probe is connected it will be recognised by the Eniscope. Each sensor has a unique identification number. To add a specific temperature sensor to a metering point, go into the Eniscope Device Configuration and select the probe you want from the list presented (under Temperature sensor heading).

To avoid confusion with multiple sensors, connect the first sensor physically, configure the meter via the software, then add the next sensor physically and repeat. This way as each new probe is added, it will appear as a newly available temperature sensor to add in the metering point. If necessary mark each probe with an identification number so you can find it in the future.

Accuracy and Temperature Ratings

The temperature probes have the following accuracy.

-10°C to +85°C **+/- 0.5°C**

-55°C to +125°C **+/- 2°C**

Distance

The temperature probes will work over significant distances without loss of accuracy. However the limit is very dependant on the quality of wiring, the number of sensors, the proximity to electrical wiring and other noise sources. We would recommend that the total network length is limited to 20 meters, however you may be able to accomplish longer distances if the wires are run separately.

Note: Care should be taken to use the correct cable/connector combination for the intended temperature range. Standard temperature probes and cable kits supplied by Best.Energy are rated for use in temperatures between -10°C to +50°C, -55°C to +125°C temperature probe and cable kits are manufactured to order.

SD CARD PORT

An SD card slot is provided for data retention during power failure or loss of connection to the server. After a brief connection or power loss the Eniscope will automatically upload the stored data once reestablished.

Currently an 8GB card is supplied, allowing up to 90 days maximum storage as standard, please do not remove or replace the SD card without consulting the support desk first. The SD card holder is a push-push type. Care should be exercised when inserting the card to ensure it is inserted correctly.

If the card is not inserted correctly, measurement data may be lost if the unit is de-powered or a power failure occurs. The card shall be inserted during the installation and before mains power is connected. Removing or inserting while the unit is powered up is not recommended.

Please ensure the SD card is fully inserted before the Eniscope is powered. Failure to do this will prevent Eniscope from backing up data in the event of a power failure.

USB PORTS

Two USB connections are provided for product expansion, such as powering 4G/3G Modem option. If you require more information on the USB ports, please contact us via the Support Desk.

http://help.bestsupportdesk.com

Please do not plug any unauthorised device into the USB ports, as this could cause damage to the Eniscope. The USBs can only supply 500mA MAX at 5v.

COMMISSIONING

A Connecting to the Network

How does the Eniscope Hybrid work?

You will be required to connect the Eniscope to the Local Area Network (LAN) with Internet access. Otherwise there is an option to connect via Mobile 3G/4G router, go to Eniscope Networking section at the support desk for more information.

http://help.bestsupportdesk.com

The Eniscope is a small networked computer designed to collate data from various metering points and display the results locally via a web browser along with transmitting data via HTTP, to enable historical data to be viewed externally via our Analytics website.

Liasing with the client's IT Department will be vital, to ensure a smooth installation.

The Eniscope can operate on a DHCP network or can have a fixed IP. If DHCP is selected and a DHCP server cannot be found, the Eniscope will revert to a default fixed address of 192.168.1.227.

In most cases, as long as you have the correct Network Settings entered into the Eniscope, it will register on the network successfully. However, in some larger networks you may find that they have a more locked down network structure. In these cases ask a network professional, who may need to know the URLs and outgoing ports that are accessed and this information is contained below.

Outbound access to transfer data using http (Port 80) and https (Port 443)
*.eniscope.com

Currently the sub domains are:

hub.eniscope.com	(hub Data Uploads)
aus.eniscope.com	(Software Updates)
checkin.eniscope.com	(Daily Diagnostics)
upload.eniscope.com	(New Hybrid Data Uploads)
analytics.eniscope.com	(Activation)

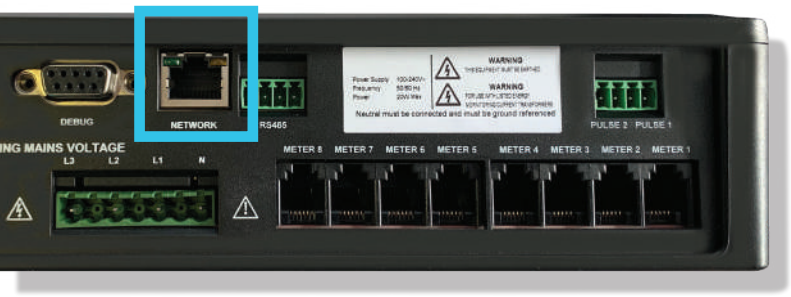
Outbound access to ntp for the time server
udp/ntp 123

Outbound access for DNS
TCP Port 53
(unless they are using an internal DNS)

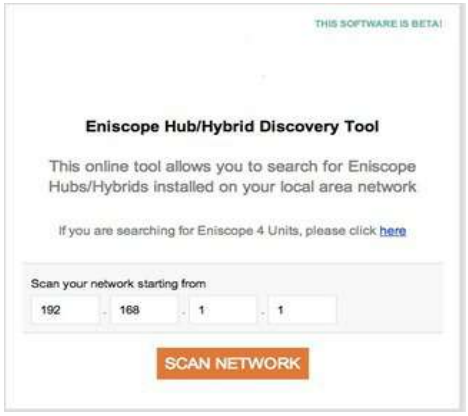
Inbound access for SSH (Optional)
TCP port 22
(you may require inbound NAT rules to achieve this)

Network Instructions

1. Connect the Eniscope to your Local Area Network (LAN) via RJ45 connection and cable.



2. Now use the HUB discovery tool found at **http://discovery.bestsupportdesk.com/**



Ensure you enter in the correct network range and then select scan network. The tool will now search the network for any Eniscope's installed that have been assigned a DHCP address (depending on the network the Eniscope may take up to 10min to register).

3. Once the Eniscope has been found click the mouse pointer on the IP Address.

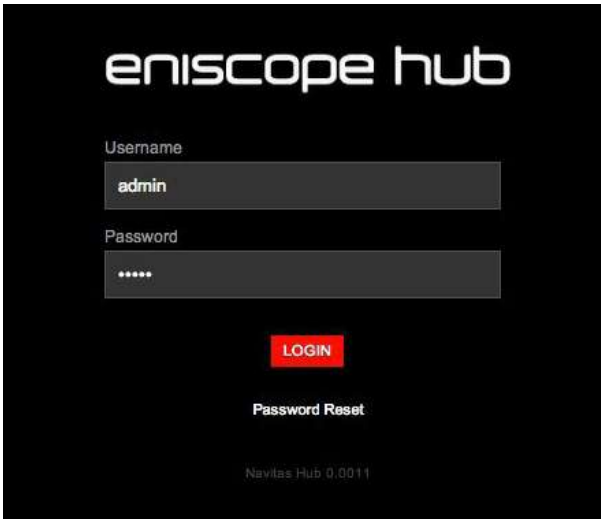
Note: Network Range.
Please ensure the computer you are using, is on the same network range as the Eniscope and has Internet access.

For example, the Eniscope connected by cable to your network (LAN), might be on 192.168.0.xxx IP range. While your office computer might be using wireless connection (WAN) on 192.168.1.xxx IP range.

To find your computer IP Range, speak to your administrator or refer to the Troubleshooting section or look at the networking section at our support desk.
http://help.bestsupportdesk.com

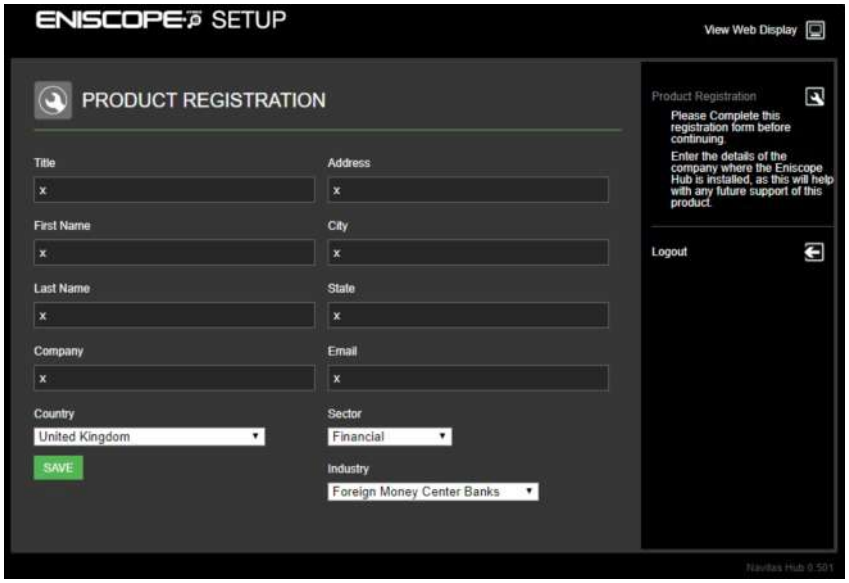
If you are unable to see any Eniscope listed, please refer to the 'Troubleshooting' section of the manual.

4. You will now be directed to the Admin login screen.



The default Username = admin Password= admin Enter and then select LOGIN.

5. Complete the Registration of the HUB by entering in your company details. And selecting save.

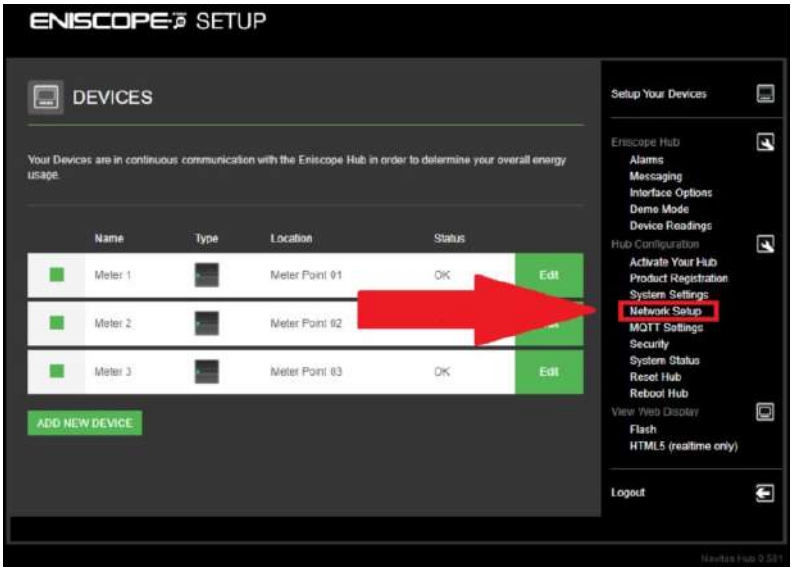


Note: Accessing the Eniscope
The Eniscope can be accessed on local network via your web browser (i.e. Google Chrome, Microsoft Edge, etc), by typing the Eniscope IP address into the address bar, followed by /admin.

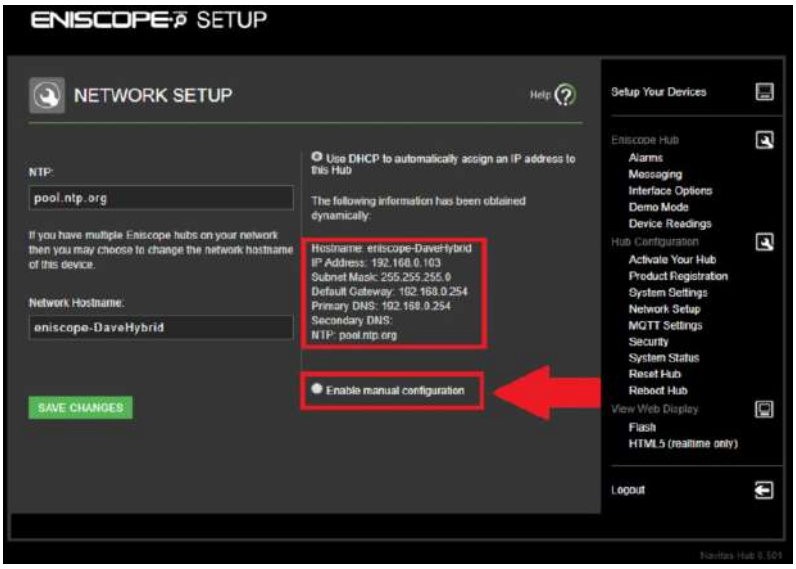
For example:
192.168.0.61/admin
Please be aware that your computer must be on the same network range, in order to connect to Eniscope locally.

Following the above example, your computer should be on the 192.168.0.xxx range. Where xxx is a unique id number for each device connected.

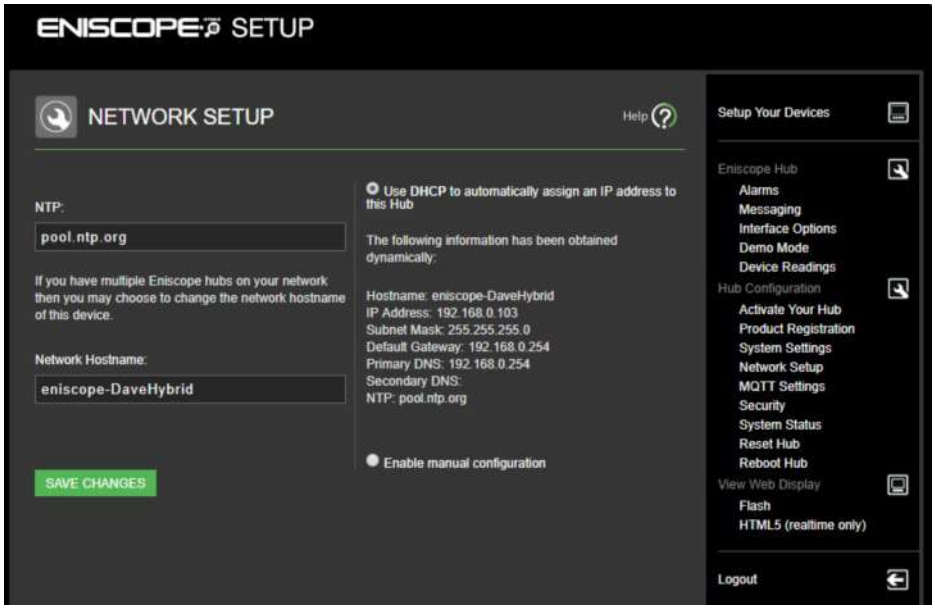
6. From the Menu selection on the right, select Network Setup.



7. You will see that the Eniscope has DHCP selected, we now highly recommend changing this to a static address to ensure it can always be located. To do this, select Enable Manual Configuration and enter in the Static address details and then save changes. The new IP settings will not take affect until you reboot and you will have to login to the Menu from the new IP.



Manual Configuration – These details will need to be supplied by an onsite IT technician familiar with the local network and should be found on your pre-installation guide.



Network Setup

This page allows you to configure how your Eniscope appears on your Local Area Network.

NTP Server The IP address or domain name of an Internet Time Server, such as pool.ntp.org (For syncing time for all devices on network).

Network Hostname If you have multiple Eniscope devices on your network then you can enter a unique network name for each device.

DHCP **Dynamic Host Configuration Protocol**
Your Eniscope will attempt to automatically obtain the required details from a DHCP server on your network in order to operate correctly. This is the most common option for many installations.

Manual Configuration

IP Address The network IP address of our Eniscope.

Subnet Mask The subnet mask for your network.

Gateway The IP address of your router or Internet gateway.

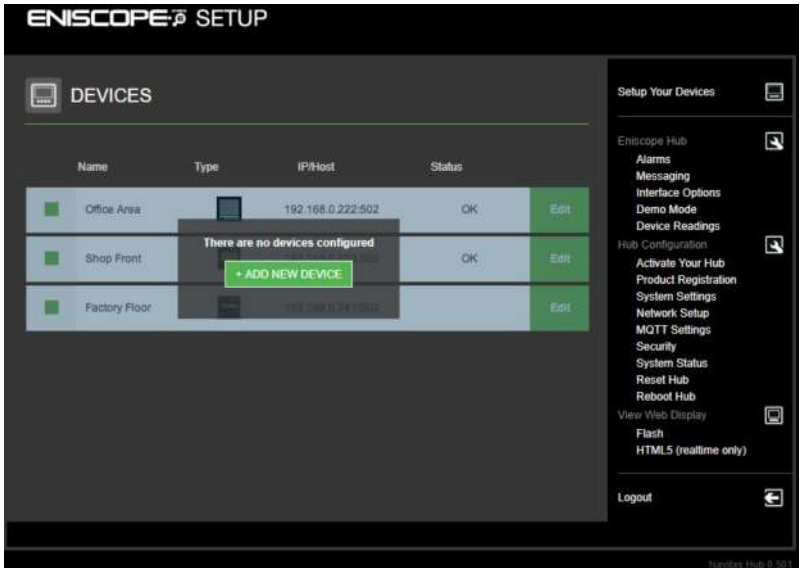
Primary DNS The IP address of your DNS server.

Secondary DNS The IP address of your backup DNS server.

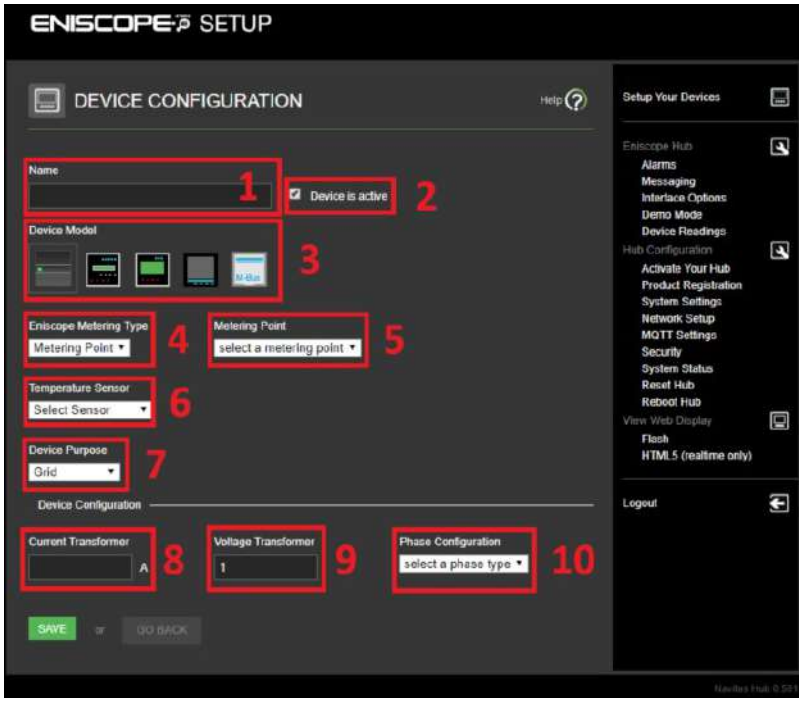
Note: for hostname use only alphabet and number characters. Do not use space bar or special characters beyond"-" which you can use as a space mechanism.

B Meter Setup

Once the device is setup on the network and the CTs have been physically placed, we can begin meter setup. Meter setup allows us via the Eniscope's software, to identify the CTs installed and set their parameters ready for data sending and real time viewing.



1. From the Menu Selection on the right side, please select Setup your Devices.



Important Note:

Before setting up your devices:

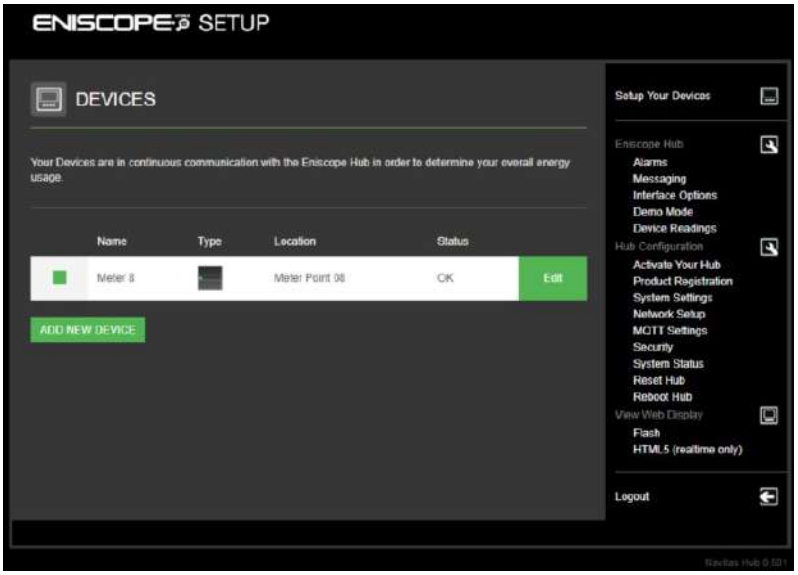
Once networked the Eniscope will automatically seek to download the latest firmware updates. It is therefore strongly recommended that you network in the Eniscope, allow it to check for firmware updates so that the Eniscope is configured with the latest firmware before you configure the device. Under normal network conditions the Eniscope will have completed it's firmware check within a couple of minutes of being powered on with network access.

After setting up your devices:

Once you have setup the meter(s) in the Eniscope hub, power off and on the Eniscope (reboot). After the reboot you can now proceed to the device readings page to check your readings (voltage, current and power). The reboot is important to ensure the new configuration is running correctly.

Device Configuration

2. Now Complete the editable fields and then press Save. With reference to Device Purpose (7), select ‘Grid’ if the CTs are monitoring the power coming into your site from the supplier, ‘Consumable for an area of your site (i.e. office space, workshop) and ‘Renewable’ if you have an onsite source, such as solar or wind generation.



3. You will now see your Meter registered on the Eniscope and can view incoming data via device Readings. Repeat the process for any remaining Meters to setup.

Device Configuration

1. Create a descriptive name for the Meter (i.e. Workshop 1).

2. Enable for Meter to send data.

3. Select the first option for CTs wired to Eniscope. For external meters please go to support desk for detailed instructions.

4. Select the Metering Point option.

5. Select the Eniscope CT Input connector (1–8), the device is on.

6. Select the related temperature sensor (if fitted).

7. Select the power source (Grid, renewable, consumable), select consumable for default.

8. Input the Max Current value stated on the CT body (i.e. 120 for a 120A CT)

9. Default value is 1. For Medium Voltage (MV) & High Voltage (HV) scaling scenarios (where supply is greater than 346V~LN / 600V~LL) this value will change. See the support desk for details.

10. Select your phase type. For multiple 2LN single phases to one CT input terminal, select 3 phase.

C Real-time Display

To access the Real time display you can select from the HTML5 or FLASH version at the bottom of the menu, while logged into Eniscope. Otherwise type the Eniscope IP Address in your web browser address bar, (i.e 192.168.0.127) for direct link to the real time display.

Note: When Renewable Display is setup, HTML5 will show the real time display and the FLASH will show the renewable display.

1. Calculated power gauge.
2. Graph, displaying either Power, Current or Apparent Power vs time (See interface menu on Eniscope to select display type).
3. Gauge displaying the voltage reference wired into Eniscope.
4. Calculated power factor.
5. Calculated cost and CO2 (See interface menu on Eniscope to setup your details).
6. Select the Meters you wish to view from the triangle (not visible if only 1 meter).
7. From Left: click to be directed to Analytics via browser, middle: provides description of energy usage and right: display settings (with full screen mode).

D Activating Eniscope Hybrid

Please follow the “Quick Start Guide to Setting up Your Eniscopes on Admin” guide at the support desk under “admin.eniscope.com” heading, to activate the Eniscope Hybrid system.
http://help.bestsupportdesk.com/

Adding the Eniscope Hybrid to Analytics

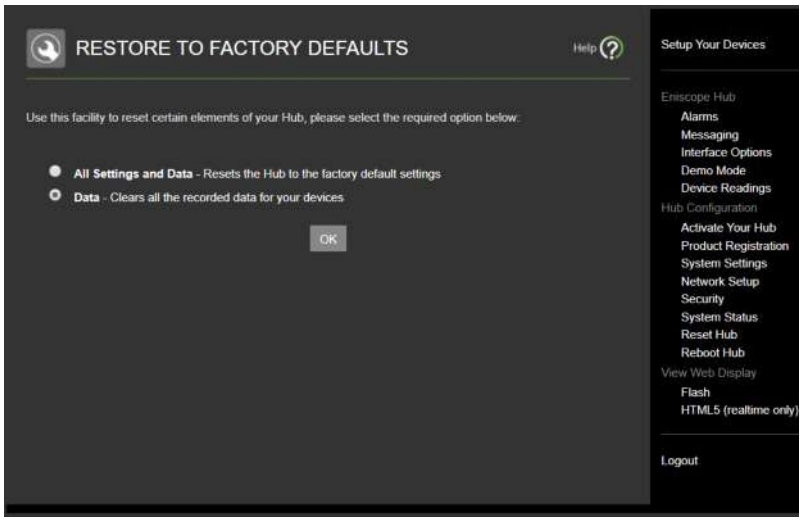
Please follow the “Quick Start Guide to Setting up Your Eniscopes on Admin” guide at the support desk under “admin.eniscope.com” heading, to setup your Eniscope to store your data and view at Analytics.
http://help.bestsupportdesk.com/

E Resetting the Eniscope Hybrid

There are 4 options for Eniscope reset, please follow the instructions below. We recommend you use the software reset option via the Eniscope Hub, but in case you have lost your login password, you have access to a hardware reset as well.

Software Reset

The software rest options can be found on the Eniscope Hub Menu, under the Reset Hub heading, where you have 2 options:



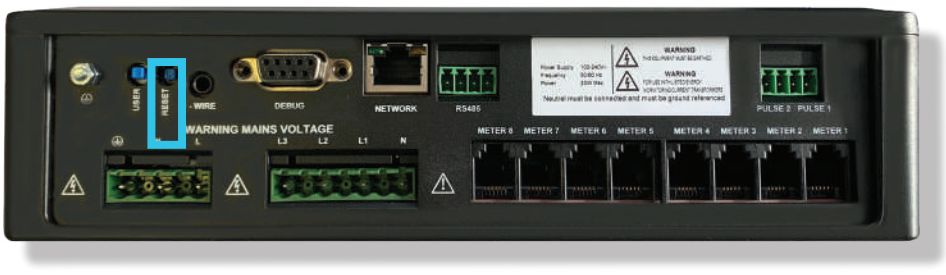
All Settings and Data: This will Factory reset the device to defaults and erase all data.

Data: All Settings are kept, but the stored meters data on the Eniscope is deleted.

Simply select your preference and click ok, it will then ask you to click again to confirm.

Hardware Reset

Holding in the reset button for more than 4 seconds will cause the Eniscope to reboot (All Settings are kept).



Hardware Factory Reset

1. Power off the Eniscope Aux Power and Voltage Reference.

2. Locate the USER button, press and hold for next step.

3. While keeping the user button pressed, power the Eniscope back on, It will then go through the following sequence.

Time	LED Light Colours	Status
1 Sec.	Random	Powering On
5 Sec.	LED's Off	Booting
24 Sec.	Multi LED's	Processing
25 Sec.	Flashing Red LED's	Resetting
30 Sec.	Green LED	Factory Reset

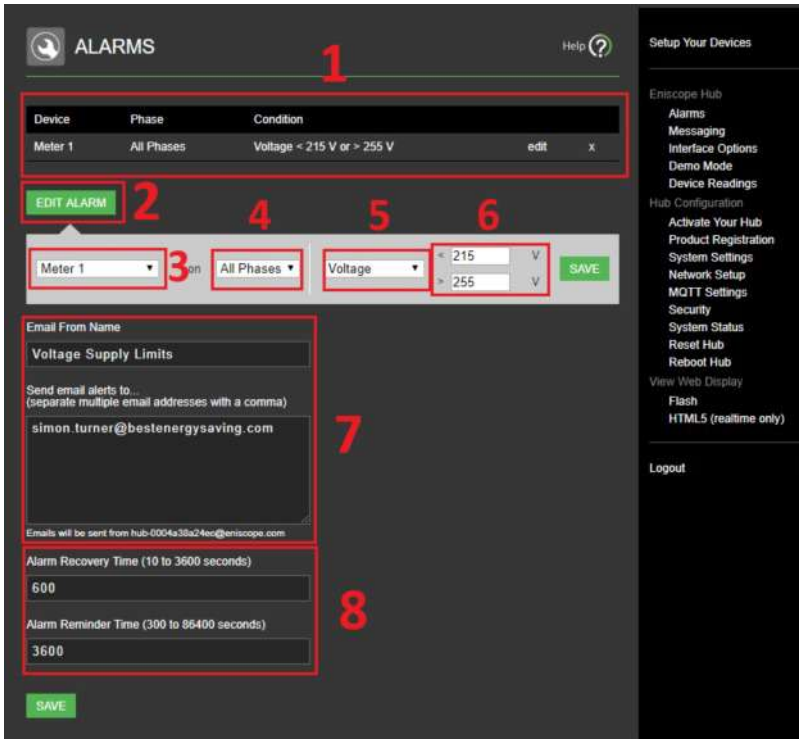
4. Let go of the USER button as your Eniscope has now performed a factory reset.

Note: During the red flashes of resetting cycle, the reset can be stopped before the lights turn green at 30 seconds.

CUSTOMISATION OPTIONS

Alarms

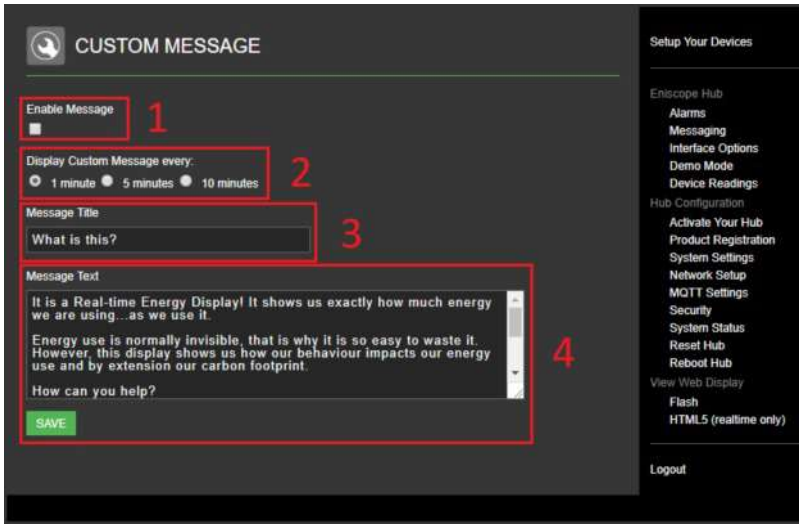
(A separate alarms service can also be set via Analytics cloud)



Used to send email alerts, if a parameter is out of specification (i.e. power factor low). You can also set up text alerts, if interested please see support desk for instructions.

1. List of current alarms, click X to delete and click edit to edit.
2. Add or edit alarm button
3. Select the Meter for the alarm to monitor (1-8).
4. Select the phase (1-3, or all) to monitor.
5. Choose Power, Voltage, current or Power factor to monitor.
6. Set the high and low limits for the alarm to activate (leave either blank if not needed), then save.
7. Select name or title for email message, then add all emails to receive the alert.
8. Set the alarm recovery and reminder time in seconds. i.e. 600s before alarm recovers,(once returned to normal state) and 3600s before reminder email if alarm continues.

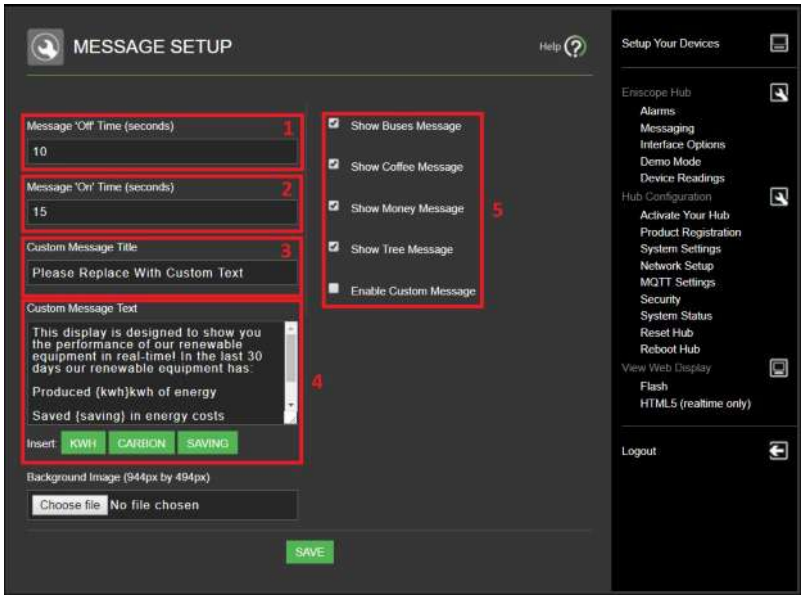
Messaging



This allows a message to be seen on the Real Time Display after a fixed time.

Custom Message option is available when Real-time Display is selected on the interface options.

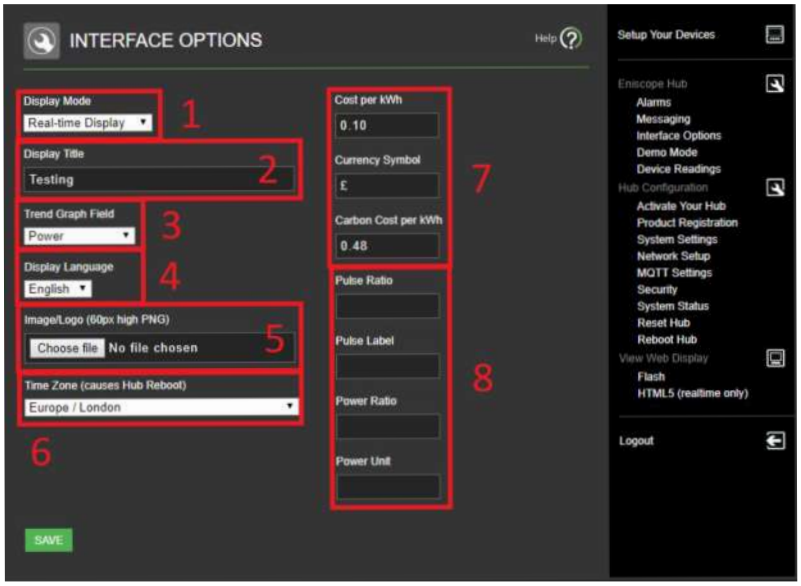
1. Enable/Disable message.
2. Specified time to elapse before message appears on display.
3. Enter message title.
4. Enter message text and save.



Message setup option is available when 'Renewable Display" is selected via the interface options.

1. Set how long you wish the system to wait before displaying the message (in seconds).
2. Set how long the message is displayed (in seconds).
3. Set your Title.
4. Set your Body of text.
5. Tick to enable or disable Custom message (also can enable/disable default messages).

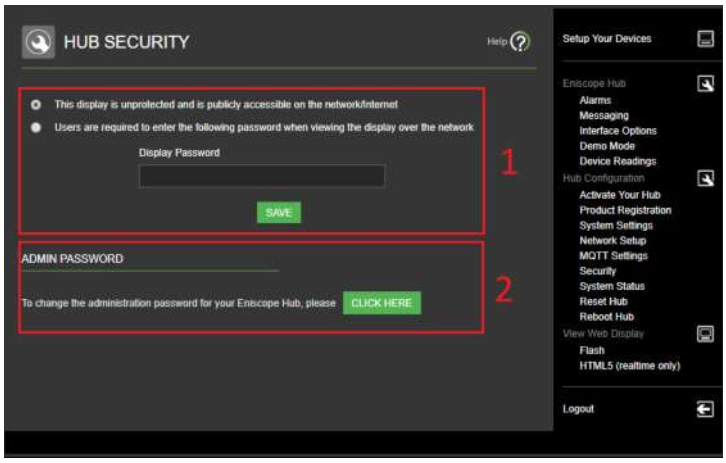
Interface Options



This is where you can edit the 'Real Time Display' and 'Renewable Display' Settings.

1. Select Real time Display, unless you are using renewable power.
2. Display Title (Renewable only)
3. Select your Graph parameters, Power, Apparent Power or current vs time.
4. Select your language for real time display.
5. Can upload company Logo in .png (appears in top left corner).
6. Select your time zone (for Real Time Display graph to display).
7. Input your energy suppliers details and currency Symbol.
8. Leave blank unless using pulse inputs.

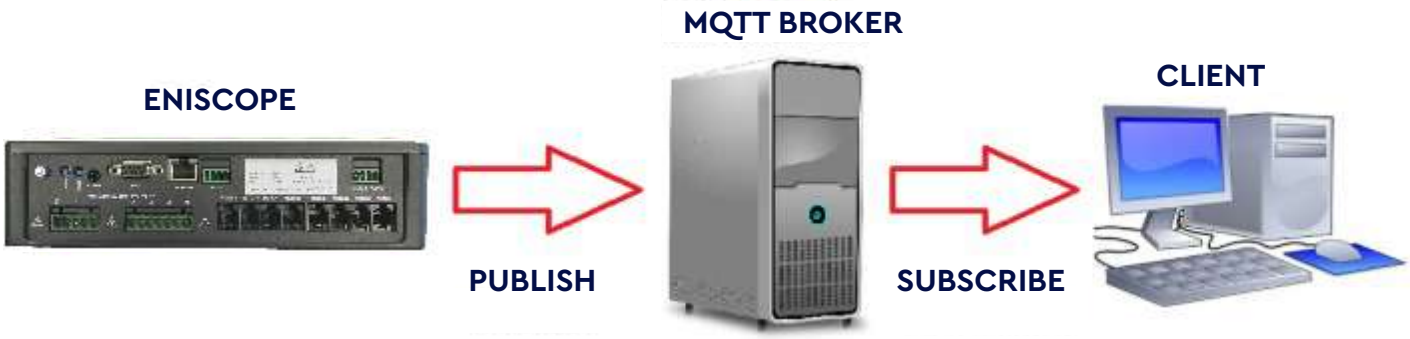
Security

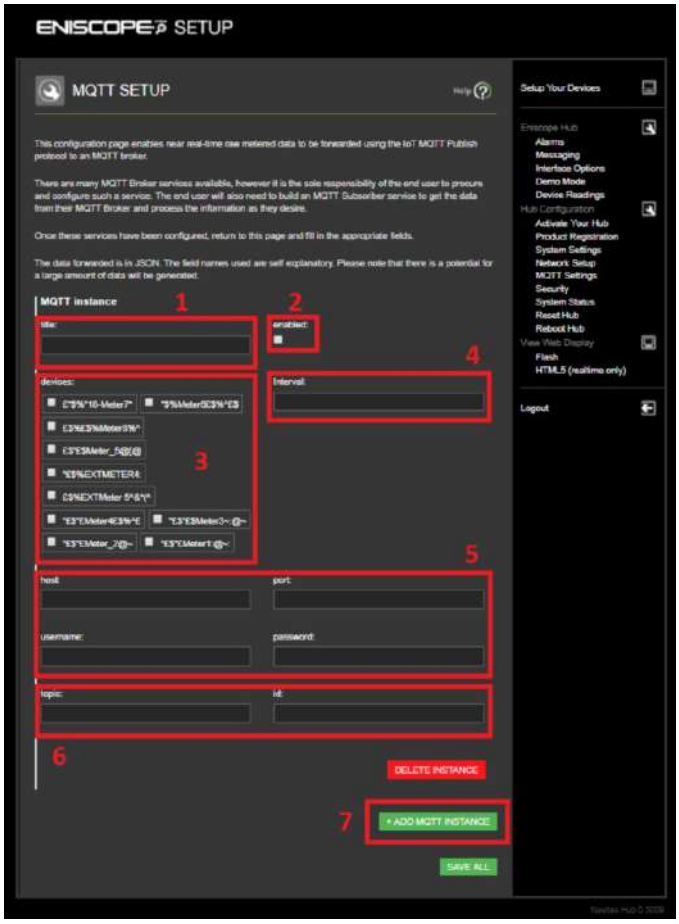


1. Enable/Disable password login to Real Time Display and set password (so when Eniscope IP is typed into a browser you can decide who can view).
2. This is where the Admin password can be changed, but we recommend you keep the default (must be a minimum of 5 characters) and is upper/lower case sensitive.

MQTT Settings

MQTT is a machine-to-machine (M2M) “Internet of Things” connectivity protocol. It was designed as an extremely lightweight publish/subscribe messaging transport on top of the TCP/IP protocol. It is useful for connections with remote locations where a small code footprint is required and/or network bandwidth is at a premium. This service allows clients to have near real time data transmitted via the Eniscope, to their chosen servers for storage and customised displays.





The Eniscope publishes in JSON via the above configuration page to the MQTT broker. There are many MQTT Broker services available, however it is the sole responsibility of the end user to procure and configure such a service. The end user will also need to build an MQTT Subscriber service to get the data from their MQTT Broker and process the information as they desire to store or display.

MQTT Setup

Go to the MQTT Settings and click Add Instance.

1. Enter a title, this is only for your reference within Eniscope.

2. Tick enable to send (is disabled by default)

3. Select the devices you wish to transmit data from via MQTT (you will only see Devices/Meters you have set up listed).

4. Set a time interval in seconds for each broadcast.

5. Input your MQTT broker details (host, address, port and login credentials).

6. Assign your topic, remembering it is upper and lower case sensitive for the subscriber to receive (i'e' / Eniscope8/04). You can optionally assign an ID otherwise leave blank.

7. If you wish to add another instance (i.e' transmit to a different Broker or assign different devices under separate topics).

Example:
JSON, for 1 meter being transmitted:

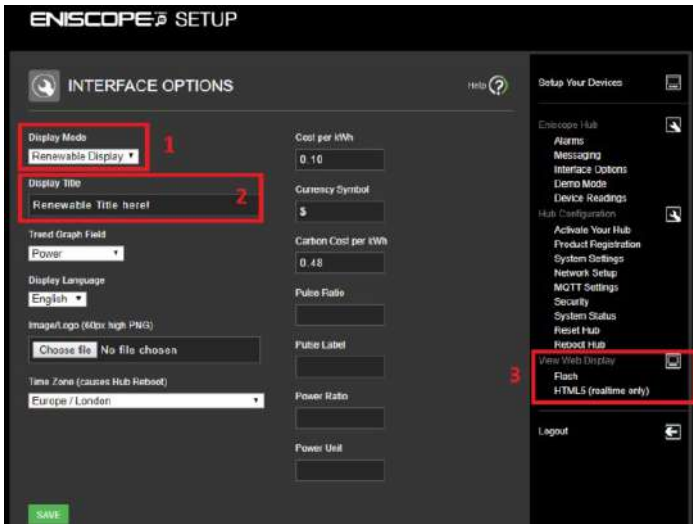
```
"rtdata" : [ {
"uid" : "00:01:02:03:04:05:00:01", "did" : 1,

"S1" : 278.59,          //Phase 1 Apparent Power      (VA)
"S" : 837.36,           //System Apparent Power       (VA)
"A1" : 0,               //Angle 1                     (Degrees)
"V3" : 242.17,          //Phase 3 Voltage             (V)
"P2" : 262.23,          //Phase 2 Power               (W)
"RE3" : 2046057.995,    //Phase 3 Reactive Energy     9varh)
"Q3" : -95.057,         //Phase 3 Reactive Power      (var)
"A2" : 0.15,            //Angle 2                     (Degrees)
"E" : 53559.31592,      //System Energy               (Wh)
"U3" : 1.025,           //Phase 3 Line to Line Voltage (V)
"P3" : 262.84,          //Phase 3 Power               (W)
"REx" : 18592.91342,    //System Reactive Energy Export (varh)
"U1" : 0.73807,         //Phase 1 Line to Line Voltage (V)
"V1" : 241.3,           //Phase 1 Voltage             (V)
"RE2" : 512121.6998,    //Phase 2 Reactive Energy     (varh)
"ts" : 1516362683,      //Server time                 (Seconds)
"Ex3" : 286326.6791,    //Phase 3 Export Energy       (Wh)
"AE2" : 541141.7201,    //Phase 2 Apparent Energy     (Vah)
"RE" : 2285337.066,     //System Reactive Energy      (varh)
"I2" : 2.423,           //Phase 2 Current             (A)
"A3" : 0.13,            //Angle 3                     (Degrees)
"E2" : 17881.0226,      //Phase 2 Energy              (Wh)
"REx1" : 352050.9531,   //Phase 1 Reactive Energy Export (varh)
"I" : 7.2894,           //System Current              (A)
"In" : 6.5333,          //Neutral Current             (A)
"S3" : 279.52,          //Phase 3 Apparent Power      (VA)
"U" : 0.7518,           //System Line to Line Voltage (V)
"F" : 50.055,           //Frequency                   (Hz)
"RE1" : 74246.0259,     //Phase 1 Reactive Energy     (varh)
 "P1" : 263.19,         //Phase 1 Power               (W)
"E1" : 110343.0785,     //Phase 1 Energy              (Wh)
"PF" : 0.94137,         //System Power Factor         No unit
"REx3" : 6239.513739,   //Phase 3 Reactive Energy Export (varh)
"AE3" : 2085295.743,    //Phase 3 Apparent Energy     (VAh)
"V" : 241.72,           //System Voltage              (V)
"Ex" : 317545.1858,     //System Export Energy        (Wh)
"Q" : -282.33,          //System Reactive Power       (var)
"S2" : 279.24,          //Phase 2 Apparent Power      (VA)
"REx2" : 7412.039811,   //Phase 2 Reactive Energy Export (varh)
"PF3" : 0.94495,        //Phase 3 Power Factor        No unit
"PF2" : 0.94336,        //Phase 2 Power Factor        No unit
"E3" : 17169.13177,     //Phase 3 Energy              (Wh)
"I3" : 2.4304,          //Phase 3 Current             (A)
"PF1" : 0.94843,        //Phase 1 Power Factor        No unit
"P" : 788.26,           //System Power                (W)
"U2" : 0.49234,         //Phase 2 Line to Line Voltage (V)
"V2" : 241.68,          //Phase 2 Voltage             (V)
"Q2" : -95.957,         //Phase 2 Reactive Power      (var)
"Q1" : -91.319,         //Phase 1 Reactive Power      (var)
"AE1" : 461996.2103,    //Phase 1 Apparent Energy     (Vah)
"Ex2" : 85510.65138,    //Phase 2 Export Energy       (Wh)
"Ex1" : 37562.71023,    //Phase 1 Export Energy       (Wh)
"AE" : 3088475.549,     //System Apparent Energy      (Vah)
"I1" : 2.436            //Phase 1 Current             (A)
```

Note: The comments are not transmitted, they have been added to point out key readings.

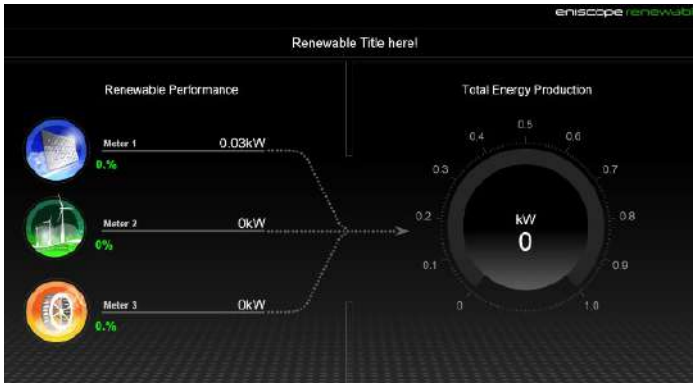
Renewable Display

There are additional settings and display options when setting up a renewable energy source such as Solar, Hydro, Wind and Heatpump options.

1. The first step is to set up your Renewable device information in 'Setup Your Devices' in addition to the normal settings explained under 'Meter setup' section.



2. Setup your Renewable Interface options for the display. You can also setup the Renewable Display Messages (or deactive), as explained under 'Messaging' section.



3. You can view your Renewable performance via the Flash Web Display.

Adding a Renewable Device

1. Select 'Renewable' for Device purpose.

2. Select your energy source.

3. Choose a colour for the Renewable Display.

4. Max Production Potential of your device for the display.

Renewable Interface Options

1. Select Renewable Display (note your Messaging section will change also).

2. Type in a Renewable title to be seen on the display.

3. Select 'Flash' for Renewable Display view. 'HTML' option will produce the normal 'Real-time Display'.

TROUBLE SHOOTING

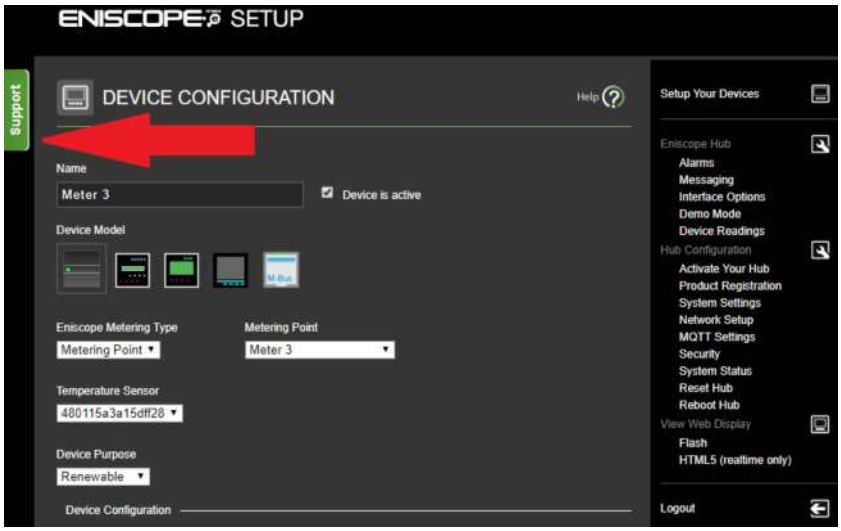
Support Desk

You will find a wealth of technical articles (including troubleshooting) via the support Desk. Please look through the Eniscope support section before raising a ticket. **http://help.bestsupportdesk.com**

Note: Top right of the Support box is a direct link to the Support desk via "Search Articles".

Support Tab

You can also send an email enquiry quickly, using the Support tab visible on the left side of your browser while logged into the Eniscope.



Complete all fields requested and you can attach any images or files of relevance.

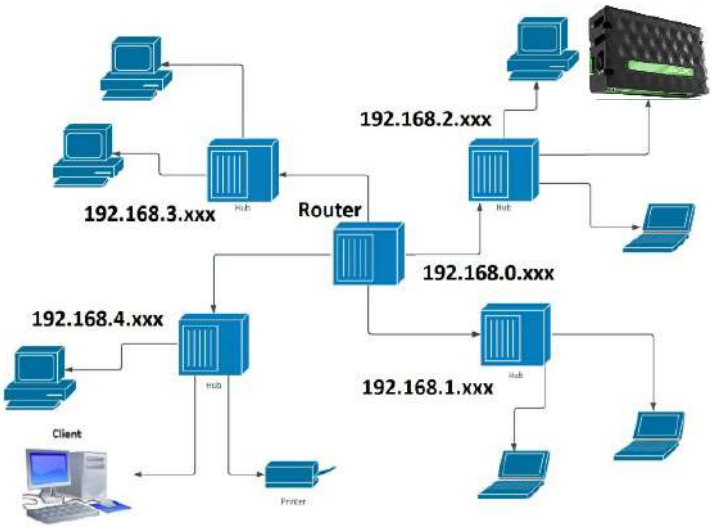
How to find your Eniscope on the Network

If the Discovery tool was unable to see the Eniscope, you should consult the local administrator or IT expert for advise and network setup details. Otherwise follow the below steps.

1. Ensure the Eniscope is powered on, by physically checking the Eniscope main LED is is blinking.

2. Check the Eniscope is connected to your network, you should see a Green LED on the Ethernet socket after powered on. If not check your cable for signs of damage or check the retaining clips on the plugs are not damaged or try another cable.

3. Check your computer is on the same IP range, for this you ideally need to check with your IT expert. As depending on the size of your network and setup, you could be using multiple switches and IP ranges. If in doubt trace the cable from the Eniscope to the nearest hub and connect your computer to the same hub via cable.



Note: As well as experiencing different IP ranges from multiple switches/hubs, you could still experience 2 different IP ranges from the same local area network, in the form of WAN and LAN.

Your local hub could be setup so Wireless devices (using WAN) are on one range (i.e. 192.168.8.xxx), while your wired/cabled devices (using LAN) are on another (i.e. 192.168.0.xxx).

If in doubt, connect via cable to the same hub the Eniscope is to physically connected to, for initial setup/testing (turn off your computer wifi and 3g modem to save confusion later). Once you know the IP range and can see the Eniscope you can move your computer back to its normal workstation.

Before you can find the Eniscope, you need to know the IP range that both your computer and the Eniscope is on. To do this follow the below instructions for windows or MAC (can also be done on Linux based system, via terminal and ifconfig command).

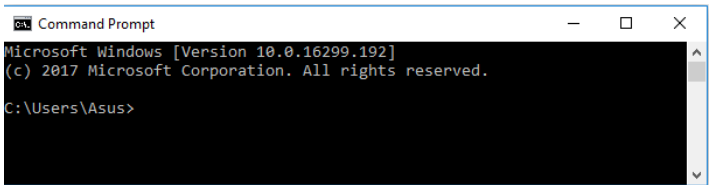
Note: In reference to different IP ranges on your local network discussed on previous page, you can see in this example my Ethernet and Wireless LAN adaptors are using different IP ranges in the same office space.

Windows OS

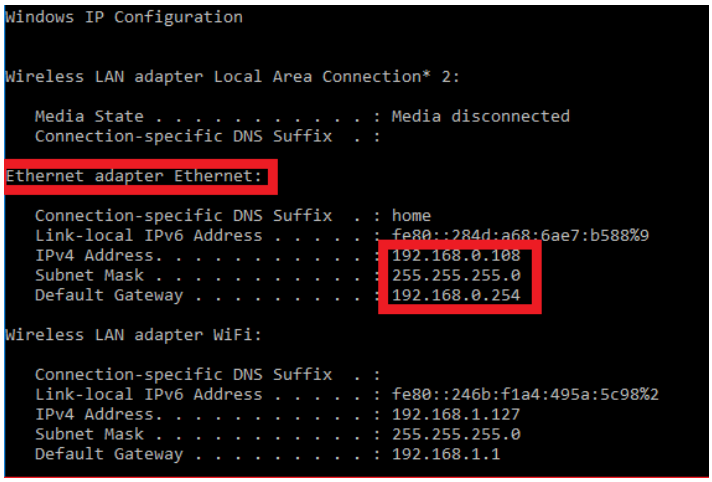
If you are using a windows operating system, click on the windows start button and type 'cmd' (don't worry, the search box in WIN10 will appear when you type).

Once the Command Line program is open type 'ipconfig' and then press the 'Enter' key.

The Command line will now return lots of information. The information that you require is the IPv4 address of your Ethernet adapter.

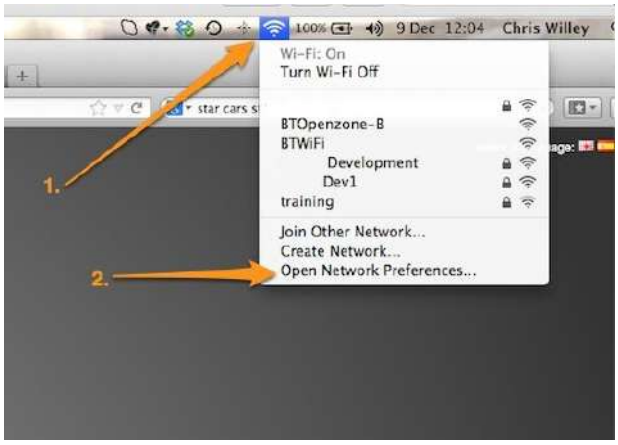


The address shown is the IP address of the Computer you are using. The first 3 sets of numbers indicate your network range. In the example above the IP address range is '192.168.0' (the fourth set is unique number to each device, like a house number).



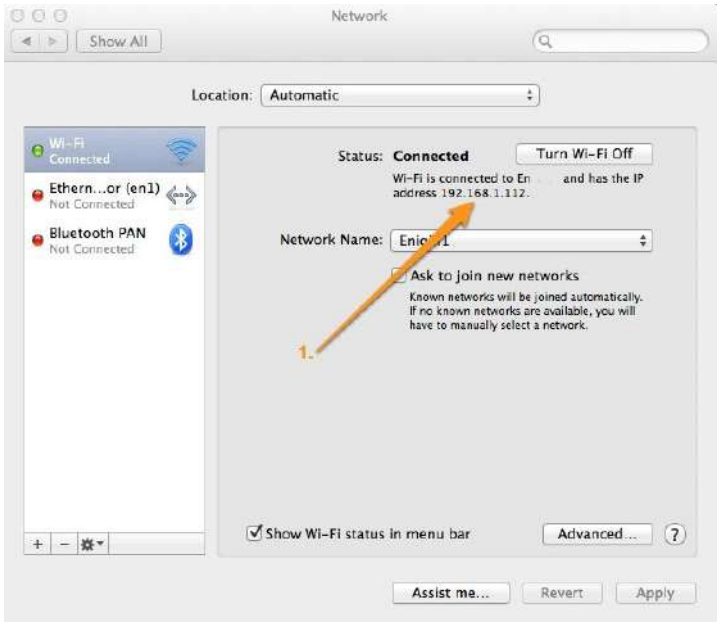
Mac

If you are using an Apple OS, then in your top menu bar, hover your cursor over the network connection icon and then select ‘open network preferences’



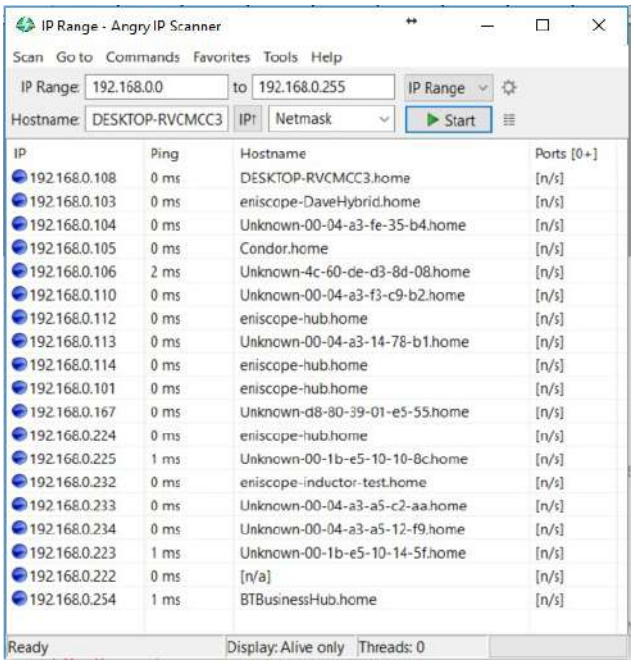
Now you will see your MAC’s IP address.

The address shown is the IP address of the Computer you are using. The first 3 sets of numbers indicate your network range. In the example above the IP address range is ‘192.168.1’ (the fourth set is unique number to each device, like a house number).



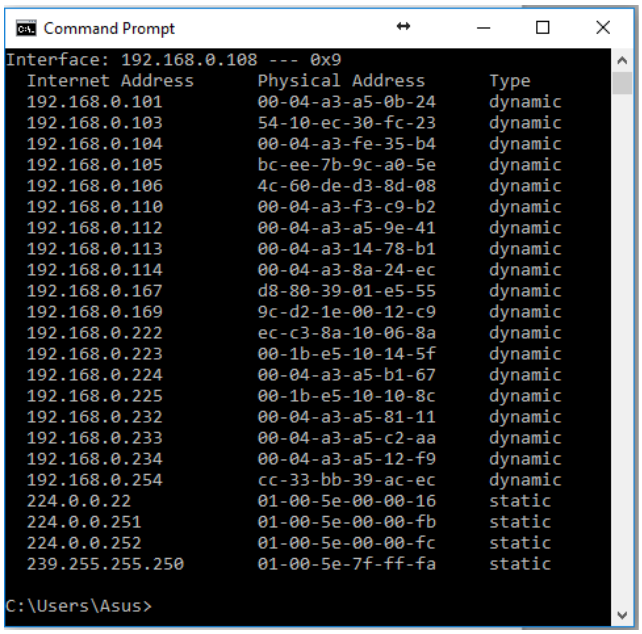
Now you know your computers IP address, you can retry the discovery tool.
http://discovery.bestsupportdesk.com/

Still not found your Eniscope?
Ok next thing to do is to download an IP scanner such as 'Angry IP Scanner'
http://angryip.org
Type in your IP range and scan, example below is using 192.168.0.xxx as my IP range.



Now open up the CMD tool in Win10 and type ARP-A (do this after IP scanner).

The IP scanner has listed all devices on your network range and should see the Eniscope in the hostname. If you have multiple Eniscopes or not sure of the MAC address, then the CMD will display the MAC address for each IP on the range.



Eniscope Direct communication

If the previous steps have not been successful, we can determine if the issue is with the Eniscope settings or your local network setup via machine to machine communication. Plus you will be able to manually assign a fixed IP for your network testing, rather than the default DHCP. Please ask your IT specialist to help you with this test.

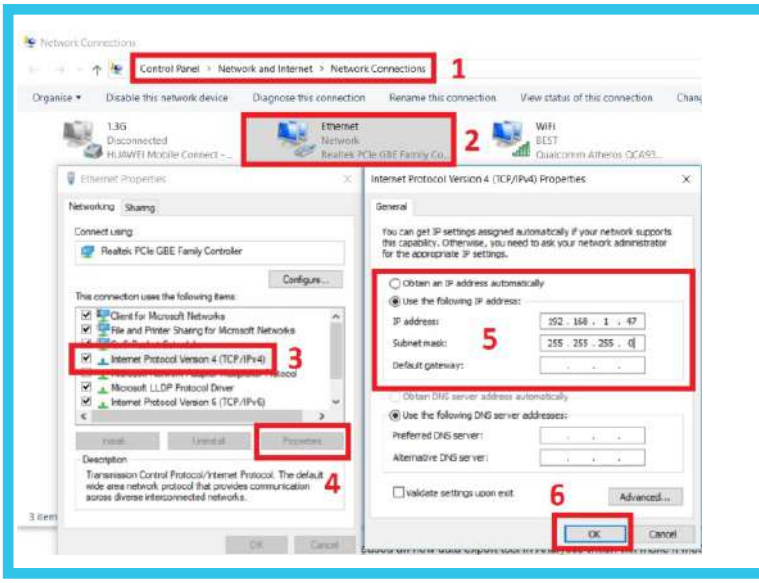
1. Disconnect the network cable from the Eniscope (so it has no network connection at all) and turn off the Aux power supply and reference voltage supply.

---

2. Turn the power back on after 10 seconds and now wait 5 minutes (the Eniscope detecting no network for DHCP settings, will default to a fixed IP), once the time has expired, connect a cat cable to the Eniscope and the other end straight to your computer Ethernet (do not connect via your network or a hub).

---

3. The Eniscope will now be on a fixed IP 192.168.1.227, but you still need to assign a fixed IP to your computer in the same range to see the Eniscope. To do this from Windows, click start button and type ‘control panel’ and enter. Navigate to ‘Network and Internet’ > ‘Network and sharing Centre’ > ‘change adapter settings’. Now right click on ‘Ethernet’ and select properties. Then finally select Internet Protocol Version 4 (TCP/Ipv4) and click properties.



You should now see the option to select 'Use the following IP address', where you should put an IP of 192.168.1.xxx (where xxx can be any number from 1 to 255 except 227, which the Eniscope is on!). Use the default mask 255.255.255.0 and click ok twice to confirm.

4. You should now be able to see the Eniscope on your IP scanner and CMD box via the ARP -A command as discussed on previous page (do IP scanner first). You can now log into the Eniscope hub menu by typing in '192.168.1.227/admin'.

   If you can see the Eniscope on on the network and login to its Menu, this shows the Eniscope is operating and communicating via TCP/IP as normal. You can now also set a fixed IP to your local network settings to retest.

5. If you found your Eniscope on the local network but still unable to see at admin. eniscope, then check the Eniscope has Internet access via the hub or IP range assigned. Simplest way to do this is to connect your computer to the same network hub as the Eniscope via cat cable and test. Don't forget to disable your wireless or 3G modem (if connected) to ensure your getting Internet through Ethernet only. If your computer has Internet and Eniscope is still not seen at the cloud, then this could be a firewall or special network setup.

You can also perform a 'System status' check via the Eniscope hub Menu for indication on where the error could be.

Note: Please remember to revert your computer back to DHCP or your original network settings once finished!

The Eniscope's data is transferred using http in the same way as you would browse the Internet. In most cases, as long as you have the correct Network Settings entered into the Hybrid, it will just work. However, in some situations you may have a more locked down network structure. In these cases, your network professional may need to know the URLs and outgoing ports that are accessed by the Hybrid and 4 Channel. This information is contained below.

Outbound access to transfer data using http (port 80) and https (port 443) for:

hub.eniscope.com (HUB Data Uploads)

aus.eniscope.com (Software Updates)

checkin.eniscope.com (Daily Diagnostics)

upload.eniscope.com (New Hybrid Data Uploads)

analytics.eniscope.com (Activation)

Outbound access to ntp for the time server:
udp/ntp 123

Outbound access for DNS:
Port 53 (unless they are using an internal DNS)

LED Indication

The Eniscope has a LED Indicator on the front of the unit. In normal operation it will flash white on/off at 1 second interval. Other sequences that may appear to flash are:

White/Blue:
This Indicates a pending upload of data to the cloud/server and the data will be stored locally on the SD card until successful. This could indicate an issue with your Eniscope settings, Internet connection or outbound access via your firewall.

White/Red
This indicates the ntp server time sync has failed. Please check your ntp settings on the Eniscope or otherwise check your firewall/ network outbound access.

TECHNICAL SPECIFICATIONS

Environment

Humidity	0 – 80% (non condensing)
Meter Operating Temperature	10°C to 40°C nominal
Storage Temperature	0°C to 50°C nominal
Altitude	2000m above sea level maximum

Aux Supply

100 – 240V~ 50/60 Hz nominal Power Consumption	< 20W
Current	20mA

Electrical Metering

Nominal Full Scale Voltage	346V~LN/600V~LL Voltage Category III
Withstand Voltage	1000V~ LN & LL
Input Impedance	> 2MΩ
Metering Frequency	50/60 Hz nominal
Pickup Voltage	0V
Voltage Accuracy	Better than 1%
CT Type	Split Core – Measurement Category III compliant ONLY to UL2808, 333 mV output per channel nominal,Max 1V
CT Operating Temperature	-40C to +55C
CT Max Primary Voltage	600V~
CT Nominal Current	According to available CT's
Metering Range	30-300 Amps as standard in stock on ECOS. 500 to 6000 amps available on request.
Withstand Current	6 x Nominal CT Current
Pickup Current	0A
Accuracy	+/-1% as per IEC60044-1, Table 11