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August 1997

Processes



TIG (GTAW) Welding

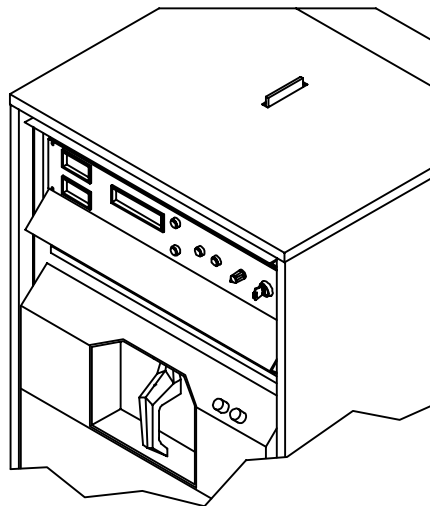


Stick (SMAW) Welding

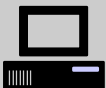
Description

Programmable Precision Controller For
Welding Power Source

Intellitig™ MPC



OWNER'S MANUAL



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www.MillerWelds.com

From Miller to You

Thank you and congratulations on choosing Miller. Now you can get the job done and get it done right. We know you don't have time to do it any other way.

That's why when Niels Miller first started building arc welders in 1929, he made sure his products offered long-lasting value and superior quality. Like you, his customers couldn't afford anything less. Miller products had to be more than the best they could be. They had to be the best you could buy.



Today, the people that build and sell Miller products continue the tradition. They're just as committed to providing equipment and service that meets the high standards of quality and value established in 1929.

This Owner's Manual is designed to help you get the most out of your Miller products. Please take time to read the Safety precautions. They will help you protect yourself against potential hazards on the worksite. We've



Miller is the first welding equipment manufacturer in the U.S.A. to be registered to the ISO 9001 Quality System Standard.

made installation and operation quick and easy. With Miller you can count on years of reliable service with proper maintenance. And if for some reason the unit needs repair, there's a Troubleshooting section that will help you figure out what the problem is. The parts list will then help you to decide which exact part you may need to fix the problem. Warranty and service information for your particular model are also provided.

Miller Electric manufactures a full line of welders and welding related equipment. For information on other quality Miller products, contact your local Miller distributor to receive the latest full line catalog or individual catalog sheets. **To locate your nearest distributor or service agency call 1-800-4-A-Miller, or visit us at www.MillerWelds.com on the web.**



Working as hard as you do – every power source from Miller is backed by the most hassle-free warranty in the business.

Miller offers a Technical Manual which provides more detailed service and parts information for your unit. To obtain a Technical Manual, contact your local distributor. Your distributor can also supply you with Welding Process Manuals such as SMAW, GTAW, GMAW, and GMAW-P.



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The following terms are used interchangeably throughout this manual:
TIG = GTAW
Stick = SMAW

SECTION 1 – SAFETY PRECAUTIONS - READ BEFORE USING

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1-1. Symbol Usage



Means Warning! Watch Out! There are possible hazards with this procedure! The possible hazards are shown in the adjoining symbols.

▲ Marks a special safety message.

☞ Means "Note"; not safety related.



This group of symbols means Warning! Watch Out! possible ELECTRIC SHOCK, MOVING PARTS, and HOT PARTS hazards. Consult symbols and related instructions below for necessary actions to avoid the hazards.

1-2. Arc Welding Hazards

▲ The symbols shown below are used throughout this manual to call attention to and identify possible hazards. When you see the symbol, watch out, and follow the related instructions to avoid the hazard. The safety information given below is only a summary of the more complete safety information found in the Safety Standards listed in Section 1-4. Read and follow all Safety Standards.

▲ Only qualified persons should install, operate, maintain, and repair this unit.

▲ During operation, keep everybody, especially children, away.



ELECTRIC SHOCK can kill.

Touching live electrical parts can cause fatal shocks or severe burns. The electrode and work circuit is electrically live whenever the output is on. The input power circuit and machine internal circuits are also

live when power is on. In semiautomatic or automatic wire welding, the wire, wire reel, drive roll housing, and all metal parts touching the welding wire are electrically live. Incorrectly installed or improperly grounded equipment is a hazard.

- Do not touch live electrical parts.
- Wear dry, hole-free insulating gloves and body protection.
- Insulate yourself from work and ground using dry insulating mats or covers big enough to prevent any physical contact with the work or ground.
- Do not use AC output in damp areas, if movement is confined, or if there is a danger of falling.
- Use AC output ONLY if required for the welding process.
- If AC output is required, use remote output control if present on unit.
- Disconnect input power or stop engine before installing or servicing this equipment. Lockout/tagout input power according to OSHA 29 CFR 1910.147 (see Safety Standards).
- Properly install and ground this equipment according to its Owner's Manual and national, state, and local codes.
- Always verify the supply ground – check and be sure that input power cord ground wire is properly connected to ground terminal in disconnect box or that cord plug is connected to a properly grounded receptacle outlet.
- When making input connections, attach proper grounding conductor first – double-check connections.
- Frequently inspect input power cord for damage or bare wiring – replace cord immediately if damaged – bare wiring can kill.
- Turn off all equipment when not in use.
- Do not use worn, damaged, undersized, or poorly spliced cables.
- Do not drape cables over your body.

- If earth grounding of the workpiece is required, ground it directly with a separate cable – do not use work clamp or work cable.
- Do not touch electrode if you are in contact with the work, ground, or another electrode from a different machine.
- Use only well-maintained equipment. Repair or replace damaged parts at once. Maintain unit according to manual.
- Wear a safety harness if working above floor level.
- Keep all panels and covers securely in place.
- Clamp work cable with good metal-to-metal contact to workpiece or worktable as near the weld as practical.
- Insulate work clamp when not connected to workpiece to prevent contact with any metal object.
- Do not connect more than one electrode or work cable to any single weld output terminal.

SIGNIFICANT DC VOLTAGE exists after removal of input power on inverters.

- Turn Off inverter, disconnect input power, and discharge input capacitors according to instructions in Maintenance Section before touching any parts.



FUMES AND GASES can be hazardous.

Welding produces fumes and gases. Breathing these fumes and gases can be hazardous to your health.

- Keep your head out of the fumes. Do not breathe the fumes.
- If inside, ventilate the area and/or use exhaust at the arc to remove welding fumes and gases.
- If ventilation is poor, use an approved air-supplied respirator.
- Read the Material Safety Data Sheets (MSDSs) and the manufacturer's instructions for metals, consumables, coatings, cleaners, and degreasers.
- Work in a confined space only if it is well ventilated, or while wearing an air-supplied respirator. Always have a trained watch-person nearby. Welding fumes and gases can displace air and lower the oxygen level causing injury or death. Be sure the breathing air is safe.
- Do not weld in locations near degreasing, cleaning, or spraying operations. The heat and rays of the arc can react with vapors to form highly toxic and irritating gases.
- Do not weld on coated metals, such as galvanized, lead, or cadmium plated steel, unless the coating is removed from the weld area, the area is well ventilated, and if necessary, while wearing an air-supplied respirator. The coatings and any metals containing these elements can give off toxic fumes if welded.



ARC RAYS can burn eyes and skin.

Arc rays from the welding process produce intense visible and invisible (ultraviolet and infrared) rays that can burn eyes and skin. Sparks fly off from the weld.

- Wear a welding helmet fitted with a proper shade of filter to protect your face and eyes when welding or watching (see ANSI Z49.1 and Z87.1 listed in Safety Standards).
- Wear approved safety glasses with side shields under your helmet.
- Use protective screens or barriers to protect others from flash and glare; warn others not to watch the arc.
- Wear protective clothing made from durable, flame-resistant material (leather and wool) and foot protection.



WELDING can cause fire or explosion.

Welding on closed containers, such as tanks, drums, or pipes, can cause them to blow up. Sparks can fly off from the welding arc. The flying sparks, hot workpiece, and hot equipment can cause fires and burns. Accidental contact of electrode to metal objects can cause sparks, explosion, overheating, or fire. Check and be sure the area is safe before doing any welding.

- Protect yourself and others from flying sparks and hot metal.
- Do not weld where flying sparks can strike flammable material.
- Remove all flammables within 35 ft (10.7 m) of the welding arc. If this is not possible, tightly cover them with approved covers.
- Be alert that welding sparks and hot materials from welding can easily go through small cracks and openings to adjacent areas.
- Watch for fire, and keep a fire extinguisher nearby.
- Be aware that welding on a ceiling, floor, bulkhead, or partition can cause fire on the hidden side.
- Do not weld on closed containers such as tanks, drums, or pipes, unless they are properly prepared according to AWS F4.1 (see Safety Standards).
- Connect work cable to the work as close to the welding area as practical to prevent welding current from traveling long, possibly unknown paths and causing electric shock and fire hazards.
- Do not use welder to thaw frozen pipes.
- Remove stick electrode from holder or cut off welding wire at contact tip when not in use.
- Wear oil-free protective garments such as leather gloves, heavy shirt, cuffless trousers, high shoes, and a cap.
- Remove any combustibles, such as a butane lighter or matches, from your person before doing any welding.



FLYING METAL can injure eyes.

- Welding, chipping, wire brushing, and grinding cause sparks and flying metal. As welds cool, they can throw off slag.
- Wear approved safety glasses with side shields even under your welding helmet.



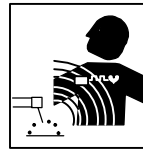
BUILDUP OF GAS can injure or kill.

- Shut off shielding gas supply when not in use.
- Always ventilate confined spaces or use approved air-supplied respirator.



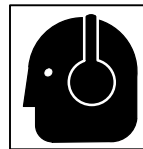
HOT PARTS can cause severe burns.

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



MAGNETIC FIELDS can affect pacemakers.

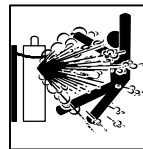
- Pacemaker wearers keep away.
- Wearers should consult their doctor before going near arc welding, gouging, or spot welding operations.



NOISE can damage hearing.

Noise from some processes or equipment can damage hearing.

- Wear approved ear protection if noise level is high.



CYLINDERS can explode if damaged.

Shielding gas cylinders contain gas under high pressure. If damaged, a cylinder can explode. Since gas cylinders are normally part of the welding process, be sure to treat them carefully.

- Protect compressed gas cylinders from excessive heat, mechanical shocks, slag, open flames, sparks, and arcs.
- Install cylinders in an upright position by securing to a stationary support or cylinder rack to prevent falling or tipping.
- Keep cylinders away from any welding or other electrical circuits.
- Never drape a welding torch over a gas cylinder.
- Never allow a welding electrode to touch any cylinder.
- Never weld on a pressurized cylinder – explosion will result.
- Use only correct shielding gas cylinders, regulators, hoses, and fittings designed for the specific application; maintain them and associated parts in good condition.
- Turn face away from valve outlet when opening cylinder valve.
- Keep protective cap in place over valve except when cylinder is in use or connected for use.
- Read and follow instructions on compressed gas cylinders, associated equipment, and CGA publication P-1 listed in Safety Standards.

1-3. Additional Symbols For Installation, Operation, And Maintenance



FIRE OR EXPLOSION hazard.

- Do not install or place unit on, over, or near combustible surfaces.
- Do not install unit near flammables.
- Do not overload building wiring – be sure power supply system is properly sized, rated, and protected to handle this unit.



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.



FALLING UNIT can cause injury.

- Use lifting eye to lift unit only, NOT running gear, gas cylinders, or any other accessories.
- Use equipment of adequate capacity to lift and support unit.
- If using lift forks to move unit, be sure forks are long enough to extend beyond opposite side of unit.



OVERUSE can cause OVERHEATING

- Allow cooling period; follow rated duty cycle.
- Reduce current or reduce duty cycle before starting to weld again.
- Do not block or filter airflow to unit.



STATIC (ESD) can damage PC boards.

- Put on grounded wrist strap BEFORE handling boards or parts.
- Use proper static-proof bags and boxes to store, move, or ship PC boards.



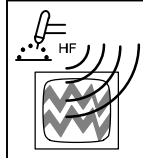
MOVING PARTS can cause injury.

- Keep away from moving parts.
- Keep away from pinch points such as drive rolls.



WELDING WIRE can cause injury.

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



H.F. RADIATION can cause interference.

- High-frequency (H.F.) can interfere with radio navigation, safety services, computers, and communications equipment.
- Have only qualified persons familiar with electronic equipment perform this installation.
- The user is responsible for having a qualified electrician promptly correct any interference problem resulting from the installation.
- If notified by the FCC about interference, stop using the equipment at once.
- Have the installation regularly checked and maintained.
- Keep high-frequency source doors and panels tightly shut, keep spark gaps at correct setting, and use grounding and shielding to minimize the possibility of interference.



ARC WELDING can cause interference.

- Electromagnetic energy can interfere with sensitive electronic equipment such as computers and computer-driven equipment such as robots.
- Be sure all equipment in the welding area is electromagnetically compatible.
- To reduce possible interference, keep weld cables as short as possible, close together, and down low, such as on the floor.
- Locate welding operation 100 meters from any sensitive electronic equipment.
- Be sure this welding machine is installed and grounded according to this manual.
- If interference still occurs, the user must take extra measures such as moving the welding machine, using shielded cables, using line filters, or shielding the work area.

1-4. Principal Safety Standards

Safety in Welding and Cutting, ANSI Standard Z49.1, from American Welding Society, 550 N.W. LeJeune Rd, Miami FL 33126

Safety and Health Standards, OSHA 29 CFR 1910, from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Recommended Safe Practices for the Preparation for Welding and Cutting of Containers That Have Held Hazardous Substances, American Welding Society Standard AWS F4.1, from American Welding Society, 550 N.W. LeJeune Rd, Miami, FL 33126

National Electrical Code, NFPA Standard 70, from National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

Safe Handling of Compressed Gases in Cylinders, CGA Pamphlet P-1, from Compressed Gas Association, 1235 Jefferson Davis Highway, Suite 501, Arlington, VA 22202.

Code for Safety in Welding and Cutting, CSA Standard W117.2, from Canadian Standards Association, Standards Sales, 178 Rexdale Boulevard, Rexdale, Ontario, Canada M9W 1R3.

Safe Practices For Occupation And Educational Eye And Face Protection, ANSI Standard Z87.1, from American National Standards Institute, 1430 Broadway, New York, NY 10018.

Cutting And Welding Processes, NFPA Standard 51B, from National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

1-5. EMF Information

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

Welding current, as it flows through welding cables, will cause electromagnetic fields. There has been and still is some concern about such fields. However, after examining more than 500 studies spanning 17 years of research, a special blue ribbon committee of the National Research Council concluded that: "The body of evidence, in the committee's judgment, has not demonstrated that exposure to power-frequency electric and magnetic fields is a human-health hazard." However, studies are still going forth and evidence continues to be examined. Until the final conclusions of the research are reached, you may wish to minimize your exposure to electromagnetic fields when welding or cutting.

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

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

About Pacemakers:

Pacemaker wearers consult your doctor first. If cleared by your doctor, then following the above procedures is recommended.

SECTION 1 – CONSIGNES DE SECURITE – LIRE AVANT UTILISATION

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1-1. Signification des symboles



Signifie Mise en garde ! Soyez vigilant ! Cette procédure présente des risques de danger ! Ceux-ci sont identifiés par des symboles adjacents aux directives.

▲ Identifie un message de sécurité particulier.

☞ Signifie NOTA ; n'est pas relatif à la sécurité.



Ce groupe de symboles signifie Mise en garde ! Soyez vigilant ! Il y a des risques de danger reliés aux CHOCS ÉLECTRIQUES, aux PIÈCES EN MOUVEMENT et aux PIÈCES CHAUDES. Reportez-vous aux symboles et aux directives ci-dessous afin de connaître les mesures à prendre pour éviter tout danger.

1-2. Dangers relatifs au soudage à l'arc

▲ Les symboles présentés ci-après sont utilisés tout au long du présent manuel pour attirer votre attention et identifier les risques de danger. Lorsque vous voyez un symbole, soyez vigilant et suivez les directives mentionnées afin d'éviter tout danger. Les consignes de sécurité présentées ci-après ne font que résumer l'information contenue dans les normes de sécurité énumérées à la section 1-4. Veuillez lire et respecter toutes ces normes de sécurité.

▲ L'installation, l'utilisation, l'entretien et les réparations ne doivent être confiés qu'à des personnes qualifiées.

▲ Au cours de l'utilisation, tenir toute personne à l'écart et plus particulièrement les enfants.



UN CHOC ÉLECTRIQUE peut tuer.

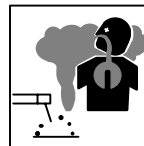
Un simple contact avec des pièces électriques peut provoquer une électrocution ou des blessures graves. L'électrode et le circuit de soudage sont sous tension dès que l'appareil est sur ON. Le circuit d'entrée et les circuits internes de l'appareil sont également sous tension à ce moment-là. En soudage semi-automatique ou automatique, le fil, le dévidoir, le logement des galets d'entraînement et les pièces métalliques en contact avec le fil de soudage sont sous tension. Des matériels mal installés ou mal mis à la terre présentent un danger.

- Ne jamais toucher les pièces électriques sous tension.
- Porter des gants et des vêtements de protection secs ne comportant pas de trous.
- S'isoler de la pièce et de la terre au moyen de tapis ou d'autres moyens isolants suffisamment grands pour empêcher le contact physique éventuel avec la pièce ou la terre.
- Ne pas se servir de source électrique à courant électrique dans les zones humides, dans les endroits confinés ou là où on risque de tomber.
- Se servir d'une source électrique à courant électrique UNIQUEMENT si le procédé de soudage le demande.
- Si l'utilisation d'une source électrique à courant électrique s'avère nécessaire, se servir de la fonction de télécommande si l'appareil en est équipé.
- Couper l'alimentation ou arrêter le moteur avant de procéder à l'installation, à la réparation ou à l'entretien de l'appareil. Déverrouiller l'alimentation selon la norme OSHA 29 CFR 1910.147 (voir normes de sécurité).
- Installer et mettre à la terre correctement cet appareil conformément à son manuel d'utilisation et aux codes nationaux, provinciaux et municipaux.
- Toujours vérifier la terre du cordon d'alimentation – Vérifier et s'assurer que le fil de terre du cordon d'alimentation est bien raccordé à la borne de terre du sectionneur ou que la fiche du cordon est raccordée à une prise correctement mise à la terre.
- En effectuant les raccordements d'entrée fixer d'abord le conducteur de mise à la terre approprié et contre-vérifier les connexions.
- Vérifier fréquemment le cordon d'alimentation pour voir s'il n'est pas endommagé ou dénudé – remplacer le cordon immédiatement s'il est endommagé – un câble dénudé peut provoquer une électrocution.
- Mettre l'appareil hors tension quand on ne l'utilise pas.
- Ne pas utiliser des câbles usés, endommagés, de grosseur insuffisante ou mal épissés.
- Ne pas enrouler les câbles autour du corps.
- Si la pièce soudée doit être mise à la terre, le faire directement avec un câble distinct – ne pas utiliser le connecteur de pièce ou le câble de retour.

- Ne pas toucher l'électrode quand on est en contact avec la pièce, la terre ou une électrode provenant d'une autre machine.
- N'utiliser qu'un matériel en bon état. Réparer ou remplacer sur-le-champ les pièces endommagées. Entretien l'appareil conformément à ce manuel.
- Porter un harnais de sécurité quand on travaille en hauteur.
- Maintenir solidement en place tous les panneaux et capots.
- Fixer le câble de retour de façon à obtenir un bon contact métal-métal avec la pièce à souder ou la table de travail, le plus près possible de la soudure.
- Isoler la pince de masse quand pas mis à la pièce pour éviter le contact avec tout objet métallique.

Il y a DU COURANT CONTINU IMPORTANT dans les convertisseurs après la suppression de l'alimentation électrique.

- Arrêter les convertisseurs, débrancher le courant électrique, et décharger les condensateurs d'alimentation selon les instructions indiquées dans la partie entretien avant de toucher les pièces.



LES FUMÉES ET LES GAZ peuvent être dangereux.

Le soudage génère des fumées et des gaz. Leur inhalation peut être dangereux pour votre santé.

- Eloigner votre tête des fumées. Ne pas respirer les fumées.
- A l'intérieur, ventiler la zone et/ou utiliser un échappement au niveau de l'arc pour l'évacuation des fumées et des gaz de soudage.
- Si la ventilation est insuffisante, utiliser un respirateur à alimentation d'air homologué.
- Lire les spécifications de sécurité des matériaux (MSDSs) et les instructions du fabricant concernant les métaux, les consommables, les revêtements, les nettoyants et les dégraissateurs.
- Travailler dans un espace fermé seulement s'il est bien ventilé ou en portant un respirateur à alimentation d'air. Demander toujours à un surveillant dûment formé de se tenir à proximité. Des fumées et des gaz de soudage peuvent déplacer l'air et abaisser le niveau d'oxygène provoquant des blessures ou des accidents mortels. S'assurer que l'air de respiration ne présente aucun danger.
- Ne pas souder dans des endroits situés à proximité d'opérations de dégraissage, de nettoyage ou de pulvérisation. La chaleur et les rayons de l'arc peuvent réagir en présence de vapeurs et former des gaz hautement toxiques et irritants.
- Ne pas souder des métaux munis d'un revêtement, tels que l'acier galvanisé, plaqué en plomb ou au cadmium à moins que le revêtement n'ait été enlevé dans la zone de soudure, que l'endroit soit bien ventilé, et si nécessaire, en portant un respirateur à alimentation d'air. Les revêtements et tous les métaux renfermant ces éléments peuvent dégager des fumées toxiques en cas de soudage.



LES RAYONS DE L'ARC peuvent provoquer des brûlures dans les yeux et sur la peau.

Le rayonnement de l'arc du procédé de soudage génère des rayons visibles et invisibles intenses (ultraviolets et infrarouges) susceptibles de provoquer des brûlures dans les yeux et sur la peau. Des étincelles sont projetées pendant le soudage.

- Porter un casque de soudage muni d'un écran de filtre approprié pour protéger votre visage et vos yeux pendant le soudage ou pour regarder (voir ANSI Z49.1 et Z87.1 énuméré dans les normes de sécurité).
- Porter des protections approuvés pour les oreilles si le niveau sonore est trop élevé.
- Utiliser des écrans ou des barrières pour protéger des tiers de l'éclair et de l'éblouissement; demander aux autres personnes de ne pas regarder l'arc.
- Porter des vêtements de protection constitué dans une matière durable, résistant au feu (cuir ou laine) et une protection des pieds.



LE SOUDAGE peut provoquer un incendie ou une explosion.

Le soudage effectué sur des conteneurs fermés tels que des réservoirs, tambours ou des conduites peut provoquer leur éclatement. Des étincelles peuvent être projetées de l'arc de soudure. La projection d'étincelles, des pièces chaudes et des équipements chauds peut provoquer des incendies et des brûlures. Le contact accidentel de l'électrode avec des objets métalliques peut provoquer des étincelles, une explosion, un surchauffement ou un incendie. Avant de commencer le soudage, vérifier et s'assurer que l'endroit ne présente pas de danger.

- Se protéger et d'autres personnes de la projection d'étincelles et de métal chaud.
- Ne pas souder dans un endroit là où des étincelles peuvent tomber sur des substances inflammables.
- Déplacer toutes les substances inflammables à une distance de 10,7 m de l'arc de soudage. En cas d'impossibilité les recouvrir soigneusement avec des protections homologués.
- Des étincelles et des matériaux chauds du soudage peuvent facilement passer dans d'autres zones en traversant de petites fissures et des ouvertures.
- Surveiller tout déclenchement d'incendie et tenir un extincteur à proximité.
- Le soudage effectué sur un plafond, plancher, paroi ou séparation peut déclencher un incendie de l'autre côté.
- Ne pas effectuer le soudage sur des conteneurs fermés tels que des réservoirs, tambours, ou conduites, à moins qu'ils n'aient été préparés correctement conformément à AWS F4.1 (voir les normes de sécurité).
- Brancher le câble sur la pièce le plus près possible de la zone de soudage pour éviter le transport du courant sur une longue distance par des chemins inconnus éventuels en provoquant des risques d'électrocution et d'incendie.
- Ne pas utiliser le poste de soudage pour dégeler des conduites gelées.
- En cas de non utilisation, enlever la bague d'électrode du porte-électrode ou couper le fil à la pointe de contact.
- Porter des vêtements de protection dépourvus d'huile tels que des gants en cuir, une chemise en matériau lourd, des pantalons sans revers, des chaussures hautes et un couvre chef.
- Avant de souder, retirer toute substance combustible de vos poches telles qu'un allumeur au butane ou des allumettes.



DES PARTICULES VOLANTES peuvent blesser les yeux.

- Le soudage, l'écaillage, le passage de la pièce à la brosse en fil de fer, et le meulage génèrent des étincelles et des particules métalliques volantes. Pendant la période de refroidissement des soudures, elles risquent de projeter du laitier.
- Porter des lunettes de sécurité avec écrans latéraux ou un écran facial.



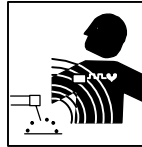
LES ACCUMULATIONS DE GAZ risquent de provoquer des blessures ou même la mort.

- Fermer l'alimentation du gaz protecteur en cas de non utilisation.
- Veiller toujours à bien aérer les espaces confinés ou se servir d'un respirateur d'adduction d'air homologué.



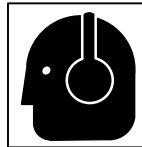
DES PIÈCES CHAUDES peuvent provoquer des brûlures graves.

- Ne pas toucher des parties chaudes à mains nues
- Prévoir une période de refroidissement avant d'utiliser le pistolet ou la torche.



LES CHAMPS MAGNÉTIQUES peuvent affecter les stimulateurs cardiaques.

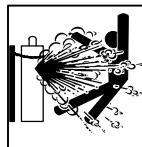
- Porteurs de stimulateur cardiaque, restez à distance.
- Les porteurs d'un stimulateur cardiaque doivent d'abord consulter leur médecin avant de s'approcher des opérations de soudage à l'arc, de gougeage ou de soudage par points.



LE BRUIT peut affecter l'ouïe.

Le bruit des processus et des équipements peut affecter l'ouïe.

- Porter des protections approuvés pour les oreilles si le niveau sonore est trop élevé.



Si des BOUTEILLES sont endommagées, elles pourront exploser.

Des bouteilles de gaz protecteur contiennent du gaz sous haute pression. Si une bouteille est endommagée, elle peut exploser. Du fait que les bouteilles de gaz font normalement partie du procédé de soudage, les manipuler avec précaution.

- Protéger les bouteilles de gaz comprimé d'une chaleur excessive, des chocs mécaniques, du laitier, des flammes ouvertes, des étincelles et des arcs.
- Placer les bouteilles debout en les fixant dans un support stationnaire ou dans un porte-bouteilles pour les empêcher de tomber ou de se renverser.
- Tenir les bouteilles éloignées des circuits de soudage ou autres circuits électriques.
- Ne jamais placer une torche de soudage sur une bouteille à gaz.
- Une électrode de soudage ne doit jamais entrer en contact avec une bouteille.
- Ne jamais souder une bouteille pressurisée – risque d'explosion.
- Utiliser seulement des bouteilles de gaz protecteur, régulateurs, tuyaux et raccords convenables pour cette application spécifique; les maintenir ainsi que les éléments associés en bon état.
- Ne pas tenir la tête en face de la sortie en ouvrant la soupape de la bouteille.
- Maintenir le chapeau de protection sur la soupape, sauf en cas d'utilisation ou de branchement de la bouteille.
- Lire et suivre les instructions concernant les bouteilles de gaz comprimé, les équipements associés et les publications P-1 CGA énumérées dans les normes de sécurité.

1-3. Dangers supplémentaires en relation avec l'installation, le fonctionnement et la maintenance



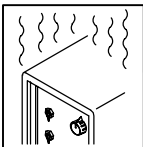
Risque D'INCENDIE OU D'EXPLOSION.

- Ne pas placer l'appareil sur, au-dessus ou à proximité de surfaces inflammables.
- Ne pas installer l'appareil à proximité de produits inflammables
- Ne pas surcharger l'installation électrique – s'assurer que l'alimentation est correctement dimensionnée et protégée avant de mettre l'appareil en service.



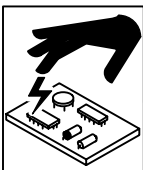
LA CHUTE DE L'APPAREIL peut blesser.

- Utiliser l'anneau de levage uniquement pour soulever l'appareil, NON PAS les chariot, les bouteilles de gaz ou tout autre accessoire.
- Utiliser un engin d'une capacité appropriée pour soulever l'appareil.
- En utilisant des fourches de levage pour déplacer l'unité, s'assurer que les fourches sont suffisamment longues pour dépasser du côté opposé de l'appareil.



L'EMPLOI EXCESSIF peut SURCHAUFFER L'ÉQUIPEMENT.

- Prévoir une période de refroidissement, respecter le cycle opératoire nominal.
- Réduire le courant ou le cycle opératoire avant de recommencer le soudage.
- Ne pas obstruer les passages d'air du poste.



LES CHARGES ÉLECTROSTATIQUES peuvent endommager les circuits imprimés.

- Établir la connexion avec la barrette de terre avant de manipuler des cartes ou des pièces.
- Utiliser des pochettes et des boîtes antistatiques pour stocker, déplacer ou expédier des cartes de circuits imprimés.



DES ORGANES MOBILES peuvent provoquer des blessures.

- Ne pas s'approcher des organes mobiles.
- Ne pas s'approcher des points de coincement tels que des rouleaux de commande.



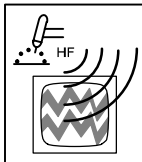
LES FILS DE SOUDAGE peuvent provoquer des blessures.

- Ne pas appuyer sur la gachette avant d'en avoir reçu l'instruction.
- Ne pas diriger le pistolet vers soi, d'autres personnes ou toute pièce mécanique en engageant le fil de soudage.



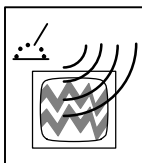
DES ORGANES MOBILES peuvent provoquer des blessures.

- Rester à l'écart des organes mobiles comme le ventilateur.
- Maintenir fermés et fixement en place les portes, panneaux, recouvrements et dispositifs de protection.



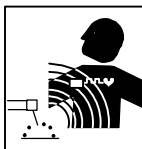
LE RAYONNEMENT HAUTE FRÉQUENCE (H.F.) risque de provoquer des interférences.

- Le rayonnement haute fréquence peut provoquer des interférences avec les équipements de radio-navigation et de communication, les services de sécurité et les ordinateurs.
- Demander seulement à des personnes qualifiées familiarisées avec des équipements électroniques de faire fonctionner l'installation.
- L'utilisateur est tenu de faire corriger rapidement par un électricien qualifié les interférences résultant de l'installation.
- Si le FCC signale des interférences, arrêter immédiatement l'appareil.
- Effectuer régulièrement le contrôle et l'entretien de l'installation.
- Maintenir soigneusement fermés les portes et les panneaux des sources de haute fréquence, maintenir les éclateurs à une distance correcte et utiliser une terre et un blindage pour réduire les interférences éventuelles.



LE SOUDAGE À L'ARC risque de provoquer des interférences.

- L'énergie électromagnétique risque de provoquer des interférences pour l'équipement électronique sensible tel que les ordinateurs et l'équipement commandé par ordinateur tel que les robots.
- Veiller à ce que tout l'équipement de la zone de soudage soit compatible électromagnétiquement.
- Pour réduire la possibilité d'interférence, maintenir les câbles de soudage aussi courts que possible, les grouper, et les poser aussi bas que possible (ex. par terre).
- Veiller à souder à une distance de 100 mètres de tout équipement électronique sensible.
- Veiller à ce que ce poste de soudage soit posé et mis à la terre conformément à ce mode d'emploi.
- En cas d'interférences après avoir pris les mesures précédentes, il incombe à l'utilisateur de prendre des mesures supplémentaires telles que le déplacement du poste, l'utilisation de câbles blindés, l'utilisation de filtres de ligne ou la pose de protecteurs dans la zone de travail.



LES CHAMPS MAGNÉTIQUES peuvent affecter les stimulateurs cardiaques.

- Porteurs de stimulateur cardiaque, restez à distance.
- Les porteurs d'un stimulateur cardiaque doivent d'abord consulter leur médecin avant de s'approcher des opérations de soudage à l'arc, de gougeage ou de soudage par points.

1-4. Principales normes de sécurité

Safety in Welding and Cutting, norme ANSI Z49.1, de l'American Welding Society, 550 N.W. Lejeune Rd, Miami FL 33126

Safety and Health Standards, OSHA 29 CFR 1910, du Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Recommended Safe Practice for the Preparation for Welding and Cutting of Containers That Have Held Hazardous Substances, norme AWS F4.1, de l'American Welding Society, 550 N.W. Lejeune Rd, Miami FL 33126

National Electrical Code, NFPA Standard 70, de la National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

Safe Handling of Compressed Gases in Cylinders, CGA Pamphlet P-1, de la Compressed Gas Association, 1235 Jefferson Davis Highway, Suite 501, Arlington, VA 22202.

Règles de sécurité en soudage, coupage et procédés connexes, norme CSA W117.2, de l'Association canadienne de normalisation, vente de normes, 178 Rexdale Boulevard, Rexdale (Ontario) Canada M9W 1R3.

Safe Practices For Occupation And Educational Eye And Face Protection, norme ANSI Z87.1, de l'American National Standards Institute, 1430 Broadway, New York, NY 10018.

Cutting and Welding Processes, norme NFPA 51B, de la National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

1-5. Information sur les champs électromagnétiques

Données sur le soudage électrique et sur les effets, pour l'organisme, des champs magnétiques basse fréquence

Le courant de soudage, pendant son passage dans les câbles de soudage, causera des champs électromagnétiques. Il y a eu et il y a encore un certain souci à propos de tels champs. Cependant, après avoir examiné plus de 500 études qui ont été faites pendant une période de recherche de 17 ans, un comité spécial ruban bleu du National Research Council a conclu: "L'accumulation de preuves, suivant le jugement du comité, n'a pas démontré que l'exposition aux champs magnétiques et champs électriques à haute fréquence représente un risque à la santé humaine". Toutefois, des études sont toujours en cours et les preuves continuent à être examinées. En attendant que les conclusions finales de la recherche soient établies, il vous serait souhaitable de réduire votre exposition aux champs électromagnétiques pendant le soudage ou le coupage.

Afin de réduire les champs électromagnétiques dans l'environnement de travail, respecter les consignes suivantes :

- 1 Garder les câbles ensemble en les torsadant ou en les attachant avec du ruban adhésif.
- 2 Mettre tous les câbles du côté opposé de l'opérateur.
- 3 Ne pas courber pas et ne pas entourer pas les câbles autour de votre corps.
- 4 Garder le poste de soudage et les câbles le plus loin possible de vous.
- 5 Relier la pince de masse le plus près possible de la zone de soudure.

Consignes relatives aux stimulateurs cardiaques :

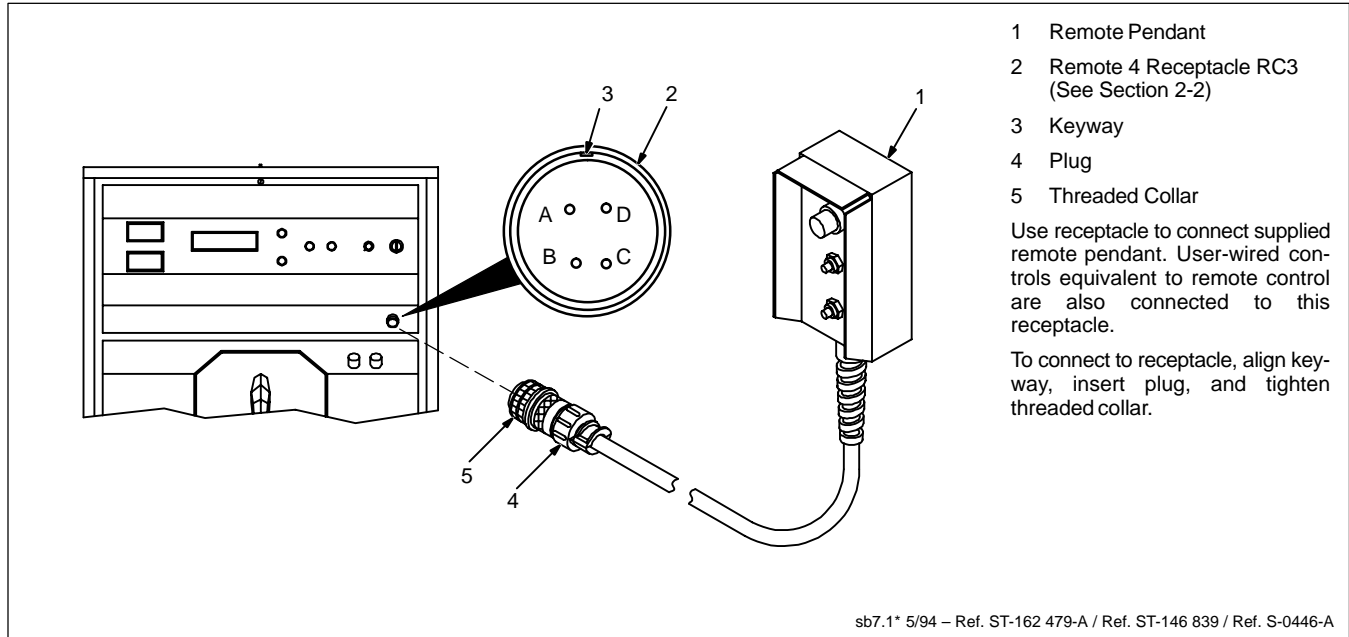
Les personnes qui portent un stimulateur cardiaque doivent avant tout consulter leur docteur. Si vous êtes déclaré apte par votre docteur, il est alors recommandé de respecter les consignes ci-dessus.

SECTION 2 – INSTALLATION

2-1. Connecting Remote Pendant Or Equivalent User-Wired Control

NOTE 



A user-wired equivalent to the remote pendant may be connected to the control unit. However, connections must be made for a Stop push button even if it is not used in unit operation. Since the Stop button is wired in a normally closed configuration, if Stop connections are not made, the control unit interprets that as the Stop button being continually pressed. Refer to Figure 8-1 for a circuit diagram of the remote pendant.

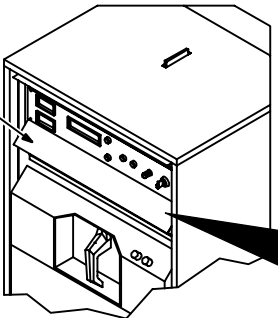


2-2. Remote 4 Socket Information

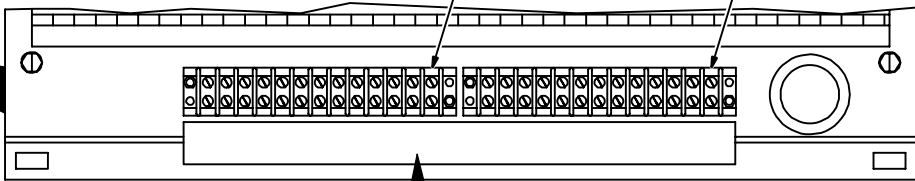
Socket	Socket Information
A	Normally closed contact with socket C, opens when pendant Stop button is pressed.
B	Normally open contact with socket C, closes when pendant Decrease button is pressed.
C	Circuit common.
D	Normally open contact with socket C, closes when pendant Start/Increase button is pressed.

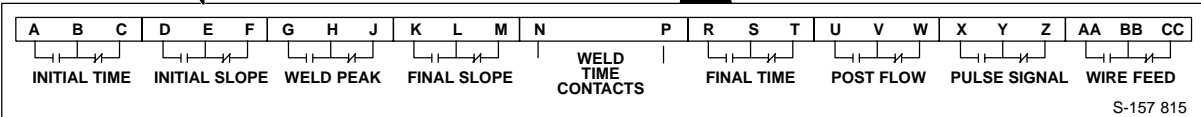
2-3. User Relay Contacts

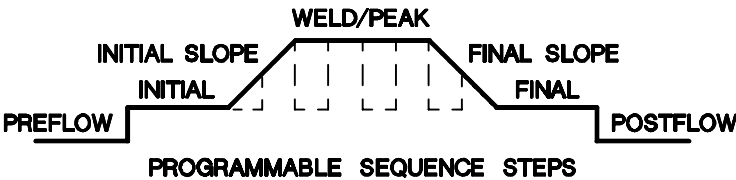


The internal control relay contacts accessible through terminal strips 3T and 4T are rated at 20 amperes, 250 volts.






S-157 815




PROGRAMMABLE SEQUENCE STEPS

Tools Needed:



Or



Ref. ST-162 477-A / ST-162 841 / Ref. SC-159 862

1 Access Door

Access door is hinged at top, and held closed with industrial interlock strips. To open, grasp bottom and pull out firmly.

2 Terminal Strip 3T

3 Terminal Strip 4T

4 Connection Label

Use 3T and 4T to connect external equipment to internal relay contacts. Pairs of normally closed and normally open contacts are provided for each weld sequence step, the

pulse signal, and for a wire feeder.

Each set of weld sequence contacts changes state at the beginning of the matching part of the weld sequence, and resets at the end of postflow. For example, the initial slope contacts change state when initial slope begins, and reset at the end of postflow. The user relay contacts change state regardless of the time value programmed for the matching portion of the weld sequence. If 0.0 seconds was entered as a time value for final slope, the user relay contacts matching final slope and final current would change states at the same time.

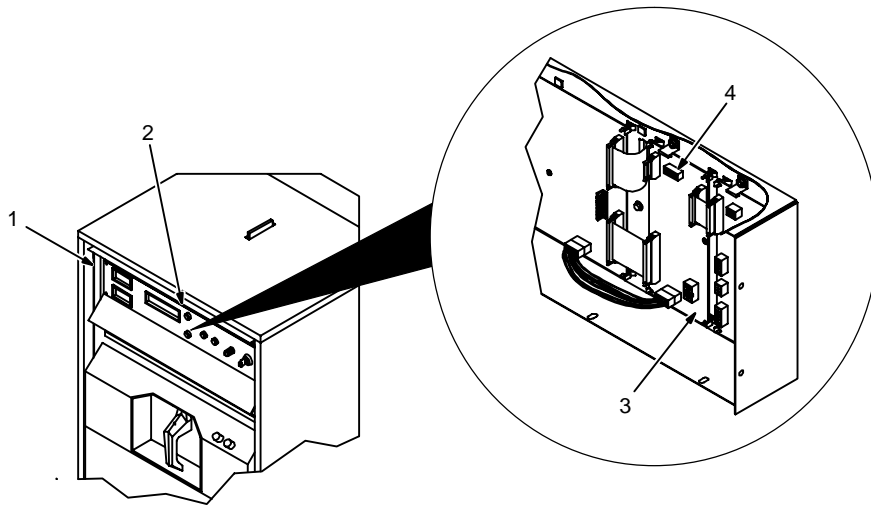
The pulse signal contacts change state as pulsed output goes between peak and background amperage.

The wire feed contacts operation is programmable, and is explained where needed in Section 5.

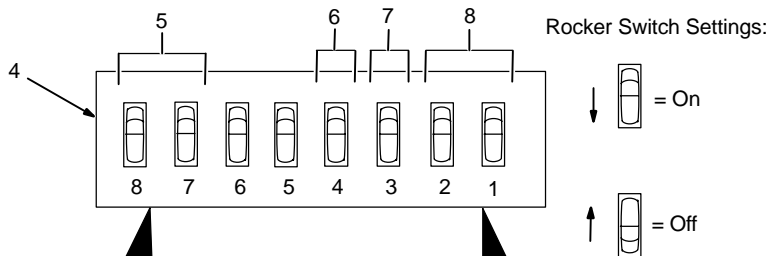
To make connections, route leads through openings in either side of access door, and make connections to terminals according to the connection label.

Close access door.

2-4. Setting DIP Switch SW1



Actual numbers 1 thru 8 below rocker switches are upside down. Positions 5 and 6 are not used.



Set DIP switch SW1 rocker switch positions as follows:

- 1 Control Box Front Panel
- 2 Retaining Screw Location

Loosen retaining screw, and open hinged front panel.

- 3 Microprocessor Board PC5
- 4 DIP Switch SW1

- 5 Positions 7 And 8

Set 7 and 8 according to table to select Semi-Automatic Modes 1 thru 5.

- 6 Position 4

Set Off to run diagnostics program.
Set On to stop diagnostics program, and for all other operations.

- 7 Position 3

Use position 3 to select whether pulses are defined as frequency or time values.

Set Off to define as frequency.

Set On to define as time.

- 8 Positions 1 And 2

In Automatic and Semi-Automatic 1 modes, weld amperage can be adjusted up or down during weld using remote pendant. Define amperage adjustment range limits by setting positions 1 and 2 according to table.

Close front panel and tighten retaining screw after setting SW1.

Position 7	Position 8	Defined Semi-Automatic Mode
On	On	*1
On	Off	2
Off	On	3
Off	Off	4
On	On	*5

*Semi-Automatic 1 mode is defined when remote Stop switch is connected. Semi-Automatic 5 mode is defined when remote Stop switch is not connected.

Position 1	Position 2	Defined Amperage Adjustment Limit
On	On	±5 Amperes
On	Off	±10 Amperes
Off	On	±20 Amperes
Off	Off	±40 Amperes

Tools Needed:

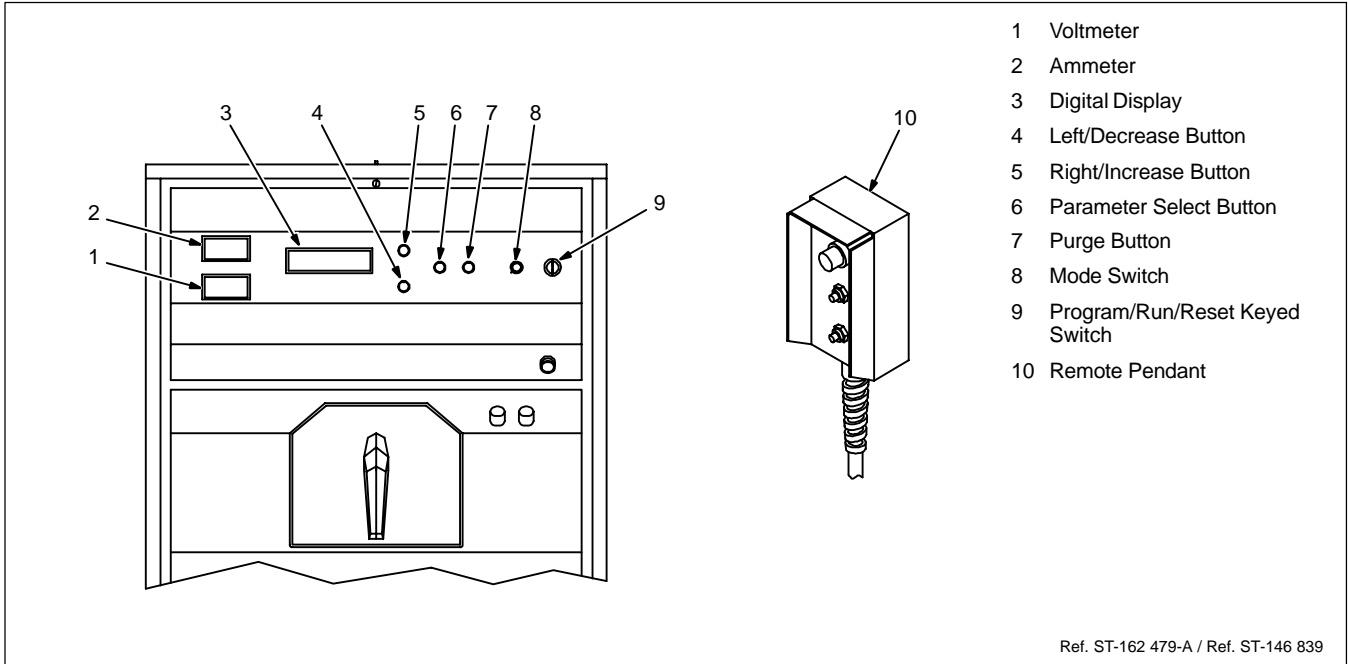


Ref. ST-800 194 / Ref. ST-162 477-A

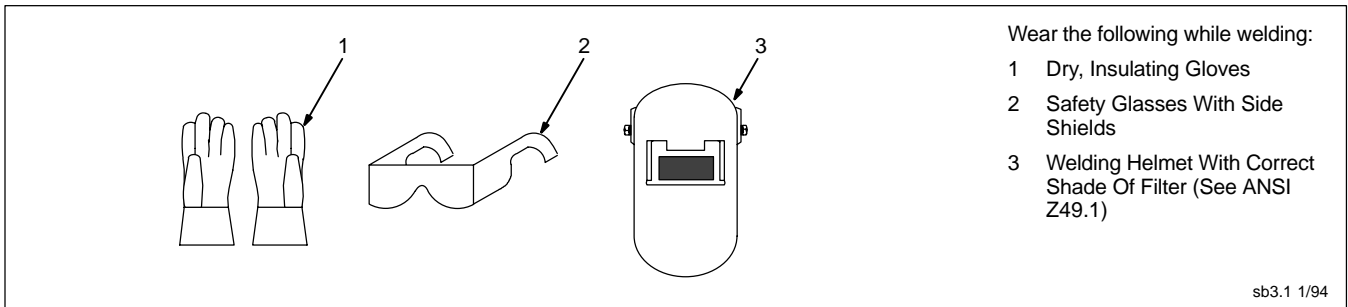
SECTION 3 – OPERATION



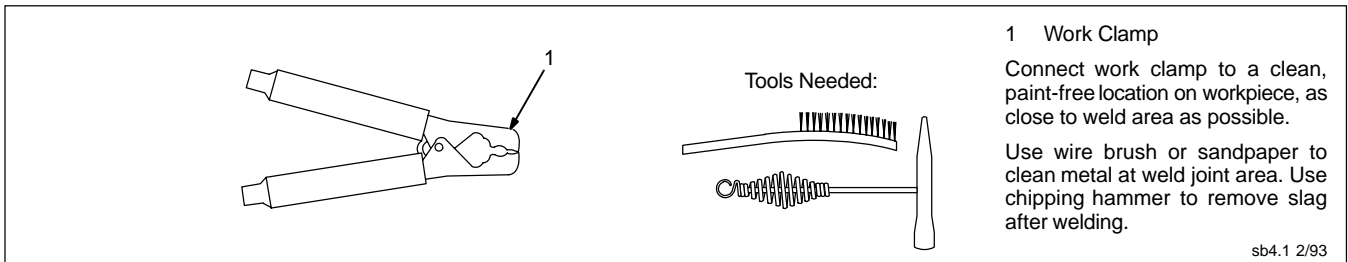
3-1. Controls



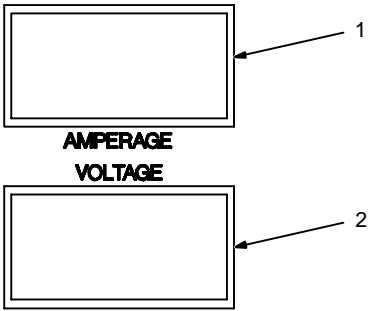
3-2. Safety Equipment



3-3. Work Clamp



3-4. Ammeter And Voltmeter

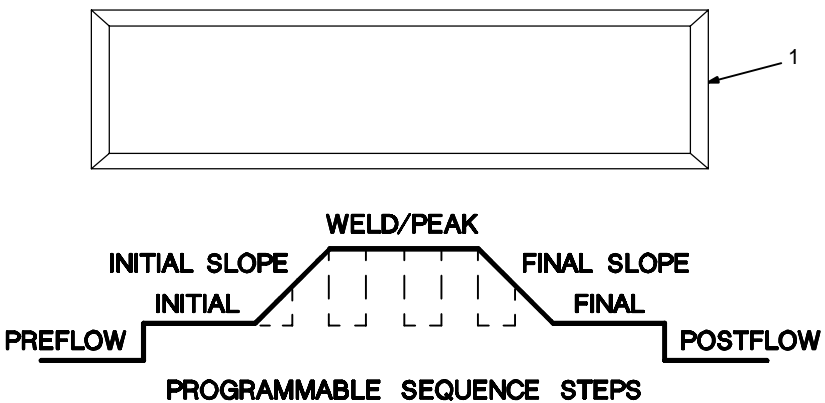


1 Ammeter
Meter displays weld amperage output of unit when welding.

2 Voltmeter
Voltmeter displays voltage at the weld output terminals, but not necessarily the welding arc due to cable resistance, poor connections, etc.

Ref. SC-159 862

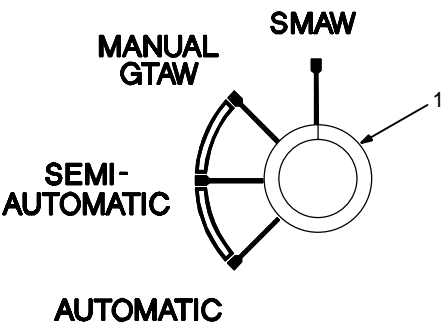
3-5. Digital Display



1 Digital Display
Use display to enter and read values. If weld sequence steps are shown, the programmed time values decrease as process time runs out.

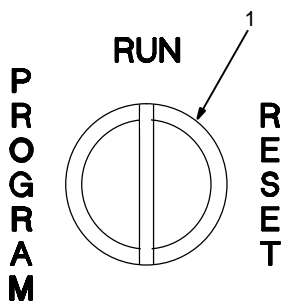
PROGRAMMABLE SEQUENCE STEPS

3-6. Mode Selector Switch



1 Mode Selector Switch
Use switch to select mode of operation.

3-7. Program/Run/Reset Keyed Switch



1 Program/Run/Reset Keyed Switch

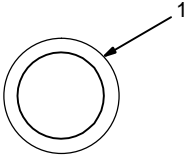
Program
Use to enter, change, and/or execute a program.

Run
Use to execute a program only. Key can be removed to prevent unauthorized access to program.

Reset
Use before switching between Run/Program positions when unit is On.

For example, use Program position to enter program, move to Reset momentarily, and move to Run to execute program. Remove key if desired. If changing program, move to Reset momentarily before moving back to Program.

3-8. Parameter Select Push Button

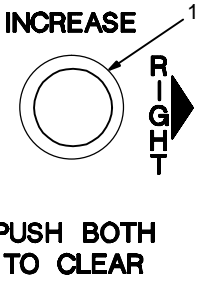


1 Parameter Select Push Button

Press switch to select and deselect parameters in a display (see Section 5-1B).

In a display with an either/or option, press switch to make selection.

3-9. Right/Increase Push Button



To zero a parameter value, select parameter and press Right/Increase and Left/Decrease switches at the same time.

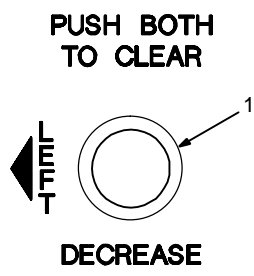
1 Right/Increase Push Button

Press switch while a parameter is selected to increase that parameter value. Press and hold switch to rapidly increase the value.

Press switch without a parameter selected to scroll to next display in the sequence.

PUSH BOTH TO CLEAR

3-10. Left/Decrease Push Button



To zero a parameter value, select parameter and press Right/Increase and Left/Decrease switches at the same time.

1 Left/Decrease Push Button

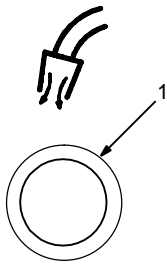
Press switch while a parameter is selected to decrease that parameter value. Press and hold switch to rapidly decrease the value.

Press switch without a parameter being selected to scroll to previous display in the sequence.

PUSH BOTH TO CLEAR

DECREASE

3-11. Purge Push Button



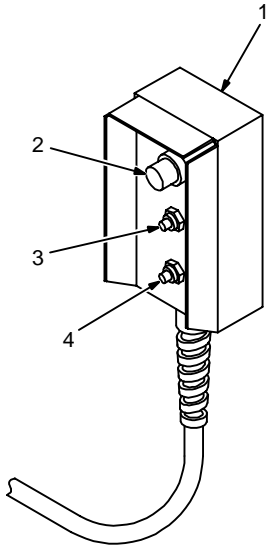
A hand is shown pressing a circular button. An arrow labeled '1' points to the button. Below the button, the word 'PURGE' is written in bold capital letters.

1 Purge Push Button

Press switch to momentarily energize gas valve and purge air from torch shielding gas line, and to allow shielding gas regulator to be adjusted without energizing the welding circuit.

Switch is only active when the repeating displays are shown.

3-12. Remote Pendant



A rectangular pendant with a coiled cable and a hook. Four buttons are labeled with numbers 1 through 4. Button 1 is at the top, button 2 is on the left side, button 3 is in the middle, and button 4 is at the bottom.

1 Remote Pendant

Use for remote operation in the Automatic and Semi-Automatic modes only. Connect to Remote 4 receptacle.

2 Stop Push Button


3 Start/Increase Push Button

4 Decrease Push Button

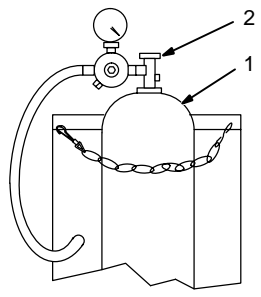
See programming and operating instructions for Automatic and Semi-Automatic modes for push button functions.

Ref. ST-146 839

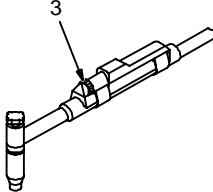
3-13. Shielding Gas



Warning icon (exclamation mark in a triangle) and a person icon with a gas cylinder.

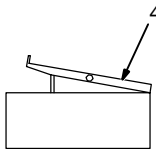


A gas cylinder with a valve and a pressure gauge. An arrow labeled '2' points to the valve and an arrow labeled '1' points to the cylinder.



A torch with a switch. An arrow labeled '3' points to the switch.

OR



A foot control pedal. An arrow labeled '4' points to the pedal.

1 Shielding Gas Cylinder

2 Valve

3 Torch Switch

4 Foot Control

Open valve on cylinder just before welding.

Torch trigger or foot control turns weld output and gas flow on and off.

Close valve on cylinder when finished welding.

sb5.2* 2/92 – S-0621-C / ST-159 059

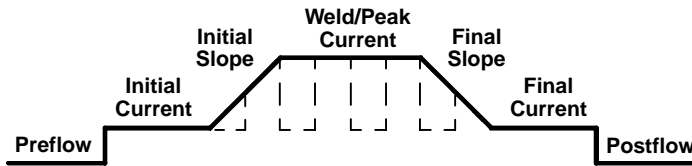
SECTION 4 – INTRODUCTION TO PROGRAMMING

4-1. General

Programs are created when parameters are defined in a series of displays. Up to four programs can be entered into each of the four modes of operation, for a total of sixteen programs. In addition, programs in certain modes can be linked or combined to run in a user-defined sequence.

This welding power source provides high frequency or scratch starting, preflow timing, start current level control and timing, initial current level control and timing, initial slope timing, final slope timing, final current level control and timing, postflow timing, and amperage control of weld/peak current for either a pulsing or nonpulsing weld current. Pulsing controls include on/off selection, pulse peak level control and timing, background current level control and timing, and pulse frequency and average current calculations.

4-2. Weld Sequence



In most cases, the weld sequence shown here is used in programming the control. Which steps are programmable and what initiates each step varies from mode to mode.

Preflow: The period during which shielding gas flows before an arc is established.

Start Level (Not Shown): A current level that can be programmed to ease arc starting.

Initial Current: The beginning maintained current level.

Initial Slope: The ramping of the initial current up to the programmed weld/peak current level.

Weld/Peak Current: The programmed weld current level (divided into peak and background current levels when pulsing is enabled).

Final Slope: The ramping down of weld/peak current to the programmed final current level.

Final Current: The end current level just before the arc is extinguished.

Postflow: The period during which shielding gas flows after the arc has been extinguished.

Ref. SB-139 983

4-3. Balance Control

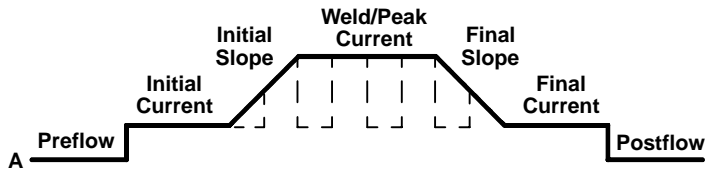
Balance Control Waveform Examples		
More Cleaning	55% Electrode Positive 45% Electrode Negative	
More Penetration	32% Electrode Positive 68% Electrode Negative	
Balanced	50% Electrode Positive 50% Electrode Negative	

When ac output is selected on the Process Selector switch, a balance control value must be programmed. The balance control value can be used to change the weld arc characteristics for either more penetration or more cleaning. The electrode negative (EN) value is user-programmed, and the electrode positive (EP) value changes accordingly so the sum always equals 100%.

4-4. Modes Of Operation

The microprocessor control has four modes of operation: Automatic, Semi-Automatic, Manual GTAW, and SMAW. In abbreviated form, the modes function as follows:

A. Automatic Mode Sequence



- A:** Momentary closure of Start/Increase push button starts sequence.
 - Preflow:** Time programmed/Volume set by gas meter.
 - Start Level (Not Shown):** Time & level programmed.
 - Initial Current:** Time & level programmed.
 - Initial Slope:** Time programmed/Slope calculated by microprocessor control.
 - Weld/Peak Current:** Time & level programmed.
 - Final Slope:** Time programmed/Slope calculated by microprocessor control.
 - Final Current:** Time & level programmed.
 - Postflow:** Time programmed/Volume set by gas meter.
- Weld/peak current can be increased or decreased during welding.
Stop push button functions throughout sequence.

In this mode, the program controls each step of the weld sequence. Pressing the Start/Increase push button starts the sequence, with no more input required from the operator.

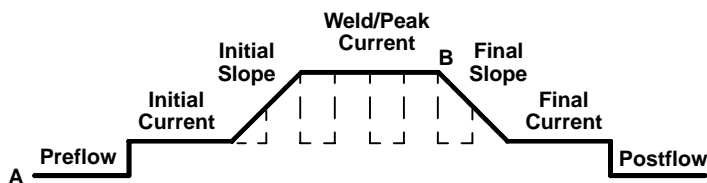
The operator can increase or decrease weld amperage during weld/peak current within the defined amperage adjustment limits (see Section 2-4). This change does not affect the programmed values.

Pressing the Stop push button during the weld sequence stops program execution and starts postflow.

Ref. SB-139 983

B. Semi-Automatic Mode Sequence

A program created in the Semi-Automatic mode controls certain portions of the weld sequence but requires the operator to control other portions. The Semi-Automatic mode has five variations. Which portions of the sequence the operator controls, and how the portions are controlled depends on which variation is used.



- A:** Momentary closure of Start/Increase push button starts sequence.
 - B:** Momentary closure of Stop push button ends weld/peak current.
 - Preflow:** Time programmed/Volume set by gas meter.
 - Start Level (Not Shown):** Time & level programmed.
 - Initial Current:** Time & level programmed.
 - Initial Slope:** Time programmed/Slope calculated by microprocessor control.
 - Weld/Peak Current:** Time undefined/Level programmed.
 - Final Slope:** Time programmed/Slope calculated by microprocessor control.
 - Final Current:** Time & level programmed.
 - Postflow:** Time programmed/Volume set by gas meter.
- Weld/peak current can be increased or decreased during welding.
Stop push button functions up to the signaled end of weld/peak current.

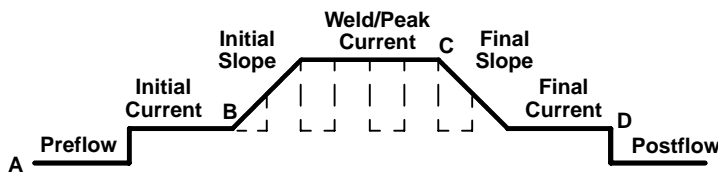
In this mode, the end time for weld/peak current is not defined. Pressing the Start/Increase push button starts the sequence. The program proceeds through each step into weld/peak current. The operator must signal the end of weld/peak by pressing the Stop push button, at which time final slope starts.

The operator can increase or decrease weld amperage during weld/peak current within the defined amperage adjustment limits (see Section 2-4). This change does not affect the programmed values.

Pressing the Stop push button before the start of weld/peak current stops program execution and starts postflow. Pressing the Stop push button after the end of weld/peak has been signalled has no effect.

Ref. SB-139 983

Figure 4-1. Semi-Automatic 1 Mode Sequence



- A:** Momentary closure of Start/Increase push button starts sequence.
- B:** Momentary closure of Start/Increase push button ends initial current.
- C:** Momentary closure of Start/Increase push button ends weld/peak current.
- D:** Momentary closure of Start/Increase push button ends final current.

Prewflow: Time programmed/Volume set by gas meter.

Start Level (Not Shown): Time & level programmed.

Initial Current: Time undefined/Level programmed.

Initial Slope: Time programmed/Slope calculated by microprocessor control.

Weld/Peak Current: Time undefined/Level programmed.

Final Slope: Time programmed/Slope calculated by microprocessor control.

Final Current: Time undefined/Level programmed.

Postflow: Time programmed/Volume set by gas meter.

Weld/peak current cannot be increased or decreased during welding.

Stop push button functions throughout sequence if Stop Button Detect is enabled in the program.

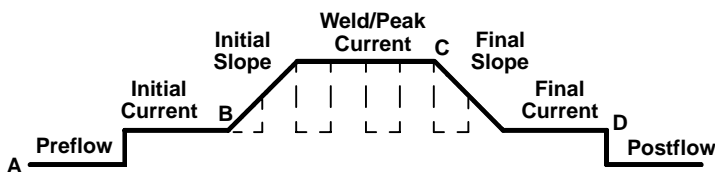
In this mode, time values are not defined for initial current, weld/peak current, and final current. The microprocessor control operates in a momentary-contact, single button format. The operator presses the Start/Increase push button to start the program, presses it again to signal the end of initial current, presses it again to signal the end of weld/peak current, and presses it for a last time to signal the end of final current.

The weld amperage cannot be increased or decreased once the sequence has started.

If Stop Button Detect is enabled in the weld program, pressing the Stop push button stops program execution and starts postflow. If Stop Button Detect is disabled, pressing the Stop push button has no affect. Postflow starts if the arc is manually broken.

Ref. SB-139 983

Figure 4-2. Semi-Automatic 2 Mode Sequence



- A:** Maintained closure of Start/Increase push button starts sequence.
- B:** Release of Start/Increase push button ends initial current.
- C:** Maintained closure of Start/Increase push button ends weld/peak current.
- D:** Release of Start/Increase push button ends final current.

Prewflow: Time programmed/Volume set by gas meter.

Start Level (Not Shown): Time & level programmed.

Initial Current: Time undefined/Level programmed.

Initial Slope: Time programmed/Slope calculated by microprocessor control.

Weld/Peak Current: Time undefined/Level programmed.

Final Slope: Time programmed/Slope calculated by microprocessor control.

Final Current: Time undefined/Level programmed.

Postflow: Time programmed/Volume set by gas meter.

Weld/peak current cannot be increased or decreased during welding.

Stop push button functions throughout sequence if Stop Button Detect is enabled in the program.

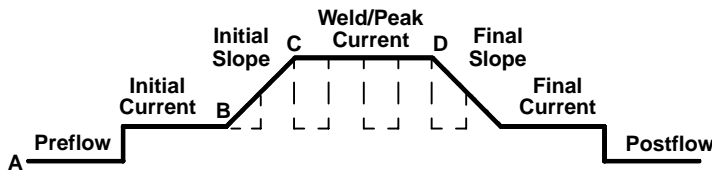
In this mode, time values are not defined for initial current, weld/peak current, and final current. The microprocessor control operates in a maintained-contact, single button format. The operator presses and holds the Start/Increase push button to start the sequence. The Start/Increase push button is released to signal the end of initial current. The sequence will then cycle through to weld/peak current. The operator presses and holds the Start/Increase push button to signal the end of weld/peak current. The sequence will then cycle through to final current. The Start/Increase push button is released to signal the end of final current.

The weld amperage cannot be increased or decreased once the sequence has started.

If Stop Button Detect is enabled in the weld program, pressing the Stop push button stops program execution and starts postflow. If Stop Button Detect is disabled, pressing the Stop push button has no affect. Postflow starts if the arc is manually broken.

Ref. SB-139 983

Figure 4-3. Semi-Automatic 3 Mode Sequence



- A:** Momentary closure of Start/Increase push button starts sequence.
- B:** Maintained closure of Start/Increase push button increases weld output; maintained closure of Decrease push button decreases weld output.
- C:** Release of Start/Increase or Decrease push button sets weld/peak current (output remains at level existing when push button released).
- D:** Maintained closure of Decrease push button decreases weld output to programmed final current level; final current starts.

Prewflow: Time programmed/Volume set by gas meter.

Start Level (Not Shown): Time & level programmed.

Initial Current: Time undefined/Level programmed.

Initial Slope: Controlled by Start/Increase and Decrease push buttons/Slope rate of change calculated by microprocessor control.

Weld/Peak Current: Time undefined/Level determined by weld output level when Start/Increase or Decrease push button released.

Final Slope: Controlled by Start/Increase and Decrease push buttons/Slope rate of change calculated by microprocessor control.

Final Current: Time & Level programmed.

Postflow: Time programmed/Volume set by gas meter.

Weld/peak current can be increased or decreased during welding.

Stop push button functions throughout sequence if Stop Button Detect is enabled in the program.

In this mode, time values are not defined for initial current, initial slope, weld/peak current, and final slope. The operator uses the Start/Increase and Decrease push buttons to vary the weld current level once initial current starts.

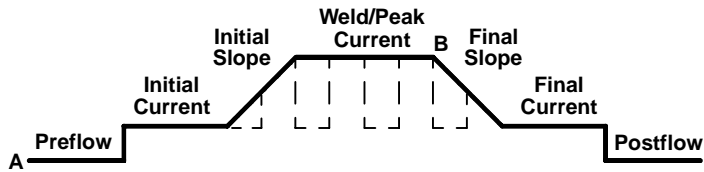
The first momentary closure of the Start/Increase push button starts the sequence. Following start level, each time the Start/Increase push button is pressed and held weld output increases at a rate calculated by the microprocessor control. The rate of increase depends on the programmed initial current level, weld/peak current level, and initial slope time. Each time the Decrease push button is pressed and held, weld output decreases at a rate calculated by the microprocessor control. The rate of decrease depends on the programmed weld/peak current level, final current level, and final slope time. The weld output will maintain at the level that exists when either the Start/Increase or Decrease push button is released. The programmed values that normally define the weld/peak current level define the upper limit that the Start/Increase push button can command.

The weld output level can be increased and decreased indefinitely until the operator decreases the weld current down to the programmed final current level. At this point the sequence enters final current and then postflow. If the weld current never exceeds the programmed final current value, the operator must decrease the weld current to zero, at which time postflow will begin.

If Stop Button Detect is enabled in the weld program, pressing the Stop push button stops program execution and starts postflow. If Stop Button Detect is disabled, pressing the Stop push button has no affect. Postflow starts if the arc is manually broken.

Ref. SB-139 983

Figure 4-4. Semi-Automatic 4 Mode Sequence



- A:** Momentary closure of Start/Increase push button starts sequence.
 - B:** Momentary closure of Start/Increase push button ends weld/peak current.
 - Prewflow:** Time programmed/Volume set by gas meter.
 - Start Level (Not Shown):** Time & level programmed.
 - Initial Current:** Time & level programmed.
 - Initial Slope:** Time programmed/Slope calculated by microprocessor control.
 - Weld/Peak Current:** Time undefined/Level programmed.
 - Final Slope:** Time programmed/Slope calculated by microprocessor control.
 - Final Current:** Time & level programmed.
 - Postflow:** Time programmed/Volume set by gas meter.
- Weld/peak current cannot be increased or decreased during welding.
 Stop push button is not functional throughout sequence.

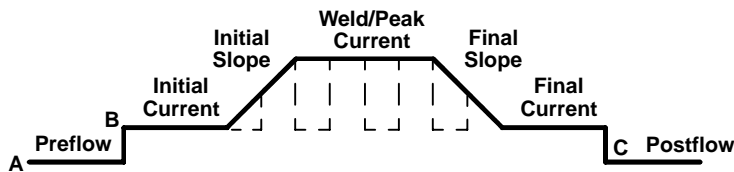
In this mode, a single momentary closure of the Start/Increase push button starts the sequence. The program continues through the programmed sequence of events until weld/peak current. The operator presses the Start/Increase push button to signal the end of weld/peak current, at which time final slope starts.

The weld amperage cannot be increased or decreased once the sequence has started, and the Stop push button is not functional. Postflow starts if the arc is manually broken.

Ref. SB-139 983

Figure 4-5. Semi-Automatic 5 Mode Sequence

C. Manual GTAW Mode Sequence



- A:** Closure of remote contactor control starts sequence.
 - B:** Arc ignition starts initial current.
 - C:** Opening of remote contactor control starts postflow.
 - Prewflow:** Time programmed/Volume set by gas meter.
 - Start Level (Not Shown):** Time & level programmed.
 - Initial Current:** Time undefined/Level programmed.
 - Initial Slope:**
 - Weld/Peak Current:**
 - Final Slope:**
 - Final Current:**
- Not separate steps.
 Current level controlled by remote amperage control.*
- Postflow:** Time programmed/Volume set by gas meter.
- Remote Pendant not used.
 Weld/peak current can be increased or decreased during welding.

A Manual GTAW program requires the operator to perform most of the control of the welding process. This is carried out through the use of a remote control providing contactor and amperage control (not the Remote Pendant). High frequency is available for non-contact weld starts.

Prewflow starts when the remote contactor control is closed. Following arc ignition, the weld sequence enters initial current. Once initial current starts, the operator controls the output level through the use of the remote amperage control. The maximum output that can be commanded is defined when the program is created. The minimum value that can be commanded is the defined initial current level. Postflow starts when the remote contactor control is opened.

Ref. SB-139 983

D. SMAW Mode

A program entered in the SMAW mode does not follow the weld sequence shown in Section 4-2. On/Off control of the welding power source contactor is accomplished through a remote contactor control, and arc initiation and extinguishing are done manually. Weld output can be controlled remotely or kept at a defined level, depending on programmed parameters. If remote control is used, the maximum output that can be commanded is defined when the program is created. The minimum is the minimum output the welding power source is capable of.

SECTION 5 – PROGRAMMING

5-1. General

A. Displays

The displays presented by the microprocessor control either provide information to the user, or allow the user to enter information needed for program execution. The displays vary from mode to mode. Within each mode, the displays are always shown in the same sequence.

Pressing the Right/Increase push button allows the user to move forward through the sequence of displays, beginning to end. Pressing the Left/Decrease push button allows the user to move backward through the displays. Either push button can be used to access displays.

B. Selecting And Defining A Parameter

The user defines a parameter by entering a value for it. This is normally a three-step process (exceptions are noted in the text), that is carried out as follows:

1. Press Parameter Select (see Section 3-8) to select the parameter (the parameter flashes).
2. Press Right/Increase (see Section 3-9) or Left/Decrease (see Section 3-10) to enter the desired value.
3. Press Parameter Select again to deselect the parameter (the parameter stops flashing). If the display contains more than one parameter, the next parameter will be selected.

Parameters are always selected in sequence. If the existing value for the first parameter is acceptable, but another parameter needs to be changed, use the Parameter Select push button to select and deselect the first parameter without changing its value. The next display in a mode cannot be accessed if a parameter remains selected (flashing) in the existing display.

C. Defining Program Number

In some displays, the first parameter is the program number. This number provides a means of identifying programs entered into the selected mode. Since parameters are selected in sequence, even when the program number is not being changed it must be selected and deselected before the next parameter can be changed.

The program number is normally defined in the first display used to enter information. The defined number carries over to the following displays and does not need to be redefined as long as the original defined number applies.

To avoid unnecessary repetition, this manual does not indicate that the program number can be redefined in each display containing it. It is assumed that when a program is entered, each display in sequence applies to the same program.

D. Display Representation

When the microprocessor control's digital display is represented in this Owner's Manual, an "X" is used to represent a parameter whose contents may vary, as shown in the following example:

```
THE ADJUSTMENT LIMIT
IS + OR - XX AMPS
```

E. Initial Displays

Each time power is applied to the microprocessor control or a reset is initiated on the Program/Run/Reset keyed switch (see Section 3-7), four displays are shown in sequence, each display shown once.

1. The first initial display identifies the welding power source and microprocessor control. The display shows:

```
* SYNCROWAVE 351 *
MPC MODULE
```

The next display scrolls into view.

2. The second initial display indicates the part number of the software program contained in the unit, and the revision level of the program. The display shows:

```
PART # XXXXX
REVISION LEVEL X
```

The next display scrolls into view.

3. The third initial display indicates the copyright for the program in the unit. The display shows:

```
COPYRIGHT 1993
MILLER ELECTRIC MFG.
```

The next display scrolls into view.

4. The fourth initial display indicates the amperage adjustment limits that have been defined (see Section 2-4). The value cannot be modified through this display. The display shows:

```
THE ADJUSTMENT LIMIT
IS + OR - XX AMPS
```

The repeating displays scroll into view.

F. Repeating Displays (Ready Condition)

After the initial displays are shown, repeating displays are shown. These displays scroll continuously until the operator takes action. The presence of the repeating displays indicates that the microprocessor control is ready for a program to be entered, or for a program to be executed.

NOTE

The program number in a display can be increased by pressing Parameter Select while any of the repeating displays are shown. This allows other programs to be accessed.

1. The first repeating display indicates the program number and that the microprocessor control is ready for program execution. The display shows:

```
PROGRAM # 0 X
USE REMOTE TO START
```

The next repeating display scrolls into view.

```
USE INC / DEC BUTTONS
TO CHECK PARAMETERS
```

2. This display indicates that the Right/Increase and Left/Decrease push buttons can be used to access the displays and verify parameter values.

The next repeating display scrolls into view.

```
USE PARAMETER SELECT
TO CHANGE PROGRAM #
```

3. This display explains the use of the Parameter Select push button to change the program number. This allows the creation of more than one program per mode.

The next repeating display scrolls into view.

```
SEMI - AUTOMATIC
MODE X
```

4. This display is present only in the Semi-Automatic mode. The display indicates which of the five versions of Semi-Automatic is active.

The next repeating display scrolls into view.

```
PROCESS POLARITY IS
< X X .>
```

5. This display indicates whether the Process Selector switch is set for ac or dc output.

The first repeating display scrolls into view, and the sequence repeats.

5-2. Automatic Mode**NOTE**

If needed, see Section 5-1B for information on selecting and defining a parameter.

NOTE

Weld output options, such as the use of pulsing, high frequency, and ac or dc output, affect how a program is entered in the Automatic mode. Be sure to follow all applicable steps, and only the applicable steps, as determined by the selected options.

A. Procedure Up To Pulse Mode Selection

1. Turn on welding power source, if applicable.
2. Place the Mode Selector switch in the Automatic position.
3. Place the Program/Run/Reset keyed switch in the Reset position, and then in the Program position. The initial displays will be shown.
4. When the repeating displays (explained in Section 5-1F) are shown, press Right/Increase.

If the Process Selector switch is in the ac output position, go to Step 5. If the Process Selector switch is in a dc output position, go to Step 8.

5. The display shows:

```
# 0 X BALANCE CONTROL
EN = X X % EP = X X %
```

6. If applicable, define the program number (see Section 5-1C). Define the electrode negative value for the ac output square wave (see Section 4-3) as desired.

The range for percentage of waveform in electrode negative is 46% to 68%, in increments of 2%.

7. Press Right/Increase, and go to Step 8.
8. The display shows:

```
HIGH FREQUENCY
> X X X X X X X X <
```

9. Press Parameter Select to display the desired choice. If the Process Selector switch is in the ac output position, the choices are Start Only high frequency or Continuous high frequency.

If the Process Selector switch is in a dc output position, the choices are Start Only high frequency or Disabled high frequency.

10. When the desired choice is shown, press Right/Increase to advance to the next display. The display shows:

```
# 0 X PREFLOW
TIME = X X .X
```

11. If applicable, define the program number (see Section 5-1C). Define the shielding gas preflow time as desired.

The range for preflow is 0.0 to 25.0 seconds, in increments of 0.1 seconds.

12. Press Right/Increase, and the display shows:

```
# 0 X      S T A R T   L E V E L
T I M E = .X X X   A M P S = X X X .X
```

13. Define the start level time and amperage as desired.

When properly used, start level eases arc starting by allowing the use of an amperage value that is higher than initial amperage for a short length of time.

The range for start level time is 0.0 to 15.0 seconds, in increments of 0.1 seconds. The range for start level amperage varies from 2.0 to 400 amperes, in increments of 1.0 amperes.

14. Press Right/Increase, and the display shows:

```
# 0 X      I N I T I A L
T I M E = X X .X   A M P S = X X X .X
```

15. Define the initial current level time and amperage values as desired.

The range for initial current level time is 0.0 to 25.0 seconds, in increments of 0.1 seconds. The range for initial current level amperage varies from 2.0 to 400 amperes, in increments of 1.0 amperes.

16. Press Right/Increase, and the display shows:

```
# 0 X      I N I T I A L   S L O P E
                T I M E = X X .X
```

17. Define the initial slope time as desired.

The range for initial slope time is 0.0 to 25.0 seconds, in increments of 0.1 seconds.

18. Press Right/Increase, and the display shows:

```
* * P U L S E   M O D E   I S * *
                > X X X <
```

19. Pressing Parameter Select toggles the display between pulse mode On and pulse mode Off. Three possibilities exist at this point, as follows:

Pulse mode On is desired and pulses are to be defined as time spent in peak current and background current (see Step 20).

Pulse mode On is desired and pulses are to be defined as a frequency, with peak current defined as a percentage of the total period (see Step 20).

Pulse mode Off is desired (see Step 21).

20. To define pulse mode On, proceed as follows:

- Be sure the desired means of defining pulse mode has been selected according to Section 2-4.
- Use the Parameter Select push button to select pulse mode On, and press Right/Increase to advance to the next display while "On" is displayed.
- If pulses are being defined as time values, go to Section 5-2B.

If pulses are being defined as a frequency, go to Section 5-2C.

21. To define pulse mode Off, proceed as follows:

- Use the Parameter Select push button to select pulse mode Off, and press Right/Increase while "Off" is displayed. The display shows:

```
# 0 X      W E L D
T I M E = X X X .X   A M P S = X X X .X
```

- Define the weld current time and amperage values as desired.

The range for weld current time is 0.0 to 999.9 seconds, in increments of 0.1 seconds. The range for weld current amperage varies from 2.0 to 400 amperes, in increments of 1.0 amperes.

- Press Right/Increase, and go to Section 5-2D.

B. Procedure With Pulse Mode On, Pulses Defined In Time Values

1. The display shows:

```
# 0 X      W E L D
                T I M E = X X X .X
```

- Define the weld current time as desired.

The range for weld current time is 0.0 to 999.9 seconds, in increments of 0.1 seconds.

2. Press Right/Increase, and the display shows:

```
# 0 X      P U L S E   A p K   = X X X .X
                P U L S E   A b K   = X X X .X
```

3. Define the ApK and AbK values as desired.

ApK defines the peak current during pulsing. AbK defines the background current.

The ranges for both ApK and AbK are 2.0 to 400 amperes, in increments of 1.0 ampere.

4. Press Right/Increase, and the display shows:

```
# 0 X      P E A K   T I M E   = X .X X
                B A C K   T I M E   = X .X X
```

- Define the peak time and background time values as desired.

Peak time is the length of time the pulse is at the peak level. Background time is the length of time the pulse is at the background level.

The ranges for both peak and background times are 0.5 to 5.0 seconds, in increments of 0.5 seconds.

- Press Right/Increase, and the display shows:

```
# 0 X   F R E Q U E N C Y   =
      X X . X X   P U L S E S / S E C O N D
```

- This display is for informational purposes. It indicates the calculated frequency of pulses per second.
- Press Right/Increase.
If the Process Selector switch is in the ac output position, go to Section 5-2D. If the Process Selector switch is in a dc output position, go to Step 9.
- The display shows:

```
# 0 X   A V G   C U R R E N T   =
      X X X . X   A M P S
```

- This display is for informational purposes. It indicates the calculated average current during pulsing.
- Press Right/Increase, and go to Section 5-2D.

C. Procedure With Pulse Mode On, Pulses Defined As A Frequency

- The display shows:

```
# 0 X           W E L D
      T I M E = X X X . X
```

- Define the weld current time as desired.
The range for weld current time is 0.0 to 999.9 seconds, in increments of 0.1 seconds.

- Press Right/Increase, and the display shows:

```
# 0 X   P U L S E   A p K   = X X X . X
      P U L S E   A b K   = X X X . X
```

- Define the ApK and AbK values as desired.
ApK defines the peak current during pulsing. AbK defines the background current.
The ranges for both ApK and AbK are 2.0 to 400 amperes, in increments of 1.0 ampere.

- Press Right/Increase, and the display shows:

```
# 0 X   P U L S E S / S E C = X X . X
      P U L S E   P E A K   %   = X X
```

- Define the pulse frequency per second and the percentage of pulse time to be spent in pulse peak as desired.

The range for pulse frequency is 0.1 to 10.0 pulses per second, in increments of 0.1 pulses per second.

The range for percentage of pulse time to be spent in pulse peak is 5% to 95%, in increments of 1%.

- Press Right/Increase.
If the Process Selector switch is in the ac output position, go to Section 5-2D. If the Process Selector switch is in a dc output position, go to Step 7.
- The display shows:

```
# 0 X   A V G   C U R R E N T   =
      X X X . X   A M P S
```

- This display is for informational purposes. It indicates the calculated average current during pulsing.
- Press Right/Increase, and go to Section 5-2D.

D. Procedure Following Pulse Mode Definition

- The display shows:

```
# 0 X   F I N A L   S L O P E
      T I M E = X X . X
```

- Define the final slope time as desired.
The range for final slope time is 0.0 to 25.0 seconds, in increments of 0.1 seconds.
- Press Right/Increase, and the display shows:

```
# 0 X           F I N A L
      T I M E = X X . X   A M P S = X X X . X
```

- Define the final current time and amperage as desired.
The range for final current level time is 0.0 to 25.0 seconds, in increments of 0.1 seconds. The range for final level amperage varies from 2.0 to 400 amperes, in increments of 1.0 amperes.
- Press Right/Increase, and the display shows:

```
# 0 X           P O S T F L O W
      T I M E = X X . X
```

- Define the shielding gas postflow time as desired.
The range for postflow is 0.0 to 25.0 seconds, in increments of 0.1 seconds.

7. Press Right/Increase, and the display shows:

```
# 0 X W I R E - F E E D S T A R T
    D E L A Y = X X . X S E C.
```

8. Define the wire feed start delay as desired.

Wire feed start delay is the amount of time between the end of initial current and when the wire feed user relay (see Section 2-3) changes states. A delay time of 0 means the wire feed relay changes state immediately at the end of initial current. A delay time of 3.5 means the relay changes state 3.5 seconds after the end of initial current.

The wire feed relay change cannot be delayed beyond the end of weld current. When weld current ends, the wire feed relay changes states whether or not the defined start delay time has elapsed.

The range for start delay time is 0.0 to 25.0 seconds, in increments of 0.1 seconds.

9. Press Right/Increase, and the display shows:

```
# 0 X W I R E - F E E D S T O P
    D E L A Y = X X . X S E C.
```

10. Define the wire feed stop delay as desired.

Wire feed stop delay is the amount of time between the end of weld current and when the wire feed user relay (see Section 2-3) change states. A delay time of 0 means the wire feed relay changes state immediately at the end of weld current. A delay time of 7.0 means the relay changes state 7.0 seconds after the end of weld current.

The wire feed relay change cannot be delayed beyond the end of postflow. When postflow ends, the wire feed relay changes states whether or not the defined stop delay time has elapsed.

The range for stop delay time is 0.0 to 25.0 seconds, in increments of 0.1 seconds.

11. Press Right/Increase, and the display shows:

```
* * * * * D R Y R U N * * * * *
U S E R E M O T E T O S T A R T
```

12. If desired, press Start/Increase on the Remote Pendant to carry out a dry run of the program (see Section 5-7 for information on the dry run feature). To place the microprocessor control in the Ready condition, press Right/Increase.

13. In the Ready condition the microprocessor control is ready to have another program entered or to execute a program. For information on executing a program, refer to Section 6.

5-3. Semi-Automatic Mode

NOTE

If needed, see Section 5-1B for information on selecting and defining a parameter.

NOTE

Weld output options, such as the use of pulsing, high frequency, and ac or dc output, affect how a program is entered in the Semi-Automatic mode. Be sure to follow all applicable steps, and only the applicable steps, as determined by the selected options.

NOTE

This section covers program entry in all five Semi-Automatic modes. Differences between one mode and another are stated. Be sure the desired Semi-Automatic mode has been defined on DIP switch SW1 (see Section 2-4) before using the following procedure to enter a program.

A. Procedure Up To Pulse Mode Selection

1. Turn on welding power source, if applicable.
2. Place the Mode Selector switch in the Semi-Automatic position.
3. Place the Program/Run/Reset keyed switch in the Reset position, and then in the Program position. The initial displays will be shown.
4. When the repeating displays (explained in Section 5-1F) are shown, press Right/Increase.

If the Process Selector switch is in the ac output position, go to Step 5. If the Process Selector switch is in a dc output position, go to Step 8.

5. The display shows:

```
# 0 X B A L A N C E C O N T R O L
    E N = X X % E P = X X %
```

6. If applicable, define the program number (see Section 5-1C). Define the electrode negative value for the ac output square wave (see Section 4-3) as desired.

The range for percentage of waveform in electrode negative is 46% to 68%, in increments of 2%.

7. Press Right/Increase, and go to Step 8.
8. The display shows:

```
H I G H F R E Q U E N C Y
> X X X X X X X X X <
```

9. Press Parameter Select to display the desired choice. If the Process Selector switch is in the ac output position, the choices are Start Only high frequency or Continuous high frequency.

If the Process Selector switch is in a dc output position, the choices are Start Only high frequency or Disabled high frequency.

10. When the desired choice is shown, press Right/Increase to advance to the next display. The display shows:

```
# 0 X          P R E F L O W
                T I M E = X X .X
```

11. If applicable, define the program number (see Section 5-1C). Define the shielding gas preflow time as desired.

The range for preflow is 0.0 to 25.0 seconds, in increments of 0.1 seconds.

12. Press Right/Increase, and the display shows:

```
# 0 X    S T A R T   L E V E L
T I M E = .X X X   A M P S = X X X .X
```

13. Define the start level time and amperage as desired.

When properly used, start level eases arc starting by allowing the use of an amperage value that is higher than initial amperage for a short length of time.

The range for start level time is 0.0 to 15.0 seconds, in increments of 0.1 seconds. The range for start level amperage varies from 2.0 to 400 amperes, in increments of 1.0 amperes.

14. Press Right/Increase, and the display shows:

- a. For Semi-Automatic 1 and 5 modes:

```
# 0 X          I N I T I A L
T I M E = X X .X   A M P S = X X X .X
```

- b. For Semi-Automatic 2, 3, and 4 modes:

```
# 0 X          I N I T I A L
                A M P S = X X X .X
```

15. Define the initial current level time (if applicable) and amperage as desired.

The range for initial current level time is 0.0 to 25.0 seconds, in increments of 0.1 seconds. The range for initial current level amperage varies from 2.0 to 400 amperes, in increments of 1.0 amperes.

16. Press Right/Increase, and the display shows:

```
# 0 X    I N I T I A L   S L O P E
                T I M E = X X .X
```

17. Define the initial slope time as desired.

The range for initial slope time is 0.0 to 25.0 seconds, in increments of 0.1 seconds.

18. Press Right/Increase, and the display shows:

```
* * P U L S E   M O D E   I S * *
                > X X <
```

19. Pressing Parameter Select toggles the display between pulse mode On and pulse mode Off. Three possibilities exist at this point, as follows:

Pulse mode On is desired and pulses are to be defined as time spent in peak current and background current (see Step 20).

Pulse mode On is desired and pulses are to be defined as a frequency, with peak current defined as a percentage of the total period (see Step 20).

Pulse mode Off is desired (see Step 21).

20. To define pulse mode On, proceed as follows:

- a. Be sure the desired means of defining pulse mode has been selected according to Section 2-4.

- b. Use the Parameter Select push button to select pulse mode On, and press Right/Increase to advance to the next display while "On" is displayed.

- c. If pulses are being defined as time values, go to Section 5-3B.

If pulses are being defined as a frequency, go to Section 5-3C.

21. To define pulse mode Off, proceed as follows:

- a. Use the Parameter Select push button to select pulse mode Off, and press Right/Increase while "Off" is displayed. The display shows:

```
# 0 X          W E L D
                A M P S = X X X .X
```

- b. Define the weld current as desired.

The range for weld current varies from 2.0 to 400.0 amps, in increments of 1.0 amperes.

- c. Press Right/Increase. Go to Section 5-3D if programming in Semi-Automatic 1 or 5 modes. Go to Section 5-3E if programming in Semi-Automatic 2, 3, or 4 modes.

B. Procedure With Pulse Mode On, Pulses Defined In Time Values

1. The display shows:

```
# 0 X    P U L S E   A p K   = X X X .X
                P U L S E   A b K   = X X X .X
```

2. Define the ApK and AbK values as desired.

ApK defines the peak current during pulsing. AbK defines the background current.

The ranges for both ApK and AbK are 2.0 to 400 amperes, in increments of 1.0 ampere.

3. Press Right/Increase, and the display shows:

```
# 0 X   P E A K   T I M E   = X . X X
        B A C K   T I M E   = X . X X
```

4. Define the peak time and background time as desired.

Peak time is the length of time the pulse is at the peak level. Background time is the length of time the pulse is at the background level.

The ranges for both peak and background times are 0.5 to 5.0 seconds, in increments of 0.5 seconds.

5. Press Right/Increase, and the display shows:

```
# 0 X   F R E Q U E N C Y   =
        X X . X X   P U L S E S / S E C O N D
```

6. This display is for informational purposes. It indicates the calculated frequency of pulses per second.

7. Press Right/Increase.

If the Process Selector switch is in the ac output position, go to Section 5-3D if programming in Semi-Automatic 1 or 5 modes; go to Section 5-3E if programming in Semi-Automatic 2, 3, or 4 modes.

If the Process Selector switch is in a dc output position, go to Step 8.

8. The display shows:

```
# 0 X   A V G   C U R R E N T   =
        X X X . X   A M P S
```

9. This display is for informational purposes. It indicates the calculated average current during pulsing.

10. Press Right/Increase. Go to Section 5-3D if programming in Semi-Automatic 1 or 5 modes. Go to Section 5-3E if programming in Semi-Automatic 2, 3, or 4 modes.

C. Procedure With Pulse Mode On, Pulses Defined As A Frequency

1. The display shows:

```
# 0 X   P U L S E   A p K   = X X X . X
        P U L S E   A b K   = X X X . X
```

2. Define the ApK and AbK values as desired.

ApK defines the peak current during pulsing. AbK defines the background current.

The ranges for both ApK and AbK are 2.0 to 400 amperes, in increments of 1.0 ampere.

3. Press Right/Increase, and the display shows:

```
# 0 X   P U L S E S / S E C   =   X X . X
        P U L S E   P E A K   %   =   X X
```

4. Define the pulse frequency per second and the percentage of pulse time to be spent in pulse peak as desired.

The range for pulse frequency is 0.1 to 10.0 pulses per second, in increments of 0.1 pulses per second.

The range for percentage of pulse time to be spent in pulse peak is 5% to 95%, in increments of 1%.

5. Press Right/Increase.

If the Process Selector switch is in the ac output position, go to Section 5-3D if programming in Semi-Automatic 1 or 5 modes; go to Section 5-3E if programming in Semi-Automatic 2, 3, or 4 modes.

If the Process Selector switch is in a dc output position, go to Step 6.

6. The display shows:

```
# 0 X   A V G   C U R R E N T   =
        X X X . X   A M P S
```

7. This display is for informational purposes. It indicates the calculated average current during pulsing.

8. Press Right/Increase. Go to Section 5-3D if programming in Semi-Automatic 1 or 5 modes. Go to Section 5-3E if programming in Semi-Automatic 2, 3, or 4 modes.

D. Procedure Following Pulse Mode Definition For Semi-Automatic 1 And 5 Modes

1. The display shows:

```
# 0 X   F I N A L   S L O P E
        T I M E   = X X . X
```

2. Define the final slope time as desired.

The range for final slope time is 0.0 to 25.0 seconds, in increments of 0.1 seconds. Define the final slope time as desired.

3. Press Right/Increase, and the display shows:

```
# 0 X           F I N A L
T I M E = X X . X   A M P S = X X X . X
```

4. Define the final current time and amperage as desired.

The range for final current level time is 0.0 to 25.0 seconds, in increments of 0.1 seconds. The range for final level amperage varies from 2.0 to 400 amperes, in increments of 1.0 amperes.

- Press Right/Increase, and the display shows:

```
# 0 X          P O S T F L O W
                T I M E = X X . X
```

- Define the shielding gas postflow time as desired.

The range for postflow is 0.0 to 25.0 seconds, in increments of 0.1 seconds.

- Press Right/Increase, and the display shows:

```
# 0 X  W I R E - F E E D  S T A R T
                D E L A Y  =  X X . X  S E C .
```

- Define the wire feed start delay as desired.

Wire feed start delay is the amount of time between the end of initial current and when the wire feed user relay (see Section 2-3) changes states. A delay time of 0 means the wire feed relay changes state immediately at the end of initial current. A delay time of 3.5 means the relay changes state 3.5 seconds after the end of initial current.

The wire feed relay change cannot be delayed beyond the end of weld current. When weld current ends, the wire feed relay changes states whether or not the defined start delay time has elapsed.

The range for start delay time is 0.0 to 25.0 seconds, in increments of 0.1 seconds.

- Press Right/Increase, and the display shows:

```
# 0 X  W I R E - F E E D  S T O P
                D E L A Y  =  X X . X  S E C .
```

- Define the wire feed stop delay as desired.

Wire feed stop delay is the amount of time between the end of weld current and when the wire feed user relay (see Section 2-3) changes states. A delay time of 0 means the wire feed relay changes state immediately at the end of weld current. A delay time of 7.0 means the relay changes state 7.0 seconds after the end of weld current.

The wire feed relay change cannot be delayed beyond the end of postflow. When postflow ends, the wire feed relay changes states whether or not the defined stop delay time has elapsed.

The range for stop delay time is 0.0 to 25.0 seconds, in increments of 0.1 seconds.

- Press Right/Increase, and the display shows:

```
* * * * *  D R Y R U N  * * * * *
USE  R E M O T E  T O  S T A R T
```

- If desired, press Start/Increase on the Remote Pendant to carry out a dry run of the program (see Section 5-7 for information on the dry run feature). To place the microprocessor control in the Ready condition, press Right/Increase.

- In the Ready condition the microprocessor control is ready to have another program entered or to execute a program. For information on executing a program, see Section 6.

E. Procedure Following Pulse Mode Definition For Semi-Automatic 2, 3, And 4 Modes

- The display shows:

```
# 0 X  F I N A L  S L O P E
                T I M E = X X . X
```

- Define the final slope time as desired.

The range for final slope time is 0.0 to 25.0 seconds, in increments of 0.1 seconds. Define the final slope time as desired.

- Press Right/Increase, and the display shows:

- For Semi-Automatic 2 and 3 modes:

```
# 0 X          F I N A L
                A M P S = X X X . X
```

- For Semi-Automatic 4 mode:

```
# 0 X          F I N A L
T I M E = X X . X  A M P S = X X X . X
```

- Define the final current time (if applicable) and amperage as desired.

The range for final current level time is 0.0 to 25.0 seconds, in increments of 0.1 seconds. The range for final level amperage varies from 2.0 to 400 amperes, in increments of 1.0 amperes.

- Press Right/Increase, and the display shows:

```
S T O P  B U T T O N  D E T E C T
                > X X X X X X X X X X <
```

- Pressing Parameter Select toggles the display between stop button detect Enabled and Disabled. When the desired choice is shown, press Right/Increase to advance to the next display. The display shows:

```
# 0 X          P O S T F L O W
                T I M E = X X . X
```

- Define the shielding gas postflow time as desired.

The range for postflow is 0.0 to 25.0 seconds, in increments of 0.1 seconds.

8. Press Right/Increase. The microprocessor control will enter the Ready condition.
9. In the Ready condition the microprocessor control is ready to have another program entered or to execute a program. For information on executing a program, see Section 6.

5-4. Manual GTAW Mode

NOTE



If needed, see Section 5-1B for information on selecting and defining a parameter.

NOTE



Weld output options, such as the use of pulsing, high frequency, and ac or dc output, affect how a program is entered in the Manual GTAW mode. Be sure to follow all applicable steps, and only the applicable steps, as determined by the selected options.

A. Procedure Up To Pulse Mode Selection

1. Turn on welding power source, if applicable.
2. Place the Mode Selector switch in the Manual GTAW position.
3. Place the Program/Run/Reset keyed switch in the Reset position, and then in the Program position. The initial displays will be shown.
4. When the repeating displays (explained in Section 5-1F) are shown, press Right/Increase.

If the Process Selector switch is in the ac output position, go to Step 5. If the Process Selector switch is in a dc output position, go to Step 8.

5. The display shows:

```
# 0 X   B A L A N C E   C O N T R O L
      E N   =   X X %   E P   =   X X %
```

6. If applicable, define the program number (see Section 5-1C). Define the electrode negative value for the ac output square wave (see Section 4-3) as desired.
The range for percentage of waveform in electrode negative is 46% to 68%, in increments of 2%.
7. Press Right/Increase, and go to Step 8.
8. The display shows:

```
H I G H   F R E Q U E N C Y
> X X X X X X X X X X <
```

9. Press Parameter Select to display the desired choice.
If the Process Selector switch is in the ac output position, the choices are Start Only high frequency or Continuous high frequency.

If the Process Selector switch is in a dc output position, the choices are Start Only high frequency or Disabled high frequency.

10. When the desired choice is shown, press Right/Increase to advance to the next display. The display shows:

```
# 0 X           P R E F L O W
                T I M E = X X .X
```

11. If applicable, define the program number (see Section 5-1C). Define the shielding gas preflow time as desired.
The range for preflow is 0.0 to 25.0 seconds, in increments of 0.1 seconds.
12. Press Right/Increase, and the display shows:

```
# 0 X   S T A R T   L E V E L
T I M E = .X X X   A M P S = X X X .X
```

13. Define the start level time and amperage as desired.
When properly used, start level eases arc starting by allowing the use of an amperage value that is higher than initial amperage for a short length of time.
The range for start level time is 0.0 to 15.0 seconds, in increments of 0.1 seconds. The range for start level amperage varies from 2.0 to 400 amperes, in increments of 1.0 amperes.

14. Press Right/Increase, and the display shows:

```
* * P U L S E   M O D E   I S * *
                > X X <
```

15. Pressing Parameter Select toggles the display between pulse mode On and pulse mode Off. Three possibilities exist at this point, as follows:
Pulse mode On is desired and pulses are to be defined as time spent in peak current and background current (see Step 16).

Pulse mode On is desired and pulses are to be defined as a frequency, with peak current defined as a percentage of the total period (see Step 16).

Pulse mode Off is desired (see Step 17).

16. To define pulse mode On, proceed as follows:
 - a. Be sure the desired means of defining pulse mode has been selected according to Section 2-4.
 - b. Use the Parameter Select push button to select pulse mode On, and press Right/Increase to advance to the next display while "On" is displayed.
 - c. If pulses are being defined as time values, go to Section 5-4B.
If pulses are being defined as a frequency, go to Section 5-4C.

17. To define pulse mode Off, proceed as follows:
 - a. Use the Parameter Select push button to select pulse mode Off, and press Right/Increase while "Off" is displayed. The display shows:

```
# 0 X      W E L D
          A M P S = X X X .X
```

- b. Define the weld current as desired.
The range for weld current varies from 2.0 to 400.0 amps, in increments of 1.0 amperes.
- c. Press Right/Increase, and go to Section 5-4D.

B. Procedure With Pulse Mode On, Pulses Defined In Time Values

1. The display shows:

```
# 0 X  P U L S E  A p K  = X X X .X
          P U L S E  A b K  = X X X .X
```

2. Define the ApK and AbK values as desired.
ApK defines the peak current during pulsing. AbK defines the background current.
The ranges for both ApK and AbK are 2.0 to 400 amperes, in increments of 1.0 ampere.
3. Press Right/Increase, and the display shows:

```
# 0 X  P E A K  T I M E  = X .X X
          B A C K  T I M E  = X .X X
```

4. Define the peak time and background time as desired.
Peak time is the length of time the pulse is at the peak level. Background time is the length of time the pulse is at the background level.
The ranges for both peak and background times are 0.5 to 5.0 seconds, in increments of 0.5 seconds.
5. Press Right/Increase, and the display shows:

```
# 0 X  F R E Q U E N C Y  =
          X X .X X  P U L S E S / S E C O N D
```

6. This display is for informational purposes. It indicates the calculated frequency of pulses per second.
7. Press Right/Increase, and go to Section 5-4D.

C. Procedure With Pulse Mode On, Pulses Defined As A Frequency

1. The display shows:

```
# 0 X  P U L S E  A p K  = X X X .X
          P U L S E  A b K  = X X X .X
```

2. Define the ApK and AbK values as desired.
ApK defines the peak current during pulsing. AbK defines the background current.
The ranges for both ApK and AbK are 2.0 to 400 amperes, in increments of 1.0 ampere.
3. Press Right/Increase, and the display shows:

```
# 0 X  P U L S E S / S E C  =  X X .X
          P U L S E  P E A K  %  =  X X
```

4. Define the pulse frequency per second and the percentage of pulse time to be spent in pulse peak as desired.
The range for pulse frequency is 0.1 to 10.0 pulses per second, in increments of 0.1 pulses per second.
The range for percentage of pulse time to be spent in pulse peak is 5% to 95%, in increments of 1%.
5. Press Right/Increase, and go to Section 5-4D.

D. Procedure Following Pulse Mode Definition

1. The display shows:

```
# 0 X      P O S T F L O W
          T I M E = X X .X
```

2. Define the shielding gas postflow time as desired.
The range for postflow is 0.0 to 25.0 seconds, in increments of 0.1 seconds.
3. Press Right/Increase, and the display shows:

```
C U R R E N T  C O N T R O L
          < X X X X X X X >
```

4. Pressing Parameter Select toggles the display between Panel and Remote. When Remote is defined, weld amperage can be varied by a remote amperage control device up to the user-defined weld current level. When Panel is defined, weld amperage is the value defined as weld current.
Whichever option is showing when this display is exited will be in effect. Use the Parameter Select push button to display the desired option (Panel or Remote).
5. Press Right/Increase. The microprocessor control will enter the Ready condition.
6. In the Ready condition the microprocessor control is ready to have another program entered or to execute a program. For information on executing a program, see Section 6.

5-5. SMAW Mode

NOTE



If needed, see Section 5-1B for information on selecting and defining a parameter.

1. Turn on welding power source, if applicable.
2. Place the Mode Selector switch in the SMAW position.
3. Place the Program/Run/Reset keyed switch in the Reset position, and then in the Program position. The initial displays will be shown.
4. When the repeating displays (explained in Section 5-1F) are shown, press Right/Increase.

If the Process Selector switch is in the ac output position, go to Step 5. If the Process Selector switch is in a dc output position, go to Step 8.

5. The display shows:

```
# 0 X   B A L A N C E   C O N T R O L
      E N   =   X X %   E P   =   X X %
```

6. If applicable, define the program number (see Section 5-1C). Define the electrode negative value for the ac output square wave (see Section 4-3) as desired.
The range for percentage of waveform in electrode negative is 46% to 68%, in increments of 2%.
7. Press Right/Increase, and go to Step 8.
8. The display shows:

```
# 0 X   S T A R T   L E V E L
      T I M E = . X X X   A M P S = X X X . X
```

9. If applicable, define the program number (see Section 5-1C). Define the start level time and amperage as desired.

When properly used, start level eases arc starting by allowing the use of an amperage value that is higher than initial amperage for a short length of time.

The range for start level time is 0.0 to 15.0 seconds, in increments of 0.1 seconds. The range for start level amperage varies from 2.0 to 400.0 amps, in increments of 1.0 amperes.

10. Press Right/Increase, and the display shows:

```
# 0 X   W E L D
      A M P S = X X X . X
```

11. Define the weld current as desired.
The range for weld current varies from 2.0 to 400.0 amps, in increments of 1.0 amperes.
12. Press Right/Increase, and the display shows:

```
# 0 X   A R C   C O N T R O L
      P E R C E N T A G E   =   0 0 0   %
```

13. Arc control increases short-circuit amperage to help start an arc or make vertical or overhead welds.

The range for arc control is 0% to 100%, in increments of 1%.

14. Press Right/Increase, and the display shows:

```
C U R R E N T   C O N T R O L
      < X X X X X X X >
```

15. Pressing Parameter Select toggles the display between Panel and Remote. When Remote is defined, weld amperage can be varied by a remote amperage control device up to the user-defined weld current level. When Panel is defined, weld amperage is the value defined as weld current.

Whichever option is showing when this display is exited will be in effect. Use the Parameter Select push button to display the desired option (Panel or Remote).

16. Press Right/Increase. The microprocessor control will enter the Ready condition.
17. In the Ready condition, the microprocessor control is ready to have another program entered or to execute a program. For information on executing a program, see Section 6.

5-6. Editing A Program

To edit an existing program, carry out the following:

1. Turn on welding power source, if applicable.
2. Use the Mode Selector switch to select the mode of the program to be edited.
3. Place the Program/Run/Reset keyed switch in the Program position.
4. When the repeating displays are shown, press the Right/Increase or Left/Decrease push button until the display to be edited is shown.
5. Edit the desired parameter(s). If needed, see Section 5-1B for information on selecting and defining parameters. See Section 5-1C for information on changing the program number in a display to access multiple programs.
6. Continue accessing displays and editing parameters until editing is complete. The newly entered parameters become a part of the program as soon as they are entered.
7. To lock out program changes and prepare for program execution, place the Program/Run/Reset keyed switch in the Run position.
8. To prepare for program execution while remaining in Program, press Right/Increase or Left/Decrease until the Ready condition is active (see Section 5-1F).

5-7. Dry Run Feature

The Dry Run feature allows a program to be verified by executing it without actually establishing an arc. All timing and contact closures are performed without gas, high frequency, or power source contactor being activated.

The Dry Run feature is only available in the Automatic mode and Semi-Automatic 1 or 5 modes. When used in the Semi-Automatic 1 or 5 modes, the weld time continues to increment until the Start/Increase on the Remote Pendant is pressed.

To use the Dry Run feature, proceed as follows:

1. Access the Dry Run display.
2. Press Start/Increase on the Remote Pendant to begin the dry run execution.
3. The microprocessor control will perform a dry run of the program. The dry run stops automatically when the programmed postflow time elapses. To stop the dry run before completion, press the Stop push button.

5-8. Stop Watch Feature

The Stop Watch feature is a part of Dry Run when Dry Run is used in the Automatic mode. Stop Watch allows the operator to define the end of weld time by pressing the Start/Increase push button. This enables the operator to observe fixturing during a dry run and define the end of weld time relative to actual positions.

To use the Stop Watch feature, proceed as follows:

1. Enter a 0 (zero) for weld time when entering a program in the Automatic mode.
2. Carry out a dry run of the entered program (see Section 5-7).
3. When the desired end of weld time is reached, press Start/Increase on the Remote Pendant. The time displayed when the push button is pressed becomes the weld time value in the program and remains so until changed.

5-9. Linking Programs

NOTE



The Link feature is only available in the following modes: Automatic, Semi-Automatic 1, and Semi-Automatic 5.

Existing programs in the required modes can be linked together so that the next program in sequence begins when Start/Increase is pressed on the Remote Pendant. Up to four programs can be linked. All linked programs must be in the same mode of operation. The first program desired in the chain of programs is assigned to position one, the second desired program is assigned to position two, etc. A reset is assigned to the Link position following the last program to signal the end of the linked programs.

NOTE



If four programs are linked together, it is not necessary for the user to assign a reset. A reset is permanently assigned to the fifth Link position.

For example, to run program 2, then program 1, and finally program 4, program 2 would be assigned to link position one, program 1 would be assigned to position two and program 4

would be assigned to position three. A reset would be assigned to position four to indicate the end of the linked programs.

When the Link mode is entered, three displays are repeated in sequence. This indicates that the Link Ready condition is active. These displays must be present in order to start execution of the linked programs.

To link programs, proceed as follows:

1. Be sure one of the proper modes is selected (see Important block at beginning of this section).
2. Place the Program/Run/Reset keyed switch in the Program position.
3. Call up the following display (this is one of the repeating displays explained in Section 5-1F).

```
PROGRAM # 0 X
USE REMOTE TO START
```

4. Press Parameter Select to increase the program number beyond 4. The following repeating Link mode displays appear:

```
PROGRAM " LINK " MODE
USE REMOTE TO START
```

```
USE INC / DEC BUTTONS
TO CHANGE THE LINKS
```

```
USE PARAMETER SELECT
TO EXIT " LINK " MODE
```

```
PROCESS POLARITY IS
< X X .>
```

5. Press Right/Increase, and the display shows:

```
LINK POSITION XX
IS XXXXXX
```

6. The Link position (1 through 4) is indicated in the upper right corner. The second line indicates what function (either a program number or Reset) is assigned to the position.
7. To change the number of the Link position, select it and press either Right/Increase or Left/Decrease to change the value as desired. As the Link position numbers change, the function currently assigned to that position is displayed in the second line.
8. To change the function assigned to a Link position, select the function and press either Right/Increase or Left/Decrease to change the value.

Reset follows Program Number 04. To assign Reset to a Link position, select the function and press Right/Increase repeatedly to go beyond Program Number 04. To assign a number when Reset is displayed, select Reset and press Left/Decrease.

9. Repeat Steps 7 and 8 as needed to define the desired function for each Link position being used.
10. Select the Link Position number in the upper right corner of the display, and press Right/Increase or Left/Decrease to display the number of the first Link position to be executed when the program is executed.

NOTE



The Link position shown when the Link mode is exited is the first position executed when the Link programs are run. Be sure the desired Link position is showing before exiting the Link mode.

11. Press Right/Increase when there are no parameters selected in the Link Position display. The repeating Link mode displays will appear.
12. Press Parameter Select while the repeating displays are shown to exit the Link mode. The display shows:

```

" C O M B I N E "   M O D E
U S E   R E M O T E   T O   S T A R T
  
```

13. If desired, use the Combine mode as explained in Section 5-10. To exit the Combine mode without using it, press Parameter Select while this display is shown. The microprocessor control will enter the Ready condition.

5-10. Combining Programs

NOTE



The Combine feature is only available in the following modes: Automatic, Semi-Automatic 1, and Semi-Automatic 5.

The Combine feature uses parameters from several programs to create a single multi-slope weld program. The first program defines preflow, initial amperage, initial to weld amperage slope, and the weld amperage. Following specified programs provide weld to weld slopes and weld times. The weld to weld slopes are calculated by the microprocessor control. The last program provides the final slope, and final amperage and post-flow values. This is useful in applications using multiple non-stop passes, such as pipe-welding with the use of a seam-tracker.

When the Combine mode is entered, three displays are repeated in sequence, indicating that the Combine Ready condition is active. These displays must be present in order to start execution of the combined programs.

To combine programs, proceed as follows:

1. Be sure one of the proper modes is selected (see Important block at beginning of this section).
2. Call up the following display (this is one of the repeating displays explained in Section 5-1F).

```

P R O G R A M   # 0 X
U S E   R E M O T E   T O   S T A R T
  
```

3. Press Parameter Select to increase the program number beyond 4. The following repeating Link mode display appears:

```

P R O G R A M   " L I N K "   M O D E
U S E   R E M O T E   T O   S T A R T
  
```

4. Press Parameter Select to enter the Combine mode. The following repeating Combine mode displays appear:

```

" C O M B I N E "   M O D E
U S E   R E M O T E   T O   S T A R T
  
```

```

U S E   I N C / D E C   B U T T O N S
T O   E N T E R   C H A N G E S
  
```

```

U S E   P A R A M E T E R   S E L E C T
T O   E X I T   " C O M B I N E "
  
```

```

P R O C E S S   P O L A R I T Y   I S
< X X . >
  
```

5. Press Right/Increase, and the display shows:

```

C O M B I N E   P O S I T I O N   X X
I S   X X X X X X X
  
```

6. The Combine position (1 through 4) is indicated in the upper right corner. The second line indicates what function (either a program number or Reset) is assigned to the position.
7. To change the number of the Combine position, select it and press either Right/Increase or Left/Decrease to change the value as desired. As the Combine position numbers change, the function currently assigned to that position will be displayed in the second line.
8. To change the function assigned to a Combine position, select the function and press either Right/Increase or Left/Decrease to change the value.

Reset follows Program Number 04. To assign Reset to a Combine position, select the function and press

Right/Increase repeatedly to go beyond Program Number 04. To assign a number when Reset is displayed, select Reset and press Left/Decrease.

NOTE



If four programs are combined together, it is not necessary for the user to assign a reset. A reset is permanently assigned to the fifth Combine position.

9. Repeat Steps 7 and 8 as needed to define the desired function for each Combine position being used.
10. Press Right/Increase when there are no parameters selected in the Combine Position display. The display shows:

* DRY RUN " COMBINE " *
USE REMOTE TO START

11. If desired, press Start/Increase on the Remote Pendant to carry out a dry run of the combined program (see Section 5-7 for information on the dry run feature). To exit the Combine mode, press Right/Increase, and then Parameter Select when the repeating Combine mode displays are shown. The microprocessor control will enter the Ready condition.

SECTION 6 – SEQUENCE OF OPERATION

6-1. Gas Tungsten Arc Welding (GTAW) In The Automatic Mode



1. Be sure welding power source and related equipment are installed as instructed in their respective Owner's Manuals.
2. Be sure desired weld program (or programs) has been entered.
3. Place Mode Selector switch in Automatic position.
4. Select and prepare tungsten electrode according to welding power source Owner's Manual.
5. Insert electrode into torch.
6. Wear dry insulating gloves and clothing.
7. Connect work clamp to clean, bare metal at workpiece.
8. Turn on shielding gas supply at source.
9. Wear welding helmet with proper filter lens according to ANSI Z49.1.
10. Energize welding power source.
11. Begin welding, observing the following:
 - a. Be sure the desired program is active before executing a program. The active program is indicated in the applicable repeating display (see Section 5-1F). To select a different program, press Parameter Select while the repeating displays are shown. This increases the program number.
 - b. When the unit is in the Ready condition (see Section 5-1F), momentarily press Start/Increase to begin the weld sequence.
 - c. The voltage and amperage meters display the weld voltage and amperage while welding. The weld sequence displays are shown on the digital display, with time values changing to reflect events being carried out.

- d. During the Weld Time portion of the program, the Start/Increase or Decrease push buttons may be pressed and held to modify the weld current level within the defined amperage adjustment limits (see Section 2-4). The programmed values will not be affected.
- e. At any time, the Stop push button may be pressed to end the weld sequence prematurely and send the program to postflow.
- f. After postflow is timed out, the control unit returns to the Ready condition and waits for the next closure of the Start/Increase push button. If Start/Increase is pressed during postflow, the program restarts the weld sequence from the beginning without preflow timing.

6-2. Gas Tungsten Arc Welding (GTAW) In The Semi-Automatic Modes



A. Shared Initial Procedure

1. Be sure welding power source and related equipment are installed as instructed in their respective Owner's Manuals.
2. Be sure desired weld program (or programs) has been entered.
3. Be sure desired Semi-Automatic mode is selected on DIP switch SW1 (see Section 2-4).
4. Place Mode Selector switch in Semi-Automatic position.
5. Select and prepare tungsten electrode according to welding power source Owner's Manual.
6. Insert electrode into torch.
7. Wear dry insulating gloves and clothing.
8. Connect work clamp to clean, bare metal at workpiece.
9. Turn on shielding gas supply at source.

10. Wear welding helmet with proper filter lens according to ANSI Z49.1.
11. Be sure applicable remote control device is connected as follows:
 - a. Semi-Automatic 1 Mode:
Connect Remote Pendant to Remote 4 receptacle RC2.
 - b. Semi-Automatic 2 Mode:
Connect Remote Pendant to Remote 4 receptacle RC2.
 - c. Semi-Automatic 3 Mode:
Connect Remote Pendant to Remote 4 receptacle RC2.
 - d. Semi-Automatic 4 Mode:
Connect Remote Pendant to Remote 4 receptacle RC2.
 - e. Semi-Automatic 5 Mode:
Do not make connections to Remote 4 receptacle RC2 at this time.
12. Energize welding power source.
13. If using the Semi-Automatic 5 mode, connect Remote Pendant to Remote 4 receptacle RC2 at this time.
14. Be sure the desired program is active before executing a program. The active program is indicated in the applicable repeating display (see Section 5-1F). To select a different program, press Parameter Select while the repeating displays are shown. This increases the program number.
15. Begin welding, observing the operation procedures for the applicable Semi-Automatic mode (see Sections 6-2B through 6-2F).
16. In all Semi-Automatic modes, the voltage and amperage meters display the weld voltage and amperage while welding. The weld sequence displays are shown on the digital display, with time values changing to reflect events being carried out.

B. Operation Procedures For Semi-Automatic 1 Mode

1. When the unit is in the Ready condition (see Section 5-1F), momentarily press Start/Increase to begin the weld sequence.
2. During the Weld Time portion of the program, the Start/Increase or Decrease push buttons may be pressed and held to modify the weld current level within the defined amperage adjustment limits (see Section 2-4). The programmed values will not be affected.
3. Before the weld sequence reaches Weld Time, the Stop push button may be pressed to end the program prematurely and send the weld sequence to postflow.
4. The Stop push button must be pressed during Weld Time to signal the end of weld/peak current. When Stop is pressed, the weld sequence enters final slope. Once Weld Time is terminated, the Stop push button has no affect on program operation.
5. After postflow is timed out, the control unit returns to the Ready condition and waits for the next closure of the Start/Increase push button. If Start/Increase is pressed

during postflow, the program restarts the weld sequence from the beginning without preflow timing.

C. Operation Procedures For Semi-Automatic 2 Mode

1. When the unit is in the Ready condition (see Section 5-1F), momentarily press Start/Increase to begin the weld sequence. After arc initiation at initial current, the control unit maintains the programmed initial current value.
2. Start/Increase must be pressed to signal the end of initial time and the beginning of initial slope. Following initial slope, the control unit maintains Weld Time current.
3. Start/Increase must be pressed to signal the end of Weld Time and the beginning of final slope. Following final slope, the control unit maintains the arc at the final current level
4. Start/Increase must be pressed to signal the end of final current and the beginning of postflow.
5. After postflow is timed out, the control unit returns to the Ready condition and waits for the next closure of the Start/Increase push button. If Start/Increase is pressed during postflow, the programs restart the weld sequence from the beginning without preflow timing.
6. The Stop push button is not functional in this mode. However, the existence of the arc is monitored by the control unit. If the arc is manually broken, the program goes directly to postflow.

D. Operation Procedures For Semi-Automatic 3 Mode

1. When the unit is in the Ready condition (see Section 5-1F), press and hold the Start/Increase push button to begin the weld sequence. After arc initiation at initial current, the control unit maintains the programmed initial current value.
2. Release the Start/Increase to signal the end of initial time and the beginning of initial slope. Following initial slope, the control unit maintains the programmed weld current.
3. Press and hold Start/Increase to signal the end of Weld Time and the beginning of final slope. Following final slope, the control unit maintains the arc at the final current level.
4. Release Start/Increase to indicate the end of final current and the beginning of postflow.
5. After postflow is timed out, the control unit returns to the Ready condition and waits for the next maintained closure of the Start/Increase push button. If Start/Increase is pressed and held during postflow, the program restarts the weld sequence from the beginning without preflow timing.
6. The Stop push button is not functional in this mode. However, the existence of the arc is monitored by the control unit. If the arc is manually broken, the program goes directly to postflow.

E. Operation Procedures For Semi-Automatic 4 Mode

1. When the unit is in the Ready condition (see Section 5-1F), momentarily press Start/Increase to begin the weld sequence. After arc initiation at initial current, the

control unit maintains the programmed initial current value.

Program execution at this point varies according to whether pulsing is enabled or disabled. Go to Step 2 if pulsing is enabled, and Step 3 if pulsing is disabled.

2. When pulsing is enabled:
 - a. Press and hold Start/Increase to increase the weld current output. The peak current output increases at a rate determined by the programmed value of initial current level, initial slope time, and peak current level. The background current output increases at a rate determined by the programmed value of initial current level, initial slope time, and background current level.
 - b. When Start/Increase is released, the peak and background current levels that exist are maintained.
 - c. The programmed peak and background current levels define the maximum limit that the Start/Increase push button can command.
 - d. Press and hold the Decrease push button to decrease the weld current output. The peak current output decreases at a rate determined by the programmed value of peak current, final slope time, and final current level. The background current output decreases at a rate determined by the programmed value of background current, final slope time, and final current level.
 - e. When Decrease is released, the peak and background current levels that exist when the push button is released are maintained.
 - f. Increasing and decreasing the pulsed weld current output can go on indefinitely.
 - g. If the weld current output is decreased to the value programmed for final current, the program enters final current and goes to postflow.
 - h. If weld current never exceeds the programmed value for final current, the weld current must be manually decreased to zero, at which time the program begins postflow.

3. When pulsing is disabled:
 - a. Press and hold the Start/Increase to increase the weld current output. The output increases at a rate determined by the programmed value of initial current level, initial slope time, and weld current level.
 - b. When Start/Increase is released, the weld current level that exists when the push button is released is maintained.
 - c. The programmed weld current defines the maximum limit the Start/Increase push button can command.
 - d. Press and hold the Decrease push button to decrease the weld current output. The output decreases at a rate determined by the programmed value of weld current, final slope time, and final current level.
 - e. When Decrease is released, the weld current level that exists when the push button is released is maintained.
 - f. Increasing and decreasing the weld current output can go on indefinitely.

- g. If the weld current output is decreased to the programmed final current, the program enters final current and goes to postflow.
- h. If weld current never exceeds the programmed final current, the weld current must be manually decreased to zero, at which time the program begins postflow.

4. After postflow is timed out, the control unit returns to the Ready condition and waits for the next closure of the Start/Increase push button. If Start/Increase is pressed during postflow, the program restarts the weld sequence from the beginning without preflow timing.
5. The Stop push button is not functional in this mode. However, the existence of the arc is monitored by the control unit. If the arc is manually broken, the program goes directly to postflow.

F. Operation Procedures For Semi-Automatic 5 Mode

1. When the unit is in the Ready condition (see Section 5-1F), momentarily press Start/Increase to begin program execution. The control unit initiates the arc and executes the programmed sequence to the programmed weld level. Press Start/Increase to indicate the end of weld and the beginning of final slope. Once final slope begins, the Start/Increase push button no longer has any affect on program execution.
2. After postflow is timed out, the control unit returns to the Ready condition and waits for the next closure of the Start/Increase push button. If Start/Increase is pressed during postflow, the program restarts the weld sequence from the beginning without preflow timing.
3. The Stop push button is not functional in this mode. However, the existence of the arc is monitored by the control unit. If the arc is manually broken, the program goes directly to postflow.

6-3. Gas Tungsten Arc Welding (GTAW) In The Manual Mode



1. Be sure welding power source and related equipment are installed as instructed in their respective Owner's Manuals.
2. Connect a suitable Contactor/Amperage remote control to the Remote 14 receptacle.
3. Be sure desired weld program (or programs) has been entered.
4. Place Mode Selector switch in Manual GTAW position.
5. Select and prepare tungsten electrode according to welding power source Owner's Manual.
6. Insert electrode into torch.
7. Wear dry insulating gloves and clothing.
8. Connect work clamp to clean, bare metal at workpiece.
9. Turn on shielding gas supply at source.
10. Wear welding helmet with proper filter lens according to ANSI Z49.1.
11. Energize welding power source.

12. Enter the Ready condition (see Section 5-1F). The operator now has control of the welding power source contactor via the remote contactor control connected to the Remote 14 receptacle.
13. Start welding as follows:
 - a. Be sure the desired program is active before executing a program. The active program is indicated in the applicable repeating display (see Section 5-1F). To select a different program, press Parameter Select while the repeating displays are shown. This increases the program number.
 - b. Use the remote contactor control to energize the welding power source contactor. This initiates preflow.
 - c. If high frequency is enabled, a high-frequency arc initiation at the defined start current level can be performed after preflow.

If high frequency is disabled, a touch or scratch start at the defined initial current level can be performed after preflow.
14. While welding, the voltage and amperage meters display the weld voltage and amperage. The weld sequence displays show on the digital display, with time values changing to reflect events being carried out.
15. Weld output can be varied with the remote amperage control. If pulsing is programmed On, the remote amperage control can increase the weld/peak and background current levels up to the programmed maximum values. The remote amperage control can decrease the weld/peak and background current levels down to the defined initial current level.

If pulsing is programmed Off, the remote amperage control can increase the weld current up to the programmed maximum weld level. The remote amperage control can decrease the weld current down to the defined initial current level.
16. To stop welding, use the remote contactor control to deenergize the welding power source contactor. Postflow will be carried out.
17. After postflow is timed out, the control unit returns to the Ready condition. The operator must use the remote contactor control to energize the welding power source contactor to start welding again. If the welding power source contactor is energized during postflow, the program restarts the weld sequence from the beginning without preflow timing.
5. Wear dry insulating gloves and clothing.
6. Connect work clamp to clean, bare metal at workpiece.
7. Select proper electrode.
8. Insert electrode into electrode holder.
9. Wear welding helmet with proper filter lens according to ANSI Z49.1.
10. Energize welding power source.
11. Enter the Ready condition (see Section 5-1F).
12. Begin welding, observing the following:
 - a. Be sure the desired program is active before executing a program. The active program is indicated in the applicable repeating display (see Section 5-1F). To select a different program, press Parameter Select while the repeating displays are shown. This increases the program number.
 - b. A closure of the remote contactor control contacts turns on the welding power source contactor. The control unit waits for an arc to be initiated with the stick electrode.
 - c. If Remote is enabled in the program (see Section 5-5), the remote control can be used to increase the weld current up to the programmed maximum weld level. The remote amperage control can decrease the weld current down to the minimum current level the welding power source can provide.
 - d. If Remote is disabled in the program, the control unit sets the weld output to the programmed weld level value.
 - e. Opening the remote contacts turns off the welding power source contactor.
 - f. While welding, the voltage and amperage meters display the weld voltage and amperage.

6-4. Shielded Metal Arc Welding (SMAW)



1. Be sure welding power source and related equipment are installed as instructed in their respective Owner's Manuals.
2. Be sure desired weld program (or programs) has been entered.
3. Connect a suitable Contactor/Amperage remote control to the Remote 14 receptacle.
4. Place Mode Selector switch in SMAW position.

6-5. Executing Linked Programs

1. Follow the Sequence Of Operation steps for the applicable mode (Automatic, Semi-Automatic 1, or Semi-Automatic 5) until the Ready condition is entered.
2. When the repeating displays are shown, press Parameter Select until the program number increases beyond 4. The Link mode will be active.
3. Be sure the Link position to be executed first is the first one in the Link Position displays.
4. Press Start/Increase on the Remote Pendant to begin linked program execution.

6-6. Executing Combined Programs

1. Follow the Sequence Of Operation steps for the applicable mode (Automatic, Semi-Automatic 1, or Semi-Automatic 5) until the Ready condition is entered.
2. When the repeating displays are shown, press Parameter Select until the program number increases beyond 4. The Link mode will be active.
3. Press Parameter Select again to enter the Combine mode.
4. Press Start/Increase on the Remote Pendant to begin combined program execution.

6-7. Shutting Down

1. Stop welding.

2. Turn off welding power source.
3. Turn off shielding gas supply at the source, if applicable.



6-8. Overheating Protection

If the unit overheats, the weld sequence goes to postflow and the contactor is deenergized. The user relay contacts stay in the state they were in before postflow was entered and remain that way until postflow ends. The following repeating displays are shown:

P O W E R S O U R C E
T H E R M A L O V E R L O A D

A L L O W T O C O O L
B E F O R E C O N T I N U I N G

The ammeter and voltmeter displays flash until one of the following events takes place:

1. The thermostat resets (indicating the unit has cooled down).
2. The operator turns the unit Off and then On again.
3. The operator moves the Program/Run/Reset keyed switch to the Reset position, then to either Run or Program, as applicable.

If the operator carries out items 2 or 3 above, the program parameters can be viewed or modified, but the unit output contactor cannot be energized. If the operator tries to energize the contactor, the unit goes to postflow and repeats the displays shown above.

If the unit overheats, wait until the unit cools down before starting to weld.

SECTION 7 – DIAGNOSTICS

7-1. Introduction

A. General

The diagnostics program allows the following to be tested:

1. Internal RAM memory
2. Front panel programming push buttons
3. Run and Program positions of the keyed switch
4. Output selector switch
5. Mode selector switch
6. Purge push button
7. Analog output circuitry
8. Output contactor
9. Background relay
10. Gas solenoid relay
11. Arc starter relay
12. User relays, which include the following:
 - Initial Time relay
 - Initial Slope relay
 - Weld Time relay
 - Final Slope relay
 - Final Time relay

Postflow relay

Wire Feed Time Delay relay

Pulse Signal relay

13. Remote Pendant

14. Current detection circuitry

15. Input contactor

The RAM test and the programming push button tests are carried out each time the diagnostics program is started. The remaining tests can be performed in sequence, or the Right/Increase or Left/Decrease push buttons can be used to access a desired test. Refer to the subsections in this section for information on each test.

B. Running The Diagnostics Program

To carry out the diagnostics program, proceed as follows:

1. Follow the directions in Section 2-4 for choosing the diagnostics program on DIP switch SW1.
2. Place Program/Run/Reset keyed switch in Run position.
3. Energize the unit.

C. Stopping The Diagnostics Program

To stop the diagnostics program, follow the directions in Section 2-4 for choosing program execution on DIP switch SW1.

7-2. Diagnostics Program

When the diagnostics program starts, the following series of informational displays is shown:

* S Y N C R O W A V E 3 5 1 *
D I A G N O S T I C P R O G R A M

T H E F O L L O W I N G
P R O G R A M W I L L C H E C K

Y O U R U N I T T O V E R I F Y
T H A T I T I S

F U N C T I O N I N G
P R O P E R L Y

A. RAM Test

1. After the four informational displays are shown, the internal RAM (random access memory) of the microprocessor control is tested to make sure each memory location is working properly. If the RAM tests okay, the display shows:

R A M I S W O R K I N G
P R O P E R L Y

If the RAM tests okay, go to Step 3.

2. If the RAM does not test okay, the following displays appear:

E R R O R ! ! ! R A M I S
N O T W O R K I N G P R O P E R L Y

P L E A S E R E P L A C E R A M
B E F O R E C O N T I N U I N G

W I T H T H E D I A G N O S T I C
T E S T P R O G R A M

If the RAM does not test okay, contact the nearest Factory Authorized Service Station/Service Distributor.

3. When the RAM tests okay, the diagnostics program proceeds to the next test.

B. Programming Push Button Tests

1. After the RAM test is passed, the front panel programming push button tests are carried out. The display shows:

P L E A S E P U S H
R I G H T / I N C B U T T O N

2. When this display appears, the control unit waits nine seconds for the Right/Increase push button to be pressed. If this is done in time and the push button is working properly, the display shows:

R I G H T / I N C B U T T O N I S
W O R K I N G P R O P E R L Y

If the Right/Increase push button tests okay, go to Step 4.

3. If the Right/Increase push button is not pressed in time, or if the push button is not working correctly, the following displays appear:

E R R O R R I G H T B U T T O N
I S N O T W O R K I N G

P L E A S E C O R R E C T E R R O R
B E F O R E C O N T I N U I N G

W I T H T H E D I A G N O S T I C
T E S T P R O G R A M

If the Right/Increase push button is not working correctly, replace the push button.

4. When the Right/Increase push button tests okay, the diagnostics program tests the Left/Decrease push button. The display shows:

P L E A S E P U S H
L E F T / D E C B U T T O N

5. When this display appears, the control unit waits nine seconds for the Left/Decrease push button to be pressed. If this is done in time and the push button is working correctly, the display shows:

L E F T / D E C B U T T O N I S
W O R K I N G P R O P E R L Y

If the Left/Decrease push button tests okay, go to Step 7.

- If the Left/Decrease push button is not pressed in time, or if the push button is not working correctly, the following displays appear:

ERROR LEFT BUTTON
IS NOT WORKING

PLEASE CORRECT ERROR
BEFORE CONTINUING

WITH THE DIAGNOSTIC
TEST PROGRAM

If the Left/Decrease push button is not working correctly, replace the push button.

- When the Left/Decrease push button tests okay, the diagnostics program tests the Parameter Select push button. The display shows:

PLEASE PUSH
PARAMETER SELECT

- When this display appears, the control unit waits nine seconds for the Parameter Select push button to be pressed. If this is done in time and the push button is working correctly, the display shows:

PARAMETER SELECT
IS WORKING PROPERLY

If the Parameter Select push button tests okay, go to Step 10.

- If the Parameter Select push button is not pressed in time, or if the push button is not working correctly, the following displays appear:

ERROR PARAMETER
SELECT NOT WORKING

PLEASE CORRECT ERROR
BEFORE CONTINUING

WITH THE DIAGNOSTIC
TEST PROGRAM

If the Parameter Select push button is not working correctly, replace the push button.

- When the Parameter Select push button tests okay, the repeating test displays appear.

C. Repeating Test Displays

- When the RAM memory and programming push buttons test okay, the repeating test displays appear as follows:

* SYNCROWAVE 351 *
DIAGNOSTIC PROGRAM

USE RIGHT / INC OR
LEFT / DEC TO SELECT

THE FUNCTION
TO TEST

PARAMETER SELECT TO
BEGIN / END THE TEST

- The remaining diagnostic tests can be accessed from these displays. This is done by pressing either the Right/Increase or Left/Decrease push buttons. The tests are presented in the following subsections in the order they would follow if the Right/Increase push button was repeatedly pressed. The Left/Decrease push button would access the tests in the opposite order.

When a test is accessed and the Parameter Select push button is not pressed to begin the test, the repeating test displays are shown.

D. Program/Run/Reset Keyed Switch Tests

This procedure tests the Run and Program positions of the Program/Run/Reset keyed switch.

- When the repeating test displays are shown (see Section 7-2C), press Right/Increase once. The display shows:

KEYED SWITCH
TEST

- Press Parameter Select to begin the test. The display shows:

PLEASE PUT KEY IN
RUN POSITION

- When this display appears, the control unit waits three seconds for the keyed switch to be placed in the Run

position. If this is done in time and the position is working correctly, the display shows:

R U N P O S I T I O N
I S W O R K I N G P R O P E R L Y

If the Run position tests okay, go to Step 5.

4. If the keyed switch is not placed in the Run position in time, or if the position is not working correctly, the display shows:

E R R O R ! ! R U N P O S I T I O N
I S N O T W O R K I N G

If the Run position is not working correctly, replace the keyed switch.

5. When the Run position tests okay, press Parameter Select. The display shows:

P L E A S E P U T K E Y I N
P R O G R A M P O S I T I O N

6. When this display appears, the control unit waits three seconds for the keyed switch to be placed in the Program position. If this is done in time and the position is working correctly, the display shows:

P R O G R A M P O S I T I O N
I S W O R K I N G P R O P E R L Y

If the Program position tests okay, go to Step 8.

7. If the keyed switch is not placed in the Program position in time, or if the position is not working correctly, the display shows:

E R R O R ! ! P R O G R A M
I S N O T W O R K I N G

If the Program position is not working correctly, replace the keyed switch.

8. When the Program position tests okay, press Parameter Select to exit the keyed switch tests. Use the Right/Increase or Left/Decrease push button to access another test, or stop the diagnostics program.

E. Output Selector Switch Test

This procedure tests the positions of the Output Selector switch.

1. When the repeating test displays are shown (see Section 7-2C), press Right/Increase or Left/Decrease until the display shows:

A C / D C S W I T C H
T E S T

2. Press Parameter Select to begin the test.
3. Place Output Selector switch in ac position. If switch is working properly, the display shows:

A C / D C S W I T C H I S I N
A C P O S I T I O N

4. Place Output Selector switch in either of the dc positions. If Process Selector switch is working properly, the display shows:

A C / D C S W I T C H I S I N
D C - E P O R D C - E N

5. Place the switch in the ac position. The display indicating ac position should again be shown.

If the display changes to match the position of the Process Selector switch, the switch is operating correctly. If the display does not change to match the position of the switch, replace the Output Selector switch.

6. When the Output Selector switch tests okay, press Parameter Select to exit the test. Use the Right/Increase or Left/Decrease push button to access another test, or stop the diagnostics program.

F. Mode Selector Switch Test

This procedure tests the positions of the Mode Selector switch.

1. When the repeating test displays are shown (see Section 7-2C), press Right/Increase or Left/Decrease until the display shows:

M O D E S W I T C H
T E S T

2. Press Parameter Select to begin the test. The display shows:

P L E A S E T U R N K N O B T O
S M A W - M A N U A L P O S I T I O N

3. When this display appears, the control unit waits three seconds for the Mode Selector switch to be placed in the SMAW position. If this is done in time and the position is working correctly, the display shows:

S M A W - M A N U A L P O S I T I O N
W O R K I N G P R O P E R L Y

If the SMAW position tests okay, go to Step 5.

- If the Mode Selector switch is not placed in the SMAW position in time, or if the position is not working correctly, the display shows:

E R R O R ! ! S M A W - M A N U A L
I S N O T W O R K I N G

If the SMAW position is not working correctly, replace the Mode Selector switch.

- When the SMAW position tests okay, press Parameter Select. The display shows:

P L E A S E T U R N K N O B T O
G T A W - M A N U A L P O S I T I O N

- When this display appears, the control unit waits three seconds for the Mode Selector switch to be placed in the Manual GTAW position. If this is done in time and the position is working correctly, the display shows:

G T A W - M A N U A L P O S I T I O N
W O R K I N G P R O P E R L Y

If the Manual GTAW position tests okay, go to Step 8.

- If the Mode Selector switch is not placed in the Manual GTAW position in time, or if the position is not working correctly, the display shows:

E R R O R ! G T A W M A N U A L
I S N O T W O R K I N G

If the Manual GTAW position is not working correctly, replace the Mode Selector switch.

- When the Manual GTAW position tests okay, press Parameter Select. The display shows:

P L E A S E T U R N K N O B T O
G T A W S E M I - A U T O

- When this display appears, the control unit waits three seconds for the Mode Selector switch to be placed in the Semi-Automatic position. If this is done in time and the position is working correctly, the display shows:

S E M I - A U T O P O S I T I O N
I S W O R K I N G P R O P E R L Y

If the Semi-Automatic position tests okay, go to Step 11.

- If the Mode Selector switch is not placed in the Semi-Automatic position in time, or if the position is not working correctly, the display shows:

E R R O R ! ! S E M I - A U T O
I S N O T W O R K I N G

If the Semi-Automatic position is not working correctly, replace the Mode Selector switch.

- When the Semi-Automatic position tests okay, press Parameter Select. The display shows:

P L E A S E T U R N K N O B T O
G T A W - A U T O P O S I T I O N

- When this display appears, the control unit waits three seconds for the Mode Selector switch to be placed in the Automatic position. If this is done in time and the position is working correctly, the display shows:

G T A W - A U T O P O S I T I O N
I S W O R K I N G P R O P E R L Y

If the Automatic position tests okay, go to Step 14.

- If the Mode Selector switch is not placed in the Automatic position in time, or if the position is not working correctly, the display shows:

E R R O R ! ! G T A W A U T O
I S N O T W O R K I N G

If the Automatic position is not working correctly, replace the Mode Selector switch.

- When the Automatic position tests okay, press Parameter Select to exit the Mode Selector switch test (the Reset position is not tested). Use the Right/Increase or Left/Decrease push button to access another test, or stop the diagnostics program (see Section 2-4).

G. Purge Push Button Test

This procedure tests the purge push button.

- When the repeating test displays are shown (see Section 7-2C), press Right/Increase or Left/Decrease until the display shows:

P U R G E B U T T O N
T E S T

- Press Parameter Select to begin the test. The display shows:

P L E A S E P U S H
P U R G E B U T T O N

- When this display appears, the control unit waits three seconds for the Purge push button to be pressed. If this

is done in time and the push button is working correctly, the display shows:

BUTTON IS
WORKING PROPERLY

If the Purge push button tests okay, go to Step 5.

4. If the Purge push button is not pressed in time, or if the push button is not working correctly, the display shows:

BUTTON IS NOT
WORKING PROPERLY

If the Purge push button is not working correctly, replace the push button.

5. When the Purge push button tests okay, press Parameter Select to exit the Purge push button test. Use the Right/Increase or Left/Decrease push button to access another test, or stop the diagnostics program (see Section 2-4).

H. +10 Volt DC Reference Test

This procedure tests the analog output circuitry of the micro-processor control.

1. When the repeating test displays are shown (see Section 7-2C), press Right/Increase or Left/Decrease until the display shows:

+ 10 V REFERENCE
TEST

2. Press Parameter Select to begin the test. The display shows:



CHECK RMT 14 C (+) TO
D FOR + 10 V + / - . 0 5 V

3. Use a suitable VOM (volt-ohmmeter) to check for a dc voltage within the specified range across pins C and D of the Remote 14 receptacle. If an acceptable voltage is present, press Parameter Select and go to Step 5.
4. If the correct dc input reference voltage is not found, contact the nearest Factory Authorized Service Station/Service Distributor.
5. The display shows:

CHECK RMT 14 C (+) TO
D FOR + 5 V + / - . 0 5 V

6. Use the VOM to check for a dc voltage within the specified range across pins C and D of the Remote 14 receptacle. If an acceptable voltage is present, go to Step 8.
7. If the correct dc input reference voltage is not found, contact the nearest Factory Authorized Service Station/Service Distributor.
8. When the analog output circuitry tests okay, press Parameter Select to exit the test. Use the Right/Increase or Left/Decrease push button to access another test, or stop the diagnostics program.

I. Output Contactor Test

 WARNING	
	ELECTRIC SHOCK can kill; OPEN CIRCUIT VOLTAGE ACROSS OUTPUT TERMINALS is present during testing. <ul style="list-style-type: none">• Do not touch live electrical parts.• Disconnect any cables from weld output terminals before performing test.
Have only qualified persons familiar with and following standard safety practices perform this test.	

This procedure tests the output contactor.

1. When the repeating test displays are shown (see Section 7-2C), press Right/Increase or Left/Decrease until the display shows:

OUTPUT CONTACTOR
TEST

2. Press Parameter Select to begin the test. This energizes the output contactor. The display shows:

CHECK VOLT METER FOR
5 3 TO 6 7 VOLTS DC

3. The Voltage meter on the control unit should indicate a voltage within the specified range.

If an acceptable voltage is not indicated, contact the nearest Factory Authorized Service Station/Service Distributor.

4. When the output contactor tests okay, press Parameter Select to deenergize the output contactor and exit the test. Use the Right/Increase or Left/Decrease push button to access another test, or stop the diagnostics program.

J. Background Relay Test

This procedure tests the internal dc background current source.

1. When the repeating test displays are shown (see Section 7-2C), press Right/Increase or Left/Decrease until the display shows:

BACKGROUND
RELAY TEST

2. Press Parameter Select to begin the test. This energizes the background relay. The display shows:

CHECK VOLT METER FOR
4 2 TO 5 4 VOLTS DC

3. The Voltage meter on the control unit should indicate a voltage within the specified range.
If an acceptable voltage is not indicated, contact the nearest Factory Authorized Service Station/Service Distributor.
4. When the background relay tests okay, press Parameter Select to deenergize the relay and exit the test. Use the Right/Increase or Left/Decrease push button to access another test, or stop the diagnostics program.

K. Gas Solenoid Relay Test

This procedure tests the gas solenoid relay. Indirectly, the gas solenoid is also tested.

1. When the repeating test displays are shown (see Section 7-2C), press Right/Increase or Left/Decrease until the display shows:

GAS SOLENOID
RELAY TEST

2. Press Parameter Select to energize the gas solenoid relay. The display shows:

GAS SOLENOID RELAY
IS ENERGIZED

3. If gas flows, the gas solenoid relay and gas solenoid are working correctly. In this case, go to Step 4.
If gas does not flow, contact the nearest Factory Authorized Service Station/Service Distributor.
4. When the gas solenoid relay tests okay, press Parameter Select again to deenergize the relay. The program automatically returns to the repeating test displays. Use the Right/Increase or Left/Decrease push button to access another test, or stop the diagnostics program.

L. Arc Starter Relay Test

This procedure tests the arc starter relay. Indirectly, the Arc Starter Board PC8 is also tested.

1. When the repeating test displays are shown (see Section 7-2C), press Right/Increase or Left/Decrease until the display shows:

ARC STARTER
RELAY TEST

2. Press Parameter Select to energize the arc starter relay. The display shows:

ARC STARTER RELAY
IS ENERGIZED

3. If a crackling sound can be heard inside the welding power source, the relay is working correctly. In this case, go to Step 4.
If a crackling sound is not heard inside the welding power source, contact the nearest Factory Authorized Service Station/Service Distributor.
4. When the relay tests okay, press Parameter Select again to deenergize the relay. The program automatically returns to the repeating test displays. Use the Right/Increase or Left/Decrease push button to access another test, or stop the diagnostics program.

M. User Relays

This procedure tests the user relays (see Section 2-3). Since the procedure is the same for each of the user relays, one example is presented that applies to all the user relays.

1. When the repeating test displays are shown (see Section 7-2C), press Right/Increase or Left/Decrease until the display shows the test display for the desired relay.

For example, if the initial time relay is being tested, the display would show:

INITIAL TIME
RELAY TEST

2. Press Parameter Select to begin the test. The display shows:

INITIAL TIME RELAY
IS ENERGIZED

After a short pause, the relay energizes.

3. Use a suitable VOM (volt-ohmmeter) to check the resistance across the relay terminals as shown in Figure 7-1.

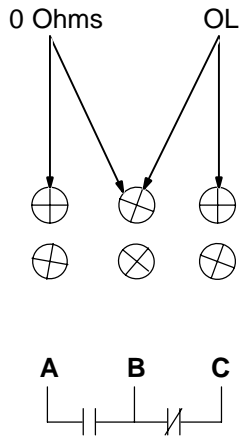


Figure 7-1. Testing Energized User Relay

- If the relay is working correctly, the VOM reads the resistances shown. In this case, go to Step 5.

If the VOM does not read the resistances shown while the relay is energized, contact the nearest Factory Authorized Service Station/Service Distributor.

- Press Parameter Select again to deenergize the relay. The program automatically returns to the repeating test displays.
- Use the VOM to check the resistance across the relay terminals as shown in Figure 7-2.

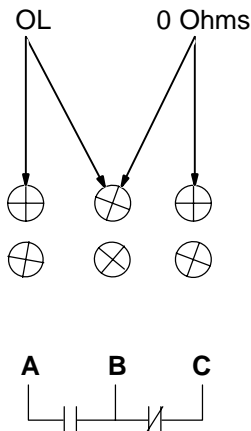


Figure 7-2. Testing Deenergized User Relay

- If the relay is working correctly, the VOM reads the resistances shown. In this case, go to Step 8.

If the VOM does not read the resistances shown while the relay is deenergized, contact the nearest Factory Authorized Service Station/Service Distributor.

- When the applicable user relay tests okay, use the Right/Increase or Left/Decrease push button to access another test, or stop the diagnostics program.

N. Remote Pendant Test

This procedure tests the operation of the push buttons on the Remote Pendant.

- When the repeating test displays are shown (see Section 7-2C), press Right/Increase or Left/Decrease until the display shows:

R E M O T E P E N D A N T
T E S T

- Press Parameter Select to begin the test. The display shows:

P U S H S T A R T / I N C
O N R E M O T E

- When this display appears, the control unit waits three seconds for the Start/Increase push button to be pressed. If this is done in time and the push button is working correctly, the display shows:

B U T T O N I S
W O R K I N G P R O P E R L Y

If the Start/Increase push button tests okay, go to Step 5.

- If the Start/Increase push button is not pressed in time, or if the push button is not working correctly, the display shows:

B U T T O N I S N O T
W O R K I N G P R O P E R L Y

If the Start/Increase push button is not working correctly, replace the push button.

- When the Start/Increase push button tests okay, press Parameter Select. The display shows:

P U S H D E C R E A S E B U T T O N
O N R E M O T E

- When this display appears, the control unit waits three seconds for the Decrease push button to be pressed. If this done in time and the push button is working correctly, the display shows:

B U T T O N I S
W O R K I N G P R O P E R L Y

If the Decrease push button tests okay, go to Step 8.

- If the Decrease push button is not pressed in time, or if the Decrease push button is not working correctly, the display shows:

B U T T O N I S N O T
W O R K I N G P R O P E R L Y

If the Decrease push button is not working correctly, replace the push button.

- When the Decrease push button tests okay, press Parameter Select. The display shows:

P U S H S T O P B U T T O N
O N R E M O T E

- When this display appears, the control unit waits three seconds for the Stop push button to be pressed. If this is done in time and the push button is working correctly, the display shows:

B U T T O N I S
W O R K I N G P R O P E R L Y

If the Stop push button tests okay, go to Step 11.

- If the Stop push button is not pressed in time, or if the push button is not working correctly, the display shows:

B U T T O N I S N O T
W O R K I N G P R O P E R L Y

If the Stop push button is not working correctly, replace the push button.

- When the Stop push button tests okay, press Parameter Select to exit the Remote Pendant tests. Use the Right/Increase or Left/Decrease push button to access another test, or stop the diagnostics program.

O. Current Detect Test

This procedure tests the operation of the circuitry that detects output current flow.

- When the repeating test displays are shown (see Section 7-2C), press Right/Increase or Left/Decrease until the display shows:

C U R R E N T D E T E C T
T E S T

- Press Parameter Select. The display scrolls through the following two displays:

P U T S H O R T C I R C U I T
O N O U T P U T S T U D S

R I G H T / I N C T O
C O N T I N U E T H I S T E S T

- Connect a suitable cable across the output terminals. The microprocessor control sends a reference current through the cable when Right/Increase is pressed.
- Press Right/Increase. If the current detect circuitry is working correctly, the display shows:

C U R R E N T D E T E C T I S
W O R K I N G P R O P E R L Y

If the current detect circuitry tests okay, go to Step 6.

- If the current detect circuitry is not working correctly, the display shows:

C U R R E N T D E T E C T I S
N O T W O R K I N G P R O P E R L Y

If the current detect circuitry is not working correctly, contact the nearest Factory Authorized Service Station/Service Distributor.

- When the current detect circuitry tests okay, press Parameter Select to exit the test. Use the Right/Increase or Left/Decrease push button to access another test, or stop the diagnostics program.

P. Input Contactor Test

This procedure tests the circuitry that detects an input contactor closure.

- When the repeating test displays are shown (see Section 7-2C), press Right/Increase or Left/Decrease until the display shows:

I N P U T C O N T A C T O R
T E S T

- Press Parameter Select to begin the test. The display shows:

P R O V I D E A C L O S U R E
O N R C 3 P I N S A T O B

3. When this display appears, the control unit waits three seconds for the specified contact closure. If this is done in time and the solid state contactor is working correctly, the display shows:

I N P U T C O N T A C T O R
I S D E T E C T E D

If the input contactor detection circuitry tests okay, go to Step 5.

4. If the input contactor closure is not carried out in time, or if the related circuitry is not working correctly, the display shows:

I N P U T C O N T A C T O R I S
N O T D E T E C T E D

If the input contactor circuitry is not working correctly, contact the nearest Factory Authorized Service Station/Service Distributor.

5. When input contactor closure tests okay, press Parameter Select to exit the test. Use the Right/Increase or Left/Decrease push button to access another test, or stop the diagnostics program.

SECTION 8 – ELECTRICAL DIAGRAMS

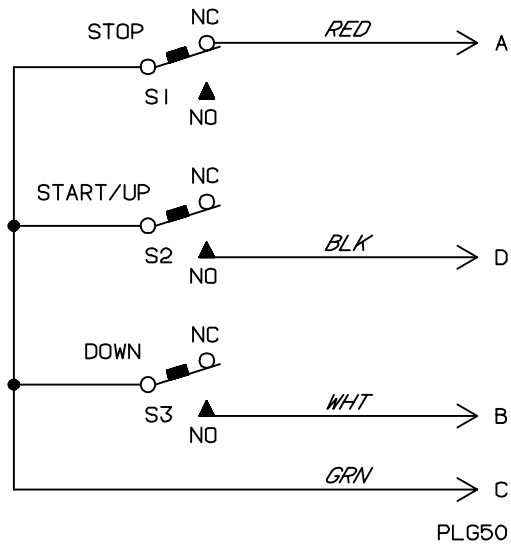


Figure 8-1. Circuit Diagram For Remote Pendant

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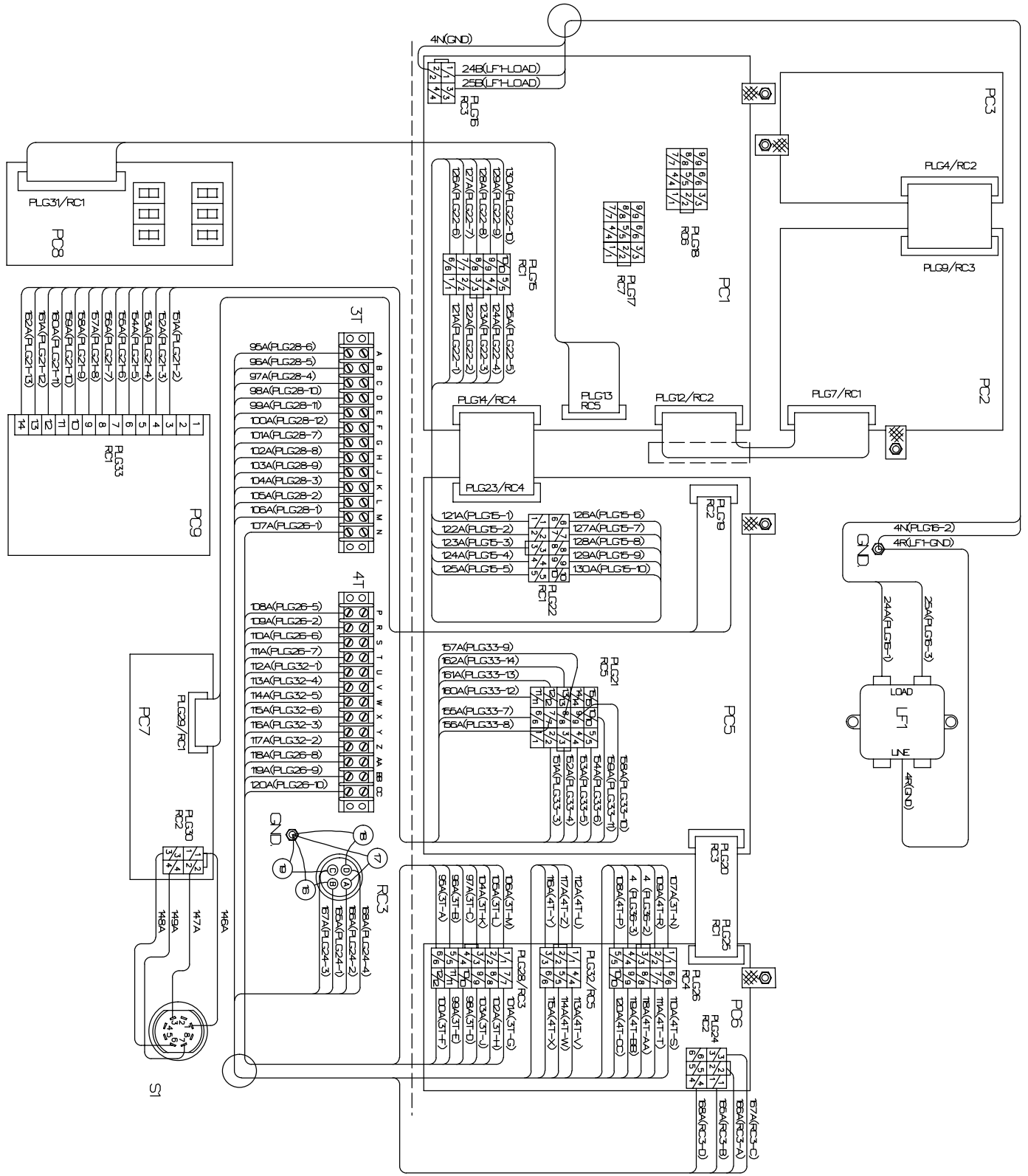


Figure 8-2. Wiring Diagram For MPC Module

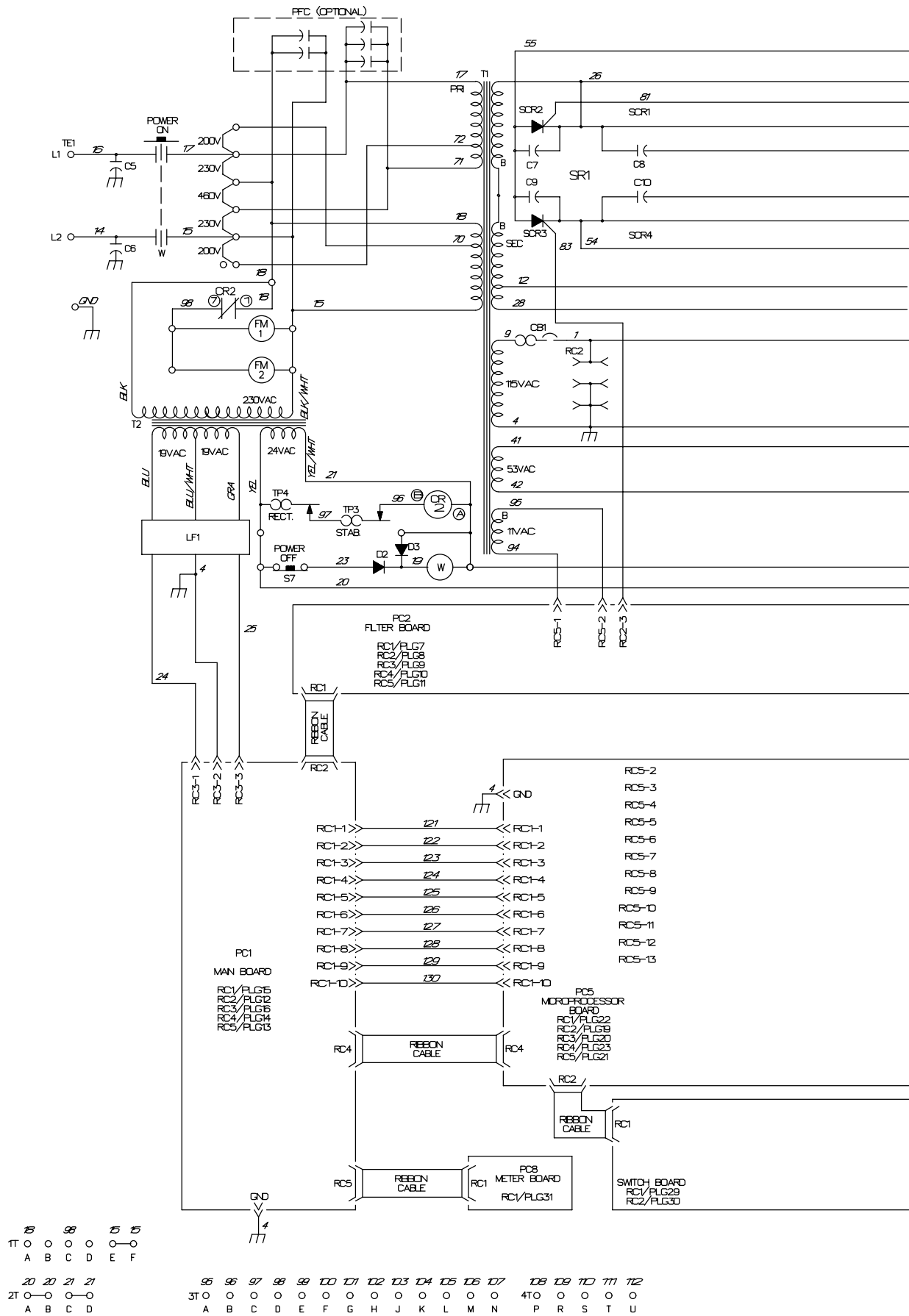
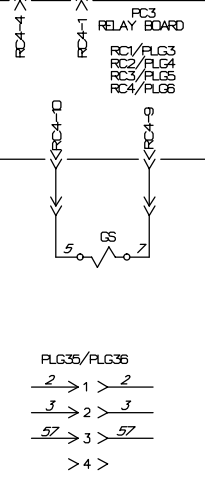
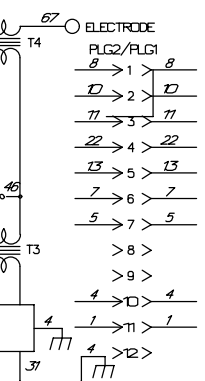
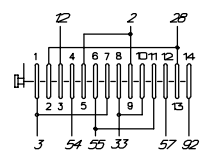
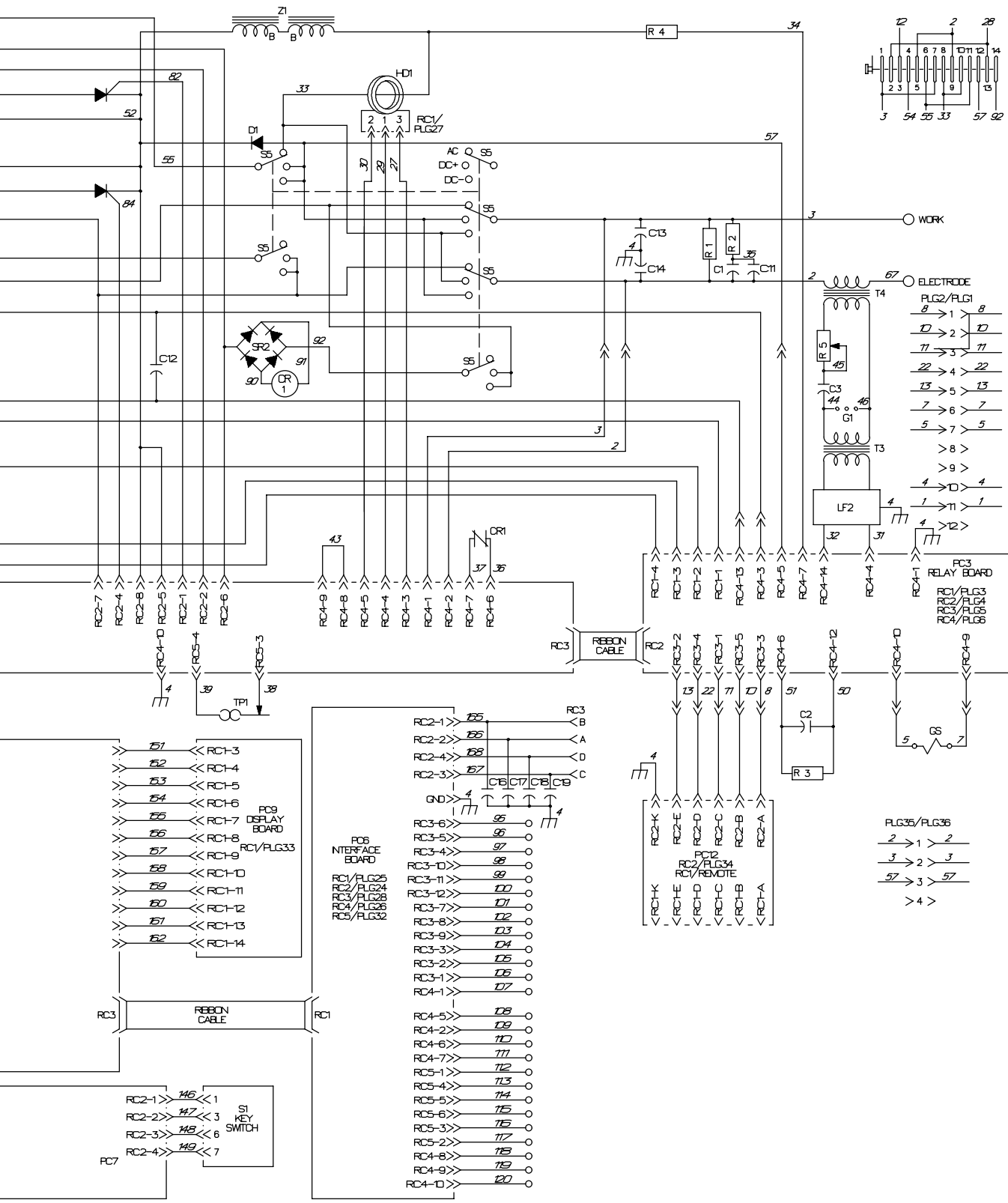


Figure 8-3. Circuit Diagram For Welding Power Source And MPC



113 114 115 116 117 118 119 120
 O O O O O O O O
 V W X Y Z AA BB CC

SECTION 9 – PARTS LIST

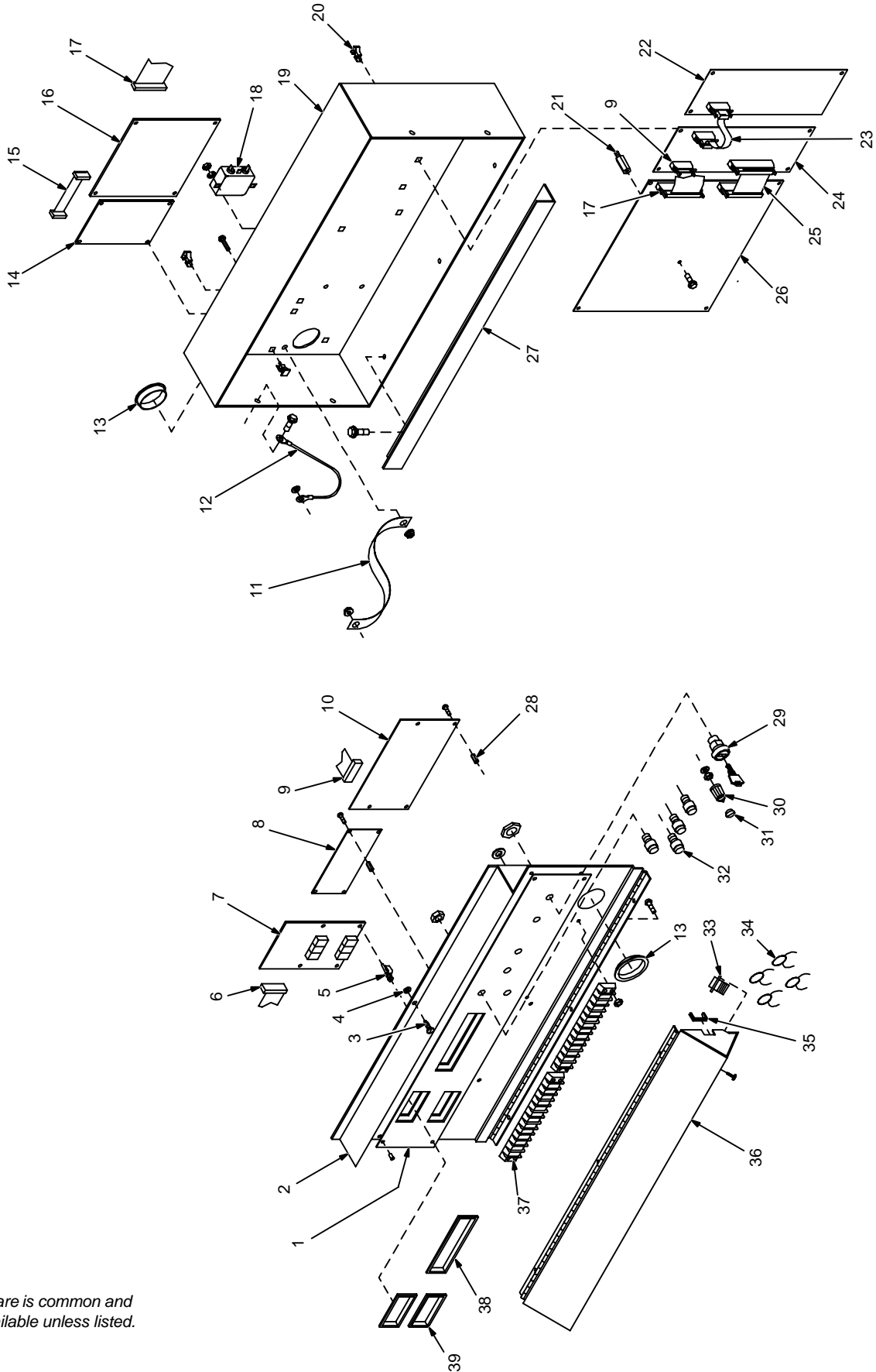


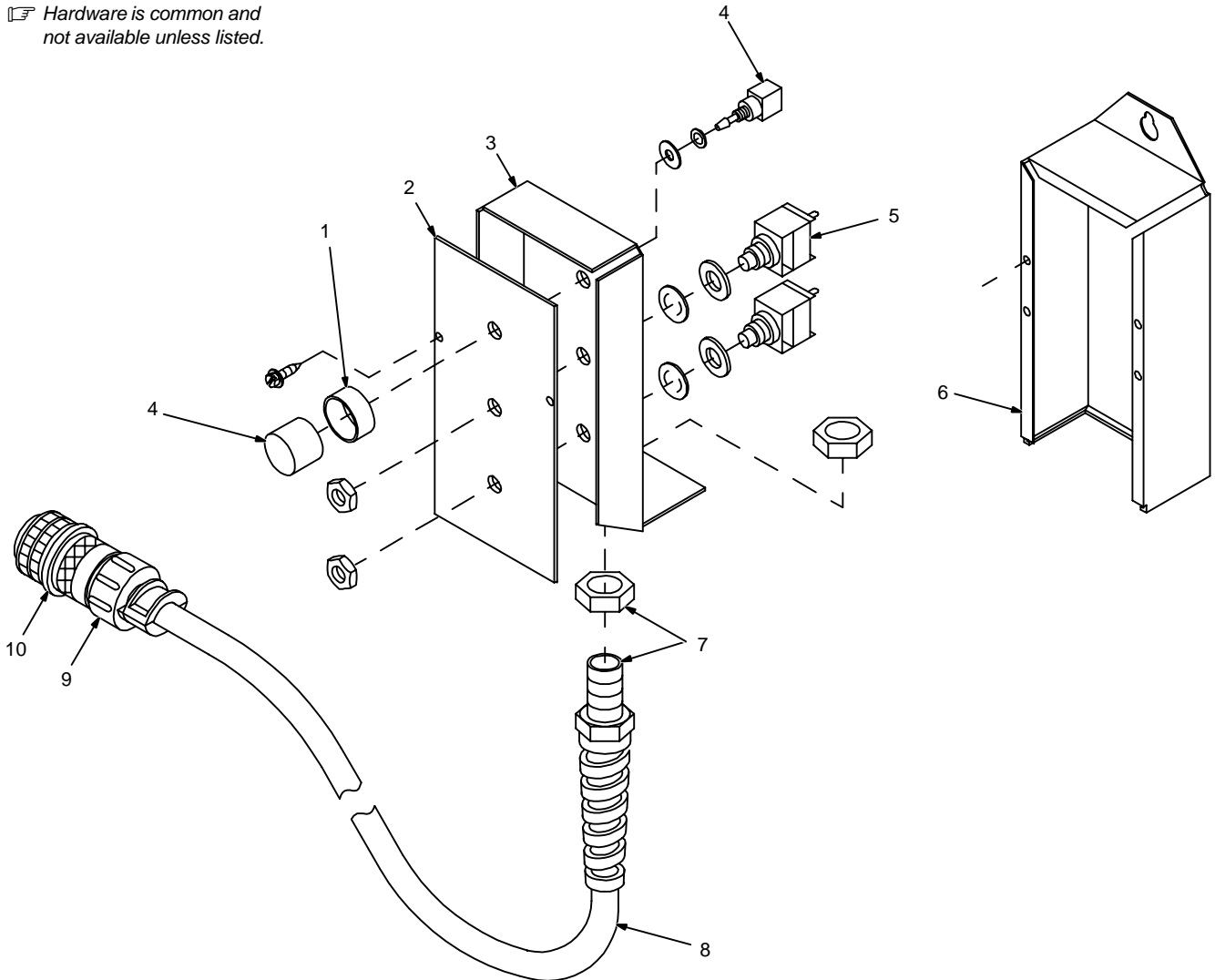
Figure 9-1. Main Assembly

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
Figure 9-1. Main Assembly				
1			NAMEPLATE, (order by model and serial number)	1
2		158 955	COVER, front electrical	1
3		078 034	FASTENER, screw sltd hd .736 lg	1
4		010 855	RETAINER, screw No. 2	1
5		110 375	STAND-OFF SUPPORT, PC card No. 6 screw	4
6	PLG13,31	155 511	CABLE, ribbon 10posn	1
7	PC8	157 741	CIRCUIT CARD, meter	1
8	PC9	156 046	DISPLAY, LED 2 x 20 alphanumeric fluorescent	1
	PLG33	156 045	CONNECTOR, rect 14skt plug Amp 1-640440-4	1
9	PLG19,29	142 138	CABLE, ribbon 14posn	1
10	PC7	151 518	CIRCUIT CARD, switch	1
	PLG30	115 094	CONNECTOR & SOCKETS	1
11		157 792	STRAP, grounding panel front	1
12		107 551	STRAIN RELIEF, cover	1
13		010 494	BUSHING, snap-in nyl 1.375 ID x 1.750mtg hole	2
14	PC3	157 737	CIRCUIT CARD, relay	1
15	PLG4,9	142 142	CABLE, ribbon 14posn	1
16	PC2	157 802	CIRCUIT CARD, filter	1
17	PLG7,12	142 141	CABLE, ribbon 40posn	1
18	LF1	084 171	FILTER, line pwr 115/250V	1
19		144 713	ELECTRONICS BOX	1
20		134 201	STAND-OFF SUPPORT, PC card .312/.375	20
21		098 691	STAND-OFF, 6-32 x .500 lg	4
22	PC6	180 158	CIRCUIT CARD, interface	1
	PLG24	153 501	CONNECTOR & SOCKETS	1
	PLG26	148 439	CONNECTOR & SOCKETS	1
	PLG28	158 720	CONNECTOR & SOCKETS	1
	PLG32	153 501	CONNECTOR & SOCKETS	1
23	PLG20,25	155 427	CABLE, ribbon 24posn	1
24	PC5	151 648	CIRCUIT CARD, microprocessor	1
	PLG21	152 249	CONNECTOR & SOCKETS	1
	PLG22	148 439	CONNECTOR & SOCKETS	1
25	PLG14,23	153 599	CABLE, ribbon 40posn	1
26	PC1	182 090	CIRCUIT CARD, control main	1
	PLG15	148 439	CONNECTOR & SOCKETS	1
	PLG16	150 317	CONNECTOR, rect 4 pin/skt plug Amp 172167-1	1
		147 995	CONNECTOR, rect skt 22-18ga Amp 170362-3	4
27		158 960	STRIP, mtg door	1
28		073 756	STAND-OFF, 6-32 x .625 lg	5
29	S1	125 945	SWITCH, key 3posn .750mtg hole	1
30		115 360	KNOB, arrow	1
31		115 359	CAP, peaked	1
32		089 186	ACTUATOR, switch	4
33	RC3	073 687	CONNECTOR, circ 4skt rcpt Amphenol MS-3102A-14S-2S	1
34	C16-19	157 856	CAPACITOR	4
35		603 107	HOSE, nprn slit bk .156 ID x .343 OD (order by ft)	1ft
36		158 959	DOOR, access terminal strip	1
37	3T,4T	038 833	BLOCK, term 20A 13P	2
38		126 908	BEZEL/FILTER, blue filter/nonglare 4 in	1
39		071 230	BEZEL/FILTER, blk bezel/red filter 2.000 viewing	2

To maintain the factory original performance of your equipment, use only Manufacturer's Suggested Replacement Parts. Model and serial number required when ordering parts from your local distributor.

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
132 064 Figure 9-2. Pendant				
1		079 725	GUARD, switch al knurled	1
2			NAMEPLATE, (order by model and serial number)	1
3		134 429	CASE SECTION, front/end	1
4	S1	079 724	SWITCH, PB MC SPDT 6A 125VAC	1
5	S2,3	021 105	SWITCH, PB Licon 76-2351 SPDT	2
6		148 348	CASE SECTION, back/sides/end	1
7		134 900	STRAIN RELIEF, cable flexible .270-.480 cable	1
8		604 571	CABLE, port No. 18 4/c (order by ft)	15ft
9		039 828	CONNECTOR, circ clamp str rlf sz 14-14S Amphenol AN-3057-6	1
10	PLG50	053 075	CONNECTOR, circ 4 pin plug Amphenol MS-3106A-14S-2P	1

☞ Hardware is common and not available unless listed.



ST-146 840-A

Figure 9-2. Pendant

To maintain the factory original performance of your equipment, use only Manufacturer's Suggested Replacement Parts. Model and serial number required when ordering parts from your local distributor.

TRUE BLUE® WARRANTY

Effective January 1, 2000

(Equipment with a serial number preface of "LA" or newer)

This limited warranty supersedes all previous Miller warranties and is exclusive with no other guarantees or warranties expressed or implied.

Warranty Questions?

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Your distributor also gives
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You always get the fast,
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parts can be in your
hands in 24 hours.

Support

Need fast answers to the
tough welding questions?
Contact your distributor.
The expertise of the
distributor and Miller is
there to help you, every
step of the way.

LIMITED WARRANTY – Subject to the terms and conditions below, Miller Electric Mfg. Co., Appleton, Wisconsin, warrants to its original retail purchaser that new Miller equipment sold after the effective date of this limited warranty is free of defects in material and workmanship at the time it is shipped by Miller. THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS.

Within the warranty periods listed below, Miller will repair or replace any warranted parts or components that fail due to such defects in material or workmanship. Miller must be notified in writing within thirty (30) days of such defect or failure, at which time Miller will provide instructions on the warranty claim procedures to be followed.

Miller shall honor warranty claims on warranted equipment listed below in the event of such a failure within the warranty time periods. All warranty time periods start on the date that the equipment was delivered to the original retail purchaser, or one year after the equipment is sent to a North American distributor or eighteen months after the equipment is sent to an International distributor.

1. 5 Years Parts – 3 Years Labor
 - * Original main power rectifiers
 - * Inverters (input and output rectifiers only)
2. 3 Years — Parts and Labor
 - * Transformer/Rectifier Power Sources
 - * Plasma Arc Cutting Power Sources
 - * Semi-Automatic and Automatic Wire Feeders
 - * Inverter Power Supplies
 - * Intelligig
 - * Engine Driven Welding Generators
(NOTE: Engines are warranted separately by the engine manufacturer.)
3. 1 Year — Parts and Labor
 - * DS-2 Wire Feeder
 - * Motor Driven Guns (w/exception of Spoolmate 185 & Spoolmate 250)
 - * Process Controllers
 - * Positioners and Controllers
 - * Automatic Motion Devices
 - * RFCS Foot Controls
 - * Induction Heating Power Sources
 - * Water Coolant Systems
 - * HF Units
 - * Grids
 - * Maxstar 140
 - * Spot Welders
 - * Load Banks
 - * Miller Cyclomatic Equipment
 - * Running Gear/Trailers
 - * Plasma Cutting Torches (except APT & SAF Models)
 - * Field Options
(NOTE: Field options are covered under True Blue® for the remaining warranty period of the product they are installed in, or for a minimum of one year — whichever is greater.)
4. 6 Months — Batteries
5. 90 Days — Parts
 - * MIG Guns/TIG Torches
 - * Induction Heating Coils and Blankets

- * APT, ZIPCUT & PLAZCUT Model Plasma Cutting Torches
- * Remote Controls
- * Accessory Kits
- * Replacement Parts (No labor)
- * Spoolmate 185 & Spoolmate 250
- * Canvas Covers

Miller's True Blue® Limited Warranty shall not apply to:

1. **Consumable components; such as contact tips, cutting nozzles, contactors, brushes, slip rings, relays or parts that fail due to normal wear.**
2. Items furnished by Miller, but manufactured by others, such as engines or trade accessories. These items are covered by the manufacturer's warranty, if any.
3. Equipment that has been modified by any party other than Miller, or equipment that has been improperly installed, improperly operated or misused based upon industry standards, or equipment which has not had reasonable and necessary maintenance, or equipment which has been used for operation outside of the specifications for the equipment.

MILLER PRODUCTS ARE INTENDED FOR PURCHASE AND USE BY COMMERCIAL/INDUSTRIAL USERS AND PERSONS TRAINED AND EXPERIENCED IN THE USE AND MAINTENANCE OF WELDING EQUIPMENT.

In the event of a warranty claim covered by this warranty, the exclusive remedies shall be, at Miller's option: (1) repair; or (2) replacement; or, where authorized in writing by Miller in appropriate cases, (3) the reasonable cost of repair or replacement at an authorized Miller service station; or (4) payment of or credit for the purchase price (less reasonable depreciation based upon actual use) upon return of the goods at customer's risk and expense. Miller's option of repair or replacement will be F.O.B., Factory at Appleton, Wisconsin, or F.O.B. at a Miller authorized service facility as determined by Miller. Therefore no compensation or reimbursement for transportation costs of any kind will be allowed.

TO THE EXTENT PERMITTED BY LAW, THE REMEDIES PROVIDED HEREIN ARE THE SOLE AND EXCLUSIVE REMEDIES. IN NO EVENT SHALL MILLER BE LIABLE FOR DIRECT, INDIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES (INCLUDING LOSS OF PROFIT), WHETHER BASED ON CONTRACT, TORT OR ANY OTHER LEGAL THEORY.

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Some states in the U.S.A. do not allow limitations of how long an implied warranty lasts, or the exclusion of incidental, indirect, special or consequential damages, so the above limitation or exclusion may not apply to you. This warranty provides specific legal rights, and other rights may be available, but may vary from state to state.

In Canada, legislation in some provinces provides for certain additional warranties or remedies other than as stated herein, and to the extent that they may not be waived, the limitations and exclusions set out above may not apply. This Limited Warranty provides specific legal rights, and other rights may be available, but may vary from province to province.





Owner's Record

Please complete and retain with your personal records.

Model Name	Serial/Style Number
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Purchase Date	(Date which equipment was delivered to original customer.)
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Distributor	
-------------	--

Address	
---------	--

City	
------	--

State	Zip
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For Service

Call 1-800-4-A-Miller or see our website at www.MillerWelds.com to locate a DISTRIBUTOR or SERVICE AGENCY near you.

Always provide Model Name and Serial/Style Number.

-
- | | |
|-------------------------------|---|
| Contact your Distributor for: | Welding Supplies and Consumables |
| | Options and Accessories |
| | Personal Safety Equipment |
| | Service and Repair |
| | Replacement Parts |
| | Training (Schools, Videos, Books) |
| | Technical Manuals (Servicing Information and Parts) |
| | Circuit Diagrams |
| | Welding Process Handbooks |

Contact the Delivering Carrier for: File a claim for loss or damage during shipment.

For assistance in filing or settling claims, contact your distributor and/or equipment manufacturer's Transportation Department.

Miller Electric Mfg. Co.

An Illinois Tool Works Company
1635 West Spencer Street
Appleton, WI 54914 USA

International Headquarters—USA

USA Phone: 920-735-4505 Auto-Attended
USA & Canada FAX: 920-735-4134
International FAX: 920-735-4125

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