YASKAWA

A World of Automation Solutions™

MotionSuite™ MP940 Machine Controller Hardware Manual

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Section 1: Introduction

The MP940 is a 1.5 axis machine controller which connects to an SGDH servo amplifier via dual-port RAM.

This combination makes a fully integrated one-and-a-half-axis machine controller. It can be used to perform point-to-point positioning, or following of external devices. It has on-board digital and analog I/O, and network connections to link to other factory automation equipment.

Note: Refer to the SGDH User's Manual for SGDH information.

Machine Controller

Figure 1.1: MP940 Machine Controller / SGDH Combination

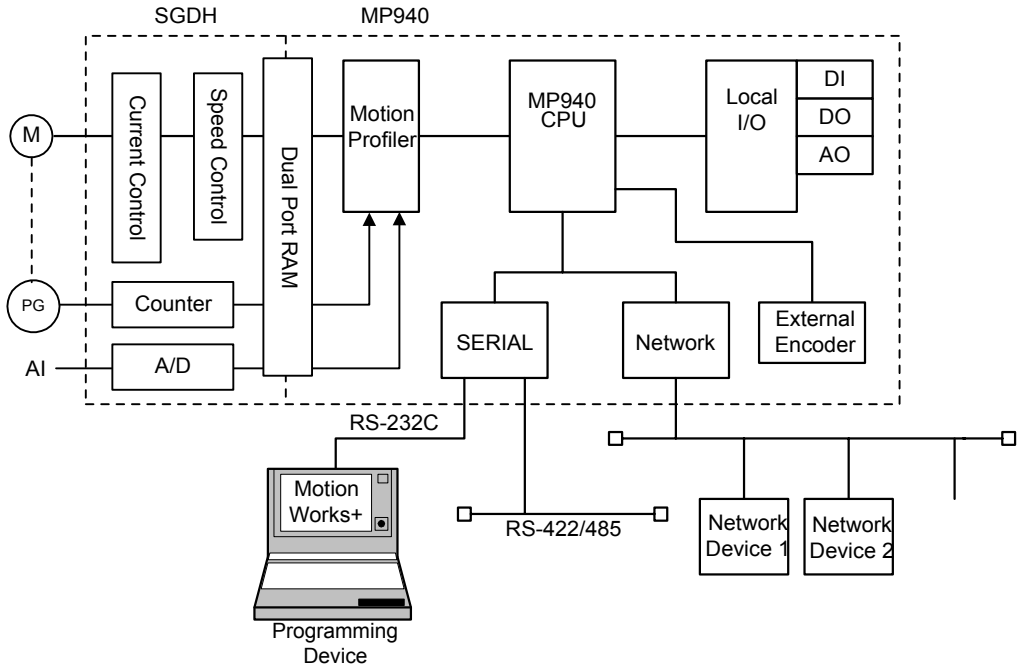
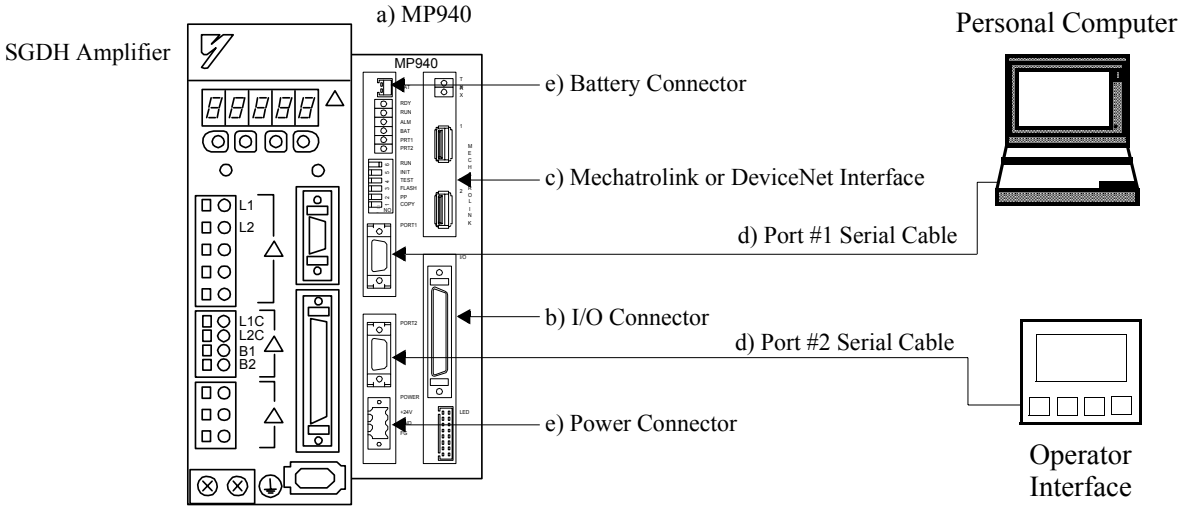


Figure 1.2: Block Diagram of MP940 Functions



Part Numbers

Description			Item Number
MP940	a)	Machine Controller with Mechatrolink Interface	JEPMC-MC400
		Machine Controller with DeviceNet Interface	JEPMC-MC410
I/O Cables	b)	1.0m 50 Pin I/O Cable	JZSP-CKI01-1
		2.0m 50 Pin I/O Cable	JZSP-CKI01-2
		3.0m 50 Pin I/O Cable	JZSP-CKI01-3
		1.0m 50 Pin I/O Cable (with terminal block)	JUSP-TA50P
Mechatrolink Cables	c)	Mechatrolink Cable 0.3m USB-USB	JEPMC-W6000-A3
		Mechatrolink Cable 0.5m USB-USB	JEPMC-W6000-A5
		Mechatrolink Cable 1.0m USB-USB	JEPMC-W6000-01
		Mechatrolink Cable 3.0m USB-USB	JEPMC-W6000-03
		Mechatrolink Cable 5.0m USB-USB	JEPMC-W6000-05
		Mechatrolink Cable 10.0m USB-USB	JPEMC-W6000-10
		Mechatrolink Network Terminator Plug	JEPMC-W6020
Serial Cables	d)	3.0m Port #1 Cable	YS-15
		3.0m Port #1 or Port #2 Pigtail Cable	YS-14
Accessories	e)	3.6V Lithium Battery (with cable and connector)	BA000518
		Battery Holder (replacement)	DF9402712
		DC Power Supply Connector (replacement)	UFS-0118
		Mounting Clip A (replacement)	DF9402713
		Mounting Clip B (replacement)	DF9402714
Software	f)	MotionWorks™	MPE720
		MotionWorks+™	CP717PLUS

NOTES:

Section 2: Startup

Mounting Orientation

Mount the SGDH and MP940 in the appropriate direction for proper cooling, as shown on the left below.

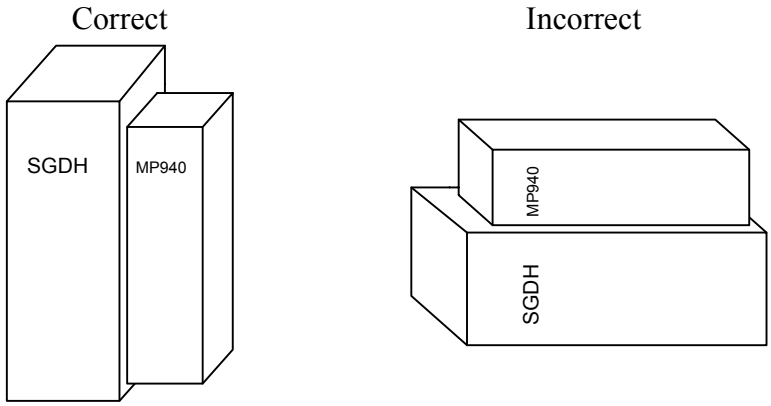


Figure 2.1: Mounting Orientation

Mounting the MP940 to an SGDH

1. Insert the lower two mounting notches into the mounting holes at the bottom of the right side of the SGDH.

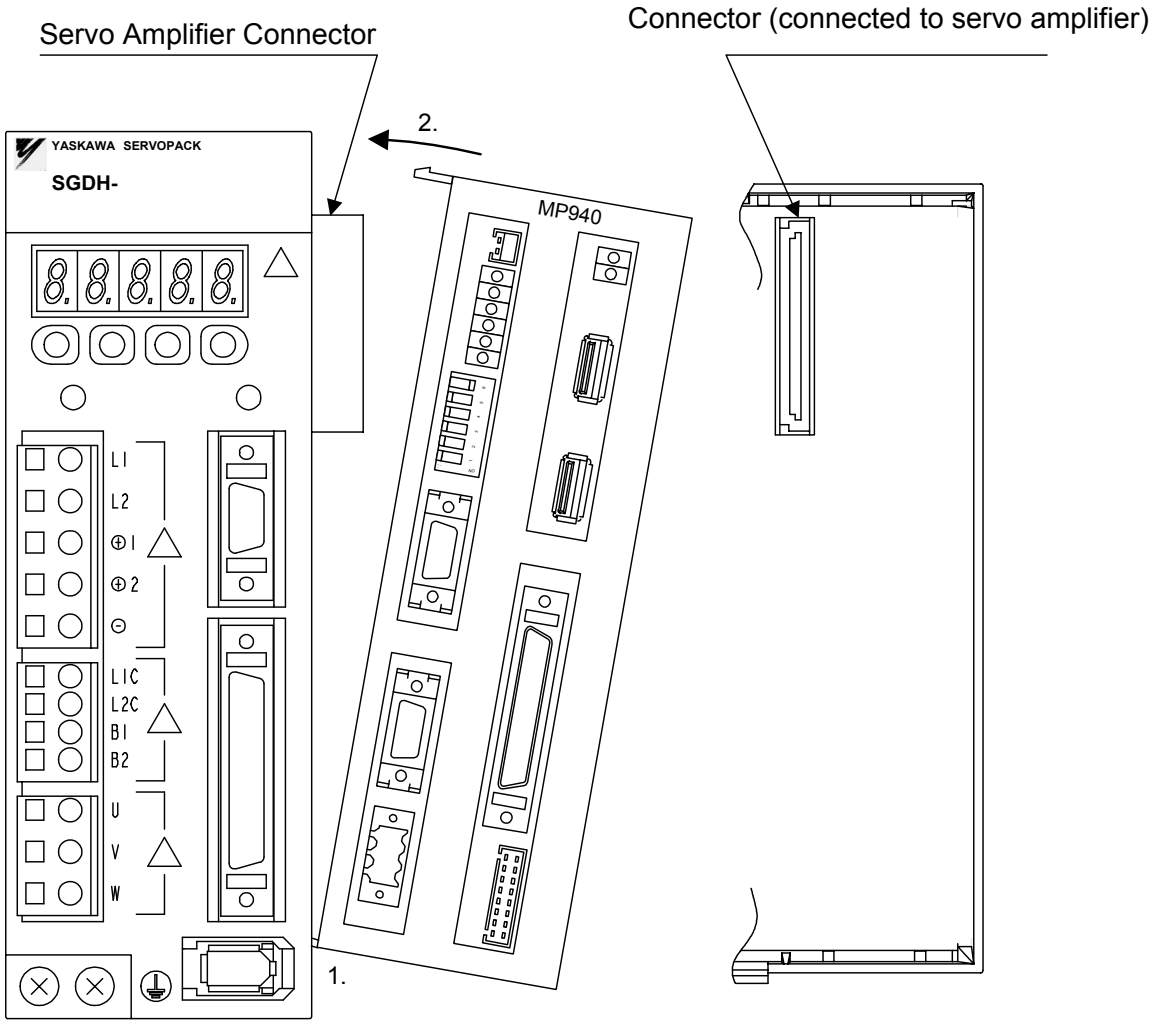
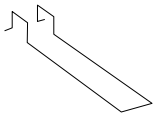
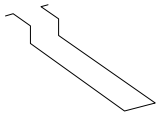
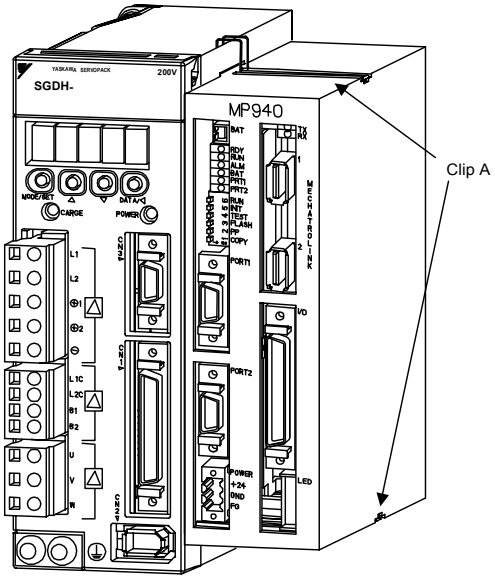
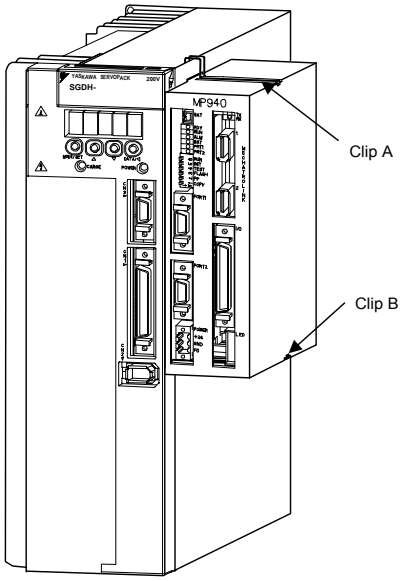


Figure 2.2: Mounting the MP940 to an SGDH Servo Amplifier

2. Push the MP940 in the direction indicated by the arrows in the figure above, and insert the upper mounting notches of the MP940 into the upper mounting holes on the right side of the SGDH.

There are two types of mounting clips due to different sizes of servo amplifiers. See the following table before mounting.

<table>
<tr><th>Clip A × 2</th><th>Clip B × 1</th></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>SGDH-A3
SGDH-A5
SGDH-01
SGDH-02
SGDH-04
SGDH-05
SGDH-08
SGDH-10
SGDH-15</td><td>SGDH-20
SGDH-30
SGDH-50
SGDH-60
SGDH-75</td></tr>
<tr><td> 

Top/Bottom: Clip A</td><td> 

Top: Clip A
Bottom: Clip B</td></tr>
</table>

3. Insert the mounting clips into the mounting holes in the MP940, as shown in the figure below.

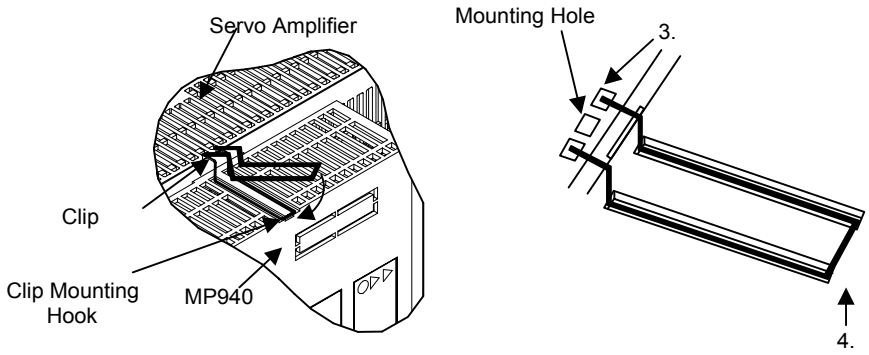


Figure 2.3: Inserting the Mounting Clips

4. While pulling out on the mounting clip, hook the mounting clip on the top of the MP940 case.
5. Mount the lower clip in the same manner.

Mounting the Battery Holder

Follow the steps below to mount the battery holder. The mounting method for the MP940 battery holder is shown in the following figure.

1. Insert the battery holder into the MP940 upper battery holder mounting hole.
2. With the upper lock in contact with the battery holder mounting hole (top), push the bottom of the battery holder into the bottom mounting hole.

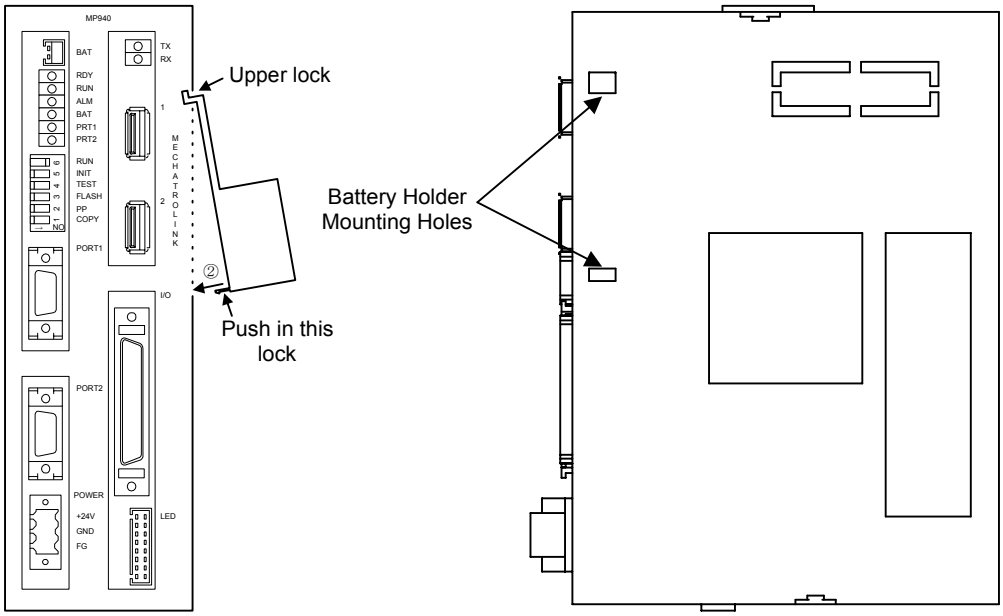


Figure 2.4: Mounting the Battery Holder

3. Push the holder up to ensure it is securely mounted.

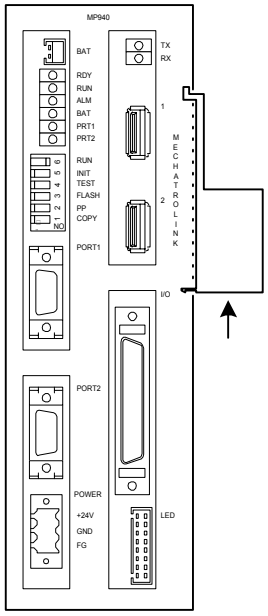


Figure 2.5: The Battery Holder is Securely Mounted

■Battery

A battery is needed during absolute encoder use for both MP940 and SGDH position data memory.

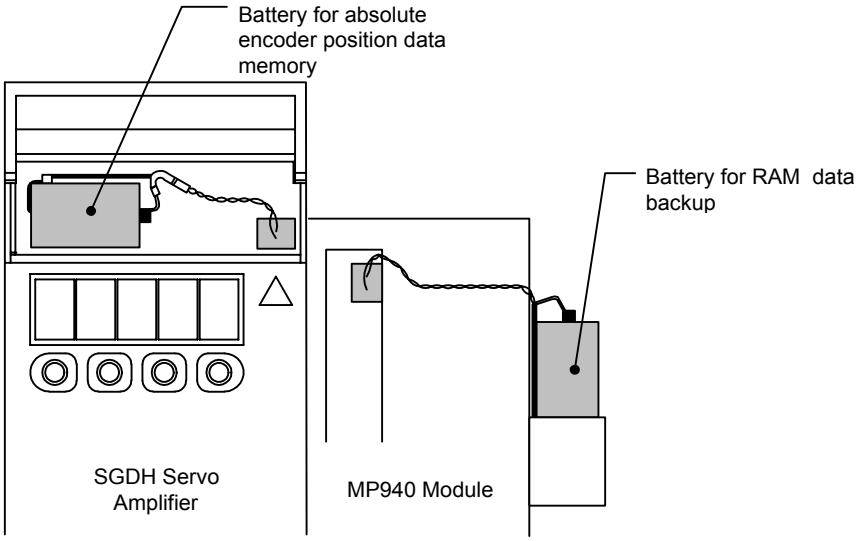


Figure 2.6: MP940 and SGDH Batteries

The batteries are required under the conditions listed below:

SGDH	MP940	Usage Method
No	No	• FLASH Operation • Incremental encoder, or absolute encoder used as an incremental encoder.
No	Yes	• No FLASH Operation (RAM used) • Incremental encoder, or absolute encoder used as an incremental encoder.
Yes	No	• FLASH Operation • Absolute encoder used.
Yes	Yes	• No FLASH Operation (RAM used) • Absolute encoder used.

Power / Connections

The MP940 must be supplied with 24VDC. Detailed information on power requirements for the SGDH are found in the SGDH User's Manual.

Power Consumption	20W
Recommended Fuse Size	1A
Type of Power Supply	Regulated 24VDC ±10%

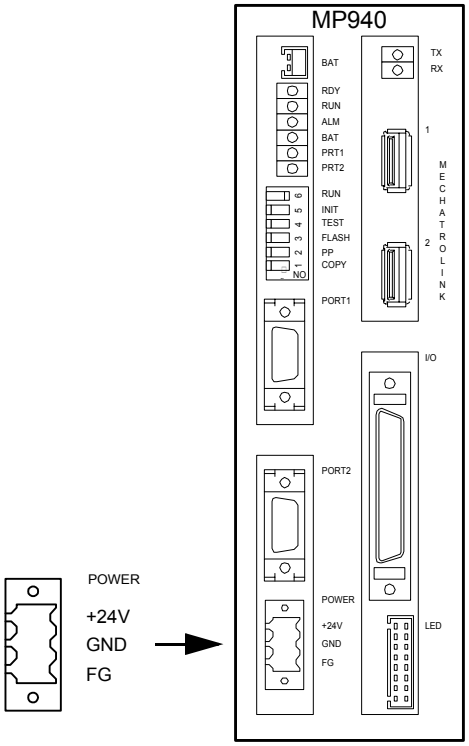


Figure 2.7: MP940 Power Connection

Signal	Name
+24V	+24VDC Input
GND	0VDC Input
FG	Frame Ground

Wiring - Single Phase

Apply power to the SGDH and MP940 at the same time. If the SGDH is not powered within 10 seconds after turning power ON to the MP940 (or vice versa), the units will not communicate with each other. Note: For maximum noise immunity, connect the FG to a ground terminal on the sub-panel, or to the ground terminal on the SGDH.

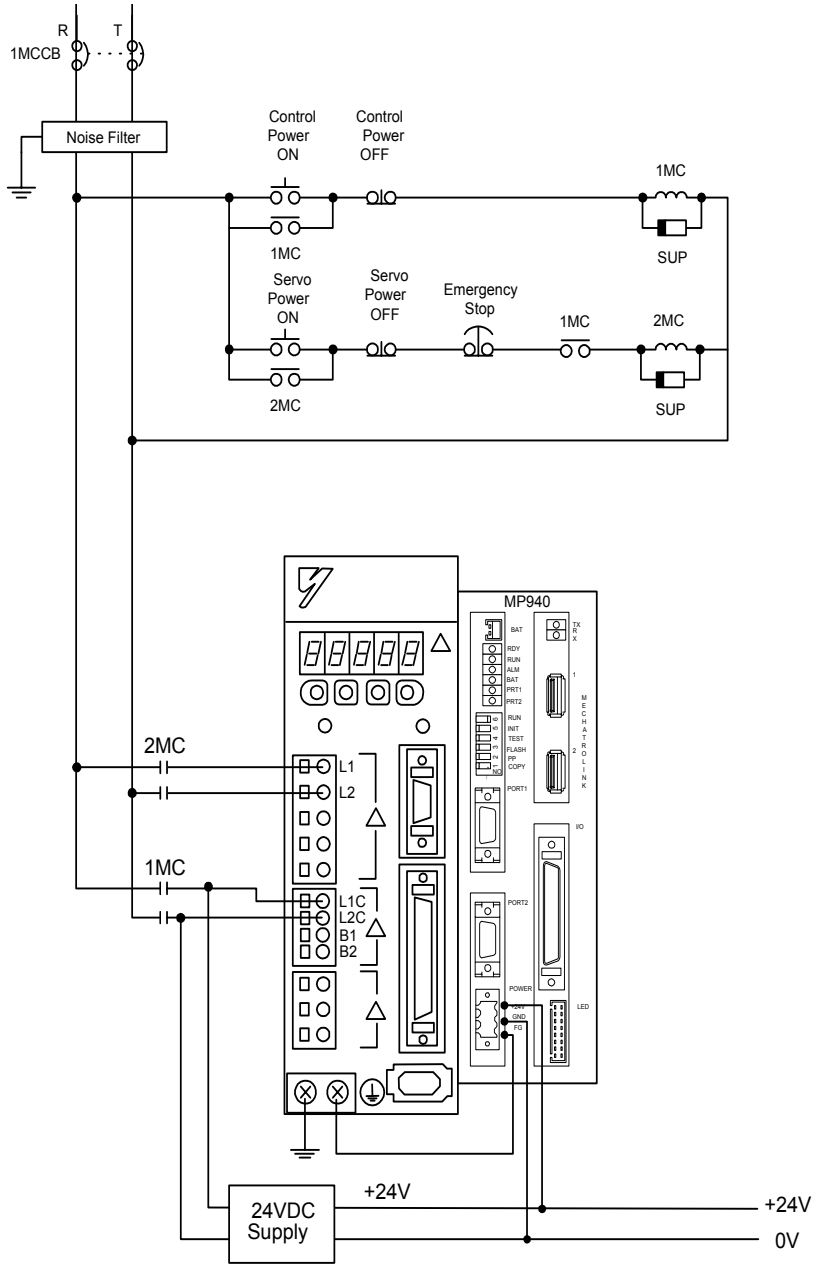


Figure 2.8: Single-phase Wiring

Wiring - Three Phase

Apply power to the SGDH and MP940 simultaneously. If the SGDH is not powered within 10 seconds after turning power ON to the MP940 (or vice versa), the units will not communicate with each other. Note: For maximum noise immunity, connect the FG to a ground terminal on the sub-panel, or to the ground terminal on the SGDH.

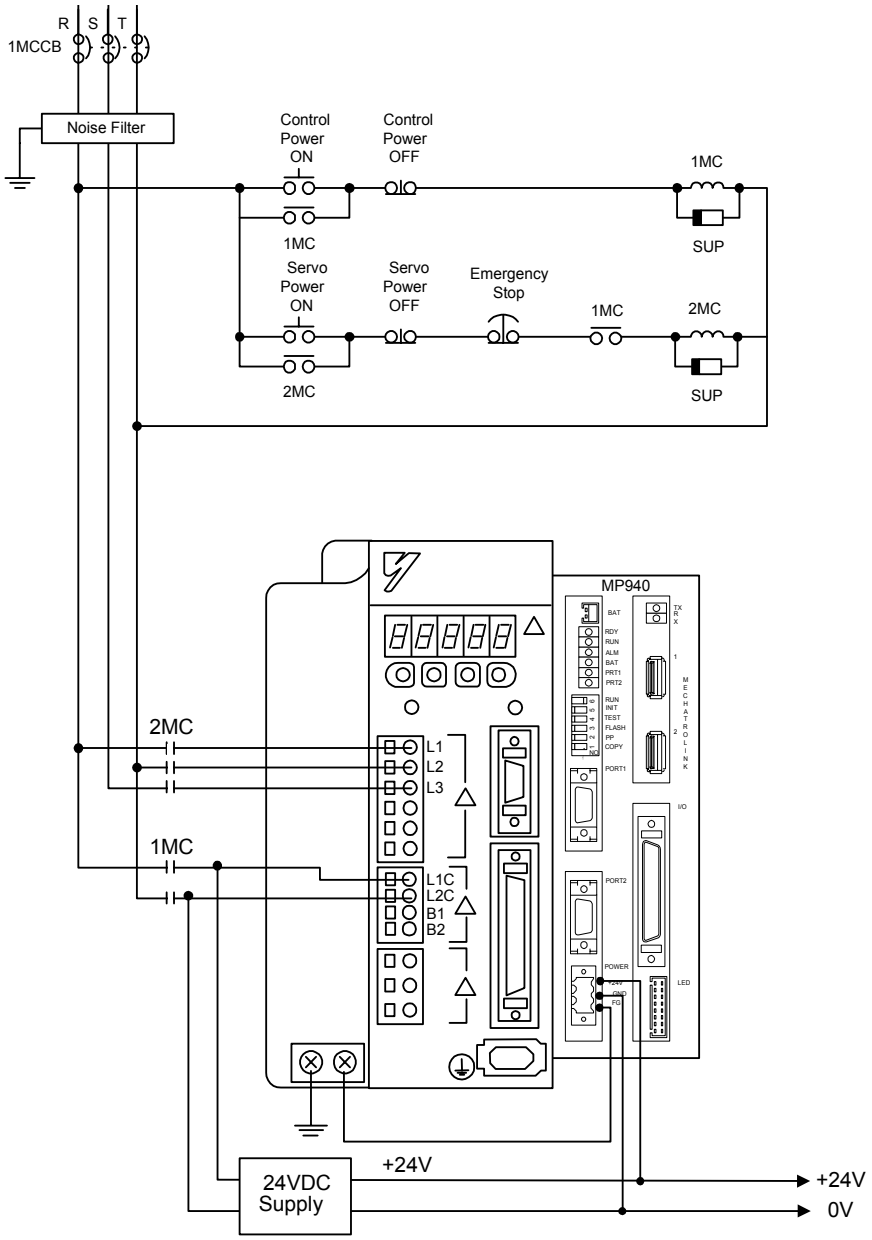


Figure 2.9: Three-phase Wiring

SGDH and MP940 Startup Procedure

Follow the steps below to set up the system.

1. Set the DIP switch of the MP940 as “MEMORY CLEAR”. (Only ‘INIT’ and TEST are ON.)
2. Apply power to both the SGDH and the MP940.
3. Verify that the MP940 is initialized. (RDY and RUN LED lights blink.)
4. Set the DIP switch to normal operation. (Only RUN is ON).
5. Cycle the power of the MP940 and the SGDH.
6. Start the MotionSuite™ software tool and connect ON LINE.

Section 3: DIP Switch Definition

The function of the six switches is explained in the table below.

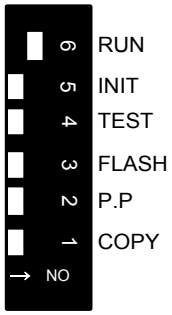


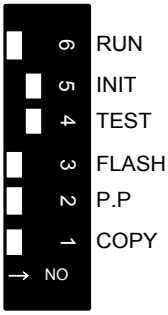
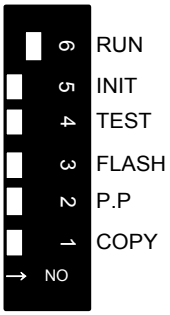
Figure 3.1: MP940 DIP Switches

DIP Switch Settings

Number	Name	Setting	Function	Default Setting
6	RUN	ON	Application program runs at power ON	ON
		OFF	Application program does not run at power ON	
5	INIT	ON	When DIP switch 4 is OFF: Data is copied from flash memory to RAM at power ON. When DIP switch 4 is ON: Memory is cleared.	OFF
		OFF	When DIP switch 4 is OFF: Data is not copied from flash memory to RAM at power ON. When DIP switch 4 is ON: Nothing	
4	TEST	ON	Terminal Mode/Initialization Mode	OFF
		OFF	Online	
3	FLASH	ON	Program is copied from flash memory to RAM at power ON.	OFF
		OFF	Program is not copied from flash memory to RAM at power ON	
2	Programming Port Default	ON	Defaults to Port 1 only	OFF
		OFF	The programming port is set up through software selection	
1	COPY	ON	Global variables are copied from flash at power ON	OFF
		OFF	Global variables are not copied from flash at power ON.	

■Memory Initialization

To erase the application program, variables, and configuration data, set the DIP switches in the following order.

Step 1	Step 2	Step 3	Step 4	Step 5
Turn the MP940 power OFF	Turn the INIT and TEST DIP switches to ON 	Turn on the power, and check that the RDY and RUN LEDs are flashing (approximately 3s).	Turn the power OFF. Turn the Run DIP switch ON. 	Turn power ON.

Note:Perform memory initialization if controller power is turned OFF while the battery is removed. This is not necessary if using the "Copy from Flash at Power Up" mode.

■Standard Operation

The DIP switch pattern shown is the factory default setting.

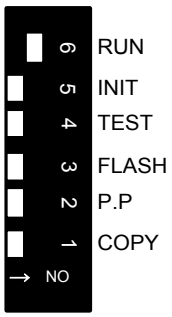


Figure 3.2: Factory Default Setting

■Flash Memory Operation

Outline Of Flash Operation

Programs created by the user are normally stored in RAM. The CPU executes programs stored in RAM. The programs stored in RAM can also be saved to the flash memory. Running programs after copying them from flash to RAM at power ON is called flash operation.

Flash memory saves programs even if there is no memory backup battery.

Flash Start Mode

Transfer from flash memory to RAM occurs when DIP switch 3 is ON (flipped to the right) and the power is turned ON.

Note: MotionSuite™ software tools have a setting which copies the application program to flash when downloading. Refer to the software manual for details. The flash start mode does not work unless an application program has been saved to flash.

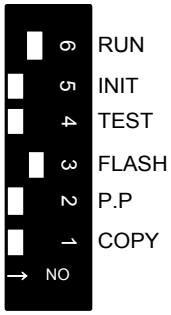


Figure 3.3: Transfer from Flash Memory to RAM

■Retaining Variable Data

The lithium battery makes it possible to save variable data in RAM even when the power is OFF. This is useful when saving data that changes during operation, such as a parts counter, or specific information about a job run. Programming must be written so that specific variables that must be retained are not initialized every time the power is turned ON.

■Copying Servo Amplifier Pn Data from MP940 to SGDH

It is possible to load parameter data that was downloaded to the controller via MotionWorks or MotionWorks+ by turning off all DIP switches except the copy switch. The parameter transfer will occur at power up. The display panel on the SGDH will go off during the parameter transfer. Return the DIP switches to standard operation and cycle power after the operation is complete.

Section 4: LED Indicators

LED Display

The MP940 runs a series of tests during start-up. If an error is detected, the ERR LED flashes, and the content of the error corresponds to the number of flashes. MotionSuite™ software tools cannot communicate with the controller while an error LED is flashing or memory initialization is occurring. The MP940 LEDs are shown in the following table.

LED Display Patterns

Type	LED				Meaning
	RDY (Green)	RUN (Green)	ERR (Red)	BAT (Red)	
Normal	ON	OFF	OFF	OFF	Application program stopped
	ON	ON	OFF	OFF	Normal application program execution
Error	OFF	OFF	ON	OFF	Memory error (initialization may be required)
	OFF	OFF	OFF	OFF	Initial operation (when display continues)
	OFF	OFF	Flashing	OFF	1. 2 flashes: RAM error 2. 3 flashes: ROM error 3. 4 flashes: Peripheral LSI letter
Warning	—	—	—	ON	Battery alarm
	ON	ON	ON	OFF	1. Operand error or I/O error
	System (S) register message (no LED display)				Hardware status (Momentary Stop, RUN/STOP, Testing Mode, etc.)
Other	Flashing	Flashing	OFF	OFF	Memory initialization by DIP switch setting complete.
	OFF	OFF	ON	OFF	Offline testing mode.

In addition, there are the following four LEDs.

Description	Type	Color	Meaning
PRT1	RS232	Green	Flashes to indicate communication
PRT2	RS422	Green	Flashes to indicate communication
TX	Mechatrolink	Green	Flashes to indicate communication
RX	Mechatrolink	Green	Flashes to indicate communication

■I/O Status LED

The status of the digital inputs and outputs can be displayed by using an LED block accessory.

No.	Signal Name	Note	No.	Signal Name	Note
1	VCC	Power (+5V)	2	—	—
3	—	—	4	LED0*	—
5	LED1*	—	6	—	—
7	LED2*	—	8	LEDPW0	—
9	LEDPW3	—	10	LEDPW2	—
11	LED3*	—	12	LED4	—
13	LED5*	—	14	LEDPW1	—
15	LED7	—	16	LED6*	—

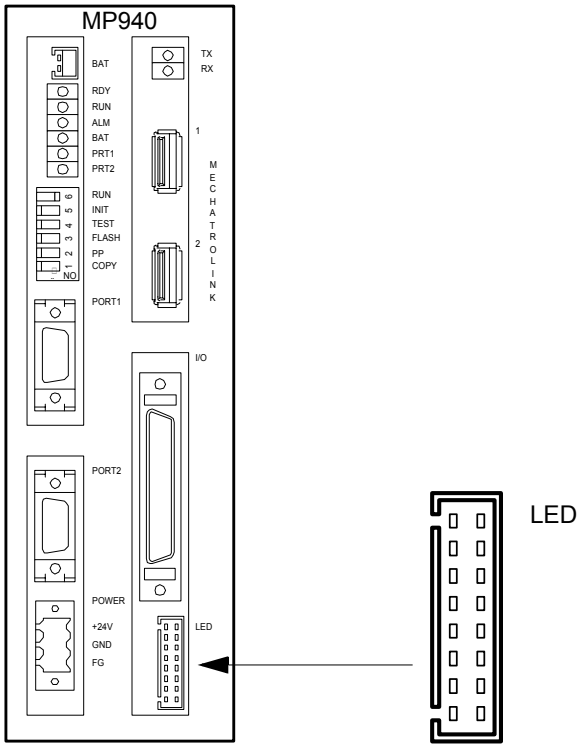


Figure 4.1: MP940 LED Block

Section 5: Communications

Serial Communication

The MP940 is equipped with one (1) RS-232C port and one (1) RS-422/485 port. PORT1 (RS-232) is the programming port.

The MP940 operates as either a master or slave according to setting in the MotionSuite™ software tools.

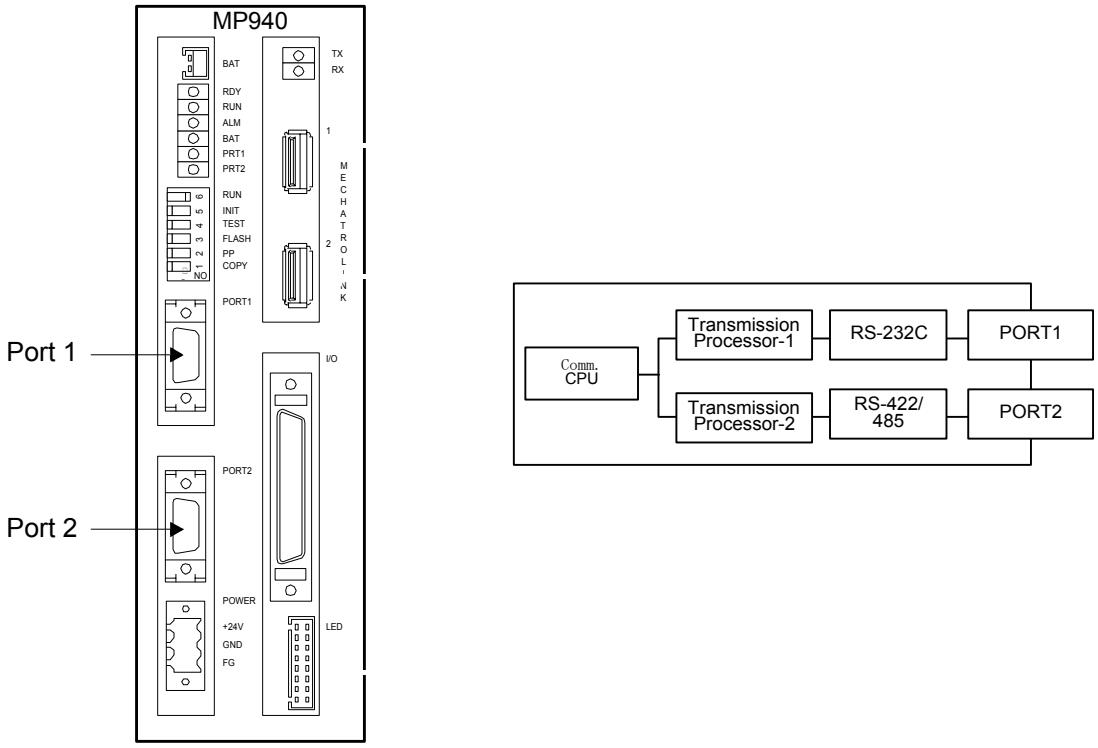


Figure 5.1: Serial Transmission Interface

System Configuration

The figure below illustrates connection of a PC and an operator interface to the MP940.

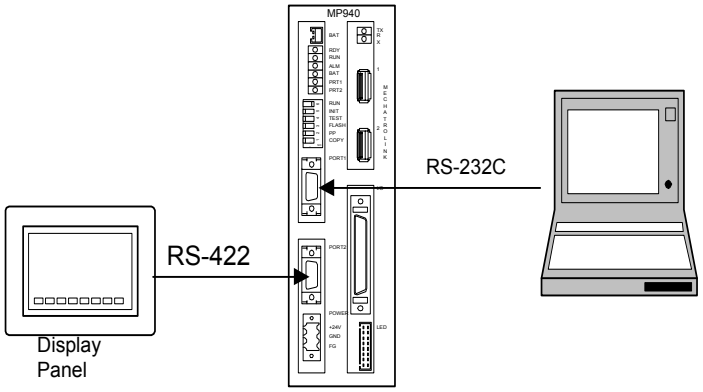


Figure 5.2: Serial System Configuration

The figure below illustrates connection of a MotionSuite™ programming tool to the RS-232C port and branched connection of peripheral devices from the RS-485 port.

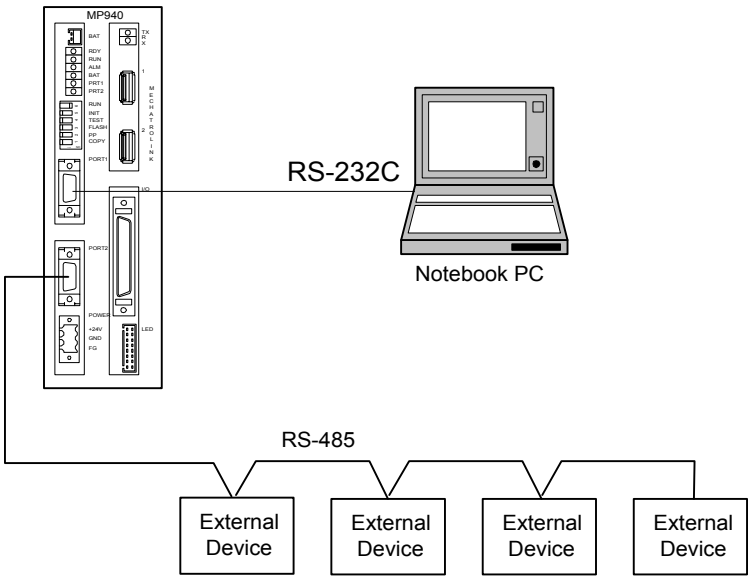
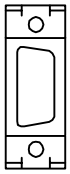


Figure 5.3: Branched Connection of Peripheral Devices

Communication Specifications

Item	Specification
Interface	RS-232, 1 Port RS-422/485 1 Port
Connector	RS-232 PORT1 MDR-14pin/female RS-422/485 PORT2 MDR-14pin/female
Transmission Range	RS-232: 15m Maximum RS-422/485: 300m Maximum
Baud Rate	RS-232 PORT1 9600, 14400, 19200bps RS-422/485 PORT2: 9600, 14400, 19200bps
Synchronization Type	Asynchronous (start-stop synchronization)
Transmission Protocol	MEMOBUS (Master/Slave)
Transmission Format	Data Bit Length 7 or 8 Bit Stop Bit 1 or 2 Bit (port 1only) port 2 is fixed at 1 stop bit Parity Bit Even/Odd/None

■Connector pins and signal names of port 1

	Pin	Signal Name	Description	Pin	Signal Name	Description
	1	TxD	Transmit data	8	—	—
	2	—	—	9	—	—
	3	RxD	Receive data	10	—	—
	4	—	—	11	—	—
	5	—	—	12	RTS	Request to Send
	6	CTS	Clear to Send	13	—	—
	7	—	—	14	GND	Ground

■Connector pins and signal names of port 2

	Pin	Signal Name	Description	Pin	Signal Name	Description
	1	TX+	+ side of transmission data	8	TX+	+ side of transmission data
	2	TX-	- side of transmission data	9	TX-	- side of transmission data
	3	RX+	+ side of received data	10	RX+	+ side of received data
	4	RX-	- side of received data	11	TXR	Transmission data termination resistor
	5	—	—	12	—	—
	6	RX-	- side of received data	13	VCC	Power +5V
	7	RXR	Received data termination resistor	14	GND	Ground

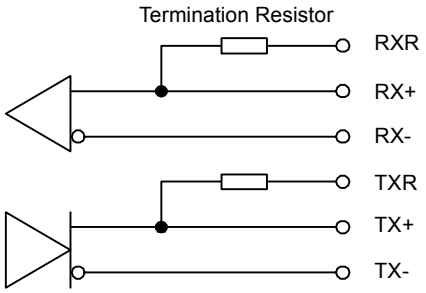


Figure 5.4: Internal Termination Resistors

The MP940 has two internal terminating resistors that are connected to the positive side of the signal. To terminate the signals, connect RXR and RX- together, as well as TXR and TX- signals.

■RS422/485 Interface Cable

1. Make sure that the drive system, control system, power system, and other transmission systems are separate from each other (i.e., do not run the power wire with the control wire).
2. The RS422/485 cable length is 300m maximum. Use the minimum length necessary.
3. The MP940 module RS422/485 interface is a non-isolated system. Errors may occur from noise in the connected terminal. If noise occurs, use a shield-type cable and modem to reduce the noise.
4. In the case of RS422, insert a terminating resistor as needed. Make the termination on the receiving side.
5. In the case of RS-485, attach a terminating resistor to both ends of the transmission line.

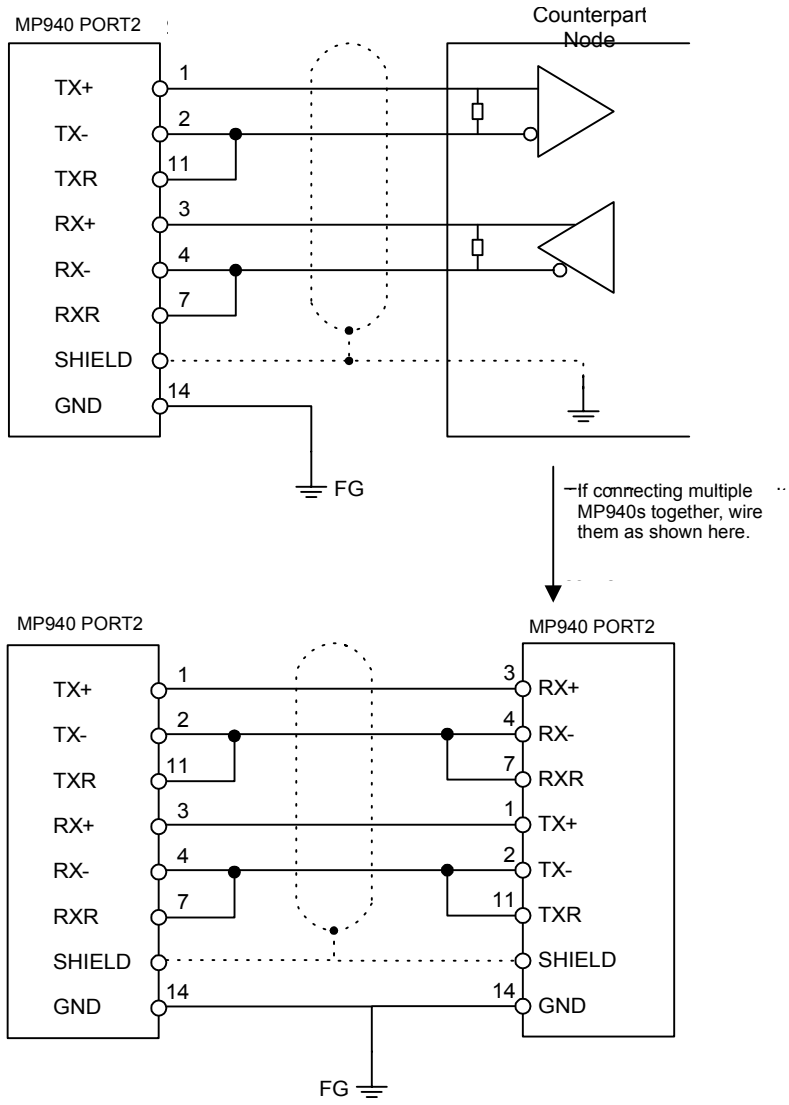


Figure 5.5: Wiring Diagram

Mechatrolink

The Mechatrolink network option is included with MP940 part number JEPMC-MC400. Mechatrolink is a high-speed Yaskawa field network. This network allows for a master / slave configuration. The MP940 can be used as a master or a slave.

MP940 Master

There can be 14 slave nodes when the MP940 is used as a master. The following is an example of a network-compatible I/O module connected as node 1 to an MP940.

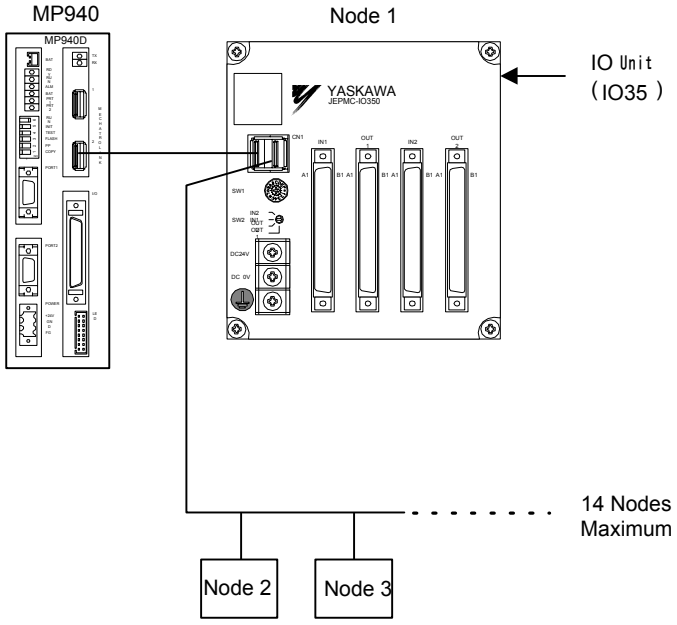


Figure 5.6: Mechatrolink Connection Example

Mechatrolink Connection

The following figure shows the connection of the MP940 module to an I/O350 unit.

Use the standard cable (JEPMC-W6000-A3) when connecting an MP940 module to an I/O350, or when connecting one I/O350 to another I/O350.

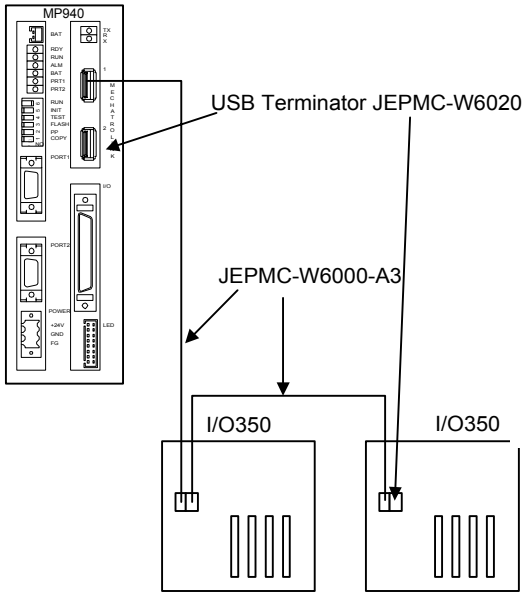


Figure 5.7: MP940 Connection to Multiple I/O 350 Modules

Insert the USB terminator (JEPMC-W6020) into the terminal connector ((1) or (2) in the figure below). The mechatrolink connectors 1 and 2 are the same; the terminator may be inserted into either one.

Insert a USB terminator (JEPMC-W6020) into unused ports.

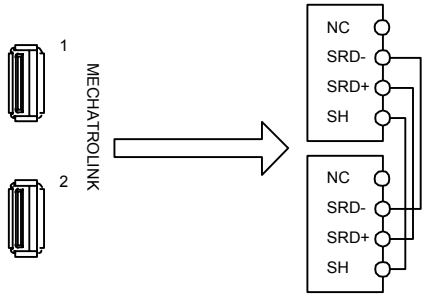
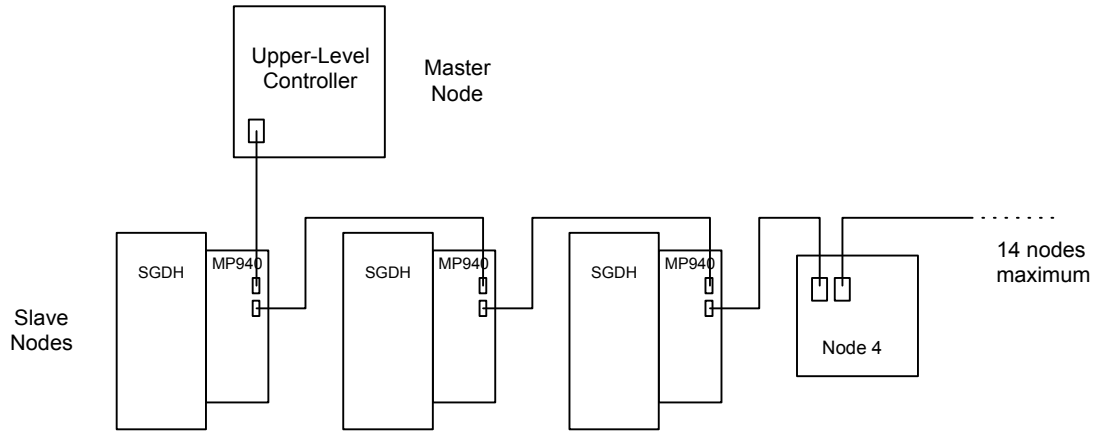


Figure 5.8: Terminal Connectors

There is only one channel per Mechatrolink port in the MP940 module. As shown in the figure above, the top and bottom of the connector are the same although there are two receptacles.

■The MP940 is used as a slave node:



The MP940 cannot communicate directly to the I/O350 or distributed I/O if configured as a slave.

DeviceNet

The DeviceNet option is included with MP940D part number JEPMC-MC410.

Network Connections

Pin	Description	Color
1	V+	Red
2	CAN+	White
3	Shield	Bare
4	CAN-	Blue
5	V-	Black

Setting the Network Address

There are two rotary switches on the side of the MP940D. Rotate the switches to the appropriate node address. Every device on the network must have a unique address. For example, to set the unit to address 46, set the left dial to "4" and the right dial to "6" as shown below. Note: The maximum number of device nodes is 63.

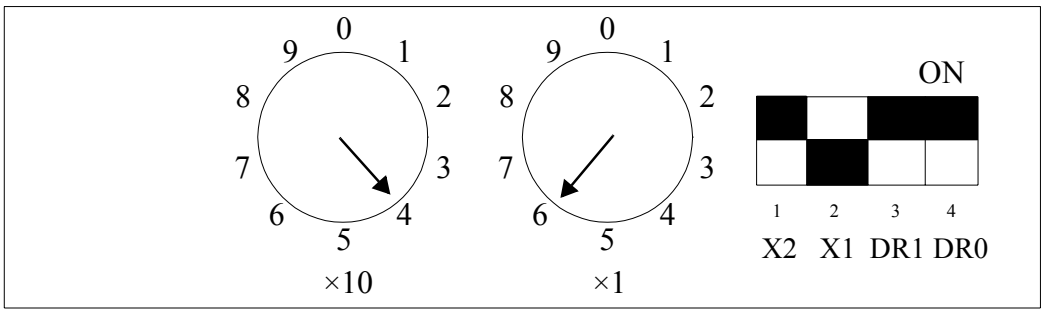


Figure 5.9: Rotary Switches

Setting the Baud Rate

There are four DIP switches on the side of the unit.

X2	not used
X1	OFF SLAVE ON MASTER
DR1	baud
DR0	baud

Figure 5.10: DIP Switches

Follow the chart to set each of the baud rates.

	DR1	DR0
125k	OFF	OFF
250k	OFF	ON
500k	ON	OFF

DeviceNet Status LEDs

There are two status LEDs above the network connector. Their display is either green or red, depending on the current status. The left LED is MS (Module Status), and the right LED is NS (Network Status).

Module Status	Network Status	Explanation	Troubleshooting
solid green	solid green	Normal running condition	No action required.
flashing green	flashing green	No network power (24V)	Check the connection state of the rack and system bus cable connectors.
solid green	flashing red	No response received from DeviceNet master	Check the connection state of the rack and system bus cable connectors. Check the baud rate setting of each device. Check the resistance and mounting of the termination resistor (121 ohms). Check the operation of the DeviceNet master.
solid red	OFF	Hardware defect	Replace module.
solid red	solid red	Hardware defect	Replace module.

Setup Requirements on the Network Master

Strobed	No
Polled I/O	Yes
Explicit	No
Input Size	256 bytes (maximum)
Output Size	256 bytes (maximum)

Input/output size can be less, but the settings must agree on both master and slave setup configuration.

Troubleshooting

When the LED detects an error during DeviceNet communications, it reports the error via the indicators. The following table gives probable causes and possible solutions.

■Master

Troubleshooting the Master

Indicators	Problem	Probable Cause	Possible Solution
MS not lit NS not lit	No DeviceNet communications	No power to the MP940D	Check the network power supply to the MP940D.
MS red lit NS not lit		Hardware malfunction	Replace MP940D.
MS red lit NS red lit		Hardware malfunction	Replace MP940D.
MS green lit NS red lit		Duplicate MAC ID	(1) Change the MAC ID address for the MP940D and cycle the power. (2) Change the MAC ID addresses for other DeviceNet devices and cycle the power to the MP940D.
		Bus-OFF	(1) Check the wiring and connections for DeviceNet cables and connectors. (2) Check the power supply voltage and connection for communications power. (3) Check the network power supply voltage on the connector of each slave (11 to 24 V). (4) Check the baud rate for each DeviceNet device in the network. (5) Check the terminator (121Ω) and connection status. Check the length of the network. Replace the MP940D. Then, either cycle the power for the MP940D or disconnect and reinsert the DeviceNet connectors.
MS green lit NS not lit		Network power supply error	(1) Check the wiring and connections for DeviceNet cables and connectors. (2) Check the power supply voltage and connection for communications power. (3) Check the network power supply voltage on the connector of each slave (11 to 24V).

Troubleshooting the Master

Indicators	Problem	Probable Cause	Possible Solution
MS green lit NS not lit (cont.)	No DeviceNet communications (cont.)	DeviceNet network error	(1) Check the wiring and connections for DeviceNet cables and connectors. (2) Check the baud rate for each DeviceNet device in the network. (3) Check the terminator (121Ω) and connection status. (4) Check the operation status of DeviceNet devices on the network. (5) Replace the MP940D.
MS green lit NS green flashing		Connection not established with DeviceNet device	Set the I/O allocations.
MS green lit NS red flashing		DeviceNet I/O sizes different to setting	(1) Change the I/O sizes for the I/O allocation. (2) Change the I/O sizes for the DeviceNet device.
		No response from DeviceNet slave	(1) Check the wiring and connections for DeviceNet cables and connectors. (2) Check the baud rate for each DeviceNet device in the network. (3) Check the operation status of DeviceNet devices on the network.
		DeviceNet device is idle	Remove the cause of the idle status of the DeviceNet device.
MS green lit NS green lit	Communications are occurring but the maximum communications cycle time exceeds the setting	Excessive traffic on DeviceNet. The communications cycle time setting is too low for the I/O command send time.	Increase communications cycle time.
	Communications are occurring but the receive data refresh is delayed	Excessive traffic on DeviceNet. The communications cycle time setting is too low for the I/O response receive time. The processing load for data exchange with the slaves is too large.	(1) Increases communications cycle time for the DeviceNet slaves. (2) Increase the baud rate. (3) Increase the setting of the CPU scan time for the I/O allocation SYNC setting.

Troubleshooting the Master

Indicators	Problem	Probable Cause	Possible Solution
MS green lit NS green lit (cont.)	MSG - SND function terminated due to error (during DeviceNet communications)	Parameter setting error	(1) Verify the MSG - SND function parameter settings are correct. •Data address •Data size
MS green lit NS green flashing		EM allocations not made	(1) Set the EM allocation under "I/O Allocations."
MS green lit NS red lit		I/O communications error	Remove the cause of the I/O error.
MS green lit NS green lit	MSG - SND function remains BUSY and does not end	MSG - SND function parameter setting error	(1) Verify the MSG - SND function parameter settings are correct. •Remote station #
		Excessive traffic on DeviceNet (Cannot send Explicit request message)	(1) Set longer communications cycle time. (2) For multi-master configuration, increase the communications cycle time for the other master.

■Slave

Troubleshooting Slaves

Indicators	Problem	Probable Cause	Possible Solution
MS not lit NS lit	No DeviceNet communica-tions	No power supply to MP940D	Check the network power supply to the MP940D.
MS red lit NS not lit		Hardware malfunction	Replace the MP940D.
MS red lit NS red lit		Hardware malfunction	Replace the MP940D.
MS green lit NS red lit		Duplicate MAC ID	(1) Change the MAC ID address for the MP940D and cycle the power (2) Change the MAC ID addresses for other DeviceNet devices and cycle the power to the MP940D.
		Bus-OFF	(1) Check the wiring and connections for DeviceNet cables and connectors. (2) Check the power supply voltage and connections for communications power. (3) Check for network power supply voltage on the DeviceNet connector of the MP940D (11 to 24V). (4) Check the baud rate for each DeviceNet device on the network. (5) Check the terminator (121Ω) and connection status. (6) Check the length of the network. (7) Replace the MP940D. Then, either cycle the power for the MP940D or disconnect and reinsert the DeviceNet connectors.
MS green lit NS not lit		Communica-tions power supply error	(1) Check the wiring and connections for DeviceNet cables and connectors. (2) Check the power supply voltage and connections for network power. (3) Check the communications power supply voltage on the DeviceNet connector of the MP940D (11 to 24V). (4) Check the terminator (121Ω) and connection status.
MS red lit NS not lit		DeviceNet network error	(1) Check the wiring and connections for DeviceNet cables and connectors. (2) Check the baud rate for each device. (3) Check the terminator (121Ω) and connection status. (4) Check the operation status of the DeviceNet master. (5) Replace the MP940D.
MS green lit NS green flash-ing		Connection not established with DeviceNet device	(1) Check the DeviceNet master scan list settings. (2) Check the wiring and connections for DeviceNet cables and connectors. (3) Check the baud rate for each device. (4) Check the operation status of the DeviceNet master.

■Slave

Troubleshooting Slaves

Indicators	Problem	Probable Cause	Possible Solution
MS green lit NS green flashing (cont.)	No DeviceNet communications (cont.)	No response from DeviceNet master	(1) Check the wiring and connections for DeviceNet cables and connectors. (2) Check the baud rate for each device. (3) Check the terminator (121Ω) and connection status. (4) Check the operation status of the DeviceNet master. (5) Check the voltage and connection for network power supply. (6) Check the communications power supply voltage on the DeviceNet connector of the MP940D (11 to 24V).
		DeviceNet I/O size different to setting	(1) Change the I/O sizes for the I/O allocations. (2) Change the I/O sizes for the DeviceNet device.
MS green lit NS red flashing		No response from DeviceNet master	(1) Check the wiring and connections for DeviceNet cables and connectors. (2) Check the baud rate for each device. (3) Check the terminator (121Ω) and connection status. (4) Check the operation status of the DeviceNet master. (5) Check the power supply voltage and connection for network power supply. (6) Check the communications power supply voltage on the DeviceNet connector of the MP940D (11 to 24V).
		DeviceNet I/O size different to setting	(1) Change the I/O sizes for the I/O allocations. (2) Change the I/O sizes for the DeviceNet device.
MS green lit NS red flashing		The MAC ID rotary switch setting is different than the MAC ID software setting	(1) Change the MAC ID software setting. (2) Change the MAC ID rotary switch setting and cycle the power.
MS green lit NS green lit		The MAC ID rotary switch setting is different than the MAC ID software setting	(1) Change the MAC ID software setting. (2) Change the MAC ID rotary switch setting and cycle the power.

■Slave

Troubleshooting Slaves

Indicators	Problem	Probable Cause	Possible Solution
MS green lit NS green lit	Communications are occurring but the receive data is not being refreshed	DeviceNet master is in idle status	Remove the cause of the idle status of the DeviceNet master.
MS green lit NS green lit	Communications are occurring but the receive data refresh is delayed	Excessive traffic on DeviceNet. The communications cycle time setting is too low for the I/O response receive time. The processing load for data exchange with the master is too large.	(1) Increase communications cycle time for the DeviceNet master. (2) Increase the baud rate. (3) Increase the CPU scan time for the I/O allocation SYNC setting.

NOTES:

Section 6: Digital I/O

The MP940 is equipped with eight digital inputs and eight digital outputs. There are two additional general purpose inputs available from the SGDH via dual port RAM.

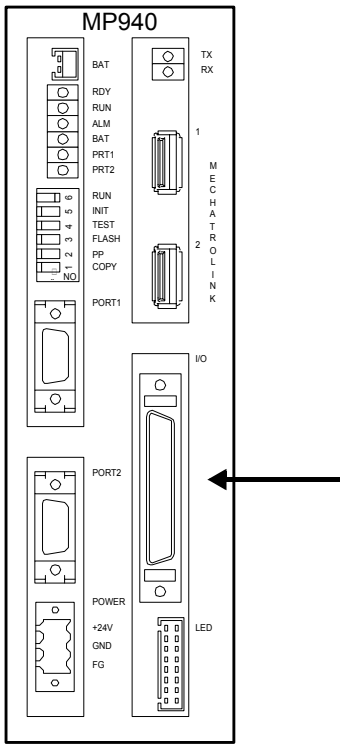
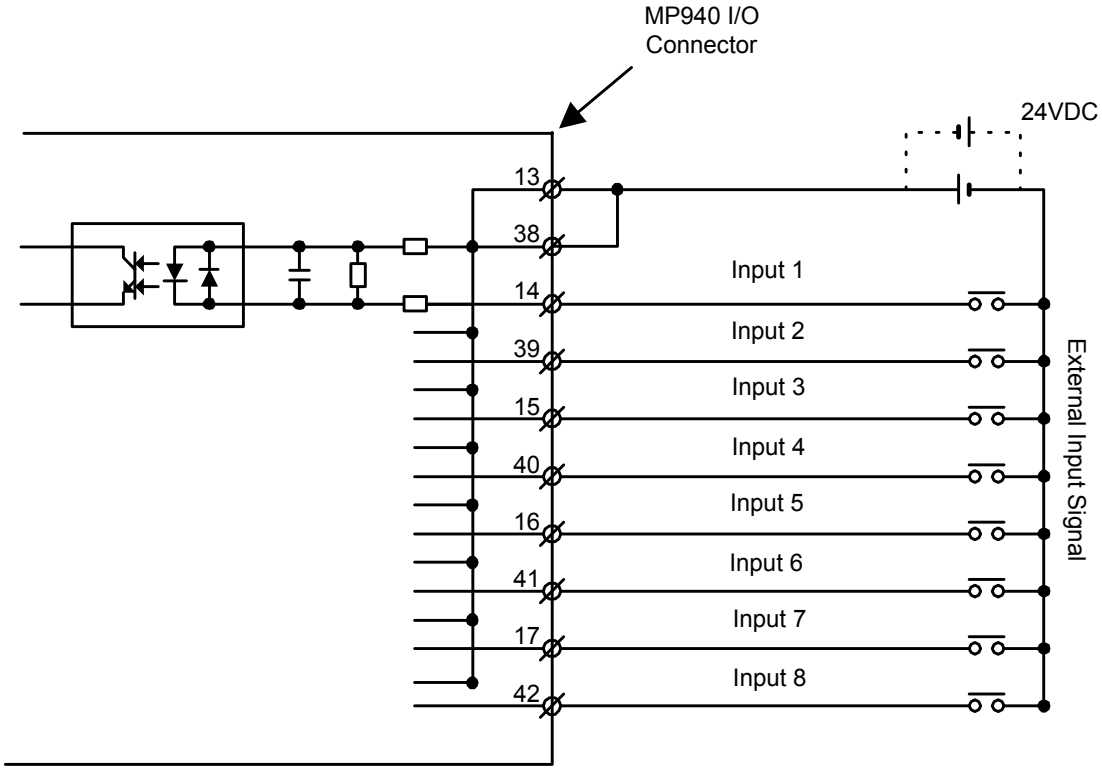


Figure 6.1: Digital I/O Connection

Digital I/O Specifications

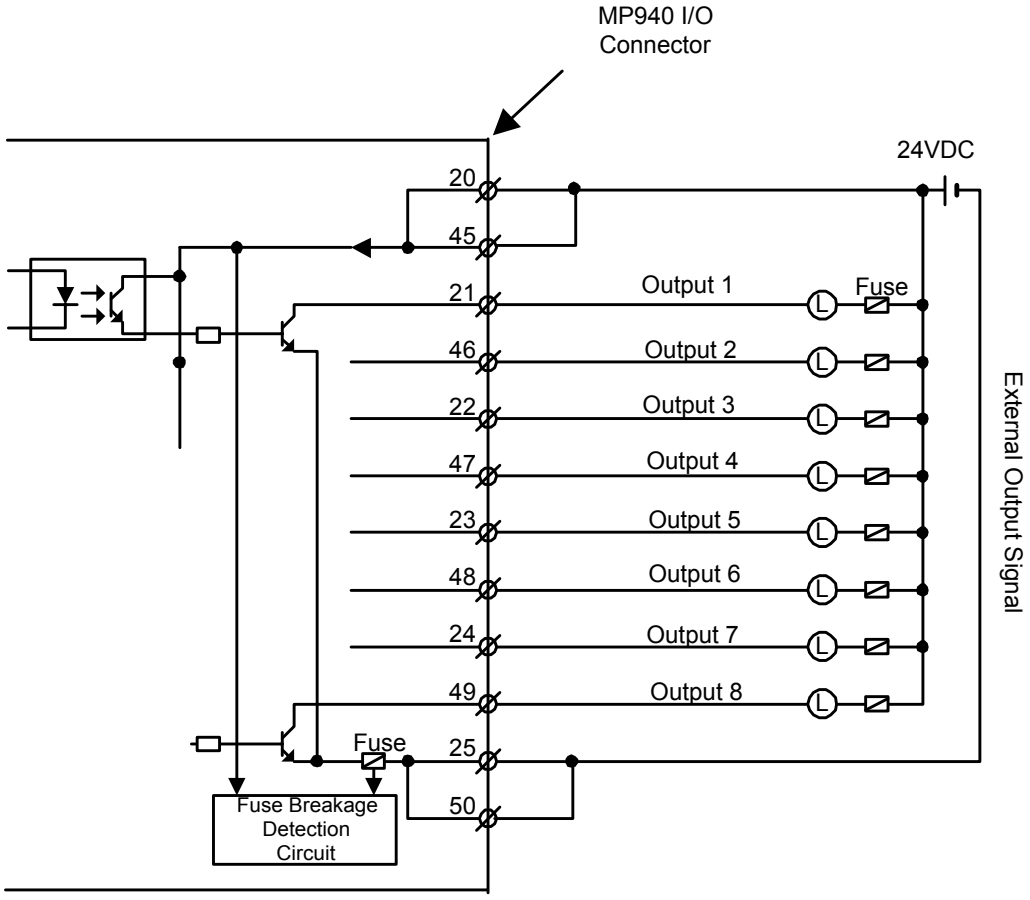
■Digital Input Specifications

Item	Specification
Number of Input Points	8
Input Format	Sinking or Sourcing
Isolation	Optical
Voltage	24VDC ±20%
Current Rating (ON)	5.3mA to activate
Input Impedance	4.4kΩ
Operation Voltage	Logic 0 < 5V Logic 1> 15V
OFF Current	0.9mA or less
Response Time	OFF to ON: < 0.5ms ON to OFF: <1.5ms



■Digital Output Specifications

Item	Specification
Number of Output Points	8
Output Format	Sinking
Output Classification	Transistor Output
Isolation	Optical
Load Voltage	24VDC ±20%
Load Current	100mA / Output
ON Voltage	1.0V or less
Response Time	OFF to ON < 0.25ms ON to OFF <0.5ms
External Common Power	24VDC ±20% 15mA
Output Protection	1 internal fuse common to all outputs
Fuse Rating	1.5A (Fusing Time: 5s or less at 3A)



A fuse is included on the common output line of the MP940 module as a protection circuit. However, there is a risk of the fuse not breaking due to an external short. Provide an external 100mA fuse on each output for added protection.

NOTES:

Section 7: Limit Switch Inputs

The limit and home inputs are wired to the SGDH amplifier as shown in the figure below.

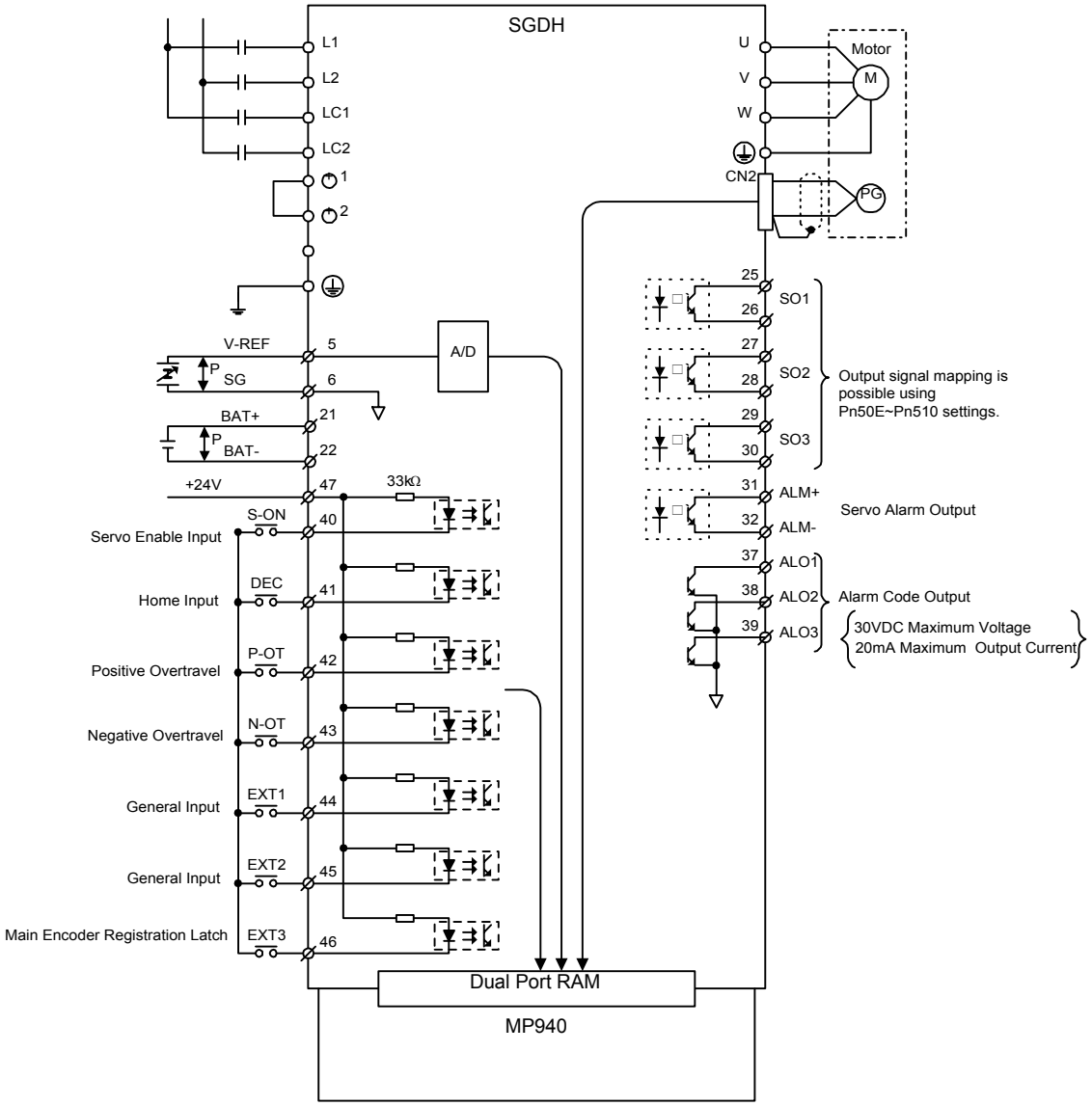


Figure 7.1: SGDH I/O Specifications

If your application does not require limit switches, they can be disabled. To disable the positive overtravel limit (P-OT), set the SGDH parameter Pn50A.digit3 to “8”.

To disable the negative overtravel limit (N-OT), set the SGDH parameter Pn50B.digit 0 to “8”.

Please read section 5.3.3 of the SGDH User’s Manual for further information.

Section 8: Analog I/O

Analog Input

The MP940 analog input comes from the SGDH analog input via dual port RAM. The analog input enters the SGDH on pin 5 of the CN1 connector. Normally, this is the VREF input, but when the MP940 and SGDH are combined, the VREF becomes available for general purpose.

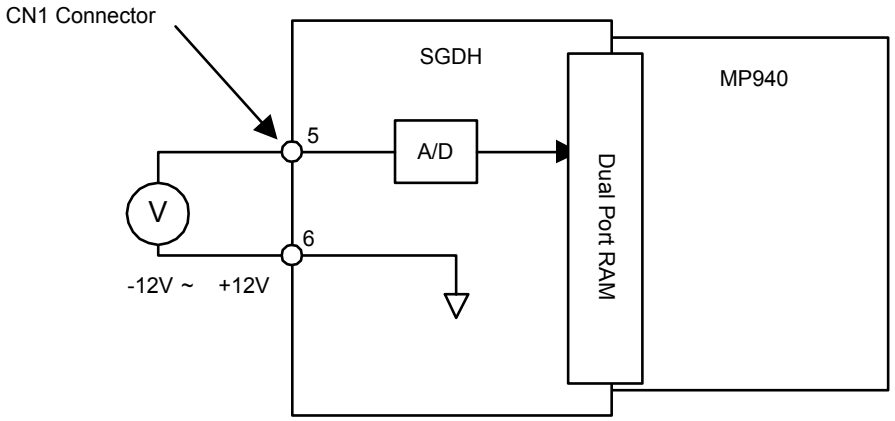
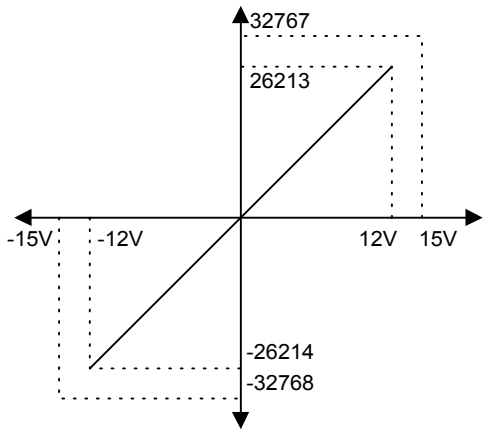


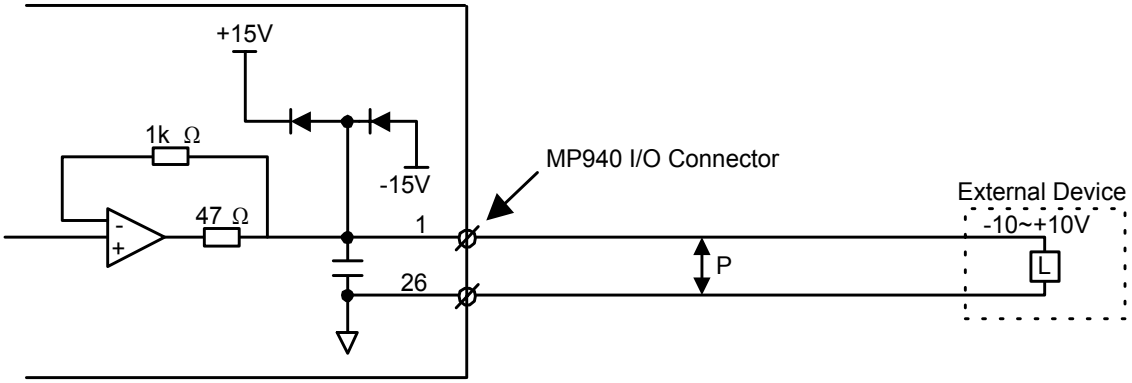
Figure 8.1: Analog Input Data

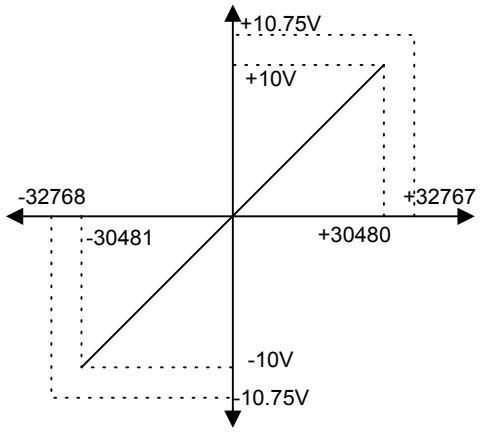
Item	Specifications
Input Voltage	± 12V
Input Impedance	Approximately 14k
Resolution	16 bits over a ±15V range or 457μV/bit
Accuracy	The linearity of the analog input is guaranteed only within the range of ±12.0V



Analog Output

Item	Content
D/A Output Resolution	16Bit over a +/-10V range, or 328μV/bit





Section 9: External Encoder

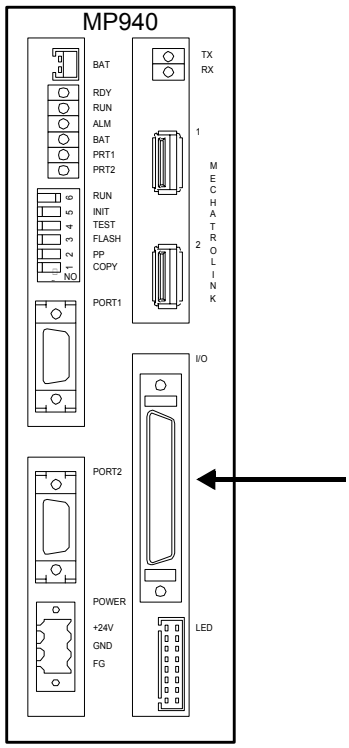
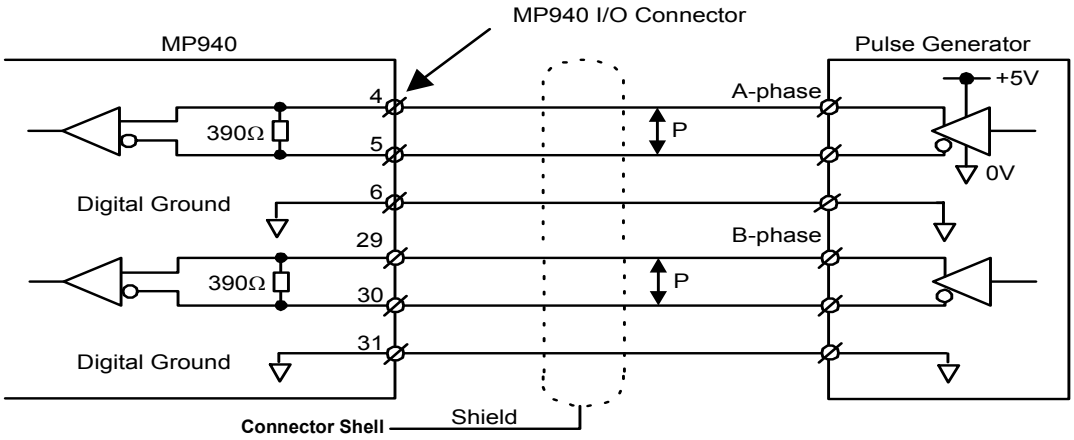


Figure 9.1: The MP940 External Encoder

External Encoder Specifications

Item	Content
Input Format	• Quadrature • Pulse and Direction • 1 channel positive, 1 channel negative
Maximum Frequency	1MHz



Section 10: Registration Latch

The registration latch is used to record (i.e., latch onto) the encoder position at the moment an external signal is input (rising edge).

Latch Input	Number of Latch Circuits	2
	Input Type	Current Source Photocoupler Isolation
	Main encoder latch input voltage	24VDC
	External encoder latch input voltage	Can be switched between 24VDC :12VDC :5VDC

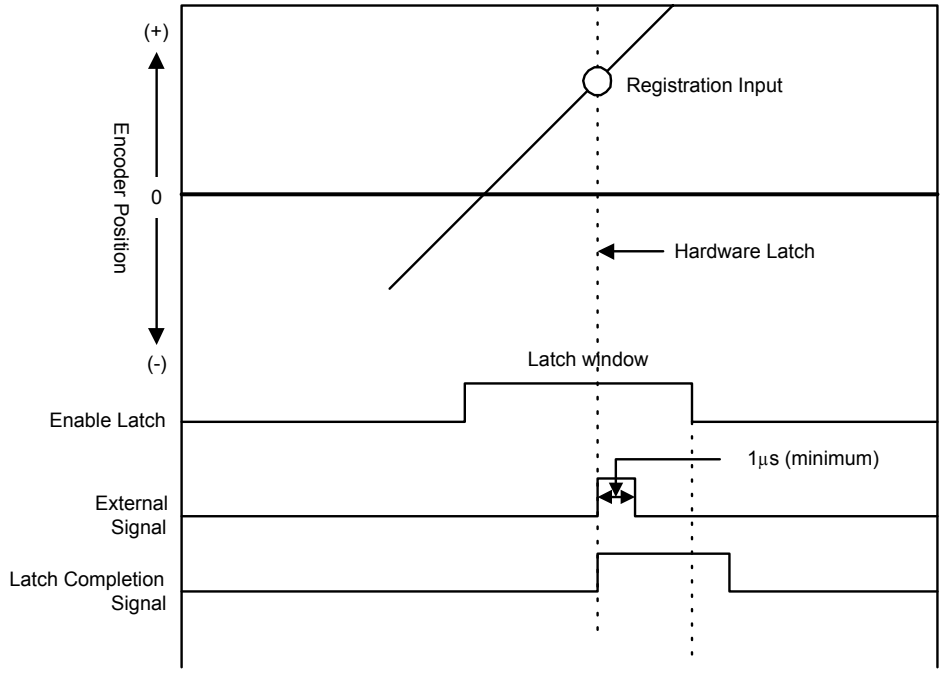
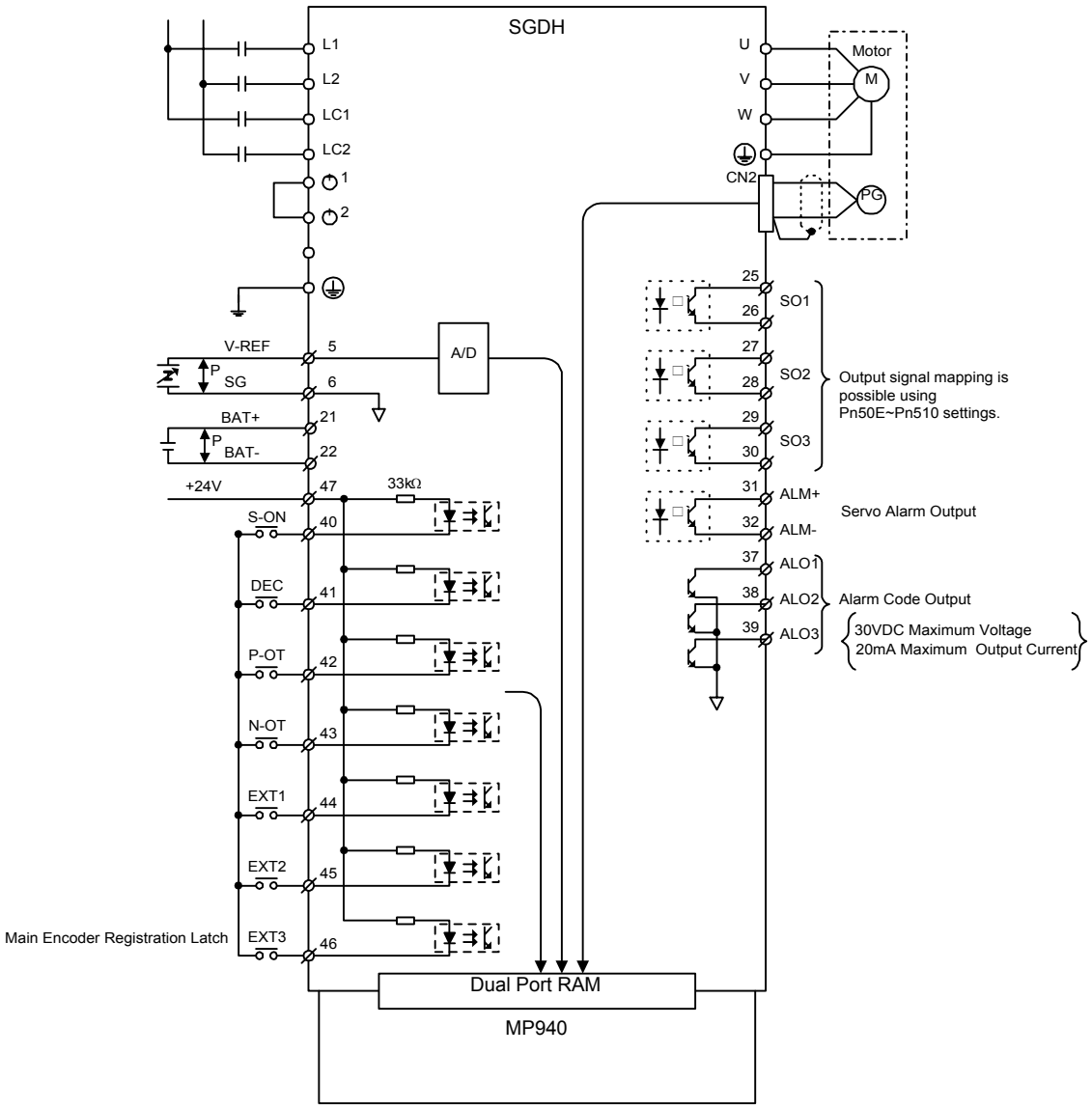


Figure 10.1: Registration Latch

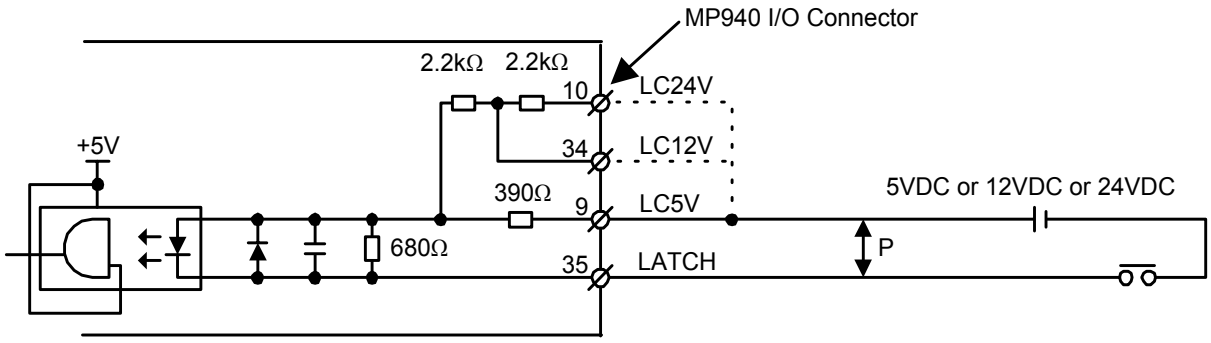
Main Encoder Registration Input

The registration latch for the SGDH is wired into the 1CN connector on the amplifier. Latch registration with this input is performed from the MP940 through dual port RAM.

Either the "C" channel or EXT3 can be used for the main encoder latch. If no latch is required by the application, EXT3 can be used for general purpose.



External Encoder Registration Input



NOTES:

Section 11: Maintenance

Battery Life

The battery can preserve the program and data for a period of one year with power off. The battery has a life expectancy of five years under normal operating conditions. However, these values change depending on external conditions such as temperature.

Replace the battery within two weeks, when the "BAT" display LED is on. If the battery is replaced beyond two weeks, programs and data stored in the MP940 memory will be lost.

Battery Replacement

Battery replacement is as follows.

■Preparation

1. Save memory contents
   Before replacing the battery, save programs and data to a floppy disk or hard disk. The disk can be used if programs and data are accidentally erased due to a mistake when replacing the battery.

2. Replacement battery
   Use replacement battery type BA000518. This battery is not standard, and must therefore be purchased from Yaskawa. The replacement battery appears as in the diagram below.

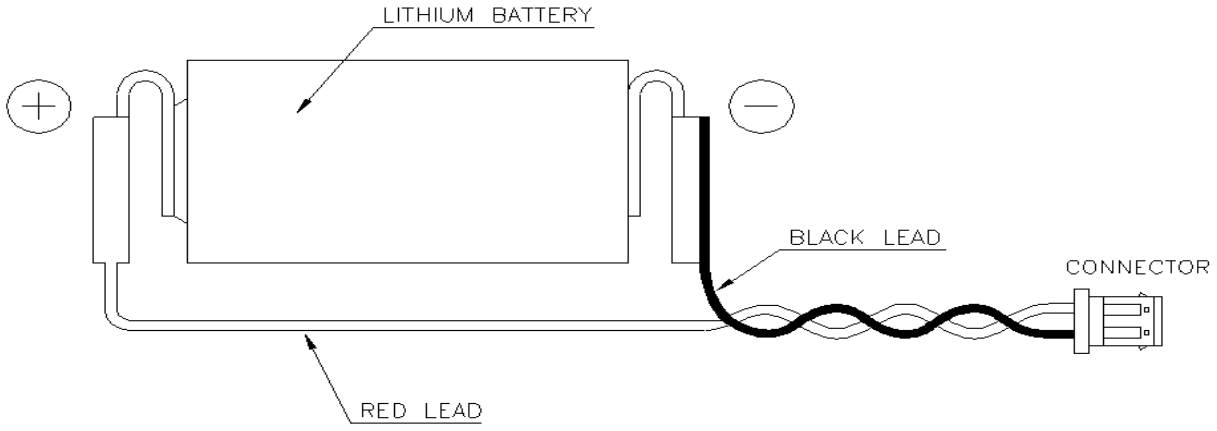


Figure 11.1: BA000518 Battery with Cable

■Prepare Replacement Battery

Prepare the replacement battery as in the drawing below.

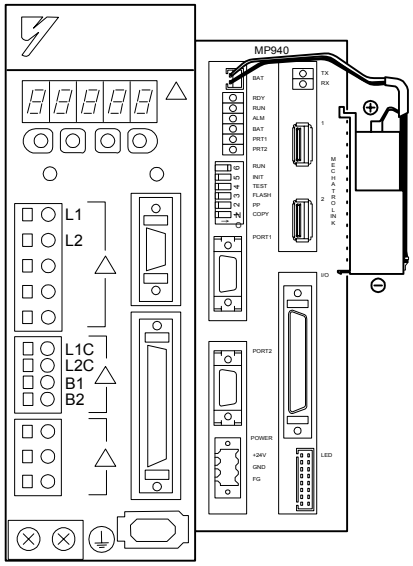


Figure 11.2: BA000518 (Battery with Cable)

■Battery Replacement

Replace the battery as follows:

1. Verify the controller power LED is ON. (The controller MUST have power when the battery is removed.)
2. Remove the connectors at the end of the battery leads from the MP940 module connector, and remove the battery from the internal battery holder.
3. Firmly insert the connector attached to the leads of the replacement battery into the MP940 module connector. Then insert the battery into the battery holder.
4. Verify the “BAT” LED is OFF.

Battery replacement is complete.

Always replace the battery with power ON. The programs and data stored in the MP940 module will be deleted if the battery is replaced with the power supply shut off from the MP940 module.

Section 12: Specifications

Physical Specifications

Physical Specifications of the MP940

	Item	Specification
Physical Environment	Ambient Usage Temperature	0 ~ +40°C (32° ~ 130°F)
	Storage Temperature	-25 ~ +85°C (-10° ~ 185°F)
	Ambient Usage Humidity	30 ~ 95%RH (no condensation)
	Storage Humidity	5 ~ 95%RH (no condensation)
	Corrosion Resistance	No flammable or corrosive gas
	Altitude	2000m or less above sea level
Electrical Operating Conditions	Noise Resistance	Normal Mode: 1500Vp-p Common Mode: 1500Vp-p Pulse Width: 100ns/1μs Pulse Rise Time: 1ns (in noise simulator)
Mechanical Operating Conditions	Vibration Resistance	Vibration Amplitude/Acceleration: $10 \leq f < 57$Hz, Zero to Peak Amplitude: 0.075mm $57 \leq f < 150$Hz, Fixed Acceleration: 9.8m/s^2 X, Y, Z, directions: Sweeps (1 octave/min) × Number of Sweeps: 10
	Shock Resistance	Peak Acceleration: 147m/s^2, Usage Time: 11ms 2 times in each direction (X, Y, and Z).
Ground Conditions	Grounding Cooling Type	Type 3 Grounding Natural Air Cooled
	External Dimensions	W 45mm H 142mm D 129mm

Hardware Specifications

Hardware Specifications of MP940

Item	Specifications
Memory	Flash: 2MB RAM: 2MB (battery backed)
Communication Ports	1 RS-232C port Baud Rate Setting: 9.6k/19.2 kbps Protocol • MEMOBUS • No Protocol
	1 RS-422/485 port Baud Rate Setting: 9.6k/19.2 kbps Protocol • MEMOBUS • No Protocol
Display LEDs	Module Status Display LEDs READY (green) RUN (green) ALM (red) BATALM (red) PRT1 (green) PRT2 (green)
	Mechatrolink Operation Display LEDs RX (green) TX (green)
DIP Switches	RUN INIT TEST FLASH PP COPY
Input Signals	Input Points: 8 Input Format: Sinking or Sourcing Isolation: Optical Voltage: 24VDC ±20% Rated Current: 5.3mA Input Impedance: 4.4kΩ Operating Voltage: ON Voltage 15VDC or more, OFF Voltage 5VDC or less OFF Current: 0.9mA or less Response Time: OFF→ON 0.25ms or less, ON→OFF 1ms or less
Output Signals	Output Points: 8 Output Format: Sinking output Output Type: Transistor output Isolation: Optical Load Voltage: 24VDC±20% Load Current: 100mA/output ON Voltage: 1.0V or less External Common Power Source: 24VDC ±20%, 15mA Output Protection: 1 common fuse Fuse Rating: 1.5A (fusing time: 5s or less at 3A) Response Time: OFF→ON 0.25ms or less, ON→OFF 1ms or less

Hardware Specifications of MP940 (Continued)

Item	Specifications
Latch Input	Latch Input Circuit: 1MHz input maximum. Latches within 30μs. Latch Input Format: quadrature; pulse and direction / channel up and channel down Latch Counter: (external signal can be switched between 5V/12V/24V)
Analog Input	SGDH velocity command used as analog input to controller
Analog Output	Resolution: 16-bit Output Range: ±10V
Controller Power Source	Input Signal: 24VDC ±20% (DC19.2V ~ 28.8V) Input Current: 0.4A Fuse Rating: 1.5A Safety Certification: UL, CSA certified

NOTES:

Section 13: Dimensional Drawings and Cable Diagrams

Dimensions

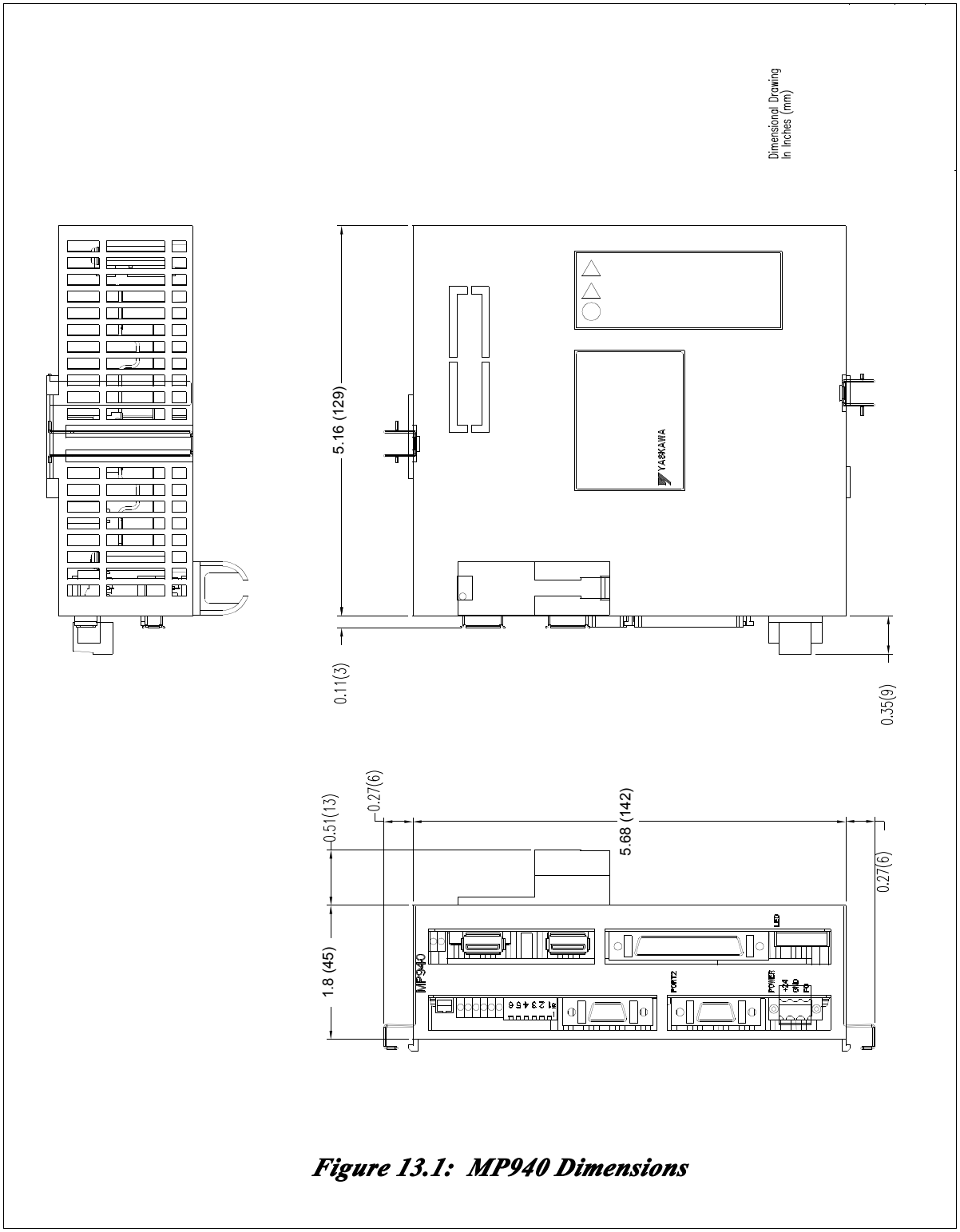


Figure 13.1: MP940 Dimensions

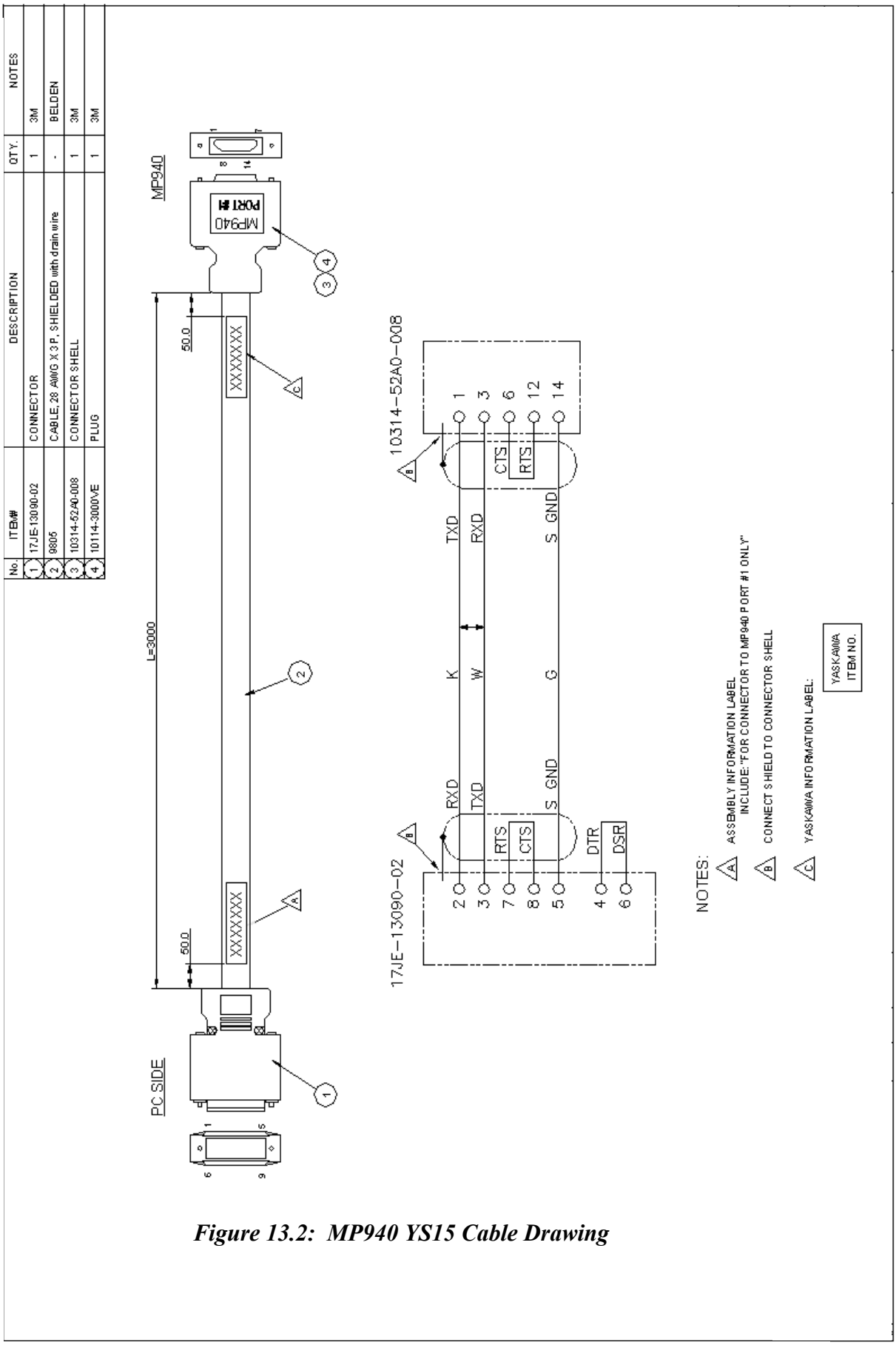


Figure 13.2: MP940 YS15 Cable Drawing

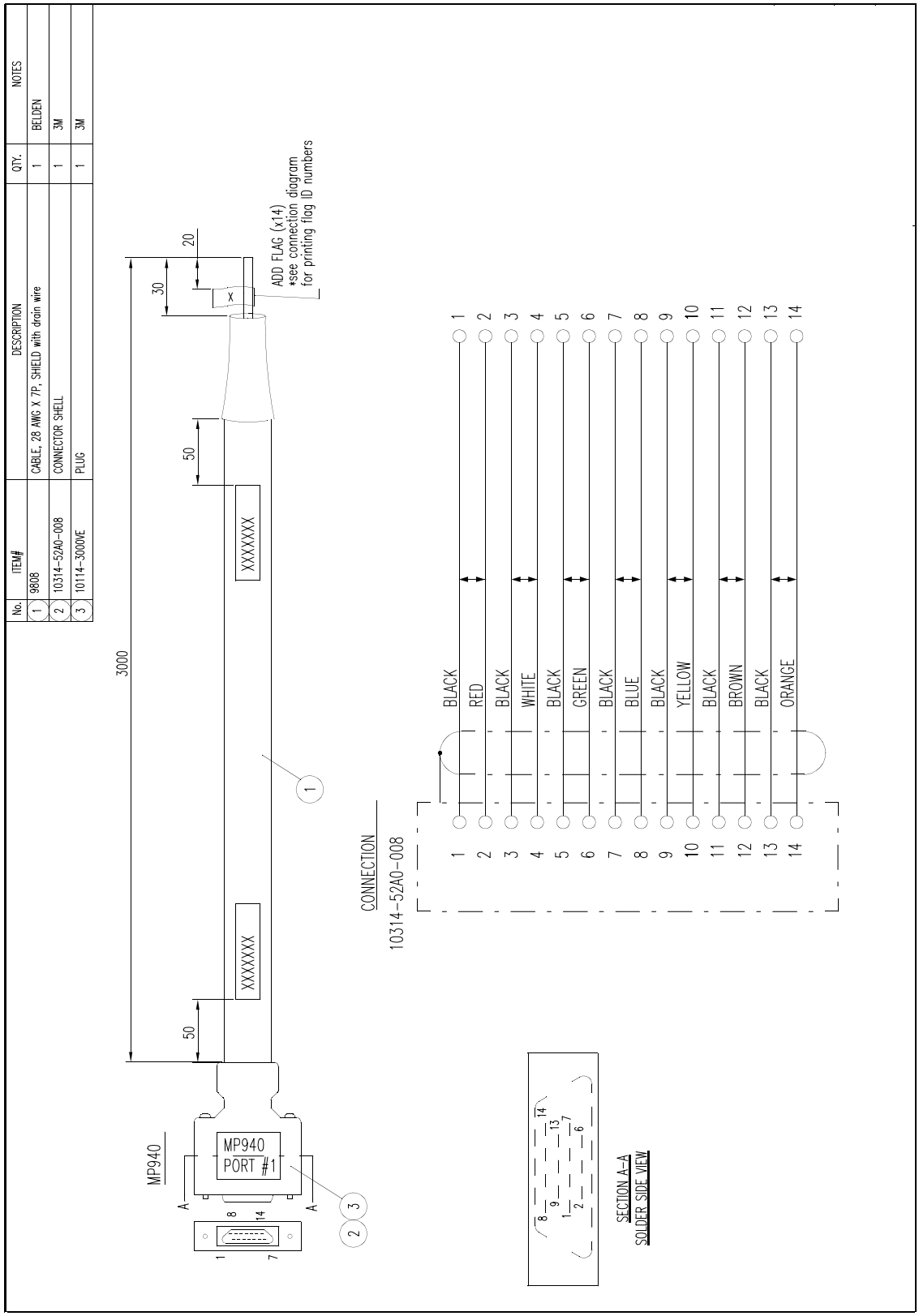


Figure 13.3: MP940 Cable

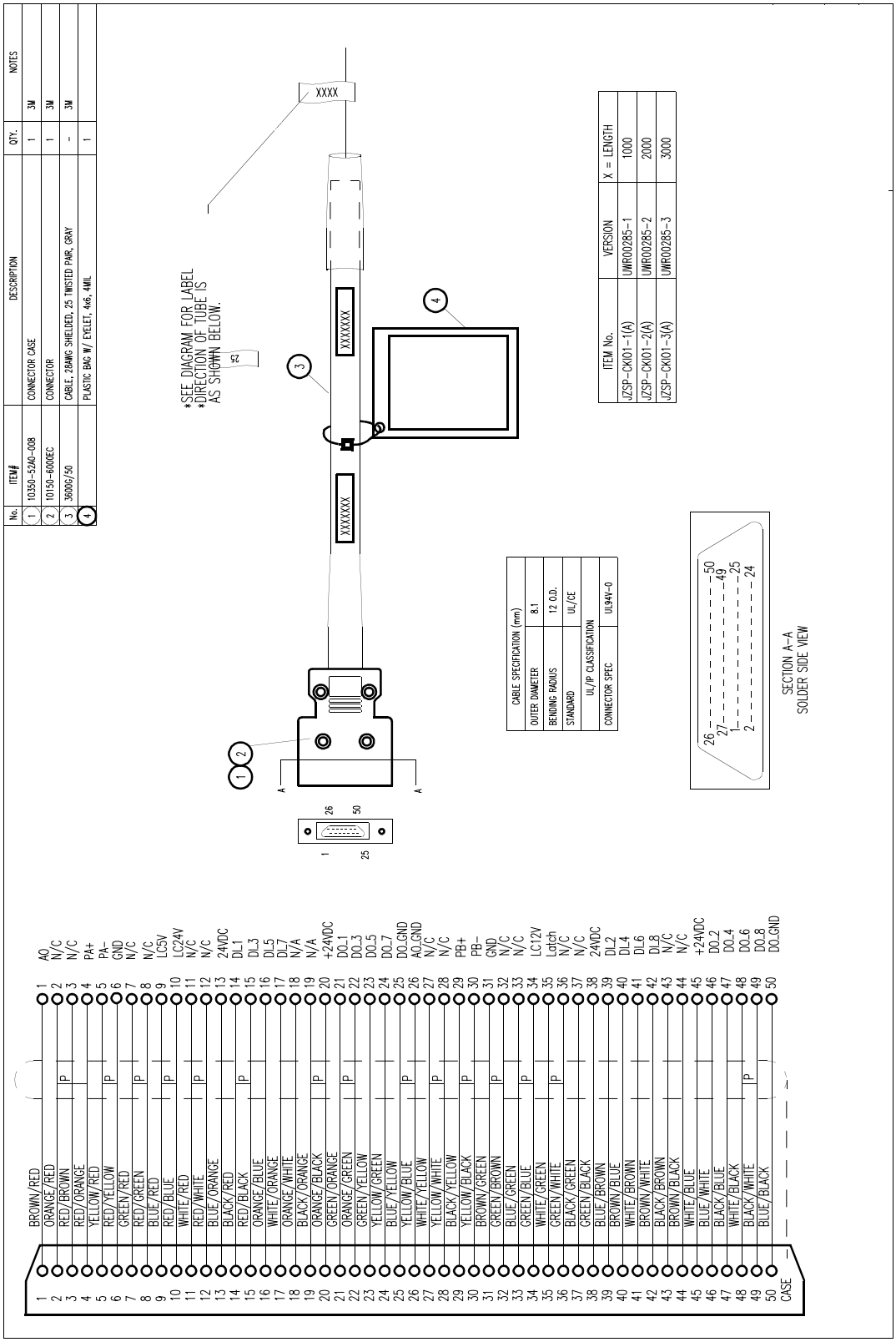


Figure 13.4: I/O Cable Drawing

Connections

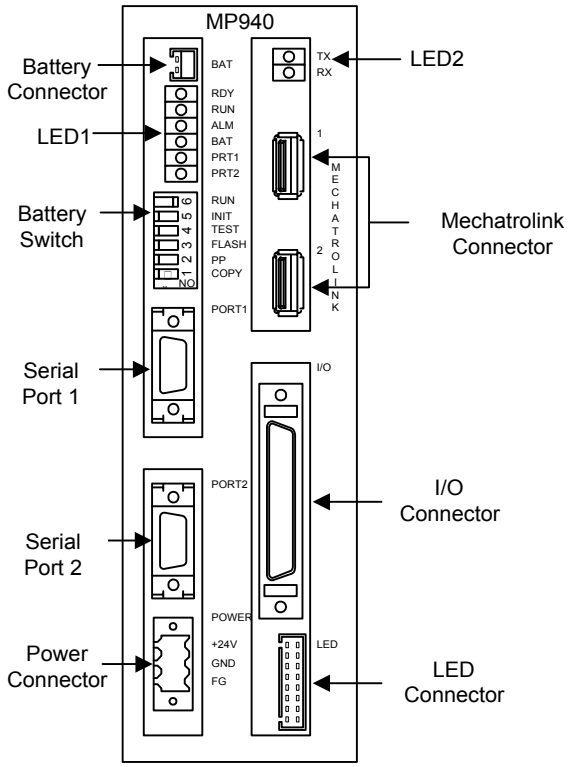


Figure 13.5: Connectors

Connector Specifications

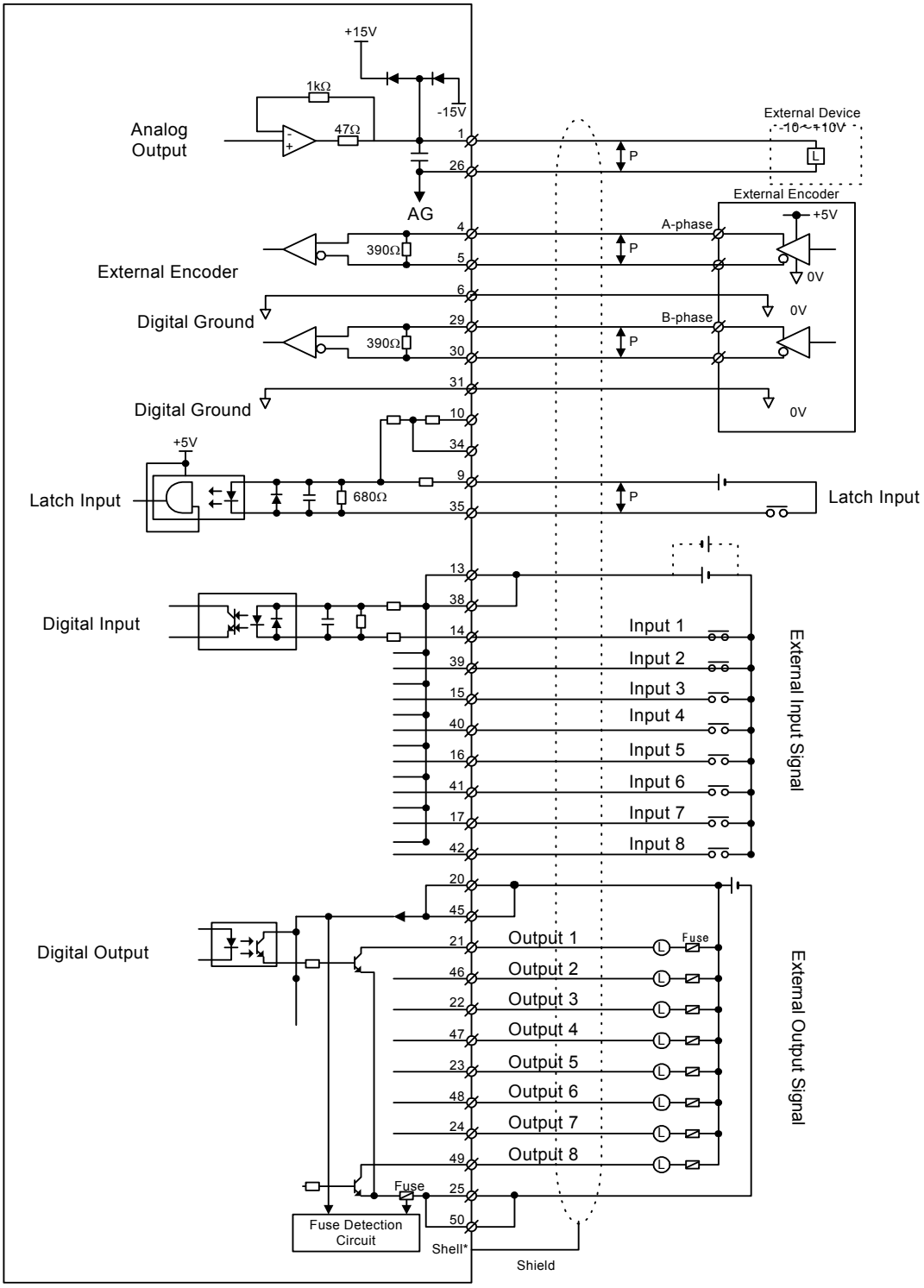
Name	Connector Name	# of Pins	Connector Model		
			Controller Side	Cable Side	Manufacturer
Battery Connector	BAT	2	DF3-2P-2DS	Battery BA000518 Connector	HIROSE
Serial Port RS-232C	PORT1	14	10214-52A2JL	Connector Unit 10114-3000VE Shell 10314-52A0-008	3M
Serial Port RS-422/485	PORT2	14	10214-52A2JL	Connector Unit 10114-3000VE Shell 10314-52A0-008	3M
Power Connector	POWER	3	SL3.5/3/90F	BL3.5/3F-AU	Weidmuller
Mechatrolink Connector	MECHATROLINK	4	DUSB-APA41-T11	DUSB-	—
I/O Connector	I/O	50	10250-52A2JL	Connector Unit 10150-3000VE Shell 10350-52A0-008	3M
LED Connector	LED	16	IMSA-9220B-16A	—	—

I/O Connector

Number	Signal Name	Reference	Number	Signal Name	Reference
1	AO	Analog Input	26	AO_GND	Analog Output Ground
2	—	—	27	—	—
3	—	—	28	—	—
4	PA+	A_ Pulse +	29	PB+	B_Pulse +
5	PA-	A_ Pulse -	30	PB-	B_Pulse -
6	GND	Pulse Input Ground	31	GND	Pulse Input Ground
7	—	—	32	—	—
8	—	—	33	—	—
9	PILC 5V	PI Latch Input Common (5V)	34	PILC 12V	PI Latch Input Common (12V)
10	PILC 24V	PI Latch Input Common (24V)	35	PIL	PI Latch Input Common
12	—	—	36	—	—
12	—	—	37	—	—
13	DC 24V	DI Power (input)	38	DC 24V	DI Power (input)
14	DI_00	DI_00 Input (DI interrupt)	39	DI_01	DI_01 Input
15	DI_02	DI_02 Input	40	DI_03	DI_03 Input
16	DI_04	DI_04 Input	41	DI_05	DI_05 Input
17	DI_06	DI_06 Input	42	DI_07	DI_07 Input
18	—	—	43	—	—
19	—	—	44	—	—
20	DC 24V	DO Power (input)	45	DC 24V	DO Power (input)
21	DO_00	DO_00 Output	46	DO_01	DO_01 Output
22	DO_02	DO_02 Output	47	DO_03	DO_03 Output
23	DO_04	DO_04 Output	48	DO_05	DO_05 Output
24	DO_06	DO_06 Output	49	DO_07	DO_07 Output (Counter coincidence output)
25	DO_GND	DO Ground(0V)	50	DO_GND	DO Ground(0V)

Figure 13.6: I/O Connector

■I/O Circuit of I/O Connector



Note: See Figure 3 for shield to connector shell termination details

Mechatrolink Cables

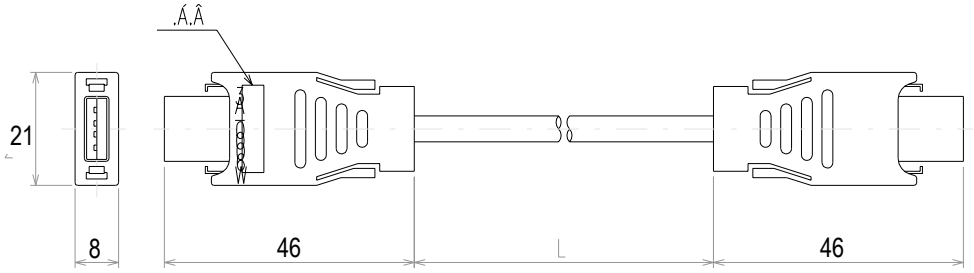
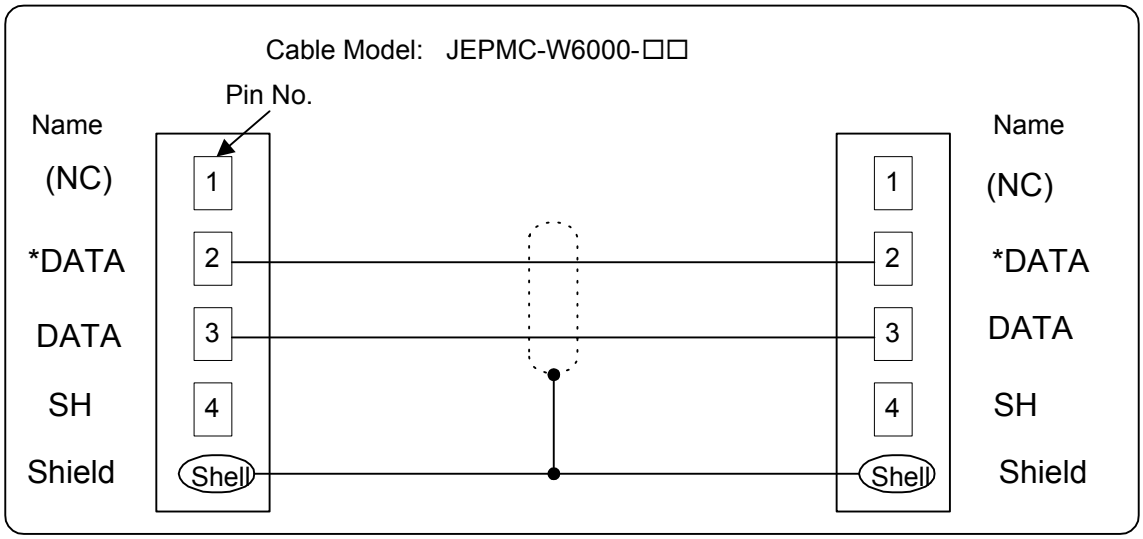


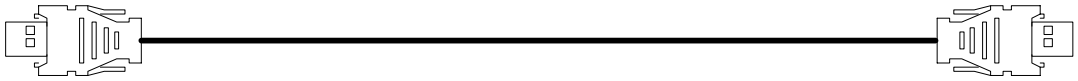
Figure 13.7: Mechatrolink Cable

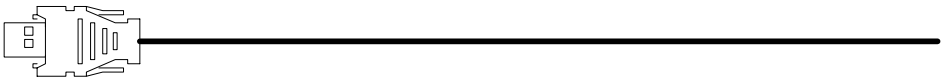
Mechatrolink Cable

The internal cable connections between the MP940 and the I/O unit are shown below:

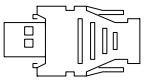


External Views of Mechatrolink Cables

Model JEPMC-W6000-□□


Model: JEPMC-W6010-□□


USB Terminator

Model: JEPMC-W6020


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Yaskawa Electric America, Inc., September 2002 YEA-SIA-C887-4.1E Printed in U.S.A.