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ELA -2 PROTOCOL

and its use for

SMART MQI FLOWMETER

Description of Application

ELA-2 PROTOCOL
and its use for

SMART MQI INDUCTIVE FLOWMETER

Description of Application

Contents:

INTRODUCTION

The general description of ELA-2 protocol (line format) can be found in the first chapter of this manual. The other chapters describe the memory elements and the quantities used by the SMART MQI flowmeter which are accessible via the protocol.

GENERAL DESCRIPTION OF ELA-2 PROTOCOL

Protocol purpose

The ELA-2 protocol (further only protocol) is designed for the communication between a host computer of technological parts/systems and slave facilities (sensors, controllers, other members, etc.) including the devices with long-term statistic records, "history" records, etc. The device is intended for a low transmission with typical 9600 baud.

Transmission network layout

The basic layout of transmission network is the RS485 interface standard with two wire arrangement (for a half-duplex transmission). The number of stations that are connected to the network is limited by the capability of excitation circuits used in the workstations (usually 32 workstations). If "twisted pair" wires and a transmission of 9600 baud are used, the communication up to 1 000 m may be achieved.

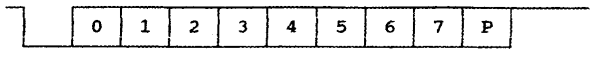
For a simple connection of a host and slave workstation the standard RS232C interface can be used; the range of communication is limited to about 10 m.

Logic network layout, control of operation

The network has one master workstation (usually PC) and few slave workstations (their number is limited by the layout of network). Transmission is carried out by a polling method (poll of host - response of slave). The order of polls and its repetition, if a transmission error was detected, is fully controlled by the host.

Transmission features

An asynchronous transmission is used (1 start-bit, 8 data bits, even parity and 1 stop-bit). The asynchronous transmission secures bit and character synchronization between devices.



Start bit Data bits Even parity Stop bit

General block structure

The general transmission block (poll and response) is as follows:

Device	Command	Space	Channel	Index	Relative address MSB	Relative address LSB	Length

Data (non-compulsory section)	Checksum SUM0 SUM1

Device: Slave workstation address (the workstation transmits/receives blocks), the range is from 0 to 255, it is recommended that the addresses above 128 are reserved.

Command: Command character that specifies the basic meaning of block, for example:
SEND (40h)..... the command of slave workstation to send the data (the block does not contain the data).

DATA (70H)..... the block with the data sent by a slave workstation.

Space: A selection of one memory space (volume) of slave workstation, for example:

ON-LINE (30h)..... on-line quantity
STATISTICS (40h) statistical data
PHYSICAL (70h) physical address

Channel: Channel number (for multi-channel devices)

Index: Memory sub-space index (or other identification), for example for a selection of month during statistical data reading

Relative address: Relative address of the first transmitted byte in the address sub-space specified by the items „space", „channel" and „index".

Length: Length of "data field", i.e. the number of bytes to be transferred, 0 corresponds to 256 !!

Data: The data transferred from/to a memory of a slave workstation (according to previous parameters), the layout of data structure and the formats and the ranges of number items depend on the memory volume (sub-volume)

Checksum: Two-byte checksum is computed from all characters from "device" to the last character before "checksum", while the initial values SUM0 and SUM1 are zero. The processing of each characters is as follows:

SUM0: = SUM0 xor CHAR.
SUM1: = RotateLeft (SUM1 xor CHAR.);

Block sychronization

Block synchronization is based on timing. The sending device (master or slave workstation) waits at least for a preset time before starting the block transmission, i.e. it generates the interval between individual blocks. The slave workstation recognizes only the block that precedes and follows the block interval of the required length (if other conditions are met , e.g. the checksum, etc.). The slave workstation does not respond to incorrect block.

To achieve the reliable functions of block synchronization, it is necessary that the lengths of block intervals can be set independently at individual workstations. The interval before the block that was sent by a master station must be longer than the interval required by a slave workstation. The ELA software for the data acquisition allows to set the interval before a response block up to 1 000 msec. in steps of 1 msec. The measuring devices of SMART series has its length of interval between blocks adjustable up to 70 msec. in steps of 0.1 msec. The devices require that the interval before the response block should be identical at least with the preset value, and the measuring devices will send the response block after the end of correct block response and after the successive interval that is equal to the preset value.

SMART MQI FLOWMETER

The SMART MQI flowmeter is one-channel and bi-directional inductive flowmeter with pulse excitation. The device is equipped with the statistical record facility for measured values (five-minute average flow rate - monthly, daily and hourly sums of total volume in forward and backward direction, measurement times and duration of failure condition - again in time sequence). A current flow rate, main internal counters of total volume and all statistical items are available via a serial link (interface) with the ELA-2 protocol. The detailed protocol of appropriate memory is described in next chapters.

ON-LINE MEMORY VOLUME

The ON-LINE memory volume (space) contains basic status bits of the device (measuring mode, failure, etc.), the value of current flow Q and the conditions of internal counters of total volume (S, S+, S-). The selective parameters and the memory map are as follows:

Space: ONLINE (30h)
Channel: 0
Index: 0

	7	6	5	4	3	2	1	0	
0:	FAIL	-	-	FAIL	1	RUN MENU	-	-	
	FAIL ..... failure RUN MENU..... main measuring mode „RUN“ If the device is not set in the measuring mode, the status byte is zero !!!								
	(For future use, 15 bytes)								
16:	Q: current flow rate in additional code: 8000h ..... -200 % from the range to be set 0000h ..... 0 7FFFh .... +200 % from the range to be set								MSB LSB
	If the device is not in the measuring mode, the quality is equal to zero !!								

32:	S: Bi-directional total flow to be flown, (S+) - (S-) 6 bytes ..... 12 BCD digits *) 1 byte ..... sign (01h is „-“)	MSB LSB sign res.
40:	S+: total volume to be flown in forward direction: 6 bytes ..... 12 BCD digits *)	MSB LSB res. res.
48:	S-: total volume to be flown in backward direction: 6 bytes ..... 12 BCD digits *)	MSB LSB res. res.

res. ..... a byte reserved (for future application)

*) The quantity is used as a counter of the total volume to be flown, where one at the lowest order has the value in compliance with the following table:

Current flow rate range Q (l/sec.)		Value of digit „1“ for the lowest order at the counter S, S+, S-(m^3)
from	to	
0.015	0.1	0.00001
0.15	1	0.0001
1.5	10	0.001
15	100	0.01
150	1000	0.1
1500	10000	1

STATISTICAL DATA

The description of the statistical data is divided into thematic sections (sub-volume for the list of months and monthly, daily and hour sums, current flow rate records, etc.). The SMART MQI device has a capacity of statistical data records for 4 months (a just running month plus three previous months).

Sub-space (sub-volume) for the list of months

The memory sub-space contains the list of months (always years and months) for which the statistical data are recorded in the device. The year is given by two-digits, i.e. mod 100. The list is arranged according to the indexes (from 0 to 3). The selective parameters and the memory map are as follows:

0: 62:	(Operational buffers and standby)	
63:	Index for a current month (just in progress)	
64:	Year and month (binary bytes, year is given as two-digit number) corresponding to the statistical data in memory sub-space with the index 0	year month
66:	Identical as for index 1	year month
68:	Identical as for index 2	year month
70:	Identical as for index 3	

Note:

The master workstation will read the list of months (bytes with relative addresses 64 to 71). This will inform you if the statistical data is present in the device. During the reading of statistical data the individual months are selected via indexes.

Monthly and daily statistical sums

The items include total volume to be flown in forward and backward direction, measurement time and failure time (if the device is not in the measuring mode, a possible failure is not included in the statistics). The selective parameters and the memory map of individual items are as follows:

Space:	STATISTICS (40h)	
Channel:	0	
Index:	0 to 3	(Selection of month)
Relative address:	512	(For monthly sum)
	512 + day *48	(For days: 1..31)

S+: Total volume to be flown in forward direction: 4 bytes, binary *)	MSB LSB
S- : Total volume to be flow in backward direction : 4 bytes, binary *)	MSB LSB
T: Measurement time, 3 bytes, binary (x 0.01 hr)	MSB LSB
Tf: Failure time: 3 bytes, binary (x 0.01 hr)	MSB LSB
Reserve for future use: 32 kilobytes	

*) The range of quantity - see „Hourly statistical sums".

Hourly statistical sum

The items include total volume to be flown in forward and backward direction, measurement time and failure time (if the device is not in the measuring mode, a possible failure is not included in the statistics). The selective parameters and the memory map of one item are as follows:

Space: STATISTICS (40 h)
Channel: 0
Index: 0 to 3 (selection of month)

Relative address: 2048 + day* 288 + hour*12
(day: 1...31, hour: 0...23)

S+ : total volume to be flown in forward direction: 2 bytes, binary *)	MSB
	LSB
S- : total volume to be flown in backward direction: 2 bytes, binary *)	MSB
	LSB
T: measurement time: 1 byte, binary (x 0.01 hour)	
Tf : failure time: 1 byte, binary (x 0.01 hour)	

*) The range of statistical sums S + and S- is given in the following table:

Current flow rate range Q (l/sec.)		Weight of the lowest statistic registers S, S+, S-(m^3)
from	to	
0.015	0.1	0.0001
0.15	1	0.001
1.5	10	0.01
15	100	0.1
150	1000	1
1500	10000	10

Flow rate records (five-minute intervals)

The items include five-minute average current flow rates Q (12 values per one hour). The selective parameters and the memory map for one item are as follows:

Space: STATISTICS (40h)
Channel: 0
Index: 0 to 3 (selection of month)

Relative address: 11264 + day * 576 + hour*24 + (min div 5)*2
(days: 1...31, hours: 0...23, minutes: 0....59

Q : Five-minute average Q in additional code:	
8001h .....-200 % from the range to be set	MSB
0000h 0	
7FFFh .....+200 % from the range to be set	LSB
8000h ..... not defined !!!	

PHYSICAL ADDRESS READING

The other quantities of the SMART MQI device are available by a physical address reading:

Space: PHYSICAL (70h)
Channel: 0
Index: 0

Relative address: Absolute (physical) address

Main available quantities via physical addresses

The status of output relays (unit bit = CLOSED):
Address: 122h

7	6	5	4	3	2	1	0
Re 4	Re 3	Re 2	Re 1				

Device range

Address: 175h

7	6	5 4 3	2 1 0
		Order (l/sec.) 000.....0.01 001.....0.1 010.....1 011.....10 100.....100 101.....1000	Magnitude: 000.....1.5 001.....2 010.....3 011.....4 100.....5 101.....6 110.....8 111.....10

The instrument measures from -200% to + 200 % of the range to be set.