THERMAL ARC®

A THERMADYNE® Company

INVERTER
ARC
WELDER

MODEL 185TSW AC/DC CC

STICK

TIG - Lift Start

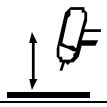
HF START

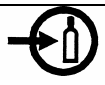
SERVICE MANUAL

February 7, 2005 Manual No. 430429-512

CONTENTS

SYMBOL LEGEND

A	**Amperage**
V	**Voltage**
Hz	**Hertz (frequency)**
SEC	**Seconds**
%	**Percent**
⎓	**DC (Direct Current)**
∿	**AC (Alternating Current**
	**Standard Function**
	**Slope Function**
	**Slope W/Repeat Function**
	**Spot Function**
	**Impulse Starting (High Frequency GTAW)**
	**Touch Start (Lift Start TIG circuit GTAW)**

	**STICK (Shielded Metal Arc SMAW)**
	**Pulse Current Function**
	**Spot Time (GTAW)**
	**Remote Control (Panel/Remote)**
	**Remote Function**
	**Arc Control (SMAW)**
	**Gas Post-Flow**
	**Gas Pre-Flow**
VRD	**Voltage Reduction Device Circuit**
—	**Negative**
+	**Positive**
	**Gas Input**
	**Gas Output**

STATEMENT OF WARRANTY

LIMITED WARRANTY: Thermal Arc®, Inc., A Thermadyne Company, hereafter, "Thermal Arc" warrants to customers of its authorized distributors hereafter "Thermal; Arc" that its products will be free of defects in workmanship or material. Should any failure to conform to this warranty appear within the time period applicable to the Thermal Arc products as stated below, Thermal Arc shall, upon notification thereof and substantiation that the product has been stored, installed, operated, and maintained in accordance with Thermal Arc's specifications, instructions, recommendations and recognized standard industry practice, and not subject to misuse, repair, neglect, alteration, or accident, correct such defects by suitable repair or replacement, at Thermal Arc's sole option, of any components or parts of the product determined by Thermal Arc to be defective.

THERMAL ARC MAKES NO OTHER WARRANTY, EXPRESS OR IMPLIED. THIS WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHERS, INCLUDING, BUT NOT LIMITED TO ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

LIMITATION OF LIABILITY: Thermal Arc shall not under any circumstances be liable for special, indirect or consequential damages, such as, but not limited to, lost profits and business interruption. The remedies of the Purchaser set forth herein are exclusive and the liability of Thermal Arc with respect to any contract, or anything done in connection therewith such as the performance or breach thereof, or from the manufacture, sale, delivery, resale, or use of any goods covered by or furnished by Thermal Arc whether arising out of contract, negligence, strict tort, or under any warranty, or otherwise, shall not, except as expressly provided herein, exceed the price of the goods upon which such liability is based. No employee, agent, or representative of Thermal Arc is authorized to change this warranty in any way or grant any other warranty.

PURCHASER'S RIGHTS UNDER THIS WARRANTY ARE VOID IF REPLACEMENT PARTS OR ACCESSORIES ARE USED WHICH IN THERMAL ARC'S SOLE JUDGEMENT MAY IMPAIR THE SAFETY OR PERFORMANCE OF ANY THERMAL ARC PRODUCT.

PURCHASER'S RIGHTS UNDER THIS WARRANTY ARE VOID IF THE PRODUCT IS SOLD TO PURCHASER BY NON-AUTHORIZED PERSONS.

The warranty is effective for the time stated below beginning on the date that the authorized distributor delivers the products to the Purchaser. Notwithstanding the foregoing, in no event shall the warranty period extend more than the time stated plus one year from the date Thermal Arc delivered the product to the authorized distributor.

POWER SUPPLIES	**POWER SUPPLIES & WIRE FEEDERS**	**LABOR**
MAIN POWER MAGNETICS (STATIC & ROTATING)	3 YEAR	3 YEAR
ORIGINAL MAIN POWER RECTIFIER	3 YEAR	3 YEAR
POWER SWITCHING SEMI-CONDUCTORS & CONTROL PC BOARD	3 YEAR	3 YEAR
ALL OTHER CIRCUITS AND COMPONENTS INCLUDING BUT NOT LIMITED TO, CONTACTORS, RELAYS, SOLENOIDS, PUMPS, SWITCHES, MOTORS	1 YEAR	1 YEAR

ENGINES: ENIGINES ARE NOT WARRANTED BY THERMAL ARC, ALTHOUGH MOST ARE WARRANTED BY THE ENGINE MANUFACTURER, SEE THE ENGINE MANUFACTURES WARRANTY FOR DETAILS.

CONSOLES, CONTROL EQUIPMENT, HEAT EXCHANGES, AND ACCESSORY EQUIPMENT	1 YEAR	1 YEAR
PLASMA TORCH AND LEADS, AND REMOTE CONTROLS	180 DAYS	180 DAYS
REPAIR/REPLACEMENT PARTS	90 DAYS	90 DAYS

Warranty repairs or replacement claims under this limited warranty must be submitted to Thermal Arc by an authorized Thermal Arc repair facility within thirty (30) days of purchaser's notice of any Warranty Claim. No transportation costs of any kind will be paid under this warranty. Transportation charges to send products to an authorized warranty repair facility shall be the responsibility of the Purchaser. All returned goods shall be at the Purchaser's risk and expense. This warranty supersedes all previous Thermal Arc warranties.

Effective April 1, 2002

1.0 GENERAL INFORMATION

1.01 Notes, Cautions and Warnings

Throughout this manual, notes, cautions, and warnings are used to highlight important information. These highlights are categorized as follows:

NOTE

An operation, procedure, or background information which requires additional emphasis or is helpful in efficient operation of the system.

CAUTION

A procedure which, if not properly followed, may cause damage to the equipment.

WARNING

A procedure which, if not properly followed, may cause injury to the operator or others in the operating area.

1.02 Important Safety Precautions

WARNING

OPERATION AND MAINTENANCE OF ARC WELDING EQUIPMENT CAN BE DANGEROUS AND HAZARDOUS TO YOUR HEALTH.

To prevent possible injury, read, understand and follow all warnings, safety precautions and instructions before using the equipment. Call 1-800-462-2782 or your local distributor if you have any questions.

GASES AND FUMES

Gases and fumes produced during the Arc welding/cutting process can be dangerous and hazardous to your health.

- Keep all fumes and gases from the breathing area. Keep your head out of the welding fume plume.
- Use an air-supplied respirator if ventilation is not adequate to remove all fumes and gases.
- The kinds of fumes and gases from the arc welding/cutting depend on the kind of metal being used, coatings on the metal, and the different processes. You must be very careful when cutting or welding any metals which may contain one or more of the following:

Antimony	Chromium	Mercury
Arsenic	Cobalt	Nickel
Barium	Copper	Selenium
Beryllium	Lead	Silver
Cadmium	Manganese	
Vanadium		

- Always read the Material Safety Data Sheets (MSDS) that should be supplied with the material you are using. These MSDSs will give you the information regarding the kind and amount of fumes and gases that may be dangerous to your health.
- For information on how to test for fumes and gases in your workplace, refer to item 1 in Subsection 1.03, Publications in this manual.
- Use special equipment, such as water or down draft welding/cutting tables, to capture fumes and gases.
- Do not use the welding torch in an area where combustible or explosive gases or materials are located.
- Phosgene, a toxic gas, is generated from the vapors of chlorinated solvents and cleansers. Remove all sources of these vapors.

ELECTRIC SHOCK

Electric Shock can injure or kill. The arc welding process uses and produces high voltage electrical energy. This electric energy can cause severe or fatal shock to the operator or others in the workplace.

- Never touch any parts that are electrically "live" or "hot."
- Wear dry gloves and clothing. Insulate yourself from the work piece or other parts of the welding circuit.
- Repair or replace all worn or damaged parts.
- Extra care must be taken when the workplace is moist or damp.
- Install and maintain equipment according to NEC code, refer to item 4 in Subsection 1.03, Publications.

- Disconnect power source before performing any service or repairs.
- Read and follow all the instructions in the Operating Manual.


FIRE AND EXPLOSION

Fire and explosion can be caused by hot slag, sparks, or the arc weld.

- Be sure there is no combustible or flammable material in the workplace. Any material that cannot be removed must be protected.
- Ventilate all flammable or explosive vapors from the workplace.
- Do not cut or weld on containers that may have held combustibles.
- Provide a fire watch when working in an area where fire hazards may exist.
- Hydrogen gas may be formed and trapped under aluminum workpieces when they are cut underwater or while using a water table. **DO NOT** cut aluminum alloys underwater or on a water table unless the hydrogen gas can be eliminated or dissipated. Trapped hydrogen gas that is ignited will cause an explosion.


NOISE

Noise can cause permanent hearing loss. Arc welding/cutting processes can cause noise levels to exceed safe limits. You must protect your ears from loud noise to prevent permanent loss of hearing.

- To protect your hearing from loud noise, wear protective ear plugs and/or ear muffs. Protect others in the workplace.
- Noise levels should be measured to be sure the decibels (sound) do not exceed safe levels.
- For information on how to test for noise, see item 1 in Subsection 1.03, Publications, in this manual.


ARC WELDING RAYS

Arc Welding/Cutting Rays can injure your eyes and burn your skin. The arc welding/cutting process produces very bright ultra violet and infra red light. These arc rays will damage your eyes and burn your skin if you are not properly protected.

- To protect your eyes, always wear a welding helmet or shield. Also always wear safety glasses with side shields, goggles or other protective eye wear.
- Wear welding gloves and suitable clothing to protect your skin from the arc rays and sparks.
- Keep helmet and safety glasses in good condition. Replace lenses when cracked, chipped or dirty.
- Protect others in the work area from the arc rays. Use protective booths, screens or shields.
- Use the shade of lens as recommended in Subsection 1.03, item 4.

1.03 Publications

Refer to the following standards or their latest revisions for more information:

1. OSHA, SAFETY AND HEALTH STANDARDS, 29CFR 1910, obtainable from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402
2. ANSI Standard Z49.1, SAFETY IN WELDING AND CUTTING, obtainable from the American Welding Society, 550 N.W. LeJeune Rd, Miami, FL 33126
3. NIOSH, SAFETY AND HEALTH IN ARC WELDING AND GAS WELDING AND CUTTING, obtainable from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402
4. ANSI Standard Z87.1, SAFE PRACTICES FOR OCCUPATION AND EDUCATIONAL EYE AND FACE PROTECTION, obtainable from American National Standards Institute, 1430 Broadway, New York, NY 10018
5. ANSI Standard Z41.1, STANDARD FOR MEN'S SAFETY-TOE FOOTWEAR, obtainable from the American National Standards Institute, 1430 Broadway, New York, NY 10018
6. ANSI Standard Z49.2, FIRE PREVENTION IN THE USE OF CUTTING AND WELDING PROCESSES, obtainable from American National Standards Institute, 1430 Broadway, New York, NY 10018
7. AWS Standard A6.0, WELDING AND CUTTING CONTAINERS WHICH HAVE HELD COMBUSTIBLES, obtainable from

American Welding Society, 550 N.W. LeJeune Rd, Miami, FL 33126

8. NFPA Standard 51, OXYGEN-FUEL GAS SYSTEMS FOR WELDING, CUTTING AND ALLIED PROCESSES, obtainable from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269
9. NFPA Standard 70, NATIONAL ELECTRICAL CODE, obtainable from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269
10. NFPA Standard 51B, CUTTING AND WELDING PROCESSES, obtainable from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269
11. CGA Pamphlet P-1, SAFE HANDLING OF COMPRESSED GASES IN CYLINDERS, obtainable from the Compressed Gas Association, 1235 Jefferson Davis Highway, Suite 501, Arlington, VA 22202
12. CSA Standard W117.2, CODE FOR SAFETY IN WELDING AND CUTTING, obtainable from the Canadian Standards Association, Standards Sales, 178 Rexdale Boulevard, Rexdale, Ontario, Canada M9W 1R3
13. NWSA booklet, WELDING SAFETY BIBLIOGRAPHY obtainable from the National Welding Supply Association, 1900 Arch Street, Philadelphia, PA 19103
14. American Welding Society Standard AWSF4.1, RECOMMENDED SAFE PRACTICES FOR THE PREPARATION FOR WELDING AND CUTTING OF CONTAINERS AND PIPING THAT HAVE HELD HAZARDOUS SUBSTANCES, obtainable from the American Welding Society, 550 N.W. LeJeune Rd, Miami, FL 33126
15. ANSI Standard Z88.2, PRACTICE FOR RESPIRATORY PROTECTION, obtainable from American National Standards Institute, 1430 Broadway, New York, NY 10018

1.04 Note, Attention et Avertissement

Dans ce manuel, les mots “note,” “attention,” et “avertissement” sont utilisés pour mettre en relief des informations à caractère important. Ces mises en relief sont classifiées comme suit :

NOTE

Toute opération, procédure ou renseignement général sur lequel il importe d’insister davantage ou qui contribue à l’efficacité de fonctionnement du système.

ATTENTION

Toute procédure pouvant résulter l’endommagement du matériel en cas de non-respect de la procédure en question.

AVERTISSEMENT

Toute procédure pouvant provoquer des blessures de l’opérateur ou des autres personnes se trouvant dans la zone de travail en cas de non-respect de la procédure en question.

1.05 Precautions De Securite Importantes

AVERTISSEMENT

L’OPÉRATION ET LA MAINTENANCE DU MATÉRIEL DE SOUDAGE À L’ARC AU JET DE PLASMA PEUVENT PRÉSENTER DES RISQUES ET DES DANGERS DE SANTÉ.

Il faut communiquer aux opérateurs et au personnel TOUS les dangers possibles. Afin d’éviter les blessures possibles, lisez, comprenez et suivez tous les avertissements, toutes les précautions de sécurité et toutes les consignes avant d’utiliser le matériel. Composez le + 1-800-462-2782 ou votre distributeur local si vous avez des questions.

 FUMÉE et GAZ

La fumée et les gaz produits par le procédé de jet de plasma peuvent présenter des risques et des dangers de santé.

- Eloignez toute fumée et gaz de votre zone de respiration. Gardez votre tête hors de la plume de fumée provenant du chalumeau.
- Utilisez un appareil respiratoire à alimentation en air si l’aération fournie ne permet pas d’éliminer la fumée et les gaz.
- Les sortes de gaz et de fumée provenant de l’arc de plasma dépendent du genre de métal utilisé, des revêtements se trouvant sur le métal et des différents procédés. Vous devez prendre soin lorsque vous coupez ou soudez tout métal pouvant contenir un ou plusieurs des éléments suivants:

antimoine	cadmium	mercure
argent	chrome	nickel
arsenic	cobalt	plomb
baryum	cuivre	sélénium
béryllium	manganèse	
vanadium		

- Lisez toujours les fiches de données sur la sécurité des matières (sigle américain “MSDS”); celles-ci devraient être fournies avec le matériel que vous utilisez. Les MSDS contiennent des renseignements quant à la quantité et la nature de la fumée et des gaz pouvant poser des dangers de santé.
- Pour des informations sur la manière de tester la fumée et les gaz de votre lieu de travail, consultez l’article 1 et les documents cités à la page 5.
- Utilisez un équipement spécial tel que des tables de coupe à débit d’eau ou à courant descendant pour capter la fumée et les gaz.
- N’utilisez pas le chalumeau au jet de plasma dans une zone où se trouvent des matières ou des gaz combustibles ou explosifs.
- Le phosgène, un gaz toxique, est généré par la fumée provenant des solvants et des produits de nettoyage chlorés. Eliminez toute source de telle fumée.

CHOC ELECTRIQUE

Les chocs électriques peuvent blesser ou même tuer. Le procédé au jet de plasma requiert et produit de l'énergie électrique haute tension. Cette énergie électrique peut produire des chocs graves, voire mortels, pour l'opérateur et les autres personnes sur le lieu de travail.

- Ne touchez jamais une pièce "sous tension" ou "vive"; portez des gants et des vêtements secs. Isolez-vous de la pièce de travail ou des autres parties du circuit de soudage.
- Réparez ou remplacez toute pièce usée ou endommagée.
- Prenez des soins particuliers lorsque la zone de travail est humide ou moite.
- Montez et maintenez le matériel conformément au Code électrique national des Etats-Unis. (Voir la page *5,* article 9.)
- Débranchez l'alimentation électrique avant tout travail d'entretien ou de réparation.
- Lisez et respectez toutes les consignes du Manuel de consignes.

INCENDIE ET EXPLOSION

Les incendies et les explosions peuvent résulter des scories chaudes, des étincelles ou de l'arc de plasma. Le procédé à l'arc de plasma produit du métal, des étincelles, des scories chaudes pouvant mettre le feu aux matières combustibles ou provoquer l'explosion de fumées inflammables.

- Soyez certain qu'aucune matière combustible ou inflammable ne se trouve sur le lieu de travail. Protégez toute telle matière qu'il est impossible de retirer de la zone de travail.
- Procurez une bonne aération de toutes les fumées inflammables ou explosives.
- Ne coupez pas et ne soudez pas les conteneurs ayant pu renfermer des matières combustibles.
- Prévoyez une veille d'incendie lors de tout travail dans une zone présentant des dangers d'incendie.
- Le gas hydrogène peut se former ou s'accumuler sous les pièces de travail en aluminium lorsqu'elles sont coupées sous l'eau ou sur une table d'eau. NE PAS couper les alliages en aluminium sous l'eau ou sur une table d'eau à moins que le gas hydrogène peut s'échapper ou se dissiper. Le gas hydrogène accumulé explosera si enflammé.

RAYONS D'ARC DE PLASMA

Les rayons provenant de l'arc de plasma peuvent blesser vos yeux et brûler votre peau. Le procédé à l'arc de plasma produit une lumière infra-rouge et des rayons ultra-violets très forts. Ces rayons d'arc nuiront à vos yeux et brûleront votre peau si vous ne vous protégez pas correctement.

- Pour protéger vos yeux, portez toujours un casque ou un écran de soudeur. Portez toujours des lunettes de sécurité munies de parois latérales ou des lunettes de protection ou une autre sorte de protection oculaire.
- Portez des gants de soudeur et un vêtement protecteur approprié pour protéger votre peau contre les étincelles et les rayons de l'arc.
- Maintenez votre casque et vos lunettes de protection en bon état. Remplacez toute lentille sale ou comportant fissure ou rognure.
- Protégez les autres personnes se trouvant sur la zone de travail contre les rayons de l'arc en fournissant des cabines ou des écrans de protection.
- Respectez le teint de lentille recommandé dans le article 4, page 5.
- Hydrogen gas may be present under aluminum workpieces during the cutting process when being cut underwater or using a water table. DO NOT cut aluminum underwater or on a water table unless the hydrogen gas can be eliminated as the hydrogen gas may detonate.

BRUIT

Le bruit peut provoquer une perte permanente de l'ouïe. Les procédés de soudage à l'arc de plasma peuvent provoquer des niveaux sonores supérieurs aux limites normalement acceptables. Vous dú4ez vous protéger les oreilles contre les bruits forts afin d'éviter une perte permanente de l'ouïe.

- Pour protéger votre ouïe contre les bruits forts, portez des tampons protecteurs et/ou des protections auriculaires. Protégez

également les autres personnes se trouvant sur le lieu de travail.

- Il faut mesurer les niveaux sonores afin d'assurer que les décibels (le bruit) ne dépassent pas les niveaux sûrs.
- Pour des renseignements sur la manière de tester le bruit, consultez l'article 1, page 5.

1.06 Documents De Reference

Consultez les normes suivantes ou les révisions les plus récentes ayant été faites à celles-ci pour de plus amples renseignements :

1. OSHA, NORMES DE SÉCURITÉ DU TRAVAIL ET DE PROTECTION DE LA SANTÉ, 29CFR 1910, disponible auprès du Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402
2. Norme ANSI Z49.1, LA SÉCURITÉ DES OPÉRATIONS DE COUPE ET DE SOUDAGE, disponible auprès de la Société Américaine de Soudage (American Welding Society), 550 N.W. LeJeune Rd., Miami, FL 33126
3. NIOSH, LA SÉCURITÉ ET LA SANTÉ LORS DES OPÉRATIONS DE COUPE ET DE SOUDAGE À L'ARC ET AU GAZ, disponible auprès du Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402
4. Norme ANSI Z87.1, PRATIQUES SURES POUR LA PROTECTION DES YEUX ET DU VISAGE AU TRAVAIL ET DANS LES ECOLES, disponible de l'Institut Américain des Normes Nationales (American National Standards Institute), 1430 Broadway, New York, NY 10018
5. Norme ANSI Z41.1, NORMES POUR LES CHAUSSURES PROTECTRICES, disponible auprès de l'American National Standards Institute, 1430 Broadway, New York, NY 10018
6. Norme ANSI Z49.2, PRÉVENTION DES INCENDIES LORS DE L'EMPLOI DE PROCÉDÉS DE COUPE ET DE SOUDAGE, disponible auprès de l'American National Standards Institute, 1430 Broadway, New York, NY 10018
7. Norme A6.0 de l'Association Américaine du Soudage (AWS), LE SOUDAGE ET LA COUPE DE CONTENEURS AYANT RENFERMÉ DES PRODUITS COMBUSTIBLES, disponible auprès de la American Welding Society, 550 N.W. LeJeune Rd., Miami, FL 33126
8. Norme 51 de l'Association Américaine pour la Protection contre les Incendies (NFPA), LES SYSTEMES À GAZ AVEC ALIMENTATION EN OXYGENE POUR LE SOUDAGE, LA COUPE ET LES PROCÉDÉS ASSOCIÉS, disponible auprès de la National Fire Protection Association, Batterymarch Park, Quincy, MA 02269
9. Norme 70 de la NFPA, CODE ELECTRIQUE NATIONAL, disponible auprès de la National Fire Protection Association, Batterymarch Park, Quincy, MA 02269
10. Norme 51B de la NFPA, LES PROCÉDÉS DE COUPE ET DE SOUDAGE, disponible auprès de la National Fire Protection Association, Batterymarch Park, Quincy, MA 02269
11. Brochure GCA P-1, LA MANIPULATION SANS RISQUE DES GAZ COMPRIMÉS EN CYLINDRES, disponible auprès de l'Association des Gaz Comprimés (Compressed Gas Association), 1235 Jefferson Davis Highway, Suite 501, Arlington, VA 22202
12. Norme CSA W117.2, CODE DE SÉCURITÉ POUR LE SOUDAGE ET LA COUPE, disponible auprès de l'Association des Normes Canadiennes, Standards Sales, 178 Rexdale Boulevard, Rexdale, Ontario, Canada, M9W 1R3
13. ivret NWSA, BIBLIOGRAPHIE SUR LA SÉCURITÉ DU SOUDAGE, disponible auprès de l'Association Nationale de Fournitures de Soudage (National Welding Supply Association), 1900 Arch Street, Philadelphia, PA 19103
14. Norme AWSF4.1 de l'Association Américaine de Soudage, RECOMMANDATIONS DE PRATIQUES SURES POUR LA PRÉPARATION À LA COUPE ET AU SOUDAGE DE CONTENEURS ET TUYAUX AYANT RENFERMÉ DES PRODUITS DANGEREUX , disponible auprès de la American Welding Society, 550 N.W. LeJeune Rd., Miami, FL 33126
15. Norme ANSI Z88.2, PRATIQUES DE PROTECTION RESPIRATOIRE, disponible auprès de l'American National Standards Institute, 1430 Broadway, New York, NY 10018

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2.0 INTRODUCTION AND DESCRIPTION

2.01 Description

The Thermal Arc™ Model 185TSW is a self contained single-phase AC/DC arc welding power source with Constant Current (CC) output characteristics. This unit is equipped with a Digital Volt/Amperage Meter, gas control valve, built in Sloper and Pulser, lift arc starter, and high-frequency arc starter for use with Gas Tungsten Arc Welding (GTAW), Gas Tungsten Arc Welding-Pulsed (GTAW-P) Gas Tungsten Arc Welding-Sloped (GTAW-S), and Shielded Metal Arc Welding (SMAW) processes. The power source is totally enclosed in an impact resistant, flame retardant and non-conductive plastic case.

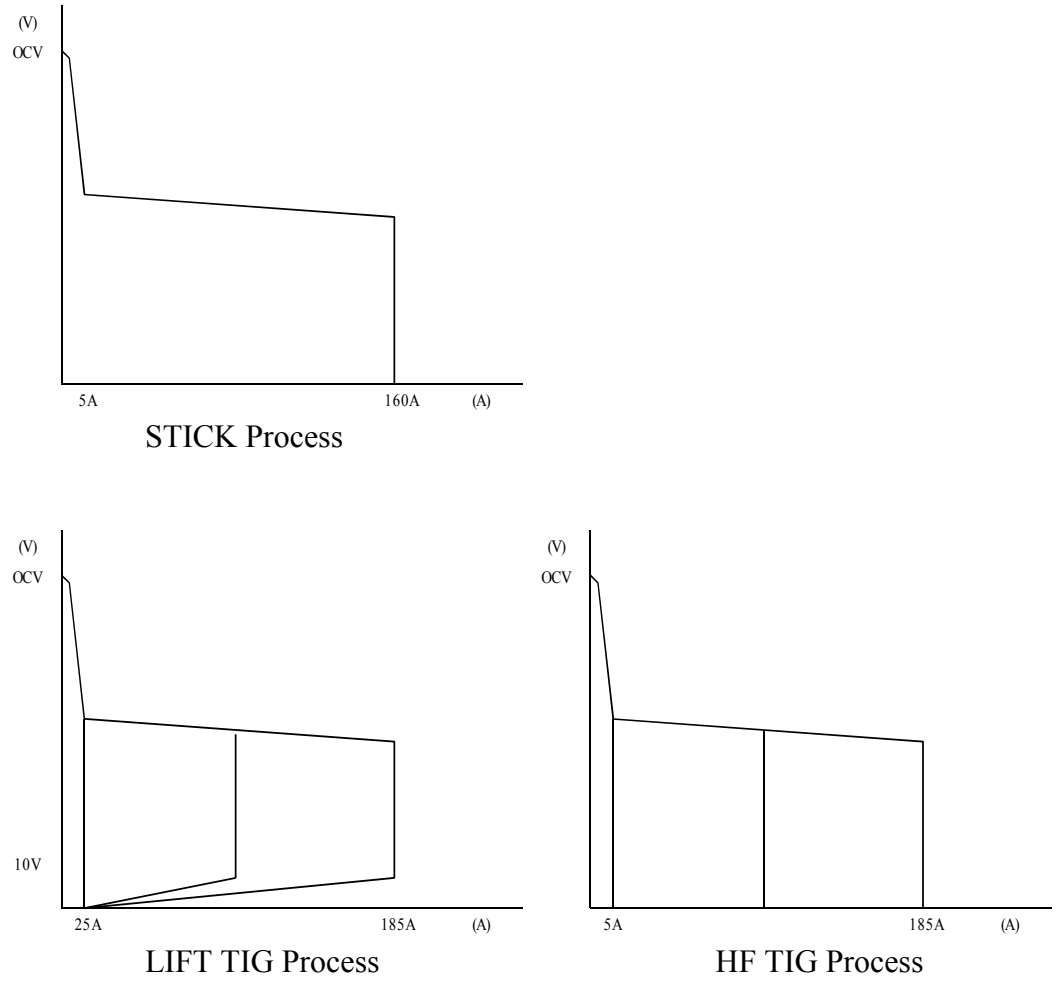

Figure 1. Model 185TSW Volt-Ampere curve

Note 1

Volt-Ampere curves show the maximum Voltage and Amperage output capabilities of the welding power source. Curves of other settings will fall between the curves shown.

2.02 Functional Block Diagrams

Figure 2 illustrates the functional block diagram of the 185TSW-power supply.

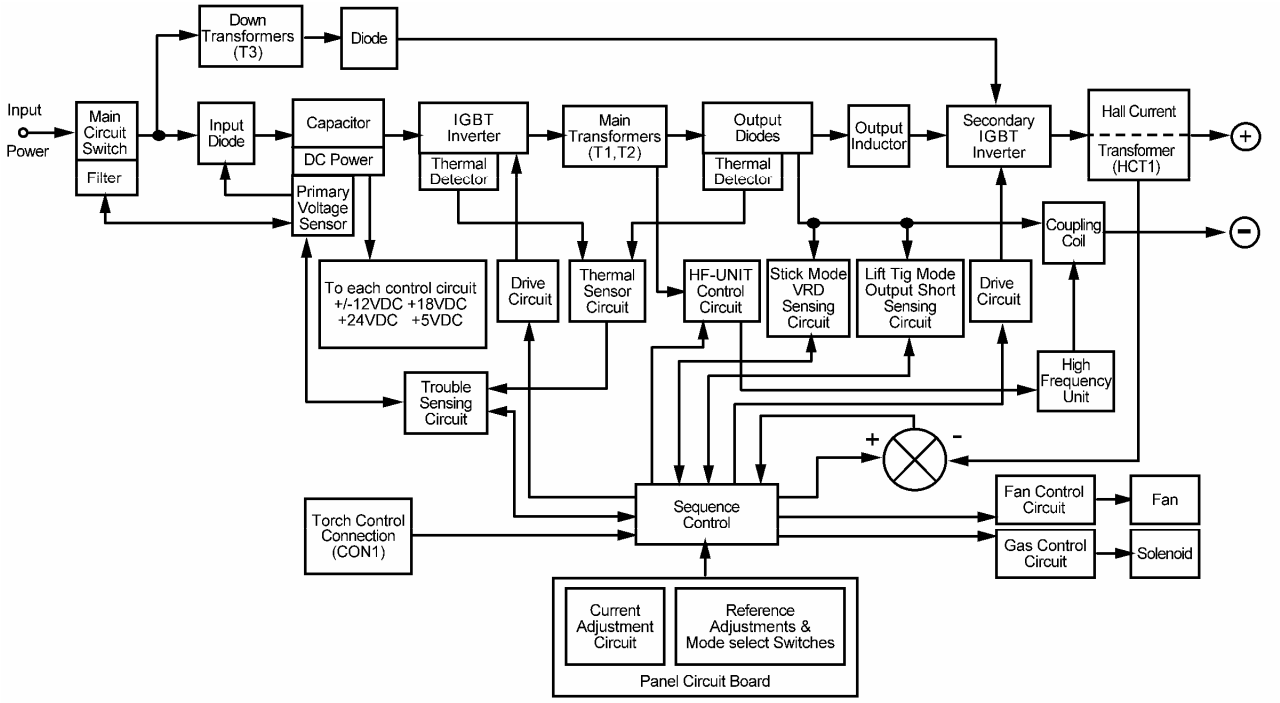

Figure 2. 185TSW Model Functional Block Diagram

2.03 Transporting Methods

These units are equipped with a handle for carrying purposes.

WARNING 1

ELECTRIC SHOCK can kill. DO NOT TOUCH live electrical parts. Disconnect input power conductors from de-energized supply line before moving the welding power source.

WARNING 2

FALLING EQUIPMENT can cause serious personal injury and equipment damage.

Lift unit with handle on top of case.
Use handcart or similar device of adequate capacity.
If using a fork lift vehicle, place and secure unit on a proper skid before transporting.

3.0 INSTALLATION RECOMMENDATIONS

3.01 Environment

The Pro-Wave 185TSW is designed for use in adverse environments.

Examples of environments with increased adverse conditions are -

a. In locations in which freedom of movement is restricted, so that the operator is forced to perform the work in a cramped (kneeling, sitting or lying) position with physical contact with conductive parts;
b. In locations which are fully or partially limited by conductive elements, and in which there is a high risk of unavoidable or accidental contact by the operator, or
c. In wet or damp hot locations where humidity or perspiration considerably reduces the skin resistance of the human body and the insulation properties of accessories.

Environments with adverse conditions do not include places where electrically conductive parts are in the near vicinity of the operator, which can cause increased hazard, have been insulated.

3.02 Location

Be sure to locate the welder according to the following guidelines:

- *In areas, free from moisture and dust.*
- *Ambient temperature between 0 degrees C to 40 degrees C.*
- *In areas, free from oil, steam and corrosive gases.*
- *In areas, not subjected to abnormal vibration or shock.*
- *In areas, not exposed to direct sunlight or rain.*
- *Place at a distance of 12" (304.79mm) or more from walls or similar that could restrict natural airflow for cooling.*

WARNING 3

Thermal Arc advises that this equipment be electrically connected by a qualified electrician.

3.03 Electrical Input Connections

WARNING 4

ELECTRIC SHOCK can kill; SIGNIFICANT DC VOLTAGE is present after removal of input power.

DO NOT TOUCH live electrical parts.
SHUT DOWN welding power source, disconnect input power employing lockout/tagging procedures. Lockout/tagging procedures consist of padlocking line disconnect switch in open position, removing fuses from fuse box, or shutting off and red-tagging circuit breaker or other disconnecting device.

3.03.01 Electrical Input Requirements

Operate the welding power source from a single-phase 50/60 Hz, AC power supply. The input voltage must match one of the electrical input voltages shown on the input data label on the unit nameplate. Contact the local electric utility for information about the type of electrical service available, how proper connections should be made, and any inspection required.

The line disconnect switch provides a safe and convenient means to completely remove all electrical power from the welding power supply whenever necessary to inspect or service the unit.

Note 2

These units are equipped with a two-conductor with earth power cable that is connected at the welding power source end for single-phase electrical input power.

Do not connect an input (WHITE or BLACK) conductor to the ground terminal.

Do not connect the ground (GREEN) conductor to an input line terminal.

Refer to figure 3 and:

1. Connect end of ground (GREEN) conductor to a suitable ground. Use a grounding method that complies with all applicable electrical codes.
2. Connect ends of line 1 (BLACK) and line 2 (WHITE) input conductors to a de-energized line disconnect switch.
3. Use Table 1 and Table 2 as a guide to select line fuses for the disconnect switch.

Input Voltage	Fuse Size
208V	45 Amps
230V	40 Amps

Table 1. Electrical Input Connections

Note 3

Fuse size is based on not more than 200 percent of the rated input amperage of the welding power source (Based on Article 630, National Electrical Code).

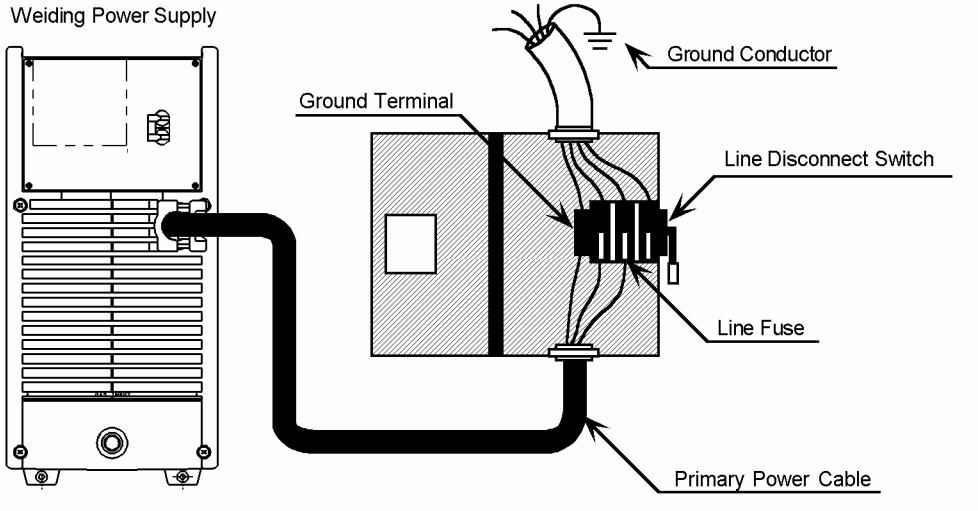

Figure 3. Electrical Input Connections

3.03.02 Input Power

Each unit incorporates an INRUSH circuit and input voltage sensing circuit. When the MAIN CIRCUIT SWITCH is turned on, the inrush circuit provides a pre-charging of the input capacitors. SCR's in the Power Control Assembly (PCA) will turn on after the input capacitors have charged to full operating voltage (after approximately 5 seconds).

Note 4

Note the available input power. Damage to the PCA could occur if 460VAC or higher is applied.

The following 208/230V Primary Current recommendations are required to obtain the maximum welding current and duty cycle from this welding equipment:

Model	**Primary Supply Lead Size (Factory Fitted)**	**Minimum Primary Current Circuit Size (Vin/Amps)**	**Current & Duty Cycle**	
			TIG	STICK
Pro-Wave 185TSW	12/3 AWG minimum	230/29	185 @ 30%	
		208/32		
		230/38	-	160 @ 40%
		208/40	-	

Table 2 – 208/230V Primary Current Circuit sizes to achieve maximum current

3.03.03 High Frequency Introduction

The importance of correct installation of high frequency welding equipment cannot be over-emphasized. Interference due to high frequency initiated or stabilized arc is almost invariably traced to improper installation. The following information is intended as a guide for personnel installing high frequency welding machines.

Warning

Explosives

The high frequency section of this machine has an output similar to a radio transmitter. The machine should NOT be used in the vicinity of blasting operations due to the danger of premature firing.

Computers

It is also possible that operation close to computer installations may cause computer malfunction.

3.03.04 High Frequency Interference

Interference may be transmitted by a high frequency initiated or stabilized arc welding machine in the following ways:

Direct Radiation

Radiation from the machine can occur if the case is metal and is not properly grounded. It can occur through apertures such as open access panels. The shielding of the high frequency unit in the Power Source will prevent direct radiation if the equipment is properly grounded.

Transmission via the Supply Lead

Without adequate shielding and filtering, high frequency energy may be fed to the wiring within the installation (mains) by direct coupling. The energy is then transmitted by both radiation and conduction. Adequate shielding and filtering is provided in the Power Source.

Radiation from Welding Leads

Radiated interference from welding leads, although pronounced in the vicinity of the leads, diminishes rapidly with distance. Keeping leads as short as possible will minimize this type of interference. Looping and suspending of leads should be avoided where possible.

Re-radiation from Unearthed Metallic Objects

A major factor contributing to interference is re-radiation from unearthed metallic objects close to the welding leads. Effective grounding of such objects will prevent re-radiation in most cases.

3.04 Specifications

Parameter		185TSW	
Rated Output Amperes Volts Duty Cycle		 185 17.4 25%	
Duty Cycle	TIG	185A / 17.4V @ 30% 160A / 16V @ 40% 130A / 15V @ 60% 100A / 14V @ 100%	
	STICK	160A / 26V @ 40% 130A / 25V @ 60% 100A / 25V @ 100%	
Output Current Range	TIG	5 – 185 (DC) 5 – 185 (AC) @ 60Hz, 50% Cleaning	
	STICK	5 – 160 (DC) 5 – 160 (AC) @ 60Hz, 50% Cleaning	
Open Circuit Voltage		69V	
Dimensions Width Height Length		 7.08” (180mm) 14.7” (360mm) 16.54” (420mm)	
Weight		41.8 lb. 19 kg	
Output @ Rated Load Rated Input Voltage Output Amperes Output Volts Duty Cycle KVA KW		 Single phase 230VAC 160A 26V 40% 8.7 5.2	
Output @ No Load KVA KW		 0.5 0.13	
Input Volts Single Phase 208V 230V		Amperage Draw @ Rated Load 40 38	No Load Amps 2.2 1.6

Thermal Arc continuously strives to produce the best product possible and therefore reserves the right to change, improve or revise the specifications or design of this or any product without prior notice. Such updates or changes do not entitle the buyer of equipment previously sold or shipped to the corresponding changes, updates, improvements or replacement of such items.
The values specified in the table above are optimal values, your values may differ. Individual equipment may differ from the above specifications due to in part, but not exclusively, to any one or more of the following; variations or changes in manufactured components, installation location and conditions and local power grid supply conditions.

3.05 Duty Cycle

The duty cycle of a welding power source is the percentage of a ten (10) minute period that it can be operated at a given output without causing overheating and damage to the unit. If the welding amperes decrease, the duty cycle increases. If the welding amperes are increased beyond the rated output, the duty cycle will decrease.

WARNING 5

Exceeding the duty cycle ratings will cause the thermal overload protection circuit to become energized and shut down the output until the unit has cooled to normal operating temperature.

CAUTION 1

Continually exceeding the duty cycle ratings can cause damage to the welding power source and will void the manufactures warranty.

NOTE 5

Due to variations that can occur in manufactured products, claimed performance, voltages, ratings, all capacities, measurements, dimensions and weights quoted are approximate only. Achievable capacities and ratings in use and operation will depend upon correct installation, use, applications, maintenance and service.

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4.0 OPERATOR CONTROLS

4.01 Pro-Wave 185TSW Controls

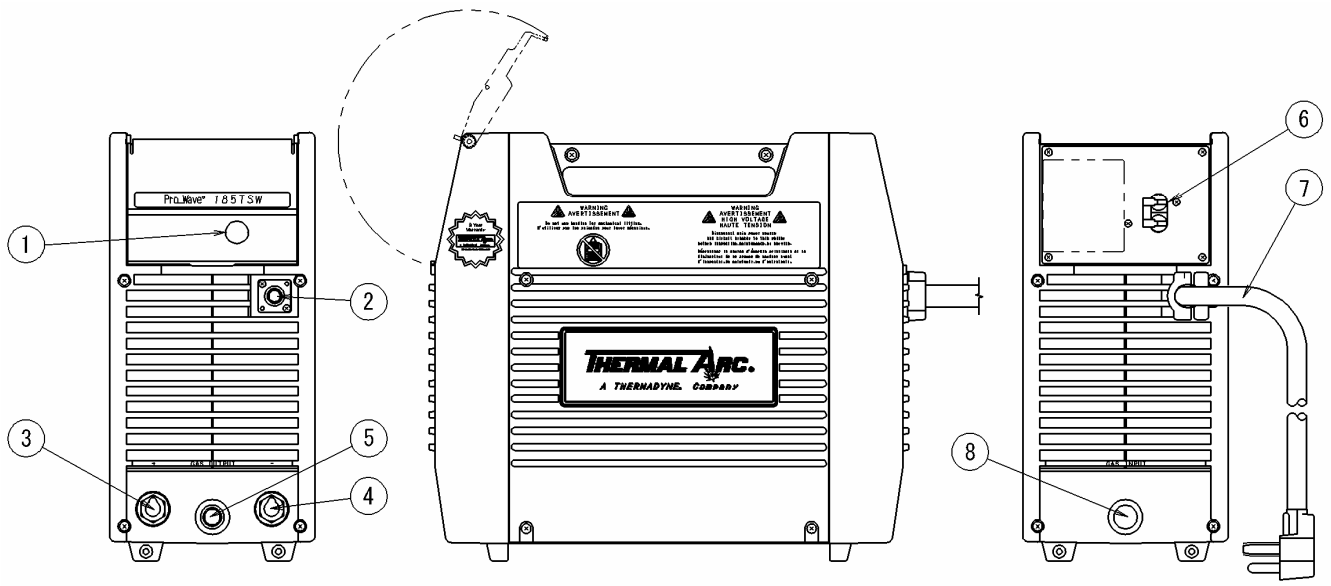


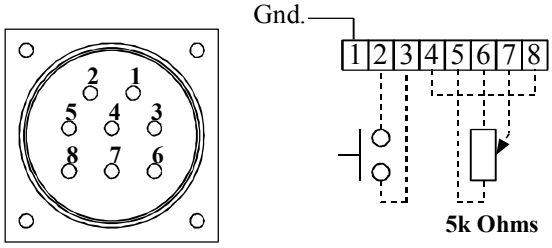
Figure 4– Pro-Wave 185TSW Power Source

1 *Control Knob*

This control sets the selected weld parameter, rotating it clockwise increases the parameter that is indicated on the digital meter. Pushing the knob inward displays the actual welding voltage.

2 *Remote Control Socket*

The 8 pin Remote Control Socket is used to connect remote current control devices to the welding Power Source. To make connections, align keyway, insert plug, and rotate threaded collar fully clockwise.



Front view of 8-Socket Receptacle

Socket Pin	Function
1	Earth (Ground)
2	Torch Switch Input (24V) to energize weld current. (connect pins 2 & 3 to turn on welding current)
3	Torch Switch Input (0V) to energize weld current (connect pins 2 & 3 to turn on welding current)
4	Connect pin 4 to pin 8 to instruct machine that a remote current control device is connected (12V DC supply)
5	5k ohm (maximum) connection to 5k ohm remote control potentiometer
6	Zero ohm (minimum) connection to 5k ohm remote control potentiometer
7	Wiper arm connection to 5k ohm remote control potentiometer
8	Connect pin 4 to pin 8 to instruct machine that a remote current control device is connected (0V)

3 *Positive Terminal*

Welding current flows from the Power Source via heavy duty Dinse type terminal. It is essential, however, that the male plug is inserted and turned securely to achieve a sound electrical connection.

4 Negative Terminal

Welding current flows from the Power Source via heavy duty Dinse type terminal. It is essential, however, that the male plug is inserted and turned securely to achieve a sound electrical connection.

CAUTION 2

Loose welding terminal connections can cause overheating and result in the male plug being fused in the bayonet terminal.

5 Gas Outlet

The Gas Outlet is a 5/8 18 UNF female gas fitting.

6 *ON/OFF Switch*

This switch connects the Primary supply voltage to the inverter when in the ON position. This enables the Power Supply.

WARNING 6

When the welder is connected to the Primary supply voltage, the internal electrical components maybe at 240V potential with respect to earth.

7 *Input Cable*

The input cable connects the Primary supply voltage to the equipment.

8 *Gas Inlet*

The Gas Inlet is a 5/8 18 UNF female gas fitting.

4.02 Weld Process selection for Pro-Wave 185TSW

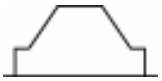
	Weld Mode			
Weld Process Selection	**STICK**	**HF TIG**	**LIFT TIG**	**Description**
 *STD*	Yes	Yes	Yes	2T operation in TIG Modes using remote devices to control contactor & current
 *SLOPE*	No	Yes	Yes	4T operation in TIG Modes with crater fill using a remote contactor device to control sequence.
 *REPEAT*	No	Yes	Yes	4T operation in TIG Modes with repeat operation and crater fill using a remote contactor device.
 *SPOT*	No	Yes	No	2T operation spot welding in HF TIG using a remote contactor device.
 *PULSE* ON/OFF	No	Yes	Yes	Pulse operation in TIG Modes
	Yes	Yes	Yes	Selects AC or DC weld current

Table 3 – Weld Process selection verses Weld Mode for Pro-Wave 185TSW

4.03 Weld Parameter Descriptions for Pro-Wave 185TSW

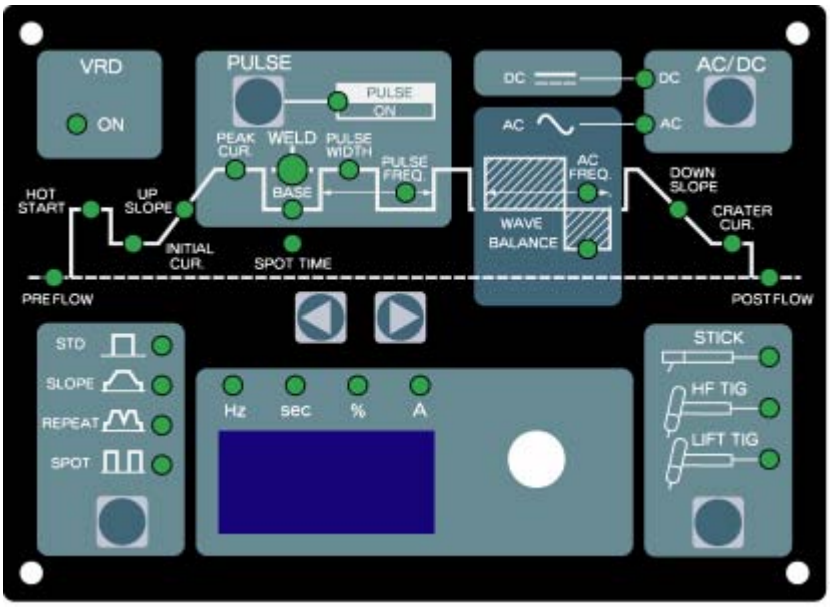


Figure 5 Pro-Wave 185TSW Front Panel with Parameter Description

Parameter	Description
 *PRE-FLOW*	This parameter operates in TIG modes only and is used to provide gas to the weld zone prior to striking the arc, once the torch trigger switch has been pressed. This control is used to dramatically reduce weld porosity at the start of a weld.
HOT START	This parameter operates in all weld modes except Lift TIG mode and is used to heat up the weld zone in TIG modes or improve the start characteristics for stick electrodes. e.g. low hydrogen electrodes. It sets the peak start current on top of the *BASE (WELD)* current. e.g. *HOT START* current = 130 amps when *BASE (WELD)* = 100 amps & *HOT START* = 30 amps
INITIAL CUR.	This parameter operates in *SLOPE* or *REPEAT* (4T) TIG modes only and is used to set the start current for TIG. The Start Current remains on until the torch trigger switch is released after it has been depressed.
UP SLOPE	This parameter operates in TIG modes only and is used to set the time for the weld current to ramp up, after the torch trigger switch has been pressed then released, from INITIAL CUR to PEAK or BASE current
PEAK CUR.	This parameter sets the PEAK weld current when in *PULSE* mode
WELD	This parameter sets the TIG WELD current in *STD*, *SLOPE*, *REPEAT* and *SPOT* modes when *PULSE* is off. This parameter also sets the STICK weld current.
BASE (Background Current)	This parameter sets the Background current when in Pulse TIG mode.
SPOT TIME	This parameter sets the duration of the *SPOT TIME* in *HF TIG* mode only

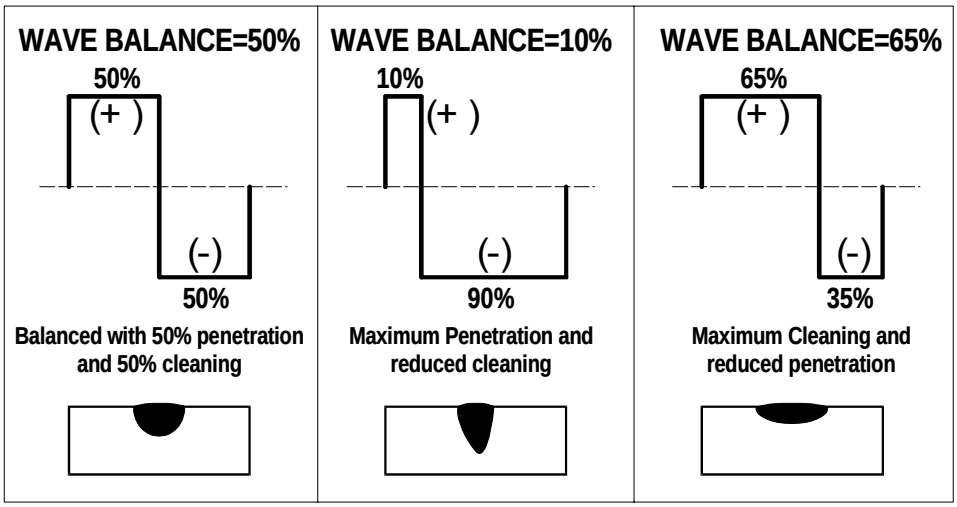
Parameter	Description
PULSE WIDTH	This parameter sets the percentage on time of the *PULSE FREQUENCY* for PEAK weld current when the *PULSE* is on.
PULSE FREQ.	This parameter sets the *PULSE FREQUENCY* when the *PULSE* is on.
AC FREQUENCY	This parameter operates in AC mode only and is used to set the frequency for the AC weld current.
WAVE BALANCE	This parameter is used for aluminum AC TIG mode and is used to set the penetration to cleaning action ratio for the AC weld current. Generally *WAVE BALANCE* is set to 50% for AC *STICK* welding. The *WAVE BALANCE* control changes the ratio of penetration to cleaning action of the AC TIG welding arc. Maximum weld penetration is achieved when the *WAVE BALANCE* control is set to 10%. Maximum cleaning of heavily oxidised aluminium or magnesium alloys is achieved when the *WAVE BALANCE* control is set to 65%. 
DOWN SLOPE	This parameter operates in TIG modes only and is used to set the time for the weld current to ramp down, after the torch trigger switch has been pressed, to *CRATER CUR.* This control is used to eliminate the crater that can form at the completion of a weld.
CRATER CUR.	This parameter operates in *SLOPE* or *REPEAT* (4T) TIG modes only and is used to set the finish current for TIG. The CRATER Current remains on until the torch trigger switch is released after it has been depressed.
POST-FLOW 	This parameter operates in TIG modes only and is used to adjust the post gas flow time once the arc has extinguished. This control is used to dramatically reduce oxidation of the tungsten electrode.

Table 4 – Weld Parameter Descriptions for Pro-Wave 185TSW

4.04 Weld Parameters for Pro-Wave 185TSW

Weld Parameter	Parameter Range	Factory Setting	Incremental Unit	Weld Mode		
				STICK	HF TIG	LIFT TIG
PRE-FLOW	0.0 to 1.0 sec	0.1 sec	0.1 sec	No	Yes	Yes
HOT START	0 to 70A	20A	1A	Yes	Yes	No
INITIAL CUR.	5 to 185A	30A	1A	No	Yes	Yes
UP SLOPE	0 to 15 sec	1 sec	0.1 sec	No	Yes	Yes
PEAK CUR.	5 to 185A	120A	1A	No	Yes	Yes
WELD CUR (TIG)	5 to 185A	80A	1A	No	Yes	Yes
WELD CUR (STICK)	5 to 160A	80A	1A	Yes	No	No
SPOT TIME	0.5 to 5.0 sec	2 sec	0.1 sec	No	Yes	Yes
PULSE WIDTH	15 to 80%	50%	1%	No	Yes	Yes
PULSE FREQ.	0.5 to 500Hz	100.0Hz	See Table 6	No	Yes	Yes
AC FREQUENCY	15 to 150Hz	50Hz	1Hz	Yes	Yes	Yes
WAVE BALANCE	10 to 65%	50%	1%	Yes	Yes	Yes
DOWN SLOPE	0 to 25 sec	3 sec	0.1 sec	No	Yes	Yes
CRATER CUR.	5 to 185A	30A	1A	No	Yes	Yes
POST-FLOW	0.0 to 60 sec	10 sec	0.1 sec	No	Yes	Yes

Table 5 – Weld Parameters for Pro-Wave 185TSW

***PULSE FREQ.* Range**	**Incremental Unit**
0.5 to 20Hz	0.1Hz
20 to 100Hz	1Hz
100 to 500Hz	5Hz

Table 6 – *PULSE FREQ.* Range and Incremental Units

4.05 Power Source Features

Feature	Description
New Digital Control	• Almost all welding parameters are adjustable
Touch Panel Switches	• Touch switches eliminate mechanical damage
Front Control Cover	• Protects front panel controls
Digital Meter	• Displays selected weld parameter value • Displays weld current when welding • Displays weld current for 20 seconds after weld has been completed • A selected weld parameter value can be adjusted at any time even while welding
Intelligent Fan Control	• The intelligent cooling system is designed to reduce dust and foreign material build-up, whilst providing optimum cooling. • Fan speed reduces approximately 30 seconds after machine is turned on • Fan speed increases when internal components reaches operating temperature
ON/OFF switch	• Primary voltage Supply ON/OFF switch located on rear panel
Voltage Reduction Device (VRD)	Reduces the OCV when the power supply is not in use. Eliminates the need for add on voltage reducers and has no effect on arc starting. • VRD fully complies to IEC 60974-1 • When Stick mode is selected the green VRD light is ON when not welding and red when welding. • When in TIG modes VRD is off.
Control Knob	• For the selected weld parameter, rotating the knob clockwise increases the parameter • Rotating the knob counter-clockwise decreases the parameter • A selected weld parameter value can be adjusted at any time even while welding • Pushing the knob in displays actual arc voltage.
Self Diagnosis Using Error Codes	• An error code is displayed on the *Digital Meter* when a problem occurs with Primary supply voltage or internal component problems. Refer to troubleshooting guide.

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5.0 SET-UP FOR SMAW (STICK) AND GTAW (TIG)

Conventional operating procedures apply when using the Welding Power Source, i.e. connect work lead directly to work piece and electrode lead is used to hold electrode. Wide safety margins provided by the coil design ensure that the Welding Power Source will withstand short-term overload without adverse effects. The welding current range values should be used as a guide only. Current delivered to the arc is dependent on the welding arc voltage, and as welding arc voltage varies between different classes of electrodes, welding current at any one setting would vary according to the type of electrode in use. The operator should use the welding current range values as a guide, then finally adjust the current setting to suit the application.

WARNING 7

Before connecting the work clamp to the work and inserting the electrode in the electrode holder make sure the Primary power supply is switched off.

CAUTION 3

Remove any packaging material prior to use. Do not block the air vents at the front or rear or sides of the Welding Power Source.

CAUTION 4

DO NOT change the Weld Mode or Weld Process Mode until after POST-FLOW time has finished.

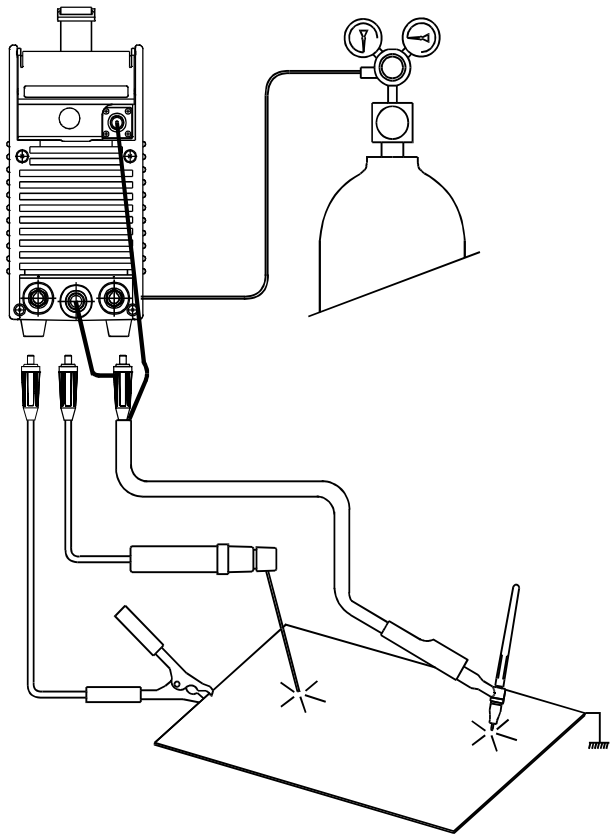


Figure 6– 185TSW AC/DC Set-up

6.0 SEQUENCE OF OPERATION

NOTE: Scroll Buttons are used to select the parameters to be set. The LED's show which function is being adjusted on the weld sequence graph. Refer to the Symbols Table located in the front of the manual for Symbol descriptions.

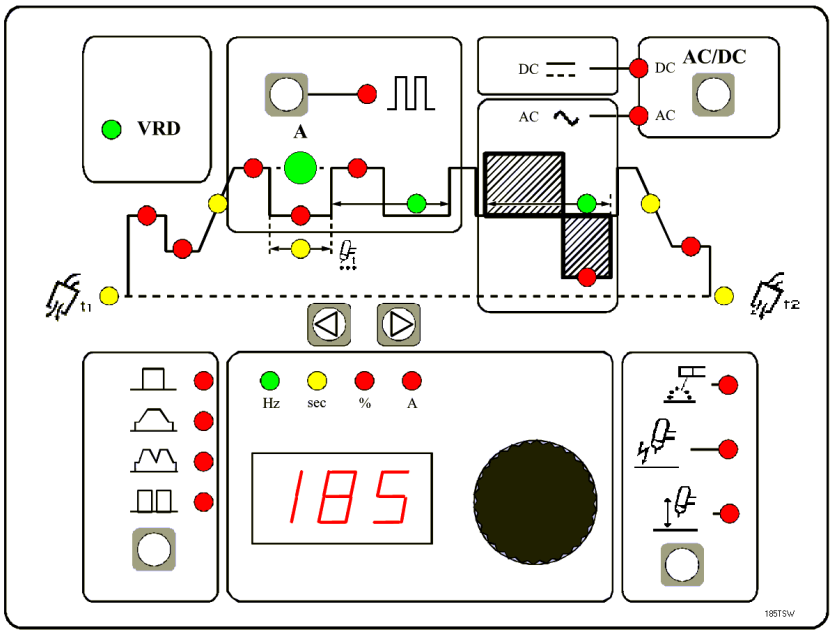
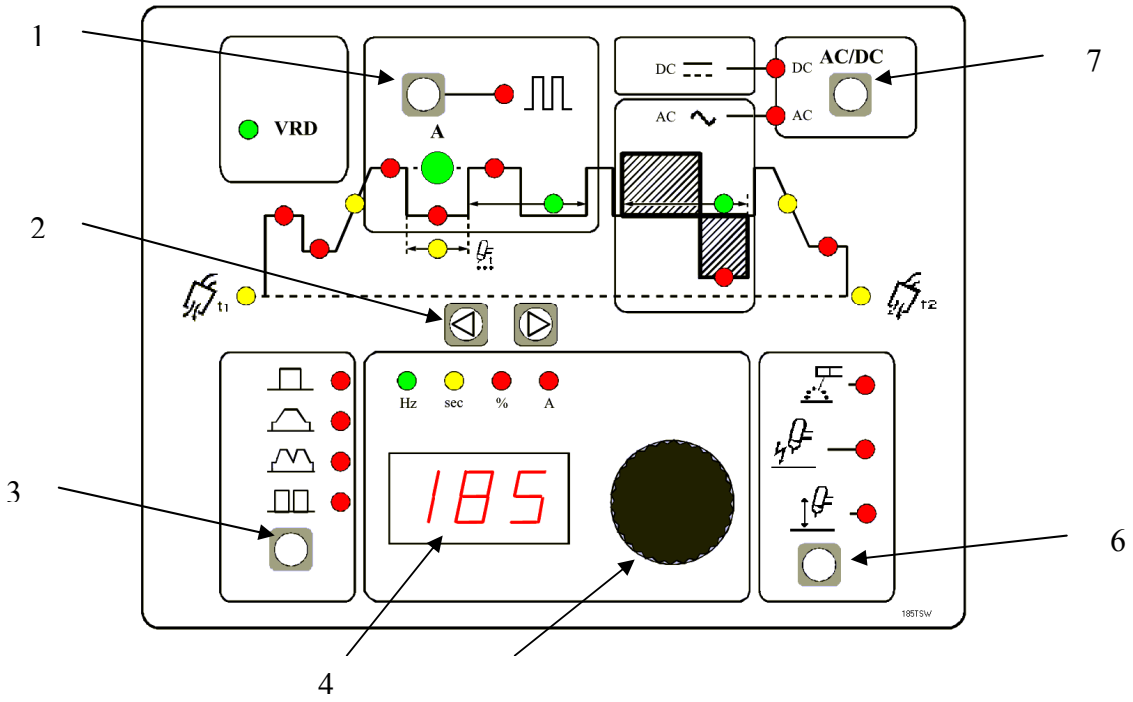


Figure 7 185TSW Front Panel



1. Pulse function – Pressing this button enables the TIG current pulse functions.

2. Scroll Buttons – used to select the parameters to be set. The LED's show which function is being adjusted on the Sequence Graph.

3. TIG Mode Functions – Pressing this button scrolls through the output TIG function modes (Standard, Slope, Slope w/repeat, Spot).

4. Digital LED display – Welding amperage and parameter values are displayed in this window. Internal warnings such as over temperature, low or high input voltage applied are signaled to the operator by a warning sound and error message on the screen.

5. Control knob – allows the operator to adjust the output amperage within the entire range of the power source, also used to set each parameter value. Pushing the knob inward displays the actual welding voltage.

6. Process Button – This button selects between STICK, Lift or HF TIG mode. A remote control device is required for use during LIFT TIG and HF TIG operation. See section 4.01, section 2 "*Remote Control Socket*", for complete details of the remote device.

7. AC/DC Button – Selects between AC or DC welding output.

6.01 Stick Welding

- Connect work lead to negative terminal
- Connect electrode lead to positive terminal
- Switch machine on
- Set *AC* or *DC* weld current. If *AC* is selected then set *AC FREQ* to 60Hz & *WAVE BALANCE* to 50%.
- Connect remote control device if required

Use the Scroll Buttons to move to the parameter to be set. The LED will show which function is being adjusted on the weld sequence graph. Use the control knob to adjust each parameter.

- Set *HOT START*
- Set *WELD* current

Commence welding

6.02 AC or DC HF TIG Welding

- Connect work lead to positive terminal
- Connect TIG torch to negative terminal
- Switch machine on
- Set *AC* or *DC* weld current. If *AC* is selected then set *AC FREQ* & *WAVE BALANCE*
- Connect remote control device. . See section 4.01, section 2 "*Remote Control Socket*", for complete details of the remote device.

Use the Scroll Buttons to move to the parameter to be set. The LED will show which function is being adjusted on the weld sequence graph. Use the control knob to adjust each parameter.

- Set *PRE-FLOW* time
- Set *HOT START* current
- Set *POST-FLOW* time
- Set *WELD* current
- Set *POST-FLOW* time

Slope Mode Parameters if required

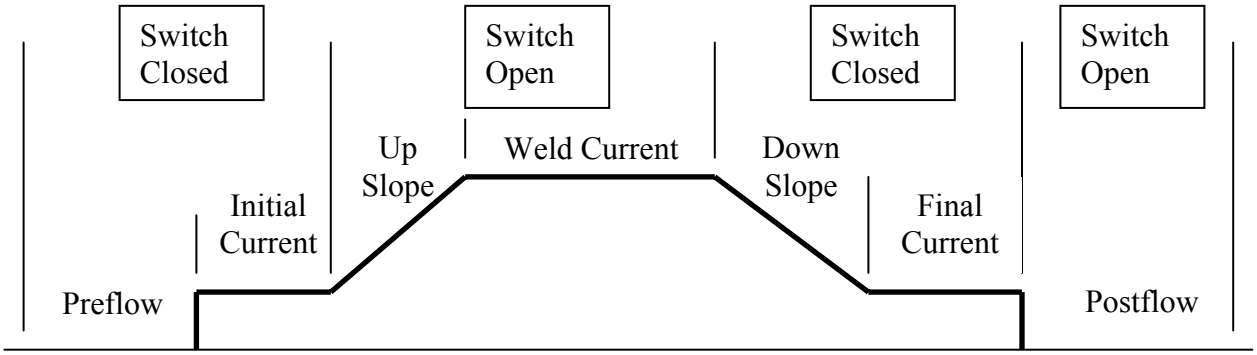
- Set *INTIAL CUR* current
- Set *UP SLOPE* time
- Set (WELD) *PEAK CUR* current
- Set *BASE* current
- Set *DOWN SLOPE* time
- Set *CRATER CUR* current

Pulse Mode parameters if required

- Set *PULSE WIDTH* % for *PEAK CURRENT*
- *Set PEAK CURRENT*
- Set *PULSE FREQ*

Commence welding

6.02.01 Slope Mode Sequence



Note 6

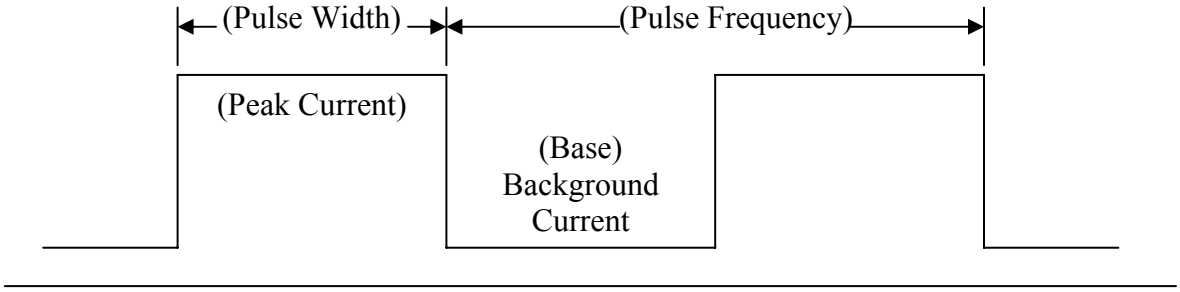
Slope function operates with a Remote ON/OFF device only.

1) To start Slope sequence Close remote switch contacts. Once the welding arc is established the Power Source will maintain initial current setting as long as the remote switch contacts are closed.
   a) In the HF TIG mode, after Preflow time, High Frequency is present at the torch. When the torch is positioned close to the work the welding current will transfer to the work and establish the arc at the initial current setting.
   b) In the Lift TIG mode, after Preflow time, Lift Start current is present at the torch. When the electrode is touched to the work and lifted off, the welding arc is established at the initial current setting.
2) Open Remote Switch – current increases to weld current. Once welding arc has reached weld current the power source will maintain weld current as long as the remote switch contacts are open.
3) Close Remote Switch – Welding current decreases to final current setting. Once final welding current is reached the power source will maintain final current setting as long as the remote switch contacts are closed.
4) Open Remote Switch – Welding arc stops and post flow begins.

6.02.02 Slope Mode with repeat sequence

The repeat function is operated during the down slope cycle of the Slope Sequence and is active through the down slope period only. During the down slope period by opening the Remote Switch contacts the current will increase back to weld current. Within the Down Slope period the repeat function can operated as many times as desired. To continue slope cycle and end slope sequence close remote switch contacts and allow weld current to reach final current setting. Once final current setting is reached opening the Remote Switch again will turn off the welding arc and post flow begins.

6.02.03 Pulse Controls



The Pulse controls are used primarily to control heat input. Pulse offers a number of advantages as follows:

1) Control puddle – size and fluidity (especially out of position).
2) Increase penetration
3) Travel speed control
4) Better consistent quality
5) Decreased distortion on lighter or thinner materials.

Pulse-current provides a system in which the welding current continuously changes between two levels. During the periods of Peak current, heating and fusion takes place, and during the background (base) current periods, cooling and solidification take place. Pulse Width is the time in one cycle the current remains at the peak current setting. Pulse Frequency, measured in Hertz, is the number of cycles per second the current travels between peak and background current settings. It is as if the foot rheostat were moved up and down to increase and decrease the welding current on a regular basis. The faster you moved the foot rheostat up and down the faster the frequency.

7.0 ROUTINE MAINTENANCE

The only routine maintenance required for the power supply is a thorough cleaning and inspection, with the frequency depending on the usage and the operating environment.

WARNING 8

Disconnect primary power at the source before opening the enclosure. Wait at least two minutes before opening the enclosure to allow the primary capacitors to discharge.

To clean the unit, open the enclosure (please refer to the Section, ”Opening the Enclosure”, and use a vacuum cleaner to remove any accumulated dirt and dust. The unit should also be wiped clean, if necessary; with solvents that are recommended for cleaning electrical apparatus.

CAUTION 5

Do not blow air into the power supply during cleaning. Blowing air into the unit can cause metal particles to interfere with sensitive electrical components and cause damage to the unit.

8.0 BASIC TROUBLESHOOTING

WARNING 9

There are extremely dangerous voltages and power levels present inside this product. Do not attempt to open or repair unless you are an Accredited Thermal Arc Service Agent and you have had training in power measurements and troubleshooting techniques.

If major complex subassemblies are faulty, then the Welding Power Source must be returned to an Accredited Thermal Arc Service Agent for repair.

The basic level of troubleshooting is that which can be performed without special equipment or knowledge.

8.01 TIG Welding Problems

Weld quality is dependent on the selection of the correct consumables, maintenance of equipment and proper welding technique.

Description	Possible Cause	Remedy
1 Excessive bead build-up or poor penetration or poor fusion at edges of weld.	Welding current is too low.	Increase weld current and/or faulty joint preparation.
2 Weld bead too wide and flat or undercut at edges of weld or excessive burn through.	Welding current is too high.	Decrease weld current.
3 Weld bead too small or insufficient penetration or ripples in bead are widely spaced apart.	Travel speed too fast.	Reduce travel speed.
4 Weld bead too wide or excessive bead build up or excessive penetration in butt joint.	Travel speed too slow.	Increase travel speed.
5 Uneven leg length in fillet joint.	Wrong placement of filler rod.	Re-position filler rod.

	Description	Possible Cause	Remedy
6	Electrode melts when arc is struck.	A Electrode is connected to the '+' terminal.	A Connect the electrode to the '–' terminal.
		B *WAVE BALANCE* is greater than 50%.	B Reduced *WAVE BALANCE* to below 50% or increase the electrode size.
7	Dirty weld pool.	A Electrode contaminated through contact with work piece or filler rod material.	A Clean the electrode by grinding off the contaminates.
		B Gas contaminated with air.	B Check gas lines for cuts and loose fitting or change gas cylinder.
8	Electrode melts or oxidizes when an arc is struck.	A No gas flowing to welding region.	A Check the gas lines for kinks or breaks and gas cylinder contents.
		B Torch is clogged with dust.	B Clean torch.
		C Gas hose is cut.	C Replace gas hose.
		D Gas passage contains impurities.	D Disconnect gas hose from torch then raise gas pressure and blow out impurities.
		E Gas regulator turned off.	E Turn on.
		F Torch valve is turned off.	F Turn on.
		G The electrode is too small for the welding current.	G Increase electrode diameter or reduce the welding current.
		H *WAVE BALANCE* is set above 50%.	H Reduced *WAVE BALANCE* to below 50% or increase the electrode size.
9	Poor weld finish.	Inadequate shielding gas.	Increase gas flow or check gas line for gas flow problems.
10	Arc flutters during TIG welding.	A Tungsten electrode is too large for the welding current.	A Select the right size electrode. Refer to Basic TIG Welding guide.
		B Absence of oxides in the weld pool.	B Refer Basic TIG Welding Guide for ways to reduce arc flutter.
11	Welding arc can not be established.	A Work clamp is not connected to the work piece or the work/torch leads are not connected to the right welding terminals.	A Connect the work clamp to the work piece or connect the work/torch leads to the right welding terminals.
		B Torch lead is disconnected.	B Connect it to the '–' terminal.

Description	Possible Cause	Remedy
	C Gas flow incorrectly set, cylinder empty or the torch valve is off.	C Select the right flow rate, change cylinders or turn torch valve on.
12 Arc start is not smooth.	A Tungsten electrode is too large for the welding current.	A Select the right size electrode. Refer to Basic TIG Welding Guide.
	B The wrong electrode is being used for the welding job.	B Select the right electrode type. Refer to Basic TIG Welding Guide.
	C Gas flow rate is too high.	C Select the correct rate for the welding job. Refer to Basic TIG Welding Guide.
	D Incorrect shielding gas is being used.	D Select the right shielding gas. Refer to Basic TIG Welding Guide.
	E Poor work clamp connection to work piece.	E Improve connection to work piece.

8.02 Stick Welding Problems

Description	Possible Cause	Remedy
1 Gas pockets or voids in weld metal (Porosity).	A Electrodes are damp. B Welding current is too high. C Surface impurities such as oil, grease, paint, etc.	A Dry electrodes before use. B Reduce welding current. C Clean joint before welding.
2 Crack occurring in weld metal soon after solidification commences.	A Rigidity of joint. B Insufficient throat thickness. C Cooling rate is too high.	A Redesign to relieve weld joint of severe stresses or use crack resistance electrodes. B Travel slightly slower to allow greater build up in C throat. Preheat plate and cool slowly.
3 A gap is left by failure of the weld metal to fill the root of the weld.	A Welding current is too low. B Electrode too large for joint. C Insufficient gap. D Incorrect sequence.	A Increase welding current B Use smaller diameter electrode. C Allow wider gap. D Use correct build-up sequence.

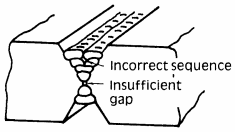


Figure 7 – Example of insufficient gap or incorrect sequence

4 Portions of the weld run do not fuse to the surface of the metal or edge of the joint.	A Small electrodes used on heavy cold plate.	A Use larger electrodes and pre-heat the plate.
	B Welding current is too low.	B Increase welding current.
	C Wrong electrode angle.	C Adjust angle so the welding arc is directed more into the base metal.
	D Travel speed of electrode is too high.	D Reduce travel speed of electrode.
	E Scale or dirt on joint surface.	E Clean surface before welding.

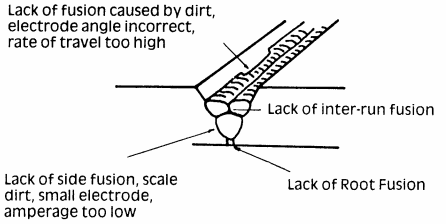


Figure 8 – Example of lack of fusion

5 Non-metallic particles are trapped in the weld metal (slag inclusion).	A Non-metallic particles may be trapped in undercut from previous run.	A If bad undercut is present, clean slag out and cover with a run from a smaller diameter electrode.
	B Joint preparation too restricted.	B Allow for adequate penetration and room for cleaning out the slag.
	C Irregular deposits allow slag to be trapped.	C If very bad, chip or grind out irregularities.
	D Lack of penetration with slag trapped beneath weld bead.	D Use smaller electrode with sufficient current to give adequate penetration. Use suitable tools to remove all slag from corners.
	E Rust or mill scale is preventing full fusion.	E Clean joint before welding.
	F Wrong electrode for position in which welding is done.	F Use electrodes designed for position in which welding is done, otherwise proper control of slag is difficult.

Figure 9 – Examples of slag inclusion

8.03 Power Source Problems

Description	Possible Cause	Remedy
1 The welding arc cannot be established.	A The Primary supply voltage has not been switched ON. B The Welding Power Source switch is switched OFF. C Loose connections internally.	A Switch ON the Primary supply voltage. B Switch ON the Welding Power Source. C Please refer to the following chapter.
2 Maximum output welding current can not be achieved with nominal Mains supply voltage.	Defective control circuit.	Please refer to the following chapter.
3 Welding current reduces when welding.	A Loose welding cable connections. B Incorrect welding cable size. C Improper input connections. D Poor electrode condition. E Wrong welding polarity.	A Tighten all welding cable connections. B Use proper size and type of cable. C Refer to Section 2.05 Electrical Input Requirements. D Replace electrode. E Verify output torch connections.
4 No gas flow when the torch trigger switch is depressed.	A Gas hose is cut. B Gas passage contains impurities. C Gas regulator turned off. D Torch trigger switch lead is disconnected or switch/cable is faulty.	A Replace gas hose. B Disconnect gas hose from the rear of Power Source then raise gas pressure and blow out impurities. C Turn gas regulator on. D Reconnect lead or repair faulty switch/cable.

Description	Possible Cause	Remedy
5 Gas flow won't shut off.	A Weld Mode (*STD*, *SLOPE*, *REPEAT* or *SPOT*) was changed before *POST-FLOW* gas time had finished.	A Strike an arc to complete the weld cycle. OR Switch machine off then on to reset solenoid valve sequence.
	B Gas valve is faulty.	B Have an Accredited Replace gas valve. Please refer to the following chapter.
	C Gas valve jammed open.	C Have an Accredited Repair or replace gas valve. Please refer to the following chapter.
	D *POST-FLOW* control is set to 60 sec.	D Reduce *POST-FLOW* time.
6 The TIG electrode has been contaminated due to the gas flow shutting off before the programmed *POST-FLOW* time has elapsed.	The Weld Process Mode (STICK, HF TIG or LIFT TIG) was changed before *POST-FLOW* gas time had finished.	Do not change Weld Process Mode before the *POST-FLOW* gas time had finished.

9.0 VOLTAGE REDUCTION DEVICE (VRD)

9.01 VRD Specification

Description	Pro-Wave 185TSW	Notes
VRD Open Circuit Voltage	15.3 to 19.8V	Open circuit voltage between welding terminals.
VRD Resistance	148 to 193 ohms	The required resistance between welding terminals to turn ON the welding power.
VRD Turn OFF Time	0.2 to 0.3 seconds	The time taken to turn OFF the welding power once the welding current has stopped.

9.02 VRD Maintenance

Routine inspection and testing (power source)

An inspection of the power source, an insulation resistance test and an earth resistance test should be carried out

a) For transportable equipment, at least once every 3 months; and

b) For fixed equipment, at least once every 12 months.

The owners of the equipment shall keep a suitable record of the periodic tests.

Note 7

A transportable power source is any equipment that is not permanently connected and fixed in the position in which it is operated.

In addition to the above tests and specifically in relation to the VRD fitted to this machine, the following periodic tests should also be conducted by an accredited Thermal Arc service agent.

Description	IEC 60974-1 Requirements
VRD Open Circuit Voltage	Less than 20V; at Vin=230V
VRD Turn ON Resistance	Less than 200 ohms
VRD Turn OFF Time	Less than 0.3 seconds

If this equipment is used in a location or environment with a high risk of electrocution then the above tests should be carried out prior to entering this location.

10.0 POWER SOURCE ERROR CODES

	Description	Possible Cause	Remedy	Remarks
1	E01 error code displayed Temperature sensor TH1 (protects IGBTs) is greater than 80ºC for about 1 second.	A The Welding Power Source's duty cycle has been exceeded. B Fan ceases to operate. C Air flow is restricted by vents being blocked.	A Let Power Source cool down then keep within its duty cycle. B Please refer to the following chapter. C Unblock vents then let Power Source cool down.	Weld current ceases. Buzzer sounds constantly. Fan operates at max speed. E01 resets when TH1 decreases to 70ºC for about 30 seconds.
2	E02 error code displayed Temperature sensor TH2 (protects secondary diodes) is greater than 80ºC for about 1 second.	A The Welding Power Source's duty cycle has been exceeded. B Fan ceases to operate. C Air flow is restricted by vents being blocked.	A Let Power Source cool down then keep within its duty cycle. B Please refer to the following chapter. C Unblock vents then let Power Source cool down.	Weld current ceases. Buzzer sounds constantly. Fan operates at max speed. E02 resets when TH2 decreases to 70ºC for about 30 seconds.
3	E03 error code displayed Primary (input) current too high.	A Primary current is too high because welding arc is too long. B Mains supply voltage is more than 10% below nominal voltage .	A Reduce length of welding arc. B A qualified electrician checks for low Mains voltage or refers to the following chapter.	Weld current ceases. Buzzer sounds constantly. Switch machine off then on to reset E03 error.
4	E04 error code displayed Output voltage exceeds the secondary voltage specification.	TIG torch cable and/or work lead are too long or leads are coiled.	Reduce the length of the TIG torch cable and/or work lead or un-coiled leads.	Weld current ceases. Buzzer sounds constantly. Switch machine off then on to reset E04 error.

	Description	Possible Cause	Remedy	Remarks
5	E11 error code displayed Over Primary supply (input) voltage at primary capacitors is exceeded for one second.	Primary supply voltage is greater than the nominal voltage plus 10%.	A qualified electrician checks the Primary voltage or refers to the following chapter.	Weld current ceases. Buzzer sounds constantly. Error code E11 automatically will reset when the voltage reduces.
6	E14 error code displayed Under mains supply (input) voltage warning primary capacitors is reduced for one second.	Mains supply voltage is less than the nominal operating voltage less 10%.	A qualified electrician checks the Mains voltage or refers to the following chapter.	Weld current available. Buzzer sounds intermittently. Error code E14 automatically will reset when the voltage increases.
7	E12 error code displayed Under mains supply (input) voltage primary capacitors is reduced for one second.	Mains supply voltage is down to a dangerously low level.	A A qualified electrician checks the Mains voltage or refers to the following chapter. B A qualified electrician checks the primary cable & fuses or refers to the following chapter.	Weld current ceases. Buzzer sounds constantly. Error code E12 automatically will reset when the voltage increases.
8	E81 error code displayed Wrong Primary supply (input) voltage connected.	When 3 phase machine is first turned on with the wrong Primary supply (input) voltage connected.	A qualified electrician checks the Mains voltage or refers to the following chapter.	No weld current is available. Buzzer sounds constantly. Switch machine off.
9	E82 error code displayed Rated voltage selection circuit abnormality.	The Primary supply (input) voltage fluctuates and is not stable.	Please refer to the following chapter.	No weld current is available. Buzzer sounds constantly. Switch machine off then on to reset E82 error.

	Description	Possible Cause	Remedy	Remarks
10	E83 error code displayed CPU checks mains supply (input) voltage when the on/off switch on rear panel of machine is turned ON.	The Primary supply (input) voltage fluctuates and is not stable.	Please refer to the following chapter.	No weld current is available. Buzzer sounds constantly. Switch machine off then on to reset E83 error.
11	E85 error code displayed Pre-charge abnormality.	Due to malfunction inside the Welding Power Source, primary capacitors are not charging correctly.	Please refer to the following chapter.	No weld current is available. Buzzer sounds constantly. Switch machine off then on to reset E85 error.
12	E93 error code displayed Memory chip (EEPROM) on control PCB can not read/write weld parameters.	Memory chip (EEPROM) error.	Please refer to the following chapter.	Weld current ceases. Buzzer sounds constantly. Switch machine off.
13	E94 error code displayed Temperature sensor TH1 for IGBTs or sensor TH2 for secondary diodes are open circuit.	The Welding Power Source's temperature sensors have malfunctioned.	Please refer to the following chapter.	Weld current ceases. Buzzer sounds constantly. Switch machine off.
14	E99 error code displayed Mains supply (input) voltage has been turned off but control circuit has power from the primary capacitors.	A Main on/off switch on machine has been turned off B Mains supply (input) voltage has been turned off.	A Turn on/off switch on. B Please refer to the following chapter.	Weld current ceases. Buzzer sounds constantly. Must switch machine off then on to reset E99 error.

11.0 ADVANCED TROUBLESHOOTING

If you are here, all of the troubleshooting suggestions in Section 8-Basic Troubleshooting have either failed to resolve the faulty operation or have indicated that one or more of the subsystems within the power supply are defective. This section provides the information needed to take live measurements on the various subsystems within the power supply, and replace those subsystems that prove faulty.

CAUTION 6

Troubleshooting and repairing this unit is a process, which should be undertaken only by those familiar with high voltage/high power electronic equipment.

WARNING 9

There are extremely dangerous voltage and power levels present inside this unit. Do not attempt to diagnose or repair unless you have training in power electronics, measurement and troubleshooting techniques.

Under no circumstances are field repairs to be attempted on printed circuit boards or other subassemblies of this unit. Evidence of unauthorized repairs will void the factory warranty. If a subassembly is found to be defective by executing any of the procedures in this Service Manual, the subassembly should be replaced with a new one. The faulty subassembly should then be returned to Thermal Arc through established procedures.

WARNING 10

Disconnect primary power at the source before disassembling the power supply. Frequently review the "Important Safety Precautions" in section 1.02. Be sure the operator is equipped with proper gloves, clothing and eye and ear protection. Make sure no part of the operator's body comes into contact with the work piece or any internal components while the unit is activated.

11.01 System-Level Fault Isolation

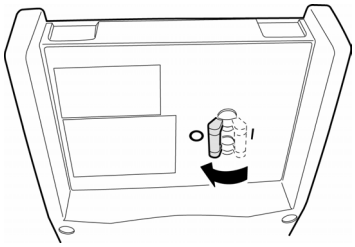
If none of the suggestions provided in Section 8 have solved the problem or corrected the faulty operation, the next step is to isolate one or more of the internal subassemblies that may be defective.

CAUTION 7

Perform all steps in each procedure, in sequence. Skipping portions of procedures, or performing steps out of sequence can result in damage to the unit, and possible injury, or worse, to the operator.

11.01.01 Opening the Enclosure

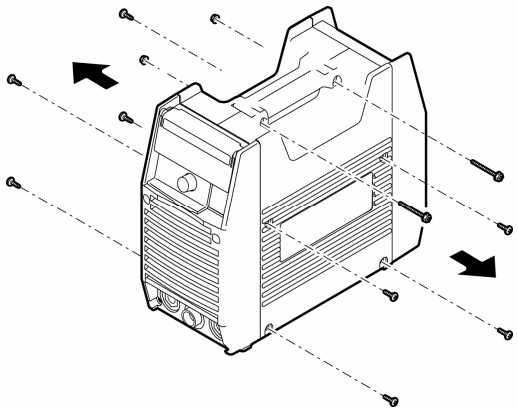
1) Confirm that the switch of power supply and the switch on switchboard (distribution panel) are all OFF.



CAUTION 8

The capacitors inside the power supply will slowly discharged after you turn off the switch of the power supply or the switch at the breaker box (distribution panel). Wait at least 5 minutes for the discharge to complete.

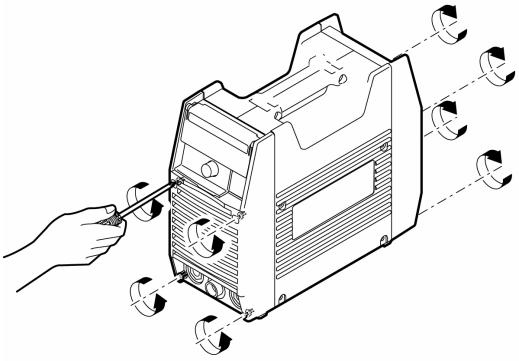
2) Remove all screws and nuts on the side covers.



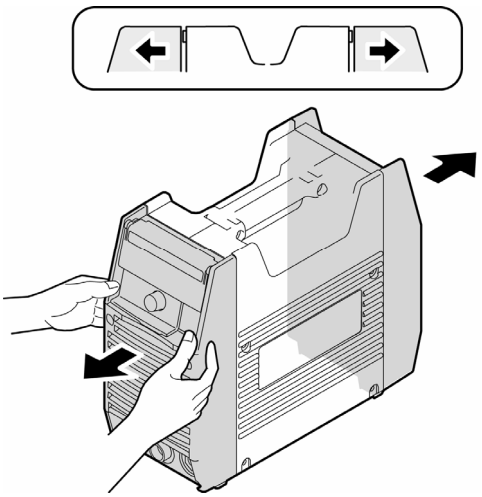
3) Loosen the screws on the front panel and the rear panel by turning them approximately two turns CCW.

Note 7

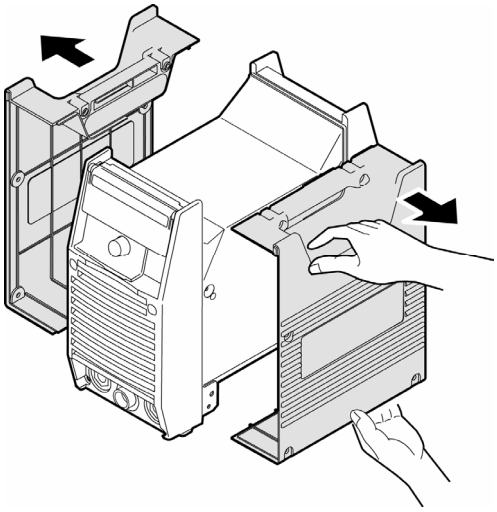
DO NOT remove the screws completely.



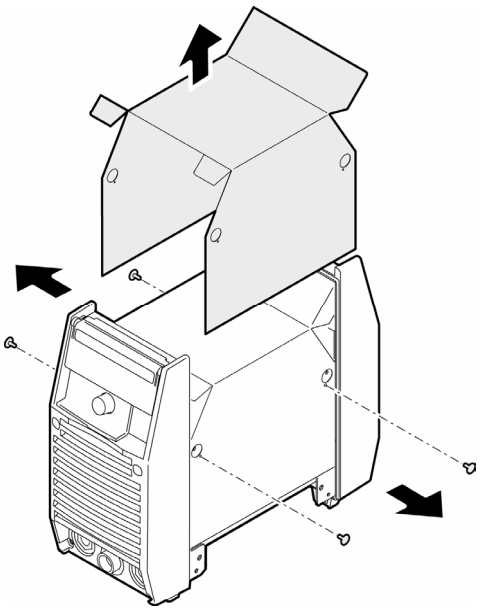
4) Pull the front panel slightly forward and pull the rear panel slightly backward. The interlocking hooks of the side case covers can now be disengaged from the front and rear panels



5) Remove the side covers.



6) Remove protection cover sheet by removing the plastic tabs.



Note 8

When you re-assemble the parts, conduct the above process backwards.

Note 9

The capacitors inside the power supply will slowly discharged after you turn off the switch of the power supply or the switch at the breaker box (distribution panel). Wait at least 5 minutes for the discharge to complete and then remove the cases to continue your inspection and repair (or maintenance) inside the power supply. As for the removal and installation of the case, refer to section 11.01.01.

Note 10

During the "**Verification/Remedy**" procedures below, follow the alphabetical sequence (a, b, c…) and proceed with your verification and confirmation.

Note 11

After you confirm and replace all spare parts and components, confirm that there are no damaged harnesses or connectors, uninstalled or loose screws.

1. E81 "Abnormal Input Voltage"

Cause

Failure detected by the input voltage detection circuit, etc.

Verification/Remedy

a) Verify the AC input voltage using a voltmeter.
- Follow the instruction in section 11.01.04.02.

b) Verify the wiring harness and connection of CN1 on PCB8 (WK-4917) and CN1 on PCB1 (WK-4914).
- Confirm a secure connection of the harness between CN1 on PCB8 and CN1 on PCB1.
- Contact the manufacturer if you find any broken connectors or damaged wiring harnesses.

c) Verify PCB2 (WK-4819) for burned or discolored components or printed circuit board.
- Confirm that the PCB is securely fastened in place. (No loose screws).
- Refer to section 11.02.04.01 for the replacement of PCB2.

2. E82 "Rated voltage selection circuit abnormality"

Cause

Failure detected by the input voltage detection circuit, etc.

Verification/Remedy

a) Verify the wiring harness and connection of CN4 on PCB2 (WK-4819).
- Confirm a secure connection of CN4 on PCB2.
- Contact the manufacturer if you find any broken connectors or damaged wiring harnesses.

b) Verify PCB2 (WK-4819) for burned or discolored components or printed circuit board.

- Confirm that the PCB is securely fastened in place. (No loose screws).
- Refer to section 11.02.04.01 for the replacement of PCB2.

3. E83 "Abnormal mains supply voltage"

Cause

Failure detected by the input voltage detection circuit, etc.

Verification/Remedy

a) Verify the AC input voltage using a voltmeter.
- Follow the instruction in section 11.01.04.02.

b) Verify the wiring harness and connection of CN1 on PCB8 (WK-4917) and CN1 on PCB1 (WK-4914).
- Confirm a secure connection of the harness between CN1 on PCB8 and CN1 on PCB1.
- Contact the manufacturer if you find any broken connectors or damaged wiring harnesses.

c) Verify PCB2 (WK-4819) for burned or discolored components or printed circuit board.
- Confirm that the PCB is securely fastened in place. (No loose screws).
- Refer to section 11.02.04.01 for the replacement of PCB2.

4. E85 "Pre-Charge Error"

Cause

Occurs, after you apply power, when a failure is detected during the preliminary charging of the capacitors.

Verification/Remedy

a) Verify the AC input voltage and the Capacitor Bus Voltage on PCB1 (WK-4914).
- Follow the instruction in section 11.01.04.02.

b) Verify the input diode, D1.
- Refer to section 11.02.06.01 for the test and replacement of D1.

c) Verify the IGBT, Q1.
- Refer to section 11.02.06.02 for the test and replacement of Q1.

d) Replace PCB1 (WK-4914) and PCB2 (WK-4819).
- If the tests in the above sections (a, b, c) are within expected results and the unit is still defective, replace PCB1 and PCB2.
- Refer to section 11.02.04.01 for the replacement of PCB1 and PCB2.

5. E11 "High Input Voltage Failure"

Cause

Occurs when the input voltage is more than approximately 275VAC (= 1/1.41 of the maximum value of the sinusoidal wave).

Verification/Remedy

a) Verify input voltage.
- Follow the instruction in section 11.01.04.02.

b) Replace PCB2 (WK-4819).
- If the voltage and current available is determined to be sufficient, replace PCB2.
- Refer to section 11.02.04.01 for the replacement of PCB2.

6. E12 "Low Input Voltage Failure"

Cause

Occurs when the input voltage is less than approximately 150VAC (= 1/1.41 of the maximum value of the sinusoidal wave).

Verification/Remedy

a) Verify input voltage.
- Follow the instruction in section 11.01.04.02.

b) Replace PCB2 (WK-4819).
- If the voltage and current available is determined to be sufficient, replace PCB2.
- Refer to section 11.02.04.01 for the replacement of PCB2.

7. E14 "Low Input Voltage Warning"

Cause

Occurs when the input voltage is less than approximately 173VAC (= 1/1.41 of the maximum value of the sinusoidal wave).

Verification/Remedy

a) Verify input voltage.
- Follow the instruction in section 11.01.04.02.

b) Replace PCB2 (WK-4819).
- If the voltage and current available is determined to be sufficient, replace PCB2.
- Refer to section 11.02.04.01 for the replacement of PCB2.

8. E01 "Over-Temperature at the primary side"

Cause

Occurs when an over-temperature condition of the primary IGBT is detected.

Verification/Remedy

a) Unit may be in thermal shutdown mode.
- Review the rated duty cycle of the unit per section 3.04. Exceeding the duty cycle can damage the unit and void the warranty. Refer also to section 3.05 for additional information.

b) Verify the ventilating condition.
- Maintain a clear and unobstructed distance of more than 30cm in the front and more that 50cm in the rear of the unit for ventilation purposes.
- Verify and maintain clean, dust free, front and rear airflow paths. Cleaning and removing dust from the front and rear panels once every six months in a normal working environment is recommended. Extremely dusty environments will require more frequent cleanings.

c) Verify the operation of the cooling fan, FAN1, and replace it if necessary.
- Verify the condition of FAN1. Verify that there are no broken or cracked fan blades and that FAN1 is not producing anY abnormal sounds.
- If broken or cracked FAN1 blades, or abnormal sounds are emanating from FAN1, replace FAN1.
- Refer to section 11.02.10 for the replacement of FAN1.
- Refer to section 11.01.04.04 for addition FAN1 tests.

d) Verify the operation of the cooling fan and replace it if the condition of FAN1 is inactive.
- Follow the instruction in section 11.01.04.04.

e) Replace PCB6 (WK-5157).
- Refer to section 11.02.04.05 for the replacement of PCB6.

9. E02 "Over-Temperature at the secondary side"

Cause

Occurs when an over-temperature condition of the secondary diode is detected.

Verification/Remedy

a) Unit may be in thermal shutdown mode.
- Review the rated duty cycle of the unit per section 3.04. Exceeding the duty cycle can damage the unit and void the warranty. Refer also to section 3.05 for additional information.

b) Verify the ventilating condition.
- Maintain a clear and unobstructed distance of more than 30cm in the front and more that 50cm in the rear of the unit for ventilation purposes.
- Verify and maintain clean, dust free, front and rear airflow paths. Cleaning and removing dust from the front and rear panels once every six months in a normal working environment is recommended. Extremely dusty environments will require more frequent cleanings.

c) Verify the operation of the cooling fan, FAN1, and replace it if necessary.
- Verify the condition of FAN1. Verify that there are no broken or cracked fan blades and that FAN1 is not producing and abnormal sounds.
- If broken or cracked FAN1 blades or abnormal sounds are emanating from FAN1, replace FAN1.
- Refer to section 11.02.10 for the replacement of FAN1.
- Refer to section 11.01.04.04 for addition FAN1 tests.

d) Verify the operation of the cooling fan and replace it if the condition of FAN1 is inactive.
- Follow the instruction in section 11.01.04.04.

e) Replace PCB6 (WK-5157).
- Refer to section 11.02.04.05 for the replacement of PCB6.

10. E03 "Primary Over-Current Failure"

Cause

Occurs when excessive current is detected flowing into the primary side of the main transformer.

Verification/Remedy

a) Confirm the operation of the machine within the rated specification.
- Refer to the specification data sheet in Section 3.04.

b) Verify the secondary diode (D2, D4, and D5).
- Refer to section 11.02.06.04 for the test and replacement of D2 and section 11.02.06.05 for D4 and D5.

c) Verify the secondary IGBT (Q2).
- Refer to section 11.02.06.03 for the test and replacement of Q2.

d) Verify the H.F. unit (HF. UNIT1).
- Refer to section 11.02.11 for the replacement of HF.UNIT 1.

e) Verify the primary IGBT (Q1).
- Refer to section 11.02.06.02 for the test and replacement of Q1.

f) Replace the Hall CT, HCT1.

Note 12

Pay special attention to installed direction of HCT1. The Hall CT will not function properly if installed in the incorrect direction.

- Refer to section 11.02.09 for the replacement of HCT1.

11. E04 "Torch Cable Failure"

Cause

The combined length of the torch cable and the work cable is too long.

Verification/Remedy

a) Verify the rated duty cycles of the torch/work cable and the power supply.
- Only use appropriate sized torch cables (length and capacity). The recommended total combined length of the torch and work cable is 50 feet.
- Torch and work cable should not be "coiled" during welding operations.
- Maintain the duty cycle of the power supply. Refer to section 3.04 for the recommended duty cycle.

b) Replace PCB6 (WK-5157) and PCB5 (WK-4916).
- Refer to section 11.02.04.05 for the replacement of PCB6 and section 11.02.04.04 for PCB5.

12. E93 "Memory Failure"

Cause

Occurs when the memory fails to save the requested welding parameters.

Verification/Remedy

a) Replace PCB6 (WK-5157).
- Refer to section 11.02.04.05 for the replacement of PCB6.

13. E94 "Thermistor Failure"

Cause

Occurs when the thermistor for the temperature detection circuitry is open.

Verification/Remedy

a) Verify the wiring harness and connection between CN8 on PCB6 (WK-5157) and thermistors TH1 and TH2.
- Confirm a secure connection of the harness wired between CN8 on PCB6 and TH1 and TH2 and re-install the harnesses with a secure connection.
- Contact the manufacturer if you find any broken connectors or damaged wiring harnesses.

b) Replace thermistors, TH1 and TH2.
- Refer to section 11.02.07 for the replacement of TH1 and TH2.

c) Replace PCB6 (WK-5157).
- Refer to section 11.02.04.05 for the replacement of PCB6.

14. E99 "Initial Power Receiving"

Cause

Occurs when the initial AC power-received signal has not reached the CPU.

Note 13

This error occurs normally during the power "OFF" sequence of the unit.

Verification/Remedy

a) Verify the wiring harness and connection of CN1 on PCB8 (WK-4917) and CN1 on PCB1 (WK-4914).
- Confirm a secure connection of the harness wired between CN1 on PCB8 and PCB1 and re-install the harness with a secure connection.
- Contact the manufacturer if you find any broken connectors or damaged wiring harness.

b) Verify and replace PCB2 (WK-4819).
- During the installation of PCB2 and PCB1, confirm that the PCB's are securely fastened in place. (No loose screws).
- Refer to section 11.02.04.01 for the replacement of PCB2.

c) Replace PCB6 (WK-5157).
- Refer to section 11.02.04.05 for the replacement of PCB6.

Refer to ***Note 9*** on Page 53.

Refer to ***Note 10*** on Page 53.

Refer to ***Note 11*** on Page 53.

1. "Cooling Fan Failure" (Fan is not rotating.)

Cause

Occurs when the cooling fan is defective, damaged or the driving voltage is incorrect.

Verification/Remedy

a) Verify the cooling fan, FAN1.
- Inspect the condition of the fan blades and all peripheral parts. Clean the fan blades and all peripheral parts if covered with dust. Cleaning and removing dust from the fan blades once every 6 months in a normal environment is recommended. Extremely dusty environments will require more frequent cleanings.
- Verify that there are no wiring harnesses entangled inside the fan, confirm that the harnesses do not have any brakes in the wire or damaged connectors.
- Contact the manufacture if you find any broken connectors or damaged wiring harnesses.
- Replace the fan if there are any broken, cracked or missing fan blades.
- Refer to section 11.02.10 for replacement of FAN1.

b) Verify the wiring harness between the cooling fan (FAN1) and CN7 on PCB3 (WK-4921).
- Confirm a secure connection of the harness to CN7 on PCB3.
- Contact the manufacture if you find any broken connectors or damaged wiring harnesses.

c) Cooling fan voltage tests and replacement of the cooling fan (FAN1).
- Follow the instruction in section 11.01.04.04.

2. "Gas Valve Failure" (No Gas flow through unit)

Cause

Occurs when the gas valve is defective, damaged or the driving voltage is incorrect.

Verification/Remedy

a) Confirm that TIG welding is selected on the welding mode.
- Do not change welding modes while welding.
- Only change welding modes when the unit is idle (torch switch OFF).
- Verify the setting of Pre-flow and Post-flow on the front panel.
- If the Pre-flow or Post-flow time is set to 0 seconds, change them to higher setting.

b) Verify the layout the of the gas hose.
- Confirm that the hose is securely connected into the fitting at the inlet and the outlet. Confirm that the layout of the gas hose so that it is not bent or kinked. Confirm there are no breaks, burns or holes in the hose.

- Confirm the layout of the TIG torch gas hose and that the hose adapters are properly connected.

c) Gas Valve (SOL1) voltage tests and replacement.
- Follow the instruction in section 11.01.04.05.

d) Replace the PCB6 (WK-5157).
- Refer to section 11.02.04.05 for the replacement and installation of PCB6.

3. "No weld output"

Note 14

When in High Frequency TIG (HF TIG) mode, if the High Frequency is not generated (present), refer to "High Frequency Output Failure" on Page 57 before performing this section.

Cause

Occurs when the 8-pin connector or associated circuitry is defective, damaged, or the TIG torch cable is defective.

Verification/Remedy

CAUTION 9

Read and understand this entire section before proceeding. Extreme personal harm and test equipment damage will occur if the procedures are not performed accurately.

a) Verify the 8-pin connector. (Applies to LIFT TIG and High Frequency TIG (HF TIG) mode.)
- Confirm a secure connection between CON1 of the 8-pin connector and the remote device.
- Confirm a secure connection of the harness and the connections between CON1 and PCB3 (WK-4921) are all correct and there are no open circuits.
- Contact the manufacture if you find any broken connectors or damaged wiring harnesses.
- Confirm the proper pins-outs of the 8-pin connector on the remote device side. (Refer to section 4.01)
- Confirm that there is no open circuit on the 8-pin connector at the remote device side.

b) Verify the condition and connections of the welding cable, the stick rod holders and the ground clamp. (Applies to all welding modes.)
- Confirm a secure connection of the welding cable, stick rod holders, ground clamp and dinse connectors and there are no open circuits.

c) Verify the no-load voltage (OCV). (Applies to STICK, High Frequency TIG (HF TIG) mode.)
- Refer to the section "Verification of No-load voltage (No OCV)" in section 11.01.04.06 first before continuing this section.
- If performing the "No-Load Voltage Failure" procedure does not rectify the failure, perform the following tests in the sequence below. Replace any defective components found.
    1) IGBT Q2. (Refer to the Section, 11.02.06.03.)

2) Diode, D2, D4 and D5. (Refer to the Section, 11.02.06.04 and 11.02.06.05.)
3) Coupling coil, CC1. (Refer to the Section, 11.02.08.01.)
4) Reactor, FCH1. (Refer to the Section, 11.02.08.02.)
5) Transformer, T1 and T2. (Refer to the Section, 11.02.08.04.)
6) IGBT, Q1. (Refer to the Section, 11.02.06.02.)
7) Hall CT, HCT1. (Refer to the Section, 11.02.09.)

4. "Operating Panel Failure" (LED's do not light properly or weld settings cannot be establish.)

Cause

Occurs when there is a connection failure among PCB6 (WK-5157), PCB7 (WK-5198) and PCB3 (WK-4921) or PCB6 and PCB3 are defective.

Verification/Remedy

a) Verify the harness connection between CN4 on PCB3 (WK-4921) and CN1 on PCB6 (WK-5157).
- Confirm a secure connection of the harness and the connections between CN16 on PCB2 and CN1 on PCB6.
- Contact the manufacture if you find any broken connectors or damaged wiring harnesses.

b) Verify the connection between PCB6 (WK-5157) and PCB7 (WK-5198).
- Confirm that all four connectors between PCB6 and PCB7 are tightly connected.
- Confirm the condition of the pins on the connectors and the connectors themselves, if bent pins or damaged connectors are found, replace the suspected PCB.
- Refer to section 11.02.04.05 for the replacement and installation of PCB6 and PCB7.

c) Verify the connection between PCB1 (WK-4914) and PCB3 (WK-4921).
- Confirm a secure connection between PCB1 and PCB3.

d) Replacement of PCB3 (WK-4921) and PCB6 (WK-5157).
- Refer to section 11.02.04.02 for the replacement and installation of PCB3 and section 11.02.04.05 for PCB6.

5. "High Frequency Output Failure" (Unit does not generate High Frequency.)

Cause

Occurs when the H.F. unit is defective or blown.

Verification/Remedy

CAUTION 10

Read and understand this entire section before proceeding. Extreme personal harm and test equipment damage will occur if the procedures are not performed accurately. The unit will generate a High Voltage component that can cause extreme personal harm and test equipment damage.

a) Verify the connection between High Frequency (H.F. Unit1) and Coupling Coil (CC1).

- Verify the connection between the H.F. Unit1 and CC1; confirm that the quick-disconnect terminals are inserted onto the terminals of H.F. Unit1 (CC1, CC2) correctly and completely.
- Confirm there are no short circuits, burnt or broken wires between the HF unit and the CC1.
- Refer to section 11.02.08.01 for the replacement and installation of CC1.

b) Verify the connection between High Frequency (H.F. Unit1) and Current limiting Resistor (R1).
- Verify the connection between the H.F. Unit1 and R1; confirm that the quick-disconnect terminals are inserted onto the terminals of H.F. Unit (R1, R2) correctly and completely.
- Confirm there are no short circuits, burnt or broken wires between the HF unit and R1.

c) Verify the connection between the terminals between AC1 – AC2.
- Verify the connection between AC1 – AC2; confirm that the quick-disconnect terminals are inserted onto the terminals of H.F. Unit1 correctly and completely.
- Confirm there are no short circuit, in the harness between AC1 – AC2.

d) Verify and replace the Gap (GAP) of the High Frequency (H.F. Unit1).
- Confirm that the GAP is connected to H.F. Unit correctly and completely.
- Confirm there is no dust or foreign debris between the space of the GAP.
- If there are any abnormalities observed with the GAP, replace the GAP.
- The GAP is factory set for an optimal setting for most welding applications. It is recommended that the GAP setting not be changed. The GAP is factory set at 0.8mm.
- If the GAP is increased (larger than 0.8mm), the HF voltage increases and the frequency tends to decrease. If the GAP is increased too much, HF will no longer be generated.
- If the GAP is decreased (smaller than 0.8mm), the HF voltage decreases and the frequency tends to increase.

e) Verify and replace the Current limiting Resistor (R1) of the High Frequency (H.F. Unit1).
- If R1 is defective (blown, burnt, cracked, etc.), replace R1.
- Refer to section 11.02.13 for the replacement and installation of R1.

f) Replace the High Frequency (H.F. Unit1).
- Refer to section 11.02.11 for the replacement and installation of H.F. Unit1.

g) Replace PCB5 (WK-4916).
- Refer to section 11.02.04.04 for the replacement and installation of PCB5.

11.01.04 Fault Isolation Tests

11.01.04.01 Preparation

The following initial conditions must be met prior to starting any of the procedures in this section (11.01.04).

1) Connect the appropriate input voltage. (Check the data tag on the rear of the power supply for the proper input voltage.)

Note 15

Operate at ALL input voltages as noted on the nameplate on the rear panel when testing the power supply.

2) Close primary power source wall disconnect switch or circuit breaker.

3) Place the power supply MAIN CIRCUIT SWITCH (S1) on rear of unit in the ON position.

WARNING 11

Dangerous voltage and power levels are present inside this unit. Be sure the operator is equipped with proper gloves, clothing and eye and ear protection. Make sure no part of the operator's body comes into contact with the workpiece or any internal components while the unit is activated.

11.01.04.02 Verification of the Power Input Circuitry.

Refer to ***Note 9*** on page 53.

Refer to ***Note 11*** on page 53.

1) Verify the AC input voltage using an AC voltmeter.
   Verify input voltage (Phase-to Phase) using an AC voltmeter. (The capability of the voltmeter should be more than 300VAC). Measure the point between lines U1 and V1 on the input switch, S1.
   The location of points U1 and V1on switch S1 are indicated in Figure 10.

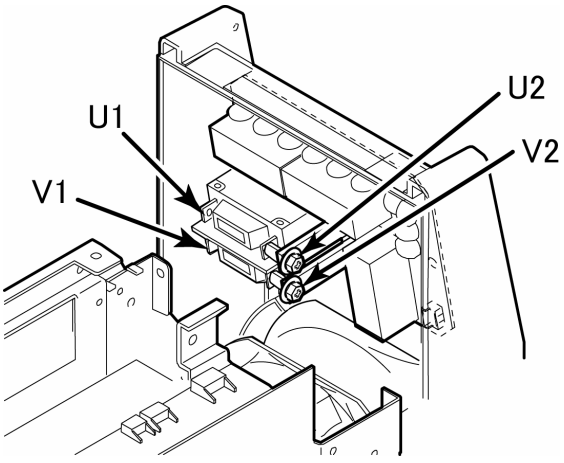


Figure 10. Check points U1, U2, V1 and V2

2) If the input voltage is out of the operating range of the unit, which is ± 10% (187 ~ 253 VAC) of the rated voltage (208, 230V), verify the available power capacity at the installed site.
If the input voltage is within the operating range, recheck the input voltage while welding, as welding may cause the input voltage to decrease to a value below the operating range of the unit.

3) Verify input voltage after the input switch (S1) using an AC voltmeter. (The capability of the voltmeter should be more than 300VAC.)
Using an AC voltmeter, measure between the points U2 and V2 on the input switch, S1.
The location of points U2 and V2 on switch S1are indicated in Figure 10.

4) If this voltage is out of the operating range, which is ± 10% (187 ~ 253 VAC) of the rated voltage (208, 230VAC), replace S1 following the process in section 11.02.05.

5) Verify the rectified output voltage of the input diode, D1 using a DC voltmeter. (The capability of the voltmeter should be more than 400VDC.)
Using a DC voltmeter, measure between the points R2[+] and C1(A)[-] on PCB1 (WK-4914). Points R2 and C1(A) are obtainable on the solder side of PCB1. See Figure 11.
The measured voltage should be approximately 1.4 times larger than input voltage measured in #1 above. Replace diode D1 if the calculated measurement is not within the corresponding range (DC260 ~ 360 V) following the process in section 11.02.06.01.

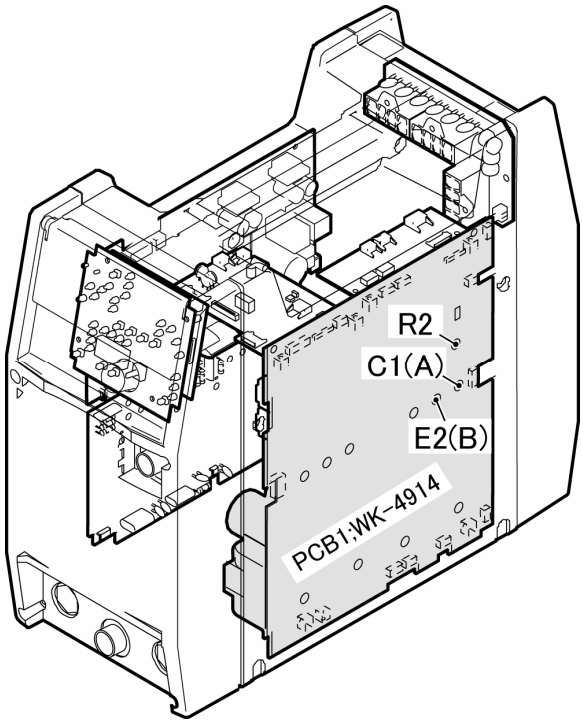


Figure 11 The check points R2, C1(A), and E2(B)

6) Verify bus voltage (the voltage of the electrolytic capacitor after rectification) using a DC voltmeter. (The capability of the voltmeter should be more than 400VDC.)
Using a DC voltmeter, measure between the points E2(B)[+] and C1(A)[-] on PCB1 (WK-4914). Points E2(B) and C1(A) can be found on the solder side of PCB1. See Figure 11.
The measured voltage should be approximately 1.4 times larger than input voltage measured in #1 above. Replace diode D1 if the calculated measurement is not within the corresponding range (DC260 ~ 360 V) following the process in section 11.02.06.01.

7) After the replacement of D1, if the above voltage is still abnormal, replace PCB1 (WK-4914).

11.01.04.03 Power Supply Voltage Test

1) Connect the power supply to a source of rated input voltage. (Check the data tag on the rear of the power supply for the proper input voltage.)

   Refer to ***Note 15*** on page 63.

2) Apply power to the unit and place the switch of the power supply to the ON position.

3) On the PCB1 (WK-4914), measure the voltages according to the following table. The test point and the reference are obtainable on the solder side of PCB1 (WK-4914). The location of points TP0-3, 6-11, 00 are indicated in Figure 12.

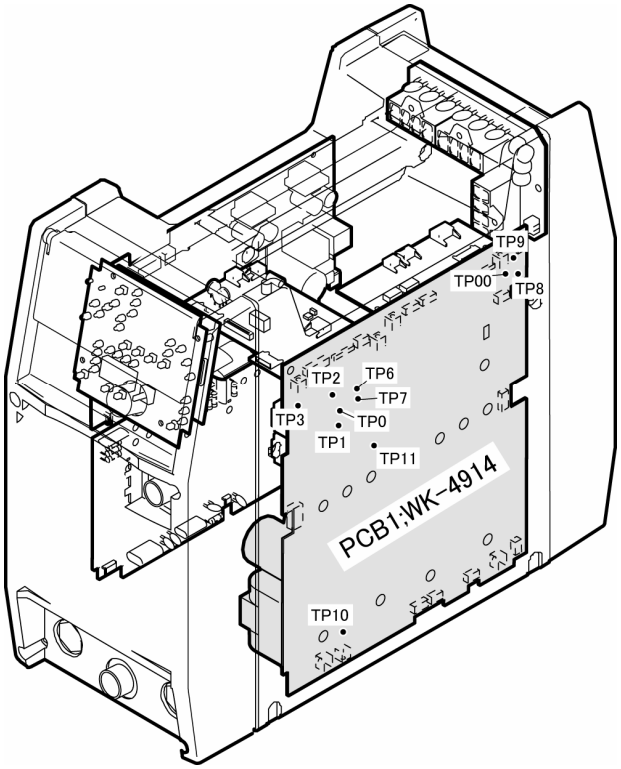


Figure 12 The check points TP0-3, 6-11, 00

Test Point (PCB1; WK-4914)	Reference (PCB1; WK-4914)	ACCEPTABLE VALUE
TP1	TP0	+12VDC
TP2	TP0	+5VDC
TP3	TP0	-12VDC
TP6	TP7	+24VDC
TP10	TP11	+18VDC
TP8	TP00	+12VDC
TP9	TP00	+5VDC

4) If any of these voltages are not present or are below a 10% tolerance, replace PCB1 (WK-4914).

5) On the PCB3 (WK-4921), measure the voltages according to the following table.
The location of points TP0-3, 6-7 are indicated in Figure 13.

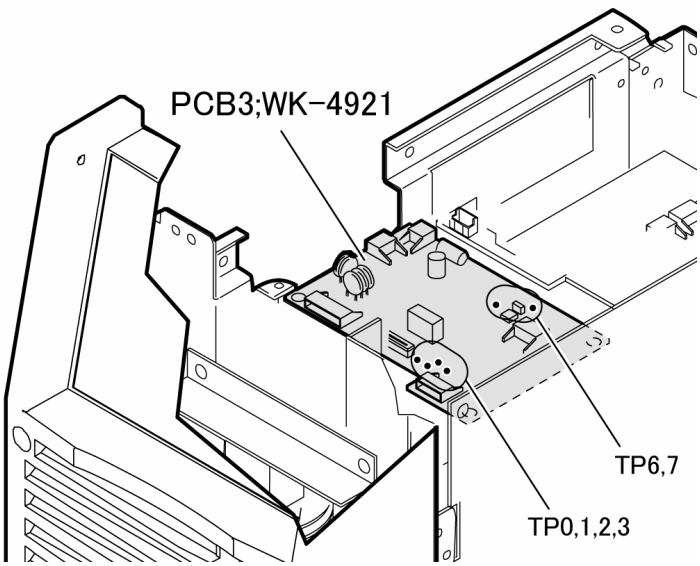


Figure 13 The check points TP0-3, 6-7

Test Point (PCB3; WK-4921)	Reference (PCB3; WK-4921)	ACCEPTABLE VALUE
TP1	TP0	+12VDC
TP2	TP0	+5VDC
TP3	TP0	-12VDC
TP6	TP7	+24VDC

6) If any of these voltages are not present or are below a 10% tolerance, replace PCB3 (WK-4921).

11.01.04.04 Verification of the Cooling Fan, FAN1, Drive Circuitry.

1) Verify the condition of the cooling fan, FAN1, using a DC voltmeter. (The capability of the voltmeter should be more than 50VDC.)
Using a DC voltmeter, measure between PIN 1[+] and PIN 2[-] of CN7 on PCB3 (WK-4921).
The location of connector CN7 of PCB3 (WK-4921) is indicated in Figure 14.

Note 16

When you measure the above voltage, do not remove the connector. Conduct the measurement while the connector plug and receptacle are still connected.

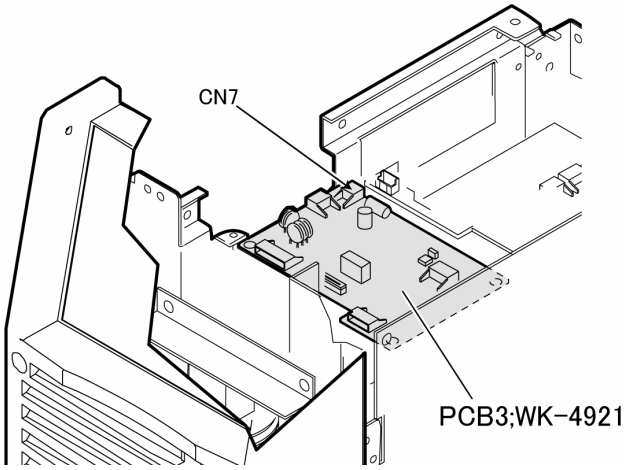


Figure 14 The location of connector CN7 of PCB3 (WK-4921)

2) Using the measurement taken above, follow the chart below for possible failure modes.

	Fan Status	**Voltage measurement. (PIN 1 – PIN 2 of CN7 on PCB3)**	**Remedy**
Case 1	Rotating	DC 18 ~ 25V	Fan drive circuit is normal.
Case 2	Rotating	Below DC 18V	Replace PCB3 (WK-4921). (Refer to section 11.02.04.02)
Case 3	Inactive	Below DC 18V	Replace PCB3 (WK-4921). (Refer to section 11.02.04.02) ↓ Conduct the "Verification of the power input circuitry" in section 11.01.04.02.
Case 4	Inactive	DC 18 ~ 25V	Replace FAN1. (Refer to section 11.02.10)

(Continued on next page.)

Note 17

This welding unit has a feature that will slow the rotational speed of the cooling fan during low output current and while in standby. Under these conditions, the voltages in the above table will be inaccurate; therefore, when verifying the voltage, do so during the failure condition.

Note 18

When verifying the voltage, confirm that the AC input voltage remain within the operating range of the unit. (The AC input does not drop below 180VAC).

11.01.04.05 Verification of the Solenoid Valve, SOL1, Drive Circuitry.

1) Verify the voltage between the PIN 1[+] and PIN 3[-] of connector CN12 on PCB1 (WK-4914) while you press the torch switch while in TIG Mode.
(The capacity of the voltmeter should be more than 50VDC.)
The location of connector CN12 of PCB1 (WK-4914) is indicated in Figure 15.

Refer to ***Note 16*** on page 63.

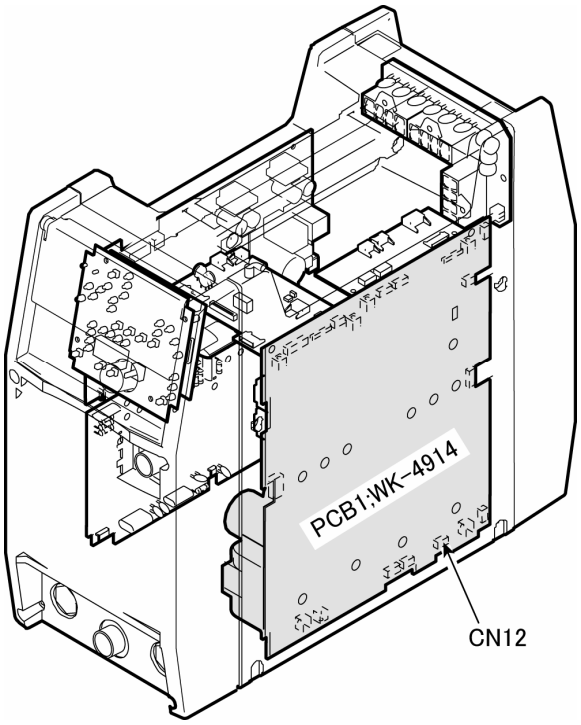


Figure 15 The location of connector CN12 of PCB1 (WK-4914)

2) Using the measurement taken above, follow the chart below for possible failure modes.

	Voltage Measurement (Between PIN 1 – PIN 3 of CN12 on PCB1)	**Remedy**
Case 1	Below DC 18V	Replace PCB1 (WK-4914). (Refer to section 11.02.04.01)
Case 2	DC 18 ~ 25V	Replace SOL1. (Refer to section 11.02.12)

Refer to ***Note 18*** on page 68.

11.01.04.06 Verification of No-load Voltage (No OCV)

a) Verify the no-load voltage in Stick mode.

CAUTION 11

Electric shock hazard. The unit will generate OCV immediately when STICK mode is selected.

1) In STICK welding mode, mark and then turn potentiometer VR1 on PCB6 (WK-5157) all the way to the right and turn off the electric shock protector function (Voltage-Reduction-Device, VRD).

2) Verify the no-load voltage using a DC voltmeter. (The capability of the voltmeter should be more than 100VDC.)

3) The normal no-load voltage is approximately 62V.

b) Verify the no-load voltage in High Frequency TIG (HF TIG) mode.

CAUTION 12

Electric shock hazard and test equipment damage. The unit will generate OCV along with a High Voltage component that can cause extreme personal harm and test equipment damage.

Note 19

When in HF TIG mode, the unit will generate high voltage. To prevent personal harm and test equipment damage, remove the indicated wires from the H.F. Unit1 shown in Figure 16. To prevent electric shock, always wrap the removed wires with electrical tape or other suitable insulation.

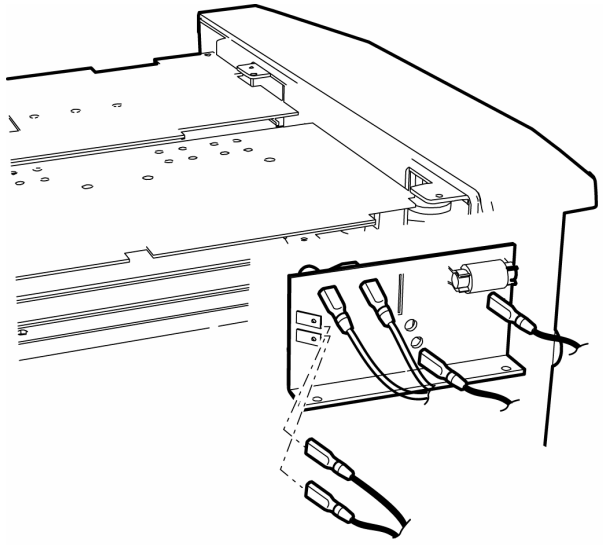


Figure 16 Remove the indicated wires from the H.F. Unit1

1) Confirm a secure connection between CON1 of the 8-pin connector and the remote device.

2) Confirm a secure connection of the harness and the connections between CON1 and PCB3 (WK-4921) are all correct and there are no open circuits.

3) Contact the manufacturer if you find any broken connectors or damaged wiring harnesses.

4) While depressing the Torch switch, verify the OCV using a DC voltmeter. (The capability of the voltmeter should be more than 100VDC.)

Note 20

In TIG mode, the OCV ceases 3 seconds after you depress the torch switch.

5) The normal no-load voltage is approximately 62V.

6) Return potentiometer VR1 to the original position.

7) Reconnect the wires to the H.F. Unit1.

11.01.04.07 Output Load Test

This test verifies that the output current, (amperage) controls are functioning properly. A clamp-type amperage meter or equivalent meter capable of reading approximately 300A full-scale will be needed for this test.

CAUTION 13

Before performing any portion of the procedure below, make certain the unit is placed in the initial set up condition as described at the beginning of this section.

1) Connect the POSITIVE (+) and NEGATIVE (-) OUTPUT TERMINALS to a piece of metal, separated by approximately three feet (one meter).

2) Connect the clamp-on amperage meter or equivalent to the output loop between the POSITIVE (+) and NEGATIVE (-) OUTPUT TERMINALS.

3) Place the power supply PRIMARY POWER SWITCH on the rear of the unit to the ON position.

4) Press the Welding mode selection button to select HF TIG welding mode. Press the AC/DC selection button to select DC mode.

WARNING 12

This welding mode produces high frequency and high voltage. Extra care shall be taken to prevent electric shock.

5) Select WELD position, press control knob. Set minimum current (counterclockwise).

6) Depress the torch switch. The amperage meter will indicate approximately 5 Amps.

7) Slowly turn the Control Knob clockwise to the maximum of the power supply, then counterclockwise, back to 5 Amps as the control returns to its minimum position. The amperage meter should indicate a continuous range of Amperes between the 5 Amps minimum and the 185A maximum.

8) Set minimum current (counterclockwise).

9) Press the Welding mode selection button to select STICK welding mode. The amperage meter will indicate approximately 5 Amps.

WARNING 13

At this time, some voltage is applied to the stick electrode holder. Never touch the current conducting portion of it. Extra care shall be taken to prevent electric shock. Further, to prevent the risk of striking the arc inadvertently, care shall be taken to keep the work piece to be welded away from the said electrode holder.

10) Slowly turn the Control Knob clockwise to the maximum of the power supply, then counterclockwise, back to 5 Amps as the control returns to its minimum position. The amperage meter should indicate a continuous range of Amperes between the 5 Amps minimum and the 160A maximum.

11) Place the power supply MAIN CIRCUIT SWITCH on the rear of the unit to the OFF position.

12) Remove the dead short between the OUTPUT TERMINALS.

Note 21

This completes the output load test. If the results of any step differ from those above, then refer to the various test procedures in this section to isolate the problem.

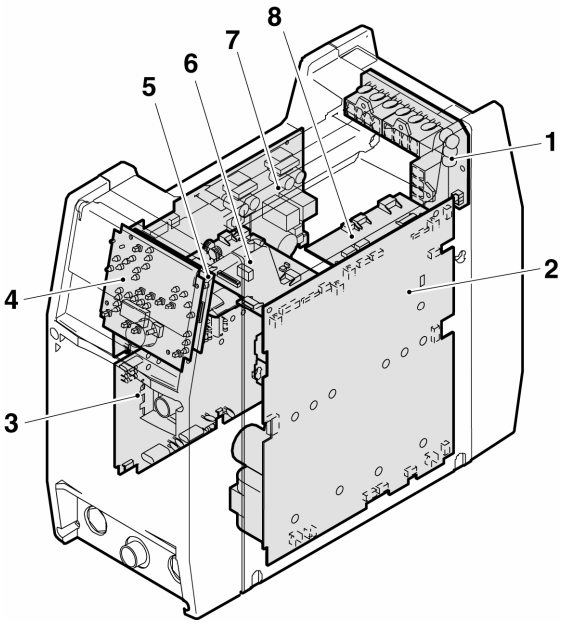
11.02 Subsystem Test and Replacement Procedures

11.02.01 Preparation

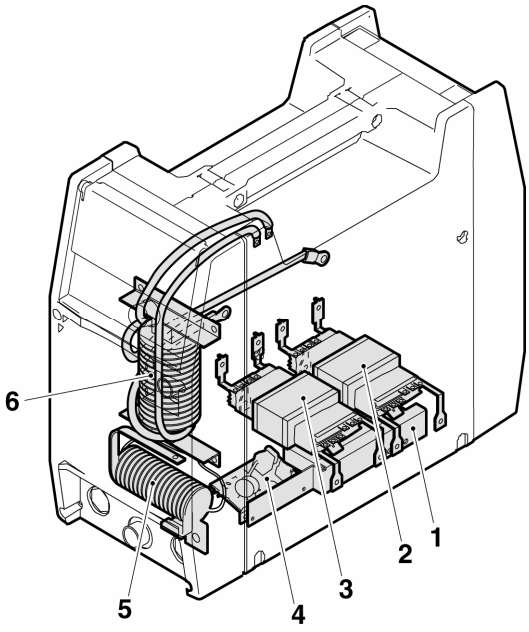
This section provides specific procedures for verifying the operation and replacement of each subsystem within the power supply. Before undertaking any of these procedures, eliminate the obvious first- visually inspect the suspect subsystem for physical damage, overheating, and loose connections.

11.02.02 Test and Replacement Parts List

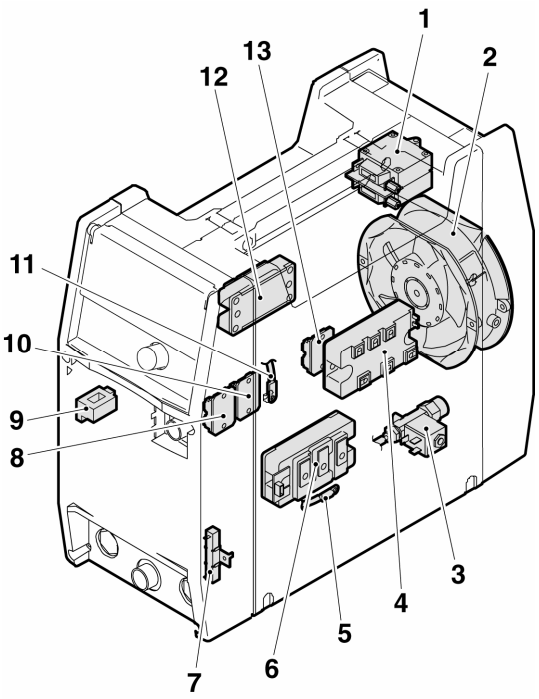
No.	DWG. NO.	Description	Manual Section Number
1	PCB8	Print Circuit Board WK-4917	11.02.04.06
2	PCB1	Print Circuit Board WK-4914	11.02.04.01
3	PCB4	Print Circuit Board WK-4915	11.02.04.03
4	PCB7	Print Circuit Board WK-4920	11.02.04.05
5	PCB6	Print Circuit Board WK-5157	11.02.04.05
6	PCB3	Print Circuit Board WK-4921	11.02.04.02
7	PCB5	Print Circuit Board WK-4916	11.02.04.04
8	PCB2	Print Circuit Board WK-4819	11.02.04.01

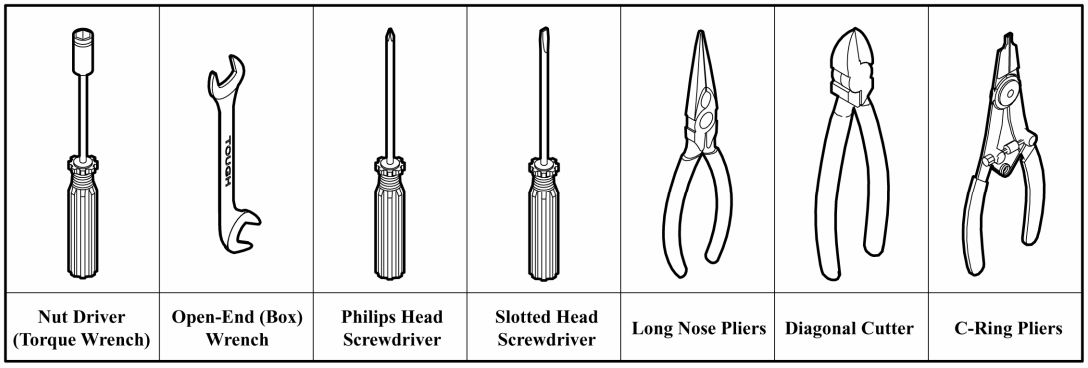


No.	DWG. NO.	Description	Manual Section Number
1	T3	Transformer	11.02.08.03
2	T1	Transformer	11.02.08.04
3	T2	Transformer	11.02.08.04
4	HF. UNIT 1	High Frequency Unit	11.02.11
5	CC1	Coupling Coil	11.02.08.01
6	FCH1	Reactor	11.02.08.02

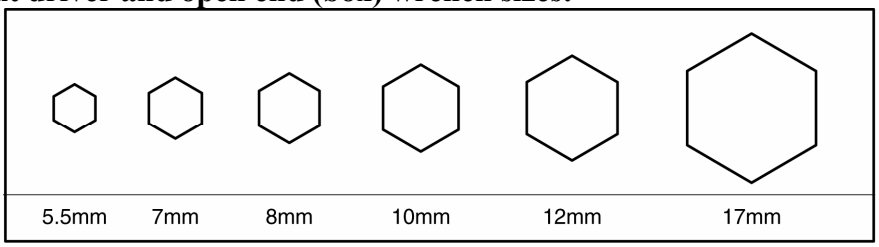


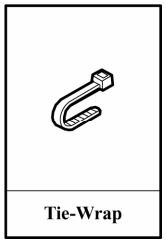
No.	DWG. NO.	Description	Manual Section Number
1	S1	Switch	11.02.05
2	FAN 1	Cooling Fan	11.02.10
3	SOL 1	Gas Valve	11.02.12
4	D1	Diode	11.02.06.01
5	TH1, 2	Thermistor	11.02.07
6	Q1	IGBT	11.02.06.02
7	R1	Current-Limiting Resistor (HF. UNIT 1)	11.02.13
8	D4	Diode	11.02.06.05
9	HCT 1	Hall Current Transformer	11.02.09
10	D5	Diode	11.02.06.05
11	TH2	Thermistor	11.02.12
12	Q2	IGBT	11.02.06.03
13	D2	Diode	11.02.06.04





Nut driver and open end (box) wrench sizes:





Note 22

When removing the locking type connectors and board supporters, disengage the locking mechanism first and then disconnect them.

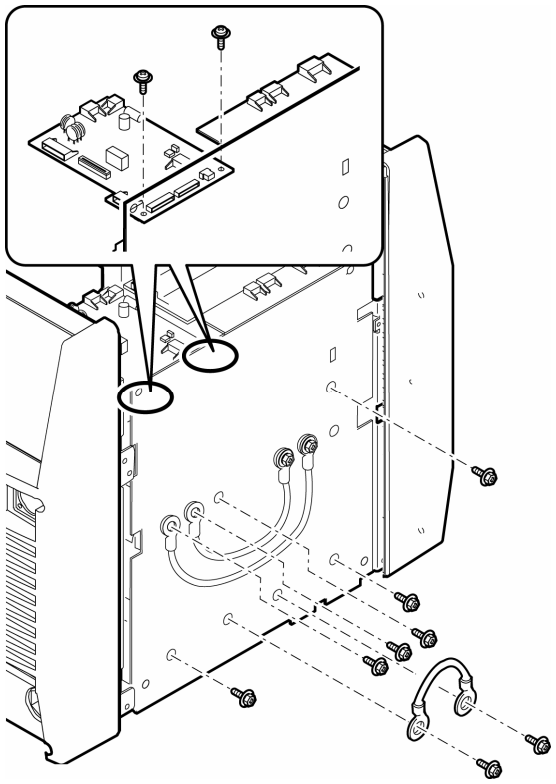
Note 23

Locking type connectors and board supporters are indicated in this manual using the following symbols; black star marks for locking connectors and white star marks for locking board supports.

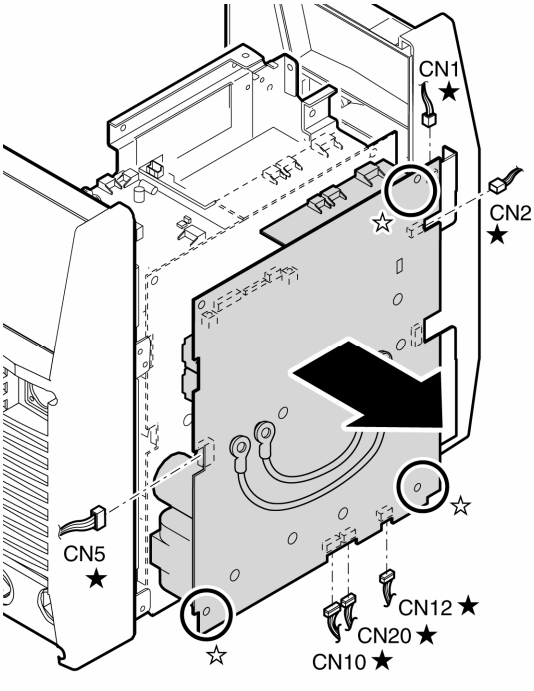
11.02.04 Printed Circuit Boards

11.02.04.01 PCB1, PCB2 Replacement Procedure

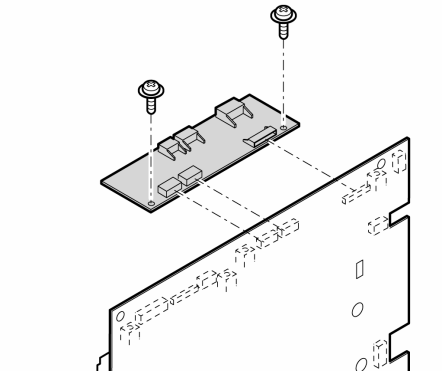
1) Remove the side covers. See section “11.01.01”.
2) Remove the eight mounting screws of PCB1.
3) Remove the two mounting screws of PCB3.



4) Unlock the board support clips and pull the board forward.
5) Remove the six locking connectors attached to PCB1.
6) Remove PCB1 from the main frame of the power supply.



7) Remove the two mounting screws of PCB2 and remove the board.



* When you re-assemble the parts, conduct the above process backwards.

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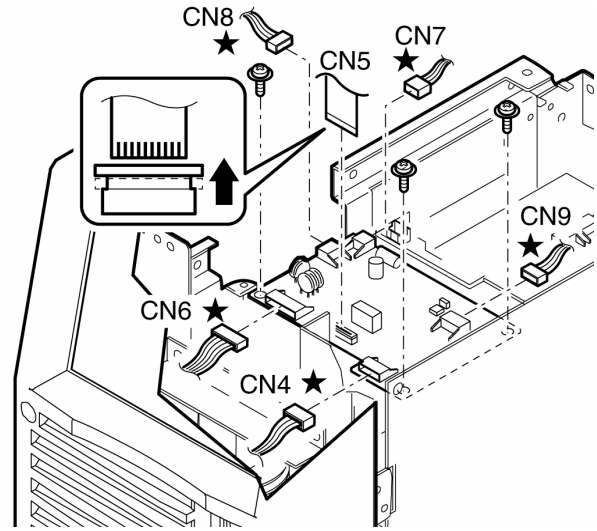
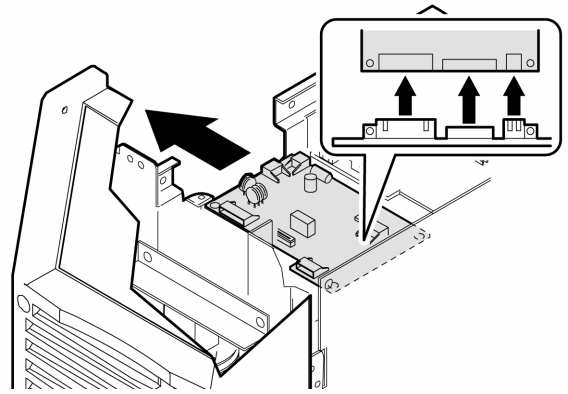
11.02.04.02 PCB3 Replacement Procedure

1) Remove the side covers. See section “11.01.01”.
2) Remove the three mounting screws of PCB3.
3) Remove the five locking connectors attached to PCB3.
4) Carefully disengage the locks and disconnect the flat ribbon cable.



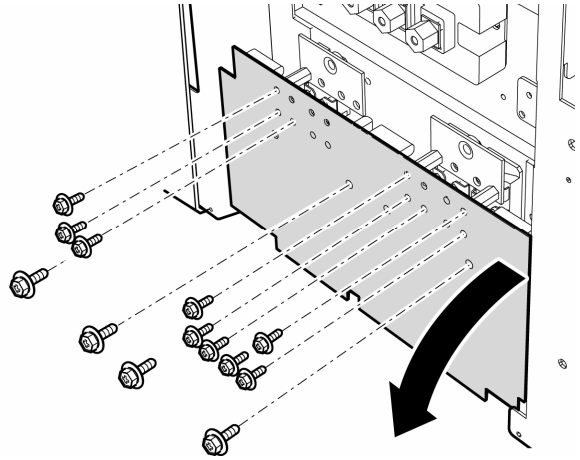
5) Disconnect PCB3 from the PCB1 by pulling PCB3 in the direction of the arrow sign as shown.



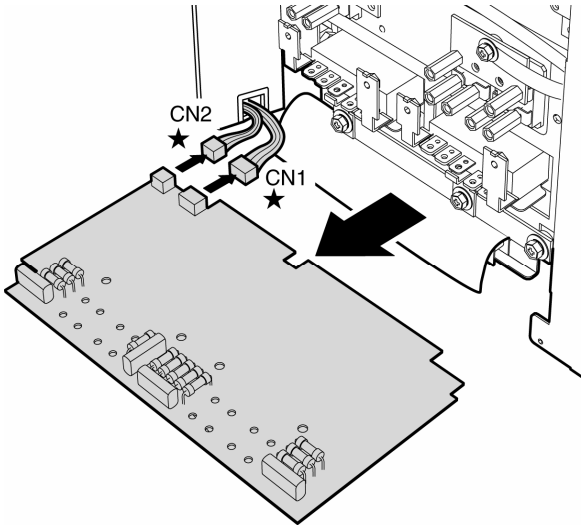
* When you re-assemble the parts, conduct the above process backwards.

11.02.04.03 PCB4 Replacement Procedure

1) Remove the side covers. See section “11.01.01”.
2) Remove the thirteen mounting screws of PCB4.



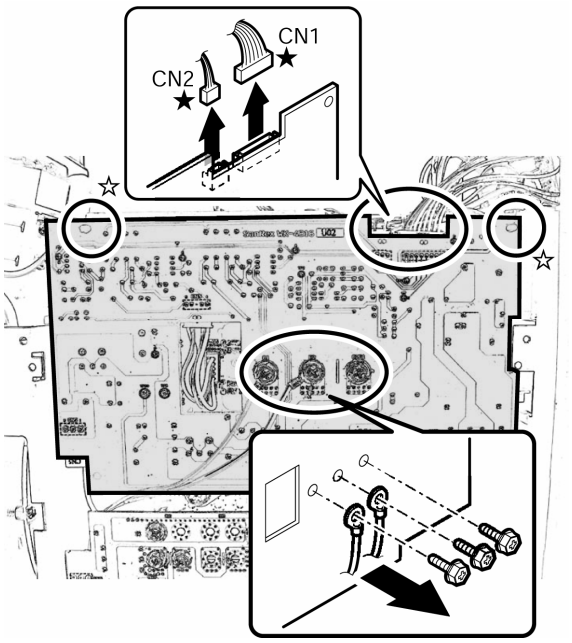
3) Swing down the top of PCB4 and remove the two locking connectors attached to PCB4.
4) Remove PCB4 from the main frame of the power supply.



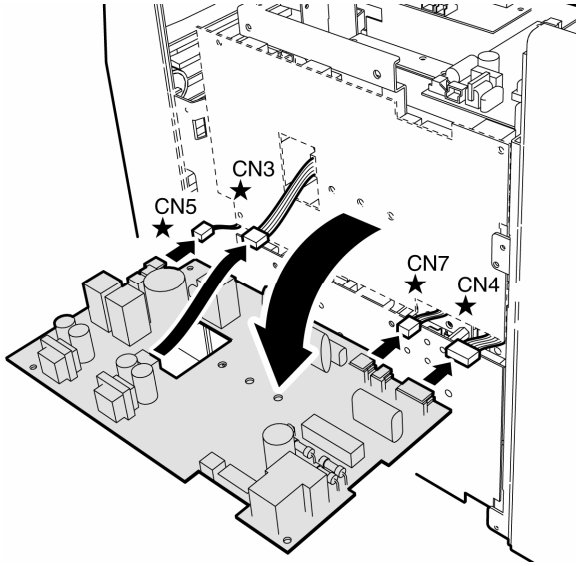
* When you re-assemble the parts, conduct the above process backwards.

11.02.04.04 PCB5 Replacement Procedure

1) Remove the side covers. See section “11.01.01”.
2) Remove the three mounting screws of PCB5.
3) Remove the two locking connectors attached to PCB5.



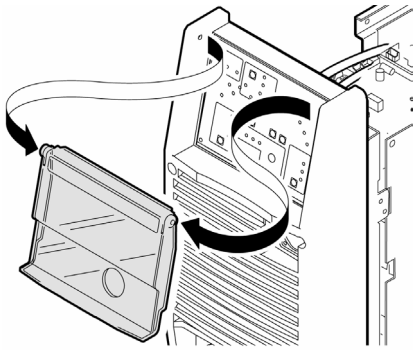
4) Disconnect PCB5 from the two board supporters.
5) Swing down the top of PCB5 and remove the four connectors attached to PCB5.
6) Remove PCB5 from the main frame of the power supply.



* When you re-assemble the parts, conduct the above process backwards.

11.02.04.05 PCB6, PCB7 Replacement Procedure

1) Remove the side covers. See section “11.01.01”.
2) Remove the protection cover over the front panel.

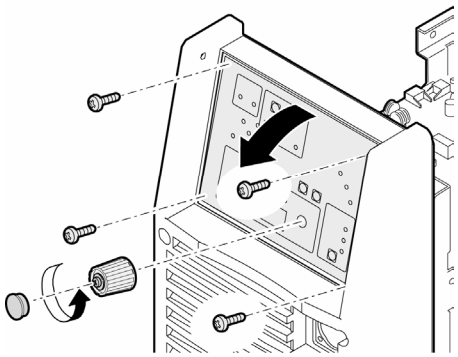


3) Remove the cap on the control knob, loosen the screw and remove the knob.

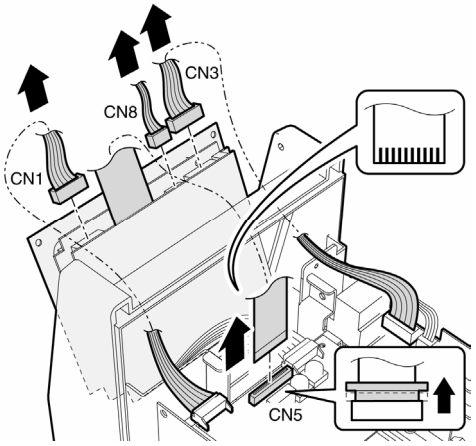
Note 24

During the re-installation of the knob, tighten the screw such that there is a space of 2mm between the control panel and the rear of the knob.

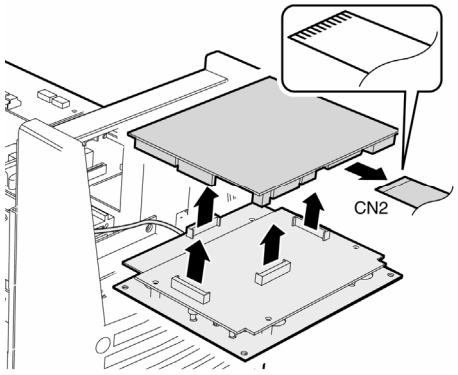
4) Remove the four mounting screws of the control panel.
5) Carefully swing down the top of the control panel slightly.



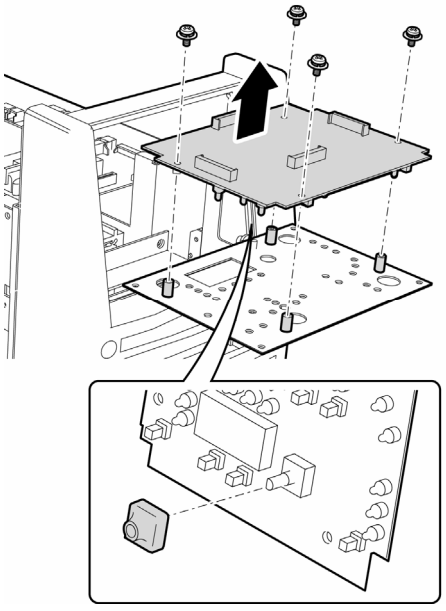
6) Carefully disengage the lock and disconnect the flat ribbon cable.
7) Disconnect the three additional connectors from PCB6.



8) Disconnect and remove PCB6 from PCB7 by pulling the two PCB's apart.
9) Carefully disengage the lock and disconnect the flat ribbon cable from PCB6.



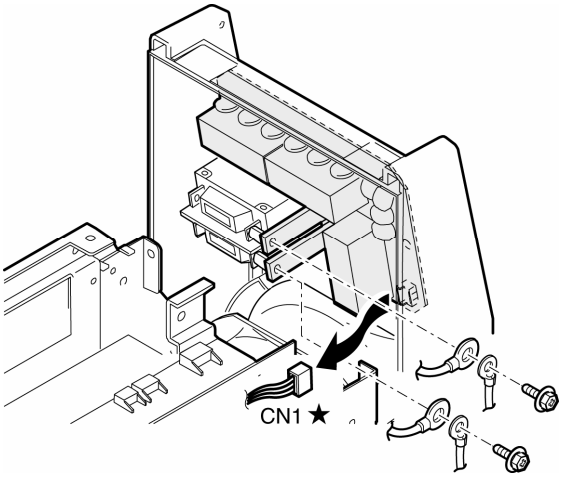
10) Remove the four mounting screws and remove PCB7 from the panel.
11) Remove the dust cover from PCB7.



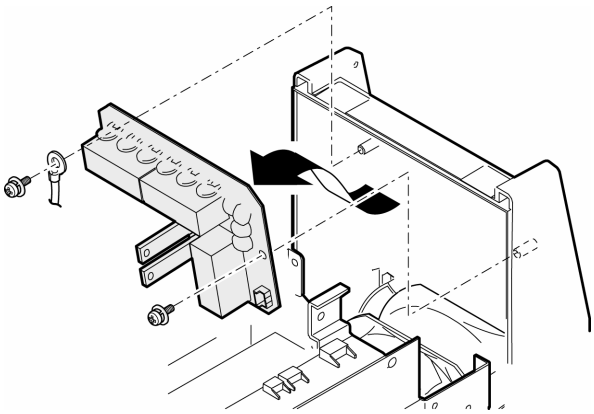
* When you re-assemble the parts, conduct the above process backwards.

11.02.04.06 PCB8 Replacement Procedure

1) Remove the side covers. See section “11.01.01”.
2) Remove the two screws from the switch along with four lug terminals.
3) Remove the one locking connector.



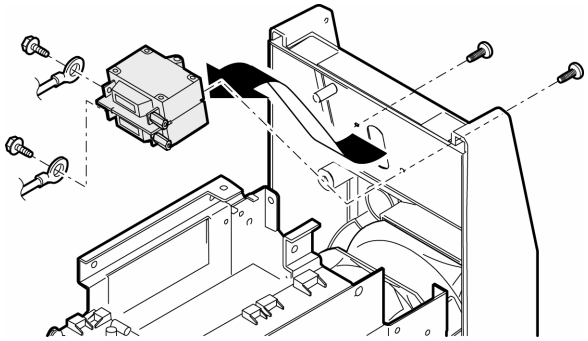
4) Remove the two mounting screws of PCB8 along with the grounding terminal.



* When you re-assemble the parts, conduct the above process backwards.

11.02.05 Switch, S1 Replacement Procedure

1) Remove the side covers. See section “11.01.01”.
2) Remove PCB8. See section “11.02.04.06”.
3) Remove the two screws from the switch along with four lug terminals.
4) Remove the two mounting screws and remove the switch.



11.02.06 Semiconductors

11.02.06.01 Diode, D1

a) Test Procedure

1) Verify the characteristic of the diode, D1, using a diode tester.
2) Refer the Table 6 and Figure 17, 18 for the checkpoints on D1.

COMPONENT TESTED	TERMINALS		ACCEPTABLE VALUE
	Positive lead	Negative lead	
Diode of D1	3,4,5 0	0 3,4,5	0.3 to 0.5V Open circuit
Diode of D1	3,4,5 2	2 3,4,5	Open circuit 0.3 to 0.5V
SCR of D1	0 1	1 0	Open circuit Open circuit

Table 6 D1 tester checkpoints

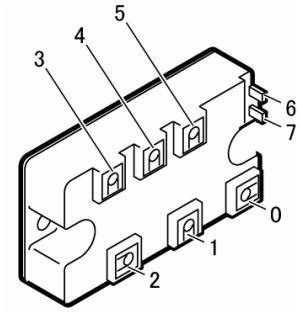


Figure 17 D1 tester checkpoints

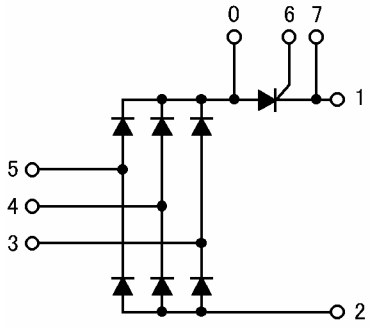
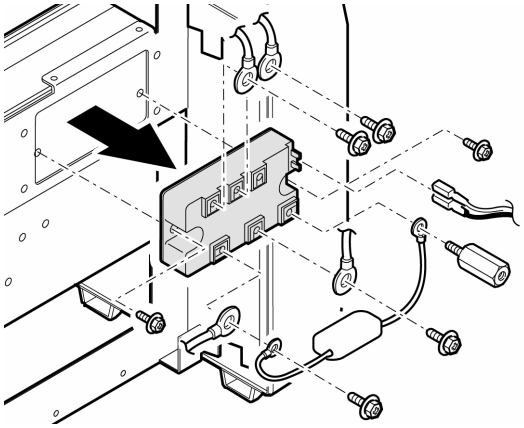


Figure 18 D1 interconnection diagram

b) Replacement Procedure

1) Remove the side covers. See section “11.01.01”.
2) Remove PCB1. See section “11.02.04.01”.
3) Remove the four screws along with the cables and capacitors.
4) Remove the one standoff.
5) Remove the two mounting screws of diode, D1, and remove the diode.



Note 25

When you re-assemble the parts, conduct the above process backwards. Additionally, when installing the diode, apply 23 in·lb-force to tighten the diode base screws and the terminal screws.

Note 26

When replacing the diode, apply heat sink compound (Shinetsu silicon G-747 or equivalent) uniformly to the base surface of the diode.

11.02.06.02 IGBT, Q1

a) Test Procedure

1) Confirm there are no abnormal appearances on PCB10 (WK-5012).
2) Verify the characteristic of the diode, Q1, using a diode tester.
3) Refer the Table 7 and Figure 19 for the checkpoints on Q1.

COMPONENT TESTED	TERMINALS		ACCEPTABLE VALUE
	Positive lead	Negative lead	
Collector-Emitter of Q1 with PCB10	C1 C2E1	C2E1 C1	Open circuit 0.2 to 0.5V
Collector-Emitter of Q1 with PCB10	C2E1 E2	E2 C2E1	Open circuit 0.2 to 0.5V

Table 7 Q1 tester checkpoints

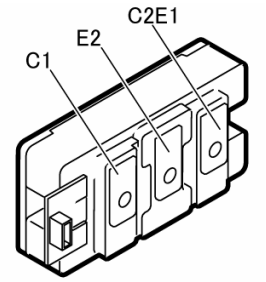
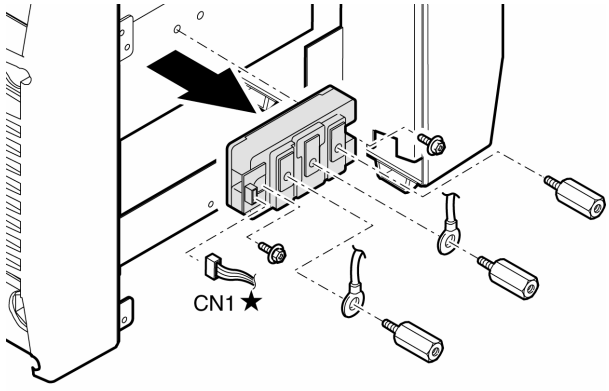


Figure 19 Q1 tester checkpoints

b) Replacement Procedure

1) Remove the side covers. See section “11.01.01”.
2) Remove PCB1. See section “11.02.04.01”.
3) Remove the three standoffs along with the cables.
4) Remove the one locking connector attached to the gate PCB.
5) Remove the two mounting screws of IGBT, Q1, and remove the IGBT.



Note 27

When you re-assemble the parts, conduct the above process backwards. Additionally, when installing the IGBT, apply 27.5 in·lb-force to the IGBT base screws and 23 in·lb-force to the terminal screws.

Note 28

When replacing the IGBT, apply heat sink compound (Shinetsu silicon G-747 or equivalent) uniformly to the base surface of the IGBT.

11.02.06.03 IGBT, Q2

a) Test Procedure

1) Confirm there are no abnormal appearances on PCB11 (WK-3367).
2) Verify the characteristic of the diode, Q2, using a diode tester.
3) Refer the Table 8 and Figure 20 for the checkpoints on Q2.

COMPONENT TESTED	TERMINALS		ACCEPTABLE VALUE
	Positive lead	Negative lead	
Collector-Emitter of Q2 with PCB11	C1 (3) C2E1 (1)	C2E1 (1) C1 (3)	Open circuit 0.2 to 0.4V
Collector-Emitter of Q2 with PCB11	C2E1 (1) E2 (2)	E2 (2) C2E1 (1)	Open circuit 0.2 to 0.4V

Table 8 Q2 tester checkpoints

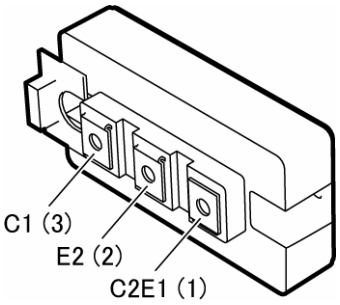
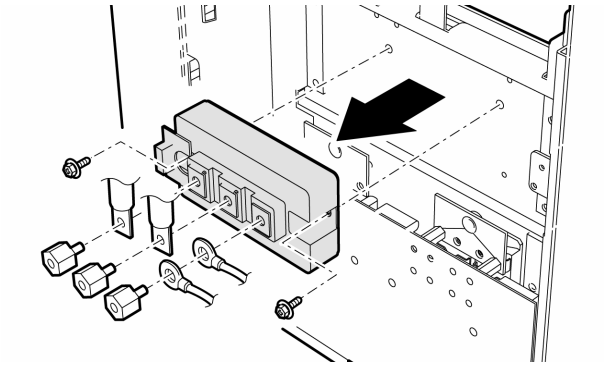


Figure 20 Q2 tester checkpoints

b) Replacement Procedure

1) Remove the side covers. See section “11.01.01”.
2) Remove PCB5. See section “11.02.04.04”.
3) Remove the three standoffs along with the cables.
4) Remove the two mounting screws of IGBT, Q2, and remove the IGBT.



Note 29

When you re-assemble the parts, conduct the above process backwards. Additionally, when installing the IGBT, apply 27.5 in·lb-force to the IGBT base screws and 23 in·lb-force to the terminal screws.

Refer to ***Note 28*** on page 91.

11.02.06.04 Diode, D2

a) Test Procedure

1) Verify the characteristic of the diode, D2, using a diode tester.
2) Refer the Table 9 and Figure 21 for the checkpoints on D2.

COMPONENT TESTED	TERMINALS		ACCEPTABLE VALUE
	Positive lead	Negative lead	
Diode1 of D2, D4, D5	Anode Cathode	Cathode Anode	0.2 to 0.3V Open circuit
Diode2 of D2, D4, D5	Anode Cathode	Cathode Anode	0.2 to 0.3V Open circuit

Table 9 D2, D4 and D5 tester checkpoints

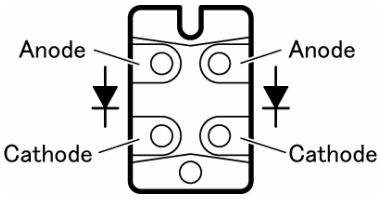
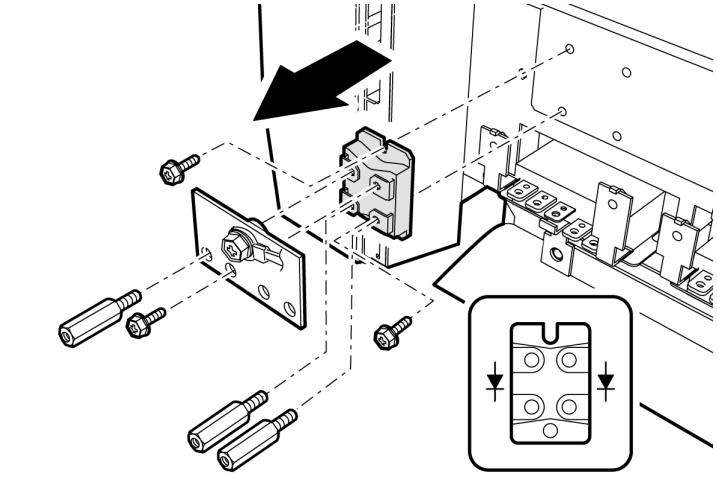


Figure 21 D2, D4 and D5 tester checkpoints

b) Replacement Procedure

1) Remove the side covers. See section “11.01.01”.
2) Remove PCB4. See section “11.02.04.03”.
3) Remove the three standoffs.
4) Remove the one remaining screw holding the bus bar and remove the bus bar.
5) Remove the two mounting screws of diode, D2, and remove the diode, noting the direction of the diode.



Note 30

When you re-assemble the parts, conduct the above process backwards. Additionally, when installing the diode, apply 11.5 in·lb-force to the diode base screws.

Note 31

Pay attention to the direction of the diode when installing the diode.

Refer to ***Note 26*** on page 89.

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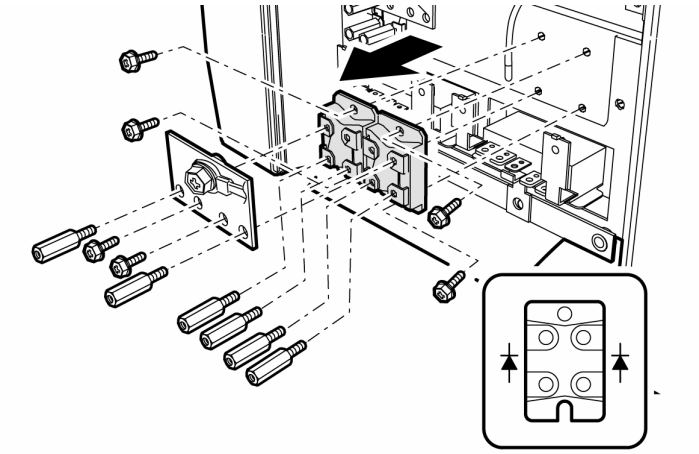
11.02.06.05 Diode, D4, D5

a) Test Procedure

1) Verify the characteristic of the diode, D4 and D5 using a diode tester.
2) Refer the Table 9 and Figure 21 for the checkpoints on D4 and D5.

b) Replacement Procedure

1) Remove the side covers. See section “11.01.01”.
2) Remove PCB4. See section “11.02.04.03”.
3) Remove the six standoffs.
4) Remove the two remaining screws holding the bus bar and remove the bus bar.
5) Remove the two (each) mounting screws of diodes, D4 and D5, and remove the diodes, noting the direction of the diodes.



Refer to ***Note 29*** on page 93.
Refer to ***Note 30*** on page 95.
Refer to ***Note 26*** on page 89.

11.02.07 Thermistors, TH1, TH2

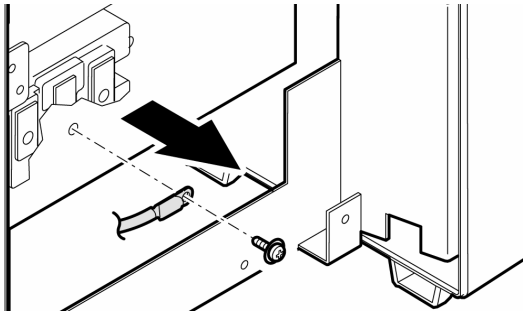
a) Test Procedure

1) Select the Ohms scale on the digital meter.
2) Disconnect the connector at CN8 on PCB6.

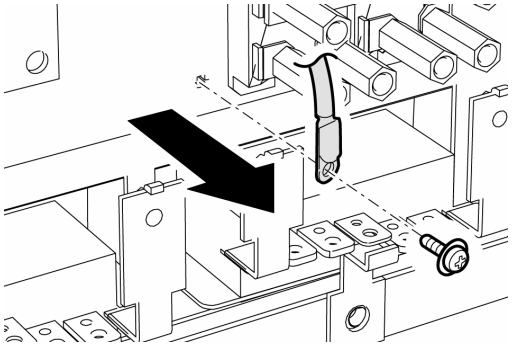
3) The resistance of a good sensor measured between pins 1 and 2 on the connector should be in the 10kΩ to 21.6kΩ range, with the reading decreasing as the temperature of the power supply increases. A shorted reading indicates a bad sensor, and it should be replaced.
4) The resistance of a good sensor measured between pins 3 and 4 on the connector should be in the 10kΩ to 21.6kΩ range, with the reading decreasing as the temperature of the power supply increases. A shorted reading indicates a bad sensor, and it should be replaced.

b) Replacement Procedure

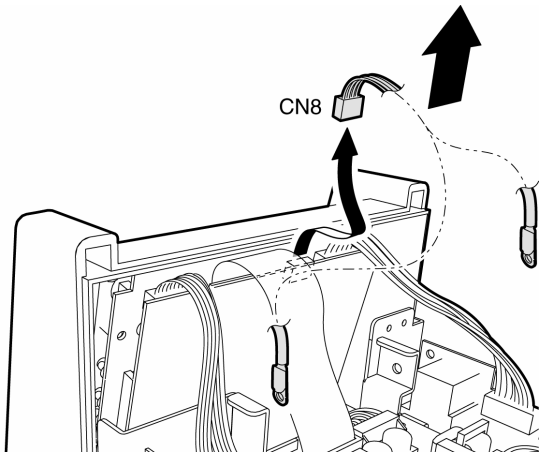
1) Remove the side covers. See section "11.01.01".
2) Remove PCB1. See section "11.02.04.01".
3) Remove the one mounting screw of the thermistor and remove the thermistor.



4) Remove PCB4 and PCB5. See section "11.02.04.03, 11.02.04.04".
5) Remove the one mounting screw of thermistor and remove the thermistor.



6) Remove one connector attached to PCB6.
7) Remove the thermistor from the main frame of the power supply.



* When you re-assemble the parts, conduct the above process backwards.

Note 32

When replacing the thermistors, apply heat sink compound (Shinetsu silicon G-747 or equivalent) uniformly to the base surface of the thermistors.

11.02.08 Coils

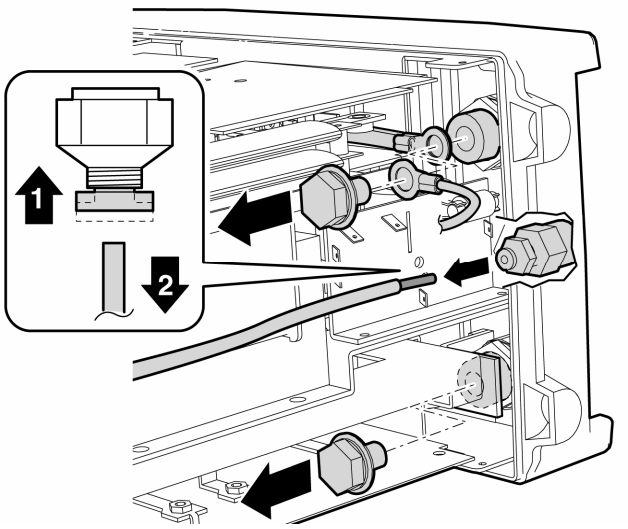
11.02.08.01 Coupling Coil, CC1

a) Test Procedure

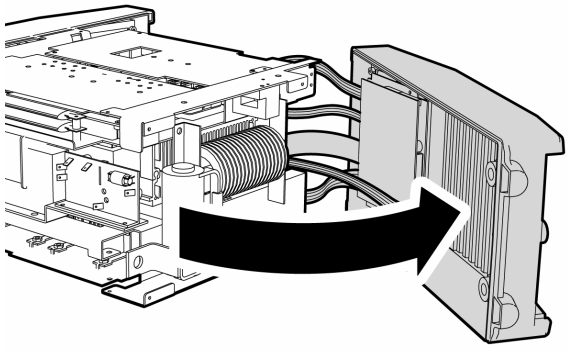
1) Inspect the Coupling Coil, CC1, for signs of overheating or loose connections.
2) Check for continuity through the coupling coil by measuring between the terminals at each end.

b) Replacement Procedure

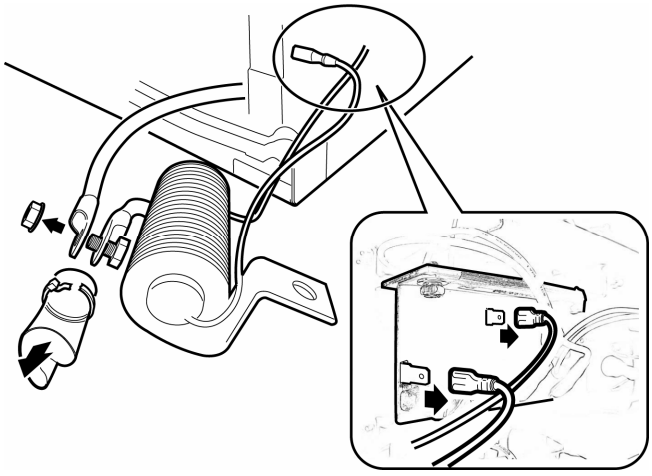
1) Remove the side covers. See section "11.01.01".
2) Remove the two bolts, which mount the lug connections to the output terminals.
3) Unlock and remove the gas tube as shown in the illustration.



4) Remove the four screws of the front frame and open the front frame as shown in the illustration.



5) Disconnect the coupling coil terminals from the H.F.UNIT1.
6) Cut off the tie-wrap and remove the insulation tube.
7) Remove all remaining screws and nuts and remove the coupling coil.



* When you re-assemble the parts, conduct the above process backwards.

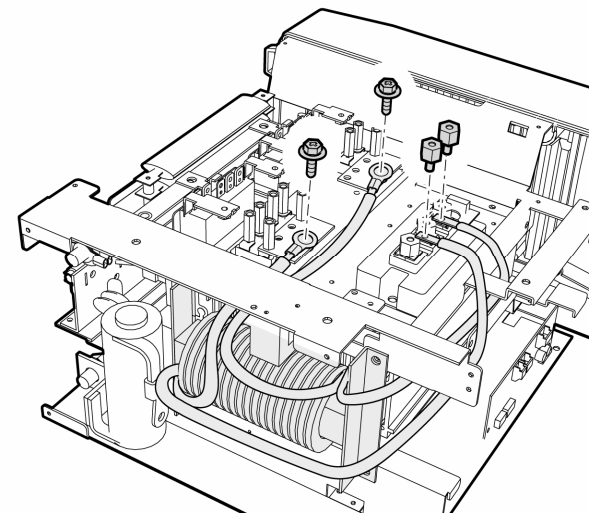
11.02.08.02 Reactor, FCH1

a) Test Procedure

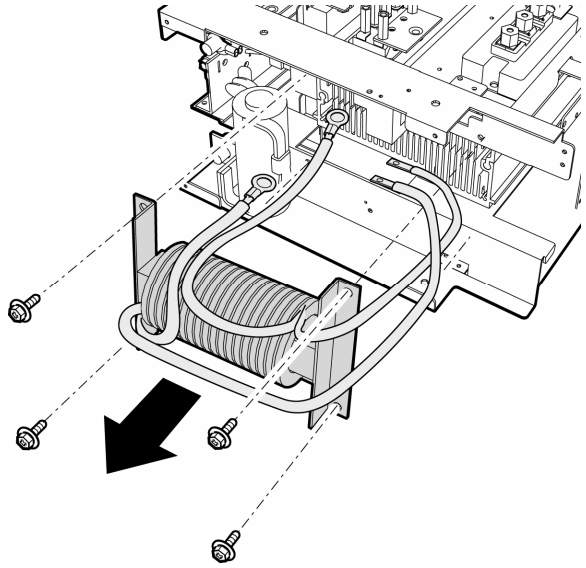
1) Inspect the Reactor, FCH1, for signs of overheating or loose connections.
2) Check for continuity through the reactor by measuring the terminals at each end.

b) Replacement Procedure

1) Remove the side covers. See section “11.01.01”.
2) Remove PCB3, 4 and 5. See sections “11.02.04.02, 11.02.04.03, 11.02.04.04”.
3) Remove two standoffs and two screws along with the terminal lugs from the reactor.
4) Open the front frame. See section “11.02.08.01”.



5) Remove the four mounting screws of the reactor and remove the reactor from the main frame of the power supply.



* When you re-assemble the parts, conduct the above process backwards.

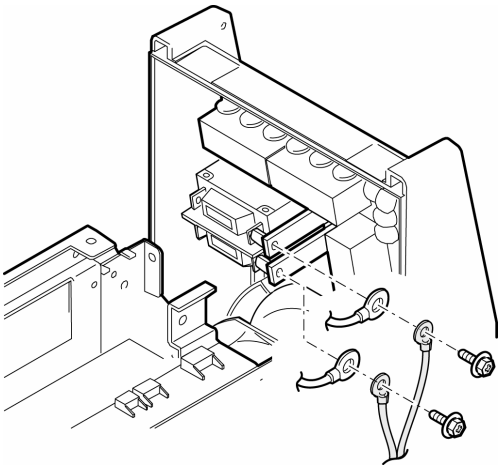
11.02.08.03 Transformer, T3

a) Test Procedure

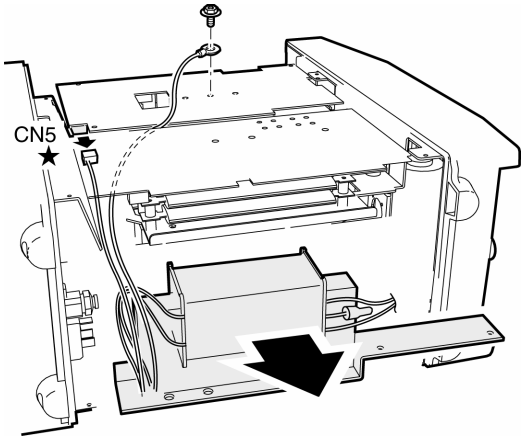
1) Inspect the Transformer, T3, for signs of overheating or loose connections.
2) Check for continuity across the primary windings of both transformers.
3) Check for continuity across the secondary windings of both transformers.
4) Check for isolation between the primary winding and the secondary winding of both transformers.

b) Replacement Procedure

1) Remove the side covers. See section “11.01.01”.
2) Remove the HF.UNIT1. See section “11.02.11”.
3) Remove the two screws from the switch along with four lug terminals.



4) Remove one locking connector.
5) Remove the one screw along with one lug terminal.
6) Remove the transformer, T3, from the main frame of the power supply.



* When you re-assemble the parts, conduct the above process backwards.

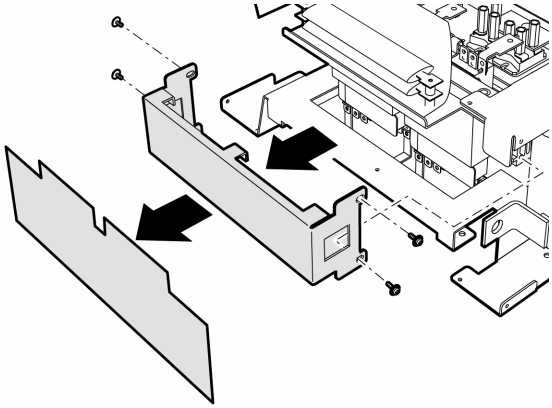
11.02.08.04 Transformer, T1, T2

a) Test Procedure

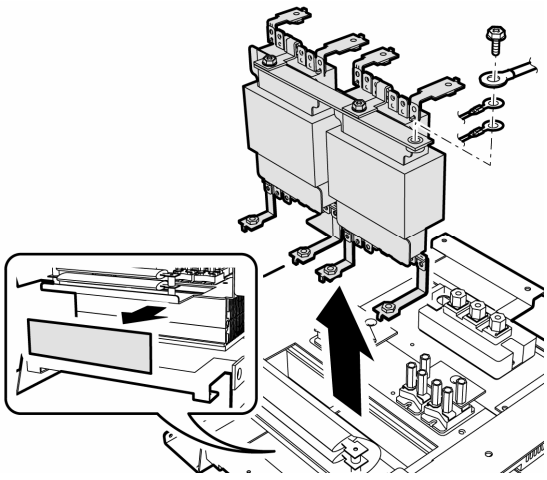
1) Inspect the Transformer, T1, T2, for signs of overheating or loose connections.
2) Check for continuity across the primary windings of both transformers.
3) Check for continuity across the secondary windings of both transformers.
4) Check for isolation between the primary winding and the secondary winding of both transformers.

b) Replacement Procedure

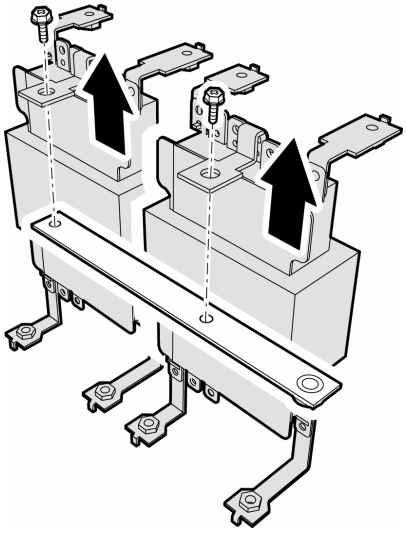
1) Remove the side covers. See section “11.01.01”.
2) Remove PCB1. See section “11.02.04.01”.
3) Remove PCB4 and PCB5. See section “11.02.04.03 and 11.02.04.04”.
4) Open up the front frame. See section “11.02.08.01”.
5) Open up the rear frame. See section “11.02.10”.
6) Remove transformer, T3. See section “11.02.08.03”.
7) Remove the reactor, FCH1. See section “11.02.08.02”.
8) Remove the insulation sheet for the transformer.
9) Remove the four mounting screws of the fixture and pull out the transformer metal housing.



10) Remove the one screw along with the lug terminals and remove the T1-T2- bus bar assembly.



11) Remove the one screw of the T1-T2-bus bar assembly and disconnect T1.
12) Remove the one screw of the remaining T2-bus bar assembly and disconnect T2.



* When you re-assemble the parts, conduct the above process backwards.

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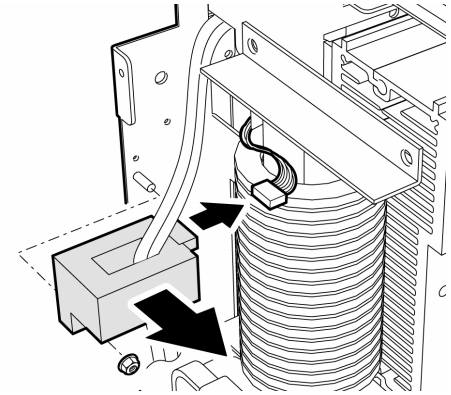
11.02.09 Hall Current Transformer (HCT), HCT1

a) Test Procedure

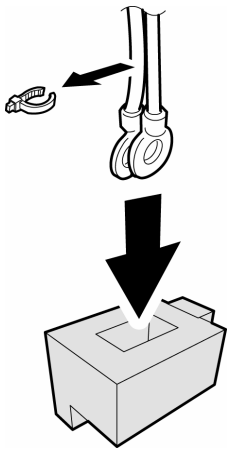
1) Remove the locking connector CN9 attached to PCB3.
2) With an Ohmmeter set the R×10 scale, measure between the pins on plug CN9 as follows:
   Pin 4 and Pin 1 about 3 to 5 MΩ
   Pin 4 and Pin 2 about 20 kΩ

b) Replacement Procedure

1) Remove the side covers. See section "11.01.01".
2) Open up the front frame. See section "11.02.08.01".
3) Remove the one mounting nut for the HCT.
4) Remove the one connector from the HCT.
5) Slide the HCT in the direction of the arrow sign as illustrated.



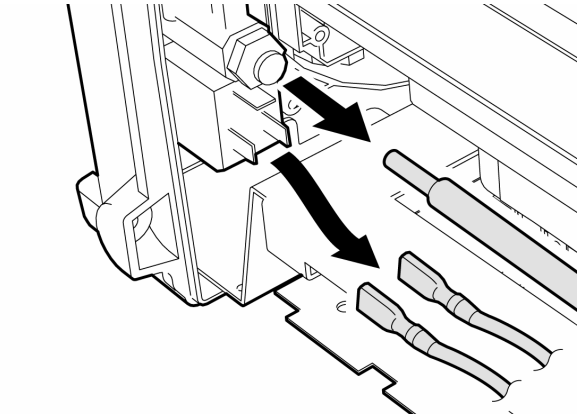
6) Cut off the tie-wrap from the cables and remove the HCT.



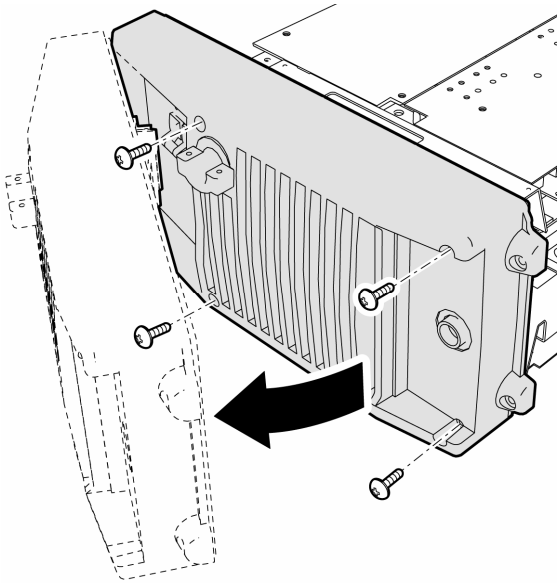
* When you re-assemble the parts, conduct the above process backwards.

11.02.10 FAN1 Replacement Procedure

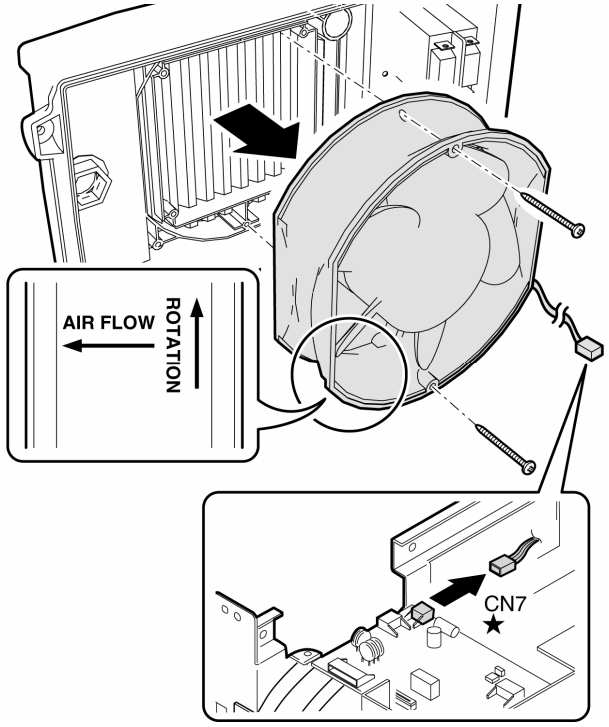
1) Remove the side covers. See section “11.01.01”.
2) Unlock and the remove the gas valve hose. Refer to section 11.02.12.
3) Mark, record and then remove the harness from the gas valve.



4) Remove the four screws of the rear frame and open up the rear frame.



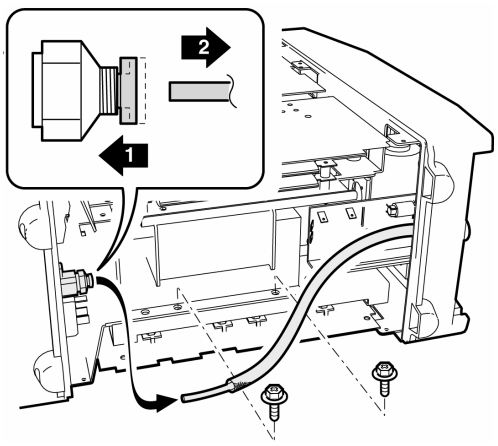
5) Remove the locking connector CN7 attached to PCB3.
6) Remove the two mounting screws and remove the fan.



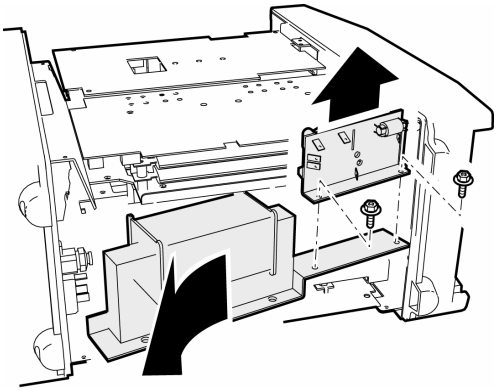
- When you re-assemble the parts, conduct the above process backwards.

11.02.11 HF. UNIT1 Replacement Procedure

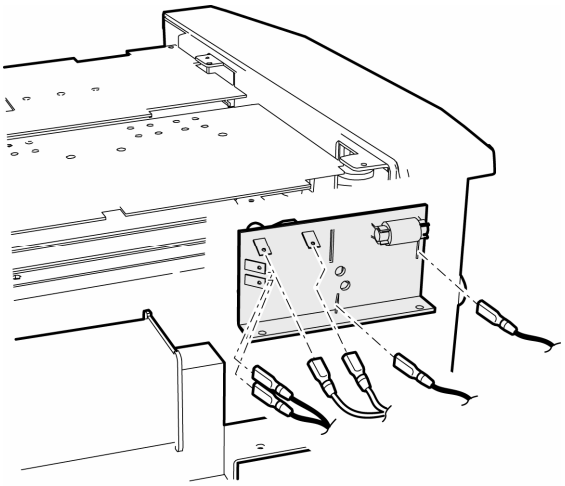
1) Remove the side covers. See section “11.01.01”.
2) Unlock and the remove the gas-valve hose.
3) Remove the two mounting screws of transformer T3.



4) Slide the transformer slightly in the direction of the arrow sign as illustrated.
5) Remove the two mounting screws of the HF.UNIT1 and remove the HF.UNIT1.



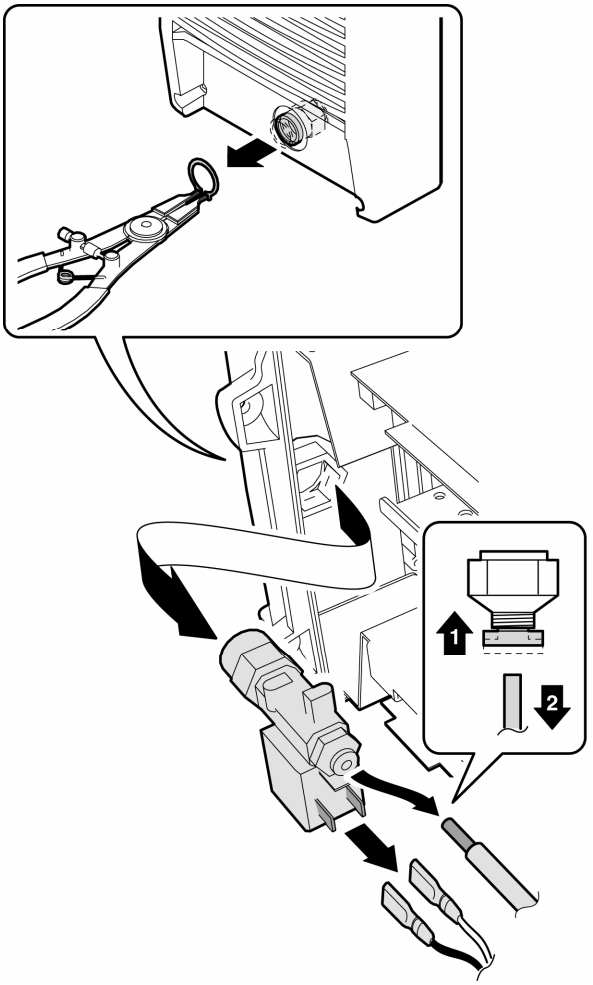
6) Mark, record and then remove the harnesses on the HF.UNIT1.



* When you re-assemble the parts, conduct the above process backwards.

11.02.12 Gas Valve, SOL1 Replacement Procedure

1) Remove the side covers. See section “11.01.01”.
2) Unlock and the remove the gas valve hose.
3) Mark, record and then remove the harness from the gas valve.
4) Remove the C-ring of the gas valve at the rear frame using C-ring pliers. Remove the gas valve.



- When you re-assemble the parts, conduct the above process backwards.

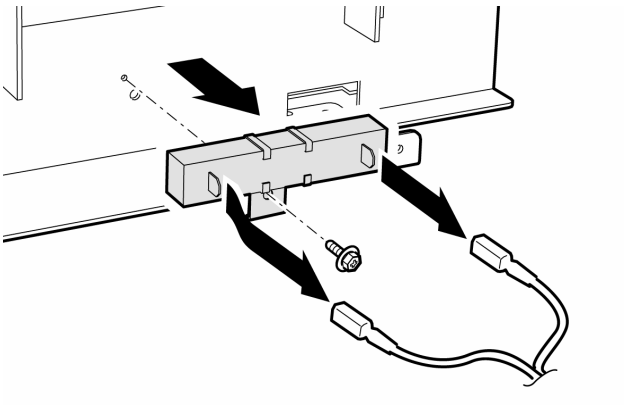
11.02.13 Current-Limiting Resistor for HF.UNIT1, R1

a) Test Procedure

1) Inspect the Resistor, R1, for signs of overheating or loose connections.
2) With an Ohmmeter set the R×1 scale, measure between both ends of the terminals. The measurement should be about 150Ω.

b) Replacement Procedure

1) Remove the side covers. See section "11.01.01".
2) Open up the front frame. See section "11.02.08.01".
3) Remove the two connectors.
4) Remove the one mounting screw of R1 and remove R1.



* When you re-assemble the parts, conduct the above process backwards.

12.0 SEQUENCE TIMING DIAGRAMS

12.01 STICK Mode

12.01.01 STICK with VRD DISABLED (Voltage Reduction Device)

Figure 22 shows the STICK timing waveforms with the VRD control disabled.
Turning potentiometer VR1 on PCB6 (WK-5157) all the way to counter-clockwise will disable the VRD.

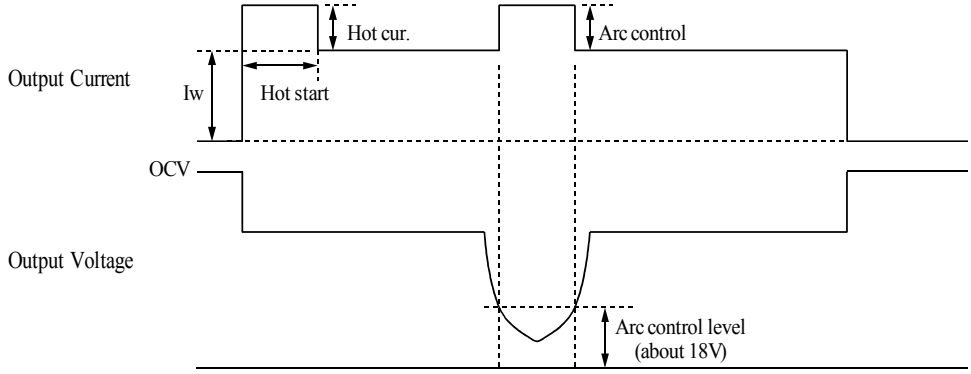


Figure 22 STICK mode timing with the VRD DISABLED

12.01.02 STICK with VRD ENABLED (Voltage Reduction Device)

Figure 23 shows the STICK timing waveforms with the VRD function enabled.
Turning potentiometer VR1 on PCB6 (WK-5157) all the way clockwise will enable the VRD.

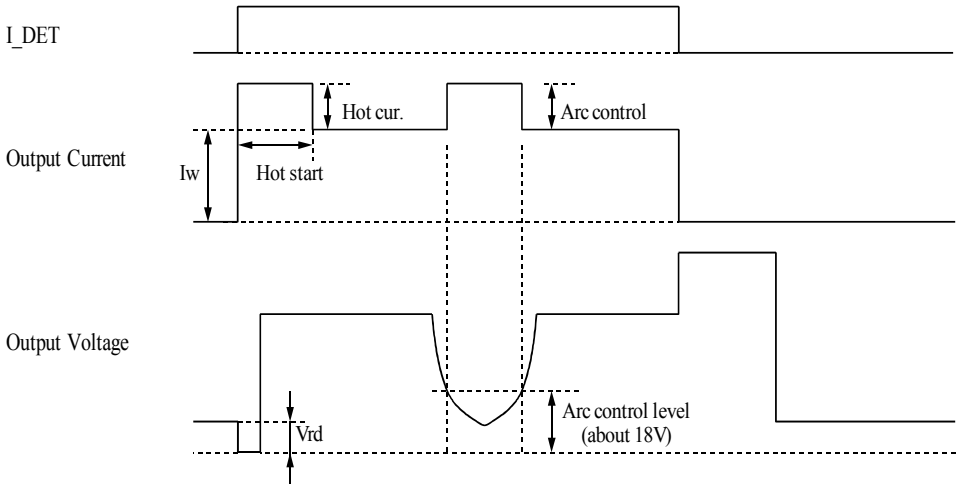


Figure 23 STICK mode timing with the VRD ENABLED

12.02 LIFT TIG Mode

12.02.01 LIFT TIG STD Mode

Figure 24 shows the LIFT TIG STD timing waveforms with PULSE control ON and OFF.

[STD MODE]

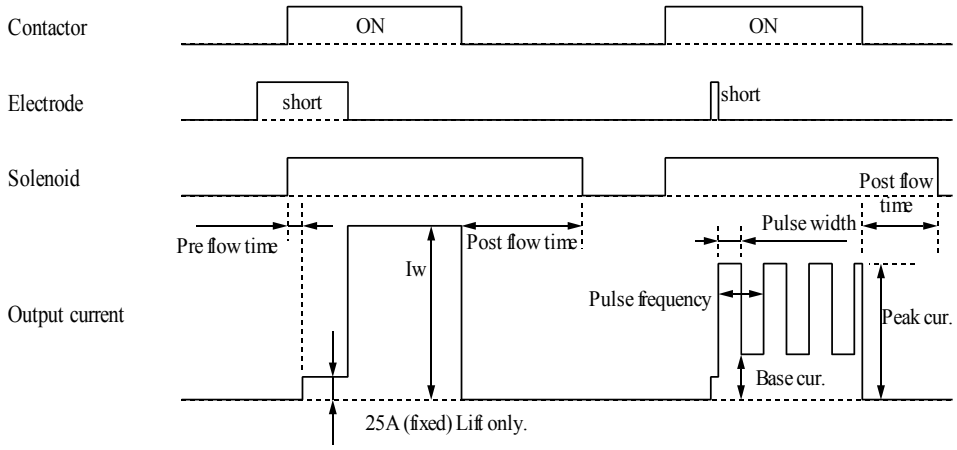


Figure 24 LIFT TIG STD mode timing

12.02.02 LIFT TIG SLOPE Mode

Figure 25 shows the LIFT TIG SLOPE timing waveforms with PULSE control ON and OFF.

[SLOPE MODE]

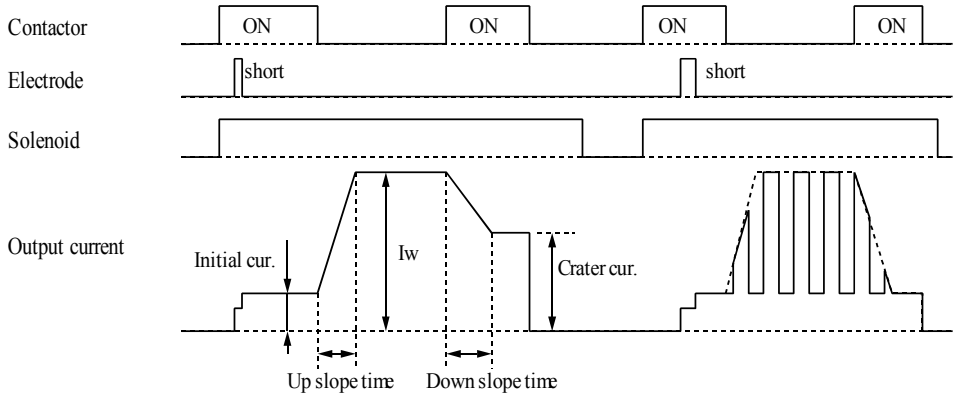


Figure 25 LIFT TIG SLOPE mode timing

12.02.03 LIFT TIG REPEAT Mode

Figure 26 shows the LIFT TIG REPEAT timing waveforms with PULSE control ON and OFF.

[REPEAT MODE]

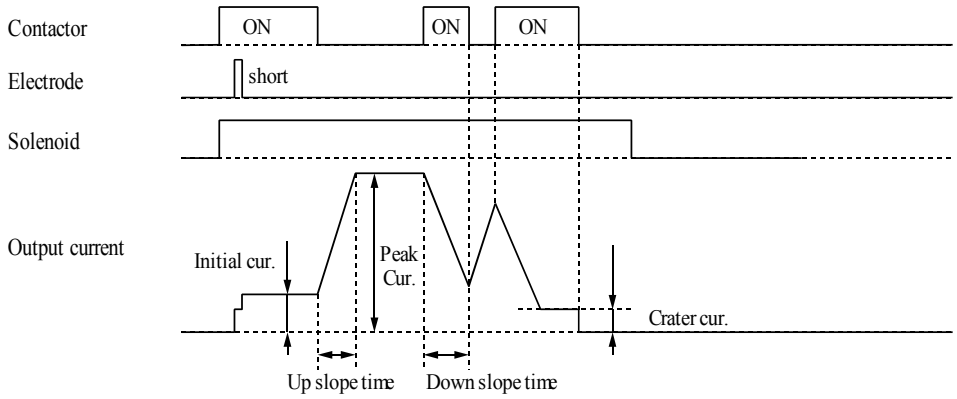


Figure 26 LIFT TIG REPEAT mode timing

12.03 HF TIG Mode

12.03.01 HF TIG STD Mode

Figure 27 shows the HF TIG STD timing waveforms with PULSE control ON and OFF.

[STD MODE]

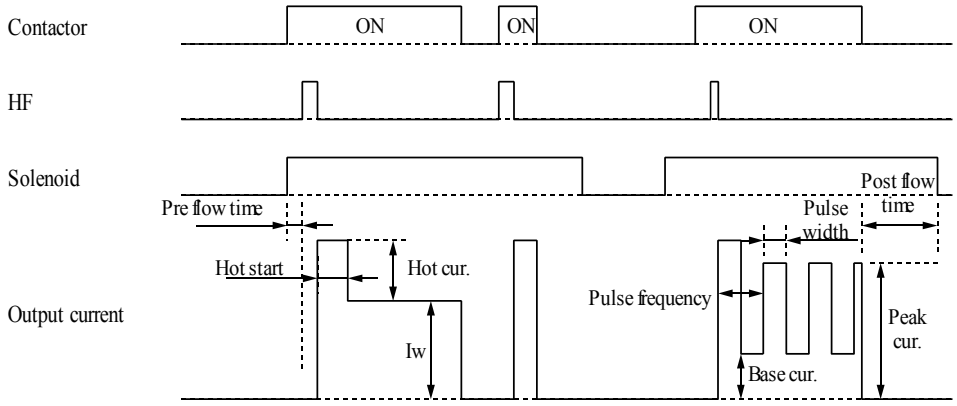


Figure 27 HF TIG STD mode timing

12.03.02 HF TIG SLOPE Mode

Figure 28 shows the HF TIG SLOPE timing waveforms with PULSE control ON and OFF.

[SLOPE MODE]

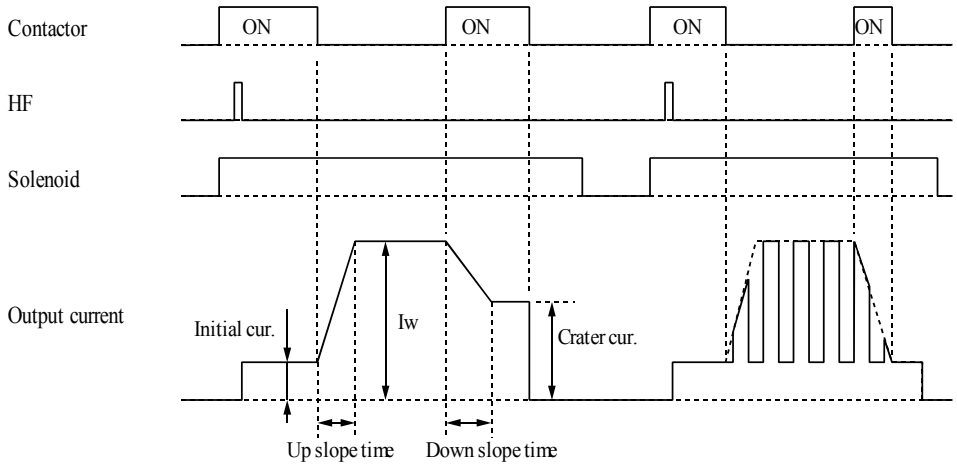


Figure 28 HF TIG SLOPE mode timing

12.03.03 HF TIG REPEAT Mode

Figure 29 shows the HF TIG REPEAT timing waveforms with PULSE control ON and OFF.

[REPEAT MODE]

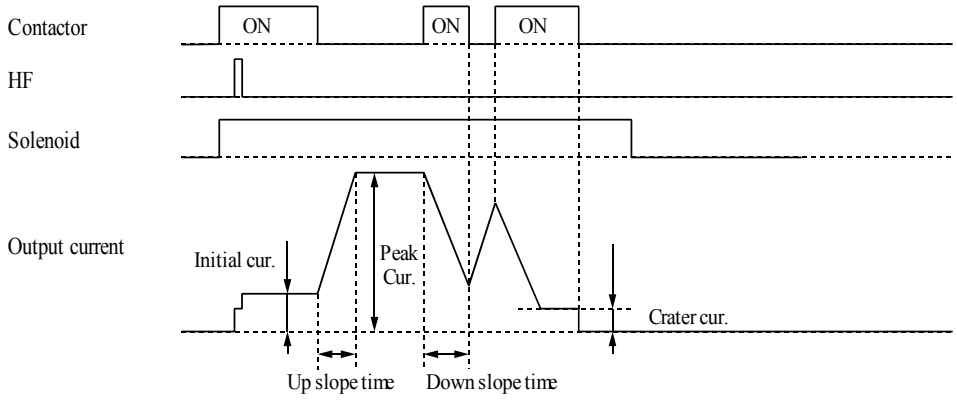


Figure 29 HF TIG REPEAT mode timing

12.03.04 HF TIG SPOT Mode

Figure 30 shows the HF TIG SPOT timing waveforms with PULSE control ON and OFF.

[SPOT MODE]

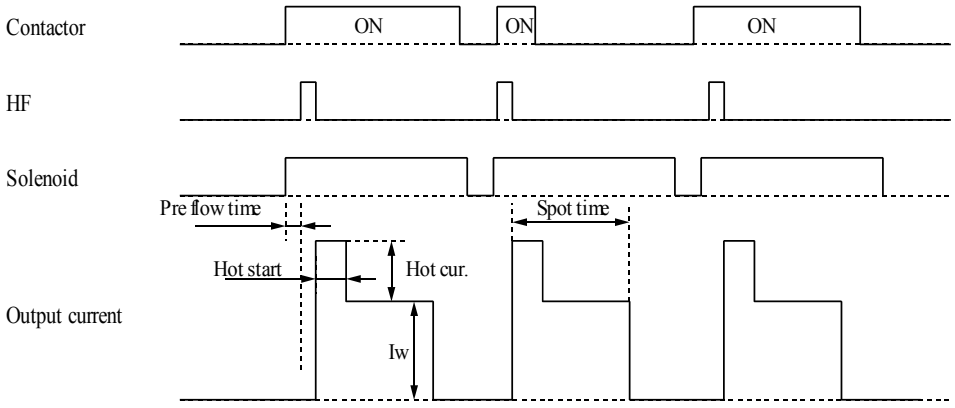
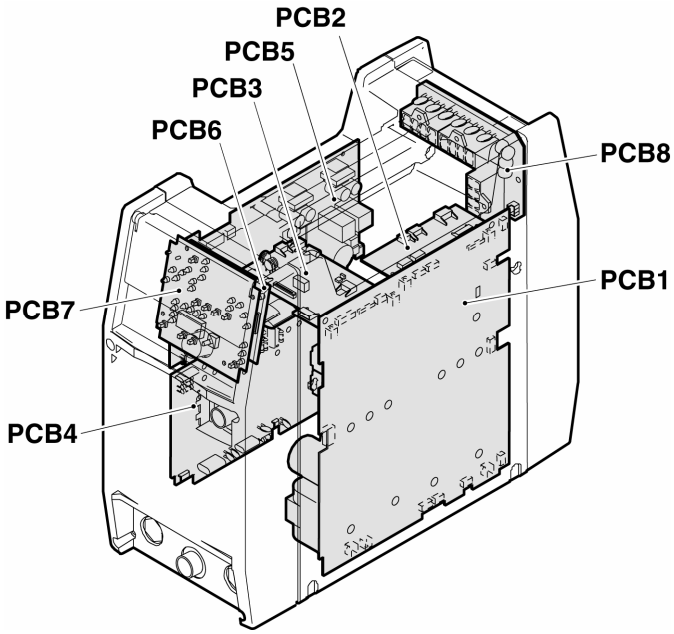
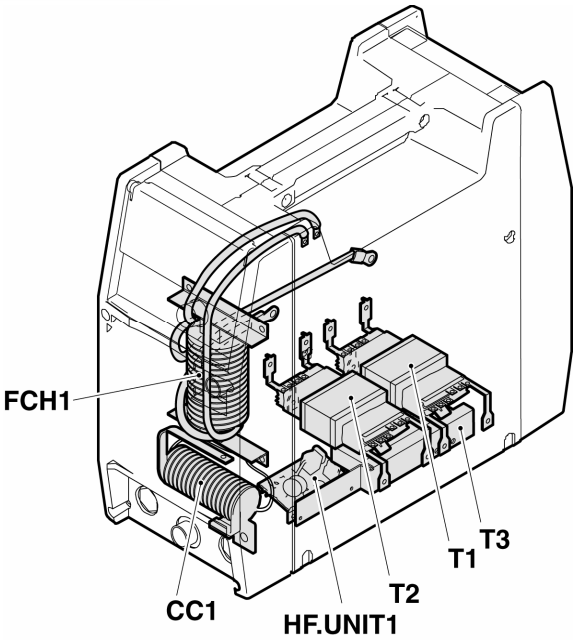


Figure 30 HF TIG SPOT mode timing

13.0 PARTS LIST





14.0 PARTS LIST

DWG. No.	Description	Type & Rating	QTY.	Code No.	Order No.
C1	Capacitor	ECQE12104MZ DC1250V 0.1uF	1	42422137100	10-2270
CC1	Coupling Coil	F2A636900 185A CC	1	F2A636900	10-6626
CON1	Remote Socket	206433-1 8P (with Wiring Assembly)	1	U0A706100	10-6627
D1	Diode	DFA50BA160	1	454160160	10-6628
D2	Diode	DBA200UA60	1	4583A0060	10-6629
D4	Diode	DBA200UA60	1	4583A0060	10-6629
D5	Diode	DBA200UA60	1	4583A0060	10-6629
D10	Diode	S2VB60 600V	1	444014023	10-6630
FAN1	Fan	109E5724H507 DC 24V 16.8W	1	U0A733500	10-6839
FCH1	Inductor	F2A676800 185A AC/DC FCH	1	F2A676800	10-6631
HCT1	Current Sensor	HC-TN200V4B15M 200A 4V	1	11251003000	10-5003
HF.UNIT 1	HF. Unit	HF.UNIT (WK-4840 U02)	1	U0A632200	10-6632
	HF. Gap	U0A601100	1	U0A601100	10-6633
L105	Inductor	1615MRE RING CORE	1	63200006500	10-6538
PCB1	Printed Circuit Board	WK-4914 U04 MAIN_PCB (with Insulation Sheet EBA501500) with Thunder Label	1	U0A705100	10-6634
PCB2	Printed Circuit Board	WK-4819 U01 DETECT PCB	1	P0A481901	10-6635
PCB3	Printed Circuit Board	WK-4921 U02 CONNECT_PCB	1	P0A492102	10-6636
PCB4	Printed Circuit Board	WK-4915 U04 2ND_DIODE with Thunder Label	1	U0A705200	10-6637
PCB5	Printed Circuit Board	WK-4916 U02 2_IGBT_PCB	1	P0A491602	10-6638
PCB6	Printed Circuit Board	WK-5157 U11 TIG CONTROL	1	P0A515711	10-6846
PCB7	Printed Circuit Board	WK-4920 U10 AC TIG PANEL	1	P0A492010	10-6640
PCB8	Printed Circuit Board	WK-4917 U06 FILTER_240V	1	P0A491706	10-6641

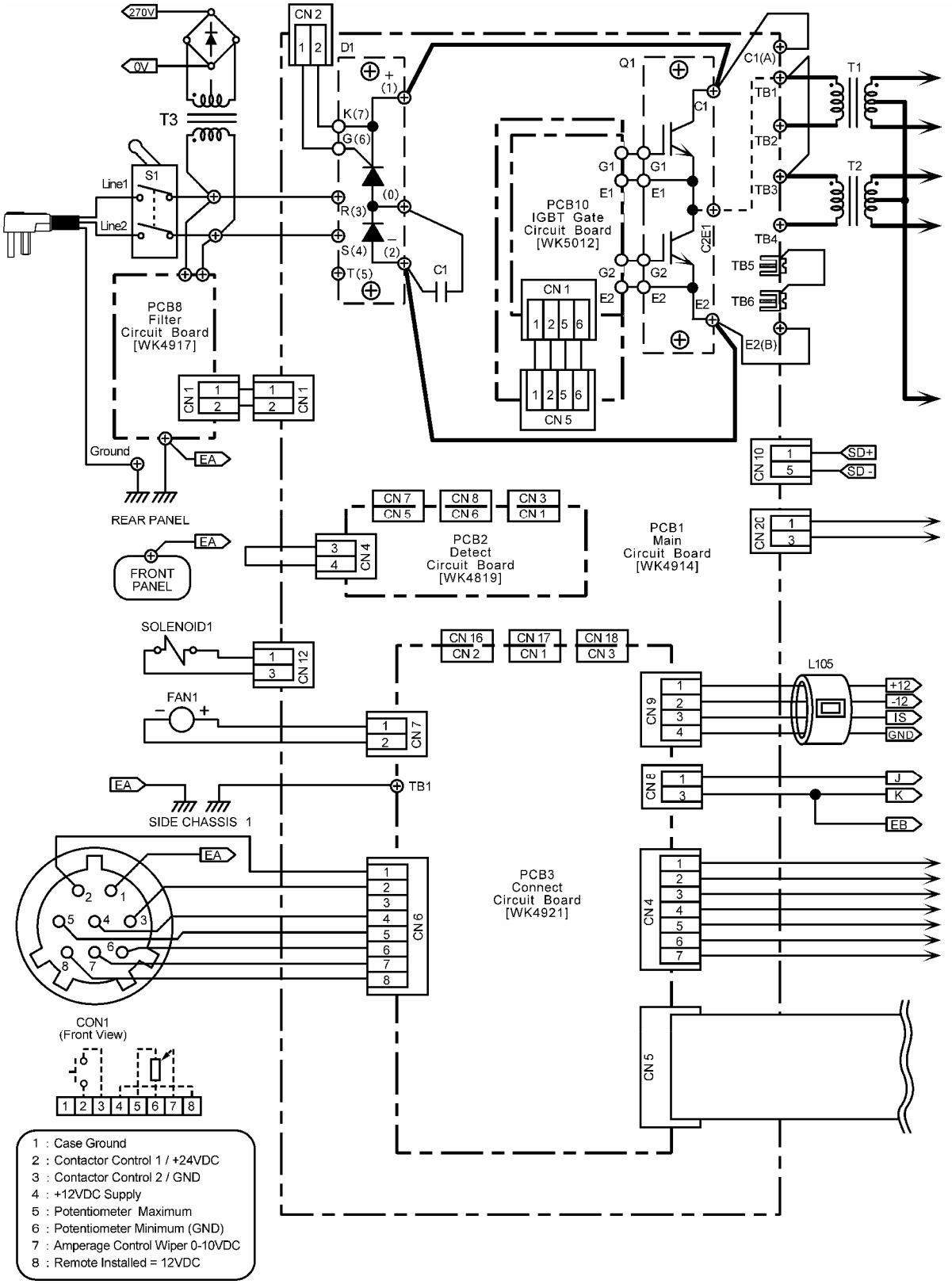
14.0 PARTS LIST Continued

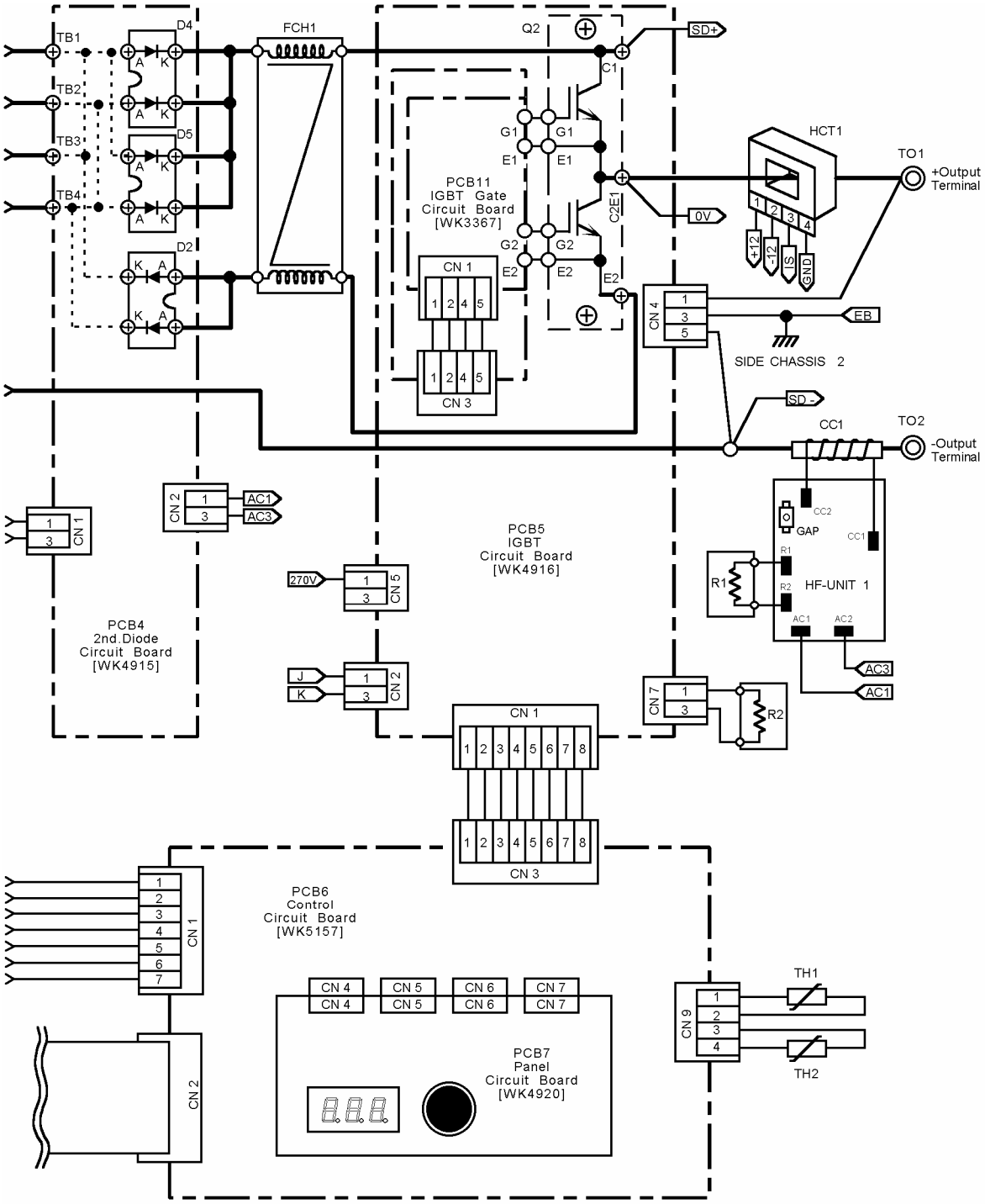
DWG. No.	Description	Type & Rating	QTY.	Code No.	Order No.
Q1	Transistor	CM100DUS12F-1 600V 100A (with WK-5012 U01)	1	U0A705300	10-6642
Q2	Transistor	GCA200CA60 (with WK-3367 U04)	1	U0A705400	10-6643
R1	Resistor (For HF Unit)	ERF20HMJ151 20W 150 Ω	1	40310211500	10-5081
R2	Resistor	JG23V101J 68W 100 Ω	2	40511000200	10-5137
S1	Switch	DCP-52SR50C-480V 2P-480V	1	25850003500	10-6644
SOL1	Solenoid Valve	5505NBR1.5 DC24V 11VA/10W (with Gas Inlet and PC4-02)	1	U0A705700	10-6645
T1	Transformer	F2A708300 250A MTR	1	F2A708300	10-6646
T2	Transformer	F2A708300 250A MTR	1	F2A708300	10-6646
T3	Transformer	F2A758000 AC/DC DTR	1	F2A758000	10-6648
TH1,2	Thermistor	ERTA53D203 20K"/25°C B=3950K	1	U0A733300	10-6784
	Front Panel	E0D005300	1	E0D005300	10-6890
	Rear Panel	E0D005500	1	E0D005500	10-6891
	Side Panel	E0D006100	2	E0D006100	10-6650
	Front Control Cover	J4B493400	1	J4B493400	10-6651
	Rear Control Cover	JCA849400 (with Label)	1	U0A705500	10-6652
	Protection Cover	E0C303200	1	E0C303200	10-6653
	Encoder Cover	EBA514400	1	EBA514400	10-6654
	PCB Cover	E1B537600 (with Caution Label)	1	U0A705600	10-6655
	Name Label	N4A007600	2	N4A007600	10-6656
	Side Label	N4A009200	2	N4A009200	10-6657
	Warning 1 Label	N0B891300	1	N0B891300	10-5497
	Warning 2 Label	N0B476400	2	N0B476400	10-5496

14.0 PARTS LIST Continued

DWG. No.	Description	Type & Rating	QTY.	Code No.	Order No.
	Output Terminal Label	N4A040100	1	N4A040100	10-6658
	Gas Outlet	EBA077600 (with PC4-02)	1	U0A705800	10-6659
	C-Ring		2	53003000600	10-5184
	Output Terminal (female)	TRAK-BE35-70S	2	26999025900	10-6660
	Input Cable	132” 10/3 SOW BLK W/6-50P	1	52031130000	10-6844
	Input Cable Clamp	EBA045800	1	EBA045800	10-6662
	Heatsink	E1B538500	1	E1B538500	10-6663
	Heatsink	E1B538600	1	E1B538600	10-6664
	Knob	2621603	1	50990001600	10-6665
	Knob Cap	3021104	1	50990000300	10-6666
	Control Cover Sheet	N0B882200	1	N0B882200	10-6667
	Flat Cable	EAA547301	1	EAA547301	10-6668
	Post1(M4-M5)	EBA424900	2	EBA424900	10-6669
	Post4(M4-M4)	EBA431100	3	EBA431100	10-6670
	Post5(M4-M4)	EBA431200	6	EBA431200	10-6671
	Post6(M5-M5)	EBA431300	1	EBA431300	10-6672
	Post7(M5-M5)	EBA435900	3	EBA435900	10-6673
	Post8(M5-M5)	EBA436000	3	EBA436000	10-6674
	D2-4 Bus Bar	EBA305600	2	EBA305600	10-6675
	CC Bus Bar	EBA306200	1	EBA306200	10-6676
	S1 Bus Bar	ECA321000	2	ECA321000	10-6677
	Clip	#74 NATURAL (Plastic Tab)	4	60602422000	10-5259
	Transformer Chassis	JCA903200	1	JCA903200	10-6678
	Right Chassis	J2C970700	1	J2C970700	10-6679
	Left Chassis	J2C970800	1	J2C970800	10-6680
	Nylon Hose	T0425B Nylon Hose L=0.5m	1	U0A706000	10-6681
	Output Terminal (male)	TRAK-SK50	2	26999025800	10-2020
	Operators Manual		1		430429-503
	Service Manual				430429-512

APPENDIX A – INTERCONNECT DIAGRAM




TB1
TB2
TB3
TB4
D4
D5
D2
FCH1
Q2
C1
SD+
G1
E1
C2E1
G2
E2
PCB11
IGBT Gate
Circuit Board
[WK3367]
CN 1
CN 3
HCT1
TO1
+Output
Terminal
+12
-12
IS
GND
0V
CN 4
EB
SIDE CHASSIS 2
SD -
CC1
TO2
-Output
Terminal
CN 2
AC1
AC3
CN 1
PCB4
2nd.Diode
Circuit Board
[WK4915]
PCB5
IGBT
Circuit Board
[WK4916]
270V
CN 5
J
K
CC2
GAP
R1
R2
HF-UNIT 1
AC2
CN 7
CN 1
CN 3
PCB6
Control
Circuit Board
[WK5157]
CN 4
CN 5
CN 6
CN 7
PCB7
Panel
Circuit Board
[WK4920]
CN 9
TH1
TH2

APPENDIX B - SIGNAL NAME LIST

WK-4921	WK-5157	WK-4916	WK-4914	WK-4915	WK-4917	WK-5012	WK-3367	WK-4819	CON1	FAN1	SOL1	HCT1	D1	HF 1	Misc.	WIRE COLOR*	SIGNAL NAME*
CN4-1	CN1-1															brown	+12 VDC
CN4-2	CN1-2															red	+5 VDC
CN4-3	CN1-3															orange	-12 VDC
CN4-4	CN1-4															yellow	GND
CN4-5	CN1-5															green	Primary IGBT gate signal
CN4-6	CN1-6															blue	Primary IGBT gate signal
CN4-7	CN1-7															purple	GND
	CN3-1	CN1-1														brown	+12 VDC
	CN3-2	CN1-2														red	GND
	CN3-3	CN1-3														yellow	Reverse polarity switch signal
	CN3-4	CN1-4														orange	Straight Polarity Signal
	CN3-5	CN1-5														blue	Reverse Polarity Signal
	CN3-6	CN1-6														purple	AC/DC Switch Signal
	CN3-7	CN1-7														gray	Secondary over-voltage
	CN3-8	CN1-8														white	n/a
			CN20-1	CN1-1												yellow	HF Input Voltage
			CN20-3	CN1-3												white	HF Input Voltage
			CN10-1												Q2-C1	brown	Output short detect +
		CN4-1													+ terminal	red	Voltage detect +
		CN4-3														green	Chassis ground
		CN4-5													- terminal	black	Output short detect -
			CN10-5												- terminal	gray	Output short detect -
CN8-1		CN2-1														brown	Secondary IGBT Gate Signal
CN8-2		CN2-2														yellow	Secondary IGBT Gate Signal
									1							green	Case Ground
CN6-1									2							red	Contactor Control (+24VDC)
CN6-2									3							orange	Contactor Control (GND)

WK-4921	WK-5157	WK-4916	WK-4914	WK-4915	WK-4917	WK-5012	WK-3367	WK-4819	CON1	FAN1	SOL1	HCT1	D1	HF 1	Misc.	WIRE COLOR*	SIGNAL NAME*
CN6-4									4							yellow	+12 VDC
CN6-5									5							blue	Potentiometer Max
CN6-6									6							purple	Potentiometer Min (GND)
CN6-7									7							white	Potentiometer Wiper (0-10)
CN6-8									8							black	Remote installed =12VDC
CN7-1										FAN +						red	FAN+
CN7-2										FAN -						black	FAN-
			CN12-1								SOL1 +					white	SOL1 +
			CN12-3								SOL1 -					black	SOL1 -
			CN1-1		CN1-1											white	Input Voltage Detection Signal
			CN1-2		CN1-2											black	Input Voltage Detection Signal
CN9-1												HCT-1				brown	+12 VDC
CN9-2												HCT-2				red	-12VDC
CN9-3												HCT-3				orange	Current Signal
CN9-4												HCT-4				yellow	GND
			CN5-1			CN1-1										white	Primary IGBT Gate signal
			CN5-2			CN1-2										black	Primary IGBT Gate signal
			CN5-5			CN1-5										red	Primary IGBT Gate signal
			CN5-6			CN1-6										white	Primary IGBT Gate signal
CN5-1	CN2-1															Flat ribbon cable	Power Signal
CN5-2	CN2-2															Flat ribbon cable	Input Error
CN5-3	CN2-3															Flat ribbon cable	+5 VDC
CN5-4	CN2-4															Flat ribbon cable	Communication signal (SD1)
CN5-5	CN2-5															Flat ribbon cable	Communication signal (RD1)
CN5-6	CN2-6															Flat ribbon cable	GND

WK-4921	WK-5157	WK-4916	WK-4914	WK-4915	WK-4917	WK-5012	WK-3367	WK-4819	CON1	FAN1	SOL1	HCT1	D1	HF 1	Misc.	WIRE COLOR*	SIGNAL NAME*
CN5-7	CN2-7															Flat ribbon cable	Short circuit detector
CN5-8	CN2-8															Flat ribbon cable	GND
CN5-9	CN2-9															Flat ribbon cable	Gas Signal
CN5-10	CN2-10															Flat ribbon cable	FAN Start Signal
CN5-11	CN2-11															Flat ribbon cable	HF Signal
CN5-12	CN2-12															Flat ribbon cable	Primary Over-Current Signal
CN5-13	CN2-13															Flat ribbon cable	Output Current Signal
CN5-14	CN2-14															Flat ribbon cable	GND
CN5-15	CN2-15															Flat ribbon cable	Output Voltage Detector
CN5-16	CN2-16															Flat ribbon cable	Output Voltage Detector
CN5-17	CN2-17															Flat ribbon cable	LIFT Signal
CN5-18	CN2-18															Flat ribbon cable	Torch Switch Signal
CN5-19	CN2-19															Flat ribbon cable	Panel/Remote Signal
CN5-20	CN2-20															Flat ribbon cable	OK-TO-MOVE
CN5-21	CN2-21															Flat ribbon cable	Potentiometer Max
CN5-22	CN2-22															Flat ribbon cable	Potentiometer Wiper (0-10)
		CN3-1					CN1-1									white	Secondary IGBT Gate Signal
		CN3-2					CN1-2									blue	Secondary IGBT Gate Signal
		CN3-4					CN1-4									orange	Secondary IGBT Gate Signal
		CN3-5					CN1-5									white	Secondary IGBT Gate Signal
			CN2-1										G (6)			white	Input Thyrister G
			CN2-2										K (7)			black	Input Thyrister K

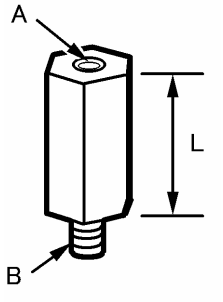
WK-4921	WK-5157	WK-4916	WK-4914	WK-4915	WK-4917	WK-5012	WK-3367	WK-4819	CON1	FAN1	SOL1	HCT1	D1	HF 1	Misc.	WIRE COLOR*	SIGNAL NAME*
				CN2-1										AC1		peach	HF Input Voltage
				CN2-3										AC2		white	HF Input Voltage
CN1-1			CN17-1													n/a	Power Signal
CN1-2			CN17-2													n/a	Input Error
CN1-3			CN17-3													n/a	+5 VDC
CN1-4			CN17-4													n/a	Internal Communications
CN1-5			CN17-5													n/a	Internal Communications
CN1-6			CN17-6													n/a	GND
CN1-7			CN17-7													n/a	Short Circuit Detect
CN1-8			CN17-8													n/a	GND
CN1-9			CN17-9													n/a	Gas Signal
CN1-11			CN17-11													n/a	HF Signal
CN1-12			CN17-12													n/a	Primary Over-Current
CN1-15			CN17-15													n/a	Output Voltage Detect
CN1-16			CN17-16													n/a	Output Voltage Detect
CN1-17			CN17-17													n/a	LIFT Signal
CN2-1			CN16-1													n/a	Secondary IGBT Gate Signal
CN2-2			CN16-2													n/a	Secondary IGBT Gate Signal
CN2-3			CN16-3													n/a	+12 VDC
CN2-4			CN16-4													n/a	+5 VDC
CN2-5			CN16-5													n/a	-12 VDC
CN2-6			CN16-6													n/a	GND
CN2-7			CN16-7													n/a	Primary IGBT gate signal
CN2-8			CN16-8													n/a	Primary IGBT gate signal
CN3-1			CN18-1													n/a	+24 VDC
CN3-3			CN18-3													n/a	GND (+24 VDC)
			CN3-1					CN1-1								n/a	P+12 VDC
			CN3-3					CN1-3								n/a	P+5 VDC
			CN3-5					CN1-5								n/a	P+5 VDC
			CN3-7					CN1-7								n/a	Pre-Start complete
			CN3-8					CN1-8								n/a	Pre-Charge signal
			CN3-10					CN1-10								n/a	Low Capacitor Voltage
			CN3-11					CN1-11								n/a	Post-rectified Voltage Signal

WK-4921	WK-5157	WK-4916	WK-4914	WK-4915	WK-4917	WK-5012	WK-3367	WK-4819	CON1	FAN1	SOL1	HCT1	D1	HF 1	Misc.	WIRE COLOR*	SIGNAL NAME*
			CN3-13					CN1-13								n/a	Pre-rectified Voltage Signal
			CN7-1					CN5-1								n/a	Power Signal
			CN7-2					CN5-2								n/a	GND
			CN7-4					CN5-4								n/a	Input Error
			CN7-5					CN5-5								n/a	GND
			CN8-1					CN6-1								n/a	+5 VDC
			CN8-2					CN6-2								n/a	Internal Communications
			CN8-3					CN6-3								n/a	Internal Communications
			CN8-4					CN6-4								n/a	GND

* Thermal Arc reserves the right to change these items for any reason without prior notice.

APPENDIX C – HARDWARE

Description	L	A	B	Code No.	Order No.
Post1 (M4-M5)	9mm	M4	M5	EAA424900	10-6669
Post2 (M5-M5)	11.4mm	M5	M5	EBA425000	10-6801
Post3 (M5-M5)	23mm	M5	M5	EBA425100	10-6802
Post4 (M4-M4)	20mm	M4	M4	EBA431100	10-6670
Post5 (M4-M4)	22mm	M4	M4	EBA431200	10-6671
Post6 (M5-M5)	21mm	M5	M5	EBA431300	10-6672
Post7 (M5-M5)	20mm	M5	M5	EBA435900	10-6673
Post8 (M5-M5)	10mm	M5	M5	EBA436000	10-6674
Post9 (M5-M5)	19mm	M5	M5	EBA491700	10-6750
Post11 (M5-M5)	9mm	M5	M5	EBA643600	10-6751
Post421 (M4-M4)	21mm	M4	M4	53602020600	10-6803



APPENDIX D – DIODE TESTING BASICS

Testing of diode modules requires a digital Volt/Ohmmeter that has a diode test scale.

1. Locate the diode module to be tested.
2. Remove cables from mounting studs on diodes to isolate them within the module.
3. Set the digital volt/ohm meter to the diode test scale.
4. Using figure 1 and 2, check each diode in the module. Each diode must be checked in both the forward bias (positive to negative) and reverse bias (negative to positive) direction.
5. To check the diode in the forward bias direction, connect the volt/ohm meter positive lead to the anode (positive, +) of the diode and the negative lead to the cathode (negative, -) of the diode (refer to figure 1). A properly functioning diode will conduct in the forward bias direction, and will indicate between 0.3 and 0.9 volts.
6. To check the diode in the reverse bias direction, reverse the meter leads (refer to figure 1). A properly functioning diode will block current flow in the reverse bias direction, and depending on the meter function, will indicate an open or "OL".
7. If any diode in the module tests as faulty, replace the diode module.
8. Reconnect all cables to the proper terminals.

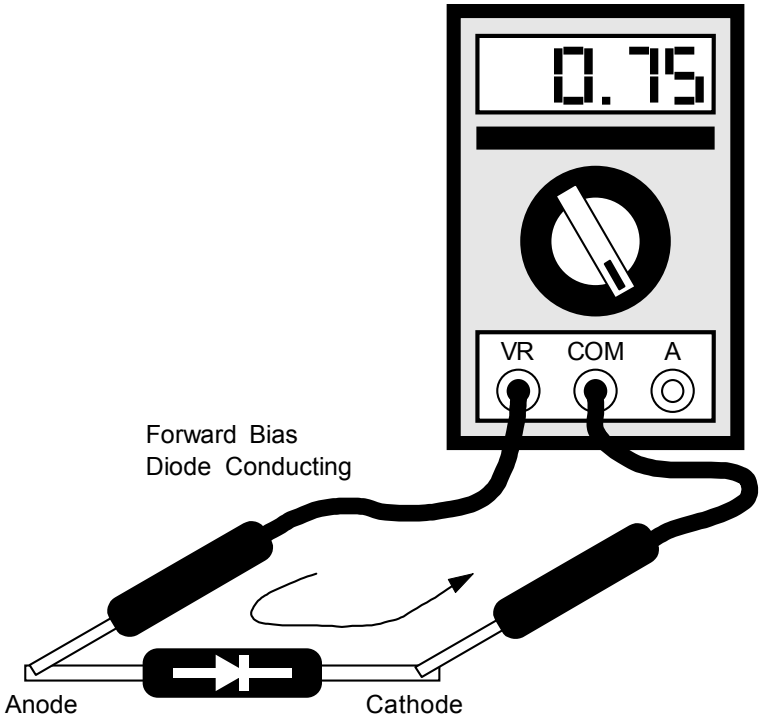


Figure 31 Forward bias diode test

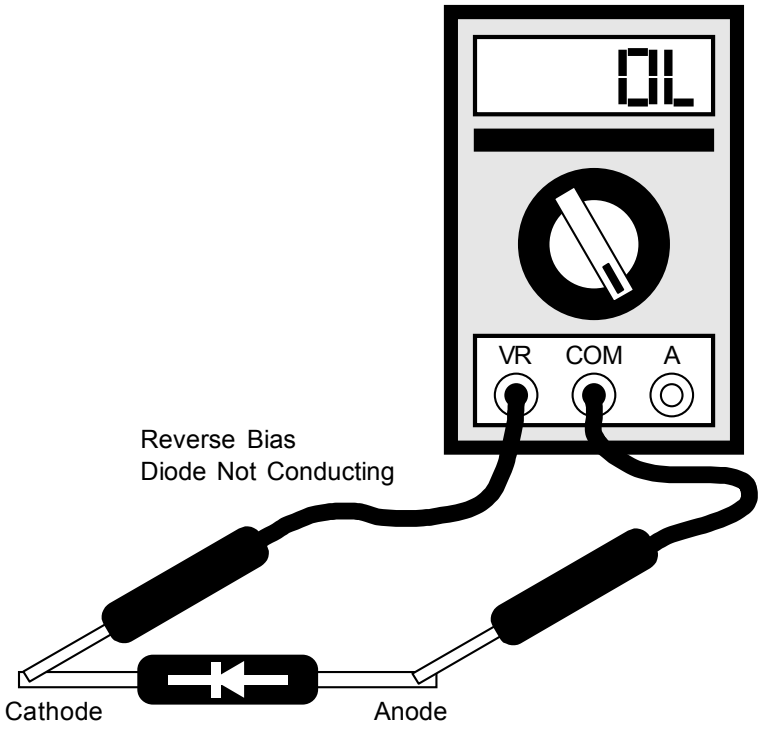


Figure 32 Reverse bias diode test

APPENDIX E - AUTOMATION

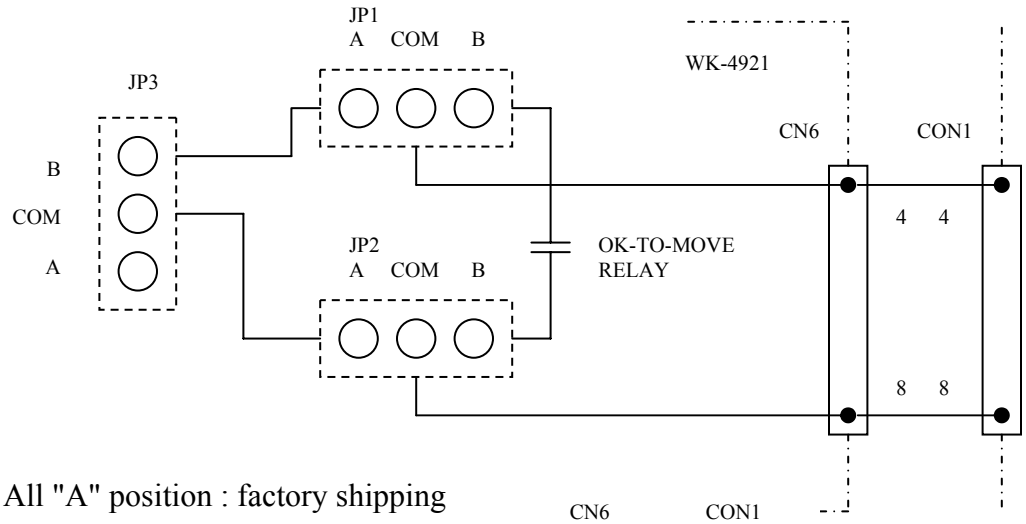
JUMPER SETTING FOR "OK–TO–MOVE". Models 185TSW

Three jumpers (JP1, JP2 and JP3) are provided on PC Board WK-4921 for automation purposes. This PCB is mounted horizontally on top of the unit just under the cover. This PCB can be accessed by removing the side covers by loosening 4 screws on each the front and rear panel, then removing the 4 side panel screws as well as the 2 handle screws. Carefully pull the front and rear panels outward to release and remove the side cover. Remove two plastic clips holding the PCB protective cover in place and lift the sheet up and over the unit. The jumpers will be accessible on the top portion of the PCB. See figure on next page for the location of the PCB.

All units are shipped from the factory with the jumpers set in position "A". This is for normal semi-automatic operation utilizing a remote device, such as a foot control. The 8-pin remote operates as described earlier in this manual.

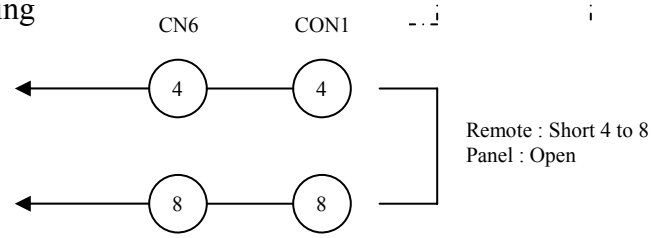
Placing all jumpers in position "B" would be primarily used for automation with an arc establish relay, remote amperage and contactor. An arc-establish signal is located from pins 4 and 8 when in this mode.

Placing jumpers JP1 and JP2 in "B" position and jumper JP3 in "A" position would have the configuration of an arc-establish signal and remote contactor, but the unit's front panel would control the amperage**.**



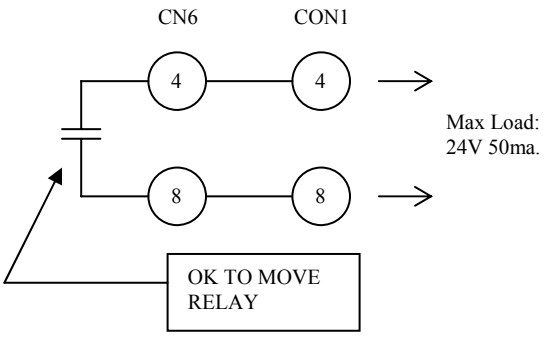
• Set All "A" position : factory shipping

	POSITION
JP1	A
JP2	A
JP3	A



• Use "OK TO MOVE signal"

	POSITION	
JP1	B	B
JP2	B	B
JP3	B	A
A/V	REMOTE	PANEL



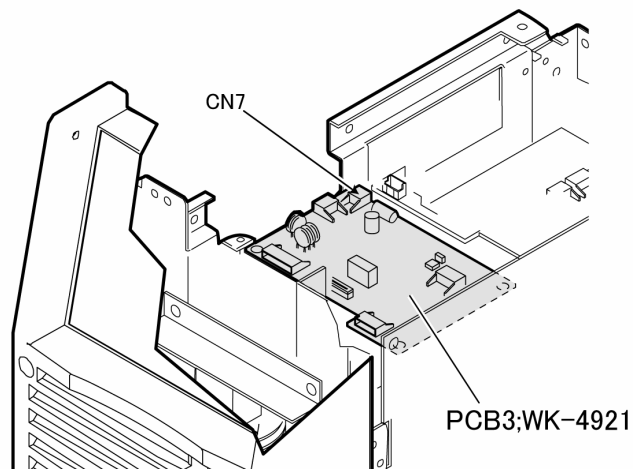


Figure 33 – Location of PCB WK-4921