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Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

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Protocol converter for Modbus RTU/ASCII to Modbus TCP

User manual

User manual

Protocol converter for Modbus RTU/ASCII to Modbus TCP

2017-06-01

Revision: B

This user manual is valid for:

Designation	Order No.
GW MODBUS TCP/RTU 1E/1DB9	2702764
GW MODBUS TCP/RTU 1E/2DB9	2702765
GW MODBUS TCP/RTU 2E/2DB9	2702766
GW MODBUS TCP/RTU 2E/4DB9	2702767

Please observe the following notes

User group of this manual

The use of products described in this manual is oriented exclusively to qualified application programmers and software engineers, who are familiar with the safety concepts of automation technology and applicable standards.

Explanation of symbols used and signal words



This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety measures that follow this symbol to avoid possible injury or death.

There are three different categories of personal injury that are indicated with a signal word.

DANGER This indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING This indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION This indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.



This symbol together with the signal word **NOTE** and the accompanying text alert the reader to a situation which may cause damage or malfunction to the device, hardware/software, or surrounding property.



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1 Description

The GW MODBUS TCP/RTU... devices provide enhanced connectivity from a wide variety of Modbus® masters to a wide variety of Modbus slaves, advanced master-to-master connectivity, and connectivity from legacy Modbus serial networks to Modbus TCP networks. Supported Modbus masters include:

- Modbus TCP
- Modbus RTU
- Modbus ASCII

Supported Modbus slaves include:

- Modbus TCP
- Modbus RTU serial
- Modbus ASCII serial

Connectivity is achieved between any master(s) and any slave(s) anywhere on an Ethernet network. Combined with a GW MODBUS TCP/RTU... device, both serial and Ethernet raw/ASCII devices can be accessed anywhere on a network from any Modbus master. GW MODBUS TCP/RTU... devices are designed to greatly enhance system maintenance capabilities, including comprehensive device and port-specific diagnostic web pages that display status, message response timing, timeouts, other error counts, and overall message statistics. A serial log provides message level diagnosis for serial devices.

The family consists of universal RS232/422/485 1-, 2-, and 4-port serial versions, with one or two Ethernet ports to fit any application.

This user manual is valid for:

Table 1-1 GW MODBUS TCP/RTU... types

Type Description	Order No.
GW MODBUS TCP/RTU 1E/1DB9	2702764
GW MODBUS TCP/RTU 1E/2DB9	2702765
GW MODBUS TCP/RTU 2E/2DB9	2702766
GW MODBUS TCP/RTU 2E/4DB9	2702767

1.1 Structure

GW MODBUS TCP/RTU 1E/1DB9

The GW MODBUS TCP/RTU 1E/1DB9 features one Ethernet port and one RS-232/422/485 serial port with a D-SUB 9 connector.

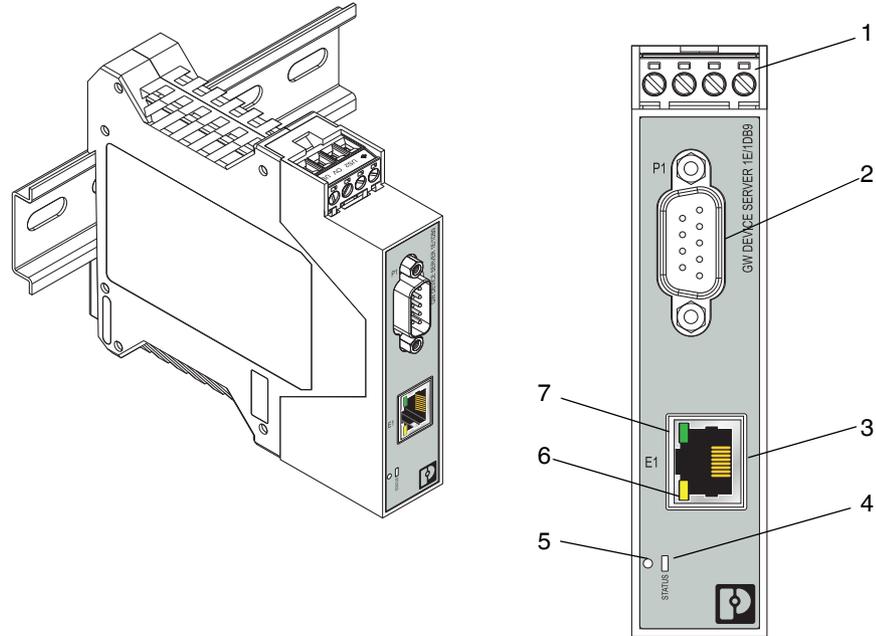


Figure 1-1 GW MODBUS TCP/RTU 1E/1DB9

Table 1-2 GW MODBUS TCP/RTU 1E/1DB9 structure

Item	Description
1	Power connector
2	P1 D-SUB 9 connector
3	Ethernet port (RJ45)
4	Status LED
5	Reset button
6	Ethernet activity status LED
7	Ethernet link status LED

GW MODBUS TCP/RTU 1E/2DB9

The GW MODBUS TCP/RTU 1E/2DB9 features one Ethernet port and two RS-232/422/485 serial ports with D-SUB 9 connectors.

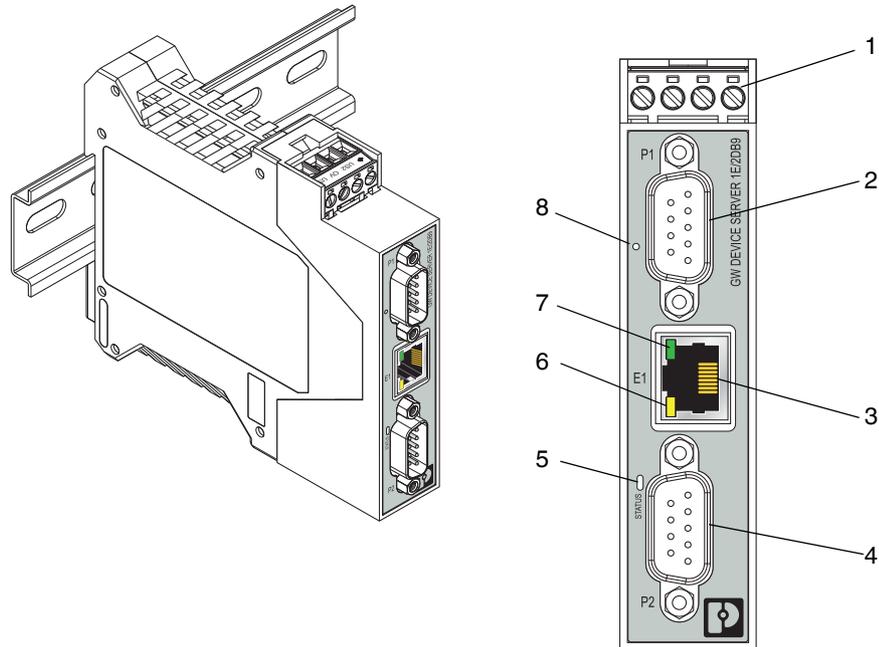


Figure 1-2 GW MODBUS TCP/RTU 1E/2DB9

Table 1-3 GW MODBUS TCP/RTU 1E/2DB9 structure

Item	Description
1	Power connector
2	P1 D-SUB 9 connector
3	Ethernet port (RJ45)
4	P2 D-SUB 9 connector
5	Status LED
6	Ethernet activity status LED
7	Ethernet link status LED
8	Reset button

GW MODBUS TCP/RTU 2E/2DB9

The GW MODBUS TCP/RTU 2E/2DB9 features two Ethernet ports with integrated switch functionality and two RS-232/422/485 serial ports with D-SUB 9 connectors.

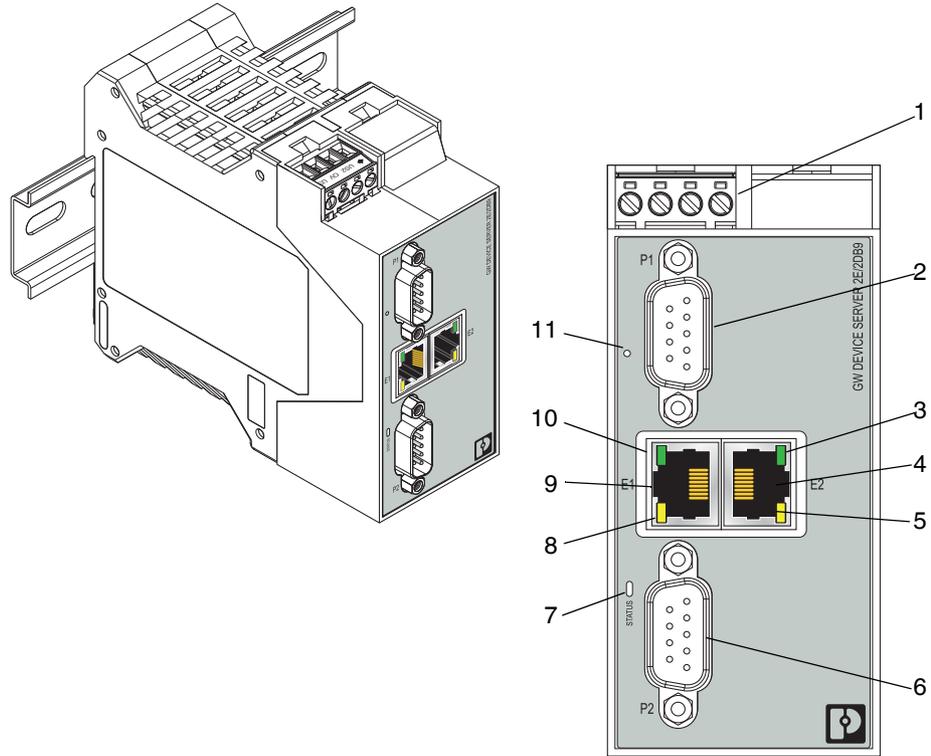


Figure 1-3 GW MODBUS TCP/RTU 2E/2DB9

Table 1-4 GW MODBUS TCP/RTU 2E/2DB9 structure

Item	Description
1	Power connector
2	P1 D-SUB 9 connector
3	Ethernet link status LED
4	E2 Ethernet port (RJ45)
5	Ethernet activity status LED
6	P2 D-SUB 9 connector
7	Status LED
8	Ethernet activity status LED
9	E1 Ethernet port (RJ45)
10	Ethernet link status LED
11	Reset button

GW MODBUS TCP/RTU 2E/4DB9

The GW MODBUS TCP/RTU 2E/4DB9 features two Ethernet ports with integrated switch functionality and four RS-232/422/485 serial ports with D-SUB 9 connectors.

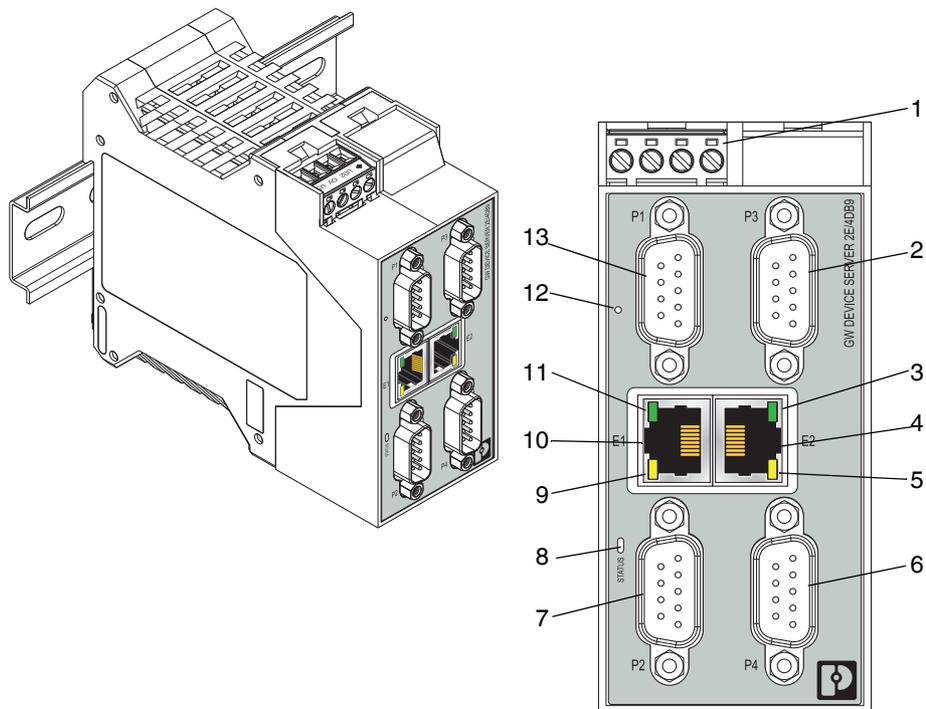


Figure 1-4 GW MODBUS TCP/RTU 2E/4DB9

Table 1-5 GW MODBUS TCP/RTU 2E/4DB9 structure

Item	Description
1	Power connector
2	P3 D-SUB 9 connector
3	Ethernet link status LED
4	E2 Ethernet port (RJ45)
5	Ethernet activity status LED
6	P4 D-SUB 9 connector
7	P2 D-SUB 9 connector
8	Status LED
9	Ethernet activity status LED
10	E1 Ethernet port (RJ45)
11	Ethernet link status LED
12	Reset button
13	P1 D-SUB 9 connector

2 Installation

2.1 Safety regulations and installation notes

Installation, operation, and maintenance may be carried out only by qualified electricians. Follow the specified installation instructions. The applicable specifications and safety directives (including the national safety directives), as well as the general technical regulations, must be observed during installation and operation. The technical data should be taken from the packaging instructions and the certificates (conformity assessment, other possible approvals).

Opening the device or making changes to it is not permitted. Do not repair the device yourself, but replace it with an equivalent device. Repairs may be carried out only by the manufacturer. The manufacturer is not liable for any damage caused by violation of the prescribed regulations.

The IP20 degree of protection (EN 60529) of the device is intended for a clean and dry environment.

Do not subject the device to any load that exceeds the prescribed limits.

The device is not designed for use in environments with danger of dust explosions.

2.2 Mounting

To mount on the DIN rail:

1. Place the device onto the DIN rail from above (A), so that the upper housing keyway hooks onto the top edge of the DIN rail.
2. Hold the device by the housing cover and carefully push the device toward the mounting surface (B).
3. After the foot is snapped onto the DIN rail, verify that it is attached securely.

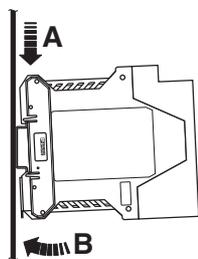


Figure 2-1 DIN rail mounting

To remove:

1. Use a suitable screwdriver to release the locking mechanism (A) on the snap-on foot of the device.
2. Hold on to the device by the housing cover and carefully tilt it upward (B).
3. Remove the device from the DIN rail (C).

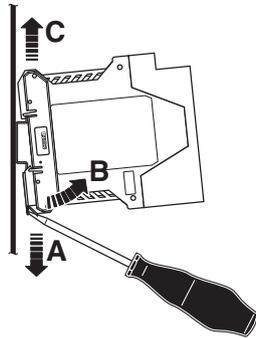


Figure 2-2 DIN rail removal

2.3 Data interfaces

2.3.1 Connecting the V.24 (RS-232) cable

The D-SUB 9 connector may function as an RS-232, RS-422, or RS-485 interface. The RS-232 interface is a data terminal equipment (DTE) device that behaves like a personal computer (PC). A null modem cable or adapter is required to connect to a PC.



The V.24 (RS-232) interface of the GW MODBUS TCP/RTU... is a DTE assignment.

Connect the GW MODBUS TCP/RTU... to the V.24 (RS-232) device to be connected (for example, a PC) by way of the PSM-KA-9SUB 9/BB/2 METER V.24 (RS-232) cable (Order No. 2799474). The cable is an interface cable with 1:1 connected contacts.

Table 2-1 D-SUB 9 to RS-232 pin out

	RS-232	End device			
		D-SUB 9 (DCE)	D-SUB 9 (DTE)	D-SUB 25 (DCE)	D-SUB 25 (DTE)
1	DCD	1	4	8	20
2	RxD	2	3	3	2
3	TxD	3	2	2	3
4	DTR	4	1, 6	20	6, 8
5	GND	5	5	7	7
6	DSR	6	4	6	20
7	RTS	7	8	4	5
8	CTS	8	7	5	4
9	RI	9	-	22	-

2.3.2 Connecting the RS-422 cable

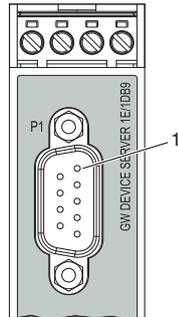


Figure 2-3 Pin 1 location

In RS-422 mode, a point-to-point connection can be established. Use a twisted-pair, common shielded bus cable to connect the I/O device.

To connect the RS-422 cable:

1. Connect the individual conductors of the data cable to the GW MODBUS TCP/RTU... using a SUBCON 9/F SH (Order No. 2761499).
2. Make sure the signal assignment is correct.
This operating mode supports full duplex transmission mode.

Table 2-2 D-SUB 9 to RS-422 and RS-485 pin out

GW MODBUS TCP/RTU...	End device			
	RS-422	RS-485	RS-422	RS-485
2	T(A)	–	D(A)	–
3	D(A)	D(A)	T(A)	D(A)
5	GND	GND	GND	GND
7	D(B)	D(B)	T(B)	D(B)
8	T(B)	–	D(B)	–

2.3.3 Connecting the RS-485 cable

In RS-485 mode, an RS-485 network with several I/O devices can be created. Use a twisted-pair, common shielded bus cable to connect the I/O devices.

Connect the individual conductors of the data cable to the GW MODBUS TCP/RTU... using a SUBCON 9/F SH (Order No. 2761499) (see Table 2-2).



NOTE:

Observe the polarity of the RS-485 cable.

Fit this bus cable with a termination network at the two furthest points of the RS-485 network.

The termination resistors are integrated in the GW MODBUS TCP/RTU... and can be switched on through the web-based management interface.

2.3.4 Connecting the Ethernet cable

The GW MODBUS TCP/RTU... has an Ethernet interface on the front in RJ45 format, to which only twisted-pair cables with an impedance of 100 Ω can be connected. The data transmission rate is either 10 or 100 Mbps. The GW MODBUS TCP/RTU... supports the auto negotiation function for automatic selection of the transmission speed, as well as an automatic crossover feature for the selection of line or crossover cabling.

Push the Ethernet cable with the crimped RJ45 connector into the GW MODBUS TCP/RTU... until it engages with a click.

2.3.4.1 Models with two Ethernet ports

When using two Ethernet ports, the GW MODBUS TCP/RTU... is classified as a switch. When using only one port, it is a simple end node device. The maximum number of daisy-chained GW MODBUS TCP/RTU... units, and the maximum distance between units, is based on the Ethernet standards, and is determined by the environment and conformity of the network to these standards. There may be some performance degradation on the devices at the end of the chain, so it is recommended to overload and test for performance in the environment. The application may also limit the total number of ports that may be installed. Some basic guidelines are listed below.

- Ethernet 10BASE-T rules
 - The maximum number of repeater segments is four.
 - Use Category 3 or 5 twisted-pair 10BASE-T cables. The maximum length of each cable is 100 m (328 ft.).
- Fast Ethernet 100BASE-TX rules
 - The maximum number of repeater segments is two (for a Class II hub). A Class II hub can be connected directly to one other Class II Fast Ethernet hub. A Class I hub cannot be connected directly to another Fast Ethernet hub.
 - Category 5 twisted-pair cable must be used. The maximum length of each twisted-pair cable is 100 m (328 ft.).
 - The total length of twisted-pair cabling (across directly connected hubs) must not exceed 205 m (672 ft.).
- IEEE 802.3 specification: A network using repeaters between communicating stations (PCs) is subject to the 5-4-3 rule of repeater placement on the network:
 - The maximum number of segments connected on a network is five.
 - Four repeaters is the maximum that can be applied to a network.
 - Only three segments can have user connections. The other two segments must act as repeaters with no user connections.

2.4 Connecting the power supply



CAUTION:

Incorrect connection may result in damage to equipment and/or serious personal injury. Only qualified personnel may connect the power, start up, and operate this device. According to the safety instructions in this text, qualified personnel are persons who are authorized to start up, to ground, and to mark devices, systems, and equipment according to the standards of safety technology. In addition, these persons must be familiar with all warning instructions and maintenance measures in this text. Disregarding this warning may result in damage to equipment and/or serious personal injury.

The device can be connected to a single power source or two power sources for redundancy. The GW MODBUS TCP/RTU... is powered using a +24 V DC SELV power supply. The power supply is connected by way of COMBICON plug-in screw terminal blocks (24 V and 0 V).

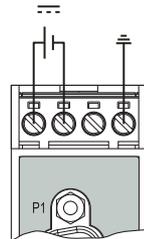


Figure 2-4 Single power supply connection

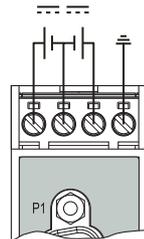


Figure 2-5 Redundant power supply connection

3 Configuration and startup

3.1 Default settings

The default network settings of the GW MODBUS TCP/RTU... are:

IP address: 192.168.254.254

Subnet mask: 255.255.255.0

Gateway: 0.0.0.0



The default settings are invoked whenever the system is reset.

3.2 Web-based management

The user-friendly, web-based management interface, a graphical user interface (GUI), can be used to manage the GW MODBUS TCP/RTU... from anywhere in the network using a standard browser. Comprehensive configuration and diagnostic functions, including a wide range of information about the device itself, the current parameters, and the operating state, are clearly displayed.

3.3 Login

To log in:

1. Set the IP address of the connected PC to the subnetwork of the GW MODBUS TCP/RTU...: for example, IP = 192.168.254.10, subnetwork = 255.255.255.0.
2. Open a web browser and enter the IP address of the GW MODBUS TCP/RTU... in the "Address" field (default = 192.168.254.254).

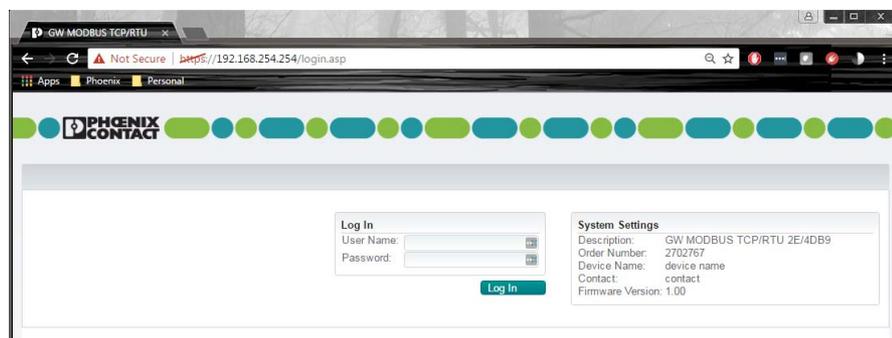


Figure 3-1 "Login" screen

The web server responds immediately.



If the web server does not load, first check the IP parameters of the PC. If everything is set correctly, check to see if there are any proxy settings loaded in the web browser. The proxy setting must be set to “Load automatically” or “Deactivated” to properly establish communication.

3. Enter the credentials to access the web server configuration pages. The default credentials are:
 User name: Admin
 Default password: admin



Powering multiple devices with factory default IP addresses causes a network conflict, and incorrect parameters may be set in the GW MODBUS TCP/RTU... modules. When programming modules for the first time, it is important to apply power to only one at a time, and change the IP address of each module to a unique IP address. Once all devices have a unique IP address, they can be powered on together while on the same network.

3.4 Home screen

Immediately after login, the “Home” screen is displayed. From the “Home” screen, the basic settings of the GW MODBUS TCP/RTU... can be immediately configured by clicking on the appropriate Ethernet port or serial port in the diagram of the module.

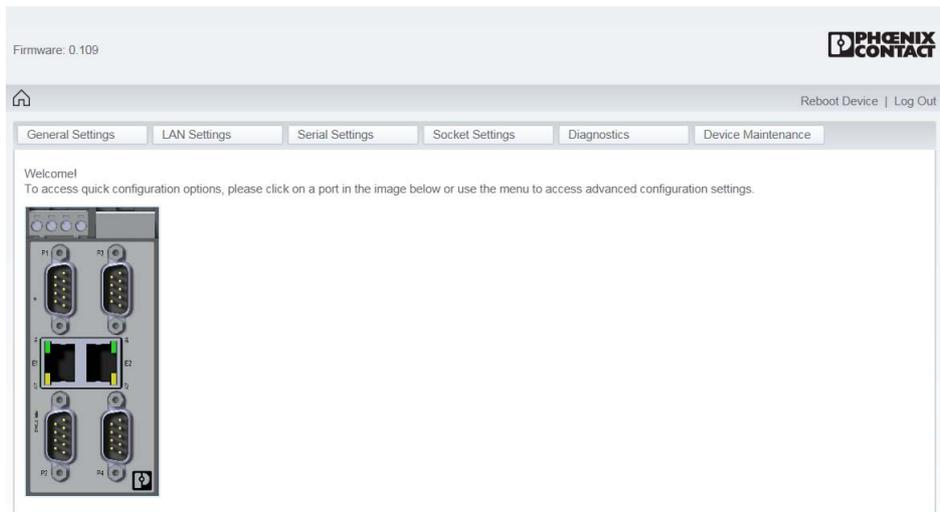


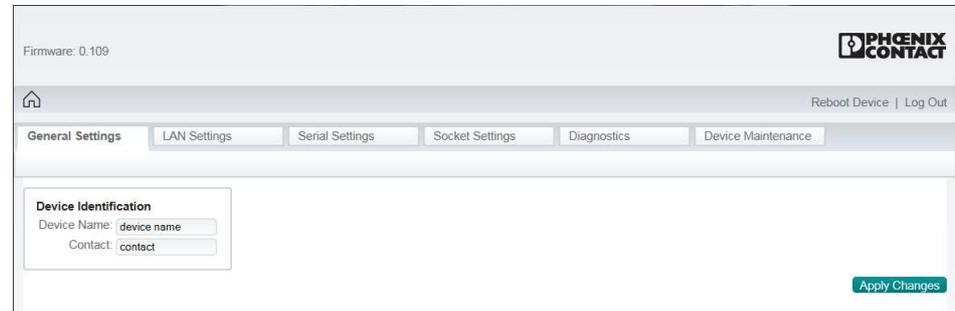
Figure 3-2 “Home” screen

Advanced settings can be accessed through the menu at the top of the screen. The “Home” screen can be accessed at any time by clicking the “Home” button in the upper-left corner of the web-based management interface.

3.5 General settings

To view and edit general settings:

1. Click the “General Settings” tab to view and edit general information about the GW MODBUS TCP/RTU....



Firmware: 0.109

PHOENIX CONTACT

Reboot Device | Log Out

General Settings | LAN Settings | Serial Settings | Socket Settings | Diagnostics | Device Maintenance

Device Identification

Device Name:

Contact:

Apply Changes

Figure 3-3 “General Settings” page

2. View the listed information.
3. If desired, change the listed information.
The “Device Identification” group provides fields for entering descriptive information about individual devices.
Device Name: Enter a name for the device. The field accepts up to 16 characters.
Contact: Enter the name of a contact person, group, or department responsible for this device. The field accepts up to 16 characters.
4. Click the “Apply Changes” button to save the configuration.

3.6 LAN settings

3.6.1 IP address

To enter the IP address:

1. From the “LAN Settings” page, click the “IP Address” tab to access the “IP Address” page.

The screenshot shows the web interface for configuring the LAN IP address. At the top, it indicates 'Firmware: 0.109' and the 'PHOENIX CONTACT' logo. The navigation menu includes 'General Settings', 'LAN Settings', 'Serial Settings', 'Socket Settings', 'Diagnostics', and 'Device Maintenance'. The 'LAN Settings' page has two tabs: 'IP Address' (selected) and 'Security'. Under 'IP Address', there are two radio button options: 'Automatic address assignment (DHCP)' and 'Manual address assignment' (selected). The 'Manual address assignment' section contains three input fields: 'IP Address' with the value '192.168.254.254', 'Subnet Mask' with '255.255.255.0', and 'Default Gateway'. To the right, a 'Hardware Address' box shows '00:a0:45:d4:09:18'. An 'Apply Changes' button is located at the bottom right of the configuration area.

Figure 3-4 “LAN Settings/IP Address” page

2. Select the method for assigning the LAN IP address.
If a DHCP server assigns IP addresses, click the “Automatic address assignment (DHCP)” button.
If using static IP addresses, click the “Manual address assignment” button and enter the appropriate information in the various fields.
MAC Address: The MAC address of the GW MODBUS TCP/RTU... is displayed.
3. Click the “Apply Changes” button to save the configuration.

3.6.2 Security

The GW MODBUS TCP/RTU... includes several security options for data encryption and device authentication. It is possible to configure the GW MODBUS TCP/RTU... so that only authorized client applications can connect using SSL/TLS. For secure operation, the GW MODBUS TCP/RTU... uses a set of four keys and certificates. These keys and certificates are configurable.

To configure security settings:

1. From the “LAN Settings” page, click the “Security” tab.

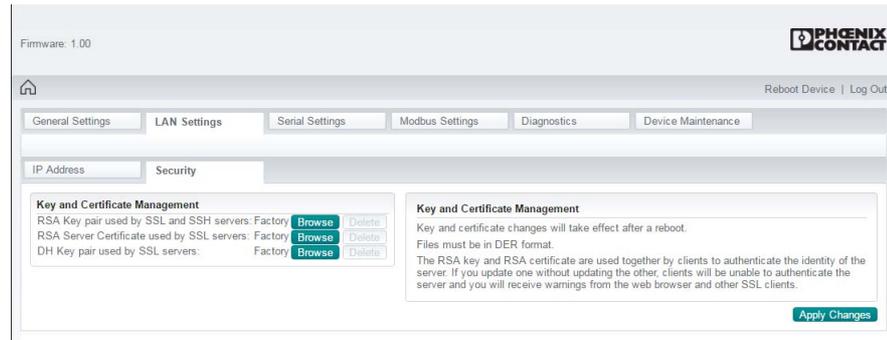


Figure 3-5 “LAN Settings/Security” page

2. Configure the GW MODBUS TCP/RTU... so that only authorized client applications can connect using SSL/TLS.

For secure operation, the GW MODBUS TCP/RTU... uses a set of four keys and certificates. These keys and certificates may be configured.

RSA Key pair used by SSL and SSH servers: This is a private/public key pair that is used for two purposes:

- It is used by some cipher suites to encrypt the SSL/TLS handshaking messages. Possession of the private portion of this key pair allows an eavesdropper to decrypt traffic on SSL/TLS connections that use RSA encryption during handshaking.
- It is used to sign the RSA server certificate in order to verify that the GW MODBUS TCP/RTU... is authorized to use the RSA server identity certificate.



Possession of the private portion of this key pair allows others to pose as the GW MODBUS TCP/RTU....

If the RSA server key is to be replaced, a corresponding RSA identity certificate must also be generated and uploaded, or clients cannot verify the identity certificate.

RSA Server Certificate used by SSL servers: This is the RSA identity certificate that the GW MODBUS TCP/RTU... uses during SSL/TLS handshaking to identify itself. It is used most frequently by SSL server code in the GW MODBUS TCP/RTU... when clients open connections to the GW MODBUS TCP/RTU... secure web server or other secure TCP ports. If a GW MODBUS TCP/RTU... serial port configuration is set up to open (as a client) a TCP connection to another server device, the GW MODBUS TCP/RTU... also uses this certificate to identify itself as an SSL client if requested by the server.

In order to function properly, this certificate must be signed using the RSA server key. This means that the RSA server certificate and RSA server key must be replaced as a pair.

DH Key pair used by SSL servers: This is a private/public key pair that is used by some cipher suites to encrypt the SSL/TLS handshaking messages.



Possession of the private portion of the key pair allows an eavesdropper to decrypt traffic on SSL/TLS connections that use DH encryption during handshaking.

The key or certificate notation changes from **factory** or **none** to **user** when the GW MODBUS TCP/RTU... is secure.



Certificates and keys to be uploaded to the GW MODBUS TCP/RTU... must be in the .DER binary file format, not in the .PEM ASCII file format. (The openssl tools can create files in either format and can convert files back and forth between the two formats.)

3.7 Serial settings

To configure serial settings:

1. Click the “Serial Settings” tab to configure the serial port(s).
The “Overview” page provides a quick summary of the current configuration of the serial port(s).
2. Click the appropriate configuration tab to edit the configuration of that port.

	Port 1	Port 2	Port 3	Port 4
Port Name:	Port 1	Port 2	Port 3	Port 4
Port Mode:	RS-232	RS-232	RS-232	RS-232
Baud Rate:	19200	19200	19200	19200
Parity:	none	none	none	none
Data Bits:	8	8	8	8
Stop Bits:	1	1	1	1
Flow Control:	none	none	none	none
RS-485 Terminating Resistor:	off	off	off	off
DTR Mode:	off	off	off	off
Rx Timeout Between Packets (ms):	200	200	200	200
Discard Messages With Errors:	yes	yes	yes	yes
Serial Device(s):	Modbus/RTU Slaves	Modbus/RTU Slaves	Modbus/RTU Slaves	Modbus/RTU Slaves
Modbus Slaves Settings				
Response Timeout (ms):	1000	1000	1000	1000
Inactivity Wait Time Before Tx (ms):	0	0	0	0
Lost Device Search Enable:	no	no	no	no
Send Write Messages First:	no	no	no	no
Write Mode:	Read/Write	Read/Write	Read/Write	Read/Write
Device ID Offset Mode:	Off	Off	Off	Off
Device ID Offset:	0	0	0	0
Valid Received Msg Device ID Range:	1-255	1-255	1-255	1-255
Valid On Port Device ID Range:	1-255	1-255	1-255	1-255

Figure 3-6 “Serial Settings/Overview” page

3.7.1 Port configuration

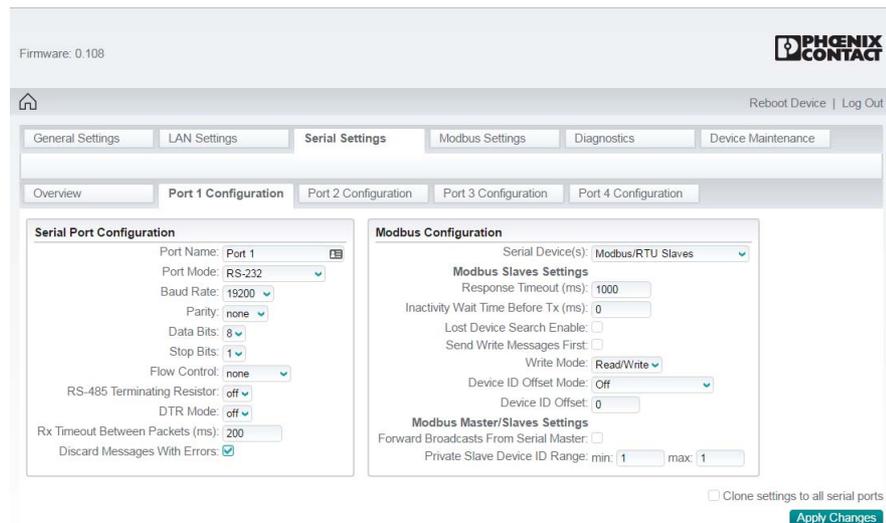


Figure 3-7 “Serial Settings/Port 1 Configuration” page

3.7.1.1 Serial port configuration

To configure serial ports:

1. From the “Serial Settings” page, click the “Port Configuration” tab.
2. In the “Serial Port Configuration” group, specify the settings of each serial port to match the connected serial device.

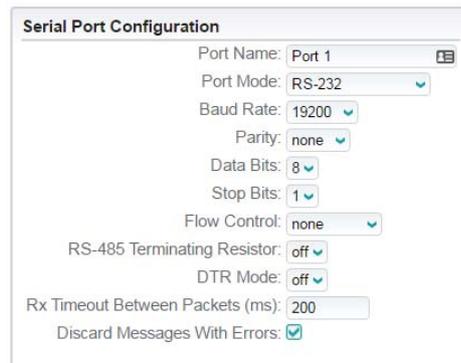


Figure 3-8 “Serial Port Configuration” page

Port Name: Enter a label for the port. This could correspond to the connected device, “Shipping Label” for example, for easy identification.

Port Mode: Select the port operating mode. Available settings are **RS-232**, **RS-422**, **RS-485 2-wire**, **RS-485 4-wire (M)**, and **RS-485 4-wire (S)**, where “M” indicates master and “S” indicates slave. When **RS-485 4-wire (M)** is selected, the RS-485 transmitter is always enabled on the GW MODBUS TCP/RTU.... When **RS-485 4-wire (S)** is selected, the RS-485 transmitter is enabled only when the GW MODBUS TCP/RTU... has data to send. This is important when a four-wire RS-485 multidrop network is installed.