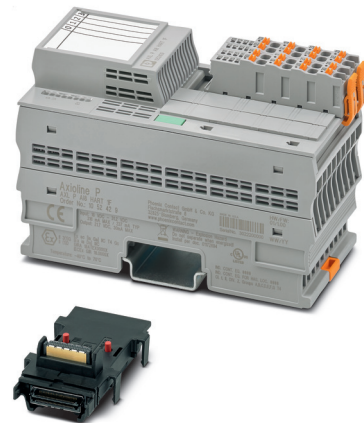


AXL P AI8 HART 1F

**Axioline P analog input module,
8 inputs, HART functionality,
2-conductor connection technology**



Data sheet
109502_en_00

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1 Description

The module is an Axioline P I/O module for use in the Axioline P modular I/O system.

The module is a modular I/O device that can be affixed to the Axioline P local bus, to communicate I/O data up to the Axioline P bus coupler, which forms the head of the station. The analog input I/O module with HART capabilities collects analog input and HART data from the field I/O terminals and makes this information available to the bus coupler through the Axioline P local bus.

The module allows the connection of up to 8 passive loop powered HART transmitters.

The module is fully hot-swappable on the Axioline P local bus, which also provides power to the module.

Features

- 8 active analog inputs for HART transmitters
- Connection of sensors in 2-conductor technology
- Current range: 4 mA ... 20 mA
- Can be used under extreme ambient conditions
- Temperature range of -40°C ... +70°C
- Hot-swappable



Make sure you always use the latest documentation.

It can be downloaded at: phoenixcontact.net/product/1052429

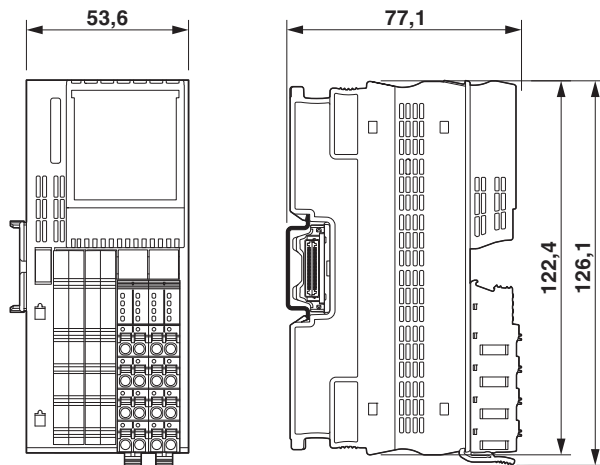
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3 Ordering data

Description	Type	Order No.	Pcs./Pkt.
Axioline P, Analog input module, Analog inputs: 8, 4 mA ... 20 mA, connection method: 2-conductor, transmission speed in the local bus: 100 Mbps, HART functionality, degree of protection: IP20	AXL P AI8 HART 1F	1052429	1
Accessories	Type	Order No.	Pcs./Pkt.
Axioline P bus base module for housing type F2	AXL P BS F2	1052428	1
Axioline shield connection set (contains 2 shield bus holders and 2 SK 5 shield connection clamps)	AXL SHIELD SET	2700518	1
Zack marker strip for Axioline F (device labeling), in 2 x 20.3 mm pitch, unprinted, 25-section, for individual labeling with B-STIFT 0.8, X-PEN, or CMS-P1-PLOTTER (Marking)	ZB 20,3 AXL UNPRINTED	0829579	25
Axioline P terminator pair	AXL P TERM PAIR	2316402	1
Replacement part	Type	Order No.	Pcs./Pkt.
Axioline P bus base module for housing type F2	AXL P BS F2	1052428	1
Optional accessories	Type	Order No.	Pcs./Pkt.
Axioline P terminator pair	AXL P TERM PAIR	2316402	1

4 Technical data

Dimensions (nominal sizes in mm)



Width	53.6 mm
Height	126.1 mm
Depth	77.14 mm
Note on dimensions	The depth is valid when a TH 35-7,5 DIN rail is used (according to EN 60715).

General data

Color	traffic grey A RAL 7042
Weight	248.9 g (with connectors and bus base module)
Ambient temperature (operation)	-40 °C ... 70 °C (Standard)
Ambient temperature (storage/transport)	-40 °C ... 85 °C
Permissible humidity (operation)	5 % ... 95 % (non-condensing)
Permissible humidity (storage/transport)	5 % ... 95 % (non-condensing)
Air pressure (operation)	70 kPa ... 106 kPa (up to 2000 m above sea level)
Air pressure (storage/transport)	70 kPa ... 106 kPa (up to 2000 m above sea level)
Degree of protection	IP20
Maximum altitude	2000 m
Protection class	III (IEC 61140, EN 61140, VDE 0140-1)
Overvoltage category	II
Degree of pollution	2

Connection data: Axioline P connector

Connection method	Push-in connection
Conductor cross section solid / stranded	0.2 mm ² ... 1.5 mm ² / 0.2 mm ² ... 1.5 mm ²

Connection data: Axioline P connector

Conductor cross section [AWG] 24 ... 16

Stripping length 8 mm



Please observe the information provided on conductor cross sections in the “Axioline P: system and installation” user manual.

Interface: Axioline P local bus

Connection method Bus base module

Transmission speed 100 Mbps

Supply of the logic voltage U_L

Supply voltage range 19.2 V DC ... 30 V DC (via bus base module (U_L) at AXL P BK...)

Supply of the Axioline P local bus U_{Bus}

Supply voltage 5 V DC (via bus base module)

Current consumption max. 135 mA

Axioline P extension module supply voltage

Supply voltage U_L (via bus base module)

Current consumption max. 260 mA (via bus base module)

Analog inputs

Number of inputs 8 (HART)

Description of the input HART enabled analog input signals

Connection method Push-in connection

Connection technology 2-conductor, shielded, twisted pair

Current input signal 4 mA ... 20 mA

Precision 0.1 % (of measuring range final value for active mean-value generation and 30 Hz filter)

Polarity reversal protection of the inputs yes

Electrical isolation/isolation of the voltage areas

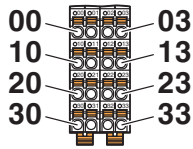
Test section	Test voltage
5 V supply of the local bus (U_{Bus}) / functional ground	500 V AC, 62 Hz, 1 min.
24 V supply (I/O)/functional ground	500 V AC, 62 Hz, 1 min.
Field to functional earth	500 V AC, 62 Hz, 1 min.
Field to 5 V and 24 V supplies	1500 V AC, 62 Hz, 1 min.

Approvals

For the latest approvals, please visit phoenixcontact.net/products.

5 Terminal point assignment

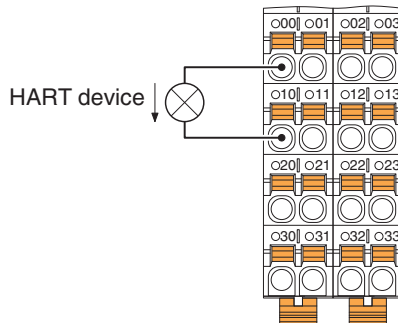
Figure 1 Terminal point assignment



Terminal point	Color	Assignment	
Analog inputs			
00 ... 03	Orange	I01+ ... I04+	Positive current connection for channel 1 ... 4
10 ... 13	Orange	I01- ... I04-	Negative current connection for channel 1 ... 4
20 ... 23	Orange	I05+ ... I08+	Positive current connection for channels 5 ... 8
30 ... 33	Orange	I05- ... I08-	Negative current connection for channels 5 ... 8

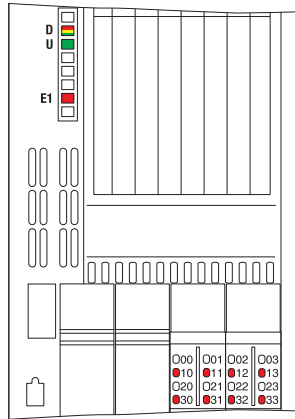
6 Connection examples

Figure 2 Connection for HART devices



7 Local diagnostic and status indicators

Figure 3 Local diagnostic and status indicators



Channel errors are errors that can be associated with a channel.
I/O errors are errors that affect the entire module.

Designation	Color	Meaning	State	Description
D	Red/yellow/green	Diagnostics of local bus communication		
		Run	Green on	The device is ready for operation, communication within the station is OK. All data is valid. An error has not occurred.
		Active	Green flashing	The device is ready to operate, communication within the station is OK. The data is not valid. The controller or superordinate network is not delivering valid data. There is no error on the module.
		Ready	Yellow on	The device is ready for operation but did not detect a valid cycle after power-up.
		Connected	Yellow flashing	The device is not (yet) part of the active configuration.
		Reset	Red on	The device is ready for operation but has lost the connection to the bus head.
		Power down	Off	Device is in (power) reset.
U	Green	U _{Logic}	On	Supply for analog modules (U _L) is present.
			Off	Supply for analog modules (U _L) is not present.
E1	Red	Supply voltage error	On	Supply for analog modules (U _L) is faulty.
			Off	Supply for analog modules (U _L) is OK.
10 ... 13, 30 ... 33	Red	Diagnostics of the input	On	Short-circuit/open-circuit/overrange/underrange of the input.
			Off	No short-circuit/open-circuit/overrange/underrange of the input.

Error code and status of the E1 LED

Error	E1 LED
No error	off
Underrange	off
Overrange	off
Wire break	off
Supply voltage faulty (supply for analog modules (U _L))	on
Parameter table invalid	off
Device error	off
Flash format error	off



The error that can actually be reported depends on the measuring range. For additional information please refer to the tables with significant measured values in various formats.

8 Process data

The module uses 24 input process data words.

Each channel is mapped to one word and two words, for the analog 4...20 mA value and the HART process value respectively.

Input words IN01 to IN08

The analog input measured values are transmitted to the controller board or the computer by means of the process data input words IN01 to IN08.

The measured values are depicted in IB IL, S7-compatible or standard format. In all cases, the measured value is displayed in 16 bit format. The data type is Integer 16 from a technical programming point of view.

INx															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Analog value															

In the IB IL format a diagnostic code is mapped to the input data in the event of an error.

Code (hex)	Cause
8001	Measuring range exceeded (overrange)
8002	Wire break
8004	Measured value invalid or no valid measured value available
8040	Device faulty / disabled
8080	Below measuring range (underrange)

Input REAL HART_IN01 to HART_IN08

The HART process values are transmitted to the controller board or the computer by means of the process data input REAL HART_IN01 to HART_IN08.

Channel 1 ... channel 8 measured value

Element	Data type	Length in bytes	Meaning
1	FLOAT32	4	Measured value in float format according to IEEE 754

Structure of the float format according to IEEE 754 in the bit representation:

VEEEE EEEE	EMMM MMMM	MMMM MMMM	MMMM MMMM
------------	-----------	-----------	-----------

V 1 sign bit, 0: positive, 1: negative

E 8 bits exponent with offset 7F_{hex}

M 23 bits mantissa

Some example values for conversion from floating point to hexadecimal representation:

Floating point	Hexadecimal representation
1.0	3F 80 00 00
10.0	41 20 00 00
1.03965528	3F 85 13 6D
- 1.0	BF 80 00 00

9 Parameter, diagnostics and information (PDI)

Parameter and diagnostic data as well as other information is transmitted as objects via the PDI channel of the Axioline P station.

The standard and application objects stored in the module are described in the following section.

The following applies to all tables below:

Abbreviation	Meaning
A	Number of elements
L	Length of the elements in bytes
R	Read
W	Write

10 Standard objects

10.1 Objects for identification (device rating plate)

Index (hex)	Object name	Data type	A	L	Rights	Meaning	Contents
Manufacturer							
0001	VendorName	Visible String	1	32	R	Vendor name	Phoenix Contact
0002	VendorID	Visible String	1	7	R	Vendor ID	00A045
0003	VendorText	Visible String	1	58	R	Vendor text	Components and systems for industrial automation
0012	VendorURL	Visible String	1	58	R	Vendor URL	http://www.phoenixcontact.com
Module - general							
0004	DeviceFamily	Visible String	1	Max. 58	R	Device family	I/O analog IN
0006	ProductFamily	Visible String	1	32	R	Product family	AXL P
000E	CommProfile	Visible String	1	Max. 4 + 1	R	Communication profile	633
000F	DeviceProfile	Visible String	1	Max. 4 + 1	R	Device profile	0010
0011	ProfileVersion	Record of Visible Strings	2	Max. 51	R	Profile version	2018-04-19; Basic profile V3.0
0017	Language	Array of Records	2	Max. 56	R	Language	en-us; English
Module - special							
0005	Capabilities	Array of Octet Strings	8	N x 8	R	Capabilities	46 77 55 70 64 74 5F 30
0007	ProductName	Visible String	1	32	R	Product name	AXL P AI8 HART 1F
0008	SerialNo	Visible String	1	22	R	Serial number	e. g., 1234512345
0009	ProductText	Visible String	1	58	R	Product text	8 analog inputs with HART
000A	OrderNumber	Visible String	1	32	R	Order No.	1052429
000B	HardwareVersion	Record of Visible Strings	2	11	R	Hardware version	e. g., 2010-06-21; 01
000C	FlexwareVersion	Record of Visible Strings	2	11	R	Firmware version	e. g., 2010-06-21; V1.10
000D	PChVersion	Record of Visible Strings	2	Max. 51	R	PDI version	2016-12-01; PDI V1.10
0037	DeviceType	Octet string	8	8	R	Device type	04 22 00 30 00 0B 0C A1 _{hex}
003A	VersionCount	Array of UINT16	4	8	R	Version counter	e. g., 0007 0001 0001 0001 _{hex}
Use of the device							
0014	Location	Visible String	1	58	R/W	Location	Can be completed by the user.
0015	EquipmentIdent	Visible String	1	58	R/W	Equipment identifier	Can be completed by the user.
0016	ApplDeviceAddr	UINT16	1	2	R/W	Application-specific device address	Can be completed by the user.

10.2 Miscellaneous standard objects

Index (hex)	Object name	Data type	A	L	Rights	Meaning/contents	
Diagnostics objects							
0018	DiagState	Record	1 0	Max. 207	R	Diagnostic state	*
0019	ResetDiag	UINT8	1	1	R/W	Acknowledge diagnostic messages	*
Objects for process data management							
0025	PDIN	Array of Records	1	48	R	Input process data	*
003B	PDIN_Descr	Array of Records	3	24	R	Description of the IN process data	
003C	PDOOUT_Descr	Array of Records	3	12	R	Description of the output process data	
Objects for device management							
002D	ResetParam	UINT8	1	1	R/W	Reset parameterization	*

The objects identified with * in the last column are described in more detail in the following sections.

The objects 003B_{hex} and 003C_{hex} are only applicable to tools.

10.3 Diagnostics objects

10.3.1 Diagnostics state (0018_{hex}: DiagState)

This object is used for a structured message of an error.

0018 _{hex} : Diagnostics state (read)				
Subindex	Data type	Length in bytes	Meaning	Contents
0	Record	21	Diagnostic state	Complete diagnostics information
1	UINT16	2	Error number	0 ... 65535 _{dec}
2	UINT8	1	Priority	00 _{hex} No error
				01 _{hex} Error
				02 _{hex} Warning
				81 _{hex} Error removed
				82 _{hex} Warning eliminated
3	UINT8	1	Channel/group/module	00 _{hex} No error
				01 _{hex} Channel 1
				: :
				08 _{hex} Channel 8
				FF _{hex} Entire device
4	UINT16	2	Error code	See table below
5	UINT8	1	More follows	00 _{hex}
6	Visible String	14	Text	See table below



The message with priority 81_{hex} or 82_{hex} is a one-off, internal message to the bus coupler. The bus coupler transfers this error message to the error mechanisms of the higher-level system.

Error and status of the local diagnostics and status indicators

Subindex	2	3	4	6					
Error	Priority	Channel/ group/ module	Error code	Text	Process data	LED			
	hex	hex	hex			D	U	E1	CH
No error	00	00	0000	Status OK	xxxx	●	●	○	○
Supply voltage faulty (supply for analog modules (U _L))	01	FF	5160	Supply fail	0000	●	○	●	○
Device error	01	FF	6301	CS FLASH	0000	●	●	○	○
Flash format error	01	FF	6302	FO FLASH	0000	●	●	○	○
Wire break	01	01 ... 08	7710	Open circuit	8002	●	●	○	●
Overrange	02	01 ... 08	8910	Overrange	8001	●	●	○	●

Subindex	2	3	4	6					
Error	Priority	Channel/ group/ module	Error code	Text	Process data	LED			
	hex	hex	hex			D	U	E1	CH
Underrange	02	01 ... 08	8920	Underrange	8080	●	●	○	●
No HART subdevice present	01	01 ... 08	A001	Device missing	-	●	●	○	○
HART subdevice replaced	02	01 ... 08	A003	Dev replaced	Channel value	●	●	○	○
HART communication error	01	01 ... 08	A020	Comm error	Last channel value	●	●	○	●
HART Timeout	01	01 ... 08	A021	Timeout	Last channel value	●	●	○	●

- Off
 ● On
 ● Green on
 ● Green/yellow flashing

10.3.2 Acknowledge diagnostic messages (0019_{hex}: ResetDiag)

You can delete the diagnostics memory and acknowledge the diagnostic messages with this object.

0019 _{hex} : Acknowledge diagnostic messages (read, write)				
Subindex	Data type	Length in bytes	Code (hex)	Meaning
0	UINT8	1	00	Permit all diagnostic messages
			02	Delete and acknowledge all diagnostic messages that are still pending
			06	Delete and acknowledge all diagnostic messages and do not permit new diagnostic messages
			Other	Reserved

10.4 Objects for process data management

IN process data (0025_{hex}: PDIN)

You can read the IN process data of the module with this object.

The structure corresponds to the representation in the "Process data" section.

0025 _{hex} : IN process data (read)			
Subindex	Data type	Length in bytes	Meaning
0	Octet string	48	Input process data

10.5 Objects for device management

Reset parameterization (002D_{hex}: ResetParam)

This object is used to reset the module to the default settings.

To reset the parameters, value 01_{hex} must be transferred during write access. All other values are invalid and will be acknowledged with an error.

Then the default settings of the channels are loaded and all the user-set parameters are reset.

11 Analog input objects

Index	Subindex	Object name	Data type	L	Rights	Meaning	Contents	
0100	FF	AI_DataFormat	UINT8	1	R/W	Data format	00 _{hex} (Default)	Inline
							02 _{hex}	S7-compatible
							06 _{hex}	Standard PD format
0200	Per channel: 00, 01 ... 08	AI_Mode	UINT8	8 1	R/W	Measuring range	06 _{hex}	4 ... 20 mA
							FF _{hex} (Default)	Channel inactive
0201	Per channel: 00, 01 ... 08	AI_Average	UINT8	8 1	R/W	Sliding average	00 _{hex} (Default)	Without mean value
							04 _{hex}	4-sample
							08 _{hex}	8-sample
							10 _{hex}	16-sample
							20 _{hex}	32-sample
0203	Per channel: 00, 01 ... 08	AI_Measured ValueFloat	32-bit FLOAT	24 4	R	Measured value	Channel float value	
0204	Per channel: 00, 01 ... 08	AI_NE43_Alarm	UINT8	8 1	R/W	NE43 Alarm	00 _{hex}	Disabled
							01 _{hex} (default)	Enabled

12 HART objects

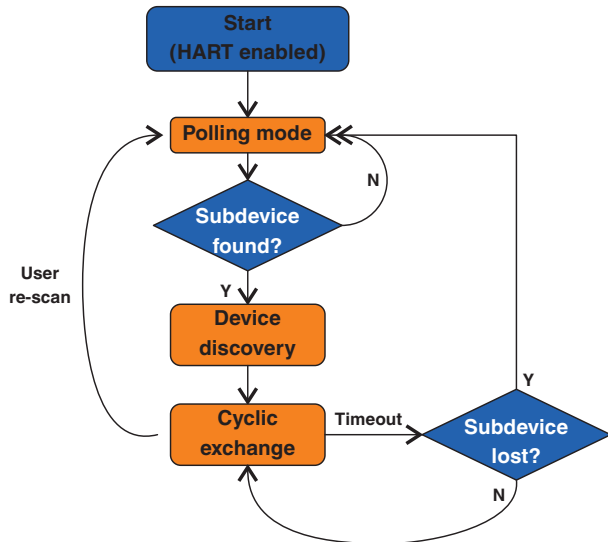
Index	Subindex	Object name	Data type	L	Rights	Meaning	Contents	
07A0	Per channel: 00, 01 ... 08	HART_Scan SubDevices	UINT8	8 1	R/W	Scan sub- devices	00 _{hex} (De- fault)	Disabled
							01 _{hex}	Enabled
07A1	Per channel: 00, 01 ... 08	HART_ ChannelEnable	UINT8	8 1	R/W	HART channel enable	00 _{hex}	Disabled
							01 _{hex}	Enabled
							02 _{hex}	Enabled, no alarms
07A2	Per channel: 00, 01 ... 08	HART_High Priority_Polling	UINT8	8 1	R/W	HART high priority polling	00 _{hex} (De- fault)	Off
							01 _{hex}	On
07A3	Per channel: 00, 01 ... 08	HART_ Channel	UINT8	8 1	R/W	HART channel	00 _{hex}	Disabled
							01 _{hex} ... 08 _{hex}	Channel 1 ... chan- nel 8
07A4	Per channel: 00, 01 ... 08	HART_Variable	UINT8	8 1	R/W	HART variable	00 _{hex}	Loop current
							01 _{hex} (de- fault)	PV
							02 _{hex}	SV
							03 _{hex}	TV
							04 _{hex}	QV
07A5	Per channel: 00, 01 ... 08	HART_Diag Value	UINT8	8 1	R/W	HART di- agnostic value	01 _{hex}	Clear HART status byte
07A6	Per channel: 00, 01 ... 08	HART_Sub DeviceInfo	Record	80 10	R	HART subdevice information		
	01	SubDevice Address	UINT8	1	R	Subdevice address		
	02	SubDevice Type	ENUM	2	R	Subdevice type		
	03	SubDeviceId	Octet string	3	R	Subdevice ID		
	04	SubDevice HartRevision	UINT8	1	R	Subdevice HART revision		
	05	SubDevice Manufacturer	ENUM	2	R	Subdevice manufacturer		
	06	SubDevice Status	UINT8	1	R	Subdevice status		

Index	Subindex	Object name	Data type	L	Rights	Meaning	Contents
07A7	Per channel: 01 ... 08	HART_Sub DeviceTag	STRING	33	R	HART subdevice tag	
07A8	Per channel: 00, 01 ... 08	HART_Sub DevicePV	32-bit FLOAT	32 4	R	HART subdevice PV	
07A9	Per channel: 00, 01 ... 08	HART_ChannelState	ENUM	8 1	R	HART channel state	00 _{hex} Idle
							01 _{hex} Starting
							02 _{hex} Polling
							03 _{hex} Getting name
							04 _{hex} Bursting
							05 _{hex} External command
							FF _{hex} Error state
07AA	Per channel: 01 ... 08	HART_External Command	Domain variable	Dy-namic	R/W	HART external command	

13 HART Functions of the Terminal

The module allows an easy-to-setup connection to HART devices. While this module does not support multi-drop, there are two HART modems embedded in the module that connect up to 8 HART devices. Once added to the Axioline P local bus, this module will start its HART loop scan until a device is found. The following diagram shows how the module polls for HART devices.

Figure 4 Polling HART devices



Configure the module so channels 1 to 8 are enabled or disabled, as well as high-priority selection. Within each HART group you have the ability to set a high priority flag for each channel, causing the polling of high priority channels to be more frequent than others.

Select the cyclic process data for each of the 8 channels in the module. Available HART data includes Loop Current, PV, SV, TV, and QV. The process data for the analog input values and HART process values is given in the following data block structure.

AI8 process data block	HART process data block
[0] [15]	[16] [47]

Figure 5 Data block structure of process data

The HART process data block provides all HART data from the module through 8 slots. Select Loop Current, PV, SV, TV or QV from the HART values of the field device to populate each of the 8 slots. Each of these 5 HART values will occupy just 1 slot. This allows a modular and customer specific configuration approach.

As an example, a HART device is connected to any one channel of the module. It is desired to receive the Loop

Current, PV, and SV from the device. In this scenario, these 3 HART variables would take up 3 of the 8 available HART slots. These 3 HART variables may be placed anywhere in the 8 slots. The module can configure HART devices to poll at different priorities, by enabling priority polling on the desired channel of the module.

As a second example, 8 different HART devices could be connected to all 8 channels of the module. In this case, it is desired to receive 1 HART variable from each device. These 8 HART variables in total can be mapped to the 8 slots of HART process data in any order and polling priority desired.

The following table shows the 8 HART slots available for configuration and that make up the HART process data block.

Slot	1				2				3				4			
Byte	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
	M				L	M			L	M			L	M		
	S				S	S			S	S			S	S		
	B				B	B			B	B			B	B		

Slot	5				6				7				8			
Byte	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
	M				L	M			L	M			L	M		
	S				S	S			S	S			S	S		
	B				B	B			B	B			B	B		

14 Power supply

The Axioline P I/O modules receive power from the Axioline P bus coupler. This supply voltage (U_L) is provided via the Axioline P local bus.

The modules are fully hot swappable and may be removed while under power.