Arc Products™
A Lincoln Electric Company

! IMPORTANT !
- For Your Safety -
Read this manual before installing or using this equipment

ARC PRODUCTS, INC

AVC-5 ARC VOLTAGE CONTROL

OPERATIONS AND SERVICE MANUAL

1245 30th Street
San Diego, CA 92154-3477
619-628-1022
619-628-1028 FAX
sales@arc-products.com
service@arc-products.com
www.ap-automation.com
www.arc-products.com

THANK YOU!!!

. . . for purchasing **Arc Products** Equipment. Our commitment to you is to provide an ever expanding family of quality arc positioning equipment, controller and accessories. Please take the time to read the following pages as they contain important information regarding proper use of this product and of welding/cutting safety and procedures.

WHO DO I CONTACT		
For help: • Contact your distributor For additional information, such as, Technical Manuals, Service and Parts, Circuit and Wire Diagrams, User's Guides, Distributor Directories • Contact your distributor	To file a claim for loss or damage during shipment • Contact your delivering carrier For assistance in filing or settling claims, • contact your distributor and/or equipment manufacturer's Transportation Department	How to contact Arc Products: Call: 619-628-1022 Fax: 619-628-1028 E-mail: sales@arc-products.com service@arc-products.com Write: Arc Products Attn: Customer Service 1245 30th Street San Diego, CA 92154
ALWAYS PROVIDE MODEL NAME AND PART NUMBER		

Overview

Table of Contents

Table of Tables

AVC-5 ARC VOLTAGE CONTROL SYSTEM

Table of Figures

AVC-5 ARC VOLTAGE CONTROL SYSTEM

SAFETY

SAFETY PRECAUTIONS

THIS MANUAL HAS BEEN DESIGNED FOR EXPERIENCED WELDING AND CUTTING EQUIPMENT OPERATORS AND MUST BE READ COMPLETELY BEFORE USING THIS EQUIPMENT. IF YOU LACK EXPERIENCE OR ARE UNFAMILIAR WITH THE PRACTICES AND SAFE OPERATION OF WELDING AND CUTTING EQUIPMENT, PLEASE CONSULT YOUR FOREMAN. DO NOT ATTEMPT TO INSTALL, OPERATE, OR PERFORM MAINTENANCE ON THIS EQUIPMENT UNLESS YOU ARE QUALIFIED AND HAVE READ AND UNDERSTOOD THIS MANUAL. IF IN DOUBT ABOUT INSTALLING OR OPERATING THIS EQUIPMENT, CONTACT YOUR DISTRIBUTOR OR THE CUSTOMER SERVICE DEPARTMENT OF ARC PRODUCTS.

DEFINITIONS

Throughout this manual, NOTE, CAUTION, WARNING and DANGER are inserted to call attention to particular information. The methods used to identify these highlights and the purpose for which each is used, are as follows:

NOTE

Operational, procedural, and background information which aids the operator in the use of the machine, helps the service personnel in the performance of maintenance, and prevents damage to the equipment.

CAUTION

An operational procedure which, if not followed, may cause minor injury to the operator, service personnel and/or bystanders.

WARNING

An operational procedure which, if not followed, may cause severe injury to the operator, service personnel and/or bystanders.

DANGER

An operational procedure which, if not followed, will cause severe injury or even death to the operator, service personnel or bystanders.

SAFETY INFORMATION

Safety is a combination of good judgment and proper training. Operation and maintenance of any arc welding and cutting equipment involves potential hazards. Individuals who are unfamiliar with cutting and welding equipment, use faulty judgment or lack proper training, may cause injury to themselves and others. Personnel should be alerted to the following potential hazards and the safeguards necessary to avoid possible injury. In addition, before operating this equipment, you should be aware of your employer's safety regulations.

BE SURE TO READ THIS MANUAL BEFORE INSTALLING OR USING THIS EQUIPMENT.

BE SURE TO READ AND FOLLOW ALL AVAILABLE SAFETY REGULATIONS BEFORE USING THIS EQUIPMENT.

ELECTRIC SHOCK

THE VOLTAGES PRESENT IN THE WELDING AND CUTTING ENVIRONMENT CAN CAUSE SEVERE BURNS TO THE BODY OR FATAL SHOCK. THE SEVERITY OF ELECTRICAL SHOCK IS DETERMINED BY THE PATH AND THE AMOUNT OF CURRENT THROUGH THE BODY.

A Install and continue to maintain equipment according to USA Standard C1, National Electric Code.

B Never allow live metal parts to touch bare skin or any wet clothing. Use only dry gloves.

C When welding or cutting in a damp area, or when standing on metal, make sure you are well insulated by wearing dry gloves, rubber soled shoes, and by standing on a dry board or platform.

D Do not use worn or damaged welding or torch cables. Do not overload the cables. Use well maintained equipment.

E When not welding/cutting, turn equipment OFF. Accidental grounding can cause overheating and create a fire hazard. Do not coil or loop the cable around parts of the body.

F The ground cable should be connected to the work piece as close to the work area as possible. Grounds connected to building framework or other locations remote to the

work area reduce efficiency and increase the potential hazard of electric shock. Avoid the possibility of the welding or cutting current passing through lifting chains, crane cables or other electrical paths.

G Keep everything dry you might touch, including clothing, the work area, welding gun, torch and welding or cutting machines. Fix water leaks immediately. Do not operate equipment standing in water.

H Never use a cutting torch or welding gun which is damaged or contains cracked housing.

I Refer to AWS-Z49.1 for grounding recommendations.

SKIN AND EYE BURNS RESULTING FROM BODY EXPOSURE TO ELECTRIC-ARC WELDING AND CUTTING RAYS OR HOT METAL CAN BE MORE SEVERE THAN SUNBURN.

A Use a proper face shield fitted with the correct filter (#10 or greater) and cover plates to protect your eyes, face, neck and ears from the sparks and rays of the cutting/welding arc when cutting/welding or observing cutting/welding. Warn bystanders not to watch the arc and not to expose themselves to the cutting/welding arc rays or to hot metal.

B Wear flameproof gauntlet-type gloves, a heavy long-sleeve shirt, cuff-less trousers, high-topped shoes, and a welding helmet or cap (for hair protection) to protect the skin from arc rays and hot sparks or hot metal.

C Protect other nearby personnel from arc rays and hot sparks with a suitable non-flammable partition.

D Always wear safety glasses or goggles when in a cutting or welding area. Use safety glasses with side shields or goggles when chipping slag or grinding. Chipped slag is hot and may travel a considerable distance. Bystanders should also wear safety glasses or goggles.

E Compressed gas cylinders are potentially dangerous, refer to the suppliers for proper handling procedures.

F Wear ear plugs or other ear protection devices when operating cutting or welding equipment.

FIRE SAFETY

HOT SLAG OR SPARKS CAN CAUSE A SERIOUS FIRE WHEN IN CONTACT WITH COMBUSTIBLE SOLIDS, LIQUIDS OR GASES.

A Move all combustible materials well away from the cutting area or completely cover materials with a non-flammable covering. Combustible materials include but are not limited to wood, clothing, sawdust, gasoline, kerosene, paints, solvents, natural gases, acetylene, propane, and similar articles.

B Do not weld, cut or perform other hot work on used barrels, drums, tanks or other containers until they have been completely cleaned. There must be no substances in the container which might produce flammable or toxic vapors.

C For fire protection, have suitable extinguishing equipment handy for instant use.

WELDING AND CUTTING FUMES AND GASES, PARTICULARLY IN CONFINED SPACES, CAN CAUSE DISCOMFORT AND PHYSICAL HARM IF INHALED OVER AN EXTENDED PERIOD OF TIME.

A At all times, provide adequate ventilation in the welding and cutting area by either natural or mechanical means. Do not weld or cut on galvanized, zinc, lead, beryllium or cadmium materials unless positive mechanical ventilation is provided to prevent inhaling fumes and gases from these materials.

B Do not weld or cut in locations close to chlorinated hydrocarbon vapors coming from degreasing or spraying operations. The heat of arc rays can react with solvent vapors to form phosgene, a highly toxic gas, and other irritant gases.

C If you develop momentary eye, nose or throat irritation during welding or cutting, it is an indication that the ventilation is not adequate. Stop work and take the necessary steps to improve ventilation in the welding or cutting area. Do not continue to weld or cut if physical discomfort persists.

D Use an air supplied respirator if ventilation is not adequate to remove all fumes and gases.

E Beware of gas leaks. Welding or cutting gases containing argon are denser than air and will replace air when used in confined spaces. Do not locate gas cylinders in confined spaces. When not in use, shut OFF the gas supply at its source.

Refer to AWS Standard Z49.1 for specific ventilation recommendations.

ADDITIONAL SAFETY HAZARDS

FIRE AND EXPLOSION

Fire and Explosion can result from placing units on, over, or near combustible surfaces.

- Do not install units on, over, or near combustible surfaces.
- Do not install unit near flammables.

FALLING EQUIPMENT

Falling Equipment can cause serious personal injury and equipment damage.

- Use lifting eyes to lift unit only, not running gear, gas cylinders, or any other accessories.
- Use equipment of adequate capacity to lift units.

- If using fork lifts to move units, be sure forks are long enough to extend beyond opposite side of the unit.

HOT PARTS

Hot parts can cause severe burns.

- Do not touch hot parts bare handed.
- Allow cooling period before working on gun or torch.

MOVING PARTS

Moving Parts can cause injury.

- Keep away from moving parts, such as fans.
- Keep all doors, panels, covers, and guards closed and securely in place.

- Keep away from pinch points, such as mechanical slides, drive rolls, carriage assemblies, etc.

MAGNETIC FIELDS CAN AFFECT PACEMAKERS

Magnetic Fields from High Currents can affect pacemaker operation.

- Pacemaker wearers should keep away.
- Wearers of pacemakers should consult their doctors before going near arc welding, gouging, plasma cutting, or spot welding operations.

WELDING WIRE

Welding wire can cause puncture wounds.

- Do not press gun trigger until instructed to do so.
- Do not point the gun toward any part of the body, other people, or any metal when threading welding wire through the gun.

FLYING PIECES OF METAL OR DIRT

Flying pieces of metal or dirt can injure eyes.

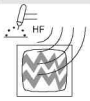
- Wear safety glasses with side shields or face shields.

OVERHEATED EQUIPMENT

High output power for long durations can cause equipment to overheat.

- Allow cooling periods.
- Reduce current or reduce duty cycle before starting to weld again.
- Follow rated duty cycle.

HIGH FREQUENCY



High Frequency can cause electrical interference.

- Take appropriate precautions to shield sensitive electronic equipment, such as computers, Programmable Logic Controllers, etc.
- Be sure to ground each component of the system to one ground point, i.e., Earth Ground (Earth) or Protective Earth (PE).

SAFETY REFERENCES

The following publications provide additional information on important welding safeguards.

A ANSI/ASC 249.1-1988, American National Standard "Safety in Welding and Cutting".

B Bulletin No. F4-1, "Recommended Safe Practices for the Preparation for Welding and Cutting Containers and Piping that have held Hazardous Substances".

C OSHA Safety and Health Standards, 29CFR 1910, available from the United States Department of Labor, Washington, DC 20210.

D NFPA Standard 51B, "Fire Prevention in Use of Cutting and Welding Processes", available from the National Fire Protection Association, 470 Atlantic Avenue, Boston, MA 00210.

E NEMA Standards Publication/No. EW1-1989, Electric Arc-Welding Apparatus, approved as ANSI C87.1-1989. Available from

National Electrical Manufacturers Association,
155 E. 44th Street, New York, NY 10017.

AVC-5 Arc Voltage Control System

DESCRIPTION OF EQUIPMENT

The AP Automation AVC-5 Arc Voltage Control system is a precision microprocessor-controlled arc voltage control unit for use with the Gas Tungsten Arc Welding process (GTAW, also known as TIG) and Plasma Arc Welding (PAW). This equipment, by means of a closed-loop servo, moves the welding torch in order to maintain a constant arc voltage. Automatic corrections are made by the drive head to match the actual arc voltage with that set on the front panel controls, thus keeping the arc length constant. Other features designed into the AVC-5 Arc Voltage Control system makes it a truly innovative product suited to the customer's needs.

ARC VOLTAGE CONTROL THEORY

The Arc Products Automation AVC-5 Arc Voltage Control System or other arc voltage/length controls are, simply stated, primarily a modified Digital Voltage Meter. A Digital Volt Meter measures a voltage drop across a resistor or other component at two points, i.e., the + and - sense leads.

As current increases or decreases through the resistor or component, the voltage drop across also increases or decreases proportionately. Likewise, in a welding arc if the arc length increases, i.e., the torch moving away from the work-piece, the arc voltage also increases. Arc Voltage is directly proportional to arc length. As one increases the other increases or as one decreases the other decreases.

Like the Digital Volt Meter, our AVC-5 system also measures the voltage across a resistor at two points. In the AVC-5 system's case, the resistor is a welding arc. In a TIG arc, the positive (+) lead connects to the work-piece and the Negative (-) lead connects to the TIG welding torch.

While welding, the AVC-5 system measures the voltage across the arc and compares this voltage to the voltage pre-set on the front panel (or from the remote input) and adjusts the torch up or down to maintain the pre-set welding arc voltage selected.

The importance of an arc voltage control system was first realized in an automated welding system where heat input is critical. TIG welding power sources are known as Consant Current (or CC) power sources, which means that no matter what arc voltage (reasonably obtained from the power source) the power source will maintain a constant current output.

But because the arc voltage wasn't kept constant, the heat (or power) into the work-piece being welded was not kept constant.

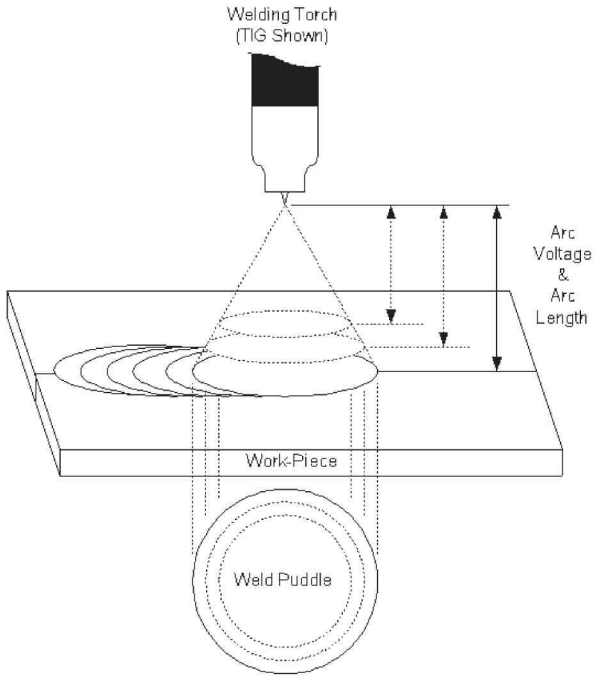


FIGURE 1 - ARC VOLTAGE CONTROL THEORY

With the advent of an arc voltage control system, arc voltage was also kept constant, thereby providing a constant heat (or power) into the work-piece being welded (see Figure 1 - Arc Voltage Control Theory on page 3).

ARC VOLTAGE CONTROL SYSTEM

The AVC-5 system includes many new features not found on any other arc voltage control systems (or arc length control systems) currently available. The most innovative feature in the AVC-5 system is our patented Lift-Start process. The AVC-5 will start an arc without any High-Frequency, using a welding power source with a touch start or Lift-Arc (an ITW trademark) starting process.

The feature enables reliable, automated non-High-Frequency (HF) arc starting on all metals. The AVC-5 commands the torch to touch the work-piece, then tungsten is preheated for an adjustable time unique to the diameter of the electrode and the type of material being welded. This provides a smooth, consistent arc start, without tungsten inclusion.

The Lift-Start feature is enabled by a DIP switch setting on the micro-controller board on the inside of the AVC-5 Control unit, allowing easy selection.

The AVC-5 controls AC welding as well as DC welding applications, without any additional components, cables, etc. This feature is also enabled via a DIP switch on the micro-controller board.

CONTROL UNIT

The control unit is a heavy gauge steel enclosure containing the electronic circuitry used in the system. Solid state circuits are used to provide long, trouble-free operation. The control unit operates on 115/230VAC, 50/60 Hz commercial power, capable of supplying approximately 2 amps peak current. The unit has a lighted power switch and fuse holder mounted on the exterior of the unit.

The system is operated using the controls, potentiometers, pushbuttons located on the front panel. Additional switches are located on the inside of the control unit, on the back side of the micro-controller board via DIP switches. A heatsink mounted on the inside of the control unit allows adequate cooling for the heat dissipating devices, i.e., motor stepper drivers.

The three connectors located on the bottom of the unit provide for connection of the drive cable and two remote interface cables.

DRIVE ASSEMBLY

The AVC System can be purchased with one of two different drive assemblies, i.e., Standard AVC-5 Drive assembly or the Compact AVC Drive assembly. The controller can also be used with older drive assemblies built by Cyclomatic™, which include the Standard AVC-3 and Standard AVC-4 Drive assemblies and the Compact AVC Drive assembly, providing these drive assemblies are in good working order.

The Standard AVC-5 Drive assembly (and Cyclomatic's™ AVC-3 and AVC-4 drives) has a 6" stroke length. This is an adequate stroke length for many applications.

The Compact AVC drive assemblies have a 1" stroke length for use in tight welding areas where physical constraints prevent the use of the Standard 6" stroke drive assembly.

Each drive is equipped with a Red Voltage Sense lead, which connects to the TIG or Plasma welding torch, and a Work-piece Stud for connecting to the work-piece, making up the two leads of a digital volt meter, as discribed earlier.

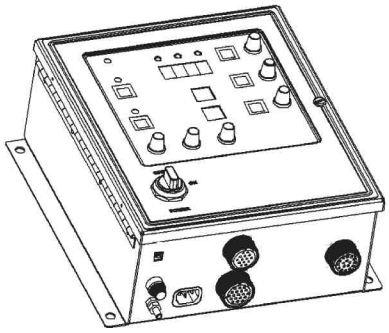


FIGURE 2 - AVC-5 CONTROL UNIT

TABLE 1 - AVC-5 CONTROL SPECIFICATIONS

DESCRIPTION	SPECIFICATIONS	RATING
Voltage Sensing	Accuracy	± 1% of setting or .1V whichever is greater
Voltage Sense Range	(Lower Limits are possible)	5 to 50V DC or AC
	Maximum Open Circuit Voltage	80VDC, 80VAC
Input Power Requirements		90 - 132 VAC / 180 - 264 VAC 50/60 Hz
Control Unit	Enclosure	Standard NEMA Style Sealed enclosure with provisions for plug-in options
Deadband Adjustment	Voltage Error Range	.1 (Min.) to 1.5 V (Max.) in DC Welding .1 (Min.) to 1.5 V (Max.) in AC Welding
Sensitivity Adjustment	Adjustment for Speed of correction	0 to 100 %
Retract Time		0 to 10 sec.
Starting Arc Gap		.01 to .09 in.
Start Delay		0.0 to 12.5 sec.
Burn-Through Detection		2.0 Voltage above Pre-Set Voltage initiates
Arc Starting Capability	AC or DC Welding	HF Start Lift-Start
Indication		Auto Tracking
		Start Delay
		Lockout
		Digital Display of Actual and Pre-Set Voltage, Start Delay, Start Gap, Tungsten Preheat, Touch-sense Voltage Threshold
Manual Inputs		Up / Down Jog (Remote and Front panel and Drive unit)
		Protect Arm
		Lockout
Power Cable	Standard Length	8' (1.8 M)

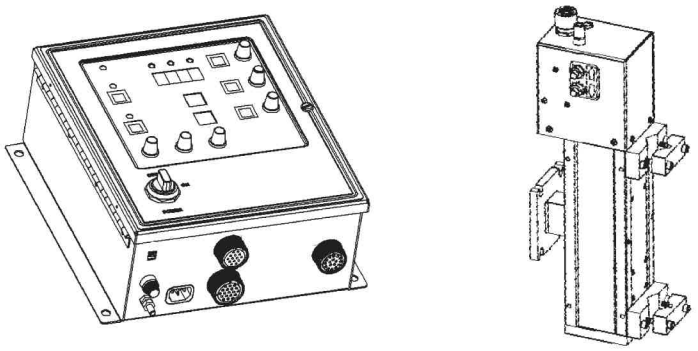


FIGURE 3 - AVC-5 SYSTEM COMPONENTS

DESCRIPTION	PART #	MODELS
Control Unit	0600-0101	AVC-5 Arc Voltage Control
Drive Assembly	0600-0009 Or 1040-0031	Standard AVC-5 6” Drive Assembly Or Compact AVC-5 1” Drive Assembly
Cables	929000-001	Power Cable Assembly
	1054-0046	Remote Interface cable assembly
	1054-0047	Auxiliary Remote Interface Cable assembly
Manual	201327-001	AVC-5 Operators and Service Manual

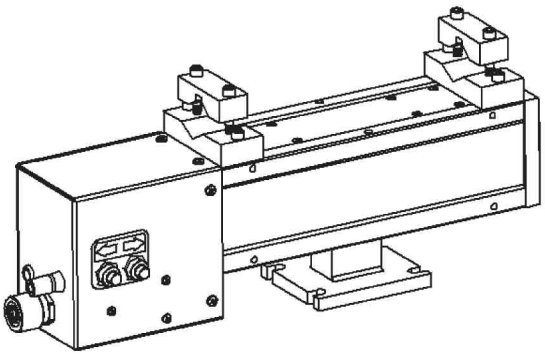


FIGURE 4 - AVC-5 STANDARD DRIVE ASSEMBLY

TABLE 3 - AVC-5 STANDARD DRIVE ASSEMBLY SPECIFICATIONS

DESCRIPTION	SPECIFICATIONS	RATING
Load Capacity	Mounted in Torch Clamp Brackets	45 lbs. (20 Kg) at Center Line of Torch
Non-Standard Stroke Length	Optionally available	4” (101 mm) to 12” (304 mm) Stroke Lengths
Tracking Controls	Manual	Up / Down
Drive System		Acme Screw with brass nut running on Dual-Vee Wheels
Drive Cable	Standard Length	10’ (3 M)
Sense Lead	Standard Length	3’ (1 M)
Weights	6” (152 mm) Drive Assembly	15 lbs. (6.8 Kg)

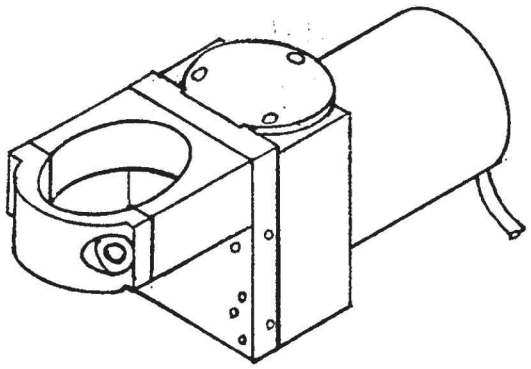


FIGURE 5 - AVC-5 COMPACT DRIVE ASSEMBLY

TABLE 4 - AVC-5 COMPACT DRIVE ASSEMBLY SPECIFICATIONS

DESCRIPTION	SPECIFICATIONS	RATING
Load Capacity	Mounted in Torch Clamp Bracket	10 lbs. (4.5 Kg) at Center Line of Torch
Tracking Controls	Manual	Up / Down
Drive System		Precision Ball Screw and Nut running on micro-slides
Drive Cable	Standard Length	10' (3 M)
Sense Lead	Standard Length	3' (1 M)
Weights	1" (25.4 mm) Drive Assembly	12 lbs. (5.4 Kg)

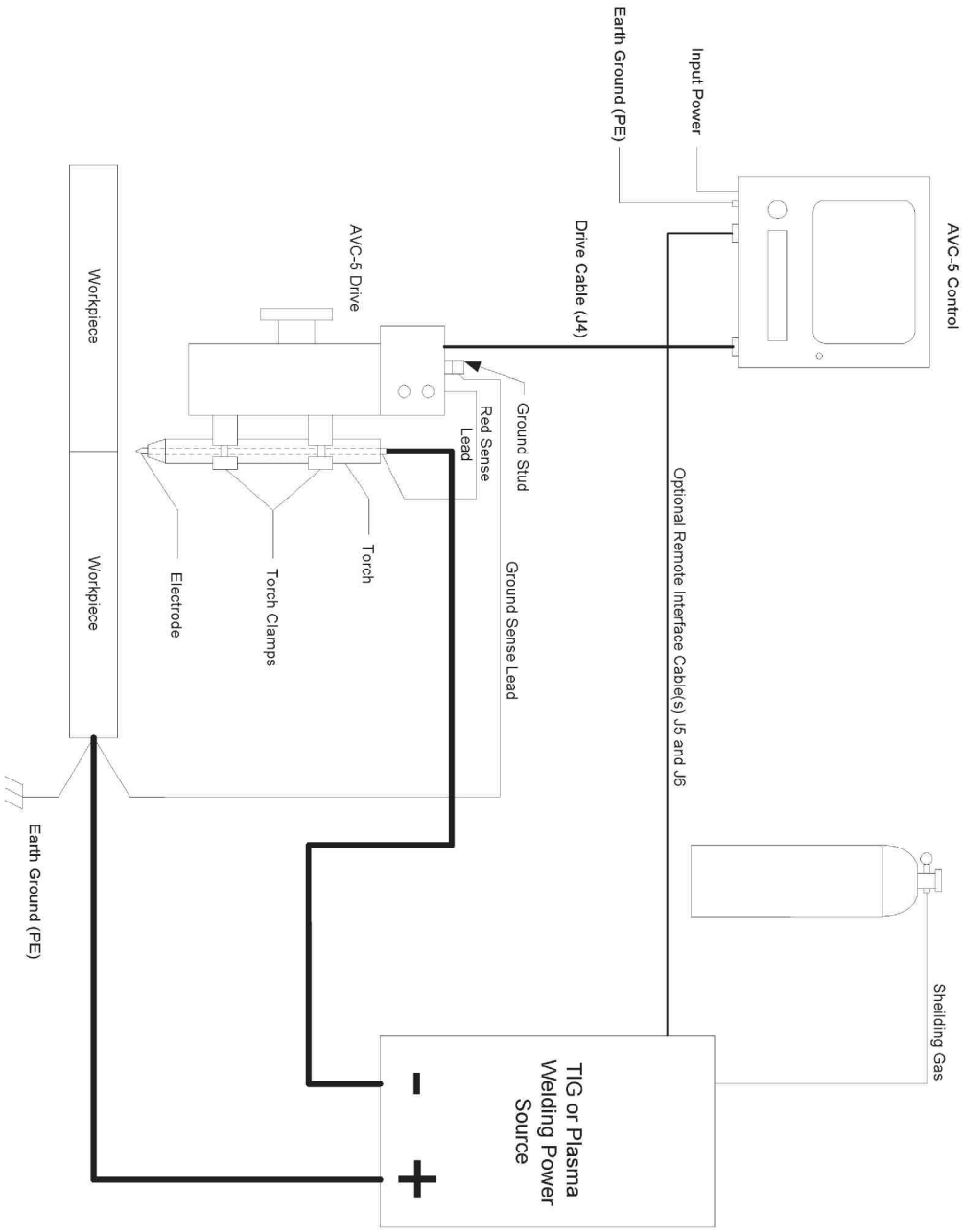


FIGURE 6 - INTERCONNECTION DIAGRAM

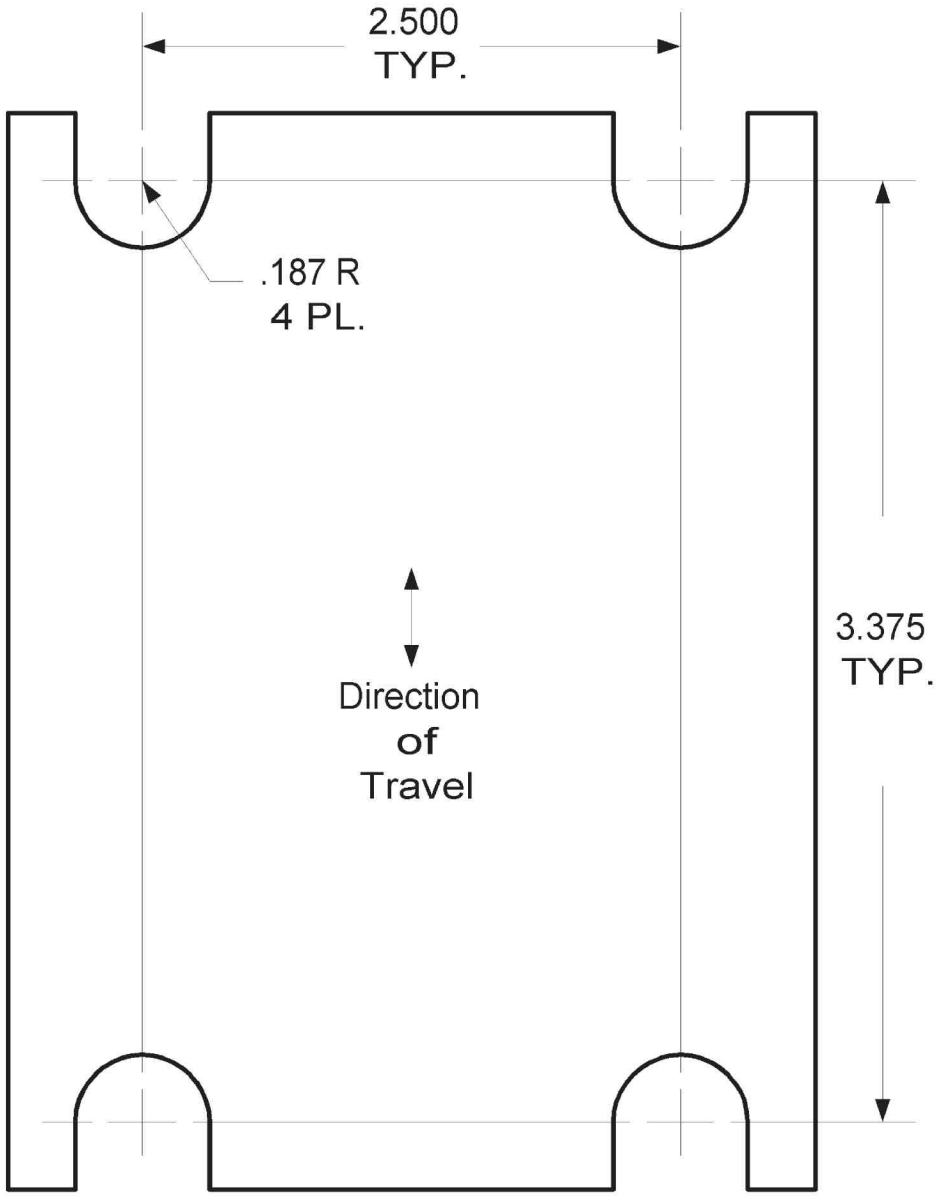


FIGURE 7 - AVC-5 STANDARD DRIVE ASSEMBLY MOUNTING DIMENSIONS

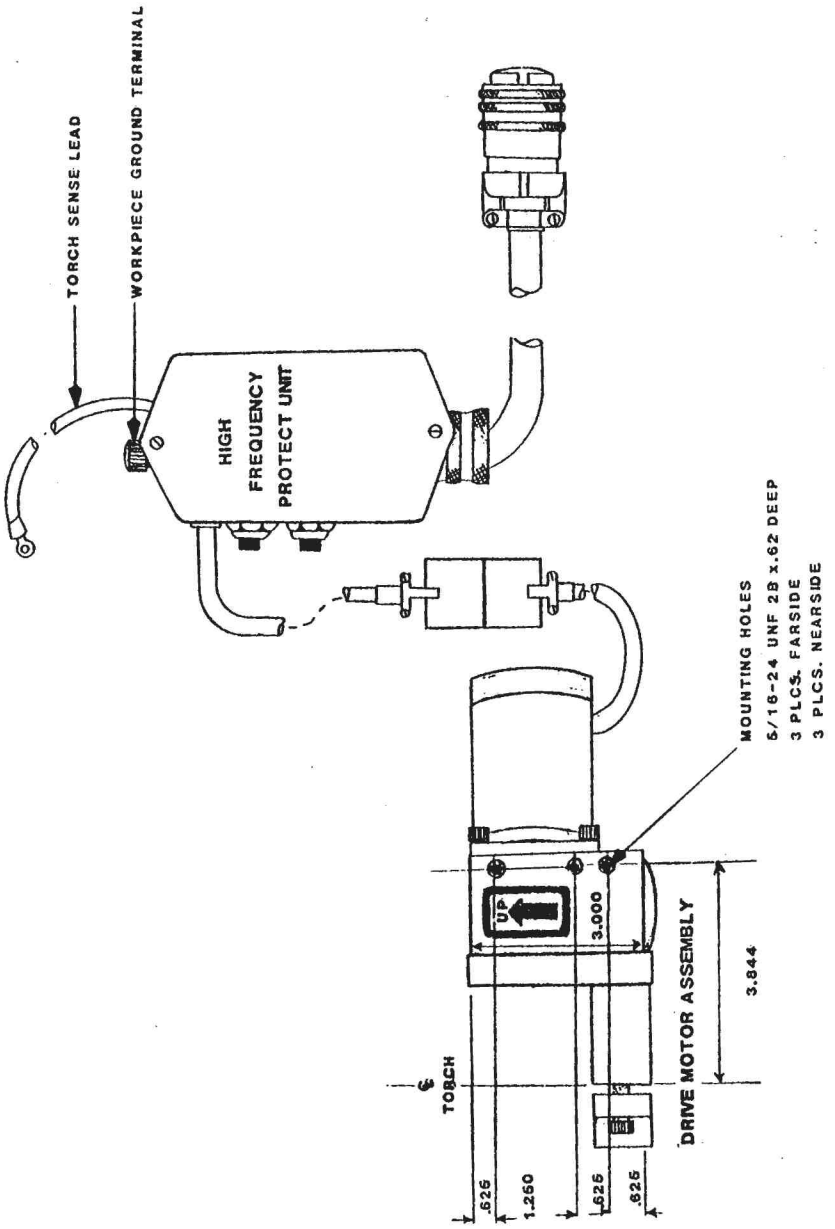


FIGURE 8 - AVC-5 COMPACT DRIVE ASSEMBLY MOUNTING DIMENSIONS

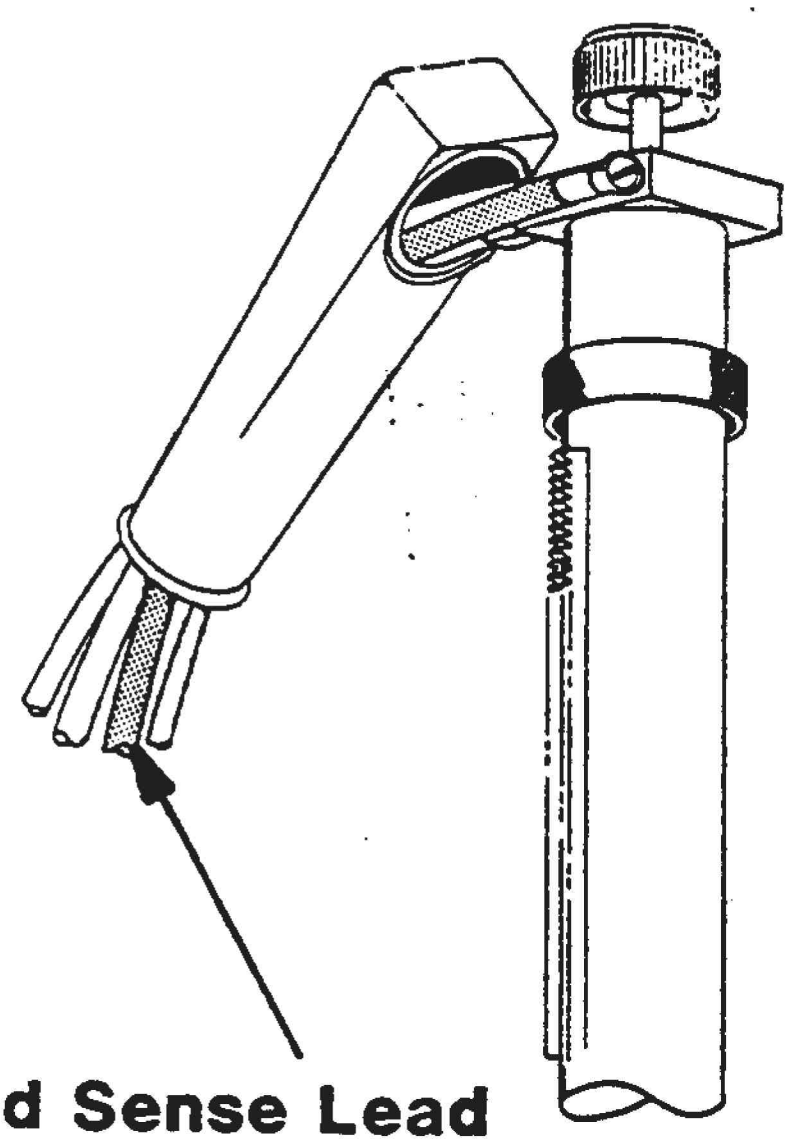


FIGURE 9 - AVC-5 SENSE LEAD TIG TORCH CONNECTION

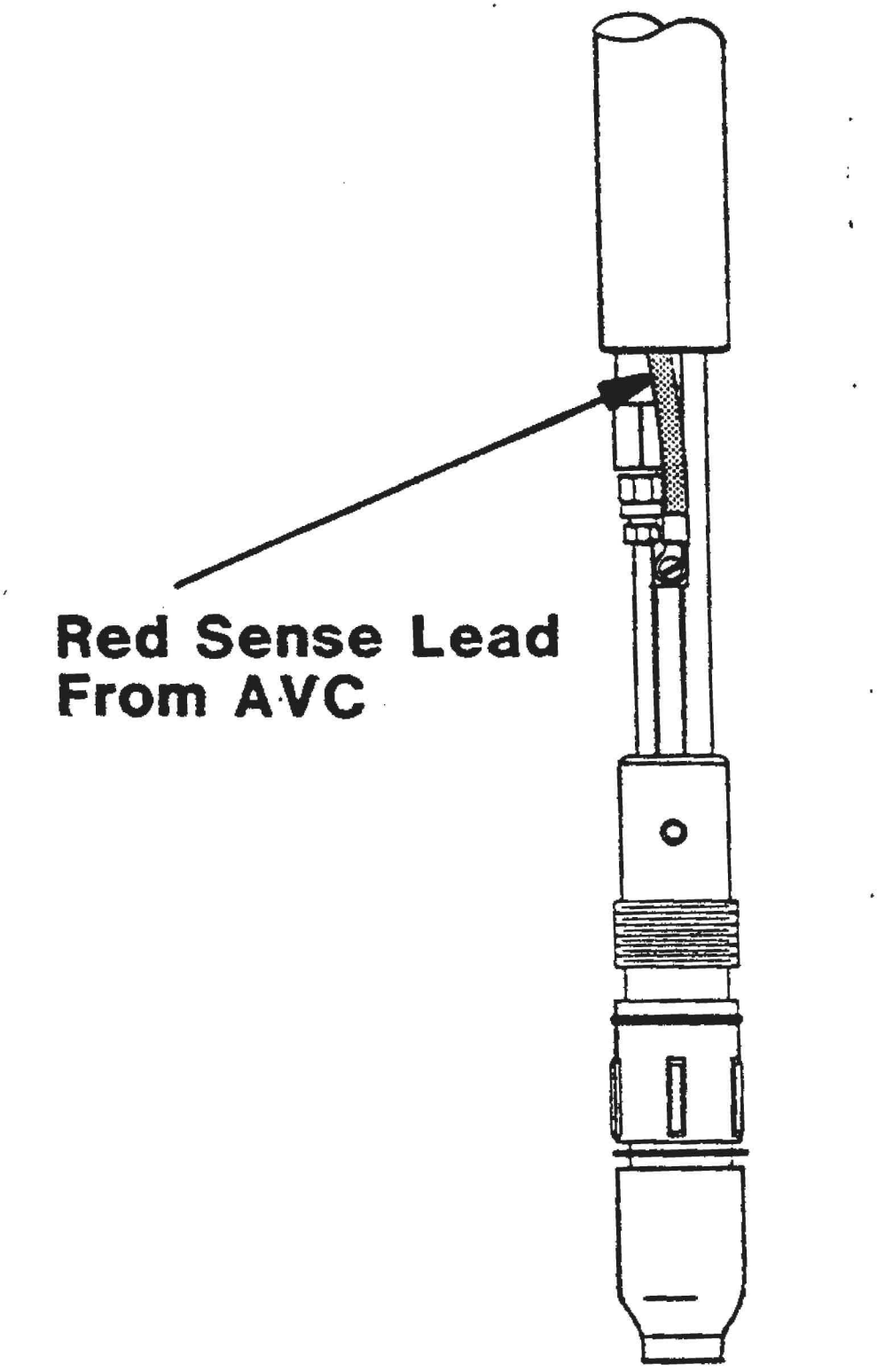


FIGURE 10 - AVC-5 SENSE LEAD PLASMA TORCH CONNECTIONS

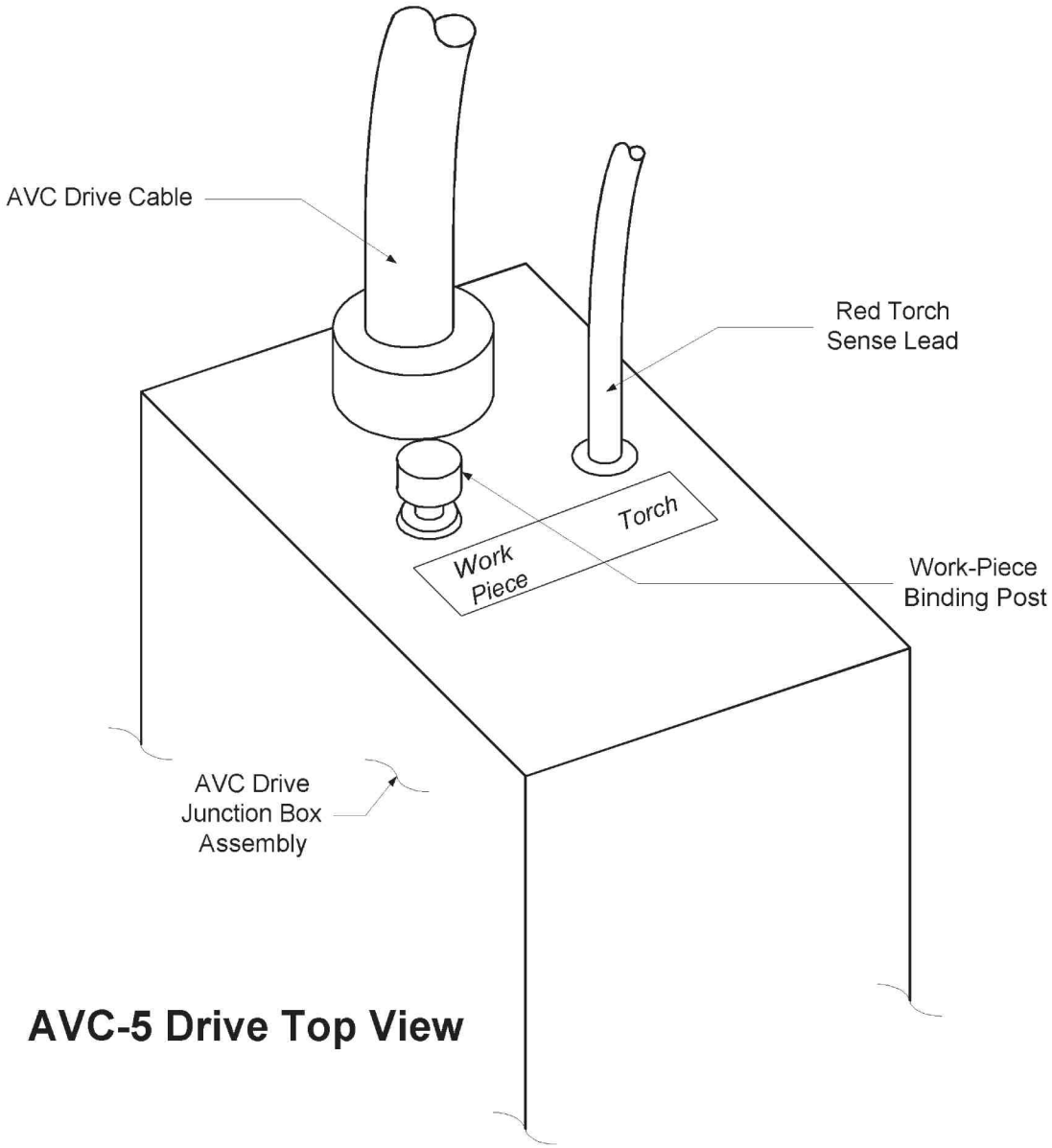


FIGURE 11 - AVC-5 DRIVE WORK-PIECE CONNECTIONS

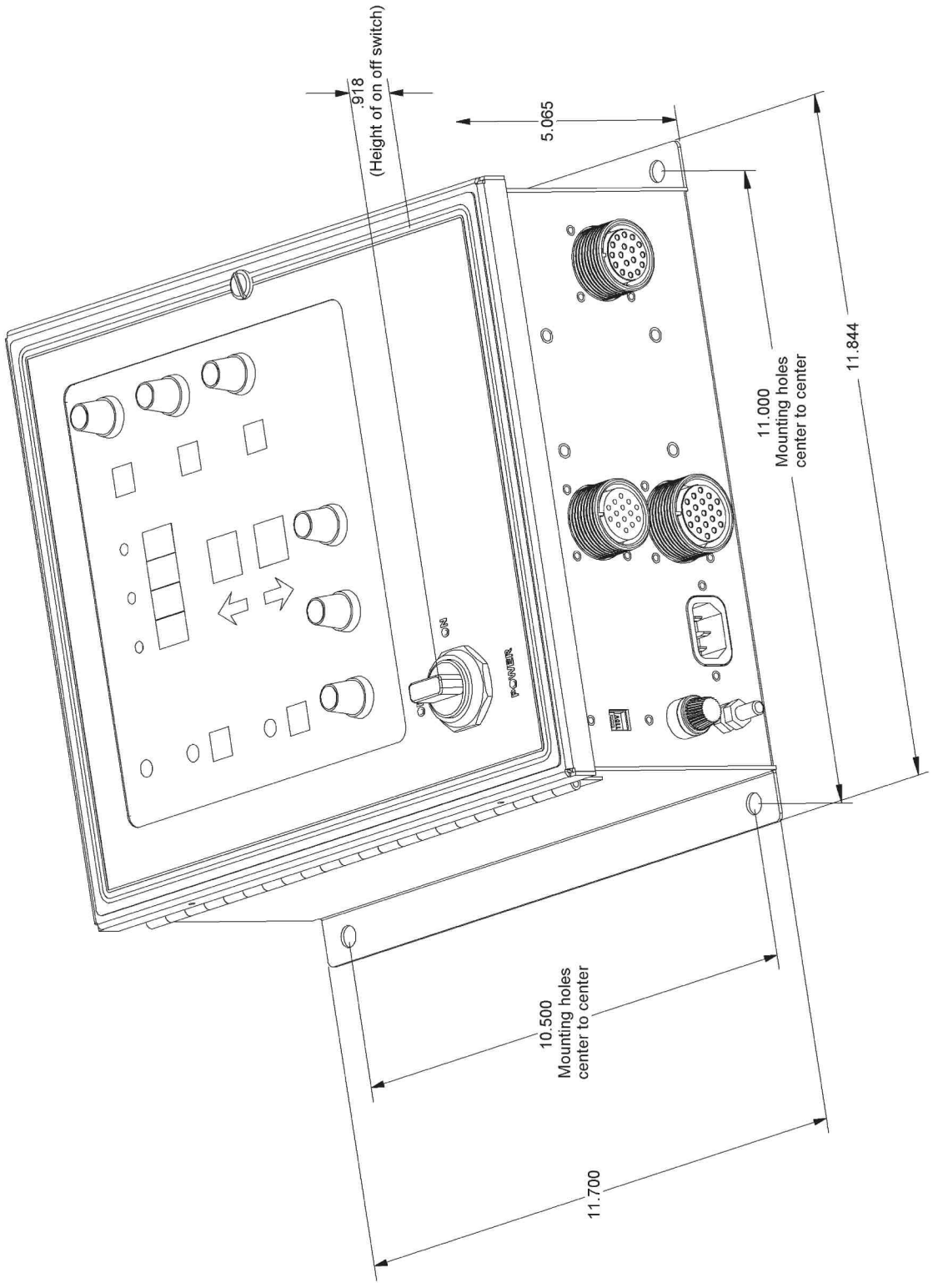


FIGURE 12 - AVC-5 CONTROL UNIT MOUNTING DIMENSIONS

OPERATION

GENERAL OPERATIONAL DESCRIPTION

The AVC-5 microprocessor-controlled system automatically controls the arc voltage and arc gap during a welding operation by digitizing and processing the arc voltage. The operational parameters required for this function, (Setpoint Voltage, Start Delay, etc.) are preset / pre-selected by the operator using the controls on the front panel of the control unit.

These operational parameters are read by the microprocessor prior to an arc start and during the welding process. When the control unit is first turned on and no arc voltage is present, manual mode of operation is in effect. When an arc is struck, the system goes into automatic. The first phase of automatic is Start Delay. During Start Delay, the drive will not adjust to control the arc voltage. When Start Delay times out, the drive will begin to adjust to control the arc voltage and continue to do so unless Lockout is activated or the arc is extinguished. The following sections describe in detail the various modes of operation.

NOTE:

In all modes of operation, the Up pushbuttons on the drive unit, on the front panel or via remote input will perform the same function.

START MODES

There are two methods of starting an arc using the AVC-5 system, i.e., High-Frequency Start and Lift-Start™ Modes. Each method is described below, but the Start Mode must be selected using DIP Switches on the back of the Micro-Controller board (see Figure 31 - AVC-5 Micro-Controller Board Layout on page 33 for the DIP switch location).

High-Frequency Start

High-Frequency (HF) arc starts is the typical method of starting a TIG welding process. The AVC-5 drive moves the torch and tungsten down to the work-piece until it touches. The AVC-5 Control senses that the tungsten has touched the work-piece and immediately drives up to the preselected Starting Arc Gap. Once the desired gap has been reached, the AVC-5 turns on the K1 relay. The K1 relay is used to turn the contactor on the power source, to start the arc. See Figure 13 - HF Start Mode and AC Welding and Figure 14 - HF Start Mode and DC Welding for DIP Switch Settings required for HF Arc Starting in AC and DC Welding Modes.

At this time, the AVC-5 control is monitoring the arc voltage and waits until a voltage is within the range of 5 to 50VDC. Once a voltage within range is sensed, the AVC-5 goes immediately into Start Delay Mode, to allow the arc to become established and stable before voltage tracking begins.

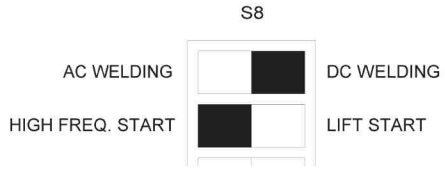


FIGURE 14 - HF START MODE AND DC WELDING

Lift-Start™

Lift-Start™ is a process (patent pending) in which a TIG welding process is started without the use of HF. The Lift-Start™ process uses a feature in certain TIG power sources that preheat the tungsten with a small amperage while in contact with the work, once the selected preheat time has completed, the AVC-5 will drive the torch up away from the work. At the moment the torch is driven up and contact between the work-piece and tungsten no longer exists, a small spark jumps the gap and the power source immediately goes into standard welding amperages to maintain the arc and begin the welding process. See Figure 15 - Lift-Start Start Mode and AC Welding on page 17 and Figure 16 - Lift-Start Start Mode and DC Welding on page 18 for DIP Switch Settings required for Lift-Start™ Arc Starting in AC and DC Welding Modes.

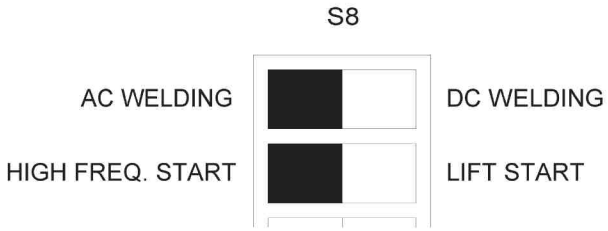


FIGURE 13 - HF START MODE AND AC WELDING

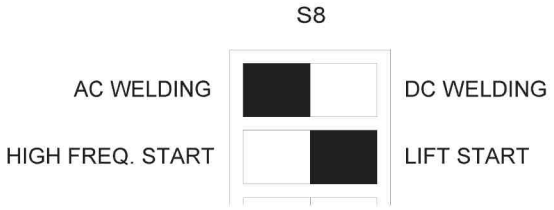


FIGURE 15 - LIFT-START START MODE AND AC WELDING

The advantage of using the Lift-Start™ method compared to the HF method of starting a TIG welding arc is that HF noise is not emitted from the area that could harm sensitive electronic equipment. In addition, the tungsten inclusion into the weld is reduced and even eliminated using this method, compared to scratch starting the arc using the tungsten electrode.

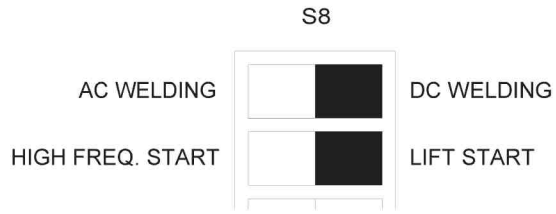


FIGURE 16 - LIFT-START START MODE AND DC WELDING

AUTOMATIC / MANUAL MODES

Manual mode

The manual mode of operation is in effect whenever the torch voltage is outside the voltage range of operation of 5 to 50VDC and the system is not in Retract. In manual, the Up / Down pushbuttons will move the drive in the selected direction.

When the drive is operated from the Up / Down pushbuttons, the drive will move at the manual motor speed in the direction selected. While in manual, all of the operational parameters can be changed.

Automatic and Start Delay Modes

The Automatic Mode of operation is in effect whenever the torch voltage is within the "Automatic Voltage Sense Range" of 5 -50VDC, which indicates that an arc is present. Prior to the arc voltage coming into range, the AVC-5 simply waits. During this time, down drive is not operable, but the up drive pushbutton is. If the Up drive pushbutton on the front panel, either remote interface cables or at the drive assembly is pressed, the AVC-5 will reset back to the manual mode of operation.

NOTE:

This is important to note, for the AVC-5 to reset and the arc to extinguished, the AVC-5 must control the contactor of the power source. This Up drive signal can be used to act as a stop signal, again, on the front panel, the remote interface cables, or on the drive assembly

As soon as the arc is present, the system goes immediately into Start Delay, indicated by flashing the arc voltage on the digital display.

During Start Delay, the drive unit will not move to control arc voltage and the Up / Down pushbuttons are inoperative. When Start Delay times out, the digital display stops flashing, the End of Start Delay (EOSD) Relay, K2, energizes, and the drive unit will now move to maintain the arc voltage at the preset value. The Automatic Mode will continue until the arc voltage falls outside the “Automatic Voltage Sense Range", after which, Retract will occur. Control of the arc voltage will continue unless Lockout is activated.

While in Automatic Mode, the Voltage Pre-set, Deadband, and Sensitivity parameters may or can be changed from the control panel.

Lockout Mode

While the Automatic Mode is in effect, AVC-5 control can be halted momentarily or continuously by activating Lockout. Lockout can be activated either through the Lockout Pushbutton on the front panel or via either of the customer interface cables. When Lockout is activated, the Lockout LED above the Lockout pushbutton will turn On. To de-activate Lockout, simply press the Lockout pushbutton or remove the Lockout input from either of the remote interface cables.

Two typical uses for the Lockout function are for amperage Downslope and for a Pulsed TIG welding. In Pulsed TIG welding the AVC-5 would be disabled or locked out during the low pulse, so that the AVC-5 will only track the voltage of the high pulse. In Downsloping of the welding amperage at the end of the welding cycle, the AVC-5 should be locked out to prevent the AVC-5 system from correcting for the voltage decreasing during the Downslope process.

It may also be desirable to be able to manually Lockout the AVC-5 during setup and initial installation.

Retract Mode

The Retract Mode is used to retract the torch away from the workpiece at the end of a weld cycle. When the torch voltage goes outside the Automatic Voltage Sense Range of 5 to 50VDC, indicating the arc has extinguished, the torch will retract for the selected time.

NOTE:

Retract will only occur if Start Delay has timed out so that false arc starts will not cause the torch position to change.

There are a number of operational parameters that control the AVC-5 operation. The user can select the desired parameters, depending on the welding process requirements. These parameters are selected

using the potentiometers on the front panel and DIP Switches on the inside of the control unit.

Deadband

Deadband is a window of voltage centered around the set point voltage selected by the user. This window is adjustable from ±.1 volt to ±1.5 volts. This window is considered an acceptable error of voltage by the AVC-5 Control system and selecting the maximum Deadband setting makes the AVC-5 the least accurate (see Figure 18 - Maximum Deadband Setting).

For example, the user selects 10 volts as the welding voltage. The user adjusts the Deadband fully clockwise. This selects the maximum Deadband setting or the largest possible window of voltage. The AVC-5 will not correct for any voltage error greater than 8.5 volts and less than 11.5 volts--a 3 volt window (±1.5 volts). If the voltage goes below the 8.5 volts or above 11.5 volts, the AVC-5 control will correct the arc length to return the voltage back into the 3 volt window.

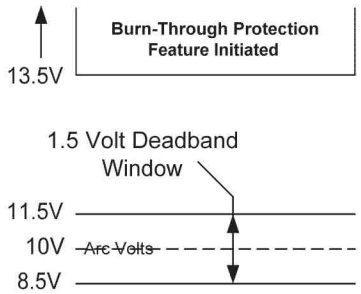


FIGURE 18 - MAXIMUM DEADBAND SETTING

Likewise, if the Deadband was adjusted fully counterclockwise (minimum Deadband or smallest possible window of voltage), the AVC-5 will correct for errors in the voltage when the voltage exceeds the .2 volt window below 9.9 volts and above 10.1 volts (see Figure 17 - Minumum Deadband Setting).

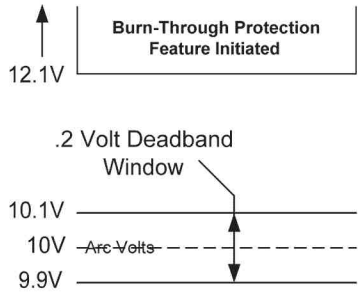


FIGURE 17 - MINUMUM DEADBAND SETTING

Sensitivity

The Sensitivity feature is an adjustment to allow the user to select how fast to correct for voltage errors once the voltage exceeds the Deadband setting. Adjusting the Sensitivity fully Counterclockwise sets the Sensitivity to minimum. Likewise, adjusting the Sensitivity clockwise sets it to maximum.

A compromise should be made when using the Sensitivity setting. Setting the Sensitivity to maximum will cause the AVC-5 system to overcompensate for arc voltage errors causing erratic type drive movement which can be detrimental to the weld. Setting this feature to minimum can also have ill effects on the weld, by causing the AVC-5 system to be sluggish in response to arc voltage errors.

In setting up the AVC-5 system for the first time, it is recommended to set the Deadband and Sensitivity settings as follows:

- Deadband set to approximately an 11 O'clock position
- Sensitivity set to approximately a 2 O'clock position

This allows the system enough tolerance to track and control the arc length without being so accurate that the system overcompensates and initiates the Burn-Through Protection feature.

Once the arc has been established and the AVC-5 system controls the arc voltage, adjustments can be made to obtain the level of accuracy desired for each application.

Burn-Through Protection (Protect)

Use of the Burn-Through Protection feature is optional. However, if the Burn-Through Protection feature is initiated, the AVC-5 system will stop tracking the arc voltage, go into Retract mode and then into Manual mode. To utilize this feature, proper electrical interfacing with the welding power source is required (or to other controlling equipment, e.g., PLC's, etc.). The maintenance section of this manual contains the necessary information for the interfacing of the Burn-Through Protection feature.

When in operation, the Burn-Through Protection circuit detects a rapid increase in the arc voltage that exceeds the preset voltage on the control unit by 2 volts. When this occurs, the welding power source is shut off via the contactor, the torch is extinguished and the AVC-5 drive retracts away from the work-piece. This eliminates the AVC-5 Control from "diving" into the work-piece, which would normally happen when a burn-though occurs. The AVC-5 must then be reset to continue operation.

NOTE:

The Burn-Through Protection feature will follow the limits of the Deadband control. The Burn-Through Protection circuit will not trigger until the rapid increase in arc voltage exceeds the Deadband window by the 2 volt threshold of the protect circuit.

Starting Arc Gap

Starting Arc Gap feature sets the starting arc gap of the arc voltage over a range of 0 to .09 inches. To set the arc gap (pre-positioning), the operator must select the desired gap length and manually drive the AVC-5 Drive head down until it touches the work-piece, at which time the AVC-5 Drive automatically backs off to the pre-selected Start Arc Gap setting.

NOTE:

During Pre-positioning, the operator must hold down the Down pushbutton, or the Down drive Input signal on either of the remote interface cables must be maintained until the K1-A relay's N.O. Contact closes, also indicated by the Protect LED illuminating.

Also, be sure the work-piece is secure. As it may spring up when the AVC-5 drive backs off, causing an incorrect arc gap setting.

Tungsten Preheat

The potentiometer that presets the Starting Arc Gap in HF Start Mode, also presets the Tungsten Preheat time in Lift-Start™ Mode.

Tungsten Preheat adjustment presets the time the tungsten is held in contact with the work-piece with the power source contactor on before driving up to start the arc.

Typically, the larger the tungsten, the longer preheat time is required. Likewise, with smaller diameter tungsten and/or thinner material, the shorter the preheat time required.

There isn't a set time for a given material and tungsten size. Therefore, tests must be conducted to determine a balance between reliable arc starting and unnecessary preheat time that may hinder production.

Tungsten Preheat time is selectable from 0 to 12.5 seconds.

NOTE:

The Tungsten Preheat time entered by the operator must include enough time to accommodate pre-purge time for the shielding gas.

INSTALLATION

NOTE

Figure 6 - Interconnection Diagram on page 10 Illustrates a typical AVC-5 system interconnection and should be used for reference in the following installation instructions.

DRIVE ASSEMBLY MOUNTING

Mount the AVC-5 drive unit to allow positioning of the weld torch above the weld joint. Refer to Figure 7 - AVC-5 Standard Drive Assembly Mounting Dimensions on page 11 for the mounting-hole pattern for the standard drive. If a compact drive is to be used, it comes in two pieces; the drive-motor assembly and the high-frequency protect unit. For the compact drive assembly, see Figure 8 - AVC-5 Compact Drive Assembly Mounting Dimensions on page 12 for placement.

Mount the drive-motor assembly from either side, using the 5/16-24 UNF -2b x .62 deep mounting holes provided. Position the high-frequency protect unit to allow the operator access to the up/down switches, and mount it using the four holes provided. Connect the two units together, using the cables provided.

The AVC-5 drive should be mounted so that adequate space around the drive is provided to accommodate the various parameters of operation (i.e., workpiece retract movement, automatic correction, etc.)

The requirements for mounting will, to a large extent, depend on the user's application. Some mounting experimentation may be required.

Red Voltage Sense Lead

Connect the red sense lead from the drive unit to the torch.

NOTE:

High voltage insulation test lead wire is provided for this purpose. The red sense lead must be connected to the conducting body of the torch. A binding screw is normally provided on the torch for this purpose. Please refer to torch manufacturers operators manual for details. Be sure to allow adequate lead length for full stroke travel, see Figure 9 - AVC-5 Sense Lead TIG Torch Connection and Figure 10 - AVC-5 Sense Lead Plasma Torch Connections for reference.

CAUTION

For safe operation, any insulating or protective covers removed for installation of the sense lead, must be replaced prior to welding.

Securely clamp the welding torch to the drive unit using the torch clamp and hardware provided.

Workpiece Ground Stud

A wire from the drive unit to the workpiece must be connected to allow the arc voltage to be sense and tracked. The secure connection to the workpiece ground to the ground stud located on the top of the drive must be connected.

IMPORTANT

Proper operation of the AVC-5 system requires that both sense lead and ground lead are properly connected, and that ground lead makes a secure electrical connection with the workpiece.

CONTROL UNIT MOUNTING

The control unit should be located or mounted in such a manner, so as not to interfere with the movement of the drive unit or the remainder of the system components. Use the mounting holes provided, making sure to mount the control unit for easy access to the power switch, cable connectors, faceplate controls and interior, see Figure 12 - AVC-5 Control Unit Mounting Dimensions on page 16 for reference.

Also be certain that the unit has unrestricted air flow.

Connect the drive interface cable from the AVC-5 drive to the AVC-5 control unit.

NOTE:

A chassis ground lug is located near the power cord. Care must be taken that this be connected to a solid earth ground in a high noise environment. All system components are connected to chassis ground thru the shields of the drive and interface cables.

Plug the control unit power cord into a properly grounded 50/60 Hz power. If 230VAC 50/60hz is to be used, first switch the power selector switch on the bottom of the control unit to the 230VAC position.

The AVC-5 drive is wired for straight polarity. If the operator is using reverse polarity in the weld process, then the AVC drive must be rewired to accommodate the reverse polarity.

This procedure is easily accomplished by following these steps:

- Remove power to the drive unit.

- Standard drive: remove the panel cover to the junction box assembly. This can be done by removing the six (6) pan head screws holding the cover in place.
- Compact drive: remove the panel cover on the high-frequency protect unit by removing the two screws holding the cover in place.
- Switch the green wire on terminal 1 to terminal 3. Change the black wire on terminal 3 to terminal 1.
- Instructions are also printed on the board for reference.
- Replace the cover using the hardware used when removing the cover.

CAUTION

Remember to wire the high frequency protect assembly for the correct polarity whenever welding polarities change.

INTERFACING THE AVC-5 WITH OTHER EQUIPMENT

When a remote interface cable is used between the customer's interface and the AVC-5 control unit, signals can be triggered remotely to achieve various functions that would normally be done manually.

These remote signals interface with the AVC-5 control through the J5 connector on the bottom of the control unit. A schematic of the cable connections and pin definitions is shown in Figure 44 - AVC-5 Control Block Diagram on page 58. The following sections describe in detail how each of the inputs are used.

CAUTION

The foil shield in the interface cable is connected to the chassis of the AVC-5 control unit. Make certain that all unused wires and shielding are insulated to prevent any accidental contact with voltages present inside the power supply.

END OF START DELAY RELAY (EOSD)

The end of start delay relay energizes upon Start Delay timeout, and de-energizes when the arc extinguishes. The relay would typically be used to turn on a wire feeder, a carriage assembly, magnetic arc controls, etc. Two sets of Form "C" contacts are provided. These are capable of switching 10 amps @ 110VAC and are protected by 130V, 10 Joule varistors. A schematic of the relay outputs is shown in Figure 48 - AVC-5 Remote Interface Cable Schematic and Figure 49 - AVC-5 Auxiliary Remote Interface Cable Schematic beginning on page 62.

LOCKOUT INPUTS

The Lockout Modes are described in the previous section (see Figure 22 - AVC-5 Remote Lockout (Relay), Figure 19 - AVC-5 Remote Lockout (Supply) and Figure 24 - AVC-5 Remote Lockout (Two Supplies) beginning on page 24). One input is provided for Lockout. The inputs are optically isolated and require an input of 5 to 35VDC @ 12.5mA to be activated. Special consideration needs to be given to input volt-

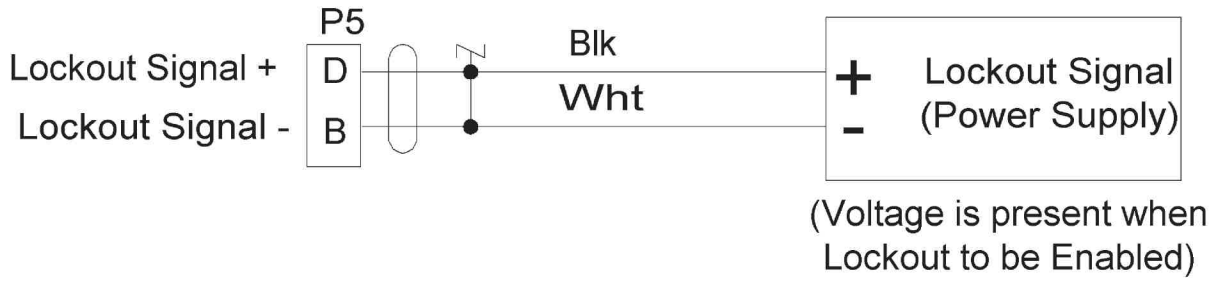


FIGURE 19 - AVC-5 REMOTE LOCKOUT (SUPPLY)

ages greater than 35V. If your inputs are greater than 35V, consult the factory for assistance. It is also possible to operate the inputs with contact closures.

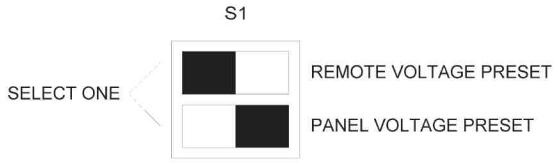
This is accomplished by using the DC voltage provided at the E+ arid E- outputs of the interface cable. A schematic of the interface-cable inputs and their typical use with voltage outputs from the power supply is shown in Figure 19 - AVC-5 Remote Lockout (Supply) and Figure 24 - AVC-5 Remote Lockout (Two Supplies). Figure 22 - AVC-5 Remote Lockout (Relay) shows the same setup only with a power supply that provides contact closures rather than voltage outputs.

REMOTE SET POINT VOLTAGE INPUT

The AVC-5 is capable of having the set point voltage set by an external voltage supplied from other equipment rather than from the front panel potentiometer. To use the Remote Set Point mode, it must first be selected using the DIP Switch, S1, inside the unit on the Micro-controller board, see Figure 31 - AVC-5 Micro-Controller Board Layout on page 33 for DIP switch locations and Figure 21 - Panel Voltage Preset DIP Switch Selection and Figure 20 - Remote Voltage Preset DIP Switch Selection beginning on page 23. This DIP Switch has two positions and they must be positioned so that only one is in the On position.

NOTE:

Both DIP Switches must not be set in the same position, i.e., both in the On position or both in the Off position. The system will not function properly if the DIP switch is positioned in such a way.



Shown in Remote Voltage Preset Mode

FIGURE 20 - REMOTE VOLTAGE PRESET DIP SWITCH SELECTION

The set point shown on the display will be the value measured at the remote set point input. From the factory, this input voltage is scaled and calibrated correctly for an input voltage of 0 to 10VDC. The resultant set point voltage will be 0 to 50VDC of actual welding arc voltage. The formula fpr scaling the input voltage is as follows:

Preset Volts = Desired Arc Volts X .2

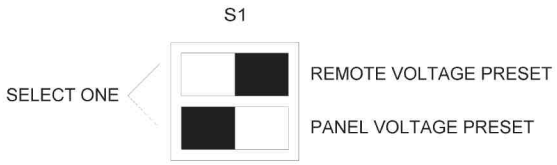
If the input voltage is not from 0 to 10VDC, you may need to adjust the scaling of the voltage measured by the controller to achieve a reading of 0 to 50VDC on the front panel. This is accomplished by adjusting the potentiometer R26, labeled “REM” while the remote input voltage signal is present.

WARNING

The Remote Preset Voltage input must be present at the AVC-5 Control, prior to the AVC-5 receiving the Drive Down signal for Touch-Sense to occur.

NOTE:

No other calibrations inside the control is required by the operator, except the R22 Trim-pot labeled “Touchsense Calibration”.



Shown in Panel Voltage Preset Mode

FIGURE 21 - PANEL VOLTAGE PRESET DIP SWITCH SELECTION

This scaling feature of the Remote Set Point input is included to allow the full range of the set point to be commanded from a wide range of applied voltages.

NOTE:

The set point range is limited to 5 to 50V. If a remote set point voltage and scale factor are chosen that would try to program a set point to be less than 5 volts, the control will set the set point to a voltage out of the AVC-5’s operating range. Likewise, if a set point of greater than 50 volts is attempted, the control will set the set point to a voltage greater than the operating range of the AVC-5.

The AVC-5 System will not function operated in this manner.

SYSTEM VISUAL CHECK

Before operation begins, verify that all system interconnections have been made. The interface cable from the drive unit should be installed in the J4 connector on the bottom panel of the control unit, see Figure 12 - AVC-5 Control Unit Mounting Dimensions on page 16.

The AC power cord from the control unit should be plugged into a properly grounded outlet. Both the Red Sense lead and the Work-Piece Ground lead should be properly attached. See Figure 6 - Interconnection Diagram on page 10 for a typical system interconnection.

TOUCHSENSE CALIBRATION

The Touchsense feature gives the AVC-5 system the to sense the work-piece and set a starting arc gap to assist in reliable, consist arc starting in HF Start Modes.

This feature uses a small voltage generated in the AVC-5 Control unit and is provided on the torch and work-piece sense leads. This voltage, typically around 3.4VDC, displayed on the AVC-5 Control unit front panel when the system is at idle, shorted or brought down to nearly zero volts when the AVC-5 Control unit drives the tungsten into contact with the work-piece.

When the AVC-5 Control unit senses the voltage is shorted, indicating the tungsten is touching the work-piece, the AVC-5 drive drives up for a pre-selected distance set by the operator on the front panel, creating the starting arc gap.

The Touchsense circuit is factory calibrated for operate with welding power sources having an open circuit impedance of 10Ω or greater. In some cases, the power source impedance may be greater, which require no adjustment to the AVC-5 Control unit.

Other power sources having an impedance of less than 10Ω do require adjustments to the Touchsense circuit, indicated by the AVC-5 Drive (standard or compact) driving Up continuously once the sense lead is connected to the tungsten and the work-piece.

To calibrate Touchsense, a potentiometer is provided on the Micro-Controller Board and is labeled, “Touchsense Calibration”, R22 (10KΩ). With all of the equipment installed and the AVC-5 connected to the welding power source, adjust this potentiometer until the AV-5 Drive just stops driving, then turn the potentiometer one-half turn counter-clockwise.

While calibrating the Touchsense circuit or anytime the AVC-5 system is at idle, pressing and holding the Start Delay and Voltage Preset buttons the AVC-5 front panel will display the Touchsense calibration setting in DC volts. This displayed voltage indicates the voltage a short circuit between the tungsten and the work-piece must go below to accurately sense a short--or a Touch. This is useful in troubleshooting the AVC-5 in the initial setup or when a different welding power source is used.

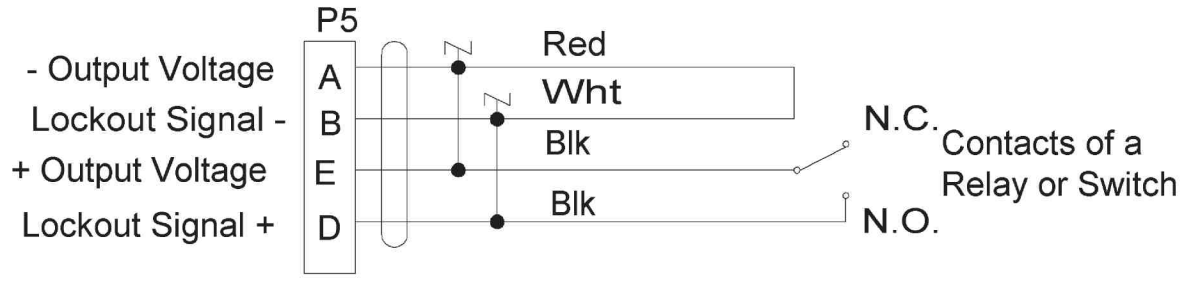


FIGURE 22 - AVC-5 REMOTE LOCKOUT (RELAY)

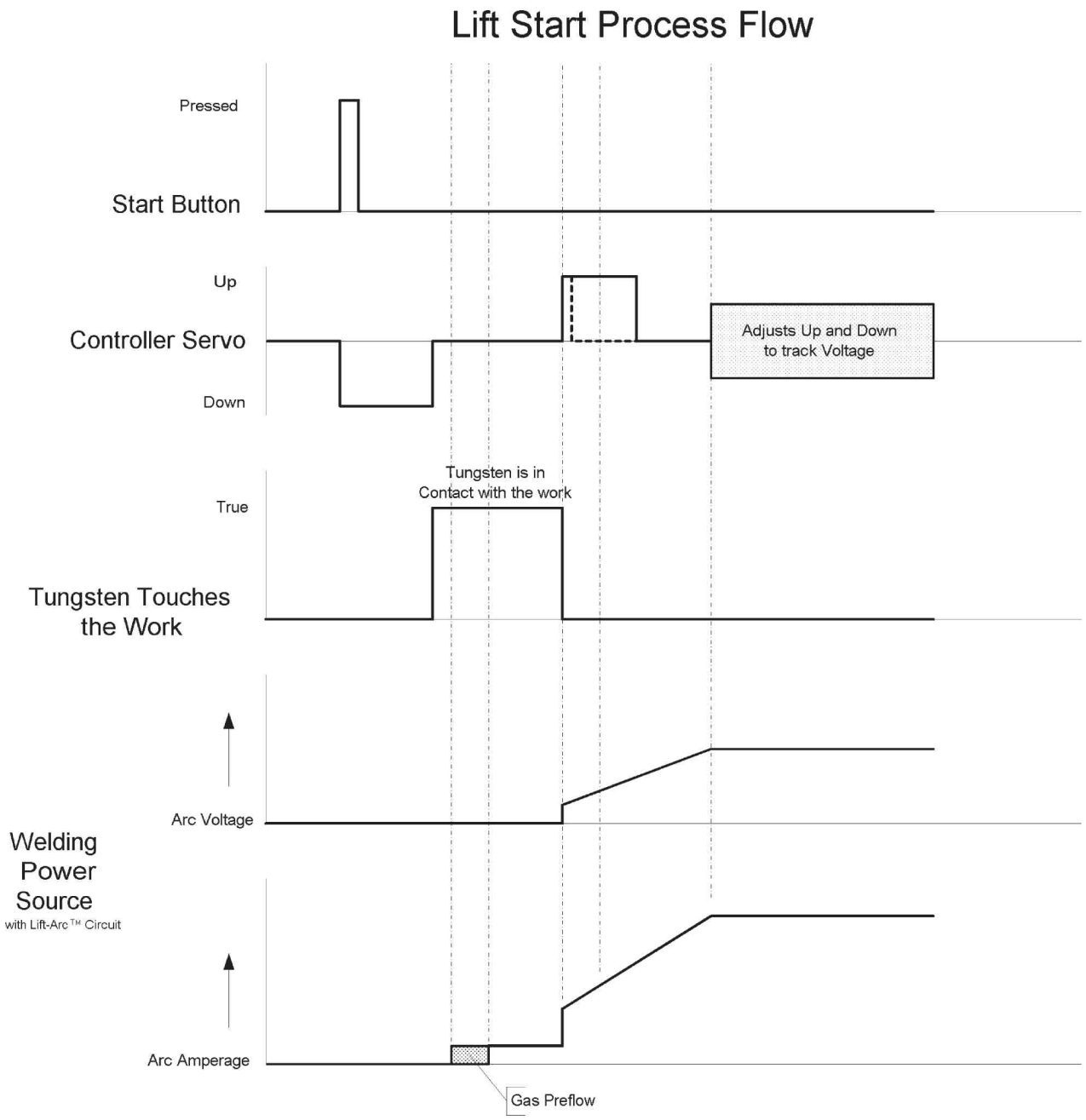


FIGURE 23 - AVC-5 PROCESS TIMELINE, EXAMPLE ONE

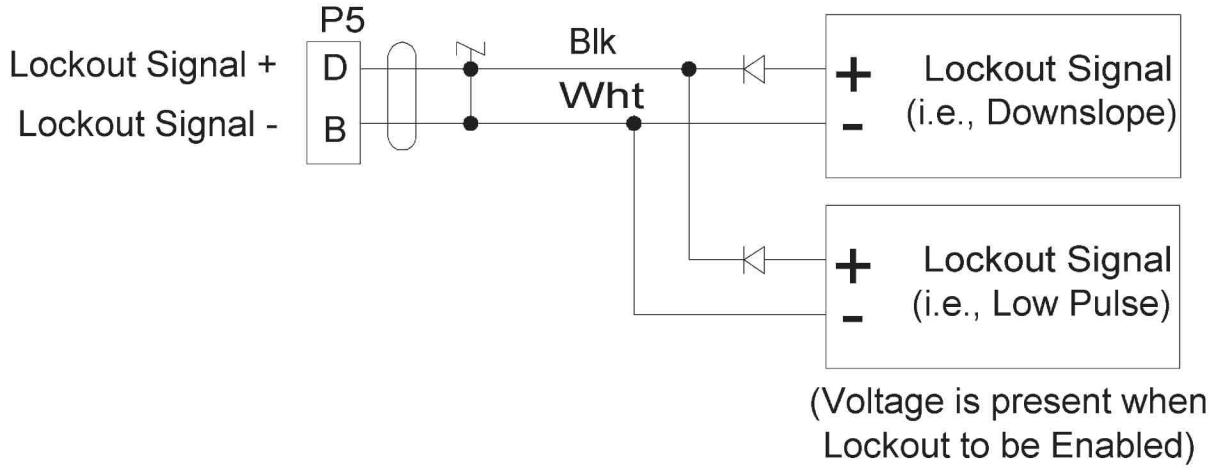


FIGURE 24 - AVC-5 REMOTE LOCKOUT (TWO SUPPLIES)

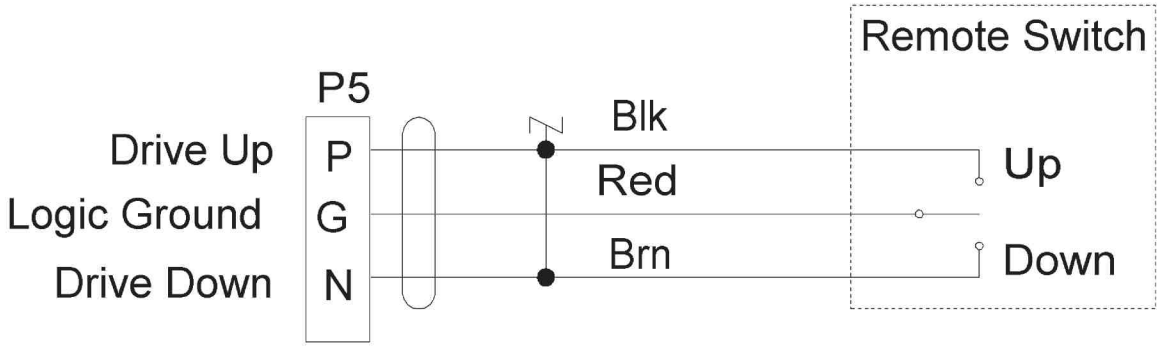


FIGURE 25 - AVC-5 REMOTE UP / DOWN DRIVE

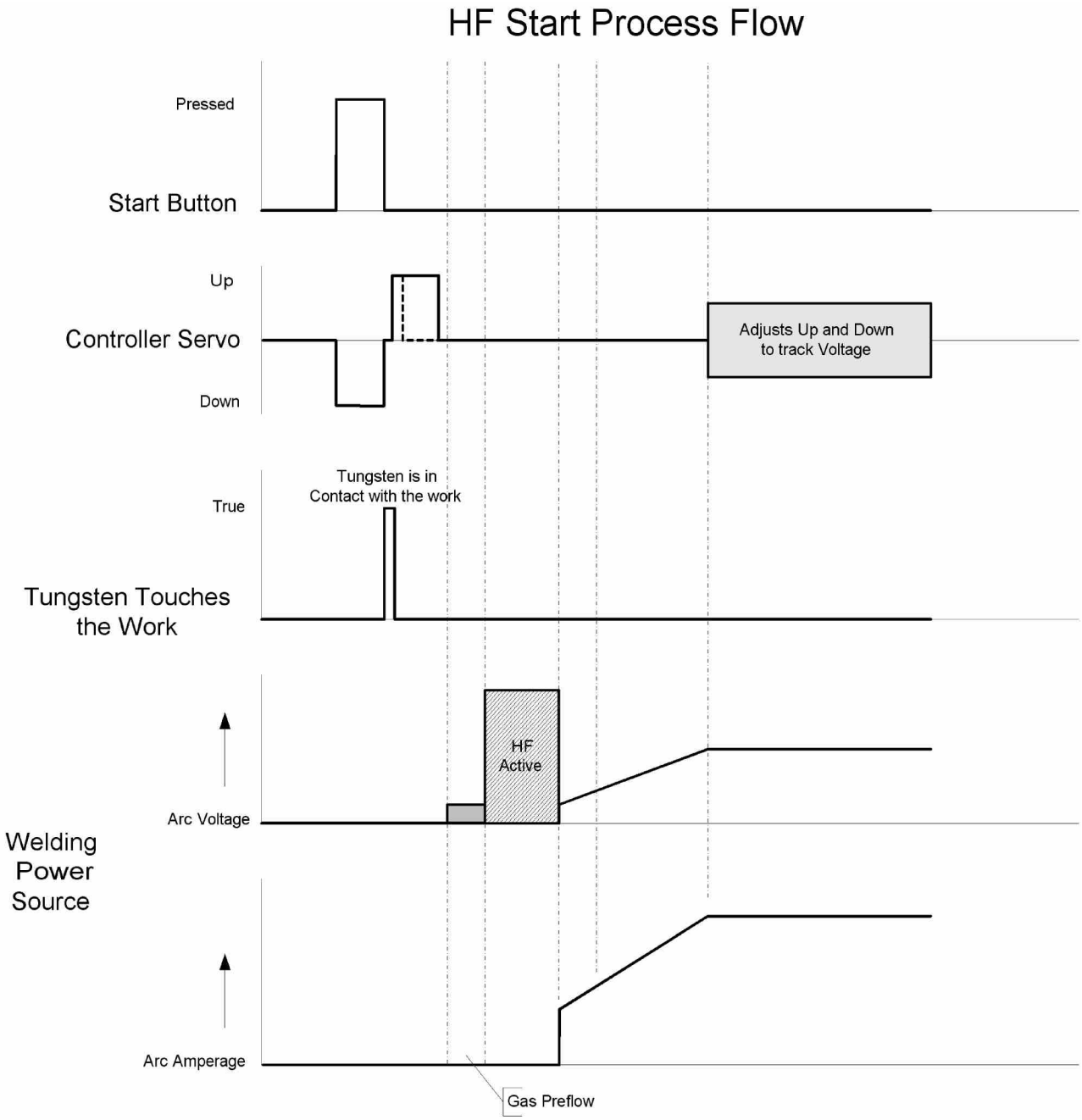


FIGURE 26 - AVC-5 PROCESS TIMELINE, EXAMPLE TWO

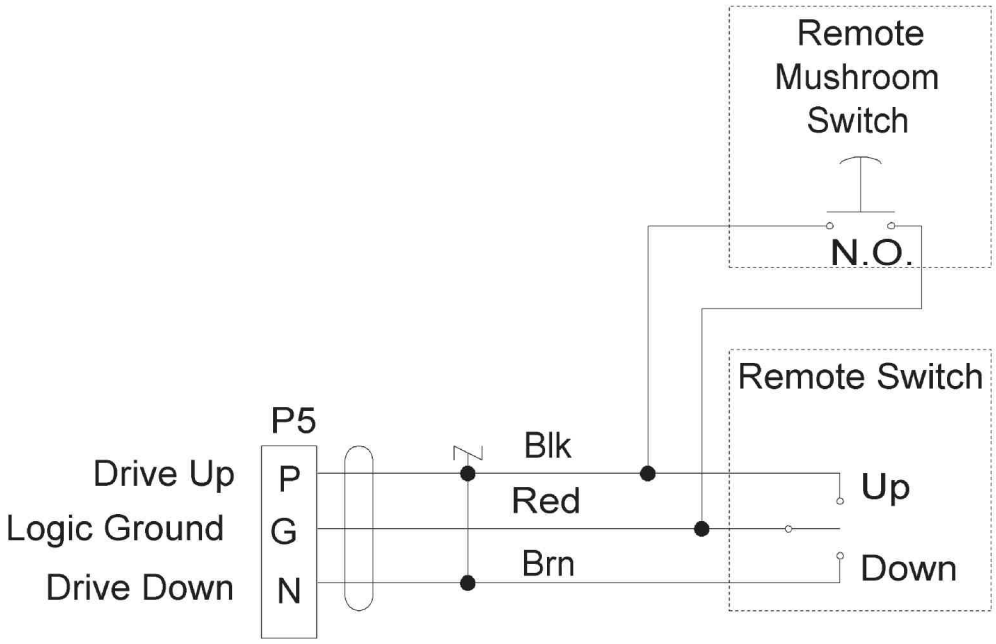


FIGURE 28 - AVC-5 REMOTE UP / DOWN DRIVE WITH E-STOP

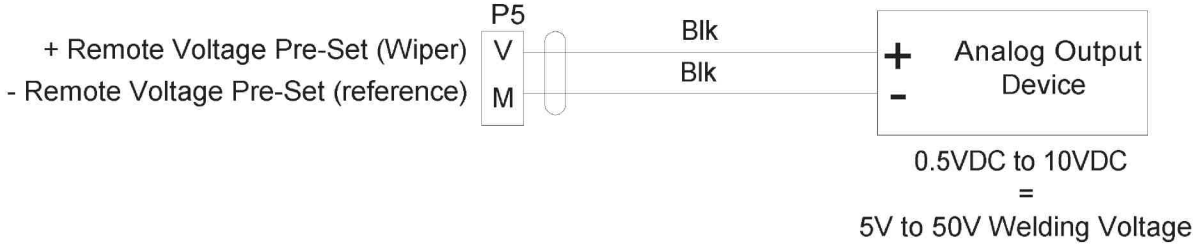


FIGURE 27 - AVC-5 REMOTE VOLTAGE SET POINT (ANALOG)

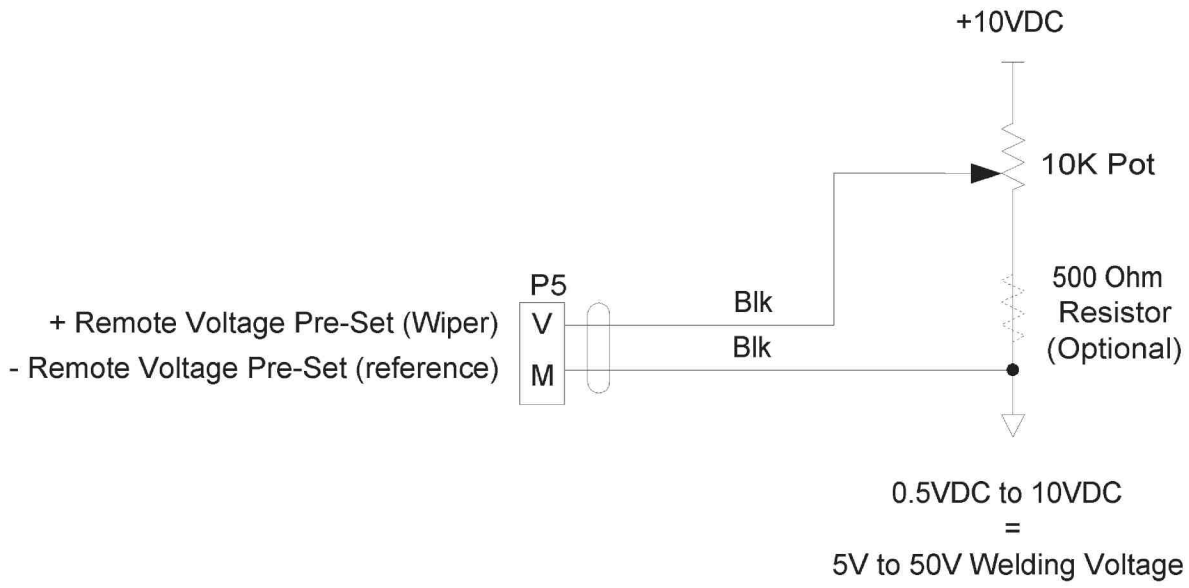


FIGURE 30 - AVC-5 REMOTE VOLTAGE SET POINT (EXTERNAL VOLTAGE)

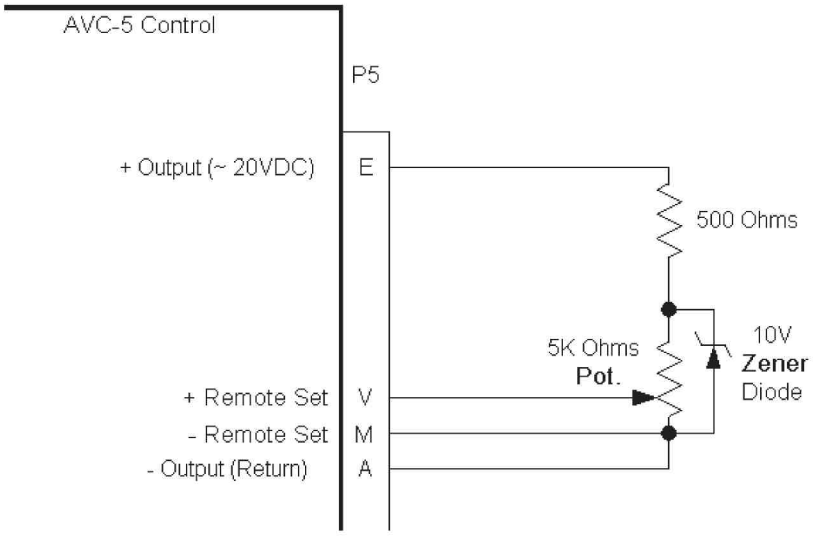


FIGURE 29 - AVC-5 REMOTE VOLTAGE SET POINT (INTERNAL VOLTAGE)

MAINTENANCE

MAINTENANCE REQUIREMENTS

AP Automation Arc Voltage Control Systems are designed for trouble-free operation and normally require only minimal preventive care and cleaning. This section of the users manual provides instructions for maintaining user serviceable items. The suggested repair procedure for all user serviceable items is to remove and replace defective assemblies or parts. Service personnel employed by the user should be familiar with electrical and electronic equipment or else service problems should be corrected by factory authorized representatives.

CONTROL UNIT ASSEMBLY

The control unit assembly (see Figure 34 - AVC-5 Control Exploded View and Table 6 - AVC-5 Control Parts List beginning on page 36) consists of an enclosure housing the major electronic assemblies of the arc voltage control system. Maintenance is generally limited to periodic dusting of the enclosure. The user should ensure that the unit is not operated with the access door open and/or cable connector mounting holes open. The user should exercise caution in operating the unit if it has been inadvertently exposed to excessive dust or liquid contamination, since such conditions may cause electrical shorting and/or malfunctioning of the electrical/electronics assemblies. The user should consult with the factory if such conditions have occurred. Repair of the control unit assembly is generally limited to a remove and replace operation.

NOTE

If the user should decide to repair unauthorized items, then the user should exercise caution when repairing the control unit subassemblies and printed circuit boards, since these repairs can void the warranty.

WARNING

When repairing the control unit assembly, disconnect A.C. power from the unit before opening the access door and turn the power switch OFF.

Assemblies and parts which are authorized for user replacement are listed in Table 6 - AVC-5 Control Parts List on page 37. Replacement should be performed after the user has determined that the part or assembly to be replaced is the cause of a system problem (see Troubleshooting on page 47).

Replacement of the fuse does not require opening the control unit; however, blowing a fuse may indicate other system problems. The fuse is replaced by unscrewing the fuse holder lid, removing and replacing the blown fuse with a new fuse. Then restore power and turn ON system to perform a test run.

Replacement of the printed circuit board, the Power Board, involves disconnecting the connectors to the board, removing the mounting screws, and replacing the Power Board with another.

The service person should exercise care in removing the Power Board to ensure that excessive force is not placed on the connectors or components on the board and that the mounting screws are not over tightened.

The Main Board is held by six screws to stand-offs mounted in the enclosure and 3 screws to standoffs mounting through the heatsink mounted to the power board. Disconnect all necessary cabling at the connection plugs provided. Remove the mounting screws and the Power Board. Install another Power board and tighten the mounting screws until snug; do not over tighten as damage to the board and enclosure standoffs may result.

Replacement of other user serviceable items is to be performed according to normal maintenance and repair standards, usually involving the removal of mounting hardware, unplugging the old part/subassembly, mounting the replacement part and reconnecting the connectors.

CABLE ASSEMBLY

Maintenance of the cable assemblies is to periodically remove dust, soot, metal particles, slag, etc., from the cable's insulation and checking for cracking in the insulation, sharp bends in the cable at the connectors. Also, check to be sure the connectors are tightened and seated correctly in their mating receptacles.

Repair of the cable assemblies is limited to replacement of defective parts. A wiring diagram of the cable assemblies is included for troubleshooting purposes (see the Schematics and Block Diagrams Section).

AVC DRIVE ASSEMBLIES

The AVC Drive assemblies maintenance should include periodic inspections for worn moving parts (e.g., drive screws and nuts, couplings). Further maintenance includes removing excess dust, weld slag, soot, etc., from the assemblies. If any connectors or parts are damaged during operation, the defective parts should be replaced as soon as practical.

Repair of the drive assemblies is limited to the replacement of defective parts and adjustment of the drive assemblies to remove play between wheels and rails or axial play between the drive screw and the bearings.

Exploded views of the drive assemblies beginning on page 42 in Figures 39, and 40and their parts lists in Tables 11, and 12 are provided to aid in parts ordering and replacement beginning on page 43.

MOUNTING BRACKETS

Each drive assembly is provided with a torch bracket for mounting the torch and other equipment to the drive assembly.

PREVENTIVE MAINTENANCE SCHEDULE

The following schedule is provided to assist in preforming timely maintenance to the system to maintain optimum performance.

Monthly Maintenance

AVC Drive Assemblies

Proper Function

There should be no play in the drive assembly throughout the entire travel of the drive. Cable connectors and strain reliefs should be tight and they should be properly seated in their mating receptacles.

Test

Clean slag, dirt and spatter from drive assembly. Verify that the drive assembly travels the full length of its stroke.

Test

Check for axial play on each axis.

Position the drive assembly in the center of its stroke. Grasp the drive assembly or torch with one hand. Try to move the torch in and out, and up and down to check for play in the drive assembly or torch mounting brackets. There should be little to no play in the drive assembly or torch bracketry.

If play is felt, troubleshoot the assembly further to determine the cause of the play and to adjust the drive or replace worn parts to remove the cause.

Quarterly Maintenance

Torch Bracket Assembly

Proper Function

Holds the torch firmly to the drive assembly.

Test

Clean dirt from bracket and torch. Check the torch to be sure it is held tight. If not, tighten bolts that hold the torch to the bracket.

Cables

Check for proper installation.

All cables should be connected tightly to the respective receptacles. Be sure that the cables do not have sharp bends in them and that the insulation of the cable is not frayed or cracked.

Semi Annual Maintenance

Control Unit Assembly

Be sure the control unit is turned off and unplugged. Using clean, dry air, blow out dust from the inside of the control unit.

Be sure all other connections in the control unit are seated firmly in their receptacles and reconnect the power cord to an electrical outlet. Turn power on and check for proper operation.

DRAWINGS AND PARTS LISTS

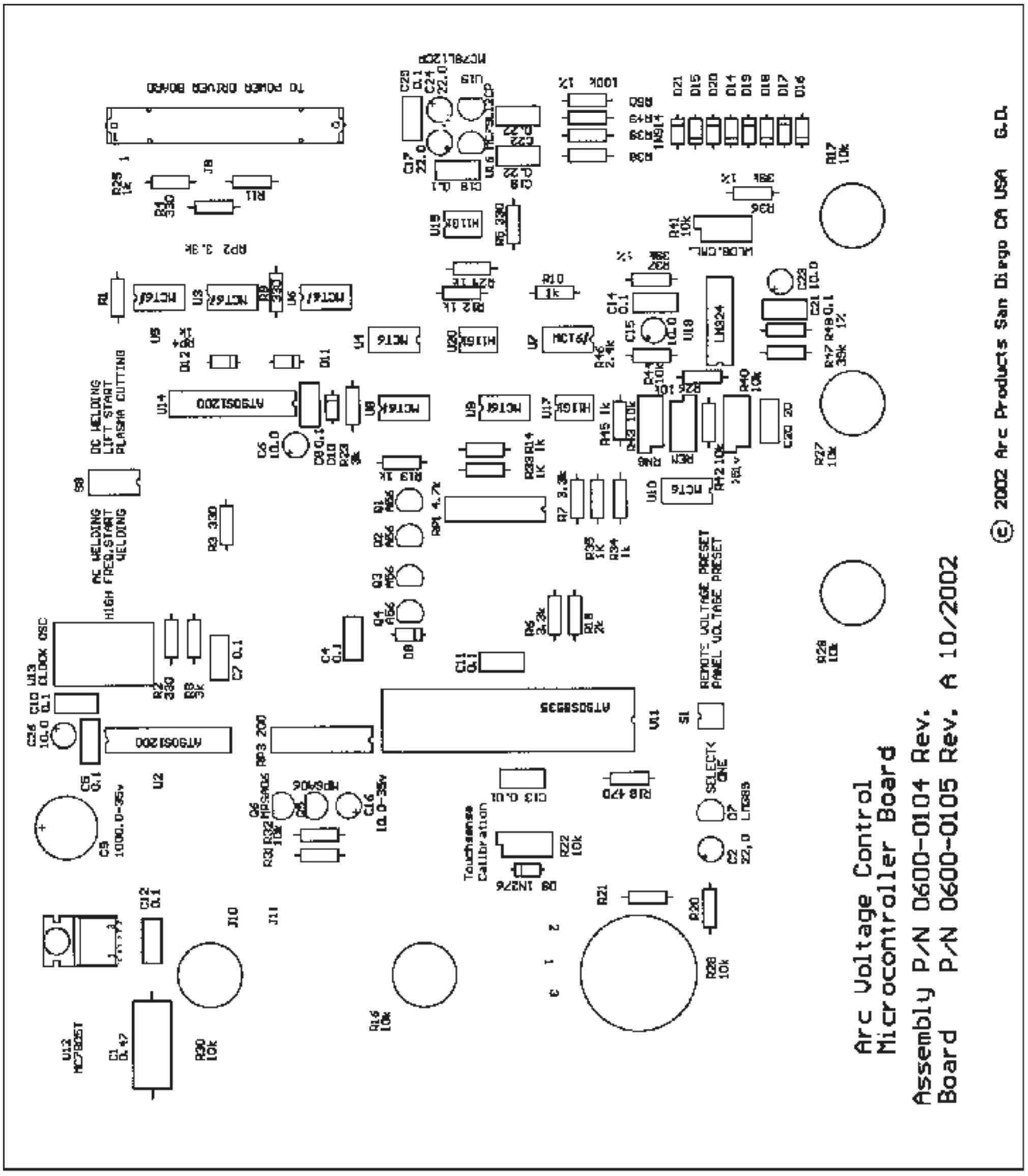


FIGURE 31 - AVC-5 MICRO-CONTROLLER BOARD LAYOUT

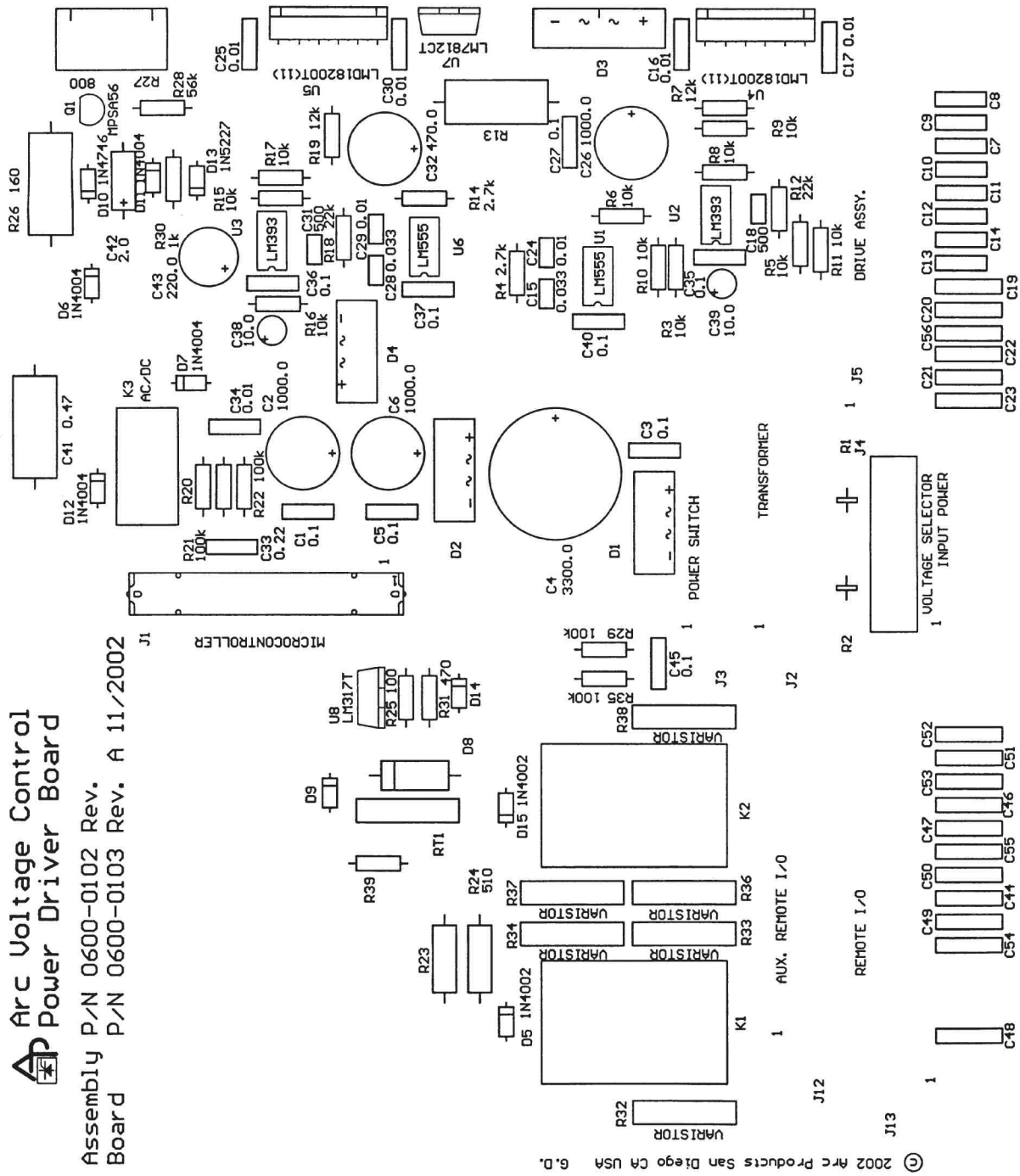


FIGURE 32 - AVC-5 POWER BOARD LAYOUT

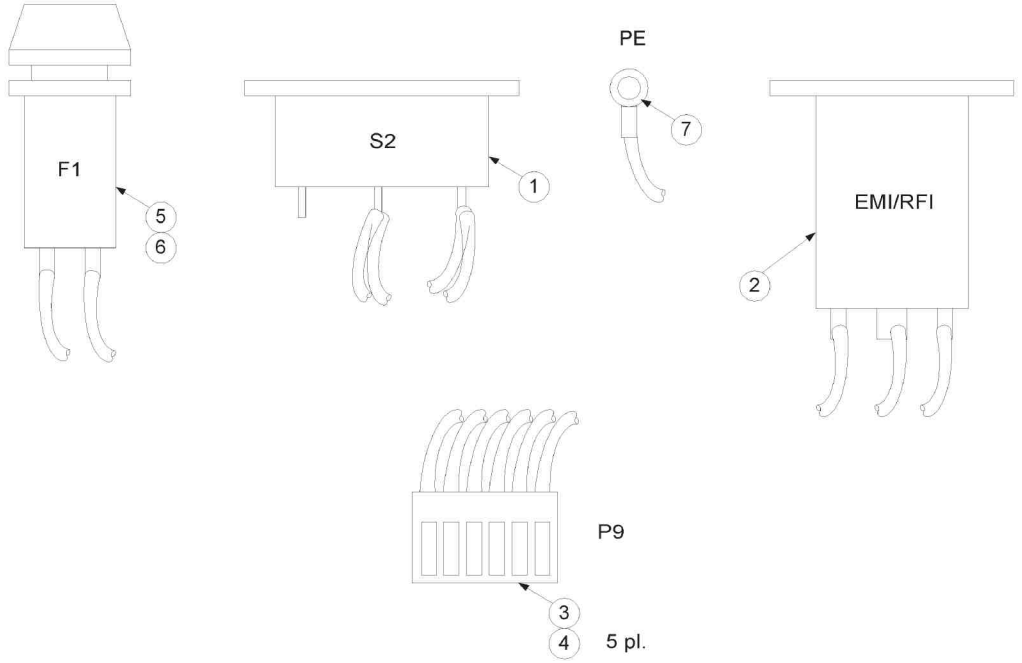


FIGURE 33 - VOLTAGE SELECTOR SWITCH ASSEMBLY EXPLODED VIEW

TABLE 5 - VOLTAGE SELECTOR SWITCH ASSEMBLY PARTS LIST

ITEM #	QPA	UM	PART NUMBER	DESCRIPTION
1	1.000	EA	920035-001	SLIDE SW 2 POS LINE VOLT SEL
2	1.000	EA	2120-0123	FILTER RFI-PWR LINE 3 AMP
3	1.000	EA	2208-0551	CONN RECT PLUG (6 PIN) .200"P
4	5.000	EA	2212-0152	TERMINAL CRIMP PIN 18-24 GA
5	1.000	EA	2120-0000	FUSE CARRIER 1/4 X 1 1/4 FEK
6	1.000	EA	2360-6087	FUSE 2.5A 250V
7	1.000	EA	2340-0618	TERM RING 1/4 22/16 RED

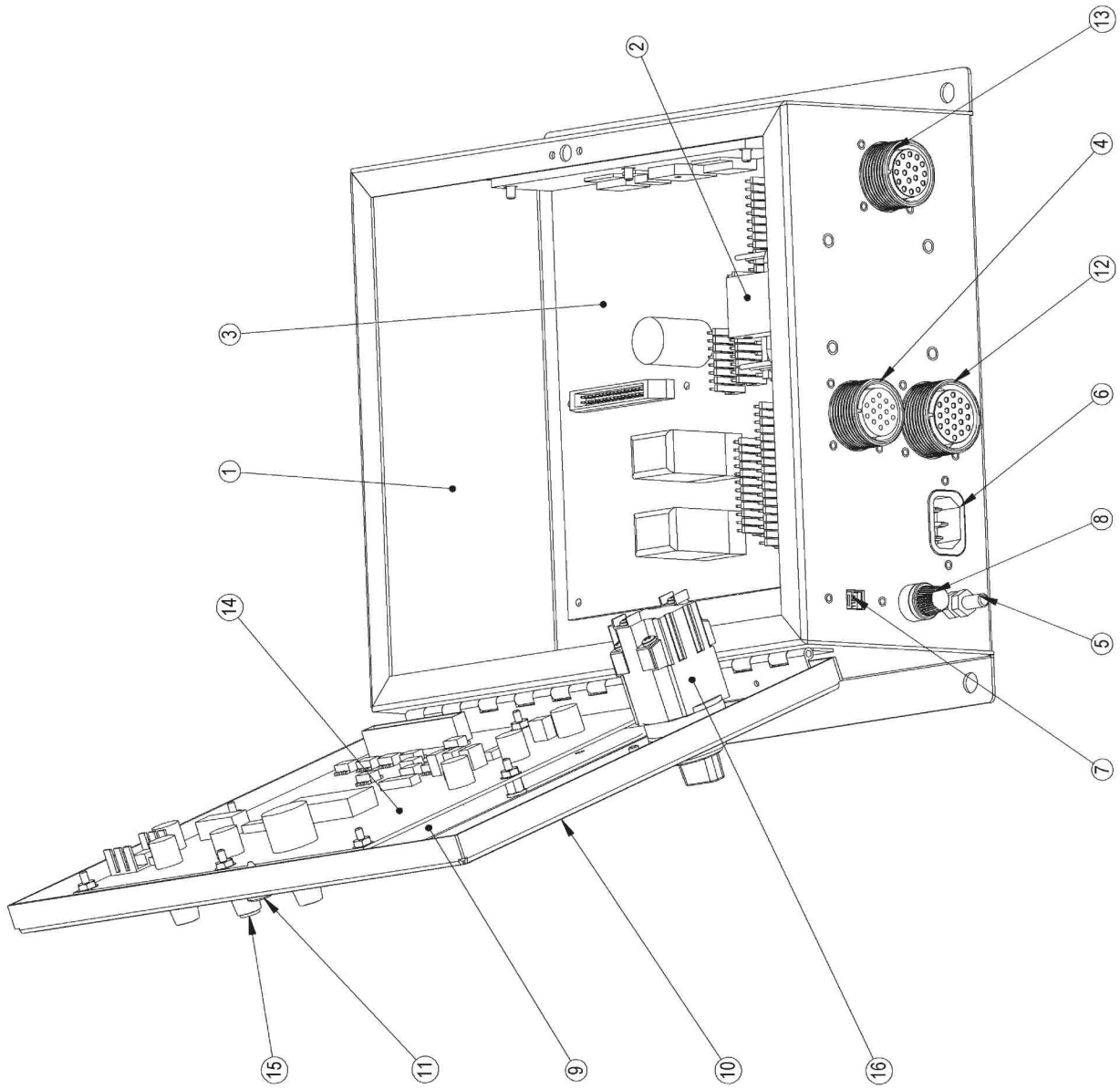


FIGURE 34 - AVC-5 CONTROL EXPLODED VIEW

TABLE 6 - AVC-5 CONTROL PARTS LIST

ITEM #	QPA	UM	PART #	DESCRIPTION
1	1.000	EA	0600-0225	CHASSIS, AVC-5 CONTROL
2	1.000	EA	0600-0354	AVC-5 TRANSFORMER ASSEMBLY
3	1.000	EA	0600-0102	AVC POWER DRIVER BOARD ASSY
4	1.000	EA	0600-0460	AVC-5 AUX REMOTE INTRFC CABLE
5	1.000	EA	970039-614	SCR 1/4-20X1.00 H SBZ G8
5	2.000	EA	974004-006	WSR, F 1/4 .734X.312X.065 SBZ
5	2.000	EA	974010-006	WSR, SL 1/4.489X.263X.062 SBZ
5	2.000	EA	972000-006	NUT, 1/4-20 H SBZ
6	1.000	EA	2120-0123	FILTER RFI-PWR LINE 3 AMP
7	1.000	EA	920035-001	SLIDE SW 2 POS LINE VOLT SEL
8	1.000	EA	2120-0000	FUSE CARRIER 1/4 X 1 1/4 FEK
9	1.000	EA	0600-0091	AVC OVERLAY PLATE
10	1.000	EA	0600-0224	DOOR & HINGE, AVC-5 CONTROL
12	1.000	EA	0600-0459	AVC-5 REMOTE INTRFC CABLE ASSY
13	1.000	EA	0600-0458	AVC-5 DRIVE CABLE ASSY
14	1.000	EA	0600-0104	AVC-5 MICROPROCESSOR BOARD ASY
15	5.000	EA	0600-0277	KNOB, SMALL AP AUTOMATION 1/8
15	1.000	EA	0600-0278	KNOB, MODIFIED TO 1/4 AP AUTO
16	1.000	EA	0600-0371	POWER SWITCH ASSEMBLY
17	1.000	EA	0600-0238	SPACER,ALUM 140X.25X.25

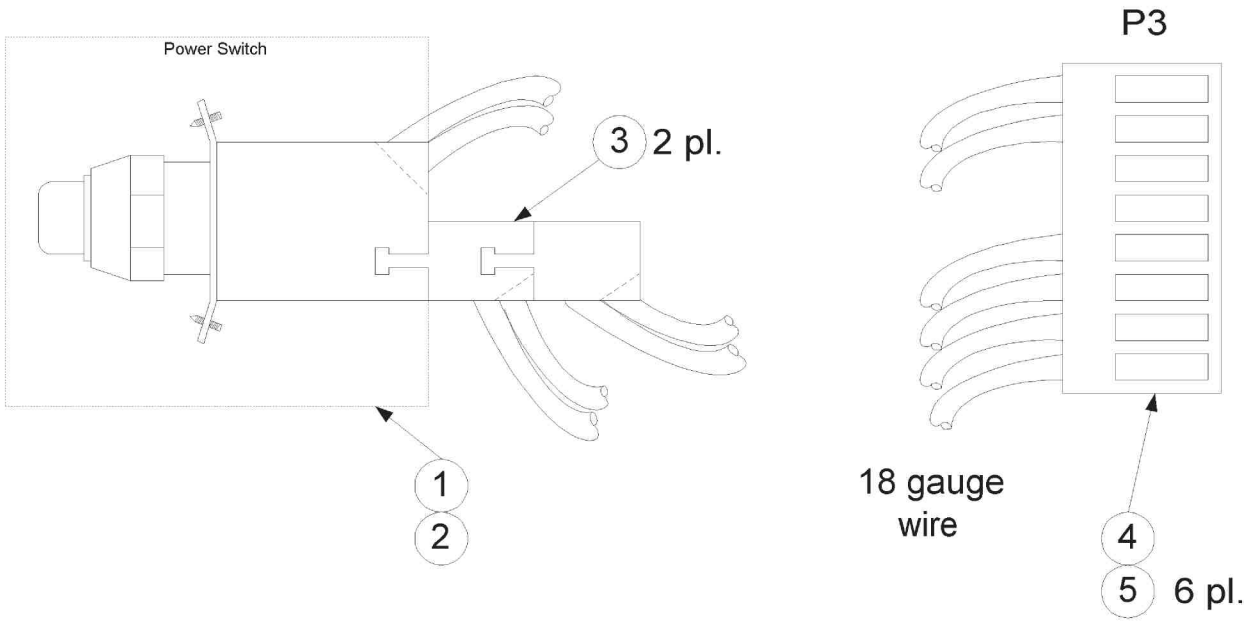


FIGURE 35 - POWER SWITCH ASSEMBLY EXPLODED VIEW

TABLE 7 - POWER SWITCH ASSEMBLY PARTS LIST

ITEM #	QPA	UM	PART NUMBER	DESCRIPTION
1	1.000	EA	2066-0171	SWITCH, SELECT 1-3/16 RED
2	1.000	EA	2100-0086	INCANDESCENT LAMP, ½ 28V
4	1.000	EA	2208-0181	CONN RECT PLUG (8CKT)
5	6.000	EA	2212-0018	TERMINAL CRIMP PIN 18-24 GA

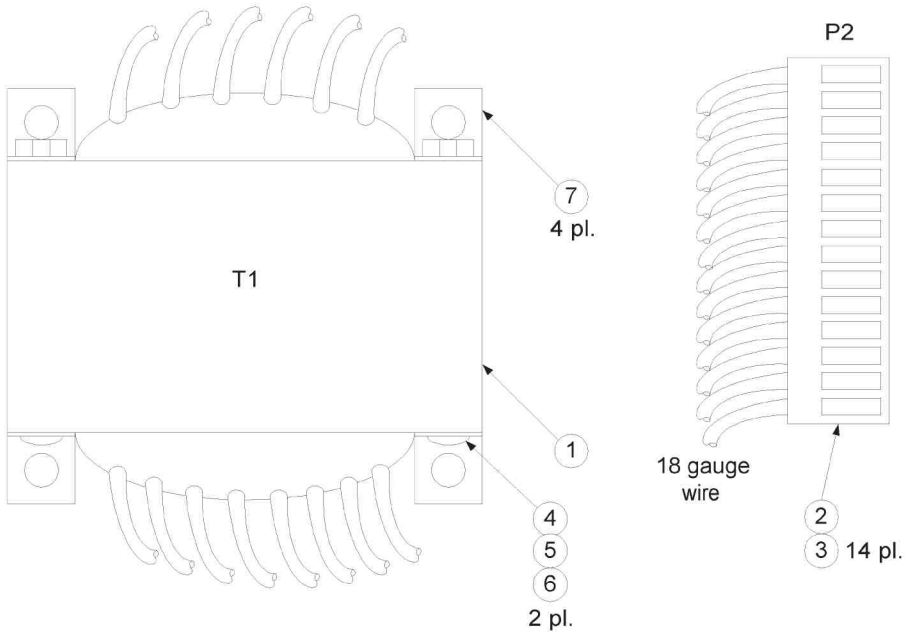


FIGURE 36 - TRANSFORMER ASSEMBLY EXPLODED VIEW

TABLE 8 - TRANSFORMER ASSEMBLY PARTS LIST

ITEM #	QPA	UM	PART NUMBER	DESCRIPTION
1	1.000	EA	1037-0061	XFRMR 115/230VAC,DUAL PRIMARY QUAD SECONDARY
2	1.000	EA	2208-0211	CONN RECT PLUG (14CKT)
3	9.000	EA	2212-0158	TERMINAL CRIMP PIN 18-24 GA
4	2.000	EA	970000-426	SCR 8-32X2.50 CR1P SBZ
5	2.000	EA	972001-004	NUT 8-32 FH SBZ SL GB
6	2.000	EA	974010-004	WSR, SL #8.293X.175X.040 SBZ

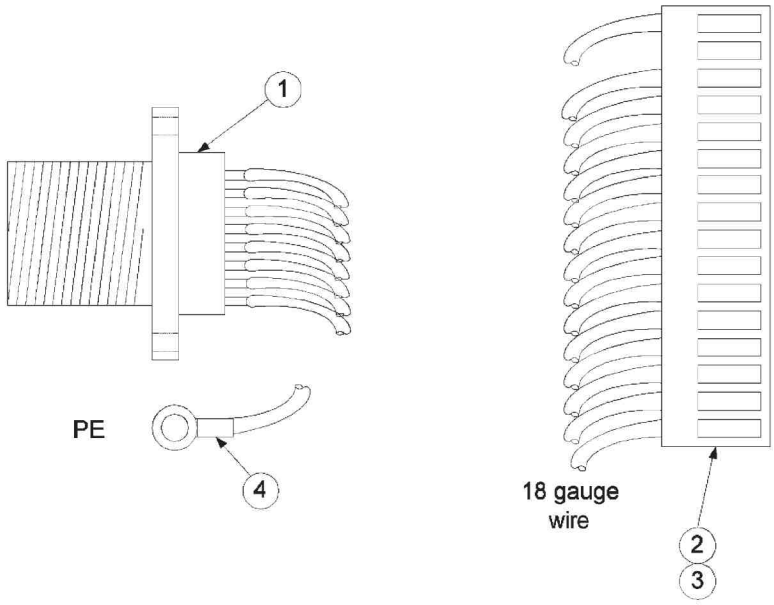


FIGURE 37 - AVC DRIVE CABLE ASSEMBLY EXPLODED VIEW

TABLE 9 - AVC DRIVE CABLE ASSEMBLY PARTS LIST

ITEM #	QPA	UM	PART #	DESCRIPTION
1	1.000	EA	930014-014	CONN CIRC BOX RCPT 20-29S
2	1.000	EA	2208-0116	TERMINL HOUSING (16PIN) .156"P
3	16.000	EA	2212-0018	TERMINAL CRMP MOLEX 18-20 .156
4	1.000	EA	2340-0588	TERM RING INSUL #6 X .92 LG
5	3.000	EA	979001-001	CABLE TIE .75 BUNDLE DIA
6	0.400	EA	ZZLABOR	SHOP LABOR

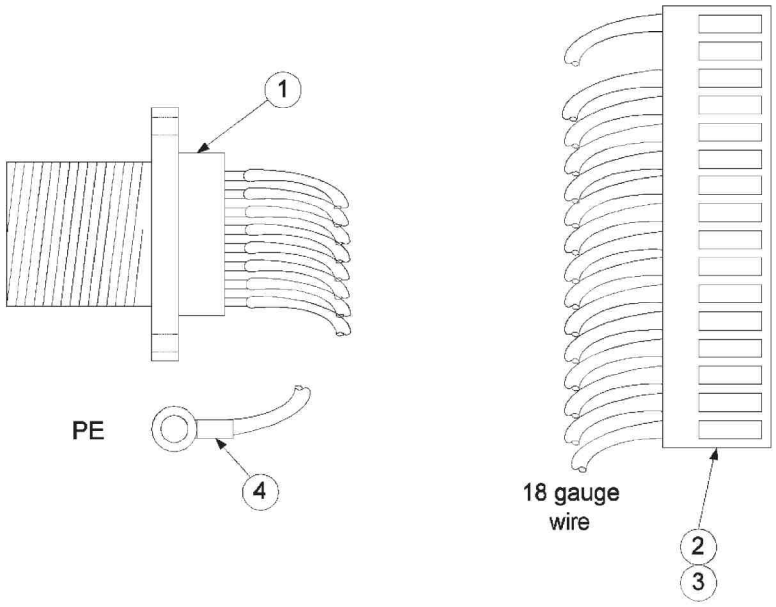


FIGURE 38 - AVC REMOTE INTERFACE CABLE EXPLODED VIEW

TABLE 10 - AVC REMOTE INTERFACE CABLE PARTS LIST

ITEM #	QPA	UM	PART #	DESCRIPTION
1	1.000	EA	930014-015	CONN CIRC BOX RCPT 22-14S
2	1.000	EA	2208-0117	TERMINL HOUSING (18PIN) .156"P
3	18.000	EA	2212-0018	TERMINAL CRMP MOLEX 18-20 .156
4	1.000	EA	2340-0588	TERM RING INSUL #6 X .92 LG
5	3.000	EA	979001-001	CABLE TIE .75 BUNDLE DIA
6	0.400	EA	ZZLABOR	SHOP LABOR

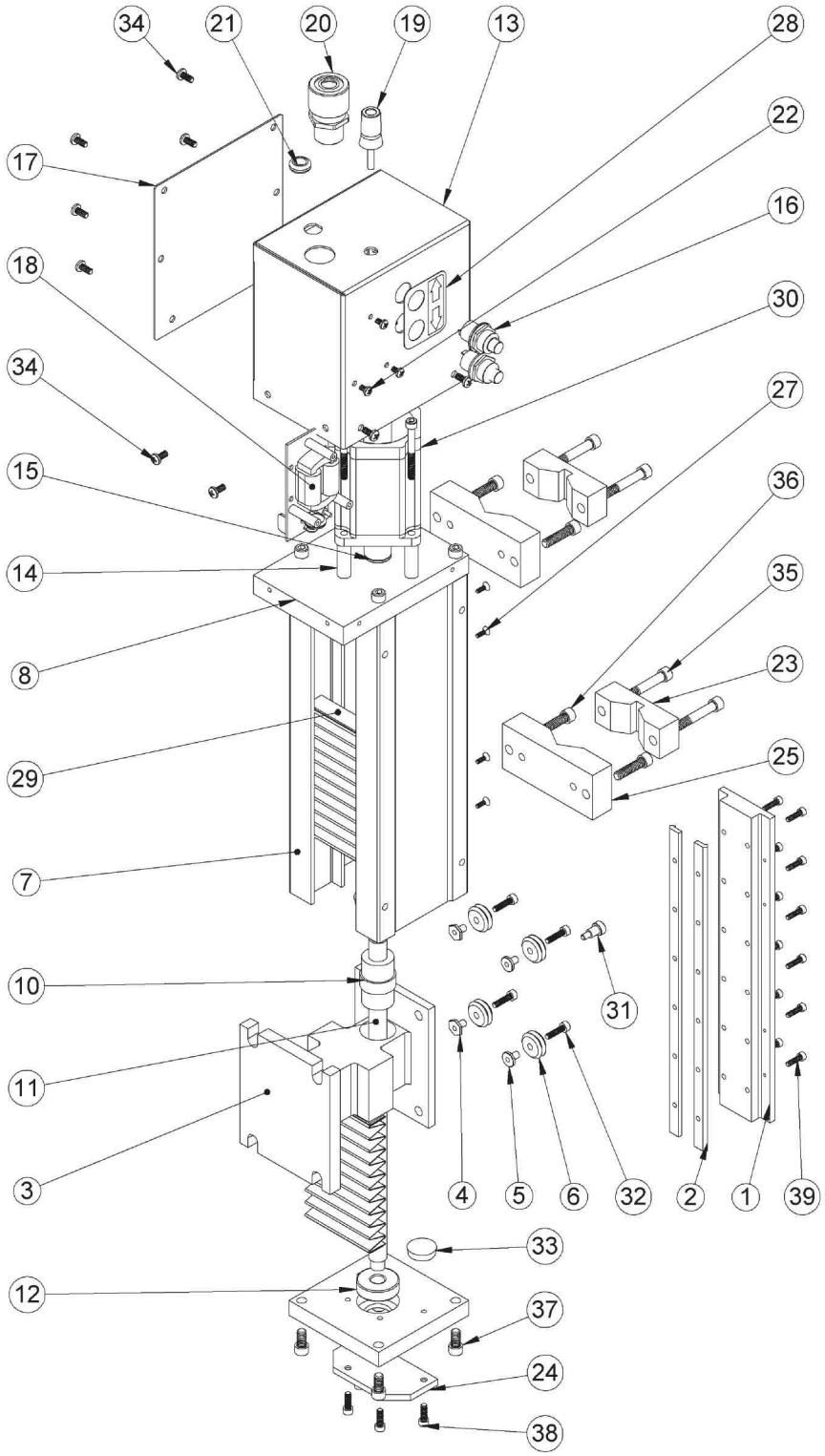


FIGURE 39 - AVC-5 STANDARD DRIVE ASSEMBLY EXPLODED VIEW

TABLE 11 - AVC-5 STANDARD DRIVE ASSEMBLY PARTS LIST

ITEM #	QPA	UM	PART #	DESCRIPTION
1	1.000	EA	0600-0010	AVC RAIL BASE
2	2.000	EA	0600-0011	AVC-5 RAIL 6" STROKE
3	1.000	EA	0600-0012	AVC DRIVE SLIDER
4	2.000	EA	0600-0014	SUPPORT BUSHING ADJUSTABLE
5	2.000	EA	0600-0015	SUPPORT BUSHING FIXED
6	4.000	EA	0600-0016	W-1 DUALVEE WHEEL
7	1.000	EA	1050-0613	BODY DRIVE AVC-4
8	1.000	EA	0600-0017	AVC TOP PLATE
9	1.000	EA	0600-0018	AVC BOTTOM PLATE
10	1.000	EA	1046-0492	NUT ASSY DRIVE
11	1.000	EA	0600-0019	AVC-5 DRIVE SCREW
12	2.000	EA	2320-0333	BEARING BALL RADIAL
13	1.000	EA	1052-0142	JUNCTION BOX DRIVE AVC
14	4.000	EA	2040-1192	SPACER .375X.194X1 1/8 LG A
15	1.000	EA	0600-0226	HELICAL COUPLING .25X.312X.625
16	2.000	EA	2062-0072	SWITCH PUSH BUTTON BLACK
17	1.000	EA	0600-0368	AVC JUNCTION BOX COVER
18	1.000	EA	1042-0041	BD ASSY AVC PROTECT CKT PC
19	1.000	EA	2340-1126	POST BINDING 8-32 30A/1KV BLK
20	1.000	EA	1054-0178	CABLE ASSY AVC DRV 8.5FT
21	1.000	EA	976000-007	GROMMET RUBBER 1/4IDX9/16 OD
22	3.000	EA	970000-304	SCR 6-32X.38 CR1P SBZ
23	2.000	EA	1110-1445	CLAMP - GTA TORCH
24	1.000	EA	1050-0801	END PLATE AVC-4 DRIVE
25	2.000	EA	1110-1453	CLAMP BASE - GTA TORCH
26	3.000	FT	2140-0301	CABLE HI VOLT 18 AWG (NOT SHOWN)
27	8.000	EA	970010-204	SCR 4-40X.38 CR1F SBZ
28	1.000	EA	1035-0450	PLATE LEGEND-UP DOWN
29	2.000	EA	1057-0212	CURTAIN BELLOWS
30	1.000	EA	2300-0406	MOTOR ASSY STEPPER AVC-5 DRV
31	1.000	EA	1050-0806	SCREW SHOULDER AVC-4 DRIVE
32	4.000	EA	0600-0040	SCREW M4 X 16MM SCH BLK
33	4.000	EA	0600-0457	VINYL BUMPER ADHESIVE BACKED
34	12.000	EA	970000-404	SCREW 8-32X.38 CR1P SBZ
35	4.000	EA	970015-622	SCREW 1/4-20 X 2.00 HSC SBZ
36	8.000	EA	970015-614	SCR 1/4-20X1.00 HSC SBZ
37	8.000	EA	970015-608	SCR 1/4-20X.62 HSC SBZ
38	4.000	EA	970015-520	SCR 10-32X1.75 HSC SBZ
39	12.000	EA	0600-0039	SCREW M3 X 12MM SCH BLK
40	3.000	EA	974010-003	WSR SL #6.250X.148X.031 SBZ (NOT SHOWN)
41	1.000	EA	2410-0472	NUT LOCK CONDUIT 1/2INCH (NOT SHOWN)

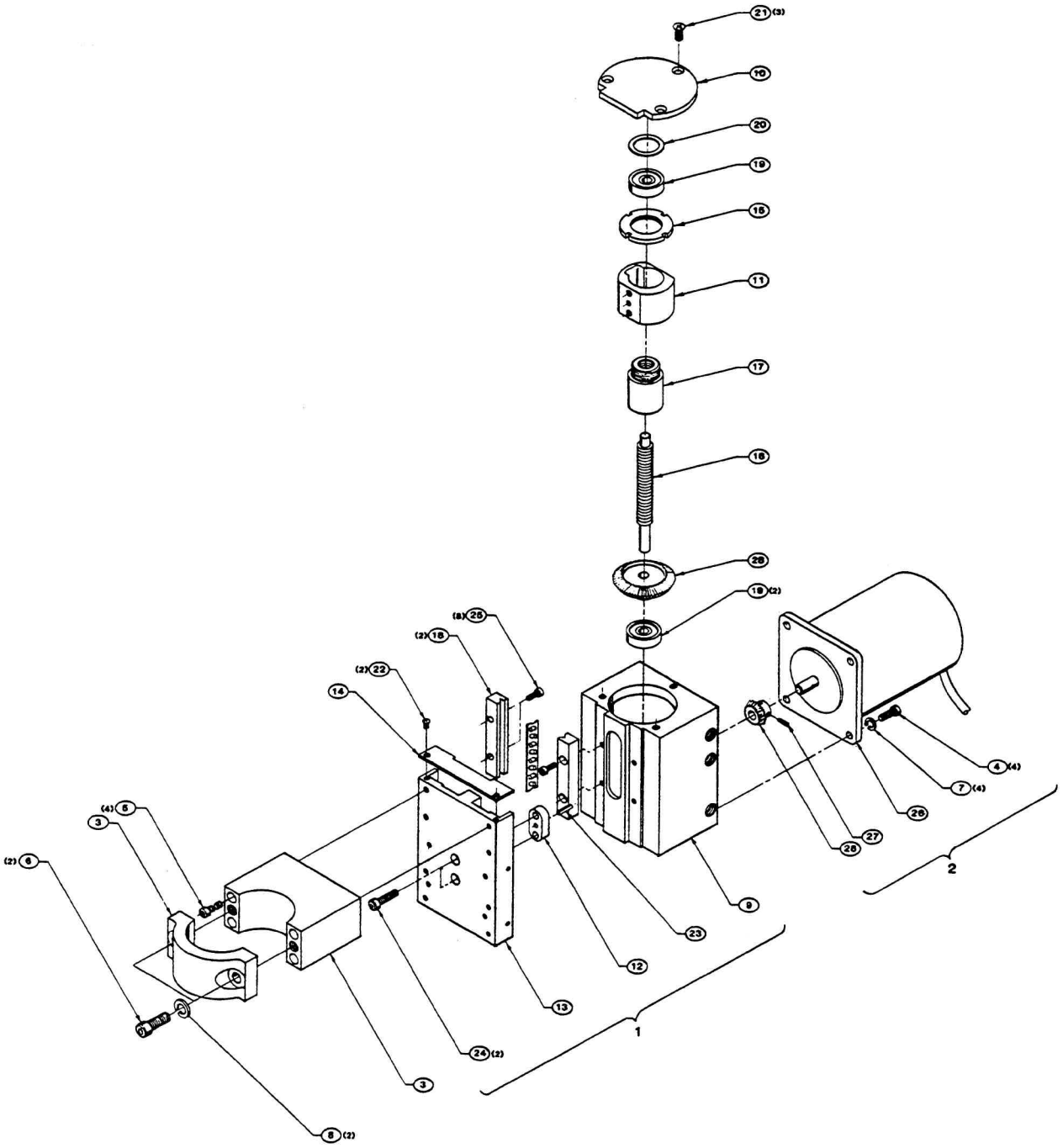


FIGURE 40 - AVC-5 COMPACT DRIVE ASSEMBLY EXPLODED VIEW

TABLE 12 - AVC-5 COMPACT DRIVE ASSEMBLY PARTS LIST

ITEM #	QPA	UM	PART #	DESCRIPTION
1	1.000	EA	1046-0069	HOUSING ASSY 1 IN STROKE
2	1.000	EA	1046-0077	MOTOR ASSY-1IN STROKE
3	1.000	EA	1050-0222	CLAMP TORCH, 1 IN STROKE
4	4.000	EA	970015-508	SCR 10-32X.62 HSC SBZ
5	1.000	EA	2208-0725	CONN RECT PLUG (8CKT) (NOT SHOWN)
5	4.000	EA	970015-314	SCREW, 6-32 x 1.00, HSC SBZ
6	2.000	EA	970015-612	SCR 1/4-20X.88 HSC SBZ
7	4.000	EA	974010-005	WSR SL #10 .334X.202X.047 SBZ
8	1.000	EA	930014-401	CONN CIRC BUSHING .220 ID
8	2.000	EA	974010-006	WSR, SL 1/4.489X.263X.062 SBZ
9	1.000	EA	1050-0150	HOUSING 1IN STROKE
10	1.000	EA	1050-0184	COVER, HOUSING, 1IN STROKE
11	1.000	EA	1050-0168	SUPPORT, BALLNUT, 1IN STR
12	1.000	EA	1050-0176	SPACER, BALLNUT, 1IN STR
13	1.000	EA	1050-0192	SLIDE HOUSING, 1IN STROKE
14	1.000	EA	1050-0214	PLATE SLIDE END, 1IN STR
15	1.000	EA	1056-0225	LOCK NUT, BALL SCREW, 1IN
15	2.000	EA	970043-300	SCR SET 6-32X.12 HHC SBZ
16	1.000	EA	1046-0085	BALL SCREW ASSY, 1IN STR
17	1.000	EA	2320-0104	BALLNUT SBN
18	1.000	EA	2320-0384	SLIDE CROSSED BRG
19	2.000	EA	2320-0325	BEARING BALL RADIAL
20	2.000	EA	974031-201	WSR F .735X.627X.032 B
20	1.000	EA	1055-0645	DECAL UP ARROW-C-AVC (NOT SHOWN)
21	3.000	EA	970010-304	SCR 6-32X.38 CR1F SBZ
22	2.000	EA	970000-102	SCREW, 4-40 x 3/16 S.Steel
23	1.000	EA	979002-005	PIN SPR .093X.375 S
24	2.000	EA	970015-308	SCR 6-32X.62 HSC SBZ
25	8.000	EA	970015-005	SCR 5-40X.31 HSC SBZ
26	1.000	EA	1057-0158	MOTOR STEPPER
27	1.000	EA	2360-0625	PIN ROLL .093 DIA X .500 LG
28	2.000	EA	2320-0228	GEAR BEVEL SET 1:3 48P (MATCHED SET)

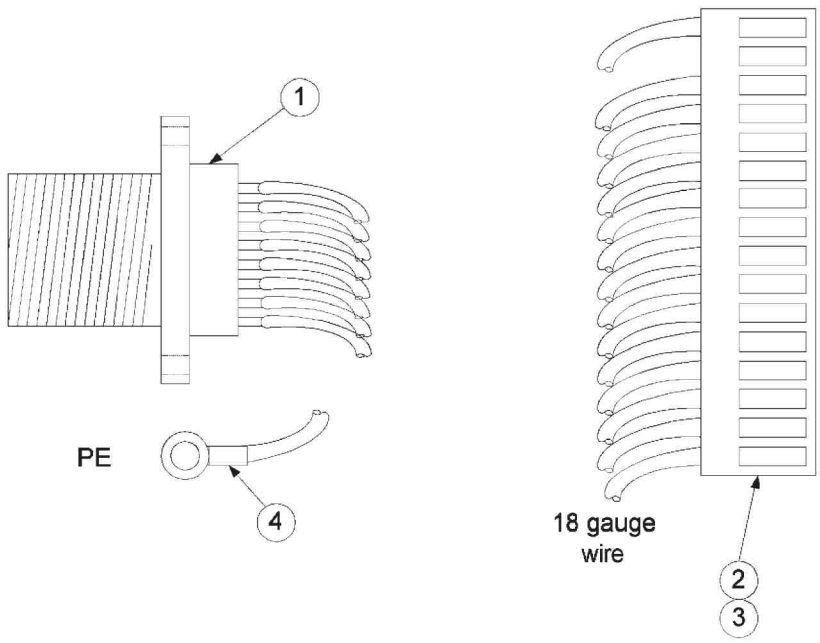


FIGURE 41 - AVC AUX REMOTE INTERFACE CABLE EXPLODED VIEW

TABLE 13 - AVC AUX REMOTE INTERFACE CABLE PARTS LIST

ITEM #	QPA	UM	PART #	DESCRIPTION
1	1.000	EA	930014-001	CONN CIRC BOX RCPT 20-27S
2	1.000	EA	2208-0114	TERMINL HOUSING (12PIN) .156"P
3	12.000	EA	2212-0018	TERMINAL CRMP MOLEX 18-20 .156
4	1.000	EA	2340-0588	TERM RING INSUL #6 X .92 LG
5	3.000	EA	979001-001	CABLE TIE .75 BUNDLE DIA
6	0.400	EA	ZZLABOR	SHOP LABOR

TROUBLESHOOTING

The following list describes typical problems and suggested corrective procedures.

The CIRCUIT DESCRIPTIONS section, which includes block diagrams and schematics, will also be a helpful reference for troubleshooting.

Full line voltage is exposed inside the control unit.

Do not turn power "ON" when the Power board is removed, partially removed or disconnected.

Many of the Integrated Circuits (IC's) on the Main board are CMOS logic, and require standard CMOS precautions against damage by static electricity discharge.

RECOMMENDED SPARES FOR TROUBLESHOOTING

This manual was written in a manner to provide enough detail to identify individual components, parts, and subassemblies for maintenance purposes. A recommended spare parts lists is given in Table 17 - Recommended Spare Parts on page 49. For troubleshooting, the following items are recommended to isolate most problems.

TABLE 14 - TROUBLESHOOTING

PROBLEM #	DESCRIPTION	CAUSE	SOLUTION
Problem 1	Lamp is not lit	• Unit unplugged • Blown Fuse • Lamp is bad	• Plug unit into an appropriate AC Source • Replace Fuse • Replace Lamp
Problem 2	Power Switch and Indicator Lamp are ON, but nothing works	• Cables disconnected from the control to other components of the system • Connectors are disconnected inside the control • Power Driver Board voltages are not present	• Check cables from the control to other components of the system • Check connectors inside the control unit • Check Power Driver Board voltage +12VDC
Problem 3	Drive assembly doesn't drive up or down in Manual Mode only	• Drive may be at its stroke limits • Drive may be binding due to too much weight on the drive assembly • Mounting hardware or other obstruction is interfering with the drive movement	• Jog the drive in the opposite direction • Remove weight from the drive assembly • Verify drive is free and clear to move up and down
Problem 4	AVC-5 System doesn't track and compensate for voltage changes in Automatic Mode	• Deaband and Sensitivity Adjustments are not set properly • Lockout is Enabled (Lockout LED is Lit) • Burn-Through Detection has been initiated (Protect LED is not lit)	• Adjust Deadband and Sensitivity settings to a more accurate setting, i.e., Deadband more CounterClockwise and Sensitivity more Clockwise • Press the Lockout Button to Disable the Lockout Feature and/or check the remote interface cables to remove remote Lockout Input • Adjust Deadband and Sensitivity settings to a less accurate setting, i.e., Deadband more Clockwise and Sensitivity more CounterClockwise
Problem 5	AVC-5 System doesn't preform a starting arc gap, i.e., Touchsense Feature	• The System is set up for Lift-Start Welding Mode • The tungsten is contaminated or the work is dirty • The ground sense lead or the red voltage sense lead is not connected to the drive assembly • The Touchsense calibration needs adjustment	• Change the system to HF Start Mode (see Figure 13 - HF Start Mode and AC Welding and Figure 14 - HF Start Mode and DC Welding on page 17) • Clean the tungsten and workpiece as necessary • Verify the leads are connected to the drive assembly • Adjust the Touchsense Calibration as necessary (page 24)

PROBLEM #	DESCRIPTION	CAUSE	SOLUTION
Problem 6	AVC-5 System doesn't track or show voltage on the front panel while wedling	• System is set for the wrong Mode, i.e., Welding with a DC and AVC-5 set for AC Mode or vice-versa • Sense leads are not connected or are loose • Voltage Preset is improperly set	• Verify the AVC-5 System is set up for the correct welding mode • Check the sense leads are securely connected • Verfiy the Voltage Preset is set between 5 to 50VDC while pressing the Preset button
Problem 7	The arc doesn't start using Lift-Start Mode on the AVC-5 System	• Power Source is not set for Lift-Start mode • Not enough Tungsten Pre-Heat Time on the AVC-5 to account for prepurge and tungsten preheat, causing the AVC-5 to drive up before the power source starts producing Lift-Start amperage • Too much Tungsten Preheat Time set on the AVC-5 causing the power source to time out in Lift-Start while the tungsten is in contact with the workpiece	• Verify the power source is set for Lift-Start arc starting • Increase the Tungsten Pre-Heat Time to include the gas pre-purge and to allow approximately 2 seconds of Tungsten Pre-Heat (as a starting point) • Decrease the Tungsten Pre-Heat Time so that the power source begins producing Lift-Start amperage while the tungsten is in contact with the workpiece
Problem 8	AVC-5 System doesn't preform a starting arc gap once the tungsten touches the workpiece, i.e., Touchsense Feature, but does drive up after the down drive signal is removed	• The Tungsten is contaminated or the work is dirty • The Touchsense calibration needs adjustment	• Clean the tungsten and workpiece as necessary • Adjust the Touchsense calibration as necessary (page 24)
Problem 9	System continuously drives up when the weld power leads are connected to the voltage sense leads on the AVC Drive	• Touchsense is out of calibration, i.e., the power source may have a low output impedance causing the AVC-5 System to sense a short between the tungsten and the workpiece	• Adjust the Touchsense calibration until the AVC-5 System stops driving up (page 24)
Problem 10	AVC-5 System shuts down the arc as soon as the arc is started	• Not enough Start Delay Time set on the AVC-5 to allow for the arc to establish and become stable • Deadband is set to narrow, causing the Burn-Through Protection Feature to be initiated • Starting Arc Gap is set to high causing the arc to start at a higher voltage than the Voltage Preset	• Increase the Start Delay Time to allow the arc to become stable and to allow Upslope of the welding amperage to complete • Increase the Deadband setting (Clockwise) to prevent the Burn-Through Protection Feature from being initiated • Decrease the Starting Arc Gap to a smaller gap preventing the arc from starting at a higher voltage above Preset, preventing the Burn-Through Protection Feature from being initiated

TABLE 15 - VOLTAGE POINTS MICRO-CONTROLLER BOARD

TP #	DESCRIPTION	VALUES
U18-11	-12 VDC	-12 VDC ±0.50 VDC
U18-4	+12 VDC	+12 VDC ±0.50 VDC
U11-10	+5 VDC	+5 VDC ±0.50 VDC
C1 (-)	Ground Reference	Ground

TABLE 16 - VOLTAGE POINTS POWER DRIVER BOARD

TP #	DESCRIPTION	VALUES
R13 (Bottom)	+40VDC	+40VDC ±1.00VDC
R13 (Top)	+25VDC	+25VDC ±1.00VDC
D5 Cathode	+20VDC	+20VDC ±1.00VDC
D15 Cathode	+20VDC	+20VDC ±1.00VDC
U3-8	+12VDC	+12VDC ±0.50VDC
C41 (-)	Ground Reference	Ground

TABLE 18 - VOLTAGE PRESET SELECTION (S1)

POS #	PANEL MODE	REMOTE MODE
1	OFF	ON
2	ON	OFF

TABLE 17 - RECOMMENDED SPARE PARTS

ITEM #	QTY	PART #	DESCRIPTION
1	2	1373-3041	Fuse, 2 Amps
2	1	2100-0086	Power Lamp
3	1	0600-0304	Micro-Controller Board Assembly
4	1	0600-0102	Power Board Assembly
5	1	2068-0161	Power Switch
6	1	2068-0078	Contact Blocks

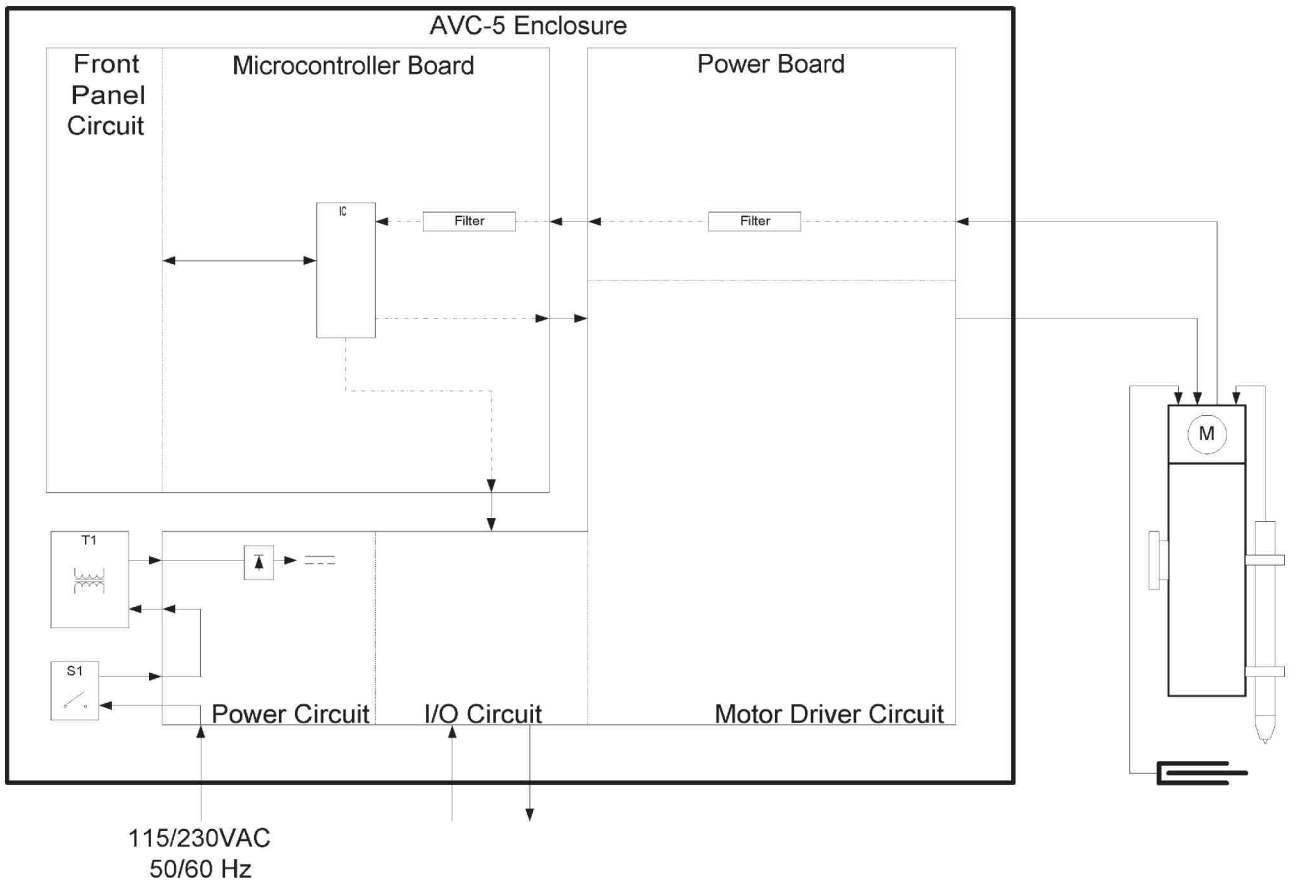


FIGURE 42 - AVC-5 SIGNAL FLOW

CIRCUIT DESCRIPTIONS

WARNING

For use by Qualified Service Technicians

SYSTEM WIRING DIAGRAM

The Figure 44 - AVC-5 Control Block Diagram and Figure 45 - AVC-5 Control Block Diagram (Cont.) beginning on page 58 is a circuit diagram of the entire AVC-5 Arc Voltage Control system. These diagrams include detailed schematics of all portions of the system except the Power Board and Micro-Controller Board assemblies. Schematics of the AVC-5 drive and Compact Drive assemblies are shown as well.

The Figures 44 and 45 show all wires and connector pins in the interfaces between the various assemblies in the control unit. Figure 34 - AVC-5 Control Exploded View on page 36 and Table 6 - AVC-5 Control Parts List on page 37 identifies the major assemblies. Parts lists for each assembly are also included in the DRAWINGS AND PARTS LISTS section beginning on page 33.

POWER DRIVER BOARD ASSEMBLY

This section will describe generally the circuitry, signal flows and test points on the Main board to assist in a better understanding and more effective and accurate troubleshooting of the system. The Figure 32 - AVC-5 Power Board Layout on page 34 is a drawing of the board to assist in placement of the Test Points for better understanding and troubleshooting. In addition to the board layout drawing, on page illustrates very simply the flow of signals in the AVC-5 control system.

The Power board contains control circuitry for the system and also performs primary input voltage and control voltage regulation. Input voltage to the control unit is supplied to the Power board through a fuse and Radio Frequency Interference and Electro-Magnetic Interference (RFI/EMI) filter and voltage selector switch mounted on the bottom of the enclosure. The system will operate from 110/220 VAC, 50/60 Hz at less than 3 amps input power.

The voltage into the control unit is brought to the Main board and is then routed through the power On/Off switch located on the door of the enclosure. Once the switch is in the On position, voltage is passed through the transformer to step down the primary input voltage to approximately 28VAC with a Center Tap (two secondaries at 14VAC), a 16VAC secondary winding, a 18VAC/31VAC tapped secondary, and a 10VAC secondary winding (used for the Microcontroller board discussed later beginning on page 51).

The voltage is rectified on the board and filtered through electrolytic capacitors. The resultant +40VDC and +25VDC is used as the source voltage for the motor driver circuit. All voltages are referenced to power ground at C41 (minus side).

MICRO-CONTROLLER BOARD ASSEMBLY

The following will describe in basic terms how the AVC-5 Control system functions, beginning from the sensing of the arc voltage, Comparative circuit and to the stepper motor drivers.

The Micro-controller board is, as the name implies, the primary controller of the AVC-5 System. The Arc Voltage Preset circuit uses an analog to digital converter built-in to the mircro-controller IC and a potentiometer to determine the desired arc voltage. Likewise, the Deadband, Sensitivity, Retract, Start Delay, and the Starting Arc Gap/Tungsten Pre-heat Features all incorporate this same method of communication with the micro-controller.

Additionally, DIP Switches are also incorporated to set other process selections to the micro-controller, i.e., AC verses DC Welding, Lift-Start verses High-Frequency Start methods, and Local or Remote Voltage Preset selections.

The micro-controller, running at a 4MHz clock frequency, is programmed with the logic required to control the welding process for the AVC-5. The micro-coontroller board communicates to the outside world via LED's, seven-segment LED digital display, and relays to control other related welding equipment, e.g., welding power source contactor, carriage start, wire feed start, etc.

In simplistic terms, the AVC-5 is a modified digital voltmeter. While welding, the AVC-5's microcontroller board is monitoring the actual arc voltage and making discisions to move the torch up or down in order to keep the actual arc voltage at the desired voltage preset by the operator. If the actual arc voltage drops below the preset voltage, the Micro-controller drive the torch upward until the actual arc voltage is at the desired voltage level. Likewise, if the actual arc voltage goes up, the AVC-5 will drive downward to keep the actual arc voltage at the desired level.

The actual arc voltage is brought to the micro-controller through the Power board through several filters to reject noise and to steady the typically erractic arc voltage. The voltage is also scaled down to an ac-

ceptable level for the micro-controller IC. Once to the micro-controller, the voltage is received on an analog to digital converter input on the IC. The voltage is monitored and compared to arc voltage preset selected by the operator and decisions are made maintain the desired arc voltage.

Throughout the process, relays are energized and/or de-energized depending upon the start method, AC or DC welding, and other setup parameters selected by the operator.

Motor Driver Circuit

The motor driver circuit is made up primarily of a single IC used to drive the motor. The motor is a stepper type (not a DC motor). The driver circuit then pulses the motor in a certain pattern to drive the rotate the motor clockwise or counter-clockwise depending upon the direction of travel needed. The drive motor pulses are generated by the micro-controller IC and passed to the driver circuit.

Remote Voltage Preset Circuit

The remote voltage preset circuit uses an exact duplicate of the circuit used to measure the actual arc voltage. There is a scalar potentiometer used to adjust the input voltage from the operator's output circuit to an acceptable level for the micro-controller. For example, the operator's output voltage may be 0 to 15 VDC. The system can be scaled to adjust this remote preset voltage to be equal to 5 to 50VDC.

EXAMPLE SYSTEM INTERFACE

AVC-5 SYSTEM INTERFACE EXAMPLE

The following describes the design and interface intent and the operation of the system of Figure 50 - AVC-5 System Interface Example beginning on page 64.

DESIGN INTENT

The design intent of the example interface wiring of the AVC-5 and other equipment in the diagram is to provide a sample interface for typical TIG applications using an AVC-5 Arc Voltage Control System. The basic components of the complete welding system is illustrated in the diagram, and include the following:

- Welding Power Source with Automation Interface Capability
- Cyclomatic DWF-3 or AP Automation DWF-4 Cold Wire Feed System
- Cyclomatic Model 80A or an AP Automation MA-20 Magnetic Arc Control System
- An output connection for a carraige controller
- And a front panel for control switches and potentiometers that can be used as a console for the operator.

With this interface and the components described, the customer can control the welding system from start to finish without the need for additional, and sometimes costly, system controllers.

INTERFACE INTENT

The interfce intent of this example is to have the remote interface cables brought into the interface enclosure and immediately terminate to a terminal strip.

TABLE 19 - AVC-5 SETUP PARAMETERS

PARAMETER	SETTING
Welding Mode	DC Welding
Starting Mode	Lift-Start
Tungsten Preheat Time	1.5 seconds
Start Delay Time	3 seconds
Deadband Adjustment	40%
Sensitivity Adjustment	60%
Retract Time	25%
Arc Voltage Preset	12 VDC
Local or Remote Voltage Preset (Internal)	Remote

From there, additional wiring installed by the customer would be used to interconnect the descrete components of the system, i.e., welding power source, magnetic arc controller, etc.

TABLE 20 - DWF-3/4 SETUP PARAMETERS

PARAMETER	SETTING
Start Delay Time	4.5 seconds
Stop Delay Time	0 seconds
Start Switch (Local or Remote)	Remote
Wire Feed Speed Selector Switch (Local or Remote)	Remote
Wire Feed Speed	As Desired

Each component of the system, will have its own terminal strip to make the enclosure less cluttered and to make it easier to troubleshoot, it needed.

The lid or cover of the enclosure where the switches and potentiometers are mounted can be used as a operator console. This saves time in that the wiring and control switches, etc., are housed in one enclosure and minimizes the possibility of grounding problems and possible HF damage often associated with these types of problems.

OPERATION OF THE SYSTEM

The operation of the system can be started and stopped by the switches and other components mounted to the lid or cover of the enclosure.

TABLE 21 - CARRIAGE CONTROL SETUP PARAMETERS

PARAMETER	SETTING
Start Input Selection	Closure to start carriage

In order for this to function properly, certain setup parameters in the AVC-5, DWF-3/4, and the welding power source must be performed. Below is a list of such parameters:

- Table 19 - AVC-5 Setup Parameters
- Table 20 - DWF-3/4 Setup Parameters
- Table 21 - Carriage Control Setup Parameters

- Table 22 - Magnetic Arc Control Setup Parameters
- Table 23 - Welding Power Source Setup Parameters

Keep in mind, each application is different and this list may need to be expanded upon to meet your needs.

TABLE 22 - MAGNETIC ARC CONTROL SETUP PARAMETERS

PARAMETER	SETTING
Model 80A or MA-20	
Position	50
Amplitude	20
Left Dwell	10
Speed	10
Right Dwell	10
MA-20	
Final Taper Time	3 seconds
Inhibit / Final Taper Input Signal set	Normally Open

Start Sequence

To start the system, be sure the above parameters are set properly. To start the welding process, press the AVC-5 Drive Down pushbutton on the console until the AVC-5 drives the torch down to the work-piece and the tungsten makes contact. The Protect Arm LED on the AVC-5 front panel will light.

At this time, the AVC-5's K1 relay is energized, turning on the welding power source and giving the start signal to the DWF-3/4 wire feeder (because of start delay on the DWF-3/4 wire feeding doesn't start until the time expires). The power source starts pre-purge and then Lift-Arc output current. The AVC-5 has also began the Tungten Preheat timer. Once the Tungsten Preheat timer has expired, the AVC-5 control drives the torch up momentarily until an arc is established.

After the arc is established, the AVC-5 immediately starts the Start Delay Timer. The welding power source also begins producing welding output current at 20 amps as selected by the initial current setting, and begins ramping the current through upslope time to reach the welding current selected--60 amps.

Once the Start Delay timer of the AVC-5 and the welding power source's Upslope timer have completed, the welding power source has reached peak welding amperage. The AVC-5 begins tracking the arc voltage, keeping the voltage at the desired level. In addition, the AVC-5 energizes the K2 relay. This relay is used to turn on the magnetic arc control system and the carriage control.

TABLE 23 - WELDING POWER SOURCE SETUP PARAMETERS

PARAMETER	SETTING
Welding Mode	DC Welding
Starting Method	Lift-Arc
Tungten Preheat Time	1 second
Upslope Time	2.5 seconds
Pre-Purge Time	.5 seconds
Welding Amperage	60 amps
Downslope Time	3.5 seconds
Initial Amperage	20 amps
Final Amperage	20 amps
Post-Purge Time	5 seconds
Pulse Amperage	Off

The DWF-3/4 has been given the start signal via the K1 relay, but since the DWF-3/4 has a start delay set at 4.5 seconds, wire feeding has been delayed. The intent of this delay is to match the start delay of the AVC-5 and the Upslope time of the welding power source, so that the wire begins at the time the welding power source reaches peak current and the AVC-5 begins tracking the arc voltage.

At this time, the system is fully active, welding is being performed, the AVC-5 is tracking the arc voltage, wire is being added to the weld pupple, the part is being rotated or the torch is being moved (depending upon your welding fixture), and the magnetic arc control is oscillating the arc.

Stop Sequence

The stop sequence is automated, but requires the operator to press the Process Stop pushbutton to begin the sequence.

Once the pushbutton has been pressed, the welding power source no longer has a output start signal and begins downsloping the amperage for the preset time of 3.5 seconds. As the welding power source downslopes, a lockout signal is provided to the AVC-5 to prevent the torch from moving during the amperage downslope and for the remainder of the weld cycle until the arc extinguished.

In addition, the Remote Start signal to the DWF-3/4 has been removed and stops feeding wire. (If you'd like wire to feed during a portion of this time, set the Stop Delay Timer to a time less than the welding power source's downslope timer.)

The Model 80A Magnetic Arc Control system is also stopped from oscillating the arc. If the MA-20 is used, the Magnetic Arc Controller will start the Final Taper feature. After this feature has timed out, the magnetic oscillation will stop.

As the amperage reaches the final amperage, 20 amps, the power source stops producing output and the arc extinguishes. Once the arc is not present, the AVC-5 goes immediately into Retract time, driving the torch away from the work-piece for the duration of the retract time. Also at the time the arc extinguishes, the AVC-5 de-energizes both the K1 & K2 relays. The carriage stops and upon the AVC-5 retract feature completing, the system resets and is ready to begin again.

Before the cycle can begin again, the operator has to release the Process Stop switch. This completes the system reset and is ready to start again.

CONSOLE FEATURES

As mentioned previously, the cover or lid can be used as an operator console to provide easy parameter changes prior to and during the welding cycle. The following describes key benefits of the console as it pertains to each of the components that is interfaced.

Cold Wire Feeder Section

The Cold Wire Feeder section on the console, provides access to common parameters used on the DWF-3/4 Cold Wire Feeder.

- Wire Feed Speed Control, using a potentiometer
- Forward and Reverse Wire Jog, using a toggle switch
- Pulse Inhibit Lockout to synchronize the feeding of wire during a High Pulse of welding current if pulse welding is used and synchronization is desired

Arc Voltage Control Section

The Arc Voltage Control section on the console, provides access to common parameters used on the AVC-5 Arc Voltage Controller, including items not needed for this example.

- Arc Voltage Preset, using a potentiometer
- Protect Arm, using a pushbutton for applications such as Plasma Arc Welding when the Tungsten doesn't protrude past the tip and therefore can't be touched to the work-piece
- Up and Down Drive, using a toggle switch

Process Control Section

The Process Control Section is made up of only two switches, and are to be a maintained contact type for proper operation.

- Emergency Stop, using a mushroom style switch
- Process Stop, using a pushbutton switch

The Emergency Stop switch stops the output amperage of the welding power source and commands an up drive signal to the AVC-5 Arc Voltage Controller. The Up drive signal to the AVC-5 during a welding cycle immediately de-energizes both K1 and K2 relays and thereby stops the remaining equipment interfaced in this example.

NOTE

It is up to the operator and/or installer to make sure this Emergency Stop switch is adequate for your application and to be within your building and safety codes.

Power Source Section

The power source section provides to simple controls, primarily because all of the other parameters are accessed on the welding power source and are not available externally.

- Welding Amperage Adjustment, using a potentiometer
- Gas Purge, using a pushbutton switch

OPTIONAL FEATURES

Optional features can be installed as needed to allow greater benefit, but have been omitted for clarity and to fit the majority of the applications.

Examples of these features are as follows with explanations and are organized by the console section:

Cold Wire Feed Section

An additional Inhibit switch could be added to prevent wire from feeding during the entire welding cycle if desired. This can also be accomplished by turning off the DWF-3/4 or by selecting the Off position on the start switch on the front panel of the DWF-3/4.

Arc Voltage Control Section

An additional Lockout Switch could be installed to provide a means of preventing the AVC-5 from tracking the arc during a welding cycle. This is useful as a troubleshooting tool, particularly during initial setup. This can also be accomplished by pressing the Lockout pushbutton on the front panel of the AVC-5 Controller.

Process Control Section

Another Process Start switch could be added to make the Process control section a bit more complete, i.e., Start, Stop and Emergency Stop. This switch's contacts would simply parallel the Down Drive Switch in the Arc Voltage Control section and would be a momentary type switch.

Power Source Section

The welding power source should have additional outputs, such as Voltage Feedback and Amperage Feedback. These outputs can be used to display the actual welding amperage and welding voltage during a welding cycle. Adding digital displays will require additional power supplies in the interface console to provide regulated voltages to these displays.

Keep in mind, the AVC-5 and quite possibly the welding power source have digital readouts on them to indicate actual welding voltage.

SCHEMATICS AND BLOCK DIAGRAMS

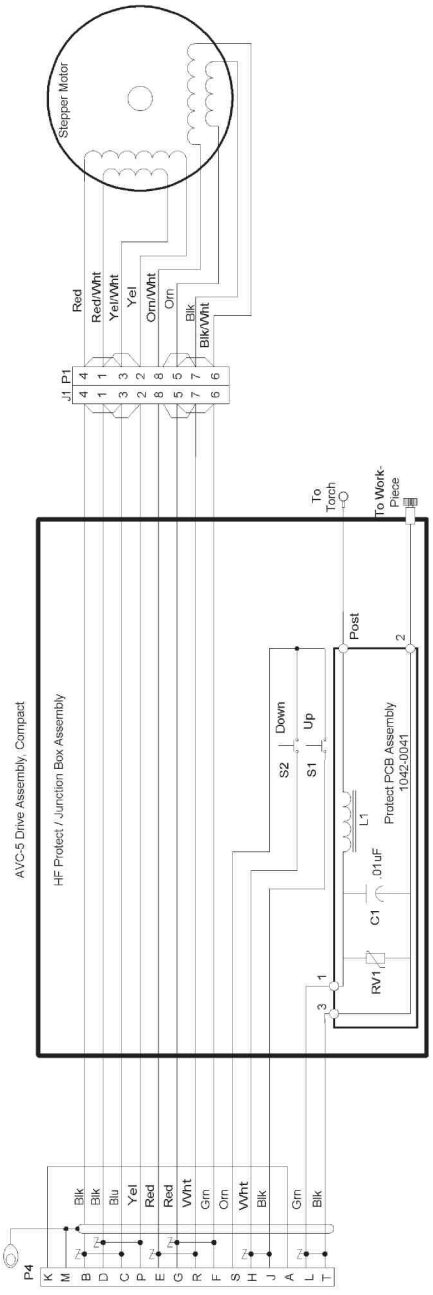


FIGURE 43 - AVC-5 COMPACT DRIVE BLOCK DIAGRAM

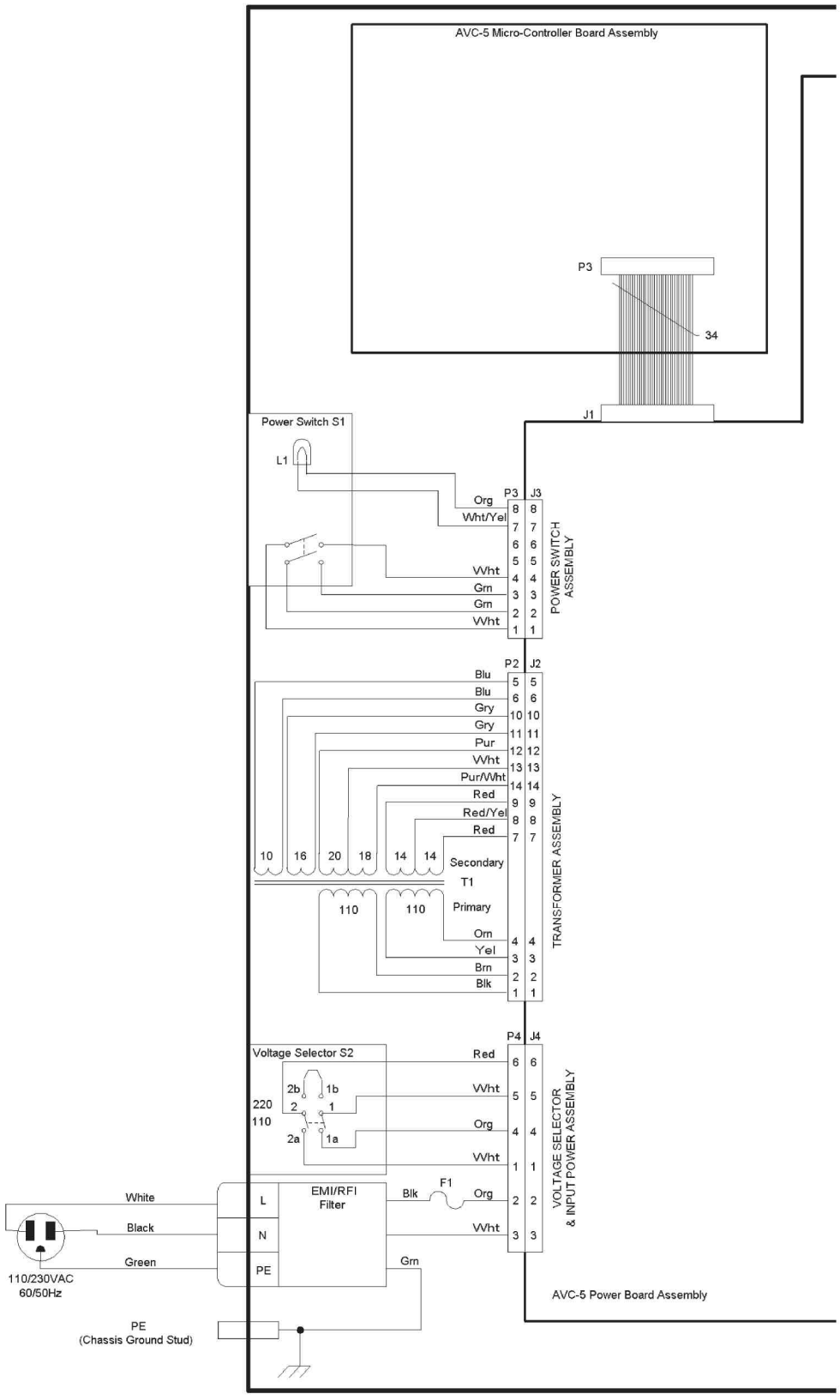


FIGURE 44 - AVC-5 CONTROL BLOCK DIAGRAM

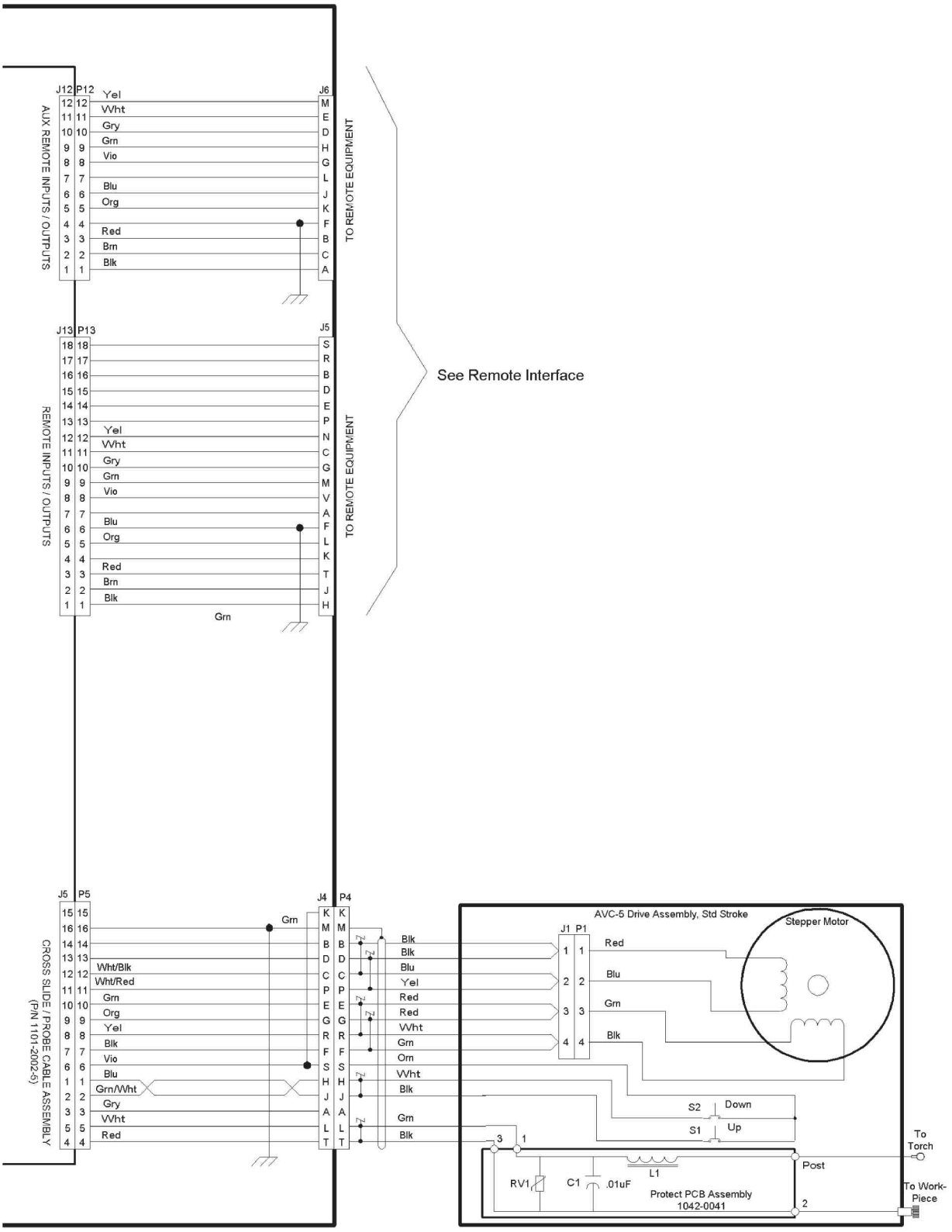


FIGURE 45 - AVC-5 CONTROL BLOCK DIAGRAM (CONT.)

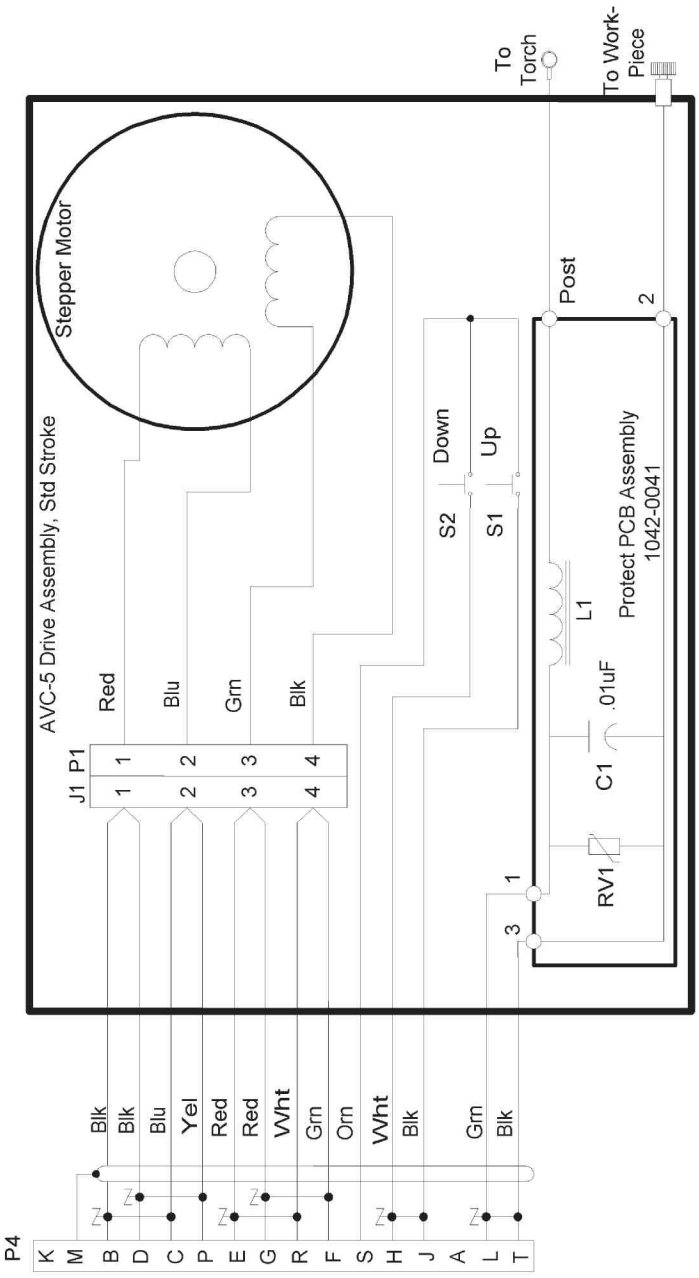


FIGURE 46 - AVC-5 STANDARD DRIVE BLOCK DIAGRAM

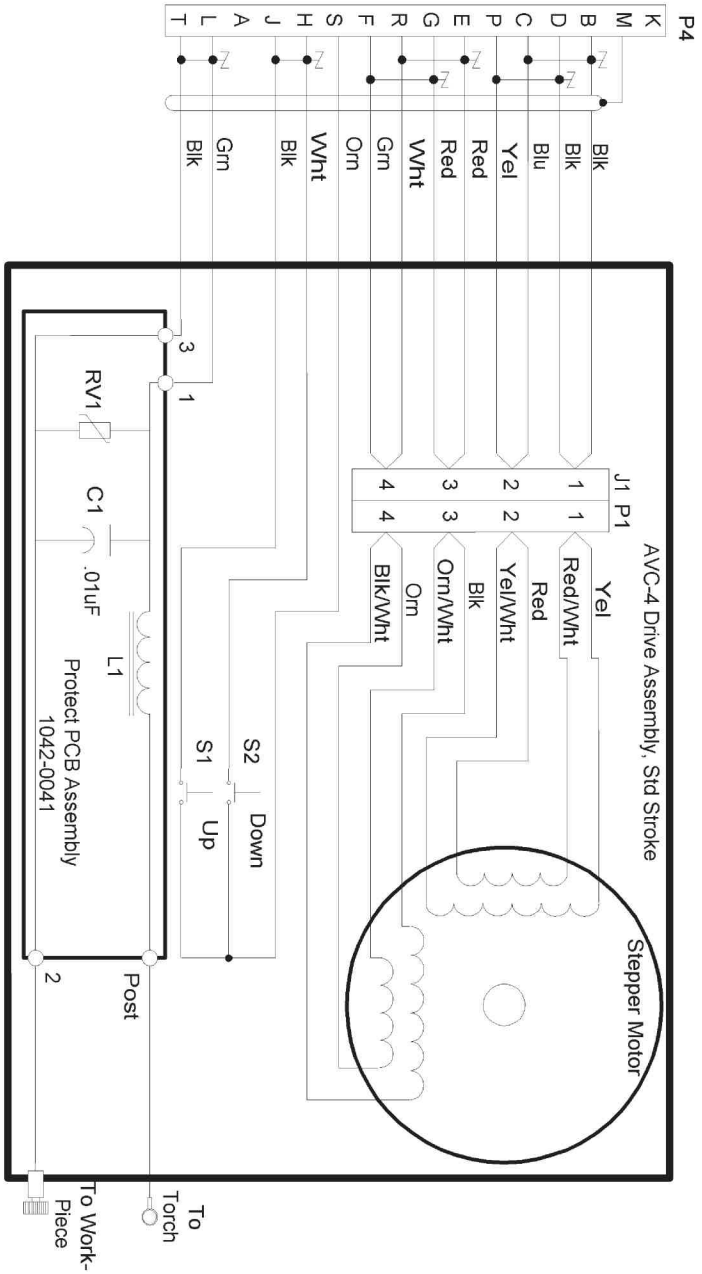


FIGURE 47 - AVC-4 STANDARD DRIVE BLOCK DIAGRAM

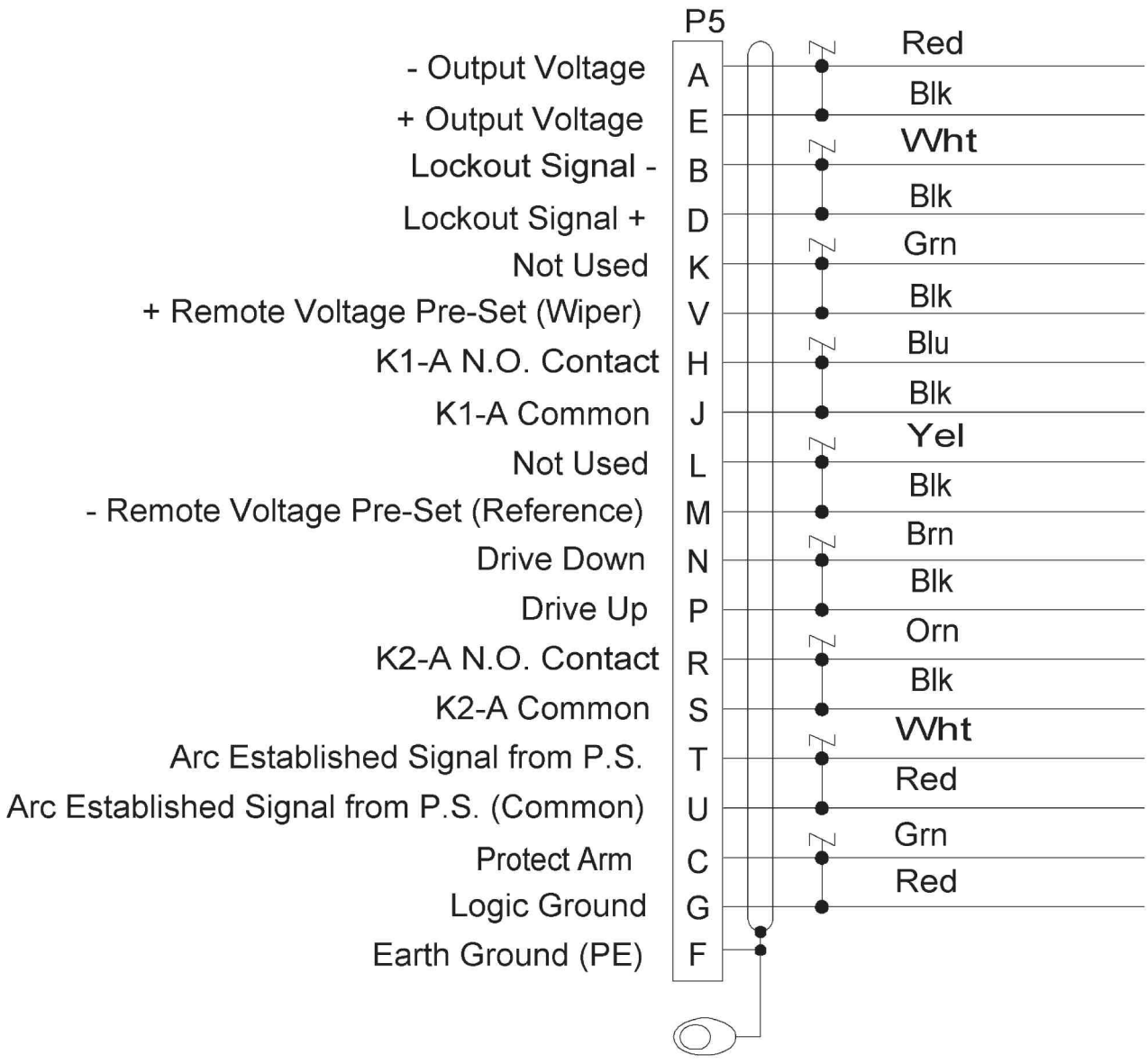


FIGURE 48 - AVC-5 REMOTE INTERFACE CABLE SCHEMATIC

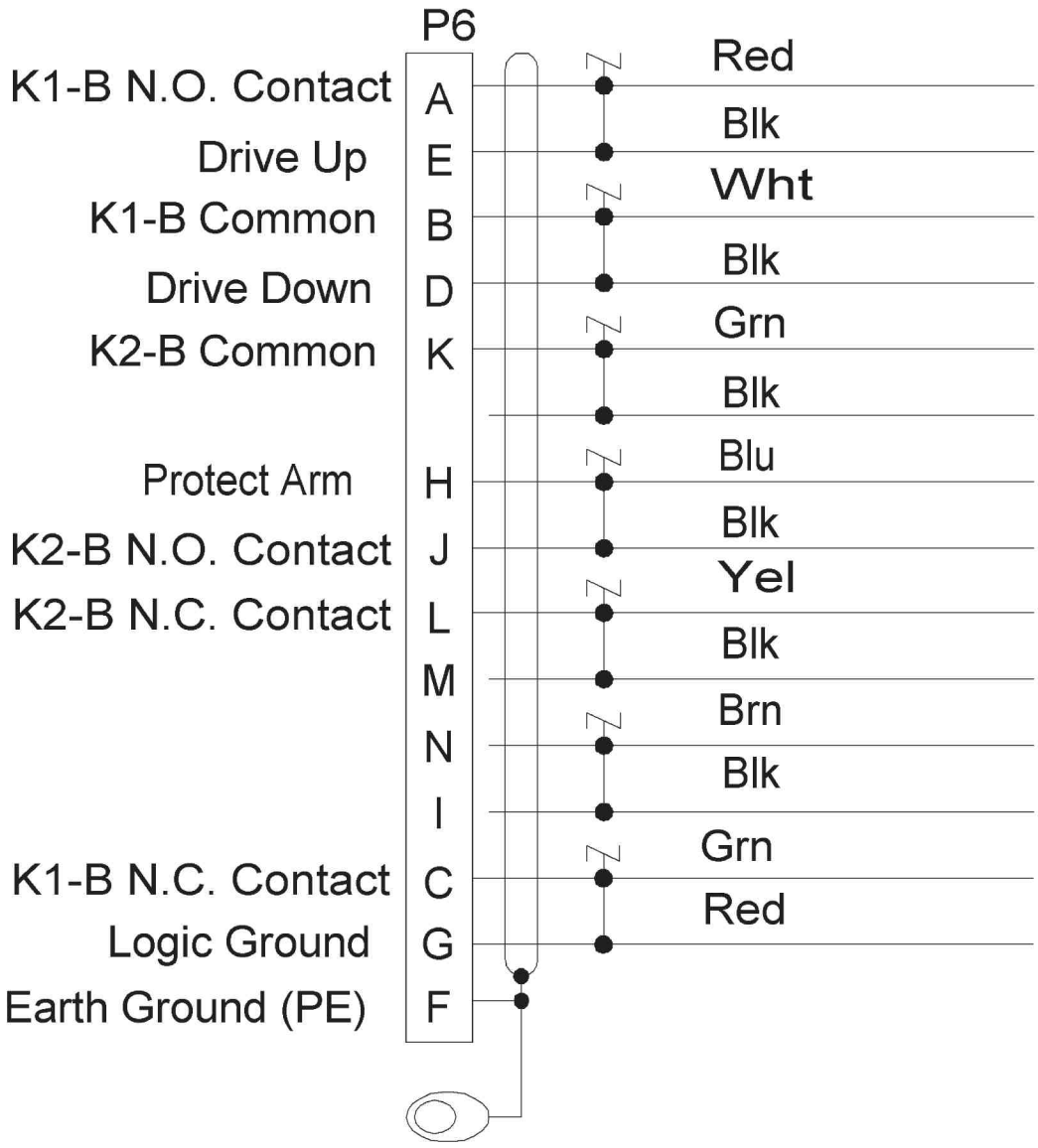


FIGURE 49 - AVC-5 AUXILIARY REMOTE INTERFACE CABLE SCHEMATIC

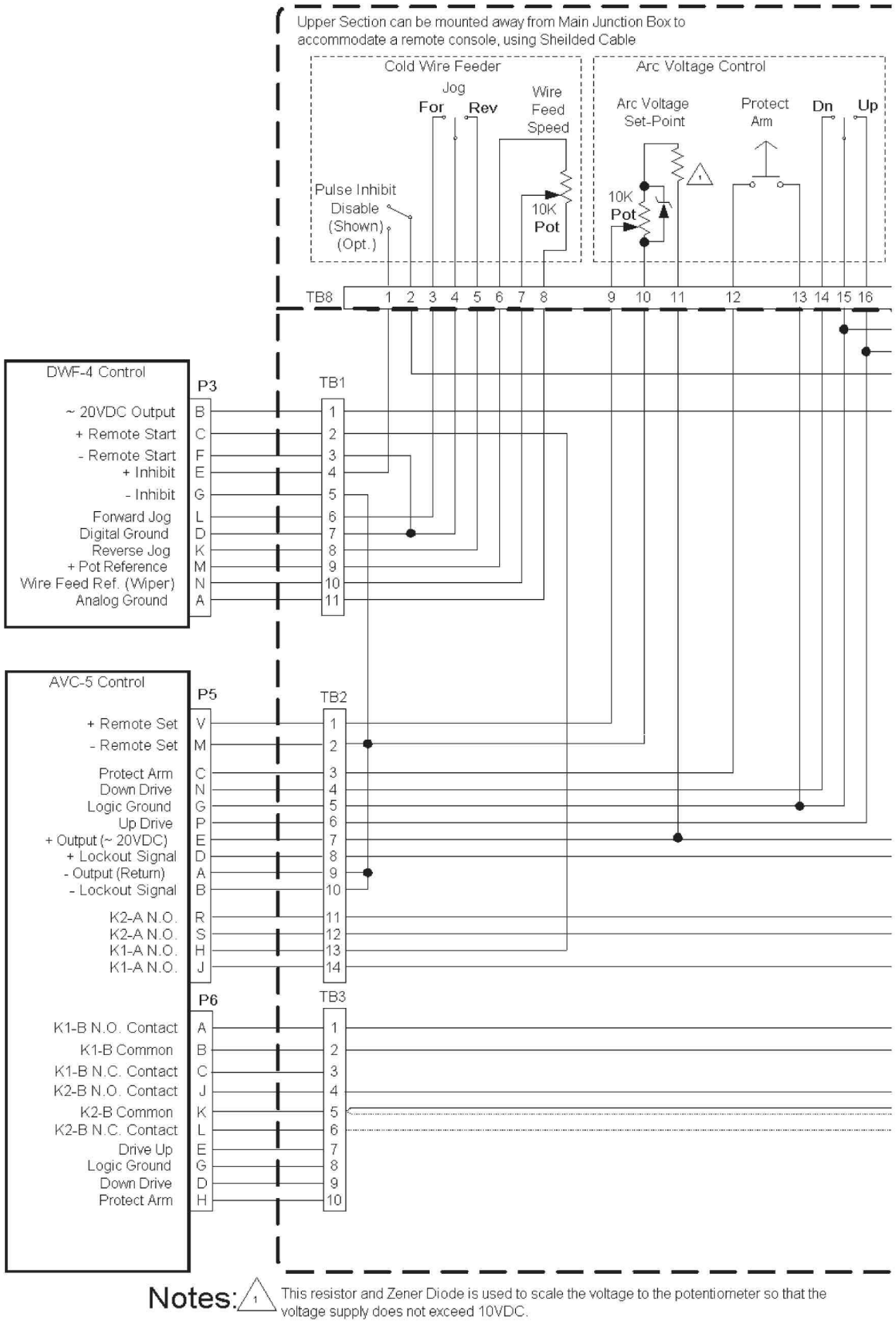


FIGURE 50 - AVC-5 SYSTEM INTERFACE EXAMPLE

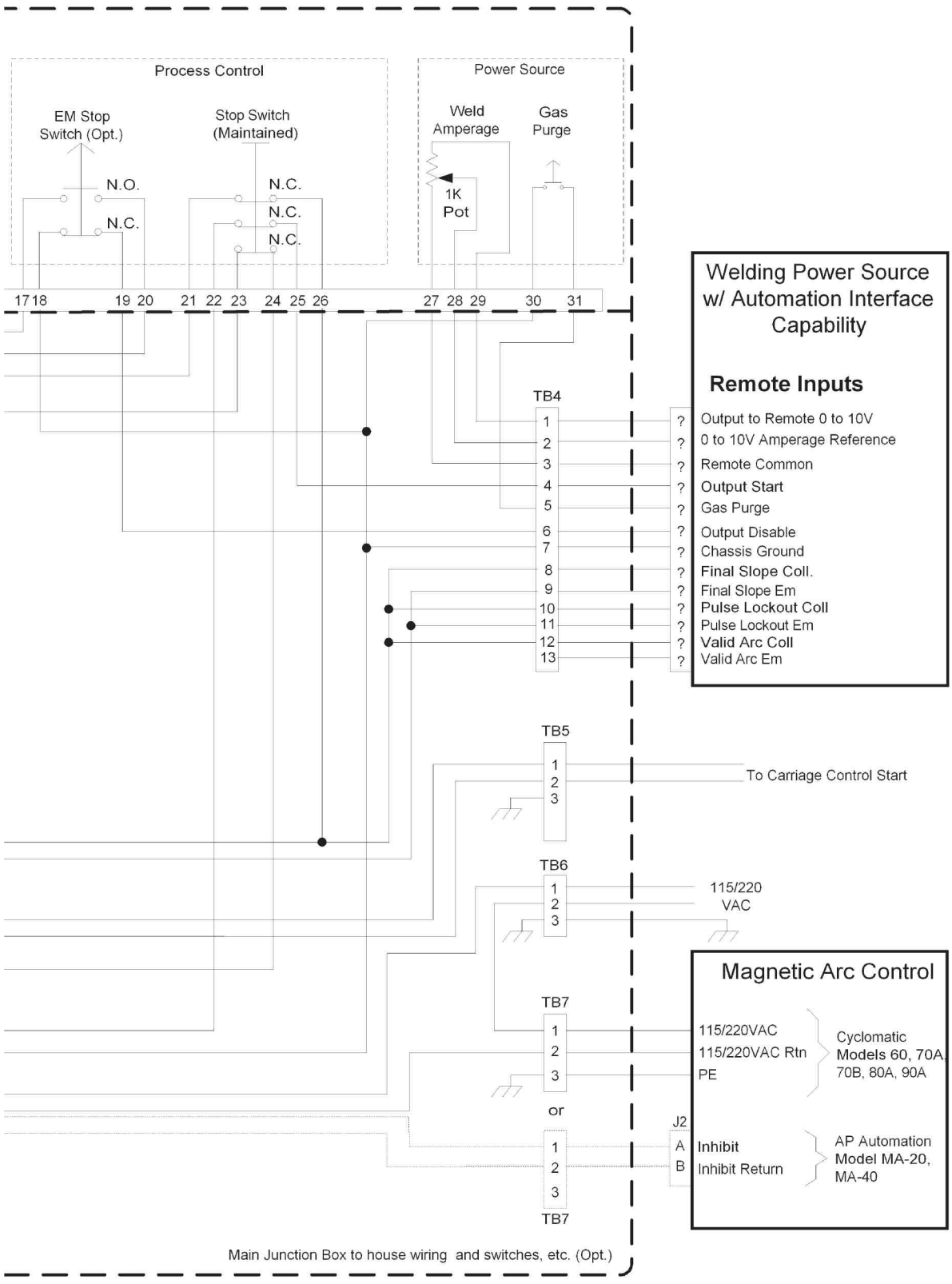


FIGURE 51 - AVC-5 SYSTEM INTERFACE EXAMPLE (CONT.)

OPTIONAL EQUIPMENT

CROSS SEAM ADJUSTMENT ASSEMBLY (1046-0271)

The Cross Seam Adjustment assembly provides for a two-inch cross seam fine adjustment of the AVC-5 and AVC-5 drive units and torch assembly. Two versions available are; knob or crank style handle.

TILTING BRACKET ASSEMBLY (1043-0046)

The Tilting Bracket assembly provides for approximately 45 degrees tilting of the standard AVC-5 and AVC-5 drive unit and torch assembly.

DRIVE CABLE EXTENSION

The Drive Cable Extension extends the cable between the drive unit and the control unit. The maximum cable length is 80 feet.

NOTE

There are several cable extension lengths available. Please consult the factory for more information regarding the cable length needed for your specific application.

MAGNETIC ARC CONTROL SYSTEMS

Magnetic Arc Control Systems can enhance and further control the arc in a TIG or Plasma application by oscillating the arc across the seam or in a direction along the seam. Using a magnetic arc control system can prevent undercutting, arc blow, arc drag, and can increase grain refinement of the base and filler material. Contact Arc Products' Sales or Technical Service departments for additional information and assistance in the proper selection of components.

COLD WIRE FEED SYSTEMS

Cold Wire Feed Systems offered by Arc Products Automation provide reliable, accurate delivery of filler wire to the weld puddle. Offered in two styles, a standard and a compact version, the systems are capable of delivering up to 300 ipm of filler wire from sizes of .020" to .062". Contact Arc Products' Sales or Technical Service departments for additional information and assistance in the proper selection of components.

ORDERING INFORMATION

Arc Products manufactures a variety of equipment for use in automatic welding processes and manufactures turn-key automated welding systems for a broad range of applications. Detailed information and literature may be obtained by consulting Arc Products' Sales and/or Technical Service departments. Part numbers for the AVC-5 system are given in the Drawing and Parts Lists Section and should be used for ordering purposes. Please consult this manual or contact Arc Products for further information.

INDEX

ARC PRODUCTS, INC
1245 30TH STREET
SAN DIEGO, CA 92154-3477
619-628-1022
619-628-1028 FAX
sales@arc-products.com
service@arc-products.com
www.ap-automation.com
www.arc-products.com

201237-001 Rev. B September 2011