THERMAL ARC™

A THERMADYNE® Company

MODEL 400 S, GMS & GTS

- Stick
- TIG - High Frequency
  - Lift Start
- MIG

Service Manual

Second Edition
April 25, 1997

Manual No. 0-2509

Read and understand this entire Service Manual and your employer's safety practices before installing, operating, or servicing the equipment.

While the information contained in this Service Manual represents our best judgement, Thermal Dynamics Corporation assumes no liability for its use.

Thermal Arc Models 400 S, GMS & GTS CC/TIG Welder
Service Manual Number 0-2509

Published by:
Thermal Dynamics Corporation
Industrial Park No. 2
West Lebanon, New Hampshire, USA 03784
(603) 298-5711

Printed in the United States of America

April 25, 1997

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.

WARNING
IMPORTANT SAFETY PRECAUTIONS

OPERATION AND MAINTENANCE OF PLASMA ARC 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 1-603-298-5711 or your local distributor if you have any questions.

GASES AND FUMES

Gases and fumes produced during the plasma 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 plasma arc 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 the Publications Section in this manual.
- Use special equipment, such as water or down draft cutting tables, to capture fumes and gases.
- Do not use the plasma 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 plasma arc 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 the Publications section of this manual.
- 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 plasma arc.

- 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. Plasma arc 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 the Publications section of this manual.

PLASMA ARC RAYS

Plasma Arc Rays can injure your eyes and burn your skin. The plasma arc 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 the Operating Manual.

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

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 :

NOTET oute 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.

AVERTISSEMENT
PRECAUTIONS DE SECURITE IMPORTANTES

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 + 603-298-5711 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 xi.
- 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.

PRECAUTIONS DE SECURITE IMPORTANTES

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 *vi,* 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 lors'quelles sont coupeés 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 mains que le gas hydrogène peut s'échapper ou se dissiper. Le gas hydrogène accumulé explosera si enflammé.

PRECAUTIONS DE SECURITE IMPORTANTES

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 manuel de consignes.

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 dúvez 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 xi.

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

DECLARATION OF CONFORMITY

Manufacturer: Thermal Dynamics Corporation
Address: Industrial Park #2
West Lebanon, New Hampshire 03784
USA

The equipment described in this manual conforms to all applicable aspects and regulations of the 'Low Voltage Directive' (European Council Directive 73/23/EU, as recently changed in Directive 93/63/EU) and to the National legislation for the enforcement of this Directive.

The equipment described in this manual conforms to all applicable aspects and regulations of the "EMC Directive" (European Council Directive 89/336/EEC) and to the National legislation for the enforcement of this Directive.

Serial numbers are unique with each individual piece of equipment and details description, parts used to manufacture a unit and date of manufacture.

National Standard and Technical Specifications

The product is designed and manufactured to a number of standards and technical requirements among them are:

* CSA (Canadian Standards Association) standard C22.2 number 60-M1990 for Arc welding equipment.

* UL (Underwriters Laboratory) rating 94VO flammability testing for all printed-circuit boards used.

* CENELEC EN50199 EMC Product Standard for Arc Welding Equipment March 1995.

* IEC 974-1 (BS 638-PT10) (EN 60 974-1) applicable to welding equipment and associated accessories.

* Extensive product design verification is conducted at the manufacturing facility as part of the routine design and manufacturing process, to ensure the product is safe and performs as specified. Rigorous testing is incorporated into the manufacturing process to ensure the manufactured product meets or exceeds all design specifications.

Thermal Dynamics has been manufacturing products that perform in a safe manner for more than 30 years and will continue to achieve excellence in our area of manufacture.

Manufacturers responsible representative: David Ashworth
Vice President & Managing Director
Thermadyne Europe
Chorley England.

CE

STATEMENT OF WARRANTY

LIMITED WARRANTY: Thermal Dynamics Corporation (hereinafter "Thermal") warrants 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 products as stated below, Thermal shall, upon notification thereof and substantiation that the product has been stored, installed, operated, and maintained in accordance with Thermal's specifications, instructions, recommen dations 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's sole option, of any components or parts of the product determined by Thermal to be defective.

THIS WARRANTY IS EXCLUSIVE AND IS IN LIEU OF ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

LIMITATION OF LIABILITY: Thermal shall not under any circumstances be liable for special or consequential damages, such as, but not limited to, damage or loss of purchased or replacement goods, or claims of customers of distributor (hereinafter "Purchaser") for service interruption. The remedies of the Purchaser set forth herein are exclusive and the liability of Thermal 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 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.

THIS WARRANTY BECOMES INVALID IF REPLACEMENT PARTS OR ACCESSORIES ARE USED WHICH MAY IMPAIR THE SAFETY OR PERFORMANCE OF ANY THERMAL PRODUCT.

THIS WARRANTY IS INVALID IF THE PRODUCT IS SOLD BY NON-AUTHORIZED PERSONS.

The limited warranty periods for Thermal products shall be as follows: A maximum of three (3) years from date of sale to an authorized distributor and a maximum of two (2) years from date of sale by such distributor to the Purchaser, and with the following further limitations on such two (2) year period:

PAK UNITS, POWER SUPPLIES	PARTS	LABOR
MAIN POWER MAGNETICS	2 YEARS	1 YEAR
ORIGINAL MAIN POWER RECTIFIER	2 YEARS	1 YEAR
CONTROL PC BOARD	2 YEARS	1 YEAR
ALL OTHER CIRCUITS AND COMPONENTS	1 YEAR	1 YEAR
INCLUDING, BUT NOT LIMITED TO, STARTING CIRCUIT, CONTACTORS, RELAYS, SOLENOIDS, PUMPS, POWER SWITCHING SEMI-CONDUCTORS		
CONSOLES, CONTROL EQUIPMENT, HEAT	1 YEAR	1 YEAR
EXCHANGES, AND ACCESSORY EQUIPMENT		
TORCH AND LEADS	180 DAYS	180 DAYS
REPAIR/REPLACEMENT PARTS	90 DAYS	90 DAYS

Warranty repairs or replacement claims under this limited warranty must be submitted by an authorized Thermal Arc® repair facility within thirty (30) days of the repair. Authorized Thermal Arc® repair facilities are authorized distributors and authorized Thermal Arc® Service Centers. 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 customer. All returned goods shall be at the customer's risk and expense. This warranty supersedes all previous Thermal warranties.

Thermal Arc® is a Registered Trademark of Thermal Dynamics.

Effective January 18, 1991

TABLE OF CONTENTS

1.0 GENERAL

1.1 Description

The Thermal Arc™ Model 400 S, GMS and GTS Series are single or three-phase DC arc welding power sources with Constant Current (CC) output characteristics. The GMS Model also features Constant Voltage (CV) output characteristics and a digital panel meter. All of the other models are available with an optional digital AMPERAGE/VOLTAGE panel meter (standard in European models).

The 400S unit is designed for use with Shielded Metal Arc Welding (SMAW) and Gas Tungsten Arc Welding -Lift Start (GTAW) processes.

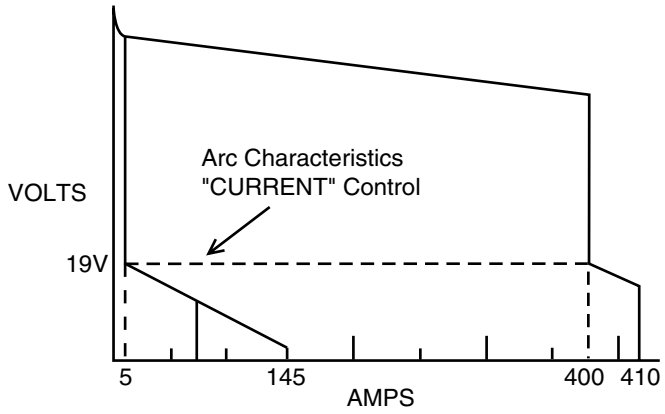


Figure 1. 400S model Volt-Ampere curve

The 400GMS unit is equipped with selectable Constant Current (CC) or Constant Voltage (CV) output characteristics. It is designed for use with Shielded Metal Arc Welding (SMAW), Gas Metal Arc Welding (GMAW), and Gas Tungsten Arc Welding -Lift Start (GTAW) processes.

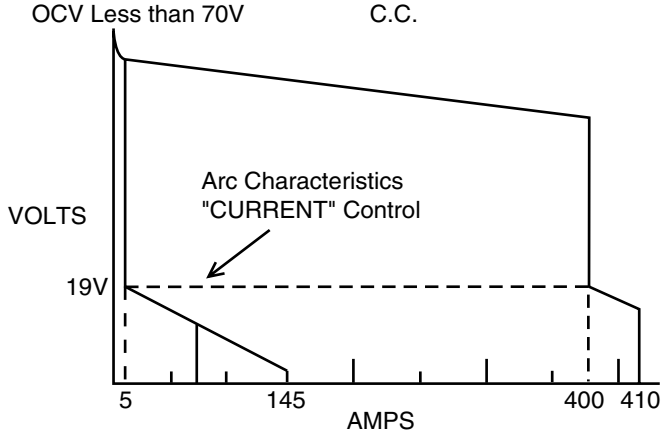


Figure 2. 400GMS model Volt-Ampere curves

The 400GTS unit is equipped with a built-in Sloper, Pulser, gas control solenoid, lift arc starter, and a 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), Gas Tungsten Arc Welding-TIG Spot (GTAW-TIG), and Shielded Metal Arc Welding (SMAW) processes.

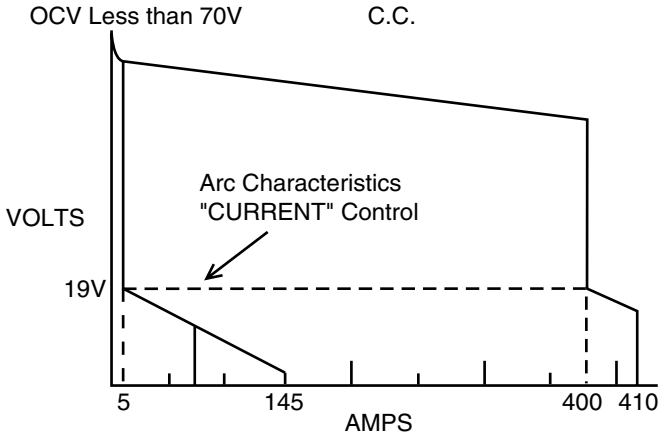


Figure 3. 400GTS model Volt-Ampere curve

NOTE 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.

Functional Block Diagrams

Figures 4a, 4b and 4c illustrate the functional block diagrams of the 400S, 400GMS and 400GTS power supplies.

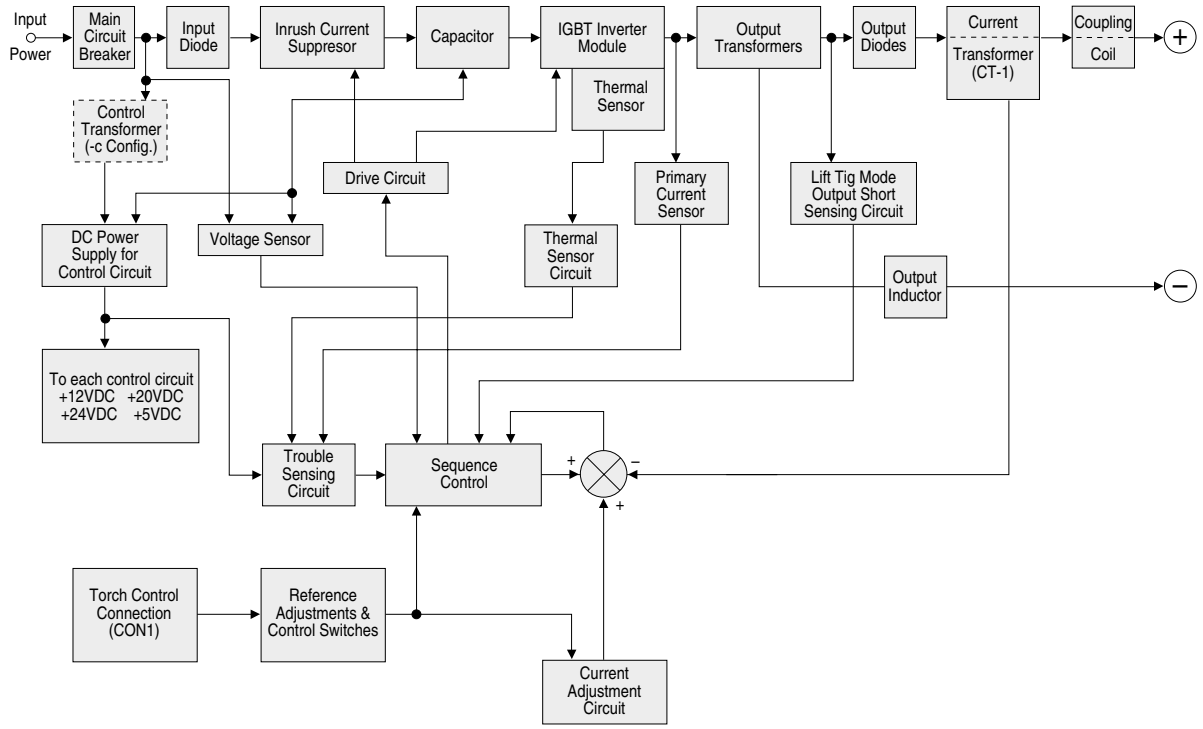
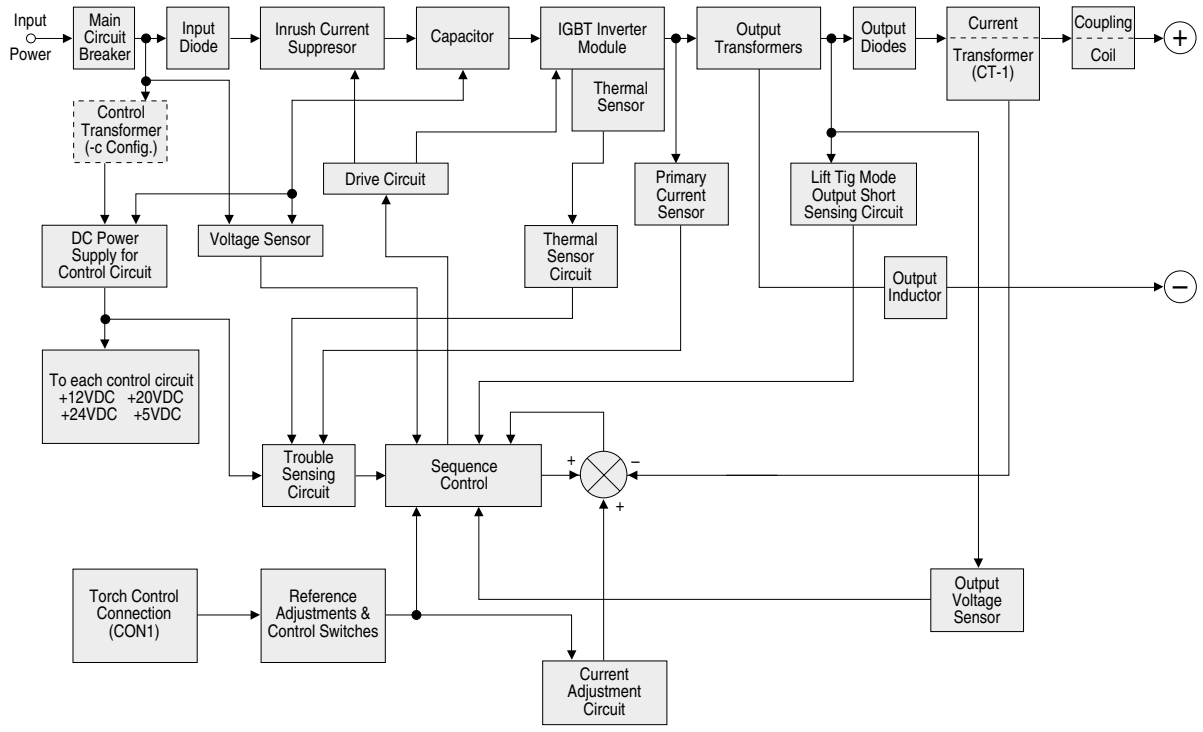


Figure 4a. S Model functional block diagram



4b. GMS Model functional block diagram

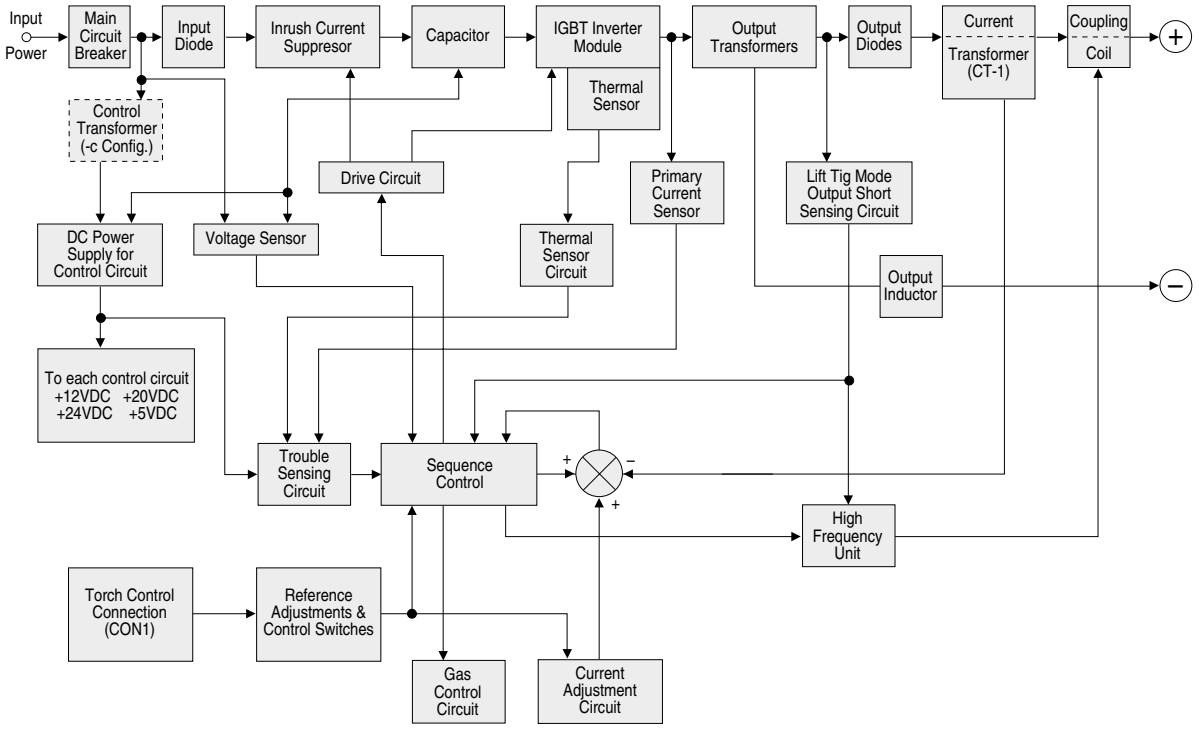


Figure 4c. GTS Model functional block diagram

WARNING Disconnect primary power at the source before disassembling the power supply. Frequently review the Important Safety Precautions (page iii). Be sure the operator is equipped with proper gloves, clothing, 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. Wait at least two minutes for the input capacitors to discharge before opening the enclosure.

1.2 Transporting Methods

These units are equipped with a handle for carrying purposes.

WARNING ELECTRIC SHOCK can kill.

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

WARNING FALLING EQUIPMENT can cause serious personal injury and equipment damage.

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

1.3 Electrical Input Connections

WARNING 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/tag out procedures. Lockout/tag out 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.

Electrical Input Requirements

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

- To operate single-phase, do not connect the RED input conductor.

- Do not connect an input (WHITE, BLACK or RED) conductor to the ground terminal.
- Do not connect the ground (GREEN) conductor to an input line terminal.

Refer to Figure 5 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), line 2 (WHITE) and line 3 (RED) input conductors to a de-energized line disconnect switch.
3. Use Table 1 below as a guide to select line fuses for the disconnect switch.

Table 1. Fuse Size Selection

Input Power/Input Voltage	Fuse Size (Amperes)	
	Three-Phase	Single-Phase
208-230VAC	70	80
380-415 VAC	40	N/A
460 VAC	30	40

NOTE 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).

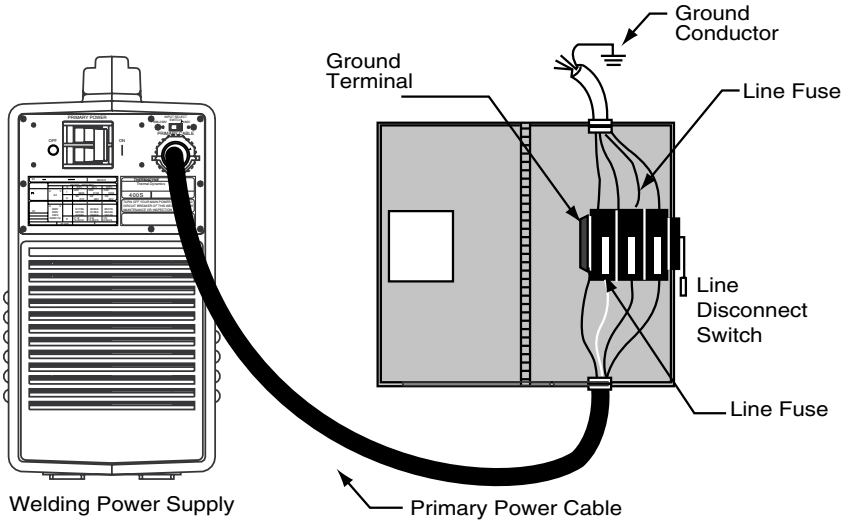


Figure 5. Electrical input connections

Input Power Each unit incorporates an INRUSH circuit and input voltage sensing circuit. When the MAIN CIRCUIT BREAKER 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).

Damage or faulty operation will occur if the INPUT SELECT switch on the rear panel of the power supply is not set to match the input voltage. Verify that the primary power and the INPUT SELECT switch agree.

NOTE Note the available input power. Damage to the PCA will occur if 460/575VAC is applied with the INPUT SELECT switch in the 208-230V position.

208VAC 50/60Hz three-phase
230VAC 50/60Hz three-phase
460VAC 50/60Hz three-phase

1.4 Specifications

Parameter	400S	400GMS	400GTS
Rated Output			
Amperes	300	400	
Volts	32	36	
Duty Cycle	60%	25%	
Output Range (Min. - Max.)		**TIG/STICK**	
Amperes	5-400	5-400	5-400
Volts	10-32	10-36	10-32
Open Circuit Voltage			
Maximum OCV	64 V	73 V	64 V
Input Data		50/60 Hz	
Dimensions/Weight			
Width		8.3 in (210 mm)	
Height		16.9 in (430 mm)	
Length		16.5 in (420 mm)	
Weight		41.8 lb (19 kg.)	
Output At Rated Load			
Input data 50/60 Hz/Duty Cycle			
Output Amperes	400	300	
Output Volts	36	32	
Duty Cycle	25%	60%	
KVA	21.9	11.3	
KW	16.9	11.3	
Output At No Load			
Input data 50/60 Hz/Duty Cycle			
KVA		0.5	
KW		0.3	

Input Volts	Amperage Draw		
	Rated Load		No Load
Three-Phase			
208	61	40	1.4
230	55	37	1.3
380	33	32	0.8
400	32	21	0.7
415	30	20	0.7
460	27	18	0.6
575	22	15	0.5
Single-Phase			
208	48	65	1.6
230	51	68	1.5

1.5 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 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.

Continually exceeding the duty cycle ratings can cause damage to the welding power source.

To calculate duty cycle:

$$\text{current} = \sqrt{\frac{(\text{rated current})^2 \times (\text{rated duty cycle})}{(\text{desired duty cycle})}}$$

i.e. At the 400A rated output current, and 25% rated duty cycle, the operator wants to work on a **50% duty cycle**. The maximum allowable current draw is:

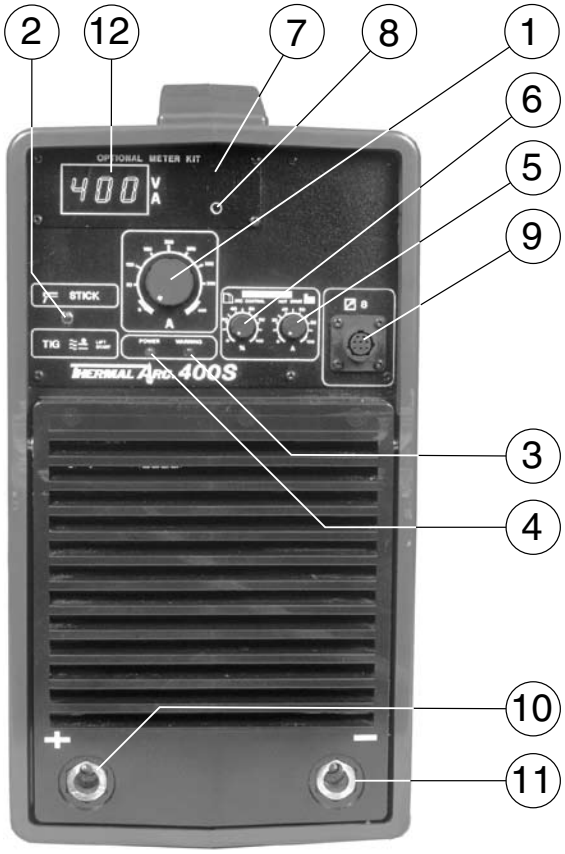
$$\text{current} = \sqrt{\frac{(400\text{A})^2 \times (.25)}{(.50)}}$$

$$\text{current} = \sqrt{160{,}000 \times (0.5)}$$

$$\text{current} = \sqrt{80{,}000}$$

$$\text{current} = 282.8\text{A}$$

2.0 OPERATOR CONTROLS



1. **Amperage Control** - The Amperage Control selects the desired amperage within the entire range of the welding power source. Rotating this control in a clockwise direction increases the amperage output. The scale surrounding the amperage control represents approximate actual amperage values.

2. **Process Selector Switch** - The Process Selector Switch allows the operator to select the STICK welding (SMAW) process or LIFT TIG (GTAW) process.

3. **Warning Indicator** - The Warning Indicator located on the front panel will become activated under the following conditions:
   - Input voltage is too low
   - Input voltage too high
   - Thermal overload

4. **AC Power Indicator** - The AC Power Indicator located on the front panel lights when the Primary Power Switch is in the ON position, indicating the unit is energized.

5. **Hot Start Control** - The Hot Start Control provides a variable selection of start circuit current that operates in the STICK mode. The Hot Start time is approximately 0.01 seconds in TIG and 0.06 seconds in STICK. The current value is adjusted from 0 to 100 Amps over the determined weld current set by the Amperage Control. Rotating the control clockwise increases Hot Start current.

6. **ARC Control** - The Arc Control is in use in the SMAW mode only. Rotate the control clockwise to increase the short circuit current available to control the welding arc.

7. **Amperage/Voltage Selector Switch** - Selects digital meter display of output amperage or voltage.

8. **Preview Pushbutton Switch** - Allows digital meter to be used to set amperage (in TIG or STICK modes) prior to welding.

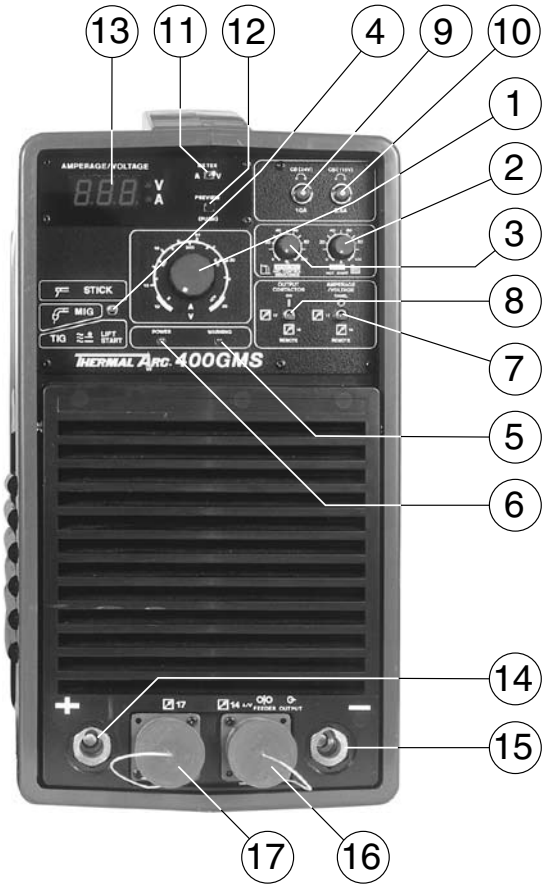
9. **8-Pin Receptacle** - Used for remote contactor and amperage controls.

10. **Positive Terminal** - 50mm DIN-style female receptacle.

11. **Negative Terminal** - 50mm DIN-style female receptacle.

12. **LCD Display**

Figure 6. 400S model front operator controls



1. **Amperage/Voltage Control** - The amperage/voltage control selects the desired amperage or open circuit voltage within the entire range of the welding power source. Rotating this control in a clockwise direction increases the amperage or voltage output. The scale surrounding the control represents approximate actual amperage (innerscale) or voltage (outerscale) values.

2. **Hot Start Control** -The Hot Start Control operates in the STICK mode. The Hot Start time is approximately 0.01 seconds in TIG and 0.06 seconds in STICK. The current value is adjusted from 0 to 100 Amps over the determined weld current set by the Amperage Control. Rotating the Control clockwise increases Hot Start current.

3. **Arc/Inductance Control** - In the STICK welding (SMAW) mode, this control provides a variation of short-circuit amperage. In the MIG (CV) mode, this control functions as an inductance control, allowing for the adjustment of the dynamic properties of the arc. The zero (0) setting provides a minimum inductance and a fast-responding arc. The 100 setting provides maximum inductance and a slower-responding arc. As the inductance is increased, the AMPERAGE/VOLTAGE control may need to be adjusted to achieve the desired weld characteristics.

4. **Process Selector Switch** - The process selector switch allows the operator to select the STICK welding (SMAW), LIFT TIG (GTAW), or MIG (GMAW) process.

5. **Warning Indicator** - The Warning Indicator located on the front panel will become activated under the following conditions:
   - Input voltage is too low
   - Input voltage is too high
   - Thermal overload

6. **AC Power Indicator** - The AC Power indicator located on the front panel lights when the PRIMARY POWER Switch is in the ON position, indicating the unit is energized.

7. **Amperage/Voltage Switch** - This selector switch determines the adjustment of amperage/voltage. In the PANEL position, amperage/voltage is controlled by the front panel control. For remote amperage/voltage control, set the switch in either the REMOTE 14 or REMOTE 17 position, depending on which remote control receptacle is used.

8. **Output Contactor Switch** - With the PRIMARY POWER Switch ON, open circuit voltage will be present at the weld output receptacle when the OUTPUT CONTACTOR SWITCH is in the ON position. For remote contactor control, set the switch in either the REMOTE 14 or REMOTE 17 position depending on which remote control receptacle is used. Open circuit voltge will be present at the weld output receptacles whenever the torch switch or remote device is closed.

9. **24V Circuit Breaker** - Push to reset. Controls 24V power source for wire feeders controlled through 14-Pin receptacle.

10. **115V Circuit Breaker** - Push to reset. Controls 115V power source for wire feeders controlled through 14-Pin receptacle.

11. **Amperage/Voltage Selector Switch** - Selects digital meter display of output amperage or voltage.

12. **Preview Pushbutton Switch** - Allows digital meter to be used to set voltage (in MIG mode) or amperage (in TIG or STICK modes) prior to welding.

13. **LCD Display**

14. **Positive Terminal** - 50mm DIN-style female receptacle.

15. **Negative Terminal** - 50mm DIN-style female receptacle.

16. **14-Pin Receptacle** - Used for remote contactor, amperage controls and wire feeder controls.

17. **17-Pin Receptacle** - Used for MIG Pulsers.

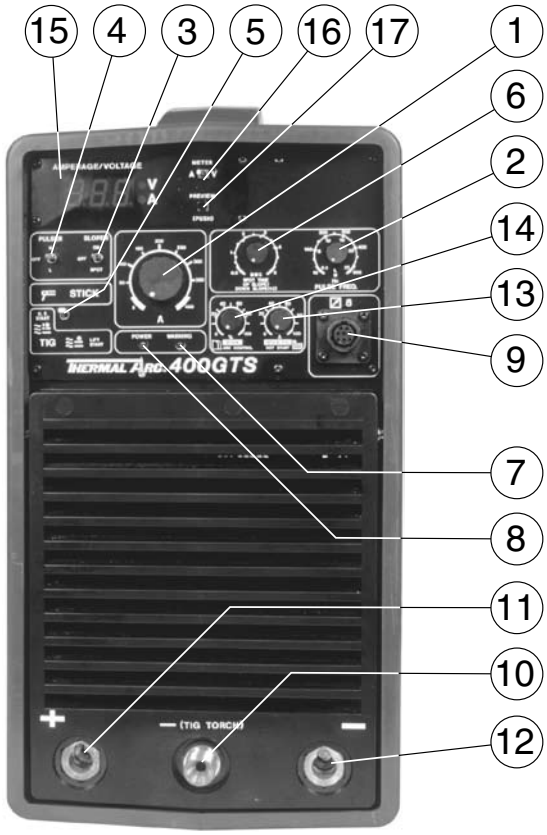
Figure 7. 400GMS model front operator controls

(1) **Amperage Control** - The Amperage Control selects the desired amperage within the entire range of the welding power source. Rotating this control in a clockwise direction increases the amperage output. The scale surrounding the amperage control represents approximate actual amperage values.

(2) **Pulse Frequency Control** - The Pulse Frequency control provides a means of selecting the pulse frequency when the Pulse switch is in the H (HIGH) or L (LOW) position. Rotating the control clockwise increases the pulse frequency. The two scales surrounding the control represent approximate actual values. The pulse frequency is adjustable from 0.5 to 25 Hz in LOW and 10 to 500 Hz in HIGH.

(3) **Sloper Switch** - When in the OFF position the Sloper is inactive. Selecting the ON position activates the Sloper. Selecting the SPOT position activates the spot welding timer. The Slope sequence and spot modes are activated by a remote ON/OFFswitch connected to the 8-pin receptacle. See the section on Slope sequence.

(4) **Pulser Switch** - When in the OFF position the Pulser is inactive. Selecting H (HIGH) or L (LOW) will activate the TIG pulser. The Pulse Frequency can be adjusted by the Pulse Frequency control. Pulse width is fixed at 35%. Background current is fixed at 1/5th of the peak current.



(5) **Process Selector Switch** - The Process Selector Switch allows the operator to select the STICK welding (SMAW) process, LIFT TIG (GTAW) or HF TIG (GTAW) process.

(6) **Spot Time Up/Down Slope Control** - This control provides Spot, Up and Down slope time control. Rotating the control clockwise increases the time. The scale surrounding the control represents approximate actual values. The Spot and Up slope time is adjustable from 0.5 to 5 seconds. The Down slope time is twice the Up slope time at 0.5 to 10 seconds.

(7) **Warning Indicator** - The Warning Indicator located on the front panel will become activated under the following conditions:

- Input voltage is too low
- Input voltage too high
- Thermal overload

(8) **AC Power Indicator** - The AC Power Indicator located on the front panel lights when the Primary Power Switch is in the ON position, indicating the unit is energized.

(9) **8-Pin Receptacle** - Used for remote contactor and amperage controls.

(10) **Output Gas Fitting** - Gas output; fitting size 5/8"-18 unf female

Output Gas Fitting - European model gas output. Accommodates 3/8" BSP monocable TIG torch.

(11) **Positive Terminal** - 50mm DIN-style female receptacle.

(12) **Negative Terminal** - 50mm DIN-style female receptacle.

(13) **Hot Start Control** - The Hot Start Control provides a variable selection of start circuit current that operates in the STICK and HF TIG modes. The Hot Start time is approximately 0.01 seconds in TIG and 0.06 seconds in STICK. The current value is adjusted from 0 to 100 Amps over the determined weld current set by the Amperage Control. Rotating the control clockwise increases Hot Start current.

(14) **ARC Control** - The Arc Control is in use in the SMAW mode only. Rotate the control clockwise to increase the short circuit current available to control the welding arc.

(15) **LCD Display**

(16) **Amperage/Voltage Selector Switch -** selects digital meter display of output amperage on voltage.

(17) **Preview Pushbutton Switch** - Allows digital meter to be used to set amperage (in HF Start Mode) or amperage (in TIG or STICK modes) prior to welding.

Gas Solenoid - The pre-flow is fixed at 150 ms. Post-flow is automatically adjusted from 1 to 30 seconds by the position of the welding Amperage Control.

Sloper Sequence -
A. Remote ON/OFF switch closed - Pre-flow starts to flow. In HF TIG mode HF and initial current is present after pre-flow. (In LIFT TIG mode HF is not present.) Initial current is 1/5th of the welding current.

B. Remote ON/OFF switch opened - Current increases to welding current at the rate set by the UP/DOWN Slope control. Welding current is set by the Amperage Control.

C. Remote ON/OFF switch closed - Current decreases to final current at twice the rate set for UP Slope. Final current is 1/5th of welding current.

D. Remote ON/OFF switch opened - Arc shuts off and post-flow time initiated.

Figure 8. 400GTS model front operator controls

1. **Primary Power Switch** - Placing the Primary Power Switch (circuit breaker) located on the rear panel to the ON position energizes the welding power source.
2. **Voltage Selector -** Manual slide switch selects the proper input voltage range. If this slide switch is not set to the position that matches the input voltage from the electrical source the Smart Logic will inhibit welding power source turn on and the warning indicator will be illuminated.
3. **Input Cable** - 10 feet
4. **Input Gas Fitting** - The input gas connection is located on the bottom center of the rear panel. Size 5/8"-18 unf female, European Fitting - 3/8" BSP male. GTS Model only.

Figure 9. 400 series rear panel operator controls

3.0 ROUTINE MAINTENANCE

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

WARNING 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 Section 5.1.1, Opening the Enclosure, page 22) 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 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.

4.0 BASIC TROUBLESHOOTING

You should always attempt to isolate and fix a problem using this section first. This section on basic troubleshooting will help you isolate faults and problems that are easily remedied without requiring that the power supply be opened, or requiring specialized test equipment and procedures. If the problem or fault cannot be corrected by following the recommendations in this section, then proceed to Section 5.0 on Advanced Troubleshooting, page 21.

4.1 Common Welding Operation Faults

The following are some of the more common operating faults that occur during welding operations:

A. Power
- Main power not connected
- Main power not turned on
- MAIN CIRCUIT BREAKER set of OFF position
- INPUT SELECTOR (Easy Link) Switch in wrong position

B. Poor Weld
- Wrong polarity
- Wrong electrode used
- Electrode not properly prepared
- Incorrect welding amperage setting
- Speed too slow or too fast
- Incorrect switch settings for intended operation
- Poor weld output connection(s)

C. Remote Operation
- Incorrect contactor switch settings
- Remote not connected

If the problem is not resolved after checking the above, the following guide may suggest more specific items to check given the faulty operating symptom(s) you are experiencing.

4.2 Specific Problems

How to Use This Guide

The following information is a guide to help you determine the most likely causes for various symptoms.

This guide is set up in the following manner:

A. Symptom (Bold Type)
- Any special instructions (Text Type)
  1. *Cause (Italic Type)*
     a. Check/Remedy (Text Type)

Locate your symptom, check the cause(s) (the simplest or most likely is listed first), then perform the remedy given. Repair as needed being sure to verify that the unit is fully operational after any repairs.

A. No Weld Output; Unit is Completely Inoperative

1. Line disconnect switch is in OFF position

a. Place line disconnect switch in ON position.

2. Line fuse(s) open

a. Check and replace line fuse(s).

3. Improper electrical input connections

a. See Section 1.3 Electrical Input Requirements, page 5, for proper input connections.

4. MAIN CIRCUIT BREAKER in OFF position

a. Check and reset MAIN CIRCUIT BREAKER if necessary.

5. INPUT SELECTOR (Easy Link) switch is set to incorrect position for applied input voltage

a. Verify primary source voltage and set INPUT SELECT switch to correct setting.

6. Easy-Link circuit is not functioning

a. Refer to Easy-Link test, Section 5.1.3.1, page 23, to verify operation.

B. WARNING Indicator is ON

1. Unit is in thermal shutdown mode

a. Allow cooling period of approximately five (5) minutes with the power ON. Duty cycle should be reviewed. To reset the WARNING indicator, the power supply must be turned OFF, then ON again.

b. Measure input voltage and verify that it matches the INPUT SELECTOR (Easy Link) switch setting. The length of the input power cable must be considered, as there will be a considerable voltage drop along its length.

c. Verify Easy-Link operation per section 5.1.3.1, page 23.

C. Erratic or Improper Weld Output

1. Loose welding cable connections

a. Tighten all welding cable connections.

2. Incorrect welding cable size

a. Use proper size and type of cable (see Operating Manual 0-2508 S Model; 0-2510 GMS Model; 0-2512 GTS Model).

3. Improper input connections

a. Refer to Section 1.3 Electrical Input Connections, page 5.

4. Poor electrode condition

a. Replace electrode.

5. If using a wire feeder, ensure that the wire is feeding at a consistent rate

a. Adjust wire feeder.

6. If in GTAW mode, check the condition of the tungsten electrode

a. Use the recommended 2% Thoriated tungsten.

7. In GTAW mode, incorrect argon gas flow

a. Verify that argon gas flow is correct.

8. Incorrectly set PROCESS SELECTOR switch

a. Verify the PROCESS SELECTOR switch is set to match the type of welding process being conducted.

9. Wrong welding polarity

a. Verify output torch connections.

D. Wandering Arc, Poor Control of Arc Direction

1. Wrong size tungsten electrode, typically larger than recommended
- a. Use proper size electrode for amperage selected (see Operating Manual 0-2508 S Model; 0-2510 GMS Model; 0-2512 GTS Model)

2. Improperly prepared tungsten electrode
- a. Prepare tungsten properly

3. Gas flow rate too high
- a. Reduce flow rate.

4. Drafts blowing shielding gas away from tungsten electrode
- a. Shield weld zone from drafts and check condition of tungsten electrode.

5. Loose gas fitting on regulator or gas line drawing air into weld zone (GTS model only)
- a. Check and tighten all gas fittings.

6. Water in torch
- a. Refer to torch parts list for part(s) requiring replacement and repair torch as necessary.

E. No High Frequency at Torch When PROCESS SELECTOR SWITCH is in HF TIG Position (GTS models only)

1. PROCESS SELECTOR SWITCH is not in the HF TIG position
- a. Place switch in HF TIG position.

2. Drafts blowing shielding gas away from tungsten electrode
- a. Shield weld zone from drafts and check condition of tungsten electrode.

3. Loose gas fitting on regulator or gas line drawing air into weld zone
- a. Check and tighten all gas fittings.

4. Water in torch
- a. Refer to torch parts list for part(s) requiring replacement and repair torch as necessary.

5. Tungsten condition is poor
- a. Replace electrode.

6. Electrode too high off metal
- a. Reduce stand-off.

7. Faulty Main Circuit Board (PCB1)
- a. Refer to the Main Circuit Board section 5.2.3, page 32.

8. Faulty Current Transformer CT1
- a. With no welding arc established, measure for 0VDC between CN1 pins 3 and 4 on PCB1. Replace CT1 if voltage is greater than 0.1VDC.

9. Faulty High Frequency Unit
- a. Refer to section 5.2.7, page 64.

F. Lack of High Frequency; Difficulty in Establishing an Arc

1. Dissipation of high frequency from torch cable or conductive gas hose
- a. Be sure that the torch cable is not near any grounded metal. Do not use conductive gas hose.

2. Weld cable leakage
- a. Check cables and torch for cracked or deteriorated insulation or bad connections. Repair or replace necessary parts.

3. Poor ground connection to power supply

a. Verify ground by trying to strike arc within one inch (2.54 cm) of ground clamp.

G. Green AC POWER Indicator OFF; Fan Not Operating

1. Input line disconnect switch in OFF position

a. Place input line disconnect switch to ON position.

2. Power supply MAIN CIRCUIT BREAKER (MCB) in OFF position

a. Place MCB to ON position.

3. Input line breaker tripped/fuses blown

a. Check primary supply breaker or fuses and replace if necessary.

4. Power supply MCB faulty

a. Check external connections to the circuit breaker and continuity. Replace if necessary.

NOTE Verify that for single-phase operation, the RED input line is not connected.

5. Open conductor in input power line

a. Check continuity and replace if necessary.

6. Faulty Main Circuit Board (PCB1)

a. Check the Main Circuit Board (PCB1) supply voltages. Refer to section 5.2.3, page 32. Replace the Main Circuit Board (PCB1) if any of the voltages are not present.

7. Faulty auxiliary transformer (T3) (GMS Model only)

a. Check auxiliary transformer (T3) primary and secondary windings for shorts or open circuits and replace if necessary. Refer to section 5.1.3.6, page 28.

H. Red WARNING Indicator ON; No Weld Output

1. Thermal sensor TH1 open (thermal shutdown)

a. Allow the unit to cool for five minutes before turning the power supply ON. If the problem still occurs, perform the PCA Thermal Sensor (TH1) test, page 53.

2. Input voltage fluctuation causing protection circuits to activate

a. Monitor input power for spikes and high voltage condition. Most power utilities will monitor and verify line voltage.

I. Front Panel 24V or 115V Circuit Breaker(s) Trips When Remote Contactor Points are Closed or, when the AMPERAGE/ VOLTAGE Selector in PANEL Position (GMS Model only).

1. Faulty feeder/remote device

a. Verify operation of external feeder device and replace if necessary.

2. Faulty Auxiliary Transformer

a. Check Auxiliary Transformer (T3) primary and secondary windings for shorts or open circuits and replace if necessary. Refer to section 5.1.3.6, page 28.

J. No Weld or Output; Fan Operating; WARNING Indicator OFF

1. OUTPUT CONTACTOR selector in REMOTE 14 position with no remote contactor connected (GMS Model Only)

a. Place OUTPUT CONTACTOR selector to ON position or connect remote contactor control to remote receptacle.

2. Faulty Remote Control Device

a. **GMS Model Only** – Set OUTPUT CONTACTOR selector to ON position and AMPERAGE/VOLTAGE selector to PANEL position. If amperage and voltage can be adjusted with front panel controls, repair or replace remote control device.

b. **S and GTS Models Only** – Connect a jumper between pins 2 and 3 of the REMOTE 8 receptacle for contactor closure. If amperage and voltage can be adjusted with front panel controls, repair or replace remote control device.

3. Faulty OUTPUT CONTACTOR selector

a. Refer to section 5.2.3, page 40, Front Panel Test Point Voltages.

4. Faulty Main Circuit Board (PCB1)

a. Check all connections on the Main Circuit Board (PCB1). Perform Power Supply Voltage tests, section 5.1.3.2, page 24.

5. Line voltage is too high

a. Verify that input voltage matches setting on rear panel INPUT SELECTOR switch.

b. Verify that INPUT SELECTOR (Easy Link) switch is functioning properly by performing test in section 5.1.3.1, page 23.

K. Low or Maximum Weld Output With No Control

1. Faulty remote control device

a. **GMS Model Only** – Set OUTPUT CONTACTOR selector to ON position and AMPERAGE/VOLTAGE selector to PANEL position. If amperage and voltage can be adjusted with front panel controls, repair or replace remote control device.

b. **S and GTS Models Only** – Connect a jumper between pins 2 and 3 of the REMOTE 8 receptacle for contactor closure. If amperage and voltage can be adjusted with front panel controls, repair or replace remote control device.

L. Limited Weld Output

1. Poor primary input voltage

a. Check primary input voltage is within ±10% of nominal voltage, i.e. 230VAC ±10%.

2. Faulty Current Transformer (CT1)

a. Check continuity and signals to current transformer CT. Refer to tests in section 5.1.3.2, page 25, step 12, CN1 pins 3 and 4, and 5.2.4, page 44.

M. Erratic or Improper Weld Output

1. Loose welding cable connections

a. Tighten all welding cable connections.

2. Improper setup

a. Check for proper connection of input power.

b. Perform Front Panel Test Point Voltage procedure, page 40.

3. Faulty Remote Device

a. Check all remote devices and repair or replace if necessary.

4. Faulty Current Transformer (CT1)

a. Check continuity and signals to current transformer CT. Refer to section 5.1.3.2, page 24, step 12, measuring between pins 3 and 4, and section 5.2.4, page 44.

N. No 115VAC or 24VAC at 14-Pin Connector (GMS Model only)

1. Front panel circuit breakers are tripped

a. Reset front panel circuit breakers.

2. Faulty auxiliary transformers

a. Perform PCA Auxiliary Transformer test, page 55. If transformer is defective, replace as necessary.

3. Bad connection in 14-pin receptacle

a. Verify wiring using an Ohmmeter per interconnection diagram, Appendix A, page 75.

O. No Weld Output; Fan Not Operating; WARNING Indicator OFF

1. Line voltage too low

a. Verify that input voltage matches setting on rear panel INPUT SELECTOR switch.

b. Verify that INPUT SELECTOR (Easy Link) switch is functioning properly by performing test in section 5.1.3.1, page 23.

2. Loose connection on Main Circuit Board (PCB1)

a. Verify all connections.

3. Incompatible remote control device

a. Verify remote device wiring matches receptacle.

4. Faulty remote control device

a. Jumper output contractor. If unit produces output, the remote device is faulty. If unit does not produce output, continue with step 5 below.

5. Faulty Main Circuit Board (PCB1)

a. Verify gate drive signals from Main Circuit Board by performing Gate Drive Enable Signal test in section 5.2.3.1, page 33.

6. Faulty output diodes

a. Perform PCA Output Diode test, page 51.

7. Faulty IGBT

a. Perform PCA IGBT Inverter tests, page 48.

5.0 ADVANCED TROUBLESHOOTING

If you are here, all of the troubleshooting suggestions in Section 4 - 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

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

WARNING 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 Dynamics through established procedures.

WARNING Disconnect primary power at the source before disassembling the power supply. Frequently review the Important Safety Precautions (page iii). Be sure the operator is equipped with proper gloves, clothing, 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.

5.1 System-Level Fault Isolation

If none of the suggestions provided in Section 4 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.

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

CAUTION

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.

5.1.1 Opening the Enclosure

400 S | 400 GMS | 400 GTS

Figure 10. Opening the enclosure (shown in GMS model)

To open the enclosure:

1. Turn off the MAIN CIRCUIT BREAKER on the rear of the power supply.
2. Wait at least two minutes to allow the input capacitors to discharge.
3. Remove the two screws on the top and three screws from bottom of the unit.
4. Remove the two screws from the middle of the case on both sides of the unit.
5. Pull the plastic enclosure halves open and away from the internal frame.
6. Remove the inner plastic shield by locating three (3) white plastic retaining plugs on the sides of the heatsink by pulling the plastic plug straight out of the hole in the heatsink. For reassembly, make a note of the relationship of the grounding screw and the fourth hole in the plastic shield that did not have a plastic plug.

To reassemble the enclosure:

1. Place the inner plastic shroud over the power supply so the three holes that will accept the plastic retaining plugs are in the correct position.
2. Insert the white plastic retaining plugs into the holes in the heatsink through the matching holes in the plastic shield.
3. Place the power supply into an enclosure half, taking care that the front and rear panel edges are seated properly into the matching grooves inside the enclosure. Repeat for the second enclosure half.
4. When the two enclosure halves are fully together, secure the two halves together with the five screws and matching nuts.
5. Install the two screws in the middle of each enclosure half.

5.1.2 Initial Setup Conditions

400 S 400 GMS 400 GTS

Before starting any of the system-level troubleshooting procedures that follow, set the front panel controls of the unit to the following. If necessary, refer to the Operator's Controls section (2.0), page 10, for the location of the various controls for the unit.

1. Set the PROCESS SELECTOR switch to STICK mode.
2. Set the AMPERAGE control to its minimum (fully counterclockwise) position.
3. No connection should be made to the remote receptacle(s).

5.1.3 Fault Isolation Tests

5.1.3.1 Easy Link Test

400 S 400 GMS 400 GTS

The Easy Link circuit configures the internal power circuits to accept the input power. This test verifies that the INPUT SELECT switch is functioning properly, and the Easy Link circuit can detect both the

maximum 460 and the minimum 208-230V input power, and correctly configure the internal power circuits for proper operation under both input power conditions.

1. Disconnect primary power at the source. Make sure the MAIN CIRCUIT BREAKER (MCB) is in the OFF position.
2. Set the INPUT SELECTOR switch on the rear panel to the low voltage (208-230VAC) range position.
3. Using an Ohmmeter, at CN13 on the Main Circuit Board between pins 1 (BLUE) and 3 (GREEN) should measure a short, and an open between CN13 pins 2 (GRAY) and 3 (GREEN).
4. Set the INPUT SELECTOR switch to the high voltage (460VAC or 575VAC if so equipped) range. NOTE: Applicable to units with the last letter of the serial number ending in "A"-"D" not "E" or "F".
5. Using an Ohmmeter, at CN13 on the Main Circuit Board between pins 1 (BLUE) and 3 (GREEN) should measure an open, and a short between CN13 pins 2 (GRAY) and 3 (GREEN).
6. Replace the INPUT SELECTOR switch if these readings are not obtained.

5.1.3.2 Power Supply Voltage Test

400 S 400 GMS 400 GTS

1. Connect the power supply to a source of either 208-230VAC or 460VAC.
2. Set the INPUT SELECT switch to match the input voltage.
3. Apply power to the unit and place the MAIN CIRCUIT BREAKER on the power supply to the ON position.
4. GMS models only, on the Front Panel Circuit Board (PCB6), measure the voltage between pin pairs 1 - 2 and 2 - 3 on connector CN10. The voltage should read 18VAC.
5. Turn the unit OFF.
6. At the Front Panel Circuit Board, disconnect the ribbon cable at connector CN7 (connects to connector CN21 on the Main Circuit Board (PCB1)). Pull up on the retaining bar to release the ribbon cable from the connector body.
7. Reapply power to the unit.

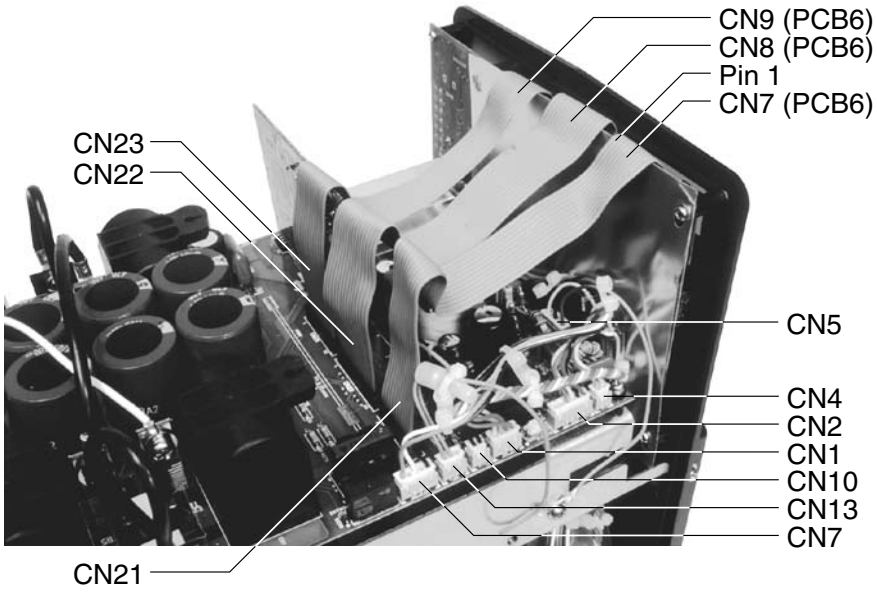


Figure 11. Power Supply Voltage Connector Locations

8. On the ribbon cable, measure for the following voltages between pins:
   Pins 2 (-) and 1 (+) +12VDC
   Pins 2 (-) and 5 (+) -12VDC
   Pins 2 (-) and 3 (+) +5VDC
   Pins 2 (-) and 4 (+) +5VDC
9. Turn the unit OFF.
10. Reconnect the ribbon cable to connector CN7 on the Front Panel Circuit Board.
11. Reapply power to the unit.
12. On the Main Circuit Board (PCB1), measure the voltages between the following points:
    CN1:
    Pin 1 and pin 4 +12VDC
    Pin 2 and pin 4 -12VDC
    Pin 3 and pin 4 0V to +12VDC; varies with AMPERAGE control setting
    CN2:
    Pin 1 and pin 2 +24VDC
    CN21:
    Pin 1 and pin 2 +12VDC
    Pin 3 and pin 2 +5VDC
    Pin 4 and pin 2 +5VDC
    Pin 5 and pin 2 -12VDC
    CN22:
    Pin 13 and pin 4 +12VDC
    CN23:
    Pin 3 and pin 2 +12VDC

If any of these voltages are not present or are below a 10% tolerance, replace the Main Circuit Board (PCB1).

5.1.3.3 Output Load Test

400 S | 400 GMS | 400 GTS

This test verifies that the output current (amperage) controls are functioning properly. A clamp-type amperage meter or equivalent meter capable of reading approximately 400A full-scale will be needed for this test.

CAUTION

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

1. Place the AMPERAGE control in its minimum (fully counterclockwise) position.
2. Connect the POSITIVE (+) and NEGATIVE (-) OUTPUT TERMINALS to a piece of metal, separated by approximately three feet.
3. Connect the clamp-on amperage meter or equivalent to the output loop between the POSITIVE (+) and NEGATIVE (-) OUTPUT TERMINALS.
4. Place the power supply PRIMARY POWER SWITCH/MCB on the rear of the unit to the ON position. After five (5) seconds, the amperage meter will indicate approximately 5 Amps.
5. Slowly turn the AMPERAGE control 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 400 Amps maximum of the power supply.
6. Place the power supply MAIN CIRCUIT BREAKER on the rear of the unit to the OFF position.
7. Remove the dead short between the OUTPUT TERMINALS.

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.

5.1.3.4 LIFT START Circuit Test

400 S | 400 GMS | 400 GTS

This test verifies proper operation of the LIFT START circuit. A clamp-type amperage meter or equivalent meter capable of reading approximately 20A full-scale, and a digital voltmeter capable of indicating 20VDC full-scale will be needed for this test.

CAUTION

Before performing any portion of the procedure below, make certain the unit is placed in the initial setup condition as described above.

1. Make sure the MAIN CIRCUIT BREAKER (MCB) is turned OFF.
2. Set the PROCESS SELECTOR switch to LIFT START TIG mode.
3. Connect a digital voltmeter between the POSITIVE (+) and NEGATIVE (-) OUTPUT TERMINALS of the unit. Set the meter to

indicate Volts DC.

4. **S and GTS Models** – Connect a jumper between pins 2 and 3 of the REMOTE 8 connector, or if a remote contactor is connected, close it. **GMS Model** – Set the front panel OUTPUT CONTACTOR switch to the ON position.
5. Place the power supply MCB on the rear of the unit to the ON position. After five (5) seconds, the voltmeter will indicate approximately 6 volts open circuit.
6. Turn off the power supply MCB.

WARNING To avoid injury or worse, Power Supply MUST be turned OFF before performing the next step in this procedure.

7. Connect the POSITIVE (+) and NEGATIVE (-) OUTPUT TERMINALS to a piece of metal, separated by approximately three feet.
8. **S and GTS Models** – Connect a jumper between pins 2 and 3 of the REMOTE 8 connector, or if a remote contactor is connected, close it. **GMS Model** – Set the front panel OUTPUT CONTACTOR switch to the ON position.
9. Place the power supply MCB on the rear of the unit to the ON position. After five (5) seconds, the voltmeter will indicate approximately 1 volt.
10. Turn off the power supply MCB.
11. Connect the clamp on the amperage meter or equivalent to the output loop between the POSITIVE (+) and NEGATIVE (-) OUTPUT TERMINALS.
12. Place the power supply MCB on the rear of the unit to the ON position. After five (5) seconds, the amperage meter will indicate approximately 17Amps.
13. Turn off the power supply MCB.
14. Remove the short circuit condition.

This completes the LIFT START circuit test. If the results of any step differ from those above, the Main Circuit Board should be replaced. Refer to section 5.2.3.5, page 35.

5.1.3.5 High Frequency (HF) START Circuit Test

400 GTS

This test verifies the operation of the HF START circuit available in **GTS models** only.

CAUTION Before performing any portion of the procedure below, make certain the unit is placed in the initial setup condition as previously described.

1. Make sure the MAIN CIRCUIT BREAKER (MCB) is turned OFF.
2. Set the PROCESS SELECTOR switch to HF START mode.
3. Connect TIG torch and shielding gas.
4. Connect a remote control or jumper between pins 2 and 3 of the

REMOTE 8 receptacle for contactor closure. If a remote switch is installed, close it.

5. Place the power supply MCB on the rear of the unit to the ON position. After PRE-FLOW of 150 ms, the HF START circuit will turn ON. If the torch is brought to within 1/2" of the work, lead arc transfer will occur. After arc transfer, the HF START circuit will turn OFF.
6. Remove the jumper, or open the remote control switch if installed. The arc turns OFF.
7. Turn off the power supply MCB.

This completes the HF START circuit test. If the results of any step differ from those above, perform the HF Unit test, section 5.2.7, page 64. If the HF Unit is good, replace the Main Circuit Board, section 5.2.3.5, page 35.

5.1.3.6 Auxiliary Transformer (T3) Test

400 GMS

This test verifies the operation of the auxiliary transformer (T3) in **GMS models** only. If the power supply fails to operate, and the WARNING indicators are OFF, the auxiliary transformer could possibly be faulty. Refer to figure 12.

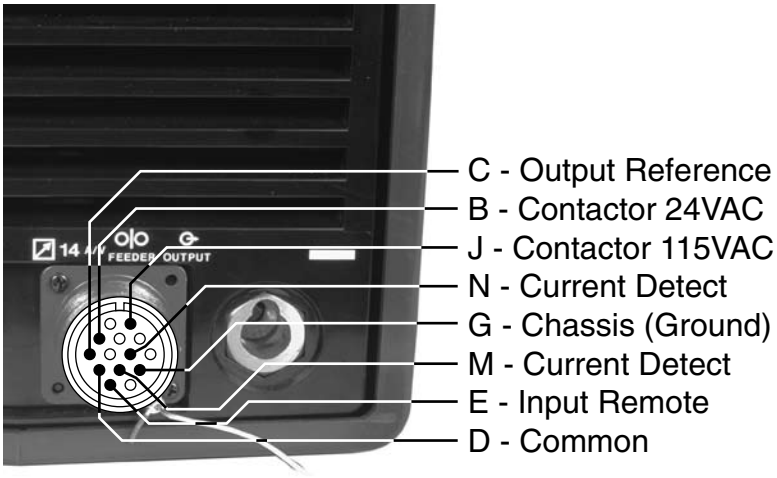


Figure 12. 14-Pin Receptacle.

CAUTION

Before performing any portion of the procedure below, make certain the unit is placed in the initial setup condition as described above.

1. Turn ON the MAIN CIRCUIT BREAKER (MCB).
2. Using a voltmeter on AC, measure voltages at the 14-PIN RECEPTACLE (CON1) between the following pairs of pins:
   Pin B and D 24VAC
   Pin J and D 115VAC

3. Turn OFF the MAIN CIRCUIT BREAKER.
4. If either or both of these voltages are not present, reset the front panel circuit breakers and perform the Auxiliary Transformer tests, page 55.

5.2 Subsystem Test and Replacement Procedures

5.2.1 Preparation

400 S 400 GMS 400 GTS

The following initial conditions must be met prior to starting any of the procedures in this section (5.2).

1. Set the PROCESS select switch to the STICK mode.
2. Set the AMP/VOLT select switch in PANEL position.
3. Disconnect all remote devices.
4. Connect the appropriate input voltage. (Check the data tag on the rear of the power supply for the proper input voltage.)

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

5. Close primary power source wall disconnect switch or circuit breaker.
6. Place power supply MAIN CIRCUIT BREAKER (MCB) on rear of unit in the ON position.

WARNING Dangerous voltage and power levels are present inside this unit. Be sure the operator is equipped with proper gloves, clothing, 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.

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.

The 400 Series S, GMS and GTS models share a number of common subassemblies. Where a test or replacement procedure differs for a particular subassembly from model to model, separate procedures are provided for each model for that subassembly.

5.2.2 Main Circuit Breaker (MCB)

Main Circuit Breaker (MCB) Replacement Procedure

400 S 400 GMS 400 GTS

WARNING Disconnect primary power at the source before performing this procedure.

Refer to figure 13.

Figure 13. MAIN CIRCUIT BREAKER (shown in GMS model)

To remove the MAIN CIRCUIT BREAKER:

1. Remove the four screws from the rear panel that secure the MAIN CIRCUIT BREAKER assembly to the rear panel.
2. Remove the three input power leads and three output power leads marked R, S, and T from the MCB terminals. Remove the MCB.

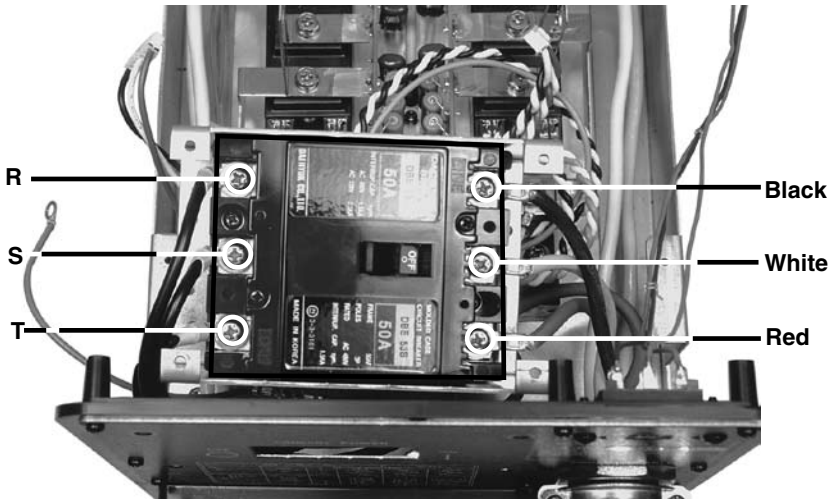


Figure 14. MAIN CIRCUIT BREAKER connections

To replace the MCB, reverse the above steps, replacing the input and output leads in the same matching positions. Refer to figure 14.

5.2.3 Main Circuit Board (PCB1) Test and Replacement Procedures

Main Circuit Board (PCB1) Test Procedures

400 S | 400 GMS | 400 GTS

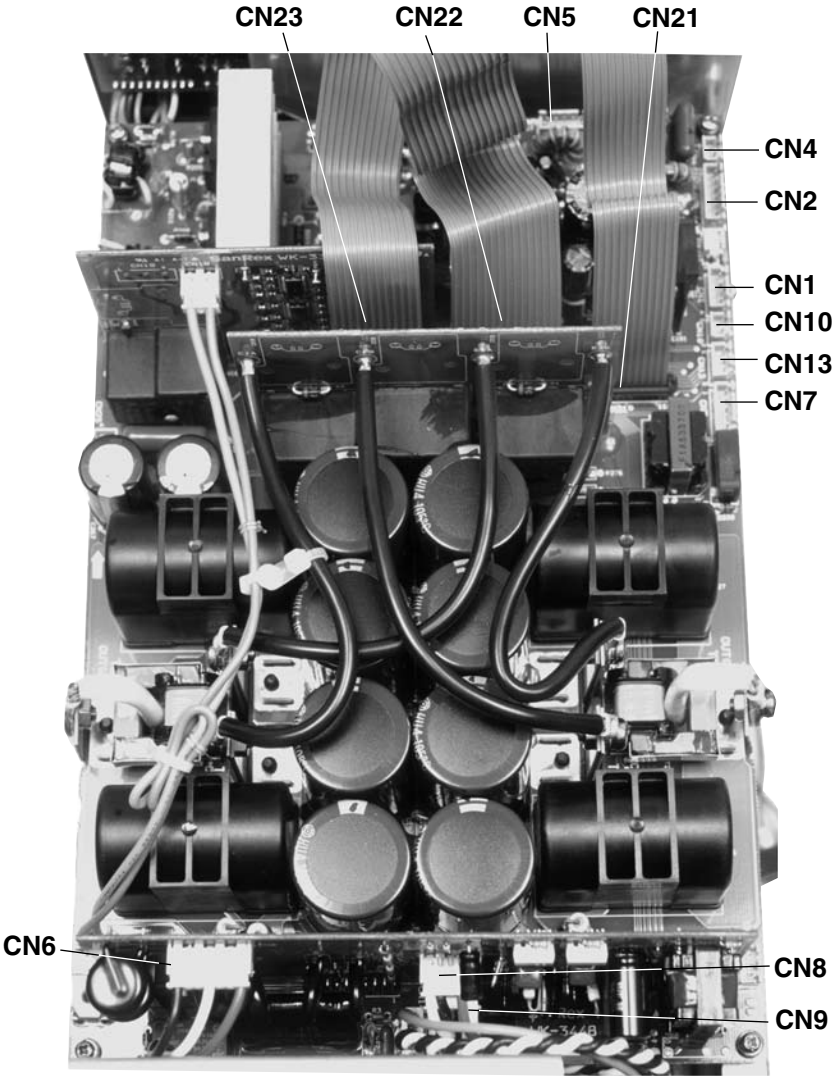


Figure 15. Main circuit board (shown in GMS model)

5.2.3.1 Gate Drive Enable Signal Test

The gate drive signals are 21.3kHz square wave signals, with an OFF level of -4VDC for 26μs, and the ON level of +11VDC for 21μs. There is a 2.5μs dead time before and after the ON time of each channel before the other goes through its OFF/ON transition. Refer to figure 16.

1. Apply power to the unit and turn the MAIN CIRCUIT BREAKER (MCB) ON.
2. Using an oscilloscope at the CN8 connector on the Main Circuit Board (PCB1), measure the voltage between Q1 signal pairs:
   Pin 1 and 2
   Pin 4 and 5
3. Using an oscilloscope at the CN9 connector on the Main Circuit Board (PCB1), measure the voltage between Q2 signal pairs:
   Pin 1 and 2
   Pin 4 and 5
4. Using a voltmeter, measure the voltage between signal pins 1 and 2 and pins 4 and 5 at connector CN8. The voltage between each pair of pins should be +5VDC. Switch the PROCESS SELECTOR switch to the TIG LIFT START position. The voltage between both pair of pins should drop to -4VDC.
5. Return the PROCESS SELECTOR switch to the STICK position.
6. Using a voltmeter, measure the voltage between signal pins 1 and 2 and pins 4 and 5 at connector CN9. The voltage between each pair of pins should be +5VDC. Switch the PROCESS SELECTOR switch to the TIG LIFT START position. The voltage between both pair of pins should drop to -4VDC.

If the results of any of these tests are incorrect, replace the Main Circuit Board (PCB1).

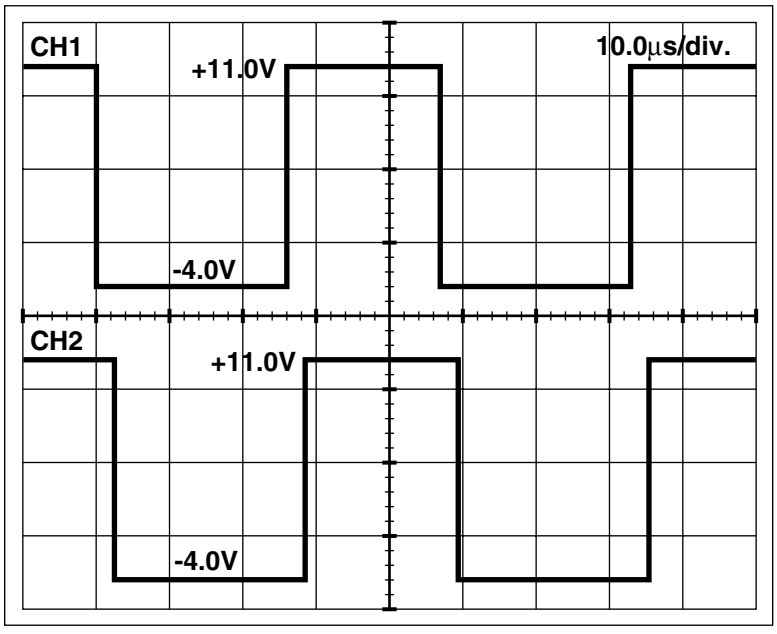


Figure 16. Gate Drive Enable Waveform

5.2.3.2 Lift Start Test

400 S 400 GMS 400 GTS

1. Disconnect primary power at the source. Make sure the MAIN CIRCUIT BREAKER is in the OFF position.
2. Measure the continuity between the front panel NEGATIVE (-) OUTPUT TERMINAL to CN5-3 on the Main Circuit Board (PCB1), and from the front panel POSITIVE (+) OUTPUT TERMINAL to CN5-1 on the Main Circuit Board (PCB1). Both should be zero Ohms. Replace wire if continuity is broken.
3. Disconnect connectors CN8 and CN9 on the Main Circuit Board (PCB1).
4. Reapply power to the unit by turning the MAIN CIRCUIT BREAKER to the ON position. Measure the voltage between CN22-5 and CN22-4 for 0VDC. Install a jumper between the (+) and (-) output terminals on the front panel. The voltage between CN22-5 and CN22-4 should increase to +5VDC.

If the voltage does not increase in step 4 above, replace the Main Circuit Board (PCB1).

5.2.3.3 Gas Control Test

400 GTS

Disconnect the remote control device from the REMOTE 8 receptacle.

1. Measure for +24VDC between pins 3 and 4 on CN2 on the Main Circuit Board (PCB1). Replace the Main Circuit Board (PCB1) if the voltage is low or not present.

With a remote control device connected to the REMOTE 8 receptacle and contact closure between pins 2 and 3, measure the voltage between the gas solenoid valve terminals. If the voltage is 24VDC and the solenoid does not operate, replace the solenoid valve. If the voltage is low or not present, replace the Main Circuit Board (PCB1).

5.2.3.4 High Frequency Test

400 GTS

1. Place the PROCESS SELECTOR Switch in the STICK position.
2. Jumper pins 1 and 5 on the CN7 plug. Apply power to the unit.
3. If the high frequency buzz is heard coming from the HF Unit, the Main Circuit Board (PCB1) should be replaced. If no sound is heard coming from the HF Unit, the HF Unit should be replaced.

5.2.3.5 Main Circuit Board (PCB1) Replacement Procedure

400 S | 400 GMS | 400 GTS

Refer to figures 17 through 22.

To remove the Main Circuit Board:

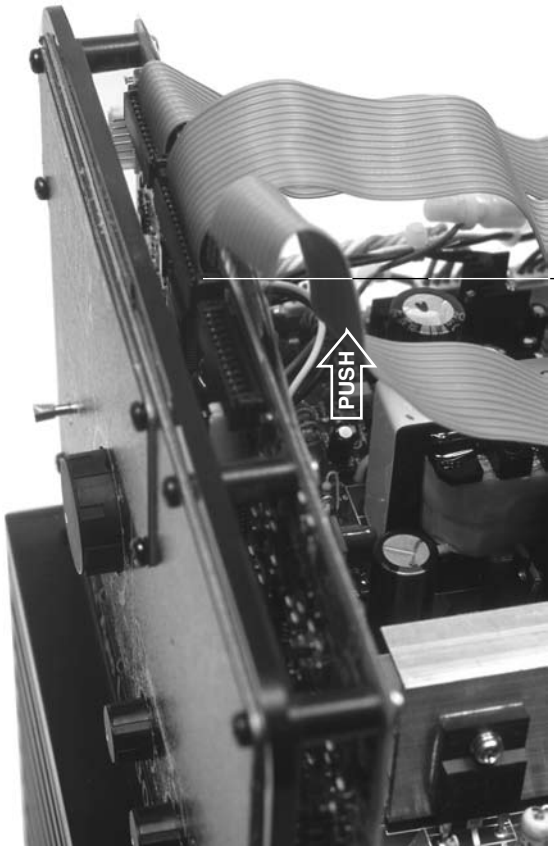


Figure 17. Ribbon cable location and release of retaining bar (shown in GMS model)

1. Locate connectors CN7, CN8 and CN9 at the top edge of the Front Panel Circuit Board.
2. Gently pull up on the retainer bar on each side of each connector to release the ribbon cable in the connectors.
3. Remove the ribbon cable by gently pulling straight up on the ribbon cable.
4. On the Main Circuit Board, remove the screw from TB12 and remove the GREEN ground wire lug from the terminal (figure 18).

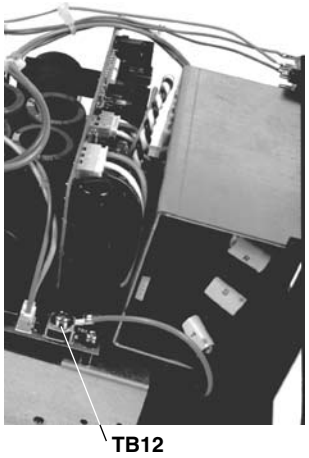


Figure 18. Location of TB12 on main circuit board (shown in GMS model)

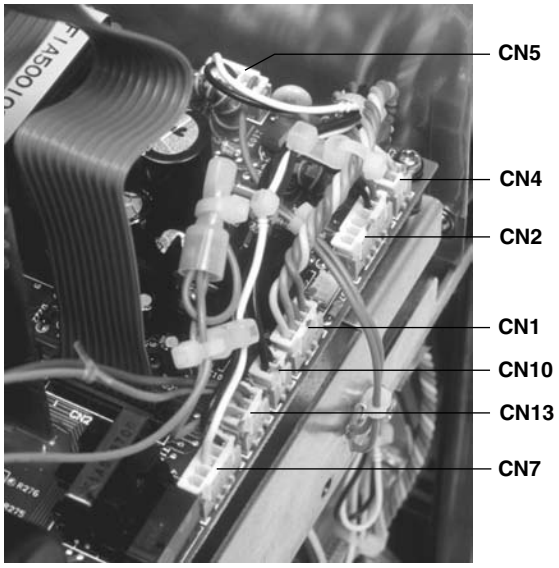


Figure 19. Connectors to be removed from main circuit board (shown in GMS model)

5. Remove all connectors from the left front corner of the Main Circuit Board – CN1 , CN2 , CN4, CN5 , CN7, CN10 and CN13.
6. Move the wiring harness aside, clear of the Main Circuit Board.
7. Remove any main wiring harness connectors that attach to vertical boards that are part of the Main Circuit Board Assembly.

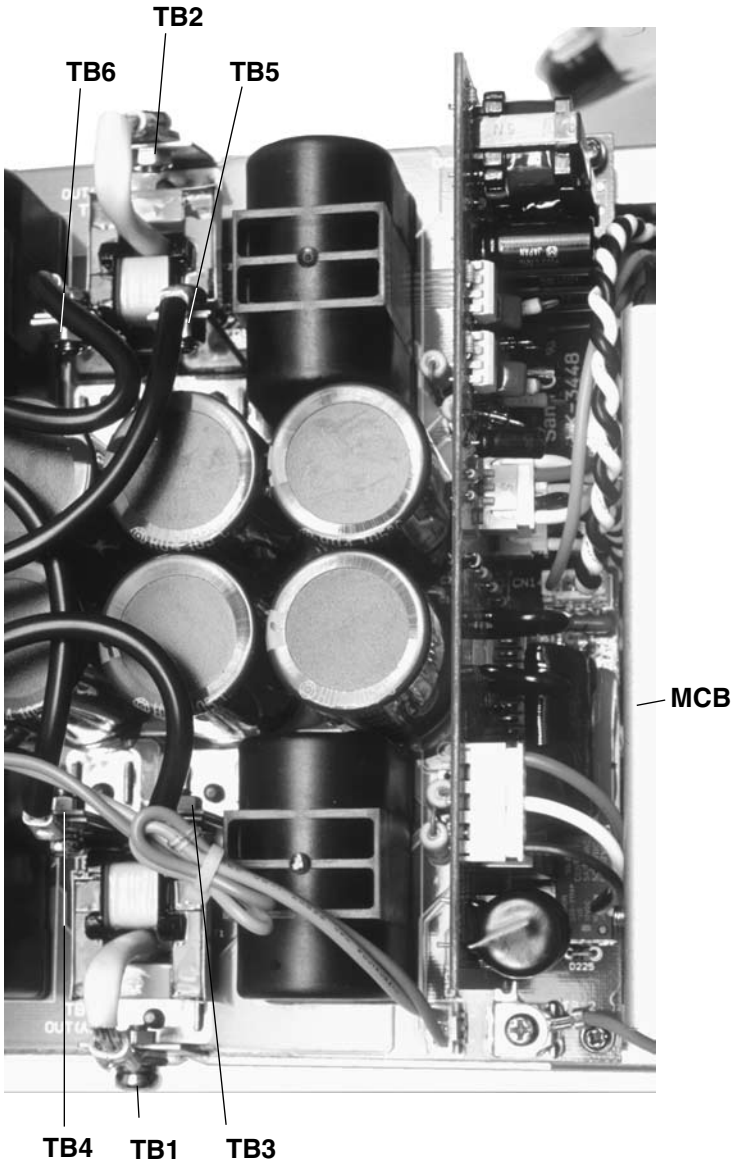


Figure 20. Location of TB1 through TB6 on main circuit board (shown in GMS model)

8. Remove screws, associated hardware and wire lugs from TB1 through TB6. Straighten the lugged wires that were removed from TB1 and TB2 so they stand vertically. This will allow the wires to pass through the current sensors when the Main Circuit Board is lifted away from the chassis in a later step.

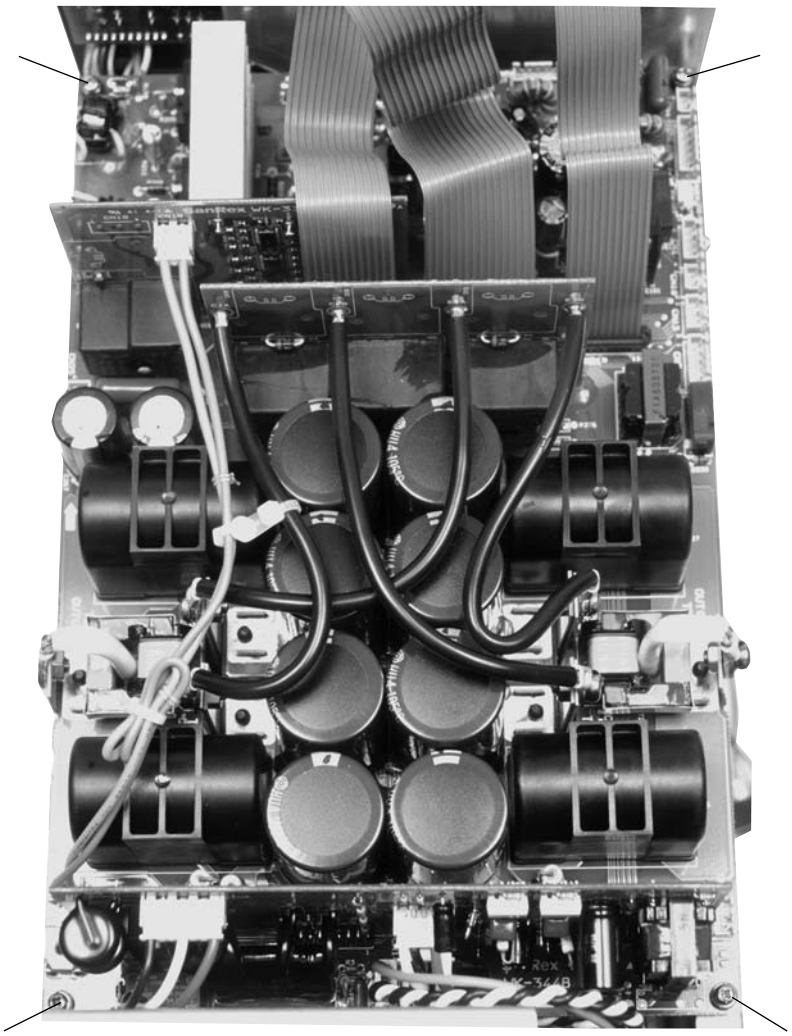
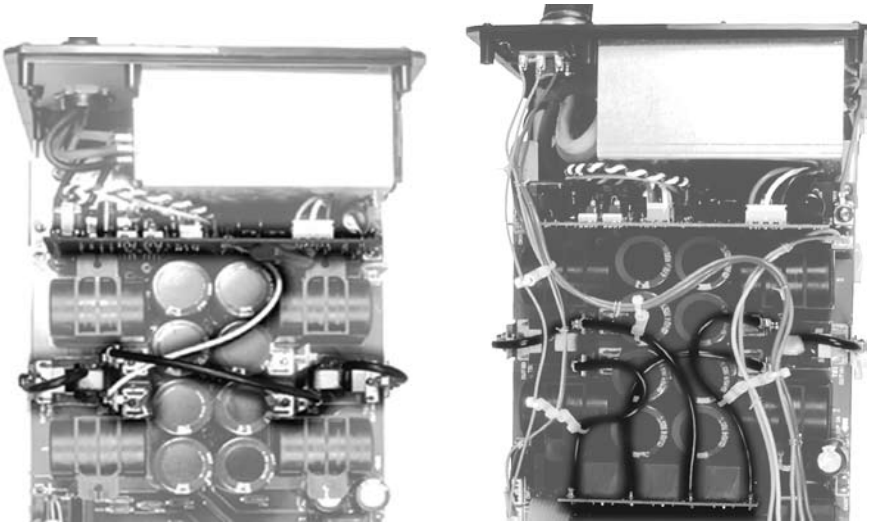


Figure 21. Main circuit board retaining screws (shown on GMS model)

9. Remove the four (4) mounting screws from the corners of the Main Circuit Board.
10. Lift the Main Circuit Board straight up, passing the lugged wires removed from TB1 and TB2 through the current sensors.
11. As you remove the Main Circuit Board, remove all connectors from the rear of the Main Circuit Board Assembly at locations CN8, CN9, and CN14.
12. Continue to pull the Main Circuit Board straight up and away from the chassis.

To replace the Main Circuit Board:

1. Hold the Main Circuit Board over the chassis, oriented so the three ribbon cables are toward the front panel of the power supply.
2. As you lower the Main Circuit Board onto the chassis, feed the lugged wires that will attach to TB1 and TB2 through the current sensors.
3. As you lower the Main Circuit Board onto the chassis, replace the connectors on the rear end of the board at locations CN8, CN9, and CN14.
4. Continue lowering the board so the vertical bus bars pass through the slots in the boards, and line up with TB3/4 and TB5/6. The board is properly seated when the holes in the vertical bus bar and the terminals TB1-6 line up, the board is seated on the black plastic spacers in the corners of the board, and there is no interference with wire harnesses.
5. Carefully pull the excess lead length of the two lugged wires that will connect to TB1 and TB2 up through the current sensors.



A **B**

Figure 22. TB1 through TB6 reconnections A) S and GTS models B) GMS model

6. Replace the hardware to secure the lugged wires to TB1 through TB6. The lugged wires that connect to TB1 and TB2 must be bent over in a loop.
7. Insert the washers and screws into the four corners of the Main Circuit Board. Do not tighten until all four screws are started in their holes.

5.2.3 Front Panel Circuit Board (PCB6) Test and Replacement Procedures

Front Panel Circuit Board (PCB6) Test Procedure

To gain access to the test points on the Front Panel Circuit Board, it is necessary to remove the front panel of the power supply unit.

Figure 23. Front panel circuit board retaining screws (shown in GTS model)

1. To accomplish this, locate and remove the six (6) screws securing the Front Panel to the front of the power supply. Move the front panel to the side to allow free access to the test points on the Front Panel Circuit Board (PCB6).

Test Point Voltages

400 S | 400 GMS | 400 GTS

The test point voltages on the Front Panel Circuit Board should be verified as follows.

1. Set up the contactor closure circuit by doing the following:
   S and GTS Models – install a jumper between pins 2 and 3 of the REMOTE 8 receptacle;
   GMS Models – set the OUTPUT CONTACTOR switch in the ON position.

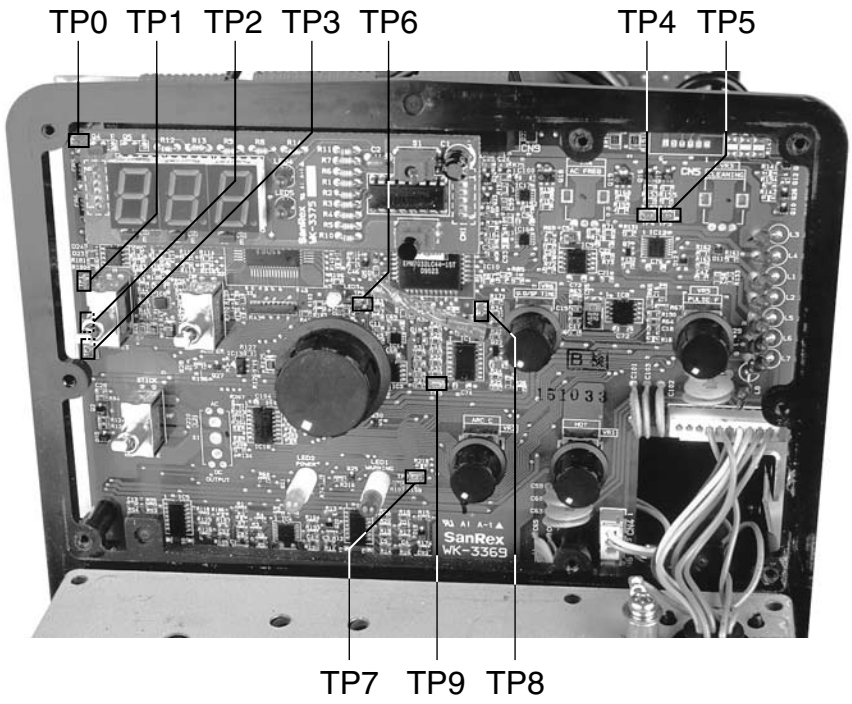


Figure 24. Front panel voltage test points (shown in GTS model)

2. Measure the voltage between test points TP8 and TP0 to be 12VDC.
3. Measure the voltage between test points TP4 and TP0 to be 5VDC.
4. Measure the voltage between test points TP5 and TP0 to be 5VDC.
5. Set up the contactor closure circuit by doing the following:
   S and GTS Models – remove the jumper from the REMOTE 8 receptacle;
   GMS Models – set the OUTPUT CONTACTOR switch in the REMOTE 14 position with no remote device connected.
6. Measure the voltage between test points TP8 and TP0 to be 3.5VDC.
7. Measure the voltage between test points TP4 and TP0 to be 0VDC.
8. Measure the voltage between test points TP5 and TP0 to be 0VDC.
9. Measure between TP0 and the test points below to verify the voltages given:

TP0	0V.	...Circuit Common
TP1		.....Regulated voltage of control circuit
TP2	+12VDC	.....Regulated voltage of control circuit
TP3	-12VDC	.....Regulated voltage of control circuit
TP6	+4VDC	.....Regulated voltage of control circuit
TP9	42.6kHz	.....PWM pulse signal

PROCESS SELECTOR Switch Test

400 S 400 GMS 400 GTS

Using CN8-4 as common, check the voltages on CN8-9 and CN8-10 for the voltage listed below with the PROCESS SELECTOR switch in each position as follows:

Switch Position:	Voltage at CN8-9	Voltage at CN8-10
STICK	15VDC	0VDC
HF TIG	0VDC	0VDC
LIFT TIG	0VDC	15VDC

Gas Control Test

400 GTS

1. Disconnect any remote control device from the REMOTE 8 receptacle.
2. Disconnect AC1 from the HF Unit (to prevent damage to the meter).
3. Place unit in HF TIG position.
4. Jumper pin 2 and pin 3 at the 8 pin receptacle.
5. Measure for +24VDC between CN2-3 and CN2-4. Replace the Front Panel Circuit Board (PCB6) if voltage is not present. If the voltage is present, replace the solenoid per section 5.2.9, page 68.

Front Panel Circuit Board (PCB6) Replacement Procedure

400 S 400 GMS 400 GTS

Refer to figures 25 and 26.

To remove the Front Panel Circuit Board:

1. Remove the Main Circuit Board, referring to section 5.2.3.5, page 35.
2. Locate and remove five (5) screws from the Front Panel Circuit Board/Shield securing them to the inside of the front panel of the unit.

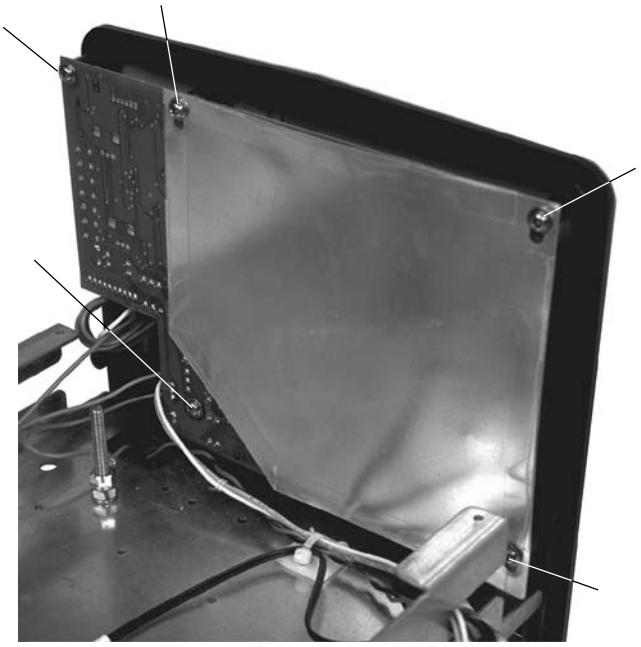


Figure 25. Front panel circuit board retaining screws

3. Pull the Front Panel Circuit Board back toward the rear of the power supply and then up to free the controls from their respective holes in the front panel. Fold the Front Panel Circuit Board down to expose the component side of the board.

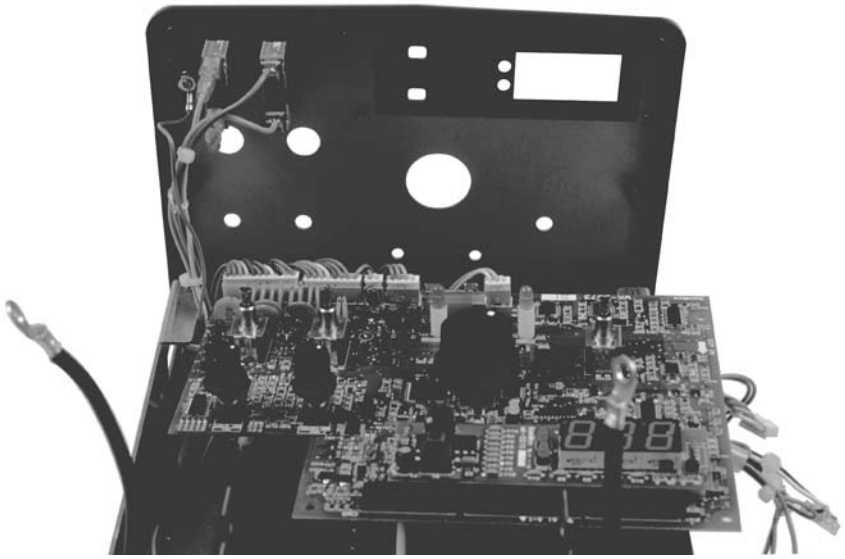


Figure 26. Component side of front panel circuit board (shown in GMS model)

4. Remove all connectors from the Front Panel Circuit Board.
5. Remove the Front Panel Circuit Board from the power supply.

To replace the Front Panel Circuit Board, reverse the removal steps above.

5.2.4 Current Transformer (CT1)

Current Transformer Test Procedure

400 S 400 GMS 400 GTS

1. Disconnect connector CN1 from the Main Circuit Board (PCB1).
2. With an Ohmmeter set the Rx10 scale, measure between the pins on the CN1 plug as follows:
   Pin 4 (YELLOW) and Pin 1 (BROWN) 120KΩ
   Pin 4 (YELLOW) and Pin 2 (RED) 20KΩ

Current Transformer Replacement Procedure

400 S 400 GMS 400 GTS

Refer to fi

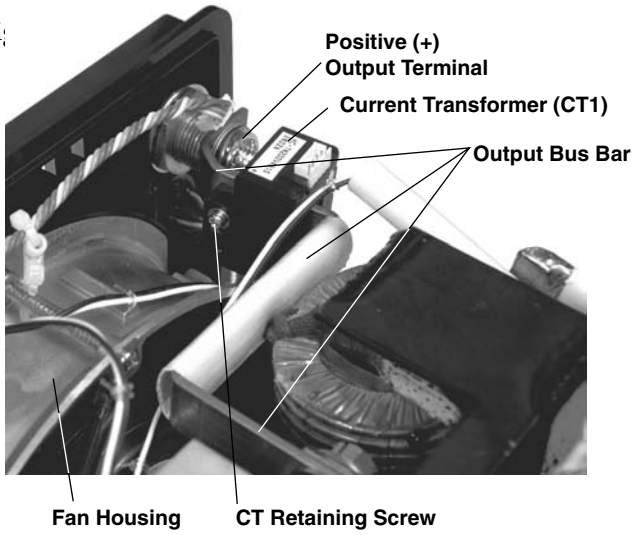


Figure 27. Current transformer, retaining screw and output bus bar (shown on GMS model)

To remove the Current Transformer:

1. Lay the power supply on its right side.
2. Remove the CT retaining screw on the bottom of the CT that screws into the output bus bar.
3. Remove the bolt and associated hardware from the inside of the POSITIVE (+) OUTPUT TERMINAL.
4. Remove the connector with the RED/YELLOW/ORANGE/BROWN twisted wiring harness from the CT.
5. While bending the output bus bar upward to make clearance for the CT, slide the CT around the bends of the bus bar and off the end.

To replace Current Transformer reverse the above steps.

5.2.5 Power Control Assembly Test and Replacement Procedures

The Power Control Assembly (PCA) consists of input diode, IGBT Inverters, output diodes, heat sinks, main and auxiliary transformers and output inductor. Perform a careful inspection of all components of the PCA first. Failure may be identified by burned insulation or other physical symptoms. If there are no signs of physical damage, conduct the following procedures.

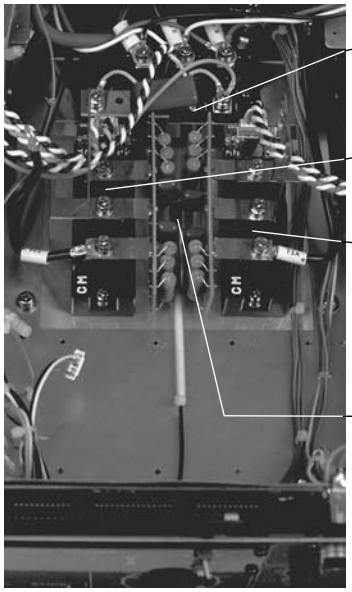


Figure 28. Top of power control assembly (shown in GMS model with main circuit board removed)

Power Control Assembly (PCA) Test Procedures

400 S | 400 GMS | 400 GTS

WARNING Disconnect primary power at the source before performing these procedures.

This procedure requires a digital Volt/Ohm meter that has a diode test scale. This procedure will give a general indication of the condition of the PCA components; a more conclusive test requires specialized equipment. Therefore, even if the results of these procedures check out as good, one or more components may still be faulty. If there is any doubt, replace the PCA. It is assumed that you are familiar with diode testing basics. If not, please refer to Appendix B, page 94.

NOTE The photo shows the Main Circuit Board removed from the unit in order to do a visual inspection of the PCA components. This test can be performed with the Main Circuit Board in place.

PCA Input Diode Bridge (D1) Test Procedure

400 S 400 GMS 400 GTS

Refer to figure 29.

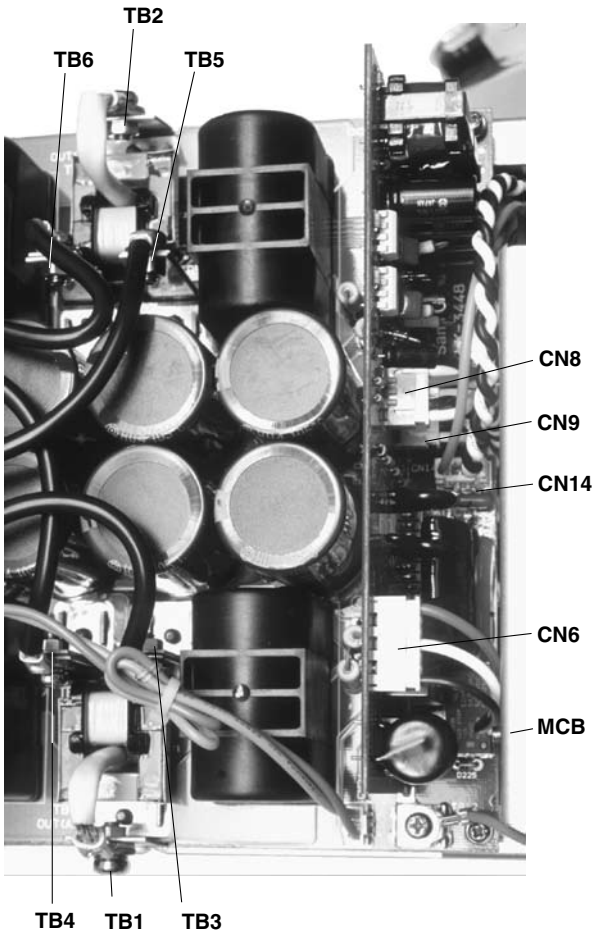


Figure 29. Input diode bridge (D1) test points (shown in GMS model)

1. Select the Ohms scale on the digital meter.
2. Check CN14 on Main Circuit Board between pins 1 and 2. The resistance should read 44Ω.
3. Select the diode test setting on the digital meter.
4. Check the diodes between the following:
   MAIN CIRCUIT BREAKER (MCB) wire R, and TB6 on the Main Circuit Board;
   MCB wire S, and TB6 on the Main Circuit Board;
   MCB wire T, and TB6 on the Main Circuit Board;
   MCB wire R, and CN14 pin 4 on the Main Circuit Board;
   MCB wire S, and CN14 pin 4 on the Main Circuit Board;
   MCB wire T, and CN14 pin 4 on the Main Circuit Board.

Input Diode Bridge (D1) Replacement Procedure

400 S 400 GMS 400 GTS

Refer to Figure 30.

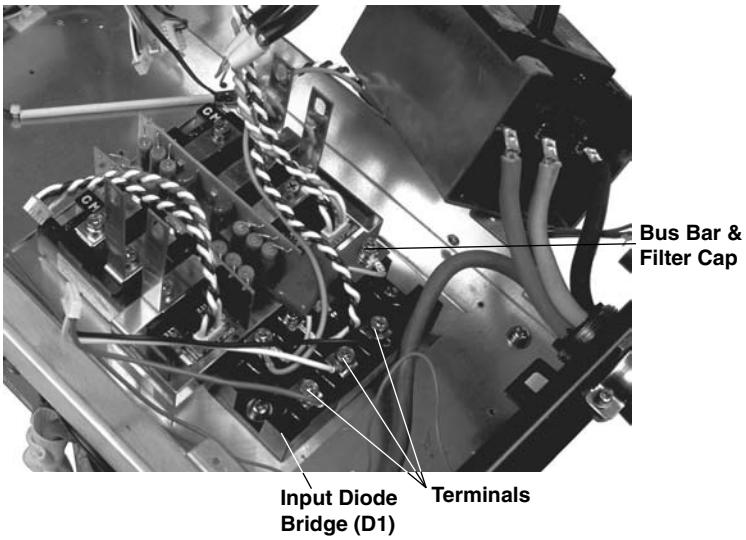


Figure 30. Input Diode Bridge (shown in GMS model)

To remove the Input Diode Bridge (D1), do the following:

1. Remove the Main Circuit Board (PCB1) per section 5.2.3.5, page 35.
2. Remove the input power and sensing lugged wires from the input terminals R and two RED, S and WHITE, T and BLACK.
3. Remove one screw from the corner bus bar/filter capacitor terminal, and another screw two terminals up on the same side at the bus bar/BLACK lugged wire that leads to plug CN14.
4. Remove the two screws that secure the Input Diode Bridge to the main chassis frame.
5. Slide the Bridge out from under the bus bar.

To replace the Input Diode Bridge (D1), do the following:

1. Spread a light coating of thermal compound on the bottom surface of the Bridge.
2. Slide the Bridge under the bus bar coming from the IGBT Inverter.
3. Reverse the remaining removal steps above. When replacing the screws that secure the Bridge to the chassis, make sure both screws are started before tightening them.

PCA IGBT Inverter Power OFF Test Procedure

400 S 400 GMS 400 GTS

The IGBT Inverter section contains two IGBT transistor/diode assemblies, Q1 and Q2. These can be tested with the power OFF to verify their proper function. If the results of this test do not indicate a fauly IGBT, perform the following test, “IGBT Inverter Power ON”.

Refer to figure 31.

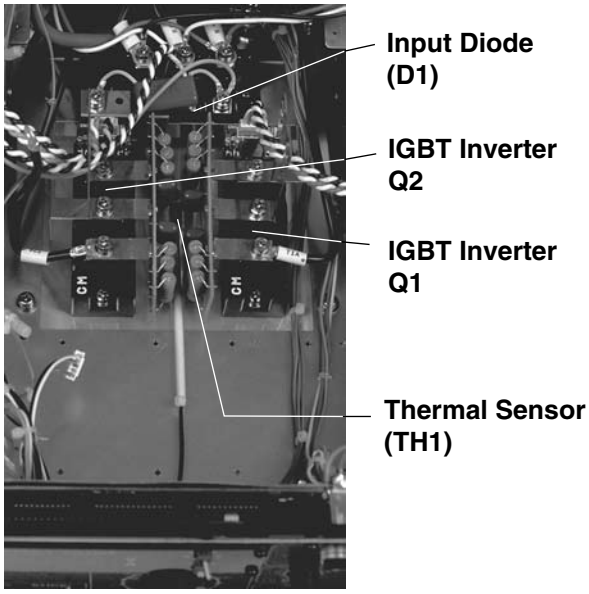


Figure 31. Power control assembly – IGBT inverter (shown in GMS model)

Power OFF Test Procedure

1. Set the diode test scale on the digital meter.
2. For Q1, check the diodes between:
   TB3 and TB1
   TB4 and TB1
3. For Q2, check the diodes between:
   TB5 and TB2
   TB6 and TB2
4. Select the Ohms scale on the digital meter.

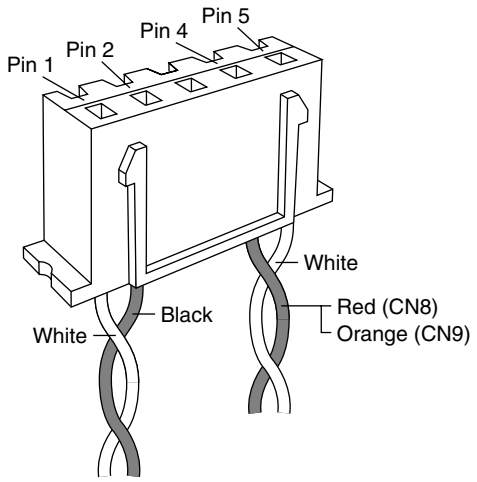


Figure 32. Plug orientation for IGBT inverter power OFF test

5. Remove connector plug CN8 from the Main Circuit Board.
6. For Q1, check that the resistance between the following points measures approximately 2.18KΩ:
   CN8 plug, pin 1 and pin 2
   CN8 plug, pin 4 and pin 5
7. Remove connector plug CN9 from the Main Circuit Board.
8. For Q2, check that the resistance between the following points measures approximately 2.18KΩ:
   CN9 plug, pin 1 and pin 2
   CN9 plug, pin 4 and pin 5

IGBT Inverters (Q1 and Q2) Replacement Procedure

400 S 400 GMS 400 GTS

Refer to Figure 33.

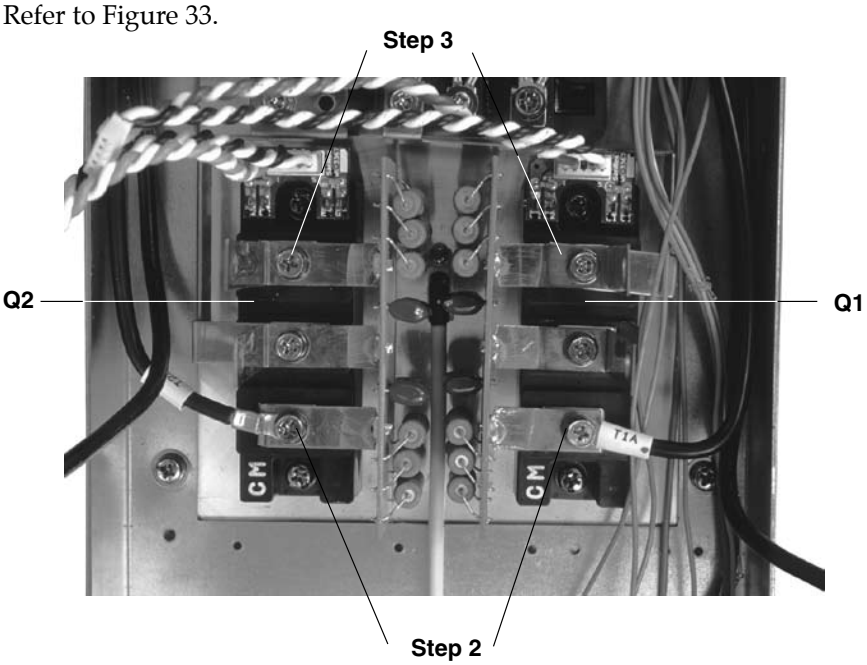


Figure 33. IGBT Inverters (shown in GMS model; Q1 on right)

To remove either of the IGBT Inverters (Q1 or Q2), do the following. Q1 is located on the right side of the unit, Q2 on the left, as you face the front panel of the power supply.

1. Remove the Main Circuit Board per section 5.2.3.5, page 35.
2. Remove the T1A or T2A heavy lugged lead, depending on which Inverter you are removing. Replace this screw if the printed circuit board is to remain with the IGBT Inverter being removed (PCB4 on Q1 or PCB5 on Q2).
3. Remove the screw from the terminal with the double bus bar. Again, replace this screw if the printed circuit board is to remain with the Inverter being removed (PCB4 on Q1 or PCB5 on Q2). Be sure the screw goes through only the hole in the bus bar connected to the printed circuit board (PCB4 or PCB5).
4. Remove the two (2) screws securing the Inverter to the main chassis frame.

To replace either Inverter (Q1 or Q2), do the following:

1. Spread a light coating of thermal compound on the bottom surface of the Inverter.
2. Slide the Inverter in place under the bus bar coming from the Input Diode Bridge.
3. Reverse the remaining removal steps above. When replacing the screws that secure the Inverter to the chassis, make sure both screws are started before tightening them.

PCA Output Diodes (D2 AND D3) Test Procedure

400 S | 400 GMS | 400 GTS

WARNING Disconnect primary power at the source before performing this procedure.

Refer to figure 34.

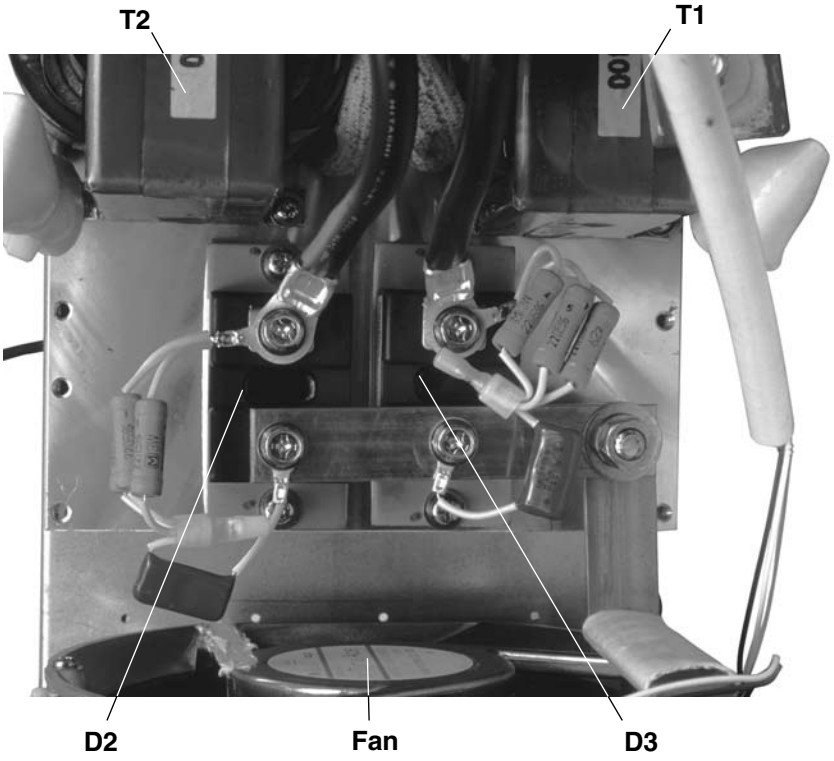


Figure 34. Power control assembly - output diodes (D2, D3) (S model shown; output inductor removed)

The output section contains two diodes, D2 and D3. Check each diode; the meter should read 0.140mV ±10%. The diodes can be checked either between their positive or negative terminals, or between the power supply POSITIVE (+) and NEGATIVE (-) OUTPUT TERMINALS.

Output Diodes (D2 and D3) Replacement Procedure

400 S 400 GMS 400 GTS

Refer to Figure 35.

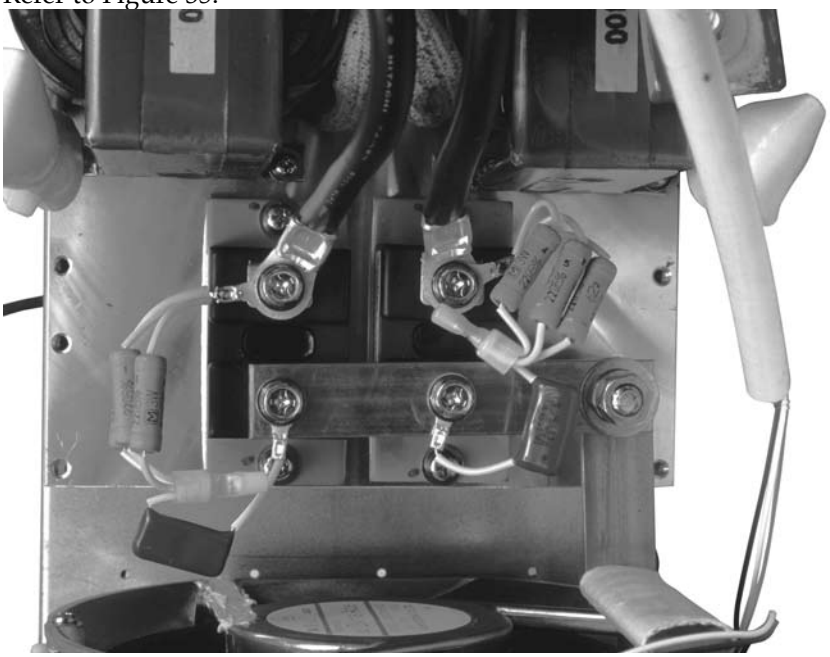


Figure 35. Output diodes D2 and D3

To remove the Output Diodes (D2 and D3), do the following:

1. Remove the Output Inductor, per procedure on page 61.
2. Remove the nut and associated hardware from the output bus bar that connects between the POSITIVE (+) OUTPUT TERMINAL and the D2-D3 bus bar.
3. Remove the two (2) screws that secure the D2-D3 bus bar to the Output Diode terminals.
4. Remove the two (2) screws from the large guage lugged wires from the Main Transformers and the associated R/C filter networks.
5. Remove the bus bar between the two Diodes.
6. Remove the two (2) screws that secure either Output Diode D2 or D3 to the main chassis frame.

To replace the Output Diodes (D2 and D3), do the following:

1. Spread a light coating of thermal compound on the bottom surface of the Diode Assembly.
2. Reverse the remaining removal steps above. When replacing the screws that secure the Diode(s) to the chassis, make sure both screws are started before tightening them.

PCA Thermal Sensor (TH1) Test Procedure

400 S 400 GMS 400 GTS

WARNING Disconnect primary power at the source before performing this procedure.

Refer to figure 36.

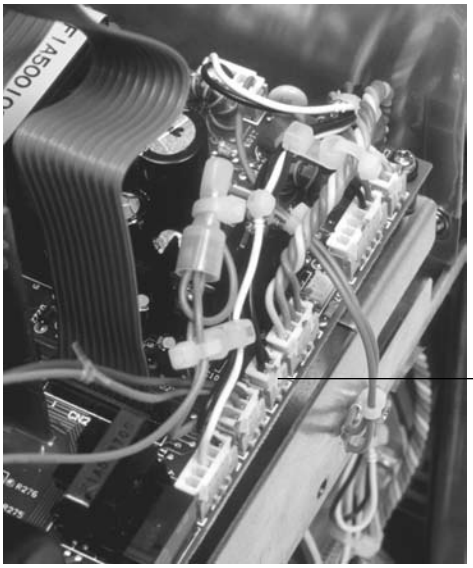


Figure 36. Power control assembly - thermal sensor (shown in GMS model)

1. Select the Ohms scale on the digital meter.
2. Disconnect the connector at CN10 on the Main Circuit Board (PCB1).
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.

Thermal Sensor (TH1) Replacement

400 S | 400 GMS | 400 GTS

Refer to Figure 37.

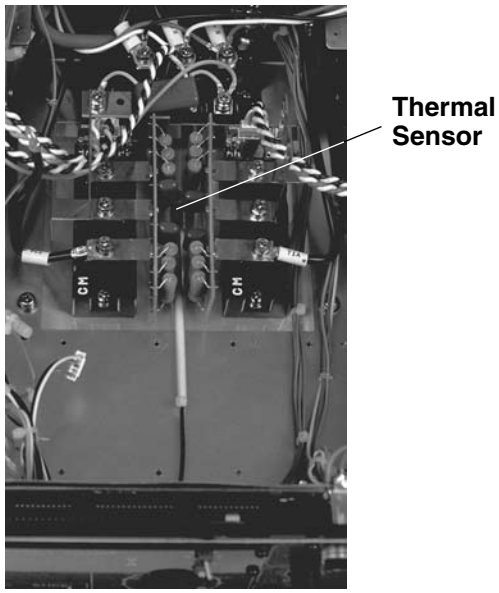


Figure 37. Location of thermal sensor (TH1)

To remove the Thermal Sensor (TH1), do the following:

1. Remove the Main Circuit Board per section 5.2.3.5, page 35.
2. Locate the sensor mounted on the main chassis, between the circuit boards (PCB4 and PCB5) that connect to the IGBT Inverters.
3. Using a magnetic or split screwdriver, remove the screw that secures the sensor to the chassis frame.
4. Cut cable ties as appropriate to free the BLACK/BLACK wire harness that connects the Thermal Sensor to connector CN10 plug.

To replace the Thermal Sensor (TH1), do the following:

1. Spread a light coating of thermal compound on the bottom surface of the Thermal Sensor.
2. Reverse the removal steps above.

Auxiliary Transformer (T3) Test Procedure

400 GMS

The Auxiliary transformer can be checked with either a power OFF or power ON test. Do the power OFF test first.

Locate the auxiliary transformer in the bottom front of the power supply.

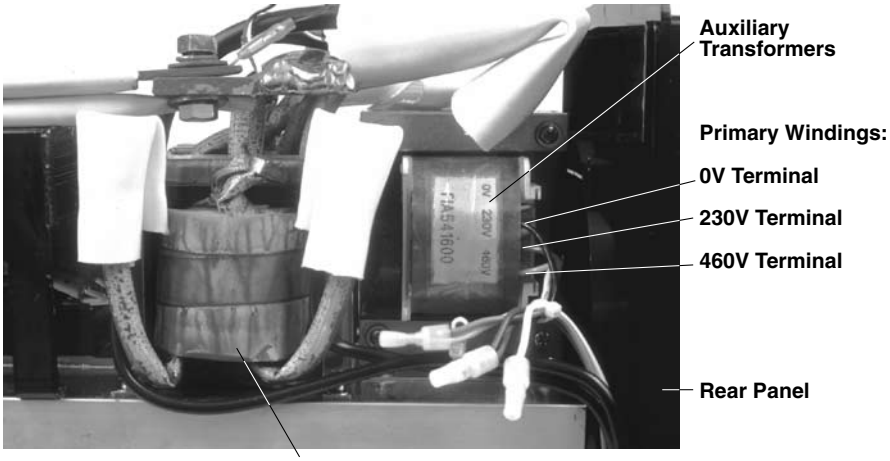


Figure 38. Auxiliary transformer primary winding (shown in GMS model)

Power OFF Test

WARNING Disconnect primary power at the source before performing this procedure.

1. Select the Ohms scale on the digital meter.
2. With the MAIN CIRCUIT BREAKER ON, verify continuity between LINE1 on the MCB and CN19 pin 3 on PCB1-1.
3. Measure the primary winding resistance between LINE 2 on the MCB and CN19 pin 1 to be 7.4Ω (208-230V) or pin 5 (460V) to be 21.8Ω.

If there is no continuity, or the resistance measurement yields an open, replace the auxiliary transformer T3.

400 GMS

1. Select the Ohms scale on the digital meter.
2. Measure the resistance between following pairs of terminals on the auxiliary transformer. If any shorted or open readings are obtained or, if the readings do not match the specified values, replace the transformer.

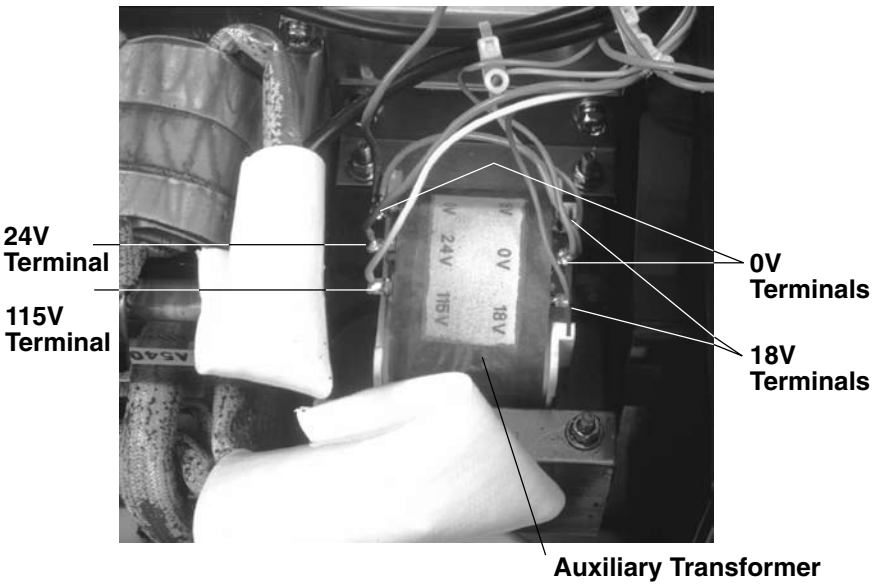


Figure 39. Auxiliary transformer secondary winding (shown in GMS model)

Primary:
Measure 21.2Ω between the 0V and 460V terminals.
Measure 7.4Ω between the 0V and 230V terminals.
Measure 14.1Ω between the 230V and 460V terminals.

Secondary:
Measure 0.2Ω between the 0V and 24V terminals.
Measure 2.2Ω between the 0V and 115V terminals.
Measure 1.0Ω between the 0V and either 18V terminal.
Measure 2.0Ω between the 18V terminals.

Power ON Test

400 GMS

WARNING Dangerous voltage and power levels are present inside this unit. Be sure the operator is equipped with proper gloves, clothing, 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.

Verify voltages on secondary windings of auxiliary transformer T3. With the unit ON, verify the voltages as shown below. Refer to figure 40.

Measure 24VAC between the 0V and 24V terminals.
Measure 115VAC between the 0V and 115V terminals.
Measure 18VAC between the 0V and either 18V terminal.
Measure 36VAC between the 18V terminals.

Auxiliary Transformer (T3) Replacement

400 GMS

Refer to Figures 40 and 41.

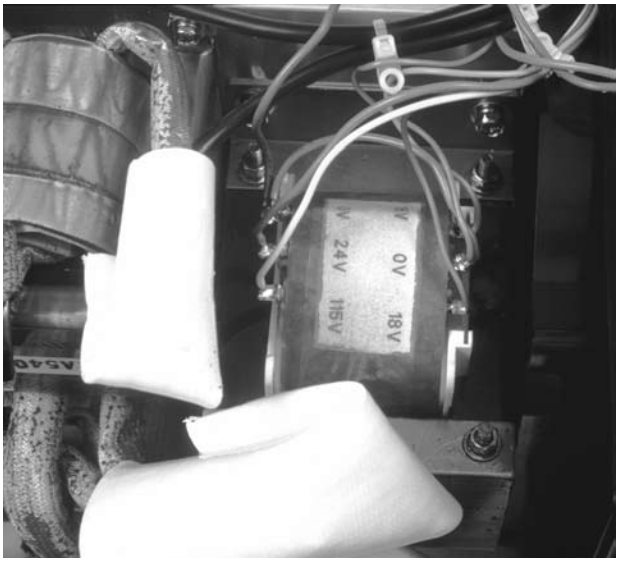


Figure 40. Auxiliary Transformer secondaries (shown in GMS model; right side of unit)

To remove the Auxiliary Transformer (T3), do the following:

1. Unsolder the wires from the six (6) secondary winding terminals.

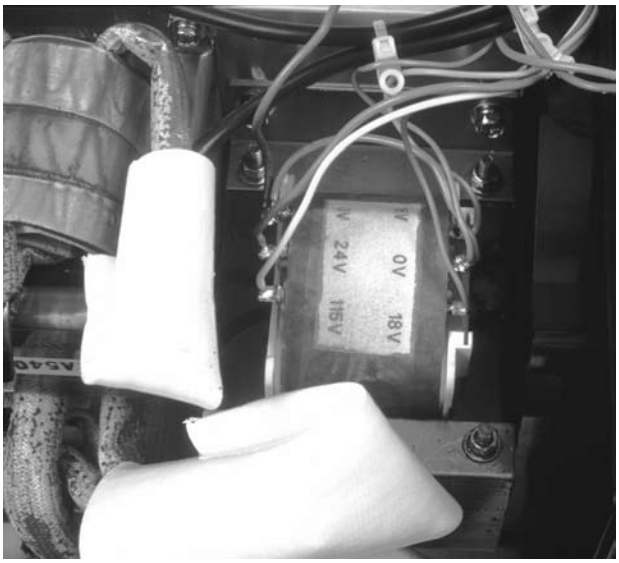


Figure 41. Auxiliary Transformer primaries (left side of unit)

2. Cut the primary leads as close as possible to the wire crimps.
3. Remove the four (4) screws securing the auxiliary Transformer to the Power Control Assembly heat sink.

To replace the auxiliary Transformer (T3), reverse the removal steps above, resoldering the secondary leads and replacing the wire crimps on the primary leads.

Main Transformer Assembly (T1 and T2) Test Procedure

400 S | 400 GMS | 400 GTS

WARNING Disconnect primary power at the source before performing this procedure.

Inspect the primary winding wires on both Main Transformers for breaks in the insulation, signs of overheating or loose connections.

Check for continuity across the primary windings of both transformers. To do this, do the following:

1. Remove the lugged leads from TB1 and TB2.
2. To test the primary of T1, measure the continuity between Main Circuit Board connector CN8 pin 2 and the lugged transformer lead removed from TB1.
3. To test the primary of T2, measure the continuity between Main Circuit Board connector CN9 pin 2 and the lugged transformer lead removed from TB2.

400 GMS

The secondaries of T1 and T2 cannot be isolated. To test the parallel combination of secondaries:

4. Measure the continuity between the connector CN7 pin 3 and CN5 pin 3.

Replace the Main Transformer/Inductor Assembly if no continuity is found in any of the windings or if there is evidence of overheating.

Main Transformer (T1 and T2) Assembly Replacement Procedure

400 S 400 GMS 400 GTS

Refer to figures 42 and 43.

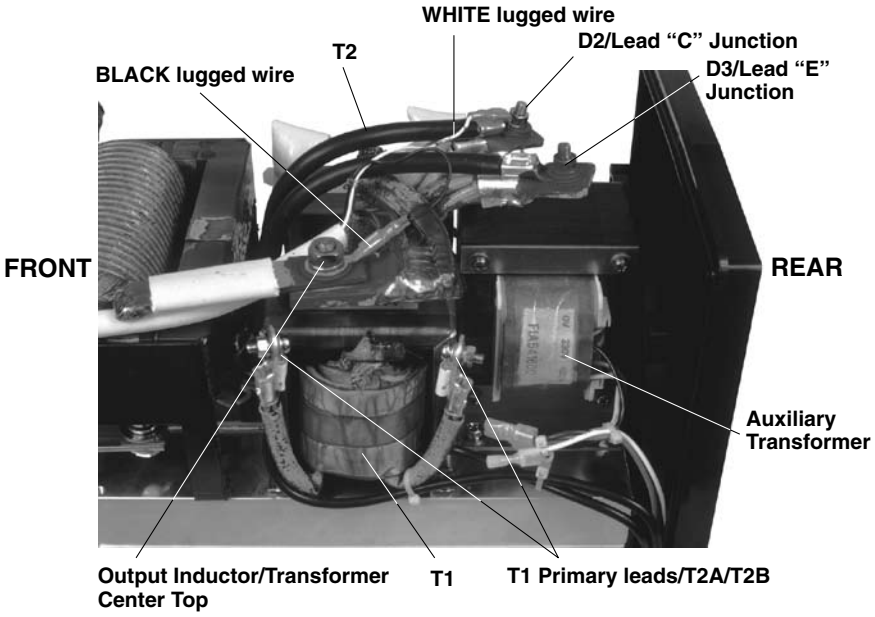


Figure 42. Preparation for removal of Main Transformers T1/T2 (shown in GMS model, with insulating boots removed from T1 leads; left side of unit)

To remove the main transformer assembly (T1 and T2):

1. Turn the power supply over so that the transformers are on top.
2. Cut cable ties and remove rubber insulating sleeves from T1 and T2 primary and secondary leads.
3. Remove bolt and associated hardware from Output Inductor/T1/T2 center tap bus bar. Note the BLACK lugged wire connection for replacement.
4. Remove bolt and associated hardware from T1/T2 secondary (lead "C")/D2 anode junction. Note the WHITE lugged wire connection for replacement.

5. Remove bolt and associated hardware from T1/T2 secondary (lead "E")/D3 anode junction.
6. Remove hardware securing TB2 and T2A lugged leads to T2 transformer primary leads. Repeat for TB1 and T1A lugged leads on transformer T1 primary leads.

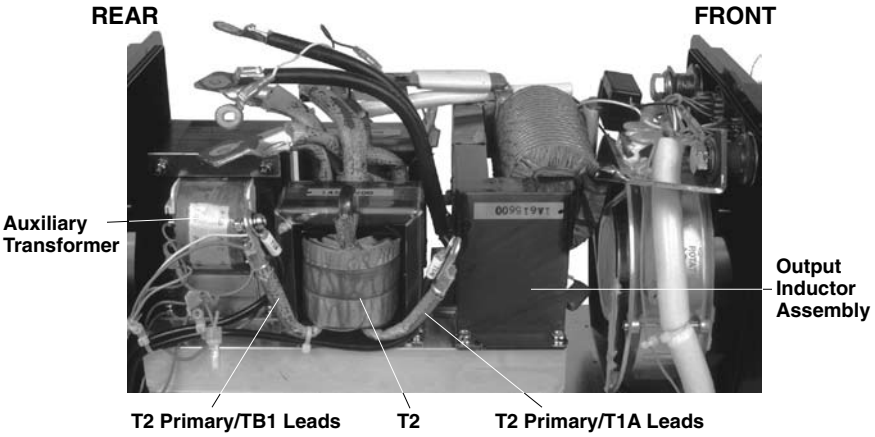


Figure 43. Preparation for removal of Main Transformers T1/T2 (shown in GMS model, right side of unit)

7. Cut cable ties securing T1A, TB2 and TB1 leads to T1 and T2 primary leads.
8. Remove eight (8) screws total from four corners of both transformers and remove the T1/T2 assembly.

To replace the Main Transformer Assembly (T1 and T2), reverse the removal steps.

Output Inductor Test Procedure

400 S 400 GMS 400 GTS

1. Inspect the Output Inductor for signs of overheating or loose connections.
2. Check for continuity through the Inductor by measuring between CN5 pin 3 and the NEGATIVE (-) OUTPUT TERMINAL.

Replace the Output Inductor Assembly if there is no continuity or if there is evidence of overheating.

Output Inductor Assembly Replacement Procedure

400 S 400 GMS 400 GTS

Refer to figures 44, 45 and 46.

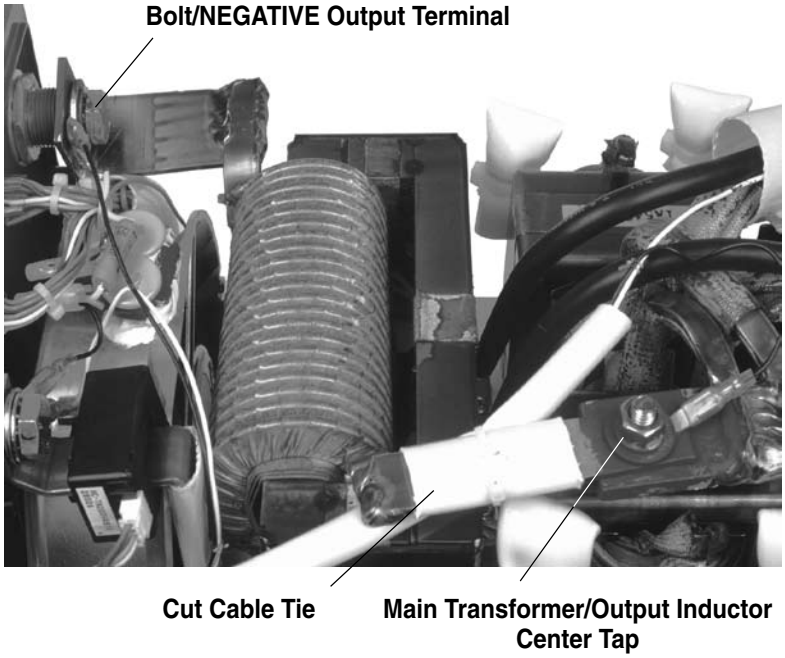


Figure 44. Output inductor assembly removal – initial steps (shown in GMS model)

400 S 400 GMS

To remove the Output Inductor Assembly:

1. Remove the bolt and hardware from the inside of the NEGATIVE (-) OUTPUT TERMINAL.
2. Remove the nut and hardware from the Main Transformer center tap/Output Inductor junction.
3. Cut the cable tie securing the BLACK/WHITE wire harness to the Output Inductor input lead.
4. Remove the three (3) screws that secure the frame of the Output Inductor Assembly to the main chassis frame.
5. Pull the Output Inductor Assembly out of power supply.

400 GTS

To remove the Output Inductor Assembly:

1. Remove the three (3) bolts and hardware from 1) the inside of the NEGATIVE (-) OUTPUT TERMINAL; 2) the TIG TORCH NEGATIVE OUTPUT TERMINAL bus bar and 3) Output Inductor/Main Transformer center tap junction.

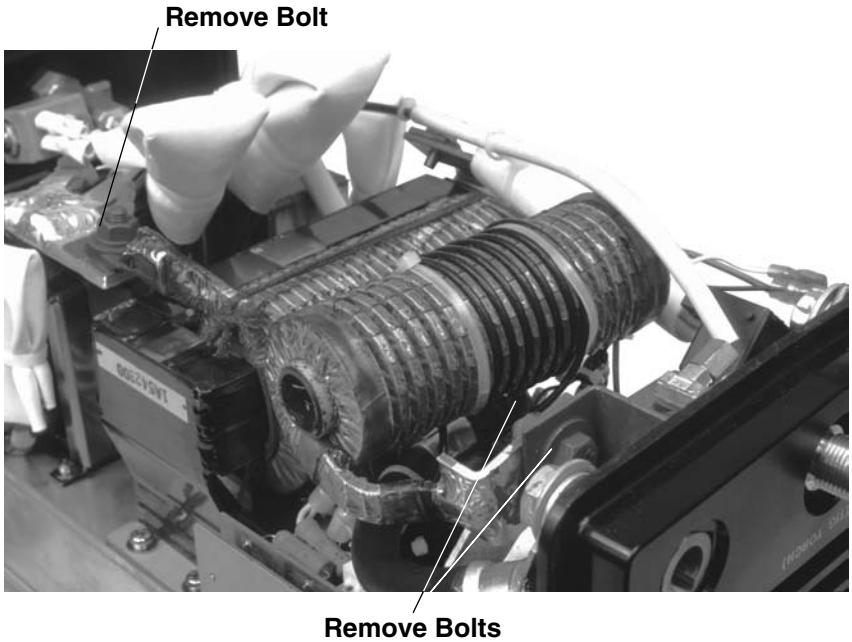


Figure 45. Output inductor assembly removal – initial steps (shown in GTS model)

2. Cut the cable tie securing the wire harness insulating sleeve to the Output Inductor frame on the right side of the unit. Cut the cable ties securing the wiring harnesses to the large black lugged lead attached to the NEGATIVE (-) OUTPUT TERMINAL.

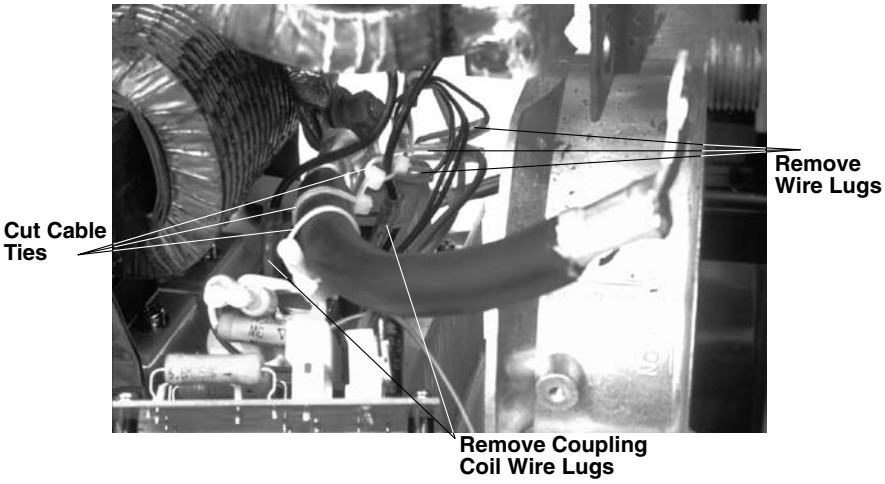


Figure 46. Output inductor assembly removal –– lugged wires to be removed from terminals on HF Unit and related areas (shown in GTS model)

3. Remove the Coupling Coil lugged leads from the HF Unit terminals. Remove the three (3) lugged leads from their lugs at the Output Inductor/Main Transformer center tap junction.

4. Remove the three (3) screws that secure the frame of the Output Inductor Assembly to the main chassis frame.
5. Pull the Output Inductor Assembly out of power supply.

To replace the Output Inductor Assembly, reverse the removal steps above.

5.2.6 Fan Assembly Replacement Procedure

400 S 400 GMS 400 GTS

Refer to figures 47 and 48.

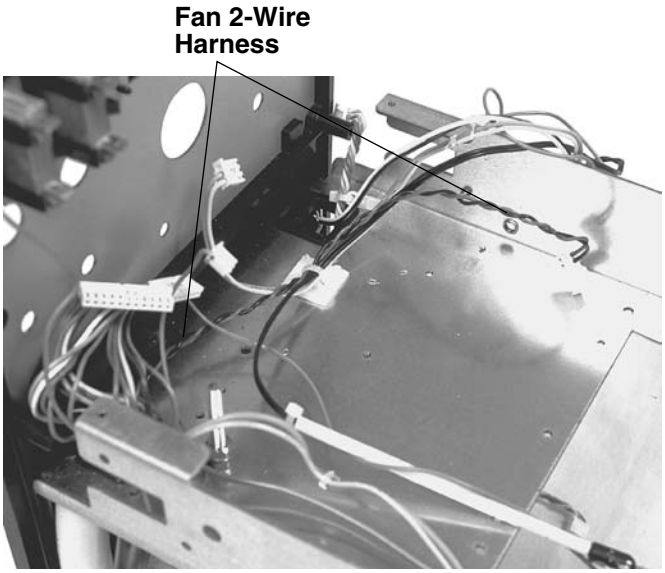


Figure 47. Fan RED/BLACK wiring harness (shown in GMS model, with Main Circuit Board removed)

To remove fan:

1. Remove the Main Circuit Board.
2. Cut the cable tie to free the RED/BLACK twisted wire pair that connects to the fan.
3. Pull the wire pair through the hole in the chassis to free them from the unit.
4. Cut the cable ties securing wiring harnesses to the fan retaining screws.
5. Pry the output filter network components off of the fan housing so the fan can be removed.
6. Remove the two screws securing the fan to the front panel assembly.
7. Lay the power supply on its left side. Remove the fan from the right side of the unit, past the wire harness from the front panel 14- and 17-pin receptacles.

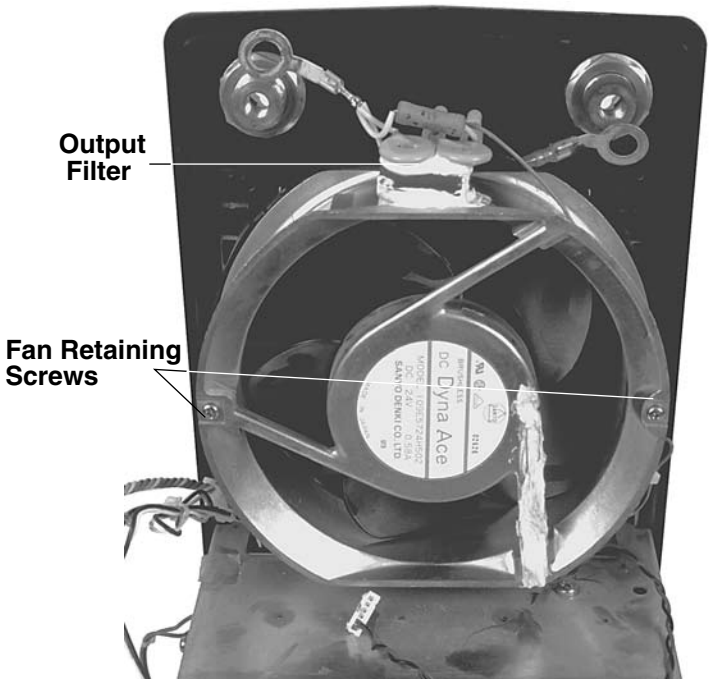


Figure 48. Fan housing, retaining screws and output filter network (shown in GMS model with Power Control Assembly removed for clarity)

To replace the fan reverse the removal steps above. Be sure to reattach the output filter network components to the fan housing with thermally conductive silicone.

5.2.7 HF Unit Test and Replacement Procedures

400 GTS

HF Unit Test Procedure

1. Place the PROCESS SELECTOR Switch in the STICK position.
2. Jumper pins 1 and 5 on the CN7 plug. Apply power to the unit.
3. If the high frequency buzz is heard coming from the HF Unit, the Main Circuit Board (PCB1) should be replaced. If no sound is heard coming from the HF Unit, the HF Unit should be replaced.

HF Unit Replacement Procedure

To remove the HF Unit:

1. Remove the Output Inductor Assembly, per procedure on page 61.
2. Remove the lugged wires from the AC1 and AC2 terminals.
3. Remove the output filter network from the side of the HF Unit.
4. Remove the two (2) screws that secure the HF Unit to the chassis.

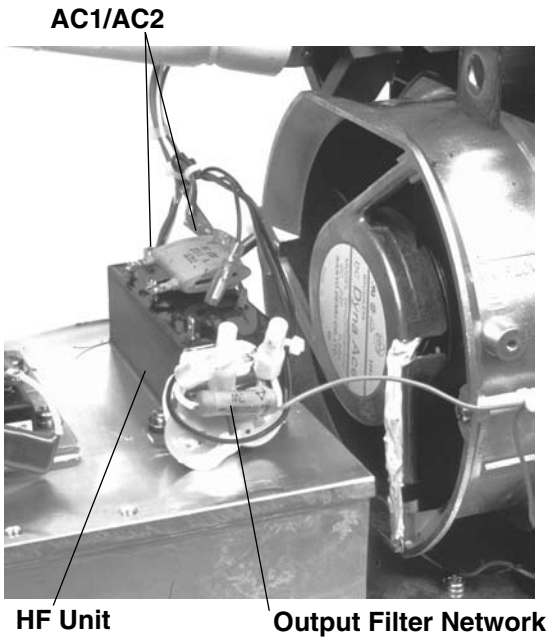


Figure 49. HF Unit replacement

To replace the HF Unit:

1. Apply a liberal amount of thermally-conductive grease to the bottom of the new HF Unit.
2. Hold the new HF Unit against the chassis while you replace the two screws that hold the HF Unit onto the chassis. Be sure to orient the new HF Unit in a similar manner to the one just removed, with the AC1/AC2 terminals and resistor R1 toward the left side of the unit.
3. Reverse the remaining removal steps.

5.2.8 HF Coupling Coil Test and Replacement Procedures

400 GTS

HF Coupling Coil Test Procedure

1. Visually inspect coil for overheating or other damage.
2. Check connections of coil wires on HF Unit terminals CC1 and CC2.
3. Verify continuity through the coil.

Replace the HF Coupling Coil if damaged on continuity is broken.

HF Coupling Coil Replacement Procedure

Refer to figure 50.

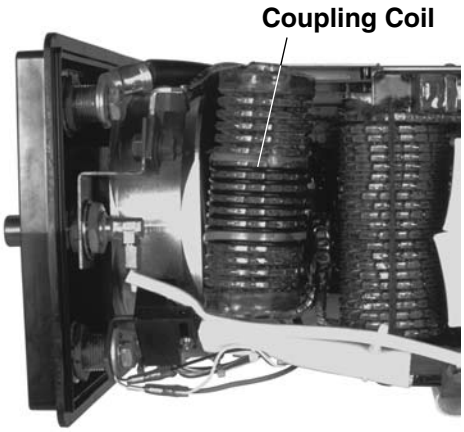


Figure 50. HF coupling coil location

To remove the HF Coupling Coil secondary:

1. Cut the cable ties that secure the Coupling Coil windings onto the Output Inductor Assembly, and to any other structure.
2. Remove the lugged ends of the Coupling Coil from the HF Unit terminals.
3. Unwrap the BLACK coupling wires from the Output Inductor Assembly.

To remove the entire Coupling Coil, remove the Output Inductor Assembly, per procedure on page 61.

To replace the HF Coupling Coil secondary:

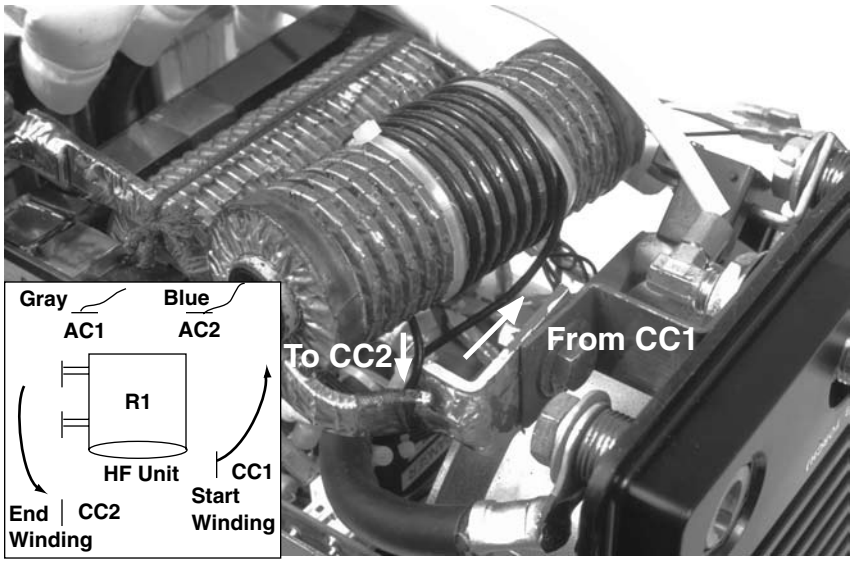


Figure 51. HF coupling coil winding onto Output Inductor Assembly

1. Connect one end of the new Coupling Coil wire to the HF Unit terminal closest to the front of the unit.
2. Referring to figure 51, wind six (6) full turns onto the Output Inductor Assembly in the direction shown in figure 51 (counter clockwise as you look at the Output Inductor Assembly from the right side of the unit).
3. Connect the other end of the Coupling Coil wire to the remaining HF Unit terminal.

To replace the entire Coupling Coil, refer to the Output Inductor Assembly procedure on page 61.

5.2.9 Gas Solenoid Valve Replacement Procedure

400 GTS

Refer to figure 52.

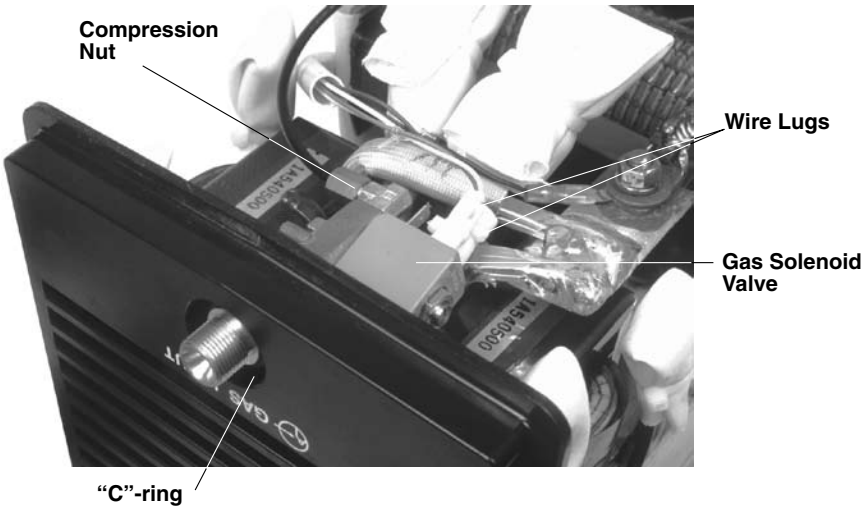


Figure 52. Gas solenoid valve

To remove the gas solenoid valve:

1. Remove the YELLOW/VIOLET wires from the lugs on the solenoid valve.
2. Remove the compression nut securing the BLACK gas line to the solenoid valve.
3. Remove the "C" retaining ring from the gas input fitting on the exterior of the Rear Panel.
4. Remove the gas solenoid valve from the unit.

To replace the gas solenoid valve, reverse the above steps.

5.3 Sequence Timing Diagrams

5.3.1 S Models

Lift TIG Mode

Figure 53 shows the LIFT TIG timing waveforms of the S model power supplies.

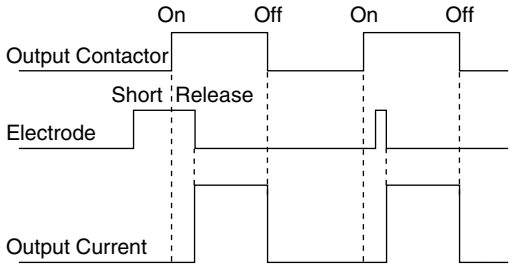


Figure 53. S Model LIFT TIG mode timing

5.3.2 GMS Models

Lift TIG Mode

Figure 54 shows the LIFT TIG timing waveforms of the GMS model power supplies.

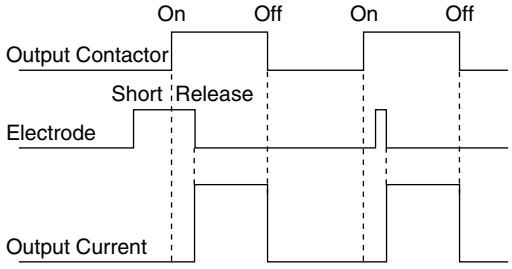


Figure 54. GMS Model LIFT TIG mode timing

5.3.3 GTS Models

HF TIG Mode

Figure 55 shows the HF TIG timing waveforms of the GTS models with the SLOPE control ON and OFF.

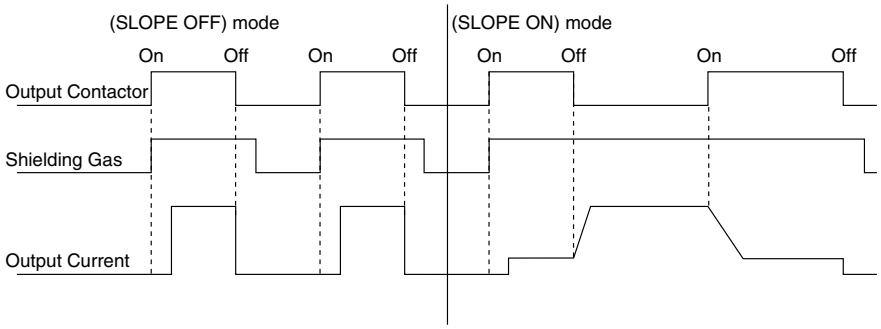


Figure 55. GTS Model HF TIG mode timing

Lift TIG Mode

Figure 56 shows the LIFT TIG timing waveforms of the GTS models with the SLOPE control ON and OFF.

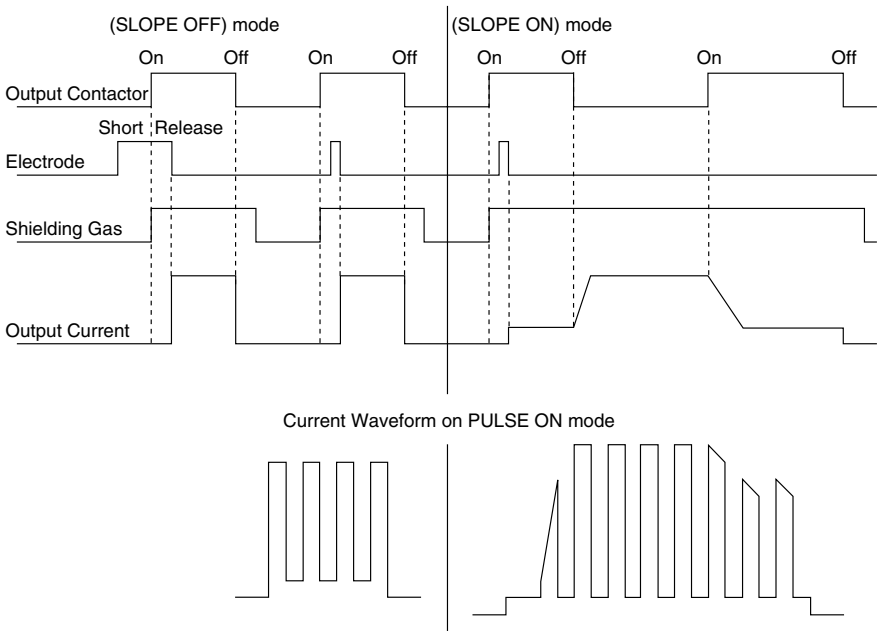


Figure 56. GTS model LIFT TIG mode timing

SPOT Mode

Figure 57 shows the SPOT timing waveforms of the GTS models with the SLOPE control OFF and ON. The GTS should be set to operate in the HF TIG mode.

use only HF TIG mode

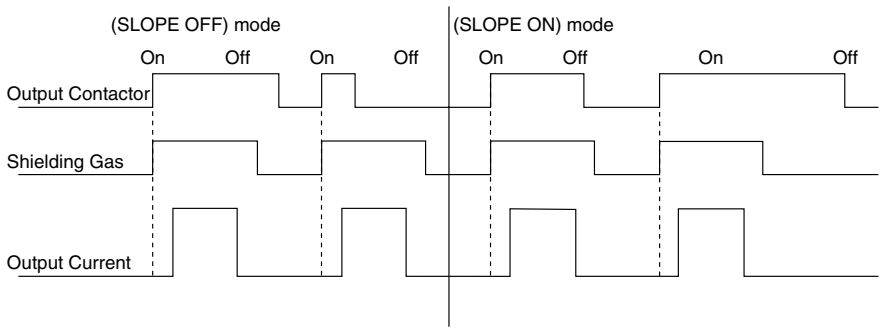


Figure 57. GTS model SPOT/HF TIG mode timing

6.0 PARTS LISTS

The parts lists provide a breakdown of all replaceable components in the 400 Series S, GMS and GTS model power supplies. Order replacement parts by catalog number and complete description of the part or assembly, as listed in the parts list. Address all inquiries to your authorized Thermal Dynamics distributor.

If a Thermal Dynamics product must be returned for service, contact your Thermal Arc distributor. Materials returned to Thermal Dynamics without proper authorization will not be accepted.

6.1 Complete Systems

Complete systems include: Power Supply with primary power cable, two male plugs, and Operating Manual.

Catalog #	Description
10-3015	400S 230/460VAC Three-Phase/Single-Phase
10-3034	400S 380VAC Three-Phase
10-3017	400S 460/575VAC Three-Phase
10-3021	400GMS 230/460VAC Three-Phase/Single-Phase
10-3022	400GMS 380VAC Three-Phase
10-3023	400GMS 460/575VAC Three-Phase
10-3018	400GTS 230/460VAC Three-Phase/Single-Phase
10-3035	400GTS 380VAC Three-Phase
10-3020	400GTS 460/575VAC Three-Phase

Parts List – 400S

DESCRIPTION	ITEM	460	E 380	575	CE 380
ACRYLIC BOARD	-	-	10-5424	-	10-5424
BUS BAR A	-	10-5412	10-5412	10-5412	10-5412
BUS BAR B	-	10-5413	10-5413	10-5413	10-5413
BUS BAR C	-	10-5414	10-5414	10-5414	10-5414
BUS BAR D	-	10-5417	10-5417	10-5417	10-5417
CABLE CONNECTOR; MALE	-	10-5226	10-5226	10-5226	10-5226
CAPACITOR	C2,C3,C5	10-5171	10-5171	-	-
CAPACITOR; 0.1 µF	C1	10-2270	10-2270	10-2270	10-2270
CAPACITOR; .01µF	C2,C3,C6,C7	10-5174	10-5174	10-5174	10-5174
CAPACITOR; 1KVDC .068 µF	C4,C8	10-5013	10-5013	10-5013	10-5013
CAPACITOR; .01 µF	C6,C7	10-2219	10-2219	10-2219	10-2219
CAPACITOR	C5	10-5014	10-5014	10-5014	10-5014
CASE HALF	-	10-5461	10-5461	10-5461	10-5461
CAUTION LABEL 2	-	10-5496	10-5496	10-5496	10-5496
CAUTION LABEL 3	-	10-5497	10-5497	10-5497	10-5497
CHASSIS	-	10-5482	10-5482	10-5482	10-5482
CIRCUIT BREAKER; MAIN					
2 POLE	MCB1	10-5078	10-5078	10-5079	-
3 POLE	MCB1	10-5224	10-5224	9-1076	10-5224
CORD CONNECTOR	-	10-5258	10-5257	10-5257	10-5257
CURRENT TRANSFOMER	CT1	10-5164	-	-	-
CURRENT TRANSFORMER	CT1	10-5003	10-5003	10-5003	10-5003
D.P.M.	PCB7	10-5126	10-5126	10-5126	10-5126
DIODE	D2,D3	10-5089	10-5089	10-5089	10-5089
DIODE	D4	-	-	10-2264	-
DIODE+THYRISTOR	D1	10-2653	10-5088	10-5088	10-5088
FAN	FAN1	10-5092	10-5092	10-5092	10-5092
FERRITE RING	L1	10-2290	10-2290	10-2290	10-2290
FILTER, PCB (EUROPE)	PCB101	-	-	-	10-5517
FLAT CABLE					
11 PIN FOR PANEL PCB	-	10-5236	10-5236	10-5236	10-5236
12 PIN FOR PANEL PCB	-	10-5235	10-5235	10-5235	10-5235
15 PIN FOR FRONT PANEL	-	10-5234	10-5234	10-5234	10-5234
FRONT FRAME	-	10-5463	10-5463	10-5463	10-5463
FRONT PANEL					
230/460 FRAME	-	10-5551	-	-	-
380-415-CE FRAME	-	-	-	-	10-5348
460/575 FRAME	-	-	-	10-5551	-
FRONT PANEL; UPPER					
230/460 2P SWITCH	-	10-5370	-	-	-
380-415-CE 2P SWITCH	-	-	-	-	10-5373
460/575 2P SWITCH	-	-	-	10-5371	-
FRONT PANEL; UPPER (2 POLE MODE)	-	10-5492	10-5492	10-5492	10-5492

DESCRIPTION	ITEM	460	E 380	575	CE 380
HEAT SINK	-	10-5458	10-5458	10-5458	10-5458
HOLDER	-	10-5249	10-5249	10-5249	10-5249
INVERTER; IGBT	Q1,Q2	-	-	10-5085	-
INVERTER; IGBT	Q1,Q2	-	-	10-5086	-
INVERTER; IGBT	Q1,Q2	-	-	10-5087	-
INVERTER; IGBT	Q1,Q2	-	9-1081	9-1081	-
INVERTER; IGBT, 600V 100A	Q1,Q2	10-5082	10-5082	10-5082	10-5082
INVERTER; IGBT, 600V 100A	Q1,Q2	10-5083	10-5083	10-5083	10-5083
INVERTER; IGBT, 600V 100A	Q1,Q2	10-5084	10-5084	10-5084	10-5084
INDUCTOR, OUTPUT	FCH	10-5154	10-5154	10-5154	10-5154
INPUT CABLE	-	-	10-5239	-	10-5239
INPUT TERMINAL	T1	10-5130	10-5129	10-5128	10-5129
INSULATION SHEET	-	-	-	10-5431	-
INSULATION SHEET; T1,2	-	10-5446	10-5446	10-5446	-
INVERTER TRANSFORMER	T4	-	-	10-5476	-
KNOB, LARGE, POTENTIOMETER	-	10-5233	10-5233	10-5233	10-5233
KNOB, SMALL POTENTIOMETER	-	10-5232	10-5232	10-5232	10-5232
LINE FILTER	L106,L107	-	-	-	10-5176
LINE FILTER	L104	-	-	-	10-5229
LINE FILTER	L102,L103	-	-	-	10-5230
LINE FILTER	L104,L105	-	-	-	10-5231
MAIN TRANSFORMER	T1,T2	10-5152	10-5467	10-5468	10-5467
MAIN TRANSFORMER	T1,T2	10-5153	10-5472	-	10-5472
MCB METAL SHIELD	-	10-5484	10-5484	10-5484	10-5488
NF INSULATION SHEET	-	-	-	-	10-5448
OUT BUS BAR 3	-	10-5426	10-5426	10-5426	10-5426
OUTPUT TERMINAL; FEMALE	-	10-5131	10-5131	10-5131	10-5131
PACKING BOX	-	10-5452	10-5452	10-5452	10-5452
PANEL 1	-	10-5491	10-5491	10-5491	10-5491
PCB SHEET	-	10-5419	10-5419	10-5419	10-5419
PLUG, 8-PIN; REMOTE					
BODY	-	10-5000	10-5000	10-5000	10-5000
CLAMP	-	10-5001	10-5001	10-5001	10-5001
PIN	-	10-5002	10-5002	10-5002	10-5002
POTENTIOMETER AMP\HOT\PULSE	-	10-5056	10-5056	10-5056	10-5056
POTENTIOMETER ARC TRIM	-	10-5221	10-5221	10-5221	10-5221
PROTECTION BAR	-	10-5443	10-5443	10-5443	10-5443
Q BUS BAR D	-	10-5415	10-5415	10-5415	10-5415

DESCRIPTION	ITEM	460	E 380	575	CE 380
REAR FRAME	-	10-5466	10-5466	10-5466	10-5466
REAR PANEL					
230/460 FRAME	-	10-5394	-	-	-
380-415-CE FRAME	-	-	-	-	10-5397
460/575 FRAME	-	-	-	10-5395	-
REAR PANEL WITHOUT EA53	-	-	10-5486	10-5486	-
REAR UPPER PANEL					
230/460 2P CB	-	10-5538	-	-	-
380-415-CE 2P CB	-	-	-	-	10-5541
460/575 2P CB	-	-	-	10-5539	-
REAR UPPER PANEL (3 POLE CB)	-	-	-	-	10-5489
RECEPTACLE, 8 PIN AMP	CON1	10-5023	10-5023	10-5023	10-5023
RESISTOR; 3 WATT 22 OHM	R2,R3	10-2713	10-2713	-	-
RESISTOR; 3 WATT 22 OHM	R2,R3	10-2213	10-2213	10-2213	10-2213
RESISTOR; 3 WATT 4.7K	R3,R7	10-5010	10-5010	10-5010	10-5010
RUBBER	-	-	10-5408	10-5408	10-5408
RUBBER FOOT	-	10-5411	10-5411	10-5411	10-5411
SIDE LABEL	-	10-5498	10-5498	10-5498	10-5498
SLIDE SWITCH	S2	10-5222	-	-	-
SPACER	-	10-5250	10-5250	10-5250	10-5250
SPACER	-	10-5253	10-5253	10-5253	10-5253
STYRENE FOAM	-	10-5459	10-5459	10-5459	10-5459
THERMISTOR	TH1	10-5228	10-5228	10-5228	10-5228
WK-3366 S01	PCB4,PCB5	-	-	10-5122	-
WK-3366 SNUBBER	PCB4,PCB5	10-5121	10-5121	10-5121	10-5121
WK-3367 IGBT GATE	PCB2,PCB3	10-5120	10-5120	10-5120	10-5120
WK-3369 STICK PANEL	PCB6	10-5503	10-5503	10-5503	10-5503
WK-3390	PCB8	10-5127	-	10-5127	-
WK-3448 S05 MAIN PCB 3P CB	PCB1	10-5511	-	-	-
WK-3448 S06 MAIN PCB 3P CB	PCB1	-	10-5512	-	10-5512
WK-3448 S07 MAIN PCB 3P CB	PCB1	-	-	10-5513	-

Parts List – 400GMS

DESCRIPTION	ITEM	460	E 380	575	CE 380
ACRYLIC BOARD	-	10-5424	10-5424	10-5424	10-5424
BUS BAR A	-	10-5412	10-5412	10-5412	10-5412
BUS BAR B	-	10-5413	10-5413	10-5413	10-5413
BUS BAR C	-	10-5414	10-5414	10-5414	10-5414
BUS BAR D	-	10-5441	10-5441	10-5441	10-5441
CABLE CONNECTOR; MALE	-	10-5226	10-5226	10-5226	10-5226
CAPACITOR; 0.1µF	C1	10-2270	10-2270	10-2270	10-2270
CAPACITOR; 1KVDC .068 µF	C4,8	10-5013	10-5013	10-5013	10-5013
CAPACITOR; .01 µF	C6,7	10-2219	10-2219	10-2219	10-2219
CAPACITOR	C5	10-5014	10-5014	10-5014	10-5014
CASE HALF		10-5461	10-5461	10-5461	10-5461
CAUTION LABEL 2		10-5496	10-5496	10-5496	10-5496
CAUTION LABEL 3		10-5497	10-5497	10-5497	10-5497
CHASSIS		10-5482	10-5482	10-5482	10-5482
CIRCUIT BREAKER	MCB3	10-2234	10-2234	10-2234	10-2234
CIRCUIT BREAKER	MCB2	10-2235	10-2235	10-2235	10-2235
CIRCUIT BREAKER; MAIN					
2 POLE	MCB1	10-5078	10-5078	10-5079	-
3 POLE	MCB1	10-5224	10-5224	9-1076	10-5224
CORD CONNECTOR	-	-	10-5257	-	10-5257
CORD CONNECTOR	-	10-5258	-	-	-
CURRENT TRANSFORMER	CT1	10-5003	10-5003	10-5003	10-5003
D.P.M.	PCB7	10-5126	10-5126	10-5126	10-5126
DIODE	D4	-	-	10-2264	-
DIODE	D2,D3	10-5089	10-5089	10-5089	10-5089
DIODE+THYRISTOR	D1	10-2653	10-5088	10-5088	10-5088
DUST COVER, 14 & 17 PIN	-	10-5225	10-5225	10-5225	10-5225
FAN; 24VDC	FAN1	10-5092	10-5092	10-5092	10-5092
FERRITE RING	L1	10-2290	10-2290	10-2290	10-2290
FILTER PCB (EUROPE)	PCB101	-	-	-	10-5517
FLAT CABLE					
11 PIN FOR PANEL PCB	-	10-5236	10-5236	10-5236	10-5236
12 PIN FOR PANEL PCB	-	10-5235	10-5235	10-5235	10-5235
15 PIN FOR FRONT PANEL	-	10-5234	10-5234	10-5234	10-5234
FRONT FRAME	-	10-5464	10-5464	10-5464	10-5464
FRONT PANEL					
230/460 FRAME	-	10-5353	-	-	-
80-415-CE FRAME	-	-	-	-	10-5356
460/575 FRAME	-	-	-	10-5354	-
FRONT PANEL; UPPER	-	10-5494	10-5494	10-5494	10-5494
FRONT PANEL; UPPER					
230/460	-	10-5378	-	-	-
380-415-CE	-	-	-	-	10-5196
460/575	-	-	-	10-5379	-

DESCRIPTION	ITEM	460	E 380	575	CE 380
HOLDER	-	10-5249	10-5249	10-5249	10-5249
INDUCTOR	FCH	10-5477	10-5477	10-5477	10-5477
INVERTER; IGBT	Q1,Q2	-	-	10-5085	-
INVERTER; IGBT	Q1,Q2	-	-	10-5086	-
INVERTER; IGBT	Q1,Q2	-	-	10-5087	-
INVERTER; IGBT	Q1,Q2	-	-	9-1081	-
INVERTER; IGBT 600V 100A	Q1,Q2	10-5082	10-5082	-	10-5082
INVERTER; IGBT 600V 100A	Q1,Q2	10-5083	10-5083	-	10-5083
INVERTER; IGBT, 600V 100A	Q1,Q2	10-5084	10-5084		10-5084
INPUT CABLE	-	-	10-5239	-	10-5239
INPUT TERMINAL	-	-	-	10-5128	-
INPUT TERMINAL	-	-	10-5129	-	10-5129
INPUT TERMINAL	-	10-5130	-	-	-
INSULATION SHEET	-	-	-	10-5431	-
INSULATION SHEET; T1,2	-	10-5446	10-5446	10-5446	-
INVERTER TRANSFORMER	T3	10-5099	10-5101	10-5102	10-5101
INVERTER TRANSFORMER	T4	-	-	10-5476	-
KNOB, LARGE PETENTIOMETER	-	10-5233	10-5233	10-5233	10-5233
KNOB, SMALL POTENTIOMETER	-	10-5232	10-5232	10-5232	10-5232
LINE FILTER	L104	-	-	-	10-5229
LINE FILTER	L102,L103	-	-	-	10-5230
LINE FILTER	L104,L105	-	-	-	10-5231
MAIN TRANSFORMER	T1,T2	-	10-5472	-	10-5472
MAIN TRANSFORMER	T1,T2	-	10-5467	10-5468	10-5467
MAIN TRANSFORMER	T1,T2	10-5152	-	-	-
MAIN TRANSFORMER	T1,T2	10-5153	-	-	-
MCB METAL SHIELD	-	10-5484	10-5484	10-5484	10-5488
MODE SWITCH	S1,S2,S3	10-5570	10-5570	10-5570	10-5570
NF INSULATION SHEET	-	-	-	-	10-5448
OUT BUS BAR 5	-	10-5440	10-5440	10-5440	10-5440
OUTPUT TERMINAL FEMALE	-	10-5131	10-5131	10-5131	10-5131
PACKING BOX	-	10-5452	10-5452	10-5452	10-5452
PCB SHEET	-	10-5419	10-5419	10-5419	10-5419
PLUG, 8-PIN; REMOTE					
BODY	-	10-5000	10-5000	10-5000	10-5000
CLAMP	-	10-5001	10-5001	10-5001	10-5001
PIN	-	10-5002	10-5002	10-5002	10-5002
POTENTIOMETER AMP\HOT\PULSE	-	10-5056	10-5056	10-5056	10-5056
POTENTIOMETER ARC TRIM	-	10-5221	10-5221	10-5221	10-5221
PROTECTION BAR	-	10-5443	10-5443	10-5443	10-5443
Q BUS BAR D	-	10-5415	10-5415	10-5415	10-5415

DESCRIPTION	ITEM	460	E 380	575	CE 380
REAR FRAME	-	10-5466	10-5466	10-5466	10-5466
REAR PANEL					
230/460 FRAME	-	10-5402	-	-	-
380-415-CE FRAME	-	-	-	-	10-5405
460/575 FRAME	-	-	-	10-5403	-
REAR UPPER PANEL					
230/460 2P CB	-	10-5546	-	-	-
380-415-CE 2P CB	-	-	-	-	10-5549
460/575 2P CB	-	-	-	10-5547	-
REAR UPPER PANEL (3 POLE CB)	-	-	-	-	10-5489
RECEPTACLE, 14 PIN	CON1	10-5107	10-5107	10-5107	10-5107
RECEPTACLE, 17 PIN	CON2	10-5108	10-5108	10-5108	10-5108
RELAY	CR1	-	-	10-5090	-
RESISTOR, 3 WATT 22 OHM	R2,R3	10-2213	10-2213	10-2213	10-2213
RESISTOR, 3 WATT 4.7K	R3,R7	10-5010	10-5010	10-5010	10-5010
RUBBER	-	-	10-5408	10-5408	10-5408
RUBBER FOOT	-	10-5411	10-5411	10-5411	10-5411
SIDE LABEL	-	10-5498	10-5498	10-5498	10-5498
SLIDE SWITCH	S2	10-5222	-	10-5222	-
SPACER	-	10-5250	10-5250	10-5250	10-5250
SPACER	-	10-5253	10-5253	10-5253	10-5253
STYRENE FOAM	-	10-5459	10-5459	10-5459	10-5459
STYRENE FOAM	-	10-5460	10-5460	10-5460	10-5460
THERMISTER	TH1	10-5228	10-5228	10-5228	10-5228
WK-3366 S01	PCB4,PCB5	-	-	10-5122	-
WK-3366 SNUBBER	PCB4,PCB5	10-5121	10-5121	-	10-5121
WK-3367 IGBT GATE	PCB2,PCB3	10-5120	10-5120	10-5120	10-5120
WK-3373 MIG PCB	PCB6	10-5505	10-5505	10-5505	10-5505
WK-3390	PCB8	-	-	10-5127	-
WK-3448 S06 MAIN PCB 3P CB	PCB1	10-5512	10-5512	-	10-5512
WK-3448 S08 MAIN PCB 3P CB	PCB1	10-5514	-	-	-
WK-3448 S09 MAIN PCB 3P CB	PCB1	10-5515	-	10-5515	-

Parts List – 400GTS

DESCRIPTION	ITEM	460	E 380	575	CE 380
ACRYLIC BOARD	-	-	10-5424	-	10-5424
BUS BAR A	-	10-5412	10-5412	10-5412	10-5412
BUS BAR B	-	10-5413	10-5413	10-5413	10-5413
BUS BAR C	-	10-5414	10-5414	10-5414	10-5414
BUS BAR D	-	10-5417	10-5417	10-5417	10-5417
CABLE CONNECTOR; MALE	-	10-5226	10-5226	10-5226	10-5226
CAPACITOR; 0.1 µF	C1	10-2270	10-2270	10-2270	10-2270
CAPACITOR; 1KVDC .068 µF	C4,C8	10-5013	10-5013	10-5013	10-5013
CAPACITOR; .01 µF	C6,C7	10-2219	10-2219	10-2219	10-2219
CAPACITOR	C5	10-5014	10-5014	10-5014	10-5014
CASE HALF	-	10-5461	10-5461	10-5461	10-5461
CAUTION LABEL 2	-	10-5496	10-5496	10-5496	10-5496
CAUTION LABEL 3	-	10-5497	10-5497	10-5497	10-5497
CHASSIS	-	10-5482	10-5482	10-5482	10-5482
CIRCUIT BREAKER, MAIN					
2 POLE	MCB1	10-5078	10-5078	10-5079	-
3 POLE	MCB1	10-5224	10-5224	9-1076	10-5224
CORD CONNECTOR	-	10-5258	10-5257	10-5257	10-5257
COUPLING COIL	CC	10-5471	10-5471	10-5471	10-5471
CURRENT TRANSFORMER	CT1	10-5003	10-5003	10-5003	10-5003
D.P.M.	PCB7	10-5126	10-5126	10-5126	10-5126
DIODE	D4	-	-	10-2264	-
DIODE	D2,3	10-5089	10-5089	10-5089	10-5089
DIODE+THYRISTOR	D1	10-2653	10-5088	10-5088	10-5088
ELBOW UNION	-	10-5316	10-5316	10-5316	10-5316
FAN; 24VDC	FAN1	10-5092	10-5092	10-5092	10-5092
FERRITE RING	L1	10-2290	10-2290	10-2290	10-2290
FILTER; PCB (EUROPE)	PCB101	-	-	-	10-5517
FLAT CABLE					
11 PIN FOR PANEL PCB	-	10-5236	10-5236	10-5236	10-5236
12 PIN FOR PANEL PCB	-	10-5235	10-5235	10-5235	10-5235
15 PIN FOR FRONT PANEL	-	10-5234	10-5234	10-5234	10-5234
FRONT FRAME	-	10-5462	10-5462	10-5462	10-5462
FRONT PANEL					
230/460 FRAME	-	10-5349	-	-	-
380-415-CE FRAME	-	-	-	-	10-5352
460/575 FRAME	-	-	-	10-5349	-
FRONT PANEL; UPPER	-	10-5493	10-5493	10-5493	10-5493
FRONT PANEL; UPPER					
230/460	-	10-5374	-	-	-
380-415-CE	-	-	-	-	10-5377
460/575	-	-	-	10-5375	-

DESCRIPTION	ITEM	460	E 380	575	CE 380
GAS INLET FITTING	-	10-5416	10-5201	10-5416	10-5201
GAS OUTLET FITTING	-	10-5410	-	10-5410	10-5449
GAS OUTLET FITTING	-	-	10-5423	-	10-5423
GAS VALVE	SOL1	10-5007	10-5007	10-5007	10-5007
GAS VALVE	SOL1	10-5008	10-5008	10-5008	10-5008
GAS VALVE C RING	-	10-5242	10-5242	10-5242	10-5242
HEAT SINK	-	10-5458	10-5458	10-5458	10-5458
HIGH FREQUENCY UNIT	-	10-5024	10-5024	10-5024	10-5024
HOLDER	-	10-5249	10-5249	10-5249	10-5249
INDUCTOR, OUTPUT	FCH	10-5470	10-5470	10-5470	10-5470
INVERTER; IGBT	Q1,Q2	-	-	10-5085	-
INVERTER; IGBT	Q1,Q2	-	-	10-5086	-
INVERTER; IGBT	Q1,Q2	-	-	10-5087	-
INVERTER; IGBT	Q1,Q2	-	-	9-1081	-
INVERTER; IGBT 600V 100A	Q1,Q2	10-5084	10-5084	-	10-5084
INVERTER; IGBT, 600V 100A	Q1,Q2	10-5082	10-5082	-	10-5082
INVERTER; IGBT, 600V 100A	Q1,Q2	10-5083	10-5083	-	10-5083
INPUT CABLE	-	-	10-5239	-	10-5239
INPUT TERMINAL	-	10-5130	10-5129	10-5128	10-5129
INSULATION SHEET	-	-	-	10-5431	-
INSULATION SHEET; T1,2	-	10-5446	10-5446	10-5446	-
INVERTER TRANSFORMER	T4	-	-	10-5476	-
KNOB, LARGE POTENTIOMETER	-	10-5233	10-5233	10-5233	10-5233
KNOB, SMALL, POTENTIOMETER	-	10-5232	10-5232	10-5232	10-5232
LINE FILTER	L106,L107	-	-	-	10-5176
LINE FILTER	L104	-	-	-	10-5229
LINE FILTER	L102,L103	-	-	-	10-5230
LINE FILTER	L104,L105	-	-	-	10-5231
MAIN TRANSFORMER	T1,T2	-	10-5472	-	10-5472
MAIN TRANSFORMER	T1,T2	10-5152	10-5467	10-5468	10-5467
MAIN TRANSFORMER	T1,T2	10-5153	-	-	-
MCB METAL SHIELD	-	10-5484	10-5484	10-5484	10-5488
NF INSULATION SHEET	-	-	-	-	10-5448
OUT BUS BAR 3	-	10-5426	10-5426	10-5426	10-5426
OUTPUT TERMINAL; FEMALE	-	10-5131	10-5131	10-5131	10-5131
PACKING BOX	-	10-5452	10-5452	10-5452	10-5452
PANEL 1	-	10-5491	-	10-5491	-
PCB SHEET	-	10-5419	10-5419	10-5419	10-5419
PLUG, 8-PIN; REMOTE					
BODY	-	10-5000	10-5000	10-5000	10-5000
CLAMP	-	10-5001	10-5001	10-5001	10-5001
PIN	-	10-5002	10-5002	10-5002	10-5002

DESCRIPTION	ITEM	460	E 380	575	CE 380
POTENTIOMETER AMP\HOT\PULSE	-	10-5056	10-5056	10-5056	10-5056
POTENTIOMETER ARC TRIM	-	10-5221	10-5221	10-5221	10-5221
PROTECTION BAR	-	10-5443	10-5443	10-5443	10-5443
Q BUS BAR D	-	10-5415	10-5415	10-5415	10-5415
REAR FRAME	-	10-5465	10-5465	10-5465	10-5465
REAR PANEL					
230/460 FRAME	-	10-5398	-	-	-
380-415-CE FRAME	-	-	-	-	10-5401
460/575 FRAME	-	-	-	10-5399	-
REAR PANEL WITHOUT EA53	-	10-5486	10-5486	-	-
REAR UPPER PANEL					
230/460 2P CB	-	10-5542	-	-	-
380-415 2P CB	-	-	-	-	10-5544
460/575 2P CB	-	-	-	10-5543	-
REAR UPPER PANEL (3 POLE CB)	-	-	-	-	10-5489
RECEPTACLE, 8 PIN AMP	CON1	10-5023	10-5023	10-5023	10-5023
RESISTOR;150 OHM 20W	R1,R4	10-5080	10-5080	10-5080	10-5080
RESISTOR; 3 WATT 22 OHM	R2,R3	10-2213	10-2213	10-2213	10-2213
RESISTOR; 3 WATT 4.7K	R3,R7	10-5010	10-5010	10-5010	10-5010
RUBBER	-	-	10-5408	10-5408	10-5408
RUBBER CAP	-	10-5315	10-5315	10-5315	10-5315
RUBBER FOOT	-	10-5411	10-5411	10-5411	10-5411
SCREW	-	10-5240	10-5240	10-5240	10-5240
SIDE LABEL	-	10-5498	10-5498	10-5498	10-5498
SLIDE SWITCH	S2	10-5222	-	-	-
SPACER	-	10-5250	10-5250	10-5250	10-5250
SPACER	-	10-5253	10-5253	10-5253	10-5253
STYRENE FOAM	-	10-5459	10-5459	10-5459	10-5459
THERMISTOR	TH1	10-5228	10-5228	10-5228	10-5228
TIG PCB	PCB6	10-5504	10-5504	10-5504	10-5504
TORCH TERMINAL BUS BAR	-	-	10-5444	-	10-5444
WK-3366 S01	PCB4,PCB5	-	-	10-5122	-
WK-3366 SNUBBER	PCB4,PCB5	10-5121	10-5121	-	10-5121
WK-3367 IGBT GATE	PCB2,PCB3	10-5120	10-5120	10-5120	10-5120
WK-3390	PCB8	-	-	10-5127	-
WK-3448 S05 MAIN PCB 3P CB	PCB1	10-5511	-	-	-
WK-3448 S06 MAIN PCB 3P CB	PCB1	10-5512	10-5512	-	10-5512
WK-3448 S07 MAIN PCB 3P CB	PCB1	10-5513	-	10-5513	-

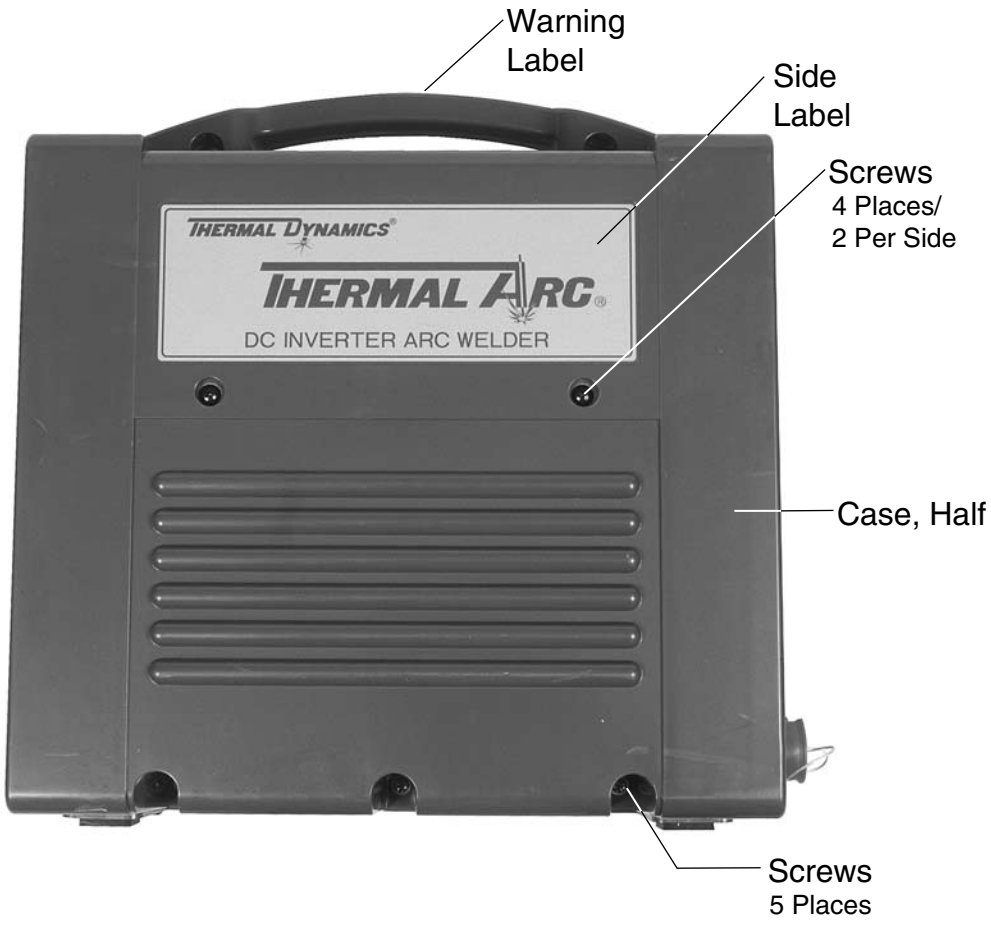


Figure 58. Enclosure

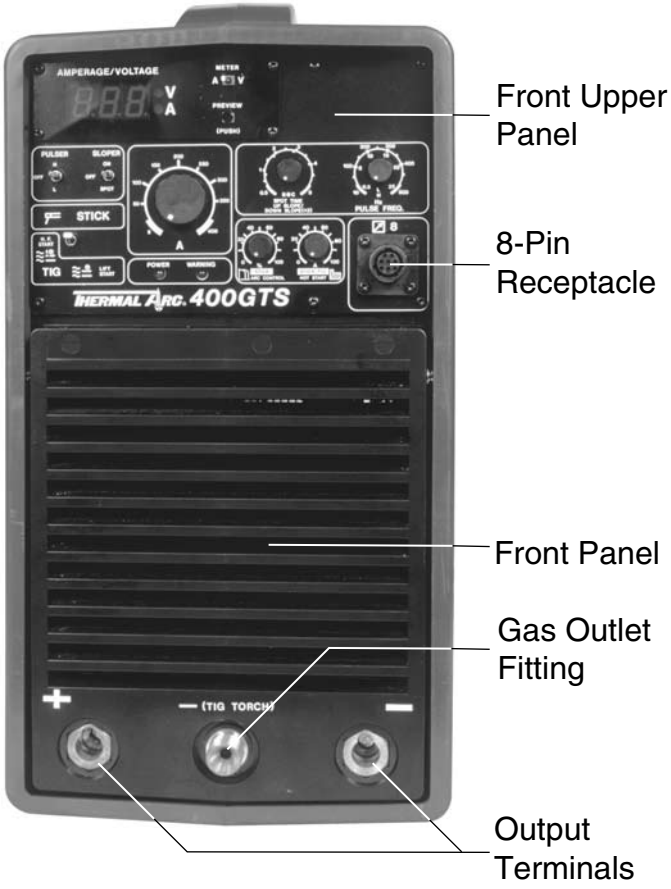


Figure 59. Front Panel

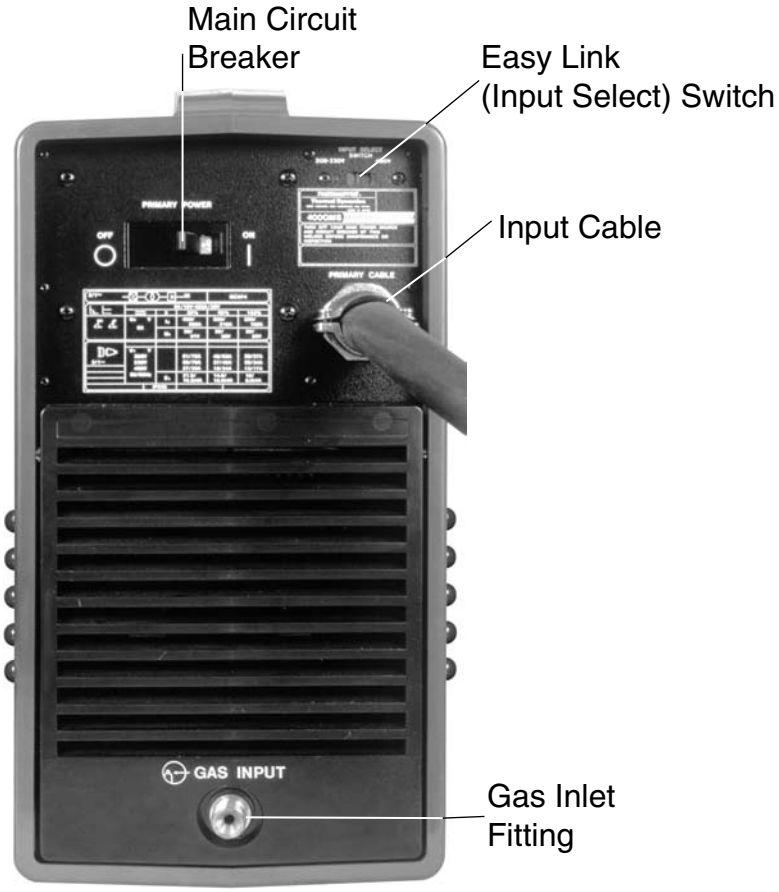


Figure 60. Rear Panel

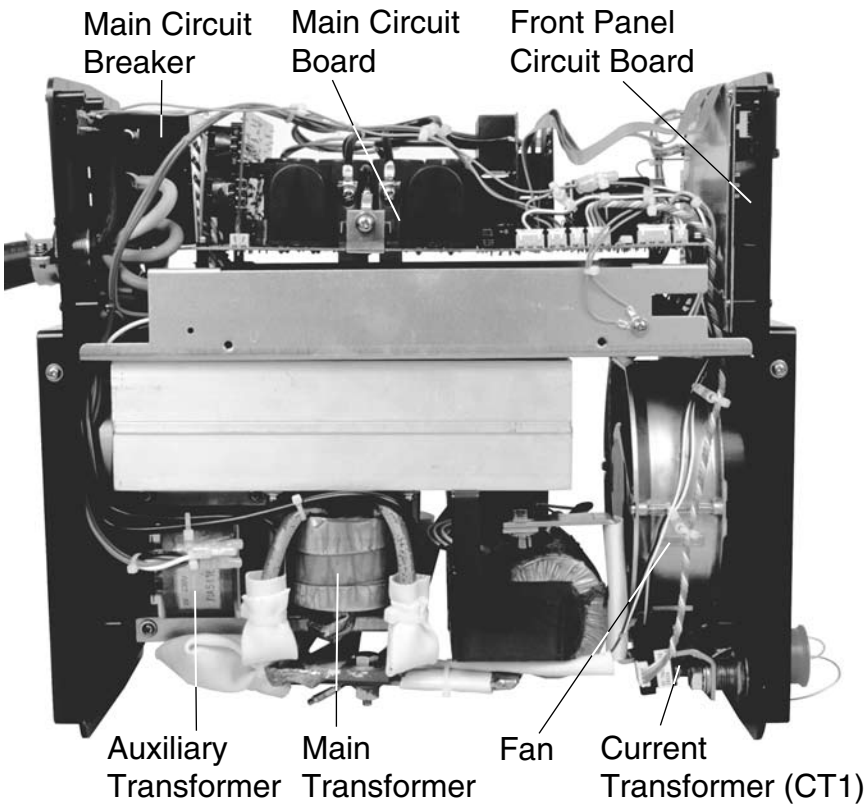


Figure 61. Left Side

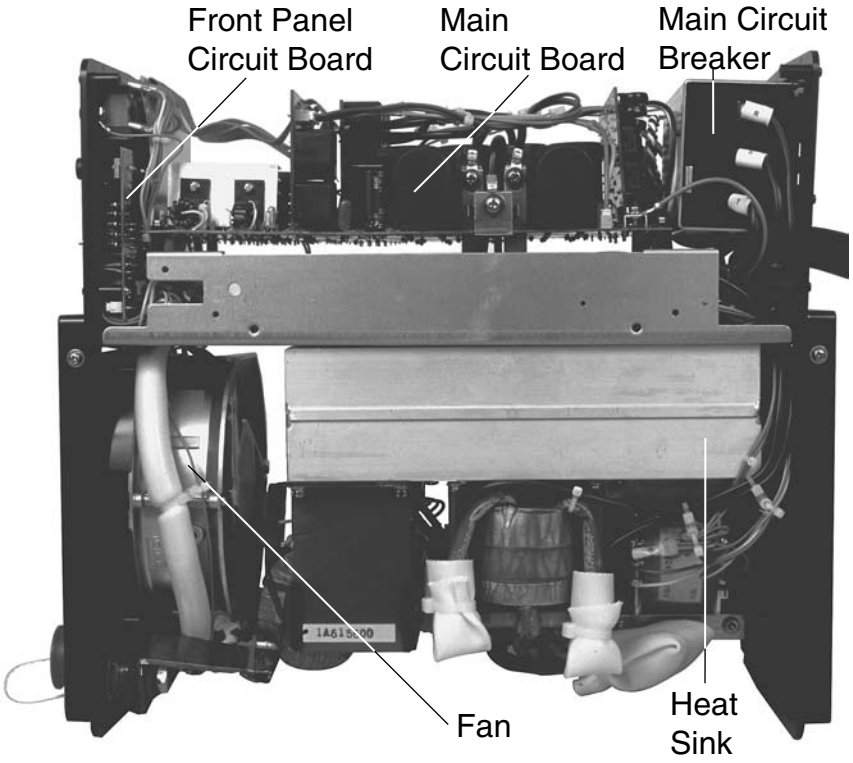


Figure 62. Right Side

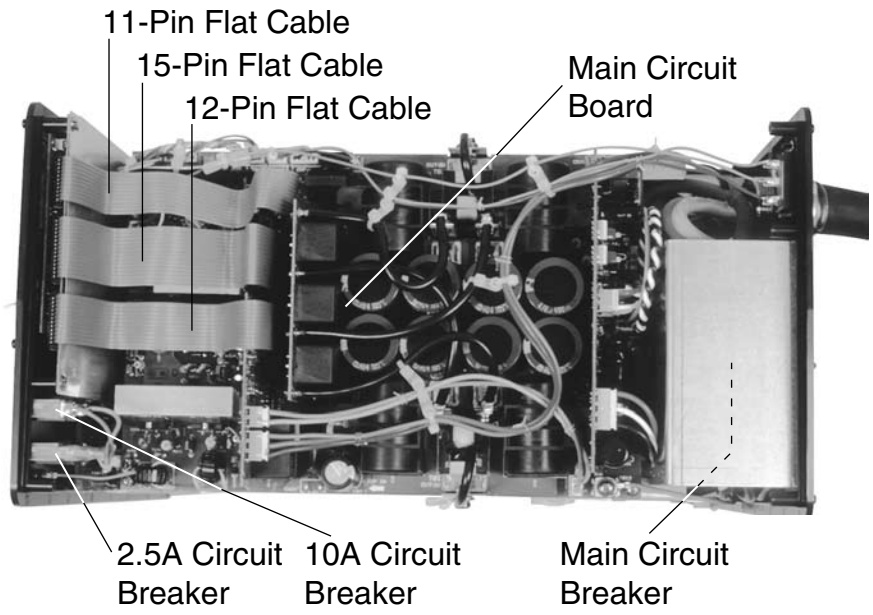


Figure 63. Top View

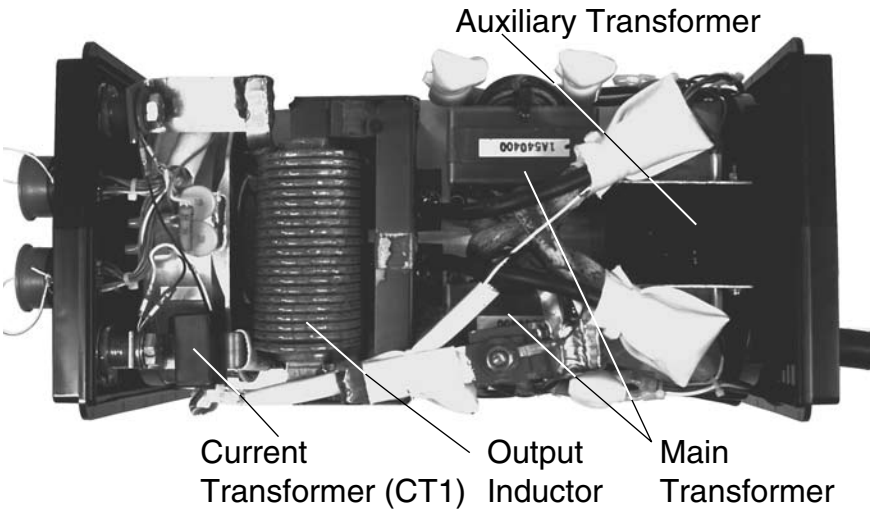


Figure 64. Bottom View

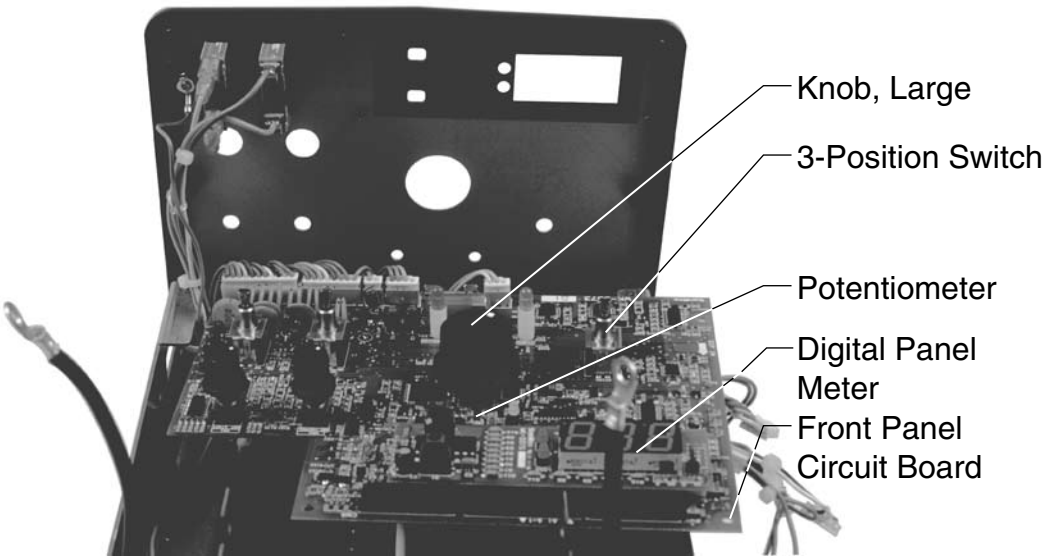


Figure 65. Front Circuit Board

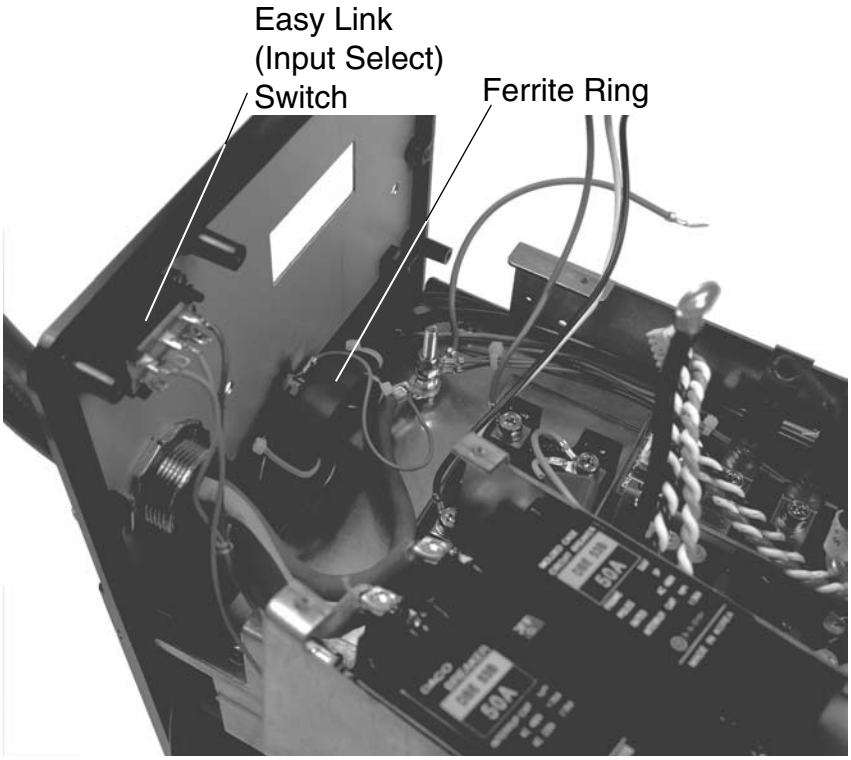


Figure 66. Internal

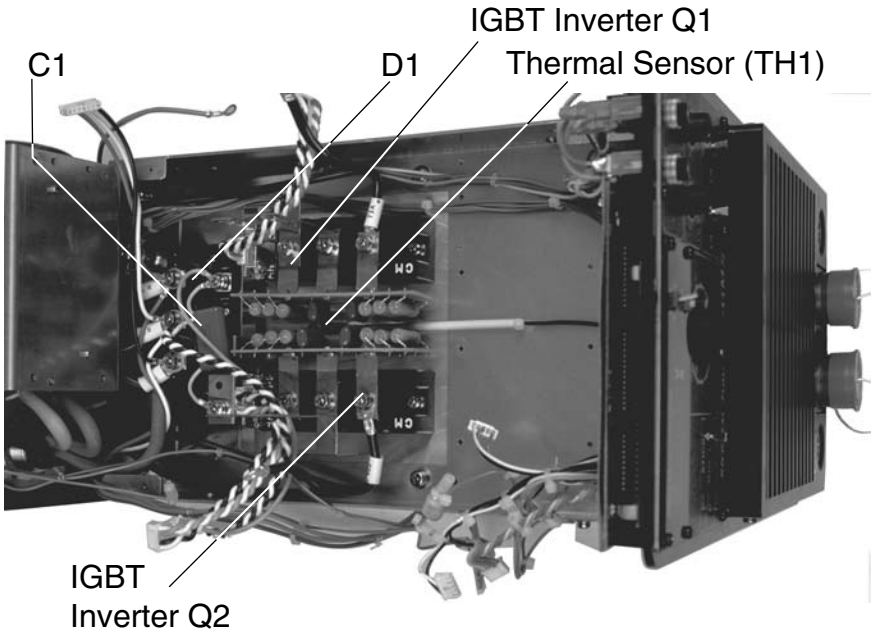


Figure 67. Internal

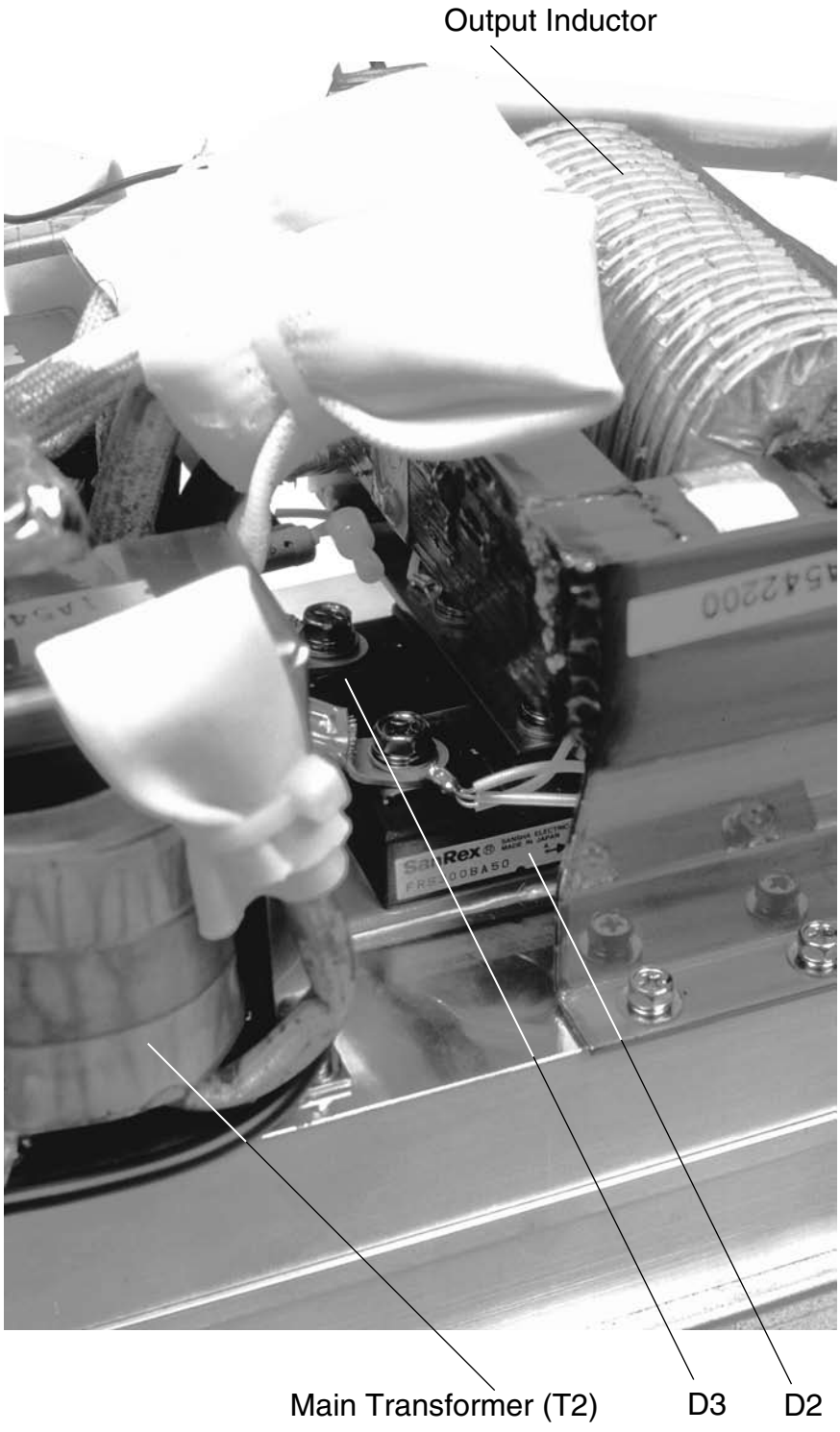


Figure 68. Internal-S

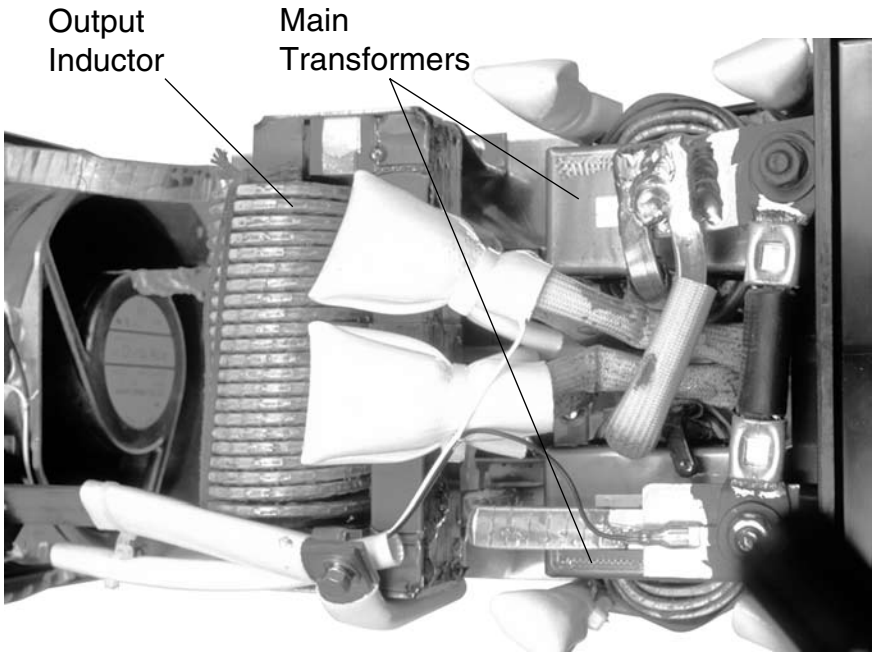


Figure 69. Internal-S

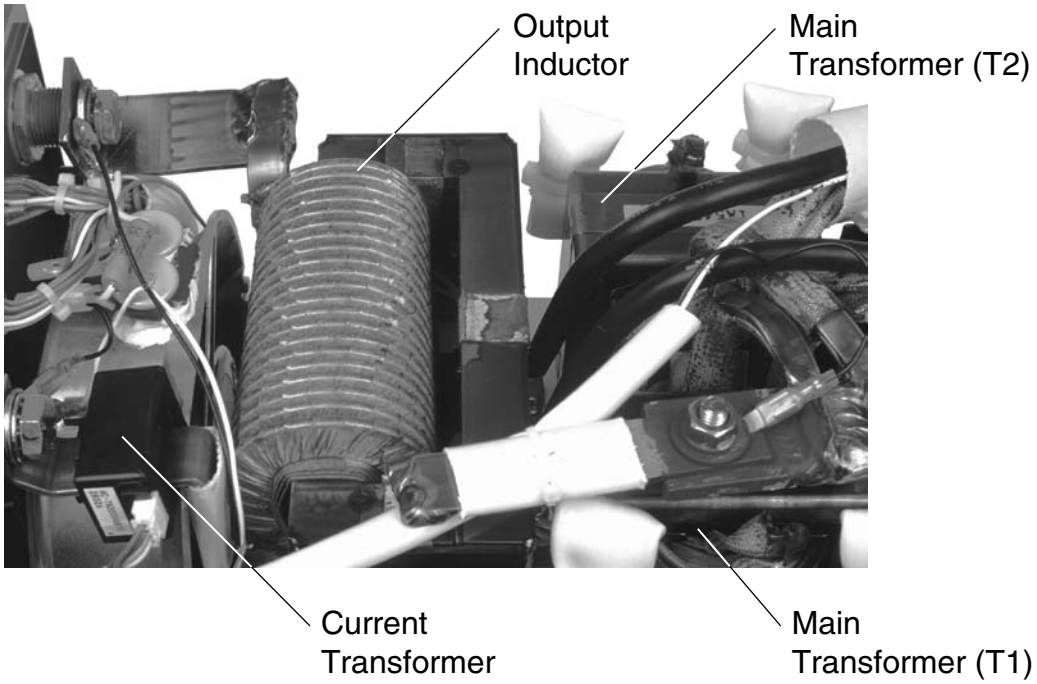


Figure 70. Internal GMS

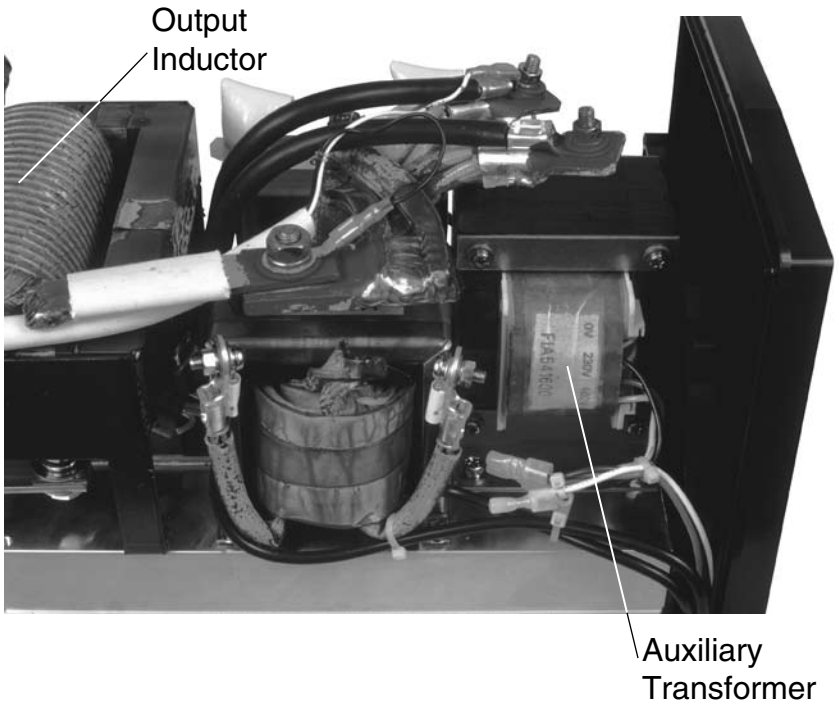


Figure 71. Internal GMS

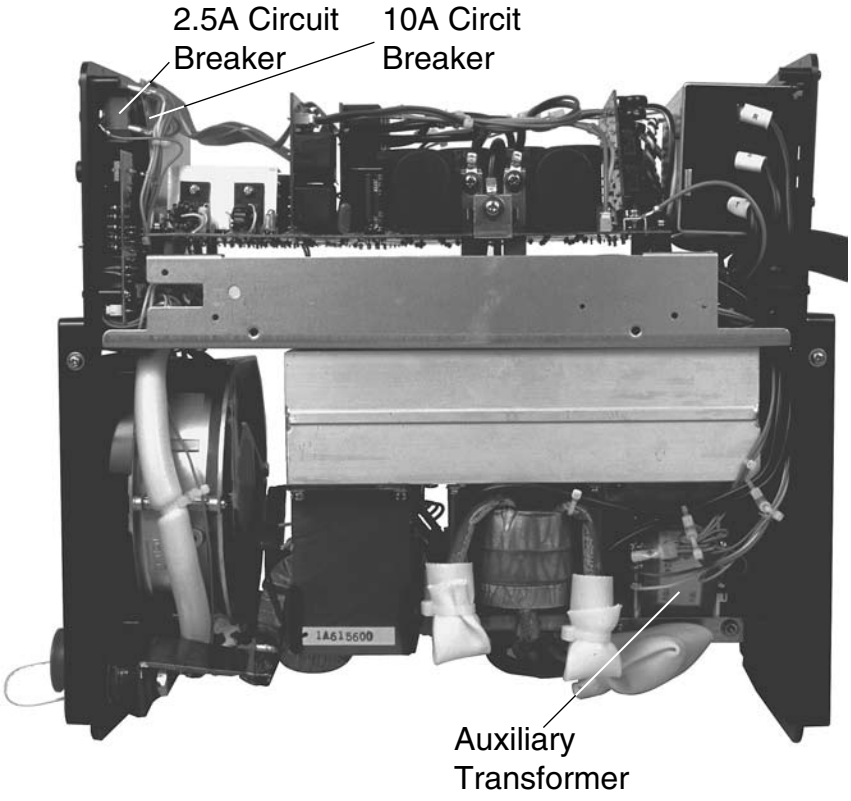


Figure 72. Internal-GMS

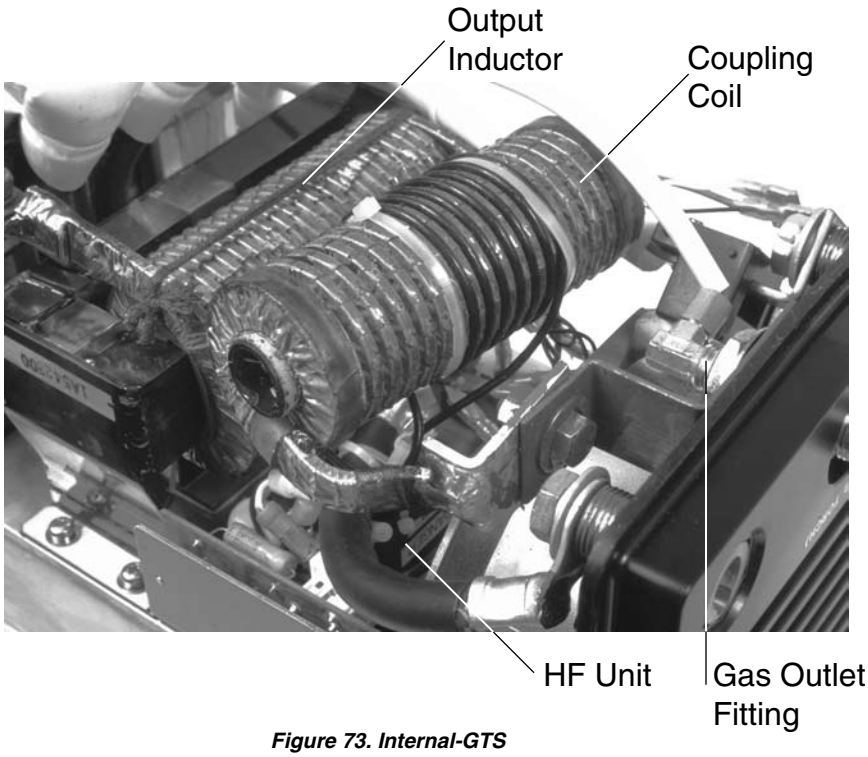


Figure 73. Internal-GTS

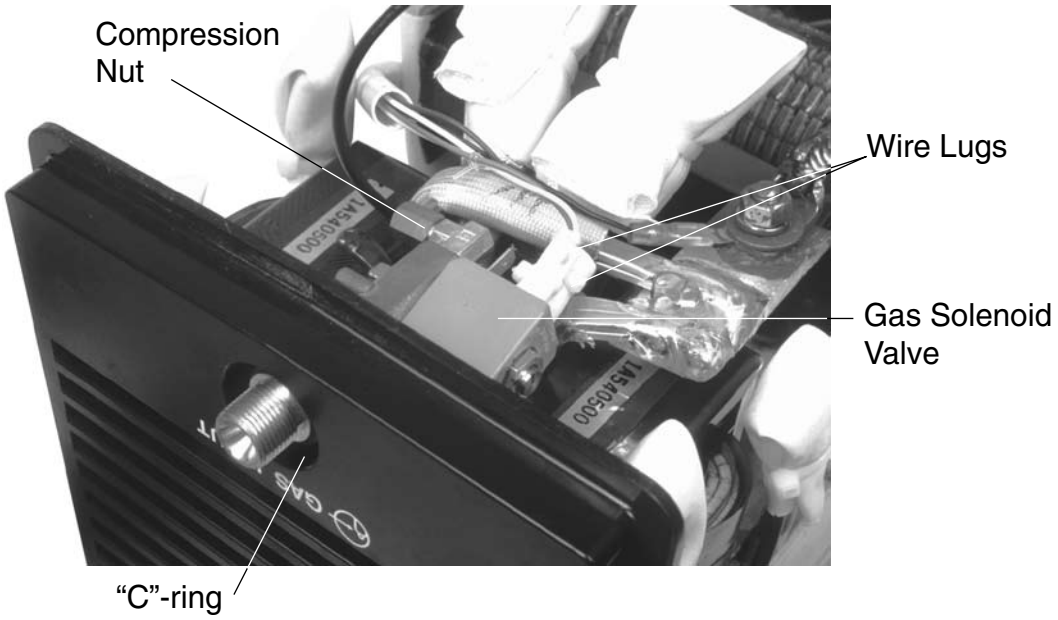
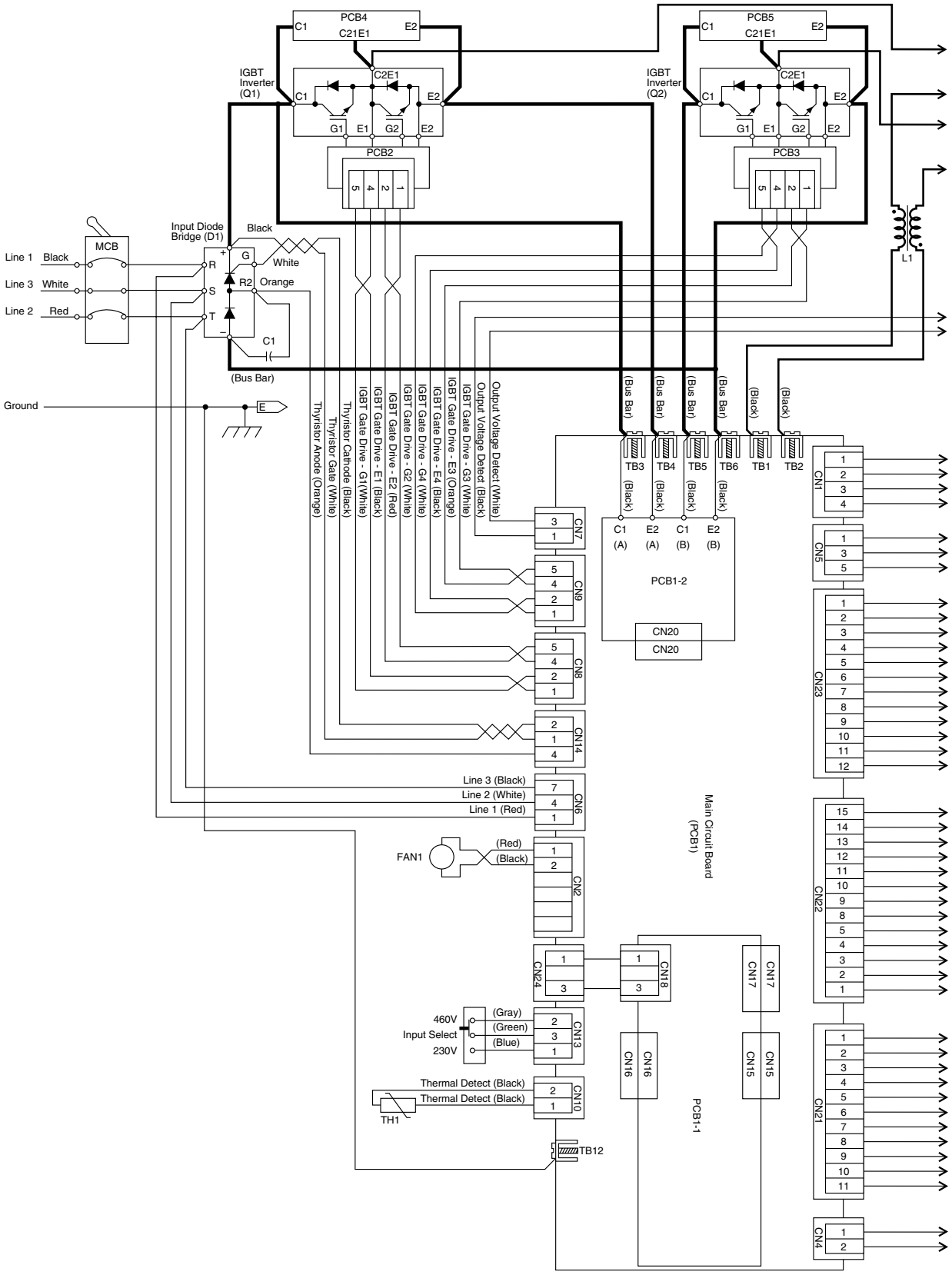


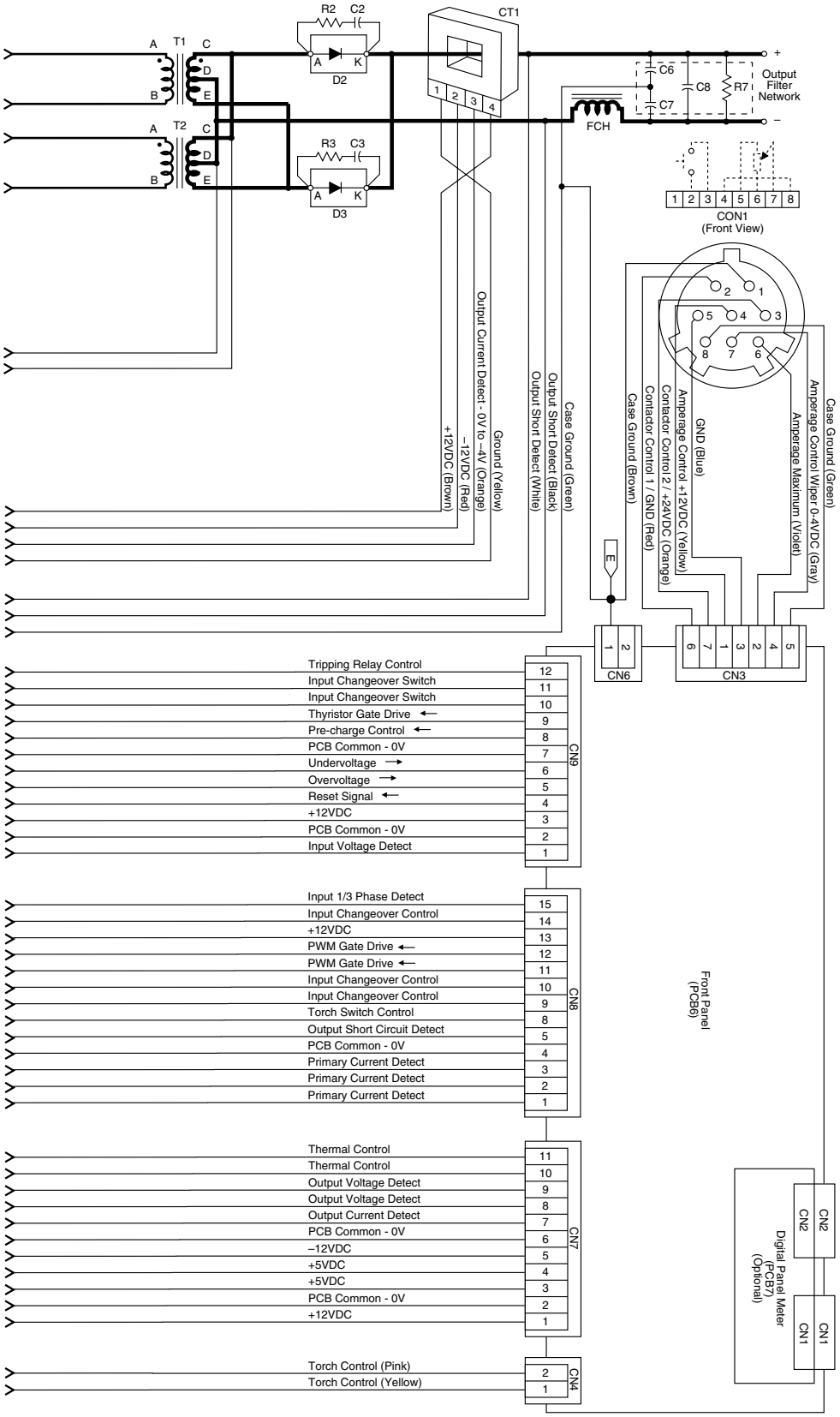
Figure 74. Internal-GTS

APPENDIX A – INTERCONNECTION DIAGRAMS

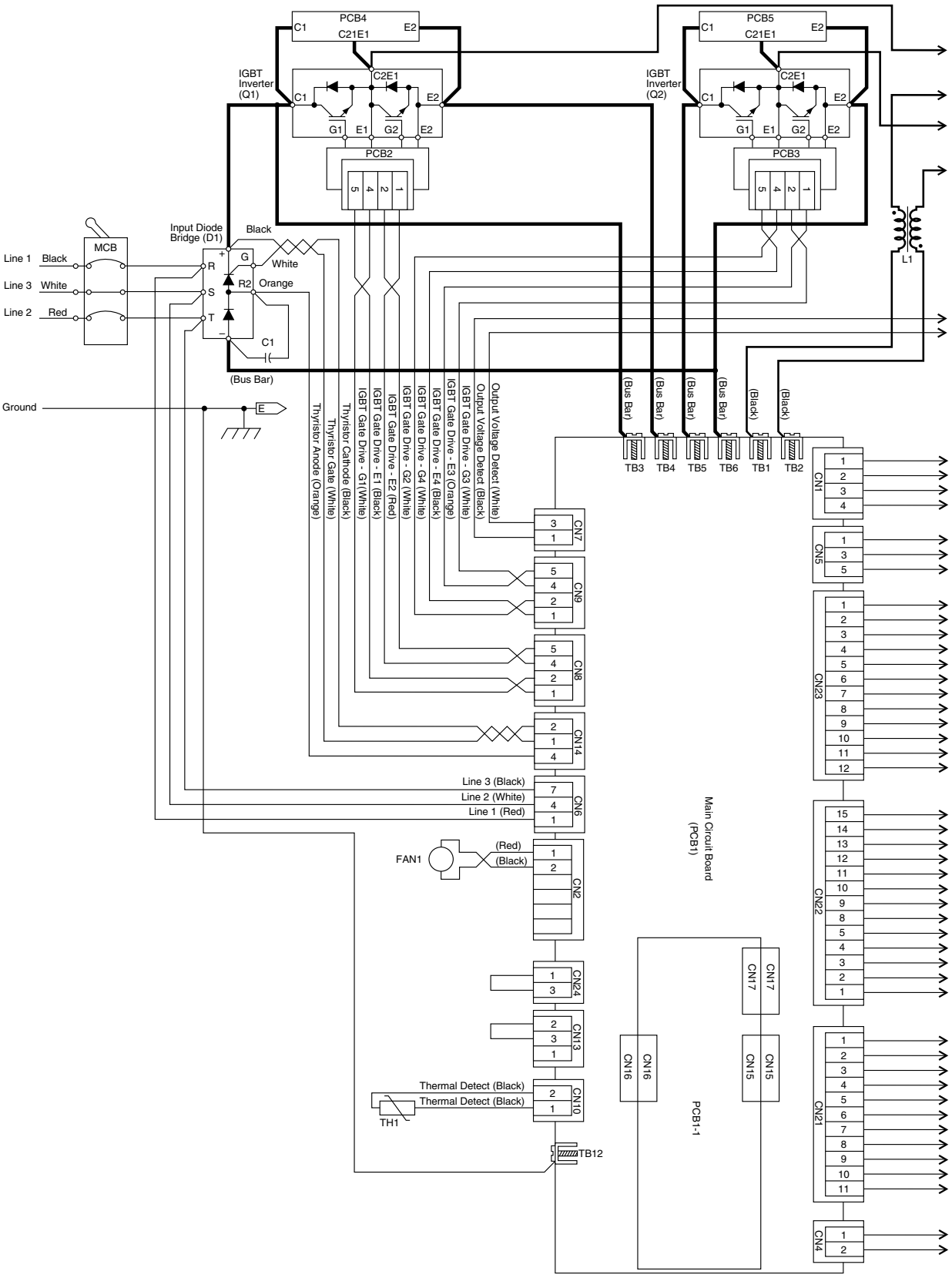
The following pages contain the interconnection diagrams for all 400S, 400GMS and 400GTS models in current production, to aid in the identification of replacement parts.

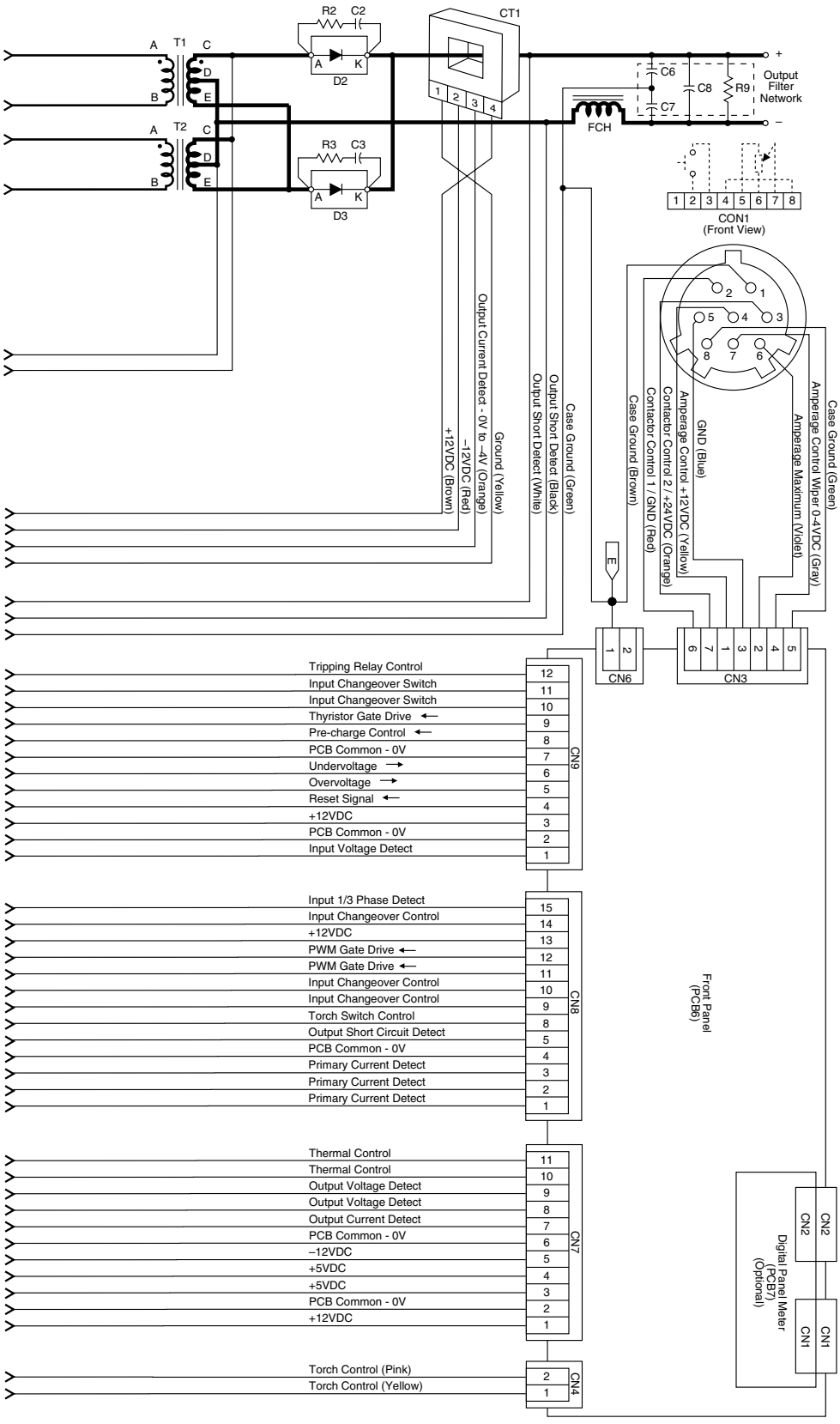
400S - 230/460V Interconnection Diagram



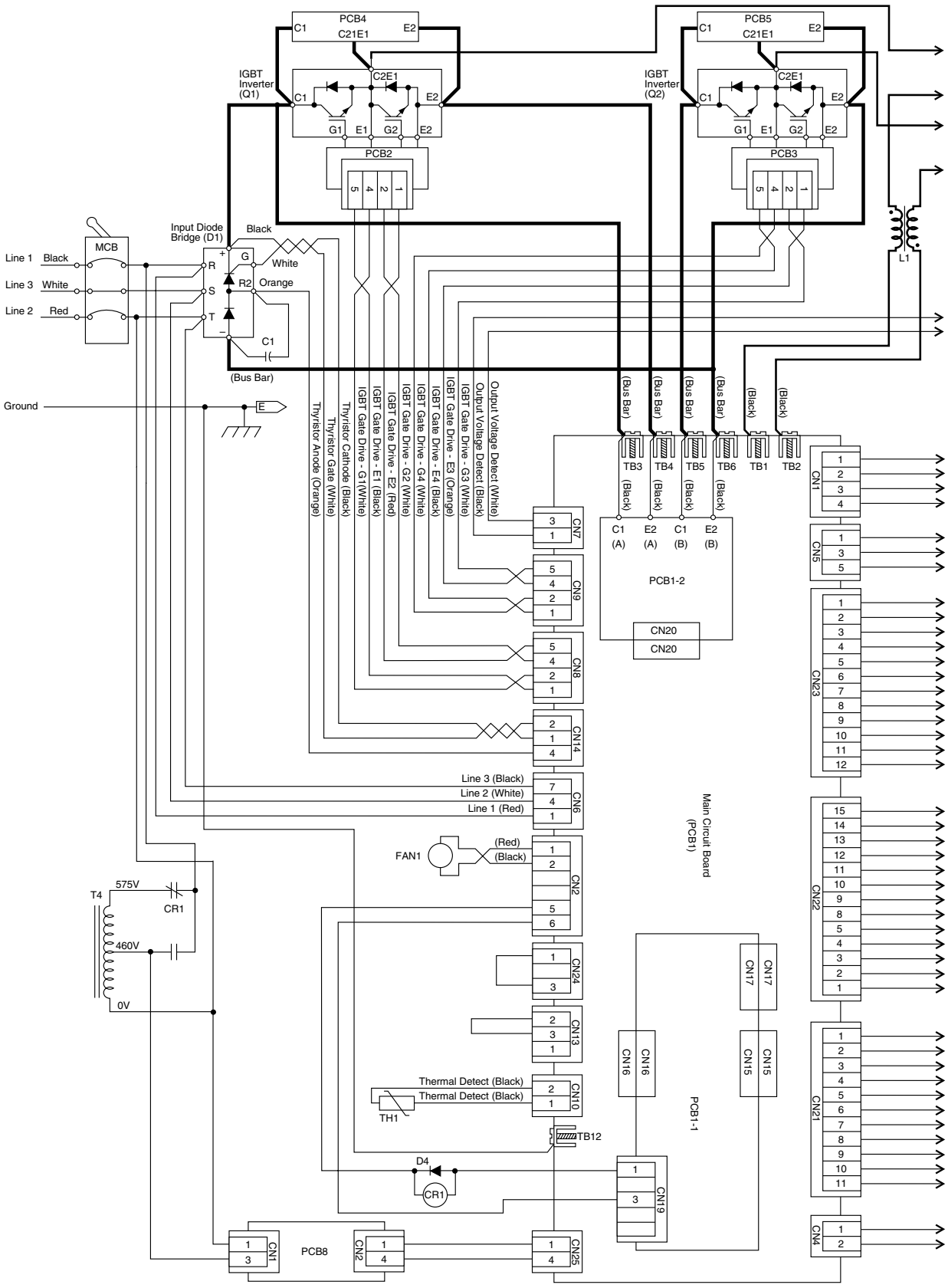

R2 C2
CT1
A T1 C
D
B E
A K
D2
1 2 3 4
C6
C8
R7
Output Filter Network
C7
FCH
A T2 C
D
B E
R3 C3
A K
D3
1 2 3 4 5 6 7 8
CON1 (Front View)
2 1
5 4 3
8 7 6
Output Current Detect - 0V to –4V (Orange)
–12VDC (Red)
+12VDC (Brown)
Ground (Yellow)
Output Short Detect (Black)
Output Short Detect (White)
Case Ground (Green)
Case Ground (Brown)
Contactor Control 1 / GND (Red)
Contactor Control 2 / +24VDC (Orange)
Amperage Control +12VDC (Yellow)
GND (Blue)
Amperage Maximum (Violet)
Amperage Control Wiper 0-4VDC (Gray)
Case Ground (Green)
E
1 2
CN6
6 7 1 3 2 4 5
CN3
Tripping Relay Control
Input Changeover Switch
Input Changeover Switch
Thyristor Gate Drive
Pre-charge Control
PCB Common - 0V
Undervoltage
Overvoltage
Reset Signal
+12VDC
PCB Common - 0V
Input Voltage Detect
12 11 10 9 8 7 6 5 4 3 2 1
CN9
Input 1/3 Phase Detect
Input Changeover Control
+12VDC
PWM Gate Drive
PWM Gate Drive
Input Changeover Control
Input Changeover Control
Torch Switch Control
Output Short Circuit Detect
PCB Common - 0V
Primary Current Detect
Primary Current Detect
Primary Current Detect
15 14 13 12 11 10 9 8 5 4 3 2 1
CN8
Front Panel (PCB6)
Thermal Control
Thermal Control
Output Voltage Detect
Output Voltage Detect
Output Current Detect
PCB Common - 0V
–12VDC
+5VDC
+5VDC
PCB Common - 0V
+12VDC
11 10 9 8 7 6 5 4 3 2 1
CN7
CN2
CN2
Digital Panel Meter (PCB7) (Optional)
CN1
CN1
Torch Control (Pink)
Torch Control (Yellow)
2 1
CN4

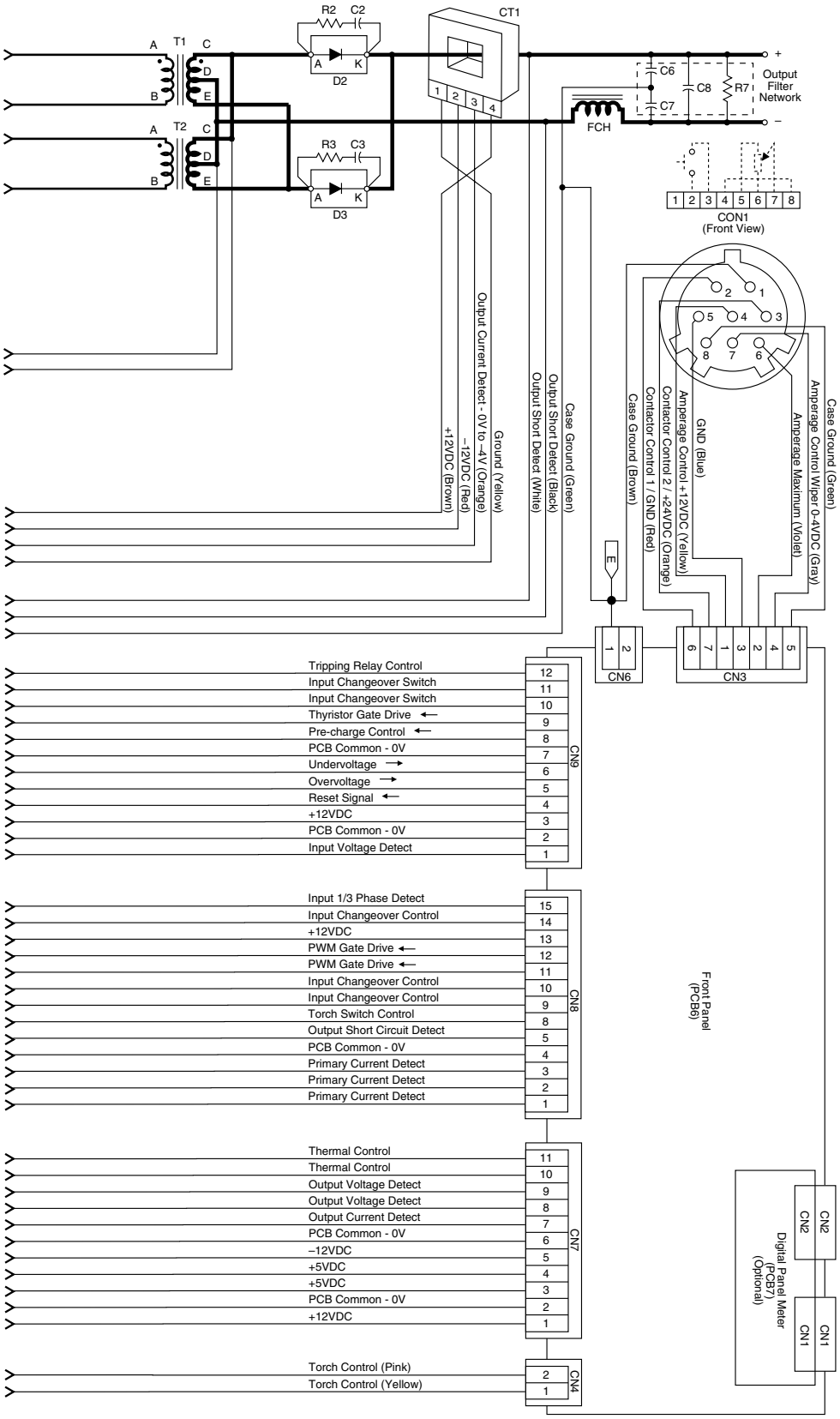
400S - 380V Interconnection Diagram



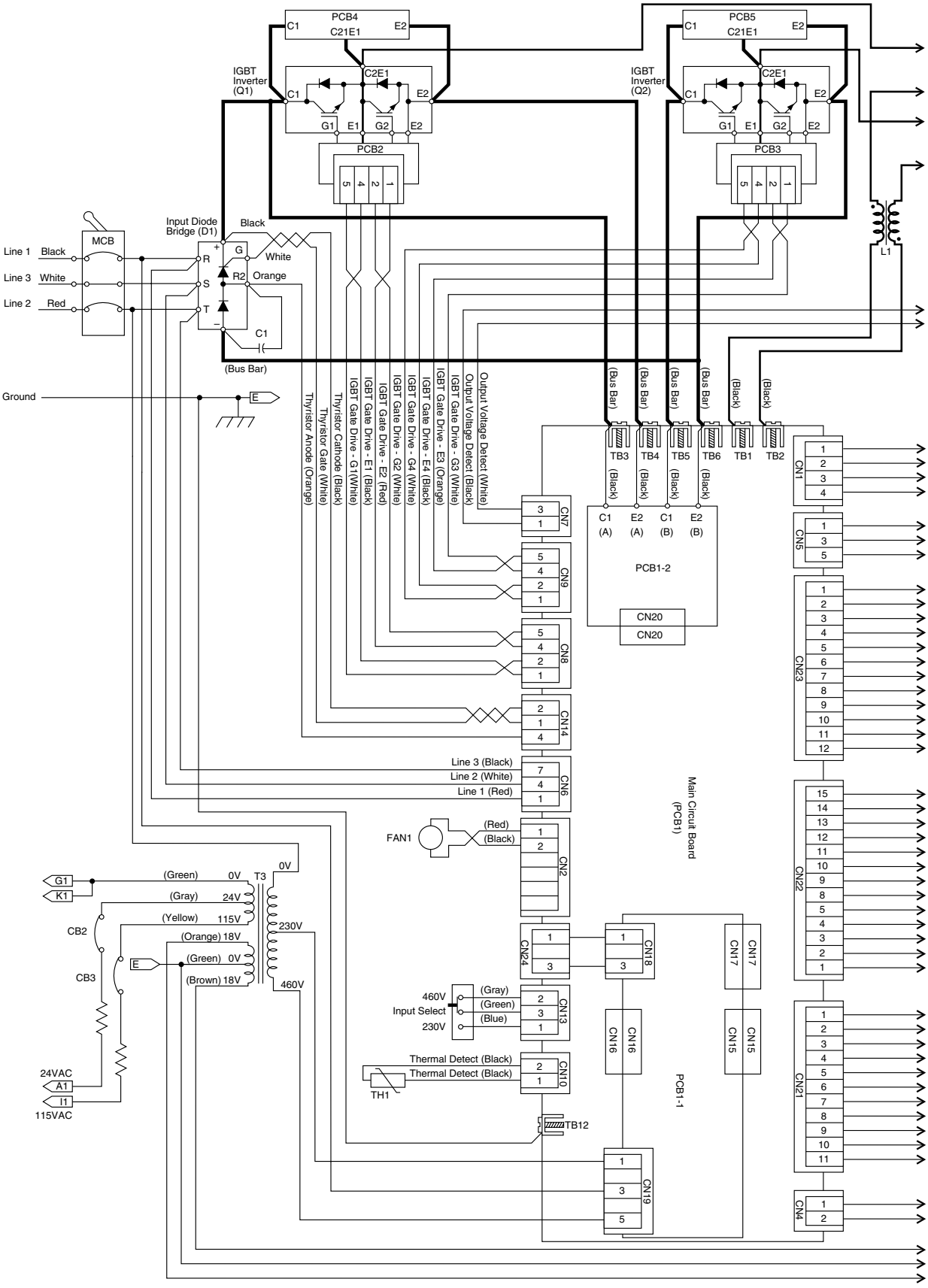

R2 C2
CT1
T1
A
C
D
E
B
D2
A K
1 2 3 4
C6
C8
R9
C7
+
Output Filter Network
–
FCH
T2
R3 C3
D3
1 2 3 4 5 6 7 8
CON1
(Front View)
2 1
5 4 3
8 7 6
Output Current Detect - 0V to –4V (Orange)
–12VDC (Red)
+12VDC (Brown)
Ground (Yellow)
Output Short Detect (Black)
Output Short Detect (White)
Case Ground (Green)
Case Ground (Brown)
Contactor Control 1 / GND (Red)
Contactor Control 2 / +24VDC (Orange)
Amperage Control +12VDC (Yellow)
GND (Blue)
Amperage Maximum (Violet)
Amperage Control Wiper 0-4VDC (Gray)
Case Ground (Green)
E
1 2
CN6
6 7 1 3 2 4 5
CN3
Tripping Relay Control
Input Changeover Switch
Input Changeover Switch
Thyristor Gate Drive ←
Pre-charge Control ←
PCB Common - 0V
Undervoltage →
Overvoltage →
Reset Signal ←
+12VDC
PCB Common - 0V
Input Voltage Detect
12 11 10 9 8 7 6 5 4 3 2 1
CN9
Input 1/3 Phase Detect
Input Changeover Control
+12VDC
PWM Gate Drive ←
PWM Gate Drive ←
Input Changeover Control
Input Changeover Control
Torch Switch Control
Output Short Circuit Detect
PCB Common - 0V
Primary Current Detect
Primary Current Detect
Primary Current Detect
15 14 13 12 11 10 9 8 5 4 3 2 1
CN8
Front Panel (PCB6)
Thermal Control
Thermal Control
Output Voltage Detect
Output Voltage Detect
Output Current Detect
PCB Common - 0V
–12VDC
+5VDC
+5VDC
PCB Common - 0V
+12VDC
11 10 9 8 7 6 5 4 3 2 1
CN7
Digital Panel Meter (PCB7) (Optional)
CN2
CN2
CN1
CN1
Torch Control (Pink)
Torch Control (Yellow)
2 1
CN4

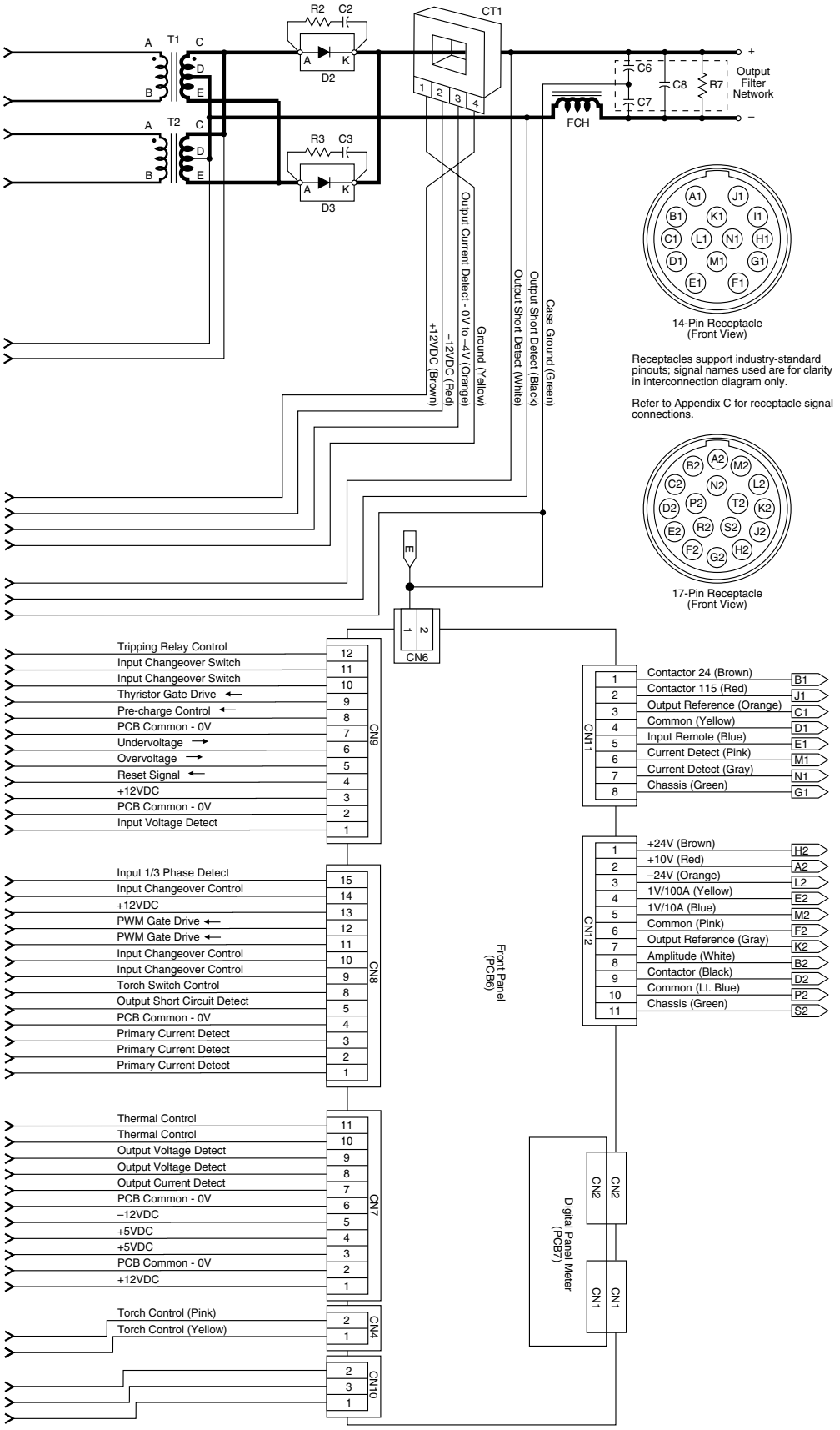
400S 460/575V Interconnection Diagram



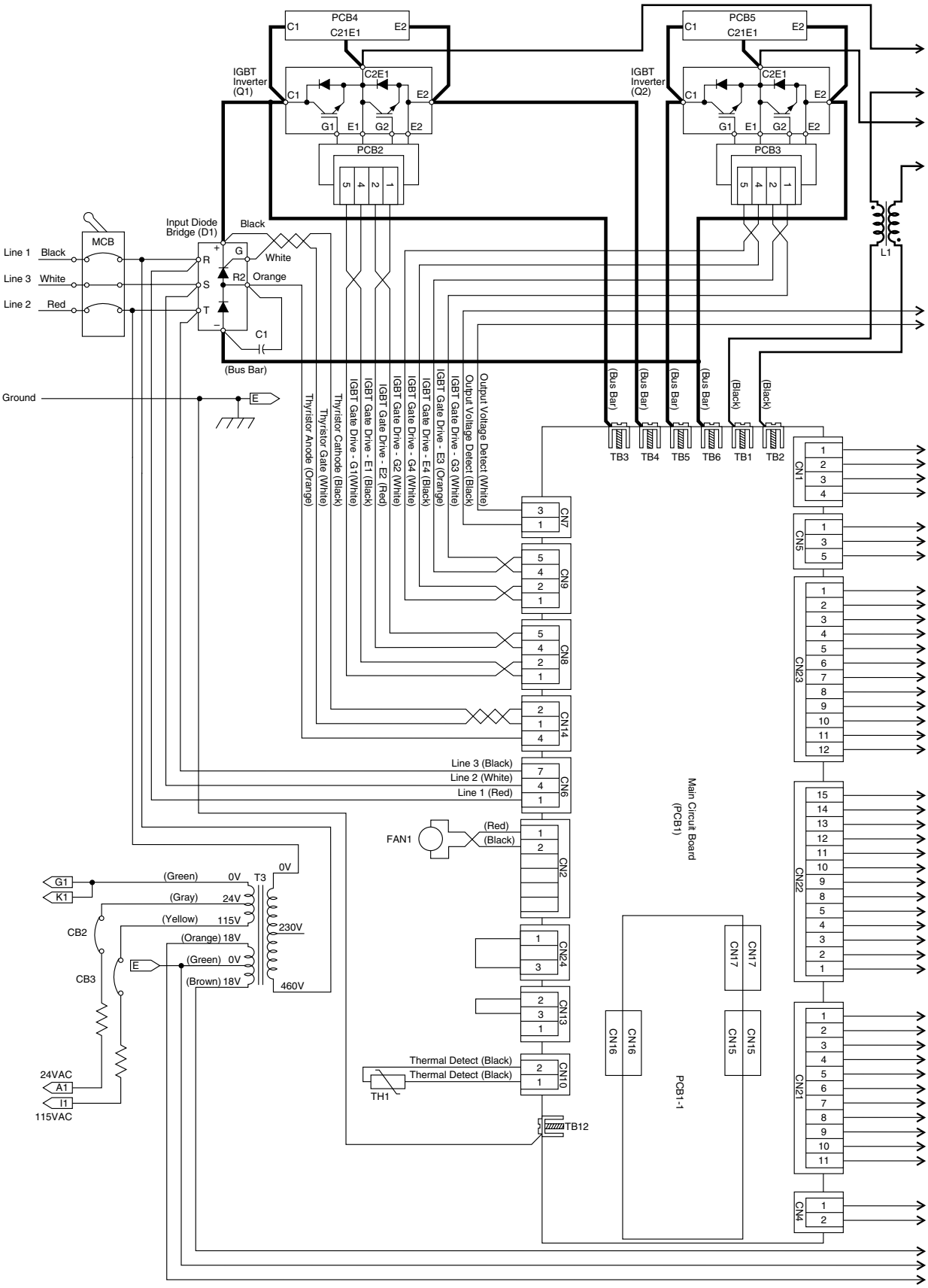

R2 C2
CT1
T1
A
B
C
D
E
D2
A K
1 2 3 4
C6
C8
R7
C7
Output Filter Network
+
–
FCH
T2
R3 C3
D3
CON1 (Front View)
1 2 3 4 5 6 7 8
Output Current Detect - 0V to -4V (Orange)
–12VDC (Red)
+12VDC (Brown)
Ground (Yellow)
Output Short Detect (Black)
Output Short Detect (White)
Case Ground (Green)
Case Ground (Brown)
Contactor Control 1 / GND (Red)
Contactor Control 2 / +24VDC (Orange)
Amperage Control +12VDC (Yellow)
GND (Blue)
Amperage Maximum (Violet)
Amperage Control Wiper 0-4VDC (Gray)
Case Ground (Green)
CN6
CN3
Tripping Relay Control
Input Changeover Switch
Input Changeover Switch
Thyristor Gate Drive
Pre-charge Control
PCB Common - 0V
Undervoltage
Overvoltage
Reset Signal
+12VDC
PCB Common - 0V
Input Voltage Detect
CN9
Input 1/3 Phase Detect
Input Changeover Control
+12VDC
PWM Gate Drive
PWM Gate Drive
Input Changeover Control
Input Changeover Control
Torch Switch Control
Output Short Circuit Detect
PCB Common - 0V
Primary Current Detect
Primary Current Detect
Primary Current Detect
CN8
Front Panel (PCB6)
Thermal Control
Thermal Control
Output Voltage Detect
Output Voltage Detect
Output Current Detect
PCB Common - 0V
–12VDC
+5VDC
+5VDC
PCB Common - 0V
+12VDC
CN7
Digital Panel Meter (PCB7) (Optional)
CN2
CN1
Torch Control (Pink)
Torch Control (Yellow)
CN4

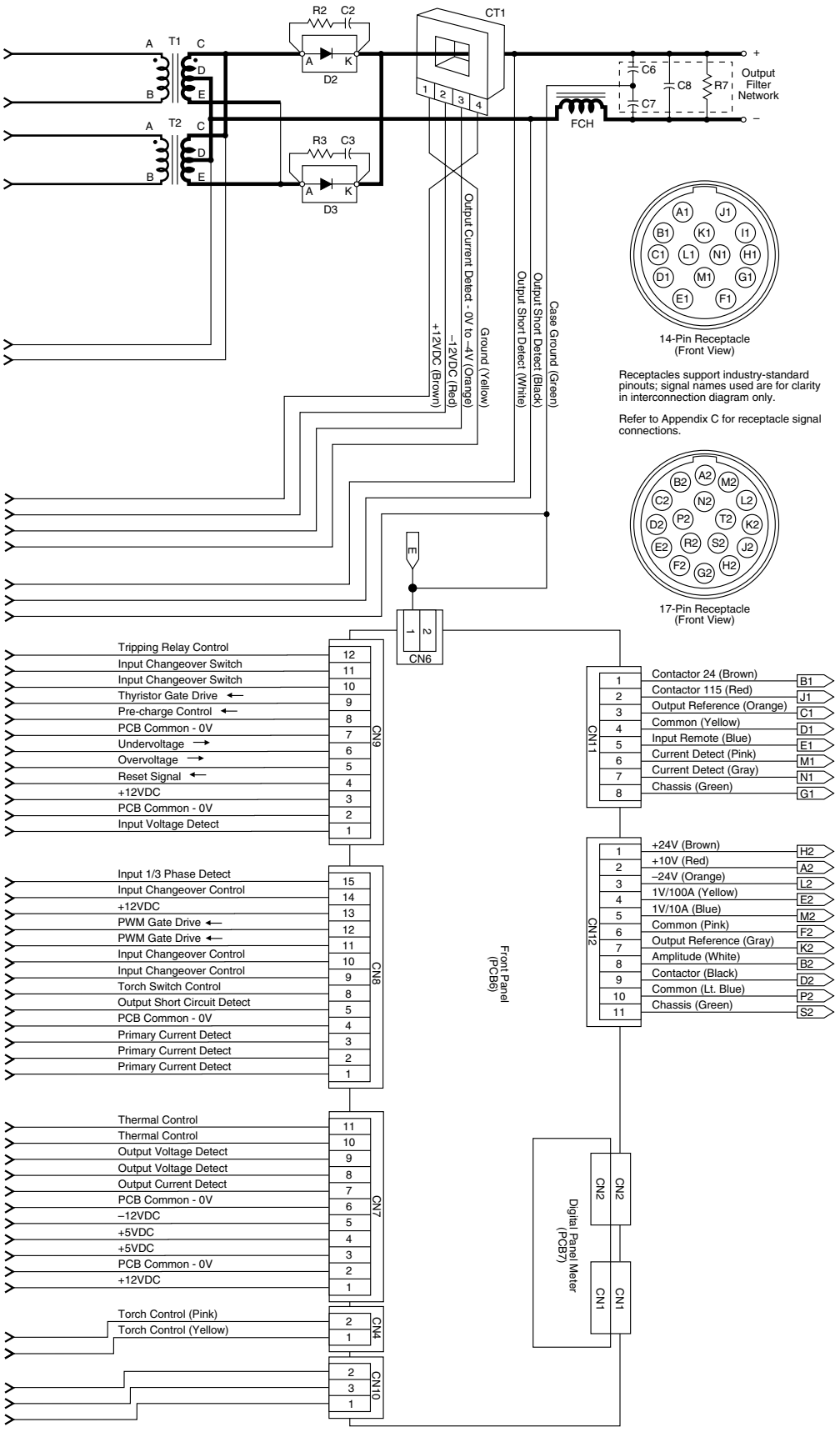
400GMS 230/460V Interconnection Diagram



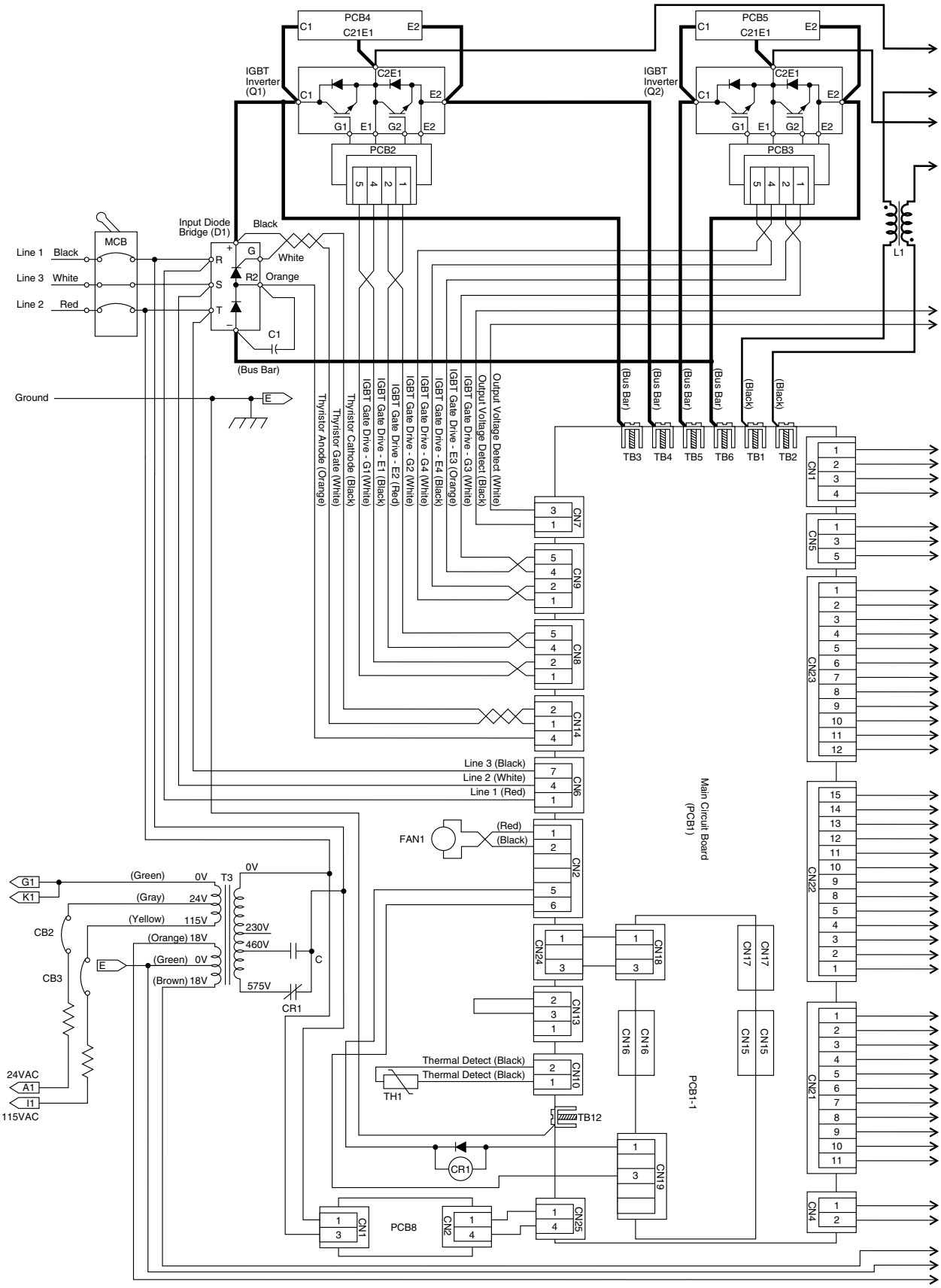

R2 C2
CT1
T1
A
B
C
D
E
D2
A K
1 2 3 4
C6
C8
R7
C7
Output Filter Network
+
–
FCH
T2
R3 C3
D3
Output Current Detect - 0V to –4V (Orange)
–12VDC (Red)
+12VDC (Brown)
Ground (Yellow)
Output Short Detect (Black)
Output Short Detect (White)
Case Ground (Green)
A1 J1 B1 K1 I1 C1 L1 N1 H1 D1 M1 G1 E1 F1
14-Pin Receptacle (Front View)
Receptacles support industry-standard pinouts; signal names used are for clarity in interconnection diagram only.
Refer to Appendix C for receptacle signal connections.
B2 A2 M2 C2 N2 L2 D2 P2 T2 K2 E2 R2 S2 J2 F2 G2 H2
17-Pin Receptacle (Front View)
CN6
Tripping Relay Control
Input Changeover Switch
Input Changeover Switch
Thyristor Gate Drive
Pre-charge Control
PCB Common - 0V
Undervoltage
Overvoltage
Reset Signal
+12VDC
PCB Common - 0V
Input Voltage Detect
CN9
CN11
Contactor 24 (Brown)
Contactor 115 (Red)
Output Reference (Orange)
Common (Yellow)
Input Remote (Blue)
Current Detect (Pink)
Current Detect (Gray)
Chassis (Green)
B1 J1 C1 D1 E1 M1 N1 G1
Input 1/3 Phase Detect
Input Changeover Control
+12VDC
PWM Gate Drive
PWM Gate Drive
Input Changeover Control
Input Changeover Control
Torch Switch Control
Output Short Circuit Detect
PCB Common - 0V
Primary Current Detect
Primary Current Detect
Primary Current Detect
CN8
Front Panel (PCB6)
CN12
+24V (Brown)
+10V (Red)
–24V (Orange)
1V/100A (Yellow)
1V/10A (Blue)
Common (Pink)
Output Reference (Gray)
Amplitude (White)
Contactor (Black)
Common (Lt. Blue)
Chassis (Green)
H2 A2 L2 E2 M2 F2 K2 B2 D2 P2 S2
Thermal Control
Thermal Control
Output Voltage Detect
Output Voltage Detect
Output Current Detect
PCB Common - 0V
–12VDC
+5VDC
+5VDC
PCB Common - 0V
+12VDC
CN7
Digital Panel Meter (PCB7)
CN2
CN1
Torch Control (Pink)
Torch Control (Yellow)
CN4
CN10

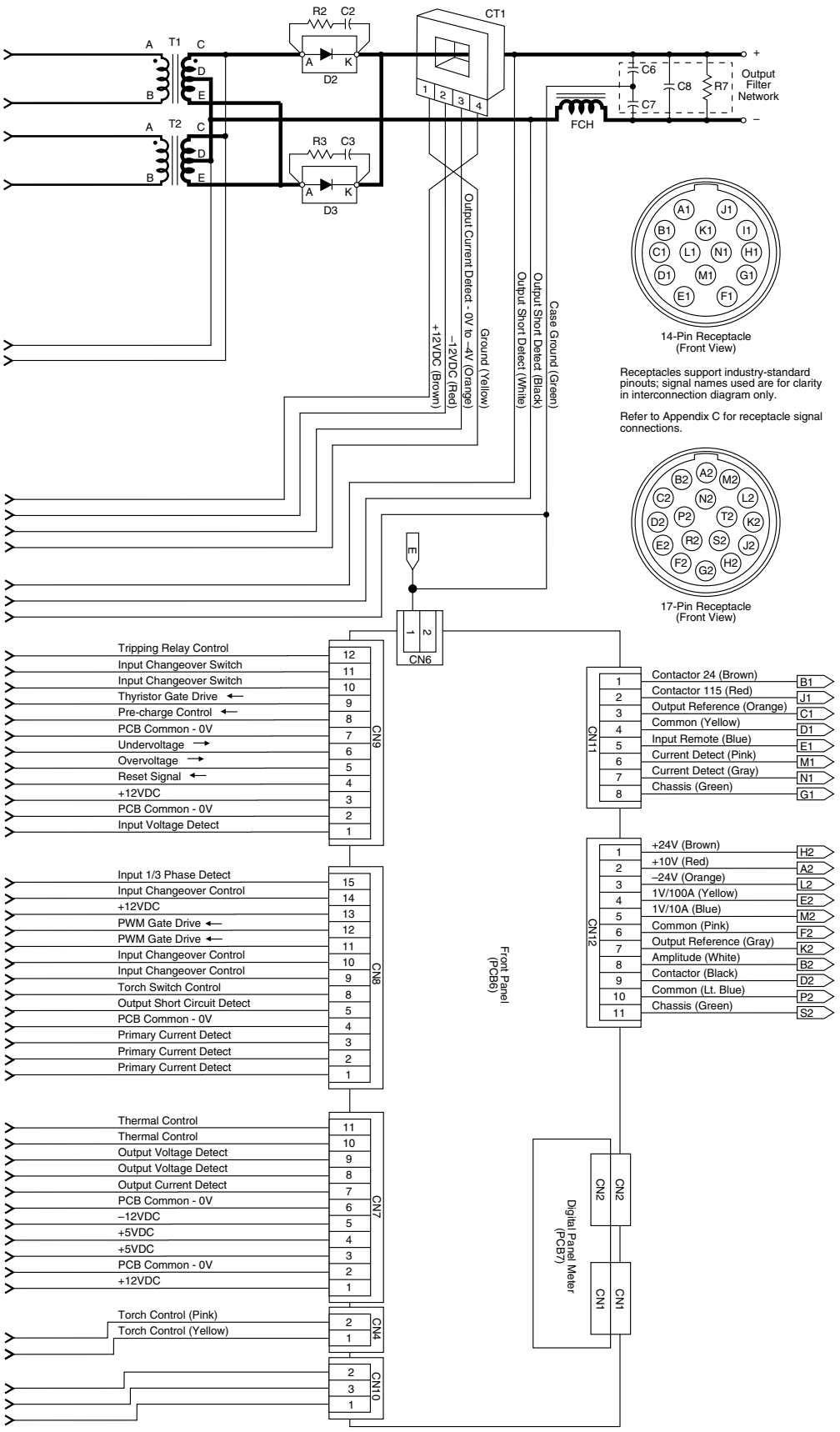
400GMS 380V Interconnection Diagram



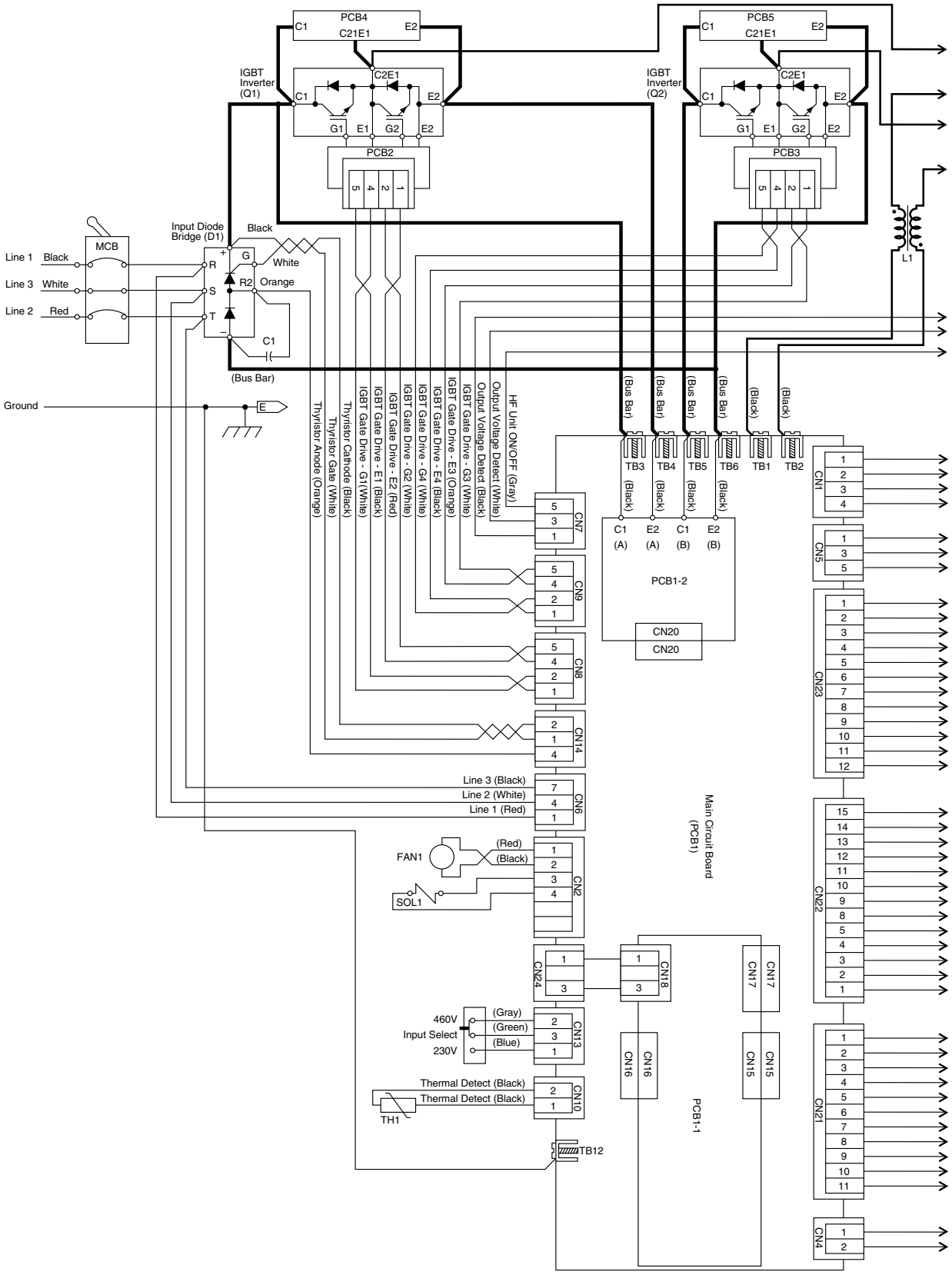

R2 C2
CT1
A T1 C
D
B E
D2
A K
1 2 3 4
+
C6
C8
R7
Output Filter Network
C7
–
FCH
A T2 C
D
B E
R3 C3
A K
D3
Output Current Detect - 0V to –4V (Orange)
–12VDC (Red)
+12VDC (Brown)
Ground (Yellow)
Output Short Detect (White)
Output Short Detect (Black)
Case Ground (Green)
A1 J1
B1 K1 I1
C1 L1 N1 H1
D1 M1 G1
E1 F1
14-Pin Receptacle
(Front View)
Receptacles support industry-standard pinouts; signal names used are for clarity in interconnection diagram only.
Refer to Appendix C for receptacle signal connections.
B2 A2 M2
C2 N2 L2
D2 P2 T2 K2
E2 R2 S2 J2
F2 G2 H2
17-Pin Receptacle
(Front View)
E
1 2
CN6
Tripping Relay Control
Input Changeover Switch
Input Changeover Switch
Thyristor Gate Drive
Pre-charge Control
PCB Common - 0V
Undervoltage
Overvoltage
Reset Signal
+12VDC
PCB Common - 0V
Input Voltage Detect
12 11 10 9 8 7 6 5 4 3 2 1
CN9
1 Contactor 24 (Brown) B1
2 Contactor 115 (Red) J1
3 Output Reference (Orange) C1
4 Common (Yellow) D1
5 Input Remote (Blue) E1
6 Current Detect (Pink) M1
7 Current Detect (Gray) N1
8 Chassis (Green) G1
CN11
Input 1/3 Phase Detect
Input Changeover Control
+12VDC
PWM Gate Drive
PWM Gate Drive
Input Changeover Control
Input Changeover Control
Torch Switch Control
Output Short Circuit Detect
PCB Common - 0V
Primary Current Detect
Primary Current Detect
Primary Current Detect
15 14 13 12 11 10 9 8 5 4 3 2 1
CN8
1 +24V (Brown) H2
2 +10V (Red) A2
3 –24V (Orange) L2
4 1V/100A (Yellow) E2
5 1V/10A (Blue) M2
6 Common (Pink) F2
7 Output Reference (Gray) K2
8 Amplitude (White) B2
9 Contactor (Black) D2
10 Common (Lt. Blue) P2
11 Chassis (Green) S2
CN12
Front Panel (PCB6)
Thermal Control
Thermal Control
Output Voltage Detect
Output Voltage Detect
Output Current Detect
PCB Common - 0V
–12VDC
+5VDC
+5VDC
PCB Common - 0V
+12VDC
11 10 9 8 7 6 5 4 3 2 1
CN7
Digital Panel Meter (PCB7)
CN2
CN2
CN1
CN1
Torch Control (Pink)
Torch Control (Yellow)
2 1
CN4
2 3 1
CN10

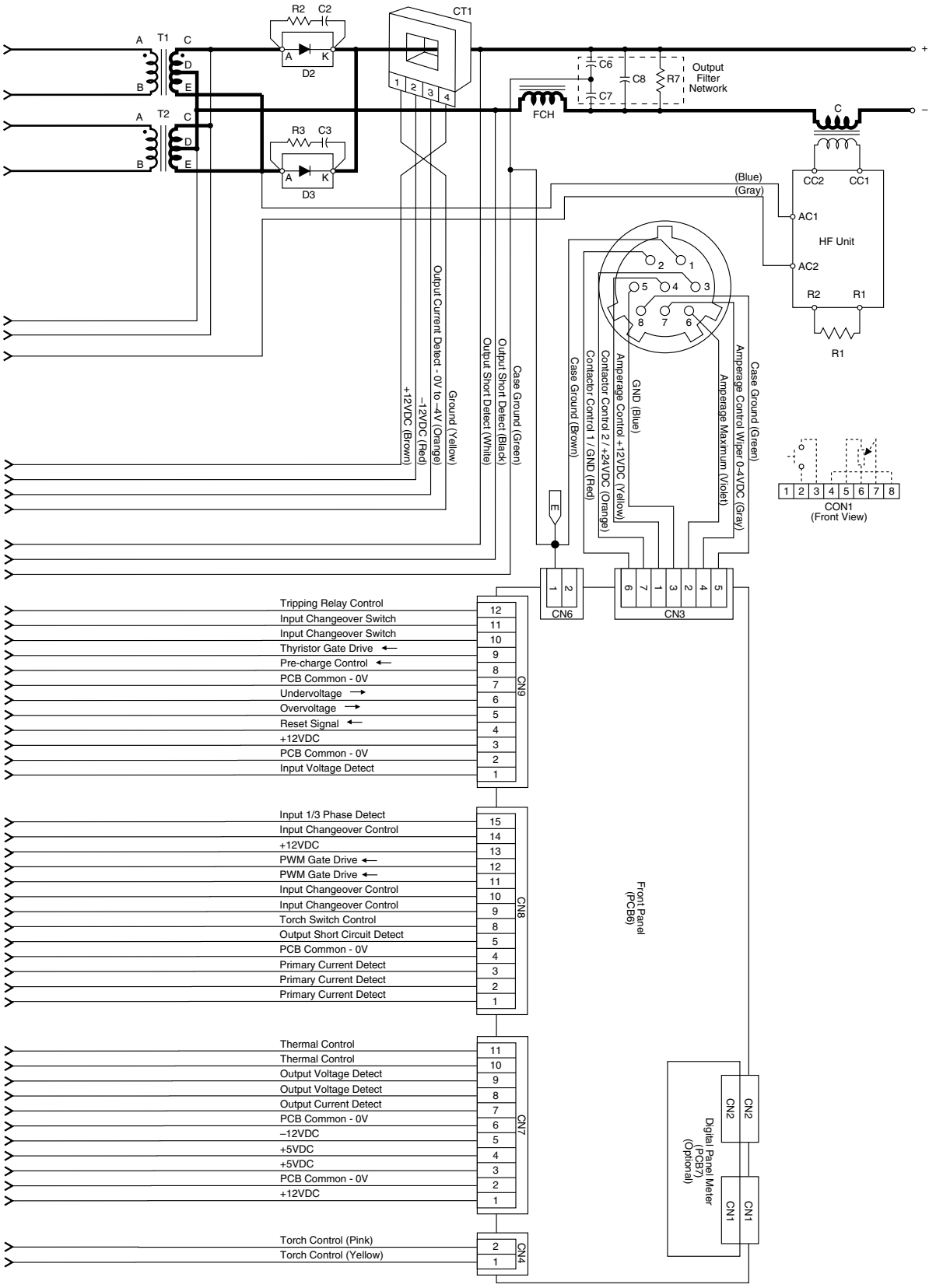
400GMS 460/575V Interconnection Diagram



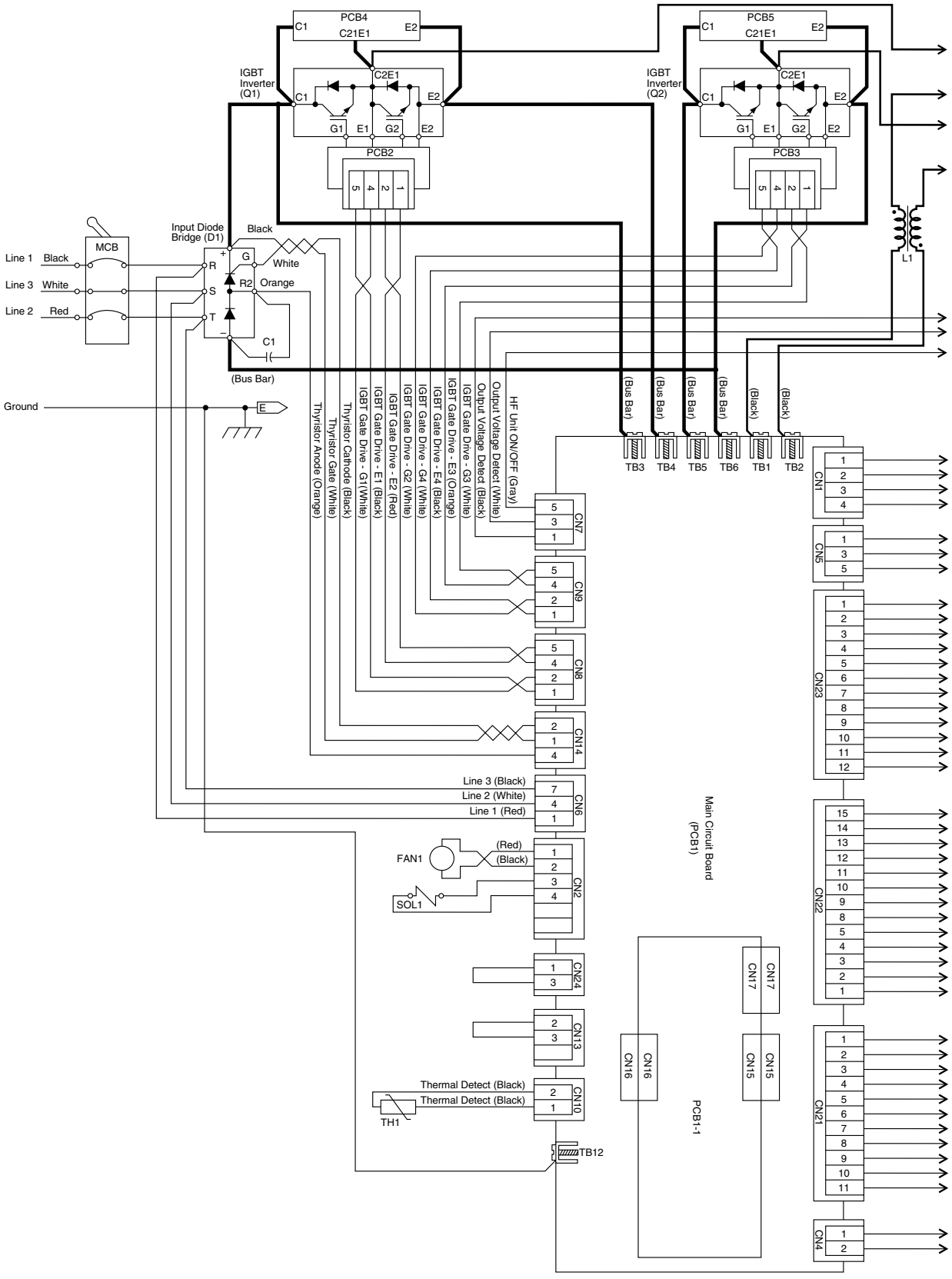

R2 C2
CT1
A T1 C
D
B E
D2
A K
1 2 3 4
C6
C8
R7
Output Filter Network
C7
FCH
A T2 C
R3 C3
D3
Output Current Detect - 0V to -4V (Orange)
Ground (Yellow)
–12VDC (Red)
+12VDC (Brown)
Output Short Detect (White)
Case Ground (Green)
A1 J1 B1 K1 I1 C1 L1 N1 H1 D1 M1 G1 E1 F1
14-Pin Receptacle (Front View)
Receptacles support industry-standard pinouts; signal names used are for clarity in interconnection diagram only.
Refer to Appendix C for receptacle signal connections.
B2 A2 M2 C2 N2 L2 D2 P2 T2 K2 E2 R2 S2 J2 F2 G2 H2
17-Pin Receptacle (Front View)
E
CN6
Tripping Relay Control
Input Changeover Switch
Input Changeover Switch
Thyristor Gate Drive
Pre-charge Control
PCB Common - 0V
Undervoltage
Overvoltage
Reset Signal
+12VDC
PCB Common - 0V
Input Voltage Detect
CN9
Input 1/3 Phase Detect
Input Changeover Control
+12VDC
PWM Gate Drive
PWM Gate Drive
Input Changeover Control
Input Changeover Control
Torch Switch Control
Output Short Circuit Detect
PCB Common - 0V
Primary Current Detect
Primary Current Detect
Primary Current Detect
CN8
Thermal Control
Thermal Control
Output Voltage Detect
Output Voltage Detect
Output Current Detect
PCB Common - 0V
–12VDC
+5VDC
+5VDC
PCB Common - 0V
+12VDC
CN7
Torch Control (Pink)
Torch Control (Yellow)
CN4
CN10
CN11
Contactor 24 (Brown)
Contactor 115 (Red)
Output Reference (Orange)
Common (Yellow)
Input Remote (Blue)
Current Detect (Pink)
Current Detect (Gray)
Chassis (Green)
B1 J1 C1 D1 E1 M1 N1 G1
CN12
+24V (Brown)
+10V (Red)
–24V (Orange)
1V/100A (Yellow)
1V/10A (Blue)
Common (Pink)
Output Reference (Gray)
Amplitude (White)
Contactor (Black)
Common (Lt. Blue)
Chassis (Green)
H2 A2 L2 E2 M2 F2 K2 B2 D2 P2 S2
Front Panel (PCB6)
Digital Panel Meter (PCB7)
CN2
CN1

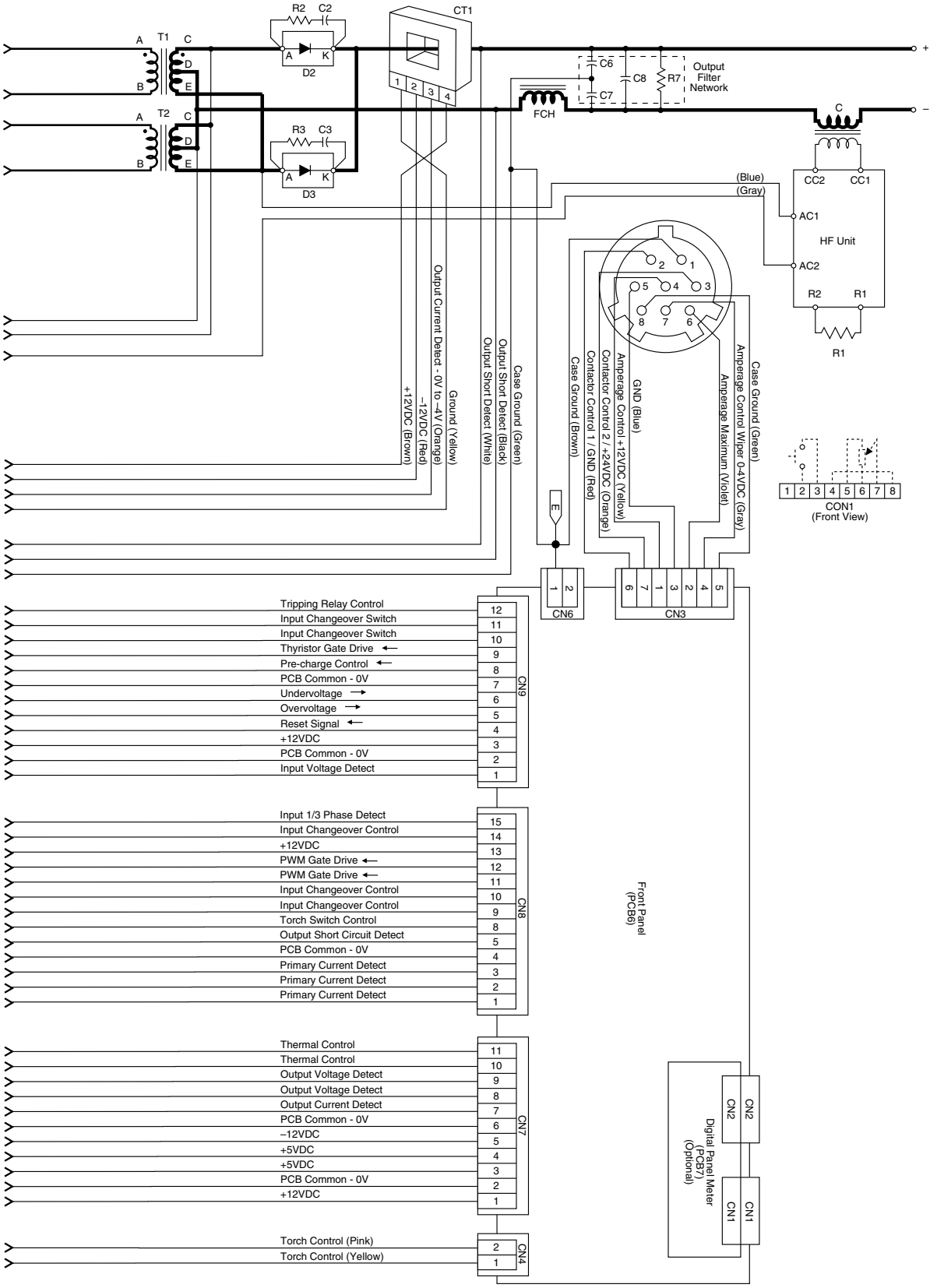
400GTS 230/460V Interconnection Diagram



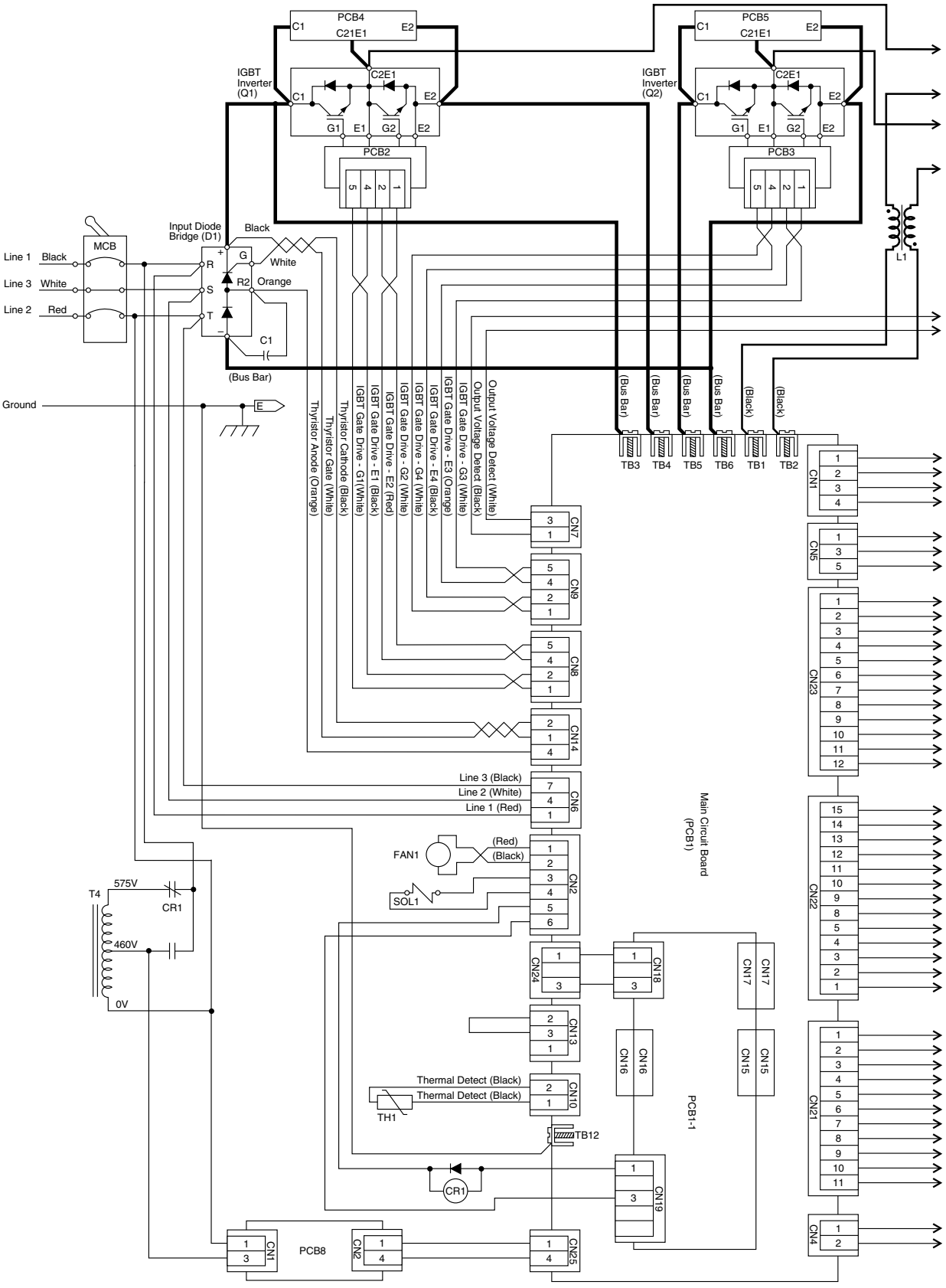

T1
T2
R2
C2
D2
R3
C3
D3
CT1
FCH
C6
C8
R7
C7
Output Filter Network
+
–
C
CC2
CC1
(Blue)
(Gray)
AC1
HF Unit
AC2
R2
R1
R1
CON1 (Front View)
Output Current Detect - 0V to –4V (Orange)
–12VDC (Red)
+12VDC (Brown)
Ground (Yellow)
Output Short Detect (White)
Output Short Detect (Black)
Case Ground (Green)
Case Ground (Brown)
Contactor Control 1 / GND (Red)
Contactor Control 2 / +24VDC (Orange)
Amperage Control +12VDC (Yellow)
GND (Blue)
Amperage Control Wiper 0-4VDC (Gray)
Amperage Maximum (Violet)
Case Ground (Green)
CN6
CN3
Tripping Relay Control
Input Changeover Switch
Input Changeover Switch
Thyristor Gate Drive
Pre-charge Control
PCB Common - 0V
Undervoltage
Overvoltage
Reset Signal
+12VDC
PCB Common - 0V
Input Voltage Detect
CN9
Input 1/3 Phase Detect
Input Changeover Control
+12VDC
PWM Gate Drive
PWM Gate Drive
Input Changeover Control
Input Changeover Control
Torch Switch Control
Output Short Circuit Detect
PCB Common - 0V
Primary Current Detect
Primary Current Detect
Primary Current Detect
CN8
Front Panel (PCB6)
Thermal Control
Thermal Control
Output Voltage Detect
Output Voltage Detect
Output Current Detect
PCB Common - 0V
–12VDC
+5VDC
+5VDC
PCB Common - 0V
+12VDC
CN7
Digital Panel Meter (PCB7) (Optional)
CN2
CN2
CN1
CN1
Torch Control (Pink)
Torch Control (Yellow)
CN4

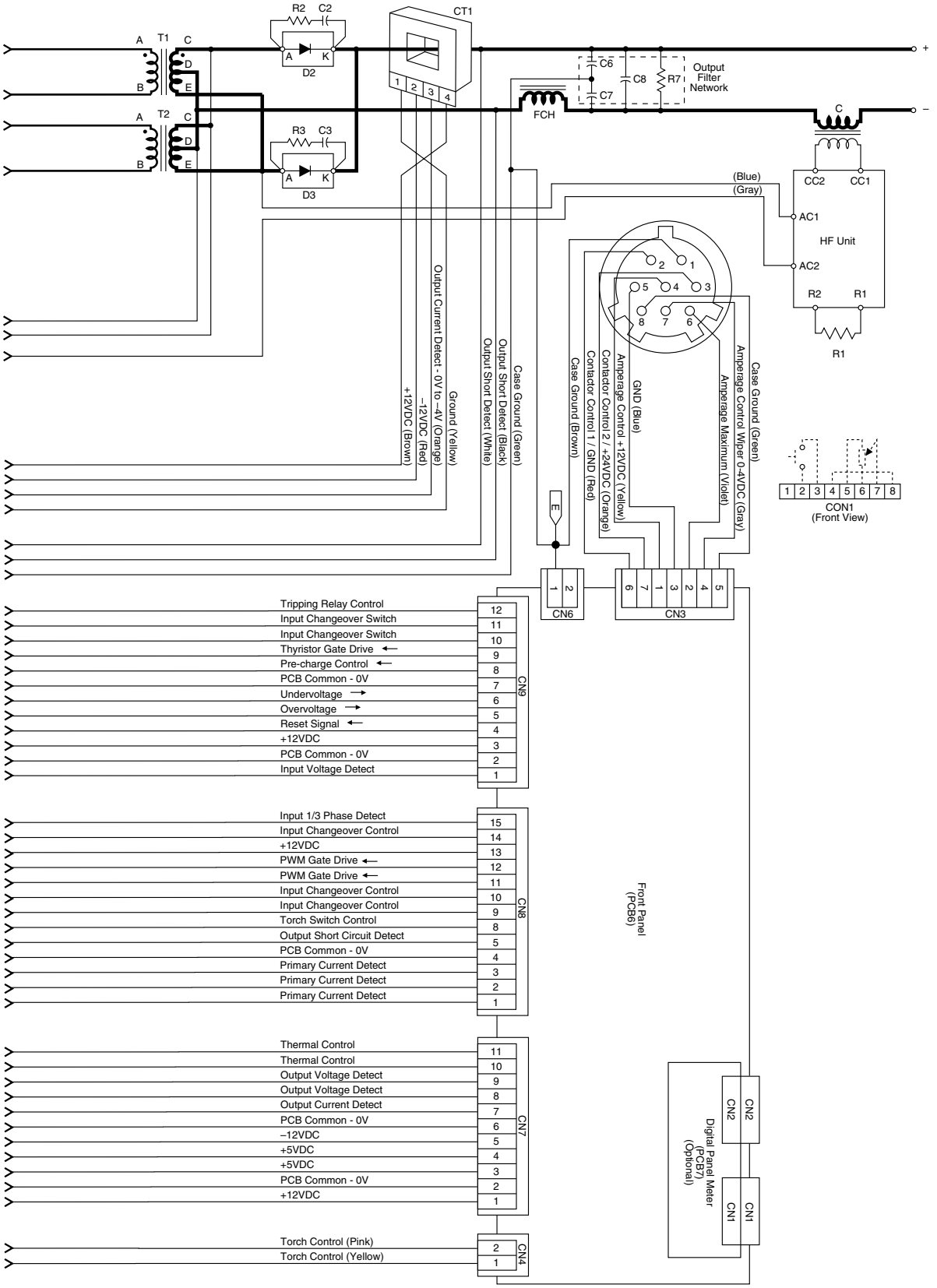
400GTS 380V Interconnection Diagram




R2 C2
CT1
T1
A
B
C
D
E
D2
K
1 2 3 4
C6
C8
R7
Output Filter Network
C7
FCH
+
–
T2
R3 C3
D3
C
CC2 CC1
(Blue)
(Gray)
AC1
HF Unit
AC2
R2 R1
R1
2 1
5 4 3
8 7 6
Output Current Detect - 0V to -4V (Orange)
Ground (Yellow)
–12VDC (Red)
+12VDC (Brown)
Output Short Detect (Black)
Case Ground (Green)
Output Short Detect (White)
Case Ground (Brown)
Contactor Control 1 / GND (Red)
Contactor Control 2 / +24VDC (Orange)
Amperage Control +12VDC (Yellow)
GND (Blue)
Amperage Maximum (Violet)
Amperage Control Wiper 0-4VDC (Gray)
Case Ground (Green)
1 2 3 4 5 6 7 8
CON1
(Front View)
E
1 2
CN6
6 7 1 3 2 4 5
CN3
Tripping Relay Control
Input Changeover Switch
Input Changeover Switch
Thyristor Gate Drive
Pre-charge Control
PCB Common - 0V
Undervoltage
Overvoltage
Reset Signal
+12VDC
PCB Common - 0V
Input Voltage Detect
12 11 10 9 8 7 6 5 4 3 2 1
CN9
Input 1/3 Phase Detect
Input Changeover Control
+12VDC
PWM Gate Drive
PWM Gate Drive
Input Changeover Control
Input Changeover Control
Torch Switch Control
Output Short Circuit Detect
PCB Common - 0V
Primary Current Detect
Primary Current Detect
Primary Current Detect
15 14 13 12 11 10 9 8 5 4 3 2 1
CN8
Front Panel (PCB6)
Thermal Control
Thermal Control
Output Voltage Detect
Output Voltage Detect
Output Current Detect
PCB Common - 0V
–12VDC
+5VDC
+5VDC
PCB Common - 0V
+12VDC
11 10 9 8 7 6 5 4 3 2 1
CN7
Digital Panel Meter (PCB7) (Optional)
CN2
CN2
CN1
CN1
Torch Control (Pink)
Torch Control (Yellow)
2 1
CN4

400GTS 460/575V Interconnection Diagram




R2 C2
CT1
T1
A
B
C
D
E
D2
A K
1 2 3 4
C6
C8
R7
C7
Output Filter Network
+
–
FCH
C
T2
R3 C3
D3
(Blue)
(Gray)
CC2 CC1
AC1
HF Unit
AC2
R2 R1
R1
Output Current Detect - 0V to –4V (Orange)
–12VDC (Red)
+12VDC (Brown)
Ground (Yellow)
Output Short Detect (Black)
Output Short Detect (White)
Case Ground (Green)
Case Ground (Brown)
Contactor Control 1 / GND (Red)
Contactor Control 2 / +24VDC (Orange)
Amperage Control +12VDC (Yellow)
GND (Blue)
Amperage Control Wiper 0-4VDC (Gray)
Amperage Maximum (Violet)
Case Ground (Green)
CON1
(Front View)
E
CN6
CN3
Tripping Relay Control
Input Changeover Switch
Input Changeover Switch
Thyristor Gate Drive
Pre-charge Control
PCB Common - 0V
Undervoltage
Overvoltage
Reset Signal
+12VDC
PCB Common - 0V
Input Voltage Detect
CN9
Input 1/3 Phase Detect
Input Changeover Control
+12VDC
PWM Gate Drive
PWM Gate Drive
Input Changeover Control
Input Changeover Control
Torch Switch Control
Output Short Circuit Detect
PCB Common - 0V
Primary Current Detect
Primary Current Detect
Primary Current Detect
CN8
Front Panel (PCB6)
Thermal Control
Thermal Control
Output Voltage Detect
Output Voltage Detect
Output Current Detect
PCB Common - 0V
–12VDC
+5VDC
+5VDC
PCB Common - 0V
+12VDC
CN7
Digital Panel Meter (PCB7) (Optional)
CN2
CN1
Torch Control (Pink)
Torch Control (Yellow)
CN4

APPENDIX B — 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.

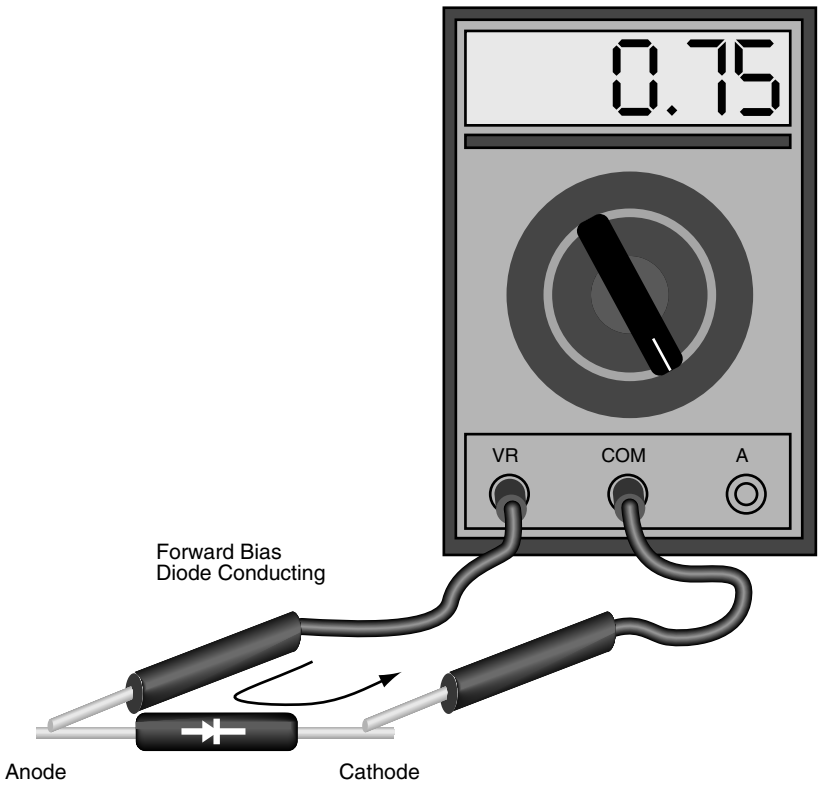


Figure 1. Forward bias diode test

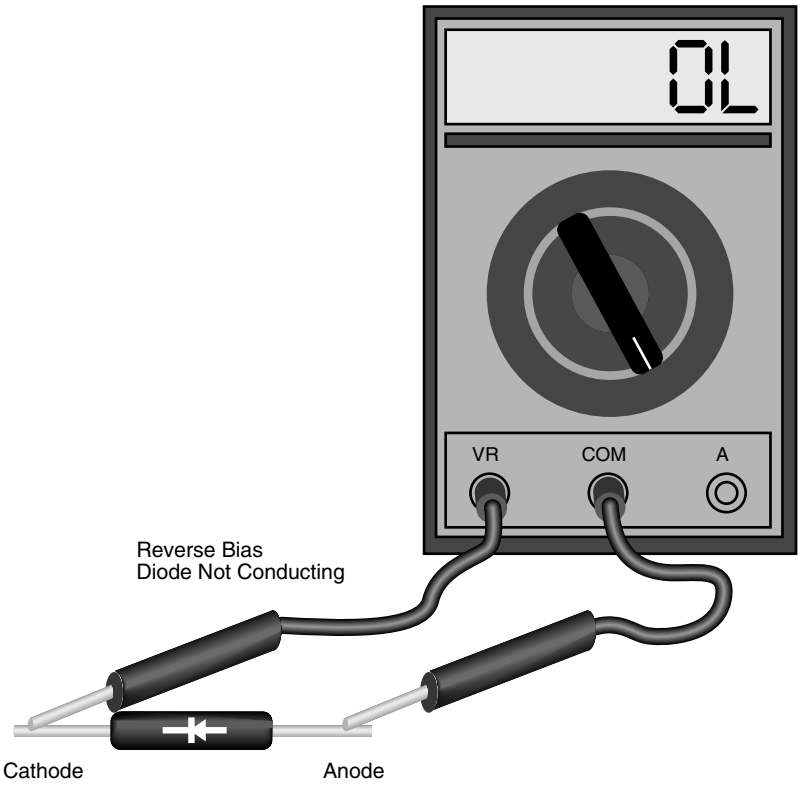


Figure 2. Reverse bias diode test

APPENDIX C – REMOTE RECEPTACLE PINOUT