INSTALLATION, OPERATION, MAINTENANCE MANUAL

Narrow Belt System Wave Commander

Wave Commander
PN 1167034
Revision Date: April 02, 2015

Contents

Purpose

It is the intent of MHS Conveyor, through this manual, to provide information that acts as a guide in the installation, operation and maintenance of MHS Conveyor 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 Conveyor Distributor or MHS Conveyor Lifetime Services at 231-798-4547.

Property & Protection

This software is the property of MHS Conveyor Inc. 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 Conveyor Inc. 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.

Software Warranty

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

MHS Conveyor Equipment Warranty

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

MHS Conveyor agrees to furnish the purchaser without charge any part proved defective within 2 years from date of shipment or before the equipment has forty-one hundred (4100) hours of running use, whichever period is shorter, provided the purchaser gives MHS Conveyor immediate notice in writing and examination proves the claim that such materials or parts were defective when furnished. For drive components specific to XenoROL® (i.e. Xeno belts, slave Xeno belts, drive spools, standard and speed-up, and spacers), this warranty shall be extended to five years or ten thousand (10,000) hours of running use, whichever period is shorter, provided the conveyors are applied, installed and maintained in accordance with MHS Conveyor published standards. Other than the above, there are no warranties which extend beyond the description on the face hereof. Consequential damages of any sort are wholly excluded.

The liability of MHS Conveyor will be limited to the replacement cost of any defective part. All freight and installation costs relative to any warranted part will be at the expense of the purchaser. Any liability of MHS Conveyor under the warranties specified above is conditioned upon the equipment being installed, handled, operated, and maintained in accordance with the written instructions provided or approved in writing by MHS Conveyor.

The warranties specified above do not cover, and MHS Conveyor makes no warranties which extend to, damage to the equipment due to deterioration or wear occasioned by chemicals, abrasion, corrosion or erosion; Purchaser's misapplication, abuse, alteration, operation or maintenance; abnormal conditions of temperature or dirt; or operation of the equipment above rated capacities or in an otherwise improper manner.

IMPORTANT

All equipment and components not manufactured by MHS Conveyor carry only such warranty as given by the manufacturer thereof, which warranty MHS Conveyor will assign or otherwise make available to Purchaser without recourse to MHS Conveyor, provided that such warranty is assignable or may be made available.

For service on motors, reduction units, electrical components, controls, air or hydraulic cylinders, contact the local authorized sales and service representative of respective manufacturer. If none is available in your locality, contact the MHS Conveyor representative. MHS Conveyor will not be responsible for units that have been tampered with or disassembled by anyone other than the authorized representative of the respective manufacturer.

THERE ARE NO WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, EXTENDING BEYOND THOSE SET FORTH IN THIS STATEMENT OF WARRANTY.
Rev 08/22/2011

MHS Conveyor Environment Standards

MHS Conveyor equipment is designed to be installed in a clean, dry warehouse environment. Exposure to extreme humidly, direct sunlight, blowing dirt or rain can permanently damage some components of MHS Conveyor. In particular, the curing agents in concrete are known to attack and degrade the urethane conveyor components.

When installing conveyor on a new construction site, be sure that the concrete is properly cured before setting conveyor on it. In addition, if conveyors are stored in the proximity of curing concrete, proper ventilation must be used to direct the curing agent fumes away from the conveyor.

Failure to comply with these guidelines will void the MHS Conveyor warranty on any failed components that result from these environment tissues.

Conveyor Design and Safety Guidelines

A safety risk evaluation is required for all of our standard equipment. The safety risk evaluation considers every potential hazard on the conveyor, weighs the probability and the severity of the potential injury, and addresses methods of mitigation to make the risk of injury either low or negligible. We use the ANSI B11 TR3 standards for all of our risk evaluation.

In addition, all of our equipment is designed to comply with the following national and industry standards:

CEMA Safety Standards and Labels - (CEMA is the Conveyor Equipment Manufacturers Association)

ASME B20.1- Safety standard for Conveyors and Related Equipment

ASME B15.1 – Safety standard for Mechanical Power Transmission Apparatus

OSHA 1910.147 – The Control of Hazardous Energy

OSHA 1910.212 - General Requirements for all Machines

OSHA 1910.95 – Occupational Noise Exposure

ANSI 2535 – Safety Color Code

MHS Conveyor Safety Recommendation

For additional safety information: MHS Conveyor agrees to the following safety instruction or guidelines listed within this manual. This is not to conflict with your state or legal requirements.

MHS Conveyor Recommends for maintenance or repair purposes, to incorporate a lock out or tag procedure. To ensure all starting devices, prime movers, or powered accessories are off before attempting to maintenance or repair.

The procedures below are designed to protect everyone involved with the conveyor against an unexpected restart. To include understanding of potential hazard of stored energy, which can exist after the power source is locked out.

For additional information, refer to the latest issue of ANSI Z244.1, American National Standard for Personnel Protection − Lockout/Tagout of Energy Sources− Minimum Safety Requirements. http://www.ansi.org/

OSHA 29CRF Part 1910.147 *"Control of Hazardous Energy Sources (Lockout/Tagout)",* which includes requirements for release of stored energy and OSHA Safety and Health Regulations for Construction 1926.555 Conveyors https://www.osha.gov/

ANSI Standards for Conveyors

It is essential for safe and efficient system operation that safety information and guidelines presented here are properly understood and implemented.

MHS Conveyor recognizes American National Standard Institute (ANSI) booklet entitled *Safety Standards for Conveyors and Related Equipment B20.1.* For more information go to http://webstore.ansi.org/default.aspx

With any piece of industrial equipment, conditions exist that might cause injury to you or your co-workers. Because it is not possible to describe each potentially hazardous situation that might develop, you must be alert at all times for unsafe conditions. To avoid injury, use maximum possible care and common sense and adhere to all safety standards.

Take special care while maintaining and inspecting electrical equipment and devices. All personnel working on or around the system should be aware of, and adhere to, all **CAUTION**, **DANGER**, and **WARNING** signs.

Labels or signs are posted to reduce the risk of injury to all personnel. Never assume that the signs and notices are applicable only to inexperienced personnel. Maintain signs in a legible condition. Contact your supervisor to post additional safety signs if you feel they are necessary. http://www.ansi.org/

ANSI Conveyor Safety Rules

Conveyor safety rules, as well as specific regulations and guidelines listed in this publication:

- DO NOT touch moving Conveyor parts.

- DO NOT walk, ride, or climb on the Conveyor.

- DO NOT operate the Conveyor with chain guards or other protective guards removed.

- Keep jewelry, clothing, hair, etc., away from the Conveyor.

- Know the location and function of all start/stop devices and keep those devices free from obstruction.

- Clear all personnel from the equipment before starting the Conveyor.

- DO NOT attempt to clear product jams while the Conveyor is running.

- Allow only trained and authorized personnel to maintain or repair Conveyor equipment.

- DO NOT load the Conveyor beyond specified design limits.

- DO NOT attempt to make repairs to the Conveyor while it is running.

- DO NOT modify equipment without checking with the manufacturer.

- DO NOT operate or perform maintenance on equipment when taking any type of drug, sedative, when under the influence of alcohol, or when over fatigued.

- Report any unsafe condition to your supervisor or maintenance staff.

Conveyor Equipment Manufacturers Association (CEMA)

The Conveyor Equipment Manufacturers Association (CEMA) provides safety information related to conveyor systems. There are Conveyor Safety Video and Conveyor Safety Poster produced by CEMA.

MHS Conveyor recommends these video for training and education purposes for a safe working environment around conveyor equipment. The video introduces awareness of operation personnel maintenance technicians, and management to safety hazards commonly associated with the automated material handling conveyor equipment.

Safety poster reviews the important safety labels and is intended to be posted in public places as a day-to-day reinforcement of good safety practices. These posters can be downloaded from the CEMA Web Site at http://cemanet.org/safety/posters.htm or for more information on the CEMA Safety Program visit the CEMA Web Site's Safety Page at http://cemanet.org/safety/index.html.

Both the safety poster and the video can be purchased from CEMA. Visit their web site – www.cemanet.org for additional information or contact them at:

Conveyor Equipment Manufacturers Association
6724 Lone Oak Blvd. Naples FL 34109
Phone (941) 514-3470

CEMA Safety Label Meanings

The word or words that designate a degree or level of hazard seriousness. The signal words for product safety signal are: DANGER, WARNING, and CAUTION.

- **DANGER** -Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme situations.
- **WARNING** – Indicates potentially hazardous situation which, if not avoided, could result in minor or moderate injury. It may also be used to alert against unsafe practices.
- **CAUTION** – Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

Warnings and Safety Instructions

Failure to follow the instructions and cautions throughout this book, and warning labels on the conveyor, may result in injury to personnel or damage to the equipment.

Your MHS Conveyor conveyor is powered by a motor and can be stopped only by turning off electrical power to the motor. As with all powered machinery, the drive-related components – including sprockets, chains, shafts, universal joints and pneumatic devices – can be dangerous. We have installed or provided guards to prevent accidental contact with these parts, along with warning labels to identify the hazards.

Special attention must be paid to the following areas of this manual:

⚠ **WARNING**	
⚠	• Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION
• Indicates a situation which, if not avoided, could result in property damage.

NOTE
This is where you will be notified of helpful information.

⚠ **WARNING**

- After maintenance, REPLACE guards immediately.
- Keep ALL warning labels clean and clear of any obstructions.
- Never remove, deface or paint over WARNING or CAUTION labels. Any damaged label will be replaced by MHS Conveyor Systems at no cost by contacting Lifetime Services.
- It is very important to instruct personnel in proper conveyor use including the location and function of all controls.
- Special emphasis must be given to emergency stop procedures.
- It is important to establish work procedures and access areas which do not require any part of a person to be under the conveyor.
- It should be required that long hair is covered by caps or hair nets.
- Loose clothing, long hair and jewelry must be kept away from moving equipment.
- Maintain enough clearance on each side of all conveyor units for safe adjustment and maintenance of all components.
- Provide crossovers or gates at sufficient intervals where needed to eliminate the temptation for personnel to climb over or under any conveyor.
- Walking or riding on a moving conveyor must be prohibited.
- Before performing maintenance on the conveyor, make sure the start-up controls are locked out and cannot be turned on by any person other than the one performing the maintenance.
- If more than one crew member is working on the conveyor, EACH CREW MEMBER MUST HAVE A LOCK ON THE POWER LOCKOUT.
- All pneumatic devices must be de-energized and air removed to prevent accidental cycling of the device while performing general maintenance.
- Make sure all personnel are clear of all conveyor equipment before restarting the system.

⚠ **WARNING**	
⚠	• Before servicing or performing any work in the motor control panel, disconnect and lock out air and the main incoming service. If only the panel disconnect is off, the incoming side will still be hot.

Unit Handling

Product: Unit Handling

Equipment: Belt Driven Live Roller Conveyors - Center and End Driven

To be located on conveyors where there are exposed moving parts which must be unguarded to facilitate function, i.e. rollers, pulleys, shafts, chains, etc.

To be placed along both sides of these conveyors since these conveyors provide surfaces and profiles attractive, but hazardous, for climbing, sitting, walking, or riding.

To be placed on removable guards to warn that operation of the machinery with guards removed would expose chains, belts, gears, shafts, pulleys, couplings, etc. which create hazards

⚠ WARNING
Moving equipment can cause severe injury
CHR930005

⚠ DANGER
Climbing, sitting, walking or riding on conveyor at any time will cause severe injury or death
KEEP OFF
CHR930004

⚠ WARNING
Exposed moving parts can cause severe injury
LOCK OUT POWER before removing guard
CHR930001

"A"
LOCATE AT TERMINAL ENDS
(BOTH SIDES)

"B"
SPACE UP TO A MAXIMUM OF 20 FT.
CENTERS (BOTH SIDES)

"C"
LOCATE ON DRIVE GUARDS
AND CHAIN / BELT GUARDS

"B" "B" "B"

"A" "A" "A"

"C" "D" "D"

CENTER DRIVE

END DRIVE

LOCATE ON DRIVE SECTION
(BOTH SIDES)

"D"
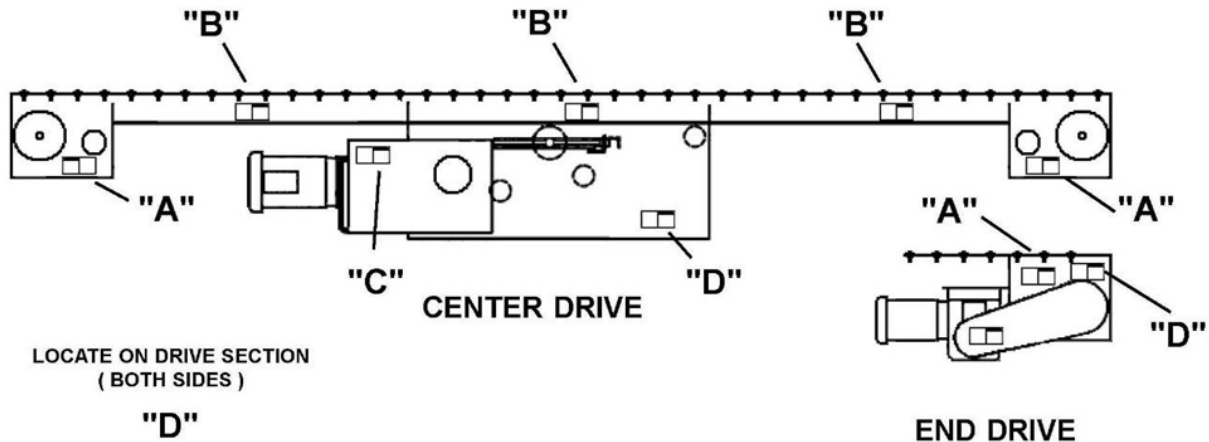
General purpose label to warn maintenance personnel that conveyors should be shut off and locked out prior to servicing; Examples: drives, take-ups, lubrication points which require guard removal.

⚠ WARNING
Servicing moving or emergized equipment can cause severe injury
LOCK OUT POWER before servicing
CHR930009

CEMA - October, 2004   UH - 4

CEMA Package Labels

Package Conveyors

Do Not Climb, Sit, Stand, Walk, Ride, or Touch the Conveyor at Any Time

Do Not Perform Maintenance on Conveyor Until Electrical, Air, Hydraulic and Gravity Energy Sources Have Been Locked Out and Blocked

Operate Equipment Only With All Approved Covers and Guards in Place

Do Not Load a Stopped Conveyor or Overload a Running Conveyor

Ensure That All Personnel Are Clear of Equipment Before Starting

Allow Only Authorized Personnel To Operate or Maintain Material Handling Equipment

Do Not Modify or Misuse Conveyor Controls

Keep Clothing, Body Parts and Hair Away from Conveyors

Remove Trash, Paperwork and Other Debris Only When Power is Locked Out

Ensure That ALL Controls and Pull Cords are Visible and Accessible

Know the Location and Function of All Stop and Start Controls

Report All Unsafe Conditions

POST IN PROMINENT AREA

Manual Structure

You should receive a separate documentation for each product line of MHS Conveyor implemented in your installation. You can identify the respective product line on the back of the folder or on the cover sheet of the IOM (Installation Operation Maintenance Manual)

- IOM Conveyor System
- PN = Part Number
- Revision Date (MM/DD/YYYY)
- Page Numbers

-
-

⚠ **WARNING**	
	Pay attention to the safety instructions! • Prior to working at or in the immediate vicinity of the system it is recommended that you make yourself familiar with the safety instructions included in the present document!

Part Inventory & Identification

Label Identification

Each subassembly is shipped completely assembled except typical loose parts, which are in boxes with the subassemblies. Segregate the conveyor subassemblies by types for inventory and ease of locating during installation.

An identification label is attached Divert Commander Module.

Label contain the following information:
- Item
- Description
- Version
- Date of manufacture
- MHS Conveyor Phone #

Commander System Controls   TGW

Item: 1161776
Desc: Wave Commander
Ver: 2.0
Date: 9 / 18 / 14

TGW Systems Inc. 231-798-4547

The tag is located in the cover of the Commander Box.

These numbers can be cross-referenced against the packing list.

Loose parts are boxed and shipped separately. You should have all conveyor sections and supports for a particular conveyor prior to installation. It is cost-effective to identify and procure any missing parts before they are needed for assembly. Small items like nuts and bolts are weigh-counted and packaged by size and type.

⚠ **WARNING**
⚠   • The Installation Supervisor must be experienced with conveyor and qualified in the mechanics of the equipment and enforce safe working procedures for the protection of the crew, customer, and customer's property.

Introduction

The Wave Commander is designed to provide the time critical control required for sortation rates of 150 cartons per minute and greater. This DeviceNet-enabled controller can also reduce the total cost of installation and ownership. This can be accomplished when connected to a sortation controller with a DeviceNet network by using networked control signals. Due to the non-proprietary design of the Wave Commander, it can also be used with sortation controllers that are not connected to the Wave Commander via a network. Instead of networked control signals, the Wave Commander can be controlled with hardwired control signals.

The basic principal of the Wave Commander is an arm, trigger, raise and then lower operation. Arming is accomplished from a sortation controller when a package, to be diverted, is approaching the destination diverter. Once the Wave Commander is armed, the leading edge of the next package triggers the Wave sequence to begin.

The Wave Commander from MHS Conveyor is supplied with the logic and timing for the speed of the NBS sorter. When the Wave Commander is networked to a sortation controller, the Wave Commander can be adjusted on-the-fly for changes in sorter speed. When the sorter speed is changed at the sortation controller, new Wave Commander Timer values need to be calculated and sent to the Wave Commander over DeviceNet.

As mentioned previously, the Wave Commander can be controlled via a DeviceNet 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
Wave diverting	x	x
Fixed-speed sorting	x	x
Variable-speed sorting		x
Ability to "teach" sorter		x
Reduced wiring		x

Table 1: Hardwired vs. Networked Control Signals Comparison

Operation

Product Gapping and Tracking

Cartons are gapped by an induction system before entering the sorter. When gapping for the wave diverter, 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 six inches. If a gap of less than six inches is detected at the tracking photo eye, those packages should be recirculated when possible. As a carton enters the NBS sorter, it is sensed by the tracking photo eye, and the sortation controller should begin tracking the carton 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 carton to its destination diverter. The pulses should be used to determine when to activate the arm signal for a diverter where a carton is to be diverted. It is very important to use a sortation 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 Turbo sorter is 425FPM. That equates to an off-to-on or on-to-off transition every 11.8 milliseconds.

Arm

When the carton approaches the destination diverter, the sortation controller activates the arm signal to the Wave Commander. This should happen when the leading edge of the carton is approximately six inches (6") away from 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 cartons, the Wave Commander will be armed to divert the next carton sensed by the divert trigger photo eye. Unless the next carton is to be diverted at the same diverter, the arm signal should be turned off when the trailing edge of the carton is approximately six inches away from the divert trigger photo eye. Again, this is based upon the tracking information from the tracking encoder. Arming the Wave Commander can be accomplished over a DeviceNet network or with a hardwired input. Hardwired arming is accomplished by providing a 24VDC signal to INPUT 5 on the Wave Commander (refer to Figure 2: Wave Commander Hardware for details).
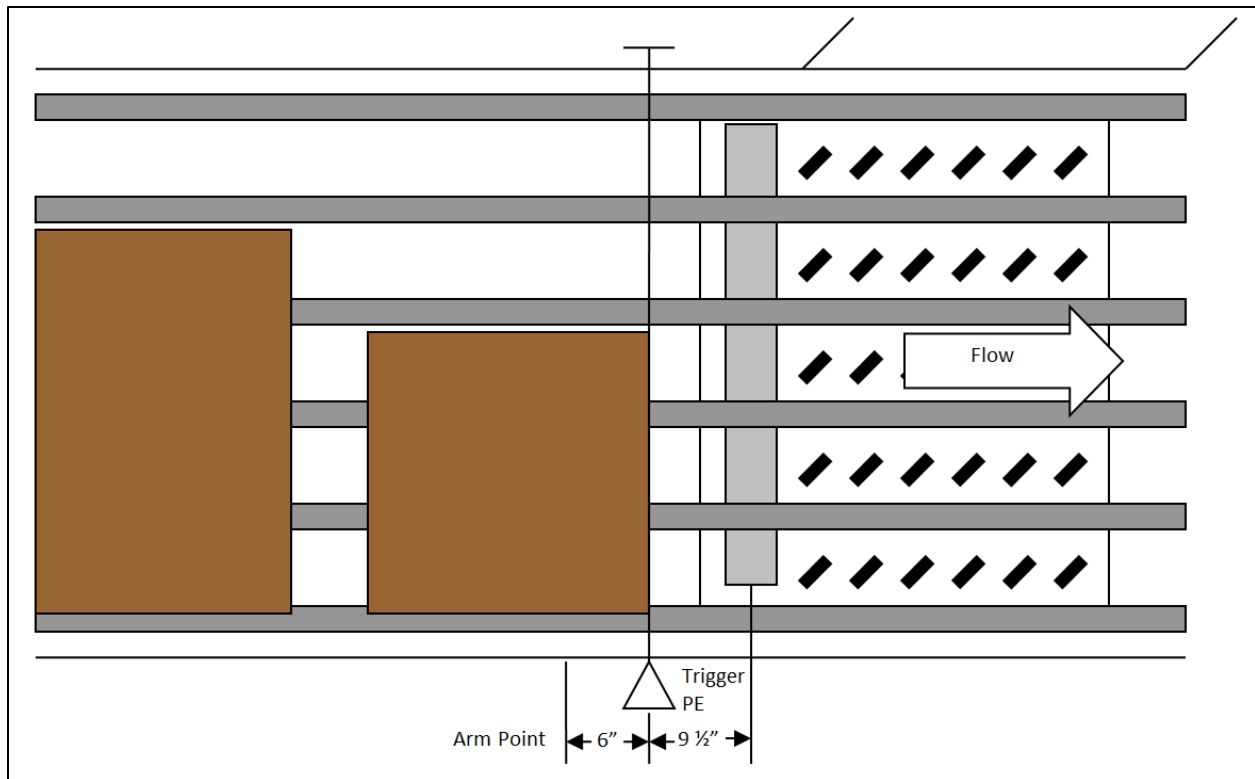
Figure 1: Trigger PE and Arm Enable Distance

Once the Wave Commander is armed and the leading edge of the next carton is detected by the divert trigger photo eye, the Wave Commander sequence will be triggered to start. The trigger photo eye should be placed nine and one half inches (9 ½") from the centerline of the first diverter drive roller. This is shown in Figure 1.

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.

Raise

Once the Wave 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 signal to energize the valve solenoid to raise 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 rise 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" 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" for all rows.

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

	1	2	3	4	5	6	7	8	9	10	11	12	13
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

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, 41mS 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

Application

Hardware Design

The following items are included with each Wave Diverter (refer to Figure 2: Wave Commander Hardware for details):

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

The Wave Commander is based on the Allen Bradley 1799-ZCIOB Embedded I/O card with 10 inputs and 10 outputs. Refer to the Allen-Bradley Zone Control I/O Cards, Installation Instructions, publication 1799-IN010A-EN-P, available at www.ab.rockwellautomation.com, for more information. The zone control functionality of the 1799-ZCIOB card is not utilized in the Wave Commander application. The Wave Commander only utilizes eight inputs and eight outputs on this card. Both inputs and outputs are configured for 24VDC PNP only. The application of a Wave Commander requires both network power and auxiliary power, even if it is not going to be networked to a sort controller. The Wave Commander is designed to work with round media cabling only. The network connection utilizes 5-pin mini DeviceNet connectors. The auxiliary power connection employs a 4-pin mini connector. These power sources should be installed per the National Electrical Code (NEC) and all applicable local codes.

The network power should be supplied by a 24VDC, NEC Class 2 source. Consult the Allen-Bradley DeviceNet Media Design and Installation Guide, publication DNET-UM072C-EN-P, available at www.ab.rockwellautomation.com, for additional information. Each divert requires approximately 166mA from the network power source. A current supply of 125mA is needed to power the 1799 card. The trigger photo eye operates on 30mA, with a maximum of 11mA needed to turn on the trigger photo eye input. If additional devices are connected to the input ports of the Wave Commander, such as a divert confirm photo eye, consideration needs to be given to the additional current requirements.

The auxiliary power can be supplied by an NEC Class 2 source, or by an NEC Class 1 source via appropriate Class 1 media. More detailed information can be found in the Allen-Bradley DeviceNet Media Design and Installation Guide, publication DNET-UM072C-EN-P. The maximum current available should be 8A, and the nominal voltage should be 24VDC. Each divert requires approximately 252mA from the auxiliary power source. There are six valve solenoids per diverter, and each solenoid draws 42mA. If additional devices are connected to the output ports of the Wave Commander, consideration needs to be given to the additional current requirements.
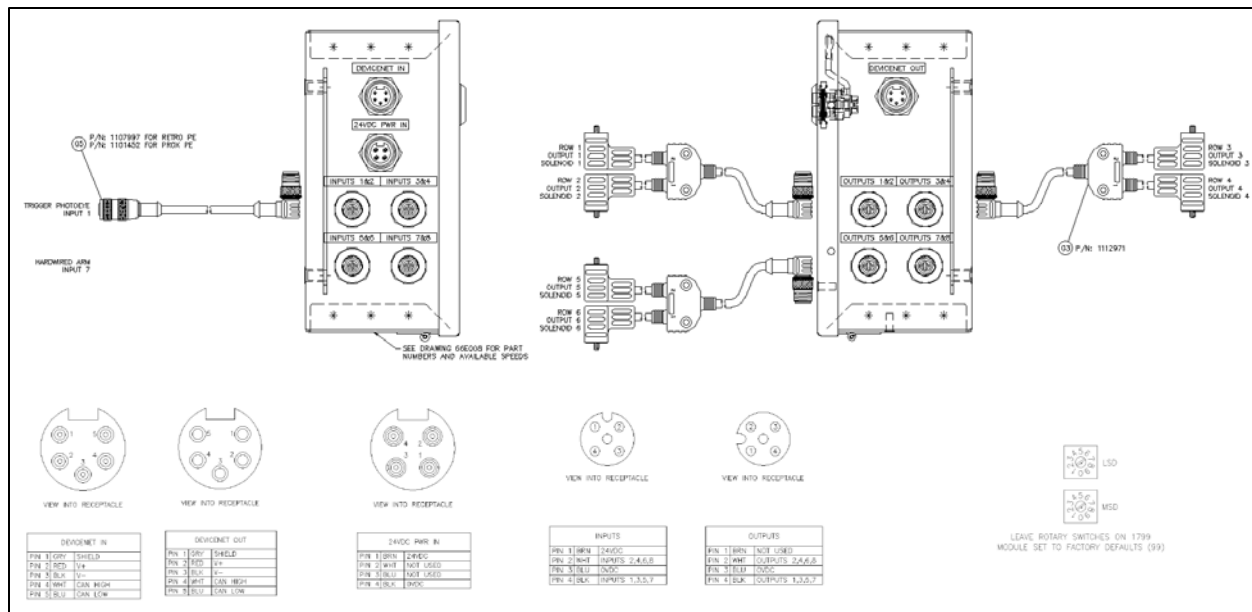
Figure 2: Wave Commander Hardware

Networking to a Sortation Controller via DeviceNet

Understanding of DeviceNet
This section describes how to network the Wave Commander to a sortation controller via DeviceNet. It assumes a sufficient understanding of Rockwell Software (RSNetworx for DeviceNet and RSLogix 5000.) It is also expected that an adequate understanding of DeviceNet media design and installation exists. The previously mentioned Allen-Bradley DeviceNet Media Design and Installation Guide, publication DNET-UM072C-EN-P, is a recommended source of further information.

Addressing
The 1799 card used in the Wave Commander is factory-set by Allen-Bradley to node address 63 in software. The rotary switches are set to 99. Since 99 is not a valid address, the address in software (63) is the default. This is fine for all Wave Commander units on a sorter if hardwired control signals are being used. If the Wave Commander units are being networked to a sortation controller, each 1799 card needs to have a unique and valid address. The address for each Wave Commander needs to be determined during the control system design phase. This address should be set on each and every Wave Commander prior to power up during commissioning. This is so that 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, there are two rotary switches on the 1799 card for addressing of the module. These switches are labeled MSD (Most Significant Digit) and LSD (Least Significant Digit). For a node address of 51, the MSD switch would be set to 5, and the LSD switch would be set to 1.

RSNetworx for DeviceNet is used to configure the addresses in software. In the General tab of the 1799-ZCIOB properties (see Figure 3), the address can be set to the desired value. This should be done for each Wave Commander 1799 card in the DeviceNet network configuration file.
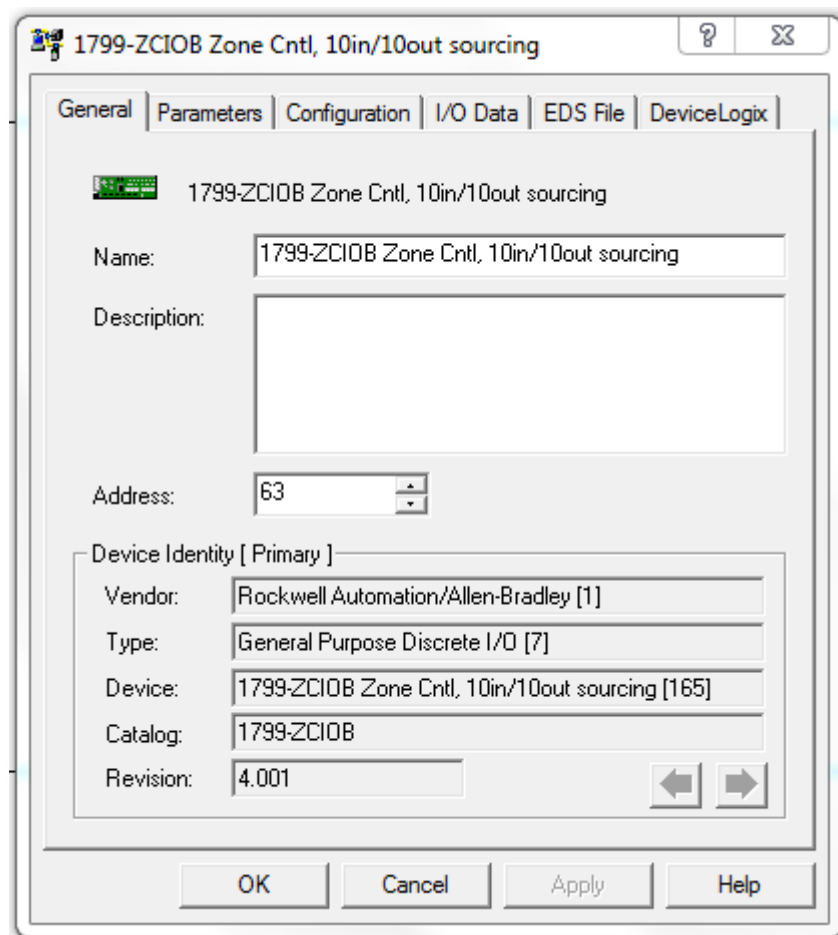
Figure 3: RSNetworx, Device Properties, General Tab

Network Configuration

A network configuration file must be created using RSNetworx for DeviceNet. All network devices, including the network scanner and all Wave Commander 1799 cards, must be part of the network configuration. Be sure to have the latest EDS files for each device. They can be downloaded from http://www.rockwellautomation.com/rockwellautomation/support/networks/eds.page.

Once the 1799 cards have been entered into the Scanlist of the network scanner, the I/O configuration for each card needs to be edited. This is done in the Scanlist tab of the network scanner properties (refer to Figure 4: RSNetworx, Network Scanner Properties, Scanlist Tab, Edit I/O.) The network scanner should be configured for Polled I/O communication with each card. Strobed and Change of State/Cyclic should be unchecked. The Polled configuration should be set for an input size of 7 bytes, and an output size of 2 bytes. The poll rate should be set for every scan.
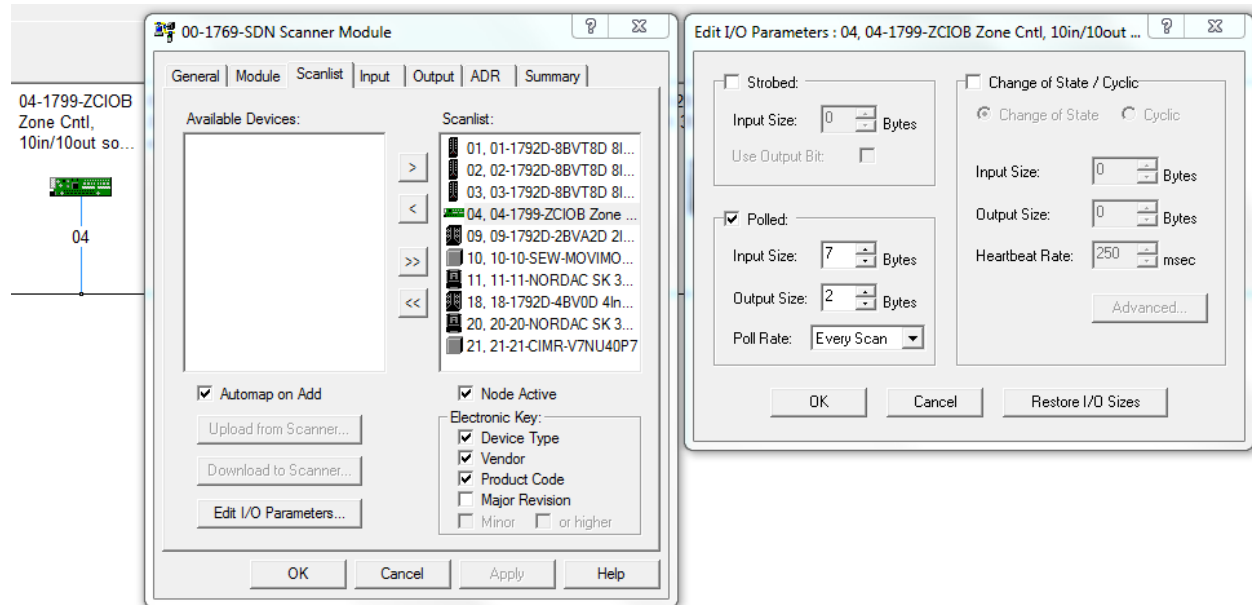
Figure 4: RSNetworx, Network Scanner Properties, Scanlist Tab, Edit I/O

I/O Mapping

The 1799-ZCIOB card in the Wave Commander produces seven bytes of input data to be consumed by the sortation controller. It consumes two bytes of output data produced by the sortation controller. When using an Allen-Bradley Logix controller, the bytes of data are mapped to words with the DINT data type. These are 32-bit words, two of which are used for inputs and one of which is used for outputs. The next three tables are data maps based upon an Allen-Bradley Logix controller.

Input Data

Input Word DINT = Local:s:I.Data[w].b (s=Slot location of DeviceNet scanner module, w= word as mapped in the DeviceNet configuration file in RSNetworx for DeviceNet, b=bit within the data word)

INPUT WORD 1		
BIT	1799-ZCIOB DESCRIPTION	WAVE COMMANDER DESCRIPTION
0	Input 0	Input 1 - Divert Trigger PE
1	Input 1	Input 2 - Spare
2	Input 2	Input 3 - Spare
3	Input 3	Input 4 - Spare
4	Input 4	Input 5 - Spare
5	Input 5	Input 6 - Spare
6	Input 6	Input 7 - Hardwired Arm
7	Input 7	Input 8 - Spare
8	Input 8	Not Used
9	Input 9	Not Used
10	Reserved	N/A
11	Reserved	N/A
12	Reserved	N/A
13	Reserved	N/A
14	Logic Enabled	Can be monitored in sortation controller
15	Auxiliary Power Fault	Can be monitored in sortation controller
16	Status Output 0	Solenoid Row 1
17	Status Output 1	Solenoid Row 2
18	Status Output 2	Solenoid Row 3
19	Status Output 3	Solenoid Row 4
20	Status Output 4	Solenoid Row 5
21	Status Output 5	Solenoid Row 6
22	Status Output 6	Spare
23	Status Output 7	Spare
24	Status Output 8	Not Used
25	Status Output 9	Not Used
26	Reserved	N/A
27	Reserved	N/A
28	Reserved	N/A
29	Reserved	N/A
30	Reserved	N/A
31	Reserved	N/A

Table 4: Input Word 1 Data Map

INPUT WORD 2		
BIT	**1799-ZCIOB DESCRIPTION**	**WAVE COMMANDER DESCRIPTION**
0	Network Output 0	Can be used to send data to sortation controller
1	Network Output 1	Can be used to send data to sortation controller
2	Network Output 2	Can be used to send data to sortation controller
3	Network Output 3	Can be used to send data to sortation controller
4	Network Output 4	Can be used to send data to sortation controller
5	Network Output 5	Can be used to send data to sortation controller
6	Network Output 6	Can be used to send data to sortation controller
7	Network Output 7	Can be used to send data to sortation controller
8	Configuration Consistency Value 0	N/A
9	Configuration Consistency Value 1	N/A
10	Configuration Consistency Value 2	N/A
11	Configuration Consistency Value 3	N/A
12	Configuration Consistency Value 4	N/A
13	Configuration Consistency Value 5	N/A
14	Configuration Consistency Value 6	N/A
15	Configuration Consistency Value 7	N/A
16	Configuration Consistency Value 8	N/A
17	Configuration Consistency Value 9	N/A
18	Configuration Consistency Value 10	N/A
19	Configuration Consistency Value 11	N/A
20	Configuration Consistency Value 12	N/A
21	Configuration Consistency Value 13	N/A
22	Configuration Consistency Value 14	N/A
23	Configuration Consistency Value 15	N/A
24	Not Used	N/A
25	Not Used	N/A
26	Not Used	N/A
27	Not Used	N/A
28	Not Used	N/A
29	Not Used	N/A
30	Not Used	N/A
31	Not Used	N/A

Table 5: Input Word 2 Data Map

Output Data
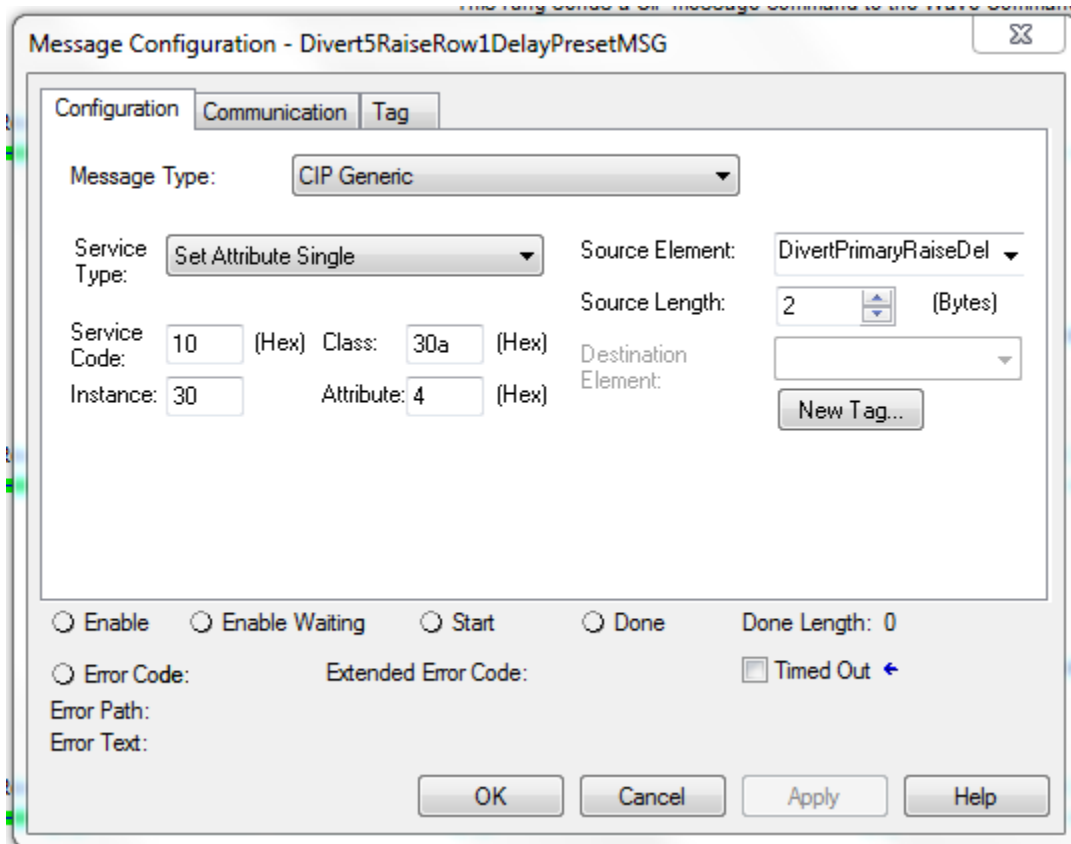
Output Word DINT = Local:s:O.Data[w].b (s=Slot location of DeviceNet scanner module, w= word as mapped in the DeviceNet configuration file in RSNetworx for DeviceNet, b=bit within the data word)

	OUTPUT WORD 1	
BIT	1799-ZCIOB DESCRIPTION	WAVE COMMANDER DESCRIPTION
0	Output 0	Networked Arm
1	Output 1	Spare
2	Output 2	Spare
3	Output 3	Spare
4	Output 4	Spare
5	Output 5	Spare
6	Output 6	Spare
7	Output 7	Spare
8	Output 8	Not Used
9	Output 9	Not Used
10	Reserved	N/A
11	Reserved	N/A
12	Reserved	N/A
13	Reserved	N/A
14	Reserved	N/A
15	Reserved	N/A
16	Not Used	N/A
17	Not Used	N/A
18	Not Used	N/A
19	Not Used	N/A
20	Not Used	N/A
21	Not Used	N/A
22	Not Used	N/A
23	Not Used	N/A
24	Not Used	N/A
25	Not Used	N/A
26	Not Used	N/A
27	Not Used	N/A
28	Not Used	N/A
29	Not Used	N/A
30	Not Used	N/A
31	Not Used	N/A

Table 6: Output Word 1 Data Map

Updating Wave Commander Timers via DeviceNet

Adjustment of the timers over the network is accomplished by using standard CIP messaging. If the speed of the sorter is adjusted, new timer values must be determined, based upon the new speed setting. When using an Allen-Bradley Logix processor, an MSG instruction in RSLogix 5000 is used to write the updated timer values to each timer in each Wave Commander (refer to Figure 5: Wave Commander Timer Update Message Configuration.)

Figure 5: Wave Commander Timer Update Message Configuration

In the Configuration tab of the Message Configuration, the following settings should be completed.

- Message Type: CIP Generic
- Service Type: Set Attribute Single
- Source Element: set to the tag containing the new timer value to be sent to the Wave Commander
- Source Length: 2 bytes
- Destination Element: N/A
- Service Code: 10
- Class: 30a
- Instance: see Table 7: Wave Commander Timer Instances
- Attribute: 4

TIMER	INSTANCE	DESCRIPTION
1	30	Delay Raise Row 1
2	31	Delay Raise Row 2
3	32	Delay Raise Row 3
4	33	Delay Raise Row 4
5	34	Delay Raise Row 5
6	35	Delay Raise Row 6
11	13	Delay Lower Row 1
12	14	Delay Lower Row 2
13	16	Delay Lower Row 3
14	18	Delay Lower Row 4
15	20	Delay Lower Row 5
16	22	Delay Lower Row 6
20	9	No Product Lower Rows Delay

Table 7: Wave Commander Timer Instances

All 12 row delay timers need to be updated to every Wave Commander. The values can be calculated for any valid NBS Turbo Sorter speed (200FPM to 425FPM.) $=11.5/(A48/5)*1000-50$ For example, 400 feet per minute (FPM) is equivalent to 80 inches per second. The distance from the trigger photo eye to the centerline of the first row of wheels is 11.5 inches. 11.5 inches divided by 80 inches per second equals 143.75 milliseconds. 50 milliseconds are subtracted from this to account for the time it takes for the first row of wheels to raise and settle into the raised position. 143.75 milliseconds minus 50 milliseconds equals 93.75 milliseconds, which is rounded off to 94 milliseconds. As can be seen in the table below, this is the first row time delay for a sorter speed of 400FPM. The rows of wheels are four inches apart between centerlines, therefore the time delay between rows is based upon four inches of travel at a given sorter speed, and is consistent from row to row.

	Sorter Speed FPM									
	200	225	250	275	300	325	350	375	400	425
Delay Raise Row 1	238	206	180	159	142	127	114	103	94	85
Delay Raise Row 2	100	89	80	73	67	62	57	53	50	47
Delay Raise Row 3	100	89	80	73	67	62	57	53	50	47
Delay Raise Row 4	100	89	80	73	67	62	57	53	50	47
Delay Raise Row 5	100	89	80	73	67	62	57	53	50	47
Delay Raise Row 6	100	89	80	73	67	62	57	53	50	47
Delay Lower Row 1	238	206	180	159	142	127	114	103	94	85
Delay Lower Row 2	100	89	80	73	67	62	57	53	50	47
Delay Lower Row 3	100	89	80	73	67	62	57	53	50	47
Delay Lower Row 4	100	89	80	73	67	62	57	53	50	47
Delay Lower Row 5	100	89	80	73	67	62	57	53	50	47
Delay Lower Row 6	100	89	80	73	67	62	57	53	50	47

Table 8: Wave Commander Delay Timers (timer values are in milliseconds)

Teaching the sorter

Another advantage of networking the Wave Commanders to a sortation controller via DeviceNet is the ability to teach the sorter diverter positions to the sortation controller. The sortation 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 sortation controller begins counting the number of off-to-on and on-to-off transitions at the tracking photo eye 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 MHS Conveyor configured for two inches per pulse. 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.

Troubleshooting

Status Indicators

There are various status indicators on the Allen-Bradley 1799-ZCIOB card. The figure below shows the location of those indicators (see Figure 6: Allen-Bradley 1799-ZCIOB Status Indicators.)
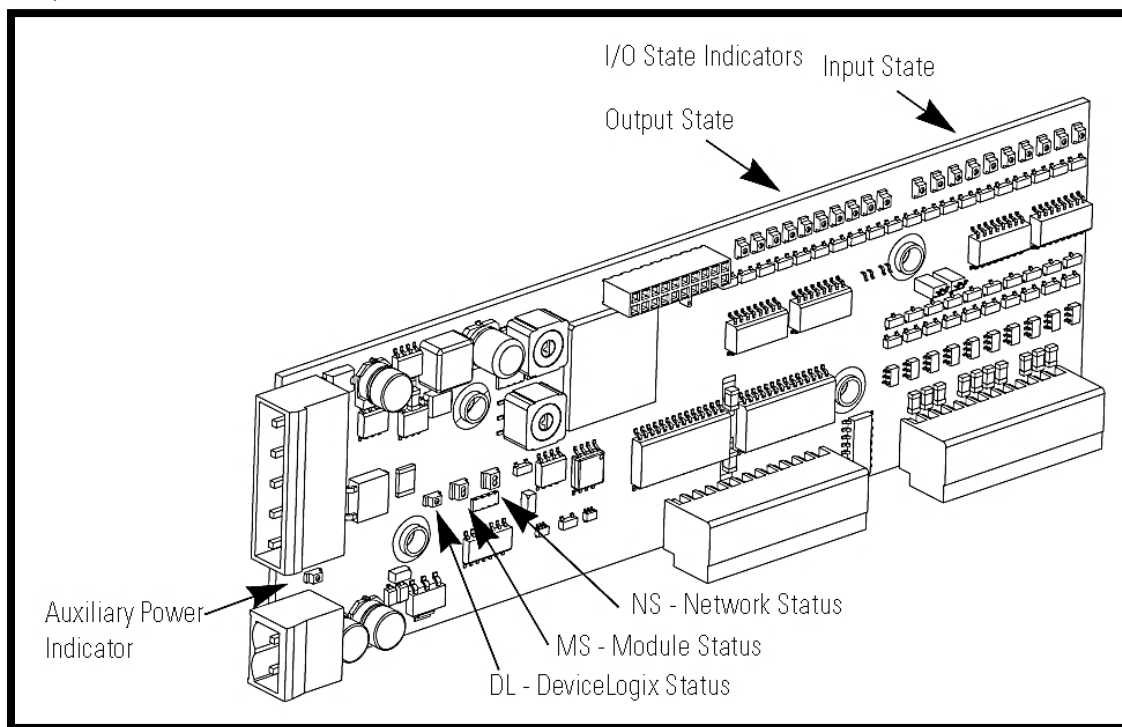
Figure 6: Allen-Bradley 1799-ZCIOB Status Indicators

The table below lists the expected state of each indicator for systems using either networked control signals or hardwired control signals (refer to Table 9: Allen-Bradley 1799-ZCIOB Status Indicators.)

Indicator	Networked Status	Hardwired Status
Module Status (MS)	Solid Green	Flashing Green
Network Status (NS)	Solid Green	Off
DeviceLogix Status (DL)	Solid Green	Solid Green
Auxiliary Power Status (AUX)	Solid Green	Solid Green

Table 9: Allen-Bradley 1799-ZCIOB Status Indicators

The status indicator for Wave Commander Input 1 (input 0 on the 1799 card) should be on whenever there is a signal from the divert trigger photo eye. For systems making use of hardwired control signals, the status indicator for Wave Commander Input 5 (input 4 on the 1799 card) should be on whenever the arm signal is on from the sortation controller. The status indicators for Wave Commander Outputs 1-6 (outputs 0-5 on the 1799 card) should be on whenever diverter solenoids 1-6 are being energized.

Troubleshooting Guide

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

Table 10: Wave Commander Troubleshooting Guide

SYMPTOMS	POSSIBLE CAUSES	RECOMMENDED SOLUTIONS
All products not diverting properly at single diverter	No network power at single diverter	Make sure there is a proper connection between the upstream DeviceNet device and the DEVICENET IN connector on the Wave Commander. There should be 24VDC between the red and black wires at the DeviceNet connection on the 1799-ZCIOB card. Check the 1799 card status indicators and compare to the information in Table 9.
	No auxiliary power at single diverter	Make sure a proper drop cable is connected between the auxiliary power trunk line and the 24VDC PWR IN connector on the Wave Commander. There should be 24VDC between the red and black wires at the auxiliary power connection on the 1799-ZCIOB card. Check the 1799 card status indicators and compare to the information in Table 9.
	No network connection at single diverter (for systems with networked control signals)	Make sure there is a proper connection between the upstream DeviceNet device and the DEVICENET IN connector on the Wave Commander. There should be valid network communication between the sortation controller and the Wave Commander. Check the 1799 card status indicators and compare to the information in Table 9.

SYMPTOMS	POSSIBLE CAUSES	RECOMMENDED SOLUTIONS
	Improper product tracking to single diverter	The sortation 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.
	No arm signal at single diverter	For hardwired control signals, there should be a cable connected from the sortation controller to the INPUTS 7&8 connector on the Wave Commander. When the arm signal is on, 24VDC should exist between the black wire and the blue wire on connector 5 of the INPUT I/O BOARD. For networked control signals, the sortation controller needs to send an arm signal to the Wave Commander. This must be done via the DeviceNet 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 from the centerline of the first drive roller.
	Misaligned divert trigger photo eye at single diverter	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 single diverter	Make sure the photo eye cable is properly installed at the photo eye, as well as at the Wave Commander. It should be connected to Input 1 (see Figure 2.)
	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.
	Disconnected valve solenoid at single diverter	Make sure the solenoid cable is properly installed at the valve, as well as at the Wave Commander. It should be connected to the appropriate output (see Figure 2.)
	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 Commander timer values for current sorter speed for single diverter	Check the label on the inside of the Wave Commander door for the speed for which the Wave Commander was programmed. The sorter should be operated at this speed +/- 12.5FPM. Otherwise, the Wave Commander timers need to be updated for the desired sorter speed.
	DeviceLogix not enabled on single diverter	Check the 1799 card status indicators and compare to the information in Table 9. If the DeviceLogix status indicator is off, then DeviceLogix needs to be enabled. This is done with RSNetworx for DeviceNet.
All products not diverting properly at multiple diverters	No network power at multiple diverters	Make sure there is a proper connection between the upstream DeviceNet device and the DEVICENET IN connector on each Wave Commander. There should be 24VDC between the red and black wires at the DeviceNet connection on the 1799-ZCIOB card. Check the 1799 card status indicators and compare to the information in Table 9.

SYMPTOMS	POSSIBLE CAUSES	RECOMMENDED SOLUTIONS
	No auxiliary power at multiple diverters	Make sure a proper drop cable is connected between the auxiliary power trunk line and the 24VDC PWR IN connector on the Wave Commander. There should be 24VDC between the red and black wires at the auxiliary power connection on the 1799-ZCIOB card. Check the 1799 card status indicators and compare to the information in Table 9.
	No network connection at multiple diverters (for systems with networked control signals)	Make sure there is a proper connection between the upstream DeviceNet device and the DEVICENET IN connector on the Wave Commander. There should be valid network communication between the sortation controller and the Wave Commander. Check the 1799 card status indicators and compare to the information in Table 9.
	Improper product gapping at multiple diverters	The minimum gap between any two packages should be six inches. If a gap of less than six inches is detected at the tracking photo eye, those packages should be recirculated when possible.
	Sortation controller input cannot handle pulse rate from encoder	The sortation 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 sortation 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.

SYMPTOMS	POSSIBLE CAUSES	RECOMMENDED SOLUTIONS
	No arm signal at multiple diverters	For hardwired control signals, there should be a cable connected from the sortation controller to the INPUTS 7&8 connector on the Wave Commander. When the arm signal is on, 24VDC should exist between the black wire and the blue wire on connector 5 of the INPUT I/O BOARD. For networked control signals, the sortation controller needs to send an arm signal to the Wave Commander. This must be done via the DeviceNet network for every package to be diverted.
	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 from the centerline of the first drive roller.
	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 Commander. It should be connected to Input 1 (see Figure 2.)
	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 Commander. It should be connected to the appropriate output (see Figure 2.)

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.
	Incorrect Wave Commander timer values for current sorter speed for multiple diverters	Check the label on the inside of the Wave Commander door for the speed for which the Wave Commander was programmed. The sorter should be operated at this speed +/- 12.5FPM. Otherwise, the Wave Commander timers need to be updated for the desired sorter speed.
	DeviceLogix not enabled on multiple diverters	Check the 1799 card status indicators and compare to the information in Table 9. If the DeviceLogix status indicator is off, then DeviceLogix needs to be enabled. This is done with RSNetworx for DeviceNet.
All products not diverting properly at all diverters	No network power at all diverters	Make sure there is a proper connection between the upstream DeviceNet device and the DEVICENET IN connector on each Wave Commander. There should be 24VDC between the red and black wires at the DeviceNet connection on the 1799-ZCIOB card. Check the 1799 card status indicators and compare to the information in Table 9.
	No auxiliary power at all diverters	Make sure a proper drop cable is connected between the auxiliary power trunk line and the 24VDC PWR IN connector on the Wave Commander. There should be 24VDC between the red and black wires at the auxiliary power connection on the 1799-ZCIOB card. Check the 1799 card status indicators and compare to the information in Table 9.

SYMPTOMS	POSSIBLE CAUSES	RECOMMENDED SOLUTIONS
	No network connection at all diverters (for systems with networked control signals)	Make sure there is a proper connection between the upstream DeviceNet device and the DEVICENET IN connector on the Wave Commander. There should be valid network communication between the sortation controller and the Wave Commander. Check the 1799 card status indicators and compare to the information in Table 9.
	Improper product gapping at all diverters	The minimum gap between any two packages should be six inches. If a gap of less than six inches is detected at the tracking photo eye, those packages should be recirculated when possible.
	Sortation controller input cannot handle pulse rate from encoder	The sortation 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 sortation 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.

SYMPTOMS	POSSIBLE CAUSES	RECOMMENDED SOLUTIONS
	No arm signal at all diverters	For hardwired control signals, there should be a cable connected from the sortation controller to the INPUTS 7&8 connector on the Wave Commander. When the arm signal is on, 24VDC should exist between the black wire and the blue wire on connector 5 of the INPUT I/O BOARD. For networked control signals, the sortation controller needs to send an arm signal to the Wave Commander. This must be done via the DeviceNet 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 from the centerline of the first drive roller.
	Misaligned divert trigger photo eye at all diverters	The photo eye needs to be aligned per the instruction provided in this document.
	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 Commander. It should be connected to Input 1 (see Figure 2.)
	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 Commander. It should be connected to the appropriate output (see Figure 2.)

SYMPTOMS	POSSIBLE CAUSES	RECOMMENDED SOLUTIONS
	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 Commander timer values for current sorter speed for all diverters	Check the label on the inside of the Wave Commander door for the speed for which the Wave Commander was programmed. The sorter should be operated at this speed +/- 12.5FPM. Otherwise, the Wave Commander timers need to be updated for the desired sorter speed.
	DeviceLogix not enabled on all diverters	Check the 1799 card status indicators and compare to the information in Table 9. If the DeviceLogix status indicator is off, then DeviceLogix needs to be enabled. This is done with RSNetworx for DeviceNet.
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.
	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 from the centerline of the first drive roller.
	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
	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 six inches. If a gap of less than six inches is detected at the tracking photo eye, those packages should be recirculated when possible.
	Sortation controller input cannot handle pulse rate from encoder	The sortation 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 sortation 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.

SYMPTOMS	POSSIBLE CAUSES	RECOMMENDED SOLUTIONS
	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 from the centerline of the first drive roller.
	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.
	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 six inches. If a gap of less than six inches is detected at the tracking photo eye, those packages should be recirculated when possible.
	Sortation controller input cannot handle pulse rate from encoder	The sortation 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 sortation 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.

| SYMPTOMS	POSSIBLE CAUSES	RECOMMENDED SOLUTIONS
	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 from the centerline of the first drive roller.
	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.

Replacement

To replace the Wave Commander, follow the steps below. This can be done without turning off power to the Wave Commander.

1. Disconnect all cables from the old Wave Commander.
2. Remove the four screws that mount the unit to the diverter.
3. Remove the old Wave Commander from the diverter.
4. Position the new Wave Commander on the diverter.
5. Install the four screws that mount the unit to the diverter.
6. Set the rotary switches of the 1799 card in the new Wave Commander to match the hardware address of the old one.
7. Connect all cables to the new Wave Commander.
8. If networked to a sortation controller over DeviceNet, configure the software address of the 1799 card in the new Wave Commander using RSNetworx for DeviceNet.
9. If networked to a sortation controller over DeviceNet, download the Wave Commander 1799 card configuration using RSNetworx for DeviceNet.

Specifications

ATTRIBUTE	DESCRIPTION
Base Control Device	Allen-Bradley 1799-ZCIOB Zone Control I/O Card with DeviceLogix
Power Supply	Network Power: 24VDC Class 2 power source
	Auxiliary Power: 24VDC Class 2 Power Source or a 24VDC UL Listed or Recognized power supply with isolated outputs limited to 200 VA in each ungrounded output line
Power Requirements	Network Power: 166mA with divert trigger photo eye as only input; 177mA with divert trigger photo eye and hardwired arm signal as only inputs
	Auxiliary Power: 242mA with six valve solenoids as only outputs
Network Connections	DEVICENET IN 5-Pin Male Mini DeviceNet Connector for Direct Connection to DeviceNet Trunk
	DEVICENET OUT 5-Pin Female Mini DeviceNet Connector for Direct Connection to DeviceNet Trunk
Auxiliary Power Connection	24VDC PWR IN 4-Pin Male Mini Connector to Power Wave Commander Outputs
Input Connections	Inputs 1-8 4-Pin Female M12 Connectors with two inputs per connector
Output Connections	Outputs 1-8 4-Pin Female M12 Connectors with two outputs per connector
Enclosure Type	Type 1
Enclosure Dimensions	8"Hx10"Wx4"D

Drawings
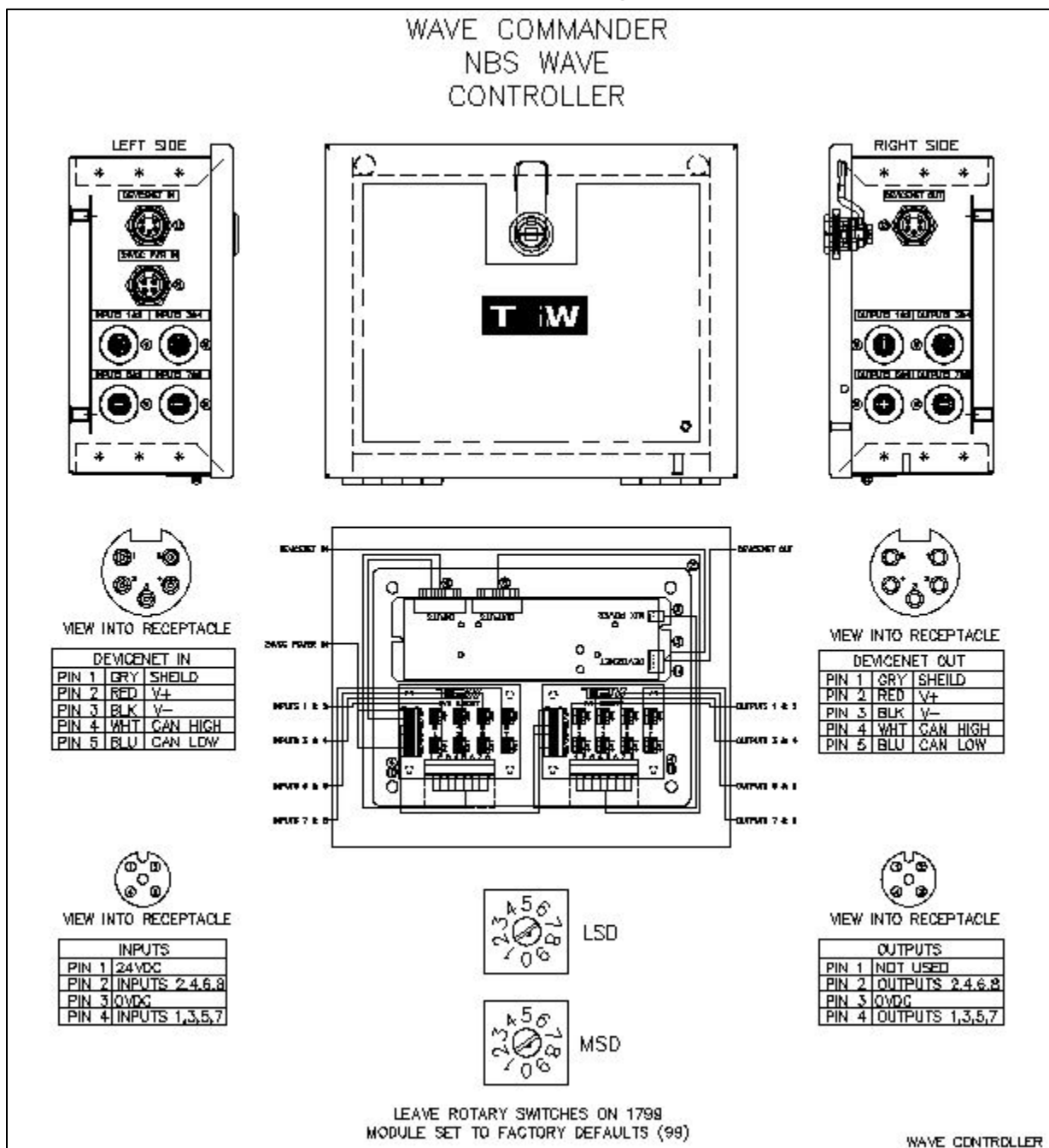
ITEM	QTY	MANUFACTURER	DESCRIPTION	TGW PART NUMBER
1	1	SCE	ENCLOSURE, 10"X8"X4", TYPE 1, PRE-CUT HOLES FOR RECEPTACLES, SCE-20 BLACK FINISH	1161754
2	1	SCE	PANEL, 8"X6"	1158456
3	1	ALLEN-BRADLEY	MODULE, DISTRIBUTED I/O, 10 IN/10 OUT, DEVICENET	1120340
4	2	WAGO	BOARD, I/O	1138197
5	1	TGW	HARNESS, POWER, 1799	1141050
6	2	TGW	HARNESS, I/O, 1799	1145157
7				
8	1	TURCK	RECEPTACLE, POWER, MALE, 4-PIN, MINI, 1/2" NPT, 0.3 METER LEADS	1158458
9	8	TURCK	RECEPTACLE, I/O, FEMALE, 4-PIN, M12, 1/2" NPT, 0.5 METER LEADS	1158460
10	16	WAGO	CONNECTOR, I/O, FEMALE, 3-PIN	1139780
11				
12	1	MENCOM	RECEPTACLE, DEVICENET, MALE, 5-PIN, MINI, 1/2" NPT, 1 FOOT LEADS	1160613
13	1	MENCOM	RECEPTACLE, DEVICENET, FEMALE, 5-PIN, MINI, 1/2" NPT, 1 FOOT LEADS	1160614
14	1	ALLEN-BRADLEY	CONNECTOR, DEVICENET, 5-PIN, FOR 1799 CARD	1799-DNETCON
15	1	TGW	LABEL, TGW, 1.1875"X3.5"	1131997

Figure 7: Wave Commander Control Panel Drawings

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.

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.

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 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 Conveyor Lifetime Services at 231-798-4547.

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/

Automation, R. (2014). *Rockwell Automation EDS*. Retrieved 12 08, 2014, from Rockwell Automation EDS: http://www.rockwellautomation.com/rockwellautomation/support/networks/eds.page

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/

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

MHS Conveyor Information

Mission

To meet or exceed all customer expectations by providing the highest quality products and services, on time, at exceptional value, in an environment which promotes safety and personal development.

MHS Conveyor
1300 E Mount Garfield Road
Norton Shores MI 49441-6097 USA
231.798.4547
Email: us-info@mhs-conveyor.com
Web Site : 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.