

P-Connect EtherCAT® Connection Gateway

BP series

Operating instructions

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1 INFORMATION ON THIS DOCUMENT

1.1 Function

These operating instructions provide information on installation, connection and safe use for the following articles: BP A1EL200•. The articles described in this document are also identified with the commercial name "P-Connect".

1.2 Target audience

The operations described in these operating instructions must be carried out by qualified personnel only, who are fully capable of understanding them, and with the technical qualifications required for operating the machines and plants in which the safety devices are to be installed.

1.3 Application field

These operating instructions apply exclusively to the products listed in paragraph FUNCTION, and their accessories.

1.4 Original instructions

The Italian language version is the original set of instructions for the device. Versions provided in other languages are translations of the original instructions.

1.5 Notes about this document

This document shows how to configure a BP unit using a Beckhoff CX8110 PLC with EL6900 safety module. The software used in the examples is TWINCAT 3.

The use of the BP gateway is only allowed in combination with the devices listed in the "WIRING INSTRUCTIONS" manual for their respective versions.

Unauthorised use or changing system components is not allowed.

The client is responsible for all safety functions, especially for safety integration in the Safety over EtherCAT® environment.

It is the responsibility of the installer to make sure that the configuration of the BP unit is correct and compliant with the relevant risk assessment for the application, safety standards, and applied regulations. Pizzato Elettrica holds no responsibility if the following manual is used improperly.

Information contained in this document is subject to change without notice. Pizzato Elettrica assumes no responsibility for possible errors that may be present in this document.

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2 Symbols used

This symbol indicates any additional information.

Attention: Any failure to observe this warning note can cause damage or malfunction, including possible loss of the safety function.

3 Description

3.1 Device description

The P-Connect BP series gateway is a network-based I/O interface device with safety functions designed for use in industrial contexts.

The unit can be used to connect the following devices:

- Up to two NG/NS/NX series safety switches with a wide selection of options using modular adapters, heads, and actuators from the range of products.
- A chain of emergency stop devices.
- Up to two BN series control device units.
- Up to two AN series handles.

The gateway integrates a network switch that facilitates "daisy-chain" connection without any additional hardware.

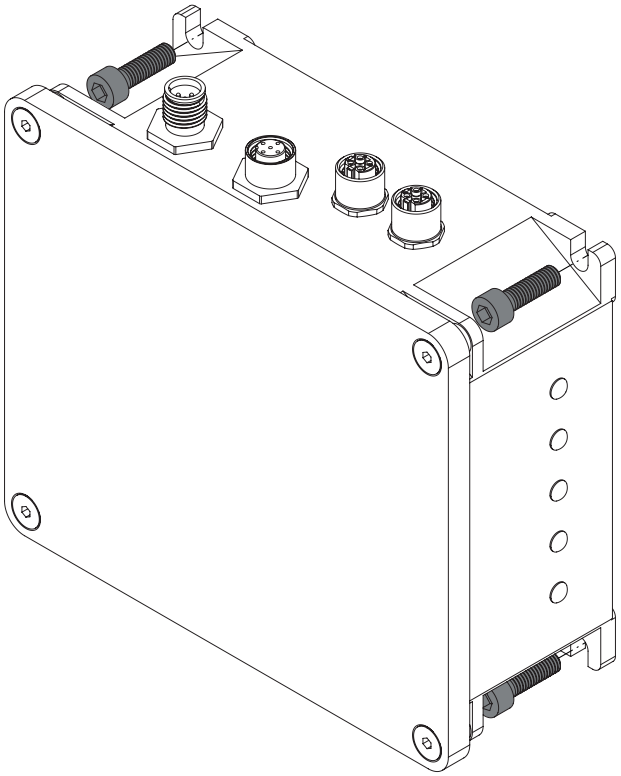
3.2 Intended use of the device

- The device described in these operating instructions is designed to be applied on industrial machines for state monitoring of movable guards.
- The direct sale of this device to the public is prohibited. Installation and use must be carried out by qualified personnel only.
- The use of the device for purposes other than those specified in these operating instructions is prohibited.
- Any use other than as expressly specified in these operating instructions shall be considered unintended by the manufacturer.
- Also considered unintended use:
  a) Using the device after having made structural, technical, or electrical modifications to it;
  b) Using the product in a field of application other than as described in paragraph TECHNICAL DATA.

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4 Installation instructions

⚠ Attention: Installing a safety device is not sufficient to ensure operator safety or compliance with machine safety standards or directives. Before installing a safety device, perform a specific risk analysis in accordance with the key health and safety requirements in the Machinery Directive. The manufacturer guarantees only the safe functioning of the product to which these operating instructions refer, and not the functional safety of the entire machine or entire plant.



The device must always be fixed to the machine using at least two M6 flat head screws with resistance class 4.6 or higher. The screws must have at least a number of threads engaged equal to or greater than their own diameter. The device must never be fixed with less than the specified number of screws.

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5 Instructions for proper use

5.1 Installation

⚠ Attention: Installation must be carried out by qualified staff only.

- Do not modify the device for any reason.
- Do not exceed the tightening torques specified in the present manual.
- The safety category of the system (according to EN ISO 13849-1), including the safety device, also depends on the external components connected to it and their type.
- Before installation, make sure the device is not damaged in any part.
- Before installation, ensure that the connection cables are not powered.
- Avoid excessive bending of connection cables in order to prevent any short circuits or power failures.
- Do not paint or varnish the device.
- Do not drill the device.
- Do not use the device as a support or rest for other structures, such as raceways, sliding guides or similar.
- Before commissioning, make sure that the entire machine (or system) complies with all applicable standards and EMC Directive requirements.
- The fitting surface of the device must always be smooth and clean.
- The documentation required for correct installation and maintenance is available online in various languages on the Pizzato Elettrica website.
- Should the installer be unable to fully understand the documents, the product must not be installed and the necessary assistance may be requested from the manufacturer (see paragraph SUPPORT).
- Always attach the following instructions to the manual of the machine in which the device is installed.
- These operating instructions must be kept available for consultation at any time and for the whole period of use of the device.

5.2 Maintenance and functional tests

⚠ Attention: Do not disassemble or try to repair the device. In case of any malfunction or failure, replace the entire device.

⚠ Attention: In case of damages or wear it is necessary to change the whole device. Correct operation cannot be guaranteed if the device is deformed or damaged.

- Perform all the foreseen safety functions prior to commissioning the machine and at least once a year (or after a prolonged shutdown).
- The device has been created for applications in dangerous environments, therefore it has a limited service life. Although still functioning, after 20 years from the date of manufacture the device must be replaced completely. The date of manufacture is placed next to the product code (see paragraph MARKINGS).

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5.3 Wiring

⚠ Attention: Check that the supply voltage is correct before powering the device.

- Keep the charge within the values specified in the electrical operation categories.
- Only connect and disconnect the device when the power is off.
- Discharge static electricity before handling the product by touching a metal mass connected to earth. Any strong electrostatic discharge could damage the device.
- Power the safety device and the other components connected to it from a single SELV/PELV source and in accordance with the applicable standards.
- Always connect the protection fuse (or equivalent device) in series with the power supply for each device.
- During and after the installation do not pull the electrical cables connected to the device.

5.4 Additional requirements for safety applications with operator protection functions

Provided that all previous requirements for the devices are fulfilled, for installations with operator protection function additional requirements must be observed:

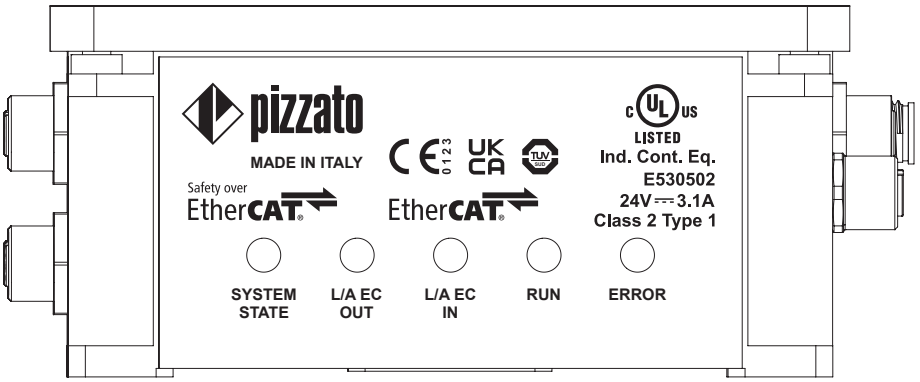
- Utilization implies knowledge of and compliance with following standards: EN 60947-1, EN ISO 13849-1, EN 62061.

5.5 Limits of use

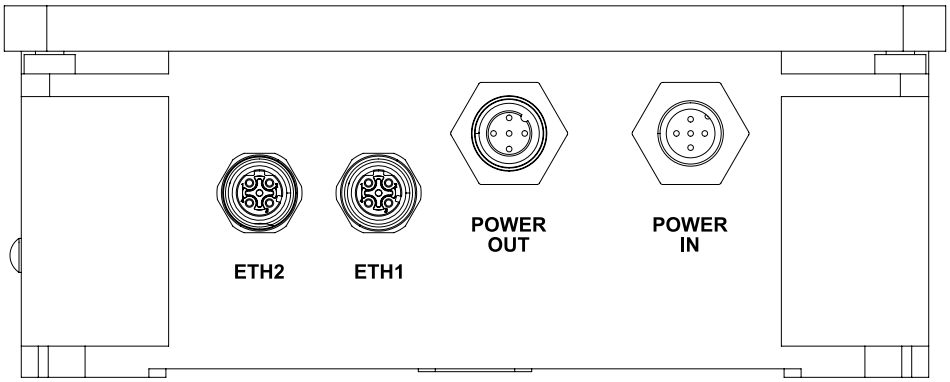
- Use the device following the instructions, complying with its operation limits and the applicable safety regulations.
- The devices have specific application limits (min. and max. ambient temperature, IP protection degree, etc.). These limitations are met by the device only if considered individually and not as combined with each other.
- The manufacturer's liability is to be excluded in the following cases:
  1) Use not conforming to the intended purpose;
  2) Failure to adhere to these instructions or regulations in force;
  3) Mounting not performed by qualified and authorised personnel;
  4) Omission of functional tests.
- For the cases listed below, before proceeding with the installation contact our technical assistance service (see paragraph SUPPORT):
  a) In nuclear power stations, trains, airplanes, cars, incinerators, medical devices or any application where the safety of two or more persons depend on the correct operation of the device;
  b) Applications not contemplated in this instruction manual.

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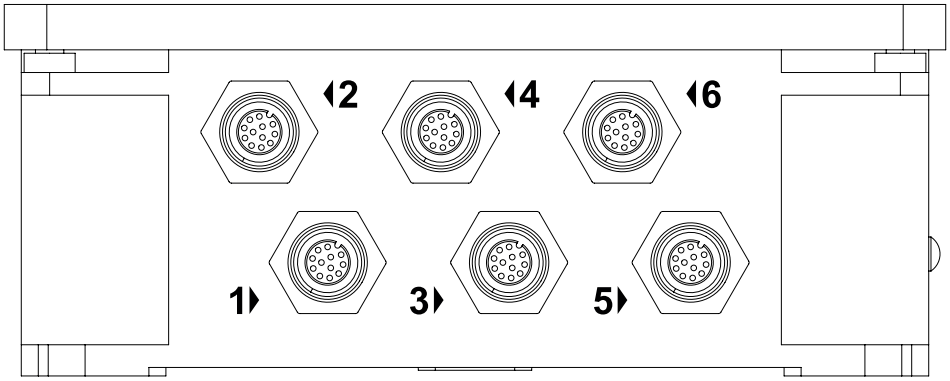
6 Device views



View "Side with LEDs"



View "Side with network and power connectors"

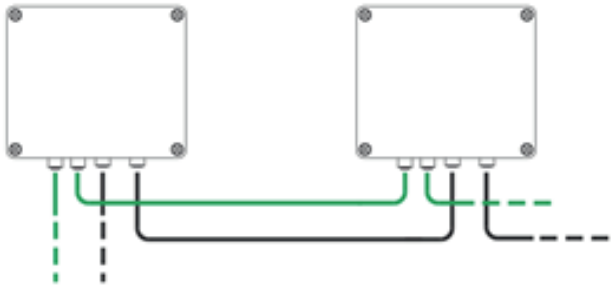


View "Side with device connectors"

Note: the images may vary based on the type of device chosen (for example in terms of shape, position, and numbering of the connectors).

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7 Series connection of the device



All P-Connect gateways are equipped with a double connector for the power supply of the device and for the fieldbus network connection. This makes it easy to install several P-Connect gateways in series by simply connecting the input and output connectors together. This feature was specially designed to reduce the time required for installation, disassembly and replacement of components during maintenance.

If the devices are powered independently, the limit of gateways that can be connected in series depends on the number of nodes supported by the PLC. If, on the other hand, power is supplied via series connection, then the limit of connected devices results from the voltage drop in the 'POWER IN' and 'POWER OUT' cables.

Pay attention to the wire cross-section (mm^2) and to the cable length to guarantee that the device will operate in the specified operating voltage range. The connectors integrated in the gateway are provided with two pins for 24 Vdc and two pins for 0 Vdc.

Pin	Function
1	+24 Vdc
2	0 Vdc
3	0 Vdc
4	+24 Vdc
5	GND

Attention: Make sure that all power supply input pins are connected. Pin 1 and 4 connected to +24 V, Pin 2 and 3 connected to 0 V. This doubles the wire cross-section (0.25 mm^2 x 2) and allows for less voltage drop along the series connection of the devices.

The table below provides an estimate of the number of P-Connect units that can be installed with connection to the power supply in series, based on the total length of the cable used. This refers to use of Pizzato 5-pole cable (5 x 0.25 mm^2) or equivalent with one of the standard P-Connect configurations.

L [m]	No. P-Connect (cable 5 x 0.25 mm^2)
<10	4
<20	2
<45	1
45+	0

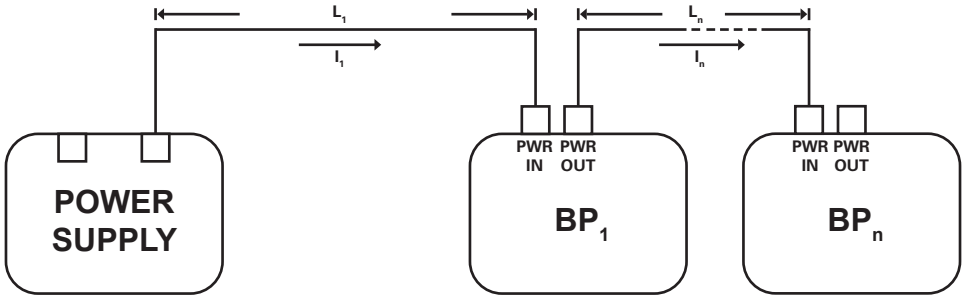
For a more accurate and less conservative calculation of the voltage drop, please consult the following paragraph EXAMPLE OF VOLTAGE DROP CALCULATION.

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7.1 Example of voltage drop calculation

Wire cross-section for Pizzato 5-pole cables: VF CA5●●●M 0.25 mm² (23 AWG)
VF CA5●●●M-MD 0.5 mm² (20 AWG)

The rated operating voltage of the module is indicated in paragraph TECHNICAL DATA in this manual.



$$V_{BP1} = V_{PWR} - 2 \cdot \rho \cdot \frac{L_1 \cdot I_1}{S}$$

$$V_{BP\,n} = V_{BP\,n-1} - 2 \cdot \rho \cdot \frac{L_n \cdot I_n}{S}$$

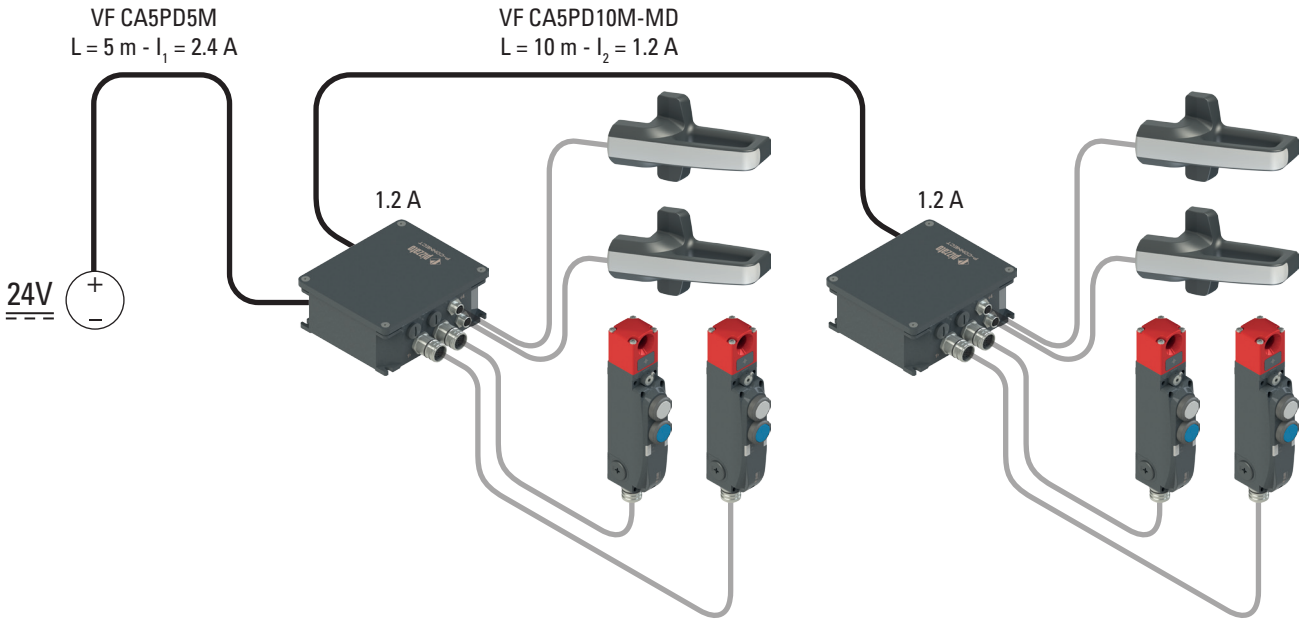
$$\rho \text{ (copper resistivity @ 20°C)} = 0.018 \left[\frac{\Omega \cdot mm^2}{m}\right]$$

S = wire cross-section [mm²]

7.1.1 Practical calculation example

Note: The configuration in the diagram has a maximum consumption of 1.2 A per P-connect unit.

The following Pizzato cables were used for calculation: VF CA5●●●M 0.25 mm2 (23 AWG)
VF CA5●●●M-MD 0.5 mm2 (20 AWG).



$$V_{BP1\text{-}2} = V_{PWR} - 2 \cdot \rho \cdot \frac{L_1 \cdot I_1}{S} - 2 \cdot \rho \cdot \frac{L_2 \cdot I_2}{S} =$$

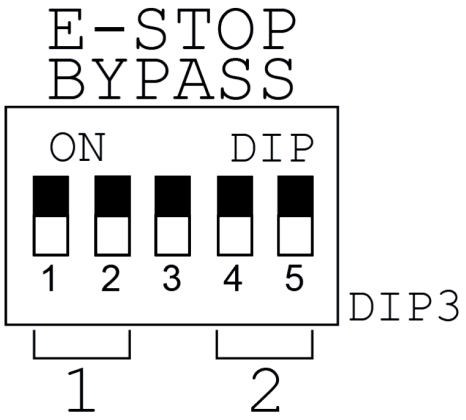
$$V_{BP1\text{-}2} = 24\,V - 2 \cdot 0.018 \frac{\Omega\ mm^2}{m} \cdot \frac{5\ m \cdot 2.4\ A}{2 \cdot 0.25\ mm^2} - 2 \cdot 0.018 \frac{\Omega\ mm^2}{m} \cdot \frac{10\ m \cdot 1.2\ A}{2 \cdot 0.5\ mm^2} = 22.7\ V$$

The configuration in the diagram functions correctly as the voltage resulting from the calculation, 22.7 V, is within the supply voltage range for P-Connect of 24 V ± 15%.

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8 Bypassing of emergency stop buttons

Some of the BP gateway configurations can be used to manage up to two emergency stop buttons, but these are connected in series to each other inside the gateway. If you are not going to use both emergency stop buttons, it is necessary to bypass one of them using the "DIP3" switch (called "E-STOP BYPASS") located under the cover of the BP gateway.



If the first two switches "1" and "2" are switched "ON" this bypasses the first emergency stop button connected. The two switches "4" and "5" bypass the second emergency stop button connected. The switches must only be operated when the BP gateway is OFF, to prevent incoherent input test signal readings.

⚠ Attention: Always check on the machine that the actual emergency stop configuration works as expected.

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9 EtherCAT®: Signalling LEDs

On the BP series connection box there are five LEDs to indicate the state of the device during normal operation:

- "SYSTEM STATE": multicolour signal, which through sequences of lighting, flashing and colour changes, indicates the various operating states of the device to the user, as well as any warnings or errors concerning internal electronic components;
- "L/A EC OUT": signals the Link/Activity status of the "EC OUT" port;
- "L/A EC IN": signals the Link/Activity status of the "EC IN" port;
- "RUN": indicates the status and operation of the EtherCAT® network;
- "ERROR": indicates EtherCAT® communication errors.

⚠ Attention: The LEDs are NOT reliable indicators and it cannot be guaranteed that they provide accurate information. They should ONLY be used for general diagnostics during commissioning and troubleshooting. Do not attempt to use LEDs as operational signals.

9.1 Signalling LED "SYSTEM STATE"

The predefined sensor operating states (OFF, RUN, ERROR, SET) are indicated by a constantly lit LED.

Every Warning / Error event is managed according to priority. A flashing LED always signals the highest priority event (lowest priority code = highest priority).

LED state	Description	Notes / Troubleshooting
Off ○	Not powered	No power supply: • Check the supply voltage • Check that the power supply cable is properly connected
Green ●	Online (RUN)	Normal device operation
Yellow ●	Wait	Waiting for network start-up • Check any signalling of the "RUN" and "ERROR" LEDs
Red ●	Error state	If steady red: serious internal error. • Restart the gateway • If the error persists, contact technical assistance If flashing red, see Table 2

Table 1

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If an ERROR event is identified, the LED cycles between continuous light corresponding to the ERROR state (see Table 1) with one of the illumination sequences listed in Table 2, each of which corresponds to a different message type.

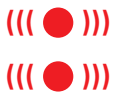
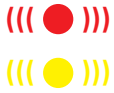
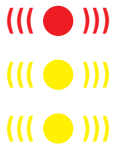
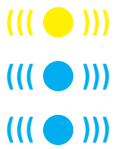
Priority code	LED flashing	Description	Notes / Troubleshooting
0	Red x 2 	Voltage error	Voltage out of permitted range: • After the gateway voltage has returned within the permitted threshold, restart the gateway
1	Red x 1 	Temperature error	Temperature out of permitted range: • After the gateway operating temperature has returned within the permitted threshold, restart the gateway
2	Red x 1 Yellow x 1 	Error - Supply current of connected devices	Device current exceeds permitted limit: • Separate the connected devices from the gateway, check for malfunctioning, and restart the gateway
3	Red x 1 Yellow x 2 	Error - Current at non-safety outputs	Current of connected devices exceeds permitted limit: • Separate the connected devices from the gateway, check for malfunctioning, and restart the gateway • Check that the load connected to the non-safety outputs is within the permitted threshold
4	Reserved		
5	Yellow x 1 Blue x 2 	Error - FSoE address	"ADDRESS" DIP switches in incorrect position: • Check that the DIP switches are correctly set to a value other than zero.

Table 2

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If a WARNING event is identified, the LED cycles between continuous light corresponding to the current operating state (see Table 1) with the corresponding illumination sequence listed in Table 3.

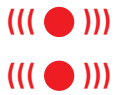
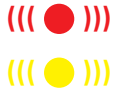
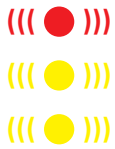
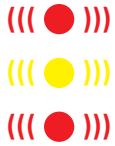
Priority code	LED flashing	Description	Notes / Troubleshooting
6	Red x 2 	Warning - Voltage	Voltage close to permitted limits: • Check the supply voltage of the gateway and adjust it to within the allowed range
7	Red x 1 	Warning - Temperature	Temperature close to permitted limits: • Check the operating temperature of the gateway and bring it back to within the allowed range
8	Red x 1 Yellow x 1 	Warning - Supply current of connected devices	Current close to permitted limits: • Check that there are no malfunctions on the devices connected to the gateway
9	Red x 1 Yellow x 2 	Warning - Total current on non-safety outputs above limit	Total current delivered on non-safety outputs close to permitted limits: • Check that there are no malfunctions on the devices connected to the gateway • Check that the load connected to the non-safety outputs is within the permitted threshold
10	Reserved		
11	Red x 1 Yellow x 1 Red x 1 	Warning - Safety inputs or outputs	Check inputs and outputs for short circuits

Table 3

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9.2 Signalling LED “RUN”

LED state	Description
Off	INIT state
Green, blinking	PRE-OPERATIONAL state
Green, single flash	SAFE-OPERATIONAL state
Green	OPERATIONAL state
Green, flashing quickly	BOOT state
Red	Critical communication error

9.3 Signalling LED “ERROR”

LED state	Notes / Troubleshooting
Off	No error
Red, blinking	Configuration received from master invalid
Red, single flash	Change in device EtherCAT® communication state
Red, double flash	Synch Manager watchdog
Red, flashing quickly	BOOT state
Red	Critical error

9.4 Signalling LED “L/A EC” (Link/Activity)

LED state	Description
Off	No link, no activity
Green	Link (100 Mbit/s) established
Green, flickering	Activity (100 Mbit/s)
Yellow	Link (10 Mbit/s) established
Yellow, flickering	Activity (10 Mbit/s)

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10 Communication data

10.1 Safety and non-safety inputs

The communication data that can be read in the various gateway configurations are listed in the "WIRING INSTRUCTIONS" manual.

The process image of the exchanged safety data contains both the data and the status of the input or output to be read.

Bit	Function	Value	Description
DIx	Current state of the safety input x	0	Input not active (safe state)
		1	Input active
QDIx	Safety input qualifier x	0	Corresponding input is in error state
		1	Corresponding input is in normal state
QDOx	Safety output qualifier x	0	Corresponding safety output is in error state
		1	Corresponding safety output is in normal state

The signals marked with DI indicate the status of the safety inputs in real time. The qualification bits QDIx and QDOx indicate whether a safety-relevant error has been detected on the corresponding input or output channel of the BP gateway. The value "0" indicates that the state of the respective input or output has switched to fail-safe state due to a malfunction caused, for example, by a short circuit. The value "1" of the qualifier indicates proper functioning.

10.2 Safety and non-safety outputs

The output process image data is used, on the one hand, to check the states of the digital safety outputs of the BP gateway and, on the other hand, to send acknowledgement data for safety-relevant errors regarding the digital inputs and outputs of the gateway. If the safety input or output switches to fail-safe state, a reset of the associated qualifier is required to acknowledge the failsafe state of the PLC by setting the ERDIx/ERDOx bit to "1". Once the reset operation has been performed, reset the ERDIx/ERDOx bits to "0".

Bit	Function	Value	Description
DOx	Activation of safety output x	0	Output not active (safe state, low)
		1	Output active
ERDIx	Reset safety input qualifier x	0	Input error reset not requested
		1	Input error reset requested
ERDOx	Reset safety output qualifier x	0	Output error reset not requested
		1	Output error reset requested

⚠ Do not use qualifiers of safety inputs and outputs (QDIn and QDOn) to activate safety functions.

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11 Configuration via TwinCAT 3

11.1 Setting Safe “FSoE Address”

The safe address (FSoE Address) provides a unique identification of the device on the EtherCAT® network.

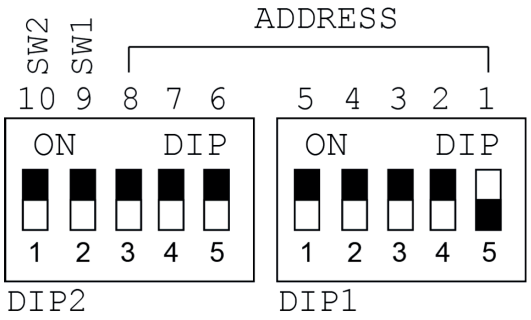
The safe FSoE Address in TwinCAT 3 is set in the Safety logic tab (see paragraph CONNECTING SECURE I/OS), and it must correspond to the physical address set within the BP housing.

The setting of the safe address must also be performed by means of two DIP switches located inside the housing. The FSoE Address can be set from 1 to 255 and must be unique for each network device. After setting the safe address, the device must be restarted.

How to set the FSoE - Address:

- Remove the 4 screws from the cover;
- Set the FSoE Address using the switches from 1-8.

The factory default address is set to 1.



The two remaining switches (9 and 10) called SW1 and SW2 are reserved and not used for the safe address.
After setting the safe address, close the cover and fasten the screws with a tightening torque of 1.2 Nm.

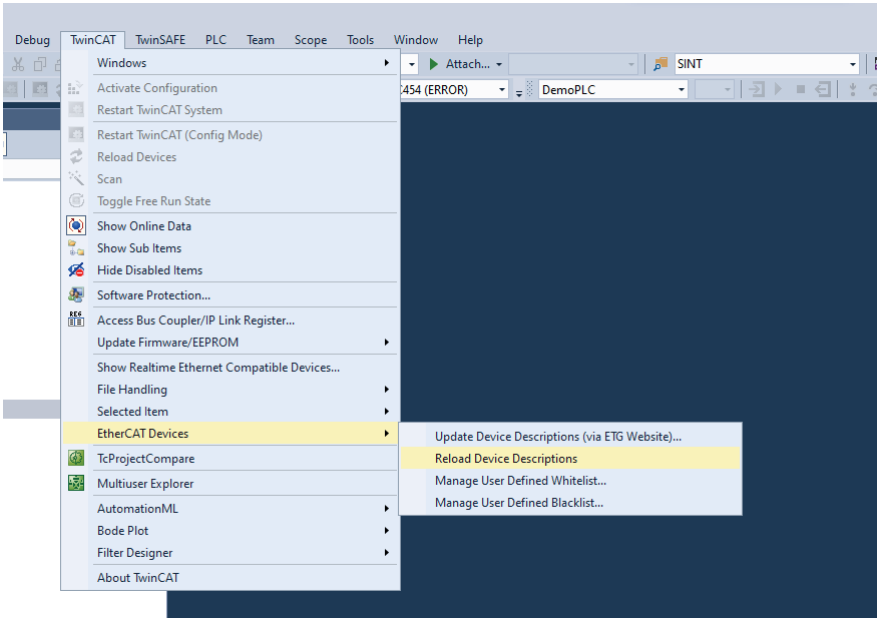
⚠ Attention: The FSoE Address set through the DIP switch must not be zero.

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11.2 Installation of ESI configuration file

The configuration file can be downloaded from the website www.pizzato.com from the specific product page and has the filename BP_A1ELxxxx_r1.xml.

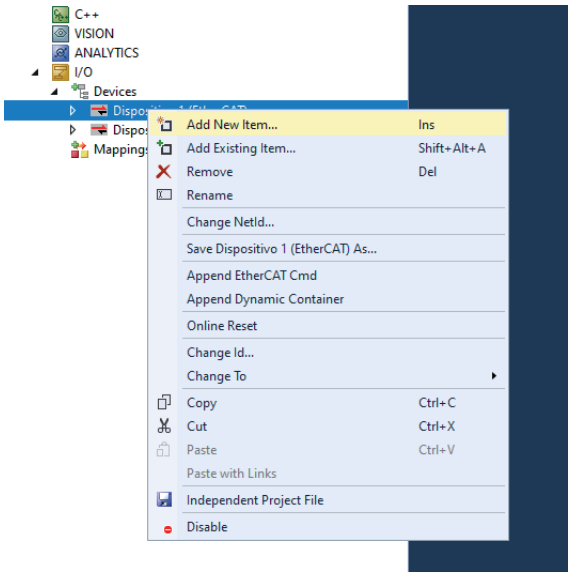
Copy the downloaded file into the folder "C:\TwinCAT\3.1\Config\Io\EtherCAT". From the menu "TwinCAT"->"EtherCAT Devices", select "Reload Device Descriptions"



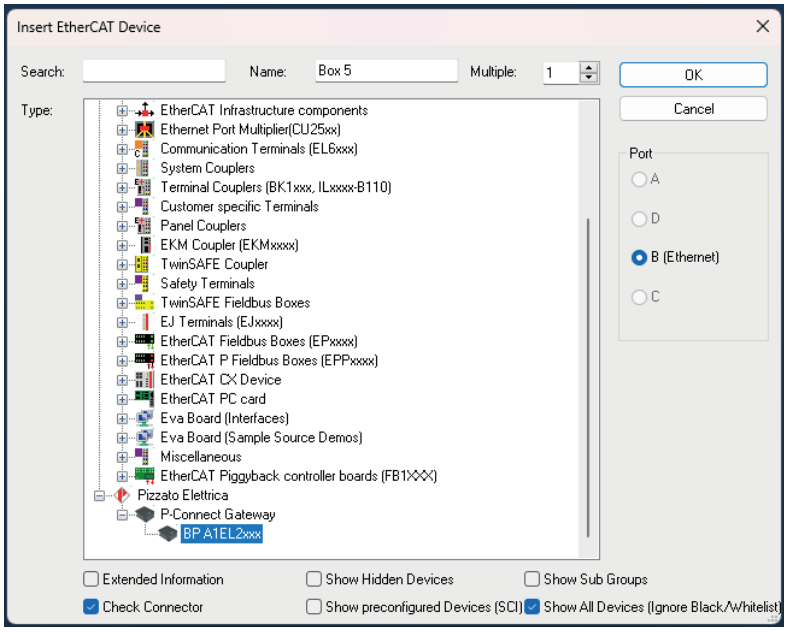
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11.3 Adding BP device to project

To add a BP gateway to an existing TwinCAT project, right click on the name of the corresponding EtherCAT® device and then select "Add New Item…".



In the window that appears, click on "Show All Devices", select P-Connect from the list and click "OK".



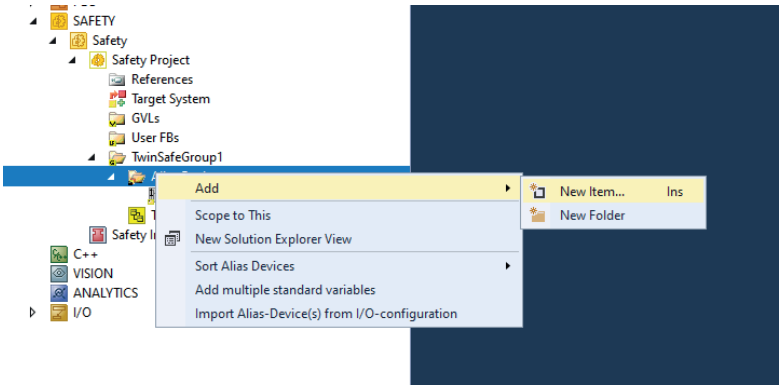
To verify the project and activate the changes, click "Activate Configuration" in the "TwinCAT" menu.

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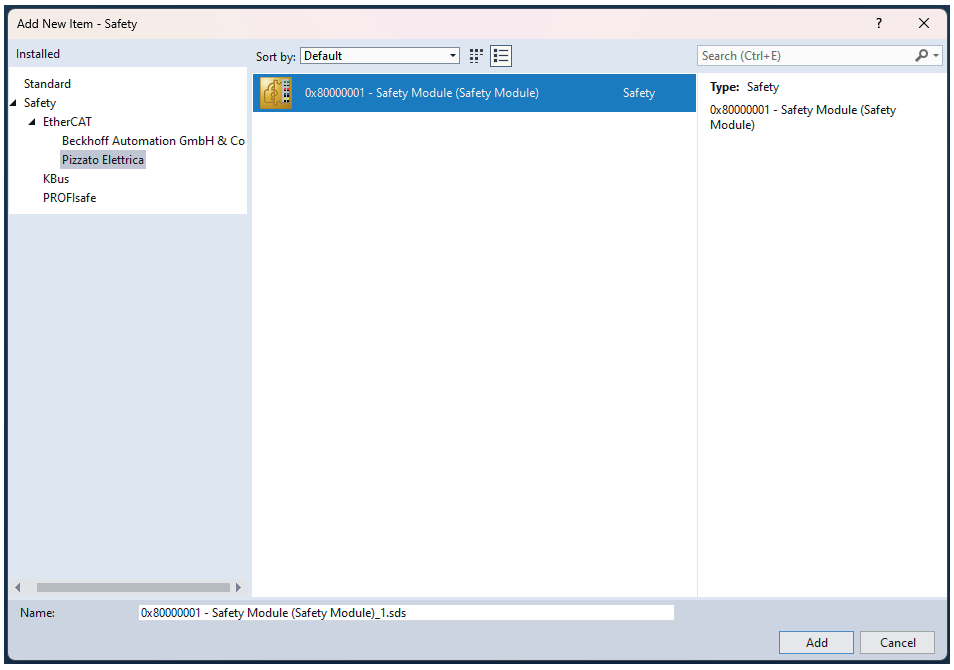
11.4 Connecting secure I/Os

In order to configure the safety logic and therefore use the I/Os of the BP gateway, a programmable safety logic component is required. This will be the "Target System" for the "SAFETY" logic.

To connect the BP gateway to the safety logic, right click on "Alias Devices" within the project structure and select "Add"->"New item…".



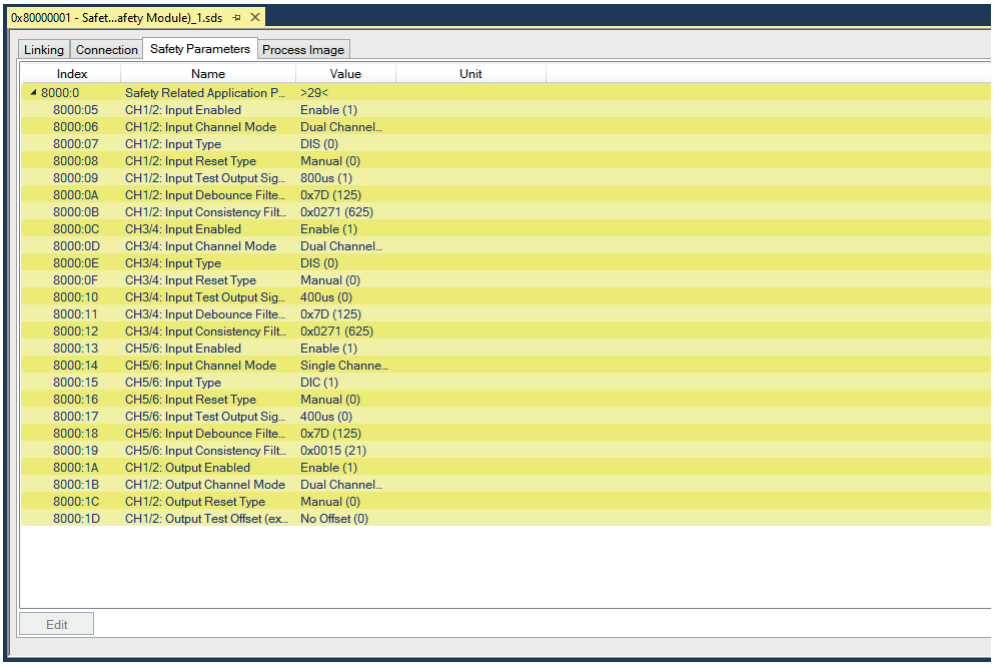
From the left-hand menu, select "Safety"->"EtherCAT"->"Pizzato Elettrica". A list of the Pizzato Elettrica gateways connected to the project will appear on the right-hand side. Click on the correct device and then on "Add".



A new entry will be created for the gateway under "Alias Devices". Double click on this to open the corresponding window. In the "Physical Device" field, enter the correct device you want to connect to the logic. In the "FSoE Address" field, enter the safe address value set via DIP switches inside the P-Connect housing.

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11.5 Setting safety parameters



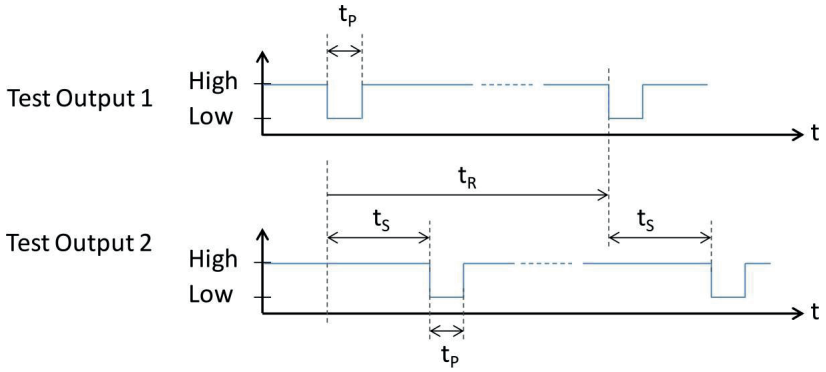
Each BP gateway can manage up to a maximum of three dual channel safety inputs (or six single-channel) and one dual channel safety output (or two single-channel). The input and output channels are managed by the software in pairs and it is possible to select their states and set some operating parameters.

The channels are divided into the following groups:

- CH1/2: Management of safety device connected to connector 1;
- CH3/4: Management of safety device connected to connector 2;
- CH5/6: Management of emergency mushroom buttons.

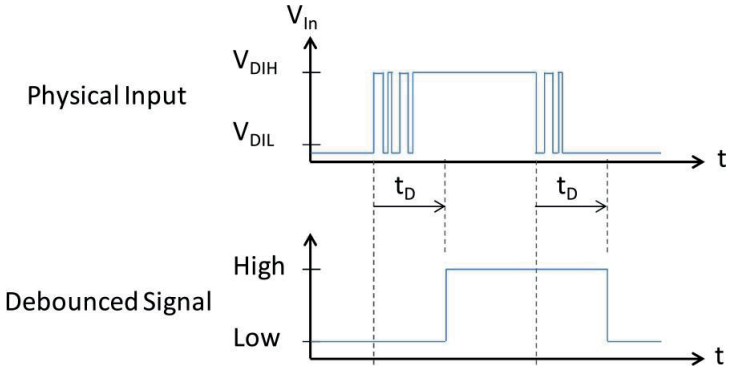
On the "Safety Parameters" tab, it is possible to modify the following parameters concerning the safety-relevant part of the device:

- **"CH*n/m*: Input Enabled"**: enabling of *n/m* safe channel pair. If no device is connected to the corresponding input connector, set the status to "Disable".
- **"CH*n/m*: Input Channel Mode"**: selection of mode for *n/m* pair (Single or Dual).
- **"CH*n/m*: Input Type"**: setting of the type of the channel input signal.
  - DIS = semiconductor input (for CH1/2 and CH3/4)
  - DIC = input for electro-mechanical contact (for CH5/6)
- **"CH*n/m*: Input Reset Type"**: reserved parameter.
- **"CH*n/m*: Input Test Output Signal"**: length of pulsed test signal (t_P). Can be configured from 400 µs to 2400 µs. To this time the hardware delay (HW_Delay) must be added, which varies from 227 µs to 447 µs. The repetition time t_R = 1 s and the phase t_S between the two test signals are constant values. Test signals are only operational if the channel is set to "DIC" mode.

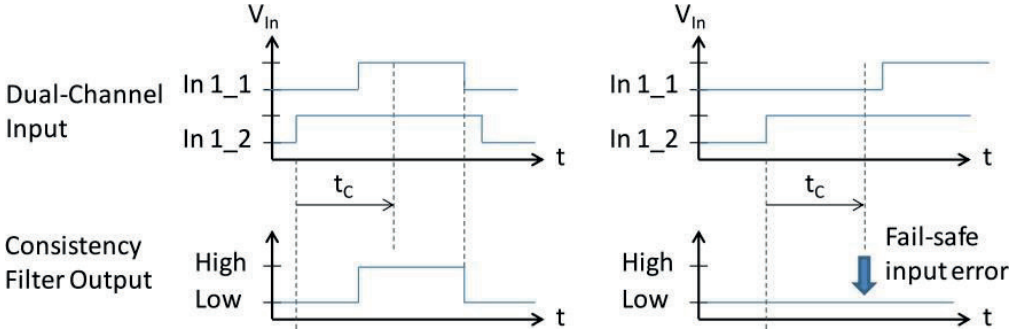


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- **"CH*n/m*: Input Debounce Filter Time (400 µs steps)"**: The debounce filter (t_D) can be configured to filter out short drops in the input signal caused by opening or closing of mechanical contacts. This can also be used to handle test pulses originating from other connected devices. The value is calculated with "x * 400 µs" and the default value is "125" equal to 50 ms.



- **"CH*n/m* Input Consistency Filter Time (400 µs steps)"**: The consistency time filter is only functional if the channel is set to dual-channel mode. In this mode, each safety input must transmit identical input signals for a specified period of time (t_C) to be interpreted as valid "active". The consistency filter is used to control this period of time. Whenever the two channels of a dual-channel input differ by a time > t_C, the safe state is set for this pair of input channels.



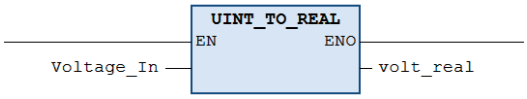
- **"CH1/2: Output Enable"**: enables the output channel. If no device is connected to the corresponding output connector, set the status to "Disable".
- **"CH1/2: Output Channel Mode"**: Selection of the channel mode (Single Channel or Dual Channel).
- **"CH1/2: Output Test Offset"**: Extends the duration of the test signal. Set it to "No Offset" if this is not required.

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11.6 Conversion of hardware diagnostics data

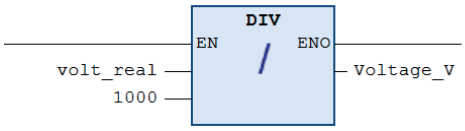
Raw analogue data can be converted into a format that is more easily readable using the functions in TwinCAT.

First, the raw data, which is provided in "Integer" (UINT) format, must be converted into the "Real" format.

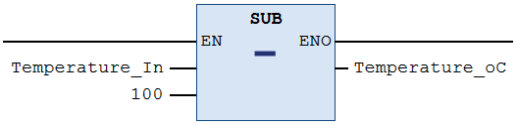


After conversion into "Real" format, the data can be further manipulated to return it to the appropriate unit of measurement:

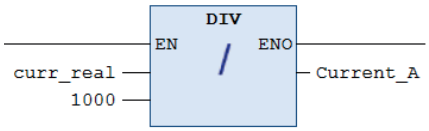
- The power supply voltage is expressed in [mV] and to display it in [V] the value must be divided by "1000";



- The temperature is given in [°C + 100] and so it is necessary to subtract "100";



- The current consumption is expressed in [mA] and to display it in [A] the value must be divided by "1000".



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11.7 Using the library

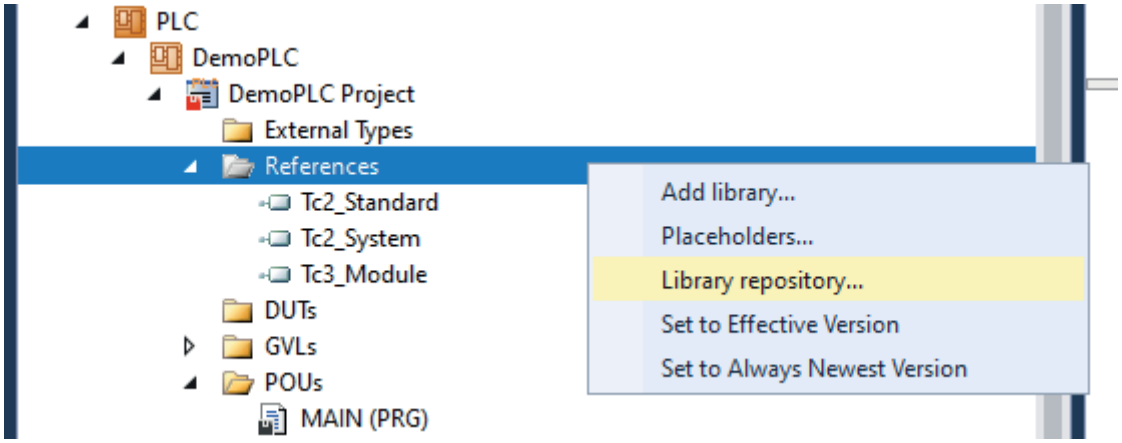
The TwinCAT library supplied by Pizzato is optional but can provide an alternative solution for quicker installation of the gateway and creation of more easily legible PLC software.

It is freely available for download from www.pizzato.com with the filename "PConnect_lib.library".

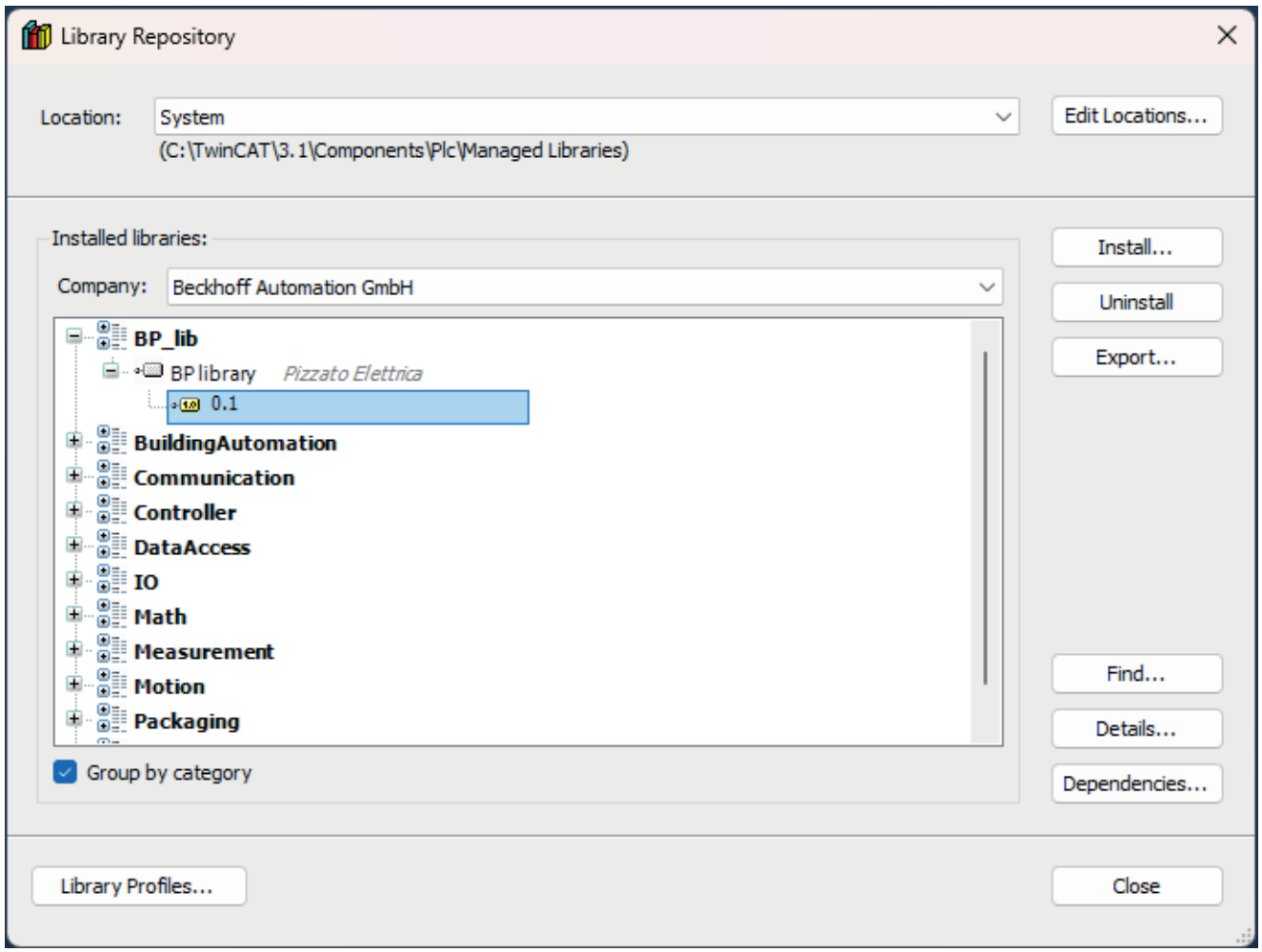
This includes:

- Data Types corresponding to non-safety inputs and outputs
- A function for the conversion of raw hardware diagnostics data.

To install the library, right click on "References" and select "Library repository…"



In the window that appears, click "Install..." and select the file downloaded previously. The new library will be added to the list.



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To include the library in the project, right click again on "References" and select "Add library…".

Select "BP library" from the library and click OK.

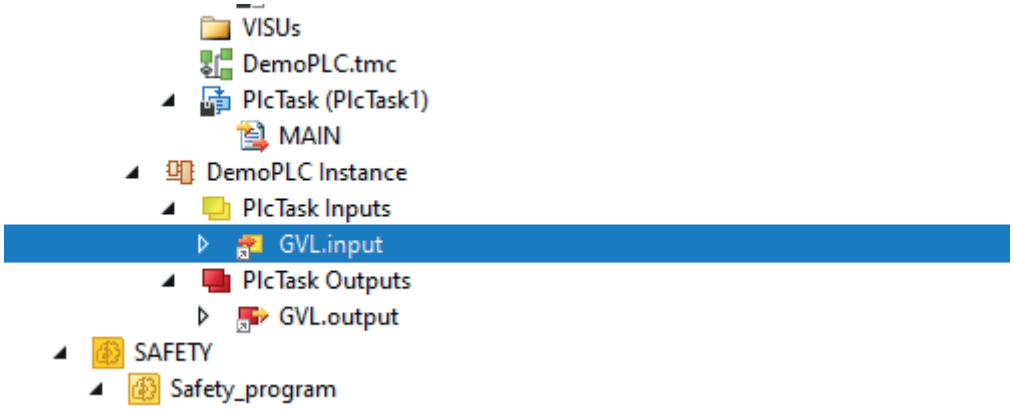
It is now possible to quickly create the variables connected to the non-safety inputs and outputs via the following Data Types:

- NonSafeInputDUT: 16 bit array for non-safety inputs
- NonSafeOutputDUT: 24 bit array for non-safety outputs.

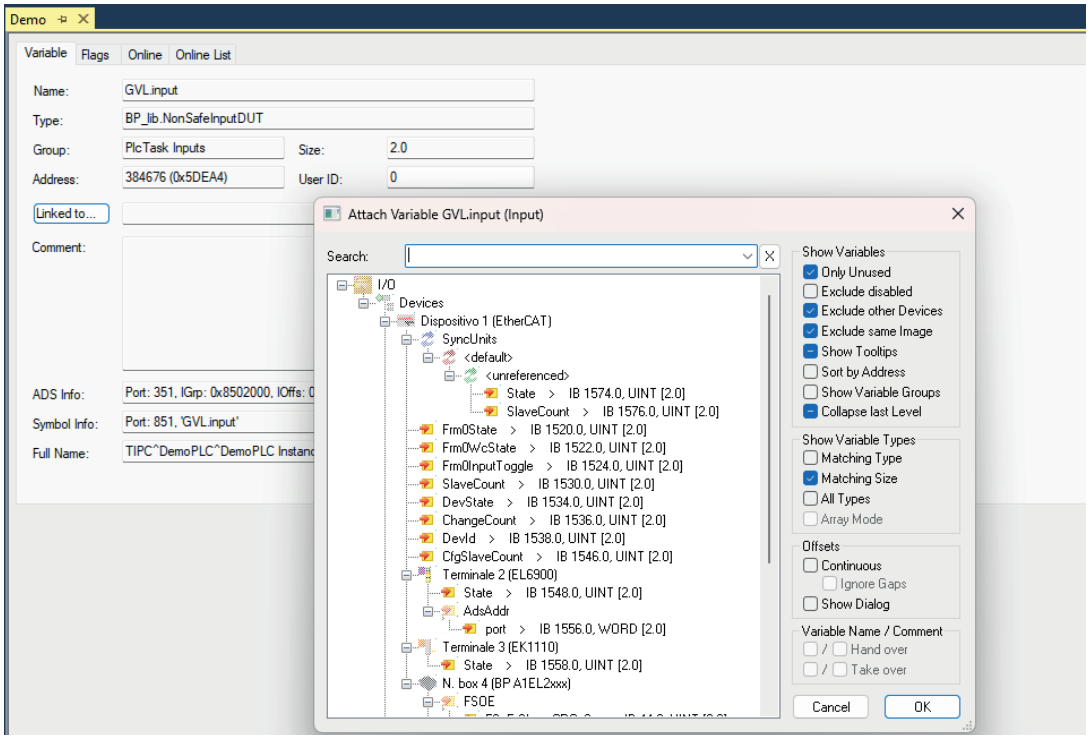
Enter the list of project variables and add the lines.

```
GVL
1  {attribute 'qualified_only'}
2  VAR_GLOBAL
3
4      input AT %I*: NonSafeInputDUT;
5      output AT %Q*: NonSafeOutputDUT;
6
7  END_VAR
8
9
```

Once the project has been compiled, you can link the created variables to the inputs and outputs of the BP by double-clicking on the newly created input instance, as shown in the figure.



In the panel that appears, click on the button "Linked to..." and select the item "Unsafe Inputs" of the BP gateway to be connected.



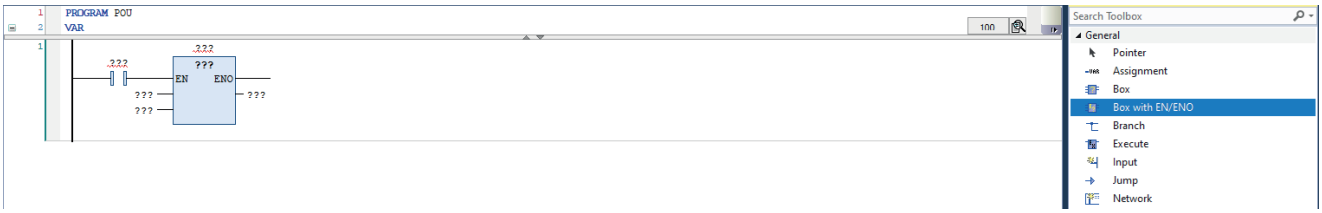
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Repeat the same steps for the non-safe outputs.

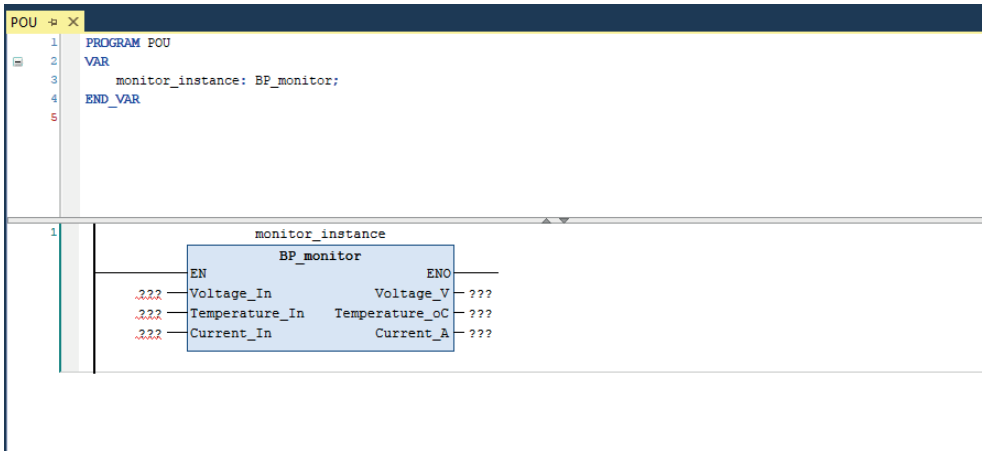
It will now be possible to access the inputs and outputs in the code using the variables previously created with the format:

- variable_list_name.variable_input_name.In (e.g. GVL.input.I3 to read the third unsafe input)
- variable_list_name.variable_output_name.Om (e.g. GVL.output.O5 to set the value of the fifth unsafe output)

Hardware monitoring data (voltage, temperature and current) can be obtained in the same way. In this case, the data are in UINT format and can be converted into "REAL" format using the "BP_monitor" function available in the library. To include it in the project, open a ladder logic program and drag "Module with EN/ENQ" from the "Toolbox" to import it.



Inside the newly created module, click on "???" and then click on the white box that appears on the right. Select the "BP_monitor" function from the "BP_lib" library and click "OK". In the program variables, instantiate the function and assign it to the newly created module, as shown below:



Connect each input and output of the module to the appropriate variable:

- Inputs, of type UNIT, must be associated with the variables linked to incoming data from the BP gateway
- Outputs, of type REAL, can be used as desired within the program.

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12 Safety application rules

Warning 1	The BP gateway is designed to be used in the industrial automation sector or in process control systems. The BP gateway final user must verify if it is allowed to use the gateway in the final application.
Warning 2	The maximum supply voltage must not be exceeded to prevent permanent damage to the BP gateway.
Warning 3	An active sensor, connected to a DI-S input, must use the same VSS reference level as the BP gateway.
Warning 4	The minimum time between the change of a single safe input and the transmission to the safety field bus is 6 ms. In the case of simultaneous changes of the input level on all 6 safe digital inputs, the maximum reaction time of the safety application is 16 ms (approx. 2 ms processing time per changed input). The delay time introduced by the input and debounce filters must be added to the maximum reaction time.
Warning 5	The diagnostic test interval for dual channel DI-C inputs is 1 hour.
Warning 6	The test output signals are not isolated. They all use the same VSS ground potential.
Warning 7	When the safety signal is deactivated (safe state), the corresponding pin is not set to the VSS reference voltage.
Warning 8	The safe state of the digital outputs of the BP gateway is “off” (high impedance). Therefore, it is not permitted to connect a device or an external safety function (like a valve or a switch) that needs a “High” level to keep the safe state.
Warning 9	To obtain a safety protection level equal to SIL 3, PL e, Cat. 4, the digital outputs of the BP gateway must be activated and connected in dual channel mode.
Warning 10	The safety devices connected to the digital outputs of the BP gateway must be resistant to the test pulses of the safety outputs.
Warning 11	The diagnostic test interval for the safety outputs is 1 hour.
Warning 12	The maximum time between the reception of a safety telegram and the setting of the corresponding digital safety output is 7.7 ms.
Warning 13	The replacement of a faulty BP gateway can only be carried out by authorised and properly trained personnel. After replacement it is necessary to perform testing and validation of all the safety functions.
Warning 14	The internal temperature of the BP gateway has to be regarded as non-safety data and therefore must not be used to control any safety function on the safety controller side.
Warning 15	All downloads of a new program must be verified by the installer via safety application tests. The configuration can only be considered as “verified” (and settings definitive) once the tests have been successfully completed.
Warning 16	Test safety-connection configurations after having applied them on an originator to confirm that the intended connection is functioning as desired.

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Danger 1	No repairs or changes to the BP gateway are allowed.
Danger 2	The BP gateway must be powered by a 24 V SELV/PELV power supply unit according to EN 60950-1, which limits maximum voltage in case of failure to 60 V.
Danger 3	The maximum operating life of the BP gateway must not exceed the 'mission time' (20 years). When the limit of the mission time is reached, the BP gateway must be replaced and permanently taken out of service.
Danger 4	The safety inputs must be configured as dual channel safe input to obtain a safety protection level of SIL 3, PL e, Cat 4. Additional measures may be necessary to exclude wiring faults or for the use of certified components.
Danger 5	The single-channel safety inputs of the BP gateway should only be used for safety applications if special precautions are applied. The safe operation of a single-channel input always requires additional safety measures or fault exclusions which must be taken into account in the overall design concept of the safety system. The values for SIL/PL are affected by the single-channel architecture. With single-channel applications, SIL 3/PL e cannot be achieved.
Danger 6	After detecting a safety-critical error, the BP gateway must not be kept in a safe state for more than 1 hour.
Danger 7	A faulty BP gateway must be replaced immediately.
Danger 8	If the BP gateway is on and does not correctly switch to the RUN state within a maximum of 8 hours, the gateway must be restarted. Subsequently, it must be checked by experienced service personnel to ensure safe operation.
Danger 9	The maximum operating altitude of 2000 m must not be exceeded.
Attention 1	The digital inputs not connected in dual channel mode will cause the BP gateway to signal inactive safety state for both channels.
Attention 2	Due to hardware limitations, the BP gateway with 3 dual channel inputs and a dual channel output has only one pair of configurable Test Outputs (TO).
Attention 3	The safety-related parts of the EDS (Electronic Data Sheet) of the BP Gateway must not be modified.

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13 Technical data

1) Housing

Housing:	Metal housing, powder-coated
Protection degree:	IP65 acc. to EN 60529 (with connectors of equal or higher protection degree)
Dimensions:	See paragraph DIMENSIONED DRAWING

2) Environmental data

Operating temperature:	-15°C … +50°C
Storage temperature:	-30°C … +70°C
Pollution degree:	2
Overvoltage category:	III

3) General data

Safety parameters	Maximum SIL	PL	Cat.	PFH
Monitoring function for the safety outputs	3	e	4	2.44E-09
Single channel actuator locking function	1	c	1	1.89E-07
Dual channel actuator locking function	3	e	4	2.46E-09

4) Power supply

Rated voltage (U_e):	24 Vdc SELV/PELV
Supply voltage tolerance:	±15%
Operating current at U_e voltage:	
- no devices connected:	0.1 A
- maximum supported current:	3.1 A
Insulation voltage U_i:	32 V
Shock and vibration resistance:	acc. to EN 60947-1
EMC protection:	acc. to EN 61000-4 and EN 61326-3-1
External protection fuse:	4 A type gG for a single BP gateway; for series connection the total load must be calculated

Features approved by UL:	
Electrical ratings:	24 Vdc, Class 2, 3.1 A Max
Environmental Ratings:	Type 1

Functional safety has not been evaluated by UL Solutions.

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5) Input and output circuits:

Number of safety inputs:	3 dual-channel
Number of safety outputs:	1 dual channel (or 2 single channel)
Number of non-safety inputs:	14
Number of non-safety outputs:	24
Number of test outputs:	2
Maximum voltage that can be applied to non-safety inputs:	24 Vdc ± 10%
Rated voltage of non-safety outputs:	24 Vdc
Maximum control current at non-safety outputs:	50 mA
Maximum current at test outputs:	100 mA
Maximum current at safe outputs:	250 mA

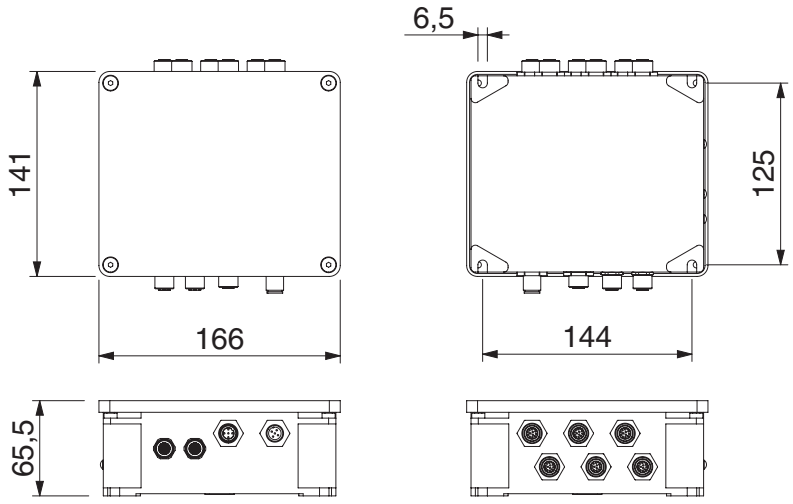
6) Compliance with standards:

EN 60947-1, EN 61326-1, EN 61326-3-1, EN IEC 63000, EN 60529, IEC 61784-3-3, EN 61508, EN 62061, EN ISO 13849-1, UL 61010-1, CSA NO. 61010-1, EN 61131-2.

7) Compliance with the requirements of:

Machinery Directive 2006/42/EC, EMC Directive 2014/30/EU, RoHS Directive 2011/65/EU.

14 Dimensioned drawing



All values in the drawings are in mm.

15 Markings

The outside of the device is provided with external marking positioned in a visible place. Marking includes:

- producer trademark
- product code
- batch number and date of manufacture. Example: A23 CS1-123456. The batch's first letter refers to the month of manufacture (A=January, B=February, etc.). The second and third letters refer to the year of manufacture (23 = 2023, 24 = 2024, etc…).

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16 Disposal



At the end of its service life, the product must be disposed of properly, according to the rules in force in the country in which the disposal takes place.

17 Support

The device has been created for safeguarding people's physical safety, therefore in case of any doubt concerning installation or operation methods, always contact our technical support service:

Pizzato Elettrica Srl - Italy

Via Torino, 1 - 36063 Marostica (VI)

Telephone +39.0424.470.930

E-mail tech@pizzato.com

www.pizzato.com

Our support service provides assistance in Italian and English.

18 EC Declaration of Conformity

I, the undersigned, as a representative of the following manufacturer:

Pizzato Elettrica Srl - Via Torino, 1 - 36063 Marostica (VI) – ITALY

hereby declare that the product is in conformity with whatever prescribed by the 2006/42/EC Machine Directive. The complete version of the present conformity declaration is available on our website www.pizzato.com

Marco Pizzato

DISCLAIMER:

Subject to modifications without prior notice and errors excepted. The data given in this sheet are accurately checked and refer to typical mass production values. The device descriptions and its applications, the fields of application, the external control details, as well as information on installation and operation, are provided to the best of our knowledge. This does not in any way mean that the characteristics described may entail legal liabilities extending beyond the "General Terms of Sale", as stated in the Pizzato Elettrica general catalogue. Customers/users are not absolved from the obligation to read and understand our information and recommendations and pertinent technical standards, before using the products for their own purposes. Taking into account the great variety of applications and possible connections of the device, the examples and diagrams given in the present manual are to be considered as merely descriptive; the user is deemed responsible for checking that the specific application of the device complies with current standards. This document is a translation of the original instructions. In case of discrepancy between the present sheet and the original copy, the Italian version shall prevail. All rights to the contents of this publication are reserved in accordance with current legislation on the protection of intellectual property. The reproduction, publication, distribution and modification, total or partial, of all or part of the original material contained therein (including, but not limited to, texts, images, graphics), whether on paper or in electronic form, are expressly prohibited without written permission from Pizzato Elettrica Srl.

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