

# APPLICATION CONTROL GUIDELINES



## Narrow Belt System Wave Commander Wave Commander

P/N: 1167034

Revision Date: March 01, 2019



# CONTENTS

---

- CHAPTER 1: PURPOSE .....4**
  - 1.1: PROPERTY & PROTECTION .....4
  - 1.2: SOFTWARE WARRANTY .....4
- CHAPTER 2: INTRODUCTION .....5**
- CHAPTER 3: OPERATION.....6**
  - 3.1: PRODUCT GAPPING AND TRACKING.....6
  - 3.2: ARM .....6
  - 3.3: RAISE.....7
  - 3.4: LOWER .....9
- CHAPTER 4: APPLICATION..... 11**
  - 4.1: HARDWARE DESIGN ..... 11
  - 4.2: UNDERSTANDING OF ETHERNET/IP ..... 12
  - 4.3: ADDRESSING ..... 12
  - 4.4: I/O CONFIGURATION..... 18
  - 4.5: I/O MAPPING ..... 19
  - 4.6: TEACHING THE SORTER ..... 24
- CHAPTER 5: TROUBLESHOOTING ..... 25**
  - 5.1: STATUS INDICATORS ..... 25
- CHAPTER 6: TROUBLESHOOTING GUIDE..... 32**
- CHAPTER 7: REPLACEMENT..... 44**
- CHAPTER 8: SPECIFICATIONS..... 45**
- CHAPTER 10: DIMENSIONAL REFERENCE POINTS..... 46**
- CHAPTER 11: CONVEYOR CONTROLS - SAFETY GUIDELINES ..... 47**
- CHAPTER 12: REPLACEMENT PARTS IDENTIFICATION ..... 48**
- CHAPTER 13: WORKS CITED ..... 49**
  - MHS Systems GENERAL INFORMATION ..... 49
- MHS Systems INFORMATION..... 50**

<b>Figure 1: Trigger PE and Arm Enable Distance.....</b>	<b>7</b>
<b>Figure 2: Wave Commander Hardware.....</b>	<b>12</b>
<b>Figure 3: Web Browser, Information.....</b>	<b>13</b>
<b>Figure 4: Web Browser, Log In.....</b>	<b>13</b>
<b>Figure 5: Web Browser, TCP/IP.....</b>	<b>14</b>
<b>Figure 6: Web Browser, Security.....</b>	<b>15</b>
<b>Figure 7: Web Browser, Information.....</b>	<b>16</b>
<b>Figure 8: Web Browser, Log In.....</b>	<b>16</b>
<b>Figure 9: Web Browser, TCP/IP.....</b>	<b>17</b>
<b>Figure 10: Web Browser, Security.....</b>	<b>18</b>
<b>Figure 11: I/O Configuration, Module Properties Report.....</b>	<b>19</b>
<b>Figure 12: Wago 750-852 Programmable Bus Coupler.....</b>	<b>25</b>
<b>Figure 13: Wago 750-602 Field Side Supply Module.....</b>	<b>28</b>
<b>Figure 14: Wago 750-403 Digital Input Module.....</b>	<b>29</b>
<b>Figure 15: Wago 750-530 Digital Output Module.....</b>	<b>30</b>

## TABLES:

---

<b>Table 1: Hardwired vs. Networked Control Signals Comparison.....</b>	<b>5</b>
<b>Table 2: Wave Commander Raise Timing Chart.....</b>	<b>8</b>
<b>Table 3: Wave Commander Lower Timing Chart.....</b>	<b>10</b>
<b>Table 4: Input Data Map.....</b>	<b>21</b>
<b>Table 5: Output Data Map.....</b>	<b>23</b>
<b>Table 6: Wago 750-852 Programmable Bus Coupler Status Indicators.....</b>	<b>26</b>
<b>Table 7: Wago 750-602 Field Side Supply Module Status Indicator.....</b>	<b>28</b>
<b>Table 8: Wago 750-403 Digital Input Module Status Indicators.....</b>	<b>29</b>
<b>Table 9: Wago 750-530 Digital Output Module Status Indicators.....</b>	<b>30</b>
<b>Table 10: Wave Divert Commander Troubleshooting Guide.....</b>	<b>32</b>
<b>Table 11: Wave Divert Commander Specifications.....</b>	<b>45</b>

# Chapter 1: PURPOSE

---

It is the intent of MHS Systems, through this manual, to provide information that acts as a guide in the installation, operation and maintenance of MHS Systems Wave Commander

This manual describes basic installation practices, assembly arrangements, preventive maintenance, and assists in replacement parts identification.

This service manual is intended for use by personnel who are knowledgeable of installation and safe working practices on conveyor systems.

Not all applications and conditions can be covered; therefore, this manual is to be used ONLY as a guide.

If additional copies of this manual are needed or if you have any question concerning the conveyor please contact your MHS Systems Distributor or MHS Systems Lifetime Services at 231-798-4547.

Visit MHS Systems website at [mhs-conveyor.com](http://mhs-conveyor.com) for maintenance videos and other application information.

## 1.1: PROPERTY & PROTECTION

This software is the property of MHS Systems and is protected by copyright laws and other intellectual property laws and treaties. You are granted a nonexclusive license to install and use the software. You may not alter, merge, modify or adapt the software in any way including reverse engineering, disassembling or decompiling. You may not loan, rent, lease, sell or license the software or any copy.

Because software is inherently complex and may not be completely free of errors, it is your responsibility to verify your work and to make backup copies. MHS Systems will not be liable in any event for indirect, special, incidentals, tort, economic, cover or consequential damages arising out of the use of or the inability to use this software product.

## 1.2: SOFTWARE WARRANTY

MHS Systems warrants that the material and workmanship entering into its equipment is merchantable and will be furnished in accordance with the specifications stated.

## Chapter 2: INTRODUCTION

The Wave Divert Commander is designed to reduce the total cost of installation and ownership. This Ethernet/IP-based controller eliminates the need to install individual wiring for each input and output signal. Therefore, installation costs are reduced. Also, the Wave Divert Commander provides the time critical control required for sortation rates of up to 200 products per minute. This local control of each diverter greatly reduces the burden on the sorter controller. The sorter controller can utilize a much more cost effective design if it does not have to directly control each diverter.

The basic principal of the Wave Divert Commander is an arm, trigger, raise and then lower operation. Arming is accomplished from a sorter controller when a package, to be diverted, is approaching the destination diverter. Once the Wave Divert Commander is armed, the leading edge of the next package triggers the Wave sequence to begin. This can be accomplished, using networked control signals, when connected to a sorter controller via an Ethernet/IP network. Using the Wave Divert Commander with a sorter controller that is connected via an Ethernet/IP network is the preferred method. However, the Wave Divert Commander can also be used with sorter controllers that are not connected via a network. Instead of networked control signals, the Wave Divert Commander can be controlled with hardwired control signals from the sorter controller.

The Wave Divert Commander, from MHS Systems Inc., is pre-programmed to control diverters in an NBS Wave Sorter. When the Wave Divert Commander is networked to a sorter controller, the sorter controller supplies the sorter speed, in feet per minute, to the Wave Divert Commander. The Wave Divert Commander calculates the timer values necessary for proper control of the Wave diverter based upon the sorter speed. This can be accomplished on-the-fly for changes in sorter speed. When the sorter speed is changed at the sorter controller, new Wave Divert Commander Timer values will be immediately calculated by the Wave Divert Commander. The new timer values will be based upon the new sorter speed sent from the sorter controller on-the-fly in real time.

As mentioned previously, the Wave Divert Commander can be controlled by the sorter controller via an Ethernet/IP network, or with a 24VDC hardwired interface. Table 1 shows a comparison of the features that are available for the two different methods of control.

Feature	Hardwired Control Signals	Networked Control Signals
<b>Reduced Cost Of Ownership Due To More Cost Effective Sorter Controller</b>	x	x
<b>Single-Speed Sorting</b>	x	x
<b>Sorting with On-The-Fly Speed Changes</b>		x
<b>Ability To “Teach” Sorter Divert Positions</b>		x
<b>Reduced Installation Costs Due To Less Wiring</b>		x

**Table 1: Hardwired vs. Networked Control Signals Comparison**

## Chapter 3: OPERATION

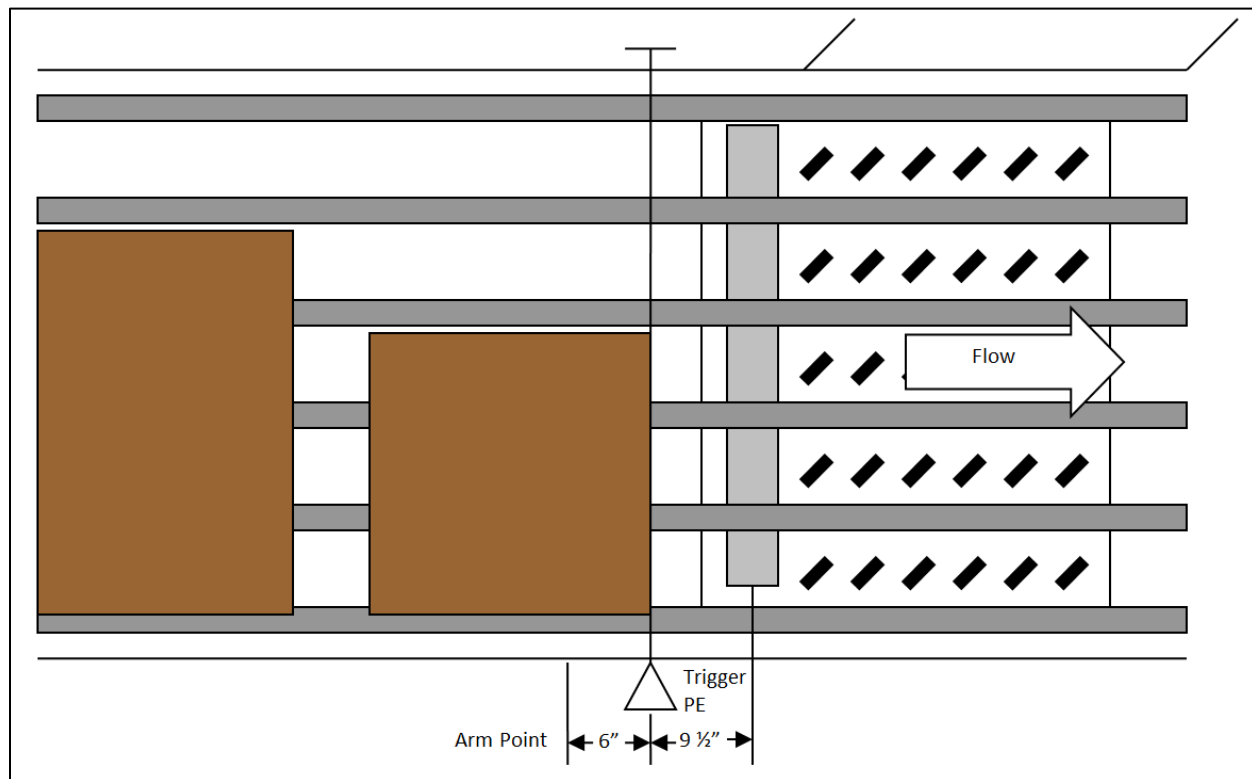
---

### 3.1: PRODUCT GAPPING AND TRACKING

Products are gapped by an induction system before entering the sorter. When gapping for the wave sorter, it is important that the target gap of the induction system is such that the minimum gap seen by the wave diverter is no less than three inches. If a gap of less than three inches is detected at the tracking photo eye, those packages should be recirculated or rejected, when possible. As a product enters the NBS sorter, it is sensed by the tracking photo eye, and the sorter controller should begin tracking the product as it travels along the sorter. The NBS sorter has a tracking encoder that generates pulses as the sorter belts move. The encoder is used for tracking of the product to its destination diverter. The pulses should be used to determine when to activate the arm signal for a diverter where a product is to be diverted. It is very important to use a sorter controller input that is appropriate for the tracking encoder signal. The tracking encoder is a pulse encoder, not an incremental or absolute encoder. It does not require an encoder input; instead, it requires a single 24VDC digital input that can handle the encoder pulse rate. For example, the maximum speed for the NBS Wave sorter is 425FPM. That equates to an off-to-on or on-to-off transition every 11.8 milliseconds.

### 3.2: ARM

When the product approaches the destination diverter, the sorter controller activates the arm signal to the Wave Divert Commander. This should happen when the leading edge of the product is approximately six inches (6") upstream of the divert trigger photo eye (see Figure 1: Trigger Photo Eye and Arm Enable Distance.) The decision as to when to turn on the arm signal is based upon the tracking information from the tracking encoder. With the arm signal on, once the divert trigger photo eye detects the gap between products, the Wave Divert Commander will be armed to divert the next product sensed by the divert trigger photo eye. Unless the following product is to be diverted at the same diverter, the arm signal should be turned off when the trailing edge of the product is approximately six inches upstream of the divert trigger photo eye, while the trigger photo eye is still blocked by the package being diverted. Again, this is based upon the tracking information from the tracking encoder. Arming the Wave Divert Commander can be accomplished over an Ethernet/IP network or with a hardwired input. Hardwired arming is accomplished by providing a 24VDC signal to INPUT 3 or 7 on the Wave Divert Commander (refer to Figure 2: Wave Divert Commander Hardware for details).



**Figure 1: Trigger PE and Arm Enable Distance**

Once the Wave Divert Commander is armed and the leading edge of the next product is detected by the divert trigger photo eye, the Wave Divert Commander sequence will be triggered to start. The trigger photo eye should be placed 9 1/2 inches from the centerline of the first diverter drive roller, or 11 1/2 inches from the centerline of the first row of diverter wheels. This is shown in Figure 1.

The trigger photo eye can be either prox-type (diffuse) or retro-type (retro-reflective.) A prox-type photo eye should be mounted with its light beam perpendicular to product travel on the sorter in the horizontal plane. The light beam should be parallel to the top surface of the sorter belts in the vertical plane. The centerline of the beam should be low enough to reliably sense the product with the shortest height without being triggered by the sorter belts. The gain on the photo eye should be adjusted to consistently detect all products while ignoring all other objects in the sensing area.

A retro-type photo eye should be mounted in the same manner as a prox-type photo eye. The reflector should be installed across the sorter from the photo eye, aligned with the centerline of the light beam, so as to maximize the amount of light reflected back to the photo eye.

### 3.3: RAISE

Once the Wave Divert Commander cycle has been triggered, the raise sequence starts. The first step of the raise sequence is a time delay. This delay is from the trigger event to turning on the output signal to energize the valve solenoid to raise the first row of diverter wheels. The amount of time delay is based upon the 11 1/2 inch distance from the trigger photo eye to the centerline of the first row of diverter

wheels, and the speed of the sorter. To compensate for the response time of the wheels, 50mS is subtracted from the calculated delay.

At the same time the raise command for the first row of diverter wheels is turned on, another time delay starts. This is a delay between raising the first and second rows of diverter wheels. The amount of this time delay is based upon the 4 inch distance between the centerlines of each row and the speed of the sorter. This delay is repeated between raising each row until all six rows have been raised. The amount of time delay between raising each row is constant for a given sorter speed since the centerline spacing is 4 inches for all rows.

Table 2 is a timing chart for the Wave Divert Commander raise sequence. The shaded areas represent the “on” state of each step. The horizontal axis of the table represents time.

ARM SIGNAL	■	■	■								
RAISE ARMED	■										
PRODUCT PRESENT AT TRIGGER PE		■	■	■							
RAISE START		■									
DELAY RAISE ROW 1		■									
RAISE ROW 1			■	■	■	■					
DELAY RAISE ROW 2			■								
RAISE ROW 2				■	■	■	■				
DELAY RAISE ROW 3				■							
RAISE ROW 3					■	■	■	■			
DELAY RAISE ROW 4					■						
RAISE ROW 4						■	■	■	■		
DELAY RAISE ROW 5						■					
RAISE ROW 5							■	■	■	■	
DELAY RAISE ROW 6							■				
RAISE ROW 6								■	■	■	■

**Table 2: Wave Commander Raise Timing Chart**



### 3.4: LOWER

When the arm signal is turned off and the gap to the next carton is detected by the divert trigger photo eye, the Wave Commander will be armed to lower the rows of wheels when the next carton is sensed by the divert trigger photo eye. Once the next carton has been detected, the lower sequence starts. The first step of the lower sequence is a time delay. This delay is from the trigger event to turning off the signal to de-energize the valve solenoid to lower the first row of diverter wheels. The amount of time delay is based upon the 11 ½" distance from the trigger photo eye to the centerline of the first row of diverter wheels, and the speed of the sorter. To compensate for the time it takes for the wheels to lower, 50mS is subtracted from the calculated delay.

At the same time the raise command for the first row of diverter wheels is turned off, another time delay starts. This is a delay between lowering the first and second rows of diverter wheels. The amount of this time delay is based upon the 4" distance between the centerlines of each row and the speed of the sorter. This delay is repeated between lowering each row until all six rows have been lowered. The amount of time delay between lowering each row is constant for a given sorter speed since the centerline spacing is 4" for all rows.

There is also a power saving feature that lowers the diverter rows after three seconds when the arm signal is off and no cartons are detected.

Table 3 is a timing chart for the Wave Commander lower sequence. The shaded areas represent the “on” state of each step. The horizontal axis of the table represents time.

ARM SIGNAL	■	■	■								
PRODUCT PRESENT AT TRIGGER PE		■	■	■		■	■	■			
LOWER ARMED					■						
LOWER START						■					
DELAY LOWER ROW 1						■					
LOWER ROW 1			■	■	■	■					
DELAY LOWER ROW 2							■				
LOWER ROW 2				■	■	■	■				
DELAY LOWER ROW 3								■			
LOWER ROW 3					■	■	■	■			
DELAY LOWER ROW 4									■		
LOWER ROW 4						■	■	■	■		
DELAY LOWER ROW 5										■	
LOWER ROW 5							■	■	■	■	
DELAY LOWER ROW 6											■
LOWER ROW 6								■	■	■	■

**Table 3: Wave Commander Lower Timing Chart**

## Chapter 4: APPLICATION

---

### 4.1: HARDWARE DESIGN

The following items are included with each Wave Diverter. Refer to Figure 2: Wave Divert Commander Hardware for details.

- Wave Divert Commander with mounting hardware
- Trigger photo eye with mounting bracket, hardware and cable to connect to the Wave Divert Commander
- Trigger photo eye reflector with mounting bracket and hardware (retro photo eyes only)
- Cabling to connect the six diverter valve solenoids to the Wave Divert Commander.

The following items are not included with each Wave Diverter. This list is not all-inclusive. If there are questions concerning what is or is not included with each Wave Divert Commander, please contact MHS Systems.

- Ethernet cabling or other network media or hardware
- 24VDC power cabling or other media or hardware
- 24VDC power supply

The Wave Divert Commander is based on the Wago 750-852 Programmable Fieldbus Controller. There are two versions of the Wave Divert Commander. The single divert controller includes four inputs and eight outputs. The dual divert controller includes eight inputs and 16 outputs. Both inputs and outputs are configured for 24VDC PNP only. All Wave Divert Commanders require a 24VDC power supply system that provides power to each unit. The application of a networked Wave Divert Commander requires both an Ethernet/IP connection and 24VDC power. The network connection utilizes two RJ45 connectors. Each Wave Divert Commander includes an Ethernet switch allowing them to be connected in a linear (daisy-chain) configuration. The 24VDC power connection employs a 4-pin mini connector. These connections should be installed per the National Electrical Code (NEC) and all applicable local codes.

The 24VDC power should be supplied by a Class 2 power source. Each single divert Wave Divert Commander requires approximately 410mA from the 24VDC power source. Each dual divert Wave Divert Commander requires approximately 710mA from the 24VDC power source. These values include one trigger photo eye and six valve solenoids per diverter. If additional devices are connected to the input ports of the Wave Divert Commander, such as a divert confirm photo eye or lane full photo eye, consideration needs to be given to the additional current requirements.

Each 100VA Class 2 circuit can power up to ten single divert Wave Divert Commanders, or five dual divert Wave Divert Commanders. The actual number depends upon the specific Class 2 power supply and the amount of current available. The maximum sorter length is 200 feet. With the recommended 24VDC power cable, the power supply can be located anywhere along the sorter. It is recommended that the cable used to supply power to the Wave Divert Commanders consists of four 16AWG (or larger) conductors and is terminated with 4-pin mini connectors. This is to minimize voltage drop in the system. It is also recommended that the power supply be located at the sorter and not a remote location. This is an additional step to minimize voltage drop in the system. If multiple sorters are installed end-to-end, each sorter should have its own power supply.

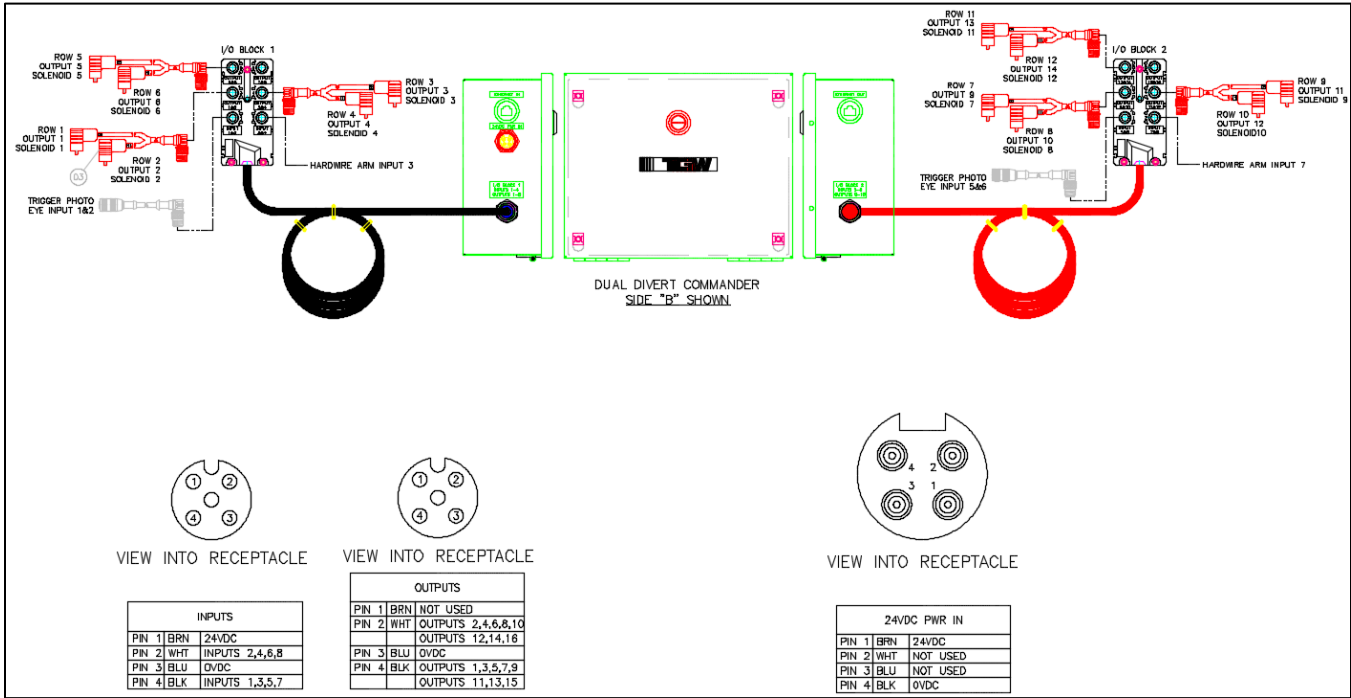


Figure 2: Wave Commander Hardware

## 4.2: UNDERSTANDING OF ETHERNET/IP

This section describes how to network the Wave Divert Commander to a sorter controller via Ethernet/IP. It assumes a sufficient understanding of general configuration of devices on an Ethernet/IP network. It is also expected that an adequate understanding of Ethernet media design and installation exists.

## 4.3: ADDRESSING

The Wave Divert Commander is factory-set to IP address 192.168.1.1 in hardware via DIP switches. This is fine for all Wave Divert Commander units on a sorter if hardwired control signals are being used. If the Wave Divert Commander units are being networked to a sorter controller, each Wave Divert Commander needs to have a unique and valid address. The address for each Wave Divert Commander needs to be determined during the control system design phase. Each Wave Divert Commander should be powered up and addressed in a manner that ensures there are not multiple units on the network with the same address.

Configuring the addresses can be done in hardware or software. To use hardware, use the DIP switch bank to set the last byte of the IP address to a value between 1 and 254, inclusive. Any time a change is made to the DIP switches, power to the controller needs to be turned off, and then back on, for the new settings to take effect. The base IP address will be 192.168.1 for the first three bytes. A Web browser can be used to change the base IP address. Enter the IP address (192.168.1.1) of the Wave Divert Commander in the address bar and then press ENTER. The Information page will be displayed in the browser (refer to Figure 3: Web Browser, Information.)

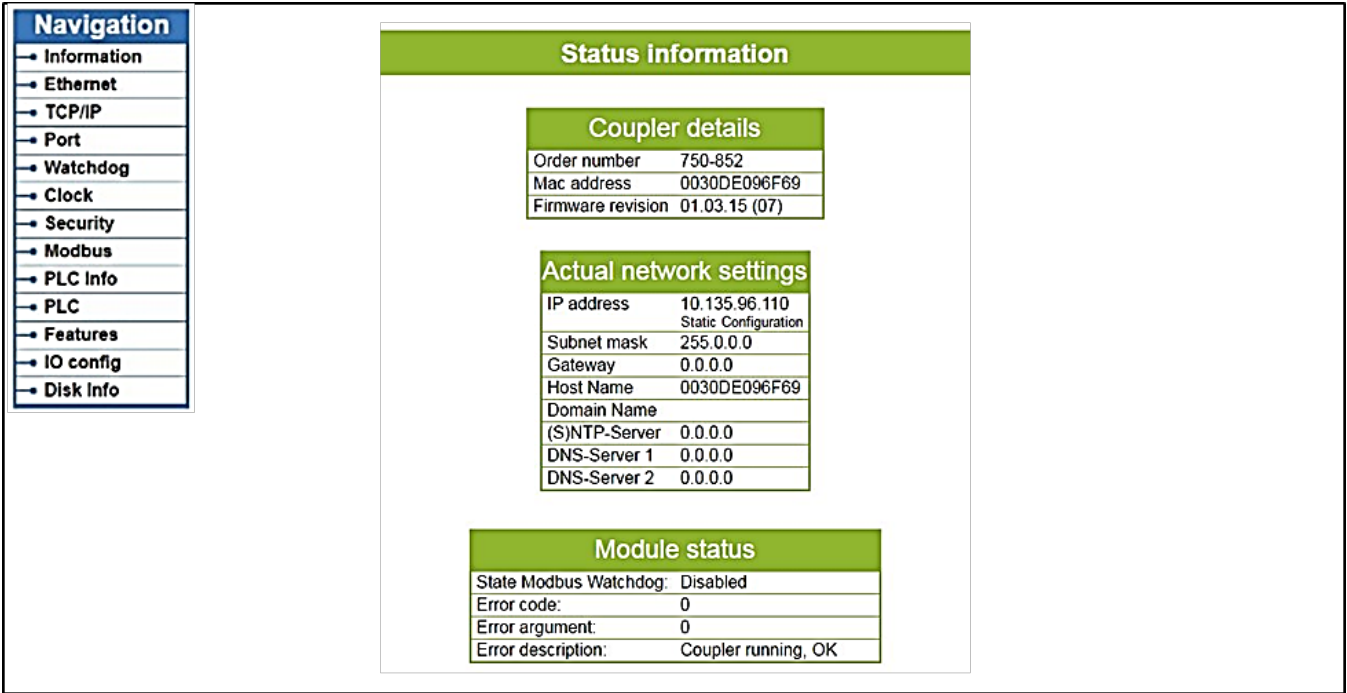


Figure 3: Web Browser, Information

Click on TCP/IP on the Navigation menu. A Log In pop up window will be displayed (refer to Figure 4: Web Browser, Log In.). Enter the User Name (admin) and Password (wago) and then click on Log In.

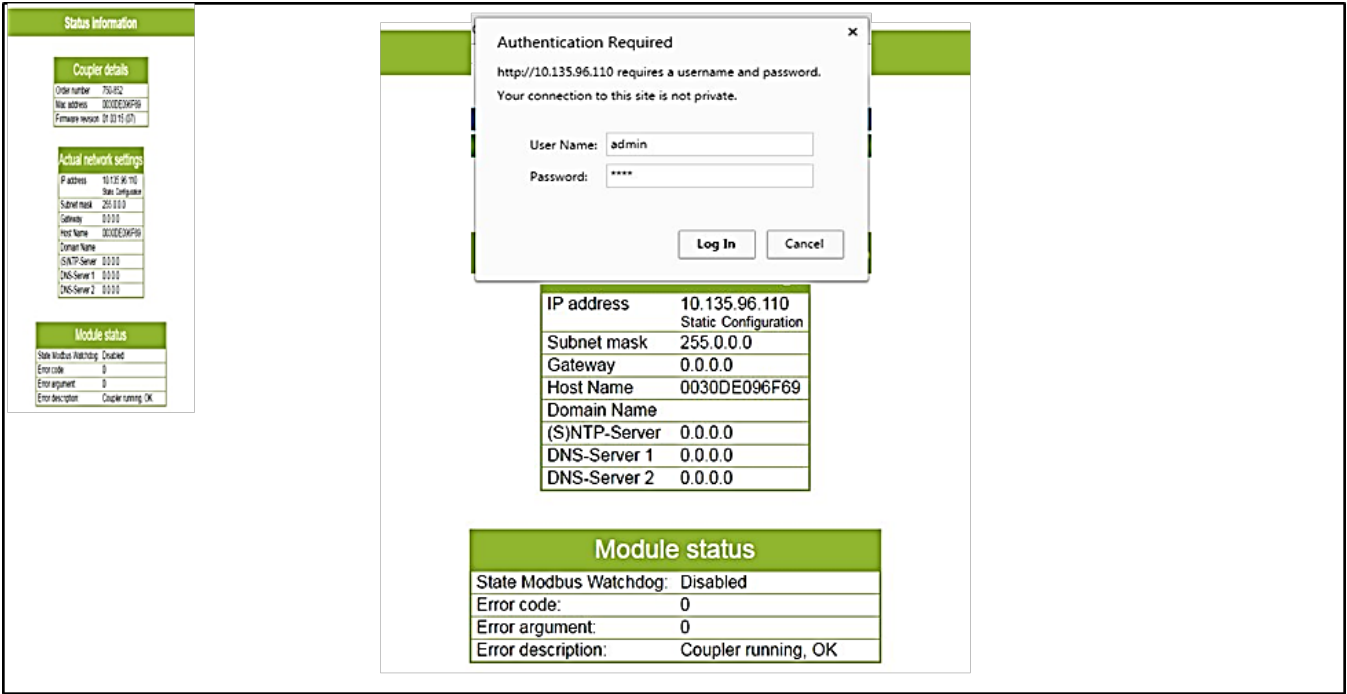


Figure 4: Web Browser, Log In

The TCP/IP page will be displayed in the browser (refer to Figure 5: Web Browser, TCP/IP.)

### TCP/IP configuration

This page is for the configuration of the basic TCP/IP network parameters. The parameters are stored in an EEPROM and changes will take effect after the next software or hardware reset.  
**Note that these settings are used only if the DIP switch is set to zero and you have selected 'use IP from EEPROM' at 'Port' configuration page! Otherwise the settings from DIP switch will be used!**

#### Status information

##### Coupler details

Order number	750-852
Mac address	0030DE096F69
Firmware revision	01.03.15 (07)

##### Actual network settings

IP address	10.135.96.110
Subnet mask	255.0.0.0
Gateway	0.0.0.0
Host Name	0030DE096F69
Domain Name	
(S)NTP Server	0.0.0.0
DNS-Server 1	0.0.0.0
DNS-Server 2	0.0.0.0

##### Module status

State Modbus Watchdog	Disabled
Error code	0
Error argument	0
Error description	Coupler running, OK

#### EEPROM Configuration Data

IP-Address	10.135.96.110
Subnet Mask	255.0.0.0
Gateway	0.0.0.0
Host Name	0030DE096F69
Domain Name	
DNS Server 1	0.0.0.0
DNS Server 2	0.0.0.0
Switch IP-Address	192.168.1
(S)NTP Server	0.0.0.0
SNTP Update Time (sec, max. 65535)	3600

UNDO

SUBMIT

Figure 5: Web Browser, TCP/IP

Enter the first three bytes of the desired base IP address in the space next to Switch IP-Address. Once the base address has been entered, click on SUBMIT. At this point, the new base IP address is stored in the EEPROM, but a hardware reset or software reset is required for the new base IP address to take effect. Perform a hardware reset by turning off power to the Wave Divert Commander and then turning power back on. A software reset can be performed by clicking on Security in the Navigation menu to display the Security page in the browser (refer to Figure 6: Web Browser, Security.)

PN 1167034

Rev: 03/01/2019

Page 14 of 50

### Security

This page is intended to disable the basic authentication. Additionally you can set new passwords for the existing user. The new values are stored in an EEPROM and changes will take effect immediately.

#### Status information

##### Coupler details

Order number	750-452
Mac address	0030CE09F69
Firmware revision	01.03.15 (07)

##### Actual network settings

IP address	10.135.90.110
Subnet mask	255.0.0.0
Gateway	0.0.0.0
Host Name	0030CE09F69
Domain Name	
(S)NTP-Server	0.0.0.0
DNS-Server 1	0.0.0.0
DNS-Server 2	0.0.0.0

##### Module status

State Modbus Watchdog	Disabled
Error code	0
Error argument	0
Error description	Coupler running, OK

### Webserver Security

Webserver authentication enabled ☒

UNDO SUBMIT

### Webserver, FTP and PLC User configuration

User: guest Password:

Confirm Password:

UNDO SUBMIT

### PLC Security

Port 2455 authentication enabled ☐

UNDO SUBMIT

Attention: You will lose the connection to the webserver after the software reset, if the IP configuration was changed. Please load the webpage with the proper address in this case again.

Software Reset

Figure 6: Web Browser, Security

Click on Software Reset to reset the Wave Divert Commander and apply the new base IP address. Once this has been completed, the last byte of the IP address can be set via the DIP switches to complete the new desired IP address.

To configure the IP address entirely in software, use a web browser. Enter the IP address (192.168.1.1) of the Wave Divert Commander in the address bar and then press ENTER. The Information page will be displayed in the browser (refer to Figure 7: Web Browser, Information.)

PN 1167034

Rev: 03/01/2019

Page 15 of 50



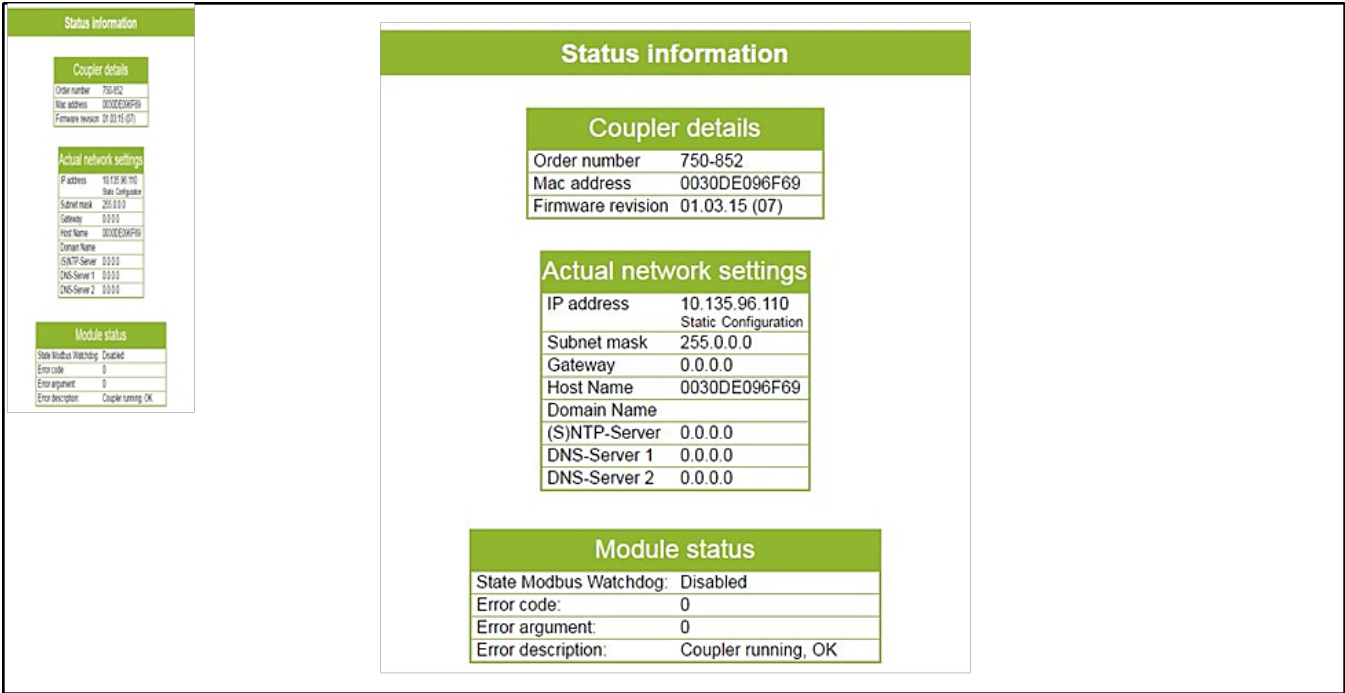


Figure 7: Web Browser, Information

Click on TCP/IP on the Navigation menu. A Log In pop up window will be displayed (refer to Figure 8: Web Browser, Log In.) Enter the User Name (admin) and Password (wago) and then click on Log In.

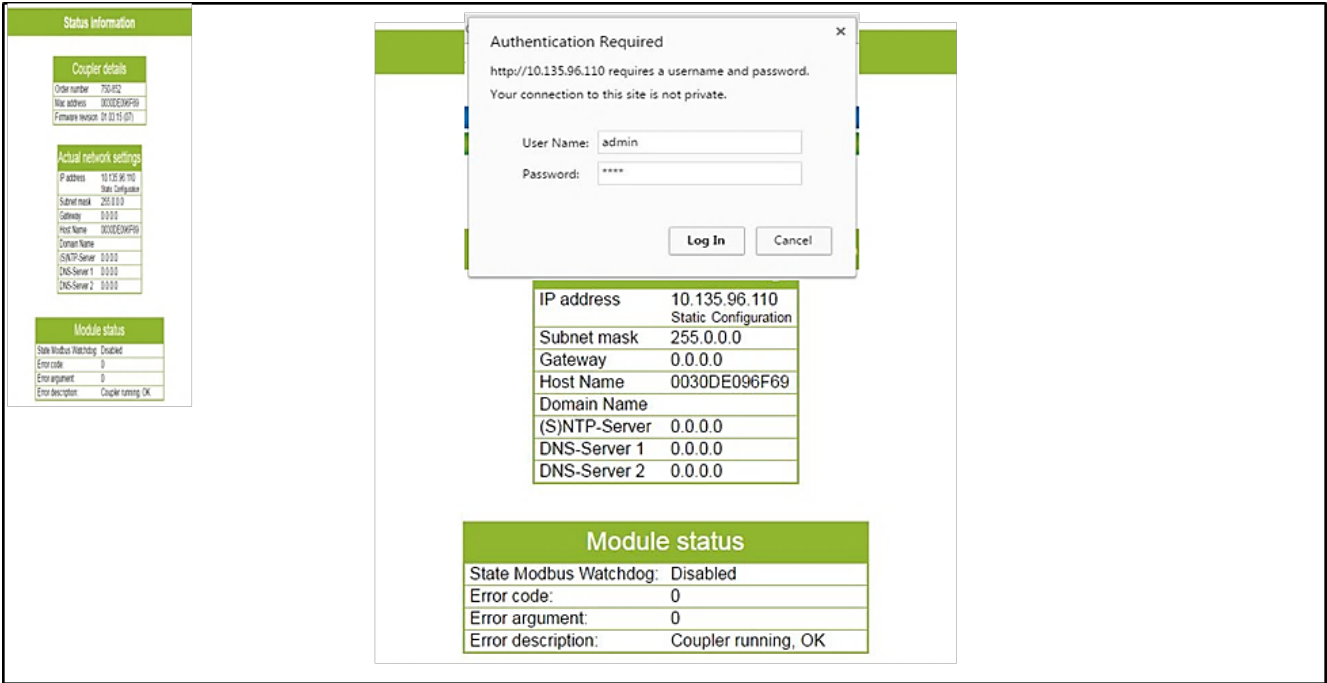


Figure 8: Web Browser, Log In

The TCP/IP page will be displayed in the browser (refer to Figure 9: Web Browser, TCP/IP.)



**TCP/IP configuration**

This page is for the configuration of the basic TCP/IP network parameters. The parameters are stored in an EEPROM and changes will take effect after the next software or hardware reset.  
 Note that these settings are used only if the DIP switch is set to zero and you have selected 'use IP from EEPROM' at 'Port' configuration page! Otherwise the settings from DIP switch will be used!

**Status information**

**Coupler details**

Order number	750-352
Mac address	0030DE096F69
Firmware revision	01.03.15 (07)

**Actual network settings**

IP address	10.135.96.110
Subnet mask	255.0.0.0
Gateway	0.0.0.0
Host Name	0030DE096F69
Domain Name	
(S)NTP-Server	0.0.0.0
DNS-Server 1	0.0.0.0
DNS-Server 2	0.0.0.0

**Module status**

State Modbus Watchdog	Disabled
Error code	0
Error argument	0
Error description	Coupler running, OK

**EEPROM Configuration Data**

IP-Address	10.135.96.110
Subnet Mask	255.0.0.0
Gateway	0.0.0.0
Host Name	0030DE096F69
Domain Name	
DNS Server 1	0.0.0.0
DNS Server 2	0.0.0.0
Switch IP-Address	192.168.1
(S)NTP Server	0.0.0.0
SNTP Update Time (sec, max. 65535)	3600

**Figure 9: Web Browser, TCP/IP**

Enter the new IP address in the space next to IP-Address. Enter the subnet mask in the space next to Subnet Mask. Once the information has been entered, click on SUBMIT. At this point, the new IP address and subnet mask are stored in the EEPROM, but a hardware reset or software reset is required for the new IP address and subnet mask to take effect. Perform a hardware reset by turning off power to the Wave Divert Commander and then turning power back on. A software reset can be performed by clicking on Security in the Navigation menu to display the Security page in the browser (refer to Figure 10: Web Browser, Security.)

### Security

This page is intended to disable the basic authentication. Additionally you can set new passwords for the existing user. The new values are stored in an EEPROM and changes will take effect immediately.

#### Webserver Security

Webserver authentication enabled ☒

#### Webserver, FTP and PLC User configuration

User:  Password:

Confirm Password:

#### PLC Security

Port 2455 authentication enabled ☐

Attention: You will lose the connection to the webserver after the software reset, if the IP configuration was changed. Please load the webpage with the proper address in this case again.

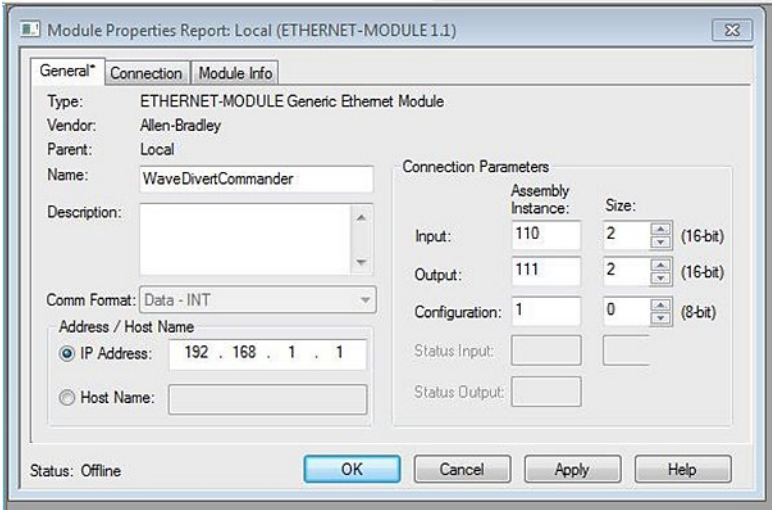
**Figure 10: Web Browser, Security**

Click on Software Reset to reset the Wave Divert Commander and apply the new IP address and subnet mask. Once this has been completed, set the DIP switches to 0 and perform a hardware reset of the Wave Divert Commander. This causes the Wave Divert Commander to use the software IP address instead of the DIP switch-based IP address.

For more information, refer to the WAGO-I/O-SYSTEM 750 ETHERNET ECO Controller 750-852 PLC - ETHERNET Programmable Fieldbus Controller ECO Manual.

## 4.4: I/O CONFIGURATION

When using an Allen-Bradley Logix controller, the Wave Divert Commander must be added to the I/O Configuration. It should be added as a Generic Ethernet Module (refer to Figure 11: I/O Configuration, Module Properties Report.)



**Figure 11: I/O Configuration, Module Properties Report**

In the Module Properties Report, the Name can be any valid name. The IP Address should match the address of the associated Wave Divert Commander. All Connection Parameters must match the settings shown above. This has to be done for each Wave Divert Commander in the system. The Name and IP Address for each Wave Divert Commander must be unique so there are no duplicates.

### 4.5: I/O MAPPING

The Wave Divert Commander writes two words of data to be read by the sorter controller. It reads two words of data written by the sorter controller. When using an Allen-Bradley Logix controller, the data are mapped to words with the INT data type. These are 16-bit words, two of which are used for inputs and two of which are used for outputs. The next two tables are data maps based upon an Allen-Bradley Logix controller.

PLC INPUT WORDS	
PLC TAG NAME	DESCRIPTION
WaveDivertCommander:I.Data[0].0	Divert 1 Divert Trigger Clear PE (Local Input 1)
WaveDivertCommander:I.Data[0].1	Divert 1 Divert Confirm PE (Local Input 2)
WaveDivertCommander:I.Data[0].2	Divert 1 Local Arm Divert (Local Input 3)
WaveDivertCommander:I.Data[0].3	Divert 1 Divert Lane Full PE (Local Input 4)
WaveDivertCommander:I.Data[0].4	Divert 2 Divert Trigger Clear PE (Local Input 5)
WaveDivertCommander:I.Data[0].5	Divert 2 Divert Confirm PE (Local Input 6)
WaveDivertCommander:I.Data[0].6	Divert 2 Local Arm Divert (Local Input 7)
WaveDivertCommander:I.Data[0].7	Divert 2 Divert Lane Full PE (Local Input 8)
WaveDivertCommander:I.Data[0].8	Spare
WaveDivertCommander:I.Data[0].9	Spare
WaveDivertCommander:I.Data[0].10	Spare
WaveDivertCommander:I.Data[0].11	Spare
WaveDivertCommander:I.Data[0].12	Spare
WaveDivertCommander:I.Data[0].13	Spare
WaveDivertCommander:I.Data[0].14	Spare
WaveDivertCommander:I.Data[0].15	Communication Heartbeat
WaveDivertCommander:I.Data[1].0	Divert 1 Raise Row 1 SOL (Local Output 1)
WaveDivertCommander:I.Data[1].1	Divert 1 Raise Row 2 SOL (Local Output 2)
WaveDivertCommander:I.Data[1].2	Divert 1 Raise Row 3 SOL (Local Output 3)
WaveDivertCommander:I.Data[1].3	Divert 1 Raise Row 4 SOL (Local Output 4)
WaveDivertCommander:I.Data[1].4	Divert 1 Raise Row 5 SOL (Local Output 5)
WaveDivertCommander:I.Data[1].5	Divert 1 Raise Row 6 SOL (Local Output 6)
WaveDivertCommander:I.Data[1].6	Spare Output (Local Output 7)
WaveDivertCommander:I.Data[1].7	Spare Output (Local Output 8)
WaveDivertCommander:I.Data[1].8	Divert 2 Raise Row 1 SOL (Local Output 9)
WaveDivertCommander:I.Data[1].9	Divert 2 Raise Row 2 SOL (Local Output 10)

PLC INPUT WORDS	
PLC TAG NAME	DESCRIPTION
WaveDivertCommander:I.Data[1].10	Divert 2 Raise Row 3 SOL (Local Output 11)
WaveDivertCommander:I.Data[1].11	Divert 2 Raise Row 4 SOL (Local Output 12)
WaveDivertCommander:I.Data[1].12	Divert 2 Raise Row 5 SOL (Local Output 13)
WaveDivertCommander:I.Data[1].13	Divert 2 Raise Row 6 SOL (Local Output 14)
WaveDivertCommander:I.Data[1].14	Spare Output (Local Output 15)
WaveDivertCommander:I.Data[1].15	Spare Output (Local Output 16)

**Table 4: Input Data Map**

Input Word 0 includes bits to monitor the status of the inputs local to the Wave Divert Commander. Two of these (Divert Trigger Clear PE and Local Arm Divert) are used by the Wave Divert Commander local program, but all of them can be monitored by the sorter controller. Input Word 1 includes bits to monitor the status of the outputs local to the Wave Divert Commander. The status bits listed as spare are not available for use by the customer. The following is a list of the inputs with a functional description for each.

- Divert Trigger Clear PE – local input for the photo eye used to sense the presence of product at the diverter. This input is used by the Wave Divert Commander program and cannot be used for any other purpose.
- Divert Confirm PE – local input for the photo eye used to sense the presence of product being diverted off the sorter. This input is not used by the Wave Divert Commander, so it can be used for any input signal to be monitored by the sorter controller.
- Local Arm Divert – local input for a hardwired arm signal. If the diverter is not being armed via the Ethernet network, this input can be used to arm the diverter. This input is used by the Wave Divert Commander program and cannot be used for any other purpose.
- Divert Lane Full PE – local input for the photo eye used to sense the presence of a full lane downstream of the sorter. This input is not used by the Wave Divert Commander, so it can be used for any input signal to be monitored by the sorter controller.
- Communication Heartbeat – network input used to receive communication heartbeat signal (0.5 seconds on, 0.5 seconds off) from the Wave Divert Commander. This signal can be used to monitor the Ethernet connection between the sorter controller and the Wave Divert Commander. Use of this signal is optional, but the input cannot be used for any other purpose.
- Raise Row 1 SOL – local output for the valve solenoid used to raise the first row of diverter wheels. This input is used by the Wave Divert Commander program and cannot be used for any other purpose.
- Raise Row 2 SOL – local output for the valve solenoid used to raise the second row of diverter wheels. This input is used by the Wave Divert Commander program and cannot be used for any other purpose.

- Raise Row 3 SOL – local output for the valve solenoid used to raise the third row of diverter wheels. This input is used by the Wave Divert Commander program and cannot be used for any other purpose.
- Raise Row 4 SOL – local output for the valve solenoid used to raise the fourth row of diverter wheels. This input is used by the Wave Divert Commander program and cannot be used for any other purpose.
- Raise Row 5 SOL – local output for the valve solenoid used to raise the fifth row of diverter wheels. This input is used by the Wave Divert Commander program and cannot be used for any other purpose.
- Raise Row 6 SOL – local output for the valve solenoid used to raise the sixth row of diverter wheels. This input is used by the Wave Divert Commander program and cannot be used for any other purpose.

PLC OUTPUT WORDS	
PLC TAG NAME	DESCRIPTION
WaveDivertCommander:O.Data[0].0	Divert 1 Network Divert Arming Signal
WaveDivertCommander:O.Data[0].1	Divert 1 Row 1 Manual Raise
WaveDivertCommander:O.Data[0].2	Divert 1 Row 2 Manual Raise
WaveDivertCommander:O.Data[0].3	Divert 1 Row 3 Manual Raise
WaveDivertCommander:O.Data[0].4	Divert 1 Row 4 Manual Raise
WaveDivertCommander:O.Data[0].5	Divert 1 Row 5 Manual Raise
WaveDivertCommander:O.Data[0].6	Divert 1 Row 6 Manual Raise
WaveDivertCommander:O.Data[0].7	Spare
WaveDivertCommander:O.Data[0].8	Divert 2 Network Divert Arming Signal
WaveDivertCommander:O.Data[0].9	Divert 2 Row 1 Manual Raise
WaveDivertCommander:O.Data[0].10	Divert 2 Row 2 Manual Raise
WaveDivertCommander:O.Data[0].11	Divert 2 Row 3 Manual Raise
WaveDivertCommander:O.Data[0].12	Divert 2 Row 4 Manual Raise
WaveDivertCommander:O.Data[0].13	Divert 2 Row 5 Manual Raise
WaveDivertCommander:O.Data[0].14	Divert 2 Row 6 Manual Raise
WaveDivertCommander:O.Data[0].15	Communication Heartbeat
WaveDivertCommander:O.Data[1]	Sorter Speed Reference (FPM)

**Table 5: Output Data Map**

Output Word 0 includes bits to control certain aspects of the Wave Divert Commander. Output Word 1 consists of the sorter speed reference to be used by the Wave Divert Commander. The control bits listed as spare are not available for use by the customer. The following is a list of the outputs with a functional description for each.

- Network Divert Arming Signal – network output used to arm the diverter. This output is used by the Wave Divert Commander program and cannot be used for any other purpose.

- Row 1 Manual Raise – network output used to manually control raising and lowering of the first row of diverter wheels. This output is used by the Wave Divert Commander program and cannot be used for any other purpose.
- Row 2 Manual Raise – network output used to manually control raising and lowering of the second row of diverter wheels. This output is used by the Wave Divert Commander program and cannot be used for any other purpose.
- Row 3 Manual Raise – network output used to manually control raising and lowering of the third row of diverter wheels. This output is used by the Wave Divert Commander program and cannot be used for any other purpose.
- Row 4 Manual Raise – network output used to manually control raising and lowering of the fourth row of diverter wheels. This output is used by the Wave Divert Commander program and cannot be used for any other purpose.
- Row 5 Manual Raise – network output used to manually control raising and lowering of the fifth row of diverter wheels. This output is used by the Wave Divert Commander program and cannot be used for any other purpose.
- Row 6 Manual Raise – network output used to manually control raising and lowering of the sixth row of diverter wheels. This output is used by the Wave Divert Commander program and cannot be used for any other purpose.
- Communication Heartbeat – network output used to send communication heartbeat signal (0.5 seconds on, 0.5 seconds off) to the Wave Divert Commander. This signal can be used to monitor the Ethernet/IP connection between the sorter controller and the Wave Divert Commander. Use of this signal is optional, but the output cannot be used for any other purpose.
- Sorter Speed Reference (FPM) – network output used to send the sorter speed reference in feet per minute to the Wave divert Commander. The Wave Divert Commander uses this information to calculate the time delay values for raising and lowering the diverter rows. Any time the sorter speed reference value changes, the Wave Divert Commander recalculates and updates the time delay values.

## 4.6: TEACHING THE SORTER

Another advantage of networking the Wave Divert Commanders to a sorter controller via Ethernet/IP is the ability to teach the sorter diverter positions to the sorter controller. The sorter controller can be programmed to take a snapshot of the tracking encoder counts at each divert trigger photo eye as a package is sent along the sorter. When the leading edge of the package is detected at the tracking photo eye at the beginning of the sorter, the sorter controller begins counting the number of off-to-on and on-to-off transitions at the tracking encoder input. Each time the leading edge of the package is sensed by a divert trigger photo eye, the current count value is store in a separate tag for each diverter. Each tracking encoder ships from the factory configured for two inches per pulse, or six pulses per revolution of the encoder wheel. If counted as described above, the count should increment by one for every inch of sorter travel. The number of counts for each diverter should be roughly equal to the distance from the tracking photo eye to that divert trigger photo eye in inches. The count for each diverter should be the basis for the point at which the arm signal is turned on when a package is to be diverted. The arm signal should be turned on about six inches or six counts prior to the leading edge of the package arriving at the divert trigger photo eye. As well, unless the next package is to be diverted at the same diverter, the arm signal should be turned off when the trailing edge of the package is about six inches or six counts upstream of the divert trigger photo eye.



## Chapter 5: TROUBLESHOOTING

### 5.1: STATUS INDICATORS

There are various status indicators on the components used in the Wave Divert Commander.

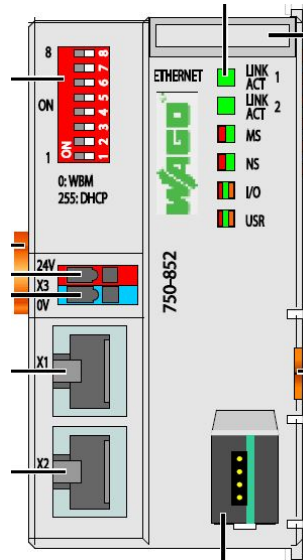


Figure 12: Wago 750-852 Programmable Bus Coupler

**Table 6: Wago 750-852 Programmable Bus Coupler Status Indicators**

LINK ACT 1,2		
LED STATUS	POSSIBLE CAUSES	RECOMMENDED SOLUTIONS
Off	Wave Divert Commander not connected to Ethernet network.	Check Ethernet connections.
Solid Green	Wave Divert Commander connected to Ethernet network.	
Flashing Green	Wave Divert Commander connected to Ethernet network and sending/receiving data.	

MS		
LED STATUS	POSSIBLE CAUSES	RECOMMENDED SOLUTIONS
Off	No 24VDC power to Wave Divert Commander.	Check power supply. Check power connections.
Flashing Red/Green	Unit performing self-test.	
Flashing Green	Wave Divert Commander not programmed.	Return Wave Divert Commander for programming.
Solid Red	Unit has non-recoverable error.	Turn power off, and then back on. If error still exists, replace Wave Divert Commander.
Solid Green	Normal operation.	

NS		
LED STATUS	POSSIBLE CAUSES	RECOMMENDED SOLUTIONS
Off	No IP address assigned to Wave Divert Commander.	Assign valid IP address to Wave Divert Commander.
Flashing Red/Green	Unit performing self-test.	
Flashing Red	Communication timeout.	Turn power off, and then back on.
Flashing Green	No connection.	
Solid Red	Network has duplicate address.	Make sure Wave Divert Commander has unique and valid address.
Solid Green	Connection established.	

I/O		
LED STATUS	POSSIBLE CAUSES	RECOMMENDED SOLUTIONS
Off	No 24VDC power to Wave Divert Commander.	Check power supply. Check power connections.
Flashing Orange	Unit performing start up.	
Flashing Red	Internal bus initialization or internal bus error.	Bus initialization lasts for 1-2 seconds. If flashing continues, note flash pattern and refer to manual for Wago 750-852 programmable fieldbus coupler.
Flashing Pattern Red	Internal bus error.	Note flash pattern and refer to manual for Wago 750-852 programmable fieldbus coupler.
Solid Red	Hardware failure.	Replace Wave Divert Commander.
Solid Green	Normal operation.	

Unit start up occurs after turning on the power supply. The I/O LED flashes orange. Then the bus is initialized. This is indicated by flashing red at 10 Hz for 1-2 seconds. After a trouble-free initialization, the I/O LED is green. In the event of an error, the I/O LED continues to flash red. Flash patterns indicate detailed error messages. An error is indicated cyclically by up to 3 flashing sequences. After elimination of the error, restart the node by turning the power supply of the Wave Divert Commander off and on again.

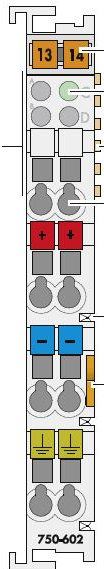


Figure 13: Wago 750-602 Field Side Supply Module

Table 7: Wago 750-602 Field Side Supply Module Status Indicator

C		
LED STATUS	POSSIBLE CAUSES	RECOMMENDED SOLUTIONS
Off	No 24VDC power to Wave Divert Commander.	Check power supply. Check power connections.
Solid Green	24VDC power present at Wave Divert Commander.	

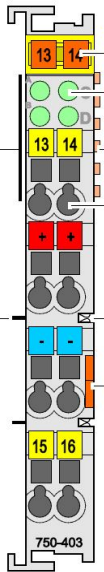


Figure 14: Wago 750-403 Digital Input Module

Table 8: Wago 750-403 Digital Input Module Status Indicators

A-D		
LED	OFF	ON
A	Divert Trigger PE signal, connected to Input 1 or 5 of Wave Divert Commander, is off. Divert Trigger PE should not be clear (product is present.)	Divert Trigger PE signal, connected to Input 1 or 5 of Wave Divert Commander, is on. Divert Trigger PE should be clear (no product present.)
B	Signal is off from device connected to Input 2 or 6 of Wave Divert Commander.	Signal is on from device connected to Input 2 or 6 of Wave Divert Commander.
C	Local Arm Divert signal, connected to Input 3 or 7 of Wave Divert Commander, is off. Sorter controller is not sending arm signal.	Local Arm Divert signal, connected to Input 3 or 7 of Wave Divert Commander, is on. Sorter controller is sending arm signal.
D	Signal is off from device connected to Input 4 or 8 of Wave Divert Commander.	Signal is on from device connected to Input 4 or 8 of Wave Divert Commander.

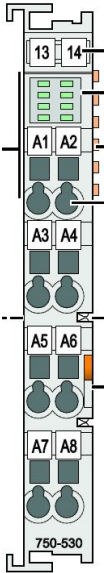


Figure 15: Wago 750-530 Digital Output Module

Table 9: Wago 750-530 Digital Output Module Status Indicators

A-H		
LED	OFF	ON
A	Raise Row 1 SOL signal, connected to Output 1 or 9 of Wave Divert Commander, is off. The first row of wheels should be lowered.	Raise Row 1 SOL signal, connected to Output 1 or 9 of Wave Divert Commander, is on. The first row of wheels should be raised.
B	Raise Row 3 SOL signal, connected to Output 3 or 11 of Wave Divert Commander, is off. The third row of wheels should be lowered.	Raise Row 3 SOL signal, connected to Output 3 or 11 of Wave Divert Commander, is on. The third row of wheels should be raised.
C	Raise Row 5 SOL signal, connected to Output 5 or 13 of Wave Divert Commander, is off. The fifth row of wheels should be lowered.	Raise Row 5 SOL signal, connected to Output 5 or 13 of Wave Divert Commander, is on. The fifth row of wheels should be raised.
D	This indicator is associated with Output 7 or 15 of the Wave Divert Commander. It is not used and should never be on.	This indicator is associated with Output 7 or 15 of the Wave Divert Commander. It is not used and should never be on.
E	Raise Row 2 SOL signal, connected to Output 2 or 10 of Wave Divert Commander, is off. The second row of wheels should be lowered.	Raise Row 2 SOL signal, connected to Output 2 or 10 of Wave Divert Commander, is on. The second row of wheels should be raised.

A-H		
LED	OFF	ON
F	Raise Row 4 SOL signal, connected to Output 4 or 12 of Wave Divert Commander, is off. The fourth row of wheels should be lowered.	Raise Row 4 SOL signal, connected to Output 4 or 12 of Wave Divert Commander, is on. The fourth row of wheels should be raised.
G	Raise Row 6 SOL signal, connected to Output 6 or 14 of Wave Divert Commander, is off. The sixth row of wheels should be lowered.	Raise Row 6 SOL signal, connected to Output 6 or 14 of Wave Divert Commander, is on. The sixth row of wheels should be raised.
H	This indicator is associated with Output 8 or 16 of the Wave Divert Commander. It is not used and should never be on.	This indicator is associated with Output 8 or 16 of the Wave Divert Commander. It is not used and should never be on.

## Chapter 6: TROUBLESHOOTING GUIDE

The table below provides a troubleshooting guide for the Wave Divert Commander (refer to Table 10: Wave Divert Commander Troubleshooting Guide.)

**Table 10: Wave Divert Commander Troubleshooting Guide**

SYMPTOMS	POSSIBLE CAUSES	RECOMMENDED SOLUTIONS
All products not diverting properly at single diverter	No power at single diverter	Check status indicators. Check 24VDC power supply. Check 24VDC power connections.
	No network connection at single diverter (for systems with networked control signals)	Check status indicators. Check Ethernet connections.
	Improper product tracking to single diverter	The sorter controller is looking for the tracked data in the wrong location or at the wrong time. The controller should see the data in the correct location when the leading edge of the package is about six inches upstream of the divert trigger photo eye.
	Incorrect product data from source of divert information for single diverter	When a decision is made by an upper-level system (WCS, etc.), make sure the correct product data is used to make that decision. If the wrong product data is used, product can be diverted to the wrong destination or not diverted to the correct destination.



SYMPTOMS	POSSIBLE CAUSES	RECOMMENDED SOLUTIONS
	No arm signal at single diverter	For hardwired control signals, there should be a cable connected from the sorter controller to the correct connector on the Wave Divert Commander (refer to Figure 2: Wave Divert Commander Hardware.) When the arm signal is on, LED C should be solid green on the Wago 750-403 Digital Input Module. For networked control signals, the sorter controller needs to send an arm signal to the Wave Divert Commander. This must be done via the Ethernet network for every package to be diverted.
	Incorrect timing of arm signal at single diverter	The arm signal should be turned on when the leading edge of the package is about six inches upstream of the divert trigger photo eye. It should be turned off when the trailing edge of the package is about six inches upstream of the divert trigger photo eye.
	Divert trigger photo eye mounted incorrect distance from first drive roller at single diverter	The centerline of the divert trigger photo eye must be mounted at a distance of 9.5 inches upstream of the centerline of the first drive roller, or 11.5 inches upstream of the first row of diverter wheels.
	Misaligned divert trigger photo eye at single diverter	The photo eye needs to be aligned per the instruction provided in this document.
	Disconnected divert trigger photo eye at single diverter	Make sure the photo eye cable is properly installed at the photo eye, as well as at the Wave Divert Commander (refer to Figure 2: Wave Divert Commander Hardware.)
	Faulty divert trigger photo eye at single diverter	If the photo eye is correctly installed, aligned and connected, but is not functioning properly, it may be faulty and needs to be replaced.

SYMPTOMS	POSSIBLE CAUSES	RECOMMENDED SOLUTIONS
	Disconnected valve solenoid at single diverter	Make sure the solenoid cable is properly installed at the valve, as well as at the Wave Divert Commander. It should be connected to the appropriate output (refer to Figure 2: Wave Divert Commander Hardware.)
	Faulty valve solenoid at single diverter	If a valve appears to be malfunctioning, it can be tested manually by pressing the actuator button on the valve. If it does not operate correctly, it may be faulty and needs to be replaced.
	Incorrect Wave Divert Commander timer values for current sorter speed for single diverter	Check to see the correct speed is being sent from the sorter controller to the Wave Divert Commander. Also, make sure it is being written to the correct location (refer to Table 5: Output Data Map.)
	Wave Divert Commander program not running on single diverter	Check the MS status indicator. If it is flashing green, the Wave Divert Commander has no program. Check to make sure the Mode Selector Switch is in the UP position.
All products not diverting properly at multiple diverters	No power at multiple diverters	Check status indicators. Check 24VDC power supply. Check 24VDC power connections.
	No network connection at multiple diverters (for systems with networked control signals)	Check status indicators. Check Ethernet connections.
	Improper product gapping at multiple diverters	The minimum gap between any two packages should be three inches. If a gap of less than three inches is detected at the tracking photo eye, those packages should be recirculated when possible.

SYMPTOMS	POSSIBLE CAUSES	RECOMMENDED SOLUTIONS
	Sorter controller input cannot handle pulse rate from encoder	The sorter controller input should be able to accept an off-to-on or on-to-off transition every 11.8 milliseconds. This is for a sorter speed of 425FPM.
	Improper product tracking to multiple diverters	The sorter controller is looking for the tracked data in the wrong location or at the wrong time. The controller should see the data in the correct location when the leading edge of the package is about six inches upstream of the divert trigger photo eye.
	Incorrect product data from source of divert information for multiple diverters	When a decision is made by an upper-level system (WCS, etc.), make sure the correct product data is used to make that decision. If the wrong product data is used, product can be diverted to the wrong destination or not diverted to the correct destination.
	No arm signal at multiple diverters	For hardwired control signals, there should be a cable connected from the sorter controller to the correct connector on the Wave Divert Commander (refer to Figure 2: Wave Divert Commander Hardware.) When the arm signal is on, LED C should be solid green on the Wago 750-403 Digital Input Module. For networked control signals, the sorter controller needs to send an arm signal to the Wave Divert Commander. This must be done via the Ethernet network for every package to be diverted.

SYMPTOMS	POSSIBLE CAUSES	RECOMMENDED SOLUTIONS
	Incorrect timing of arm signal at multiple diverters	The arm signal should be turned on when the leading edge of the package is about six inches upstream of the divert trigger photo eye. It should be turned off when the trailing edge of the package is about six inches upstream of the divert trigger photo eye.
	Divert trigger photo eye mounted incorrect distance from first drive roller at multiple diverters	The centerline of the divert trigger photo eye must be mounted at a distance of 9.5 inches upstream of the centerline of the first drive roller, or 11.5 inches upstream of the first row of diverter wheels.
	Misaligned divert trigger photo eye at multiple diverters	The photo eye needs to be aligned per the instruction provided in this document.
	Disconnected divert trigger photo eye at multiple diverters	Make sure the photo eye cable is properly installed at the photo eye, as well as at the Wave Divert Commander (refer to Figure 2: Wave Divert Commander Hardware.)
	Faulty divert trigger photo eye at multiple diverters	If the photo eye is correctly installed, aligned and connected, but is not functioning properly, it may be faulty and needs to be replaced.
	Disconnected valve solenoid at multiple diverters	Make sure the solenoid cable is properly installed at the valve, as well as at the Wave Divert Commander. It should be connected to the appropriate output (see Figure 2.)
	Faulty valve solenoid at multiple diverters	If a valve appears to be malfunctioning, it can be tested manually by pressing the actuator button on the valve. If it does not operate correctly, it may be faulty and needs to be replaced.

SYMPTOMS	POSSIBLE CAUSES	RECOMMENDED SOLUTIONS
	Incorrect Wave Divert Commander timer values for current sorter speed for multiple diverters	Check to see the correct speed is being sent from the sorter controller to the Wave Divert Commander. Also, make sure it is being written to the correct location (refer to Table 5: Output Data Map.)
	Wave Divert Commander program not running on single diverter	Check the MS status indicator. If it is flashing green, the Wave Divert Commander has no program. Check to make sure the Mode Selector Switch is in the UP position.
All products not diverting properly at all diverters	No power at all diverters	Check status indicators. Check 24VDC power supply. Check 24VDC power connections.
	No network connection at all diverters (for systems with networked control signals)	Check status indicators. Check Ethernet connections.
	Improper product gapping at all diverters	The minimum gap between any two packages should be three inches. If a gap of less than three inches is detected at the tracking photo eye, those packages should be recirculated when possible.
	Sorter controller input cannot handle pulse rate from encoder	The sorter controller input should be able to accept an off-to-on or on-to-off transition every 11.8 milliseconds. This is for a sorter speed of 425FPM.
	Improper product tracking to all diverters	The sorter controller is looking for the tracked data in the wrong location or at the wrong time. The controller should see the data in the correct location when the leading edge of the package is about six inches upstream of the divert trigger photo eye.

SYMPTOMS	POSSIBLE CAUSES	RECOMMENDED SOLUTIONS
	Incorrect product data from source of divert information for all diverters	When a decision is made by an upper-level system (WCS, etc.), make sure the correct product data is used to make that decision. If the wrong product data is used, product can be diverted to the wrong destination or not diverted to the correct destination.
	No arm signal at all diverters	For hardwired control signals, there should be a cable connected from the sorter controller to the correct connector on the Wave Divert Commander (refer to Figure 2: Wave Divert Commander Hardware.) When the arm signal is on, LED C should be solid green on the Wago 750-403 Digital Input Module. For networked control signals, the sorter controller needs to send an arm signal to the Wave Divert Commander. This must be done via the Ethernet network for every package to be diverted.
	Incorrect timing of arm signal at all diverters	The arm signal should be turned on when the leading edge of the package is about six inches upstream of the divert trigger photo eye. It should be turned off when the trailing edge of the package is about six inches upstream of the divert trigger photo eye.
	Divert trigger photo eye mounted incorrect distance from first drive roller at all diverters	The centerline of the divert trigger photo eye must be mounted at a distance of 9.5 inches upstream of the centerline of the first drive roller, or 11.5 inches upstream of the first row of diverter wheels.
	Misaligned divert trigger photo eye at all diverters	The photo eye needs to be aligned per the instruction provided in this document.

SYMPTOMS	POSSIBLE CAUSES	RECOMMENDED SOLUTIONS
	Disconnected divert trigger photo eye at all diverters	Make sure the photo eye cable is properly installed at the photo eye, as well as at the Wave Divert Commander (refer to Figure 2: Wave Divert Commander Hardware.)
	Faulty divert trigger photo eye at all diverters	If the photo eye is correctly installed, aligned and connected, but is not functioning properly, it may be faulty and needs to be replaced.
	Disconnected valve solenoid at all diverters	Make sure the solenoid cable is properly installed at the valve, as well as at the Wave Divert Commander. It should be connected to the appropriate output (see Figure 2.)
	Faulty valve solenoid at all diverters	If a valve appears to be malfunctioning, it can be tested manually by pressing the actuator button on the valve. If it does not operate correctly, it may be faulty and needs to be replaced.
	Incorrect Wave Divert Commander timer values for current sorter speed for all diverters	Check to see the correct speed is being sent from the sorter controller to the Wave Divert Commander. Also, make sure it is being written to the correct location (refer to Table 5: Output Data Map.)
	Wave Divert Commander program not running on single diverter	Check the MS status indicator. If it is flashing green, the Wave Divert Commander has no program. Check to make sure the Mode Selector Switch is in the UP position.
Intermittent products not diverting properly at single diverter	Incorrect product data from source of divert information for single diverter	When a decision is made by an upper-level system (WCS, etc.), make sure the correct product data is used to make that decision. If the wrong product data is used, product can be diverted to the wrong destination or not diverted to the correct destination.

SYMPTOMS	POSSIBLE CAUSES	RECOMMENDED SOLUTIONS
	Incorrect timing of arm signal at single diverter	The arm signal should be turned on when the leading edge of the package is about six inches upstream of the divert trigger photo eye. It should be turned off when the trailing edge of the package is about six inches upstream of the divert trigger photo eye.
	Divert trigger photo eye mounted incorrect distance from first drive roller at single diverter	The centerline of the divert trigger photo eye must be mounted at a distance of 9.5 inches upstream of the centerline of the first drive roller, or 11.5 inches upstream of the first row of diverter wheels.
	Faulty divert trigger photo eye at single diverter	If the photo eye is correctly installed, aligned and connected, but is not functioning properly, it may be faulty and needs to be replaced.
	Misaligned divert trigger photo eye at single diverter	The photo eye needs to be aligned per the instruction provided in this document.
	Faulty valve solenoid at single diverter	If a valve appears to be malfunctioning, it can be tested manually by pressing the actuator button on the valve. If it does not operate correctly, it may be faulty and needs to be replaced.
Intermittent products not diverting properly at multiple diverters	Improper product gapping at multiple diverters	The minimum gap between any two packages should be three inches. If a gap of less than three inches is detected at the tracking photo eye, those packages should be recirculated when possible.
	Sorter controller input cannot handle pulse rate from encoder	The sorter controller input should be able to accept an off-to-on or on-to-off transition every 11.8 milliseconds. This is for a sorter speed of 425FPM.



SYMPTOMS	POSSIBLE CAUSES	RECOMMENDED SOLUTIONS
	Improper product tracking to multiple diverters	The sorter controller is looking for the tracked data in the wrong location or at the wrong time. The controller should see the data in the correct location when the leading edge of the package is about six inches upstream of the divert trigger photo eye.
	Incorrect product data from source of divert information for multiple diverters	When a decision is made by an upper-level system (WCS, etc.), make sure the correct product data is used to make that decision. If the wrong product data is used, product can be diverted to the wrong destination or not diverted to the correct destination.
	Incorrect timing of arm signal at multiple diverters	The arm signal should be turned on when the leading edge of the package is about six inches upstream of the divert trigger photo eye. It should be turned off when the trailing edge of the package is about six inches upstream of the divert trigger photo eye.
	Divert trigger photo eye mounted incorrect distance from first drive roller at multiple diverters	The centerline of the divert trigger photo eye must be mounted at a distance of 9.5 inches upstream of the centerline of the first drive roller, or 11.5 inches upstream of the first row of diverter wheels.
	Misaligned divert trigger photo eye at multiple diverters	The photo eye needs to be aligned per the instruction provided in this document.
	Faulty divert trigger photo eye at multiple diverters	If the photo eye is correctly installed, aligned and connected, but is not functioning properly, it may be faulty and needs to be replaced.

SYMPTOMS	POSSIBLE CAUSES	RECOMMENDED SOLUTIONS
	Faulty valve solenoid at multiple diverters	If a valve appears to be malfunctioning, it can be tested manually by pressing the actuator button on the valve. If it does not operate correctly, it may be faulty and needs to be replaced.
Intermittent products not diverting properly at all diverters	Improper product gapping at all diverters	The minimum gap between any two packages should be three inches. If a gap of less than three inches is detected at the tracking photo eye, those packages should be recirculated when possible.
	Sorter controller input cannot handle pulse rate from encoder	The sorter controller input should be able to accept an off-to-on or on-to-off transition every 11.8 milliseconds. This is for a sorter speed of 425FPM.
	Improper product tracking to all diverters	The sorter controller is looking for the tracked data in the wrong location or at the wrong time. The controller should see the data in the correct location when the leading edge of the package is about six inches upstream of the divert trigger photo eye.
	Incorrect product data from source of divert information for all diverters	When a decision is made by an upper-level system (WCS, etc.), make sure the correct product data is used to make that decision. If the wrong product data is used, product can be diverted to the wrong destination or not diverted to the correct destination.
	Incorrect timing of arm signal at all diverters	The arm signal should be turned on when the leading edge of the package is about six inches upstream of the divert trigger photo eye. It should be turned off when the trailing edge of the package is about six inches upstream of the divert trigger photo eye.

SYMPTOMS	POSSIBLE CAUSES	RECOMMENDED SOLUTIONS
	Divert trigger photo eye mounted incorrect distance from first drive roller at all diverters	The centerline of the divert trigger photo eye must be mounted at a distance of 9.5 inches upstream of the centerline of the first drive roller, or 11.5 inches upstream of the first row of diverter wheels.
	Misaligned divert trigger photo eye at all diverters	The photo eye needs to be aligned per the instruction provided in this document.
	Faulty divert trigger photo eye at all diverters	If the photo eye is correctly installed, aligned and connected, but is not functioning properly, it may be faulty and needs to be replaced.
	Faulty valve solenoid at all diverters	If a valve appears to be malfunctioning, it can be tested manually by pressing the actuator button on the valve. If it does not operate correctly, it may be faulty and needs to be replaced.

## Chapter 7: REPLACEMENT

---

To replace the Wave Divert Commander, follow the steps below

1. Disconnect all cables from the old Wave Divert Commander.
2. Remove the four screws that mount the unit to the diverter.
3. Remove the old Wave Divert Commander from the diverter.
4. Position the new Wave Divert Commander on the diverter.
5. Install the four screws that mount the unit to the diverter.
6. Set the IP address on the new Wave Divert Commander to match the IP address of the old one.  
Connect power cable to set IP address in software, if necessary.
7. Connect all cables to the new Wave Divert Commander.

## Chapter 8: SPECIFICATIONS

---

ATTRIBUTE	DESCRIPTION
<b>Base Control Device</b>	Wago 750-852 Programmable Fieldbus Controller configured for Ethernet/IP
<b>Power Supply</b>	24VDC Class 2 power source
<b>Power Requirements</b>	Single Diverter Controller: 410mA per Wave Divert Commander Dual Diverter Controller: 710mA per Wave Divert Commander
<b>Network Connections</b>	ETHERNET IN: Female RJ45 receptacle ETHERNET OUT: Female RJ45 receptacle
<b>Power Connection</b>	4-Pin Male Mini receptacle
<b>Input Connections</b>	4-Pin Female M12 Connectors with two inputs per connector
<b>Output Connections</b>	4-Pin Female M12 Connectors with two outputs per connector
<b>Enclosure Type</b>	Type 1
<b>Enclosure Dimensions</b>	8"Hx10"Wx4"D

Table 11: Wave Divert Commander Specifications

## Chapter 10: DIMENSIONAL REFERENCE POINTS

---

The path of each conveyor in the system is determined by establishing a reference point at each end. The center line of the conveyor is established and a chalk line is snapped between these points.

Conveyors should be installed with the center line of the bed matching the center line of the conveyor path within 1/8" of true center. Locate and mark the center of the crossmembers at each end of the conveyor. Use a plumb line or other acceptable means to ensure accuracy to the chalk line.

Always carry out a thorough check for any obstructions such as building columns, manholes, etc. It may be necessary to reroute the conveyor to avoid the obstruction. In this case it would be advisable to begin installation at this point, using the obstruction as a reference point (Datum), and install the sections in either direction as required.

All conveyor sections must be checked for squareness prior to installation as "racking" or being knocked out of square may have occurred during shipping and handling.

## Chapter 11: CONVEYOR CONTROLS - SAFETY GUIDELINES

---

The following are basic conveyor controls safety guidelines for common controls equipment.

START-UP WARNING HORN - If all conveyors being started cannot be seen from the start pushbutton location, then an audible warning device is required. It could be a horn, buzzer or bell. It must be loud enough to be heard at any point on the conveyor being started. It should sound for the duration of five seconds after the start pushbutton is pushed, prior to the conveyor starting. Any auxiliary equipment such as vertical lifts, turntables, etc. must be included in the warning circuitry.

START PUSHBUTTON - Start pushbutton should be the flush type or guarded such that inadvertently leaning against them will not actuate them. They should be provided with a legend plate clearly defining which conveyors will be started.

STOP PUSHBUTTON - Stop pushbutton should be the extended type such that any contact with it is sufficient to stop the conveyor. They should have a legend plate defining which conveyors will be stopped.

EMERGENCY STOPS - All locations where high voltage motors are used and an operator is working must be protected by an emergency stop.

Emergency stop devices should also protect high pedestrian areas where high voltage motors are used. Actuating an emergency stop must dropout the start circuit and all electrical power, requiring restarting the system using the start pushbutton provided.

All locations where low voltage motors are used (under 50 volts) and an operator is working all require an emergency stop circuit. This requirement also applies to high pedestrian areas.

## Chapter 12: REPLACEMENT PARTS IDENTIFICATION

---

This section is used to identify parts that may require replacement during the life of the conveyor.

Parts which specifically pertain to NBS Wave Divert Commander are included with illustrations.

A "Recommended Spare Parts List" is published for all conveyor orders of \$20,000 or more. This spare parts list is sent to the purchaser approximately (2) weeks after the order is received. It includes part numbers, description, pricing and recommended quantities to be kept on hand for maintenance.

If you are unable to locate this document another may be obtained by contacting the MHS Systems Lifetime Services at 231-798-4547 or Fax 231-798-4549.



## Chapter 13: WORKS CITED

---

ANSI. (2013-2014). *American National Standards Institute*. Retrieved 2014, from ANSI Standards Store: <http://www.ansi.org/>

ASME. (2014). *The American Society of Mechanical Engineers*. Retrieved 12 05, 2014, from <https://www.asme.org/>

CEMA. (2014). *Conveyor Equipment Manufacturers Association*. Retrieved 2014, from Conveyor Equipment Manufacturers Association: <http://www.cemanet.org/>

EN. (2014). *EN European Standards*. Retrieved 2014, from European Standards: <http://www.en-standard.eu/>

OSHA. (2014). *Occupational Safety & Health Administration*. Retrieved 2014, from OSHA QuickTakes: <https://www.osha.gov/>

## GENERAL INFORMATION

### Website:

[mhs-conveyor.com](http://mhs-conveyor.com)

## MHS Systems INFORMATION

---

### Mission

MHS Systems, located in Norton Shores, Michigan, is a leading deliverer of “smart” material handling systems, technologies, products, and services, creating solutions for material flow applications. As a global supplier of conveyor systems and equipment since 1964, MHS Systems provides sorters, conveyors, and accessories to satisfy a broad spectrum of accumulation, transportation, and sortation applications.



MHS Systems

1300 E Mount Garfield Road

Norton Shores, MI 49441-6097 USA

231.798.4547

Email: [us-info@mhs-conveyor.com](mailto:us-info@mhs-conveyor.com)

Web Site : [mhs-conveyor.com](http://mhs-conveyor.com)



Regional sales offices and authorized Business Partners located throughout the United States and Canada. Licensees and Business Partners in Europe, South America, and Southeast Asia.