EMS24 Series

THREE-PHASE MOTOR CONTROL RELAY



INSTRUCTIONS FOR USE

Ver. 03 (EN) – 10/23

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INTRODUCTION

This manual contains the information required for proper installation and the instructions for use and maintenance of the product. It is therefore recommended to read it carefully and preserve it.

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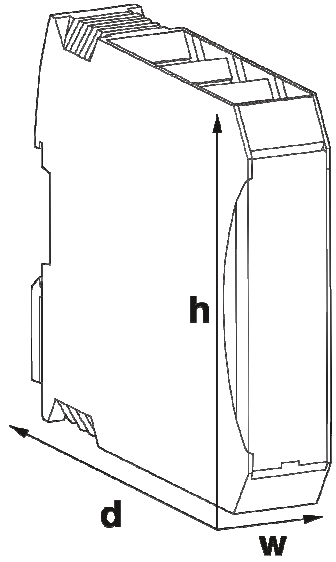
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If a malfunction or failure of the device can create hazardous or dangerous situations for people, animals or property, the system must be equipped with additional security devices.

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1 – DIMENSIONS (mm)

1.1 - EMS24 SERIES MODULE FOR DIN RAIL ASSEMBLY



w = 22.5 mm
h = 100 mm
d = 113.65 mm

2 - DEVICE DESCRIPTION

2.1 - GENERAL DESCRIPTION

The EMS24 series consists of hybrid motor starters that replace the classic reversing circuit and motor protection in a single device. With the motor starters of EL.CO., you can switch the motor reliably and safely. It can be used where there is a need to use three-phase asynchronous motors. The range consists of 4 product versions:

- EMS24x: Motor starter with only the motor start function.
- EMS24x-R: Motor starter with the function of starting and reversing the motor.
- EMS24x-RC: Motor starter with the function of starting, reversing and control of load.
- EMS24x-RCS: Motor starter with the function of starting, reversing, control of load and enable function.

Each version is available in both 3A and 9A versions.
(x = 3 or 9 depending on the choice of 3A or 9A)

For easy reading of the manual, we consider the product names EMS24x, EMS24x-R, EMS24x-RC, EMS24x-RCS without specifying the amperage as it is indifferent to reading the manual.

3 - SMART-CONNECTION

3.1 – PROGRAMMING/MONITORING FUNCTION

The EMS24x-xxx series is a strong innovation over similar product. The smart-connection function allows you to communicate with the motor starters to monitor the status or to configure the device.
The communication phase is not mandatory for the use of the device as it is possible to access all the features through the physical part of the device.

3.2 - COMMUNICATION VIA RS485 MODBUS

3.2.1 - DESCRIPTION

All devices are equipped with an RS485 serial communication interface through the bus and the terminal (Paragraph 4.4).

To keep the line at rest, the use of a termination resistor of 120 Ohm is required. The device does not mount this resistor. The termination of the RS485 line with the 120 Ohm resistor can be done through the terminal given as an accessory (see Paragraph 10.6).

The communication speeds implemented range from 1200 to 38400 baud rates and allow very satisfactory performances, while remaining well below the limits set by the RS485 standard. This allows the wiring of the line to be made using a medium quality shielded twisted pair: it is sufficient that the total capacity of the line does not exceed 200nF.

The poll rate during programming and use must not be less than 50ms.

The maximum length of an RS485 transmission is 400 meters.

3.2.2 - DESCRIPTION OF THE COMMUNICATION PROTOCOL

The protocol is a subset of the widely used MODBUS RTU protocol. This choice guarantees easy of connection to many PLCs and to all commercial supervision programs.

The default MODBUS address is 100.

For those wishing to develop their own application software, all the necessary tips and information are available.
The MODBUS RTU protocol functions implemented in the EMS24x-xxx instruments are:

function 3 - reading of n words
function 6 - writing a word

These functions (Paragraph 7) allow the supervision program to read and edit any data of the module.

Each message contains four fields:

- slave address: the values between 1 and 255 are valid; address 0 (zero) is reserved by MODBUS RTU for broadcasting messages, **but it is not adopted** in the EMS24x-xxx series due to the implicit unreliability of this type of communication;
- function code: it contains 3 or 6 depending on the specified function;
- information field: it contains the addresses or the value of the words, as required by the function used;
- control word: it contains a cyclic redundancy check (CRC) calculated according to the rules envisaged for CRC16.

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

3.2.3 - DATA EXCHANGE

The data exchanged consist of a 16-bit word. All readable and writable data appear as 16-bit words allocated in the device's memory.
The operating and configuration parameters of the device can be read and written via serial communication.

The configurable parameters are found in Paragraph 6.

4 - INSTALLATION AND USE WARNINGS

4.1 - PERMITTED USE

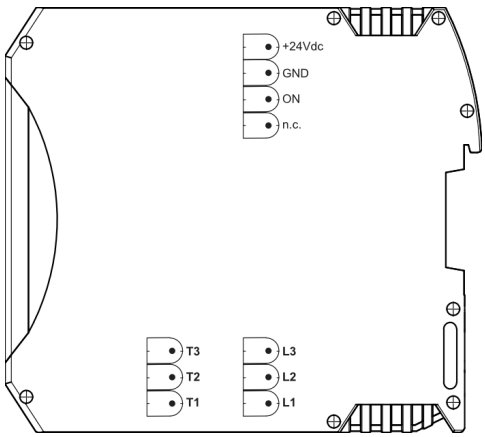
The device has been designed as a measurement and adjustment device in compliance with the EN60947-4-2 standard for operation at altitudes up to 2000 m. The use of the device in applications not expressly provided for by the above-mentioned standard must provide for all appropriate protection measures. The device CANNOT be used in hazardous (inflammable or explosive) environments without proper protection. It should be remembered that the installer must ensure that the electromagnetic compatibility rules are respected even after the device has been installed, possibly using special filters. If a failure or malfunction of the device can create hazardous or dangerous situations for persons, animals or property, the system must be equipped with additional electromechanical devices to ensure safety.

4.2 - MECHANICAL ASSEMBLY

All models of the EMS24x-xxx series must be installed on a DIN rail. Avoid placing the internal part of the device in places subject to high humidity or dirt that may cause condensation or the introduction of conductive parts or substances into the device. Ensure that the device has adequate ventilation and avoid installation in containers where devices that can lead the device to operate outside the declared temperature limits are located. Install the device as far as possible from sources that may generate electromagnetic disturbances such as motors, contactors, relays, solenoid valves etc.
Keep in mind that, once the motor starter has been installed on the DIN bar, its only accessible part will be the front panel.
An installation that does not comply with the provisions set out in this paragraph could compromise the declared protection levels.

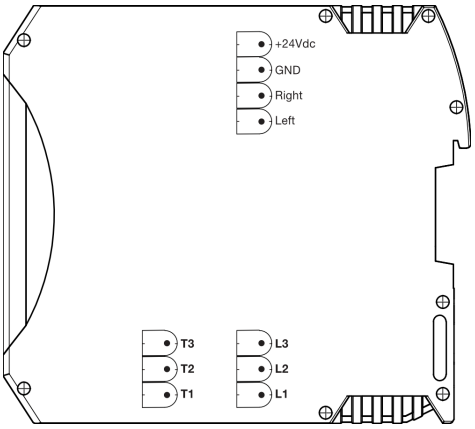
4.3 - WIRING DIAGRAM

4.3.1 – EMS24x



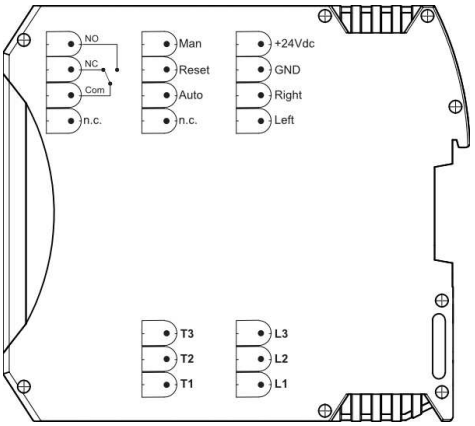
GND-+24Vdc power supply
ON
start motor
L1 L2 L3
load supply
T1 T2 T3
load

4.3.2 – EMS24x-R



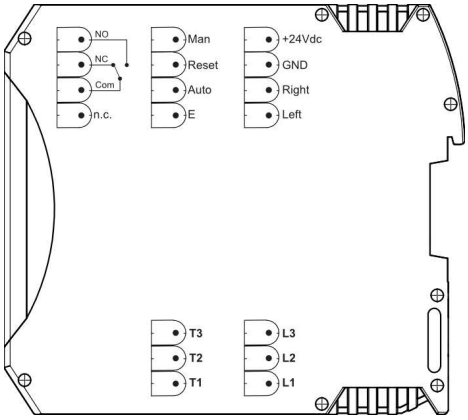
GND-+24Vdc power supply
RIGHT
start motor on the right
LEFT
start motor on the left
L1 L2 L3
load supply
T1 T2 T3
load

4.3.3 – EMS24x-RC



GND-+24Vdc power supply
RIGHT
start motor on the right
LEFT
start motor on the left
MAN
Manual reset
RESET
Reset command
AUTO
Automatic reset
L1 L2 L3
load supply
T1 T2 T3
load
NO NC COM
Alarm output relay

4.3.4 – EMS24x-RCS



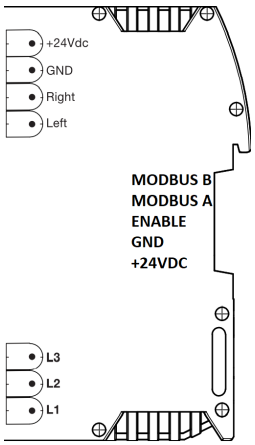
GND…+24Vdc power supply
RIGHT
start motor on the right
LEFT
start motor on the left
MAN
Manual reset
RESET
Reset command
AUTO
Automatic reset
E
Enable
L1L2L3
load supply
T1 T2 T3
Load
NO NC COM
Alarm output relay

4.4 – CONNECTION FROM A DEVICE TO ANOTHER DEVICE

The devices of the EMS24x-xxx series can be connected to each other through the bus connector (code: BC-5P) supplied as an accessory.



For access to the Modbus line, there are special connection terminals (TC-5PL, TC-5PR). One to get to the master and the other to terminate the line with a special resistor.
The pinout from the bus connector is shown below.



⚠ **A device battery must consist of a maximum of 16 devices.**

4.5 - POWER SUPPLY TECHNIQUES

EMS24x-xxx devices have 2 possibilities of being programmed:
- Traditional technique
- Smart-Supply

4.5.1 - TRADITIONAL TECHNIQUE

The traditional technique involves the direct power supply of the modules by connecting the 24VDC source to each of the terminals

4.5.2 - SMART-SUPPLY

The Smart-Supply system is based on the use of the bus connector. Up to 16 modules, the power distribution via bus takes place by powering a single module. In this way it is sufficient to power only 1 of the 16 modules to power them all.

5 - OPERATION

5.1 – DESCRIPTION

The motor starters have the function of switching and reversing the motors in a reliable and safe way. The 4 models differ in having more functions.

5.2 – EMS24x

This motor starter is the basic version of the series. It only has the function of starting the motor.
The product is powered at 24 Vdc and has only an ON input to enable the motor to run. The lower part of the device has 2 terminals relating to the input of the phases and the load.

+24Vdc: 24V DC voltage
GND: Common for voltage
ON: It enables 24Vdc to give the start command to the product

T3, T2, T1: Three-phase load
L3, L2, L1: Three-phase current

The LEDs arranged in front are:
Explanation: A = LED off, E = LED on with constant light

Status	Description	POWER	ON
OFF	Device off	A	A
ON	Device on	E	A
ON	Device on and running	E	E

5.3 – EMS24x-R

This motor starter has the start and reverse function.
The product is powered at 24 Vdc and has 2 inputs so you can select whether you want to start the motor clockwise (Right) or counterclockwise (Left). The lower part of the device has 2 terminals relating to the input of the phases and the load.

+24Vdc: 24V DC voltage
GND: Common for voltage
Right: It enables 24Vdc to give the right tip command
Left: It enables 24Vdc to give the left tip command

T3, T2, T1: Three-phase load
L3, L2, L1: Three-phase current

The LEDs arranged in front are:
Explanation: A = LED off, E = LED on with constant light

Status	Description	POWER	Right	Left
OFF	Device off	A	A	A
ON	Device on	E	A	A
ON	Device switched on and running clockwise	E	E	A
ON	Device switched on and running counter-clockwise	E	A	E

The device cannot go left or right at the same time.

5.4 – EMS24x-RC

This motor starter has the function of starting, reversing and control of load.
The product is powered at 24 Vdc and has 2 inputs so you can select whether you want to start the motor clockwise (Right) or counterclockwise (Left). It has a terminal for managing inputs relating to manual and automatic reset and a terminal relating to the alarm relay output through a clean contact.
This type of product has the possibility, through a trimmer, to set the alarm threshold current percentage. To perform the current set, you need to:

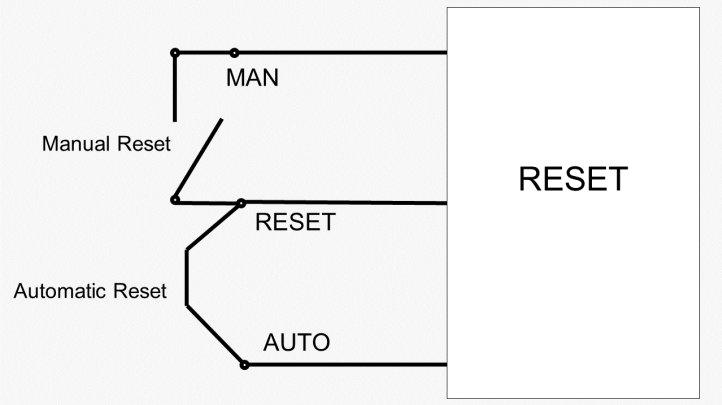
- Turn the trimmer to the desired position
- Press the button on the front for 3 seconds
- Wait for the blinking of the led

The lower part of the device has 2 terminals relating to the input of the phases and the load.

+24Vdc: 24V DC voltage
GND: Common for voltage
Right: It enables 24Vdc to give the right tip command
Left: It enables 24Vdc to give the left tip command

Reset: Internal 24Vdc. To decide the type of reset, it is necessary to make a bridge between Reset and Auto to have the automatic reset. To carry out the manual reset, a bridge must be made between Reset and Man enabled by an external device.

⚠ **Connections for AUTO, MAN and RESET must have a maximum length of 30m**



There is a terminal for managing the error through a clean contact. When faced with an error, the relay closes and then the contact closes between NO and Com. Normally the closed contact is the one between NC and Com.
NO: Normal open
NC: Normal close
Com: Common

T3, T2, T1: Three-phase load
L3, L2, L1: Three-phase current

The LEDs arranged in front are:
Explanation: A = LED off, E = LED on with constant light, B = Symmetrical flashing

Status	Description	POWER	Err	Right	Left	Reset
OFF	Device turned off	A	A	A	A	-
ON	Device turned on	E	A	A	A	-
ON	Device switched on and running clockwise	E	A	E	A	-
ON	Device switched on and running counter-clockwise	E	A	A	E	-
ERR	Motor protection: When the motor					-

	current is greater than the rated current. (Cooling time 20min)					
	Error during clockwise running	E	B	E	A	-
	Error during counter-clockwise running	E	B	A	E	-
	After 2 minutes “Right” or “Left” fl					
	Error during clockwise running	E	B	B	A	YES
	Error during counter-clockwise running	E	B	A	B	YES
ERR	**Symmetry:** Two phases differ by more than 33%	E	B	A	A	YES
ERR	**No load:** The product does not detect the load					
	Error during clockwise running	B	B	E	A	-
	Error during counter-clockwise running	B	B	A	E	-
	Error without any input	B	B	A	A	-
	After 2 minutes, the device can be reset					
	Error during clockwise running	B	B	B	A	YES
	Error during counter-clockwise running	B	B	A	B	YES
	Error without any input	B	B	A	A	YES

When the product goes into error, after a certain time, the product can be resettable.

In the event of a "Motor protection" and "No Load" error, after 2 minutes if:

- We have connected on AUTO, the product resets itself automatically
- Otherwise, we must connect between Reset and Man as described above and give a signal on MAN or press the button on the front of the product for 1 second.

5.4 – EMS24x-RCS

This motor starter has the function of starting, reversing, control and enable of load.
The product is powered at 24 Vdc and has 2 inputs so you can select whether you want to start the motor clockwise (Right) or counterclockwise (Left). It has a terminal for managing inputs relating to manual/automatic reset, enable and a terminal relating to the relay output through a clean contact.
This type of product has the possibility, through a trimmer, to set the current percentage of the full scale. In this way, you can vary the maximum threshold current. To perform the current set, you need to:

- Turn the trimmer to the desired position
- Press the button on the front for 3 seconds
- Wait for the blinking of the led

In the event of an error, the device communicates the problem through an output with a clean contact. (Described below)
The lower part of the device has 2 terminals relating to the input of the phases and the load.
Unlike the EMS24x-RC model, this model has an additional input called **E**, which indicates Enable.
This device works only with the Enable signal enabled, i.e., by inserting a 0V signal directly on the terminal. This terminal is used to connect safety devices and is used to block the motor in an emergency.

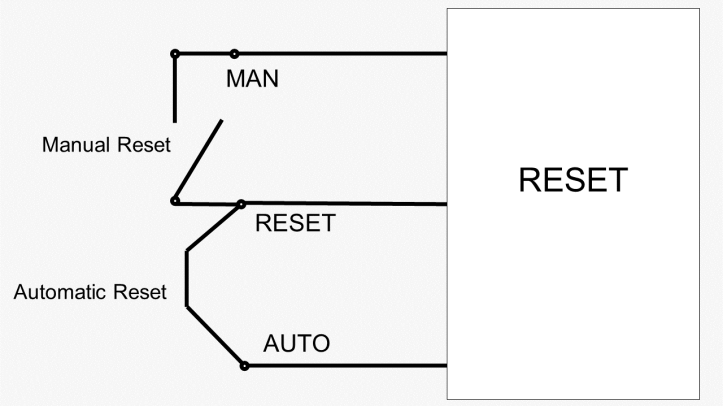
⚠ **Without the E (Enable) signal inserted, the product does not work.**

⚠ **This device is not a safety device, but it can be locked with a safety device**

+24Vdc: 24V DC voltage
GND: Common for voltage
Right: It enables 24Vdc to give the right tip command
Left: It enables 24Vdc to give the tip command to the left

Reset: Internal 24Vdc. To decide the type of reset, it is necessary to make a bridge between Reset and Auto to have the automatic reset. To carry out the manual reset, a bridge must be made between Reset and Man enabled by an external device.

⚠ **Connections for AUTO, MAN and RESET must have a maximum length of 30m**



There is a terminal for managing the output through a clean contact. When faced with an error, the relay closes and then the contact closes between NO and Com. Normally the closed contact is the one between NC and Com.
NO: Normal open
NC: Normal close
Com: Common

T3, T2, T1: Three-phase load
L3, L2, L1: Three-phase current

The LEDs arranged in front are:
Explanation: A = LED off, E = LED on with constant light, B = Symmetrical flashing

Status	Description	POWER	Err	Right	Left	Reset
OFF	Device off	A	A	A	A	-
ON	Device on	E	A	A	A	-
ON	Device switched on and running clockwise	E	A	E	A	-
ON	Device switched on and running counter-	E	A	A	E	-

	clockwise					
ERR	**Motor protection**: When the motor current is greater than the rated current. (Cooling time 20min)					-
	Error during clockwise running	E	B	E	A	-
	Error during counter-clockwise running	E	B	A	E	-
	After 2 minutes “Right” or “Left” fl					
	Error during clockwise running	E	B	B	A	YES
	Error during counter-clockwise running	E	B	A	B	YES
ERR	**Symmetry:** Two phases differ by more than 33%	E	B	A	A	YES
ERR	**No load:** The product does not detect the load					
	Error during clockwise running	B	B	E	A	-
	Error during counter-clockwise running	B	B	A	E	-
	Error without any input	B	B	A	A	-
	After 2 minutes the device can be reset					
	Error during clockwise running	B	B	B	A	YES
	Error when running counterclockwise	B	B	A	B	YES
	Error without any input	B	B	A	A	YES

When the product goes into error, after a certain time, the product can be resettable.

In the event of a "Motor protection" and "No Load" error, after 2 minutes if:

- We have connected on AUTO, the product resets itself automatically
- Otherwise, we must connect between Reset and Man as described above and give a signal on MAN or press the button on the front of the product for 1 second.

6 - PROGRAMMABLE PARAMETERS TABLE

Below are all the parameters that the device can be equipped with.

The hex address is used exclusively for the series. The address in decimal value is also available for better reading.

RO: It indicates "Read Only"
RW: It indicates "Writing and Reading"
WO: It indicates "Write Only"

Description		Range	Def.	Hex-dec address
CP1 (RO)	1st field of the product code	'C' (in ascii)	C	0x01-1
CP2 (RO)	2nd field of the product code	‘M’ (in ascii)	M	0x02-2
CP3 (RO)	3rd field of the product code	‘T’ (in ascii)	T	0x03-3
CP4 (RO)	4th field of the product code	‘-’ (in ascii)	-	0x04-4
CP5 (RO)	5th field of the product code	‘A’ (in ascii): EMS24x series ‘B’ (in ascii): EMS24x-R series ‘C’ (in ascii): EMS24x-RC series ‘D’ (in ascii): EMS24x-RCS series		0x05-5
Max. current (RO)	Maximum current	3 or 9	A	0x0F-15
Status (RW)	Device status (R)	‘AS’: Product on and stopped ‘AR’: Product on and running to the right ‘AL’: Product on and running to the left ‘EO’: Overcurrent error ‘ED’: Phase asymmetry error ‘EL’: Load missing error The error return is 2 bytes in hexadecimal. The letters correspond to the correspondence in the ascii table	-	0x64-100
	Reset default (W)	9999		

Current Perc. (RW) (Only for EMS24x-RC and EMS24x-RCS models)	Percentage of current The percentage of current indicates how much to set the load control threshold.	0 - 100	100	0x21-33
Address	Modbus address	1 - 255	100	0x09-9

Modbus speed	Modbus speed	1200 2400 9600 19200 38400	9600	0x0A-10

7 - FUNCTIONS OF THE RS485 TRANSMISSION PROTOCOL

7.1 - FUNCTION 3 - READING N WORDS

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

The request has the following structure:

Number of the slave	Function number	Address of the first word MSB LSB		Number of words MSB LSB		CRC LSB MSB	
byte 0	byte1= 0x03	byte 2	byte 3	byte 4	byte 5	byte 6	byte 7

The response has the following structure:

Number of the slave	Function number	NB Number of bytes read	Value of the first word MSB LSB		Subsequent words	CRC LSB MSB	
byte 0	byte1= 0x03	byte 2	byte 3	byte 4	byte 5	byte NB+2	byte NB+3

7.2 - FUNCTION 6 - WRITING A WORD

The request has the following structure:

Number of the slave	Function number	Address of the first word MSB LSB		Value to write MSB LSB		CRC LSB MSB	
byte 0	byte1= 0x06	byte 2	byte 3	byte 4	byte 5	byte 6	byte 7

The normal response is purely an echo of the request message:

Number of the slave	Function number	Address of the first word MSB LSB		Value to write MSB LSB		CRC MSB LSB	
byte 0	byte1= 0x06	byte 2	byte 3	byte 4	byte 5	byte 6	byte 7

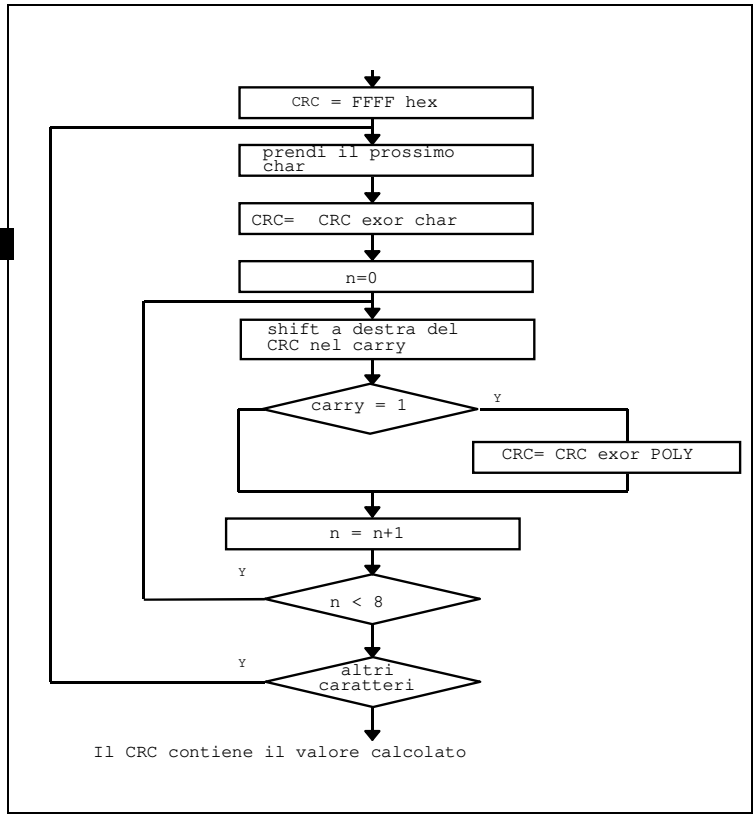
7.5 – CYCLIC REDUNDANCY CHECK (CRC)

The CRC is a check word that allows you to verify the integrity of a message.
Each message, sent or received, contains the CRC word in the last two characters.

After receiving a request, the controller checks the validity of the message received, thus comparing the CRC contained in the message with the one calculated during reception.

During transmission, the controller calculates the CRC and places the two characters at the end of the message.
The calculation of the CRC is performed on each character of the message excluding the last two.

Since the EMS24x-xxx devices are compatible with the MODBUS RTU (JBUS) protocol, they use the same algorithm for the calculation of the CRC.



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

Note: the first character of the CRC transmitted is the less significant of the two calculated.

9 - TECHNICAL DATA

9.1 - ELECTRICAL CHARACTERISTICS

Power supply: 24VDC+-10%,
Maximum absorption: 60mA
Input/s: 1 to 2 run inputs (depending on the model) at 24VDC, 0 or 3 reset inputs (depending on the model)
Outputs: three-phase 500VAC
3A/3A or 9A/7A AC51/AC53a (depending on the model)
Duty cycle: 80cycle/min AC51, 6cycle/min AC53
Cycle guaranteed: 30 milions

Isolation: 1.5 KV

9.2 - MECHANICAL CHARACTERISTICS

Container: Self-extinguishing plastic UL 94 V0
Dimensions: 22.5 x 100 x 113.65 mm
Weight: 200g
Installation: Omega DIN rail
Connections: screw terminals and extractable bus on din bar
Front protection degree: IP 20
Pollution degree: 2
Use environment: indoor.
Working ambient temperature: -25 ... 70°C
Working ambient humidity: 30 ... 95 RH% with no condensation
Temperature for the transportation and storage -40 ... 80°C

9.3 - DEVICE CODING

EMS24x
EMS24x-R
EMS24x-RC
EMS24x-RCS

x: AMPERAGE:
3 = 3 Ampere
9 = 9 Ampere

9.4 - ACCESSORIES (Not supplied)

BC-5P = bus connector for bar connection

TC-5PR = connector for female RS485 line termination resistor

TC-5PL = connector for male RS485 line termination resistor

The TC-5PR and TC-5PL terminals are used to finish or extend the product's RS485 line.

11 - PROBLEMS, MAINTENANCE AND WARRANTY

11.1 - CLEANING

It is recommended to clean the device only with a slightly soaked cloth of water or non-abrasive detergent and not containing solvents.

11.2 - WARRANTY AND REPAIR

The device is guaranteed by manufacture defects or defects in material found within 12 months from the date of delivery.
Warranty is limited to repair or replacement of the product.
Possible opening of the container, tampering with the device, or improper use and installation of the product will automatically result in the warranty being decayed.
In the event of a defective product during the warranty period or outside the warranty period, contact the EL.CO. Sales Dept. to obtain authorization for shipment.
The defective product, therefore, accompanied by the indications of the defect found, must be sent to the EL.CO. unless otherwise agreed.