MLX100
INSTRUCTIONS

Upon receipt of the product and prior to initial operation, read these instructions thoroughly and retain for future reference.

Part Number: 162647-1CD
Revision: 1

For use with system:
701878A001
MANDATORY

- This manual explains setup, diagnosis, maintenance, hardware, etc. of the MLX100 Robot Gateway. Read this manual carefully and be sure to understand its contents before using the MLX100 Robot Gateway.
- General items related to safety are listed in Section 1. To ensure correct and safe operation, carefully read the section.

CAUTION

- Some drawings in this manual are shown with the protective covers or shields removed for clarity. Be sure that all covers and shields are replaced before operating this product.
- The drawings and photos in this manual are representative examples, and differences may exist between them and the delivered product.
- YASKAWA may modify this model without notice when necessary due to product improvements, modifications, or changes in specifications. If such a modification is made, the manual number will also be revised.
- If your copy of the manual is damaged or lost, contact a YASKAWA representative to order a new copy. The representatives are listed on the back cover. Be sure to tell the representative the manual number listed on the front cover.
- YASKAWA is not responsible for incidents arising from unauthorized modification of its products. Unauthorized modification voids your product’s warranty.
Notes for Safe Operation

Read this manual carefully before installation, operation, maintenance, or inspection of the MLX100 Robot Gateway.

In this manual, the Notes for Safe Operation are classified as “WARNING,” “CAUTION,” “MANDATORY,” or “PROHIBITED.”

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

**CAUTION**
Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury to personnel and damage to equipment. It may also be used to alert against unsafe practices.

**MANDATORY**
Always be sure to follow explicitly the items listed under this heading.

**PROHIBITED**
Must never be performed

Even items described as “CAUTION” may result in a serious accident in some situations. At any rate, be sure to follow these important items.

To ensure safe and efficient operation at all times, be sure to follow all instructions, even if not designated as “CAUTION” and “WARNING.”
WARNING

• Confirm that no person is present in the P-point maximum envelope of the manipulator and that you are in a safe location before:
  - Turning ON the MLX power
  - Moving the manipulator with programming pendant or MLX HMI
  - Running the system in the check mode
  - Performing automatic operations

Injury may result if anyone enters the P-point maximum envelope of the manipulator during operation. Always press the emergency stop button immediately if there are problems. The emergency stop button is located on the right of the programming pendant.

• Observe the following precautions when performing teaching operations within the P-point maximum envelope of the manipulator:
  - View the manipulator from the front whenever possible.
  - Always follow the predetermined operating procedure.
  - Ensure that you have a safe place to retreat in case of emergency.

Improper or unintended manipulator operation may result in injury.

• Before operating the manipulator, check that servo power is turned OFF when the emergency stop button on programming pendant is pressed.
  When the servo power is turned OFF, the SERVO ON INDICATOR on the programming pendant or MLX HMI is turned OFF.

Injury or damage to machinery may result if the Emergency Stop circuit cannot stop the positioner during an emergency. The positioner should not be used if the EMERGENCY STOP buttons do not function.

Figure 1: EMERGENCY STOP Button

- Release the EMERGENCY STOP button (refer to Figure 2). Once this button is released, clear the cell of all items which could interfere with the operation of the positioner. Then turn servo power ON.

Injury may result from unintentional or unexpected positioner motion.

Figure 2: Release of EMERGENCY STOP Button
Definition of Terms Used Often in This Manual

The MOTOMAN is the YASKAWA industrial robot product.

The MOTOMAN consists of the manipulator, the drive panel, and manipulator cables.

In this manual, the equipment is designated as follows.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manual Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>MLX100 Drive Panel</td>
<td>MLX100 Robot Gateway</td>
</tr>
</tbody>
</table>

Registered Trademark

In this manual, names of companies, corporations, or products are trademarks, registered trademarks, or brand names for each company or corporation. The indications of (R) and TM are omitted.

Explanation of Warning Labels

The following warning labels are attached to the manipulator.

Fully comply with the precautions on the warning labels.

- The label described below is attached to the manipulator. Observe the precautions on the warning labels.
- Failure to observe this caution may result in injury or damage to equipment.

Refer to the manipulator manual for the warning label location.
MLX100 Robot Gateway

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1 Introduction

The MLX100 Robot Gateway enables the user to replace the traditional DX100 robot controller with PLC-based software and general purpose motion control hardware.

The MLX100 Robot Gateway enables the user to integrate select Yaskawa manipulator models with Rockwell Automation ControlLogix Programmable Automation Controller (PAC) and RSLogix 5000 development software via Agile Planet’s set of RLX software modules and associated computer hardware.

Fig. 1-1: Layout (MPL160 Shown)

1.1 MLX100 Robot Gateway Components

Several MLX100 Robot Gateway configurations are available and include the appropriate control panel, servo amplifiers, cables, and components required to interface with the Rockwell ControlLogix controller and target manipulator.

The robot gateway module includes the RLX-R (runtime license) from Agile Planet. This is the operating system for the robot and provides full kinematics for the supplied manipulator. In addition, the software provides interference zones, robot jogging controls in multiple coordinate systems, and tool frame control. The gateway module handles all motion control tasks. This architecture limits backplane communications to a minimum and allows multiple MLX100 Robot Gateway controlled robots to be run from a single ControlLogix processor.
1.1.1 User Supplied Components

When using an MLX100 Robot Gateway controlled robot, the user must supply the following items:

- RockWell ControlLogix Programmable Automation Controller (PAC) (1756-L61 minimum processor)
- ControlLogix Rack with communication card (1756-ENTB suggested)
- RockWell Automation RSLogix 5000 software (v19)
- Network communication modules
- EtherNet switch (managed switch suggested)
- I/O and safety modules
- FactoryTalk View Machine Edition or Studio Edition (v6)

Many of these items can be purchased from Yaskawa Motoman. Contact your Yaskawa sales representative for more information.

1.2 For Your Safety

Robots generally have requirements which are different from other manufacturing equipment, such as larger working areas, high-speed operation, rapid arm movements, etc., which can pose safety hazards.

Read and understand the instruction manuals and related documents, and observe all precautions in order to avoid the risk of injury to personnel and damage to equipment.

It is the user’s responsibility to ensure that all local, state, and national codes, regulations rules, or laws relating to safety and safe operating conditions are met and followed.
1 Introduction

1.3 Special Training

MANDATORY

• Teaching maintenance of the robot must conform to:
  – Industrial Safety and Health Law
  – Enforcement Order of Industrial Safety and Health Law
  – Ordinance of Industrial Safety and Health Law

Other related laws are:
  – Occupational Safety and Health Act in USA
  – Factory Act (Gewerbeordnung) in Germany
  – Health and Safety at Work, etc. Act in UK
  – EC Machinery Directive 98/37/EC

• Prepare
  – SAFETY WORK REGULATIONS
    based on concrete policies for safety management complying with related laws.

• Observe the
  – MANIPULATING INDUSTRIAL ROBOTS-SAFETY (ISO 10218)
    for safe operation of the robot. (Japan Only) (JIS B 8433)

• Reinforce the
  – SAFETY MANAGEMENT SYSTEM
    by designating authorized workers and safety managers, as well as giving continuing safety education.

• Teaching and maintaining the robot are specified as "Hazardous Operations" in the Industrial Safety and Health Law

1.3 Special Training

MANDATORY

• Persons who teach or inspect the manipulator must undergo required training before using the manipulator.

• For more information on training, inquire at the nearest YASKAWA branch office.

The telephone numbers are listed on the back cover of this manual.
This supplementary instruction manual describes how manipulators with the MLX100 Robot Gateway are different from those with the standard DX100 controller.

MANDATORY

Read this supplementary instruction manual thoroughly together with the following instruction manuals:

- Yaskawa Motoman Manipulator Instructions for your model. Disregard all references to the "DX100" controller when reading using the manipulator manual. This manual is to be used for manipulator hardware only.
  - Motoman-MH5 Instructions (P/N 156411-1CD)
  - Motoman-MH5L Instructions (P/N 156483-1CD)
  - Motoman-MH5LS Instructions (P/N 161052-1CD)
  - Motoman-MH5S Instructions (P/N 160475-1CD)
  - Motoman-MPK50 Instructions (P/N 156865-1CD)
  - Motoman-MPL80 Instructions (P/N 157283-1CD)
  - Motoman-MPL160 Instructions (P/N 156830-1CD)
  - Motoman-MPL300 Instructions (P/N 157284-1CD)
  - Motoman-SIA20D Instructions (P/N 156387-1CD)
- RLX User Guide and Instruction Manual (P/N 159133-1CD)

Confirm that you have the appropriate manipulator manual and RLX user guide on hand. If any manuals are missing, contact your salesman from YASKAWA’s local branch office. The relevant telephone numbers are listed on the back cover.
1.5 Personnel Safety

The entire manipulator P-point maximum envelope is potentially dangerous.

All personnel working with the MOTOMAN (safety administration, installation, operation, and maintenance personnel) must always be prepared and “Safety First” minded, to ensure the safety of all personnel.

**CAUTION**

- Avoid any dangerous actions in the area where the MOTOMAN is installed.
  
  There is a danger of injury if there is contact with the manipulator or peripheral equipment.

- Please take strict safety precautions by placing signs such as “Flammable”, “High Voltage”, “Waiting”, and “Off-limits to Unauthorized Personnel” in necessary areas in the factory.
  
  Failure to observe these cautions may result in fire, electric shock, or injury due to contact with the manipulator and other equipment.

- Strictly observe the following items:
  
  - Always wear approved work clothes (no loose-fitting clothes).
  
  - Do not wear gloves when operating the MOTOMAN.
  
  - Do not allow underwear, shirts, or neckties to hang out from the work clothes.
  
  - Do not wear large jewelry, such as earrings, rings, or pendants.
  
  Always wear protective safety equipment such as helmets, safety shoes (with slip-proof soles), face shields, safety glasses, and gloves as necessary.
  
  Improper clothing may result in injury.

- Unauthorized persons should not approach the manipulator or associated peripheral equipment.
  
  Failure to observe this caution may result in injury due to contact with the MLX100 Robot Gateway, the workpiece, the positioner, etc.
CAUTION

- Never forcibly move the manipulator axes. Failure to observe this caution may result in injury or equipment damage.

- Never lean on MLX100 Robot Gateway or other controllers, and avoid inadvertently pushing buttons. Failure to observe this caution may result in injury or damage by unexpected movement of the manipulator.

- Never allow unauthorized personnel to touch the MLX100 Robot Gateway during operation. Failure to observe this caution may result in injury or damage resulting from unexpected movement of the manipulator.
## 1.6 Motoman Safety

### 1.6.1 Installation and Wiring Safety

In planning installation, adapt an easy to observe arrangement to ensure safety. Take safety into consideration when planning the installation. Observe the following when installing the manipulator:

**WARNING**

- Select an area such as that described below to install the manipulator:
  Confirm that the area is large enough so that the fully extended manipulator arm with tool will not reach a side wall, safeguarding, or the drive panel.

Failure to observe this caution may result in injury or damage resulting from unexpected movement of the manipulator.

- Perform grounding in accordance with all applicable electrical codes.

Failure to observe this caution may result in fire or electric shock.

**CAUTION**

- Operation of cranes, slings, or forklifts should only be performed by authorized personnel.

Failure to observe this precaution may result in injury or equipment damage.
MOTOMAN should be lifted with a crane using appropriately rated cable or strapping threaded through the provided lifting eyes and lifted in an upright posture as described in the manipulator instruction manual.

Failure to observe these precautions may cause the manipulator to turn downward, potentially causing injury or damage to equipment.

**CAUTION**

- When lifting the MLX100 drive panel, please check the following:
  - As a rule, handling of the MLX100 drive panel can be performed by two or more people.
  - The MLX100 drive panel weighs approximately 31 - 47 kg (69 - 104 lbs). Be sure movers are strong enough to handle this weight.

Failure to observe this caution may result in injury or damage to equipment.

- If storing the manipulator temporarily before installation, be sure to place it on a stable and flat surface and take precautions to prevent unauthorized personnel from touching it.

Failure to observe this precaution may result in injury of damage to equipment.

**CAUTION**

- Be sure there is sufficient room for maintenance on the manipulator, MLX100 Robot Gateway, and other peripheral equipment.

Failure to observe this precaution could result in injury during maintenance.

- To ensure safety, be sure to operate the drive panel from a location where the manipulator is easily visible.

Operation by unauthorized personnel may result in injury or equipment damage.

- Install the MLX100 drive panel outside the safeguarding of the manipulator’s safety enclosure.

Failure to observe this precaution may result in injury or damage to equipment resulting from contact with the manipulator.

- Install the manipulator using bolts of the size and type specified for each MOTOMAN in the MOTOMAN INSTRUCTION MANUAL.

Failure to observe this caution may result in injury or damage to equipment.
Carelessness contributes to serious accidents in the work area.

To ensure safety, enforce the following precautions:

WARNING

• Install a safeguarding around the manipulator to prevent any accidental contact with the manipulator while power is ON. Post a warning sign stating "Off-limits During Operation" at the entrance of the enclosure. The gate of the safeguarding must be equipped with a safety interlock. Be sure the interlock operates correctly before use.

Failure to observe this caution may result in a serious accident due to contact with the manipulator.

CAUTION

• Store tools and similar equipment in proper locations outside of the enclosure.

Tools and loose equipment should not be left on the floor around the manipulator, MLX100 Robot Gateway, or welding fixture, etc., as injury or damage to equipment can occur if the manipulator comes in contact with objects or equipment left in the work area.
1.6.3 Operation Safety

### WARNING

- When attaching a tool such as the welding torch to the manipulator, be sure to turn OFF the power supply of the MLX100 Robot Gateway and the tool, lock the switch, and display a warning sign. Turning the power ON during tool installation may cause electric shock or injury due to unexpected movement of the manipulator.

- Never exceed the rated capacity of the manipulator (capacity can be found in the specifications section of the manipulator manual.) Failure to observe this caution may result in injury or damage to equipment.

- Teach jobs from outside the manipulator’s work area whenever possible.

- Observe the following precautions when performing teaching operations within the P-point maximum envelope of the manipulator:
  - Always view the manipulator from the front.
  - Always follow the predetermined operating procedure.
  - Always have an escape plan in mind in case the manipulator comes toward you unexpectedly.
  - Ensure that you have a place to retreat to in case of emergency. Improper or unintentional manipulator operation can result in injury.

### WARNING

- Before operating the manipulator, check that all emergency stop buttons are pressed. And confirm that the servo power is turned OFF. Injury or damage to machinery may result if the manipulator cannot be stopped in case of an emergency.

- Prior to performing the following operations, be sure that no one is in the P-point maximum envelope of the manipulator when:
  - Turning ON the MLX100 Robot Gateway power
  - Moving the manipulator.
  - Running the system in the check mode
  - Performing automatic operations
Injury may result from contact with the manipulator if persons enter the P-point maximum envelope of the manipulator.
Press the emergency stop button immediately if there are problems.
1.7 Notes for Moving and Transferring the MOTOMAN

When moving or transferring the Motoman, observe the following safety precautions:

**CAUTION**

- Perform the following inspection procedures prior to teaching the manipulator. If problems are found, correct them immediately, and be sure that all other necessary tasks have been performed.
  - Check for problems in manipulator movement.
  - Check for damage to the insulation and sheathing of external wires.

- Always return the optional programming pendant to a safe location after use.

If the programming pendant is inadvertently left on the manipulator, a fixture, or on the floor, the manipulator or a tool could collide with it during manipulator movement, possibly causing injury or equipment damage.

**MANDATORY**

- Persons operating or inspecting the manipulator should be trained as required by applicable laws and company policies.
- Refer to chapter 1.3 “Special Training” at page 1-3

**CAUTION**

- Attach the instructions to the drive panel cabinet so that all users have access to necessary manuals. See chapter 1.4 “Motoman Manual List” at page 1-4 for a complete list of manuals.

If any manuals are missing, contact your Yaskawa representative.

- If the warning labels on the manipulator and MLX100 Robot Gateway are illegible, clean the labels so that they can be read clearly. Note that some local laws may prohibit equipment operation if safety labels are not in place.

Contact your YASKAWA representative if you require new warning labels.

- When the MOTOMAN is transferred, it is recommended to check with Yaskawa Engineering Co. which is listed on back cover of this manual.

Incorrect installation or wiring may result in personal injury and property damage.
1.8 Notes on MOTOMAN Disposal

PROHIBITED

- Never modify the manipulator.
  Failure to observe this precaution could result in injury or damage
  resulting from fire, power failure, or operation error.

CAUTION

- When disposing of the MOTOMAN, follow the applicable national/
  local laws and regulations.
- Anchor the manipulator well, even when temporarily storing it
  before disposal.
  Failure to observe this precaution may result in injury due to the
  manipulator falling down.
2 Product Confirmation

2.1 Before Unpacking

Carefully inspect all shipping crates for evidence of damage during transit. Pay special attention to tilt and shock indication labels on the exterior of the containers. If any damage is indicated, request that the carrier's agent be present at the time the container is unpacked.

2.2 Unpacking

The MLX100 drive panel is shipped in a crate along with any miscellaneous hardware, and any accessories ordered.

2.3 Contents Confirmation

Confirm the contents of the delivery when the product arrives.

Standard delivery includes the following five items (Information for the content of optional goods is given separately):

- Manipulator
- MLX100 Drive Panel
- MLX100 Robot Gateway module
- Regen Cabinet
- Manipulator Cables (Between Manipulator and MLX100)
- Complete Set of Manuals

Fig. 2-1: Standard Items
2.3.1 Optional Programming Pendant

The optional Programming Pendant (see Fig. 2-2) provides the primary means of programmer/operator interaction with the MLX100 Robot Gateway system. The pendant features a 7.5-inch, color LCD, touch-screen display (640 X 480 VGA).

The features include a menu-driven interface unique to the MLX environment, by using the Programming Pendant, the operator can teach and adjust the robots points; perform programming, editing, maintenance, and diagnostic functions.

Figure 2-2: MLX100 Programming Pendant

<table>
<thead>
<tr>
<th>Call Out</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Enable/Deadman Switch</td>
<td>Enables and disables the teach pendant. The unit is operative when the switch is pressed.</td>
</tr>
<tr>
<td>2</td>
<td>Emergency Stop Switch</td>
<td>Implements an emergency stop condition and sends an emergency stop signal to the external equipment.</td>
</tr>
<tr>
<td>3</td>
<td>Display</td>
<td>7.5-inch, color LCD, touch-screen display (640 X 480 VGA)</td>
</tr>
</tbody>
</table>
2 Product Confirmation

2.4 Warranty ID Confirmation

Confirm that the warranty ID pasted on the manipulator and hardware match.

The warranty ID stickers are affixed as shown in the figure.

THE MANIPULATOR, DRIVE PANEL AMPLIFIERS, GATEWAY MODULE, AND REGEN CABINET SHOULD HAVE THE SAME WARRANTY ID.
3 Installation

3.1 Handling Procedure

### CAUTION

- Avoid jarring, dropping, or hitting the drive panel during handling. Excessive vibration or impacting the MLX100 Robot Gateway may adversely affect the performance of the MLX100 Robot Gateway.

3.1.1 Moving the Drive Panel

The MLX100 drive panel weighs approximately 31 - 47 kg (68 - 104 lbs). Be sure movers are strong enough to handle this weight.

3.2 Installation Environment

The conditions listed below must be met before installing the MLX100 Robot Gateway:

- Ambient temperature must be -5 to +55°C (23 to 131°F) during operation, transportation and maintenance.
- Humidity must be low with no condensation (10~85%RH).
- It must be a place with little dirt, dust, or water.
- No flammable or corrosive liquids or gases, etc. in the area.
- Little jarring or potential for striking of the MLX100 Robot Gateway (under 0.5 g oscillation).
- No large electric noise source (such as a TIG welding device, etc.) nearby.
- No potential for collision with moving equipment such as forklifts.

3.2.1 Installation guidelines relevant to EMC Directive for EU

1. The interface assembly, 159181-701878, and heat sink assembly, 160268-1 shall be installed in a common enclosure.
2. The common enclosure shall conform to IEC 60529, IP30 and all other applicable EU and national standards.
3. The PE locations for the interface and heat sink assemblies shall be bonded to an appropriate enclosure PE location.
4. The robot cable bulk head connectors shall be bonded to an appropriate enclosure PE location using provided ground wire.
5. This partly completed machinery must not be put into service until the machinery into which it is to be incorporated, has been declared in conformity with the provisions of the MACHINERY DIRECTIVE, 2006/42/EC.
3.3 Location

1. The MLX100 drive panel is designed to be installed in a suitable industrial cabinet located outside of the P-point maximum envelope of the manipulator (outside of the safeguarding.)

*Fig. 3-1: Location of MLX100 Robot Gateway*

2. Install the drive panel in a location from which the manipulator is easily visible.

3. Install the drive panel in a location from which you can easily inspect it.

4. Install the drive panel at least 500 mm from the nearest wall to allow maintenance access.

*NOTE* Refer to the Instruction Manual for information on installation of the manipulator.

5. See fig bone and table bone for drive panel dimension requirements.
3.3 Location

6. The customer supplied cabinet must be modified as appropriate to accept the drive panel pigtail for the manipulator and regen cables. See fig. 3-3(a), fig. 3-3(b), and fig. 3-3(c).

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**Table 3-1: MLX Drive Panel Dimensions (mm)**

<table>
<thead>
<tr>
<th>Manipulator</th>
<th>Drive Panel</th>
<th>Approximate Weight (kg)</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>D1</th>
<th>E</th>
<th>E1</th>
</tr>
</thead>
<tbody>
<tr>
<td>MH5, MH5L, MH5S, MH5LS</td>
<td>159181-1</td>
<td>31</td>
<td>730</td>
<td>730</td>
<td>250</td>
<td>700</td>
<td>15</td>
<td>680</td>
<td>25</td>
</tr>
<tr>
<td>MPK50</td>
<td>158547-1</td>
<td>41</td>
<td>820</td>
<td>655</td>
<td>290</td>
<td>790</td>
<td>15</td>
<td>605</td>
<td>25</td>
</tr>
<tr>
<td>MPL160, MPL300</td>
<td>158546-1</td>
<td>43</td>
<td>820</td>
<td>655</td>
<td>290</td>
<td>790</td>
<td>15</td>
<td>605</td>
<td>25</td>
</tr>
</tbody>
</table>
3 Installation
3.3 Location

Fig. 3-3(a): MPK50 Pigtail Connections

Fig. 3-3(b): MPL160/300 Pigtail Connections
Fig. 3-3(c): MH5 / MHL5 / MH5S / MH5LS Pigtail Connections

Fig. 3-4(a): MH5 / MH5L / MH5S / MH5LS Regen Cabinet Mounting Dimensions and Weight

7. The regen cabinet may produce significant heat and should be mounted outside the main cabinet with the fans directed up. See figures fig. 3-4(a) and fig. 3-4(b).

Weight: 8 kg
Fig. 3-4(b): MPK50 and MPL160/300 Regen Cabinet Mounting
Dimensions and Weight

Weight: 13 kg
4 Connections

WARNING

• The system must be grounded. Failure to ground equipment may result in injury from fire or electric shock.

• Before wiring, make sure to turn OFF the primary power supply, and put up a warning sign. (ex. DO NOT TURN THE POWER ON) Failure to observe this caution may result in injury and electric shock.

• Do not touch any board inside the drive panel for five minutes after turning OFF the power supply. Capacitors inside the drive panel store electricity after power is turned OFF. Exercise caution whenever handling circuit boards. Failure to observe this caution may cause electrical shock.

• Power cannot be turned ON unless the door is closed. Interlocks prevent power from being turned ON. Failure to observe this caution may result in fire and electric shock.

• Any occurrence during wiring while the MLX100 Robot Gateway is in the emergency stop mode is the user’s responsibility. Do an operation check once the wiring is completed. Failure to observe this caution could lead to injury or mechanical failure.

CAUTION

• Wiring must be performed only by authorized personnel. Incorrect wiring may cause fire and electric shock.

• Perform wiring in accordance with the rated capacity as specified in the Instructions. Incorrect wiring may cause fire or mechanical breakdown.

• Be sure the power circuit screws are securely tightened. Loose power circuit wires can cause fire and electric shock.

• Do not handle the circuit board directly by hand. The IC board may malfunction due to electrostatics.
4.1 Notes on Cable Junctions

- The cables that connect the drive panel to peripheral device are low voltage circuits. Keep drive panel signal cables away from the primary power circuit. High voltage power lines should not be run in parallel to drive panel signal cables. If running parallel cables is unavoidable, use metal ducts or conduit to isolate electrical signal interference. If cables must be crossed, run the power cables perpendicular across the signal cables.

- Confirm the connector and cable numbers to prevent misconnection and equipment damage. One connects the manipulator and MLX100 Robot Gateway. Another connects the MLX100 Robot Gateway and peripheral device. A wrong connection can cause damage to electronic equipment.

- Clear the area of all unauthorized personnel while making cable connections. Place all cables in a covered cable channel in the floor.

Fig. 4-1: MLX100 Robot Gateway Cable Junction Diagram

4.2 Power Supply

4.2.1 Three-Phase Power Supply

The power failure processing circuit operates when there is a black out or drop in voltage, and the servo power turns OFF.

Connect the power supply to a stable power source that is not prone to power fluctuations.

The three-phase power supply consists as follows:

- Without built-in transformer: 230 VAC at 50/60 Hz
4.2.2 Primary Power Supply Breaker/Fuse Installation

It is the customer’s responsibility to provide adequate breaker/fusing for their application.

Install the primary power supply breaker/fuse as shown.

Fig. 4-2: Installation of the Primary Power Supply Breaker/Fuse

<table>
<thead>
<tr>
<th>Manipulator</th>
<th>Power Capacity (kVA)</th>
<th>Cable size (In case of Cabtyre cable (three cores)) (AWG)</th>
<th>Capacity of breaker/fuse in MLX (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MH5, MH5L, MH5S, MH5LS</td>
<td>1</td>
<td>16</td>
<td>10</td>
</tr>
<tr>
<td>MPL160/300</td>
<td>10.0</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>MPK50</td>
<td>6.0</td>
<td>14</td>
<td>15</td>
</tr>
</tbody>
</table>

Select and utilize the breaker/fuse with appropriate breaking capacity in consideration of the MLX100 panel power capacity for the manipulator to be used.

The maximum load value (payload, operation speed, and frequency, etc.) is displayed.

However, the power capacity is different depending on work conditions.

Inquire at the nearest branch office listed on the back cover for information when selecting the transformer.
4.3 Connection Methods

A connection diagram for the manipulator, manipulator cable, primary power cable and optional programming pendant is shown below.

*Fig. 4-3: Cable Connection*

---

### 4.3.1 Connecting the Primary Power Supply

1. Confirm that the primary power supply is OFF.
2. Run the primary power supply through fuses to TB1-1, TB1-2, and TB1-3. Connect a ground wire to reduce noise and prevent electric shock (Customer must provide fusing).

*Fig. 4-4: Details for Running the Primary Power Supply Cable*

Perform grounding in accordance with all relevant local and national electrical codes. The size of ground wire must the same as listed on table 4-1 "MLX100 Robot Gateway Power Capacity, Cable Sizes, and Breaker/Fuse Capacities" at page 4-3.

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>The customer must prepare the ground wire.</td>
</tr>
</tbody>
</table>
4.3.2 Connecting the Manipulator Cable

1. Remove the package, and take out the manipulator cable. Connect the cable to the MLX100 Robot Gateway connectors.

2. Connect the manipulator to the MLX100 Robot Gateway.
   - Confirm the shape and size of the cable connector, the key fitting, and the position of the pins of the manipulator. Push the cable connector into the manipulator side connector firmly, and tighten securely.

**NOTE**

Don't connect the grounding wire with the wires for the electric power source, the welder, etc.

Ground in accordance with all relevant governmental regulations when using metallic ducts, metallic conduits, and cable tray to construct the cable.

For more information on connecting the manipulator cable, please refer to the Instruction Manual which corresponds to the particular robot model.

**CAUTION**

Always keep the MLX100 panel in an isolated enclosure.
If dust or water enter inside the drive panel, electric shock or breakdown of MLX100 Robot Gateway may result.
5 Turning ON and OFF the Power Supply

5.1 Turning ON the Main Power Supply

WARNING

Confirm that nobody is present in the P-point maximum envelope of the manipulator when turning ON the MLX power supply.

Failure to observe this caution could result in injury caused by accidental contact with the manipulator.

Press an emergency stop button immediately if any problems occur.

The main power supply is turned ON when the customer prepared, 3-phase power supply is engaged.

5.2 Turning OFF the Power Supply

5.2.1 Turning OFF the Servo Power (Emergency Stop)

The manipulator cannot be operated when an emergency stop button is pressed.

• Press the emergency stop button and the servo power supply is turned off.

• The brake operates once the servo power supply is turned OFF, and the manipulator can no longer operate. The emergency stop can be operated at any mode. (Teach mode, Play mode)

Typical Emergency Stop
6 Test of Program Operation

6.1 Movement of the Axes

Move each axis of the manipulator by pressing the appropriate axis buttons on the MLX HMI.
The following figures illustrate each axis of motion in the joint coordinates.

**NOTE**

Be sure to remove all items from the area before moving the manipulator. Refer to the INSTRUCTION MANUAL for the appropriate position of the fixture.

*Fig. 6-1: 4-Axis Manipulator*

![4-Axis Manipulator Diagram]

*Fig. 6-2: 5-Axis Manipulator*

![5-Axis Manipulator Diagram]
Fig. 6-3: 6-Axis Manipulator

Fig. 6-4: 7-Axis Manipulator
7 System Setup

7.1 Home Position Calibration

**WARNING**

- Various settings control system compatibility and manipulator performance characteristics. Exercise caution when changing settings that can result in improper manipulator operation.

Personal injury and/or equipment damage may result if incorrect settings are applied by the user.

- Observe the following precautions to safeguarding system settings:
  - Maintain supervisory control of user functions.
  - Retain data backups of control settings each time settings are changed.

**WARNING**

- Before operating the manipulator, check that the servo power turns OFF when the system emergency stop buttons are pressed.

Injury or damage to machinery may result if the manipulator cannot be stopped in case of an emergency.

- Observe the following precautions when performing teaching operations within the P-point maximum envelope of the manipulator:
  - View the manipulator from the front whenever possible.
  - Always follow the predetermined operating procedure.
  - Always prepare your reactions to a manipulator’s unexpected approach toward you.
  - Ensure that you have a safe place to retreat in case of emergency.

Improper or unintended manipulator operation may result in injury.

- Prior to performing the following operations, be sure that no one is in the P-point maximum envelope of the manipulator, and be sure that you are in a safe place when:
  - Turning ON the MLX100 Robot Gateway power.

Injury may result from contact with the manipulator if persons enter the P-point maximum envelope of the manipulator.

Always press an emergency stop button immediately if there are problems.

Emergency stop buttons should be located within easy access of the MLX100 Robot Gateway.
7 System Setup
7.1 Home Position Calibration

CAUTION

- Perform the following inspection procedures prior to teaching the manipulator. If problems are found, correct them immediately, and be sure that all other necessary tasks have been performed.
  - Check for problems in manipulator movement.
  - Check for damage to the insulation and sheathing of external wires.

7.1.1 Home Position Calibration

Teaching and playback are not possible before the completion of the home position calibration.

In a system with two or more manipulators, the home position of all the manipulators must be calibrated before starting teaching or playback.

Home position calibration is an operation in which the home position and absolute encoder position coincide. Although this operation is performed prior to shipment at the factory, the following cases require this operation to be performed again.

- Change in the combination of the manipulator and MLX100 Robot Gateway drive panel
- Replacement of the motor or absolute encoder
- Clearing stored memory (MLX Gateway, weak battery, etc.)
- Home position deviation caused by hitting the manipulator against a workpiece, etc.

To calibrate the home position, use the axis keys to calibrate the home position mark on each axis so that the manipulator can take its posture for the home position. There are two operations for home position calibration:

- Axes can be moved individually: Recalibrate the home position for the individual axes that were affected by the replacement, if replacing the motor or absolute encoder.

If the absolute data of its posture for the home position is already known, set the absolute data again after completing home position registration.
7 System Setup
7.1 Home Position Calibration

7.1.2 Calibrating Operation

**NOTE**
Home position calibration can only be performed in management mode.

1. From the [Login] screen, enter User: "manager" and Password: "manager". The main screen shows "MANAGER" when successful.

2. Press the [Teach Screen] button. The RLX - Teaching and Jogging screen appears.

3. Set Jog Speed to "Inch" and Coordinate System to "Axis."

4. Turn servo power ON by pressing [Reset], and then the [Enable Servos] button.

---

162647-1CD 40/66
5. Jog the robot to its home position marks. Adjust the Jog Speed as required.

6. When in home position, press [MENU], then [Robot Configuration].


8. Wait 10 seconds and press [Save Home Offsets].
   • Observe a WARNING appears.

9. Press the [Save Home Offsets] on the !!WARNING!! pop-up screen.
10. Wait five seconds then press [MENU] in the lower left and press the [Restart RLX-R] button.

11. The robot is now homed.

NOTE

When communication is re-established, the Axis Position list values should be close to zero, Motoman may have drifted slightly at servo off. It should take 15 to 30 seconds for the Robot Gateway to return to active communication.
7.1.3 Home Position of the Robot

In case of MH5, the home position are as follows.

Other manipulator models have different positions. Always refer to "MANIPULATOR INSTRUCTIONS" for the correct manipulator model.
7.1.4 Purpose of Position Check Operation

If the absolute number of rotation detected at power supply ON does not match the data stored in the absolute encoder the last time the power supply was turned OFF, an alarm is issued when the drive panel power is turned ON.

There are two possible causes of this alarm:

- Error in the encoder system
- The manipulator was moved after the power supply was turned OFF.

If there is an error with the encoder system, the manipulator may stall when playback is started. If the absolute data allowable range error alarm has occurred, playback and test runs will not function and the position must be checked.

7.1.5 Procedure after the Alarm

WARNING

- Be aware of safety hazards when performing the position confirmation of the specified point.

Abnormality of the encoder system may be the cause of the alarm. The manipulator may operate in an unexpected manner, and there is a risk of damage to equipment or injury to personnel.
7.2 Tool Data Setting

7.2.1 Registering Tools

7.2.1.1 Number of Tools

There are 24 tool files numbered 0 to 23.

7.2.1.2 Registering Coordinate Data

When the number input operation is used for registering the tool file, input the TCP of the tool on the flange coordinates.

1. From the Teach screen, select [Set Tool].
2. The system must be in Teach mode with all errors cleared before adjustments can be made to Tool Data. The message "Switch to TEACH mode to set" appears if the system is left in Play mode.

Fig. 7-1: Setup Tool Properties

3. While in Teach Mode, press the tool number to select the Tool Number and modify. Press the Return key after the tool number is entered.
4. Click the box to the right of the tool number to enter a text description.
5. Enter the tool data following the examples shown below in Tool A and Tool B:
Fig. 7-2: Tool A and Tool B

**Tool Properties Setup**

- **Robot**: MLXL
- **Tool Number**: 2 - Tool A
- **Active Tool**: 1

**Tool Size**

- **X**: 0.80 mm, Rz: 0.00 deg
- **Y**: 260.00 mm, Ry: 0.00 deg
- **Z**: 0.80 mm, Rz: 0.00 deg

**Tool Mass**

- **Xg**: 0.00 mm, Ix: 0.00 Kg m²
- **Yg**: 0.00 mm, Iy: 0.00 Kg m²
- **Zg**: 0.00 mm, Iz: 0.00 Kg m²
- **W**: 0.00 kg

**Dimensions**

- **TCP Tool A**: 260 mm
- **TCP Tool B**: 260 mm
6. Click the [Save Tool Data] button to store the modified tool information.

**NOTE**

Tool data is not saved to the MLX until the [Save Tool Data] button is clicked. If data is incorrectly modified, simply close this screen and no changes will be made to the tool data. Similarly, changes are not retained until the [Save Tool Data] button is clicked.

7. Click on the [Execute Change Tool] button to have the robot use this tool when moving in the Tool Coordinate system. The tool appears as the active tool on the Teach screen.
8. The active tool can also be changed by entering the [Active Tool] button.
7.2.1.3 Registering Tool Angle

The tool pose data is angle data which shows the relation between the flange coordinates and the tool coordinates. The angle when the flange coordinates are rotated to meet to the tool coordinates becomes an input value. Clockwise toward the arrow is the positive direction.

In the following case, register $R_z=180$, $R_y=90$, $R_x=0$

![Diagram showing tool angles]

- Input rotation angle around $Z_F$ of the flange coordinates.
Ry must be the input rotation angle around $Y'_F$ flange coordinates.

$\text{Rx} = 0$

Rx must be the input rotation angle around $X'_F$ of flange coordinates.
7.2.1.4 Setting the Tool Load Information

The tool load information includes weight, a center of gravity position, and moment of inertia at the center of gravity of the tool installed at the flange.

7.2.2 Tool Calibration

To ensure that the manipulator can perform motion type operations such as linear and circular motion types correctly, accurate dimensional information on tools such as torches, tools, and guns must be registered and the position of the TCP must be defined.

Tool calibration is a function that enables this dimensional information to be registered easily and accurately. When this function is used, the TCP is automatically calculated and registered in the tool file.

What is registered in tool calibration is the coordinates of the TCP and the tool posture data in the flange coordinates.

<Flange coordinates>
XF: Vertically upward direction when the current position on the T-axis of the manipulator is "0"
YF: Y-axis complementing XF and ZF
ZF: Direction perpendicular to the flange face
After registering the tool file, check if the TCP is correctly registered by performing a TCP fixed operation like the one shown below, in any coordinate system other than the joint.

1. Move the R, B, or T axes using the axis key.
   - By pressing the axis keys for the A3, A4, and A5 axes, change the manipulator pose without changing the TCP position. If this operation shows a large TCP error, adjust the tool data.
WARNING

• When turning ON the power to MLX, be sure that there is no one within the P-point maximum envelope of the manipulator, and that you are in a safe place.

Injury may result from collision with the manipulator to anyone entering the P-point maximum envelope of the manipulator. Always press the emergency stop button immediately if there are problems.

• Always set the teach lock before starting teaching.

• Observe the following precautions when performing teaching operations within the P-point maximum envelope of the manipulator:
  – View the manipulator from the front whenever possible.
  – Always follow the predetermined operating procedure.
  – Always have an escape plan in mind in case the manipulator comes toward you unexpectedly.
  – Ensure that you have a place to retreat to in case of emergency.

Improper or unintentional manipulator operation can result in injury.

• Before operating the manipulator, check that servo power is removed when an emergency stop button is pressed.

Injury or damage to machinery may result if the manipulator cannot be stopped in case of an emergency.

CAUTION

• Perform the following inspection procedures prior to performing teaching operations. If problems are found, correct them immediately, and be sure that all other necessary processing has been performed.
  – Check for problems in manipulator movement.
  – Check for damage to the insulation and sheathing of external wires.
## 8.1 Specification List

<table>
<thead>
<tr>
<th>Drive Panel</th>
<th>Construction</th>
<th>Free-standing, open sub panel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions</td>
<td>Refer to following</td>
<td></td>
</tr>
<tr>
<td>Cooling System</td>
<td>Indirect cooling</td>
<td></td>
</tr>
</tbody>
</table>
| Ambient Temperature | -5°C to + 55°C (During operation)  
-5°C to + 55°C (During transit and storage) | |
| Relative Humidity | 10% to 85%RH (non-condensing) | |
| Power Supply (24 VDC) | Allen Bradley | |
| Grounding | Grounding resistance: 100Ω or less  
Exclusive grounding | |
| Digital I/O | - None provided  
- Add in via PLC modules | |
| Positioning System | By serial communication  
(absolutely encoded) | |
| Drive Unit | SERVOPACK for AC servomotors | |
| Acceleration/Deceleration | Software servo control | |
| Memory Capacity | PLC processor dependent | |
8.2 Equipment Configuration

The MLX100 Robot Gateway drive panel is comprised of individual units and modules. Malfunctioning components can generally be easily repaired after a failure by replacing a unit or a module.

This section explains the configuration of the MLX100 Robot Gateway equipment.

8.2.1 Arrangement of Units and Circuit Boards

The arrangements of units and circuit boards in one robot model is shown. Other robot models follow a similar layout.

- Small Capacity

Fig. 8-1: Configuration - MPL160 Shown

Table 8-1: MLX100 Parts

<table>
<thead>
<tr>
<th>Description</th>
<th>MPK50</th>
<th>MPL160</th>
<th>MPL300</th>
<th>MH5</th>
<th>MH5L</th>
<th>MH5S</th>
<th>MH5LS</th>
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<tbody>
<tr>
<td>MLX100 Robot Package</td>
<td>159078-1</td>
<td>159079-1</td>
<td>159433-1</td>
<td>159185-1</td>
<td>160622-1</td>
<td>161997-1</td>
<td>161965-1</td>
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<td>MLX100 Control Panel</td>
<td>158547-1</td>
<td>158546-1</td>
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<td>Robot Manipulator</td>
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<td>158466-1</td>
<td>159473-1</td>
<td>159134-1</td>
<td>157710-9</td>
<td>160427-5</td>
<td>160741-5</td>
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<tr>
<td>Manipulator 1BC Cable Length, 5M</td>
<td>155685-2</td>
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<td>Manipulator 2BC Cable Length, 5M</td>
<td>155688-2</td>
<td>151482-2</td>
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<td>Manipulator 3BC Cable Length, 5M</td>
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<td>156874-2</td>
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<td>160268-1</td>
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<td>Cable, Regen Resistor Unit, 1M</td>
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<tr>
<td>MLX100 Gateway Module</td>
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8-3
## Table 8-2: Configuration

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<tr>
<th>Model Type</th>
<th>S</th>
<th>L</th>
<th>U</th>
<th>R</th>
<th>B</th>
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<td><strong>MPK50</strong></td>
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<td>SV0</td>
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<td>SV3</td>
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<tr>
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<td>REGEN RESISTOR</td>
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<tr>
<td><strong>MH5, MH5L, MH5S, MH5LS</strong></td>
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</table>
WARING

- When turning ON the power to MLX100 Robot Gateway, be sure that there is no one within the P-point maximum envelope of the manipulator, and that you are in a safe place.

Injury may result from collision with the manipulator to anyone entering the P-point maximum envelope of the manipulator. Always press the emergency stop button immediately if there are problems.

- Always set the teach lock before starting teaching.

- Observe the following precautions when performing teaching operations within the P-point maximum envelope of the manipulator:
  - View the manipulator from the front whenever possible.
  - Always follow the predetermined operating procedure.
  - Always have an escape plan in mind in case the manipulator comes toward you unexpectedly.
  - Ensure that you have a place to retreat to in case of emergency.

Improper or unintentional manipulator operation can result in injury.

- Before operating the manipulator, check that servo power is removed when an emergency stop button is pressed.

Injury or damage to machinery may result if the manipulator cannot be stopped in case of an emergency.

CAUTION

Perform the following inspection procedures prior to performing teaching operations. If problems are found, correct them immediately, and be sure that all other necessary processing has been performed.

- Check for problems in manipulator movement.

- Check for damage to insulation and sheathing of external wires.
Cautions for Connection of Dual Channel Safety Input Signals

CAUTION

• Connect the switch (contact) that turns the dual signals ON and OFF simultaneously.
• If the timing that turns the two signals ON and OFF is not right, a disagreement alarm occurs. Refer to the figure below.

![Diagram of MLX100 Robot Gateway](image)

CAUTION

• Do not connect two signals to the same contact point. (Prepare two individual contact points)
• Since the power supply for each signal is reversed, it will short-circuit and may cause breakdown of MLX100 Unit if the signals are connected to the same contact point.

![Diagram of MLX100 Robot Gateway](image)
External Emergency Stop
This signal is used to connect the emergency stop switch of an external device. If the signal is input, the servo power is turned OFF and the job is stopped. While the signal is input, the servo power cannot be turned ON.

CAUTION

- Always connect the signals after removing jumper cable.
If the cables are not removed, injury or damage to machinery may result and the external emergency stop will not work even if the signal is input.

Fig. 9-1: Connection for External Emergency Stop
### Safety Plug

This signal is used to turn OFF the servo power if the door on the safeguarding is opened. Connect to the interlock signal from the safety plug on the safeguarding door. If the interlock signal is input, the servo power turns OFF. While the signal is turned ON, the servo power cannot be turned ON. Note that these signals are disabled in teach mode.

**CAUTION**

- Always connect the signals after removing jumper cable. If the cables are not removed, injury or damage to machinery may result and the external emergency stop will not work even if the signal is input.

*Fig. 9-2: Connection for Safety Plug*
Installation of Safety Plug

The manipulator must be surrounded by a safeguarding and a door protected by an interlock function. The door must be opened by the technician to enter and the interlock function stops the robot operation when the door is open. The safety plug input signal is connected to the interlock signal from the gate.

If the servo power is ON when the interlock signal is input, the servo power turns OFF. The servo power cannot be turned ON while the interlock signal is input. However, the servo power does not turn OFF when the door is opened only during the teach mode. In this case, the servo power can be turned ON while the interlock signal is input.
### External Enable Switch

This signal is used to connect Enable switch other than the one on the programming pendant when two people are teaching.

**CAUTION**

- Always connect the signals after removing jumper cable. Injury or damage to machinery may result because the external emergency stop do not work even if the signal is input.

*Fig. 9-3: Connection for External Enable Switch*

![Diagram of External Enable Switch](image)

<table>
<thead>
<tr>
<th>Signal Name</th>
<th>Connection No. (TB2)</th>
<th>Dual input</th>
<th>Function</th>
<th>Factory Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXTESP1+</td>
<td>TB2-7</td>
<td></td>
<td>External Emergency Stop</td>
<td>Switch included and wired.</td>
</tr>
<tr>
<td>EXTESP1-</td>
<td>TB2-8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXTESP2+</td>
<td>TB2-14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXTESP2-</td>
<td>TB2-15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PPESP1+</td>
<td>TB2-8</td>
<td></td>
<td>Programming Pendant Emergency Stop</td>
<td>Short-circuit with a jumper cable (Wired if purchased with Teach Pendant.)</td>
</tr>
<tr>
<td>PPESP1-</td>
<td>TB2-9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PPESP2+</td>
<td>TB2-15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PPESP2-</td>
<td>TB2-16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PBESP1+</td>
<td>TB2-9</td>
<td></td>
<td>Push Button Emergency Stop</td>
<td>Short-circuit with a jumper cable</td>
</tr>
<tr>
<td>PBESP1-</td>
<td>TB2-10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PBESP2+</td>
<td>TB2-16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PBESP2-</td>
<td>TB2-17</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
A SERVOPACK consists of a converter and a PWM amplifier.

### 9.1 SERVOPACK Configuration

#### Table 9-1: Servopack Configuration

<table>
<thead>
<tr>
<th>Configuration Device</th>
<th>MPK50 Model</th>
<th>MPL160, MPL300 Model</th>
<th>MH5, MH5L, MH5S, MH5LS Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>SERVOPACK</td>
<td>SV0 157430-9</td>
<td>SV0 157430-9</td>
<td>SV0 157430-5</td>
</tr>
<tr>
<td></td>
<td>SV1 157430-9</td>
<td>SV1 157430-9</td>
<td>SV1 157430-5</td>
</tr>
<tr>
<td></td>
<td>SV2 157430-9</td>
<td>SV2 157430-9</td>
<td>SV2 157430-3</td>
</tr>
<tr>
<td></td>
<td>SV3 157430-2</td>
<td>SV3 157430-7</td>
<td>SV3 157430-10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SV4 157430-10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SV5 157430-10</td>
</tr>
</tbody>
</table>
10 Inspection and Maintenance

10.1 Panel Inspection

The following procedures in the table below is for the inspection and maintenance of the MLX panel. No other routine inspections are required.

<table>
<thead>
<tr>
<th>Item</th>
<th>Frequency</th>
<th>Procedure</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exterior</td>
<td>At least once a year</td>
<td>Check for dust, dirt, and oil on the surfaces.</td>
<td>Clean with compressed air.</td>
</tr>
<tr>
<td>Loose Screws</td>
<td></td>
<td>Check for loose terminal block and connector screws.</td>
<td>Tighten any loose screws.</td>
</tr>
</tbody>
</table>

10.2 Part Replacement Schedule

Electrical or electronic components are subject to mechanical wear or deterioration over time. To avoid failure, replace parts per manufacturer requirements.