

Technical Document

for the

HB 510 Driver Card



2006

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Revision index:

rev.	date	pos.	name	Procedure / modification

1. Introduction

HB-510 is the new generation of Built-in ZPA Logic Hybrid Driver Card. The HB-510 is now applicable to FP series power power unit as well as to FS, FE standard units. Having both slug (train) and singulated tote release mode along with sensor and jam timer functions, the HB 510 perfectly suits the most common ZPA conditions. In addition, the HB-510 is designed to be "lead free" while keeping the functions like flexible zone recognizing, sychronized speed variation, stable speed, and signal sentry function to satisfy even the most diverse and more sophisticated automation needs.

The designation of HB-510 series cards are:

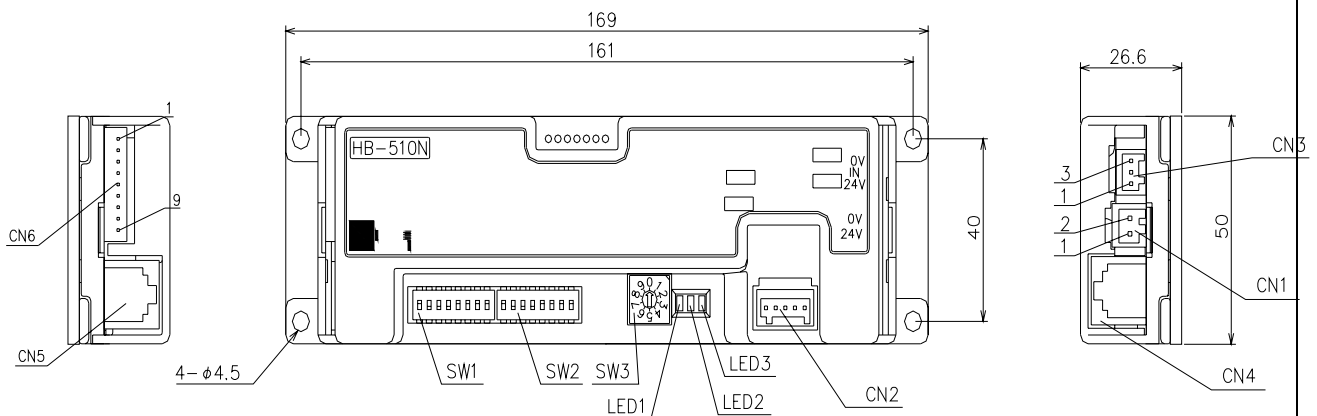
- HB 510N for standard Power Moller, NPN signal
- HB 510P for standard Power Moller, PNP signal
- HB 510BN for built-in brake Power Moller, NPN signal
- HB 510BP for built-in brake Power Moller, PNP signal

2. Features

- Applicable to FP series high power motors as well as FS, FE series standard motor.
- Lead free design for RoHS conformity
- Integral indexed rotary switch for easy speed adjustment
- Achieves both singulated and slug (train) tote release ZPA
- Flexible zone recognition (patented): The slug release mode also enables 'Flexible Zone Recognition'; Whatever the tote length is, and whenever the tote occupies multiple zones, the zones that are occupied by the tote are recognized as one zone to continuously achieve ZPA.
- More LED functionality to communicate operating and error status.
- Run hold timer, Sensor timer and jam timer function
- Signal sentry function
- Synchronized speed variation
- 1 zone plural motors synchronized drive
- Helps motor to have Stable speed against varying load. (when the motor is running at nominal speed or less and applied load is less than the rated tangential force)
- Applicable for both PNP and NPN input signal (by the Dip switch selection)
- Simplified wiring – totally 'plug & play'

3. Dimensions

Dimensions: PCB 145 x 46 x 1.6(mm)
Complete assembly: 169 x 50 x 32(mm)
Enclosure: Fire resistant ABS (grey colour)



4. Connectors

CN 1 – for power WAGO #734-132

CN 2 – for control WAGO #733-335 (optional – not inclusive as standard accessory)

CN 3 – for sensor WAGO #733-363

CN 4 – for communication cable MOLEX #52018-8845

CN 5 - for communication cable MOLEX #52018-8845

CN 6 – for motor JST #S9B-XH-A

CN1 Power Connector 2P

	Driver side WAGO #734 - 162	Power cable side WAGO #734 - 102
1	Power (+24V)	Wire AWG28-14
2	Power (0V (GND))	

Power must be full wave rectified and smoothed current 10% ripple

CN2 Control Connector 5P

	Driver side WAGO #733 - 335	Control cable side WAGO #733 - 105 (Option)
1	Error output	Wire AWG28-20 Input +24V/0V 0-10VDC to vary the speed Output: Open collector (Max 25mA DC)
2	Synchronization / sensor output	
3	Speed variation voltage input	
4	DIR / E-stop input	
5	Terminal input	

CN 3 Sensor Connector 3P

	Driver side WAGO #733-363	Motor cable side WAGO #733-103
1	+ 24VDC	wire AWG28-20 Sensor should be set to be ON to discharge a signal when detecting.
2	Sensor	
3	0V	
4	Alarm (optional 4Pconnector)	

CN4 Communication connector 8P

	Driver side MOLEX #52018-8845	Motor cable side Hirose #TM8P-88P equivalent (Option)
1	Sensor signal output	wire AWG26 equivalent 8P cable
2	Sensor signal input	
3	Speed variation	
4	Error signal	
5	Drive input	
6	Drive output	
7	Direction signal	
8	Emergency stop	

CN5 Communication connector 8P

	Driver side MOLEX #52018-8845	Motor cable side Hirose #TM8P-88P equivalent (Option)
1	Sensor signal input	wire AWG26 equivalent 8P
2	Sensor signal output	
3	Speed variation	
4	Error signal	
5	Drive input	
6	Drive output	
7	Direction signal	
8	Emergency stop	

CN6 Motor connector 9P for standard motor (10P for brake motor)

	Driver side JST #S9B-XH-A 9P	Motor cable side JST #XHP-9 (Fixed motor cable)
1	GND (gray)	Socket pressured connection terminal JST#SXH-001T-P0.6 Wire AWG28-22 except AWG24-22 used for motor phases
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)	
10	Brake (yellow) - optional	

5. Switches

Dip switch 1

No	Function	ON		OFF		Initial setting
		CN 5 left	CN 4 right	CN 5 left	CN 4 right	
1	Error signal transmission to the right adjacent zone	Transmit & Receive	Transmit & Receive	Transmit & Receive	Blocked	ON
2	DIR signal transmission to the right adjacent zone				Blocked	ON
3	Emergency stop transmission to the right adjacent zone				Blocked	ON
4	Speed variation voltage transmission to the left adjacent zone	n.a.	n.a.	Blocked	n.a.	ON
5	Speed variation voltage transmission to the right adjacent upstream zone	n.a.	Transmit & Receive	n.a.	Blocked	ON
6	Speed variation selection	External		Integral rotary switch		OFF
7	DIR/E-stop input selection	E-stop signal input		Direction signal input		OFF
8	Recovery for thermister or voltage drop(15V) reaction	Manual		Automatic		ON

Dip Switch 2

No	Function	ON	OFF
1	Output signal selection	PNP	NPN
2	OUT A selection	Synchronization output	Sensor output
3	Gear reduction setting 2	See the bottom table of the next page	
4	Gear reduction setting 1		
5	ZPA mode	Slug (train)	Singulated

6	Downstream end setting	NO	YES
7	Motor turning direction	FE series	FS/FP series
8	Input terminal function	RUN	STOP

Initial setting: all except No.3 are ON

Dip Switch 3 Rotary switch (effected by SW1-6 is set to OFF)

Different speeds obtained by the rotary switch or external voltage change
(when PM486FE-60 motor is used)

Rotary switch	External voltage (V)	Speed 1 stage gear (m/min)	Speed 2 stage gear (m/min)	Speed 3 stage gear (m/min)	Tolerance (objective)	Initial setting
9	9.5±0.2	215	60	17	+/-3%	Rotary SW 9
8	8.5±0.2	195	55	15.5		
7	7.5±0.2	180	50	14		
6	6.5±0.2	160	45	12.5		
5	5.5±0.2	140	40	11		
4	4.5±0.2	125	35	10		
3	3.5±0.2	105	30	8.5		
2	2.5±0.2	90	25	7		
1	1.5±0.2	70	20	5.5		
0	0.5±0.2	55	15	4.5		

* Note: 20m/min motor for instance reaches to its maximum speed at rotary switch's level 2, or external analog voltage input between 2-3V, and larger number than this won't increase the speed.

Different speeds obtained by the rotary switch or external voltage change
(when PM486FP-55 motor is used)

Rotary switch	External voltage (V)	Speed 1 stage gear (m/min)	Speed 2 stage gear (m/min)	Speed 3 stage gear (m/min)	Tolerance (objective)	Initial setting
9	9.5±0.2	277.8	63.8	16.2	+/-3%	Rotary SW 9
8	8.5±0.2	271.1	58.4	15.1		
7	7.5±0.2	245.8	53.7	14.2		
6	6.5±0.2	221.5	48.4	12.7		
5	5.5±0.2	195.4	43.0	11.2		
4	4.5±0.2	174.1	37.8	10.0		
3	3.5±0.2	147.0	32.4	8.6		
2	2.5±0.2	124.5	27.1	7.1		
1	1.5±0.2	97.1	21.7	5.6		
0	0.5±0.2	76.5	16.2	4.5		

Selection of motor gear reduction by dip switch 2-3 and 2-4

SW2-3	SW2-4	setting
OFF	OFF	1 stage gearing
OFF	ON	2 stage gearing
ON	OFF	3 stage gearing
ON	ON	Forcible RUN

Initial setting is 2 stage gearing setting (SW2-3 OFF, SW2-4 ON) unless otherwise specified.

6. LEDs and Error Indications

LEDs : LED 1 (green) for power indication
 LED 2 (orange) for sensor or jam error indication
 LED 3 (red) for motor failure indication (thermister, motor block or current limiter)

Sympton	LED1 (green)	LED2 (orange)	LED3 (red)	Error output	Error causes	Reaction	Solution
Normal	Lights	Lights with sensor signal	Off		n.a.	n.a.	n.a.
	Blinks while running						
Thermister error	Lights	Lights with sensor signal	Lights	X	Critical temperature on Motor or PCB	Motor stop	*1
Motor does not turn	Lights	Lights with sensor signal	Blinks 1Hz		Motor blocked 4 sec	Motor stop	*2
Motor unplugged	Lights	Lights with sensor signal	Lights	X	Connector not plugged	Motor output stop	*3
JAM error	Lights	Blinks 1Hz	Off	X	JAM time	Motor stop	*4
Fuse brown	Off	Lights with sensor signal	Blinks 1Hz	X	Low voltage or current Exceeding 5A	Motor stop	*5
Current limit	Blinks 1Hz	Lights with sensor signal	Blinks 6Hz		n.a.	n.a.	n.a.

*1 – after the thermister recovery, stop then restart the motor, or switch off the power first then on the power.

*2 – remove the cause of the motor block

*3 – switch off the power first, then plug in the connector properly, then switch on the power.

*4 – remove the cause of the Jam error

*5 – replace the card as it is almost dead if the fuse is blown. In case of manual recovery of lower voltage error, stop then restart the motor, or switch off the power first then on the power.

7. Functions

7-1 ZPA function

- HB-510 can directly be connected to the sensor in the present zone.
- The communication cables allow for signal exchanges with the next adjacent zones controlled by the HB-510:
- Based on the signal, the HB-510 either receives the tote into or evacuates the tote from the present zone, depending on the occupied status in the present, and next adjacent up and downstream zones.
- ZPA modes (single or slug release) can be selected by the dip switch #2-5 setting. (See Section 5)
- In case HB-510 is used in the last downstream zone, the motor in the zone can be stopped by detecting tote presence (sensor ON) in the present zone. (This mode can be selected by dip swith #2-6 – See Section 5)

7-2 Sensor timer

- When the motor in the present zone is running, and if there's no further tote entry into the present zone in the certain period of adjusted time after the sensor turns OFF, and in addition, there is no tote presence in the next adjacent upstream zone, the motor in the present zone will be stopped by this sensor timer function.
- Time which differs by motor gear reduction is adjustable by DIP switch 2-3 and 2-4.
- Adjustable range of time: between 0.3 and 1.2 seconds for 1 stage gearing unit
between 1 and 4 seconds for 2 stage gearing unit
between 4 and 14 seconds for 3 stage gearing unit
* transfer 1 meter in ant gearing
- Depending on its zone length, tote size and speed of transportation, the tote may not be reached to the present zone in the certain period of adjusted timer.

7-3 RUN hold timer

- When the motor in the present zone is running and if there's no further tote entry in the present zone in the certain period of adjusted time after the sensor OFF in the same zone, the motor will be stopped.
- Time which differs by motor gear reduction is adjusted by DIP switch 2-3 and 2-4 to ensure conveying any tote for 1 meter for any motor speed. (see Switch in the page 6)
- Run hold time setting : between 0.3 and 1.2 seconds for 1 stage gearing unit
between 1 and 4 seconds for 2 stage gearing unit
between 4 and 14 seconds for 3 stage gearing unit
* Those time are calculated to conveyor tote 1 meter in any gearing or any motor speed. Therefore, the run holding time is longer with slower motor speed, and shorter with higher speed motor even with the same gearing.
- Depending to its distance from present zone to the last downstream zone and speed of transportation, the tote may not be evacuated from present zone.

7-4 Jam timer

- When the present zone is in a sensor ON status (tote presence), thereby activating its motor, and if there's no sensor status change in the zone during the certain period of adjusted time after the tote is initially detected in the zone, this condition would indicate a jam, and the motor in the zone will be stopped. At the same time an error signal will be discharged.
- To correct the error (i.e. jam), the blocking tote should be removed to switch off the sensor or sensor in the downstream should be ON.
- Jam timer setting: between 0.6 and 2.2 seconds for 1 stage gearing unit
between 2 and 8 seconds for 2 stage gearing unit
between 7.5 and 27 seconds for 3 stage gearing unit
* Those time are calculated to conveyor tote 2 meter in any gearing or any motor speed. Therefore, the Jam timer set time is longer with slower motor speed, and shorter with higher speed motor even with the same gearing.
by Dip switch 2-3 and 2-4. (see Switch in the page 6)
- Depending to its zone length, tote size and speed of transportation, motor in the zone may be stopped for detected in a jam condition and tote may not be evacuated from the zone.

7-5 PNP / NPN input signal

Input, DIR (direction), sensor, alarm input terminals accept both NPN and PNP signals. NPN or PNP signal input is selected by JP1(input), JP2 (direction), JP3 (sensor) and JP4 (alarm)

7-6 PNP / NPN output signal

- OUT A (Sensor or synchronization signal) and Error output terminal signal can be either PNP or NPN open collector (selectable by the switch 2-1)

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- Sensor signal output and synchronization signal output are alternative and can be selected by the dip switch #2-2 (See Section 5)

7-7 Sensor input (CN3)

Sensor outputs should be set to be ON when detecting tote.

7-8 Alarm input (CN3)

Alarm input (CN3) alarm output should be set to be ON when error is detected.

7-9 Motor Run (CN2 - INPUT)

- Motor will automatically be activated and stopped by ZPA logic function depending on the sensor status in the present, next adjacent up and downstream zones.
- Regardless of the ZPA logic, the motor will be forcibly activated by switching on (close) the input terminal. RUN input signal should be 1 shot pulse. In case of tote stops in downstream zones or Jam timer activates, motor will stop. (in case the dip switch #2-8 is ON setting) (the motor is subject to ZPA logic when the contact is open)
- When the motor is running, LED1 (green) blinks

7-10 Motor reversing (CN2 - DIR)

- When SW#1-7 is OFF, transfer direction can be changed by input to DIR terminal.
- Switching on the DIR (direction) input terminal will make the same HB 510 connected to CN5 be upstream, and the one to CN4 be downstream.
- Reversing the motor by DIR input terminal will automatically reverse the motor in next adjacent up and downstream zone.
- Transfer direction of the multiple zones (maximum up to 30 zones) can be reversed simultaneously by reversing command signal from one of these zones, as all these zones are linked with communicated cable containing direction command signal.
- Single motor direction can be reversed by the dip switch #2-7 setting (because motor turning direction of FS and FE unit differs respectively)
- When the DIR terminal is ON, the motor must run toward CW direction. Thus, the dip switch #2-7 must be OFF for FS series motor, and be ON for FE series motor.

7-11 Block setting

- Transfer direction (DIR input), synchronized input (Vin), Error signal can be made a "block" in multiple zones by dip switch #1-1, 1-2, 1-3 and 1-4. Each block can be controlled individually. When SW is OFF, the present zone belongs to left side block.
- When the SW for left side control card and present zone is OFF, present zone is controlled independently.
- Quantity of the zones in the same block to share DIR, (direction), ERR (error) and synchronized speed variation input is limited while the quantity of zones to achieve ZPA is unlimited.

7-12 Sensor signal output (CN2 – OUT A)

- Output of the sensor signal of the present zone. (discharged from CN2 OUT A terminal, when the dip switch #2-2 is OFF) Output transistor will be ON, when detecting tote (sensor ON) and LED 2 illuminates orange when sensor output signal is discharged.

7-13 Error signal output (CN2 - ERR, LED 1)

- Error signal is discharged from the CN2 error output terminal in normal status, and is relayed to all the HB 510 cards connected through communication cables.

- Failed (troubled) zone can easily be identified by the LED 2 and LED 3 in the individual HB 510. (LED 3 illuminates or blinks red on the HB 510 card in the troubled zone. Neither LED 2 (orange) or LED 3 (red) illuminates when power is disconnected.
- Error signal is discharged at any of the following failures:
 - reaction of thermal overload device either circuitry (stops to motor cease ZPA function, lighting LED 3 red)
 - Jam timer setting time over and jam timer error(stops motor to cease ZPA, lighting LED 3 orange)

Causes of those failure must be removed to ensure the proper function.

7-14 Synchronization signal output (CN2 – OUT A)

- Synchronization signal is discharged when the motor in the present zone starts running.
- This signal enables synchronized motor operation in plural zones connected by the communication cable to individual HB 510.
- This also allows the synchronized operation of the plural motors in the same zone.
- CN2 – OUT A will be synchronization signal output terminal if the dip switch #2-2 is set ON.
- Transistor of open collector out becomes ON, when running (max 25mA)

7-15 Synchronized speed variation (CN2 - VIN)

- Motor speed change can be synchronized in the multiple zones which are connected by communication cables as set in the dip switch 1-4 and 2-5.
- Motor speed can be varied both externally (by varying voltage input between 0 and 10V if the switch 1-6 is ON) and internally (by the integral 10 index rotary switch – SW3 if the SW 1-6 is OFF)
- If different voltages are applied to plural zones, the higher voltage gets priority.
- The voltage at maximum speed varies depending on the motor speed.

7-16 Communication terminal (CN4, CN5)

- Allows the communication of sensor signal, and the motor drive status signal among the present zone, up and downstream zones.
- Transmits the transfer direction signal.
- Transmits simultaneously speed variation signal.
- Transmits the error signal.
- Transmits the emergency stop signal

7-17 LED indications

LED 1 – Power (green): illuminates green when 24V and 0V are supplied to CN1, and blinks when the motor is running.

LED 2 – Sensor (orange): illuminates orange when sensor detects, and blinks at 1Hz in case of JAM error.

LED 3 – Error (red): illuminates red when thermister reacts, and blinks at 1Hz when the motor is blocked, or voltage drops lower than 15V (if manual recovery is selected with dip switch 1-8). If both occurs at the same time, thermister error has priority. In case the current limiter reacts, LED 3 blinks at 6Hz.

7-18 Speed variation

Speed can be varied in 10 steps by SW3 rotary switch if Dip SW 1-6 is set to OFF.

7-19 Motor blocking

Motor automatically reduces its output power if motor is blocked or overloaded continuously for 4 seconds. Error signal won't be discharged in this case.

Motor output recovers automatically as soon as the motor starts turning normally.

7-20 Forcible stop

When SW#2-8 is OFF, input signal to CN2 will bring a tote into the present zone, but will not evacuate it because the zone is recognized as the last downstream zone.

The forcible stop and RUN input are alternative, and cannot be controlled together.

7-21 RUN when powered

By setting SW #2-8 ON, "RUN when powered" function is enabled.

With this function, motor runs for a short period of time when powered to receive or evacuate any box that may exist between photo sensors (even if present zone sensor is not blocked and stops when the sensor in the present zone is blocked) then go to normal ZPA movement.

By setting SW #2-8 OFF, motor does not run when powered. Motor runs with normal ZPA logic.

7-22 Connection to the HB 510 in the other zones

- If the HB-510 in the upstream zone is not connected by communication cable to the one in the present zone, tote entry into the present zone will be done only with signal from INPUT terminal.
- Tote evacuation from the present zone is done according to its ZPA logic. In case tote entry is done by INPUT terminal, the tote existence of the zone must be recognized by sensor signal output, so as to prevent the bumping of totes. The program has been made accordingly to prevent the bumping of the totes.
- If the HB-510 in the downstream zone is not connected to the one in the present zone with the communication cable, tote entry is done by ZPA logic.
- Evacuation from the zone will be done only by injecting to INPUT terminal, if the Dip Switch #2-8 is set to OFF. If the Dip Switch #2-8 is set to ON, tote will be automatically evacuated from the zone as in normal ZPA, recognizing the next adjacent downstream zone is empty.

7-23 ZPA Signal Sentry function

- By setting the dip switch #2-8 OFF, the corresponding zone is forcibly stopped by inputting forcible stop signal to CN 2 input terminal. The zone receives the incoming tote from the next upstream zone, but won't evacuate it to the next downstream zone.
- Forcible stop and RUN input does not work at the same time.

7-24 Emergency stop (E-STOP)

- Emergency stop function is enabled by setting the dip switch #1-7 ON.
- Motors in all the zones (maximum 30 zones) connected through the communication cables stop by inputting signal to CN 2 DIR terminal of one of those HB 510 cards.
- If the DIR and E-STOP function are required at the same time, each of them should be set separately on the multiple HB 510 cards connected through communication cable.

7-25 Thermister recovery setting

- Mode of thermister recovery (either manual or automatic) can be selected by SW#1-8.
- Manual recovery mode is selected if the SW#1-8 is set ON. In this case, the motor stops 4 seconds after the thermister reacts. The motor won't restart even if the unit is cooled down. To reset the error to restart, input signal to CN2-1 or CN2-2.
- Automatic recovery mode is selected if the SW#1-8 is set OFF. In this case, the motor stops 4 seconds after the thermister reacts, but will automatically recover as soon as the unit is cool down.

8. Electrical specifications

- Input Voltage : 24VDC +/- 10%
- Thermal Overload Device: Reacts to lower the motor output to prevent motor overheat and burnout. When this reacts, LED 3 will also illuminate red.
- Current Limiter: is set at 4A maximum (motor locking current is 4A)
- 5A fuse
- Diode to prevent mis-wiring
- Circuit is protected against the sensor power short-circuit
- 20,000 hours expected service life

9. Environmental concerns

- Ambient temperature: between 0 and 40 (no condensation)
- Ambient humidity: 90%RH
- Atmosphere: no corrosive gas
- Vibration: 0.5G
- Indoor use only

10. Precautions to ensure the best performance

- The multiple HB 510 cards connected by communication cables should be powered on and off all together. If any card(s) in the same group connected by communication cables are unpowered, current flows to unpowered card(s) to cause malfunction. If the quantity of unpowered cards is larger than the one for powered cards, the unpowered card may be damaged.
- Use a sensor that would have an active output when the zone is occupied. Sensor mounting position should be 150mm toward upstream from the downstream end of the same zone to ensure the smooth tote transfer.
- In case thrubeam and reflective sensor is used, the sensor should be positioned above the conveyor rollers to ensure the proper tote detection.
- If HB 508S is the adjacent upstream zone card, then dip switch #1-3 on the HB 510 has to be set OFF. If the HB 508S is adjacent downstream card, then pin8 on the communication cable between them has to be disabled. [pin #8 is the ground (0V) on the HB 508S, while pin #8 is the E-Stop on the HB 510. When connected together, the E-Stop signal is pulled low by the ground i.e. activating the E-STOP]
- If tote causing JAM is removed, motor runs by RUN hold timer.
- Remove the cause(s) of error if it occurs frequently.

Specifications are subject to change without prior notice.