Arc Products
A Lincoln Electric Company

IM 6100

March, 2012
201326-001 Rev. D

SEAM TRACKER SYSTEM

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

Safety Depends on You
Lincoln arc welding equipment is designed and built with safety in mind. However, your overall safety can be increased by proper installation ... and thoughtful operation on your part. **DO NOT INSTALL, OPERATE OR REPAIR THIS EQUIPMENT WITHOUT READING THIS MANUAL AND THE SAFETY PRECAUTIONS CONTAINED THROUGHOUT.** And, most importantly, think before you act and be careful.

OPERATOR'S MANUAL AND SERVICE MANUAL

LINCOLN ELECTRIC

World's Leader in Welding and Cutting Products
Sales and Service through Subsidiaries and Distibutors Worldwide
Cleveland, Ohio 44117-1199 U.S.A. TEL: 216.481.8100 FAX: 216.486.1751 WEB SITE: www.lincolnelectric.com

⚠ WARNING

⚠ CALIFORNIA PROPOSITION 65 WARNINGS ⚠

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

The Above For Diesel Engines

The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

The Above For Gasoline Engines

ARC WELDING CAN BE HAZARDOUS. PROTECT YOURSELF AND OTHERS FROM POSSIBLE SERIOUS INJURY OR DEATH. KEEP CHILDREN AWAY. PACEMAKER WEARERS SHOULD CONSULT WITH THEIR DOCTOR BEFORE OPERATING.

Read and understand the following safety highlights. For additional safety information, it is strongly recommended that you purchase a copy of "Safety in Welding & Cutting - ANSI Standard Z49.1" from the American Welding Society, P.O. Box 351040, Miami, Florida 33135 or CSA Standard W117.2-1974. A Free copy of "Arc Welding Safety" booklet E205 is available from the Lincoln Electric Company, 22801 St. Clair Avenue, Cleveland, Ohio 44117-1199.

BE SURE THAT ALL INSTALLATION, OPERATION, MAINTENANCE AND REPAIR PROCEDURES ARE PERFORMED ONLY BY QUALIFIED INDIVIDUALS.

FOR ENGINE powered equipment.

1.a. Turn the engine off before troubleshooting and maintenance work unless the maintenance work requires it to be running.

1.b. Operate engines in open, well-ventilated areas or vent the engine exhaust fumes outdoors.

1.c. Do not add the fuel near an open flame welding arc or when the engine is running. Stop the engine and allow it to cool before refueling to prevent spilled fuel from vaporizing on contact with hot engine parts and igniting. Do not spill fuel when filling tank. If fuel is spilled, wipe it up and do not start engine until fumes have been eliminated.

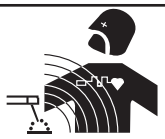
1.d. Keep all equipment safety guards, covers and devices in position and in good repair.Keep hands, hair, clothing and tools away from V-belts, gears, fans and all other moving parts when starting, operating or repairing equipment.

1.e. In some cases it may be necessary to remove safety guards to perform required maintenance. Remove guards only when necessary and replace them when the maintenance requiring their removal is complete. Always use the greatest care when working near moving parts.

1.f. Do not put your hands near the engine fan. Do not attempt to override the governor or idler by pushing on the throttle control rods while the engine is running.

1.g. To prevent accidentally starting gasoline engines while turning the engine or welding generator during maintenance work, disconnect the spark plug wires, distributor cap or magneto wire as appropriate.

1.h. To avoid scalding, do not remove the radiator pressure cap when the engine is hot.



ELECTRIC AND MAGNETIC FIELDS may be dangerous

2.a. Electric current flowing through any conductor causes localized Electric and Magnetic Fields (EMF). Welding current creates EMF fields around welding cables and welding machines

2.b. EMF fields may interfere with some pacemakers, and welders having a pacemaker should consult their physician before welding.

2.c. Exposure to EMF fields in welding may have other health effects which are now not known.

2.d. All welders should use the following procedures in order to minimize exposure to EMF fields from the welding circuit:

2.d.1. Route the electrode and work cables together - Secure them with tape when possible.

2.d.2. Never coil the electrode lead around your body.

2.d.3. Do not place your body between the electrode and work cables. If the electrode cable is on your right side, the work cable should also be on your right side.

2.d.4. Connect the work cable to the workpiece as close as possible to the area being welded.

2.d.5. Do not work next to welding power source.

ELECTRIC SHOCK can kill.

3.a. The electrode and work (or ground) circuits are electrically "hot" when the welder is on. Do not touch these "hot" parts with your bare skin or wet clothing. Wear dry, hole-free gloves to insulate hands.

3.b. Insulate yourself from work and ground using dry insulation. Make certain the insulation is large enough to cover your full area of physical contact with work and ground.

In addition to the normal safety precautions, if welding must be performed under electrically hazardous conditions (in damp locations or while wearing wet clothing; on metal structures such as floors, gratings or scaffolds; when in cramped positions such as sitting, kneeling or lying, if there is a high risk of unavoidable or accidental contact with the workpiece or ground) use the following equipment:

- **Semiautomatic DC Constant Voltage (Wire) Welder.**
- **DC Manual (Stick) Welder.**
- **AC Welder with Reduced Voltage Control.**

3.c. In semiautomatic or automatic wire welding, the electrode, electrode reel, welding head, nozzle or semiautomatic welding gun are also electrically "hot".

3.d. Always be sure the work cable makes a good electrical connection with the metal being welded. The connection should be as close as possible to the area being welded.

3.e. Ground the work or metal to be welded to a good electrical (earth) ground.

3.f. Maintain the electrode holder, work clamp, welding cable and welding machine in good, safe operating condition. Replace damaged insulation.

3.g. Never dip the electrode in water for cooling.

3.h. Never simultaneously touch electrically "hot" parts of electrode holders connected to two welders because voltage between the two can be the total of the open circuit voltage of both welders.

3.i. When working above floor level, use a safety belt to protect yourself from a fall should you get a shock.

3.j. Also see Items 6.c. and 8.

ARC RAYS can burn.

4.a. Use a shield with the proper filter and cover plates to protect your eyes from sparks and the rays of the arc when welding or observing open arc welding. Headshield and filter lens should conform to ANSI Z87. I standards.

4.b. Use suitable clothing made from durable flame-resistant material to protect your skin and that of your helpers from the arc rays.

4.c. Protect other nearby personnel with suitable, non-flammable screening and/or warn them not to watch the arc nor expose themselves to the arc rays or to hot spatter or metal.

FUMES AND GASES can be dangerous.

5.a. Welding may produce fumes and gases hazardous to health. Avoid breathing these fumes and gases. When welding, keep your head out of the fume. Use enough ventilation and/or exhaust at the arc to keep fumes and gases away from the breathing zone. **When welding with electrodes which require special ventilation such as stainless or hard facing (see instructions on container or MSDS) or on lead or cadmium plated steel and other metals or coatings which produce highly toxic fumes, keep exposure as low as possible and within applicable OSHA PEL and ACGIH TLV limits using local exhaust or mechanical ventilation. In confined spaces or in some circumstances, outdoors, a respirator may be required. Additional precautions are also required when welding on galvanized steel.**

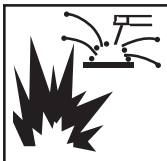
5. b. The operation of welding fume control equipment is affected by various factors including proper use and positioning of the equipment, maintenance of the equipment and the specific welding procedure and application involved. Worker exposure level should be checked upon installation and periodically thereafter to be certain it is within applicable OSHA PEL and ACGIH TLV limits.

5.c. Do not weld in locations near chlorinated hydrocarbon vapors coming from degreasing, cleaning or spraying operations. The heat and rays of the arc can react with solvent vapors to form phosgene, a highly toxic gas, and other irritating products.

5.d. Shielding gases used for arc welding can displace air and cause injury or death. Always use enough ventilation, especially in confined areas, to insure breathing air is safe.

5.e. Read and understand the manufacturer's instructions for this equipment and the consumables to be used, including the material safety data sheet (MSDS) and follow your employer's safety practices. MSDS forms are available from your welding distributor or from the manufacturer.

5.f. Also see item 1.b.



WELDING and CUTTING SPARKS can cause fire or explosion.

6.a. Remove fire hazards from the welding area. If this is not possible, cover them to prevent the welding sparks from starting a fire. Remember that welding sparks and hot materials from welding can easily go through small cracks and openings to adjacent areas. Avoid welding near hydraulic lines. Have a fire extinguisher readily available.

6.b. Where compressed gases are to be used at the job site, special precautions should be used to prevent hazardous situations. Refer to "Safety in Welding and Cutting" (ANSI Standard Z49.1) and the operating information for the equipment being used.

6.c. When not welding, make certain no part of the electrode circuit is touching the work or ground. Accidental contact can cause overheating and create a fire hazard.

6.d. Do not heat, cut or weld tanks, drums or containers until the proper steps have been taken to insure that such procedures will not cause flammable or toxic vapors from substances inside. They can cause an explosion even though they have been "cleaned". For information, purchase "Recommended Safe Practices for the Preparation for Welding and Cutting of Containers and Piping That Have Held Hazardous Substances", AWS F4.1 from the American Welding Society (see address above).

6.e. Vent hollow castings or containers before heating, cutting or welding. They may explode.

6.f. Sparks and spatter are thrown from the welding arc. Wear oil free protective garments such as leather gloves, heavy shirt, cuffless trousers, high shoes and a cap over your hair. Wear ear plugs when welding out of position or in confined places. Always wear safety glasses with side shields when in a welding area.

6.g. Connect the work cable to the work as close to the welding area as practical. Work cables connected to the building framework or other locations away from the welding area increase the possibility of the welding current passing through lifting chains, crane cables or other alternate circuits. This can create fire hazards or overheat lifting chains or cables until they fail.

6.h. Also see item 1.c.

6.I. Read and follow NFPA 51B " Standard for Fire Prevention During Welding, Cutting and Other Hot Work", available from NFPA, 1 Batterymarch Park, PO box 9101, Quincy, Ma 022690-9101.

6.j. Do not use a welding power source for pipe thawing.

CYLINDER may explode if damaged.

7.a. Use only compressed gas cylinders containing the correct shielding gas for the process used and properly operating regulators designed for the gas and pressure used. All hoses, fittings, etc. should be suitable for the application and maintained in good condition.

7.b. Always keep cylinders in an upright position securely chained to an undercarriage or fixed support.

7.c. Cylinders should be located:
- Away from areas where they may be struck or subjected to physical damage.
- A safe distance from arc welding or cutting operations and any other source of heat, sparks, or flame.

7.d. Never allow the electrode, electrode holder or any other electrically "hot" parts to touch a cylinder.

7.e. Keep your head and face away from the cylinder valve outlet when opening the cylinder valve.

7.f. Valve protection caps should always be in place and hand tight except when the cylinder is in use or connected for use.

7.g. Read and follow the instructions on compressed gas cylinders, associated equipment, and CGA publication P-l, "Precautions for Safe Handling of Compressed Gases in Cylinders," available from the Compressed Gas Association 1235 Jefferson Davis Highway, Arlington, VA 22202.

FOR ELECTRICALLY powered equipment.

8.a. Turn off input power using the disconnect switch at the fuse box before working on the equipment.

8.b. Install equipment in accordance with the U.S. National Electrical Code, all local codes and the manufacturer's recommendations.

8.c. Ground the equipment in accordance with the U.S. National Electrical Code and the manufacturer's recommendations.

Refer to **http://www.lincolnelectric.com/safety** for additional safety information.

PRÉCAUTIONS DE SÛRETÉ

Pour votre propre protection lire et observer toutes les instructions et les précautions de sûreté specifiques qui parraissent dans ce manuel aussi bien que les précautions de sûreté générales suivantes:

Sûreté Pour Soudage A L'Arc

1. Protegez-vous contre la secousse électrique:

   a. Les circuits à l'électrode et à la piéce sont sous tension quand la machine à souder est en marche. Eviter toujours tout contact entre les parties sous tension et la peau nue ou les vétements mouillés. Porter des gants secs et sans trous pour isoler les mains.
   b. Faire trés attention de bien s'isoler de la masse quand on soude dans des endroits humides, ou sur un plancher metallique ou des grilles metalliques, principalement dans les positions assis ou couché pour lesquelles une grande partie du corps peut être en contact avec la masse.
   c. Maintenir le porte-électrode, la pince de masse, le câble de soudage et la machine à souder en bon et sûr état defonctionnement.
   d. Ne jamais plonger le porte-électrode dans l'eau pour le refroidir.
   e. Ne jamais toucher simultanément les parties sous tension des porte-électrodes connectés à deux machines à souder parce que la tension entre les deux pinces peut être le total de la tension à vide des deux machines.
   f. Si on utilise la machine à souder comme une source de courant pour soudage semi-automatique, ces precautions pour le porte-électrode s'applicuent aussi au pistolet de soudage.

2. Dans le cas de travail au dessus du niveau du sol, se protéger contre les chutes dans le cas ou on recoit un choc. Ne jamais enrouler le câble-électrode autour de n'importe quelle partie du corps.

3. Un coup d'arc peut être plus sévère qu'un coup de soliel, donc:

   a. Utiliser un bon masque avec un verre filtrant approprié ainsi qu'un verre blanc afin de se protéger les yeux du rayonnement de l'arc et des projections quand on soude ou quand on regarde l'arc.
   b. Porter des vêtements convenables afin de protéger la peau de soudeur et des aides contre le rayonnement de l'arc.
   c. Protéger l'autre personnel travaillant à proximité au soudage à l'aide d'écrans appropriés et non-inflammables.

4. Des gouttes de laitier en fusion sont émises de l'arc de soudage. Se protéger avec des vêtements de protection libres de l'huile, tels que les gants en cuir, chemise épaisse, pantalons sans revers, et chaussures montantes.

5. Toujours porter des lunettes de sécurité dans la zone de soudage. Utiliser des lunettes avec écrans lateraux dans les zones où l'on pique le laitier.

6. Eloigner les matériaux inflammables ou les recouvrir afin de prévenir tout risque d'incendie dû aux étincelles.

7. Quand on ne soude pas, poser la pince à une endroit isolé de la masse. Un court-circuit accidental peut provoquer un échauffement et un risque d'incendie.

8. S'assurer que la masse est connectée le plus prés possible de la zone de travail qu'il est pratique de le faire. Si on place la masse sur la charpente de la construction ou d'autres endroits éloignés de la zone de travail, on augmente le risque de voir passer le courant de soudage par les chaines de levage, câbles de grue, ou autres circuits. Cela peut provoquer des risques d'incendie ou d'echauffement des chaines et des câbles jusqu'à ce qu'ils se rompent.

9. Assurer une ventilation suffisante dans la zone de soudage. Ceci est particuliérement important pour le soudage de tôles galvanisées plombées, ou cadmiées ou tout autre métal qui produit des fumeés toxiques.

10. Ne pas souder en présence de vapeurs de chlore provenant d'opérations de dégraissage, nettoyage ou pistolage. La chaleur ou les rayons de l'arc peuvent réagir avec les vapeurs du solvant pour produire du phosgéne (gas fortement toxique) ou autres produits irritants.

11. Pour obtenir de plus amples renseignements sur la sûreté, voir le code "Code for safety in welding and cutting" CSA Standard W 117.2-1974.

PRÉCAUTIONS DE SÛRETÉ POUR LES MACHINES À SOUDER À TRANSFORMATEUR ET À REDRESSEUR

1. Relier à la terre le chassis du poste conformement au code de l'électricité et aux recommendations du fabricant. Le dispositif de montage ou la piece à souder doit être branché à une bonne mise à la terre.

2. Autant que possible, l'installation et l'entretien du poste seront effectués par un électricien qualifié.

3. Avant de faires des travaux à l'interieur de poste, la debrancher à l'interrupteur à la boite de fusibles.

4. Garder tous les couvercles et dispositifs de sûreté à leur place.

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 a moment 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

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STANDARD SEAM TRACKER SYSTEM

ADVANCED PROGRAMMING CONTROL OPTION

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, or others in the operating area.

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 A WS 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.

Standard Seam Tracker System

DESCRIPTION OF EQUIPMENT

Arc Products Automation Seam Tracker Systems are used for torch positioning in automated welding processes requiring a constant torch position with respect to the joint to be welded. The system can be configured for various combinations of manual and automatic positioning maneuvers.

A typical standard Arc Products Automation (APA) Seam Tracker System (see Figure 1 - ST40 System Components, Figure 2 - ST250 System Components, Figure 3 - ST450 System Components beginning on page 4) consists of a Control Unit Assembly, Drive Cable Assembly, Cross-Slide Assembly, Seam Sensor Assembly (with standard 1/8" ball tip and extension rod) 5 Axis Mount, Torch Clamp Bracket, and Control Pendant Assembly. An optional Universal Bracket is also available in addition to the Torch Clamp Bracket. The user's welding torch or weld head is normally mounted to the adapter plate which is a part of the cross-slide assembly providing two-axis positioning control of the torch.

The seam sensor assembly is normally mounted to the welding torch via the torch clamp bracket, but can optionally be mounted to the universal bracket. The sensor tip on the seam sensor contacts the joint to be welded and senses any horizontal or vertical movement of the weld joint with respect to the welding torch.

The control unit contains the solid state electronic controls that apply the proper voltage to the motors on the cross-slide assembly to correct the positioning error detected by the seam sensor. APA Seam Tracker Systems will correct positioning errors within .005 inches and provide various proportional correction speeds.

The control pendant assembly, connected to the control unit via a cable (attached), provides the controls used to initially position the cross-slides and start the tracking operation. The pendant assembly is made so that the faceplate and cable can be removed from the pendant enclosure allowing the pendant faceplate to be mounted to another control console without re-wiring the pendant assembly.

Included with the pendant assembly are mounting brackets to mount it to a fixture and an attachable hook to allow convenient location changes as required by the operator or application.

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 standard unit operates on 115/230VAC, 50/60 Hz commercial power, capable of supplying approximately 5 amps peak current. The unit has a lighted power switch and fuse holder mounted on the exterior of the unit.

The system is operated from the controls located on the control pendant assembly which connects to the control unit. A sealed heatsink mounted on the side of the control unit allows for convection cooling of heat dissipating devices, while preventing dust and dirt from entering the enclosure.

Two blank panels, located on the front cover and the bottom right of the enclosure, allow provision for factory and field installation of the Advanced Programming Control Option (see Advanced Programming Control beginning on page 85).

The two connectors located on the bottom of the unit provide for connection of the control pendant cable and the drive cable to the cross-slide assembly.

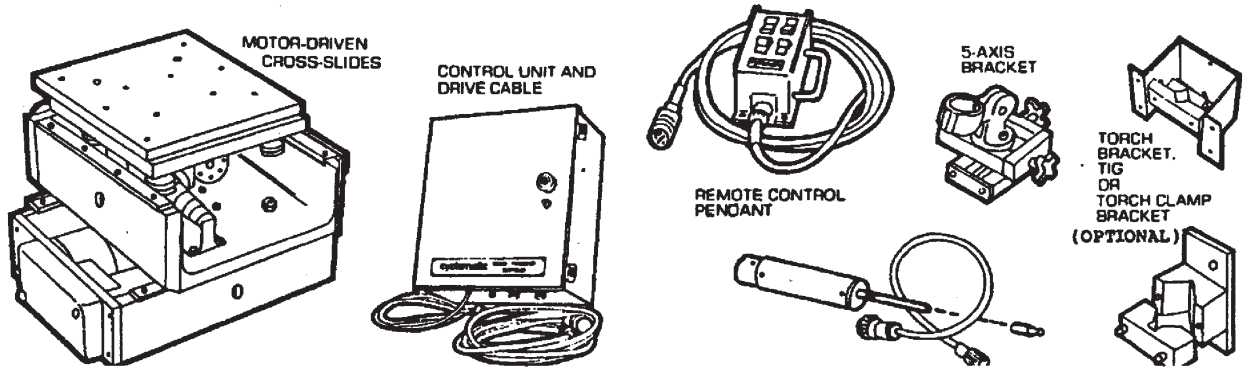


FIGURE 1 - ST40 SYSTEM COMPONENTS

TABLE 1 - ST40 SYSTEM SPECIFICATIONS

DESCRIPTION	SPECIFICATIONS	RATING
Load Capacity	6” (152 mm) from Faceplate	40 lbs. (18 Kg)
Standard Stroke Length	Vertical x Horizontal	3” (76 mm) x 3” (76 mm)
Non-Standard Stroke Length	Vertical x Horizontal	6” (152 mm) x 6” (152 mm)
Minimum Envelope	Standard Stroke 3” (76 mm) x 3” (76 mm)	12” (305 mm) Diameter
Tracking Accuracy	Maximum Correction Rate 24 ipm (610 mm/min.)	Within .005” (1.27 mm)
Tracking Controls	Manual	Up/Down and Left/Right
	Automatic	Left/Right Sidetrack and Off
Drive System		Precision Ball Screw with Mechanical Override Clutch
Control Unit	Enclosure	Standard NEMA Style Sealed enclosure with provisions for plug-in options
Remote Control Pendant	Enclosure	Handheld or mounted steel enclosure containing manual and automatic tracking controls with provisions for plug-in options
Cross Slide Cable	Standard Length	10’ (3 M)
Seam Sensor Cable	Standard Length	4’ (1.2 M)
Power Cable	Standard Length	6’ (1.8 M)
Pendant Cable	Standard Length	10’ (3 M)
Weights	Cross-slide Assembly (cable incl.)	10 lbs. (4.1 Kg)
	Seam Sensor	1 lb. (.45 Kg)
	Control Unit (power cable incl.)	33 lbs. (15 Kg)
	Remote Control Pendant (cable incl.)	4 lbs. (1.8 Kg)
	Torch Bracket, TIG	1 lb. (.45 Kg)
	Torch Clamp Bracket	2 lb. (.9 Kg)
	5-Axis Mount	3 lbs. (1.4 Kg)
Plug-in Option	Advanced Programming Control	

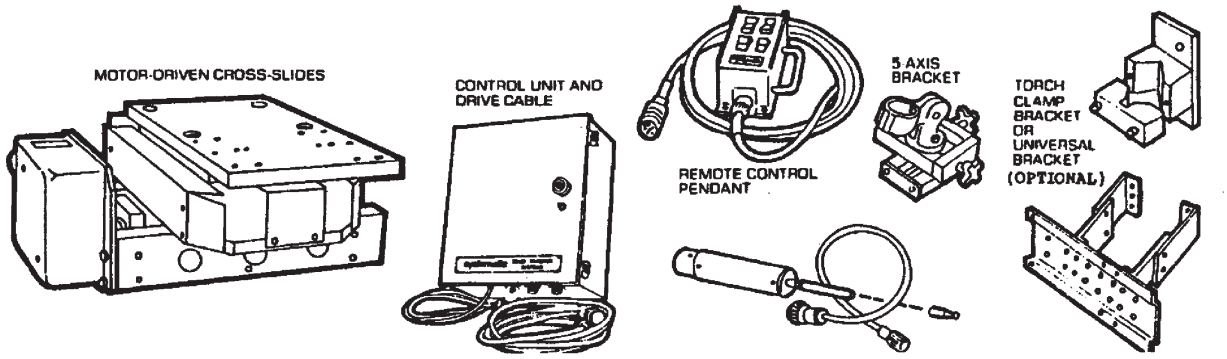


FIGURE 2 - ST250 SYSTEM COMPONENTS

TABLE 2 - ST250 SYSTEM SPECIFICATIONS

DESCRIPTION	SPECIFICATIONS	RATING
Load Capacity	12” (305 mm) from Faceplate	250 lbs. (114 Kg) Derated 15 lbs./inch (6.8 Kg/25.4 mm) beyond 12” (305 mm)
Standard Stroke Length	Vertical x Horizontal	5” (127 mm) x 5” (127 mm) or 10“ (254 mm) X 10“ (254 mm)
Non-Standard Stroke Length	Vertical x Horizontal	10” (254 mm) x 10” (254 mm) Inboard Drive Assy 24” (610 mm) x 24” (610 mm) Outboard Drive Assy
Minimum Envelope	Standard Stroke 5” (127 mm) x 5” (127 mm)	19” (431 mm) Diameter
Tracking Accuracy	Maximum Correction Rate 0 -35 ipm (890 mm/min.) under no load	Within .005” (1.27 mm)
Tracking Controls	Manual	Up/Down and Left/Right
	Automatic	Left/Right Sidetrack and Off
Drive System		Precision Ball Screw with Mechanical Override Clutch
Control Unit	Enclosure	Standard NEMA Style Sealed enclosure with provisions for plug-in options
Remote Control Pendant	Enclosure	Handheld or mounted steel enclosure containing manual and automatic tracking controls with provisions for plug-in options
Cross-Slide Cable	Standard Length	10’ (3 M)
Seam Sensor Cable	Standard Length	4’ (1.2 M)
Power Cable	Standard Length	6’ (1.8 M)
Pendant Cable	Standard Length	10’ (3 M)
Weights	Cross-slide Assembly (5” x 5”)	38 lbs. (16 Kg)
	Seam Sensor	1 lb. (.45 Kg)
	Control Unit (power cable incl.)	33 lbs. (15 Kg)
	Remote Control Pendant (cable incl.)	4 lbs. (1.8 Kg)
	Torch Bracket, TIG	1 lb. (.45 Kg)
	Torch Clamp Bracket	2 lb. (.9 Kg)
	5-Axis Mount	3 lbs. (1.4 Kg)
Plug-in Option	Advanced Programming Control	

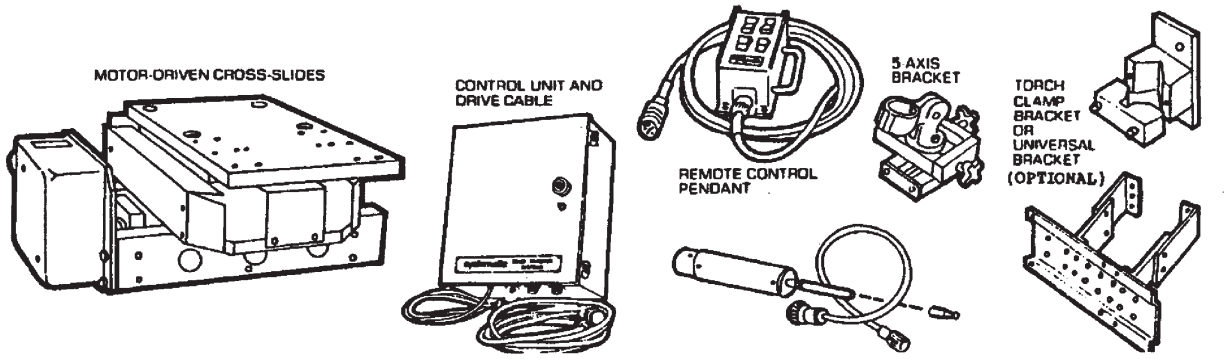


FIGURE 3 - ST450 SYSTEM COMPONENTS

TABLE 3 - ST450 SYSTEM SPECIFICATIONS

DESCRIPTION	SPECIFICATIONS	RATING
Load Capacity	12” (305 mm) from Faceplate	450 lbs. (204 Kg) Derated 15 lbs./inch (6.8 Kg/25.4 mm) beyond 12” (305 mm)
Standard Stroke Length	Vertical x Horizontal	5” (127 mm) x 5” (127 mm) or 10“ (254 mm) X 10“ (254 mm)
Non-Standard Stroke Length	Vertical x Horizontal	10” (254 mm) x 10” (254 mm) Inboard Drive Assy 24” (610 mm) x 24” (610 mm) Outboard Drive Assy
Minimum Envelope	Standard Stroke 5” (127 mm) x 5” (127 mm)	19” (431 mm) Diameter
Tracking Accuracy	Maximum Correction Rate 0 -35 ipm (890 mm/min.) under no load	Within .005” (1.27 mm)
Tracking Controls	Manual	Up/Down and Left/Right
	Automatic	Left/Right Sidetrack and Off
Drive System		Precision Ball Screw with Mechanical Override Clutch
Control Unit	Enclosure	Standard NEMA Style Sealed enclosure with provisions for plug-in options
Remote Control Pendant	Enclosure	Handheld or mounted steel enclosure containing manual and automatic tracking controls with provisions for plug-in options
Cross-Slide Cable	Standard Length	10’ (3 M)
Seam Sensor Cable	Standard Length	4’ (1.2 M)
Power Cable	Standard Length	6’ (1.8 M)
Pendant Cable	Standard Length	10’ (3 M)
Weights	Cross-slide Assembly (5” x 5”)	38 lbs. (16 Kg)
	Seam Sensor	1 lb. (.45 Kg)
	Control Unit (power cable incl.)	33 lbs. (15 Kg)
	Remote Control Pendant (cable incl.)	4 lbs. (1.8 Kg)
	Torch Bracket, TIG	1 lb. (.45 Kg)
	Torch Clamp Bracket	2 lb. (.9 Kg)
	5-Axis Mount	3 lbs. (1.4 Kg)
Plug-in Option	Advanced Programming Control	

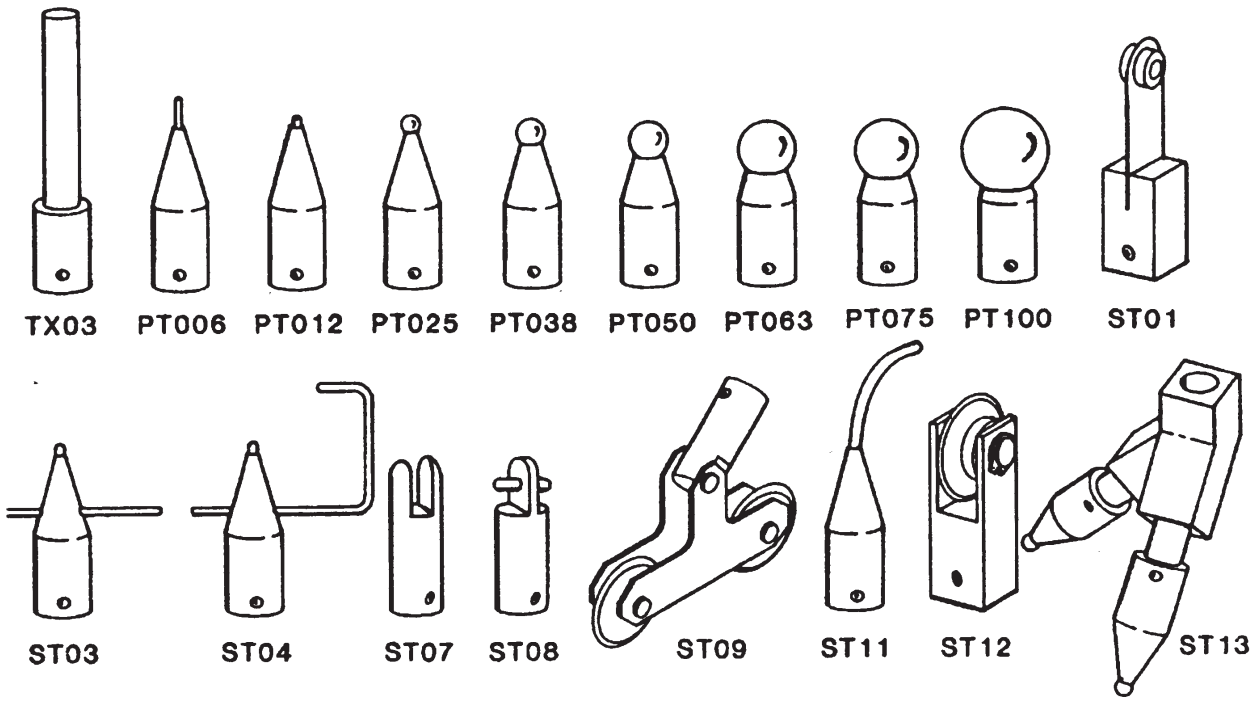


FIGURE 4 - SEAM SENSOR TIPS

TABLE 4 - SEAM SENSOR TIPS PARTS LIST

MODEL #	DESCRIPTION	PART #	ALTERNATE PART #
TX03	3” Extension Tip	1110-2107	179746
PT006	1/16” Diameter Round	1106-1974	179747
PT012	1/8” Diameter Round	1106-1923	179748
PT025	1/4” Diameter Ball	1106-2032	179749
PT038	3/8” Diameter Ball	1106-2024	179750
PT050	½” Diameter Ball	1106-2016	179751
PT063	5/8” Diameter Ball	1106-2008	179752
PT075	3/4” Diameter Ball	1106-1991	179753
PT100	1” Diameter Ball	1106-1982	179754
ST01	Blade & Roller	1103-0262	179755
ST03	Straight Side Extension	1103-0271	179756
ST04	Curved Extension	1103-0301	179758
ST07	Tack Weld Groove	1103-0289	179759
ST08	Tack Weld Fillet	1103-0327	179760
ST09	Tack Weld Over-ride	1103-0297	179761
ST11	Curved Tip	1103-0505	179763
ST12	Single Wheel Tip	1103-0319	179765
ST13	Twin Tip Assembly	1103-1209	N/A

TABLE 5 - FILLETS AND V-GROOVES

MODEL	DESCRIPTION
PT006	1/16” Dia. Round
PT012	1/8” Dia. Round
PT025	1/4” Dia. Ball
PT038	3/8” Dia. Ball
PT050	½” Dia. Ball
PT063	5/8” Dia. Ball
PT075	3/7” Dia. Ball
PT100	1” Dia. Ball

(See Figure 5 - Tip Selection, Fillet and V-Groove)

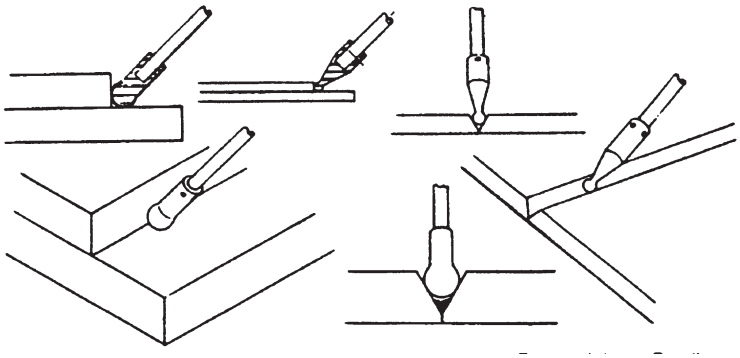


FIGURE 5 - TIP SELECTION, FILLET AND V-GROOVE

TABLE 6 - BUTT TYPE JOINTS

MODEL	DESCRIPTION
ST01	Blade and Roller

(See Figure 6 - Tip Selection, Butt Type Joints)

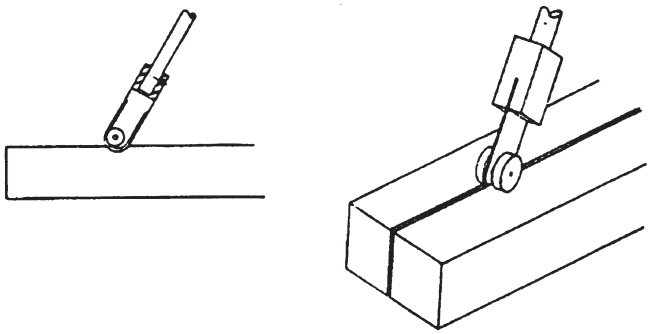


FIGURE 6 - TIP SELECTION, BUTT TYPE JOINTS

TABLE 7 - ADJACENT OR PARALLEL

MODEL	DESCRIPTION
ST04	Curved Side Extension

(See Figure 7 - Tip Selection, Adjacent or Parallel)

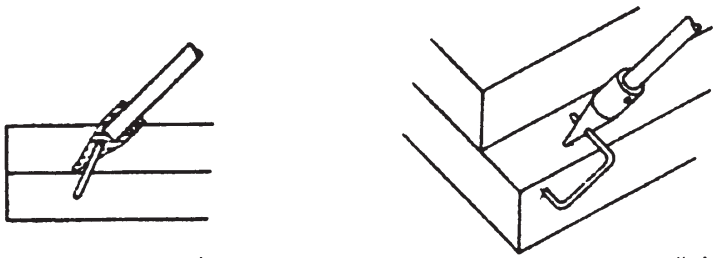


FIGURE 7 - TIP SELECTION, ADJACENT OR PARALLEL

TABLE 8 - TACK WELD GROOVES

MODEL	DESCRIPTION
ST07	Tack Weld Groove

(See Figure 8 - Tip Selection, Tack Weld Groove)

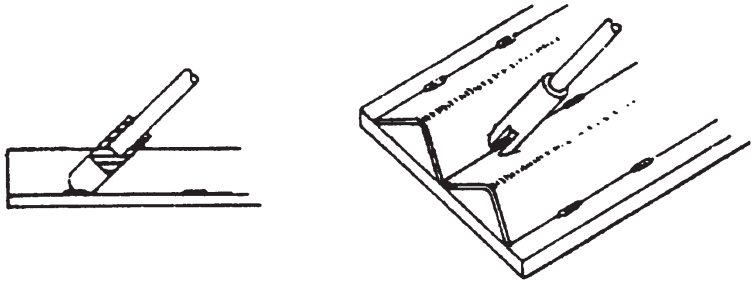


FIGURE 8 - TIP SELECTION, TACK WELD GROOVE

TABLE 9 - TACK WELD FILLET

MODEL	DESCRIPTION
ST03	Tack Weld Fillet
ST08	Straight Side Extension

(See Figure 9 - Tip Selection, Tack Weld Fillet)

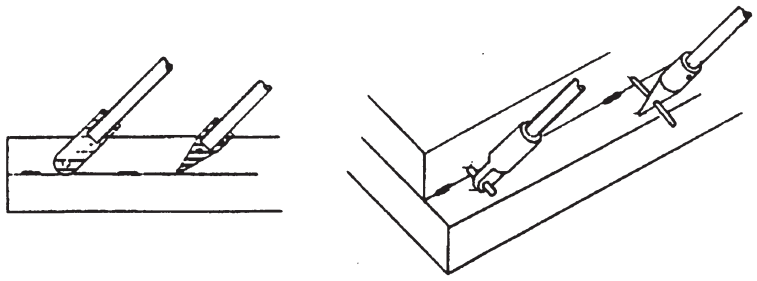


FIGURE 9 - TIP SELECTION, TACK WELD FILLET

TABLE 10 - TACK WELD OVER-RIDE

MODEL	DESCRIPTION
ST09	Tack Weld Over-ride

(See Figure 10 - Tip Selection, Tack Weld Over-Ride)

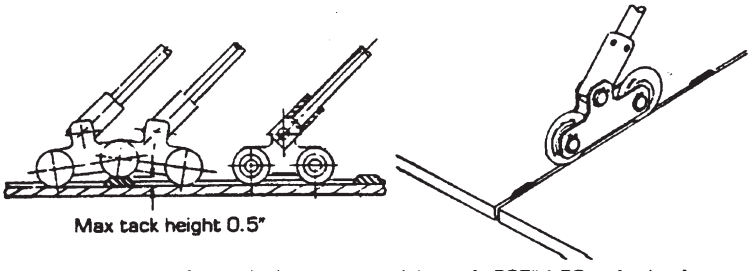


FIGURE 10 - TIP SELECTION, TACK WELD OVER-RIDE

TABLE 11 - TUBE MILLS

MODEL	DESCRIPTION
ST11	Single Wheel

(See Figure 11 - Tip Selection, Tube Mills)

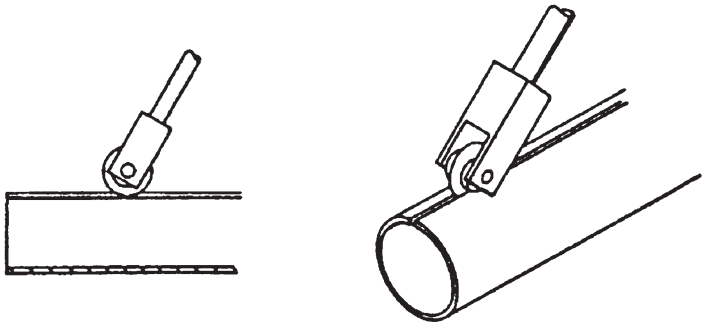


FIGURE 11 - TIP SELECTION, TUBE MILLS

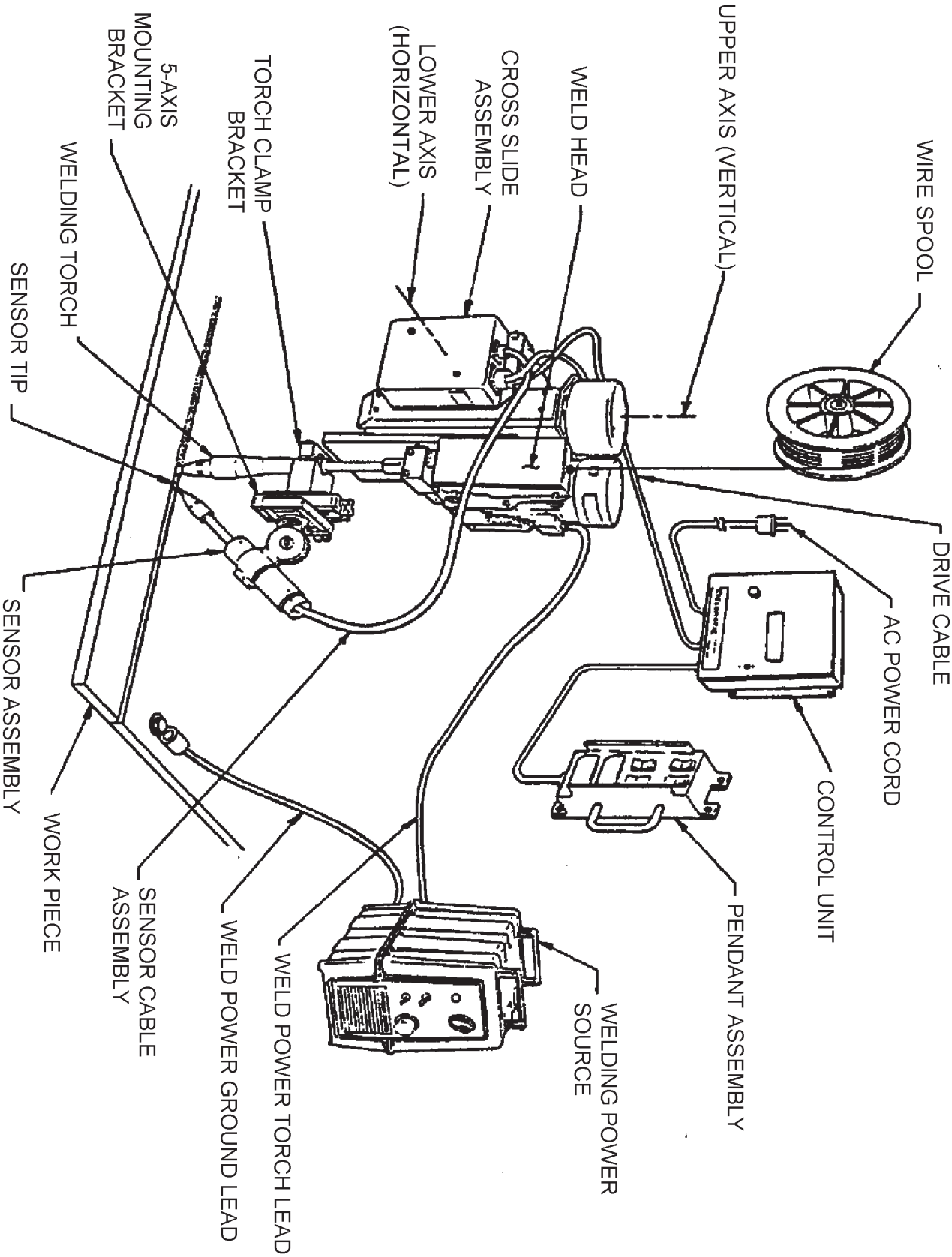


FIGURE 12 - INTERCONNECTION DIAGRAM

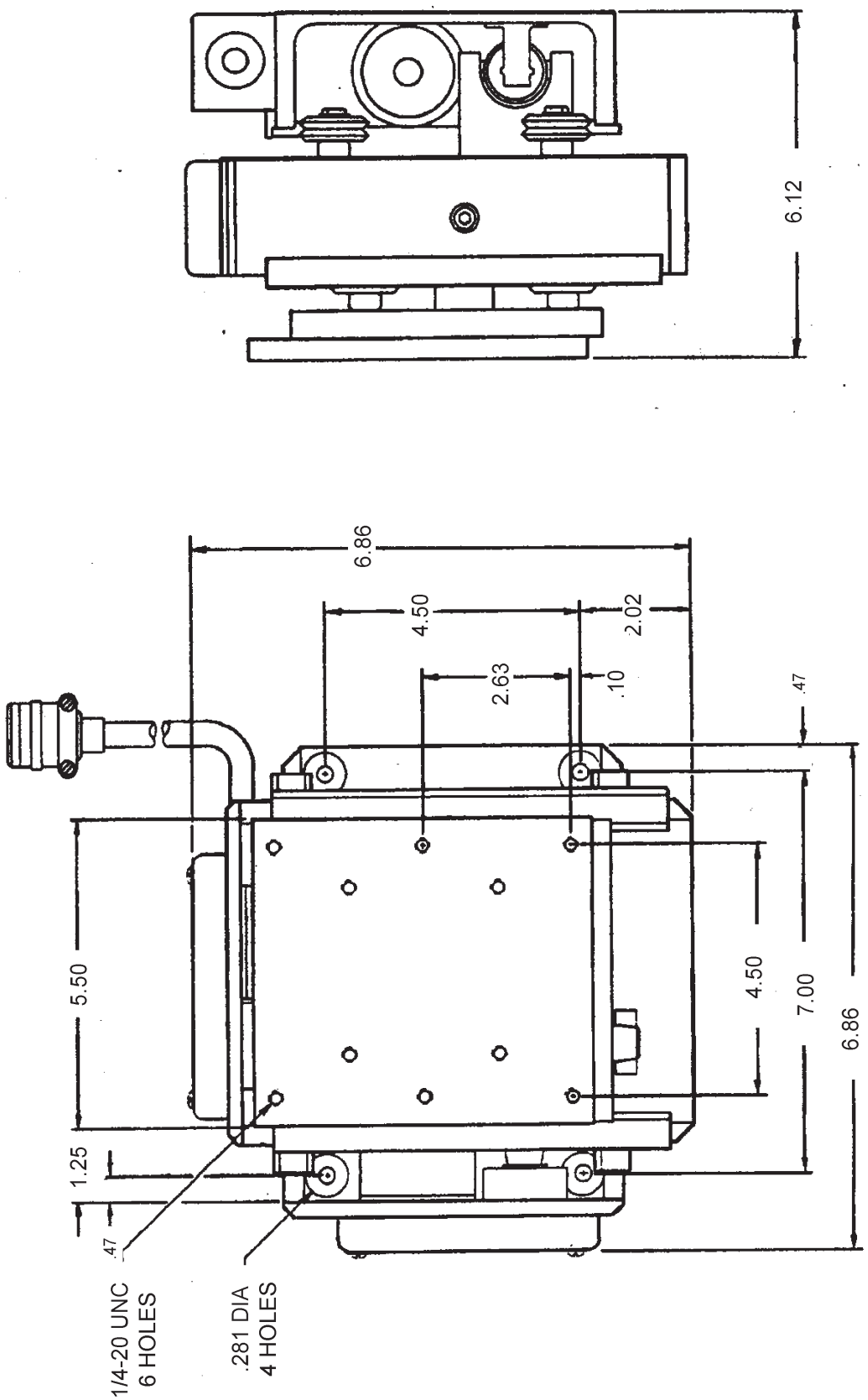


FIGURE 13 - ST40 CROSS-SLIDE MOUNTING DIMENSIONS

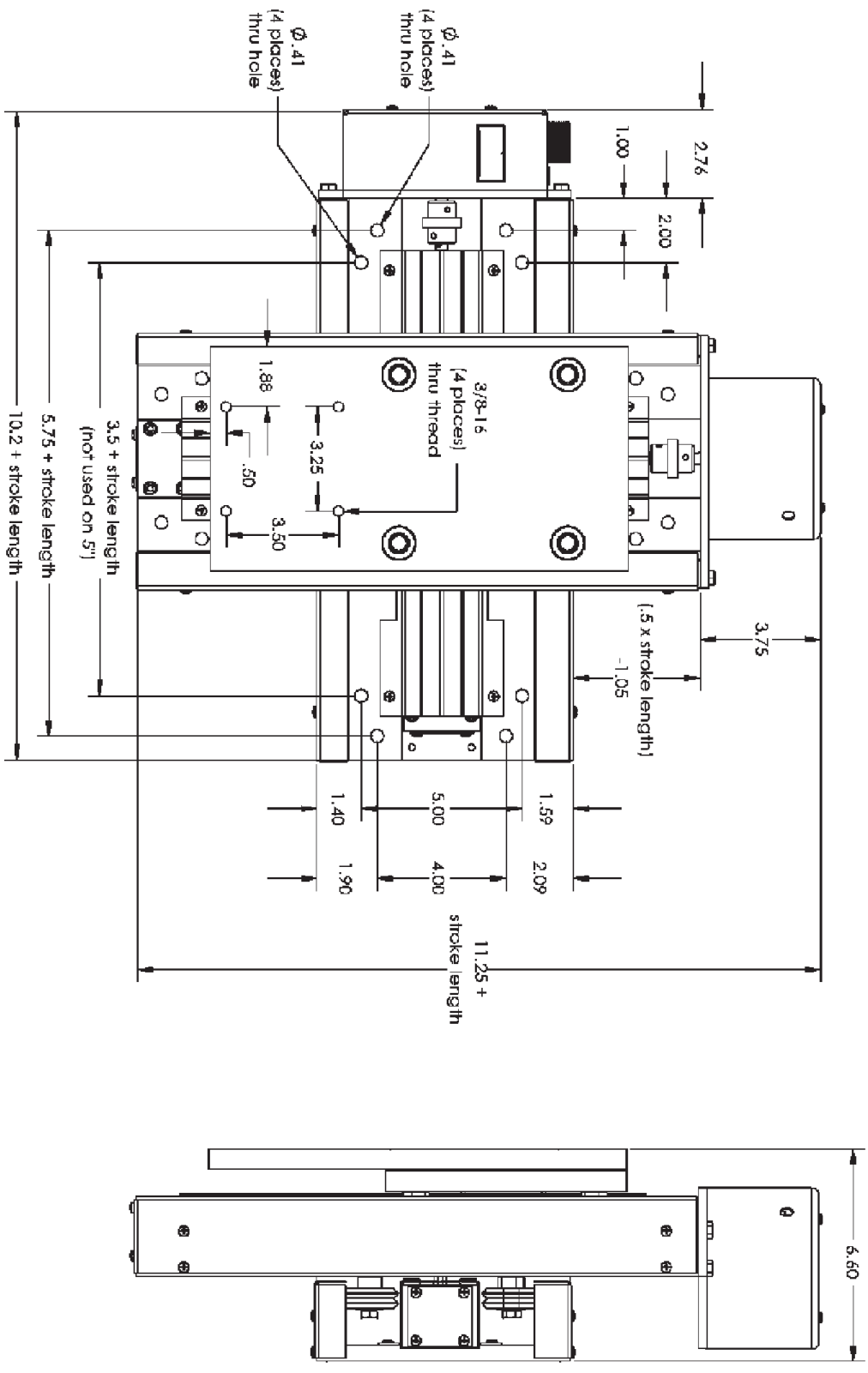


FIGURE 14 - ST250 CROSS-SLIDE MOUNTING DIMENSIONS

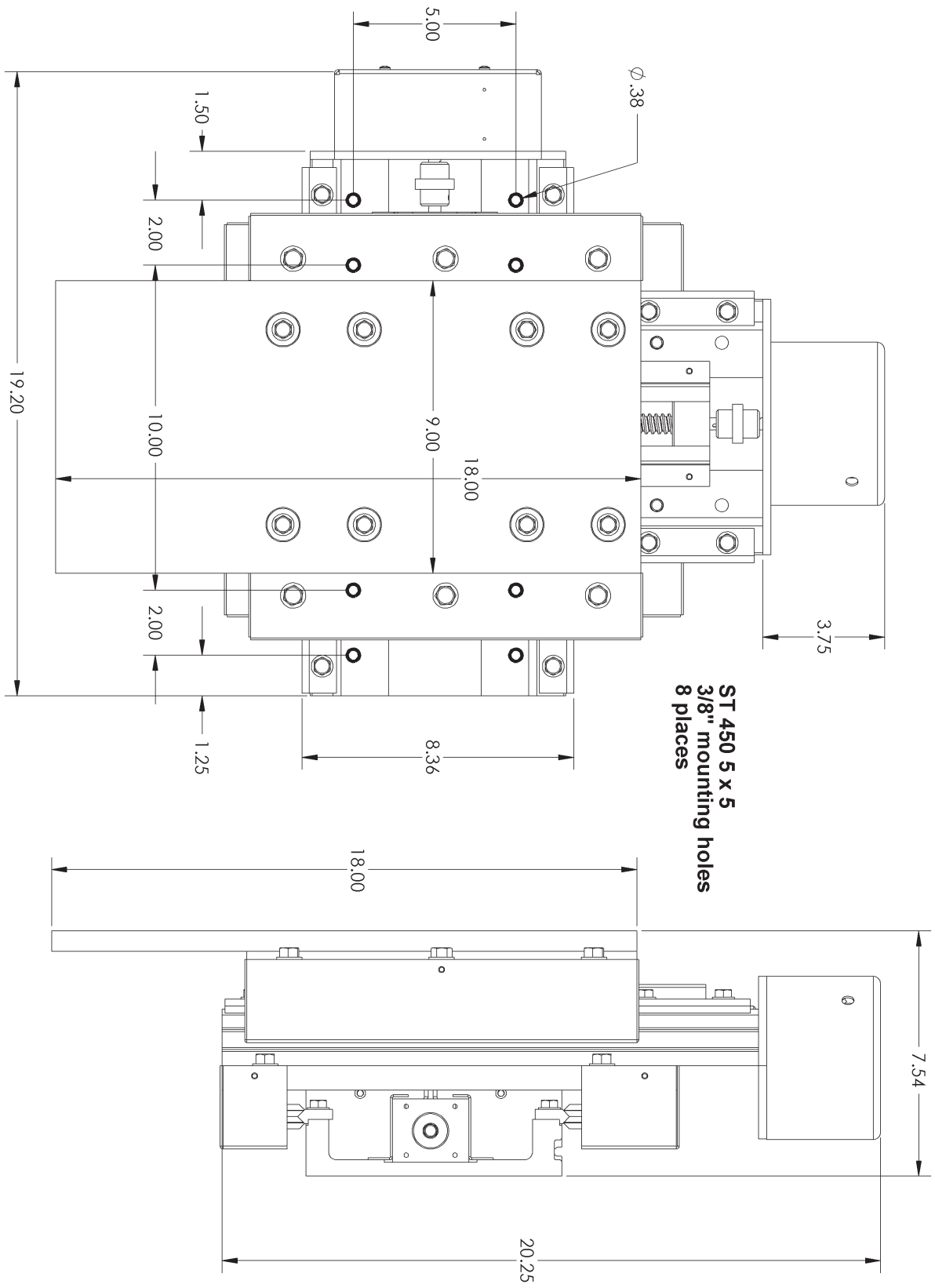


FIGURE 15 - ST450 5 X 5 CROSS SLIDE MOUNTING DIMENSIONS

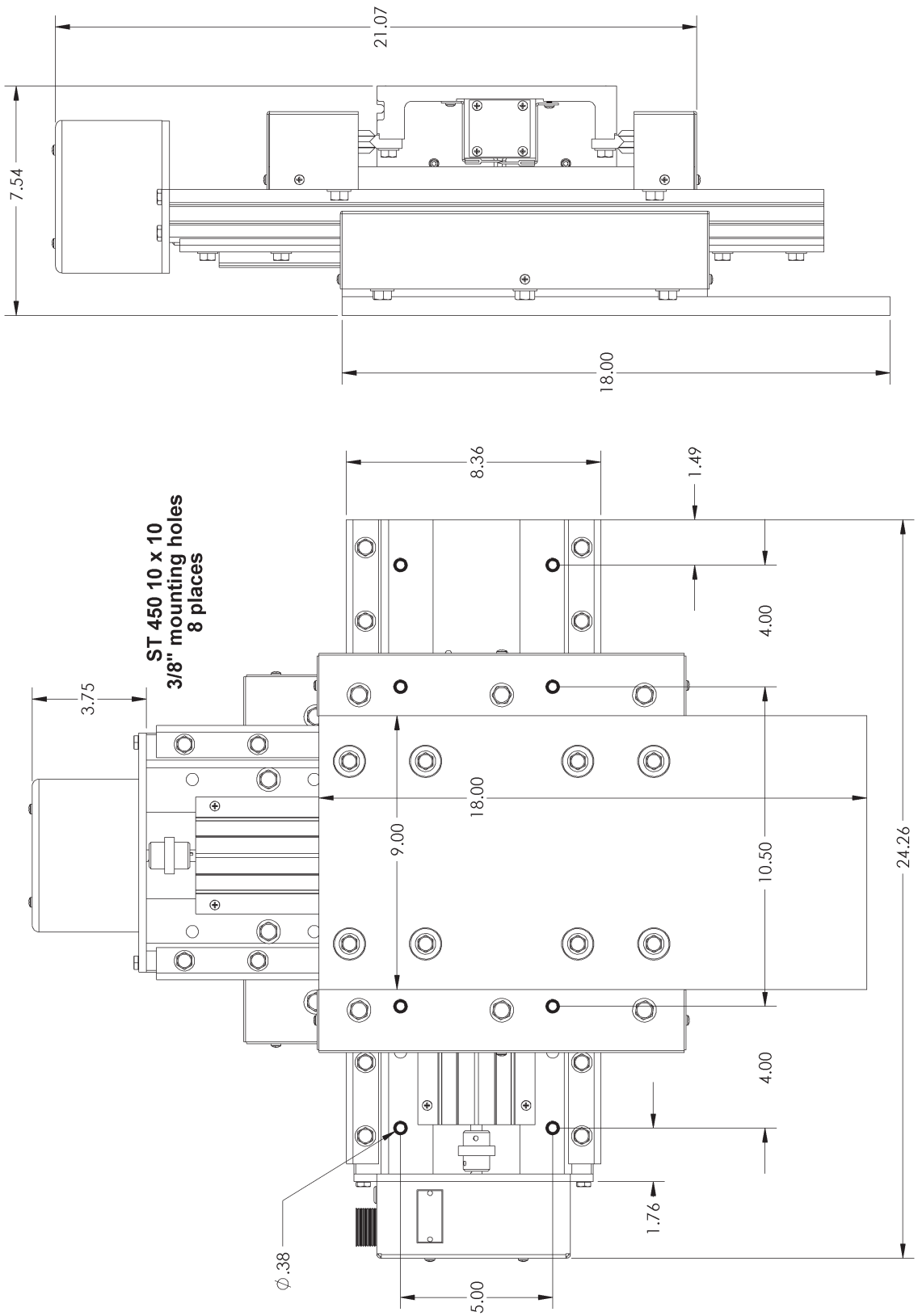


FIGURE 16 - ST450 10 X 10 CROSS SLIDE MOUNTING DIMENSIONS

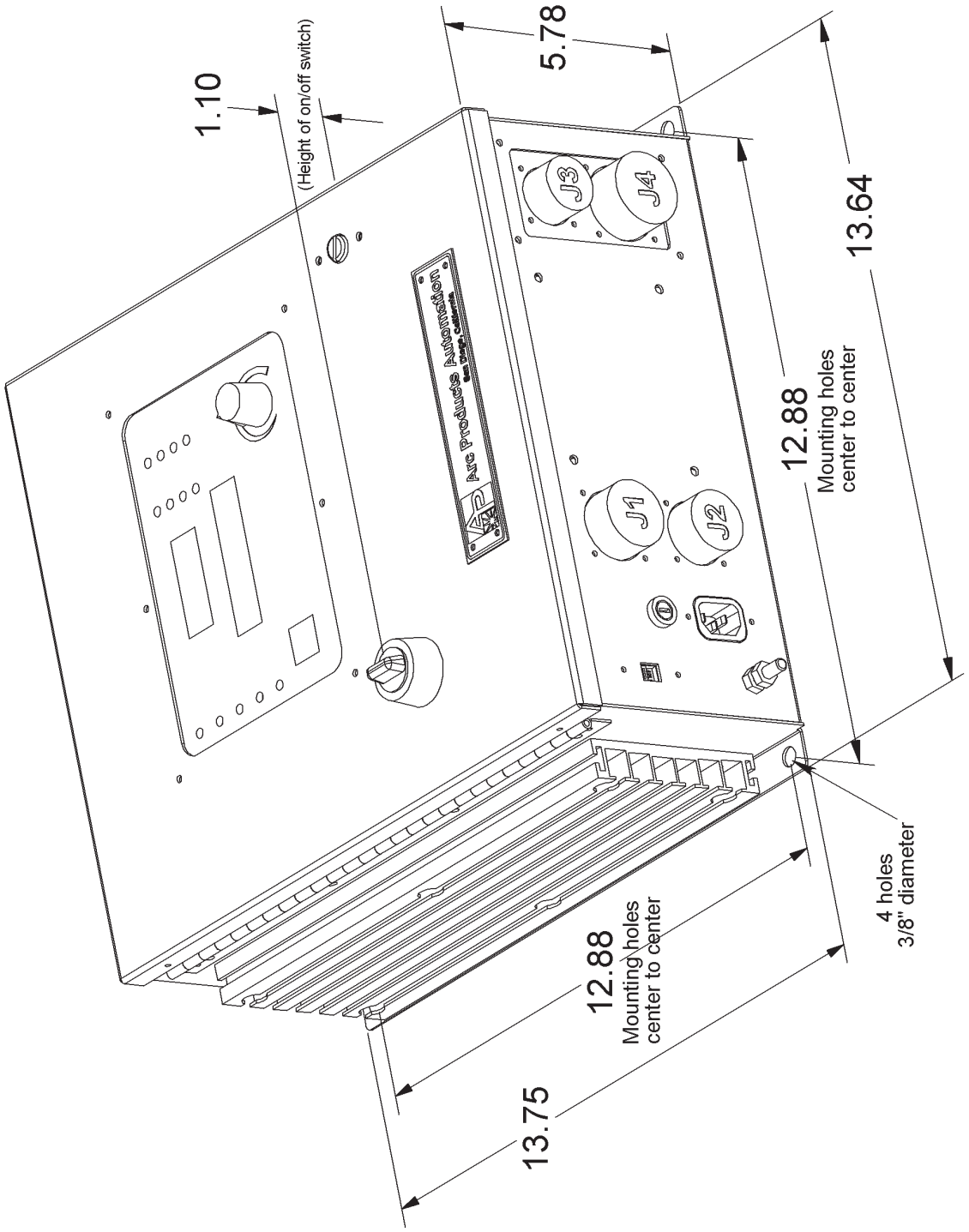


FIGURE 17 - CONTROL UNIT MOUNTING DIMENSIONS

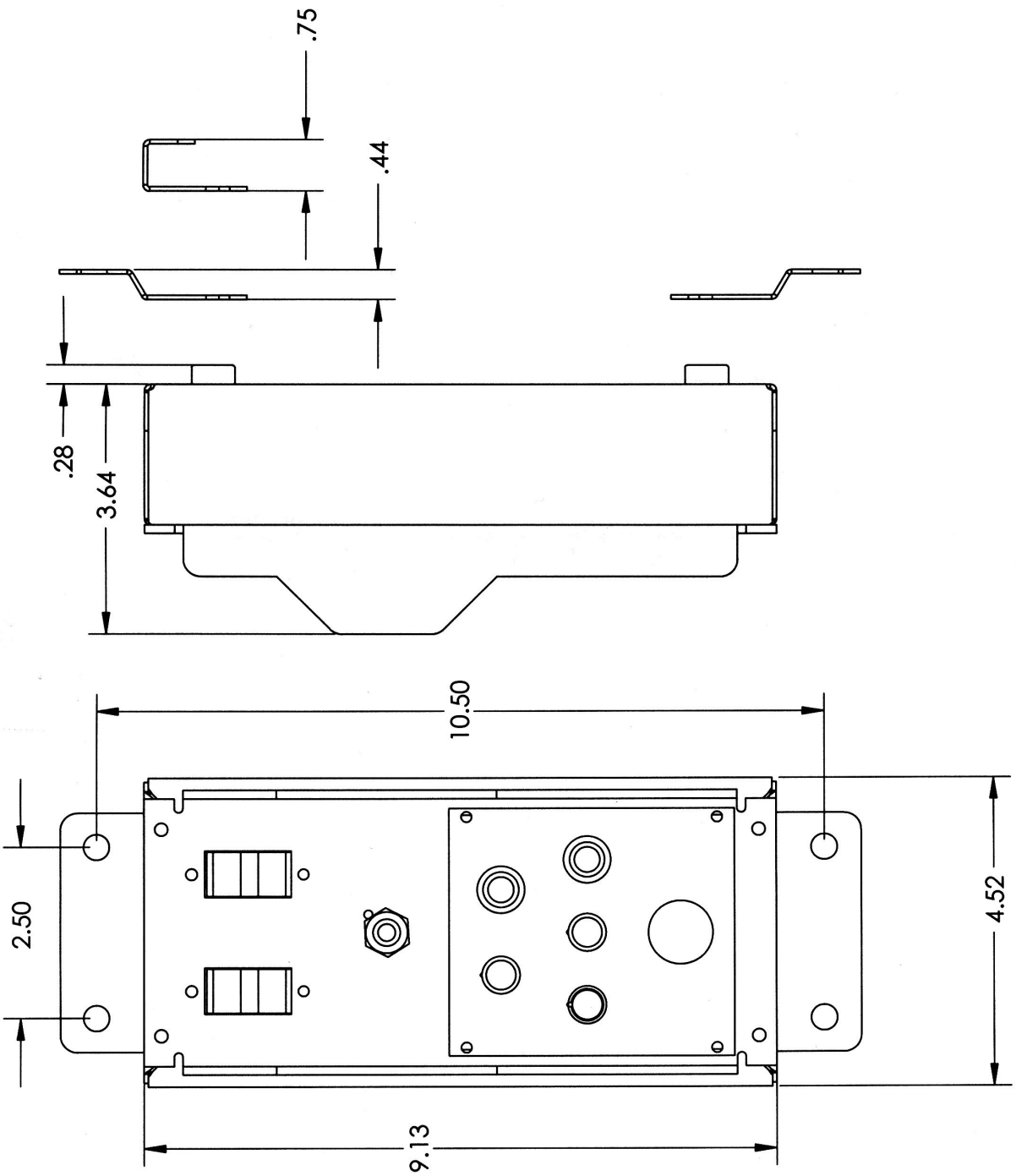


FIGURE 18 - CONTROL PENDANT MOUNTING DIMENSIONS

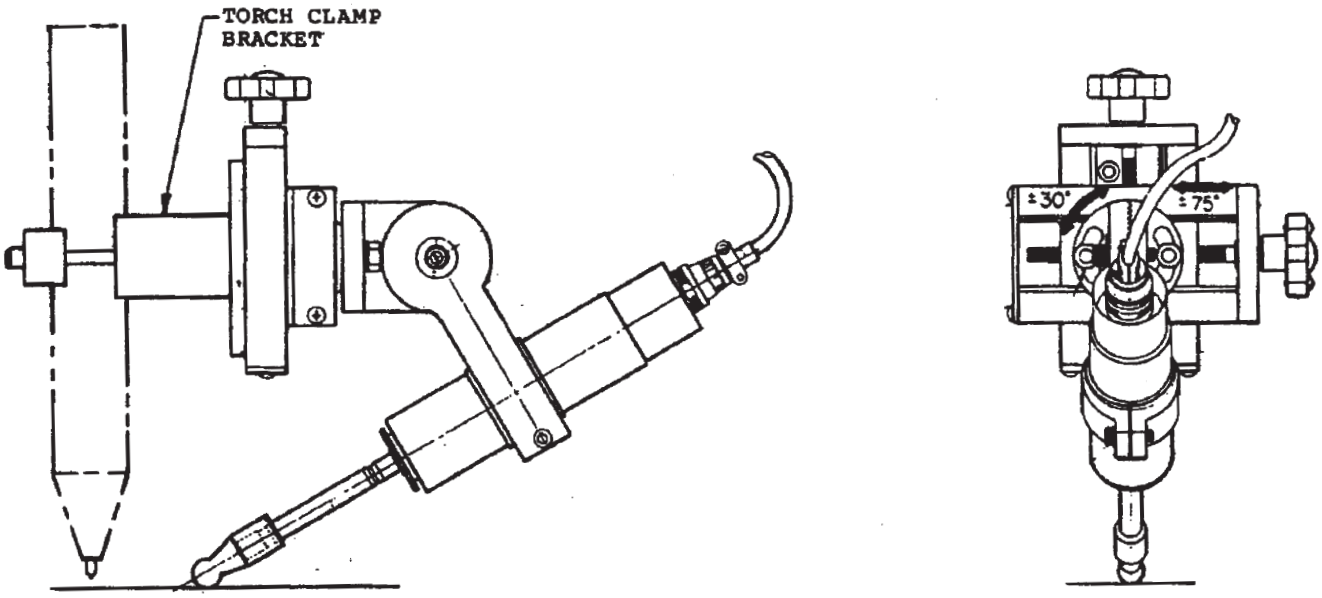
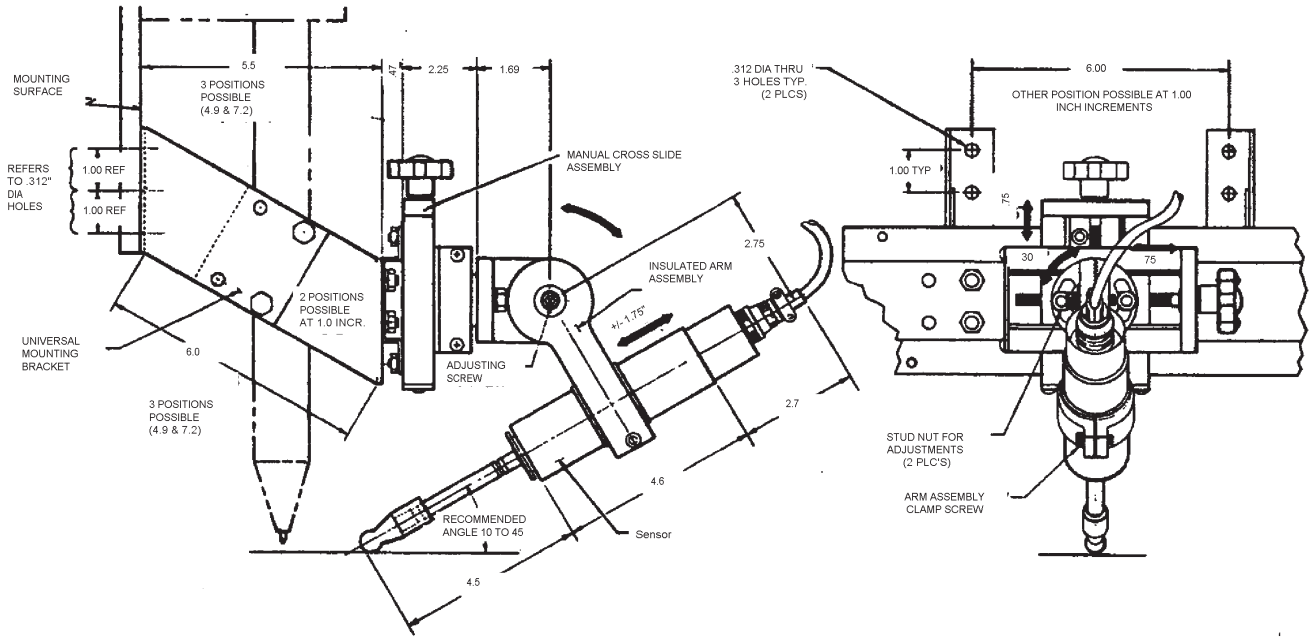


FIGURE 19 - SEAM SENSOR MOUNTING (STD. BRACKET)



SENSOR WITH UNIVERSAL BRACKET AND 5-AXIS
MOUNT SHOWN IN NORMAL MOUNTING POSITION.
VARIOUS ADJUSTMENTS ARE POSSIBLE AS SHOWN.

FIGURE 20 - SEAM SENSOR MOUNTING (UNIV. BRACKET)

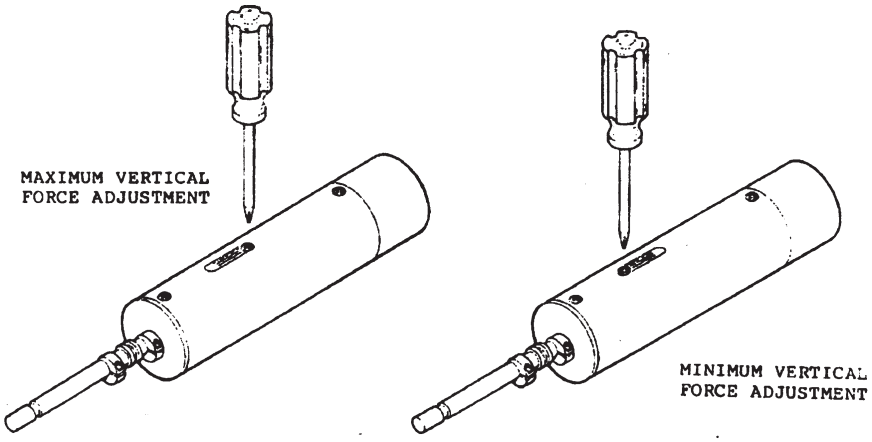


FIGURE 21 - VERTICAL FORCE ADJUSTMENTS

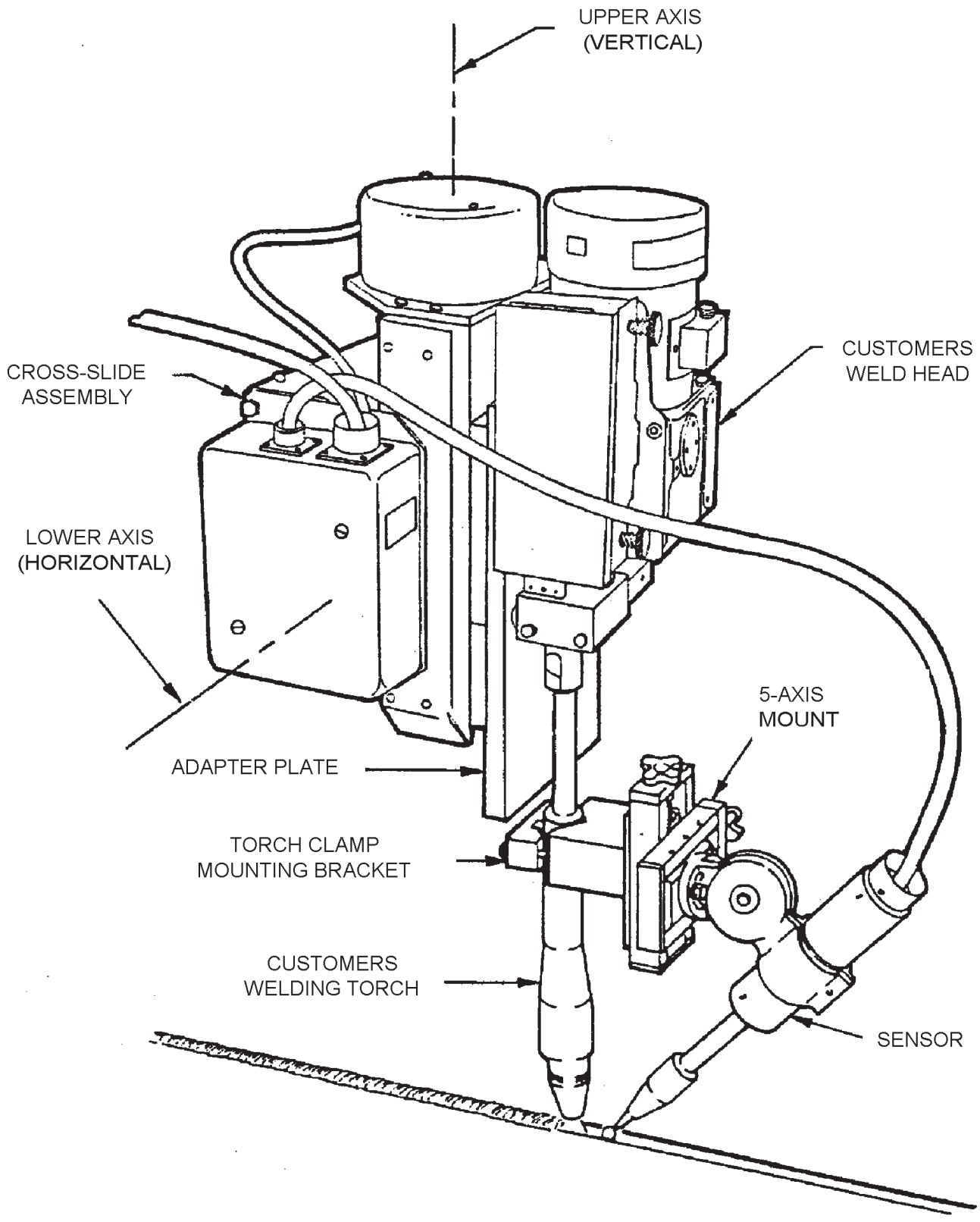


FIGURE 22 - TORCH CLAMP MOUNTING BRACKET

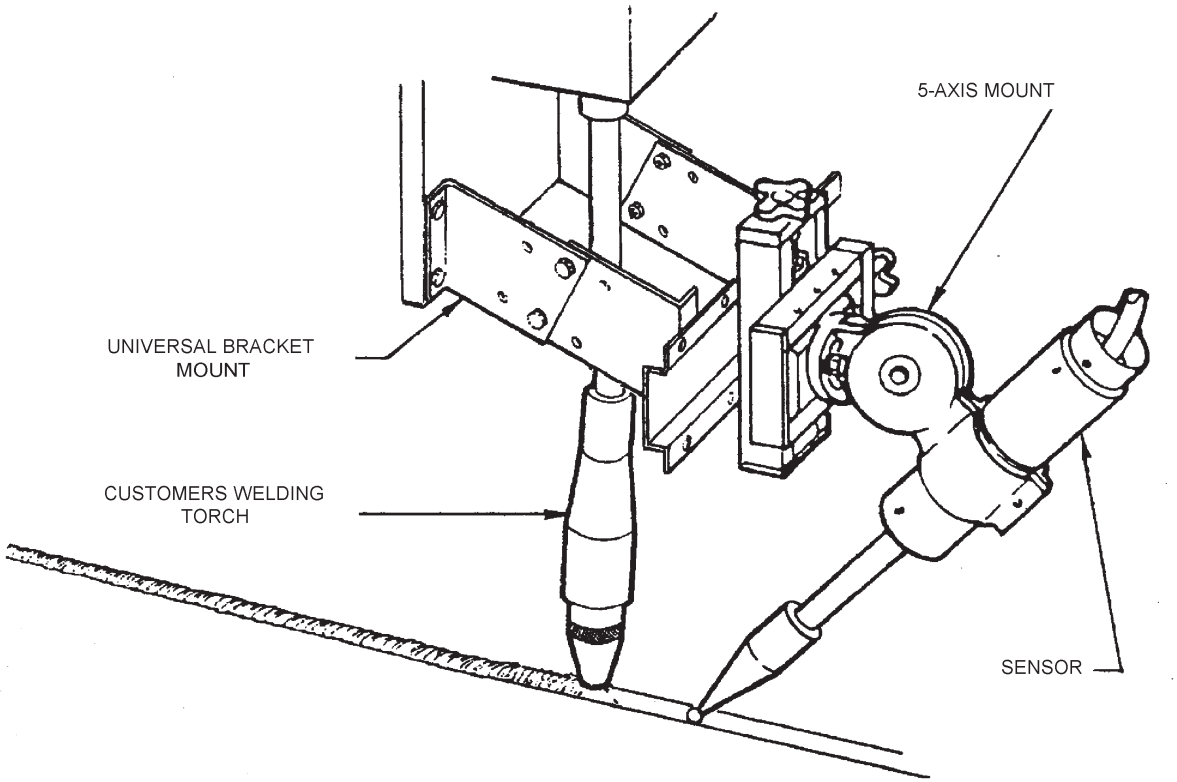


FIGURE 23 - UNIVERSAL MOUNTING BRACKET

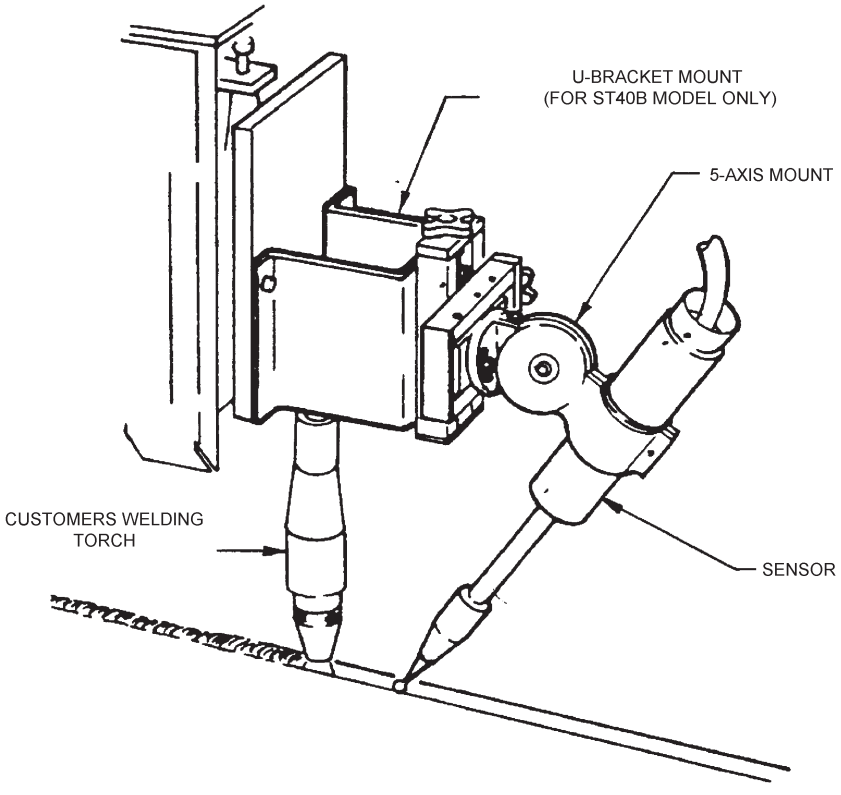


FIGURE 24 - OPT. U-BRACKET MOUNTING BRACKET (ST40)

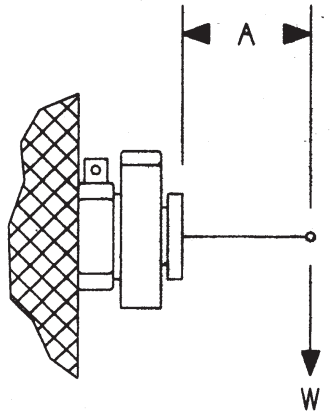


FIGURE 25 - SIDE VIEW, ST40

TABLE 12 - ST40 LOAD SPECIFICATIONS

"A" Inches	6	7	8	9
"W" lbs.	40	30	20	10
"B" Inches	6	7	8	9
"C" Inches	3	3.5	4	4.5
"D" Inches	2	2	2	2

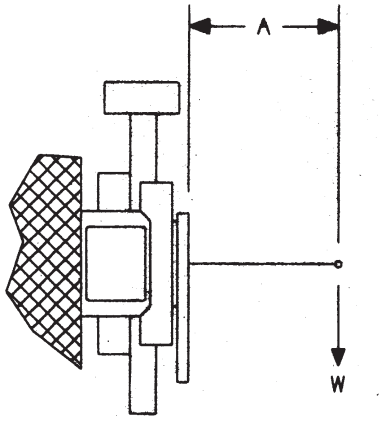


FIGURE 26 - SIDE VIEW, ST250

TABLE 13 - ST250 LOAD SPECIFICATIONS

"A" Inches	12	16	20	24
"W" lbs.	250	190	130	70
"B" Inches	12	16	20	24
"C" Inches	4	4	4	4
"D" Inches	3	3	3	3

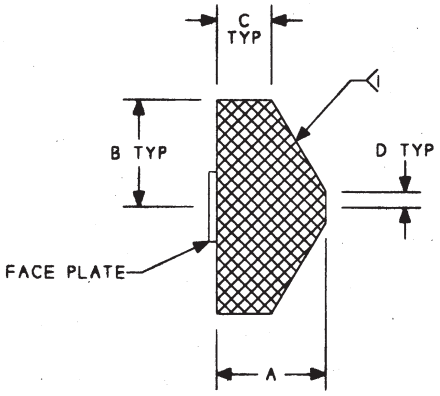


FIGURE 27 - LOAD SPECIFICATIONS ENVELOPE TOP VIEW

NOTE

1> Center of Gravity (CG) of load (W) to be within envelope.

2> ST600B Load Ratings determined with the lower axis positioned horizontally and upper axis positioned vertically.

OPERATION

DRIVE CABLE

The drive cable connects the cross-slide assembly to the control unit. It is used to transmit signals and power between the units. The standard drive cable is 10 feet long (for longer lengths, consult our factory).

CROSS-SLIDE ASSEMBLY

The seam tracker cross-slide assemblies are light weight compact designs consisting of two motorized linear slides mounted at right angles to provide X-Y axis positioning. Guidance along each axis is accomplished through the use of ball bearing vee wheels riding on hardened steel tracks which are in turn mounted to thick wall aluminum channel sections forming the basic structure.

Wheels and tracks are factory adjusted to remove play and provide smooth uniform motion along the full stroke. A DC gear motor coupled to a drive screw provides linear motion along each axis. The drive screws are ball bearing mounted, and are specially constructed to free wheel at the end of travel in each direction. This prevents damage should the unit reach the end of stroke and eliminates the need for limit switches.

Seam tracker model numbers indicate the acceptable load rating of the cross-slide assembly, e.g., ST40 is rated at 40 lbs. Load (see Table 1 - ST40 System Specifications and Table 13 - ST250 Load Specifications beginning on page 4).

Some seam tracker models, such as the ST250, include a brake mounted on the vertical motor shaft. With power removed either by switching power off or disconnecting the control cable, the brake is actuated and prevents creep in the slides when heavy loads are applied. In some cases special adjustment may be required (see Troubleshooting Section).

Electrical connections are made at the junction box or the motor cover mounted to the lower slide depending on the model. Connectors are provided for attaching the control and seam sensor cables to the slide assembly.

An adapter plate is furnished which mounts to the face plate of the cross-slides. Insulation is provided between the face plate and adapter plate as well as on the seam sensor mount to permit mounting of electrically "hot" torches or weld heads without danger of electrical currents shorting to the drive unit or work piece. Holes can be added to the adapter plate for mounting wire feeder, weld head, torch, wire spool, etc. Torch clamp brackets are furnished to mount the seam sensor in the proper position relative to the torch and seam. Optional mounting bracketry is also available on certain models.

SEAM SENSOR AND ACCESSORIES

The APA seam sensor assembly is a two-axis sensing device. When connected to the appropriate control electronics, deflection of the pivoted rod end results in an electrical signal proportional to the amount of deflection from a set null position. By causing the end of the rod to ride in a groove or along the edge of a work piece, the position of the material to be welded can be indicated. Signals from the seam sensor are translated by the control unit which in turn provides drive signals to the motors on the slides, thus keeping the weld head positioned properly relative to the seam.

A standard 1/8" diameter round end tip and tip extension are provided with each unit. Other standard tips are available for applications on most weld joint configurations. Some of these tips are shown in Figure 4 - Seam Sensor Tips on page 7, along with a selection table for standard tips in Table 4 - Seam Sensor Tips Parts List on page 7.

The ball style tips have a cobalt steel ball at the tip end. A shielded seam sensor cable, 4' length is provided for system interconnection.

Principle of Operation

The seam sensor rod end is spring loaded to provide centering about a null position in the horizontal direction and at the same time force the rod down toward the work piece in the vertical direction.

A flat groove lengthwise along the cylindrical outer case of the seam sensor provides orientation and is to be positioned away from the work piece. Two additional grooves are provided for special applications (see Figure 19 - Seam Sensor Mounting (Std. Bracket) on page 17).

The sensing device used in the APA seam sensor is designed for ruggedness and simplicity of operation. It consists of a two-axis variable reluctance sensor which is fully encapsulated in the end housing of the sensor. Movements of a magnetic coupling block on the end of the sensor rod causes an electrical imbalance in the sensor coils, resulting in an indication of rod deflection from the null position. This unique approach requires no mechanical contact between the sensor rod and the control circuitry, thus the unit is rugged and resistant to wear or damage from normal use:

5-AXIS MOUNT

The 5-axis mount supports and positions the seam sensor relative to the weld torch. It includes a manual cross-slide assembly and an insulated arm assembly. The manual cross-slides allow fine positioning over a 1.5 inch range in the vertical and horizontal axes. The insulated arm assembly clamps the seam sensor and permits adjustment of its angular orientation to the weld torch in three different planes.

NOTE

Special non-standard 5-axis mounts of up to 6 inches in stroke length are also available.

CONTROL PENDANT AND CABLE ASSEMBLY

The standard control pendant has two sealed rocker switches and one sealed joystick switch mounted in an aluminum housing suitable for handheld or mounted operation. The switches are:

Rocker Switches

- MODE (Manual/Automatic)
- SIDETRACK (Left/Off/Right)

Joystick Switch

- MANUAL (Up/Down) and (Left/Right)

The control pendant connects to the control unit with a 10 foot standard cable attached.

SPECIAL LENGTH CABLE ASSEMBLIES

Special length cables and extension cables can be made to order for the control pendant to the control unit in lengths to 60 feet and for the cross-slide assembly to the control unit up to 95 feet.

NOTE

Long length, non-standard cables normally require heavier gauge conductors to reduce voltage drop. Consult factory before making cable length changes from standard as system performance may be affected.

STANDARD OPTIONS

Several standard options are available for use with standard seam tracker systems. These options include electronic features for special welding operation controls and other mechanical options (e.g., Rotary Table Bracket illustrated in Figure 57 - Rotary Table Bracket on page 84) to enhance the system performance and adaptability. These options are described in the OPTIONAL EQUIPMENT section.

TIP SELECTION GUIDE

These tips are used for most conventional fillet and V-Groove joints. Small diameter balls are generally utilized on thin machine cut parts without tacks or spatter. Larger diameters are generally utilized on rougher cut parts to allow smoother movement over grooves, multi pass welds, tacks, splatter, etc. Examples of these tips and applications are illustrated in Figures 4, 5, 6, 7, 8, 9, 10 and 11 beginning on page 7.

INSTALLATION

INFORMATION

ALL INSTALLATIONS TO BE MADE WITH AC POWER OFF.

A typical APA Seam Tracker interconnection diagram is shown in Figure 12 - Interconnection Diagram on page 10. The major system components are listed below. When unpacking, check all items for damage and make certain nothing is missing.

- Seam Tracker Cross-Slide Assembly
- Adapter Plate
- Drive Cable
- Seam Sensor Assembly with Tip and Cable
- 5-axis Seam Sensor Mount Assembly
- Mounting Bracketry; ST40 -"U" Bracket, ST250 Torch Clamp Bracket (STD) or Universal Bracket (OPT)
- Control Pendant
- Control Unit
- Options (as ordered)

All required lubrication has been performed at the factory and needs no further attention at this time. The interconnecting cables are standard length; however, other lengths may be ordered, if needed.

CROSS-SLIDE ASSEMBLY MOUNTING

APA Cross Slide models ST40 (Figure 13 - ST40 Cross-Slide Mounting Dimensions on page 11) and ST250 (Figure 14 - ST250 Cross-Slide Mounting Dimensions on page 12) outline drawings show the size and location of the holes for mounting the unit in any required position. The mounting surface must be nearly flat to assure that no twist will be applied to the base of the slide assembly when it is bolted down, causing a bind in operation.

Also, the mounting surface must be rigid to prevent movement or vibration of the unit during operation. For proper operation, the slide assembly must be oriented correctly with respect to the weld. The lower (horizontal) axis is mounted parallel to the plane of the weld, and the upper (vertical) axis is mounted perpendicular to the plane of the weld (see Figure 12 - Interconnection Diagram on page 10).

Once the cross-slide assembly has been mounted, make certain that adequate clearance is maintained between the moving slides and any protrusion that could restrict the full travel of the slides or interfere with the movement of the electrical cable.

SEAM SENSOR MOUNTING

WARNING

The vertical axis of the seam sensor must be in line with the vertical axis of the weld torch and cross-slide assembly for proper operation.

The seam sensor is installed in the insulated arm assembly mounting clamp hole by aligning the seam sensor orientation key with the proper key-way on the seam sensor, and inserting the seam sensor into the clamp. The proper key-way for normal use is the center key-way without screws installed (See NOTE below). The seam sensor is clamped securely to the insulated arm assembly by tightening the cap screw on the arm assembly clamp.

Left or right angular adjustment of the seam sensor relative to the work is made by loosening the stud nuts on the arm assembly base, rotating the base to the desired angle and re-tightening the stud nuts.

NOTE

Some installations may require extreme left or right angular adjustments. These situations may require additional compensation to keep the seam sensor axis properly oriented. Two additional key-ways in the casing are provided for this purpose with two small screws installed to prevent unintentional use. If it is necessary to utilize one of these key-ways remove the screws first.

Vertical angular positioning is acquired by loosening the cap screw on the arm assembly and rotating one side of the serrated arm until the seam sensor is positioned to provide vertical sensing in close proximity to the welding torch. It may also be necessary to loosen the cap screw on the insulated arm assembly mounting clamp at this time and in combination with angular positioning, described above, to obtain the optimum position and orientation for vertical sensing relative to the weld joint and torch.

For best results, an angle of less than 45 degrees should be maintained between the seam sensor and the work piece (Figure 19 - Seam Sensor Mounting (Std. Bracket) and Figure 20 - Seam Sensor Mounting (Univ. Bracket) beginning on page 17). Steeper angles may be used, however, performance is degraded as the angle is increased and proper operation should be verified in each application. The seam sensor tip should be located as close to the welding torch as possible. (½" to 1" ahead of torch is acceptable for most applications).

SEAM SENSOR TIPS

Seam sensor tips are installed and removed by tightening or loosening the set screws in the tips. The seam sensor rod or extension rod should be fully inserted into the tip for proper installation.

SEAM SENSOR VERTICAL SPRING FORCE ADJUSTMENT

APA seam sensor's are equipped with a feature to allow mechanical adjustment of vertical spring force. This feature is useful for optimizing operation in various welding applications.

On the side of the seam sensor case opposite the key-way groove is a slot approximately one inch long. In this slot is a panhead screw, which when loosened ½ turn can be moved to various positions in the slot. The location of this screw determines the amount of vertical force that the seam sensor exerts on the work-piece during tracking. Move the screw away from the rod end and toward the connector to achieve maximum spring force (Figure 21 - Vertical Force Adjustments on page 18). Move the screw toward the rod end to achieve minimum spring force. Varying degrees of force occur at intermediate positions between the two extremes.

IMPORTANT

Re-tighten the screw once the proper adjustment has been made.

Minimum force is recommended when sidetracking across a work-piece surface occurs. The drag on the tip is minimized and the seam sensor will move at a more uniform speed and is not likely to stop prematurely due to roughness or friction of the work surface.

Maximum force is suggested when tracking “V” grooves at high rates of speed or when the groove is shallow and not well defined. The increased pressure provides more tracking force in the downward direction.

SEAM SENSORS AND 5-AXIS MOUNT ASSEMBLY

The standard ST250 model is furnished with a torch clamp mounting bracket designed to fit most weld torches and give proper mounting for the seam sensor 5-axis mount. Figure 22 - Torch Clamp Mounting Bracket on page 19 illustrates a typical mounting with the torch clamp bracket attached to the barrel of the torch.

An optional universal bracket is also available for models ST250. Designed for a multitude of configurations to fit most weld heads, these brackets can be extended to several positions as well as reversed, Figure 20 - Seam Sensor Mounting (Univ. Bracket) on page 17 illustrates typical mounting.

The standard ST40 model is furnished with a "U" shaped metal bracket for mounting the seam sensor manual slide assembly. A set of “V” clamps is provided for clamping a torch barrel. Several hole patterns are provided for alternate mounting. The adapter plate on the ST40 may be inverted to provide an additional configuration. The mounting bracketry used on models ST250 can also be used on model ST40, if required.

CONTROL PENDANT INSTALLATION

The seam tracker control pendant is constructed from a rugged steel housing with mounting brackets (see Figure 18 - Control Pendant Mounting Dimensions on page 16). The control pendant has a standard cable length of 10 feet. Special cable lengths are available upon request.

Complete control of the seam tracker system is achieved through the sealed rocker switches which are in the cover of the control pendant. Manual operation of the vertical and horizontal axes, sidetrack to the right or left and automatic control, as well as the Advance Programming Control option plug-in for the Seam Tracker, are handled with the control pendant assembly.

CONTROL UNIT INSTALLATION

On page 15, Figure 17 - Control Unit Mounting Dimensions shows the size and location of holes for mounting the control unit in the proper position. It should be located for ready access to the power switch and allow clearance for opening the hinged door. This allows for inspection, replacement of parts or installation of the Advanced Programming Control components, when necessary.

Another important consideration is to make certain that the control unit has unrestricted air flow over the cooling fins to assure adequate cooling during operation.

A chassis ground lug is located near the power cord/RFI Filter connection. Care must be taken that this be connected to a solid earth ground (Protective Earth or PE) in a high noise environment. All system components except the seam sensor and control pendant are connected to chassis ground through cable shields.

WELD HEAD INSTALLATION

Weld head installation is made by bolting the weld head to the cross-slide assembly adapter plate. This plate can have additional holes drilled to accommodate the users weld head, as required. The user must ensure that any added holes or hole patterns permit proper orientation of the weld head and torch axis to the drive axis. Review Figure 12 - Interconnection Diagram on page 10 and Figure 20 - Seam Sensor Mounting (Univ. Bracket) on page 17 prior to assembly of the weld head to the adapter plate, and before drilling any additional holes.

SYSTEM INTERCONNECTION

Once the cross-slide assembly and control unit are properly mounted, the cables can be connected for operation. On page 15, Figure 17 - Control Unit Mounting Dimensions shows connector arrangement on the control unit. Connect the control pendant to J1 on the control unit. The drive cable connects to J2.

NOTE

Model ST40 drive cable is permanently attached to the slide assembly. On all other models it is a separate cable assembly which also has a connector at the slide.

Additional connectors may be used in conjunction with various options to provide relay switching for remote initiation of welding power, carriage, travel, etc. These connectors mount in the provided blank panel when used (see Advanced Programming Control).

The seam sensor cable assembly connects the seam sensor to the junction box or connector on the cross-slide assembly. Refer to Figure 12 - Interconnection Diagram on page 10, which illustrates typical system interconnection.

WARNING

For your own safety and to ensure proper operation of this equipment, read this manual and all operating precautions before operating the equipment.

With the power off:

a) Read this entire Operator's Manual prior to operation of the APA Seam Tracker System.

b) Be sure that adequate eye protection and ventilation is provided in the vicinity of the welding area.

Be sure that all insulators and protective covers on the torch and torch lead connections are in place.

Check the following connections on the seam tracker system:

- Control Unit to Cross-Slides
- Cross-Slides to Seam Sensor
- Control Pendant

Insure that all are properly installed prior to applying power to the control unit.

Insure all cables are of adequate length and clear of moving parts to prevent possible damage during operation.

DURING OPERATION

Keep fingers, hands, etc. away from the cross-slides during operation of the seam tracker.

NOTE

When unit is on and in manual mode, downward drift may occur under heavy load conditions. Directions for correcting this condition can be found in the TROUBLESHOOTING section.

DURING MECHANICAL ADJUSTMENTS

Ensure that the AC power is disconnected from the control unit to prevent possible shock when adjusting the control unit, and accidental operation of moving parts being adjusted.

DURING ELECTRICAL ADJUSTMENTS

Do not disconnect connectors or remove circuit boards when the power is connected at the control unit.

INITIAL SET-UP INSTRUCTIONS

To take full advantage of seam tracker stroke capability, the cross-slide assembly should be positioned at the center of both horizontal and vertical strokes. Weld torch mounting should be such that it is approximately in its nominal welding position relative to the weld joint. This then allows for error compensation in all directions during welding. There are exceptions to this, however.

For example, you may want the majority of the vertical stroke to be available for manually driving the slides upward and clear of the part after welding for inspection, part removal and insertion of a new part. When mounting the seam sensor and its bracketry , adjust the brackets and mounting hardware to position the seam sensor in the proper relationship to the torch (see Figure 19 - Seam Sensor Mounting (Std. Bracket) and Figure 20 - Seam Sensor Mounting (Univ. Bracket) beginning on page 17). Keep the manual seam sensor cross-slides at approximately their center position to permit fine adjustment later.

Certain weld joint configurations will require use of the Sidetrack feature of the seam tracker system. The sidetracking force required should be set up at this time. Follow the instructions under Operating Sequence, page 28, to place the seam sensor in position.

Sidetrack Force Adjustment

Adjustment of Sidetrack Force is possible through the use of the adjustment potentiometer on the Seam Tracker Main Board (see Figure 30 - Sidetrack Force Adjustment on page 38) in the control box. This adjustment varies the pressure to the left or right, depending upon the Sidetrack switch position. A CCW rotation of the knob reduces this pressure and a CW rotation increases the pressure (see Figure 30 - Sidetrack Force Adjustment on page 38).

OPERATING SEQUENCE

Work Engagement Sequence

The user insures that the Seam Tracker System has been properly installed and the initial set-up has been made. Next, AC power is connected to the control unit. The control unit power switch is turned CW to the ON position. The Switch Lamp should turn “On”, indicating that the system is ready for operation (if the light is not on, refer to the Troubleshooting Section later in this manual).

The user can now operate the Seam Tracker System manually according to the instructions in this manual.

Review these instructions before allowing the seam tracker/sensor to touch the work and/or begin tracking the seam. Then proceed as follows:

- Manually drive the vertical axis down until the seam sensor contacts the work and its rod is approximately parallel to the case (vertical null).
- Adjust the manual seam sensor cross-slides so that the torch arc gap is in its approximate desired position.
- Insure the Sidetrack switch is in the desired position, if necessary.
- Switch from MAN to AUTO at the control pendant, the seam sensor will now seek its true null automatically.
- Fine adjustments can now be made using the manual seam sensor cross-slides to attain final cross-seam and arc gap positions.
- The unit is now ready for operation under weld conditions.

The user must now consider the weld to be made, then select the system to operate in one of two modes, manual or automatic.

Manual Operations

Manual operations are controlled by the user at the control pendant. The user selects this mode by pushing the “MAN” side of the MODE switch. This action allows the user to be able to move the cross-slide assembly to a desired position by use of the joystick switch on the pendant assembly.

These switches are momentary switches and will cause the indicated movement to occur only when depressed and held. Release of the switch causes the movement to stop.

The Sidetrack switch is not active during manual operations.

Automatic Operations

Automatic operations are also selected by the user at the control pendant. This mode is engaged by depressing the “AUTO” side of the MODE switch. Automatic tracking operations are directed by the control unit as it responds to signals from the seam sensor and the type of joint being tracked.

The Sidetrack switch selects the tracking mode. These modes are LEFT, OFF, and RIGHT Sidetrack modes. LEFT and RIGHT modes cause a constant tracking pressure to be exerted in the direction selected. The OFF mode is used where neutral or equal side forces are required.

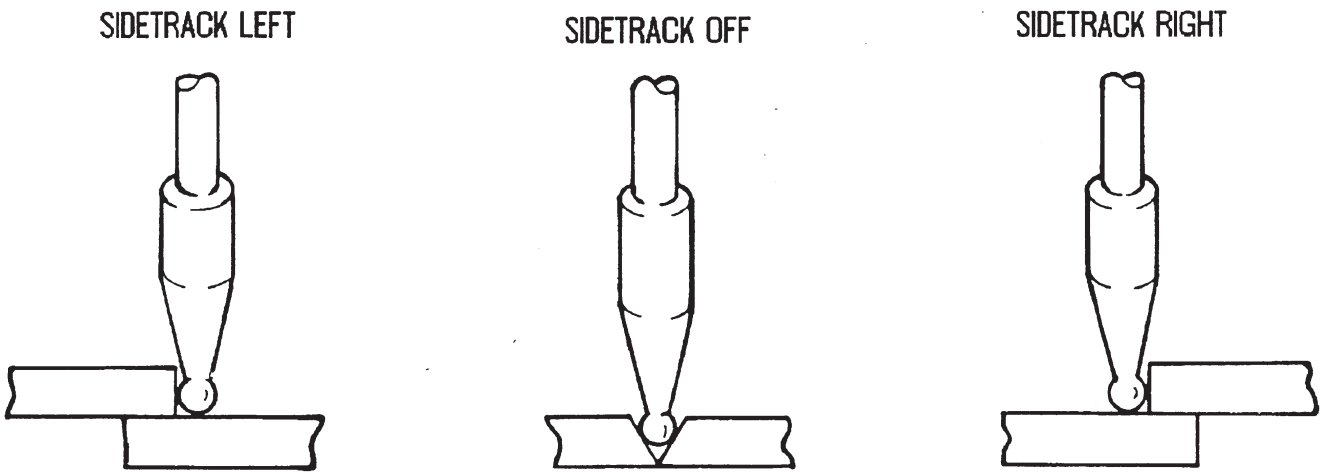


FIGURE 28 - TRACKING DIAGRAM

MAINTENANCE

MAINTENANCE REQUIREMENTS

APA Seam Tracker 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 (Figure 35 - Seam Tracker Control Exploded View on page 52) consists of an enclosure housing the major electronic assemblies of the seam tracker 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 option plates and 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 to OFF.

Assemblies and parts which are authorized for user replacement are listed in Table 21 - Seam Tracker Control Parts List on page 53. 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 69).

Replacement of the fuse does not require access to the housing interior; however, the blowing of the 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 Main board, involves disconnecting the connectors to the board, removing the mounting screws, and replacing the Main board with another.

The service person should exercise care in removing the Main 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 eight screws to stand-offs mounted in the enclosure. Disconnect all necessary cabling at the connection plugs provided. Remove the mounting screws and the Main board. Install another Main board and tighten the mounting screws until snug; do not over tighten as damage to the board and enclosure standoffs may result.

Replacement of heatsink assembly is accomplished by the removal of six screws and the disconnection of the appropriate connectors. Replace with a working assembly. Individual transistors may be replaced by removing two screws and the defective part (easiest if heatsink is out of the control unit.) The replacement part may then be installed in the existing socket provided, using heatsink compound (Thermal Compound) on the transistors to ensure good heat transfer and long life. Secure the replaced transistors with the two screws.

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 unit, mounting the replacement part and reconnecting the connectors.

CONTROL PENDANT AND CABLE ASSEMBLY

Maintenance of the control pendant and cable assembly is to periodically remove dust, soot, metal particles, slag, etc., from the face plate.

Repair of the control pendant and cable assembly is limited to replacement of defective units (see Figure 36 - Control Pendant Exploded View on page 54). A wiring diagram includes control pendant schematics for troubleshooting purposes (see Figure 53 - Pendant Schematic, Standard Seam Tracker on page 79).

CROSS-SLIDE ASSEMBLY

The cross-slide assembly should be maintained by periodic inspections for worn moving parts (e.g. ball screws, couplings, magnetic brakes). 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 cross-slide is limited to the replacement of defective parts and adjustment of the Dual-Vee Guide Rails to remove play between wheels and rails.

Exploded views of the cross-slides in Figures 32 and 33 and their parts lists in Tables 15 and 16 are provided to aid in parts ordering and replacement beginning on page 42. The Dual-Vee Guides are adjusted by loosening their retaining screw, adjusting, and re-tightening the screws.

SEAM SENSOR ASSEMBLY

The seam sensor assembly may require adjustment as noted in the Installation section under Figure 21 - Vertical Force Adjustments on page 18 and in the Operation section under Initial Setup Instructions.

Otherwise keep the unit free of dust and slag. The seam sensor assembly is to be removed and replaced only. The seam sensor assembly is shown in an exploded view Figure 31 - Seam Sensor Exploded View with the parts lists in Table 14 - Seam Sensor Parts List beginning on page 41 for reference.

MOUNTING BRACKETS

Each drive unit is provided with an adapter plate for mounting to the face plate. This plate is furnished for drilling to suit the requirements of the intended application.

IMPORTANT

The face plate should not be removed, drilled or tapped, as the guide wheels and drive screw unit are factory adjusted, and thus, alignment may be affected. Use the adapter plate only for mounting purposes.

A bracket assembly is furnished for mounting the manual slides and includes a torch clamp bracket for mounting to the barrel of the welding torch. The two-axis manual slides and seam sensor adjustment bracket, as well as the seam sensor assembly, mount to this bracket. The ST250 cross slide assembly can also be provided with an optional Universal Mounting Bracket designed to accommodate a wide variety of weld-heads and torches.

The ST40 is supplied with a U-Shaped Bracket Kit. Provisions are also made for using this kit on an ST250, if desired.

The Drawings and Parts Lists are provided to aid in parts ordering information and for parts replacement for each of these Mounting Brackets beginning on page 63.

PREVENTIVE MAINTENANCE SCHEDULE

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

Monthly Maintenance

Seam Sensor Assembly

Proper Function

There should be spring tension on the Sensor Rod throughout the entire horizontal travel.

Test

Clean slag and splatter from seam sensor's rod & tip. Notice that the sensor rod is sprung downward. With the index finger and thumb, grasp the sensor rod and move it upward slightly while keeping slight upward pressure on the sensor rod, move it left and right very slightly and very slowly. if there is any play horizontally (un-sprung movement), the seam sensor assembly should be repaired or replaced.

NOTE

There will always be spring tension pressing downward on the seam sensor's rod.

Probe Bracket Assembly

(Bracket that holds seam sensor)

Proper Function

Allows the operator to position the torch over the weld seam. It should be snug, enough to allow the operator to position the torch across the weld seam but without play in the bracket itself. No play should exist in the bracket.

Test

Clean the bracket to remove weld splatter and dust. Grasp the seam sensor assembly's outer case and try to move it left, up, right and down. If you feel play in the bracket, try to pinpoint which axis it is in. There are 3 set screws on each axis base, simply tighten them until there isn't any play.

Quarterly Maintenance

Torch Bracket Assembly

Proper Function

Holds the torch firmly to the cross-slide assembly at the desired angle.

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.

Pendant Assembly

Check for Proper function

The pendant assembly should be clean. Maintenance for the pendant assembly simply involves cleaning dust, slag, etc. from the face plate. Verify the switches function normally and the joystick returns to is center position.

Cross Slides

Proper Function

Verify that the cross-slide assembly travels the full length of its stroke on each axis. Also, it should freewheel at each end of its axis.

Test

Check for axial play on each axis.

Step # 1 - Center the Slides

Position slides in the center of their strokes. Put one hand on the motor assembly (on the left hand slide of the horizontal (lower) axis on most cross slides). Using your other hand, push the cross-slides face plate/adaptor plate toward the motor and then pull it back away from the motor assembly. If no play is felt, go on to step # 2.

If you feel any play on the lower axis; notice the drive screw; if it moves back and forth (not spinning), the assembly needs shimmed.

Step # 2 - Check for Play, Horizontal

If the drive screw does not move back and forth, try to spin the dual-vee wheels without the slide moving. If they do not spin, go to step # 3.

If both the wheels do not spin and the drive screw does not move back and forth and there is still play in the lower axis, the drive screw is showing wear and may need to be replaced.

Step # 3 - Check for Play, Vertical

Check the vertical (upper) axis, using the same procedure starting with Step # 1.

Semi Annual Maintenance

Control Unit Assembly

Be sure the control unit is turned off and unplug. Using clean, dry air blowout 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.

SEAM SENSOR CALIBRATION PROCEDURE

This procedure will describe the calibration to be performed on all seam sensors for maintenance purposes.

Tools Required

Digital Volt-Meter (DVM) capable of reading 3 places to the right of the decimal point.

To determine whether calibration of the seam sensor is required can be done using the steps explained earlier in Monthly Maintenance section of the Preventive Maintenance Schedule on page 32.

In addition, calibration can be required, if during operation, the cross slides drift left or right while driving downward in search of the seam when Sidetrack is in the off position.

Seam Sensor Interface Circuitry

Step # 1 - Power on the Control

Turn the POWER SWITCH to the ON position. Let the Seam Tracker warm up for 15 minutes.

Step # 2 - Connect the Calibration Tool

Connect the Calibration Tool to the Omni-Guide cable, if available.

Step # 3 - Connect the DVM

Connect the ground lead of the digital volt-meter to the ground test point TP11 (GND) on the main board of the seam tracker control. (See on page .) Connect the positive lead of the digital volt-meter to the Horizontal Probe test point TP10 (HP) on the main board.

Step # 4 - Adjust Horizontal

Adjust the trimpot labeled HA on main board until the digital volt-meter reads .000VDC ±.005VDC.

Seam Sensor Interface circuit is now calibrated.

Step # 5 - Remove the Calibration Tool

Disconnect the Calibration Tool from the Omni-Guide cable.

Calibration Of The Seam Sensor Assembly

Step # 1 - Connect the Sensor

Connect the Seam Sensor assembly to be tested to the sensor cable. Hold the Seam Sensor so that the grooves are facing the upward direction (12 o'clock) during testing.

Step # 2 - Connect the DVM to VP

Move the positive lead of the Digital Voltmeter from Horizontal Probe (HP) test point to the Vertical Probe (VP) test point on the main board.

Step # 3 - Verify Reading

Verify that the digital volt-meter reads + 4 VDC minimum in the rest position.

Step # 4 - Vertical Deflection Reading

Push the lower rod toward the upward (vertical direction) and verify that the digital volt-meter reads - 4 VDC ±1 VDC minimum in the vertical direction.

Step # 5 - Vertical Check Complete

There is no vertical adjustment of the Seam Sensor assembly. This test checks for correct vertical operation of the Seam Sensor assembly.

Step # 6 - Connect the DVM to HP

Now, move the positive lead of the digital volt-meter back to the Horizontal Probe (HP) test point main board.

Step # 7 - Right Horizontal Deflection Reading

Push (deflect) the Seam Sensor's lower rod by hand in a slightly upward and horizontal right direction and hold it. The digital volt-meter should read +4 VDC minimum in this direction.

Step # 8 - Left Horizontal Deflection Reading

Do the same thing as in Step # 7, but deflect the lower rod in the full, left horizontal direction. The digital volt-meter should read a -4 VDC minimum in this direction.

Step # 9 - Verify Mechanical and Electrical Null

Push (deflect) and release the lower rod in a slightly upward and full horizontal right direction and let the lower rod of the Seam Sensor settle. The reading on the digital volt-meter should be between 0 VDC and + .050 VDC with the rod at rest. Preform the same lower rod deflection as above, but in the opposite horizontal direction--left. The reading on the digital volt-meter should be between 0 VDC and - .050 VDC with the rod at rest.

Step # 10 - Adjusting the Sensor's Mechanical Null

If the volt-meter reading is more than .050V from 0 in either direction, then the Seam Sensor must be centered in the horizontal axis. This is accomplished by turning the adjusting screw inside the Seam Sensor assembly (See Item # 31 in Figure 31 - Seam Sensor Exploded View). The adjusting screw is accessible through a hole in the case and can be turned with 3/32" hex key. A setscrew is inserted into the access hole and can be removed with a 1/8" hex key; setscrew prevents dust and dirt from getting into the internal parts of the Seam Sensor Assembly.

Step # 11 - Adjust the Sensor's Horizontal Null

To center the horizontal axis, perform the following:

- Push the lower rod vertically until the adjusting screw can be reached with the hex key.
- Turn the adjusting screw slightly and remove the hex key.
- Push and release rod, as in Step # 9, in both directions. Observe the digital volt-meter reading when the rod returns to its rest position. The voltage reading cannot exceed ±.050VDC in either direction (+ or -).
- Repeat the above steps until the readings are achieved. Replace setscrew using a thread locking compound to prevent the setscrew from becoming loose.

End of Calibration.

SERVO AMPLIFIER CIRCUITRY CALIBRATION

This procedure describes the calibration techniques needed to for regular maintenance. This is useful and may become necessary to perform when a motor or heatsink transistor is replaced. When these components are replaced during troubleshooting or regular maintenance, the feedback to this circuitry also changes, making this calibration necessary.

Tolls Required

Digital Volt-Meter (DVM) capable of reading 3 places to the right of the decimal point.

Oscilloscope

Step # 1 - Adjust HI and VI Full Clock-Wise

Adjust the Servo Amplifier Circuitry trim-pots Horizontal Current (HI) and Vertical Current (VI) full Clock-Wise.

Step # 2 - Monitor TP4 and TP8

Monitor the + 15 VDC (TP4) and - 15VDC (TP8) test points on main board with a digital volt-meter to verify voltage in and out of Servo Amplifier Circuitry on the main board. Use test point TP11 (GND) as reference for the volt-meter.

Step # 3 - Connect the Oscilloscope to TP2

Connect an oscilloscope to the Vertical Error (VE) test point main board, TP2.

Step # 4 - Verify Reading

Observe on oscilloscope approximate 0 VDC.

Step # 5 - Adjust VI Trimpot Counter Clock-Wise

Adjust the Vertical Current (VI) Trim-pot Counter Clock-Wise (CCW) until signal on the oscilloscope begins to oscillate.

Step # 6 - Adjust VI Trimpot Clock-Wise

Slowly adjust the Vertical Current (VI) Trim-pot Clock-Wise (CW) until the oscillation just stops, then adjust the trim-pot CW an additional four (4) turns.

Step # 7 - Verify Reading

On the pendant, move the joystick switch up and observe the vertical slide moving up and observe on oscilloscope approximately + 15 VDC.

NOTE

Some ripple may be seen, this is typical

Step # 8 - Repeat Step 7

Perform the same function as in Step # 7, but only in the down position on the joystick. Observe the vertical slide moves down and observe on the oscilloscope, approximately - 15 VDC.

NOTE

Some ripple may be seen, this is typical.

Step # 9 - Verify Reading and No Movement

Release the joystick on the pendant and observe approximately 0 VDC on the oscilloscope and observe on the cross-slides, no drive movement.

Step # 10 - Connect the Oscilloscope to TP1

Connect an oscilloscope to the Horizontal Error (HE) test point on the main board, TP1 and observe approximately 0 VDC.

Step # 11 - Adjust HI trimpot Counter Clock-Wise

Adjust the Horizontal Current (HI) Trim-pot Counter Clock-Wise (CAW) until signal on the oscilloscope begins to oscillate.

Step # 12 - Adjust HI Trimpot Clock-Wise

Slowly adjust the Horizontal Current (HI) Trim-pot Clock-Wise (CW) until the oscillation just stops, then adjust the trim-pot CW an additional four (4) turns.

Step # 13 - Verify Reading

On the pendant, move the joystick switch right and observe the horizontal slide move right and observe on the oscilloscope observe approximately + 15 VDC.

NOTE

Some ripple may be seen, this is typical.

Step # 14 - Repeat Step 13

Perform the same function as in Step # 13, but only in the left position on the joystick. Observe on the oscilloscope approximately - 15 VDC and observe the horizontal slide moving to the left.

NOTE

Some ripple may be seen, this is typical.

Step # 15 - Verify Reading and No Movement

Release the joystick on the pendant and observe approximately 0 VDC on the oscilloscope and observe on the cross-slides, no drive movement.

This completes the Servo Amplifier Circuitry on the main board.

DRAWINGS AND PARTS LISTS

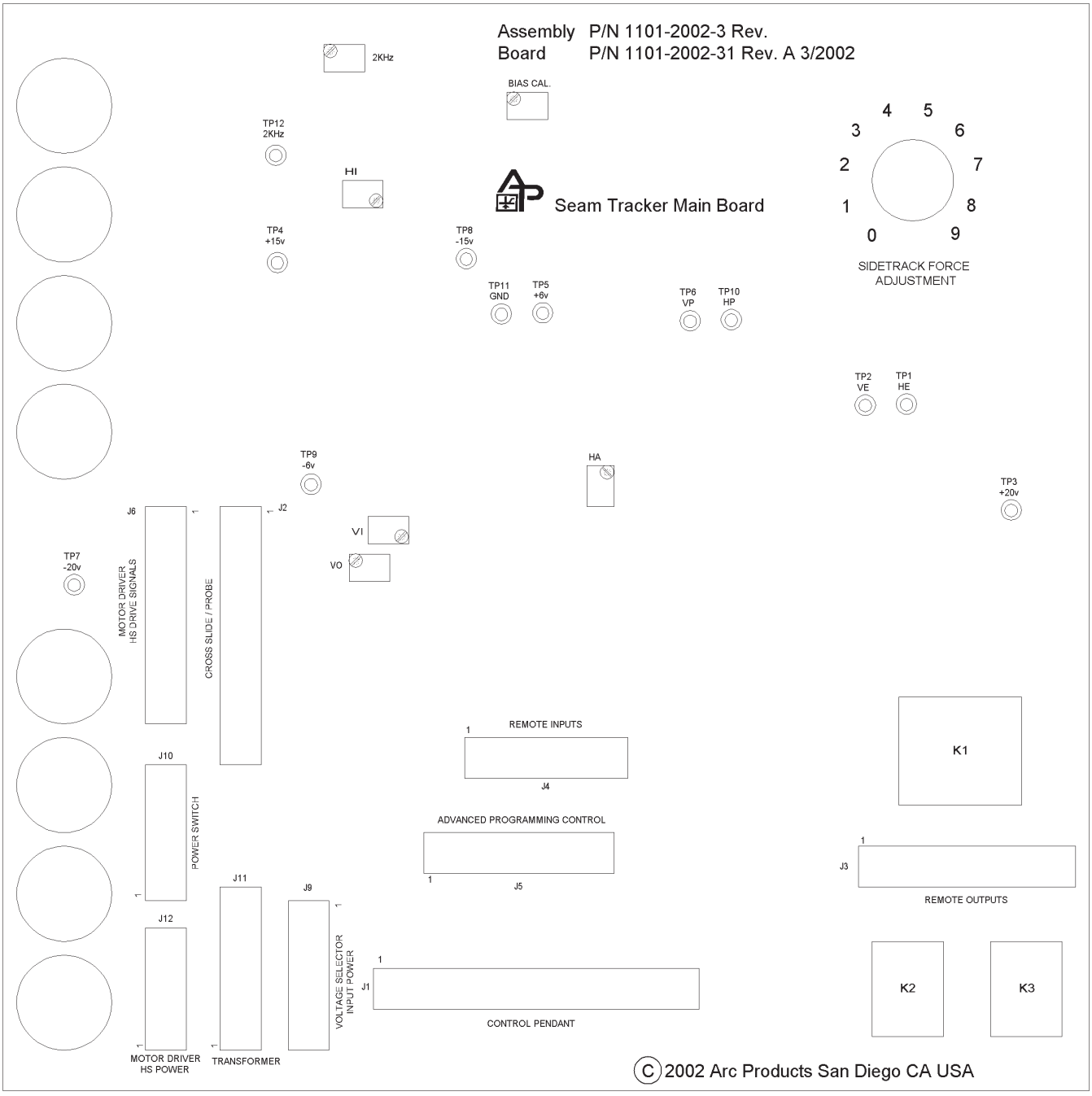


FIGURE 29 - SEAM TRACKER MAIN BOARD LAYOUT

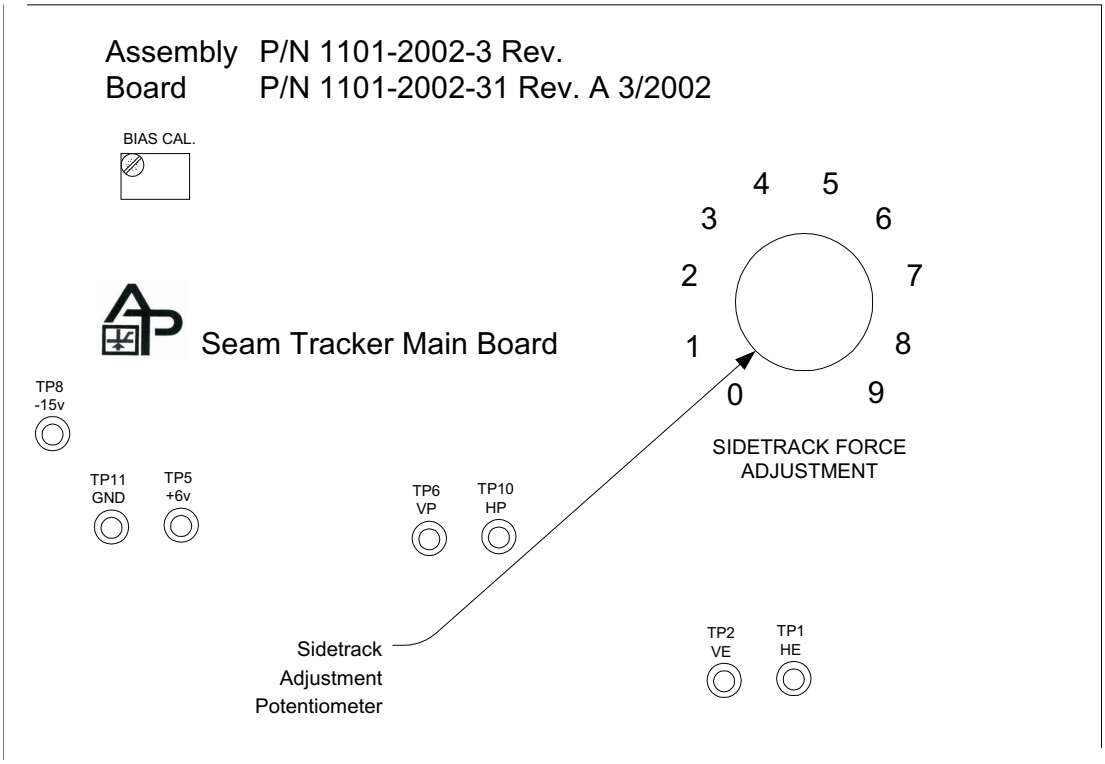


FIGURE 30 - SIDETRACK FORCE ADJUSTMENT

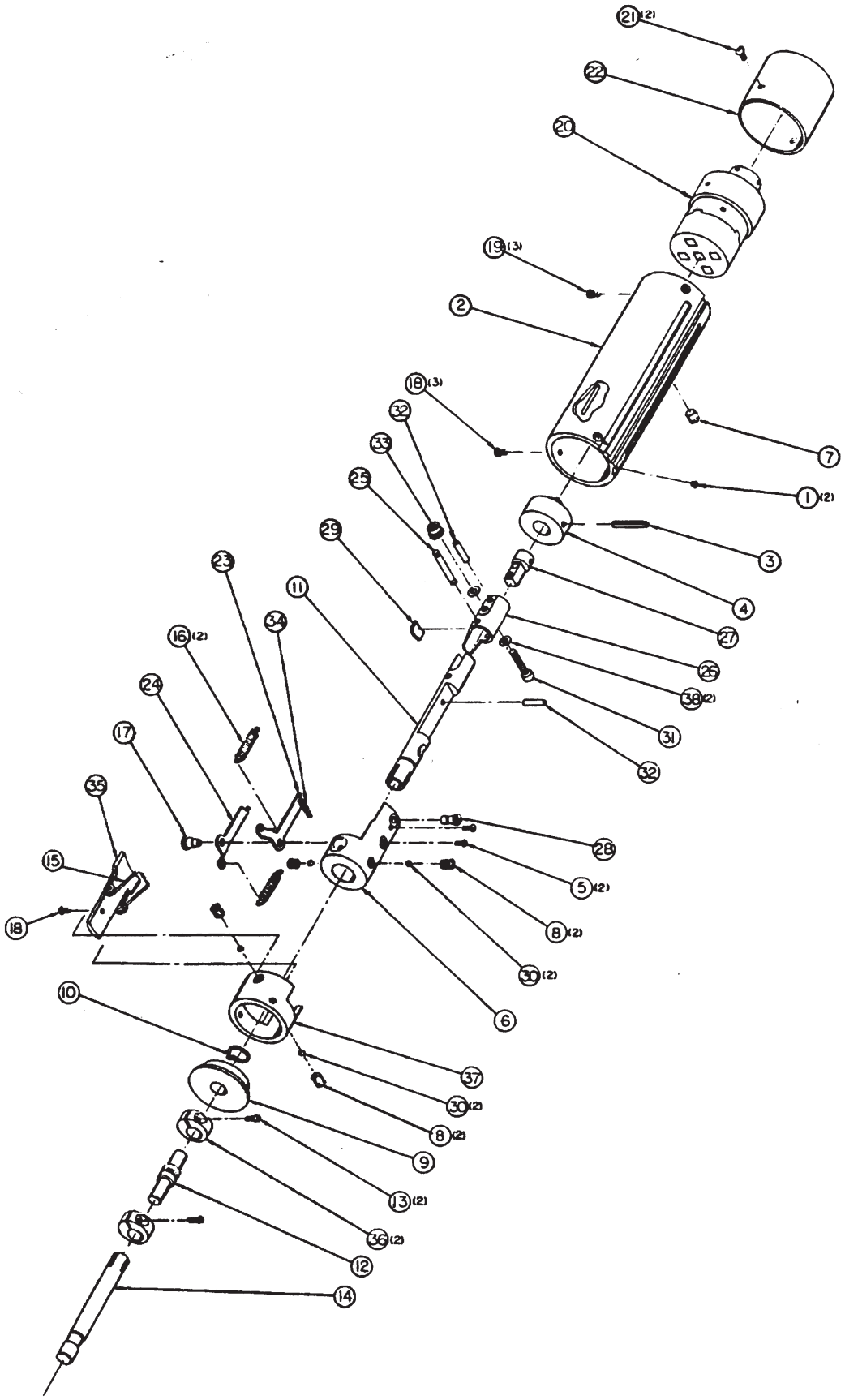


FIGURE 31 - SEAM SENSOR EXPLODED VIEW

TABLE 14 - SEAM SENSOR PARTS LIST

ITEM #	QPA	UM	PART #	DESCRIPTION
1	2.000	EA	970010-100	SCREW, 2-56 X .12 CR1F SBZ
2	1.000	EA	1110-1119	OUTER CASE
3	1.000	EA	2360-1109	PIN ROLL .0938 DIA X .750 LG
4	1.000	EA	1106-0811	SHORTING BAR ASSY
5	2.000	EA	970004-101	SCR 2-56 X .19 CR1P SSP
6	1.000	EA	1110-1194	COLLAR
7	1.000	EA	970043-001	SCREW, SET, 1/4-28 X .19 HHC SBZ
8	4.000	EA	1116-0484	SETSCREW PIVOT
8	AR	EA	3070-0082	TORQUE SEAL
9	1.000	EA	1110-1062	SHIELD, SEAM SENSOR
10	1.000	EA	979006-375	RING RTNG EXTERNAL SHAFT .375
12	1.000	EA	1110-2093	INSULATOR, OMNI GUIDE
14	1.000	EA	1110-1054	LOWER ROD
16	2.000	EA	2360-0404	SPRING EXT.(HORIZ AXIS)
17	1.000	EA	1110-1208	SUPPORT, LEVER ARM
18	4.000	EA	970000-201	SCREW, 4-40 X .19 CR1P SBZ
19	3.000	EA	970000-102	SCREW, 4-40 X .25 CR1P SBZ
20	1.000	EA	1106-0838	SENSOR MODULE
21	2.000	EA	970000-202	SCREW, 4-40 X .25 CR1P SBZ
22	1.000	EA	1110-1046	SHIELD CONNECTOR
23	1.000	EA	1110-1216	ARM LEVER
24	1.000	EA	1110-1224	ARM LEVER
25	1.000	EA	1110-2387	POST SPRING
26	1.000	EA	1110-2441	ROD UPPER
26	1.000	EA	1110-2417	SLEEVE SHORTING BAR
27	1.000	EA	1110-1232	SLIDE ADJUSTING
28	1.000	EA	1110-1241	PIN ELLIPTICAL ADJUST
29	1.000	EA	1110-1071	BEARING SLIDE
30	4.000	EA	2360-0030	SPHERE 1/8IN CHROME STEEL G25
31	1.000	EA	1116-0514	SCR 4-40 X .75 HSC SBZ N
32	2.000	EA	2360-1117	PIN DOWEL HRD .125 X .500 LG
33	1.000	EA	972014-001	NUT 4-40 H SS NL
34	1.000	EA	2360-0331	SPRING
35	1.000	EA	1106-3205	SPRING SLIDE ASSY
36	2.000	EA	1110-1101	CLAMP ROD
37	1.000	EA	1110-1089	SLEEVE
38	2.000	EA	974000-002	WSR F #4 .312 X .125 X .032 SBZ

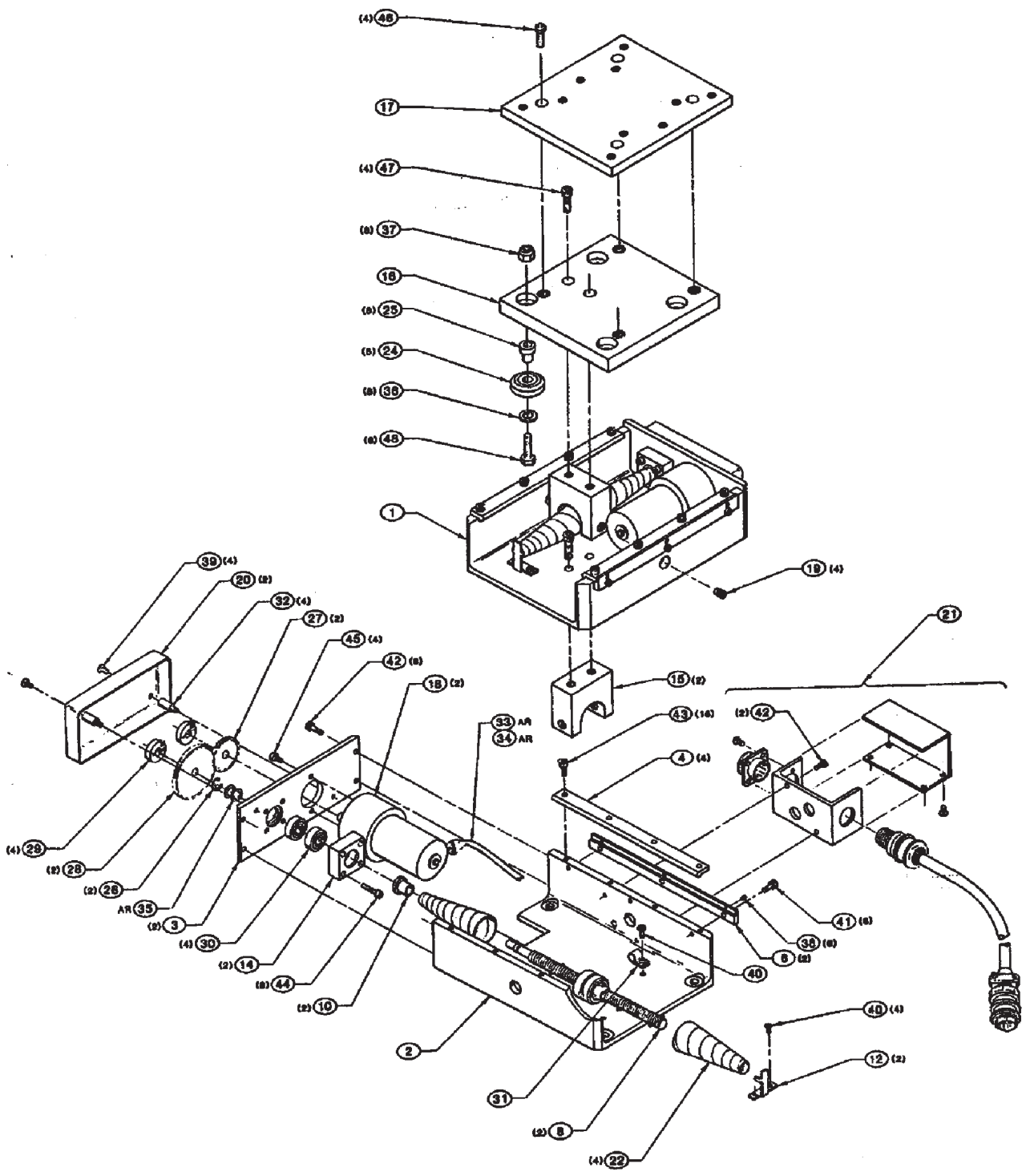


FIGURE 32 - ST40 CROSS-SLIDE EXPLODED VIEW

TABLE 15 - ST40 CROSS-SLIDE PARTS LIST

ITEM #	QPA	UM	PART # 3” X 3”	PART # 6” X 6”	DESCRIPTION
1	1.000	EA	1110-0007	1110-0066	BASE UPP-ST40
2	1.000	EA	1110-0015	1110-0074	BASE LWR ST40
3	2.000	EA	1110-2310	1110-2310	PLATE END - ST40
4	4.000	EA	1116-0000	1116-0034	SEAM TRACKER RAIL - ST40
6	2.000	EA	1110-0121	1110-0155	BAR RAIL ADJ
8	2.000	EA	1116-0042	1116-0077	ASSY SCR ACTR ST40
10	2.000	EA	1110-0180	1110-0091	COVER RETAINER - ST40
12	2.000	EA	1112-0008	1112-0016	COVER RETAINER
14	2.000	EA	1110-0198	1110-0198	BEARING HOUSING ST40A
15	2.000	EA	1110-0210	1110-0210	NUT HOUSING-ST40A
16	1.000	EA	1110-0171	1110-0171	FACEPLATE - ST40
17	1.000	EA	1110-0236	1110-0236	ADAPTER PLATE ST40
18	2.000	EA	1117-0587	1117-0587	MOTOR-ST40
19	4.000	EA	1116-0115	1116-0115	SET SCR HALF DOG - MOD
20	2.000	EA	1116-0107	1116-0107	COVER GEAR - ST40
21	1.000	EA	1106-0048	1106-0048	JUNCTION BOX ASSY - ST40
22	4.000	EA	2000-0015	2000-0058	COVER TELESCOPING .50 X 1.0 X 3.5 STRK
24	8.000	EA	2360-0552	2360-0552	WHEEL GUIDE DUAL VEE #2
25	8.000	EA	2360-0226	2360-0226	BUSHING ADPTR STNRY ¼ X 9/16 L
26	2.000	EA	2416-0157	2416-0157	RING RTNG-BOWED “E” RING .025 THK
27	2.000	EA	2320-0139	2320-0139	GEAR SPUR 36T 32P
28	2.000	EA	2320-0147	2320-0147	GEAR SPUR 60T 32P SS
29	4.000	EA	2040-0544	2040-0544	GEAR CLAMP SPLIT HUB
30	4.000	EA	2320-0112	2320-0112	BEARING BALL
31	1.000	EA	989009-004	989009-004	CLAMP CABLE 1/8 ID
32	4.000	EA	981007-003	981007-003	STDOFF M/F 6-32 X .250 X .562 LG A
33	AR	EA	933001-105	933001-105	SHRINK TUBING 3/16 PVC BLK
34	AR	EA	974031-103	974031-103	WSR F .505 X .317 X .005 SBZ
36	8.000	EA	974005-006	974005-006	WSR, F ¼ .468 X .255 X .032 SBZ
37	8.000	EA	972014-008	972014-008	NUT, 1/4-20 H SS NL
38	6.000	EA	970043-300	970043-300	SCR SET 6-32 X .12 HHC SBZ
39	4.000	EA	970000-302	970000-302	SCR 6-32 X .25 CR1P SBZ
40	5.000	EA	970000-402	970000-402	SCR 8-32 X .25 CR1P SBZ
41	6.000	EA	970015-306	970015-306	SCR 6-32 X .50 HSC SBZ
42	10.000	EA	970015-404	970015-404	SCR 8-32 X .38 HSC SBZ
43	16.000	EA	970015-406	970015-406	SCR 8-32 X .50 HSC SBZ
44	8.000	EA	970015-410	970015-410	SCR 8-32 X .75 HSC SBZ
45	4.000	EA	970015-502	970015-502	SCR 10-32 X .25 HSC SBZ
46	4.000	EA	970015-604	970015-604	SCREW 1/4-20 X .38, HSC SBZ
47	4.000	EA	970015-608	970015-608	SCR 1/4-20 X .62 HSC SBZ
48	8.000	EA	970039-616	970039-616	SCR 1/4-20 X 1.25H SBZ G8
49	1.000	EA	932009-005	932009-005	LUG SOLDER #8 X 5/8 FLT LCKG

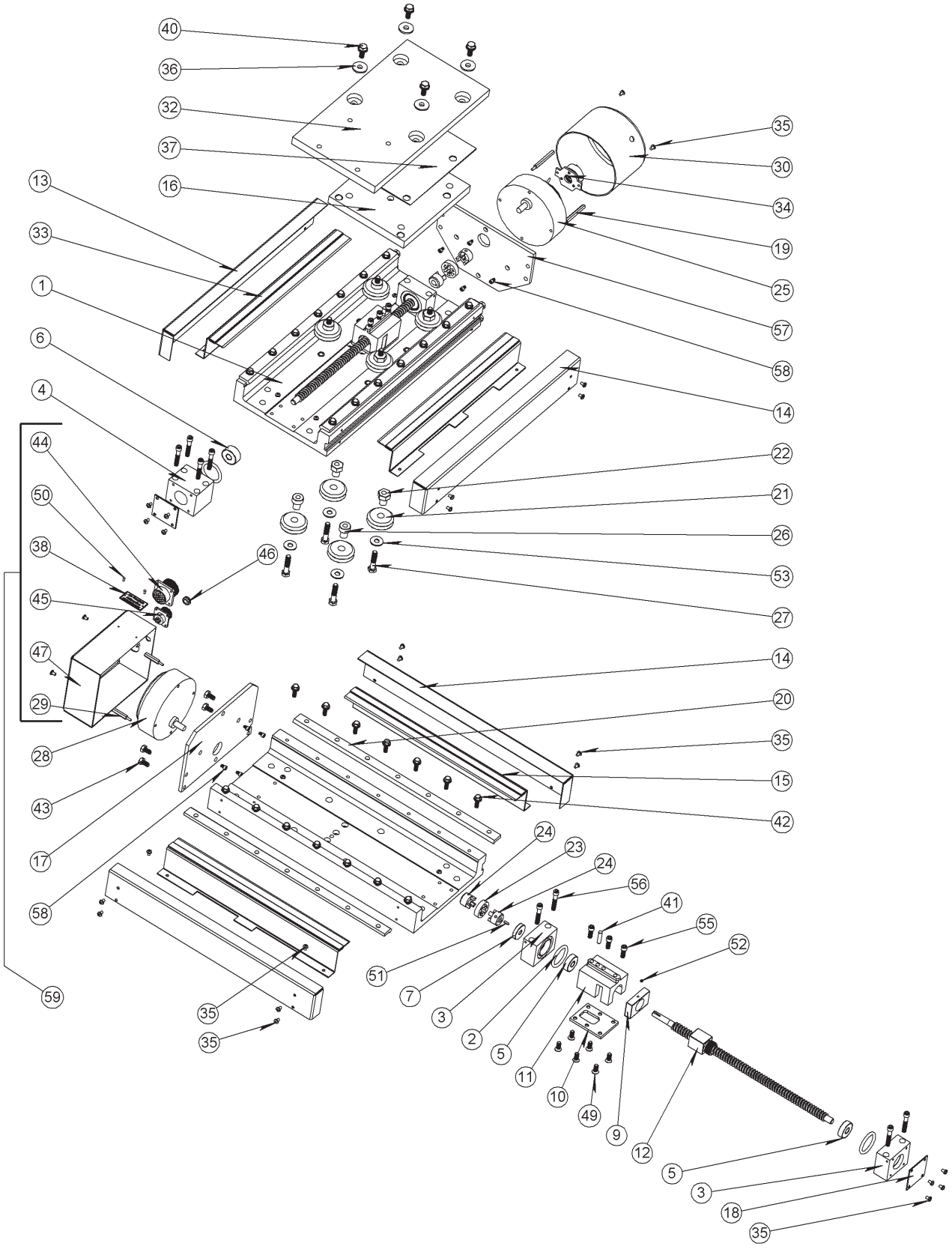


FIGURE 33 - ST250 CROSS-SLIDE EXPLODED VIEW

TABLE 16 - ST250 CROSS-SLIDE PARTS LIST

ITEM #	QPA	UM	PART # 5” X 5”	PART # 10” X 10”	DESCRIPTION
1	2.000	EA	0600-0034	0600-0036	UNIVERSAL BASE,ST250
2	4.000	EA	0600-0366	0600-0366	BEARING BLOCK O-RING
3	3.000	EA	0600-0302	0600-0302	UNIVERSAL BRG BLK ST250
4	1.000	EA	0600-0372	0600-0372	4 BOLT ST250 BRG BLOCK
5	3.000	EA	2320-0244	2320-0244	BEARING BALL, ANLR CONT
6	1.000	EA	0600-0123	0600-0123	BALL BEARING ST250
7	2.000	EA	2380-0128	2380-0128	SEAL OIL .375X1.125X.312
9	2.000	EA	0600-0346	0600-0346	NUT HOUSING INSERT ST250
10	2.000	EA	0600-0339	0600-0339	NUT HOUSING PLATE ST250
11	2.000	EA	0600-0336	0600-0336	NUT HOUSING ST250
12	2.000	EA	0600-0380	0600-0374	ST250 SCREW ACTUATOR ASSY
13	2.000	EA	0600-0064	0600-0068	TRACK COVER, LOWER LEFT
14	2.000	EA	0600-0065	0600-0069	TRACK COVER, LOWER RIGHT
15	4.000	EA	0600-0159	0600-0098	SCREW COVER ASSY ST250
16	1.000	EA	0600-0058	0600-0058	FACEPLATE
17	1.000	EA	0600-0048	0600-0048	END PLATE, LOWER
18	2.000	EA	1112-0211	1112-0211	COVER SEAL, BEARING
19	2.000	EA	0600-0373	0600-0373	2" STAND-OFF
20	4.000	EA	0600-0279	0600-0282	RAIL ST250
21	8.000	EA	2360-0561	2360-0561	WHEEL, GUIDE, DUAL VEE
22	4.000	EA	0600-0054	0600-0054	ADAPTOR BUSHING, ADJUSTABLE
23	2.000	EA	2320-1151	2320-1151	INSERT COUPLING
24	4.000	EA	2320-1160	2320-1160	COUPLING HALF, 3/8 IN
25	1.000	EA	0600-0111	0600-0111	MOTOR ASSY ST250 UPPER
26	4.000	EA	2360-0234	2360-0234	BUSHING ADAPTER
27	8.000	EA	970039-718	970039-718	SCR 5/16-18X1.50 H SBZ G8
28	1.000	EA	1116-0123	1116-0123	GEAR MOTOR, 25:1
29	2.000	EA	981002-004	981002-004	STDOFF HX M/F 8-32X.25X1.12 SS
30	1.000	EA	0600-0377	0600-0377	UPPER MTR CVR ST250 3.5"
32	1.000	EA	1110-0392	1110-0392	ADAPTER PLATE
34	1.000	EA	0600-0094	0600-0094	BRAKE ASSY
35	36.00	EA	970000-402	970000-402	SCREW, 8-32X.25 CR1P SBZ
36	4.000	EA	1110-0406	1110-0406	COLLAR, INSULATING
37	1.000	EA	0600-0488	0600-0488	ST250 INSULATING PLATE
38	1.000	EA	1115-0705	1115-0705	NAMEPLATE SEAM TRACKER
40	4.000	EA	970039-710	970039-710	SCR 5/16-18X.75 H SBZ G8
41	2.000	EA	970039-725	970039-725	DOWEL PIN 1/4 X 1
42	28.00	EA	970039-610	970039-610	SCREW, 1/4-20X.75 H SBZ G8
43	8.000	EA	970039-606	970039-606	SCREW, 1/4-20X.50 H SBZ G8
44	1.000	EA	930014-013	930014-013	CONN CIRC BOX RCPT 20-27P
45	1.000	EA	930014-010	930014-010	CONN CIRC BOX RCPT 14S-6S
46	1.000	EA	976000-005	976000-005	GROMMET RUBBER 5/16ID X 5/8 OD
47	1.000	EA	0600-0060	0600-0060	MOTOR COVER, LOWER

TABLE 18 - ST250 CROSS-SLIDE PARTS LIST (CONT.)

ITEM #	QPA	UM	PART # 5” X 5”	PART # 10” X 10”	DESCRIPTION
49	12.00	EA	970010-608	970010-608	SCR 1/4-20X.62 CR1F SBZ
50	2.000	EA	2414-0201	2414-0201	SCR RND HD U-DRV #2X1/4
51	2.000	EA	2360-0863	2360-0863	3/32 X .375 SQ. KEY
52	2.000	EA	970043-401	970043-401	SET SCREW, 8-32x.19 HHC SBZ
53	8.000	EA	970000-003	970000-003	WASHER 5/16
55	6.000	EA	970015-610	970015-610	SCREW, 1/4-20X.75 HSC SBZ
56	10.00	EA	970015-618	970015-618	SCREW, 1/4-20X1.50 HSC SBZ
57	1.000	EA	0600-0052	0600-0052	END PLATE, UPPER UNIVERSAL
58	8.000	EA	970015-402	970015-402	SCREW, 8-32X.25 HSC SBZ
59	1.000	EA	0600-0099	0600-0099	MTR CVR ASSY LWR ST250

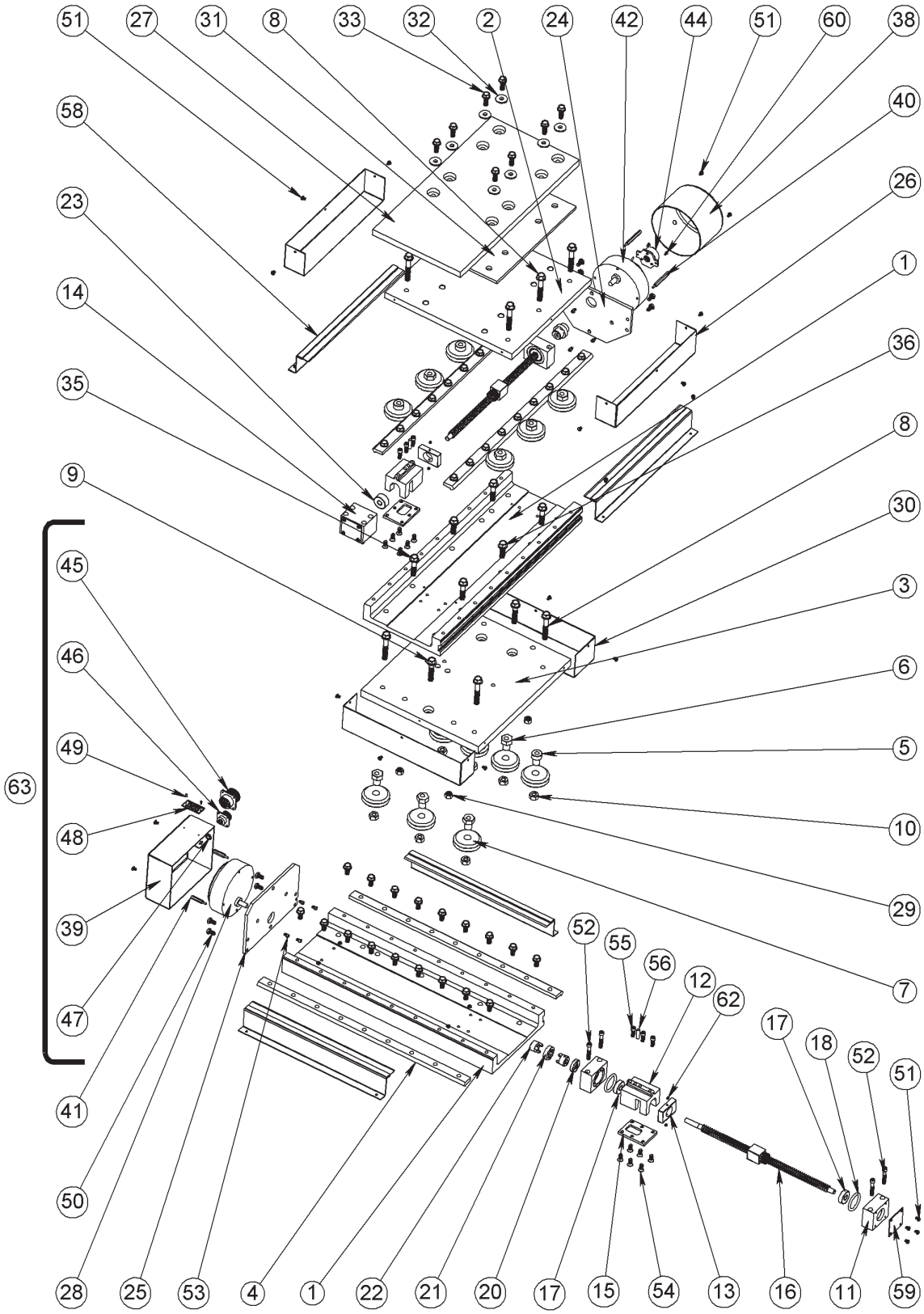


FIGURE 34 - ST450 CROSS-SLIDE EXPLODED VIEW

TABLE 19 - ST450 CROSS SLIDE PARTS LIST

ITEM #	QPA	UM	PART # (5 X 5)	PART # (10 X 10)	DESCRIPTION
1	2.000	EA	0600-0074	0600-0076	BASE ST450
2	1.000	EA	0600-0078	0600-0078	FACEPLATE ST450
3	1.000	EA	0600-0079	0600-0079	INTERMEDIATE PLATE ST450
4	4.000	EA	0600-0430	0600-0431	RAIL ST450
5	4.000	EA	2360-0242	2360-0242	BUSHING ADPTR STNRY 3/8X7/8 L
6	9.000	EA	2360-0277	2360-0277	BUSHING ADPTR ADJ 3/8X7/8 L
7	13.000	EA	2360-0579	2360-0579	WHEEL GUIDE DUAL VEE (4)
8	4.000	EA	970039-711	970039-711	3/8-16 X 2.5 GR8 FLANGE HD
9	10.000	EA	970039-822	970039-822	SCREW 3/8-16X2.00 H SBZ G8
10	3.000	EA	970039-712	970039-712	3/8-16 FLANGE LOCKNUT
11	3.000	EA	0600-0302	0600-0302	UNIVERSAL BRG BLK 250/450
12	2.000	EA	0600-0336	0600-0336	NUT HOUSING ST250/450
13	2.000	EA	0600-0346	0600-0346	NUT HOUSING INSERT ST250/450
14	1.000	EA	0600-0372	0600-0372	4 BOLT ST250/450 BRG BLOCK
15	2.000	EA	0600-0339	0600-0339	NUT HOUSING PLATE ST250/450
16	2.000	EA	0600-0380	0600-0374	ST250/450 SCREW ACT. ASSY
17	3.000	EA	2320-0244	2320-0244	BEARING BALL ANLR CONT
18	4.000	EA	0600-0366	0600-0366	BEARING BLOCK O-RING
20	2.000	EA	2380-0128	2380-0128	SEAL OIL .375X1.125X.312
21	2.000	EA	2320-1151	2320-1151	INSERT COUPLING (BF7)
22	2.000	EA	2320-1160	2320-1160	COUPLING HALF3/8 IN
23	1.000	EA	0600-0123	0600-0123	BALL BEARING ST250/450
24	1.000	EA	0600-0052	0600-0052	MOTOR PLATE UPPER UNIVERSAL
25	1.000	EA	0600-0048	0600-0048	MOTOR PLATE LOWER
26	3.000	EA	1112-0105	1112-0105	COVER WHEEL
27	1.000	EA	0600-0418	0600-0418	ADAPTER PLATE ST450
28	1.000	EA	0600-0513	0600-0513	GEAR MOTOR. 50:1-OUTBD
30	1.000	EA	0600-0432	0600-0432	WHEEL COVER DEEP ST450
31	1.000	EA	0600-0419	0600-0419	PHENOLIC PLATE ST450
32	8.000	EA	1110-0406	1110-0406	COLLAR INSULATING
33	8.000	EA	970039-714	970039-714	SCR 5/16-18X1.00 H SBZ G8
36	2.000	EA	970039-713	970039-713	3/8-16 X 1.25 FLANGE HEAD BOLT
38	1.000	EA	0600-0377	0600-0377	UPPER MTR CVR ST250/450 3.5"
39	1.000	EA	1116-0298	1116-0298	MOTOR COVER LOWER
40	2.000	EA	0600-0289	0600-0289	STAND-OFF 8-32 X 1/4 X 2.00
41	2.000	EA	0600-0121	0600-0121	STANDOFF 8-32 X 1/4 X 1.OO
42	1.000	EA	0600-0429	0600-0429	ST450 UPPER MTR ASSY
44	1.000	EA	0600-0094	0600-0094	BRAKE ASSY
45	1.000	EA	930014-013	930014-013	CONN CIRC BOX RCPT 20-27P
46	1.000	EA	930014-010	930014-010	CONN CIRC BOX RCPT 14S-6S
47	2.000	EA	976000-005	976000-005	GROMMET RUBBER 5/16ID X 5/8 OD
48	1.000	EA	0600-0127	0600-0127	NAME PLATE AP AUTOMATION
49	2.000	EA	2414-0201	2414-0201	SCR RND HD U-DRV #2X1/4

TABLE 20 - ST450 CROSS SLIDE PARTS LIST

ITEM #	QPA	UM	PART # (5 X 5)	PART # (10 X 10)	DESCRIPTION
50	8.000	EA	970039-606	970039-606	SCREW 1/4-20X.50 H SBZ G8
51	28.000	EA	970000-402	970000-402	SCREW 8-32X.25 CR1P SBZ
52	10.000	EA	970015-618	970015-618	SCREW 1/4-20X1.50 HSC SBZ
53	8.000	EA	970015-402	970015-402	SCREW 8-32X.25 HSC SBZ
54	12.000	EA	970010-608	970010-608	SCR 1/4-20X.62 CR1F SBZ
55	6.000	EA	970015-610	970015-610	SCR 1/4-20X.62 HSC SBZ
56	2.000	EA	970039-725	970039-725	DOWEL PIN 1/4 X 1
58	4.000	EA	0600-0159	0600-0098	SCREW COVER ASSY.5" ST250/450
59	2.000	EA	1112-0211	1112-0211	COVER SEAL BEARING
60	2.000	EA	970000-202	970000-202	SCREW 4-40X.25 CR1P SBZ
62	2.000	EA	970043-400	970043-400	SCR SET 8-32X.12 HHC SBZ
63	1.000	EA	0600-0099	0600-0099	MTR CVR ASSY LWR ST250/450
64	2.000	IN	2360-0862	2360-0862	KEY STOCK 3/32 SQ
65	2.000	FT	0600-0359	0600-0359	MOTOR CABLE 4 COND
66	36.000	EA	970039-710	970039-710	SCR 5/16-18X.75 H SBZ G8

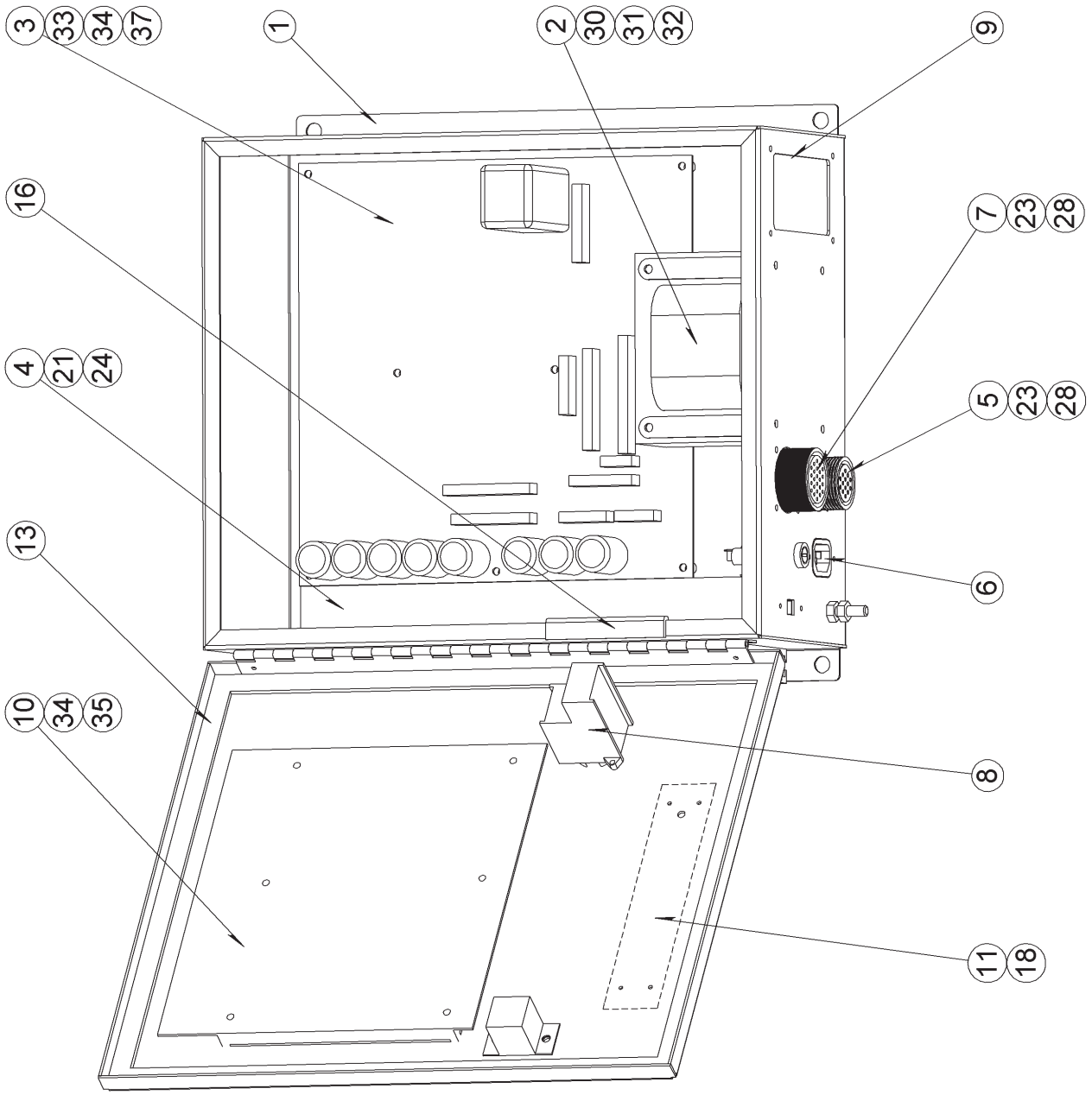


FIGURE 35 - SEAM TRACKER CONTROL EXPLODED VIEW

TABLE 21 - SEAM TRACKER CONTROL PARTS LIST

ITEM #	QPA	UM	PART NUMBER	DESCRIPTION
1	1.000	EA	0600-0002	CONTROL ENCLOSURE
2	1.000	EA	1101-2002-2	CONTROL TRANSFORMER ASSY
3	1.000	EA	1101-2002-3	MAIN BOARD ASSY
4	1.000	EA	1101-2002-4	MOTOR DRIVER ASSY
5	1.000	EA	1101-2002-5	CONTROL DRIVE CABLE ASSY
6	1.000	EA	1101-2002-6	VOLTAGE SELECTOR SWITCH ASSY
7	1.000	EA	1101-2002-7	CONTROL PENDANT CABLE ASSY
8	1.000	EA	1101-2002-8	POWER SWITCH ASSY
9	1.000	EA	1101-2002-9	OPTION PLATE COVER - CONNECTOR
10	1.000	EA	1101-2002-10	OPTION PLATE COVER, FRONT PANEL
11	1.000	EA	0600-0008	APA NAME PLATE
12	1.000	EA	1175-0079	LABEL CAUTION 110/220VAC (NOT SHOWN)
13	0.625	EA	999005-005	TAPE NEO FOAM ADH 1/8INX1/4THK
14	5.000	EA	979001-001	CABLE TIE .75 BUNDLE DIA (NOT SHOWN)
15	1.000	EA	989003-001	CBL TIE MNT ADH BACK .75IN SQ (NOT SHOWN)
16	0.417	FT	2040-0536	GROMMET CATERPILLAR
17	1.000	EA	929000-001	3 CONDCTR PWR SPLY CORD (NOT SHOWN)
18	4.000	EA	2414-0201	SCR RND HD U-DRV #2X1/4
19	4.000	EA	970000-204	SCR 4-40X.38 CR1P SBZ
21	15.000	EA	970000-406	SCR 8-32X.50 CR1P SBZ
23	8.000	EA	974010-002	WSR SL #4.209X.121X.025 SBZ
24	7.000	EA	974010-004	WSR SL #8.293X.175X.040 SBZ
28	8.000	EA	972000-002	NUT 4-40 H SBZ
30	4.000	EA	972000-005	NUT 10-32 H SBZ
31	4.000	EA	974010-005	WSR SL #10 .334X.202X.047 SBZ
32	4.000	EA	974006-005	WSR F #10 .374X.195X.032 B
33	8.000	EA	970000-404	SCR 8-32X.38 CR1P SBZ
34	8.000	EA	974010-004	WSR SL #8.293X.175X.040 SBZ
35	6.000	EA	972000-003	NUT 6-32 H SBZ
37	6.000	EA	974000-004	WSR F #8 .438X.188X.049 SBZ

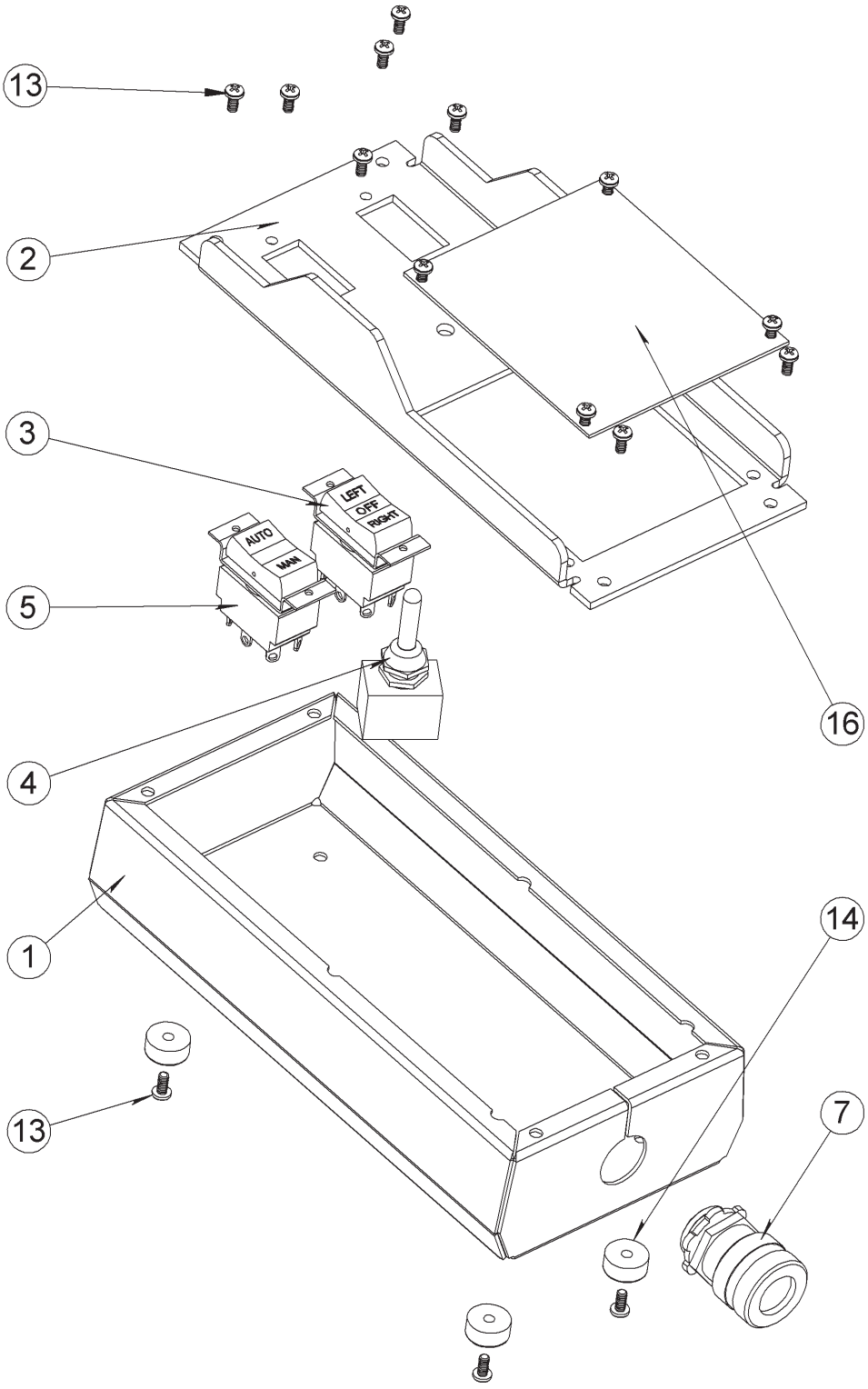


FIGURE 36 - CONTROL PENDANT EXPLODED VIEW

TABLE 22 - CONTROL PENDANT PARTS LIST

ITEM #	QPA	UM	PART NUMBER	DESCRIPTION
1	1.000	EA	0600-0021	SEAM TRACKER PENDANT ENCLOSURE
2	1.000	EA	0600-0022	SEAM TRACKER PENDANT FACEPLATE
3	1.000	EA	1116-0352	SWITCH SIDETRACK
4	1.000	EA	2066-0112	SW JOY STICK 9 POS SNGL POLE
5	1.000	EA	1116-0387	SWITCH AUTO/MAN
6	1.000	EA	1114-1332	APA ST PENDANT ASSY, 10 FT. (NOT SHOWN)
7	1.000	EA	2040-0579	CBL FTTNG W/NUT&BSH .375-.500
8	1.000	EA	2208-0105	CONN RECT PLUG (9CKT) (NOT SHOWN)
9	2.000	EA	2212-0107	TERM PIN CRIMP 24-30 GA (NOT SHOWN)
10	1.000	EA	2208-0059	CONN RECT RCPT (9CKT) (NOT SHOWN)
11	9.000	EA	2212-0093	TERM SOCKET CRIMP 18-24 GA (NOT SHOWN)
12	1.000	EA	900007-003	CAP CER .1UF 500V +80 -20% (NOT SHOWN)
13	16.00	EA	970021-404	SCR 8-32X.38 HSBC SBZ
14	4.000	EA	0600-0026	FEET, RUBBER
15	1.000	EA	0600-0042	ST PENDANT BLANK APC PANEL

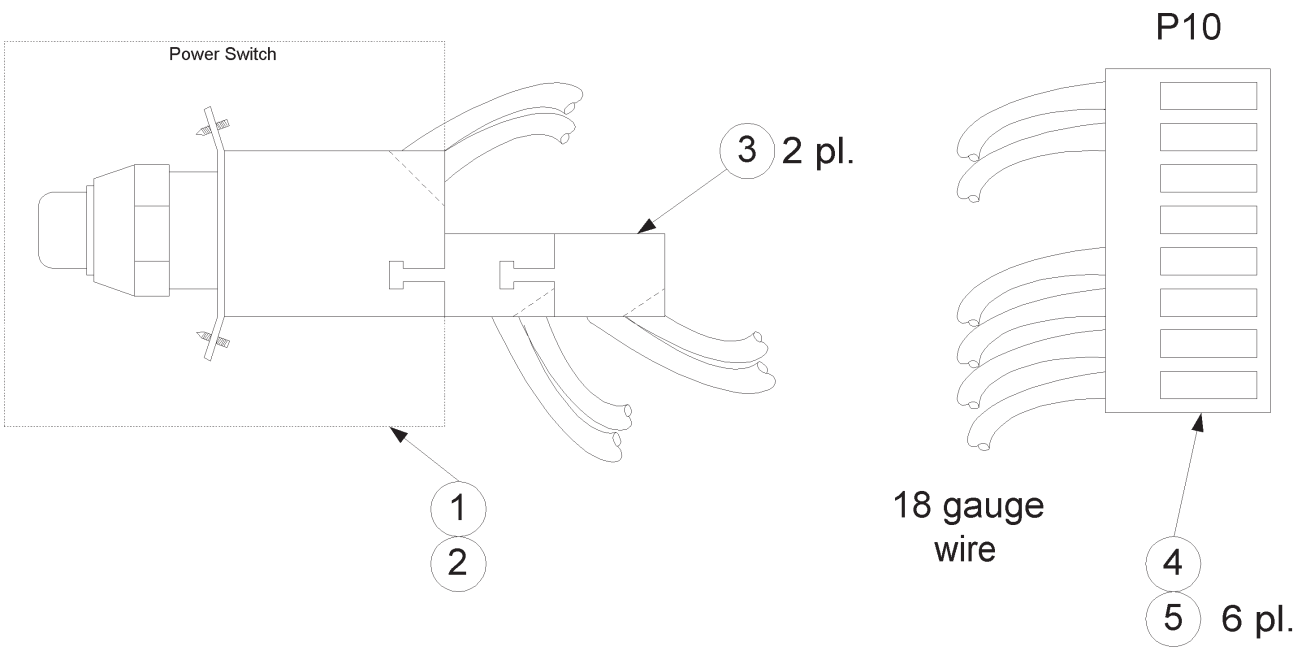


FIGURE 37 - POWER SWITCH ASSEMBLY EXPLODED VIEW

TABLE 23 - 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
3	2.000	EA	2068-0172	BLOCK CONTACT N.O.
4	1.000	EA	2208-0181	CONN RECT PLUG (8CKT)
5	6.000	EA	2212-0018	TERMINAL CRIMP PIN 18-24 GA

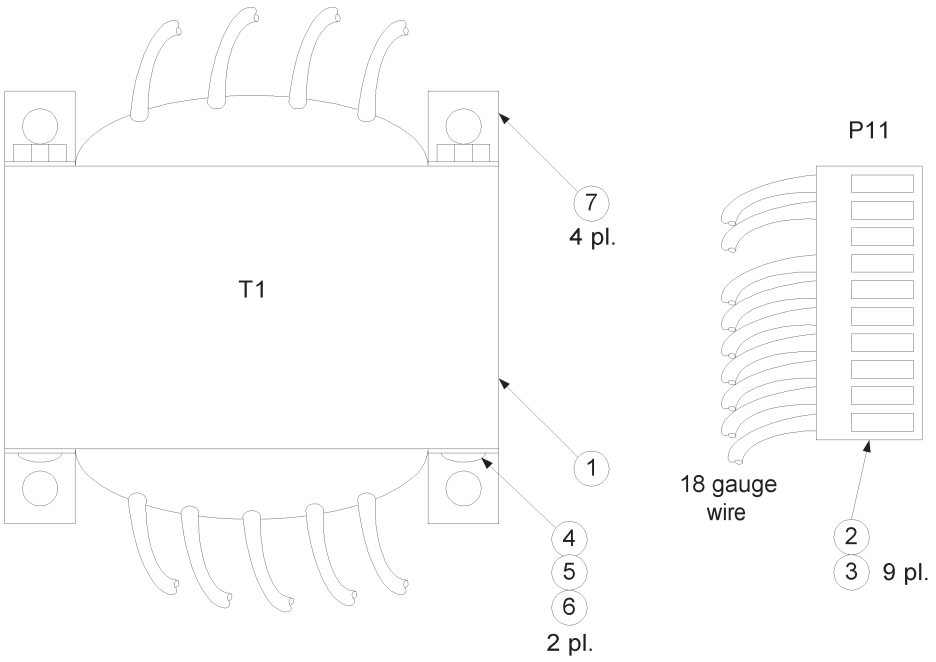


FIGURE 38 - TRANSFORMER ASSEMBLY EXPLODED VIEW

TABLE 24 - TRANSFORMER ASSEMBLY PARTS LIST

ITEM #	QPA	UM	PART NUMBER	DESCRIPTION
1	1.000	EA	1117-1118	XFRMR 115/230VAC,30VCT/10.5VAC
2	1.000	EA	2208-0199	CONN RECT PLUG (10CKT)
3	9.000	EA	2212-0018	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

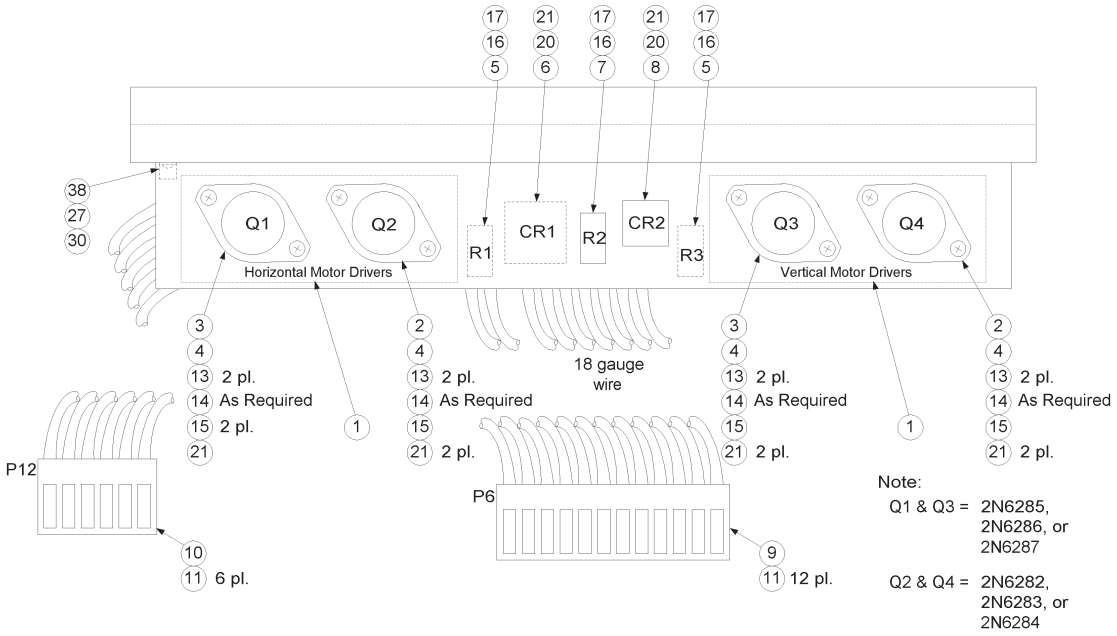


FIGURE 39 - MOTOR DRIVER HEATSINK ASSEMBLY EXPLODED VIEW

TABLE 25 - MOTOR DRIVER HEATSINK ASSEMBLY PARTS LISTS

ITEM #	QPA	UM	PART NUMBER	DESCRIPTION
1	2.000	EA	1103-0491	TRANSISTOR REPLACEMENT KIT
			CONSISTING OF:	
2	2.000	EA	2708-0081	XSTR 2N6282 PWR 60V NPN (ALT: 2N6283 OR 2N6284)
3	2.000	EA	2708-0103	XSTR 2N6285 PWR 80V PNP (ALT: 2N6286 OR 2N6287)
4	4.000	EA	2716-0000	INSULATOR MICA TO-3
5	2.000	EA	902004-019	RES WW .1 OHM +/- 3% 5W
6	1.000	EA	2702-0186	RECITIFIER BRIDGE CBR35-01P
7	1.000	EA	2610-1093	RES WW 250 OHM +/- 3% 10W
8	1.000	EA	2702-0178	RECTIFIER BRIDGE 2AMP 200V
9	1.000	EA	2208-0202	CONN RECT PLUG (12 CKT)
10	1.000	EA	2208-0172	CONN RECT PLUG (6 CKT)
11	18.00	EA	2212-0019	TERMINAL CRIMP MOLEX 18-20 .156
12	2.000	EA	2500-0692	CAP CER 680PF (NOT SHOWN)
13	8.000	EA	970015-412	SCREW 8-32 X .88 HSC SBZ
14	0.000	AR	3070-0058	THERMAL COMPOUND

TABLE 26 - MOTOR DRIVER HEATSINK ASSEMBLY PARTS LISTS (CONT.)

ITEM #	QPA	UM	PART NUMBER	DESCRIPTION
15	4.000	EA	2716-0034	TRANSISTOR SOCKET TO-3
16	6.000	EA	970000-103	SCREW 2-56 X .31 CR1P SBZ
17	6.000	EA	974010-001	WASHER SPLIT LOCK # 2
20	2.000	EA	970000-308	SCREW 6-32 X .62 CR1P SBZ
21	10.000	EA	974010-003	WASHER SPLIT LOCK # 6
27	1.000	EA	970000-502	SCREW 10-32 X .25 CR1P SBZ
30	1.000	EA	974010-005	WASHER SPLIT LOCK # 10
38	1.000	EA	989009-005	CABLE CLAMP 3/16” PVC BLACK

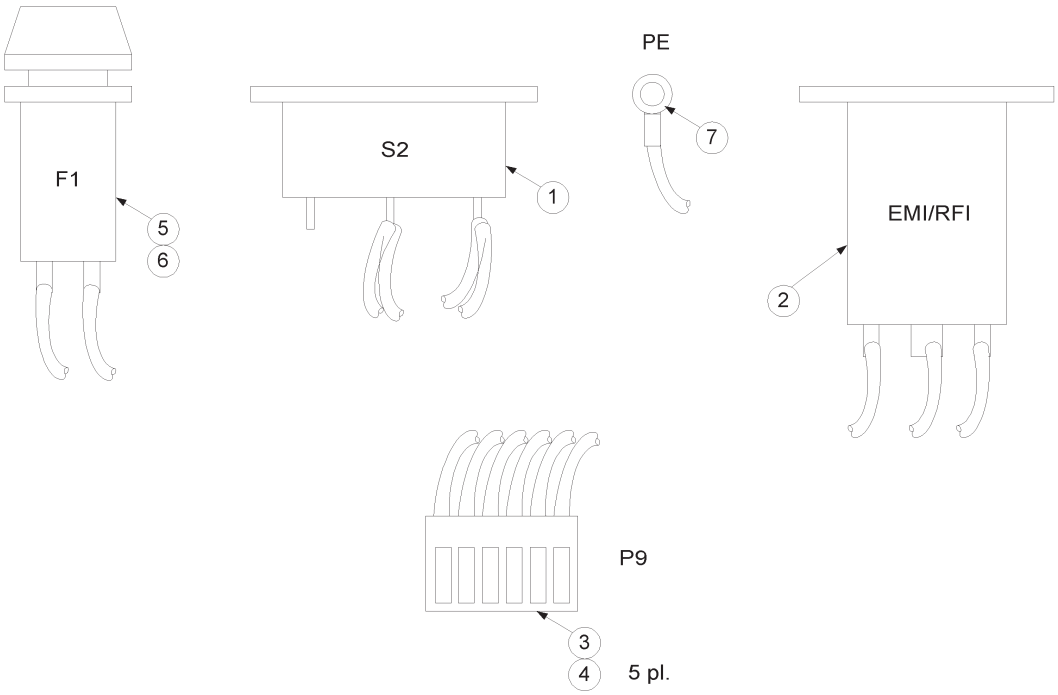


FIGURE 40 - VOLTAGE SELECTOR SWITCH ASSEMBLY EXPLODED VIEW

TABLE 27 - 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	2120-0263	FUSE 7-1/2A 250V
7	1.000	EA	2340-0618	TERM RING 1/4 22/16 RED

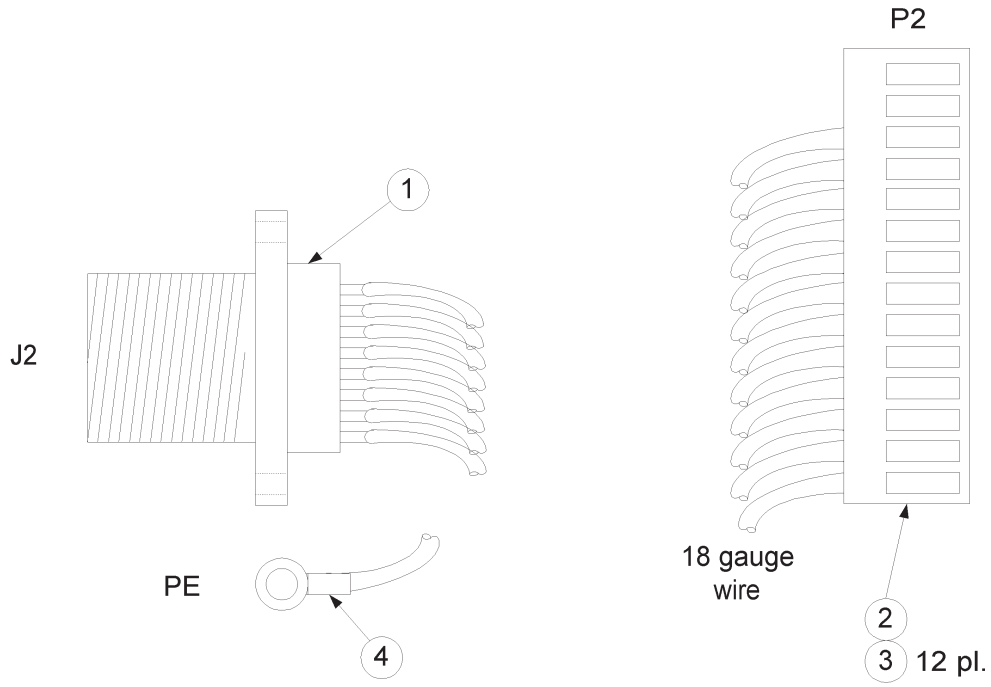


FIGURE 41 - DRIVE CONNECTOR HARNESS EXPLODED VIEW

TABLE 28 - DRIVE CONNECTOR HARNESS ASSEMBLY PARTS LIST

ITEM #	QPA	UM	PART NUMBER	DESCRIPTION
1	1.000	EA	930014-001	CONN CIRC BOX RCPT 20-27S
2	1.000	EA	2208-0211	CONN RECT PLUG (14CKT)
3	1.000	EA	2212-0018	TERMINAL CRIMP PIN 18-24 GA
4	1.000	EA	2340-0588	TERM RING INSUL #6 X .92 LG

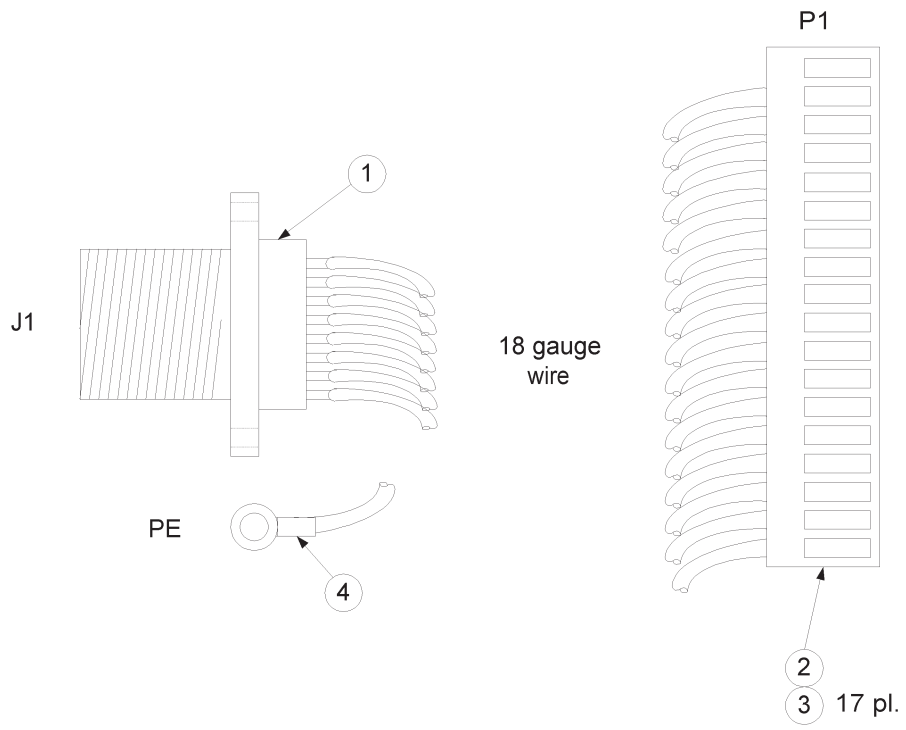


FIGURE 42 - PENDANT CONNECTOR HARNESS EXPLODED VIEW

TABLE 29 - PENDANT CONNECTOR HARNESS ASSEMBLY PARTS LIST

ITEM #	QPA	UM	PART NUMBER	DESCRIPTION
1	1.000	EA	930014-015	CONN CIRC BOX RCPT 22-14S
2	1.000	EA	2208-0117	CONN RECT PLUG (18 CKT)
3	17.000	EA	2212-0019	TERMINAL CRIMP PIN 18-24 GA
4	1.000	EA	2340-0588	TERM RING INSUL #6 X .92 LG

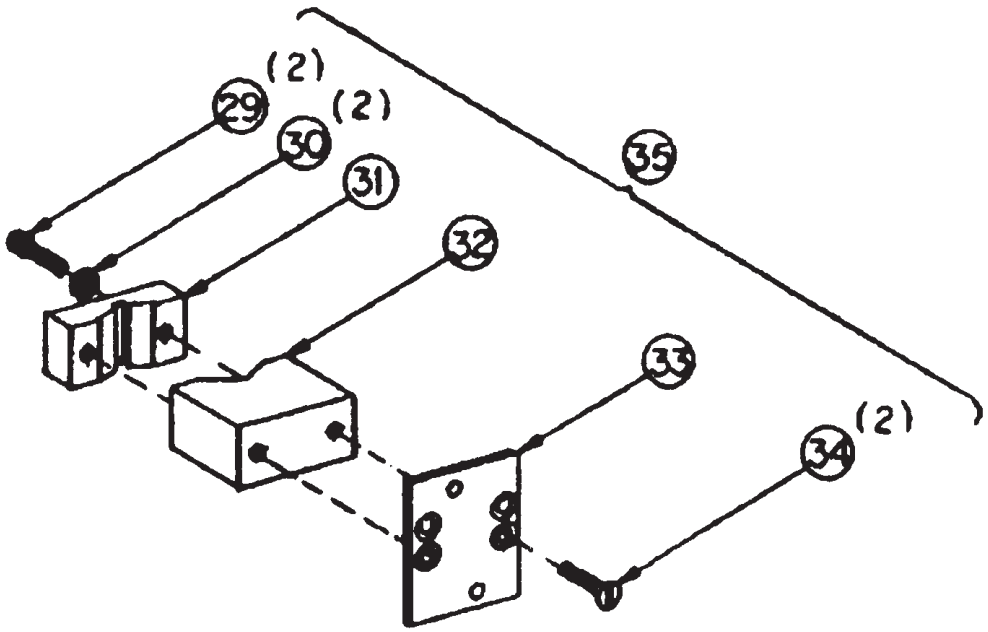


FIGURE 43 - STD. TORCH CLAMP BRACKET, 1103-0017

TABLE 30 - STD. TORCH CLAMP BRACKET PARTS LIST

ITEM #	QPA	UM	PART #	DESCRIPTION
	2.000	EA	974010-005	WSR SL #10 .334 X .202 X .047 SBZ (NOT SHOWN)
	2.000	EA	972000-005	NUT, 10-32 H SBZ (NOT SHOWN)
	2.000	EA	970010-510	SCREW, 10-32 x .75 CR1F SBZ (NOT SHOWN)
29A	2.000	EA	970015-616	SCR 1/4-20 X 1.25 HSC SBZ
29B	2.000	EA	970015-623	SCR 1/4-20 X 2.25 HSC SBZ
30	2.000	EA	974010-006	WSR SL ¼ .489 X .263 X .062 SBZ
31	1.000	EA	1110-1445	CLAMP - GTA TORCH
32	1.000	EA	1110-1461	CLAMP BASE - TORCH MTG BRKT
33	1.000	EA	1110-1470	BASE PLATE - TORCH MTG BRKT
34	2.000	EA	970010-608	SCR 1/4-20 X .62 CR1F SBZ

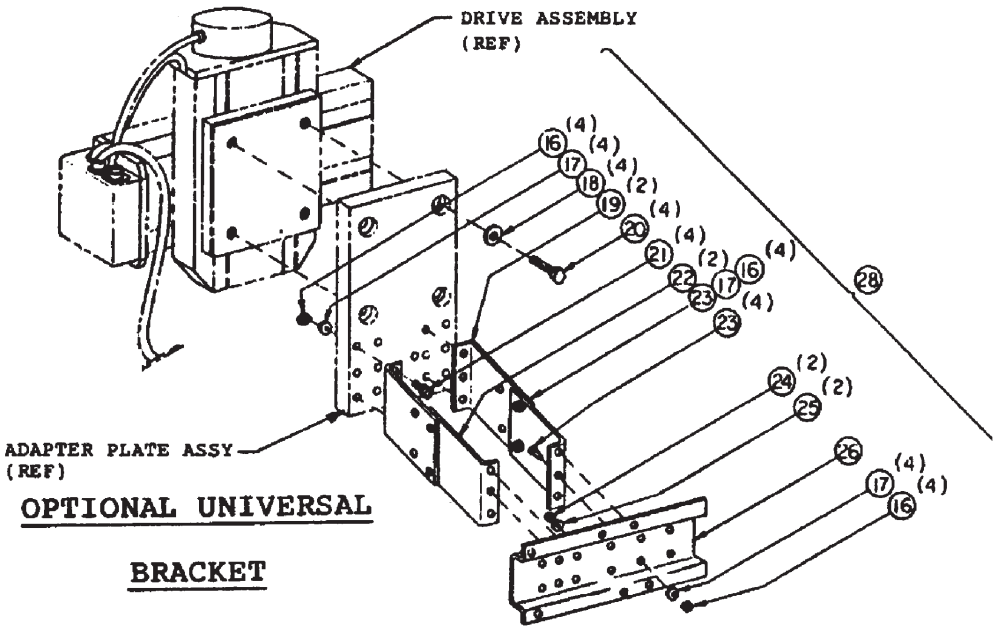


FIGURE 44 - OPTIONAL UNIVERSAL BRACKET, 1103-0009

TABLE 31 - OPTIONAL UNIVERSAL BRACKET PARTS LIST

ITEM #	QPA	UM	PART #	DESCRIPTION
16	12.000	EA	972000-006	NUT, 1/4-20 H SBZ
17	12.000	EA	974010-006	WSR SL 1/4.489X.263X.062 SBZ
19	2.000	EA	1113-0020	BRACKET UNIV - STAMPING
21	4.000	EA	970039-614	SCR 1/4-20X1.00 H SBZ G8
22	2.000	EA	1113-0038	BRACKET UNIV - STAMPING
23	8.000	EA	970039-606	SCR 1/4-20X.50 H SBZ G8
24	2.000	EA	972000-005	NUT, 10-32 H SBZ
25	2.000	EA	974010-005	WSR SL #10 .334X.202X.047 SBZ
26	1.000	EA	1112-0059	BRACKET PROBE
27B	2.000	EA	970010-510	SCREW, 10-32 x .75 CR1F SBZ
27A	2.000	EA	970010-506	SCR 10-32X.50 CR1F SBZ

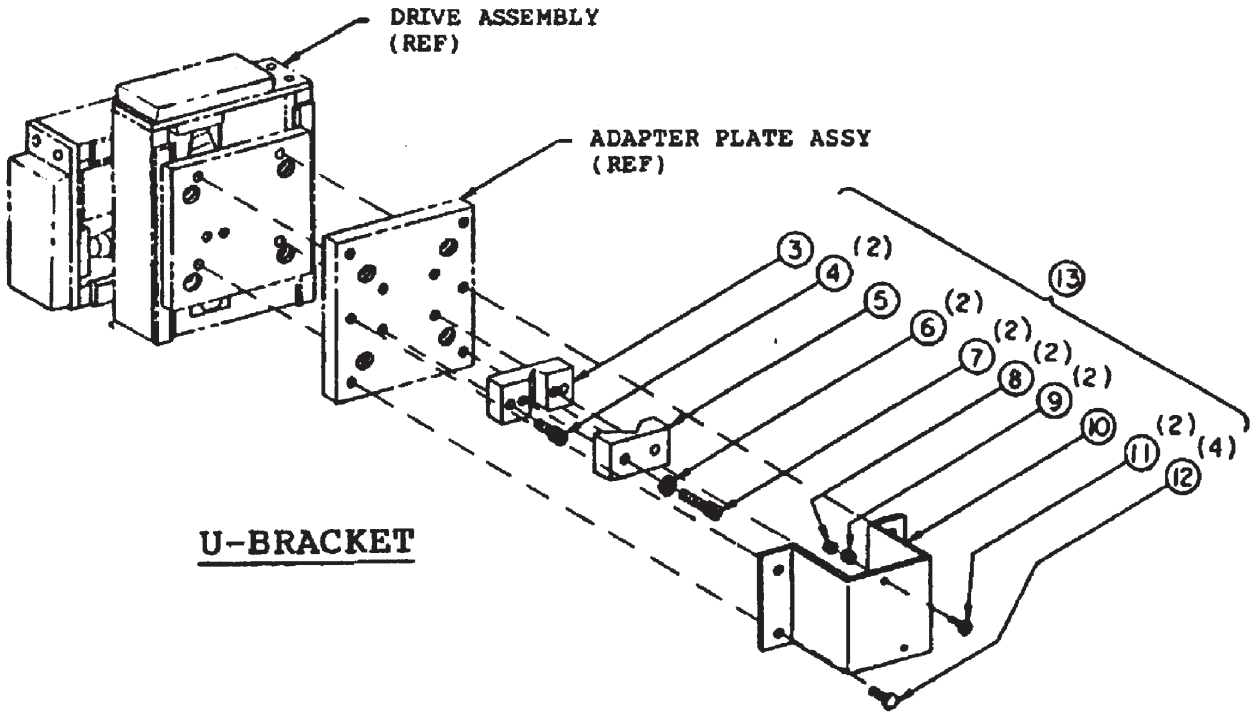


FIGURE 45 - U-BRACKET (ST40), 1103-0025

TABLE 32 - U-BRACKET (ST40) PARTS LIST

ITEM #	QPA	UM	PART #	DESCRIPTION
3	1.000	EA	1110-1453	CLAMP BASE - GTA TORCH
5	1.000	EA	1110-1445	CLAMP - GTA TORCH
6	2.000	EA	974004-006	WSR, F 1/4 .734X.312X.065 SBZ
7	2.000	EA	970015-622	SCREW, 1/4-20 X 2.00, HSC SBZ
8	2.000	EA	972000-005	NUT, 10-32 H SBZ
9	2.000	EA	974010-005	WSR SL #10 .334X.202X.047 SBZ
10	1.000	EA	1112-0113	BRACKET SLIDE - GTA TORCH
11	2.000	EA	970010-506	SCR 10-32X.50 CR1F SBZ
12	4.000	EA	970039-606	SCR 1/4-20X.50 H SBZ G8

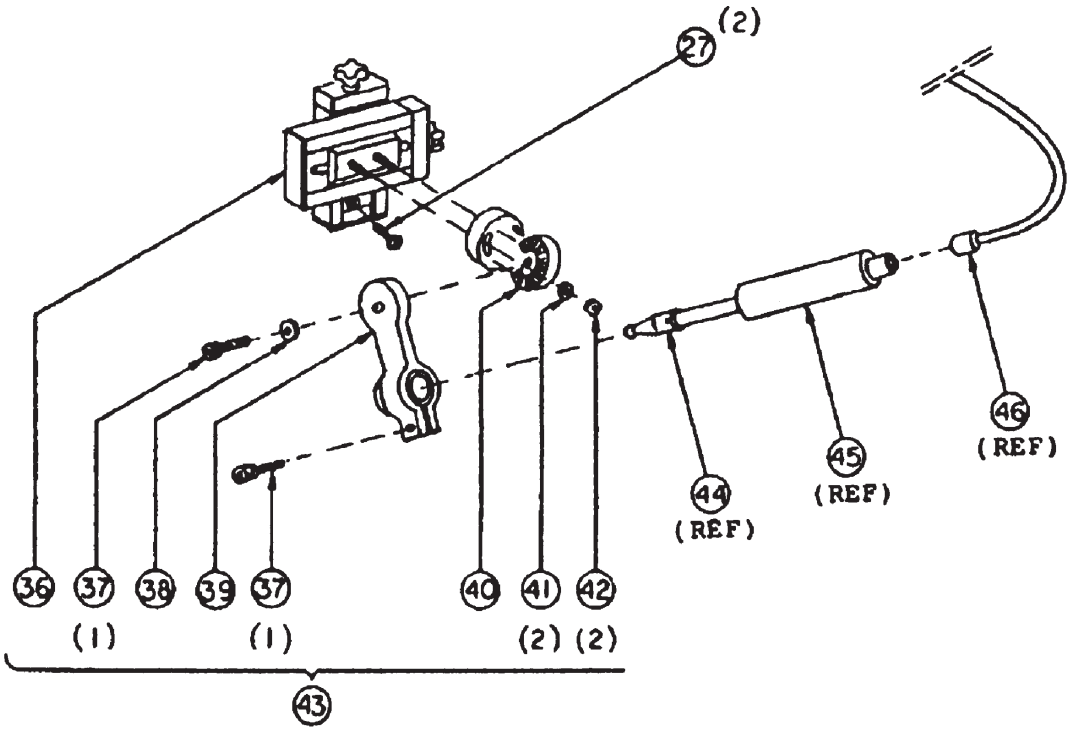


FIGURE 46 - 5-AXIS MOUNT

TABLE 33 - 5-AXIS MOUNT PARTS LIST

ITEM #	QPA	UM	PART #	DESCRIPTION
36	1.000	EA	1106-0692	SLIDE ASSEMBLY PROBE H.D.
				Consisting of:
1	2.000	EA	1110-0830	BASE SLIDE - 1 1/2IN STR
3	1.000	EA	1110-1402	CROSS SLIDE LOWER
4	1.000	EA	1110-2298	CROSS SLIDE UPPER
5	2.000	EA	1112-0156	GIB SLIDE - 1 1/2IN STR
7	2.000	EA	1110-0856	HOUSING BUSHING
8	2.000	EA	1112-0164	END PLATE STOP
9	2.000	EA	1110-3880	SCR ADJUSTING-1 1/2IN STR
11	1.000	EA	1110-3898	NUT DRIVE-LOWER AXIS
12	1.000	EA	1110-3901	NUT DRIVE-UPPER AXIS
13	2.000	EA	2320-0180	BUSHING FLG .38 X .63 X .625LG BRZ
14	2.000	EA	1116-0450	KNOB - MODIFIED
20	2.000	EA	974031-105	WSR F .630 X .380 X .010 SBZ
21	4.000	EA	970000-404	SCR 8-32 X .38 CR1P SBZ

TABLE 34 - 5-AXIS MOUNT PARTS LIST (CONT.)

ITEM #	QPA	UM	PART #	DESCRIPTION
22	4.000	EA	970015-406	SCR 8-32 X .50” HSC SBZ
23	2.000	EA	970010-001	SCR 10-24 X 1.25” CR1F SBZ
24	2.000	EA	2408-1036	STUD PRESS 1/4-20 X 1.00” LG S
25	6.000	EA	970043-401	SET SCREW, 8-32 X 1/4” SHCP
26	2.000	EA	2416-0203	EXT RET RING .035” THK
28	2.000	EA	2360-1109	PIN ROLL .0938” DIA X .750” LG
29	2.000	EA	974031-002	WSR F .750” X .401” X .075” SSP
	1.000	EA	1106-0668	BRKT ASSY PROBE ADJUST
				Consisting of:
37	2.000	EA	970015-614	SCR 1/4-20 X 1.00” HSC SBZ
38	1.000	EA	974004-006	WSR, F 1/4 .734” X .312” X .065” SBZ
39	1.000	EA	1106-0684	ARM ASSY - PROBE ADJUST
40	1.000	EA	1110-0805	PIVOT - MACHINED
41	2.000	EA	974005-006	WASHER FLAT ¼ .468” X ..255” X .032”
42	2.000	EA	972014-008	NUT 1/4-20 NL
43	1.000	EA	1100-0258	5-AXIS PROBE BRACKET ASSEMBLY
44	1.000	EA		SEE SENSOR TIPS BEGINNING ON PAGE 7
45	1.000	EA	1100-1017	SENSOR ASSEMBLY (SEE PAGE 40)
46	1.000	EA	1114-0378	SENSOR CABLE ASSEMBLY

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 Main 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 and parts for maintenance purposes. A recommended spare parts lists is given in Table 39 - Recommended Spare Parts on page 70. For troubleshooting, the following items are recommended to isolate most problems.

TABLE 35 - TROUBLESHOOTING

PROBLEM #	DESCRIPTION	CAUSE	SOLUTION
Problem 1 - Lamp Off	Lamp is not lit	• Unit unplugged • Blown Fuse • Lamp is bad	• Plug unit into an appropriate AC Source • Replace Fuse • Replace Lamp
Problem 2 - No Operation	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 • Main board voltages are not present	• Check cables from the control to other components of the system • Check connectors inside the control unit • Check Main board voltages, ±20VDC, ±15VDC, and ±6VDC
Problem 3 - Horizontal Drift	Cross-slide drifts horizontally in Automatic Mode only	• Sidetrack is enabled • Main board is out of calibration • Seam sensor is out of adjustment	• Check the Sidetrack switch to verify it is in the desire position • Adjust the Horizontal Null Adjustment Potentiometer on the Main board • Replace the seam sensor with a known good sensor or send the sensor in for repair
Problem 4 - Vertical Drift	Cross-slide drifts vertically in Manual Mode only	• Main board Vertical Offset may need adjustment • Main board may be faulty	• Adjust Vertical Offset on the Main board • Replace the Main board with a known good board
Problem 5 - System Oscillation	System oscillates while tracking in Automatic Mode	• Seam sensor is not in the correct orientation with the drive assemblies axes • The system is mounted on a fixture that is not stable • The cross-slides have mechanical play in the horizontal and/or vertical axes	• Check the seam sensor to verify its X and Z axes are in the same orientation as the cross-slides X and Z axes. Make adjustments as necessary • Check the fixture for rigidity and eliminate the instability • Check the cross-slides for mechanical play or looseness and eliminate it
Problem 6 - Doesn’t Drive Downward	System doesn’t drive down and contact the work when the Mode Switch on the pendant assembly is switched to Automatic Mode (no Advanced Programming Control Option is installed)	• Possibly Main board may be faulty • Possibly heatsink assembly may be faulty • Possibly seam sensor may be faulty	• Check vertical drive signals on the Main board to verify the proper voltages • Check the output test points on the Main board for verify the heatsink voltages are correct • Check the seam sensor’s lower rod is pointing in the downward position, check voltages on the Main board for the seam sensor’s output

PROBLEM #	DESCRIPTION	CAUSE	SOLUTION
Problem 7 - Slides will not Drive	Cross-slides will not drive in one or more directions using manual commands on Manual Mode	• Switches on the pendant assembly are faulty • Main board is faulty • Heatsink assembly is faulty	• Switch commands from the pendant assembly are not getting to the main board • Check Test Points on the Main board to verify the signals are being received and sent to the motors on the cross-slides (see the following tables)
Problem 8 - Slides Drive, One Direction	System continuously drives at full speed in one direction with no control	• Main board is faulty • One or more transistors on the heatsink assembly may be faulty	• Check the Test Points on the Main board to determine if the Main board is or is not giving commands to drive the system, if no commands are given from the main board, check the heatsink assembly (see the following tables) • Check the transistors on the heatsink assembly
Problem 9 - Slides Drive, Both Direction	System continuously drives at full speed in two directions with no control	• One of the regulated voltages on the Main board is faulty	• Check the voltages on the Main board • Replace the Main board
Problem 10 - Motor Oscillation	One or both of the cross-slide motors is oscillating continuously and the heatsink assembly is becoming hot	• The IR Compensation Adjustment on the Main board is out of adjustment for vertical or horizontal axes	• Adjust the IR Compensation Adjustment on the Main board counterclockwise until the oscillation just stops, then continue adjusting the potentiometer 4 more turns to complete the adjustment.

TABLE 36 - VOLTAGE TEST POINTS

TP #	DESCRIPTION	VALUES
TP7	-20 VDC	-20 VDC ±1.0 VDC
TP3	+20 VDC	+20 VDC ±1.0 VDC
TP8	-15 VDC	-15 VDC ±0.5 VDC
TP4	+15 VDC	+15 VDC ±0.5 VDC
TP9	-6 VDC	-6 VDC ±0.5 VDC
TP5	+6 VDC	+6 VDC ±0.5 VDC

TABLE 37 - DRIVE SIGNAL TEST POINTS

TP #	DESCRIPTION	VALUES
TP1	Horizontal Error (VE)	RIGHT ≈ +12.5 VDC LEFT≈ -12.5 VDC
TP2	Vertical Error (HE)	UP ≈ +12.5 VDC DN ≈ -12.5 VDC

TABLE 38 - SEAM SENSOR TEST POINTS

TP #	DESCRIPTION	VALUES
TP6	Vertical Probe (VP)	UP ≈ -4 VDC DN ≈ +4 VDC
TP10	Horizontal Probe (HP)	RIGHT ≈ -4 VDC LEFT≈ +4 VDC
TP12	2KHz Clock/Probe Drive	2KHz +/- 300Hz

TABLE 39 - RECOMMENDED SPARE PARTS

ITEM #	QTY	PART #	DESCRIPTION
1	2	2120-0263	Fuse
2	1	2100-0086	Power Lamp
3	1	1101-2002-3	Main Board
4	2	1110-2093	Insulator
5	2	1110-1101	Rod Clamp
6	1	2702-0186	Rectifier
7	1	1103-0491	Transistor Kit
8	1	A/R	Seam Sensor Tip(s)

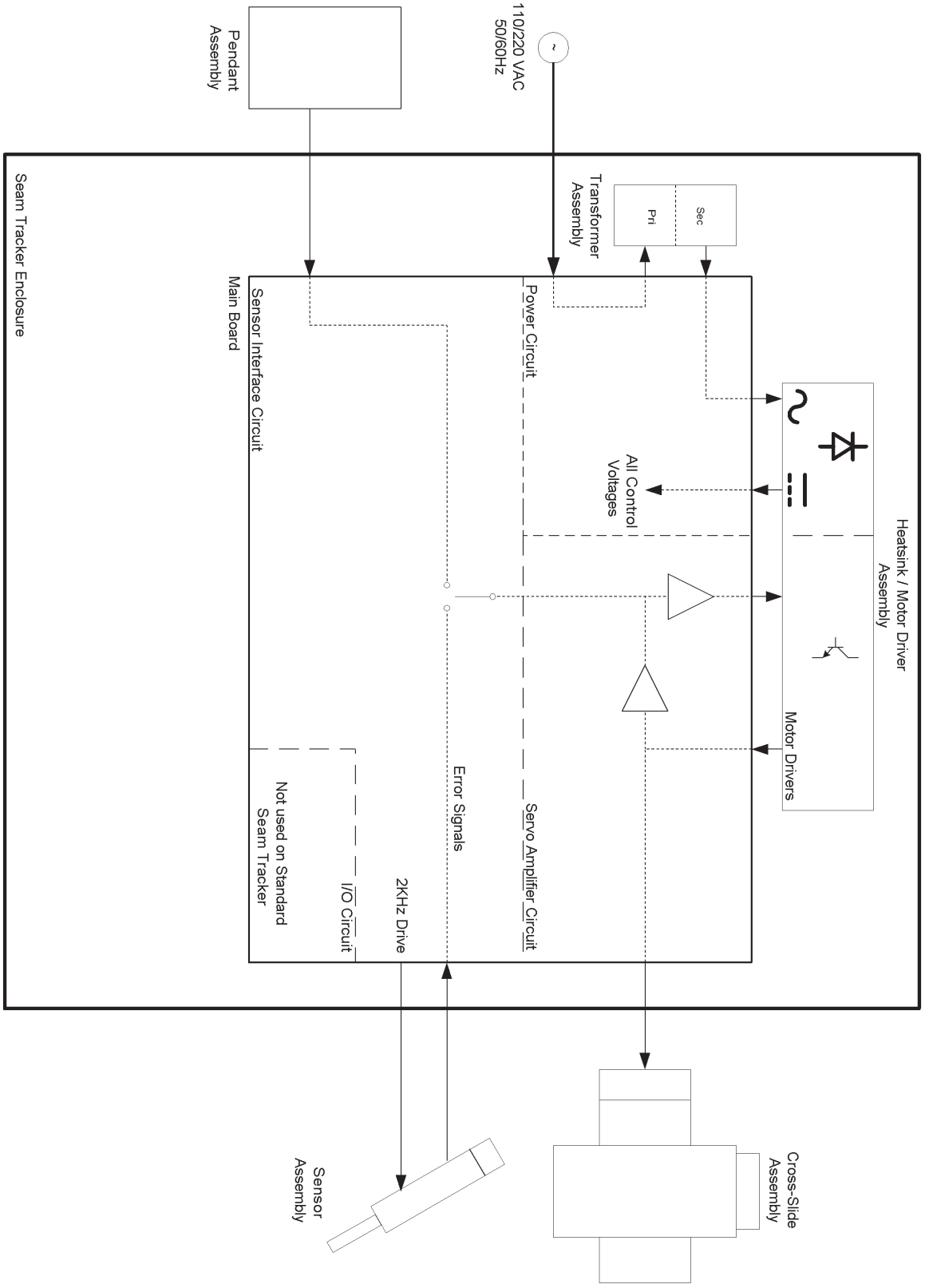


FIGURE 47 - SEAM TRACKER SIGNAL FLOW

HELPFUL HINTS

The sensor position and angle are crucial for proper tracking and sidetrack performance. Below are a few tips to assist in proper sensor adjustment to maintain optimum performance.

Hint # 1 - Lap Joint Welding Applications

The angle of the sensor is extremely important when tracking a lap joint. If the sensor's tip is at a 90° degree angle from the Lower Member, the sensor could be pulled out of the joint by the Upper Member of the lap joint. This is especially true if the Upper Member of the joint has a sharp edge at the top of the joint, which can capture the sensor's tip and pull it onto the Upper Member. Once on top of the Upper Member of the lap joint the seam tracking system has lost the weld joint with no hope of recovery.

By adjusting the sensor's angle, this problem can be reduced or eliminated. By pointing the tip into the lap joint, as in Figure 48 - Sensor Angle on Lap Joints on page 72, we no longer track the top edge of the Upper Member and minimize the chances of the tip from being captured by a burr or sharp edge.

Hint # 2 - Circumferential Welding Applications

Like with lap joint welding applications, Circumferential welding applications also require proper angle settings for the system to track properly, both while welding and when trying to locate the seam.

If the sensor angle is too steep, the sensor's tip will tend to gouge or scribe the material. In doing so, the sensor often gets caught by the material being welded, preventing the system from finding the joint properly or from properly tracking the joint when using sidetrack to bias one side of the joint.

The Figure 49 - Sensor Orientation on Tanks, Pressure Vessels and Pipes on page 72 shows a typical angle for welding on a tank or pipe. The acceptable angles are from 10° to 45° degrees. The system performs better and will require less maintenance, when the angle is set less than 45° degrees. As a initial angle setting for the sensor, efforts should be made to position the sensor at or around a 30° degree angle.

Notice also in Figure 49 - Sensor Orientation on Tanks, Pressure Vessels and Pipes that the angle measurement is not made from our horizon, but from the location of the tip to work contact point. This is important to note, because often the sensor is located on the leading side of the tank (as illustrated), which requires the sensor angle to appear to be pointing upward when measuring the angle from our horizon.

In circumferential applications welding smaller tanks, vessels or pipes, the sensor angle must change considerably to maintain the 10° to 45° degree angle requirement.

Hint # 3 - Cross Slide to Sensor Relationship

The cross slide to sensor relationship must be maintained to within ± 5° degrees. The cross slide is made up of two axes--vertical and horizontal. The sensor also has these two axes. To properly track the joint, the two must be in the same axis. For example, an upward movement on the sensor's tip, must direct the slide to move upward as well. If these relationships aren't maintained, an upward movement of the sen-

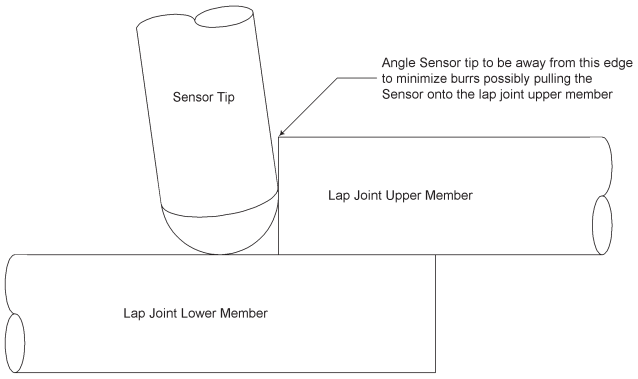


FIGURE 48 - SENSOR ANGLE ON LAP JOINTS

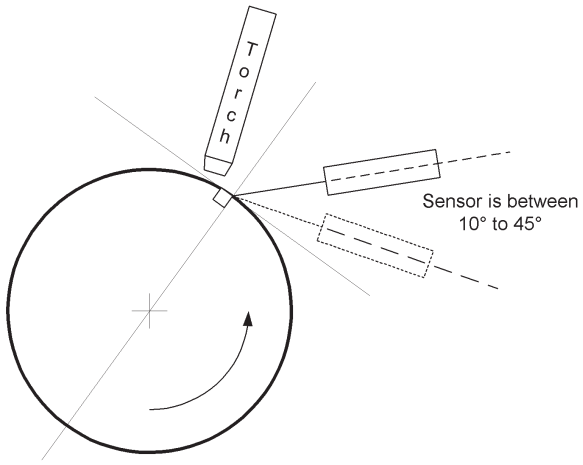


FIGURE 49 - SENSOR ORIENTATION ON TANKS, PRESSURE VESSELS AND PIPES

sor's tip could cause the slides to move up and to the right. This could cause the system to climb out of the joint or worse. Figure 50 - Cross Slide to Sensor Relationship, Correct on page 73 illustrates the proper configuration of the sensor and the cross slide. Figure 51 - Cross Slide to Sensor Relationship, Incorrect shows a configuration to avoid when setting up the seam tracking system. Please note in the figure the grooves on the outer case of the sensor. The groove on the sensor traveling the entire length of the sensor body indicates the vertical up direction and should be oriented with the vertical axis of the cross slide.

Hint # 4 - Sensor Rotated 180° Degrees

Certain Applications and fixtures require the sensor to be rotated 180° degrees from the designed configuration. Figure 12 - Interconnection Diagram on page 10 and Figure 22 - Torch Clamp Mounting Bracket on page 19 and others in the Description of Equipment section of this manual illustrate proper installation of the sensor to the cross slides. The sensor is mounted to the front and tracks the seam in front of the cross slide's face plate. This plate mounted to the cross slide's vertical slider is used to mount a wire feed head assembly, torch, etc., and to mount the 5-axis mount assembly and the sensor.

Occasionally, the sensor must be mounted to the back side of the cross slides (180° degrees out of original design configuration) to accommodate fixtures or other needs of the system as shown in Figure 52 - Sensor Rotated 180° Degrees on page 74.

This configuration causes two problems: the horizontal slide will want to travel in the wrong direction as commanded from the sensor; and the Joystick switch on the pendant will, when commanding the slides to move left will cause the horizontal slide to move right.

To correct these problems, it is necessary to change two sets of wires.

Cross Slides Correction

ST250 / ST450 Cross Slides

There is two methods to correct this for the slide assembly. For the ST250 and ST450 Cross Slides it is best and esiest to correct this at the Cross Slide Horizontal Motor Cover.

Inside the Horizontal Motor Cover assembly, item # 59 in Figure 33 - ST250 Cross-Slide Exploded View on page 44, is a motor with two leads. Simply reverse these two leads. This corrects the cross slide problem.

ST40 Cross Slides

The ST40 Cross Side doesn have a Horizontal Motor Cover in which to reverse two wires. Instead, to correct this ST40 Cross Slide it is best to make the change inside the control unit.

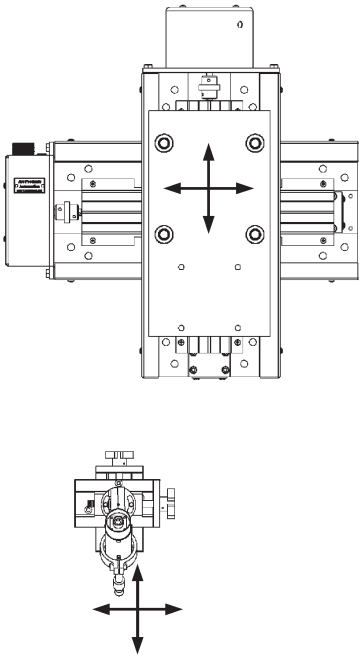


FIGURE 50 - CROSS SLIDE TO SENSOR RELATIONSHIP, CORRECT

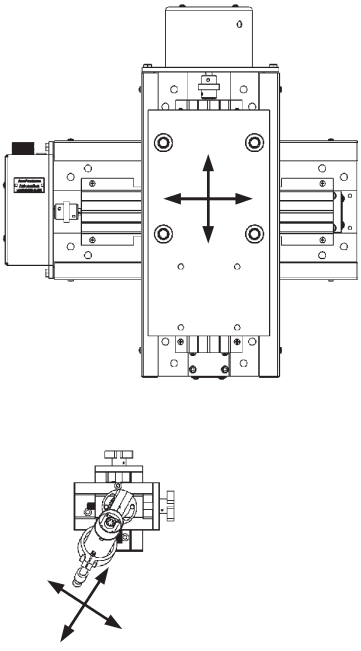


FIGURE 51 - CROSS SLIDE TO SENSOR RELATIONSHIP, INCORRECT

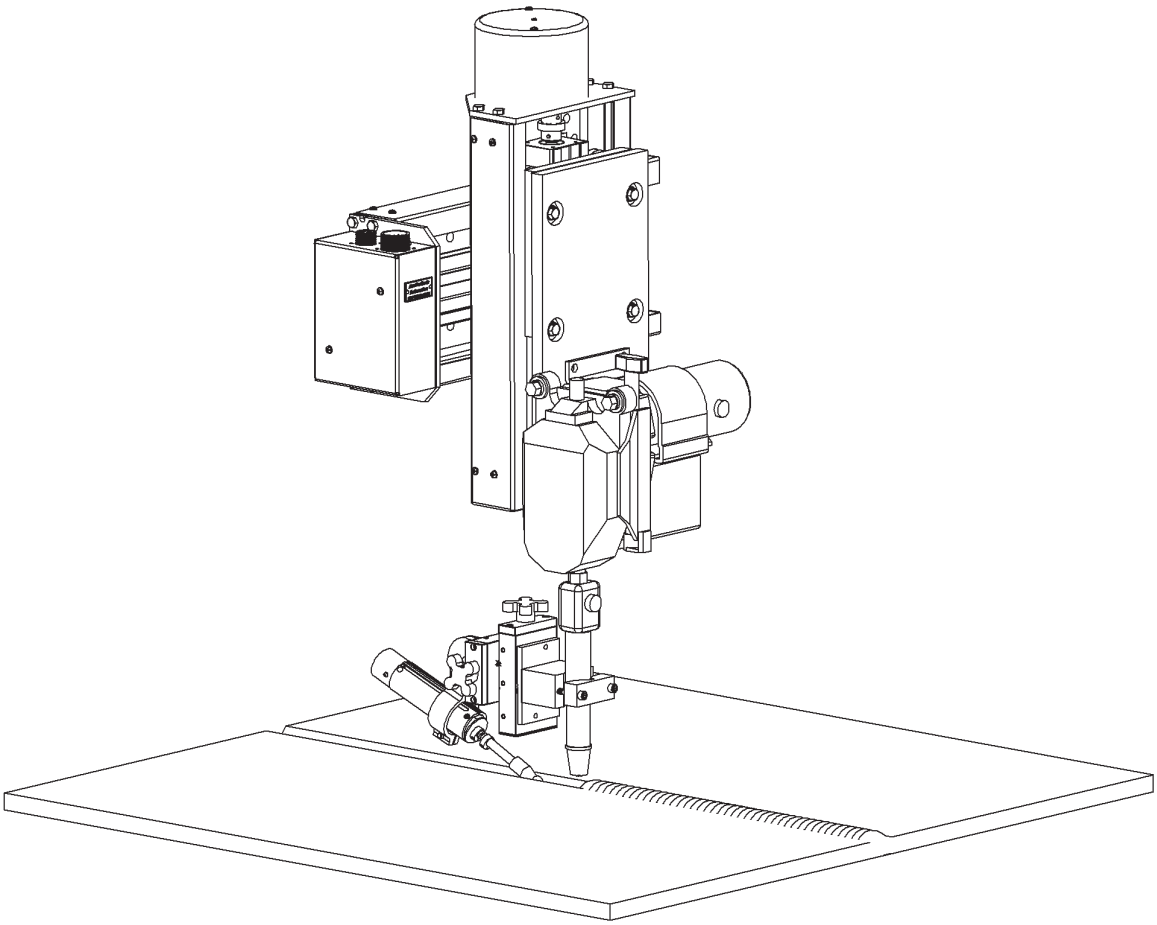


FIGURE 52 - SENSOR ROTATED 180° DEGREES

The J2 / P2 connector on the main board in the is a 14 pin connector. Pins 13 and 14 are not used. To correct the horizontal problem, swap the wires on pins 8 and 10 on the P2 connector going to the main board. See on page for the connector position on the main board.

Pendant Assembly Correction

To correct the Joystick pendant problem, swap pins 6 & 7 on the wiring harness at the P1 connector of the main board inside the control unit. See on page for the location of the P1 connector.

CIRCUIT DESCRIPTIONS

WARNING

For use by Qualified Service Technicians

The APA Seam Tracker electronic circuitry consists primarily of two nearly identical servo systems, one for the horizontal axis and one for the vertical axis; and is known as a closed loop feedback system. These servo systems position the cross-slides to maintain the seam sensor rod in a null (centered) position.

When no external forces are applied to the sensor rod, mechanical spring loading inside the seam sensor keeps the rod Nulled in the horizontal axis and full down in the vertical axis. Due to the spring loaded in the down deflection, the vertical servo drives down until the sensor rod contacts the work piece just hard enough to push the rod up to the null position.

In normal operation, the tip of the sensor rod rides in the weld joint just ahead of a welding torch mounted on the cross-slides. During welding, as the work piece moves under the seam tracker slides, the seam sensor and torch are moved over the work piece. The horizontal movement of the weld joint relative to the slides causes a left or right deflection of the seam sensor rod. The servo system then immediately moves the cross-slide just enough to put the sensor rod back in the null position. Likewise, the vertical servo follows any relative vertical movement of the work piece. Thus the welding torch is always kept in the proper position over the weld joint.

The operation just described requires that the weld joint captures the sensor rod tip like a needle in a phonograph record, by applying left or right and vertical (downward) forces to it. As illustrated in Figure 28 - Tracking Diagram on page 29, some types of weld joints can exert only left or right pressure on the sensor rod. The seam tracker handles this situation by applying an electrical bias to the horizontal servo, so that it pushes the sensor tip (to the left or right as required) against the weld joint to be tracked. This mode of operation is referred to as "Sidetracking."

As with all of the seam tracker control switches, except the power switch, the Sidetrack control switch is located on the control pendant. This switch has LEFT, OFF, and RIGHT positions. The amount of sidetracking force can be adjusted by the "Sidetrack Adjust" knob located inside the control unit on the Main board as shown in Figure 30 - Sidetrack Force Adjustment on page 38.

All of the previously described operations are performed with the standard seam tracker (Advanced Programming Control Option is not installed) in the automatic mode selected by placing the MODE switch on the control pendant in the AUTO position.

When the MODE switch is in the MAN (Manual) position, it disables the Sidetrack switch and the Sidetrack feature and enables the MANUAL switches, allowing the cross-slides to be positioned manually by pressing the momentary contact switches for UP/DOWN and LEFT/RIGHT, as desired.

Switching to the manual mode also disables sensing of the seam sensor signals in the down direction, so that the servo will not drive down due to the spring loaded down deflection that occurs when the sensor rod is moved away from the work piece. A modified form of signals from the seam sensor are enabled during MANUAL mode, allowing UP, LEFT and RIGHT movement of the cross-slides. This is done so that sensor rod deflection signals will override the manual signals if the sensor rod is accidently driven against an obstruction, thus preventing damage. This is referred to as the "Anti-Jam" feature.

SYSTEM WIRING DIAGRAM

The Figure 54 - Seam Tracker Block Diagram and Figure 55 - Seam Tracker Block Diagram (Cont.) beginning on page 80 and Figure 53 - Pendant Schematic, Standard Seam Tracker on page 79 is a circuit diagram of the entire seam tracker system. These diagrams include detailed schematics of all portions of the system except the Main board. Schematics of the ST40 and ST250 drives are shown in Figure 54, as well. Substituting one drive for the other is the only electrical difference between ST40 and the ST250 Seam Trackers.

The Figures 53 and show all wires and connector pins in the interfaces between the various assemblies in the control unit. Figure 35 - Seam Tracker Control Exploded View on page 52 and Figure 36 - Control Pendant Exploded View on page 54 identifies the major assemblies covered in Figure 53 and 54. The physical location of sub-assemblies packaged inside the control unit assembly are shown in Figure 35 - Seam Tracker Control Exploded View. Parts lists for each assembly are also included in the DRAWINGS AND PARTS LISTS section beginning on page 37.

MAIN 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 29 - Seam

Tracker Main Board Layout on page 37 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, Figure 47 - Seam Tracker Signal Flow on page 71illustrates very simply the flow of signals in the standard seam tracker system.

Voltage Regulation

The Main 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 Main 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 30VAC with a Center Tap (two secondaries at 15 VAC), and a third secondary of approximately 10 VAC (used for the Advanced Programming Control Option discussed later beginning on page 85). A fourth 115VAC secondary winding is routed directly to the heatsink assembly and is rectified to ≅ 130VDC for used with a cross-slide assembly with brakes installed on the motors or screw shafts. No filtration is provided on this voltage, due to the brake coil acting as a current filter to smooth the power.

The 30 VAC is rectified on the heatsink assembly and sent back to the Main board where the ±20 VDC (TP3 +20 VDC and TP7 -20 VDC) is filtered through 8 electrolytic capacitors. The ±20 VDC is used as the source voltage for the motor driver circuit and is also regulated down to ±15 VDC (TP4 +15 VDC and TP8 -15 VDC (for servo amplification--Pre-amplifier)). The ±15 VDC is also regulated down to ±6 VDC (TP5 +6 VDC and TP9 -6 VDC (for seam sensor applications and control circuitry)). All voltages are referenced to power ground on TP11 GND.

Control Circuitry Description

The following will describe in basic terms how the seam tracker system functions, beginning from the seam sensor's operation, remote pendant assembly, and Motor Drivers (heatsink assembly).

Seam Sensor Interface

The seam sensor is used to track the seam and produces horizontal and vertical error signals proportional to the mechanical movement of the sensor's rod while tracking the seam. For clarity, this circuitry will be referenced as seam sensor Interface.

The Seam Sensor Interface (SSI) has two primary functions; control of servo drive signals commanded from the remote pendant assembly (pendant) and conversion of the signals from the seam sensor to DC signals of appropriate magnitude and direction.

The signal conversion function of the SSI is to convert the 2KHZ square wave signals coming from the seam sensor into a DC voltage appropriate for driving the servo amplifier board. This conversion is accomplished by rectifier circuits U1 for vertical deflection and U2 for horizontal deflection.

The seam sensor can be considered a transformer with a primary and four secondary coils oriented 90 degrees from each other. Attached to the sensor tip is a magnetic coupling bar that couples a portion of the primary signal to the secondary coils. The closer the coupling bar is to a particular secondary coil, the larger the signal will be in that particular winding. Also, the farther away the bar is from particular winding the smaller the signal will be on that coil. The secondary coils are designated horizontal (+) horizontal (-) for horizontal deflection, and vertical (+) and vertical (-) for vertical deflection.

The primary voltage for the seam sensor is generated by an oscillator circuitry. The seam sensor drive signal is a nominal 2KHz square wave of approximately 12V p-p. This drive signal or "Clock" can be adjusted by R90 while monitoring the signal on the TP12.

Because of mechanical springs and component variations, the DC error voltage will not be exactly equal at null. So Horizontal Adjustment (R84) is required to account for these variations. To properly adjust R84, the system should be in the MANUAL mode of operation with the sensor tip off of the work piece in free air.

Monitor the horizontal sensor output TP10 HP (Horizontal Probe Adjustment) with a D.V.M. or oscilloscope. Deflect the sensor tip right and left and allow the internal probe tip springs to return the tip to its normal mechanical null position. Adjust R84 either CW or CCW until the voltage on the monitoring equipment is 0 VDC ±0.1 VDC. Repeat sensor deflection and again monitor horizontal output to insure it returns to 0 VDC ±0.1 VDC.

NOTE

During the time the sensor is being deflected the horizontal and/or vertical slides may move due to the Anti-jam circuitry being activated. The horizontal adjustment

R84 is adjusted properly at the factory and need not be readjusted even when a new seam sensor is installed.

The vertical channel circuitry functions the same as the horizontal with a few exceptions. There is no vertical adjustment required on the vertical channel, because the vertical slide will force the seam sensor downward to compensate for component variations and stays down against the part due to the spring in the seam sensor. In addition, while monitoring voltage at TP6 VP (Vertical Probe) with the seam sensor is in free air, you will notice voltage will read 4 VDC ±0.5 VDC.

These error signals generated on TP6 VP and TP10 HP are converted to motor drive signals depending upon what mode of operation the system is in, determined by the Pendant switches.

Pendant Control

Manual Mode

Selecting Manual mode on the pendant allows Left, Right, Up and Down control of the cross-slides. As the operator selects either the Left, Right, Up or Down manual controls, the generated signals can be monitored at TP1 VE (Vertical Error) and TP2 HE (Horizontal Error). The voltages when these manual controls are selected will generate a +12 VDC ±1.0 VDC for Up or Right and -12 VDC ±1.0 VDC for Down and Left.

While the operator selects one of the manual controls, i.e., Vertical and Horizontal, and the seam sensor's rod comes in contact with an obstruction a protection circuit is activated. This protection circuit, called Anti-jam, overrides the pendant manual controls, protecting the sensor, the bracketry, the torch and other related components at the torch area.

Automatic Mode

Selecting Auto mode of operation on the pendant activate seam tracking of the system. The system begins by driving downward in search of the seam. Once in contact with the workpiece, signals proportional to the seam sensors vertical and horizontal error deflection drive the horizontal and vertical slides in the appropriate direction. These signals can be monitored at the Test points for the Probe Signals, i.e., TP6 VP and TP10 HP and at the Error Signals, i.e., TP1 VE and TP2 HE.

Two other horizontal control signals may occur in the Auto mode of operation. These signals are either Right Sidetrack or Left Sidetrack. When one of the sidetrack controls is selected on the pendant, this signal drives the horizontal slide to the Right (or Left) until the seam sensor finds the weld joint, and continues until an opposing voltage generated by the Sidetrack Force Adjustment is 0 VDC at TP6 HP.

Servo Amplifier

The primary purpose of the Servo Amplifier Circuitry is to amplify the signals generated by the SSI circuit to the appropriate levels required by the complementary Darlington Push-Pull Transistors located on the heatsink assembly used to drive the motors and to regulate the motor current.

What is actually required of the Servo Amplifier is that it produces a motor speed proportional to the error signal voltage from the SSI. Motor speed is regulated by measuring back EMF from the motor. The technique used to regulate motor speed is known as IR Compensation.

Motor Speed is made up of two parts, Voltage and Current. The resistance from one motor to another will vary. The motor resistance can be accommodated by adjusting R18 Vertical IR Comp and R20 Horizontal IR Comp. An EMF Sense Resistor (0.1 Ω) for each axis is used as a shunt to accurately measure and limit the motor current.

The adjustment procedure is to turn R18 and R20 counter-clockwise until the horizontal slide oscillates or vibrates. Then turn them clockwise to the point where oscillations stop, which should be checked by alternately driving the slides in the Manual mode with normal operating weight on the cross-slides. When this point has been established, turn them clockwise an additional two and one-half turns to allow a margin for circuit variations due to temperature, etc.

NOTE

If R18 and R20 is backed off too far (Clockwise), the servo will have sluggish response.

The signal through R13 is derived from motor current, which can be sensed directly. The Motor's DC resistance enters in as a constant factor, the exact value of which is accounted for by trimpot adjustment, R11 , as described later. Motor current is sensed as a voltage across the 0.1 ohm "horizontal EMF sense" resistor. The resistor's voltage drop is fed to the differential inputs, pins 5 & 6, of amplifier U2. The signal is further amplified when it reaches the output of U2 pin 8, where it is connected through trimpot R11 to drive R13. R11 adjusts the amount of motor current proportional voltage fed back for correct compensation.

The vertical and horizontal channels are identical, except for the R7 trimpot on the vertical channel. R7 is normally adjusted completely clockwise, which makes the circuit completely the same as the horizontal channel. With heavy loads, the vertical slide may creep down while in the manual mode. In this case, R7 is adjusted counter-clockwise just enough to offset the creep.

One remaining point should be covered with regard to the Servo Amplifier. Occasionally, users want to mount the seam sensor rotated 180 degrees in order to track in the reverse direction. Rotating the seam sensor to track in the opposite direction, causes the system to interpret the Right and Left Signals as Left and Right signals instead. This requires that the horizontal drive motor leads be reversed.

The reversal is best accomplished in the Motor Cover Assembly or in the Junction Box Assembly in the case of the ST40 drive (see Figure 32 - ST40 cross-slide Exploded View on page 42). The cord from the horizontal motor has two leads, white and black, whose connections can be reversed in the junction area mentioned above. Reversing the white and black leads reverses the direction that the motor drives and takes only a moment to complete.

Advance Programming Option Components

Additional components required for the Advanced Programming Control Option (APC) is also located on the Main board. These components allow the APC to interface with external equipment, such as carriages, power sources and wire feeders, PLC's and others.

The relays, K1, K2, and K3 are among some of the components required. Other components are used to convert the Standard Seam Tracker System to an Advanced Tracking system when the APC option is installed and plugged into the Main board via the ribbon cable at the J5 connector.

SCHEMATICS AND BLOCK DIAGRAMS

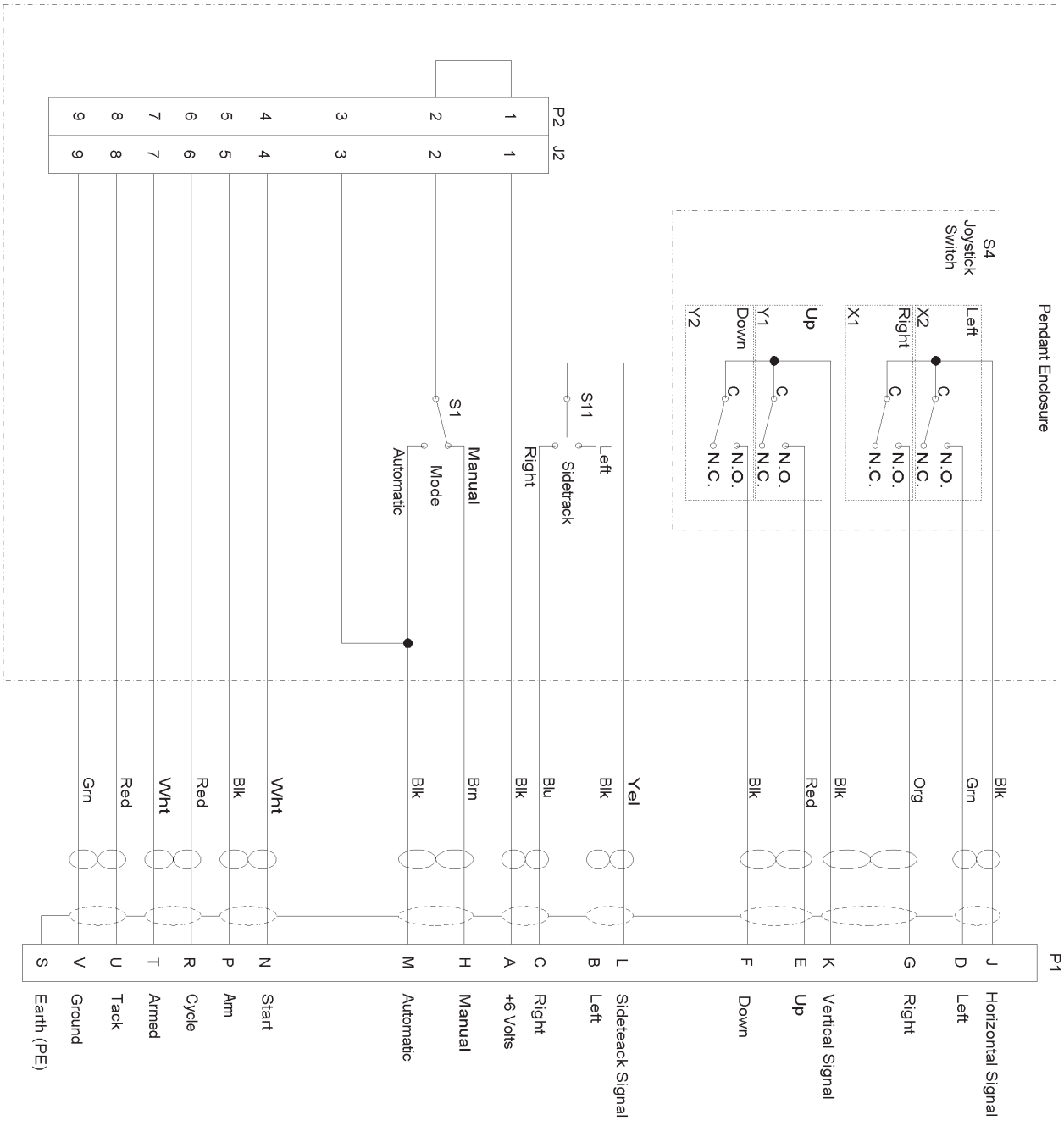


FIGURE 53 - PENDANT SCHEMATIC, STANDARD SEAM TRACKER

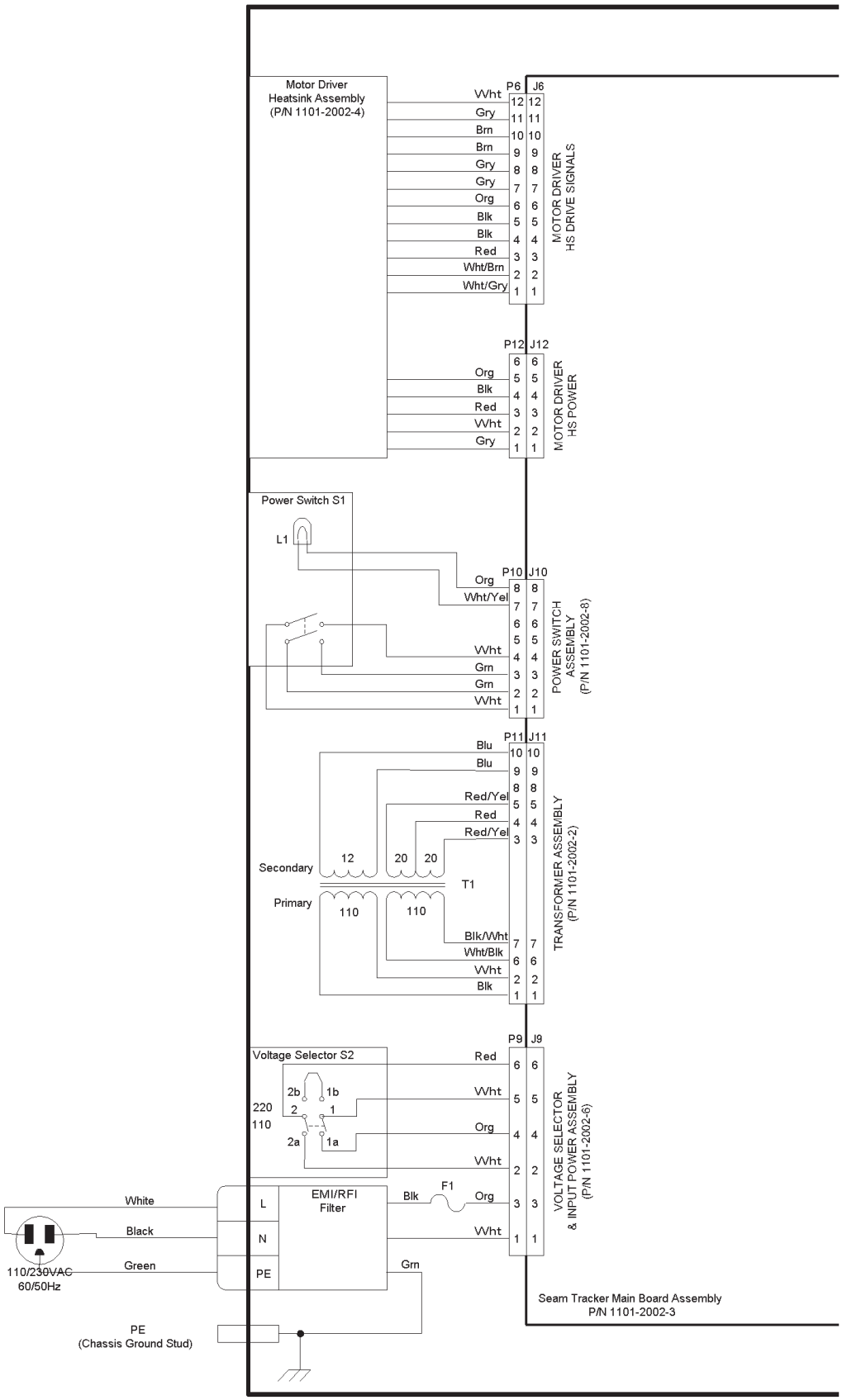


FIGURE 54 - SEAM TRACKER BLOCK DIAGRAM

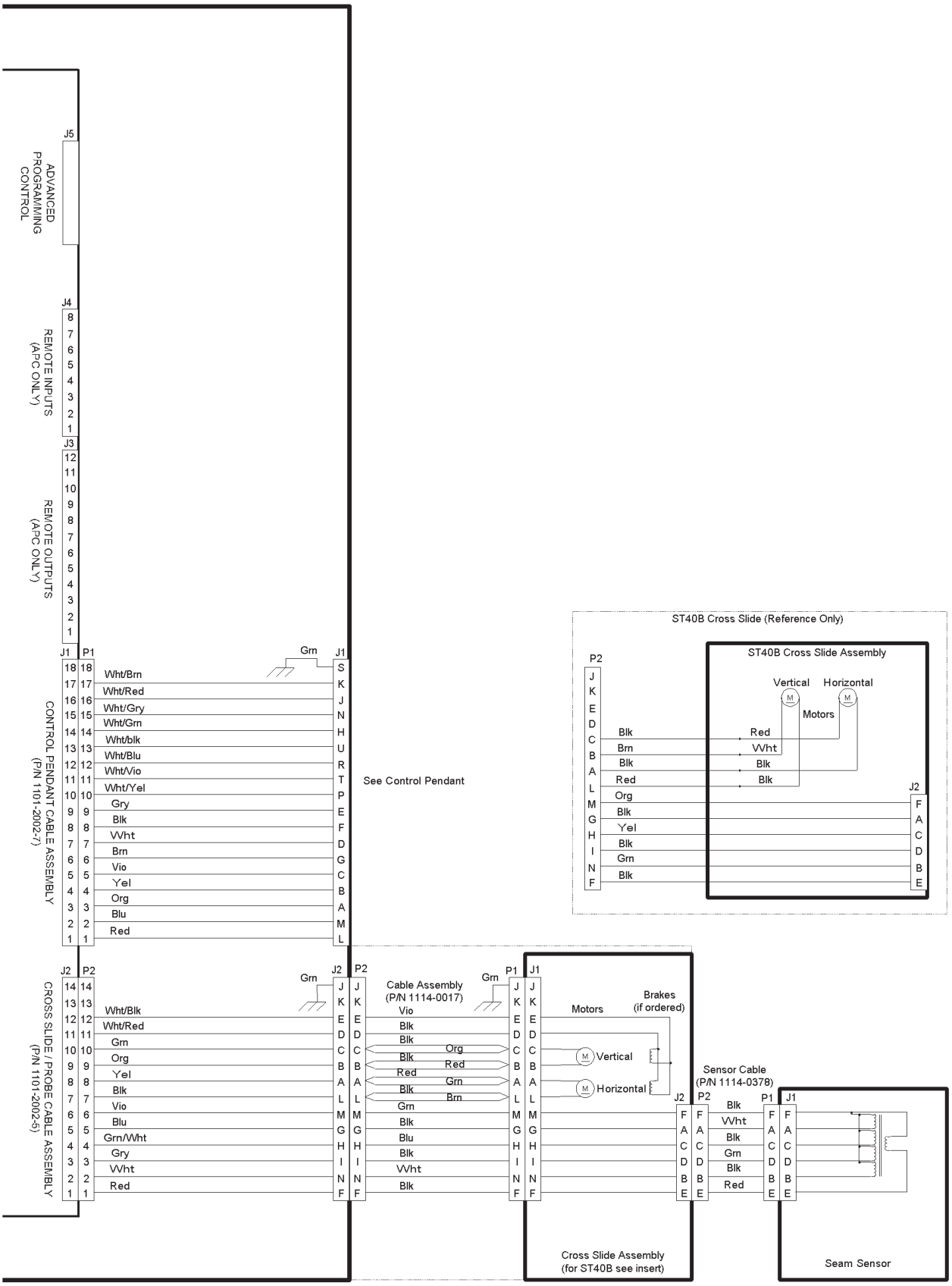


FIGURE 55 - SEAM TRACKER BLOCK DIAGRAM (CONT.)

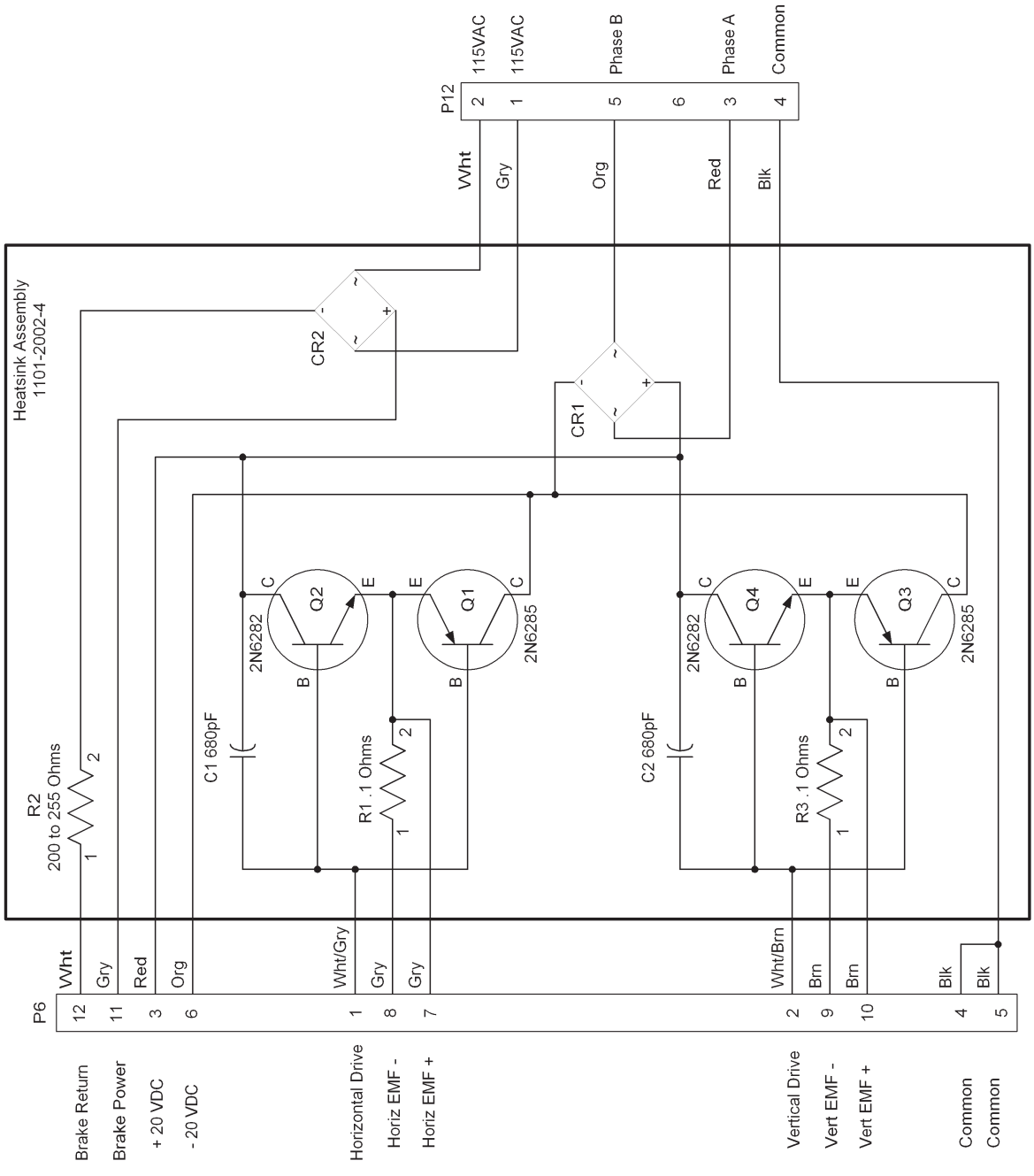


FIGURE 56 - MOTOR DRIVER HEATSINK SCHEMATIC DIAGRAM

OPTIONAL EQUIPMENT

ROTARY TABLE BRACKET

Engineered and designed for use with ST250 seam tracker systems, the Rotary Table Bracket allows the user to position equipment at any point through 360 degrees and lock it into place. Used primarily for fillet weld applications where angling of the torch is necessary or for operations requiring the removal of welding equipment away from the immediate work area to provide ample access for inspection, part removal, etc.

Convenient indexing detents are provided every 90 degrees and positive positioning of table is achieved by means of a short, single stroke of the locking handle. Two adjustable stops are also included, providing the user the facility to accurately re-position equipment after it has been rotated away from the operating position. Sturdily constructed from solid aluminum the mounting plate houses a large diameter ball bearing carrying the rotating faceplate on which the welding equipment is mounted.

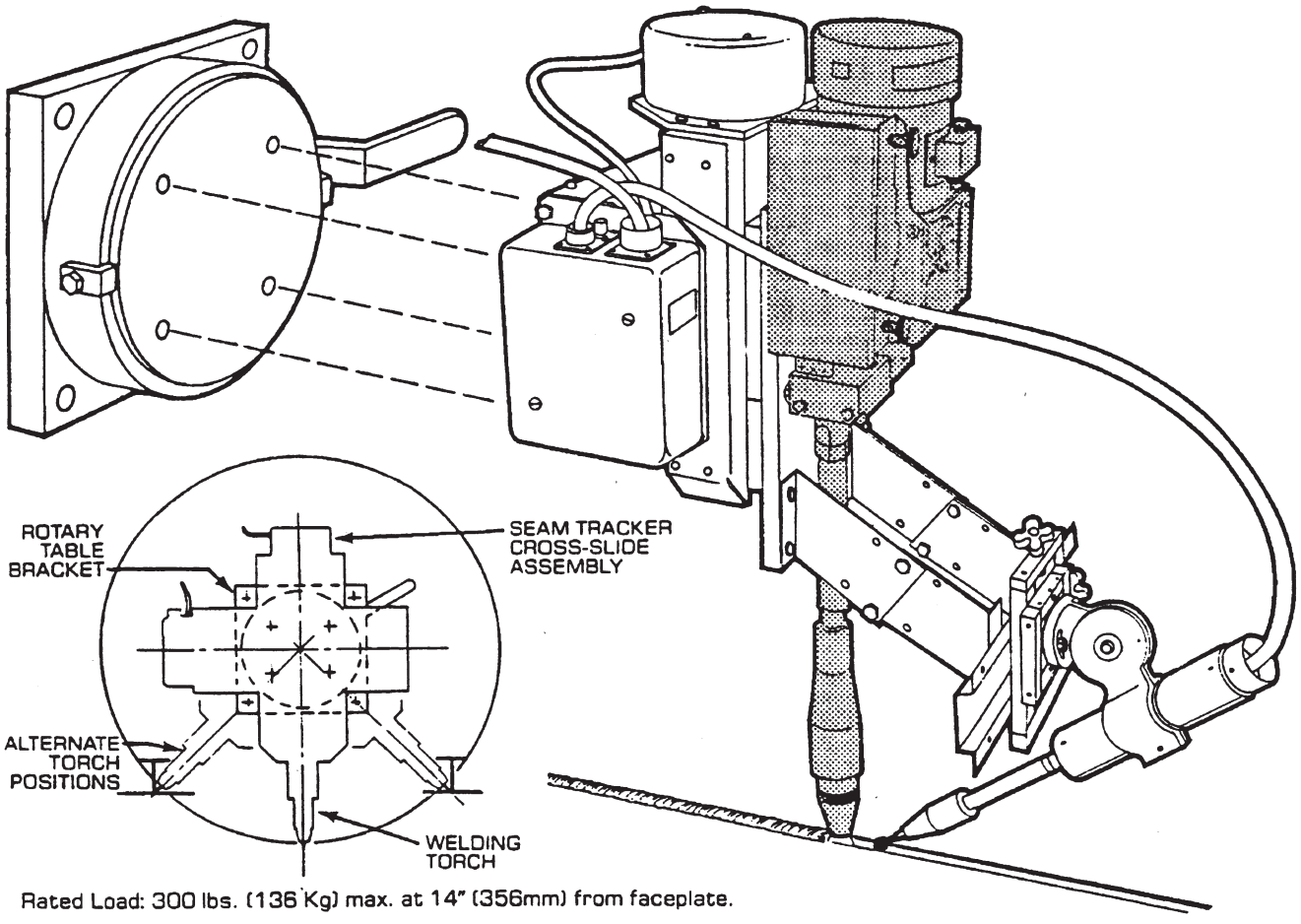


FIGURE 57 - ROTARY TABLE BRACKET

Advanced Programming Control Option

ADVANCED PROGRAMMING CONTROL OPTION

The Advanced Programming Control Option performs various automatic seam tracking functions. Such functions are required for highly mechanized weld processes which need automatic starting and stopping of the weld cycle. These functions are listed below and are described in the following section.

- Timed Cycle
- Auto Cutoff Cycle
- Switched Auto Disable
- Tack Cutoff

The Advanced Programming Control Option may be programmed to perform either the Timed Cycle or Auto Cutoff weld cycle control functions. These features can be performed either by themselves or in combination with Horizontal/Vertical Disable or with the Tack Cutoff features.

In addition to these basic functions, special features which enhance the automation or provide user flexibility in various welding applications are programmable. These special features are:

- Z Search Feature
- Lockout Time
- Crater Fill Time
- Horizontal Retract Delay
- Multi System Synchronization
- Remote Input/Output Control
- Automatic Sidetrack Disable at Null
- Vertical Search Delay

These features are described in the following section.

FEATURES APPLICATIONS

Timed Cycle Function

This function is used for circumferential and fixed length longitudinal welds when it is appropriate to time the weld cycle. It is used for high production applications where the operator must be free to perform other tasks, such as loading and unloading a second fixture.

This feature needs to be programmed and stored into memory on the APC using S5 DIP switch position # 2 (in the Off or Up position). The Weld and Retract presetable timers are provided on the seam tracker control for the selection of Weld and Retract times (see Figure 59 - Timed Mode on page 90).

The operator simply depresses the Start Cycle push button on the control pendant and the following automatic sequence takes place:

- Seam sensor locates the weld joint.
- The arc is initiated.
- Weld travel commences and the seam is accurately tracked.
- The Weld Time duration completes.
- Travel stops.
- Arc is extinguished.
- Torch is raised up and out of the work area to the start position.

Auto Cutoff Function

This function is used for I beams, T sections, plate-to-plate and circumferential welds, where the length of the automatic cycle may vary due to variable speed or length from one weld or part to the next.

This option is similar to the Timed Cycle function except the end of the weld is not determined by the weld timer, but instead by the seam sensor sensing the end-of-weld. This feature is also programmed and stored into memory using the S5 DIP switch position # 2 (in the On or Down position). The Weld Timer is used to disable the end-of-weld sensing function for most of the weld duration to allow the seam sensor to track over tacks or rough seams without ending the weld prematurely (see Figure 60 - Auto Cutoff, Down Cutoff and Figure 61 - Auto Cutoff, Up Cutoff beginning on page 91).

The operator simply depresses the Start Cycle push button on pendant assembly and the following automatic sequence takes place:

- Seam sensor locates the weld joint.
- Arc is initiated.
- Weld travel commences and seam is accurately tracked.
- Weld/Enable Timer times out before sensor reaches the end-of-weld cutoff point.
- When sensor reaches the cutoff point, the seam tracker is locked out to prevent the torch from moving out of position and continues welding for the duration of the Overlap and Final Timer setting.
- When the torch reaches the end of the weld, the travel is automatically stopped and the torch is raised up out of the work area and back to the start position.

As stated above, there are two methods of Auto Cutoff--Up or Down. The following describes these methods.

Auto Up Cutoff

Auto Up Cutoff mode uses the seam sensor to determine the end-of-weld. While welding in a circumferential application, the seam sensor senses the beginning of the weld by the upward movement of the sensor's tip as it begins riding up onto the weld bead. This upward movement is typically a rapid movement the sensor / controller can't compensate for fast enough, which triggers the Auto Up Cutoff. This trigger level can be adjusted by the Threshold Adjustment potentiometer on the APC front panel, labeled Threshold. The Threshold adjustment potentiometer can be adjusted to account for large or small beads.

A large bead can be sensed as an end-of-weld cutoff rather easily. The Threshold adjustment could be set to a minimum Threshold position, or counter-clockwise.

A small bead is a bit more difficult to sense the end-of-weld position, because the sensor will only rise up a small amount. Sensing small beads, it will be necessary to increase the Threshold adjustment level by turning the Threshold potentiometer toward the clockwise position. The lowers the trigger level so that even small upward movements will trigger the system into Overlap.

The Auto Up Cutoff method is also used in Tack Cutoff operations with one expection. When the Auto Up Cutoff Threshold is triggered, the system goes into Overlap Mode.

NOTE

Care should be used to select am Auto Up Cutoff / Tack Cutoff Threshold setting that will accommodate the needs of both functions.

Auto Down Cutoff

Auto Down Cutoff works in the same manner as the Auto Up Cutoff function, but in the opposite direction. Like the name implies, Auto Down Cutoff senses the downward movement of the seam sensor to determine the end-of-weld position. This method of end-of-weld cutoff is typically much easier to sense than the Auto Up Cutoff method, because the sensor normally falls off the end of the plate, indicating the end-of-weld position.

The Auto Down Cutoff also has an adjustable Threshold. This Threshold potentiometer is located on the inside of the APC Board, near the lower right of the board. Auto Down Cutoff Threshold adjustment is normally not adjusted in typical applications.

Its main use is to eliminate nuisance end-of-weld cutoffs from occuring due to tracking a rough part, or from bounce created from an older carriage. To minimize the false triggers, the Down Cutoff Threshold can be adjusted to a counter-clockwise position to make the system less sensitive to these errors, while still sensing the true end-of-weld position. The Auto Down Threshold potentiometer is factory set at a full clock-wise position, giving maximum sensitivity to sense the end-of-weld position.

Switched Auto-Disable Function

The Switched Auto-Disable feature is typically used in conjunction with AVC or in multi-pass applications when after the root pass has been performed, the a seam is not able to be reliably tracked (typically in the horizontal axis) on subsequent passes.

Used for manual override, this function requires a switch on the remote inputs cable (see Figure 78 - Remote Input Interface Connections on page 126 and Figure 81 - Auto-Disable Operation and Wiring on page 129), which allows the operator to "Disable" the automatic function of either the horizontal or the vertical axes.

For example, when the system is in Automatic Mode, and the horizontal axis is disabled, the vertical axis is controlled normally by the seam sensor, but the horizontal axis is controlled by the joystick's Left and Right directions on the pendant assembly (manually).

An example of when this situation is used would be on a cap pass where there is no horizontal joint edge to track.

This function may be incorporated with either the Timed Cycle or the Auto Cutoff function.

Tack Cutoff Function

An "Arm" push button is provided on the APC Option assembly on the pendant for manually arming or disarming of the Tack Circuitry.

When selected by the S5 DIP switch position # 1 (in the On or Down position) and stored into memory on the Advanced Programming Control (APC) board, the tack circuit is automatically armed when the weld seam is located.

This function automatically disables the seam tracker's cross-slide's movement when the seam sensor contacts a tack; this prevents the torch from moving out of position and causing cold laps, or leaving the weld joint. When the sensor has passed over the tack, the seam tracker is re-enabled and contin-

ues tracking normally (see Figure 62 - Tack Cutoff Mode on page 92).

Sensitivity of the Tack Cutoff circuitry is adjustable for different tack sizes. The circuitry's sensitivity can be adjusted using the Threshold potentiometer located on the APC assembly and is accessible on the front panel of the control unit and is labeled "Threshold."

This function may be used with either the Timed Cycle or the Auto Cutoff function.

FEATURES

Z Search Feature

Z Search is used to locate an end cap weld seam, such as, gas propane tanks, or to find a seam where there may be holding fixture interference.

When selected by the S5 DIP switch position # 3 (in the On or Down position) and stored into memory on the Advanced Programming Control (APC) board, the Z Search feature is automatically enabled when the Start Cycle push button on the pendant or a Start input is commanded from the remote input cable (see Figure 78 - Remote Input Interface Connections on page 126).

The horizontal slide will move at the factory set (non-adjustable) manual speed in the direction of the selected Sidetrack for a preset time of two seconds (if the Vertical Delay feature is selected and stored into memory see Figure 58 - Z Search Feature on page 89 and Figure 67 - APC Z Search Feature on page 103). This allows the sensor to clear any fixture interference before moving downward in search of the weld seam. After the two-second delay, the vertical slide is allowed to move downward, causing the sensor to move at a 45° angle, overshooting the weld seam.

When the sensor touches the work piece and vertical null is achieved, the horizontal slide will move in the opposite direction of the selected sidetrack until the sensor drops into the weld seam. Sidetrack reverts back to the selected sidetrack direction. When null is achieved, the sidetrack pressure is then controlled by the Sidetrack Force Adjustment potentiometer (see Figure 30 - Sidetrack Force Adjustment on page 38) on the Main board. If Sidetrack Disabled at Null is selected and programmed using the S5 DIP switch position # 4 (in the On or Down position), sidetrack is disabled at this time. Thus, the slides search for the weld seam at manual speed and once the seam is located, reduces the sidetrack pressure or removes it

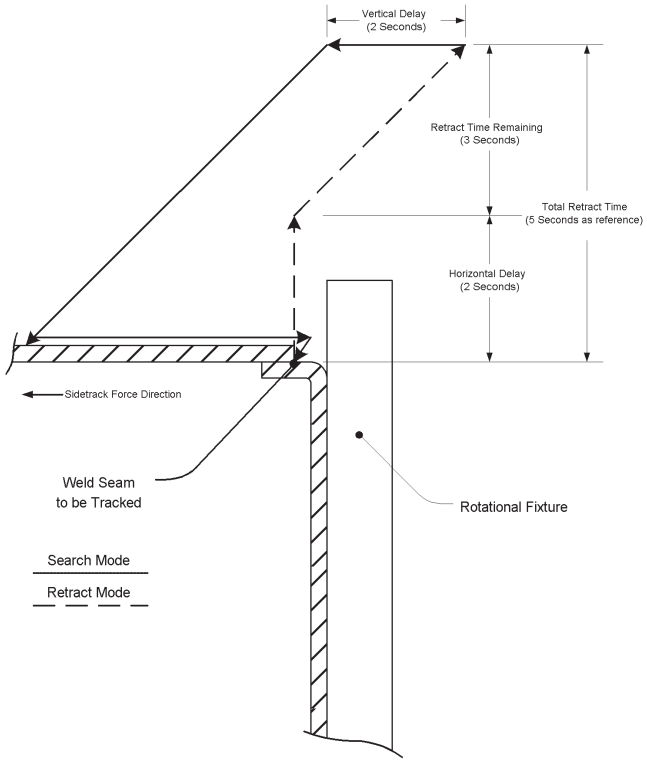


FIGURE 58 - Z SEARCH FEATURE

completely, ensuring the sensor tip does not climb out of the seam.

NOTE

Automatic removal of sidetrack pressure is typically used when welding "V" grooves.

Lockout Feature

This feature is applicable when a constant current power supply drops out at initial arc due to heavy wire feed displacing the work piece. It is also useful for allowing arc adjustment during the time the torch is on a run-on tab.

When selected by the S5 DIP switch position # 7 (in the On or Down position) and stored into memory on the Advanced Programming Control (APC) board, the Lockout circuitry is automatically enabled when the weld seam is located.

The seam sensor locates the weld seam and energizes the user relay, K1. (The relay may be used to turn on the wire feeder, power source, etc.) For one second after the relay is turned on, the slides are in the manual mode of operation preventing any horizontal or vertical movement from the seam sensor. During this time, movement is allowed of the slides from the joystick switch on the pendant. After this one second delay, the slides are in automatic mode, tracking the seam, and the Weld/Enable timer begins.

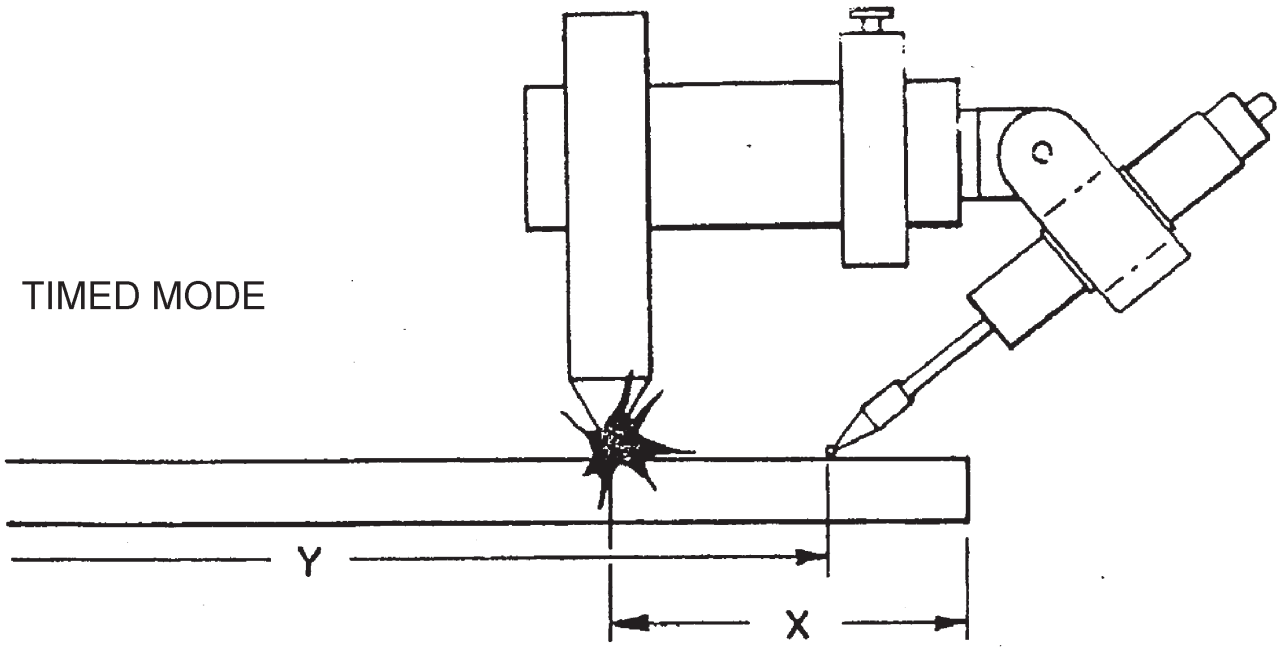


FIGURE 59 - TIMED MODE

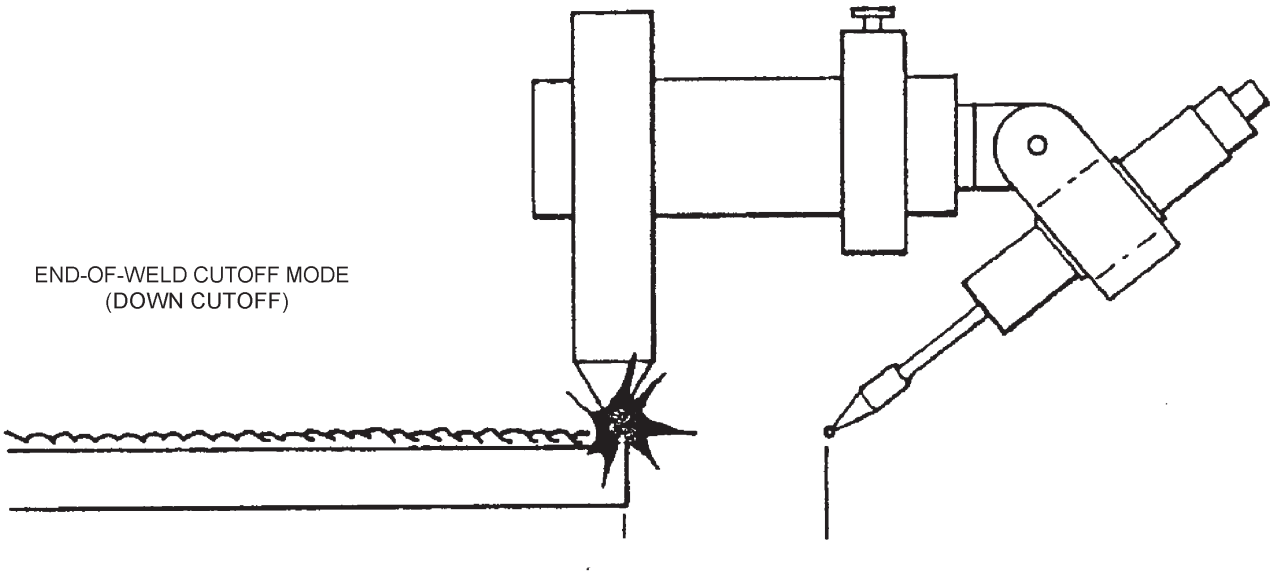


FIGURE 60 - AUTO CUTOFF, DOWN CUTOFF

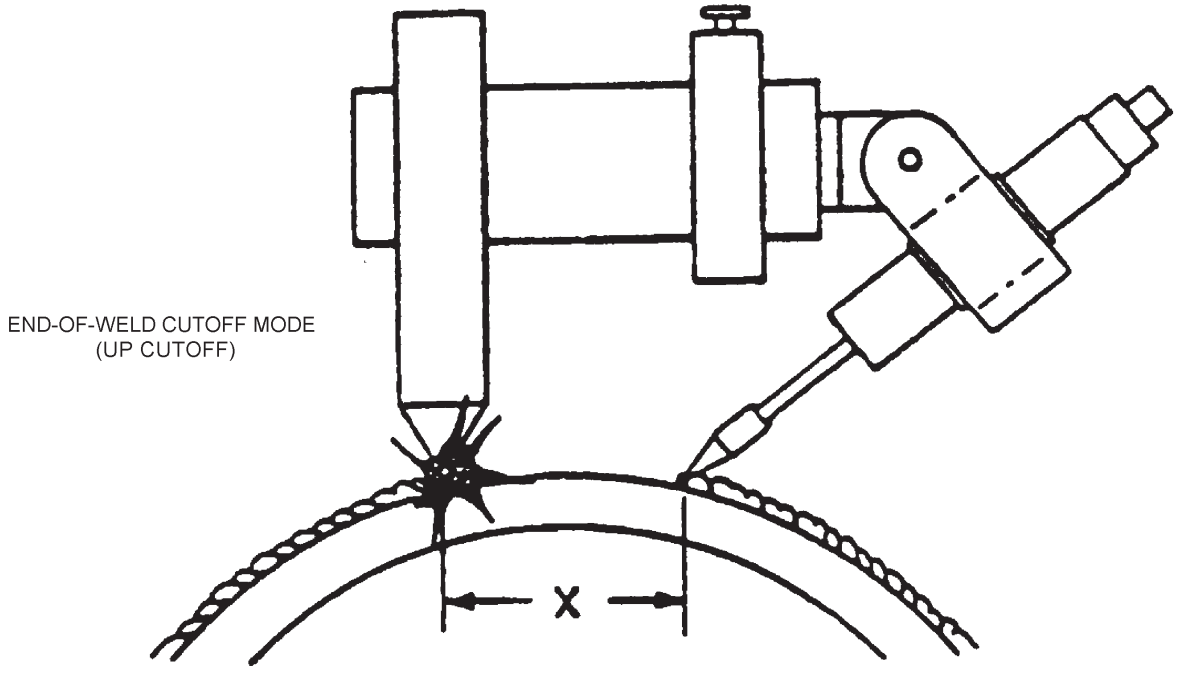


FIGURE 61 - AUTO CUTOFF, UP CUTOFF

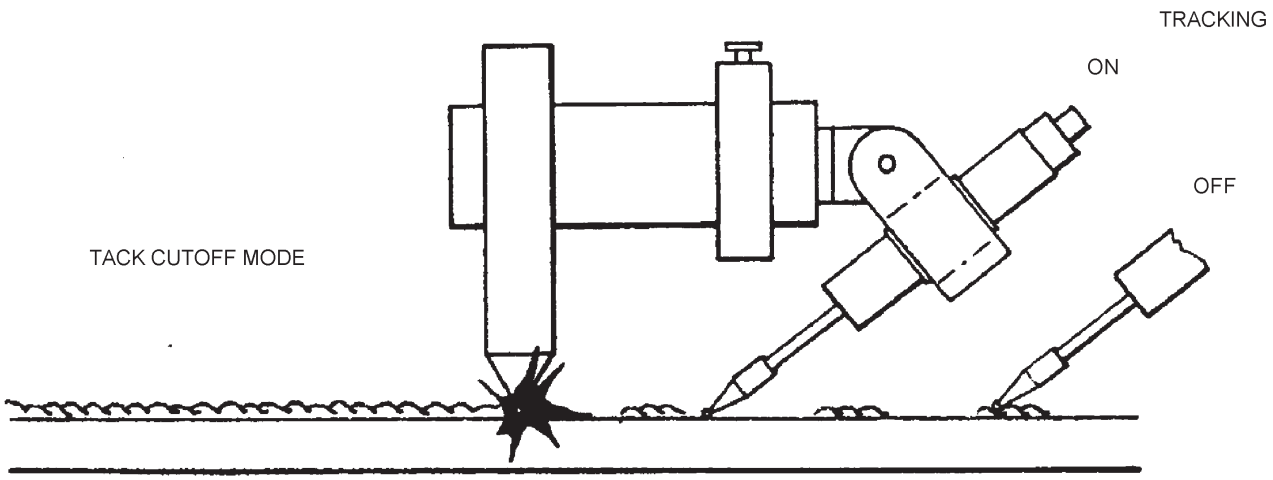


FIGURE 62 - TACK CUTOFF MODE

Crater Fill Delay

This feature is useful at the end of a weld seam allowing the power supply to down-slope, additional wire to be fed into the joint (crater) and wire to burn back.

When selected by the S5 DIP switch position # 8 (in the On or Down position) and stored into memory on the APC board, the Crater Fill Delay circuitry is automatically enabled when the weld seam is located.

If the user relay, K1, controls the carriage, the torch will be located at the end of the weld seam when the Weld/Enable and Overlap times have completed. When K1 relay contacts open, many TIG welding power sources initiate a down-slope function. In addition, many MIG power sources and wire feed controllers initiate a crater fill and wire burn-back function.

The Crater Fill Delay maintains the slides in the manual mode of operation for 2 seconds at their last position prior to the K1 relay contacts opening, not allowing the cross-slides to move during this 2 second delay. After the Crater Fill Delay has completed, the slides will retract for the duration of the Retract Timer setting.

Horizontal Retract Delay

Normally, this feature is used in conjunction with Vertical Search Delay (below) and Z Search features (see Figure 58 - Z Search Feature on page 89 and Figure 67 - APC Z Search Feature on page 103).

When selected by the S5 DIP switch position # 6 (in the On or Down position) and stored into memory on the APC board, the Horizontal Retract Delay circuitry is automatically enabled when the weld seam is located.

This combination enables the seam sensor to find a weld seam close to a fixture obstruction. The horizontal slide is inhibited for 2 seconds allowing the vertical slides to retract approximately one inch (12 ipm) before the horizontal slide starts to retract. The Horizontal Retract time is the Retract Time stored into the selected program minus 2 seconds, if this feature is selected.

Vertical Search Delay

Normally, this feature is used in conjunction with Horizontal Retract Delay (above) and Z Search features (see Figure 58 - Z Search Feature on page 89 and Figure 67 - APC Z Search Feature on page 103).

When selected by the S5 DIP switch position # 5 (in the On or Down position) and stored into memory on the APC board, the Vertical Search Delay circuitry is automatically enabled when the weld seam is located.

The combination enables the seam sensor to find a weld seam close to a fixture obstruction. The vertical slide is inhibited for 2 seconds allowing the horizontal slide to move approximately one inch (12 ipm) before the vertical slide starts to drive downward in search of the seam.

Sidetrack Disable at Null

Normally, this feature is used in conjunction with primarily the Z Search feature (see Figure 58 - Z Search Feature on page 89 and Figure 67 - APC Z Search Feature on page 103), but can be used with other features to enhance the performance of the system.

When selected by the S5 DIP switch position # 4 (in the On or Down position) and stored into memory on the APC board, the Sidetrack Disable at Null circuitry is automatically enabled when the weld cycle starts (or the seam has been found).

Sidetrack Disable at Null is useful when tracking a V-groove seam and when Z Search is used to locate the seam. Since Z Search requires a Sidetrack direction to be enabled on the pendant (either Left or Right) for proper operation, it is required then to have a means to disable it after the seam has been located. If a V-groove is to be tracked when a Sidetrack direction is enabled, the seam sensor may climb out of the joint. Enabling Sidetrack Disable at Null reduces the likelihood of this occurring.

APC OPERATION

USER INTERFACE

Two interface connectors are available to the user to connect and control other equipment. Two cables are supplied with the system to assist in interfacing the seam tracker system with other equipment such as welding power sources, wire feeder controllers, carriages, Programmable Logic Controllers (PLC's), etc.

J3 Output Relay Connector

This connector makes available to the user, three relays, K1, K2, and K3. When reviewing these outputs or performing system wiring, please see on page , as well as Figure 80 - Multi-System Operation and Wiring on page 128 and Figure 81 - Auto-Disable Operation and Wiring on page 129 for additional information.

K1 Relay

The K1 relay has three normally open relay contact closures capable of carrying 10A @ 12OVAC (form "C"). These three sets of contacts from the K1 relay are protected by 130V varistors. A closure of the three contacts indicates the seam tracker has found the seam and the weld cycle can now commence. The contact closures are normally used to turn on the carriage, wire feeders, power supplies, etc.

The K1 relay is energized at the moment the weld seam is found to the end of the Final Timer.

In addition to the K1 relay, there are two relays that are capable of carrying 5A @ 120VAC. These relay contacts from relays K2 and K3 are provided to allow extended interfacing options to the customer and are also protected by 130V varistors.

K2 Relay

The K2 relay energizes at the start of Final Time (if not set to zero seconds) and remains On for the duration of Final time. At the completion of the Final time, the K2 relay de-energizes, opening the relay contact.

K3 Relay

The K3 relay acts in a similar manner, but is energized at the start of Retract time and remains On for the duration of the Retract time. At the completion of the Retract time, the K3 relay de-energizes, opening the relay contact. The Weld Cycle is complete at this time.

J4 Input Connector

Six input control lines used in conjunction with the seam tracker control pendant allow the operator to control the seam tracker from a remote control panel or from other equipment, e.g., PLC's.

These control lines are:

- Start
- Emergency Stop
- Horizontal Disable
- Vertical Disable
- Null Input
- Cutoff

Below are definitions of each of these Remote Inputs. When reviewing these inputs or preforming system wiring, please see Figure 78 - Remote Input Interface Connections on page 126, as well as Figure 80 - Multi-System Operation and Wiring on page 128 and Figure 81 - Auto-Disable Operation and Wiring on page 129 for additional information.

Start

A momentary contact closure between P4-A and P4-J will start the cycle when the Auto Mode of Operation is selected on the control pendant. If the closure is maintained, the cycle will repeat immediately after the retract cycle has finished. This input may be paralleled with other seam tracker systems for use in Multi-System Operations.

Emergency Stop

A maintained or momentary contact closure between P4-B and P4-J will interrupt the cycle turning OFF the interface relays, K1, K2, and K3 and placing the seam tracker in the manual mode of operation. This input may be paralleled with other seam tracker systems for use in Multi-System Operations. Contact closure must be released before another cycle can be initiated.

Horizontal Disable

A maintained contact closure P4-F and P4-J will disable horizontal tracking while the closure is maintained. While a closure is made on these two lines, the sidetrack selection is overridden.

Null Input

A maintained contact closure between P4-G and P4-I will inhibit the system from initiating the Weld/Enable Time and will prevent the interface relay K1 from turning On until this closure is released. This input may be paralleled with other seam tracker systems in a multi-system operation. The last seam tracker achieving a null (locating the seam) will turn On (or release) all other seam tracker relays.

A switch may also be used on the Null Input line to prevent the relay K1 from energizing (and the welding arc from continuing after the seam tracker has found the seam) until the operator has verified the seam

sensor(s) are in the seam and all is okay to release the K1 relay(s) (and the Arcs).

Cutoff

A momentary contact closure between P4-C and P4-I will interrupt the cycle, placing the system in the Overlap Mode of Operation. This input may be paralleled with other seam tracker systems in a multi-system operation.

This momentary contact closure could also be from a encoder or PLC, to force the system into the Overlap Mode of Operation, eliminating the seam sensor from sensing the end-of-weld. This is useful if the weld bead is not uniform and the seam sensor has difficulty reliably and repeatably sensing the end-of-weld.

No matter where in the Weld/Enable time cycle, if an remote Cutoff input signal is received by the seam tracker, the system is forced to go into the Overlap mode of operation.

Vertical Disable

A maintained contact closure between P4-E and P4-J will disable vertical tracking as long as the closure is maintained. (Similar to Horizontal Disable.)

MULTI-SYSTEM OPERATION

Each seam tracker is a self contained tracking system. Figure 80 - Multi-System Operation and Wiring on page 128 shows a typical system interface in a multi-system setup. Properly paralleling common input control lines, one or more seam trackers systems may be:

- Started
- Stopped (Emergency)
- Disable Vertical Tracking
- Disable Horizontal Tracking
- Initiate Remote Cutoff

The seam tracker systems can also turn On user related equipment:

- Welding power supplies
- Wire feeder, Carriage, etc.
- Synchronize more than one seam tracking system
- and other equipment

Start

Paralleling P4-A and P4-J with Double Pole (DP) momentary pushbutton enables the operator to start one or more seam tracker systems simultaneously. The switch should have one pole for each seam tracker system being started simultaneously.

Emergency Stop

Paralleling P4-B and P4-J with a normally open switch, such as a mushroom switch enables the operator to stop one or more seam tracker systems anywhere in their cycle by placing all systems in the Manual Mode of Operation and de-energizing the K1, K2, and K3 relays.

Synchronized Timing (Null Input)

Paralleling P4-G and P4-I from seam tracker system to another seam tracker system (and so on) will inhibit each seam tracker system from turning On their respective K1 relay and starting the Weld/Enable Timers until the last seam tracker system has achieved a null (located the seam).

These same lines may also be paralleled with a normally closed switch. Each system will find its respective weld seam and remain in the tracking mode. The operator may then check each system making any alignment or adjustments, as required. Opening the switch will immediately initiate the weld cycle by turning On each seam tracker's K1 relay.

Cutoff

Used in applications where the operation may be interrupted, such that the Weld/Enable timer need not be used.

The operator may elect to place a micro-switch at the end of the weld seam or fixture or an encoder and counter combination counting pulses/degrees of rotation. The micro-switch closure or the counter’s relay output are placed between P4-C and P4-I. This will interrupt the cycle, placing the system in the Overlap Mode of Operation.

Vertical Disable and Horizontal Disable

These remote control inputs are usually associated with single system operation. The Horizontal and Vertical Disable inputs are usable at any time. A closure between P4-F and P4-J disables the vertical slide and a closure between P4-E and P4-J disables the horizontal slide.

CAUTION

For optimum performance of the seam tracker system, certain precautions and limitations should be adhered to.

OPERATIONAL PRECAUTIONS

Z Search Feature

Proper application of the Z Search feature requires that the seam sensor tip drops down into a weld seam.

Vertical and Horizontal Disable

Vertical and Horizontal Disable may be initiated after the seam tracker has achieved a null (Cycle Lamp On and K1 relay energized). Disabling these axes prior to this will not allow the seam sensor to contact the work piece. Vertical or Horizontal Disable will inhibit the anti-jam feature of the seam tracker. Care must be taken not to exceed the mechanical deflection capability of the seam sensor's lower rod and tip.

TABLE 41 - APC DIP SWITCH DESCRIPTIONS

POSITION #	OFF POSITION (UP)	ON POSITION (DOWN)
1	Tack Cutoff Feature Disabled	Tack Cutoff Feature Enabled
2	Timer Weld Mode of Operation	Auto Cutoff Mode of Operation
3	Z Search Disabled	Z Search Enabled
4	Sidetrack Enabled at Null	Sidetrack Disabled at Null
5	Vertical Search Delay Disabled	Vertical Search Delay Enabled
6	Horizontal Retract Delay Disabled	Horizontal Retract Delay Enabled
7	Lockout Disabled	Lockout Enabled
8	Crater Fill Delay Disabled	Crater Fill Delay Enabled

Tack Function

The number of tacks and height of the tack relative to the weld seam are important considerations for proper operation. Tacks should not be above the weld seam when sidetrack is required for tracking. Sidetrack preloads the horizontal spring located in the seam sensor. When a tack is sensed, the vertical and horizontal slides are switched into the manual mode of operation. If the tack is above the weld seam, the seam sensor tip is not constrained by the weld seam and the horizontal springs in the seam sensor will position the tip in a mechanical zero position, which may be outside of the weld seam.

NOTE

This tack problem may be corrected to some extent by reducing the number of tacks to a minimum and biasing the tack in such a way as to force the seam sensor tip around the tack in a direction where the horizontal springs will return the tip to the weld seam.

Remote Interface Connections

P-4 cabling shall be routed away from heavy current-carrying cables to prevent erroneous triggering of remote control inputs.

P-4 pins I and J must not be connected to chassis ground, earth ground (PE) or any power source. They can be connected between other seam tracker systems for multi-system operation, but should use discrete contacts to maintain isolation between each seam tracker system. Seam tracker signal grounds (P4-I) are isolated from chassis ground. The +6 VDC output (P4-J) for remote use should also be isolated from other power sources.

P-4 cable must be removed when remote control inputs are not used. This prevents accidental shorting and false triggering of remote inputs.

P-4 and P-3 cable shields are tied to the seam tracker's control box chassis ground at their connectors and so they should be taped back at the cable end to prevent shorting and possible grounding/noise interference.

FIELD INSTALLATION

Refer to Figure 35 - Seam Tracker Control Exploded View on page 52, Figure 36 - Control Pendant Exploded View on page 54, Figure 71 - Seam Tracker Control With APC Exploded View on page 114 and Figure 72 - Pendant with APC Exploded View on page 116 to aid in identifying the location of areas where changes will be made to your equipment needed to install the Advanced Programming Control Options in your existing system as a field installation.

CONTROL PENDANT

On the control pendant remove top blank APA plate (save the screws). Install the APC Pendant Option assembly, P/N 1101-2002-4 in the pendant opening by connecting assembly's P1 connector to the

prewired pendant J1 connector. Secure the assembly with the screws.

CONTROL BOX

Be sure the power is disconnected from the control unit prior to servicing the unit for field installation of the APC option.

Advanced Programming Control Option

In the control box remove the standard option plate in the door of the enclosure and install the APC assembly in the opening using the same hardware, i.e., washers, star washers, and nuts (just removed).

Install the ribbon cable from J1 of the APC board to the Main board ribbon cable connector J5.

Remote Interface Connector Assembly

Install the Remote Interface Connector Assembly by removing the washers, star washers, and nuts attaching the blank plate and install the connector assembly plate utilizing the same hardware just removed. Connect the J3 amphenol connector (the larger of the two connectors) harness to the J3 connector on the Main board, located between the K1 relay and the K2 and K3 relays. Also connect the J4 amphenol connector harness to the J4 connector on the Main board, located near the center of the board.

PROGRAM SWITCH SETTINGS

The Program DIP switch, S5, is used to select the various functions provided by the APC (see Figure 70 - Advanced Programming Control Board Layout on page 113). Changes of the function desired may occur as a result of changing weld requirements. These changes in functions are easily implemented by the customer simply by changing a switch setting, storing the settings into memory and selecting the desired program for welding.

Table 41 - APC Dip Switch Descriptions on page 97 describes the function of each DIP switch.

NOTE

The following describes the results of the different DIP switch settings after storing them into memory.

Tack Cutoff

If this switch is in the On position when the cycle has been initiated and the seam sensor has found the seam and settled into a "Null" condition, the Tack Cutoff circuitry will arm itself automatically. This function allows sensing of tacks by the seam sensor as it travels across them. The result is automatic lockout of the slides to prevent displacement of the torch. When the seam sensor has crossed over the tack, normal tracking is resumed.

If this switch is in the Off position when the program button on the APC board has been pressed and confirmed, the system will prevent the tack circuitry from becoming active at null. However, the Tack Arm switch, located on the pendant, may still be used to Arm or Disarm the Tack Cutoff circuitry.

Timed Weld/Auto Cut-Off Mode

With this switch in the Off position when the program button on the APC board has been pressed and confirmed, the seam tracker is in the Timed Cycle Mode of Operation, and the cycle times are controlled by the values stored in memory for the Weld/Enable Timer.

If this switch is in the On position when the program button on the APC board has been pressed and confirmed, the seam tracker is in the Auto Cut-Off Mode of Operation. This mode is most useful for ending the weld cycle when welds of varying lengths must be accomplished.

It is important when operating in this mode to ensure that the value stored in the Weld/Enable Timer is shorter than the actual time required to finish the weld. After the weld timer has timed out, the next Up or Down signal from the seam sensor will automatically place the seam tracker in the Overlap Mode.

Z Search

With this switch in the Off position when the program button on the APC board has been pressed and confirmed, the Z Search feature is disabled.

If this switch is in the On position when the program button on the APC board has been pressed and confirmed, the Z Search feature is Enabled.

Sidetrack Disable at Null

Sidetrack will ***not*** automatically be disabled at Null when this switch is in the Off position when the program button on the APC board has been pressed and confirmed.

If this switch is in the On position when the program button on the APC board has been pressed and confirmed, Sidetrack will automatically be disabled at Null.

This is helpful in V-grooves when sidetrack pressure may tend to cause the seam sensor to *“climb the walls*” of the groove.

TABLE 42 - APC PROGRAMS, FACTORY DEFAULT

	TIMER VALUES				FEATURES SELECTED							
#	*WELD / ENABLE*	*OVERLAP*	*FINAL*	*RETRACT*	*TACK CUTOFF*	*TIMED / AUTO CUTOFF*	*Z SEARCH*	*SIDETRACK DISABLED AT NULL*	*VERTICAL DELAY*	*HORIZONTAL DELAY*	*LOCKOUT*	*CRATER FILL DELAY*
1	60	0.0	1.0	0.5	✓	T						✓
2	60	0.0	2.0	1.0	✓	T	✓		✓	✓		✓
3	60	0.0	3.0	2.0		T	✓	✓	✓	✓		✓
4	60	5.0	4.0	3.0		T						
5	60	0.0	5.0	4.0		T	✓		✓	✓		✓
6	60	2.0	5.0	5.0		T					✓	✓
7	60	0.0	5.0	10.0		T	✓					✓
8	60	0.0	5.0	5.0		T	✓	✓				✓
9	60	0.5	5.0	5.0	✓	T	✓	✓	✓	✓		✓
10	60	0.0	5.0	5.0	✓	T	✓	✓				✓
11	60	0.0	5.0	5.0	✓	A	✓		✓	✓		✓
12	60	0.0	5.0	5.0		A	✓	✓				✓
13	60	0.0	5.0	5.0		A	✓		✓	✓		✓
14	60	0.0	5.0	5.0		A	✓	✓	✓	✓		✓
15	60	0.0	5.0	5.0		A	✓					✓
16	60	3.0	5.0	5.0		A					✓	✓
17	60	0.0	5.0	5.0	✓	A	✓	✓				✓
18	60	0.0	5.0	5.0	✓	A						✓
19	60	1.0	5.0	5.0	✓	A	✓	✓	✓	✓		✓

Note:

✓ = Feature is Enabled
A = Auto Cutoff Mode
T = Timed Mode
Blank = Feature is Disabled

Vertical Search and Horizontal Retract Delay

These two switches are used mostly in conjunction with the Z Search feature, however, they can be used independently to provide "delays" in slide motion if necessary to clear fixture obstructions (see Figure 67 - APC Z Search Feature on page 103).

With these switches in the Off position when the program button on the APC board has been pressed and confirmed, these Delay features are disabled.

If these switches are in the On position when the program button on the APC board has been pressed and confirmed, these Delay features are enabled.

Lockout

This feature is to allow *settling* of the seam sensor after null, following the start of a MIG arc when the wire feed may push against the work, causing *jitter*.

With this switch in the Off position when the program button on the APC board has been pressed and confirmed, the Lockout feature is disabled.

If this switch is in the On position when the program button on the APC board has been pressed and confirmed, the Lockout feature is enabled.

Crater Fill Delay

The feature provides a two second delay to be inserted between the end of Final time and the beginning of Retract.

With this switch in the Off position when the program button on the APC board has been pressed and confirmed, the Crater Fill Delay feature is disabled.

If this switch is in the On position when the program button on the APC board has been pressed and confirmed, the Crater Fill Delay feature is enabled.

APC INSTALLATION

A seven segment digital display has been provided for use during programming of the APC's 19 weld programs. This digital display allows the operator to select and store timer values for each of the timers, i.e., Weld/Enable, Overlap, Final, and Retract. LED indicators are also an indication of which timer value the operator is storing into memory. These LEDs are labeled Weld/Enable, Overlap, Final, and Retract and are visible on the front panel of the APC option.

As the seam tracker is in the welding cycle and the Weld/Enable Timer has become active, the digital display will count backwards to indicate the remaining time left for each of the timer values. The LED will also light to indicate which one of the timers is active.

A Program LED is also visible on the front panel of the APC option and indicates that the program value is being displayed on the digital display.

APC PROGRAMMING

The APC is stored with default values from the factory for your immediate use. These default values are listed in Table 42 - APC Programs, Factory Default on page 99. Any one of these values or settings can be changed to meet your specific welding needs.

Programming the APC is a five step process. The first is to select which program you wish to change. Press the Select button to select between the LED's and the timers they represent ordered in this manner; Weld/Enable, Overlap, Final, Retract and Program. Once the Program LED is lit, use the 2 keys on the right (there are 4 keys total) located below the 7 segment display to change the numbers to indicate the Program # (1 through 19) you wish to program/change.

After you have chosen the program to modify, press the Select button again. The Weld/Enable LED will light indicating the Weld/Enable Timer value. The 7 segment display (from now on, referred to as display) will show the current stored value.

To change this timer value, press the 4 buttons below the display to increment the numbers to the desired timer setting. On the inside of the control unit located on the back side of the APC Board, press the Program Button (see Figure 70 - Advanced Programming Control Board Layout on page 113). This stores the timer value into the Weld/Enable timer setting. You'll notice the display will go blank for a moment and then the display and the LED's will flash in succession as it stores the values from each timer and for the features.

Press the Select button on the front panel once to move from the Weld/Enable LED to the Overlap LED. Perform the same actions to modify the Overlap Time as done with the Weld/Enable Timer. Once completed, press the Program Button on the inside of the control unit on the back side of the APC board.

Continue these steps for each of the remaining timers, i.e., Final and Retract. Remembering to press the Program button on the back side of the APC board each time after the desired time has been entered on the panel.

APC PROGRAMMING OF THE FEATURES

The APC features are programmed and stored into memory using the S5 DIP Switches, located on the inside of the APC board (see Figure 70 - Advanced Programming Control Board Layout on page 113).

Select the Features you want for a particular program (the features can be unique for each program stored in memory).

Refer to Table 41 - APC Dip Switch Descriptions on page 97 for a complete list of these features and how to enable or disable them.

To program the features, select which features you want enabled and disabled using the S5 DIP Switch and then Press the Program button on the back side of the APC Board. The APC will indicate which Features are different from those currently stored in memory on the front panel of the APC board by lighting the Features LED.

If you are satisfied with the Features Selection, press the Program button once more for confirmation. The Features are now stored in memory.

If you are not satisfied with the selection after you press the Program button the first time, you may

change the Features you want enabled/disabled now by changing the DIP switches. The APC indicates the Features that are different and allows you to change them prior to storing them into memory.

NOTE

Once the Program button has been pressed once and the APC indicates the Features on the front panel that are different than those stored into memory, the next time Program button is pressed, those Features will be stored into memory (along with the Timer value displayed on the APC for any of the timers).

This second confirmation is useful in that it gives a Features verification to the operator. Providing this verification will reduce/eliminate unwanted Features stored into memory when the operator simply wants to change the time stored into the Weld/Enable Timer for example. Prior to pressing the Program button, the operator should verify the positions of the DIP switches to ensure the proper Features are stored for all programs.

APC PRELIMINARY CHECKOUT PROCEDURE

NOTE

Please review the Standard Seam Tracker Section to become familiar with the operation of the Seam Tracker.

Before starting the checkout procedure, ensure the following checklist has been accomplished:

- ☑ The power switch on the control unit is in the Off position and the power cord is disconnected from the wall outlet.
- ☑ The pendant is in the Manual Mode and Sidetrack is in the Off position.
- ☑ Recheck all cables ensuring enough slack to prevent cable stretching, binding or pinching when slides are operated to their maximum stroke lengths.
- ☑ Verify the seam sensor tip is facing toward the torch and in the opposite direction of the weld travel.

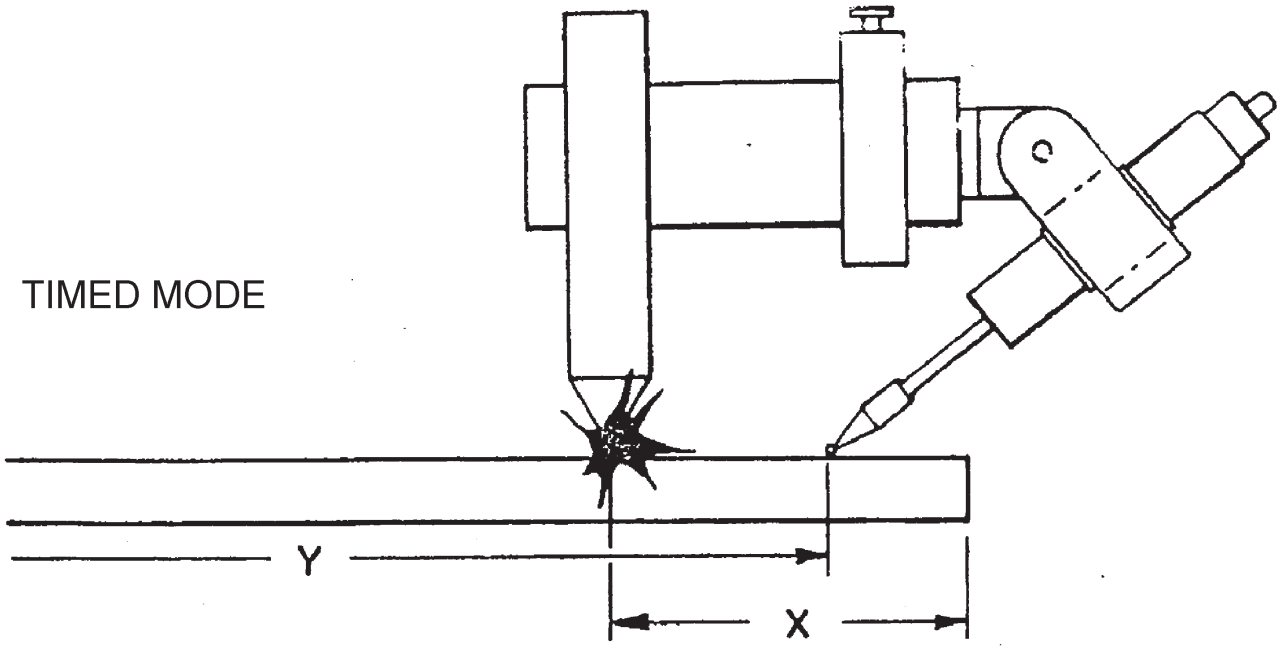


FIGURE 63 - APC TIMED MODE

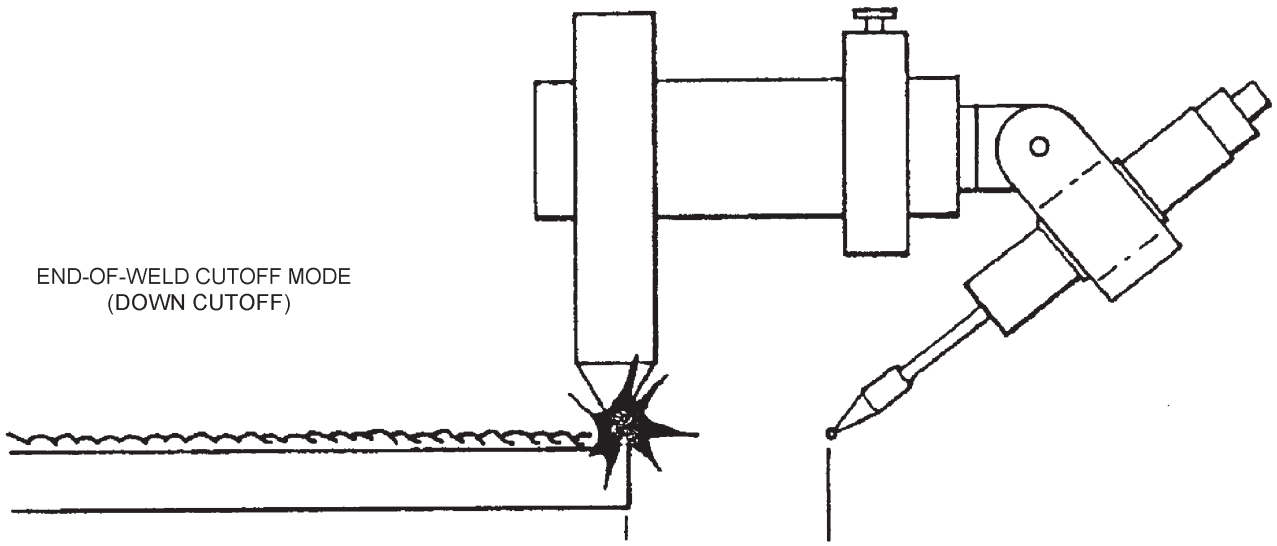


FIGURE 64 - APC AUTO DOWN CUTOFF

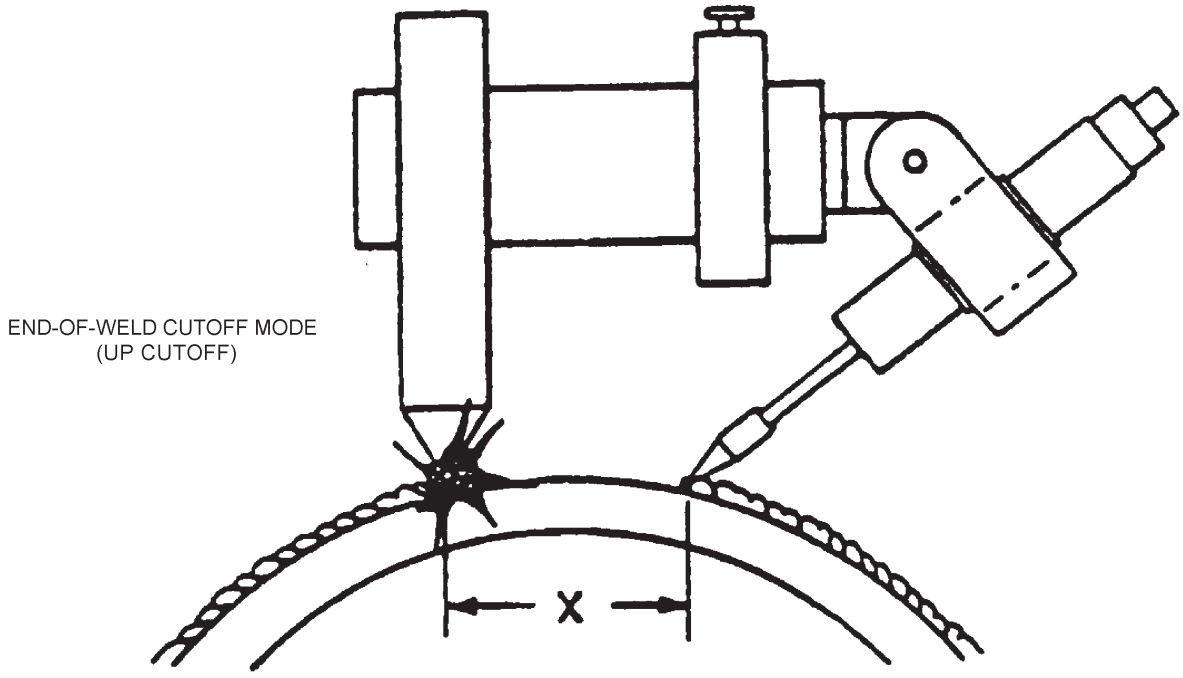


FIGURE 65 - APC AUTO UP CUTOFF

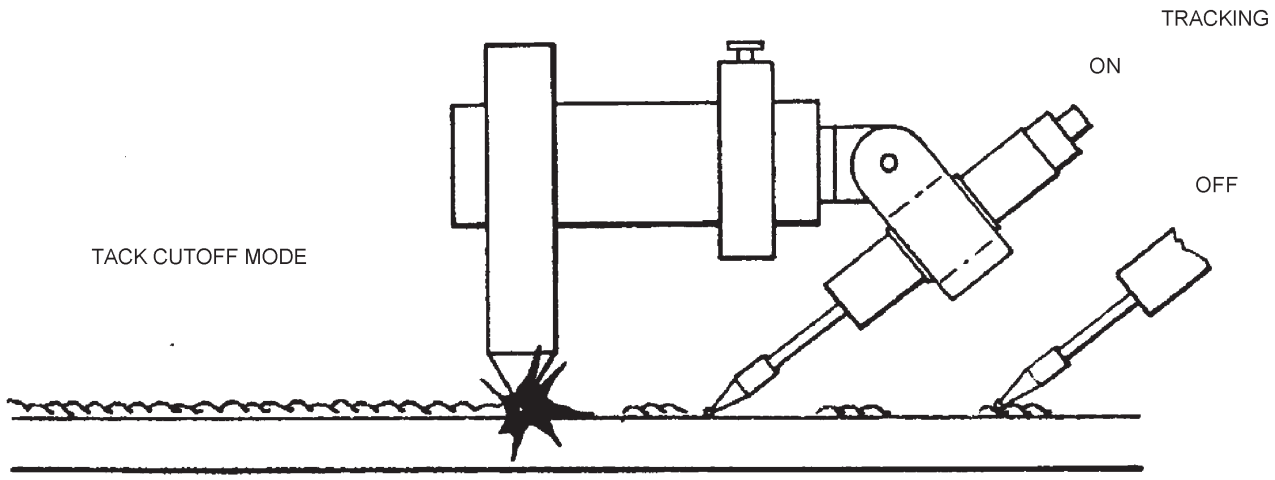


FIGURE 66 - APC TACK CUTOFF

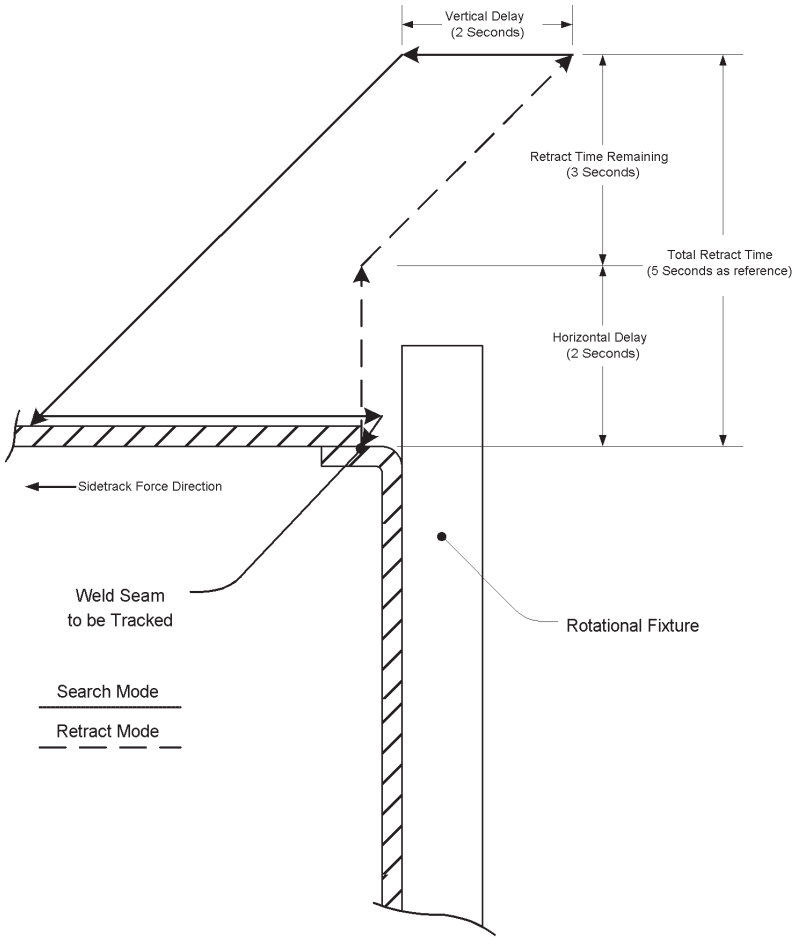


FIGURE 67 - APC Z SEARCH FEATURE

☑ Ensure the seam sensor-to-torch relationship is properly adjusted.

CAUTION

The relationship of the seam sensor to the torch is a critical adjustment. Care must be taken in positioning the torch and the seam sensor prior to selecting the Automatic Mode in order to prevent damage to any of the equipment.

Reconnect power cord and turn the control unit On. Operate the vertical and horizontal slides by moving the joystick switch on the pendant in the desired direction and verify the cross-slides move in the same direction.

Move the seam sensor's lower rod and tip upward, and verify the vertical slide also moves upward. Move the seam sensor's lower rod and tip to the Left and Right directions and again verify the slides move in the same directions.

Manually drive the vertical axis down until the seam sensor contacts the work and its rod is approximately parallel to the case (Vertical Null). Set the torch arc gap is in its approximate desired position (see Figure 19 - Seam Sensor Mounting (Std. Bracket) and Figure 20 - Seam Sensor Mounting (Univ. Bracket) beginning on page 17). If so, manually drive the vertical slide up and switch from Manual to Automatic Mode at the pendant, first ensuring that the appropriate sidetrack switch is in its desired position (see the many figures and tables beginning on page 7 and Figure 28 - Tracking Diagram on page 29 to assist in the proper position and tip selection). The seam sensor will seek its true null automatically. Using the fine adjustments of the manual slides of the 5-axis mount, adjustments can be attained for the final arc gap positions and the cross-seam alignment.

APC CHECKOUT PROCEDURE

After the pre-check procedure, the APC may be checked for proper operation. Provided below are two examples of Sequence of Operations, that will help in understanding the process, each processes role in the system and assist in troubleshooting the system, if needed.

SEQUENCE OF OPERATION

Example One

This sequence of operation describes the cyclic events for a seam tracker system configured with Timed Weld Mode, Tack Cutoff, Z Search, Vertical Search Delay, Lockout, Crater Fill Delay and Horizontal Retract Delay, along with the timer values stored into the memory of the APC. Figure 68 - APC Time Line, Example One on page 105 is a diagram provided to help in understanding the seam tracker's process and typical automated welding sequence of events. Each step is indicated by a letter to reference from these descriptions to the actual Time Line. Below is a table of the Timer Values stored and the Features enabled in the APC for this example.

TABLE 43 - PROGRAM VALUES, EXAMPLE 1

DESCRIPTION	VALUES
Weld/Enable Timer	60 seconds
Overlap Timer	5 seconds
Final Timer	4 seconds
Retract Timer	4 seconds
Tack Cutoff	Enabled
Timed / Auto Cutoff Mode	Timed Mode
Z-Search	Enabled
Sidetrack Disable at Null	Disabled
Vertical Search Delay	Enabled
Horizontal Retract Delay	Enabled
Lockout	Enabled
Crater Fill Delay	Enabled
Sidetrack Selected	Left

Start

Set the pendant controls to Auto and select the desired sidetrack direction. Start may be initiated by either the Start Cycle pushbutton on the pendant or via the Remote Interface (see Figure 78 - Remote Input Interface Connections on page 126). Indicated by the **"A"**.

Cycle

The Cycle has started. Cycle allows sequential circuitry to be activated for the search mode of operation.

Search

The horizontal slide will move at maximum speed in the direction of the selected sidetrack for a preset time of two seconds (vertical search delay). Indicated by the **"B"**. This allows the sensor to clear any fixture interference before moving downward in search of the weld seam. After the two-second delay the vertical

slide is allowed to move downward, causing the sensor to move at a 45 degree angle, overshooting the weld seam. When the sensor touches the workpiece and vertical null is achieved, indicated by the **"C"**, the horizontal slide will move in the opposite direction of the selected sidetrack until the sensor drops into the weld seam, indicated by the **"D"**. Sidetrack reverts back to the select sidetrack direction. When null is achieved, the sidetrack pressure is then controlled by the side track adjust potentiometer and once the seam is located, reduces the side track pressure ensuring the sensor tip does not walk out of the seam.

System Null

When in system null the seam tracker is in the tracking mode of operation waiting for other tracking systems to find their respective seams and null. After all systems have nulled, each systems relay is turned On. This is indicated by the **"E"**.

Relay

Each tracking system has a relay which, when activated, turns on the start lamp of their respective control pendants. The contact closures from this relay may be used to start carriages, wire feeders, etc. Three sets of contact closures are present at the J3 customer interface connector of each control box.

Lockout

Energizing the relay will lock the slides in the manual mode of operation for a preset time of two seconds, allowing each system to strike an arc. This is the area between **"E"** and **"F"**.

Tracking

At the end of the two-second lockout delay, indicated by the **"F"**, the system is in the tracking mode of operation. (Tracking mode of the slides is indicated by a grayed area along the horizontal and vertical slides axis on the time line.) The tack circuitry is armed (pendant Arm lamp is lit) and the weld time is displayed on the display and begins counting down.

Weld Time

During weld time if a tack is encountered, indicated by the **"G"**, the slides will stay in a manual mode of op-

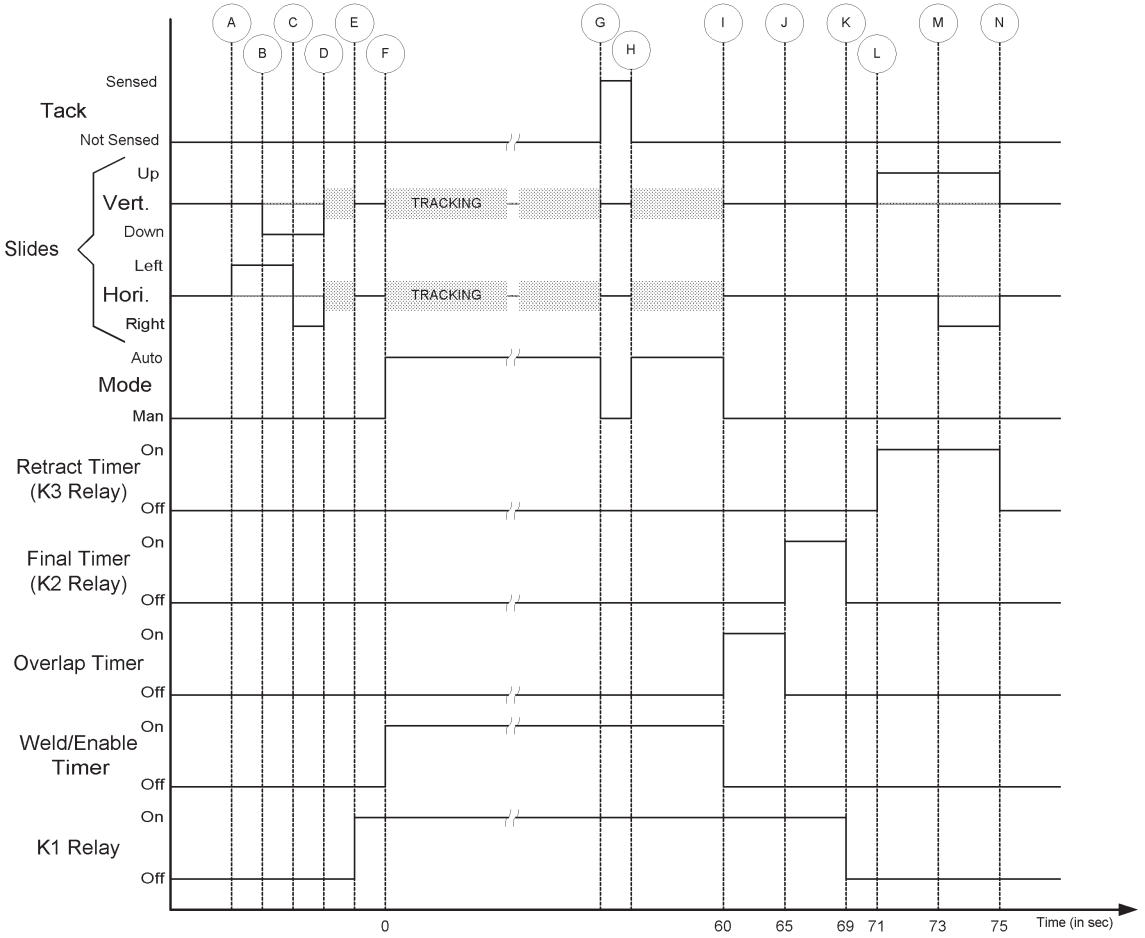


FIGURE 68 - APC TIME LINE, EXAMPLE ONE

eration until the tack is passed, indicated by the **"H"**. (Only one tack is shown here for clarity.) During weld time the tack circuitry may be disabled from the pendant. Activating the remote cut-off will terminate the weld time. After the weld timer times out, indicated by the **"I"**, the system will be in the overlap mode of operation.

Overlap Time

In the Overlap Mode of operation, the slides are in the Manual Mode and the K1 relay remains On. This timer useful to allow the torch position to "Catch up" to the position at which the Cutoff signal was received (if used, not shown in this example) or where the weld timer timed out, indicated by the **"J"**. This timer acts as a delay to the Final time.

Final Time

After the Overlap timer times out, **"J"**, the system is forced to the Final Timer. During the Final time, the K2 relay is energized and remains energized for the duration of the timer setting. Final time is useful to allow other equipment indication of what portion of the sequence the cycle it in. By providing the K2 relay output, the seam tracker can signal the power source or other weld controller's to change from one weld schedule to another. Extremely useful in circumferential welding applications when a hotter weld is needed to flatten out the overlap pass at the end of the weld.

When the timer is completed the system is forced into Crater Fill Delay Mode, indicated by the **"K"**, and the K1 and K2 relays are de-energized.

Crater Fill Delay

At the start of Crater Fill Delay (a two-second delay), the K1 and K2 relays are turned off indicating Crater Fill Delay Mode of operation, the area between **"K"** and **"L"**. The slides still remain in manual mode of operation, locked in their last position. After two seconds, the system is forced into the Retract Mode of operation, indicated by the **"L"**.

Retract Time

Immediately after Crater Fill Delay, the vertical slide will move upward, indicated by the **"L"**. The horizontal slide will not retract until after a two-second delay, Horizontal Retract Delay, indicated by the **"M"**. Thus, the horizontal retract time will be the Retract Timer setting minus two seconds, .i.e., the Horizontal Retract Delay. After the delay is completed, the sensor is clear of the workpiece and the horizontal slide is allowed to move to the right. After the Retract Timer times out, the sensor is positioned back to the start position and the cycle is complete, indicated by the **"N"**. The system is ready for the next welding operation.

Example Two

This sequence of operation describes the cyclic events for a seam tracker system configured with Auto Cutoff Weld Mode, Tack Cutoff, Z Search, Vertical Search Delay, Lockout, Crater Fill Delay and Horizontal Retract Delay, along with the timer values stored into the memory of the APC. Figure 69 - APC Time Line, Example Two on page 108 is a diagram provided to help in understanding the seam tracker's process and typical automated welding sequence of events. Each step is indicated by a letter to reference from these descriptions to the actual Time Line. Below is a table of the Timer Values stored and the Features enabled in the APC for this example.

TABLE 44 - PROGRAM VALUES, EXAMPLE 2

DESCRIPTION	VALUES
Weld/Enable Timer	60 seconds
Overlap Timer	5 seconds
Final Timer	4 seconds
Retract Timer	4 seconds
Tack Cutoff	Enabled
Timed / Auto Cutoff Mode	Auto Cutoff Mode
Z-Search	Enabled
Sidetrack Disable at Null	Disabled
Vertical Search Delay	Enabled
Horizontal Retract Delay	Enabled
Lockout	Enabled
Crater Fill Delay	Enabled
Sidetrack Selected	Left

Start

Set the pendant controls to Auto and select the desired sidetrack direction. Start may be initiated by either the Start Cycle pushbutton on the pendant or via the Remote Interface (see Figure 78 - Remote Input Interface Connections on page 126). Indicated by the **"A"**.

Cycle

The Cycle has started. Cycle allows sequential circuitry to be activated for the search mode of operation.

Search

The horizontal slide will move at maximum speed in the direction of the selected side track for a preset time of two seconds (vertical search delay). Indicated by the **"B"**. This allows the sensor to clear any fixture interference before moving downward in search of the weld seam. After the two-second delay the vertical slide is allowed to move downward, causing the sensor to move at a 45 degree angle, overshooting the weld seam. When the sensor touches the workpiece and vertical null is achieved, indicated by the **"C"**, the horizontal slide will move in the opposite direction of the selected sidetrack until the sensor drops into the weld seam, indicated by the **"D"**. Side track reverts back to the select side track direction. When null is achieved, the side track pressure is then controlled by the side track adjust potentiometer and once the seam is located, reduces the side track pressure ensuring the sensor tip does not walk out of the seam.

System Null

When in system null the seam tracker is in the tracking mode of operation waiting for other tracking systems to find their respective seams and null. After all systems have Nulled, each systems relay is turned On. This is indicated by the **"E"**.

Relay

Each tracking system has a relay which, when activated, turns on the start lamp of their respective control pendants. The contact closures from this relay may be used to start carriages, wire feeders, etc. Three sets of contact closures are present at the J3 customer interface connector of each control box.

Lockout

Energizing the relay will lock the slides in the manual mode of operation for a preset time of two seconds, allowing each system to strike an arc. This is the area between **"E"** and **"F"**.

Tracking

At the end of the two-second lockout delay, indicated by the **"F"**, the system is in the tracking mode of operation. (Tracking mode of the slides is indicated by a grayed area along the horizontal and vertical slides axis on the time line.) The tack circuitry is armed (pendant Arm lamp is lit) and the weld time is displayed on the display and begins counting down.

Weld Time

During weld time if a tack is encountered, indicated by the **"G"**, the slides will stay in a manual mode of operation until the tack is passed, indicated by the **"H"**. (Only one tack is shown here for clarity.) During weld time the tack circuitry may be disabled by remote. Activating the remote cut-off will terminate the weld time. After the weld timer times out, indicated by the **"I"**, the system will continue tracking the joint until the next tack is sensed, indicated by the **"J"**. The tack sensed could be simply another tack or it could be the beginning of the weld bead, as those sensed on a circumferential welding application, such as, a fuel tank, pressure vessel, etc. Once the weld bead is sensed, the system is forced into the Overlap Mode of operation.

Overlap Time

In the Overlap Mode of operation, the slides are in the Manual Mode and the K1 relay remains on. This timer useful to allow the torch position to "Catch up" to the position at which the Cutoff signal was received (if used, not shown in this example) or where the weld timer timed out, indicated by the **"K"**. This timer acts as a delay to the Final time.

Final Time

After the Overlap timer times out, **"K"**, the system is forced to the Final Timer. During the Final time, the K2 relay is energized and remains energized for the duration of the timer setting. Final time is useful to allow other equipment indication of what portion of the sequence the cycle it in. By providing the K2 relay output, the seam tracker can signal the power source or other weld controller's to change from one weld schedule to another. Extremely useful in circumferential welding applications when a hotter weld is needed to flatten out the overlap pass at the end of the weld.

When the timer is completed the system is forced into Crater Fill Delay Mode, indicated by the **"L"**, and the K1 and K2 relays are de-energized.

Crater Fill Delay

At the start of Crater Fill Delay (a two-second delay), the K1 and K2 relays are turned off indicating Crater Fill Delay Mode of operation, the area between **"L"** and **"M"**. The slides still remain in manual mode of operation, locked in their last position. After two seconds, the system is forced into the Retract Mode of operation, indicated by the **"M"**.

Retract Time

Immediately after Crater Fill Delay, the vertical slide will move upward, indicated by the **"M"**. The horizontal slide will not retract until after a two-second delay, Horizontal Retract Delay, indicated by the **"N"**. Thus, the horizontal retract time will be the Retract Timer setting minus two seconds, .i.e., the Horizontal Retract Delay. After the delay is completed, the sensor is clear of the workpiece and the horizontal slide is allowed to move to the right. After the Retract Timer times out, the sensor is positioned back to the start position and the cycle is complete, indicated by the

"O". The system is ready for the next welding operation.

SEAM TRACKER GROUNDING AND CABLING

It is necessary to have the Seam Tracker grounded properly to protect the unit from electrical noise. This is of particular importance during GTAW (TIG) applications which employ high frequency or high voltage spikes for arc starting.

The seam tracker is provided with a 1/4-20 ground stud on the bottom of the unit. ***USE IT!*** The seam tracker should be tied to a good earth ground (PE). The seam tracker ground should not be hooked up to the fixture, unless the fixture is using a known good earth ground (PE).

NOTE

All cabling provided with this system is shielded. If you extend cables, in particular cables for remote interfacing, they must be in shielded cables. The outer shield should be continuous back to the seam tracker. Do not hook up the shield to the equipment which the remote cable is going to. Tape the shield back, this forms a drain system taking noise off the cables back to the seam tracker and ground.

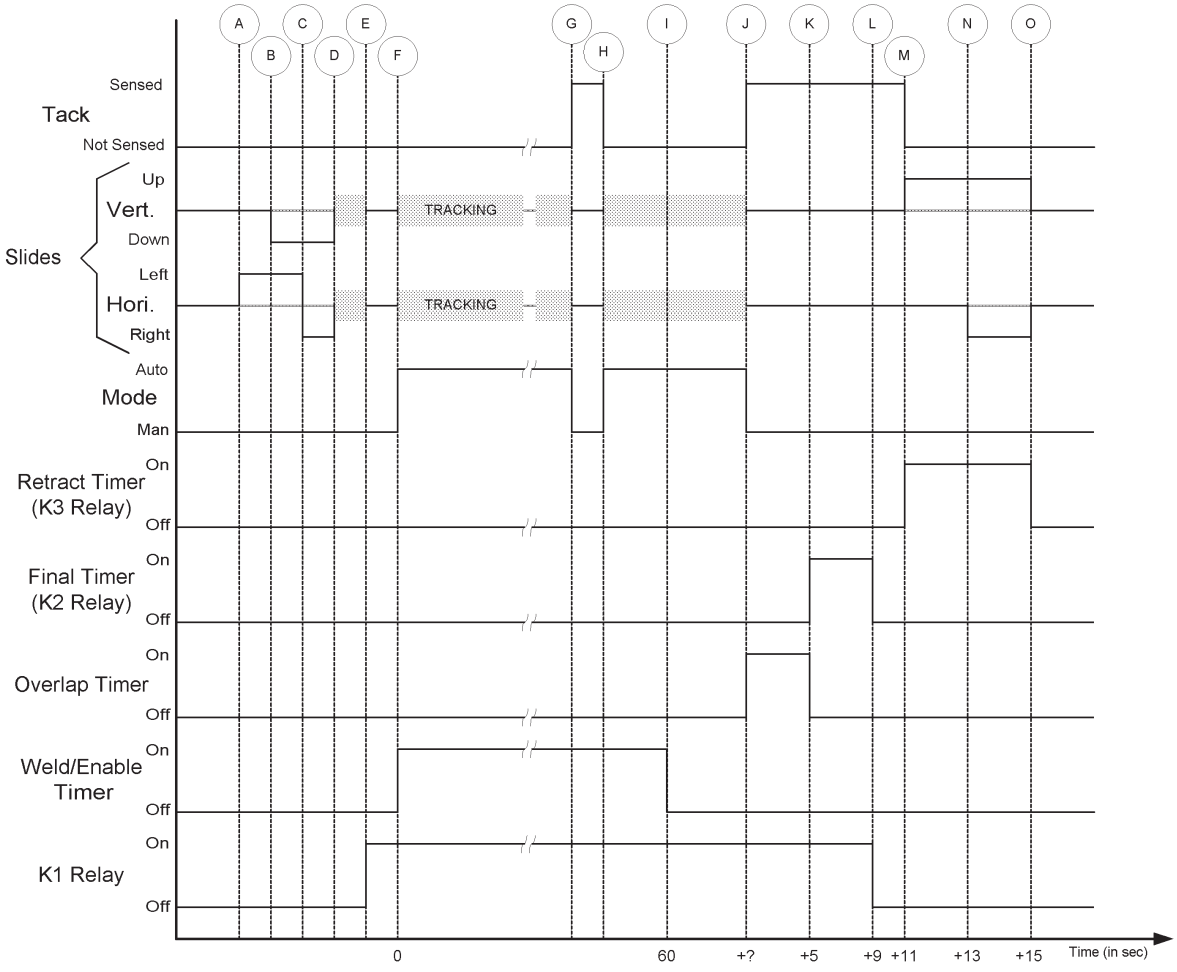


FIGURE 69 - APC TIME LINE, EXAMPLE TWO

TABLE 45 - ST CONTROL WITH APC PROGRAM WORKSHEET

Product / Part Information

ST Control Unit Program #: _____

Part #: _____ Description: _____

Application Information

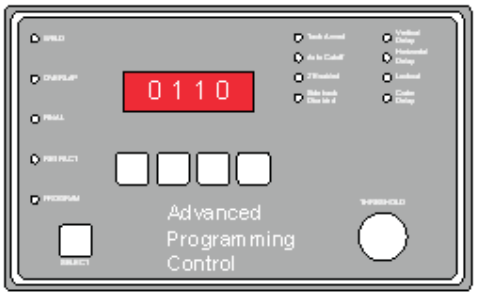
Type of Part: ❑ Pipe ❑ Tank ❑ Cylinder ❑ Fittings ❑ I / H Beams ❑ Other _____

Welding Process: ❑ DC TIG/GTAW ❑ AC TIG/GTAW ❑ Plasma/PAW ❑ Sub-Arc _____

Type of Material: ❑ Steel ❑ Stainless ❑ Aluminum ❑ Other _____

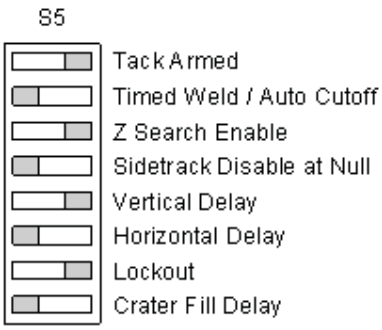
APC Timer Settings

	Value Stored in Memory
Weld / Enable Timer:	
Overlap Timer:	
Final Timer:	
Retract Timer:	



APC Feature Settings

	Position	
	Off Position (Up)	On Position (Down)
Tack Cutoff:	Disabled ❑	Enabled ❑
Timed Weld / Auto-Cutoff:	Timed Weld ❑	Auto Cutoff ❑
Z Search:	Disabled ❑	Enabled ❑
Sidetrack Disable at Null:	Disabled ❑	Enabled ❑
Vertical Search Delay:	Disabled ❑	Enabled ❑
Horizontal Retract Delay:	Disabled ❑	Enabled ❑
Lockout:	Disabled ❑	Enabled ❑
Crater Fill Delay:	Disabled ❑	Enabled ❑



Additional Information / Comments

_____

_____

_____

_____

APC MAINTENANCE

Maintenance required by the APC option is minimal. The best preventive maintenance to be preformed on the APC or on the seam tracker is to be sure the door of the enclosure is closed tightly. This prevents dust, dirt and other contaminants from entering and fouling the circuit boards inside.

Additional maintenance to be preformed on the APC option is periodic cleaning of the front panel overlay and the pendant face plate.

There is periodic mechanical maintenance necessary to keep the system in optimum working condition. A Preventive Maintenance Schedule is provided in the Maintenance section earlier in this manual. The Preventive Maintenance Schedule and other mechanical maintenance functions and procedures can be found in the Maintenance Section beginning on page 31.

APC DRAWINGS AND PARTS LISTS

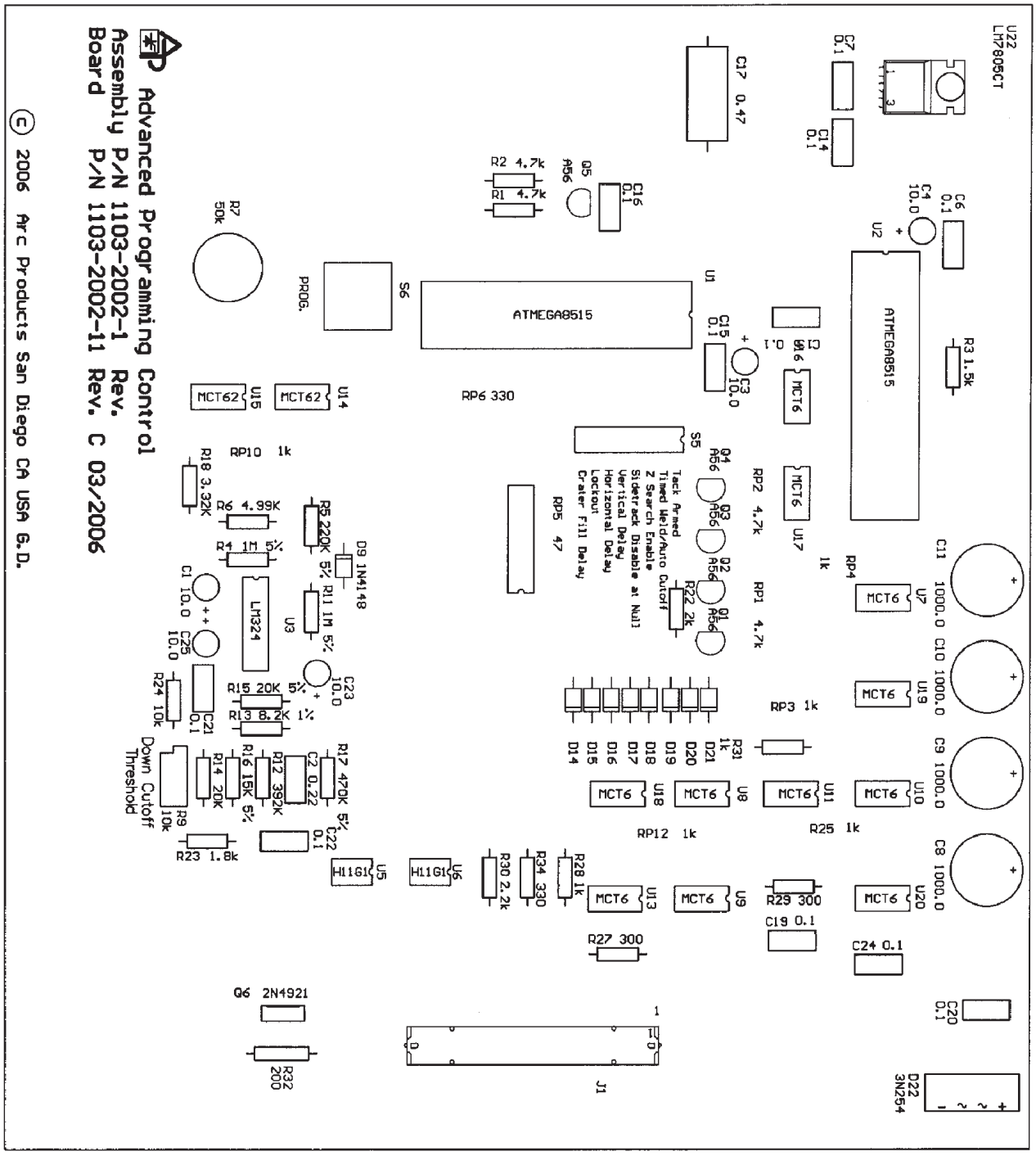


FIGURE 70 - ADVANCED PROGRAMMING CONTROL BOARD LAYOUT

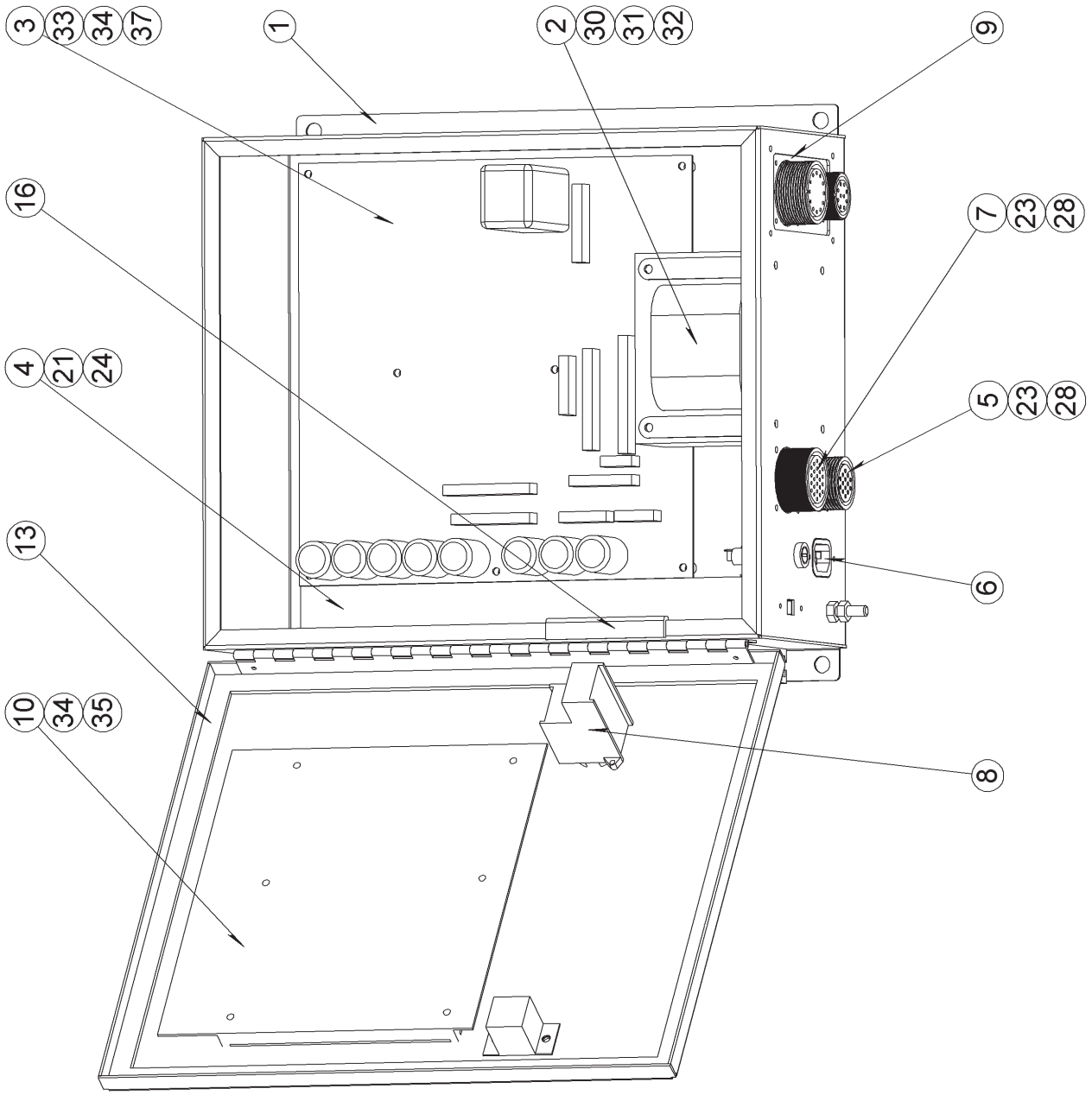


FIGURE 71 - SEAM TRACKER CONTROL WITH APC EXPLODED VIEW

TABLE 46 - SEAM TRACKER CONTROL WITH APC PARTS LIST

ITEM #	QPA	UM	PART NUMBER	DESCRIPTION
1	1.000	EA	0600-0002	CONTROL ENCLOSURE
2	1.000	EA	1101-2002-2	CONTROL TRANSFORMER ASSY
3	1.000	EA	1101-2002-3	MAIN BOARD ASSY
4	1.000	EA	1101-2002-4	MOTOR DRIVER ASSY
5	1.000	EA	1101-2002-5	CONTROL DRIVE CABLE ASSY
6	1.000	EA	1101-2002-6	VOLTAGE SELECTOR SWITCH ASSY
7	1.000	EA	1101-2002-7	CONTROL PENDANT CABLE ASSY
8	1.000	EA	1101-2002-8	POWER SWITCH ASSY
9	1.000	EA	1103-2002-3	REMOTE PANEL/HARNESS ASSY-APC
10	1.000	EA	1103-2002-1	ADVANCED PROGRAM CONTROL ASSY
11	1.000	EA	0600-0381	ST PANEL AND OVERLAY ASSEMBLY(NOT SHOWN)
12	1.000	EA	1175-0079	LABEL CAUTION 110/220VAC (NOT SHOWN)
13	0.625	EA	999005-005	TAPE NEO FOAM ADH 1/8INX1/4THK
14	5.000	EA	979001-001	CABLE TIE .75 BUNDLE DIA (NOT SHOWN)
15	1.000	EA	989003-001	CBL TIE MNT ADH BACK .75IN SQ (NOT SHOWN)
16	0.417	FT	2040-0536	GROMMET CATERPILLAR
17	1.000	EA	929000-001	3 CONDCTR PWR SPLY CORD (NOT SHOWN)
18	4.000	EA	2414-0201	SCR RND HD U-DRV #2X1/4
19	4.000	EA	970000-204	SCR 4-40X.38 CR1P SBZ
21	15.000	EA	970000-406	SCR 8-32X.50 CR1P SBZ
23	8.000	EA	974010-002	WSR SL #4.209X.121X.025 SBZ
24	7.000	EA	974010-004	WSR SL #8.293X.175X.040 SBZ
28	8.000	EA	972000-002	NUT 4-40 H SBZ
30	4.000	EA	972000-005	NUT 10-32 H SBZ
31	4.000	EA	974010-005	WSR SL #10 .334X.202X.047 SBZ
32	4.000	EA	974006-005	WSR F #10 .374X.195X.032 B
33	8.000	EA	970000-404	SCR 8-32X.38 CR1P SBZ
34	8.000	EA	974010-004	WSR SL #8.293X.175X.040 SBZ
35	6.000	EA	972000-003	NUT 6-32 H SBZ
37	6.000	EA	974000-004	WSR F #8 .438X.188X.049 SBZ
38	1.000	EA	1103-2002-5	APC RIBBON CABLE (NOT SHOWN)

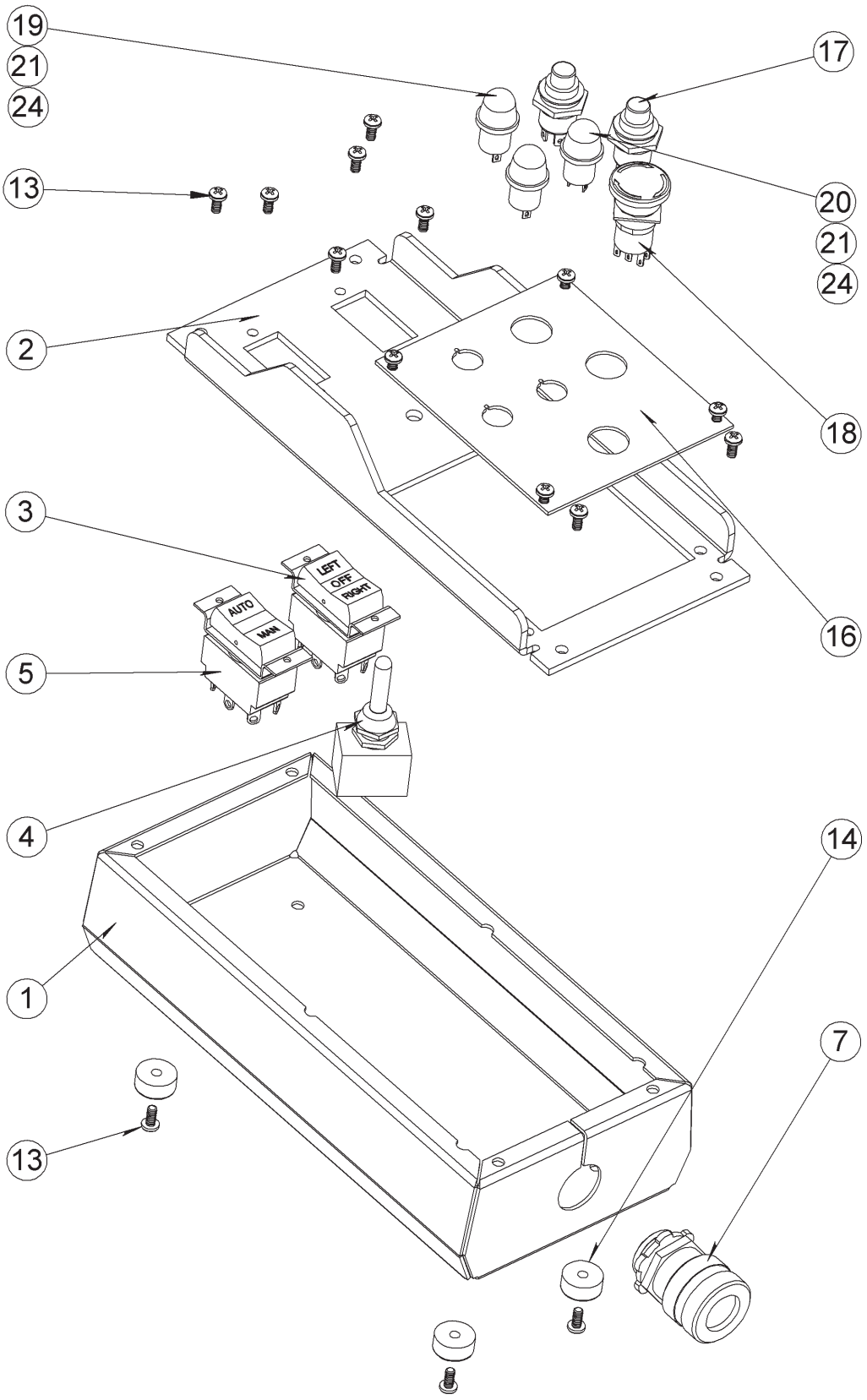


FIGURE 72 - PENDANT WITH APC EXPLODED VIEW

TABLE 47 - PENDANT WITH APC PARTS LIST

ITEM #	QPA	UM	PART NUMBER	DESCRIPTION
1	1.000	EA	0600-0021	SEAM TRACKER PENDANT ENCLOSURE
2	1.000	EA	0600-0022	SEAM TRACKER PENDANT FACEPLATE
3	1.000	EA	1116-0352	SWITCH SIDETRACK
4	1.000	EA	2066-0112	SW JOY STICK 9 POS SNGL POLE
5	1.000	EA	1116-0387	SWITCH AUTO/MAN
6	1.000	EA	1114-1332	APA ST PENDANT ASSY, 10 FT. (NOT SHOWN)
7	1.000	EA	2040-0579	CBL FTTNG W/NUT&BSH .375-.500
10	1.000	EA	2208-0059	CONN RECT RCPT (9CKT) (NOT SHOWN)
11	9.000	EA	2212-0093	TERM SOCKET CRIMP 18-24 GA (NOT SHOWN)
12	1.000	EA	900007-003	CAP CER .1UF 500V +80 -20% (NOT SHOWN)
13	16.00	EA	970021-404	SCR 8-32X.38 HSBC SBZ
14	4.000	EA	0600-0026	FEET, RUBBER
15	1.000	EA	1101-2004	APA ST PENDANT ADV PROG OPTION
			Consisting of:	
16	1.000	EA	0600-0023	ST PENDANT APC OPTION PLATE
17	2.000	EA	2062-0081	SWITCH PB 10 AMP BLACK
18	1.000	EA	1116-0400	SW MUSHROOM STOP ST PENDANT
19	2.000	EA	941000-103	LAMP LENS TRANSLUCENT YELL SM
20	1.000	EA	941000-101	LAMP LENS TRANSLUCENT RED SM
21	3.000	EA	941000-200	LAMP HOLDER LH73/1
22	1.000	EA	2208-0105	CONN RECT PLUG (9CKT) (NOT SHOWN)
23	9.000	EA	2212-0107	TERM PIN CRIMP 24-30 GA (NOT SHOWN)
24	3.000	EA	941000-011	LAMP 387

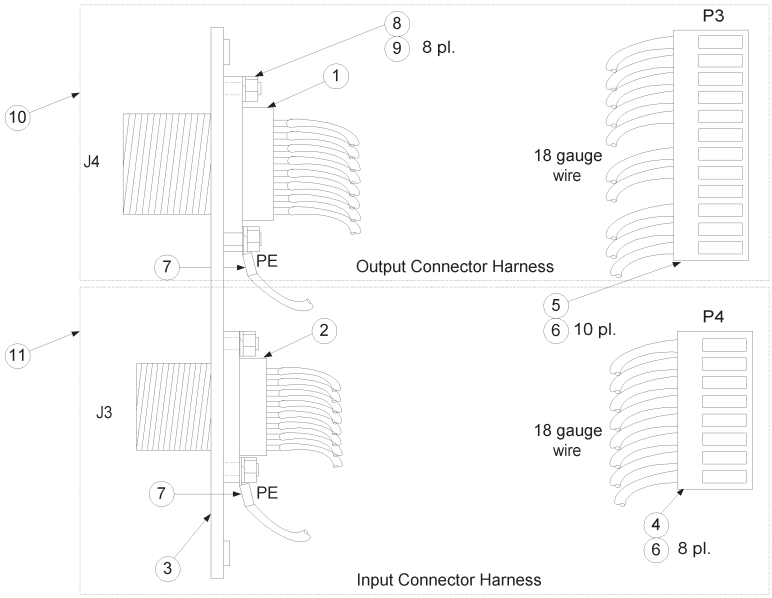


FIGURE 73 - REMOTE CONNECTOR HARNESS EXPLODED VIEW

TABLE 48 - REMOTE INPUT/OUTPUT CONNECTOR HARNESS PARTS LIST

ITEM #	QPA	UM	PART NUMBER	DESCRIPTION
1	1.000	EA	930014-016	CONN CIRC BOX RCPT 24-19S
2	1.000	EA	930014-011	CONN CIRC BOX RCPT 18-1S
3	1.000	EA	0600-0005	APA REMOTE OPTION PLATE
4	1.000	EA	2208-0114	CONN RECT PLUG (8 CKT)
5	1.000	EA	2208-0112	CONN RECT PLUG (12 CKT)
6	18.000	EA	2212-0019	TERMINAL CRIMP PIN 18-24 GA
7	2.000	EA	2340-0588	TERM RING INSULATED #6
8	8.000	EA	974000-002	WSR SL #6
9	8.000	EA	972000-002	NUT #6

APC TROUBLESHOOTING

INTERFACING THE SEAM TRACKER TO OTHER EQUIPMENT

The interconnect diagrams in on page and Figure 75 - Pendant Schematic, Advanced Programming Control Option on page 123, shows the functional relationship of the APC with subassemblies in the seam tracker system.

In addition to the board layout drawings, Figure 74 - Seam Tracker Signal Flow with APC on page 121 illustrates very simply the flow of signals in the seam tracker system with the Advanced Programming Control installed.

Subassembly Interface

The interface between the APC and the other subassemblies in the control unit are modular. The subassemblies make discrete connections to primarily the Main board via molex connectors and wiring harnesses (see Figure 35 - Seam Tracker Control Exploded View on page 52 and Figure 71 - Seam Tracker Control With APC Exploded View on page 114).

A basic signal flow diagram is provided in Figure 74 - Seam Tracker Signal Flow with APC on page 121 to provide effective troubleshooting should the need arise.

GENERAL

NOTE

For use by qualified service technicians

The following list describes typical problems and suspect assemblies for the system. The schematics and circuit descriptions will be a helpful reference for troubleshooting.

CAUTIONS

- Full line voltage is exposed inside the control unit.
- Do not turn the power On when any of the connectors are removed from their position.
- Use discretion when substituting components. It is possible for the unit to have defects that could damage replaced components.
- The main and APC boards contain CMOS logic components, which require standard CMOS precautions against damage by Electro-Static Discharge (ESD).

Recommended Troubleshooting Equipment.

- Digital multi-meter (with frequency counter and diode and capacitor checker)
- Miscellaneous screw drivers, nut drivers, and wrenches

Setup and General Information

It is assumed that switches, connectors and power supply voltages are proper. The reference for the digital multi-meter may be obtained on the Main board. All analog signals are referenced to signal (logic) ground (GND). This troubleshooting guide is limited to the substitution of assemblies only. No schematic of boards or assistance are provided for troubleshooting to the component level of the boards.

Many problems appear to be electrical in nature, when in fact, they are mechanical problems in the cross-slides, seam sensor, bracketry, cables, etc. Inspection of the mechanical components the Seam Tracker System and of the complete system should be performed periodically and prior to continuing electrical troubleshooting (see the Maintenance section earlier in this manual for detailed information on troubleshooting mechanical system issues beginning on page 31. Also within this section review the Preventive Maintenance Schedule beginning on page 32 for periodic maintenance requirements).

Vertical Delay

Vertical delay is evidenced by watching the torch slides. The horizontal slide will move in the direction of the selected sidetrack for approximately 2 seconds before the vertical slide will move downward. If this doesn't occur, verify the Feature is selected by the Vertical Delay LED being lit.

Lockout

Lockout is initiated for 2 seconds after the start lamp on the pendant illuminates. This is verified by displacing the seam sensor tip resulting in no slide movement, or the tack lamp illuminating 2 seconds after start lamp illuminates. If this doesn't occur, verify the Feature is selected by the Lockout LED being lit.

Tack Cutoff

Tack operation is evident when the tack lamp on the control pendant illuminates when the seam sensor is displaced upward. This function is only operative when the arm lamp is illuminated. If this doesn't occur, verify the Feature is selected by the Tack Cutoff LED being lit.

Crater Fill Delay

Crater delay will occur immediately after the start lamp on the control pendant extinguishes. The vertical and horizontal slides will remain stationary for 2 seconds before retracting. If this doesn't occur, verify the Feature is selected by the Crater Fill Delay LED being lit.

Horizontal Delay

Horizontal delay occurs during retract. The vertical slides will retract upward for 2 seconds and then the horizontal slides will retract the opposite direction of the selected sidetrack. If this doesn't occur, verify the Feature is selected by the Horizontal Delay LED being lit.

Relay K1 does not operate

Verify the seam tracker has found the seam and that the seam sensor is not binding or gouging the workpiece. Try jogging the seam sensor's lower rod and tip back and forth to ensure the tip is free to move (if binding or gouging is at fault, this may allow the K1 relay to energize).

Verify the relay is seated correctly in the relay socket.

Z Search

Verify the seam sensor is not binding or gouging the workpiece as it tries to traverse the work-piece, adjusting the angle to allow proper tip movement along the work-piece. Try jogging the seam sensor's lower rod and tip back and forth to ensure the tip is free to move (if binding or gouging is at fault, this may allow the Z-Search feature operate properly).

Verify the Feature is selected by the Z-Search LED being lit.

Seam tracker continues to cycle when start is not activated.

Verify the remote Start input is not being held on or closed. This will cause the system to immediately start another cycle after a cycle has been completed.

Try to isolate the remote cables to determine if noise is being picked up by the control unit and is false starting a cycle.

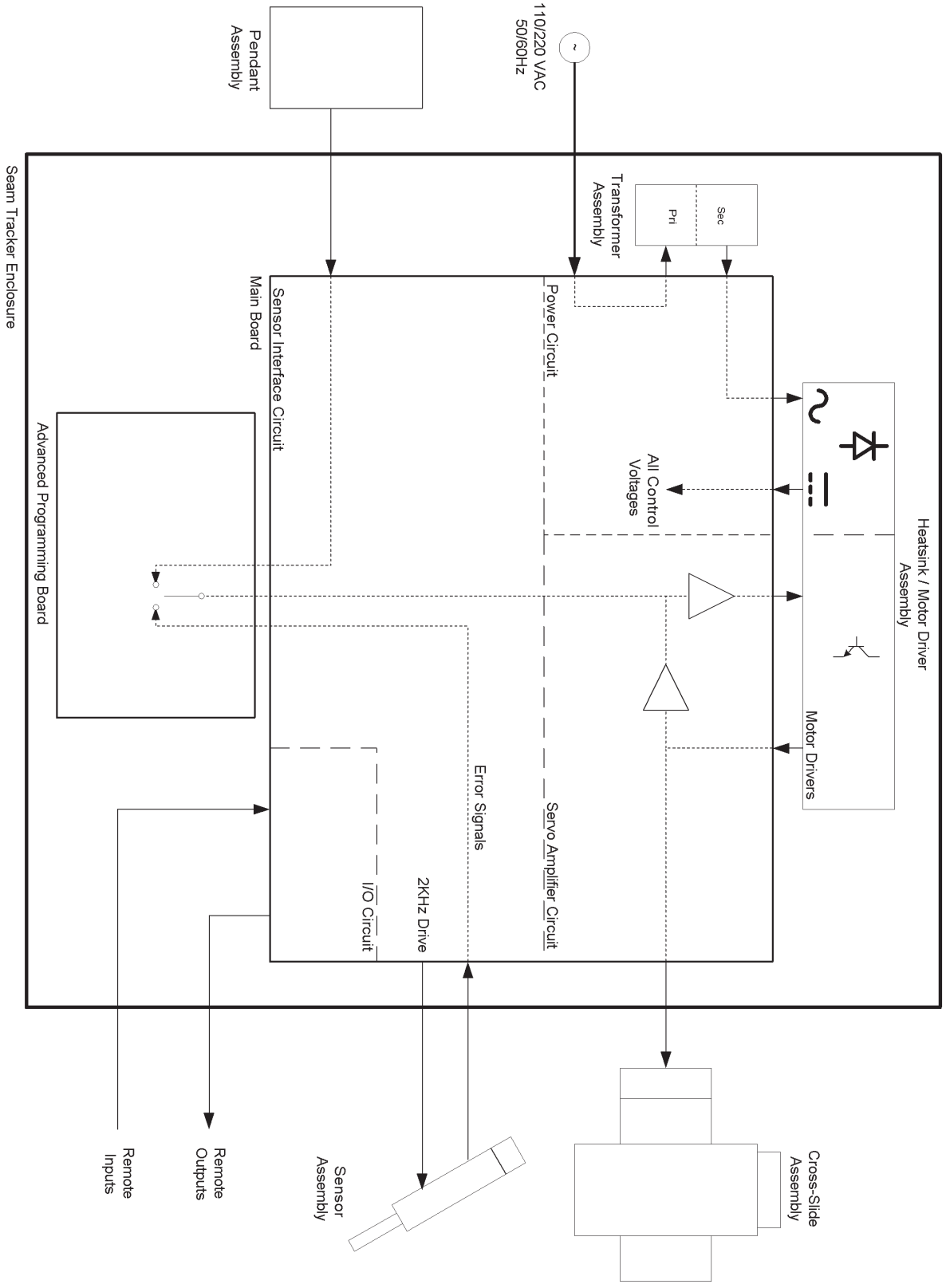


FIGURE 74 - SEAM TRACKER SIGNAL FLOW WITH APC

APC SCHEMATICS AND BLOCK DIAGRAMS

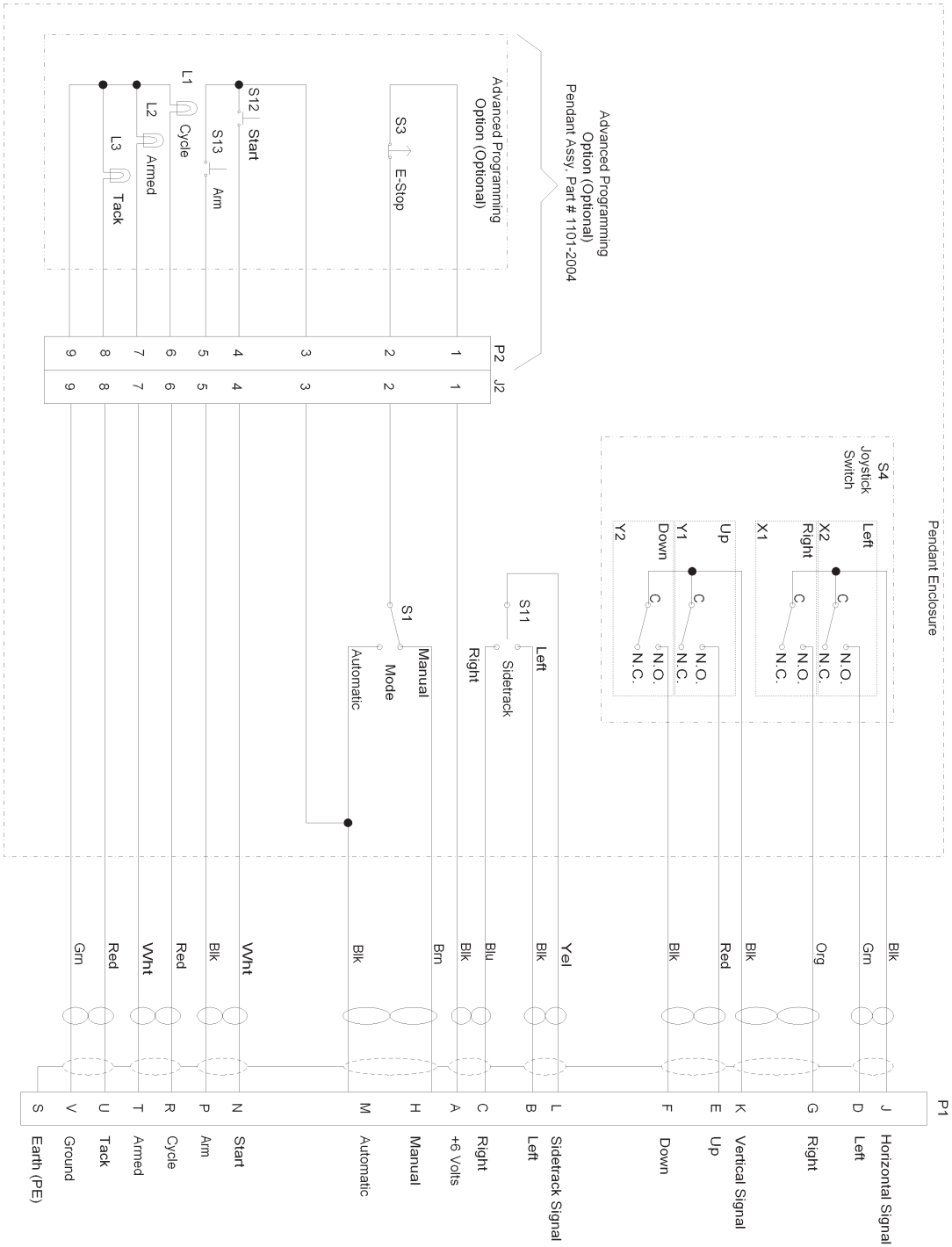


FIGURE 75 - PENDANT SCHEMATIC, ADVANCED PROGRAMMING CONTROL OPTION

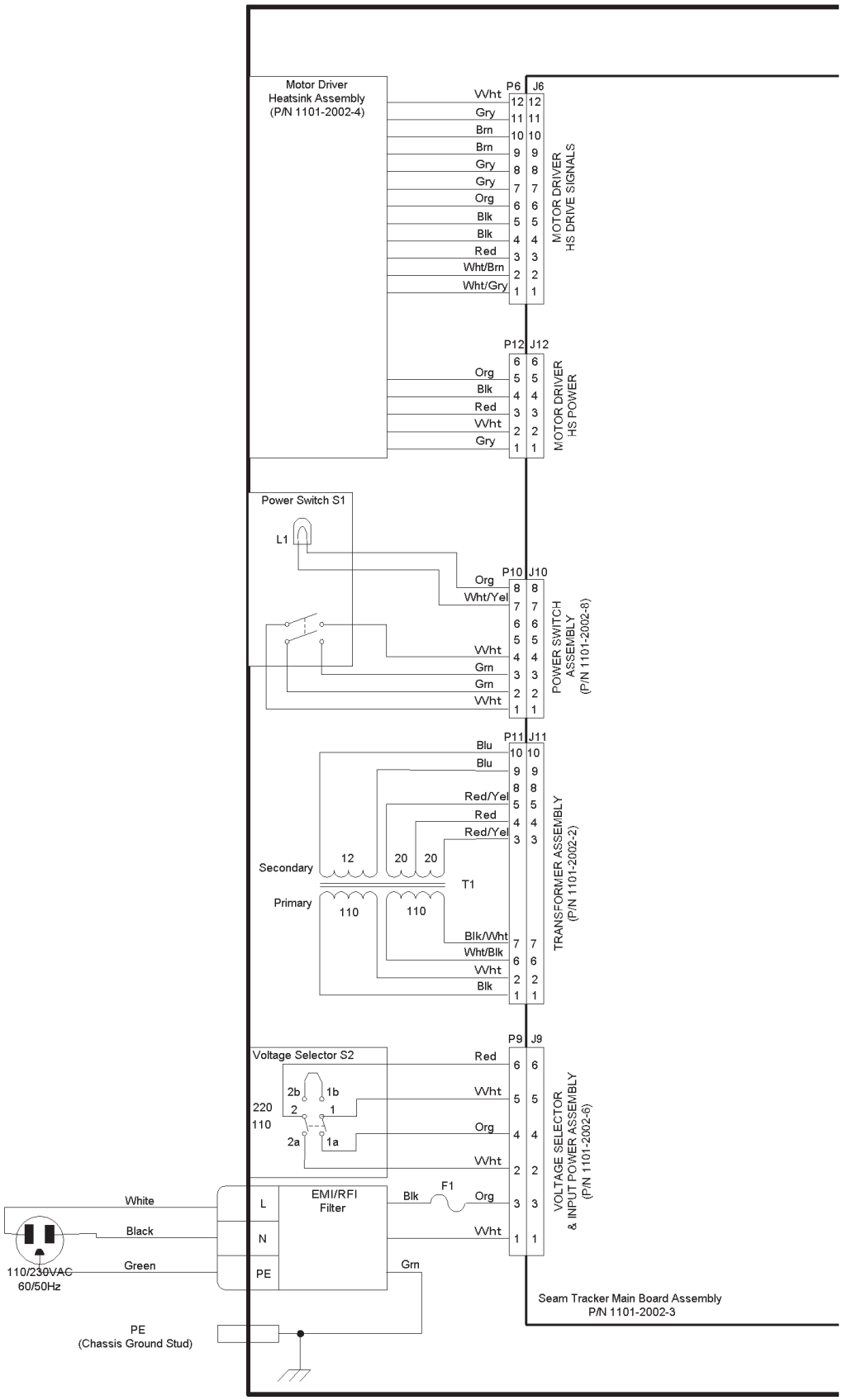


FIGURE 76 - SEAM TRACKER BLOCK DIAGRAM WITH APC

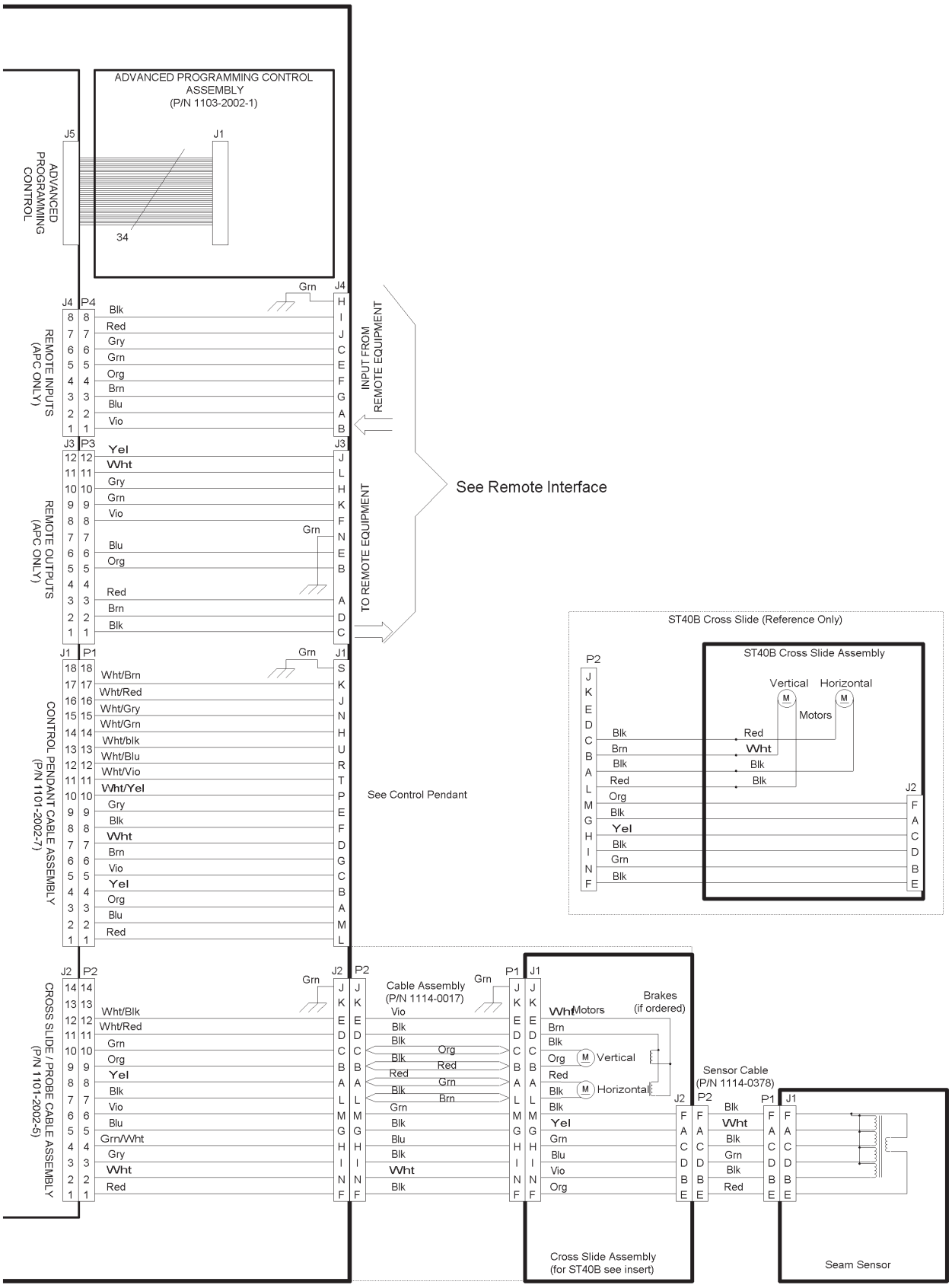


FIGURE 77 - SEAM TRACKER BLOCK DIAGRAM WITH APC (CONT.)

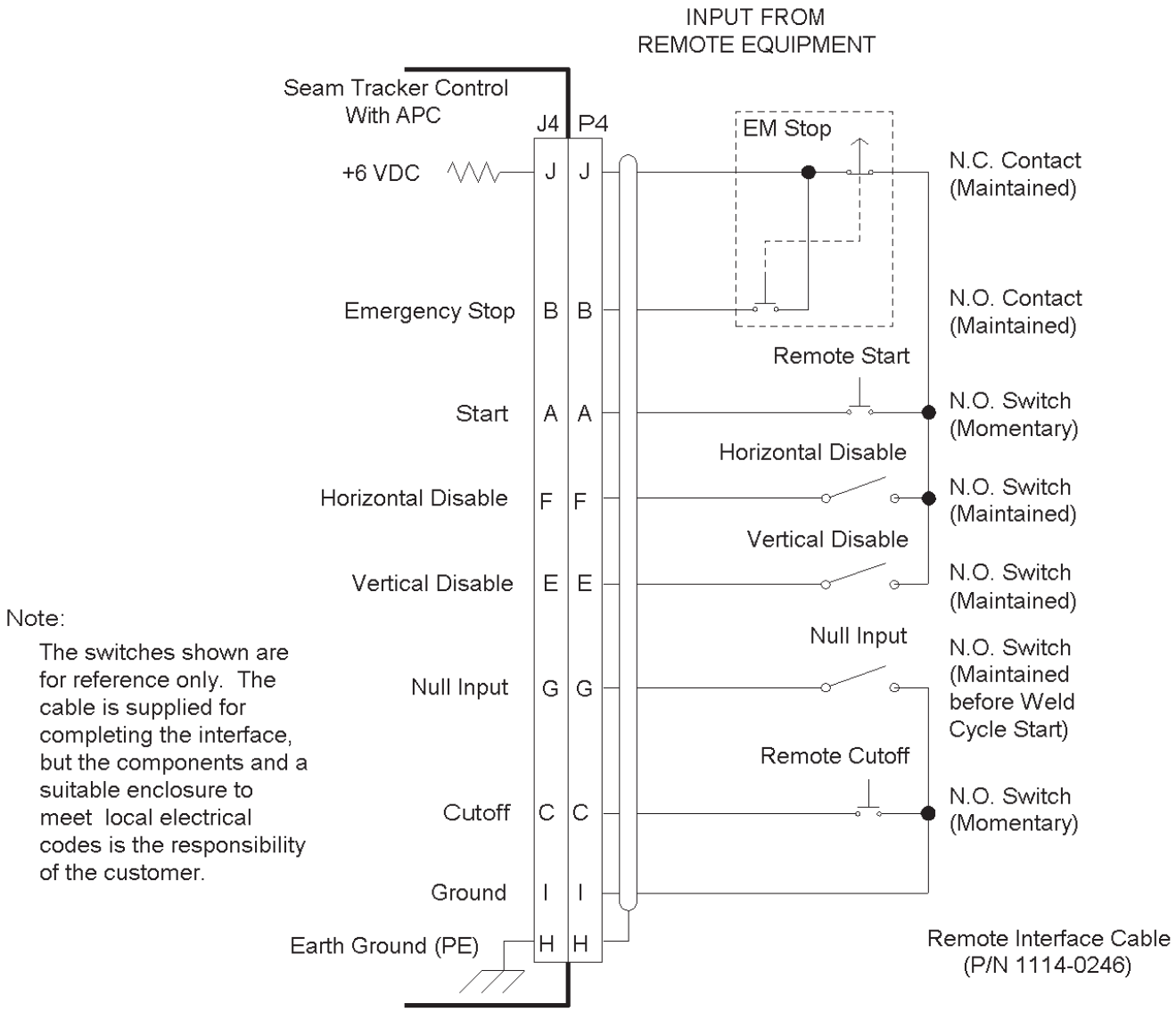
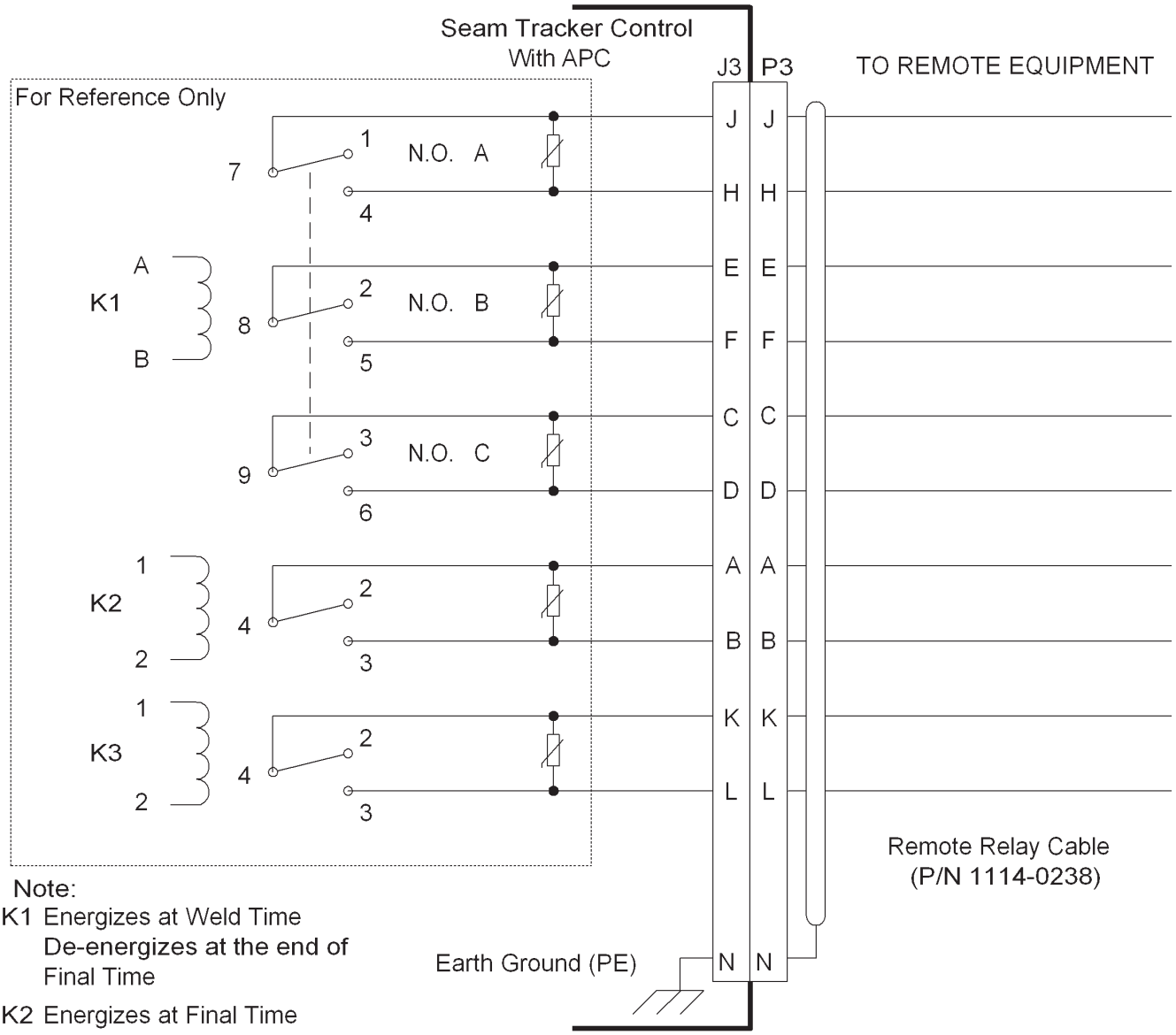


FIGURE 78 - REMOTE INPUT INTERFACE CONNECTIONS



Note:

K1 Energizes at Weld Time
De-energizes at the end of Final Time

K2 Energizes at Final Time
De-energizes at the end of Final Time

K3 Energizes at Retract Time
De-energizes at the end of Retract Time

FIGURE 79 - REMOTE OUTPUT INTERFACE CONNECTIONS

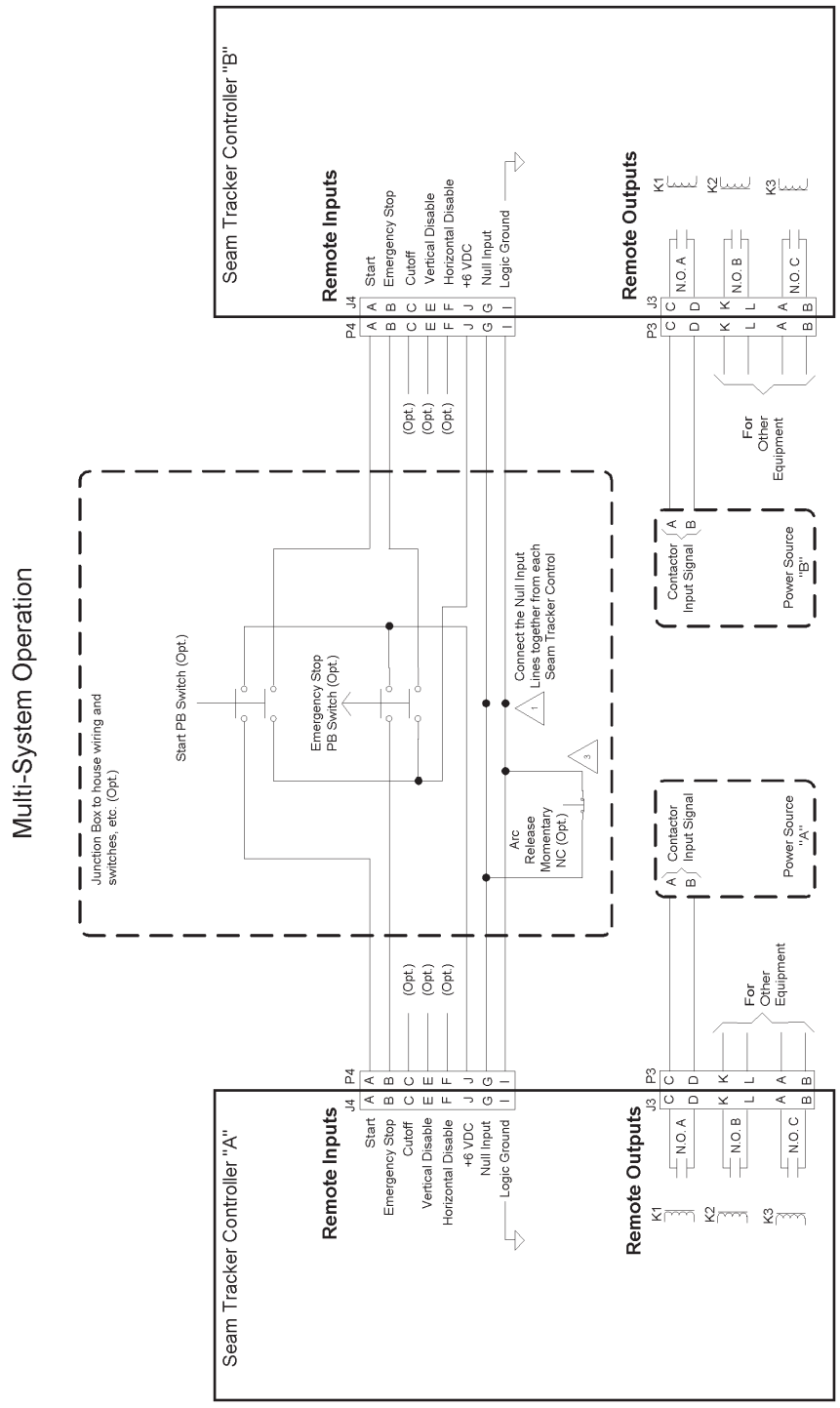


FIGURE 80 - MULTI-SYSTEM OPERATION AND WIRING

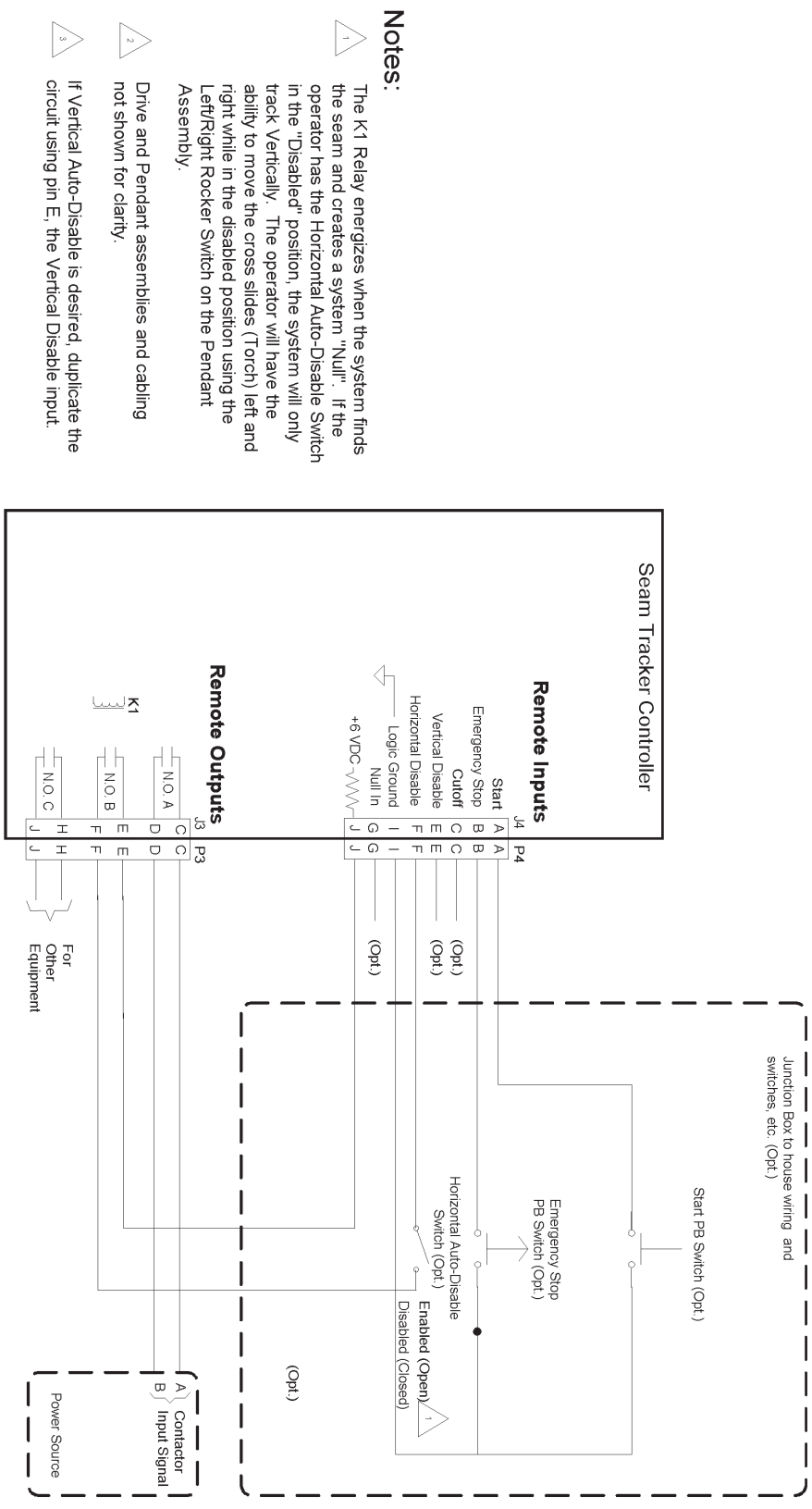


FIGURE 81 - AUTO-DISABLE OPERATION AND WIRING

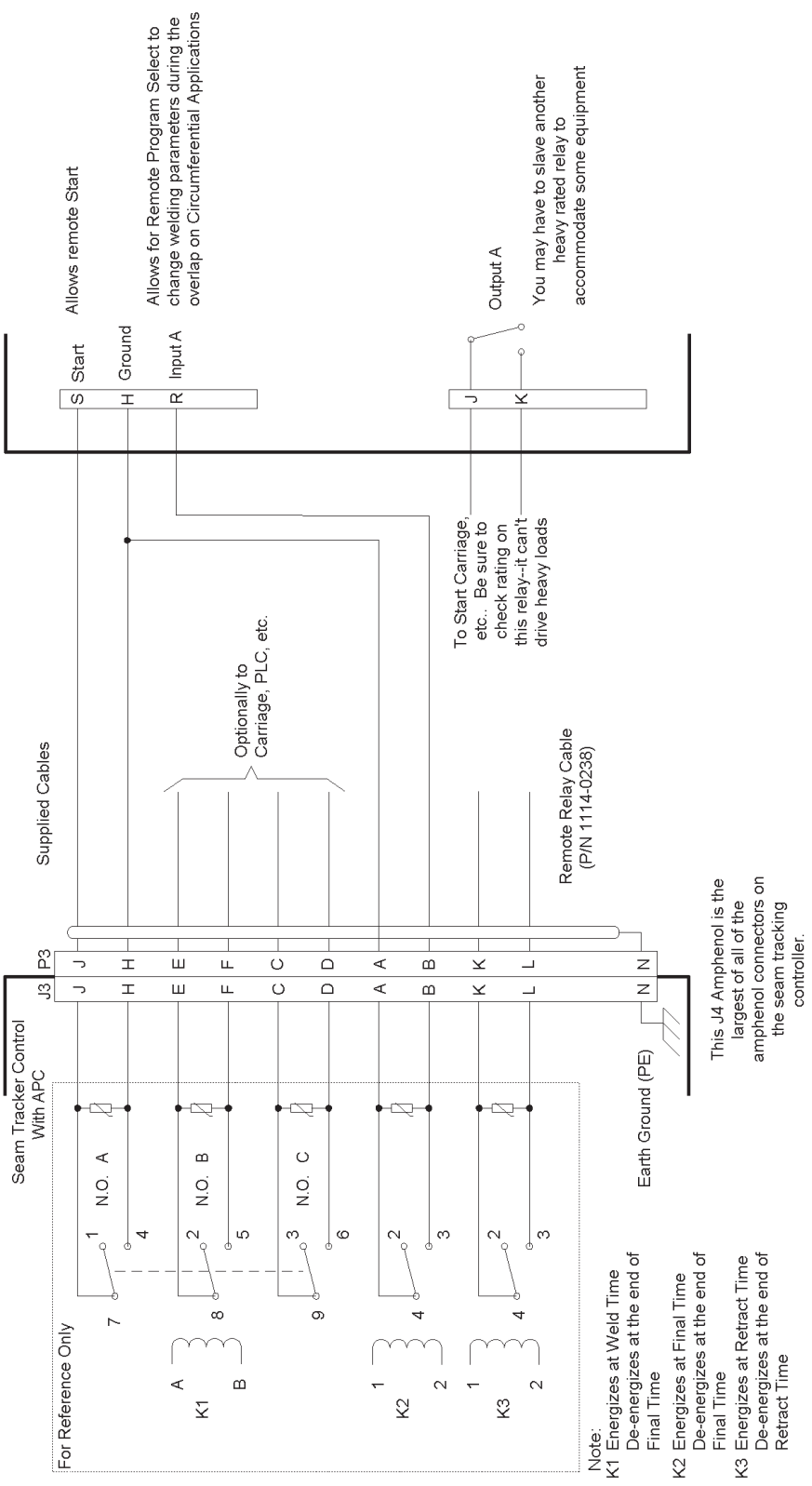


FIGURE 82 - ST CONTROL WITH APC TO OTHER EQUIPMENT

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PARTS LIST FOR

Arc Products Replacement Parts Cross Reference List

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# Indicates a change this printing.

	DESCRIPTION	ARC PRODUCTS NO.	LECO NO.	QTY
1	5-Axis Probe Bracket Assembly	1100-0258	K52026-1	
2	Sensor Cable Assembly	1114-0378	K52033-1	
3	1/8” Diameter Round	1106-1923	KP52028-1	
4	Insulator, Omni Guide	1110-2093	KP52029-1	
5	1/16” Diameter Round	1106-1974	KP52047-1	
6	1” Diameter Ball	1106-1982	KP52048-1	
7	3/4” Diameter Ball	1106-1991	KP52049-1	
8	5/8” Diameter Ball	1106-2008	KP52050-1	
9	1/2” Diameter Ball	1106-2016	KP52051-1	
10	3/8” Diameter Ball	1106-2024	KP52052-1	
11	1/4” Diameter Ball	1106-2032	KP52053-1	
12	3” Extension Tip	1110-2107	KP52055-1	
13	Remote Panel/Harness Asbly-APC	1103-2002-3	S29276-38	
14	APA St. Pendant Adv Prog Option	1101-2004	S29276-39	
15	St. Panel and Overlay Assembly	0600-0381	S29276-41	
16	Upper Mtr Cvr ST250 3.5”	0600-0377	S29276-53	
17	Switch, Select 1-3/16 Red	2066-0171	S29276-64	
18	Pot 10K Linear 10% 3TCERMET	903002-011	S29276-69	
19	Switch Sidetrack	1116-0352	S29276-70	
20	Advanced Program Control Assembly	1103-2002-1	S29276-72	
21	Control Transformer Assembly	1101-2002-2	S29276-74	
22	Lamp Lens Translucent Red Sm	941000-101	S29276-78	
23	Lamp 387	941000-011	S29276-81	
24	Lamp Holder LH73/1	941000-200	S29276-202	
25	Switch PB 10 Amp Black	2062-0081	S29276-247	
26	Switch Toggle DTSP`	2060-0071	S29276-248	
27	Main Board Assembly	0600-0388	S29276-304	
28	Lamp Lens Translucent Yellow Sm	941000-103	S29276-85	
29	Mtr Cvr Assembly Lwr ST250	0600-0099	S29276-91	
30	Gear Motor, 25:1	1116-0123	S29276-96	
31	Sw Mushroom Stop St Pendant	1116-0400	S29276-98	
32	Switch Auto/Man	1116-0387	S29276-99	
33	Std Off HXx M/F 8-32 x .25 x 1.12 (SS)	981002-004	S29276-106	
34	Knob Sm Skirt/Lt Gray Pointer	940024-001	S29276-108	
35	Shield, Seam Sensor	1110-1062	S29276-110	
36	Slide Assembly Probe H.D	1106-0692	S29276-111	
37	Brake Assembly	0600-0094	S29276-113	
38	Motor Driver Assembly	1101-2002-4	S29276-117	
39	Main Board Assembly	1101-2002-3	S29276-118	
40	Motor Assembly ST250 Upper	0600-0111	S29276-119	
41	Transistor Socket to-3	2716-0034	S29276-120	
42	Pivot - Machined	1110-0805	S29276-121	
43	Sw Joystick 9 Pos Single Pole	2066-0112	S29276-122	
44	Arm Assembly - Probe Adjust	1106-0684	S29276-124	
45	Transistor Replacement Kit	1103-0491	S29276-125	
46	Sensor Module	1106-0838	S29276-128	
47	3 Conductor Power Supply Cord	929000-001	S29276-129	
48	Collar, Insulating	1110-0406	S29276-131	
49	Sensor Rebuild Kit	See Kit BOM’s	S29080	
50	CS40 3 in Strk Rebuild Kit	See Kit BOM’s	S29081	
51	CS40 6 in Strk Rebuild Kit	See Kit BOM’s	S29082	
52	CS250 5 in Strk Rebuild Kit	See Kit BOM’s	S29083	

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# Indicates a change this printing.

	DESCRIPTION	ARC PRODUCTS NO.	LECO NO.	QTY
53	CS250 10 in Strk Rebuild Kit	See Kit BOM's	S29084	
54	CS450 5 in Strk Rebuild Kit	See Kit BOM's	S29085	
55	CS450 10 in Strk Rebuild Kit	See Kit BOM's	S29086	
56	Probe Bracket Assembly Rebuild Kit	See Kit BOM's	S29087	
	REBUILD KIT BOM's:			
	Sensor Rebuild Kit, Includes:		S29080	
	Lower Rod	1110-1054		1
	Support, Lever Arm	1110-1208		1
	Arm Lever	1110-1216		1
	Arm Lever	1110-1224		1
	Pin Elliptical Adjust	1110-1241		1
	Sphere 1/8 in Chrome Steel G25	2360-0030		1
	Clamp Rod	1110-1101		1
	ST40 3" Rebuild Kit, Includes:		S29081	
	Bar Rail Adj	1110-0121		1
	Assembly SCR Actr ST40	1116-0042		1
	Cover Retainer - ST40	1110-0180		1
	Motor - ST40	1117-0587		1
	Set SCR Half Dog - Mod	1116-0115		2
	Cover Telescoping .50 x 1.0 x 3.0 Strk	2000-0015		2
	Wheel Guide Dual Vee #2	2360-0552		4
	Gear Clamp Split Hub	2040-0544		2
	Bearing Ball	2320-0112		2
	ST40 6" Rebuild Kit, Includes:		S29082	
	Bar Rail Adj	1110-0155		1
	Assembly SCR Actr ST40	1116-0077		1
	Cover Retainer - ST40	1110-0091		1
	Motor - ST40	1117-0587		1
	Set SCR Half Dog - Mod	1116-0115		2
	Cover Telescoping .50 x 1.0 x 3.0 Strk	2000-0058		2
	Wheel Guide Dual Vee #2	2360-0552		4
	Gear Clamp Split Hub	2040-0544		2
	Bearing Ball	2320-0112		2
	ST250 5" Rebuild Kit, Includes:		S29083	
	Bearing Ball, Anlr Cont	2320-0244		2
	Ball Bearing ST250	0600-0123		1
	Seal Oil .375 x 1.125 x .312	2380-0128		1
	ST250 Screw Actuator Assembly	0600-0380		1
	Screw Cover Assembly ST250	0600-0159		2
	Wheel, Guide, Dual Vee	2360-0561		4

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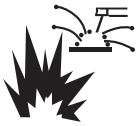
# Indicates a change this printing.

	DESCRIPTION	ARC PRODUCTS NO.	LECO NO.	QTY
	ST250 10” Rebuild Kit, Includes:		S29084	
	Bearing Ball, Anlr Cont	2320-0244		2
	Ball Bearing ST250	0600-0123		1
	Seal Oil .375 x 1.125 x .312	2380-0128		1
	ST250 Screw Actuator Assembly	0600-0374		1
	Screw Cover Assembly ST250	0600-0098		2
	Wheel, Guide, Dual Vee	2360-0561		4
	ST250 10” Rebuild Kit, Includes:		S29085	
	Wheel Guide Dual Vee (4)	2360-0579		6
	ST250 Screw Actuator Assembly	0600-0380		1
	Bearing Ball, Anlr Cont	2320-0244		2
	Ball Bearing ST250	0600-0123		1
	Screw Cover Assembly ST250	0600-0159		2
	ST250 10” Rebuild Kit, Includes:		S29085	
	Wheel Guide Dual Vee (4)	2360-0579		6
	ST250 Screw Actuator Assembly	0600-0380		1
	Bearing Ball, Anlr Cont	2320-0244		2
	Ball Bearing ST250	0600-0123		1
	Screw Cover Assembly ST250	0600-0159		2
	ST450 10” Rebuild Kit, Includes:		S29086	
	Wheel Guide Dual Vee (4)	2360-0579		6
	ST250 Screw Actuator Assembly	0600-0374		1
	Bearing Ball, Anlr Cont	2320-0244		2
	Ball Bearing ST250	0600-0123		1
	Screw Cover Assembly ST250	0600-0098		2
	Probe Bracket Assembly Rebuild Kit, Includes:		S29087	
	Nut Drive - Lower Axis	1110-3898		1
	Nut Drive - Upper Axis	1110-3901		1
	GIB Slide - 1-1/2 in Str	1112-0156		2

			
WARNING	● Do not touch electrically live parts or electrode with skin or wet clothing. ● Insulate yourself from work and ground.	● Keep flammable materials away.	● Wear eye, ear and body protection.
Spanish **AVISO DE PRECAUCION**	● No toque las partes o los electrodos bajo carga con la piel o ropa mojada. ● Aislese del trabajo y de la tierra.	● Mantenga el material combustible fuera del área de trabajo.	● Protéjase los ojos, los oídos y el cuerpo.
French **ATTENTION**	● Ne laissez ni la peau ni des vêtements mouillés entrer en contact avec des pièces sous tension. ● Isolez-vous du travail et de la terre.	● Gardez à l'écart de tout matériel inflammable.	● Protégez vos yeux, vos oreilles et votre corps.
German **WARNUNG**	● Berühren Sie keine stromführenden Teile oder Elektroden mit Ihrem Körper oder feuchter Kleidung! ● Isolieren Sie sich von den Elektroden und dem Erdboden!	● Entfernen Sie brennbarres Material!	● Tragen Sie Augen-, Ohren- und Körperschutz!
Portuguese **ATENÇÃO**	● Não toque partes elétricas e electrodos com a pele ou roupa molhada. ● Isole-se da peça e terra.	● Mantenha inflamáveis bem guardados.	● Use proteção para a vista, ouvido e corpo.
Japanese **注意事項**	● 通電中の電気部品、又は溶材にヒフやぬれた布で触れないこと。 ● 施工物やアースから身体が絶縁されている様にして下さい。	● 燃えやすいものの側での溶接作業は絶対にしてはなりません。	● 目、耳及び身体に保護具をして下さい。
Chinese **警 告**	● 皮肤或濕衣物切勿接觸帶電部件及銲條。 ● 使你自己與地面和工件絕緣。	● 把一切易燃物品移離工作場所。	● 佩戴眼、耳及身體勞動保護用具。
Korean **위 험**	● 전도체나 용접봉을 젖은 헝겁 또는 피부로 절대 접촉치 마십시요. ● 모재와 접지를 접촉치 마십시요.	● 인화성 물질을 접근 시키지 마시요.	● 눈, 귀와 몸에 보호장구를 착용하십시요.
Arabic **تحذير**	● لا تلمس الاجزاء التي يسري فيها التيار الكهربائي أو الالكترود بجلد الجسم أو بالملابس المبللة بالماء. ● ضع عازلا على جسمك خلال العمل.	● ضع المواد القابلة للاشتعال في مكان بعيد.	● ضع أدوات وملابس واقية على عينيك وأذنيك وجسمك.

READ AND UNDERSTAND THE MANUFACTURER'S INSTRUCTION FOR THIS EQUIPMENT AND THE CONSUMABLES TO BE USED AND FOLLOW YOUR EMPLOYER'S SAFETY PRACTICES.

SE RECOMIENDA LEER Y ENTENDER LAS INSTRUCCIONES DEL FABRICANTE PARA EL USO DE ESTE EQUIPO Y LOS CONSUMIBLES QUE VA A UTILIZAR, SIGA LAS MEDIDAS DE SEGURIDAD DE SU SUPERVISOR.

LISEZ ET COMPRENEZ LES INSTRUCTIONS DU FABRICANT EN CE QUI REGARDE CET EQUIPMENT ET LES PRODUITS A ETRE EMPLOYES ET SUIVEZ LES PROCEDURES DE SECURITE DE VOTRE EMPLOYEUR.

LESEN SIE UND BEFOLGEN SIE DIE BETRIEBSANLEITUNG DER ANLAGE UND DEN ELEKTRODENEINSATZ DES HERSTELLERS. DIE UNFALLVERHÜTUNGSVORSCHRIFTEN DES ARBEITGEBERS SIND EBENFALLS ZU BEACHTEN.

			
● Keep your head out of fumes. ● Use ventilation or exhaust to remove fumes from breathing zone.	● Turn power off before servicing.	● Do not operate with panel open or guards off.	**WARNING**
● Los humos fuera de la zona de respiración. ● Mantenga la cabeza fuera de los humos. Utilice ventilación o aspiración para gases.	● Desconectar el cable de alimentación de poder de la máquina antes de iniciar cualquier servicio.	● No operar con panel abierto o guardas quitadas.	Spanish **AVISO DE PRECAUCION**
● Gardez la tête à l'écart des fumées. ● Utilisez un ventilateur ou un aspirateur pour ôter les fumées des zones de travail.	● Débranchez le courant avant l'entretien.	● N'opérez pas avec les panneaux ouverts ou avec les dispositifs de protection enlevés.	French **ATTENTION**
● Vermeiden Sie das Einatmen von Schweibrauch! ● Sorgen Sie für gute Be- und Entlüftung des Arbeitsplatzes!	● Strom vor Wartungsarbeiten abschalten! (Netzstrom völlig öffnen; Maschine anhalten!)	● Anlage nie ohne Schutzgehäuse oder Innenschutzverkleidung in Betrieb setzen!	German **WARNUNG**
● Mantenha seu rosto da fumaça. ● Use ventilação e exhaustão para remover fumo da zona respiratória.	● Não opere com as tampas removidas. ● Desligue a corrente antes de fazer serviço. ● Não toque as partes elétricas nuas.	● Mantenha-se afastado das partes moventes. ● Não opere com os paineis abertos ou guardas removidas.	Portuguese **ATENÇÃO**
● ヒュームから頭を離すようにして下さい。 ● 換気や排煙に十分留意して下さい。	● メンテナンス・サービスに取りかかる際には、まず電源スイッチを必ず切って下さい。	● パネルやカバーを取り外したままで機械操作をしないで下さい。	Japanese **注意事項**
●頭部遠離煙霧。 ●在呼吸區使用通風或排風器除煙。	●維修前切斷電源。	●儀表板打開或沒有安全罩時不準作業。	Chinese **警 告**
● 얼굴로부터 용접가스를 멀리하십시요. ● 호흡지역으로부터 용접가스를 제거하기 위해 가스제거기나 통풍기를 사용하십시요.	● 보수전에 전원을 차단하십시요.	● 판넬이 열린 상태로 작동치 마십시요.	Korean **위 험**
● ابعد رأسك بعيداً عن الدخان. ● استعمل التهوية أو جهاز ضغط الدخان للخارج لكي تبعد الدخان عن المنطقة التي تتنفس فيها.	● اقطع التيار الكهربائي قبل القيام بأية صيانة.	● لا تشغل هذا الجهاز اذا كانت الاغطية الحديدية الواقية ليست عليه.	Arabic **تحذير**

LEIA E COMPREENDA AS INSTRUÇÕES DO FABRICANTE PARA ESTE EQUIPAMENTO E AS PARTES DE USO, E SIGA AS PRÁTICAS DE SEGURANÇA DO EMPREGADOR.

使う機械や溶材のメーカーの指示書をよく読み、まず理解して下さい。そして貴社の安全規定に従って下さい。

請詳細閱讀並理解製造廠提供的說明以及應該使用的銀焊材料，並請遵守貴方的有関勞動保護規定。

이 제품에 동봉된 작업지침서를 숙지하시고 귀사의 작업자 안전수칙을 준수하시기 바랍니다.

اقرأ بتمعن وافهم تعليمات المصنع المنتج لهذه المعدات والمواد قبل استعمالها واتبع تعليمات الوقاية لصاحب العمل.

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