QA-12DI-4DO

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CONTENTS

SAFETY WARNINGS AND CAUTIONS

The following warnings and cautions must be observed to ensure personal safety and prevent damage.

Death or **serious injury** may result from failure to heed this warning.

Material damage or **serious personal injury** may result from failure to heed this warning.

The manufacturer **declines all responsibility** for electrical safety in the event of improper use of the equipment.

It is essential to read the entire contents of this manual before carrying out any work.

Installation and commissioning must be carried out by qualified personnel only.

Before commissioning, make sure that:

- the maximum values for all connections are not exceeded; refer to the product data sheet;
- the connection cables are not damaged or live during wiring;
- the direction of current flow and phase rotation are correct.

During installation, ensure that a switch or circuit-breaker is near the product and easily accessible.

The unit must be uninstalled if safe operation can no longer be guaranteed (e.g. visible damage). Disconnect all connections in this case. The unit should be returned to the manufacturer or to an authorised service centre for repair.

WARNING: High-intensity magnetic fields may alter the values measured by the transformer. Avoid installation near: permanent magnets, electromagnets, or iron masses. If irregularities are detected, reposition or move the unit to a more suitable location.

Failure to observe the warnings may result in damage to the equipment or failure to operate as intended.

Please note that the information on the nameplate must be observed.

It is necessary to comply with national regulations when installing and picking materials for power lines.

Repairs and modifications must be carried out only by the manufacturer. It is forbidden to open the case and make any changes to the device. Tampering with the device will invalidate the warranty.

The product described in this document may only be used for the specified application. The maximum performance data and environmental conditions specified in the product data sheet must be observed. Proper transport and storage, as well as professional assembly, installation, handling and maintenance are required for the correct and safe operation of the device.

Use under ambient conditions other than those specified, application of signals or voltages other than those specified, may cause significant deviations from the specified measurement tolerances, which may be irreversible.

Although the contents of this document have been checked for accuracy, it may contain errors or inconsistencies and we cannot guarantee its completeness or accuracy.

This document is subject to periodic revision and updating. QEED reserves the right to make changes to the product and/or its technical documentation at any time in the interests of continuous quality improvement. Always consult the latest version of the documentation available on the website:

www.qeed.it

If you find any errors or missing information in this document, please notify us by e-mail to:

technical@qeed.it

Disposal of waste electrical and electronic equipment (applicable in the European Union and other countries with separate collection). The symbol on the product or its packaging indicates that the product should not be treated as household waste. Instead, it will be handed over to an authorised collection point for the recycling of electrical and electronic waste. Ensuring that the product is disposed of properly will prevent potential negative effects on the environment and human health, which could otherwise be caused by inappropriate waste management of the product. Recycling materials helps to conserve natural resources. For further information, please contact your local authority, waste disposal service or the retailer from whom you purchased the product.

PRODUCT OVERVIEW

The QA-12DI-4DO is an I/O slave module equipped with 12 opto-isolated digital inputs and 4 SPDT relay outputs 5A - 230V$_{AC}$. All inputs can be set as totalizers or simple contacts, for which a 12V auxiliary output is provided for dry contact detection and GND reclose for active contacts. The maximum number of counts is 2^{32} and an underflow/overflow flag is provided to report when the maximum number of counts has been reached.

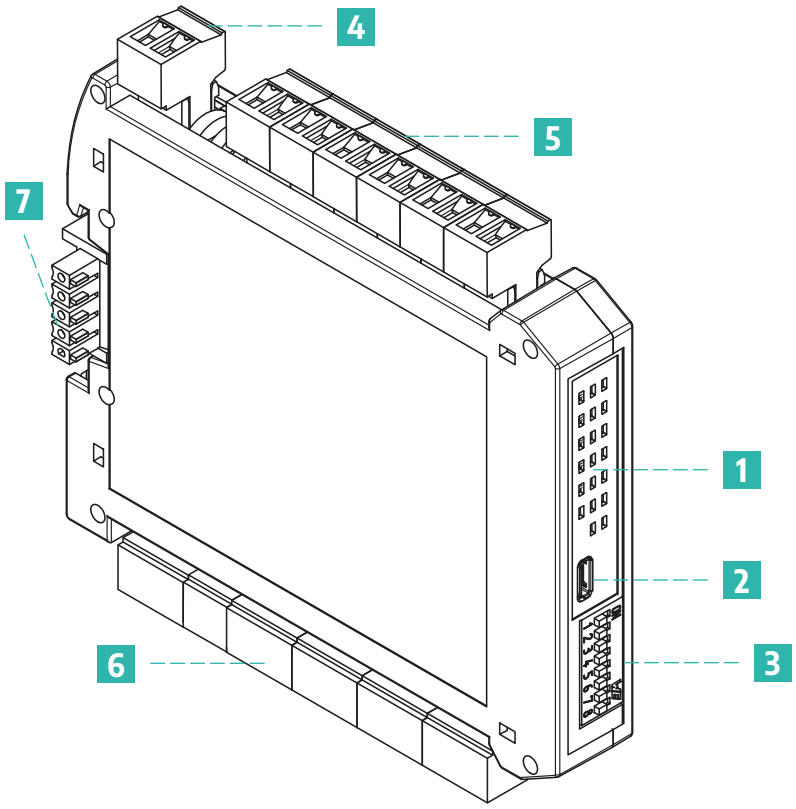
It can run from both AC or DC power.

It has full galvanic isolation between power supply, serial and USB interface and inputs and outputs.

Power/error/communication/output status LEDs are on the front of the case.

RS485 serial interface for communication with Modbus RTU protocol, either from the **Q-WIZARD configuration tool (download at link)**, or with third party Modbus masters by acting on register map registers.

Ready for DIN rail mounting with T-BUS terminal (optional) for fast connection with hot insertion/removal option.



1 Status LEDs
2 MicroUSB Port
3 Settings DIP switch
4 Power supply terminals
5 Output terminals
7 Input and RS485 Modbus RTU terminals
8 T-BUS terminal for both power supply and Modbus RTU communication (optional)

TECHNICAL SPECIFICATIONS

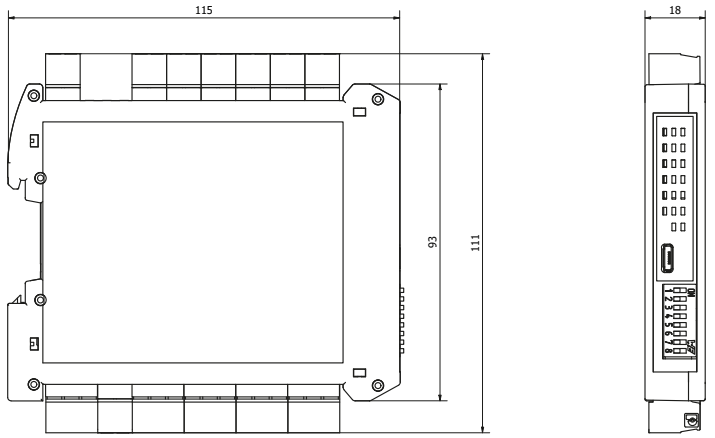
Electrical characteristics

Power supply	10÷40 V_{DC} or 20÷28 V_{AC} @50/60Hz
Current consumption	250mA max
Isolation	RS485 serial interface, USB interface and power supply are galvanically isolated from each other at 1.5 kV Output relays isolated at 4 kV
Input	#12 digital inputs, PNP type with negative common, 32-bit counter and 10 kHz maximum sampling rate Input voltage range for active inputs: 12-24 V_{DC} 12 V terminal presence for dry contact detection
Output	#4 digital relays SPDT 5A / 250V_{AC} relays
Communication interface	RS485 Modbus RTU microUSB port
Visual interface	Status LEDs

Communication characteristics

Protocollo	Modbus RTU
Baudrate	1200÷115200 bps (default 9600)
Addresses	1÷247 (default 1)
Data format	1 start bit, 8-bit data, NO/ODD/EVEN parity (default NO parity)
Response delay	1÷1000ms
Connection	Via removable terminal, T-BUS or microUSB

General data

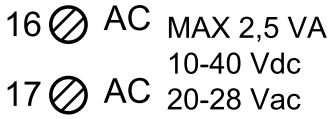
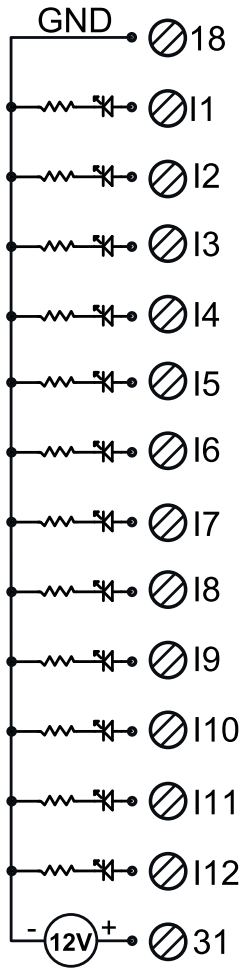
Working temperature	-15÷60° C
Storage temperature	-40÷85° C
Relative humidity	10÷90% not condensing
Elevation	Up to 2000m a.s.l.
Protection degree	IP20
Measurements	115x111x18 mm 
Weight	140 g
Terminal cable cross-section	0.05÷1.5 mm² (30÷14 AWG)
Approvals and certifications	EN 61000-6-3 + A1 2011; EN64000-6-2/2005; EN61010-1/2010
Installation	DIN rail mounting

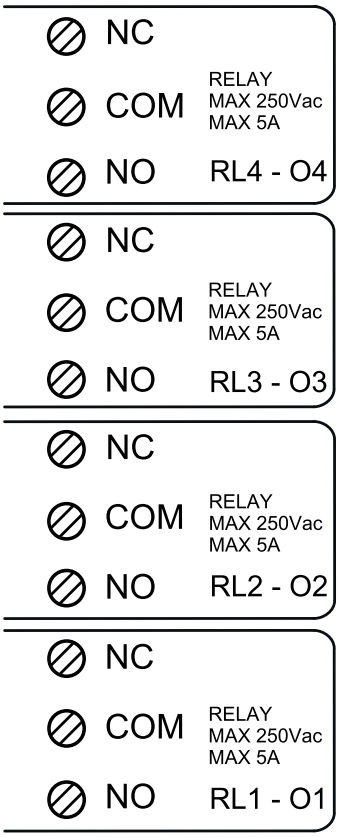
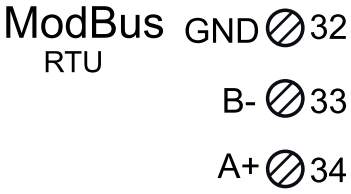
Order codes

Product	QA-12DI-4DO
Product without logo	QA-12DI-4DO-T-NL
T-BUS	QA-TBUS-22

CONNECTION AND INSTALLATION

For the connection of several instruments with reduced wiring, the unit is designed for DIN rail mounting, with or without T-BUS connector.
The functionality of the terminals is described below:

	Device power supply. **Please note:** Wiring must be protected against short circuits and/or accidental faults
	DIGITAL INPUTS: Allowed pulsed inputs up to 10kHz from (electro)mechanical contacts, 12÷24V, PNP

	DIGITAL OUTPUTS: No. 4 SPDT 5A / 250VAC changeover relays RL1 - O1: digital output #1 RL2 - O2: digital output #2 RL3 - O3: digital output #3 RL4 - O4: digital output #4
	RS485 Modbus RTU connection: terminals 32 (GND), 33 (B-), 34 (A+)
	T-BUS connection (requires optional T-BUS accessory): the T-BUS accessory can be fitted to the module base to provide both power supply and serial communication (see figure below). The number of modules supported by the bus depends on the power supply used (please check the power consumption of the modules)

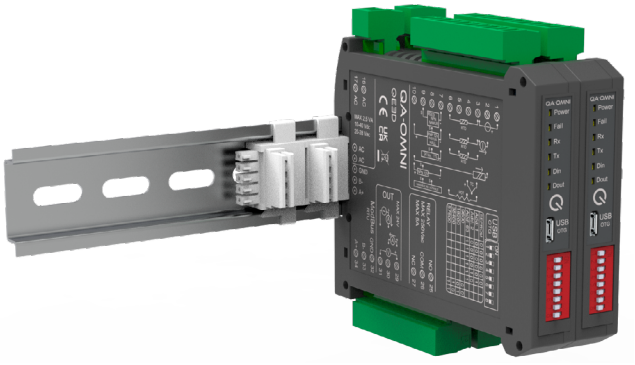


Figure 1: DIN-rail installation with T-BUS

RS485 bus termination

To avoid unbalances on the transmission bus, it is advisable to insert a termination resistor at the beginning of the RS-485 bus (typically on the USB-RS485 adapter) and at the end (typically on the last slave - which can also be activated by dip-switch). It is advisable to use 120Ω resistors with 1% tolerance, which corresponds to the typical impedance of RS485 cables.

The following images are for illustrative purposes only:

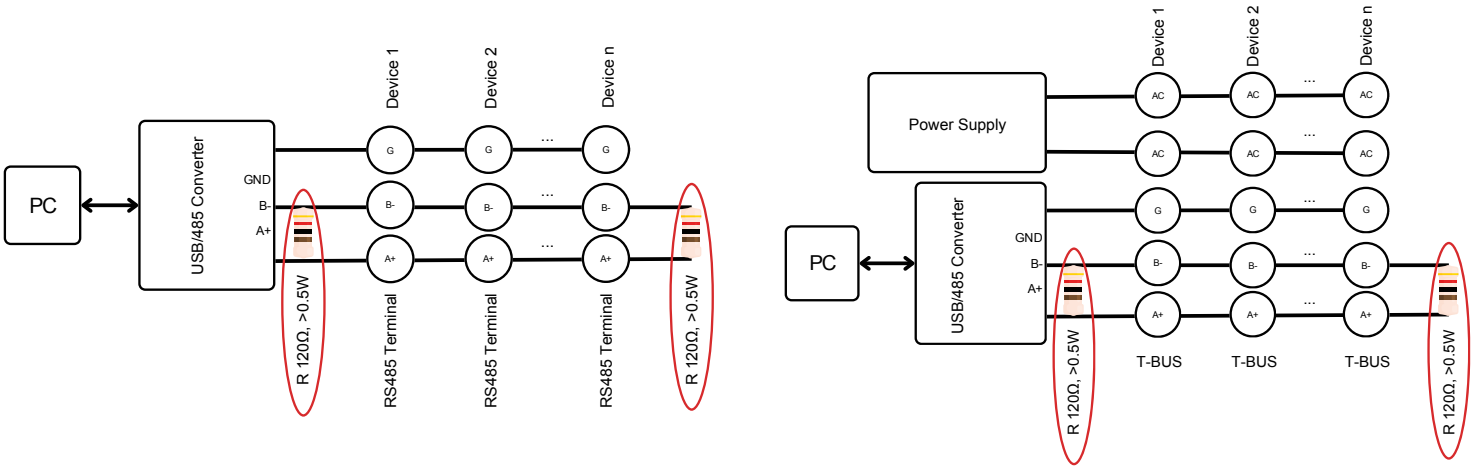


Figure 2: RS485 dynamic bus termination

STATUS LEDS

Function	Status	Meaning
Power (green)	ON	Powered device
Fail (yellow)	ON	Presence of one or more module anomalies/errors (configurable via **Q-WIZARD** or via dedicated registers - see page 13)
RX (red)	Flashing	The system is receiving data on the RS485
TX (red)	Flashing	The system is transmitting data from RS485
O1...O4 (green)	ON	Active digital output
I1...I12 (green)	ON	Active digital input

PRODUCT FEATURES

The following functions can be configured using the configuration software or the dedicated registers:

Modbus

Address, baud rate, parities and stop bits are adjustable.

Digital inputs

Ability to enable counting on rising or falling edge [Reg. 40079], whether to count by incrementing or decrementing [Reg. 40092] and set 6 filtering levels [Reg. 40080 - 40091] to vary the sampling rate to mitigate contact bounce.

Digital outputs

Digital output status can also be set by operator [Reg. 40011]

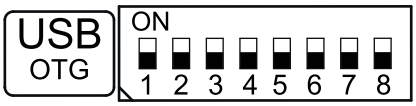
Status memory for outputs and totalizers

Possibility of enabling the saving of the states of the outputs and totalizers in the memory, so that they are retained when the instrument is rebooted [Reg. 40093]

DEVICE CONFIGURATION

Dip-switch Modbus RTU address and baud rate setting

The DIP switches on the front of the module can be used to change the Modbus RTU address and baud rate. If all DIP switches are set to zero, the module takes the configuration from the EEPROM, otherwise it takes the configuration set by the DIP switches.



EEPROM	0	0	0	0	0	0		
Add: 1	0	0	0	0	0	1		
Add: 2	0	0	0	0	1	0		
Add: 63	1	1	1	1	1	1		
9600							0	0
19200							0	1
38400							1	0
57600							1	1

Addresses greater than 63 and baud rates other than those selected by the DIP switches can be configured using the **Q-WIZARD configuration tool** or the Modbus RTU functions below by acting on the dedicated registers.

Raising DIP switch 1, visible through the hole in the product casing (see figure below), activates the dynamic termination (120Ω) of the Modbus RTU (to be performed only on the last module in the chain - see Figure 2 under RS485 bus termination).

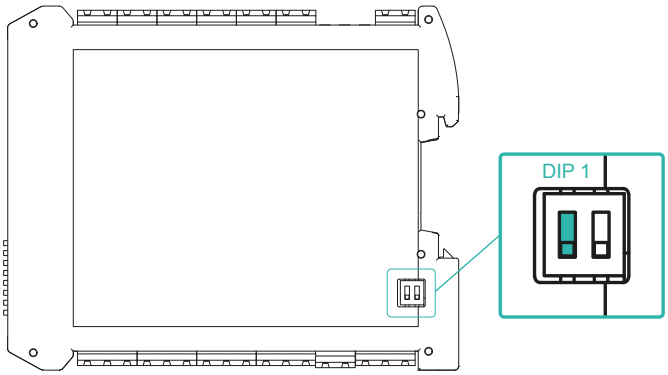


Figure 3: Dip-switch

PLEASE NOTE: To activate any DIP switch changes, it is necessary to switch the unit off and on again.

Functionality configuration

It is possible to connect to the product via an RS485 serial device, such as our Q-USB485, or via the microUSB port.

If the microUSB is used for configuration only, the main power supply from the terminals is not necessary, but it must be present to have all the functions active (real-time monitoring); if configuration is made from the terminals, the power supply must always be present.

The configuration of the module can be done with our **Q-WIZARD configuration tool** or with any third-party Modbus master, by acting on the registers of the card - see page 13.

Q-WIZARD

Using the **Q-WIZARD configuration tool (downloadable from here)**, all device parameters can be configured by following the simple, intuitive steps.

In addition to the configuration of various parameters, inputs and outputs, the **Q-WIZARD** also allows real-time monitoring of device variables.

Third-party Modbus Master

Alternatively, the product can communicate directly with a third-party Modbus RTU Master using the communication settings according to the DIP switch configuration (when using microUSB the DIP switch settings are irrelevant).

The communication protocol supported is Modbus RTU Slave:

- Modbus RTU connections: A+ and B- according to Modbus RTU standards
- Supported Modbus RTU functions: 03 hexadecimal (read multiple registers, max 100), 06 hexadecimal (write single), 10 hexadecimal (write multiple registers)
- Modbus RTU address numbering is by convention '1 BASED' (standard), but the physical register is base 0; the logical address, e.g. 40010, corresponds to the physical address #9, as required by Modbus RTU standards

PLEASE NOTE: All setting changes of calibration and configuration parameters must be followed by the flash save command 0xC1C0 = Flash settings save command in register 40121; changes of device communication parameters in addition must also be followed by the command 0xC1A0 = Reboot command in register 40121.

In this case, all device configurations are performed by accessing the Modbus RTU register map available in the last chapter of this document using the functions:

- Read holding registers (function 03 hexadecimal)
- Write single holding register (function 06 hexadecimal)
- Write multiple registers (function 10 hexadecimal)

Function 03 Hexadecimal (Read Holding Registers)

This function is used to read the contents of a contiguous block of holding registers (words). The request frame specifies the source register address and the number of registers to read. A maximum of 120 registers (words) can be read with a single request, unless otherwise specified. The register data in the response message is packaged as two bytes per register (word), with the binary contents right-justified within each byte. For each register, the first byte contains the most significant bits (MSB) and the second byte contains the least significant bits (LSB).

Request Frame			
Description	**Lenght**	**Value**	**Comments**
Physical address	1 byte	1 to F7 HEX (1 to 247)	
Function code	1 byte	03 HEX	
Starting address	2 bytes	0000 to FFFF HEX	Bytes order: MSB, LSB
Number of registers (N word)	2 bytes	1 to 10 HEX (1 to 16)	Bytes order: MSB, LSB
CRC	2 bytes		

Response frame (right action)			
Description	**Lenght**	**Value**	**Comments**
Physical address	1 byte	1 to F7 HEX (1 to 247)	
Function code	1 byte	03 HEX	
Required Number of bytes	1 byte	N word * 2	
Register value	N*2 bytes		Bytes order: MSB, LSB
CRC	2 bytes		

Response frame (wrong action)			
Description	**Lenght**	**Value**	**Comments**
Physical address	1 byte	1 to F7 HEX (1 to 247)	Possible exception: 01: illegal function 02: illegal data address 03: Illegal data value 04: Slave device failure
Function code	1 byte	83 HEX	
Exception code	1 byte	01, 02, 03, 04 (see note)	
CRC	2 bytes		

Function 06 Hexadecimal (Write Single Holding Register)

This function is used to write a single holding register. The request frame specifies the address of the register (word) to be written and its contents.
The correct response is an echo of the request, returned after the contents of the register have been written.

Request frame			
Description	**Lenght**	**Value**	**Comments**
Physical address	1 byte	1 to F7 HEX (1 to 247)	
Function code	1 byte	06 HEX	
Starting address	2 bytes	0000h to FFFF HEX	Bytes order: MSB, LSB
Register value	2 bytes	0000h to FFFF HEX	Bytes order: MSB, LSB
CRC	2 bytes		

Response frame (right action)			
Description	**Lenght**	**Value**	**Comments**
Physical address	1 byte	1 to F7 HEX (1 to 247)	
Function code	1 byte	06 HEX	
Starting address	2 bytes	0000h to FFFF HEX	Bytes order: MSB, LSB
Register value	2 bytes	0000h to FFFF HEX	Bytes order: MSB, LSB
CRC	2 bytes		

Response frame (wrong action)			
Description	Lenght	Value	Comments
Physical address	1 byte	1 to F7 HEX (1 to 247)	Possible exception: 01: illegal function 02: illegal data address 03: Illegal data value 04: Slave device failure
Function code	1 byte	86 HEX	
Exception code	1 byte	01, 02, 03, 04 (see note)	
CRC	2 bytes		

Function 10 Hexadecimal (Write Multiple Registers)

This function is used to write a block of contiguous registers (maximum of 2). The required values to be written are specified in the data field of the request. The data is packed as two bytes per register.

A correct response returns the function code, the starting address and the number of registers written.

Request frame			
Description	**Lenght**	**Value**	**Comments**
Physical address	1 byte	1 to F7 HEX (1 to 247)	
Function code	1 byte	10 HEX	
Starting address	2 bytes	0000 to FFFF HEX	Bytes order: MSB, LSB
Number of registers (N word)	2 bytes	0001 to 0078 HEX	Bytes order: MSB, LSB
Byte counting	1 byte	N word * 2	
Register value	N * 2 bytes	value	Bytes order: MSB, LSB
CRC	2 bytes		

Response frame (right action)			
Description	**Lenght**	**Value**	**Comments**
Physical address	1 byte	1 to F7 HEX (1 to 247)	
Function code	1 byte	10 HEX	
Starting address	2 bytes	0000 to FFFF HEX	Bytes order: MSB, LSB
Number of registers (N word)	2 bytes	0001 to 0078 HEX	Bytes order: MSB, LSB
CRC	2 bytes		

Response frame (wrong action)			
Description	**Lenght**	**Value**	**Comments**
Physical address	1 byte	1 to F7 HEX (1 to 247)	Possible exception: 01: illegal function 02: illegal data address 03: Illegal data value 04: Slave device failure
Function code	1 byte	90 HEX	
Exception code	1 byte	01, 02, 03, 04 (see note)	
CRC	2 bytes		

FIRMWARE UPDATE

Using a standard pendrive to hold the file and a micro-USB OTG cable, the product is ready for firmware updates via the USB port.

To update the firmware, simply remove power from the module, insert the pendrive on the card with the file on it and restore the power supply. At this point the card will automatically download the file and update the firmware without changing the settings during programming.

The FAIL LED will flash during the update phase.

REGISTER MAP

Register Name	Description	Register Type	R/W	Default	Address Modbus
Machine ID	Machine ID	UShort [16b]	R	9	40001
FW version	Firmware version	UShort [16b]	R		40002
Status	bit 0 → fail EEPROM calibration bit 1 → fail EEPROM configuration bit 2 → fail HW bit 3 → fail log bit 4 → fail RTC bit 5 → fail EEPROM bit 6 → fail FRAM init bit 7 → fail FRAM	UShort [16b]	R	0	40003
Digital input real-time status	bit[0] = Din1; ... Bit[11]= Din12	UShort [16b]	R		40004
Digital output real-time status	Dout real output: bit[0]=Dout1 bit[1]=Dout2 bit[2]=Dout3 bit[3]=Dout4	UShort [16b]	R		40005
DIP	bit[0-7] = dip switch status	UShort [16b]	R		40006
Digital output commander	Manual conf. Dout: bit[0]=Dout1 bit[1]=Dout2 bit[2]=Dout3 bit[3]=Dout4	UShort [16b]	R/W		40011
Overflow	bit[0]= 0 →Totalizer 1 not in overflow/underflow 1 →Totalizer 1 in overflow/underflow bit[1]= 0 →Totalizer 2 not in overflow/underflow 1 →Totalizer 2 in overflow/underflow ... bit[11]= 0 →Totalizer 12 not in overflow/underflow 1 →Totalizer 12 in overflow/underflow	UShort [16b]	R/W		40012
Totalizer Din 1	Totalizer 1	ULong [32b-LSW]	R/W	0	40015
Totalizer Din 2	Totalizer 2	ULong [32b-LSW]	R/W	0	40017
Totalizer Din 3	Totalizer 3	ULong [32b-LSW]	R/W	0	40019
Totalizer Din 4	Totalizer 4	ULong [32b-LSW]	R/W	0	40021
Totalizer Din 5	Totalizer 5	ULong [32b-LSW]	R/W	0	40023
Totalizer Din 6	Totalizer 6	ULong [32b-LSW]	R/W	0	40025
Totalizer Din 7	Totalizer 7	ULong [32b-LSW]	R/W	0	40027
Totalizer Din 8	Totalizer 8	ULong [32b-LSW]	R/W	0	40029
Totalizer Din 9	Totalizer 9	ULong [32b-LSW]	R/W	0	40031
Totalizer Din 10	Totalizer 10	ULong [32b-LSW]	R/W	0	40033
Totalizer Din 11	Totalizer 11	ULong [32b-LSW]	R/W	0	40035
Totalizer Din 12	Totalizer 12	ULong [32b-LSW]	R/W	0	40037
Totalizer mode	bit[0]= **0 → Din1 rising** 1 → Din1 falling bit[1]= **0 → Din2 rising** 1 → Din2 falling ... bit[11]= **0 → Din12 rising** 1 → Din12 falling	UShort [16b]	R/W	0	40079
Filter Din 1	Number of samples of the filter (every 41us)	UShort [16b]	R/W	1	40080
Filter Din 2	Number of samples of the filter (every 41us)	UShort [16b]	R/W	1	40081
Filter Din 3	Number of samples of the filter (every 41us)	UShort [16b]	R/W	1	40082
Filter Din 4	Number of samples of the filter (every 41us)	UShort [16b]	R/W	1	40083
Filter Din 5	Number of samples of the filter (every 41us)	UShort [16b]	R/W	1	40084

Register Name	Description	Register Type	R/W	Default	Address Modbus
Filter Din 6	Number of samples of the filter (every 41us)	UShort [16b]	R/W	1	40085
Filter Din 7	Number of samples of the filter (every 41us)	UShort [16b]	R/W	1	40086
Filter Din 8	Number of samples of the filter (every 41us)	UShort [16b]	R/W	1	40087
Filter Din 9	Number of samples of the filter (every 41us)	UShort [16b]	R/W	1	40088
Filter Din 10	Number of samples of the filter (every 41us)	UShort [16b]	R/W	1	40089
Filter Din 11	Number of samples of the filter (every 41us)	UShort [16b]	R/W	1	40090
Filter Din 12	Number of samples of the filter (every 41us)	UShort [16b]	R/W	1	40091
Up-down mode	bit[0]= **0 →Totalizer 1 incremental** 1 →Totalizer 1 decremental bit[1]= **0 →Totalizer 2 incremental** 1 →Totalizer 2 decremental ... bit[11]= **0 →Totalizer 12 incremental** 1 →Totalizer 12 decremental	UShort [16b]	R/W	0	40092
Digital output initial state	bit[14] = FRAM for totalizer disabled/**enabled** bit[15] = FRAM for Dout disabled/**enabled**	UShort [16b]	R/W	0xC000	40093
Address, parity, stopbits	MSB: modbus address LSB: bit[0-1] = parity **0 → none** 1 → Odd 2 → Even LSB: bit[2] = stop bits **0 → 1** 1 → 2	UShort [16b]	R/W	256	40094
Baudrate	0 → 1200 1 → 2400 2 → 4800 **3 → 9600** 4 → 19200 5 → 38400 6 → 57600 7 → 115200	UShort [16b]	R/W	3	40095
Command	0xC1C0: Flash setting save command 0xD166: Dip read command 0xC1A0: Reboot command	UShort [16b]	R/W		40121
Serial Number (min, sec)	Partial serial number (format: mm-ss)	UShort [16b]	R/W		40124
Serial Number (day, hour)	Partial serial number (format: dd-hh)	UShort [16b]	R/W		40125
Serial Number (year, Month)	Partial serial number (format: yy-MM)	UShort [16b]	R/W		40126
HW version	HW version	UShort [16b]	R/W		40127

LEGEND:

Short [16b] = Signed Short (16 bit)
UShort [16b] = Unsigned Short (16 bit)

Long [32b-MSW] = Signed Long (32 bit - MSW First Register)
Long [32b-LWS] = Signed Long (32 bit - LSW First Register)
ULong [32b-LSW] = Unsigned Long (32 bit - LSW First Register)
ULong [32b] = Unsigned Long (32 bit)

Float [32b-MSW] = Float (32 bit - MSW First Register)
Float [32b-LSW] = Float (32 bit - LSW First Register)

UInt [16b] = Unsigned Integer (16 bit)
UInt [32b-MSW] = Unsigned Integer (32 bit - MSW First Register)
Int [64b-LSW] = Signed Long Long (64 bit - LSW First Register)