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.

HX6020 Hadron Xtorm Series module offers 8 analog inputs for RTD and resistance reading which can be individually configured according to the desired range.

Its main features are:

- 8 analog inputs for RTD points reading
- Independent inputs configuration in different scales by software
- Filters configurable by software
- Galvanic isolation between inputs and internal logic
- 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:

- Module HX6020
- Four connectors with 10 terminals HX9402

2.2. Product Code

The following code should be used to purchase the product:

Code	Description
HX6020	8 AI Temperature (RTD) Module

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 Nexto 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 Nexto 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

	HX6020
Module type	8 analog inputs
Input type	RTD and resistance input individually configurable
Status and diagnostics indication	Yes
One Touch Diag (OTD)	Yes
Electronic Tag on Display (ETD)	Yes
Status indication and Diagnostics	Display, web page and CPU's internal memory
Hot swap support	Yes
Isolation **Input to logic** **Input to protective earth** ⏚ **Logic for protective earth** ⏚	 2500 Vac / 1 minute 2500 Vac / 1 minute 2500 Vac / 1 minute
Backplane current consumption	320 mA
Maximum power dissipation	3 W
Wire size	0,5 to 1,5 mm²
IP level	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: General Features

Notes:

One Touch Diag (OTD): This option is available only when the module is in operating mode.

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 4: Standards and Certifications

5.3. Temperature Mode Characteristics (RTD)

	HX6020
Precision (25 °C) **0..400 Ω** **0..4000 Ω** **Pt(100, 1000)** **Ni(100)**	 ±0,1% of full scale rating ±0,1% of full scale rating ±1 °C ±1 °C
Additional error in case of open channel (interference between channels)	±0,1% of full scale rating
Conversion time for Ni, Pt, 400Ω and 4000Ω scales **50 Hz** **60 Hz**	 206 ms / channel 195 ms / channel
Update time	It is the sum of conversion time of each channel enabled.
Data format	16 bits in two's complement, justified to the left
Converter resolution	24 bits monotonicity guaranteed, no missing codes
Over scale	+ 5% of full scale rating (when the input type selected is resistance reading)
Excitation current	452 µA

	HX6020
Connection type	2, 3 and 4 wires
Configurable parameters	Input type per point Filters Temperature units (°F or °C) for RTD scale
Noise suppression filter	50 or 60 Hz
Low pass filter	1st order digital filter
Low pass filter time constant	1 or 10 s
Open input detection	Yes, available in diagnostic
Over range indication	Yes
Under range indication	Yes
Sensor cable maximum impedance	20 Ω per wire

Table 5: Temperature Mode Characteristics (RTD)

Notes:

Noise suppression filter: The value of the selected filter in this parameter will be applied to all module inputs.

Conversion time: Time for conversion of one channel depending on the sensor type and filter configuration.

Update time: Time for updating the measured values (process data).

Open input detection: In this situation will be presented an over range indication and the read value presented will be the full-scale rating selected.

Maximum impedance of the sensor cable: On a two-wire connection, the value read is the result of the sum of the sensor reading and resistance of each wire. In case of using this connection with large cables, the value read by the module will be affected by the effect of the resistance of the cable wires. On a three-wire connection, the error due to wire resistance is compensated by measuring the resistance value of one of the cable wires. Therefore, to enable a correct compensation is necessary for all the cable wires to have the same resistance.

5.4. Input Types

Input type	Model	Scale	Count	Resolution
RTD measurement °C mode European curve (DIN 43760) α = 0,00385	Pt100E	-200 to +850 °C	-2000 to 8500	0,1 °C
	Pt1000E	-200 to +850 °C	-2000 to 8500	0,1 °C
RTD measurement °C mode American Curve α =0,00392	Pt100A	-100 to +457 °C	-1000 to 4570	0,1 °C
	Pt1000A	-100 to +457 °C	-1000 to 4570	0,1 °C
RTD measurement °F mode European curve (DIN 43760) α = 0,00385	Pt100E	-328 to 1562 °F	-3280 to 15620	0,2 °F
	Pt1000E	-328 to 1562 °F	-3280 to 15620	0,2 °F
RTD measurement °C mode American Curve α = 0,00392	pt100A	-148 to 854 °F	-1480 to 8540	0,2 °F
	Pt1000A	-148 to 854 °F	-1480 to 8540	0,2 °F
Ni100 °C (DIN 43760)	Ni100	-60 to 250 °C	-600 to 2500	0,1 °C
Ni100 °F (DIN 43760)	Ni100	-76 to 482 °F	-760 to 4820	0,2 °F
Resistance	0-400	0 to 400 Ω	0 to 4000	0,1 Ω
	0-4000	0 to 4000 Ω	0 to 4000	1 Ω

Table 6: Input type

6. Physical Dimensions

Dimensions in mm.

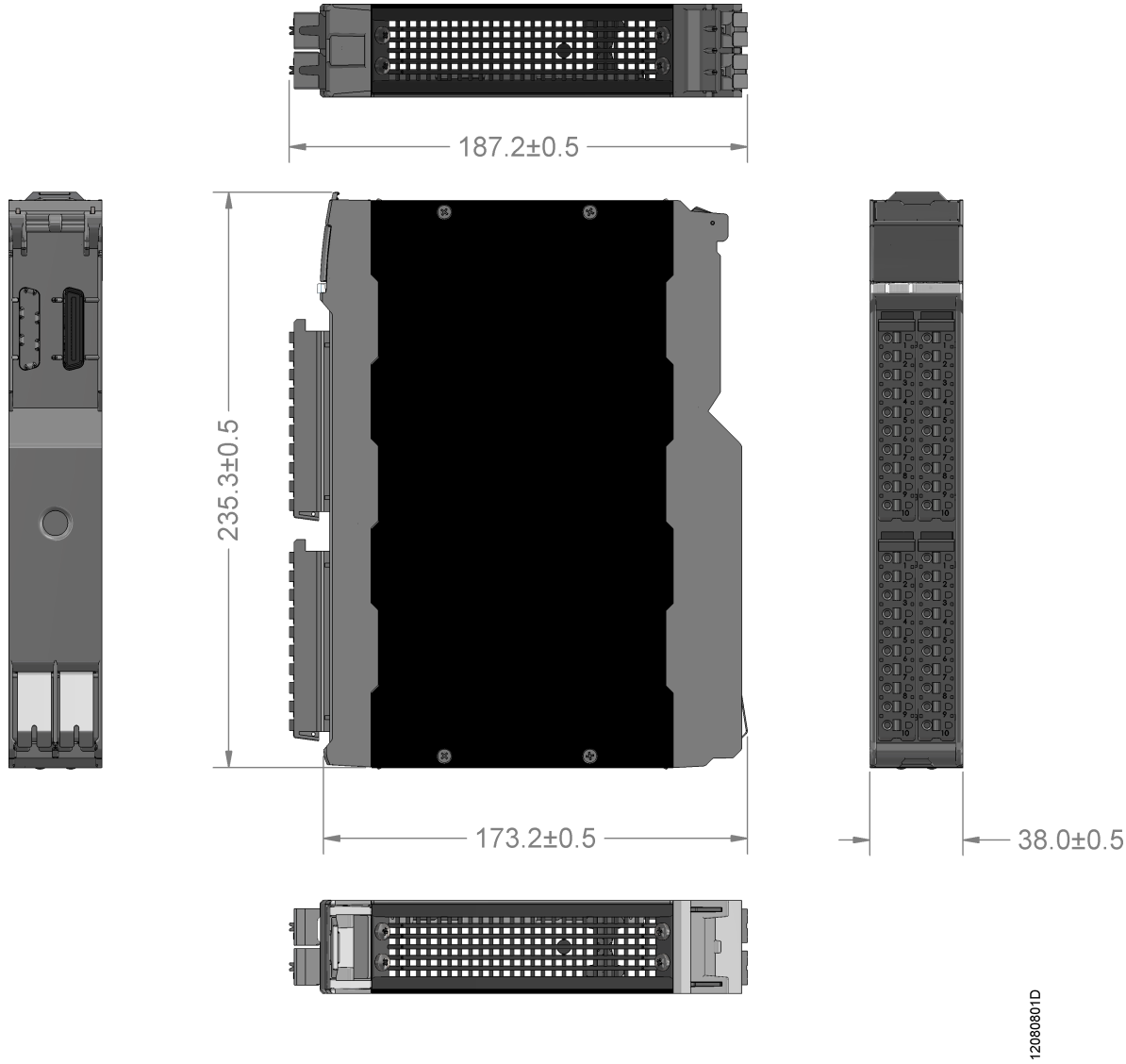

Figure 1: Physical Dimensions

7. 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.

7.1. Product Identification

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

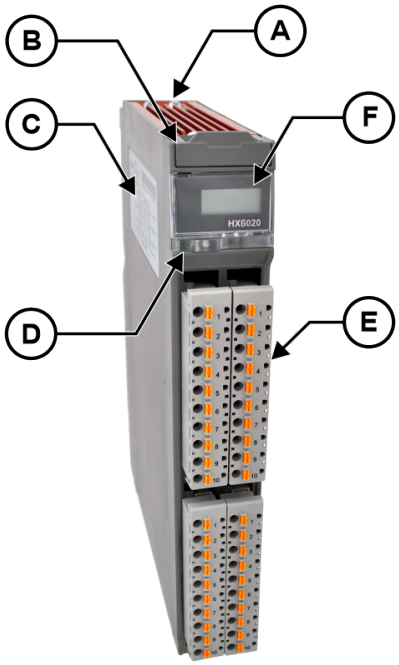

Figure 2: HX6020

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

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.

7.2. Electrical Installation

The figure below shows an example where some of the HX6020 inputs are being used: input 00, input 02, input 05 and input 07. Each of these inputs has a different type of connection as shown below.

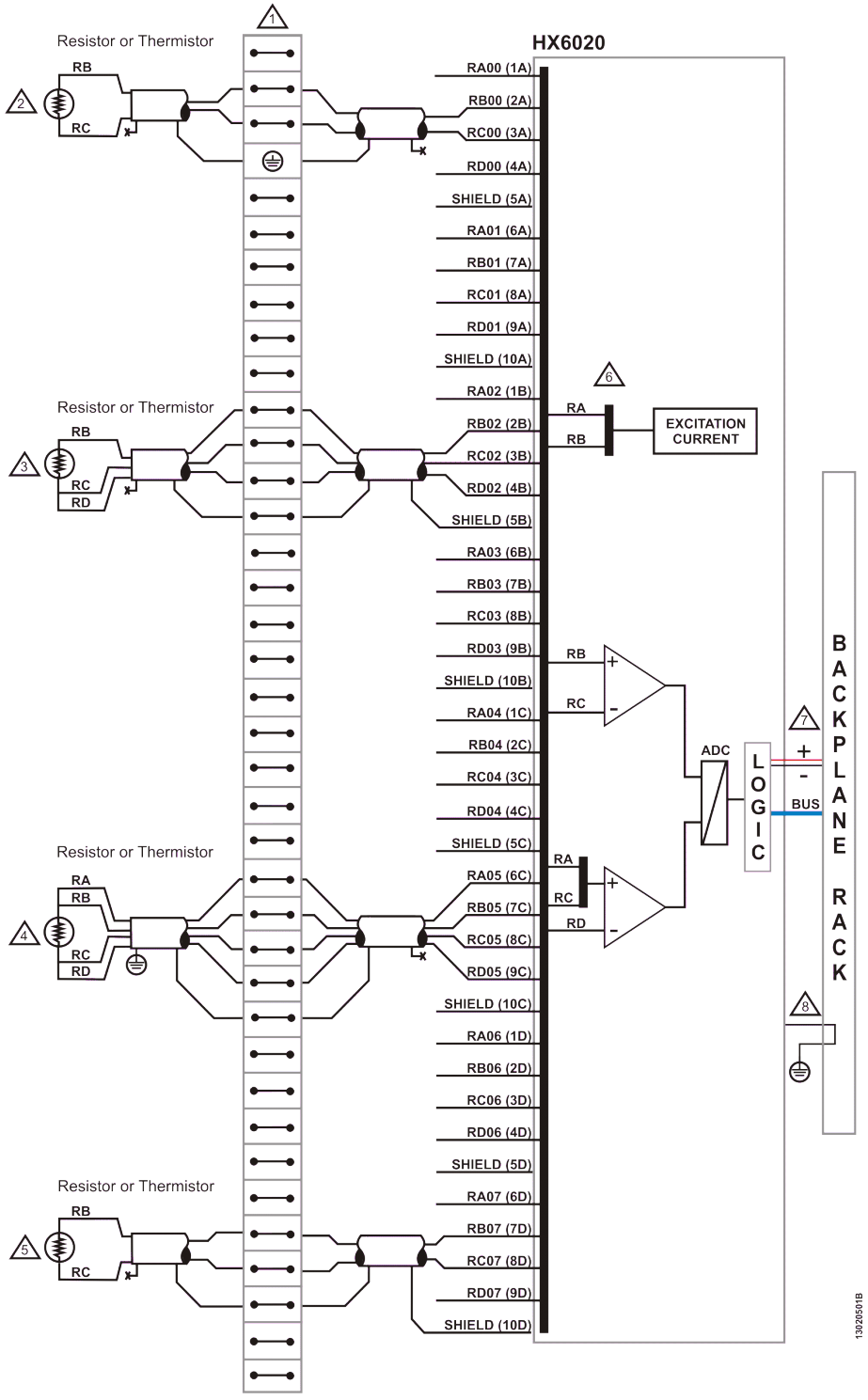

Figure 3: Electrical diagram

Notas:

1. Terminal group.
2. Input 00 and 07 show examples of a 2 wire connections.
3. Input 02 show example of a 3 wire connection.
4. Input 05 show example of a 4 wire connection.
5. In all examples the cable shielding is connected only in one point.
6. The output of the current source depends on the number of wires used for the connection.
7. The power supply of the module is derived from the connection to the backplane rack, not requiring external connections.
8. HX6020 is grounded ⏚ through the backplane racks.

7.2.1. Connector Pinout

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

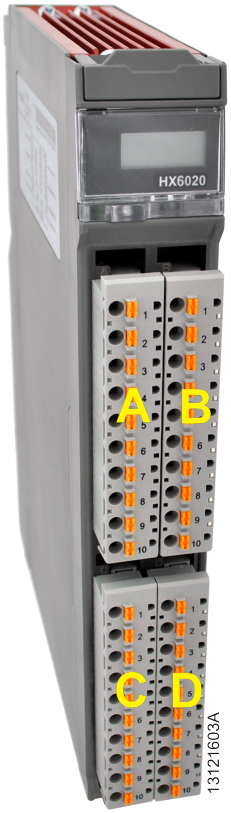

Figure 4: Connector Positions

The following table shows the description of each terminal:

A	Terminal Number	B
Description		**Description**
Input 00 excitation current for 4 wire sensor	1	Input 02 excitation current for 4 wire sensor
Input 00 excitation current for 2 or 3 wire sensors / RTD positive sign	2	Input 02 excitation current for 2 or 3 wire sensors / RTD positive sign
Input 00 RTD negative sign	3	Input 02 RTD negative sign
Input 00 compensation for 3 or 4 wire sensor	4	Input 02 compensation for 3 or 4 wire sensor
Input 00 grounding	5	Input 02 grounding
Input 01 excitation current for 4 wire sensor	6	Input 03 excitation current for 4 wire sensor
Input 01 excitation current for 2 or 3 wire sensors / RTD positive sign	7	Input 03 excitation current for 2 or 3 wire sensors / RTD positive sign
Input 01 RTD negative sign	8	Input 03 RTD negative sign
Input 01 compensation for 3 or 4 wire sensor	9	Input 03 compensation for 3 or 4 wire sensor
Input 01 grounding	10	Input 03 grounding
C	**Terminal Number**	**D**
Description		**Description**
Input 04 excitation current for 4 wire sensor	1	Input 06 excitation current for 4 wire sensor
Input 04 excitation current for 2 or 3 wire sensors / RTD positive sign	2	Input 06 excitation current for 2 or 3 wire sensors / RTD positive sign
Input 04 RTD negative sign	3	Input 06 RTD negative sign
Input 04 compensation for 3 or 4 wire sensor	4	Input 06 compensation for 3 or 4 wire sensor
Input 04 grounding	5	Input 06 grounding
Input 05 excitation current for 4 wire sensor	6	Input 07 excitation current for 4 wire sensor
Input 05 excitation current for 2 or 3 wire sensors / RTD positive sign	7	Input 07 excitation current for 2 or 3 wire sensors / RTD positive sign
Input 05 RTD negative sign	8	Input 07 RTD negative sign
Input 05 compensation for 3 or 4 wire sensor	9	Input 07 compensation for 3 or 4 wire sensor
Input 05 grounding	10	Input 07 grounding

Table 7: Connector Pinout

7.3. Mechanical Assembly

Information and orientations about correct mechanical installation can be found at 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.

8. Configuration

HX6020 was developed to be used with Hadron Xtorm Series products. All configuration data of a given module can be accessed through a double click in the desired module on the Graphical Editor.

8.1. 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 HX6020 module. 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
AI 00	Analog Input 00	Input (Read)
AI 01	Analog Input 01	Input (Read)
AI 02	Analog Input 02	Input (Read)
AI 03	Analog Input 03	Input (Read)
AI 04	Analog Input 04	Input (Read)
AI 05	Analog Input 05	Input (Read)
AI 06	Analog Input 06	Input (Read)
AI 07	Analog Input 07	Input (Read)

Table 8: Process Data

8.2. Module Parameters

Name	Description	Default Value	Options	Configuration
Noise Suppression Filter	Configures the noise suppression filter features in the frequencies of 50 Hz or 60 Hz	60 Hz	50 Hz 60 Hz Disabled	Per module
Temperature unit	Select temperature unit	Degrees Celsius	Degrees Celsius Degrees Fahrenheit	Per module
Input type	Input type configuration	400 Ω	Not configured 400 Ω Pt100A Pt100E Ni100 4000 Ω Pt1000A Pt1000E	Per channel
Connection type	Configures the type of connection	2-Wires	2-Wires 3-Wires 4-Wires	Per channel
Digital filter	Low pass filter time constant	Disabled	Disabled 1 s 10 s	Per channel
Alarms	Enable or disable alarms triggering feature	Disabled	Disabled Enabled	Per channel
Alarms - HH	High-High alarm setpoint	0	-	Per channel
Alarms - H	High alarm setpoint	0	-	Per channel
Alarms - L	Low alarm setpoint	0	-	Per channel
Alarms - LL	Low-Low alarm setpoint	0	-	Per channel

Table 9: Module Parameters

Notes:

Noise Suppression Filter: The filter value selected in this parameter will be applied to all the module's inputs.

Digital filter: If a signal is present on a channel with filter enabled and a hot-swap is performed in the module, the channel will start with the lower scale value to dynamically, according to the selected time constant, reach the present value at the input.

Configuration: Configuration indicates if the parameter is related to the entire module (per module) or if the parameter is related to a single input (per input).

Alarm Setpoints: These parameters must be configured within the range of the selected sensor type. To use this feature, the alarm triggering function must be enabled.

9. Utilization

9.1. RTD Analog Input Reading

HX6020 module has one variable for each input. The parameters of minimum and maximum values are automatically configured according to the selected RTD type.

10. Maintenance

Altus recommends that all modules' 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 mapped to internal memory.

10.1. 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.

10.2. Status and Diagnostic Indicators

HX6020 Hadron Xtorm Series module has a display and a bi-color LED to represent the diagnostics with the following symbols: D, E, 0, and numerical characters. The states of the symbols D and E are common for all Hadron Xtorm Series slaves modules and the symbol states are indicated by the color of the LED in module front panel. These states can be consulted in the table below.

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

10.2.1. 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.

10.2.2. 0 and Numerical Characters

The segment 0 is used to group the numerical characters used for the 8 analog inputs of RTD reading. The characters that are placed to the right side of the character 0 represent inputs from 00 to 07, where the character 0 represents the input 00 and character 7 represents the input 07. The figure below shows the relation between numerical characters and the respective input.

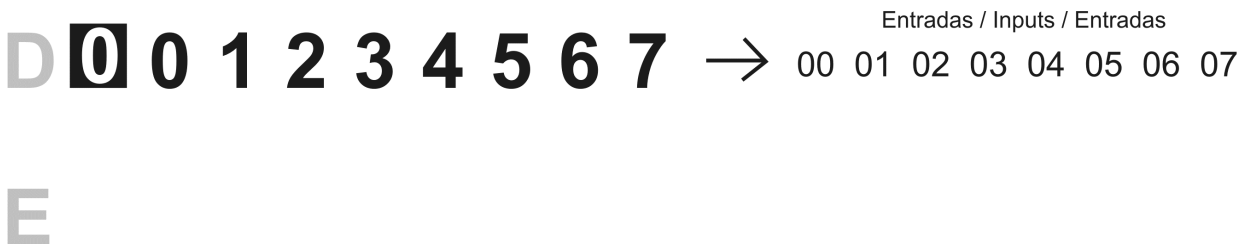

Figure 5: Display

10.3. 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 CPU's has an embedded web pages 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.

10.4. Diagnostics Mapped through Variables

All HX6020's diagnostics can be accessed through variables that can be handled by the user application or even forwarded to a supervisory using a communication channel. The table below shows all available diagnostics for HX6020 and their respective symbolic variables, description, symbolic variable and string that will be shown on the CPU Graphical Display and Web.

10.4.1. 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 –** Fatal error **FALSE –** No 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

10.4.2. Specific Diagnostics

Diagnostic Message	Symbolic Variable DG_modulename.tSpecific.	Description
-	bReserved_08..15	Reserved
INPUT 00 W/ DIAG	bActiveDiagnosticsInput00	**TRUE –** Input 00 has active diagnostics **FALSE –** Input 00 doesn't have active diagnostics
INPUT 01 W/ DIAG	bActiveDiagnosticsInput01	**TRUE –** Input 01 has active diagnostics **FALSE –** Input 01 doesn't have active diagnostics
INPUT 02 W/ DIAG	bActiveDiagnosticsInput02	**TRUE –** Input 02 has active diagnostics **FALSE –** Input 02 doesn't have active diagnostics

Diagnostic Message	Symbolic Variable DG_modulename.tSpecific.	Description
INPUT 03 W/ DIAG	bActiveDiagnosticsInput03	**TRUE –** Input 03 has active diagnostics **FALSE –** Input 03 doesn't have active diagnostics
INPUT 04 W/ DIAG	bActiveDiagnosticsInput04	**TRUE –** Input 04 has active diagnostics **FALSE –** Input 04 doesn't have active diagnostics
INPUT 05 W/ DIAG	bActiveDiagnosticsInput05	**TRUE –** Input 05 has active diagnostics **FALSE –** Input 05 doesn't have active diagnostics
INPUT 06 W/ DIAG	bActiveDiagnosticsInput06	**TRUE –** Input 06 has active diagnostics **FALSE –** Input 06 doesn't have active diagnostics
INPUT 07 W/ DIAG	bActiveDiagnosticsInput07	**TRUE –** Input 07 has active diagnostics **FALSE –** Input 07 doesn't have active diagnostics

Table 12: Specific Diagnostics

10.4.3. Detailed Diagnostics

Diagnostic Message	Symbolic Variable DG_modulename.tDetailed. tAnalogInput_XX.	Description
-	bReserved_08..15	Reserved
OVER RANGE	bOverRange	**TRUE –** Over range condition at the input **FALSE –** No over range condition at the input
UNDER RANGE	bUnderRange	**TRUE –** Under range condition at the input **FALSE –** No under range condition at the input
-	bReserved_02	Reserved
-	bInputNotEnable	**TRUE –** Input is not enabled **FALSE –** Input is enabled
-	bHHAlarm	**TRUE –** High-High Alarm is active **FALSE –** High-High Alarm is not active
-	bHAlarm	**TRUE –** High Alarm is active **FALSE –** High Alarm is not active
-	bLLAlarm	**TRUE –** Low-Low Alarm is active **FALSE –** Low-Low Alarm is not active
-	bLAlarm	**TRUE –** Low Alarm is active **FALSE –** Low Alarm is not active

Table 13: Detailed Diagnostics

Notes:

Under Range: This diagnostic becomes active when the input selected is RTD reading type and the value read in the channel is less than the minimum value of full scale for the selected range. E.g. for Pt100E scale (-200 to +850 °C), the symbolic variable will be TRUE when the measured value is less than -200 ºC. In addition, the module will fix the value read to the minimum value of full scale configured for this channel. For resistance reading scale, this alarm is not available.

Over Range: When the input selected is RTD reading type and the sensor input value is greater than the maximum value of full scale for the range selected, the symbolic variable becomes TRUE. In addition, the module will fix the value read to the maximum value of full scale configured for this channel.

In case of resistance reading, the diagnostic becomes active when the input value read is 1% greater than the maximum value of full scale configured for this channel. If the value read exceeds 5% of the maximum value of full scale, the module will fix the reading variable of this channel to this value.

10.5. Hot Swap

These products supports hot swap. For more information about how to correctly perform a hot swap, see the Hadron Xtorm Utilization Manual – MU223600.

11. 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 14: Related Documents