Network-specific properties of the Axioline E PROFINET IO-Link devices

User manual

UM EN AXL E PN IOL

PHOENIX CONTACT
INSPIRING INNOVATIONS

User manual

Network-specific properties of the Axioline E PROFINET IO-Link devices

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This user manual is valid for Axioline E PROFINET IO-Link devices.

AXL E PN IOL8 DI4 M12 6M, Order No. 2701519
AXL E PN IOL8 DI4 M12 6P, Order No. 2701513

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1 For your safety

Read this user manual carefully and keep it for future reference.

1.1 Labeling of warning notes

This symbol indicates hazards that could lead to personal injury.
There are three signal words indicating the severity of a potential injury.

DANGER
Indicates a hazard with a high risk level. If this hazardous situation is not avoided, it will result in death or serious injury.

WARNING
Indicates a hazard with a medium risk level. If this hazardous situation is not avoided, it could result in death or serious injury.

CAUTION
Indicates a hazard with a low risk level. If this hazardous situation is not avoided, it could result in minor or moderate injury.

This symbol together with the **NOTE** signal word alerts the reader to a situation which may cause damage or malfunction to the device, hardware/software, or surrounding property.

Here you will find additional information or detailed sources of information.

1.2 Qualification of users

The use of products described in this user manual is oriented exclusively to:

- Qualified electricians or persons instructed by them. The users must be familiar with the relevant safety concepts of automation technology as well as applicable standards and other regulations.
- Qualified application programmers and software engineers. The users must be familiar with the relevant safety concepts of automation technology as well as applicable standards and other regulations.

1.3 Product changes

Changes or modifications to hardware and software of the device are not permitted.

Incorrect operation or modifications to the device can endanger your safety or damage the device. Do not repair the device yourself. If the device is defective, please contact Phoenix Contact.

1.4 Security in the network

NOTE: : Risk of unauthorized network access

Connecting devices to a network via Ethernet always entails the risk of unauthorized access to the network.

Therefore, please check your application for any option of deactivating active communication channels . Setting passwords to prevent third parties from accessing the controller without authorization and modifying the system.

Because of the controller's communication interfaces, we advise against using the controller in safety-critical applications without additional security appliances.
Please take additional protective measures according to the IT security requirements and the standards applicable to your application (for instance virtual networks (VPN) for remote maintenance access, firewalls, etc.) for protection against unauthorized network access.

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For the protection of networks for remote maintenance via VPN, Phoenix Contact offers the mGuard product series security appliances which you can find described in the latest Phoenix Contact catalog (phoenixcontact.net/products).

Additional measures for protection from unauthorized network access can be found in the AH EN INDUSTRIAL SECURITY application note. The application note can be downloaded at phoenixcontact.net/products.

2 PROFINET data model

The Axioline E PROFINET device is modular. The first slot 1.1 (slot 1 and subslot 1) always contains the “Status/control module” with 4 bytes each of IN and OUT process data. In slots 1.2 to 1.9 the operating mode and the process data length for the respective IO-Link port are parameterized.

2.1 Status/control module

IN process data

Byte	Byte 0			Byte 1			Byte 2			Byte 3					
Bit	0	...	7	8	...	15	16	...	23	24	...	27	28	...	31
Function	Port status (COM status)			PD VALID state			DI state on pin 4 (C/Q)			DI state on pin 2			Reserved		
Connection	X01	...	X08	X01	...	X08	X01	...	X08	X01	...	X04	-	-	-
Pin	4	...	4	4	...	4	4	...	4	2	...	2	-	-	-
Port	1	...	8	1	...	8	1	...	8	1	...	4	-	-	-

The **COM state** indicates whether the corresponding port has established communication with the IO-Link device.

The **PD Valid state** indicates whether the IO-Link process data of the corresponding port is valid.

The **DI state on pin 4** indicates the state of the corresponding IO-Link port in the DI operating mode.

The **DI state on pin 2** indicates the state of the hardwired digital inputs on pin 2.

OUT process data

Byte	Byte 0			Byte 1			Byte 2			Byte 3		
Bit	0	...	7	8	...	15	16	...	23	24	...	31
Function	Port configuration (COM control)			Reserved			DO state on pin 4 (C/Q)			Reserved		
Connection	X01	...	X08	-	-	-	X01	...	X08	-	-	-
Pin	4	...	4	-	-	-	4	...	4	-	-	-
Port	1	...	8	-	-	-	1	...	8	-	-	-

Byte 0 **(COM control)** can be used to temporarily (as long as the corresponding COM control bit is set) switch one or more IO-Link ports that were previously configured in digital input mode (DI) to IO-Link mode. Cyclic and acyclic communication can therefore be established with the connected IO-Link device.

DO state on pin 4 (C/Q): the digital output on the corresponding port can be controlled via process data. The I/O-Link port must be set beforehand to function in the DO operating mode.

Start-up parameters

The status/control module in slot 1 contains the following startup parameters, which refer to the runtime behavior of the entire device.

Parameter	Possible values (bold = default)	Description
Port synchronization		
Port synchronization	**0 = free**	Synchronization of the port running in the IO-Link mode
Diagnostic settings		
Channel-specific diagnostics	0 = deactivated	The channel-related diagnosis can be deactivated/activated.
	1 = activated	
Extended channel-specific diagnostics	0 = deactivated	The extended channel-specific diagnostics can be deactivated.
	1 = activated	
Diagnostics status IOLM	0 = deactivated	The IO-Link master diagnosis can be deactivated/activated.
	1 = activated	
Diagnostics IOLD port 1 … Diagnostics IOLD port 8	0 = deactivated	For each IO-Link port, the IO-Link diagnosis can be separately deactivated/activated.
	1 = activated	**NOTE: When activated, the IO-Link events of the IO-Link device are acknowledged at the respective port and mapped in the PROFINET diagnostics. When deactivated, the events are only acknowledged.**
Substitute values		
Behavior in the event of an error for status/control module	**0 = all zero**	Substitute value behavior for the IO-Link ports in DO mode (pin 4); with the **Substitute values** option, the substitute values sample under the **Substitute values for DO** parameter is active.
	1 = Set all	
	2 = hold last value	
	3 = Substitute value	
Substitute values for DO	**0 = Zero**	Specification of a replacement value sample for the IO-Link ports in the DO operating mode (pin 4)
	Possible values: 0 … 255_{dec}	NOTE: in order to use this parameter, the value “Replacement values” must be set beforehand in the “Behavior in the event of error for state/control module” parameter.
Behavior in the event of an error at port 1 ... behavior in the event of an error at port 8	**0 = all zero**	Substitute behavior for the OUT process data of the IO-Link port in the IO-Link operating mode
	1 = Set all	
	2 = hold last value	
	4 = IO-Link master command	NOTE: the “IO-Link master command” option enables the use of IO-Link-specific mechanisms for valid/invalid OUT process data.

2.2 Flexible module configuration

Up to 8 further modules can be flexibly configured in slots 1.2 to 1.9, whereby each of these represents a physical IO-Link port.The basic operating mode of the IO-Link port, as well as the process data length, is determined when selecting the module.

Operating mode and process data of the IO-Link port

The possible submodules are shown below.

Submodule	Process data length in bytes		Description/start-up parameters
	Input	Output	
Deactivated	0	0	**Port mode (operating mode):** deactivated **NOTE: In this operating mode, the sensor supply voltage is also switched off.**
Digital IN	0*	0	**Port mode (operating mode):** digital input **NOTE: * The process data are located in the status/control module.**
Digital OUT	0	0*	**Port mode (operating mode):** digital output **NOTE: * The process data are located in the status/control module.**
DI with IO-Link	0*	0	**Port mode (operating mode):** DI with IO-Link (Digital input with IO-Link communication)
			Identification level (device check): - Vendor ID (2 bytes) - Device ID (3 bytes)
			Data Storage: 0 = disabled 1 = download only 2 = upload only 3 = download and Upload 4 = disabled and cleared **NOTE: * The process data are located in the status/control module.**

Submodule	Process data length in bytes		Description/start-up parameters
	Input	Output	
IOL_I_nByte (+DevPrm*) ... IOL_O_nByte (+DevPrm*) ... IOL_I/O_nByte (+DevPrm*) Key: I = Input O = Output n = Number of bytes	1 ... 32	1 ... 32	**Port mode (operating mode):** IO-Link
			Identification level (device check): - Vendor ID (2 bytes) - Device ID (3 bytes)
			Data Storage: 0 = disabled 1 = download only 2 = upload only 3 = download and Upload 4 = disabled and cleared
			*** +DevPrm (deviceparameter - DPP2):** If such a submodule is selected, then the deviceparameter - DPP2 (byte 10_{hex} ... $1F_{hex}$) can be parameterized for the port during startup. **NOTE: If the IO-Link process data length of the device is not available in the submodules, then select the next largest constellation.**
AXL E IOL AI1 I M12 R AXL E IOL AI1 I M12 S AXL E IOL AI1 U M12 R AXL E IOL AI1 U M12 S AXL E IOL AO1 I M12 S AXL E IOL AO1 I M12 R AXL E IOL AO1 U M12 S AXL E IOL AO1 U M12 R AXL E IOL RTD1 M12 R AXL E IOL RTD1 M12 S	2	2	**Port mode (operating mode):** IO-Link **Identification level (device check):** - Vendor ID (2 bytes) = $B0_{hex}$ (Phoenix Contact) - Device ID (3 bytes) = specific to each device **Data Storage:** 0 = disabled **Converter parameter:** specific to each device **NOTE: These are special submodules for the Phoenix Contact IO-Link/analog converter. The IO-Link port is configured automatically, so that no further parameters must be set for the process data exchange. The device parameters available can be found in the respective device data sheet.**

Start-up parameters

There is the option of carrying out start-up parameterization for the IO-Link submodules. The following parameters can be set:

Parameter	Possible values	Description
Operating mode		
Port mode	Deactivated	In this operating mode, the sensor supply voltage is also switched off.
	Digital IN	In this operating mode, the IO-Link port functions as a standard digital input.
	Digital OUT	In this operating mode, the IO-Link port functions as a standard digital output.
	DI with IO-Link	The operating mode can be used if an IO-Link device is to be acquired as quickly as possible. The device can be parameterized via IO-Link (C/Q state is IO-Link). After parameterization, the IO-Link master switches the C/Q cable to the DI mode (C/Q state is DI). The switching state of the device is now acquired as a digital signal rather than via IO-Link communication.
	IO-Link	Use this operating mode to communicate with IO-Link sensors and actuators.
Identification level (device check)		
Vendor ID	0000_{hex} ... $FFFF_{hex}$	**Vendor ID, identification level 1** The vendor ID of the connected IO-Link device for the respective port can be parameterized via this. The vendor ID can be found in the data sheet of the IO-Link device.
Device ID	000000_{hex} ... $FFFFFF_{hex}$	**Device ID, identification level 2** The device ID of the connected IO-Link device for the respective port can be parameterized via this. The device ID can be found in the data sheet of the IO-Link device. To check the device ID, a vendor ID check must be carried out first of all.
NOTE: As soon as the content of the vendor ID and/or device ID is not equal to "0", the IO-Link "Type Compatible" inspection level is activated. It is only if the vendor ID parameterized as well as the device ID correspond with the information read out (in the device) that communication to the device is established (COM-State Bit of the corresponding port = 1), otherwise this is rejected (IO-Link LED is red).		
Data storage		
Data storage	Deactivated	The data storage mechanism is deactivated.
	Download only	The parameter data are sent to the device from the IO-Link master. In the event of an inconsistency between the parameter data of the IO-Link device and the master, the data from the IO-Link master is taken as the default. As such it is possible to exchange the IO-Link device.
	Upload only	The parameter data are sent from the IO-Link device to the master. In the event of an inconsistency between the parameter data of the IO-Link device and the master, the data from the device is taken as the default. As such it is possible to exchange the IO-Link master.
	Download and Upload	The parameter data are saved in both the IO-Link master as well as the device. In the event of an inconsistency between the parameter data of the IO-Link device or the master, the data from both is used as the default. As such it is possible to exchange the IO-Link device or the IO-Link master.
	Disabled and cleared	The Data Storage mechanism is deactivated and the master deletes all stored parameters for the respective port.
NOTE: The data storage mechanism is only supported by the IO-Link specification v1.1. Both the IO-Link master and device must support at least IO-Link v1.1.		
Device parameters		
DevPrm	00_{hex} ... FF_{hex}	The device parameter page 2 describes the area between the IO-Link objects 10_{hex} … $1F_{hex}$. This relates to the manufacturer-specific area of the IO-Link device data. This is optionally made available by IO-Link devices and can be read as well as written from the master.

3 I&M functions

The PROFINET device supports Identification & Maintenance functions (I&M). The general Identification & Maintenance functions 0 to 4 can be read out via slot 0. IO-Link-specific Identification & Maintenance functions 0, 16 ... 23, and 99 can be read via slot 1 and subslot 1.

Slot 0 and slot 1 have their own respective I&M function (I&M 0).

I&M 0 (slot 0)

I&M data	Access / data type	Presets
MANUFACTURER_ID	Read / 2 bytes	$B0_{hex}$ (Phoenix Contact GmbH & Co. KG)
ORDER_ID	Read / 20 bytes	2701519 or 2701513
SERIAL_Number	Read / 16 bytes	Stipulated in the product process
HARDWARE_Revision	Read / 2 bytes	Corresponds to the hardware version of the device
SOFTWARE_Revision	Read / 4 bytes	Corresponds to the firmware version of the device
REVISION_Counter	Read / 2 bytes	0000_{hex} (reserved)
PROFILE_ID	Read / 2 bytes	$F600_{hex}$ (generic device)
PROFILE_SPECIFIC_TYPE	Read / 2 bytes	0003_{hex} (I/O modules)
IM_VERSION	Read / 2 bytes	0101_{hex} (Version 1.1)
IM_SUPPORTED	Read / 2 bytes	$001E_{hex}$ (I&M 1 ... 4)

I&M 1 (slot 0)

I&M data	Access / data type	Presets
TAG_FUNCTION	Read/write / 32 bytes	“20_{hex}” (empty)
TAG_LOCATION	Read/write / 22 bytes	“20_{hex}” (empty)

I&M 2 (slot 0)

I&M data	Access / data type	Presets
INSTALLATION_DATE	Read/write / 16 bytes	“20_{hex}” (empty)
RESERVED	Read/write / 38 bytes	00_{hex}

I&M 3 (slot 0)

I&M data	Access / data type	Presets
DESCRIPTOR	Read/write / 54 bytes	“20_{hex}” (empty)

I&M 0 (slot 1): IO-Link-specific

The I&M functions (I&M 0) of the IO-Link can be read out via slot 1.

They are different from the I&M functions (I&M 0) of Slot 0 in PROFILE_ID / PROFILE_SPECIFIC_TYPE and IM_SUPPORTED.

I&M data	Access / data type	Presets
MANUFACTURER_ID	Read / 2 bytes	$B0_{hex}$ (Phoenix Contact GmbH & Co. KG)
ORDER_ID	Read / 20 bytes	2701519 or 2701513
SERIAL_Number	Read / 16 bytes	Stipulated in the product process
HARDWARE_Revision	Read / 2 bytes	Corresponds to the hardware version of the device
SOFTWARE_Revision	Read / 4 bytes	Corresponds to the firmware version of the device
REVISION_Counter	Read / 2 bytes	0000_{hex} (reserved)
PROFILE_ID	Read / 2 bytes	$4E00_{hex}$ (IO-Link)
PROFILE_SPECIFIC_TYPE	Read / 2 bytes	0000_{hex}
IM_VERSION	Read / 2 bytes	0101_{hex} (Version 1.1)
IM_SUPPORTED	Read / 2 bytes	0001_{hex} (Profile specific)

I&M 16 ... 23 (slot 1, subslot 1): IO-Link device directory

For each IO-Link, an individual Identification & Maintenance Function is available in the area of I&M 16 (Index $B000_{hex}$) to I&M 23 (Index $B007_{hex}$).

For I&M functions 16 to 23, the structure is made up of the following parameters:

Access is only with read permission and exclusively via slot 1 and subslot 1 (status/control module).

I&M data	Access / data type	Presets
VENDOR_ID	Read / 2 bytes	Vendor ID from the connected IO-Link device. If no device is available, then 0000_{hex}
DEVICE_ID	Read / 4 bytes	Device ID from the connected IO-Link device. The high-order byte is always equal to zero. If no device is available, then 000000_{hex}
FUNCTION_ID	Read / 2 bytes	Function ID from the connected IO-Link device. If no device is available, then 0000_{hex}
RESERVED	Read/10 bytes	Reserved

I&M 99 (slot 1): IO-Link master directory

In I&M 99 (Index $B063_{hex}$), other relevant IO-Link master data is available.

Access is only with read permission and exclusively via slot 1 and subslot 1 (status/control module).

I&M data	Access / data type	Presets
IO-Link version	Read/1 byte	11_{hex} (IO-Link Version e.g., 11_{hex} for v1.1)
IO-Link profile version	Read/1 byte	10_{hex} (IO-Link profile version, e.g., 10_{hex} for v1.0)
IO-Link feature support	Read / 4 bytes	00000000_{hex}
Number of ports	Read/1 byte	08_{hex} (number of supported ports)
REF_ Port_Config	Read/1 byte	00_{hex} (not supported)
REF_ IO_Mapping	Read/1 byte	00_{hex} (not supported)
REF_ iPar_Directory	Read/1 byte	00_{hex} (not supported)
REF_IOL_M	Read/1 byte	00_{hex} (not supported)
Number of CAPs	Read/1 byte	01_{hex} (number of Client Access Points)
Index CAP1	Read / 2 bytes	255_{dez} (Client Access Point for IOL_CALL's)

4 Startup

Default upon delivery/default settings

By default upon delivery, the following functions and features are available:

PROFINET

PROFINET name:	No name assigned
IP parameters:	0.0.0.0
Subnet mask:	0.0.0.0
Default Gateway:	0.0.0.0
Device designation:	AXL E PN IOL8 DI4 M12 6M/ AXL E PN IOL8 DI4 M12 6P
Vendor ID:	$00B0_{hex}$
Device ID:	0104_{hex}

Firmware update

Firmware update on next restart:	deactivated
TFTP server IP address:	192.168.210.211
Firmware file name:	FIRMWARE.NXF

System identification

Device name:	No name assigned
Description:	No description assigned
Device location:	No location assigned
Contact:	No contact assigned

Web-based Management (WBM)

User name:	admin
Password:	private

Restoring the default settings

The default settings can be restored via WBM.

To do this, go to:
Administration web page > default settings and follow the instructions.

Firmware started

Once you have connected the power, the firmware is started. After completion of the firmware boot process, the BF LED either lights up or flashes.

5 Parameterization

PC Worx

Parameterization of the PROFINET device in PC Worx requires at least PC Worx Version 6.30.601. This is part of the AUTOMATION Software Suite, Version 1.81, Order No. 2985660.

An online data sheet of the device with important technical data and a configuration file are integrated into PC Worx. If several versions of the configuration file are available, make sure that you are working with the file version that corresponds to the firmware/hardware version used.

Other tools

The PROFINET device is parameterized using the configuration tool of the PROFINET controller. For parameterization, integrate the corresponding device GSDML file in the relevant software tool (STEP 7/HW Config, etc.).

Make sure you use the latest version of the FDCML/GSDML file and the latest documentation for the device. The latest files and documentation can be found on the Internet at phoenixcontact.net/products.

6 LLDP - Link Layer Discovery Protocol

The device supports LLDP according to IEEE 802.1AB and therefore enables topology detection of devices that also have LLDP activated.

Advantages of using LLDP:

– Improved error location detection
– Improved device replacement
– More efficient network configuration

The following information is received by or sent to neighbors, as long as LLDP is activated:

– The device sends its own management and connection information to neighboring devices.
– The device receives management and connection information from neighboring devices.

Engineering tools can be used to represent the LLDP information as a topology overview.

7 MRP - Media Redundancy Protocol

The device supports the role of a Media Redundancy Client (MRC) in an MRP network.

8 SNMP - Simple Network Management Protocol

The device supports SNMP v1.

Management Information Base - MIB

The corresponding latest MIBs are available on the Internet at phoenixcontact.net/products.

For the object descriptions, please refer to the ASN1 descriptions for this product. The password for read access is “public” and cannot be changed.
By default upon delivery, the password for write/read access is “private” and can be modified at any time.

9 Prioritized startup function

The device supports the prioritized startup function. This function enables the priorized startup of the PROFINET device. The device is ready to operate in 2.3 s.

10 Shared device

The device supports the Shared Device function. This enables two controllers to simultaneously establish a cyclic connection to the device. Only one master can establish a cyclic connection to each submodule. The I/O data of another submodule, which is used by the other master in cyclic connection, cannot be accessed.

11 IO-Link master

IO-Link is an internationally standardized I/O technology (IEC 61131-9) for communicating with sensors and actuators. An IO-Link master is integrated in the PROFINET device. The IO-Link master establishes the connection between the IO-Link devices and the automation system. The device supports IO-Link specification v1.1.

12 WBM - Web-based management

The device has a web server, which generates the required pages for web-based management and, depending on the requirements of the user, sends them to a standard web browser. Web-based management can be used to access static information (e.g., technical data, MAC address) or dynamic information (e.g., IP address, status information).

Calling web-based management

The device web server can be addressed using the IP address if configured accordingly. The homepage (web page) of the device is accessed by entering the URL “http://ip-address”. Example: http://172.16.113.38
The default user name is “admin”, the default password is “private”.

If you cannot access the WBM pages, check the connection settings in your browser and deactivate the proxy, if set.

13 Firmware update

In order to update the firmware of the device, the device must be provided with a firmware container via a TFTP server or it must be loaded onto the device via FTP. Any FTP client or TFTP server can be used for this. The update must always be initiated by the web-based management. When carrying out the firmware update, the RDY LED flashes yellow.

14 Diagnostic alarms

PROFINET enables the PROFINET device to store diagnostic information together with the error location and error type. In the default upon delivery the alarms are enabled, however, they can be disabled with parameters on startup. An incoming alarm informs the PROFINET controller that diagnostic information has been entered.

When the diagnostic information has been removed, an outgoing alarm is sent to the device. If at least one piece of diagnostic information is stored, the SF LED is on. If no diagnostic information is present, the SF LED is off. The following PROFINET diagnostic messages are indicated by the PROFINET device:

Diagnostic messages	Status bit process data	Network-specific diagnostic mapping
Overtemperature device	-	Yes
Undervoltage U_S	-	Yes
Overload U_S	-	Yes
Overvoltage U_S	-	Yes
Undervoltage/Overload/ Short-circuit U_A	-	Yes
Overvoltage U_A	-	Yes
Overload/Short-circuit of an output	-	Yes
Cable break at IO-Link port	Port status/ Status module*	Yes

* Port status = 1; the IO-Link connection is active.
* Port status = 0; the IO-Link connection is interrupted.

The LED status can be found in the data sheet.

15 Device replacement

Devices can be replaced without having to reconfigure them within the PROFINET network. Device replacement is only then possible if the new device is in its default state. The controller must support the device replacement function.

The device name and the device address are assigned by the controller to the newly added PROFINET device with the help of the neighborhood detection function.

16 Substitute value behavior

If PROFINET communication fails, all device outputs are set to the parameterized substitute values. Please refer to the “Status/control module > startup parameters” and “Flexible module configuration > startup parameters” sections for the precise parameterization of substitute values.

Please observe the following notes

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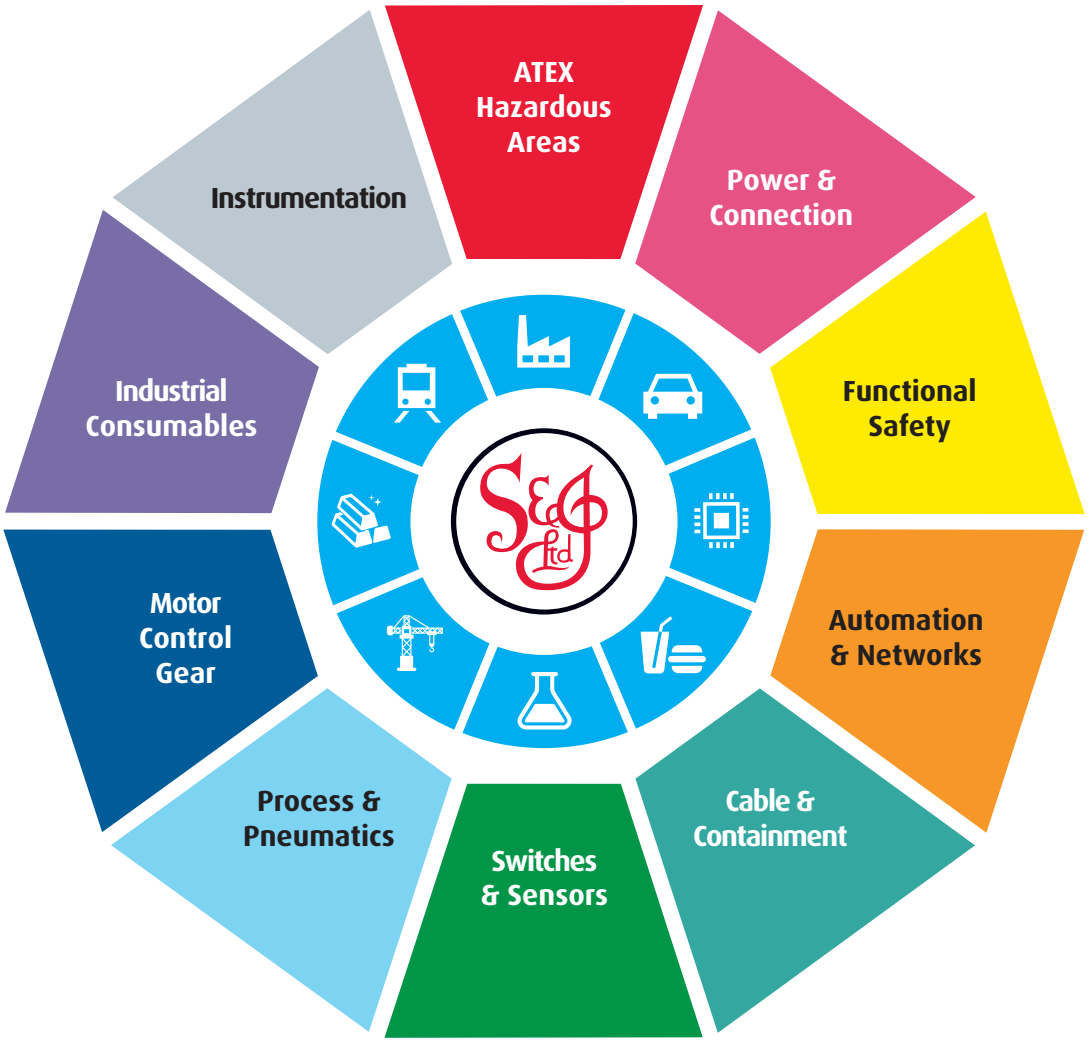

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