# CONTROLLER WITH ZPA-LOGIC
# CONTROL SYSTEM WITH A SIEMENS PLC



ROBOTUNITS®
THE MODULAR AUTOMATION SYSTEM

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# 1. Introduction

ZPA stands for Zero Pressure Accumulation conveying. The controller (module) offers this function in order to achieve zero pressure accumulation conveying, completely independent of a higher-level control system.

For this purpose, each zone is equipped with a zone sensor, which is connected to the controller. With the help of these sensors, the controller detects if there is conveyed material within the zone. A controller can communicate with the respective upstream or downstream controllers. This ensures that, should the conveyed materials stop in one zone, the respective upstream zone is also stopped in order to avoid a collision.

Although this function can be operated completely independently, it is possible to additionally establish a connection between one or more ConveyLinxAi2 module(s) and a PLC in order to influence the conveying process or to collect data of the processes.

In the following it is shown how the connection between a Siemens PLC and a preconfigured controller (ConveyLinxAi2) is established.

Attached to the document is a printout of the corresponding UDTs, which show which options are available for data acquisition as well as for control.

## 2. Preparation of the TIA Portal

After a new project has been created or an existing project has been opened and adapted according to the other hardware, a GDS file must be installed once. This file contains the logical description of the controller's hardware. The file can be found at www.robotunits.com/en/product/powered-roller-conveyor/?tab=Downloads.

By accessing the path "Extras" → "Manage Device Description Files" in the TIA Portal, the file is installed by specifying the source path.

There is a UDT available which should also be added to the project. The file can be found at www.robotunits.com/en/product/powered-roller-conveyor/?tab=Downloads.
Please add the file to the project as follows:

1. Project navigation: " [PLC Name]" → "External Sources" → "Add New File"
2. After adding, right-click on the file and select "Generate Modules from Source".
3. The PLC-Variables are therefore successfully generated. The project is now prepared for use with ConveyLinxAi2.
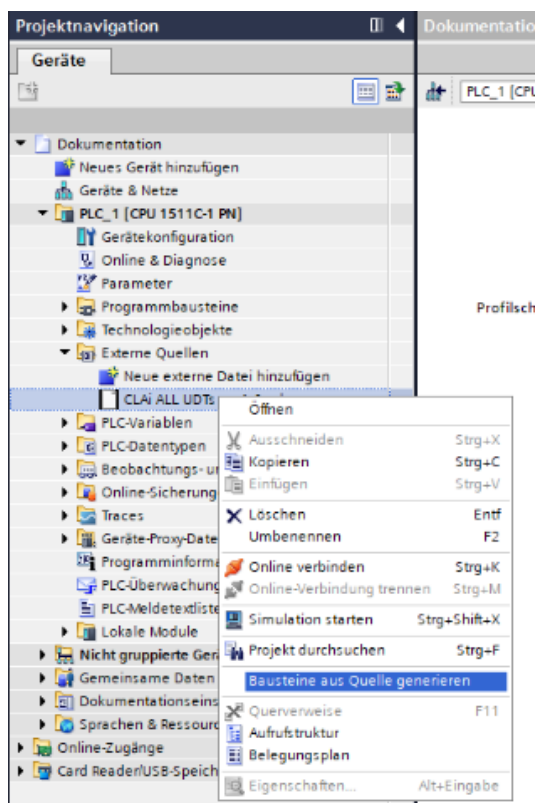
# 3. Adding a controller

Select the network view and open the hardware catalog. The correct controller will be added to the network view from the following path:
"Hardware Catalog" → "Additional Field Devices" → "PROFINET IO" → "I/O" → "Industrial Software Co." → "ConveyLinx" → "**Conveyor Control with standard configuration**". Add **ConveyLinx Ai**. It is important that exactly this controller is added under the exact specified path!
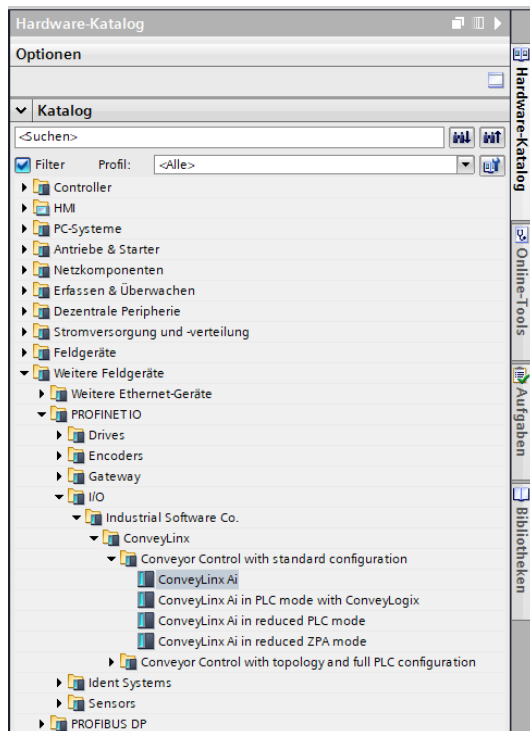


Via the auto-configuration the Profinet Name of the controller has already been changed according to the following syntax: conveylinxzpa-X-Y. Here X for the second last Byte of the IP-Address of the controller and Y for the last Byte of the IP-Address. In this example, the IP-Address of the controller is **192.168.0.20.** Therefore, the Profinet Name is: **conveylinxzpa-0-20**. This name must be used in the project and cannot be changed. After adding the controllers, adjust the Profinet Names and the IP-Addresses in the TIA Portal.
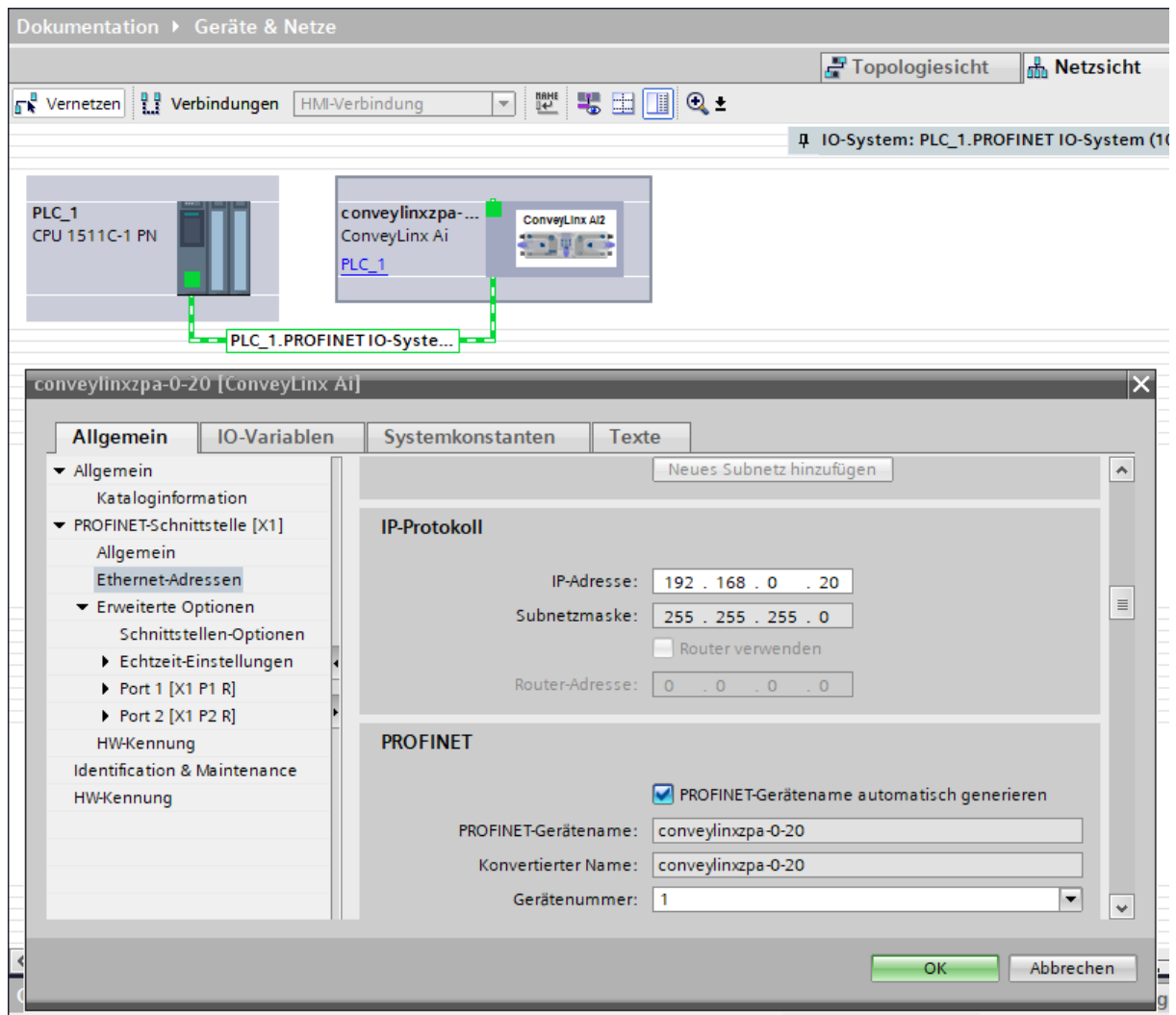
Now assign the specific data types, which are generated by the UDT, to each controller. For this you need the I/O Addresses of the controller. The respective start addresses can be viewed in the device view.
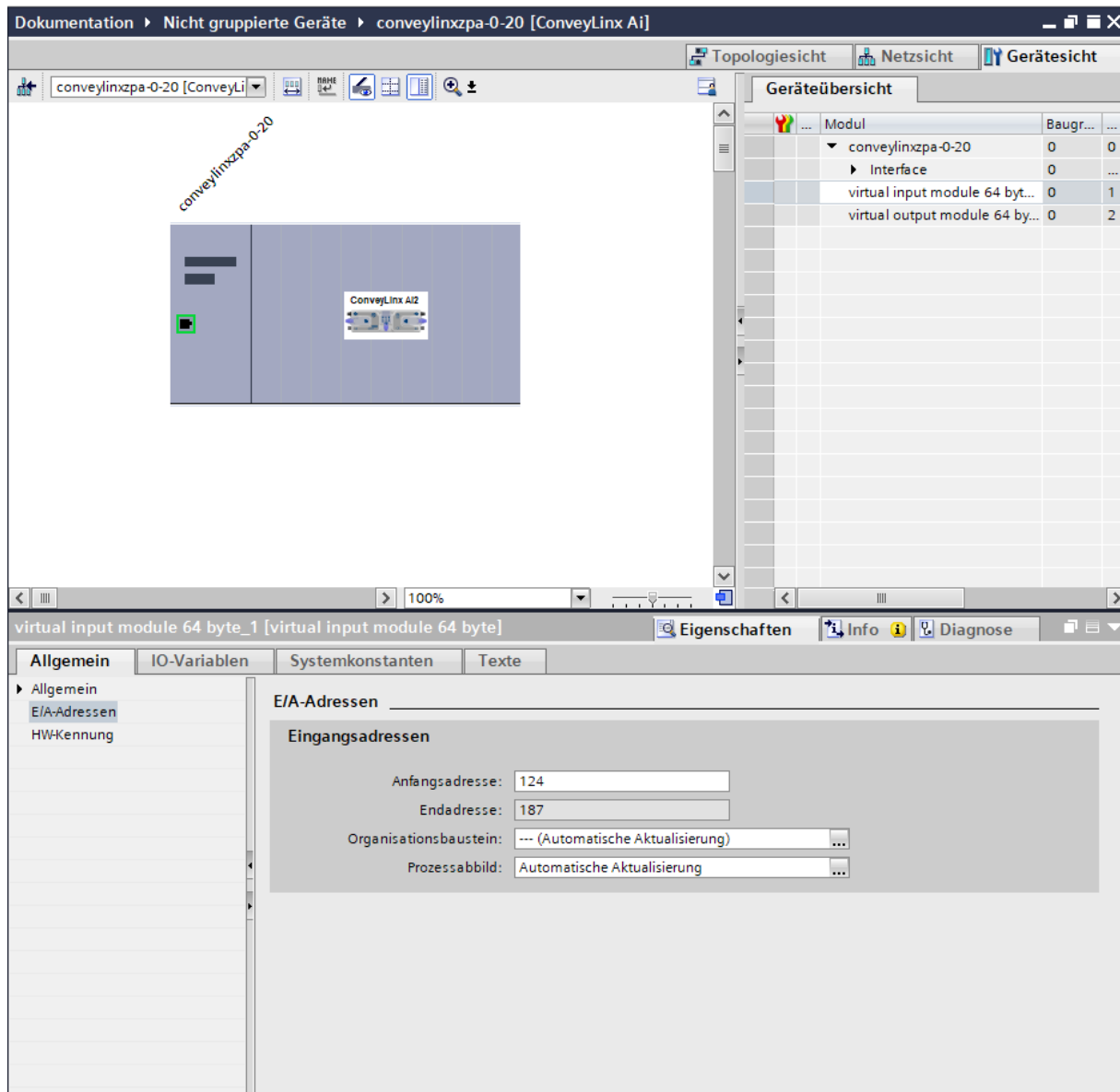
In this example, the start address of the input controller is 124 and the start address of the output controller is 126.

Add a new variable table: "Project navigation" → "[PLC Name]" → "PLC-Variables" → "Add New Variable Table".

Add an input variable and an output variable to the table for each controller. The names are user-definable. The data type to be used is "CLAiZPA_In" for each input controller and "CLAiZPA_OUT" for each output controller. In the third column, the corresponding start address, which was read before, is entered in each case. Make sure that the operand labeling is assigned correctly (Output=Q or A and Input = I or E). The initial bit is always "0". In this example, it looks like this:

The controller is now correctly integrated and be can be used in the program.

## 4. Example program

In the example program displayed below, it is demonstrated how to work the newly added variables. "Modul1_IN" and "Modul1_OUT" are placeholders for all registers starting from the specified start address. In the example, the left digital input of the controller is read. If this is HIGH, the downstream zone is accumulated. If this is LOW, the downstream zone is not accumulated. The description of all registers is attached to this document.

```
1 IF "Modul1_IN".AllSensors.LeftPin2 = 1 THEN
2     "Modul1_OUT".AccumulateControlDownstream.Accumulate := 1;
3 ELSE
4     "Modul1_OUT".AccumulateControlDownstream.Accumulate := 0;
5 END_IF;
```

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## CLXAiZPA_IN

| CLXAiZPA_IN Eigenschaften | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Allgemein** | | | | | | | |
| Name | CLXAiZPA_IN | Nummer | 2 | Typ | UDT | Sprache | |
| Nummerierung | | | | | | | |
| **Information** | | | | | | | |
| Titel | | Autor | | Kommentar | | Familie | |
| Version | | Anwenderdefinierte ID | | | | | |

| Name | Datentyp | Defaultwert | Erreichbar aus HMI/OPC UA | Schreibbar aus HMI/OPC UA | Sichtbar in HMI Engineering | Einstellwert | Kommentar |
|---|---|---|---|---|---|---|---|
| StateUpstreamZoneInverce | Byte | 16#0 | True | True | False | False | Zone status when the conveyor is running in opposite to configured direction .The values have the same meaning as in "StateUpstreamZone" field |
| StateUpstreamZone | Byte | 16#0 | True | True | False | False | Empty = 1 /Empty Motor Run = 2 /Empty Sending = 3 / Full Running = 4 / Full Stopped = 5 / Empty but Accumulate = 6 |
| StateDownstreamZoneInverce | Byte | 16#0 | True | True | False | False | Zone status when the conveyor is running in opposite to configured direction .The values have the same meaning as in "StateDownstreamZone" field |
| StateDownstreamZone | Byte | 16#0 | True | True | False | False | Empty = 1 /Empty Motor Run = 2 /Empty Sending = 3 / Full Running = 4 / Full Stopped = 5 / Empty but Accumulate = 6 |
| ArrivalCounterUpstreamZone | Int | 0 | True | True | False | False | Every time a product arrives on the Upstream zone this counter is incremented |
| DisarrivalCounterUpstreamZone | Int | 0 | True | True | False | False | Every time a product leaves the Upstream zone this counter is incremented |
| ArrivalCounterDownstreamZone | Int | 0 | True | True | False | False | Every time a product arrives on the Downstream zone this counter is incremented |
| DisarrivalCounterDownstreamZone | Int | 0 | True | True | False | False | Every time a product leaves the Downstream zone this counter is incremented |
| ▼ Diagnostic | Struct | | True | True | False | False | 32 bit diagnostic field . When bits are set the error is active . |
| LeftMDR_Overheat | Bool | false | True | True | False | False | The Left MDR temperature has exceeded 105 degrees Celsius |
| LeftMDR_MaxTorque | Bool | false | True | True | False | False | The Left MDR is running with maximum torque output |
| LeftMDR_Short | Bool | false | True | True | False | False | There is a short circuit on the Left MDR |
| LeftMDR_NotConn | Bool | false | True | True | False | False | The Left MDR is not connected |
| LeftMDR_Overload | Bool | false | True | True | False | False | The Left MDR has been overloaded - the motor has been running for 20s in Stalled. |
| LeftMDR_Stalled | Bool | false | True | True | False | False | The Left MDR has stalled - this means its speed is less than 10% of the selected speed |
| LeftMDR_BadHall | Bool | false | True | True | False | False | The Left MDR has a Hall Efect Sensor error |
| LeftMDR_NotUsed | Bool | false | True | True | False | False | The Left MDR is not used |
| Reserved_for_Modbus | Bool | false | True | True | False | False | |
| Reserved_1 | Bool | false | True | True | False | False | |
| OverVoltage | Bool | false | True | True | False | False | The sum of the module power supply voltage + the MDR - generated voltage has exceeded 30 volts |
| LeftMDR_AnyErr | Bool | false | True | True | False | False | A general error on the Left MDR. |
| ConnectionsNotOK | Bool | false | True | True | False | False | The Ethernet connections are not ok . |
| UpstreamJamErr | Bool | false | True | True | False | False | Jam error is present on Upstream zone |
| LeftSensLowGain | Bool | false | True | True | False | False | Left sensor error |
| LowVoltage | Bool | false | True | True | False | False | Module power supply is less than 18 Volts |
| RightMDR_Overheat | Bool | false | True | True | False | False | The Right MDR temperature has exceeded 105 degrees Celsius |
| RightMDR_MaxTorque | Bool | false | True | True | False | False | The Right MDR is running with maximum torque output |
| RightMDR_Short | Bool | false | True | True | False | False | There is a short circuit on the Right MDR |
| RightMDR_NotConn | Bool | false | True | True | False | False | The Right MDR is not connected |
| RightMDR_Overload | Bool | false | True | True | False | False | The Right MDR has been overloaded - the motor has been running for 20s in Stalled. |
| RightMDR_Stalled | Bool | false | True | True | False | False | The Right MDR has stalled - this means its speed is less than 10% of the selected speed |
| RightMDR_BadHall | Bool | false | True | True | False | False | The Right MDR has a Hall Efect Sensor error |
| RightMDR_NotUsed | Bool | false | True | True | False | False | The Right MDR is not used |
| Reserved | Bool | false | True | True | False | False | |
| Reserved_2 | Bool | false | True | True | False | False | |
| OverVoltage1 | Bool | false | True | True | False | False | The sum of the module power supply voltage + the MDR -generated voltage has exceeded 30 volts |
| RightMDR_AnyErr | Bool | false | True | True | False | False | A general error on the Right MDR. |
| Reserved_3 | Bool | false | True | True | False | False | |
| DownstreamJamErr | Bool | false | True | True | False | False | Jam error is present on Downstream zone |
| RightSensLowGain | Bool | false | True | True | False | False | Right sensor error |
| LowVoltage1 | Bool | false | True | True | False | False | Module power supply is less than 18 Volts |
| TrackingUpstreamZone | DWord | 16#0 | True | True | False | False | The Tracking data of the product currently on this zone |
| TrackingDownstreamZone | DWord | 16#0 | True | True | False | False | The Tracking data of the product currently on this zone |

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| Name | Datentyp | Defaultwert | Erreichbar aus HMI/OPC UA | Schreib-bar aus HMI/OPC UA | Sichtbar in HMI En-gineering | Einstell-wert | Kommentar |
|---|---|---|---|---|---|---|---|
| ReleaseCounterUpstreamZone | Int | 0 | True | True | False | False | Same register as is read in the CLXZPA_OUT in-stance .Used to confirm the ReleaseCounter |
| ReleaseCounterDownstream-Zone | Int | 0 | True | True | False | False | Same register as is read in the CLXZPA_OUT in-stance .Used to confirm the ReleaseCounter |
| ModuleDischargeTracking | DWord | 16#0 | True | True | False | False | Tracking data of a product that has just been dis-charged to a non-ConveyLinx part of a conveyor , when the module is operating in default direction |
| ModuleDischargeTrackingIn-verce | DWord | 16#0 | True | True | False | False | Tracking data of a product that has just been dis-charged to a non-ConveyLinx part of a conveyor , when the module is operating in opposite to default direction |
| ▼ AllSensors | Struct | | True | True | False | False | All sensor inputs |
| Reserved[0] | Bool | false | True | True | False | False | |
| Reserved[1] | Bool | false | True | True | False | False | |
| Reserved[2] | Bool | false | True | True | False | False | |
| Reserved[3] | Bool | false | True | True | False | False | |
| Reserved[4] | Bool | false | True | True | False | False | |
| Reserved[5] | Bool | false | True | True | False | False | |
| Reserved[6] | Bool | false | True | True | False | False | |
| Heartbeat | Bool | false | True | True | False | False | This bit toggles every 2 seconds . |
| LeftPin2 | Bool | false | True | True | False | False | Left sensor port state (Pin2) |
| Reserved[9] | Bool | false | True | True | False | False | |
| RightPin2 | Bool | false | True | True | False | False | Right sensor port state (Pin2) |
| Reserved[11] | Bool | false | True | True | False | False | |
| LeftSensor | Bool | false | True | True | False | False | Left sensor port state (Pin4) |
| Reserved[13] | Bool | false | True | True | False | False | |
| RightSensor | Bool | false | True | True | False | False | Right sensor port state (Pin4) |
| Reserved[15] | Bool | false | True | True | False | False | |
| Reserved | Word | 16#0 | True | True | False | False | |
| ▼ Convey_stop_status | Struct | | True | True | False | False | Status of ConveyStop |
| Reserved0 | Bool | false | True | True | False | False | |
| Reserved1 | Bool | false | True | True | False | False | |
| StopActiveCommandPLC | Bool | false | True | True | False | False | Stop active due to stop command from the PLC |
| Reserved3 | Bool | false | True | True | False | False | |
| Reserved4 | Bool | false | True | True | False | False | |
| Reserved5 | Bool | false | True | True | False | False | |
| Reserved6 | Bool | false | True | True | False | False | |
| Reserved7 | Bool | false | True | True | False | False | |
| Reserved8 | Bool | false | True | True | False | False | |
| Reserved9 | Bool | false | True | True | False | False | |
| Reserved10 | Bool | false | True | True | False | False | |
| Reserved11 | Bool | false | True | True | False | False | |
| Reserved12 | Bool | false | True | True | False | False | |
| StopActiveOtherModule | Bool | false | True | True | False | False | Stop condition is active on a module in the Convey-Stop group |
| StopActiveLostConn | Bool | false | True | True | False | False | Stop is active due to a loss of communication connec-tion |
| StopActiveLostPLC | Bool | false | True | True | False | False | Stop active due to a loss of connection with the PLC |
| ▼ Future | Array[21..31] of Word | | True | True | False | False | |
| Future[21] | Word | 16#0 | True | True | False | False | |
| Future[22] | Word | 16#0 | True | True | False | False | |
| Future[23] | Word | 16#0 | True | True | False | False | |
| Future[24] | Word | 16#0 | True | True | False | False | |
| Future[25] | Word | 16#0 | True | True | False | False | |
| Future[26] | Word | 16#0 | True | True | False | False | |
| Future[27] | Word | 16#0 | True | True | False | False | |
| Future[28] | Word | 16#0 | True | True | False | False | |
| Future[29] | Word | 16#0 | True | True | False | False | |
| Future[30] | Word | 16#0 | True | True | False | False | |
| Future[31] | Word | 16#0 | True | True | False | False | |

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## CLXAiZPA_OUT

| CLXAiZPA_OUT Eigenschaften | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Allgemein** | | | | | | | |
| Name | CLXAiZPA_OUT | | Nummer | 1 | Typ | UDT | Sprache |
| Nummerierung | | | | | | | |
| **Information** | | | | | | | |
| Titel | | | Autor | | Kommentar | | Familie |
| Version | | | Anwenderdefinierte ID | | | | |

| Name | Datentyp | Defaultwert | Erreichbar aus HMI/OPC UA | Schreibbar aus HMI/ OPC UA | Sichtbar in HMI Engineering | Einstellwert | Kommentar |
|---|---|---|---|---|---|---|---|
| InductTrackingOnUpstreamZone | DWord | 16#0 | True | True | False | False | Writes the tracking data of the product currently on the zone .The Release counter of the zone must be incremented by 1. |
| InductTrackingOnDownstreamZone | DWord | 16#0 | True | True | False | False | Writes the tracking data of the product currently on the zone .The Release counter of the zone must be incremented by 1. |
| ▼ AccumulateControlUpstream | Struct | | True | True | False | False | |
| AccumUpstreamToThisZone | Bool | false | True | True | False | False | Accumulates the Upstream zone relative to this zone .Useful in Merge/Divert operations |
| FakeConfirm | Bool | false | True | True | False | False | Fake confirmation bit . Useful for Divert operations . Please check documentation for more information . |
| Reserved[2] | Bool | false | True | True | False | False | |
| Reserved[3] | Bool | false | True | True | False | False | |
| Reserved[4] | Bool | false | True | True | False | False | |
| Reserved[5] | Bool | false | True | True | False | False | |
| Reserved[6] | Bool | false | True | True | False | False | |
| Reserved[7] | Bool | false | True | True | False | False | |
| Accumulate | Bool | false | True | True | False | False | Accumulates this zone of this ConveyLinx Ai module |
| Reserved[9] | Bool | false | True | True | False | False | |
| Reserved[10] | Bool | false | True | True | False | False | |
| Reserved[11] | Bool | false | True | True | False | False | |
| Reserved[12] | Bool | false | True | True | False | False | |
| Reserved[13] | Bool | false | True | True | False | False | |
| Reserved[14] | Bool | false | True | True | False | False | |
| Reserved[15] | Bool | false | True | True | False | False | |
| ▼ AccumulateControlDownstream | Struct | | True | True | False | False | |
| AccumUpstreamToThisZone | Bool | false | True | True | False | False | Accumulates the Upstream zone relative to this zone .Useful in Merge/Divert operations |
| FakeConfirm | Bool | false | True | True | False | False | Fake confirmation bit . Useful for Divert operations . Please check documentation for more information . |
| Reserved[2] | Bool | false | True | True | False | False | |
| Reserved[3] | Bool | false | True | True | False | False | |
| Reserved[4] | Bool | false | True | True | False | False | |
| Reserved[5] | Bool | false | True | True | False | False | |
| Reserved[6] | Bool | false | True | True | False | False | |
| Reserved[7] | Bool | false | True | True | False | False | |
| Accumulate | Bool | false | True | True | False | False | Accumulates this zone of this ConveyLinx Ai module |
| Reserved[9] | Bool | false | True | True | False | False | |
| Reserved[10] | Bool | false | True | True | False | False | |
| Reserved[11] | Bool | false | True | True | False | False | |
| Reserved[12] | Bool | false | True | True | False | False | |
| Reserved[13] | Bool | false | True | True | False | False | |
| Reserved[14] | Bool | false | True | True | False | False | |
| Reserved[15] | Bool | false | True | True | False | False | |
| SpeedLeftMDR | Int | 0 | True | True | False | False | The speed of the MDR in m/s*1000 (or in shaft RPM*10 for PGD). The allowed values depend on the Speed code of the MDR . |
| SpeedRightMDR | Int | 0 | True | True | False | False | The speed of the MDR in m/s*1000 (or in shaft RPM*10 for PGD). The allowed values depend on the Speed code of the MDR . |
| ReleaseControlUpstream | Int | 0 | True | True | False | False | Changing the value causes the Upstream zone to release the current product . Even if Accumulation is set for this zone , the current product is released |
| ReleaseControlDownstream | Int | 0 | True | True | False | False | Changing the value causes the Downstream zone to release the current product . Even if Accumulation is set for this zone , the current product is released |
| InductControlState | Word | 16#0 | True | True | False | False | Used as a "Wake up" signal . If '4' is written the Zone will attempt to accept product . If 1 is written the zone will stop accepting . |
| DishargeControlState | Word | 16#0 | True | True | False | False | Used as a "Lane full" signal .Set 5 to cause the zone to accumulate product here . Set 1 to allow the zone to release the product . |
| ModuleInductTrackingOnInductSide | DWord | 16#0 | True | True | False | False | When the conveyor is running in configured direction ,writing Tracking data here will cause the next product to appear on the zone to have this tracking data assigned . |

| | Totally Integrated Automation Portal | | | | | | | |
|---|---|---|---|---|---|---|---|---|

| Name | Datentyp | Defaultwert | Erreichbar aus HMI/OPC UA | Schreib-bar aus HMI/OPC UA | Sichtbar in HMI En-gineering | Einstell-wert | Kommentar |
|---|---|---|---|---|---|---|---|
| ModuleInductTrackingOnDischargeSide | DWord | 16#0 | True | True | False | False | When the conveyor is running in opposite to configured direction ,writing Tracking data here will cause the next product to appear on the zone to have this tracking data assigned . |
| ClearMotorError | Word | 16#0 | True | True | False | False | Writing '1' to this field clears the MDR error .There needs to be a transition from 0 to 1 in order to clear the error . |
| Reserved | Word | 16#0 | True | True | False | False | |
| Reserved_1 | Word | 16#0 | True | True | False | False | |
| Convey_stop_control | Word | 16#0 | True | True | False | False | Writing '1' causes the Stop group to go into STOP state . Writing '2' clears the STOP state. Transition 0 - 2 is needed to clear the Stop |
| JamClearUpstream | Word | 16#0 | True | True | False | False | Transition of this value from '0' to '1' clears the JAM condition on the zone |
| JamClearDownstream | Word | 16#0 | True | True | False | False | Transition of this value from '0' to '1' clears the JAM condition on the zone |
| GlobalDirectionControlUpstream | Word | 16#0 | True | True | False | False | Used to change direction of flow or accumulation mode for a continuous group of zones beginning with the local zone . |
| GlobalDirectionControlDownstream | Word | 16#0 | True | True | False | False | Used to change direction of flow or accumulation mode for a continuous group of zones beginning with the local zone . |
| ▼ Future | Array[24..31] of Word | | True | True | False | False | |
| Future[24] | Word | 16#0 | True | True | False | False | |
| Future[25] | Word | 16#0 | True | True | False | False | |
| Future[26] | Word | 16#0 | True | True | False | False | |
| Future[27] | Word | 16#0 | True | True | False | False | |
| Future[28] | Word | 16#0 | True | True | False | False | |
| Future[29] | Word | 16#0 | True | True | False | False | |
| Future[30] | Word | 16#0 | True | True | False | False | |
| Future[31] | Word | 16#0 | True | True | False | False | |

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