



Operation and Maintenance Manual with
Illustrated Parts List for GPU-600
3-Phase Solid State
Transformer-Rectifiers



Series 500082-6xx
28.5 Volts, 600 Amps

Introduction

This manual contains operation and maintenance information for “GPU-600” solid-state Transformer-Rectifiers manufactured by ITW GSE, Troy, Ohio 45373.

This manual is not intended to be a textbook on electricity or electronics. Its primary purpose is to provide information and instructions to experienced operators, electricians, and mechanics who have never operated this equipment. It is the intent of this manual to guide and assist operators and maintenance people in the proper use and care of the equipment.

Use of the manual should not be put off until a trouble or need for help develops. Read the instructions before starting the unit. Learn to use the manual and to locate information contained in it. Its style and arrangement are very similar to commercial aircraft manuals.

The manual is divided into five chapters plus an appendix. Each chapter is divided into as many sections as required. Each new section starts with page 1. Each page is identified by chapter, section and page number, which are located in the lower, outside corner. When information located in another portion of the manual is referred to, its location is identified by a chapter, section, paragraph or figure number.

For example: “(see Section 2-3, Paragraph 1.a.)” refers to information located in Chapter 2, Section 3, Paragraph 1.a. If a chapter and section are not indicated in a reference, the referenced material is located in the same section as the reference, for example: “(see Paragraph 1.a.)”

The Appendix is the last section. Its contains a list of available options that may be purchased with that unit. Items on the list with check marks next to them have been added to the standard unit per the customer's order. Literature for each option follows. The Appendix will help control the information in the manual: making it unique to the unit purchased.

In addition to operation and maintenance instructions, the manual contains an illustrated parts list in Chapter 4, and a collection of manufacturer's literature and supplemental information in Chapter 5.

Contents of the manual is arranged as follows:

Chapter 1. Description/Operation

Chapter 2. Servicing/Troubleshooting

Chapter 3. Overhaul/Major Repair

Chapter 4. Illustrated Parts List

Chapter 5. Manufacturer's Literature

Appendix A Options

If you have any questions concerning your ITW GSE equipment, immediately contact our Service Department by mail, telephone, FAX, or E-Mail.

Write:	ITW GSE Service Department 11001 US Highway 41, North Palmetto, FL 34221 U.S.A.
Call Inside U.S.A./Canada:	(866)-845-0441 (Parts) (877) 874-5322 (Technical Support)
Call From Foreign Countries:	(941) 721-1092 (Technical Support) (941) 721-1000 (Spare Parts)
FAX inside U.S.A.	(877) 874-5321
FAX From Foreign Countries:	(941) 721-1091
E-Mail:	technicalsupport@itwgse.us parts@itwgse.us
Web Page:	www.itwgse.com

Safety Warnings and Cautions

WARNING

ELECTRIC SHOCK can KILL. Do not touch live electrical parts.

ELECTRIC ARC FLASH can injure eyes, burn skin, cause equipment damage, and ignite combustible material. **DO NOT** use power cables to break load. Prevent tools from causing short circuits.

IMPROPER PHASE CONNECTION, PARALLELING, OR USE can damage this and attached equipment.

IMPORTANT

Protect all operating personnel. Read, understand, and follow all instructions in the Operating/Instruction Manual before installing, operating, or servicing the equipment. Keep the manual available for future use by all operators.

1) General

Equipment that supplies electrical power can cause serious injury or death, or damage to other equipment or property. The operator must strictly observe all safety rules and take precautionary actions. Safe practices have been developed from past experience in the use of power source equipment. While certain practices below apply only to electrically-powered equipment, other practices apply to engine-driven equipment, and some practices to both.

2) Shock Prevention

Bare conductors, terminals in the output circuit, or ungrounded, electrically-live equipment can fatally shock a person. Have a certified electrician verify that the equipment is adequately grounded and learn what terminals and parts are electrically HOT. Avoid hot spots on machine. Use proper safety clothing, procedures, and test equipment. The electrical resistance of the body is decreased when wet, permitting dangerous currents to flow through it. When inspecting or servicing equipment, do not work in damp areas. Stand on a dry rubber mat or dry wood, and use insulating gloves when dampness or sweat cannot be avoided. Keep clothing dry, and never work alone.

a) Installation and Grounding of Electrically Powered Equipment

This equipment must be installed and maintained in accordance with the National Electrical Code, ANSI/NFPA 70, or other applicable codes. A power disconnect switch or circuit breaker must be located at the equipment. Check the nameplate for voltage, frequency, and phase requirements. If only 3-phase power is available, connect any single-phase rated equipment to only two wires of the 3-phase line. **DO NOT CONNECT** the equipment grounding conductor (lead) to the third live wire of the 3-phase line, as this makes the equipment frame electrically HOT, which can cause a fatal shock.

Always connect the grounding lead, if supplied in a power line cable, to the grounded switch box or building ground. If not provided, use a separate grounding lead. Ensure that the current (amperage) capacity of the grounding lead will be adequate for the worst fault current situation. Refer to the National Electrical Code ANSI/NFPA 70 for details. Do not remove plug ground prongs. Use correctly mating receptacles.

b) Output Cables and Terminals

Inspect cables frequently for damage to the insulation and the connectors. Replace or repair cracked or worn cables immediately. Do not overload cables. Do not touch output terminals while equipment is energized.

3) Service and Maintenance

This equipment must be maintained in good electrical condition to avoid hazards stemming from disrepair. Report any equipment defect or safety hazard to the supervisor and discontinue use of the equipment until its safety has been assured. Repairs should be made by qualified personnel only. Before inspecting or servicing this equipment, take the following precautions:

- a) Please lock-out and Tag procedure, Shut off all power at the disconnecting switch or line breaker before inspecting or servicing the equipment.
- b) Lock switch OPEN (or remove line fuses) so that power cannot be turned on accidentally.
- c) Disconnect power to equipment if it is out of service.
- d) If troubleshooting must be done with the unit energized, have another person present who is trained in turning off the equipment and providing or calling for first aid.

4) Fire And Explosion Prevention

Fire and explosion are caused by electrical short circuits, combustible material near this equipment, or unsafe operating conditions. Overloaded or shorted equipment can become hot enough to cause fires by self destruction or by causing nearby combustibles to ignite. For electrically-powered equipment, provide primary input protection to remove short circuited or heavily overloaded equipment from the line.

5) Bodily Injury Prevention

Serious injury can result from contact with live circuit components inside this equipment. Shut DOWN this equipment for inspection and routine maintenance. When equipment is in operation, use extreme care in doing necessary troubleshooting and adjustment.

6) Medical and First Aid Treatment

First aid facilities and a qualified first aid person should be available for each shift for immediate treatment of all injury victims. Electric shock victims should be checked by a physician and taken to a hospital immediately if any abnormal signs are observed.

**EMERGENCY
FIRST AID**

CALL EMERGENCY RESCUE SQUAD IMMEDIATELY. Seek additional assistance. Use First Aid techniques recommended by American Red Cross until medical help arrives.

IF BREATHING IS DIFFICULT, give oxygen, if available, and have victim lie down.

FOR ELECTRICAL SHOCK, turn off power. Remove victim; if not breathing, begin artificial respiration, preferably mouth-to-mouth. If no detectable pulse, begin external heart massage.

7) Equipment Precautionary Labels

Inspect all precautionary labels on the equipment monthly. Order and replace all labels that cannot be easily read.

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Appendix A

Chapter 1 Description/Operation

Section 1 Description

1) General

The GPU-600 Solid State Transformer-Rectifiers covered by this manual are manufactured by ITW GSE, Troy, Ohio 45373. These Transformer Rectifiers (GPUs) are designed to provide ground power for maintenance and startup of aircraft having 28-VDC electrical systems.

The number 500082 identifies the “model or series” of the GPU. The part number is followed by a different dash number, which separates the basic units available. The criteria for input voltages, Amps, and frequencies change with each dash number. Figure 1 uses the part number to identify the variations possible covered by this manual.

Part & Dash Number	Mounting	CE Certified	Input Voltage	Input Frequency	Output Voltage	Output Current
DCS600T60208	Trailer	--	220/230/460	60 Hz.	28.5 VDC	600 A
DCS600T50380	Trailer	--	220/380	50 Hz.	28.5 VDC	600 A
DCS600T60575	Trailer	--	230/460/575	60 Hz.	28.5 VDC	600 A
DCS600T50380CE	Trailer	Y	220/380	50 Hz.	28.5 VDC	600 A
DCS600S60208	Stationary	--	208/230/460	60 Hz.	28.5 VDC	600 A
DCS600S50380	Stationary	--	220/380	50 Hz.	28.5 VDC	600 A
DCS600S50380CE	Stationary	Y	220/380	50 Hz.	28.5 VDC	600 A
DCS600B60208	Bridge		220/230/460	60Hz	28.5 VDC	600 A
DCS600B60380	Bridge		220/380	60HZ	28.5 VDC	600 A

Figure 1 Series 500082 Transformer-Rectifier Part Number Descriptions

2) Optional Equipment - Appendix A

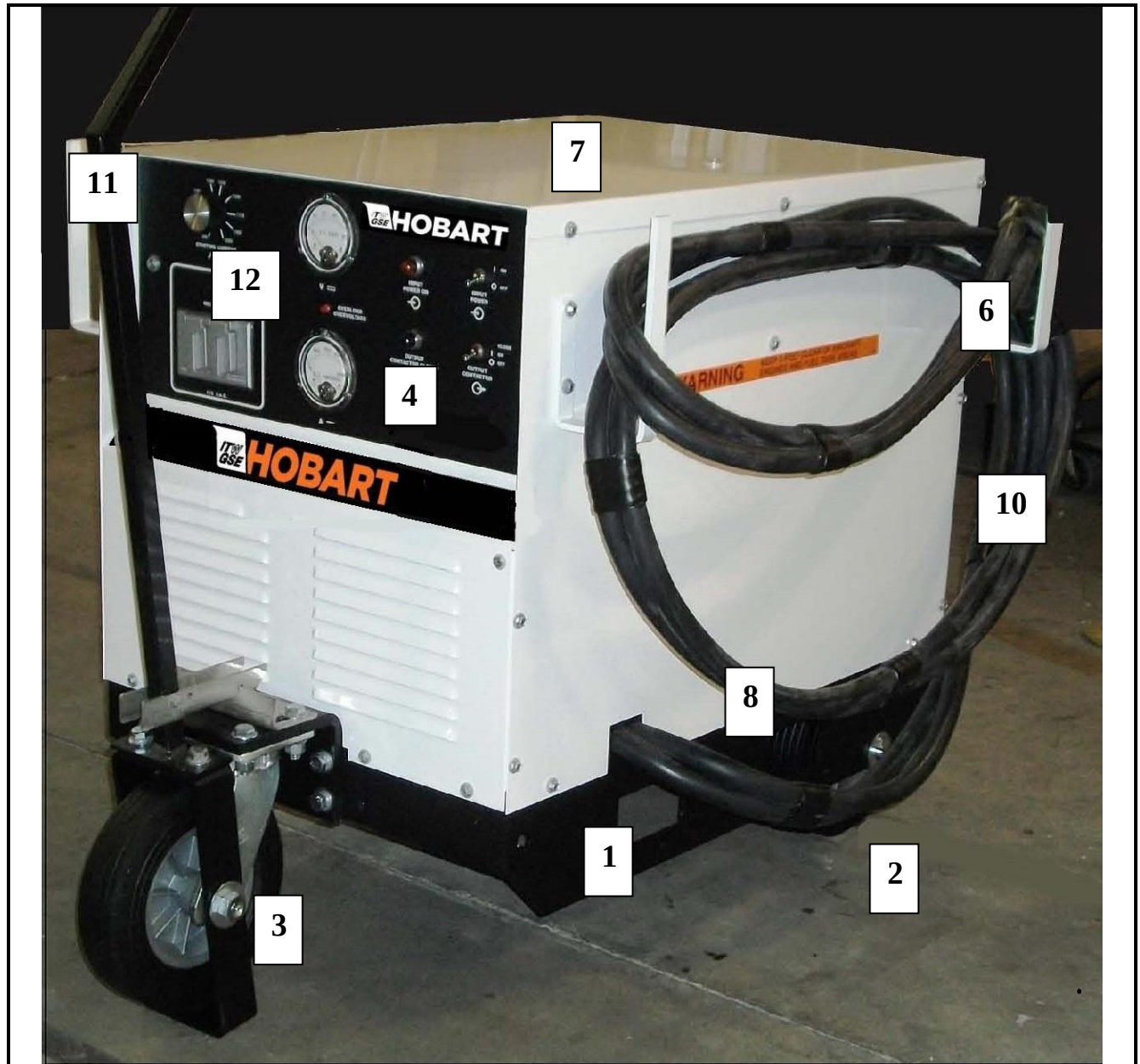
Chapters 1 through 5 of this Operation and Maintenance Manual identifies only the basic version of a Series 500082 GPU. Component differences between the different machines will be listed when necessary. A list of optional equipment, which make this manual unique to the GPU that you have purchased, appears in Appendix A. An example of an item located Appendix A would be a cable basket option.

3) Orientation

To avoid confusion in the location of components, the control panel is considered to be the front of the unit. Left and right are determined by looking at the unit from the front.

4) Mounting for the GPU

As a standard, the Transformer-Rectifier GPU-600 is mounted on three wheels with a caster style front wheel serving as a pivot point for easy maneuverability (i.e. 5th wheel). The GPU-600 can also be mounted stationary as well as mounted on a boarding bridge with the optional bridge mount bracket.



- 1. Mounting Base
- 2. Rear Wheels
- 3. Front Caster
- 4. Front/Control Panel
- 5. Rear Panel [Not Shown]
- 6. Cable Hanger

- 7. Top Panel
- 8. Side Panel (Right Side Shown)
- 9. Cable Storage Basket [Option Only]
- 10. Output Cable
- 11. Pull Handle
- 12. AC Power Receptacle

Assembly of GPU-600 Power

ELECTRICAL DATA			
MODEL	6T28-600CL	5T28-600CL	6T28-600CL
SPECIFICATION NUMBER	DCS600T60208	DCS600T50380	DCS600T6O575
	DCS600S60208	DCS600T50380CE	DCS600B60380
	DCS600B60208	DCS600S50380CE	DCS600S50380
INPUT			
Voltage	208 / 230 / 460	220 / 380	230 / 460 / 575
Amps	86 / 78 / 39	82 / 47	79 / 39 / 32
Frequency	60	50	60
Phase	3	3	3
Convenience Receptacle	10A / 115V / 60 Hz	10A / 220V / 50 Hz	10A / 115V / 60 Hz
For ground cable size See Section 2, Figure 1			
OUTPUT			
D.C. Voltage	28.5	28.5	28.5
Amps	600	600	600
Duty Cycle	100%	100%	100%
Kilowatts	17.1	17.1	17.1

PHYSICAL / DIMENSIONS					
Model	Length (overall)	Width (case)	Width (overall)	Height (w/o cable basket)	Weight (overall)
Trailer	45.7 inches (116.1 cm)	24.1 inches (61.3 cm)	33 inches (83.8 cm)	35 inches (88.8 cm)	650 lbs. (295 kg)
Stationary	35.1 inches (89.2 cm)	24.1 inches (61.3 cm)	33 inches (83.8 cm)	29.3 inches (74.5 cm)	600 lbs. (272 kg)
Bridge	36 inches (91 cm)	24.1 inches (61.3 cm)	34.4 inches (87.3 cm)	59.8 inches (151.9 cm)	

Figure 3 Specifications and Capabilities

5) Safety Features

The GPU continuously monitors output values and automatically shuts down if a fault occurs in order to minimize risks to the user, the aircraft, and the GPU.

See Sub-section 7, "Detailed Description of GPU-600 Components", for details on the types and levels of protection provided by the control system.

6) Theory of Operation

The GPU provides regulated 28.5V DC. Power to the GPU is provided from the local utility company, through the input contactor. The output contactor, controlled by the Output Switch, connects DC power to the load.

The 28V DC power supply consists of a simple and reliable step-down transformer (1, Figure 5) whose output is rectified by six silicon-controlled rectifiers (SCRs) (3, Figure 7) in a full-wave, center tapped configuration. A filter consisting of an inductor and capacitors produces a low ripple DC voltage.

The printed circuit board (PC Board) (9, Figure 5) regulates the output voltage by controlling the SCR turn-on. It does this via the phase control method; which uses the SCRs to select the desired portion of the voltage that has been stepped down by the main transformer to produce the DC voltage. The PC Board also provides current limiting, over-voltage and overload protection for loads connected to the DC output. This output is floating (isolated from chassis ground), eliminating any grounding problems between the load and the chassis ground.

CAUTION

Capacitor charge can injure! Allow capacitors to discharge fully and verify capacitor discharge with voltmeter before touching the capacitor circuitry.

7) Detailed Description of GPU-600 Components

a) Front Panel Control Components (See Figure 4)

(1) Front Panel

The GPU operator controls mount directly to the front panel.

(2) Convenience Receptacle (Figure 4 Item 2)

The convenience provides AC power from a secondary winding on the transformer. The output voltage is 115 VAC for the 60 Hz units and 220 VAC for the 50 Hz units. The receptacle has a weather cover and an MOV surge suppressor.

(3) Starting Current Control (Figure 4 Item 3)

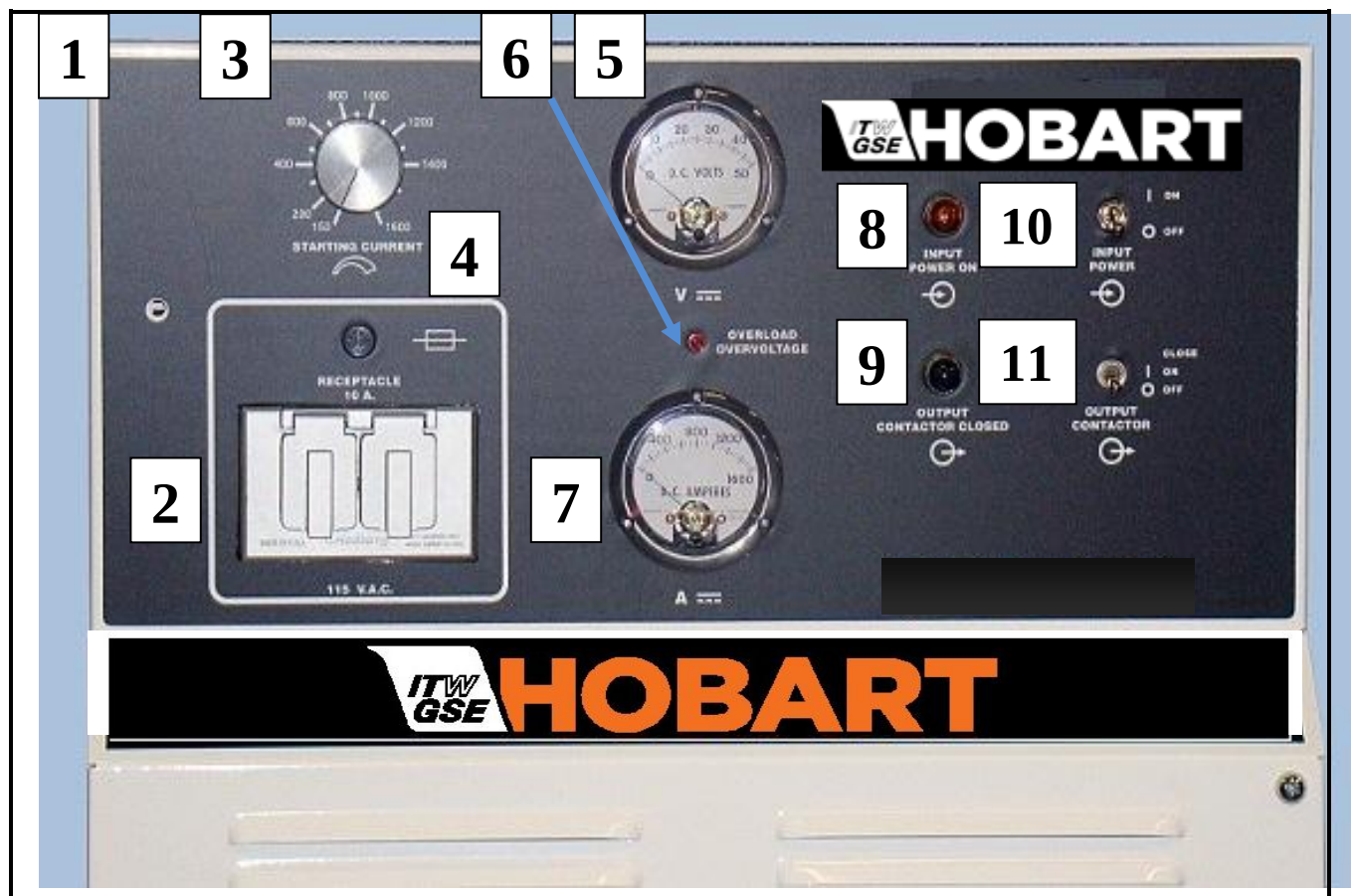
The R13 starting current potentiometer can select any initial or starting current from 200 amperes to a maximum of 2000 amperes. The GPU limits the output current by lowering the output voltage for loads that draw more than the specified current.

(4) Receptacle Fuse (Figure 4 Item 4)

This front-panel fuse protects the convenience receptacle. It is rated at 10 amps.

(5) DC Voltmeter

The M2 output voltmeter (Figure 4 Item 5) measures the DC output voltage across the main filter capacitors. The scale has a 50 V DC maximum reading.



- | | |
|---|--|
| 1. Front Panel | 7. DC Ammeter |
| 2. Convenience Receptacle (115 VAC Shown) | 8. Input Power Light (amber) |
| 3. Starting Current Control | 9. Output Contactor Light (green) |
| 4. Receptacle Fuse | 10. Input Power On-Off Switch |
| 5. DC Voltmeter (M2) | 11. Output Contactor Close-On-Off Switch |
| 6. Overload/Overvoltage Light (red) | |

Figure 4 Front Panel Assembly of GPU-600

(6) Overload/Overvoltage Light (Figure 4 Item 6)

The overload/overvoltage trip light turns on whenever one of the following system faults occur:

- The output voltage has exceeded 31.5 V DC.
- The output current has exceeded 2125 to 2200 A DC.

This light is an LED assembly.

(7) DC Ammeter (Figure 4 Item 7)

The DC ammeter has a 0 to 2000-amp scale. It actually measures the mill volt drop across the R11 ammeter shunt that corresponds to the scale calibration. The scale range is so much more than the rated output because the unit is capable of providing much more current for short durations (engine starts).

(8) Input Power Light (Figure 4 Item 8) (amber)

This light is connected across the coil of the contactor, so it turns on when that contactor has been energized.

(9) Output Contactor Light (Figure 4 Item 9) (green)

This light is connected across the coil of the output contactor, so it turns on when that contactor has been energized.

(10) Input Power On-Off Switch (Figure 4 Item 10)

This switch turns the input contactor on and off. The control transformer T2 supplied power to the input contactor coil through this switch and fuse F8. The input contactor connects the input power to the power transformer primary windings through the voltage changeover board.

(11) Output Contactor Close-On-Off Switch (Figure 4 Item 11)

The S2 output contactor close-on-off switch has a spring loaded up position for the “close” mode, a middle position for “on” mode, and a bottom position for the “off” mode. The output contactor connects the DC output power to the output cable. To turn the output contactor on, move the output contactor switch to the “close” position and then release it to the center “on” position. To turn the output contactor off, move the output contactor switch to the “off” position.

(12) Emergency Stop Switch (CE certified units only – not shown)

This switch is located in the lower right corner. Press to shut off the GPU.

b) Control Board (Figure 5 Item 9)

The control board mounts inside the GPU, on a steel panel behind the left side panel. This circuit board controls for the following functions:

(1) Electronic Overvoltage/Overload Protection Circuit

The control board turns off the power supply and turns on the DS2 red overload trip light on the front panel if more than 31.5 V DC or 2125 A overload exists. To reset, correct the cause of the condition and then turn the input switch off and back on.

(2) Electronically Controlled Current Limit

The starting current or output surge current is selected by adjusting R13 starting current control on the front panel from the minimum 200 A DC to the maximum 2000 A DC.

CAUTION

Excess starting current may cause damage to load, blow fuses or damage the power supply. Contact the factory if you require a current limit lower than the 150 A DC standard minimum limit.

(3) Regulated DC Output Voltages

The voltage value is continuously compared to the actual output. If adequate input voltage exists, deviation from the desired voltage output is corrected by the change in SCR conduction time set by the printed circuit board firing pulse output. This corrective action is done quickly because the control is done electronically with only limited stored energy in the circuitry. Typical response time is about 25 milliseconds.

(4) Thermal Overload Protection

Normally Closed, open on over temperature.

The control board turns off the SCR firing or gate pulses when the S5 overload thermostat (item 18 in Figure 5) opens. The power supply cannot produce any DC output until the S5 thermostat cools enough to automatically reset (close).

c) Main Transformer (Figure 5 Item 1)

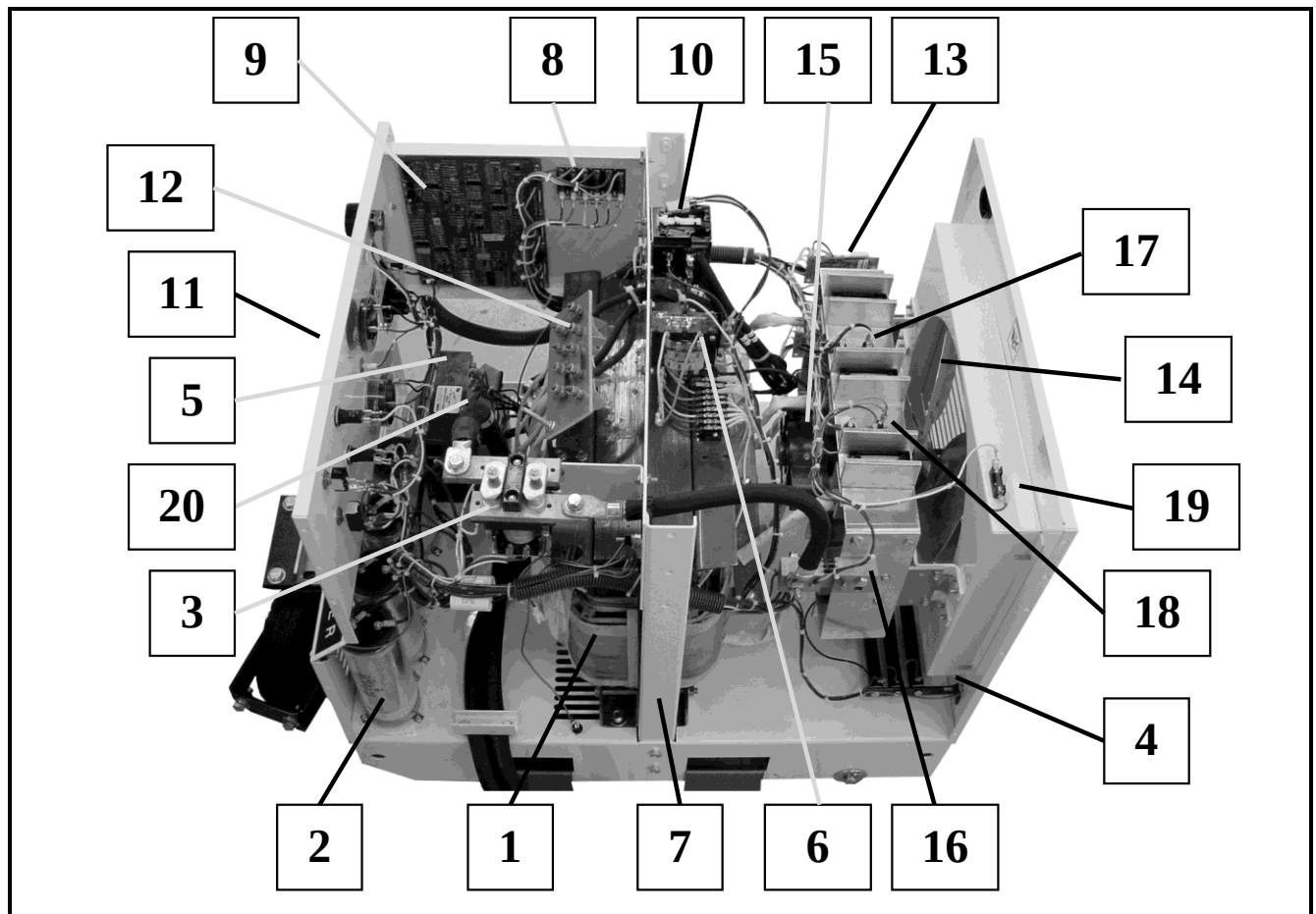
The main power transformer is a forced air-cooled, core-type, three-phase unit that reduces the rated input voltage or voltages to a voltage somewhat higher than the maximum rated output voltage. The extra voltage for the output provides a reserve capability to compensate for under voltage on the input circuit, for the higher IR voltage drop found as the transformer, cables and other components heat up with load and ambient temperature rises.

The main transformer in the GPU supplies power for the DC output and powers the auxiliary output receptacle and the fan. The main transformers for the 60 Hz. units have windings to provide 115 VAC for the auxiliary power receptacle and fan motor. The main transformers for the 50 Hz. units have windings to provide 220 VAC winding for its auxiliary power receptacle and a 110 VAC winding for the fan motor.

The main transformer has a center tapped coil on each phase that provides six fused (F2-F7) sensing or synchronizing voltage signals to the solid state printed circuit control board (Figure 5 Item 9). Be certain to follow the changeover diagram for both the main transformer and the control transformer (Figure 5 Item 6) for the input voltage you have available.

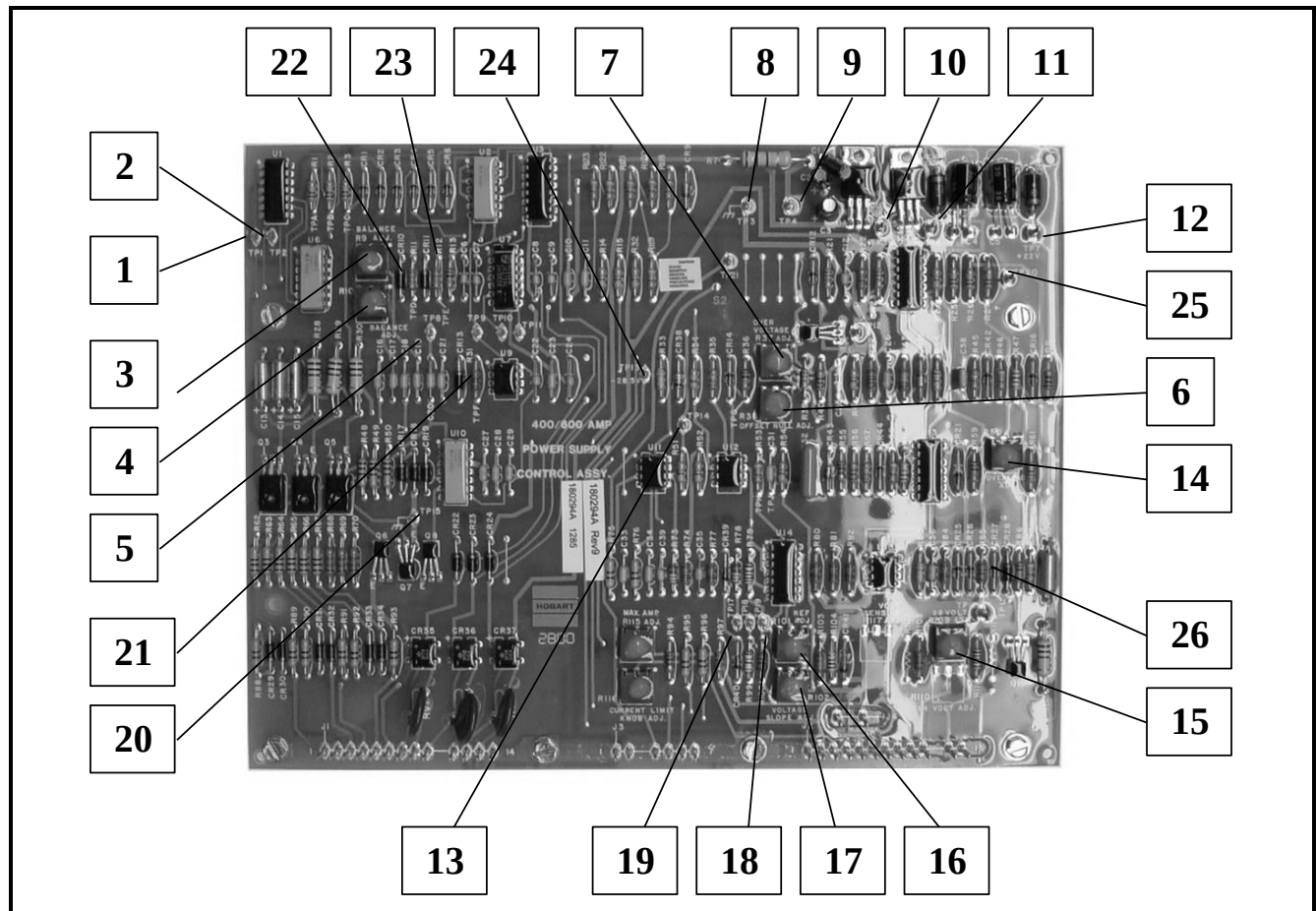
CAUTION

Improper connections will cause damage. Contact factory if your equipment specification information and/or voltage changeover diagram does not agree with your rated three-phase input voltage.



- | | |
|--|---------------------------------|
| 1. Power Transformer (T1) | 11. Front Panel |
| 2. Capacitors (C15, C16, C17) | 12. Voltage Changeover Board |
| 3. 28.5 VDC Output Contactor (K2) | 13. SCR Heat Sink Assembly |
| 4. Pre-load Resistor Assembly (R2, R3, R4) | 14. Fan Blade |
| 5. Choke (L1) | 15. Fan Motor (B1) |
| 6. Control Transformer (T2) | 16. Feedback Shunt (R12) |
| 7. Interior Panel | 17. Fan Turn-on Thermostat (S4) |
| 8. Fuse Block (F2 through F7) | 18. Overload Thermostat (S5) |
| 9. Printed Circuit Board (A1) | 19. Fan Fuse (F1) |
| 10. Line Contactor (K1) | 20. Ammeter Shunt (R11) |

Figure 5 Internal Components of GPU-600



- | | |
|---|---|
| 1. TP1 SCR Gate Pulse from R10 Adjustment | 14. R60 Overload Limit (TP20) |
| 2. TP2 SCR Gate Pulse from R9 Adjustment | 15. R109 28 V DC Output Calibration (TP13) |
| 3. R9 Balance Adjustment Phase 2 (TP2) | 16. R101 5 V Reference Volt Adjustment (TP19) |
| 4. R10 Balance Adjustment Phase 3 (TP1) | 17. R102 Voltage Slope Adjustment (TP17) |
| 5. TP8 Balance SCR Gate Pulse Phase1 | 18. TP19 Reference Volt Test Point (R101) |
| 6. R38 No Load Amp Off Set Null (TP14)* | 19. TP17 Voltage Slope Test Point (R102) |
| 7. R37 Over-voltage Trip Point | 20. TP15 Common, PC Board Volts |
| 8. TP3 PC Board Common | 21. TPF SCR Gate Pulse Timer |
| 9. TP4 +9.1 VDC Timer Voltage | 22. TPE Gate Timer Output Phase 2 |
| 10. TP5 +15 V Regulated Voltage | 23. TPD Gate Timer Output Phase 3 |
| 11. TP6 -15 V Regulated Voltage | 24. TP13 Actual Output Volt (28.5 or 14.25) |
| 12. TP7 +24 V Non regulated Voltage | 25. TP20 Overload Limit (R60) Adjustment |
| 13. TP14 Null at 0 A DC TP (R38)* | 26. TPL Overload Trip Summing Point |

* Note TP14 provides amplified load amp reading for comparison with overload limit (TP20) and starting amperage limit (TP21) set by R13 control on front panel.

Figure 6 Solid State Printed Circuit Control Board Test Points of GPU-600

The 1 amp, F2 through F7 fuses (8, Figure 5) are located near the control board behind the left side panel. These fuses are accessible by removing the top panel.

d) Control Transformer (Figure 5 Item 6)

The small control transformer located on the interior panel (7, Figure 5) provides 115 V AC to the K1 (10, Figure 5) input contactor coil, input contactor light A (12, Figure 4), and S1 (10, Figure 4) input contactor switch via the half amp F8 contactor fuse (located on the control transformer). This transformer does not provide the 10A, 115 VAC auxiliary power.

WARNING

Electric shock can kill! Disconnect input power at the source to remove voltage to the control transformer, input fuses and contactor.

e) Auxiliary Power Circuitry

The single-phase auxiliary power receptacle (Figure 4 Item 5) has the same frequency as the primary input voltage. It is protected by the F9 fuse (Figure 4 Item 11), located on the front panel, typically 10 Amperes. The auxiliary power circuitry is turned off whenever the primary contactor is open or off. The auxiliary power winding is typically located on the middle leg (B phase) of the main transformer. It provides power to the receptacle (5, Figure 4) and to the fan motor via the S4 fan turn-on thermostat. The fan thermostat saves energy and reduces internal dust accumulation by allowing the fan to run only when necessary to prevent overheating.

A "MOV" voltage surge suppressor, RV1 (6, Figure 4), is installed across the receptacle terminals to reduce voltage surge problems to the load equipment and the power source.

f) Output Contactor Circuitry

Output contactor K2 (Figure 5 Item 3) is operated by the output contactor ON-OFF switch S2 (Figure 4 Item 11). Placing this switch momentarily in the TOP (spring-loaded) position turns the output contactor ON, and placing it in the DOWN position turns the output contactor OFF.

The positive output lead is to be connected to the positive output terminal of the K2 contactor. The negative output lead is to be connected to the R11 ammeter shunt. A small notch has been made in the bottom of the right and left side panels to allow the output cable assembly to pass out either side.

The S5 normally-closed overload thermostat (18, Fig. 5) mounted on the main SCR rectifier heat sink is designed to remove the output command signal whenever the heat sink temperature rise becomes too high from overload, loss of cooling air flow, etc. The thermostat automatically resets on cool down.

g) Output Filter Circuitry

The DC output voltage is smoothed (filtered) by an L-C filter made up of L1 iron core reactor (4, Figure 5) carrying the output current to the load and the ripple current to the C15, C16, C17 capacitors (2, Figure 5) in parallel with the load terminals. The R2, R3, R4 bypass resistors (4, Figure 5) provide both a pre-load to the SCR devices and a safety discharge circuit for quickly discharging the filter capacitors whenever the power supply is turned off.

Note: The 50 Hz. units have an additional capacitor in this circuit.

CAUTION

Capacitor charge can injure. Be sure capacitors are discharged before touching.

The CR7 flyback diode (9, Figure 7) acts to facilitate discharge of the output filter circuitry as well as to protect the main SCR rectifier assembly from damaging reverse voltage spikes.

h) Main SCR Heat Sink Assembly (See Figure 7)

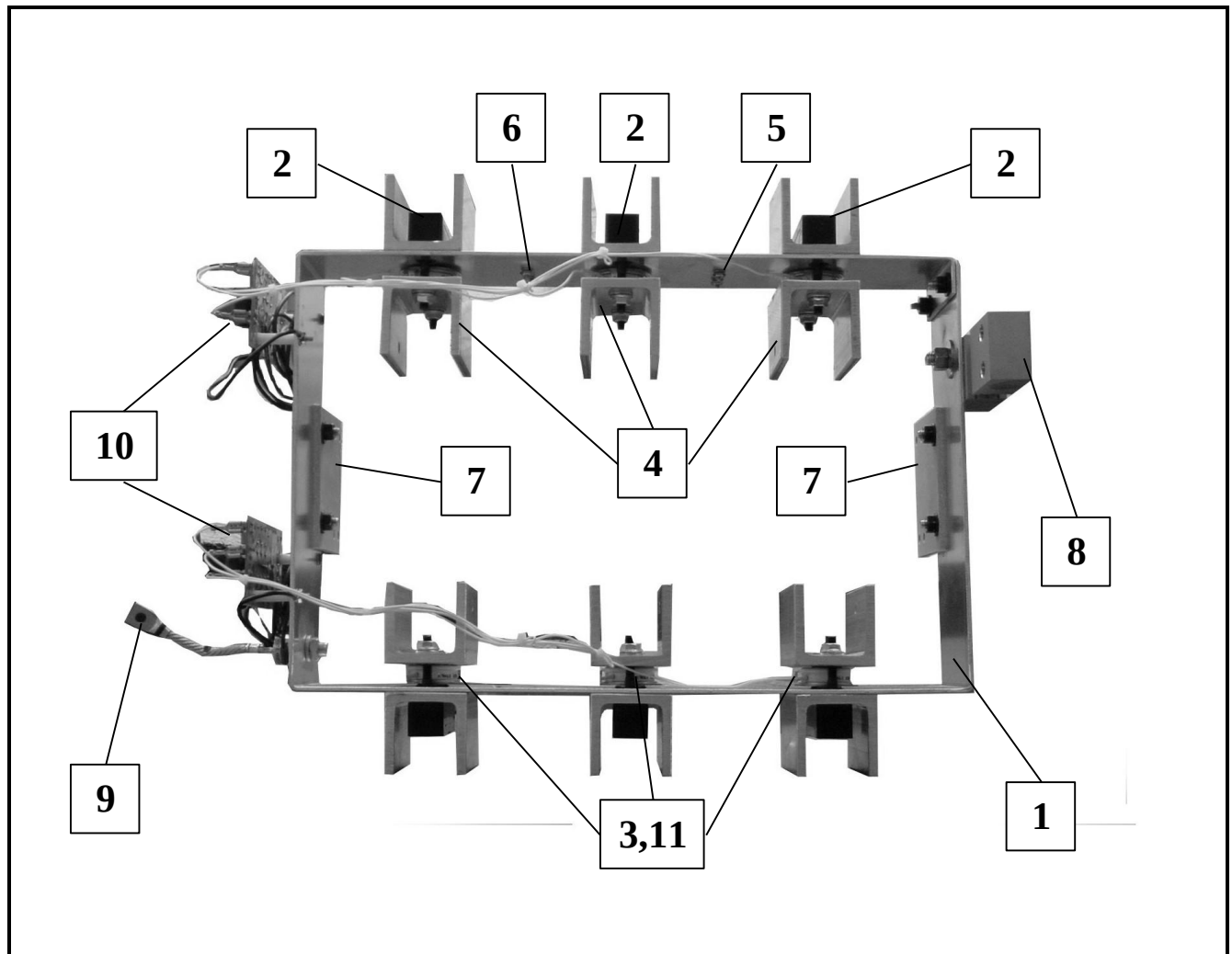
The main SCR heat sink assembly is mounted on the front of the rear panel. It surrounds the 115 V AC cooling fan assembly for optimum cooling efficiency. The SCR heat sink consists of a formed aluminum heat sink with 6 "hockey puck" silicon controlled rectifiers (3, Figure 7) held by 6 insulated compression spring assemblies (2, Figure 7), held against it by 12 U-shaped aluminum heat sinks (4, Figure 7) for the "SCR" device cooling. There are two snubber pc board assemblies for SCR gate signal control and protection (10, Figure 7), and the associated insulators, thermostats and hardware.

The solid-state printed circuit board (9, Figure 5) provides a properly timed and sequenced turn on signal to the silicon controlled rectifiers that must be conducted to provide the desired output.

If the output voltage is too high or if the output current is above the limit set by controls such as the R13 starting potentiometer, the control board delays the SCR turn-on signal to allow less SCR device conduction time for a corresponded lower output. Conversely, if the output voltage is too low, the SCR turn-on signal is delivered earlier in the possible conduction time for each SCR; thereby, allowing more power to be supplied because of the longer conduction time. Proper operation of the SCR devices requires phase sequence and presence of all 6 voltage sensing signals, proper phase sequence and presence of the output voltage to the SCR devices, and the proper magnitude and sequence of the SCR turn-on signal to the SCR gate leads.

i) Thermostatically Controlled Fan (Normally open closes on rise of temperature)

The 115 V AC fan motor (Figure 5 Item 15) does not run until the SCR heat sink gets hot enough to turn on the S4 thermostat (Figure 7 Item 6). This feature can reduce the need for internal power supply cleaning and the use of electricity.



- | | |
|--|---------------------------------------|
| 1. Rectifier Heat Sink | 7. Rectifier Mounting Insulator |
| 2. SCR Mounting Clamp | 8. Feedback Shunt (Not Shown) (R12) |
| 3. Silicon Rectifier (CR1 through CR6) | 9. Positive Base Silicone Diode (CR7) |
| 4. SCR Heat Sink | 10. Surge Suppressors (A2, A3) |
| 5. Overload Thermostat (S5) | 11. Pin Spring |
| 6. Fan Turn-on Thermostat (S4) | |

Figure 7 SCR Heat Sink Assembly of GPU-600

Section 2 Preparation for Use, Storage, or Shipping

1) Receipt and Inspection of Equipment

The GPU has been thoroughly inspected and tested at the factory and prepared for shipment in accordance with standard industrial practices for safe shipment. Upon receiving this equipment, inspect it as follows.

- a) Visually inspect the shipping crate for damage. If any damage is detected, request that the carrier agent inspect the shipment and note the damage on the delivery receipt. This is for your protection.
- b) If there is no obvious damage to the shipping crate, unpack the unit as follows:

2) Unpacking the Unit

- a) Remove the crate. Take care to avoid damage to the equipment if bars, hammers, etc. are used in unpacking. Remove all unused hardware from the unit.
- b) Visually inspect the unit for evidence of external damage such as damaged sheet metal, scratches, dents, etc. Check also for loose connections and components. If the equipment has been damaged in transit, file a claim for damage at once. If you require assistance with a damage claim, furnish ITW GSE with full information about the claim.

NOTE: Save the shipping container until the unit has been put into service and determined to be operating correctly.

3) Operating Location Selection

For best operating characteristics and longest unit life, select an installation site that is not exposed to high humidity, dust, high ambient temperature, flooding, or corrosive agents. Moisture can condense on electrical components, causing corrosion or shorting circuits. Dirt on components helps retain this moisture in addition to providing a conducting material.

Adequate air circulation is needed at all times in order to assure proper operation. Provide a minimum of 12 inches (305mm) of free air space at both the front and rear of the unit. Make sure that the ventilator openings are not obstructed. The unit should not be installed on a grade greater than 10°.

4) Input Cable Selection

Figure 1 shows input cable size requirements for GPU units covered by this manual. This information is from the U.S. National Electrical Code ANSI/NFPA 70. Install this equipment per the latest edition, available from the National Fire Protection Association (www.nfpa.org). The customer must also furnish a suitable means to safely disconnect power from the GPU.

The GPU has a large inrush current when it is first turned on, much like a large electric motor. Therefore, to avoid falsely tripping the supply line circuit breaker or fuse, the circuit breaker or fuse should be the type used with electric motors.

Any problems consult our Service Department

LINE VOLTS	RATED	COPPER LINE WIRE SIZE	
		In Conduit (*)	In Flexible Cable (**)
208	86	No. 3 AWG	No. 4 AWG
220	82	No. 3 AWG	No. 4 AWG
230	78	No. 3 AWG	No. 4 AWG
380	47	No. 6 AWG	No. 8 AWG
460	39	No. 8 AWG	No. 8 AWG
575	32	No. 8 AWG	No. 8 AWG

* Conductor sizes listed are for 30 feet or less of each conductor in conduit and for **copper** conductors having **90° C insulation**, such as type **FEB, FEPB, RHH, and THHN** as based on an ambient temperature of 50° C. For conductors having other insulation, or for conductors longer than 30 feet, consult **local electrical code** for the required conductor size.

** Conductor sizes listed are for 30 feet or less of each conductor in conduit and for **copper** conductors having **90° C insulation**, such as type **W, SC, SCE, SCT, PPE, G, and G-GC** as based on an ambient temperature of 50° C. For conductors having other insulation, or for conductors longer than 30 feet, consult **local electrical code** for the required conductor size.

Figure 1 Recommended Wire and Fuse Size Table

5) Installation

A ITW GSE GPU requires no additional preparation in order to supply power to an aircraft. It needs only to have its input cable connected to an appropriate source of power and its output cable connected to an aircraft. Proceed as follows for putting the GPU unit into service.

WARNING	The method of installation, conductor size, and over-current protection shall conform to the requirements of the local electrical code, the national electrical code, or other national codes, as applicable. Qualified persons shall do all installation wiring and machine reconnection.
----------------	--

WARNING	Electric shock can kill! Open the disconnect switch, or breaker, and determine that no voltage is present before removing top canopy and connecting wires between the input service and power supply or working on the power supply.
----------------	--

a) Locate the Cable Entry Locations

Input and output cable entrance shall be made through the cable entrance holes provided in the GPU cabinet.

The GPU has an 1.75" diameter entry hole for the input cable on the rear of the unit. The customer is responsible for supplying a suitable cable clamp.

The GPU canopy has slots on the side for the output cable. A cable clamp holds the output cable to the unit base.

Please contact the Service Department if you have any problem with this

b) Verify the Input Voltage Configuration

The GPU may be configured for various input voltages, depending on the specific model (specification number). The factory pre-configures each unit before shipment according to the customer specifications for the input voltage. While the GPU is open for connecting cables, verify the voltage configuration. Figure 2 shows the interior panel as viewed from the right side of the GPU.

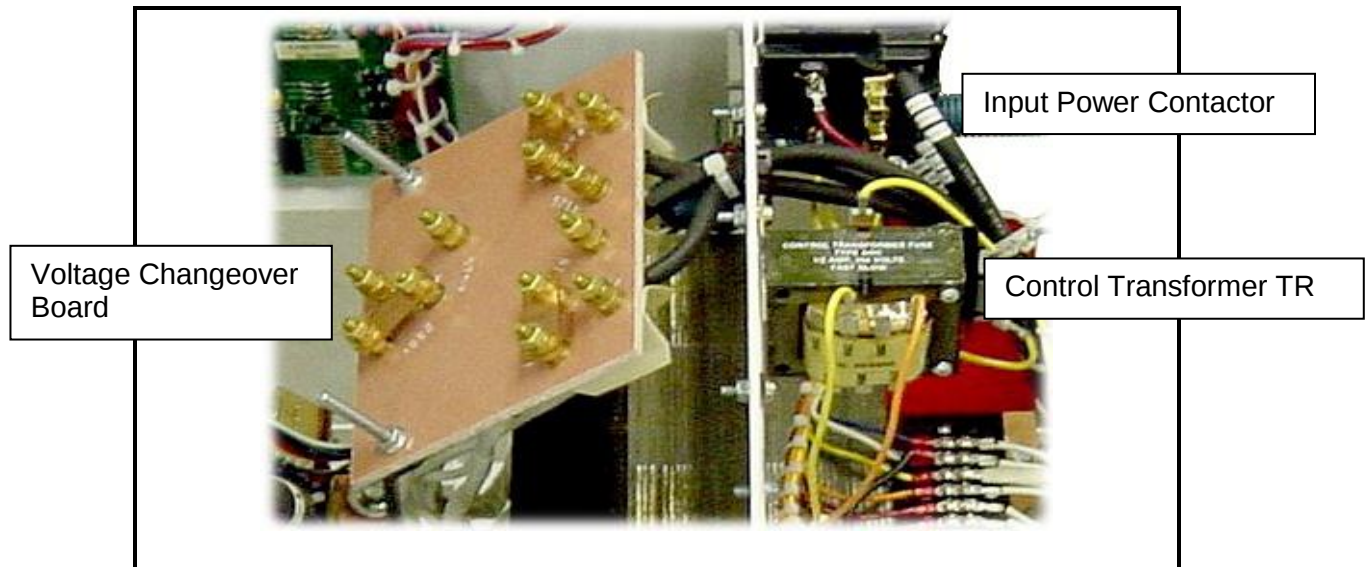


Figure 2 Input Voltage Configuration Locations

On the left is Voltage Changeover Panel, which sets the input voltage for the main transformer. On the right is the control transformer, which has different taps for the various input voltages.

- (1) Make sure the GPU is not connected to the electrical service.
- (2) Remove the top cover.
- (3) Locate the items pictures in Figure 2.
- (4) Refer to Sheet 6 of the schematic diagram, which is located in Chapter 5 of this manual.
- (5) Verify that the configuration matches the appropriate diagram on the schematic.

CAUTION

Reconnection of control transformer as well as main input connection panel must be made when changing rated input voltage. See changeover diagram.

Changing the voltage configuration requires changes to main transformer T1 configuration on the Changeover Board and changes to control transformer T2 by moving a yellow wire to a different tap on the right side of the transformer. (See Figure 2)

If it is necessary to change the configuration, follow these steps:

- (1) On the T1 Changeover Board, move the jumper links as shown on the diagram for your voltage requirement.
- (2) On the right side of control transformer, move the yellow wire to the tap specified in the diagram.

c) Connect the Input Cable to the GPU

- (1) Route the cable through the hole provided in the rear panel.
- (2) Connect the three-phase line leads to input terminals on line contactor, which is located on the interior panel inside the power supply cabinet.
- (3) Be certain that the cable will not contact the fan or hot parts on the SCR heat sink assembly.
- (4) Attach the equipment ground conductor to the stud provided adjacent to the contactor.

WARNING

To help protect against electrical shock from line voltage or static discharge, make sure the GPU is grounded.

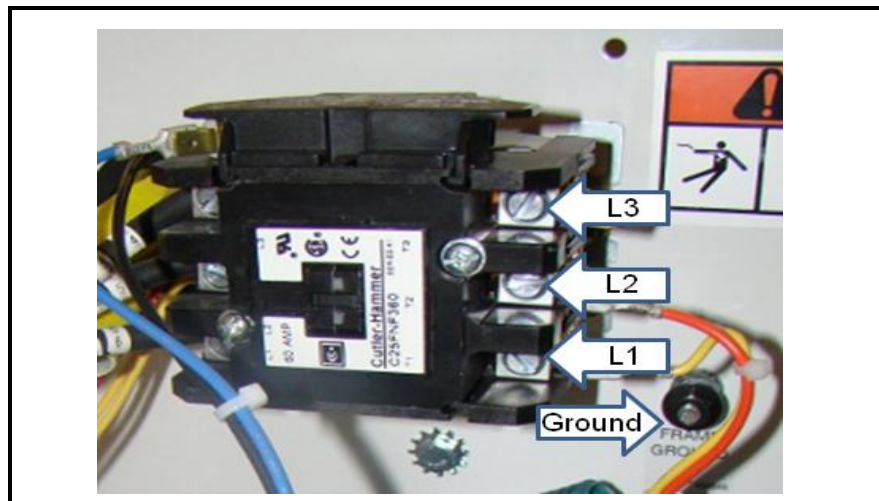


Figure 3 Input Contactor

NOTE: After connecting the input cables, it is recommended that ITW GSE # 904021 urethane coating be sprayed on the connections at the contactor to protect these connections from corrosion, fungus, and contamination. Spraying these connections will also reduce the potential for arcing from dirt and condensation.

d) Connect the Input Cable to the Utility Service

Before connecting input cables to the power supply service, check voltage, amperage and phase ratings of the service. Make certain that the capacity of the service is adequate for the power requirements of the unit being connected to it. Make certain that the service used as the source of input power is grounded. Refer and conform to your local electrical code when selecting and installing power supply service.

- (1) Make sure electrical service is off.
- (2) Connect the input power cables to the input power source.
- (3) Connect the grounding conductor to a proper ground.
- (4) Leave the electrical service turned off.

e) Connect the Output Cable

Wheel-mounted GPUs are generally shipped with the output cable already installed. For bridge-mount or stationary GPUs, the customer must supply and connect the output cable. To connect the output cable, follow these steps:

- (1) Route the cable through the side panel and under the cable clamp.
- (2) Connect the positive output lead to the positive output terminal of Output Contactor K2.
- (3) Connect the negative output lead to Ammeter Shunt R11.
- (4) Tighten the cable clamp.

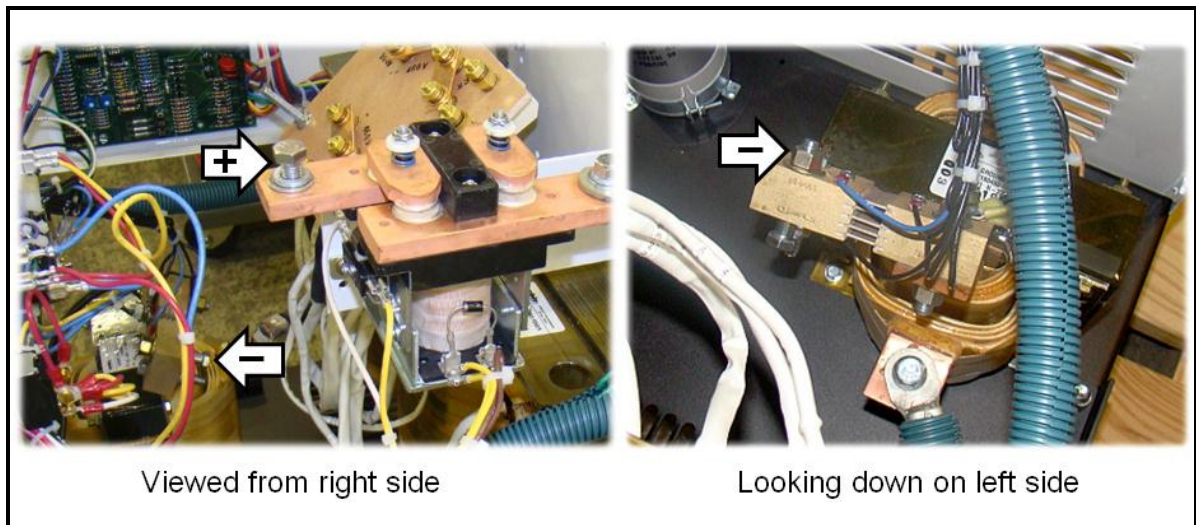


Figure 4 Output Connections

f) Check GPU No-Load Operation

A no-load check should be made before the GPU is connected to an aircraft. Proceed as follows.

- (1) Replace the top panel.
- (2) Apply input power to the GPU from the input power source.
- (3) On the front panel of the GPU, turn on the input power switch.
- (4) Verify that the amber input power light turns on.
- (5) Hold the output contactor switch up in the "Close" position until the green output contactor light turns on.
- (6) Release the output contactor switch to the middle "On" position.
- (7) Verify that the voltmeter shows the proper voltage.

- (8) Using a handheld voltmeter, verify that voltage is present at the aircraft connector.
- (9) Turn off the GPU.

The unit is now available for regular service.

6) Preparation for Storage

a) General

- (1) The unit should be prepared for storage as soon as possible after being removed from service.
- (2) The unit should be stored in a building which is dry and which may be heated during winter months. The unit shall be stored on a grade no greater than 10°.
- (3) Moisture absorbing chemicals are available for use where excessive dampness is a problem. However, the unit must be completely packaged and sealed if moisture-absorbing chemicals are to be effective.

b) Temporary Storage

When storing the unit for 30 days or less, prepare as follows:

- (1) Use moisture-absorbing chemicals where excessive dampness is a problem. However, the unit must be completely packaged and sealed if moisture-absorbing chemicals are to be effective. Seal all openings. Use a waterproof, vapor proof material that is strong enough to resist puncture damage.
- (2) Store the unit in a building which is dry and which may be heated during winter months.

c) Long Time Storage

- (1) To protect the GPU's components, the complete unit should be packaged, using moisture proof packaging and sealing material. Place containers of moisture-absorbing chemicals, such as silica gel, in the unit before packaging.
- (2) Store the unit in a building which is dry and which may be heated during winter months.

7) Preparation for Shipment

During long shipments, vibration, jolting, etc may loosen the GPU unit's retaining hardware. Check this hardware periodically during the shipment to make certain that retaining hardware is secure.

Section 3 Operation

IMPORTANT

Before attempting to operate the converter, read this entire section to become fully familiar with how the converter operates.

1) General

This section contains information for safe and efficient operation of the equipment. Operating instructions are presented in step-by-step sequence of procedures to be followed in supplying 28 V DC to an aircraft or similar load.

WARNING

Electric shock and fire can kill! Read and understand all operating instructions before attempting to operate the equipment. Operation attempts by untrained personnel can endanger people, this equipment, and the load. Do not attempt to operate the equipment for uses not approved by the manufacturer, or at input and output ratings not listed in the specification table located in 1-1, Figure 3.

The repeated opening of input fuses or repeated functioning of the overload trip circuitry indicates a misapplication, a faulty main component, or an improper connection or load. Correct the problem by following the instructions in Chapter 2 before attempting to operate the power supply. Be certain that a input disconnect means is readily accessible between the power input source and this DC power supply. You may need to quickly isolate the DC power source from all power during an emergency, fire, or equipment malfunction.

2) Normal and Bridge Preparation

a) Normal Preparation

- (1) Verify input power is disconnected at source.
- (2) Verify that the supply-input connections agree with the input voltage available by comparison to the voltage changeover diagram.
- (3) Connect output cable between load and the proper connection points in the DC power supply.
- (4) When all covers or panels are in place, turn on the source of input power.
- (5) Set R13 start level control knob (1-1, 8, Figure 4) to the output surge limit required for your load.

b) Bridge Preparation

- (1) Perform steps a) – e) under Normal Preparation.
- (2) Place S1 Input Contactor Switch in ON position (1-1, 10, Figure 4).

3) Operation Procedure

a) Input Control Functions

- (1) Turn on S1 input contactor switch (1-1, 10, Figure 4).
- (2) Verify that only the amber input power light (1-1, 12, Figure 4) glows. If the light glows, no problems exist requiring service.

b) Output Control Functions

- (1) Hold the S2 output contactor switch (1-1, 11, Figure 4) in the up "CLOSE" position long enough for the green output contactor light (1-1, 13, Figure 4) to glow.
- (2) Release S2 switch to the middle "ON" position.
- (3) Verify that M1 DC ammeter (1-1, 2, Figure 4) does not read excessive amperage.
- (4) The DC power supply should continue to deliver power until the S2 switch is placed in the down "OFF" position or one of the other control functions turn the unit "OFF".

4) Voltmeter

- a) Verify on the M2 DC voltmeter (1-1, 3, Figure 4) that the DC output voltage level is correct. If not, turn off power supply, disconnect your load, and refer to Service, Chapter 2 for instructions.

5) Output Current Limit

- a) If the DC ammeter continuously reads more than 600 A DC after start-up, immediately turn R13 current limit control (1-1, 8, Figure 4) down to continuous operation current point, normally 600 A DC. This may prevent input fuse blowing and automatic overload trip out.
- b) If R13 has no effect or if the output current cannot be decreased to about 200 A DC at the R13 minimum position, a faulty SCR device or control circuit malfunction is indicated requiring power supply repair. Refer to Chapter 2 for service instructions.

Chapter 2 Servicing / Troubleshooting

Section 1 Troubleshooting

1) General

The troubleshooting information provided in this section is limited to procedures for determining the cause of faults and for restoring the GPU to operation after faults develop which shut off the unit.

Calibration, service, and repair are to be done by ITW GSE Service Department personnel, authorized distributors of ITW GSE equipment, or trained qualified electronic technicians.

If you have any questions concerning your ITW GSE, contact our Service Department by mail, telephone, FAX or E-Mail.

Write:	ITW GSE Service Department 11001 US Highway 41, North Palmetto, FL 34221 U.S.A.
Call Inside U.S.A./Canada:	(866)-845-0441 (Parts) (877) 874-5322 (Technical Support)
Call From Foreign Countries:	(941) 721-1092 (Technical Support) (941) 721-1000 (Spare Parts)
FAX inside U.S.A.	(877) 874-5321
FAX From Foreign Countries:	(941) 721-1091
E-Mail:	technicalsupport@itwgse.us parts@itwgse.us
Web Page:	www.itwgse.com

2) Troubleshooting

a) Description

The troubleshooting chart lists information under three headings:

- Trouble, symptom, and condition
- Probable cause
- Test, check, and remedy

a) Use of the Troubleshooting Chart

The troubleshooting chart is designed to provide maintenance and repair personnel with a timesaving guide for locating the source of trouble.

- (1) Terminal points (reference applicable schematic and connection diagrams) provide easily accessible and identifiable test points for checking circuits and electrical components.
- (2) Test points are located throughout the circuitry in such a manner that input and output power may be used for test purposes. Because of these test points and their location, a complete check of circuitry may be completed very quickly. Therefore, "probable causes" and "remedies" are listed in a step-by-step sequence which will insure power for testing in all instances where input or output power may be used with proper safety practices, test equipment, and training experience.
- (3) Printed circuit board output troubles should be pinpointed only to determine if the problem is a board calibration problem or a PC board failure problem. Failure of PC board requires replacement of the board. Field repair attempts are not recommended.
- (4) Always check circuit fuses, circuit breakers and the position of switches first in troubleshooting. The incorrect positioning of a switch may cause a condition that could be misinterpreted as a fault.
- (5) Electrical component reference designators (such as S1, K2, R10) may be used in the troubleshooting chart (in parentheses after the item name) to help maintenance personnel identify parts on the schematic diagrams.

3) Equipment for Troubleshooting

For basic troubleshooting, use a good quality multi-scale volt-ohmmeter (VOM). Troubleshooting erratic, intermittent, or phase relationship problems requires a good oscilloscope with an isolated neutral connection.

WARNING

High voltage - electric shock and fire can kill! Exercise extreme care to avoid contact with high voltage leads and components that could cause serious shock and injury if touched when troubleshooting or operating the equipment. Stay clear of moving parts. Locate equipment in a safe environment. Have proper safety equipment available. Do not attempt operation or repair without adequate training.

4) Voltages of Interest

- a) Across the secondary on all 3 phases - 66 VAC $\pm 10\%$ *
- b) To secondary coil center tap on all phases - 33 VAC $\pm 10\%$ *
- * The $\pm 10\%$ refers to the possibility of input voltage being out of balance or not at the nominal value.
- c) Across the 115 VAC receptacle - 115 VAC (230 VAC on 50hz units) $\pm 10\%$ *
- d) Between X1 and X3 on Fuse Block - 37 VAC $\pm 10\%$ *
- e) Test Point Values for PC board

A control board malfunction will probably result in one or more of the following symptoms:

- loss of output voltage
- inability to produce full load current
- output voltage too high or too low

Section 2-2 shows the circuit board test points and provides standard voltages at those points.

NOTE: The circuit board potentiometers are preset at the factory and should not have to be reset in the field. If a need arises that would indicate the need for field adjustments, please contact the factory. The only exception is R109, which adjusts the 28 V output level. If necessary, use this control to increase the output voltage slightly to compensate for the voltage drop in a long output cable.

5) SCR Malfunction Instructions

- a) SCR Failure Symptoms

SCR failure is not common. When they do fail, they generally do so either by shorting or by failing to turn on.

- Shorted SCRs will generally result in tripping the circuit breaker at the power source. However, a shorted fly-back diode (on the filter choke input or across the output contactor coil) may also trip the breaker. This is a severe malfunction.
- If an SCR does not turn on, it may be because it is open or because the gate signal from the control board is not reaching the SCR.
 - If one SCR does not turn on, a very small change will occur at the output, which will be difficult to notice. The ripple voltage at the output will increase.
 - If two SCR's do not turn on, the ripple current will increase and can cause other problems. (consult troubleshooting procedure).

b) Troubleshooting Shorted SCRs and Diodes

WARNING

Electric shock and fire can kill!

- Do not touch energized parts. Always turn off utility power to the unit before touching anything inside.
- Do not leave the GPU on long enough to overheat or fail in the faulty condition.

- (1) Turn off the unit and turn off the input power at the utility source.
- (2) Disconnect the leads from the transformer to the heat sink assembly.
- (3) Wrap each disconnected transformer lead with electrical tape. Mark each lead to identify it so it can be reconnected to its proper location.
- (4) Check the SCRs and fly-back diodes with the ohmmeter to located shorted devices.
- (5) With the SCRs and fly-back diodes disconnected, apply power to the unit. Make sure that the other components are not the cause of the tripped breaker.
- (6) If no problems have been found, check for a device that only breaks down to a shorted condition when voltage is applied by reconnecting one device at a time.

c) Troubleshooting Excessive Output Ripple

An open gate or an open SCR cannot be checked with a VOM. If an SCR is not firing, the AC ripple current will increase across the filter capacitors, but that will not blow fuses.

Follow these steps to locate a bad SCR:

- (1) Connect an oscilloscope across the unfiltered output:
 - Connect the probe of an oscilloscope to the heat sink
 - Connect the isolated neutral of the oscilloscope to the braid of the fly-back diode.

The output should appear as six evenly spaced pulses of about the same height. If an SCR is not firing, one of the pulses will be missing.

Note: if every third pulse is low or missing, check the balance adjustments, R9 and R10, before attributing the problem to faulty components.

- (2) Disconnect the gate lead for one SCR from the applicable suppressor board. If the lead disconnection does not affect the output waveform, that is probably the bad SCR.
- (3) If that SCR was not the source of the problem, reconnect the gate lead.
- (4) Repeat for other SCRs, one at a time, until the defective device is located.



Figure 1 Gate Lead Connections

If no Oscilloscope is available: Remove all six service fuses next to the A1 PC board. Keep in mind during this test only one fuse at a time will be placed in the holder with the with fuses other removed.

CAUTION

- **The input power switch should be off whilst removing and installing each fuse for this Test**

Systematically put only one fuse in it's holder at a time and turn the input power switch on and see if 28.5VDC Is indicated on the Ground Power Unit Voltmeter. If voltage is present at the voltmeter then that particular SCR(Diode) is good. Continue putting one Fuse at a time in it's holder to check if the 28.5 VDC is present at the voltmeter , do this until all six fuse holders (SCR) have been checked. If a particular fuse placed in its holder (again no other fuses installed) does not indicate 28.5 VDC the SCR or that circuit has failed.

6) Troubleshooting Tables

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
Machine Will Not Operate		
1. Machine will not start	a. The input power is turned OFF at remote disconnect switch	Turn the power ON at remote disconnect switch.
	b. Blown fuse in remote disconnect switch	Replace blown fuse. If fuse blows frequently, determine and remedy the cause.
	c. Incorrect input power connections at machine	Check input power connections against appropriate connection diagram in Chapter 5.
	d. Incorrect power input (frequency and voltage)	Check that voltage and frequency of power input for this ground power unit, according to the rating on its nameplate.
	e. Broken input cable	Repair cable as necessary.
2. Line contactor fails to close	a. Line contactor fuse F8 blown	Replace fuse. Check for cause if fuse blows frequently.
	b. Mechanical obstruction on contactor	Remove obstruction.
	c. Defective line contactor switch	Replace line contactor switch.
	d. Defective coil in line contactor	Replace contactor if coil is open or shorted.
	e. Cable broken at line contactor	Repair broken cable as necessary.

3. Line contactor chatters	a. Input cables too small or too long	Use input cables of sufficient capability for proper operation of the machine. Refer to Section 1-2, Figure 1 for proper cable size to be used.
	b. Faulty contactor coil	Check coil voltage. If correct, replace contactor.
	c. Low line voltage	Check line voltage. Correct problem as necessary.

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
Machine Will Not Operate, continued		
4. Contactor operates and trips power source circuit breaker or blows fuses	a. Wrong line voltage	Check nameplate of machine for line voltage to be used. Then measure line voltage. If line voltage is of improper value, correct this condition as is necessary to provide proper voltage input to the machine.
	b. Breaker incorrect size or type or fuse	Refer to Section 1-2, Figure 1 for input current requirements. Make sure the breaker is appropriate for a high inrush current – use a breaker designed for motor starting applications.
	c. Links on voltage changeover board incorrectly connected	Check appropriate voltage changeover diagram in Chapter 5 for proper link positions. Make correction as necessary.
	d. SCR failure or shorted fly-back diode	Refer to detail troubleshooting instructions.
	e. Short circuit in primary connections	Remove short circuit.

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
Unit Turns Off After Starting		
1. Unit delivers power but soon shuts down (Thermal overload, electronic overload or over-voltage circuit trips)	a. Power supply overloaded	Reduce load, overload can be carried only for a short time.
	b. Duty cycle too high	Do not operate continually at overload currents.

	c. Ambient temperature too high	Operate at reduced loads when temperature exceeds 104° F (40° C) or improve cooling ambient.
	d. Ventilation blocked	Check that air intake and exhaust openings are not obstructed.
	e. Fan not operating	Check fuse F1 on the fan shroud. If it is good, disconnect the fan motor leads and apply 115 VAC directly to fan motor. Replace fan motor if it fails to operate or if its bearings are defective.
	f. Shorted output	Reset electronic overload.
2. Over-voltage/Overload trip malfunction is in unit's internal circuitry.	a. Control circuit board failure	Refer to detail troubleshooting instructions.
	b. Loose connections in voltage control circuit	Check for loose connections. Tighten and secure as required.
	c. Starting current potentiometer (R13) open	Replace potentiometer.
3. Fan not operating (also see causes and remedies under "Machine will not start")	a. Blown fuse (F1)	Replace fuse.
	b. Fan control thermostat defective	Place a jumper wire across the overheated thermostat. If fan then runs, replace thermostat.
	Note: A properly operating fan thermostat will turn on the fan at 100°F and keep the fan running until 80° F is reached at heat sink.	
	c. Broken lead or connection to fan motor	Repair wiring as necessary.
	d. Fan motor defective	Disconnect fan motor leads and apply 115 VAC directly to fan motor. If it fails to operate, replace it.

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
Voltage on GPU Case		
1. Operator gets shock when machine case is touched	a. Case of machine not grounded	Ground machine case to an earth-type ground if utility ground is already connected. Connect the normal safety ground and recheck if "utility" ground had not been connected.
Output Current Varies Without Voltage Change		

1. Abnormal current fluctuation, voltage nearly constant	a. Loose cable connections at output	Check for overheated connections and tighten.
GPU Will Not Turn Off		
1. Contactor fails to open	a. Contacts sticking in contactor	Clean contacts or replace contactor, whichever is needed.
No Voltage Output		
1. Unit on, but no output voltage	a. Protective circuit tripped	Determine and correct cause of trip. Then reset and restart unit.
	b. Component failure in protective circuit	Find the defective component and replace it.
	c. Control circuit board failure	Check control board per Section 2-2 and replace it if faulty.

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
Output Voltage Not Proper Level		
1. Poor voltage regulation	a. Loose connection of voltage sensing lead	Check connection at output contactor and control circuit board. Tighten connection as necessary.
2. Output voltage too high (above 32 Volts)	a. Voltage calibration off	Attempt calibration per Section 2-2. If calibration isn't possible replace PC control board.
	b. Voltage sensing lead open	Repair or replace voltage-sensing lead.
3. Unstable voltage	a. Open filter capacitor	Find and replace defective capacitor.
	b. One or more SCRs not firing properly	Adjust balance control or replace defective SCR heat sink assembly if oscilloscope shows faulty SCR devices. Replace PC control boards if oscilloscope shows no gate pulse and the PC control board inputs and controls are proper except for output.

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
Output Contactor Fault		
1. Output contactor will not close.	a. Defective output switch (S2)	With the unit turned off, place a jumper between terminals 2 and 4 on S2. Turn S1 on. If output contactor closes, S2 is defective. Replace.
	b. Defective input contactor auxiliary contacts (K1)	With the unit turned off, place a jumper between terminals NO 1 and COM 3 on input contactor. Turn S1 on, and place S2 in Close position. If output contactor closes, K1 is defective. Replace.
	c. Defective output voltage select switch (S103) (if applicable)	With the unit turned off, place a jumper between terminals 4 and 5 on S103. Turn S1 on, and place S2 in Close position. If Output contactor closes, S103 is defective. Replace.

	d. Defective output contactor (K2).	Measure voltage between + and – terminals on K2 Coil with S1 on and S2 held in Close position. If 28.5 VDC is present K2 is defective.
2. Output contactor will not stay closed.	a. Defective output switch (S2)	With the unit turned off, place a jumper between terminals 1 and 3 on S2. Turn S1 on, and place S2 in Close position. If output contactor stays closed after S2 is released, S2 is defective. Replace.
	b. Defective output contactor auxiliary contacts (K2)	With the unit turned off, place a jumper between terminals NO 3 and NO 4 on output contactor. Turn S1 on, and place S2 in Close position. If output contactor stays closed after S2 is released, K2 is defective. Replace.

Section 2 Calibration and Test of PC Control Board

IMPORTANT

Before attempting to make tests and adjustments on the GPU, READ THIS ENTIRE SECTION to become familiar with the proper procedures.

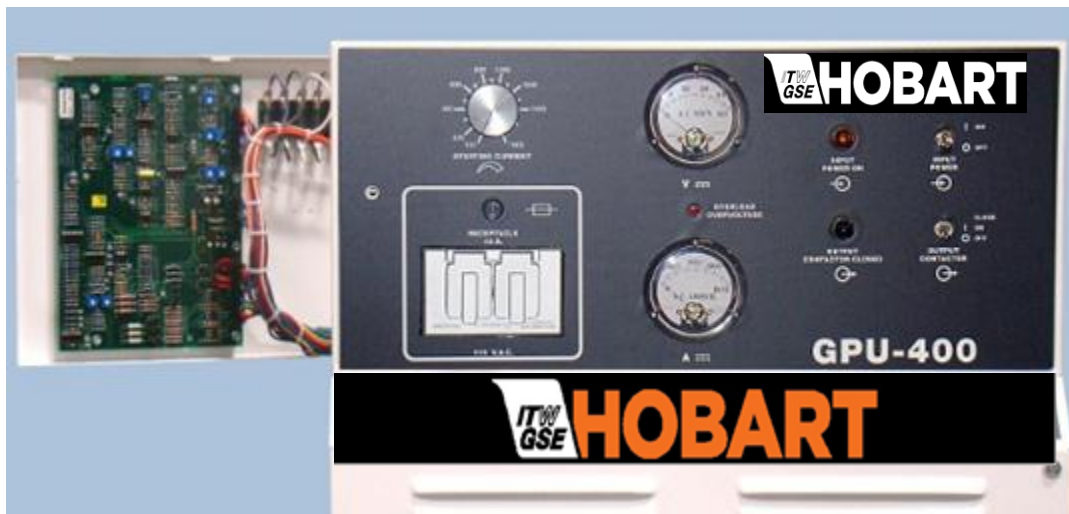
1) General

This section describes the test points, test values, and adjustment locations for testing and adjusting the printed circuit board that controls the GPU. The control board is mounted on a hinged panel. To access the board for measurements and adjustments, open the panel so that the board is accessible from the front of the GPU and you do not have to work next to hazardous voltages.

Use the Test Procedure (Part 3 of this section) to determine if the circuit board is operating properly. ITW GSE recommends calibration of the PC board at the factory, but the calibration procedure is included in this section (Part 4) in case field calibration is necessary. Faulty control boards should be returned to the manufacturer for repair.

WARNING

Electric shock and arcs can kill or injure! Use caution to inspect or test the printed circuit control board while the equipment is running. The voltages on the printed circuit board are safe; however, removing the top panel exposes people to dangerous voltages. When working with the circuit board, rotate the panel out to move the board away from internal parts.



2) Circuit Board Components

This section is provided to help you locate test points and controls on the circuit board and understand their functions. Figures 2 and 3 show the locations of test points and adjustment potentiometers for possible field adjustment. Table 1 shows the functions of the test points and adjustments.

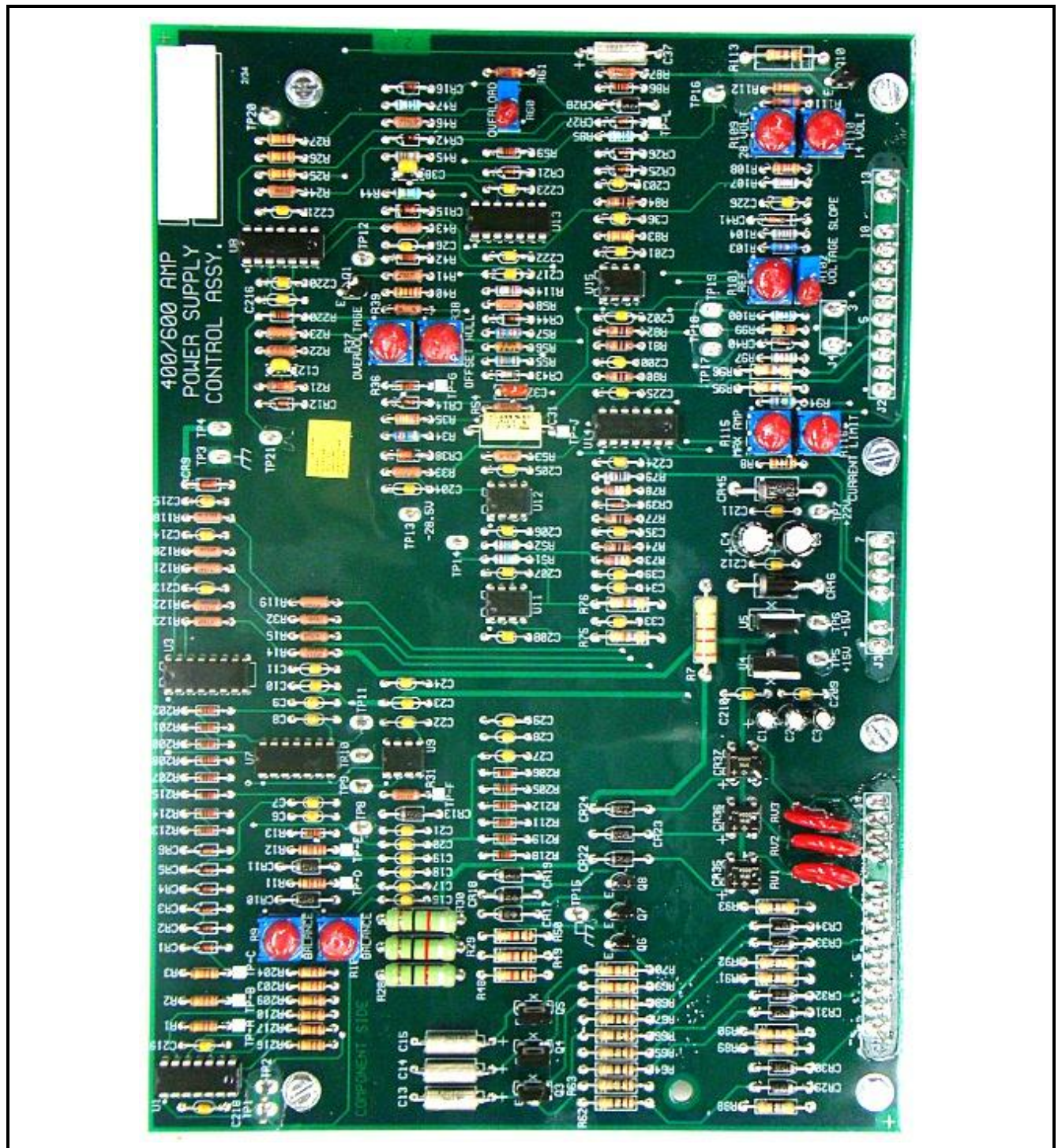


Figure 2 GPU Circuit Board Components

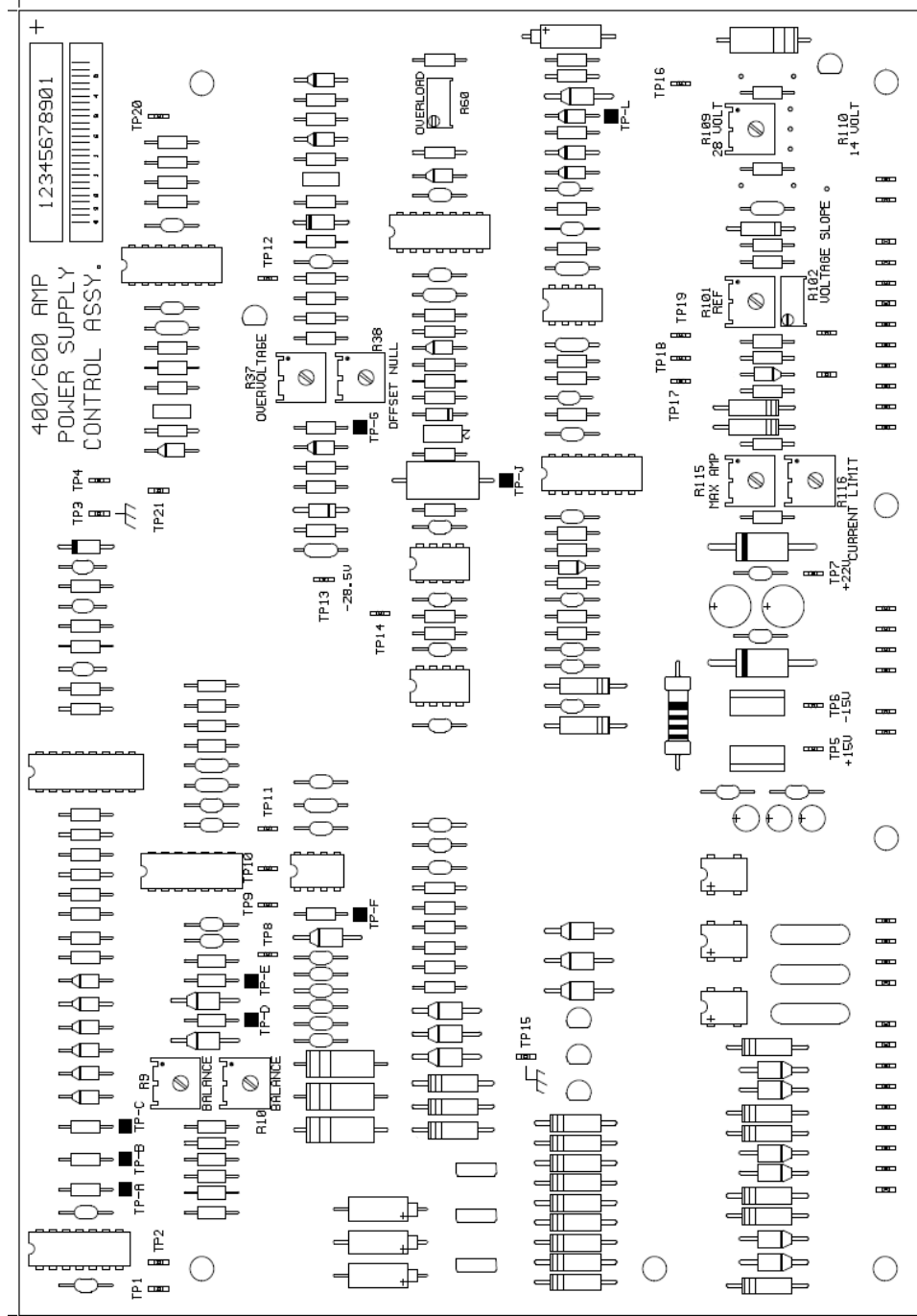


Figure 3 GPU Circuit Board Test Points and Controls

Test Point	Function	Signal Controlled by:
TP1	SCR Gate Pulse Phase 3	R10
TP2	SCR Gate Pulse Phase 2	R9
TP3	PC Board Common	
TP4	+10.0 VDC Timer Voltage	
TP5	+15 V Regulated Voltage	
TP6	-15 V Regulated Voltage	
TP7	+24 V Unregulated Voltage	
TP8	SCR Gate Pulse Phase 1	
TP13	Actual Output Voltage (28.5 or 14.25)	R109 (-28.5 V) or R110 (-14 V)
TP14	Null at zero output current: provides amplified load amp reading for comparison with overload limit (TP20) and starting amperage limit (TP21) set by R13 control on front panel.	R38
TP15	PC Board Common	
TP17	Voltage Slope Test Point	R102
TP19	Reference Volt Test Point	R101
TP20	Overload Limit	R60
TP21	Starting Current	R13 (front panel)
TPD	SCR Gate Timer Output Phase 3	
TPE	SCR Gate Timer Output Phase 2	
TPF	SCR Gate Timer Output Phase 1	
TPL	Overload Trip Summing Point	

Table 1 GPU Circuit Board Test Points and Controls

3) Test Procedure

Follow the table steps in this section to verify that the PC board is functioning properly. If the voltage readings to the PC board common are not within specification, attempt to correct the reading by adjusting the applicable control. Be certain the operating conditions are exactly as stated in the table.

If the board does not adjust, check the leads, fuses (F2-F7), and connectors. If no external problems are found, the PC control board is faulty. Replace it with a known good board.

After replacing the board, recheck the voltages. In some cases, minor adjustments may be required for optimum calibration. If the replacement board shows the same magnitude of error and lack of adjustment control, it is possible that the control board is not at fault. The voltages in the following table are all referenced to pc board common, which is Test Point 3 (TP3) and Test Point 15 (TP15). Connect the negative voltmeter lead to either of those test points.

TEST STEP	TEST POINT	TEST CONDITION	VOLTAGE MEASUREMENT	TEST DESCRIPTION
1	TP5	Open circuit: no load	+ 15 VDC $\pm$ 5%	Checks (+) voltage regulator output set by U4.
2	TP6	Open circuit: no load	- 15 VDC $\pm$ 5%	Checks (-) voltage regulator output set by U5.
3	TP7	Open circuit: no load	+ 24 VDC $\pm$ 10%	Checks unregulated control voltage needed for 1 and 2
4	TP4	Open circuit: no load	+ 10 VDC $\pm$ 10%	Checks gate pulse timer volts supply set by CR9
5	TPD	Open circuit: no load	+ 3.3 VDC $\pm$ 10%	Checks gate pulse timer operation before phase balancing and amplification
	TPE	Open circuit: no load	+ 3.3 VDC $\pm$ 10%	Checks gate pulse timer operation before phase balancing and amplification
	TPF	Open circuit: no load	+ 3.3 VDC $\pm$ 10%	Checks gate pulse timer operation before phase balancing and amplification
6	TP1	With a 100 A load, adjust R9 and R10 carefully for lowest ripple voltage (typically 100 to 160 mV).	-8.2 VDC $\pm$ 10% (measured with no load)	Checks gate pulse timer operation and balance adjustment
	TP2		-8.2 VDC $\pm$ 10% (measured with no load)	Checks gate pulse timer operation and balance adjustment
	TP8		-8.2 VDC $\pm$ 10% (measured with no load)	Checks gate pulse timer operation and balance adjustment.

TEST STEP	TEST POINT	TEST CONDITION	VOLTAGE MEASUREMENT	TEST DESCRIPTION
7	TP14	Open circuit: no load	0 VDC $\pm$.01V	Checks for null (0) by R38 for the no load current signal
8	TP17	---	+ 1.25 $\pm$ 10%	Checks voltage slope calibrated with R102
9	TP19	---	- 5 VDC $\pm$ 1%	Checks reference voltage adjusted by R101
10	TP13	---	- 28.5 VDC $\pm$ 1%	Checks output volts set by R109 in 28 VDC mode
	TP13	---	- 14.3 VDC $\pm$ 1%	Checks output volts set by R110 in 14 VDC mode
11	TP20	---	6 $\pm$.5 VDC	Checks R60 overload current setting
12	TPL	Standard load	Near zero (0.002 V)	Optional test
	TPL	Overload	12 to13 VDC	Checks overload light, DS2, and circuit functioning (Q10)

Table 2 GPU Circuit Board Tests

4) Circuit Board Calibration

Equipment Requirements

Calibration requires the following equipment:

- a load bank – able to pull 2200 amps at 28.5 volts
- two voltmeters - $\pm$ 2% accuracy
- an oscilloscope
- a 3.3 k Ω resistor
- small test clips

Also, if your GPU is set up for bridge interlock and remote connection option, you will need to add switches:

- Connect normally open "Start" switch between TB101-1 and TB101-2.
- Connect normally closed "Stop" switch between TB101-2 and TB101-3.

Calibration Procedure

- (1) Connect the output cable to the load bank.
- (2) Connect a voltmeter to the output.
- (3) Turn the power switch on. The amber "Power On" light should be on.
- (4) Set the SCR gate balance
 - a) Connect the oscilloscope probe to the heat sink and the oscilloscope ground to the braid of the heat sink fly-back diode (CR 7).
 - b) Verify output pulses for the six SCRs.
 - c) Balance the levels with R9 and R10.
- (5) Close the output contactor. Make sure the green "Contactor Closed" light turns on.
- (6) Turn the GPU off.
- (7) Adjust the offset null
 - a) Connect another voltmeter to TP14 (positive) and TP15 (negative).
 - b) Turn on the GPU and close the output contactor.
 - c) The test point voltage should be 0.000 ± 0.005 VDC.
 - d) Adjust R38 (offset null adjust) for the proper reading.
- (8) Adjust the voltage reference
 - a) Move the positive voltmeter lead to TP19.
 - b) The voltage should be -5.00 ± 0.010 VDC.
 - c) Adjust R101 (reference adjust) for the proper reading.
- (9) Check the over-voltage adjustment

When an over-voltage occurs, the output contactor should open and the red "Overload" light should turn on.

 - a) Turn the "Starting current" knob to the maximum setting.
 - b) Turn R109 (28 volt adjust) all the way counterclockwise. The output voltage will drop to around 22 volts.
 - c) Jumper a 3.3 k Ω resistor across R111 (next to R109). The output voltage will increase to about 30 volts.
 - d) Use R109 to raise the output voltage until the over-voltage fault trips. The output voltage must be between 31.0 and 31.8 VDC at the trip point.
 - e) Adjust R37 (over voltage adjust – control very touchy) for proper trip point.
 - f) Remove the 3.3 k Ω jumper resistor and reset output voltage for 28.50 to 28.60 VDC.

(10) Check the voltage slope adjustment

- a) Apply a 400 amp load.
- b) Connect the voltmeter positive to TP17 and negative to TP14.
- c) The test point voltage should be 0.000 to 0.020 VDC.
- d) Adjust R102 (voltage slope adjust) for proper reading.

(11) Check the current limit adjustment

- a) Turn the starting current knob to the 2000 amp setting.
- b) Apply a 2000 amp load and check to make sure the unit is not current limiting.
- c) The output voltage should be 22.0 to 25.0 VDC.
- d) Adjust R115 (max amp. adjust) for proper output voltage.

(12) Check overload trip point

When an overload occurs, the output contactor should open and the red "Overload" light should turn on.

- a) Increase the load at the load bank to make sure the overload turns on between 2125 and 2200 amps.
- b) Adjust R60 (overload adjust) to adjust the current overload trip point.

(13) Check the starting current adjustment

- a) Set starting current knob to 500 and apply a 700-amp load.
- b) The output current should be 500 amps $\pm$ 25 amps.
- c) If not, adjust R116 (current limit knob adjust) until output current equals 500 amps.
- d) Remove the load.

Section 3 Scheduled Maintenance

1) General

The ITW GSE GPU is designed to be as maintenance free as possible. Therefore, there are few maintenance requirements. Field maintenance of the GPU should be performed only by qualified service personnel, and should be limited to cleaning and inspection of the unit and its components, as well as, the replacement of lamps and fuses. All service and repair work, including testing and calibration, should be referred to the ITW GSE Service Department, to an authorized service shop for ITW GSE equipment, or to qualified electronic technicians.

2) Maintenance Schedule

	As required	Daily 8 hrs.	1 month 200 hrs.	3 months 600 hrs.	6 months 1200 hrs.
* EXTERIOR CABLES					
Inspect equipment		X			
Inspect AC input cables		X			
Check cable connections (internal)					X
* CONTROLS AND INSTRUMENTS					
Check voltmeter functioning	X				
Check ammeter functioning	X				
Check fan thermostat operation		X			
Check indicating lights		X			
Check starting current limit functioning			X		
Check all output contactor contacts					X
Check power input contactor contacts					X
Check voltmeter & ammeter accuracy					X
Check all wiring and connections					X
Inspect and clean general (light duty)					X
Inspect and clean general (severe duty)				X	
* FAN MOTOR					
See Lubrication section below					

*Suspicious performance overrides timetable

Figure 1 Inspection Schedule

3) Inspection During Operation

- a) Make sure the meters are functioning. If a meter is suspected of being inaccurate, check it against a test instrument.
- b) Verify the lights for Input Power On and Output Contactor closed are functional. Replace if necessary. The Overload/Over Voltage light is an LED, so it will probably not fail.
- c) Verify that the fan turns on after the unit has been operating for a while. If the fan turns on immediately on a cold unit, that might indicate a shorted fan thermostat switch.
- d) Check the Starting Current potentiometer. If this control has no effect on currents above its minimum setting, that might indicate a faulty potentiometer or faulty circuit board.

4) Preparation for Internal Inspection

- a) Turn off input power at the source. Make sure that power cannot be inadvertently turned back on.

WARNING

High voltage may be present inside the GPU cabinet, even when the unit is off. Exercise extreme caution or **FATAL SHOCK** may result.

WARNING

HIGH VOLTAGE - electric shock can kill! Be certain the input power source is turned off before opening the cabinet. Stop operation immediately if a possible dangerous fault is discovered. The front panel input contactor switch does not remove input power from all components. Be sure capacitors are discharged before you touch.

- b) Observe the front panel voltmeter and make sure the voltage is zero. If the voltage is not zero, the capacitors still hold a charge, indicating a problem with the connection to the preload resistors.
- c) Observe general condition of power-input cables and equipment output cables. Inspect for cuts and abrasions in the insulation that could cause a short circuit. Visually inspect the output cable plug connector for physical damage and evidence of overheating.
- d) Remove the top cover.

5) Internal Inspection

- a) Using compressed air or a soft brush, clean any dirt and debris from the interior.
- b) Inspect terminal blocks for evidence of overheating due to loose electrical connections.
- c) Inspect electrical and mechanical connections for tightness.
- d) Remove the front panel screw that holds the circuit board panel. Swing the circuit board panel out to the side.
- e) Inspect the circuit board for evidence of overheating, such as burned components.
- f) Inspect the hinge for the circuit board panel. If this hinge sticks or is difficult to operate, spray the hinge with a silicone spray lubricant.
- g) Inspect all wiring, leads, and cables. Inspect for cuts, abrasions, and signs of deterioration and overheating. Inspect the leads for broken strands and terminals.

- h) Inspect the output contactor. If the contacts are badly burned, the contactor should be replaced as soon as possible. Slightly pitted and burned contacts can be cleaned up with a commercial contact cleaner and very fine-grained emery cloth or equivalent.
- i) Turn the fan blade by hand to make sure that it turns freely.
- j) If required, lubricate the fan (refer to the next section for the lubrication schedule).
- k) When finished with inspections:
 - Return the circuit board panel to its closed position and secure with the screw.
 - Replace the top cover.
 - Turn on power at the source and check for normal operation.

6) Lubrication

No lubrication is required, except for the fan motor. The fan motor incorporates a sleeve bearing, and therefore requires periodic lubrication.

a) Lubrication Schedule

The following table shows the fan motor manufacturer's recommendations for lubricating the motor.

Type of Duty	Usage – Starts Per Hour	Usage – Hours Per Day	Lubrication Interval (years)
Light	0 – 4 starts	0 – 8 hours	Every 4 years
Moderate	5 - 10 starts	9 – 16 hours	Every 3 years
Heavy	Over 10 starts	17 - 24 hours	Every 2 years

Fan Motor Lubrication Schedule
Figure 2

Lubricate more frequently in dirty environments (3, 2, or 1 years instead of 4, 3, or 2).

b) Oil Type

Use SAE-20 or 10W30 electric motor or automotive oil. Do not use definite purpose oils such as those for sewing machines, cleaning, rust preventative, or cutting applications.

c) Quantity

Use 10 – 15 drops per end (approximately 1.0 cc or 1/8 teaspoon). Do not over oil.

d) Oil Locations

The figure below shows a tube extending upward from the rear bearing. The front bearing has a similar tube. Use these tubes to oil the bearings.

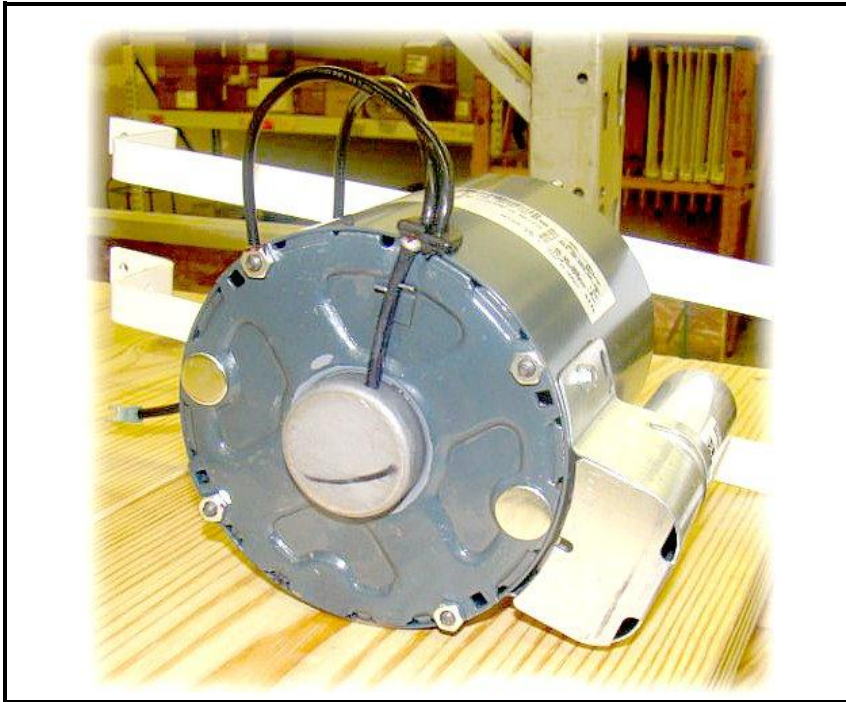


Figure 3 Fan Motor Oil Locations

7) Inspection Records

Since the fan lubrication is so infrequently, you should keep track of the lubrications using the chart below or some similar record.

Inspection Date	Fan Motor Oiled? (circle Y or N)	Inspection Notes
	Y N	
	Y N	
	Y N	
	Y N	
	Y N	
	Y N	
	Y N	
	Y N	
	Y N	
	Y N	

Chapter 3 Overhaul / Major Repair / Inspection

Unscheduled Repair

1) General

Repair of the GPU will consist primarily of parts replacement. Most of the components used in the GPU cannot be disassembled and repaired, and must be replaced if faulty. Additionally, inoperative PC boards cannot be repaired in the field, but must be replaced as a complete unit. PC boards may be returned to the factory for replacement. Contact ITW GSE for parts and replacement instructions.

2) Service Information and Factory Repair

The ITW GSE Service Department can answer questions concerning the operation, repair, or servicing of this GPU. When making such an inquiry, be sure to provide the model number, serial number, and approximate date of receipt of the unit. If it is deemed necessary to return the unit to the factory for servicing, contact the Service Department for authorization. It is rarely necessary to return a failed GPU since the unit uses plug-in type assemblies throughout its systems. For warranty information, refer to the warranty statement at the front of this manual or contact the ITW GSE Service Department.

When ordering parts from your ITW GSE Distributor, be sure to include all pertinent information from the unit's identification plate: Specification No., Model No., and unit rating.

3) GPU Removal and Replacement

If extensive repairs are to be made on the GPU, you may wish to move it to a more convenient location.

WARNING

High voltages may be present inside the cabinet, even when the unit is off. Exercise extreme caution or **FATAL SHOCK** may result.

- a) Turn off the input power at the source. Make sure that the power cannot be inadvertently turned back on.
- b) Remove the top cover.
- c) Disconnect the three AC input leads at the terminals on the input contactor and the grounding wire at the grounding lug.
- d) Loosen the cable clamp on the rear of the GPU and remove the input cable from the clamp.
- e) Disconnect the output cable from the output contactor (+) and the ammeter shunt (-).

- f) Loosen the cable clamp at the base and remove the output cable from the GPU.
- g) If the unit is a bridge mount unit, also disconnect and remove the remote control cables.
- h) If the unit is bridge mount or fixed mount, attach a lifting hoist or forklift to the bottom of the GPU and remove the mounting screws or bolts that attach the GPU to its mounting.
- i) Carefully remove the GPU.
- j) Move the GPU to a clear working area where it can be placed on a solid supporting structure.
- k) Re-install the GPU in the reverse order of removal. See Section 1-2 for additional information on installing the GPU.

4) Component Removal and Replacement

Most of the components in the GPU are easily replaced when necessary. Chapter 1 and Chapter 4 show the locations of the components in the GPU.

WARNING

To avoid the danger of electric shock, always make sure that the input power is turned off at the source and cannot be inadvertently turned back on before working inside the GPU.

a) Lights

The light bulbs are accessible from the front by unscrewing the lens.

Light	Unit	Bulb Type
Input Power On	Standard	Type 120 MB (120 V, .025 A, T-2-1/2)
	Units with CE marking	Type 757 (28 V, .08 A)
Output Contactor Closed	All	Type 757 (28 V, .08 A)
Overload/Overvoltage	No bulb – this is an LED assembly	

b) Circuit Board

Chapter 4-3, Figure 2 gives the location and part number of the circuit board. To replace the circuit board, unplug the connectors and remove the six screws.

c) Fuses

The following table provides the locations and functions of the fuses. If a fuse has blown, check the related circuitry. Always replace the fuses with similar fuses having the same type and rating.

Fuse	Protects	Location	Rating
F1	Fan	Fan shroud	5 A, 250 V, Type ABC
F2 – F7	Circuit Board	Fuse block next to circuit board	1 A, 250 V, Type AGC, Fast blow
F8	Input Contactor	Control transformer	0.5 A, 250 V, Type AGC, Fast blow
F9	Receptacle	Front Panel	10 A, 250 V, Type ABC

d) Thermostat Switches

Two thermostat switches mount to the top of the heat sink assembly. Refer to Chapter 4-3, Figure 7. The switch on the left side controls the fan. The switch on the right side shuts down the GPU when an overload occurs.

The fan thermostat is normally open. If this switch fails in the open position, the fan will never turn on and the unit will eventually shut off with an overload indication. If the fan thermostat fails in the closed position, the fan will run continuously, even when the unit is cold. This switch turns on when the temperature reaches $100^{\circ} \pm 8^{\circ} \text{ F}$ and turns off when the temperature falls back down to $80^{\circ} \pm 5^{\circ} \text{ F}$.

The overload thermostat is normally closed. If this switch fails in the open position, the GPU will not produce any output voltage. If this switch fails in the closed position, the GPU will not shut down if the heat sink gets too hot. This switch opens when the temperature reaches $190^{\circ} \pm 5^{\circ} \text{ F}$ and closes when the temperature falls back down to $172^{\circ} \pm 8^{\circ} \text{ F}$.

Both of these switches can be tested using an ohmmeter and a heat gun. To replace a thermostat, unplug the wires and then remove the two screws that hold it. Reconnect the wires to the new thermostat.

e) Fly-back Diode

The fly-back diode, CR7, is located on the left side of the heat sink assembly near the base. Failure is not common, but if fails in a shorted condition, it can cause high input current. Refer to Chapter 2-1 for troubleshooting information.

Chapter 4-3, Figure 7 gives the part number for the diode.

- (1) Buff the heat sink in the area where the diode attaches to remove any oxidation.
- (2) Smear a thin film of Burndy Penetrox "A" (or similar oxide-inhibiting electrical joint compound) in the area where the diode attaches to the heat sink.
- (3) When replacing the diode, torque the nut to 4.2 to 5.2 ft-lb. (5.7 to 7.05 N-m).

f) SCR Diodes

The six SCR diodes mount to the heat sink. If an SCR fails to conduct, it can cause excessive ripple in the output. If an SCR fails by shorting, the unit can draw excessive input current. SCR replacement is somewhat complicated, so be sure that a failed SCR is the cause of the problem before replacing. Refer to Chapter 2-1 for troubleshooting information.

If you plan to replace an SCR, you will need a 903878 Force Indicator Gauge. This gauge, shown in Figure 1, measures the deflection of the flat spring on top of the SCR as the screws are tightened. The gauge consists of two metal plates that are free to rotate about a common point where they are fastened together.

- When this gauge is placed on a flat surface so that it makes three-point contact, the sheet metal plates rotate so that the left edge of the rear plate aligns with the right edge of the front piece at the calibration notch.
- When this gauge is placed on a properly-adjusted SCR spring, the left edge of the rear plate aligns with the right edge of the front plate at the top notch (marked VE3000/VE2500).

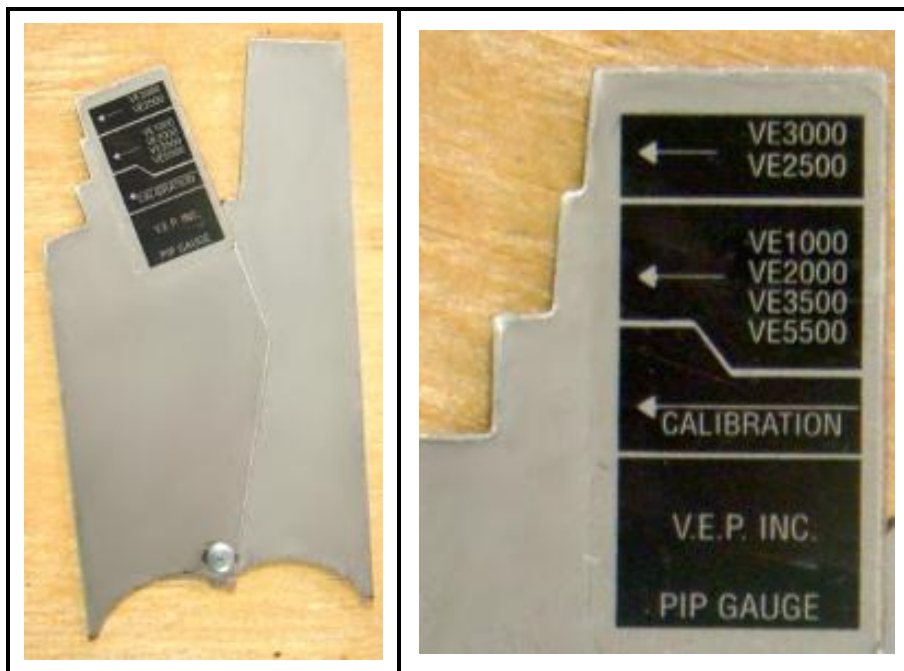


Figure 1 Force Indicator Gauge

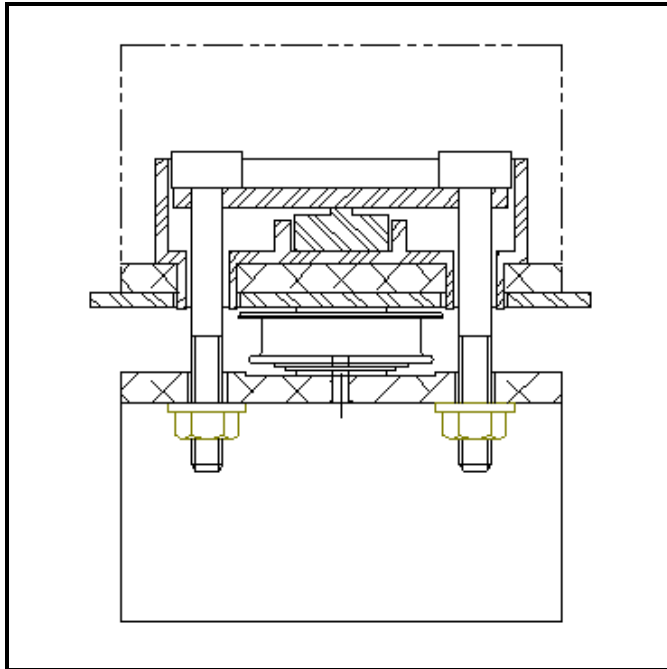


Figure 2 SCR Mounting Components

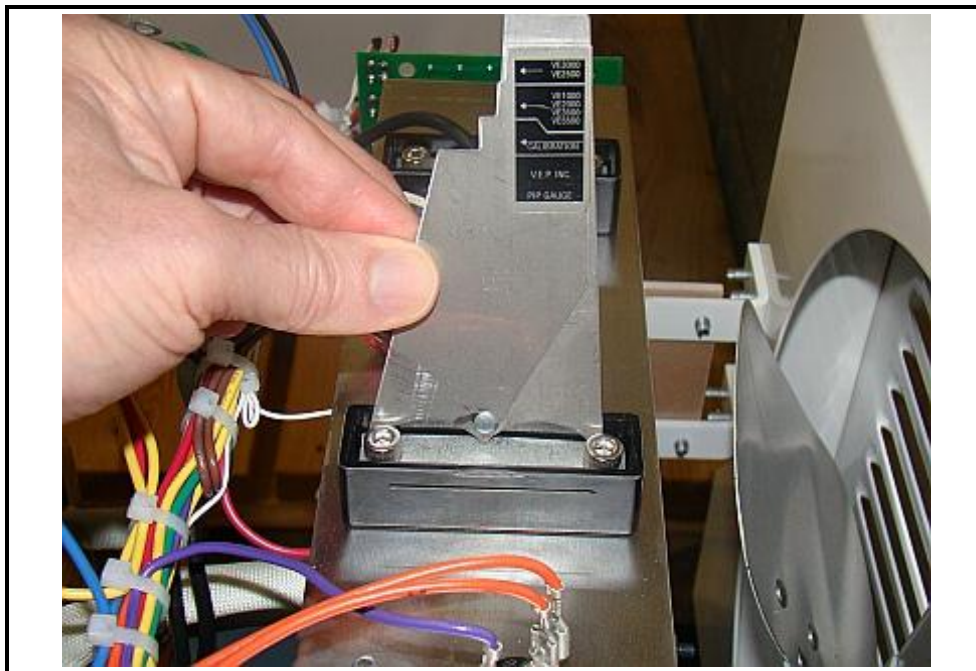


Figure 3 Measuring the Spring Deflection

Chapter 4-3, Figure 7 gives the part number for the diode.

- (1) Disconnect and remove the failed SCR diode noting how the pieces are assembled. Figure 2 shows a cross section.
- (2) Buff the heat sink in the area where the diode attaches to remove any oxidation.
- (3) Smear a thin film of Burndy Penetrox "A" (or similar oxide-inhibiting electrical joint compound) in the area where the diode attaches to the heat sink.
- (4) Tighten the nuts evenly until they are finger tight.
- (5) Tighten each screw in 1/4 turn increments using the correct size hex key.
- (6) Place the Force Indicator Gauge firmly against the top spring as shown in Figure 3. Be sure both ends and the center are in firm contact with the spring.
- (7) Tighten the screws in 1/4 turn increments until the gauge shows correct alignment between the left edge of the rear gauge plate and the right edge of the top notch (VE3000/VE2500) on the front gauge plate.
- (8) If you have tightened the screws too much, loosen both nuts and start over. Never adjust the force by backing off the nuts. Friction will always produce a false reading.

Chapter 4 Illustrated Parts List

Section 1 Introduction/ Numerical Index

1) General

The Illustrated Parts List identifies, describes, and illustrates main assemblies, subassemblies, and detail parts of your ground power unit manufactured by ITW GSE Palmetto Florida.

2) Purpose

The purpose of this list is to provide parts identification and descriptive information to maintenance and provisioning personnel for use in provisioning, requisitioning, purchasing, storing, and issuing of spare parts.

3) Arrangement

Chapter 4 is arranged as follows:

Section 1 - Introduction
Section 2 - Manufacturer's Codes
Section 3 - Illustrated Parts List

4) Explanation of Parts List

a) Contents

The parts list contains a breakdown of the equipment into assemblies, subassemblies, and detail parts. All parts of the equipment are listed except:

- (1) Standard hardware items (attaching parts) such as nuts, screws, washers, etc., which are available commercially.
- (2) Bulk items such as wire, cable, sleeving, tubing, etc., which are also commercially available.
- (3) Permanently attached parts, which lose their identity by being welded, soldered, riveted, etc., to other parts, weldments, or assemblies.

b) Parts List Form

This form is divided into six columns. Beginning at the left side of the form and proceeding to the right, columns are identified as follows:

OM-2244 / Operation and Maintenance Manual
DCS-600/ Series 500082 / Solid State Transformer-Rectifiers

(1) FIGURE-ITEM NO. Column

This column lists the figure number of the illustration applicable to a particular parts list and also identifies each part in the list by an item number. These item numbers also appear on the illustration. Each item number on an illustration is connected to the part to which it pertains by a leader line. Thus the figure and item numbering system ties the parts lists to the illustrations and vice versa. The figure and index numbers are also used in the numerical index to assist the user in finding the illustration of a part when the part number is known.

(2) ITW GSE PART NUMBER Column

All part numbers appearing in this column are ITW GSE numbers. In all instances where the part is a purchased item, the vendor's identifying five-digit code and his part number will appear in the "NOMENCLATURE" column. Vendor parts, which are modified by ITW GSE, will be identified as such in the "NOMENCLATURE" column. In case ITW GSE does not have an identifying part number for a purchased part, the "ITW GSE PART NUMBER" column will reflect "No Number" and the vendor's number will be shown in the "NOMENCLATURE" column. Parts manufactured by ITW GSE will reflect no vendor or part number in the "NOMENCLATURE" column.

(3) NOMENCLATURE Column

The item identifying name appears in this column. The indenture method is used to indicate item relationship. Thus, components of an assembly are listed directly below the assembly and indented one space. Vendor codes and part numbers for purchased parts are also listed in this column when applicable. ITW GSE modification to vendor items is also noted in this column.

(4) EFF (Effective) Column

This column is used to indicate the applicability of parts to different models of equipment. When more than one model of equipment is covered by a parts list, there are some parts that are used on only one model. This column is used for insertion of a code letter A, B, etc., to indicate these parts and to identify the particular model they are used on. Since this manual covers only one generator set specification, this column is not used in this manual.

EFF Code	Part & Dash Number	Mounting	CE Certified	Input Voltage	Input Frequency	Output Voltage	Output Current
A	DCS600T60208	Trailer	--	220/230/460	60 Hz.	28.5 VDC	600 A
B	DCS600T50380	Trailer	--	220/380	50 Hz.	28.5 VDC	600 A
C	DCS600T60575	Trailer	--	230/460/575	60 Hz.	28.5 VDC	600 A
E	DCS600T50380CE	Trailer	Y	220/380	50 Hz.	28.5 VDC	600 A
F	DCS600S60208	Stationary	--	208/230/460	60 Hz.	28.5 VDC	600 A
G	DCS600S50380	Stationary	--	220/380	50 Hz.	28.5 VDC	600 A
H	DCS600S50380CE	Stationary	Y	220/380	50 Hz.	28.5 VDC	600 A
J	DCS600B60208	Bridge	--	208/230/460	60 Hz.	28.5 VDC	600 A
K	DCS600B60380	Bridge	--	220/380	50 Hz.	28.5 VDC	600 A

(5) UNITS PER ASSEMBLY Column

This column indicates the quantity of parts required for an assembly or subassembly in which the part appears. This column does not necessarily reflect the total used in the complete end item.

Numerical Index

6 Explanation of Numerical Index

The purpose of this index is to assist the user in finding the illustration and description of a part when the part number is known. Part numbers are arranged in alphanumerical sequence.

FIGURE – ITEM NO.	ITW GSE PART NO.	FIGURE – ITEM NO.	ITW GSE PART NO.
5-4	16DA2162	2-7	287637
7-12	16DA954-012	7-6	287929-001
2-4	180065	4-7	288251
2-2	180294B	4-1	288262
3-	180358	1-3	288266
2-3	180480	1-2	288267
5-8	180914	5-1	288270
5-9	180914	2-1	288271
3-	181565	1-16	288272
2-	201015	6-1	288273
2-10	201016	7-1	288277
6-5	201673-004	5-2	288280-002
3-6	280023	1-	288281
7-9	280023	4-2	288282
1-5	282658	4-3	288283
6-13	283066-001	1-	288284
4-8	283322	4-4	288297-001
1-4	283323	1-	288298-001
6-14	286432-001	1-14	288300
1-10	286441	2-11	288303-001
5-3	286607-001	7-5	288304
3-3	286810-001	2-8	288305-002
6-4	286810-001	7-	288305-002
1-12	287460	5-	288307-003
5-12	287460	5-	288307-004
6-10	287460	5-	288307-006
1-15	287547-001	5-	288307-008

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FIGURE – ITEM NO.	ITW GSE PART NO.	FIGURE – ITEM NO.	ITW GSE PART NO.
6-	288310-001	5-14	402670
6-	288310-002	7-10	402832-003
6-	288310-003	3-	403091-008
6-	288310-004	5-11	403189
6-	288310-005	5-	403955-017
6-	288310-006	7-7	404044-006
4-	288321-001	5-	404172-002
4-	288321-002	5-	404172-003
1-13	288322	5-	404277
2-	288322	5-	404335
4-	288349	5-15	404336
5-19	288351	2-	404915-001
4-5	288353	5-6	405072-002
1-7	288356	2-6	405129-001
1-8	288362-001	7-3	405139
1-	288362-002	7-2	405140-001
2-	288363	3-2	405278-007
5-18	288364	5-10	405365-001
5-13	288365	6-9	405548
2-	288366	5-	405734
1-17	288542	6-	406247-002
3-11	288731	6-	406247-003
3-12	288732	6-6	406392-001
6-	288733-001	6-	406392-002
1-11	288866	6-	406484
3-	350488-094	2-9	406991
3-	361052-009	2-	408352
7-11	367634A-003	2-12	408567
7-8	369641	6-12	408584
7-4	369642	2-	408585
2-	400234-003	4-	486143-002
5-	400613-003	3-7	487050-005
5-	400613-006	6-3	487898A
5-5	400641-012	3-9	488819
5-7	400642-003	3-8	489603
2-	400647-005	4-	489971
5-	400647-008	3-4	589561
6-8	400663	5-20	77A1157
5-	401532-002	3-	788732
1-6	402025-002	1-9	78B1130
6-2	402037-027	2-	83A1105
5-16	402658	6-11	83A1105

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FIGURE – ITEM NO.		ITW GSE PART NO.	FIGURE – ITEM NO.		ITW GSE PART NO.
4-6		83B1101			
2-		W11166-009			
6-		W11166-011			
3-10		W9760-066			

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Section 2 Manufacturer's Codes

1) Explanation of Manufacturer's (Vendor) Code List

The following list is a compilation of vendor codes with names and addresses for suppliers of purchased parts listed in this publication. The codes are in accordance with the Federal Supply Codes for Manufacturer's Cataloging Handbook H4-1, (CAGE CODES) and are arranged in numerical order. Vendor codes are inserted in the nomenclature column of the parts list directly following the item name and description. If a manufacturer does not have a code, the manufacturer's full name is listed in the nomenclature column.

Code	Vendor's Name and Address	Code	Vendor's Name and Address
D0024	SEMIKRON ELEKTRONIK GMBH Sigmundstrasse 200 P.O. Box 82 02 51 Nuernberg, Germany 90431	01XD4	Contact Industries Inc 25 Lex-Industrial Dr Mansfield OH 44903 - 8699
E0615	Kraus and Naimer 42 Miramar Avenue P.O. Box 15-009 Wellington, New Zealand	01428	Tuthill Corporation DBA Tuthill Controls Group 2110 Summit St. New Haven, IN 46774-9524
S7023	Bossard LTD Fasteners Steinhauserstrasse 70 Zug, Switzerland, CH-6300	02660	Amphenol Corp. Spectra-Strip/ltd 40-60 Delaware Ave SIDNEY, NY 13838 - 1395
0CYC7	Western Rubber & Supply 7888 Marathon Dr Ste Livermore, CA 94550 - 9314	02768	Illinois Tool Works Inc. Fastex Division 195 S. Algonguin Rd. Des Plaines, IL 60016-6197
0E8J0	Emka Inc. 1961 Fulling Mill Rd. Middletown, PA 17057-3125	02929	Newark Electronics Div 4801 N Ravenswood Ave Chicago, IL 60640 - 4457
0HZIP9	Diesel Radiator Co. 1985 Janice Ave. Melrose Park, IL 60160-1008	05HB5	Magnecomp Inc. 161 Eagles Nest Dr Pickens, SC 29671-7808
0MR72	Henkel Corp 26941 Cablot Rd, Suite 124 Laguna Hills, CA 92653-7007	05YB3	Acon Inc. 22 Bristol Dr. South Easton, MA 02375-1108
0TSE6	Infineon Technologies Industrial Power Inc. 1050 US HWY 22 Lebanon, NJ 08833-4208	1AA44	Collmer Semiconductor Inc. 2542 Highlander Way Carrollton, TX 75006
00779	Tyco Electronics (Amp) 2800 Fulling Mill Rd Bldg-38 Middletown, PA 17057 - 3142	1DG36	Phillips And Temro Industries Inc E. M. Products Inc. 5380 Cottonwood Ln Prior Lake, MN 55372

Code	Vendor's Name and Address	Code	Vendor's Name and Address
1DL99	Fleetguard Inc. Div. of Cummins Engine Company 311 N. Park Street Lake Mills, IA 50450 - 1299	2N562	Power Transmission Sales Inc. 531 Washington P.O. Box 229 Chagrin Falls, OH 44022-0229
1E045	Austin Hardware and Supply Co. 950 Northwest Technology Dr Lees Summit, MO 64086 - 5692	23803	N T N Bearing Corp of America 191 Sheree Blvd Ste 101 Exton PA 19341-1265
1SPJ9	ITW GSE 11001 US Hwy 41 N Palmetto, FL 34221	24161	Gates Corporation 900 S Broadway Denver CO 80217-5887
1W134	Eaton Corp. 4201 N. 27 TH St Milwaukee, WI 53216-1897	24446	General Electric Co. 3135 Easton Tpke. Fairfield, CT 06431
12662	Peterson Mfg Co. 4200 E 135th St Grandview MO 64030-2896	25710	Deka Plastics Inc. 914 Westfield Ave. Elizabeth, NJ 07208-1222
13445	Cole-Herse 20 Old Colony Ave. Boston, MA 02127-2405	27410	Harris Corp. 1025 W NASA Blvd. Melbourne, FL 32901
14552	Microsemi Corporation 2381 Morse Ave Irvine, CA 92614-6233	28520	Heyco Inc. 1800 Industrial Way N. Toms River, NJ 08755-4809
14799	Square D Company, Inc Dba Schneider Electric USA, Inc. 9522 Winona Ave Schiller Park, IL 60176-1084	3A054	McMaster Carr Supply Co. 9630 Norwalk Blvd. Santa Fe Springs, CA 90670-2932
16476	Maxima Technologies & Systems Llc 1811 Rohrerstown Rd Lancaster, PA 17601-2321	3Y208	Taylor And Summerville Battery Co 3485 Successful Way Dayton Oh 45414-4319
18265	Donaldson Company Inc. DBA Torit Products 1400 W. 94th St. Minneapolis, MN 55431-2370	30104	Automotive Controls Corp. 1300 W. Oak St. P.O. Box 788 Independence, KS 67301-0788
2B428	MJO Industries Inc. DBA Hughes-Peters 8000 Technology Blvd. Huber Heights, OH 45424 - 1573	30430	Marathon Electric Mfg. Corp. 398 Beach Rd. Burlingame, CA 94010-2004
2B664	All-Phase Electric Supply Co 1620 W Main St P.O. Box 149 Springfield OH 45501-0149	311K7	Kissling Electrotec Incorporated 320 Business Pkwy, Ste A Greer, SC 29651
		38151	Marathon Electric Mfg. Co. 100 E. Randolph St. Wausau, WI 54401-2568

Code	Vendor's Name and Address	Code	Vendor's Name and Address
39TH9	Motion Industries Inc. 8580 Industry Park Dr. Piqua, OH 45356-8535	57347	Wall Industries Inc. 5 Watson Brook Rd. Exeter, NH 03833-4589
40121	Peterson Mfg. Co. Inc. 700 W. 143rd St. Plainfield, IL 60544-9733	57733	Stewart-Warner Corporation 333 Ludlow St Stamford, CT 06902-6987
44655	Heico Ohmite LLC 1600 GOLF RD 850 ROLLING MEADOWS, IL 60008-4204	59656	Dean Technology Inc. DBA CKE 1000 Lucerne Road Lucernemines, PA 15754-0211
46922	Crawford Electric Co 445 E 32 Mile Rd Romeo MI 48065-5270	6S553	Wes-Garde Components Group Inc 300 Enterprise Dr Westerville, OH 43081-8840
49234	Protectoseal Company 225 W Foster Ave Bensenville, IL 60106-1631	6Y440	Micron Technologies Inc. 8000 S. Federal Way Boise, ID 83716-7128
5N8K3	Alpha Devices 11963 Abbey Rd. Cleveland, OH 44133	60038	Timken Corporation 1835 Dueber Ave Sw Canton, OH 44706-2728
5P059	Tech Products Corp. 2215 Lyons Rd Miamisburg, OH 45342-4465	61706	EAO Switch Corporation 98 Washington St. Milford, CT 06460-3133
50508	Magnetic Components Inc. 9520 Ainslie St. Schiller Park, IL 60176-1191	62292	EBM Industries Inc. 110 Hyde Rd. P.O. Box 4009 Farmington, CT 06034-4009
52793	Saginaw Products Corp. DBA CIGNYS 68 Williamson St. Saginaw, MI 48601-3246	62445	Deutz Corporation 3883 Steve Reynolds Blvd Norcross Ga 30093
54646	Clampco Products Inc. 1743 Wall Road Wadsworth, OH 44281-9558	66180	Automatic Timing and Controls 3312 Bloomingdale Melrose Park, IL 60160-1030
55752	Parker Hannifin Corp. DBA Racor Div. 3400 Finch Rd. Modesto, CA 95354-4125	66844	Powerex Inc. 173 PAVILION LN Youngwood, PA 15697-1800
56289	Sprague Electric Company 678 Main St Sanford, MA, 04073-7003	7M613	Wright F.B. Co. of Cincinnati 4689 Ashley Dr. Hamilton, OH 45011-9706
57330	Remke Industries Inc. 310 Chadick Drive Wheeling, IL 60090-6039	71382	Seal Master Bearings Sub Of Emerson Electric Co. 1901 Bilter Rd. Aurora, IL 60502-9704

Code	Vendor's Name and Address	Code	Vendor's Name and Address
71400	Cooper Bussmann Inc. 114 Old State Road Ellisville, MO 63021-5942	81703	Mulberry Metal Products Inc. 2199 Stanley Terrace Union , NJ 07083-4399
72619	Dialight Corporation 1501 State Rte 34 S Farmingdale, NJ 07727-3932	82866	Research Products Corp. P.O. Box 1467 1015 E. Washington Ave. Madison, WI 53701
74400	Hobbs Corporation 1034 East Ash Street PO Box 19424 Springfield, IL 62794-9424	86797	Rogan Corp 3455 Woodhead Dr. Northbrook, IL 60062-1812
74542	Hoyt Electrical Instruments 23 Meter ST. Concord, NH 03303-1894	9Y826	Marsh Electronics Inc. 1563 S. 101st St. Milwaukee, WI 53214-4032
74545	Hubbell Inc Wiring Device Div 185 Plains Road Milford, CT 06460	91637	Vishay Dale Electronics Inc. 1122 23RD St. Columbus, NE 68601-3647
74829	Ilsco Corp. 4730 Madison Rd. Cincinnati, OH 45227-1426	91929	Honeywell International Inc. DBA Honeywell 11 W. Spring St. Freeport, IL 61032-4316
75418	Kysor Industrial Corporation 1 Madison Ave Cadillac, Michigan 49601-9784	94222	Southco Inc. 210 N. Brinton Lake Rd. Concordville, PA 19331
75915	Littelfuse, Inc. 8755 W Higgins Road Ste 500 Chicago, IL 60631 - 2701	97520	Basler Electric Company Route 143 Highland, IL 62249-1074
77342	TYCO Electronics Corporation 8010 Piedmont Triad Pkwy Greensboro, NC 27409		
78388	Woodward Controls Inc. 6250 W Howard St Niles, IL 60714-3433		
8A334	Cummins Bridgeway LLC 2297 SW Blvd Ste K Grove City, OH 43123-1822		
8T246	Whitesell RO & Associates, Inc. 7009 CORPORATE WAY Dayton, OH 45459-4238		
81483	International Rectifier Corp 233 Kansas St. El Segundo, CA 90245		

Section 3 Illustrated Parts List

1) Explanation of Parts List Arrangement

The parts list is arranged so that the illustration will appear on a left-hand page and the applicable parts list will appear on the opposite right-hand page. Unless the list is unusually long, the user will be able to look at the illustration and read the parts list without turning a page.

2) Symbols and Abbreviations

The following is a list of symbols and abbreviations used in the parts list:

*	-	Item not illustrated
A, or AMP	-	Ampere
AC	-	Alternating current
AR	-	As required
DC	-	Direct current
Fig.	-	Figure
Ft-lb.	-	Foot-pounds
Hd.	-	Head
Hex	-	Hexagon
Hz	-	Hertz (cycles-per-second)
I.D.	-	Inside diameter
IN	-	Inch
KVA	-	Kilovolt-ampere
UF	-	Microfarad
Number	-	Number
NHA	-	Next higher assembly
N-m	-	Newton-meters
PRV	-	Peak reverse voltage
PSI	-	Pounds per square inch
Ref	-	Reference (the item has been listed previously)
TM	-	Technical Manual
T-R	-	Transformer-rectifier
V	-	Volt (when used as a prefix to a five-digit number, indicates vendor code)

NOTE: An item which does not reflect an index number is an assembly which is not illustrated in its assembled state, or it is similar (right-hand, left-hand, top, etc.) to an item which is illustrated.



Figure 1 Final Assembly of GPU-600 Power Supply

FIGURE ITEM NO.	ITW GSE PART NO.	NOMENCLATURE	EFF	UNITS PER ASSY.
1		Base Assembly (See Figure 4)		Ref.
2	288267	Panel, Side		2
3	288266	Panel, Top		1
4	283323	Bracket, Cable Hanger		4
5	282658	Label, Warning Clearance		1
6	402025-002	Cable, Output, 28 V , 20 ft <i>[Other Lengths Available]</i>		1
7	288356	Handle Assembly	A-G	1
	288284	...Handle, 5 th Wheel	A-G	1
	288281	...Latch, 5 th Wheel	A-G	1
	288298-001	...Grip, Foam	A-G	2
* 8	288362-001	Cover, Protective, Changeover Board	A,C,F,J,L	1
*	288362-002	Cover, Protective, Changeover Board	B,E,G,H,K	
* 9	78B1130	Nameplate, Identification		1
* 10	286441	Label, General		1
* 11	288866	Label, Service		1
* 12	287460	Label, Danger, High Voltage	D,E,H	1
* 13	288322	Label, Fan	D,E,H	1
* 14	288300	Label, Emergency Stop	D,E,H	1
* 15	287547-001	Label, CE		1
* 16	288272	Support, Bridge Mount	J,K,L	2
* 17	288542	Shield, Control Box		1

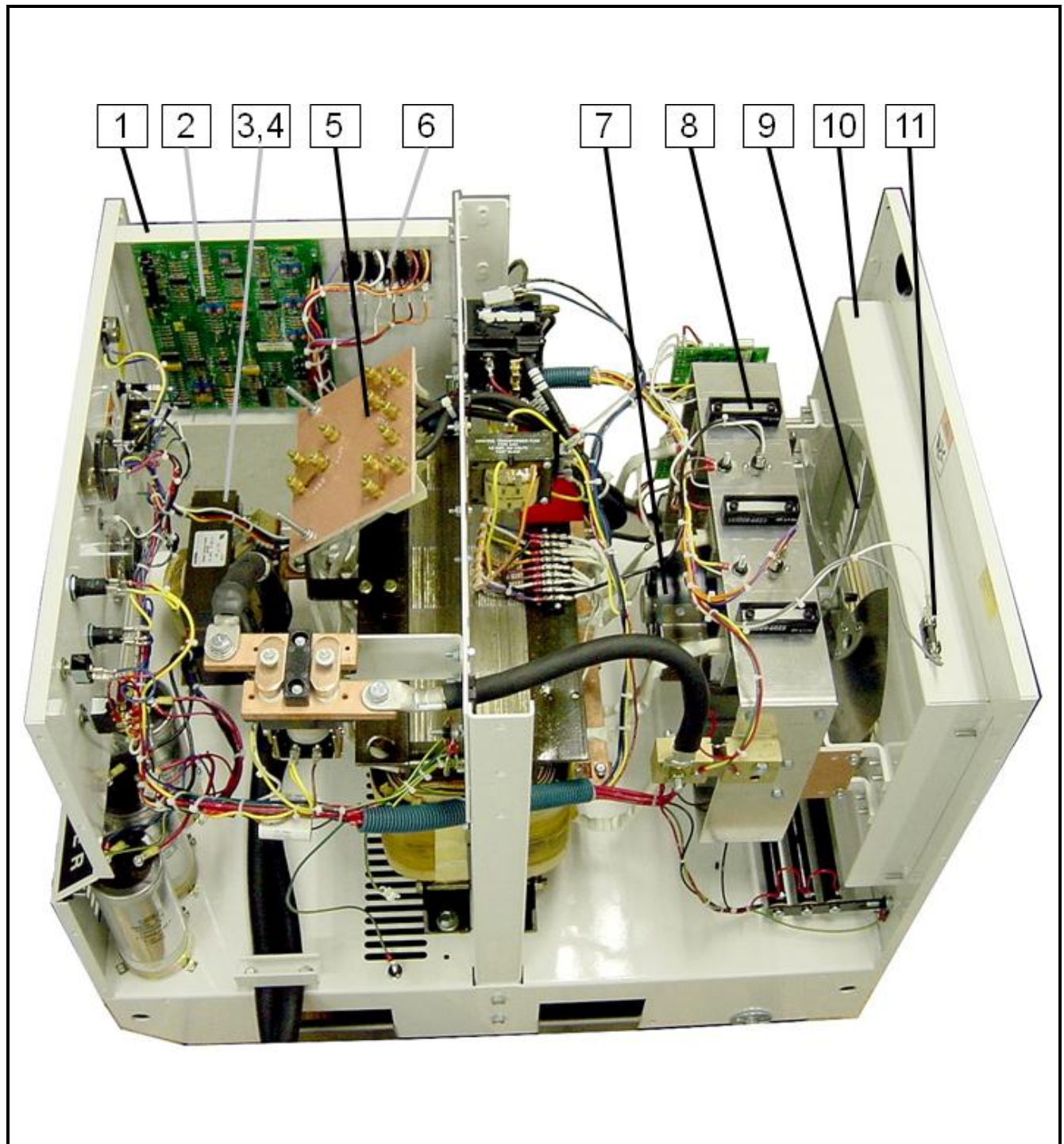


Figure 2 Internal Components – Part 1

FIGURE ITEM NO.	ITW GSE PART NO.	NOMENCLATURE	EFF	UNITS PER ASSY.
2 -	1 288271	Panel, PC Board		1
	2 180294B	Board, PC, Control, Ay.		1
	404915-001	...Spacer, Pc Board		6
	3 180480	Choke Assembly		1
	4 180065	Shunt, 2000 Amp, 50 mV (for ammeter)		1
	5 Ref.	Voltage Changeover Board (see note)		Ref.
	6 405129-001	Block, Fuse		1
	W11166-009	...Fuse, Fast Blow, AGC 1 A, 250 V		6
	83A1105	...Label, Fuse		1
	7 287637	Motor, Fan		1
	8 288305-002	Rectifier, Output, SCR Assembly (See Figure 7)		1
	9 406991	Blade, Fan		1
	10 201016	Shroud, Fan		1
	288322	...Label, Warning, Fan		1
	400234-003	...Tag, Instructions		2
	201015	...Bracket, Mounting, Fan Shroud		2
	11 288303-001	Block, Fuse		1
	400647-005	...Fuse, 5 A		1
	288363	...Label, Precautionary, Fan Fuse		1
*	12 408567	Relay, 24 VAC, 4PDT (shown on Figure 6)	J,K,L	2
*	408352	...Socket, Relay	J,K,L	2
*	408585	...Spring, Relay	J,K,L	2
*	288366	...Chart, Wire, Bridge Mount Units	J,K,L	2

Note: Item 5, the Voltage Changeover Board, is part of the transformer.

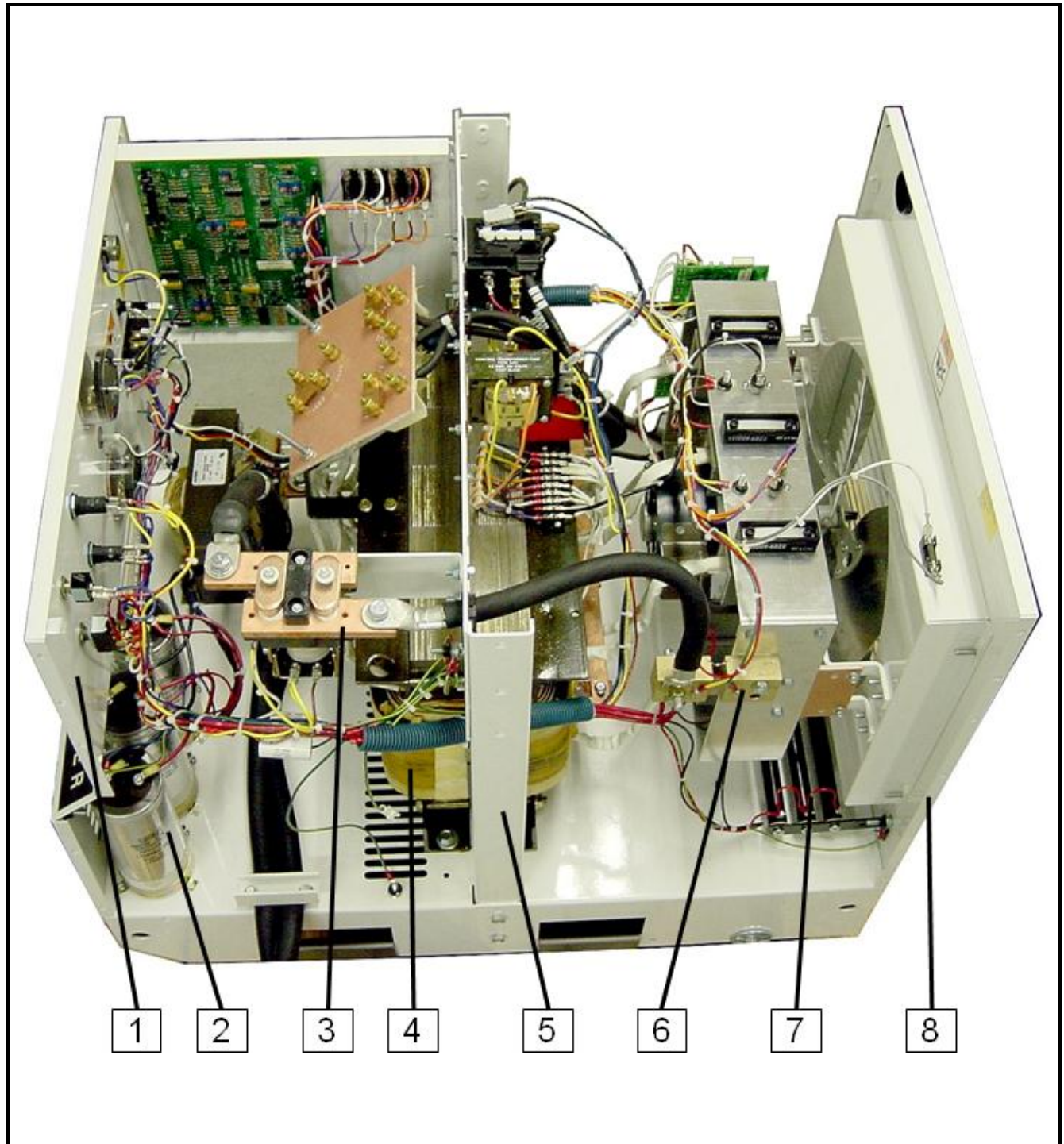


Figure 3 Internal Components – Part 2

FIGURE ITEM NO.	ITW GSE PART NO.	NOMENCLATURE	EFF	UNITS PER ASSY.
3 -	1	Panel, Front, GPU, Ay. (See Figure 5)		Ref.
	2	405278-007 Capacitor, ALS, 115000 MF, 40 VDC (V56289, # 36DX772F200DF2A)	A,C,F,J,	3
		Capacitor, ALS, 115000 MF, 40 VDC	B,E,G,H,K	4
*	350488-094	...Insulator, Mylar, .014, 2" Wide	A,C,F,J,	3
*		...Insulator, Mylar, .014, 2" Wide	B,E,G,H,K	4
*	361052-009	...Clamp, Mounting, Capacitor	A,C,F,J,	3
*	361052-009	...Clamp, Mounting, Capacitor	B,E,G,H,K	4
*	788732	Cover, Capacitors, CE	E,H	1
3	286810-001	Output Contactor, 28.5 VDC		1
4	589561	Transformer, Power	A,F,J	1
	180358	Transformer, Power	B,E,G,H,K	1
	181565	Transformer, Power	C,	1
5		Panel, Interior Assembly (See Figure 6)		Ref.
6	280023	Feedback Shunt (See Figure 7)		Ref.
7	487050-005	Resistor, Pre-load, Assembly		1
8	489603	Panel, Rear		1
	403091-008	...Plug, Hole, Plastic		1
*	9	488819 Cable, 2/0 (#202)		1
*	10	W9760-066 Cable, # 6 (#201)		1
*	11	288731 Cover, Contactor & Transformer	E,H	1
*	12	288732 Cover, Capacitors, CE	E,H	1

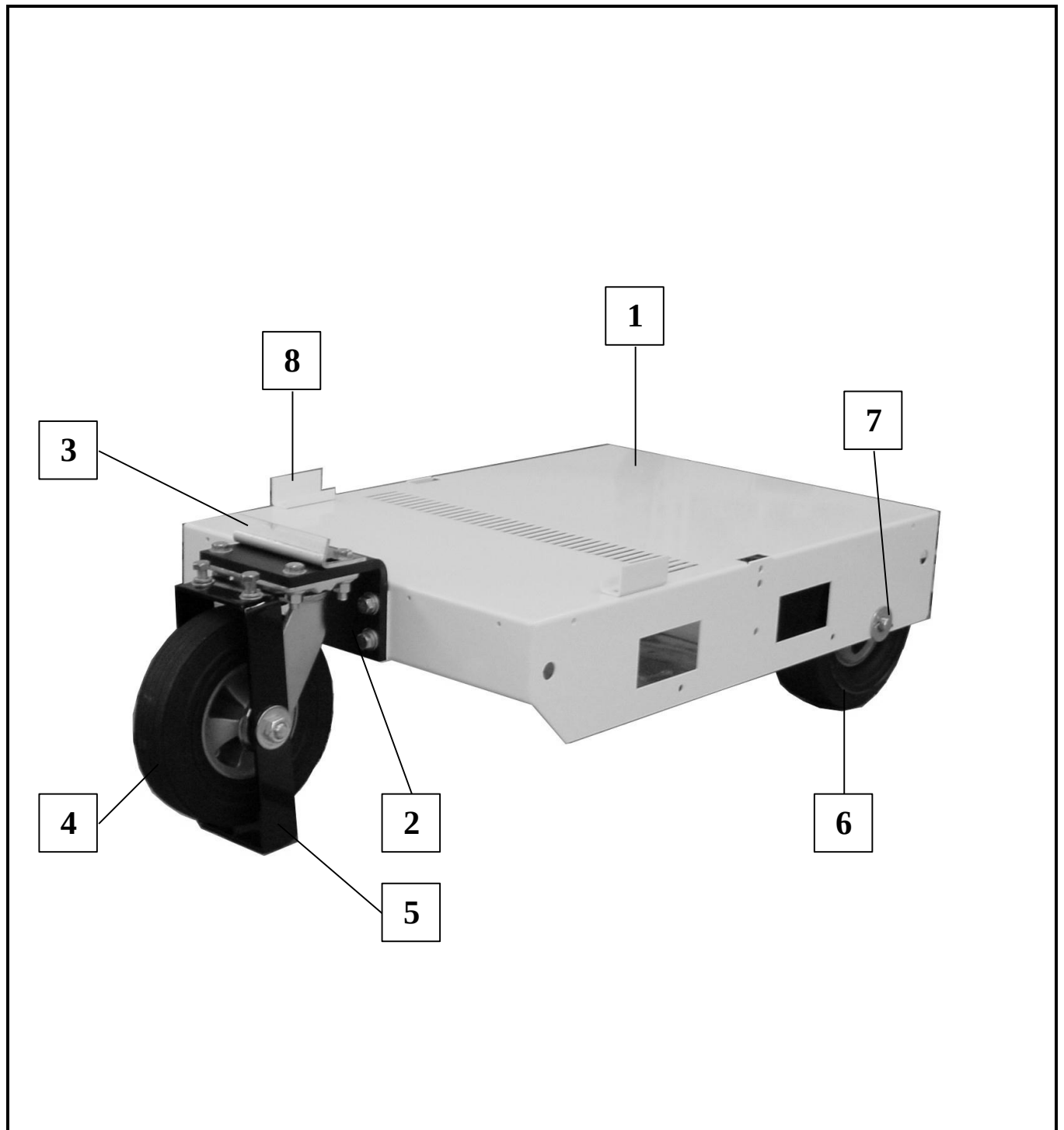


Figure 4 Base Assembly

FIGURE ITEM NO.	ITW GSE PART NO.	NOMENCLATURE	EFF	UNITS PER ASSY.
4 -	288321-001	Base, Ay.	A-E	1
	288321-002	Base, Ay.	F-K	1
1	288262	Base, Mounting, GPU		1
2	288282	Support, Caster, 5 th Wheel	A-E	1
	288349	...Spacer, 5 th Wheel	A-E	1
3	288283	Catch, Latch	A-E	1
4	288297-001	Kit, Caster	A-E	1
5	288353	Brake, 5 th Wheel	A-E	1
6	83B1101	Tire, Symmetrical, Ball Bearing, 10°	A-E	2
7	288251	Axle, Mounting, Wheels	A-E	1
	486143-002	...Spacer, Black, Pipe	A-E	2
8	283322	Bracket, Output, Cable		2
	489971	...Spacer, Output Cable		4

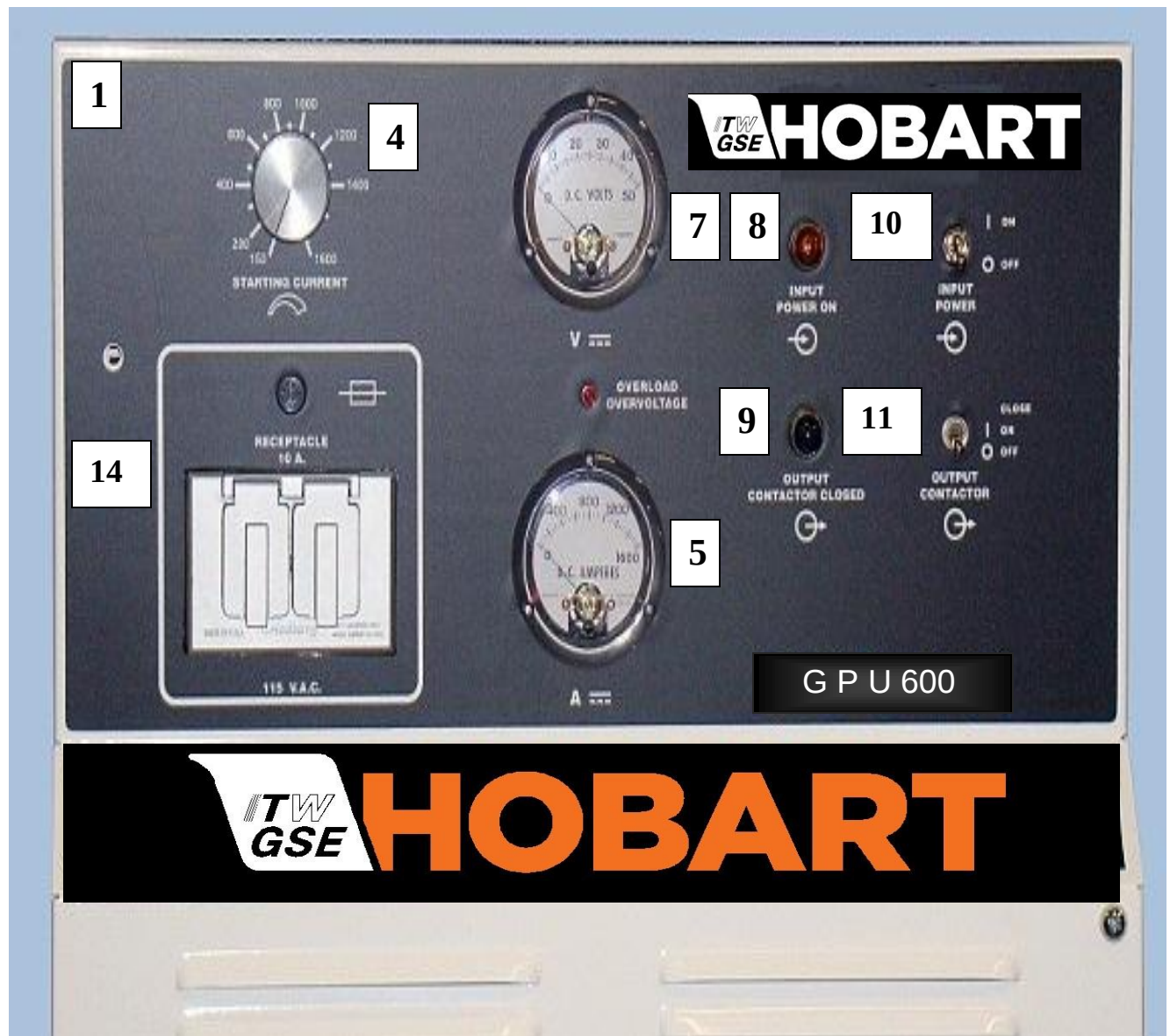


Figure 5 Front panel Assembly

FIGURE ITEM NO.	ITW GSE PART NO.	NOMENCLATURE	EFF	UNITS PER ASSY.
5 -	288307-003	Panel, Front, GPU, Assembly	A,C,F,J,L	1
	288307-004	Panel, Front, GPU, Assembly	B,G,K	1
	288307-006	Panel, Front, GPU, Assembly	E,H	1
	288307-008	Panel, Front, GPU, Assembly		1
1	288270	Panel, Front		1
2	288280-002	Label, Controls (GPU-600)		1
3	286607-001	Potentiometer, 10k Ohm, 2 W (see note)		Ref.
4	16DA2162	Knob, Rheostat (V44655, #5150)		1
5	400641-012	Ammeter, DC, 0-2000 Amps, 50 mVDC		1
6	405072-002	Diode, Light		1
	405734	...Clip, Retainer, LED		1
7	400642-003	Voltmeter, DC		1
8	180914	Base, Light, Pilot		1
	400613-006	...Lamp, 120 MB, 120 V, .025 A, T-2-1/2	A-C,F-G,J-	1
	400613-003	...Lamp, Type 757, 28 V, .08 A	E,H	1
	404172-002	...Lens, Light, Pilot, Amber (V72619)		1
9	180914	Base, Light, Pilot		1
	400613-003	...Lamp, Type 757, 28 V, .08 A		1
	404172-003	...Lens, Light, Pilot, Green (V72619 #261193300)		1
10	405365-001	Switch, Toggle		1
11	403189	Switch, Toggle, 3 Position (V91929, #312TS)		1
*	12	287460 Label, Danger, High Voltage [Not Shown]		1
	13	288365 Nameplate, ITW GSE, GPU		1
	14	402670 Receptacle, 3-Wire [125 V, 15 A]	A,C,F,J,	1
	404277	...Cover, Receptacle (V81703, # WPDC)	A,C,F,J,	1
	401532-002	...Suppressor Assembly	A,C,F,J,	1
15	404336	Receptacle, 3-Wire [230 V, 15 A] (V77116)	B,E,G,H,K	1
	404335	...Cover, Receptacle (V81703, # WPRC)	B,E,G,H,K	1
	403955-017	...Suppressor Assembly	B,E,G,H,K	1
16	402658	Holder, Fuse (V71400, # HKP-HH)		1
	400647-008	...Fuse, 10 A, 250 V (V71400, # ABC-10)		1
17		Grounding Hardware		Ref.
*	18	288364 Label, Precautionary, Recpt., Fuse		1
*	19	288351 Harness, Wire [not shown]		1
*	20	77A1157 Switch, Maintained, Push/Pull	E,H	1
Notes: - A,C,F,J are 60 Hz. - B,E,G,H,K are 50 Hz. - Potentiometer (item 3) is included with wire harness (item 19)				

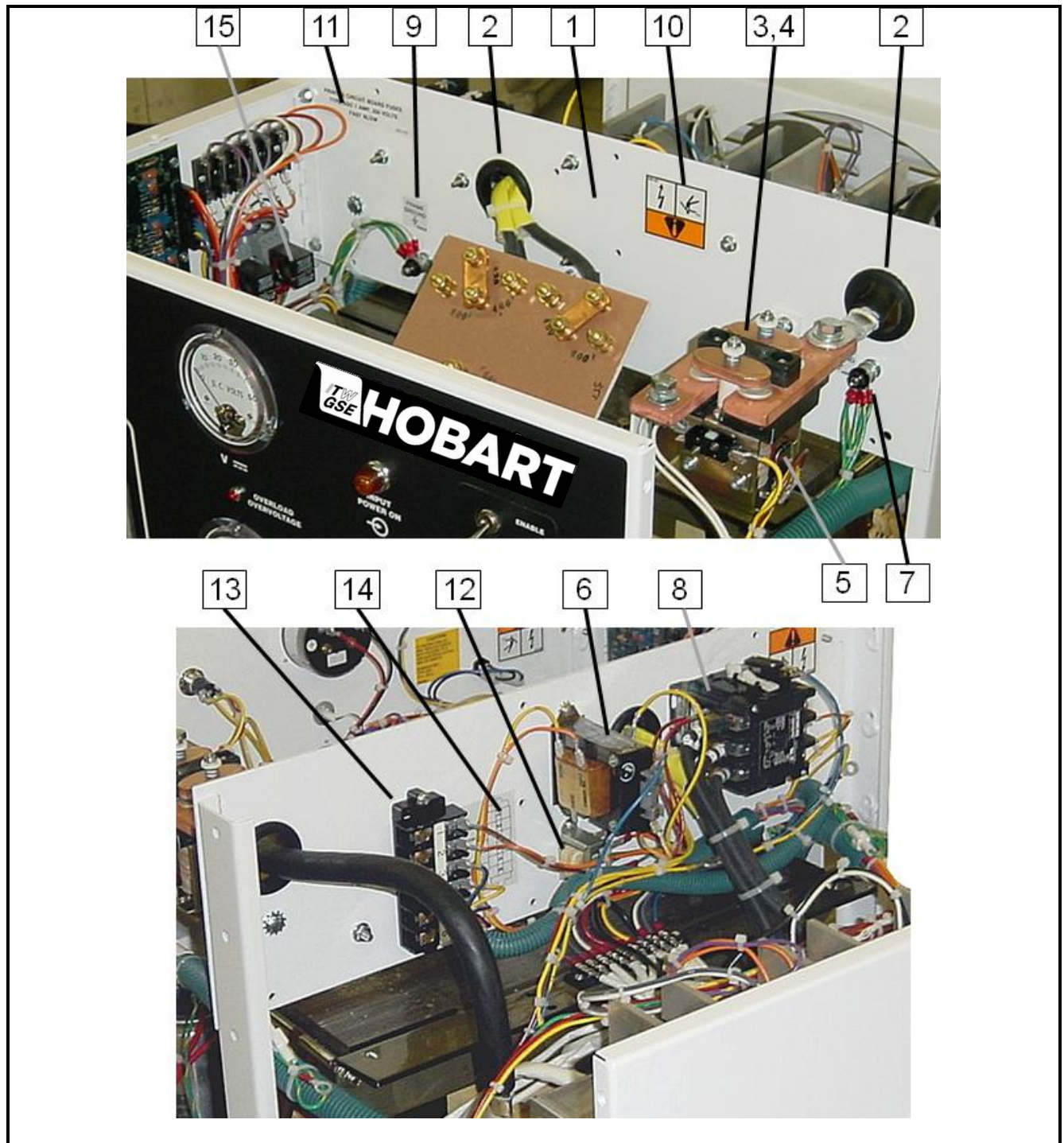


Figure 6 Interior Panel Assembly (shown with bridge mount option)

FIGURE ITEM NO.	ITW GSE PART NO.	NOMENCLATURE	EFF	UNITS PER ASSY.
6 -	288310-001	Panel, Interior, Ay.	A,F	1
	288310-002	Panel, Interior, Ay.	B,C,G	1
	288310-003	Panel, Interior, Ay.	J	1
	288310-004	Panel, Interior, Ay.	K	1
	288310-005	Panel, Interior, Ay.	E,H	1
	288310-006	Panel, Interior, Ay.		1
1	288273	Panel, Interior		1
2	402037-027	Grommet, Rubber		2
3	487898A	Bracket, Contactor		1
4	286810-001	Contactor, 28.5 VDC		1
5	201673-004	Diode Assembly (on line contactor)		1
6	406392-001	Transformer, Control	A,F,J	1
	406392-002	Transformer, Control	B,C,G,K,	1
	406247-002	Transformer, Control		1
	406247-003	Transformer, Control	E,H	1
	406484	...Label, Fuse, 4-400-S, .5 Amp, 250 V		1
	W11166-011	...Fuse, Fast Blow, AGC (V71400, #AGC/2)		1
7		Grounding Screws (1/4-20 Hardware)		3
8	400663	Contactor, Line	A-C,F-G,J-	1
	288733-001	Contactor, Line	E,H	1
9	405548	Label, Ground		3
10	287460	Label, Danger, High Voltage		2
11	83A1105	Label, Fuse "PC Board Fuses"		1
12	408584	Transformer, Signal	J,K,	1
13	283066-001	Block, Terminal, 6 Position	J,K,	1
14	286432-001	Label, Bridge Interlock	J,K,	1
15		Relays for bridge mount (see Figure 2)	J,K,	Ref

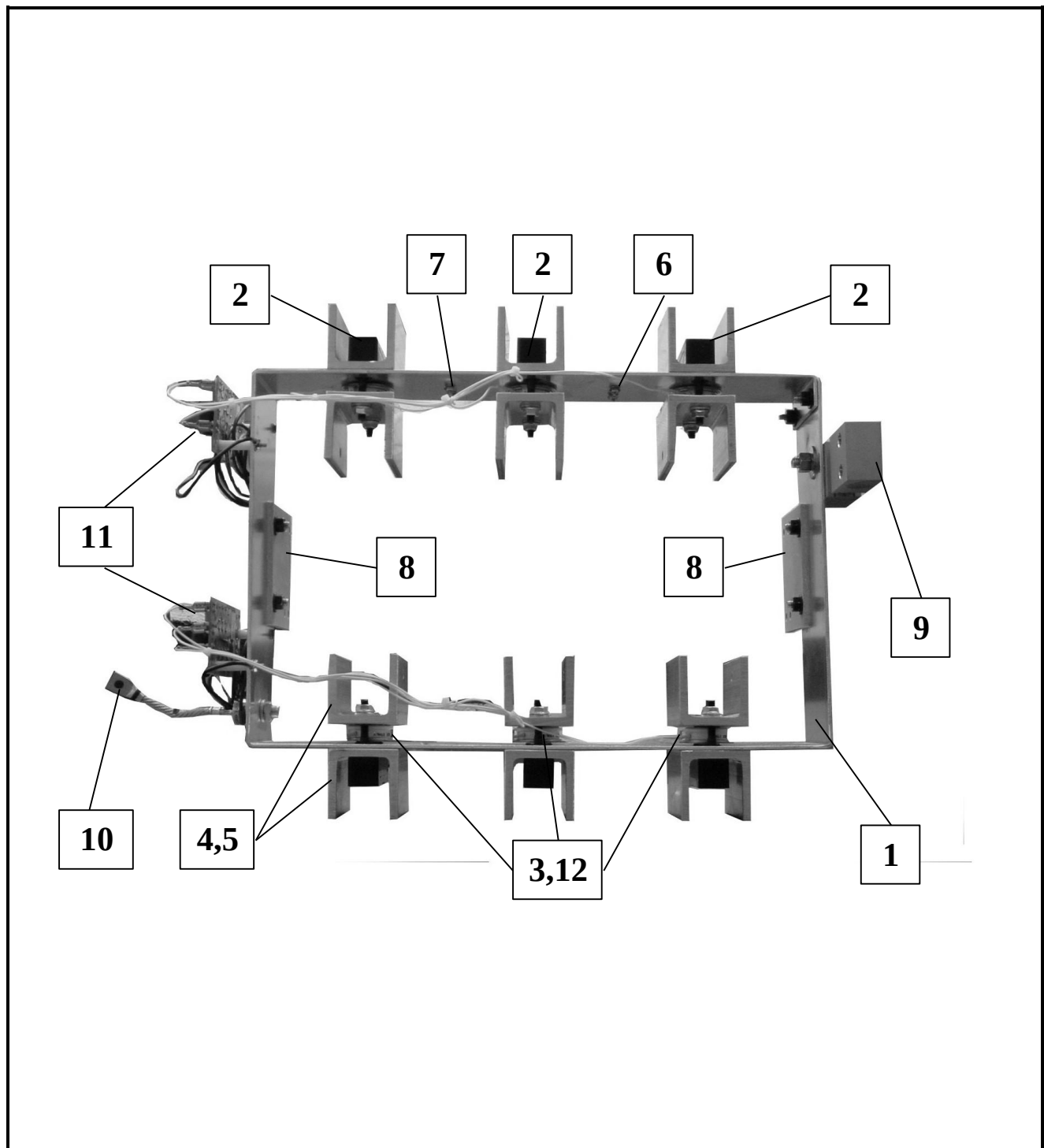


Figure 7 SCR Output Rectifier Assembly of GPU-600 Power Supply

FIGURE ITEM NO.	ITW GSE PART NO.	NOMENCLATURE	EFF	UNITS PER ASSY.
7 -	288305-002	Rectifier, Output, SCR Assembly GPU-600		Ref.
1	288277	Heat Sink, Rectifier		1
2	405140-001	Clamp, Mounting		6
3	405139	Rectifier, Silicon, Cont.		6
4	369642	Heat Sink, SCR		6
5	288304	Heat Sink, SCR, Top		6
6	287929-001	Thermostat, Overload		1
7	404044-006	Thermostat, Fan Turn On		1
8	369641	Insulator, Mounting, Rectifier		2
9	280023	Shunt, 1200 A, 50 mV, Assembly		1
10	402832-003	Diode, Silicon, Positive Base		1
11	367634A-003	Suppressor, Surge, Assembly		2
12	16DA954-012	Pin, Spring		6

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Chapter 5 Manufacturer's Literature

Diagram Number	Diagram Description
288326, Rev. 0	Outline, Dimensional/Installation
288367, Rev 11	Diagram, Schematic & Connection

Contact ITW GSE if copies of these drawings are not with this manual. Refer to Appendix A for specific information on GPU-600 Solid State Transformer-Rectifier optional equipment.

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Appendix A Options / Features

The following is a list of options/features available for the 500082, GPU-600 Solid State Transformer-Rectifier. This chart contains the description, part number, and document number of the option/feature. There is also a column to identify which option/feature is contained in this Appendix.

Option/Features Available			
Description	Part Number	Document Number	In This Section
Kit, Cable Tray	288360	TO-274	
Plug, Locking (Fits 50 Hz. Aux.)	288582-001		
Kit, Cable Interlock, GPU 400/600	290698		
Kit, Cover, Dust	291594-001	TO-338	

Unusual Service Conditions

This information is a general guideline and cannot cover all possible conditions of equipment use. The specific local environments may be dependent upon conditions beyond the manufacturer's control. The manufacturer should be consulted if any unusual conditions of use exist which may affect the physical condition or operation of the equipment.

Among such conditions are:

1) Exposure to:

- a) Combustible, explosive, abrasive or conducting dusts
- b) Environments where the accumulation of lint or excessive dirt will interfere with normal ventilation
- c) Chemical fumes, flammable, or explosive gases
- d) Nuclear radiation
- e) Steam, salt-laden air, or oil vapor
- f) Damp or very dry locations, radiant heat, vermin infestation, or atmospheres conducive to fungus growth
- g) Abnormal shock, vibration or mechanical loading from external sources during equipment operation
- h) Abnormal axial or side thrust imposed on rotating equipment shafts
- i) Low and/or high ambient temperatures
- j) High electromagnetic fields

2) Operation at:

- a) Voltages above or below rated voltage
- b) Speeds other than rated speed
- c) Frequency other than rated frequency
- d) Standstill with rotating equipment windings energized
- e) Unbalanced voltages
- f) Operation at loads greater than rated

3) Operation where low acoustical noise levels are required

4) Operation with:

- a) Improper fuel, lubricants or coolant
- b) Parts or elements unauthorized by the manufacturer
- c) Unauthorized modifications

5) Operation in poorly ventilated areas

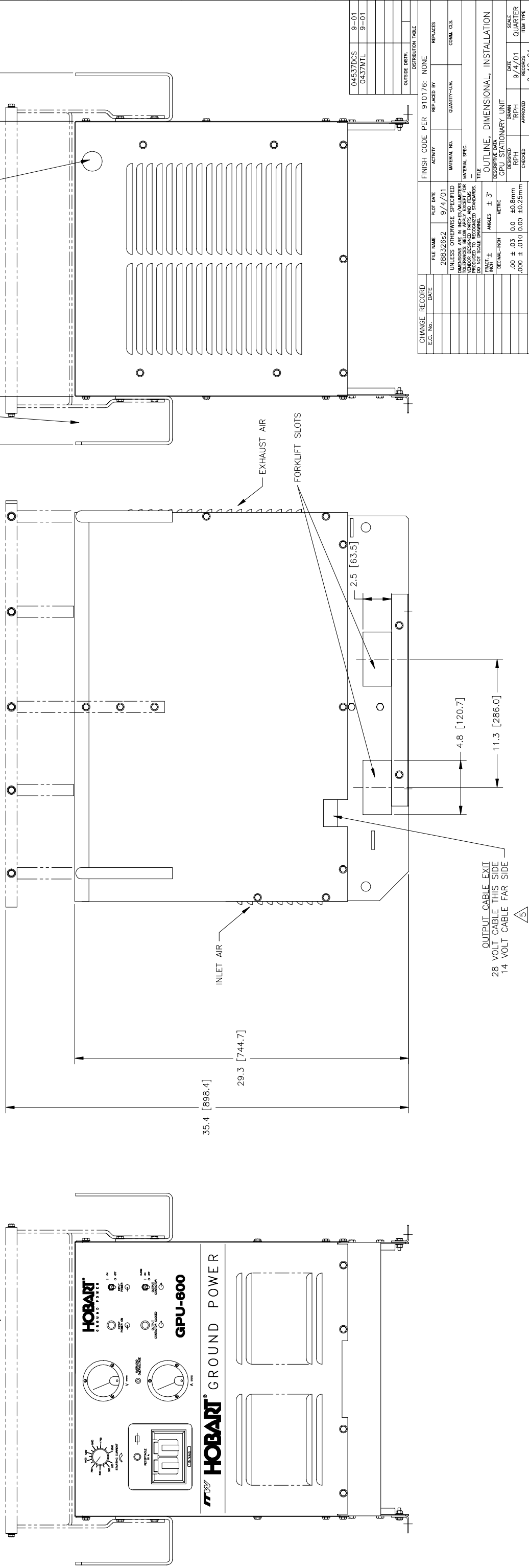
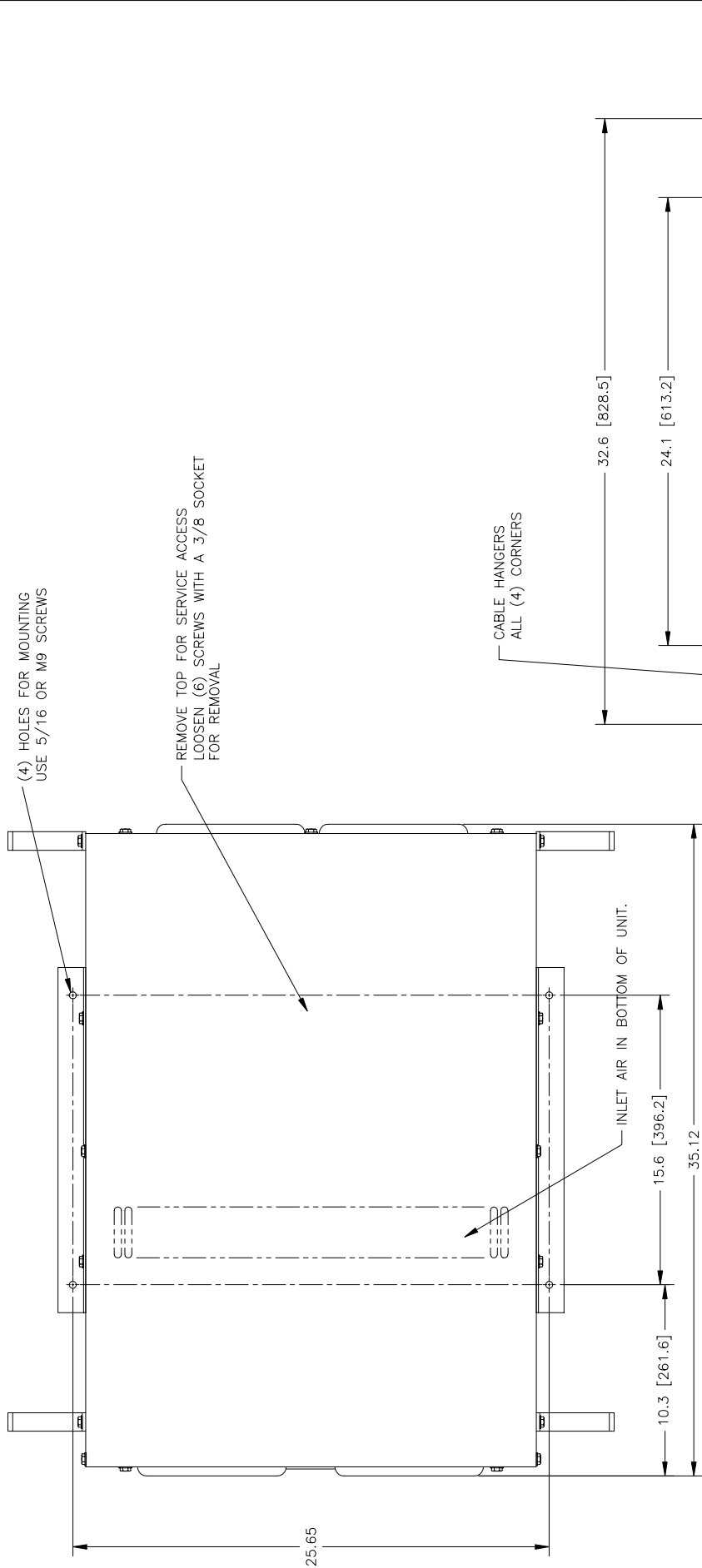
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NOTES:

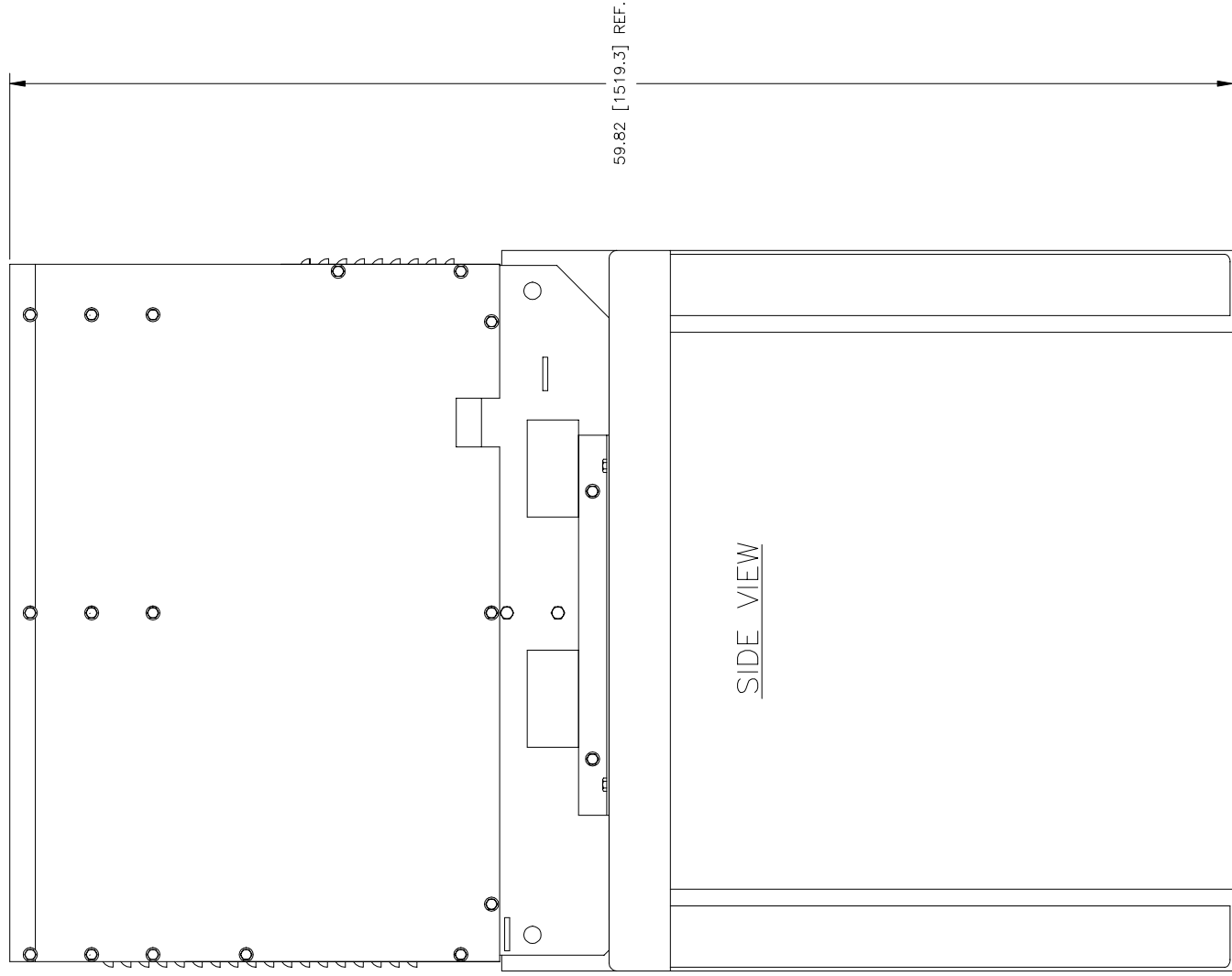
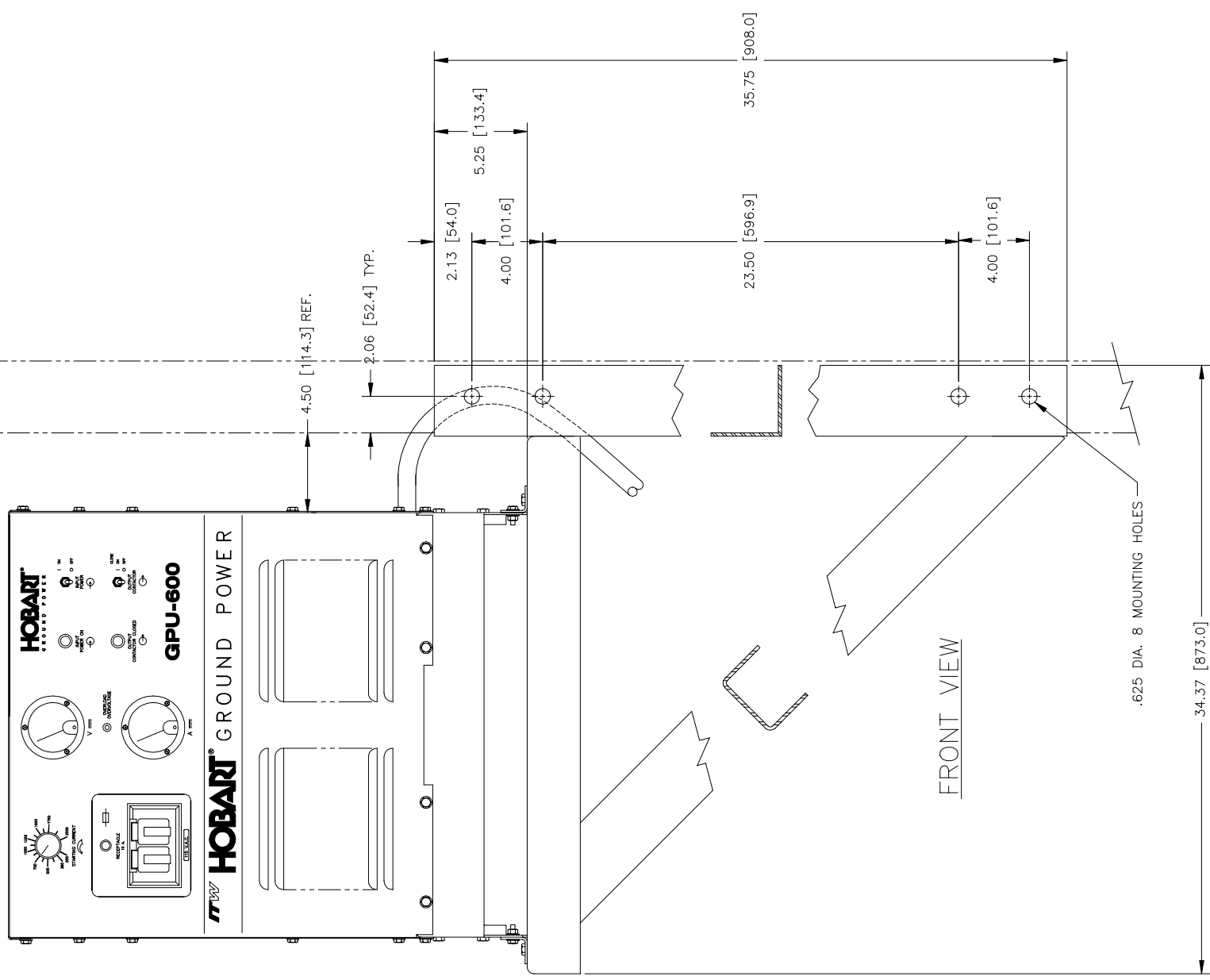
1. FIRST DIMENSION IN INCHES, [] MILLIMETERS.
2. CONVENIENCE RECEPTACLE AND ITS FUSE IS LOCATED ON FRONT PANEL. THE FUSE FOR THE FAN IS LOCATED ON FAN SHROUD, AND OTHER MISC. FUSES ARE BEHIND THE FRONT PANEL ADJACENT TO THE P.C. BOARD.
3. 14-25 VOLT AVAILABLE WITH GPU 400.

4. 1-3/4" DIA. HOLE PROVIDED, USE WATERTIGHT STRAIN RELIEF IF UNIT WILL BE USED OUTDOORS. LOCATED ON INTERIOR PANEL, 18.0 [458] INPUT CABLE CONNECTIONS. A SCREW DRIVER AND A 9/16 WRENCH BEHIND CABLE ENTRANCE. REQUIRED.

5. NEGATIVE OUTPUT CABLE CONNECTION LOCATED ON SHUNT AND POSITIVE CABLE CONNECTION LOCATED ON CONTACTOR, 9/16 SOCKET AND WRENCH REQUIRED.



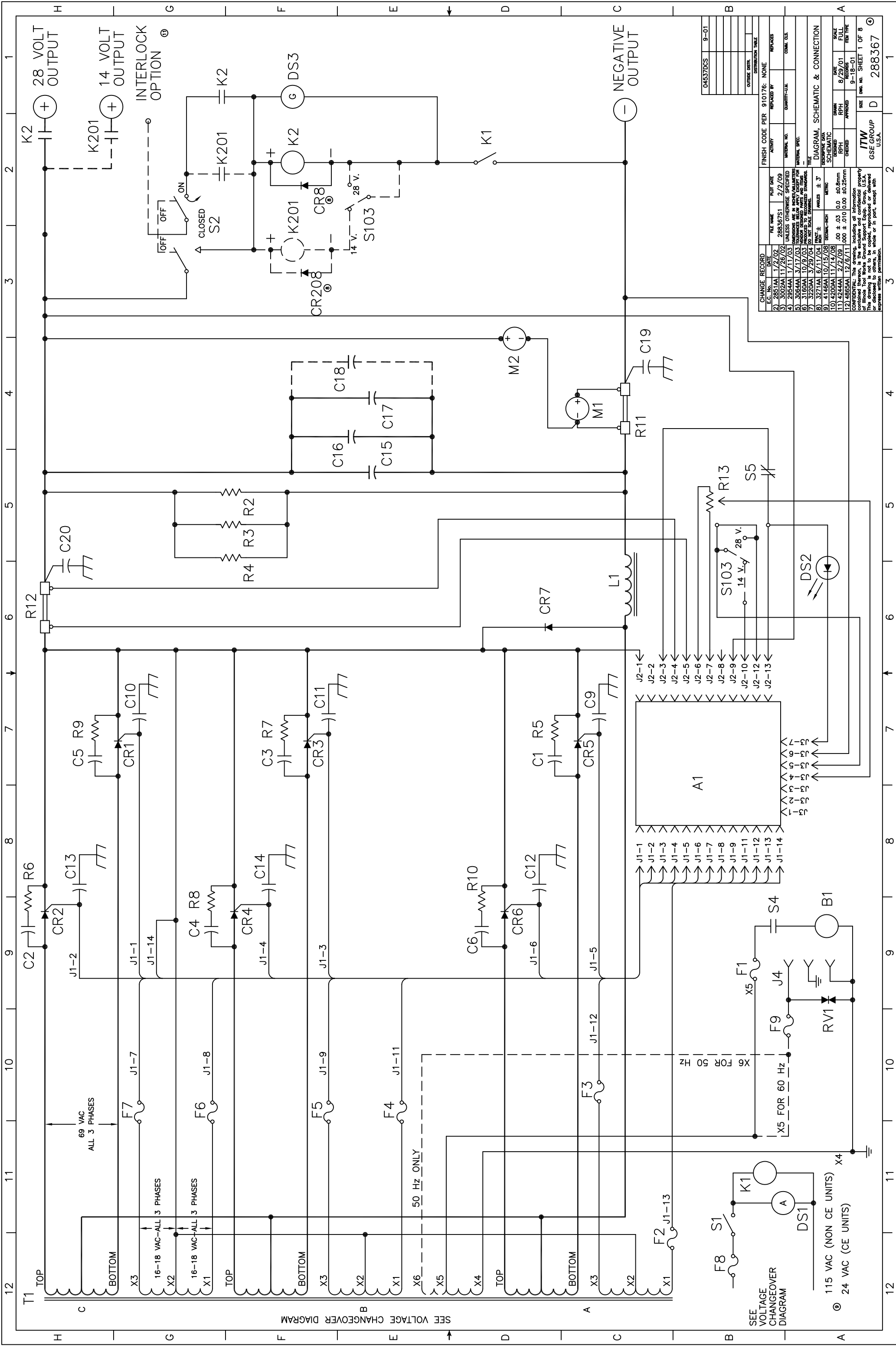
CHANGE RECORD		FINISH CODE PER 910176: NONE									
E.C. No.	DATE	FILE NAME	PLOT DATE	ACTIVITY	REPLACED BY	REPLACES					
		288326s2	9/4/01								
				MATERIAL NO.	QUANTITY-UM.	COMM. CLS.					
		DIMENSIONS ARE IN INCHES/ALL OTHERS ARE IN METERS/ALL DIMENSIONS ARE TO FACE UNLESS OTHERWISE SPECIFIED									
		VENDOR DESIGNED PARTS AND ITEMS ARE TO BE SUPPLIED BY THE VENDOR									
		DO NOT SCALE DRAWINGS									
		DO NOT SCALE DRAWING									
		TITLE									
		OUTLINE: DIMENSIONAL, INSTALLATION									
		DESCRIPTIVE DATA									
		CPU STATIONARY UNIT									
		DESIGNED	DRAWN	DATE	SCALE						
		UNCHECKED	RPHI	9/4/01	QUARTER						
		APPROVED			1/8"=1"						
				9-18-01							
		SIZE				ENG. NO. SHEET 2 OF 3					
		D				288326					
		TROY, OHIO 45373				U.S.A.					
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— BRIDGE MOUNTING SUPPORT AVAILABLE

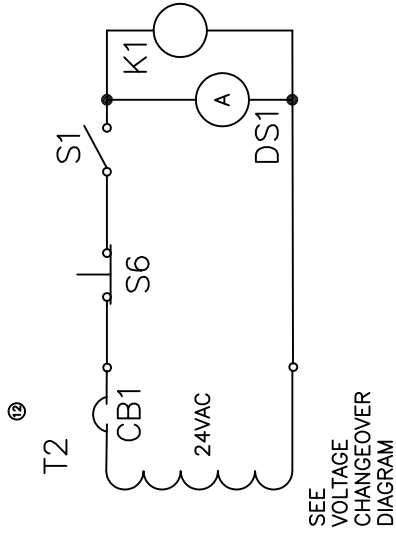
NOTE: INCHES [mm]

CHANGE RECORD		FINISH CODE PER 910176: NONE					
E.C. No.	DATE	FILE NAME	PLOT DATE	ACTIVITY	REPLACED BY	REPLACES	
		288326s3	9/7/01	MATERIAL NO.	QUANTITY-UM.	COMM. CLS.	
				DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED			
				UNLESS NOTED OTHERWISE, ALL DIMENSIONS ARE TO FACE OF PARTS AND MATERIALS			
				VENDOR DESIGNED PARTS AND ITEMS			
				DO NOT SCALE DRAWINGS			
				TITLE			
				OUTLINE: DIMENSIONAL, BRIDGE MTG			
				DESIGNER'S DATA			
				BRIDGE MOUNTED GPU--600			
				DESIGNED	DRAWN	DATE	SCALE
				RPHI	RPHI	9/1/01	QUARTER
				CHECKED	APPROVED		TITLE TYPE
						9-18--01	
				FRACT ± ANGLES ± 3°			
				DECIMAL-INCH METRIC			
				0.00 ± .03	0.0 ± 0.8mm		
				0.00 ± .010	0.00 ± 0.25mm		
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				SIZE	ENG. NO.		SHEET 3 OF 4
				D	288326		
				TROY, OHIO 45373 U.S.A.			

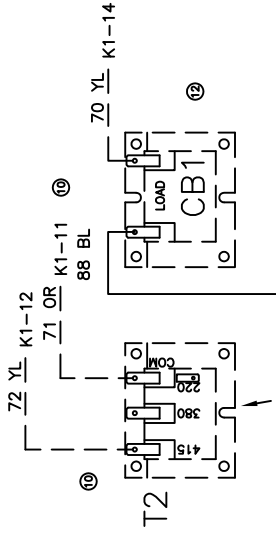




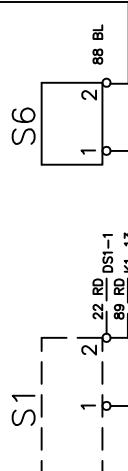
CE SCHEMATIC DIAGRAM



CE CONNECTION DIAGRAM



FACING REAR OF INTERIOR PANEL

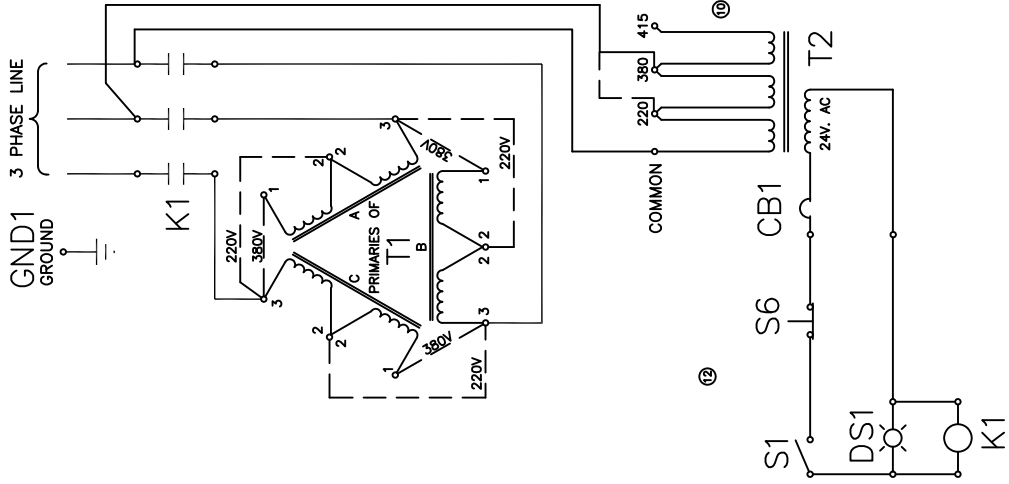


COLOR CODE			
BK	BLACK	RD	RED
BL	BLUE	TAN	TAN
BR	BROWN	VT	VIOLET(PURPLE)
GR	GREEN	WT	WHITE
GY	GRAY (SLATE)	YL	YELLOW
OR	ORANGE	D	DARK (PREFIX)
PK	PINK	L	LIGHT (PREFIX)

Applies only to:

500160-412

220/380 VAC, 50 Hz, CE

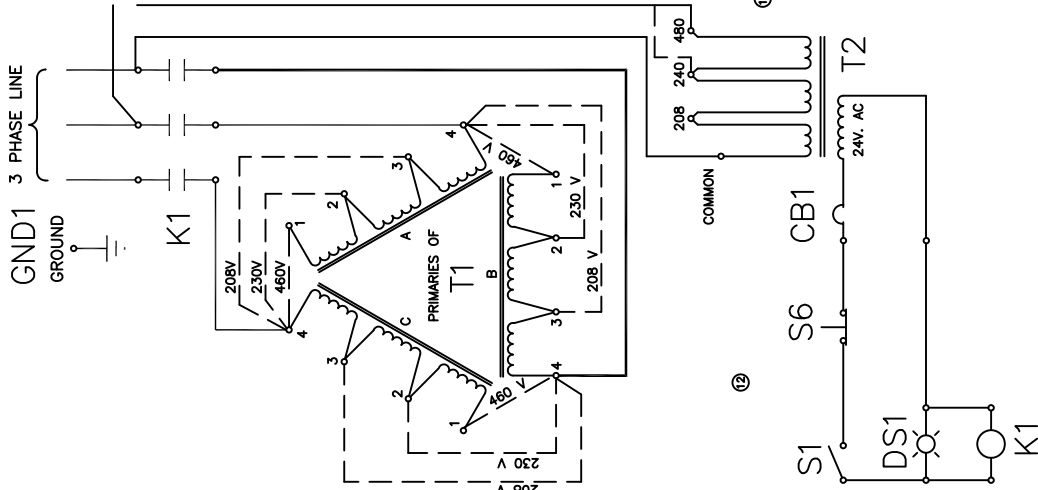


FACING VOLTAGE CHANGEOVER PANEL FROM TOP FRONT

Applies only to:

500160-411

208/230/460 VAC, 60 Hz, CE

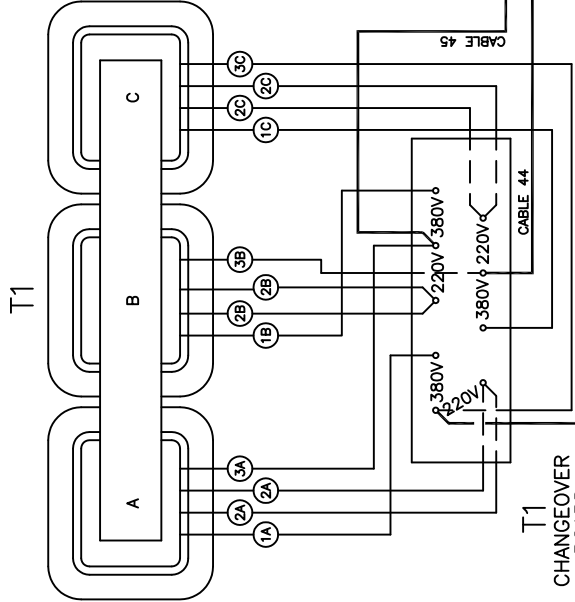
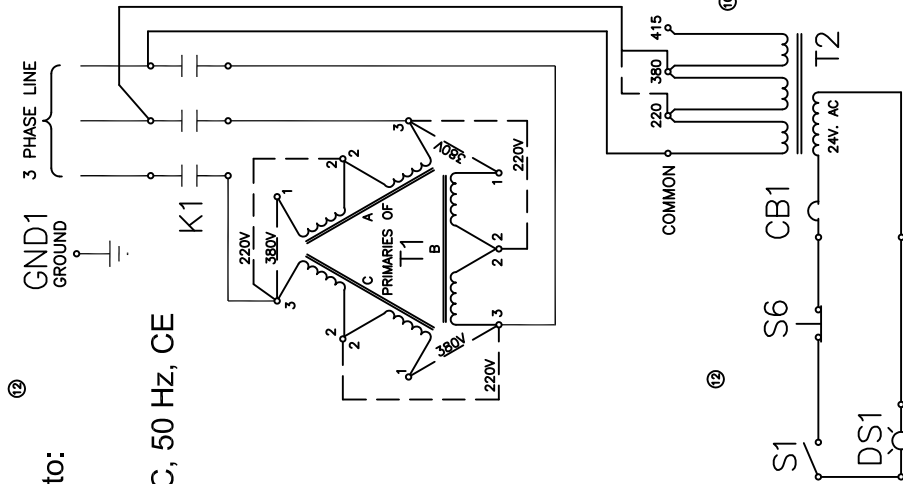


FACING VOLTAGE CHANGE OVER PANEL FROM TOP FRONT

Applies only to:

500160-612

220/380 VAC, 50 Hz, CE



FACING VOLTAGE CHANGEOVER PANEL FROM TOP FRONT

[illegible]

