

# **MX Series Operating Manual**

**MX Series  
Modular Automation for  
Nano, Micro, and Analytical Scale  
HPLC Applications**

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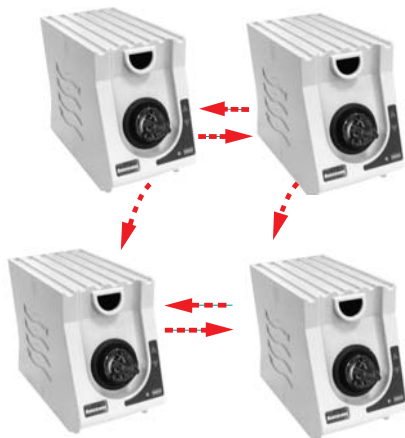
# Introduction to MX Automated Valves

## Introduction

MX units are self-contained fluid handling solutions available in a variety of flow paths and valve positions for use in many applications. For multiple valve applications, the MX's unique "Snap n' Stack" system allows units to be stacked on top of each other or connected side to side to conserve available bench space and to reduce connection volumes. Each MX unit can be operated via push button, allowing the MX unit to function as a manual valve, or can be controlled remotely by contact closure for automation.



Fig. 1. Representative illustration of MX family of automated, ready-to-use, fluid valves. The MX 2-Position, 6-Port unit is shown above as an example.



Convenient "Stack n' Snap" connection system allows MX Valves to be joined on top of each other and side to side to save bench space and keep tubing to minimal lengths.

## Unpacking the MX Unit

Inspect contents for damage and/or shortage. Keep the original packaging in case the device

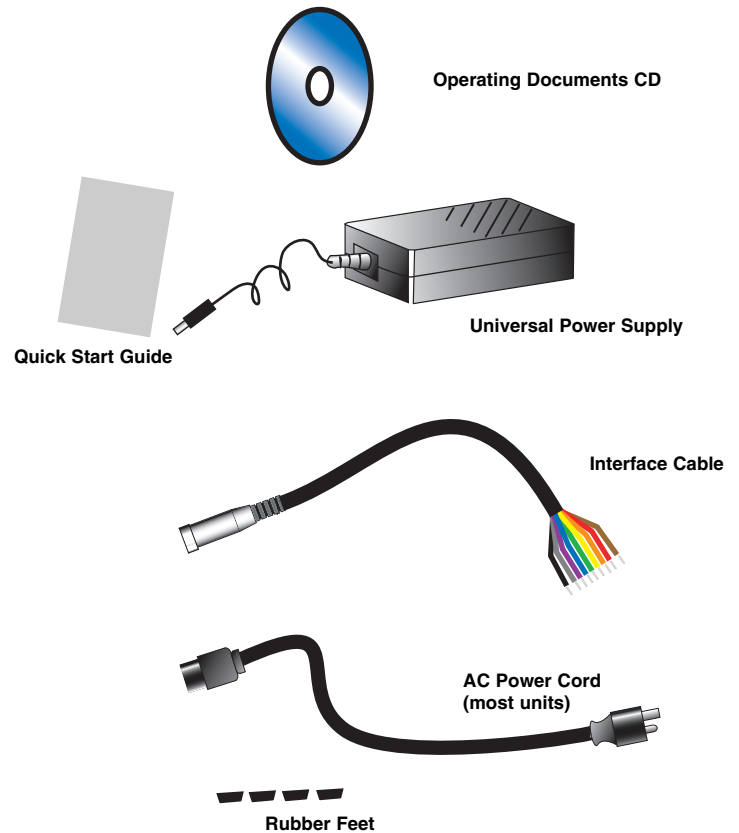
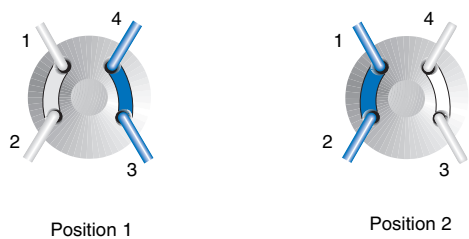


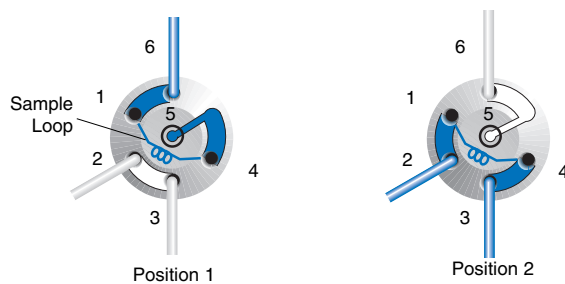
Fig. 2. Contents: MX unit, RheFlex® Fittings, Interface Cable, Rubber Feet, Universal Power Supply, Power Cord (most units), Quick Start Guide, and Operating Instructions CD.

# MX Flowpaths

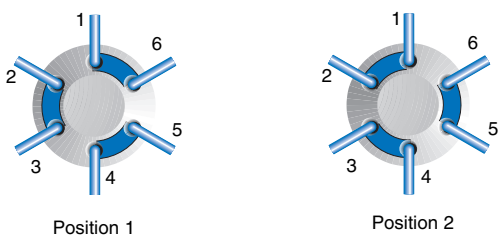
## High-Pressure Two-Position



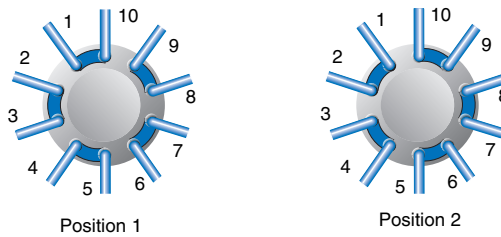
**Fig. 3. Nano-Scale (10 nL) Sample Injectors MX7984-000 (DuraLife™ II).**



**Fig. 4. Analytical-Scale Syringe Loading Injector MX7925-000 (Stainless Steel) and (Biocompatible) MX9925-000.**



**Fig. 5. Analytical-Scale MX7900-000 (Stainless Steel) and (Biocompatible) MX9900-000, and Nano-Scale MX7980-000 (DuraLife™ II).**



**Fig. 6. Analytical-Scale MX7960-000 (Stainless Steel) and Nano-Scale MX7986-000 (DuraLife™ II).**

# MX Specifications

## Device Specifications

- Temperature Range: 0°- 40°C, non-condensing.
- Storage and Shipment Temperature: -40° to 75°C.
- Maximum Relative Humidity: 80% up to 31°C decreasing to 50% at 40°C.
- Maximum Operating Pressures:

### 35 Mpa (345 bar, 5000 psi)

MX7900-000 and MX9900-000  
MX7925-000 and MX9925-000  
MX7960-000  
MX7980-000  
MX7984-000  
MX7986-000

- Wetted Surfaces:

### Stainless Steel

MX7900-000  
MX7925-000  
MX7960-000

### Biocompatible

MX9900-000  
MX9925-000

### DuraLife™ II

MX7980-000  
MX7984-000  
MX7986-000

- Connections:

### 10-32 Male Threaded Fittings

MX7900-000 and MX9900-000  
MX7925-000 and MX9925-000  
MX7960-000

### M4 Male Threaded Fittings

MX7980-000  
MX7984-000  
MX7986-000

- Weight: 0.58 Kg (1 lb 4.5 oz)
- Dimensions (HxWxD): 11.7 cm (4.6 in) x 7.6 cm (3.0 in) x ~15.0 cm (5.9 in).
- CE Mark represents compliance with laboratory electromagnetic emission regulations.

# Installation

## Cautions

- Use only a contact closure or a TTL relay for connections from your instrument to the MX unit.
- Do not supply more than 18 VDC to the MX unit or it will be damaged.
- Rinse the valve after using buffer solutions to prevent the formation of crystals that can scratch the sealing surfaces.
- Use only the supplied Universal Power Supply for connection to the MX unit.
- Operate within temperature range of 0°- 40°C only.

## Warnings

- Do not submerge MX units in liquids.
- Confirm that there is adequate ground between your controlling instrument and the MX unit. Adequate grounding is especially important with electrospray mass spectroscopy.
- Plug the Universal Power Supply into the MX unit first, then plug the Universal Power Supply into an AC power source.
- When disconnecting, unplug at the AC power source first.



## General Description

The MX unit is small and is capable of both automated and manual control.

Schematics of the available flow diagrams are shown on page 4. The circles represent the ports in the valve Stator. The grooves represent the connecting passages in the Rotor Seal.

All electrical and communication connections to the MX unit are made in the rear of the device (see Figure 9).

## Electrical Connections

- Plug the Universal Power Supply (1) male barrel connector (2) into the MX unit female port (3).
- Plug the IEC 320 connector (4) of the Power Cord into the Universal Power Supply (1).
- Plug the opposite end of the Power Cord into a properly grounded power source (5). The Universal Power Supply can be operated from inputs of 100-240 VAC, 50-60 Hz. The output is 18 VDC, 1.0A.

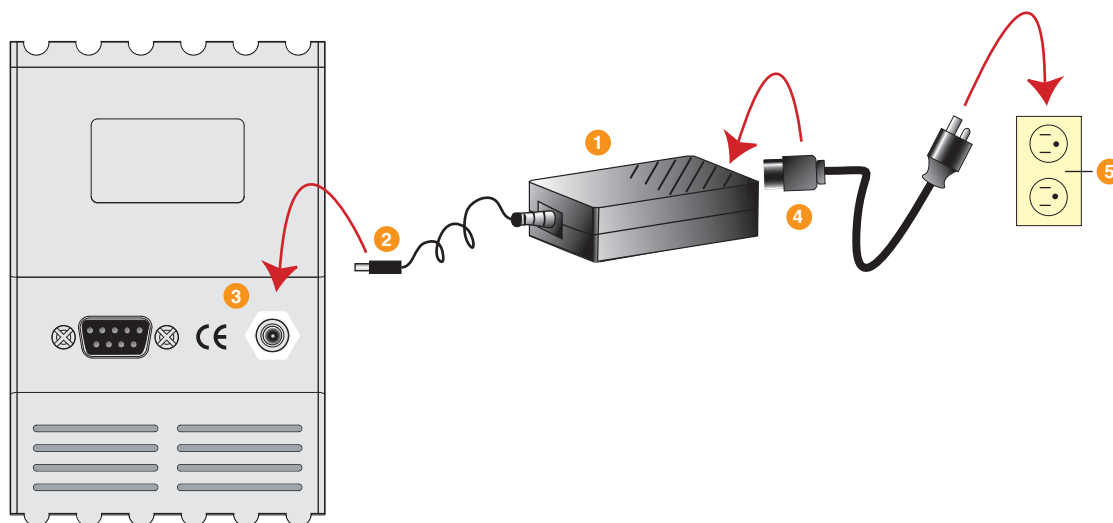


Fig. 9. Electrical connections to MX unit.

# Installation (Cont.)

## Communication Cable Connections

There are two ways to automate control of the MX unit. The first is Input Line Control with level logic using the supplied interface cable and contact closures or TTL relays of the controlling instrument. The second is Level Line Control with BCD Logic.

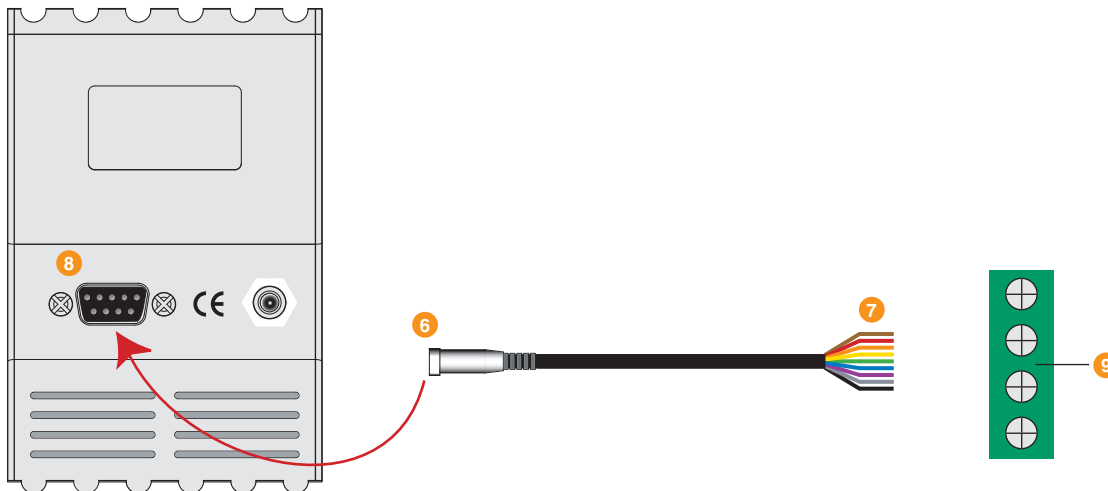


Fig. 10. Communications connections for input line control 2-position MX units.

## Remote or Automated Operation

- Connect the interface cable (6) to the mating connector (8) on the back of the MX unit.
- Connect the interface cable wires (7) to the controlling instrument contact closure or TTL relay (9).
- The instrument used to control the MX unit must have one TTL or contact closure output (one event relay) for 2-position valves and three TTLs or contact closure outputs for multi-position valves. Figure 11 shows wiring the connecting wires (1) from the MX unit to the controlling instrument (2) for Input Line Control.

### Two-Position MX Units

- Connect the BROWN wire of the interface cable from the MX unit to the ground terminal of the controlling instrument event relay 1 (R1).
- Connect the BLUE wire from the MX interface cable to the controlling instrument event relay 1 (R1).
- See example on page 9 of generic time programming commands for this type of control.

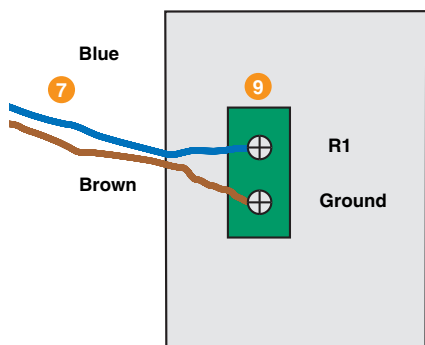
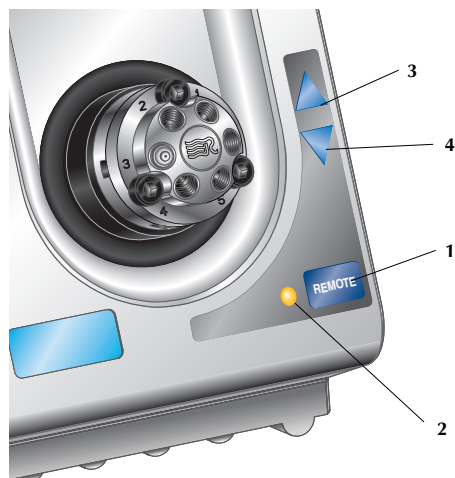


Fig. 11. Wire connections for 2-position MX units.

# Operation

## Control Panel Overview



The MX unit control panel is shown in Figure 13.

- (1) Remote Button
- (2) Remote Indicator Light
- (3) Manual Forward Position Selector Button
- (4) Manual Backward Position Selector Button

Fig. 13. MX unit control panel.

## Local or Manual Operation

- Put the MX unit in the Local mode by pushing the Remote button. Local mode is indicated when the LED next to the Remote Button is not illuminated.
- Use the Forward Position Selector Button to move the valve in the clockwise direction.
- Use the Backward Position Selector Button to move the valve in the counterclockwise direction.

## The Electronic Self Test

- To confirm proper operation, the MX unit can be put through a Self Test. This test is a valuable diagnostic tool to help determine potential problems.
- Put the MX unit in the Local mode. Local mode is indicated when the LED next to the Remote Button is not illuminated
- To start the Self Test, simultaneously press the Forward Position Selector Button and the Backward Position Selector Button.
- The MX unit will cycle through all available positions and return to the home position if it passes the Self Test.
- If "EE" (ERROR) appears in the numeric display the Self Test has failed, Refer to **Troubleshooting**.

# Operation (Cont.)

## Remote or Automated Operation

### 1. Input Line Control (controlling with a contact closure or TTL relay)

a) 1-line control (for models with two positions). The instrument used to control this model must have one [1] *TTL* or contact closure output.

(1) When the logic state is changed to OPEN, (HIGH, or OFF), the valve will rotate to position #1. When the logic state is changed to CLOSED, (LOW, ON, or GROUND), the valve will rotate to position #2.

(2) Wire the interface cable to the instrument for 1-line control (see Figure 11).

(3) 1-line level logic generic time programming example follows. (Note: the actual programming will vary depending on the manufacturer of the instrument used):

Program 1		
Time	Relay 1	Comments
Initial	Open	Valve is in position #1
30	Closed	Moves to position #2
40	Open	Moves to position #1

# Maintenance

## Electrical Maintenance

- If an electrical problem is encountered, please consult **Electrical Connections** on pages 6-9 and **Troubleshooting** on pages 12-14. If the problem persists contact your vendor for assistance.
- No maintenance is required for the electronic components.

## High-Pressure Valve Maintenance

With normal use the MX unit will provide tens of thousands of cycles. The main cause of early failure, which is seen as valve leakage, is abrasive particles in the sample and/or mobile phase or crystallization of buffer solutions. Either can cause scratches on the Rotor Seal and Stator Face Assembly. RheBuild® Kits are available from your vendor for repair needs (see Figure 16).

## Valve Disassembly

- Remove the Stator Screws from the Stator with the Hex Key provided with the RheBuild® Kit.
- Remove the Stator and the Stator Face Seal\* from the valve body.
- Slip a flat head screwdriver underneath the old Rotor Seal to remove it.
- Remove the Stator Face Seal\* from the Stator.

## Valve and Reassembly

- Mount the new Stator Face Seal\* on the Stator. The three pins on the Stator Face Seal\* fit into the mating holes in the Stator only one way.
- Mount the Stator and Stator Face Seal\* on the Shaft Assembly so the stator locating pins in the body enter the mating holes in the Stator.
- Mount the new Rotor Seal with the grooves facing the Stator. The three pins on the Shaft Assembly (orange) fit into the mating holes in the Stator (orange) only one way.
- Replace the three Stator Screws. Tighten each down firmly (no more than 6 in/lbs [0.7 Nm]).

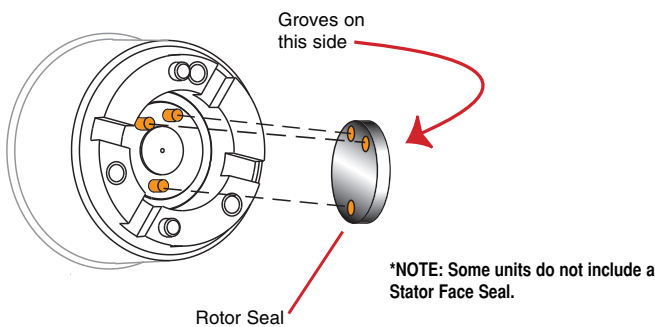


Fig. 15. Replacing Rotor Seal in MX unit.

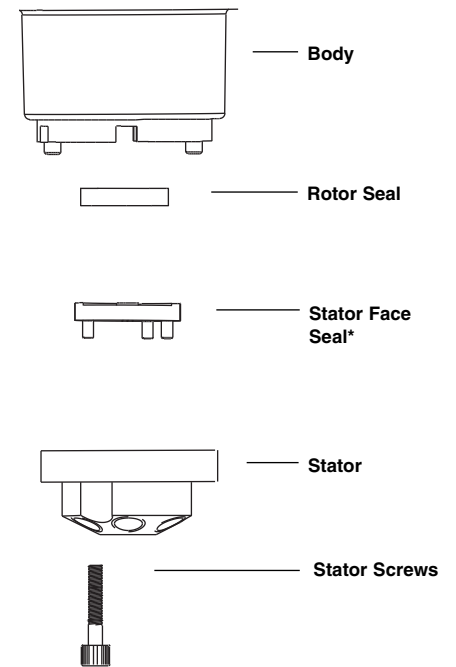


Fig. 14. Exploded view of generic high-pressure MX valve.

\*NOTE: Some units do not include a Stator Face Seal.

## MX RheBuild® Kits

Please contact your vendor for MX RheBuild Kits. Each kit contains all the parts and instructions to maintain your MX unit valve.



Fig. 16. Complete RheBuild® Kit for MX unit containing all the parts, tools, and instructions to maintain precision performance. Parts may vary in each RheBuild Kit

# Definitions

## Contact Closure

Also known as open collector or relay. It simply means there is no connection when the circuit is open. The line is either grounded (CLOSED) or not (OPEN).

## Event Relay

See External Event Relay.

## External Event Relay

These are the terminals on the controlling instrument where the MX unit is connected. They are also known as Timed Event Terminals, External Event Terminals or Time Function Switches. Each relay has two terminals. When the relay is a TTL, one is ground, the other is HI/LO (+5 volts/0 volts). When the relay is a contact closure either terminal can be ground, the other is to the control line.

## Ground

Common reference point required between two or more devices.

## Input

The electrical communication coming into a device. For example, the MX unit requires either a TTL or contact closure.

## Level Logic

Type of electrical signal. In reference to the MX unit, any change in the control signal's logic state will cause the valve to move one position.

## Line Control

A remote control scheme employing separate wires. Each wire is used with a common ground to send signals controlling the instrument.

## Logic State

The terminal at the event relay is in either one or the other state in the following pairs, HI/LO, OPEN/CLOSE, OFF/ON, OPEN/GROUND. For example, in a contact closure switch the relay is either grounded (GROUND) or not (OPEN).

## Output

The electrical communication coming out of a device. For example, the MX unit has two output lines which are provided via the terminal block. Pin number 5 of the terminal block is the Busy/Done feedback (LO = busy, HI = done) and Pin number 6 is the Error feedback (LO = error detected, HI = no error detected).

## State

See Logic State.

## Terminal

The position at the event relay where the wire is connected. Each event relay has two terminals.

## TTL

Abbreviation for Transistor-Transistor-Logic, also called digital logic. A control line is either HI (+5 volts) or LO (0 volts). Typical OFF state of an instrument's TTL switch is HI.

## Universal Power Supply

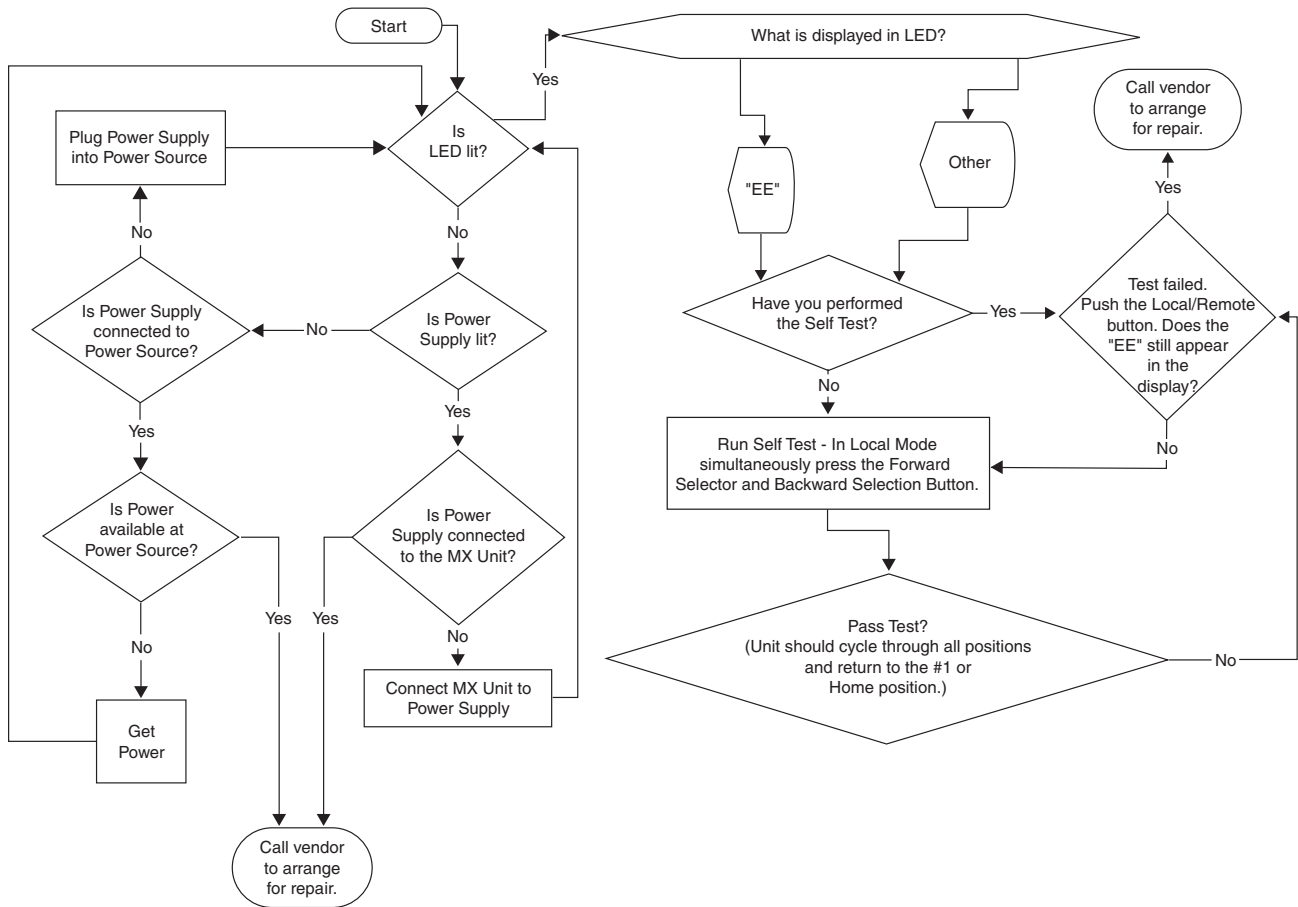
The adapter that converts electrical power from a wall socket to usable power to run the MX unit. The input required is 100-240 VAC, 50-60 Hz. The output of the power supply to run is 18 VDC.

# Troubleshooting

Symptom	Cause	Solution
1: Valve leaks between the Stator and Stator Ring or from a port.	<b>A:</b> The Rotor Seal and Stator Face Assembly have been damaged by abrasive particles in the sample and/or mobile phase or crystallization of buffer solutions.	Replace the Rotor Seal and Stator Face Assembly using the MX unit RheBuild <sup>®</sup> Kit available from your vendor. Filter sample and mobile phase. Flush the valve frequently to prevent crystallization of buffer solutions.
	<b>B:</b> The pressure rating of the valve has been exceeded.	Confirm that the pressure increase is not caused by a blockage in the flow path. If no blockage, lower the flow rate or change the post MX unit tubing to decrease the pressure.
	<b>C:</b> The port is damaged and a fitting does not seal correctly.	Replace the Stator.
2: Valve is not rotating.	<b>A:</b> There is no power to the MX unit.	Confirm there is power at the source and all electrical connections are secure.
	<b>B:</b> The program and/or wiring to control the MX unit is incorrect.	Check the program used to control the MX unit. Review the wiring on page 7.
	<b>C:</b> Nothing happens when pressing the Forward Position Selector button while attempting to change the valve position.	Set the control mode to local (manual) mode.
	<b>E:</b> Attempting to rotate the valve using the Remote (automated) control mode (with either TTL or contact closure).	Verify that you have programmed the computer or instrument control software correctly and that the device is outputting a correct output (either TTL or contacts).
	<b>F:</b> Additional problems.	See <b>Troubleshooting Flow Charts</b> on pages 13-14.
3: After running the Self Test (see <b>Electronic Self Test</b> on page 8) "EE" shows in the LED display.	<b>A:</b> The electronics are not responding correctly.	See <b>Troubleshooting Flow Charts</b> on pages 13-14.
4: Remote control problems.	<b>A:</b> Problems arise when attempting to use Input Line Control.	See Flow Chart on <b>Troubleshooting Remote Input Line Control</b> on page 14.

# Troubleshooting Flowcharts

## Local (Manual), Power and Display Problems



# Troubleshooting Flowcharts

## Remote (Automatic) Input Line Control

