Bastian Solutions' Conveyor ZoneControl & EC5000 Reference Guide

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Bastian SOLUTIONS
a TOYOTA ADVANCED LOGISTICS company

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1 Card Overview

1.1 Basic Features

- Standard ZPA Logic with PTP communication over standard Cat5e/RJ45 cables
- (2) Sensor ports for Zone Sensor (accumulation) and Start Sensor (wake-up)
- Singulation and Train Release modes, set by dipswitches
- External inputs can hold and release cartons
- 8 speed settings (5 – 100%) set by dipswitches
- Error output (health signal) transmitted to all connected cards via PTP

1.2 General Arrangement

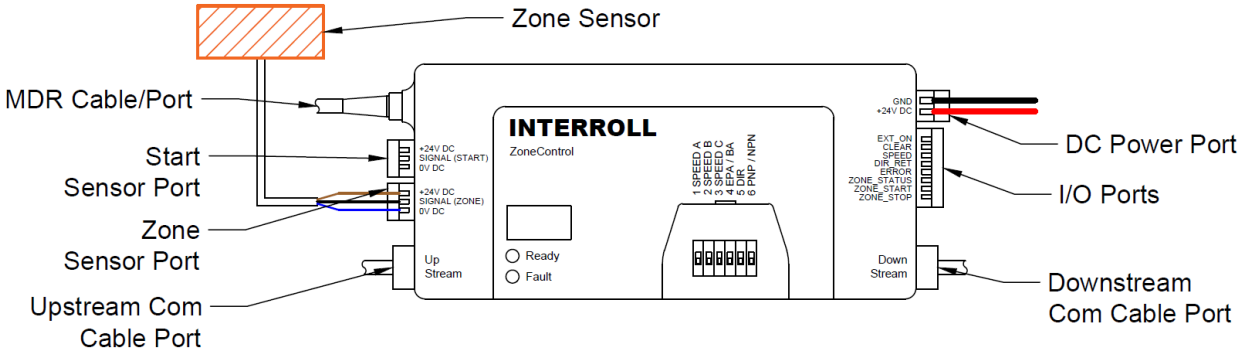


Figure 1 - General Arrangement of ZoneControl Card

1.3 Card Functions

The ZoneControl card has two modes to accommodate different conveyor applications.

1.3.1 Zero Pressure Accumulation (ZPA) Mode

When the ZoneControl card is connected to one or two neighboring cards via PTP (RJ45) cables, it automatically enters ZPA mode. In this mode, ZoneControl cards communicate to wake-up when cartons are coming from upstream, transport them when the downstream zones are clear, and accumulate when downstream zones are full. In ZPA mode, external controls are only required at the start and end of a conveyor line, or at any location where the standard ZPA function needs to be overridden.

1.3.2 DriveControl Mode

When the ZoneControl card is not connected to any neighboring cards with PTP cables, it automatically enters DriveControl Mode. In this mode, all built in zero-pressure ZPA functions are disabled and the card will only run when commanded by an external run signal. This mode is commonly used when conveyors are ordered as “live roller” or if the application requires the PLC to have complete control of when the zone runs and stops.

2 Card Connections

2.1 WAGO Connectors

The WAGO connectors used on the ZoneControl card are smaller than those found on previous BSC drive cards, such as the Interroll 9006. Special consideration is needed to ensure that the correct wire gages are available during electrical installation. The connectors have separate ratings for ferruled and non-ferruled connections.

Table 1 - ZoneControl Connector Wire Ratings

	WAGO PN	Strip Length	Wire Rating – Unferruled	Wire Rating – Ferruled
Power	734-102	6 - 7mm	0.08 – 1.5mm^2 (28 – 14 AWG)	0.25 – 1.5mm^2 (24 - 16 AWG)
I/O and Sensors	733-108, 733-103	5 - 6mm	0.08 – 0.5mm^2 (28 – 20 AWG)	0.25 – 0.34mm^2 (24 – 22 AWG)

The WAGO card tools used to easily land wires in the ZoneControl card's connectors are also smaller than those used on the 9006 card. Part numbers and tool / card compatibility for each tool are shown in the table below. Card tools can be supplied by Bastian Solutions Conveyor upon request.

Table 2 - WAGO Card Tool Overview

Tool Color	WAGO PN	9006 Use	ZoneControl use	
White	231-131	Left Connector	N/A	
Long Black	734-231	Right Connector	Power Connector	
Black	734-191	Right Connector	Power Connector	
Yellow	733-191	N/A	Sensor and IO Connectors	

2.2 Connector Pin Outs

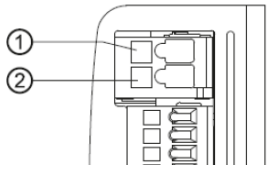


Table 3 - ZoneControl Power Connector Pinout

ZoneControl Sensor Connectors – WAGO 733-103		
Pin 1	0V (GND)	0V (GND) Connection for card
Pin 2	+24V	+24V power input for card

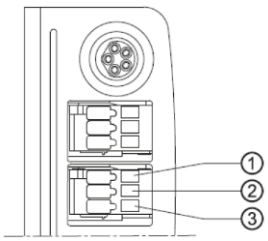


Table 4 - ZoneControl Sensor Connector Pinout

ZoneControl Sensor Connectors – WAGO 733-103			
Pin 1	+24V	BRN	+24V Supply for Zone / Start Sensor
Pin 2	Sensor Signal	BLK	Sensor Output (Dark to Operate)
Pin 3	0V (GND)	BLU	0V (GND) for sensor

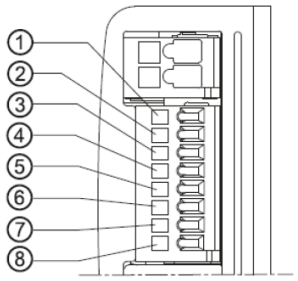


Table 5 - ZoneControl I/O Connector Pinout

ZoneControl Inputs / Outputs Connector – WAGO 733-108			
Pin 1	EXT_ON	Output	Outputs +24V when MDR running
Pin 2	CLEAR	Input	Forces all P2P connected zones to run
Pin 3	SPEED	Input	Analog input to adjust MDR speed
Pin 4	DIR_RET	Input	Reverses MDR direction when using CLEAR
Pin 5	ERROR	Output	Error Signal
Pin 6	ZONE_STATUS	Output	Used for handshaking with 9006 card
Pin 7	ZONE_START	Input	Start / Run Signal
Pin 8	ZONE_STOP	Input	Stop / Accumulate Signal

2.3 Peer-to-Peer Communication (P2P)

The ZoneControl card uses commonly available Cat5e ethernet cables with RJ45 connectors. Cables used on past cards such as the 9006 were a flat cable with RJ12 connectors. RJ12 cables are not compatible with the ZoneControl card.

Table 6 - Comparison of RJ45 and RJ12 Connectors

RJ45 (8p8c) - ZoneControl	RJ12 (6p6c) – **9006 Card Only**
	

3 Frequently Asked Questions

How do you wake up the first (entry) zone in a string of ZPA cards?	**Option 1**: Add a sensor upstream of the zone connected to the "Start Sensor" input (Section 5.1) **Option 2**: Pulse the ZONE_START input on the first card in a ZPA string to wake-up the entry zone (Section 5.2). This input can be held high to continuously accept product
How do you release a carton at the end of a line of accumulation?	When a carton has accumulated at an exit zone, hold ZONE_START (Pin 7) high. The input must be held high for the duration of the release until the carton is no longer blocking the Zone Sensor.

Why do empty zones run for several seconds when the power is switched on?	When the ZoneControl is powered on, it goes through an initialization process. All zones with unblocked zone sensors will run for 4 seconds or until it's Zone Sensor is blocked. All cartons that were previously "lost" between zones will now be indexed properly at sensors.
How do you force a zone to run?	Any ZoneControl card can be forced to run using the input ZONE_START (Pin 7). **WARNING**: Forcing a transport zone to run can cause collisions between cartons if downstream zones are already occupied by accumulated cartons.
How do you change the direction of rotation of the MDR?	Dipswitch 5 sets the direction of rotation of the RollerDrive: On = CCW, OFF = CW (viewed from the cable end)
How do you set the speed of the MDR?	There are 8 speed settings possible with the (3) ZoneControl speed dipswitches. Specific ZoneControl & EC5000 speed settings can be found in Section 4.2
Can you adjust the acceleration and deceleration rate of the MDR?	No, the speed ramp is fixed at an optimized value for each speed setting.
How do you accumulate product in the middle of a string of cards?	Holding the ZONE_STOP input high on any transport zone will prevent it from releasing downstream. The zone receiving the ZONE_STOP command will still accept packages from upstream.
How do you reset a zone after a jam?	Remove jammed packages. Once clear, the zone will re-initialize and resume normal ZPA operation.
Is the error output linked through PTP?	Yes, the error output on each card will go high if any card in the string is faulted
How do you release all zones in a string of cards connected PTP at the same time?	The CLEAR input (Pin 2) immediately forces all ZoneControl cards linked via PTP to drive regardless of sensor state. The CLEAR input can only be used on the first or last ZoneControl in a PTP chain.
What is the difference between EPA and BA (Single Release and Train Release)?	**EPA (Singulation Release):** Upstream zones will release once the downstream product clears the downstream zone sensor **BA (Train Release):** Upstream zones will release 100ms after the downstream zone begins to move
What's the difference between the CLEAR input and Train Release (BA Dipswitch)?	CLEAR forces all the zones to drive and ignore ZPA logic. When the CLEAR signal is dropped, the zones must re-initialize. In train release, ZPA is always active and zones do not need to re-initialize when the release signal is dropped.
How do you super-zone with the ZoneControl Card?	Super-zoning to create an oversized zone requires a single jumper wire. Connect one end to EXT_ON (Pin 1) of the "leader" card and the other end to ZONE_START (Pin 7) of the "Follower" card. If the super-zone is being used for accumulation, com cables and the Zone Sensor should only be connected to the "Leader" card (Section 5.6)
How can you monitor the output of the Zone Sensor?	Option 1 (**Non-critical applications ONLY**): monitor ZONE_STATUS card output, NOTE: ZONE_STATUS signal will drop if the card is faulted for any reason. Option 2: Tap directly into the sensor output wire – example shown in Section 5.3

4 Reference Tables

4.1 MDR Speed Conversion

Table 7 – MDR Speed Conversion (fpm to m/s)

fpm	m/s	fpm	m/s	fpm	m/s	fpm	m/s
10	0.05	**60**	0.30	**110**	0.56	**160**	0.81
20	0.10	**70**	0.36	**120**	0.61	**170**	0.86
30	0.15	**80**	0.41	**130**	0.66	**180**	0.91
40	0.20	**90**	0.46	**140**	0.71	**190**	0.97
50	0.25	**100**	0.51	**150**	0.76	**200**	1.02

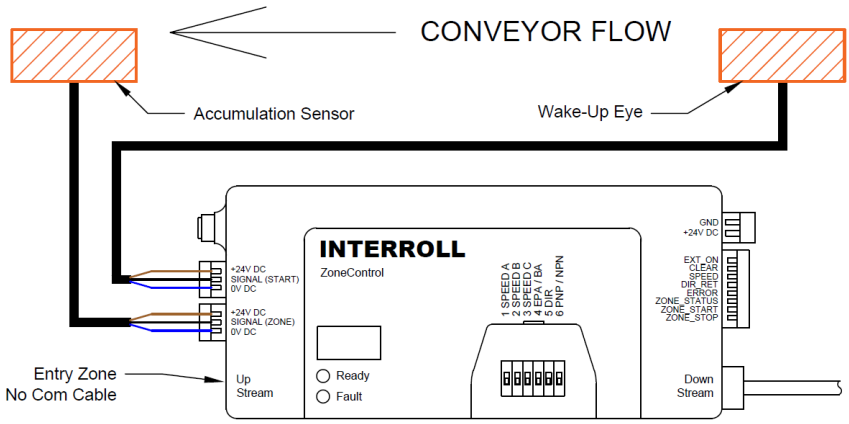
4.2 ZoneControl & EC5000 Speed Settings

Table 8 - Possible MDR Speeds by Gear Ratio

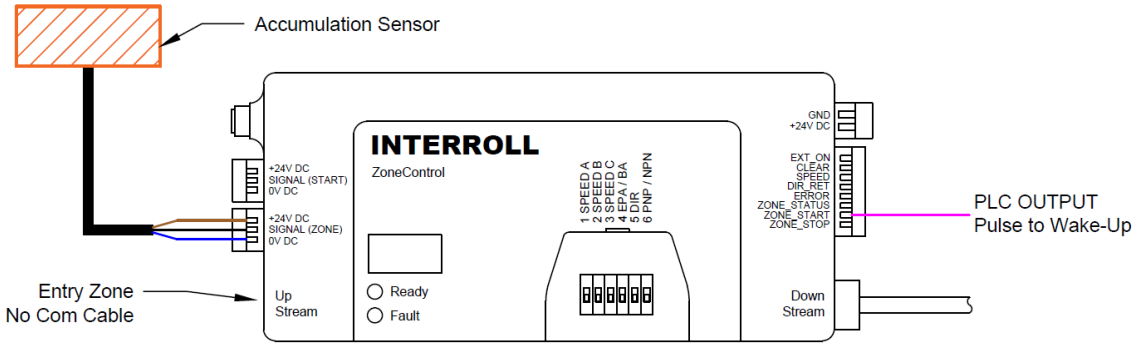
Dipswitch Setting			**Speed Percentage**	**EC5000 Gear Ratios**, Speed in FPM				
A	**B**	**C**		**13:1**	**18:1**	**21:1**	**30:1**	**42:1**
ON	ON	ON	100 %	264	190	163	114	82
ON	ON	*off*	86 %	228	164	141	99	71
ON	*off*	ON	73 %	192	138	119	83	59
ON	*off*	*off*	59 %	156	112	97	68	48
off	ON	ON	46 %	120	86	75	52	37
off	ON	*off*	32 %	84	60	52	37	26
off	*off*	ON	19 %	48	34	30	21	15
off	*off*	*off*	5 %	12	8	8	6	4

5 ZoneControl Wiring Diagrams

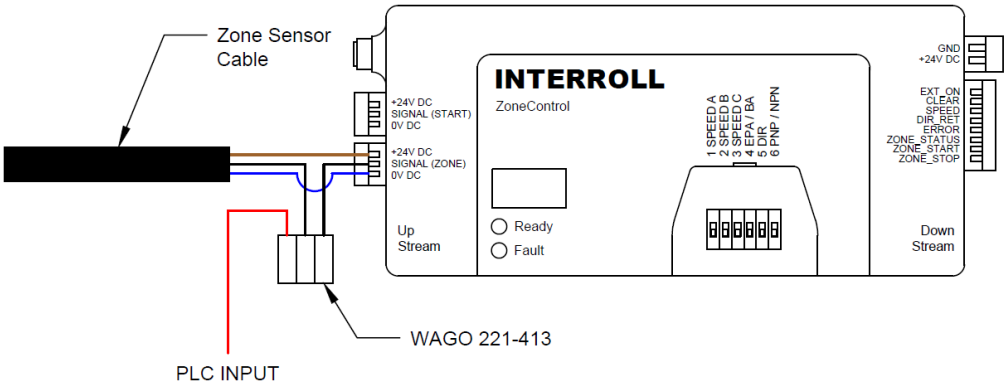
5.1 Entry Zone with Wake-Up Sensor



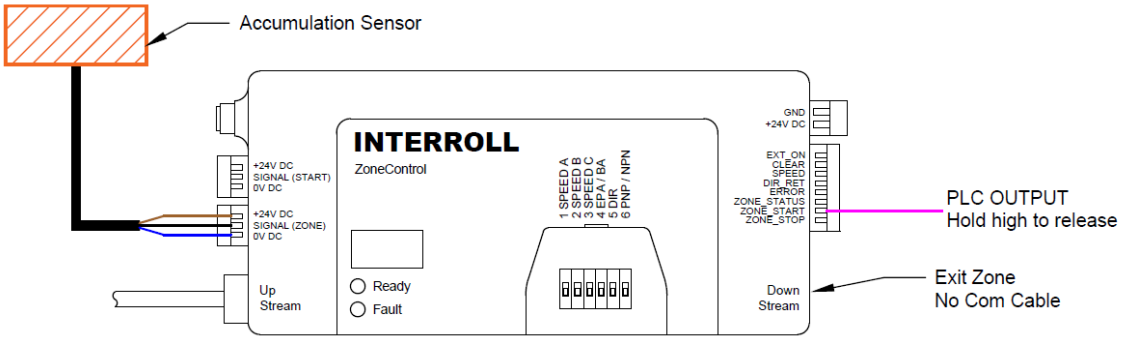
5.2 Wake-Up Entry Zone with PLC



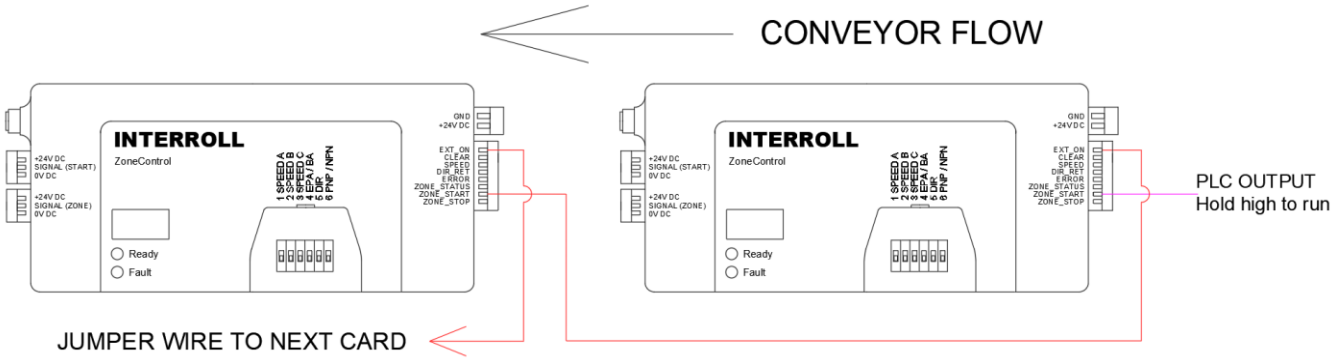
5.3 Directly Monitor Sensor Output



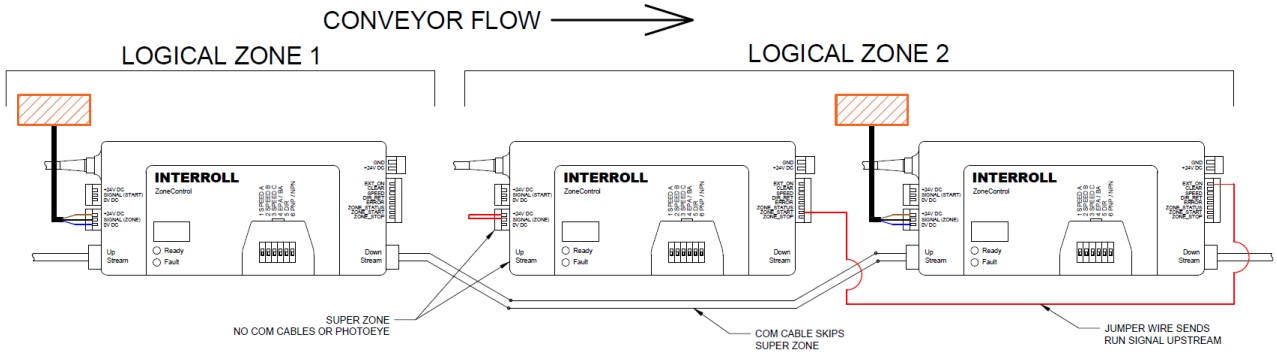
5.4 Release Carton at Exit Zone



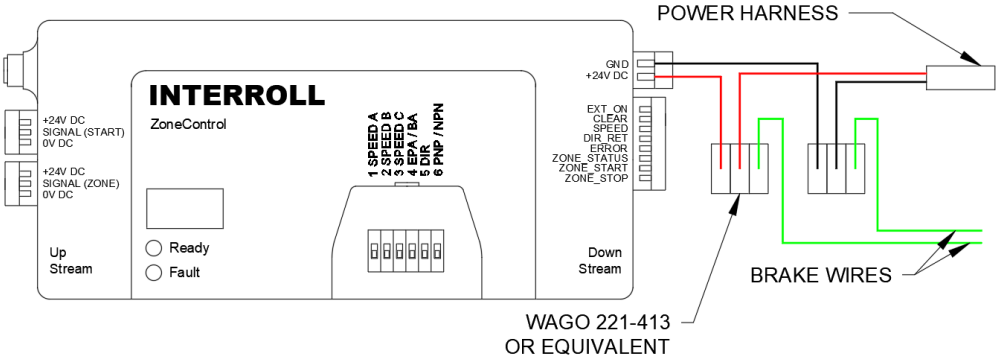
5.5 Run Signal for "Live" Conveyor



5.6 Super Zoning (linking cards together)



5.7 Brake Roller



6 9006, EC100/110, and EC310 Replacement

As Interroll's product line has matured, standardization and global harmonization resulted in the introduction of the ZoneControl card and EC5000 MDR family. This single EC family now takes the place of the EC100/110 as well as the EC310 families. Through the end of 2022, legacy components for these families will become difficult and expensive to source. The information contained in this section outlines the steps required to replace a legacy EC100, 110, or 310 MDR and 9006 card with the readily available ZoneControl card and EC5000 MDR.

6.1 Determine Zone Function

When a legacy drive card or MDR needs replacement, the first step should always be to determine how the affected zone(s) are being used in the conveyor system. Depending on the application, multiple zones may need to have their cards and MDR's swapped. For each zone requiring replacement, compare the existing wiring to the diagrams in section 6.2 to determine the zone's type and function.

6.2 Drive Card Application and Wiring

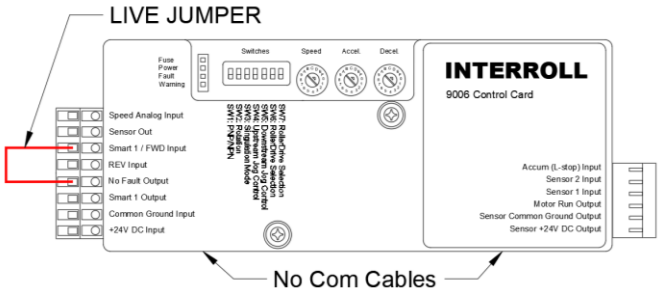
6.2.1 Live Roller Conveyors

Live roller conveyors RLVDC and BLVDC have shipped with multiple iterations of wiring standards. Prior to 2019, live conveyors shipped with a live jumper to run on power. During 2019, wiring standards transitioned to a daisy chained run signal which allowed conveyors to be switched on and off with a PLC signal without disconnecting power.

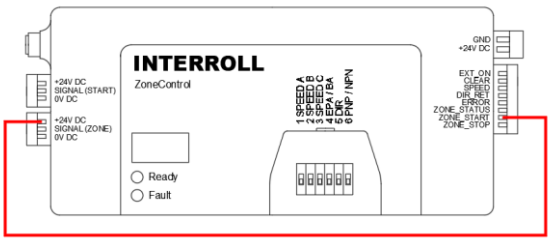
When replacing a live roller 9006 card, it's important to take note of the wiring scheme and use the appropriate wiring on the replacement ZoneControl Card. For all live roller applications, 9006 cards and EC100/110 MDR's can be replaced individually.

6.2.1.1 Run Live Jumper

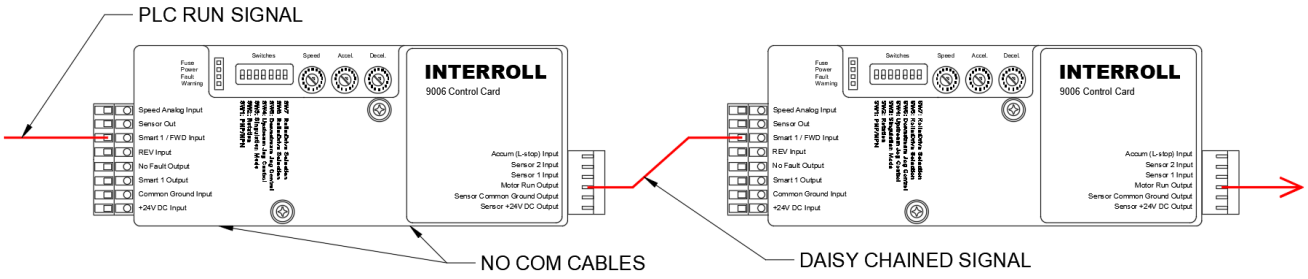
Existing 9006 Wiring



Replacement ZoneControl



6.2.1.2 Daisy Chained Run Signal



See section 0 for Daisy Chained ZoneControl Wiring diagram.

6.2.2 Zero Pressure Conveyors

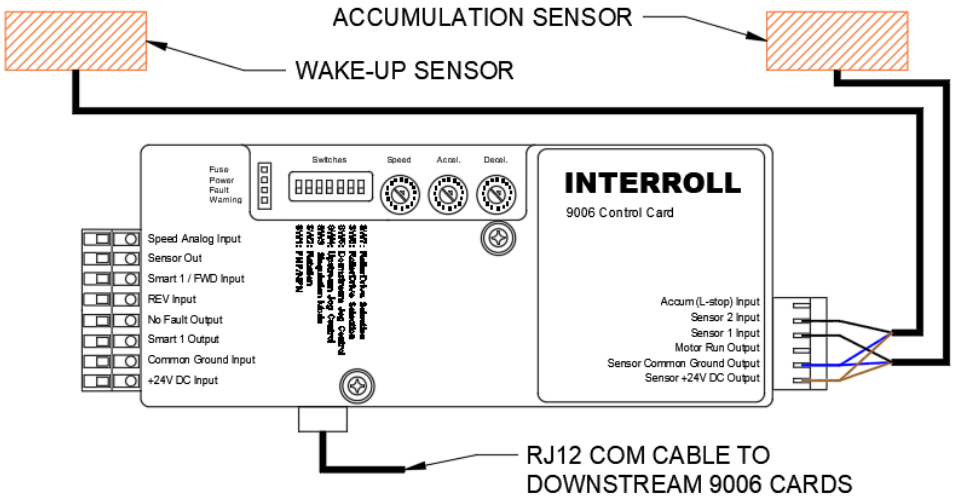
9006 cards used in zero pressure applications (with photoeyes and communication cables between cards) must be replaced in pairs. This is required to maintain zero-pressure function between the 9006 and ZoneControl cards. Use the table below to determine how the second card being replaced should be chosen. When replacing any cards, it's important to ensure all 9006's and ZoneControl's have at least one like neighbor.

Table 9 - Card Pairings for Replacement

Failed Card / MDR	Additional Card to Swap	Diagram (Red = Failed, Yellow = Swap Pair)
First Card in Chain (1)	Second Card (2)	1 2 3 4 5 6 7 8 9 10
Second Card in Chain (2)	First Card (1)	1 2 3 4 5 6 7 8 9 10
Third Card (3)	Fourth Card	1 2 3 4 5 6 7 8 9 10
Third to Last	Fourth to last (e.g. 7 of 10)	1 2 3 4 5 6 7 8 9 10
Second to Last	Last Card	1 2 3 4 5 6 7 8 9 10
Last Card	Second to last (e.g. 9 of 10)	1 2 3 4 5 6 7 8 9 10
Other	Upstream or Downstream	1 2 3 4 5 6 7 8 9 10

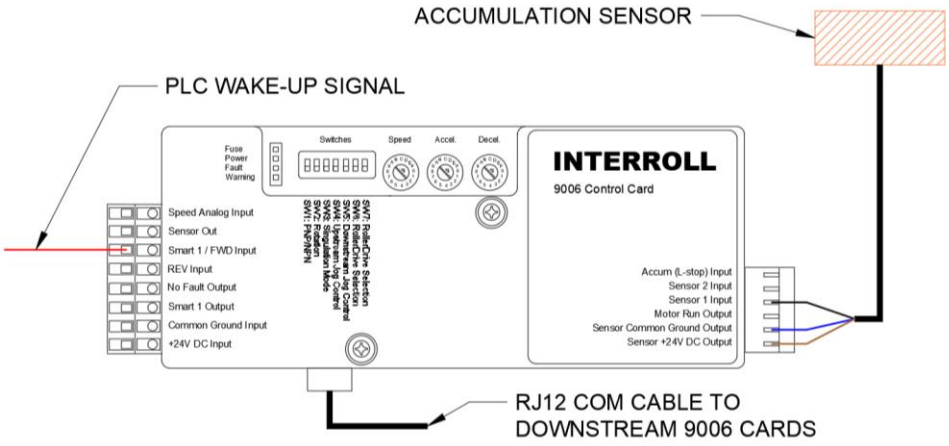
Once the specific zones requiring replacement have been identified, continue to Section 6.3 to determine the best EC5000 for each zone.

6.2.2.1 Entry Zone with Wake-Up Photoeye



See Section 5.1 for ZoneControl with wake-up photoeye wiring diagram. Zones 1 & 2 of the local zero pressure chain must both be replaced with ZoneControl cards. Refer to section 6.4.2 for connecting the new ZoneControl cards to the downstream 9006's.

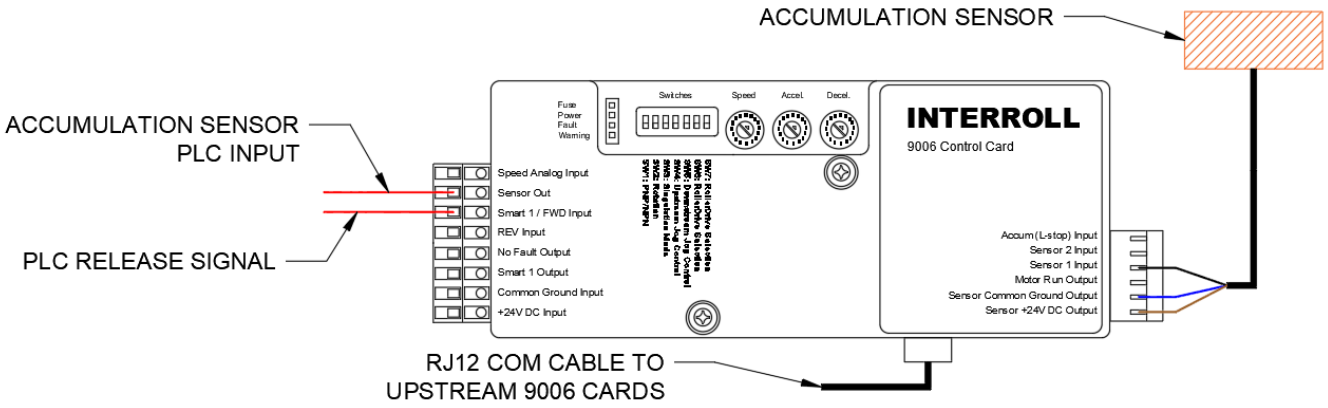
6.2.2.2 Entry Zone with PLC Signal



See Section 5.2 for ZoneControl with PLC wake-up signal. Zones 1 & 2 of the local zero pressure chain must both be replaced with ZoneControl cards. Refer to section 6.4.2 for connecting the replaced ZoneControl cards to the downstream 9006's.

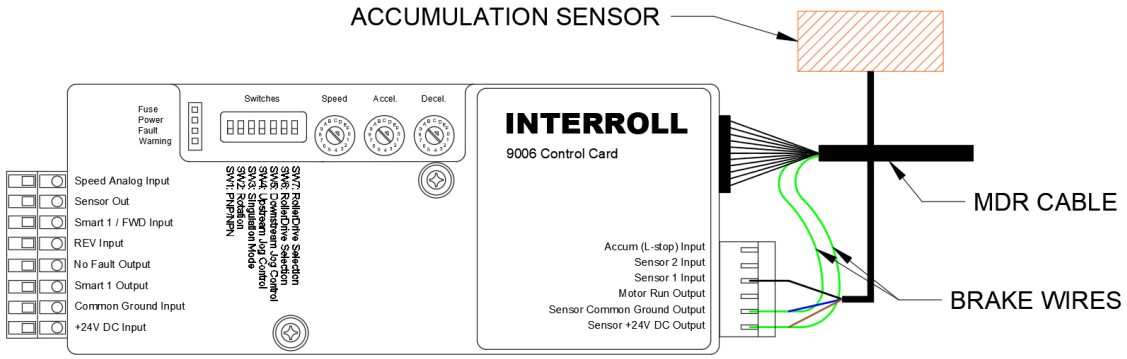
6.2.2.3 Exit Zone

Exit zones will typically have a PLC output and a PLC input connected to them. It's important to note which wire is the PLC output sending the run signal, and which is monitoring the photoeye status. See section 5.4 for connecting the PLC release signal. See section 5.3 for connecting the PLC input for monitoring the photoeye status. When replacing an exit zone, the zone immediately upstream must also be replaced. See section 6.4.1 for handshaking the upstream 9006 cards with the new ZoneControl cards.



6.2.2.4 Brake MDR Zone

Declining belted MDR conveyors will often use integrated brakes to prevent product drift during system shutdown events. On the 9006 card, the brakes could be powered off the sensor power and ground pins on the right-hand connector. See section 5.7 for brake roller wiring instructions with the ZoneControl card.



6.3 EC5000 MDR Selection

6.3.1 Identifying Existing MDR's

The first step to determining the best EC5000 to replace an existing MDR is correctly identifying the MDR to be replaced. Follow the steps outlined below to gather the information required to choose an appropriate EC5000.

6.3.1.1 End Cap Label

Read the label on the fixed side of the MDR to be replaced. This label is used to determine the MDR Model Type (Item # 7) and Gear ratio (Item #3) as shown in Figure 2 below.

Figure 2 - Common MDR End Cap Labels

6.3.1.2 Drive Type

Examine the MDR to be replaced to determine the groove type. Standard 2-Groove and Poly-V are the most common options.

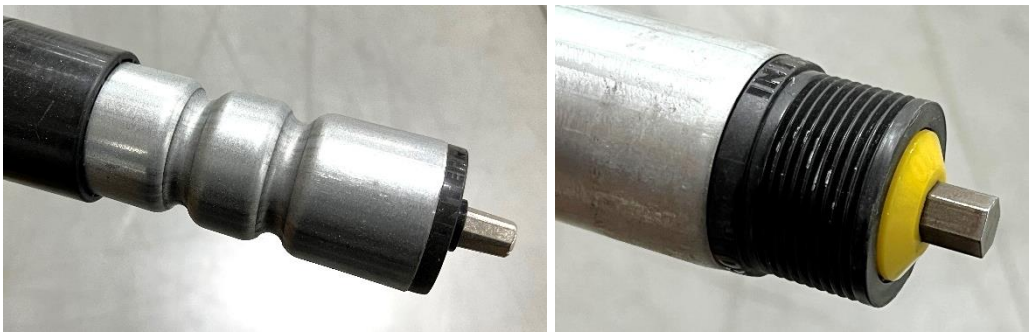


Figure 3 - 2-Groove (Left) and Poly-V (Right) Drive Options

6.3.1.3 Between Frame Measurement

Use a tape measure to determine the between frame distance as shown in Figure 4 below. Bastian Solutions' Conveyor's standard between frame options are 14.5", 16.5", 20.5", 26.5", and 32.5".

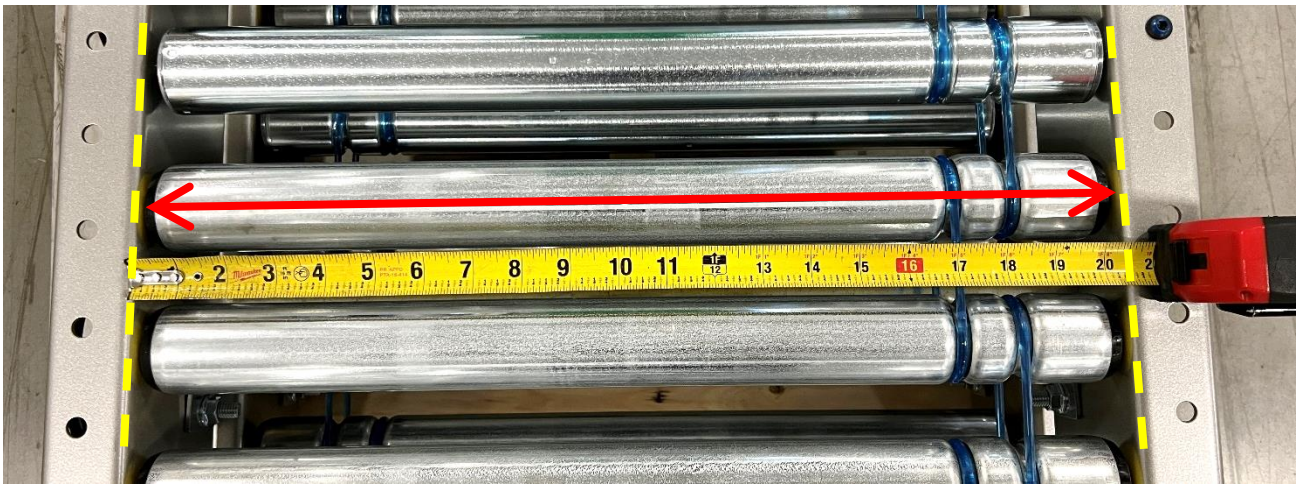


Figure 4 - Example of Between Frame Measurement (20.5" between frame shown)

6.3.1.4 Special Options

6.3.1.4.1 Tapered Sleeves

MDRs and rollers used on curves use tapered sleeves to keep product centered in the conveyor as it travels around the curved section.

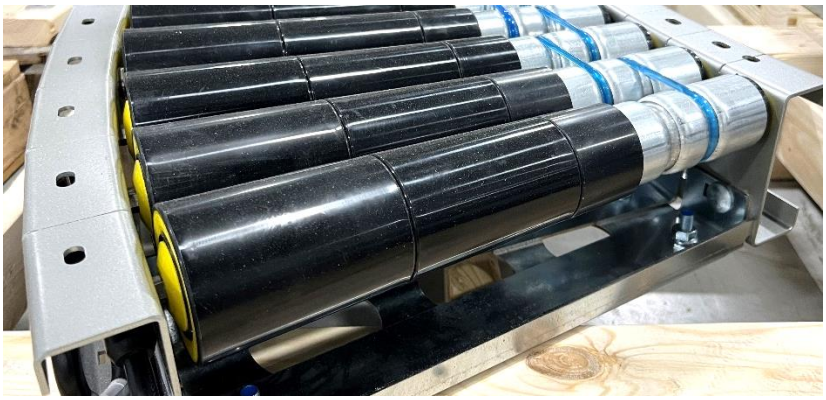


Figure 5 - Example of Rollers with Taper Sleeves

6.3.1.4.2 Integrated Brakes

EC100 MDR's had an option to include an integrated brake. The method for identifying a brake vs. non-brake variant of the EC100 is by examining the end of the MDR cable. Brake MDR's have two extra green wires that are not landed in the MDR connector.

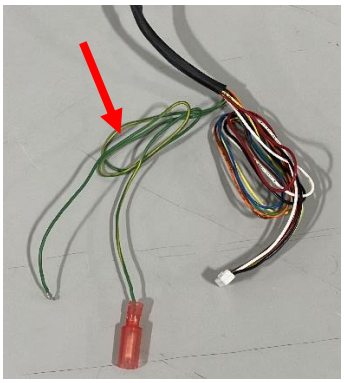


Figure 6 - Example of Green Wires Indicating Presence of Integrated Brake

6.3.1.4.3 Roller Coatings

Polyurethane and PVC roller coatings were available for the EC100 and 110 family. These are still an option on the newer EC5000 but must be called out as a custom option. **For all cases when an MDR with a roller coating needs replacement, please contact Bastian Solutions' Conveyor for assistance.**

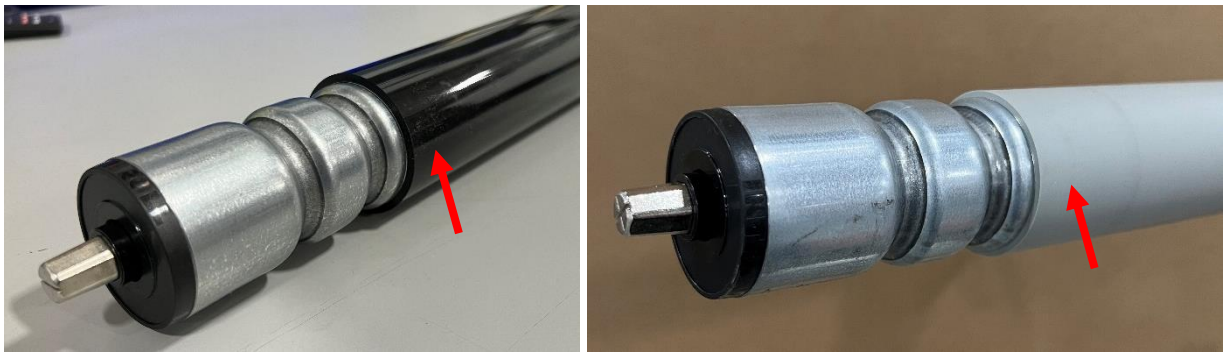


Figure 7 - Examples of Polyurethane (PU) and PVU Roller Coatings

6.3.1.5 Review Cross-Reference Tables

Once the MDR Model Type, Gear ratio, drive type, between frame measurement, and any special options are known. Review the tables in Sections 6.3.2 through 6.3.4 to find the nearest equivalent EC5000.

Part numbers have been truncated in the tables. Each EC5000 part number begins with "A001PR-" and ends with the 5-digit number + letter code shown in the table. For example, an EC100, 24:1, 2-Groove, 20.5" BF would be A001PR-10234A.

If there is not a part number listed for the MDR required contact BSC for assistance.

6.3.2 EC100 Cross Reference

6.3.2.1 Straight MDR's

MDR Model	Gear Ratio	Groove Type	Special Option	14.5"	16.5"	20.5"	26.5"	32.5"
EC100	12:1	2-GR	None			10276A		
EC100	16:1	2-GR	None	10294A		10325A	10323A	10320A
EC100	24:1	2-GR	None	10327A	10281A	10234A	10239A	10255A
EC100	36:1	2-GR	None	10257A	10242A	10243A	10258A	10241A
EC100	12:1	POLYV	None			10277A		
EC100	16:1	POLYV	None			10326A		
EC100	24:1	POLYV	None			10235A	10263A	10305A
EC100	36:1	POLYV	None	10271A	10302A	10240A	10307A	10315A

6.3.2.2 Tapered MDR's

MDR Model	Gear Ratio	Groove Type	Special Option	14.5"	16.5"	20.5"	26.5"	32.5"
EC100	12:1	2-GR	TAPER			10329A		
EC100	16:1	2-GR	TAPER			10330A		
EC100	24:1	2-GR	TAPER	10317A		10238A	10262A	
EC100	16:1	POLYV	TAPER	CONTACT BASTIAN SOLUTIONS' CONVEYOR				
EC100	24:1	POLYV	TAPER					

6.3.2.3 Brake MDR's

The EC5000 family of MDR's does not currently have an integrated brake option like the EC100. To compensate for this, standalone brake rollers can be ordered and installed alongside the EC5000 to prevent roll-away during system shut down events. For each EC100 with brake that is being replaced, one EC5000 MDR and one brake roller must be ordered. Take note of the groove type of the MDR being replaced. For any 2GR brakes, contact BSC for assistance.

MDR Model	Gear Ratio	Groove Type	Special Option	14.5"	16.5"	20.5"	26.5"	32.5"
EC100	16:1	2-GR	BRAKE	10294A + Contact BSC		10325A + Contact BSC	10323A + Contact BSC	10320A + Contact BSC
EC100	24:1	2-GR	BRAKE	10327A + Contact BSC	10281A + Contact BSC	10234A + Contact BSC	10239A + Contact BSC	10255A + Contact BSC
EC100	36:1	2-GR	BRAKE	10257A + Contact BSC	10242A + Contact BSC	10243A + Contact BSC	10258A + Contact BSC	10241A + Contact BSC
EC100	16:1	POLYV	BRAKE			10326A + A001RL-10113A		
EC100	24:1	POLYV	BRAKE			10235A + A001RL-10113A	10263A + A001RL-10115A	10305A + A001RL-10116A
EC100	36:1	POLYV	BRAKE	10271A + A001RL-10296A	10302A + A001RL-10297A	10240A + A001RL-10113A	10307A + A001RL-10115A	10315A + A001RL-10116A

6.3.3 EC110 Cross Reference

6.3.3.1 Straight MDR's

MDR Model	Gear Ratio	Groove Type	Special Option	14.5"	16.5"	20.5"	26.5"	32.5"
EC110	9:1	2-GR	None			10274A	10282A	
EC110	12:1	2-GR	None	10304A	10314A	10261A	10265A	10267A
EC110	16:1	2-GR	None					10318A
EC110	9:1	POLYV	None			10275A	10285A	
EC110	12:1	POLYV	None			10260A	10252A	10284A
EC110	16:1	POLYV	None	10350A		10306A	10249A	10309A

6.3.3.2 Tapered MDR's

MDR Model	Gear Ratio	Groove Type	Special Option	14.5"	16.5"	20.5"	26.5"	32.5"
EC110	9:1	2-GR	TAPER			10273A	10283A	
EC110	12:1	2-GR	TAPER			10266A	10264A	
EC110	16:1	2-GR	TAPER					
EC110	9:1	POLYV	TAPER	CONTACT BASTIAN SOLUTIONS' CONVEYOR				
EC110	12:1	POLYV	TAPER					
EC110	16:1	POLYV	TAPER					

6.3.4 EC310 Cross Reference

6.3.4.1 Straight MDR's

MDR Model	Gear Ratio	Groove Type	Special Option	14.5"	16.5"	20.5"	26.5"	32.5"
EC310	16:1	2-GR	None	10304A	10314A	10261A	10265A	10267A
EC310	20:1	2-GR	None				10248A	10254A
EC310	16:1	POLYV	None			10260A	10252A	10284A
EC310	20:1	POLYV	None			10286A	10301A	10312A

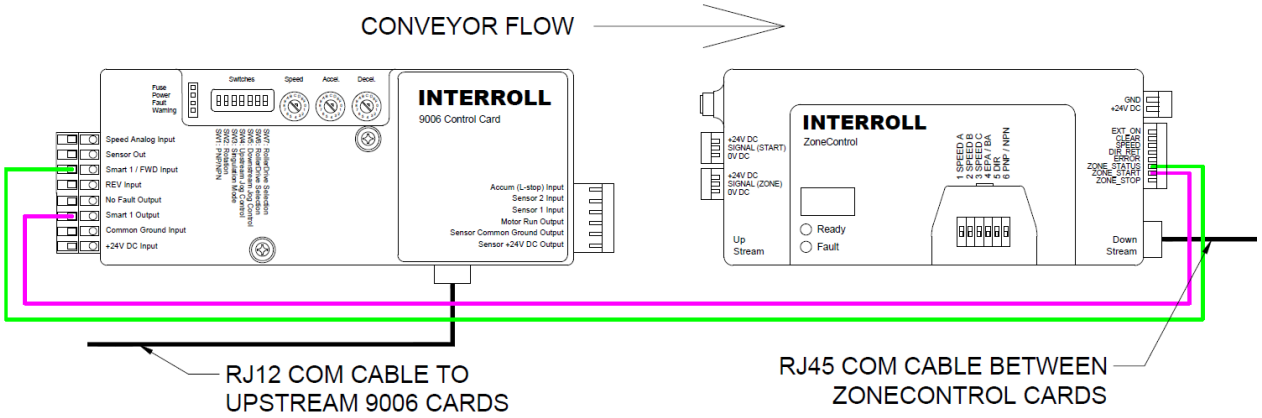
6.3.4.2 Tapered MDR's

MDR Model	Gear Ratio	Groove Type	Special Option	20.5"	26.5"
EC310	16:1	2-GR	TAPER	10266A	10264A

6.4 9006 to ZoneControl Interfaces

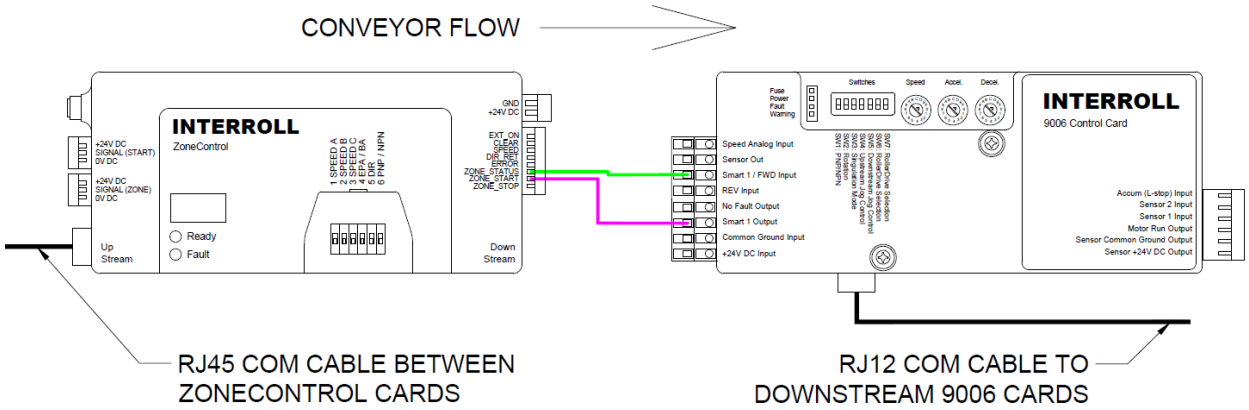
6.4.1 9006 to ZoneControl Handshaking

- Green: 9006 CN1:6 (Smart 1 / FWD Input) >> ZoneControl CN3:6 (Zone_Status)
- Purple: 9006 CN1:3 (Smart 1 Output) >> ZoneControl CN3:7 (Zone_Start)



6.4.2 ZoneControl to 9006 Handshaking

- Green: ZoneControl CN3:6 (Zone_Status) >> 9006 CN1:6 (Smart 1 / FWD Input)
- Purple: ZoneControl CN3:7 (Zone_Start) >> 9006 CN1:3 (Smart 1 Output)



Bastian Solutions Conveyor ZoneControl Reference Guide

Bastian Solutions' Conveyor
10585 N. Meridian St.
Indianapolis, IN 46290 USA