CPU 6 ETH, 2 SERIALS, IRIG-B, RED. HX3040

Hadron Xtorm Series

Doc. Code.: CE123100 Revision: A

Product Description

Automation of power applications is characterized by the use of rugged and reliable equipment and devices with high technology, capability to operate in hostile environments, where there are significant levels of electromagnetic interference and higher operating temperatures. This is the reality of applications in hydropower plants, power substations and wind farms, among others.

In this context, Hadron Xtorm Series is an innovative Remote Terminal Unit (RTU), perfect for applications in power generation, transmission and distribution. The Series has an ideal set of features with high performance for the different stages in the life cycle of any application, like engineering, installation and commissioning, offering cost and risk reduction for every single stage. It also minimizes downtime and system maintenance when in operation. With intuitive and friendly interfaces, accurate and smart diagnostics, modern and robust design, as well as several innovative features, Hadron Xtorm Series surpasses the requirements of applications in this market.

The Series has a smart and versatile architecture, offering modularity in input and output (I/O) points, redundancy options, module hot swapping, high-speed communication protocols, such as IEC 61850 and DNP3, logic implementation in accordance to IEC 61131-3 standard and time synchronism.

Its main features are:

- CPU redundancy support in the same rack
- Ethernet ports redundancy support
- 6 Ethernet ports with RJ45 connector
- 1 RS-232/485 port
- 1 RS-485/RS-422 isolated port
- SD Card Interface
- Time synchronization via IRIG-B, SNTP, DNP3
- DNP3 client and server protocol
- MMS Server protocol
- GOOSE protocol
- MODBUS RTU, MODBUS TCP and MODBUS RTU via TCP protocol
- High-speed 32-bit processor
- Web server resources
- Enhanced diagnosis services
- Messages log system
- Automation features with 6 languages (IEC 61131-3)
- One Touch Diag
- Real Time Clock
- Hot swap
- Robust design
- Easy insertion and removal
- Fan less design (no moving parts and internal batteries)

Ordering Information

Included Items

The product package contains the following items:

- HX3040 module
- 04 terminal connector HX9405
- Installation guide

Product Code

The following codes should be used to purchase the product:

Code	Description
HX3040	High-speed CPU, 6 Ethernet ports, 2 serial channels, memory card interface, and redundancy support

Related Products

The following product must be purchased separately when needed:

Code	Description
HD8500	MasterTool Xtorm
AL-2600	RS-485 net derivatior and terminatior
AL-2301	RS-485 Net cable (up to 1000 m)
AL-2306	RS-485 Net cable (up to 500 m)
AL-1729	RJ45-CMDB9 cable
AL-1748	CMDB9-CFDB9 cable
AL-1752	CMDB9-CMDB9 cable
AL-1753	CMDB9-CMDB25 cable
AL-1754	CMDB9-CFDB9 cable
AL-1762	CMDB9- CMDB9 cable
AL-1763	CMDB9 terminal block cable
NX9202	RJ45-RJ45 2 m cable
NX9205	RJ45-RJ45 5 m cable
NX9210	RJ45-RJ45 10 m cable
NX9101	8 GB MicroSD CARD with SD adaptors and miniSD
HX9405	4-terminal connector
HX9102	Rack Connector Cover

Notes:

HD8500: MasterTool Xtorm is the configuration and programming tool used for the Hadron Xtorm Series.

AL-2600: This module is used for derivation and termination of RS-422/485 networks. For each network node must exist an AL-2600. The AL-2600 modules that are in the ends of the network must be configured as termination, except when there is a device with active internal termination. The other modules must be configured as derivation.

AL-2301 e AL-2306: Shielded cable with two twisted pairs, with no connectors, used for RS-485 and RS-422 networks, with 1000 m and 500 m of maximum length respectively.

AL-1729: RS-232C standard cable with one RJ45 connector and one DB9 male connector for communication between CPUs of Hadron Xtorm Series and the other Altus products (DUO, Piccolo and Ponto Series).

AL-1748: RS-232C standard cable with one DB9 male connector and 1 DB9 female connector for communication between CPUs of Hadron Xtorm Series and other products of the Altus Cimrex Series.

AL-1752: RS-232C standard cable with one DB9 male connector for communication between CPUs of Hadron Xtorm Series and the Altus products of the H Series and IX Series HMIs.

AL-1753: RS-232C standard cable with one DB9 male connector and one DB25 male connector for communication between CPUs of Hadron Xtorm Series and the Altus H Series products.

AL-1754: RS-232C standard cable with one DB9 male connector and one DB9 female connector for communication between CPUs of Hadron Xtorm Series and the Altus Exter Series products or a microcomputer serial port, RS-232C standard.

AL-1762: RS-232C standard cable with two DB9 male connectors for communication between CPUs of Hadron Xtorm Series and also for communication between CPUs of Nexto Series.

AL-1763: Cable with one DB9 male connector and terminal blocks for communication between CPUs of Hadron Xtorm Series and the products with RS-485/RS-422 standard terminal blocks.

NX9202, NX9205 and NX9210: Ethernet CAT5 cable, shielded, twisted pair, with RJ45 male connectors in the ends, supports temperature of -5 ºC to 70 ºC, used for Ethernet networks with 2, 5 and 10 m of maximum length respectively.

NX9101: Kit with a 8 Gbytes microSD card, one adaptor for the SD standard and other adaptor for the miniSD standard.

HX9405: 4-terminal connector with wiring fixing through a spring pressure system, and with a connector fixing system in the module through screws.

HX9102: It is a cover to protect the Hadron Xtorm Series rack connectors.

Innovative Features

Hadron Xtorm Series brings to the user several innovations in utilization, supervision and system maintenance. These features were developed focusing a new concept in automation of hydropower plants, substations and other applications of the segment.The list below shows some new features that the user will find in Hadron Xtorm Series:

Battery Free Operation: The Hadron Xtorm Series does not require any kind of battery for memory maintenance and real time clock operation. This feature is extremely important because it reduces the system maintenance needs and allows the use in remote locations where maintenance can be difficult to be performed. Besides, this feature is environmentally correct.

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Multiple Block Storage: Several kinds of memories (volatile and non-volatile) are available to the user in Hadron Xtorm Series CPUs offering the best option for any user needs. The CPUs of Hadron Xtorm Series offer direct representation input variables (%I), direct representation output variables (%Q), data memory and symbolic variables. For applications that require non-volatile memory functionalities, Hadron Xtorm Series allow the use of direct representation variables of retain memory (%Q), retain data memory, symbolic variables persistent data memory, program memory, source code memory, file system in the CPU (DOC files, PDF, images, data, among others) and miniSD card interface.

One Touch Diag: This Hadron Xtorm Series feature allows the user to check diagnostic information of any module present in the system directly on graphic display with one single press in the diagnostic switch. OTD is a powerful diagnostic tool that can be used offline, reducing maintenance and commissioning times.

OFD – On Board Full Documentation: Hadron Xtorm Series CPUs are capable of storing the complete project documentation in its own memory. This feature can be very convenient for backup and maintenance purpose, since the complete information is stored in a single and reliable place.

ETD – Electronic Tag on Display: This functionality makes the process of checking the tag names of any I/O terminal or module used in the system directly on the CPU's graphic display. Along with this information, the user can check the description, as well. This feature is extremely useful during maintenance and troubleshooting procedures

Product Features

Basic Features

	HX3040
Direct representation input variables memory (%I)	96 Kbytes
Direct representation output variables memory (%Q)	96 Kbytes
Symbolic variables memory	6 Mbytes
Retain symbolic variables memory	8 Kbytes
Persistent symbolic variables memory	4 Kbytes
Redundant variables memory	512 Kbytes
Program memory	12 Mbytes
Source code memory (backup)	100 Mbytes
User files memory	32 Mbytes
Maximum number of tasks	32
Maximum number of expansion racks	8
Ethernet TCP/IP local interface	6
Ethernet TCP/IP interfaces redundancy support	Yes
CPU redundancy support (same rack)	Yes
Clock synchronization (SNTP)	Yes

Notes:

Direct representation input variable memory (%I): It is the area where all the direct representation variables for the input type are assigned. A direct representation variable means that the variable can be accessed directly in the memory using the desired address. For example: %IB0, %IW100. Direct representation input variable can be used for mapping analogic or digital input points. As a reference, 8 digital input points can be represented by one byte and 1 analogic input point can be represented by two bytes.

The Hadron Xtorm Series HX3040 CPU defines all the direct representation input variables memory (%I) as redundant variables, which means that the user does not need to select this area.

Direct representation output variable memory (%Q): It is the area where all the direct representation variables for the output type are assigned. A direct representation variable means that the variable can be accessed directly in the memory using the desired address. For example: %QB0, %QW100. Direct representation output variable can be used for mapping analogic or digital output points. As a reference, 8 digital output points can be represented by one byte and 1 analogic output point can be represented by two bytes.

The Hadron Xtorm Series HX3040 CPU defines all the direct representation output variables memory (%Q) as redundant variables, which means that the user does not need to select this area.

Symbolic variables memory: It is the area where the symbolic variables are assigned. Symbolic variables are IEC variables created in POUs and GVLs during application development, not addressed directly in memory. Symbolic variables can be defined as retain or persistent. In this case the retain symbolic variables memory or the persistent symbolic variables memory area will be used, respectively.

Retain symbolic variables memory: It is the area where the retain symbolic variables are assigned. Retain data keep their respective values even after a power on/power off cycle of the CPU. The complete list of when retain variables keep their values and when the value is lost can be found on the table below.

Persistent symbolic variable memory: It is the area where the persistent symbolic variables are assigned. Persistent data keep their respective values even after a download of a new application into CPU. The complete list of when persistent variables keep their values and when the value is lost can be found on the table below.

The table below shows the behavior of retain, persistent and symbolic variables for different situations where “-” means that the value is lost and “X” that the value is kept.

Command	Symbolic variable	Retain variable	Persistent variable
Reset warm	-	X	X
Power-on cycle	-	X	X
Reset cold	-	-	X
Reset origin	-	-	-
Download	-	-	X
Online change	X	X	X
Reboot CPU	-	X	X

Program memory: It is memory area that corresponds to the maximum size that can be used to store the user application. This area is shared with the source code memory, thus the total area is the sum of the “program memory” plus the “source code memory”.

Source code memory (backup): It is the memory area available to store a backup from the project. In case the user decides to import the project, the MasterTool Xtorm software will search the required information in this area. It is important to ensure that the backup project is updated to avoid the loss of critical information. This area is shared with the program memory, thus the total area is the sum of the “program memory” plus the “source code memory”.

User files memory: It is the memory area available to store files such as doc, pdf, images, and more. This function allows saving data like a memory card. More information can be found at Hadron Xtorm User Manual – MU223600.

Maximum number of tasks: Maximum number of tasks can be found at Hadron Xtorm User Manual – MU223600.

Redundancy support (same rack): The HX3040 supports CPU redundancy when placed ate the same rack. More information can be found at Hadron Xtorm User Manual – MU223600.

General Features

	HX3040
Programming languages	Instruction list (IL) Structured text (ST) Ladder diagram (LD) Sequential function chart (SFC) Function block diagram (FBD) Continuous function chart (CFC)
Types of tasks	Cyclic (periodic) Event (software interruption) External event (hardware interruption) Continuous (free run) Status (software interruption)
Online changes	Yes
Hot swap support	Yes
Bus expansion redundancy support	Yes
Serial interfaces	1 x RS-232C / RS-485 (COM 1) 1 x RS-485 / RS-422 (COM 2)
MODBUS Protocol	RTU Master and slave (COM 1 and COM 2) TCP Client and server (NET 1 to NET 6) RTU via TCP Client and server (NET1 to NET6)
DNP3 Protocol	TCP Client and server (NET 1 to NET 6)
MMS Protocol	TCP Server (NET 1 to NET 6)
Real time clock (RTC)	Yes Resolution of 1 ms and maximum variance of 2 s per day
Watchdog	Yes
Status and diagnostic indication	Display, LED, web page and CPU’s internal memory
One Touch Diag (OTD)	Yes
Electronic Tag on Display (ETD)	Yes

Isolation **Logic to protective earth** **Logic to Ethernet interfaces** **Logic to serial port (COM 2)** **Logic to IRIG-B port** **Ethernet interfaces to protective earth** **Ethernet Interfaces to serial port (COM 2)** **Ethernet interface to Ethernet interface** **Serial port (COM 2) to protective earth**	 2500 Vac / 1 minute 1500 Vac / 1 minute 2000 Vac / 1 minute 2500 Vac / 1 minute 1500 Vac / 1 minute 2500 Vac / 1 minute 1500 Vac / 1 minute 2500 Vac / 1 minute
Current consumption from backplane rack	1500 mA
Dissipation	7.5 W
Operating temperature	-5 to 60 °C
Storage temperature	-25 to 85 °C
Operating and storage relative humidity	5 to 96 %, no condensation
Conformal coating	Yes
Protection Level	IP 20
Standards	IEC 61131-2 IEC 61131-3 CE, Electromagnetic Compatibility (EMC) and Low-Voltage Directive (LVD) CE
Module dimensions (W x H x D)	38.0 x 235.3 x 184.2 mm
Package dimensions (W x H x D)	55.0 x 308.0 x 266.0 mm
Weight	1000 g
Weight with package	1300 g

Notes:

Types of tasks: Task is an object used to call POUs. A Task can be achieved by period, events or can run in freewheeling mode. Each task can call one or more POUs.

Real Time Clock (RTC): The retention time, which is the time that the real time clock keeps updating the date and time after the CPU goes off, is 15 days considering environments with temperature of 25 °C. Up to the maximum product operation temperature, retain time is reduced to 10 days.

Isolation: Logic is the name for the internal circuits like processors, memories and interfaces like backplane rack.

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

COM 1

	HX3040
Connector	DB9 shielded female
Physical interface	RS-232C or RS-485 (depending on the connected cable)
Communication direction	RS-232C: full duplex RS-485: half duplex
Maximum number of	32

transceivers RS-485	
RS-485 termination	No (allows the use of external active termination)
Modem signals	RTS, CTS, DCD
Baud rate	600, 1200, 1800, 2400, 4800, 9600, 19200, 38400, 57600, 115200 bps
Protocols	MODBUS RTU (Master/ Slave) Open protocol

COM 2

	HX3040
Connector	DB9 shielded female
Physical interface	RS-422 or RS-485 (depending on the selected cable)
Communication direction	RS-422: full duplex RS-485: half duplex
Maximum number of RS-422 transceivers	11 (1 sender and 10 receivers)
Maximum number of RS-485 transceivers	32
Termination	Yes (optional via cable selection)
Baud rate	600, 1200, 1800, 2400, 4800, 9600, 19200, 38400, 57600, 115200 bps
Protocols	MODBUS RTU (Master/ Slave) Open protocol

Notes:

Physical interface: Depending on the cable configuration it is possible to choose the type of physical interface: RS-232C or RS-485 to COM1, and RS-422 or RS-485 to COM2.

Maximum number of RS-422 transceivers: The maximum number of RS-422 interfaces that can be used on the same bus.

Maximum number of RS-485 transceivers: The maximum number of RS-485 interfaces that can be used on the same bus.

NET1 to NET6

	HX3040
Connector	RJ45 shielded female
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 (logic link control)
Network layer	IP (internet protocol)

Transport layer	TCP (transmission control protocol) UDP (user datagram protocol)
Application layer	MODBUS TCP Client / Server MODBUS RTU via TCP Client / Server DNP3 Client / Server GOOSE Protocol (sending and receiving messages) MMS Server HTTP (web server) Mastertool Xtorm programming protocol (only NET 1) SNTP (Clock synchronism)

Note:

Mastertool Xtorm Programming protocol: In the cases where NET 1 is configured as redundant, NET 2 can also be used to the Mastertool Xtorm programming protocol.

IRIG-B

	HX3040
Connector type	Removable terminal connector with 4 terminals (HX9405)
Maximum cable length	5 m
Wire gauge	0.5 mm^2
Input and output level	TTL
Input impedance	> 100 kΩ
Delay between input and output	< 10 ns
Maximum output current	10 mA
Maximum output load	500 Ω
Protection against short circuit	Yes
Voltage levels	0 to 1.5 Vdc to logic level 0 3.5 to 5 Vdc to logic level 1

Graphic Display

The Hadron Xtorm Series CPUs have a graphic display used to show status and diagnostics of the entire system including specific diagnostics of each additional module. The display also offers an easy-to-use menu that brings to the user a fast way to read or set some parameters like: internal temperature (read only); graphic display contrast and IP address for each NET interface (read only). More information about how to use the graphic display can be found at Hadron Xtorm User Manual – MU223600.

Memory Card Interface

The memory cards can be used for different kinds of data storage like user's logs, webpages, project documentation and source files. More information about how to use memory card interface can be found at Hadron Xtorm User Manual – MU223600.

	HX3040
Maximum capacity	8 Gbytes
Minimum capacity	2 Gbytes
Type	SD
File system	FAT32
Remove card safely	Yes, via the CPU menu option

Notes:

Maximum capacity: The memory card capacity should be equal or below this limit for the Hadron Xtorm CPU correct functioning. The CPU may not recognize the card or data loss may occur during the transfer processes.

Minimum capacity: The memory card capacity should be equal or above this limit for the Hadron Xtorm CPU correct functioning. The CPU may not recognize the card or data loss may occur during the transfer processes.

File system: It is recommended to format the memory using the Hadron Xtorm CPU itself, otherwise performance loss may occur when accessing the memory card interface.

CPU Redundancy

Hadron Xtorm Series offers CPU redundancy. The redundant CPUs must be located in the same rack. In the redundant architecture, the system will have one CPU running (active CPU) and another one acting as the standby CPU, The standby CPU is capable of automatic switchover and assume the control of the application in the event of a primary controller failure. This means that critical processes are not affected by control system hardware failures. The result is increased productivity and minimized downtime.

The communication between the CPUs is done at the end of each cycle across two high-speed redundancy links located at the position 2 and 3 of the rack.

The example below demonstrates the redundant mode provided by Hadron Xtorm Series. More information about how to configure and use CPU's redundant features can be found at Hadron Xtorm User Manual – MU223600.

CPU Redundancy on the Same Rack

This Series provides the redundancy feature using two CPUs connected on the same rack. Each CPU may contain one or more net protocols configured to communicate with the control center. When an error with the active CPU occurs, standby CPU automatically takes over the connections control. This application is easy to configure and dismisses the user to create a special programming or parameterization. In this redundant mode, CPUs must be placed side by side. The figure below demonstrates an example of a rack with a CPU redundant topology.

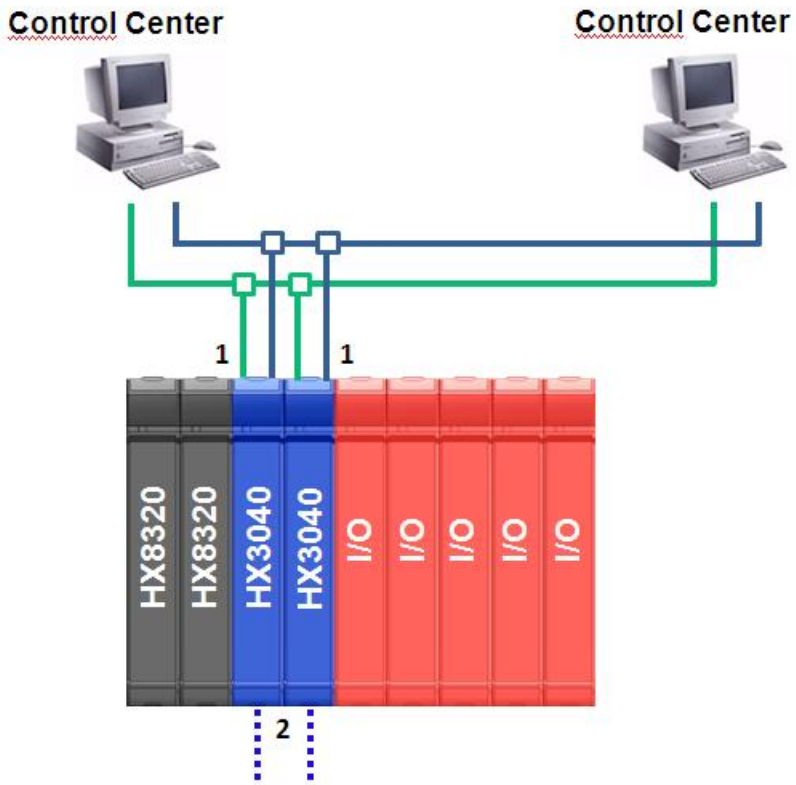


Diagram Notes:

1- Ethernet net topology

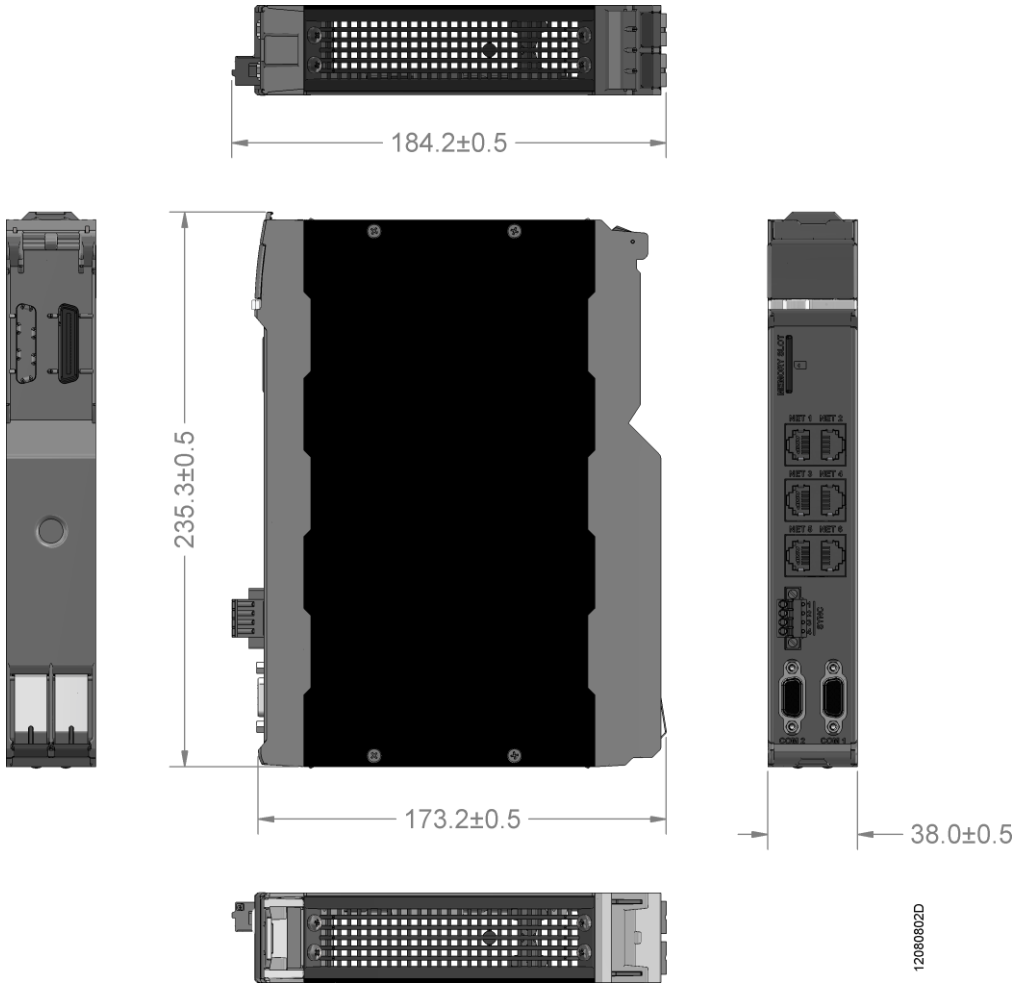
2- The configuration of each CPU must be identical

Compatibility with other Products

Hadron Xtorm Series CPUs do not present any incompatibility with the other modules of Hadron Xtorm Series or MasterTool Xtorm.

Physical Dimensions

Dimensions in mm.



Installation

All the information about electrical installation, mechanical assembly and module insertion can be found at Hadron Xtorm User Manual – MU223600.

Configuration

Hadron Xtorm Series CPUs were developed to be used with Hadron Xtorm Series products. All the products of the Series are configured with MasterTool Xtorm. Information about the right procedure to add/remove modules from the system can be found at Hadron Xtorm User Manual – MU223000.

Programming

Hadron Xtorm Series CPUs use the IEC 61131-3 standard languages, which are IL, ST, LD, SFC and FBD. IL and ST are textual languages and they are similar to Assembly and C languages, respectively while LD, SFC and FBD languages are graphical. LD uses the representation of relays and blocks and is similar to relay diagrams. SFC uses an arrangement of sequence diagram, allowing a clear view of functions performed on each action. Series CPUs also offer a sixth language – CFC.

The programming is performed on the MasterTool Xtorm interface. The Mastertool Xtorm enables the use of six languages in the same project, thus providing the best features that each language can offer to the user, resulting in efficient application developments, allowing easy documentation and future maintenance.

Additional information about programming can be found at Hadron Xtorm User Manual – MU223600.

Maintenance

Altus recommends that all modules' connections must be checked and that all dust or any kind of dirt located at the module's enclosure must be removed at least every 6 months.

Hadron Xtorm Series CPUs offer five important features to assist users during maintenance: Electronic Tag on Display, One Touch Diag, Status and Diagnostics Indicators, web page with complete status and diagnostics list and status and diagnostics mapped through internal memory.

Electronic Tag on Display and One Touch Diag

Electronic Tag on Display and One Touch Diag are important features that provides to the user the chance to check the tag, description and diagnostics related to a given module directly on the CPU display.

Electronic Tag on Display and Onde Touch Diag are easy to use features. To check the tag and diagnostics of a given module, it's required only one short press (less than 1 sec) on its diagnostic switch. After press once, CPU will show the tag information and the diagnostic information of the module. To access the respective description just long press (more than 1 second) the diagnostic switch of the respective module.

More information about Electronic Tag on Display can be found at Hadron Xtorm User Manual – MU223600.

Status and Diagnostics Indicators

The Hadron Xtorm Series CPUs present a graphic display containing the status and some useful information to the user, such as: application states (Run and Stop), SD card status, activity on the serial interfaces (RX and TX) and others. Additionally, the Hadron Xtorm Series CPUs also provides a bicolor LED used to indicate the status and diagnostics. The table below shows the meaning of each LED status.

DL (Color)	Description	Causes	Priority
Off	Display failure or module off	No external supply or hardware failure	-
On (Blue)	Applications in Run Mode	-	4 (Lowest)
Blinking 2 x (Blue)	Bus modules or CPU with diagnosis	There is at least one bus module with some active diagnostic (including the CPU)	2
Blinking 3 x (Blue)	Data forcing	Some memory area is being forced by the user through MasterTool Xtorm	3
On (Red)	Applications on Stop Mode	-	4 (Lowest)
Blinking 1 x (Red)	Software watchdog	Watchdog of the user application	1
Blinking 4 x (Red)	Configuration error or Hardware in the bus	The bus is damaged or it is not properly configured	0 (Highest)

Notes:

Software watchdog: To clear any watchdog indication an application reset must be performed or the CPU must be turned off and on again.The watchdog happens when the user application time is higher than the configured watchdog.

Web Page with Complete Status and Diagnostics List

Another way to access diagnostic information on Hadron Xtorm Series is via web pages. Hadron Xtorm Series CPUs has an embedded web pages server that provides all status and diagnostic information, which can be accessed using a simple browser in a computer, tablet or smartphone.

Diagnostics Mapped through Variables

The list of all CPUs status and diagnostics can be found at the Hadron Xtorm User Manual – MU223600.

Manuals

For technical details, configuration, installation and programming of Hadron Xtorm Series, see the documents in the table below.

The table below is only a guide of some relevant documents that can be useful during the use and maintenance of HX3040. The complete and updated table containing all documents of Hadron Xtorm Series can be found at the Hadron Xtorm User Manual – MU223600.

Document Code	Description	Language
CT123000 **CE123000** **CS123000**	Série Hadron Xtorm – Características Técnicas Hadron Xtorm Series – Technical Characteristics Serie Hadron Xtorm – Especificaciones y Configuraciones	Portuguese English Spanish
MU223000 **MU223600** **MU223300**	Manual de Utilização Hadron Xtorm Hadron Xtorm User Manual Manual Del Usuario Hadron Xtorm	Portuguese English Spanish