VERTICAL EXPRESS

HD98 Door Operator

with Owner's Service Tool (OST)

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Published February, 2005
Third Edition, November 2011
Printed in the United States of America

Manual Number: 89170 v.1.1

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Safety Precautions

IMPORTANT! **Read this page before any work is performed on elevator equipment. The procedures contained in this manual are intended for the use of qualified elevator personnel. In the interest of your personal safety and the safety of others, do not attempt any procedure that you are not qualified to perform.**

All procedures must be accomplished in accordance with the applicable rules in the latest edition of the National Electrical Code, the latest edition of ASME A17.1, and any governing local codes.

Terms in This Manual

CAUTION **CAUTION statements identify conditions that may result in damage to the equipment or other property if improper procedures are followed.**

WARNING **WARNING statements identify conditions that may result in personal injury if improper procedures are followed.**

General Safety

CAUTION **Before applying power to the controller, check that all factory wire connections are tight on relays, contactors, fuse blocks, resistors, and terminals on cards and DIN rail terminals. Connections loosened during shipment may cause damage or intermittent operation.**

Other specific warnings and cautions are found where applicable and do not appear in this summary. See the *Elevator Industry Field Employees' Safety Handbook* for electrical equipment safety information on installation and service.

Electrical Safety

All wiring must be in accordance with the National Electrical Code and be consistent with all state and local codes.

Use the Proper Fuse

To avoid fire hazards, use only a fuse of the correct type, voltage, and current rating. See the job specific drawings sheet (Power Supplies) for fusing information.

Electric shocks can cause personal injury or loss of life. Circuit breakers, switches, and fuses may not disconnect all power to the equipment. Always refer to the wiring diagrams. Whether the AC supply is grounded or not, high voltage will be present at many points.

Printed Circuit Cards

Printed circuit boards may be damaged if removed or installed in the circuit while applying power. Before installation and/or removing printed circuit boards, secure all power.

Always store and ship printed circuit cards in separate static bags.

Electrical Safety
(continued)

Mainline Disconnect

Unless otherwise directed, always Turn OFF, Lock, and Tag out the mainline disconnect to remove power from elevator equipment. Before proceeding, confirm that the equipment is de-energized with a volt meter. Refer to the *Elevator Industry Field Employees' Safety and Accident Prevention Program Manual* for the required procedure.

Test Equipment Safety

Always refer to manufacturers' instruction book for proper test equipment operation and adjustments.

Megger or buzzer-type continuity testers can damage electronic components. Connection of devices such as voltmeters on certain low level analog circuits may degrade electronic system performance. Always use a voltmeter with a minimum impedance of 1M Ohm/Volt. A digital voltmeter is recommended.

When Power Is On

To avoid personal injury, do not touch exposed electrical connections or components while power is ON.

Mechanical Safety

See the *Elevator Industry Field Employees' Safety Handbook* for mechanical equipment safety information on installation and service.

Static Protection Guidelines

IMPORTANT! **Read this page before working with electronic circuit boards.**

Elevator control systems use a number of electronic cards to control various functions of the elevator. These cards have components that are extremely sensitive to static electricity and are susceptible to damage by static discharge.

Immediate and long-term operation of an electronic-based system depends upon the proper handling and shipping of its cards. For this reason, the factory bases warranty decisions on the guidelines below.

Handling

- Cards shipped from the factory in separate static bags must remain in the bags until time for installation.
- Anti-static protection devices, such as wrist straps with ground wire, are required when handling circuit boards.
- Cards must not be placed on any surface without adequate static protection.
- Only handle circuit cards by their edges, and only after discharging personal static electricity to a grounding source. DO NOT touch the components or traces on the circuit card.
- Extra care must be taken when handling individual, discrete components such as EPROMS (which do not have circuit card traces and components for suppression).

Shipping

- Complete the included board discrepancy sheet.
- Any card returned to the factory must be packaged in a static bag designed for the card.
- Any card returned to the factory must be packaged in a shipping carton designed for the card.
- “Peanuts” and styrofoam are unacceptable packing materials.

Note: Refer to the *Vertical Express Replacement Parts Catalog* to order extra static bags and shipping cartons for each card.

Failure to adhere to the above guidelines will VOID the card warranty!

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Overview

The following is a list of the major components of a door operator including a description of their functions, an overview of some of the critical adjustments, and maintenance information. See Figure 1 on page 8.

- Adjustable Arm - The arm mounted to the drive wheel is used to change the amount of linear door movement or stroke.
- Connecting Arm - Connects the drive arm to the door panel.
- Door Operator Support - A metal plate welded to the header. The door operator is mounted to the door operator support with four bolts through the four mounting slots of the door operator.
- Drive Arm - The linkage connected between the drive arm support and the connecting arm.
- Drive Arm Support - The bracket containing two holes is located on top of the door operator. The drive arm should be connected to the right-hand hole, looking from the hatch, at the front of the door operator.
- Drive Wheel - A metal sheave containing a slotted cam surface. The adjustable arm mounts to the drive wheel and is adjusted in the slotted cam surface. The drive wheel is driven by the jack shaft sheave using 3 V belts.

  To change the linear door travel or stroke, move the adjustable arm:
  - Closer to the center of the drive wheel = less door travel for the same amount of wheel rotation.
  - Further from the center of the drive wheel = more door travel for the same amount of wheel rotation.
- Idler Arm - An adjustable arm mounted to the front of the door operator which controls the tension of the 3 V belts between the jack shaft sheave and the drive wheel.
- Intermediate Arm - Adjustable linkage connected between the drive wheel adjustable arm and the pivot arm. The connection at the pivot arm is adjustable to control the length of the intermediate arm.
- Mechanical Stops - Metal L brackets mounted to the front of the door operator. The stops have slots to adjust the amount of drive wheel rotation and, once positioned, they limit the physical rotation of the drive wheel.
- Motor - 115V or 230V DC Motor
- Pivot Arm - Connects the drive arm to the intermediate arm and provides an adjustment for the length of the intermediate arm.
- Sheave, Jack Shaft - A spoked sheave driven by the door operator motor with a single V belt. The motor sheave drives the jack shaft sheave which drives the drive wheel.
- Sheave, Motor - A sheave attached directly to the door operator motor shaft.
- Support Strut - Unistrut legs on the rear of the door operator which are used to secure the rear of the operator to the car top, and also to plumb the face of the drive wheel.

Overview
(continued)

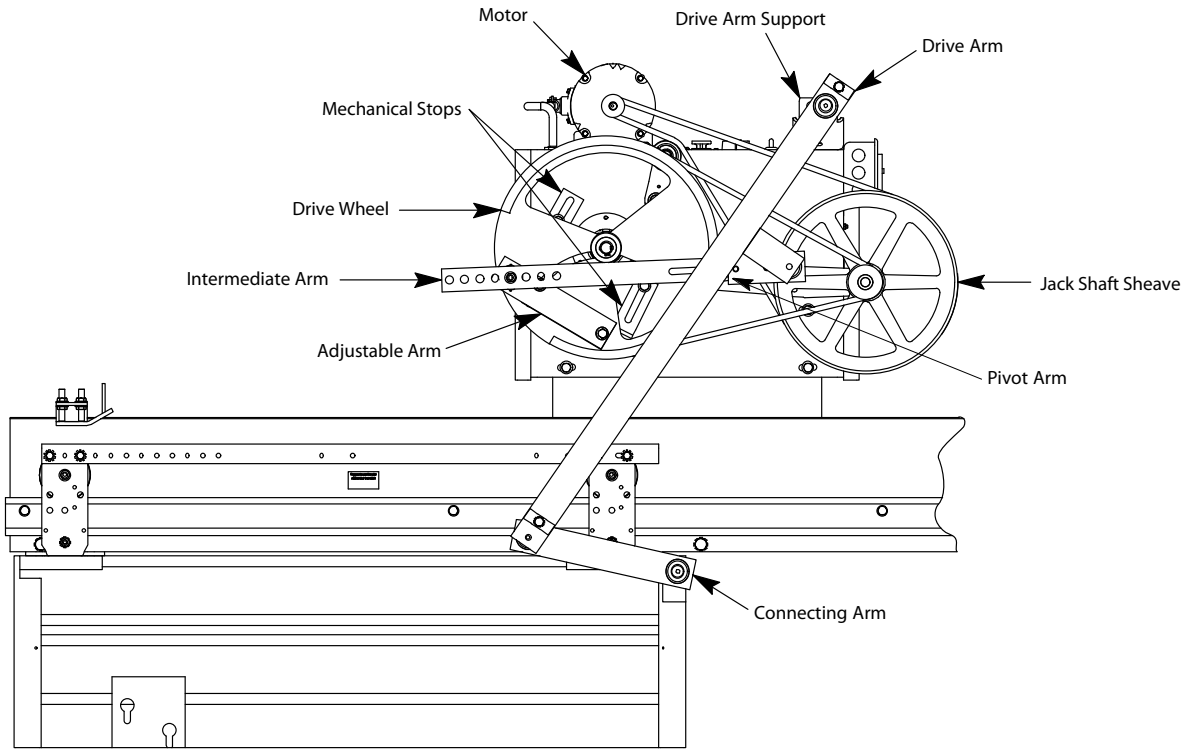


Figure 1 - Single Speed Door Operator

Mechanical Installation and Adjustment

Preparing the Door Operator

Installation and adjustment of the door operator is best accomplished from an upper landing. Place the car top at a comfortable working height, and use the landing as a working platform.

1. Turn OFF, Lock, and Tag out the mainline disconnect.
2. Remove the door operator from the shipping carton and crate. Locate and store the bag of parts.
3. Remove the cover from the rear of the operator by loosening the two top screws and the two lower rear screws.
4. Inspect the wiring. Make sure all connections are secure.
5. Loosen the bolts holding the mechanical stops.
6. While observing the shaft containing the cams (inside the operator), rotate the drive wheel.
7. Check and adjust, as necessary, the tension of the 3 V belts between the drive wheel and the jack shaft sheave. See Figure 2 on page 9.
    a. Loosen the two bolts on the idler arm, and turn the locknut on the adjustment screw (located at the end of the idler arm).
    b. Securely tighten the idler arm bolts and the locknut.

Preparing the Door Operator
(continued)

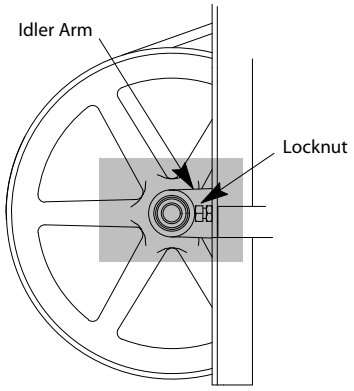


Figure 2 - Locknut Adjustment Screw

8. Check and adjust as necessary the tension on the single V belt between the motor sheave and jack shaft sheave:
   a. Loosen the four motor mounting bolts and position the motor.
   b. Securely tighten the motor mounting bolts.

Mounting the Door Operator

1. Lift the door operator to the car top. Center the operator in the slots of the door operator support. Install the four bolts and tighten. See Figure 3 on page 10, Detail A.

Note: The operator may require repositioning within the slots to achieve the correct drive arm-to-connecting arm relationship with the doors fully open. The hole in the drive arm support bracket may also be used to achieve this relationship. For more details, see Figure 5 on page 13.

2. Attach the drive arm to the right hand hole in the drive arm support, as you look at the front of the operator, in the drive arm support. See Figure 3, Detail B.
3. Attach the connecting arm to the door panel. See Figure 3, Detail C.
4. Install the rear support. See Figure 3, Detail D.
   a. Attach the rear foot mount to the car top. Use the support clips to attach the strut to the mount.
   b. With a level, plumb the face of the drive wheel. Loosen the cap screws inside the door operator frame and adjust the strut nuts up or down in the support struts (as needed).
   c. Tighten all bolts securely.
5. With a level, check the drive arm for plumb. If necessary, space the drive arm from the door with no more than 3/8" (10mm) flat washers.

Mounting the Door Operator
(continued)

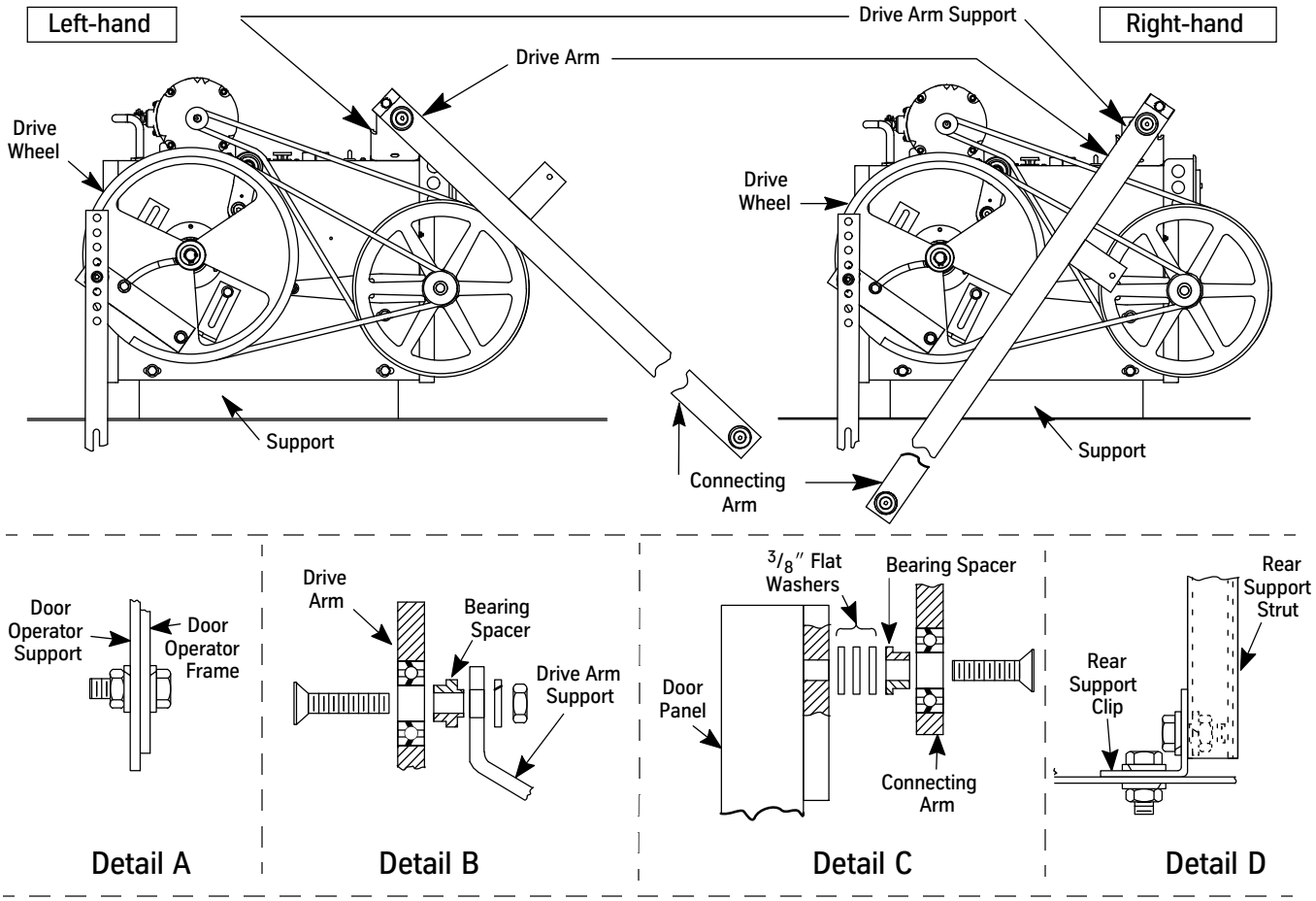


Figure 3 - Mounting the Door Operator

Setting the Stroke

Notes:

- The two cap screws securing the intermediate arm to the pivot arm should be loose when setting the stroke.
- Fully Open Position - The point where the doors are flush with or slightly recessed behind the open door jamb.
- Fully Closed Position - The point where the leading edge of the door contacts the door jamb, or in the case of center opening doors, the point where the two leading edges of the doors contact.

1. Place the doors in the Fully Open Position.
2. Measure the distance from **B** to **C** and record this measurement as Door Open (DO). See Figure 4.
3. Place the doors in the Fully Closed Position.
4. Measure the distance from **B** to **C** and record this measurement as Door Closed (DC). See Figure 4.
5. Calculate the stroke using the following formula:

$$\text{STROKE} = \frac{\text{DO} - \text{DC}}{2} + 1/8"$$

6. Loosen the two cap screws in the adjustable arm.
7. Move the adjustable arm in the circular slot of the drive wheel so that the distance from **A** to **B** is equal to the calculated stroke length. See Figure 4.
8. Tighten the two cap screws in the adjustable arm.

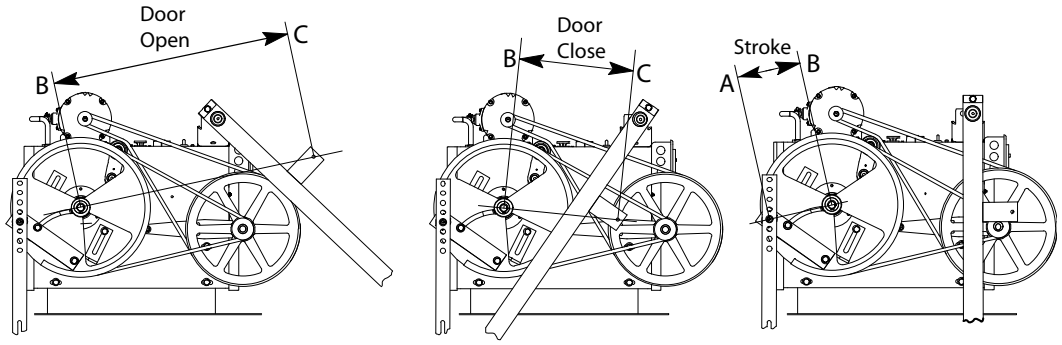


Figure 4 - Door Operator Stroke

Adjusting the Drive Arms

See Figure 5 on page 13 for all steps in this procedure.

1. Place the doors in the Fully Open Position.

2. Slide the pivot arm to the end of the slot in the intermediate arm so that the hole in the bearing is exposed.

3. Attach the pivot arm to the intermediate arm through the bearing with a 3/8" (10mm) flathead socket cap screw.

Note: Ensure that the spacer plate is between the two arms, the bearing spacer is installed, and that the doors are still in the Fully Open Position.

4. Align the drive arm and connecting arm in a straight line. Vice grips may be used to hold these two arms in alignment.

5. Maintain the doors in Fully Open Position, and rotate the drive wheel until all three points A, B, and C are in a straight line.

6. Tighten the two cap screws attaching the pivot arm to the intermediate arm.

7. Use a pencil to trace a line along both sides of the adjustable arm on the drive wheel.

Note: This will be the reference mark in the event that the stroke requires further adjustment.

8. Remove the vice grips and move the doors to the Fully Closed Position.

Note: If the doors will not fully close: loosen the two cap screws in the adjustable arm, and reposition the arm toward the outside of the drive wheel in small increments of 1/8" (3mm).

9. Measure the distance from the top of the intermediate arm to the center of the drive wheel. The correct distance for this measurement is 1/2" (13mm) to 1 1/2" (38mm). Ensure that the doors can be opened from the inside per local code. The smaller this diameter, the more difficult it will be to pull the car doors open manually.

   If the measurement is correct - Securely tighten the cap screws in the adjustable arm and the cap screws connecting the intermediate arm to the pivot arm. Proceed to *Setting the Mechanical Stops*.

   If the measurement is less than 1/2" (13mm) - Loosen the two cap screws in the adjustable arm. Reposition the arm toward the outside of the drive wheel and tighten the two cap screws.

   If the measurement is more than 1 1/2" (38mm) - Loosen the two cap screws in the adjustable arm. Reposition toward the center of the drive wheel and tighten the two cap screws.

   a. Move the doors to the Fully Open Position, and check the alignment of the connecting arm and the three points A, B, and C.

   b. Move the doors to the Fully Closed Position, and measure the distance from the top of the intermediate arm to the center of the drive wheel.

   c. If these measurements are not correct, repeat the adjustment of the arm until the correct operation and measurement is obtained.

Note: Once the stroke has been properly adjusted, check to ensure that the two cap screws in the adjustable arm and the two cap screws holding the pivot arm to the intermediate arm are securely tightened.

Adjusting the Drive Arms
(continued)

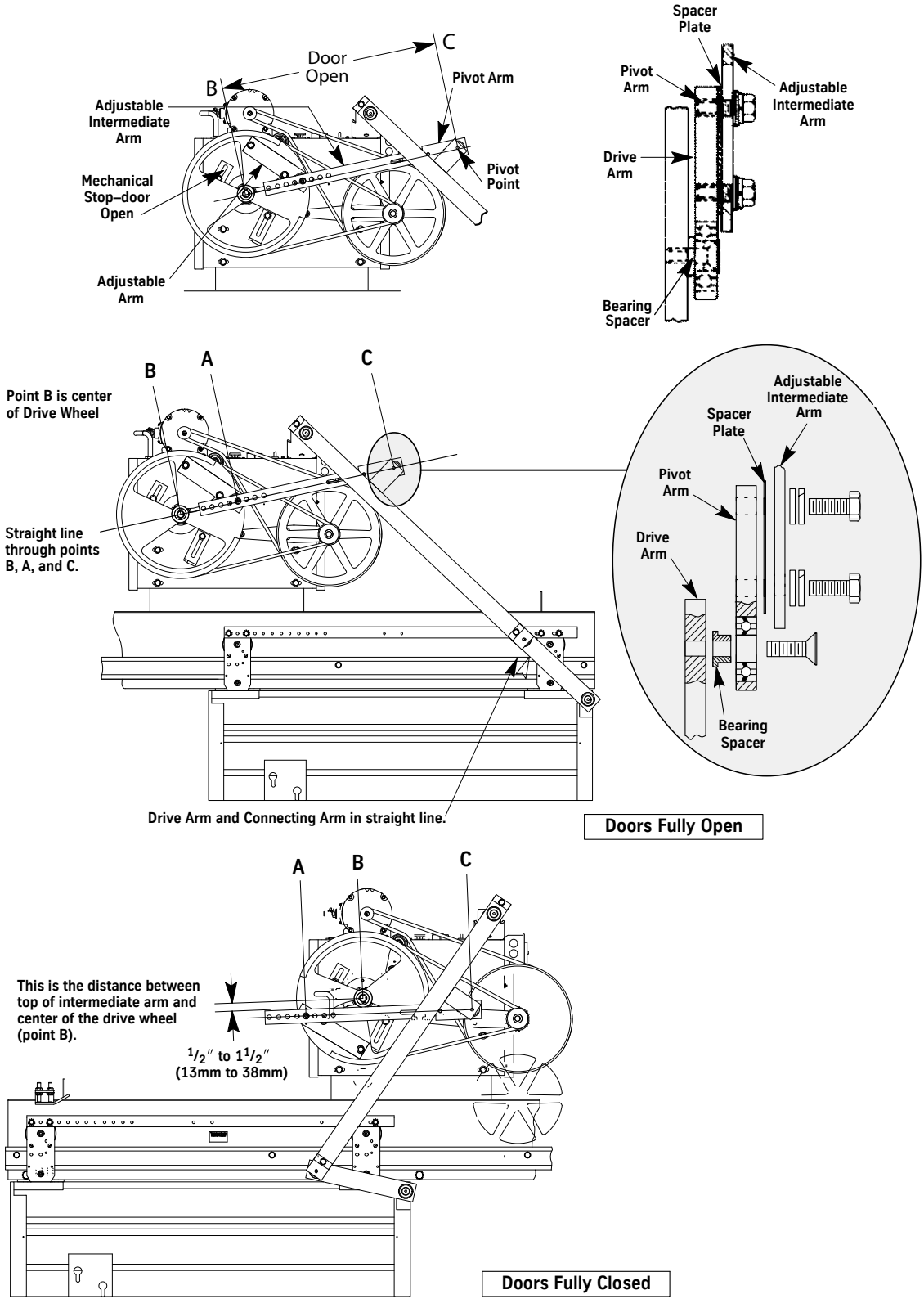


Figure 5 - Adjusting the Drive Arms

Setting the Mechanical Stops

1. Move the doors to the Fully Open Position.
2. Position the open mechanical stop 1/8" (3mm) from the inside surface of the drive wheel, and tighten the bolt securely.
3. Move the doors to the Fully Closed Position.
4. Position the closed mechanical stop 1/8" (3mm) from the inside surface of the drive wheel, and tighten the bolt securely.

Adjustment

Limit Setting and Direction Check

For jobs with both front and rear doors, separately adjust the door operators.

1. Turn OFF, Lock, and Tag out the mainline disconnect.
2. Verify that the door card is 6300PY1, and the U4 software is 675HA_. See Figure 6 on page 15 for the remaining steps in this procedure.
3. Manually move the door to the Fully Closed Position, noting which direction the cam shaft rotates.
4. Loosen DCL and DOL Cams, and rotate them until their magnets face the door card.
5. Loosen the door card mounting bracket screws.
6. Slide the door card and bracket toward or away from the DCL and DOL Cams until there is 1/8" between the card and the cams. The card must be square with the DCL and DOL Cams.
7. Tighten the door card mounting bracket screws.
8. Slide the DCL and DOL Cams to align the center of their magnets with the center of their respective magnetic sensors at the edge of the door card.
9. Turn ON the mainline disconnect.

WARNING **To prevent automatic movement of the door while adjusting limit switches, place the elevator on INSPECTION Operation.**

10. Rotate the DCL Cam in the same direction that the cam shaft rotated in Step 3 until the DCL LED just turns ON. Tighten the set screw.

Note: When power is turned ON or the door reset button on the door card is pushed, the watchdog LED on the door card should come on for 2 seconds, turn OFF, then come back ON and remain ON.

Limit Setting and Direction Check
(continued)

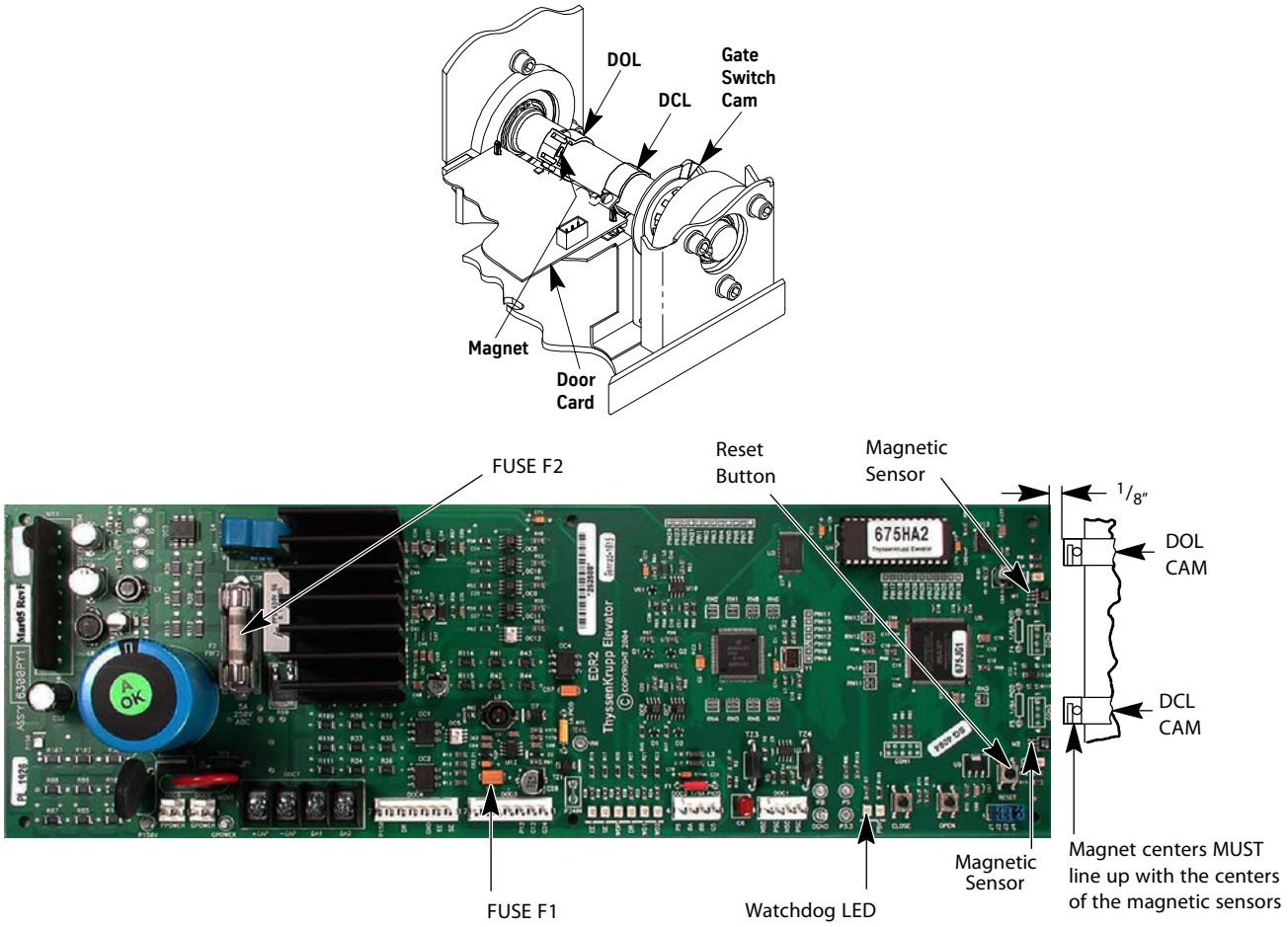


Figure 6 - Door Operator Limit Cams and Door Card

Door Card Configuration

1. Verify that the door configuration jumpers on the door card are installed. See Figure 7.
2. To clear the memory, press the reset button on the door card.
3. Verify that the black wire from the door motor is connected to the DA1 terminal, and the red wire is connected to the DA2 terminal.
4. Verify that the encoder wiring is correct. See the wiring diagrams for proper wiring configuration.
5. Press the manual OPEN button to ensure that the door moves in the open direction. If the door moves in the closing direction, remove the J2 jumper.
6. Press the manual CLOSE button on the door card to ensure that the door moves in the closing direction.

Note: If the door does not move, see “Door Operator Parts” on page 28.

Door Card Configuration
(continued)

7. For jobs with rear doors:
   - The rear door card must be addressed as a rear door card; Remove the J1 jumper from the rear door card.
   - Repeat the sections “Limit Setting and Direction Check” on page 14 and “Door Card Configuration” on page 15 for the rear door subsystem.

Door Type	Jumpers			
	J1	J2	J3	J4
RH Front	ON	ON	OFF	Not Used
RH Rear	OFF	ON	OFF	Not Used
LH & CO Front	ON	OFF	OFF	Not Used
LH & CO Rear	OFF	OFF	OFF	Not Used

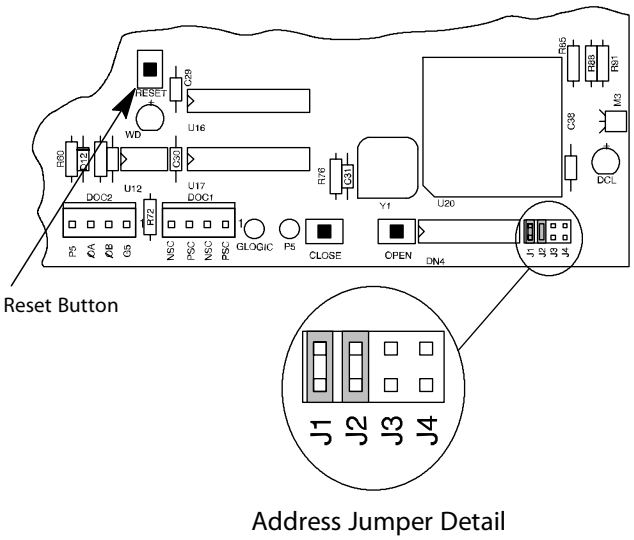


Figure 7 - Door Configuration Jumpers

Door Setup

1. Verify that the hoistway setup has been completed.
2. Place the car at floor level on Automatic Operation.
3. Activate the doors to setup automatically.
   a. Use the OST and set adjustment D26 = 0 to deactivate the door disconnect.
   b. Set adjustment E56 = 0.
      - Display the E56 value in the OST Adjustment menu.
      - Press the UP key on the OST. The screen displays "SCAN W____", (with the existing E56 value after the W).
      - Press the Enter key on the OST. The screen displays "E56 *0".
      - To accept the change, press the Enter key again.
      - To save E56 as zero, press the Enter key a third time.
      - Press the Enter key a fourth time. The doors should automatically scan the opening for the new value.

Note: The doors will not scan with a value other than zero (0) in E56.

4. View E56 to verify that a value was learned.
5. Use the OST to issue the WRT Command.

Nudging Duty

Notes:

- If there is a safety edge or photo-eye failure, the doors will run closed at nudging duty.
- If an electronic safety edge is used, the doors can operate at nudging duty on Fire Service.
- Front and rear doors must be adjusted separately; a force gauge is required for this procedure.

1. Use the OST and set adjustment D11=1 to enable the nudging option.
2. Set the nudging timer D19 to 10-15 seconds.
3. Set the door watchdog timer to 600 (60 seconds).
   - D20 for front doors.
   - D21 for rear doors (this prevents a door reopen from a watchdog failure).
4. Use the door open push button in the car to open the doors, and then place a car call away from the present position of the car. Use the safety edge to prevent the doors from closing.
5. When nudging operation starts, use the force gauge to stall the doors in mid-travel, and note the reading. See Figure 8 for safe operation of the force gauge.

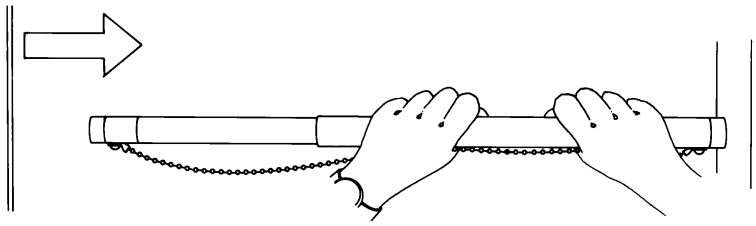


Figure 8 - Safe Operation of the Door Gauge

6. Modify the nudging duty (E21), until the reading on the gauge matches, or is less than, the maximum force allowed by National, State, or Local code.
7. Set D20 and D21 to their original values, and set D11 and D19 per the job contract option requirements.
8. Use the OST to issue the WRT Command.

Final Door Adjustments

The door operator is now set up to operate using the factory preset values. If additional adjustments are needed, see the following:

- "Open Adjustments Procedure" on page 18
- "Close Adjustments Procedure" on page 19
- "Door Adjustment Diagrams" on page 21

Notes:

- While making door adjustments, it is sometimes useful to put the doors in continuous cycle mode with door adjustment E23=1.
- Saving door adjustments takes the doors out of continuous cycle mode.

Open Adjustments Procedure

CAUTION

To avoid mechanical damage to the doors when increasing Open and Close High Speed, do NOT make drastic changes.

1. E04 (Open High Speed) - Change the E04 value to a value that gives the desired high speed. Open high speed increases as the E04 value is increased.
2. E05 (Slowdown Deceleration Rate) - Change E05 to a value that gives the desired slowdown rate from high speed to manual speed.
3. E06 (Manual Open Speed) - Change E06 to reduce the manual speed to a level that causes the doors to stall when the open deceleration is complete.
4. E08 (Open Slowdown Distance) - Change E08 to a value that allows the doors to stall about 1/2" from the open position when E06 (Open Manual Speed) is adjusted to 1.

Notes:

- If the slowdown distance is set too low, there will not be enough slowdown distance for the doors to stop before the door open limit is reached. The open slowdown distance increases as the E08 value is increased.
- After the doors have stalled, the manual open speed must be increased to allow the doors to run to the door open limit. After making a slowdown adjustment, the manual adjustment speed can be returned to 1 in order to verify that the doors will stall about 1/2" from the jamb.

5. E06 (Manual Open Speed) - Change E06 to a value that allows the doors to move quickly but smoothly into the door open limit. Manual open speed increases as the E06 value is increased.
6. E09 (Backlash Speed) - Change E09 to a level which allows the clutch to smoothly engage the interlock prior to the door beginning its acceleration to high speed. The backlash speed increases as the working value is increased.
7. E10 (Backlash Timer) - Change E10 to a level which allows the clutch to engage the interlock prior to the door beginning its acceleration to high speed. Backlash time increases as the E10 value is increased.
8. E07 (Acceleration Rate To Open High Speed) - Change E07 to a value that allows the door to move smoothly but rapidly to high speed. The acceleration rate increases as the E07 value is increased.

Close Adjustments Procedure

CAUTION **To avoid mechanical damage to the doors when increasing Open and Close High Speed, do NOT make drastic changes.**

1. E12 (Close High Speed) - Change E12 to a value that gives the desired close high speed. The close high speed increases as the E12 value is increased.

2. E13 (Close Slowdown Deceleration Rate) - Change E13 to a value that gives the desired deceleration rate from high speed to manual speed. The deceleration rate increases as the E13 value is increased.

3. E14 (Manual Close Speed) - Change E14 to a level that causes the doors to stall when the close deceleration is complete. This action determines if the close slowdown distance (E16) is set correctly.

4. E18 (Close Travel-in Distance) - Change E18 to reduce travel-in distance to a level that does not affect the close adjustment.

5. E16 (Close Slowdown Distance) - Change E16 to a value that allows the doors to stall 1” to 2” from the closed position when E14 (Manual Close Speed) is adjusted to 1.

Note: If the slowdown distance is set too low there will not be enough slowdown distance for the doors to stop before the door close limit is reached. The close slowdown distance increases as the E16 value is increased.

6. After the doors have stalled in the close direction, use the door open button to cycle the doors and verify that the doors stall 1” to 2” from the jamb.

7. E14 (Manual Close Speed) - Change E14 to a value that allows the doors to move quickly but smoothly into the door close limit. The manual close speed increases as the E14 value is increased.

8. E18 (Travel-in Distance) - Change E18 to a value that allows the doors to travel smoothly into the door close limit. The travel-in distance increases as the E18 value is increased.

Note: Travel-in Distance - The point at which the door torque will be boosted on the fifth or sixth attempt if the doors have been stalled while closing, and the watchdog timer has expired.

9. E15 (Close Acceleration Rate) - Change E15 to a value that allows the doors to move smoothly but quickly from 3/4 manual speed to high speed. The close acceleration rate increases as the E15 value is increased.

Torque

1. E20 (Door Closing Torque) - Change E20 to adjust the door closing torque to a value that produces less than 30 lbs. in the center 1/2 of travel. The torque will increase as the E17 value is increased.

Notes:

- Measure the torque with a kinetic force gauge. See Figure 11 for safe operation of the kinetic force gauge.
- Do not set the torque low enough to affect the closing speed of the doors.
- If reduced door torque is desired, set E17=1 to enable the reduced torque option.

2. Use a kinetic force gauge to verify that the door kinetic force does not exceed the local code requirements (typically 7 ft. lbs.). If this is a problem, reduce either the door speed or the torque (E20).

3. Verify that the doors have enough torque to continue moving if the doors are stalled, and then released, from all positions of door travel.

Reopen Adjustment

E11 (Smooth Turnaround) - Change E11 to adjust the initial turnaround smoothness of a reopen. A reopen signal can be given from the safety edge, photo eye, or door open button. Test this with various door positions and adjust to achieve a fast but smooth reopen. Reopen turnaround is faster if the E11 value is increased.

High Speed Clamp Adjustment

E19 (High Speed Clamp) - Set E19 to a value that is at least 8 more than the value of E04 (Open High Speed).

Note: This adjustment prevents the doors from over-speeding when a door bridge failure occurs. Avoid setting E19 greater than 50 so that if a card failure does occur, adequate overspeed protection will be provided. E19 must have a setting at least 8 more than the greater of E04 or E12.

Save Door Adjustments (WRT)

1. From the startup screen of the OST, press ENTER to display the select CAR/GROUP screen (this screen allows access to either CAR or GROUP functions).

2. Press the UP or DOWN arrow keys to display either CAR or GROUP on the second line.

3. When CAR or GROUP displays, press ENTER.

4. Use the UP or DOWN arrow keys to scroll to FRONT ELCT DOOR or REAR ELCT DOOR adjustment.

5. Press ENTER to accept the selection.

6. Door adjustments are displayed.

   a. To change the current value, press ENTER (an asterisk appears in front of the value).

   b. Use the UP or DOWN arrow keys to change values within the allowed range.

7. When the adjustment value is correct, press ENTER. The OST displays "Hit ENTER to WRT."

8. To save the parameter, press ENTER.

Door Adjustment Diagrams

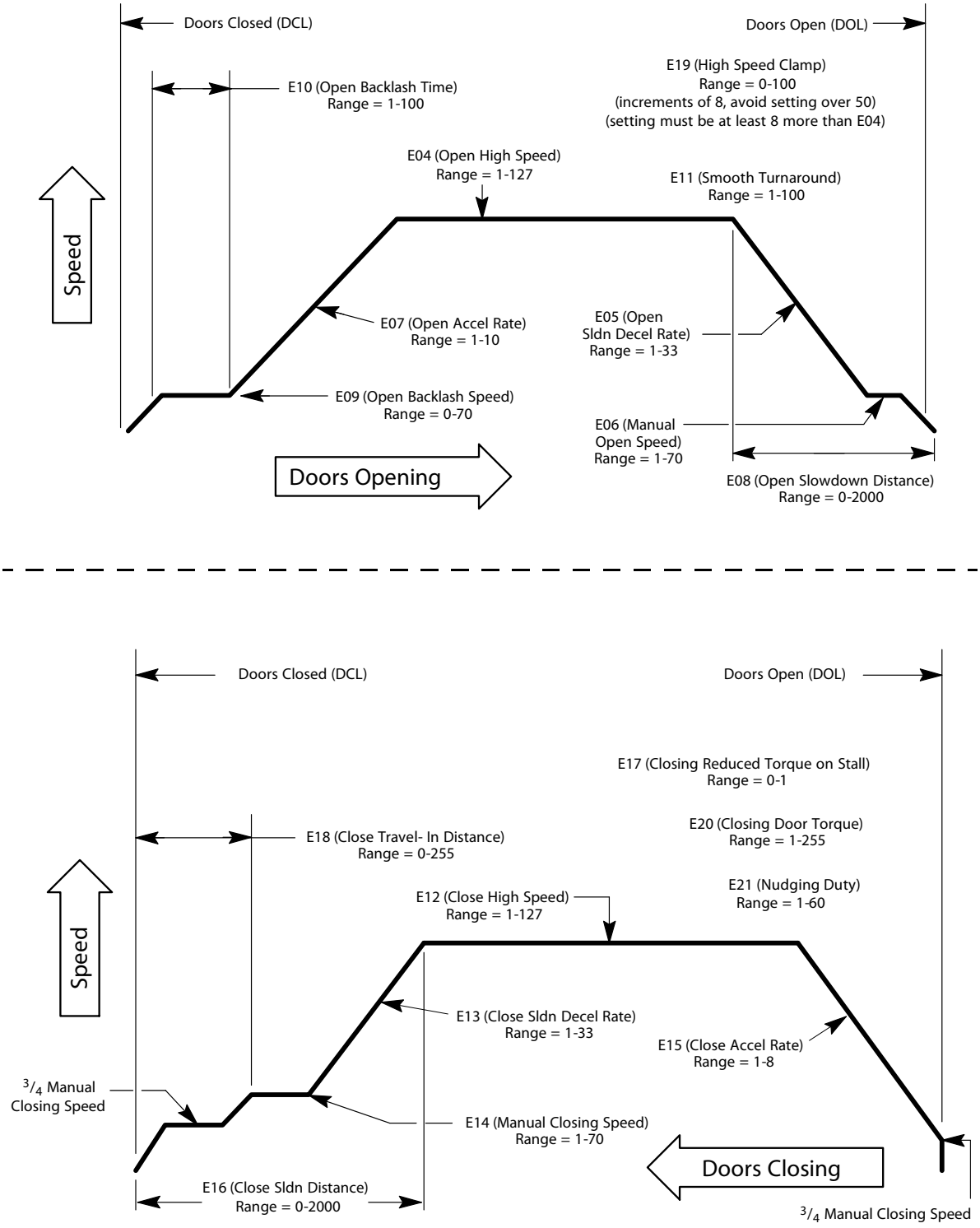


Figure 9 - Door Opening and Door Closing Adjustments

Setting the Gate Switch

1. Position the doors 1 1/2" (38mm) from Fully Closed.
2. Rotate the disk in the CLOSE direction until the shorting bar just touches the two leaf contacts. See Figure 10.
3. Locate a tab on the locking ring that lines up with a notch in the contact disk.
4. Rotate the drive wheel until the doors are Fully Closed and ensure that the shorting bar has not run past the leaf contacts.
5. Open and close the doors to verify that the gate switch shorting bar enters the leaf contacts at 1 1/2" (38mm) from Fully Closed.

Note: Verify that the shorting bar remains between the leaf contacts in the Fully Closed Position. Be sure that the gate switch leaf contacts do not rub on the thin portion of the plastic disk during normal operation.

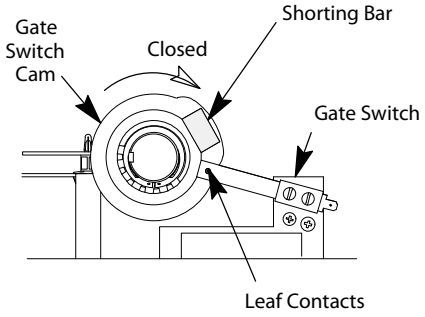


Figure 10 - Gate Switch

Final Security

Recheck all bolts, cap screws, cam hex screws, and belt tensions for proper tightness

Diagnostics

Electronic Door Operator Adjustments

- Use the OST to access the electronic door adjustments.
- Edit adjustments as required.
- Use the WRT command to save adjustments to flash memory.

Adjustment	Range	Default	Definition
E03	0-1	0	Clear Fault Buffer - When set to 1, the electronic door fault buffer is cleared.
E04	1-127	85	Open High Speed - This adjusts the high speed of the door motor in the open direction. The door will move faster as this adjustment value is increased.
E05	0-33	16	Open Slowdown Deceleration Rate - The doors will travel at high speed until the slowdown distance position is reached. The door speed will then be linearly reduced until manual speed is reached. The deceleration rate will be increased (doors will slow down faster) as this adjustment value is increased
E06	1-70	32	Manual Open Speed - This adjusts the door speed after deceleration to the door open limit. This is also the speed the doors travel if the manual open button is pressed on the door operator card. Manual speed will be increased as this adjustment value is increased.
E07	1-10	6	Open Acceleration to High Speed - This adjusts the speed the doors accelerate from backlash speed to open high speed. The acceleration rate will increase as this adjustment value is increased.
E08	0-2000	200	Open Slowdown Distance - This adjusts the point that the doors begin decelerating to manual open speed. Slowdown distance should be large enough to allow manual speed to be reached prior to reaching the door open limit. The slowdown distance will increase as this adjustment value is increased.
E09	0-70	20	Open Backlash Speed - This adjusts the speed the doors travel during backlash time. This is used to allow the clutch to smoothly engage the interlock prior to beginning its acceleration to high speed. Backlash speed is increased as E09 value is increased. **Note:** If this adjustment is set to zero (000), the doors will not open.
E10	1-100	5	Backlash - This adjusts the time the doors travel at open backlash speed before ramping into open high speed. Backlash time will begin after the door leaves the door close limit. Backlash is adjusted to prevent the clutch assembly from suddenly engaging the interlock. The backlash adjustment only affects the door opening. Backlash time is increased as this adjustment value is increased.
E11	0-40	12	Smooth Turn-Around Adjustment - This adjusts the speed at which the door will receive a direction reversal (reopen or close reversal). This adjustment is used to provide a quick but smooth initial turn- around on a reopen. The turn-around will be more abrupt as this adjustment value is increased.
E12	1-127	50	Close High Speed - This adjusts the high speed of the door motor in the close direction. The door will move faster as this adjustment is increased.
E13	0-33	16	Close Slowdown Deceleration Rate - This adjusts the close slow- down deceleration rate. The doors will travel at high speed until the slowdown distance position is reached. The door speed will then be linearly reduced until manual speed is reached. The deceleration rate will be increased (doors will slow down faster) as this adjustment value is increased.

Adjustment	Range	Default	Definition
E14	0-70	25	Manual Closing Speed - This adjusts door speed after deceleration until travel-in distance is reached. When travel-in distance is reached, the doors will then run 3/4 manual speed to the door close limit. This is also the speed the doors will travel if the manual close button is pressed on the door operator card. Manual closing speed will be increased as this adjustment value is increased.
E15	1-8	4	Close Acceleration to High Speed - This adjusts the rate the doors accelerate to close high speed. The acceleration rate will be increased as this adjustment value is increased
E16	0-2000	110	Close Slowdown Distance - This adjusts the point the doors begin decelerating to manual close speed. Slowdown distance should be large enough to allow manual close speed to be reached prior to reaching the door close limit. Close slowdown distance will be increased as this adjustment value is increased.
E17	0-1	0	Reduced Torque On Stall -This adjustment can be used to cause the door torque to be reduced when the doors are stalled. Door torque will be increased as this adjustment value is increased.
E18	0-255	34	Close Travel-In Distance - This adjusts the distance the doors travel at 3/4 manual close speed into the door close limit. This occurs after deceleration has reduced the door speed to manual speed. This is also the point where the door torque is increased for stalled doors on the 5th and 6th cycles. The close travel-in distance will be increased as this adjustment value is increased.
E19	0-100	40	High Speed Clamp - This sets the maximum speed (from motor rpm) the doors will be allowed to travel (open or close) before the doors are stopped. When the clamp is activated, the doors are momentarily stopped and then allowed to run again with constant over-speed protection. When this clamp stops the doors, a door fault will be set to inform of the overspeed (326 open, 327 closed). The High Speed Clamp speed will be increased as this adjustment value is in- creased.
E20	1-255	41	Closing Door Torque - This adjusts the static closing force in the center third of door travel. Door torque will be increased as this adjustment value is increased.
E21	1-60	20	Nudging Duty - This adjusts the closing speed when the doors are on nudging operation, or safety edge or photo eye failure. Nudging speed will be increased as this adjustment value is increased.
E22	0-255	130	Six Inch From Closed - Position count for the 6-inch from close point.
E23	0-1	0	Continuous Door Cycle - When set to 1, causes the door to cycle continuously. Set to 0, the door works in normal operation.
E24	0-1	0	Manual Door Cycle - When set to 1, causes the door to run at manual speed opening and closing. Set to 0, the door runs at normal speed.
E56	0-1921	0	Travel - This adjustment is the number of pulse counts between DOL (door open limit) and DCL (door close limit). This count is automatically set on power-up when the saved value in the CPU memory is zero. The doors will begin the set-up count from DOL. If the doors are not on DOL, they will move to DOL and then close, counting pulses until their arrival at DCL.

Electronic Door Faults

- The door fault buffer can store a maximum of 30 door faults. Each fault is different regardless of the number of times it occurs.
- Use Adjustment E03 (Clear Fault Buffer) to clear door faults.
- 300 Series Fault Code = Front Door Operator
  600 Series Fault Code = Rear Door Operator

Fault Code	Description / Causes / Solutions
301 / 601	Defective Components on Door Operator Card • Replace Door Operator Card. This can be caused by an over current condition.
302 / 602	Defective Components on Door Operator Card • Replace Door Operator Card
304 / 604	Defective Components on Door Operator Card • Replace Door Operator Card
305 / 605	Defective Components on Door Operator Card • Replace Door Operator Card
306 / 606	150 Volts not available at Door Operator. • Blown fuse in Power Control • Blown fuse in Door Operator • Defective Door Operator Card
307 / 607	Motor Sensor Fault - Door travel value is not in a valid range (96 - 1280 counts). • Motor Wiring • Defective Motor Sensors
308 / 608	Motor Direction Fault - During set up, the doors have been trying to power OFF of either limit more than 14 seconds. • Motor Wired Backwards • Right/Left (J2) Jumper Set Incorrectly
309 / 609	Motor Sensor Fault - Phases A and B - During set up, the door travel pulse count was not a negative number when DCL was reached. The pulse count is zeroed at DOL and counts down when the doors are closing. • Phase A or B Wired Backward • Right/Left Jumper (J2) Set Incorrectly • Defective Motor Sensor
310 / 610	Manual Door Control Push Buttons Both Enabled. • Defective Door Operator Card • Both Control Buttons are Pressed
312 / 612	Limit Fault - DCL or DOL Failed or Belt Slipped - Door travel pulse count indicates the doors have traveled approximately 3" past the limit. • Drive Belt Loose • Invalid Door Travel Parameter Value • Improper Adjustment of Limit Cams • Defective Limit Cam • Defective Door Operator Card

Fault Code	Description / Causes / Solutions
313 / 613	DR Failed to Activate - DR input is active when the doors reach DOL. • Faulty DR Contact • Maladjusted or Faulty DOL Limit Sensor
314 / 614	DR Failed to Activate - DR input is not active when the doors reach DCL. • Maladjusted or Faulty DR Limit Sensor (DR must activate before DCL) • Faulty DR Contact • Improper DR Input Wiring • Defective Door Operator Card
317 / 617	Pulse Count did not Reach Expected Value - Pulse count was 40 counts less than travel parameters. • Phases A and B reversed • Defective Motor Sensors or Wiring **Note:** The door will not run at high speed until this fault is corrected or the door is reset.
318 / 618	Defective Components on Door Operator Card. • Replace Door Operator Card
319 / 619	Defective Components on Door Operator Card. • Replace Door Operator Card
320 / 620	Defective Components on Door Operator Card. • Grounded or Shorted Door Motor Armature • Replace Door Operator Card
321 / 621	Defective Components on Door Operator Card. • Grounded or Shorted Door Motor Armature • Replace Door Operator Card
322 / 622	Defective Components on Door Operator Card. • Grounded or Shorted Door Motor Armature • Replace Door Operator Card
323 / 623	Defective Components on Door Operator Card. • Grounded or Shorted Door Motor Armature • Replace Door Operator Card
324 / 624	Motor Circuit not Continuous. • Open Door Motor Armature or Wiring • Defective Door Operator Card
325 / 625	Defective Components on Door Operator Card. • Grounded or Shorted Door Motor Armature • Defective Door Operator Card
326 / 626	Open Overspeed Error - Indicates opening door speed exceeded the setting of the high speed clamp (DO ADJ-13). • DO ADJ-13 is set too low. The high speed clamp should be set 8 above the level at which speed clamping occurs. • Door Speed has increased. This can be caused by a defective door operator card or by physically pushing the doors until overspeed occurs.

Fault Code	Description / Causes / Solutions
327 / 627	Closed Overspeed Error - Indicates that the closing door speed exceeded the setting of the high speed clamp E19. • High Speed Clamp (E19) is set too low. The high speed clamp should be set 8 above the level at which speed clamping occurs. • Door Speed has increased. This can be caused by a defective door operator card or by physically pushing the doors until overspeed occurs.
328 / 628	EEPROM Checksum Fault. The checksum of the EEPROM is incorrect. • Defective components on door controller card. • Replace door controller card.
329 / 629	EEPROM Write Verify Fault. The EEPROM is damaged. • Defective components on door controller card. • Replace door controller card.
330 / 630	FSCHED Task Re-entry Fault. • Defective components on door controller card. • Replace door controller card.
331 / 631	Task List Array Full Fault. • Defective components on door controller card. • Replace door controller card.
332 / 632	Invalid MCSS State Fault. • Defective components on door controller card. • Replace door controller card.
333 / 633	Bridge Watch Dog Failure. The bridge watch dog test failed during power up. • Defective components on door controller card. • Replace door controller card.
334 / 634	FSCHED Chronic Re-entry Fault. • Defective components on door controller card. • Replace door controller card.
335 / 635	Bad Parameter Fault. • Attempt to save invalid parameter. • Defective components on door controller card. • Replace door controller card.

Troubleshooting Section

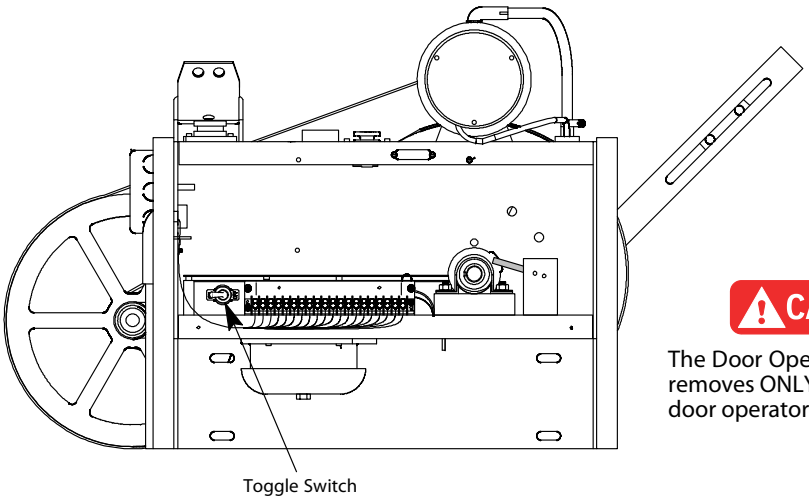
Door Operator Parts

These procedures can be used to check all parts of the door operator: mechanics, power supplies, communications, and I/O.

Troubleshoot the door operator in the following order:

1. Visually check the mechanical operation and adjustment. Most door problems are mechanical.
2. Check the power supplies.
3. Check, for correct operation, All LED indicators and I/O on the door operator card.
4. Check the communications.

WARNING **Interlocks and gate switch contacts are at 150 VDC. Use EXTREME caution when servicing the system.**



CAUTION

The Door Operator Toggle Switch removes ONLY 150VDC from the door operator. P24 may still be ON.

Mechanical Troubleshooting

1. Visually check the following items for correct operation and adjustment:
   - Clutch
   - Interlocks
   - Linkage
2. To check for binding or obstructions, hand-crank the doors open and closed.
3. Visually check the following items inside the door operator:
   - Wiring to the door operator card.
   - The DOL and DCL cams for the correct positioning:
     - DOL LED illuminates when the doors are Fully Open.
     - DCL LED illuminates when the doors are Fully Closed.
     - The car door switch closes 1” from Fully Closed.

WARNING **Door watchdog operation will recycle the doors if the interlocks (DR or DCL) do not make up. When servicing, be prepared for the doors to cycle. To disable watchdog operation, place the car on Inspection Operation.**

Troubleshooting Guide

For assistance, please call 1-866-HELP-TKE.

Problem	Possible Causes or Solutions
Doors move sluggish and jerky.	1. Worn or loose V belts. 2. Motor sheave loose on shaft. 3. Poor mechanical adjustment of doors. 4. Worn door rollers and/or gibs.
Doors Will Not Fully Open	1. DOL cam set wrong or stop adjustment incorrect. 2. Open Slowdown speed(s) adjusted too low. 3. Position of pivot arm to intermediate arm incorrect (not enough stroke).
Doors Will Not Fully Close	1. DCL cam set wrong or stop adjustment incorrect. 2. Close slowdown speed(s) adjusted too low. 3. Stroke adjustment improper. 4. Trash in sill grooves. 5. Loose pivot connections, jack shaft, loose rollers, gibs, or safety edge activating arms.

Power Supply Checks

1. Turn ON the mainline disconnect.
2. Place the car on Inspection Operation.
3. Check the door operator power supplies for correct voltages. See Table 1.

Note: These voltage readings should be taken from MTA Connectors or door operator terminals as indicated in Table 1. See Figure 11 on page 30 for MTA locations.

Power Supply	Description	Meter Connection		Correct Voltage
		Positive	Common	
TB1-4, 5	115 VAC Supply	AC1S/TB1-5	AC2/TB-4	115 VAC
P150/G150	150 VDC Supply (P150 LED will be ON if supply is ON)	Test Point P150V	Test Point GPOWER	145-170 VDC
P24/G24	24 VDC Supply	TE (P24)	G24	22-28 VDC
P5/G5	Internal 5 VDC Supply Test Point (P5V LED will be ON if supply is ON)	Test Point P5	Test Point DGND	4.8-5.25 VDC
P3.3/G3.3	Internal 3.3 VDC Supply	Test Point P3.3	Test Point DGND	3.23-3.37 VDC
Note: Check FUSE F2 on the door operator card for 150 VDC on both sides. Use GPOWER for G150 Connection. If a fuse is blown, check the door faults for a possible cause.				

Table 1 - Door Operator Power Supply Checks

Power Supply Checks
(continued)

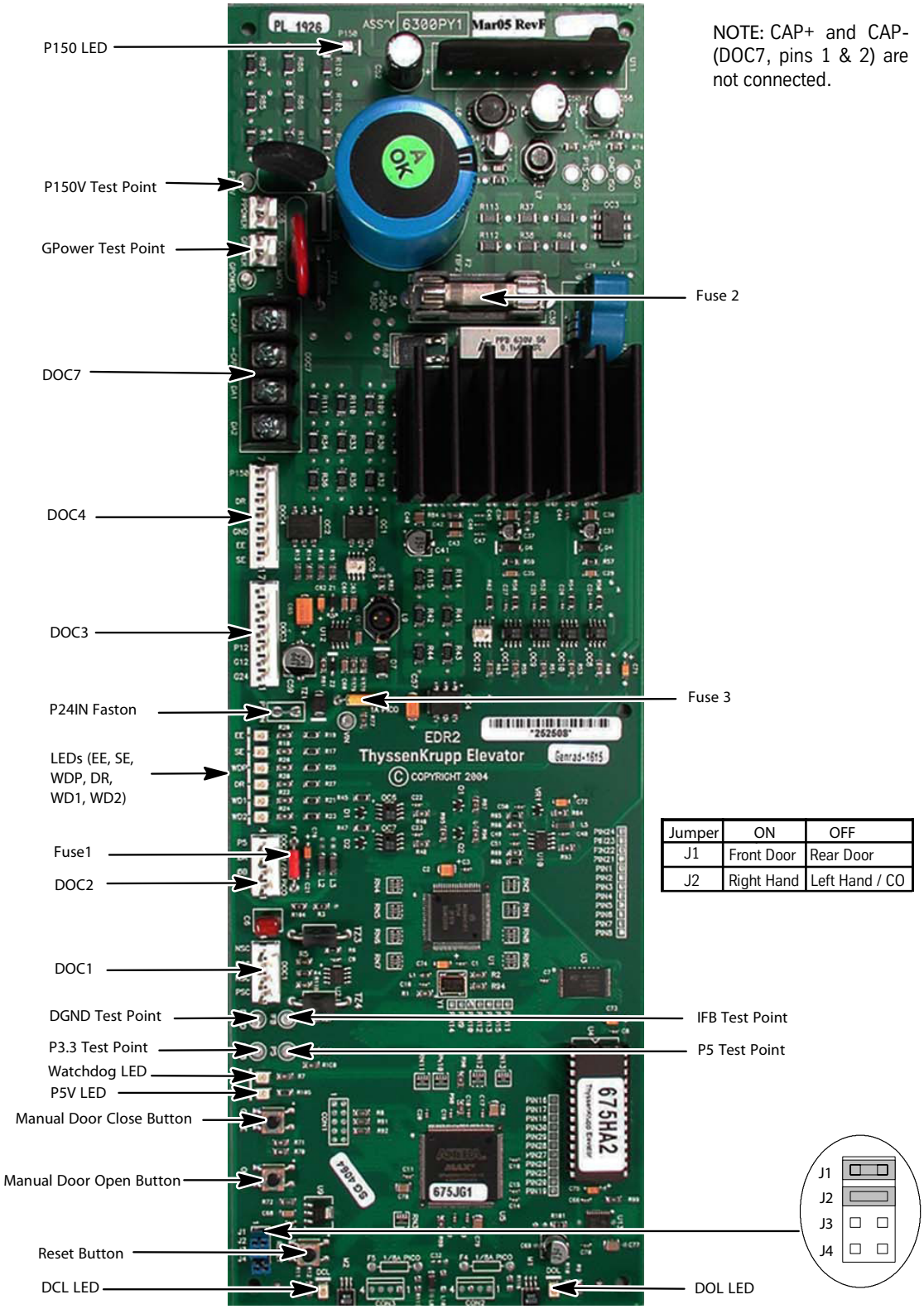


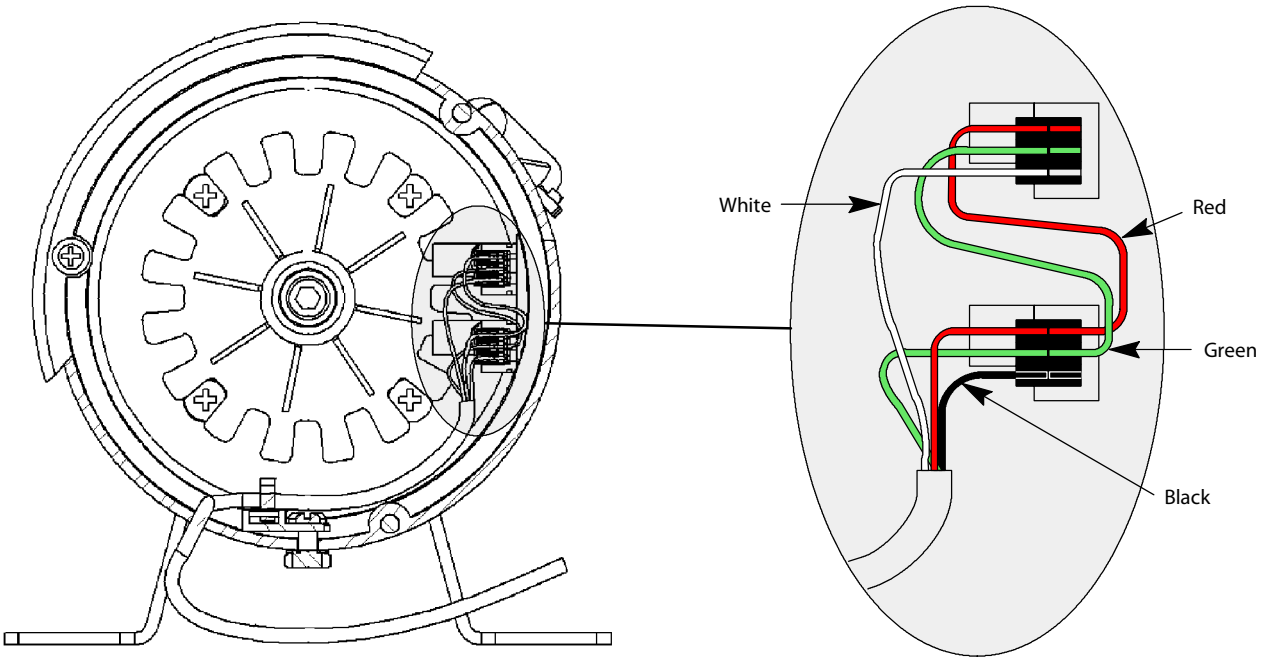
Figure 11 - Door Operator Card

Phasing J2, Motor Leads, and Encoder Connections

For the door operator to function correctly, the door motor armature, the J2 jumper, and the Phase A and Phase B sensors must be in phase with each other. To reverse motor direction, the wiring is designed to allow removal or installation of the J2 jumper.

If phasing is not correct:

1. Verify that the black motor lead is connected to DA1 on the door operator card, and the red motor lead is connected to DA2 on the door operator card. See Figure 11 on page 30.
2. Check for the correct encoder wiring on the DOC2 MTA connector (located on the door operator card). See Figure 12.
3. Verify that the wiring and connectors are correct in the encoder housing.
4. Set jumpers J1 and J2 on the door operator card.



DOC2 Connector Pin No.	Wire Color
1	Green
2	White
3	Black
4	Red
NOTE: Pin 1 is on the right side of the connector.	

Figure 12 - Encoder Wiring

Phase A and Phase B Motor Sensor Check

The door microprocessor can correctly detect Phase A and Phase B sensors if the sensors toggle each time a notch in the encoder disk passes by a sensor.

1. Connect the negative lead of a voltmeter to the DGND test point, and connect the positive lead to DOC2 pin 2 (Phase B) or DOC2 pin 3 (Phase A). See Figure 11 on page 30.
2. While observing the voltmeter, very slowly rotate the motor.

Notes:

- The door motor must be rotated very slowly for the voltmeter to detect a change.
- If the sensor is responding correctly, the voltmeter will alternate between 0 and 5 VDC.
- Both sensors must operate properly. If either sensor is not functioning, check Fuse F1 on the door operator card, and check the wiring at the door card and the encoder housing.

DOL and DCL Check

1. Verify that the door microprocessor is detecting the magnetic limits correctly. See Table 2.
2. Hand-crank the door operator, or use the MDO/MDC buttons to move the doors to each limit. Each respective LED should light.
3. Use the OST, and verify that the door status indicates that the proper limit has been activated.

Note: If DOL or DCL require adjustment, the doors must be set up again to obtain the new door travel parameters. See “Door Setup” on page 16.

Signal	Condition	LED	Condition of LED
DOL	DOL activated (Doors Fully Open)	DOL	ON
	DOL not activated (Doors not Fully Open)	DOL	OFF
DCL	DCL activated (Doors Fully Closed)	DCL	ON
	DCL not activated (Doors not Fully Closed)	DCL	OFF

Table 2 - DOL and DCL Checks

Door Operator I/O Checks

1. Reset the door operator card by pressing the reset button. The WD LED should come ON. See Figure 11 on page 30 for all steps in this procedure.

Note: If the OST cannot communicate with the door operator card, see “Door Communications Troubleshooting” on page 34.

2. If the WD LED is not ON, verify if the P5V LED is ON.
   - If P5V LED is ON:
     a. Check the door operator card faults with the OST.
     b. See “Electronic Door Faults” on page 25.
   - If P5V LED is not ON:
     a. Check the Fuse F3 on the door operator card.
     b. Verify that the P24IN faston and DOC3 are connected to the door card.
     c. Verify whether P24 is present in the door operator.

Door Operator I/O Checks
(continued)

3. If the WD LED is ON, press the MDO button. The doors should move in the open direction.
   - If the doors do not move, or if the doors move in the closed direction:
     a. Change the status of the J2 jumper (ON to OFF or OFF to ON)
     b. Press the reset button to reset the door operator card.
   - If the doors still do not move, or if erratic door movement occurs, perform the procedures in "Phasing J2, Motor Leads, and Encoder Connections" on page 31.
4. Use the MDC button to repeat the previous step. The doors should move in the closed direction.

Note: Use the OST when troubleshooting I/O. When a conflict occurs, use a meter to determine whether it is a card or wiring problem. However, the OST will check more hardware than the meter.

SE, EE, DR, and WDP

1. Check the I/O to the door operator. See Table 3.
2. Operate each device to see if the door micro is receiving each signal correctly.
3. Verify that the LED indicators for each input respond as shown in Table 3.
4. With the OST, verify that the door status indicates that the proper input has been activated.

Note: The DR input is not connected to the door operator card, therefore it cannot be verified on the door operator OST.

Signal	Condition	Positive	Common	Volts	Condition
SE	Safety edge activated	SE (DOC4-1)	G24	0 VDC	OFF
	Safety edge not activated	SE (DOC4-1)	G24	24 VDC	ON
EE	Electric eye activated	EE (DOC4-2)	G24	0 VDC	OFF
	Electric eye not activated	EE (DOC4-2)	G24	24 VDC	ON
DR	Car door closed	DR-B (TB1-8)	AC2 (TB1-5)	150 VDC	ON
	Car door not closed	DR-B (TB1-8)	AC2 (TB1-5)	0 VDC	OFF
WDP	P150 to bridge	*D3 Anode	GPOWER Test Point	150 VDC	ON
	No P150 to bridge	*D3 Anode	GPOWER Test Point	0 VDC	OFF
WD1	Signal to move doors	DA1	DA2	Armature voltage	ON
	No signal to move doors	DA1	DA2	No armature voltage	OFF
WD2	Signal to move doors	DA1	DA2	Armature voltage	ON
	No signal to move doors	DA1	DA2	No armature voltage	OFF
Note:	Meter connection may also be made at Fuse F2.				

Table 3 - I/O Checks

Door Communications Troubleshooting

If any of the following conditions are present, there is no communication between the 188E CPU Card (CPU) and the EDR2 Electronic Door Operator Card (EDR2):

- The doors are not working.
- Remove the CON23 plug from the CPU while the system is powered up, and the STAT LED on the CPU should blink 3 times. If not, no communication is present.
- The OST adjustments for the door (E03-E56) display W0 as the values, and door faults will not be viewable (no faults shown even if they exist in the door card).

If communications cannot be established between the CPU and the EDR2, perform the following procedure to determine the cause:

1. Turn OFF, Lock, and Tag out the mainline disconnect.
2. Verify the fuses on the door card, and replace as necessary.
3. Remove the CON23 plug from the CPU.
4. Use an Ohm Meter and measure for 100 Ohms on the CPU, CON23, pins 1-2. If any other measurement is seen, replace the CPU.
5. Use an Ohm Meter and measure for 125-135 Ohms on the CON23 plug–as it hangs loose–pins 1-2.
   - If the measurement is correct, move to Step 8.
   - If the measurement is not correct, continue with Step 6.
6. Place a temporary jumper on the CON23 plug, pins 1-2. Move to the car top with the Ohm Meter, and then remove the DOC1A and DOC1B plugs from the EDR2.
7. Measure for a short (zero ohms) on the removed DOC1B plug, pins 1-2.

- If the Ohm Meter does not display the short (zero ohms):
  a. Find the wiring problem. See Figure 19.
  b. Reconnect both DOC1A and DOC1B plugs to the EDR2.
  c. Remove the temporary jumpers, and reconnect CON23 to the CPU.
  d. Verify the door communications.
- If the Ohm Meter displays the short (zero ohms):
  a. Replace the DOC1A and DOC1B plugs onto the EDR2, and return to the machine room.
  b. Remove the temporary jumper from the CON23 plug, and replace this plug onto the CPU.

8. Power up the disconnect.
9. Check for the proper door communications.

- If communications do not work:
  a. Use a volt meter on DC to measure voltage on the PSC and NSC terminals on the TCID Card (located at the top of the controller).

Note: A correct measurement is 2.25vdc to 2.75vdc (meter-averaged values of proper 5vdc communications packet activity).

  b. If the correct measurement is not seen, replace the EDR2.

Door Communications Troubleshooting
(continued)

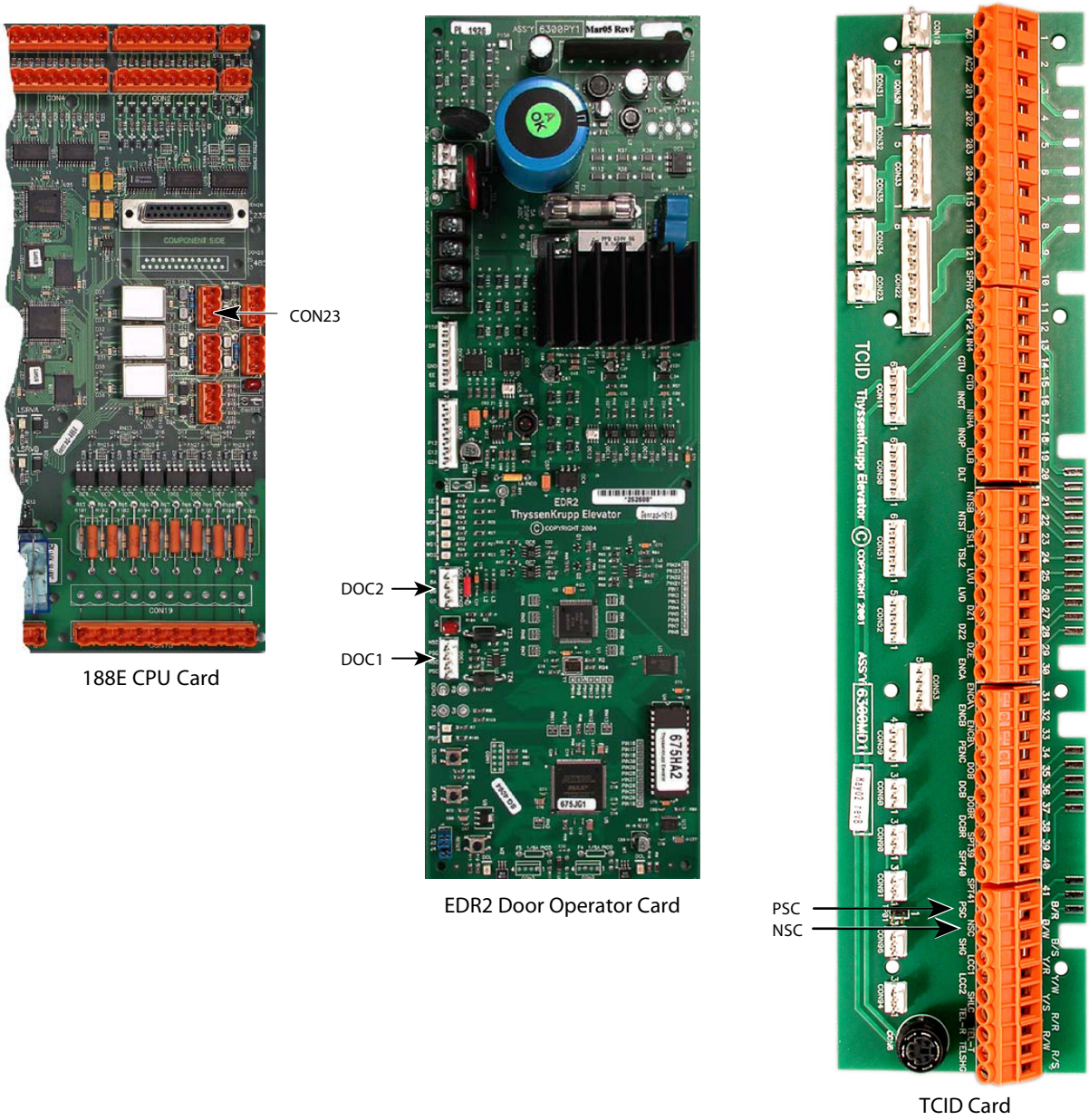
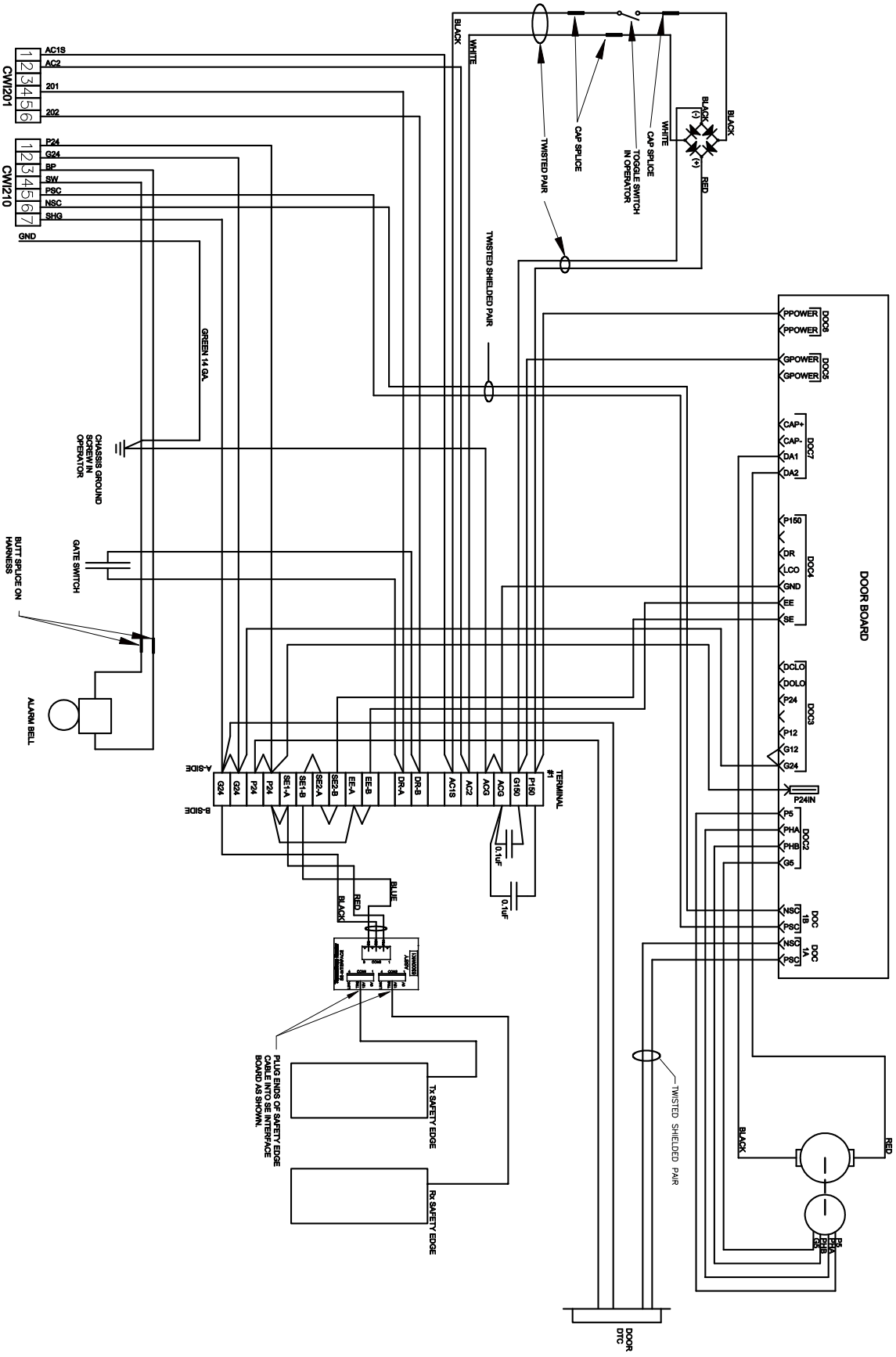


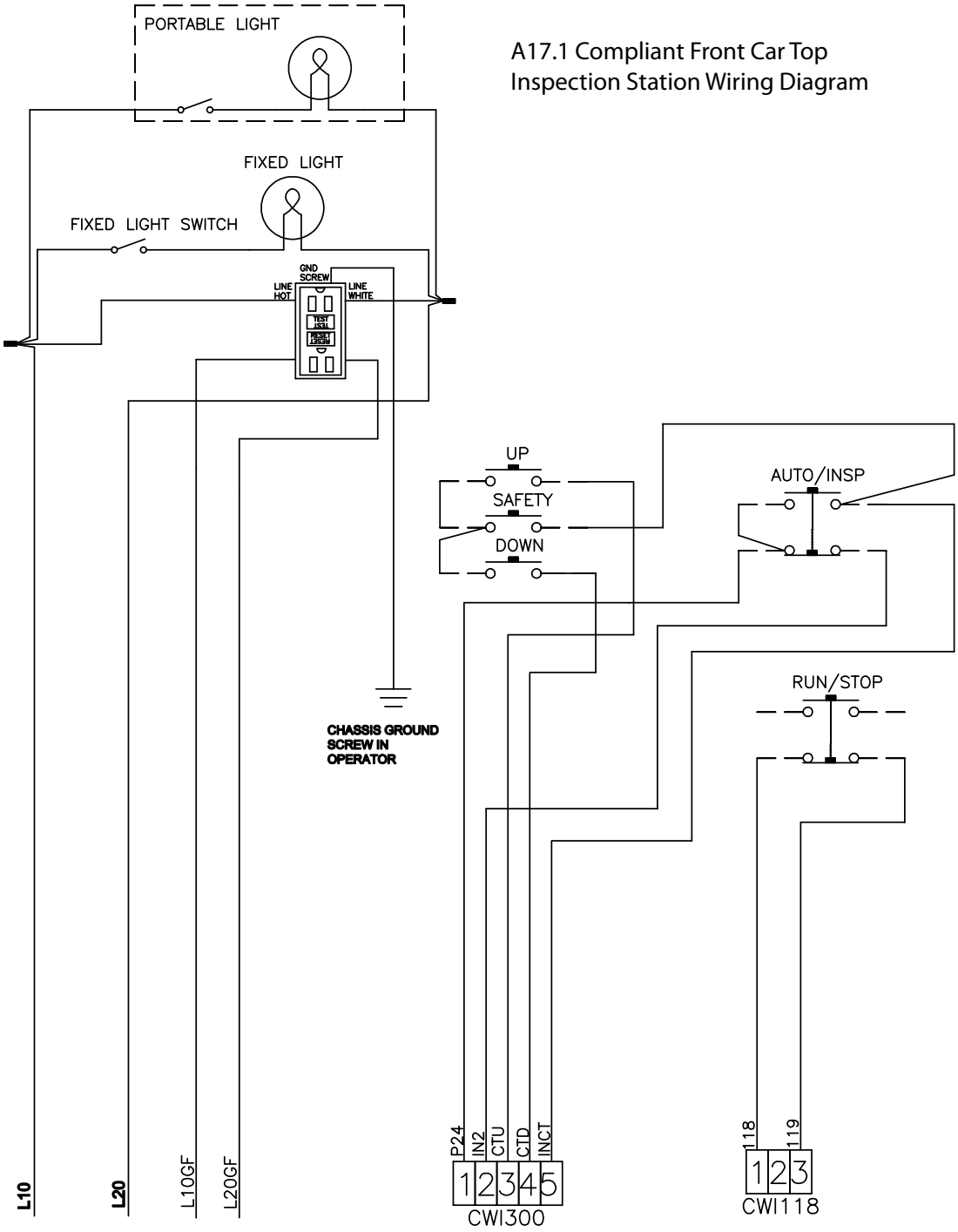
Figure 13 - Connectors on Door Communications Cards

Wiring Diagrams



Wiring Diagrams
(continued)

A17.1 Compliant Front Car Top Inspection Station Wiring Diagram



Maintenance

1. Check that the motor mounting bolts are tight.
2. Remove the brush covers (where applicable), blow out the brush holders, check the brushes for wear, and reinstall the covers.
3. Inspect the operator belts for the following:
   a. Cracks or glazing
   b. Even wear on both sides of the belt
   c. The belts are not bottomed out in the grooves
   d. Proper tension (belt slippage).

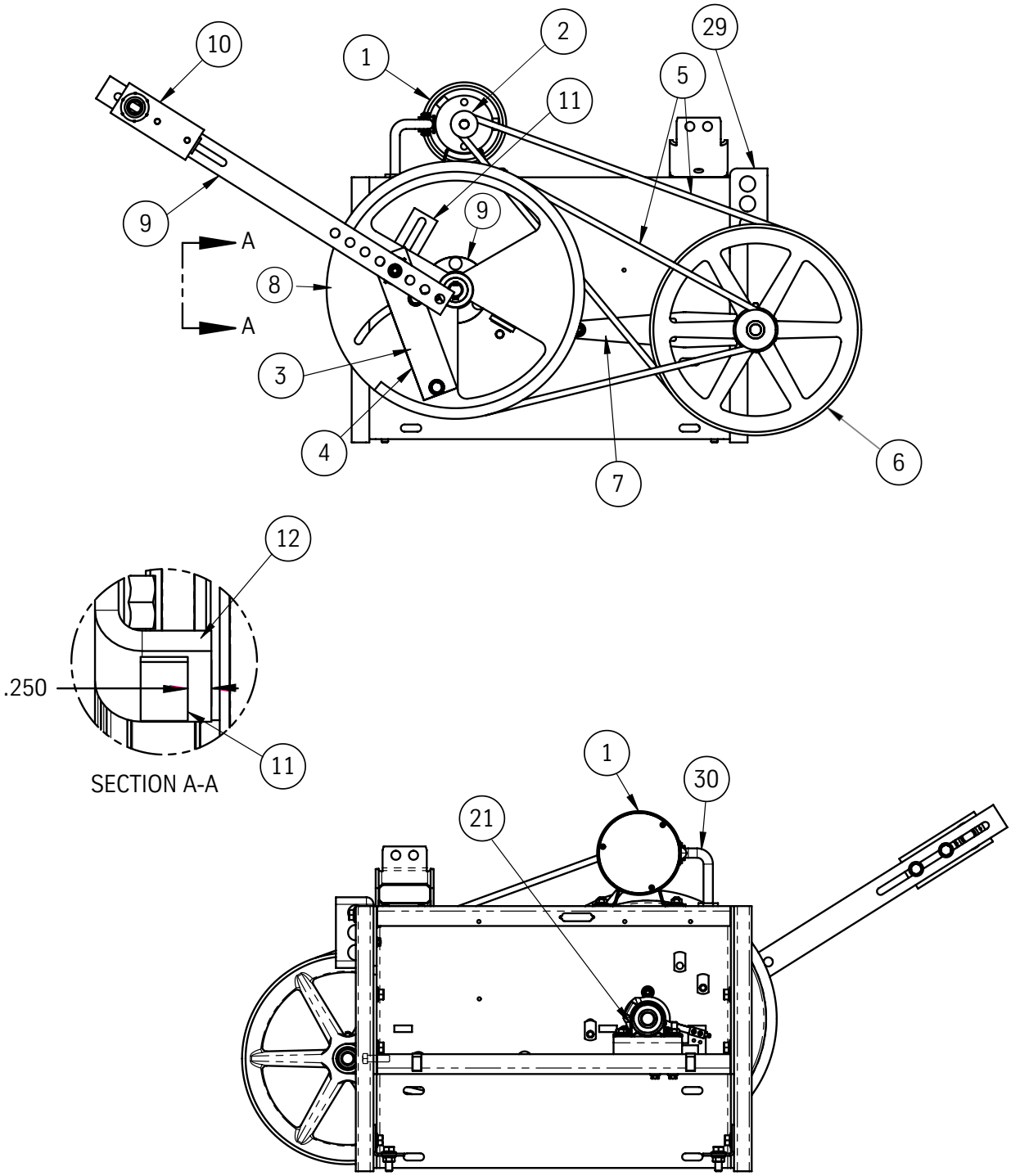
The following guidelines apply when testing, adjusting, or replacing belts:

- Ideal tension is the lowest tension at which the belt will not slip at peak load.
- All belts in the set should be tested for equal tension by pushing each belt down at the midpoint between the pulleys. (Typical deflection is 3/8" with 10 lbf applied).
- If belts require tensioning, check the sheave alignment with a straight edge.
- If belts are replaced on multi-groove sheaves, change the belts as a matched set.

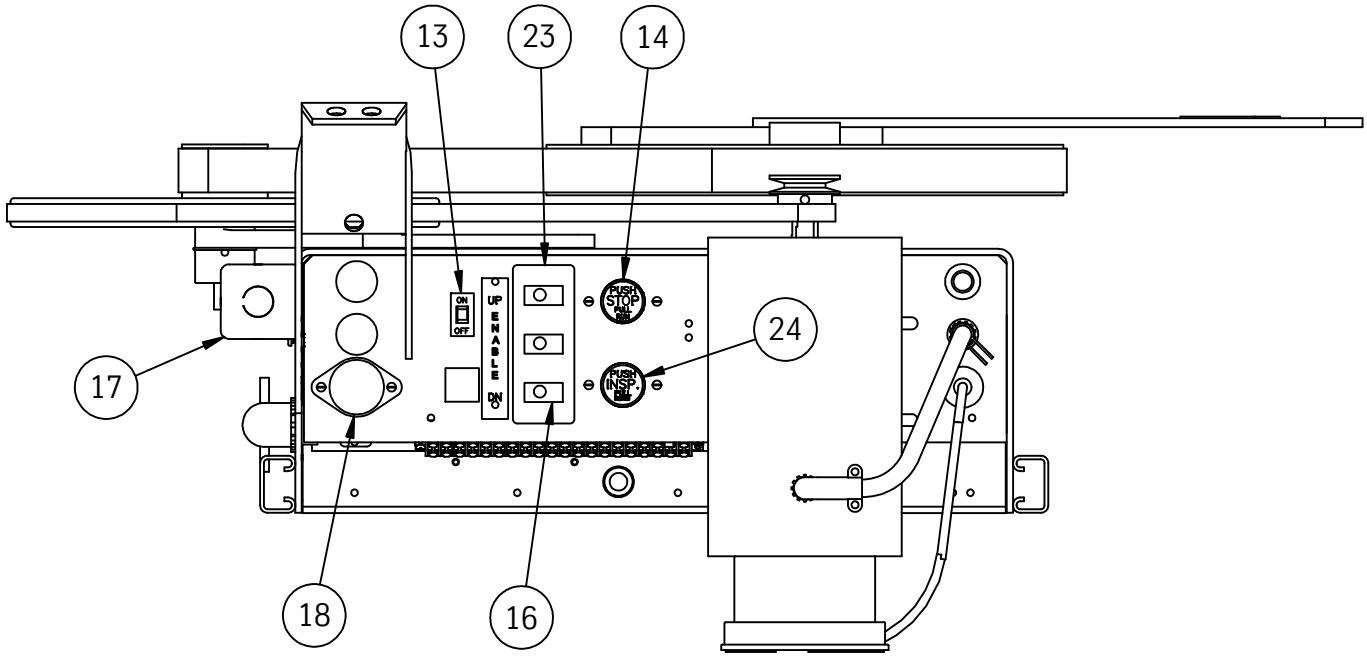
4. Check that all of the linkage bolts are tight.
5. Remove the door operator cover, rotate the door operator by hand, and check the operation of the DOL and DCL sensors.
6. Check the operation of the gate switch, and make sure that it is adjusted per code.
7. Use a burnishing tool or clean rough paper, and clean the gate switch contacts (if necessary).
8. Replace the door operator cover.
9. Check for excessive bearing wear.

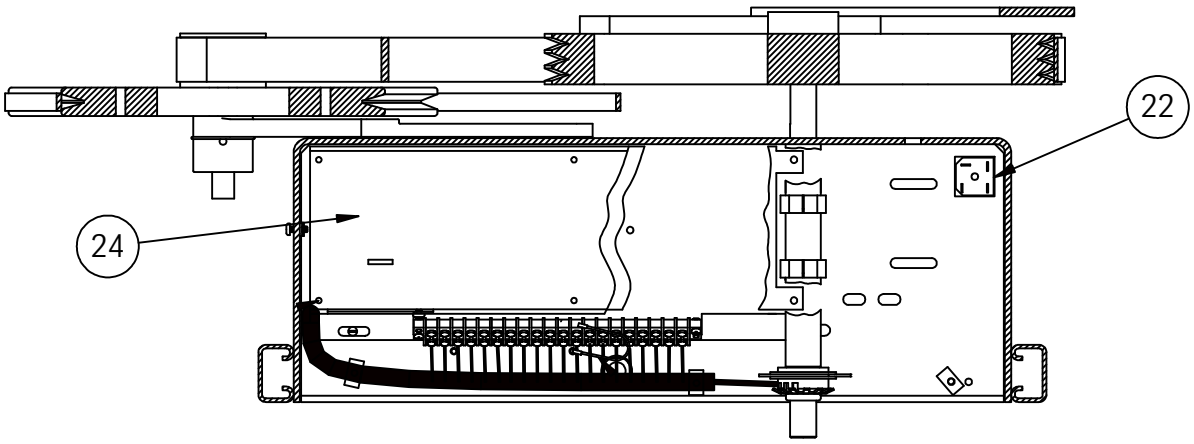
Replacement Parts

3001AD_ HD-98 Door Operator



3001AD_ HD-98 Door Operator
(continued)





3001AD_ HD-98 Door Operator
(continued)

ITEM	PART NO.	PRINT NO.	DESCRIPTION
1		591BH1	115 VDC, 1/6 H.P. w/Optical Sensor Assembly
2	9820966	750DB1	Sheave, Motor
3		124050	Tap Bar, Arm
4	9723997	123992	Arm, Adjustable
5	9749470	77920	Belts, Drive
6	9876686	67668	Sheave Assembly, Jack Shaft
7	9838820	63882	Arm, Adjustable Idler
8	9842214	750CV1	Wheel, Drive
9		103268	Arm, Adjustable Assembly (Intermediate)
10	9723985	123990	Arm, Pivot Assembly
11		40148	Bumper
12	9814656	114653	Stop, Mechanical
13	9743637	76703	Switch, Light
14	9810857	108150	Switch, (Run Stop)
15	9810985	109888	Switch, (Inspection)
16	9739555	127196	Switch, Push Button
17		687BR1	Receptacle (GFCI)
18	9781821	78182	Socket, Lamp
19		744FE1	Shaft, Cam
20	9711715	101171	Bearing, Main
21	9711739	101172	Bearing, Rear
22	9879183	689AE1	Rectifier, Bridge, 15A, 1000V
23	9748632	127195	Guard, Button
24	9832875	6300PY1	Card, Electronic Door Operator
25	9765841	6300WK1	Card, SE Interface
26		196APE1	Bracket, Safety Edge Interface Board
27	9875412	850RW1	Tools, Magnetic-Based Trouble Light
28		286AH37	NM Connector, Zinc Die Cast, .500
29		77550	Junction Box
30		101145	Flex Conduit, .375 Dia. x 9.5 L.

3001AD_ HD-98 Door Operator
(continued)

Parts not shown

31		109789	Guard, Lamp
32	9886667	68666	Capacitor, Assembly, .1mfd, 600VDC
33		320HJ2	Cover, Gate Switch
34	9772637	171BJ1	Switch, Leaf, Gate
35	9741227	141222	Holder, Magnet
36	9741252	141251	Magnet, Cam
37		171CM1	Switch, Toggle
38	9782527	108252	Bell, Emergency Alarm
39	9736254	177AM1	Alarm, Audible Signal, 12V
40	9763754	141787	Stand-off, Card, Locking
41		786AJ1	Spacer, Card

Vertical Express

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