

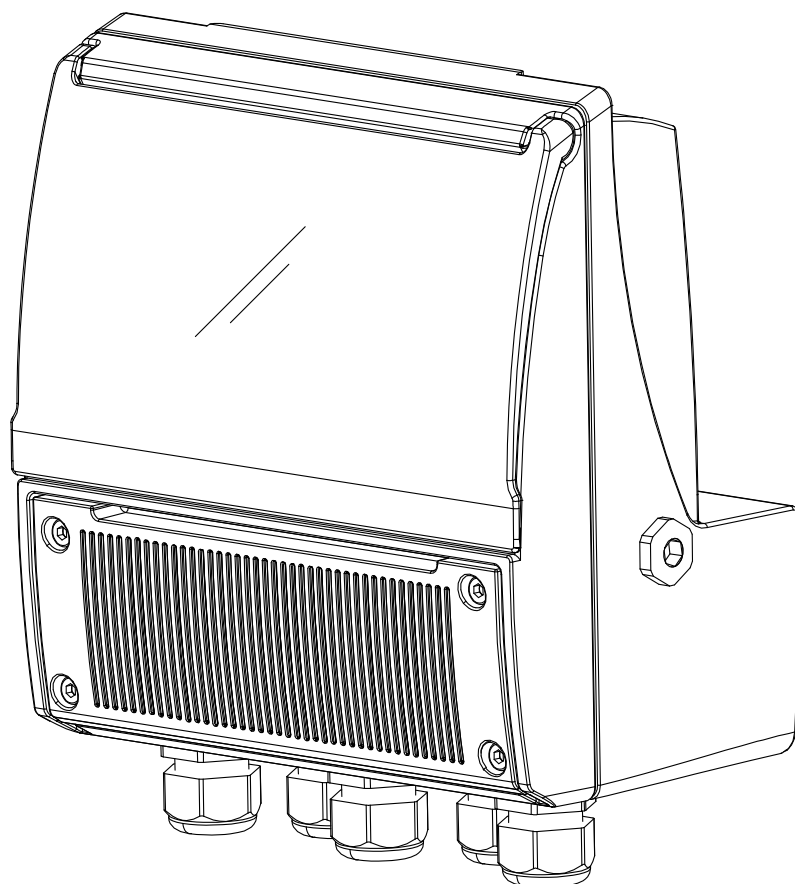


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MANUALE

MODBUS PROTOCOL MV145



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MV145 MODBUS PROTOCOL

RS485 HARDWARE CONNECTION

For the hardware connection see the relative section in this manual and MODBUS manual.

Data word format

The data bytes travelling in serial form on the communication line are enclosed in words which have a fixed length of 10 bits:

1 START BIT

8 DATA BITS = 1 DATA BYTE

1 STOP BIT

Each word contains one byte of data plus additional bits which serve to synchronise and make the communication safer. These extra bits are added automatically in the transmission phase by the transmitter integrated circuit. In the reception phase, the reverse operation is executed by the receiver integrated circuit:

the eight data bits are extracted and the others eliminated. These operations are executed entirely on a hardware level. The 8 data bits must be serialised starting from bit 0 (the least significant one).

Communication speed

The millennium series instruments have 4 communication speeds:

4800 bps

9600 bps

19200 bps

38400 bps

Serial port settings

Serial port setting:

Data bits: 8

Parity: Manu < 7-Communication >, function - < Parity >

Stop bits: 1

Flow control: none (no control lines no xon/xoff characters used)

General description

All data are sent in group of 16 bits registers, except for function 110. The format used is BIG ENDIAN, MSB byte is sent first, LSB is sent last. When a variable is more than 16 bits in size, it uses two adjacent registers. For the correct representation of the totalizer values expressed as integer numbers in case there is also a fractional part, the decimal dot must be placed in the position specified by the next variable register following the totalized value.

All values relative to the flow rate are averaged. The number of samples that compose the average value varies depending on the measure sample rate and the MODBUS reading requests.

Example: measure sample rate = 50 Hz, MODBUS reading frequency = 10 Hz, Number of samples used for average calculation = $50/10 = 5$.

FUNCTION 04: READ PROCESS VARIABLE

ADDRESS	SIZE	TYPE OF DATA	MEANING
0000-0001	2 registers, 32 bits	FLOAT	full scale flow rate in the unit of measure chosen (as can be seen in the display of the instrument)
0002-0003	2 registers, 32 bits	FLOAT	flow rate value in percentage
0004-0005	2 registers, 32 bits	FLOAT	flow rate value in the unit of measure chosen
0006-0007	2 registers, 32 bits	FLOAT	flow speed in the unit of measure chosen (m/s or ft/s)
0008-0009	2 registers, 32 bits	UNSIGNED LONG	totalizer T+ value
10	1 register, 8+8 bits	TWO BYTES	first byte (MSB): number of overflows recorded, second byte (LSB): number of decimal places
0011-0012	2 registers, 32 bits	UNSIGNED LONG	totalizer P+ value
13	1 register, 8+8 bits	TWO BYTES	first byte (MSB): number of overflows recorded, second byte (LSB): number of decimal places
0014-0015	2 registers, 32 bits	UNSIGNED LONG	totalizer T- value
16	1 register, 8+8 bits	TWO BYTES	first byte (MSB): number of overflows recorded, second byte (LSB): number of decimal places
0017-0018	2 registers, 32 bits	UNSIGNED LONG	totalizer P- value
19	1 register, 8+8 bits	TWO BYTES	first byte (MSB): number of overflows recorded, second byte (LSB): number of decimal places
20	1 register, 8+8 bits	TWO BYTES	first byte (MSB): status / alarm flags 1, (LSB): status / alarm flags 2
21	1 register, 16 bits	UNSIGNED SHORT	number of measure samples used for to calculate the latest read average value of flow rate
22	1 register, 16 bits	UNSIGNED SHORT	equivalent resistance measured between electrode E1 and the common point, in kilo ohm
23	1 register, 16 bits	UNSIGNED SHORT	equivalent resistance measured between electrode E2 and the common point, in kilo ohm
24	1 register, 16 bits	SIGNED SHORT	voltage measured between electrode E1 and the common point, in millVolts
25	1 register, 16 bits	SIGNED SHORT	voltage measured between electrode E2 and the common point, in millVolts
26	1 register, 16 bits	UNSIGNED SHORT	voltage measured at rechargeable terminals, in milliVolts
27	1 register, 16 bits	UNSIGNED SHORT	EXTIMATED battery capacity in percentage (derived from measured voltage, inaccurate for primary lithium) (!)
28	1 register, 16 bits	SIGNED SHORT	CPU temperature in the unit of measure chosen
29	1 register, 16 bits	SIGNED SHORT	Board temperature BT1 in the unit of measure chosen
30	1 register, 16 bits	SIGNED SHORT	Board temperature BT2 in the unit of measure chosen
31	1 register, 16 bits	SIGNED SHORT	Flow sensor coil's temperature in the unit of measure chosen
0032-0033	2 registers, 32 bits	UNSIGNED LONG	latest sensor test result code
34	1 register, 16 bits	UNSIGNED SHORT	number of alarms currently active
0035-0036	2 registers, 32 bits	FLOAT	flow rate value in liter per second (l/s) (fixed, not dependent on unit chosen on device)
0037-0038	2 registers, 32 bits	FLOAT	value of AIN 1 in unit chosen
0039-0040	2 registers, 32 bits	FLOAT	value of AIN 2 in unit chosen
41	1 register, 8+8 bits	TWO BYTES	status / alarm flags for analog inputs
0042-0043	2 registers, 32 bits	UNSIGNED LONG	board's serial number
44	1 register, 16 bits	UNSIGNED SHORT	flow rate unit and decimals

45	1 register, 16 bits	UNSIGNED SHORT	Totalizer T+ unit and decimals
46	1 register, 16 bits	UNSIGNED SHORT	Totalizer P+ unit and decimals
47	1 register, 16 bits	UNSIGNED SHORT	Totalizer T- unit and decimals
48	1 register, 16 bits	UNSIGNED SHORT	Totalizer P- unit and decimals
49	2 registers, 32 bits	FLOAT	totalizer T+ value with overflows in selected units (*)
51	2 registers, 32 bits	FLOAT	totalizer P+ value with overflows in selected units (*)
53	2 registers, 32 bits	FLOAT	totalizer T- value with overflows in selected units (*)
55	2 registers, 32 bits	FLOAT	totalizer P- value with overflows in selected units (*)
57	2 registers, 32 bits	FLOAT	totalizer NET total value with overflows in selected units (*)
59	2 registers, 32 bits	FLOAT	totalizer NET partial value with overflows in selected units (*)
61	2 registers, 32 bits	FLOAT	Battery voltage in Volt

(!): Percentage value is obtained with this formula: $\text{percentage} = 100 * (\text{READ voltage} - \text{CUT-OFF voltage}) / (\text{MAX voltage} - \text{CUT-OFF voltage})$; Residual battery life is accurate ONLY for rechargeable battery. For alkaline type the indication may be effective but with some degrees of inaccuracy. For primary lithium batteries the indication is absolutely inaccurate because the voltage profile is flat for almost all the useful life.

(*): value comprises also the number of overflows: $\text{value} = \text{totalizer value} + \text{overflows} * 1.000.000.000$ Precision loss may occur because floating point variables mantissa have only 24 bits accuracy but 30 bits is required instead.

Meaning and value of the status / alarm flags 1 returned with the register 0020 (MSB):

- bit 7 (MSB): flow rate alarm MIN (flow rate below the minimum threshold set)
- bit 6: flow rate alarm MAX (flow rate over the maximum threshold set)
- bit 5: flow rate sign (1 = negative)
- bit 4: flow rate below the cut-off value
- bit 3: measure range active (0= range 1, 1= range 2)
- bit 2: flow rate measure reset value status (1= measure is forcibly reset to zero)
- bit 1: volume counters lock status (1= counters are locked)
- bit 0 (LSB): internal use, no meaning

Meaning and value of the status / alarm flags 2 returned with the register 0020 (LSB):

- bit 7 (MSB): flow rate overflow (value greater than full scale)
- bit 6: pulse channel #2 overflow (frequency greater than maximum possible for the given parameters)
- bit 5: pulse channel #1 overflow (frequency greater than maximum possible for the given parameters)
- bit 4: measure signal amplitude out of A/D converter range
- bit 3: measure signal amplitude out of amplifier capability
- bit 2: input signal error (out of input chain capability)
- bit 1: coils excitation error
- bit 0 (LSB): pipe empty

Meaning and value of the status / alarm flags 3 returned with the register 0041 (MSB):

- bit 7 (MSB): cumulative sensor error indication (input error + empty pipe + excitation error)
- bit 6: reserved
- bit 5: battery low / battery fault
- bit 4: mains power supply present
- bit 3: USB power supply present
- bit 2: flooding alarm
- bit 1: intrusion / tampering alarm
- bit 0 (LSB): reserved

Meaning and value of the status / alarm flags 4 returned with the register 0041 (LSB):

- bit 7 (LSB): analog measure 1 error
- bit 6: analog measure 1 overflow / out of range
- bit 5: analog measure 1 above MAX threshold
- bit 4: analog measure 1 below MIN threshold
- bit 3: analog measure 2 error
- bit 2: analog measure 2 overflow / out of range
- bit 1: analog measure 2 above MAX threshold
- bit 0 (LSB): analog measure 2 below MIN threshold

Meaning and value of the sensor test flags returned with the register 0032 (MSW):

- bits 15-03 (MSB): reserved
- bit 02 : empty pipe
- bit 01 : reference values not set
- bit 00 (LSB): excitation error

Meaning and value of the sensor test flags returned with the register 0033 (LSW):

- bit 15 (MSB): resistance at electrode E2 is outside the limits respect to the reference value
- bit 14 : resistance at electrode E1 is outside the limits respect to the reference value
- bit 13: coil time B is outside the limits respect to the reference value
- bit 12: coil time A is outside the limits respect to the reference value
- bit 11: coil temperature is outside the limits respect to the reference value
- bit 10: coil leakage current is outside the limit
- bit 09: coil driver output 2 voltage is out of tolerance during test phase 3
- bit 08: coil driver output 1 voltage is out of tolerance during test phase 3
- bit 07: coil driver output 2 voltage is out of tolerance during test phase 2
- bit 06: coil driver output 1 voltage is out of tolerance during test phase 2
- bit 05: coil driver output 2 voltage is out of tolerance during test phase 1
- bit 04: coil driver output 1 voltage is out of tolerance during test phase 1
- bit 03: coil driver power generator voltage is out of tolerance during test phase 2
- bit 02: coil driver power generator voltage is out of tolerance during test phase 1
- bit 01: coil driver power generator value is out of tolerance during test phase 2
- bit 00 (LSB): coil driver power generator value is out of tolerance during test phase 1

Meaning and value of the unit of measures registers 0044, 0045, 0046, 0047, 0048:

- bit 15 (MSB) 0 = unit is metric, 1 = unit is imperial
- bit 14 0 = volume unit, 1 = weight unit
- bits 13-08 index of unit of measure (unit kind depend on bits 14 and 15, see below)
- bits 07-05 reserved
- bits 04-02 decimal point position (number of digits after the decimal dot)
- bits 01-00 (LSB) time unit (for flow rate only): 0= day, 1=hour, 2=minute, 3=second

Index of metric volume units for flow rate, totalizers and batching

- 0: ml (milliliter = 0.001 liter)
- 1: cm³ (cubic centimeter = 0.001 liter)
- 2: l (liter)
- 3: dm³ (cubic decimeter = 1 liter)
- 4: dal (decaliter = 10 liters)
- 5: hl (hectoliter = 100 liters)
- 6: m³ (cubic meter = 1000 liters)
- 7: Ml (Megaliter = 1000000 liters)

Index of metric volume units for flow rate, totalizers

- 0: in³ (cubic inches)
- 1: Gal (US gallon)
- 2: IGL (UK gallon)
- 3: ft³ (cubic feet)
- 4: bbl (standard barrel)
- 5: BBL (oil barrel)
- 6: hf³ (hundred cubic feet = 100 cubic feet)
- 7: KGL (kilo-US gallon = 1000 US gallons)
- 8: IKG (kilo-UK gallon = 1000 UK gallons)
- 9: kf³ (kilo-cubic feet = 1000 cubic feet)
- 10: ttG (ten-thousand US gallon = 10000 US gallons)
- 11: Aft (acre feet)
- 12: MGL (Mega-US gallon = 1000000 US gallons)
- 13: IMG (Mega-UK gallon = 1000000 UK gallons)

Index of metric weight units for flow rate, totalizers

- 0: g (gram)
- 1: kg (kilogram = 1000 grams)
- 2: t (metric ton 0 1000000 grams)

Index of imperial weight units for flow rate, totalizers

- 0: oz (ounce = 1/16 lb)
- 0: lb (pound)
- 0: ton (short ton)

FUNCTION 05: ACTIVATE FUNCTIONS

ADDRESS	SIZE	TYPE OF DATA	FUNCTION VALUE	MEANING
0000	1 register, 16 bits	UNSIGNED SHORT	0xFF00 (HEX)	Reset the enabled totalizers (same totalizer enabled for reset from digital input).

FUNCTION 08: DIAGNOSTICS

SUB.- FUNCTION CODE	SIZE	TYPE OF DATA	Function / value
0	1 register, 16 bits	UNSIGNED SHORT	Return query data
1	1 register, 16 bits	SIGNED SHORT	Restart communication
4	1 register, 16 bits	SIGNED SHORT	Activate listen mode
10	1 register, 16 bits	SIGNED SHORT	Clear Diagnostic counters
11	1 register, 16 bits	UNSIGNED SHORT	number of total received packets
12	1 register, 16 bits	UNSIGNED SHORT	number of received packets with CRC error
13	1 register, 16 bits	UNSIGNED SHORT	number of received packets with exception error
14	1 register, 16 bits	UNSIGNED SHORT	number of addressed or broadcast received packets
15	1 register, 16 bits	UNSIGNED SHORT	number of broadcast received packets
16	1 register, 16 bits	UNSIGNED SHORT	number of received packets with NAK flag
17	1 register, 16 bits	UNSIGNED SHORT	number of received packets with BUSY flag
18	1 register, 16 bits	UNSIGNED SHORT	number of received packets with OVERRUN flag

COMMAND 110, MCP COMMAND ENCAPSULATION

This command permits to send MCP encapsulated commands into MODBUS packets.

Maximum allowed = 250 bytes of payload, data are NOT structured in 16-bit words as MODBUS standard, but 8-bits ascii characters strings instead.

See MCP manual for commands structure and syntax.

Reply to MCP commands sent must fit into 250 bytes packet size.

At the end of its lifetime, this product shall be disposed of in full compliance with the environmental regulations of the state in which it is located.

MANUAL REVIEWS

REVIEW	DATE	DESCRIPTION
MAN_MV145-210_MODBUS_EN_IT_IS_R00	22/06/2021	First edition
MAN_MV145-210_MODBUS_EN_IT_IS_R01	21/12/2021	Corrected some errors on table pag.3
MAN_MV145-210_MODBUS_EN_IT_IS_R02	05/04/2024	Updated MODBUS functions

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