

MBDC-200

Modbus Data Concentrator and Gateway

User manual

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Important user information

This manual explains how to install, operate and configure a MBDC-200. This device may only be used for the applications described in this document.

This manual is to be used with a MBDC-200 with firmware version 3.0.

These instructions are intended for use by trained specialists in electrical installation and control and automation engineering, who are familiar with the applicable national standards and safety procedures.

Safety Precautions



ELECTRICAL HAZARD

- This equipment must be installed and serviced only by qualified personnel. Such work should be performed only after reading this entire set of instructions.
- 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 MBDC-200 is to be installed before installing, wiring or removing the MBDC-200.
- Always use a properly rated voltage sensing device to confirm that power is off.
- 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 could result in death or serious injury!

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 replaceable text. Replaceable text is a placeholder for data you have to provide, like filenames 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 MBDC-200 is a Modbus/TCP data concentrator for Modbus RTU networks.

The data concentrator features an Ethernet port and two serial ports which can be configured as either RS-232 or RS-485 or combined to form one RS-422 port. It can be mounted on a DIN rail.

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



Possible areas of application are:

- PLC connection
- Operator panel interfacing
- HMIs
- SCADA integration
- Remote control & monitoring
- Data logging

Features

The MBDC-200 data concentrator provides the following key features:

- Modbus/TCP protocol (Ethernet)
- Modbus RTU protocol (either RS-232, RS-485 or RS-422, software configurable)
- 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 communication status

Quick start checklist

- Read this set of instructions properly and in its entirety.
- Mount the unit.
- Connect the power. Do not connect yet serial ports.
- Configure the Ethernet communications settings with a web browser (using an Ethernet crossover cable) or with a terminal program like *HyperTerminal* (using a null modem cable)
- Configure the serial line communication settings.
- Configure the operational aspects of the device.
- Wire serial line interfaces.

Chapter 2. Description

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

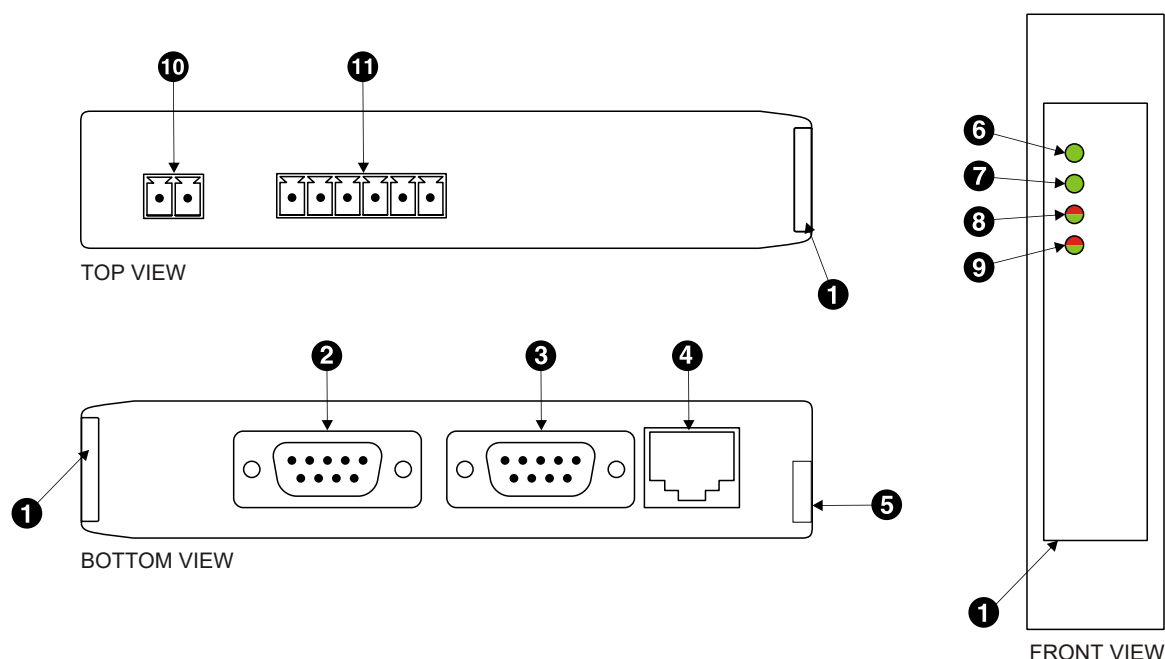


Figure 2.1: Location of connectors

- ❶ Clear front cover
- ❷ Serial port 1 RS-232 connector
- ❸ Serial port 2 RS-232 connector
- ❹ Ethernet connector
- ❺ DIN rail clip
- ❻ Power LED
- ❼ Ethernet link LED
- ❽ Device status LED
- ❾ Communication status LED
- ❿ Power terminals
- ⓫ Serial port 1 and 2 RS-485 or serial port 1 RS-422 terminals

LED indicators

Four LEDs located at the front panel indicate the status of the device. 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 device 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 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 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 | Communication status | Off | No Modbus/TCP connection. |
| | | Green | Modbus/TCP connection established. |
| | | Flashing red 1 s rate | Communication error Modbus slave devices. |
| | | Flashing red-green 1 s rate | Modbus/TCP connection established but communication error Modbus slave devices. |

Table 2.1: LED diagnostic codes

Chapter 3. Installation

Regulatory notes



1. The MBDC-200 is suitable for use in non-hazardous locations only.
2. The MBDC-200 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. This is a Class A device and intended for commercial or industrial use. This equipment may cause radio interference if used in a residential area; in this case it is the operator's responsibility to take appropriate measures.
5. The precondition for compliance with EMC limit values is strict adherence to the guidelines specified in this set of instructions. This applies in particular to the area of grounding and shielding of cables.

FCC Notice (USA only)

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Industry Canada Notice (Canada only)

This Class A digital apparatus complies with Canadian ICES-003.

Unpacking, handling and storage



1. Please read this set of instructions. carefully before fitting it into your system.
2. Keep all original packaging material for future storage or warranty shipments of the unit.
3. Do not exceed the specified temperatures.

Before connecting anything

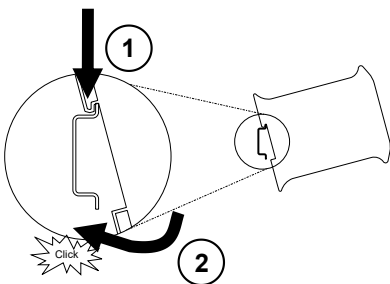


1. Before installing or removing the unit or any connector, ensure that the system power and external supplies have been turned off.
2. Check the system supply voltage with a multimeter for correct voltage range and polarity.

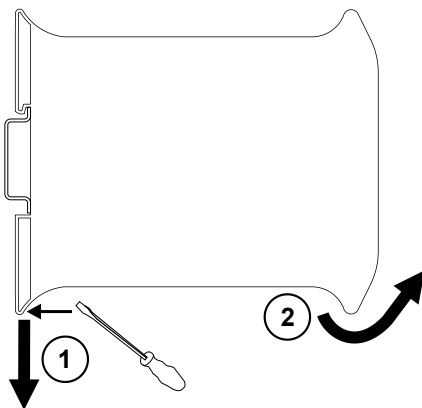
3. Connect the power supply cable and switch on the system power. Check if the Power LED is lit.
4. Turn off system power.
5. Connect all I/O cables.
6. Once you are certain that all connections have been made properly, restore the power.

DIN rail mounting and removal

The MBDC-200 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 unit on a DIN rail, slot the top part of the MBDC-200 into the upper guide of the rail and lower the enclosure until the bottom of the red hook clicks into place.



To remove the MBDC-200 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 unit 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 unit observe the following rules:



- No water splash and water drops
- No aggressive gas, steam or liquids
- Avoid dusty environments.
- Avoid shock or vibration

- Do not exceed the specified operational temperatures and humidity range.
- Mount inside an electrical switchboard or control cabinet.
- Make sure there is sufficient air ventilation and clearance to other devices mounted next to the unit.
- Observe applicable local regulations like EN60204 / VDE0113.

Powering the MBDC-200



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 located at the top side of the mounted unit (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, DC power return |

Table 3.1: Power supply connector pinout

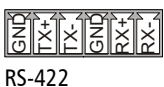
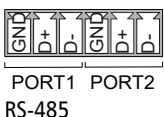


Make sure that the polarity of the supply voltage is correct before connecting any device to the serial ports! A wrong polarity can cause high currents on the ground plane between the V- power supply pin and the serial port ground pins, which can cause damage to the device.

Wiring the RS-485/422 interface

The RS-485/422 port is used for integrating the MBDC-200 into a two-wire or four-wire Modbus over Serial Line network. The use of either the RS-485 or RS-422 interface must be configured using the web interface (See the section called “Configuring serial line Modbus”). The MBDC-200 is a Modbus Master device on this interface.

The RS-485 and RS-422 signals are located at the 3.81 mm 6-pin pluggable terminal block on the top side of the mounted unit (refer to Figure 2.1, “Location of connectors”). The following table and picture shows the pinout:



| Pin | RS-485 signal | RS-422 signal | Description |
|-----|---------------|---------------|-------------------|
| 3 | GND | GND | Modbus Common |
| 4 | D+ port 1 | TX+ | Modbus D1 or TXD1 |
| 5 | D- port 1 | TX- | Modbus D0 or TXD0 |
| 6 | GND | GND | Modbus Common |
| 7 | D+ port 2 | RX+ | Modbus D1 or RXD1 |
| 8 | D- port 2 | RX- | Modbus D0 or RXD0 |

Table 3.2: RS-485/RS-422 connector pinout

- Line termination is required and is typically done with a 120 Ohm 1/4 W resistor. For RS-485 operation the bus must be terminated at both ends. For RS-422 operation a termination resistor must be inserted between the RX+/RX- signals.
- Maximum number of RS-485 nodes without repeater is 32.
- Stub connections off the main line should be avoided if possible or at least be kept as short as possible. Stub connections must not have terminating resistors.
- Maximum cable length to 1200 m (4000 ft).
- To assure a high degree of electromagnetic compatibility and surge protection the cable should be twisted pairs and shielded. An additional cable conductor or pair may be used for the GND reference.

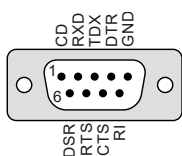


Do *not* connect the cable shield to the GND pins! Use an external chassis ground connection to terminate the shield.

Wiring the RS-232 interface

The RS-232 port can alternatively be used for serial communication to a Modbus Slave device instead of RS-485. The use of the RS-232 interface must be configured using the web interface (See the section called “Configuring serial line Modbus”). The MBDC-200 is a Modbus Master device on this interface.

The Modbus RS-232 connector is a male 9-pin D-sub type located at the bottom side of the mounted unit (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 |

Table 3.3: Modbus RS-232 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.
- To assure a high degree of electromagnetic compatibility and surge protection the RS-232 cable should be shielded. The shield shall be connected to an external chassis ground at the either or both ends, depending on the application.

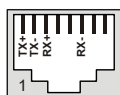
- The shield must *not* be connected to the GND pin.



To connect the MBDC-200 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 |

Table 3.4: Ethernet connector pinout

- We recommend to use Category 5 UTP network cable.
- Maximum cable length is 100 m (3000 ft).

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Chapter 4. Ethernet & IP configuration

Before configuring the MBDC-200, obtain a unique static IP address, subnet mask, and default gateway address from your network administrator.

The factory default IP address of the MBDC-200 is 169.254.0.10 which is in the Automatic Private IP Addressing (APIPA) address range.

There are several methods of configuring the unit'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 Serial Port 1 and a terminal program like *HyperTerminal* (see the section called "IP setup using a terminal program like 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 MBDC-200 (see the section called "Temporarily changing the IP settings on your PC").



In order to connect to the MBDC-200 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.

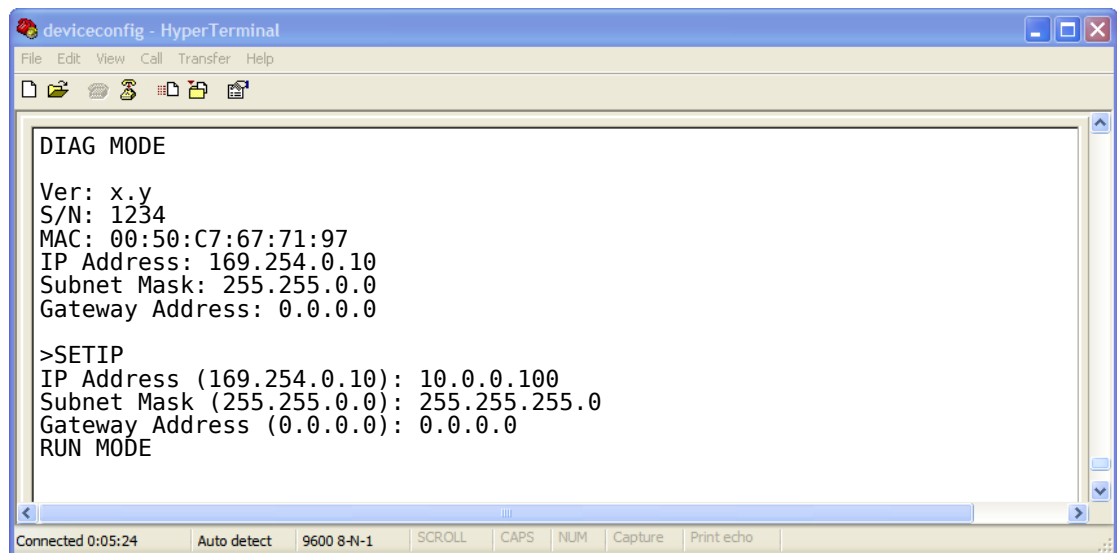
IP setup using a web browser and a cross-over network cable

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 (Windows PCs only).
2. Connect an Ethernet crossover cable from the MBDC-200 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 MBDC-200, then click **save**.
7. Reconnect your computer to your corporate network.

IP setup using a terminal program like HyperTerminal

1. Connect a null modem RS-232 cable between your PC and the MBDC-200's Serial Port 1.
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:



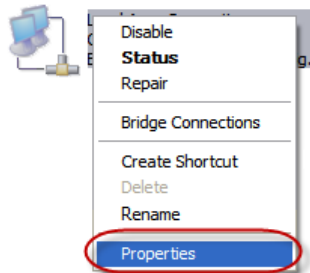
10. The device will show current values and prompt for new values for IP address, net mask and gateway address. Enter the new values and press **Enter**. A key press must be received at least every 10 seconds otherwise the device will go back to *RUN MODE* and resume normal operation.
11. The gateway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

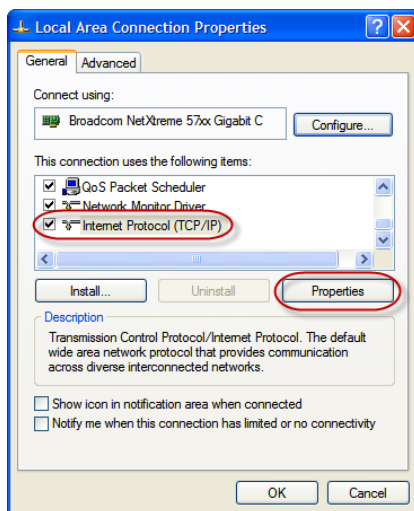
This method involves manually assigning an IP address to your PC in the same subnet as the gateway. The default subnet of the gateway is 169.254.0.0/16.

1. Connect the MBDC-200 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**:

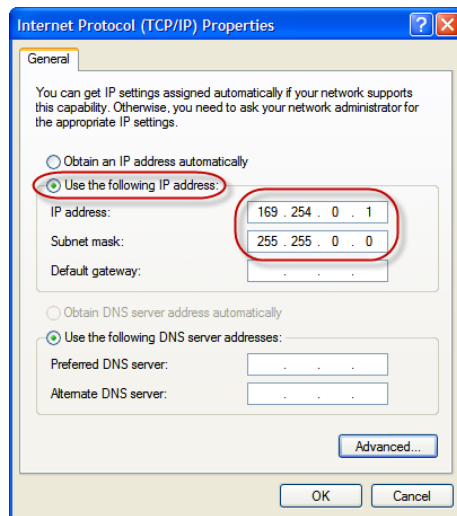
LAN or High-Speed Internet



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 MBDC-200, then click **Save**.
10. Restore your computer's original settings.

Chapter 5. Web browser based management

The MBDC-200 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 MBDC-200

Once you made sure that your PC is configured to be on the same subnet as the MBDC-200, 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:

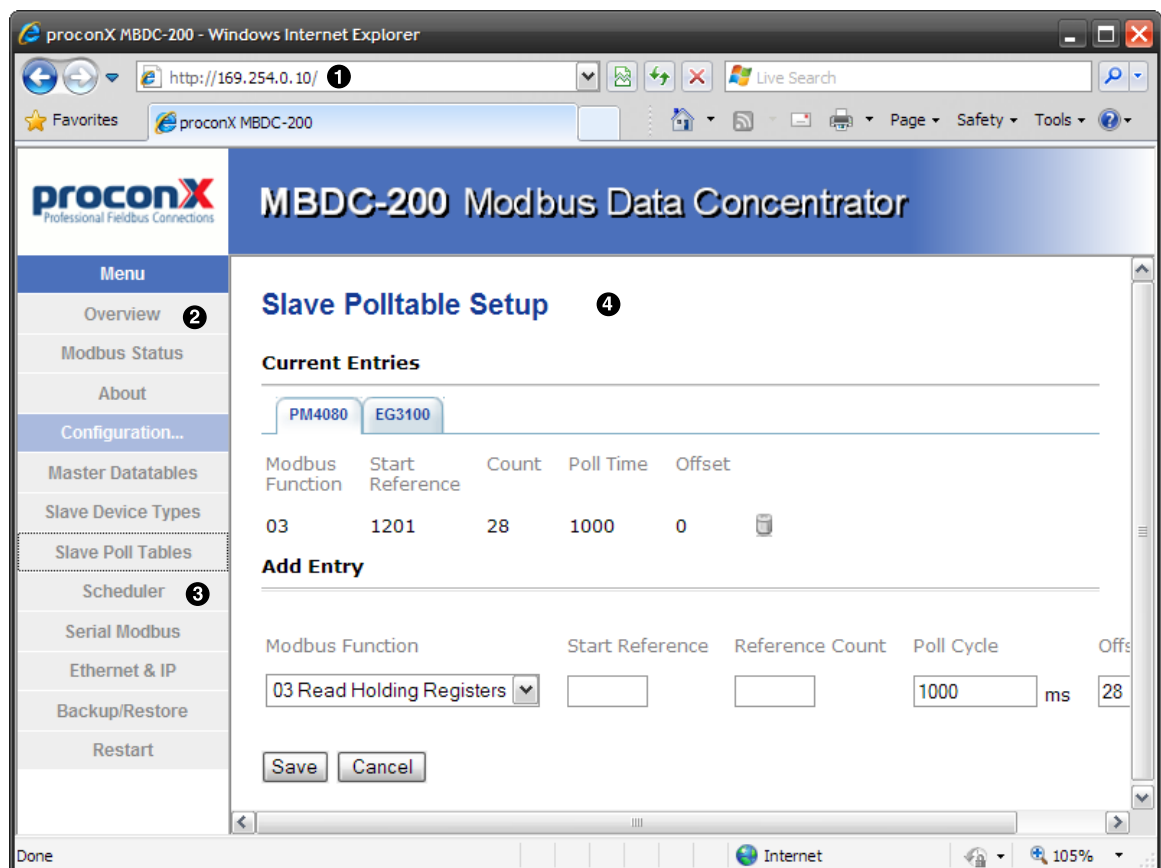


Figure 5.1: Device management and configuration via the web browser

- ❶ Gateway IP address
- ❷ Main menu
- ❸ Configuration sub-menu
- ❹ Information area

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



In order to connect to the MBDC-200 via TCP/IP, your PC must be on same IP subnet as the data concentrator. In most situations this means that the first three numbers of the IP address have to be identical.

Monitoring and diagnostic

The MBDC-200 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: Overview 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.

Modbus connection status

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.

Modbus Status

Modbus Serial Line

| Port | Requests | Replies | Broadcasts | Exceptions | Total Rx | Rx Errors | Rx Overruns | Rx Time-outs |
|------|----------|---------|------------|------------|----------|-----------|-------------|--------------|
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Modbus/TCP

| Socket | TCP Status | Accumulative Connections | Requests | Replies | Exceptions | Rx Errors | Tx Errors |
|--------|------------|--------------------------|----------|---------|------------|-----------|-----------|
| 1 | LISTEN | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | LISTEN | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | LISTEN | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | LISTEN | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | LISTEN | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | LISTEN | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | LISTEN | 0 | 0 | 0 | 0 | 0 | 0 |
| 8 | LISTEN | 0 | 0 | 0 | 0 | 0 | 0 |

Clear Counter

Figure 5.3: Modbus status page



This page shows accumulated readings since the MBDC-200 was last activated or reset. If power to the MBDC-200 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 MBDC-200. 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.

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 5.4: 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

MBDC-200 hardware version.

Firmware version

The firmware version that is installed on the MBDC-200.

Serial number

The serial number of the MBDC-200. 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:

Configuration

Ethernet

MAC Address 00-50-C7-67-70-7B

IP Settings

IP Address

Subnet Mask

Gateway Address

Figure 5.5: 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 indexterm2:[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:



Your network configuration has been changed.

The IP address is now [169.254.0.10](#).

Please click the button below to redirect your browser to the new IP address!

[Go to New IP Address](#)

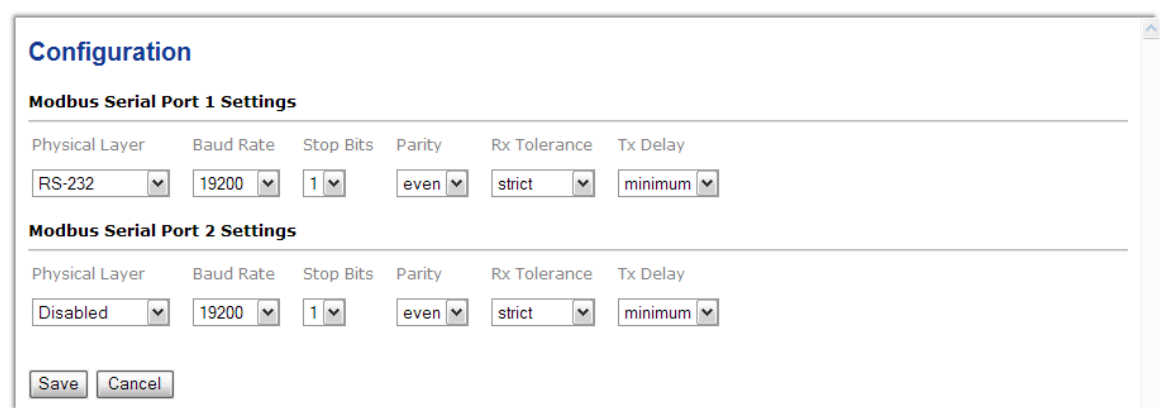
Figure 5.6: IP settings changed confirmation



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

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:



Configuration

Modbus Serial Port 1 Settings

| Physical Layer | Baud Rate | Stop Bits | Parity | Rx Tolerance | Tx Delay |
|----------------|-----------|-----------|--------|--------------|----------|
| RS-232 | 19200 | 1 | even | strict | minimum |

Modbus Serial Port 2 Settings

| Physical Layer | Baud Rate | Stop Bits | Parity | Rx Tolerance | Tx Delay |
|----------------|-----------|-----------|--------|--------------|----------|
| Disabled | 19200 | 1 | even | strict | minimum |

[Save](#) [Cancel](#)

Figure 5.7: Modbus settings page

The following Modbus settings can be entered:

Physical layer

Can be set to two-wire RS-485, RS-422 or 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-485/422) of the MBDC-200 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:

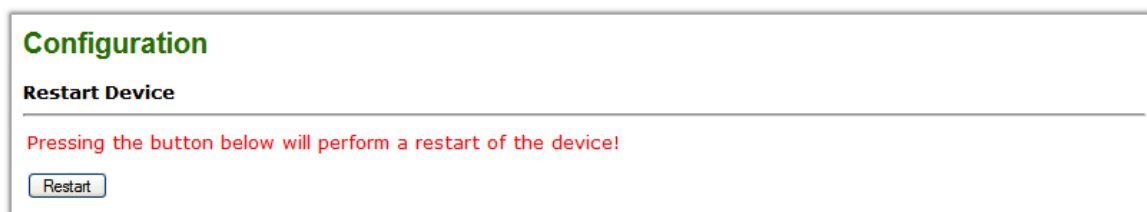


Figure 5.8: Restart device page

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

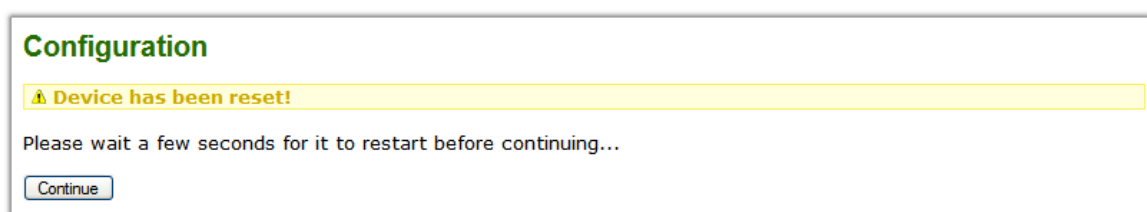


Figure 5.9: Restart confirmation page

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. Programming the communication flow

Compared to an ordinary Modbus gateway, the configuration of a Modbus data concentrator requires additional configuration steps. The data concentrator requires knowledge of the type of slave devices connected and also how the data in those slave devices is structured as well as what data items the master devices are interested in.

The following configuration steps must be performed:

1. Nominate the different types of the slave devices to be connected.
2. Configure how the data of interest in those slave devices is structured.
3. Define the size and location of the data area the master devices will see.
4. Define how the data of an individual slave device is mapped into that master data area.

Slave Device Types Setup

One of the first steps to configure the data concentrator is to identify the slave devices by a name.

Click on **Configuration**→**Slave Device Types**. In the Add Entry section enter a name for the slave device and click the **save** button.

Slave Device Types Setup

Current Entries

| Name | Time-out | Fault Behaviour |
|------------------------|----------|-----------------|
| PM500A | 1000 ms | Retain |

Add Entry

Name

Figure 6.1: Example of a Slave Device Types Setup page

Name

Textual identifier for a class of devices sharing the same Modbus register layout.

Fault Behaviour

Defines how a communication error should be treated.

Slave Polltable Setup

Once the Slave Device Types are defined by name (refer to the section called “Slave Device Types Setup”), a set of registers can be associated with each device type. This set of registers is called a Polltable.

Click on **Configuration**→**Slave Polltable Setup**.

This page shows which Modbus register ranges shall be polled for a particular device type. You can select a device on the device tab and add new entries and remove existing entries.

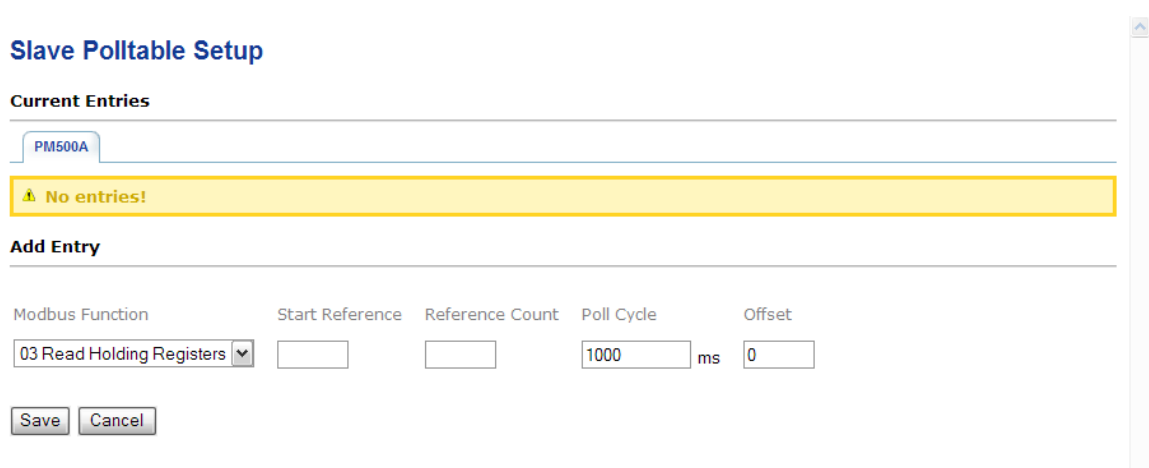


Figure 6.2: Example of a Slave Polltable Setup page

Modbus Function

The Modbus function code to be used for the Modbus transaction.

Start Reference

Defines the start register for the Modbus transaction. This number is 1-based meaning the first Modbus register is identified as register 1.

Reference Count

Defines how many registers are to be read or written.

Poll Cycle

Defines the minimum time span between two consecutive Modbus transactions of this type. Please note, that this is a minimum time and the actual cycle time may be longer depending on the scheduling order of other Modbus transactions.

Offset

The offset defines where in relation to the start of this poll table the returned data is to be stored. In most situations the offset is 0 for the first entry and then incremented by the number of registers polled by the previous entry.

Example

In this example we are using the Schneider PM500 power meter with the following Modbus table layout:

7

| Decimal address | Hexadecimal address | Number of words | Description | Units |
|-----------------|---------------------|-----------------|---|----------|
| 768 | 300 | 2 | I1: instantaneous current, phase 1 | mA |
| 770 | 302 | 2 | I2: instantaneous current, phase 2 | mA |
| 772 | 304 | 2 | I3: instantaneous current, phase 3 | mA |
| 774 | 306 | 2 | IN: neutral current | mA |
| 776 | 308 | 2 | U12: phase-to-phase voltage, phase 1 to 2 | V/100 |
| 778 | 30A | 2 | U23: phase-to-phase voltage, phase 2 to 3 | V/100 |
| 780 | 30C | 2 | U31: phase-to-phase voltage, phase 3 to 1 | V/100 |
| 782 | 30E | 2 | U1N: phase-to-neutral voltage, phase 1 | V/100 |
| 784 | 310 | 2 | U2N: phase-to-neutral voltage, phase 2 | V/100 |
| 786 | 312 | 2 | U3N: phase-to-neutral voltage, phase 3 | V/100 |
| 788 | 314 | 2 | F: frequency | Hz/100 |
| 790 | 316 | 2 | ΣP : total active power \pm | kW/100 |
| 792 | 318 | 2 | ΣQ : total reactive power \pm | kvar/100 |
| 794 | 31A | 2 | ΣS : total apparent power | kVA/100 |
| 798 | 31E | 2 | P1: active power, phase 1 \pm | kW/100 |
| 800 | 320 | 2 | P2: active power, phase 2 \pm | kW/100 |
| 802 | 322 | 2 | P3: active power, phase 3 \pm | kW/100 |
| | 324 | 2 | Q1: reactive power, phase 1 \pm | kvar/100 |

| | | | | |
|--------------------|-----|---|---|-------|
| 868 ⁽¹⁾ | 364 | 2 | C2: input 2 pulse counter | - |
| 870 | 366 | 2 | PF: total power factor | 0.001 |
| 872 | 368 | 2 | PF1: power factor, phase 1 | 0.001 |
| 874 | 36A | 2 | PF2: power factor, phase 2 | 0.001 |
| 876 | 36C | 2 | PF3: power factor, phase 3 | 0.001 |
| 878 | 36E | 2 | IN AVG: demagnetization time in the neutral | mA |

We are interested in the current, voltage and power values which we read in one block starting at register 768 with a count of 37 registers. In addition we like to read the energy counters which we read using a second Modbus transaction from start address 870 and a count of 8 registers. Because the PM500 document is using 0-based register numbering, we have to add an offset of 1 to all register addresses before they are entered into the MBDC-200.

This results in the following configuration Slave Polltable:

Slave Polltable Setup

Current Entries

| Modbus Function | Start Reference | Count | Poll Time | Offset |
|-----------------|-----------------|-------|-----------|--------|
| 03 | 769 | 34 | 1000 | 0 |
| 03 | 871 | 8 | 1000 | 34 |

Add Entry

| Modbus Function | Start Reference | Reference Count | Poll Cycle | Offset |
|---------------------------|-----------------|-----------------|------------|--------|
| 03 Read Holding Registers | | | 1000 ms | 42 |

Buttons: Save, Cancel

Figure 6.3: A basic Slave Polltable for a PM500 power meter

Master Datable Setup

The Master Datable defines how big the data area is a master can access as well as its start address and a slave ID.

Datable Setup

Current Entries

| Slave Address | Table Type | Register Range |
|---------------|------------|----------------|
| 1 | Any Type | 1 - 1000 |

Memory: 2000 of 8000 bytes used.

Add Entry

| Slave Address | Table Type | Start Reference | Reference Count |
|---------------|------------|-----------------|-----------------|
| | Any Type | | |

Buttons: Save, Cancel

Figure 6.4: Example of a Master Datable page

Slave Address

This is the slave ID or unit ID this data table must be addressed with.

Table Type

This defines what Modbus data types this table can hold. It also limits the Modbus function codes a Master can use to access the data table.

Start Reference

This value defines the first register of the table. This number is 1-based meaning the first Modbus register is identified as register 1.

Reference Count

The number of registers this table can hold.

Scheduler Configuration

Entering scheduler entries is the last step of the data concentrator's configuration. Once a scheduler entry has been made, the MBDC-200 starts communicating with the relevant slave device.

To add or delete a scheduler entry, select the **Configuration→Scheduler Configuration** sub-menu from the menu bar.

Scheduler Configuration

Current Entries

| Connection | Slave Address | Slave Device | Datatable | Offset | |
|---------------|---------------|--------------|-----------|--------|--|
| Serial Port 1 | 5 | PM500A | 1:1-1000 | 0 | |
| Serial Port 1 | 6 | PM500A | 1:1-1000 | 100 | |
| Serial Port 1 | 7 | PM500A | 1:1-1000 | 200 | |

Add Entry

| Connection | Slave Address | Slave Device | Datatable | Offset |
|---------------|----------------------|--------------|-----------|----------------------|
| Serial Port 1 | <input type="text"/> | PM500A | 1:1-1000 | <input type="text"/> |

Figure 6.5: Example of a Scheduler Configuration page

Connection

The serial port where the slave device is physically connected to.

Slave Address

The Modbus Slave ID of the slave device.

Slave Device

The type of the slave device (refer to the section called "Slave Device Types Setup"). This selection defines which register layout is used.

Datatable

The Master Data Table (refer to the section called "Master Datatable Setup"). The Master Data Table is the location where read data is stored and data to be written to the slave device is taken from.

Offset

A register offset where the data is located within the Master Data Table.

The order and timing of the Modbus communication cycles depends on the poll cycle, the order of poll table entries and the order of the scheduler entries.

Chapter 7. Internal Status and Diagnostic Registers

This section describes the layout of the Diagnostic data table accessible from the MBDC-200's Modbus/TCP interface.

The data table is addressed as *Holding Registers* (Modbus function code 03) using slave ID 0 and start address 1. Should this region already be used by a Master Databtable, then the diagnostic data table can alternatively be reached as slave ID 255 or using start address 65000.

| Address block | Register address | Description |
|---------------|------------------|---|
| 4 | 0001 | Device status ^a Bit 1-3: reserved for future use Bit 4: Device out of memory Bit 5: Device configuration data write failure Bit 6: Reset to factory defaults Bit 7: Brown out reset Bit 8: Watchdog reset Bit 9: Communication error Modbus slave devices Bit 10-16: reserved for future use |
| 4 | 0002 | Status register 1 for Scheduler entry 1-16 ^b |
| 4 | 0003 | Status register 2 for Scheduler entry 17-32 |
| 4 | 0004 | Status register 3 for Scheduler entry 33-48 |
| 4 | 0005 | Status register 4 for Scheduler entry 49-64 |
| 4 | 0006 | Status register 5 for Scheduler entry 65-80 |
| 4 | 0007 | Status register 6 for Scheduler entry 81-96 |
| 4 | 0008 | Status register 7 for Scheduler entry 97-112 |
| 4 | 0009 | Status register 8 for Scheduler entry 113-128 |

^aFault bits 1-8 are latched and must be cleared via the web interface or by writing a 0 to this register

^bA bit set to 1 indicates communication OK for the corresponding scheduler entry

Table 7.1: Modbus register addresses for MBDC-200 diagnostic data

Chapter 8. Decommissioning

Before disconnecting the MBDC-200 unit please follow the rules in the section called "Safety Precautions".

Disconnecting



1. Ensure that the system power and external supplies have been turned off.
2. Disconnect power supply plug.
3. Disconnect all I/O cables.
4. Remove the MBDC-200 from the DIN rail following the procedure described in the section called "DIN rail mounting and removal".

Disposal



This product must be disposed of at a specialized electronic waste recycling facility. Do not dispose of in domestic waste.

Appendix A.Specifications

| | |
|--|--|
| Product name | MBDC-200 |
| Interfaces | |
| Ethernet | 1 |
| Serial ports | 2, software configurable as either 2 x RS-232 or 2 x RS-485 or 1 x RS-232 + 1 x RS-485 or 1 x RS-422 |
| 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 |
| Serial Port 1 RS-232 interface | |
| 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 master |
| Serial Port 1 RS-485/RS-422 interface | |
| Connector | 3.81 mm 6-pin pluggable terminal block header |
| Physical layer | EIA-485-A, 2-wire or 4-wire |
| Isolation | non-isolated |
| Speed | 300, 600, 1200, 2400, 4800, 9600, 19200, 57600, 115200 bps |
| Max. number of nodes | 32 |
| Protocols | Modbus RTU master |
| Serial Port 2 RS-232 interface | |
| Connector | male 9-pin D-sub, DTE, EIA-574 pin-out |
| Physical layer | EIA-232-F |
| Isolation | non-isolated |
| Signals | RXD, TXD |
| Speed | 9600 bps |
| Protocols | Modbus RTU master |
| Serial Port 2 RS-485 interface | |
| Connector | 3.81 mm 6-pin pluggable terminal block header |
| 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 master |
| Ethernet port | |
| Connector | 8-pin RJ-45 socket for Cat 5 UTP |
| Physical & Data Link Layer Layer | IEEE 802.3i 10BASE-T |
| Isolation | 1.5 kV galvanic |

| | |
|--------------------------------------|---|
| Speed | 10 Mbit/s |
| Max. cable length | 100 m (328 ft) |
| Ethernet frame types | 802.3 |
| Protocols | Modbus/TCP slave, HTTP, IP, TCP, ARP |
| Concurrent connections | 8 Modbus/TCP slave, 2 HTTP |
| Power supply | |
| Connector | 3.81 mm 2-pin pluggable terminal block header |
| Voltage | 10-30 V DC |
| Current | 30 mA typical @ 24 V DC |
| Intrinsic consumption | 750 mW |
| Electromagnetic compatibility | |
| Emissions (radiated and conducted) | AS/NZS CISPR 22 / EN 55022 (Class A) |
| Immunity | EN 55024 |
| Electrostatic discharge | EN 61000-4-2 |
| Radiated RF | EN 61000-4-3 |
| Fast transients | EN 61000-4-4 |
| Conducted RF | EN 61000-4-6 |
| 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 |
| Cooling | Convection |
| Environmental | |
| Operating temperature | 0 to 60 °C / 32 to 140 °F |
| Storage temperature | -25 to 85 °C / -13 to 185 °F |
| Humidity rating | 10 to 95% relative humidity, 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 | 0.12 kg / 0.265 lb |
| Compliance | |
| Australia | C-Tick |
| Europe | CE, RoHS |
| USA | FCC Part 15 (Class A) |
| Canada | ICES-003 (Class A) |

Dimensions

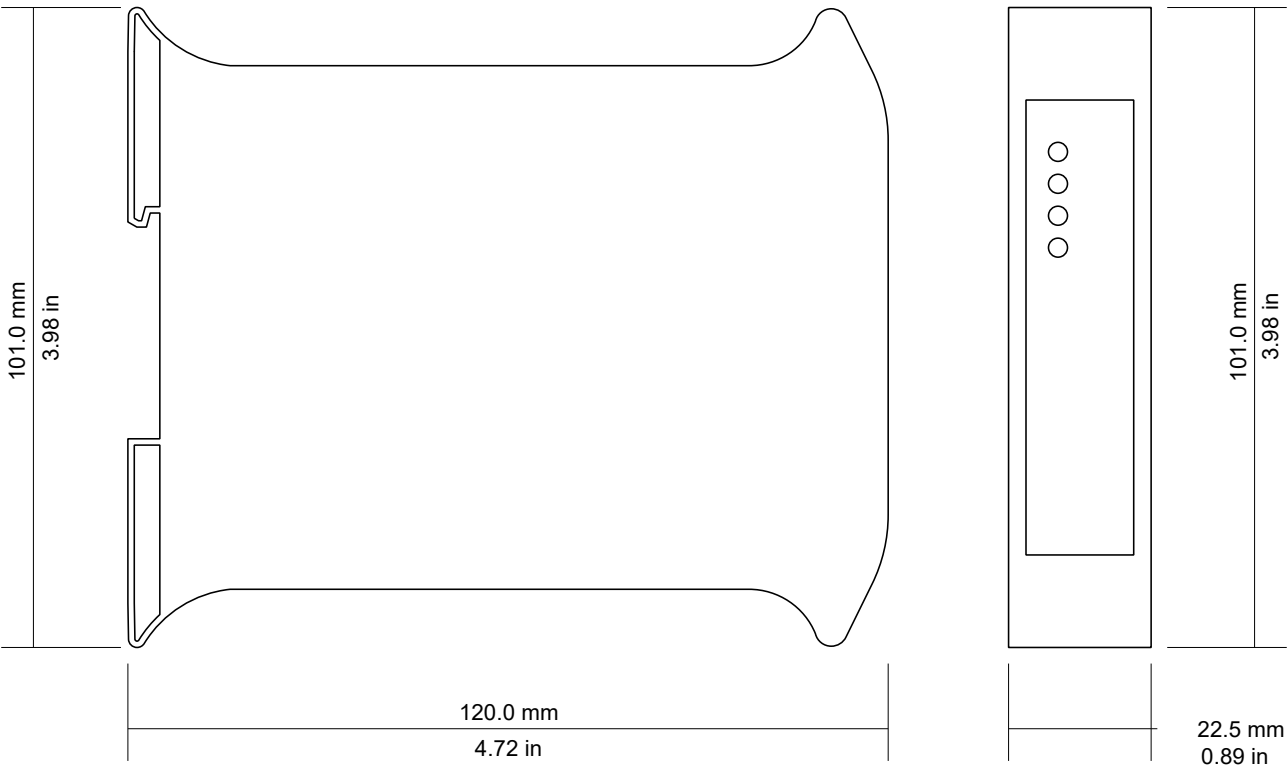


Figure A.1: Enclosure dimensions

Glossary

10BASE-T

10 Mbit/s twisted pair Ethernet standard. Standardized in IEEE 802.3i

APIPA

Automatic Private IP Addressing

Class A

Class A equipment is that used in commercial or light industrial environments.

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.

EMC

Electromagnetic compatibility

EMI

Electromagnetic interference

ESD

Electrostatic discharge. ESD can damage electronic equipment.

Ethernet

The standard for local area networks developed jointly by Digital Equipment Corp., Xerox, and Intel. Ethernet is used as the underlying transport vehicle by several upper-level protocols, including TCP/IP.

Gateway

A network device that passes data between different networks or fieldbusses.

Gateway address

The IP address of the gateway or router used to access the Internet from the local area network.

IEEE

Institute of Electrical and Electronics Engineers

IP

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

IP address

A numeric address used by computer hosts to transmit and receive information over the Internet.

ISO

International Standards Organisation

MAC address

Every piece of Ethernet hardware has a unique number assigned to it called its 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*.

Subnet mask

A numeric address used in conjunction with an IP address to segment network traffic; used to restrict transmissions to certain subnets.

Switch

A device that facilitates transmissions between nodes in a star-formed network.

TCP/IP

Transport Control Protocol/Internet Protocol. Connection-orientated transfer protocol.

Telnet

A network protocol (RFC 854) for character based terminal access to remote machines.

UL 94

Plastics flammability standard released by Underwriters Laboratories of the USA.

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