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Series EV10

Electronic proportional flow control controller

MODBUS protocol

REVISIONS

Rev.	Date	Description
0	16/03/2022	Issue
1	22/07/2022	RS485 communication information added
2	17/02/2023	Checksum command information added
3	27/02/2025	Details added on RS485 address configuration

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1 INTRODUCTION

This document contains specifications for the MODBUS protocol used in the EV10 flow controller by CMATIC S.P.A.

2 MODBUS PROTOCOL

The electronic flow controller uses a RTU MODBUS protocol and by default the NODE ID is equal to 0x00.
To activate the electronic flow controller and to integrate it into an RS485 bus it is necessary to configure the desired NODE ID using the command specified in section 3.2.2 SET NODE ID COMMAND.

2.1 RS485

The digital interface used for MODBUS protocol is RS485 (2 wires). The serial port configuration is as follows:

- Speed (Baud Rate): 115200
- Data bits: 8
- Parity: None
- Stop Bits: 1

2.2 RTU STANDARD FORMATTING

The MODBUS protocol model used for the EV10 uses RTU packet formatting (Hex Addressing).

Each packet consists of the following:

Name	Length (bits)
Address	8
Function	8
Data Address	16
Date	n × 16
CRC	16

The CRC is polynomial x16 + x15 + x2 + 1, where n can be equal to up to 5. The error packet is formed as follows:

Name	Length (bits)
Address	8
Function	0x80 + Function required
Date	Error code
CRC	16

N.B.: after receiving a response packet, it is necessary to wait for at least 10 ms before sending the next request.

3 EV10 PROTOCOL

The protocol implemented in the EV10 flow controller consists of different read and write commands used to communicate with the EV10 bootloader and with application of the flow controller itself. The EV10 board on the 485 network is the slave type and is always waiting for a command. Each packet received corresponds to a specific response (both in read and in write) or an error packet
Error packet:

Error code	Name
0x0001	ILLEGAL FUNCTION
0x0002	ILLEGAL DATA ADDRESS
0x0003	ILLEGAL DATA VALUE
0x0004	SLAVE DEVICE FAILURE

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3.1 BOOTLOADER

3.1.1 KEEP ALIVE BOOT MODE

WRITE ONLY
Function = 0x1002
Data = 0x0001
This command allows the board to remain in bootloader mode.
After sending the command, the electronic board will remain in BOOT MODE for 15 seconds.

3.1.2 CHECKSUM COMMAND

READ ONLY
Function = 0x1001
This command serves to read the checksum for the FW currently loaded on the board. It is calculated with the same function described in chapter 4.3.
After sending the command, the electronic board will remain in BOOT MODE for 15 seconds.

3.1.3 BOOT MODE COMMANDS

These commands come from an internal protocol. They are in any case sent via Modbus protocol, writing multiple registers (command 0x10), to address 0x1000.
The packet must be sent to the Data field, using the following form:

Name	Length (bits)
Slave ID	8
Function	8 (0x10)
Address	16
Data length	16
Bytes to write	8 = (Data length * 2)
Data ... 1	16
Data ... 2	16
Data ... n	16
CRC	16

If the packet to be sent is odd, then one byte (0xFF) must be added at the end.

3.1.3.1 FLASH ERASE

This command serves to prepare the memory for an update. It must be sent before any update. After sending the command, the JUMP APPLICATION timer will be reset to 15 seconds.

0xFD	0xDF	0x00	0x01	0x03	CRC	CRC	0xFF
START	START	DATA No.	DATA No.	COMMAND	CRC LSB	CRC MSB	

3.1.3.2 FLASH WRITE

This command serves to write the flash memory. The start address is 0x2000. The end address is 0xFFFF.

The size of the update files is (0xFFFF – 0x2000), and they must be written entirely to the internal memory of the microprocessor. The maximum size of the Bytes written in a single packet is 64.

After sending the command, the JUMP APPLICATION timer will be reset to 15 seconds.

0xFD	0xDF	0xNN	0xNN	0x04	ADDR MSB	ADDR LSB
START	START	DATA No.	DATA No.	COMMAND	MEM. ADDRESS	MEM. ADDRESS

DATA 1	DATA 2	DATA ..	DATA N	CRC	CRC	0XFF
DATUM 1	DATUM 2	DATUM ..	DATUM N	CRC LSB	CRC MSB	

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3.1.3.3 JUMP TO APPLICATION

This command serves to pass directly to the application without waiting for the JUMP APPLICATION time..

0xFD	0xDF	0x00	0x01	0x07	CRC	CRC	0xFF
START	START	DATA No.	DATA No.	COMMAND	CRC LSB	CRC MSB	

3.2 APPLICATION

The following section lists the different commands available for the application part

3.2.1 BOOTLOADER REQUEST

WRITE ONLY
Function = 0x01
Data = 0x0001
This command serves to restart the board in bootloader mode directly from the application.

3.2.2 SET NODE ID COMMAND

WRITE
Data address = 0x02
Data = 0x0001 – 0x00FE
This command is used to set a new node address on the RS485 communication bus.
Should the specific address of the electronic flow controller be unknown, a BROADCAST NODE ID address set at 0xFF can be used. This function is available only when a single flow controller is connected to the RS485 bus.
By sending the SET NODE ID COMMAND addressed to the 0xFF node, the flow controller will receive the command, store the new NODE ID, and overwrite the previously configured NODE ID, regardless of its prior setting.
From the next power-up, it will only respond to the newly configured NODE ID. At this point, the electronic flow controller can be reconnected to the RS485 bus and managed together with the other regulators in the system.

3.2.3 CALIBRATION

WRITE/READ
Data address = 0x03
Data = 0x0000 CALIB_READY
0x0001 CALIB_START
0x0002 CALIB_WAIT_1
0x0003 CALIB_RUN_HOME
0x0004 CALIB_WAIT_2
0x0005 CALIB_RUN_CLOSE
0x0006 CALIB_END
0x0007 CALIB_ERROR
This command serves to start and read the motor calibration status. The only command possible to write is CALIB_START if the current status is CALIB_READY and the motor is currently not running.

3.2.4 MAX STEP

READ ONLY
Data address = 0x04 (LSB), 0x05 (MSB)
Data = 0x0000 – 0xFFFF
This command serves to read the value for the steps counted during calibration.

3.2.5 PERCENTAGE COMMAND

WRITE/READ
Data address = 0x06
Data = 0x0000 – 0x0064
This command serves to set the opening percentage of the Flow controller.

3.2.6 TEMPERATURE

READ ONLY
Data address = 0x07
Data = 0x0000 – 0x04E2
This command serves to read the temperature value detected on the flow controller's electronic board.
Example:
Data = 0x0160 → 352 → 35.2 °C

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3.2.7 STATUS BOARD

READ ONLY
Data address = 0x08
Data = 0x0000 BOARD_OFF
0x0001 BOARD_READY
0x0002 BOARD_MOTOR_RUNNING
0x0003 BOARD_ERROR
0x0004 BOARD_MOTOR_RUNNING_WITH_ERROR
0x0005 BOARD_CALIBRATION
This command serves to read the current status of the flow controller board application.

3.2.8 ERROR LIST

WRITE/READ
Data address = 0x09

Data = NO_ERROR	0x0000
FIRST_HOMING_ERROR	(0x0001 << 0)
STALL_GUARD_ERROR	(0x0001 << 1)
SHORT_LOW_SIDE_CIRCTUIT_PHASE_A	(0x0001 << 2)
SHORT_LOW_SIDE_CIRCTUIT_PHASE_B	(0x0001 << 3)
SHORT_GND_CIRCTUIT_PHASE_A	(0x0001 << 4)
SHORT_GND_CIRCTUIT_PHASE_B	(0x0001 << 5)
OVERTEMP_PRE_WARNING	(0x0001 << 6)
OVERTEMP_DETECTED	(0x0001 << 7)
CALIBRATION_ERROR	(0x0001 << 8)
TIMEOUT_ERROR	(0x0001 << 9)
MOTOR_CONTROL_ERROR	(0x0001 << 10)

This command serves to read errors implemented by the flow controller board application.
In case of writing, the bit set in the packet sent to EV10 will be reset.
Example:
current errors 0x0003 → Sent 0x0001 → current errors 0x0002

3.2.9 INPUT COMMAND

WRITE/READ
Data address = 0x0A
Data = 0x0000 (analog input) - 0x0001 (RS485 - MODBUS).
This command serves to set the command input for the flow controller board.

3.2.10 SERIAL NUMBER

WRITE/READ
Data address = 0x0B (LSB), 0x0C, 0x0D, 0x0E, 0x0F (MSB)
Data = 0x0000 – 0xFFFF
This command serves to set the serial number for the flow controller board.
Example:
commands 0x3132, 0x3334, 0x3536, 0x3738, 0x3900
Serial: 123456789

3.2.11 GET POSITION

READ ONLY
Data address = 0x10
Data = 0x0000 – 0x0064
This command serves to read the current position, in percentage terms, of the servo-motor commanded by the flow controller board.

3.2.12 FIRMWARE VERSION

READ ONLY
Data address = 0x11 (Major), 0x12 (Minor)
Data = 0x0000 – 0xFFFF
This command serves to read the firmware version currently loaded onto the flow controller board.
Example:
received 0x0001, 0x0002
Firmware Version: 01.02

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3.3 CRC EXAMPLE FUNCTION

```
long crc16_MODBUS(int lg_buffer, unsigned char *pt_buffer)
{
        int no_octet;
        unsigned char val_octet;
        int no_bit;
        int retenue;
        long crc;
        crc = 0X0000FFFF;
        for (no_octet=0 ; no_octet < lg_buffer ; no_octet++)
        {
                val_octet = pt_buffer[no_octet];
                crc = crc ^ val_octet;
                for (no_bit=0 ; no_bit < 8 ; no_bit++)
                {
                        retenue = crc & 0X0001;
                        crc     = crc >> 1;
                        if (retenue == 1)
                        crc = crc ^ 0XA001;
                }
        }
        return(crc);
```