Miller
The Power of Blue.

OM-169 510

June 1995

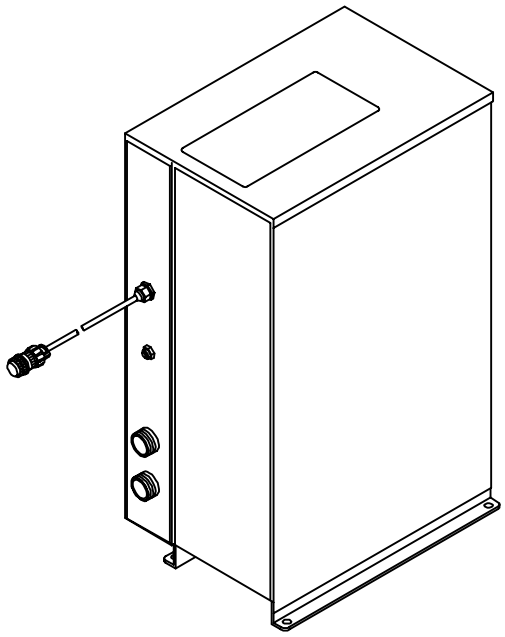
Processes

Plasma Arc (PAW) Welding

Description

Automatic Welding

Robot PAW Interface



OWNER'S MANUAL

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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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TABLE OF CONTENTS

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 MRH^2 or MRV^2 robot system for the Plasma Arc Welding (PAW) process.

SECTION 3 – INSTALLATION

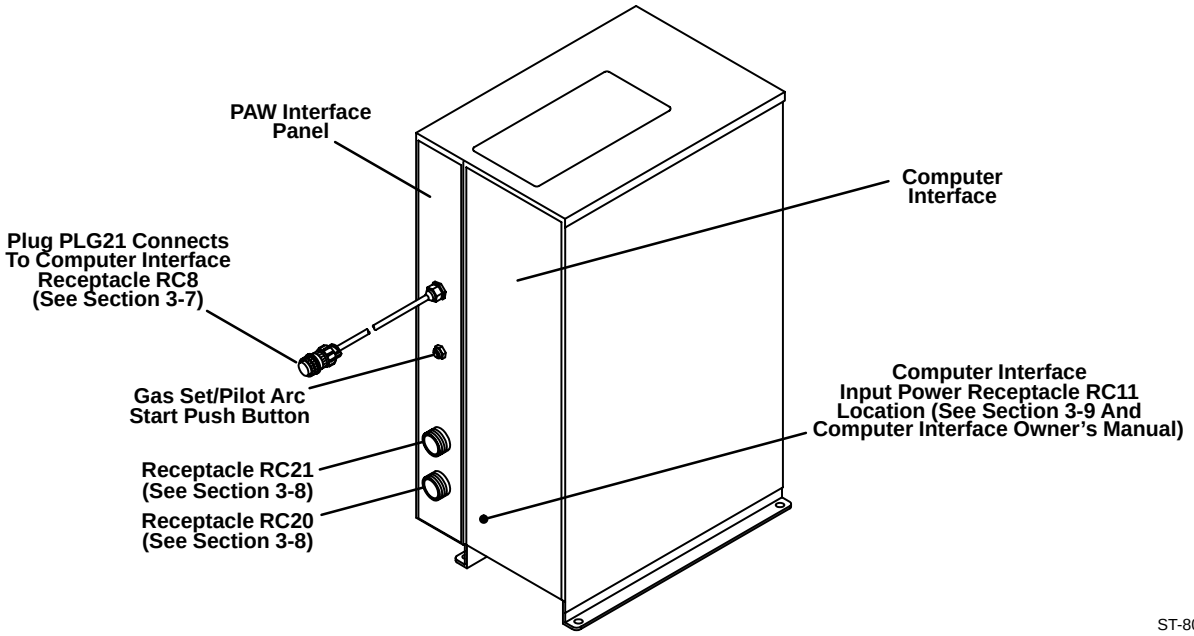

Figure 3-1. PAW Interface Panel

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 lockout/tagging procedures before beginning this installation.*

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.

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).

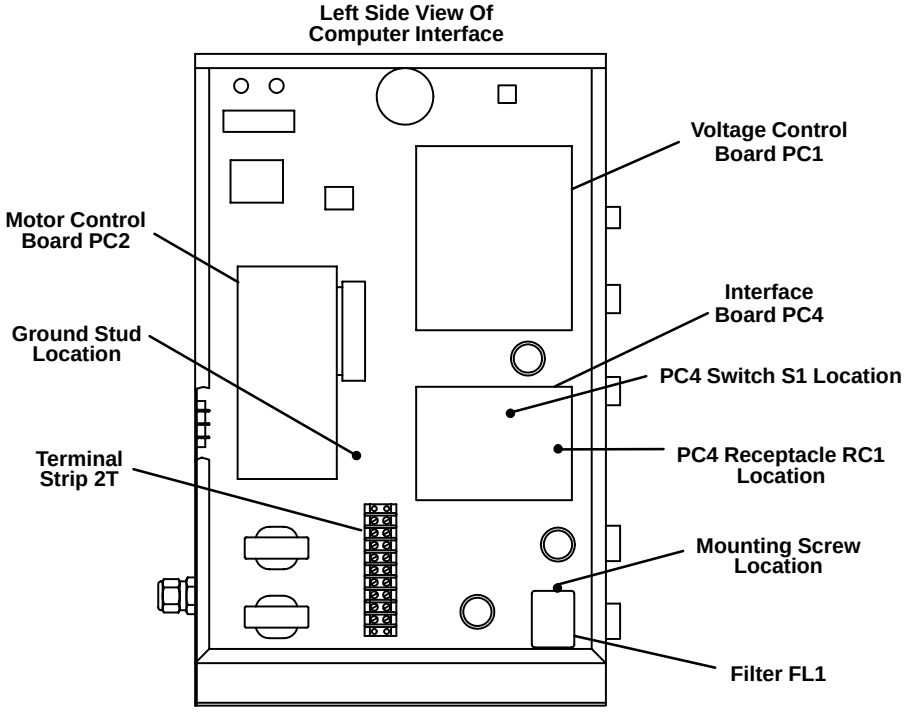

Figure 3-2. Computer Interface Internal Connections

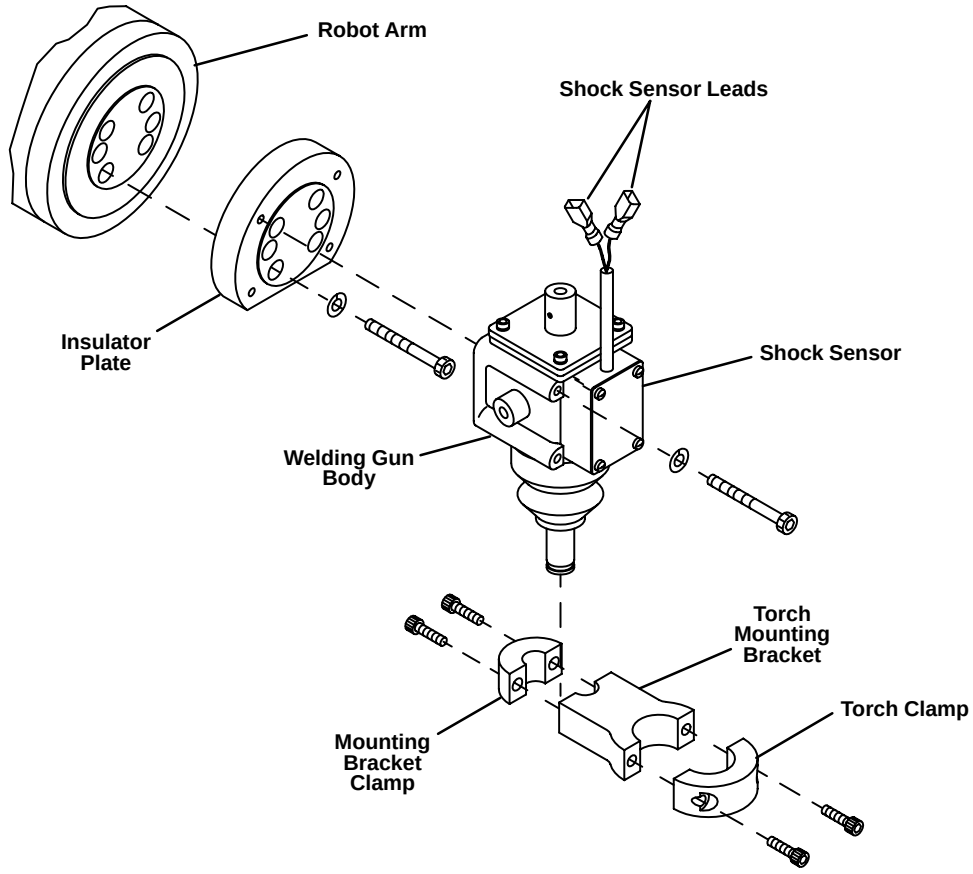

Figure 3-3. MRH^2 Shock Sensor Unit Assembly And Installation

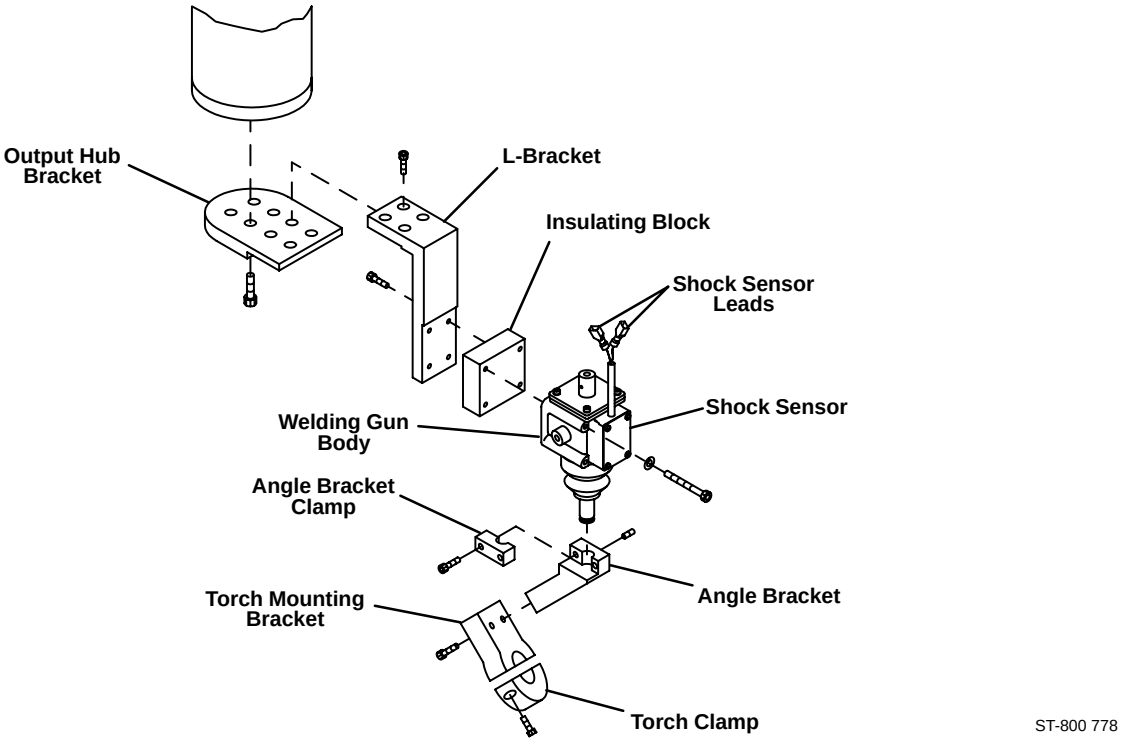

Figure 3-4. MRV^2 Shock Sensor Unit Assembly And Installation

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 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.

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. MRH^2 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. MRV^2 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.

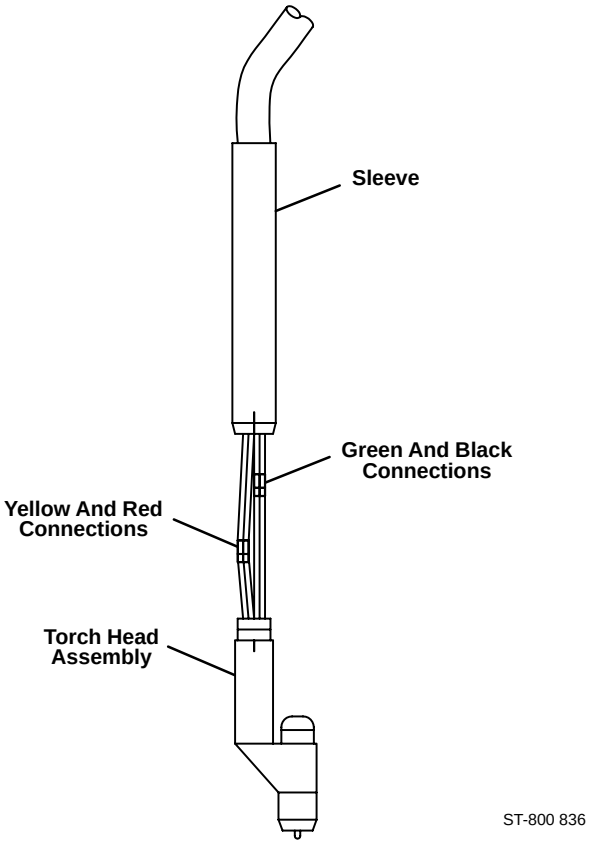

Figure 3-5. Connections At Torch Head Assembly

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 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.

MOVING PARTS can cause serious injury.

- *Keep away from moving parts.*

HOT SURFACES can cause severe burns.

- *Allow cooling period before servicing.*

A. MRH^2 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:

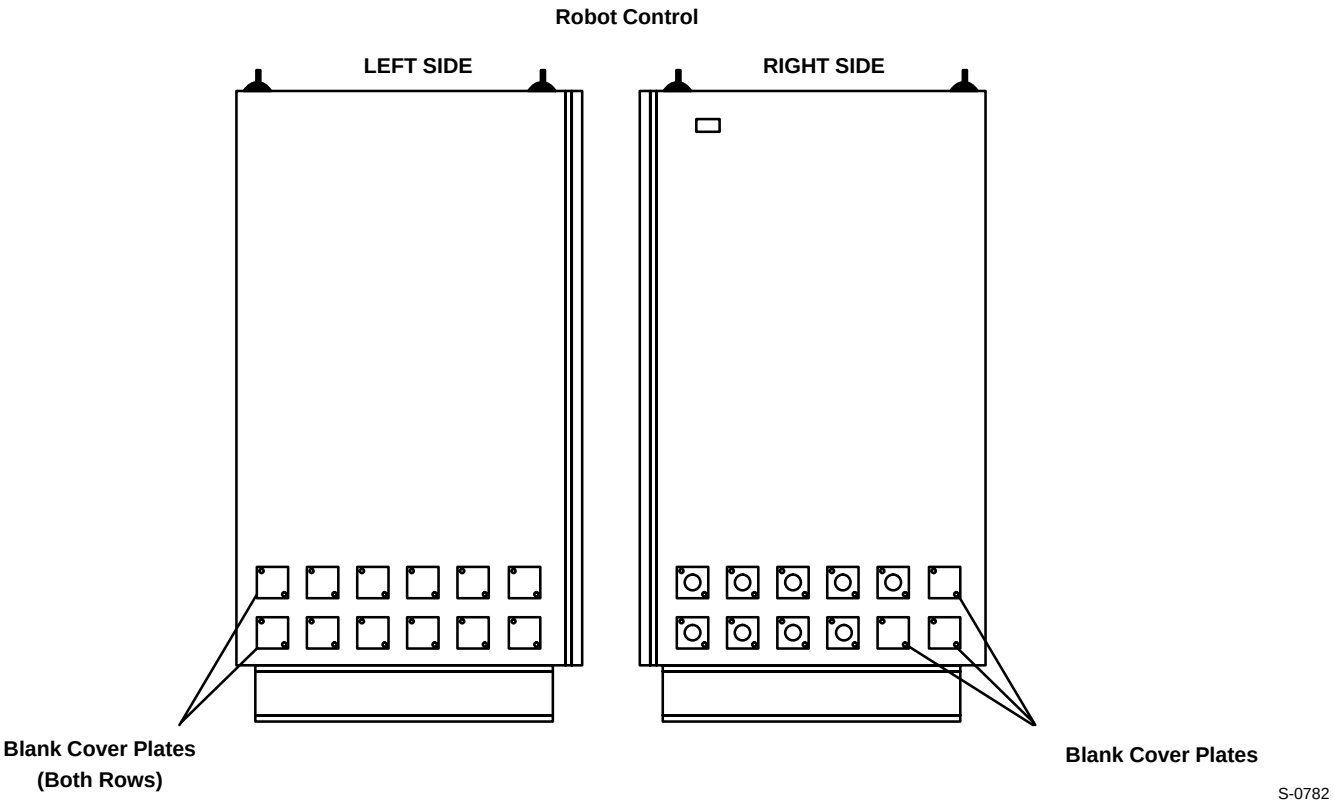

Figure 3-6. View Of Left And Right Sides Of Robot Control

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.

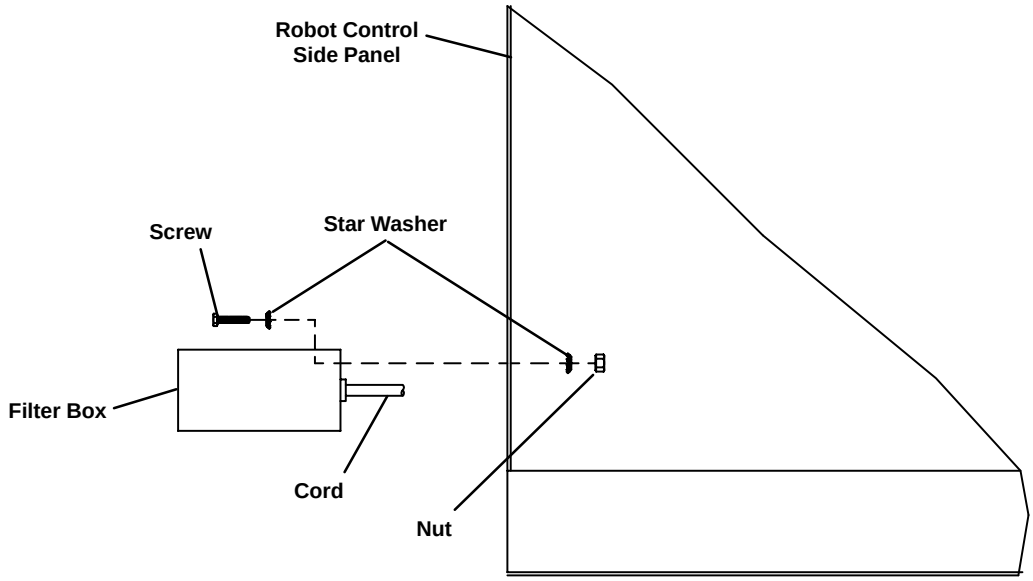

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Figure 3-7. Installation Of Securing Hardware For Filter Box

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.

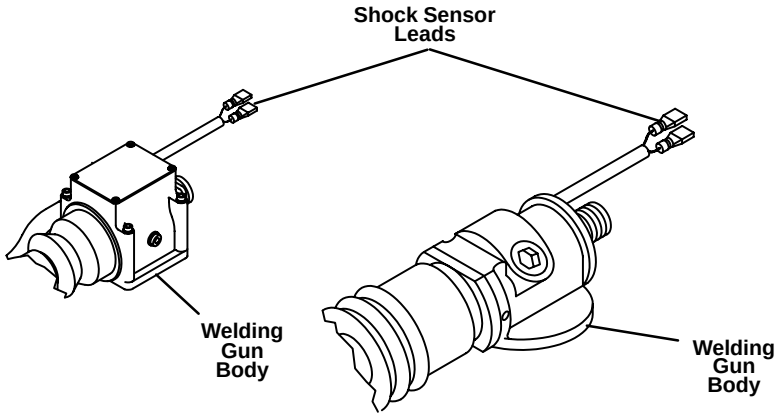

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Figure 3-8. Welding Gun/Torch Shock Sensor Leads

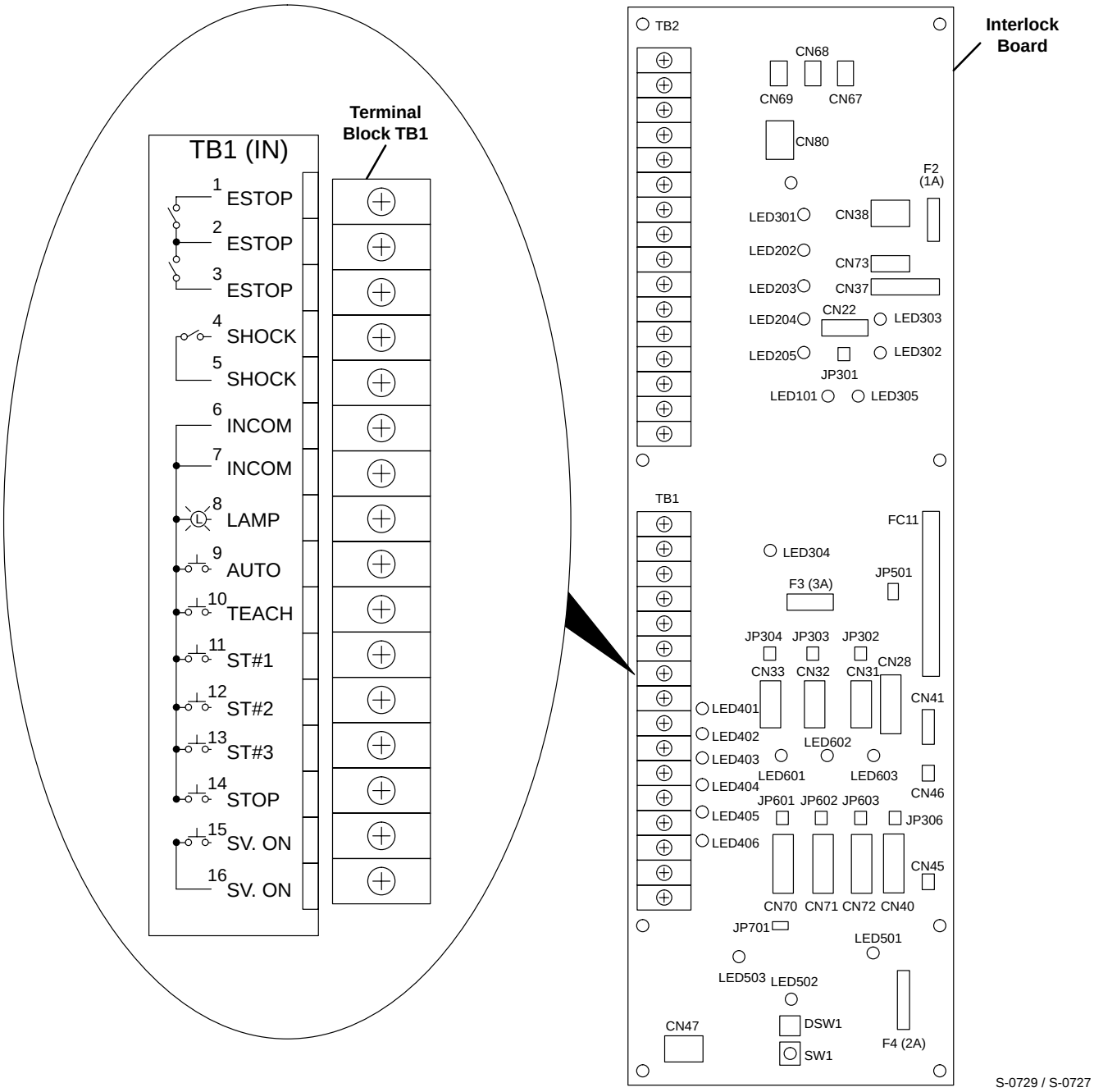


Figure 3-9. Function Control Terminal Block TB1 On Interlock Board Inside Robot Control

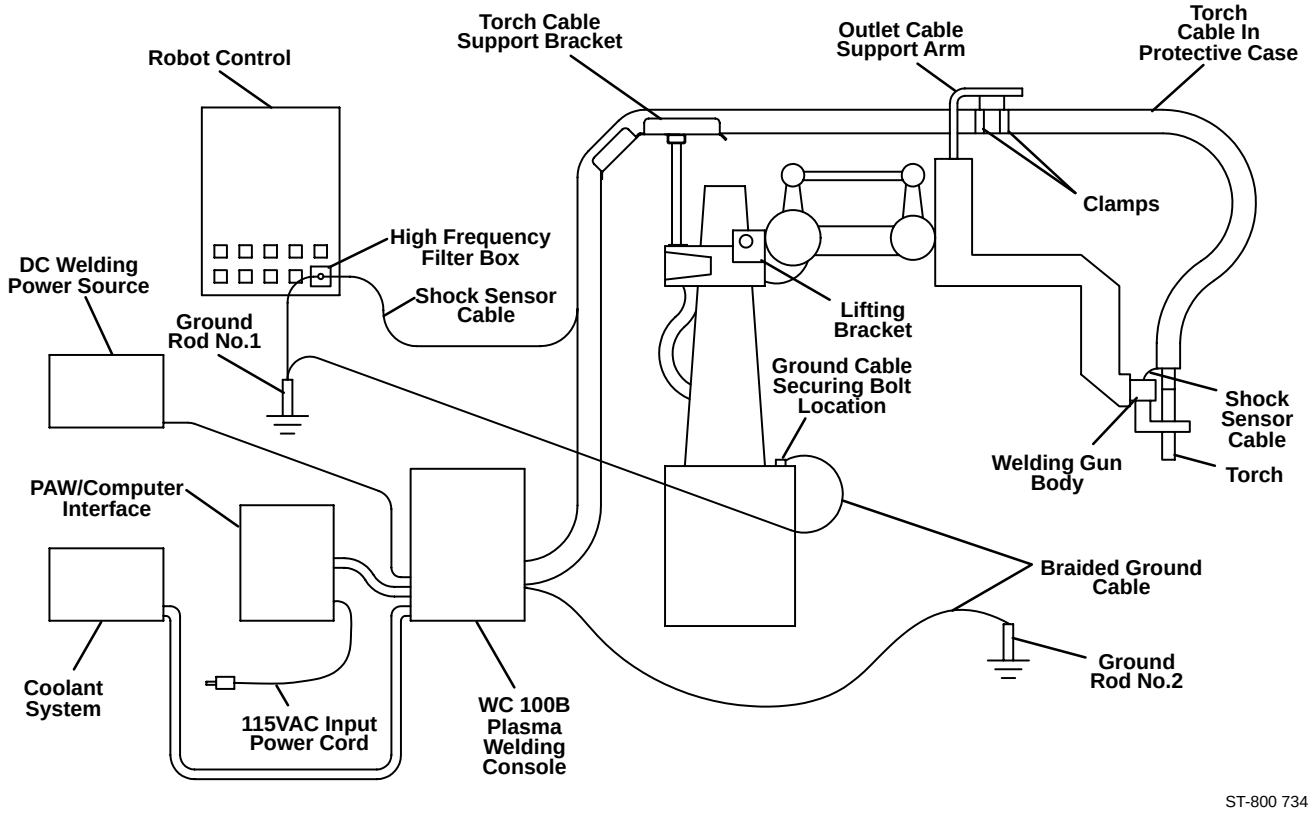


Figure 3-10. MRH^2 Robot PAW System

B. MRV^2 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 MRH^2 or I-bar for MRV^2) 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 MRH^2 (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.

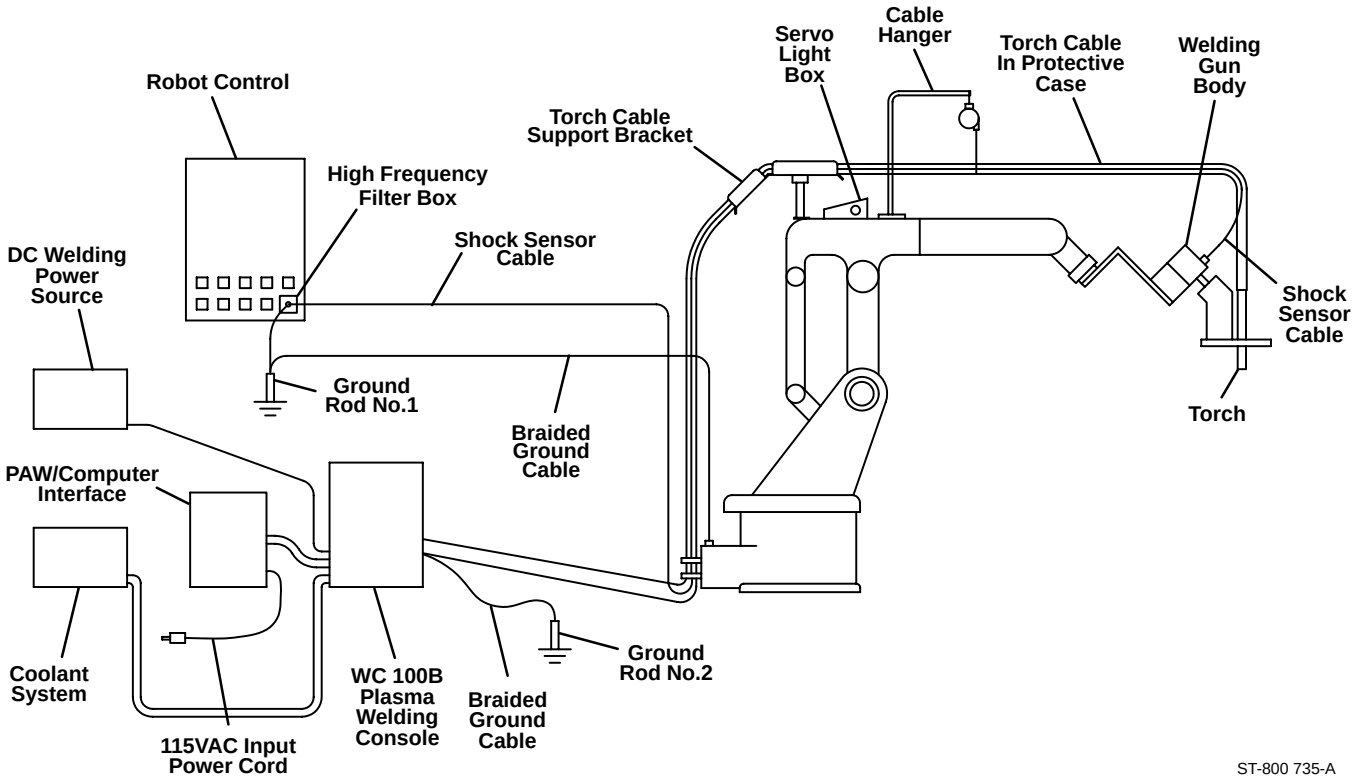


Figure 3-11. MRV^2 Robot PAW System

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 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.

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.

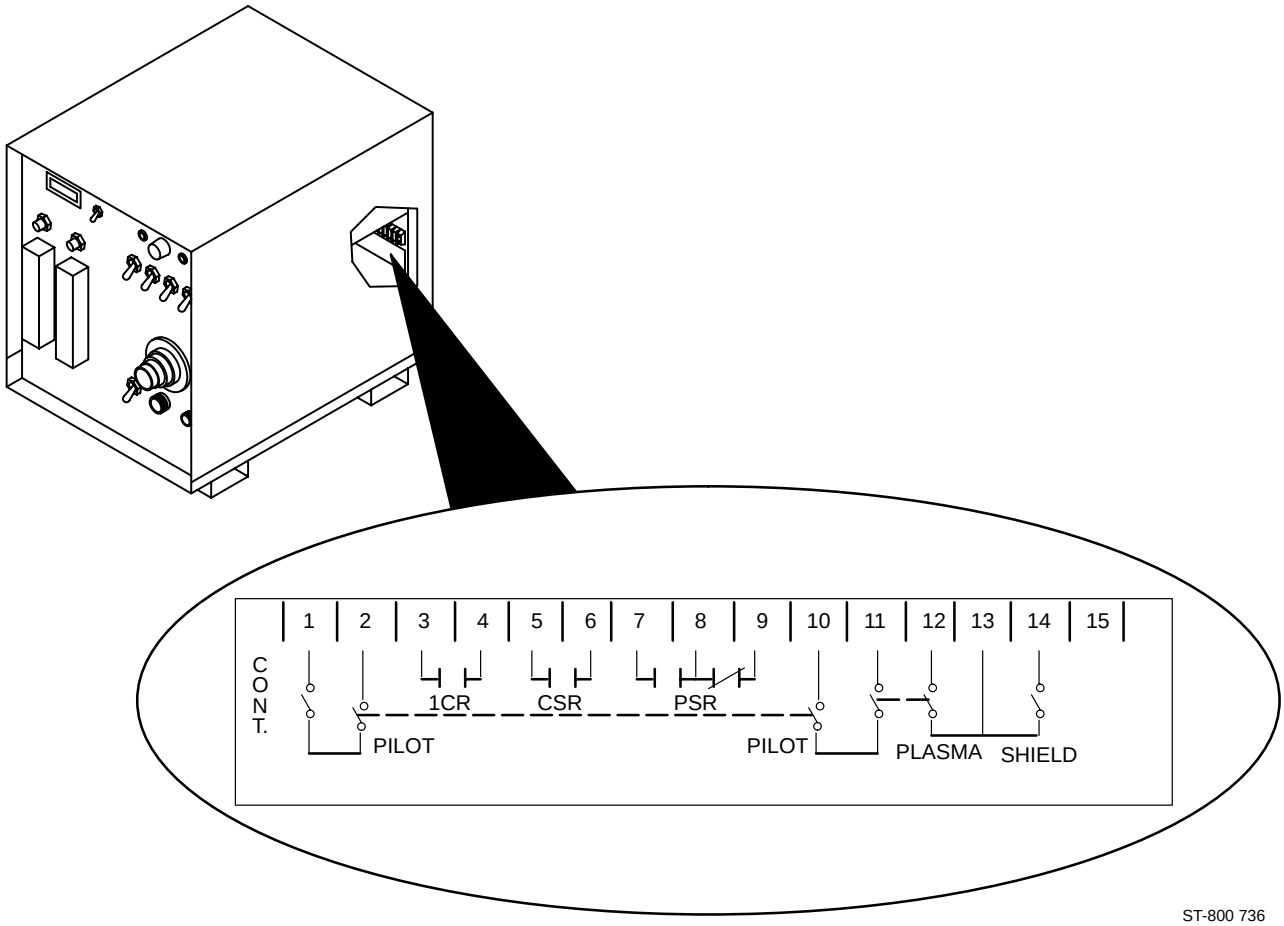


Figure 3-12. Terminal Strip TB1 Location Inside WC 100B Console

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 RC20 to 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).*

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 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.

4-1. SETTING UP PLASMA (NON-STANDARD) TORCH FOR MRH^2 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.

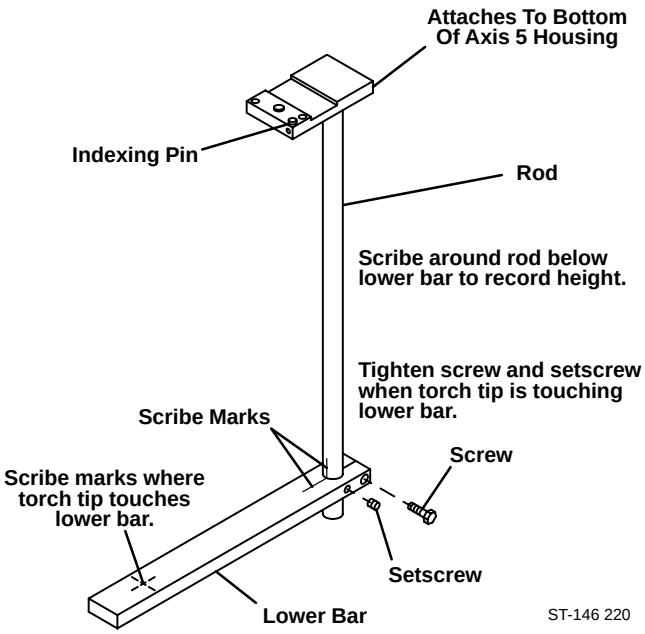


Figure 4-1. Scribe Marks on Universal J-Bar

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 MRV^2 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.

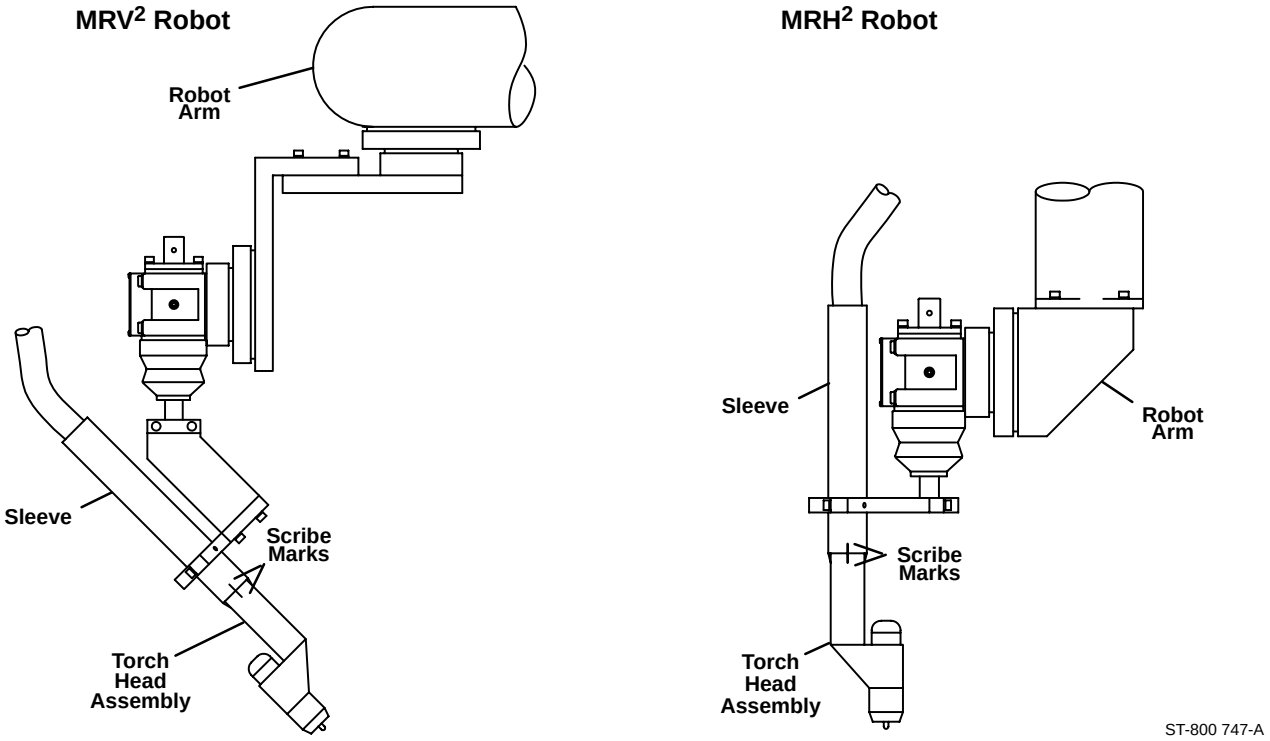


Figure 4-2. Marking Position Of Torch Head Assembly

4-4. SYSTEM SETUP FOR MRH^2 AND MRV^2 WITH C2 ROBOT CONTROL

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

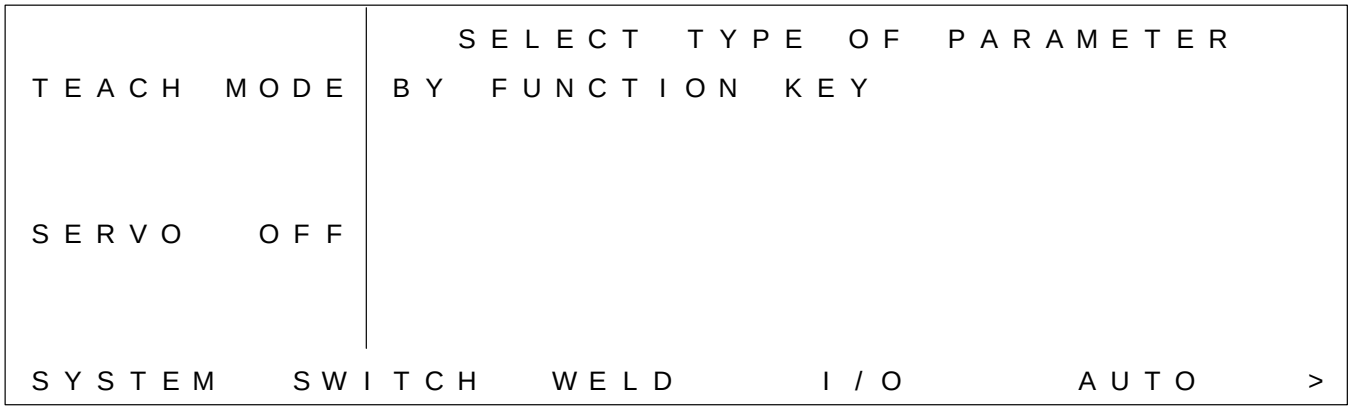
1. Turn on Robot Control input power by placing the power switch handle on the Robot Control cabinet door in the ON position, and the following displays will appear as shown:

D I A G N O S I S '92–07–31 08:30	W E L C O M E T O M I L L E R C O O P E R A T I V E C O N T R O L M I L L E R E L E C T R I C M f g . C o . S T A R T D I A G N O S I S

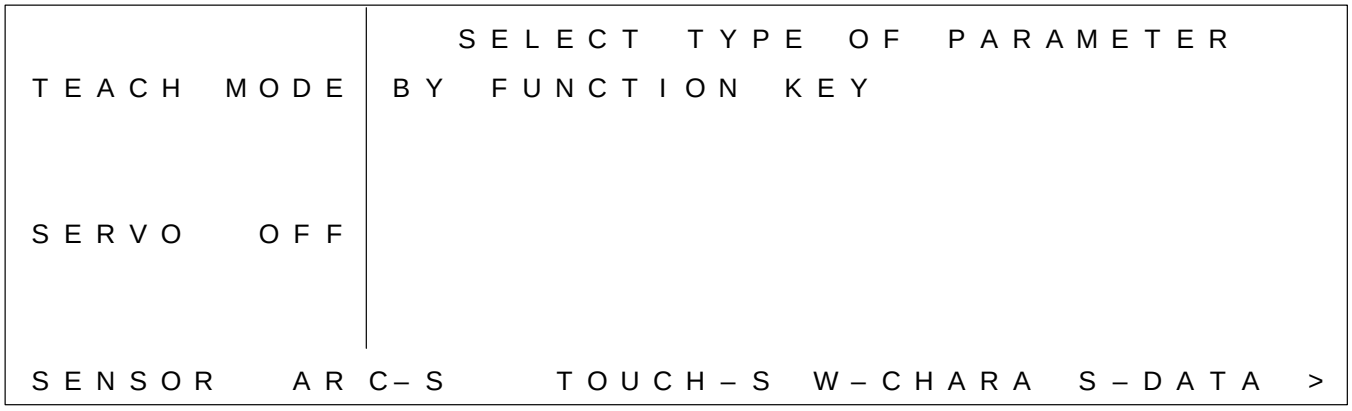
D I A G N O S I S '92–07–31 08:30	W E L C O M E T O M I L L E R C O O P E R A T I V E C O N T R O L S T E P O F I N I T I A L D I A G N O S I S 1, 2, 3, 4, 5,

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

3. Press the F1 [F1] key for the PARMTER function.



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



5. Press F4 [F4] key for the W–CHARA function to set welding characteristics.

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				

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

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				

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

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

8. To check settings, press the F4 [F4] key for 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
```

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

```
AXIS      ML4        RATING OF POWER SOURCE
TEACH                $WTBD31
                     TYPE          SEPA. SYNER. TIG
                     RATING CURRENT          200A
SERVO     OFF        W-FEEDER RATING         256i.

                     PUSH RECORD AFTER SETTING
```

10. Use the INCREMENT [+] or DECREMENT [-] key to select RATING CURRENT parameter.

```
AXIS      ML4        RATING OF POWER SOURCE
TEACH                $WTBD31
                     TYPE          SEPA. SYNER. TIG
                     RATING CURRENT          200A
SERVO     OFF        W-FEEDER RATING         256i.

                     PUSH RECORD AFTER SETTING
```

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

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

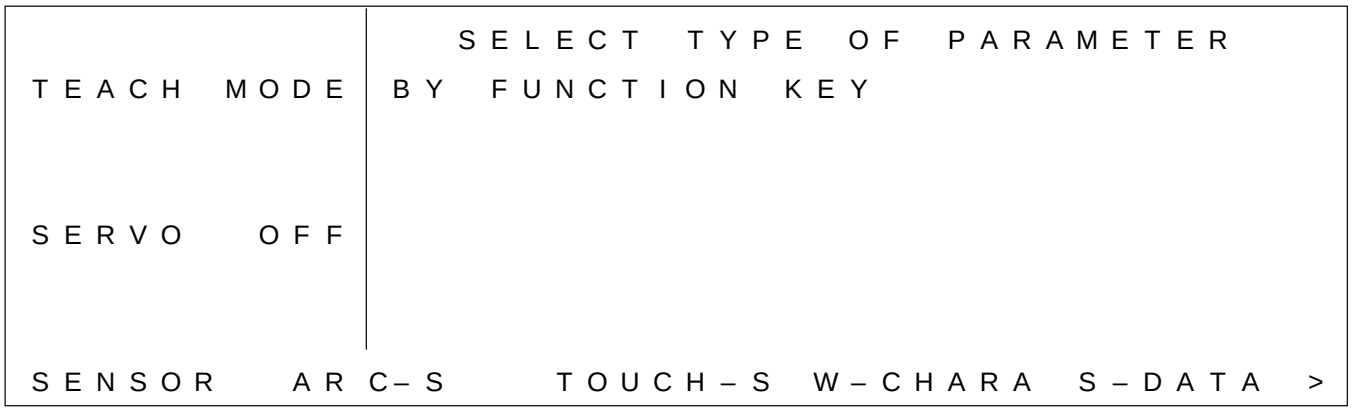
12. Press the RECORD (RECORD) key.

AXIS	ML4	DISP.	REF.	DISP.	REF.
TEACH		1. 50A	1.5V	50i.	2.0V
		2.150A	4.5V	102i.	4.0V
		3.200A	6.0V	153i.	6.0V
SERVO	OFF	4.250A	7.5V	205i.	8.0V
		5.300A	10.0V	256i.	10.0V

13. Use the INCREMENT (+) or DECREMENT (–) key and forward or back DISPLAY SELECT key to change the scaling of the amperage and reference voltage.

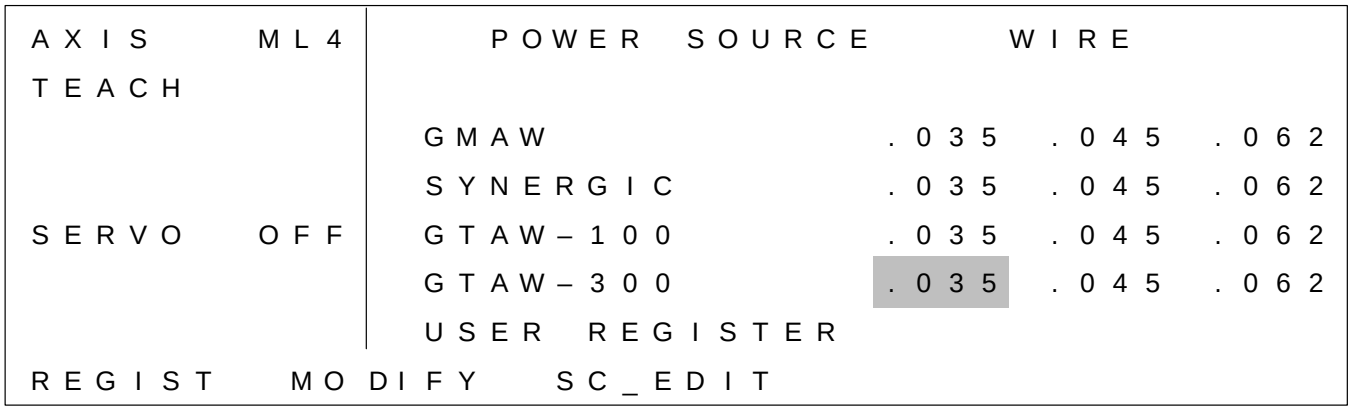
AXIS	ML4	DISP.	REF.	DISP.	REF.
TEACH		1. 5A	0.0V	50i.	2.0V
		2. 79A	2.0V	102i.	4.0V
		3.190A	5.0V	153i.	6.0V
SERVO	OFF	4.301A	8.0V	205i.	8.0V
		5.375A	10.0V	256i.	10.0V

14. Press the RECORD (RECORD) key.

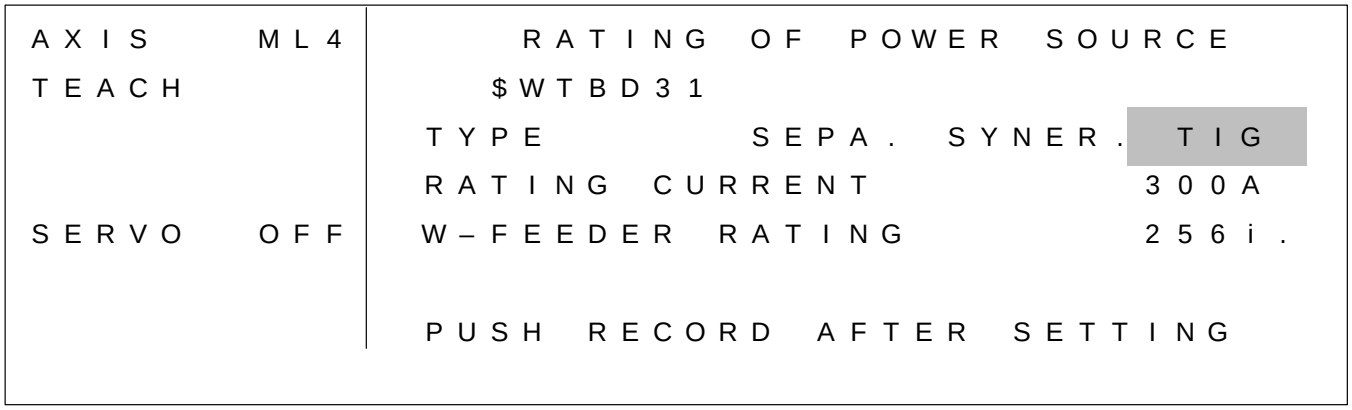


15. Check settings of weld characteristics as follows:

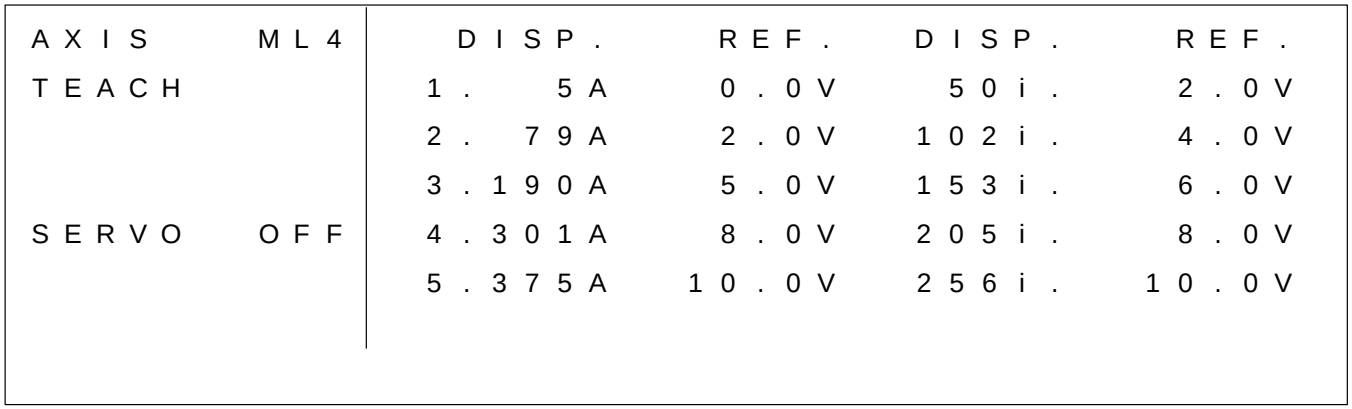
a. Press the F4 [F4] key to select the W–CHARA function.



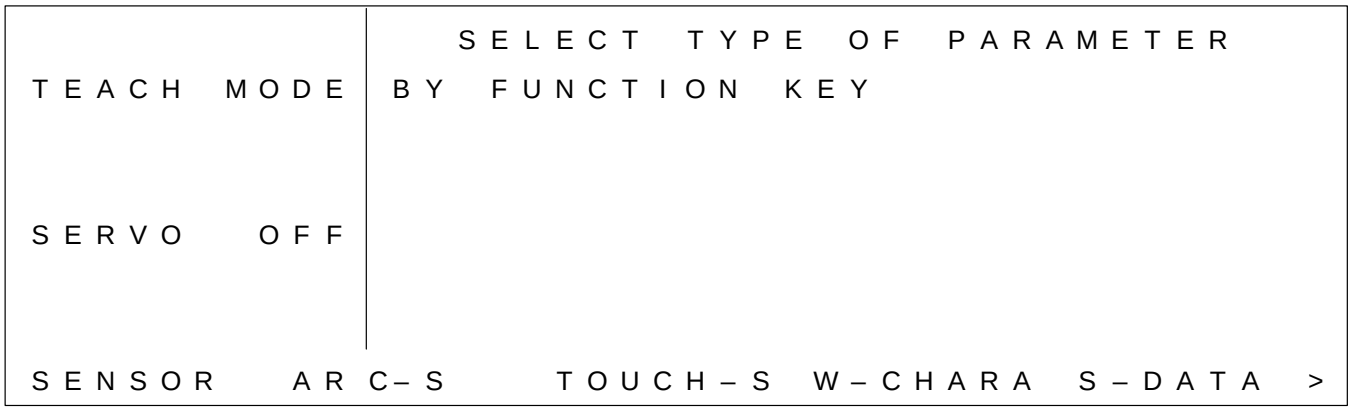
b. Press the F2 [F2] key to select the MODIFY function.



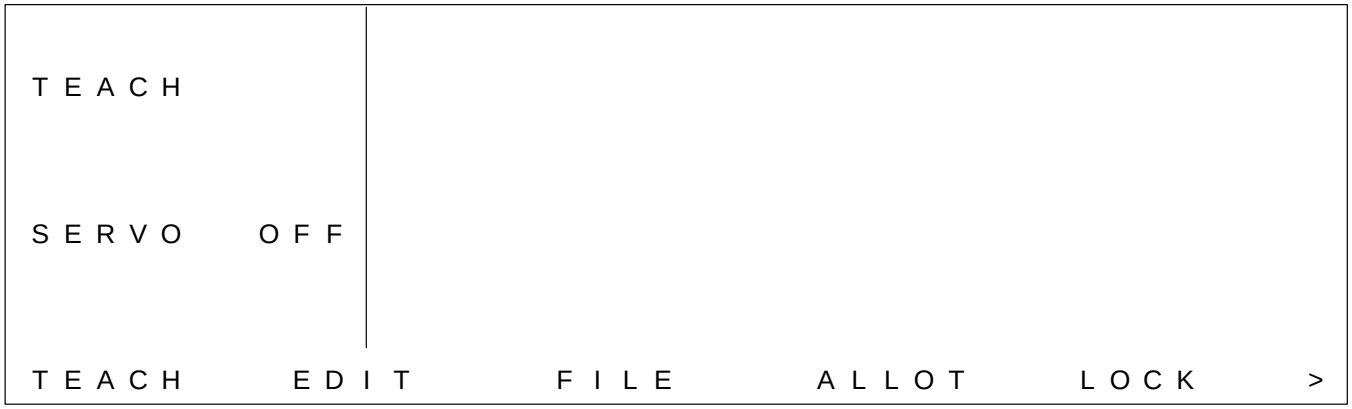
c. Press the RECORD (RECORD) key.



16. Press the RESET (RESET) key.



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



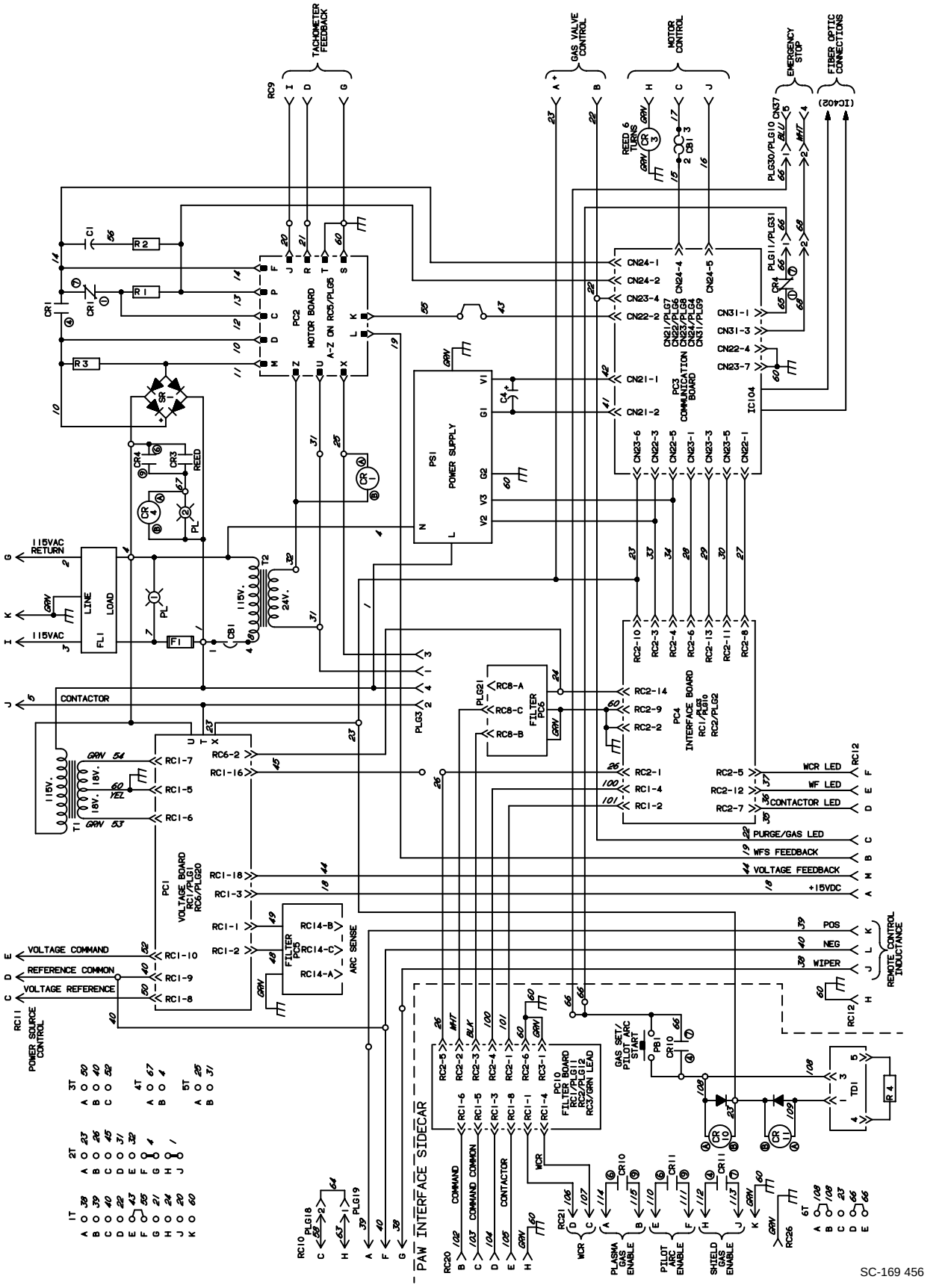
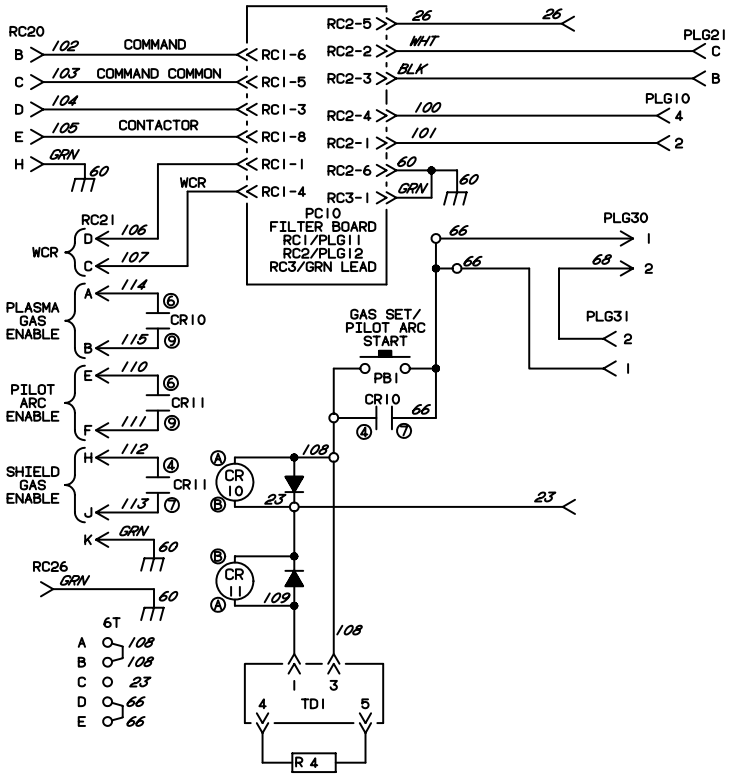


Figure 5-1. Circuit Diagram For Robot PAW System



SB-169 458

Figure 5-2. Circuit Diagram For Robot PAW Interface Panel

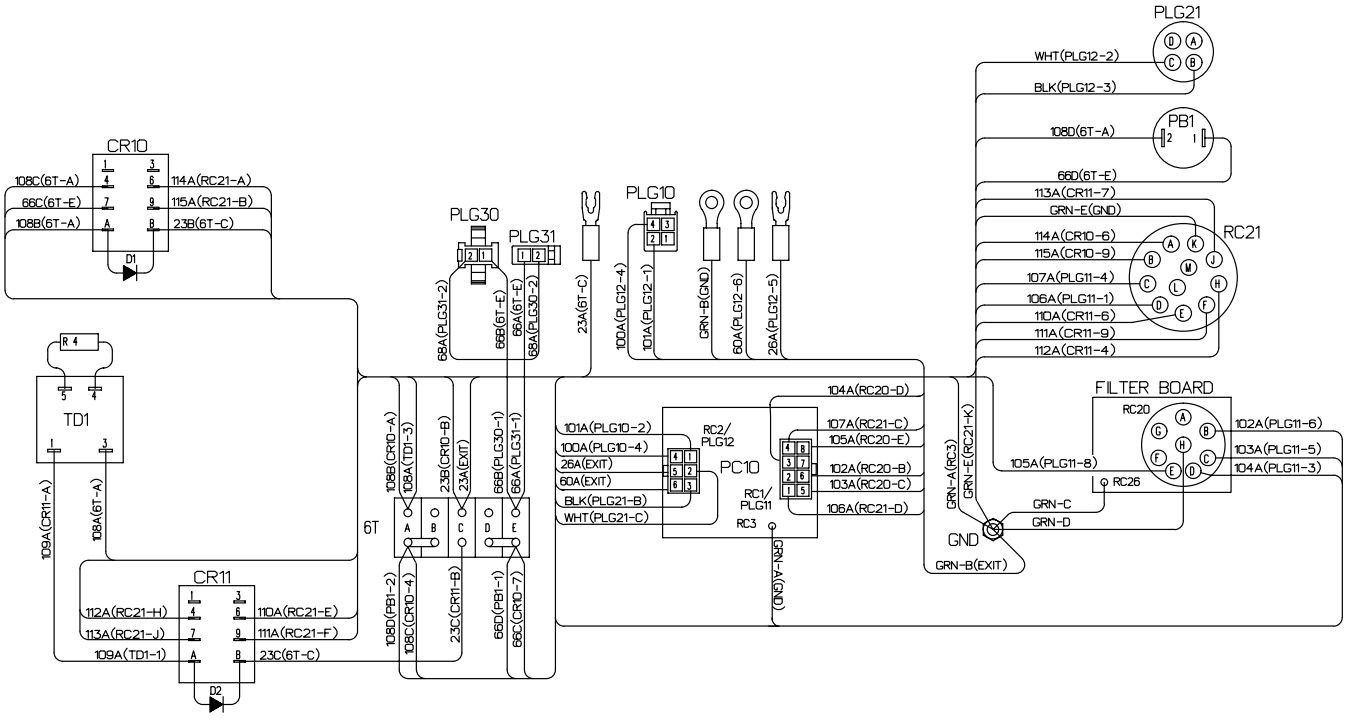


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Figure 5-3. Wiring Diagram For Robot PAW Interface Panel

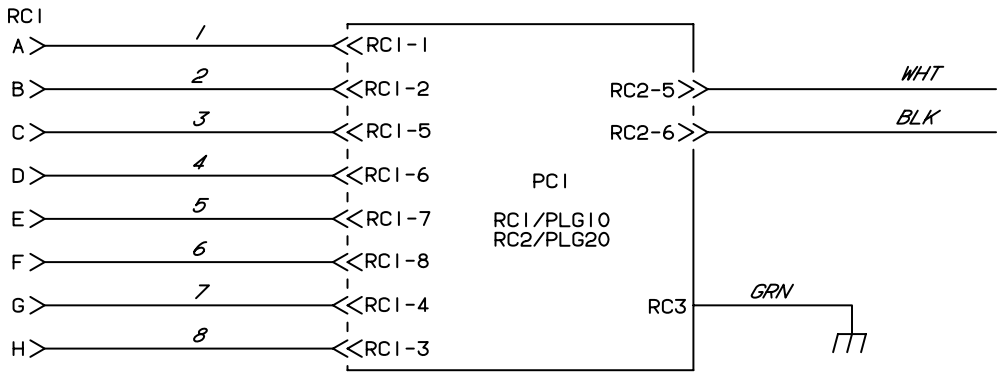


Figure 5-4. Circuit Diagram For High-Frequency Filter

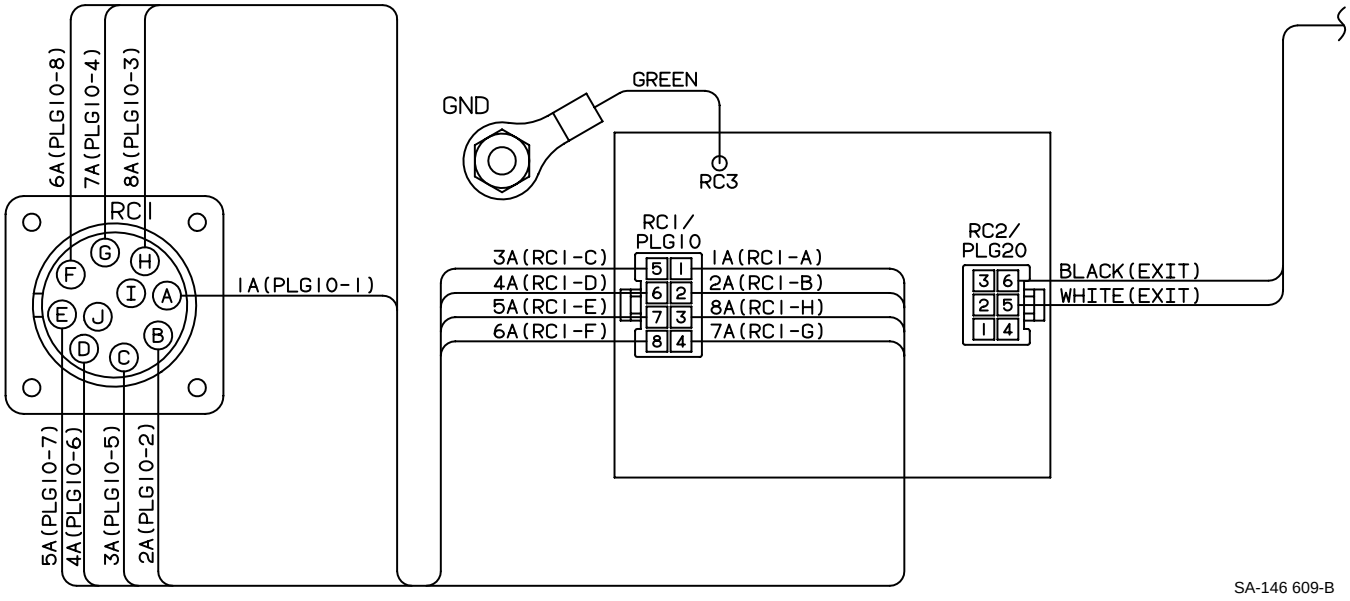
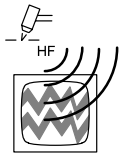


Figure 5-5. Wiring Diagram For High-Frequency Filter

SECTION 6 – HF IN PLASMA ARC WELDING

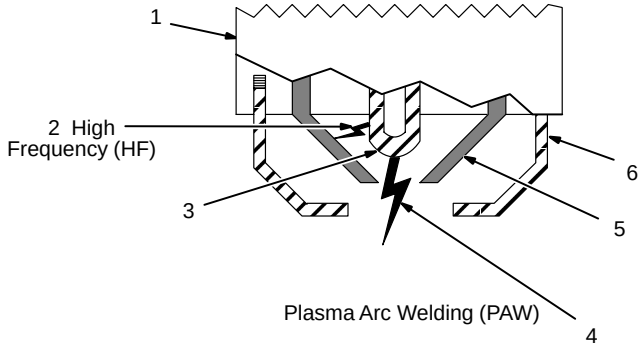
mod6.2* 5/94

⚠ 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

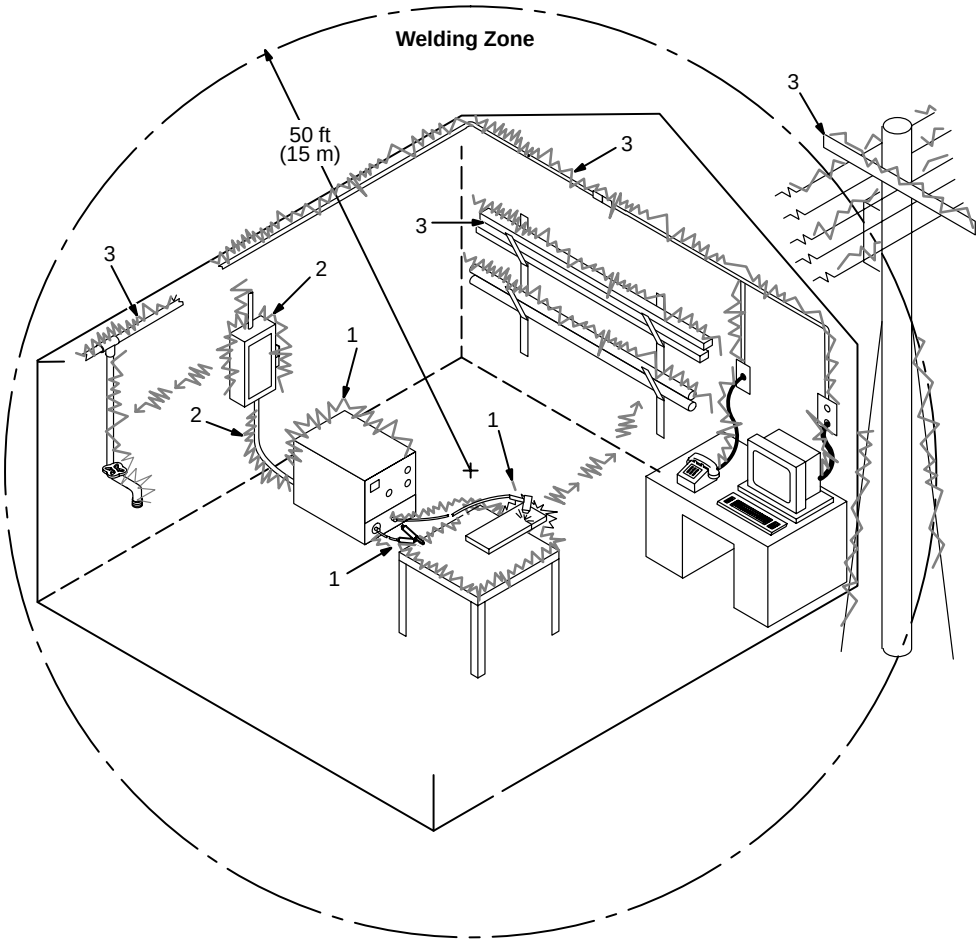
4 Pilot Arc

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, work-piece, and work table.

2 Sources Of Conduction Of High Frequency

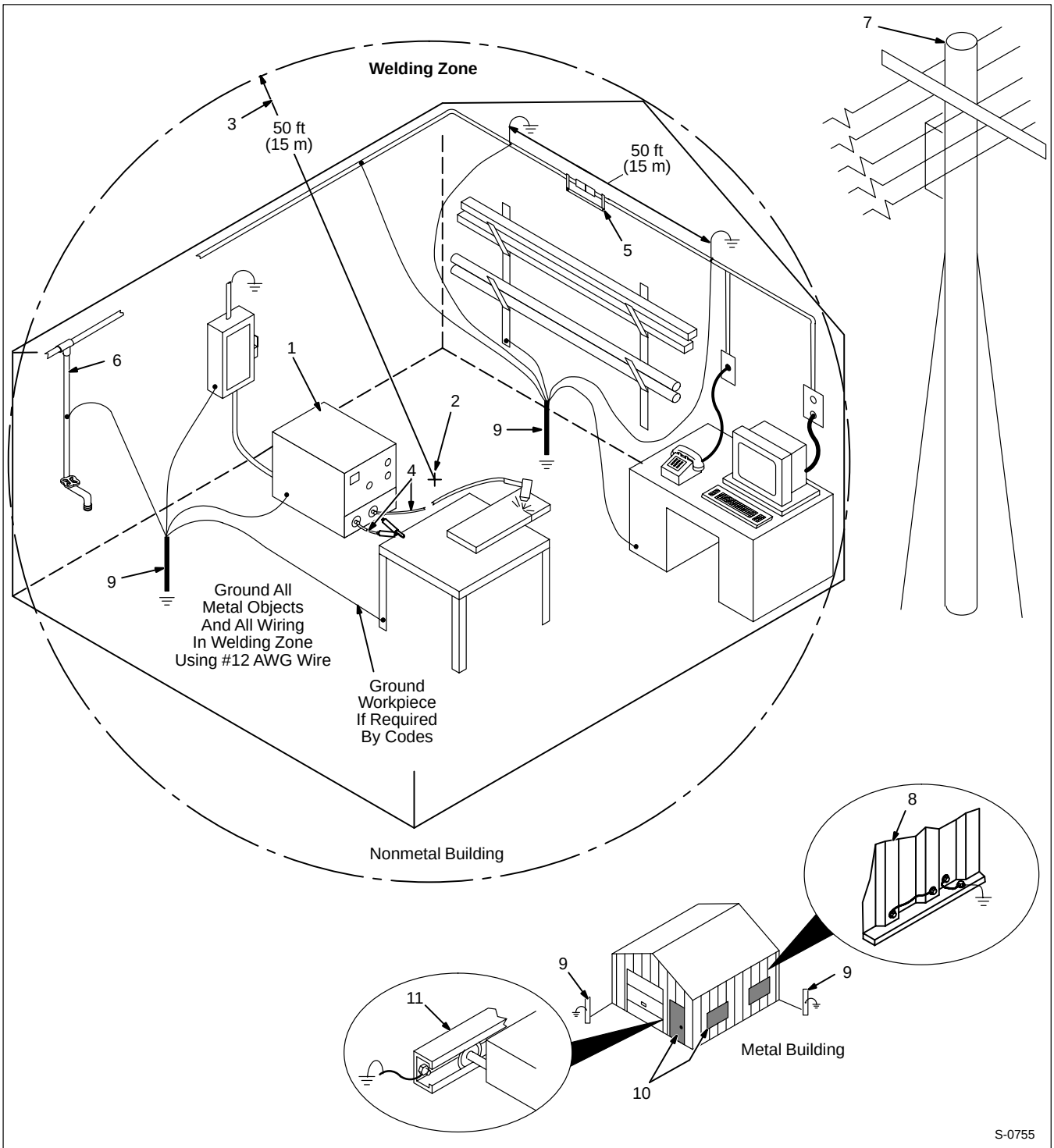
Input power cable, line disconnect device, and input supply wiring.

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



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

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.

Notes