



Installation and Maintenance Manual

Model: Conveyor Director AC 1.0

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a TOYOTA ADVANCED LOGISTICS company

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Term and Acronym Definitions

TERM/ACRONYM	DEFINITION
2 Groove	Roller format which uses O-Rings to transfer rotational motion from one roller to another in DC conveyor.
Accumulation	The collection or staging of multiple cartons, cases, or totes of product on conveyor.
Back pressure	Pressure against carton(s) in the direction of carton flow resulting from weight of densely accumulated cartons.
BOM	Bill of Materials
Brake Solenoid	Motorized drive roller (Solenoid) with mechanical brake.
Brake Roller	A powered roller with an internal mechanical brake needed to hold cartons, cases, or totes position in incline, decline, or e-stop conditions. Brake applies whenever the leads are de-energized.
BZPDC	Belted Zero Pressure Direct Current; DC belted conveyor format powered by Solenoids with the intent to maintain zero pressure conditions
Carton or Case	Term for conveyable items generally contained in cardboard boxes.
CB	Carriage bolt
CCW	Counter-clockwise
CDAC 1.0	Conveyor Director Control Card 1.0 - Bastian Solutions' dual zone control card designed for zero pressure control of low-voltage (24V or 48V nominal) DC powered Solenoids.
CW	Clockwise
DC	Direct current
DC Card	A control card used to power and control the logic used when operating a Solenoid in DC conveyor applications.
Diffuse	A photoeye format that houses both the emitter and receiver and senses an object when the light beam is reflected back to the sensor. This type of photoeye is a standalone unit and does not use reflectors.
Discharge	The point where cartons, cases, or totes exit a conveyor or similar unit used in a material handling system.
Divert	(noun) A conveyor unit used to change the direction of a carton, case, or tote in a controlled manner. (verb) To change the direction of a carton, case, or tote in a controlled manner.
Double-dispense	Event in which two or more cartons are dispensed by a shotgun zone when a single carton, case, or tote is requested. This is generally a result of two cartons, cases, or totes being in full contact just prior to reaching the shotgun zone.
E-stop	A highly visible button or pull cable designed to shut down equipment in the case of an emergency.

TERM/ACRONYM	DEFINITION
Gapping	The separation of cartons, cases, or totes which are initially in contact with one another. Generally done by progressively increasing the speed of consecutive zones, forcing cartons, cases, or totes to "pull a gap."
Guide Rail	Mechanism used to maintain the desired position of conveyable cartons, cases, or totes on their respective conveying surface.
Infeed	The point where cartons, cases, or totes enter a conveyor or similar unit used in a material handling system.
Live	A zone of conveyor runs "live" when it runs whenever energized. It is for this reason that live zones of conveyor do not have or need any photoeyes or reflectors.
LOTO	Lockout Tagout
Mark Number	A numeric or alphanumeric term used to uniquely identify a conveyor bed or collection of beds (of similar model type) within a material handling system.
Match	A mark made on mating conveyor assemblies to assist in identifying orientation and placement within a system.
Solenoid	Motorized drive roller; DC powered conveyor roller with an internally mounted motor which may be controlled via internal or external commutation.
MSD	Master specification document; a document used to describe a product's intended capabilities, appearance, and interaction with users.
OAW	Overall width of any given conveyor bed.
OSHA	Occupational Safety and Health Administration
PELV	Protected Extra Low Voltage, a voltage level (less than 60V DC or 25Vrms AC in the context of EN 60204-1) that is low enough to be safe in the case of indirect or small area direct contact. PELV circuits are required to be connected to earth ground.
PE	Photoeye; Device used to detect the presence of an object-such as a carton, case, or tote-by use of an emitter and receiver (not necessarily in the same unit as one another).
PM	Project Management (or Project Manager)
PO	Purchase Order
Poly-V	A band or roller hub format with longitudinal ribs used for power transmission in DC conveyor applications.
PPE	Personal protective equipment
Prox Sensor	A sensor able to detect the presence of nearby objects without any physical contact.
Reflector	A reflective component needed for retroreflective photoeyes to receive transmitted light or radiation when no object is in front of the photoeye.
Retroreflective	Of or relating to a surface or device that reflects light or other radiation back to its source.

TERM/ACRONYM	DEFINITION
RLVDC	Roller Live Direct Current; DC roller conveyor powered by live Solenoids.
Roller	Powered or unpowered cylindrically shaped material handling component used for mechanical power transmission, a conveying surface, and/or support for a belted conveying surface.
RZPDC	Roller Zero Pressure Direct Current; DC roller conveyor powered by Solenoids with the intent to maintain zero pressure conditions.
RZPDCS	Roller Zero Pressure Direct Current Skew; RZPDC format conveyor configured as a skew.
Shingling	Event in which surfaces of adjacent cartons, cases, or totes are forced to lift off the conveyor due to elevated uneven carton, case, or tote back pressure.
Shotgun	Zone of conveyor (typically BZPDC) located at the discharge end of a conveyor mark. Used to accelerate a carton, case, or tote enough to get it well within the conveying path of another mark (typically RZPDC or RLVDC) mounted perpendicular to the initial mark.
Side Cover	A PVC cover used to conceal and protect electrical components and wiring from foreign debris and moving obstacles.
Side Frame	Structural member used to support rotating components needed for conveyor beds.
Singulation	The active separation of cartons, cases, or totes.
Skew	A format of DC conveyor where one end of all rollers are shifted one roller position to provide an angled conveying surface for left or right justification of cartons, cases, or totes.
SKU	Stock Keeping Unit; Product and service identification code for a product (i.e. bar code).
Train	The release or activation of all zones in a line of accumulating conveyor at the same time while still maintaining zero back pressure between products.
Wire Ferrule	Metal tube crimped over stranded wire to make a uniformly shaped terminal for increased connection quality and consistency.
Wiz Nut	A serrated flange nut used to cut into the surface of the component it is tightened against.
Zero Pressure	Condition where adjacent cartons, cases, or totes are not in contact with one another.
Zone	Any section of DC conveyor driven by a single Solenoid.
ZPA	Zero Pressure Accumulation; a method of collecting, staging, and/or transporting multiple cartons, cases, or totes of product on conveyor while making sure they do not touch.

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Reference Documents

MANUFACTURER	DOCUMENT TITLE	URL
Bastian Solutions Conveyor	Side Cover and Guiderail Installation Manual	https://www.bastiansolutions.com/assets/1/6/zipline_side_covers_and_guide_rail_installation_manual.pdf
Bastian Solutions Conveyor	Support Installation Manual	https://www.bastiansolutions.com/assets/1/6/zipline_conv_eyor_supports_installation_manual.pdf

1 Introduction

Thank you for choosing Bastian Solutions' conveyor. The following manual serves as a guide for installation, part replacement, and general maintenance for your material handling equipment. It is important to read the manual and follow any instructions as it provides important safety information for personnel and will maximize the longevity of the conveyor.

The information contained in this manual applies only to the products described. Uses, activities, or processes related to installing or maintaining the equipment that are not explicitly described in this manual are considered out of scope, and all in-built equipment protection methods or safety-related components may be compromised as a result. Please contact Bastian Solutions for any questions or support that is not clearly addressed in this document. Bastian Solutions is not responsible for misuse of the equipment described in this manual or misuse of information in this manual. If you have any questions, contact Bastian Solutions' conveyor support at ConveyorSupport@BastianSolutions.com.

2 OSHA and Safety

Bastian Solutions is not responsible for ensuring that conveyors used in a system abide by OSHA standards. Safety is of primary importance to our company, but as a product distributor we ask that system integrators and end users conform with all applicable OSHA standards. We encourage that all warnings in this manual are followed to avoid unnecessary risk. If Bastian Solutions' CDAC 1.0 control card is not used as instructed in this manual, the protection provided by the equipment may be impaired. The following categorizes and defines all forms of warnings used on the equipment and throughout this manual:



Outlines a hazardous scenario which will result in death or serious injury if not avoided.



Outlines a hazardous scenario which could result in equipment damage.



Provides additional information beyond the immediate scope of the discussion



This symbol on the control card indicates that all safety-related precautions that should be taken while using the card will be found in this manual. Additionally, the user will be able to find the answer to most of their questions and concerns pertaining to the control card in this manual.

3 **Model: Conveyor Director 1.0**

Bastian Solutions' Conveyor Director AC 1.0 (CDAC 1.0) is a dual-zone control card designed for zero pressure control of belt-under-roller conveyor actuated by pneumatic solenoids. To provide for application flexibility, CDAC 1.0 has the following features:

- Selectable singulation, enhanced singulation, and train release modes
- Independent per-zone on and off delay settings
- 1 configurable 24V discrete input and 1 configurable 24V discrete output per zone, as well as courtesy power and ground for a wakeup photoeye
- Peer-to-peer communications network with the ability to push settings changes to all connected cards, and to restore settings upon card replacement
- Dedicated per-zone live running mode switch, for live operation without accumulation, or for troubleshooting
- Discrete error signal output
- Compatible with 24V DC solenoids up to 5 watts.



This control card is intended for indoor use only. If used on outdoor equipment, the continued functionality of the control card cannot be guaranteed, and the control card will likely be damaged.

4 **Receiving**

Conveyor Director control cards can be shipped in one of two different forms; installed on Bastian Solutions' conveyor product or shipped loose. A card would typically be shipped loose either for spares orders or if the application requires various atypical mounting procedures.

When shipped as a spare part, Conveyor Director control cards will arrive fully assembled with labels applied as appropriate. As received, it should be ready to install using existing power harness(es), communication cables, photoeyes, Solenoid cables or extension cables, I/O wiring, and bolting hardware as required. Spare Conveyor Director control cards will not come with any of said equipment unless they are ordered separately as needed.

Whether shipped as a spare part or installed on Bastian Solutions' conveyor product, when receiving Conveyor Director control cards, always perform the following:

- Validate received item quantity using the Bill of Lading
- Visually inspect equipment to identify any damage that may have occurred during shipping
- Document equipment damage with pictures

If there are any missing or damaged components, contact your Bastian Solutions' conveyor representative and provide them with pictures and as much detail as possible. Refer to your respective product Installation and Maintenance Manual(s) for an in-depth discussion of what is intended to arrive onsite along with your new equipment, located at BastianSolutions.com. If you are unaware of your how to contact your Bastian Solutions' conveyor representative, contact customer service at

ConveyorSupport@BastianSolutions.com.

5 **Installation**

When you purchase Bastian Solutions' conveyor products that use the CDAC 1.0 control card, it will arrive installed and tested. Once electrical installation of your conveyor product is complete as recommended in the respective installation and maintenance manual, your control card should not require further mechanical or electrical installation beyond what is required for I/O-based control or monitoring the

control card(s) in question (both of which are application specific and will require field installation). See Section 5.3 for details about how to control and monitor your CDAC 1.0 control card.

5.1 Required Hardware (Ships Installed)



All item quantities provided in this section assume the control card is installed on conveyor. If the control card is purchased as a spare part, it will not come with the hardware listed.

- (1) 3/8"-16 x 1"-long carriage bolt
- (1) 3/8"-16 wiz nut

5.2 Required Electrical Components (Ship Installed)



All item quantities provided in this section assume the control card is being used to drive two zones. If the control card is driving one zone, or if one of the zones is running live, these cable quantities may be inaccurate.

- All configurations:
 - (1) 24V power harness
 - (2) Solenoid cables
 - (2) RJ45 communication cables
 - (2) Photoeyes with M8 4-pin pigtail (or M8 4-pin extension cable)
 - RJ45 termination resistors (for the first and last cards in a string of connected cards)

5.3 Electrical Install



Ensure all Bastian Solutions' conveyor products using CDAC 1.0 are given a direct electrical connection to earth ground at the negative rail of the DC power supply. If not connected to earth ground, some voltages will be floating which can lead to unpredictable zone behavior and potential equipment damage.

6 Technical Specifications

Table 1: Technical Specifications and Performance Criteria

ITEM	SPECIFICATION	MIN	TYP.	MAX	UNITS	NOTES
Bus Power	Rated Voltage	21.6	24	26.4	VDC	
	Rated Input Current	--	150	2000	mA	Measured at 24V
	Ripple	--	--	3%	--	
Solenoid	Output Current (per solenoid)	--	40	210	mA	Measured at 24V
Configurable Inputs, Wakeup Photoeye Input, Zone Photoeye Inputs	Logic Level LOW	0	--	3	VDC	PNP (sinking input)
	Logic Level HIGH	7.5	24	36	VDC	ESD protected to ±30kV
	Input Current	--	0.8	--	mA	Measured at 24V
Configurable output, error output	Logic Level LOW impedance to ground	--	100	--	kΩ	PNP (sourcing output)
	Logic Level HIGH	23.5	24	24.5	VDC	Open circuit voltage
	Source Current when HIGH	--	48	--	mA	Short circuit current (per output) ESD protected to ±30kV
Zone Photoeye Power, Courtesy 24V Power	Rated Output Voltage	23.5	24	24.5	VDC	
	Rated Output Current (total)	--	--	390	mA	Resettable polyfused
Ingress Protection		IP20				
Ambient Conditions	Operation	32	--	104	°F	
		0	--	40	°C	
		0	--	90	%RH	Non-condensing
	Storage and Transport	-22	--	167	°F	
		-30	--	75	°C	
		0	--	90	%RH	Non-condensing
Standard Altitude of Operation		0	--	6500	ft	Above sea level
		0	--	2000	m	
Pollution Rating		Pollution Degree 2 (PD2)				

6.1 Board Layout Basic Overview

This section offers a general overview of CDAC 1.0 features. See Section 7 for more details.

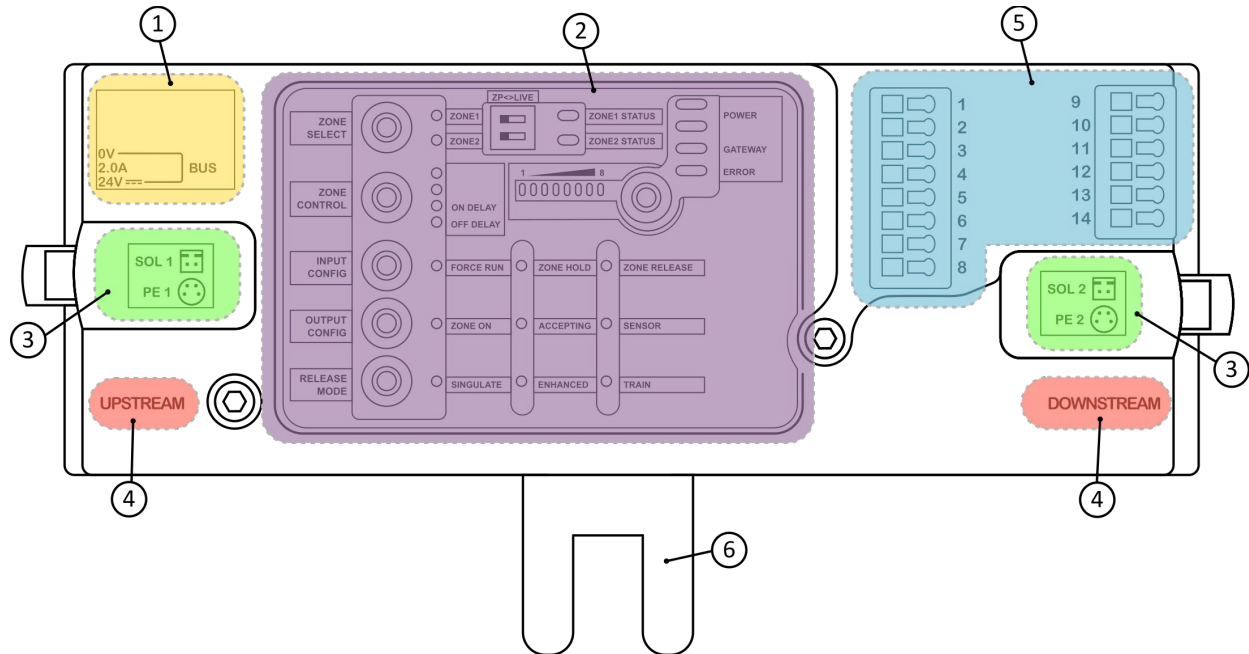


Figure 1: Board Layout Subsystem Identification

- ① Power connection
- ② User interface
- ③ Solenoid and photoeye connection
- ④ UPSTREAM and DOWNSTREAM peer-to-peer communication connections
- ⑤ I/O terminals
- ⑥ Backplane

6.1.1 User Interface

The user interface provides the user with a means of monitoring and adjusting the performance and logic driving your DC conveyor. In total, there are six buttons and two DIP switches used to toggle through and adjust your zone performance parameters. The INPUT and OUTPUT CONFIG buttons allow the user to control how the card responds to input signals, and what output signals it provides at the I/O terminals. Independent of these buttons and switches are five status indicators: ZONE1 state, ZONE2 state, POWER, GATEWAY control, and ERROR state.

6.1.2 Solenoid and Photoeye Connection

There are two solenoid and photoeye connections on each board. Compatible solenoids have 2-pin header style connectors. Compatible photoeyes have 4-pin M8 connectors. Solenoid 1 and PE1 always correspond to the upstream zone, while Solenoid 2 and PE2 always correspond to the downstream zone. If ZPA is required, any driven solenoid must have a corresponding photoeye connected. The only time operation without photoeyes is permissible is when a zone is driven live or controlled by the PLC.

6.1.3 Power

CDAC 1.0 is a dual-zone control card designed to drive 24V solenoids. The card is provided power using power harnesses provided with your Bastian Solutions' conveyor product.

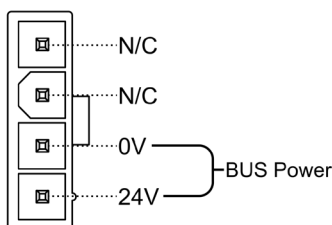


Figure 2: Power Connector Pinout

6.1.4 UPSTREAM and DOWNSTREAM Connections

CDAC 1.0 makes use of RJ45 cables for peer-to-peer communication. Cards connected via these cables use zone status to inform one another about how and when to handle an incoming package, best executing the selected ZPA format. Communication cables will come installed on your Bastian Solutions' conveyor product.

6.1.5 I/O Terminals

There are two sets of I/O spring terminals used for discrete control and monitoring of CDAC 1.0. One is an 8-pin terminal block while the other is a 6-pin terminal block. All pin numbers corresponding to those labeled on the CDAC 1.0 control card case may be found in Table 2 and Table 3.

Table 2: 8-Pin Terminal I/O pinout and functional description

TERMINAL	PIN	NAME	FUNCTIONAL DESCRIPTION
8-Pin Terminal	1	OUTPUT 2	Configurable output offering the user a means of monitoring either Solenoid ON, zone ACCEPTING, or SENSOR flagged in the zone driven by Solenoid 2. See Section 7.2 for additional details.
	2	OUTPUT 1	Configurable output offering the user a means of monitoring either Solenoid ON, zone ACCEPTING, or SENSOR flagged in the zone driven by Solenoid 1. See Section 7.2 for additional details.
	3	INPUT 2	Configurable input used by the control card firmware to identify when to drive Solenoid2. Available configurations are FORCE RUN, ZONE HOLD, and ZONE RELEASE. See Section 7.3 for additional details.

TERMINAL	PIN	NAME	FUNCTIONAL DESCRIPTION
	4	INPUT 1	Configurable input used by the control card firmware to identify when to drive Solenoid1. Available configurations are FORCE RUN, ZONE HOLD, and ZONE RELEASE. See Section 7.3 for additional details.
	5	COMMON	Additional connection to ground (optional)
	6	UNUSED	---
	7	COMMON	Additional connection to ground (optional)
	8	UNUSED	---

Table 3: 6-Pin Terminal I/O pinout and functional description

TERMINAL	PIN	NAME	FUNCTIONAL DESCRIPTION
6-Pin Terminal	9	ERR OUT	This pin goes HIGH when the respective control card enters any kind of error state. See Table 7 for ERROR flashing sequence definitions.
	10	UNUSED	---
	11	COMMON	Additional connection to ground (optional)
	12	COMMON	Additional connection to ground (optional)
	13	WAKEUP PE	The wakeup photoeye's output signal lead should be landed here. This connection is used to identify when the first zone in a string of connected cards should drive and induct incoming package(s) when not informed by a PLC.
	14	VCC 24V	24V power intended to be used to power a wakeup photoeye (see Pin 13). This may be used for other purposes as needed; however, it is limited to 390mA total.

7 **Maintenance and Operation**

The longevity and proper functionality of Bastian Solutions' conveyor is based upon standard operating practices and general maintenance of equipment. Setting up a regular maintenance schedule will help to ensure that products comply with the equipment's warranty.

7.1 **Safety During Operation**

The list below explains a series of recommended precautions that should be taken when personnel are near the equipment. This list is not intended to be the only precautions taken, but it serves as a guide of important steps to follow.

1. Only trained personnel should operate, adjust the configuration of, or perform maintenance on a CDAC 1.0 control card.
2. When adjusting the configuration of CDAC 1.0, personnel must keep their bodies and hands clear of the affected conveyor.
3. When operating CDAC 1.0, personnel should ensure the conveyor is clear of debris.
4. Do not perform mechanical work on energized equipment (i.e. remove/replace rollers, adjust floor support height, etc.)
5. Perform regular inspections of control card to ensure no visible damage and firm connections of all cables and discrete connections.
6. If the control card is not working, de-energize equipment and follow site-specific lockout-tagout protocol. Take pictures of the incident, report all known details, and ship the failed control card to Bastian Solutions.



When performing electrical work on Bastian Solutions' conveyor, ensure adherence to all applicable OSHA standards.

7.2 **User Interface**



If the GATEWAY indicator is illuminated, that means the card settings communications are being controlled and monitored by the PLC. If this is the case, any changes made to the card will automatically revert back to the GATEWAY-driven settings.



CDAC 1.0 must be energized for the user to make changes to the settings. When making settings changes, wait for the user interface to dim before removing power (15s after last button press), or settings may not be retained.

7.2.1 **Indicators and Settings Changes**



When the user interface hasn't been touched for 15 seconds or more, it will dim. When making any changes, the first button push will do nothing except brighten the LEDs. The second button push will perform the desired operation.

The control card UI (user interface) offers a means of visually informing the user how a card has been configured and/or what changes are actively being made to the card's configuration. The UI will always reflect the settings of the card, including when it is being configured via a gateway. This section of the manual provides the purpose of all predefined LED indicator illuminations and flashing sequences. When decoding any of the symbols, illumination and/or flashing sequences in Table 5, Table 6, and Table 7, refer to Table 4.

Table 4: Button, LED, and flashing sequence definition symbology key









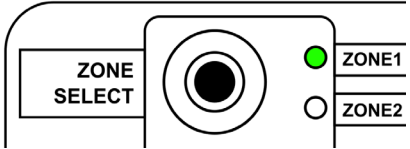
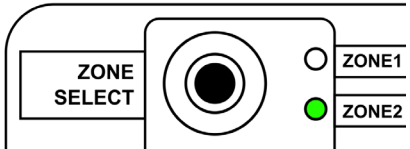
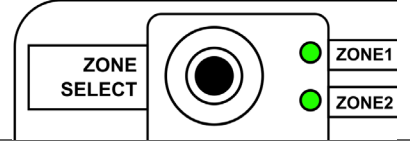
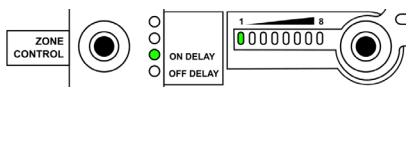
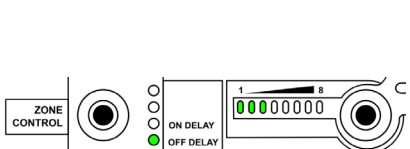
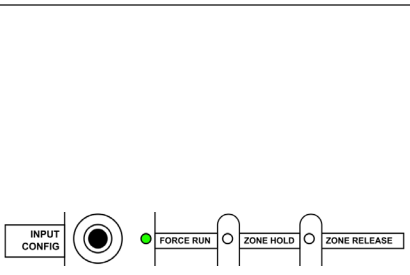
SYMBOL	DEFINITION	SYMBOL	DEFINITION
	Button		ZONE CONTROL Level LED (Table 5)
	DIP Switch ZP (left) and LIVE (right)		FUSE/GATEWAY/ERROR LED (Table 5)
	Illuminated LED (Table 5)		ZONE STATUS LED (Table 5)
	1/2-second pulse		2-second LED pulse (may be red/amber)
	Off LED (Table 5)		
	Off for 1/2-second		

Table 5: User interface regions and use case definitions

NAME	STATE	OPERATION	NOTES	UI INDICATOR ILLUMINATION
ZONE SELECT	ZONE1	All UI settings shown apply to ZONE1. All UI settings adjusted will be applied to ZONE1.	-	
	ZONE2	All UI settings shown apply to ZONE2. All UI settings adjusted will be applied to ZONE2.		
	ZONE1 & ZONE2	All UI settings shown and/or adjusted apply to both ZONE1 and ZONE2.		
ZONE CONTROL	ON DELAY	Adjustable delay in between a triggering event and when the zone starts moving.	Press button to right of ZONE CONTROL to select ON DELAY or OFF DELAY. Press button to the right of "8" to adjust parameter.	
	OFF DELAY	Adjustable delay after a package has exited a zone before the zone turns off.		
INPUT CONFIG	FORCE RUN	If configurable input pin is HIGH, drive respective zone regardless of product position	If adjusting INPUT CONFIG for ZONE1, this affects I/O pin 4	
		If configurable input is LOW, adhere to selected RELEASE MODE (first zone requires wakeup, last zone holds)	If adjusting INPUT CONFIG for ZONE2, this affects I/O pin 3	

NAME	STATE	OPERATION	NOTES	UI INDICATOR ILLUMINATION
INPUT CONFIG (cont'd)	ZONE HOLD	If configurable input is HIGH, hold incoming product	If adjusting INPUT CONFIG for ZONE1, this affects I/O pin 4	
		If configurable input is LOW, adhere to selected RELEASE MODE (first zone does not require wakeup, last zone releases)		
	ZONE RELEASE	If configurable input is HIGH, release incoming product	If adjusting INPUT CONFIG for ZONE2, this affects I/O pin 3	
		If configurable input is LOW, adhere to selected RELEASE MODE (first zone requires wakeup, last zone holds)		
OUTPUT CONFIG	ZONE ON	If configurable output is HIGH, the respective zone is driving	If adjusting OUTPUT CONFIG for ZONE1, the selected signal is mapped to I/O pin 2	
		If configurable output is LOW, the respective zone is not driving		
	ACCEPT-ING	If configurable output is HIGH, the respective zone is available to receive product	If adjusting OUTPUT CONFIG for ZONE2, the selected signal is mapped to I/O pin 1	
		If configurable output is LOW, the respective zone is not available to receive product		
OUTPUT CONFIG (cont'd)	SENSOR	If configurable output is HIGH, respective photoeye is blocked or misaligned		
		If configurable output is LOW, respective photoeye is properly aligned and not blocked		
RELEASE MODE	SINGULATE	Only release package when downstream photoeye is clear	Train mode does not guarantee zero pressure conditions	
	ENHANCED	Release package after the downstream zone has released its package		

NAME	STATE	OPERATION	NOTES	UI INDICATOR ILLUMINATION
	TRAIN	Release package after the downstream zone has released its package		
ZP<>LIVE	ZP	When DIP switch is OFF (in the direction of "ZP" on the label), zone will assume whatever RELEASE MODE is selected	Setting these DIP switches to LIVE overrides all drive-related signals both discrete and gateway-based	
	LIVE	When DIP switch is ON (in the direction of "LIVE" on the label), zone will drive regardless of all input signals		







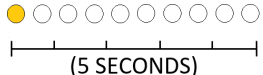
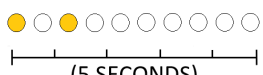
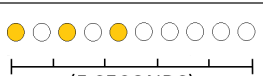
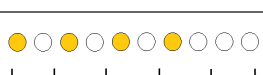
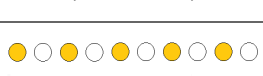


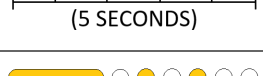
Table 6: ZONE STATUS indicator state descriptions

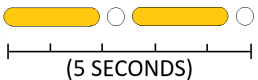
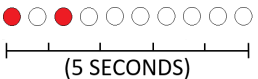
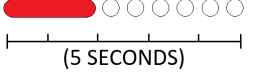
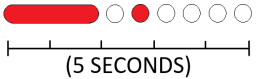
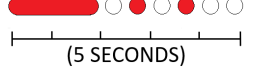

NAME	UI INDICATOR ILLUMINATION	STATE DESCRIPTION
ZONE STATUS		No solenoid is plugged in
		Solenoid is plugged in but non-functional. See ERROR Indicator in Table 7 for respective state descriptions.
		Solenoid is plugged in improperly or not fully seated.
		Solenoid is plugged in and braking. Power is available.
		Solenoid is plugged in and driving.

The POWER, GATEWAY, and ERROR indicator illumination and flashing sequence definitions and appearances may be found in Table 7. Yellow error lights (YXX error code) are advisory warnings and will automatically clear as soon as the condition that has caused the error is removed. Red error lights (RXX error code) remain until cleared by a power cycle.

If an error has been experienced and a relevant error code is identified (or if the control card is displaying a flashing sequence that isn't shown), please provide the respective error code along with your concerns to your Bastian Solutions representative, or Bastian Solutions' conveyor support at ConveyorSupport@BastianSolutions.com.

Table 7: POWER, GATEWAY, and ERROR indicator state descriptions

NAME	UI INDICATOR ILLUMINATION	STATUS CODE	STATE DESCRIPTION
POWER		N/A	Control card is energized
		N/A	Control card is not energized
		N/A	Input fuse is blown
		N/A	Problem with input voltage. See error codes Y01, Y02, and R01
GATEWAY		N/A	Problem with internal power supply regulator
		N/A	Control card is locked out by the gateway. When illuminated, the only manual adjustment that will have any effect is the ZP< >LIVE DIP switch(es).
ERROR		Y01	Control card is unlocked. Gateway is either not connected or is not commanded to lock out the card. Manual settings changes on the UI will work
		Y02	Internal power supply undervoltage
		Y03	Supply voltage too low
		Y04	PLC communication error
		Y05	Card-to-card communication error
		Y10	Stuck UI button
		Y11	Zone jam detected
		Y12	Solenoid overcurrent

NAME	UI INDICATOR ILLUMINATION	STATUS CODE	STATE DESCRIPTION
	 (5 SECONDS)	Y20	Card overtemperature
	 (5 SECONDS)	R02	Supply voltage too high
	 (5 SECONDS)	R10	Internal FW Error
	 (5 SECONDS)	R11	FW update failed
	 (5 SECONDS)	R12	Settings restore failed
	 (5 SECONDS)	R22	Internal hardware error

7.2.2 Manual Multi-Card Programming

If you need to make the same change to all connected cards in the field, perform the following:

1. Press and hold the ZONE SELECT button and ZONE CONTROL parameter adjustment button (shown in Figure 3). The eight level indicators will illuminate one at a time from right to left until all eight are lit, then the ZONE SELECT indicators on all connected cards will start flashing.



Settings that are not modified when in multi-card flashing mode will not change on any cards.

- a. As the user starts making changes, they can press and hold the ZONE SELECT button to see what changes they have made so far. All changes made at that point will illuminate. To continue making changes, release the ZONE SELECT button, and continue as needed.
- b. To complete the change, press and hold the ZONE SELECT button until the card displays the currently active changes, then, while holding ZONE SELECT, press, and hold the ZONE CONTROL parameter adjustment button until you see all user interface indicators illuminate with the new settings.

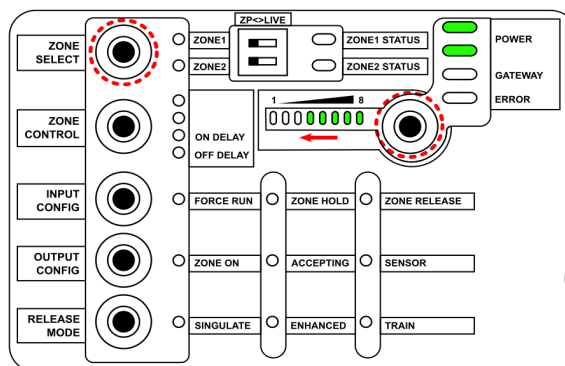


Figure 3: User Interface multi-card programming operation button sequence

NOTE

If the changes being made are no longer required, stop pushing any buttons and all changes will automatically time out after 10 seconds.

NOTE

Duration of button pushes while in this mode are slightly extended to ensure the user is fully aware of the change they are making.

7.2.3 Card Replacement

If there is a need to replace a control card, perform the following:

1. De-energize respective power supply and ensure all personnel and debris are clear of affected equipment.
2. Observe control card settings and document associated card and conveyor conditions (e.g., ERROR state, etc.) prior to removing control card.
3. One at a time, disconnect each cable from the existing card, and connect them to the respective port on the new control card before removing the next cable.
4. Inspect ZP< >LIVE switches of the control card and ensure the new card is set to match the observed existing DIP switch settings.
5. Remove control card by loosening the wiz nut behind the conveyor side frame using a 9/16" socket wrench.

NOTE

For easier installation of your new control card, do not completely remove the existing carriage bolt and wiz nut. Loosen enough to easily remove the damaged control card.

6. Install new control card with all cables plugged in and leads landed (as required):
 - a. Press the wiz nut against the side frame (to maximize clearance between the head of the carriage bolt and the side frame)
 - b. Slide the new card into position from above the carriage bolt
 - c. Release the wiz nut and apply pressure on the head of the carriage bolt, rotating as needed to make sure the carriage bolt square shank is properly aligned with both the heat sink slot and the side frame square hole.
 - d. Finger-tighten wiz nut while making sure cables and wires are clear of any parts that will clamp when torquing the hardware.
 - e. Tighten wiz nut to a nominal value of 31 ft-lb.
 - f. Ensure all cables are connected to the correct ports and plugged in fully.
7. Ensure personnel and debris are clear of equipment and energize power supply.

NOTE

When replacing an existing card with a new card, neighboring cards connected to the card being removed will store and automatically push the settings from the previous card onto the new card.

8. Verify proper conveyor functionality.



If neighbor restore feature is desired with a used CDAC 1.0 card, perform factory reset on used card before installation. See Section 7.2.4. Neighbor restore feature will only trigger if the card has factory default settings when power is first applied. If a used card is installed without first performing a factory reset, the settings on the replacement card will overwrite the neighbor restore settings on adjacent cards.

9. Mail damaged control card to Bastian Solutions, send tracking information, and e-mail your point of contact with the conditions documented in step 2.
10. If cards or card fuses are blowing on a regular basis:
 - a. Ensure there are no shorts or instances of reverse polarity in system power wiring.
 - b. Verify that the control card power supply connector matches the pinout in Figure 2: Power Connector Pinout.
 - c. Ensure all conveyor side frames are electrically bonded and provided a direct connection to earth ground.
 - d. Verify that the solenoid(s) is/are undamaged and plugged in correctly, and solenoid rated voltage matches the system BUS voltage.
 - e. Verify correct wiring and voltage ratings of any devices connected to the terminal I/O blocks.
 - f. If problems persist, refer to the respective technical manual listed in the Reference Documents section of this document.

7.2.4 Manual Factory Reset

If there is a need to perform a manual factory reset on your CDAC 1.0 control card, ensure respective power supply is energized and perform the following:

1. Disconnect all RJ45 communication cables from the card.



If the factory reset is performed without first disconnecting communication cables, it will also clear the neighbor restore settings on adjacent cards.

2. Press and hold the ZONE SELECT button and ZONE CONTROL button (shown in Figure 4). The 3x3 matrix of LEDs indicating Input Config, Output Config, and Release Mode will illuminate in banks of 3, starting from the right and moving left.
3. Once an Input Config LED begins blinking (either “Force Run” or “Zone Release”, the card has entered reset mode. Release the ZONE SELECT and ZONE CONTROL buttons.
4. To confirm the reset, press the “RELEASE MODE” button. The UI will clear and then display factory default settings.
 - a. To cancel the reset process, do not push any buttons and the card will exit reset mode after approximately 30 seconds.
5. Your CDAC 1.0 control card is now factory reset.
6. If you wish for the neighbor restore feature to activate, the COM cables must be reconnected with the power off, then the chain of cards must be powered on.

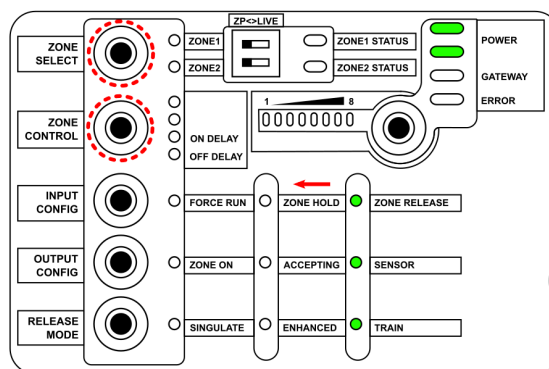


Figure 4: User Interface manual factory reset button sequence

7.2.5 Dynamic Zone Allocation (DZA)

Dynamic Zone Allocation (DZA) mode is a special operating mode where multiple adjacent zones in the same chain can detect and convey over-length packages by behaving as a single longer zone. By default, DZA mode is enabled and will be activated automatically when an extra-long package is detected.

1. Press and hold the ZONE SELECT button and ZONE CONTROL button (shown in Figure 4). The 3x3 matrix of LEDs indicating Input Config, Output Config, and Release Mode will illuminate in banks of 3, starting from the right and moving left.
2. Once an Input Config LED begins blinking (either “Force Run” or “Zone Release”, the card has entered reset mode. Release the ZONE SELECT and ZONE CONTROL buttons.
3. If the blinking LED is “Force Run”, DZA mode is currently disabled. If the blinking LED is “Zone Release”, DZA mode is currently enabled.
4. Press the INPUT CONFIG button to toggle DZA mode enable.

7.2.6 Belt Tracking

Belt tracking mode is a special operation mode, intended for use during installation and commissioning, that allows all zones to be actuated simultaneously. This is used so the influence of the modules on belt tracking can be compensated for.

1. Verify the conveyor is empty of products and all personnel are clear. The air supply to the modules will need to be on.
2. Press and hold the ZONE SELECT button and ZONE CONTROL button (shown in Figure 4). The 3x3 matrix of LEDs indicating Input Config, Output Config, and Release Mode will illuminate in banks of 3, starting from the right and moving left.
3. Once an Input Config LED begins blinking (either “Force Run” or “Zone Release”, the card has entered reset mode. Release the ZONE SELECT and ZONE CONTROL buttons.
4. Press and hold the “MDR Select” button until the Input Config LED stops blinking to enable belt tracking mode. All connected cards of the same chain ID will actuate when belt tracking mode is enabled.
5. To disable belt tracking mode and restore normal operation, repeat steps 1-3, then press and hold the “Mode Select” button until the Input Config LED stops blinking.
6. Belt tracking mode is not a saved setting. Power cycling the cards will also restore normal operation.

7.2.7 UI Lockout Recovery/Reset

When the gateway is controlling the CDAC 1.0 control card in question and manual changes need to be made on the button interface, these changes will be ignored completely. This is called “UI Lockout.” See Table 8 for more details. To recover from (or reset) the UI Lockout, perform the following:

1. Disconnect the upstream and downstream communication cables.
2. Perform a factory reset (see 7.2.4).
3. Change the speed setting of Solenoid 1 (or Solenoid 2) to any value other than original setting.
4. Reconnect the upstream and downstream communication cables.
5. Return the speed setting of Solenoid 1 (or Solenoid 2) to its original speed setting.

7.3 Zero Pressure Operating States

7.3.1 Chain Assignment

For CDAC 1.0 cards to communicate, they must be connected in a string with RJ45 communication cables, which may or may not be connected back to a gateway. Each connected string of cards may be split into one or more “chains” representing independent segments of conveyor. Each chain has a first zone, one or more intermediate zones, and a last zone. Chain breaks may correspond to physical breaks

between mark numbers, but they can also be assigned with a connected gateway or through the Conveyor Director Configurator (Windows software tool). A chain break will always be assigned where the card-to-card communication is not present, so it is possible to force a chain break with a special RJ45 cable, or by unplugging a COM cable. Contact BSC for details if needed.



The RJ45 ports on the CDAC 1.0 cards are not Ethernet ports. Cross-connecting CDAC 1.0 cards to Ethernet devices may result in unintended operation or possible device damage.



Any unused RJ45 ports at the ends of each string of cards should be populated with termination resistors. Resistors are not needed for single cards with no PLC communication, but the presence of these resistors becomes critical with longer runs of cable and larger numbers of cards. If PLC gateway communication problems are observed, check for a missing resistor.

Behavior of a zone varies depending on its operating mode (singulation, enhanced, or train), its input configuration (force on, zone hold, or zone release), and its position within a chain (first, intermediate, or last). Understanding the configuration of chain breaks is important when debugging zero pressure control issues.

7.3.2 Presence Detection

On startup, each card will briefly toggle both zone solenoids. Any zone where a solenoid is detected will be assigned a sequential node ID and will participate in zero pressure accumulation. Any zone where a solenoid is not detected (typically if one zone of the card is not populated due to an odd number of zones per bed) will be skipped over and will not participate.



A random delay in the startup sequence ensures that all solenoids don't fire simultaneously and stress the conveyor's drivetrain. It is normal for the initialization to happen in a random order.

7.3.3 Automatic Indexing

After each zone has initialized, all unoccupied zones will briefly turn on, to ensure any packages between photoeyes are detected by the system. Occupied zones will not run during automatic indexing.



Automatic indexing propagates from discharge to infeed of each chain, with a short delay between each zone, to prevent stressing the conveyor's drivetrain.

7.3.4 Live Mode Switch

The live mode switch has two distinct functions. If a zone is set to LIVE before the card is powered on, that zone will be treated as live during node addressing. The solenoid will be constantly actuated (the zone will always be driving) and it will not respond to configurable input signals or photoeye signals. Changing the LIVE mode switch back to ZP will not have any effect until the card is power cycled.



If an unused zone is set to live, it will cause a chain break in that location.

If the zone is changed from ZP to LIVE while the card is powered on, it will cause the solenoid to immediately actuate (equivalent to setting the configurable input to “Force Run” and pulling it high). Changing the zone back to ZP will restore normal operation without requiring a power cycle. In this state, LIVE zones are always accepting and always releasing from the perspective of surrounding zero pressure zones.

7.3.5 Operating Modes

7.3.5.1 Singulation

In singulation mode, each zone waits for the downstream zone to be fully clear (falling edge of the downstream photoeye) before starting to run. Therefore, when packages are moving down the conveyor, there will be approximately 1 empty zone between each package, and when the packages come to a stop, there will be exactly 1 package in each zone. Singulation mode is the most reliable at keeping packages separated, but has the slowest overall case rate for a given conveyor speed.

7.3.5.2 Enhanced Singulation

In enhanced mode, each zone is allowed to run as soon as the downstream zone is running (with a short propagation delay). Packages moving down the conveyor will travel close together, approximately maintaining the same spacing of 1 package per zone as when they are stopped. Enhanced mode significantly improves case rate over singulation mode, but in certain circumstances (when the downstream zone is stopped due to an external signal) can cause packages to stop between zones. In these cases, normal zero pressure operation of 1 package per zone will be restored when the conveyor starts moving again.

7.3.5.3 Train

Train mode behaves like enhanced singulation mode except during a release event. A release signal sent to the last zone of a chain in train mode, with configurable input set to “Zone Release”, will initiate a train release. During the train release event, all affected zones will run live, ignoring photoeye flags and zero pressure inputs, until the entire train of product has cleared or until the train release signal is dropped. This mode ensures a consistent, high case rate during train release discharges as would be typical to feed a downstream merge bed. Train mode does not guarantee zero pressure operation during the release, and especially if the release is interrupted, products may end up back-to-back, across zone boundaries, or multiple products per zone.

The train release will propagate back from the last zone of the chain to all connected upstream zones in the same chain, which are also in train mode. A zone not in train mode will stop the propagation of the train release signal, and all zones upstream of that point will behave with normal zero pressure operation during the train release.

7.3.6 Zone Behavior with Input Configurations

7.3.6.1 Force Run

If the Force Run signal is LOW:

1. First zone:
 - a. Zone will not run when empty

- b. Zone will run and accept a package whenever the wakeup photoeye is triggered (unless zone is occupied)
 - c. Zone will release a package and send a wakeup signal downstream whenever it has a package and the downstream zone is accepting
- 2. Intermediate zone:
 - a. Zone will not run when empty
 - b. Zone will run and accept a package when a wakeup signal is received from an upstream zone (unless zone is occupied)
 - c. Zone will release a package and send a wakeup signal downstream whenever it has a package and the downstream zone is accepting
- 3. Last zone:
 - a. Zone will not run when empty
 - b. Zone will run and accept a package when a wakeup signal is received from an upstream zone (unless zone is occupied)
 - c. Zone will not release packages

If the Force Run signal is HIGH:

- 1. First zone:
 - a. Zone runs continuously (**regardless of whether downstream zone is accepting**)
 - b. Zone will send a wakeup signal downstream only when the zone photoeye is blocked
- 2. Intermediate zone:
 - a. Zone runs continuously (**regardless of whether downstream zone is accepting**)
 - b. Zone will send a wakeup signal downstream only when the zone photoeye is blocked
 - c. Zone is always accepting of upstream packages
- 3. Last zone:
 - a. Zone runs continuously
 - b. Zone is always accepting of upstream packages

On RISING EDGE of Force Run signal:

- 1. First zone:
 - a. Zone immediately starts running
- 2. Intermediate zone:
 - a. Zone immediately starts running
- 3. Last zone:
 - a. Zone immediately starts running

On FALLING EDGE of Force Run signal:

- 4. First zone:
 - a. Zone will stop running immediately, unless:
 - i. Zone has a package and the downstream zone is accepting, or:
 - ii. Zone is empty and wakeup photoeye is blocked
- 5. Intermediate zone:
 - a. Zone will stop running immediately, unless:
 - i. Zone has a package and the downstream zone is accepting, or:
 - ii. Zone is empty and is receiving a wakeup signal from upstream
- 6. Last zone:
 - a. Zone will stop running immediately, unless:
 - i. Zone is empty and is receiving a wakeup signal from upstream

7.3.6.2 Zone Hold

If the Zone Hold signal is LOW:

1. First zone:
 - a. Zone will run when empty (no wakeup signal sent downstream)
 - b. Zone will accept a package (unless zone is occupied) without need for a wakeup photoeye
 - c. Zone will release a package and send a wakeup signal downstream whenever it has a package and the downstream zone is accepting
2. Intermediate zone:
 - a. Zone will not run when empty
 - b. Zone will run and accept a package when a wakeup signal is received from an upstream zone (unless zone is occupied)
 - c. Zone will release a package and send a wakeup signal downstream whenever it has a package and the downstream zone is accepting
3. Last zone:
 - a. Zone will not run when empty
 - b. Zone will run and accept a package when a wakeup signal is received from an upstream zone
 - c. Zone will immediately release any package that it accepts

If the Zone Hold signal is HIGH:

1. First zone:
 - a. Zone will not run when empty
 - b. Zone will run and accept a package whenever the wakeup photoeye is triggered (unless zone is occupied)
 - c. Zone will not release packages
2. Intermediate zone:
 - a. Zone will not run when empty
 - b. Zone will run and accept a package when a wakeup signal is received from an upstream zone (unless zone is occupied)
 - c. Zone will not release packages
3. Last zone:
 - a. Zone will not run when empty
 - b. Zone will run and accept a package when a wakeup signal is received from an upstream zone (unless zone is occupied)
 - c. Zone will not release packages

On RISING EDGE of Zone Hold signal:

1. First zone:
 - a. If zone is releasing, release and downstream wakeup signal will stop immediately
 - b. If zone is empty, it will stop immediately
 - c. If zone is accepting a product, it will finish accepting then hold the product.
2. Intermediate zone:
 - a. If zone is releasing, release and downstream wakeup signal will stop immediately
 - b. If zone is empty, no change
 - c. If zone is accepting a product, it will finish accepting then hold the product.
3. Last zone:
 - a. If zone is releasing, release will stop immediately
 - b. If zone is empty, no change
 - c. If zone is accepting a product, it will finish accepting then hold the product.

On FALLING EDGE of Zone Hold signal:

1. First zone:
 - a. If zone is occupied and downstream zone is accepting, it will send a wakeup signal and release the product
 - b. If zone is empty, it will start running
 - c. If zone is accepting a product, it will continue accepting
2. Intermediate zone:
 - a. If zone is occupied and downstream zone is accepting, it will send a wakeup signal and release the product
 - b. If zone is empty, no change
 - c. If zone is accepting a product, it will continue accepting
3. Last zone:
 - a. If zone is occupied and downstream zone is accepting, it will release the product
 - b. If zone is empty, no change
 - c. If zone is accepting a product, it will continue accepting

7.3.6.3 Zone Release

If the Zone Release signal is LOW:

1. First zone:
 - a. Zone will not run when empty
 - b. Zone will run and accept a package whenever the wakeup photoeye is triggered (unless zone is occupied)
 - c. Zone will release a package and send a wakeup signal downstream whenever it has a package and the downstream zone is accepting
2. Intermediate zone:
 - a. Zone will not run when empty
 - b. Zone will run and accept a package when a wakeup signal is received from an upstream zone (unless zone is occupied)
 - c. Zone will release a package and send a wakeup signal downstream whenever it has a package and the downstream zone is accepting
3. Last zone:
 - a. Zone will not run when empty
 - b. Zone will run and accept a package when a wakeup signal is received from an upstream zone (unless zone is occupied)
 - c. Zone will not release packages

If the Zone Release signal is HIGH:

1. First zone:
 - a. Zone will run when empty (no wakeup signal sent downstream)
 - b. Zone will accept a package (unless zone is occupied) without need for a wakeup photoeye
 - c. Zone will release a package and send a wakeup signal downstream whenever it has a package and the downstream zone is accepting
2. Intermediate zone:
 - a. Zone will run when empty (no wakeup signal sent downstream)
 - b. Zone will accept a package (unless zone is occupied)
 - c. Zone will release a package and send a wakeup signal downstream whenever it has a package and the downstream zone is accepting
3. Last zone:
 - a. Zone will not run when empty

- b. Zone will run and accept a package when a wakeup signal is received from an upstream zone
- c. Zone will immediately release any package that it accepts

On RISING EDGE of Zone Release signal:

1. First zone:
 - a. If zone is occupied and downstream zone is accepting, it will send a wakeup signal and release the product
 - b. If zone is empty, it will start running
 - c. If zone is accepting a product, it will continue accepting
1. Intermediate zone:
 - a. If zone is occupied and downstream zone is accepting, it will send a wakeup signal and release the product
 - b. If zone is empty, it will start running
 - c. If zone is accepting a product, it will continue accepting
2. Last zone:
 - a. If zone is occupied, it will release the product
 - b. If zone is empty, no change
 - c. If zone is accepting a product, it will continue accepting
 - d. If zone is also in Train mode, create a train release signal and propagate upstream.
Zones affected by the train release signal must:
 - i. Be in the same chain as the zone originating the signal
 - ii. Be connected to the zone originating the signal by an unbroken string of zones in Train mode. Any zone not in Train mode stops the train release signal.
 - e. All zones affected by the train release will run live (equivalent to receiving a Force Run HIGH command) for as long as the Zone Release signal stays HIGH, or until all affected zones are clear of product for 30 seconds.

On FALLING EDGE of Zone Release signal:

1. First zone:
 - a. Zone will stop running immediately, unless:
 - i. Zone has a package and the downstream zone is accepting, or:
 - ii. Zone is empty and wakeup photoeye is blocked
2. Intermediate zone:
 - a. Zone will stop running immediately, unless:
 - i. Zone has a package and the downstream zone is accepting, or:
 - ii. Zone is empty and is receiving a wakeup signal from upstream
3. Last zone:
 - a. Cancel train release signal if present (all affected zones will halt immediately, then resume normal ZP operation)
 - b. Zone will stop running immediately, unless:
 - i. Zone is empty and is receiving a wakeup signal from upstream

8 Controls Integration

The Conveyor Director control card ships with the ability to utilize the CAN communication protocol in order to change settings and read settings from the card. In order to utilize the CAN communication protocol with PLC control, select systems will ship with a CAN-Ethernet gateway in order to allow Allen-Bradley and Siemens PLCs to utilize CAN protocol to control and read settings from the card. When using the gateway, it is best practice to lockout the cards' UI to prevent any unintended changes to card settings. More details on how to use this feature, along with many others, can be seen in the example program in Section 8.1.4.

AOIs are also available for aiding CAN communication between the PLC and CDAC cards.

The following section will detail the configuration of the CAN-Ethernet gateway. It will also detail the use of the Allen Bradley AOIs to interact with the control cards.

8.1 Gateway configuration and troubleshooting

8.1.1 CAN Communicator Configuration

The CAN-Ethernet Gateway that has been selected for gateway controlled systems is the AB7318B Anybus Gateway from HMS networks.

The Anybus gateway acts as a communication protocol translator for ethernet messages sent by and CAN messages received from the control card.

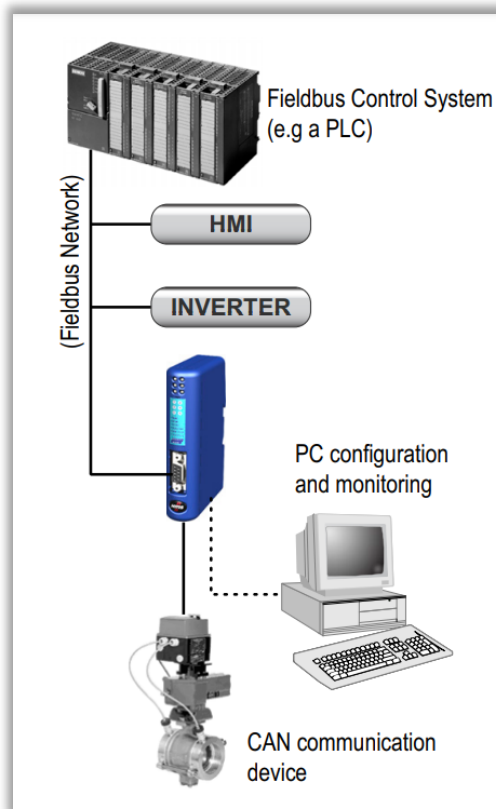


Figure 5: Communication Protocol Connection Diagram

The Anybus gateway works by having a shared memory register internal to the device that both the PLC and control card communicate with. The PLC updates internal tag values to reflect the memory locations present on the gateway on a specific timed program execution cycle.

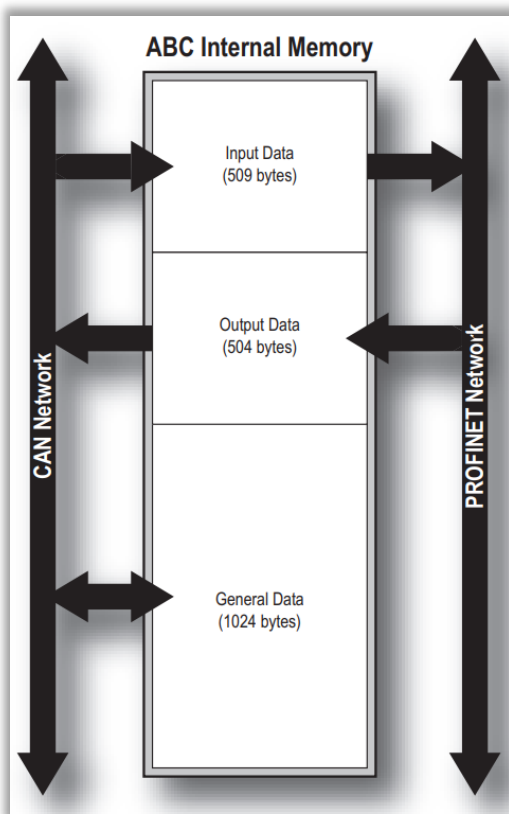


Figure 6: Internal Memory Mapping of Gateway

This may be specified in the configuration of the EDS module within Studio 5000. Instructions for configuring the EDS module can be found in Section 8.1.2.

There are a number of settings that must be specified on the gateway to ensure proper function including:

- a. Network Type
- b. TCP/IP Settings
- c. IP Address
- d. Bit Rate
- e. CAN identifier length
- f. Silence Time

In addition to this core functionality, the gateway must also be programmed for the types of messages and CAN IDs that will represent the control data being sent to and from the control card. These are referred to as transactions. There are five types of transactions:

1. Produce
2. Consume
3. Query/Response
4. Dynamic Produce
5. Dynamic Consume

The conveyor director control card uses many different CAN IDs to communicate to and from the control cards and therefore a dynamic produce and dynamic consume transaction is utilized for the data addressing and internal memory allocation.

Please refer to the **Anybus AB7318B user manual** for more specific information on transaction management and memory allocation.

For ease of configuration the gateway will come with a provided transaction and settings configuration file. On new projects the configuration file will need to be loaded onto the gateway. Projects will not have unique gateway configurations and all projects will operate from the gateway configuration file that will be provided.

To load the correct configuration file on the gateway follow these steps:

1. Download the latest version of the Anybus Configuration Manager - Communicator CAN for the AB7318B resource page on the HMS Networks webpage
<https://www.anybus.com/support/file-doc-downloads/x-gateway-specific?orderCode=ab7318>
2. Place the “Conveyor_Director_Gateway_Configuration.hcg” file in a known location on the same computer
3. Open the Anybus Configuration Manager – Communicator CAN program

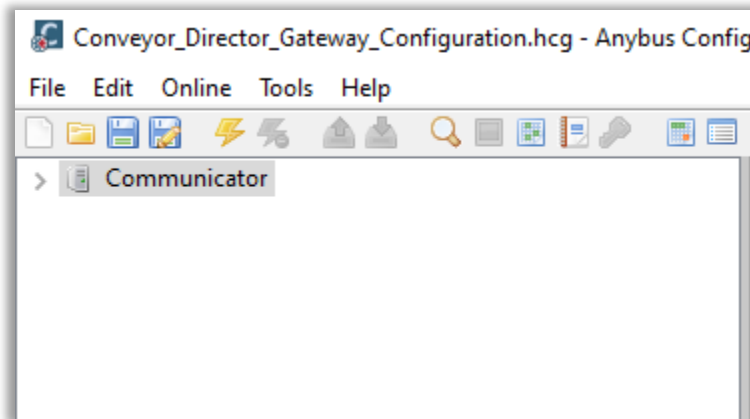


Figure 7: Anybus Configuration Manager

4. Select “File” and then “Open” and navigate to the “Conveyor_Director_Gateway_Configuration.hcg” file
5. Make sure the computer is connected to the CAN gateway with the provided USB-C cable
6. Click on the “Connect” icon which appears as a lightning bolt

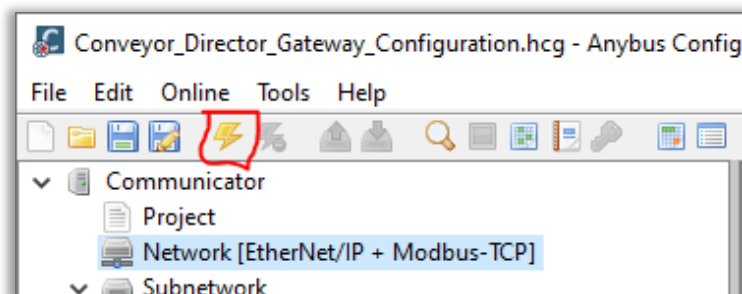


Figure 8: “Connect” icon

7. Click on the “Download Configuration to Device” icon

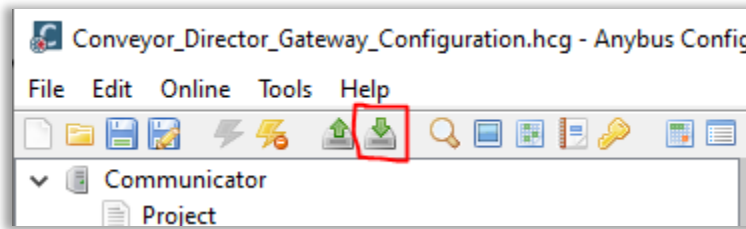


Figure 9: “Download Configuration to Device” icon

8. The gateway will power cycle and resume function with full operational behavior. The CAN gateway configurator comes with a utility that allows you to inspect incoming and outgoing CAN packets. This utility is important for troubleshooting and verifying incoming and outgoing data packets. The utility can be accessed by clicking on the “CAN Line Listener” icon.

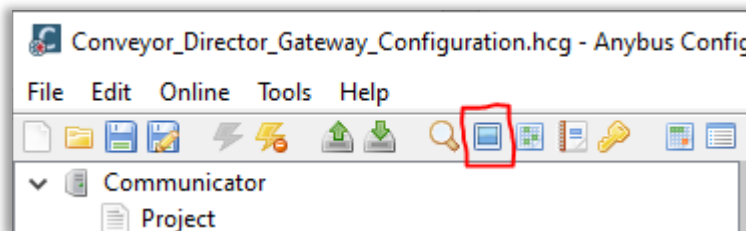
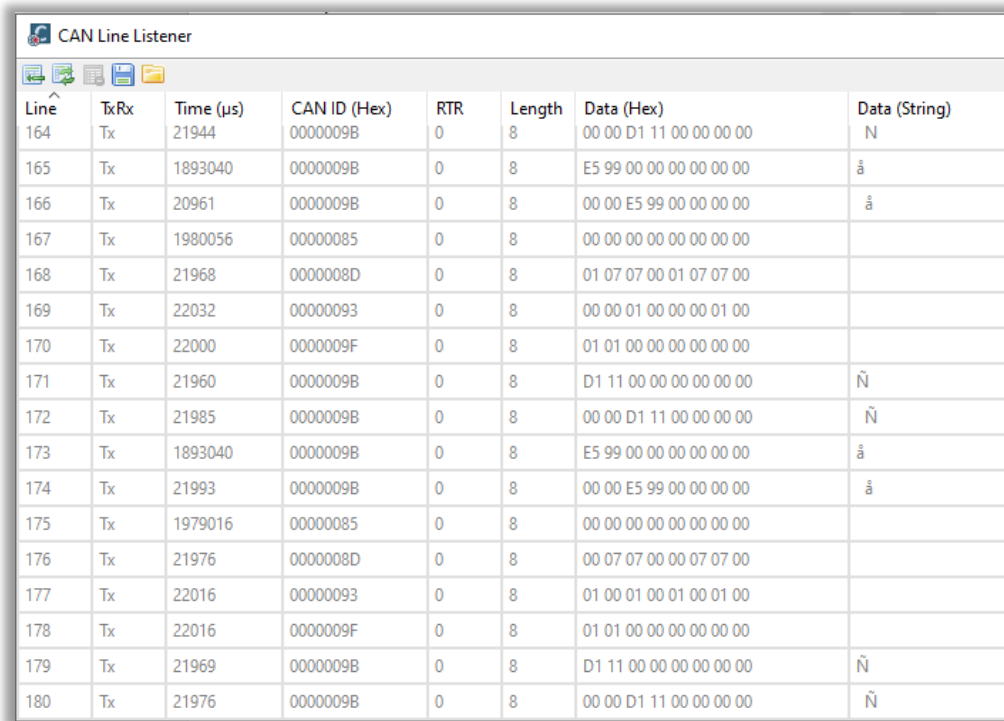


Figure 10: “CAN Line Listener” icon

The line listening utility depicts both incoming and outgoing Tx and Rx CAN information. It also lists the CAN ID, time, length, and data payload. See Figure 11 for more details.



Line	TxRx	Time (µs)	CAN ID (Hex)	RTR	Length	Data (Hex)	Data (String)
164	Tx	21944	0000009B	0	8	00 00 D1 11 00 00 00 00	N
165	Tx	1893040	0000009B	0	8	E5 99 00 00 00 00 00 00	ã
166	Tx	20961	0000009B	0	8	00 00 E5 99 00 00 00 00	ã
167	Tx	1980056	00000085	0	8	00 00 00 00 00 00 00 00	
168	Tx	21968	0000008D	0	8	01 07 07 00 01 07 07 00	
169	Tx	22032	00000093	0	8	00 00 01 00 00 00 01 00	
170	Tx	22000	0000009F	0	8	01 01 00 00 00 00 00 00	
171	Tx	21960	0000009B	0	8	D1 11 00 00 00 00 00 00	Ñ
172	Tx	21985	0000009B	0	8	00 00 D1 11 00 00 00 00	Ñ
173	Tx	1893040	0000009B	0	8	E5 99 00 00 00 00 00 00	ã
174	Tx	21993	0000009B	0	8	00 00 E5 99 00 00 00 00	ã
175	Tx	1979016	00000085	0	8	00 00 00 00 00 00 00 00	
176	Tx	21976	0000008D	0	8	00 07 07 00 00 07 07 00	
177	Tx	22016	00000093	0	8	01 00 01 00 01 00 01 00	
178	Tx	22016	0000009F	0	8	01 01 00 00 00 00 00 00	
179	Tx	21969	0000009B	0	8	D1 11 00 00 00 00 00 00	Ñ
180	Tx	21976	0000009B	0	8	00 00 D1 11 00 00 00 00	Ñ

Figure 11: CAN Line Listener Output

This line listening utility is very helpful to inspect incoming and outgoing transactions to compare expected PLC behavior with card response behavior. Please refer to the CAN API to detail the specific CAN ID and data function codes.

8.1.2 Studio 5000 Gateway Configuration

In order to communicate to the gateway and get information from the gateway, you will need to add the gateway as an ethernet module to the I/O configuration of the PLC. The added module will come with memory tag locations that correspond to the functions that are programmed on the gateway. In order to add the module to the Studio 5000 project perform the following steps:

1. Download the “EDS File for Ethernet/IP” for the module from the AB7318 Files and Documentation website through HMS networks
<https://www.anybus.com/fr/support/file-doc-downloads/x-gateway-specific?orderCode=ab7318>
2. Open the “EDS Hardware Installation Tool” from Rockwell Automation and select the “Add” button.



Figure 12: Rockwell Automation – Hardware Installation Tool

3. Select the “register a single file” radio button and select “browse”. Navigate to the “EDS File for Ethernet/IP” and select “Next” 4 times.

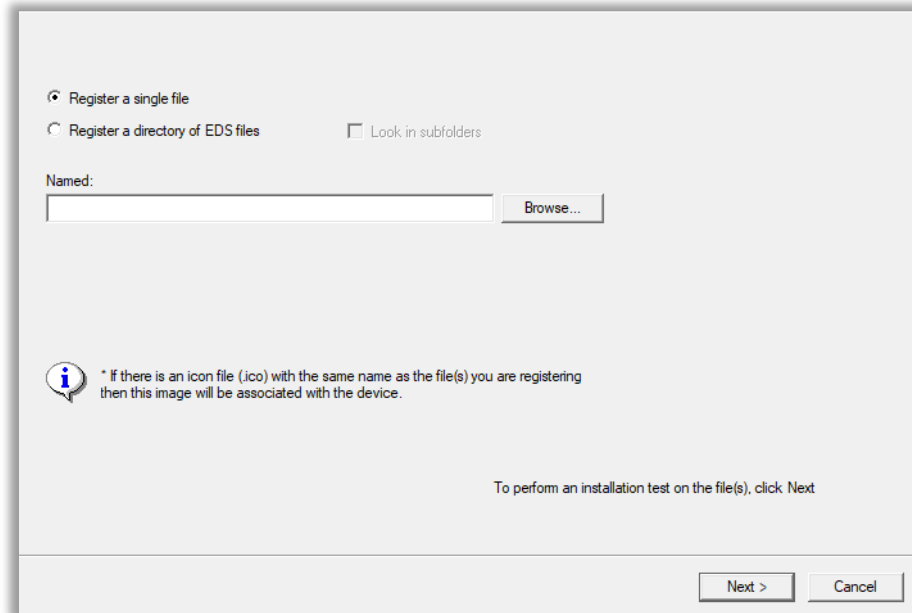


Figure 13: Rockwell Automation – EDS Wizard Prompt

4. Start Studio 5000 and open the project that corresponds to the gateway project you are working on

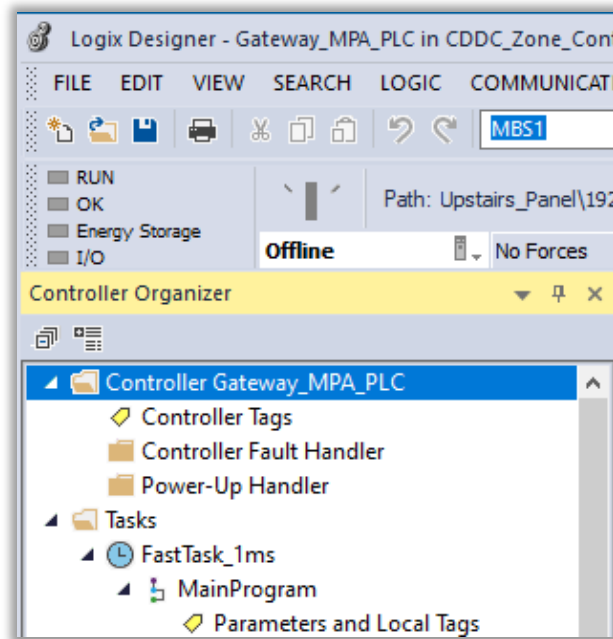


Figure 14: Logix Designer – File Example

5. Navigate to the I/O configuration section and right click the ethernet device to which you are adding the gateway and select “New Module”

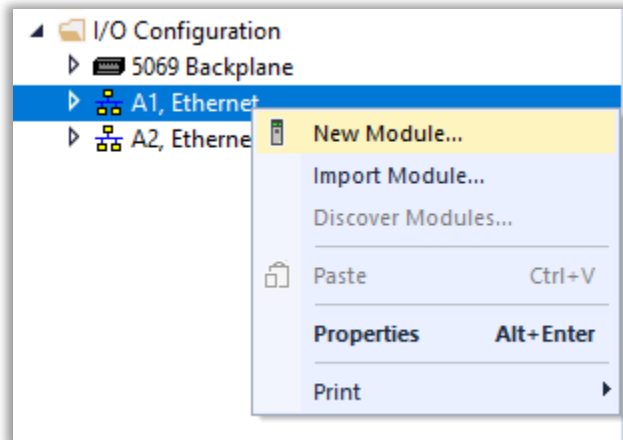


Figure 15: Logix Designer – New Module

6. Select the “AB7318 module by HMS Industrial” and click “Create”

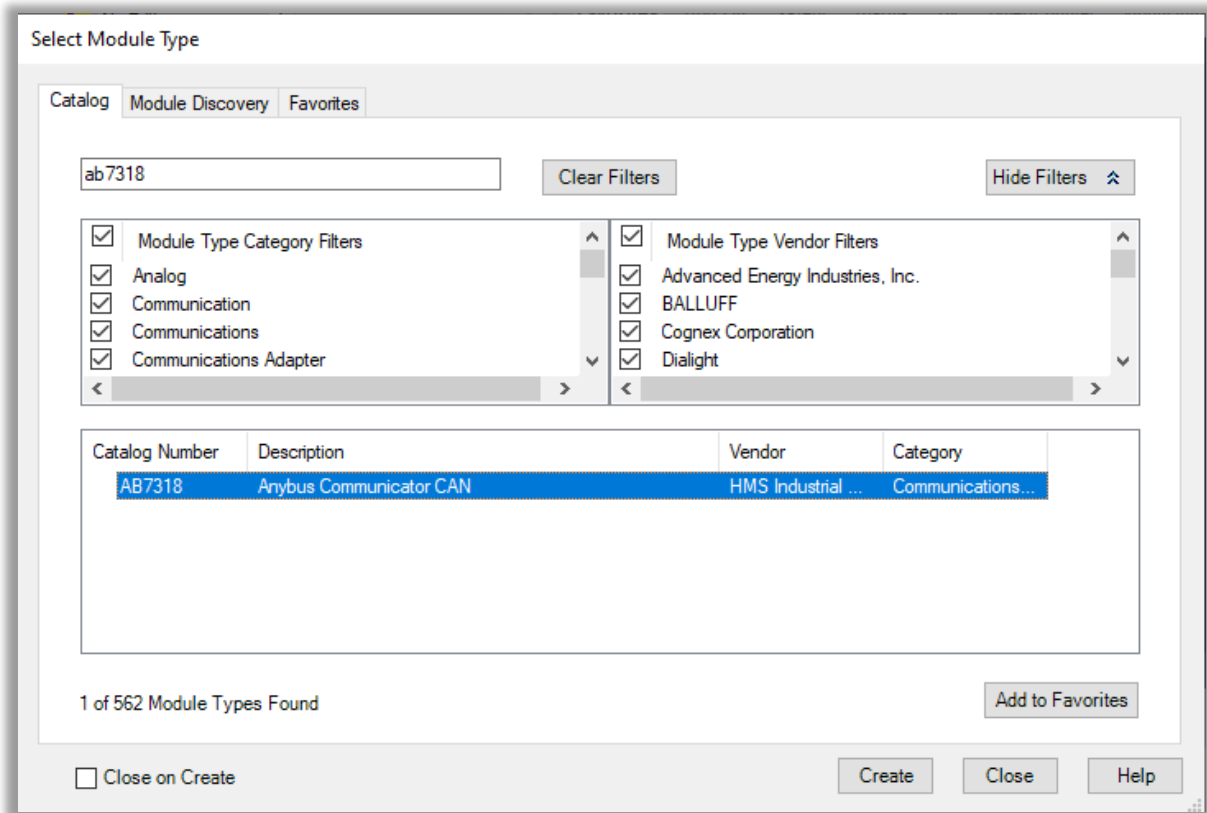


Figure 16: Logix Designer – Connect Anybus Module

7. Choose a descriptive name for the gateway and add the ethernet device name that corresponds with the IP address you have chosen on the gateway

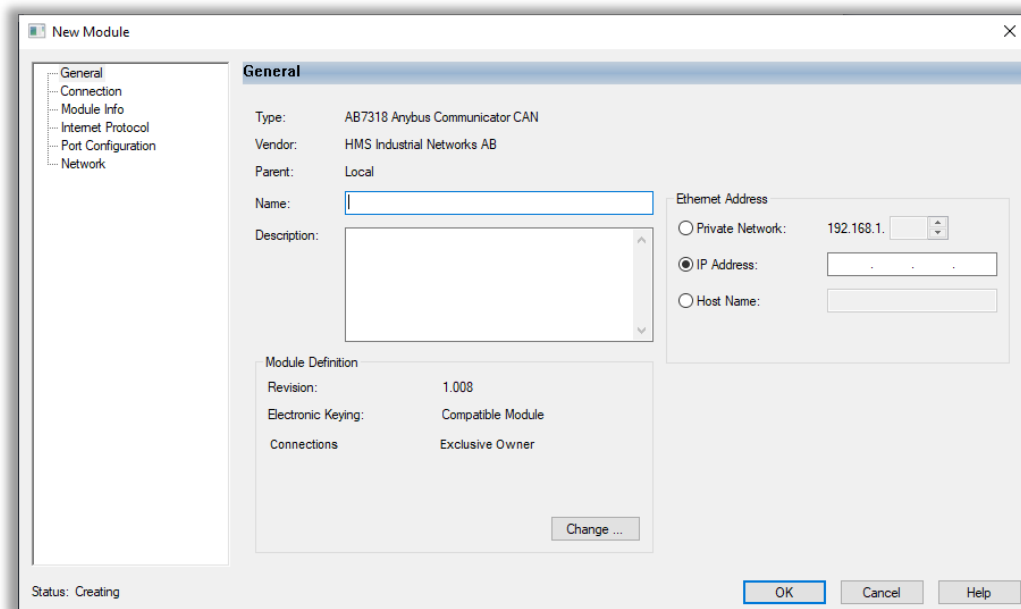


Figure 17: Logix Designer – Module Configuration

8. Click on the “Change” button and select 25 bits for input and 21 bits for output

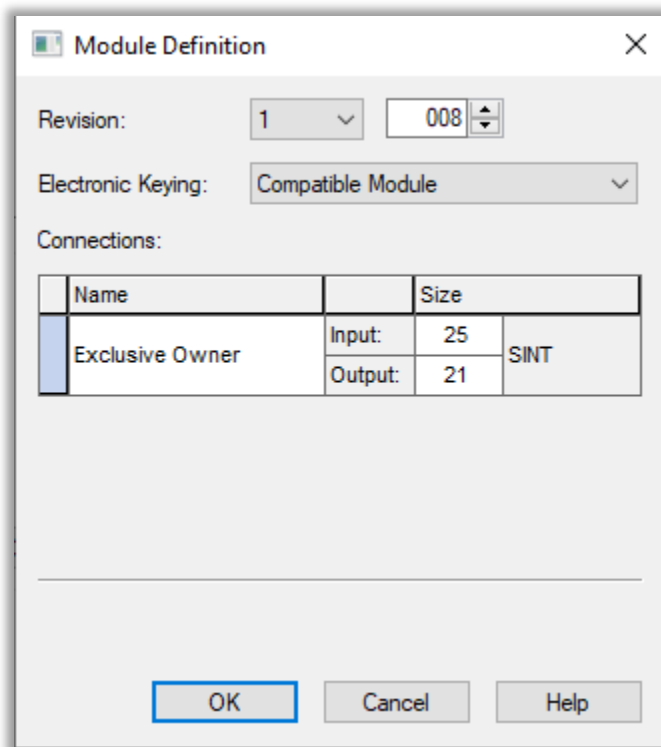


Figure 18: Logix Designer – Gateway Configuration Complete

9. The gateway is now configured and ready to use in the Studio 5000 project

8.1.3 Studio 5000 AOI Import and Utilization

The CDAC control card and gateway use five standardized AOIs for control, configuration, and data collection. These AOIs are the “AOI_Conveyor_Director_Message_Unloader”, “CDAC_Settings_ReadWrite”, “Gateway_Photo_Eye”, “Gateway_Zone_Control”, and “Gateway_Fault_Status” AOIs. The AOIs allow the use of zone control statements for card control, settings changes, photo eye monitoring, and data gathering. The functions and usage of the AOIs are detailed below. To request access to these AOI's, please contact Bastian Solutions' conveyor support at ConveyorSupport@BastianSolutions.com

8.1.3.1 AOI_Conveyor_Director_Message_Unloader

The conveyor director message unloader's primary purpose is the sending and receiving of buffered data to and from the control card to be handled by the controls engineer. The AOI automatically handles the specific hex codes and message timing required for control signals and data collection.

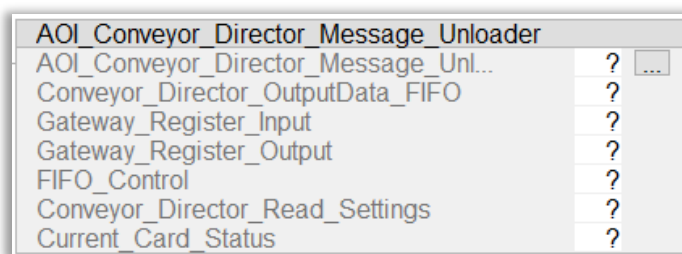


Figure 19: AOI – CDAC Message Unloader

Parameters:

1. AOI_Conveyor_Director_Message_Unloader

Data Type:

AOI_Conveyor_Director_Message_Unloader

Description:

Defines the name of the AOI message unloader. Can be anything descriptive. Will be gateway specific and should include the number and location of the gateway being utilized.

2. Conveyor_Director_OutputData_FIFO

Data Type:

UDT_Conveyor_Director_OutputData_FIFO[100]

Description:

This object defines the data buffer for outgoing information to the control card. Should include a description of the gateway and location in system.

Same tag name used in: CDAC_Settings_ReadWrite, Gateway_Photo_Eye, and Gateway_Zone_Control

3. Gateway_Register_Input

Data Type:

_005A:AB7318_E44F4328:I:0:I.Data

Description:

Corresponds to the physical register space tags associated with the gateway as defined in the gateway configuration procedure. Must be the same tag name created with the definition of the gateway and will have the same name as the gateway configuration.

Example:

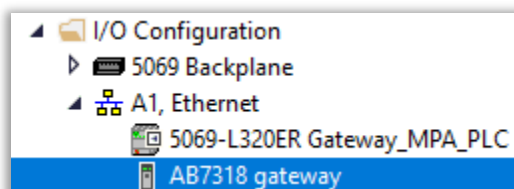


Figure 20: AOI – CDAC Message Unloader – Gateway Register

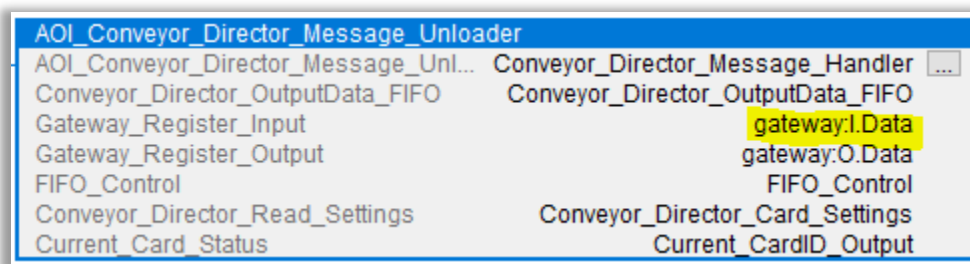


Figure 21: AOI – CDAC Message Unloader – Gateway Register Input

4. Gateway_Register_Output

Data Type:

_005A:AB7318_E939F794:O:0

Description:

Corresponds to the physical register space tags associated with the gateway as defined in the gateway configuration procedure. Must be the same tag name created with the definition of the gateway and will have the same name as the gateway configuration.

5. FIFO_Control

Data Type:

CONTROL

Description:

Corresponds to the FIFO control for the buffered outgoing data to the gateway for transactions.

Same tag name used in: CDAC_Settings_ReadWrite, Gateway_Photo_Eye, and Gateway_Zone_Control

6. Conveyor_Director_Read_Settings

Data Type:

UDT_Conveyor_Director_Settings

Description:

Includes all the most recently read settings in the incoming data memory location. Can be used to examine the most recent settings from the control card. When used in the program, you must keep track of the most recently requested information and save / use the card information that is received back appropriately.

Same tag name used in: CDAC_Settings_ReadWrite

7. Current_Card_Status

Data Type:

UDT_Conveyor_Director_Current_CardID

Description:

Includes the Card ID, Chain ID, and Error status of the most recently read card. This is used to identify which card has had its photoeye flagged or has entered an error state.

Same tag name used in: Gateway_Photo_Eye, Gateway_Fault_Status, and Gateway_Zone_Control

8.1.3.2 CDAC_Settings_ReadWrite

This AOI is used to request a read or write command to the cards via the gateway. The required input parameters (highlighted below) are used to indicate whether to read or write, what card to talk to, and where to store the latest settings. The other optional input parameters are used for writing. When writing, any nonzero value will update the corresponding parameter, and a zero value will not change the parameter setting. This AOI will always read the current card settings before it writes to them.

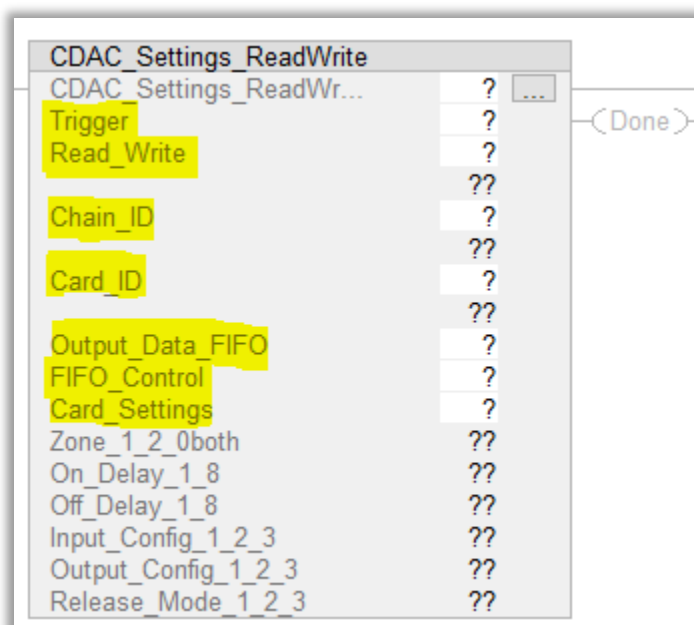


Figure 22: AOI – CDAC Settings Read/Write

Parameters:

1. **CDAC_Settings_ReadWrite**

Data Type:

CDAC_Settings_ReadWrite

Description:

The definition for the AOI for the CDAC_Settings_ReadWrite AOI. Should be named with a description and location of the gateway that is being utilized.

2. **Trigger**

Data Type:

BOOL

Description:

When the trigger is pulled from a logical 0 to 1, the message for a read/write request is queued for transmission to the control card specified by the chain and card id. The trigger remains high until brought low by the user.

3. **Read_Write**

Data Type:

SINT

Description:

Defines a read or write command. Read = 0, Write = 1.

4. **Chain_ID**

Data Type:

DINT

Description:

The chain id of the card that is requested to be read or written.

5. **Card_ID**

Data Type:

DINT

Description:

The card ID of the card that is requested to be read or written.

6. **Output_Data_FIFO**

Data Type:

UDT_Conveyor_Director_OutputData_FIFO[100]

Description:

This object defines the data buffer for outgoing information to the control card. Should include a description of the gateway and location in system.

Same tag name used in: AOI_Conveyor_Director_Message_Unloader

7. **FIFO_Control**

Data Type:

CONTROL

Description:

Corresponds to the FIFO control for the buffered outgoing data to the gateway for transactions.

Same tag name used in: AOI_Conveyor_Director_Message_Unloader

8. **Card_Settings**

Data Type:

UDT_Conveyor_Director_Settings

Description:

Includes all the most recently read settings in the incoming data memory location. Can be used to examine the most recent settings from the control card. These settings are written back to the cards unless otherwise specified by the user (selecting a nonzero value in the optional input parameters).

Same tag name used in: AOI_Conveyor_Director_Message_Unloader

9. **Zone_1_2_0both**

Data Type:

SINT

Description:

Specify the zone to be written to.

Acceptable values: 1 (Zone 1), 2 (Zone 2), 0, (both Zones)

10. **On_Delay_1_8**

Data Type:

SINT

Description:

Specify the On Delay value to be written.

Acceptable values: 0 (no change), 1 (shortest) – 8 (longest)

11. **Off_Delay_1_8**

Data Type:

SINT

Description:

Specify the Off Delay value to be written.

Acceptable values: 0 (no change), 1 (shortest) – 8 (longest)

12. **Input_Config_1_2_3**

Data Type:

SINT

Description:

Specify the Input Configuration setting to be written.

Acceptable values: 0 (no change), 1 (Force Run), 2 (Zone Hold), 3 (Zone Release)

13. **Output_Config_1_2_3**

Data Type:

SINT

Description:

Specify the Output Configuration setting to be written.

Acceptable values: 0 (no change), 1 (MDR On), 2 (Accepting), 3 (Sensor)

14. **Release_Mode_1_2_3**

Data Type:

SINT

Description:

Specify the Release Mode setting to be written.

Acceptable values: 0 (no change), 1 (Singulation), 2 (Enhanced Singulation), 3 (Train)

8.1.3.3 Gateway_Photo_Eye

This AOI is used to detect the state changes of a photoeye (i.e. when a photoeye is flagged or unflagged). It is also used to define a tag name associated with a specific photoeye.

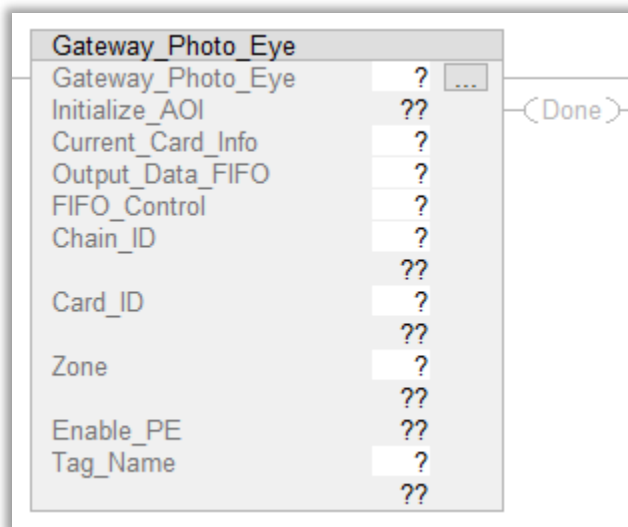


Figure 23: AOI – CDAC Photoeye

Parameters:

1. Gateway_Photo_Eye

Data Type:

Gateway_Photo_Eye

Description:

Defines the Gateway_Photo_Eye AOI object tag.

2. Initialize_AOI

Data Type:

BOOL

Description:

When the initialize trigger is pulled from a logical 0 to 1, the request to enable the photoeye messaging is queued for transmission to the control card specified by the chain and card id. The trigger remains high until brought low by the user. The trigger only needs to be activated once to enable the photoeye.

3. Current_Card_Info

Data Type:

UDT_Conveyor_Director_Current_CardID

Description:

Includes the Card ID and Chain ID used to identify which card has had a change in photoeye state.

Same tag name used in: AOI_Conveyor_Director_Message_Unloader, and Gateway_Zone_Control

4. **OutputData_FIFO**

Data Type:

UDT_Conveyor_Director_OutputData_FIFO[100]

Description:

This object defines the data buffer for outgoing information to the control card. Should include a description of the gateway and location in system.

Same tag name used in: AOI_Conveyor_Director_Message_Unloader

5. **FIFO_Control**

Data Type:

CONTROL

Description:

Corresponds to the FIFO control for the buffered outgoing data to the gateway for transactions.

Same tag name used in: AOI_Conveyor_Director_Message_Unloader

6. **Chain_ID**

Data Type:

DINT

Description:

The chain id of the card that is requested to be written to.

7. **Card_ID**

Data Type:

DINT

Description:

The card id of the card that is requested to be written to.

8. Zone

Data Type:

SINT

Description:

The card zone that is requested to be written to.

Acceptable values: 1 (Zone 1), 2 (Zone 2)

9. Enable_PE

Data Type:

BOOL

Description:

Determines if the photoeye should send messages to the PLC during state changes.

Acceptable values: 0 (Off), 1 (On)

10. Tag_Name

Data Type:

SINT

Description:

Tag name used to indicate when the photoeye has changed states. The tag name should be descriptive to indicate where the photoeye is located and what the function is.

Example: Card5_Z1_FullPE

8.1.3.4 Gateway_Zone_Control

This AOI is responsible for sending zone control messages to a card specified by the chain_id, card_id, and zone. The modifiable parameters for the zone control AOI are the chain_id, card_id, zone, and zone control trigger.

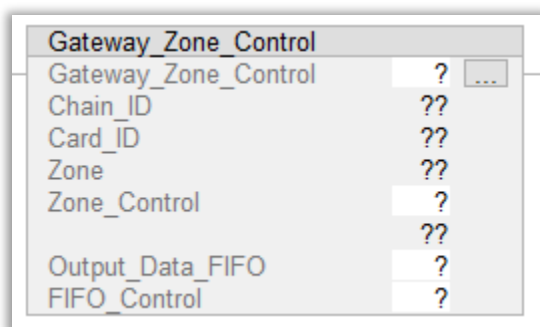


Figure 24: AOI – CDAC Zone Control

Parameters:

1. **Gateway_Zone_Control**

Data Type:

Gateway_Zone_Control

Description:

Defines the Gateway_Zone_Control AOI object tag.

2. **Chain_ID**

Data Type:

DINT

Description:

The chain id of the card that is requested to be written to.

3. **Card_ID**

Data Type:

DINT

Description:

The card id of the card that is requested to be written to.

4. **Zone**

Data Type:

DINT

Description:

Specifies either zone one or two for the control message.

5. **Zone_Control**

Data Type:

BOOL

Description:

The trigger variable to queue a zone control message to be sent to the chain_id, card_id, and zone specified.

6. **Conveyor_Director_OutputData_FIFO**

Data Type:

UDT_Conveyor_Director_OutputData_FIFO[100]

Description:

This object defines the data buffer for outgoing information to the control card. It will need to be used for all instances of the Conveyor_Director_OutputData_FIFO in other AOIs for the gateway being utilized. Should include a description of the gateway and location in system.

Same tag name used in: AOI_Conveyor_Director_Message_Unloader

7. FIFO_Control

Data Type:

CONTROL

Description:

Corresponds to the FIFO control for the buffered outgoing data to the gateway for transactions. Must be the same control used in the other conveyor director AOIs.

Same tag name used in: AOI_Conveyor_Director_Message_Unloader

8.1.3.5 Gateway_Fault_Status

This AOI is responsible for detecting and displaying card specific error messages when the card's firmware enters a fault state. This information is to be used by the controls engineer for troubleshooting and jam detection.

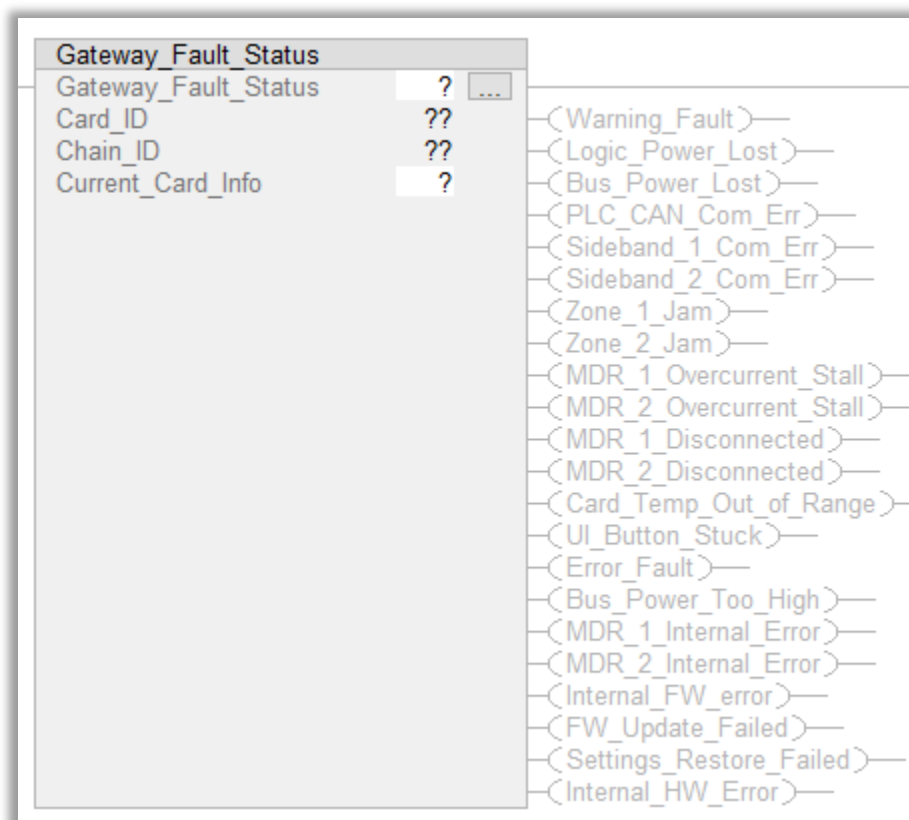


Figure 25: AOI – CDAC Fault Status

Parameters:

1. **Gateway_Fault_Status**

Data Type:

Gateway_Fault_Status

Description:

Defines the Gateway_Fault_Status AOI object tag

2. **Card_ID**

Data Type:

DINT

Description:

The card id of the card that has the most recent error message. Used for diagnostic purposes.

3. **Chain_ID**

Data Type:

DINT

Description:

The chain id of the card that has the most recent error message. Used for diagnostic purposes

4. **Current_Card_Info**

Data Type:

UDT_Conveyor_Director_Current_CardID

Description:

Includes the Card ID, Chain ID, and error information used to identify which card has entered what error.

Same tag name used in: AOI_Conveyor_Director_Message_Unloader

8.1.4 Studio 5000 Example AOI Utilization

The following section will describe a specific use case of the AOIs to achieve functional behavior on the control card. The program in this section utilizes all mentioned AOIs. The script "Gateway_Mapping.L5X" first defines the message handler unloader for all other AOIs to talk to the gateway. The fault status AOI is then defined as an indicator for when any card enters a faulted state. The read/write AOI is then defined for HMI control. The photoeye AOIs are defined for the last two photo eyes in the loop. Lastly, the zone control AOI is placed at the end to force run a zone on command.

1. The AOI_Conveyor_Director_Message_Unloader is defined to set up communication with the gateway.

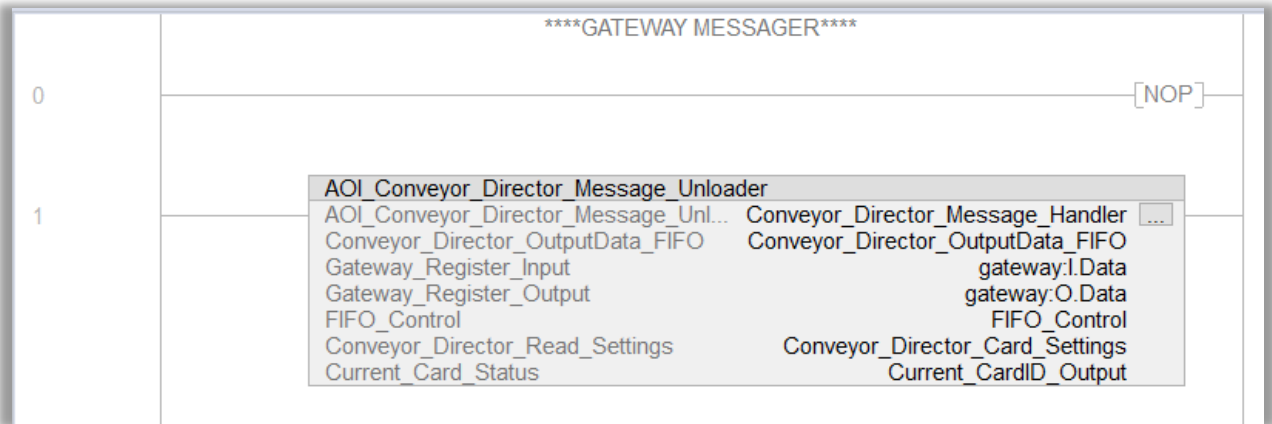


Figure 26: AOI Usage – Gateway Communication Setup

2. The Gateway_Fault_Status is defined to detect card specific faults and set a general signal to abort any ongoing test specified in other scripts.



Figure 27: AOI Usage – CDAC Fault Status Setup

3. The CDAC_Settings_ReadWrite AOI is programmed to be used with an HMI, where the user can toggle “HMI_Upload” to initiate the trigger and read the card settings. Note is it set up such that there must not be a card fault to execute this AOI. Also, is does not matter what values are placed for the card setting – since we are using the AOI to read the card settings, it never writes the input values to the cards.

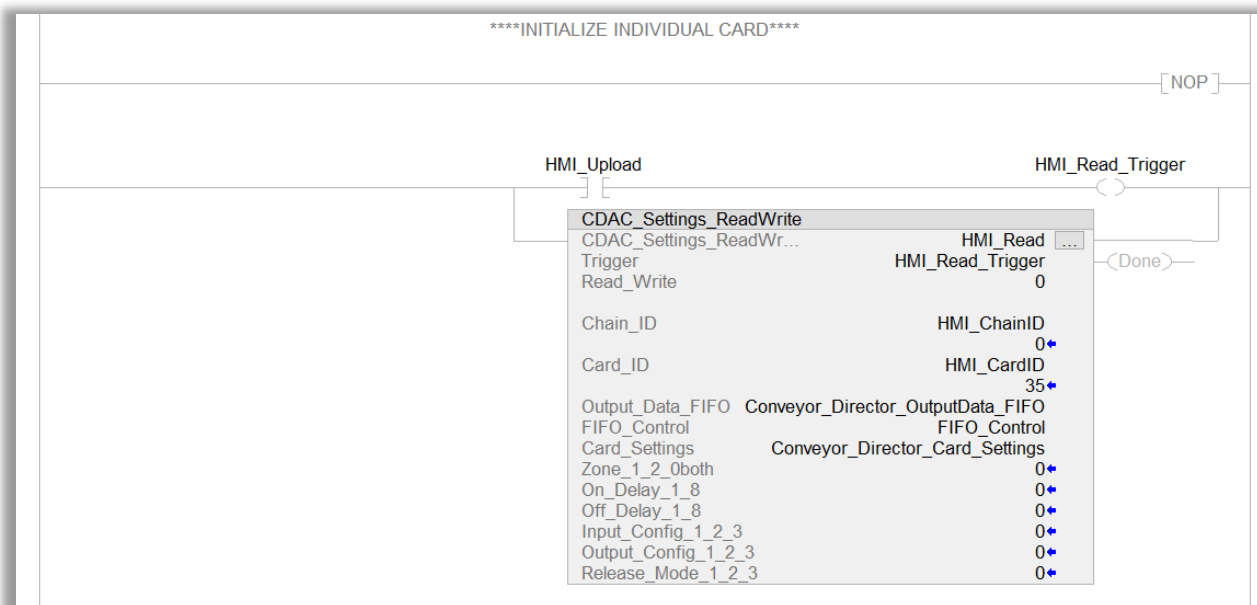


Figure 28: AOI Usage – CDAC Settings Read/Write Setup

- The CDAC_Settings_ReadWrite AOI is also programmed to be used with an HMI, where the user can toggle “HMI_Download” to initiate the trigger and write to the cards. The inputs above the first AOI are not visible but are an additional library of options that can be used for the cards. Below is a summary of what each bit does when energized and written to a specific card:

Table 8: CDAC AOI Bit Definitions

Bit Name	Function
.LOCKOUT	Disables the ability to use the physical button interface (i.e., UI Lockout)
.DISABLE_FORCE_COMMIT	Changes written to the cards do not save when rebooted
.REBOOT	Reboots the card
.DEBUG	Turns on CAN debug messaging
.FIND_ME	Flashes the LEDs on the card's UI
.DISABLE_ERROR_PUSH	Turns off unsolicited error messages coming from the card
.DZA_ON	Turn on DZA mode

When triggered, card 5 zone 1 is written to have an On-Delay value of 8 and an Input Configuration value of 1 (Force Run). All other parameters are unchanged from 0, and therefore do not change. The read/write AOIs must wait for the previous to finish executing by utilizing the .Done output parameter. This separate AOI is needed for zone 2 because it has a different On-Delay value of 7. If both zones had all of the same settings, then a single AOI can be used, and “Zone_1_2_0both” would be 0.

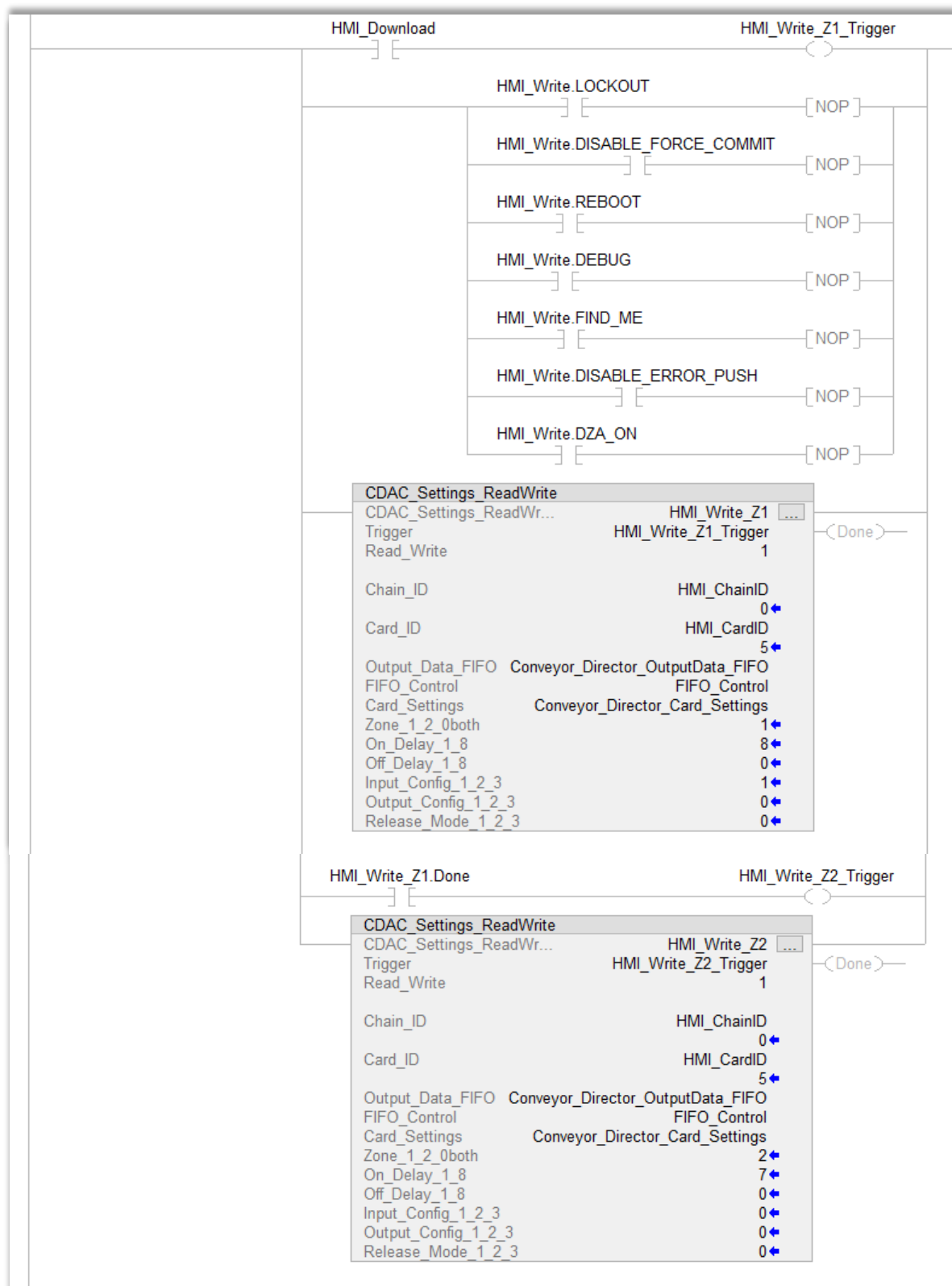


Figure 29: AOI Usage – CDAC Settings Read/Write

- The Gateway_Photo_Eye is enabled for Card 23 Zone 1 and Card 45 Zone 2. Once the user toggles "Enable_Gateway_PE", the AOIs have been initialized and never have to be again. During first initialization, the AOIs must wait for the previous instruction to finish executing by utilizing the .Done output parameter. Thereafter, the user can change the "Enable_PE" input parameter to be 0 (disable) or 1 (enable) to detect the corresponding photoeye's state changes.

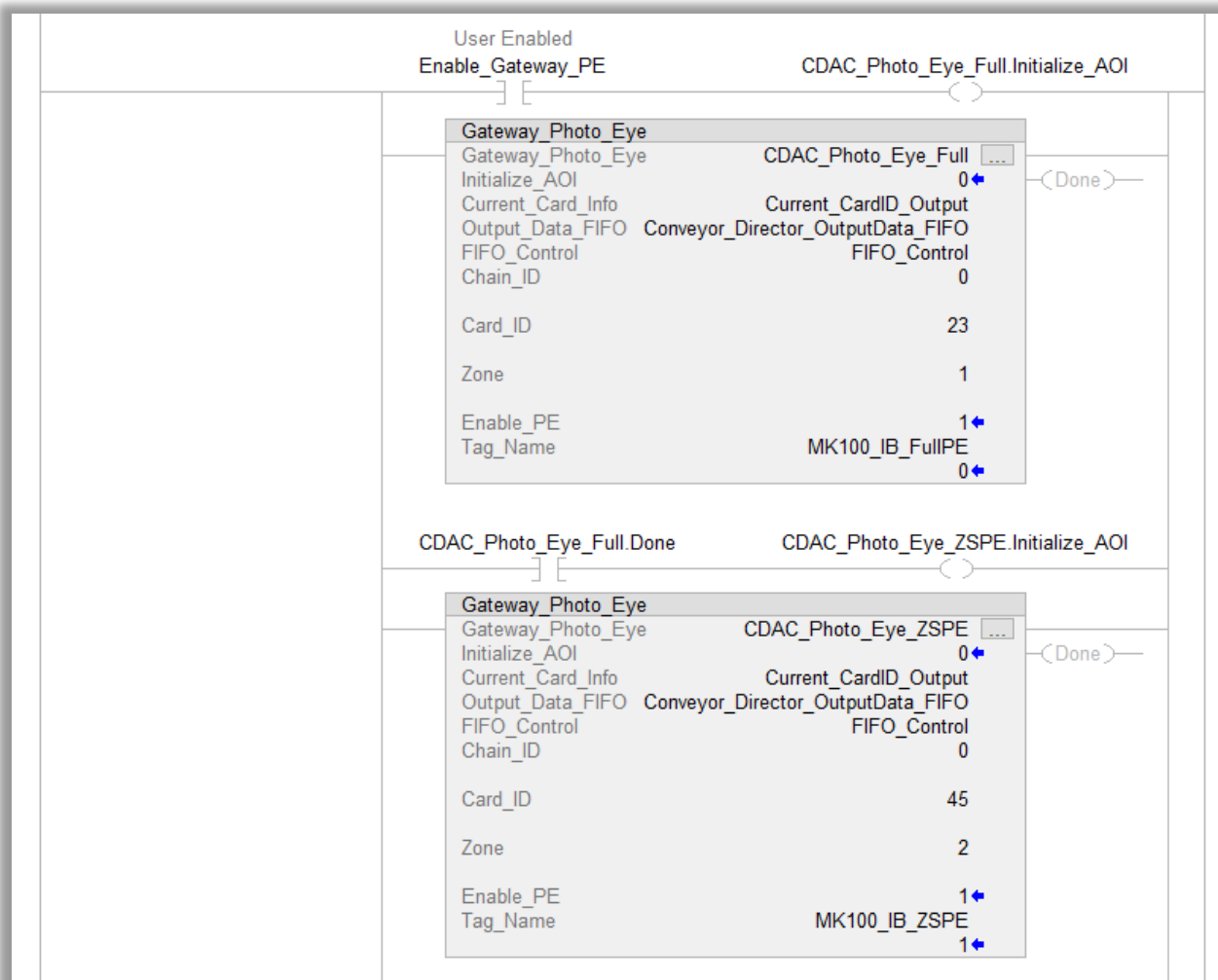


Figure 30: AOI Usage – Photoeye Mapping

6. The Gateway_Zone_Control AOI is used to force run Card 46 Zones 1 and 2. Once the user toggles "Force_Run_Example" the zone control triggers are enabled and turn the conveyor zones on. Note Card 46 has both zones to be set as force run from the CDAC_Settings_ReadWrite AOI described in step 4. The example below sets the general configurable input zone control high/low.

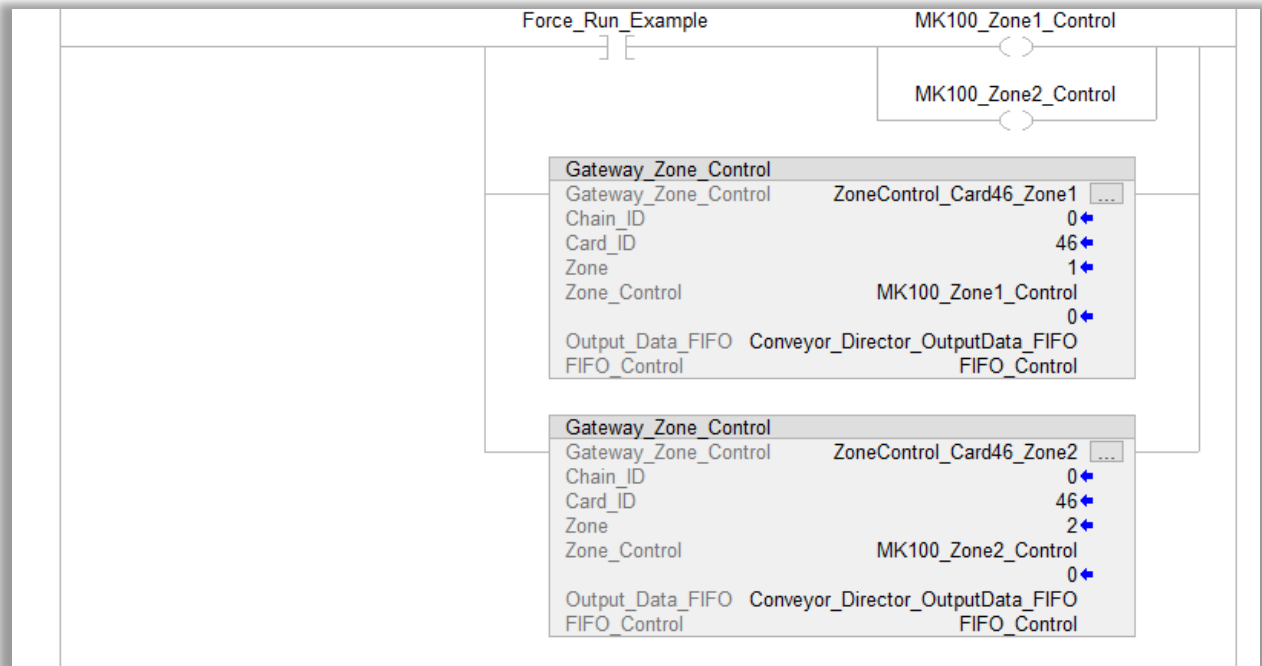


Figure 31: AOI Usage – CDAC Zone Control

Bastian Solutions Conveyor Director AC 1.0 Installation and Maintenance Manual

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