MIO-8288

MIO-8288 User Manual & Reference Guide

Eagle Technology – Cape Town, South Africa

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DAQ Remote Devices

Data Acquisition and Process Control

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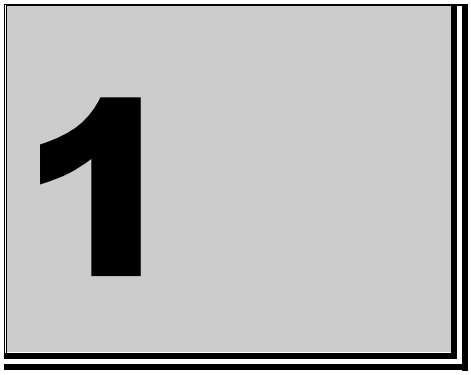

1 Introduction

General Description:

The MIO-8288 is much more than just a Data Logger. It is the next generation in data acquisition hardware.
The MIO-8288 comes standard with a selection of four different interface ports. These can be used to control the units 8 analog input channels, 2 analog output channels, 8 optically isolated digital inputs and 8 electro-mechanical relay outputs. All IO's are fitted with removable screw terminals blocks for easy and fast installation.
The MIO-8288 provides the user with the option of setting the analog input from +/-10 Volt input range to 4-20mAmp input range with the flick of a switch. No external components or accessories needed.
The MIO-8288 uses an SD Card for data storage, providing it with stand-alone data logging capability. Data logger setup is easily done in a web browser. The data is then logged on the SD Card in CSV (comma separated value) format that can be easily loaded into any spreadsheet. No driver or any software installation necessary.
The key to the MIO-8288 concept is that it is easy to use, flexible and cost effective. You do not need engineering experience in complicated data acquisition hardware. Anyone familiar with a personal computer and some programming skills can construct a data acquisition system. The devices can be interfaced to any personal computer with a USB or serial port or to a PLC.

In the Box

MIO-8288 package will contain the following:

- MIO-8288 Multi IO DAQ unit.
- Documentation and Software CD.
- Din Rail Mounting Kit.
- Quick Start Guide.

Device features:

Connection Types

- Serial RS-232
- Serial RS-422/RS-485
- Ethernet 10/100Mbps
- USB

Protocol Types

- EDRE
- MODBUS RTU (Remote Terminal unit)

Power Supply

- 8-40 VDC, 4.2W Max

Data Inputs/Output Types

- 8 Analog Inputs.
- 2 Analog Outputs.
- 8 Optically Isolated Inputs.
- 8 Electro-Mechanical Relay Outputs.

Applications

The MIO-8288 can be used in many different applications:

- Automation test equipment.
- Plant/Factory process control.
- Controlling and monitoring of equipment.
- Mobile computing.
- Laboratory applications.
- Interface with PLC.
- Remote Data Logging Applications

Software Support

The MIO-8288 have support for different communication protocols. The most well known is MODBUS. The MIO-8288 supports the industry standard MODBUS RTU (Remote Terminal Unit) protocol. Because the device supports a standard protocol, NO driver and NO software installation is needed.
The MIO-8288 also supports the EDRE software protocol. This makes the interface faster and easier.
Each device comes with example code. The example software will help you to get your hardware going very quickly. It also makes it easy to develop complicated control applications. All operating system are supported as no drivers are needed.
For further support information see the Contact Details section.

Contact Details

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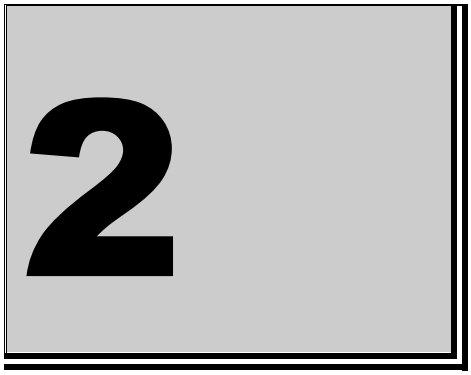


2 Installation

Because this Data Logger is configured via an Internet Browser and DAQ control can be done using the MODBUS protocol, no drivers are necessary and no software needs to be installed. If you however want to use the EDRE protocol, you need to install the EDRE API.

Operating System Support

- Windows 2000
- Windows XP (32 bit)
- Windows Vista (32 bit)
- Windows Vista (64 bit)
- Windows 7 (32 bit)
- Windows 7 (64 bit)

Installation

There are two parts to the installation. Installing the EDRE API and installing the USB Usart driver.

EDRE API

Run the file EDREAPI.exe on the CD that was supplied.
Follow the installation instructions to complete the installation.

USB Usart

Ensure that the USB port is configured as a Usart. Connect the MIO-8288 device to the PC's USB port. Ensure that the MIO-8288 unit is power up. Doing this for the first time will open a new hardware installation window.

Choose not to connect to Windows Update for this installation and click “Next”.

Figure 2-1: Found New Hardware Wizard.

On the next screen, select “Install from a list or specific location (Advanced)” and click “Next”.

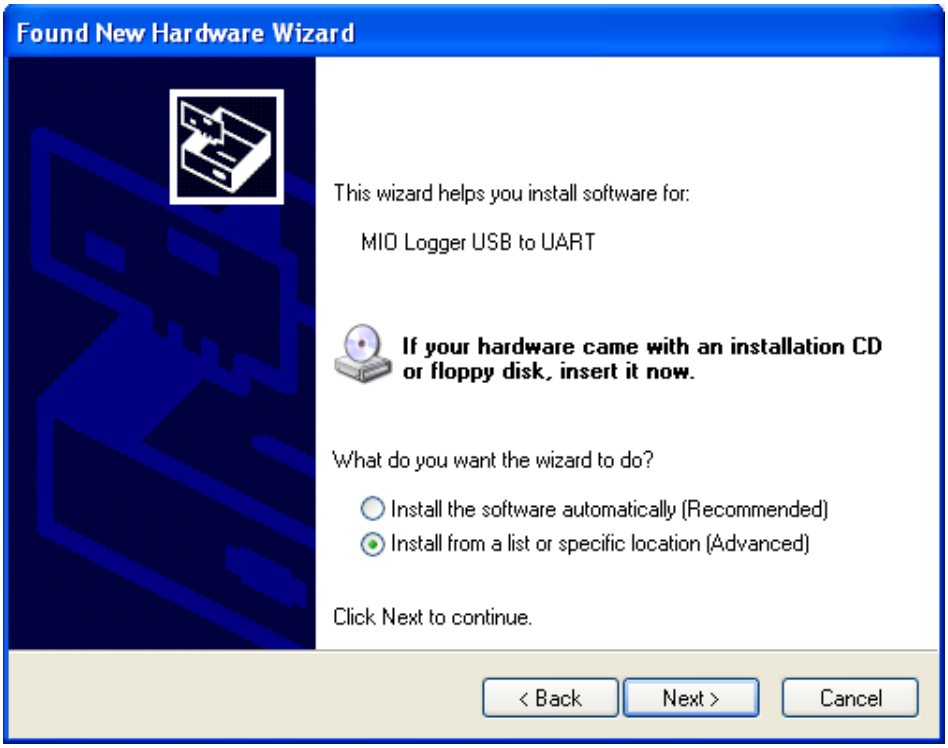


Figure 2-2: Install from a list or specific location

Then request to search in the “\Drivers\USB Usart\” on the CD that was include and click “Next”.

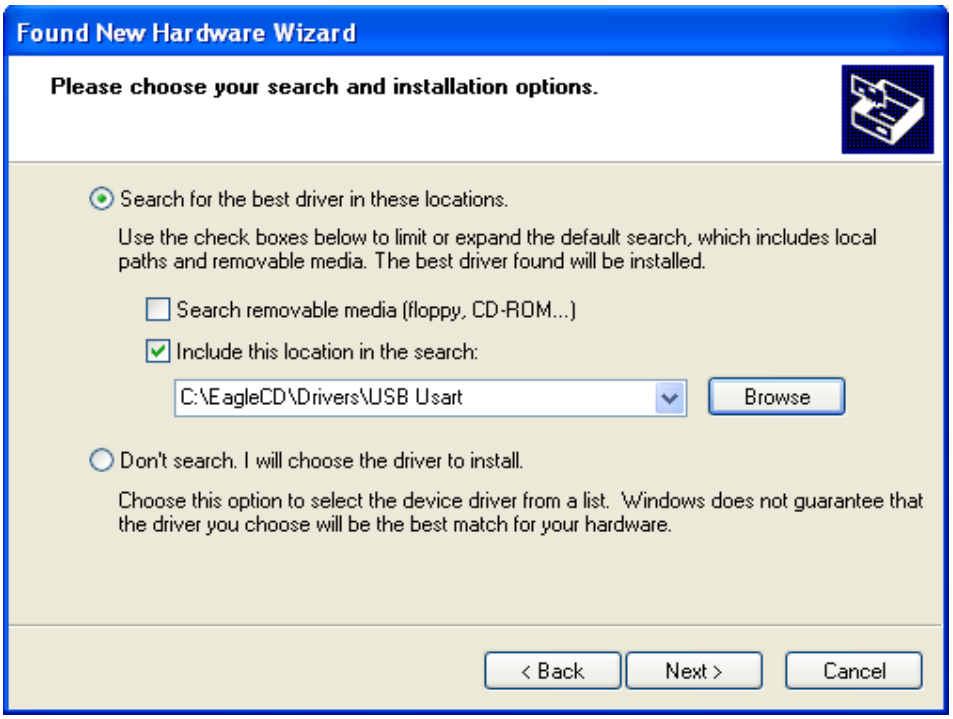


Figure 2-3: Browse Directory.

Windows will then process the installation of the driver. Once completed, click “Finish”.

Figure 2-4: Finish.

The USB Usart should now be listed as “MIO Logger USB to UART” under “Ports (COM & LPT)” in the “Device Manager”. It will also indicate the assigned COM number for the port.

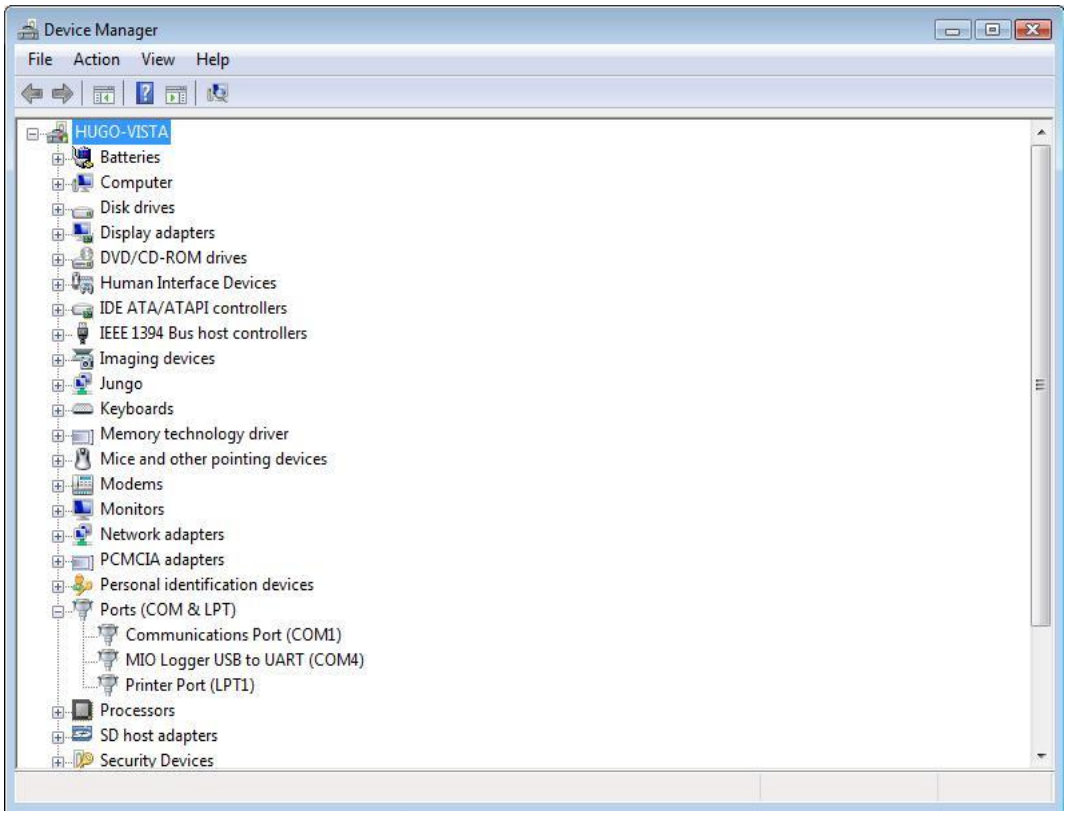
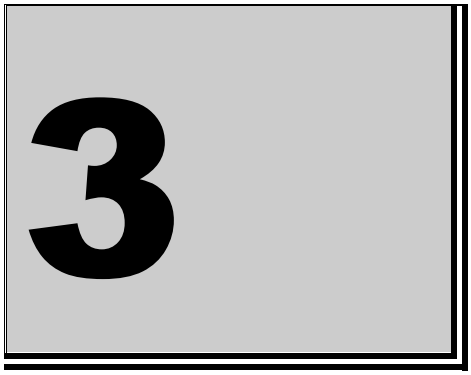


Figure 2-5: USB Usart Port Number in Device Manager.



3 Programing Guide

Even tho the MIO-8288 can be controlled and configured without installing any drivers or using any custom software, the EDRE SDK is still provided.
The EDRE comes with drivers and a common application program interface (API). The API also serves as a hardware abstraction layer (HAL) between the control application and the hardware. The EDRE API makes it possible to write an application that can be used on all hardware with common sub-systems.

EDR Enhanced API

The EDR Enhanced SDK comes with both ActiveX controls and a Windows DLL API. Examples are provided in many different languages and serves as tutorials. EDRE is also supplied with a software manual and user's guide.

The EDRE API hides the complexity of the hardware and makes it really easy to program the MIO-8288 device. It has got functions for each basic sub-system and is real easy to learn.

Digital Inputs

The MIO-8288 have 8 optically isolated input channels. The 8 inputs are situated on a 8-bit port.

Reading the digital inputs

A single call is necessary to read a digital Input. The **Port** parameter will always be equal to 0 because there is only one digital input port.

API-Call

long EDRE_DioRead(unsigned long SerialNumber, unsigned long Port, unsigned long *Value);
The serial number, port and pointer to variable that return the result must be passed by the calling function. A return code will indicate if any error occurred.

ACTIVEX Call

long EDREDioX.Read(long Port);
Only the port number needs to be passed and the returned value will either hold an error or the value read. If the value is negative an error occurred.

Digital Outputs

The MIO-8288 have 8 electro-mechanical relays. The 8 outputs are situated on a 8-bit port.

Writing the digital outputs

A single call is necessary to write a digital output. The **Port** parameter will always be equal to 0 because there is only one digital output port.

API Call

long EDRE_DioWrite(unsigned long SerialNumber, unsigned long Port, unsigned long Value);
The serial number, port and a value must be passed by the calling function. A return code will indicate if any error occurred.

ACTIVX Call

long EDREDioX.Write(long Port, long Value);
The port number and value to be written needs to be passed and the return value will indicate if an error occurred.

Analog Output

The MIO-8288 has 2 12-bit analog output channels with a range of ±10 volt. These channels are very easy to program. A single command is used to write to them.

Writing the Analog Outputs

A single call is necessary to write voltage levels to a analog output channel. The table below shows the relation between the software channel and the channel on the connector.

Assigned Software Channel	Assigned Connector Pin
0	AO1
1	AO2

Table 3-1: DAC Software Channel to Hardware Connections.

API Call

long EDRE_DAWrite(unsigned long SerialNumber, unsigned long Channel, long uVoltage);
The serial number, DAC channel and micro-voltage level is needed to set the DAC output. A return code will indicate if any error occurred.

Parameter	Type	Description
Serial Number	unsigned long	Device Serial Number
Channel	unsigned long	The analog channel to write.
uVoltage	long	The voltage to write to the analog output channel in micro volts.

Table 3-2: EDRE_DAWrite function.

ACTIVEX Call

long EDREDAX.Write(unsigned long Channel, long uVoltage);
The DAC channel and micro-voltage is needed to set a DAC channel's voltage. A return code will indicate if any errors occurred.

Analog Input

The MIO-8288 have 8 analog input channels.
The inputs can be used as 8 single-ended inputs, 4 differential-ended inputs or combination of the two.

Reading the Analog Inputs

A single call is necessary to configure a analog input channel and at the same time read the voltage level on the analog input.

API Call

long EDRE_ADCSingle(unsigned long SerialNumber, unsigned long Channel, unsigned long Gain, unsigned long Range, long *uVoltage);
The serial number, ADC channel, gain, range and a pointer to the uVoltage variable must be passed. A return code will indicate if an error occurred.

<table>
<tr><th>Parameter</th><th>Type</th><th>Description</th></tr>
<tr><td>Serial Number</td><td>unsigned long</td><td>Device Serial Number.</td></tr>
<tr><td>Channel</td><td>unsigned long</td><td>The channel to sample.</td></tr>
<tr><td>Gain</td><td>unsigned long</td><td>Gain contains the gain setting of the channel that is being sampled.
<table>
<tr><th>Value</th><th>Single-Ended</th><th>Differential-Ended</th></tr>
<tr><td>0</td><td>±10V</td><td>±20V</td></tr>
<tr><td>1</td><td></td><td>±10V</td></tr>
<tr><td>2</td><td></td><td>±5V</td></tr>
<tr><td>3</td><td></td><td>±4V</td></tr>
<tr><td>4</td><td></td><td>±2.5V</td></tr>
<tr><td>5</td><td></td><td>±2V</td></tr>
<tr><td>6</td><td></td><td>±1.25V</td></tr>
<tr><td>7</td><td></td><td>±1V</td></tr>
</table></td></tr>
<tr><td>Range</td><td>unsigned long</td><td>Range contains the range setting of the channel that is being sampled.
<table>
<tr><th>Value</th><th>Range</th></tr>
<tr><td>0</td><td>Single-Ended</td></tr>
<tr><td>1</td><td>Differential-Ended</td></tr>
</table></td></tr>
<tr><td>uVoltage</td><td>Pointer to a long</td><td>A pointer to the uVoltage variable that must return the result of the channel being sampled, in micro Voltage.</td></tr>
</table>

Table 3-3: EDRE_ADCRead function.

ACTIVEX Call

long EDREADX.SingleRead(long Channel);
Make sure to set the gain and Range properties of the ActiveX control. This will in turn set range and gain when reading the ADC channel. A return code will indicate if any errors occurred.

Single-Ended

Value	AI1	AI2	AI3	AI4	AI5	AI6	AI7	AI8	GND
0	+								- (AGND)
1		+							- (AGND)
2			+						- (AGND)

Value	AI1	AI2	AI3	AI4	AI5	AI6	AI7	AI8	GND
3				+					- (AGND)
4					+				- (AGND)
5						+			- (AGND)
6							+		- (AGND)
7								+	- (AGND)

Table 3-4: Single Ended Assigned Software Channel to Hardware Connections.

Differential-Ended

Value	AI1	AI2	AI3	AI4	AI5	AI6	AI7	AI8
0	+	-						
1			+	-				
2					+	-		
3							+	-
4	-	+						
5			-	+				
6					-	+		
7							-	+

Table 3-5: Differential-Ended Assigned Software Channel to Hardware Connections.

Gain Settings

Value	Voltage Range
0	±10

Table 3-6: Single-Ended Gain Settings.

Value	Voltage Range	Gain x
0	±20	1
1	±10	2
2	±5	4
3	±4	5
4	±2.5	8
5	±2	10
6	±1.25	16
7	±1	20

Table 3-7: Differential-Ended Gain Settings.

Range Settings

Value	Range
0	Single-Ended
1	Differential-Ended

Table 3-8: Range Settings.

Query Function

The Query function can be used to get or set more information about the MIO-8288 device.

API Call

long EDRE_Query(unsigned long SerialNumber, unsigned long QueryCode, unsigned long Param);
A serial number, query code and parameter must be specified when doing a query. A return value will indicate the result. The return code will be negative if an error occurred.

Query Codes

Name	Value	Description
APIMAJOR	1	Query EDRE API major version number.
APIMINOR	2	Query EDRE API minor version number.
APIBUILD	3	Query EDRE API build version number.
APIOS	4	Query API OS type.
APINUMDEV	5	Query number of devices installed.
BRDTYPE	10	Query a board's type.
BRDREV	11	Query a board's revision.
BRDYEAR	12	Query a board's manufactured year.
BRDMONTH	13	Query a board's manufactured month.
BRDDAY	14	Query a board's manufactured day.
BRDSERIALNO	15	Query a board's serial number.
DRVMAJOR	20	Query driver's major version number.
DVRMINOR	21	Query driver's minor version number.
DRVBUILD	22	Query driver's build version number.
FRMMAJOR	23	Query the firmware major version number.
FRMMINOR	24	Query the firmware minor version number.
FRMBUILD	25	Query the firmware build version number.
ADNUMCHAN	100	Query number of ADC channels.
DANUMCHAN	200	Query number of DAC channels.
DIONUMPORT	400	Query number of digital I/O ports.
NETSETIPADDRESS	604	Set board's IP Address.
NETSETMASK	605	Set board's Mask Address.
NETSETGATEWAY	606	Set board's Gateway.
NETGETIPADDRESS	608	Get board's IP Address.
NETGETMASK	609	Get board's Mask Address.
NETGETGATEWAY	610	Get board's Gateway.
NETGETMACCOMPANYID	613	Get board's company MAC ID.
NETGETMACEXTENSIONID	614	Get board's extension MAC ID.
SRLGETBAUD	700	Query the device Baud Rate.
SRLSETBAUD	701	Set the device Baud Rate.
RTCSETTIME	800	Set device time.
RTCGETTIME	801	Get device time.

Table 3-9: Query Codes

Error Codes

Name	Value	Description
EDRE_OK	0	Function successful.
EDRE_FAIL	-1	Function call failed.
EDRE_BAD_FN	-2	Invalid function call.
EDRE_BAD _SN	-3	Invalid serial number.
EDRE_BAD_DEVICE	-4	Invalid device.
EDRE_BAD_OS	-5	Function not supported by operating system.
EDRE_EVENT_FAILED	-6	Wait on event failed.
EDRE_EVENT TIMEOUT	-7	Event timed out.
EDRE_INT_SET	-8	Interrupt in use
EDRE_DA_BAD_RANGE	-9	DAC value out of range.
EDRE_AD_BAD_CHANLIST	-10	Channel list size out of range.
EDRE_BAD_FREQUENCY	-11	Frequency out of range.
EDRE_BAD_BUFFER_SIZE	-12	Data passed by buffer incorrectly sized.
EDRE_BAD_PORT	-13	Port value out of range.
EDRE_BAD_PARAMETER	-14	Invalid parameter value specified.
EDRE_BUSY	-15	System busy.
EDRE_IO_FAIL	-16	IO call failed.
EDRE_BAD_ADGAIN	-17	ADC-gain out of range.
EDRE_BAD_QUERY	-18	Query value not supported.
EDRE_BAD_CHAN	-19	Channel number out of range.
EDRE_BAD_VALUE	-20	Configuration value specified out of range.
EDRE_BAD_CT	-21	Counter-timer channel out of range.
EDRE_BAD_CHANLIST	-22	Channel list invalid.
EDRE_BAD_CONFIG	-23	Configuration invalid.
EDRE_BAD_MODE	-24	Mode not valid.
EDRE_HW_ERROR	-25	Hardware error occurred.
EDRE_HW_BUSY	-26	Hardware busy.
EDRE_BAD_BUFFER	-27	Buffer invalid.
EDRE_REG_ERROR	-28	Registry error occurred.
EDRE_OUT_RES	-29	Out of resources.
EDRE_IO_PENDING	-30	Waiting on I/O completion.

Table 3-10: Error Codes

4 Interconnections

Communication Connection Types

- RS-232 (DB9 Male)
- RS-422/485 (5-Way Screw Terminal)
- USB as Usart (Type B)
- Ethernet (RJ-45)

Communication Connection Pin Assignments

RS-232 (DB9 Male)

Pin Number	RS-232 Signal
2	RXD
3	TXD
5	GND
7	RTS
8	CTS

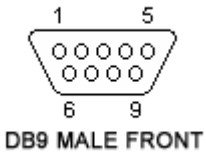


Table 4-1: RS-232

RS-422/485 (5-Way Screw Terminal)

Pin Number	RS-485 Signal
1	TXD+
2	TXD-
3	RXD+
4	RXD-
5	GND

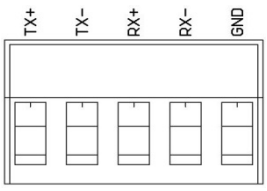


Table 4-2: RS-422/485

Ethernet (RJ-45)

Pin Number	Ethernet Signal
1	TD+
2	TD-
3	RD+
4	TDCT
5	RDCT
6	RD-
8	GND

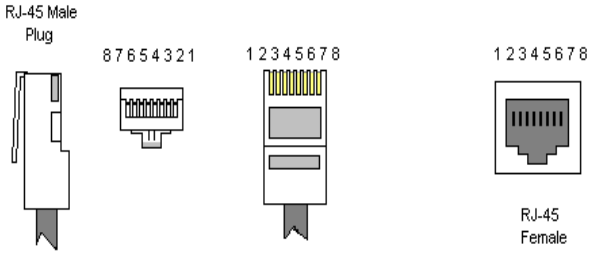


Table 4-3: Ethernet

Data Connection Types

- Analog Input (2x 5-Way Screw Terminal)
- Analog Output (3-Way Screw Terminal)
- Digital Input (2x 8-Way Screw Terminal)
- Digital Output (2x 12-Way Screw Terminal)

Data Connection Pin Assignments

Analog Input

Pin Number	Signal
1	AI1
2	AI2
3	AGND
4	AI3
5	AI4
6	AI5
7	AI6
8	AGND
9	AI7
10	AI8

Table 4-4: Analog Input

Analog Output

Pin Number	Signal
1	AO1
2	AGND
3	AO2

Table 4-5: Analog Output

Digital Input

Pin Number	Signal
1	DI1A
2	DI1B
3	DI2A
4	DI2B
5	DI3A
6	DI3B
7	DI4A
8	DI4B
9	DI5A
10	DI5B
11	DI6A
12	DI6B
13	DI7A
14	DI7B
15	DI8A
16	DI8B

Table 4-6: Optically Isolated Inputs

Digital Output

Pin Number	Signal
1	NO1
2	COM1
3	NC1
4	NO2
5	COM2
6	NC2
7	NO3
8	COM3
9	NC3
10	NO4
11	COM4
12	NC4
13	NO5
14	COM5
15	NC5
16	NO6
17	COM6
18	NC6
19	NO7
20	COM7
21	NC7
22	NO8
23	COM8
24	NC8

Table 4-7: Electro-Mechanical Relay

Power Connection Types

- 8 – 40 VDC (3-Way Screw Terminal)

Power Connection Pin Assignments

8 - 40 VDC

Pin Number	Signal
1	+ Power Supply
2	- Power Supply
3	EARTH

Table 4-8: Power Supply Contact

Pin Descriptions

AI1...8

Analog Input channels 1 to 8.

AO1...2

Analog Output channels 1 and 2.

DI1A...8A

Optically Isolated Input channels input pin A. This is the Positive input terminal for the optically isolated input channel

DI1B...8B

Optically Isolated Input channels input pin B. This is the Negative or reference input terminal for the optically isolated input channel.

NO1...8

Electro-Mechanical Relay Normally Open Contact Pin. When the relay is in the ON position, this pin is connected to its relevant COM pair and not connected or open when the relay is in the OFF position.

NC1...8

Electro-Mechanical Relay Normally Close Contact Pin. When the relay is in the OFF position, this pin is connected to its relevant COM pair and not connected when the relay is in the ON position.

COM1...8

Electro-Mechanical Relay Common Contact Pin. This Pin is either connected to its relevant NO or NC contact pin depending on the state of the relay.

AGND

Analog Ground used in conjunction with analog inputs and analog outputs.

GND or DGND

Digital Ground. This is the same as the “-” or Negative input on the Power Supply (8–40VDC) connector.

5

5 Hardware Introduction

Physical

MIO-8288 Panel View

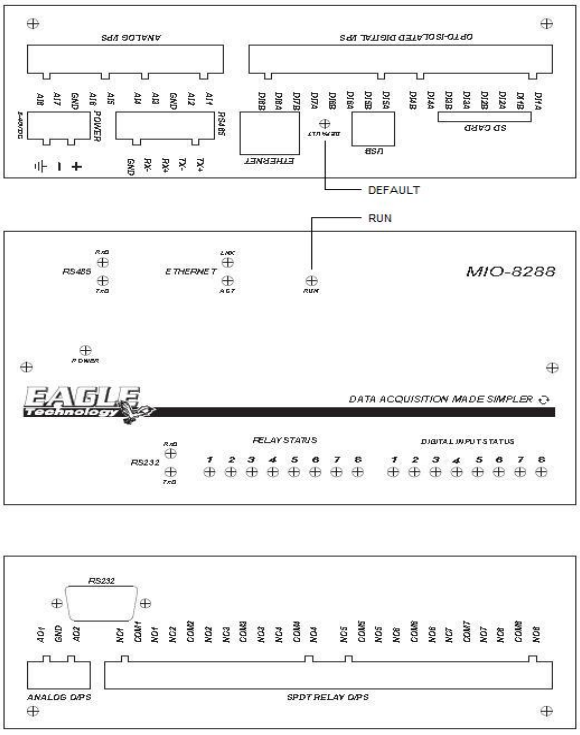


Figure 5-1: MIO-8288 Panel View

Dimensions

(W x D x H)	163 x 108 x 60 mm (With Feet) 6.42 x 4.25 x 2.36 in(With Feet) 163 x 108 x 70 mm (DIN Rail) 6.42 x 4.25 x 2.75 in(DIN Rail)

Operation

Load Default IP Settings

DEFAULT Button – Press the DEFAULT button continuously for 10 seconds to load the factory default IP settings: Use a pointed object, such as a straightened paper clip or toothpick, to press the DEFAULT button. This will cause the RUN LED to stop blinking. The

LED will change state after 10 seconds and the default IP settings will be loaded. At this state you should release the DEFAULT button. To finish loading the default settings, a **Hardware Reset** should be done.

Description	Default Settings
IP Address	192.168.0.2
GATEWAY	192.168.0.1
NET MASK	255.255.255.0

Table 5-1: Default IP Settings

Hardware Reset

To do a hardware reset the power must be disconnected for ±5 Seconds and then be reconnected. The device will now reboot and reload all settings. This might take a couple of seconds.

RUN LED

The RUN LED will indicate when the device is used as a Data Logger and busy logging data to the SD/MMC storage device.

Firmware Upgrade

Firmware is the software the runs on a micro controller. It is like the O/S and application program all in one running on you PC.
When the firmware on the device needs to be upgrade, two components are needed. The program that is used to load the firmware and the new firmware.

BatchISP

The application that is used to load the firmware is called “BatchISP”.
BatchISP is a command line tool that allows to program parts containing an embedded Atmel ISP. It comes with FLIP 3. To install BatchISP, first install FLIP 3 using its installer. You can find the application on the CD. “Flip_Installer_3.4.2.exe”.

Activating the ISP

To load new firmware, the ISP must be activated.

- This is done by disconnecting the power to the MIO-8288 device.
- Connect the MIO-8288 device to the PC via a USB cable.
- Push and hold the **DEFAULT** button while the MIO-8288 device is power up.
- This will activate the SPI.

Driver Installation

Activating the ISP for the first time will open a new hardware installation window. Choose not to connect to Windows Update for this installation and click “Next”.

Figure 5-2: Found New Hardware Wizard.

On the next screen, select “Install from a list or specific location (Advanced)” and click “Next”.

Figure 5-3: Install from a list or specific location.

Then request to search in the “USB” folder of the FLIP installation directory as shown below and click “Next”.

Figure 5-4: Browse Directory.

Windows will then process the installation of the driver corresponding to the ISP of the connected part. Once completed, click “Finish”.

Figure 5-5: Finish

Loading Firmware

First see Activating the ISP.

To launch BatchISP, open a command prompt. Windows or Cygwin command prompt can be used provided that the `bin` folder of the FLIP installation directory is in the `PATH` (Windows' or Cygwin's) environment variable.
When running BatchISP on AT32UC3A0512, the target part has to be specified with `-device at32uc3A0512` and the communication port with `-hardware usb`. Commands can then be placed after `-operation`. These commands are executed in order. BatchISP options can be placed in a text file invoked using `-cmdfile` rather than on the command line.
BatchISP works with an internal ISP buffer per target memory. These ISP buffers can be filled from several sources. All target operations (program, verify, read) are performed using these buffers.
A typical BatchISP command line programming an application will look like this:

```
batchisp -device at32uc3a0512 -hardware usb -operation erase f memory flash
blankcheck loadbuffer MIO-8288.elf program verify start reset 0
```

A Hardware Reset must now be done.

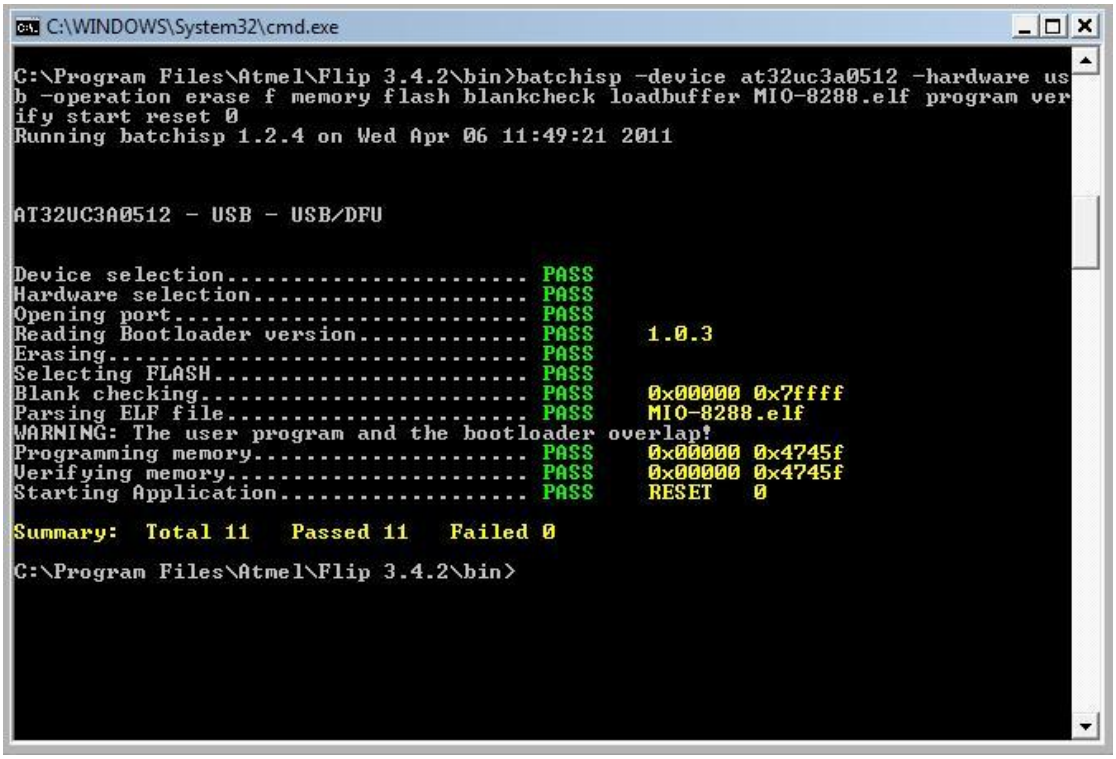
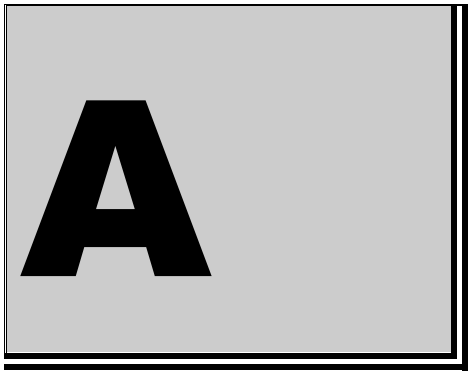


Figure 5-6: Typical BatchISP Command Line



A. Specifications

Digital Input/Output Characteristics

Elector Mechanical Relay Characteristics

DC Rating	
Rated Current / Voltage DC	6 Amp / 28 VDC
Max. Switching Power	336W
Max. Switching Voltage	110VDC
AC Rating	
Rated Current / Voltage AC	5 Amp / 250 VAC
Max. Switching Power	1250VA
Max. Switching Voltage	380VAC
Contact Resistance	< 100mΩ
Operate Time	< 10mS
Release Time	< 5mS
Vibration resistance	10~55Hz double amplitude 1.5mm
Shock resistance	100m/s² 11mS
Terminals Strength	5N
Contact Configuration	Single Pole Double Throw (SPDT)
Ambient temperature range	-55 ~ 85°C
Relative Humidity	93% (@ 40°C)

Optically Isolated Characteristics

Frequency Response	Up to 10 kHz
Logic Levels	High: 3V min, 24V max Low: 0.0V min, 1.2V max
Isolated Voltage	2500V
Input Current	30mA Continuous 1A Peak (100µs Pulse)
Max forward current [LED]	50mA

Analog Input/Output Characteristics

Analog Input Characteristics

Number of Channels	8 single-ended, 4 differential-ended
Input Coupling	DC
Maximum Working Voltage	±20V relative to module ground
Resolution	14 Bit
Relative Accuracy	±2 LSB
Input range, single-ended	±10V
Input range, differential-ended	±20, ±10, ±5, ±4, ±2.5, ±2, ±1.25, ±1 (V)
Input impedance	2 MΩ

Analog Output Characteristics

Number of Channels	2
Maximum Output	+10V
Minimum Output	-10V
Output Current	5mA
Resolution	12 Bits
Zero offset error	5mV
Full scale error	30mV

Serial Interface

Connection Type	USB (USB as USART) RS-232 RS-485/RS-422
Communication Protocol	MODBUS RTU (Remote Terminal Unit) protocol EDRE
Baud Rate	1200 - 230400 Baud
Word length	8
Parity	NONE
Stop Bits	1

LAN Interface

Connection Type	RJ-45
Communication Protocol	MODBUS RTU (Remote Terminal Unit) protocol EDRE
Port	7070

Power Requirements

Power	8 to 40 VDC, 4.2W Max

Environmental / Physical

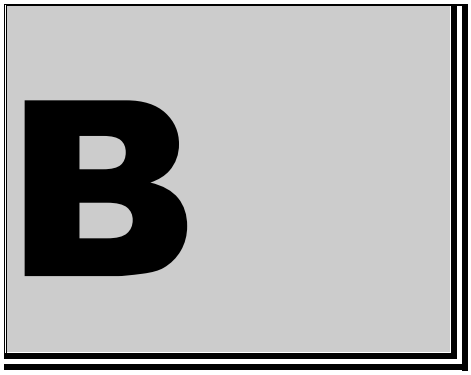
Relative Humidity	5% to 90% (non-condensing)
Operating Temperature	0°C to 55°C (32 to 131°F)
Housing	Powder coated Aluminium
Dimension (W x D x H)	163 x 108 x 60 mm (With Feet) 6.42 x 4.25 x 2.36 in(With Feet) 163 x 108 x 70 mm (DIN Rail) 6.42 x 4.25 x 2.75 in(DIN Rail)

Isolation

Magnetic Isolation	1.5 KV for Ethernet
Optically Isolation	2.5 KV for Digital Input

Data Storage

SD Card or MMC	2 Giga Byte (Max)



B. MODBUS Codes and Address Registers

Function Codes

0x01 Read Coils

This function code is used to read from 1 to 8 contiguous status of coils in a remote device. The Request PDU specifies the starting address, i.e. the address of the first coil specified, and the number of coils. In the PDU Coils are addressed starting at zero. Therefore coils numbered 1-8 are addressed as 0-7.
The coils in the response message are packed as one coil per bit of the data field. Status is indicated as 1= ON and 0= OFF. The LSB of the first data byte contains the output addressed in the query. The other coils follow toward the high order end of this byte, and from low order to high order in subsequent bytes.
If the returned output quantity is not a multiple of eight, the remaining bits in the final data byte will be padded with zeros (toward the high order end of the byte). The Byte Count field specifies the quantity of complete bytes of data.

Request

Function Code	1 Byte	0x01
Starting Address	2 Bytes	0x0000 to 0x0007
Quantity of Coils	2 Bytes	0x0001 to 0x0008

Response

Function Code	1 Byte	0x01
Byte Count	1 Bytes	N*
Coil Status	n Bytes	n=N or N + 1

*N = Quantity of Outputs / 8, if the remainder is different of 0 → N = N + 1

Error

Function Code	1 Byte	0x81
Exception Code	1 Bytes	01 or 02 or 03 or 04

Address Register	Description
0x00	OPTO 1
0x01	OPTO 2
0x02	OPTO 3
0x03	OPTO 4
0x04	OPTO 5
0x05	OPTO 6
0x06	OPTO 7
0x07	OPTO 8

Table B-1: Coil Address Register for Digital Inputs

0x05 Write Single Coil

This function code is used to write a single output to either ON or OFF in a remote device. The requested ON/OFF state is specified by a constant in the request data field. A value of FF

00 hex requests the output to be ON. A value of 00 00 requests it to be OFF. All other values are illegal and will not affect the output.
The Request PDU specifies the address of the coil to be forced. Coils are addressed starting at zero. Therefore coil numbered 1 is addressed as 0. The requested ON/OFF state is specified by a constant in the Coil Value field. A value of 0XFF00 requests the coil to be ON. A value of 0X0000 requests the coil to be off. All other values are illegal and will not affect the coil.
The normal response is an echo of the request, returned after the coil state has been written.

Request

Function Code	1 Byte	0x05
Output Address	2 Bytes	0x0000 to 0x0007
Output Value	2 Bytes	0x0000 or 0xFF00

Response

Function Code	1 Byte	0x05
Byte Count	2 Bytes	0x0000 to 0x0007
Coil Status	2 Bytes	0x0000 or 0xFF00

Error

Function Code	1 Byte	0x85
Exception Code	1 Bytes	01 or 02 or 03 or 04

0x0F Write Multiple Coils

This function code is used to force each coil in a sequence of coils to either ON or OFF in a remote device. The Request PDU specifies the coil references to be forced. Coils are addressed starting at zero. Therefore coil numbered 1 is addressed as 0.
The requested ON/OFF states are specified by contents of the request data field. A logical '1' in a bit position of the field requests the corresponding output to be ON. A logical '0' requests it to be OFF.
The normal response returns the function code, starting address, and quantity of coils forced.

Request

Function Code	1 Byte	0x0F
Starting Address	2 Bytes	0x0000 to 0x0007
Quantity of Outputs	2 Bytes	0x0001 to 0x0008
Byte Count	1 Byte	N*
Outputs Value	N* x 1 Byte	

*N = Quantity of Outputs / 8, if the remainder is different of 0 → N = N + 1

Response

Function Code	1 Byte	0x0F
Starting Address	2 Bytes	0x0000 to 0x0007
Quantity of Outputs	2 Bytes	0x0001 or 0x0008

Error

Function Code	1 Byte	0x8F
Exception Code	1 Bytes	01 or 02 or 03 or 04

Address Register	Description
0x00	Relay 1
0x01	Relay 2
0x02	Relay 3
0x03	Relay 4
0x04	Relay 5
0x05	Relay 6
0x06	Relay 7
0x07	Relay 8

Table B-2: Coil Address Register for Relays

0x04 Read Input Registers

This function code is used to read from 1 to approx. 125 contiguous input registers in a remote device. The Request PDU specifies the starting register address and the number of registers. In the PDU Registers are addressed starting at zero. Therefore input registers numbered 1-16 are addressed as 0-15.
The register data in the response message are packed as two bytes per register, with the binary contents right justified within each byte. For each register, the first byte contains the high order bits and the second contains the lower order bits.

Request

Function Code	1 Byte	0x04
Starting Address	2 Bytes	0x0000 to 0x000F
Quantity of Input Registers	2 Bytes	0x0001 to 0x0010

Response

Function Code	1 Byte	0x04
Byte Count	1 Bytes	2 x N
Input Registers	N x 2 Bytes	

N = Quantity of Input Registers.

Error

Function Code	1 Byte	0x84
Exception Code	1 Bytes	01 or 02 or 03 or 04

Address Register	Description
0x00	ADC 1 MSB
0x01	ADC 1 LSB
0x02	ADC 2 MSB
0x03	ADC 2 LSB
0x04	ADC 3 MSB
0x05	ADC 3 LSB
0x06	ADC 4 MSB
0x07	ADC 4 LSB
0x08	ADC 5 MSB
0x09	ADC 5 LSB
0x0A	ADC 6 MSB
0x0B	ADC 6 LSB
0x0C	ADC 7 MSB
0x0D	ADC 7 LSB
0x0E	ADC 8 MSB
0x0F	ADC 8 LSB

Table B-3: Input Register Map

0x10 Write Multiple Registers

This function is used to write a block of contiguous registers, from 1 to approx. 120 registers, in a remote device.
The requested written values are specified in request data field. Data is packed as two bytes per register.
The normal response returns the function code, starting address, and quantity of registers written.

Request

Function Code	1 Byte	0x10
Starting Address	2 Bytes	0x0000 to 0x005F
Quantity of Registers	2 Bytes	0x0001 to 0x0008
Byte Count	1 Byte	2 x N
Registers Value	N x 2 Bytes	Value

N = Quantity of Registers.

Response

Function Code	1 Byte	0x10
Starting Address	2 Bytes	0x0000 to 0x005F
Quantity of Registers	2 Bytes	0x0001 to 0x0008

Error

Function Code	1 Byte	0x90
Exception Code	1 Bytes	01 or 02 or 03 or 04

Address Register	Description
0x0000	DAC 1 MSB
0x0001	DAC 1 LSB
0x0002	DAC 2 MSB
0x0003	DAC 2 LSB
...	...
...	...
0x0050	ADC Gain 1
0x0051	ADC Gain 2
0x0052	ADC Gain 3
0x0053	ADC Gain 4
0x0054	ADC Gain 5
0x0055	ADC Gain 6
0x0056	ADC Gain 7
0x0057	ADC Gain 8
0x0058	ADC Range 1
0x0059	ADC Range 2
0x005A	ADC Range 3
0x005B	ADC Range 4
0x005C	ADC Range 5
0x005D	ADC Range 6
0x005E	ADC Range 7
0x005F	ADC Range 8

Table B-4: Output Register Map

0x03 Read Holding Registers (Query function)

This function is used to query specific holding registers.
The register data in the response message are packed as four bytes per register, with the binary contents right justified within each byte. For each register, the first byte contains the high order bits and the fourth contains the low order bits.

Request

Function Code	1 Byte	0x03
Starting Address	2 Bytes	0x0000 to 0xFFFF
Quantity of Input Registers	2 Bytes	0x0001 to 0x000f

Response

Function Code	1 Byte	0x03
Byte Count	1 Bytes	4 x N
Input Registers	N x 4 Bytes	

N = Quantity of Input Registers.

Error

Function Code	1 Byte	0x83
Exception Code	1 Bytes	01 or 02 or 03 or 04

Address Register	Description
0x000A	Device Type
0x000B	Device Revision
0x000C	Manufactured Year
0x000D	Manufactured Month
0x000E	Manufactured Day
0x000F	Serial Number
0x0017	Firmware Major Revision
0x0018	Firmware Minor Revision
0x0019	Firmware Build Revision
0x0260	Get Network IP Address
0x0261	Get Network Mask
0x0262	Get Network Gate Way
0x0265	MAC Company ID
0x0266	MAC Extension ID

Table B-5: Holding Register Map

0x08 Diagnostics

MODBUS function code 08 provides a series of tests for checking the communication system between a client (Master) device and a server (Slave), or for checking various internal error conditions within a server.
The function uses a two–byte sub-function code field in the query to define the type of test to be performed. The server echoes both the function code and sub-function code in a normal response. Some of the diagnostics cause data to be returned from the remote device in the data field of a normal response.
In general, issuing a diagnostic function to a remote device does not affect the running of the user program in the remote device. User logic, like discrete and registers, is not accessed by the diagnostics. Certain functions can optionally reset error counters in the remote device. A server device can, however, be forced into 'Listen Only Mode' in which it will monitor the messages on the communications system but not respond to them. This can affect the outcome of your application program if it depends upon any further exchange of data with the remote device. Generally, the mode is forced to remove a malfunctioning remote device from the communications system.
The following diagnostic functions are dedicated to serial line devices.

Request

Function Code	1 Byte	0x08
Sub-function	2 Bytes	
Data	N X 2 Bytes	

Response

Function Code	1 Byte	0x08
Sub-function	2 Bytes	
Data	N x 2 Bytes	

Error

Function Code	1 Byte	0x88
Exception Code	1 Bytes	01 or 02 or 03 or 04

Here the list of **sub-function** codes supported by the serial line devices.

Code	Description
0x0000	Echo Query Data
0x0001	Reset Communications Option
0x0004	Force Listen Only Mode
0x000A	Clear Counters and Diagnostic Register
0x000C	Return Bus Communication Error Count
0x000D	Return Bus Exception Count
0x000E	Return Slave Message Count

Table B-6: Diagnostic Sub-functions

0x0B Get Communication Event Count (Serial Line Only)

This function code is used to get a status word and an event count from the remote device's communication event counter.
By fetching the current count before and after a series of messages, a client can determine whether the messages were handled normally by the remote device.
The device's event counter is incremented once for each successful message completion. It is not incremented for exception responses, poll commands, or fetch event counter commands.
The event counter can be reset by means of the Diagnostics function (code 08), with a sub-function of Restart Communications Option (code 00 01) or Clear Counters and Diagnostic Register (code 00 0A).
The normal response contains a two–byte status word, and a two–byte event count. The status word will be all ones (FF FF hex) if a previously–issued program command is still being processed by the remote device (a busy condition exists). Otherwise, the status word will be all zeros.

Request

Function Code	1 Byte	0x0B

Response

Function Code	1 Byte	0x0B
Status	2 Bytes	0x0000 to 0xFFFF
Event Count	2 Bytes	0x0000 to 0xFFFF

Error

Function Code	1 Byte	0x8B
Exception Code	1 Bytes	01 or 02 or 03 or 04

General Description

Protocol Description

The MODBUS protocol defines a simple protocol data unit **(PDU)** independent of the underlying communication layers. The mapping of MODBUS protocol on specific buses or network can introduce some additional fields on the application data unit **(ADU)**.

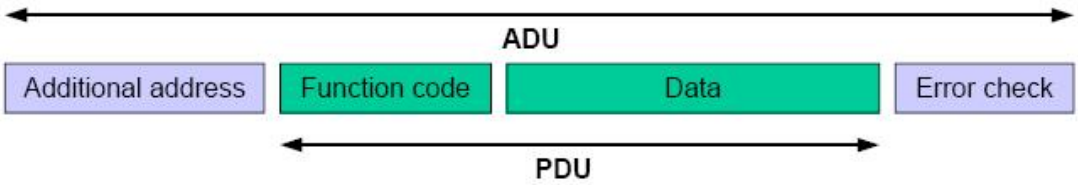


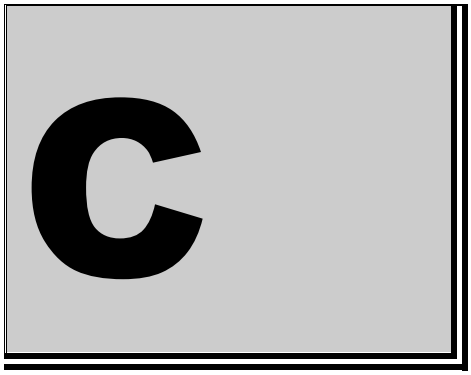
Figure B-1: General MODBUS frame

The MODBUS application data unit is built by the client that initiates a MODBUS transaction. The function indicates to the server what kind of action to perform. The MODBUS application protocol establishes the format of a request initiated by a client.

The size of the MODBUS PDU is limited by the size constraint inherited from the first MODBUS implementation on Serial Line network (max. RS485 ADU = 256 bytes).
Therefore:
MODBUS **PDU for serial line communication =** 256 - Server address (1 byte) - CRC (2 bytes) = **253 bytes**.
Consequently:
RS232 / RS485 **ADU** = 253 bytes + Server address (1 byte) + CRC (2 bytes) = **256 bytes**.
TCP MODBUS **ADU** = 253 bytes + MBAP (7 bytes) = **260 bytes**.

Data Encoding

MODBUS uses a ‘big-Endian’ representation for addresses and data items. This means that when a numerical quantity larger than a single byte is transmitted, the most significant byte is sent first.



C. Troubleshooting & Maintenance

Troubleshooting

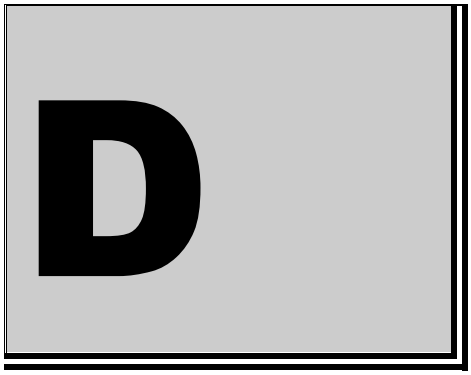
Device Unavailable on Serial Connection

- Make sure that the Slave address is correct, as selected.
- Check that correct serial port number is correct and correctly configured.
- Check that your Baud Rate is correct, as selected.
- Reset device after any changes was made to the device configuration settings.
- Reset device by disconnecting the power.

Maintenance

Calibration

The device should be returned every two years for recalibration. A service fee will be charged for all work done as well as for any parts that needs replacement.
Courier and / or delivery cost will also be for the clients cost.



D. Ordering Information

For ordering information please contact Eagle Technology directly or visit our website.

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