1. Product Description

The automation of electric power systems is characterized by the use of robust, reliable, and high-tech equipment and devices with the ability to operate in hostile environments, where there are significant levels of electromagnetic interference and exposure to higher operating temperatures. This is the reality of applications in hydroelectric power plants (HPPs), electricity substations, and wind farms, among others.

In this context, the Hadron Xtorm Series is an innovative Remote Terminal Unit (RTU), perfect for applications in electricity generation, transmission, and distribution. The Series has an ideal set of features with high performance and facilities for the various stages in the life cycle of an application, to reduce engineering, installation, and commissioning costs and minimize downtime and system maintenance when in operation. With intuitive and user-friendly interfaces, precise and intelligent diagnostics, a modern and robust design, and several innovative features, Hadron Xtorm exceeds the requirements of applications in this market.

The Series has an intelligent and versatile architecture, offering modularity in input and output (I/O) points, redundancy options, hot-swapping of modules, high-speed communication protocols such as IEC 61850 and DNP3, implementation of logic in compliance with the IEC 61131-3 standard and time synchronization.

The input modules of Hadron Xtorm Series offer 32 digital isolated source/sink inputs with the functionality of event logging with 200 us precision and double points mapping.

Its main features are:

- 32 input points with event logging with 200 us precision
- Four independent input groups isolated by optoisolators which can be used as sink or source inputs
- Display for module diagnostics and input state indication
- Hot swap support
- Mechanical design with high robustness and extended operating temperature
- High immunity to electromagnetic noise (EMC/EMI)
- Smart diagnostics such as One Touch Diag and Electronic Tag on Display

2. Ordering Information

2.1. Included Items

The product package contains the following items:

- HX1100 or HX1120 module
- Four connectors with 10 terminals HX9402

2.2. Product Code

The following codes should be used to purchase the product:

Code	Description
HX1100	32 DI 24 Vdc Module w/ Time Stamping
HX1120	32 DI 125 Vdc Module w/ Time Stamping

Table 1: Product Code

3. Related Products

The following products must be purchased separately when necessary:

Code	Description
HX9402	10-terminal Connector

Table 2: Related Products

4. 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:

One Touch Diag: One Touch Diag is an exclusive feature that Hadron Xtorm Series brings to PLCs. With this new concept, the user can check diagnostic information of any module present in the system directly on CPU's graphic display with one single press in the diagnostic switch of the respective module. OTD is a powerful diagnostic tool that can be used offline (without supervisor or programmer), reducing maintenance and commissioning times.

ETD – Electronic Tag on Display: Another exclusive feature that Hadron Xtorm Series brings to PLCs is the Electronic Tag on Display. This new functionality brings the process of checking the tag names of any I/O pin or module used in the system directly to 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.

5. Product Features

5.1. General Features

	HX1100	HX1120
Module type	32 digital inputs	
Input type	Source or sink	
Input voltage	24 Vdc 15 to 30 Vdc for logic level 1 0 to 5 Vdc for logic level 0	125 Vdc 91 to max.* for logic level 1 0 to 35 Vdc for logic level 0 *see values in the following table
Typical equivalent input impedance	3,5 kΩ	64 kΩ
Typical input current per channel	6,9 mA @ 24 Vdc	1,95 mA @ 125 Vdc
Maximum input current per channel	9,2 mA @ 30 Vdc	2,35 mA @ 135 Vdc 2,82 mA @ 150 Vdc
Input filter	25 μs (↑) / 40 μs (↓) (by hardware))	40 μs (↑) / 75 μs (↓) (by hardware)
Input update time	10 ms	
Event log precision	200 us	
Minimum pulse width	250 us	
Input state indication	Yes	
One Touch Diag (OTD)	Yes	
Electronic Tag on Display (ETD)	Yes	
Status and diagnostics indication	Display, web page and CPU's internal memory	
Hot swap support	Yes	
Isolation **Between input groups** **Inputs to logic** **Inputs to protective earth** ⏚ **Logic to protective earth** ⏚	 2000 Vac / 1 minute 2500 Vac / 1 minute 2500 Vac / 1 minute 2500 Vac / 1 minute	
Current consumption from rack	195 mA	
Maximum power dissipation	9,8 W	11,1 W
Wire size	0,5 to 1,5 mm^2	
Protection Index	IP 20	
Operating temperature	-5 to 70 °C	
Storage temperature	-25 to 75 °C	
Operation and storage relative humidity	5 to 96 %, non-condensing	
Conformal coating	Yes	
Module dimensions (W x H x D)	38,0 x 235,3 x 187,2 mm	
Package dimensions (W x H x D)	55,0 x 308,0 x 266,0 mm	
Weight	900 g	
Weight with package	1200 g	

Table 3: Product Features

Notes:

Input type: The inputs of HX1100 and HX1120 modules are divided in 8 input groups: 00 to 03, 04 to 07, 08 to 11, 12 to 15, 16 to 19, 20 to 23, 24 to 27 and 28 to 31. Each group can be used as a source or sink inputs, independently. To use an input group as source inputs, the respective common terminal must be connected to the positive potential. To use an input group as sink inputs, the respective common terminal must be connected to 0 Vdc. For more information please check the section Installation in this document.

Maximum input voltage for HX1120: The table below shows the relationship between the maximum input voltage and the operating temperature limit.

Maximum operating temperature	Number of inputs driven simultaneously	Maximum input voltage
60 °C	32	150 Vdc
70 °C	32	135 Vdc
70 °C	22	150 Vdc

Table 4: Maximum input voltage for HX1120

Event log precision: This value represents the maximum time difference to the CPU clock. The system time precision depends on the method used for time synchronization (IRIG-B, SNTP, etc...).

Minimum pulse width: For inputs with the Input Filter enabled, this time must be added to the Filter Time.

Maximum power dissipation: Maximum power dissipated by the module considering all inputs at maximum operating voltage.

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

5.2. Standards and Certifications

Standards and Certifications	
IEC	61131-2: Industrial-process measurement and control - Programmable controllers - Part 2: Equipment requirements and tests
CE	2014/30/EU (EMC) 2014/35/EU (LVD) 2011/65/EU and 2015/863/EU (ROHS)
UKCA	S.I. 2016 No. 1091 (EMC) S.I. 2016 No. 1101 (Safety) S.I. 2012 No. 1101 (ROHS)
EAC	TR 004/2011 (LVD) CU TR 020/2011 (EMC)

Table 5: Standards and Certifications

5.3. Compatibility with Other Products

Support for this product was introduced in version 1.03 of MasterTool Xtorm. Additional information regarding compatibility can be found in the Hadron Xtorm User Manual – MU223600.

6. Installation

For the correct installation of this product, it is necessary to use a rack (backplane rack) and it must be carried out according to the mechanical and electrical installation instructions that follow.

6.1. Product Identification

This product has some parts that must be observed before installation and use. The following figure identifies each of these parts.

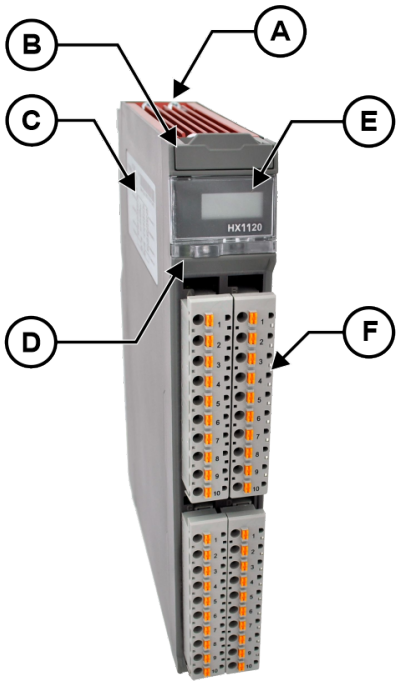

Figure 1: HX1120

Ⓐ Fixing lock.
Ⓑ Module Slot locking slider.
Ⓒ Label for module identification.
Ⓓ Diagnostic LED and switch.
Ⓔ Status and diagnostic display.
Ⓕ 10 pin terminal blocks.

The product has in its mechanics a label that identifies it and in it are presented some symbols whose meaning is described below:

⚠ Attention! Before using the equipment and installing, read the documentation.

⎓ Direct Current.

6.2. Electrical Installation

The figure below shows an example where the HX1100 and HX1120 modules inputs are being used as source or sink inputs. The inputs 00 to 03, 10 to 13, 20 to 23 and 30 to 33 are being used as sink type input, while the inputs 04 to 07, 14 to 17, 24 to 27 and 34 to 37 are being used as source type inputs. Each input group is isolated.

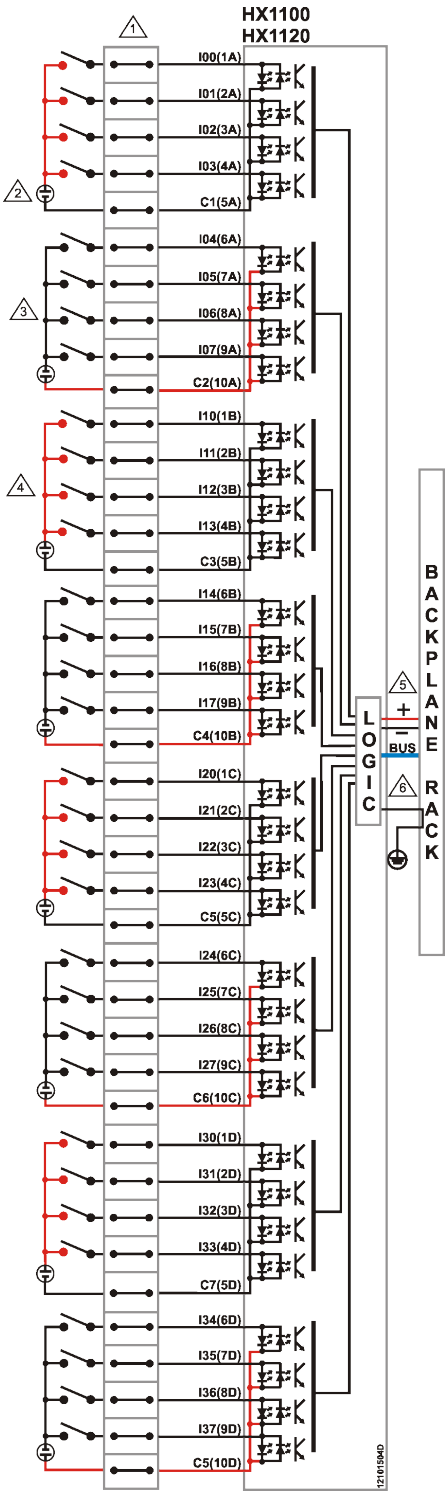

Figure 2: Electrical Installation

Diagram Notes:

1. Terminal group.

2. The nominal input voltage is 24 Vdc for HX1100 module and 125 Vdc for HX1120 module.

3. Typical usage of source digital inputs, C2 is the common positive potential for the input group I04 to I07.

4. Typical usage of sink digital inputs, C3 is the 0 Vdc for the input group I10 to I13.

5. The module power supply is derived from the connection to the backplane rack, not requiring external connections.

6. The HX1100 and HX1120 modules are grounded through the backplane rack.

Protective conductor terminal.

6.3. Connector Terminals

The figure below indicates the position of the connectors A, B, C and D.

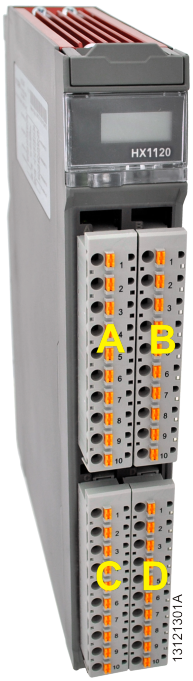

Figure 3: Connector Terminals

The following table shows the description of each terminal:

Terminal number	Description
1A	Input 00
2A	Input 01
3A	Input 02
4A	Input 03
5A	Common for inputs 00 a 03
6A	Input 04
7A	Input 05
8A	Input 06
9A	Input 07
10A	Common for inputs 04 a 07
1B	Input 10
2B	Input 11
3B	Input 12
4B	Input 13
5B	Common for inputs 10 a 13
6B	Input 14
7B	Input 15
8B	Input 16
9B	Input 17
10B	Common for inputs 14 a 17
1C	Input 20
2C	Input 21
3C	Input 22
4C	Input 23
5C	Common for inputs 20 a 23
6C	Input 24
7C	Input 25
8C	Input 26
9C	Input 27
10C	Common for inputs 24 a 27
1D	Input 30
2D	Input 31
3D	Input 32
4D	Input 33
5D	Common for inputs 30 a 33
6D	Input 34
7D	Input 35
8D	Input 36
9D	Input 37
10D	Common for inputs 34 a 37

Table 6: Connector Terminals

6.4. Mechanical and Electrical Assembly

The mechanical and electrical assembly and the insertion or removal of an input/output module are described on Hadron Xtorm Utilization Manual – MU223600.

ATTENTION

Products with broken warranty seal are not covered in warranty.

CAUTION

The device is sensitive to static electricity (ESD). Always touch in a metallic grounded object before handling it.

DANGER

Hadron Xtorm Series can operate with voltage up to 250 Vac. Special care must be taken during the installation, which should only be performed by qualified technical personnel. Do not touch the field wiring when in operation.

6.5. Physical Dimensions

Dimensions in mm.

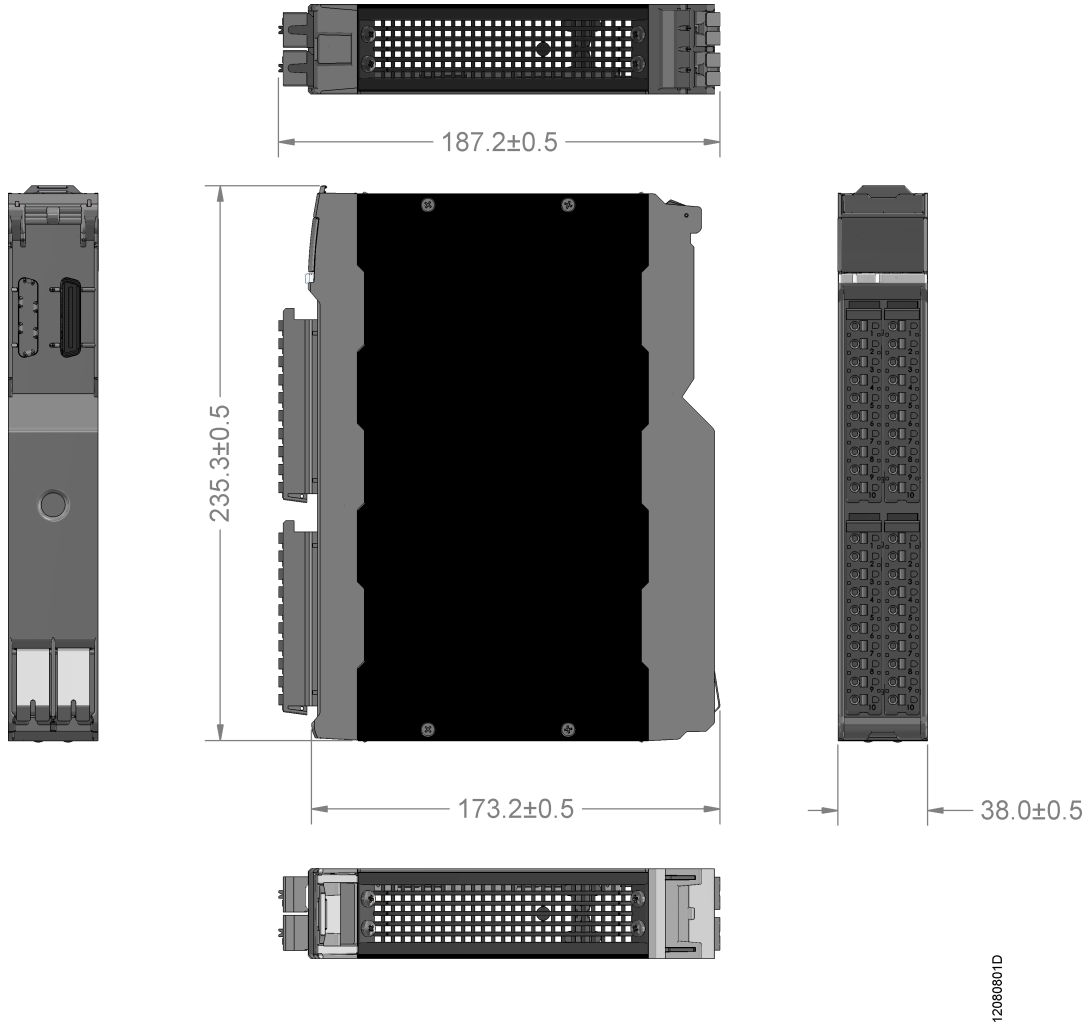

Figure 4: Physical Dimensions

7. Configuration

The HX1100 and HX1120 modules were designed for use with the Hadron Xtorm Series products. The configuration of a specific module can be accessed by double-clicking on the desired module in the graphical editor.

7.1. Process Data

The process data, when available, are the variables used to access and control the module. The table below shows all the variables delivered by the HX1100 and HX1120 modules. Besides this data, the module also provides a set of variables containing information related to diagnostics which are also described in this document.

Process Data	Description	Type
Digital Inputs Byte-0	Input value of the channel 00 to 07	Input (Read)
Digital Inputs Byte-1	Input value of the channel 10 to 17	Input (Read)
Digital Inputs Byte-2	Input value of the channel 20 to 27	Input (Read)
Digital Inputs Byte-3	Input value of the channel 30 to 37	Input (Read)

Table 7: Process Data

7.2. Module Parameters

Name	Description	Standard Value	Options
Event Detection Enabling Mask	Enables or disables the events detection	FALSE	TRUE or FALSE
Input Filter Enabling Mask	Enables or disables the input filter	FALSE	TRUE or FALSE
Input Filter Time	Sets Input filter time (ms)	10	1 to 255

Table 8: Module Parameters

Notes:

Input Filter Enabling Mask: The field can be selected by the user to enable the filter feature in a specific channel. If the input filter is enabled in a channel, the module will reject pulses smaller than the time configured in the Input Filter Time parameter. Enabling the filter does not affect the accuracy of event logging. Detection is performed immediately upon the occurrence of the input signal edge, keeping the event temporarily stored until the input trigger is confirmed (pulse longer than the filter time), when it is then effectively transmitted.

Input Filter Time: The field determines the Filter Time, which determines the minimum pulse width that will be detected by the module. This parameter is global for all inputs, and can be set from 1 to 255 ms.

8. Utilization

8.1. General Purpose Input Reading

The HX1100 and HX1120 modules have four variables to access its inputs (Digital Inputs Byte-0, Digital Inputs Byte-1, Digital Inputs Byte-2 and Digital Inputs Byte-3). Each variable has 8 bits where each bit represents the logical state of each input channel. The relationship between each bit and its respective input can be found on the Bus I/O Mapping tab.

8.2. Event Log

The input module with event log monitors the 32 digital inputs and registers variations of these inputs with 200 us precision. The result comes in the form of "events", i.e., logs that contain varying time (hour/minutes/seconds/milliseconds), the input number and its new state.

The modules HX1110 and HX1120 internally store the events in a structure containing from 1 to 32 events. When only one input changes its state, the structure stores only one event. Similarly, when all 32 inputs change their state simultaneously, the structure stores 32 events.

The module has an internal queue with capacity to store up to 420 structures (in other words, from 420 to 13.440 events). The CPU performs the reading of 38 such structures through local bus at every 3 execution cycles (MainTask) of the RTU.

The time is kept by the module in sync with the CPU through pulses received each second. This ensures timing precision of 200 us between the the CPU and module internal clocks.

The system time is set in the module by the CPU periodically. These synchronization operations and time setting are controlled internally by the module and is fully transparent to the application.

8.3. Double Points Mapping

Double point's mappings are used to map digital double points to the digital input modules. This type of mapping is used to indicate the position of equipment such as valves, circuit breakers and disconnect switches where the transition between the open and closed states require a certain time, thus indicate an intermediate state of transition between the two final states. The relationship between the logic inputs and logic points are shown in the following table:

Mapping	Logic Input	Logic Point
Byte-0	00	0
	01	
	02	1
	03	
	04	2
	05	
	06	3
	07	
Byte-1	10	4
	11	
	12	5
	13	
	14	6
	15	
	16	7
	17	

Mapping	Logic Input	Logic Point
Byte-2	20	8
	21	
	22	9
	23	
	24	10
	25	
	26	11
	27	
Byte-3	30	12
	31	
	32	13
	33	
	34	14
	35	
	36	15
	37	

Table 9: Double Points Mapping

The variables to be used for the mapping of double points must be declared using the type DBP.

In the case of points mapped as double points, the variable "ON" (variablename.ON) should be mapped into an odd number input of the module, and the variable "OFF" (variablename.OFF) should be mapped into an even number input of the module as shown in the following figure:

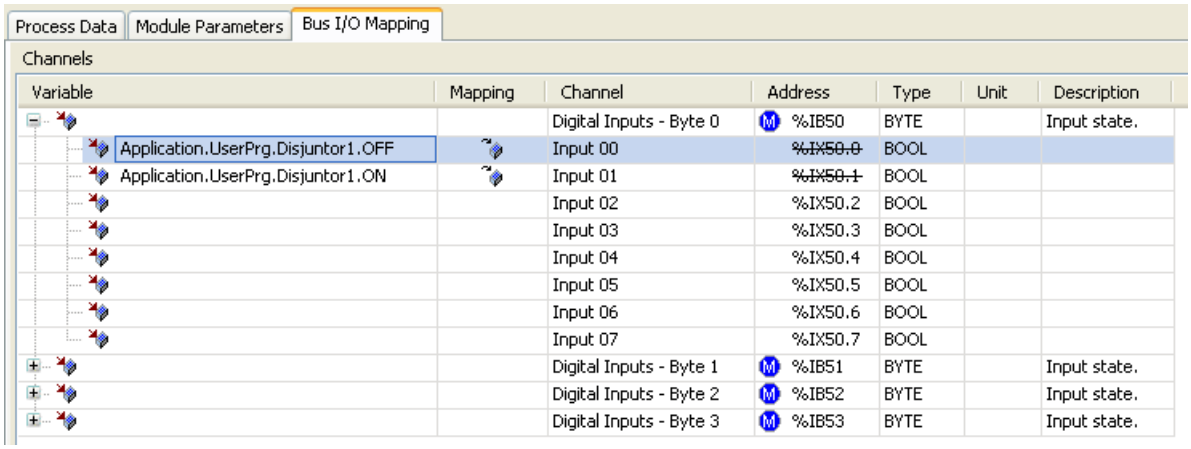

Figure 5: Double Points Mapping

For double input points, the parameter “Event Detection Enabling Mask” or “Input Filter Enabling Mask” must be configured with the same value for both inputs of the double point.

9. Maintenance

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

This module offers 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 Diagnostics through Variables.

9.1. 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.

To check the module tag and diagnostics of a given module, it's required only one short press on its diagnostic switch. After press once, CPU will start to scroll tag information and diagnostic information of the module. To access the respective description for the module just long press the diagnostic switch of the respective module.

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

9.2. Status and Diagnostic Indicators

The HX1100 and HX1120 modules of Hadron Xtorm Series have a display and a bi-color LED to indicate the diagnostics. The display has the following symbols: D, E, 0, 1, 2, 3 and numerical characters. States of D and E symbols are common for all slave modules of Hadron Xtorm Series. These states can be found in the following table. The same D and E symbol states are indicated by the color of the LED in module front panel.

The meaning of the numerical characters may be different for specific modules.

9.2.1. D, E and Diagnostics LED (DL) States

Symbol D	Symbol E	DL (Color)	Description	Cause	Solution	Priority
Off	Off	Off	Display fail, module off or OTD fail	Disconnected module, no external supply, hardware fail or OTD button fail	Check if the module is completely connected to the backplane rack and if the backplane rack is supplied by an external power supply	-
On	Off	On (Blue)	Normal use	-	-	7 (Lower)
Blinking 1x	Off	Blinking 1x (Blue)	Active Diagnostics	There is at least one active diagnostic related to this module	Check what the active diagnosis is. More information can be found in the Maintenance section of this document	6
Blinking 2x	Off	Blinking 2x (Blue)	CPU in STOP mode	CPU in STOP mode	Check if CPU is in RUN mode. More information can be found on CPU's documentation	5

Symbol D	Symbol E	DL (Color)	Description	Cause	Solution	Priority
Blinking 4x	Off	Blinking 4x (Blue)	Hardware non-fatal error	Hardware fault	The module remains with its main functionality, but in order to correct the fault, Altus support team must be contacted	4
Off	Blinking 1x	Blinking 1x (Red)	Parameterization Error	The module isn't parameterized or received an invalid parameter	Check if the module parameterization is correct	2
Off	Blinking 2x	Blinking 2x (Red)	Loss of master	Loss of communication between module and CPU	Check if the module is completely connected to the backplane rack. Check if CPU is in RUN mode	3
Off	Blinking 4x	Blinking 4x (Red)	Hardware fatal error	Hardware fault	Contact Altus support team in case of hardware fatal error	1 (Higher)

Table 10: D, E and Diagnostics LED (DL) States

Note:
Any signaling pattern different from those listed above indicates that the module should be forwarded to Altus Support.

9.2.2. 0, 1, 2, 3 and Numerical Characters

The segments 0, 1, 2 and 3 sare used to group the numerical characters used for the 32 inputs. The numerical characters that are placed at the right side of character 0 represent the inputs from 00 to 07, where character 0 is related to input 00 and character 7 is related to input 07. The numerical characters that are placed at the right side of character 1 represent the inputs from 10 to 17, where character 0 is related to input 10 and character 7 is related to input 17. The numerical characters that are placed at the right side of character 2 represent the inputs from 20 to 27, where character 0 is related to input 20 and character 7 is related to input 27. In the same way, the numerical characters that are placed at the right side of character 3 represent the inputs from 30 to 37, where character 0 is related to input 30 and the character 7 is related to input 37. The figure below shows the relation between numerical characters and the respective inputs.

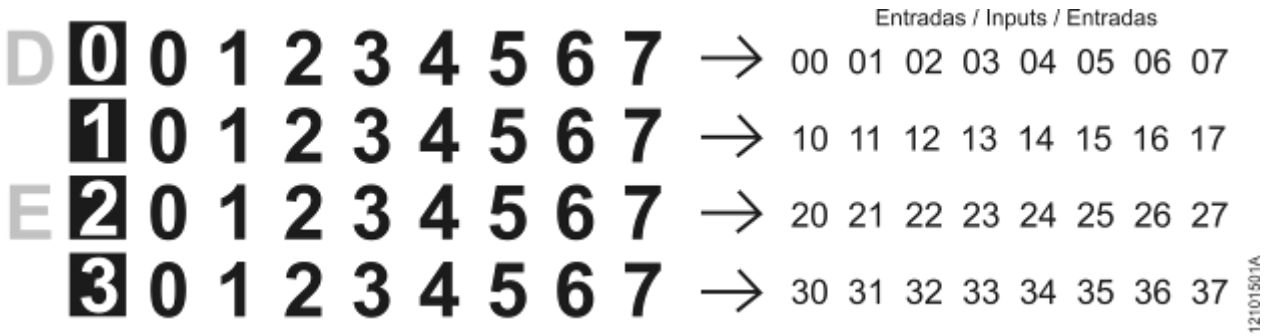

Figure 6: 0, 1, 2, 3 and Numerical Characters

9.3. Web Page with Complete Status and Diagnostics List

Another way to access diagnostic information on Hadron Xtorm Series is via web page. Hadron Xtorm Series CPU's has an embedded web page server that provides all status and diagnostic information, which can be accessed using a simple browser.

More information about web page with complete status and diagnostic list can be found at Hadron Xtorm Utilization Manual – MU223600.

9.4. Diagnostics Mapped through Variables

All the diagnostics of HX1100 and HX1120 modules can be accessed through symbolic variables that can be handled by the user application or even mapped to a supervisory using a communication channel. The table below shows all available diagnostics for HX1100 and HX1120 modules and their respective memory addresses, description, symbolic variable and string that will be shown on the CPU Graphical Display and Web.

9.4.1. General Diagnostics

Diagnostic Message	Symbolic Variable DG_modulename.tGeneral.	Description
UNKNOWN DIAGNOSTIC	bReserved_08..15	Reserved
MODULE W/ DIAGNOSIS	bActiveDiagnostics	**TRUE –** Module has active diagnostics **FALSE –** Module doesn't have active diagnostics
NO DIAG		
MODULE W/ FATAL ERROR	bFatalError	**TRUE –** Module with fatal error **FALSE –** Module without fatal error
CONFIG. MISMATCH	bConfigMismatch	**TRUE –** Parameterization error **FALSE –** Parameterization OK
WATCHDOG ERROR	bWatchdogError	**TRUE –** Watchdog has been detected **FALSE –** No watchdog detected
OTD SWITCH ERROR	bOTDSwitchError	**TRUE –** Failure on the diagnostic switch **FALSE –** No failure on the diagnostic switch
UNKNOWN DIAGNOSTIC	bReserved_05..06	Reserved
BUS COM. ERROR	bCommunicationError	**TRUE –** failure in module communication with the bus **FALSE –** module communication with the bus is OK

Table 11: General Diagnostics

Note:

Symbolic Variable: Some symbolic variables are used to access the diagnostics. All diagnostics automatically mapped in symbolic variables can be found at the Diagnostics object.

9.4.2. Detailed Diagnostics

Diagnostic Message	Symbolic Variable DG_modulename.tDetailed.	Description
-	wEventBufferOverflowCounter	Number of times the event buffer had an overflow in the queue.

Table 12: Detailed Diagnostics

Note:
wEventBufferOverflowCounter: This variable will be reset every time the CPU is turned off.

9.5. Hot Swap

This product supports hot swap. For further information about how to correctly perform a hot swap, consult Hadron Xtorm Utilization Manual – MU223600.

10. Manuals

For further technical details, configuration, installation and programming, the table below should be consulted.

The table below is only a guide of some relevant documents that can be useful during the use, maintenance, and programming of this product.

Code	Description	Language
CE123000	Hadron Xtorm Series Technical Characteristics	English
CT123000	Características Técnicas Série Hadron Xtorm	Portuguese
MU223600	Hadron Xtorm Utilization Manual	English
MU223000	Manual de Utilização Hadron Xtorm	Portuguese

Table 13: Related Documents