



**ITOH DENKI USA, INC.**

**HB-508S**  
24 VDC Hybrid Driver Card  
With Built-in ZPA Logic

Rev09-0423

**SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE**

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## Introduction

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No. HB-508S – Hybrid Driver Card with Built-in ZPA Logic



**HB-508S** is the new generation of Built-in ZPA Logic Hybrid Driver Card. The HB-508S has both slug (train) tote release mode and singulated tote release mode along with sensor and jam timer functions to perfectly suit the most common ZPA conditions. In addition, The HB-508S provides the additional functions of flexible zone recognizing, synchronized speed variation, stable speed, and signal sentry function to satisfy even the most diverse and more sophisticated automation needs.

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## 1 Features

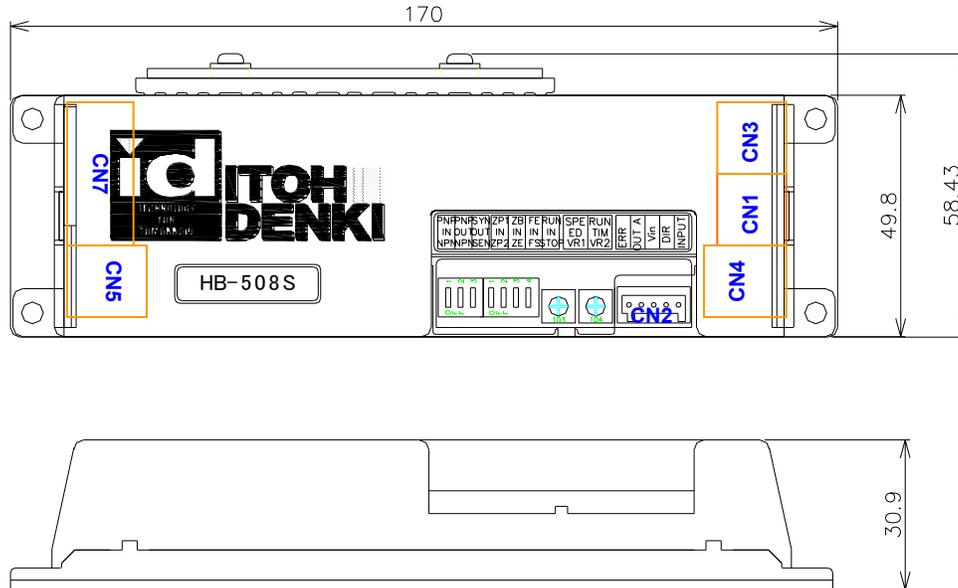
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- **Singulated or Slug (Train) Tote Release ZPA**
  - **Singulated Release**
    - As soon as the sensor in the downstream zone detects an empty zone, the sensor signal will then activate the occupied upstream zones to transfer the tote in each zone one by one
  - **Slug (Train) Release**
    - As soon as the sensor in the downstream zone detects an empty zone, the sensor signal will then activate the occupied upstream zones to transfer the tote in each zone simultaneously.
      - **Flexible Zone Recognition** (Patented): Flexible Zone Recognition is enabled in Slug Release Mode. When the tote is long enough to occupy multiple zones, the occupied zones are recognized as one zone to maintain continuous ZPA.
      - **Tote Separation**: Multiple totes can be separated properly by using the Singulated Release function downstream from the Slug Release zones.
- **Sensor Timer and Jam Timer Function**
- **Signal Sentry Function**
- **Single Zone Plural Motor Drive**
  - The HB-508S has a RUN signal output to drive multiple motors in a single zone simultaneously. This is useful when
    - The zone is longer than other zones
    - The zone needs more than one motor to transfer heavier loads
- **Synchronized Speed Variation**
  - Synchronized speed variation of multiple zones is achieved by varying the analog voltage input to any **one** of the HB-508S units connected by the communication cable
- **Stable Speed against Varying Load**
  - Applicable when
    - The motor is running at nominal speed or less
    - The applied load is less than the rated tangential force
- **PNP or NPN Input Signal**
  - DIP switch selectable input type
- **Simplified Wiring**
  - 'plug & play'
- **Reverse Polarity Protection**
  - HB-508S is protected in case the supply voltage wiring is reversed (+24V for 0V and 0V for +24V)

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## 2 Dimensions



(Dimensions are in mm)

- CN1: Power connector (WAGO #734-132)
- CN2: I/O control connector (WAGO #733-335)
- CN3: Sensor connector (WAGO #733-363)
- CN4: Communication cable connector (MOLEX #52018-8845)
- CN5: Communication cable connector (MOLEX #52018-8845)
- CN6: Motor connector (not used)
- CN7: Motor connector (JST #S9B-XH-A)

## 3 Basic Specifications

- Input Voltage: 24VDC +/- 10%2
- LEDs: LED 1 lights green when powered. LED 2 lights red in case thermal overload device reacts.
- Applicable environment
  - Temperature: Between 0 – 40°C non-freezing (32 – 104°F)
  - Humidity: < 90% RH (no condensation)
  - Atmosphere: No corrosive gas
  - Vibration: 0.5G or less
  - Installation: Indoor

## 4 Applicable Motorized Roller

- PM486FS/FE, PM500FS/FE, PM570ES, PM605ES series brushless DC motorized roller

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## 5 Functions

### 5-1 ZPA function

- The HB-508S receives the signal of the sensor from the present zone when a tote enters the zone.
- The communication cables allow signals to be exchanged between the present and adjacent zones controlled by the HB-508S
  - Based on the signal, the HB-508S either receives the tote into or evacuates the tote from the present zone, depending on the occupied status in the present and adjacent upstream and downstream zones.
- ZPA modes (single or slug release) can be selected by the DIP switch #2-1 setting (Figure 1)
- Refer to Section 7

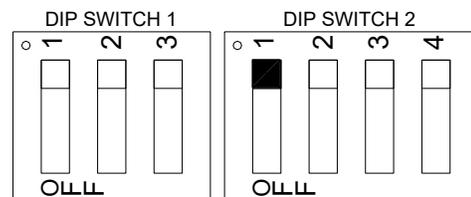


Figure 1

- When an HB-508S is used in the last downstream zone, the motor in the last zone can be stopped when detecting the presence of a tote (sensor ON) in the present zone
- This mode can be selected by DIP switch #2-2 (Figure 2)
- Refer to Section 7

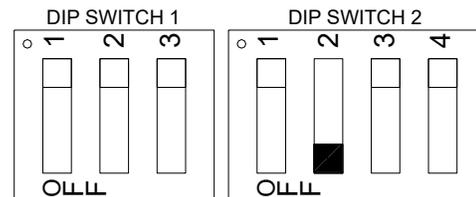


Figure 2

### 5-2 Sensor timer

- The motor in the present zone will be stopped by sensor timer function when
  - The motor in the present zone is running
  - No tote entry into the present zone for 5 seconds after the sensor turns OFF
  - No tote present in the adjacent upstream zone
- Timer setting: 6±0.5 seconds (fixed)

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### 5-3 RUN holding timer (VR2)

- The motor in the present zone will be stopped by the RUN hold timer when
  - The motor in the present zone is running
  - No tote entry in the present zone (within a certain period of adjustable time) after the sensor turns OFF
- Time adjustable by integral potentiometer VR2 (Figure 3)
- Adjustable range of time: Between 0.6 – 7.5 seconds

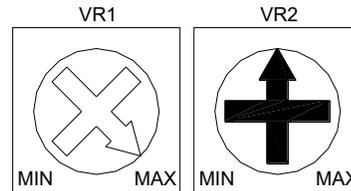


Figure 3

### 5-4 Jam timer

- Error signal is sent and motor is stopped when
  - Present zone has a sensor ON status (presence of tote), thereby activating its motor
  - No sensor status change in the zone for 4 seconds after the tote was initially detected
- Error correction – the blocking tote should be removed to switch off the sensor (i.e. clear jam)
- Jam timer setting: 4.5 seconds ( fixed)

### 5-5 PNP / NPN input signal

- Sensor, RUN, DIR (direction) input terminals accept both NPN and PNP signals by receiving the signal through a photo coupler
- NPN or PNP input signal is selected by DIP switch #1-1 (Figure 4)
- ON – PNP, OFF – NPN
- Refer to Section 7

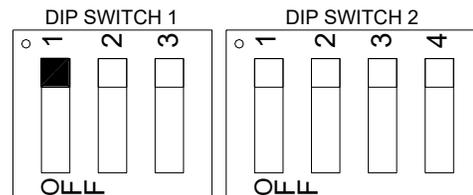


Figure 4

### 5-6 PNP / NPN output signal

- Sensor, synchronization and error output signal can be either PNP or NPN open collector
- PNP or NPN output signal is selected by DIP switch #1-2 (Figure 5)
- Refer to Section 7

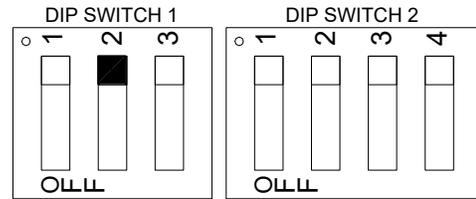


Figure 5

- Sensor signal output and synchronization signal output are alternatives and can be selected by the DIP switch #1-3 (Figure 6)
- In case both signal outputs are needed at the same time, the sensor signal output can be retrieved from the sensor terminal of CN3
- Refer to Section 7

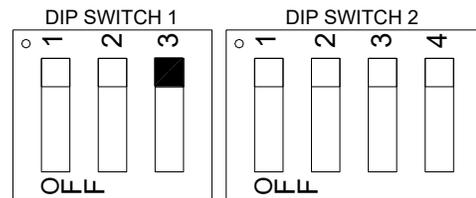


Figure 6

### 5-7 Sensor input (CN3)

- Sensor and sensor alarm outputs should be set ON when detecting tote

### 5-8 Motor run (CN2)

- The motor will be activated and stopped automatically by ZPA logic functions (which depend on the sensor status in the present and adjacent upstream and downstream zones)
- The motor is subject to ZPA logic when the input terminal is open
- The motor will be forcibly activated by closing the input terminal, but will not override the ZPA logic
- The motor will forcibly run as long as the RUN input is closed when DIP switch 2-4 is ON (Figure 7)

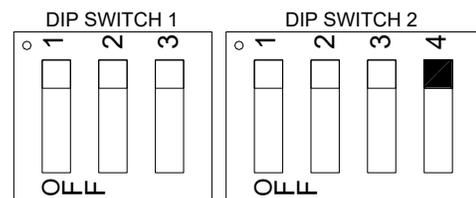


Figure 7

### 5-9 Motor reversing (CN2)

- DIR (direction) signal input will
  - Cause the HB-508S connected to CN5 be upstream
  - Cause the HB-508S connected to CN4 be downstream
  - Reverse all the motors in the adjacent upstream and downstream zones
    - Adjacent HB-508S must be linked by the communication cable
      - Communication cable carries DIR signal
    - 30 zones maximum can simultaneously reverse direction
    - DIR signal can be inputted to any **one** zone to change all zones
    - DIR signal inputted – the FS series motor will rotate CW (from lead side)
- Single motor direction can be reversed by using DIP switch #2-3 (Figure 8)
- Motor turning direction of FS and FE units differ
- DIP #2-3 ON, FE units rotate CCW; OFF, FE units rotate CW
- DIP #2-3 OFF, FS units rotate CCW; ON, FS units rotate CW

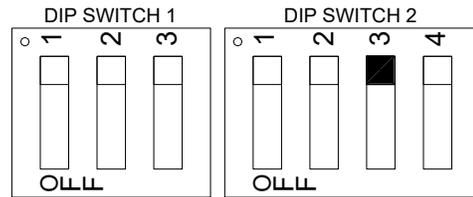


Figure 8

### 5-10 Sensor signal output (CN2)

- Signal sensor output of the present zone is from CN2 terminal 4, when the DIP switch #1-3 is OFF
- Output transistor will be ON, when detecting tote (sensor ON) (Figure 9)

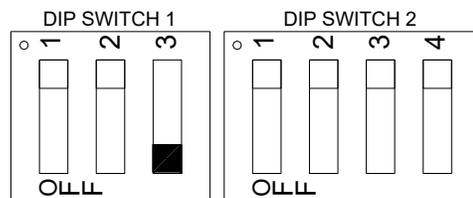


Figure 9

### 5-11 Error signal output (CN2, LED 2)

- Error signal output terminal in CN2 terminal 5 will **emit a signal** (high) if all the HB-508S in the zones linked through the communication cables are in **normal status**
- Output transistor is ON in normal status (to allow error output in case of fuse failure)
- Failed (troubled) zone can easily be identified by LED 1 (lights green when powered – normal status) and LED 2 (lights red in case of error) on individual HB-508S
- Error signal (low) for any of the following failures
  - Reaction of thermal overload device either circuitry (> 85°C) or motor (> 105°C) (motor continues to run with lowered output, lighting LED 2 and maintaining ZPA)
  - Jam timer setting time over (stops motor to cease ZPA, lighting LED 2)

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**5-12 Synchronization signal output (CN2)**

- Synchronization signal is discharged when the motor in the present zone starts running.
  - This signal enables synchronized motor operation in multiple zones which are linked by communication cables to other HB-508S
- This also allows the synchronized operation of the multiple motors in the same zone (plural motor drive)
- CN2 terminal #4 will be the synchronization signal output terminal if the DIP switch #1-3 is set ON (Figure 10)

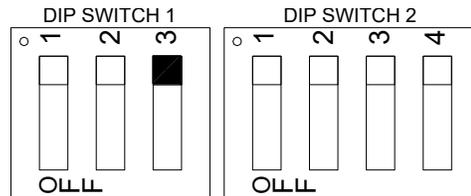


Figure 10

- Transistor of open collector output is ON when running (max 25mA)

**5-13 Speed variation (VR1)**

- Motor speed can be varied by turning the integral potentiometer VR1 (Figure 11)

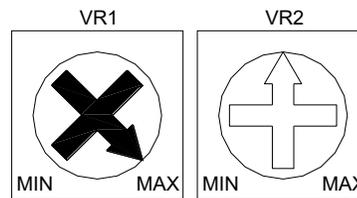


Figure 11

- Speed of the motors in all zones can be simultaneously varied by
  - Inputting an analog voltage to the CN2 #3 terminal of any **one** HB-508S
  - Adjusting the voltage input (0-10V)
  - Having all the HB-508S linked by communication cables
  - Setting the integral potentiometer to minimum
- 20mA current is consumed at 10V
  - Therefore 400mA capacity is needed to control 20 zones.

**5-14 Communication terminals (CN4, CN5)**

- Allows transmission and communication
  - Of signals
    - Sensor
    - Error
    - Transfer direction
    - External speed variation
    - Motor drive status
  - Between present, upstream, and downstream zones

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### 5-15 Power indication (LED 1)

- Lights green when powered (+24V and 0V are supplied to CN1)

### 5-16 Connection of HB-508S

Present (HB508S) zone to non-HB-508S zones or HB-508S zones without communication cable

Present zone to upstream zone

- Tote entry (present zone) through forcible RUN signal from upstream zone to input terminal CN2 #1
- Sensor output to prevent tote collision – signals upstream zone if present zone is occupied – through output terminal CN2 #4
- Logic designed to prevent tote collision
- DIP settings (Figure 12)

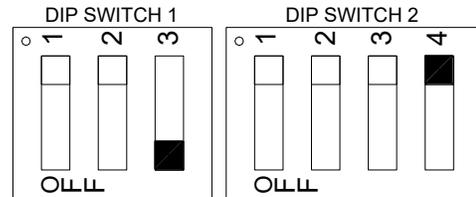


Figure 12

Present zone to downstream zone

- Case 1 – Normal Zone setting
- Signal input from downstream zone (downstream zone clear) to input terminal CN2 #1
- Normal ZPA Logic
- Tote automatically evacuates when downstream zone is clear
- DIP settings (Figure 13)

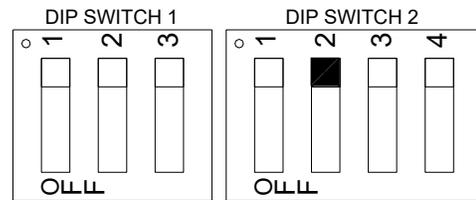


Figure 13

Present zone to downstream zone

- Case 2 – Last Downstream Zone setting
- Signal input from downstream zone to input terminal CN2 #1
- Totes accumulate to present zone in normal ZPA fashion
- Tote will not evacuate present zone until downstream zone signals it to RUN forcibly
- DIP settings (Figure 14)

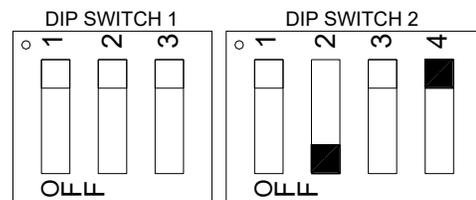


Figure 14

### 5-17 Protections

- Thermal Overload Device: Reacts either at 105°C (221°F) inside motor or 85°C (185°F) on PCB to lower the motor output to prevent motor overheat and burnout. When this reacts, LED will also light red.
- Current Limiter: is set at 3A maximum (motor locking current is 3A)

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### 5-18 ZPA Signal Sentry function

- Forcible STOP
- Tote is received from upstream zone
- Tote in present zone does not evacuate while receiving a signal at input terminal CN2 #1
- Normal ZPA logic operates while there is no input signal
- DIP settings (Figure 15)

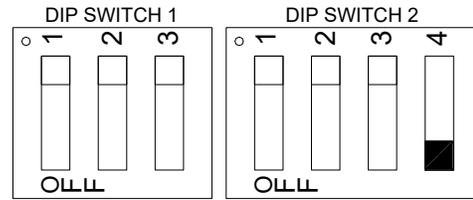


Figure 15

## 6 Connector Specifications

### 6-1 CN1 Power Connector (2P) – Included

	Wago #734-132 For driver side	WAGO #734-102 For control cable side
1	+24VDC	Wire AWG28-14 Input 100W or over
2	0V	

### 6-2 CN2 Control Connector (5P) – Not Included

	WAGO #733-335 For driver side	WAGO #733-105 (option) For control cable side
1	Terminal input	Wire AWG28-20 Input 0-10V (external speed variation only) Input +24V or 0V (all others) Output: Open collector (Max 25mA DC)
2	DIR input	
3	Speed variation voltage input	
4	Synchronization/sensor output	
5	Error output	

### 6-3 CN3 Sensor Connector (3P) – Included

	WAGO #733-363 For driver side	WAGO #733-103 For control cable side
1	+24VDC	Wire AWG28-20  High – Active
2	Sensor	
3	0V	

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**6-4 CN4 Communication Connector (8P) – Not Included**

	MOLEX #52018-8845 For driver side	Hirose #TM10P-88P equivalent (Option) For control cable side
1	Sensor signal output	Wire AWG26 equivalent
2	Sensor signal input	
3	Speed variation	
4	Error signal	
5	Drive input	
6	Drive output	
7	Direction signal	
8	GND	

**6-5 CN5 Communication Connector (8P) – Not Included**

	MOLEX #52018-8845 For driver side	Hirose #TM10P-88P equivalent (Option) For control cable side
1	Sensor signal input	Wire AWG26 equivalent 8P
2	Sensor signal output	
3	Speed variation	
4	Error signal	
5	Drive output	
6	Drive input	
7	Direction signal	
8	GND	

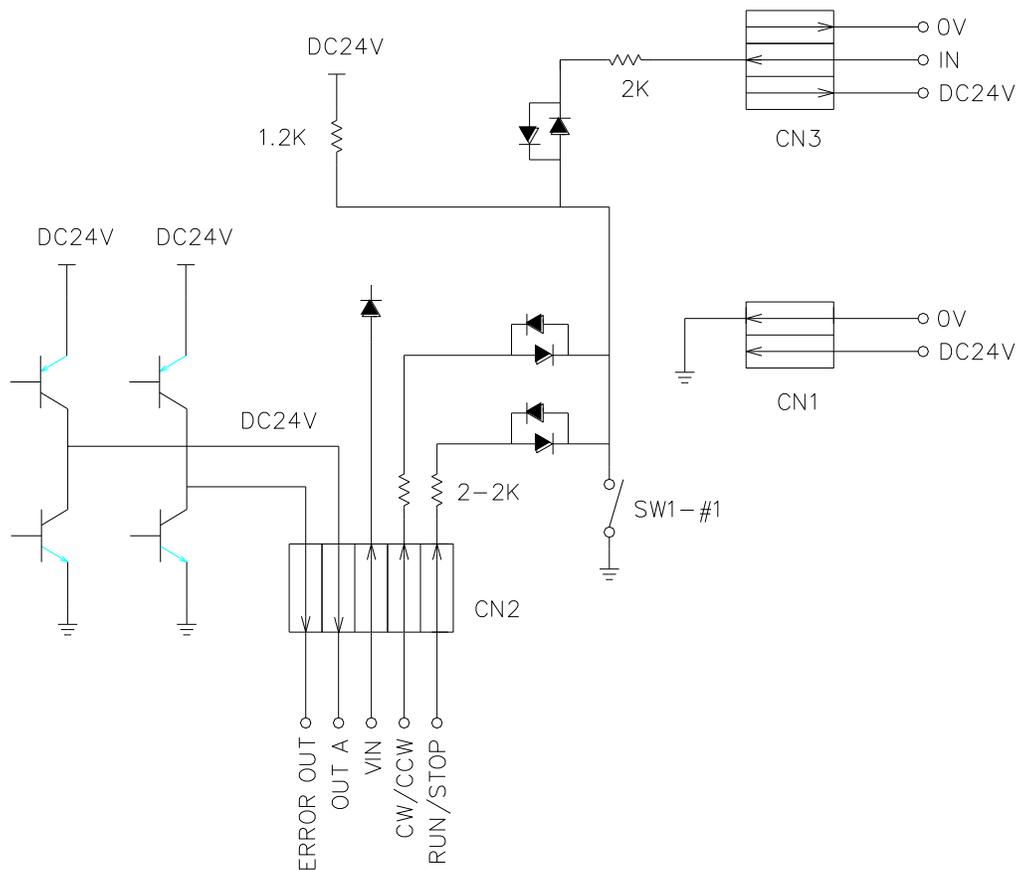
**6-6 CN7 Motor Connector (9P) – Included with Power Moller**

	JST #S9B-XH-A 9P For driver side	JST #XHP-9 Mounted to the motor cable
1	GND (gray)	Pressured connection terminal #DF3-22SCF (supplied in reel) Wire AWG28-22 except AWG24-22 used for motor phases  * brake option is customized
2	+12V (blue)	
3	Motor phase U (red)	
4	Motor phase V (white)	
5	Motor phase W (black)	
6	Hall sensor U (violet)	
7	Hall sensor V (orange)	
8	Hall sensor W (green)	
9	Thermister (light blue)	

## 7 DIP Switches

	SW #	Function	Setting	Standard Setting
DIP Sw 1	1	PNP/NPN input signal switch	ON – PNP, OFF – NPN	ON
	2	PNP/NPN output signal switch	ON – PNP, OFF – NPN	ON
	3	Synchronization or sensor output switch	ON – Synchronization output OFF – Sensor signal output	ON
DIP Sw 2	1	Singulated or slug release mode switch	ON (ZP1) – slug (train) release mode OFF (ZP2) – singulated release mode	ON
	2	Last downstream zone setting	ON (ZB)– Normal zone OFF (ZE)– The last downstream zone	ON
	3	Motor setting FS or FE	ON – FE unit OFF – FS unit	ON
	4	Forcible RUN or Forcible Stop switch	ON – Forcible RUN OFF – Forcible Stop	ON

## 8 Wiring Diagram

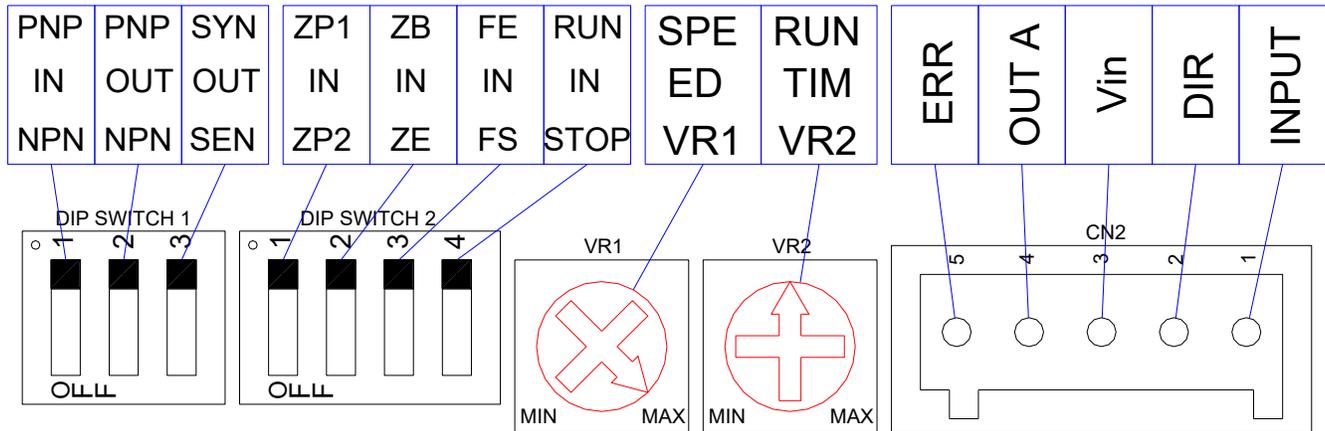


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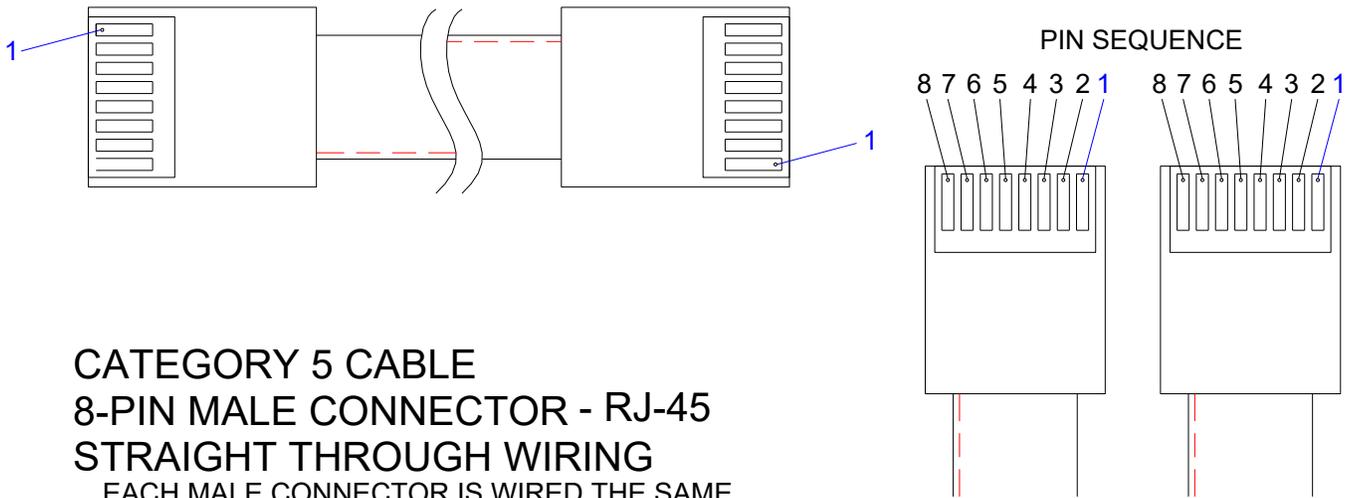
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## 9 User Controls

### DEFAULT HB-508S CARD SETTINGS



## 10 Communication Cable



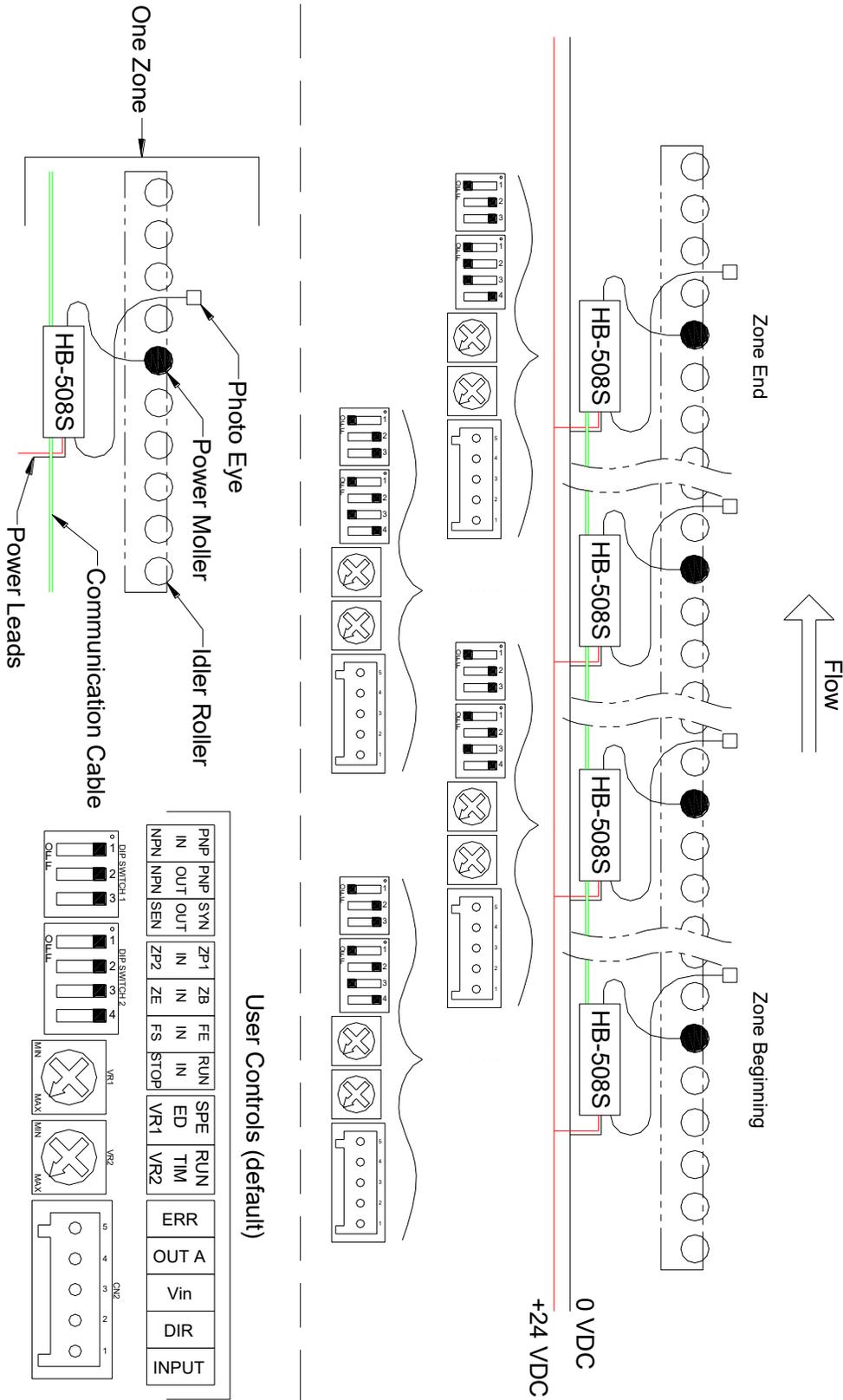
## 11 Common Applications

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- The following pages illustrate
  - Common applications of the HB-508S
  - DIP switch settings for HB-508S
  - General wiring of the HB-508S
  
- Common applications of the HB-508S are
  - **Basic Setup** (Page 17)
    - NPN input from photo-eye
    - HB-508S linked by communication cables
    - HB-508S in the last downstream zone is set for Zone End (ZE)
  
  - **Infeed Conveyor Setup** (Page 18)
    - Similar to basic setup
    - Except it uses photo-eye
      - Setup at the end of the upstream conveyor
      - To forcibly RUN the rollers in the first zone
  
  - Discharge Conveyor Setup
    - These are just two basic discharge setups
      - **PE (photo-eye) discharge setup** (Page 19)
        - HB-508S in last downstream zone
          - Set to ZB
          - Set to STOP
          - Receives signal from photo-eye to forcibly STOP
        - Normal ZPA logic operation
      - **PLC discharge setup** (Page 20)
        - HB-508S in last downstream zone
          - Set to ZE
          - Set to RUN
          - Receives signal from PLC to forcibly RUN
        - Operation
          - Normal ZPA until last downstream zone
          - Tote waits in final zone
            - Until HB-508S receives command to RUN from PLC

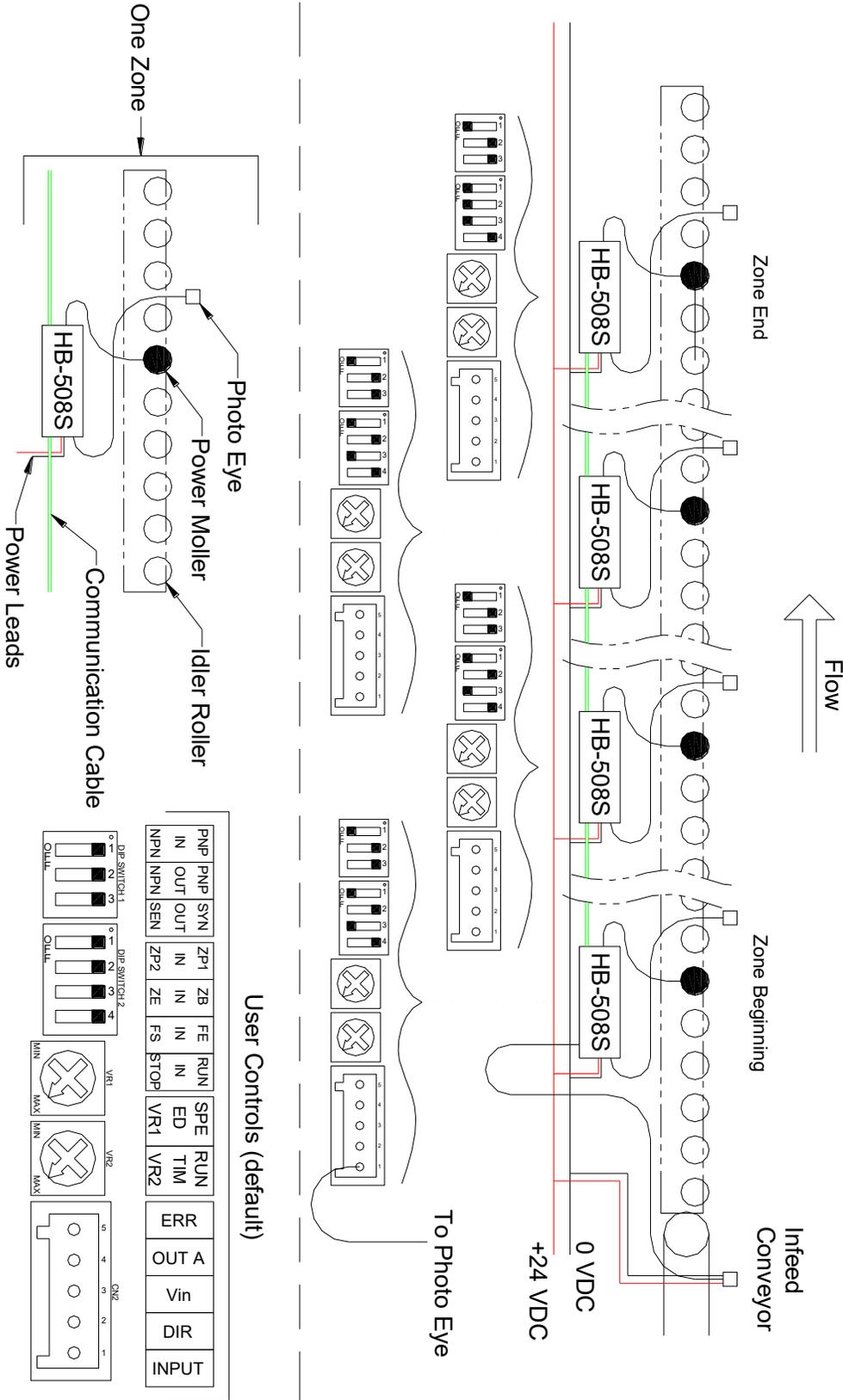
### EXAMPLE - ZPA Conveyor Setup

FS Power Moller - Singulated - NPN Photoeye - Zone End



## EXAMPLE - ZPA Conveyor Setup

FS Power Moller - Singulated - NPN Photoeye - Zone End - Infeed Conveyor

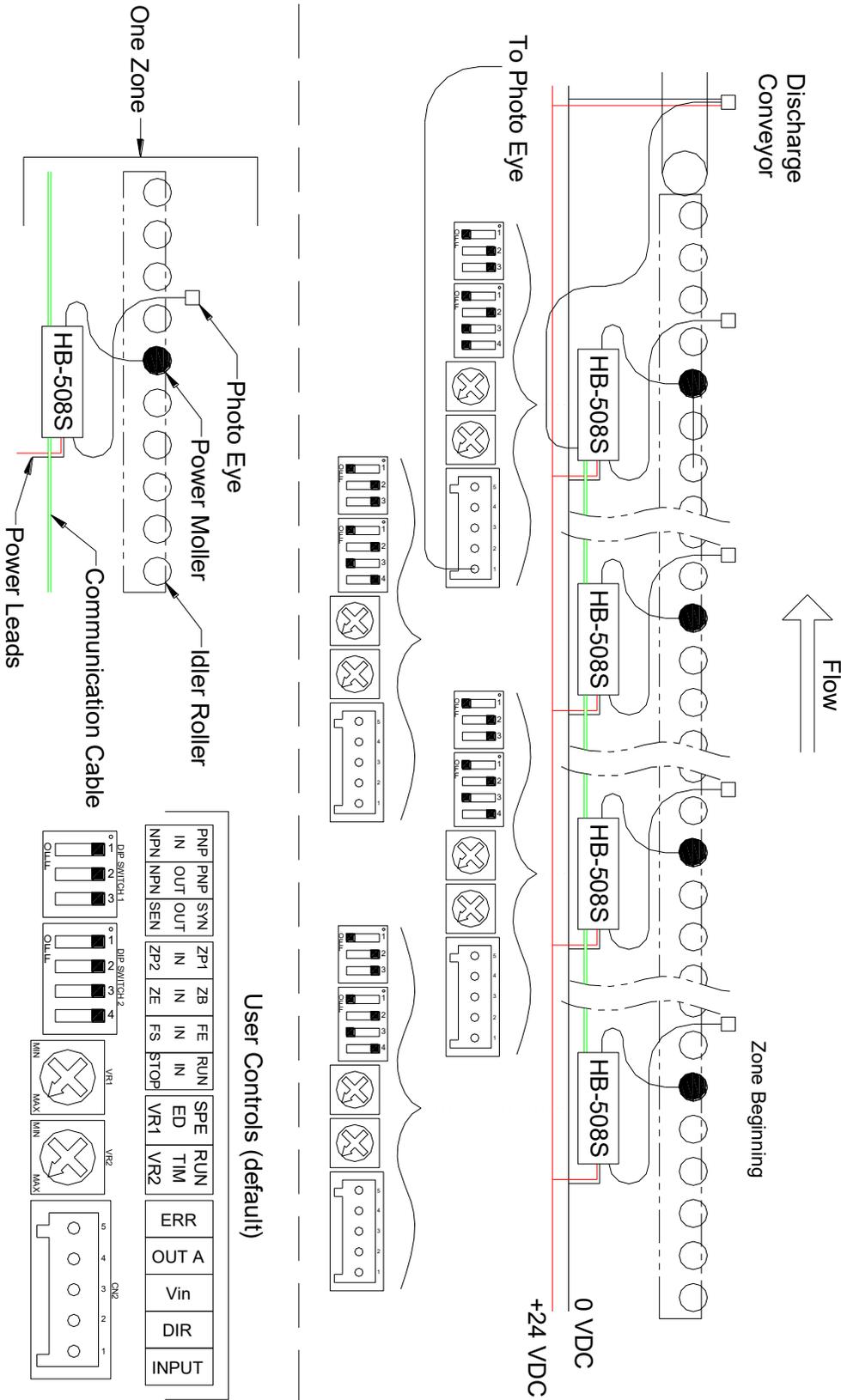


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## EXAMPLE - ZPA Conveyor Setup

FS Power Moller - Singulated - NPN Photoeye - PE Discharge Conveyor

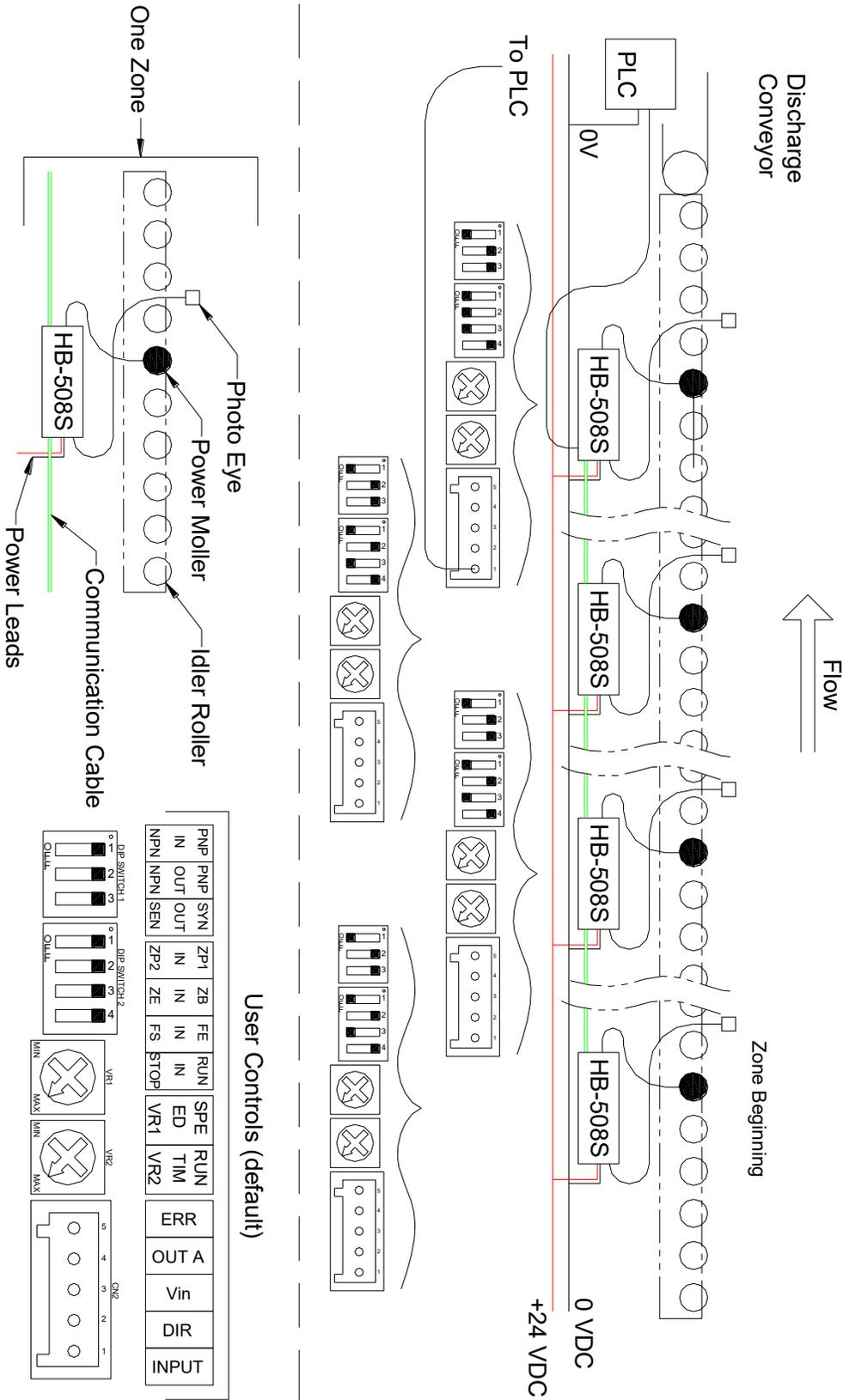


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### EXAMPLE - ZPA Conveyor Setup

FS Power Moller - Singulated - NPN Photoeye - PLC Discharge Conveyor





**Installation Precautions – IMPORTANT, PLEASE READ BEFORE INSTALLATION**

Precaution	Action	Reason
<b>Multiple power supplies</b>	0V line of all power supplies on the same conveyor line (powering the card/rollers, & controls) need to be physically linked together.	This completes the signal path from one section of the conveyor (powered by a power supply) to the adjacent section of conveyor (powered by another power supply) and allows for proper communication through the cable and external interfaces.
<b>Voltage drop across the power bus</b>	Use suitable gauge wire in relation to distance and current draw to prevent voltage drop.  <u>Operating</u> DC voltage is 24V ±10%	When running long distances from a DC power supply, the voltage drop during motor operation across the power bus may be significant (may drop below 15V!). If there is a large enough drop in voltage, the roller(s) may behave in a strange manner. In order to prevent this, a larger gauge wire must be used.
<b>Grounding</b>	Ensure the control card is securely grounded to the conveyor frame. The conveyor frame should also be at the same potential reference as earth ground. Standard grounding practices should be followed.	Static discharge may interfere and damage internal components.
<b>Electrical</b>	24V DC ±10% 4A maximum current limiter (motor lock is 4A) Diode protection for miswiring Sensor power short circuit protection 5A fuse for power supply protection	Improper power will damage the card. The motor/card should not be subject to locked conditions repeatedly. Internal fuse is not replaceable. If the fuse has blown, more serious damage has occurred within the card/motor.
<b>Environment</b>	Ambient temperature is 32~104°F Ambient humidity is < 90%RH Atmosphere has no corrosive gas Vibration is < 0.5G Indoor use only	Extreme environmental variables may cause poor or no performance and damage the card.
<b>Over-speeding</b>	Over-speeding of the roller's no-load speed by more than 50% may cause damage.	Back EMF will be generated.

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## Revision History

Revision Number	Change
A-12.19.02	Initial document
A-06.30.03	Layout restructured, wording clarified Added: cover page; table of contents; communication cable drawing; common applications section; standard configuration drawing; infeed configuration drawing; and 2 discharge configuration drawings
A-10.07.03	Updated VR2 drawings to match default setting
A-10.27.03	Updated photograph and dimensional drawing to reflect heat-sink implementation
05-0816	Revision number format changed
05-0822	Updated speed variation information (VR1)
08-0115	Added revision history table Adjusted page numbers and referenced page number throughout document
09-0423	Added precautions
09-0526	Added < to 90% RH on page 5