



OM-169 510

June 1995

Processes



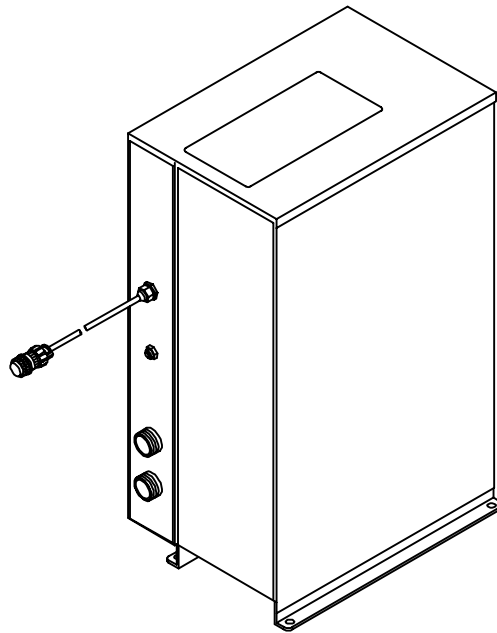
Plasma Arc (PAW) Welding

Description



Automatic Welding

Robot PAW Interface



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OWNER'S MANUAL

EMF INFORMATION

NOTE



Considerations About Welding And The Effects Of Low Frequency Electric And Magnetic Fields

The following is a quotation from the General Conclusions Section of the U.S. Congress, Office of Technology Assessment, *Biological Effects of Power Frequency Electric & Magnetic Fields – Background Paper*, OTA-BP-E-53 (Washington, DC: U.S. Government Printing Office, May 1989): “. . . there is now a very large volume of scientific findings based on experiments at the cellular level and from studies with animals and people which clearly establish that low frequency magnetic fields can interact with, and produce changes in, biological systems. While most of this work is of very high quality, the results are complex. Current scientific understanding does not yet allow us to interpret the evidence in a single coherent framework. Even more frustrating, it does not yet allow us to draw definite conclusions about questions of possible risk or to offer clear science-based advice on strategies to minimize or avoid potential risks.”

To reduce magnetic fields in the workplace, use the following procedures:

1. Keep cables close together by twisting or taping them.
2. Arrange cables to one side and away from the operator.
3. Do not coil or drape cables around the body.
4. Keep welding power source and cables as far away as practical.
5. Connect work clamp to workpiece as close to the weld as possible.

About Pacemakers:

The above procedures are among those also normally recommended for pacemaker wearers. Consult your doctor for complete information.

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SECTION 1 – SAFETY PRECAUTIONS AND SIGNAL WORDS

1-1. GENERAL INFORMATION AND SAFETY

A. General

Information presented in this manual and on various labels, tags, and plates on the unit pertains to equipment design, installation, operation, maintenance, and troubleshooting which should be read, understood, and followed for the safe and effective use of this equipment.

B. Safety

The installation, operation, maintenance, and troubleshooting of plasma arc welding equipment requires practices and procedures which ensure personal safety and the safety of others.

Read and follow safety information in the Plasma Welding Console Owner's Manual and Welding Torch Owner's Manual, as well as the other Owner's Manuals for this system, to ensure the safe installation and operation of the Plasma Arc Welding system.

1-2. SAFETY ALERT SYMBOL AND SIGNAL WORDS

The following safety alert symbol and signal words are used throughout this manual to call attention to and identify different levels of hazard and special instructions.



This safety alert symbol is used with the signal words **WARNING** and **CAUTION** to call attention to the safety statements.



WARNING statements identify procedures or practices which must be followed to avoid serious personal injury or loss of life.



CAUTION statements identify procedures or practices which must be followed to avoid minor personal injury or damage to this equipment.

IMPORTANT statements identify special instructions necessary for the most efficient operation of this equipment.

SECTION 2 – INTRODUCTION

2-1. DESCRIPTION

The robot PAW interface panel is a control designed to be used with a Thermal Dynamics WC 100B plasma

welding console and a plasma arc welding torch PWM-3A, MILLER Computer Interface, and MRH² or MRV² robot system for the Plasma Arc Welding (PAW) process.

SECTION 3 – INSTALLATION

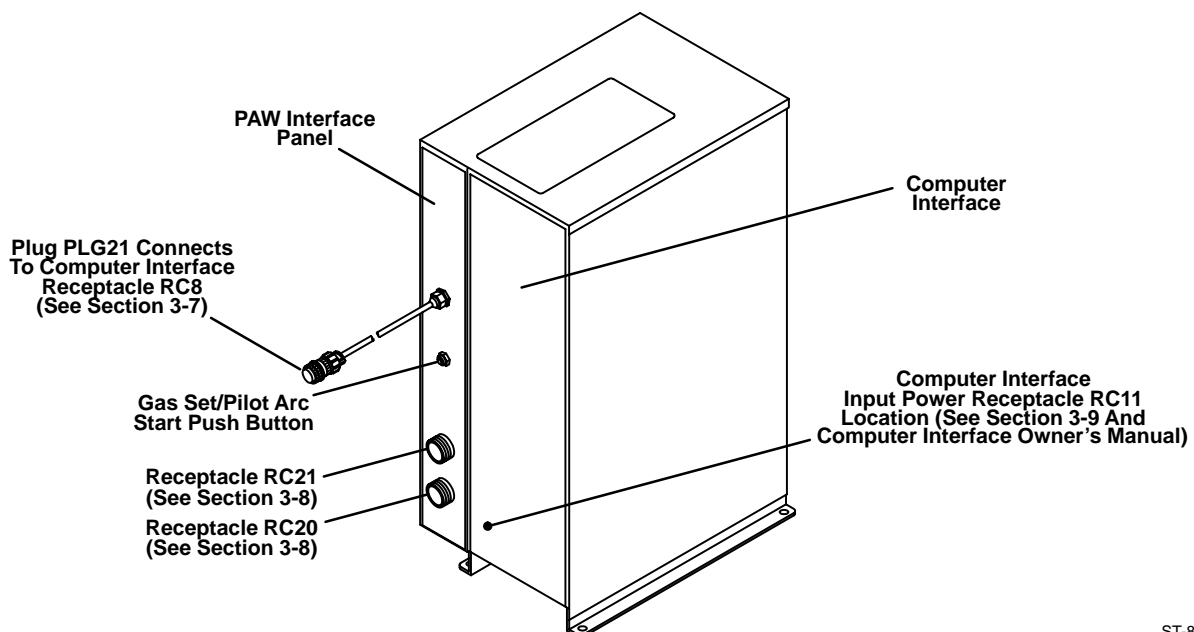


Figure 3-1. PAW Interface Panel

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IMPORTANT: When installing or operating plasma arc welding equipment, refer to the Plasma Welding Console Owner's Manual and Welding Torch Owner's Manual for specific precautionary information that applies to this equipment.

3-1. FIELD INSTALLATION INSTRUCTIONS FOR PAW INTERFACE PANEL TO COMPUTER INTERFACE (Figure 3-1 And Figure 3-2)



WARNING: ELECTRIC SHOCK can kill.

- Do not touch live electrical parts.
- Shut down robot and welding power source, and disconnect input power employing lock-out/tagging procedures before beginning this installation.

Lockout/tagging procedures consist of pad-locking line disconnect switch in open position, removing fuses from fuse box, or shutting off and red-tagging circuit breaker or other disconnecting device.



CAUTION: ELECTROSTATIC DISCHARGE (ESD) can damage circuit boards.

- Put on properly grounded wrist strap BEFORE handling circuit boards.
- Perform work only at a static-safe work area.

INCORRECT INSTALLATION or misaligned plugs can damage circuit board.

- Be sure that plugs are properly installed and aligned.

EXCESSIVE PRESSURE can break circuit board.

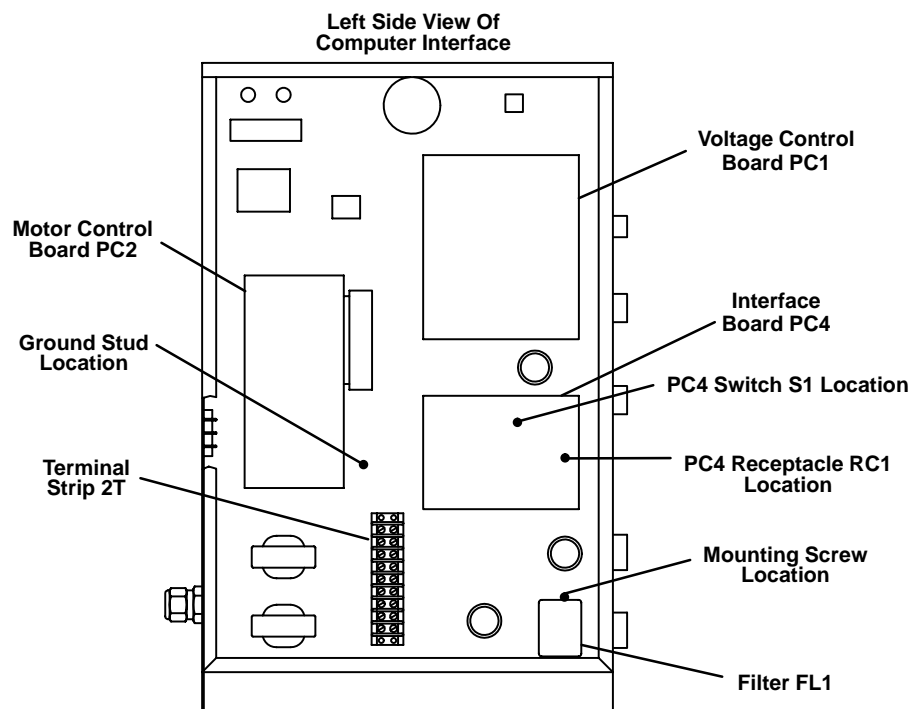
- Use only minimal pressure and gentle movement when disconnecting or connecting board plugs and removing or installing board.

IMPORTANT: All directions, such as left or right, are with respect to the operator facing the Computer Interface front panel. Retain all hardware removed during this procedure for reinstallation unless specifically told otherwise.

1. Remove Computer Interface top cover and left side panel.
2. Remove side panel from PAW Interface panel.
3. Install PAW Interface frame onto left side panel of Computer Interface with sheet metal screws removed in Step 1 (see Figure 3-1).
4. Make the following internal connections to the Computer Interface (see Figure 3-2).
 - a. Remove jumper link between terminals B and C on terminal strip 2T.
 - b. Connect lead 26 from the Interface panel to terminal B on terminal strip 2T.
 - c. Connect lead 60 from the Interface panel to top mounting screw on filter FL1.
 - d. Connect green lead from the Interface panel to the ground stud located directly above terminal strip 2T.

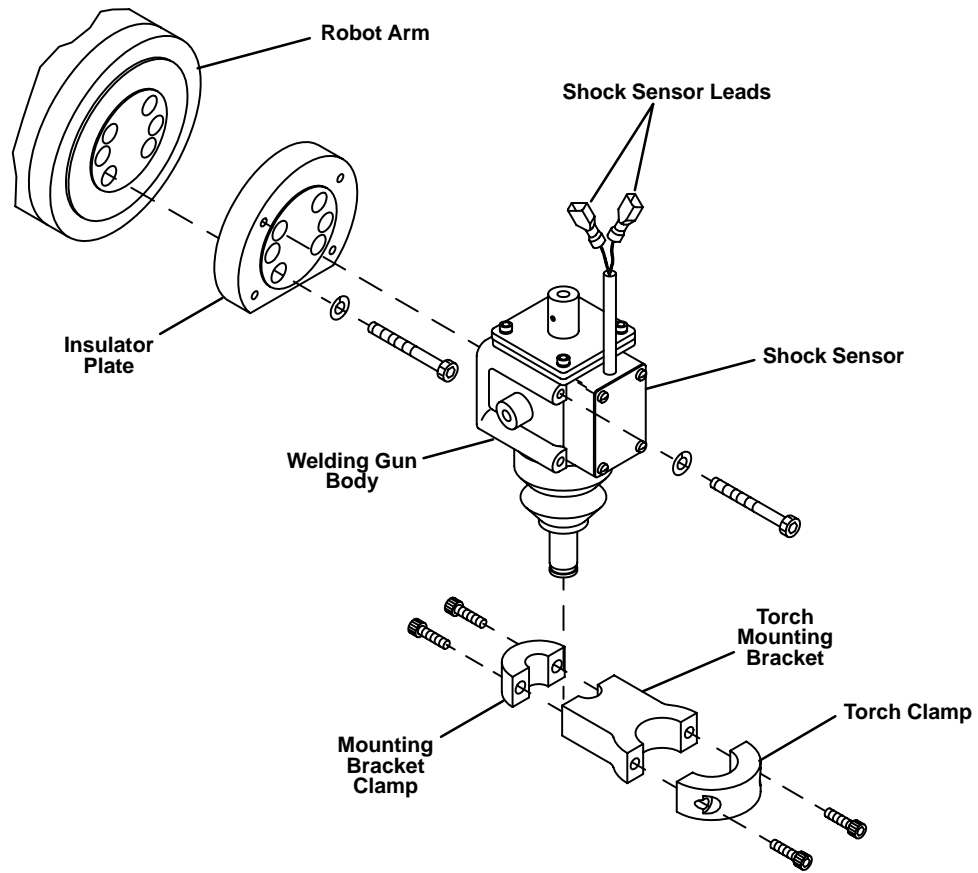
IMPORTANT: Remove the outside star washer from the ground stud to make room for the green lead terminal.

- e. Remove plug PLG3 from receptacle RC1 on Interface Board PC4.
- f. Connect plug PLG10 from the PAW Interface panel to Interface Board PC4 receptacle RC1 where plug PLG3 was removed in Step 4e (plug PLG3 is not connected for this application).



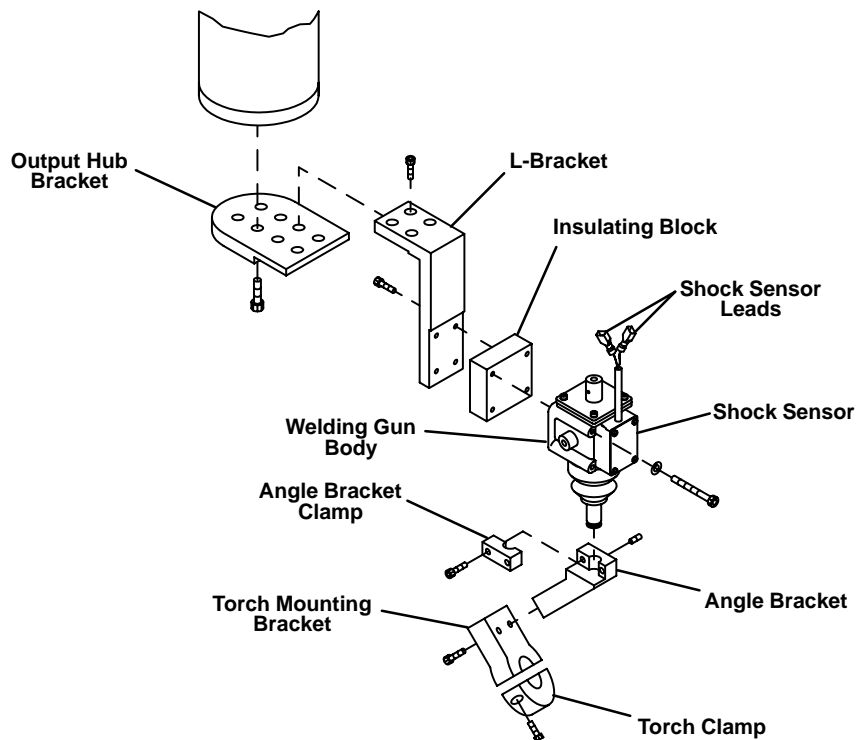
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Figure 3-2. Computer Interface Internal Connections



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Figure 3-3. MRH² Shock Sensor Unit Assembly And Installation



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Figure 3-4. MRV² Shock Sensor Unit Assembly And Installation

- g. Connect lead 23 from PAW interface panel to terminal A on terminal strip 2T.
 - h. Route plug 30/31 from PAW interface panel through center baffle in computer interface. Disconnect plug PLG10 from plug PLG11 and connect PLG 30/31 to PLG 10/11.
5. Locate switch S1 on Interface Board PC4 (see Figure 3-2). Remove varnish and potting compound from S1 and place the two DIP switches on S1 in the following positions:
 - a. S1-1 (Disable Voltage Ramp) in OFF position.
 - b. S1-2 (Disable Stick Checking) in ON position.
 6. Reinstall side panel onto PAW Interface panel.
 7. Install supplied top cover onto the Computer Interface – PAW Interface panel.

3-2. SHOCK SENSOR UNIT ASSEMBLY AND INSTALLATION TO ROBOT (Figure 3-3 And Figure 3-4)



WARNING: ELECTRIC SHOCK can kill.

- *Do not touch live electrical parts.*
- *Shut down robot and welding power source, and disconnect input power employing lock-out/tagging procedures before inspecting or installing.*

Lockout/tagging procedures consist of padlocking line disconnect switch in open position, removing fuses from fuse box, or shutting off and red-tagging circuit breaker or other disconnecting device.

MOVING PARTS can cause serious injury.

- *Keep away from moving parts.*

HOT SURFACES can cause severe burns.

- *Allow cooling period before servicing.*

To assemble and install the shock sensor unit, refer to Figure 3-3 or Figure 3-4 and proceed as follows:

A. MRH² Models

1. If applicable, remove existing gun/torch and insulator plate from robot arm.

2. Install supplied insulator plate to robot arm with screws removed in Step 1.
3. Assemble shock sensor, mounting bracket, and torch clamp as shown in Figure 3-3.
4. Install shock sensor unit to the insulator plate installed in Step 2 with supplied screws.

B. MRV² Models

1. If applicable, remove existing shock sensor from robot arm.
2. Assemble shock sensor, mounting bracket, and torch clamp as shown in Figure 3-4.
3. Install shock sensor unit to robot insulating block with screws removed in Step 1.

3-3. HIGH-FREQUENCY PROTECTION FOR TORCH CABLE

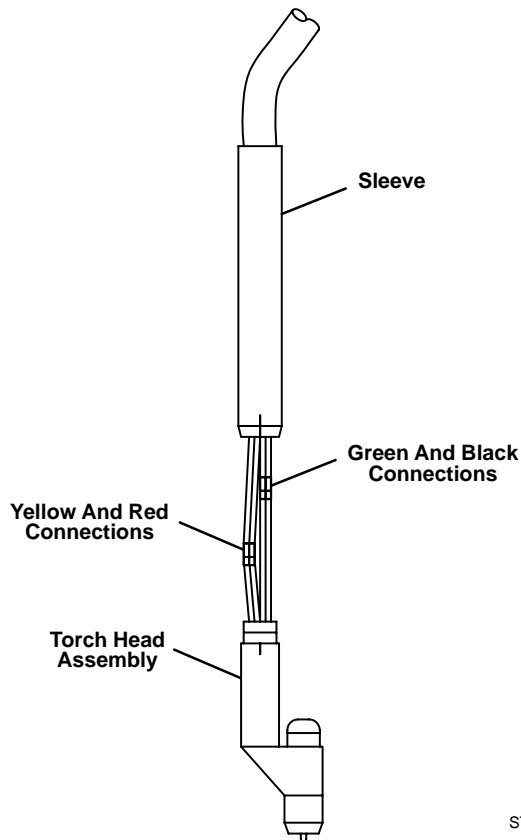
The Pilot mode switch on the WC 100B console provides a selection for the pilot arc mode of operation. If plasma arc welding is performed with the switch in the NORMAL position, the optional shield sleeving should be installed on the torch cable.

The optional shield sleeving is for covering the torch cable to prevent high frequency from interfering with robot operations.

IMPORTANT: *When installing shield sleeving, be sure end with lead and attached ring terminal is at console end of the torch cable.*

To install shield sleeving, proceed as follows:

1. Unscrew sleeve from torch head assembly (see Figure 3-5).
2. Disconnect fittings and remove torch head assembly.
3. Insert torch cable into shield sleeving at end with lead and attached ring terminal.
4. Slide shield sleeving over torch cable until end of torch cable exits opposite end of shield sleeving.
5. Reconnect fittings from torch cable to torch head assembly (match color-coded markings).
6. Check for coolant leaks at fittings by turning on recirculating coolant system. Tighten fittings if necessary.



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Figure 3-5. Connections At Torch Head Assembly

7. Screw sleeve onto torch head assembly.
8. Secure shield sleeving to torch cable using supplied clamp.

3-4. TORCH AND TORCH CABLE INSTALLATION TO ROBOT (Figure 3-3 Thru Figure 3-11)



WARNING: ELECTRIC SHOCK can kill.

- Do not touch live electrical parts.
- Shut down robot and welding power source, and disconnect input power employing lock-out/tagging procedures before inspecting or installing.

Lockout/tagging procedures consist of padlocking line disconnect switch in open position, removing fuses from fuse box, or shutting off and red-tagging circuit breaker or other disconnecting device.



MOVING PARTS can cause serious injury.

- Keep away from moving parts.

HOT SURFACES can cause severe burns.

- Allow cooling period before servicing.

A. MRH² Models

1. If applicable, remove the existing wire feed motor/reed relay mounting bracket and stabilizer brace from the robot (refer to robot Owner's Manual for bracket and brace locations). Reinstall the two lifting brackets only (see robot Owner's Manual and Figure 3-10).
2. If applicable, remove the wire feed hub support from the robot (refer to robot Owner's Manual for hub support location). Install supplied torch cable support bracket in location where hub support was secured (see Figure 3-10).
3. The torch cable is enclosed in a black protective case. Secure torch in torch clamp.

IMPORTANT: Before operating, see Section 4 and robot Owner's Manual for instructions for absolute offset adjustment. When doing this procedure, remove the shield cup and tip from torch and install the supplied brass tip gauge.

4. If applicable, remove the existing clamps suspended from the outlet cable support arm and replace them with the two supplied clamps. Route torch cable through new clamps so there is about 3-1/2 ft. (1 m) of cable between the top of the shock sensor and the first clamp (see Figure 3-10).
5. Route torch cable through torch cable support bracket tray and secure with rubber straps.
6. Route remaining end of torch cable to the WC 100B welding panel for internal connections (see Step 3, Section 3-6B).
7. The supplied high frequency filter box prevents noise interference at the shock sensor circuit in the Robot Control. To install the filter, proceed as follows:

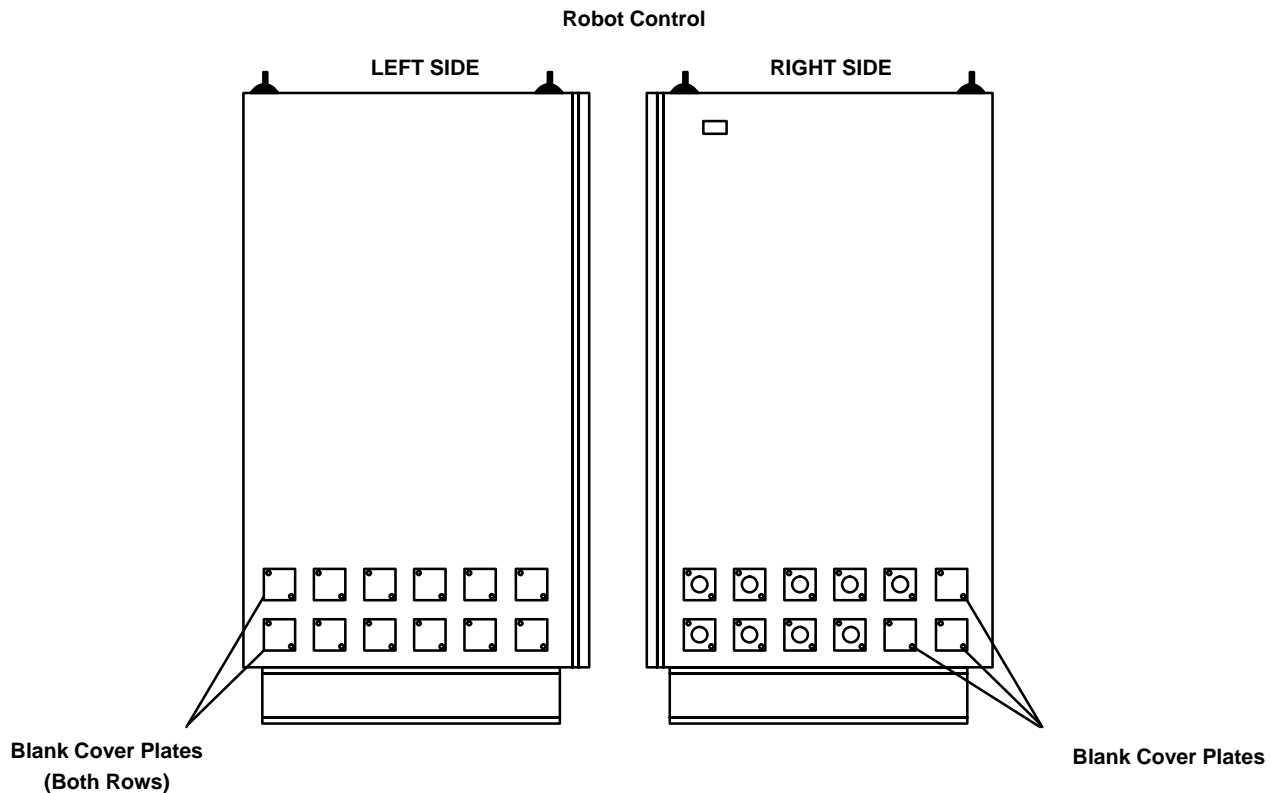


Figure 3-6. View Of Left And Right Sides Of Robot Control

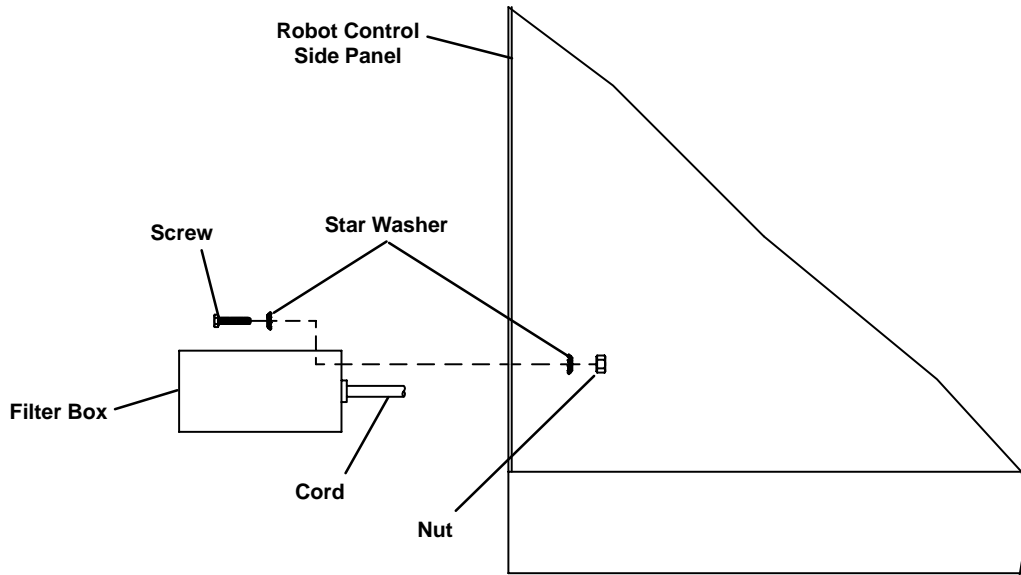


WARNING: ELECTRIC SHOCK can kill. ELECTROSTATIC DISCHARGE (ESD) can damage circuit boards.

- Do not touch live electrical parts.
- Shut down welding power source and Robot Control, and disconnect input power employing lockout/tagging procedures before inspecting high-frequency filter.

Lockout/tagging procedures consist of padlocking line disconnect switch in open position, removing fuses from fuse box, or shutting off and red-tagging circuit breaker or other disconnecting device.

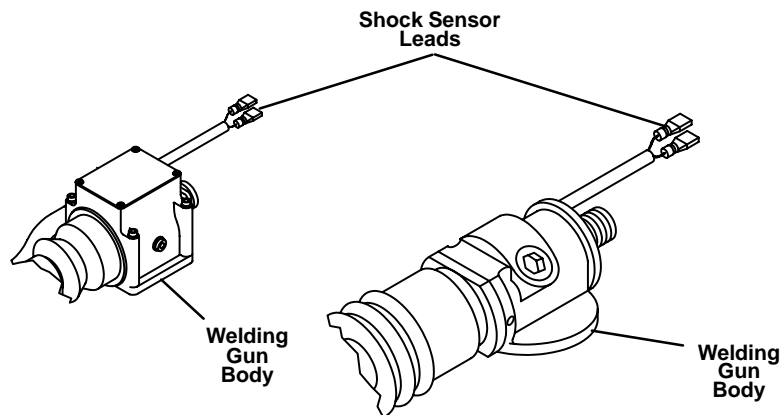
- Put on properly grounded wrist strap BEFORE handling circuit boards or making connections inside Robot Control.
 - Transport circuit boards in proper static-shielding carriers or packages.
 - Perform work only at a static-safe work area.
- a. Open Robot Control cabinet door using the two supplied keys, and rotate the power switch handle beyond the OFF position to the Reset/Open position.
 - b. Select and remove a blank cover plate from Robot Control for installing high-frequency filter (see Figure 3-6).
 - c. Remove screws securing cover to high-frequency filter box, and remove cover from box.
 - d. Insert cord attached to box through opening in Robot Control side panel where cover plate was removed.
 - e. Place a supplied external star washer over each screw, and thread screws into mounting holes in side panel (see Figure 3-7).
 - f. Tighten screws until star washers flatten and penetrate through paint into metal surface.
 - g. Place remaining star washers over threaded portion of each screw extending out from side panel inside Robot Control, and install nut on each screw.
 - h. Tighten nuts until star washers flatten and penetrate through paint into metal surface.
 - i. Reinstall and secure cover onto filter box.
 - j. Route high-frequency cord inside Robot Control to Interlock board on left side panel of cabinet.
 - k. Route black and white leads to terminal block TB1 (see Figure 3-9).
 - l. Connect black lead to terminal 4 on TB1.
 - m. Connect white lead to terminal 5 on TB1.
 - n. Close and secure Robot Control cabinet door.
 - o. Disconnect friction terminals on leads of existing shock sensor cord from shock sensor leads at welding gun body (see Figure 3-8).
 - p. Remove existing shock sensor cord by disconnecting plug from receptacle on robot.



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Figure 3-7. Installation Of Securing Hardware For Filter Box

- q. Route supplied 35 ft. (10.5 m) shielded shock sensor cable under the torch cable securing straps on the outside of the protective casing so that the two leads with friction connectors are located near the shock sensor.
- r. Connect plug on end of cord to filter box receptacle.
- s. Connect friction connectors or plug on remaining end of cord to shock sensor leads or receptacle at shock sensor.



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Figure 3-8. Welding Gun/Torch Shock Sensor Leads

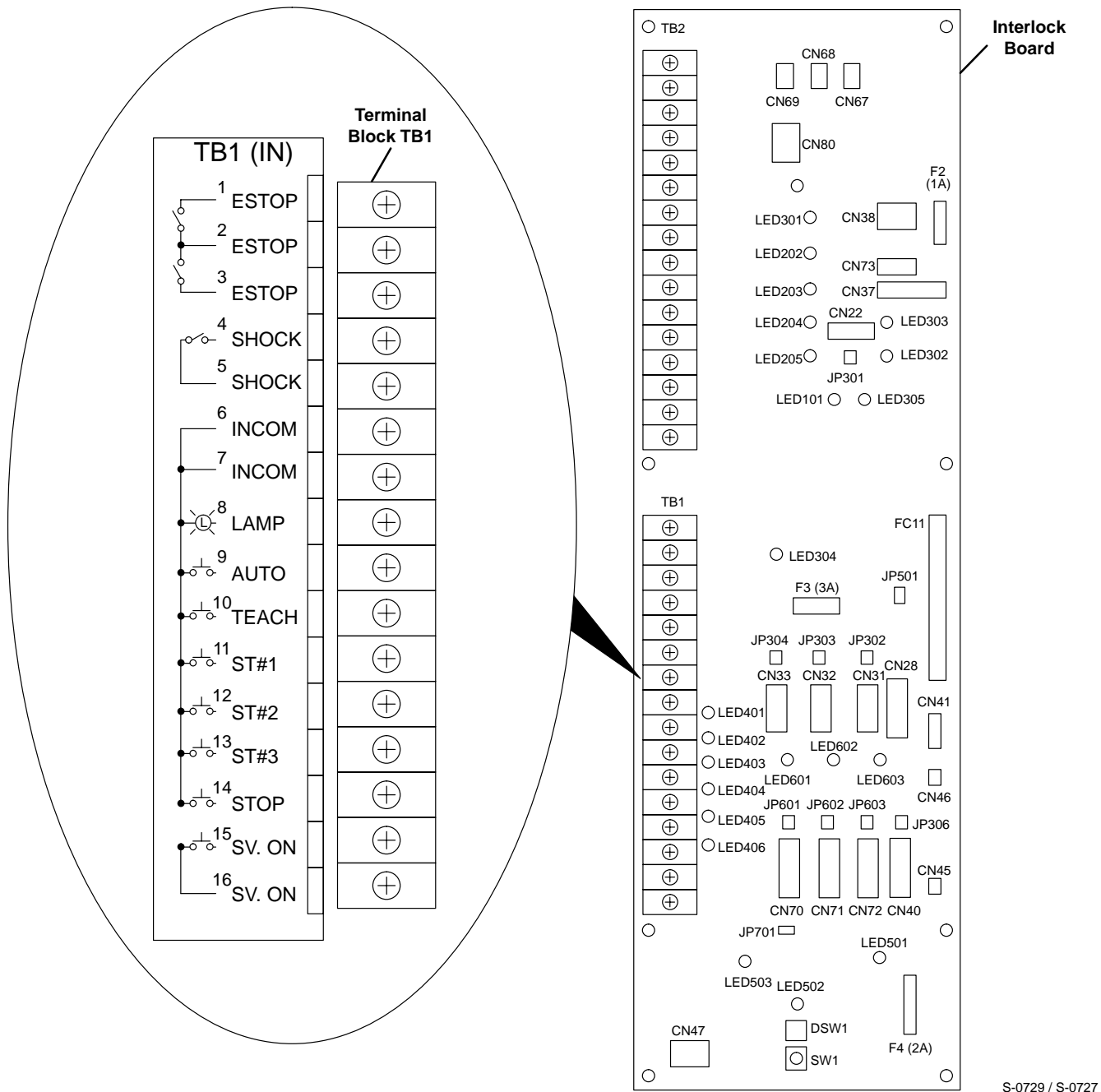
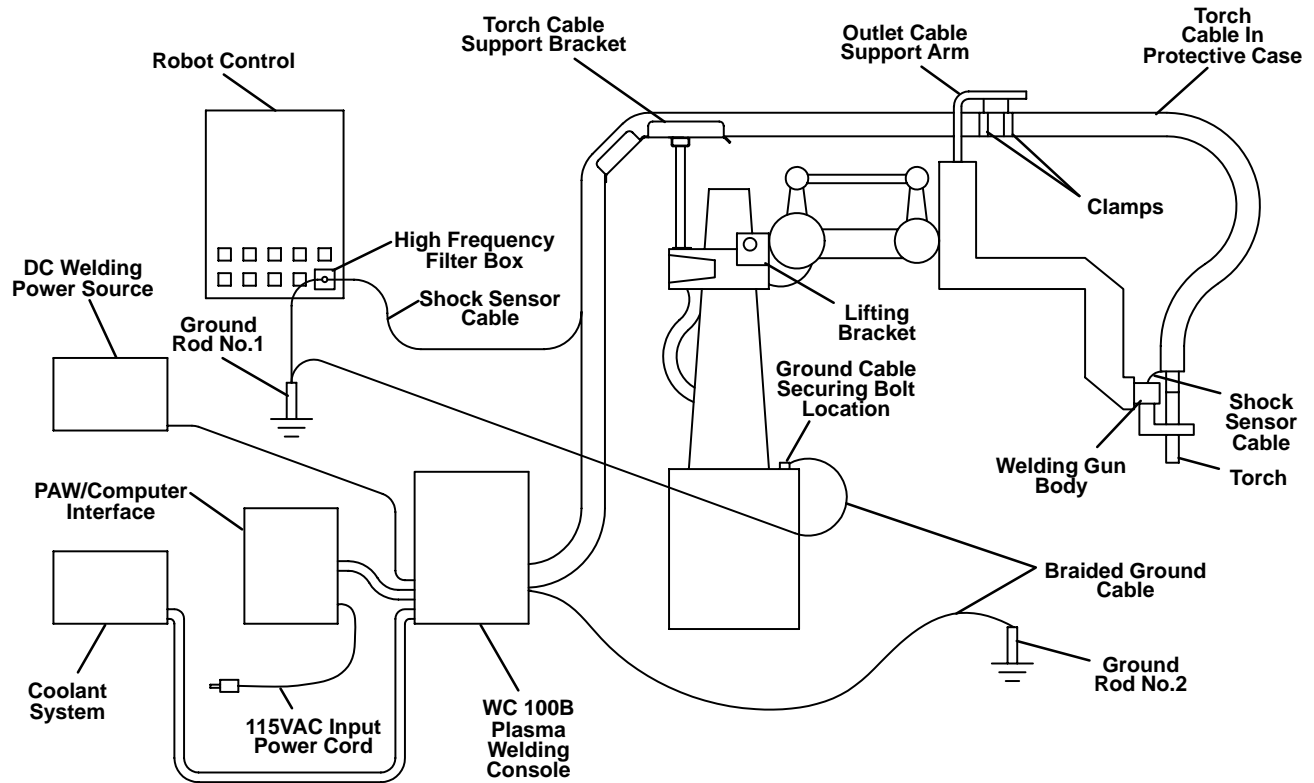


Figure 3-9. Function Control Terminal Block TB1 On Interlock Board Inside Robot Control



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Figure 3-10. MRH² Robot PAW System

B. MRV² Models

1. Remove the outlet cable support arm and wire drive assembly from the robot Axis 3 housing.
2. Install supplied torch cable support bracket onto robot Axis 3 housing using the existing mounting holes. Position supplied insulator plate between bracket and robot, align holes and secure with supplied hardware (see Figure 3-11).
3. Install supplied servo light box onto robot Axis 3 housing directly in front of torch cable support bracket using the existing mounting holes (see Figure 3-7). Position supplied insulator plate between light box and robot, align holes and secure with supplied hardware. Connect plug on light box cord to nearby matching receptacle located on the side of the Axis 3 housing. The receptacle on the light box is not used for this application.
4. Install cable hanger assembly with tool balancer onto robot Axis 3 housing.
5. The torch cable is enclosed in a black protective case. Secure torch in torch clamp using supplied shim. Position torch handle so that there is approximately 4 in. (96 mm) between the bottom of the torch clamp and the torch tip. Clamp torch cable to tool balancer on cable hanger and route cable through support bracket.

IMPORTANT: Before operating, see Section 4 and robot Owner's Manual for instructions for absolute offset

adjustment. Install positioning gauge (universal J-bar for MRH² or I-bar for MRV²) onto robot output hub bracket. Remove the shield cup and tip from torch and install the supplied brass tip gauge.

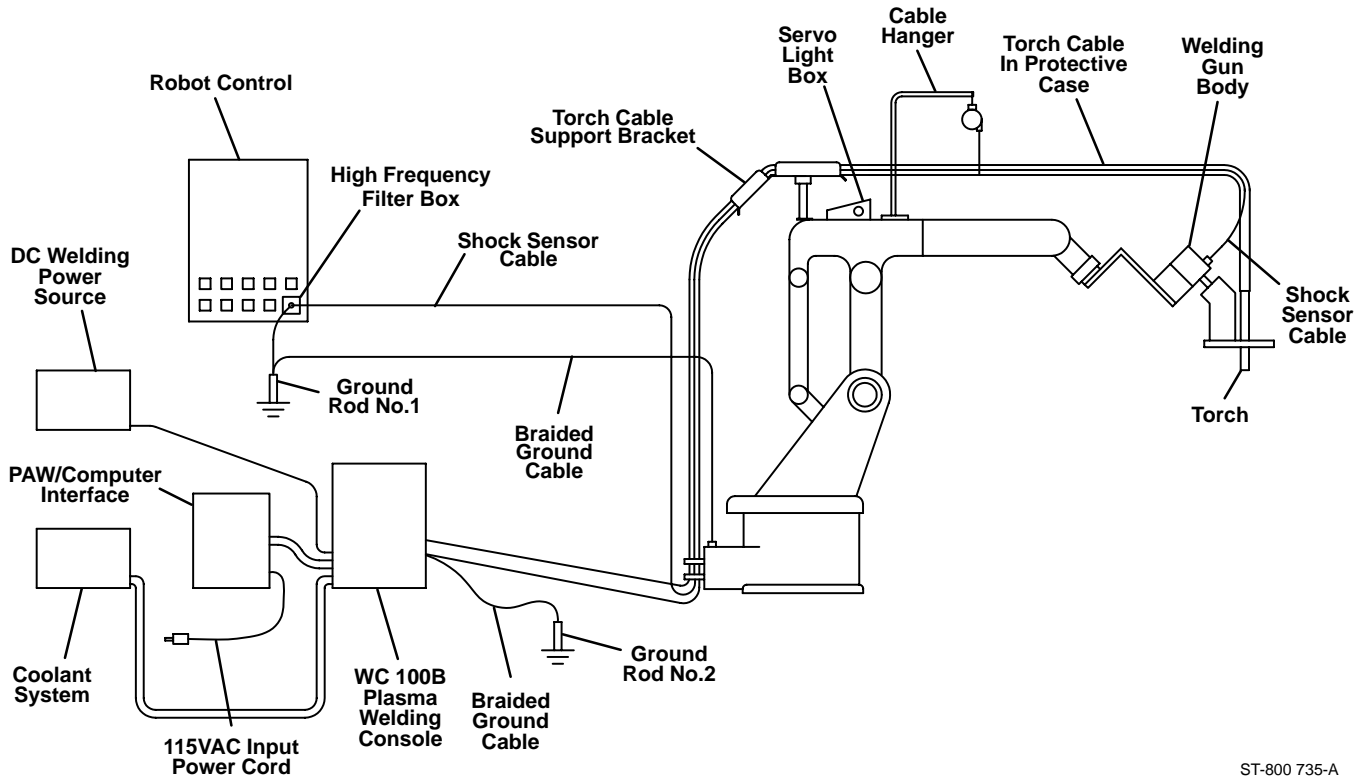
6. Route remaining end of torch cable to the WC 100B welding panel for internal connections (see Step 3, Section 3-6B).
7. Install supplied high frequency filter box according to instructions for MRH² (see Section 3-4A).

3-5. GROUND CABLE CONNECTIONS (Figure 3-10 And Figure 3-11)

IMPORTANT: If welding power source is equipped with a plastic case, only one ground cable is necessary for connecting to robot base.

See Figure 3-10 or Figure 3-11 and install three supplied flat, braided ground cables as follows:

1. Connect one end of the ground cables to the customer-supplied ground rod (see robot Owner's Manual).
2. Connect remaining end of one ground cable to robot base as follows:
 - a. Locate unused threaded hole on robot base.
 - b. To ensure good electrical conduction, scrape away enough paint from around the hole so that the ground cable terminal will touch bare metal.
 - c. Attach ground cable terminal to base with supplied 12 mm bolt.



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Figure 3-11. MRV² Robot PAW System

3. Route remaining end of another ground cable to the plasma welding console. Connect ground cable together with the lead from the shield sleeving after completing internal connections (see Section 3-8).
4. Route remaining end of the last ground cable to the welding power source. Connect ground cable to welding power source case unless welding power source is equipped with a plastic case, then no connection is necessary.

3-6. TORCH CABLE INTERNAL CONNECTIONS TO PLASMA WELDING CONSOLE (Figure 3-12)



WARNING: ELECTRIC SHOCK can kill.

- Do not touch live electrical parts.
- Shut down robot and welding power source, and disconnect input power employing lock-out/tagging procedures before inspecting or installing.

Lockout/tagging procedures consist of padlocking line disconnect switch in open position, removing fuses from fuse box, or shutting off and red-tagging circuit breaker or other disconnecting device.

MOVING PARTS can cause serious injury.

- Keep away from moving parts.

HOT SURFACES can cause severe burns.

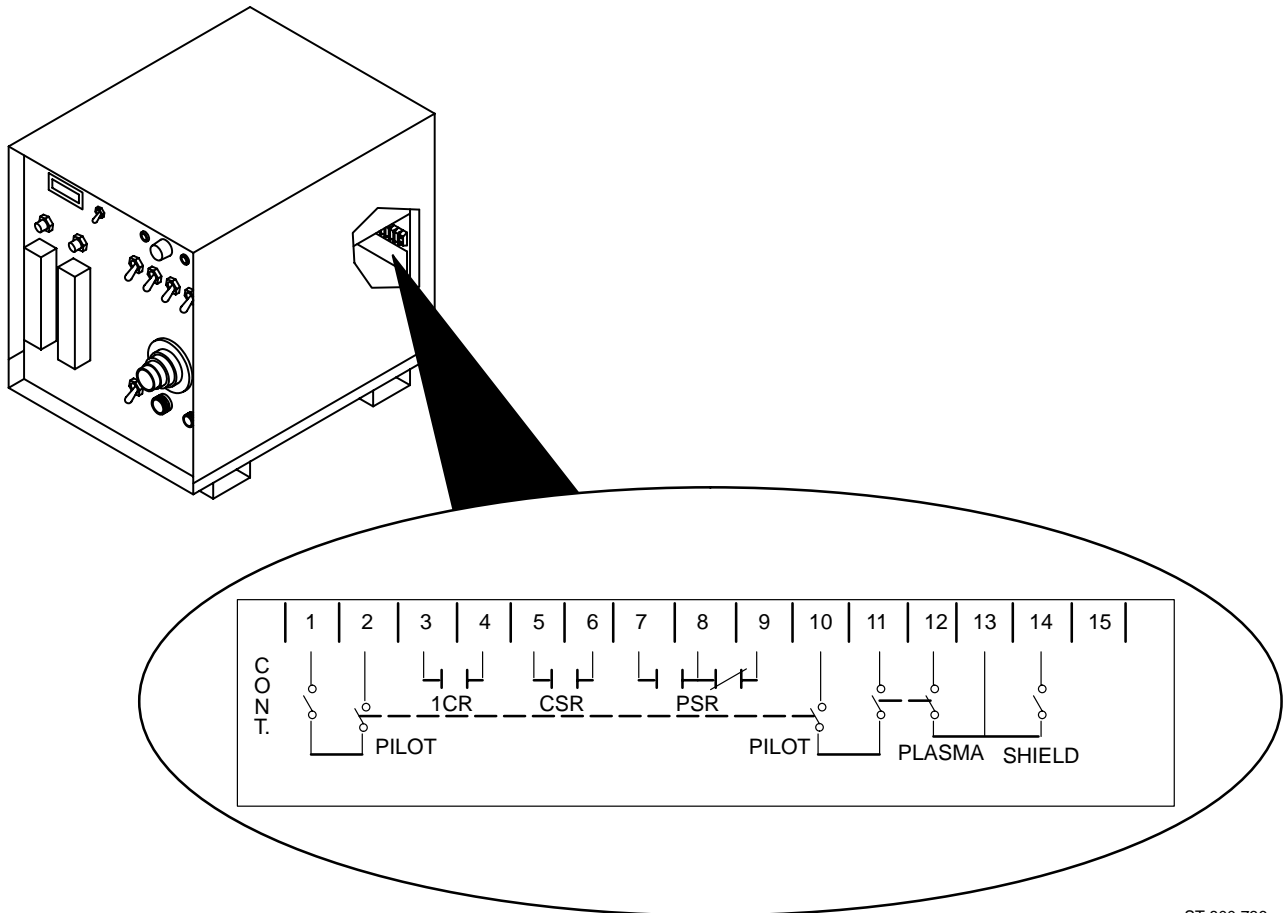
- Allow cooling period before servicing.

To make torch cable internal connections, proceed as follows:

1. Remove WC 100B wrapper.
2. Route torch cable through strain relief on front panel.
3. Connect 2 cables and 2 hoses to torch mounting panel. The color-coded cables and hoses match the color-coded connectors as follows:
 - a. Red to red
 - b. Yellow to yellow
 - c. Black to black
 - d. Green to green
4. Reinstall WC 100B wrapper.

3-7. PAW INTERFACE PANEL – COMPUTER INTERFACE CONNECTION (Figure 3-1, Figure 3-10, And Figure 3-11)

Connect plug PLG21 attached to cord extending from the PAW Interface panel front panel to weld current relay receptacle RC8 on the Computer Interface front panel. Make connections as follows: align keyway, insert plug, and rotate threaded collar fully clockwise.



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Figure 3-12. Terminal Strip TB1 Location Inside WC 100B Console

3-8. PAW INTERFACE PANEL – WELDING POWER SOURCE – PAW CONSOLE CONNECTIONS (Figure 3-1, Figure 3-10, And Figure 3-11)



WARNING: ELECTRIC SHOCK can kill.

- Do not touch live electrical parts.
- Shut down robot and welding power source, and disconnect input power employing lockout/tagging procedures before inspecting or installing.

Lockout/tagging procedures consist of padlocking line disconnect switch in open position, removing fuses from fuse box, or shutting off and red-tagging circuit breaker or other disconnecting device.

Make connections to units as follows:

1. Locate supplied cord with matching plug for welding power source Remote 14 receptacle and connect plug to receptacle.
2. Connect plug on remaining end of cord from Remote 14 receptacle to receptacle labeled Power Supply Control on rear of WC 100B console.
3. Locate supplied cord with matching plug for PAW interface panel receptacle RC20 and connect plug to receptacle.
4. Connect plug on remaining end of cord from receptacle labeled Remote Control on front of WC 100B console.
5. Locate supplied cord with matching plug for PAW interface panel receptacle RC21 and connect plug to receptacle.
6. Remove wrapper from WC 100B console. Route cord to rear of WC 100B console. Insert cord through strain relief and route end of cord to terminal strip TB1 (see Figure 3-12).
7. Remove jumper leads from terminals on TB1 as follows:
 - a. 10 and 11
 - b. 12 and 13
 - c. 13 and 14
8. Connect terminal connectors on remaining end of cord to terminals as follows:
 - a. Green lead to terminal 5
 - b. Orange lead to terminal 6
 - c. Brown lead to terminal 10
 - d. Blue lead to terminal 11
 - e. White lead to terminal 12
 - f. Black and red leads to terminal 13

- g. Yellow lead to terminal 14.
- 9. Route cable from welding power source negative (-) weld output receptacle through opening in rear of WC 100B console. Route end of cable to shunt, located where torch cable bus bar is connected, and connect cable to shunt at end opposite from bus bar.
- 10. Route cable from welding power source positive (+) weld output receptacle and connect end of cable to workpiece.
- 11. Reinstall WC 100B wrapper.
 - a. Remove paint from around right front screw hole on right side of wrapper,
 - b. Connect ring terminal, located on end of lead from shield sleeving, to wrapper using screw that secures right front side of wrapper.

3-9. COMPUTER INTERFACE – INPUT POWER CONNECTIONS (Figure 3-1, Figure 3-10, And Figure 3-11)

Connect plug on supplied input power cord to 14-pin input power receptacle RC11 on the Computer Interface front panel as follows: align keyway, insert plug, and rotate threaded collar fully clockwise. Connect input power plug on other end of cord to a 115 volts ac external supply.

3-10. GAS SET/PILOT ARC START PUSH BUTTON

IMPORTANT: *Thoroughly purge plasma torch gas line before starting pilot arc.*

This button starts shielding gas flow when the Run/Set switch on the WC 100B welding panel is in the Set position. When the switch is in Run position, pressing the button starts shielding gas flow and 5 seconds later plasma gas flows and the pilot arc ignites.



WARNING: PLASMA ARC can cause injury.

- *Keep away from the torch tip.*
- *Pilot arc can cause burns – keep away from torch tip when pilot arc is present.*

The pilot arc can be intermittent or continuous depending on the application. ALWAYS point torch away from personnel and toward work when starting the pilot arc or leaving the pilot arc on continuously.

To purge the plasma torch gas line, proceed as follows:

1. Turn on input power to welding power source and WC 100B console.
2. Place Run/Set switch in the Set position.
3. Press the Gas Set/Pilot Arc Start push button.

IMPORTANT: *Gas flow and pilot arc stop when an Emergency Stop button is pressed.*

3-11. REMOTE GAS SET/PILOT ARC START SWITCH CONNECTIONS



WARNING: ELECTRIC SHOCK can kill.

- *Do not touch live electrical parts.*
- *Shut down robot and welding power source, and disconnect input power employing lockout/tagging procedures before inspecting or installing.*

Lockout/tagging procedures consist of padlocking line disconnect switch in open position, removing fuses from fuse box, or shutting off and red-tagging circuit breaker or other disconnecting device.

To make remote Gas Set/Pilot Arc Start switch connections, proceed as follows:

1. Remove side panel from PAW Interface panel.
2. Route one end of a 2-conductor, customer-supplied cord through strain relief on rear of PAW Interface panel.
3. Installing terminal connectors for connecting to terminal strip 6T onto leads at end of cord inside PAW Interface panel. Install a normally open momentary contact switch to remaining end of cord.
4. Connect leads to terminals 6TB and 6TD. Tighten strain relief.
5. Reinstall side panel onto PAW Interface panel.

IMPORTANT: *The remote Gas Set/Pilot Arc Start switch operates the same as the front panel push button switch (see Section 3-10).*

SECTION 4 – ROBOT PROGRAM MODIFICATIONS

IMPORTANT: The robot program must be changed to accommodate plasma arc welding. The program is factory set to accommodate factory installed plasma arc welding equipment. The following information pertains to the robot Owner's Manual and must be followed when field installing plasma arc welding equipment.



WARNING: ELECTRIC SHOCK can kill.

- Do not touch live electrical parts.
- Shut down robot and welding power source, and disconnect input power employing lock-out/tagging procedures before inspecting or installing.

Lockout/tagging procedures consist of padlocking line disconnect switch in open position, removing fuses from fuse box, or shutting off and red-tagging circuit breaker or other disconnecting device.

4-1. SETTING UP PLASMA (NON-STANDARD) TORCH FOR MRH² ROBOT (Figure 4-1)

It is necessary to use the robot Owner's Manual in addition to this manual to complete the proper installation of the torch.

IMPORTANT: Follow entire procedure in presented order.

1. Check System Data settings against the test sheet supplied with the unit. These should match before beginning installation.
2. Mount plasma arc welding torch according to Section 3-3 of this manual. Make sure that supplied brass tip gauge and holder have been installed on torch.
3. Do tool center point adjustment according to Section 4.6 of the robot Owner's Manual.
4. The universal J-bar is included to record exact torch position so that it is possible to recover position in case of a robot crash. Install universal J-bar as follows:
 - a. Remove 2 screws and cover plate from bottom of Axis 5 gear housing.
 - b. Install universal J-bar onto Axis 5 by aligning index pin with hole in housing, and securing with supplied screws.

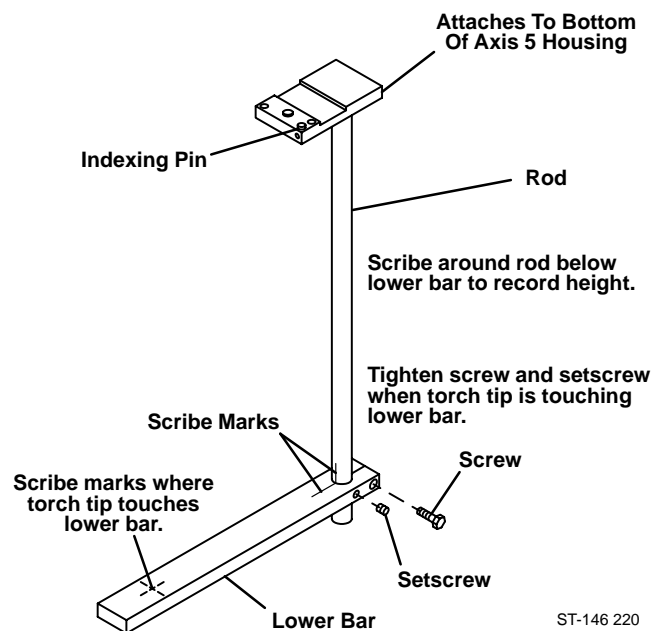


Figure 4-1. Scribe Marks on Universal J-Bar

5. Position lower bar of universal J-bar so that it touches torch tip gauge, and scribe marks on the J-bar to indicate exact torch position as shown in Figure 4-1.
6. Remove universal J-bar, and retain for future use.

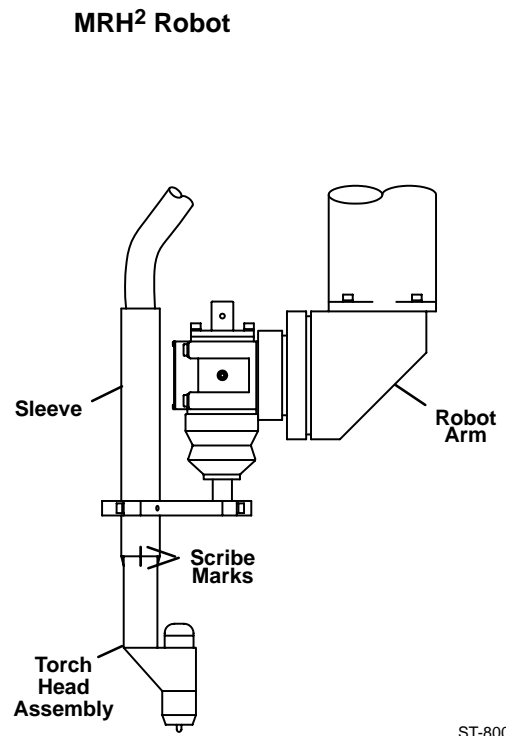
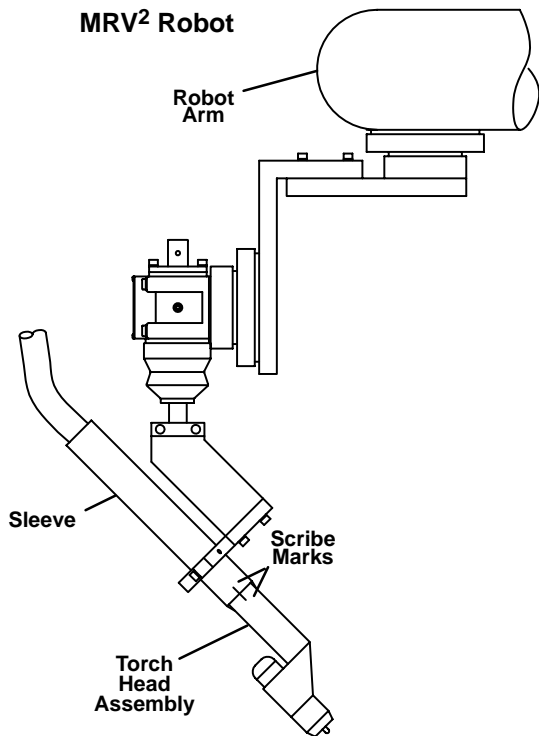
4-2. SETTING UP PLASMA TORCH FOR MRV² ROBOT (Figure 4-1)

The plasma torch does not require any changes to data in PARMTER/SYSTEM/TOOL PARAMETER. The standard I-bar is used for adjusting torch position and for position recovery after a robot crash. Mount plasma arc welding torch, install tip gauge, and follow mounting adjustment procedures according to instructions in Section 4 – System Set Up in the robot Owner's Manual. Loosen torch clamp setscrews and position torch so that tip gauge touches I-bar reference point. Retighten setscrew.

After completing torch adjustment procedure, remove tip gauge and reinstall cup onto end of torch.

4-3. MARKING POSITION OF TORCH HEAD ASSEMBLY (Figure 4-2)

When the mounting adjustment procedure is complete, place scribe marks on the torch head assembly and sleeve to mark the torch head assembly position for future alignment adjustments.



ST-800 747-A

Figure 4-2. Marking Position Of Torch Head Assembly

4-4. SYSTEM SETUP FOR MRH² AND MRV² WITH C2 ROBOT CONTROL

Set welding power source specifications in user parameters for the Plasma Arc Welding (PAW) process according to the following instructions.

1. Turn on Robot Control input power by placing the power switch handle on the Robot Control cabinet door in the ON position, and the following displays will appear as shown:

<p>DIAGNOSIS</p> <p>' 9 2 - 0 7 - 3 1</p> <p>0 8 : 3 0</p>	<p>W E L C O M E T O</p> <p>M I L L E R C O O P E R A T I V E C O N T R O L</p> <p>M I L L E R E L E C T R I C M f g . C o .</p> <p>S T A R T D I A G N O S I S</p>
--	---

<p>DIAGNOSIS</p> <p>' 9 2 - 0 7 - 3 1</p> <p>0 8 : 3 0</p>	<p>W E L C O M E T O</p> <p>M I L L E R C O O P E R A T I V E C O N T R O L</p> <p>S T E P O F I N I T I A L D I A G N O S I S</p> <p>1 , 2 , 3 , 4 , 5 ,</p>
--	---

TEACH					
SERVO	OFF				
TEACH	EDIT	FILE	ALLOT	LOCK	>

2. Press the FUNCTION APPLICATION  key for additional functions to appear on the display.

PARMTER	CHECK	MANAGE	SYS.SET	MEMORY	>

3. Press the F1  key for the PARMTER function.


		SELECT TYPE OF PARAMETER			
TEACH	MODE	BY FUNCTION KEY			
SERVO	OFF				
SYSTEM	SWITCH	WELD	I/O	AUTO	>

4. Press the FUNCTION APPLICATION  key for additional functions to appear on the display.


		SELECT TYPE OF PARAMETER			
TEACH	MODE	BY FUNCTION KEY			
SERVO	OFF				
SENSOR	ARC-S	TOUCH-S	W-CHARA	S-DATA	>

5. Press F4  key for the W-CHARA function to set welding characteristics.

A X I S	M L 4	P O W E R	S O U R C E	W I R E
T E A C H				
		G M A W	. 0 3 5	. 0 4 5 . 0 6 2
		S Y N E R G I C	. 0 3 5	. 0 4 5 . 0 6 2
S E R V O	O F F	G T A W - 1 0 0	. 0 3 5	. 0 4 5 . 0 6 2
		G T A W - 3 0 0	. 0 3 5	. 0 4 5 . 0 6 2
		U S E R R E G I S T E R		
R E G I S T	M O D I F Y	S C _ E D I T		

6. Use the INCREMENT  or DECREMENT  key and forward  or back  DISPLAY SELECT key to select GTAW-300 by setting a wire size selection.


A X I S	M L 4	P O W E R	S O U R C E	W I R E
T E A C H				
		G M A W	. 0 3 5	. 0 4 5 . 0 6 2
		S Y N E R G I C	. 0 3 5	. 0 4 5 . 0 6 2
S E R V O	O F F	G T A W - 1 0 0	. 0 3 5	. 0 4 5 . 0 6 2
		G T A W - 3 0 0	. 0 3 5	. 0 4 5 . 0 6 2
		U S E R R E G I S T E R		
R E G I S T	M O D I F Y	S C _ E D I T		

7. Press the F1  key for the REGIST function to register the change in Robot Control memory.

T E A C H	M O D E	S E L E C T	T Y P E	O F	P A R A M E T E R
		B Y	F U N C T I O N	K E Y	
S E R V O	O F F				
S E N S O R	A R C - S	T O U C H - S	W - C H A R A	S - D A T A	>

8. To check settings, press the F4  key for the W-CHARA function.

AXIS	ML 4	POWER SOURCE	WIRE
TEACH			
		GMAW	. 0 3 5 . 0 4 5 . 0 6 2
		SYNERGIC	. 0 3 5 . 0 4 5 . 0 6 2
SERVO	OFF	GTAW - 1 0 0	. 0 3 5 . 0 4 5 . 0 6 2
		GTAW - 3 0 0	. 0 3 5 . 0 4 5 . 0 6 2
		USER REGISTER	
REGISTER	MODIFY	SC_EDIT	

9. Press the F2  key to select the MODIFY function.

AXIS	ML 4	RATING OF POWER SOURCE
TEACH		\$WTBD31
		TYPE SEPA . SYNER . TIG
		RATING CURRENT 200 A
SERVO	OFF	W-FEEDER RATING 256 i .
		PUSH RECORD AFTER SETTING

10. Use the INCREMENT  or DECREMENT  key to select RATING CURRENT parameter.


AXIS	ML 4	RATING OF POWER SOURCE
TEACH		\$WTBD31
		TYPE SEPA . SYNER . TIG
		RATING CURRENT 200 A
SERVO	OFF	W-FEEDER RATING 256 i .
		PUSH RECORD AFTER SETTING

11. Use the numerical keys to amperage to the maximum current output of the welding power source.

A X I S	M L 4	R A T I N G O F P O W E R S O U R C E			
T E A C H		\$ W T B D 3 1			
		T Y P E	S E P A .	S Y N E R .	T I G
		R A T I N G	C U R R E N T		3 0 0 A
S E R V O	O F F	W - F E E D E R	R A T I N G		2 5 6 i .
		P U S H R E C O R D A F T E R S E T T I N G			

12. Press the RECORD  key.

A X I S	M L 4	D I S P .	R E F .	D I S P .	R E F .
T E A C H		1 . 5 0 A	1 . 5 V	5 0 i .	2 . 0 V
		2 . 1 5 0 A	4 . 5 V	1 0 2 i .	4 . 0 V
		3 . 2 0 0 A	6 . 0 V	1 5 3 i .	6 . 0 V
S E R V O	O F F	4 . 2 5 0 A	7 . 5 V	2 0 5 i .	8 . 0 V
		5 . 3 0 0 A	1 0 . 0 V	2 5 6 i .	1 0 . 0 V


13. Use the INCREMENT  or DECREMENT  key and forward  or back  DISPLAY SE-
LECT key to change the scaling of the amperage and reference voltage.

A X I S	M L 4	D I S P .	R E F .	D I S P .	R E F .
T E A C H		1 . 5 A	0 . 0 V	5 0 i .	2 . 0 V
		2 . 7 9 A	2 . 0 V	1 0 2 i .	4 . 0 V
		3 . 1 9 0 A	5 . 0 V	1 5 3 i .	6 . 0 V
S E R V O	O F F	4 . 3 0 1 A	8 . 0 V	2 0 5 i .	8 . 0 V
		5 . 3 7 5 A	1 0 . 0 V	2 5 6 i .	1 0 . 0 V


14. Press the RECORD  key.

TEACH MODE	SELECT TYPE OF PARAMETER BY FUNCTION KEY			
SERVO OFF				
SENSOR	ARC-S	TOUCH-S	W-CHARA	S-DATA >

15. Check settings of weld characteristics as follows:

a. Press the F4  key to select the W-CHARA function.


AXIS ML4	POWER SOURCE	WIRE		
TEACH	GMAW	.035	.045	.062
	SYNERGIC	.035	.045	.062
SERVO OFF	GTAW-100	.035	.045	.062
	GTAW-300	.035	.045	.062
	USER REGISTER			
REGIST	MODIFY	SC_EDIT		

b. Press the F2  key to select the MODIFY function.


AXIS ML4	RATING OF POWER SOURCE			
TEACH	\$WTBD31			
	TYPE	SEPA.	SYNER.	TIG
	RATING CURRENT			300A
SERVO OFF	W-FEEDER RATING			256i.
	PUSH RECORD AFTER SETTING			

c. Press the RECORD  key.

AXIS	ML 4	DISP .	REF .	DISP .	REF .
TEACH		1 . 5 A	0 . 0 V	50 i .	2 . 0 V
		2 . 79 A	2 . 0 V	102 i .	4 . 0 V
		3 . 190 A	5 . 0 V	153 i .	6 . 0 V
SERVO	OFF	4 . 301 A	8 . 0 V	205 i .	8 . 0 V
		5 . 375 A	10 . 0 V	256 i .	10 . 0 V

16. Press the RESET  key.

TEACH MODE	SELECT TYPE OF PARAMETER BY FUNCTION KEY			
SERVO OFF				
SENSOR	ARC-S	TOUCH-S	W-CHARA	S-DATA >

17. Press the TEACH MODE  key to return to the beginning of the Teach mode.

TEACH				
SERVO OFF				
TEACH	EDIT	FILE	ALLOT	LOCK >

SECTION 5 – ELECTRICAL DIAGRAMS

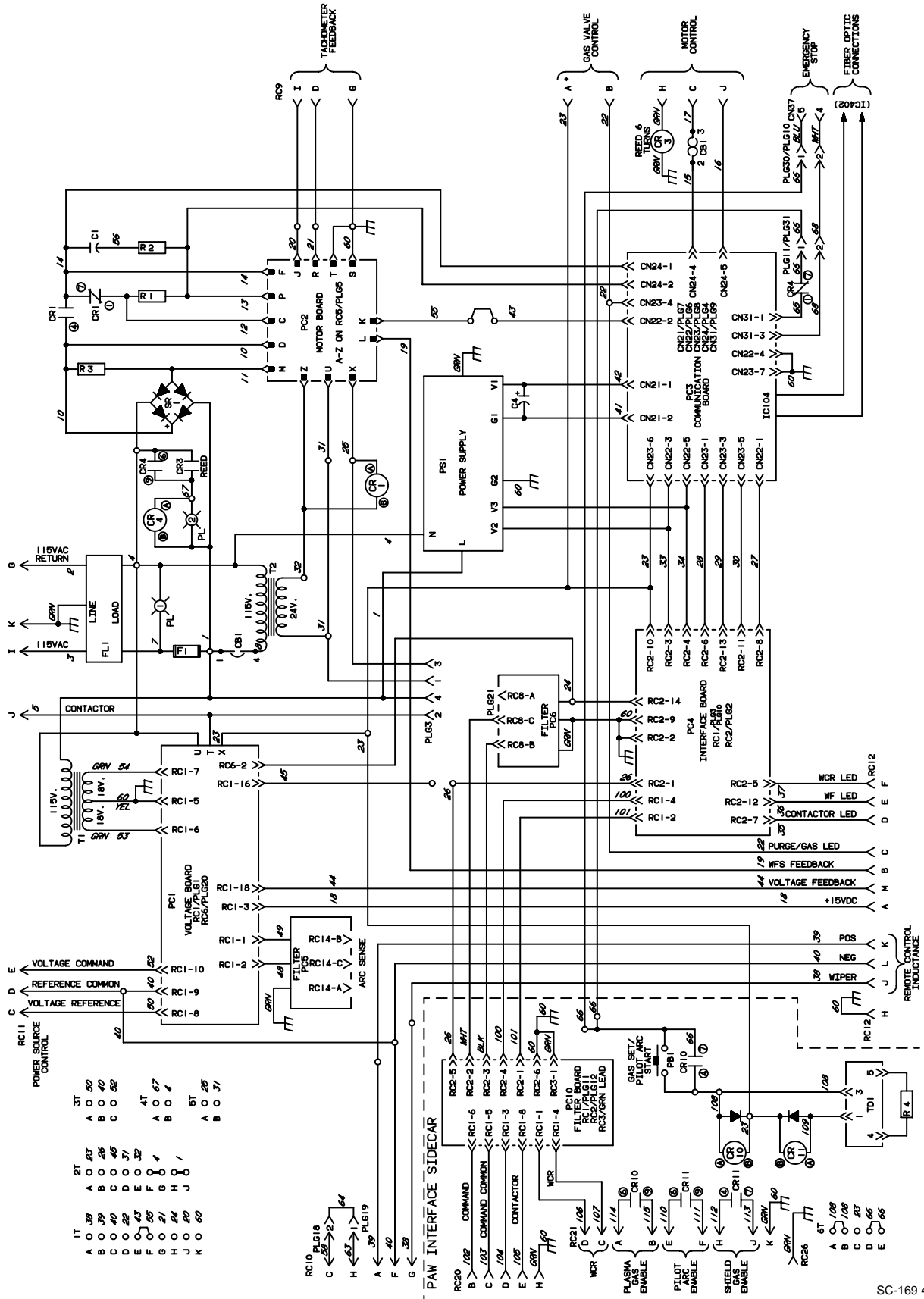
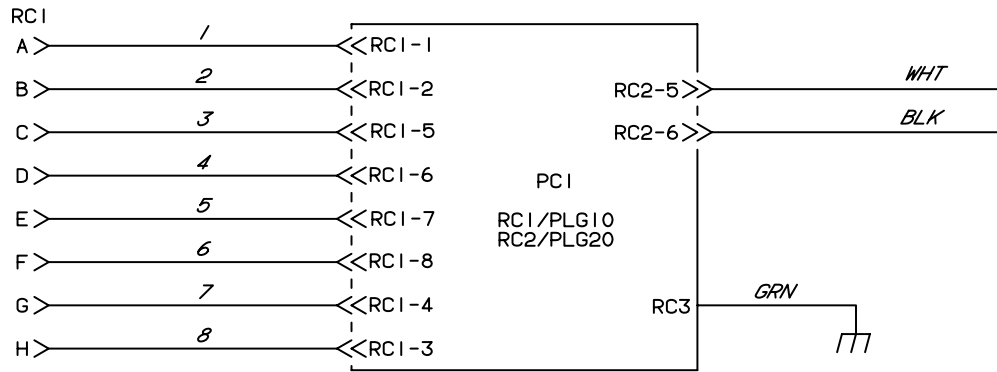


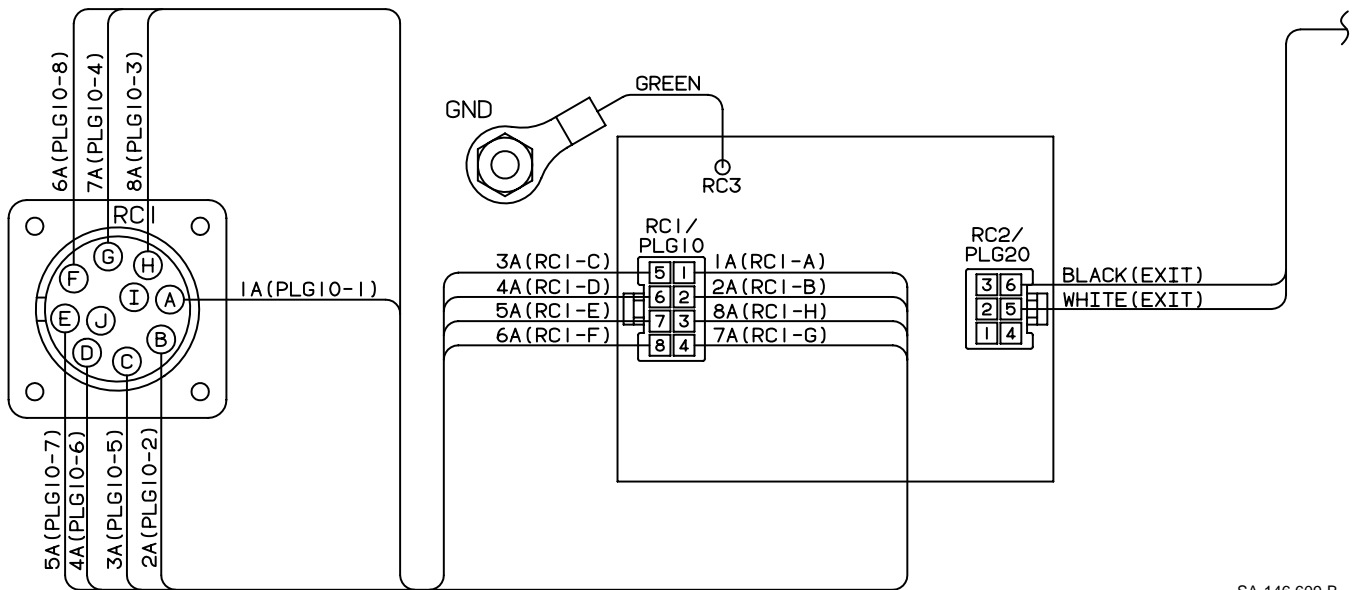
Figure 5-1. Circuit Diagram For Robot PAW System

SC-169 456



SA-146 608-A

Figure 5-4. Circuit Diagram For High-Frequency Filter



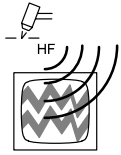
SA-146 609-B

Figure 5-5. Wiring Diagram For High-Frequency Filter

SECTION 6 – HF IN PLASMA ARC WELDING

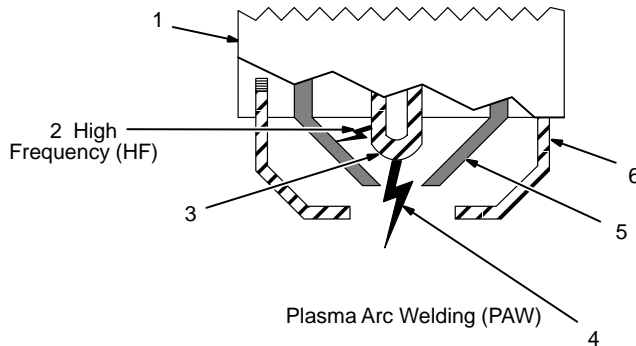
mod6.2* 5/94

⚠ WARNING



HIGH-FREQUENCY RADIATION can interfere with radio navigation, safety services, computers, and communications equipment.

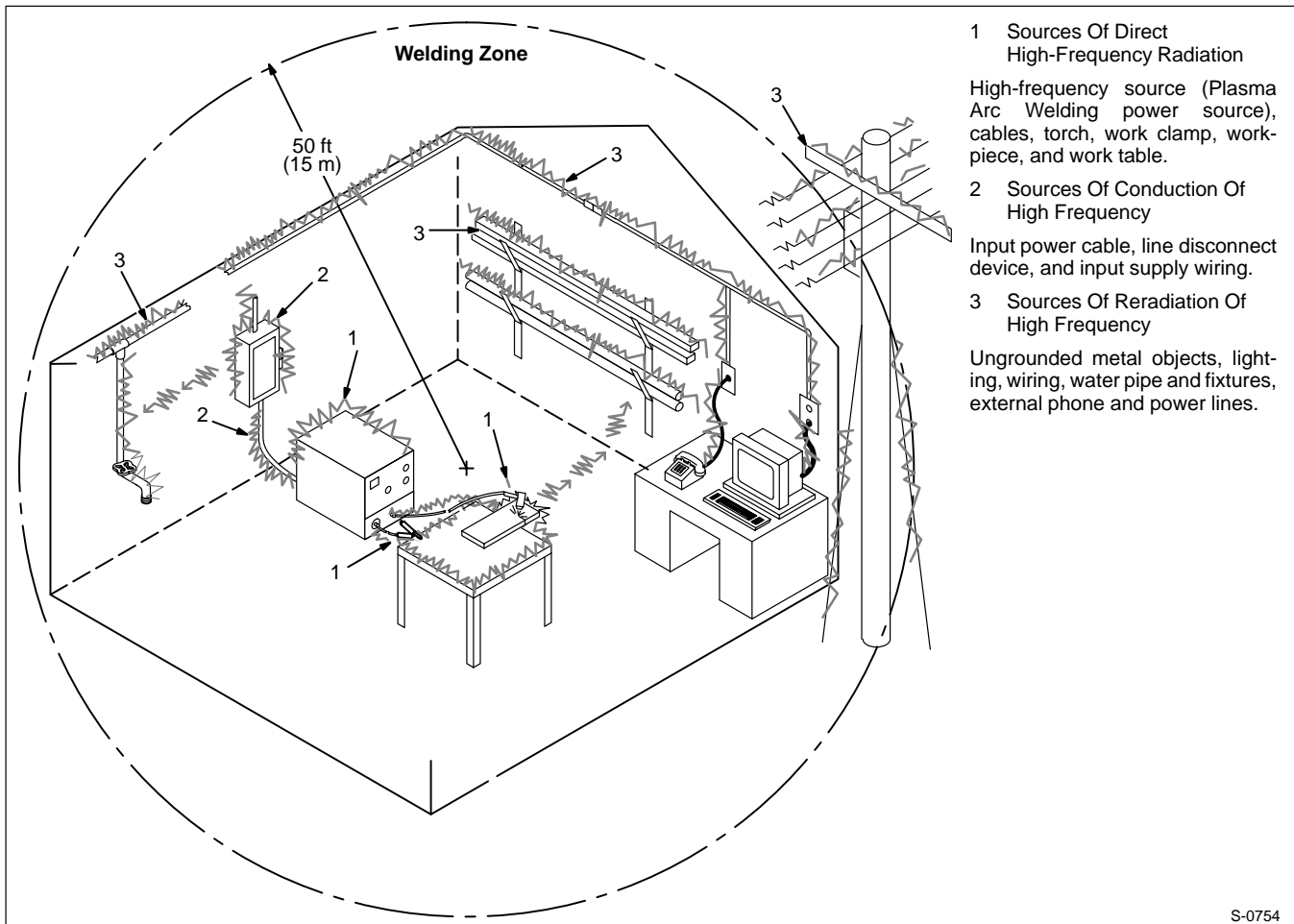
- Have only qualified person familiar with electronic equipment perform this installation.
- The user is responsible for having a qualified electrician promptly correct any interference problem resulting from the installation.
- If notified by the FCC about interference, stop using the equipment at once.
- Have the installation regularly checked and maintained.
- Keep high-frequency source doors and panels tightly shut, keep spark gaps at correct setting, and use grounding and shielding as shown in Figure 6-3 to minimize the possibility of interference.



- 1 Plasma Arc Torch
- 2 High-Frequency Voltage
Used inside torch to ionize gap between electrode and tip to help start the pilot arc.
- 3 Electrode
- 4 Pilot Arc
- 5 Tip
- 6 Shield Cup

Ref. S-0753

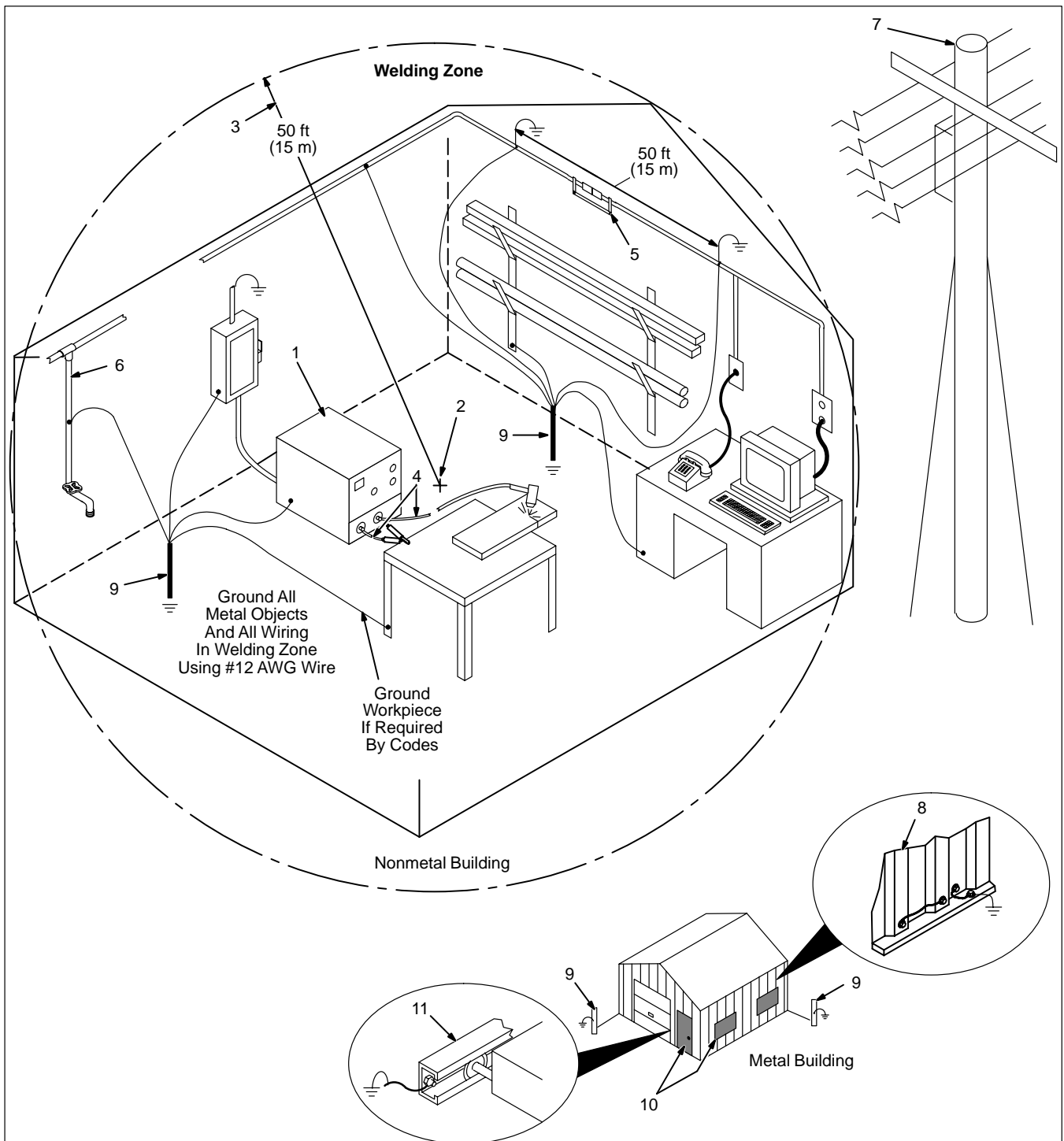
Figure 6-1. High Frequency In Plasma Arc Welding (PAW)



- 1 Sources Of Direct High-Frequency Radiation
High-frequency source (Plasma Arc Welding power source), cables, torch, work clamp, workpiece, and work table.
- 2 Sources Of Conduction Of High Frequency
Input power cable, line disconnect device, and input supply wiring.
- 3 Sources Of Reradiation Of High Frequency
Ungrounded metal objects, lighting, wiring, water pipe and fixtures, external phone and power lines.

S-0754

Figure 6-2. Sources Of High-Frequency Radiation From Incorrect Installation



S-0755

1 Plasma Arc Welding Power Source

Ground metal machine case, line disconnect device, input supply, and workpiece (if required).

2 Center Point Of Welding Zone

Midpoint between high-frequency source and welding torch.

3 Welding Zone

A circle 50 ft (15 m) from center point in all directions.

4 Torch And Work Cables

Keep cables close together.

5 Conduit Joint Bonding And Grounding

Electrically join (bond) all conduit sections using copper straps or braided wire. Ground conduit every 50 ft (15 m).

6 Water Pipe And Fixtures

Ground water pipe every 50 ft (15 m).

7 External Power Or Telephone Lines

Locate high-frequency source at least 50 ft (15 m) away from power and phone lines.

8 Metal Building Panel Bonding Methods

Bolt or weld building panels together, install copper straps or braided wire across seams, and ground frame.

9 Grounding Rod

Consult the National Electrical Code for specifications.

10 Windows And Doorways

Cover all windows and doorways with grounded copper screen of not more than 1/4 in (6.4 mm) mesh.

11 Overhead Door Track

Ground the track.

Figure 6-3. Correct Installation

SECTION 7 – PARTS LIST

Dia. Mkgs.	Part No.	Description	Quantity
Spectrum Interface			
. CR10,11	052 964	RELAY, encl 24VDC DPDT	2
... D1	169 465	DIODE, w/leads	1
... D2	169 467	DIODE, w/leads	1
... PB1	113 333	SWITCH, PB MC NO SPST	1
.. PC10	140 510	CIRCUIT CARD, RF filter	1
.....	110 375	STAND-OFF SUPPORT, PC card No. 6 screw	4
.. PLG10	115 094	CONNECTOR & SOCKETS, (consisting of)	1
.....	113 746	CONNECTOR, rect skt 24-18ga	4
.. PLG11	115 092	CONNECTOR & SOCKETS, (consisting of)	1
.....	113 746	CONNECTOR, rect skt 24-18ga	8
.. PLG12	115 093	CONNECTOR & SOCKETS, (consisting of)	1
.....	113 746	CONNECTOR, rect skt 24-18ga	6
.. PLG21	047 544	CONNECTOR, circ 4 pin plug	1
.. PLG30	131 054	CONNECTOR & SOCKETS, (consisting of)	1
.....	113 746	CONNECTOR, rect skt 24-18ga	2
.. PLG31	135 635	CONNECTOR & PINS, (consisting of)	1
.....	114 656	CONNECTOR, rect pin 24-18ga	2
.....	039 828	CONNECTOR, circ clamp str rlf sz 14-14S	1
.....	113 746	CONNECTOR, rect skt 24-18ga	2
.....	049 455	CABLE, port No. 18 2/c (order by ft)	3ft
.....	139 040	BUSHING, strain relief .231/.394 ID x .733mtg hole	1
.. RC20,26	145 706	CIRCUIT CARD/CONNECTOR	1
.. RC21	077 175	CONNECTOR, circ 11 pin sz 20 rcpt	1
... TD1	169 460	TIMER, w/resistor	1
... 6T	038 839	BLOCK, term 20A 5P	1
.....	169 462	CASE SECTION, front/bottom	1
.....	139 454	PANEL, rear	1
.....		NAMEPLATE, (order by model and serial number)	1
.....	134 241	CABLE, port No. 18 2/c (order by ft)	35ft
.....	146 212	CONNECTOR, circ 10 pin plug	1
.....	138 033	CONNECTOR, circ clamp str rlf sz 18	1
.....	073 516	CONNECTOR, circ 11 skt plug	1
.....	116 964	CONNECTOR, circ clamp str rlf sz 20-22	1
.....	097 426	CABLE, shld No. 18ga 10/c (order by ft)	5ft
.....	169 455	CABLE, interconnecting 15ft (consisting of)	1
.....	141 162	CONNECTOR & PINS, (consisting of)	1
.....	134 731	CONNECTOR, circ pin push-in 14-18ga	14
.....	079 739	CONNECTOR, circ clamp str rlf sz 17-20	1
.....	110 015	CABLE, port No. 18 7/c (order by ft)	15ft
.....	048 598	CONNECTOR & SOCKETS, (consisting of)	1
.....	079 534	CONNECTOR, circ skt push-in 14-18ga	16
.....	079 739	CONNECTOR, circ clamp str rlf sz 17-20	1
.....	169 464	CABLE, interconnecting 15ft (consisting of)	1
.....	047 636	CONNECTOR & PINS, (consisting of)	1
.....	079 535	CONNECTOR, circ pin push-in 14-18ga	14
.....	079 739	CONNECTOR, circ clamp str rlf sz 17-20	1
.....	120 104	CABLE, shld No. 18ga 6/c (order by ft)	15ft
.....	146 211	CONNECTOR, circ 8 pin plug	1
.....	073 296	CONNECTOR, circ clamp str rlf sz 20-22	1
.....	141 224	CABLE, pwr interface (consisting of)	1
.....	152 370	CONNECTOR & SOCKETS, (consisting of)	1
.....	079 534	CONNECTOR, circ skt push-in 14-18ga	14
.....	143 922	CONNECTOR, circ clamp str rlf sz 17-20	1
.....	604 825	CABLE, port No. 18 3/c (order by ft)	16ft
.....	073 690	PLUG, str grd armd 2P3W 15A 125V	1
.....	073 476	CLAMP, strap rbr 5 holes .375 wide x 4.625 lg	10

Dia. Mkgs.	Part No.	Description	Quantity
Spectrum Interface (Continued)			
	169 452	.. SHOCK SENSOR, w/cover (consisting of)	1
	602 173	... SCREW, set stl sch 10-32 x .250 cup point	2
	141 564	.. CABLE, grd machine to rod	1
	146 002	.. TORCH GAUGE, universal	1
	169 454	.. TIP GAGE	1
	◆ 171 042	.. SHIELD, plasma welding torch	1
	143 352	.. CLAMP, cable	4
	169 453	.. BRACKET, mtg torch	1
	157 173	.. HOLDER, cable	1
	141 409	.. INSULATOR, plate torch	1
	141 449	.. PANEL, side	1
	+139 465	.. COVER	1
	134 464	.. LABEL, warning general precautionary	1
	602 969	.. PLUG, protective No. 6 plastic	2
	146 696	.. HF FILTER BOX, (consisting of)	1
PC1	140 510	... CIRCUIT CARD, RF filter	1
	134 201	... STAND-OFF SUPPORT, PC card .312/.375	4
PLG10	115 092	... CONNECTOR & SOCKETS, (consisting of)	1
	113 746	... CONNECTOR, rect skt 24-18ga	8
PLG20	115 093	... CONNECTOR & SOCKETS, (consisting of)	1
	113 746	... CONNECTOR, rect skt 24-18ga	6
	600 340	... CABLE, port No. 16 2/c (order by ft)	4ft
RC1	139 268	... CONNECTOR, circ 10skt rcpt	1
	148 104	.. CASE SECTION, front/bottom/rear	1
	148 103	.. WRAPPER	1
	139 040	... BUSHING, strain relief .231/.394 ID x .733mtg hole	1
	107 983	... BLANK, snap-in nyl .500mtg hole	2
	148 943	.. LIGHT BOX, servo (consisting of)	1
	134 171	... CABLE, shock sensor and lights (consisting of)	1
RC1	048 282	... CONNECTOR w/SOCKETS, (consisting of)	1
	079 534	... CONNECTOR, circ skt push-in 14-18ga Amp 66358-6	4
	604 571	... CABLE, port No. 18 4/c (order by ft)	1ft
	010 116	... GROMMET, rbr .375 ID x .500mtg hole	1
PLG1	134 860	... CONNECTOR & PINS, (consisting of)	1
	134 184	... CONNECTOR, rect pin 20-16ga JST SLM-41T-1.3E	4
	117 160	.. PILOT LAMP, (consisting of)	2
	*115 276	... BULB, LED red 28V min bayonet	1
	144 629	... BRACKET, shock sensor and lights	1
	134 518	.. HANGER, cable assembly	1
	134 529	.. INSULATOR, cable hanger	1
	159 599	.. SUPPORT, cable	1
	149 442	.. BRACKET, mtg torch	1
	135 090	.. INSULATING BRACKET	1
	170 395	.. BLOCK, angle	1
	170 396	.. CLAMP, block angle	1
	170 397	.. BRACKET, offset	1
	137 063	.. SPRING, ext .625 OD x .062 wire x 4.500 lg	1
	119 622	.. CABLE CLAMP	1
	134 011	.. INSULATOR, bracket	1

+When ordering a component originally displaying a precautionary label, the label should also be ordered.

*Recommended Spare Parts.

◆OPTIONAL

BE SURE TO PROVIDE MODEL AND SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS.

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