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|---|------------|------------|-----------------|
| EL.CO. SRL Via Lago di Molveno, 20 – 36015 SCHIO (VI) | | | |
| Document title : User manual communication protocol | | | |
| Codice documento : ELK22xS.ManualeProtocollo.ENG | | Mag. code: | |
| .00.ELK22xS.DOC | | | |
| replace code : | | Mag. code: | |
| replaced by: | | Mag. code: | |
| Commision code : | Section : | Modul: | Total page : 10 |
| Document type : | Sig.doc : | Vers : 02 | |
| written : | Verified : | Approved : | |
| Date : 21/07/2021 | Date : | Date : | |

Variazioni rispetto al documento precedente:

ELK22S / ELK22MS

Communication protocol

user's guide

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1 Preface

This document is intended to describe the ELK22 and ELK22MS controllers using the MODBUS protocol in their communication capability and is mainly directed to technicians, system integrators and software developers.

The subject is subdivided in four levels of interest:

- The first level describes the physical connection to the line;
- The second level presents the data link protocol, that is a subset of the MODBUS RTU protocol;
- The third level describes in detail each data that can be exchanged;
- The fourth level states performance characteristics of the system.

2 Physical connection

2.1 Interface

ELK22S and ELK22MS controllers are provided with a RS485 serial communication interface, insulated so that any problem arising from ground potential is removed.

While at rest, the instruments are in a receive condition and are revert to transmission after a correct message has been decoded that matches the configured address.

2.2 Line

The instruments are equipped with 2 terminals named A and B. The connection between ELKs has to be carried on in parallel, i.e. all A terminals have to be connected between them so as B terminals. A termination resistor of 120 ohm is required to maintain the quiescent condition on the line; Adopted baud rates range from 1200 to 38400 baud, that is very satisfactory for application performances, yet very slow for RS485 interface. This fact allows the wiring of the line with a medium quality twisted pair cable: total capacity of the line should not exceed 200 nF.

3 Communication protocol

The protocol adopted by ELK22S and ELK22MS controllers is a subset of the widely used MODBUS RTU protocol, so that connections are easy for many commercial PLCs and supervisory programs. The default is 9600,N,8,1 modbus address 1.

The polling rate to the device must be greater than or equal to 1 second.

For users needing to develop their own communication software, all information is available as well as implementation hints.

The MODBUS RTU communication functions implemented in ELK22S and ELK22MS are:

- function 1 - output status read
- function 3 - n word read
- function 6 - one word write
- function 7 - allarm status read

These functions allow the supervisory program to read and modify any data of the controller. The communication is based on messages sent by the master station (host) to the slave stations (ELK22S and ELK22MS) and viceversa. The slave station that recognises the message as sent to it, analyses the content and, if it is formally and semantically correct, generates a reply message directed back to the master.

The communication process involves four types of messages:

| from master to slave | from slave to master |
|--|---------------------------------------|
| function 1: output status read request | function 1: output status read replay |
| function 3: n word read request | function 3: n word read replay |
| function 6: one word write request | function 6: one word write replay |
| function 7: allarm status read request | function 7: allarm status read replay |

Every message contains four fields:

- Slave address: valid value from 1 to 255; address 0 is reserved from MODBUS RTU for all broadcasting messages, but due to inherent unreliability of its not implemented for ELK22S and ELK22MS;
- function code: contains 1 or 2 or 3 or 6 or 7 for specified functions;
- information field: contains data like word addresses and word values as requires by function use;
- control word: a cyclic redundancy check (CRC) performed with particular rules for CRC16.

The characteristics of asynchronous transmission are 8 bits, no parity, one stop bit.

3.1 Function 1 – read output status

The address first word must be less of the number of the output and the number of the word to read, must be less or equal of the number of output minus address first word.

The request has the following frame:

| | | | | | | | |
|--------------|--------|--|--------|---|--------|-------------------------------------|--------|
| slave number | 1 | First word address MSB LSB | | Number of words MSB LSB | | CRC LSB MSB | |
| byte 0 | byte 1 | byte 2 | byte 3 | byte 4 | byte 5 | byte 6 | byte 7 |

The reply has the following frame:

| | | | | | |
|--------------|--------|---------------------------------|--------------------------|--------|--------|
| slave number | 1 | NB Number of read byte | Status output byte | CRC | |
| | | | | LSB | MSB |
| byte 0 | byte 1 | byte 2 | byte 3 | byte 4 | byte 5 |

3.2 Function 3 – read n word

The number of words to be read must be less or equal twenty-eight.

The request has the following frame:

| | | | | | | | |
|--------------|--------|--|--------|---|--------|-------------------------------------|--------|
| slave number | 3 | First word address MSB LSB | | Number of words MSB LSB | | CRC LSB MSB | |
| byte 0 | byte 1 | byte 2 | byte 3 | byte 4 | byte 5 | byte 6 | byte 7 |

The reply has the following frame:

| | | | | | | | |
|--------------|--------|---------------------------------|---|--------|--------------------|-------------------------------------|--------------|
| slave number | 3 | NB Number of read byte | Value of first word MSB LSB | | Following words | CRC LSB MSB | |
| | | | LSB | MSB | | | |
| byte 0 | byte 1 | byte 2 | byte 3 | byte 4 | byte 5 | byte NB+2 | byte NB+3 |

3.3 Function 6 - one word write

The request has the following frame:

| | | | | | | | |
|--------------|--------|--|--------|--|--------|-------------------------------------|--------|
| slave number | 6 | First word address MSB LSB | | Value to write MSB LSB | | CRC LSB MSB | |
| byte 0 | byte 1 | byte 2 | byte 3 | byte 4 | byte 5 | byte 6 | byte 7 |

The normal reply is merely an echo of the request message:

| | | | | | | | |
|--------------|--------|--------------------|--------|----------------|--------|--------|--------|
| slave number | 6 | First word address | | Value to write | | CRC | |
| | | MSB | LSB | MSB | LSB | LSB | MSB |
| byte 0 | byte 1 | byte 2 | byte 3 | byte 4 | byte 5 | Byte 6 | byte 7 |

3.4 Function 7 – read allarm status

The request has the following frame:

| | | | |
|--------------|--------|--------|--------|
| slave number | 7 | CRC | |
| | | LSB | MSB |
| byte 0 | byte 1 | byte 6 | byte 7 |

The reply has the following frame:

| | | | | |
|--------------|--------|---------------|--------|--------|
| slave number | 7 | Stato allarme | CRC | |
| | | | LSB | MSB |
| byte 0 | byte 1 | byte 2 | Byte 3 | byte 4 |

3.5 Cyclic redundancy check (CRC)

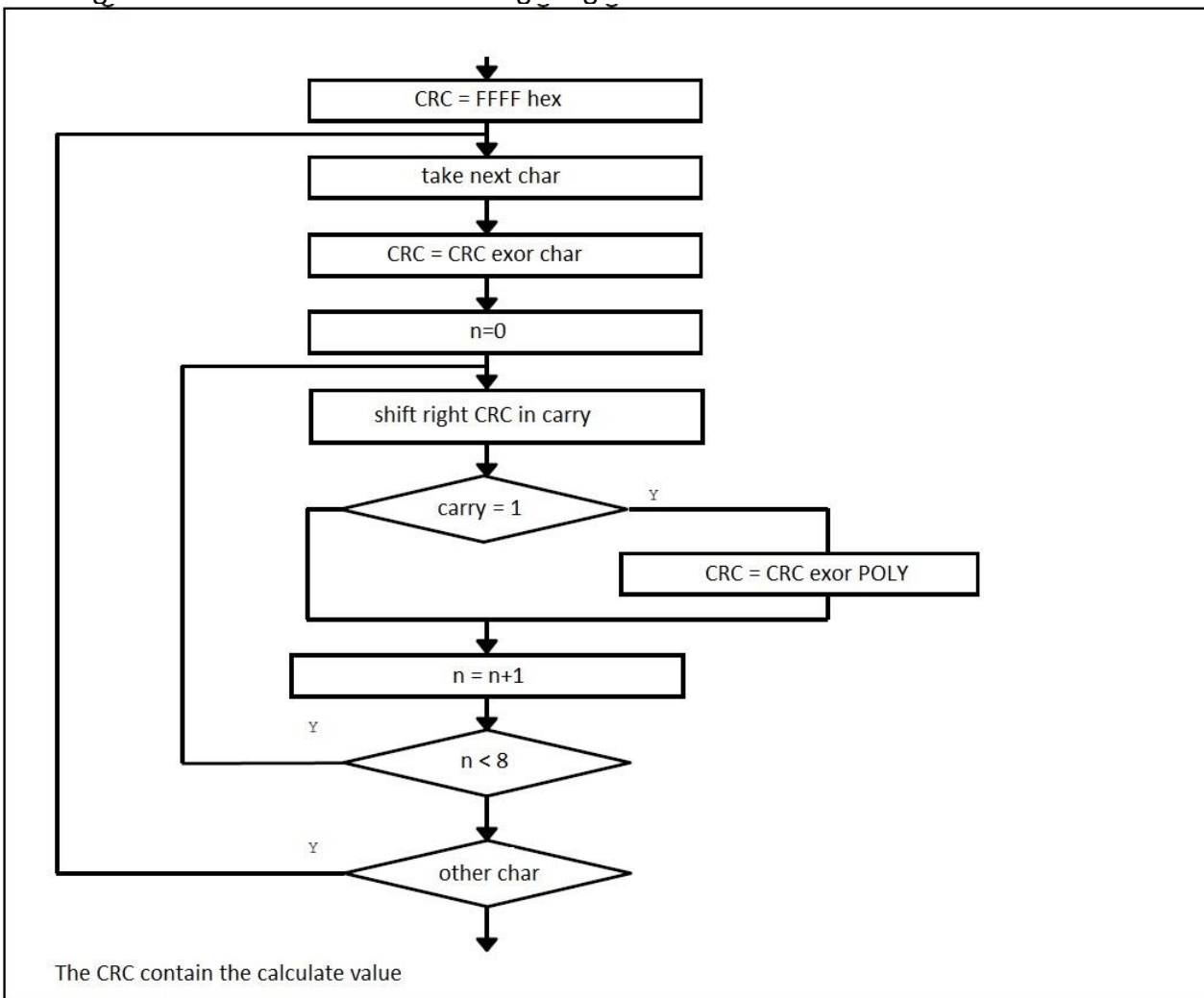
CRC is a check word that permits to verify the integrity of a message. Every message, sent or received, has in the two last characters the CRC check word.

After receiving a request, the controller checks the validity of the received message comparing the received CRC with the calculated one.

When a reply is ready the controller calculates the CRC word and adds two characters to the prepared message. CRC calculation is performed on every character of the message, excluding the last two.

Being MODBUS RTU (JBUS) protocol compatible, ELK22S and ELK22MS controllers adopt an identical algorithm for CRC calculation.

This algorithm is sketched in following diagram:



The polinimial adopted by MODBUS RTU (JBUS) is 1010 0000 0000 0001.

Note: the first transmitted character of the CRC word is the least significant between calculated bytes..

4 Data exchange

This section contains informations about data exchanged with ELK series controllers concerning numerical and not numerical data, with their formats and limits.

4.1 Some definitions

All All exchanged data are in the form of 16 bit words.

4.2 Memory

All readable and writable data appear to be allocated as 16 bit words in the memory of the instrument.

4.3 Program parameters

The operating and configuration parameters of the instrument can be read and written by serial communication.

| Parameter | address dec | Description | setting value | |
|-----------|----------------|-----------------------|--|---|
| SP1 | 0000 | Setpoint 1 | SSP ÷ FSP | |
| SENS | 0001 | Input type | ELK22S 1)TCJ 2)TCK 3)NTC 4)PTC 5)PT100 | ELK22MS 1)TCJ 2)TCK 3)TCS 4)NTC 6)PTC 6)PT100 7)0-10V 0) 8)4- 20mA |
| DP | 0002 | Number of decimal | 0, 1 | |
| SSC | 0003 | Minimus visualization | -999 ÷ 1000 | |
| FSC | 0004 | Maximum visualization | -999 ÷ 1000 | |
| UNIT | 0005 | Measure unit | C, F | |
| CA | 0006 | Measure offset | -100 ÷ 100 | |
| FIL.D | 0007 | Display refresh time | 50 ÷ 200 | |
| CONT | 0008 | Type of regulation | 0) PID 1) ON/OFF 2) Neutral zone | |
| AUTO | 0009 | Enabling autotuning | 0) Off 1) Start every powerup 2) Start next powerup 3) Manual start | |
| BP | 0010 | Proportional band | 1 ÷ 1000 | |
| TI | 0011 | Integral time | 0 ÷ 1000 | |

| Parameter | address dec | Description | setting value |
|-------------------|-------------|--------------------------------|--|
| TD | 0012 | Derivative time | 0 ÷ 1000 |
| TR1 | 0013 | Time period out | 50 ÷ 200 |
| HPOS | 0014 | Positiv hysteresis | 0 ÷ 100 |
| HNEG | 0015 | Negativ hysteresis | 0 ÷ 100 |
| SSP | 0016 | Minumum limit setpoint setting | SSC ÷ FSC |
| FSP | 0017 | Maximun setpoint setting | SSC ÷ FSC |
| O1F | 0018 | Function mode out 1 | 0) Not used 1) heating 2) cooling 3) always ON |
| O2F | 0019 | Function mode out 2 | 0) Not used 1) heating 2) cooling 3) allarm 4) always ON |
| AL1T | 0020 | Function mode allarm 1 | 0) not used 1) minimun 2) maximun |
| AL1 | 0021 | Allarm setpoint | SSP ÷ FSP |
| HAL1 | 0022 | Hysteresis allarm 1 remedy | 0 ÷ 100 |
| AL1D | 0023 | Delay allarm 1 remedy | 0 ÷ 1000 |
| ADR ₁ | 0024 | Module address | 1 ÷ 16 |
| ADRM ₂ | 0025 | Modbus address | 1 ÷ 250 |
| VELM ₂ | 0026 | Modbus baud | 0) 1200 baud 1) 2400 baud 2) 9600 baud 3) 19200 baud 4) 38400 baud |
| PASS ₂ | 0027 | Password menù | xxxx |
| REV. ₂ | 0028 | Firmware revision | xxx |
| Read input | 0512 | Measure read on input | |

- 1) Not present in ELK22S
- 2) On ELK22S address dec respectly 0024 0025 0026 0027
- 3) Writing value 9999 the device make reset default

Is possible hidden or show every parameter in the user menu: setting 1 the MSB of the WORD we hidden the parameter from the user menù and we can modify it only under password menu.

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