User Manual
NX-ERA

Xpress MU216600

Rev. F January 16, 2020

Contents

1. Introduction

NX-ERA Xpress is a powerful compact Programmable Logic Controller (PLC) part of NX-ERA Series family of controllers and I/O modules. NX-ERA Xpress delivers high-speed processing power in a compact design with embedded I/O. There are several options to choose from, allowing the best solution for entry-level applications.

This product portfolio targets small control systems, offering models containing from a few digital inputs and outputs up to options with 43 I/O points concentrated in a single controller, including analog inputs and outputs with temperature support (RTD sensors). In case of additional I/O needs, the system can be easily expanded through CANopen using the Remote I/O Mode. This mode transforms the product into a non-programmable slave I/O device, which can then be connected to a XP3xx controller with CANopen Manager protocol. It can also be expanded using other available ports like Ethernet and RS-485.

NX-ERA Xpress is suitable for small applications and remote distributed I/O. It may be applied in verticals such as infrastructure, building automation, water, wastewater, food, textiles, factory automation, machines and several other OEM solutions. Additionally, it is an ideal solution for complementing big applications along with NX-ERA Series portfolio, extending the range of applications using the same technology and engineering environment. This is a great advantage for OEMs and systems integrators with needs of small to large applications.

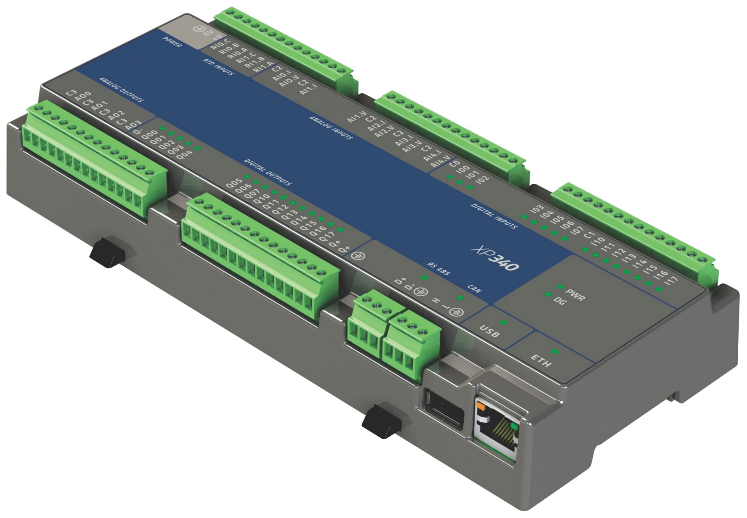


Figure 1: NX-ERA Xpress

1.1. Documents Related to this Manual

This manual will focus on information that is specific for the controllers of NX-ERA Xpress family. For other functionalities that are identical along all controllers of NX-ERA Series, this manual will just point to the corresponding manual of NX-ERA Series that contains the information. These related manuals are described on the following table, and are available in its last version on the site www.messung.com

Code	Description	Language
CE114000	NX-ERA Series – Technical Characteristics	English
MU216600	NX-ERA Xpress User Manual	English
MU214600	NX-ERA Series User Manual	English
MU214605	NX-ERA Series CPUs User Manual	English
MU299609	MasterTool IEC XE User Manual	English
MP399609	MasterTool IEC XE Programming Manual	English

Table 1: Documents Related

1.2. Visual Inspection

Before resuming the installation process, it is advised to carefully visually inspect the equipments, verifying the existence of transport damage. Verify if all parts requested are in perfect shape. In case of damages, inform the transport company or Messung distributor closest to you.

CAUTION:
Before taking the modules off the case, it is important to discharge any possible static energy accumulated in the body. For that, touch (with bare hands) on any metallic grounded surface before handling the modules. Such procedure guaranties that the module static energy limits are not exceeded.

It's important to register each received equipment serial number, as well as software revisions, in case they exist. This information is necessary, in case the Messung Technical Support is contacted.

1.3. Technical Support

For Technical Support contact send an email to sahir.chopdar@messung.com

If the equipment is already installed, you must have the following information at the moment of support requesting:

- The model of the used equipments and the installed system configuration
- The product serial number
- The equipment revision and the executive software version, written on the tag fixed on the product side
- CPU operation mode information, acquired through MasterTool IEC XE
- The application software content, acquired through MasterTool IEC XE
- Used program version

1.4. Warning Messages Used in this Manual

In this manual, the warning messages will be presented in the following formats and meanings:

DANGER: Reports potential hazard that, if not detected, may be harmful to people, materials, environment and production.
CAUTION: Reports configuration, application or installation details that must be taken into consideration to avoid any instance that may cause system failure and consequent impact.
ATTNTION: Identifies configuration, application and installation details aimed at achieving maximum operational performance of the system.

2. Technical Description

This chapter presents all technical features of NX-ERA Xpress controllers.

2.1. Panels and Connections

The following figure shows the XP325 front panel:

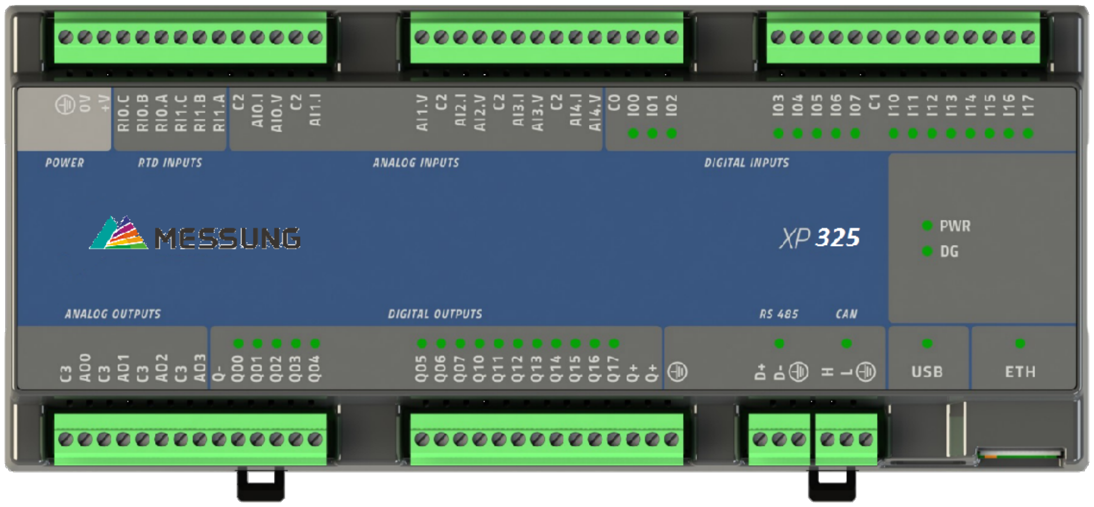


Figure 2: XP325 front panel

The front panel contains the identification of the I/O and communication interfaces available on NX-ERA Xpress controllers. The digital I/O interfaces have one LED for each point to indicate the logic state, while the communication interfaces have one LED each to indicate activity. The availability of these interfaces on each model is described on next section.

Additionally, on the right side of front panel there are 2 LEDs used to indicate power and diagnostics. The following table shows the LEDs description. For further information regarding the LEDs status and meaning, see Maintenance chapter.

LED	Description
PWR	Status of internal power supply
DG	Diagnostic indication
Ixx.x	Status of digital inputs
Qxx.x	Status of digital outputs
D+/-	Status of RS-485 interface (blinks on activity)
H/L	Status of CAN interface (blinks on activity)
USB	Status of USB port (turns on when device is mounted)
ETH	Status of Ethernet interface (turns on when connected, blinks on activity)

Table 2: LEDs Description

2.2. Product Features

2.2.1. General Features

	XP300	XP315	XP325	XP340
Digital Inputs	12			
Fast Inputs	4			
Digital Outputs	12			
Fast Outputs	4			
Max. number of high-speed counters	1			
Max. number of external interruptions	2			
Max. number of PTO outputs	2			
Max number of VFO/PWM outputs	4			
V/I analog inputs (AI)	-	5	5	5
RTD analog inputs (AI)	-	2	2	2
V/I analog outputs (AO)	-	-	4	4
Ethernet TCP / IP interface	1			
RS-485 Serial interface	1			
CAN Interface	1			
USB Host port	1			
CANOpen Manager protocol	Yes			
IEC 60870-5-104 Server protocol	No	No	No	Yes
User web pages (Webvisu)	No	No	No	Yes
Remote I/O Mode	Yes			
Addressable input variables memory (%I)	2 KB			
Addressable output variables memory (%Q)	2 KB			
Addressable variables memory (%M)	1 KB			
Symbolic variables memory	2 MB			
Program memory	2 MB	2 MB	2 MB	6 MB
Retain/persistent memory (user configurable)	7.5 KB			
Source code memory (backup)	26 MB			
User files memory (backup)	8 MB			
Maximum number of tasks	5			
Programming languages	Structured Text (ST) Ladder Diagram (LD) Sequential Function Chart (SFC) Function Block Diagram (FBD) Continuous Function Chart (CFC)			
Online changes	Yes			
Watchdog	Yes			
Real-time clock (RTC)	Yes Resolution of 1 ms, max. variance of 3 seconds per day, retention time of 14 days.			
Status and diagnostic indication	LEDs, web pages and CPU's internal memory			
Isolation Protective earth ⏚ to all Logic/RS-485/CAN/USB to all Ethernet to all Power Supply/Analog I/O to all Digital Inputs to all Digital Inputs Group I0x to I1x	 1,500 Vdc / 1 minute (1,000 Vac / 1 minute) 1,500 Vdc / 1 minute (1,000 Vac / 1 minute) 1,500 Vdc / 1 minute (1,000 Vac / 1 minute) 1,500 Vdc / 1 minute (1,000 Vac / 1 minute) 1,500 Vdc / 1 minute (1,000 Vac / 1 minute) 1,500 Vdc / 1 minute (1,000 Vac / 1 minute)			

	XP300	XP315	XP325	XP340
Digital Outputs to all	1,500 Vdc / 1 minute (1,000 Vac / 1 minute)			
Maximum power dissipation	5 W			
Maximum wire size	0.5 mm^2 (20 AWG) with ferrule 1.5 mm^2 (16 AWG) without ferrule			
Minimum wire temperature rating	75 °C			
Wire material	Copper only			
IP level	IP 20			
Conformal coating	Yes			
Operating temperature	0 to 60 °C			
Storage temperature	-25 to 75 °C			
Operating and storage relative humidity	5% to 96%, non-condensing			
Standards	IEC 61131-2 CE – 2011/65/EU (RoHS), 2014/35/EU (LVD) and 2014/30/EU (EMC) UL/cUL Listed - UL 61010-1 (file E473496)			
Product dimensions (W x H x D)	215.5 x 98.8 x 34.0 mm			
Package dimensions (W x H x D)	270.0 x 102.0 x 40.0 mm			
Weight	370 g			
Weight with package	430 g			

Table 3: General Features

Notes:

Persistent and Retain symbolic variables memory: Area where are allocated the retentive symbolic variables. The retentive data keep its respective values even after a CPU's cycle of power down and power up. The persistent data keep its respective values even after the download of a new application in the CPU.

ATTENTION:
The declaration and use of symbolic persistent variables should be performed exclusively through the Persistent Vars object, which may be included in the project through the tree view in Application -> Add Object -> Persistent Variables. It should not be used the VAR PERSISTENT expression in the declaration of field variables of POUs.

The full list of when the symbolic persistent variables keep their values and when the values are lost can be found in the following table. Additionally to the persistent area size mentioned on general features table, 44 bytes are reserved for the storage of information about the persistent variables (not available for use).

The following table shows the behavior of retentive and persistent variables for different situations where "-" means the value is lost and "X" means the value is kept.

Command	Symbolic Variable	Retain variable	Persistent variable
Reset warm / Power-on/off cycle	-	X	X
Reset cold	-	-	X
Reset Origin	-	-	-
Download	-	-	X
Online change	X	X	X
Reboot PLC	-	X	X
Clean All	-	-	X

Table 4: Post-command Variable Behavior

Notes:

Isolation: The Logic term refers to the internal interfaces such as processors, memories and USB, serial and CAN communication interfaces.

Conformal coating: Conformal coating protects the electronic components inside the product from moisture, dust and other harsh elements to electronic circuits.

2.2.2. RS-485

	RS-485
Connector	3-pin terminal block
Physical interface	RS-485
Communication direction	RS-485: half duplex
RS-485 max. transceivers	32
Termination	Yes (Configurable)
Baud rate	2400, 4800, 9600, 19200, 38400, 57600, 115200 bps
Protocols	Master/Slave MODBUS RTU Open protocol

Table 5: RS-485 Serial Interface Features

2.2.3. CAN

	CAN
Connector	3-pin terminal block
Physical interface	CAN bus
Supported standards	CAN 2.0A 2.0B (11-bit and 29-bit identifiers)
Max. number of nodes	32
Termination	Yes (Configurable)
Baud rate	10, 20, 50, 100, 125, 250, 500, 800, 1000 kbit/s
Protocols	CANOpen Manager (Master) CANOpen Slave CANOpen low level

Table 6: CAN Interface Features

2.2.4. USB

	USB
Connector	USB A Female
Physical interface	USB V2.0
Baud rate	1.5 Mbps (Low Speed), 12 Mbps (Full Speed) and 480 Mbps (High Speed)
Maximum current	500 mA
Supported devices	Mass storage USB RS-232 Serial converters based on FTDI and Prolific controller chips

Table 7: USB Interface Features

2.2.5. Ethernet

	Ethernet
Connector	Shielded female RJ45
Auto crossover	Yes
Maximum cable length	100 m
Cable type	UTP or ScTP, category 5
Baud rate	10/100 Mbps
Physical layer	10/100 BASE-TX
Data link layer	LLC
Network layer	IP
Transport layer	TCP (Transmission Control Protocol) UDP (User Datagram Protocol)
Application layer	MODBUS TCP Client and Server MODBUS RTU Master/Slave OPC DA Server OPC UA Server EtherNet/IP Scanner MQTT Client HTTP Server MasterTool IEC XE programming protocol SNTP Client SNMP Agent (Ethernet Network Management)
Diagnostics	LED (Link/Activity)

Table 8: Ethernet Interface Features

2.2.6. Power Supply

	Power Supply
Nominal input voltage	24 Vdc
Input voltage	19.2 to 30 Vdc
Maximum input current (in-rush)	50 A / 300 us
Maximum input current	300 mA

Table 9: Power Supply Features

2.2.7. Digital Inputs

	Digital Inputs
Input type	Optoisolated sink type 1 Two isolated groups of 8 inputs each
Input voltage	24 Vdc 15 to 30 Vdc for logic level 1 0 to 5 Vdc for logic level 0
Input impedance	4.95 kΩ
Maximum input current	6.2 mA @ 30 Vdc
Input state indication	Yes
Response time	0.1 ms
Input filter	Disabled or 2 ms to 255 ms – by software

Table 10: Digital Inputs Features

Note:

Input filter: The filter sampling is performed on MainTask (or Refresh function), then it's recommended to use multiple values of the task interval.

2.2.8. Fast Inputs

	Fast Inputs
Number of fast inputs	4 (can be used as high-speed counter, External interrupt or normal input)
Max. number of high-speed counters	1
Max. number of external interrupts	2
Connector configuration	I00, I01, I02 and I03
Input voltage	24 Vdc 15 to 30 Vdc for logic level 1 0 to 5 Vdc for logic level 0
Input impedance	1.85 kΩ
Input maximum current	16.2 mA @ 30 Vdc
Configuration mode	1-input modes Normal digital input External interrupt 2-input modes Up/Down (A count, B direction) with zero (uses I00, I01, I02) Quadrature 2x (uses I00, I01) Quadrature 2x with zero (uses I00, I01, I02) Quadrature 4x (uses I00, I01) Quadrature 4x with zero (uses I00, I01, I02)
Counting direction control	By software or hardware
Counting input detection edge	Rising edge, active at logic level 1 (except for quadrature 4x, where it counts on both edges)
Data format	Signed 32-bit integer
Operation limit	From - 2,147,483,648 to 2,147,483,647
Maximum input frequency	100 kHz
Minimum pulse width @ 24 Vdc	2 μs

Table 11: Fast Inputs Features

2.2.9. Digital Outputs

	Digital Outputs
Output type	Optoisolated transistor source type
Maximum output current	1.5 A per output 12 A total
Leakage current	35 µA
On state resistance	105 mΩ
External power supply	19.2 to 30 Vdc
Switching time	20 µs - off-to-on transition @ 24 Vdc 500 µs - on-to-off transition @ 24 Vdc
Maximum switching frequency	250 Hz
Configurable parameters	Yes
Output state indication	Yes
Output protections	Yes, protection against surge voltages

Table 12: Digital Outputs Features

Note:
Switching time: The required time to turn off one specific output depends on the load.

2.2.10. Fast Outputs

	Fast Outputs	
Number of outputs	4 (can be used as VFO/PWM, PTO or normal output)	
Max. number of PTO outputs	2	
Max number of VFO/PWM outputs	4	
Connector configuration	Q14, Q15, Q16 and Q17	
Maximum current	0.5 A @ 30 Vdc by output 2 A @ 30 Vdc total	
Output type	Transistor source	
Pulse generation maximum frequency	200 kHz @ 60 mA	
Minimum pulse width @ 24 Vdc	MINIMUM LOAD	MINIMUM PULSE TIME
	400 Ω	320 ns
State indication	Through static reserved operands	
Protections	TVS diode at all transistor outputs	
Operation voltage	19.2 to 30 Vdc	
Output impedance	700 mΩ	
Output modes	Normal digital output, VFO/PWM and PTO	
Functions executed by software	PTO	VFO/PWM
	Writing of number of pulses to be generated Writing of acceleration and deceleration number of pulses Start/end outputs operation Fast outputs diagnostics Fast outputs current state monitoring	Writing of the frequency value to be generated (1 Hz to 200 kHz). Writing of outputs duty cycle (1% to 100%) Start/end of outputs operations Fast outputs diagnostics.

Table 13: Fast Outputs Features

2.2.11. Analog Inputs

	Analog Inputs
Input type	Voltage or current input, single ended, individually configured
Data format	16 bits in two's complement, justified to the left
Converter resolution	12 bits monotonicity guaranteed, no missing codes
Conversion time	400 µs (all V/I and RTD channels enabled)
Input state indication	Yes
Module protections	Yes, protection against surge voltages and polarity inversion

Table 14: Analog Inputs Features

	Voltage Input Mode		
Input ranges	Range	Engineering Scale	Resolution
	0 to 10 Vdc	0 to 30,000	2.5 mV
Precision	±0.3 % of full scale rating @ 25 °C ± 0.010 % of full scale rating / °C		
Over scale	3 % of full scale rating		
Maximum input voltage	12 Vdc		
Input impedance	21 kΩ		
Configurable parameters	Signal type per input Filters		
Low pass filter time constant	100 ms, 1 s, 10 s or disabled		

Table 15: Voltage Input Mode Features

	Current Input Mode		
Input ranges	Range	Engineering Scale	Resolution
	0 to 20 mA 4 to 20 mA	0 to 30,000 0 to 30,000	5.12 µA 5.12 µA
Precision	±0.3 % of full scale rating @ 25 °C ± 0.015 % of full scale rating / °C		
Over scale	3 % of full scale rating		
Maximum input current	30 mA		
Input impedance	119 Ω		
Configurable parameters	Signal type per input Filters Open Loop Value		
Low pass filter time constant	100 ms, 1 s, 10 s or disabled		

Table 16: Current Input Mode Features

Note:

Input ranges: When configured as 4 to 20 mA, input signals lower than 4 mA will result in negative values (-7,500 for 0 mA). Starting from MasterTool IEC XE version 3.16, a new parameter called Open Loop Value was included to select the behavior in this situation. The default value is Disabled (which provides a linear reading as described above), having also the option to provide a fixed reading equal to lower and upper limits ("0" or "30000").

	RTD Input
Precision	±0.5 % of full scale rating @ 25 °C
Supported scales	Pt100, Pt1000, 0 to 400 Ω, 0 to 4000 Ω
Excitation current	1 mA
Resistance range	0 to 4000 Ω
Over Scale	5 % of full scale rating
Configurable parameters	Signal type per input Filters
Low pass filter time constant	100 ms, 1 s, 10 s or disabled
Maximum sensor cable impedance	20 Ω

Table 17: RTD Input Features

Note:

Maximum sensor cable impedance: Maximum total resistance added by the two wires of the sensor.

2.2.12. Analog Outputs

	Analog Outputs
Output type	Voltage or current output, individually configured
Data format	16 bits in two's complement, justified to the left
Converter resolution	12 bits monotonicity guaranteed, no missing codes
Update time	450 µs (all outputs enabled)
Output state indication	Yes
Module protections	Yes, protection against surge voltages and polarity inversion

Table 18: Analog Outputs Features

	Voltage Output Mode		
Output ranges	Range	Engineering Scale	Resolution
	0 to 10 V	0 to 30,000	2.5 mV
Precision	±0.3 % of full scale rating @ 25 °C ± 0.025 % of full scale rating / °C		
Stabilization time	4 ms		
Maximum output value	+ 10.3 Vdc		
Load impedance	> 1 kΩ		
Configurable parameters	Signal type per output		

Table 19: Voltage Output Mode Features

	Current Output Mode		
Output ranges	Range	Engineering Scale	Resolution
	0 to 20 mA 4 to 20 mA	0 to 30,000 0 to 30,000	5.18 µA 5.18 µA
Precision	±0.3 % of full scale rating @ 25 °C ± 0.020 % of full scale rating / °C		
Stabilization time	4 ms		
Maximum output value	+ 20.6 mA		
Load impedance	< 600 Ω		
Configurable parameters	Signal type per output		

Table 20: Current Output Mode Features

Note:

Output ranges: When configured as 4 to 20 mA, the output can be set to values lower than 4 mA by assigning negative values to the output variable (-7,500 for 0 mA).

2.3. Compatibility with Other Products

To develop an application for NX-ERA Xpress controllers, it is necessary to check the version of MasterTool IEC XE. The following table shows the minimum version required (where the controllers were introduced) and the respective firmware version at that time:

Controller model	MasterTool IEC XE	Firmware version
XP300, XP315 and XP325	3.10 or above	1.7.0.0 or above
XP340	3.18 or above	1.8.0.0 or above

Table 21: Compatibility with other products

Additionally, along the development roadmap of MasterTool IEC XE some features may be included (like special Function Blocks, etc...), which can introduce a requirement of minimum firmware version. During the download of the application, MasterTool IEC XE checks the firmware version installed on the controller and, if it does not meets the minimum requirement, will show a message requesting to update. The latest firmware version can be downloaded from Messung website, and it is fully compatible with previous applications.

2.4. Performance

The performance of NX-ERA Xpress controller relies

- on: Application Interval Time
- User Application Time
- Operational System Time
- Number of integrated I/O channels enabled

2.4.1. Interval Time

The application and I/O update are executed on a cyclic (periodic) task called Main Task. The interval time of this task can be configured from 5 to 100 ms. The time spent for these operations is called Cycle Time, and should always be smaller than the interval, because the free time is used for communication and other low priority tasks of the controller.

Additionally, the integrated I/O can be updated asynchronously at any point of user application code using the refresh functions available on LibIntegrated Io, which is described in details on NX-ERA Series CPUs User Manual code MU214605.

2.4.2. Application Times

The execution time of the application (cycle time) depends on the following variables:

- Integrated inputs read time
- Task execution time
- Integrated outputs write time

The time required for reading and writing the integrated I/O is dependent of the number and the type of the I/O channels enabled. For digital I/O, all channels are always enabled and the time added to MainTask is not relevant. For analog I/O, the time added to MainTask is determined by the conversion time (for analog inputs) and by the update time (for analog outputs), both described on General Features table.

2.4.3. Time for Instructions Execution

The below table presents the necessary execution time for different instructions in NX-ERA Xpress CPUs.

Instruction	Language	Variables	Instruction Times (µs)
1000 Contacts	LD	BOOL	20
1000 Divisions	ST	INT	306
		REAL	114
	LD	INT	306
		REAL	114
1000 Multiplications	ST	INT	23
		REAL	36
	LD	INT	23
		REAL	36
1000 Sums	ST	INT	23
		REAL	36
	LD	INT	23
		REAL	36

Table 22: Instruction Times

2.4.4. Initialization Times

The initialization time of NX-ERA Xpress controllers is approximately 40 s.

2.5. Physical Dimensions

Dimensions in mm.

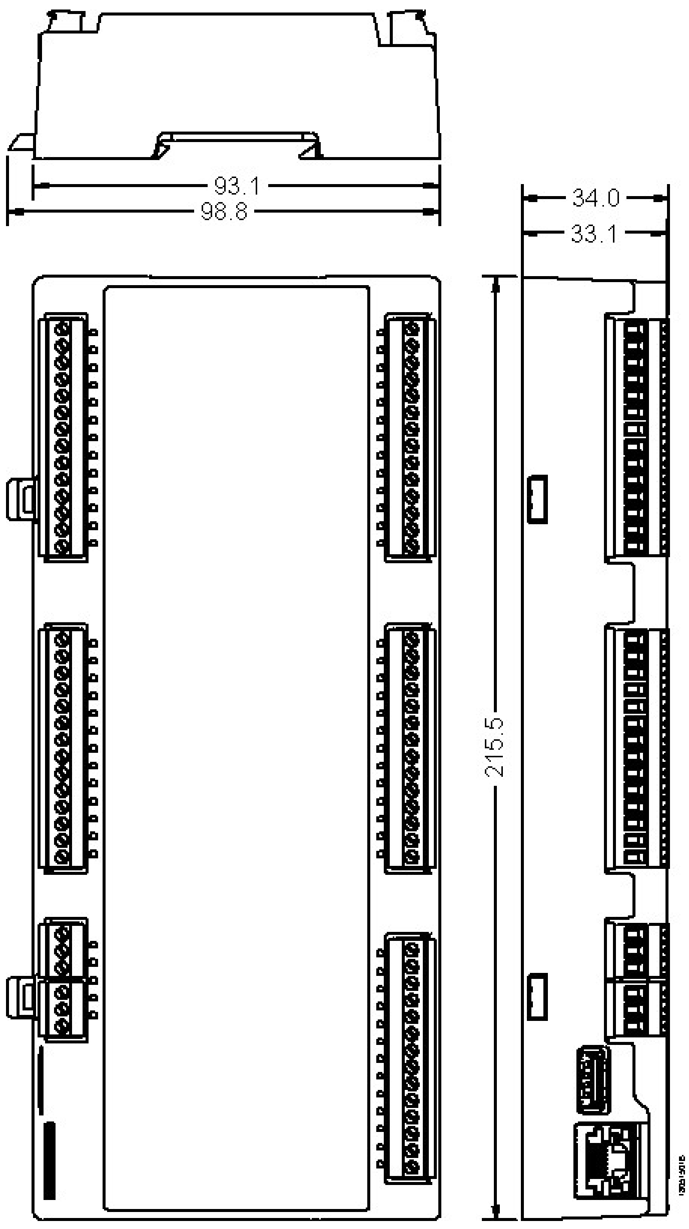


Figure 3: XP3xx Physical Dimensions

2.6. Purchase Data

2.6.1. Integrant Items

The product package has the following items:

- Compact PLC module
- Connectors
- Installation guide

2.6.2. Product Code

The following code should be used to purchase the product:

Code	Description
XP300	High-Speed Compact PLC with 16 DI, 16 DO Transistor, 1 Ethernet, 1 RS-485 Serial and CANopen Master
XP315	High-Speed Compact PLC with 16 DI, 16 DO Transistor, 5 V/I AI, 2 RTD AI (3 wire), 1 Ethernet, 1 RS-485 Serial and CANopen Master
XP325	High-Speed Compact PLC with 16 DI, 16 DO Transistor, 5 V/I AI, 2 RTD AI (3 wire), 4 AO, 1 Ethernet, 1 RS-485 Serial and CANopen Master
XP340	High-Speed Compact PLC with 16 DI, 16 DO Transistor, 5 V/I AI, 2 RTD AI (3 wire), 4 AO, 1 Ethernet, 1 RS-485 Serial, CANopen Master and user web pages support

Table 23: NX-ERA Xpress Controller Models

2.7. Related Products

The following products must be purchased separately when necessary:

Code	Description
MT8500	MasterTool IEC XE
NX9202	RJ45-RJ45 2 m Cable
NX9205	RJ45-RJ45 5 m Cable
NX9210	RJ45-RJ45 10 m Cable
AL-2600	RS-485 network branch and terminator
AL-2301	RS-485 network cable (up to 500 meters)
AL-2306	RS-485 network cable (up to 1000 meters)
FBS-USB-232M9	Universal USB-Serial converter cable / 2m

Table 24: Related Products

Notes:

MT8500: MasterTool IEC XE is available in four different versions: LITE, BASIC, PROFESSIONAL and ADVANCED. For more details, please check MasterTool IEC XE User Manual - MU299609.

NX92xx: Cable for programming the CPUs of the NX-ERA Series and Ethernet point-to-point with another device with
Ethernet interface communication.

AL-2600: This module is used for branch and termination of RS-485 networks. For each network node, an AL-2600 is required. The AL-2600 that are at the ends of network must be configured with termination, except when there is a device with active internal termination, the rest must be configured without termination.

AL-2301: Two shielded twisted pairs cable without connectors, used for networks based on RS-485 interface, with 500 meters of maximum length.

AL-2306: Two shielded twisted pairs cable without connectors, used for networks based on RS-485 interface, with 1000 meters of maximum length.

FBS-USB-232M9: Cable for use as a USB-Serial converter on the USB interface of Xpress controllers.

3. Installation

This chapter presents the necessary proceedings for the physical installation of NX-ERA Xpress controllers, as well as the care that should be taken with other installation within the panel where the controller is been installed.

> CAUTION:
> If the equipment is used in a manner not specified by in this manual, the protection provided by the equipment may be impaired.

3.1. Mechanical Installation

NX-ERA Xpress controllers were designed to be installed in a standard DIN rail. Additionally, the user shall provide a suitable enclosure that meets the system protection and safety requirements. The next sections shows the procedures for installing and removing the controller.

> CAUTION:
> For achieving the temperature specification of the controller, the installation must provide a free space around the device as described on section Panel Design of NX-ERA Series User Manual code MU214600.

3.1.1. Installing the controller

To install the controller on the DIN rail, first move the two locks on open position as indicated on the figure below:

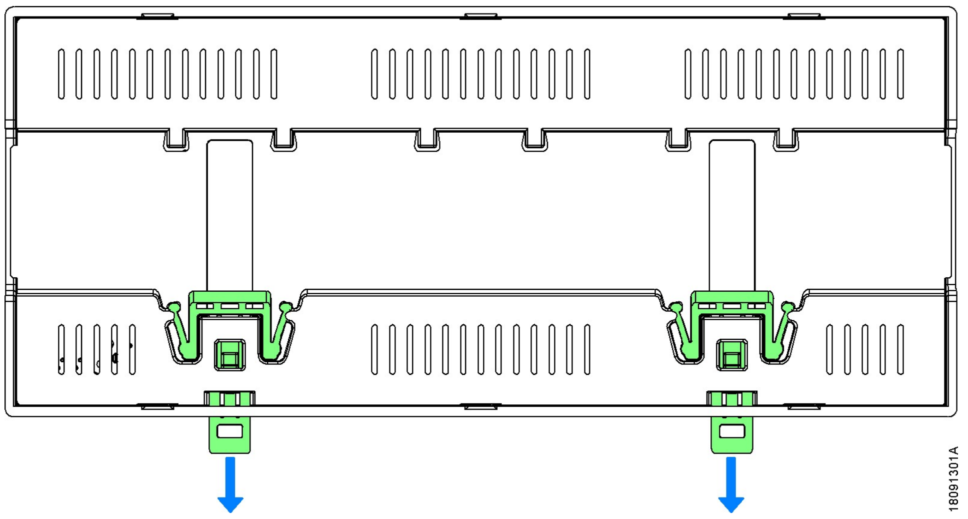


Figure 4: Moving the two locks to open position

Next, place the controller on the DIN rail fitting the top side first and then the bottom side, as indicated on steps 1 and 2 of the figure below:

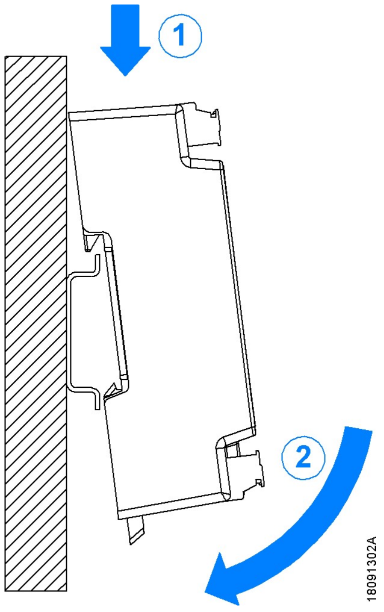


Figure 5: Fixing the controller on the DIN rail

Finally, move the two locks to closed position to lock the controller on the DIN rail, as shown on the figure below:

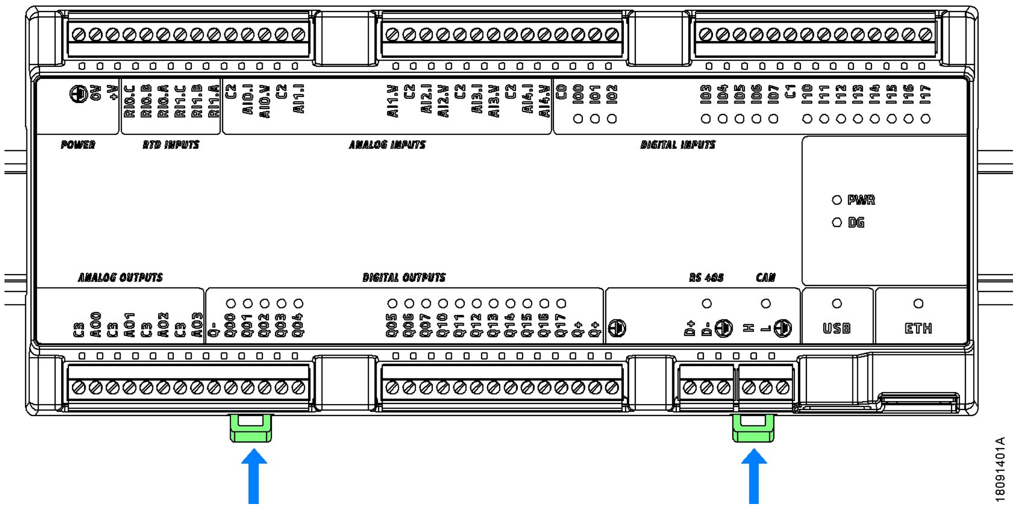


Figure 6: Locking the controller on the DIN rail

3.1.2. Removing the controller

To remove the controller from the DIN rail, just move the two locks to the open position as shown on the figure below:

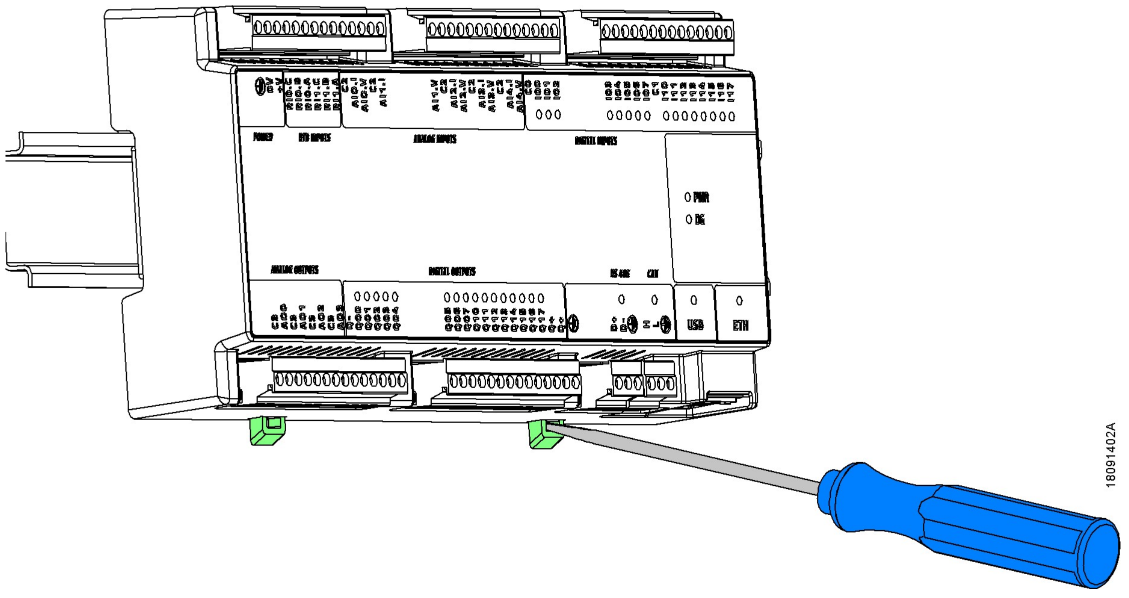


Figure 7: Unlocking the controller from the DIN rail

3.2. Electrical Installation

DANGER:
When executing any installation in an electric panel, certify that the main energy supply is OFF.

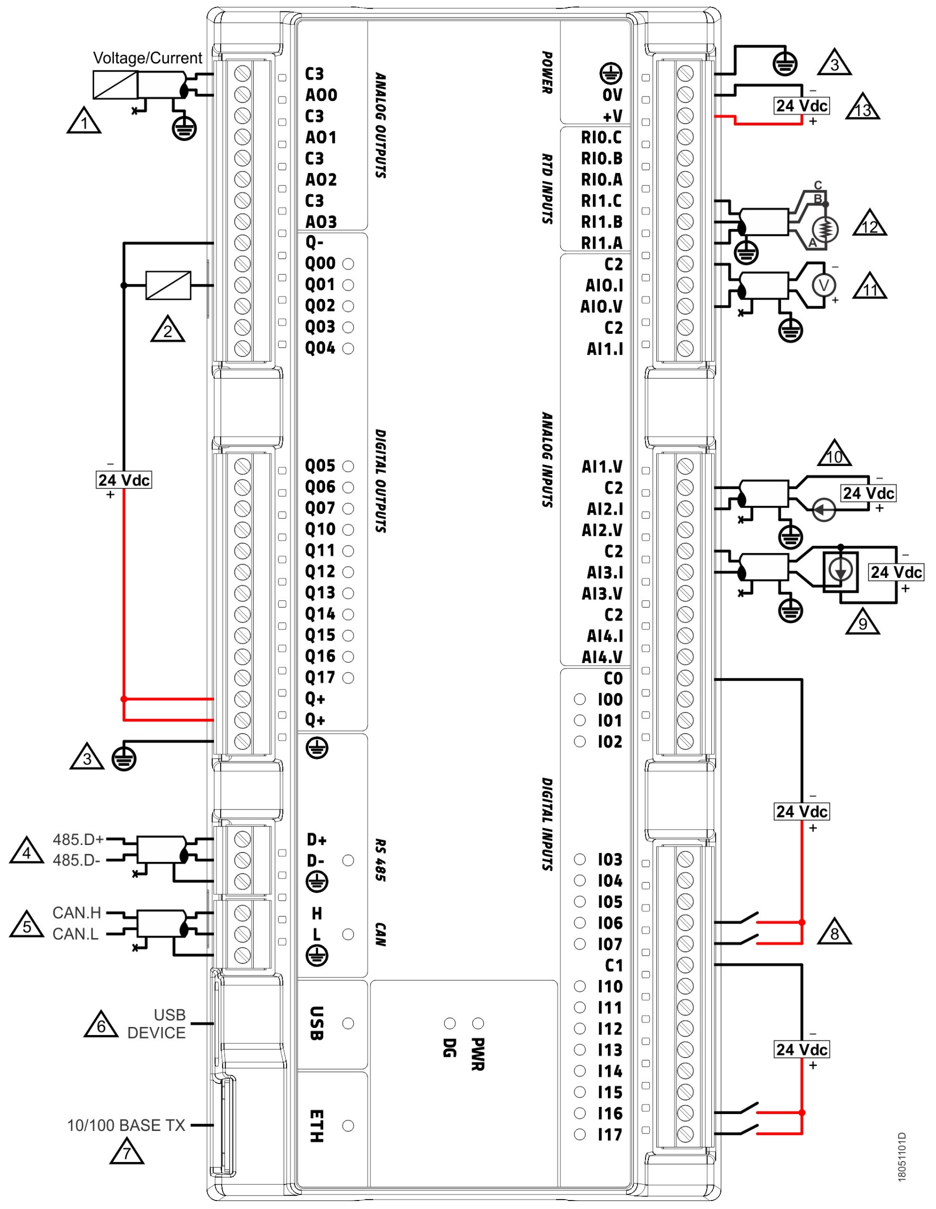


Figure 8: XP3xx Electric Diagram

Diagram Notes:

1. Typical connection of analog output on voltage/current mode
2. Typical connection of digital output (source type)
3. Protective Earth terminals for power supply and communication ports. Both shall be externally connected to ground
4. Typical connection of RS-485 serial interface
5. Typical connection of CAN interface. It's recommended to use a twisted pair shielded cable (like Belden 3105ENH)
6. Please check the technical characteristics table of USB port for the list of supported devices
7. Use Ethernet cables informed on Related Products section
8. Typical connection of digital input (sink type). C0 and C1 are the common points for the isolated groups I0x and I1x respectively
9. Typical connection of current analog input (field device with power supplied separately from analog signal)
10. Typical connection of current analog input (field device with power supplied with the analog signal, 2-wire)
11. Typical connection of voltage analog input
12. Typical connection of RTD analog input (3-wire)
13. External power supply connection

3.3. Ethernet Network Connection

The ETH communication interface, identified as NET 1 on MasterTool IEC XE, allows the connection with an Ethernet network and programming with this tool.

The Ethernet network connection uses twisted pair cables (10/100Base-TX) and the speed detection is automatically made by the NX-ERA Xpress controller. This cable must have one of its endings connected to the interface that is likely to be used and another one to the HUB, switch, microcomputer or other Ethernet network point.

3.3.1. IP Address

The Ethernet interface comes with the following default parameters configuration:

	NET 1
IP Address	192.168.15.1
Subnet Mask	255.255.255.0
Gateway Address	192.168.15.253

Table 25: Default Parameters Configuration for Ethernet NET 1 Interface

First, the NET 1 interface must be connected to a PC network with the same subnet mask to communicate with MasterTool IEC XE, where the network parameters can be modified. For further information regarding configuration and parameters modifications, see Ethernet Interface chapter.

3.3.2. Gratuitous ARP

The NET1 Ethernet interface promptly sends ARP packets type in broadcast informing its IP and MAC address for all devices connected to the network. These packets are sent during a new application download by the MasterTool IEC XE software and in the controller startup when the application goes into Run mode.

Five ARP commands are triggered with a 200 ms initial interval, doubling the interval every new triggered command, totalizing 3 s. Example: first trigger occurs at time 0, the second one at 200 ms and the third one at 600 ms and so on until the fifth trigger at time 3 s.

3.3.3. Network Cable Installation

NX-ERA Xpress Ethernet port have standard pinout which are the same used in PCs. The connector type, cable type, physical level, among other details, are defined in the General Features table. Below is the description of the RJ-45 female connector, with the identification and description of the valid pinout for 10Base-T and 100Base-TX physical levels.

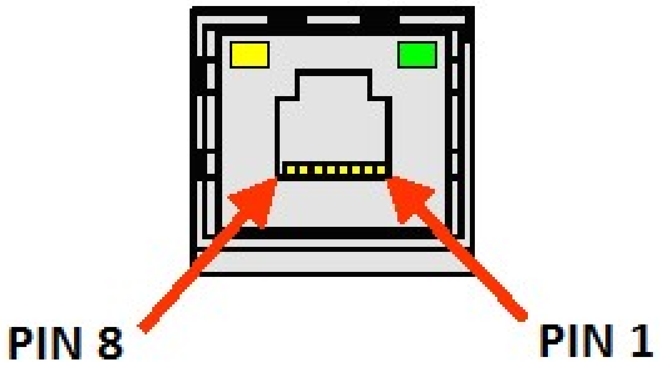


Figure 9: RJ45 Female Connector

Pin	Signal	Description
1	TXD +	Data transmission, positive
2	TXD -	Data transmission, negative
3	RXD +	Data reception, positive
4	NU	Not used
5	NU	Not used
6	RXD -	Data reception, negative
7	NU	Not used
8	NU	Not used

Table 26: RJ45 Female Connector Pin out

The interface can be connected in a communication network through a hub or switch, or straight from the communication equipment. In this last case, due to Auto Crossover feature, there is no need for a cross-over network cable, the one used to connect two PCs point to point via Ethernet port.

It is important to stress that it is understood by network cable a pair of RJ45 male connectors connected by a UTP or ScTP cable, category 5 whether straight connecting or cross-over. It is used to communicate two devices through the Ethernet port.

These cables normally have a connection lock which guarantees a perfect connection between the interface female connector and the cable male connector. At the installation moment, the male connector must be inserted in the module female connector until a click is heard, assuring the lock action. To disconnect the cable from the module, the lock lever must be used to unlock one from the other.

4. Initial Programming

The main goal of this chapter is to help the programming and configuration of NX-ERA Xpress controllers, allowing the user to take the first steps before starting to program the device.

Just like for the other devices of NX-ERA Series, the programming of NX-ERA Xpress controllers is made through the MasterTool IEC XE (IDE) development interface, which offers a full IEC 61131-3 programming system with all languages defined by this standard (ST, LD, SFC, FBD, etc...) plus an additional one, the CFC. These languages can be used simultaneously on the same project, allowing the user to use the best features of each language, resulting in more efficient applications development, for easy documentation and future maintenance.

For further information regarding programming, see User Manual MasterTool IEC XE - MU299609, Programming Manual MasterTool IEC XE - MU399609 or IEC 61131-3 standard.

4.1. Memory Organization and Access

Different from other devices of NX-ERA Series (which are based on big-endian CPU), the NX-ERA Xpress controllers are based on a ARM CPU, which uses the traditional little-endian memory organization (the same found on x86 and Intel processors). On this type of memory organization, the least significant byte is stored first and will always be the smallest address (e.g.
%QB0 will always be less significant than %QB1, as shown on the table below, where, for CPUNX-ERA string, the letter O is byte 0 and the letter C is the byte 7).

Besides this, the memory access must be done carefully as the variables with higher number of bits (WORD, DWORD, LONG), use as index the most significant byte, in other words, the %QD4 will always have as most significant byte the %QB4. Therefore it will not be necessary to make calculus to discover which DWORD correspond to defined bytes. The Table 27, shows little and big endian organization.

MSB ← Little-endian → LSB								
BYTE	%QB7	%QB6	%QB5	%QB4	%QB3	%QB2	%QB1	%QB0
	C	P	U	N	E	X	T	O
WORD	%QW3		%QW2		%QW1		%QW0	
	CP		UN		EX		TO	
DWORD	%QD1				%QD0			
	CPUN				EXTO			
LWORD	%QL0							
	CPUNX-							
MSB ← Big-endian → LSB								
BYTE	%QB0	%QB1	%QB2	%QB3	%QB4	%QB5	%QB6	%QB7
	C	P	U	N	E	X	T	O
WORD	%QW0		%QW2		%QW4		%QW6	
	CP		UN		EX		TO	
DWORD	%QD0				%QD4			
	CPUN				EXTO			
LWORD	%QL0							
	CPUNX-							

Table 27: Example Memory Organization and Access

	SIGNIFICANCE					OVERLAPPING							
	Bit	Byte	Word	DWord	LWord	Byte	Word		DWord				
	%QX0.7												
	%QX0.6												
	%QX0.5												
	%QX0.4	%QB				%QB00							
	%QX0.3	00											
	%QX0.2												
	%QX0.1												
	%QX0.0		%QW				%QW						
	%QX1.7		00				00						
	%QX1.6												
	%QX1.5												
	%QX1.4	%QB				%QB01							
	%QX1.3	01											
MSB	%QX1.2												
	%QX1.1												
⇑	%QX1.0			%QD				%QW	%QD				
	%QX2.7			00				01	00				
LSB	%QX2.6												
	%QX2.5												
	%QX2.4	%QB				%QB02							
	%QX2.3	02											
	%QX2.2												
	%QX2.1												
	%QX2.0		%QW				%QW			%QD			
	%QX3.7		02				02			01			
	%QX3.6												
	%QX3.5												
	%QX3.4	%QB				%QB03							
	%QX3.3	03											
	%QX3.2												
	%QX3.1												
	%QX3.0				%QL			%QW			%QD		
	%QX4.7				00			03			02		
	%QX4.6												
	%QX4.5												
	%QX4.4	%QB				%QB04							
	%QX4.3	04											
	%QX4.2												
	%QX4.1												
	%QX4.0		%QW				%QW					%QD	
	%QX5.7		04				04					03	
	%QX5.6												
	%QX5.5												
	%QX5.4	%QB				%QB05							
	%QX5.3	05											
MSB	%QX5.2												
	%QX5.1												
⇑	%QX5.0			%QD				%QW					%QD
	%QX6.7			04				05					04
LSB	%QX6.6												
	%QX6.5												
	%QX6.4	%QB				%QB06							
	%QX6.3	06											
	%QX6.2												
	%QX6.1												
	%QX6.0		%QW				%QW						
	%QX7.7		06				06						
	%QX7.6												
	%QX7.5												
	%QX7.4	%QB				%QB07							
	%QX7.3	07											
	%QX7.2												
	%QX7.1												
	%QX7.0												

Table 28: Memory Organization and Access

4.2. Project Profiles

A project profile in the MasterTool IEC XE consists in an application template combined with a group of verification rules which guides the development of the application, reducing the programming complexity. For NX-ERA Xpress controllers, there is only one project profile available: Machine Profile.

The Project Profile is selected on the project creation wizard. Each project profile defines a template of standard names for the tasks and programs, which are pre-created according to the selected Project Profile. Also, during the project compilation (generate code), MasterTool IEC XE verify all the rules defined by the selected profile.

The following sections details the characteristics of each profile. It is important to note that the programming tool allows the profile change from an existent project (see project update section in the MasterTool IEC XE User Manual – MU299609), but it's up to the developer to make any necessary adjustments so that the project becomes compatible with the rules of the new selected profile.

ATTENTION:
Through the description of the Project profiles some tasks types are mentioned, which are described in the section 'Task Configuration', of the MasterTool IEC XE User Manual – MU299609.

4.2.1. Machine Profile

In the Machine Profile, by default, the application has a user task of the Cyclic type called MainTask. This task is responsible for implementing a single Program type POU called MainPrg. This program can call other programming units of the Program, Function or Function Block types, but any user code will run exclusively by MainTask task.

This profile is characterized by allowing shorter intervals in the MainTask, allowing faster execution of user code. This profile may further include an interruption task, called TimeInterruptTask00, with a higher priority than the MainTask, and hence, can interrupt its execution at any time.

Task	POU	Priority	Type	Interval	Event
MainTask	MainPrg	13	Cyclic	20 ms	-
TimeInterruptTask00	TimeInterruptPrg00	01	Cyclic	4 ms	-

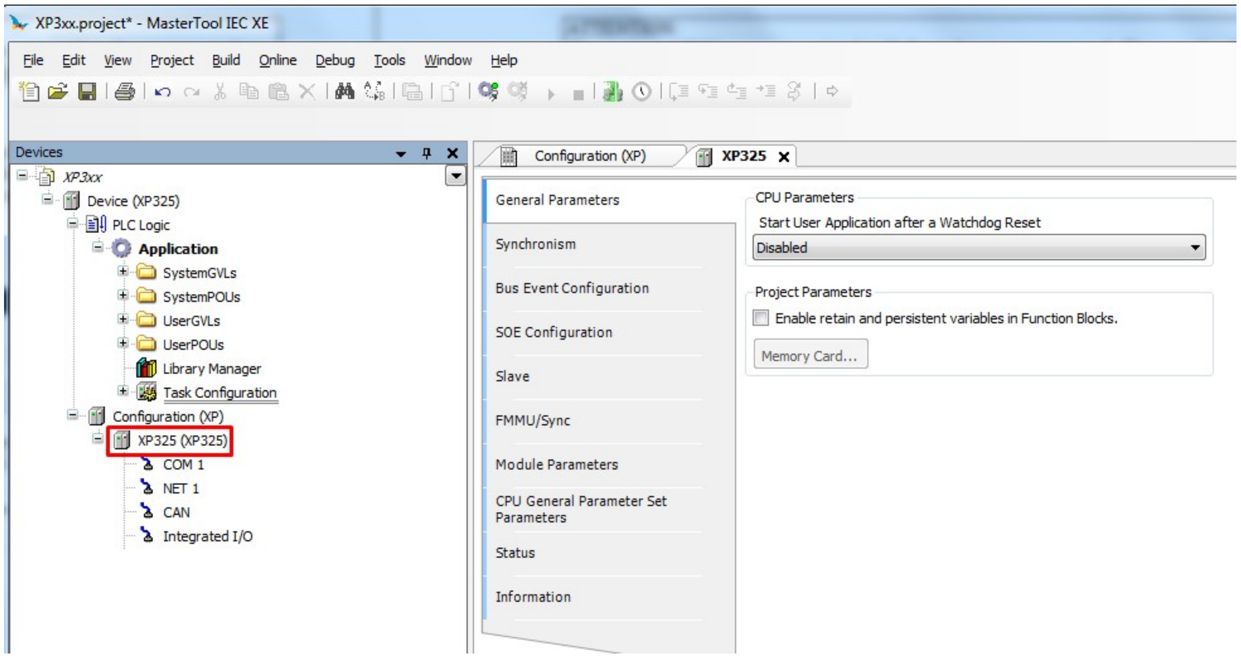
Table 29: Machine Profile Tasks

Also, this profile supports the inclusion of additional tasks associated to the external interruptions.

ATTENTION:
The suggested POU names associated with the tasks are not consisted. They can be changed, as long as they are also changed in the tasks configurations.

4.3. CPU Configuration

The controller's CPU configuration is located in the device tree, as shown on the figure below, and can be accessed by a double-click on the corresponding object. In this tab it's possible to configure watchdog behavior, clock synchronism, among other parameters, as described on section Controller's CPU.

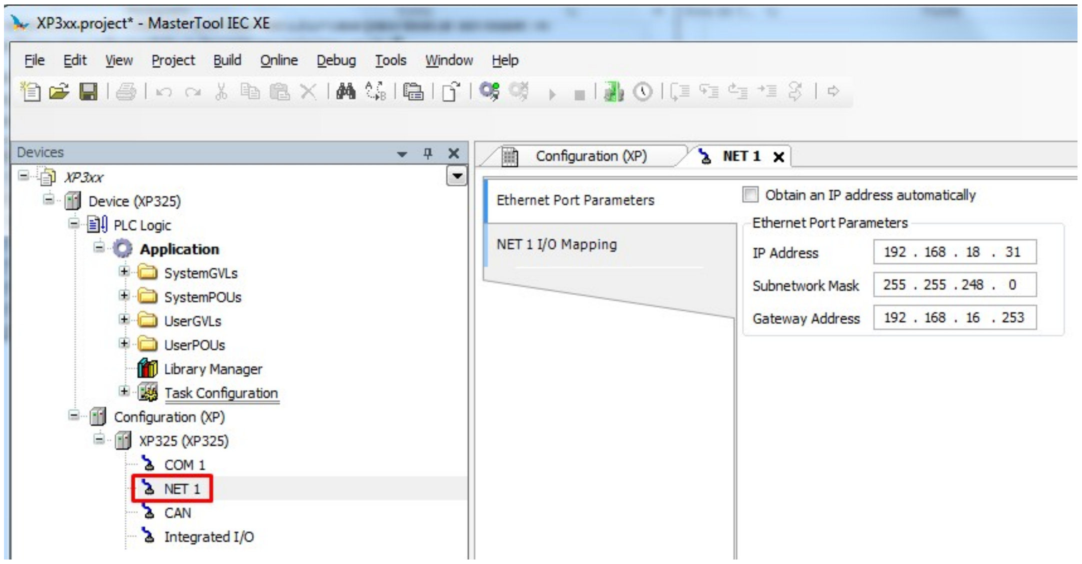


CPU Parameters
Start User Application after a Watchdog Reset: Disabled

Project Parameters
[ ] Enable retain and persistent variables in Function Blocks.

Figure 10: CPU Configuration

Besides that, by double-clicking on controller's NET 1 icon, it's possible to configure the Ethernet interface that will be used for communication between the controller and the software MasterTool IEC XE.



☐ Obtain an IP address automatically

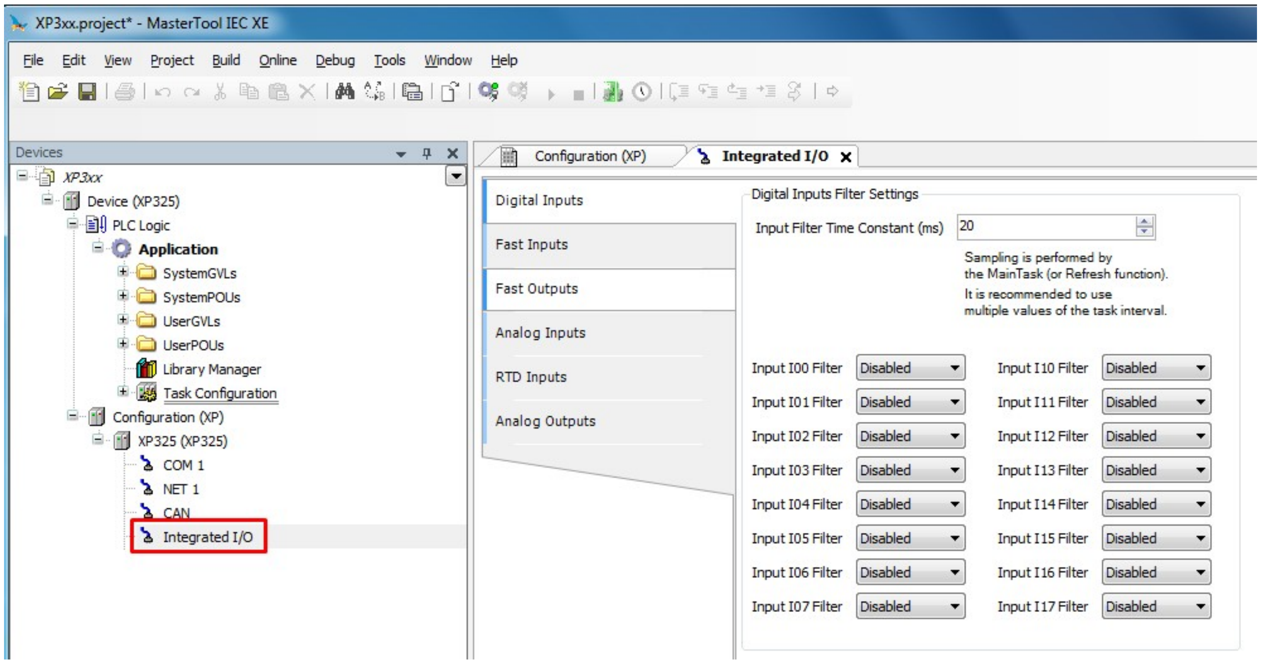
Ethernet Port Parameters

IP Address	192 . 168 . 18 . 31
Subnetwork Mask	255 . 255 . 248 . 0
Gateway Address	192 . 168 . 16 . 253

Figure 11: Configuring the Communication Port

The configuration defined on this tab will be applied to the device only when sending the application to the device (download), which is described further on sections Finding the Device and Login.

Additionally, the device tree also offers the configuration of the integrated I/O available on NX-ERA Xpress controllers, as shown on the figure below. In this tab it is possible to configure digital inputs filters, the mode of each analog input, among other parameters.



Digital Inputs Filter Settings

Input Filter Time Constant (ms) 20

Sampling is performed by the MainTask (or Refresh function).
It is recommended to use multiple values of the task interval.

Input I00 Filter	Disabled	Input I10 Filter	Disabled
Input I01 Filter	Disabled	Input I11 Filter	Disabled
Input I02 Filter	Disabled	Input I12 Filter	Disabled
Input I03 Filter	Disabled	Input I13 Filter	Disabled
Input I04 Filter	Disabled	Input I14 Filter	Disabled
Input I05 Filter	Disabled	Input I15 Filter	Disabled
Input I06 Filter	Disabled	Input I16 Filter	Disabled
Input I07 Filter	Disabled	Input I17 Filter	Disabled

Figure 12: Configuring the Integrated I/O

4.4. Libraries

There are several programming tool resources which are available through libraries. Therefore, these libraries must be inserted in the project so its utilization becomes possible. The insertion procedure and more information about available libraries may be found in the MasterTool Programming Manual – MP399609.

4.5. Inserting a Protocol Instance

The NX-ERA Xpress controllers, as described on General Features table, offers several communication protocols. Except for the OPC communication, which have a different configuration procedure, the insertion of a protocol can be done by simply right-clicking on the desired communication interface, selecting to add the device and finally performing the configuration as shown in the Communication Protocols section. Below are presented some examples.

4.5.1. MODBUS Ethernet

The first step to configure the MODBUS Ethernet (Server in this example) is to include the instance in the desired NET (in this case, NET 1, as the XP3xx has only one Ethernet interface). Click on the NET with the mouse right button and select Add Device..., as shown on Figure 13:

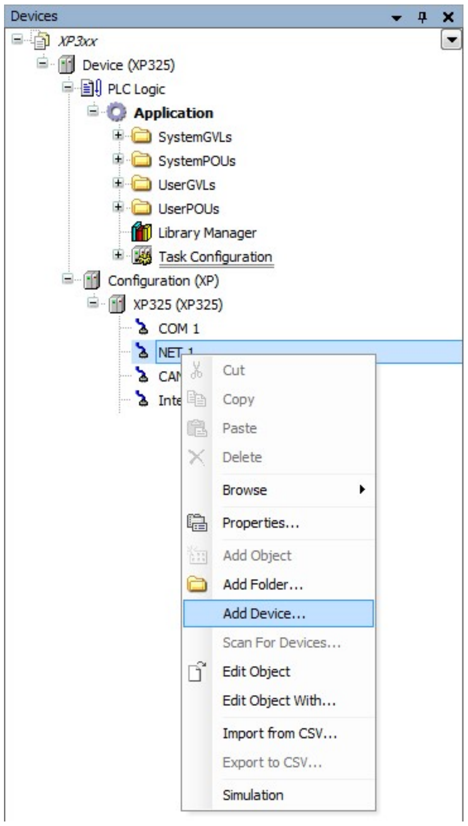
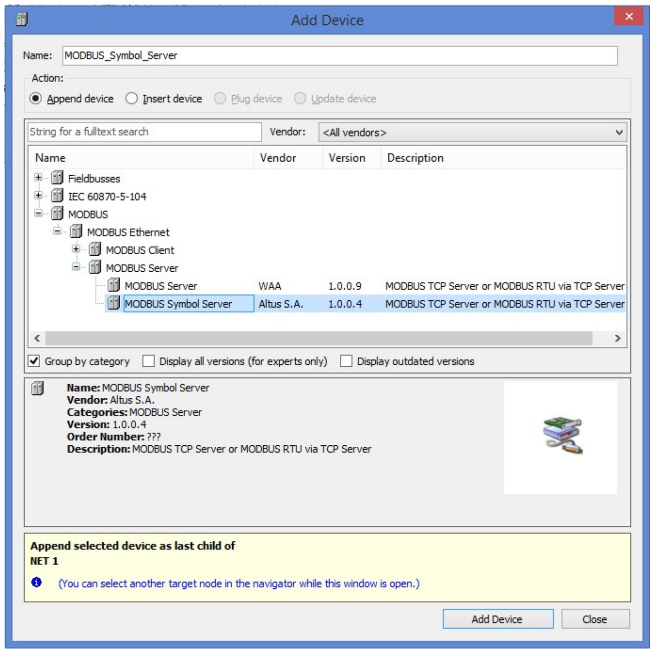


Figure 13: Adding the Instance

After that, the list of protocols will appear on the screen. Simply select MODBUS Symbol Server as described on the figure below:


Add Device
Name: MODBUS_Symbol_Server
Action:
(●) Append device ( ) Insert device ( ) Plug device ( ) Update device
String for a fulltext search
Vendor: <All vendors>
Fieldbusses
IEC 60870-5-104
MODBUS
MODBUS Ethernet
MODBUS Client
MODBUS Server
Group by category
Display all versions (for experts only)
Display outdated versions
Add Device
Close

Name	Vendor	Version	Description
MODBUS Server	WAA	1.0.0.9	MODBUS TCP Server or MODBUS RTU via TCP Server
MODBUS Symbol Server	Altus S.A.	1.0.0.4	MODBUS TCP Server or MODBUS RTU via TCP Server

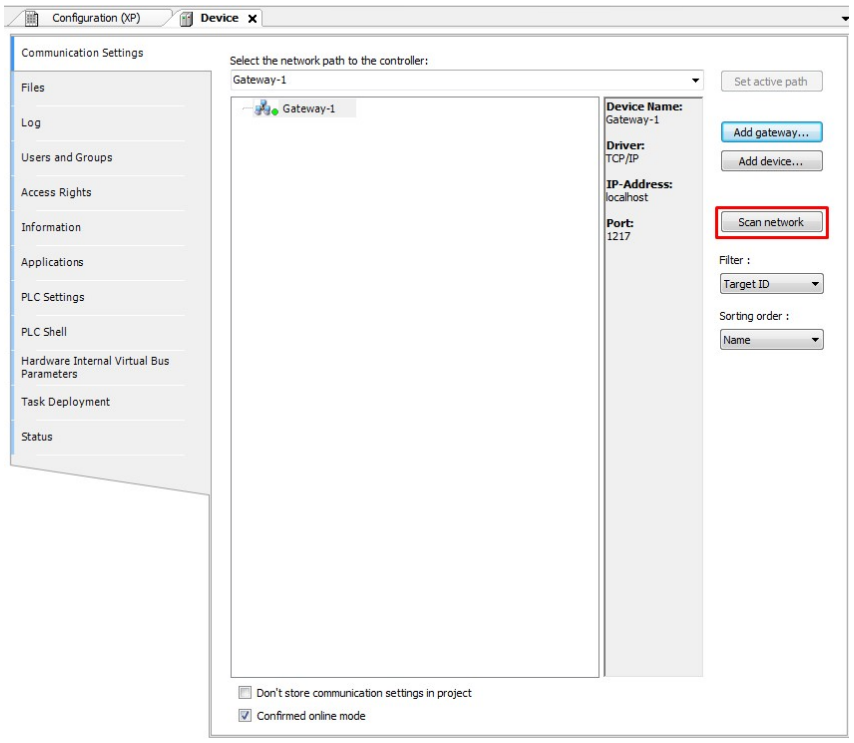
Name: MODBUS Symbol Server
Vendor: Altus S.A.
Categories: MODBUS Server
Version: 1.0.0.4
Order Number: ???
Description: MODBUS TCP Server or MODBUS RTU via TCP Server

Append selected device as last child of
NET 1
(You can select another target node in the navigator while this window is open.)

Figure 14: Selecting the Protocol

4.6. Finding the Device

To establish the communication between the controller and MasterTool IEC XE, first it's necessary to find and select the desired device. The configuration of this communication is located on the object Device on device tree, on Communication Settings tab. On this tab, after selecting the Gateway and clicking on button Scan network, the software MasterTool IEC XE performs a search for devices and shows the controllers found on the network of the Ethernet interface of the station where the tool is running.



Select the network path to the controller: Gateway-1

Gateway-1

Device Name: Gateway-1
Driver: TCP/IP
IP-Address: localhost
Port: 1217

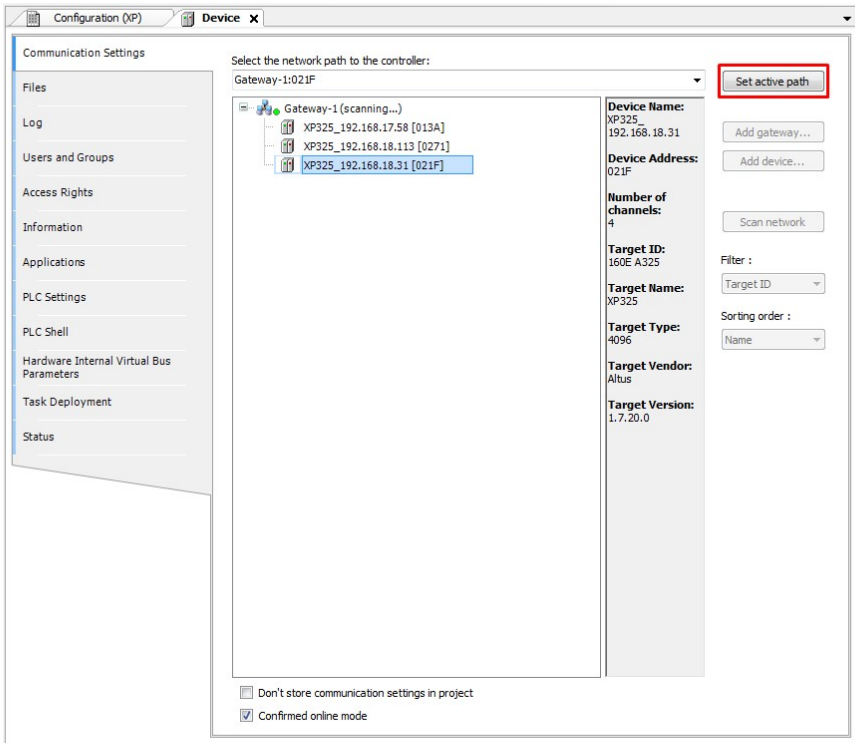
Filter : Target ID
Sorting order : Name

☐ Don't store communication settings in project
☑ Confirmed online mode

Figure 15: Finding the Device

If there is no gateway previously configured, it can be included by the button Add gateway, using the default IP address localhost to use the gateway resident on the station or changing the IP address to use the device internal gateway.

Next, the desired controller must be selected by clocking on Set active path clicked. This action selects the controller and informs the configuration software which controller shall be used to communicate and send the project.



Select the network path to the controller:
Gateway-1:021F

Gateway-1 (scanning...)
XP325_192.168.17.58 [013A]
XP325_192.168.18.113 [0271]
XP325_192.168.18.31 [021F]

Device Name: XP325_ 192.168.18.31
Device Address: 021F
Number of channels: 4
Target ID: 160E A325
Target Name: XP325
Target Type: 4096
Target Vendor: Altus
Target Version: 1.7.20.0

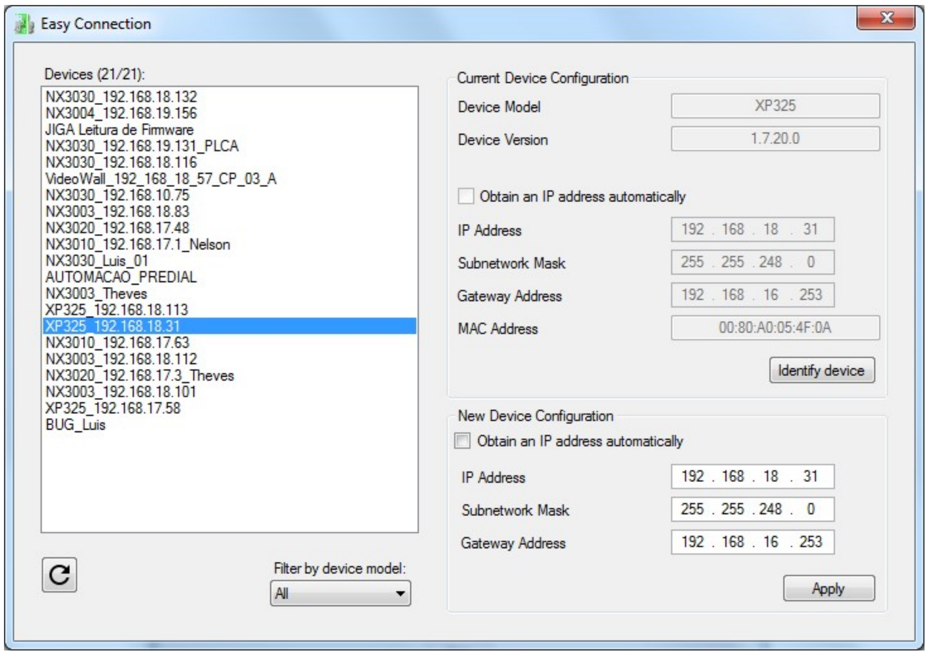
Filter : Target ID
Sorting order : Name

☐ Don't store communication settings in project
☑ Confirmed online mode

Figure 16: Selecting the controller

Additionally, the user can change the default name of the device that is displayed. For that, you must click the right mouse button on the desired device and select Change Node Name. After a name change, the device will not return to the default name under any circumstances.

In case the Ethernet configuration of the controller to be connected is in a different network from the Ethernet interface of the station, the software MasterTool IEC XE will not be able to find the device. In this case, it's recommended to use the command Easy Connection located on Online menu.



Devices (21/21):
NX3030_192.168.18.132
NX3004_192.168.19.156
JIGA Leitura de Firmware
NX3030_192.168.19.131_PLCA
NX3030_192.168.18.116
VideoWall_192_168_18_57_CP_03_A
NX3030_192.168.10.75
NX3003_192.168.18.83
NX3020_192.168.17.48
NX3010_192.168.17.1_Nelson
NX3030_Luis_01
AUTOMACAO_PREDIAL
NX3003_Theves
XP325_192.168.18.113
XP325_192.168.18.31
NX3010_192.168.17.63
NX3003_192.168.18.112
NX3020_192.168.17.3_Theves
NX3003_192.168.18.101
XP325_192.168.17.58
BUG_Luis

Filter by device model: All

Current Device Configuration

Device Model	XP325
Device Version	1.7.20.0
☐ Obtain an IP address automatically	
IP Address	192 . 168 . 18 . 31
Subnetwork Mask	255 . 255 . 248 . 0
Gateway Address	192 . 168 . 16 . 253
MAC Address	00:80:A0:05:4F:0A

New Device Configuration

☐ Obtain an IP address automatically	
IP Address	192 . 168 . 18 . 31
Subnetwork Mask	255 . 255 . 248 . 0
Gateway Address	192 . 168 . 16 . 253

Figure 17: Easy Connection

This command performs a MAC level communication with the device, allowing to permanently change the configuration of the controller's Ethernet interface, independently of the IP configuration of the station and from the one previously configured on the device. So, with this command, it's possible to change the device configuration to put it on the same network of the Ethernet interface of the station where MasterTool IEC XE is running, allowing to find and select the device for the communication. The complete description of Easy Connection command can be found on User Manual of MasterTool IEC XE code MU299609.

4.7. Login

After compiling the application and fixing errors that might be found, it's time to send the project to the controller. To do this, simply click on Login command located on Online menu of MasterTool IEC XE as shown on the following figure. This operation may take a few seconds, depending on the size of the generated file.

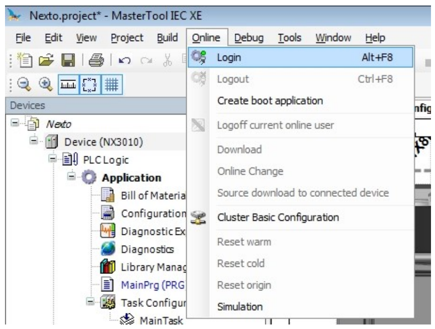
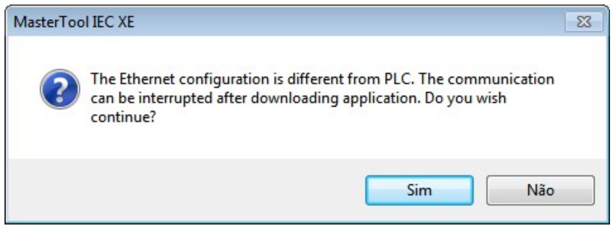


Figure 18: Sending the Project to the controller

After the command execution, some user interface messages may appear, which are presented due to differences between an old project and the new project been sent, or simply because there was a variation in some variable.

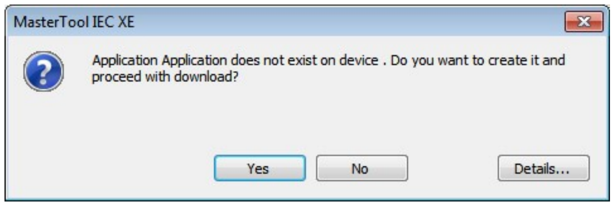
If the Ethernet configuration of the project is different from the device, the communication may be interrupted at the end of download process when the new configuration is applied on the device. So, the following warning message will be presented, asking the user to proceed or not with this operation:


MasterTool IEC XE

The Ethernet configuration is different from PLC. The communication can be interrupted after downloading application. Do you wish continue?

Figure 19: IP Configuration Warning

If there is no application on the controller, the following message will be presented.

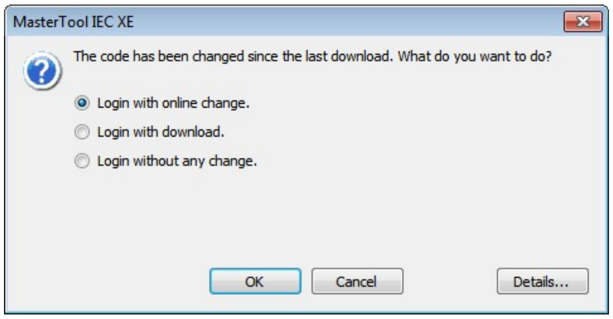

MasterTool IEC XE

Application Application does not exist on device . Do you want to create it and proceed with download?

Figure 20: No application on the device

If there is already an application on the controller, depending on the differences between the projects, the following options will be presented:

- Login with online change: execute the login and send the new project without stopping the current controller application (see Run Mode item), updating the changes when a new cycle is executed
- Login with download: execute the login and send the new project with the controller stopped (see Stop Mode item). When the application is initiated, the update will have been done already
- Login without any change: executes the login without sending the new project


MasterTool IEC XE

The code has been changed since the last download. What do you want to do?

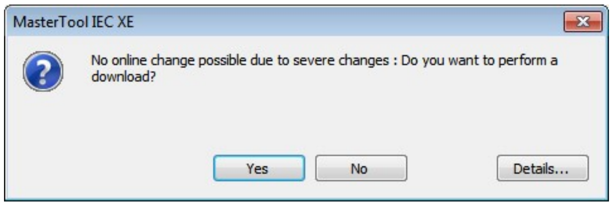
(●) Login with online change.
( ) Login with download.
( ) Login without any change.

Figure 21: New application download

ATTENTION:
In the online changes is not permitted to associate symbolic variables mapping from a global variable list (GVL) and use these variables in another global variable list (GVL).

If the new application contains changes on the configuration, the online change will not be possible. In this case, the MasterTool IEC XE requests whether the login must be executed as download (stopping the application) or if the operation must be canceled, as shown on the following figure.

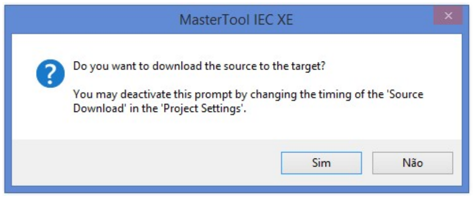
PS.: The button Details... shows the changes made in the application.


MasterTool IEC XE

No online change possible due to severe changes : Do you want to perform a download?

Figure 22: Configuration change

Finally, at the end of this process the MasterTool IEC XE offers the option to transfer (download) the source code to the internal memory of the device, as shown on the following figure:


MasterTool IEC XE

Do you want to download the source to the target?

You may deactivate this prompt by changing the timing of the 'Source Download' in the 'Project Settings'.

Figure 23: Source code download

Transferring the source code is fundamental to ensure the future restoration of the project and to perform modifications on the application that is loaded into the device.

4.8. Run Mode

Right after the project has been sent to the controller, the application will not be immediately executed (except for the case of an online change). For that to happen, the command Start must be executed. This way, the user can control the execution of the application sent to the controller, allowing to pre-configure initial values which will be used by the controller on the first execution cycle.

To execute this command, simply go to the Debug menu and select the option Start, as shown on Figure 24.

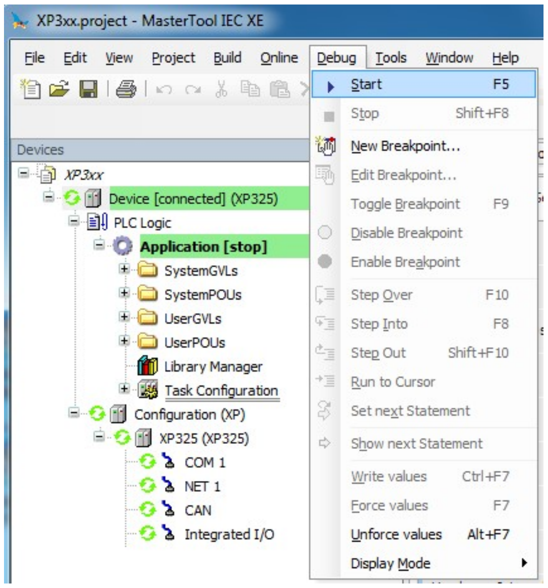
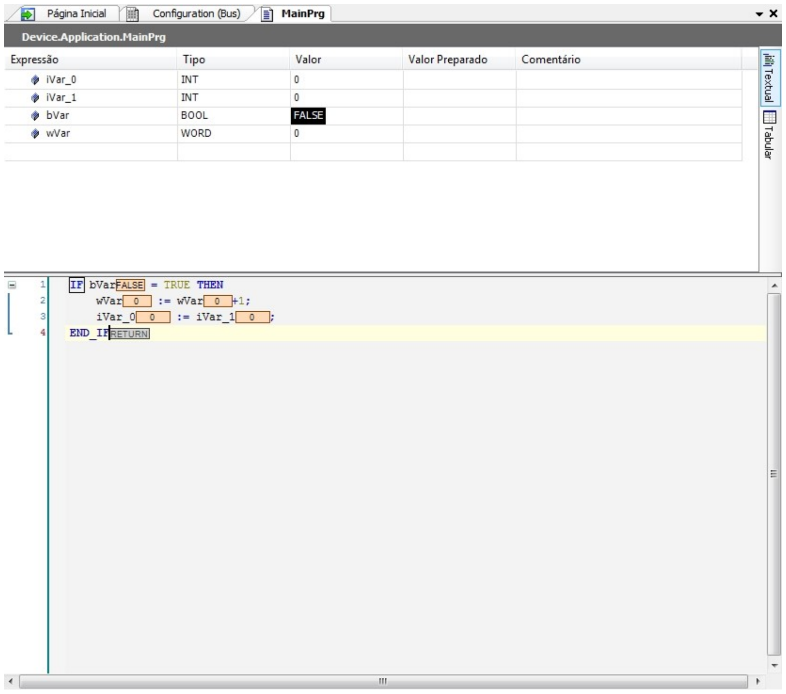


Figure 24: Starting the Application

Figure 25 shows the application in execution. In case the POU tab is selected, the created variables are listed on a monitoring window, in which the values can be visualized and forced by the user.



Expressão	Tipo	Valor	Valor Preparado	Comentário
iVar_0	INT	0		
iVar_1	INT	0		
bVar	BOOL	FALSE		
wVar	WORD	0		

```
IF bVar FALSE = TRUE THEN
    wVar 0 := wVar 0 +1;
    iVar_0 0 := iVar_1 0 ;
END_IF RETURN
```

Figure 25: Program running

If the controller already have a boot application internally stored, it goes automatically to Run Mode when the device is powered on, with no need for an online command through MasterTool IEC XE.

4.9. Stop Mode

To stop the execution of the application, the user must execute the Stop command, available at the menu Debug, as shown on Figure 26.

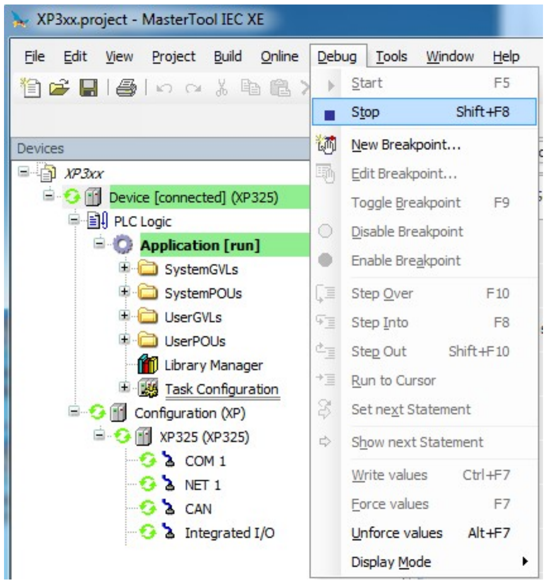


Figure 26: Stopping the Application

In case the controller is initialized without the stored application, it automatically goes to Stop Mode, as it happens when a software exception occurs.

4.10. Writing and Forcing Variables

After Logging into a PLC, the user can write or force values to a variable of the project.

The writing command (CTRL +F7) writes a value into a variable and this value could be overwritten by instructions executed in the application.

Moreover, the forced writing command (F7) writes a value into a variable without allowing this value to be changed until the forced variables be released.

It is important to highlight that, when using the MODBUS RTU Slave and the MODBUS Ethernet Server, and the Read-only option from the configured relations is not selected, the forced writing command (F7) must be done over the available variables in the monitoring window as the writing command (CTRL + F7) leaves the variables to be overwritten when new readings are done.

ATTENTION:
The variables forcing can be done only in Online mode.
Diagnostic variables cannot be forced, only written, because diagnostics are provided by the controller and will be overwritten by it.

ATTENTION:
When a controller is with forced variables and it is de-energized, the variables will lose the forcing in the next initialization.
The limit of forcing for all models of NX-ERA controllers is 128 variables.

4.11. Logout

To finalize the online communication with the controller, the command Logout must be executed, located in the Online menu, as shown on Figure 27.

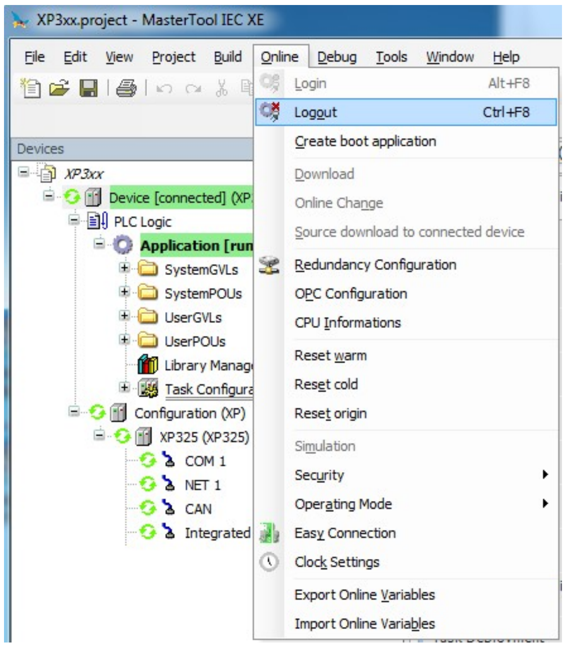


Figure 27: Ending the online communication with the controller

4.12. Project Upload

NX-ERA Xpress controllers are capable to store the source code of the application on the internal memory of the device, allowing future retrieval (upload) of the complete project and to modify the application.

To recover a project previously stored on the internal memory of the controller, the command located on File menu must be executed as shown on the following figure.

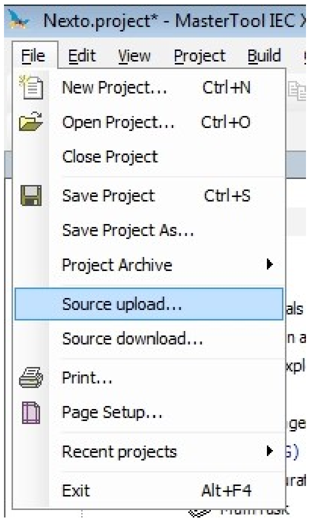
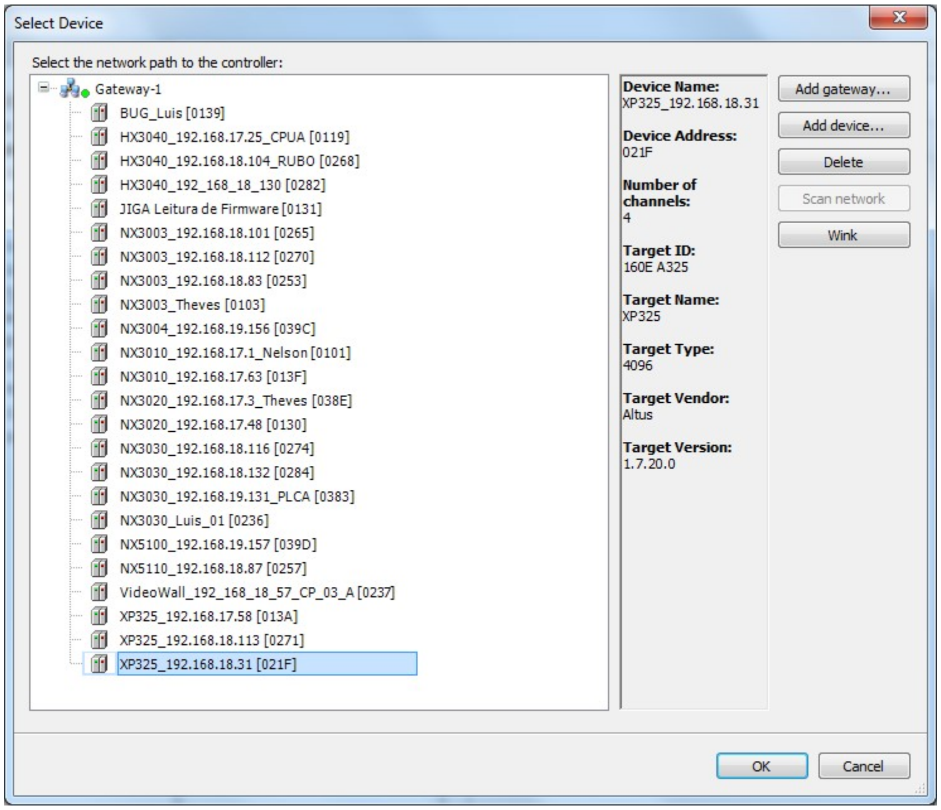


Figure 28: Project Upload Option

Next, just select the desired controller and click OK as shown on Figure 29.


Select Device
Select the network path to the controller:
Gateway-1
BUG_Luis [0139]
HX3040_192.168.17.25_CPUA [0119]
HX3040_192.168.18.104_RUBO [0268]
HX3040_192_168_18_130 [0282]
JIGA Leitura de Firmware [0131]
NX3003_192.168.18.101 [0265]
NX3003_192.168.18.112 [0270]
NX3003_192.168.18.83 [0253]
NX3003_Theves [0103]
NX3004_192.168.19.156 [039C]
NX3010_192.168.17.1_Nelson [0101]
NX3010_192.168.17.63 [013F]
NX3020_192.168.17.3_Theves [038E]
NX3020_192.168.17.48 [0130]
NX3030_192.168.18.116 [0274]
NX3030_192.168.18.132 [0284]
NX3030_192.168.19.131_PLCA [0383]
NX3030_Luis_01 [0236]
NX5100_192.168.19.157 [039D]
NX5110_192.168.18.87 [0257]
VideoWall_192_168_18_57_CP_03_A [0237]
XP325_192.168.17.58 [013A]
XP325_192.168.18.113 [0271]
XP325_192.168.18.31 [021F]
Add gateway...
Add device...
Delete
Scan network
Wink
OK
Cancel

Device Name: XP325_192.168.18.31
Device Address: 021F
Number of channels: 4
Target ID: 160E A325
Target Name: XP325
Target Type: 4096
Target Vendor: Altus
Target Version: 1.7.20.0

Figure 29: Selecting the controller

To ensure that the project loaded in the controller is identical and can be accessed in other workstations, consult the chapter Projects Download/Login Method without Project Differences at the MasterTool IEC XE User Manual MT8500 - MU299609.

ATTENTION:
The memory size area to store a project in the NX-ERA Xpress controller is defined on General Features table.

ATTENTION:
The Upload recovers the last project stored in the controller as described in the previous paragraphs. In case only the application was downloaded, without transferring its source code, it will not be possible for it to be recovered by the Upload procedure.

4.13. CPU Operating States

4.13.1. Run

When the controller is in Run mode, all application tasks are executed.

4.13.2. Stop

When a CPU is in Stop mode, all application tasks are stopped. The variable values in the tasks are kept with the current value and output points go to the safe state.

When a CPU goes to the Stop mode due to the download of an application, the variables in the application tasks will be lost except the persistent variables type.

4.13.3. Breakpoint

When a debugging mark is reached in a task, it is interrupted. All the active tasks in the application will not be interrupted, continuing their execution. With this feature, it's possible to go through and investigate the program flow step by step in Online mode according to the positions of the interruptions included through the editor.

For further information about the use of breakpoints, please consult the MasterTool IEC XE Utilization Manual - MU299609.

4.13.4. Exception

When a CPU is in Exception it indicates that some improper operation occurred in one of the application active tasks. The task which caused the Exception will be suspended and the other tasks will pass for the Stop mode. It is only possible to take off the tasks from this state and set them in execution again after a new CPU start condition. Therefore, only with a Reset Warm, Reset Cold, Reset Origin or a CPU restart puts the application again in Run mode.

4.13.5. Reset Warm

This command puts the CPU in Stop mode and initializes all the application tasks variables, except the persistent and retentive type variables. The variables initialized with a specific value will assume exactly this value, the other variables will assume the standard initialization value (zero).

4.13.6. Reset Cold

This command puts the CPU in Stop mode and initializes all the application tasks variables, except the persistent type variables. The variables initialized with a specific value will assume exactly this value, the other variables will assume the standard initialization value (zero).

4.13.7. Reset Origin

This command removes all the application tasks variables, including the persistent type variables and deletes the CPU application.

Notes:

Reset: When a Reset is executed, the breakpoints defined in the application are disabled.

Command: To execute the commands Reset Warm, Reset Cold or Reset Origin, is necessary to have MasterTool IEC XE in Online mode with the controller.

4.14. Programs (POUs) and Global Variable Lists (GVLs)

The project created by MasterTool IEC XE contains a set of program modules (POUs) and global variables lists that aims to facilitate the programming and utilization of the controller. The following sections describes the main elements that are part of this standard project structure.

4.14.1. MainPrg Program

The MainTask task is associated to one unique POU of program type, named MainPrg. The MainPrg program is created automatically and cannot be edited by user.

The MainPrg program code is the following, in ST language:

```
(*Main POU associated with MainTask that calls StartPrg,
 UserPrg/ActivePrg and NonSkippedPrg.
 This POU is blocked to edit.*)

PROGRAM MainPrg
VAR
                                    isFirstCycle : BOOL := TRUE;
END_VAR

IF isFirstCycle THEN StartPrg(); isFirstCycle := FALSE;
ELSE UserPrg();
END_IF;
```

MainPrg call other two POUs of program type, named StartPrg and UserPrg. While the UserPrg is always called, the StartPrg is only called once in the PLC application start.

Differently from the MainPrg program, that must not be modified, the user can change the StartPrg and UserPrg programs. Initially, when the project is created from the wizard, these two programs are created empty, but the user might insert code in them.

4.14.2. StartPrg Program

In this POU the user might create logics, loops, start variables, etc. that will be executed only one time in the first PLC's cycle, before execute UserPrg POU by the first time. And not being called again during the project execution.

In case the user load a new application, or if the PLC gets powered off, as well as in Reset Origin, Reset Cold and Reset Warm conditions, this POU is going to be executed again.

4.14.3. UserPrg Program

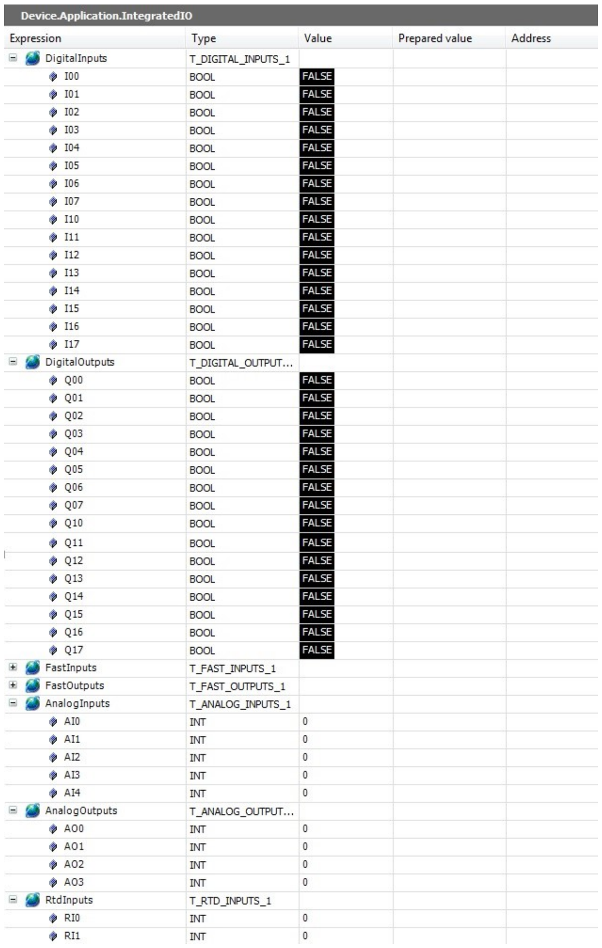
In this POU the user must create the main application, responsible by its own process control. This POU is called by the main POU (MainPrg).

The user can also create additional POUs (programs, functions or function blocks), and called them or instance them inside UserPrg POU, to ends of its program instruction. Also it is possible to call functions and instance function blocks defined in libraries.

4.14.4. GVL IntegratedIO

The GVL IntegratedIO contains the variables correspondent to the physical input and output channels integrated into the controller.

The following picture shows an example of the presentation of this GVL when in Online mode.



Device.Application.IntegratedIO

Expression	Type	Value	Prepared value	Address
⊟ DigitalInputs	T_DIGITAL_INPUTS_1			
I00	BOOL	FALSE		
I01	BOOL	FALSE		
I02	BOOL	FALSE		
I03	BOOL	FALSE		
I04	BOOL	FALSE		
I05	BOOL	FALSE		
I06	BOOL	FALSE		
I07	BOOL	FALSE		
I10	BOOL	FALSE		
I11	BOOL	FALSE		
I12	BOOL	FALSE		
I13	BOOL	FALSE		
I14	BOOL	FALSE		
I15	BOOL	FALSE		
I16	BOOL	FALSE		
I17	BOOL	FALSE		
⊟ DigitalOutputs	T_DIGITAL_OUTPUT...			
Q00	BOOL	FALSE		
Q01	BOOL	FALSE		
Q02	BOOL	FALSE		
Q03	BOOL	FALSE		
Q04	BOOL	FALSE		
Q05	BOOL	FALSE		
Q06	BOOL	FALSE		
Q07	BOOL	FALSE		
Q10	BOOL	FALSE		
Q11	BOOL	FALSE		
Q12	BOOL	FALSE		
Q13	BOOL	FALSE		
Q14	BOOL	FALSE		
Q15	BOOL	FALSE		
Q16	BOOL	FALSE		
Q17	BOOL	FALSE		
⊞ FastInputs	T_FAST_INPUTS_1			
⊞ FastOutputs	T_FAST_OUTPUTS_1			
⊟ AnalogInputs	T_ANALOG_INPUTS_1			
AI0	INT	0		
AI1	INT	0		
AI2	INT	0		
AI3	INT	0		
AI4	INT	0		
⊟ AnalogOutputs	T_ANALOG_OUTPUT...			
AO0	INT	0		
AO1	INT	0		
AO2	INT	0		
AO3	INT	0		
⊟ RtdInputs	T_RTD_INPUTS_1			
RI0	INT	0		
RI1	INT	0		

Figure 30: IntegratedIO GVL in Online Mode

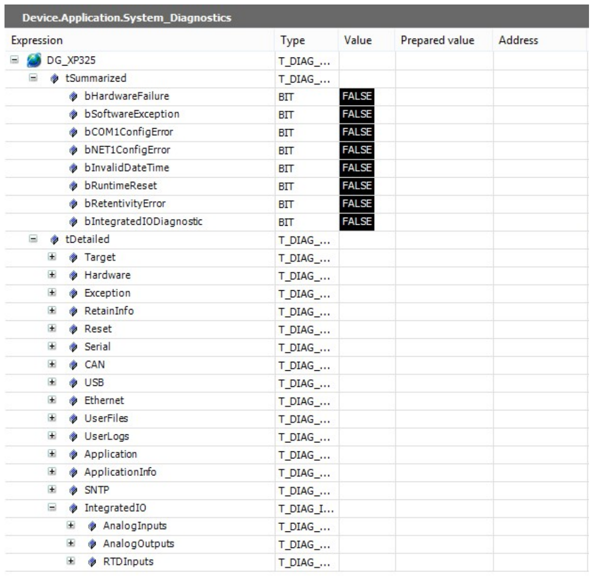
4.14.5. GVL System_Diagnostics

The System_Diagnostics GVL contains the diagnostic variables of the controller's CPU, communication and I/O interfaces. This GVL isn't editable and the variables are declared automatically with type specified by the device to which it belongs when it is added to the project.

ATTENTION:
In System_Diagnostics GVL, are also declared the diagnostic variables of the direct representation MODBUS Client/Master requisitions.

Some devices, like the MODBUS Symbol communication driver, doesn't have its diagnostics allocated at %Q variables with the AT directive.

The following picture shows an example of the presentation of this GVL when in Online mode.



Device.Application.System_Diagnostics

Expression	Type	Value	Prepared value	Address
DG_XP325	T_DIAG_...			
tSummarized	T_DIAG_...			
bHardwareFailure	BIT	FALSE		
bSoftwareException	BIT	FALSE		
bCOM1ConfigError	BIT	FALSE		
bNET1ConfigError	BIT	FALSE		
bInvalidDateTime	BIT	FALSE		
bRuntimeReset	BIT	FALSE		
bRetentivityError	BIT	FALSE		
bIntegratedIODiagnostic	BIT	FALSE		
tDetailed	T_DIAG_...			
Target	T_DIAG_...			
Hardware	T_DIAG_...			
Exception	T_DIAG_...			
RetainInfo	T_DIAG_...			
Reset	T_DIAG_...			
Serial	T_DIAG_...			
CAN	T_DIAG_...			
USB	T_DIAG_...			
Ethernet	T_DIAG_...			
UserFiles	T_DIAG_...			
UserLogs	T_DIAG_...			
Application	T_DIAG_...			
ApplicationInfo	T_DIAG_...			
SNTP	T_DIAG_...			
IntegratedIO	T_DIAG_I...			
AnalogInputs	T_DIAG_...			
AnalogOutputs	T_DIAG_...			
RTDInputs	T_DIAG_...			

Figure 31: System_Diagnostics GVL in Online Mode

4.14.6. GVL Disables

The Disables GVL contains the MODBUS Master/Client by symbolic mapping requisition disabling variables. It is not mandatory, but it is recommended to use the automatic generation of these variables, which is done clicking in the button Generate Disabling Variables in device requisition tab. These variables are declared as type BOOL and follow the following structure:

Requisition disabling variables declaration:

```
[Device Name]_DISABLE_[Requisition Number] : BOOL;
```

Where:

Device name: Name that shows on TreeView to the MODBUS device.

Requisition Number: Requisition number that was declared on the MODBUS device requisition table following the sequence from up to down, starting on 0001.

Example:

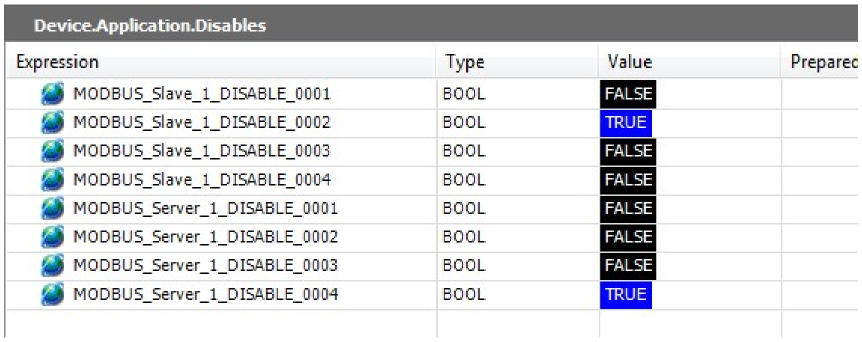
Device.Application.Disables

```
VAR_GLOBAL
MODBUS_Device_DISABLE_0001 : BOOL;
MODBUS_Device_DISABLE_0002 : BOOL;
MODBUS_Device_DISABLE_0003 : BOOL;
MODBUS_Device_1_DISABLE_0001 : BOOL;
MODBUS_Device_1_DISABLE_0002 : BOOL;
END_VAR
```

The automatic generation through button Generate Disabling Variables only create variables, and don't remove automatically. This way, in case any relation is removed, its respective disabling variable must be removed manually.

The Disables GVL is editable, therefore the requisition disabling variables can be created manually without need of following the model created by the automatic declaration and can be used both ways at same time, but must always be of BOOL type. And it is need to take care to do not delete or change the automatic declared variables, cause them can being used for some MODBUS device. If the variable be deleted or changed then an error is going to be generated while the project is being compiled. To correct the automatically declared variable name, it must be followed the model exemplified above according to the device and the requisition to which they belong.

The following picture shows an example of the presentation of this GVL when in Online mode. If the variable values are TRUE it means that the requisition to which the variables belongs is disabled and the opposite is valid when the variable value is FALSE.



Device.Application.Disables

Expression	Type	Value	Preparec
MODBUS_Slave_1_DISABLE_0001	BOOL	FALSE	
MODBUS_Slave_1_DISABLE_0002	BOOL	TRUE	
MODBUS_Slave_1_DISABLE_0003	BOOL	FALSE	
MODBUS_Slave_1_DISABLE_0004	BOOL	FALSE	
MODBUS_Server_1_DISABLE_0001	BOOL	FALSE	
MODBUS_Server_1_DISABLE_0002	BOOL	FALSE	
MODBUS_Server_1_DISABLE_0003	BOOL	FALSE	
MODBUS_Server_1_DISABLE_0004	BOOL	TRUE	

Figure 32: Disable GVL in Online Mode

4.14.7. GVL ReqDiagnostics

In ReqDiagnostics GVL, are declared the requisition diagnostics variables of symbolic mapping MODBUS Master/Client. It is nor mandatory, but recommended the use of these variables' automatic generation, what is done by clicking in the button Generate Diagnostic Variables in device requisitions tab. These variables declaration follow the following structure:

Requisition diagnostic variable declaration:

```
[Device Name]_REQDG_[Requisition Number]: [Variable Type];
```

Where:

Device Name: Name that appear at the TreeView to the device.

Mapping Number: Number of the mapping that was declared on the device mapping table, following the up to down sequence, starting with 0001.

Variable Type: NXMODBUS_DIAGNOSTIC_STRUCTS.
T_DIAG_MODBUS_RTU_MAPPING_1 to MODBUS Master and
NXMODBUS_DIAGNOSTIC_STRUCTS.
T_DIAG_MODBUS_ETH_MAPPING_1 to MODBUS Client.

ATTENTION:
The requisition diagnostics variables of direct mapping MODBUS Master/Client are declared at System_Diagnostics GVL.

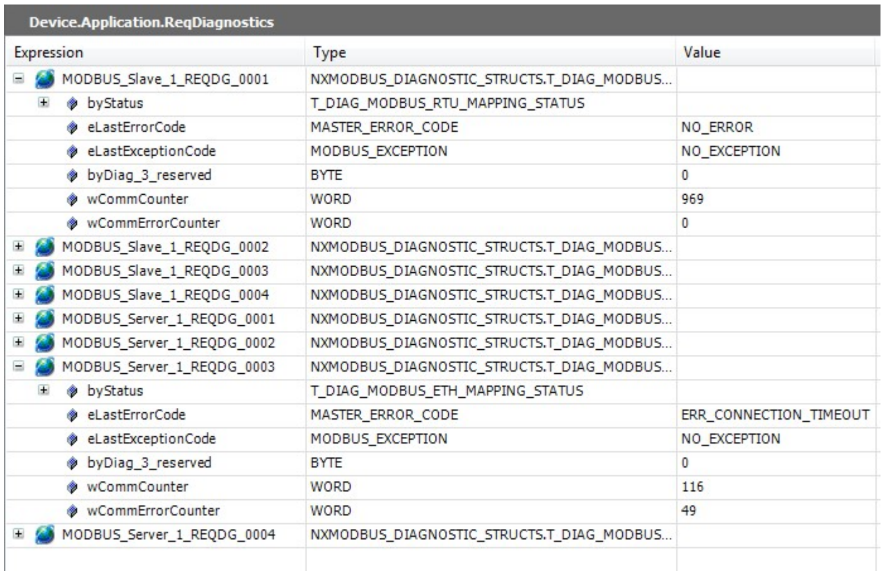
Example:

Device.Application.ReqDiagnostics

```
VAR_GLOBAL
MODBUS_Device_REQDG_0001   : NXMODBUS_DIAGNOSTIC_STRUCTS.
                                T_DIAG_MODBUS_RTU_MAPPING_1;
MODBUS_Device_REQDG_0002   : NXMODBUS_DIAGNOSTIC_STRUCTS.
                                T_DIAG_MODBUS_RTU_MAPPING_1;
MODBUS_Device_REQDG_0003   : NXMODBUS_DIAGNOSTIC_STRUCTS.
                                T_DIAG_MODBUS_RTU_MAPPING_1;
MODBUS_Device_1_REQDG_0001  : NXMODBUS_DIAGNOSTIC_STRUCTS.
                                T_DIAG_MODBUS_ETH_MAPPING_1;
MODBUS_Device_1_REQDG_0002  : NXMODBUS_DIAGNOSTIC_STRUCTS.
                                T_DIAG_MODBUS_ETH_MAPPING_1;
END_VAR
```

The ReqDiagnostics GVL is editable, therefore the requisitions diagnostic variables can be manually created without need to follow the model created by the automatic declaration. Both ways can be used at same time, but the variables must always be of type referring to the device. And take care to don't delete or change a variable automatically declared, because they might being used by some device. If the variable be deleted or changed an error is going to be generated while the project is being compiled. To correct the automatically declared variable name, it must be followed the model exemplified above according to the device and the requisition to which they belong.

The following picture shows an example of the presentation of this GVL when in Online mode.



Device.Application.ReqDiagnostics

Expression	Type	Value
MODBUS_Slave_1_REQDG_0001	NXMODBUS_DIAGNOSTIC_STRUCTS.T_DIAG_MODBUS...	
byStatus	T_DIAG_MODBUS_RTU_MAPPING_STATUS	
eLastErrorCode	MASTER_ERROR_CODE	NO_ERROR
eLastExceptionCode	MODBUS_EXCEPTION	NO_EXCEPTION
byDiag_3_reserved	BYTE	0
wCommCounter	WORD	969
wCommErrorCounter	WORD	0
MODBUS_Slave_1_REQDG_0002	NXMODBUS_DIAGNOSTIC_STRUCTS.T_DIAG_MODBUS...	
MODBUS_Slave_1_REQDG_0003	NXMODBUS_DIAGNOSTIC_STRUCTS.T_DIAG_MODBUS...	
MODBUS_Slave_1_REQDG_0004	NXMODBUS_DIAGNOSTIC_STRUCTS.T_DIAG_MODBUS...	
MODBUS_Server_1_REQDG_0001	NXMODBUS_DIAGNOSTIC_STRUCTS.T_DIAG_MODBUS...	
MODBUS_Server_1_REQDG_0002	NXMODBUS_DIAGNOSTIC_STRUCTS.T_DIAG_MODBUS...	
MODBUS_Server_1_REQDG_0003	NXMODBUS_DIAGNOSTIC_STRUCTS.T_DIAG_MODBUS...	
byStatus	T_DIAG_MODBUS_ETH_MAPPING_STATUS	
eLastErrorCode	MASTER_ERROR_CODE	ERR_CONNECTION_TIMEOUT
eLastExceptionCode	MODBUS_EXCEPTION	NO_EXCEPTION
byDiag_3_reserved	BYTE	0
wCommCounter	WORD	116
wCommErrorCounter	WORD	49
MODBUS_Server_1_REQDG_0004	NXMODBUS_DIAGNOSTIC_STRUCTS.T_DIAG_MODBUS...	

Figure 33: ReqDiagnostics GVL in Online Mode

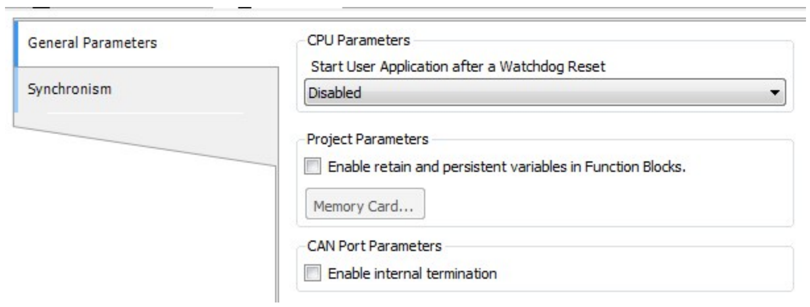
5. Configuration

The NX-ERA Xpress controllers are configured and programmed through the MasterTool IEC XE software. The configuration defines the behavior and utilization modes for peripherals use and special features of the controller. The programming represents the application developed by the user, also known as Application.

5.1. Controller's CPU

5.1.1. General Parameters

The parameters related to the controller's CPU are located at project tree view on item XP3xx just below Configuration. Each item must be properly verified for the correct project execution. These parameters are described below:



Start User Application after a Watchdog Reset: Disabled
Enable retain and persistent variables in Function Blocks.
Enable internal termination

Figure 34: CPU configuration

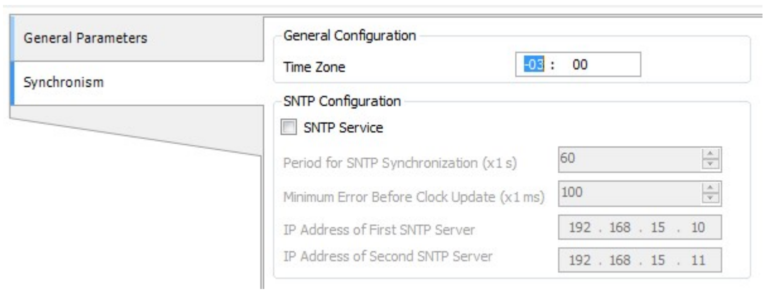
Configuration	Description	Default	Options
	CPU Parameters		
Start User Application After a Watchdog Reset	When enabled starts the user application after the hardware watchdog reset or through the Runtime restart, but keeps the diagnostics indication via LED DG and via variables	Disabled	Enabled Disabled
Enable retain and persistent variables in Function Blocks	Configuration to allow the use of retain and persistent variables on Function Blocks	Unmarked	Marked: allows the use of retain and persistent variables on Function Blocks. Unmarked: If this is done with this option unmarked, it may occur an exception error on startup.
Enable internal termination	When enabled use internal termination on CAN interface.	Unmarked	Marked: enabled internal termination on CAN interface. Unmarked: disabled internal termination on CAN interface.

Table 30: CPU Configuration

5.1.2. Time Synchronization

For the time synchronization, NX-ERA Xpress controllers use the SNTP (Simple Network Time Protocol) protocol.

To use the time sync protocol, the user must set the following parameters at Synchronism tab located at CPU configuration on project treeview.



General Configuration

Time Zone -03 : 00

SNTP Configuration

SNTP Service

Period for SNTP Synchronization (x1 s) 60

Minimum Error Before Clock Update (x1 ms) 100

IP Address of First SNTP Server 192 . 168 . 15 . 10

IP Address of Second SNTP Server 192 . 168 . 15 . 11

Figure 35: SNTP Configuration

Configuration	Description	Default	Options
Time zone (hh:mm)	Time zone of the user location. Hours and minutes can be inserted.	-3:00	-12:59 to +13:59
SNTP Service	Enables the SNTP service.	Disabled	Disabled or Enabled
Period for SNTP Synchronization (x1 sec)	Time interval of the synchronization requests (seconds).	60	1 to 255
Minimum Error Before Clock Update (x1 ms)	Offset value acceptable between the server and client (milliseconds).	100	1 to 65519
IP Address of the First SNTP Server	IP Address of the primary SNTP server.	192.168.15.10	1.0.0.1 to 223.255.255.254.
IP Address of the Second SNTP Server	IP Address of the secondary SNTP server.	192.168.15.11	1.0.0.1 to 223.255.255.254.

Table 31: SNTP Configurations

Notes:

SNTP Server: It is possible to define a preferential address and another secondary one in order to access a SNTP server and, therefore, to obtain a synchronism of time. If both fields are empty, the SNTP service will remain disabled.

Time zone: The time zone configuration is used to convert the local time into UTC and vice versa. While some sync sources use the local time (SetDateAndTime Function), others use the UTC time (SNTP). The UTC time is usually used to stamp events (internal device log), while the local time is used by another CPU's features (GetDateAndTime function).

5.1.2.1. SNTP

When enabled, the controller will behave as a SNTP client, which is, it will send requests of time synchronization to a SNTP/NTP server which can be in the local net or in the internet. The SNTP client works with a 1 ms resolution. The precision of the time sync through SNTP depends on the protocol configurations (minimum error to clock update) and the features of the Ethernet network where it is, if both client and server are in the same network (local) or in different networks (remote). Typically the precision is in tens of milliseconds order.

The controller sends the cyclic synchronization requests according to the time set in the SNTP Synchronization Period field. In the first synchronization attempt, just after the service start up, the request is for the first server set in the first server IP address. In case it does not respond, the requests are directed to the second server set in the second server IP address providing a redundancy of SNTP servers. In case the second server does not respond either, the same process of synchronization attempt is performed again but only after the Period of Synchronization having been passed. In other words, at every synchronization period the controller tries to connect once in each server, it tries the second server in case the first one does not respond. The waiting time for a response from the SNTP server is defined by default in 5 s and it cannot be modified.

If, after a synchronization, the difference between the current time of the controller and the one received by the server is higher than the value set in the Minimum Error Before Clock Update parameter, the controller time is updated.

SNTP uses the time in the UTC (Universal Time Coordinated) format, so the Time zone parameter needs to be set correctly so the time read by the SNTP will be properly converted to a local time.

The execution process of the SNTP client can be exemplified with the following steps:

1. Attempt of synchronization through the first server. In case the synchronization occurs successfully, the controller waits the time for a new synchronization (Synchronization Period) and will synchronize again with this server, using it as a primary server. In case of failure (the server does not respond in less than 5 s) step 2 is performed.
2. Attempt of synchronization through the second server. In case the synchronization occurs successfully, the controller waits the time for a new synchronization (Synchronization Period) and will try to synchronize with this server using the primary server. In case of failure (the server does not respond in less than 5 s) the time relative to the Synchronization Period is waited and step 1 is performed again.

As the waiting time for the response of the SNTP server is 5 s, the user must pay attention to lower than 10 s values for the Synchronization Period. In case the primary server does not respond, the time for the synchronization will be the minimum of 5 s (waiting for the primary server response and the synchronization attempt with secondary server). In case neither the primary server nor the secondary one responds, the synchronization time will be 10 s minimum (waiting for the two servers response and the new connection with first server attempt).

ATTENTION:
The SNTP Service depends on the user application only for its configuration. Therefore, this service will be performed even when the controller is in STOP or BREAKPOINT modes since there is an application in the controller with the SNTP client enabled and properly set.

5.1.2.2. Daylight Saving Time (DST)

The DST configuration must be done indirectly through the function SetTimeZone, which changes the time zone applied to the RTC. In the beginning of the DST, it has to be used a function to increase the time zone in one hour. At the end of the DST, it is used to decrease it in one hour.

For further information, see the section RTC Clock of this manual.

5.2. Serial Interface

5.2.1. COM 1

The COM 1 interface is a RS-485 standard serial interface. It allows the point to point or network communication in the open protocols MODBUS RTU slave or MODBUS RTU master.

When using the MODBUS master / slave protocol, some of these parameters (such as Serial Mode, Data Bits, RX Threshold and Events Serial) are automatically adjusted by MasterTool tool for the correct operation of this protocol.

The parameters which must be configured for the proper functioning of the application are described below:

Configuration	Description	Default	Options
Serial Type	Serial channel configuration	RS-485	RS-485
Baud Rate	Serial communication port speed configuration	115200	2400, 4800, 9600, 19200, 38400, 57600, 115200 bps
Parity	Serial port parity configuration	None	Odd Even No parity
Data Bits	Sets the data bits quantity in each serial communication character	8	6, 7 and 8
Stop Bits	Sets the serial port stop bits	1	1 and 2
Serial Mode	Sets the serial port operation mode	Normal Mode	- Extended Mode: Extended operation mode which delivers information regarding the received data frame (see note on COM 1 section) - Normal Mode: Serial communication normal operation mode

Table 32: RS-485 Standard Serial Configurations

5.2.2. Advanced Configurations

The advanced configurations section allows to configure additional parameters of the serial port as described below:

Configuration	Description	Default	Options
UART RX Threshold	Bytes quantity which must be received for a new UART interruption to be generated. Low values make the TIMESTAMP more precise when the EXTENDED MODE is used and minimizes the overrun errors. However, values too low may cause several interruptions delaying the CPU.	8	1, 4, 8 and 14
RS-485 Termination	Enables the internal standard RS-485 termination. Must be enabled only if the controller is physically positioned at one of the extremities of the RS-485 network.	Enabled	Disabled or Enabled

Table 33: RS-485 Standard Serial Advanced Configurations

5.3. Ethernet Interface

5.3.1. NET 1

The NET 1 interface is composed by a RJ45 communication connector 10/100Base-TX standard. It allows the point to point or network communication with several protocols, for example: MODBUS, OPC UA, etc...

The parameters which must be configured for the proper functioning of the application are described below:

Configuration	Description	Default	Options
Obtain an IP address automatically	Enables the DHCP Client functionality on the device for automatic IP assignment.	Unmarked	Marked or Unmarked
IP Address	IP address of the controller in the Ethernet bus.	192.168.15.1	1.0.0.1 to 223.255.255.254
Sub network Mask	Subnet mask of the controller in the Ethernet	255.255.255.0	128.0.0.0 to 255.255.255.252
Gateway Address	Controller Gateway address in the Ethernet bus.	192.168.15.253	1.0.0.1 to 223.255.255.254

Table 34: NET 1 Configuration

5.3.2. Reserved TCP Ports

The following TCP ports of the Ethernet interfaces, both local and remote, are used by CPUs services, so they are reserved and cannot be used by the user: 80, 161, 8080, 1217, 1740, 1741, 1742,1743 and 11740.

5.4. Controller Area Network Interface

5.4.1. CAN

The CAN interface allows point to point or network communication with other devices that have this interface using CANopen application protocol.

The parameters of CAN interface which must be configured for the proper functioning of the application are described below:

Configuration	Description	Default	Options
Network	CAN interface ID number	0	0 (fixed)
Baudrate	CAN Bus baudrate (kbit/s). The other devices must to use the same baudrate.	250	10, 20, 50, 100, 125, 250, 500, 800, 1000

Table 35: CAN Configuration

The parameters related to CANopen protocol are described on Communication Protocols section.

5.5. Integrated I/O

NX-ERA Xpress controllers have integrated I/O points, which allows it to interface with external devices like sensors, actua- tors, step motors, encoders, etc...

There are two objects on project treeview related to Integrated I/O, as shown on the figure below:

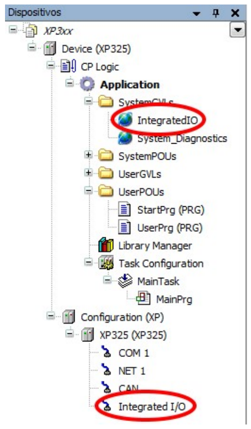


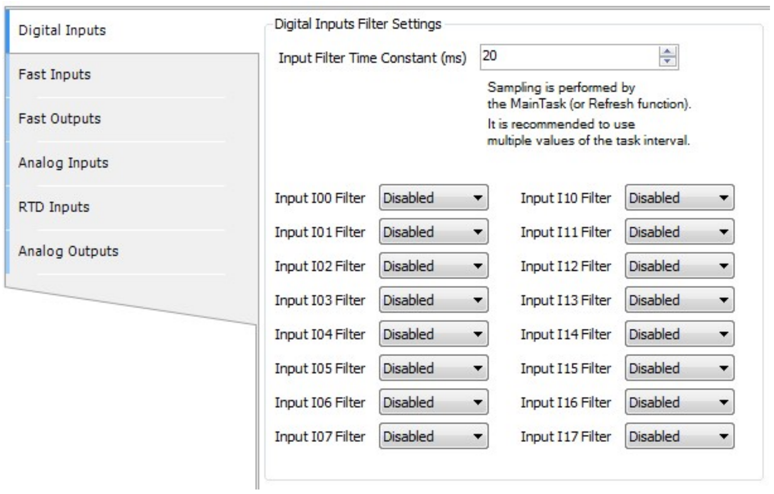
Figure 36: Integrated I/O objects on project tree view

One of these objects is the GVL IntegratedIO, which is created automatically by MasterTool IEC XE and contains a list of global symbolic variables that are directly mapped to the onboard inputs and outputs.

The other object is the connector Integrated I/O, which contains the configuration for each type of I/O point. These configurations will be detailed on next sections.

5.5.1. Digital Inputs

The parameters related to the Digital Inputs are located on the screen below (example from XP325), for both standard and fast inputs (when configured as normal digital inputs):



Digital Inputs Filter Settings

Input Filter Time Constant (ms) 20

Sampling is performed by the MainTask (or Refresh function). It is recommended to use multiple values of the task interval.

Input I00 Filter	Disabled	Input I10 Filter	Disabled
Input I01 Filter	Disabled	Input I11 Filter	Disabled
Input I02 Filter	Disabled	Input I12 Filter	Disabled
Input I03 Filter	Disabled	Input I13 Filter	Disabled
Input I04 Filter	Disabled	Input I14 Filter	Disabled
Input I05 Filter	Disabled	Input I15 Filter	Disabled
Input I06 Filter	Disabled	Input I16 Filter	Disabled
Input I07 Filter	Disabled	Input I17 Filter	Disabled

Figure 37: Digital Inputs Parameters

The table below shows the possible configuration values:

Configuration	Description	Default	Options
Filter time	Minimum time that an input must remain in a given state to confirm the state change	20 ms	2 to 255 ms
Filter	Enable/Disable filter for each input	Disabled	Enabled or Disabled

Table 36: Digital Inputs Parameters

Note:

Input Filter Time Constant: The filter sampling is performed on MainTask (or Refresh function), then it's recommended to use multiple values of the task interval.

5.5.2. Fast Inputs

The fast inputs are special input signals that can be used for special high-speed functions. These special physical inputs can be assigned to two types of logical elements: high-speed counters and external interruption. Each of these logical elements consumes a certain amount of fast inputs signals. For the high-speed counters unit, it depends on the selected mode (Up/Down, Quadrature, etc. . .), while each external interruption uses one fast input signal. The number of physical fast inputs, as well as the maximum number of high-speed counter and external interruption logical elements assignable for these inputs is described on Technical Description section.

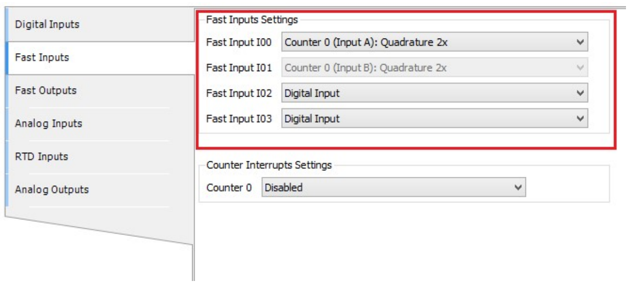
The following table shows how each high-speed counter unit is assigned to the fast inputs signals:

High-Speed Counter	Counter Mode	Fast Inputs			
		I00	I01	I02	I03
Counter 0	Up/Down (A count, B direction) with zero	B	Z	A	-
	Quadrature 2X	A	B	-	-
	Quadrature 2X with zero	A	B	Z	-
	Quadrature 4X	A	B	-	-
	Quadrature 4X with zero	A	B	Z	-

Table 37: High-Speed Counters and Fast Inputs allocation

For each configuration described above, the remaining fast input signals (not used by the high-speed counter units) can be used as external interruption, respecting the maximum number of this kind of logical element specified on Technical Description section.

The configuration of high-speed counters and interruptions is located on the following screen:



Fast Inputs Settings
Fast Input I00 Counter 0 (Input A): Quadrature 2x
Fast Input I01 Counter 0 (Input B): Quadrature 2x
Fast Input I02 Digital Input
Fast Input I03 Digital Input

Counter Interrupts Settings
Counter 0 Disabled

Figure 38: Fast Inputs settings

When selecting the function of a fast input, the following inputs are automatically assigned (locked for edition) according to the mode of the high-speed counter unit.

The table below shows the possible configuration values for each fast input:

Configuration	Description	Default	Options
Fast Input I00	Fast Input I00 configuration	Digital Input	Digital Input Counter 0 (Input B): Up/Down (A count, B direction) with zero Counter 0 (Input A): Quadrature 2X Counter 0 (Input A): Quadrature 2X with zero Counter 0 (Input A): Quadrature 4X Counter 0 (Input A): Quadrature 4X with zero
Fast Input I01	Fast Input I01 configuration	Digital Input	Digital Input Obs: This field will be set automatically when Fast Input I00 is configured as Up/Down or Quadrature Counter.
Fast Input I02	Fast Input I02 configuration	Digital Input	Digital Input Interruption (Rising Edge) Obs: This field will be set automatically when Fast Input I00 is configured as Up/Down or Quadrature Counter with zero.
Fast Input I03	Fast Input I03 configuration	Digital Input	Digital Input Interruption (Rising Edge)

Table 38: Fast Inputs Parameters

Even if a fast input is configured as a counter or interruption, it's digital value can still be read through IntegratedIo.DigitalInputs variable. The next subsections give more details about the Fast Inputs configuration and programming.

5.5.2.1. High-Speed Counters

The high-speed counter units have multiple operating modes. The following table describes the details of each of these modes:

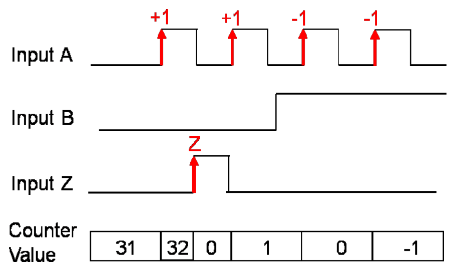
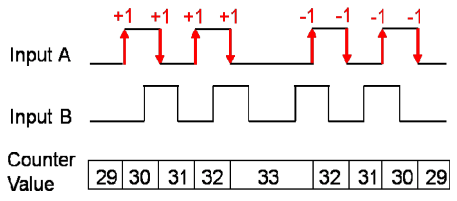
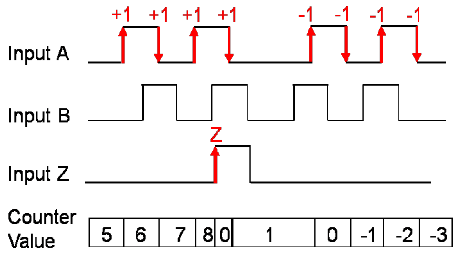
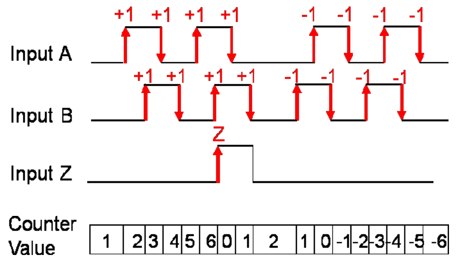
Counter Mode	Counting waveforms
Up/Down (A count, B direction) with zero	 Input A; Input B; Input Z; Counter Value; +1 +1 -1 -1; Z; 31 32 0 1 0 -1
Quadrature 2X	 Input A; Input B; Counter Value; +1 +1 +1 +1 -1 -1 -1 -1; 29 30 31 32 33 32 31 30 29
Quadrature 2X with zero	 Input A; Input B; Input Z; Counter Value; +1 +1 +1 +1 -1 -1 -1 -1; Z; 5 6 7 8 0 1 0 -1 -2 -3
Quadrature 4X	
Quadrature 4X with zero	 Input A; Input B; Input Z; Counter Value; +1 +1 +1 +1 -1 -1 -1 -1; +1 +1 +1 +1 -1 -1 -1 -1; Z; 1 2 3 4 5 6 0 1 2 1 0 -1 -2 -3 -4 -5 -6

Table 39: High-speed counter modes

The overall behavior is the same for all counters: when counting UP and the maximum positive value is reached, the next value will be the minimum negative value. The same thing happens for the oposite direction, so when counting DOWN and the minimum negative value is reached, the next value will be the maximum positive value.

The user program can access the high-speed counters through the FastInputs symbolic structure, which is automatically created on IntegratedIo GVL. For each high-speed counter unit, there are 3 main areas as shown on the following figure:

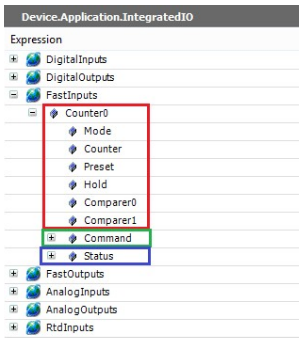


Figure 39: Counter structure

The table below describes the counter variables structure:

Variable	Description	Type	Allowed Values
Mode	Configured counter mode (read only)	ENUM_COUNTER _MODE	DISABLED UP_DOWN_A_COUNT_B _DIR_WITH_ZERO QUADRATURE_2X QUADRATURE_2X _WITH_ZERO QUADRATURE_4X QUADRATURE_4X _WITH_ZERO
Counter	Counter value	DINT	-2147483648 to 2147483647
Preset	Preset value	DINT	-2147483648 to 2147483647
Hold	Hold value	DINT	-2147483648 to 2147483647
Comparer0	Lower value of counter comparison	DINT	-2147483648 to 2147483647
Comparer1	Higher value of counter comparison	DINT	-2147483648 to 2147483647
Command	Counter commands structure	T_COUNTER _COMMAND	-
Status	Counter status structure	T_COUNTER _STATUS	-

Table 40: Counter structure variables

The command and status are structures of bits that allow the user program to control the counter operation. The following table describes the counter command structure.

Variable	Description	Type	Allowed Values
Stop	Stop the counter. The counter remains stopped while this bit is set	BIT	FALSE or TRUE
Reset	Reset the counter. The counter remains zeroed while this bit is set	BIT	FALSE or TRUE
Load	Load the preset value to the counter value. This operation is performed on rising edge of this bit	BIT	FALSE or TRUE

Variable	Description	Type	Allowed Values
Sample	Sample the counter storing its value in hold. This operation is performed on rising edge of this bit	BIT	FALSE or TRUE

Table 41: Counter command structure

The following table describes the counter status structure.

Variable	Description	Type	Allowed Values
Enabled	Counter is enabled	BIT	FALSE or TRUE
Direction	Counter direction (TRUE = Up, FALSE = Down)	BIT	FALSE or TRUE
EQComparer0	Counter value is equal to Comparer0	BIT	FALSE or TRUE
LTComparer0	Counter value is less than Comparer0	BIT	FALSE or TRUE
GTComparer0	Counter value is greater than Comparer0	BIT	FALSE or TRUE
EQComparer1	Counter value is equal to Comparer1	BIT	FALSE or TRUE
LTComparer1	Counter value is less than Comparer1	BIT	FALSE or TRUE
GTComparer1	Counter value is greater than Comparer1	BIT	FALSE or TRUE

Table 42: Counter status structure

Additionally to the IntegratedIo global variables, there is a function block from LibIntegratedIo library which allows to instantiate high-speed counter in POUs written in graphical languages (e.g Ladder Logic Diagram). This function block is, actually, a wrapper to the structured variables described before. The figure below shows the function block instantiated in a Ladder program.

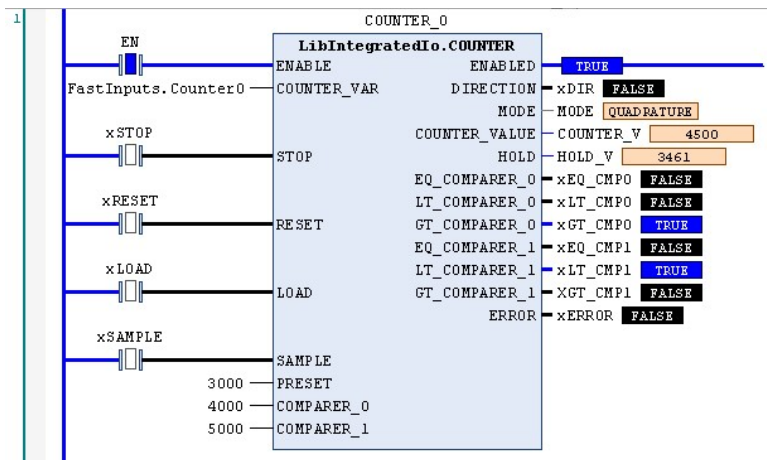


Figure 40: LibIntegratedIo.COUNTER function block

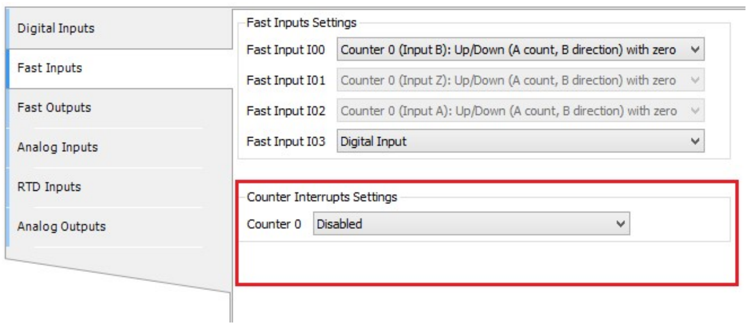
The table below describes the inputs and outputs variables of the function block.

Variable	Description	Type	Allowed Values
ENABLE	Enable the function block execution	BOOL	FALSE or TRUE
COUNTER_VAR	Counter variable	REFERENCE TO T_COUNTER	FastInputs.Counter0
STOP	Stop the counter	BOOL	FALSE or TRUE
RESET	Reset the counter	BOOL	FALSE or TRUE
LOAD	Load the preset value to the counter value	BOOL	FALSE or TRUE
SAMPLE	Sample counter storing its value in hold	BOOL	FALSE or TRUE
PRESET	Preset value	DINT	-2147483648 to 2147483647
COMPARER_0	Lower value of counter comparison	DINT	-2147483648 to 2147483647
COMPARER_1	Higher value of counter comparison	DINT	-2147483648 to 2147483647
ENABLED	Counter is enabled	BOOL	FALSE or TRUE
DIRECTION	Counter direction (TRUE = Up, FALSE = Down)	BOOL	FALSE or TRUE
Mode	Counter mode	ENUM_ COUNTER_MODE	DISABLED UP_DOWN_A_- COUNT_ B_DIR_- WITH_ZERO QUADRATURE_2X QUADRATURE_2X_- WITH_ZERO QUADRATURE_4X QUADRATURE_4X_- WITH_ZERO
COUNTER_VALUE	Counter value	DINT	-2147483648 to 2147483647
HOLD	Hold value	DINT	-2147483648 to 2147483647
EQ_COMPARER_0	Counter value is equal to Comparer0	BOOL	FALSE or TRUE
LT_COMPARER_0	Counter value is less than Comparer0	BOOL	FALSE or TRUE
GT_COMPARER_0	Counter value is greater than Comparer0	BOOL	FALSE or TRUE
EQ_COMPARER_1	Counter value is equal to Comparer1	BOOL	FALSE or TRUE
LT_COMPARER_1	Counter value is less than Comparer1	BOOL	FALSE or TRUE
GT_COMPARER_1	Counter value is greater than Comparer1	BOOL	FALSE or TRUE
ERROR	Error occurred in function block execution. Can be caused by invalid COUNTER_VAR or counter disabled.	BOOL	FALSE or TRUE

Table 43: Lib Integrated Io. COUNTER function block description

5.5.2.1.1. Counter Interrupts

The high-speed counter units have the ability to generate interrupts by comparison, i.e., when the counter reach a certain comparison value, an specific task will run and interrupt the main program execution. Each high-speed counter unit have two comparison values, called Comparer0 and Comparer1, which are present on the corresponding global symbolic data structure or FunctionBlock as described on previous sections. The configuration of counter interrupt for each high-speed counter unit is located on the following screen:



Fast Inputs Settings

Fast Input I00: Counter 0 (Input B): Up/Down (A count, B direction) with zero
Fast Input I01: Counter 0 (Input Z): Up/Down (A count, B direction) with zero
Fast Input I02: Counter 0 (Input A): Up/Down (A count, B direction) with zero
Fast Input I03: Digital Input

Counter Interrupts Settings

Counter 0: Disabled

Figure 41: Counter interrupt settings

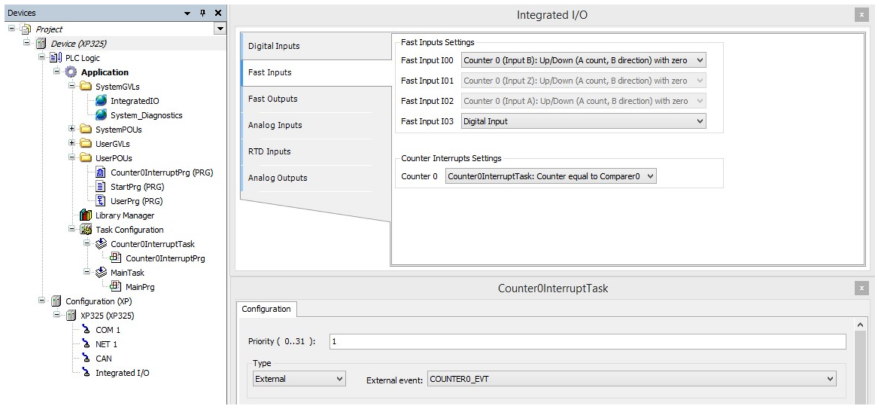
The table below shows the possible configuration values for the counter interrupt:

Configuration	Description	Default	Options
Counter 0	Counter0 comparator interrupt configuration	Disabled	Disabled Counter0InterruptTask: Counter equal to Comparer0 Obs: This configuration is available when the Counter0 is associated to some Fast Input.

Table 44: Counter interrupt parameters

The counter interrupt will generate an specific event. This event must trigger the execution of external event task, which must call an specific POU. For example, the comparison event generated for Counter 0 is called COUNTER0_EVT. So, an external event task called Counter0InterruptTask must be configured to be triggered by this event, and must call a POU called Counter0InterruptPrg which will contain the user program to be executed.

The figure below shows this configuration scenario in MasterTool IEC XE.



Fast Inputs Settings

Fast Input I00: Counter 0 (Input B): Up/Down (A count, B direction) with zero
Fast Input I01: Counter 0 (Input Z): Up/Down (A count, B direction) with zero
Fast Input I02: Counter 0 (Input A): Up/Down (A count, B direction) with zero
Fast Input I03: Digital Input

Counter Interrupts Settings

Counter 0: Counter0InterruptTask: Counter equal to Comparer0

Priority (0..31): 1
Type: External
External event: COUNTER0_EVT

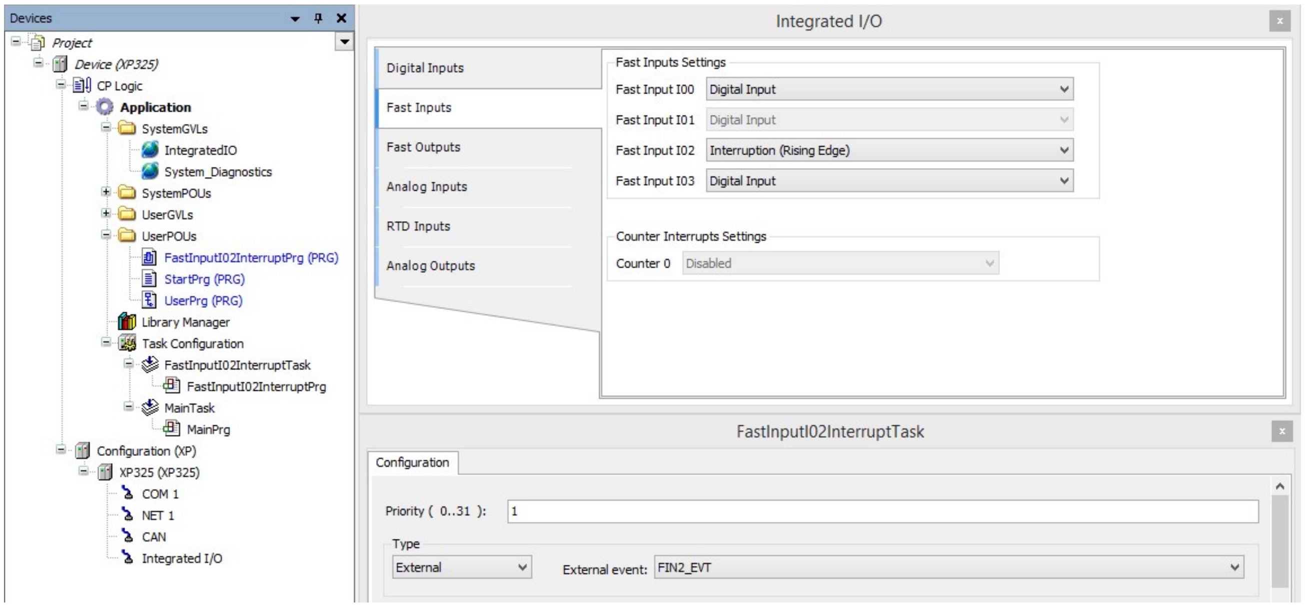
Figure 42: Counter Interrupt Settings

5.5.2.2. External Interruption

The fast inputs can be set as Interruption (Rising Edge) mode, which means that when a rising edge (0V to 24V transition) is performed on the input, an specific task will run and interrupt the main program execution.

Each external interruption will generate an specific event. This event must trigger the execution of external event task, which must call an specific POU. For example, the external interruption event generated for fast input I02 is called FIN2_EVT. So, an external event task called FastInputI02InterruptTask must be configured to be triggered by this event, and must call a POU called FastInputI02InterruptPrg which will contain the user program to be executed.

The figure below shows this configuration scenario in MasterTool IEC XE.



Fast Inputs Settings

Fast Input I00: Digital Input
Fast Input I01: Digital Input
Fast Input I02: Interruption (Rising Edge)
Fast Input I03: Digital Input

Counter Interrupts Settings

Counter 0: Disabled

Priority (0..31): 1
Type: External
External event: FIN2_EVT

Figure 43: Fast Inputs Interruption Settings

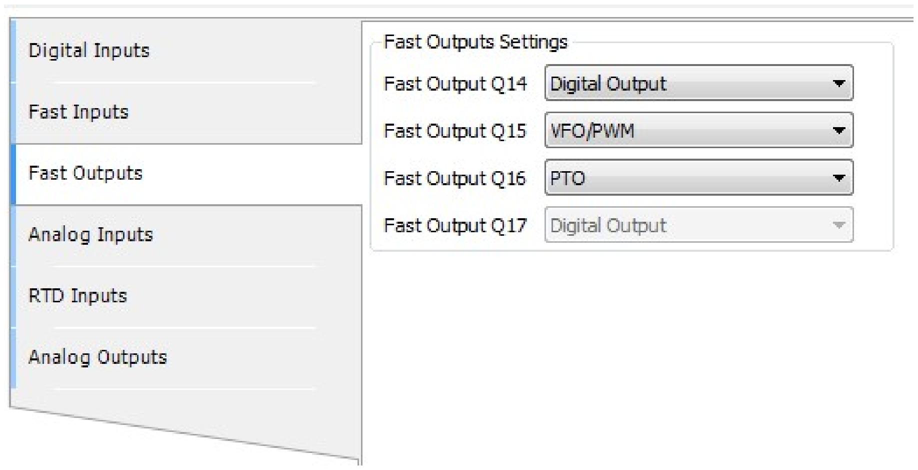
ATTENTION:
The external interruption input have a 10ms time window filter to protect the controller against spurious transitions on the input signal. This window starts right after the occurrence of the interruption and, during this time, any other external interruption event will be discarded.

ATTENTION:
The external interruption does not supports reentrancy. If another interruption occurs (after the filter time) and its program execution is still not finished, this interruption will be discarded.

5.5.3. Fast Outputs

The fast outputs are special output signals that can be used for pulse generator outputs. These special physical outputs can be assigned to two types of logical elements: VFO/PWM (variable frequency/pulse width) and PTO (pulse train output). Each of these logical elements consumes one fast output signal each one. The number of physical fast outputs, as well as the maximum number of the VFO/PWM and PTO logical elements assignable to these outputs is described on Technical Description section.

The configuration of fast outputs is located on the following screen:



Fast Output Q14: Digital Output
Fast Output Q15: VFO/PWM
Fast Output Q16: PTO
Fast Output Q17: Digital Output

Figure 44: Fast Outputs Parameters

The table below shows the possible configuration values:

Configuration	Description	Default	Options
Fast Output Q14	Fast Output Q14 configuration.	Digital Output	Digital Output VFO/PWM PTO
Fast Output Q15	Fast Output Q15 configuration.	Digital Output	Digital Output VFO/PWM
Fast Output Q16	Fast Output Q16 configuration.	Digital Output	Digital Output VFO/PWM PTO
Fast Output Q17	Fast Output Q17 configuration.	Digital Output	Digital Output VFO/PWM

Table 45: Fast Outputs Parameters

As shown on the previous table, the fast outputs can be configured as normal digital output. In this case, its digital value can be set using the standard global variable IntegratedIo.DigitalOutputs.

When configured as VFO/PWM or PTO, the user program can control the fast ouputs through the FastOutputs symbolic structure, which is automatically created on IntegratedIo GVL as shown on the following figure:

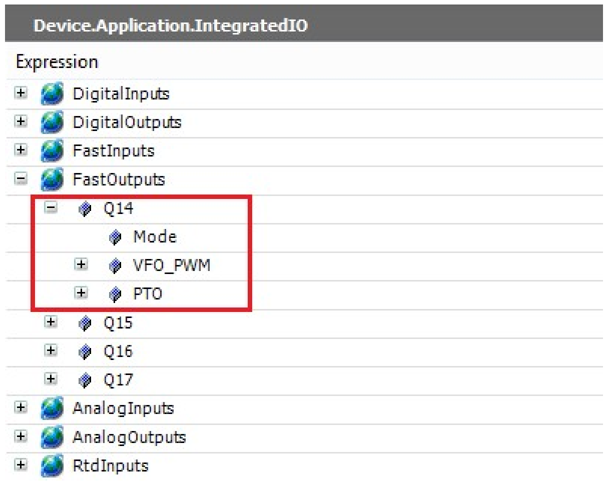


Figure 45: Fast Output structure

The table below describes the fast output variables structure:

Variable	Description	Type	Allowed Values
Mode	Fast output configured mode (read only)	ENUM_FAST_OUTPUT_MODE	DIGITAL_OUTPUT PWM PTO
VFO_PWM	VFO/PWM structure. It contains a structure to control the fast output when it's configured as VFO/PWM.	T_VFO_PWM	-
PTO	PTO structure. It contains a structure to control the fast output when it's configured as PTO.	T_PTO	-

Table 46: Fast Output structure variables

The next subsections give more details about how to use these pulse generator functions, describing these structures for each mode.

5.5.3.1. VFO/PWM

The VFO/PWM (Variable Frequency Output / Pulse Width Modulator) is a pulse generator output mode where the frequency and duty cycle can be controlled by the user program. It's appliable, for example, to control the power transferred to an electric load or to control the angle of a servo motor. The principle of operation of VFO/PWM output is very simple, see the pulsed waveform that is shown in the figure below:

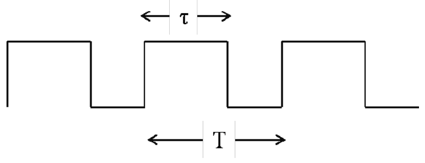


Figure 46: VFO/PWM waveform

The figure shows a pulsed waveform, where T is the period of the pulses and τ is the pulse width. Those are the pulse parameters which can be changed on VFO/PWM mode. The frequency is defined as the inverse of period, then:

$$f = \frac{1}{T}$$

The duty cycle is the reason between the pulse width and the period, then:

$$D = \frac{\tau}{T} 100\%$$

To control the VFO/PWM output, the user program must access the VFO_PWM variable of the fast output structure. The structure of VFO_PWM is shown on the table below:

Variable	Description	Type	Allowed Values
Frequency	Frequency in Hertz	UDINT	1 to 200000
DutyCycle	Duty Cycle in percent	USINT	0 to 100
Command	VFO/PWM commands structure	T_VFO_PWM_COMMAND	-
Status	VFO/PWM status structure	T_VFO_PWM_STATUS	-

Table 47: VFO_PWM variable structure

The table below shows the VFO_PWM commands structure.

Variable	Description	Type	Allowed Values
Enable	Enable VFO/PWM output	BIT	FALSE or TRUE

Table 48: VFO/PWM Command structure

The table below shows the VFO_PWM status structure.

Variable	Description	Type	Allowed Values
InvalidFrequency	Frequency value is invalid (out of range)	BIT	FALSE or TRUE
InvalidDutyCycle	Duty Cycle value is invalid (out of range)	BIT	FALSE or TRUE

Table 49: VFO/PWM Status structure

Once the Enable command is TRUE, the input parameters will be continuously checked and the status variables will be updated accordingly.

Additionally to the IntegratedIo global variables, there is a function block from LibIntegratedIo library which allows to instantiate VFO/PWM in POUs written in graphical languages (e.g Ladder Logic Diagram). This function block is, actually, a wrapper to the structured variables described before. The figure below shows the function block instantiated in a Ladder program.

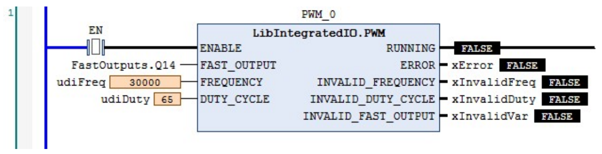


Figure 47: LibIntegratedIo.PWM function block

The table below describes the inputs and outputs variables of the function block.

Variable	Description	Type	Allowed Values
ENABLE	Enable the function block execution.	BOOL	FALSE or TRUE
FAST_OUTPUT	Fast Output Variable.	REFERENCE TO T_FAST _OUTPUT	FastOutputs.Q14 FastOutputs.Q15 FastOutputs.Q16 FastOutputs.Q17
FREQUENCY	Frequency in Hertz.	UDINT	1 to 200000
DUTY_CYCLE	Duty Cycle in percent.	USINT	0 to 100
RUNNING	VFO/PWM is being performed.	BOOL	FALSE or TRUE
ERROR	Error occurred in function block execution. The follow variables provide detailed information.	BOOL	FALSE or TRUE
INVALID_FREQUENCY	Frequency value is invalid (out of range).	BOOL	FALSE or TRUE
INVALID_DUTY_CYCLE	Duty Cycle value is invalid (out of range).	BOOL	FALSE or TRUE
INVALID_FAST_OUTPUT	FAST_OUTPUT was not assigned to the block or isn't configured as VFO/PWM.	BOOL	FALSE or TRUE

Table 50: LibIntegratedIo.PWM function block description

5.5.3.2. PTO

The PTO (Pulse Train Output) is a pulse generator mode. It's used, for example, to control step motors responsible for positioning of mechanisms with considerable inertia. For these cases, the rotation speed must increase slowly (acceleration) when the movement is starting and decrease slowly (deceleration) when the movement is stopping. These acceleration and deceleration are made on pulse train by increasing and decreasing the frequency of the pulses, maintaining the 50% of duty cycle.

There are a set of parameter that must be defined for a pulse train: Start frequency, operation frequency, stop frequency, acceleration profile, total number of pulses, number of pulses in acceleration step, number of pulses in deceleration step. The figure below shows, on Cartesian plane, the relation between the frequency of the pulses and time. The pulse train shown is called trapezoidal profile, because the acceleration and deceleration ramps produce a trapezium shape.

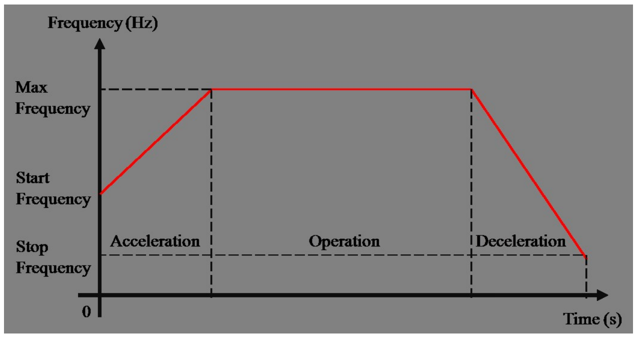


Figure 48: PTO with trapezoidal profile

For some applications it is more recommended to use the "S" profile, which acceleration and deceleration curves are similar to “S” shape. The figure below shows this profile.

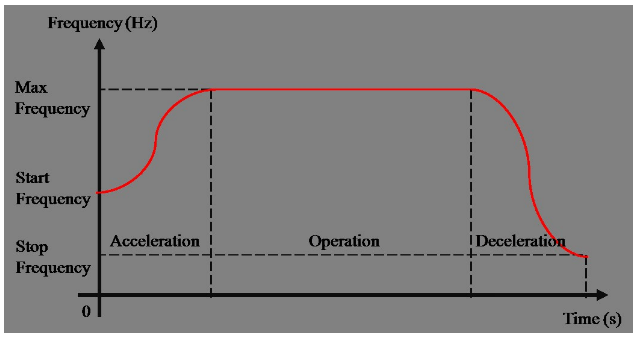


Figure 49: PTO with “S” profile

Besides the PTO parameters, there are status information and commands that the user program can use to control the output. Some important status information are the pulse counter (proportional to a position), the pulse train step (acceleration, operation, deceleration) and, even, if the output is working fine. The commands required to control PTO are to start the pulse train, to stop the pulse train and to stop the pulse train softly (soft stop). The soft stop command is very important, once can be used for emergency situations where the system can’t stop abruptly. The figures below shows how the soft stop command change the pulse train when it is performed. The dashed blue lines represents the PTO if the soft stop command is performed on acceleration and operation steps. The soft stop command on deceleration step has no effect, once the system is already stopping.

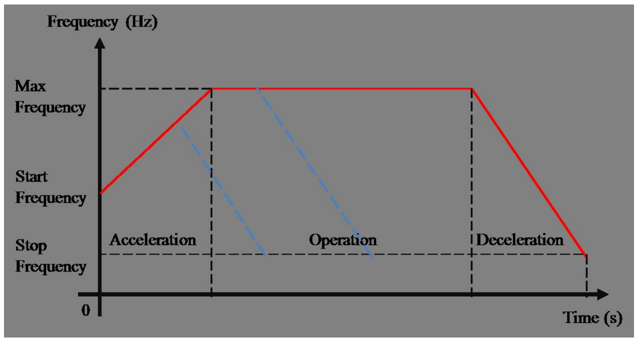


Figure 50: PTO Softstop on trapezoidal profile

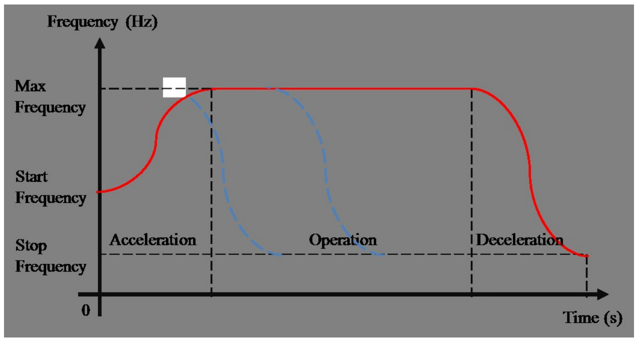


Figure 51: PTO Softstop on "S" profile

To control the PTO, the user program must access the PTO variable of the fast output structure. The structure of PTO is shown on the table below:

Variable	Description	Type	Allowed Values
StartFrequency	Start frequency in Hertz	UDINT	0 to 200000
StopFrequency	Stop frequency in Hertz	UDINT	0 to 200000
MaxFrequency	Maximum frequency in Hertz	UDINT	1 to 200000
AccelerationProfile	Acceleration profile (FALSE = Trapezoidal profile, TRUE = S profile)	BOOL	FALSE or TRUE
AccelerationPulses	Pulses in acceleration	UDINT	0 to (TotalPulses-DecelerationPulses-1)
DecelerationPulses	Pulses in deceleration	UDINT	0 to (TotalPulses-AccelerationPulses-1)
TotalPulses	Total number of pulses	UDINT	1 to 4294967295
PulsesCounter	Number of pulses generated for the current pulse train	UDINT	0 to 4294967295
Command	PTO commands structure	T_PTO_COMMAND	-
Status	PTO status structure	T_PTO_STATUS	-

Table 51: PTO variable structure

The table below shows the PTO commands structure.

Variable	Description	Type	Allowed Values
Start	Start the pulse train when this bit is set (rising edge)	BIT	FALSE or TRUE
Stop	Stop the pulse train when this bit is set (rising edge)	BIT	FALSE or TRUE
Softstop	Stop softly the pulse train when this bit is set (rising edge)	BIT	FALSE or TRUE

Table 52: PTO Command structure

The table below shows the PTO status structure.

Variable	Description	Type	Allowed Values
Running	Pulse train is being performed	BIT	FALSE or TRUE
Acceleration	Acceleration step (from StartFrequency to MaxFrequency)	BIT	FALSE or TRUE
Deceleration	Deceleration step (from MaxFrequency to StopFrequency)	BIT	FALSE or TRUE
Operation	Operation Step (MaxFrequency)	BIT	FALSE or TRUE
Done	Pulse train has already been performed	BIT	FALSE or TRUE
InvalidFrequency	Frequency (start, stop or maximum) is invalid	BIT	FALSE or TRUE
InvalidPulses	Number of pulses (TotalPulses, Acceleration or	BIT	FALSE or TRUE

Table 53: PTO Status structure

Once the Start command is TRUE, the input parameters will be continuously checked and the status variables will be updated accordingly.

Additionally to the IntegratedIo global variables, there is a function block from LibIntegratedIo library which allows to instantiate PTO in POUs written in graphical languages (e.g Ladder Logic Diagram). This function block is, actually, a wrapper to the structured variables described before. The figure below shows the function block instantiated in a Ladder program.

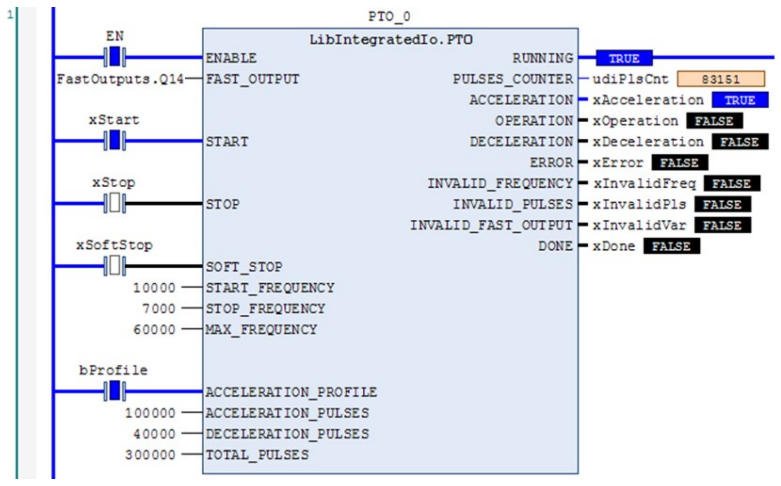


Figure 52: LibIntegratedIo.PTO function block

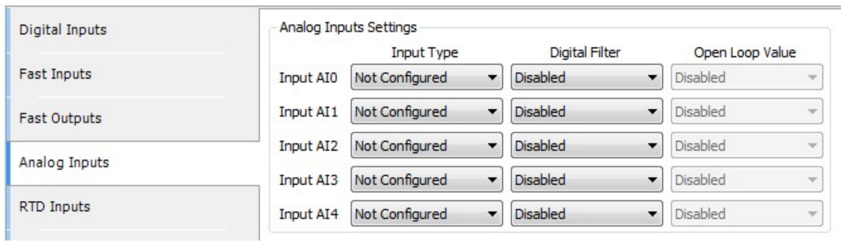
The table below describes the inputs and outputs variables of the function block.

Variable	Description	Type	Allowed Values
ENABLE	Enable the function block execution	BOOL	FALSE or TRUE
FAST_OUTPUT	Fast Output Variable	REFERENCE TO T_FAST _OUTPUT	FastOutputs.Q14 FastOutputs.Q15 FastOutputs.Q16 FastOutputs.Q17
START	Start the pulse train when this bit is set (rising edge)	BOOL	FALSE or TRUE
STOP	Stop the pulse train when this bit is set (rising edge)	BOOL	FALSE or TRUE
SOFT_STOP	Stop softly the pulse train when this bit is set (rising edge)	BOOL	FALSE or TRUE
START_FREQUENCY	Start frequency in Hertz	UDINT	1 to 200000
STOP_FREQUENCY	Stop frequency in Hertz	UDINT	1 to 200000
MAX_FREQUENCY	Maximum frequency in Hertz	UDINT	1 to 200000
ACCELERATION_PROFILE	Acceleration profile (FALSE = Trapezoidal profile, TRUE = S profile)	BOOL	FALSE or TRUE
ACCELERATION_PULSES	Pulses in acceleration	UDINT	0 to (TotalPulses-DecelerationPulses-1)
DECELERATION_PULSES	Pulses in deceleration	UDINT	0 to (TotalPulses-AccelerationPulses-1)
TOTAL_PULSES	Total number of pulses	UDINT	1 to 4294967295
RUNNING	Pulse train is being per- formed	BOOL	FALSE or TRUE
PULSES_COUNTER	Number of pulses generated for the current pulse train	UDINT	0 to 4294967295
ACCELERATION	Acceleration step (from StartFrequency to MaxFrequency)	BOOL	FALSE or TRUE
OPERATION	Operation Step (MaxFrequency)	BOOL	FALSE or TRUE
DECELERATION	DecelerationStep (from MaxFrequency to StopFrequency)	BOOL	FALSE or TRUE
ERROR	Error occurred in function block execution. The follow variables detail the error.	BOOL	FALSE or TRUE
INVALID_FREQUENCY	Frequency (start, stop or maximum) is invalid	BOOL	FALSE or TRUE
INVALID_PULSES	Number of pulses (acceleration or deceleration) is in- valid	BOOL	FALSE or TRUE
INVALID_FAST_OUTPUT	FAST_OUTPUT was not as- signed to the block or isn't configured as PTO.	BOOL	FALSE or TRUE
DONE	Pulse train has already been performed	BOOL	FALSE or TRUE

Table 54: LibIntegratedIo.PTO function block description

5.5.4. Analog Inputs

The parameters related to the Analog Inputs are shown below:



Analog Inputs Settings

	Input Type	Digital Filter	Open Loop Value
Input AI0	Not Configured	Disabled	Disabled
Input AI1	Not Configured	Disabled	Disabled
Input AI2	Not Configured	Disabled	Disabled
Input AI3	Not Configured	Disabled	Disabled
Input AI4	Not Configured	Disabled	Disabled

Figure 53: Analog Inputs Parameters

The table below shows the possible configuration values:

Configuration	Description	Default	Options
Input Type	Selects the input type	Not configured	Not configured Voltage 0 - 10 Vdc Currrent 0 - 20 mA Current 4 - 20 mA
Digital Filter	Enable/Disable a 1st order low pass digital filter for each input	Disabled	Disabled 100 ms 1 s 10 s
Open Loop Value	Set value when in open loop condition (Only valid for 4 - 20 mA scale)	Disabled	Disabled 0 30000

Table 55: Analog Inputs Parameters

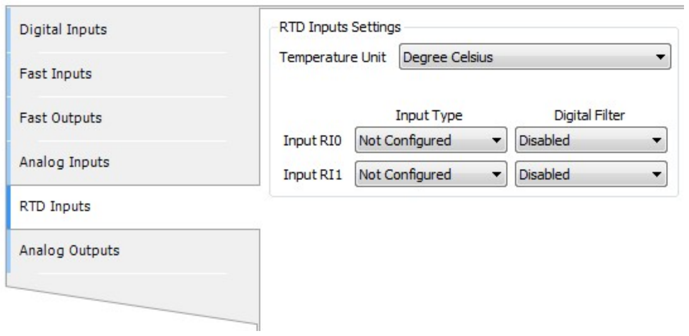
Notes:

Input Type: Be sure to use the proper pin on the terminal block correspondent to the selected type (voltage or current).

Open Loop Value: : Determines the behavior of the input variable when set to 4 - 20 mA scale and current less than 3 mA.

5.5.5. RTD Inputs

The parameters related to the RTD Inputs are shown below:



Temperature Unit: Degree Celsius

	Input Type	Digital Filter
Input RI0	Not Configured	Disabled
Input RI1	Not Configured	Disabled

Figure 54: RTD Inputs Parameters

The table below shows the possible configuration values:

Configuration	Description	Default	Options
Temperature Unit	Selects the temperature unit	Degree Celsius	Degree Celsius Degree Fahrenheit
Input Type	Selects the input type	Not configured	Not configured 400 Ω 4000 Ω Pt100A Pt100E Pt1000A Pt1000E
Digital Filter	Enable/Disable a 1st order low pass digital filter for each input	Disabled	Disabled 100 ms 1 s 10 s

Table 56: RTD Inputs Parameters

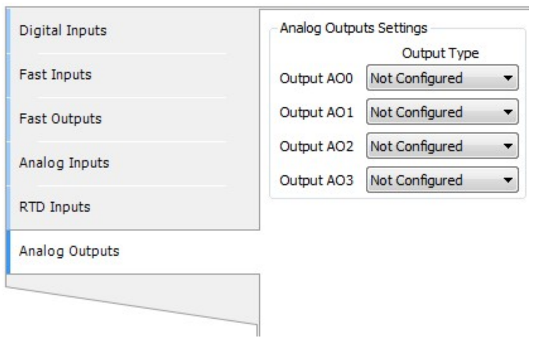
The next table describes additional details about each input type:

Input type	Temperature Coefficient (α)	Measurement Band	Count	Resolution
400 Ω	-	0 to 400 Ω	0 to 4000	0.1 Ω
4000 Ω	-	0 to 4000 Ω	0 to 4000	1 Ω
Pt100E Pt1000E	0,00385	-200 to 850 °C -328 to 1562 °F	-2000 to 8500 -3280 to 15620	0.1 °C 0.2 °F
Pt100A Pt1000A	0,003916	-200 to 630 °C -328 to 1166 °F	-2000 to 6300 -3280 to 11660	0.1 °C 0.2 °F

Table 57: RTD Input Types

5.5.6. Analog Outputs

The parameters related to the Analog Outputs are shown below:



Analog Outputs Settings

Output Type

Output AO0 Not Configured

Output AO1 Not Configured

Output AO2 Not Configured

Output AO3 Not Configured

Figure 55: Analog Outputs Parameters

The table below shows the possible configuration values:

Configuration	Description	Default	Options
Output Type	Selects the output type	Not configured	Not configured Voltage 0 - 10 Vdc Current 0 - 20 mA Current 4 - 20 mA

Table 58: Analog Outputs Parameters

5.6. USB Port

The USB Host port present on NX-ERA Xpress controllers allows to extend the controller's functionalities by using several types of USB dongles. Due to the wide range of USB devices available on the market (flash drives, Ethernet/Wifi adapters,
3G/4G modem, etc...), the support for each specific device is provided by a firmware update.

The following sections describes the currently supported devices.

5.6.1. Mass Storage Devices

5.6.1.1. General Storage

Mass storage devices can be used to expand the controller's flash memory to store big amount of data, like on data logger applications, for instance. To use a USB mass storage device, simply connect it to the USB port. After a few seconds, when the device is properly detected and mounted, the USB LED will turn on and a new folder called Mass_Storage will appear on the controller's memory as shown on the picture below:

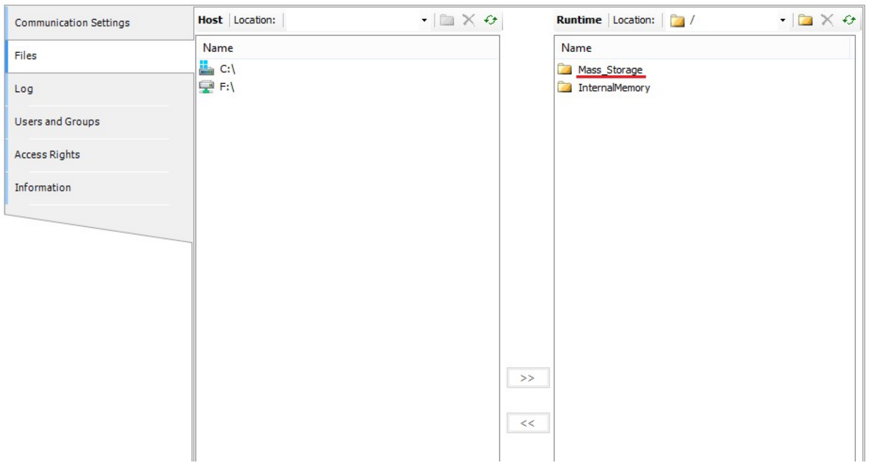
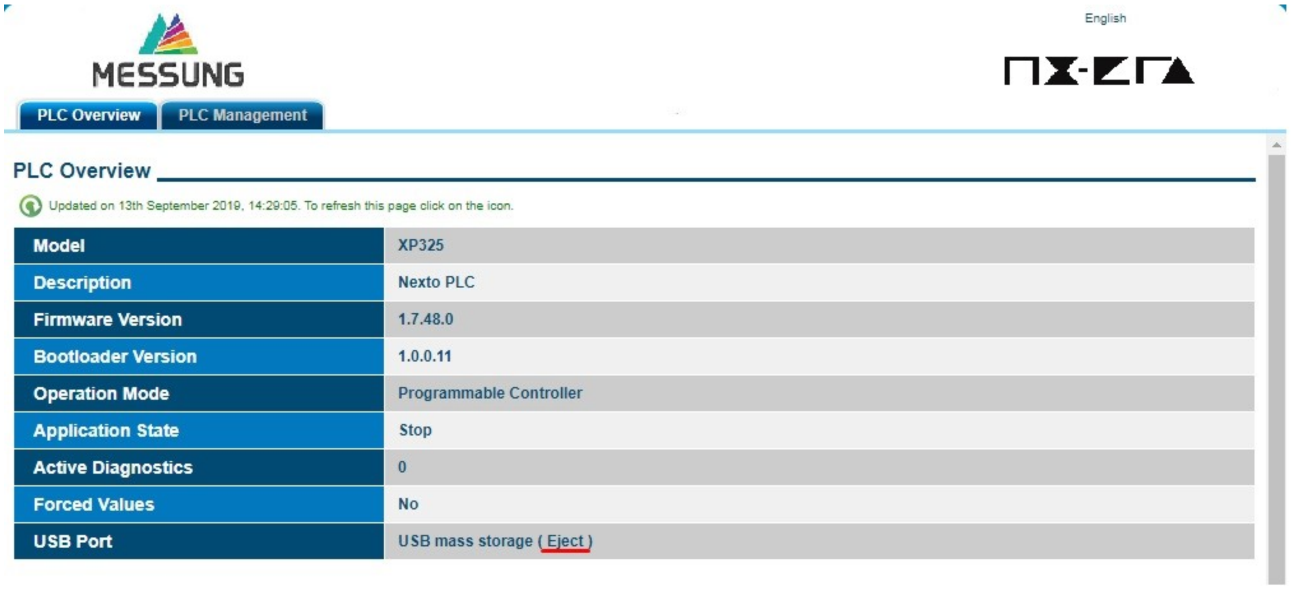


Figure 56: USB Mass Storage Folder

ATTENTION:
The USB mass storage device must be formatted as a FAT32 volume. Other file system formats are not supported.

To eject the mass storage device, use the command provided on the tab PLC Overview of the controller's diagnostics webpage as shown on the picture below:



PLC Overview

Updated on 13th September 2019, 14:29:05. To refresh this page click on the icon.

Model	XP325
Description	Nexto PLC
Firmware Version	1.7.48.0
Bootloader Version	1.0.0.11
Operation Mode	Programmable Controller
Application State	Stop
Active Diagnostics	0
Forced Values	No
USB Port	USB mass storage (Eject)

Figure 57: Ejecting the Mass Storage Device

5.6.1.2. Not Loading the Application at Startup

The USB mass storage device can be used to prevent the controller from automatically loading the application after the power on. To do that, simply place an empty text file called "dontbootapp.txt" on the root folder of mass storage device.

5.6.1.3. Transferring an Application from the USB device

The USB mass storage device can also be used to transfer an application to the controller. To do that, place the two files Application.app and Application.crc on the root folder of mass storage device (these files are created using MasterTool IEC XE executing the command Online -> Create boot application when offline). After the power on, if the controller detects the presence of these files on the USB mass storage device, the following sequence of actions will occur:

- The controller will start copy of the application from USB device to internal memory
- After finishing the copy process, the USB device will be ejected (USB LED will turn off)
- The new application will start (RUN) automatically (if "dontbootapp.txt" is not present)

5.6.2. USB to RS-232 Converters

NX-ERA Xpress allows to implement a RS-232 port using a USB to Serial converter. These converters are all based on an internal controller chip. Currently, NX-ERA Xpress support the two most popular controllers: FTDI and Prolific.

This port is intended to be used exclusively with the Serial communication function blocks provided by the NX-ERASerial library, allowing to implement a point-to-point communication with equipments that use simple protocols (non time critical) like Radio modems, Barcode readers, RFID readers, etc...

After plugging the converter into the USB port, the USB LED may turn on indicating that the device was properly detected and mounted. This additional serial port will be identified internally as COM10, and will not have a representation on the project treeview. From this point, this port can be used for communication using the NX-ERASerial functions similar to the native ports. For this kind of port, the handshake configuration is limited to RS232_MANUAL only (must be considered when configuring the port with SERIAL_CFG function).

5.7. Communication Protocols

NX-ERA Xpress controllers offers several communication protocols, including MODBUS (exclusively Symbolic), OPC UA and other. The following table describes the configuration limits:

	XP3xx
Mapped Points	20480
Symbolic MODBUS Mappings	5120
MODBUS Requests	512
NETs – Clients or Servers instances	4
COM (n) – Master or Slave instances	1

Table 59: Limits for communication protocols

Notes:

Mapped Points: Each variable or item of a given data type is assumed to be a mapping. The same is considered for each position of the ARRAY type. This means that if a simple variable is declared, it will be considered a mapping and if an ARRAY type is declared, the count will be equal to the size of the declared ARRAY. The amount of mappings increments by one when there is a simple type of variable being declared independent of the size of the given type. Then, mapping a variable of INT type (16-bit) in a Holding Register of symbolic Modbus drivers or a variable of type LINT (64-bit) in four Holding Register of symbolic Modbus drivers is accounted for as just a mapping.

Symbolic MODBUS Mappings: A mapping is a relationship between an application intern variable and an application protocol object. The limit value for the project mappings corresponds to the sum of all the mappings made within the instances of communication protocols and their respective devices.

MODBUS Requests: MODBUS requests for MODBUS by symbolic mapping.

Additional information about specific MODBUS protocol limits and protocol behavior according to the CPU state can be found on this same section of NX-ERA Series CPUs User Manual code MU214605.

5.7.1. MODBUS RTU MASTER

This protocol is the same one available on other NX-ERA Series devices, which is described on this same section of NX-ERA Series CPUs User Manual code MU214605.

5.7.2. MODBUS RTU SLAVE

This protocol is the same one available on other NX-ERA Series devices, which is described on this same section of NX-ERA Series CPUs User Manual code MU214605.

5.7.3. MODBUS ETHERNET

NX-ERA Xpress controllers supports only the newest MODBUS Symbolic Client/Server drivers. These protocols are the same ones available on other NX-ERA Series devices, which is described on this same section of NX-ERA Series CPUs User Manual code MU214605.

5.7.4. OPC DA Server

This protocol is the same one available on other NX-ERA Series devices, which is described on this same section of NX-ERA Series CPUs User Manual code MU214605.

5.7.5. OPC UA Server

This protocol is the same one available on other NX-ERA Series devices, which is described on this same section of NX-ERA Series CPUs User Manual code MU214605.

5.7.6. CANopen Manager

CANopen is a protocol based on CAN bus which provides fast I/O update (around 5 ms for a 1000 kbit/s network with a few slaves) with a simple twisted pair physical bus infrastructure.

The CANopen Manager (master) is responsible for controlling the slave devices, managing their operation state and exchanging I/O and other service data. By default, the CANopen manager protocol activities (bus cycle) are executed on the context of MainTask, keeping it synchronous with the execution of application code.

The configuration of CANopen network is performed with the support of EDS files, which describes the I/O data and service objects (PDO and SDO) of the slave and must be provided by the device manufacturer.

Additionally, an application library called CiA405 is provided with FunctionBlocks which allows to perform several specific actions like changing the slave state (NMT), receiving emergency object, querying the slave state and performing SDO read/write commands. The complete description of CiA405 library can be found on Online Help (F1) of MasterTool IEC XE.

ATTENTION:
- Only one CANopen Manager instance per project is allowed
- Although CANopen specification allows up to 127 nodes (including Manager), applications with NX-ERA Xpress must not exceed a maximum of 32 slave devices.

A special care must be taken considering the physical bus length and the selected baudrate. The following table shows the maximum bus length that can be used safely with a given baudrate:

Baudrate	Maximum bus length
1000 kbit/s	25 m
800 kbit/s	50 m
500 kbit/s	100 m
250 kbit/s	250 m
125 kbit/s	500 m
100 kbit/s	700 m
$<$ 50 kbit/s	1000 m

Table 60: Baudrate vs Bus Length

5.7.6.1. Installing and inserting CANopen Devices

The configuration of a CANopen network uses the same standard procedure of other fieldbuses configuration on MasterTool IEC XE.

To add a CANopen Manager, right-click on the CAN interface and select Add Device. Expand the itens until finding CANopen_ Manager device and click on the Add Device button. The CANopen Manager device will appear below the CAN interface as shown on the following picture:

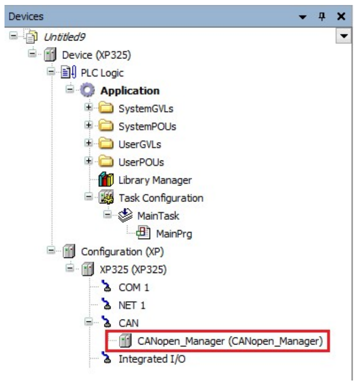
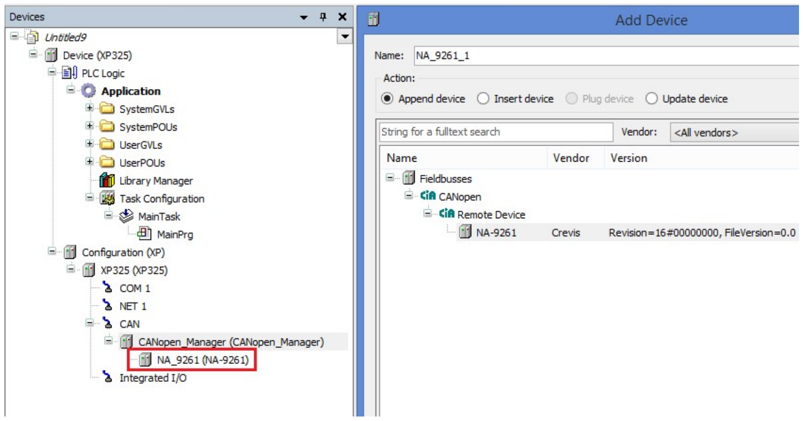


Figure 58: Adding CANopen Manager

To add a CANopen slave device, first you need to install it on the Device Repository. To do that, go to Tools -> Device Repository and install the device EDS file.

After that, right-click on the CANopen_Manager device and click on Add Device. Search the devices you desire and click on Add Device button like shown on the following picture:



Name: NA_9261_1

Action: (● Append device) ○ Insert device ○ Plug device ○ Update device

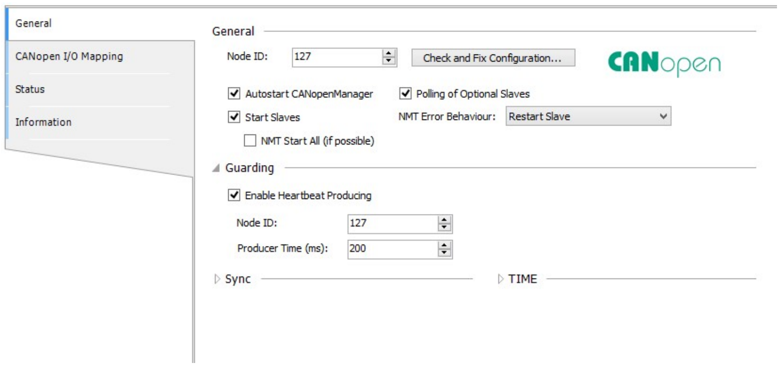
Name	Vendor	Version
NA-9261	Crevis	Revision=16#00000000, FileVersion=0.0

Figure 59: Adding CANopen Slave Device

5.7.6.2. CANopen Manager Configuration

The CANopen Manager comes with a ready-to-use configuration (default values). Typically, it is just needed to set the correct baudrate and slave address to have a network running.

The main parameters of CANopen manager are located at General tab:



Node ID: 127

[✓] Autostart CANopenManager
[✓] Polling of Optional Slaves
[✓] Start Slaves
NMT Error Behaviour: Restart Slave
[ ] NMT Start All (if possible)

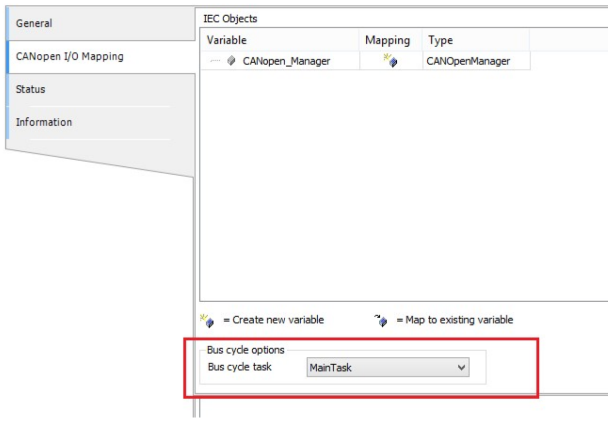
Guarding

[✓] Enable Heartbeat Producing
Node ID: 127
Producer Time (ms): 200

Figure 60: CANopen Manager general parameters

The detailed description of CANopen Manager general parameters can be found on section Device Editors -> CANopen of MasterTool IEC XE Online Help (F1).

Additionally, the tab CANopen I/O Mapping allows to change the bus cycle task:



Variable	Mapping	Type
CANopen_Manager		CANOpenManager

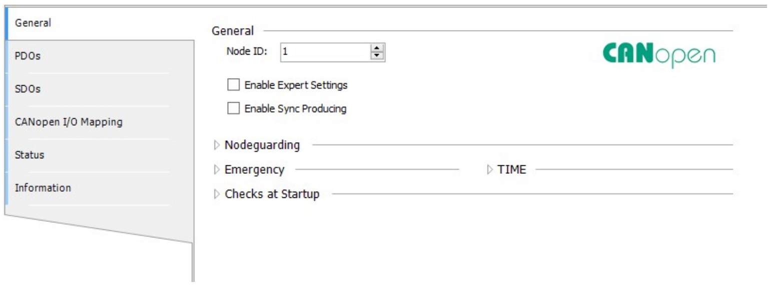
Bus cycle options
Bus cycle task: MainTask

Figure 61: CANopen Manager bus cycle task setting

By default, the bus cycle task is configured to use the MainTask. This is the recommended setting for most of the applications. Changing this setting is only required on a very specific scenario which requires the implementation of a time-critical control loop using CANopen I/O (5ms lets say) that can not be performed on MainTask due to heavy application code.

5.7.6.3. CANopen Slave Configuration

The configuration of CANopen Remote Devices (Slaves) is separated in the first four tabs shown on the following picture:



Node ID: 1
☐ Enable Expert Settings
☐ Enable Sync Producing

Figure 62: CANopen Slave parameters

The General tab contains the slave address (Node ID), Nodeguarding and Emergency object settings.

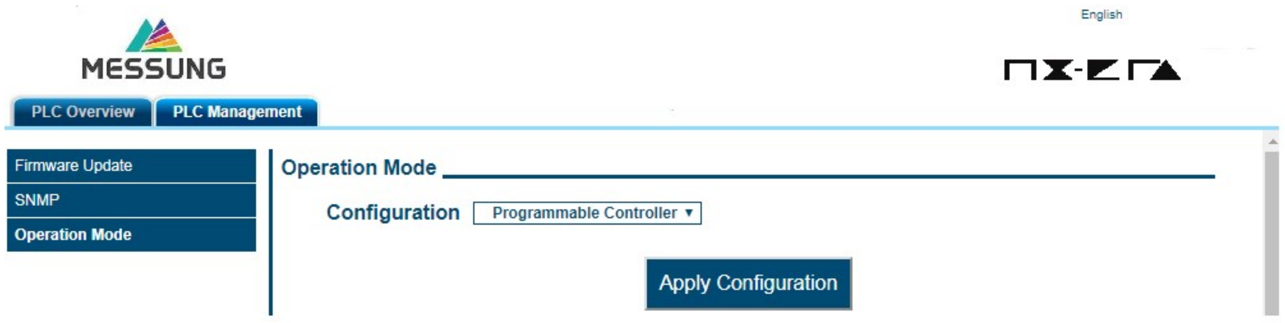
The PDO tab contains the configuration of process data (I/O data) that will be exchanged.

The SDO tab contains the SDO objects which can be selected to be accessed by SDO read/write FunctionBlock provided by CiA405 library.

The detailed description of CANopen Slave parameters can be found on section "Device Editors -> CANopen of MasterTool IEC XE Online Help (F1).

5.8. Remote I/O Mode

NX-ERA Xpress controllers have a remote operation mode, which is used as I/O expansion. This expansion is based in CANopen protocol. When the controller is in remote mode, it isn't a standard PLC, operating only as a remote slave. To configure your Xpress as a remote I/O expansion, access the product Web page PLC Management, in the Operation Mode tab.



Operation Mode

Configuration: Programmable Controller

Figure 63: Remote I/O Configuration Screen

In this tab, it's possible to choose the controller operation mode through the combo box. This is available only when the controller is in STOP. Use the Apply Configuration button to change to the desired mode. The Xpress will reboot and configure the new operation mode. The available options are:

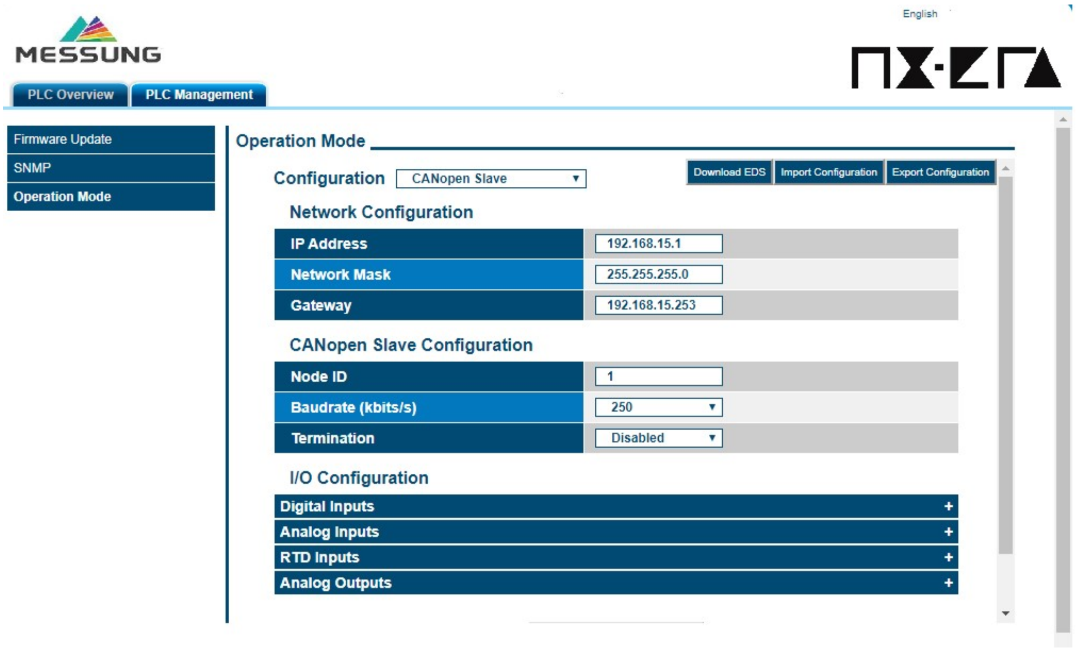
- Programmable Controller: default controller function, which can be programmed according to user needs.
- CANopen Slave: remote I/O expansion function, where the controller becomes a CANopen slave, which can communicate to other controllers through CANopen Manager.

ATTENTION:
The remote operation mode uses an application developed only for I/O expansion, which runs in a 5 ms MainTask cycle. It's not possible change or download an application in this mode.

When in remote operation mode, some features of the controller will be modified. The controller can't be found by the MasterTool. However, it's possible to find the device via Easy Connection, even change its IP, without erase the application. Besides that, in the Firmware Update tab on the Web page, the Erase Application option is unavailable.

5.8.1. CANopen Slave

To use the expansion mode as a CANopen Slave, first, change the Operation Mode to CANopen Slave, in Operation Mode on the Web page. Next, make the configurations of the CANopen Slave: configure the network (IP Address, Network Mask and Gateway); configure the CANopen parameters (Node ID, Baudrate and Termination); and the I/O configuration (according to the controller). These settings are similar to a typical application.



Operation Mode

Configuration: CANopen Slave

Network Configuration

IP Address	192.168.15.1
Network Mask	255.255.255.0
Gateway	192.168.15.253

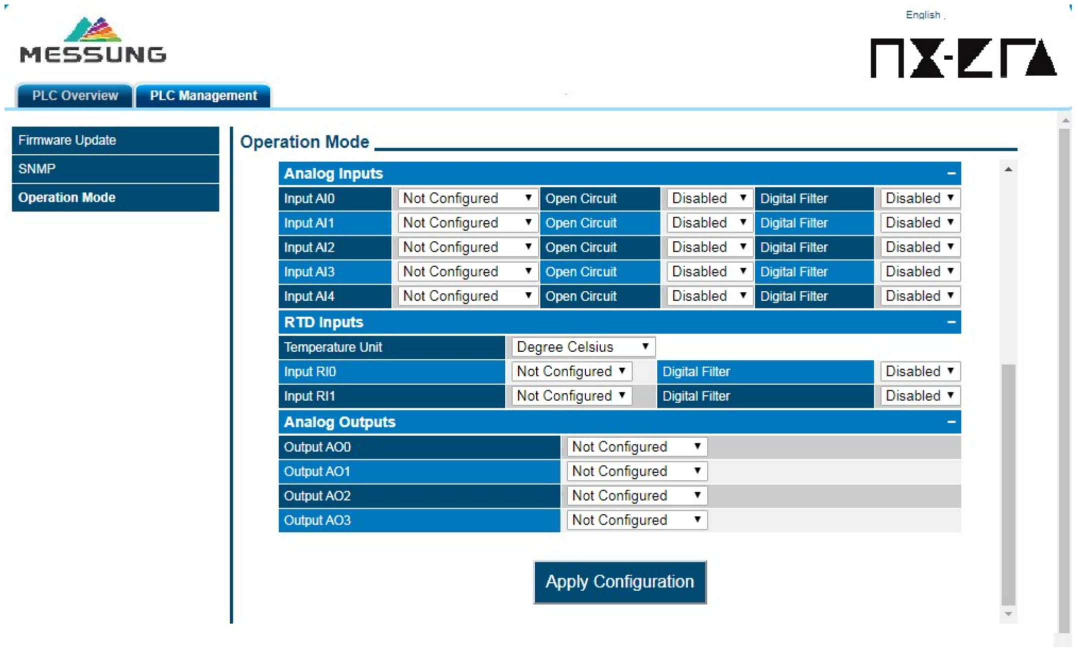
CANopen Slave Configuration

Node ID	1
Baudrate (kbits/s)	250
Termination	Disabled

I/O Configuration

Figure 64: CANopen Slave Remote Configuration Screen

Click in the items with the + on the right to expand the configuration panel. All parameters shown in the I/O Configuration are the same mentioned in the Integrated I/O section. While the CANopen Slave Configuration parameters are the same of those in the CANopen Manager section.



Operation Mode

Analog Inputs −

Input AI0	Not Configured	Open Circuit	Disabled	Digital Filter	Disabled
Input AI1	Not Configured	Open Circuit	Disabled	Digital Filter	Disabled
Input AI2	Not Configured	Open Circuit	Disabled	Digital Filter	Disabled
Input AI3	Not Configured	Open Circuit	Disabled	Digital Filter	Disabled
Input AI4	Not Configured	Open Circuit	Disabled	Digital Filter	Disabled

RTD Inputs −

Temperature Unit	Degree Celsius		
Input RI0	Not Configured	Digital Filter	Disabled
Input RI1	Not Configured	Digital Filter	Disabled

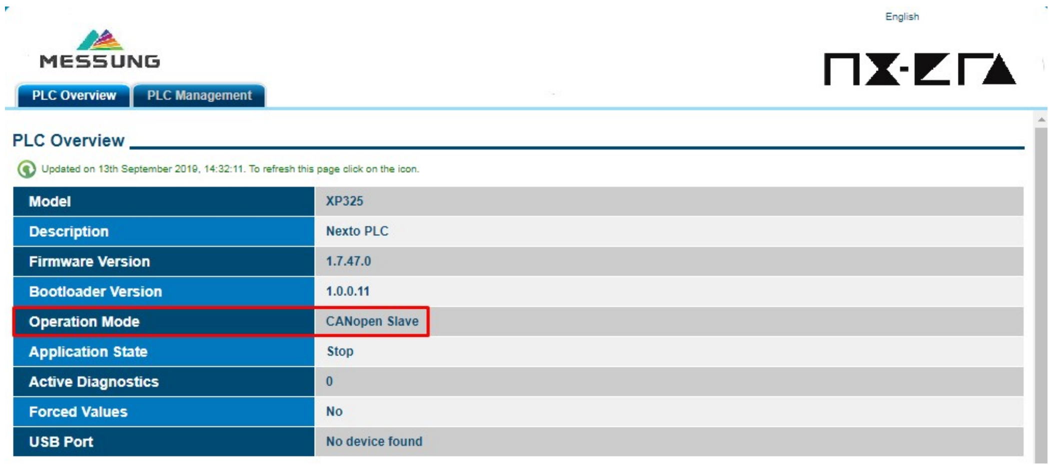
Analog Outputs −

Output AO0	Not Configured
Output AO1	Not Configured
Output AO2	Not Configured
Output AO3	Not Configured

Figure 65: Expanded I/O Configuration Screen

After the configuration step, it's possible to use the Export Configuration button to download a file called WebRemote-Configuration.config. This file contains all parameters configured in the Remote I/O Configuration screen. You can use this file to load the configuration through the Import Configuration button. Besides that, you can download the CANopen Slave Electronic Data Sheet (EDS) file directly by the Download EDS button in the Web.

When the configuration is done, click in Apply Configuration to reboot the controller with the new settings. The Web page will automatically reload to the configured IP. The mode change can be confirmed by the CANopen Slave in the Operation Mode field, in the PLC Overview tab.



PLC Overview

Updated on 13th September 2019, 14:32:11. To refresh this page click on the icon.

Model	XP325
Description	Nexto PLC
Firmware Version	1.7.47.0
Bootloader Version	1.0.0.11
Operation Mode	CANopen Slave
Application State	Stop
Active Diagnostics	0
Forced Values	No
USB Port	No device found

Figure 66: Operation Mode in the PLC Overview Screen

Therefore, it's possible to use a controller with the CANopen Manager feature (e.g. XP325) to access the CANopen Slave I/O. See the CANopen Manager section in this document to learn how use this feature. The CANopen Slave Remote PDOs are organized as follow:

Variable Name	Representation	Variable Type
Digital_Outputs_1	Q0 Group	USINT - 8 bits
Digital_Outputs_2	Q1 Group	USINT - 8 bits
Analog_Outputs_1	AO0	INT - 16 bits
Analog_Outputs_2	AO1	INT - 16 bits
Analog_Outputs_3	AO2	INT - 16 bits
Analog_Outputs_4	AO3	INT - 16 bits
Digital_Inputs_1	I0 Group	USINT - 8 bits
Digital_Inputs_2	I1 Group	USINT - 8 bits
Analog_Inputs_1	AI0	INT - 16 bits
Analog_Inputs_2	AI1	INT - 16 bits
Analog_Inputs_3	AI2	INT - 16 bits
Analog_Inputs_4	AI3	INT - 16 bits
Analog_Inputs_5	AI4	INT - 16 bits
RTD_Inputs_1	RI0	INT - 16 bits
RTD_Inputs_2	RI1	INT - 16 bits
Diagnostics_Analog_Inputs_1	AI0 Diagnostics	USINT - 8 bits
Diagnostics_Analog_Inputs_2	AI1 Diagnostics	USINT - 8 bits
Diagnostics_Analog_Inputs_3	AI2 Diagnostics	USINT - 8 bits
Diagnostics_Analog_Inputs_4	AI3 Diagnostics	USINT - 8 bits
Diagnostics_Analog_Inputs_5	AI4 Diagnostics	USINT - 8 bits
Diagnostics_RTD_Inputs_1	RI0 Diagnostics	USINT - 8 bits
Diagnostics_RTD_Inputs_2	RI1 Diagnostics	USINT - 8 bits
Diagnostics_Analog_Outputs_1	AO0 Diagnostics	USINT - 8 bits
Diagnostics_Analog_Outputs_2	AO1 Diagnostics	USINT - 8 bits
Diagnostics_Analog_Outputs_3	AO2 Diagnostics	USINT - 8 bits
Diagnostics_Analog_Outputs_4	AO3 Diagnostics	USINT - 8 bits

Table 61: CANopen Slave Remote PDOs Organization

Digital I/Os are accessed by groups. They use a byte, where each bit is an digital I/O (e.g. I00 is the less significant bit - LSB - and I07, the most significant bit - MSB). Analog I/Os are transmitted/received directly through an integer. And the diagnostics of each analog I/O are received in a byte, according to the following tables:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	-	bOpenLoop	bOverRange	bInputNotEnable

Table 62: AIx Diagnostics

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	-	bUnderRange	bOverRange	bInputNotEnable

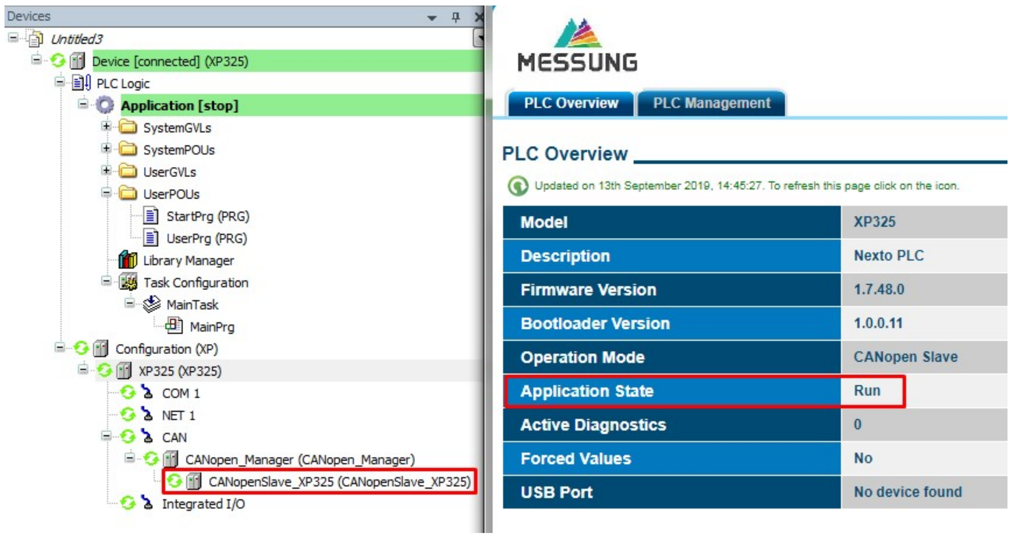
Table 63: RIx Diagnostics

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	-	bShortCircuit	bOpenLoop	bOutputNotEnable

Table 64: AOx Diagnostics

ATTENTION:
PDOs can't be edited or removed from the CANopen Slave. It's not possible to create your own CANopen slave device.

How the CANopen Slave is not accessible by the user via MasterTool, the RUN and STOP state of the application are controlled by the CANopen slave operation state. To put the CANopen Slave in RUN, it's necessary to set the state to Operational (green symbol next to the device). To put it in STOP, you need to use the NMT Function Block of the CiA405 library - see Online Help (F1) - to change the CANopen slave operation state (recommended). Or, you can remove the CAN connector of the remote controller. The CAN LED can keep blinking once it indicates the message transmission and reception, not the operation state of the CANopen protocol.

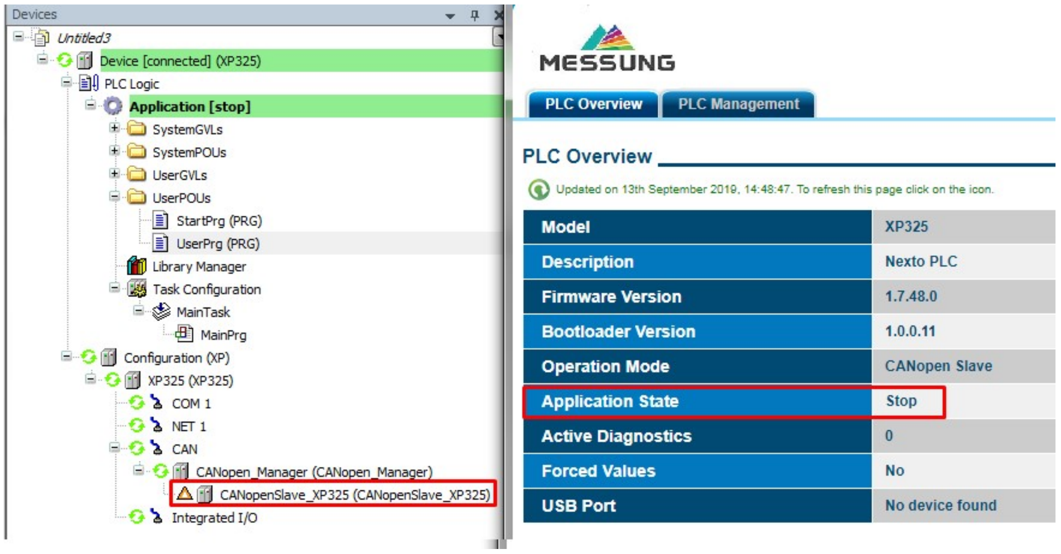


PLC Overview

Updated on 13th September 2019, 14:45:27. To refresh this page click on the icon.

Model	XP325
Description	Nexto PLC
Firmware Version	1.7.48.0
Bootloader Version	1.0.0.11
Operation Mode	CANopen Slave
Application State	Run
Active Diagnostics	0
Forced Values	No
USB Port	No device found

Figure 67: CANopen Slave in Operational - RUN



PLC Overview

Updated on 13th September 2019, 14:48:47. To refresh this page click on the icon.

Model	XP325
Description	Nexto PLC
Firmware Version	1.7.48.0
Bootloader Version	1.0.0.11
Operation Mode	CANopen Slave
Application State	Stop
Active Diagnostics	0
Forced Values	No
USB Port	No device found

Figure 68: CANopen Slave in Pre-Operational - STOP

5.9. User Web Pages

Also called Web Visualization, or simply Webvisu, this feature allows to implement a simplified SCADA embedded into the PLC. The Visualization screens are developed on the same environment of the PLC application using MasterTool IEC XE. Once the application is downloaded, the PLC starts a web server hosting this special web page.

The complete information about this functionality can be found on Help of MasterTool IEC XE.

5.10. SNMP

5.10.1. Introduction

SNMP (Simple Network Management Protocol) is a protocol widely used by network administrators to provide important information and diagnostic equipment present in a given Ethernet network.

This protocol uses the concept of agent and manager, in which the manager sends read requests or write certain objects to the agent. Through a MIB (Management Information Base) the manager is aware of existing objects in the agent, and thus can make requests of these objects, respecting the read permissions or writing the same.

MIB is a collection of information organized hierarchically in which each object of this tree is called OID (Object Identifier). For all equipments with SNMP, it is mandatory to support MIB-II, which have key information for managing Ethernet networks.

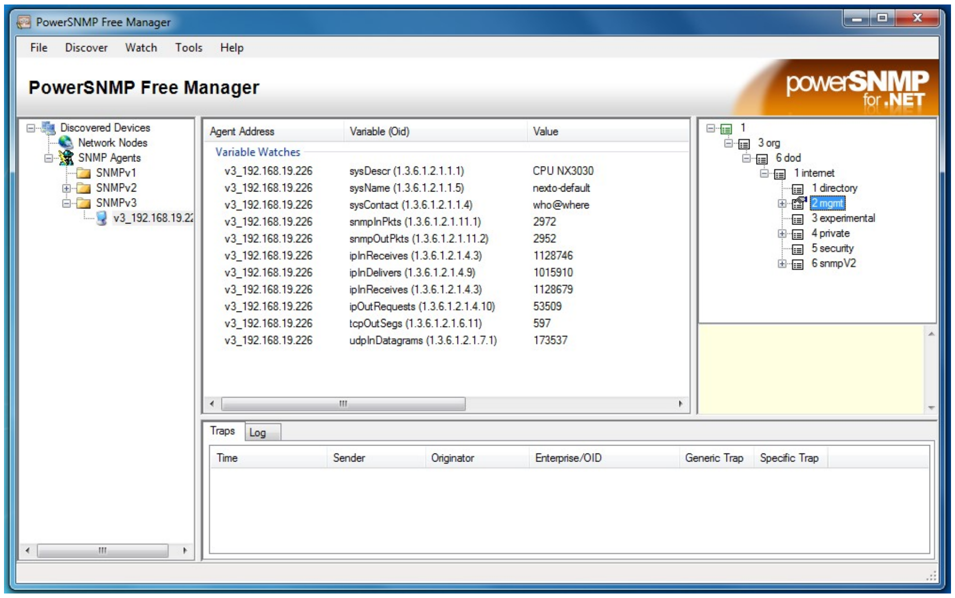
5.10.2. SNMP in NX-ERA Xpress Controllers

The NX-ERA Xpress controllers behaves as agents in SNMP communication, with support for protocols SNMPv1, SNMPv2c, SNMPv3 and support the MIB-II, where required objects are described in RFC-1213. The information provided by the SNMP cannot be manipulated or accessed through the user application, requiring an external SNMP manager to perform access. The following table describes the objects available in NX-ERA Xpress controllers.

OID	Name	Description
1.3.6.1.2.1.1	System	Contains name, description, location and other equipment identification information.
1.3.6.1.2.1.2	Interfaces	Contains information of the machine's network interfaces. The ifTable table (OID 1.3.6.1.2.1.2.2) has the indexes 6 and 7 available, which can be viewed by the network interfaces statistics NET 1 and NET 2, respectively, of the NX-ERA series
1.3.6.1.2.1.3	At	Contains information of the last required connections to the agent.
1.3.6.1.2.1.4	IP	Contains statistical connections using IP protocol.
1.3.6.1.2.1.5	ICMP	Contains statistical connections using ICMP protocol.
1.3.6.1.2.1.6	TCP	Contains statistical connections using TCP protocol.
1.3.6.1.2.1.7	UDP	Contains statistical connections using UDP protocol.
1.3.6.1.2.1.11	SNMP	Contains statistical connections using SNMP protocol.
1.3.6.1.2.1.31	ifMib	Extension to Interfaces, OID 1.3.6.1.2.1.2

Table 65: MIB II Objects – NX-ERA Xpress SNMP Agent

By default, the SNMP agent is activated, i.e., the service is initialized at the time the controller is started. The access to the agent information is via the Ethernet interface, TCP port 161. The following figure shows an example of an SNMP manager reading some values.



Agent Address	Variable (Oid)	Value
Variable Watches		
v3_192.168.19.226	sysDescr (1.3.6.1.2.1.1.1)	CPU NX3030
v3_192.168.19.226	sysName (1.3.6.1.2.1.1.5)	nexto-default
v3_192.168.19.226	sysContact (1.3.6.1.2.1.1.4)	who@where
v3_192.168.19.226	snmpInPkts (1.3.6.1.2.1.11.1)	2972
v3_192.168.19.226	snmpOutPkts (1.3.6.1.2.1.11.2)	2952
v3_192.168.19.226	ipInReceives (1.3.6.1.2.1.4.3)	1128746
v3_192.168.19.226	ipInDelivers (1.3.6.1.2.1.4.9)	1015910
v3_192.168.19.226	ipInReceives (1.3.6.1.2.1.4.3)	1128679
v3_192.168.19.226	ipOutRequests (1.3.6.1.2.1.4.10)	53509
v3_192.168.19.226	tcpOutSegs (1.3.6.1.2.1.6.11)	597
v3_192.168.19.226	udpInDatagrams (1.3.6.1.2.1.7.1)	173537

Figure 69: SNMP Manager Example

For SNMPv3, in which there is user authentication and password to requests via SNMP protocol, is provided a standard user described in the User and SNMP Communities section.

If you want to disable the service, change the SNMPv3 user or communities for SNMPv1 / v2c predefined, you must access the controller's web page as described on the following section.

5.10.3. Configuration

SNMP settings can be changed through the controller's web page, in the PLC Management tab. To access the settings, you must first log in, as shown in the figure below.

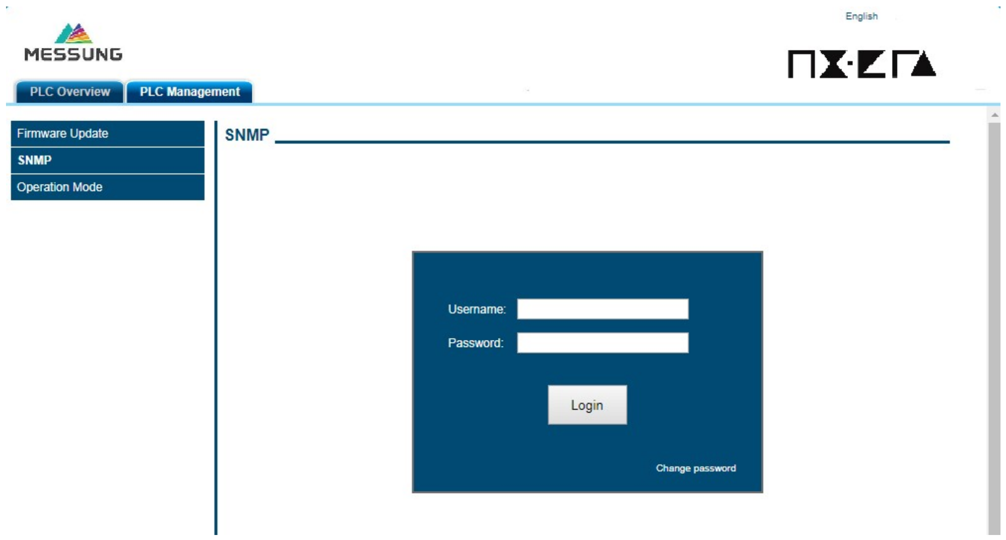


Figure 70: SNMP Login screen

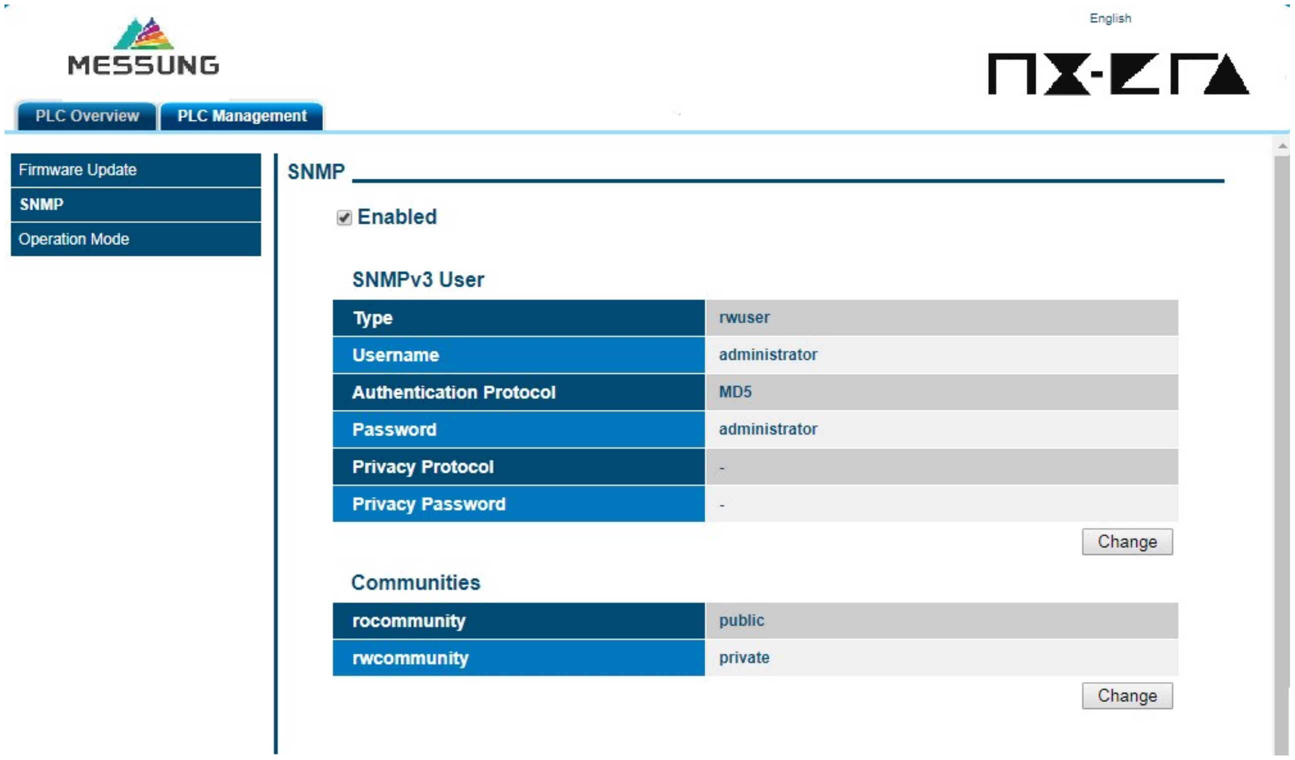
After a successful login, the current state of the service (enabled or disabled) as well as the user information SNMPv3 and communities for SNMPv1 / v2c can be viewed.

The user can enable or disable the service via a checkbox at the top of the screen.

It's also possible to change the SNMPv3 information by clicking the Change button just below the user information. Will open a form where you must complete the old username and password, and the new username and password. The other user information SNMPv3 cannot be changed.

To change the data of SNMPv1/v2c communities, the process is similar, just click the Change button below the information community. A new screen will open where the new data to the rocommunity fields and rwcommunity will be inserted. If you fail any of the fields blank, their community will be disabled. That way, if the user leaves the two fields blank, access to the SNMP agent will only be possible through SNMPv3.

If the user wants to return to the default settings, it must be manually reconfigure the same according to the User and SNMP Communities section. Therefore, all current SNMP configurations will be kept in the firmware update process. These options are shown on the figure below.



SNMP

☑ Enabled

SNMPv3 User

Type	rwuser
Username	administrator
Authentication Protocol	MD5
Password	administrator
Privacy Protocol	-
Privacy Password	-

Communities

rocommunity	public
rwcommunity	private

Figure 71: SNMP status configuration screen

ATTENTION:
If the pages shown above are different from ones displayed on the browser, it may be necessary to clean the browser cache.

ATTENTION:
The user and password to login on the SNMP settings web page and to access the agent via SNMP protocol are the same.

5.10.4. User and SNMP Communities

To access the SNMPv1 / v2c of the NX-ERA Xpress controllers, there are two communities, according to following table.

Communities	Default String	Type
rocommunity	Public	Only read
rwcommunity	Private	Read and Write

Table 66: SNMP v1/v2c Default Communities info

It's possible to access SNMP v3 using default user, see table below:

User	Type	Authentication Protocol	Authentication Password	Private Protocol	Private Password
administrator	rwuser	MD5	administrator	-	-

Table 67: SNMP v3 User info

For all settings of communities, user and password, some limits must be respected, as described on the following table:

Configurable item	Minimum Size	Max Size	Allowed Characters
rocommunity	-	30	[0-9][a-z][A-Z]@$*_.
rwcommunity	-	30	[0-9][a-z][A-Z]@$*_.
V3 User	-	30	[0-9][a-z][A-Z]@$*_.
Password v3	8	30	[0-9][a-z][A-Z]@$*_.

Table 68: SNMP settings limits

5.11. RTC Clock

NX-ERA Xpress controllers have an internal clock that can be used through the NX-ERAStandard.lib library. This functionality is the same one available on other NX-ERA Series devices, which is described on this same section of NX-ERA Series CPUs User Manual code MU214605.

5.12. Function Blocks and Functions

The Function Blocks and Functions available for NX-ERA Xpress controllers are the same ones provided for NX-ERA Series
CPUs, which are described on this same section of NX-ERA Series CPUs User Manual code MU214605.

6. Maintenance

6.1. Diagnostics

NX-ERA Xpress controllers permit many ways to visualize the diagnostics generated by the system, which are:

- Diagnostics via LED
- Diagnostics via WEB
- Diagnostics via Variables
- Diagnostics via Function Bloc

The first one is purely visual, generated through two LEDs placed on the front panel (PWR and DG). The next feature is the graphic visualization in a WEB page. The diagnostics are also provided as global symbolic variables to be used on the user application, for instance, being presented in a supervisory system. The last ones present specific conditions of the system functioning.

These diagnostics function is to point possible system installation or configuration problems, and communication network problems or deficiency.

6.1.1. Diagnostics via LED

NX-ERA Xpress controllers have a power (PWR) and a diagnostic indication (DG) LEDs. The following table shows the meaning of each state and its respective descriptions:

PWR	DG	Description	Causes	Priority
Off	Off	Not used	No power supply or Hardware problem	-
On	Off	Controller is booting	-	-
On	On	CPU is in RUN state, and there are no active diagnostics	-	5 (low)
On	Blinking 1x	CPU is in STOP state or no application loaded	-	2
On	Blinking 2x	There are active diagnostics	-	3
On	Blinking 3x	Data forcing	Some memory area is being forced by the user through MasterTool IEC XE	4
On	Blinking 4x	Hardware error	Internal hardware error	1
On	Blinking 5x	Power Failure	External power supply voltage is lower than acceptable threshold	0 (high)

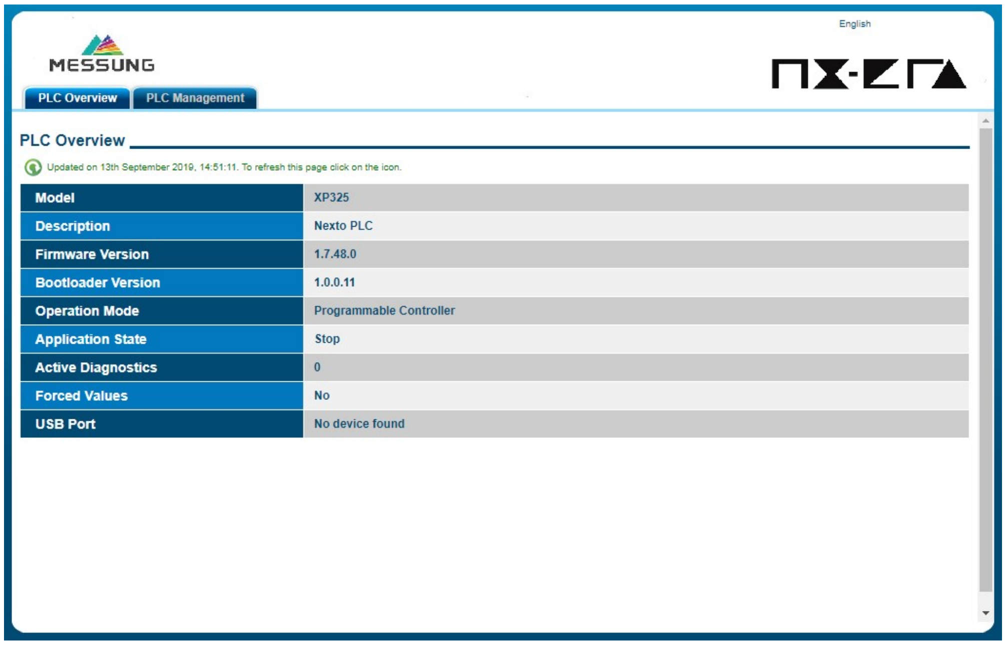
Table 69: Description of the Diagnostic LEDs States

6.1.2. Diagnostics via WEB

As already known on NX-ERA Series, NX-ERA Xpress provides access to the system diagnostics and operation states through a
WEB page.

The utilization, and dynamics, is very intuitive and facilitates the user operations. The use of a supervisory system can be replaced when it is restricted to system status verification.

To access the controller WEB page, it is just to use a standard navigator (Internet Explorer 7 or superior, Mozilla Firefox 3.0 or superior and Google Chrome 8 or superior) and type, on the address bar, the controller IP address (e.g. Ex.: http://192.168.15.1). First, the controller information is presented, according to figure below:



PLC Overview

Updated on 13th September 2019, 14:51:11. To refresh this page click on the icon.

Model	XP325
Description	Nexto PLC
Firmware Version	1.7.48.0
Bootloader Version	1.0.0.11
Operation Mode	Programmable Controller
Application State	Stop
Active Diagnostics	0
Forced Values	No
USB Port	No device found

Figure 72: Initial Screen

The user can choose from three language options: Portuguese, English and Spanish. The desired language is selected through the upper right menu. Additionally, the management tab has other features like Firmware Update and SNMP.

Firmware Update tab is restricted to the user, that is, only for internal use of Messung. In cases where the update is performed remotely (via a radio or satellite connection for example), the minimum speed of the link must be 128Kbps.

6.1.3. Diagnostics via Variables

NX-ERA Xpress controllers offers a set of global symbolic variables, which provides several diagnostics information related to the hardware and software. These symbolic data structures are automatically created by the MasterTool IEC XE.

6.1.3.1. Summarized Diagnostics

The following table shows the meaning of summarized diagnostics:

DG_XP3xx.tSummarized.*	Type	Description
bHardwareFailure	BOOL	TRUE – Controller has internal hardware failure.
		FALSE – The hardware is working properly.
bSoftwareException	BOOL	TRUE – One or more exceptions generated by the software.
		FALSE – No exceptions generated in the software.
bCOM1ConfigError	BOOL	TRUE – Error during/after the COM 1 serial interface configuration.
		FALSE – Correct COM 1 serial interface configuration.
bNET1ConfigError	BOOL	TRUE – Error during/after the NET 1 Ethernet interface configuration.
		FALSE – Correct NET 1 Ethernet interface configuration.
bInvalidDateTime	BOOL	TRUE – Invalid date/hour.
		FALSE – Correct date/hour.
bRuntimeReset	BOOL	TRUE – The RTS (Runtime System) has been restarted at least once. This diagnostics is only cleared during the system restart.
		FALSE – The RTS (Runtime System) is operating normally.
bRetentivityError	BOOL	TRUE – Invalid data in the retentive memory during start up.
		FALSE – Valid data in the retentive memory during start up.
bIntegratedIODiagnostic	BOOL	TRUE - There is some diagnostic in the Integrated I/O (see detailed)
		FALSE – No diagnostic in the Integrated I/O
bUSBDiagnostic	BOOL	TRUE - There is some diagnostic in the USB (see detailed)
		FALSE – No diagnostic in the USB

Table 70: Summarized Diagnostics

Notes:

Hardware Failure: In case the Hardware Failure diagnostic is true, the controller must be sent to Messung Technical Assistance, as it has problems in the RTC or other hardware resources.

Software Exception: In case the software exception diagnostic is true, the user must verify his application to guarantee it is not accessing the memory wrongly. If the problem remains, the Messung Technical Support sector must be consulted. The software exception codes are described next in the controller's detailed diagnostics table.

Retentively Error: This diagnostic indicates that there was loss of non-volatile data (retain/persistent variables and event queue). It is turned on only when the loss is caused by internal hardware and/or software problems. Cold reset commands and reset origin triggered by MasterTool does not cause the indication of this diagnosis.

6.1.3.2. Detailed Diagnostics

The tables below contains NX-ERA Xpress controllers' detailed diagnostics. It is important to have in mind the observations below before consulting them:

- Visualization of the Diagnostics Structures: The Diagnostics Structures added to the Project can be seen at the item Library manager of MasterTool IEC XE tree view. There, it is possible to see all data types defined in the structure
- Counters: All controller diagnostics counters return to zero when their limit value is exceeded

DG_XP3xx.tDetailed.*		Type	Description
Target.*	dwCPUModel	ENUM (BYTE)	Controller model, ex: MODEL_XP325
	abyCPUVersion	BYTE ARRAY(4)	Firmware version
	abyBootloaderVersion	BYTE ARRAY(4)	Bootloader version
Hardware.*	bRTCFailure	BOOL	The main processor is unable to communicate with the RTC hardware.
	bIntegratedIoFailure	BOOL	The main processor is unable to communicate with the integrated I/O
Exception.*	wExceptionCode	WORD	Exception code generated by the RTS.
	byProcessorLoad	BYTE	Level, in percentage (%), of charge in the processor.
WebVisualization.*	byConnectedClients	BYTE	Clients number connected to the WebVisualization.
RetainInfo.*	byCPUInitStatus	BYTE	Controller startup status: 01: Hot start 02: Warm Start 03: Cold Start PS.: These variables are restarted in all startup.
	wCPUColdStartCounter	WORD	Counter of cold startups: It is increased when system starts up with bRetentivityError condition, and not due to the command of Reset Cold from MasterTool IEC XE (0 to 65535).
	wCPUWarmStartCounter	WORD	Counter of hot startups: It is increased during a normal start up, and not due the command of Reset Warm from MasterTool IEC XE (0 to 65535).
	wRTSResetCounter	WORD	Counter of reset performed by the RTS - Runtime System (0 to 65535).
	wWritesCounter	WORD	Retentive memory writes counter.
Reset.*	bBrownOutReset	BOOL	Last reset caused by failure in power supply.
	bWatchdogReset	BOOL	Last reset caused by internal watchdog error.
Serial. COM1.*	byProtocol	ENUM (BYTE)	Selected protocol in COM 1: NO_PROTOCOL (0): No protocol MODBUS_RTU_MASTER (1): MODBUS RTU Master MODBUS_RTU_SLAVE (2): MODBUS RTU Slave OTHER_PROTOCOL (3): Other protocol
	dwRXBytes	DWORD	Counter of characters received from COM 1 (0 to 4294967295).
	dwTXBytes	DWORD	Counter of characters transmitted from COM 1 (0 to 4294967295).

DG_XP3xx.tDetailed.*		Type	Description
	wRXPendingBytes	WORD	Number of characters left in the reading buffer in COM 1 (0 to 65535).
	wTXPendingBytes	WORD	Number of characters left in the transmission buffer in COM 1 (0 to 65535).
	wBreakErrorCounter	WORD	These counters are restarted in the following conditions: - Energizing - COM 1 serial port configuration - Removal of RX and TX queues PS.: When the controller is set Without Parity, the parity errors counter is not incremented in case it receives a different parity. In this case, an error of frame is indicated. The maximum value of each counter is 65535.
	wParityErrorCounter	WORD	
	wFrameErrorCounter	WORD	
	wRXOverrunCounter	WORD	
CAN.*	bBusAlarm	BOOL	The bus has a critical error and is shut-down.
	byBusState	ENUM (BYTE)	Informs the status of the device: UNKNOWN: impossible to get the net-work state. ERR_FREE: no occurrence of CAN bus errors. ACTIVE: only few CAN bus errors (below warning level). WARNING: occurrence of some CAN bus errors (above warning level). PASSIVE: too many CAN bus errors (above error level). BUSOFF: the node is shutdown (errors exceeded the admissible maximum).
	udiTxCounter	UDINT	Number of packets Tx changed in the PLC CAN bus.
	udiRxCounter	UDINT	Number of packets Rx changed in the PLC CAN bus.
	udiTxErrorCounter	UDINT	Number of packets Tx with errors in the PLC CAN bus.
	udiRxErrorCounter	UDINT	Number of packets Rx with errors in the PLC CAN bus.
	udiLostCounter	UDINT	Number of lost packets in the PLC CAN bus.
	byUSBDevice	ENUM (BYTE)	Type of the device connected to the USB port: NO_DEVICE UNKNOWN_DEVICE MASS_STORAGE_DEVICE SERIAL_CONVERTER_DEVICE
	bOvercurrent	BOOL	The device connected on the USB port is draining more current than supported
	tMassStorage. byMountState	ENUM (BYTE)	Informs the status of the device: MOUNTED UNMOUNTED
	tMassStorage. dwFreeSpaceKb	DWORD	Informs the free space on the mass storage device.

DG_XP3xx.tDetailed.*		Type	Description
USB.*	tMassStorage. dwTotalSizeKb	DWORD	Informs the total size of the mass storage device.
	tSerialConverter. byProtocol	ENUM (BYTE)	Selected protocol in COM 10: NO_PROTOCOL (0): No protocol
	tSerialConverter. dwRXBytes	DWORD	Counter of characters received from COM 10 (0 to 4294967295).
	tSerialConverter. dwTXBytes	DWORD	Counter of characters transmitted from COM 10 (0 to 4294967295).
	tSerialConverter. wRXPendingBytes	WORD	Number of characters left in the reading buffer in COM 10 (0 to 65535).
	tSerialConverter. wTXPendingBytes	WORD	Number of characters left in the transmission buffer in COM 10 (0 to
	tSerialConverter. wBreakErrorCounter	WORD	These counters are restarted in the following conditions: - Energizing - COM 10 serial port configuration - Removal of RX and TX queues PS.: When the controller is set Without Parity, the parity errors counter is not incremented in case it receives a different parity. In this case, an error of frame is indicated. The maximum value of each counter is 65535.
	tSerialConverter. wParityErrorCounter	WORD	
	tSerialConverter. wFrameErrorCounter	WORD	
	tSerialConverter. wRXOverrunCounter	WORD	
Ethernet. NET1.*	bLinkDown	BOOL	Indicates the link state in the interface.
	wProtocol	WORD	Selected protocol in NET 1: 00: Without protocol
	wProtocol. bMODBUS_RTU_ ETH_Client	BOOL	MODBUS RTU Client via TCP
	wProtocol. bMODBUS_ETH_ Client	BOOL	MODBUS TCP Client
	wProtocol. bMODBUS_RTU_ ETH_Server	BOOL	MODBUS RTU Server via TCP
	wProtocol. bMODBUS_ETH_ Server	BOOL	MODBUS TCP Server
	szIP	STRING(15)	Port IP Address
	szMask	STRING(15)	Port Subnet Mask
	szGateway	STRING(15)	Port Gateway Address
	szMAC	STRING(15)	Port MAC Address
	abyIP	BYTE ARRAY(4)	Port IP Address
	abyMask	BYTE ARRAY(4)	Port Subnet Mask
	abyGateway	BYTE ARRAY(4)	Port Gateway Address
	abyMAC	BYTE ARRAY(6)	Port MAC Address
	dwPacketsSent	DWORD	Counter of packets sent through the inter-face (0 to 4294967295).
	dwPacketsReceived	DWORD	Counter of packets received through the interface (0 to 4294967295).

DG_XP3xx.tDetailed.*		Type	Description
	dwBytesSent	DWORD	Counter of bytes sent through the interface (0 to 4294967295).
	dwBytesReceived	DWORD	Counter of bytes received through the port (0 to 4294967295).
	dwTXDropErrors	DWORD	Counter of connection losses in the transmission through the interface (0 to 4294967295).
	dwTXCollisionErrors	DWORD	Counter of collision errors in the trans-mission through the interface (0 to 4294967295).
	dwRXDropErrors	DWORD	Counter of connection losses in the reception through the interface (0 to 4294967295).
	dwRXFrameErrors	DWORD	Counter of frame errors in the reception through the interface (0 a 4294967295).
UserFiles.*	byMounted	BYTE	Indicates if the memory used for recording the user files is able to receive data.
	dwFreeSpacekB	DWORD	Free memory space for user files (Kbytes).
	dwTotalSizekB	DWORD	Storage capacity of the memory of user files (Kbytes).
UserLogs.*	byMounted	BYTE	Status of memory in which the user logs are inserted.
	wFreeSpacekB	WORD	Free memory space of user logs (Kbytes)
	wTotalSizekB	WORD	Storage capacity of the memory of user logs (Kbytes).
Application.*	byCPUState	ENUM (BYTE)	Informs the controller's CPU operation state: RUN (1): The application is in execution (Run Mode). STOP (3): The application is stopped (Stop Mode).
	bForcedIOs	BOOL	Some memory area is being forced by the user through MasterTool.
Application Info.*	dwApplicationCRC	DWORD	32 bits CRC of Application. When the application is modified and sent to the controller, a new CRC is generated.
SNTP.*	bServiceEnabled	BOOL	SNTP Service enabled.
	byActiveTimeServer	ENUM (BYTE)	Indicates which server is active: NO_TIME_SERVER (0): None active server. PRIMARY_TIME_SERVER (1): Active Primary Server. SECONDARY_TIME_SERVER (2): Active Secondary Server.
	wPrimaryServerDownCount	WORD	Counter of times in which the primary server is unavailable (0 to 65535).
	wSecondaryServerDownCount	WORD	Counter of times in which the secondary server is unavailable (0 to 65535).
	dwRTCTimeUpdatedCount	DWORD	Counter of times the RTC was updated by the SNTP service (0 to 4294967295).
	byLastUpdateSuccessful	ENUM (BYTE)	Last update status: NOT_UPDATED (0): Not updated. UPDATE_FAILED (1): Failure. UPDATE_SUCCESSFUL (2): Successful.

DG_XP3xx.tDetailed.*		Type	Description
	byLastUpdateTimeServer	ENUM (BYTE)	Server used in the last update: NO_TIME_SERVER (0): None update. PRIMARY_TIME_SERVER (1): Primary Server. SECONDARY_TIME_SERVER (2): Secondary Server.
	sLastUpdateTime	EXTENDED_DATE _AND_TIME	Date and time of the last sync time via SNTP.
	sLastUpdateTime. byDayOfMonth	BYTE	
	sLastUpdateTime. byMonth	BYTE	
	sLastUpdateTime. wYear	WORD	
	sLastUpdateTime. byHours	BYTE	
	sLastUpdateTime. byMinutes	BYTE	
	sLastUpdateTime. bySeconds	BYTE	
	sLastUpdateTime. byMilliseconds	WORD	
IntegratedIO.*	AnalogInputs. tAnalogInput_xx. bInputNotEnable	BOOL	The input channel is not enabled on the configuration.
	AnalogInputs. tAnalogInput_xx. bOverRange	BOOL	The input signal level is above the maximum value defined for the selected input type.
	AnalogInputs. tAnalogInput_xx. bOpenLoop	BOOL	The input signal level is below minimum (only for 4-20mA mode).
	AnalogOutputs. tAnalogOutput_xx. bOutputNotEnable	BOOL	The output channel is not enabled on the configuration.
	AnalogOutputs. tAnalogOutput_xx. bOpenLoop	BOOL	The impedance of the load connected to the output channel is above the maximum accepted (only for current output mode).
	AnalogOutputs. tAnalogOutput_xx. bShortCircuit	BOOL	The impedance of the load connected to the output channel is below the minimum accepted (only for voltage output mode).
	RTDInputs. tRtdInput_xx. bInputNotEnable	BOOL	The input channel is not enabled on the configuration.
	RTDInputs. tRtdInput_xx. bOverRange	BOOL	The resistance is above the maximum value defined for the selected type.
	RTDInputs. tRtdInput_xx. bUnderRange	BOOL	The resistance is below the minimum value defined for the selected type (only for temperature sensors).

Table 71: Detailed Diagnostics Description

Notes:

Exception Code: The exception codes generated by the RTS (Runtime System) is presented below:

Code	Description	Code	Description
0x0000	There is no exception code.	0x0051	Access violation.
0x0010	Watchdog time of the expired IEC task (Software Watchdog).	0x0052	Privileged instruction.
0x0012	I/O configuration error.	0x0053	Page failure.
0x0013	Check-up errors after program download.	0x0054	Stack overflow.
0x0014	Fieldbus error.	0x0055	Invalid disposition.
0x0015	I/O updating error.	0x0056	Invalid maneuver.
0x0016	Cycle time (execution) exceeded.	0x0057	Protected page.
0x0017	Program online updating too long	0x0058	Double failure.
0x0018	Unsolved external references.	0x0059	Invalid OpCode.
0x0019	Download rejected.	0x0100	Data type misalignment.
0x001A	Project unloaded, as the retentive variables cannot be reallocated.	0x0101	Arrays limit exceeded.
0x001B	Project unloaded and deleted.	0x0102	Division by zero.
0x001C	Out of memory stack.	0x0103	Overflow.
0x001D	Corrupted retentive memory; cannot be mapped.	0x0104	Cannot be continued.
0x001E	Project can be loaded but it causes a break later on.	0x0105	Watchdog in the processor load of all IEC task detected.
0x0021	Target of startup application does not match to the current target.	0x0150	FPU: Not specified error.
0x0022	Scheduled tasks error... IEC task configuration failure. Application working with wrong target. Illegal instruction.	0x0151	FPU: Abnormal operand.
		0x0152	FPU: Division by zero.
0x0023	Downloaded file Check-up error.	0x0153	FPU: Inexact result.
0x0024	Mismatch between the retentive identity and the current boot project program identity	0x0154	FPU: Invalid operation.
0x0025	IEC task configuration failure.	0x0155	FPU: Overflow.
0x0026	Application is running with the wrong target.	0x0156	FPU: Stack verification.
0x0050	Illegal instruction.	0x0157	FPU: Underflow.

Table 72: Exception Codes

Brownout Reset: The brownout reset diagnostic is only true when the power supply exceeds the minimum limit required in its technical features, remaining in low voltage, without suffering any interruption. The controller identifies the voltage break and indicates the power supply failure diagnostic. When the voltage is reestablished, the controller is restarted automatically and indicates the brownout reset diagnostic.

Parity Error Counter: When the serial COM 1 is configured Without Parity, this error counter won't be incremented when it receives a message with a different parity. In this case, a frame error will be indicated.

User Partition: The user partition is a memory area reserved for the storage of data in the CPU. For example: files with PDF extension, files with DOC extension and other data.

RTD Inputs: the table below describes the behavior of over and under range diagnostics according to the input type selected:

Diagnostics	0 to 400 Ω Scale		0 to 4000 Ω Scale		Sensors of Platinum type (Pt) α = 0.00385		Sensors of Platinum type (Pt) α = 0.003916	
	Resist.	Count	Resist.	Count	Temp.	Count	Temp.	Count
Over range	>420 Ω (420 to 404.1 Ω)	4200 (4200 to 4041)	>4200 Ω (4200 to 4041 Ω)	>4200 (4200 to 4041)	>850 °C	8500	>630 °C	6300
No diagnostics	0 to 404 Ω	0 to 4040	0 to 4040 Ω	0 to 4040	-200 to 850 °C	-2000 to 8500	-200 to 630 °C	-2000 to 6300
Under range	-	-	-	-	<-200 °C	-2000	<-200 °C	-2000

Table 73: RTD Input Diagnostics

6.1.4. Diagnostics via Function Blocks

The Function Blocks for advanced diagnostics available for NX-ERA Xpress controllers are the same ones provided for NX-ERA
Series CPUs, which are described on this same section of NX-ERA Series CPUs User Manual code MU214605.

6.2. Preventive Maintenance

- It must be verified, each year, if the interconnection cables are connected firmly, without dust accumulation, mainly the protection devices
- In environments subjected to excessive contamination, the equipment must be periodically cleaned from dust, debris, etc.
- The TVS diodes used for transient protection caused by atmospheric discharges must be periodically inspected, as they might be damaged or destroyed in case the absorbed energy is above limit. In many cases, the failure may not be visual. In critical applications, is recommendable the periodic replacement of the TVS diodes, even if they do not show visual signals of failure
- Connector block tightness and cleanness every six months