GCP-MG
Ethernet Modbus gateway
User manual

Edition 1.1
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UMGCPMG-0801

GCP-MG Ethernet Modbus gateway: User manual

Document revision history

2007-05-14, 1.0	Initial Release for hardware version J367-S3-PB and firmware version 1.0
2008-07-28, 1.1	LED description added. Added max. number of Modbus/TCP connections. Corrected weight. Updated company name and address. Editorial Changes.

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Contact

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About this manual

This manual explains how to install, operate and configure a *GCP-MG*.

This manual is to be used with a *GCP-MG* with firmware version 1.0.

Document Conventions

Throughout this manual we use the following symbols and typefaces to make you aware of safety or other important considerations:

	Indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.
	Indicates a potentially hazardous situation that, if not avoided, could result in damage to equipment.
	Indicates information that is critical for successful application and understanding of the product.
	Provides other helpful user information that does not fall in above categories.
	Provides supplemental user information.
Acronym	This typeface is used to introduce acronyms or product names.
`Command`	This typeface is used to represent commands, prompts, input fields and filenames. In the context of programming it is used for functions, variable names, constants or class names.
`Placeholder`	This typeface is used to represent replacable text. Replaceable text is a placeholder for data you have to provide, like file-names or command line arguments.
`User input`	This typeface is used to represent data entered by the user or buttons.
`Screen output`	Screen output or program listing

Chapter 1. Introduction

The *GCP-MG* is a next-generation Modbus/CAN gateway specifically designed to interface Woodward's *GCP-30 Series Genset Controls* and *LS 4 Circuit Breaker Controls* with Modbus networks.

The *GCP-MG* gateway has been developed in cooperation with Woodward to ensure the highest possible degree of interoperability with Woodward equipment.

The gateway features CAN, serial RS-232 and RS-485 ports as well as an Ethernet port and can be mounted on a DIN rail. On the CAN side it implements the Woodward CAL protocol to connect to the GCP controls. On the serial ports and on Ethernet it implements a Modbus server (Modbus RTU and Modbus/TCP) and accepts connections from Modbus master devices like PLCs and SCADA systems.

Usage and configuration of the gateway is simple and conveniently performed using a web browser which connects to the embedded web server.

Figure 1.1: GCP-MG mounted on DIN rail

Possible areas of application are:

- PLC connection
- Operator panel interfacing
- HMIs
- SCADA integration
- Power station automation
- Gen set control
- Remote control & monitoring
- Data logging

Features

The *GCP-MG GCP-MG* gateway provides the following key features:

- Modbus/TCP protocol (Ethernet)
- Modbus RTU protocol (either RS-232 or RS-485, software configurable)
- Interfaces with up to 16 GCP-30 controls and up to 8 LS 4 controls
- Full support of Option SB03 (Cat CCM) and Option SC06 (MTU MDEC)
- GW4 backward compatible Modbus register layout
- Dedicated Modbus slave ID for each GCP-30 and LS 4 control
- Complete data set of one GCP-30 unit can be read with a single Modbus transaction
- Integer/Exponent value pairs for voltages, power and currents are additionally represented as 32-bit floating point registers
- Serial baud rate up to 115200 bps
- Support of Modbus function codes 03, 04, 06 and 16
- Concurrently one Modbus serial line and up to two Modbus/TCP connections
- Embedded web server for easy configuration and commissioning using a web browser
- Firmware upgradeable via Ethernet
- DIN rail mountable
- 24 V DC (10-30 V) power supply
- Status LEDs for power, Ethernet link, device status and Modbus/CAN status

Chapter 2. Description

The power, CAN and RS-485/RS-422 connectors are placed on the top side of the module. The RS-232 and Ethernet connectors are placed on the bottom side of the module as shown in the following illustration:

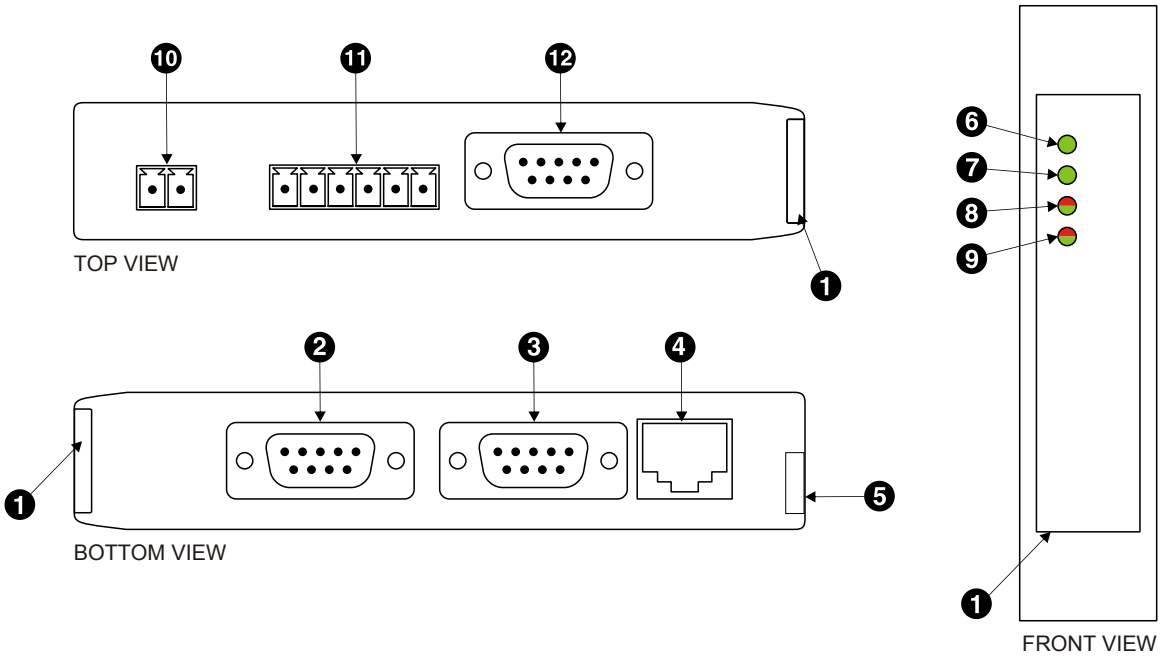


Figure 2.1: Location of connectors

❶ Clear front cover
❷ Primary RS-232 (Modbus) connector
❸ Secondary RS-232 (Diagnostic) connector
❹ Ethernet connector
❺ DIN rail clip
❻ Power LED
❼ Ethernet link LED
❽ Device status LED
❾ Modbus/CAN status LED
❿ Power terminal block socket
⓫ Modbus RS-485 terminal block socket
⓬ CAN connector

Chapter 3. Installation

Safety precautions

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Only qualified workers should install this equipment. Such work should be performed only after reading this entire set of instructions.
- NEVER work alone.
- Before performing visual inspections, tests, or maintenance on this equipment, disconnect all sources of electric power. Assume that all circuits are live until they have been completely de-energized, tested, and tagged. Pay particular attention to the design of the power system. Consider all sources of power, including the possibility of backfeeding.
- Apply appropriate personal protective equipment and follow safe electrical practices.
- Turn off all power supplying the equipment in which the *GCP-MG* is to be installed before installing and wiring the *GCP-MG*.
- Always use a properly rated voltage sensing device to confirm that power is off.
- Beware of potential hazards, wear personal protective equipment, and carefully inspect the work area for tools and objects that may have been left inside the equipment.
- The successful operation of this equipment depends upon proper handling, installation, and operation. Neglecting fundamental installation requirements may lead to personal injury as well as damage to electrical equipment or other property.

Failure to follow these instructions will result in death or serious injury!

Regulatory notes

1. The *GCP-MG* module is suitable for use in non-hazardous locations only.
2. The *GCP-MG* module is not authorized for use in life support devices or systems.
3. Wiring and installation must be in accordance with applicable electrical codes in accordance with the authority having jurisdiction.
4. The *GCP-MG* is designed for installation into an electrical switchboard or cubical as part of a fixed installation.

Unpacking and handling

1. Please read this manual carefully before opening the module or fitting it into your system.
2. Keep all original packaging material for future storage or warranty shipments of the module.

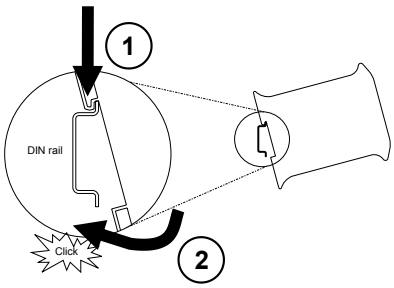
3. Do not exceed the specified temperatures.

Before connecting anything

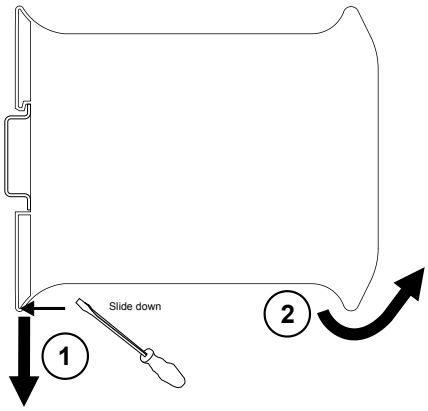
1. Before installing or removing the module or any connector, ensure that the system power and external supplies have been turned off.
2. Check the system supply voltage with a multimeter for correct voltage range and polarity.
3. Connect the power supply cable and switch on the system power. Check if the Power LED is lit.
4. Turn off system power.
5. Connect all I/O cables.
6. Once you are certain that all connections have been made properly, restore the power.

DIN rail mounting and removal

The *GCP-MG* gateway is designed to be mounted on a 35 mm DIN rail according to DIN/EN 50022. The enclosure features a 35 mm profile at the back which snaps into the DIN rail. No tools are required for mounting. Please observe the rules outlined in the section called “Mounting rules”.



To mount the module on a DIN rail, slot the top part of the *GCP-MG* into the upper guide of the rail and lower the enclosure until the bottom of the red hook clicks into place.



To remove the *GCP-MG* from the DIN rail, use a screw driver as a lever by inserting it in the small slot of the red hook and push the red hook downwards. Then remove the module from the rail by raising the bottom front edge of the enclosure.

Mounting rules

The enclosure provides protection against solid objects according to IP 20 / NEMA Type 1 protection rating. When mounting the enclosure observe the following rules:

- Avoid splash water and water drops
- Avoid aggressive gas, steam or liquids
- Avoid dusty environments
- Make sure there is sufficient air ventilation and clearance to other devices mounted next to the module
- Do not exceed the specified operational temperatures.
- Mount inside a sealed electrical switchboard or cubicle
- Observe applicable local regulations like EN60204 / VDE0113

Powering the GCP-MG

Before connecting power please follow the rules in the section called “Safety precautions” and the section called “Before connecting anything”.

Power is supplied via a 3.81 mm 2-pin pluggable terminal block (Phoenix Contact *Mini Combicon* type MC1,5/2-ST-3.81) located at the top side of the mounted module (refer to Figure 2.1, “Location of connectors”). The following table and picture shows the power terminal socket pinout:

Pin	Signal	Function
1	V+	Positive voltage supply (10 - 30 V DC)
2	V-	Negative voltage supply, ground

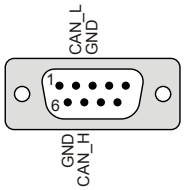
Table 3.1: Power supply connector pinout

Make sure that the polarity of the supply voltage is correct before connecting any device to the serial and CAN ports! A wrong polarity can cause high currents on the ground plane between the V- power supply pin and the CAN port and serial port GND pins, which can cause damage to the device.

Wiring the CAN interface

The CAN interface connects to the GCP-30 and LS 4 devices.

The CAN connector is a male 9-pin D-sub type located at the top side of the mounted module (refer to Figure 2.1, “Location of connectors”). It has industry standard CiA DS-102 pinout as shown in the following table and picture:



Pin	Signal	Function
1	NC	
2	CANL	CAN_L bus line
3	GND	CAN ground
4	NC	
5	NC	
6	GND	Optional CAN ground
7	CANH	CAN_H bus line
8	NC	
9	NC	
	FG	*Connector frame/shell is internally connected to ground*

Table 3.2: CAN connector pinout

- The bus must be terminated at both ends with its characteristic impedance, typically a 120 Ohm resistor.
- The cable must be a twisted pair (for CAN_H/CAN_L) and a third wire (for the ground).
- Maximum number of CAN nodes is 64
- Maximum CAN cable length is 250 m (820 ft).
- Stub connections off the main line should be avoided if possible or at least be kept as short as possible.
- The cable must be shielded and the shield must be connected to a protective ground at a single point to assure a high degree of electromagnetic compatibility and surge protection.
- The shield must *not* be connected to the GND pins or the connector shell.

Wiring the Modbus RS-485 interface

The Modbus RS-485 port is used for integrating the *GCP-MG* into a two-wire Modbus over Serial Line network. The *GCP-MG* is a Modbus slave device.

The RS-485 signals are located at the 3.81 mm 6-pin pluggable terminal block (Phoenix Contact *Mini Combicon* type MC1,5/2-ST-3.81) on the top side of the mounted module (refer to Figure 2.1, “Location of connectors”). The following table and picture shows the pinout:

Pin	EIA-485 Name	Modbus name	Description
1	C/C'	Common	Signal common (GND)
2	B/B'	D1	Non-inverting transceiver terminal 1 (RX/TX+)
3	A/A'	D0	Inverting transceiver terminal 0 (RX/TX-)
4			Signal common (GND)
5			*Reserved for 2nd port, must be left unconnected*
6			*Reserved for 2nd port, must be left unconnected*

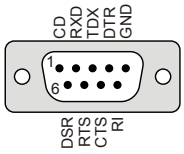
Table 3.3: RS-485 connector pinout

- The bus must be terminated at both ends with its characteristic impedance, typically a 120 Ohm resistor.
- The bus lines are to be biased (polarized) at one point, typically at the master connection.
- The cable must be a twisted pair (for B+/A-) and a third wire (for the common).
- Maximum number of RS-485 nodes without repeater is 32.
- Maximum cable length to 1200 m (4000 ft).
- Stub connections off the main line should be avoided if possible or at least be kept as short as possible.
- To assure a high degree of electromagnetic compatibility and surge protection, the RS-485 cable must be shielded and the shield must be connected to a protective ground at a single point.
- The shield must *not* be connected to the GND pin.

Wiring the Modbus RS-232 interface

The module's primary RS-232 port is used for serial communication to a Modbus Master device. The *GCP-MG* is a Modbus slave device.

The Primary RS-232 (Modbus) port connector is a male 9-pin D-sub type located at the bottom side of the mounted module (refer to Figure 2.1, “Location of connectors”). It has industry standard EIA-574 data terminal equipment (DTE) pinout as shown in the following table and picture:



Pin	Signal	Function	Direction
1	DCD	unused	in
2	RXD	Receive data	in
3	TXD	Transmit data	out
4	DTR	unused	out
5	GND	Signal ground	
6	DSR	unused	in
7	RTS	unused	out
8	CTS	unused	in
9	RI	unused	in
	FG	*Connector frame/shell is internally connected to ground*	

Table 3.4: Primary RS-232 (Modbus) connector pinout

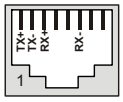
- Maximum cable length is 15 m (50 ft) or a length equal to a line capacitance of 2500 pF, both at the maximum standard bit rate of 20 kbps. If operating at higher bit rates the maximum cable length drops to 3 m (10 ft) at a bit rate of 57.6 kbps.

- The RS-232 cable must be shielded and the shield must be connected to a protective ground at a single point to assure a high degree of electromagnetic compatibility and surge protection.
- The shield must *not* be connected to the GND pin or the connector shell.

To connect the *GCP-MG* to a PC (Personal Computer) or any other device with data terminal equipment (DTE) pinout you need a null-modem or cross-over cable.

Connecting Ethernet

The following table describes the 10BASE-T Ethernet RJ-45 connector pinout:



Pin	Signal	Function
1	TX+	Non-inverting transmit signal
2	TX-	Inverting transmit signal
3	RX+	Non-inverting receive signal
4		*Internal termination network*
5		*Internal termination network*
6	RX-	Inverting receive signal
7		*Internal termination network*
8		*Internal termination network*
	FG	*Connector frame/shell is internally connected to ground*

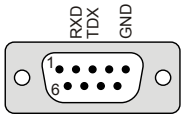
Table 3.5: Ethernet connector pinout

- We recommend to use Category 5 shielded twisted pair network cable.
- Maximum cable length is 100 m (3000 ft).
- The network cable must be shielded and the shield must be connected to a protective ground at a single point to assure a high degree of electromagnetic compatibility and surge protection.
- The shield must *not* be connected to the connector frame.

Connecting to the diagnostic port

The module's secondary RS-232 port is used as Diagnostic port and only active power-up of the device. It allows configuration of the IP settings and reset of the settings to factory defaults via a terminal program.

The Secondary RS-232 (Diagnostic) port connector is a male 9-pin D-sub type located at the bottom side of the mounted module. It has industry standard EIA-574 data terminal equipment (DTE) pinout as shown in the following table and picture:



Pin	Signal	Function	Direction
1	NC		
2	RXD	Receive data	in
3	TXD	Transmit data	out
4	NC		
5	GND	Signal ground	
6	NC		
7	NC		
8	NC		
9	NC		
	FG	*Connector frame/shell is internally connected to ground*	

Table 3.6: Secondary RS-232 (Diagnostic) connector pinout

- Maximum cable length is 15 m (50 ft) or a length equal to a line capacitance of 2500 pF, both at the maximum standard bit rate of 20 kbps. If operating at higher bit rates the maximum cable length drops to 3 m (10 ft) at a bit rate of 57.6 kbps.
- The cable must be shielded and the shield must be connected to a protective ground at a single point to assure a high degree of electromagnetic compatibility and surge protection.
- The shield must *not* be connected to the GND pin or the connector shell.

To connect the *GCP-MG* to a PC (Personal Computer) or any other device with data terminal equipment (DTE) pinout you need a null-modem or cross-over cable.

Chapter 4. Ethernet & IP configuration

Before configuring the *GCP-MG*, obtain a unique static IP address, subnet mask, and default gateway address from your network administrator.

The factory default IP address of the *GCP-MG* is 169.254.0.10 which is in the Automatic Private IP Addressing (APIPA) address range.

There a several methods of configuring the module's IP address:

1. Removing your PC from your corporate network and using a cross-over network cable (see the section called “IP setup using a web browser and a cross-over network cable”).

2. Via the secondary serial port and a terminal program like *HyperTerminal* (see the section called “IP setup using HyperTerminal”).

3. Leaving your PC connected to your corporate network and temporarily changing the IP settings on your PC to match the subnet of the *GCP-MG* (see the section called “Temporarily changing the IP settings on your PC”).

In order to connect to the *GCP-MG* via TCP/IP, your PC must be on same IP subnet as the gateway. In most situations this means that the first three numbers of the IP address have to be identical.

IP setup using a web browser and a cross-over network cable

This method applies only to operating systems like Windows, which support APIPA (Automatic Private IP Addressing). It also requires your PC to be configured for DHCP. If your computer is configured with a static IP address, follow the procedure in the section called “Temporarily changing the IP settings on your PC”.

1. Disconnect your PC from your corporate network. If your computer is configured for DHCP it should now automatically fall back to use a default IP address from the APIPA range 169.254.x.x.

2. Connect an Ethernet crossover cable from the *GCP-MG* to the computer.

3. Start *Internet Explorer*.

4. In the address box, type **`169.254.0.10`** and then press **`Enter`**.

5. Click **`Configuration…`** and then **`Ethernet & IP`** in the menu on the left side of the page.

6. Enter the IP address, subnet mask, and gateway address assigned to your *GCP-MG*, then click **`Save`**.

7. Reconnect your computer to your corporate network.

IP setup using HyperTerminal

1. Connect a null modem RS-232 cable between your PC and the *GCP-MG*'s diagnostic port.

2. In Windows XP, click **Start**, point to **All Programs**, point to **Accessories**, point to **Communications**, and then click **HyperTerminal**.

3. When *HyperTerminal* starts, it opens a dialog box and asks for a name for the new connection. Enter a name (for example, `deviceconfig`) then click **OK**.

4. The `Connect to` dialog opens. Select the ***COM port*** you will be using in the `Connect using` drop-down list box, then click **OK**.

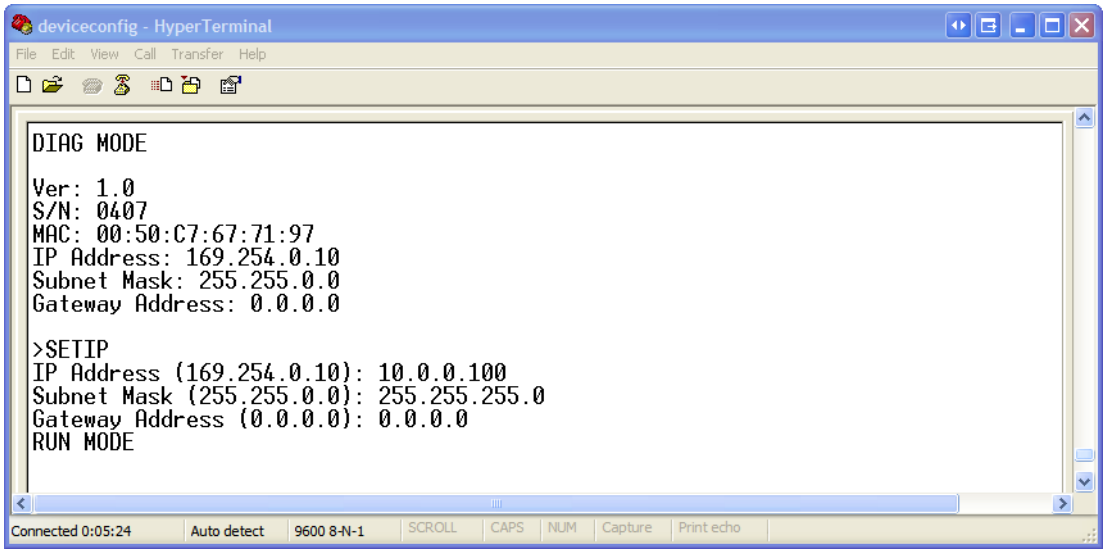
5. Select **9600**, **8**, **None**, **1**, **None** in the `COM Properties` dialog, then click **OK**.

6. *HyperTerminal* is now connected to the serial line.

7. Keep the **space** bar pressed in *HyperTerminal* and power-cycle your device at the same time.

8. A menu should appear after one or two seconds showing device information, the current IP configuration and a > prompt.

9. Type **SETIP**, then press **Enter** within 10 seconds after the prompt is shown.



10. The device will show current values and prompt for new values for IP address, net mask and gateway address. Enter the new values and press **Enter**. A key press must be received at least every 10 seconds otherwise the device will go back to *RUN MODE* and resume normal operation.

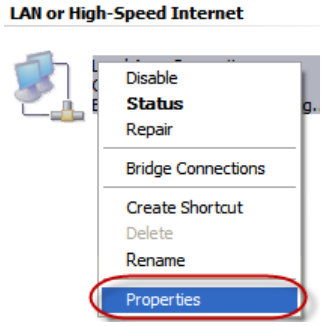
11. The gateway will return to the main prompt. Type **X** and press **Enter** to leave *DIAG MODE* and resume normal operation indicated with RUN MODE.

Temporarily changing the IP settings on your PC

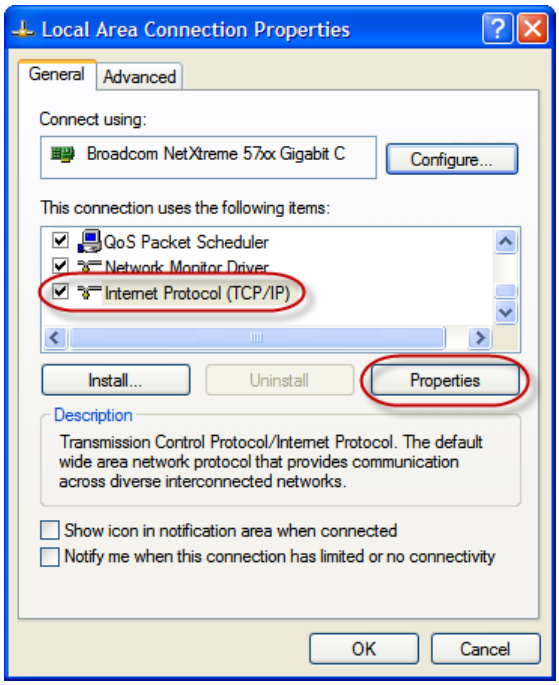
This method involves manually assigning an IP address to your PC in the same subnet as the gateway. The default subnet of the gateway is 169.254.0.0/16.

1. Connect the *GCP-MG* to your Ethernet network.

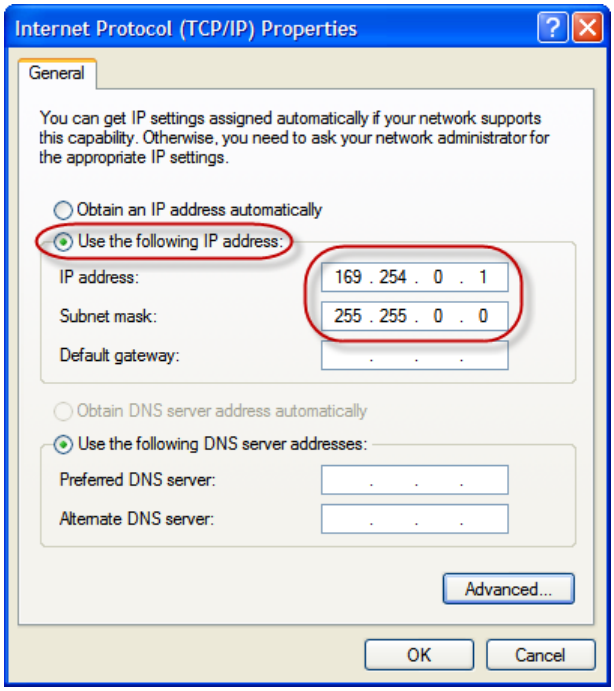
2. On a Windows PC, open the Control Panel and double-click on **Network Connections**. Right-click on the Network Connection associated with your network adapter and select **Properties**.



This will show the Local Area Connection Properties Dialog:



3. Select the **Internet Protocol (TCP/IP)** entry and click on **Properties** to open the TCP/IP Properties dialog as shown below:



4. Write down your current settings so they can be restored later.

5. Select **`Use the following IP address`** and configure a static IP address in the same subnet as the device, for example `169.254.0.1` and the subnet mask `255.255.0.0`. Click **`OK`** to save the changes.

6. Start *Internet Explorer*.

7. In the address box, type **`169.254.0.10`** and then press **`Enter`**.

8. Click **`Configuration…`** and then **`Ethernet & IP`** in the menu on the left side of the page.

9. Enter the IP address, subnet mask, and gateway address assigned to your *GCP-MG*, then click **`Save`**.

10. Restore your computer's original settings.

Chapter 5. Web browser based management

The *GCP-MG* incorporates an embedded web server. This allows you to connect to the device and monitor and configure it using a web browser. Most browsers should work, provided they support JavaScript. We recommend *Internet Explorer* 6.0 or higher.

Connecting to the GCP-MG

Once you made sure that your PC is configured to be on the same subnet as the *GCP-MG*, start your web browser. In the address box, type the IP address of your device (169.254.0.10 is the default), and then press **Enter**. (See Chapter 4, *Ethernet & IP configuration*)

The web browser will establish communication with the embedded web server and an overview page similar to the following picture will appear:

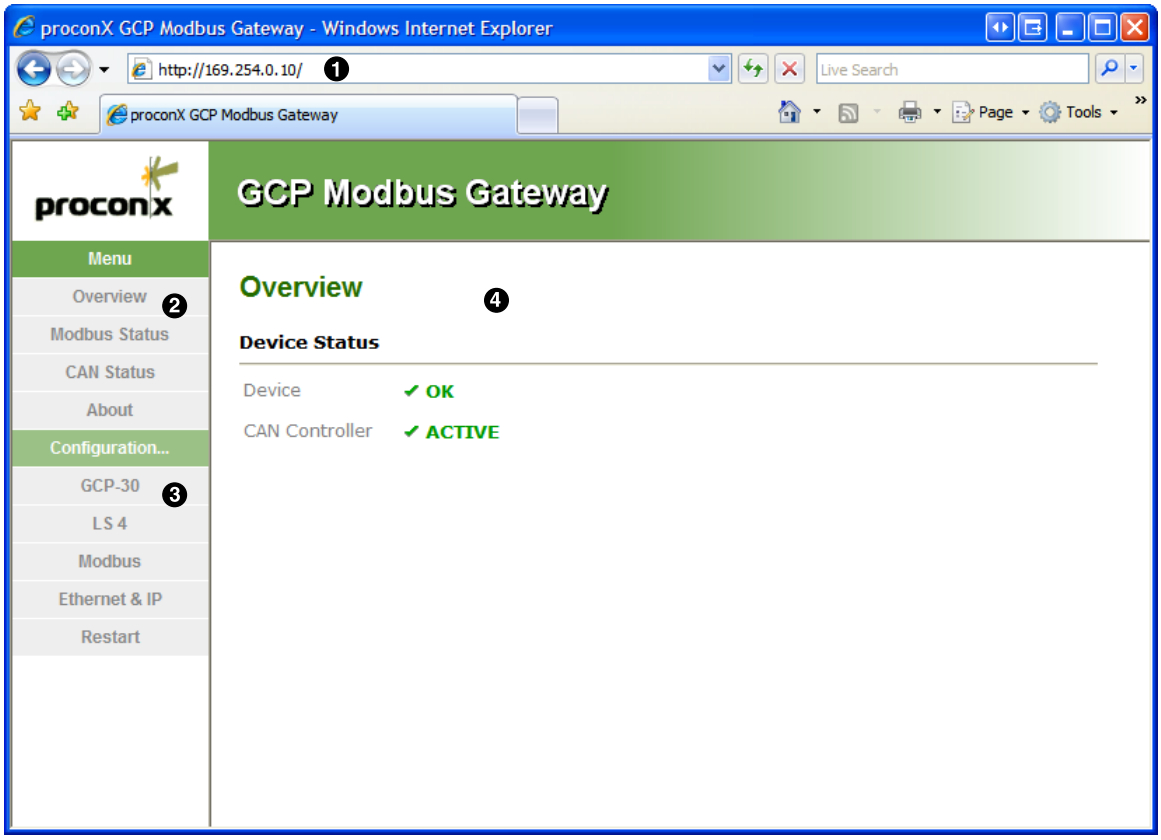


Figure 5.1: Device management and configuration via the web browser

❶ Gateway IP address
❷ Main menu
❸ Configuration sub-menu

❹ Infomation area

Use the menu bar shown on the left side to navigate the different pages.

In order to connect to the *GCP-MG* via TCP/IP, your PC must be on same IP subnet as the gateway. In most situations this means that the first three numbers of the IP address have to be identical.

Monitoring and diagnostic

The *GCP-MG* offers several web pages which allow monitoring of the status of the different communication networks and the device performance.

Device status

The `Overview` page shows the principal device status as shown in the following picture:

Figure 5.2: Overwiew page

The value shown in the `Device` row represents the device status register which keeps track of run-time faults. All run-time faults are latched and must be reset by the user. The following faults can be listed here:

`OK`
: The device is fault free.

`Watchdog reset`
: This warning indicates that the device was reset by it's internal watchdog supervision circuit.

`Brown out reset`
: This warning indicates that the device was reset by it's internal supply voltage monitoring circuit. This fault occurs when the supply voltage drops below the lower limit.

`Device out of memory`
: This warning indicates that the internal dynamic memory has been exhausted and due to this a certain function could not be completed.

`Device configuration data write failure`
: This alarm indicates that the configuration data could not be written to the non-volatile memory. Configuration data changes will be lost once the device is power-cycled or reset.

`Reset to factory defaults`
: This alarm indicates that the device' configuration data was reset to factory defaults. The device requires re-commissioning.

The `CAN controller` status indicates the status of the CAN interface and can be in one of the following states:

`ACTIVE`
: The CAN bus is fault free.

`PASSIVE`
: CAN's built in fault confinement mechanism has set the node to *error passive state* due to a large number of errors on the CAN bus. This warning indicates a wiring error.

`BUS-OFF`
: CAN's built in fault confinement mechanism has set the node to *bus-off* state due to excessive errors on the CAN bus. This alarm indicates a wiring error. The *GCP-MG* will not transmit or receive any message on the CAN bus once entered this state. The device needs to be manually restarted on order to recover from this fault.

The `Modbus Status` page shows status and statistics about the Modbus traffic. These values provide valuable information used to troubleshoot Modbus network problems. This page is automatically updated every 5 seconds.

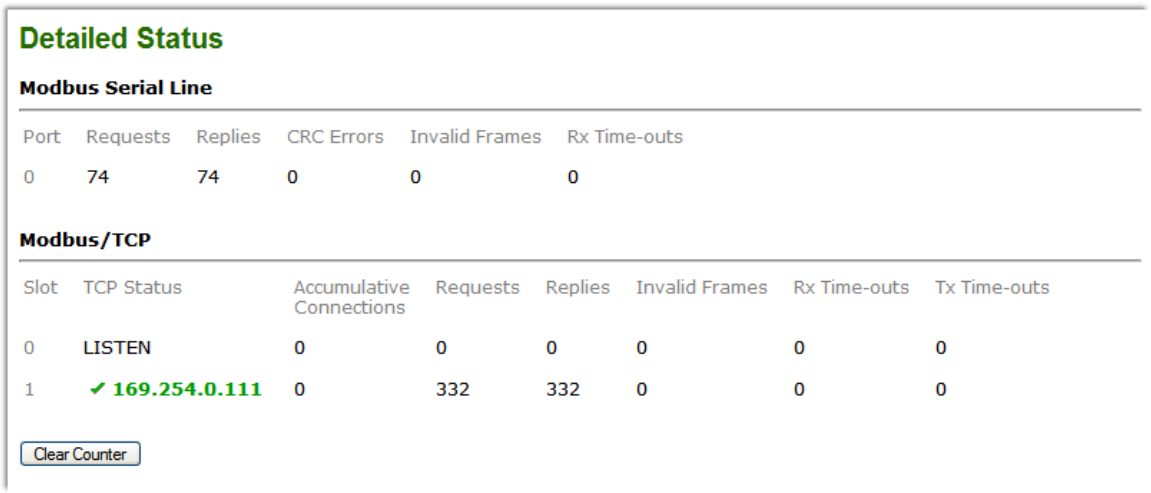


Figure 5.3: Modbus status page

This page shows accumulated readings since the *GCP-MG* was last activated or reset. If power to the *GCP-MG* is lost, all cumulative values are reset to zero.

The following statistics are maintained:

`TCP status`
Status of the TCP/IP connection as per TCP finite state machine (refer to RFC 793). If no client is connected the status indicates `LISTEN`. If a client is connected, it's IP address is shown.

`Accumulative connections`
A counter that increments each time a client opens a Modbus/TCP connection.

`Requests`
A counter that increments each time an inbound request message is successfully received.

`Replies`
A counter that is incremented each time a reply message is sent back to the master. This includes exception replies.

`CRC errors`
A counter that increments each time a message is received that has a CRC that does not match what is calculated. Typically the result of wiring issues. Messages with CRC errors are discarded and not replied to.

`Invalid frames`
A counter that increments each time a malformed Modbus frame is detected. Malformed frames are for example messages larger than the allowed maximum PDU size defined in the Modbus standards. This can be caused by non-Modbus traffic on the network.

`Rx time-outs` (Modbus serial line)
A counter that increments each time an inter-character time-out occurred during the reception of an inbound message.

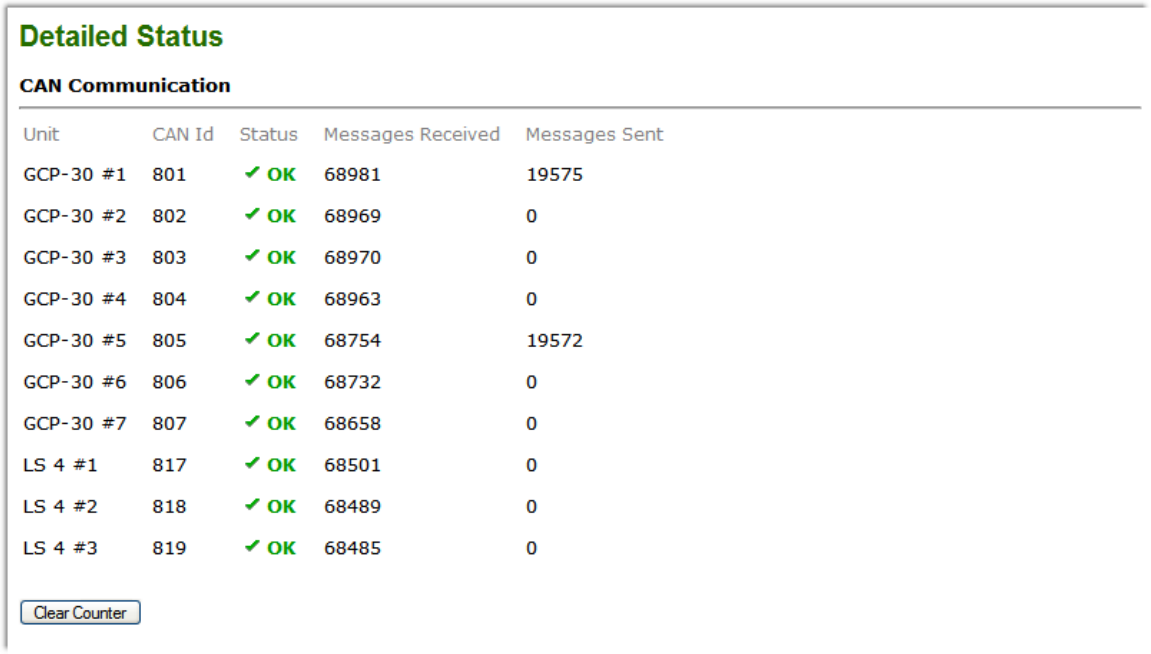
`Rx time-outs` (Modbus/TCP)
A counter that increments if the master connection has timed out. Subsequently the connection is terminated by the *GCP-MG*. A time-out occurs if no Modbus request is received from a connected client within a 10 second period.

`Tx time-outs`
Number time-outs occurred when attempting to send a reply message.

The cumulative diagnostic data is reset when the device is power cycled or reset. The data is also reset by pressing the **`Clear Counter`** button.

CAN communication status

The *CAN status* page shows status and statistics about the CAN bus traffic. These values provide valuable information used to troubleshoot CAN problems. This page is automatically updated every 5 seconds.



Detailed Status

CAN Communication

Unit	CAN Id	Status	Messages Received	Messages Sent
GCP-30 #1	801	✔ OK	68981	19575
GCP-30 #2	802	✔ OK	68969	0
GCP-30 #3	803	✔ OK	68970	0
GCP-30 #4	804	✔ OK	68963	0
GCP-30 #5	805	✔ OK	68754	19572
GCP-30 #6	806	✔ OK	68732	0
GCP-30 #7	807	✔ OK	68658	0
LS 4 #1	817	✔ OK	68501	0
LS 4 #2	818	✔ OK	68489	0
LS 4 #3	819	✔ OK	68485	0

Clear Counter

Figure 5.4: CAN communication status page

This page shows accumulated readings since the *GCP-MG* was last activated or reset. If power to the *GCP-MG* is lost, all cumulative values are reset to zero.

The CAN communication channel between a GCP-30 or LS 4 unit and the *GCP-MG* can be in one of the following states:

`OK`
: The CAN communication channel with the GCP-30 or LS 4 unit has been established. The GCP-30 or LS 4 control is cyclically updating data.

`WAIT`
: The presence of a GCP-30 or LS 4 unit has been detected however the *GCP-MG* is currently waiting to receive a complete data set. It takes approximately between 2.3 and 3 seconds to receive a full data set from the GCP-30 and approximately 10 seconds from the LS 4.

`TIME-OUT`
: No CAN message was received for a period of 1 second. A GCP-30 control is supposed to send a CAN message every 100 ms, a LS 4 every 200 ms.

The following statistics are maintained:

`Messages received`
: A counter that increments each time an inbound CAN message matching the shown CAN ID is successfully received.

`Messages sent`
: A counter that is incremented each time a CAN message is sent. CAN messages are only sent if Remote Control is enabled for this GCP-30 or LS 4.

The cumulative diagnostic data is reset when the device is power cycled or reset. The data is also reset by pressing the `Clear Counter` button.

Finding the firmware version and serial number

Click on the **`About`** menu entry on the menu bar to show the product information as shown below:

Figure 5.5: About page

This product information is important for service and support inquiries. The following product information is provided:

`Product name`
The name of the product.

`Hardware version`
GCP-MG hardware version.

`Firmware version`
The firmware version that is installed on the *GCP-MG*.

`Serial number`
The serial number of the *GCP-MG*. The serial number is specific to your device.

Configuring and commissioning

The configuration pages are accessed by clicking on the `Configuration…` menu entry on the menu bar which then expands a configuration sub-menu. All configuration settings are kept in the device' non-volatile memory.

If you make changes to any settings, remember to save each page before changing to a different page!

Configuring Ethernet and IP

Select the **`Configuration→Ethernet & IP`** sub-menu from the menu bar to open the `Ethernet and IP` settings which are shown below:

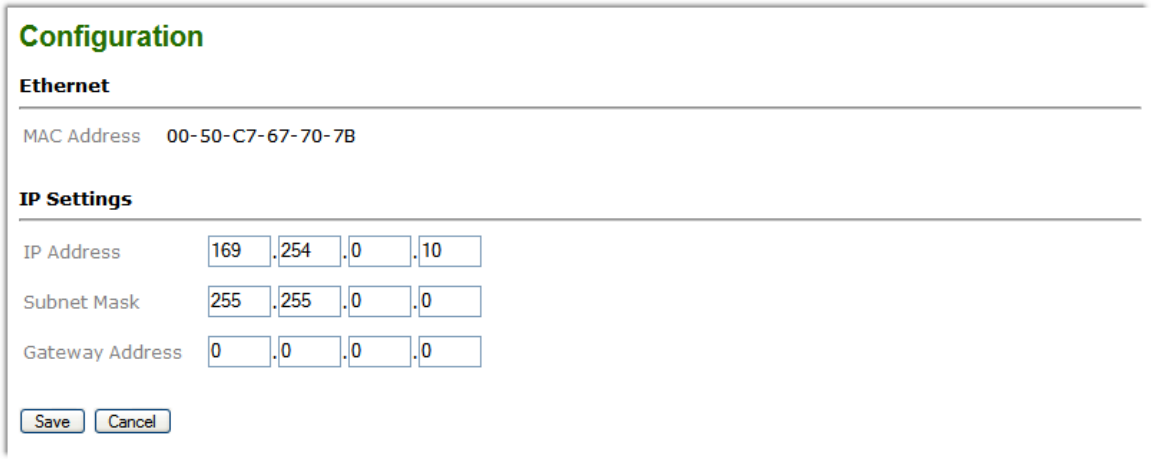


Figure 5.6: Ethernet and IP settings page

The following Ethernet parameters are shown:

`MAC address`
The device' unique MAC address. This number is hard coded and cannot be changed.

The following Internet protocol (IP) settings can be entered:

`IP address`
The IP address assigned to this device.

`Subnet mask` (also known as network mask)
If you have a router, enter the subnet mask for the segment to which this device is attached.

`Gateway address`
If your network segment has a router, enter its IP address here. Otherwise leave the address as `0.0.0.0`.

Once you click **Save** the new settings are stored and applied instantly. The new settings are confirmed with the following page:

Figure 5.7: IP settings changed confirmation

Please write down the new IP address so you are able to communicate with the device in the future!

Configuring GCP-30 and LS 4 Modbus access

Access from the Modbus to a GCP-30 and LS 4 unit can be configured on a per unit basis. You have the option of completely disabling a gen set control for Modbus access, have read-only access or enabling remote control either unsupervised or time-out supervised.

To configure the Modbus access, enter the `Configuration` sub-menu and click on either the `GCP-30` or `LS 4` menu entry. This opens either the GCP-30 settings or the LS 4 settings as shown below:

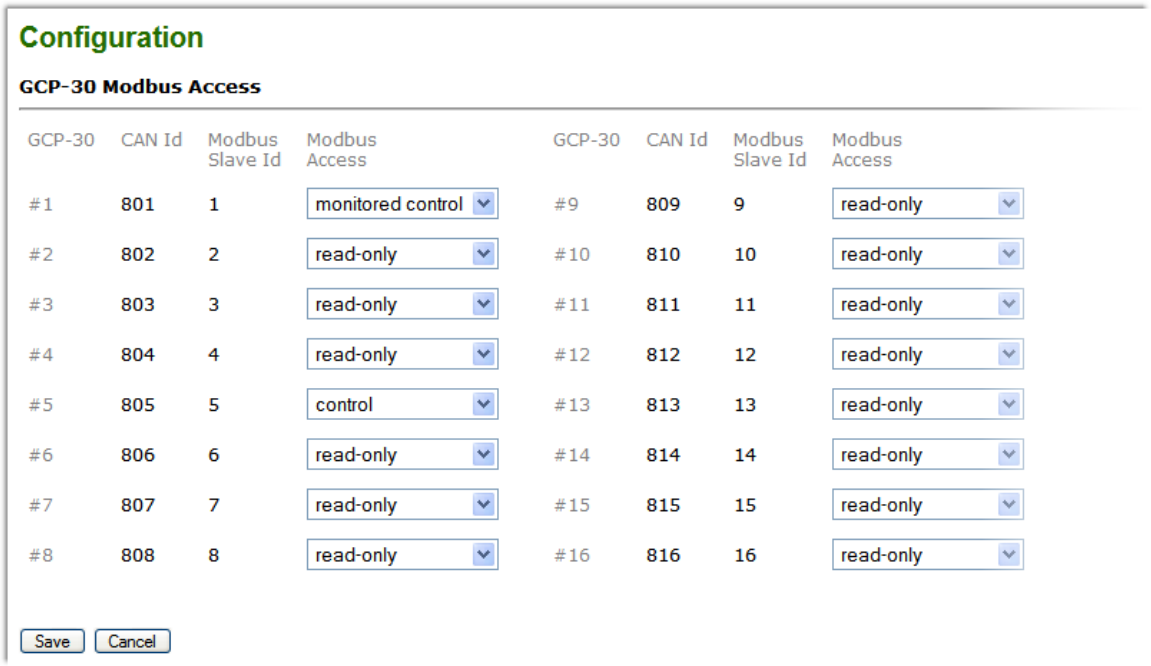


Figure 5.8: GCP-30 settings page

The CAN identifiers and Modbus slave identifiers are preassigned and cannot be changed. The following Modbus access options can be selected:

`disabled`
: Modbus access to this unit is completely disabled. The gateway does not respond to a Modbus master query and ignores messages for the associated Modbus slave ID. The associated slave ID can be used by another Modbus device connected to the Modbus network.

`read-only`
: Modbus access is enabled for read-only data. No remote control is possible, access to the remote control data table 4:0001 will result in Modbus exception code 03 *Illegal Value* being returned.

`control`
: Modbus access is enabled for reading and for remote control. No supervision of Modbus master activity takes place (See Monitored Control). Before being able to use Remote Control, please check that the GCP-30 unit has been parameterized accordingly, otherwise the messages sent by the *GCP-MG* are ignored by the GCP-30. Refer to chapter *Interface* in your *GCP-30 Series Genset Control* manual. For Remote Control to

work, GCP-30 parameter 120 `Control via COM X1X5` must be turned on and discrete input `Automatic 2` (terminal 5) must be asserted. If remote alarm acknowledgment is required, GCP-30 parameter 122 `Ackn. F2,F3 via COM interf` must be turned on in addition.

`monitored control`
Similar to `control` but in addition the remote control is monitored and a Modbus muster must cyclically update the remote control words by writing to the remote control data table. If a Modbus master fails to do this within a certain time limit, the *GCP-MG* will trigger an `Interface error X1X5` alarm on the GCP-30. For Monitored Control to be effective, GCP-30 Parameter 121 `Supervision X1X5` must be turned on.

Once you click **`Save`** the new settings are stored and applied instantly. A confirmation message is shown.

Configuring serial line Modbus

The Modbus settings for serial line can be configured to match the network configuration of your Modbus master device. Select the **`Configuration→Modbus`** sub-menu from the menu bar to open the Modbus settings which are shown below:

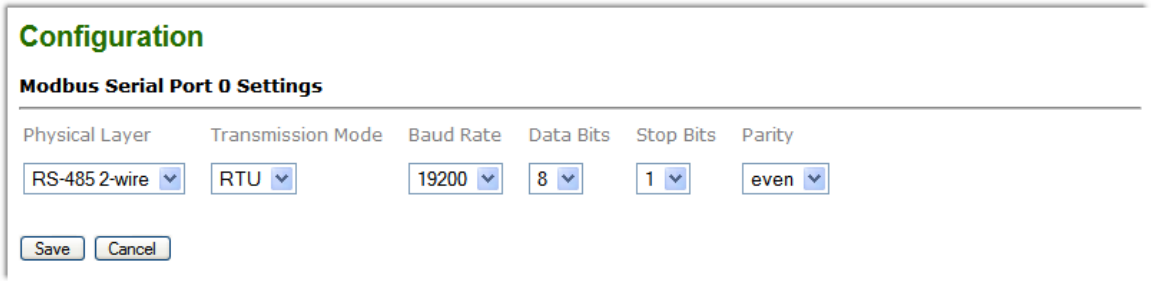


Figure 5.9: Modbus settings page

The following Modbus settings can be entered:

`Physical layer`
Can be set to two-wire TIA/EIA-485 (`RS-485`) or TIA/EIA-232-F (`RS-232`) mode. RS-485 is the default. Depending on this setting either the D-sub (`RS-232`) connector or the terminal block connector (`RS-485`) of the *GCP-MG* is utilized.

`Transmission mode`
Only RTU mode can be selected here.

`Baud rate`
9600 and 19200 are the most common baud rates for Modbus. 19200 is the default setting.

`Data bits`
Only 8 data bits can be selected here which is a requirement for RTU.

`Stop bits`
Can be configured to be 1 or 2. The Modbus standard mandates that 2 stop bits are configured when using no parity.

`Parity`
: Changes parity mode to either none, even or odd. The default parity mode for Modbus is even parity.

Once you click **`Save`** the new settings are stored and applied instantly. A confirmation message is shown.

Remote restarting the device

You can perform a remote restart of the device from the web interface. A remote restart is similar to power cycling the device. Possibly connected clients are disconnected and communication is interrupted until the device has rebooted.

To perform a remote restart, click on the **`Configuration`** sub-menu and then click on the **`Restart`** menu entry. This will open the device restart page as shown below:

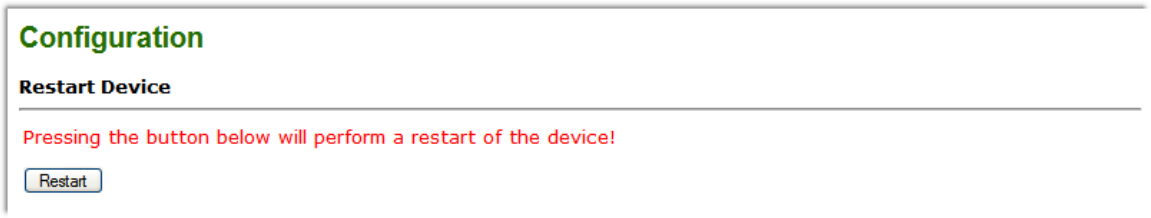


Figure 5.10: Restart device page

Click on the **`Restart`** button to perform a restart of the device. The restart is confirmed with the following notification:

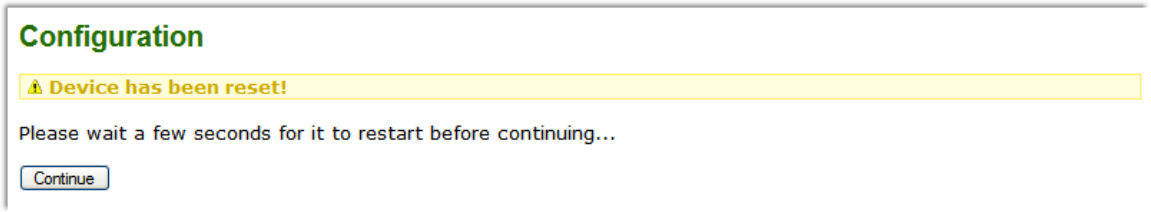


Figure 5.11: Restart confirmation page

Please allow a few seconds before continuing working with the device as it has to fully start-up first, before being able to respond to further web browser requests.

After a remote restart a `Watchdog reset` alarm is shown on the device' home page. This is a side-effect of the remote restart procedure and the alarm shall be ignored and cleared.

Chapter 6. Gateway operation

This chapter describes the principal operation of the gateway.

The *GCP-MG* establishes a communication channel to each GCP-30 and LS 4 unit connected to the CAN bus. All GCP-30 and LS 4 units transmit multiplexed data values which the *GCP-MG* stores in its internal data tables. A GCP-30 for example sends a new value every 100 ms, a LS 4 every 200 ms.

The *GCP-MG* acts as a Modbus server on Ethernet and the serial interface. It accepts connections and Modbus queries from Modbus master devices. The Modbus registers are then served from the *GCP-MG*'s internal data tables. Because of the data table buffering, the Modbus can be polled significantly faster than the update rate on the CAN bus. However faster poll rates would not offer higher update cycles of the data values. The *GCP-MG* allows a maximum of 2 connections via Modbus/TCP and in addition one serial connection via either RS-485 or RS-232.

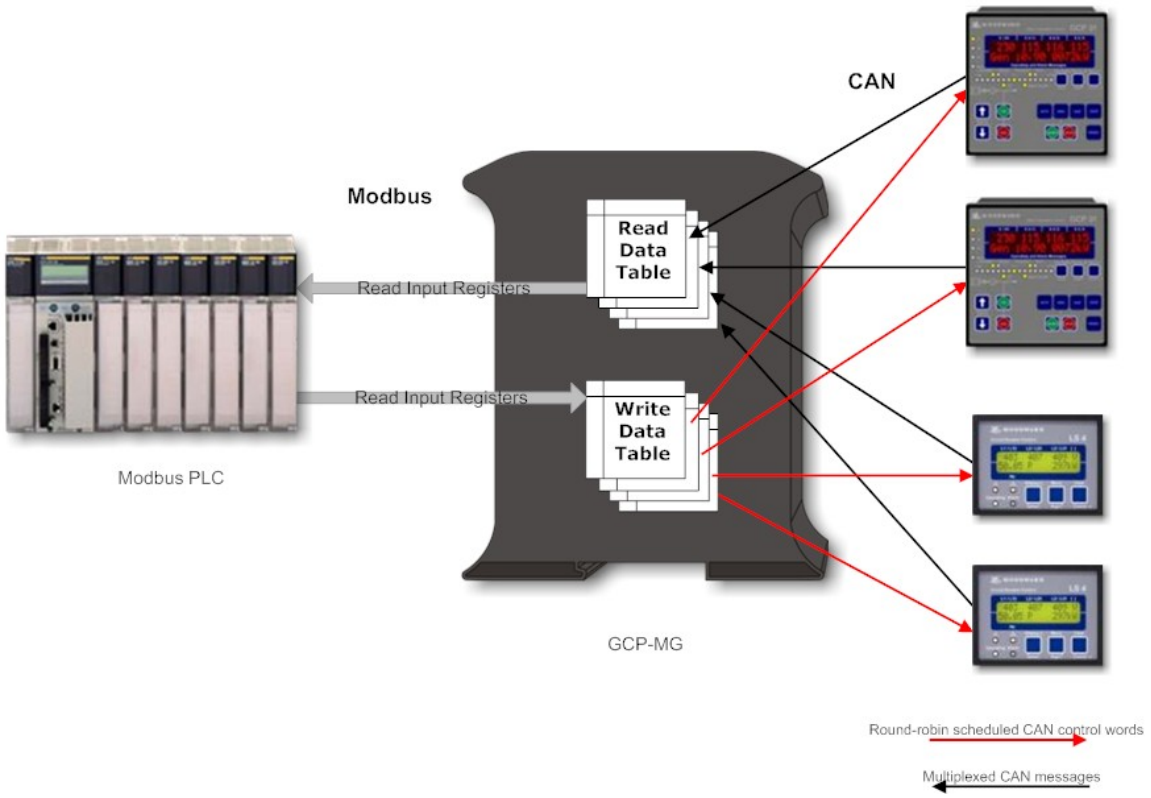


Figure 6.1: Gateway operation

For remote control, a Modbus master writes control words to a dedicated internal data table which is then cyclically sent to the corresponding GCP-30 or LS 4 unit. One remote control data table is processed every 100 ms. This makes the remote control update cycles depend on the number of units enabled for remote control. For example if 3 GCP-30s are enabled for remote control, it takes 300 ms to send all control words to all GCP-30s, if all 16 GCP-30 and all 8 LS 4 units are enabled for remote control it takes 2.4 seconds ((16 + 8) x 0.1 s) to transmit all control words to the connected units.

LED indicators

Four LEDs located at the front panel indicate the status of the module. The LEDs assist maintenance personnel in quickly identifying wiring or communication errors.

A LED test is exercised at power-up, cycling each LED off, green and then red for approximately 0.25 seconds. At the same time the power-on self test of the module is performed.

The following table outlines the indicator condition and the corresponding status after the power-on self test has been completed:

LED	*Function*	*Condition*	*Indication*
Power	Power	Off	No power applied to the device.
		Green	Power supply OK
Link	Ethernet link	Off	No Ethernet link
		Green	Ethernet link OK
Status1	Device status	Off	The device has an unrecoverable fault; may need replacing.
		Flashing green at 1 s rate	Device operational but needs commissioning due to configuration missing, incomplete or incorrect.
		Green	The device is operating in normal condition.
		Flashing red at 1 s rate	Device operational but has a fault listed which requires acknowledgment.
		Red	The device has an unrecoverable fault; may need replacing. Flashing sequence and rate of Status2 LED indicates fault class.
Status2	Modbus/CAN status	Off	CAN connection OK, Connection time-out on Modbus
		Green	Both Modbus and CAN connection OK
		Flashing red-green at 1 s rate	Modbus connection OK, Connection time-out on CAN
		Flashing red at 1 s rate	Connection time-out on both CAN and Modbus
		Red	The device has detected an error that has rendered it incapable of communicating on CAN.

Table 6.1: LED diagnostic codes

Chapter 7. Modbus data organization

This chapter describes how GCP-30 and LS 4 data values are organized in logical blocks and accessed via Modbus.

The *GCP-MG* supports the Modbus function codes 03, 04, 06 and 16. A maximum of 100 16-bit words can be requested with Modbus command 04. This makes it possible to read the complete data set of a GCP-30 or LS 4 unit with a single Modbus transaction.

Modbus function code	*Function name*	*Access*	*Max. number of 16-bit words per transaction*	*Data table/block*
04	Read input registers	read	100	3:0000
03	Read holding registers	write	3	4:0000
06	Write single register	write	1	4:0000
16	Write multiple registers	write	3	4:0000

Table 7.1: Supported Modbus function codes

The *GCP-MG* emulates a virtual Modbus slave device for each GCP-30 and LS 4 unit connected to the CAN bus. This simplifies management of PLC and SCADA variable tag tables, as the Modbus start address is identical for all GCP-30 and LS 4 units.

The following tables show the relation of an individual unit with the Modbus slave ID and the Modbus register range:

It is of great importance to ensure that there is not two devices with the same Modbus address. In such a case, an abnormal behavior of the whole serial bus can occur, the Master being then in the impossibility to communicate with all present slaves on the bus.

Unit	Modbus slave ID	Modbus read address range	Modbus write address range	Modbus floating point address range	CAN ID
GCP-30 #1	1	3:0001-3:0100	4:0001-4:0003	3:1001-3:1076	801
GCP-30 #2	2	3:0001-3:0100	4:0001-4:0003	3:1001-3:1076	802
GCP-30 #3	3	3:0001-3:0100	4:0001-4:0003	3:1001-3:1076	803
GCP-30 #4	4	3:0001-3:0100	4:0001-4:0003	3:1001-3:1076	804
GCP-30 #5	5	3:0001-3:0100	4:0001-4:0003	3:1001-3:1076	805
GCP-30 #6	6	3:0001-3:0100	4:0001-4:0003	3:1001-3:1076	806
GCP-30 #7	7	3:0001-3:0100	4:0001-4:0003	3:1001-3:1076	807
GCP-30 #8	8	3:0001-3:0100	4:0001-4:0003	3:1001-3:1076	808
GCP-30 #9	9	3:0001-3:0100	4:0001-4:0003	3:1001-3:1076	809
GCP-30 #10	10	3:0001-3:0100	4:0001-4:0003	3:1001-3:1076	810
GCP-30 #11	11	3:0001-3:0100	4:0001-4:0003	3:1001-3:1076	811
GCP-30 #12	12	3:0001-3:0100	4:0001-4:0003	3:1001-3:1076	812
GCP-30 #13	13	3:0001-3:0100	4:0001-4:0003	3:1001-3:1076	813
GCP-30 #14	14	3:0001-3:0100	4:0001-4:0003	3:1001-3:1076	814
GCP-30 #15	15	3:0001-3:0100	4:0001-4:0003	3:1001-3:1076	815
GCP-30 #16	16	3:0001-3:0100	4:0001-4:0003	3:1001-3:1076	816
LS 4 #1	17	3:0001-3:0100	4:0003	3:1001-3:1034	817
LS 4 #2	18	3:0001-3:0100	4:0003	3:1001-3:1034	818
LS 4 #3	19	3:0001-3:0100	4:0003	3:1001-3:1034	819
LS 4 #4	20	3:0001-3:0100	4:0003	3:1001-3:1034	820
LS 4 #5	21	3:0001-3:0100	4:0003	3:1001-3:1034	821
LS 4 #6	22	3:0001-3:0100	4:0003	3:1001-3:1034	822
LS 4 #7	23	3:0001-3:0100	4:0003	3:1001-3:1034	823
LS 4 #8	24	3:0001-3:0100	4:0003	3:1001-3:1034	824

Table 7.2: Modbus slave ID relationship

A standard LS 4 occupies only the range from 3:0001 to 3:0029. The remaining range is reserved for future expansion of the LS 4 or custom versions.

If no response was obtained from the target GCP-30 unit, Modbus exception code 0B *Gateway target device failed to respond* is returned.

The following table lists the Modbus exception responses sent by the gateway instead of a normal response message in case of an error:

Modbus exception code	Exception name	Reason
01	Illegal function	A Modbus master sent a Modbus function which is not supported by the gateway. Please refer to the documentation of the individual data tables for valid function codes.
02	Illegal data address	A Modbus master queried a non-existing Modbus address or the queried range points outside of a data table. Please refer to the documentation of the individual data tables for valid address ranges.
03	Illegal value	A Modbus master sent a Modbus message which's structure or implied length is invalid. Also returned if a Modbus master tries to access remote control functions for a unit configured as read-only.
0B	Gateway target device failed to respond	A Modbus master tries to access data which is unavailable because no response was obtained from the target GCP-30 or LS 4 unit. Usually means that the unit is not present on the CAN bus.

Table 7.3: Modbus exception codes

GCP-30 MUX data table 3:0001

The GCP-30 MUX data table contains all data values a GCP-30 is transmitting cyclically on the CAN bus. A GCP-30 sends a value every 100 ms. Therefore it takes approximately between 2.3 and 3 seconds for a ((complete update)) of the data table with new values from the CAN bus. The data table can be polled much faster by a Modbus master, however faster poll rates would not offer higher update cycles.

The GCP-30 MUX data table is located in the so called *Input register* address block, which sometimes is also identified with offset 3:0000. The block is accessed using Modbus function code 04 *Read input registers*.

Only Modbus address 0001 can be accessed at all times. All other Modbus addresses can only be accessed if the CAN communication between *GCP-MG* and GCP-30 has been established. If this is not the case, Modbus exception code 0B *Gateway target device failed to respond* is returned indicating the GCP-30 is not present on the CAN bus.

For the GCP-30 MUX data table, the *GCP-MG* acts as a transparent gateway between the GCP-30 unit and the Modbus. Except for the device status register at Modbus address 0001, it does not perform any modification to the representation of the data values.

The Woodward "GCP-30 Series Genset Control" manual [GCP30] is the ultimate reference for the encoding and representation of the data values. Please refer to the "Transmission Telegram" table in Appendix C "Interface Control" of this manual for further details.

The following table shows the relationship between Modbus addresses and the so called *MUX* identifiers or word numbers:

Block	Modbus address	GCP-30 MUX	GCP-30 word no.	GCP-30 manual designator
3	0001	n/a	n/a	CAN device status register Bit 1: 1 = CAN communication between *GCP-MG* and GCP-30 OK Bit 2-16: reserved for future use
3	0002	0/1	1	Generator voltage delta V12
3	0003	0/2	2	Generator frequency f
3	0004	0/3	3	Actual generator real power P
3	0005	1/1	4	Exponents
3	0006	1/2	5	Real power set point value
3	0007	1/3	6	Conversion factor steps to kW

Block	Modbus address	GCP-30 MUX	GCP-30 word no.	GCP-30 manual designator
3	0008	2/1	7	Bus bar voltage delta V12
3	0009	2/2	8	Mains voltage delta V12
3	0010	2/3	9	Currently present alarm class
3	0011	3/1	10	Control register 2
3	0012	3/2	11	Actual mains interchange (import/export) real power
3	0013	3/3	12	Control register 1
3	0014	4/1	13	Alarm message IKD (SC06)
3	0015	4/2	14	Internal alarm 6
3	0016	4/3	15	Generator voltage delta V23
3	0017	5/1	16	Generator voltage delta V31
3	0018	5/2	17	Generator voltage delta V1N
3	0019	5/3	18	Generator voltage delta V2N
3	0020	6/1	19	Generator voltage delta V3N
3	0021	6/2	20	Configuration [T1]-[T4]
3	0022	6/3	21	Engine speed measured via the Pickup
3	0023	7/1	22	Generator current in L1
3	0024	7/2	23	Generator current in L2
3	0025	7/3	24	Generator current in L3
3	0026	8/1	25	Actual generator reactive power
3	0027	8/2	26	Generator cos phi
3	0028	8/3	27	Current reserve power in the system in kW
3	0029	9/1	28	Current actual real power in the system
3	0030	9/2	29	Number of participants on the CAN bus
3	0031	9/3	30	High byte: Mains status, Low byte: Generator status
3	0032	10/1	31	Exponents
3	0033	10/2	32	Bus bar frequency
3	0034	10/3	33	Configuration [T5]-[T8]
3	0035	11/1	34	Mains voltage delta V23
3	0036	11/2	35	Mains voltage delta V31
3	0037	11/3	36	Mains voltage delta V1N
3	0038	12/1	37	Mains voltage delta V2N
3	0039	12/2	38	Mains voltage delta V3N
3	0040	12/3	39	Mains frequency out off VN12/VN23/VN31
3	0041	13/1	40	Mains current in L1
3	0042	13/2	41	Mains reactive power
3	0043	13/3	42	Mains power factor
3	0044	14/1	43	Exponents
3	0045	14/2	44	Exponents
3	0046	14/3	45	Engine operating hours, high word
3	0047	15/1	46	Engine operating hours, low word
3	0048	15/2	47	Hours until next maintenance
3	0049	15/3	48	Engine start number
3	0050	16/1	49	Operation mode
3	0051	16/2	50	Generator active energy, high word
3	0052	16/3	51	Generator active energy, low word

Block	Modbus address	GCP-30 MUX	GCP-30 word no.	GCP-30 manual designator
3	0053	17/1	52	Battery voltage
3	0054	17/2	53	Internal alarm 1
3	0055	17/3	54	Internal alarm 2
3	0056	18/1	55	Internal alarm 3
3	0057	18/2	56	Internal alarm 4
3	0058	18/3	57	Internal alarm 5
3	0059	19/1	58	External alarm 1
3	0060	19/2	59	External alarm 2
3	0061	19/3	60	Internal alarm 7
3	0062	20/1	61	Analogue input T1
3	0063	20/2	62	Analogue input T2
3	0064	20/3	63	Analogue input T3
3	0065	21/1	64	Analogue input T4
3	0066	21/2	65	Analogue input T5
3	0067	21/3	66	Analogue input T6
3	0068	22/1	67	Analogue input T7
3	0069	22/2	68	Alarm messages IKD2 (SC06)
3	0070	22/3	69	LCD-display / Pickup
3	0071 - 0100			Not used by a standard GCP-30, reserved for options, future expansion or custom versions. See below for allocation by option SB03 and SC06.

Table 7.4: Modbus addresses for GCP-30 MUX values

If no response was obtained from the target GCP-30 unit, Modbus exception code 0B *Gateway target device failed to respond* is returned.

Allocation with options SB03 and SC06

Block	Modbus address	GCP-30 MUX	GCP-30 word no.	SB03 option Cat CCM designator	SC06 option MTU MDEC designator
3	0071	23/1	70	Coolant temperature	Woodward ST-3 control lambda set-point
3	0072	23/2	71	Oil pressure	Woodward ST-3 control lambda reading
3	0073	23/3	72	Raw water temperature	Woodward ST-3 control actuator po-sition
3	0074	24/1	73	Turbo charger intake temperature	Engine speed
3	0075	24/2	74	Oil temperature	Oil pressure
3	0076	24/3	75	Intake manifold temperature	Alarm code
3	0077	25/1	76	Throttle position	Operating hours
3	0078	25/2	77	Engine speed	Coolant temperature
3	0079	25/3	78	Multiplexed ECU alarms 1	Oil temperature
3	0080	26/1	79	Multiplexed ECU alarms 2	Fuel temperature
3	0081	26/2	80	Multiplexed ECU alarms 3	Speed reply
3	0082	26/3	81	Multiplexed ECU alarms 4	Multiplexed ECU alarm group 1
3	0083	27/1	82		Multiplexed ECU alarm group 2
3	0084	27/2	83		Reserved MDEC bit 11
3	0085	27/3	84		Reserved MDEC bit 12
3	0086	28/1	85		Reserved MDEC bit 13
3	0087	28/2	86		Reserved MDEC bit 14
3	0088	28/3	87		Reserved MDEC bit 15
3	0089	29/1	88		Reserved MDEC bit 16
3	0090	29/2	89		Reserved MDEC bit 17
3	0091	29/3	90		Reserved MDEC bit 18

Table 7.5: Modbus addresses for *SB03 Cat CCM* and *SC06 MTU MDEC* options

GCP-30 floating point table 3:1001

The GCP-30 floating point data table is located in the so called *Input register* address block, which is sometimes also identified with offset 3:0000. This block is accessed using Modbus function code 04 *Read input registers*.

The floating point values are encoded in industry standard single-precision (32-bit) IEEE 754 format. The 32-bit floating point values are transmitted as pairs of two consecutive 16-bit registers in little-endian word order.

Block	Modbus address	GCP-30 MUX	GCP-30 word no.	GCP-30 manual designator	Unit
3	1001	0/1	1	Generator voltage delta V12	V
3	1003	0/2	2	Generator frequency f	Hz
3	1005	0/3	3	Actual generator real power P	kW
3	1007	1/2	5	Real power set point value	kW
3	1009	2/1	7	Busbar voltage delta V12	V
3	1011	2/2	8	Mains voltage delta V12	V
3	1013	3/2	11	Actual mains interchange (import/export) real power	kW
3	1015	4/3	15	Generator voltage delta V23	V
3	1017	5/1	16	Generator voltage delta V31	V
3	1019	5/2	17	Generator voltage delta V1N	V
3	1021	5/3	18	Generator voltage delta V2N	V
3	1023	6/1	19	Generator voltage delta V3N	V
3	1025	6/3	21	Engine speed measured via the pickup	rpm
3	1027	7/1	22	Generator current in L1	A
3	1029	7/2	23	Generator current in L2	A
3	1031	7/3	24	Generator current in L3	A
3	1033	8/1	25	Actual generator reactive power	kW
3	1035	8/2	26	Generator cos phi	
3	1037	8/3	27	Current reserve power in the system in kW	kW
3	1039	9/1	28	Current actual real power in the system	kW
3	1041	10/2	32	Busbar frequency	Hz
3	1043	11/1	34	Mains voltage delta V23	V
3	1045	11/2	35	Mains voltage delta V31	V
3	1047	11/3	36	Mains voltage delta V1N	V
3	1049	12/1	37	Mains voltage delta V2N	V
3	1051	12/2	38	Mains voltage delta V3N	V
3	1053	12/3	39	Mains frequency out off VN12/VN23/VN31	V
3	1055	13/1	40	Mains current in L1	A
3	1057	13/2	41	Mains reactive power	kVAR
3	1059	13/3	42	Mains power factor	
3	1061	17/1	52	Battery voltage	V
3	1063	20/1	61	Analogue input T1	
3	1065	20/2	62	Analogue input T2	
3	1067	20/3	63	Analogue input T3	
3	1069	21/1	64	Analogue input T4	
3	1071	21/2	65	Analogue input T5	
3	1073	21/3	66	Analogue input T6	
3	1075	22/1	67	Analogue input T7	

Table 7.6: Modbus addresses for GCP-30 floating point data table

GCP-30 remote control data table 4:0001

The GCP-30 remote control data table is located in the so called *Holding register* address block, which sometimes is also identified with offset 4:0000. This block can be written to using Modbus function code 16 *Write multiple registers* or function code 06 *Write single register*.

If remote control is enabled, the three remote control words are sent cyclically to the respective GCP-30. They are also stored in the *GCP-MG*'s memory and can be read back using Modbus function code 03 *Read holding registers*.

Remote control is disabled by default and Modbus exception code 03 *Illegal value* is returned if a Modbus master tries to access remote control functions for a unit configured as read-only. Remote control can be enabled on a per unit basis through the GCP-30 settings page of the *GCP-MG* (see the section called “Configuring GCP-30 and LS 4 Modbus access”).

Block	Modbus address	GCP-30 word no.	GCP-30 manual designator	Encoding
4	0001	501	Generator real power set-point	kW with control argument
4	0002	502	Generator power factor set-point	cos phi x 100
4	0003	503	Control word	Bit 1: 1 = Remote start Bit 2: 1 = remote stop (high priority) Bit 3: write always 0 Bit 4: write always 0 Bit 5: 1 = Alarm acknowledgment Bit 6-16: internal use

Table 7.7: Modbus addresses for GCP-30 remote control

If no response was obtained from the target GCP-30 unit, Modbus exception code 0B *Gateway target device failed to respond* is returned.

LS 4 MUX data table 3:0001

The LS 4 MUX data table contains all data values a LS 4 is transmitting cyclically on the CAN bus. A LS 4 sends a value every 200 ms. Therefore it takes approximately 10 seconds for a complete update of the data table with new values from the CAN bus. The data table can be polled much faster by a Modbus master, however faster poll rates would not offer higher ((update cycles)).

The LS 4 MUX data table is located in the so called *Input register* address block, which sometimes is also identified with offset 3:0000. The block is accessed using Modbus function code 04 *Read input registers*.

Only Modbus address 0001 can be accessed at all times. All other Modbus addresses can only be accessed if the CAN communication between *GCP-MG* and LS 4 has been established. If this is not the case, a Modbus exception code 0B *Gateway target device failed to respond* is returned, indicating the LS 4 unit is not present on the CAN bus.

For the LS 4 MUX data table, the *GCP-MG* acts as a transparent gateway between the LS 4 unit and the Modbus. Except for the device status register at Modbus address 0001, it does not perform any modification to the representation of the data values.

The Woodward "LS 4 Circuit Breaker Controls" manual [LS4] is the ultimate reference for the encoding and representation of the data values. Please refer to the "Transmission telegram" table in Appendix E "Interface" of this manual for further details.

The following table shows the relationship between Modbus addresses and the so called MUX identifiers or word numbers.

Block	Modbus address	LS 4 MUX	LS 4 word no.	LS 4 manual designator
3	0001	n/a	n/a	CAN device status register Bit 1: 1 = CAN communication between *GCP-MG* and LS 4 OK Bit 2-16: reserved for future use
3	0002	0/1	1	Protocol number `1600`
3	0003	0/2	2	Voltage L12 system A
3	0004	0/3	3	Voltage L23 system A
3	0005	1/1	4	Voltage L31 system A
3	0006	1/2	5	Voltage L1N system A
3	0007	1/3	6	Voltage L2N system A
3	0008	2/1	7	Voltage L3N system A
3	0009	2/2	8	Frequency system A
3	0010	2/3	9	Current L1 system A
3	0011	3/1	10	Current L2 system A
3	0012	3/2	11	Current L3 system A
3	0013	3/3	12	Power factor
3	0014	4/1	13	Real power system A
3	0015	4/2	14	Reactive power system A
3	0016	4/3	15	Voltage L12 system B
3	0017	5/1	16	Voltage L23 system B
3	0018	5/2	17	Voltage L31 system B
3	0019	5/3	18	Frequency system B
3	0020	6/1	19	Exponent
3	0021	6/2	20	Exponent
3	0022	6/3	21	Internal alarms 1
3	0023	7/1	22	Internal alarms 2
3	0024	7/2	23	Internal alarms 3
3	0025	7/3	24	Internal alarms 4
3	0026	8/1	25	Internal alarms 5
3	0027	8/2	26	Internal alarms 6
3	0028	8/3	27	Internal alarms 7
3	0029	9/1	28	Internal Diagnosis
3	0030 - 0100			Not used by a standard LS 4, reserved for future expansion or custom versions.

Table 7.8: Modbus addresses for LS 4 MUX values

If no response was obtained from the target LS 4 unit, Modbus exception code 0B *Gateway target device failed to respond* is returned.

LS 4 floating point data table 3:1001

The LS 4 floating point data table is located in the so called *Input register* address block, which is sometimes also identified with offset 3:0000. This block is accessed using Modbus Function Code 04 *Read input registers*.

The floating point values are encoded in industry standard single-precision (32-bit) IEEE 754 format. The 32-bit floating point values are transmitted as pairs of two consecutive 16-bit registers in little-endian word order.

Block	Modbus address	LS 4 MUX	LS 4 word no.	LS 4 manual designator	Unit
3	1001	0/2	2	Voltage L12 system A	V
3	1003	0/3	3	Voltage L23 system A	V
3	1005	1/1	4	Voltage L31 system A	V
3	1007	1/2	5	Voltage L1N system A	V
3	1009	1/3	6	Voltage L2N system A	V
3	1011	2/1	7	Voltage L3N system A	V
3	1013	2/2	8	Frequency system A	Hz
3	1015	2/3	9	Current L1 system A	A
3	1017	3/1	10	Current L2 system A	A
3	1019	3/2	11	Current L3 system A	A
3	1021	3/3	12	Power factor	
3	1023	4/1	13	Real power system A	kW
3	1025	4/2	14	Reactive power system A	kVAR
3	1027	4/3	15	Voltage L12 system B	V
3	1029	5/1	16	Voltage L23 system B	V
3	1031	5/2	17	Voltage L31 system B	V
3	1033	5/3	18	Frequency system B	Hz

Table 7.9: Modbus addresses for LS 4 floating point data table

If no response was obtained from the target LS 4 unit, Modbus exception code 0B *Gateway target device failed to respond* is returned.

LS 4 remote control data table 4:0001

The LS 4 remote control data table is located in the so called *Holding register* address block, which sometimes is also identified with offset 4:0000. The block can be written to using Modbus function code 16 *Write multiple registers* or function code 06 *Write single register*.

If Remote Control is enabled, the three remote control words are sent cyclically to the respective LS 4. They are also stored in the *GCP-MGs memory and can be read back using Modbus function code 03 'Read holding registers*.

Remote control is disabled by default and Modbus exception code 03 *Illegal value* is returned if a Modbus master tries to access remote control functions for a unit configured as read-only

Remote control can be enabled on a per unit basis through the LS 4 settings page of the *GCP-MG* (see the section called "Configuring GCP-30 and LS 4 Modbus access").

Block	Modbus address	LS 4 word no.	LS 4 manual designator	Encoding
4	0001	501	(not used for LS-4)	
4	0002	502	(not used for LS-4)	
4	0003	503	Control word	Bit 1: 1 = Open CB (high priority) Bit 2: 1 = Close CB Bit 3: write always 0 Bit 4: write always 0 Bit 5: 1 = Alarm Acknowledgment Bit 6-16: internal use

Table 7.10: Modbus addresses for LS 4 remote control

If no response was obtained from the target LS 4 unit, Modbus exception code 0B *Gateway target device failed to respond* is returned.

Chapter 8. Specifications

Modbus Gateway for GCP-30 (GCP-MG)

Interfaces	
Ethernet	1
Serial ports	1 for Modbus (either RS-232 or RS-485, software configurable) 1 for diagnostics (RS-232)
CAN	1
User interface	
LED indicators	Power (green), Ethernet link (green), 2 status (bi-color red/green)
Monitoring & configuration	Web browser based
Diagnostic	
High availability features	Watchdog supervision, brown-out detection
CAN port	
Connector	male 9-pin D-sub, CiA DS-102 pin-out
Physical layer	ISO 11898
Isolation	non-isolated
Speed	125 kBit/s
Max. number of nodes	64
Protocols	CAL 2.0
RS-485 Modbus port	
Connector	3.81 mm 6-pin pluggable terminal block header (*Mini Combicon*)
Physical layer	EIA-485-A, 2-wire
Isolation	non-isolated
Speed	300, 600, 1200, 2400, 4800, 9600, 19200, 57600, 115200 bps
Max. number of nodes	32
Protocols	Modbus RTU slave
RS-232 Modbus port	
Connector	male 9-pin D-sub, DTE, EIA-574 pin-out
Physical layer	EIA-232-F
Isolation	non-isolated
Signals	RXD, TXD, RTS, CTS, DTR, DSR, DCD, RI
Speed	300, 600, 1200, 2400, 4800, 9600, 19200, 57600, 115200 bps
Protocols	Modbus RTU slave
RS-232 diagnostic port	
Connector	male 9-pin D-sub, DTE, EIA-574 pin-out
Physical layer	EIA-232-F
Isolation	n/a
Signals	RXD, TXD
Speed	9600 bps
Protocols	ASCII terminal
Ethernet port	
Connector	8-pin RJ-45 socket for Cat 5 shielded twisted pair
Physical & Data Link Layer Layer	IEEE 802.3i 10BASE-T
Isolation	1.5 kV galvanic
Speed	10 Mbit/s, half-duplex
Max. cable length	100 m (328 ft)
Ethernet frame types	802.3

Protocols	Modbus/TCP slave, HTTP, IP, TCP, ARP
Concurrent connections	2 Modbus/TCP, 2 HTTP
Enclosure	
Material	Self-extinguishing PC/ABS blend (UL 94-V0)
Mounting	35 mm DIN rail (EN 60715)
Classification / Type rating	IP 20 / NEMA Type 1
Power supply	
Connector	3.81 mm 2-pin pluggable terminal block header (*Mini Combicon*)
Voltage	10-30 V DC
Current	30 mA typical @ 24 V DC
Intrinsic consumption	750 mW
Environmental	
Operating temperature	0 to 60 °C / 32 to 140 °F
Storage temperature	-25 to 85 °C / -13 to 185 °F
Humidity	10 to 95% non condensing
Operating ambience	Free from corrosive gas, minimal dust
Physical	
Dimensions	101 x 22.5 x 120 mm / 3.98 x 0.886 x 4.72 in
Weight	0.13 kg / 0.287 lb

Dimensions

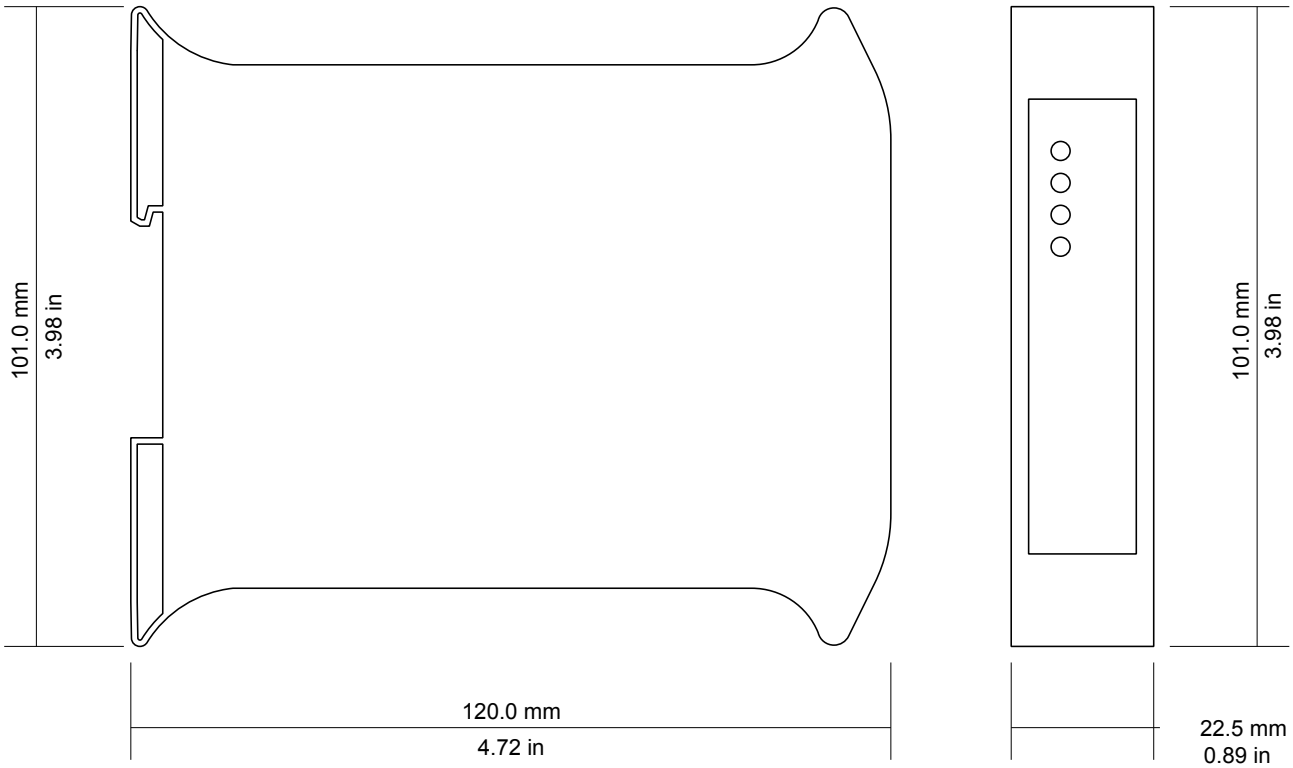


Figure 8.1: Enclosure dimensions

References

[GCP30] Woodward Governor Company, "GCP-30 Series Packages Genset Control — Configuration", Manual 37365A, February 2007

[LS4] Woodward Governor Company, "LS 4 Circuit Breaker Control — Manual", Manual 37105A, May 2004

Glossary

10BASE-T
: 10 Mbit/s twisted pair Ethernet standard. Standardized in IEEE 802.3i

APIPA
: Automatic Private IP Addressing

CAN
: Controller area network. Standardized in ISO 11898.

CiA DS-102
: Standard for the pinout of CAN connectors

DCE
: Data communications equipment. DTE and DCE devices have different pinouts for RS-232 connectors. A Modem for example is a DCE.

DIN rail
: 35 mm wide mounting bracket standardized in DIN/EN 50022.

DTE
: Data terminal equipment. DTE and DCE devices have different pinouts for RS-232 connectors. A PC for example is a DTE.

EIA-232
: Standard for serial transmission of data between two devices, also known as RS-232 and V.24.

EIA-422
: ANSI/TIA/EIA-422 standard for serial transmission of data between two devices, also known as RS-422 and V.11.

EIA-485
: ANSI/TIA/EIA-485 standard for serial transmission of data between multiple devices, also known as RS-485.

EIA-574
: Standard for the pinout of serial D-sub connectors.

ESD
: Electrostatic discharge. ESD can damage electronic equipment.

IEEE
: Institute of Electrical and Electronics Engineers

IP
: Ingress Protection Rating standardized in IEC 60529. Standard for various grades of electrical enclosures.

ISO
: International Standards Organisation

MAC address
: Every piece of Ethernet hardware has a unique number assigned to it called it's MAC address. MAC addresses are administered and assigned by the IEEE organization.

Modbus
: Fieldbus protocol used in the process automation industry. It uses a master and slave structure. Originally developed by Modicon, now part of Schneider Automation.

NEMA
: National Electrical Manufacturers Association. NEMA defines standards for various grades of electrical enclosures.

Node
: A communications device on the network

PC/ABS
: Polycarbonate-ABS. Widely used thermoplastic material.

PLC
: Programmable Logic Controller

RS-232
: See *EIA-232*.

RS-422
: See *EIA-422*.

RS-485
: See *EIA-485*.

UL 94
: Plastics flammability standard released by Underwriters Laboratories of the USA.

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