

**INSTALLATION, COMMISSIONING AND OPERATION INSTRUCTION MANUAL FOR
THE G100 METERING PANEL, AND CUSTOMER EXPORT / IMPORT LIMITATION
SCHEME CONTROL PANEL.**

Note: This manual should be read and understood before any work commences on this system.

CLS Scheme to issue G100/2-1

DOCUMENT STATUS	
Author:	John Baxter
Release date:	November 2022

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Revision Record

Revision:	Date:	Description:	Prepared:	Checked:	Approved:	Status:
A	27/08/2020	First issue.	JPB	SM	JPB	A
B	19/01/22	Changed how AQ1 works so that it is active all the time regardless of what is happening for constraints and G100 as these are hardwired for tripping and the loss of mA was leading to conveyance confusion on site.	JPB	JP	JPB	A
C	20/4/23	Revised to align with G100/2 and then re-written to pick up Amendment 2. Now based on G100/2-2	JPB			

Status: A = Accepted. B = Accepted with Comments. C = Rejected

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1 Abbreviations and Acronyms

FDS	Functional Design Specification
LoM	Loss of Mains protection relay configured to comply with the G99 regulations or country of use requirements
OEM	Original Equipment Manufacturer
O&M	Operation & Maintenance
HMI	Human Machine Interface
GCB	Generator Circuit Breaker
MCB	Main Circuit Breaker (connection between Utility and Essential loads).
CB	Circuit Breaker
HV	High Voltage
PLC	Programmable Logic Controller
SCADA	Supervisory Control and Data Acquisition
DNO	Distribution Network Operator
LV	Low Voltage
Alternator	This refers to the engine driven AC alternator that is directly connected to the engine flywheel
LAN	Local Area Network
WAN	Wide Area Network
Device	A machine that makes electricity or consumes electricity, which typically can be modulated / made to stop by the CLS
PID	Proportional, Integral and Derivative
CT	Current Transformer
VT	Voltage Transformer
VSD	Variable Speed Drive
EPO	Emergency Power Off
SAP	Senior Authorised Person
ISP	Internet Service Provider
IP	Internet Protocol
ADSL	Asymmetrical Digital Subscribed Line
GRP	Glass Reinforced Plastic
UDP	User Datagram Protocol
TCP	Transport Communications Protocol
CHP	Combined Heat and Power (usually engine and generator with heat recovery of engine heat output)
WORD	16-BIT WORD as far as this document is concerned
Bool	Data value that is either on or off (true or false), usually as a BIT within a Word. Expressed as Boolean and named after the mathematician George Bool.
BIT	Single BIT expressed as either 1 or 0
Byte	8 BITS
NEC	Neutral Earthing Contactor
NER	Neutral Earthing Resistor
Utility	Mains electricity supply
DBI	Double Bit Indication, slang termed as Don't Believe It. Both BITS should be exclusive in operation i.e. 1- 0 or 0 - 1. Never 1 -1 or 0 - 0.
DHCP	Dynamic Host Communications Protocol
Modbus	Communications protocol developed in 1979 by Modicon. Now a de facto communication standard that is open source and free of charge to use
DNO	Distribution Network Operator
G100	Export Prevention Scheme Guidance released by the Energy Networks Association
CLS	Customers' Export and Import Limitation Scheme
MEL	Maximum Export Limit
MIL	Minimum Import Limit
CP	Control Panel

Where possible terms have been aligned with EREC G100/2-2.

2 Safety

Intended usage: The system or systems described in this manual should not be used for any other usage outside the scope of the application that it is intended for. The system is designed for controlling the site import / export current (amps) for G100 compliance or to ensure generated power is not given to the Utility when it could be curtailed to a cost advantage to the site or where there are technical reasons for curtailing generation.

2.1 Installation Requirement Competencies




The panel(s) and associated cabling should only be installed by competent personnel with the required qualifications and experience for installing this type of equipment.

2.2 User Operation / Maintenance Competencies

The system or systems described in this manual are intended to be used by competent personnel. It is not intended to be used by children, persons with reduced mental or physical sensory capabilities, or persons with a lack of knowledge / experience on this type of system. G100 specific settings are password protected as per the EREC G100 documentation. Interfering with the systems described in this manual out of the scope of normal operation is not permissible and may break the site's Connection Agreement and in worst cases damage the site's electrical network or the DNO's electrical network, which may lead to criminal or civil prosecution.






2.3 Warnings

A warning is an instruction that draws attention to the risk of injury or death. Failure to observe warnings may lead to bodily injury or death of personnel in the vicinity of the equipment. This may also lead to criminal prosecution.

	Electrical equipment in the control panel(s) can operate at 400 volts AC. It may cause injury or death. Isolate and lock off internal MCB switches and external feeds to equipment before starting work on any electrical component. Ensure that all covers are closed prior to energisation and system filling.
	Prior to use check the supply voltage to the control panel(s) is within tolerance.
	The control panel(s) may contain voltages from foreign sources and therefore additional consideration should be given when working inside the control panels. Isolating the control panel may not be suffice for full panel isolation.

2.4 Cautions

A caution is an instruction that draws attention to the risk of damage to the equipment, process, or surroundings. Failure to observe cautions may lead to irreparable damage to the equipment, surroundings or connected equipment. This may invalidate warranties.

	Where reference is made in this manual to repair, or service, trained and competent personnel must only carry out the work.
	The electrical systems and equipment in the panel(s) is electrically cross-bonded. The installer should ensure that a suitable earthing arrangement is made on all connections connected to the panel(s) and the electrical supply connection. It is the installer's responsibility to ensure that the electrical installation complies with the rules and regulations for the country that this system is installed.
	The equipment can start external generating assets in an automatic start sequence and may start without prior warning. Do not carry out intrusive work on parts without first isolating the electrical supply.
	This equipment contains sensitive electronic components, which may be adversely affected by electrical installation testing. The equipment must be isolated from the supply during these tests, in particular insulation resistance testing.
	This panel is not intended to be installed outside. The IP rating of the panel is IP54 and should be suitably protected against water ingress.

3 Reference Documents

The following documents should be referenced to get a holistic understanding of the systems described in this manual:

Reference number / ID	Title
P0291 G100-2-2 Power Mod Logic Rev C.docx	This document.
Site specific	Device Control Panel Drawing.
Site specific	G100 Metering Control Panel.
Site specific	Site LV or HV Single Line Diagrams.
Site specific	Functional Design Specification.
Site specific	CLS Control Panel Electrical Drawing.
Site specific	Device manuals, FDS etc.
DNO / IDNO Connection Agreement	Client / site should make this available and comply as part of the CLS.
Accuenergy Acuvim II manuals	Manuals for the meter and add-on modules.

4 Standards

Control panel built and logic / control is designed to comply / conform to the following standards:

- 2014/35/EU The Low Voltage Directive
- 2014/30/EU The Electromagnetic Compatibility Directive
- 2006/42/EC The Machinery Safety Directive
- Logic controller compliance to CE, VDE 0631, IEC 1131, FM Class 1, Div 2, CuLus, C-Tick, and marine approvals.

The panel is built to comply / conform to the following standards BS-EN60204-1 and BS-EN61439-2.

5 Location

The site address is:

Various as panel and logic are standardised.

6 Purpose of this Document

This document aims to set out how the CLS control panel logic works.

The scope of this document covers the G100 Metering control panel, CLS LOGO PLC logic for the Power Modulation / G100 control logic. The main salient point of the logic is to give G100 compliance / protection in line with EREC G100/2-2.

The CLS conveys signals back to the Device control system via digital and analogue outputs.

There is also additional, optional, user conveyance via the embedded Webserver within the LOGO PLC and the Modbus TCP/ IP connection.

The setting up of the Acuvim IIR kWh meters to integrate with the CLS is also covered in this document.

7 Overview

There will be a Device installed on site that is capable of generating electricity that has a rating higher than the agreed MEL. *Devices with an aggregate rating lower than the MEL do not necessarily require a CLS.* The electrical output of the Device will feed the site and the CLS Control Panel will monitor the site load and instigates Device generation output modulation / full generation trip, termed 'G100 trip' for the remainder of this document.

The control panels that form the basis of the G100 / CLS offering are such that there are two distinct components that may be separated or combined into a single control panel, this is dependent on the installation requirements. Note that multiple metering points can also be arranged with these panels feeding their data back to the CLS Control Panel, an example being a site with two supplies and both supplies need monitoring, this would require different logic, but is available should it be required.

The two basic components (panels) consist of the following:

G100 Metering Panel:

1. Connections for CTs and VTs (voltage sense) and auxiliary supply for the meter / Reverse Power Relay
2. Connections to interlink the G100 Metering Panel to the CLS Panel (Current, voltage and kWe signals, via analogue, digital and Modbus)
3. Fuses and MCBs for overcurrent protection and component isolation.

CLS CP:

1. Connection from the G100 Metering Panel
2. PLC for logic control
3. HMI for user conveyance and data logging / storage
4. Connections for hardwiring trip signals to Device
5. Analogue (mA or 0-10V) signal to profile the Device's output
6. 230-volt AC to 24-volt DC power supply for control circuits
7. Ethernet switch 10/100Mbps for connecting to the PLC, HMI and Modbus TCP network
8. Ethernet to serial gateway module, for Modbus communications (RS485 and RS232 supported)
9. Fuses and MCBs for overcurrent protection and component isolation.

If the panels can be combined, installation permitting, then this will be a simpler installation and will be a cheaper overall solution. However, this is not always going to be possible. This might be due to the metering, which needs to be close to the site's incomer (Connection Point), being a considerable distance from the Device and therefore cabling back to this position is not going to be practicable.

Additional consideration needs to be made for personnel access to the CLS CP as the G100 Metering Panel does not require viewing once the CLS CP is commissioned, where-as the CLS CP's HMI needs monitoring for various events such as excursions and excursion investigation and subsequent resetting, so therefore putting the CLS CP in a highly restrictive place like a HV room may pose a problem.

8 Scope

The CLS CP is designed primarily to allow persons operating generating assets (Devices) the ability to comply with the EREC G100/2 requirements, where they need to curtail export of current (amperes) at an agreed setting. This threshold value will be determined by the local DNO and will be contained in the DNO's Connection Agreement, which should be in the possession of the asset's responsible / nominated person.

The CLS CP can also be used to profile the site's generation by passing on the site average current (amps) to the Device control system so that it can curtail its generation to reduce the average current at the Connection Point.

The CLS CP can work with many different types of electricity generator such as:

- Solar PV, single or multiple inverters
- Wind / hydro turbine inverter or control system
- Gas turbine
- Gas reciprocal engine
- Diesel reciprocal engine
- Battery storage inverter / control system
- Any hybrid of the above.

For the purposes of this document a 'generator' is a machine that produces electricity from any source i.e. solar or gas engine and is termed to align with EREC G100 as a Device.

The CLS scheme should form the basis of the site generation / load control as implementing as an afterthought is costly and difficult to implement.

9 Functionality

The basic function of the system is to ensure that the MEL is not exceeded, this is afforded by the following mechanisms.

State 1,2,3 and 4 references are from §4.3 of the G100 Issue 2 document, and to simplify the States, a basic list is described below:

State	State description
1	Normal operation of the CLS system, with generation modulating to be below the MEL.
2	Excursions outside of the MEL criteria for short durations (EREC G100/2 §4.3.2) whilst the State 1 controls bring the excursion back to norms i.e. large load transients caused by the site's electricity utilisation.
3	Failure of the CLS system or CLS has not been able to maintain control of the MEL limits as allowed for State 2.
4	Operation without a CLS. This would need prior agreement with the DNO and would need reviewing on a site-by-site basis. In its simplest form there may be generation on site that cannot physically generate enough to exceed a MEL and in this case a CLS would not be required, or this generator may not be required to be part of the CLS scheme.

9.1 Import / export control, G100 State 1 control – Profiling the site load using Modbus or analogue signal(s)

In this state the site electrical generation is profiled using the Device's logic controller PI(D) loop to maintain an import / export setting lower than the MEL. The value for the process variable (Amps) comes from the G100 Metering Panel via the CLS CP and can be delivered via Modbus or as analogue signal. This function means that the site's generation will have a higher utilisation rate as the generation can be turned down in a much finer granulation (normally ~0.1% granulation, but depends on the inverter / generator type), than would be achieved by tripping the Device off.

Profiling the site load obviously will involve tuning the PI(D) loop and this tuning will need to consider the speed that the Device can respond to the output commands. Inverters will be able to change their output rapidly, where-as a gas engine, especially using the Miller cycle, will take considerably longer to reduce their respective electrical outputs and thus reduce their current output. This speed of response also needs to be considered in concert with the site's electrical load changes induced by what the site is switching on and off. Whilst tuning will allow profiling to take place, where the site has a large transient load characteristic and the generator has a slow response time, then the control set point setting may need to be set considerably lower than the MEL. It might also be desirable for the site to consider power factor correction or any mechanism that can curtail kVARs and keep the ratio between the kVA and kWe as close as possible so that the power factor is kept close to unity to avoid having a high current flow, which will be seen by the CLS, and may lead to tripping or modulation of the Device to maintain the current lower than the MEL..

9.2 Import / export control, G100 State 1 – Cascading the Devices if there is more than one generator on site or more than one load to control

The intention of cascading the Devices (where there is more than one source of generation) is to reduce the current by tripping the lowest rated Device first and then monitoring the 'Connection Point' and tripping the next Device should the breach above the set point not be resolved, if it is resolved then further tripping is stopped and some generation is still allowed. As a basic description, the trip setting and time delay for this protection will be such that the MEL threshold and time will be higher than the settings for this control and the cascade rate will act faster and will thus keep any State 3 excursions in check.

Cascade control may be used to compliment the profiling control, or in place of the profiling control. In certain cases i.e. with Diesel or gas engines there will be a minimum turn down allowed (50% normally) and therefore further reductions in site generation can only be afforded by shutting down one of the engines.

The cascade rate is based on the number of Devices and the time allowed for the excursion above the MEL. The trip setting for the cascade trip will be lower and the time delay will be such that the overall cascade time to remove all Devices is less than the time allowed for a MEL excursion. Example:

There are 10 generators and the DNO applied trip setting is 5 seconds in this example. (G100 issued updates etc. are being ignored in this example). Therefore the maximum allowable time for the delay for the cascade trip is 0.5 seconds, with the last generator disconnecting at 5-seconds. Even 0.5 second might be considered too long as there will be some latency in the generator tripping its breaker or removing its electrical output (<100ms typically). This could be mitigated by using 0.4 seconds between cascade, which would be well within the required time criterion. Obviously the DNO has the final say on what settings will be prudent for the site in regards the DNO's wider network.

For cascade control, the Devices must reduce their output to 0 within a reasonable time. This reasonable amount of time being in the order of 100ms and certainly no longer than 500ms. If the Device 'trip' speed is considered excessive, then the allowable time between the cascades should be reduced.

For a single Device installation the cascade control can be used as an additional trip setting in concert with the other State 1 controls described in this section i.e. modulation of Device output.

9.3 Export control, G100 State 2 control – Tripping all the Devices

During State 1 control loss of modulation or curtailment of the generation to maintain the current below the desired MEL resulting in an excursion that does not breach the excursion time as per EREC G100/2 §4.3.2, but is longer in duration than 15-seconds is counted as an excursion. Excursions are dealt with in EREC G100/2 §4.5.1.3, and are summarised below:

Excursion criteria:

1. A single excursion into State 2 operation that persists for more than 1 minute (or 3 minutes as allowed in EREC G100/2 §4.3.2)
2. There are more than three excursions (each of more than 15-seconds and less than 1 minute (or 3 minutes as allowed in §4.3.2) into State 2 operation in any 24-hour period
3. The time between any two consecutive excursions into State 2 operation of greater than 15-seconds in 10 minutes or less (measured from the time of re-entry into State 1 operation from State 2 operation following the first excursion), or
4. For installations where the maximum excursion period is 3 minutes (as allowed in §4.3.2) the total time in State 2 operation in any 24 hour period, but neglecting any excursion of 15-seconds or less, exceeds 8 minutes.

There are two mechanisms for tripping all the Devices, the first is controlled by the CLS PLC and trips all the Devices if the threshold setting is breached for the time allowed, normally EREC G100/2 §4.3.2 time allowance for criteria 1. This is termed 'G100 trip' and if there should an excursion result from loss of site load or over generation for reasons unknown that have not been curtailed by modulation controls as in State 1. In this case the PLC will open the closed enable generation contacts for each Device instantaneously and will reduce the power generation set point to 0kWe / 0amps. This is an instant State 3 trip and requires a user reset to clear.

The time during the excursion above the initial 15-seconds will be recorded for excursion criteria 2,3,4. Should these criteria be breached then the CLS will enter into State 3 and will require user intervention.

The next trip is the "Reverse Power Relay" trip and this is issued from the RPR PLC. The component that carries out the reverse power function, albeit the trip may be required on an import threshold, is the Accuenergy Acuvim II power monitoring transducer / meter. This determines the kWe and current from the CT and VT voltage sense for LV connections and sends on this signal to the RPR PLC, via Modbus. This being an independent form of protection derived outside the scope of the CLS PLC. The time delay should be set such that this trip is in line with the EREC G100/2 §4.3.2 time and is the last trip mechanism. This is an instant State 3 trip and requires a user reset to clear. This trip should never activate as the other functions already described should have activated. The time delay is set in the RPR PLC.

9.4 Import / export control, G100 State 3 control – Failure of the CLS system or Components of the system

Should the CLS system fail then the generation on site will be inhibited from running. The CLS as a system has multiple fail safes that will result in a G100 State 3 condition. This being defined as no generation allowed for the generation under the control of the CLS system. The fail safes are described in §9.6 of this document.

9.5 Import / export control, G100 State 4 control – Operation without CLS system

Should the CLS be compromised then the site generation shall not be operated and the CLS should be repaired and tested so that it can be returned to State 1 operation. The CLS system will be in a fail-safe position (State 3).

Should State 4 operation be required then the site asset manager should speak with the DNO to form a solution, this is not within the scope of this document.

9.6 CLS System, Component fail safe and general alarms

To afford fail safe protection and G100 protection the following mechanisms are continuously monitored and assessed:

9.6.1 Communication between the G100 Meters (CLS Meter and Reverse Power Relay Meter)

The data is communicated as a Modbus signal and the PLC monitors the change of the clock in the Acuvim II meter, and on initial CLS PLC power on synchronises its seconds count with the Acuvim II's seconds' count. After this there should not be more than a 1 second difference between the two timers. Should the timers differ by too much then a communication alarm is issued. The difference

allowed is -3 to +4 with this difference needing to be present for 8 seconds and therefore determining the communications loss within 15-seconds as per EREC G100. The timer is re-synchronised every 60 seconds so that the clocks do not start to drift over time causing nuisance false trips. Should a communications loss occur then the PLC timer will continue to count where-as the Acuvim II's count will have stopped, once the difference between the two counts is more than 4 for a period 8 seconds then the communications alarm will activate.

There is also an additional monitor that looks at the Acuvim II's serial number, it should always be more than 0, if communications are lost, after a brief period ~6-7seconds, the register will default to 0 and this will trigger a loss of communications state (State 3). It should be noted that the 0 value only gets written when connected directly on Modbus TCP/IP, if via a gateway device then the gateway device may continue to send the last value that it received from the meter. This has been the case for the tGW-715 gateway device that we tested and was also the case for a Phoenix device that we tested. In reality only one communications mechanism is needed..

As per EREC G100/2 §4.5.2.2 the communications loss is auto resetting, albeit other conditions may have triggered due to the failure.

Alarm:



Note the alarm is self-resetting, but the screen latches to show what caused the error, press 'OK' to clear the latched screen.

Possible causes are wire break, wire short, meter power off or malfunction, loose connection or faulty RJ45 connector at meter or CLS PLC, faulty switch, faulty gateway device.

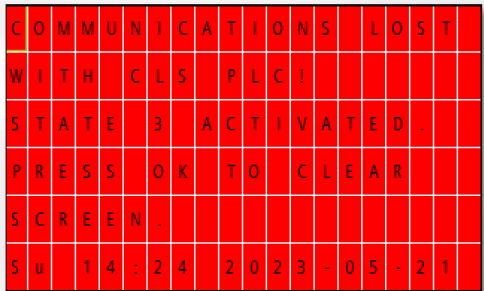
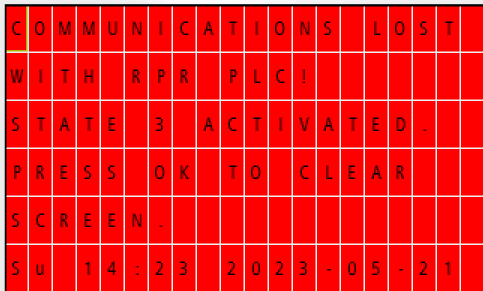
It may take up to 120-seconds to clear the loss of communications alarm once it is restored.

The CLS PLC and the Reverse Power PLC both monitor for loss of communications and will instigate a State 3 if a loss is detected.

9.6.2 Communications failure between the CLS PLC and the RPR PLC

The two PLCs poll each other's heartbeat that toggles a bit every 0.5 seconds. This bit acts on an edge triggered input that maintains an off delay timer (set at 14-seconds) from switching off. Should communications be lost then the heart beat will not keep the off delay timer from timing out and after 14 seconds the CLS will enter into a State 3. The system will reset once communications are back, however the screens will continue to show a fault until the 'OK' button is pressed.

Alarm screens, left CLS PLC, right RPR PLC alarm:



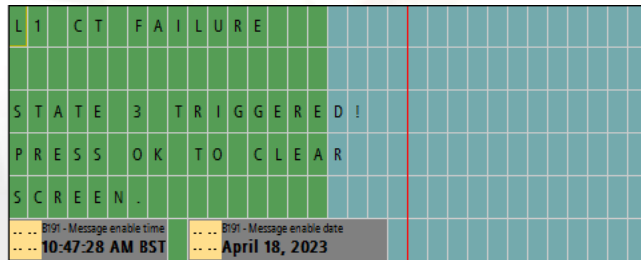
9.6.3 Communications failure for current transformer monitoring (CT failure)

The current transformers are monitored for loss of current flow down to the mA level. This is monitored on the Modbus connection to the PLC from the Acuvim II and has a Modbus exponent register that allows for 0 to 32767 monitoring with an exponent of /1000, /100/, /10, x10, x100. The PLC expects to see more than 0mA as it is highly unlikely that there will never be current flow across a phase unless there is a CT failure (open circuit) or the supply to that phase is lost, which would be an abnormal situation and will result in State 3 operation. Should the supply be lost to this phase then the voltage communications loss alarm for that phase will also be present.

The CLS PLC and the Reverse Power PLC both monitor for CT failure and will instigate a State 3 if a failure is detected.

As per EREC G100/2 §4.5.2.2 the communications loss is auto resetting, albeit other conditions may have triggered due to the failure.

Alarm (also available for L2 and L3).



Note the alarm is self-resetting, but the screen latches to show what caused the error, press 'OK' to clear the latched screen.

Possible causes are wire break, loss of communication with Acuvim II meter, meter power off or malfunction, CT failure or open circuit / loose wire, phase that the CT is monitoring is open circuit.

9.6.4 Loss of voltage sense communications failure

The Reverse Power Relay uses the voltage sense to determine the kWe in concert with the CTs. To avoid unduly burdening the voltage transformers the panel may be supplied by a local source, this being the power to keep the relay powered and not the voltage sense for kWe determination mechanism. To remain compliant with certain standards, i.e. 60204-1 / LVD, and OEM manufacturer's installation instructions, there are slow blow fuses on the voltage sense and installed door interlocked isolators to restrict access to the "layman". From this it would be possible to isolate the voltage sense supply or a fuse or VT could fail and you could lose one of the phases for voltage sense, the relay then interprets for that phase or all phases lost the following:

$$P = IV \text{ or } 20 \times 0 = 0. \text{ (20amps, 0volts [all phase] as an example for this illustration).}$$

As anything multiplied by 0 results in 0 then the relay will return a 0kWe value regardless of current flow and therefore the Reverse Power Relay will be compromised.

Loss of a VT or fuse on the voltage sense will result in loss of power sense on that phase or any number of phases that have lost their respective voltage sense. This is the case regardless of the CT direction as a loss of phase would give a potential 1/3 under read of the actual power, which could then result in breaching the agreed G100 trip set point, especially on export.

To mitigate this the CLS monitors the phase to neutral voltage and phase to phase voltages of all phases. Should the value fall below 180 volts for 14-seconds (<15-seconds as per that allowed in EREC G100/2), then the CLS will move into a State 3 condition. This '180 volts' value is out of the way of the G99 relay and will work for both LV and HV (HV ratio will have already been applied at the meter so will be in the kilo range) as it is to purely show a loss of voltage for that phase.

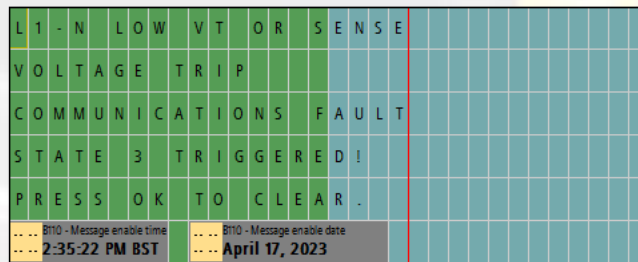
The voltage loss mechanism is not part of G99 and is not there to afford this protection, the G99 should be by separate Component that is not in the scope of this document.

The CLS PLC and the Reverse Power PLC both monitor for loss of voltage sense and will instigate a State 3 if a voltage sense is detected.

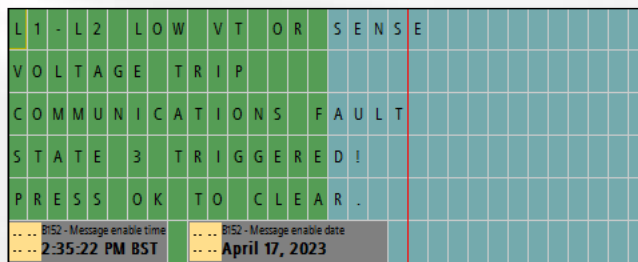
As per EREC G100/2 §4.5.2.2 the communications loss is auto resetting, albeit other conditions may have triggered due to the failure.

Alarm.

Alarm screens also exist for L2 and L2.



Alarm screens also exist for L2-L3 and L3-L1.



Note the alarm is self-resetting, but the screen latches to show what caused the error, press 'OK' to clear the latched screen.

Possible causes are wire break, loss of communication with Acuvim II meter, meter power off or malfunction, VT failure or open circuit / loose wire, phase that the VT is monitoring is open circuit, power loss to that phase from internal or external influence (DNO supply failure), blown sense fuse, faulty Acuvim II meter.

9.6.5 Communication loss between CLS and Device

The communications between the CLS and the Device for the main 'G100 trip' is a maintained normally open, energised closed for healthy that feeds back a signal to the Device to allow it to generate. Should the wire break, there be a malfunction or power loss at the CLS then the circuit will become open, and the Device will stop generation.

For State 1 and 2 controls the CLS will use analogue (via either 4-20mA or Modbus) to indicate the load or use digital controls to taper generation in a stepped manner as per the table below.

The table below is the Power Reduction Control as used on Solar Edge solar inverters and is an example of a generation reduction control for State 1 and 2 control that does not afford itself to analogue control due to the limitation of the inverter.

Input 1	Input 2	Input 3	Input 4	Maximum kWe output as %
0	0	0	0	0%
0	1	0	0	30%
0	0	1	0	60%
0	0	0	1	100%
1	0	0	0	0%

In all events an open circuit of the analogue or taper control digital signals will result in the generation either stopping or moving to its lowest output.

The CLS CP does not monitor upstream of the system and the alarm for loss of generation will be shown on the Device.

9.6.6 Reverse power trip from Reverse Power Relay

The G100 Metering has two Acuvim II meters, one is for CLS State 1,2,3 control and the other is dedicated for the Reverse Power Relay function. This communicates back to the Reverse Power PLC via a dedicated serial line and gateway that is independent of the CLS PLC's system.

The Reverse Power Relay (RPR) PLC monitors the communications, voltage, CT failure, in the same way as the CLS PLC, so has more functionality than a standard Reverse Power Relay, in reality it has the same functionality of the CLS PLC so sits in duplicate as a redundant system to trip generation should the CLS PLC fail.

This alarm is normally open, closed (maintained) when healthy, so therefore a wire break or loss of supply to the G100 Metering or RPR PLC will result in an open circuit, as would a wire break, all these events will move the CLS to Stage 3.

The G100 Metering RPR Meter independently monitors the kWe at the Connection Point and if the kWe breaches the internal set point of the 'Reverse Power Relay' for the time as per EREC G100/2 §4.3.2, then this alarm is issued (below), and the generation is stopped immediately and the CLS moves to State 3.

A general note on this setting is that it should be set that the CLS PLC has the main control and this is the last line of defence. This trip should not be normally invoked as the CLS PLC's reverse power trip setting should be set to activate before this trip.

From a settings point of view the trip value can be derived by using the stated MEL ampere rating and applying the following maths:

$MEL[amps] * \text{nominal volts L-L} * 1.732 * 0.9[\text{allowing some scope for PF}] = P$ (reverser power trip setting)

Example: The DNO has issued a MEL of 25 amps of export on a 11,000volts connected installation. We need to determine a reverse power trip setting and the maths would be:

$25 * 11000 * 1.732 * 0.9 = 428.7kWe$. Therefore the trip setting is 428kWe in the relay. The time delay could be as per EREC G100 §4.3.2, but the DNO may wish for this trip to be instant as per EREC G100 §4.5.3.1. The EREC G100/2-2 is not very clear on this one as you are allowed to have excursions above the MEL but are not allowed for the 'Reverse Power Relay'. We have interpreted G100 that G100 EREC §4.5.3.1 is written for non-failsafe CLS and the statement for HV connected installations would allow a timer to be present above the MEL to allow for State 2 excursions otherwise what is the point of G100 EREC §4.3.2.

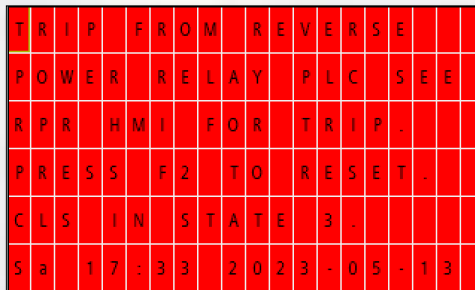
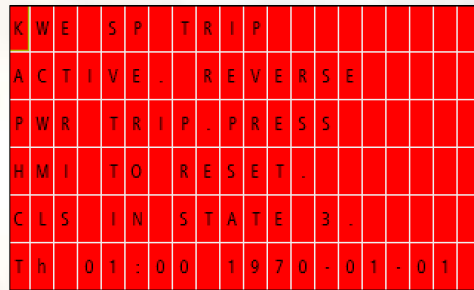
Additionally G100 EREC §4.5.3.1 does not provide guidance, scope or any more information on the setting of the Reverse Power Relay and therefore the maths provided above, especially the PF component will be based on a discussion between the DNO and the nominated G100 CLS test engineer.

It is also possible to set the RPR PLC to trip on average current, as well as kWe.

Alarm on RPR PLC current (amps) trip left, kWe set point breached trip right, trip that is shown on the CLS HMI bottom.

It is required that the RPR PLC's integral HMI be viewed for the specific alarm, and this is within the panel.

The trip can be reset by pressing F2 on the mains door mounted HMI.



9.6.7 G100 cascade inverters

Future use.

9.6.8 Constraint 1 active - load limited to Constraint 1 setting

Future use if not in Device control, i.e. mixed schemes and solar PV schemes.

9.6.9 Constraint 2 active - generation inhibited.

Future use if not in Device control, i.e. mixed schemes and solar PV schemes.

9.6.10 Excursion lockouts

During State 1 control, loss of modulation or curtailment of the generation to maintain the current below the desired MEL resulting in an excursion that does not breach the excursion time as per EREC G100/2 §4.3.2 but is longer in duration than 15-seconds is counted as an excursion. Excursions are dealt with in EREC G100/2 §4.5.1.3, and are summarised below:

Excursion criteria:

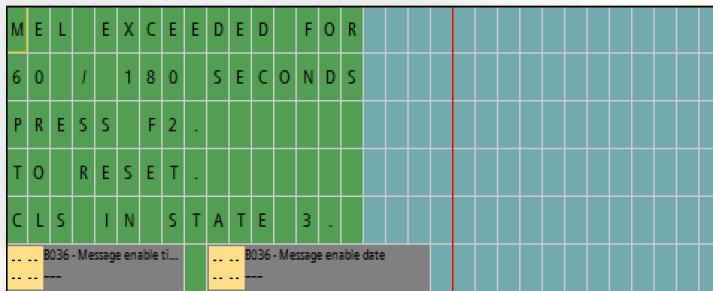
1. A single excursion into State 2 operation that persists for more than 1 minute (or 3 minutes as allowed in EREC G100/2 §4.3.2)
2. There are more than three excursions (each of more than 15-seconds and less than 1 minute (or 3 minutes as allowed in EREC G100/2 §4.3.2) into State 2 operation in any 24-hour period
3. The time between any two consecutive excursions into State 2 operation of greater than 15-seconds in 10 minutes or less (measured from the time of re-entry into State 1 operation from State 2 operation following the first excursion), or
4. For installations where the maximum excursion period is 3 minutes (as allowed in §4.3.2) the total time in State 2 operation in any 24 hour period, but neglecting any excursion of 15-seconds or less, exceeds 8 minutes.

Note a State 3 condition that is caused by an excursion causes the CLS PLC to lock the reset button for 4-hours. This is detailed in §4.5.2.1. Communications failures are not part of this process and will reset or require resetting once they have entered the healthy condition.

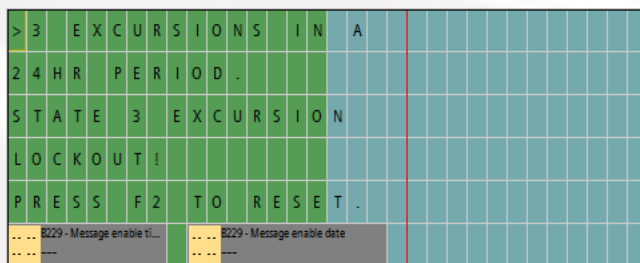
For excursion criteria 1 the CLS PLC trips all the Devices if the threshold setting is breached for the time allowed, normally based on EREC G100/2 §4.3.2 time allowance for criteria 1. (60 / 180 seconds depending on the Device).

This is a State 3 trip and requires a user reset to clear.

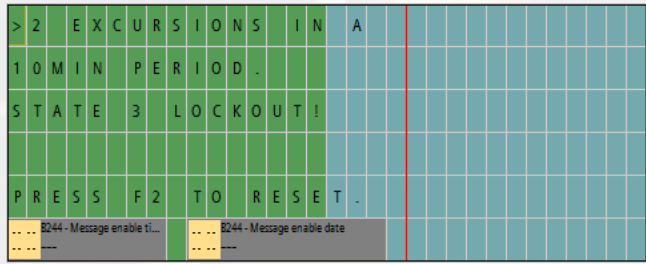
The time during the excursion above the initial 15-seconds will be recorded for excursion criteria 2,3,4. Should these criteria be breached then the CLS will enter State 3 and will require user intervention.



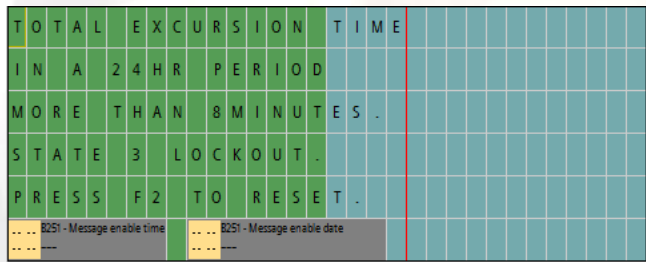
For excursion criteria 2 the CLS PLC monitors each excursion in a continuously rolling 24hr window and should there be more than 3 excursions i.e. 4, then the CLS will move to State 3 excursion lockout and the alarm screen below will show.



For excursion criteria 3 the CLS PLC monitors for an excursion into State 2 and should this occur it starts a 10-minute timer after the excursion has ended and should there be another excursion within this 10-minute window then the CLS will move to State 3 excursion lockout and the alarm screen below will show.



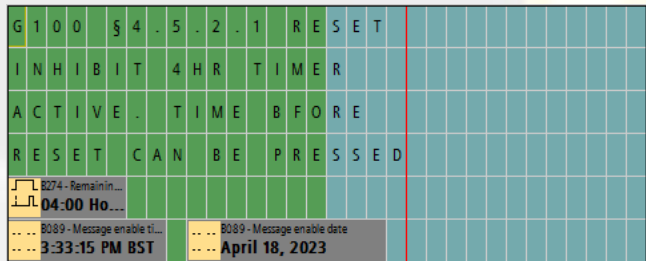
For excursion criteria 4 the CLS PLC monitors each excursion in a continuously rolling 24hr window and should there be more than 480-seconds (8-minutes) within one of the rolling 24hr windows then the CLS will move to State 3 excursion lockout and the alarm screen below will show.



As per EREC G100/2 §4.5.1.3 all excursion timers, lock out alarms are stored in non-volatile memory to ensure that the states are maintained in the event of a CLS PLC loss of supply and subsequent restoration of supply.

9.6.11 4-hour reset inhibit timer

As per EREC G100/2 §4.5.2.1 it is not possible in a non-domestic installation to reset a State 3 latch without waiting 4 hours. The PLC starts a timer once the State 3 is entered and a warning / indication screen is issued on the HMI as per below, this details that the reset inhibit is active and shows the amount of time remaining that the user will need to wait.



The CLS as described in this document is not intended for domestic installations.

All Excursion timed data and latched state are stored in retentive memory as per the Siemens PLC for storing memory items into non-volatile storage so that the latch or timed criteria is remembered should the PLC / CLS be power cycled.

10 Features

The CLS system (G100 Metering Panel and CLS CP) range offers the following features:

- Quality micro program logic controller from Siemens for control of the system. Extremely reliable. Over 5,000,000 sold
- Low stand-by power consumption
- Software may be quickly altered for bespoke project requirements
- Alarms are time and date stamped
- Modbus TCP or serial
- Embedded Web server off PLC
- Additional grid code functions can be added such as LFSM-O control, DNO Constraints etc.
- Modbus control of inverters or generating assets or loads for State 1 control
- Connection to site's 'Connection point' (incomer) can be done using simple split CTs on existing CT wiring meaning that intrusive work is not required and CT burden is not a consideration
- G100 control using our equipment / logic installed in over 100MWe of embedded generation.

11 Installation and Location

The panel's dimensions are (typically):

G100 Metering Panel: 400mm wide, 400mm high and 210mm depth. The panel weighs ~25kg.

CLS Control Panel: 600mm wide, 600mm high and 300mm depth. The panel weighs ~35kg.

Combined CLS CP and G100 Metering Panel: 800mm wide, 600mm high and 300mm depth. The panel weighs ~45kg.

The panel should be installed on a wall that is true with suitable fixings to support the weight of the panel, taking into account the risk of additional weight being applied during the installation of cabling etc. The wall should be dry and free from damp.

If the panel is not fixed to the wall in a true / plumb fashion, or the wall is not flat, then the body of the panel may twist, and the door interlocked isolator may struggle to marry with the door mounted handle and the IP rating of the panel may be compromised.

11.1.1 Installation environmental factors

The installation location should take into account the following factors for the panel.

- Protection against extreme ambient temperatures.

The panel's operating temperature envelope is 0°C to 60°C.

- Commissioning / user access.

Access to the panel is via the front panel door, access should be such that an operative may fully open the door and can comfortably work on the panel.

- Humidity.

The environment that the panel is installed in should not have a high level of humidity that could lead to condensate entering the panel.

- Ultra Violet consideration.

The panel should be protected against prolonged exposure to UV light. The HMI will be damaged if left in direct sunlight for prolonged lengths of time. With all products that have external plastic components, UV over prolonged exposure will degrade the plastic parts and lead to them cracking and becoming brittle.

- Dust ingress.

The panel should not be installed where high levels of dust are present.

- IP rating of panel for environment.

The panel is designed and built to the rating of IP54. The panel is designed for indoor use only, in an environment that will not give rise to water getting onto the panel in quantities above that afforded by IP54 protection. IP54 offers protection from most dust particles, but not completely dust proof and water splashing onto the enclosure from any direction.

- Protection from excessive vibration / shock.

The panel should not be subject to excessive vibration, shock, or aggressive movement. The panel is intended to be used in a fixed location. Where the panel is to be installed in a containerised installation that may be moved from one place to another then the electrical connections should be checked every time the container is moved.

- Accidental damage, vermin, and vandalism.

The panel should be installed in a location giving sufficient protection from accidental damage. Consideration should be given for areas where vehicles have access, and the area should have sufficient protection to allow persons to work on the panel without risk of impact from vehicle movements.

Vermin control should be in place. The panel should not be installed where insects will be able to enter the panel.

The panel should not be installed where it may be subject to vandalism.

11.2 Welding around the panel

Welding should be avoided around the panel. The earth conductors in the panel are designed to cope with the earth fault currents that would result from an internal component fault, not welding currents from badly placed welding clamps. Damage may occur to the earthing conductors within the panel if welding is carried out around the panel.

The main issue is the large currents generated when welding that have the potential to burn out cabling within the panel if a welding earth clamp is badly placed.

11.3 Electrical Connections

The electrical connections for the panels should be made off in compliance to the local regulations. The biggest cross-sectional area (CSA) of the cable that the panel can accommodate at the termination point is 4mm² for the VT, CT and auxiliary connections. The Device control terminals are limited to a 4mm².

The 400 (3-phase voltage sense) volt electrical connection to the panel is direct onto 2-Q1. This being the mains isolator for the panel and capable of carrying 25 amps. The earth connections are direct onto the panel's earth terminal block next to 2-Q1. The capacity of the supply feeding the panel should be no smaller than 10 amps 'C' type curve and no bigger than 16 amps or if on a fused spur connector, 13 amps using BS1362 fuses.

The MCBs in the panel are to the following standards:

IEC / EN 60947-2 and IEC / EN 60898. The maximum prospective fault current that the panel can cope with is 6kA as per EN 60898.

All MCBs are short termed rated to 10kA to exceed our 6kA stipulation.

The output contacts for the Device control (Device trip) are volt free and are rated to 5 amps resistive load and 0.5 amps reactive load (reactive loads will reduce contact life and are non-desirable).

The mixing up of voltages with the client's system and the CLS CP's system could damage the equipment on site so please use caution when connecting cables.

CAUTION: The connections for the panel's 400 volt AC supply are supplied on terminal blocks near the client connections. The supply for the panel should be isolated prior to installing.

The cable entry to the panel is via the gland plate at the bottom of the panel. It is down to the installer to use the correct cable glanding and termination technique to maintain IP54 and any regulatory or legislative requirements. The installer should not gland cables into the top of the panel. Gland plates should be removed for drilling.

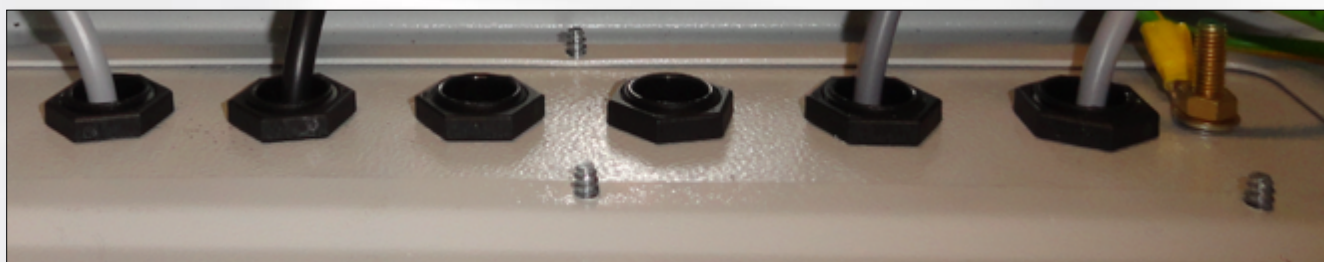


Figure 1. Site electrical connection (example).

Project specific terminations will be issued via cable schedules, Block Cable Diagrams (BCD), electrical panel schematics.

G100 metering connections should be in-line with the G100/2 criteria as set out in EREC G100/2 §4.2. The CT connections will be project specific with a connection point as close to the 'Connection point', if using "Split type" CTs then the CT should be suitably supported.

11.4 EMC considerations

To reduce the possibility of failure or mal-operation due to the effects of conducted and radiated electro-magnetic interference, the panel should be installed in accordance to the guidelines described in this section. The details below give consideration from both view points of the panel interfering with field devices and field devices interfering with the panel.

11.4.1 Field instrumentation

Instruments and other field devices should be installed and cabled in accordance with the manufacturer's recommendations, paying particular attention to any EMC requirements. The panel does not pose any significant risk of interfering with other devices when used and installed correctly.

11.4.2 Cabling

Cables should be grouped according to the voltage carried and presence of any high frequency interfering currents. This generally leads to three groups:

1. Low voltage. Instrumentation cabling
2. High voltage. Power supply and alternator 3-phase cabling
3. Interfering. Inverter drive outputs or high voltage switched outputs.

As far as possible these three groups should be run in separate cable trays or trunking. The minimum separation between groups 1 and 2 or 2 and 3 is 300mm. The minimum separation between groups 1 and 3 is 600mm. Where separation is not possible (e.g. as the cable exits a panel) the groups of cables shall not be run together for no more than 300mm and should be separated as soon as leaving the panel. Where cable runs must cross when in close proximity, they should cross at 90 degrees. All cable routes should be as short as possible.

11.4.3 Emissions from ancillary equipment

By its nature, the panel will normally operate in close proximity to electrical plant such as generator sets, variable speed drives for pumps and cooling fans etc. These have the potential to emit radiated interference. While the control panel is not unduly susceptible to the radiated emissions from other equipment, it is important that sensible precautions are taken to prevent interference as follows:

- All ancillary equipment must be installed in accordance with the manufacturer's EMC recommendations, particularly those regarding enclosures, cable shielding and earthing requirements.
- The door of the panel should be kept shut at all times and should only be opened for specific maintenance tasks.

12 Technical Data – G100 Metering Panel and CLS CP

Description	G100 Metering Panel	CLS Control Panel	Other
Voltage power supply *1	230 V.AC	230 V.AC	45 - 65 Hz
Voltage control circuits	N/A	24 V.DC	
Electrical power consumption (stand-by)	5 Watts	~25 Watts	
Current consumption	0.03 amp (maximum)	0.07 amp (maximum)	@230V.AC
Weight	~25kg	~35kg	
Minimum ambient temperature	0°C	0°C	
Maximum ambient temperature	60°C	60°C	
Humidity	5% to 85% non-condensing	5% to 85% non-condensing	Control panel doors closed and cable entries to required IP rating of IP54 or above
Site connections maximum voltage, pulse / disable generation control	230 V.AC	230 V.AC	24 volt preferred
Site connections maximum current, pulse / disable generation control	100 mA resistive (reactive not allowed)	5 amp resistive (0.5 amp reactive)	Reactive switching is non-desirable
Modbus	RTU Serial / TCP/IP	TCP/IP (RTU serial option available on request, with suitable gateway device)	Other protocols on request by suitable gateway or meter / PLC add-on
Meter / logic controller	Accuenergy Acuvim II	Siemens LOGO 8.3	
IP rating	IP54	IP54	BS EN 60529:1992. Higher rated panels by special order
Duty rating	S1 Continuous	S1 Continuous	
Current transformer split core primary current (per channel)	5 amp (maximum)	N/A	CT on CT wiring type, 0.333 volts CT
Current transformer split core secondary voltage (per channel)	0.333 volt	N/A	CT on CT wiring type, 0.333 volts CT
Current transformer direct connection (per channel)	5 amp (maximum)	N/A	If using direct connection CTs
Current transformer burden (per channel)	0.05VA @ 5 amp RMS (directly connected CTs, split 0.333 volt CTs are negligible burden)	N/A	When wired to directly connected CTs, if split core 0.333 volt then burden is non-applicable *2
Withstand current CT connections (per channel)	20 amp RMS continuous	N/A	
	100 amp RMS for 1 second, non-recurring		
CT accuracy (per channel)	0.2% full scale	N/A	
Voltage sense nominal maximum	400 V.AC L-N, 690 V.AC L-L	N/A	RMS value
Voltage sense maximum withstand	1500 V.AC continuous	N/A	RMS value. Electrical insulation resistance testing not permitted on the meter
	3250 V.AC 50/60 Hz for 1 minute, non-recurring		
Voltage sense input impedance (per phase)	2 Mega ohms	N/A	
Voltage sense burden (per phase) @110volts L-L *3	0.011 VA	N/A	±10%
Voltage sense burden (per phase) @400volts L-L*3	0.14 VA	N/A	±10%
Voltage sense accuracy	0.2% full scale	N/A	
Power accuracy	0.2% full scale	N/A	
Power resolution	1 Watt	4-20mA range divided by 800 = resolution*4	LOGO to Device controller
Control loop speed of operation	100 milli-second analogue output update rate	250 milli-second, PLC loop cycle and relay change state time	Maximum overall time, worst case 350 milli-seconds. Generating asset time to respond not included

Power and current consumption values are at 50 Hz. Panels available that will operate at 60 Hz by special order.

*1System designed for UK and European electricity networks and are RMS values.

*2Split core 0.333 volt CTs cannot be run in series with other meters and must be wired directly to the G100 Metering Panel.

*3Calculated by the following: Voltage (L-L) / Impedance = amps. Voltage L-L * 1.732 * amps = Burden in Watts with PF assumed as 1 so Watts = VA.

*4Expressed worst case. Example: 4mA = -200kWe and 20mA = 2000kWe, therefore the range between the two values is 2200kWe. 2200kWe / 800 = 2.75kWe of resolution. The lower the range the better resolution.

Additional information on the Acuvim II meter can be found in the Accuenergy manual Document #1040E2203 "Acuvim II Series Power Meter User's Manual".

13 CT and VT Burden Declaration

Where a G100 Metering Panel is to be connected to the site's metering point directly then the G100 Metering Panel's voltage and current sense circuits will place an additional burden on the site's metering equipment. This section details the burden that the site metering will be subjected to. Note panel might be combined with the CLS panel.

CT Burden:

There are two ways that the site's current (amperage) monitoring can be undertaken.

Method 1: CTs wired direct into the existing CT wiring.

Method 2: CTs on the existing CT circuit (special clamp on CTs).

With method 1 there is a burden that will be applied from the G100 Metering Panel's meter including any associated cabling from the CT to the G100 Metering Panel's meter as the cabling will sit in series with the existing CT wiring.

With method 2 there is negligible burden placed on the circuits as the new special CTs clamp around the existing CT wiring so that the CT wiring does not need disturbing nor does the meter or cabling sit in series with the existing CT wiring. The CT turns the 0-5 amp signal in the existing CT secondary wiring into a 0-333mV signal, which is used by the G100 Meter in place of the 0-5 amp signal from conventional CTs.

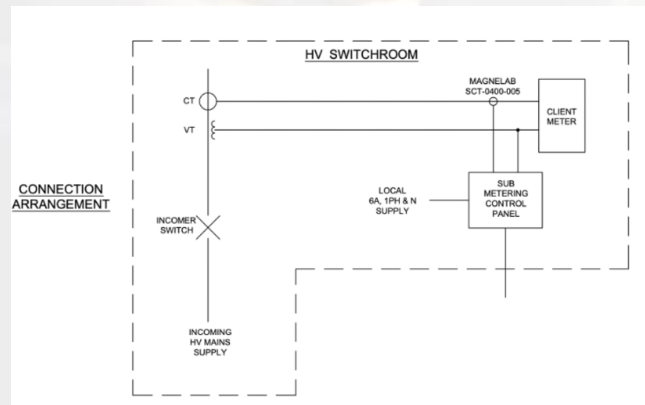


Figure 2. G100 Metering Panel connections (showing only a single-phase connection for clarity)

CT installation method 1 burden (excluding the cabling): **0.05VA per phase. Cabling needs to be factored in for its impedance on the circuit.**

CT installation method 2 burden: **Burden is non-applicable due to the CT having no electrical connection to the CT wiring and the burden imposed by the magnetic change of flux through the new CT is negligible.**

VT burden:

The G100 Metering Panel can be supplied from the VTs or from a separate supply. The actual VT burden will increase if the G100 Metering Panel is supplied off the VTs.

Burden if G100 Metering Panel is supplied off the VTs: **2.511 VA per phase @ 110 volts L-L.**

2.511 VA is to supply the meter and the impedance of the voltage sense circuit.

Burden if G100 Metering Panel is not supplied off the VTs: **0.011 VA per phase @ 110 volts L-L.**

0.011 VA is the voltage sense circuit only.

Burden of VT is calculated as per the statement in §12.

Where the voltage sense is connected direct i.e. LV connected site, then the burden is 2.64 VA per phase if powering the meter and 0.14 VA if just doing the voltage sense only.

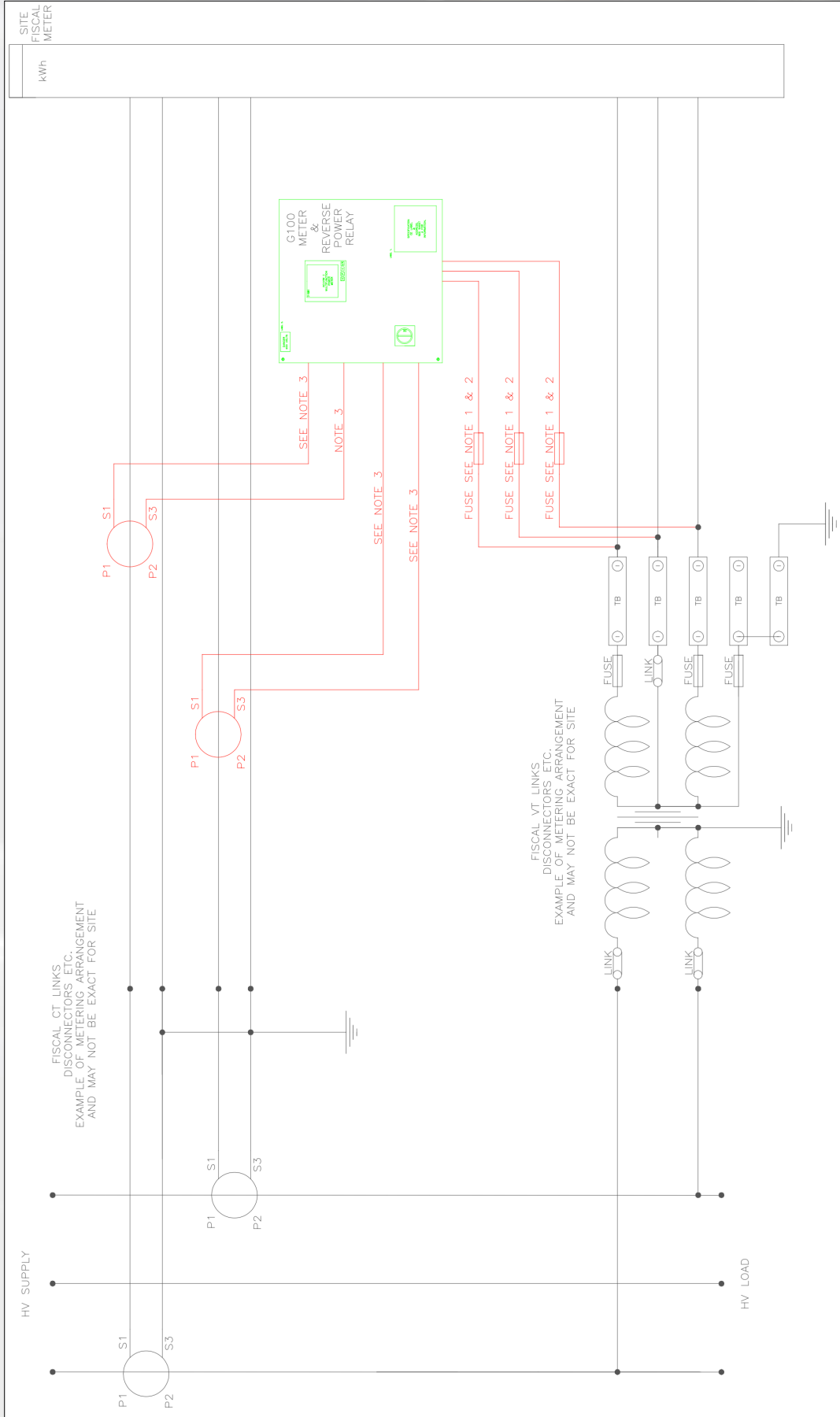
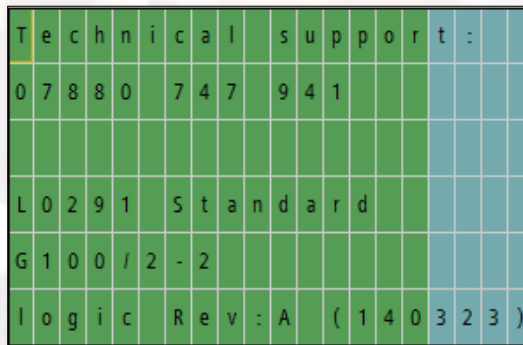


Figure 3. Example of split (0.333volt) CT on CT wiring for HV connected sites picking up current and voltage from Fiscal metering.

14 Siemens LOGO PLC (CLS PLC)

The CLS control panel has one 6ED 1052-1MD08-0BA1 Siemens LOGO PLC controller that performs the logic as described in this document. This is fitted in the control panel that is located in the LV or HV switch room, or near to the site's electrical Incomer from the DNO's Connection Point.

PLC Logic version can be found on the bottom screen of the TDE HMI:



Current version is: L0291 Revision A.



Figure 4 LOGO PLC base module with LCD display.

Conveyance of what the PLC logic is doing is expressed to the user via the following mediums:

1. PLC LCD base module display (Figure 4 LOGO PLC base module with LCD display).
2. HMI TDE panel door mounted display (Figure 5 LOGO TDE HMI display, door mounted on control panel. (Text in display is an example).
3. Digital volt free fault outputs
4. Modbus TCP/IP
5. Web browser accessing the LOGO's embedded Webserver.

14.1 Siemens LOGO TDE HMI

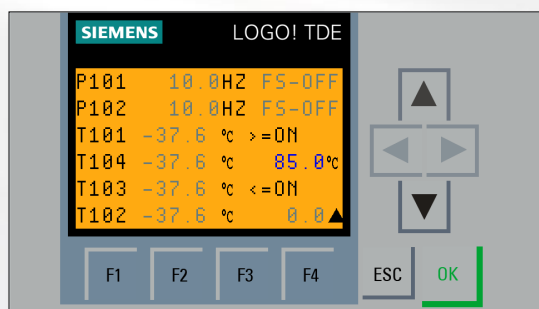
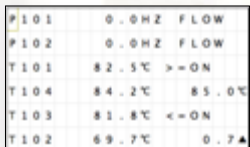


Figure 5 LOGO TDE HMI display, door mounted on control panel. (Text in display is an example).

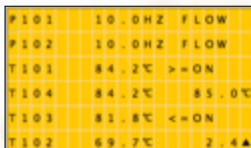
The picture above shows the Siemens LOGO TDE HMI display with the function keys underneath the display. This display gives conveyance of logic operation and error information for user conveyance.

Additional conveyance is given by the colour of the display's backlight. The colours change based on what the PLC is doing, the colours represent the following:



P101	0.0HZ	FLOW
P102	0.0HZ	FLOW
T101	82.5°C	>=ON
T104	84.2°C	85.0°C
T103	81.8°C	<=ON
T102	69.7°C	0.7A

- White: Healthy, no issues detected.



P101	10.0HZ	FLOW
P102	10.0HZ	FLOW
T101	84.2°C	>=ON
T104	84.2°C	85.0°C
T103	81.8°C	<=ON
T102	69.7°C	2.4A

- Amber: MEL limit breached, trip timer active.
- Red: Communications failure for voltage sense, current sense (CT), Modbus link from the power measurement module communications loss (Acuvim II meter), MEL breached for agreed period of time [EREC G100 4.3.2 definition], excursion lockout. Basically a red display is indicating that the Device(s) have been inhibited from producing electricity i.e. State 3.



P-101	OFF
P-102	OFF
STATUS: FAULT	
MODE: P-102 VSD	
FAULT: ALL PUMP	
OPERATIONS OFF	

As an elaboration:

White = all systems healthy.

Amber = MEL limit breached but timer not expired [State 2].

Red = any fault / alarm that is considered critical for the reliable, efficient and safe operation of the Power Modulation logic.

If there is no back light then this is indicative of a fault, probably the PLC's power supply is off. The Device(s) will be in State 3 operation for this condition as the G100 trip is a maintained normally open contact that is held closed to indicate a healthy state.

14.1.1 PLC I/O

PLC I/O.	
Inputs (Digital)	
1	Spare
2	Spare
3	Spare
4	Spare
5	Spare
6	Spare
7	Spare
8	Spare
Outputs (Digital)	
1	Hard stop to gen-set (closed when healthy) – G100 trip Device
2	Hard stop to gen-set (closed when healthy) – G100 trip Device
3	Hard stop to gen-set (closed when healthy) – G100 trip, used for testing
4	Hard stop to gen-set (closed when healthy) – G100 trip, spare
Analogue (Inputs)	
1	Spare
2	Spare
3	Spare
4	Spare
5	Spare
6	Spare
7	Spare
8	Spare
Analogue (Outputs)	
1	Site average current for the site Incomer (4-20mA output = to be set during commissioning)
2	Site kWe for the site Incomer (4-20mA output = to be set during commissioning)
3	Spare
4	Spare
5	Spare
6	Spare

15 Logic

The CLS PLC carries out two functions, these being:

- G100 export prevention compliance
- Conveying on the site incoming average current to the Device for State 1 control, or for implementing State 1 control if the Device is not capable of doing this.

Below is a basic graphical representation of a typical CLS scheme.

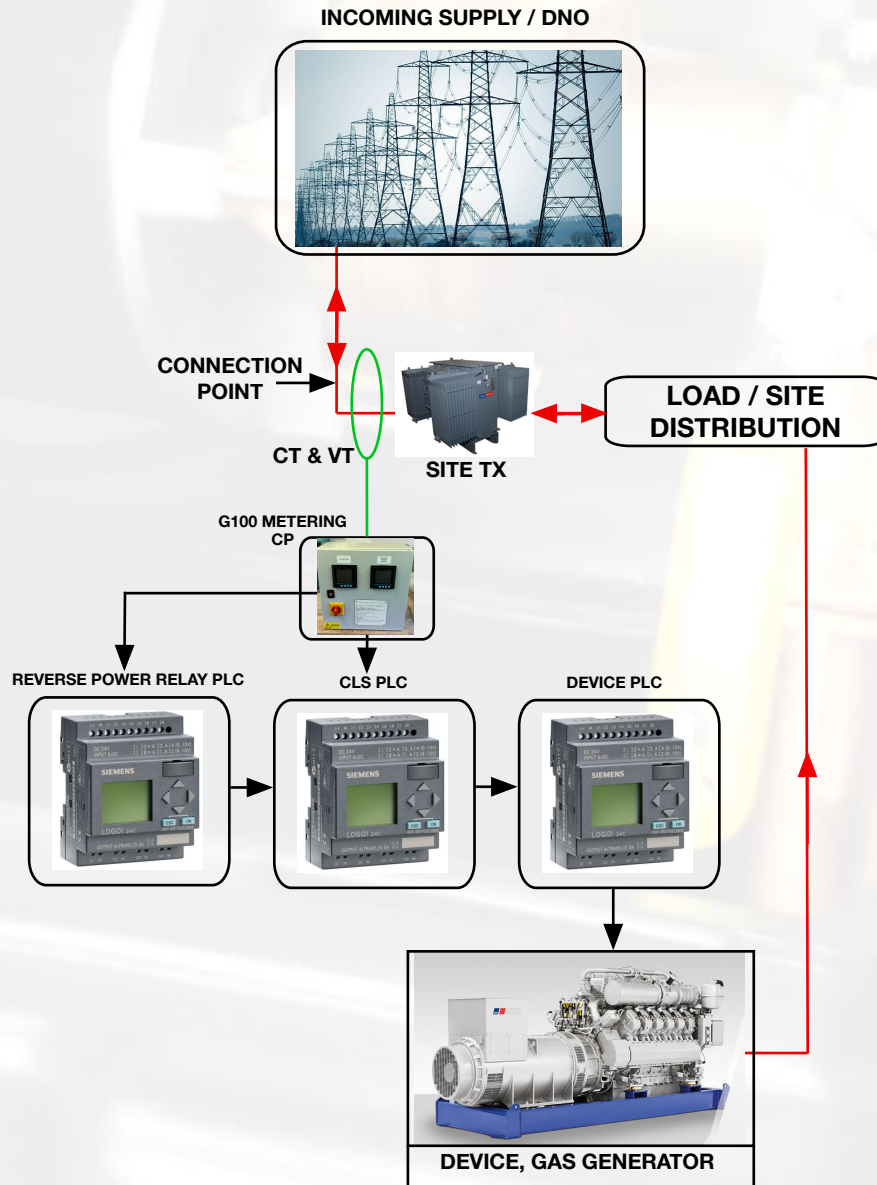


Figure 6. CLS connected to HV supply. Typical example. This being the conceptual representation as per EREC G100 §4.1.

15.1 Modbus Signals from the G100 Meters (Acuvim II Meters)

The CLS PLC receives the average current as defined by the Acuvim II meter, via a Modbus connection, which is continuously polled to ascertain the latest value.

There are several other values that we require from the meter to allow for G100/2-2 compliance. These are:

Current L1 (used for CT communications failure)

Current L2 (used for CT communications failure)

Current L3 (used for CT communications failure)

Current average across all 3-phases (used for State 1 and State 2 control and to monitor and record excursions and instigation of State 3)

Current exponent value (used for current monitoring from the mA range up to 32767amps)

Voltage L1 (used for voltage communications failure)

Voltage L2 (used for voltage communications failure)

Voltage L3 (used for voltage communications failure)

Voltage L1-L2 (used for voltage communications failure)

Voltage L2-L3 (used for voltage communications failure)

Voltage L3-L1 (used for voltage communications failure)

Voltage exponent value (used for voltage communications failure to express a voltage from 0 to 20000)

Total kWe (used for indication and tertiary reverse power trip)

kWe exponent value (used for kWe to express from 0 to 32767)

Frequency (not required but used for indication and future FFR or other projects)

Meter serial number first register (Modbus from meter to CLS PLC communication monitoring)

Meter time second register (Modbus from meter to CLS PLC communication monitoring)

For the purposes of EREC G100/2 the current flow is the control variable and whilst ENA have not defined what type of current they wish monitoring i.e. it is vague and open to interpretation then we have reasoned that they want an average of the 3 phases.

15.1.1 Device and CLS PLC Interface

The Device control system and the CLS PLC share the roll of profiling the site's electrical load in the following ways:

Device system does the following:

- Monitors the mA signal coming from the CLS PLC and should this fall below the agreed current (amps) set point then the load will be lowered to maintain the correct current flow for export / import using the Device's 'PID' loop. The setting will be set so that there is sufficient headroom between the modulation control and the MEL.
- The Device will stop the generation should the load drop below the predetermined set point after a specific time has elapsed. This setting should be set with sufficient headroom below and above to allow modulation to take place and to avoid excursions that breach the MEL limit.
- Device can start the generation if the load goes above a set point, normally termed 'Start level' for the time 'Start delay'. This is to ensure that there is sufficient load on site to avoid starting the Device without sufficient load that does not start frequent start / stopping or excursions of the MEL.

The CLS PLC does the following:

- Monitors the electrical Incomer, ranges the mA output value and then sends onto the Device control system.
- G100/2 compliance logic including monitoring and lockout on excursions.
- Constraint logic (if used).
- Offers a datum platform should the power modulation routine be complicated by dual incomers or two gas gen-sets or any of the other flavours of power modulation i.e. easy to add bespoke applications.

15.2 G100 Export Prevention Compliance

The CLS PLC will open Q2, Q3 and Q4 should the G100 logic become active to prevent export. The CLS HMI screen will turn red and the relevant alarm message will show on the CLS HMI. The Device in this case will hard stop as per the G100 criteria.

The various alarms states of the CLS are described in §9 of this document.

The RPR PLC will also issue a stop signal if it detects a breach for the pre-determined amount of time. This is communicated to the CLS PLC and the Devices in concert with any CLS derived alarms.

A	C	U	V	I	M	C	O	M	M	U	N	I	C	A	T	I	O	N
S	e	r	i	a	l	N	o	:									0	
S	e	c	o	n	d	s	c	o	u	n	t	:						
					0	A	c	u	v	i	m	I	I					
				3	0	L	O	G	O	C	L	S	P	L	C			
				3	0	D	I	F	F	E	R	E	N	C	E			

The screen above is showing the state of the communications between the Acuvim II meter and the CLS PLC. In the example above the Acuvim II is not connected and therefore we are seeing a 0 for the serial number, which would instigate a communications alarm and the synchronised clocks for the CLS PLC and the Acuvim are out of step and thus would also trigger a communications alarm. The communications alarm and mechanism are described more in §9.6.1 of this document.

E	X	C	U	R	S	I	O	N	S	>	3	I	N	2	4	H																				
2	4	H	1	T	R	I	G	G	E	R	S	+	=	B	1	0	8	-	A	q	a	m	p	l	i	f	i	e	d							
												A	→																							
2	4	H	2	T	R	I	G	G	E	R	S	+	=	B	1	0	9	-	A	q	a	m	p	l	i	f	i	e	d							
												A	→																							
2	4	H	1																																	
2	4	H	3																																	

The screen above is for indication of the current excursions for the criteria “More than 3 excursions in a 24-hour period”.

The logic is such that the PLC monitors for excursions above the MEL and if the breach exceeds 15-seconds then this is classed as a trigger. There are 3 trigger windows, which once instigated start independent 24hr timers so that excursion MEL breaches during this 24hr window are monitored. There is no requirement to have more than 3 windows as any more than this will lead to a State 3 excursion lockout based on the excursion lockout of more than 3 excursions in a 24-hr period.

This process of having 3 independent windows allows for a rolling 24hr window that tracks excursions and times.

The triggers are the number of recorded excursions in this timer window, the 24H1 times is the time remaining for this window before the excursions in this window are reset.

The values are stored in non-volatile memory and will remain after power cycling of the PLC.

E	X	C	U	R	S	I	O	N	S	>	2	I	N	1	0	M	
E	X	C	U	R	S	I	O	N	T	R	I	G	G	E	R	E	D
I	N	L	A	S	T	1	0	M	I	N	:	N	O				
T	R	I	G	G	E	R	T	I	M	E							
R	E	M	A	I	N	I	N	G	:	0	0	:	0	0	m		

The screen above is for indication of the current excursions for the criteria “More than 2 excursions in a 10 minute period”.

Line 3 shows if an excursion has been seen within the last 10-minutes and line 5 is showing the remaining time from the 10-minute timer that was started when the first MEL breach was exited. For an excursion to trigger the MEL needs to be breached for more than 15-seconds, MEL breaches below this limit are ignored.

The values are stored in non-volatile memory and will remain after power cycling of the PLC.

E	X	C	U	R	S	I	O	N	S	>	8	M	I	N	I	N	2	4	H	R	S	(4	8	0	s)
W	I	N	D	O	W	1	:			↕	B249 - Counter	S	E	C	S												
										+/-	0																
W	I	N	D	O	W	2	:			↕	B263 - Counter	S	E	C	S												
										+/-	0																
W	I	N	D	O	W	3	:			↕	B273 - Counter	S	E	C	S												
										+/-	0																
W	I	N	D	O	W	4	:			↕	B086 - Counter	S	E	C	S												
										+/-	0																
W	I	N	D	O	W	5	:			↕	B099 - Counter	S	E	C	S												
										+/-	0																

The screen above is for indication of the current excursions for the criteria of “MEL breaches totalling 8 minutes in a rolling 24-hour period”. For an excursion to trigger the MEL needs to be breached for more than 15-seconds, MEL breaches below this limit are ignored.

There are 5 windows for monitoring and maintaining MEL breach times, should there be more than 3 breaches then the CLS will enter State 3 as per the more than 3 excursions criteria.



Every time there is a MEL breach a new 24-hour timer window is started that records the duration of the breach. If another breach occurs another timer window is started, and this breach time is recorded in this new window and added to the breach time in the previous window. Should the breach exceed 480 seconds (8 minutes) then the CLS will enter the State 3 excursion lockout. Should the 24-hour timer window expire then the breach time for that window will be reset to 0 and this window is now available for monitoring additional breach times.

The values are stored in non-volatile memory and will remain after power cycling of the PLC.


```

A D J U S T M E N T   S C R E E N S
A V A I L A B L E   F O R : 0 0 : 0 0 m
F 4   T O   E X I T
A D J U S T M E N T S .
  
```



```

I N S T A N T   A M P S   T R I P   F O R   G 1 0 0 .
I F   T H E   A M P S   G O   B E L O W
B E L O W :  B011 - On -5   A M P S
F O R :  B034 - Off-Delay 60:00 Se...
T H E N   A   H A R D   T R I P
O F   T H E   D E V I C E   S H O U L D   O C C U R .
  
```

The screen above should not be adjusted after initial set-up, as these are the figures that were agreed with the DNO when it was tested. For the example above the site electrical export of current flow needs to breach -5 amps for 60 seconds [EREC G100/2 §4.5.1.3]and then the G100 trip logic will activate opening the various outputs and signals to stop the Device(s) and instigating the alarm detailed in §9.6.10 of this document.

It is also possible for the logic to deal with signed integers i.e. -5 as a threshold trigger for excursion trip. Note in this case the output of the CLS PLC's mA output will need to be suitably configured to deal with the minus (signed) values.

```

A N A L O G   O U T   A Q 1 & A Q 2
R A N G E   A V E R A G E   A M P S
T O   D E V I C E .
4 m A =  B038 MIN - V1 0   A M P S
2 0 m A =  B044 - V1 1000   A M P S
F 4   T O   E X I T .
  
```

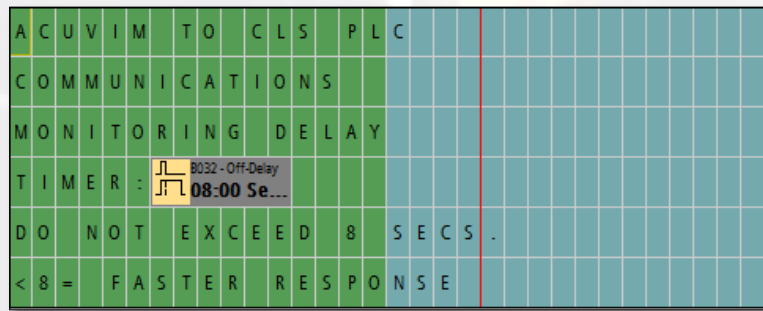
The screen above is showing the adjustment for the analogue output value to the Device. The Device's mA input will need configuring the same so that both values are the same. This should be checked at commissioning.

Note that the range should be such that it covers the required range requirements including minus values where the site can export.

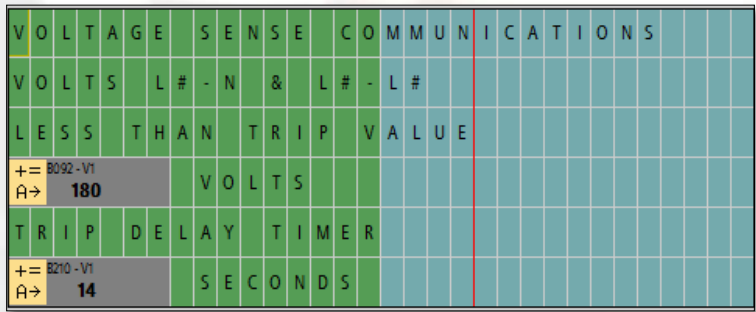
Whilst current is not typically expressed as a negative, the CLS PLC looks at the kW_e value and if this has a minus value in front of it then the PLC will put a minus value in front of the average amps.

For the purposes of this document -ve is export and +ve is for import.

There is also a screen for setting AQ2 for the kW_e output.



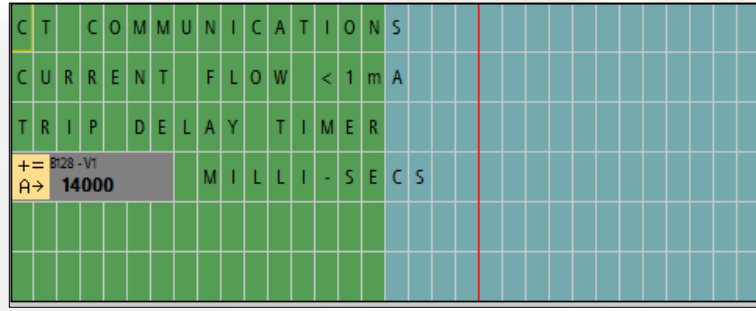
The screen above is used to adjust the Acuvim to PLC Modbus communication failure detection mechanism should the commissioning engineer or DNO wish to make the trip mechanism faster. This value should not be increased to more than 8 seconds as this will exceed the 15-second allowed time in certain failure scenarios. Reducing the value will make the trip faster.



The screen above is used to adjust the voltage communication failure detection mechanism should the commissioning engineer or DNO wish to make the trip mechanism faster. The CLS PLC monitors the voltage for L to N and L to L on all phases and should one of them fall below the set value (180 in the screen above), the trip timer will start (14 seconds in the screen above) and this will result in the CLS moving to State 3. 14-seconds has been chosen as the trip time in EREC G100/2 is 15-seconds, so the State 3 change will be less than 15-second.

Increasing the volts and reducing the times will make the mechanism more sensitive and trip faster. Avoid moving the trip so that it interferes with the G99 criteria as that could breach the Connection Agreement / Grid codes.

The volts monitoring can remain the same for LV and HV connections as we are looking for open circuits on the sense input or a blown fuse and are not tripping due to low volts as this will be afforded by the G99 LoM relay.



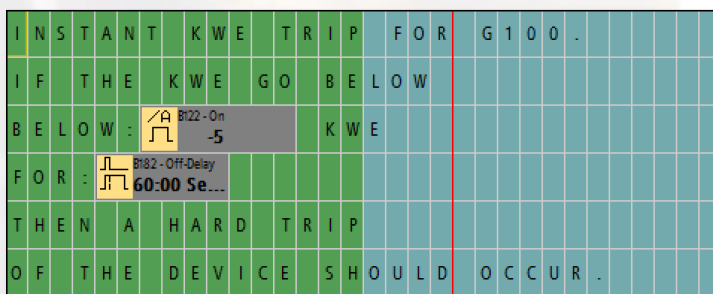
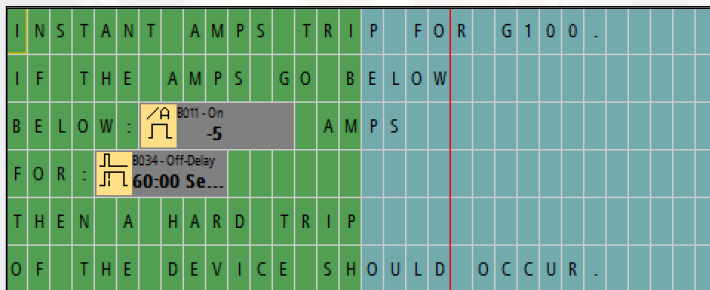
The screen above is used to adjust the current transformer communication failure detection mechanism should the commissioning engineer or DNO wish to make the trip mechanism faster.

The <1mA value is hard coded in the logic and the CLS PLC will start a timer if the current flow is at 0, which would be indicative of a CT open circuit. The delay timer is in milli-seconds and is set at 14000 milli-seconds in the screen above.

Avoid times > 15000 milli-seconds as this would breach EREC G100/2 criteria. Making the time smaller will result in faster tripping on this fault.

17 Reverse Power Relay PLC

The Reverse Power Relay PLC has screens that are the same as per the previous section and should be configured the same for communications monitoring of the CTs, voltage sense and meter monitoring, *if these require changing*. However there are two adjustment screens that exist in the RPR PLC, that don't in the CLS PLC and these are used to set the Reverse Power Relay trip threshold for current and power and the amount of time the breach needs to be present before instigating a trip.



To turn off a trip set the value to -20000.

18 Commissioning

18.1 General

All work should be carried out by competent personnel and with the appropriate risk assessments and method statements.

18.2 Items that the panel(s) are shipped with

The system is shipped with the following items:

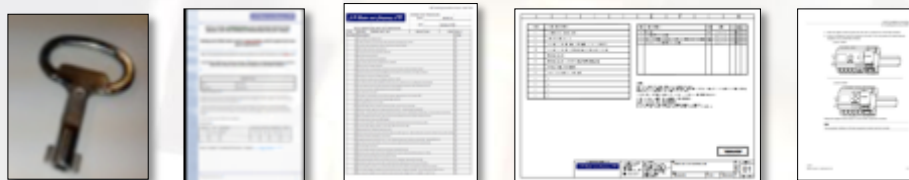


Figure 7. Standard parts that should be shipped with the system.

- Panel keys
- Instruction manual
- Electrical drawings
- OEM instruction manuals
- Cable schedules and BCDs.

The system should be commissioned so that each Device's wiring is checked end to end prior to energising. This includes metering panels, CLS panel, power supplies etc. The cable schedule should be used as a sign off documents to detail that an end-to-end check of the cabling has been made.

As for power supplies to the panels and the installation in general, then these should be in the tolerances as stated in §11.

Once the end-to-end checks have been made and any LV electrical testing is completed (BS7671 electrical test certificates available), then the systems should be powered on and the metering and controls configured.

18.3 Acuvim IIR meter configuration

The Acuvim IIR can be used with an AXM-WEB module. Testing has shown that this device may not be reliable enough for our CLS application and therefore for Modbus communications with the meter we will be using the meter's native RS485 output and fitting a ICPCON tGW-715 gateway device.

This gateway device will need configuring as part of the set-up procedure.



Figure 8. tGW-715 Modbus RTU to TCP/IP gateway.

Power on the CLS Modbus network gateway device and put your computer into the manual IP domain of 192.168.255.***, ensuring that the fourth octet is not 1 or >250.

Connect your laptop to the spare RJ45 port on the TDE HMI and type 192.168.255.1 into a web browser and the following screen will load. The gateway's IP address as default from the factory is: 192.168.255.1. If it doesn't work, trying polling the device and investigating further.



Tiny Modbus Gateway

[Home](#) | [Port1](#) | [Network](#) | [Filter](#) | [Monitor](#) | [Password](#) | [Logout](#)

The system is logged out.
To enter the web configuration, please type password in the following field.

Login password

Passwords...
Suggest New Password

When using IE, please disable its cache as follows.
Menu items: Tools / Internet Options... / General / Temporary Internet Files / Settings... / Every visit to the page

The default password is admin.

Once the main screen loads, click on 'Port 1'

From here the Modbus serial baud rate is set.

Port Settings	Current	Updated	Comment
Baud Rate	115200	115200 (select <input type="text"/>)	bps (bits/second)
Data Size	8	<input type="text" value="8"/>	bits/char
Parity	None	<input type="text" value="None"/>	
Stop Bits	1	<input type="text" value="1"/>	
Flow Control	None	<input type="text" value="None"/>	
Remove Errors	PE FE BE	<input type="checkbox"/> Parity Error <input type="checkbox"/> Framing Error <input type="checkbox"/> Break Error	Clear RX FIFO data when serial errors.
Modbus Settings	Current	Updated	Comment
Slave Timeout	300	<input type="text" value="300"/>	10 - 65000 ms (step 10), Default: 300
Char Timeout	4	<input type="text" value="4"/>	4 - 15 bytes, Default: 4
Silent Time	0	<input type="text" value="0"/>	0 - 65000 ms (step 10), Default: 0
Protocol	Modbus RTU	<input type="text" value="Modbus RTU"/>	
Virtual ID Range	0 - 247	<input type="text" value="0"/> to <input type="text" value="247"/>	Range: 0 to 247. Note: Gateway skips the Modbus messages if its ID is NOT in the specified range.
Virtual ID Offset	0	<input type="text" value="0"/>	Offset: -246 to 246, No change=0. For example: Virtual ID = 1 to 10, offset = 10, then physical Slave ID = 11 to 20. Virtual ID = 31 to 40, offset = -10, then physical Slave ID = 21 to 30.
Modbus TCP Settings	Current	Updated	Comment
Read Cache	980	<input type="text" value="980"/>	0 - 65000 ms (step 10), Disable: 0
Local TCP Port	502	<input type="text" value="502"/>	Default: 502
MTCP Length Swap	0	<input type="text" value="0"/>	0:TX/RX=High byte first. 1:TX=High, RX=Low byte first. 3:TX/RX=Low byte first. 2:TX=Low, RX=High byte first.
Connection Idle	1	<input type="text" value="1"/>	0 - 65000 seconds, Default: 180, Disable: 0
Pair-Connection Settings (Master/Slave Mode)	Current	Updated	Comment
Application Mode	Server	<input type="text" value="Server"/>	Server=Slave, Client=Master

The baud rate should be set to 115200, 8 bits, stop bits 1 as per the grab above. Write the settings to the gateway using the Submit icon at the bottom of the screen.

If it reboots the module, log back in again and proceed as follows:

Now click network, the screen below should load:

IP Address	
IPv4 Address	
Address Type	Static IP
Static IPv4 Address	192 . 168 . 1 . 253
Subnet Mask	255 . 255 . 0 . 0
Default Gateway	192 . 168 . 1 . 1
MAC Address	00-0d-e0-82-13-be (Format: FF-FF-FF-FF-FF-FF)
IPv6 Address	
Link Local Address	fe80:0:0:20d:e0ff:fe82:13be
SLAAC Address	0:0:0:0:0:0:0:0
SLAAC Timeout	0 (30 ~ 65000 seconds, 0 = Default Disabled)
User-defined Address	fc00:0:0:0:0:0:1
DNS Settings Client Mode Only	
Auto DNS Configuration	<input checked="" type="checkbox"/> (Auto DNS Server Configuration by IPv4 DHCP, default enabled.)
Preferred DNS Server IP	208.67.222.222 IPv4 example: 208.67.222.222 , IPv6 example: 2620:119:35::35
Alternate DNS Server IP	208.67.220.220 IPv4 example: 208.67.220.220 , IPv6 example: 2620:119:53::53
<small>Update Settings</small>	

Now change the IP address of the gateway to 192.168.1.252, subnet 255.255.255.0, default gateway 192.168.1.1.

After this press 'Submit' and the screen will need reloading whilst the gateway reboots. You will now need to change your laptop's IP address to 192.168.1.5.

Now type 192.168.1.252 into a browser and log back into the tGW-715 webserver. Now click 'Password' and change the devices password to [Password is made available to commissioning personnel only]. This is part of the security for the CLS.

Once this is complete repeat the process for the RKP PLC, but make the IP address in this meter 192.168.1.253.

The Acuvim II meter will now need setting up and this is done by using the Acuvim.exe program and connecting via the Modbus RTU Serial interface or via the screen. In this example we will setup the serial connection through the meter and then use the gateway device to access the meter via Acuvim.exe

The following is from the Acuvim manual:

Press the 'H' and 'V/A' buttons simultaneously on the Acuvim II series. Release the buttons and the meter will enter the meter selecting mode, as indicated by the flashing 'Meter' cursor.

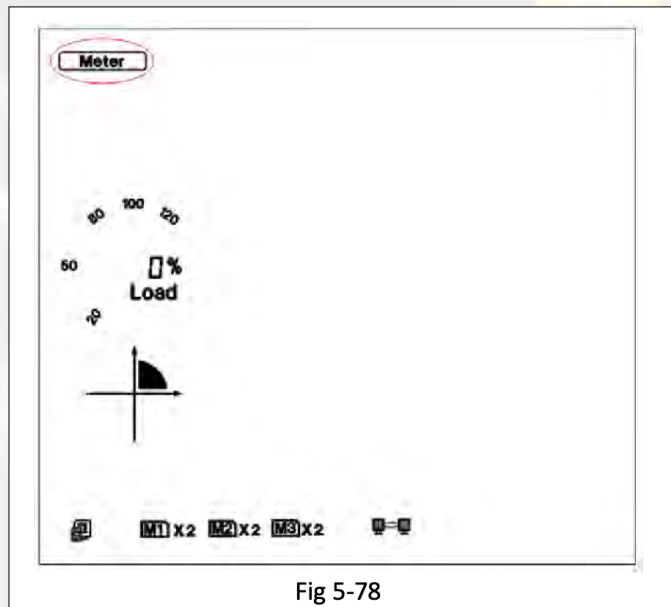


Fig 5-78

Press the 'P' or 'E' button to move the cursor to 'Setting'. Press 'V/A' button to enter the parameter setting mode. The device address page is the first page of the 'Setting' mode. It will show the Modbus address of the meter for a second before prompting for the password of the device.

You will be required to type in a password in the 'PASSWORD' screen. Leave the password as default '0000' and press 'V/A' to enter the parameter selection Mode.

The cursor will be on 'SYS'. Press 'V/A' on this screen to get to the system [SYS] settings. This will show screen 'S01 ADDR'.

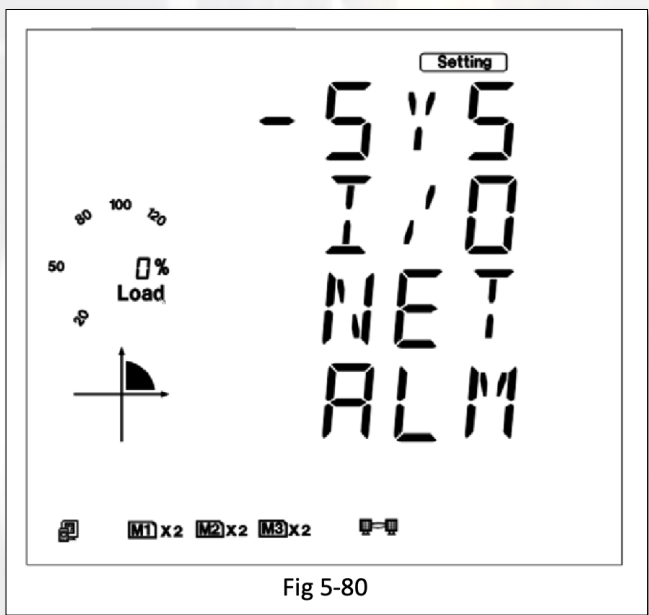
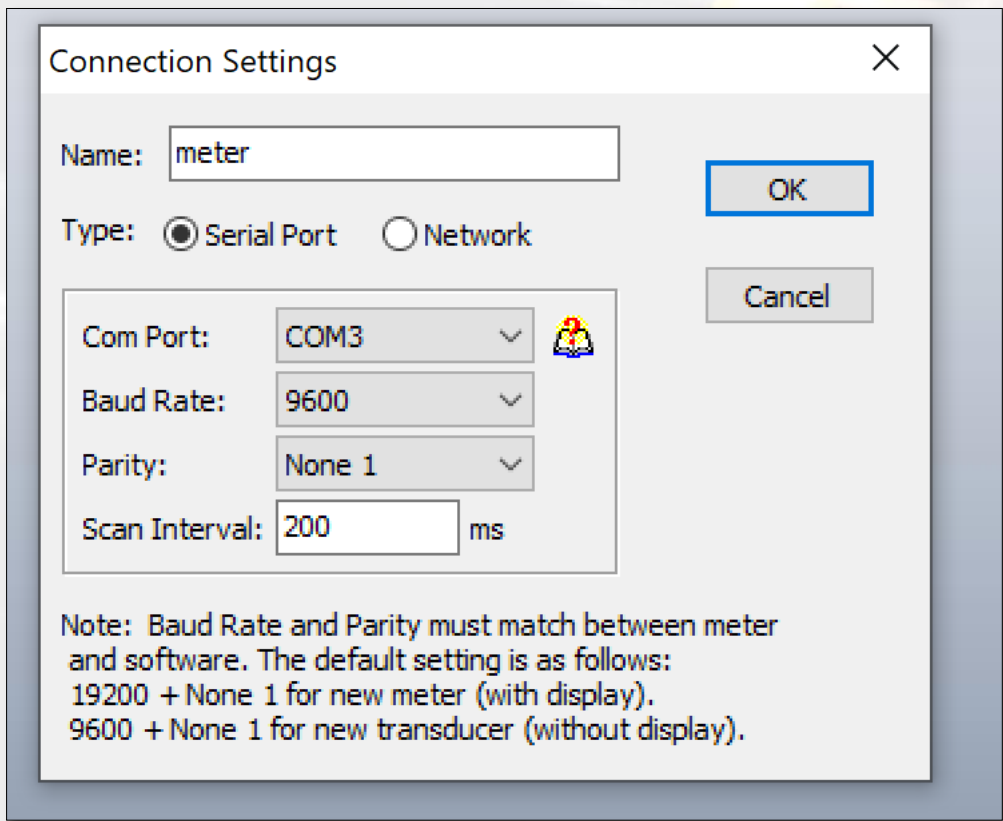


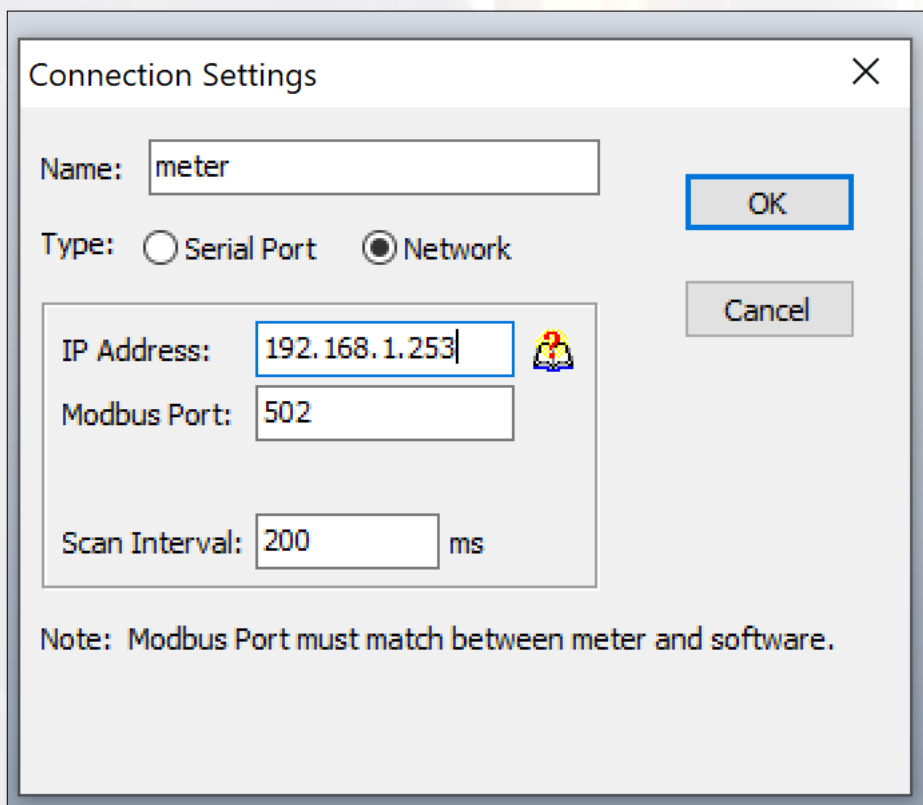
Fig 5-80

Leave 'S01' as 1 and scroll using 'P' to 'S02' and press 'V/A' to select and change the baud rate to 115000. Now press 'V/A' to enter 'H' & 'V/A' to scroll the mode option back to meter.

From here it is possible to access the meter using the tGW-715 as a gateway. Open the program Acuvview.exe. The dialog box below should appear.



Change the selection to network and the IP address to 192.168.1.252 to configure the CLS meter or 192.168.1.253 to configure the RPR meter.



Connection Settings

Name: meter

Type: Serial Port Network

IP Address: 192.168.1.253

Modbus Port: 502

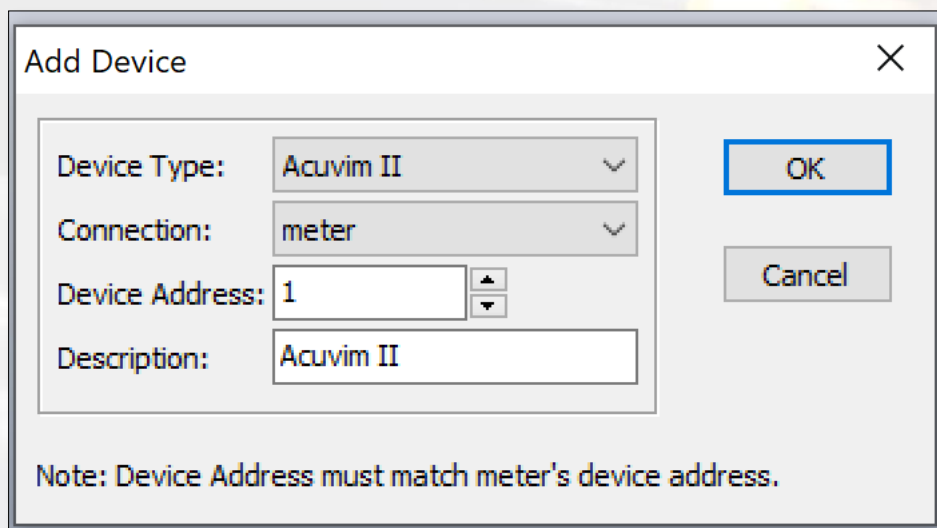
Scan Interval: 200 ms

OK

Cancel

Note: Modbus Port must match between meter and software.

Accessing the Acuvim via the gateway.



Add Device

Device Type: Acuvim II

Connection: meter

Device Address: 1

Description: Acuvim II

OK

Cancel

Note: Device Address must match meter's device address.

Click 'OK' on this screen and the main metering screen will load up.

The screenshot shows a software interface for real-time metering. On the left is a tree view with categories like Real-Time Metering, Energy, Harmonics, and Sequence Component. The main area displays 'Readings > Real-Time Metering' with several data tables.

Power Meter					
Volts AN	0.00 V	Volts AB	0.00 V	I A	2.4276 A
Volts BN	0.00 V	Volts BC	0.00 V	I B	2.4639 A
Volts CN	0.00 V	Volts CA	0.00 V	I C	4.8970 A
Volts LN Average	0.00 V	Volts LL Average	0.00 V	I Average	3.2629 A

Watt A	0.00000 kW	VAR A	0.00000 kvar	VA A	0.00000 kVA
Watt B	0.00000 kW	VAR B	0.00000 kvar	VA B	0.00000 kVA
Watt C	0.00000 kW	VAR C	0.00000 kvar	VA C	0.00000 kVA
Watt Total	0.00000 kW	VAR Total	0.00000 kvar	VA Total	0.00000 kVA

Pwr Factor A	1.000	Frequency	0.00 Hz	Load Type	R
Pwr Factor B	1.000	I N	9.7886 A		
Pwr Factor C	1.000	Unbalance V	0.0 %		
Pwr Factor Total	1.000	Unbalance I	100 %	<input type="button" value="Reset Demand"/>	

Dmd Watt Total	0.00000 kW	Dmd VAR Total	0.00000 kvar	Dmd VA Total	0.00000 kVA
Dmd I A	2.4769 A	Dmd I B	2.5160 A	Dmd I C	4.9925 A

Analog Input			
Name	Category	Reading	Unit

Live data to indicate communications is shown on the bottom of the screen as HEX read outs:

```
TXD: 02 D5 00 00 00 06 01 03 43 81 00 18
RXD: 02 D5 00 00 00 33 01 03 30 03 6A 03 ...
```

It is now necessary to set the meter up for voltage and CT configuration as per the screen below, which is set to a site that is connected at 6600 volts L to L and has a CT ratio of 150 amps and is connected using split 333mV CTs. Most sites are 11000 volt connected or 400 volt connected. For 400 volt connected to the PT for PT1 and PT2 will be the same i.e. 400 for both.

Settings > Power Meter > General

Communication Channel 1
 Protocol: Modbus Address: 1 Baud Rate: 19200 bps Parity: None 1

Communication Channel 2
 Protocol: Default Address: 1 Baud Rate: 38400 bps Parity: None 1

Wiring
 Voltage: 2LL Current: 2CT

PT and CT Ratios
 PT1: 6600.0 V CT1: 150 A
 PT2: 110.0 V CT2: 333 mV

I L1 Direction: Positive Negative
 I L2 Direction: Positive Negative
 I L3 Direction: Positive Negative

Security
 Password: 0000

Demand
 Sliding Window Demand
 Sub-Interval: 1 min

Demand
 Averaging Interval Window: 15 min

DO Energy Pulse Const
 Watt: 5000 Pulse/kWh
 VAR: 5000 Pulse/kvarh

Other
 Turn On the Backlight: 1 min

Energy Type
 Fundamental
 Fund. + Harm.

Energy Reading
 Primary (0.1kWh)

VAR/PF Convention
 IEC
 IEEE

VAR Calculation Method
 Method 1 (True)
 Method 2 (Generalized)

SOE Enabled
 None AXM-IO11 AXM-IO21 AXM-IO31 AXM-IO12 AXM-IO22 AXM-IO32

Non-Standard Seal Options of Seals
 Device Run-Time Communication Channel 1
 DI Counters Communication Channel 2

Real-Time Reading
 Secondary
 Primary

Load
 Percentage of: Current
 Rated Watt Total: 1200 W

Update Device

Once settings have been changed you need to click 'Update Device' and this will write the settings to the meter. It is good practice to exit the screen and then re-enter to the screen as this forces a re-load of the screen from the meter, this will confirm that the meter has the correct desired settings.

The commissioning engineer will now need to determine the site's CT and VT ratio and ensure that these are configured.

For the set-up shown in the previous figure this is a typical arrangement for connecting into a site's fiscal metering where there is only 2 VTs and 2 CTs. It is important that the meter wiring be altered to accommodate this set-up and that if using 333mV CTs that the CT link is not connected to earth.

4. 2LL, 2CT

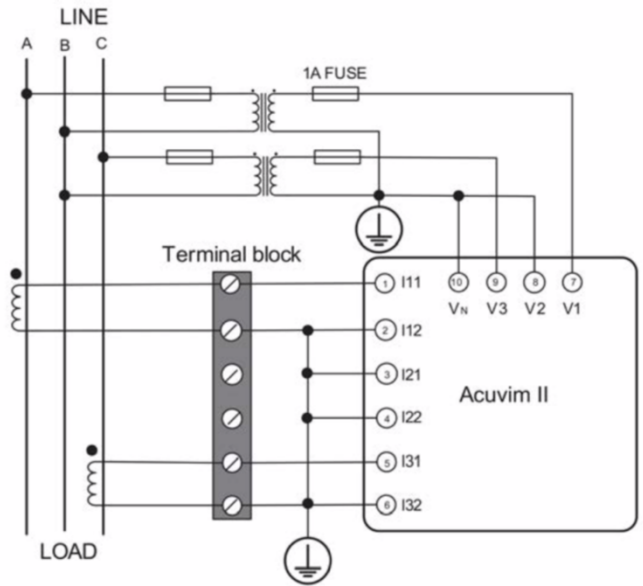


Fig 2-19 2LL, 2CT

Figure 9. Wiring off fiscal meters for 2 CT and 2 VT with L2 at the same potential as earth.

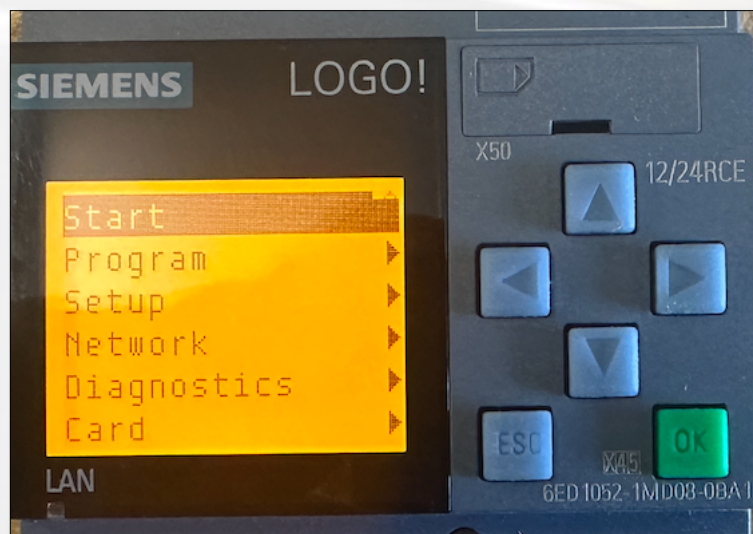
For additional information on meter configuration consult the Acuvim II manual.

Now update the device ensuring that communications are present, exit and re-enter the screen to ensure that the values are correct. The readings on the meter should be validated with the readings from a site meter or by clamp on meter to measure the current flow.

Once satisfied that the meter is reading correctly, then set a password on the meter in settings, password. This should be the commissioning engineers password for this Component and is not listed in this document.

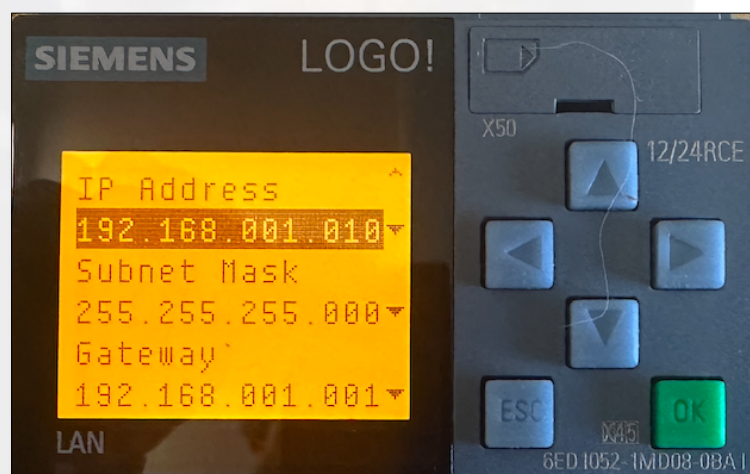
18.4 CLS PLC LOGO set-up

The LOGO PLC will need its IP address setting for the network. Power on the LOGO PLC and select 'Network' from the power on screen.



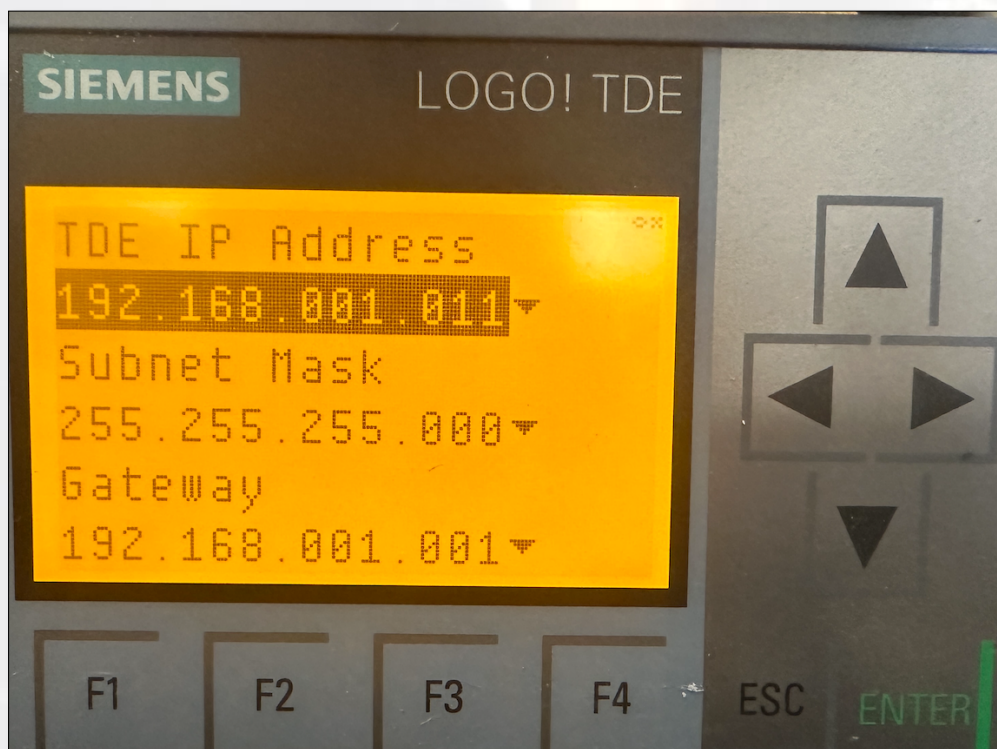


Select IP address as per the image above.

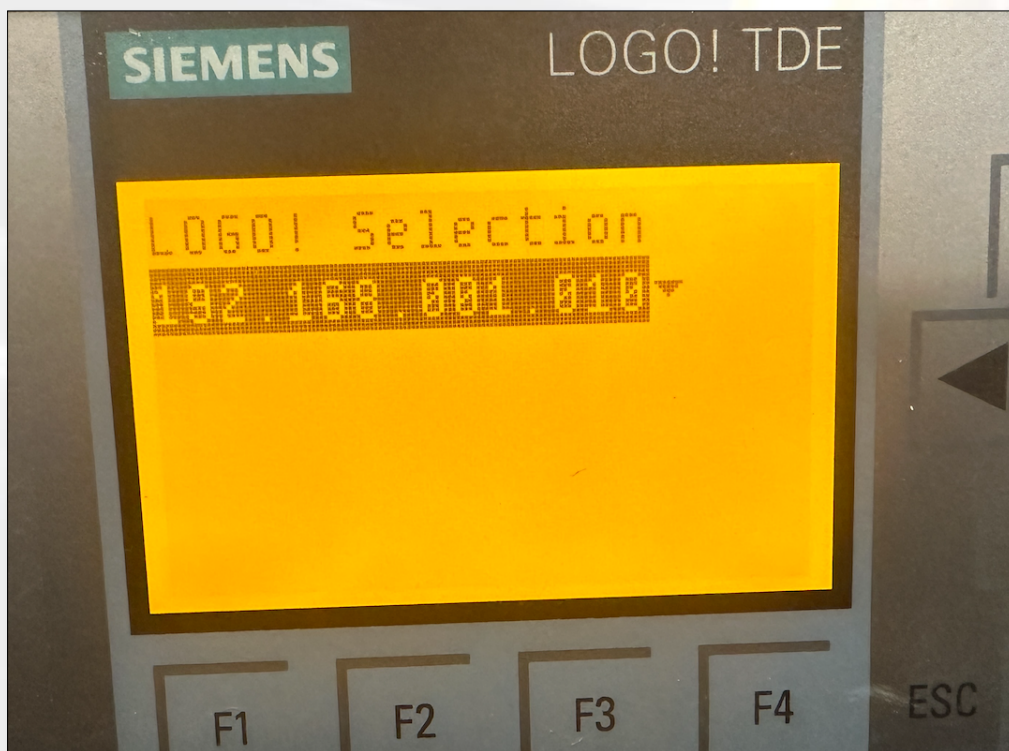


Set IP address, subnet and gateway as per the image above, this is on the CLS PLC. Do the same on the RPR PLC, but make the IP address 192.168.1.20.

It is now required to set the HMI screen to the correct settings.



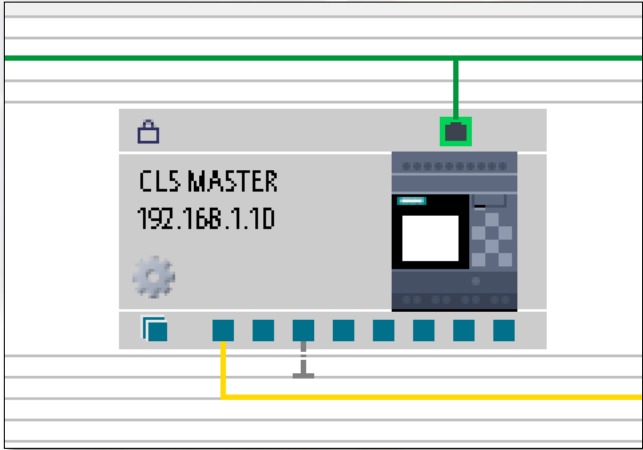
Navigate the HMI to TDE network settings and assign the addresses as per the image above.




Navigate the HMI to adjust the LOGO selection and set as per the screen above.

Once this is complete the network settings for the PLC and HMI are complete.

Now open Siemens LOGO Soft Comfort program and load the PLC logic L0291_Rev2. Click on the PLC icon, as per the image below. The password is [Commissioning engineers have will be issued the password and it is not for this document].



Once the logic has loaded click  and this will load the logic into the PLC.



Once the logic has been transferred click on the PLC cog icon and the following screen will appear.

Name settings

Device name:

Program Name:

IP settings

IP Address:


Subnet Mask:


Default gateway

Customize DNS Server

DNS Server Address:

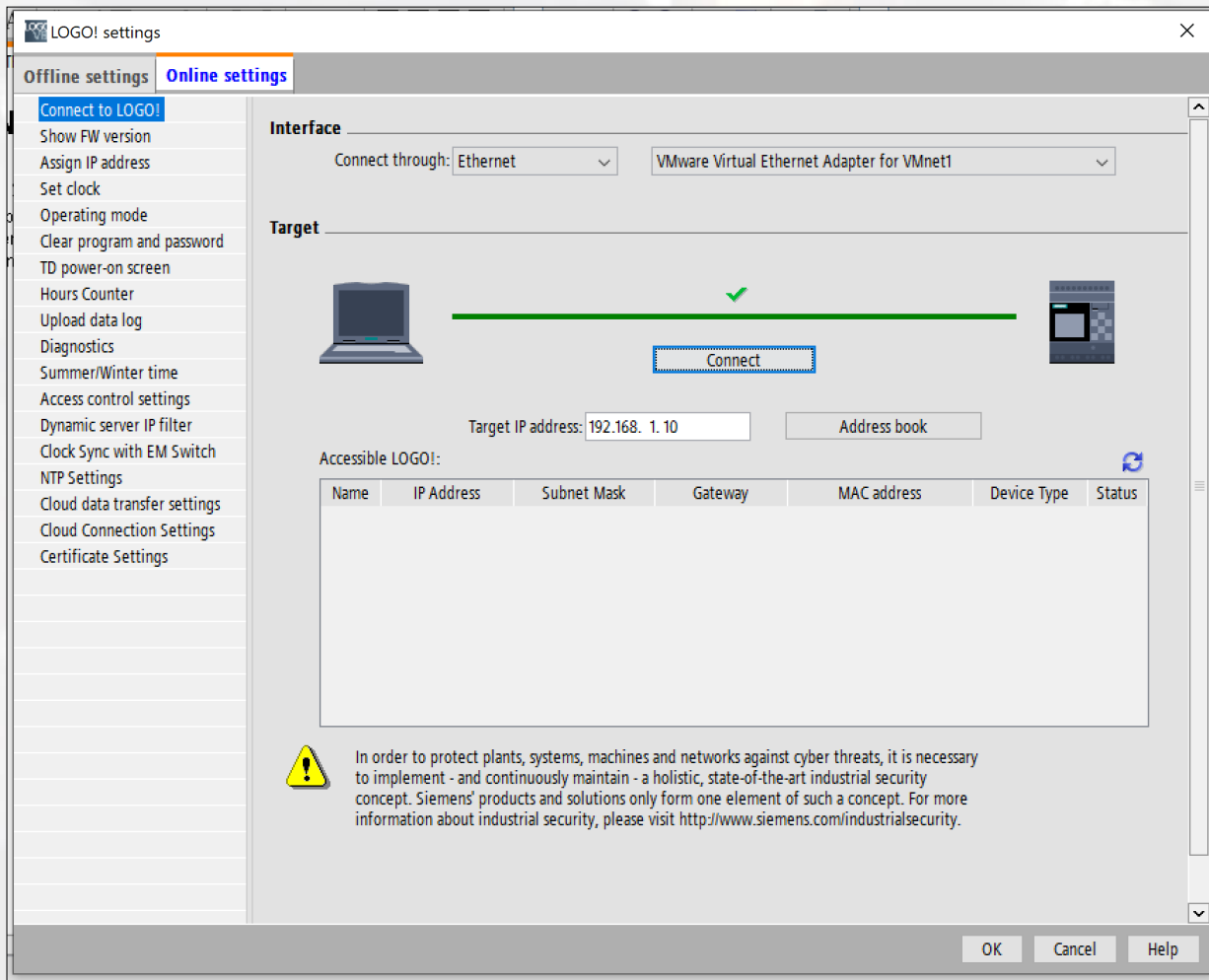
Ethernet connections

Allow S7 access  Enabling the S7 access will open the unsecure port 102.

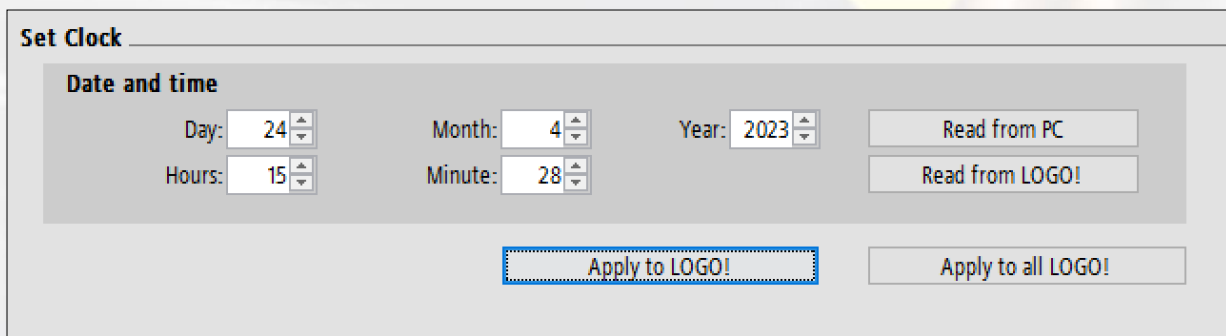
Allow Modbus access  Enabling the Modbus access will open the unsecure port 502~510.

Ensure that the 'Allow S7 access' and 'Allow Modbus access' icons have been ticked. If they need ticking, please tick them, exit this screen and write the logic again to the PLC.

Now it is required to set the 'On-line' settings for the PLC, this is done by pressing File, Properties, Online settings, connect.



From here click 'Set clock'.











Once the set clock option opens you will be asked to stop the PLC as it is in run mode, click stop. Now click 'Read from PC' and then 'Apply to LOGO!'. This has now set the clock.

Now click 'Summer/wintertime'. If it asks about the PLC run mode just keep putting it in stop or pressing 'ok'.

Summertime/Wintertime

Activate summertime/wintertime conversion

 EU	 UK
 US1	 US2
 Australia	 Tasmania
 New Zealand	 Freely adjustable

Summertime

Start: -

End: -

Time difference

Minutes


Set the tick icon to activate the summer / wintertime conversion. Now select UK as the country and press 'Apply'.

Now click 'Access control settings' and enable the embedded webserver.

Web server access

Allow Web server access

Allow HTTP access (Web Server and LOGO! App)
 Allow HTTPS access only


 Enabling the HTTP access will open the unsecure port 80 and 8080.

Enable Web User

Web User

New password:

Password Strength: --- -- -- --

Confirm New Password:

Tick 'Allow Web server access and ensure it is selected to HTTP, press 'Apply'. Now tick the 'Enable web user' icon and set the password as 7450. Press 'Apply' and put the PLC into 'Run' mode.

Complete the process again for the RPR PLC.

18.5 Device set-up

The Device should be configured for the mA signals and the instant trip signal. The CLS PLC will need its mA output signals ranging during this process, this is described in §16.2.1.

18.6 Testing

Once the systems are online then the values coming from the meters must be validated with another site meter or the generation must be run to displace the kWe so that the values on the meter(s) can be validated. The meter's values and the CLS PLC and RPR PLC values should be checked to be the same. The enable / inhibit (G100 trip Q*) functions should be checked to each Device. Any Constraints or additional DNO requirements should be checked to be functioning correctly.

Once the installer is satisfied that the system is functioning correctly then the DNO may wish to witness the system's function. Use EREC G100/2 issue §5 for the commissioning guidelines and fill in Appendix B and C as required.

During testing it is possible that excursions will lockout the CLS PLC for 4-hrs, clearly this is not going to work during testing, so it is possible to reset the excursion timers and lockouts by pressing F1, entering the commissioning engineer's password and then pressing F2. This function is designed for testing only and is not an operational function.

19 Local Area Network

19.1 Cyber security and network overview

The CLS PLC and RPR PLC can operate as a stand-alone system without interaction with the Internet or other wider networks. Where the Modbus function is required or Webserver access is desirable, then this is implemented via Local Area Networks only and they should not be exposed to wider networks i.e. physically isolated from the Internet.

It is preferable that the network be isolated from the outside world, either by physical connection (air gap), or by suitable firewall, firewall as a last alternative. Due consideration should also be given for possible threats introduced by memory storage hardware crossing any physical gap or firewall i.e. persons using memory sticks on hardware on the same network as the PLCs.

Note that the Siemens PLCs will only communicate on Modbus if the client has the IP address that has been pre-programmed in the PLC (this is adjustable at commissioning). What this means is that the IP address of the client must match the IP address that the PLC expects to see in the header of the IP packet, furthermore the PLC will only send data to that pre-programmed IP address. This is very important, as communications will not work if the IP addresses do not match. The main areas of hardware that may be affected are typically those that can be connected to a LAN or a WAN network.

Extracted from Siemens (PLC OEM) and adjusted for this document: In order to protect the CLS CP from possible cyber threats, it is necessary to implement and continuously maintain a holistic, up to date and continuously reviewed security concept. The logic controller only forms part of this concept and it is down to the end user to ensure that sufficient protection is maintained from such threats i.e. don't interfere with the PLC's networks or connect anything to the PLC's network without consulting the person responsible for the generating Device. Keep the panel secure from unauthorised personnel, persons gaining direct access to the CLS CP can cause malicious intent by physical damage or by disconnecting network Components or adding malicious Components, this falls out of the remit of this document as local access by persons with malicious intent can do harm and the CLS provider cannot post a sentinel to secure the panel 24/7, this would be down to the end user to ensure that the Device and the Components that form the CLS are kept secure from restricted access and are not interfered with by site personnel or other agents.

Information about 'Air-gapped' networks.

Air gaps have been a common security measure in the critical infrastructure sector, where a cyber-attack can disrupt or halt major operations. The systems that deploy gapping normally include:

- Military computer systems and networks
- Governmental computer systems and networks
- Financial computer systems and networks
- Industrial control systems
- Nuclear power plants
- Aviation computers
- Medical equipment.

This isn't to say that an air-gapped network is completely safe, the obvious example being the Stuxnet incident that occurred in Iran, which was propagated using USB storage drives carried across the air-gap. For our network there is no USB connection and there is no permanent personal computer on the network and on a day to day basis there is no reason for a user to access the network or connect to the network as user conveyance is via the HMI, so this somewhat mitigates the air-gap breach scenario.

General basic network security concepts adopted in this CLS:

1. PLC password protected
2. Webserver password protected
3. Acuvim II meter password protected, albeit only on a serial connection, so unlikely to be an attack vector
4. Modbus data from the Acuvim II and PLC is set as read only, non-writable
5. LAN network is isolated by air-gap (no physical connection to a wider network / Internet).

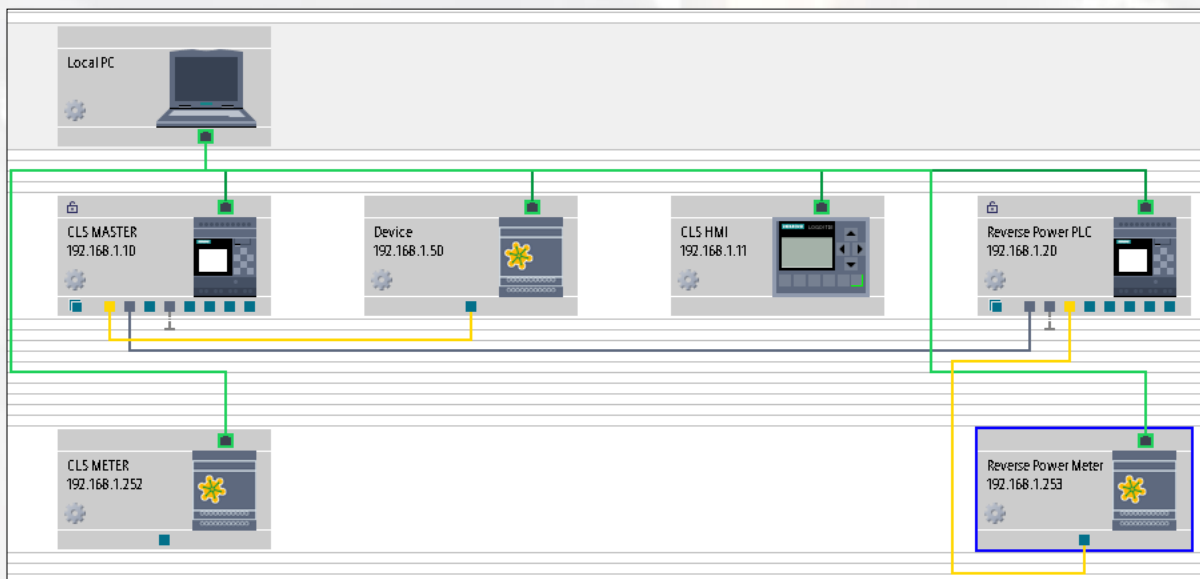


Figure 10. Local Area Network architecture for the connection to the CLS PLC, Acuvim II meter, HMI and Device.

The IP addresses for the devices on the network as per the figure previously are:

Component	IP address	Subnet Mask	Node ID
Device client – generator or inverter (port 502)	192.168.1.50	255.255.255.0	n/a
RPR PLC base module	192.168.1.20	255.255.255.0	1
CLS PLC base module	192.168.1.10	255.255.255.0	1
CLS TDE HMI display	192.168.0.11	255.255.255.0	n/a
Acuvim II meter via gateway CLS PLC	192.168.1.252	255.255.255.0	1
Acuvim II meter via gateway RPR PLC	192.168.1.253	255.255.255.0	1
Local PC (Commissioning engineers' laptop)	192.168.1.5	255.255.255.0	n/a

If required, the addresses may be changed during commissioning. The default gateway address is 192.168.1.1. DHCP is not supported.

Note: All Components on the network should have unique IP addresses to avoid network issues.

The CLS provider / Device provider / Installer will undertake a study with the site to determine the best cyber security approach to be undertaken. In its simplest, should the client wish to receive Modbus data from the CLS, then we could convert this from TCP/IP to serial (all Modbus data is read only) and this would then limit the extent that the communications can propagate and the type of systems that can gain access to this type of network (serial). A serial network embedded inside a building would be considerably safe from a cyber-attack from an external malicious agent.

20 Modbus for Device or Client

The CLS CP uses Modbus TCP/IP and this data can be used by a Device to read the average current and other values pertinent to State 1 & 2 operation.

There will always be a hardwired circuit, closed when healthy, for instigation of State 3.

The CLS CP has a Siemens LOGO PLC as its logic controller and this supports the traditional form of Modbus as envisaged by Modicon. This section deals with how the Modbus registers can be read from the CLS PLC.

The AcuVim II meter should not be read by the Device or any other piece of equipment on the network, if this is required then we can review this as a bespoke requirement and put suitable security and update latency mitigations in place.

20.1 MSW and LSW.

Definitions:

MSW: Most Significant Word.

LSW: Least Significant Word.

The Modbus messages are returned in 16-BIT format within the specific register. Holding registers are always provided with two registers attached to them so that a value greater than 65536 can be expressed.

So, if it were required to display the number of starts of a specific event, with only 1 holding register the value would end at 65536. Now with two it is possible to display a value of $65536 * 65536 = 4,294,967,269$ (32-BIT). Note that the PLC for event starts resets the value at 999,999 due to the counter function block reaching the end of its limit and auto resetting.

20.1.1 Test Register

To allow the Modbus integration engineer a chance to get some sensible values, the holding registers 6 and 7 are reserved with the value of 123456.

If the holding registers were polled, then the value read back on the registers would be:

6 = 1 (MSW)

7 = 57920 (LSW)

6	40006	400006	0...	□	1
7	40007	400007	0...	@	57920

The grab above is from a Modbus scanner and shows the 123456 number for the addresses 40006 and 40007.

To calculate back to the original 123456 value, then the maths would be:

$(65536 * HR40050) + HR40051 = \text{Actual value}$ or in this case the 123456 test number.

$(65536 * 1) + 57920 = 123456$.

20.1.2 MSB (byte) and LSB (byte) within the Modbus Message Frame (WORD)

Modbus messages are sent in 2 of 8-BIT packages for each register, or 2 of 1-byte packages. To allow for 16-BIT messages to be sent the message is split into two sections with a MSB and a LSB.

All references to MSB and LSB mean byte and not BIT.

20.2 Signed and Un-Signed.

The table below describes the values that can be read for the WORD type registers:

Function code / register	Name	Min / Max
03 (4#####)	Read holding registers (4#####)	- 32768 to +32767 (signed) and / or 0 to 65536.
04 (3#####)	Read input registers (3#####)	- 32768 to +32767 (signed)

In most cases the register will read sensible if the integer is configured as un-signed, but negative numbers will be expressed as high values based on Modbus standard signed register standards.

20.3 Requests and Responses Using the Modbus Protocol

Requests to the logic controller for data may be in either BITS or WORDS using standard Modbus protocol.

The client device requests the data from the server as function names as per below with the addresses as per those in the brackets:

Function code	Name	Data type
01	Read coil status (0#####)	Bit
02	Read input status (1#####)	Bit
03	Read holding registers (4#####)	WORD
04	Read input registers (3#####)	WORD

Structure of requests / polls:

Data string structure for requests / polls otherwise known as message framing:

Address	Function code	Start address	Start address	Number of WORDS	Number of WORDS	CRC	CRC
8-BITS	8-BITS	MSB	LSB	MSB	LSB	MSB	LSB

Data string structure for response:

Address	Function code	Number of bytes	Data MSB	Data LSB	Data MSB n.....	Data LSB n.....	CRC
8-BITS	8-BITS	#	8-BITS	8-BITS	n.....	n.....	MSB & LSB

n = Number of WORDS, so for only 1 register to be read out the value would have nothing in the WORDS n..... but if there was 50 registers to be read out then these would be read out with 100 bytes and with n..... populated with values, note these would be holding registers or input holding registers in this case.

Example (BITS) (Node ID in this example is set to 200):

If we request a simple BIT i.e. input 1 on the logic controller then the address for this input is 10001, the request (poll) to the controller will be hexadecimal and this will be:

Poll: C8 02 00 00 00 01

Response: C8 02 01 00 (this is indicating that the input is off / low)

If we polled it again and the input was on, then the return value would be:

Poll: C8 02 00 00 00 01

Response: C8 02 01 01 (this is indicating that the input is on / high)

Digesting this we can see that the poll started with C8, converting this to decimal shows that this is 200, and is the Node (server) address. The 02 component is the function code "Read input status." The 00 00 are MSB and LSB start addresses and the remaining 00 01 are the MSB and LSB number of BITS to be read, so we don't want any MSB, but we do want a LSB value, but only 1.

Broken down into the table as the poll:

Address	Function code	Start address MSB	Start address LSB	Number of WORDS MSB	Number of WORDS LSB	CRC	CRC
C8 (200)	02	00	00 10001	00	01 (1)	Not shown	Not shown

*CRC values are not shown for clarity.

To give another example of polling, if you were to poll address 10010 and want 5 BITS back it would poll = C8 02 00 09 00 05. If we put this in the table, it should become clearer.

Address	Function code	Start address MSB	Start address LSB	Number of WORDS MSB	Number of WORDS LSB	CRC	CRC
C8 (200)	02	00	09 10010	00	05 (5)	Not shown	Not shown

The response component for the single request will now be dealt with:

The response echoes the first part of the request message by stating, Node 200, function code request 02, the next section is the number of bytes, and the next section is the data.

To elaborate on the number of bytes returned section:

The number of bytes returned is normally 2 for each register requested, except when BIT type data is requested that does not contain more than 8 BITS. For function codes 1 and 2 a request is returned as hexadecimal and is converted into binary. So, the addresses for inputs or outputs are returned within a single WORD expressing all the BIT values.

This is important as the data will be returned as a single value in hexadecimal and will then need converting to binary for it to make any sense.

So, if we digest the response from the logic controller we will see how it is made up.

Response: C8 02 01 01

C8 = 200 Node address.

02 = Function code.

01 = Number of bytes (only requesting 1 BIT).

00 = Data returned in hexadecimal.

Let's put this in the table:

Address	Function code	Number of bytes	Data MSB	Data LSB	Data MSB n.....	Data LSB n.....	CRC
C8 (200)	02	01	00	****	-	-	Not shown

****Only 1 byte so not required.

If we elaborate and request 8 input values off the logic controller and go through the framing for the return message it should elaborate how it works a little simpler. The poll value will be C8 02 00 00 00 08 the response will be C8 02 01 60, this is showing that input 6 and 7 are on.

Address	Function code	Number of bytes	Data MSB	Data LSB	Data MSB n.....	Data LSB n.....	CRC
C8 (200)	02	01	60	****	-	-	Not shown

**** ≤8 BITS polled so still only 1 byte.

Now let's turn the hexadecimal into something easier to follow:

Data MSB = HEX 60 converted to binary = 0110 0000

Data LSB = n/a as the single byte can show the status of the 8 inputs requested.

Now 0110 0000 doesn't mean a lot, but if we put it into the table below we can make sensible values of it:

Input No'	8	7	6	5	4	3	2	1
Binary	0	1	1	0	0	0	0	0

As can now be seen the binary value is expressing the state of the inputs of the logic controller and is correct in that inputs 6 and 7 are high.

20.4 Modbus Registers

Modbus address	Function code	Physical connection on logic controller	Physical description	BIT / WORD	Range (min / max)	Decimal places
08193	01	Output Q1	Device hard stop to Device 'G100 trip'	BIT	0-1	-
08194	01	Output Q2	Device hard stop to Device 'G100 trip'	BIT	0-1	-
08195	01	Output Q3	Device hard stop to Device 'G100 trip'	BIT	0-1	-
08196	01	Output Q4	Device hard stop to Device 'G100 trip'	BIT	0-1	-
08197	01	Output Q5	Spare	BIT	0-1	-
08198	01	Output Q6	Spare	BIT	0-1	-
08199	01	Output Q7	Spare	BIT	0-1	-
08200	01	Output Q8	Spare	BIT	0-1	-
08201	01	Output Q9	Spare	BIT	0-1	-
08202	01	Output Q10	Spare	BIT	0-1	-
08203	01	Output Q11	Spare	BIT	0-1	-
08204	01	Output Q12	Spare	BIT	0-1	-
08205	01	Output Q13	Spare	BIT	0-1	-
08206	01	Output Q14	Spare	BIT	0-1	-
08207	01	Output Q15	Spare	BIT	0-1	-
08208	01	Output Q16	Spare	BIT	0-1	-
10001	02	Input I1	Spare	BIT	0-1	-
10002	02	Input I2	Spare	BIT	0-1	-
10003	02	Input I3	Spare	BIT	0-1	-
10004	02	Input I4	Spare	BIT	0-1	-
10005	02	Input I5	Spare	BIT	0-1	-
10006	02	Input I6	Spare	BIT	0-1	-
10007	02	Input I7	Spare	BIT	0-1	-
10008	02	Input I8	Spare	BIT	0-1	-
8280	01	M24	Modbus heartbeat (1 for 0.5secs, 0 for 0.5secs, forever). Used for CLS to Device communications monitoring	BIT	0-1	-

Modbus address	Function code	Physical connection on logic controller	Physical description	BIT / WORD	Range (min / max)	Decimal places
40001	3	B205	Current (Amps) average	WORD	- 32768 to 32767	0
40002	3	B013	Power (kWe) for Incomer total	WORD	- 32768 to 32767	0
40003	3	B015	Current (Amps) L1	WORD	- 32768 to 32767	0
40004	3	B017	Current (Amps) L2	WORD	- 32768 to 32767	0
40005	3	B019	Current (Amps) L3	WORD	- 32768 to 32767	0
40006	3	B259	Test register 123456 (MSW = 1)	DWORD	0-65536	0
40007	3	B259	Test register 123456 (LSW = 57920)	DWORD	0-65536	0
40008	3	B057	Voltage L1-N	WORD	- 32768 to 32767	0
40009	3	B059	Voltage L2-N	WORD	- 32768 to 32767	0
40010	3	B061	Voltage L3-N	WORD	- 32768 to 32767	0
40011	3	B023	Voltage L1-L2	WORD	- 32768 to 32767	0
40012	3	B025	Voltage L2-L3	WORD	- 32768 to 32767	0
40013	3	B027	Voltage L3-L1	WORD	- 32768 to 32767	0
40014	3	B021	Frequency Hz	WORD	- 32768 to 32767	0
40015	3	B257	Count from CLS PLC communications count 0 to 32767 then back to 0, increments every second	DWORD	0-65536	0
40016	3	B257	Count from CLS PLC communications count 0 to 32767 then back to 0, increments every second	DWORD	0-65536	0
40017	3	B030	Acuvim II seconds count	WORD	- 32768 to 32767	0
40018	3	B129	CLS PLC seconds count	WORD	- 32768 to 32767	0
40019	3	B050	Difference in count	WORD	- 32768 to 32767	0
40020	3	B220	Excursion: >3 in 24hr window 1 count	DWORD	0-65536	0
40021	3	B220	Excursion: >3 in 24hr window 1 count	DWORD	0-65536	0
40022	3	B222	Excursion: >3 in 24hr window 2 count	DWORD	0-65536	0
40023	3	B222	Excursion: >3 in 24hr window 2 count	DWORD	0-65536	0
40024	3	B266	Excursion: >3 in 24hr window 3 count	DWORD	0-65536	0
40025	3	B266	Excursion: >3 in 24hr window 3 count	DWORD	0-65536	0
40026	3	B219	Excursion: >3 in 24hr window 1 time left	WORD	- 32768 to 32767	0

Modbus address	Function code	Physical connection on logic controller	Physical description	BIT / WORD	Range (min / max)	Decimal places
40027	3	B216	Excursion: >3 in 24hr window 2 time left	WORD	- 32768 to 32767	0
40028	3	B264	Excursion: >3 in 24hr window 3 time left	WORD	- 32768 to 32767	0
40029	3	B225	Excursion: x2 in 10min time left, 0=no excursion present	WORD	- 32768 to 32767	0
40030	3	B238	Excursion: >8m in 24hr window 1 time left	WORD	- 32768 to 32767	0
40031	3	B255	Excursion: >8m in 24hr window 2 time left	WORD	- 32768 to 32767	0
40032	3	B260	Excursion: >8m in 24hr window 3 time left	WORD	- 32768 to 32767	0
40033	3	B006	Excursion: >8m in 24hr window 4 time left	WORD	- 32768 to 32767	0
40034	3	B087	Excursion: >8m in 24hr window 5 time left	WORD	- 32768 to 32767	0
40035	3	B120	Metrics - MEL breaches >15s count	DWORD	0-65536	0
40036	3	B120	Metrics - MEL breaches >15s count	DWORD	0-65536	0
40037	3	B121	Metrics - MEL breaches >60s count	DWORD	0-65536	0
40038	3	B121	Metrics - MEL breaches >60s count	DWORD	0-65536	0
40039	3	B122	Metrics - Reverse Power Relay trips	DWORD	0-65536	0
40040	3	B122	Metrics - Reverse Power Relay trips	DWORD	0-65536	0
40041	3	B008	4-20mA output on AQ1 and AQ2	WORD	- 32768 to 32767	2
Alarm flags						
8257	3	M1	MEL >60sec alarm active	BIT, 1=alarm	0-1	0
8258	3	M2	Reverse power relay trip	BIT, 1=alarm	0-1	0
8259	3	M3	L1-N low volts communications failure	BIT, 1=alarm	0-1	0
8260	3	M4	L2-N low volts communications failure	BIT, 1=alarm	0-1	0
8261	3	M5	L3-N low volts communications failure	BIT, 1=alarm	0-1	0
8262	3	M6	L1-L2 low volts communications failure	BIT, 1=alarm	0-1	0
8263	3	M7	L2-L1 low volts communications failure	BIT, 1=alarm	0-1	0
8264	3	M8	L3-L1 low volts communications failure	BIT, 1=alarm	0-1	0
8265	3	M9	Communications loss to Acuvim II meter	BIT, 1=alarm	0-1	0
8266	3	M10	10min x2 excursion timer active	BIT, 1=active	0-1	0
8267	3	M11	>3 excursions in 24hrs alarm	BIT, 1=alarm	0-1	0
8268	3	M12	>8min in 24hrs excursion alarm	BIT, 1=alarm	0-1	0
8269	3	M13	10min x2 excursion alarm	BIT, 1=alarm	0-1	0
8270	3	M14	Phase 1 CT failure communications alarm	BIT, 1=alarm	0-1	0
8271	3	M15	Phase 2 CT failure communications alarm	BIT, 1=alarm	0-1	0
8272	3	M16	Phase 3 CT failure communications alarm	BIT, 1=alarm	0-1	0
8273	3	M17	4hr reset lockout timer active	BIT, 1=alarm	0-1	0

20.5 Modbus Permissions

The LOGO PLC (CLS PLC) allows Modbus reads from all inputs, outputs and the assigned analogue and digital flags.


This is represented in the permissions table below:

Device name:

IP Address:

PORT:

Client Server



Device name:

IP Address:

PORT:

Client Server

Data transfer Add data transfer information (i)

ID	Start Address	Length	Direction	Start Address	Length	Unit ID
1	V 0.0	123 bits	->	Coil 1	123 bits	0
2	VW 0	123 words	->	HR 1	123 words	0
3	M 1	64 bits	->	Coil 1	64 bits	0
4	Q 1	20 bits	->	Coil 1	20 bits	0
5	I 1	24 bits	->	Coil 1	24 bits	0
6	AI 1	8 words	->	HR 1	8 words	0
7	AQ 1	8 words	->	HR 1	8 words	0
8	AM 1	64 words	->	HR 1	64 words	0

20.6 Typical Modbus Response

A typical Modbus response for BIT data is reproduced below, captured using a Modbus scanner acting as the client (Device).

Offset	Standa...	6 digit ...	Value
1	10001	100001	0
2	10002	100002	0
3	10003	100003	1
4	10004	100004	0
5	10005	100005	0
6	10006	100006	0
7	10007	100007	0
8	10008	100008	0
9	10009	100009	0

The register above is showing input 3 high and all other inputs low.

A typical Modbus response for WORD data is reproduced below, captured using a Modbus scanner acting as the client (Device).

Offset	Standa...	6 digit ...	Hex	uint16	int16
1	40001	400001	0x0000	0	0
2	40002	400002	0x0000	0	0
3	40003	400003	0x0000	0	0
4	40004	400004	0x0000	0	0
5	40005	400005	0x0000	0	0
6	40006	400006	0x0000	0	0
7	40007	400007	0x0000	0	0
8	40008	400008	0x0000	0	0
9	40009	400009	0x0000	0	0
10	40010	400010	0x0005	5	5
11	40011	400011	0x0000	0	0
12	40012	400012	0x0000	0	0
13	40013	400013	0x0000	0	0
14	40014	400014	0x11EA	4586	4586
15	40015	400015	0x2715	10005	10005
16	40016	400016	0xFE88	65160	-376
17	40017	400017	0xFE88	65160	-376
18	40018	400018	0xFE88	65160	-376
19	40019	400019	0xFE88	65160	-376
20	40020	400020	0x0000	0	0

20.7 Modbus Heartbeat and Identifier

To further help the Modbus integration commissioning engineer, there is a Modbus register that counts to 32766 and then resets to 0 and then counts back to 32766 (register 40017 and 18). This allows for the Modbus client to monitor for continuous communications, as it should see this value continuously changing if the communications are working. To further support this there is a register (8280), which pulses the BIT value to 1 and then to 0 every 0.5seconds. This could be termed the Modbus “heartbeat” and the integration engineer can choose to use this, if desired.

21 Logic Controller Embedded Webserver

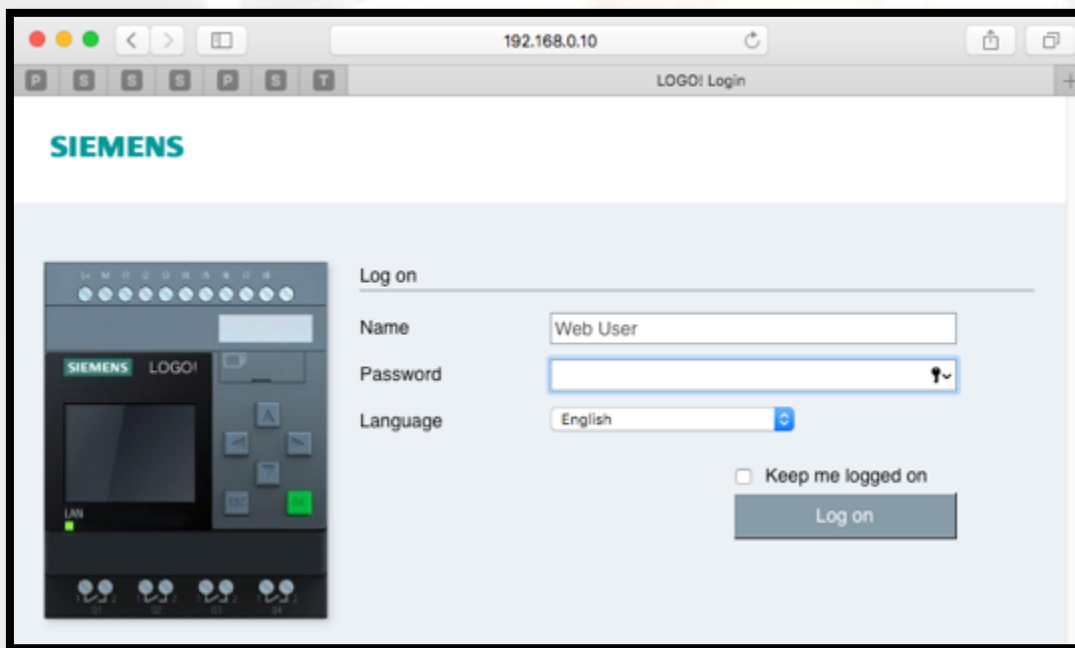
LOGO logic controllers using the TDE display have an internal Webserver as developed by Siemens.

The Webserver may be accessed by connecting directly to the RJ45 connection on the TDE HMI or by connecting to the LAN network that the logic controller is connected to, i.e. the same network as the Modbus.

To connect on the LAN, it is possible to use a PC or laptop. Just type 192.168.0.10 into an Internet Browser (Safari, Chrome, Firefox or if required, MS Edge). Once this has been typed the LOGO PLC Web Browser should load.

Modbus communications remain un-affected by connections to the Webserver.

Once this is complete the following screen will load:



IP Address may differ on this picture from the address you will use.

The name is always Web User and the password is: 7450

Once you have gained access, the logic controller is then offered up and will allow access to the screens on the HMI and the PLC display via the connected computer. Adjustments may also be made directly from the computer to the CLS / RPR PLC as per those that are allowed directly via the HMI display as long as the correct password is inserted, and adjustments are being made in-line with the DNO's permission or during initial commissioning.

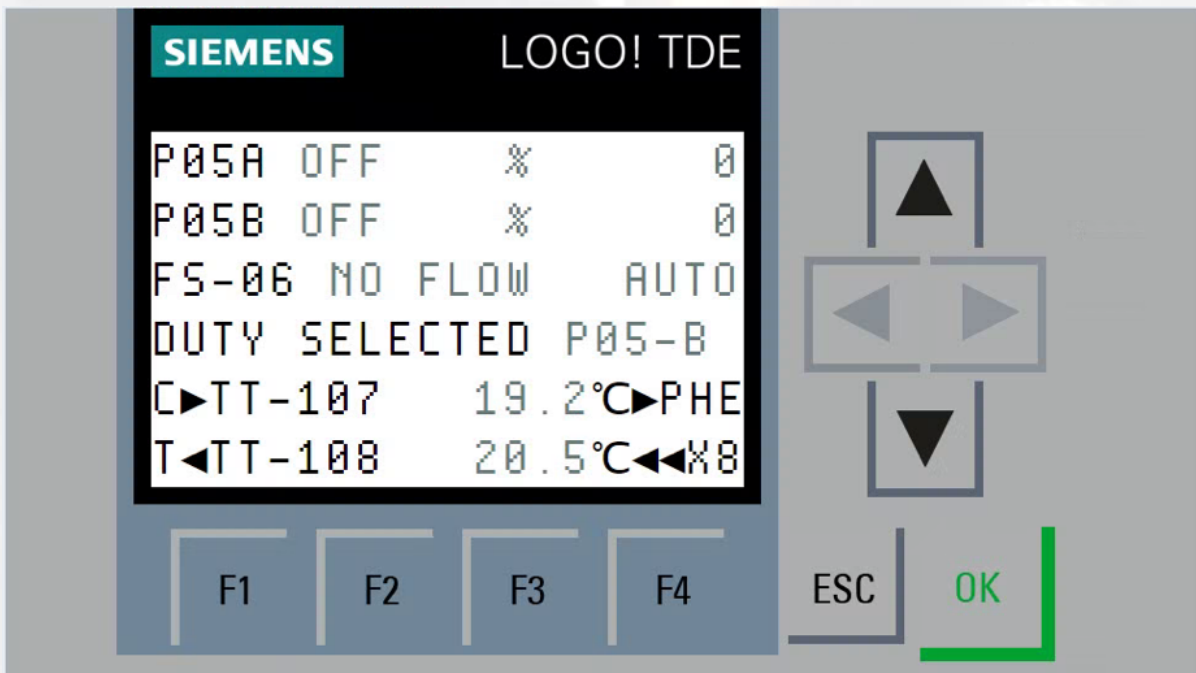


Figure 11. Example of the webserver screen showing home screen.

22 PLC Watchdogs

The LOGO PLC (CLS PLC) on this project is one of the most reliable on the market and issues with the PLCs are seldom. Whilst this may be the case the logic controller is equipped with standard internal system checks hard coded in its firmware. Should the logic controller lock-up, fail, lose power or become corrupt then all digital outputs will open and the mA signals shall be zero.

Where possible the HMI will attempt to display that the system is in a watchdog status, but as the PLC itself may be in fault then this may not be possible.

23 General Usage

Once the CLS system has been commissioned the operation is automatic and there is no requirement to open the control panel doors.

During normal usage the control panel doors should be closed. Leaving either door open poses a risk of electric shock.

Ensure that control panel doors are fully closed when the system is not being worked on.

24 UNIX Epoch Time Stamp

The LOGO PLC (CLS PLC) uses the UNIX Epoch time stamp for determining the current time. This time is based on the seconds elapsed since 00:00:00 UTC on Thursday the 1st January 1970. The LOGO PLC then uses look up tables to acquire the current UTC time and date and then offsets these for the country that the LOGO PLC has been installed (set-up during commissioning).

Tests have shown that this Component has no issues dealing with the time after 03:14:07 on Tuesday, 19th January 2038. We have tested the LOGO PLC with a time stamp of 2099 and left it running for several days without detriment. The LOGO PLC can accept dates from 2000 to 2099 without issue and is therefore not going to be affected by the Y2038 problem.

25 End User Maintenance

This document does not cover the maintenance requirements of the Device plant or any other plant on the system. This information is contained in the relevant OEM O&M manuals and should be read, understood, and adhered to.

This CLS requires basic maintenance such as checking for alarms on the HMI, checking that the control panel has not been damaged (vermin / water ingress), and that all the circuit breakers in the control panel are closed.

The system should be checked yearly to ensure that all the peripheral controls are still working.

26 Disposal - WEEE

The control panels are made up of parts that can be widely recycled. The panels should be recycled following the regulations enforced within your area at the time of disposal. The panel is constructed of metal with some electronic components, all components in the panel can potentially be recycled. For further information on end-of-life WEEE disposal contact the supplier of the CLS components, whom will give additional advice.

27 Disclaimer

Due to the continuous investment into development of this product this document is subject to change without prior notice. For latest information or for more precise details of an individual product please contact your supplier contact.

28 CE.

CE EC Declaration of Conformity

We J. P. Baxter and Company LTD. Company No. 08507855.
of Moss House Farm, Long Hill, Buxton, Derbyshire, SK17 6SS

in accordance with the essential requirements of the following Directive(s):

2014/95/EC	The Low Voltage Directive
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hereby declare that:

Equipment: Control Panels
 Model type: G100 Metering Panel and CLS Control Panel
 Serial Number: 250 to 500

Is in conformity with the applicable requirements of the following documents / harmonised standards:

Ref. No.	Title
BSEN61439-2	Low-voltage switchgear and control gear assemblies. Power switchgear and control gear assemblies
BSEN60204-1	Safety of Machinery. Electrical Equipment of Machines. General requirements.

I hereby declare that the equipment named above has been designed to comply with the relevant sections of the above referenced specifications, standards and EEC Directives.

Responsible person: Mr J. P. Baxter. February 2023. Revision 1.

Signed:



John Baxter. Managing Director J. P. Baxter and Company LTD.

29 UKCA.



United Kingdom Conformity Assessment, Declaration of Conformity.

We J. P. Baxter and Company LTD. Company No. 08507855.
of Moss House Farm, Long Hill, Buxton, Derbyshire, SK17 6SS

This product complies with the following standards:

1	Electrical Equipment (Safety) Regulations 2016
---	--

hereby declare that:

Equipment: Control Panels
Model type: G100 Metering Panel and CLS Control Panel
Serial Number: 250 to 500

Is in conformity with the applicable requirements of the following documents:

Ref. No.	Title
BSEN61439-2	Low-voltage switchgear and control gear assemblies. Power switchgear and control gear assemblies
BSEN60204-1	Safety of Machinery. Electrical Equipment of Machines. General requirements.

I hereby declare that the equipment named above has been designed to comply with the relevant sections of the above referenced specifications and standards.

Responsible person: Mr J. P. Baxter. February 2023. Revision 1.

Signed:

John Baxter. Managing Director J. P. Baxter and Company LTD.

30 Contact details:

J.P. Baxter and Company LTD.
Moss House Farm, Long Hill, Buxton, Derbyshire, SK17 6SS (Registered Office)
Phone: 07880 747 941 / 07535 410 709
E-Mail: sc360@jpbaxterandcompany.co.uk
Web: www.jpbaxterandcompany.co.uk

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