

INTERFACE IO-Link
FOR MFC-3000 WELDING CONTROL

ESA-12

Version 1.2 - 2021/20



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INTRODUCTION

IO-Link interface for welding control SERRATRON MFC-3000

The ESA-12 board for the SERRATRON MFC-3000 welding control is a communication Master for a ModBus over TCP industrial communication net.

The net is configured by means of the CPC-Connect software.

Together with one or more ModBus/IO-Link gateway allows the communication with IO-Link sensors and actuators.

The internal configuration of the ModBus/IO-Link gateways is done by means of the manufacturer's specific software.

Input/ Output ModBus modules can also be used.

The input/output data are processed by the PLC internal function of the welding controller.

Main features

- ESA-12 board can communicate with up to 8 Gateways ModBus/IO-Link.
- ESA-12 board can manage up to 24 devices Gateways ModBus/IO-Link + IO-Link devices.
- Integrates digital and analog signals from IO-Link sensor easily into the PLC functionality of the SERRATRON MFC-3000
- Physical interface with 4 RJ-45 Ethernet 10/100 Base T connectors.
- 16 Digital inputs 24Vdc.
- 8 Digital outputs 24Vdc.

LEGAL INFORMATION

Safety warning system

This manual contains warnings that must be observed to maintain safety of users and to prevent property damage. Warnings related to personal safety are signaled in the manual with an alert symbol, those related to property damage have no alert symbol.

According to the danger classification:



Indicates that lack of corresponding precautions **will** result in death or irreversible personal injury.



Indicates that lack of corresponding precautions **can** result in death or irreversible personal injury.



Indicates that lack of corresponding precautions can result in reversible personal injury.



Indicates that lack of corresponding precautions can result in property damage.

If more than one danger level is present, the danger signal will relate to the highest danger level.

A warning with the personal injury symbol can also include a warning on property damage.

Qualified Personnel

The product or system described in this documentation can only be operated by qualified personnel for the job according to the relevant information, particularly with the safety warnings and instructions.

Qualified personnel are those who, based on their experience and training are capable of identifying risks and avoid potential dangers during the use of the product or system.

Appropriate use of Serra Soldadura SAU products



Products Engineered and Manufactured by Serra Soldadura can only be used for the functions and applications described in their catalog and the relevant technical documentation. If products and components from other manufacturers are used these must be recommended or approved by Serra Soldadura. The appropriate transport, storage, installation, assembly, commissioning, operation and maintenance are mandatory to ensure that products will work in a safe and problem free manner. Acceptable ambient conditions must be fulfilled. The information in the relevant documentation must be taken into account.

Trademarks

ModBus is a *Schneider Electric* registered trademark licensed to the *Modbus Organization Inc.*

IO-Link is a *PROFIBUS Nutzerorganisation e.V.* Registered trademark.

PACTware *PACTWARE CONSORTIUM e.V.* Registered trademark.

TURCK is a *Hans Turck GmbH & Co. KG.* Registered trademark.

SMC is a SMC Corporation registered trademark.

Disclaimer

The contents of this publication have been reviewed to ensure consistency with the described hardware and software.

As the possibility of discrepancies cannot be completely eliminated, we cannot guarantee complete consistency.

However, the information in this publication is regularly reviewed and necessary corrections are included in subsequent editions.

PRODUCT DESCRIPTION

Specifications

Electrical characteristics

Communication	ModBus over TCP. Ethernet 10/100 BaseT.
Digital Inputs	16 inputs with LED. Consumption: 10 mA @ 24Vdc Voltage max. 40Vdc. Optically isolated.
Digital Outputs	8 outputs with LED. Short circuit protected. Max. Current each: 800 mA @ 24 Vdc Max. Global consumption: 1.6 A @ 24 Vdc Optically isolated.

Ambient conditions

Temperatures	Storage and Transport: -25 a 70 °C. Operation: 0 a 40 °C
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Mechanical characteristics

Weight:	170 g
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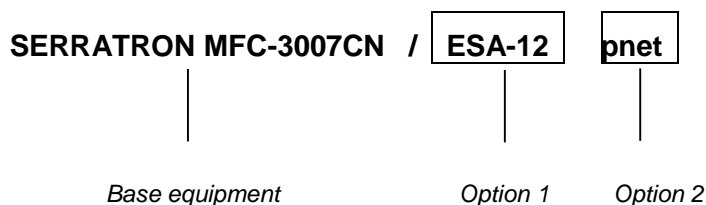
Coding and spare parts

OPTIONAL BOARDS	Código SERRA	SUFIJO
EXPANSION INTERFACE IO-Link ESA-12	CARTA ESA-12	ESA-12

OPTION CODING

Depending on the optional equipment installed, the coding of the welding controller must be complemented.
Maximum 2 options.

Example: SERRATRON MFC-3007CN with ESA-12 expansion IO-Link and ProfiNet fieldbus.



Spare part	Manufacturer	Reference
P1 (aerial connector)	Weidmüller	BL 3.50/16/180LH orange cod. 1687790000
P2 (aerial connector)	Weidmüller	BL 3.50/03/180LH orange cod. 1687660000
P3 (aerial connector)	Weidmüller	BL 3.50/10/180LH orange cod. 1687960000

Accessories	Code	Description
TP-10	TP-10	Handheld programming unit
UPF-107	UPF-107	HMI Touch panel 7"
Cable MFC-3000 - PC	RS-232	Cable for PC connection
Cable Bus IOEX	Data trans. cable	LI-YCY paired and braided 2x2x0.22 mm ²
ESA-10 board	CARTA ESA-10	32 digital inputs and 16 digital outputs
ESA-12 board	CARTA ESA-12	IO-Link Interface
IBUS-5 board	CARTA IBUS-5	InterBus Interface: Copper, 500 kbaud
IBUS-6 board	CARTA IBUS-6	InterBus Interface: Optic Fiber, 500 kbaud
IBUS-3opc board	CARTA IBUS-3opc	InterBus Interface: Optic Fiber OPC, 500 kb/2 Mb
PDP-1 board	CARTA PDP-1	Profibus Interface: Copper, auto baud
DVNET-2 board	CARTA DVNET-2	DeviceNet Interface: Copper, 125/250/500 kbaud
ETHIP-1 board	CARTA ETHIP-1	EtherNet-IP Interface: Copper or Optic Fiber
PNET-2 board	CARTA PNET-2	PROFINET 2.32 Interface: Copper or Optic Fiber

FUNCTIONAL DESCRIPTION

Operating principle

The ESA-12 board is a ModBus/TCP controller (master) exchanging the network modules inputs/outputs state with the PLC function of the welding controller MFC-3000.

The network configuration is stored in the welding controller and is programmed using the CPC-Connect software (see PROGRAMMING).

The configuration consists in the selection of the ModBus/IO-Link gateways connected to the network, and the mapping of their input and output signals to the PLC address space.

After the IO-Link modules connected to these gateways are configured, and their inputs and outputs mapped to the PLC address space.

The IO-Link configuration options stored in the ModBus/IO-Link gateways is accomplished using the software provided by the PACTware Consortium, this allows to use the features of the IO-Link technology.

Once the configuration is ready, the ESA-12 interface executes the cyclic I/O exchange between the ModBus/IO-Link gateways (which in turn exchange this information with the IO-Link modules) and the MFC-3000 welding controller PLC function. It also collects the network diagnostic information.

In addition the ESA-12 board has 16 digital inputs and 8 digital outputs (24Vcc) PLC controlled (see Connection examples).

STATUS LED signaling

The board mounts a diagnostic LED in the front panel of the MFC-3000, labeled "Status".

It allows easy diagnostics of the ESA-12 operating state.

Possible states are:









	Off	Faulty ESA-12 board
	Green	Correct operation
	Green blinking	No communication with ModBus/IO-Link gateway
	Green – Red blinking	Synchronism with MFC controller lost
	Red blinking	Board waiting for initialization
	Red	Hardware fault
	Double Green blinking	Waiting for new firmware reception.
	Double Green – Red blinking	Program/Data corrupted.

Figure 1 - Led Status

SIGNAL DESCRIPTION

External connection

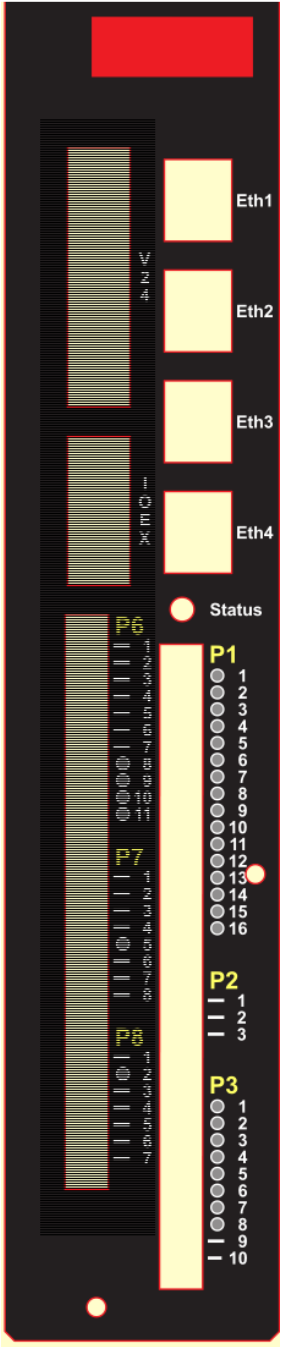


Figure 2 – Connector Layout

Ethernet connectors Eth1..4

These are connection points to the internal Ethernet switch, following the 10/100 Base-T IEEE 802.3 specification (copper wire, transmission speed 10/100 Mbit/s).

Connector type is RJ-45. The connected cable should not exceed 100m length, type UTP, category 5.

It has the auto-crossing feature, this allows connection using straight cables and crossover cables.

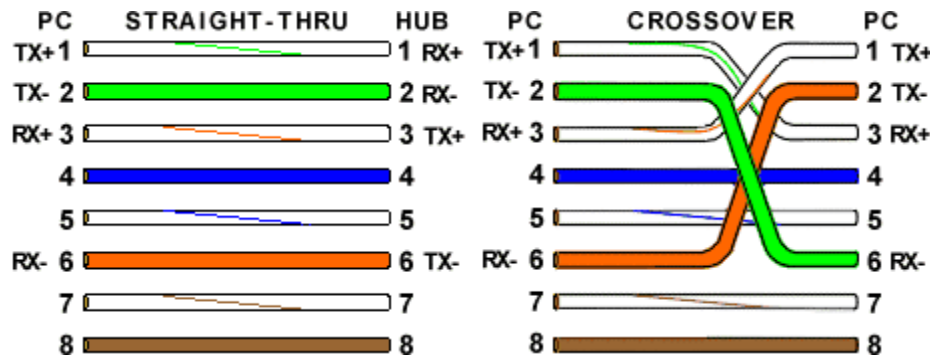


Figure 3 – Ethernet wiring

Input connector P1: E0.0..E1.7

P1 connector contains the 16 digital inputs, named E0.0 to E1.7. See Electrical characteristics.

Commutation between on-off states takes place as the represented hysteresis cycle indicates, to avoid undetermined states at low signal voltages or low power supply voltages.

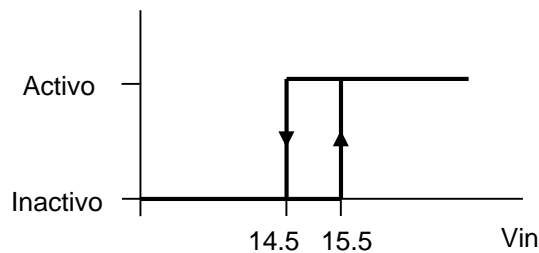


Figure 4 – Digital input hysteresis

For connection options see Connection examples.

The activation of every input can be visually confirmed through LED visible beside the connector.

Table 1 - Connector P1

Pin	Signal	Description
1	E0.0	-
2	E0.1	-
3	E0.2	-
4	E0.3	-
5	E0.4	-
6	E0.5	-
7	E0.6	-
8	E0.7	-

Pin	Signal	Description
9	E1.0	-
10	E1.1	-
11	E1.2	-
12	E1.3	-
13	E1.4	-
14	E1.5	-
15	E1.6	-
16	E1.7	-

Power connector P2

Pins in this connector allow powering digital inputs and outputs using the internal source of the MFC-3000 controller. Indicated fusing limits must be taken into account. For power connection examples see Connection examples.

Table 2 - Connector P2

Pin	Signal	Description
1	+24VEN	+24 Vdc for input switches. This power supply is protected by a resettable fuse 1A.
2	+24VOUT	+24 Vdc for output actuators. This power supply is protected by a resettable fuse 3A.
3	0VEN/OUT	0Vdc reference voltage for +24VEN y +24VOUT

Output connector P3: S0.0..S0.7

P3 connector contains 8 digital outputs, named S0.0..S0.7.

Its voltage level is not regulated and depends directly from MFC-3000 P4 connector power input, when connected to the internal power supply. For connection options see Connection examples

For electrical characteristics see Electrical characteristics.

The output state is made visible by LED visible beside the connector.

In case of short circuit the protection fuse will disconnect the pin and the LED will be off until the short circuit cause is eliminated.

Tabla 3 - Conector P3

Pin	Signal	Description
1	S0.0	-
2	S0.1	-
3	S0.2	-
4	S0.3	-
5	S0.4	-
6	S0.5	-

Pin	Signal	Description
7	S0.6	-
8	S0.7	-
9	+24VEXT	+24 Vdc external output supply, see Connection examples.
10	0VEXT	0 Vdc reference for external output supply, see Connection examples.

Connection examples

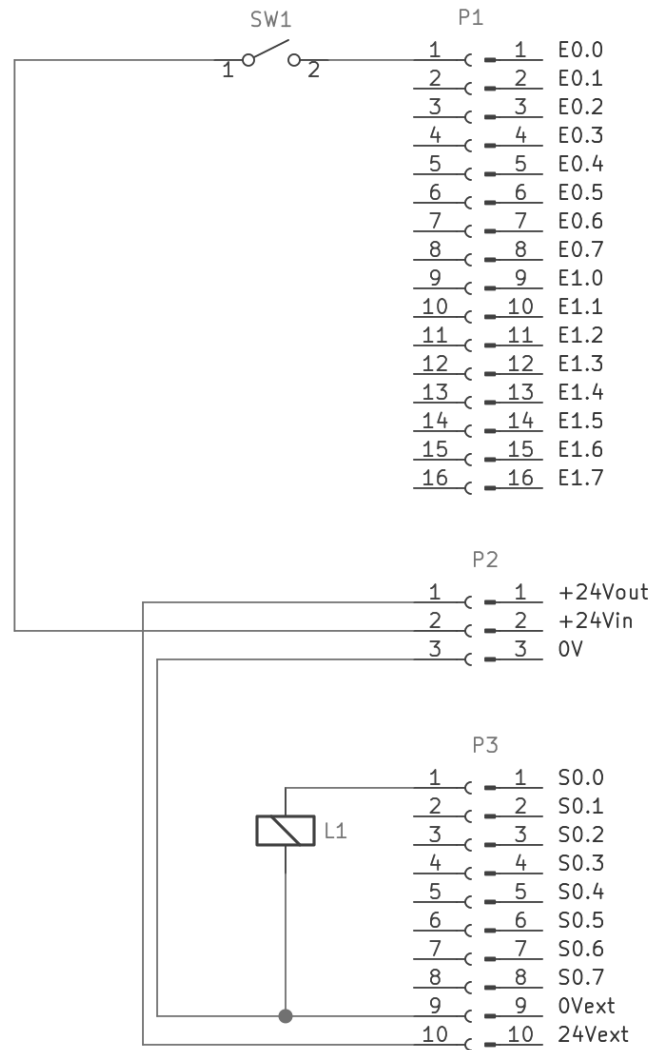


Figure 5 – Internal I/O power supply

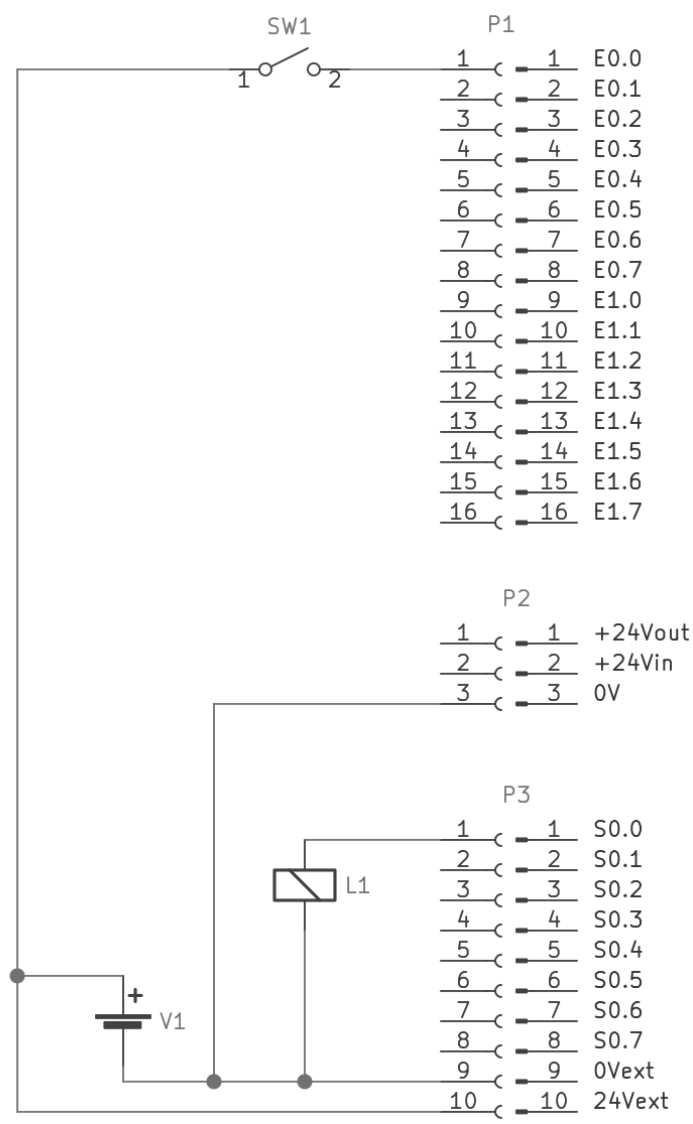


Figure 6 – External I/O power supply

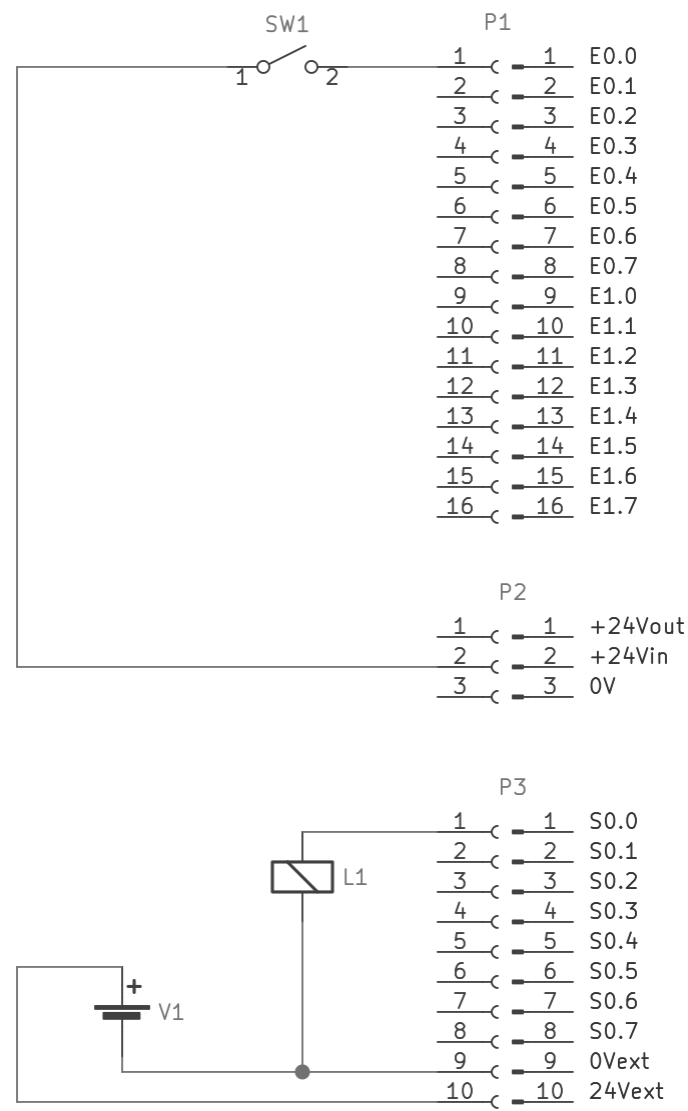


Figure 7 – Isolated output power supply

PROGRAMMING

Slave configuration¹

Using software CPC-Connect, the configuration of the Network can be found in the PLC programming screen.

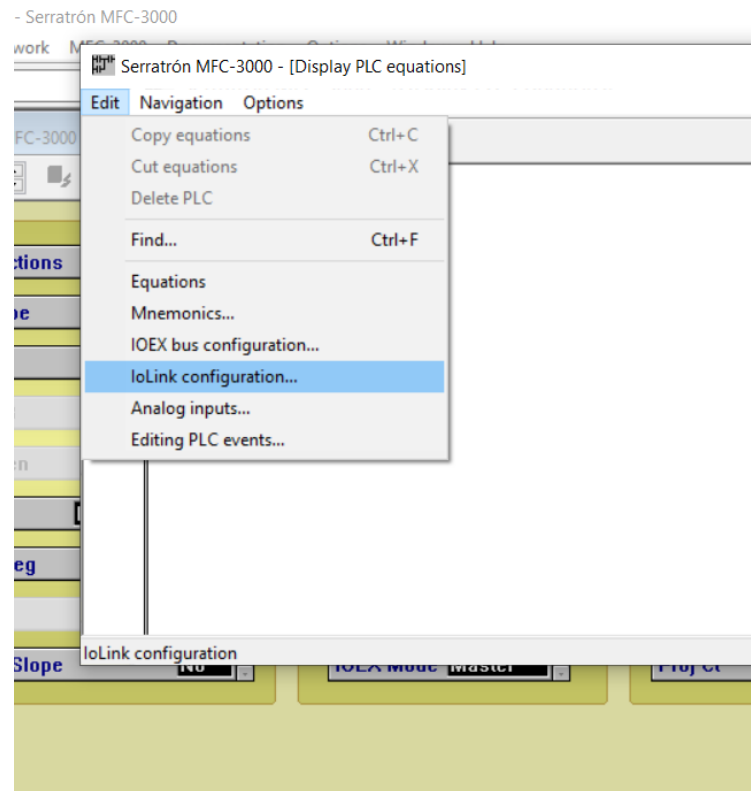


Figure 8 - CPC configuration menu selection

In the space labeled 'ESA12 card configuration', the TCP/IPv4 parameters for the ModBus master can be configured, additionally the operation of the ESA-12 board can be disabled.

¹ If the use of network components not listed in this document is required, please contact Serra Soldadura SAU. An evaluation of the possibility to include the requested module will be carried out.

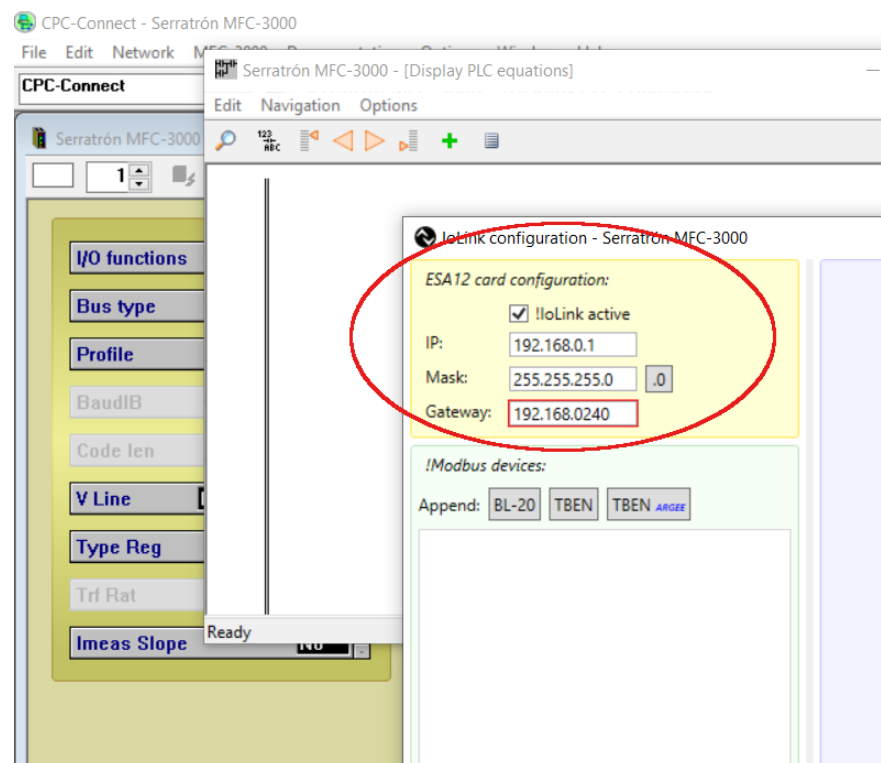


Figure 9 - CPC Ethernet configuration

Once the operating parameters of the ModBus master ESA-12 are fixed, the different ModBus/IO-Link gateways present in the network are configured from the available options.

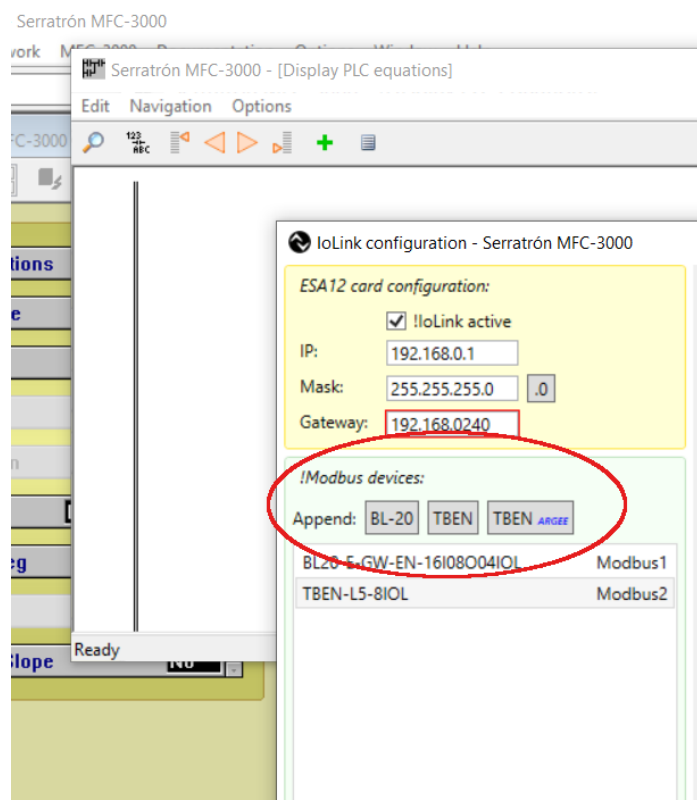
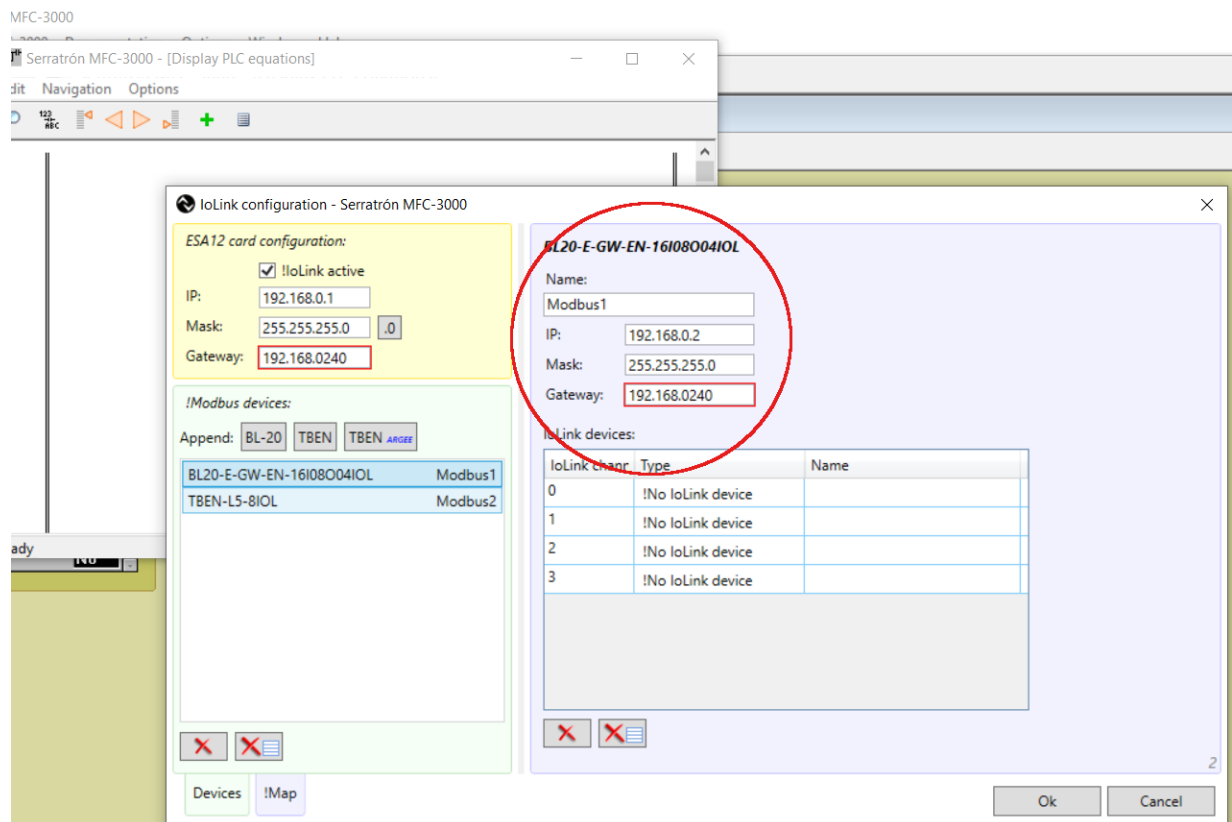


Figure 10 - CPC ModBus Gateway selection

Table 4 – Available ModBus/IO-Link gateways

TAG	FIRM	REFERENCE	DESCRIPTION
BL-20	TURCK	<i>HEADER Ethernet</i> BL20-E-GW-EN <i>MOD. 16 DIGITAL Inputs</i> BL20-E-16DI-24VDC-P <i>MOD. 8 DIGITAL Outputs</i> BL20-E-8DO-24VDC-0.5A-P <i>IO-Link MASTER 4 CHANNEL</i> BL20-E-4IOL-10	Pre-configured selection of IP20 modules inside control cabinet.
TBEN	TURCK	TBEN-L5-8IOL	IP6X module with up to 8 IO-Link configurable channels. Manufacturer default addressing.
TBEN ARGEE	TURCK	TBEN-L5-8IOL + ARGEE internal program.	IP6X module with up to 8 IO-Link configurable channels. 24 word in / 24 word out. Optimized communication cycle.

Every ModBus/IO-Link Gateway has a TCP/IPv4 set of parameters needed for the network communication with the master ESA-12.

**Figure 11 - CPC ModBus Gateway configuration 1**

Modbus/IO-Link can be named according to the machine operation or construction, to help the process of configuration and addressing, better than its commercial reference.

Together with the TCP/IPv4 parameters and the module name, the ModBus/IO-Link gateway, a table with as many rows as IO-Link connections the gateway supports is shown.

Inside this table, the IO-Link modules connected to the gateway are configured, selecting from list of available modules for configuration.

Figure 12 - CPC IO-Link slave configuration

It is also possible to name the IO-Link modules in order to make the configuration more readable.

Table 5 – Available IO-Link slaves

TAG	FIRM	REFERENCE	DESCRIPTION
TBIL-M1-16DXP	TURCK	TBIL-M1-16DXP	IP-6X module with 16 digital inputs/outputs (configurable).
EX260-SIL1-00I32O	SMC	EX260-SIL1	Valve Block Header, 32 outputs.
EX260-SIL1-16I32O	SMC	EX260-SIL1	Valve Block Header, 16 digital inputs (diagnostics) and 32 digital outputs.
PF3W704	SMC	PF3W704-X445	Flow meter measuring flow and water temperature.
ITV-IO	SMC	ITV/10X0/20X0/30X0-X395	Servo valve with set point (output) and measuring of the actual pressure.

TAG	FIRM	REFERENCE	DESCRIPTION
D-MPXXX	SMC	D-MPXXX-A/B/C	Pneumatic cylinder position measure.
LiXXXPX-Q25L	TURCK	LiXXXPX-Q25L	Position measuring ruler, high precision.

Addressing configuration

Once the network modules are selected and configured it is necessary to map their inputs and outputs to PLC's address space.

The map function is used for this purpose.

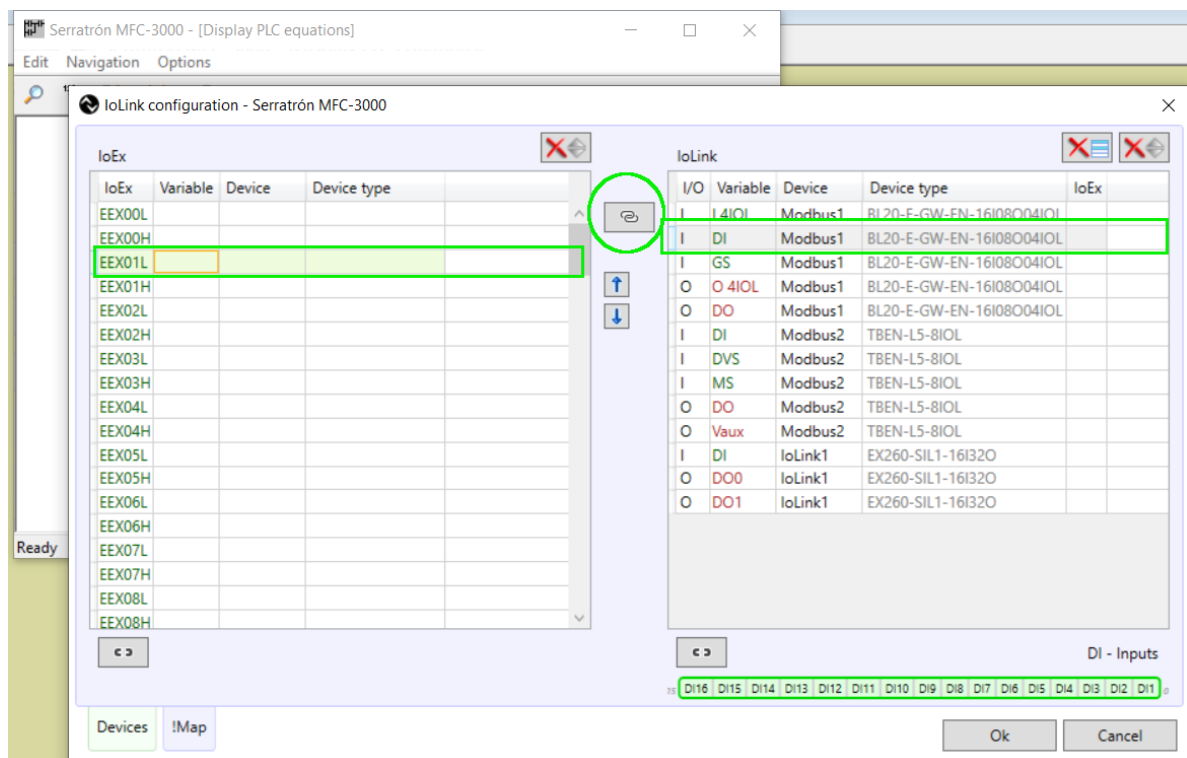


Figure 13 - CPC address map configuration 1

In the IO-Link table, to the right, the information that we want to make available to the PLC function is selected. In the left table IoEx, the target map position is selected. Pressing the 'chain' button the final mapping instruction for the ESA-12 is created. Finally the accepted mapping instruction is indicated:

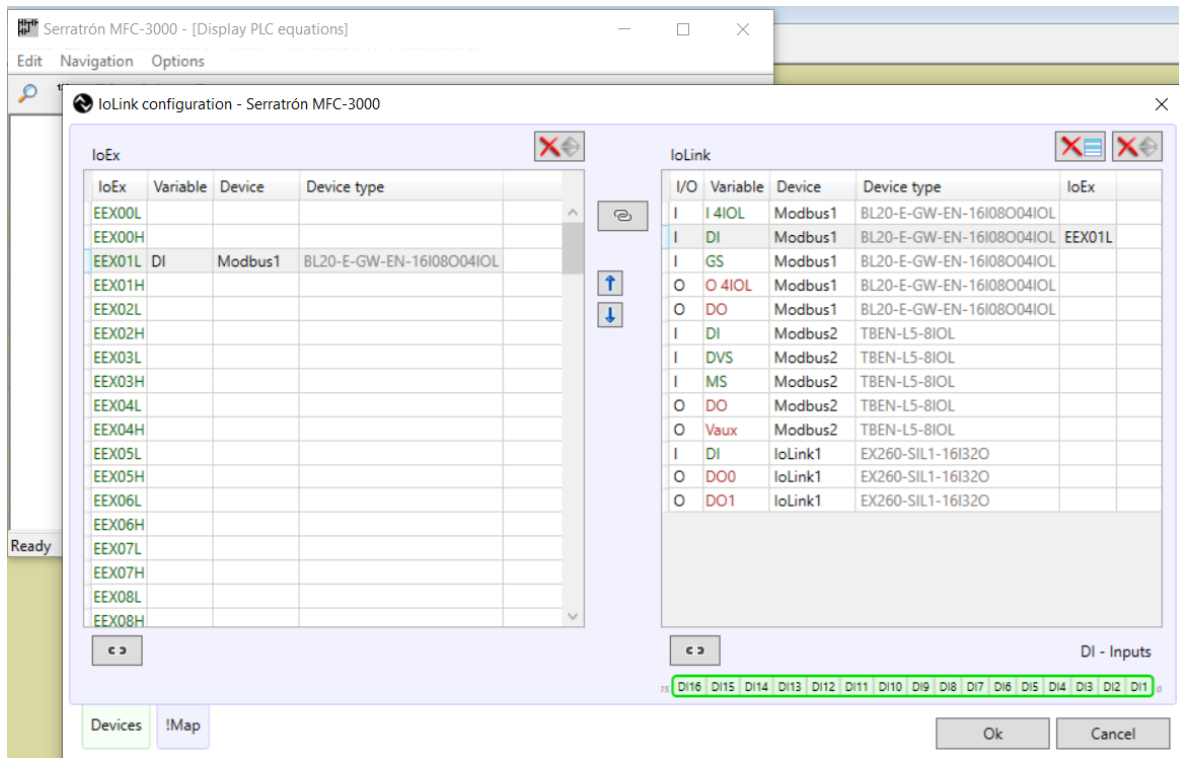


Figure 14 - CPC address map configuration 2

With the Accept button the configuration is sent to the MFC-3000 welding controller, who saves it and loads it in the ESA-12 every time it is started.

IO-Link configuration

In order to configure the ModBus/IO-Link gateways with the IO-Link master parameters, it is necessary to use the software supplied by the Gateway manufacturer.

The manufacturer association PACTware Consortium supplies the configuration software:

For use it is advisory to refer to the program instructions and the configuration manuals of the used IO-Link devices. You will find this information in www.serrasold.com

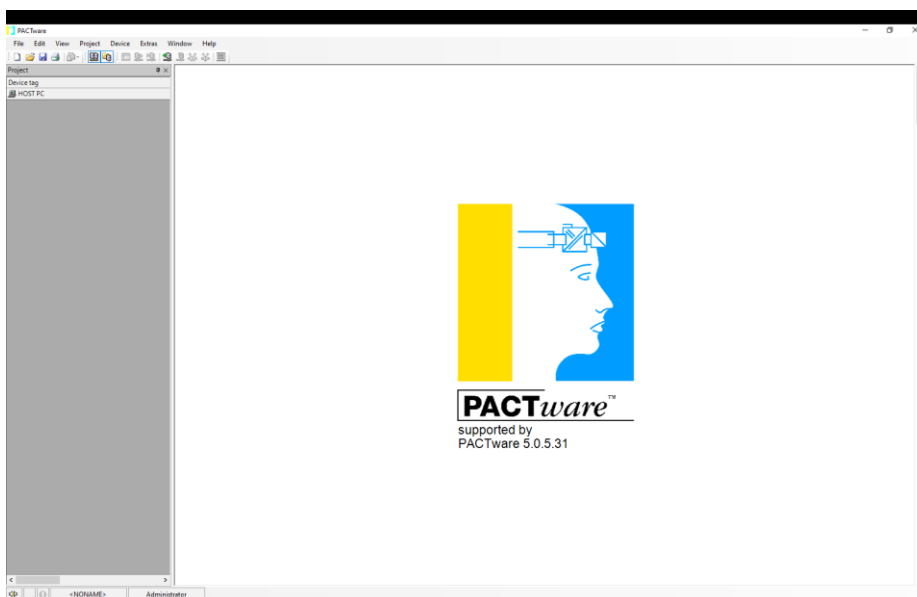


Figure 16 - IO-Link Gateway configuration software

FIRMWARE UPDATE

To update the ESA-12 firmware version, the CPC-Connect 'Loader' option must be used.

The available firmware files can be found in <http://serratron.serrasold.com>

The same procedure as with the MFC-3000 firmware is used. The ESA-12 firmware file in the file system is selected in the MFC-3000 row, by double clicking the File field.

The firmware type is automatically recognized by the software and sent to the ESA-12 board when the Send button is pressed.

Under menu item 'Network', selection 'Loader', the required menu appears:

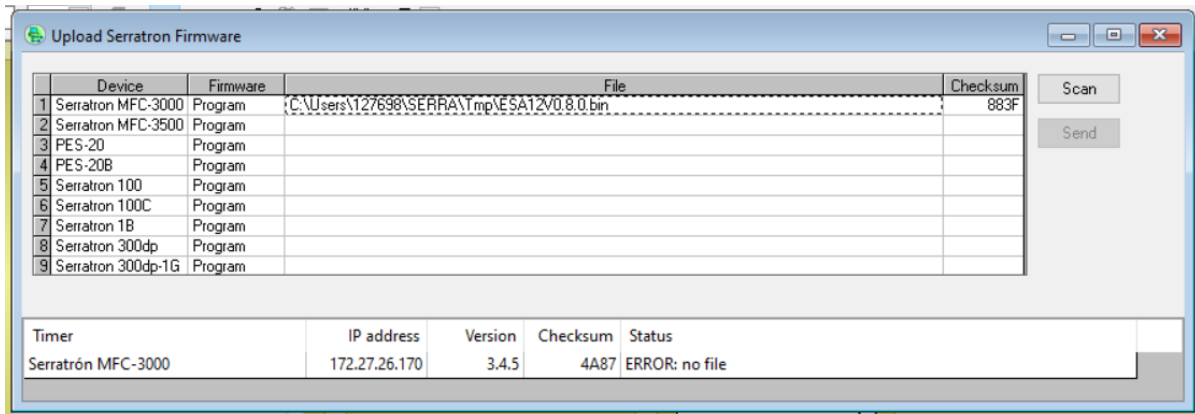


Figure 15 - CPC firmware update

The file name will use the form ESA12Vx.y.bin.

FIND DEVICE (NET SCANNING)

It is possible to identify an ESA-12 interface board connected to a Ethernet network, using the Dispector program inside CPC-Connect. You can start it following the menu item 'Network' option 'Dispector'.

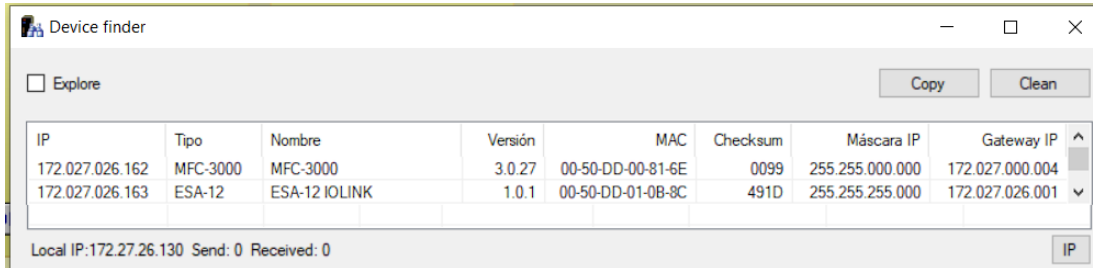


Figure 16 - CPC Net scan

By clicking the explore check, a continuous scan of the network is executed and the Serra Soldadura SAU devices present in the network are shown, together with some identifying parameters.

FAULTS

The CPC-Connect software or eventually the TP-10 handheld terminal show the MFC-3000 welding controller diagnostics. This diagnostics include a generic error for the ESA-12 interface numbered 48, beside this number there is an Index number.

This index number show specific information about the error and is documented in the following table.

Fault List

Table 6 – Fault List

Nº	Description
5	Master ModBus/IO-Link not enabled ⓘ In the welding controller configuration, the ESA-12 interface is not enabled. ☒ The ESA-12 board is not operative. ☑ Update/correct configuration using the CPC-Connect software.
9	Service task fault ⓘ An internal error has occurred in the asynchronous communication services of the ESA-12 board ☒ The communication with the ModBus/IO-Link gateways in the network is interrupted. ☑ Press/activate welding controller error reset.
12	I/O polling task #1 fault ⓘ An internal error has occurred in the periodic communication services of the ESA-12 board. ☒ The communication with the ModBus/IO-Link gateways in the network is interrupted. ☑ Press/activate welding controller error reset.
15	I/O polling task #2 fault ⓘ An internal error has occurred in the periodic communication services of the ESA-12 board. ☒ The communication with the ModBus/IO-Link gateways in the network is interrupted. ☑ Press/activate welding controller error reset.
18	Startup task waiting for Ethernet connection ⓘ At startup any of the 4 RJ45 connectors of the ESA-12 switch (see Ethernet connectors Eth1..4) Must be connected to an Ethernet network. ☒ The ESA-12 board is not operative. ☑ Connect the ESA-12 to the network.
21	Board configuration running ⓘ During a second fraction, the configuration loaded is processed in the ESA-12 board. ☒ The ESA-12 board is not operative. ☑ This error should disappear in a few seconds.

Nº	Description
24	Maximum number of ModBus/IO-Link gateways exceeded <ul style="list-style-type: none"> ① This number is limited to 8. ☒ The ESA-12 board is not operative. ☑ Update/correct configuration using the CPC-Connect software.
27	Maximum number of network modules exceeded <ul style="list-style-type: none"> ① This number is limited to 24, including the ModBus/IO-Link gateways. ☒ The ESA-12 board is not operative. ☑ Update/correct configuration using the CPC-Connect software.
30	There is no configured network <ul style="list-style-type: none"> ① There is no valid network configuration stored in the ESA-12 board. ☒ The ESA-12 board is not operative. ☑ Update/correct configuration using the CPC-Connect software. ☑ At least one mapping instruction must be included in the configuration.
xx05	ModBus/IO-Link gateway xx disconnected <ul style="list-style-type: none"> ① Gateway with module number xx in the configuration does not communicate. ☒ Error is displayed, communication with the remaining connected gateways continues. In the gateway configuration (see IO-Link configuration) the local response to this situation must be configured. ☑ Check cabling and Gateway configuration: configured IP address. ☑ Press/activate welding controller error reset.
xx06	ModBus/IO-Link gateway xx identification error <ul style="list-style-type: none"> ① The gateway identification string obtained by a query of the gateway module number xx does not match the configured expected id. ☒ Error is displayed, communication with the remaining connected gateways continues. The faulty module remains inoperative. ☑ See if the locally configured IP address matches the address configured in the CPC-Connect software.
xx10	ModBus/IO-Link gateway xx configuration running <ul style="list-style-type: none"> ① A new configuration of the Gateway module xx has been requested and is running. ☒ - ☑ This error disappears automatically when configuration is over.
xx11	ModBus/IO-Link gateway xx internal error <ul style="list-style-type: none"> ① Program internal error. ☒ The ESA-12 board discontinues the communication with gateway module xx and restarts the communication automatically. ☑ If the error persists restart the ESA-12 by powering off the controller. ☑ If the error persists restart the network by powering off all its connected modules. ☑ Contact Serra Soldadura SAU Customer Support Team.

Nº	Description
xx12	<p>ModBus/IO-Link gateway xx error in service task</p> <ul style="list-style-type: none"> ① Program internal error. ☒ The ESA-12 board discontinues the communication with gateway module xx and restarts the communication automatically. ☑ If the error persists restart the ESA-12 by powering off the controller. ☑ If the error persists restart the network by powering off all its connected modules. ☑ Contact Serra Soldadura SAU Customer Support Team.
xx13	<p>ModBus/IO-Link gateway xx error in polling task</p> <ul style="list-style-type: none"> ① Communication with the gateway module xx is disturbed. ☒ The gateway continues to communicate. It is a warning message. ☑ If error appears continuously contact Serra Soldadura SAU Customer Support Team.
xx16	<p>ModBus/IO-Link gateway xx error in data exchange</p> <ul style="list-style-type: none"> ① An errors has been detected in the communication with gateway module xx during input read or output write. ☒ ESA-12 executes some retries if the Exchange is not successful it restarts the communication automatically. ☑ If the error persists restart the ESA-12 by powering off the controller. ☑ If the error persists restart the network by powering off all its connected modules. ☑ Contact Serra Soldadura SAU Customer Support Team.
xx18	<p>ModBus/IO-Link gateway xx internal operation error</p> <ul style="list-style-type: none"> ① Program internal error. ☒ The ESA-12 board discontinues the communication with gateway module xx and restarts the communication automatically. ☑ If the error persists restart the ESA-12 by powering off the controller. ☑ If the error persists restart the network by powering off all its connected modules. ☑ Contact Serra Soldadura SAU Customer Support Team.
xx20	<p>ModBus/IO-Link gateway xx hardware error</p> <ul style="list-style-type: none"> ① Hardware error in ModBus gateway module xx ☒ The ESA-12 board discontinues the communication with gateway module xx and restarts the communication automatically. ☑ If the error persists restart the ESA-12 by powering off the controller. ☑ If the error persists restart the network by powering off all its connected modules. ☑ Contact Serra Soldadura SAU Customer Support Team.
xx22	<p>ModBus/IO-Link gateway xx configuration error</p> <ul style="list-style-type: none"> ① Some error has been detected in the received gateway module xx configuration. ☒ The ESA-12 board does not start communication with the affected module. ☑ Update/correct configuration using the CPC-Connect software.

Nº	Description
xx23	ModBus/IO-Link gateway xx error in IOEX mapping instruction ⓘ Some error has been detected in the received gateway module xx configuration, related to its mapping. ☒ The ESA-12 board does not start communication with the affected module. ☑ Update/correct configuration using the CPC-Connect software.
xx24	ModBus/IO-Link gateway xx data error ⓘ Program internal error. ☒ The ESA-12 board does not start communication with the affected module. ☑ Reload configuration using the CPC-Connect software. ☑ If the error persists Contact Serra Soldadura SAU Customer Support Team.

Abbreviations used in table header:

Nº Index number shown in user interface (Handheld TP-10 or CPC-Software) .

Symbols used in fault explanation:

- ⓘ Fault additional information.
- ☒ Possible origin of the fault.
- ☑ Fix for the fault.

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