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060707 – Revision 3

Operation and Maintenance Manual

PowerMaster EV

Model: 60SE200
60 kVA, 3 Phase, 115/200 Volt,
400 Hz. Solid State Frequency Converter

Series 500381

ITW GSE Group
Hobart Ground Power
Troy, Ohio 45373
U.S.A.

Warranty

Data Sheet 165
Index: 990223
Replaces: 980601

HOBART GROUND POWER
TROY, OHIO 45373

1. Hobart Brothers Company (hereinafter called HOBART) warrants that each new and unused Hobart Ground Power Equipment, (hereinafter called the PRODUCT) is of good workmanship and is free from mechanical defects, provided that (1) the PRODUCT is installed and operated in accordance with the printed instructions of HOBART, (2) the PRODUCT is used under the normal operating conditions for which it is designed, (3) the PRODUCT is not subjected to misuse, negligence or accident, and (4) the PRODUCT receives proper care, lubrication, protection, and maintenance under the supervision of trained personnel.
2. This warranty expires 15 months after shipment by HOBART to the first user, or 12 months after installation, whichever first occurs.
3. This warranty does not apply to: primary and secondary switch contacts, cable connectors, carbon brushes, fuses, bulbs, and filters unless found to be defective prior to use.
4. Hobart DOES NOT WARRANT THE FOLLOWING COMPONENTS: Engines, engine components; such as: starters, alternators, regulators, governors, etc., and cable retrieving devices. Many of the foregoing components are warranted directly by the manufacturer to the first user and serviced by a worldwide network of distributors and others authorized to handle claims for component manufacturers. A first user's claim should be presented directly to such an authorized component service outlet. In the event any component manufacturer has warranted its component to HOBART and will not deal directly with a first user then HOBART will cooperate with the first user in the presentation of a claim to such manufacturer. Under NO circumstances does HOBART assume any liability for any warranty claim against or warranty work done by or in behalf of any manufacturer of the foregoing components.
5. This warranty is extended by HOBART only to the purchaser of new PRODUCTS from HOBART or one of its authorized distributors. The PRODUCTS purchased under this warranty are intended for use exclusively by the buyer and his employees and by no other persons and, therefore, there shall be no third party beneficiary to this warranty.
6. A claim of defects in any PRODUCT covered by this warranty is subject to HOBART factory inspection and judgment. HOBART'S liability is limited to repair of any defects found by HOBART to exist, or at HOBART'S option the replacement of the defective product, F.O.B. factory, after the defective product has been returned by the purchaser at its expense to HOBART'S shipping place. Replacement and exchange parts will be warranted for the remainder of the original Warranty, or for a period of ninety (90) days, whichever is greater.
7. UNDER NO CIRCUMSTANCES whatsoever shall HOBART and its authorized distributors be liable for any special or consequential damages, whether based on lost goodwill, lost resale profits, work stoppage impairment of other goods or otherwise, and whether arising out of breach of any express or implied warranty, breach of contract, negligence or otherwise, except only in the case of personal injury as may be required by applicable law.
8. Continued use of the PRODUCT(S) after discovery of a defect VOIDS ALL WARRANTIES.
9. Except as authorized in writing, this warranty does not cover any equipment that has been altered by any party other than HOBART.
10. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HERE OF. HOBART MAKES NO WARRANTIES, EXPRESSED OR IMPLIED, OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.
11. HOBART neither assumes nor authorizes any person to assume for HOBART any liability in connection with the PRODUCTS sold, and there are no oral agreements or warranties collateral to or affecting this written Warranty. This warranty and all undertakings of HOBART thereunder shall be governed by the laws of the State of Ohio, United States of America.

WARNING AT ALL TIMES, SAFETY MUST BE CONSIDERED AN IMPORTANT FACTOR IN THE INSTALLATION, SERVICING AND OPERATION OF THE PRODUCT, AND SKILLED, TECHNICALLY QUALIFIED PERSONNEL SHOULD ALWAYS BE EMPLOYED FOR SUCH TASKS.

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) How to read this manual

To avoid hazards the following safety instructions noted in this section and throughout the manual must be followed to ensure personnel's health and safety during installation, daily operation and during maintenance interventions.

The PoWerMaster EV can be delivered with several optional features. Therefore, kindly refer to Appendix A for information about the configuration of this particular equipment before installing, operating or performing maintenance of the equipment.

2) 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.

3) Installation and 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) General 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) Converter Installation safety instructions

Prior to the installation of this equipment, you should read all relevant chapters and sections within this manual. Special attention must be given to Chapter 1, Section 3, which describes the requirements for the building installation, the interlock safety system, short circuit protection and minimum cable dimensions to get the maximum performance of the equipment.

For safety reasons the interlock cables must be connected in accordance to this manual. If the interlock cables are not correctly mounted, this may cause hazard to operators, as the output plug would then be left with voltage on, when the start push button has been pushed.

After installation of interlock cables, output cable(s) and plug(s), the phase sequence and the function of the interlock system must be thoroughly checked prior to connection of any aircraft.

c) 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 terminal while equipment is energized.

4) Operator safety instructions

The manual should be read thoroughly before operating equipment. The user will gain an overall introduction of how to operate the equipment.

If the equipment is plugable at the input by means of an industrial plug and in the case that you are not sure that the building installation complies with the requirements of the equipment to be connected, please refer to the installation safety instructions or contact a qualified service technician..

5) Service and Maintenance

Service personnel should study the complete manual carefully. It is important not only to be confident with the equipment, but also to be aware of local health and safety rules applicable where the equipment is installed.

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) 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.

6) 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 fans or hot spots inside some equipment. Shut **DOWN** such equipment for inspection and routine maintenance. When equipment is in operation, use extreme care in doing necessary troubleshooting and adjustment. Do not remove guards while equipment is operating.

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 physician 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. **ALWAYS CALL EMERGENCY RESCUE SQUAD IMMEDIATELY.**

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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Introduction

This manual contains operation and maintenance information for a PoWerMaster EV, 400 Hz Solid State Frequency Converter manufactured by ITW GSE Group, Hobart Ground Power, 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 chapters. Each chapter is divided into as many sections as required.

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

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

Write:	ITW GSE Group Hobart Ground Power Service Department 1177 Trade Road East Troy, Ohio 45373 U.S.A.
Call Inside U.S.A.:	(800) 422-4166 (Parts) (800) 422-4177 (Service)
Call From Foreign Countries:	(937) 332-5050 (Parts) (937) 332-5060 (Service)
FAX Inside U.S.A.	(800) 367-4945
FAX From Foreign Countries:	(937) 332-5121
E-Mail :	service@itwgsegroup.com
Web Page :	www.itwgsegroup.com

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Section 1 General Description

Figure 1 on which the following description is based shows the basic design principle. A detailed description of the power part is found in Section 5 whereas the electronic part is described in Section 6.

The block diagram shows the power part and electronic part. The power modules and the power switch gear make up the power part, whereas the electronic modules make up the electronic part.

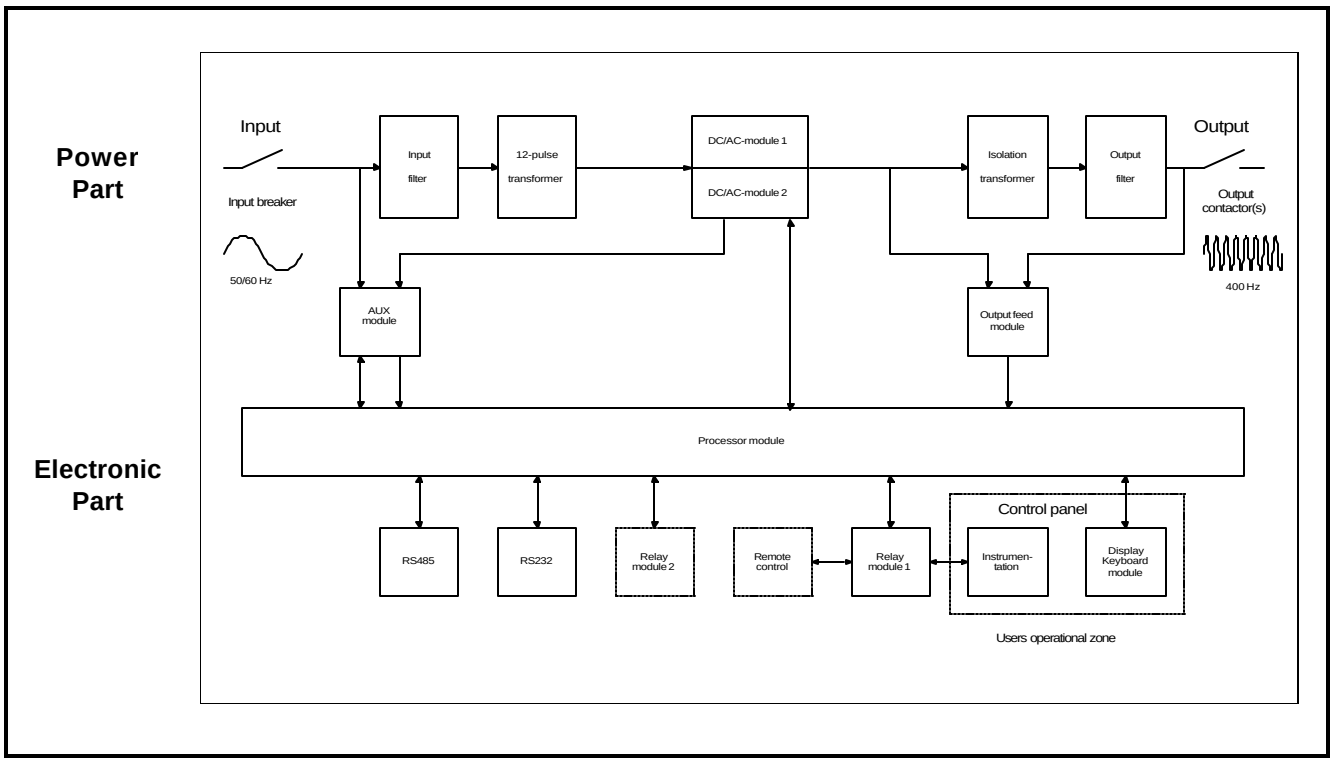


Diagram and Design Principle
Figure 1

The input filter protects the converter from mains transients. After the filtering, the three phases of the mains are transformed into six phases which are then rectified in a non-regulated 12-pulse full bridge rectifier. The combination of the 12 pulse rectifier, the related transformer and the input filter ensures that harmonic feed back into the mains is reduced to a minimum (i.e. no mains pollution/distortion).

An additional benefit provided by the 12 pulse rectifier is the soft start facility which limits the inrush currents at the input to a value much lower than the converter's nominal current.

The filtered DC-voltage supplies the inverter which generates a 3-phase 400 Hz system with a regulated amplitude and a low harmonic content. The inverter technology is based on a Space Vector Pulse Width Modulation (SV-PWM) concept which is an advanced type of the PWM technology. The SV-PWM system provides the converter with extremely fast dynamic properties and a low distortion.

The isolation transformer secures galvanic separation between the mains and the 400 Hz output.

The converter has individual voltage regulation at each output phase. This secures a precise 400 Hz voltage at the aircraft plug even in case of a high degree of unbalanced load and long cables. The harmonic content of the output voltage is further reduced by means of an output filter resulting in a total distortion of less than 2%.

The processor module is based on a micro-controller and a digital signal processor (DSP), which together regulate, supervise and diagnose external and internal faults. As soon as the converter is connected to the mains, and constantly during normal operation, the processor module runs through a self-check program which checks all internal functions. If an internal or external error is detected, the display shows the nature of the error. All immediate parameters related to a shut-down are stored in the converter's memory whereas up to 1000 error situations can be stored.

Section 2 Technical Specifications

1) Standards

DFS 400	Specification for 400 Hz aircraft power supply.
ISO 6858	Aircraft ground support electrical supplies- General requirements
BS 2G 219	General requirements for ground support electrical supplies for aircraft
MIL-704E	Aircraft electric power characteristics.
EN 50091-1	General and safety requirements
EN 61000-6-4	Electromagnetic compatibility, Generic emission standard
EN 61000-6-2	Electromagnetic compatibility, Generic immunity standard
SAE ARP 5015	Ground equipment – 400 Hz ground power performance requirement
EN2282	Aerospace series characteristics of aircraft electrical supplies

2) Electrical Specifications

a) Input

Voltage:	3 x 460/480V ± 15% or according to customers specification.
Frequency:	50 / 60 Hz ± 5 %
Rectification:	12-pulse
Line Current:	75 A ± 15%
Max. Pre-fusing:	100 A
Line Current Distortion:	< 10%
Power Factor:	> 0.96 at 100% load
Inrush current:	None, soft start
Power interruption:	Up to 20 ms

b) Output

Power:	60 kVA, P.F. = 0.8
Voltage:	3 x 200/115 V.
Power factor:	0.7 lagging to 0.95 leading.
Voltage regulation:	< 0.5% for balanced load and 30% unbalanced load
Voltage transient recovery:	ΔU < 8% and recovery time < 10 ms at 100% load change
Total harmonic content:	< 2% at linear load (typically < 1.5%) < 2% at non-linear load according to ISO 1540
Crest factor:	1.414 ± 3%
Voltage modulation:	< 1.0% (typically< 0.5%)
Phase angle symmetry:	120° ± 1° for balanced load 120° ± 2° for 30% unbalanced load
Frequency:	400 Hz ± 0.1%
Overload:	120% for 600 seconds 150% for 30 seconds 170% for 5 seconds 200% for 1 second

3) Efficiency

Overall efficiency:	> 0.93 at 35-90 kVA load
Stand-by losses:	< 50 W
No-load losses:	< 1500 W

4) Setup

Output voltage:	100-128 V
Voltage compensation:	0-9V (individual for each outlet)
Delay to stand-by:	0-15 min.
Time:	Year, month, day, hour, minute and seconds
Interlock:	Bypass on / off
Fan:	Test on / off
Serial Protocol:	3964R or JBUS
Serial Port:	RS232 or RS422/485
JBUS slave address:	1-247
Error log / Power log:	Reset
Timer (hour counter):	Reset

5) Protections

No Break Power Transfer
Input over-and under voltage
Input overload
Internal high temperature
Internal voltage error
Output over-and under voltage (according to DFS 400)
Overload at output
Short circuit at output

6) Physical

Weight

Fixed model:	1102 lbs (500 kg)
Bridge-mounted model:	1102 lbs (500 kg)
Mobile model:	1700 lbs (600 kg)

For dimensions, kindly refer to layout drawings enclosed under Chapter 5.

7) Environmental

Operating temperature:	-40 °C to +52 °C
Relative humidity:	10-95%
Noise level:	< 65 dB (A) at 1m, typically 60 dB(A)
Standard protection:	IP55 (Electronic part)

8) Life, etc.

Operational life:	Min 25 years

Mean time between failures (MTBF):

Converter:	Min 25.000 hours
Ventilation system:	Min. 100.000 hours

Mean time to repair (MTTR):	Max. 20 min.

Section 3 Preparation, Adjustment and Maintenance

1) Storage Before Installation

To secure optimal storage conditions prior to installation, it is recommended that the converter be stored inside to protect it from rain and excessive humidity while it is left without power on.

Only equipment in seaworthy packing can be stored outside.

2) Operational and Environmental Conditions after Commissioning

When the converter has been installed and commissioned, we recommend that the input always be kept with input power ON to provide optimal conditions for the electronic components and to avoid humidity in the form of condensation from reaching vital parts.

If for some reason the converter has been without input voltage for a long period, a visual inspection should be carried out. In case that condensation is discovered on any internal parts, the parts have to dry out before input voltage is again applied.

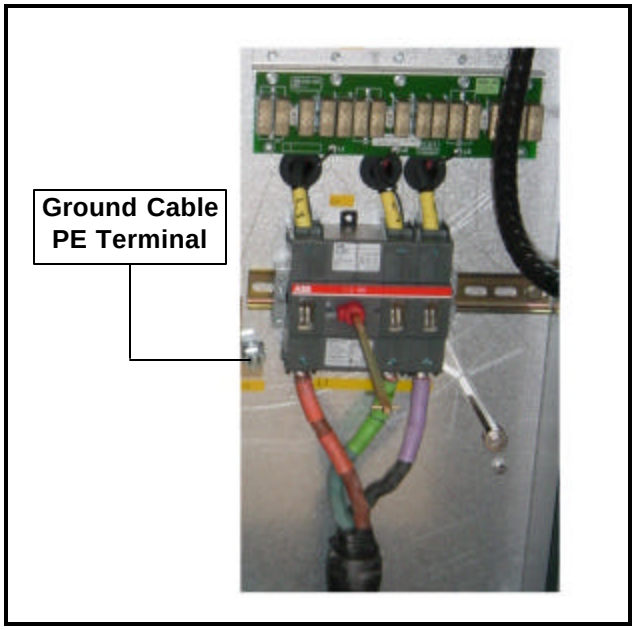
3) Mounting of Bottom Filter (only valid for stationary/fixed models)

Due to transport safety, fixed models are delivered without the bottom filter mounted. The filter is mounted in the hole (designated for fork-lifting) at the bottom by means of the accompanying mounting devices.

4) Connection of Cables

a) Input

Due to personal safety the converter most be protected by grounding of the PE terminal (Figure 1). The converter should be pre-fused according to the table below:



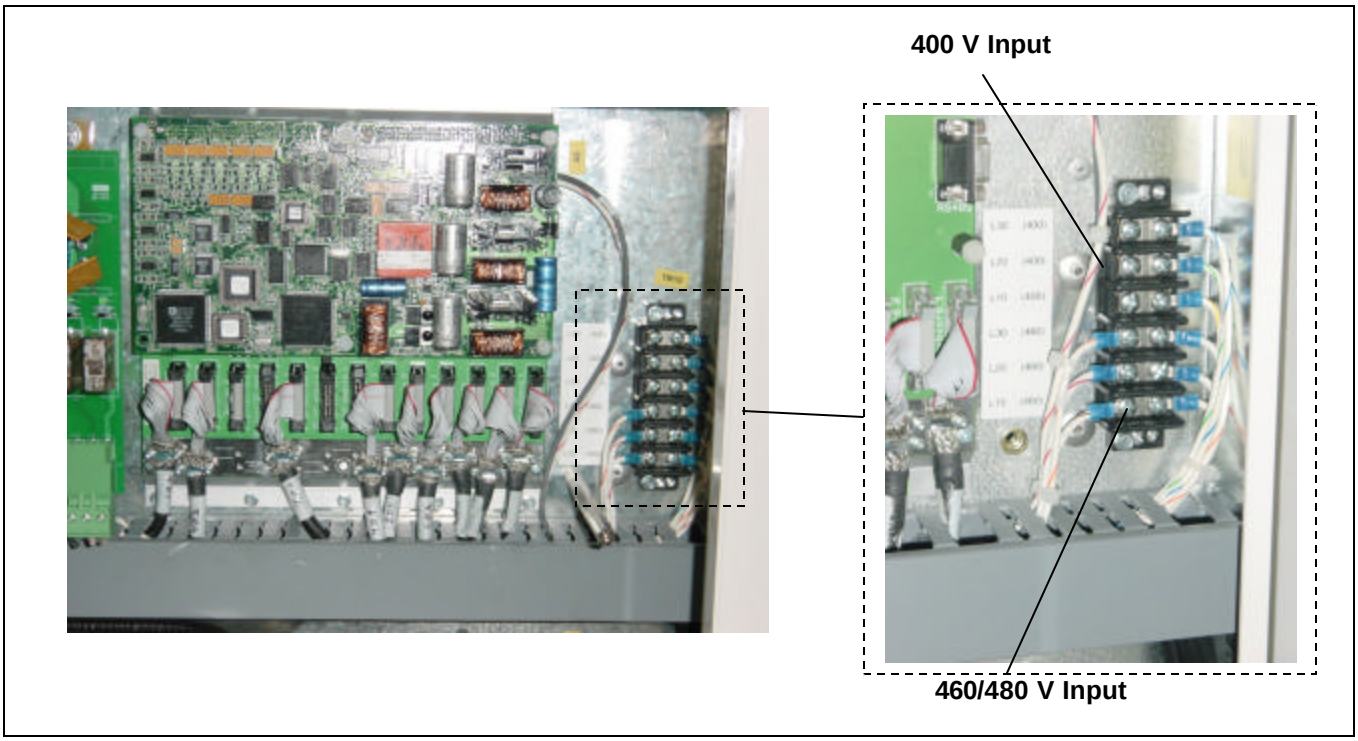
Input Cable Connections
Figure 1

kVA Rating	Input	Line Current	Maximum pre-fuse
60	400 V	76 A ± 15%	100 A
	460 V	66 A ± 15%	
	480 V	63 A ± 15%	

Input Voltage Requirements
Figure 2

The three phases of the input voltage supply and the earth connection are connected to the terminals labeled L1, L2, L3 and PE. As the phase sequence is of importance for the converter's function, the phase sequence is checked by means of the built-in auto test (when input power is applied). If the phase sequence is wrong, this is shown at the display. If wrong, the correction is made by changing the two phases. All connection diagrams can be found in Chapter 5.

The internal converter circuitry operates at 400 VAC, so when setting the converter up to run on one of the voltage settings in Figure 2, please make the proper connections are made on the terminal strip in Figure 3.



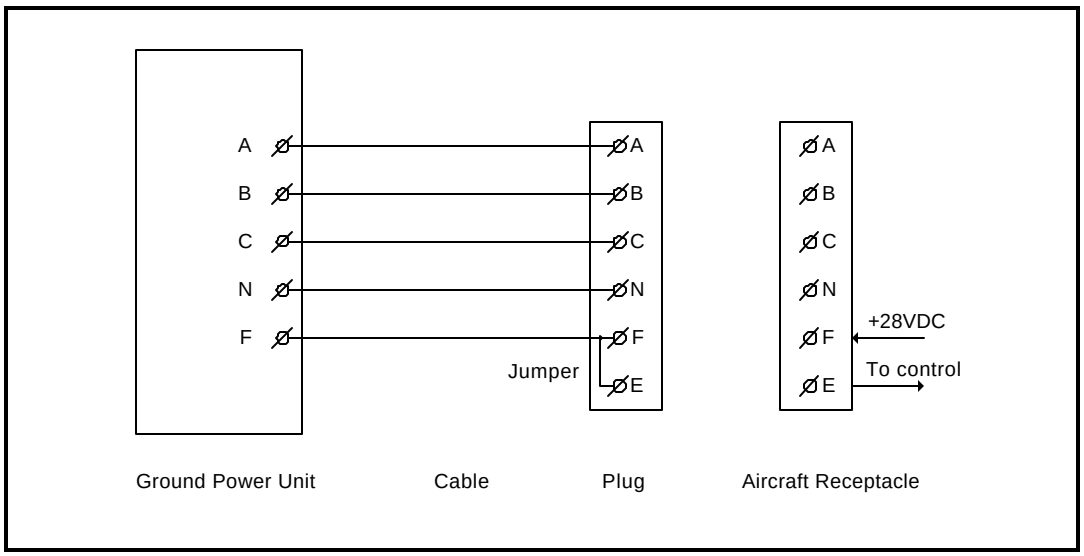
Input Voltage Connections
Figure 3

b) Output

The supply cables to the aircraft, or to an eventual distribution box, are connected to the terminals labeled A, B, C and N on the output contactor (Q2). All connection diagrams can be found in Chapter 5.

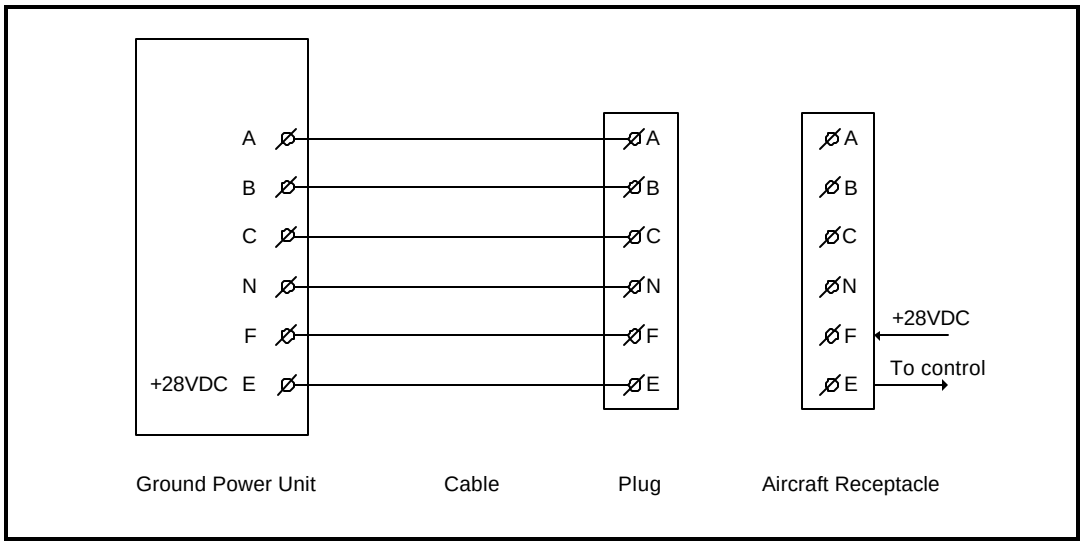
c) Interlock Safety System

To secure personnel's health and safety, the converter is equipped with an interlock system. The system ensures that the output contactor only stays energized as long as the plug is inserted in the aircraft receptacle (i.e. as long as the aircraft provides 28 VDC with respect to 400 Hz neutral to terminal F). Standard wiring between converter and plug is shown in Figure 4.



Standard wiring diagram, Civil aircraft
Figure 4

When used in connection with some military aircraft, the converter normally has to provide 28 VDC with respect to 400 Hz neutral to ensure a proper interlock function. Standard wiring between converter and plug is shown in Figure 5.



Standard wiring diagram, Military aircraft
Figure 5

For service, maintenance and test purposes, the interlock system can be by-passed via the display and keyboard set-up. To secure personnel's health and safety, the unit automatically returns into normal mode once it receives 28 VDC at terminal F. (i.e. when the converter is connected to an aircraft).

d) Remote Control

The converter can be operated by means of the remote control terminals, which are labeled in accordance with the diagrams found in Chapter 5. In case of very long remote control cables, it might be necessary to use shielded cables. The shield has to be connected at both ends.

5) Setup of Parameters

It is possible to set and to adjust the following parameters by means of the converter's display and keyboard. The procedure is described in Chapter 3, Section 4.

a) Language

The displayed text is provided in 3 languages as a standard. It is possible to switch between the languages by means of the dip switch (S1) situated on the back of the display. The table shows how to select language.

Language/Position	**S1 - 1**	**S1 - 2**	**S1 - 3**	**S1 - 4**
English	OFF	OFF	X	X
English	ON	ON	X	X
Spanish	OFF	ON	X	X
French	ON	OFF	X	X

X = position is random

b) Output Voltage Phase-Neutral

At delivery, the converter is set to nominal output voltage. This level can be adjusted, if required (i.e. due to voltage drop in the supply cable). The adjustment range is nominal voltage of ± 15%.

PLEASE NOTICE! If the voltage level falls outside the converter's operation range under adjustment, the converter disengages and reports an under or over-voltage fault. The nominal voltage as well as the levels for under and over-voltage are shown in Chapter 1, Section 2.

c) Output Voltage Compensation

If long output cables are used, the voltage drop becomes considerable during load situations. However, it is possible to increase the converter's output voltage proportionate to the load current. The adjustment is made while the converter is loaded and when the output cables have been mounted. With a load current above 20% of the nominal output current, the voltage at the output plug is adjusted to the required value (larger load current gives a better result). At delivery, the compensation is pre-set to 0. The maximum compensation is 9V.

If only one outlet is available, only set up 1 is in use.
If two outlets are available, each output has its own set up (1 and 2). In case both outlets are in use at the same time, the compensation will be set to half of the mean value of the two set up values.

d) Delay from Contactor OFF to Standby

If the converter's output contactor(s) is (are) not energized, the converter automatically passes into standby mode after elapse of a pre-set period of time. This time delay can be set to values between 1 and 900 seconds. At delivery, the time delay is set to 15 seconds.

e) Date and Hour

The converter has a built-in real time clock showing the date and the hour. At delivery, the clock is set to actual hour (USA EST time). The clock does not adjust itself at changes from summer time to winter time and vice versa (no daylight savings time adjustment). It is possible to set year, month, day, hour, minutes and seconds.

f) Setup of Interlock By-pass

The interlock safety system can be by-passed by setting the value to 1. For further information of the interlock system, kindly refer to paragraph 4 in this chapter.

g) Setup of Fan By-pass

From the factory the by-pass value is set to 0, which means that the fan is temperature controlled. In order to by-pass the temperature control, for instance for test purposes, the by-pass value is set to 1. This means that the fan will run continuously.

h) Setup of Serial Protocol

There are two protocols available. If the value is set to 1, the Siemens 3964R protocol is chosen. If the value is set to 2, the JBUS protocol is chosen. For further information about the protocols please contact HOBART.

i) Setup of Serial Port

It is possible to select an RS232 port and an RS422/485 port. If the value is set to 1, the RS232 port is selected. With the value set to 2, the RS422/485 protocol is selected.

j) Setup of JBUS Slave Address

If the JBUS protocol is selected, the slave address can be set up. The slave address can be set to values between 1 and 247. At delivery, the address is set to 1.

k) Setup of Error Log, Power Log, Black Box

From the factory the by-pass value is set to 0. If for some reason it is necessary to clear the memory log after installation the by-pass value is set to 1. After the reset, the by-pass value is automatically set to 0.

l) Setup of Counters

The hour counter and the energy counter are reset, when the value is set to 1 (used to clear the counter memory after installation). The value is automatically set to 0 after reset.

6) Maintenance

At least once a year it is recommended to

1. Check air filters - Wash or change as appropriate.

Note: We recommend, however, checking the air filters once a month to ensure proper air flow in harsh environments.

2. Check that all fans are running properly.
3. Check bolt/screw and wire connections.
4. Check vibration dampers.
5. Visual inspection of all components.
6. Visual inspection of PCB's - control unit / gate drive.
7. Control of the contactors' contact sets and coil.
8. Control of output voltage.
9. Check of external cables and plugs.

Especially for outside mounted models, we recommend to:

10. Check rubber seals around panels and doors.

Especially for mobile-converters:

11. Check trailer tires for wear and tear.
12. Check that air pressure.

Note: We recommend, however, checking the tire pressure on a more frequent basis.

Battery back-up:
Situated on the processor board, a lithium battery assures that set-up data etc. is not lost if input power is removed. The expected life of the battery is approximately 10 years. However, a low battery voltage does not affect the internal safety system of the GPU that monitors the output voltage, among other things. Thus aircraft connected to the GPU is not exposed to any danger. To avoid loss of data we recommend you to replace the battery after 8 to 9 years of use.

Section 4 Instruction for Use

The converter is equipped with the following operational controls and indications:

- Input breaker On/Off
- Emergency stop
- Display and keyboard
- Control panel with
  - Input voltage indication (Mains)
  - Fault indication (Common Error)
  - Start / Reset push-button and indication for each output contactor
  - Stop push-button for each output contactor
  - Push button for lamp test (in common with indication of input voltage)

1) Input Breaker

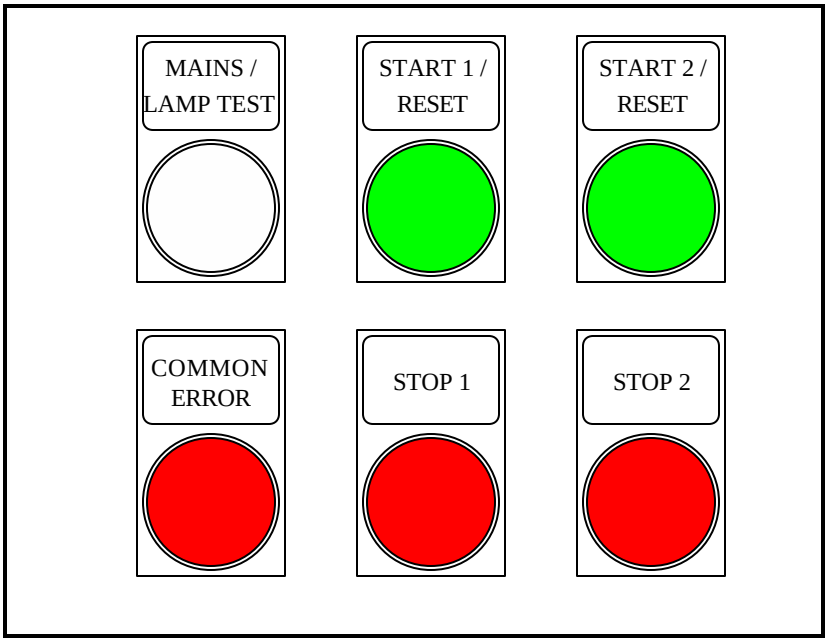
When activated it connects the converter to the input power. Upon energizing, the converter runs through a check program which tests the converter's internal and external conditions. If no faults or irregularities are detected, the converter passes into standby mode.

2) Emergency Stop

The converter can be immediately stopped by activation of the emergency stop.

PLEASE NOTICE! The emergency stop must be released, before it is possible to restart the converter.

3) Control Panel



Control Panel
Figure 1

a) Mains/Lamp Test

The mains lamp is lit, as soon as the converter is connected to the input power, and the input breaker is activated. A push-button for lamp test can be built in. If built in, the activation of the button lights all workable buttons at the control panel and keeps them lit until the button is released.

b) Common Error

This lamp is lit in case of a fault in the converter. The converter passes into alarm mode, and the fault is displayed (for further information see Chapter F. The lamp is lit as long as the fault has not been corrected.

c) Start/Reset

(1) Converter in Standby Mode:

A push of the Start/Reset button resets the converter, which then performs an auto-test of internal and external parameters. If the test program is performed without detection of any errors the system will state it is ready for use. The corresponding output contactor can now be energized and the converter automatically passes from standby into 400 Hz available mode. The Start/Reset button is lit, when 400 Hz is available at the output. The output contactor is activated for 1 second no matter whether the interlock signal is present or not. If the interlock signal is not available, the converter passes into standby mode after the elapse of the time delay to standby. Missing interlock signal is shown at the display.

(2) Converter in 400 Hz Available

The converter is in 400 Hz available when at least one of the output contactors is energized. A push of Start/Reset engages the output contactor of the corresponding outlet and the button is lit, indicating that the output contactor is energized. The converter supplies 400 Hz at the output, until the output contactor(s) is de-energized. If one (single output) or both (dual output) interlock signals become unavailable, the converter passes into stand-by mode after the elapse of the time delay to standby. Missing interlock signal is shown at the display.

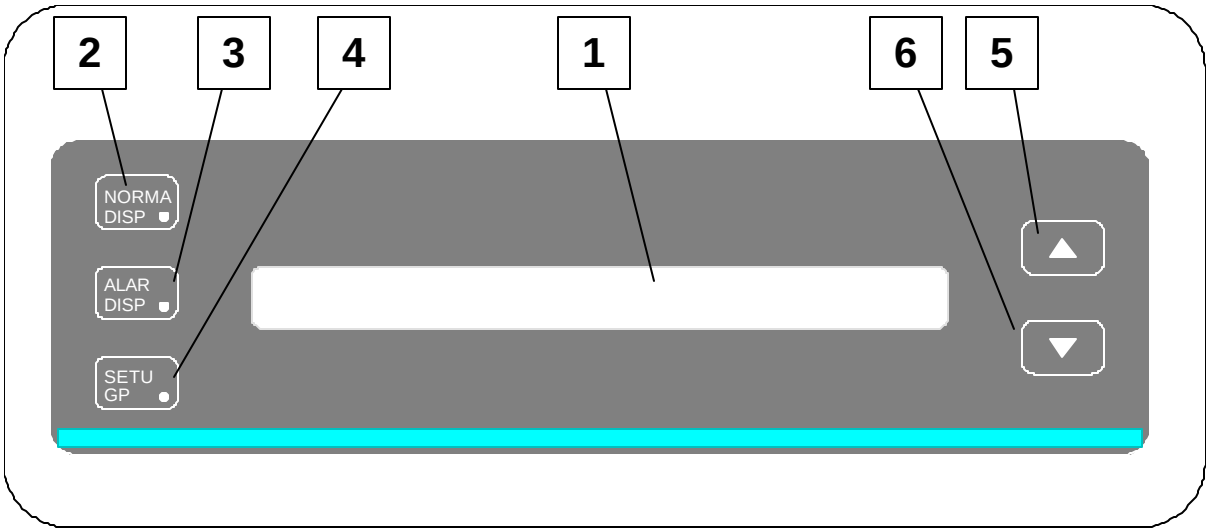
d) Stop

A push of the stop button disengages the corresponding output contactor. At de-energizing of both output contactors, the converter immediately passes into standby mode.

4) Display/Keyboard Interface

a) Basic Information

From the display/keyboard it is possible to:
1. view different internal and external parameters.
2. change GPU settings.
3. browse through the GPU memory.
4. adjust the display contrast.



1. Display text area, 2 lines of 40 characters per line.
2. Key and LED : NORMAL DISP.
3. Key and LED : ALARM DISP.
4. Key and LED : SET-UP GPU.
5. Key : ARROW UP.
6. Key : ARROW DOWN.

Display/Keyboard
Figure 2

b) How to Use Display/Keyboard

The display/keyboard reacts in 2 different ways on a key press.

(1) If switching between display modes or selecting a new picture, the display reacts on a key press when the key is released. In these cases, the LED NORMAL DISP. flashes in order to show that the key press is registered and that the display is working. The flashing stops when the desired text appears on the display.
(2) If adjusting GPU-settings or display-contrast the value keeps changing, as long as one of the ARROW keys is held down.

The keyboard is read 4 times per second. Therefore pressing a key must last longer than 1/4 of a second to make sure that the key press is registered.

c) Signification of the LED Signals

As already mentioned above, the LED NORMAL DISP flashes when the display has registered a key press until the instruction has been carried out. Additionally, the LED's are lit as shown below:

Display mode:	LED lit:
Default mode:	NORMAL DISP.
View mode:	NORMAL DISP.
Alarm mode:	ALARM DISP.
Black box mode:	ALARM DISP. & NORMAL DISP.
Power log mode:	ALARM DISP. & SETUP GPU
Setup mode 1:	SETUP GPU (constant light)
Setup mode 2:	SETUP GPU (flashing light)

d) Parameter Updating

The time from a key press to the new picture shows, and the time between updating of the parameter values, depend on the number of parameters in the picture. Normally this time will be less than 1 second. However, this is not applicable when adjusting setup parameters, where the update time is very short.

e) Parameters Measuring Range

If the value of a parameter, in a selected display picture, is below the measuring range the display will show the parameter as "< xxx", where "xxx" shows the lowest value of the measuring range.

f) Adjusting Display Contrast (only LCD display)

If the light conditions or the viewer's position makes it difficult to read the display, the display-contrast can be adjusted by means of the NORMAL DISP. and ARROW UP/ ARROW DOWN keys. Contrast adjusting can be made in any display mode.

Start by pressing NORMAL DISP and keep it down. Press ARROW UP or ARROW DOWN until the display contrast is satisfactory. Release NORMAL DISP. key as the last. If not, the display changes according to last pressed ARROW key.

g) Display Modes

There are 6 basic display modes:

- Default mode (display shows actual converter status)
- View mode (viewing parameters)
- Alarm mode (browsing through error log)
- Black box mode (browsing through errors and related parameters)
- Power log mode (browsing through logged operation information)
- Setup mode (viewing or changing settings)

The user can switch freely between the different display modes.

(1) Default Mode

Possibilities in Default mode:
In Default mode, the displayed picture is one of the following 5 pictures or an ALARM picture, depending on the status of the converter.

STANDBY	year-mo-da	ho.mi
SYSTEM READY FOR USE		

OR

SYSTEM IN OPERATION	year-mo-da	ho.mi
xxx/xxx.x V	xxx A	xxx.x Hz

OR

INTERLOCK SIGNAL MISSING
VERIFY PLUG POSITION OR CHECK CABLING

OR

EMERGENCY STOP ACTIVATED
SYSTEM STOP

OR

CONTROL UNIT IS WORKING
PLEASE WAIT

OR

ALARM PICTURE, according to Alarm mode

In case of built-in options such as magnetic card readers or 90% switches integrated in the plug, additional display default pictures may occur.

Switching to other modes from Default mode:

Switch to:	**By pressing key:**
View mode	NORMAL DISP. or ARROW UP or ARROW DOWN
Alarm mode	ALARM DISP.
Black box mode	ALARM DISP. and ARROW UP
Power log mode	ALARM DISP. and ARROW DOWN
Setup mode	SETUP GPU

Switching to Default mode from other modes:

Switch from:	**By pressing key:**
View mode	NORMAL DISP
Alarm mode	NORMAL DISP. first key press gives View mode, the second Default mode
Black box mode	NORMAL DISP. first key press gives View mode, the second Default mode
Power log mode	NORMAL DISP. first key press gives View mode, the second Default mode
Setup mode	NORMAL DISP.

(2) View Mode

Possibilities in View mode:
When from one of the other display modes View mode is selected, the first picture shown is:

INPUT VOLTAGE: PHASE - PHASE		[V]
L1 - L2=xxx	L2 - L3=xxx	L3 - L1=xxx

By pressing and releasing ARROW UP or ARROW DOWN, the user can browse through the following pictures, including the above shown picture.

ARROW UP: Order as shown below
ARROW DOWN: Reverse order of below

INPUT FREQUENCY	[Hz]
	xxx.x

VOLTAGE AT DC CAPACITOR BANK	[V]
	xxx

OUTPUT VOLTAGE: PHASE - NEUTRAL			[V]
A=xxx	B=xxx	C=xxx	Avg=xxx.x

OUTPUT VOLTAGE: PHASE - PHASE			[V]
AB=xxx	BC=xxx	CA=xxx	Avg=xxx

OUTPUT CURRENT			[A]
A=xxx	B=xxx	C=xxx	Avg=xxx.x

INVERTER CURRENT			[A]
A=xxx	B=xxx	**C**=xxx	

ACTIVE OUTPUT POWER			[kW]
A=xxx	B=xxx	**C**=xxx	**S** =xxx

APPARENT OUTPUT POWER			[kVA]
A=xxx	B=xxx	**C**=xxx	**S** =xxx

OUTPUT FREQUENCY	[Hz]
	xxx.x

MODULE TEMPERATURE	[°C]
DC / AC 1=xxx	DC / AC 2=xxx

TOTAL TIME	[hhhhh.mm.ss]
OUTPUT AVAILABLE	xxxxx.xx.xx

TOTAL ENERGY CONSUMPTION OUTPUT	[MWh]
OUTPUT AVAILABLE	xxxxx.xxx

Switching to other modes from View mode:

Switch to:	**By pressing key:**
Default mode:	NORMAL DISP
Alarm mode:	ALARM DISP.
Black box mode:	ALARM DISP. and ARROW UP
Power log mode:	ALARM DISP. and ARROW DOWN
Setup mode:	SETUP GPU

The display remains in View mode until another mode is selected from the keyboard, unless the converter is reset/restarted from alarm status.

Switching to View mode from other modes:

Switch from:	**By pressing key**:
Default mode:	NORMAL DISP
Alarm mode:	NORMAL DISP.
Black box mode:	NORMAL DISP.
Power log mode:	NORMAL DISP.
Set mode	NORMAL DISP. first key press gives Default mode, the second View mode

(3) Alarm Mode

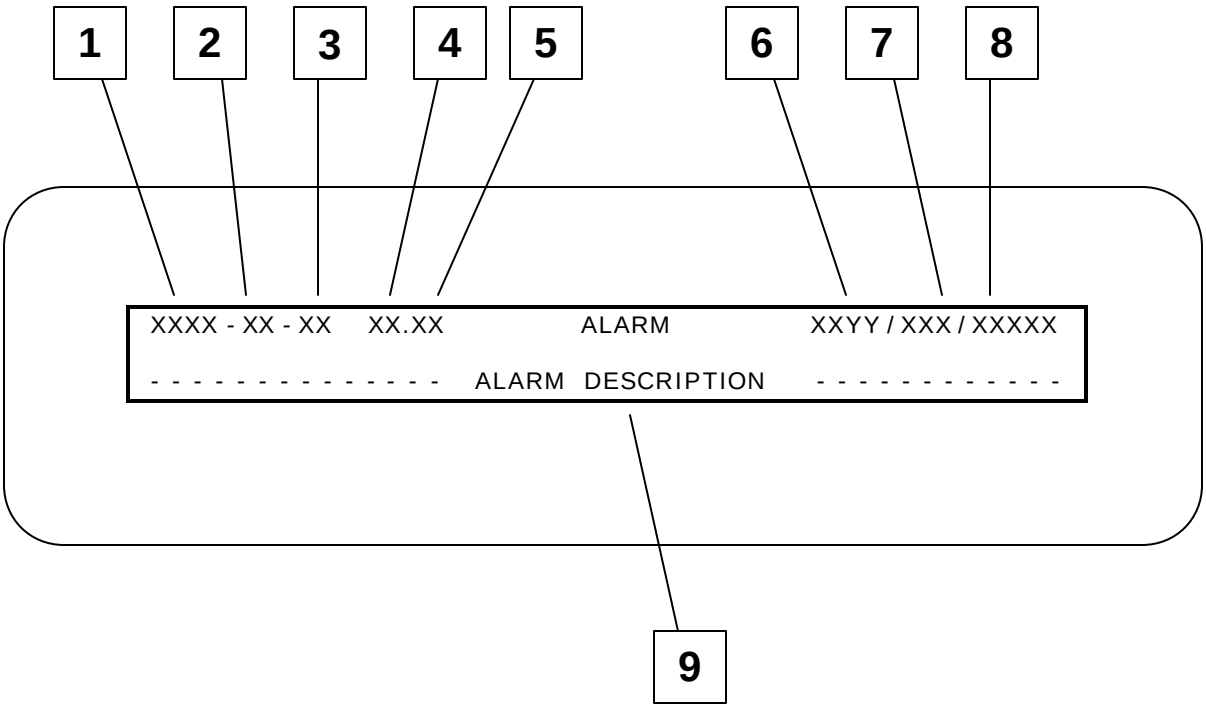
Possibilities in Alarm mode:
In Alarm mode the user can browse through the logged errors. When entering the Alarm mode the last logged error is displayed on the screen.

By pressing and releasing one of the keys ARROW UP or ARROW DOWN, browsing is done in the order:

ARROW UP: Younger towards older
ARROW DOWN: Older towards younger

By pressing and releasing key ALARM DISP. the display returns to the last logged alarm.

The maximum number of loggings is 1000. If this number should be reached, the oldest error logged disappears, when a new error is logged, according to Chapter F.



1. Year of the shown logging.
2. Month of the shown logging.
3. Day of the shown logging.
4. Hour of the shown logging.
5. Minute of the shown logging.
6. Unambiguous error code for the shown logging, see section F.
7. Log number for the shown logging, youngest = 1, oldest = 999 or less.
8. Total logging, counting from 1 to 1000.
9. Error explanation in plain text.

Alarm Display
Figure 3

The displayed text in Alarm mode complies with Figure 3. The top line of the display contains logging data such as date and time, unambiguous error code and numbers concerning the actual and all logging. The bottom line contains an explanation in clear language of the alarm/error in question.

As long as the fault has not been corrected, the display keeps switching between one of the following messages and the one shown in Figure 3, depending of the nature of the error.

INTERNAL ERROR PRESS RESET OR CALL TECHNICIAN

EXTERNAL ERROR PRESS RESET OR CALL TECHNICIAN

For detailed information on the various display pictures and their signification in Alarm mode, see Chapter F.

Switching to other modes from Alarm mode:

Switch to:	**By pressing key:**
View mode	NORMAL DISP
Black box mode	ALARM DISP. and ARROW UP
Power log mode	ALARM DISP. and ARROW DOWN
Setup mode	SETUP GPU
Alarm mode	ALARM DISP. (youngest logging)
Default mode	NORMAL DISP. first key press gives View mode, the second Default mode.

Switching to Alarm mode from other modes:

Switch from:	**By pressing key:**
Default mode	ALARM DISP.
View mode	ALARM DISP.
Black box mode	NORMAL DISP. gives View mode, then press ALARM DISP.
Power log mode	ALARM DISP.
Setup mode	ALARM DISP.

If Alarm mode is selected from another display mode, and the converter is not in alarm status, the display returns to Default mode, after elapse time of 1 minute without any key press.

If the converter is in alarm status, the display shows the last logged alarm after being timed out.

(4) Black Box Mode

Black box mode consists of 2 modes.

Mode 1: Viewing/browsing through the last 50 logged errors and related parameters
Mode 2: Viewing of chosen input and output parameters for the last 50 logged errors

When entering Black box mode from another display mode, the display passes into Black box mode 1.

a Possibilities in Black Box Mode 1

In Black box mode 1, the user can browse through the last 50 logged errors and related parameters just as he can browse through different alarms in Alarm mode. When changing to Black box mode, by pressing and releasing ALARM DISP, the display shows the last occurring error logged by the converter.

By pushing ARROW UP or ARROW DOWN it is possible to browse in the following order:

ARROW UP: From latest towards previously logged errors
ARROW DOWN: From older towards recent logged errors

If the operator wants to have a closer look at the recorded input and output parameters in relation to a given logged error, this is done by pushing and releasing ALARM DISP. In that way, the display passes into Black box mode 2.

b Black Box Mode 2, Viewing of Registered Parameters

In Black box mode 2, the first picture shown is:

INPUT VOLTAGE: PHASE - PHASE		[V]
L1 - L2=xxx	L2 - L3=xxx	L3 - L1=xxx

By pushing ARROW UP or ARROW DOWN, the operator can browse though the following pictures incl. the above shown.

ARROW UP: Order as shown below
ARROW DOWN: Reverse order

INPUT FREQUENCY	[Hz]
	xxx.x

VOLTAGE AT DC CAPACITOR BANK	[V]
Instant=xxx	Avg=xxx

OUTPUT CURRENT		[A]
A=xxx	B=xxx	C=xxx

INVERTER CURRENT		[A]
A=xxx	B=xxx	C=xxx

OUTPUT VOLTAGE: PHASE - NEUTRAL		[V]
A=xxx.x	B=xxx.x	C=xxx.x

MODULE TEMPERATURE	[°C]
DC / AC 1=xxx	DC / AC 2=xxx

INTERNAL DC-VOLTAGES			[V]
-5V=xx.x	12V=xx.x	17V=xx.x	30V=xx.x

SETUP VALUES	
VOLT=xxx	COMP=xxx

By pushing and releasing ALARM DISP. the display reverts to Black box mode 1, where it shows the error logged prior to the change into Black box mode 2.

The converter can store up to 50 logged errors with their related parameters. If this number is reached, the oldest error is deleted when a new error is logged.

Switching to other modes from Black box mode

Switch to:	**By pressing key:**
View mode	NORMAL DISP
Alarm mode	NORMAL DISP. (gives View mode). ALARM DISP:
Power log mode	ALARM DISP. and ARROW DOWN
Setup mode	SETUP GPU
Default mode	NORMAL DISP. first key press gives View mode, the second Default mode.

Switching to Black box mode from other modes

Switch from:	**By pressing key:**
Default mode	ALARM DISP. and ARROW UP
View mode	ALARM DISP. and ARROW UP
Alarm mode	ALARM DISP. and ARROW UP
Power log mode	ALARM DISP. and ARROW UP
Setup mode	ALARM DISP. and ARROW UP

(5) Power Log Mode

a Possibilities in Power Log Mode

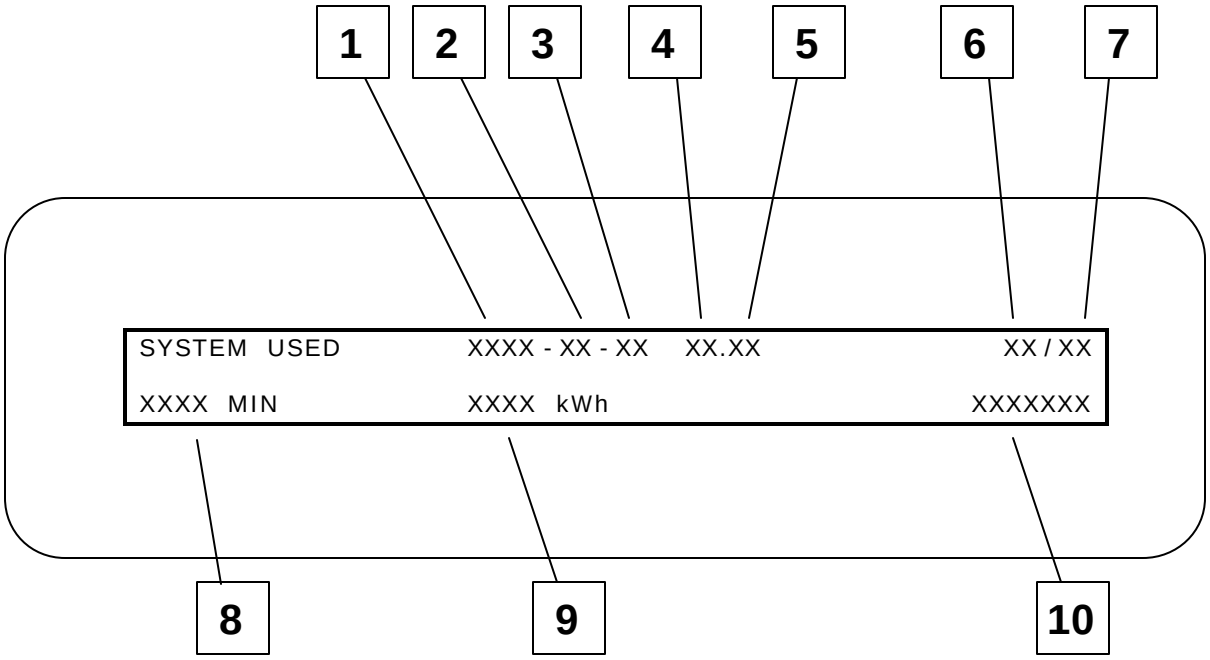
In Power log mode, the user can browse through previously recorded operations. When changing to Power log mode, the display shows the last operation recorded by the converter.

By pushing ARROW UP or ARROW DOWN it is possible to browse in the following order:

ARROW UP: From latest recorded towards previously recorded operations.
ARROW DOWN: From older towards recent recorded operations.

By simultaneous push and release of ALARM DISP. and ARROW DOWN, the display returns to the last recorded operation.

The converter can store up to 50 recorded operations. If this number should be reached, the oldest recording is deleted when a new is recorded.



1. Year of the shown logging.
2. Month of the shown logging.
3. Day of the shown logging.
4. Hour of the shown logging.
5. Minute of the shown logging.
6. Log number for the shown logging, youngest = 1, oldest = 50 or less.
7. Total logging, counting from 1 to 50.
8. Total time consumption for the shown logging.
9. Total energy consumption for the shown logging.
10. Customer number for the shown logging.

Power Log Display
Figure 4

The text shown in Power log mode is in accordance with Figure 4. First line contains logging data such as date, hour, log number code for the actual operation and for previous loggings. The bottom line contains time and energy consumption.

Switching to other modes from Power Log mode

Switch to:	**By pressing key:**
View mode	NORMAL DISP
Black box mode	ALARM DISP. and ARROW UP
Setup mode	SETUP GPU
Alarm mode	ALARM DISP. (last logged record)
Default mode	NORMAL DISP. first key press gives View mode, the second Default mode.

Switching to Power log mode from other modes

Switch from:	**By pressing key:**
Default mode	ALARM DISP. and ARROW DOWN
View mode	ALARM DISP. and ARROW DOWN
Black box mode	ALARM DISP. and ARROW DOWN
Alarm mode	ALARM DISP. and ARROW DOWN
Setup mode	ALARM DISP. and ARROW DOWN

(6) Setup Mode

Setup mode consists of 2 modes:

Mode 1: Viewing/Selecting setup parameter.
Mode 2: Adjusting setup parameter.

When you enter Setup mode from another display mode, the display is in Setup mode 1.

Setup mode 1, Selecting Parameter to Adjust

When in Setup mode 1:

Select wanted parameter, among the following in forward or reverse order, by activating key ARROW UP or ARROW DOWN.

```
OUTPUT VOLTAGE PHASE-NEUTRAL                    [V]
SETUP                                    VALUE=xxx.x
```

```
OUTPUT VOLTAGE COMPENSATION 1                [V/100A]
SETUP                                    VALUE=xxx.x
```

```
OUTPUT VOLTAGE COMPENSATION 2                [V/100A]
SETUP                                    VALUE=xxx.x
```

```
DELAY FROM CONTACTOR OFF TO STANDBY
SETUP                                   SECONDS=xxxx
```

REAL TIME CLOCK SETUP	
SETUP	YEAR=xx

REAL TIME CLOCK SETUP	
SETUP	MONTH=xx

REAL TIME CLOCK SETUP	
SETUP	DAY=xx

REAL TIME CLOCK SETUP	
SETUP	HOUR=xx

REAL TIME CLOCK SETUP	
SETUP	MINUTE=xx

REAL TIME CLOCK SETUP	
SETUP	SECOND=xx

INTERLOCK BY-PASS	1=BYPASS
SETUP	VALUE=xx

FAN CONSTANTLY ON	1=CONSTANTLY ON
SETUP	VALUE=xx

SERIAL PROTOCOL	1=3964R	2=JBUS
SETUP		VALUE=xx

SERIAL PORT	1=RS232	2=RS422/485
SETUP		VALUE=xx

JBUS SLAVE ADDRESS	
SETUP	VALUE=xxx

RESET ERROR/BLACKBOX/POWER LOG	1=RESET
SETUP	VALUE=xx

RESET HOUR COUNTER	1=RESET
SETUP	VALUE=xx

Additional setup parameters might occur on an optional basis.

When the wanted parameter is found, press and release SETUP GPU key to select this parameter for adjusting. To avoid undesired adjustments the confirmation procedure, explained below, has to be carried out. If this is successfully done, the display passes into Setup mode 2.

Setup mode 2: Adjustment of Parameter

Setup mode 2 is only possible after successful confirmation of parameter selection in Setup mode 1. The displayed picture is identical to that in Setup mode 1, but it is now possible to adjust the value of the selected parameter.

When in Setup mode 2:

Adjust parameter by pressing key ARROW UP or ARROW DOWN.

Continued pressure on the key will increase the adjustment speed. When satisfied with the parameter choice, press SETUP GPU. Once again the confirmation procedure, explained below, has to be carried out in order to store the new setup value.

If the confirmation is successful the below text will be displayed for 20 seconds or until activation of another key. Afterwards the display returns to Setup mode part 1, displaying the same parameter.

SETUP CONFIRMED
NEW SETUP ACTIVATED

If a parameter (for example output voltage) is adjusted, while the converter is supplying 400 Hz at the output, the converter follows the commands from the display/keyboard. If setup confirmation is not successful, the converter returns to the old setup value.

As for the reset parameters (logs and counters) the value automatically returns back to 0 after confirmation.

After a time delay of 1 minute without any key press, the display automatically returns to the Default mode. Previous parameter adjustments will be regarded as "not confirmed" and the parameter value remains as before entering setup mode.

Confirmation Procedure

Switch (S2) at PCB Display interface (A10) must be in top position, if not, the text below is displayed for 20 seconds or until key activation. In this case, the confirmation is not successful.

CONFIRMATION SWITCH IN WRONG POSITION
CORRECT POSITION TO CONTINUE

If the conditions in 1 are met, the text below is displayed.

CONFIRM SETUP
TO CONTINUE

To confirm the setup, move switch (S2) from top position to bottom position and back again to top position. If this is done within 30 seconds, the confirmation is successful, otherwise it is not. If the confirmation is successful, the display reacts as described in Setup mode 1 or 2.

If the confirmation is not successfully done, the text below is displayed for 20 seconds or until key activation.

SETUP NOT CONFIRMED. NEW SETUP IGNORED OLD SETUP REACTIVATED

Switching to other modes from Setup mode

Switch to:	**By pressing key:**
Default mode:	NORMAL DISP.
Alarm mode:	ALARM DISP.
Black box mode:	ALARM DISP. and ARROW UP
Power log mode:	ALARM DISP. and ARROW DOWN
View mode:	NORMAL DISP. first key press gives Default mode, second key press View mode.

The display automatically returns to Default mode when 1 minute has elapsed without any key press.

Switching to Setup mode from other modes

Switch from:	**By pressing key:**
Default mode	SETUP GPU
View mode	SETUP GPU
Black box mode	SETUP GPU
Power log mode	SETUP GPU
Alarm mode	SETUP GPU

Selecting Setup mode from other modes always results in Setup mode 1.

Section 5 Functional Description of Power Part

1) Input Breaker

When activated it connects the converter to the input power. Upon closure, the converter runs through a check program which tests the converter's internal and external conditions. If no faults or irregularities are detected, the converter passes into standby mode.

2) Input Filter

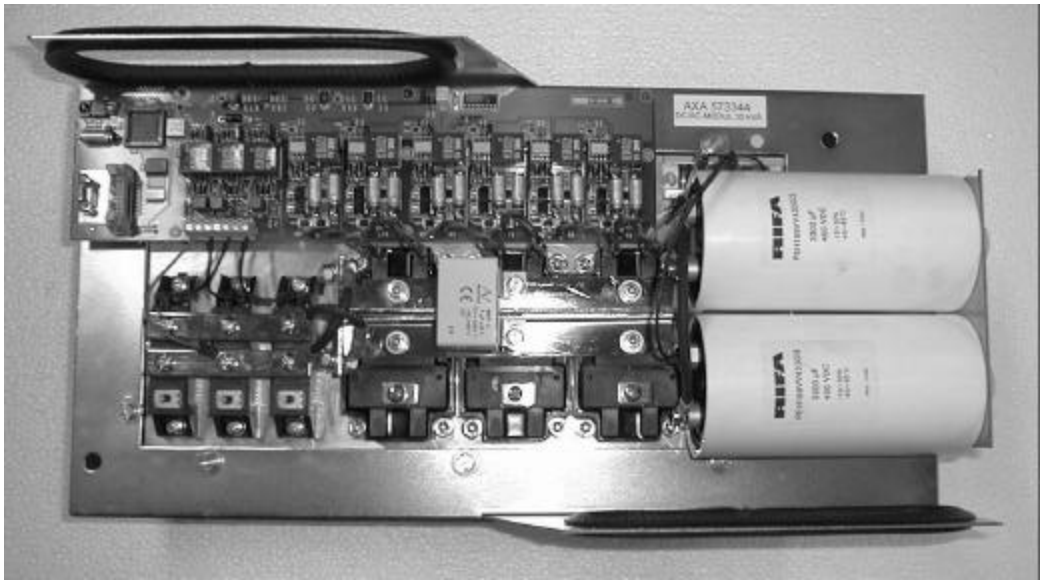
The purpose of the filter is to reduce the EMC back into the input lines to such a level that surrounding equipment is not disturbed. At the same time, the filter prevents input transients from reaching vital parts in the converter.

The filter consists of an RFI-filter (X and Y capacitors) and a series choke. The purpose of the RFI filter is to limit the high frequency emission, whereas the series choke prevents deformations and voltage injections back into the input during the commutation between two diodes.

The distortion of the supply voltage depends on:

- The actual consumption of the connected GPU
- The impedance of the input (Rk and Xk)
- The distortion caused by other users

3) 12-pulse Transformer/ DC/AC Module



The 12-pulse transformer transforms the three phases of the input into six phases. The six phases are rectified in a 12-pulse semi-conductor full bridge. The rectifier is made up of six thyristor diode modules 3 of each are placed on each DC/AC module. The combination of the 12-pulse rectifier, the 12-pulse transformer and the input filter choke means that there are hardly no harmonic feed back into the supply (i.e. no input pollution/distortion).

The 12-pulse rectifier also provides a soft start by gradually increasing the firing angle of the thyristors. In this way, the inrush current caused by the low-pass filter's capacitor is limited to a value less than the converter's nominal current. During operation, the thyristors are fully turned on and the rectifier bridge is acting as an unregulated 6-phase rectifier bridge.

The 12-pulse rectifier system is characterized by an almost sinusoidal line current and a power factor better than 0.96. This means less stress on the input supply network and distribution transformers.

The DC Filter smoothes the pulsating DC voltage received from the 12-pulse rectifier to a level which does not cause any significant voltage modulation at the output. During an inductive load, the filter's capacitor battery supplies the reactive part of the current which means that the converter's apparent output power (kVA) might be bigger than the consumed power.

Based on the unregulated DC voltage, the converter's inverter part generates a 400 Hz voltage with adjustable amplitude. The amplitude adjustment of the voltage's fundamental is made by application of Space Vector Pulse Width Modulation. This gives the converter very good dynamic properties in case of load or input variations.

IGBT-transistors are used as switches. The transistors, which have a blocking voltage of 1200 V, can handle the currents that occur in case of a short circuit at the output or a malfunction in the converter. Short circuits are detected by means of current sensors measuring the inverter current thus ensuring a quick stop. The module is equipped with a gate-drive that generates the necessary firing signals for the transistors.

4) Isolation Transformer

The output transformer secures galvanic separation between input and output. It also transforms the voltages from the DC/AC module into the required aircraft voltage (3 phase, 200/ 115V). The filter choke for the output AC-filter is an integrated part of the transformer.

5) Output Filter

The output AC filter reduces the content of harmonics resulting in an output voltage with a total distortion of less than 2%. Beside the filter choke (integrated in the transformer) and the capacitor bank, the AC-filter consists of a RFI-filter that reduces the high frequency emission from the converter.

6) Output Contactor(s)

The converter is equipped with one (or two) output contactor(s). The contactor is energized at start up of the corresponding output, and it is de-energized, when the stop button is applied. If the converter does not receive the aircraft's interlock voltage after 1 second, the contactor opens. In case of repair/service, the converter's interlock system can be by-passed.

Section 6 Functional Description of Electronic Part

By means of interface components, the processor module takes care of controlling, supervising and regulating tasks in the converter. The processor module is based on a micro-controller and a digital signal processor making it possible:

- To implement complex mathematical relations (PWM systems), to achieve better performance.
- To monitor, store and recall a great number of parameters and information to give the best possible service (i.e. in case of operation problems).
- To be flexible in relation to I/O signals.

1) Facilities

The processor module provides the following facilities:

Communication with the operator via the displaying:
- of the converter's electrical and thermal parameters
- adjustment of the converter's parameters (output voltage, current limit, date etc.)
- error messages in a clear language and in related code form, as well as, input and output parameters of the time when the error occurred.
- of customer information (customer number, power and time consumption).

Safety
- Check of the power components' function.
- Monitoring of internal and external parameters.

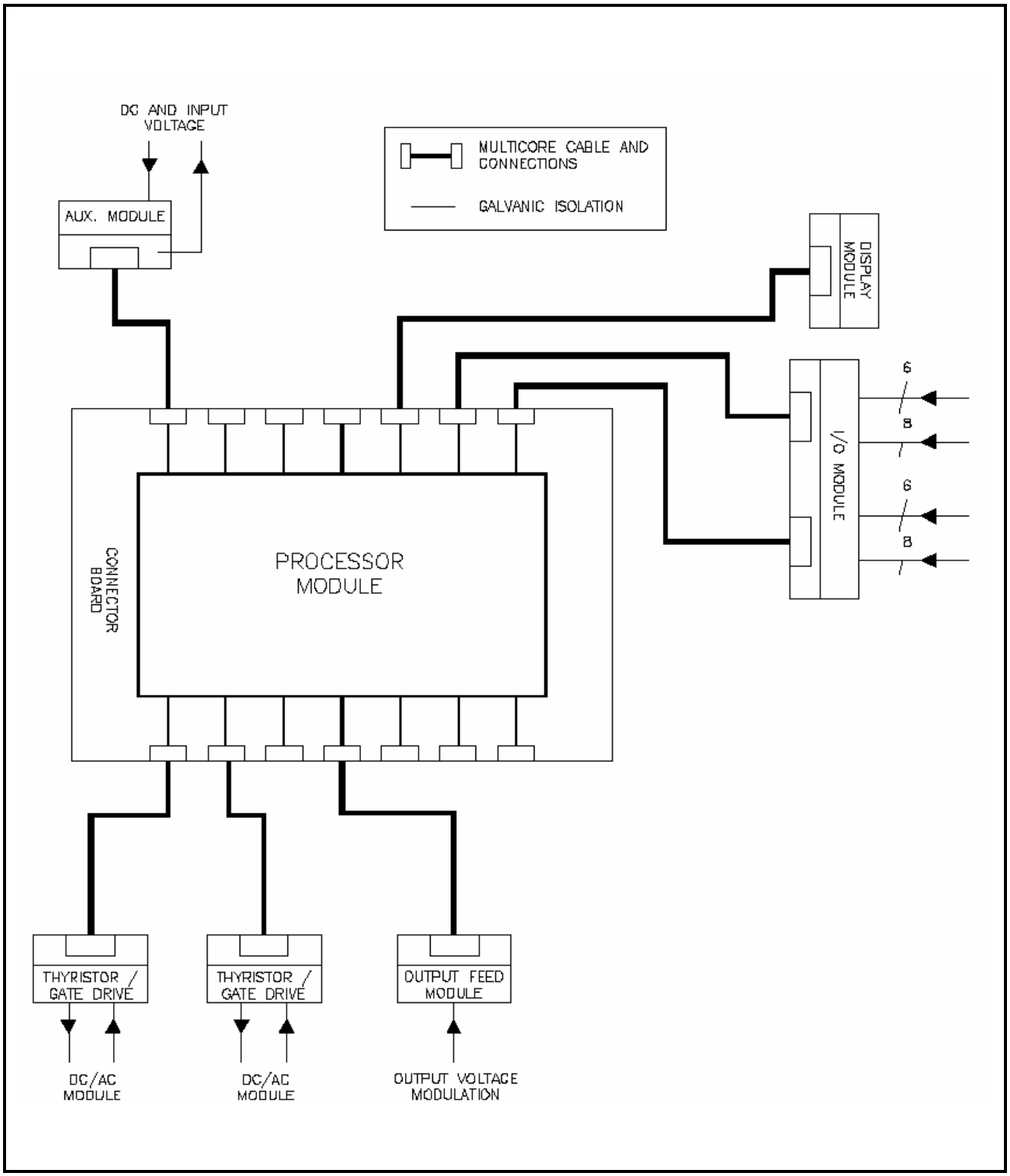
Error logging and Investigation
- Date (year, month, day), time (hour, minute, second) and error code is logged in case of errors.
- Up to 1000 errors are available for recalling and investigation.
- As for the last 50 errors, input and output parameters recorded at the moment the fault occurred can be recalled and investigated.
- Battery backup capacity for 10 years without external supply.

Customer registration
- Date (year, month, day), time (hour, minute, second), customer number, power consumption and duration are recorded.
- The last 50 operations can be recalled and examined.

Programming of the converter's electrical and functional characteristics
- Possibility of customer modification (lamp test, fuse indicators, potential free contacts)
- Expansion possibility (i.e. implementation of RS232 and or RS422/485 interface for computer reading)
- Precise regulation of the output voltage.

2) Composition of Processor Module and Interfaces

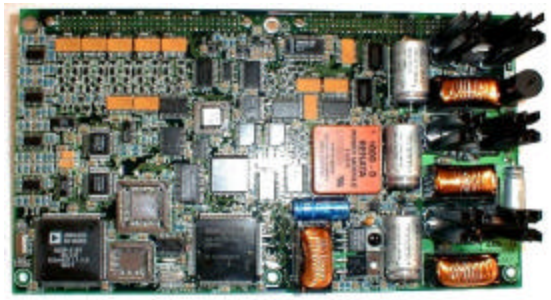
Figure 1 shows the composition of the processor module as well as the relation between the processor module and the interfaces. The processor module and the interfaces are built-up in modules with only few single core connectors, thus leading to easy service and repair. The interface modules provide galvanic isolation, transformation and over current protection between the processor module and the power part.



Processor Modules and Interface
Figure 1

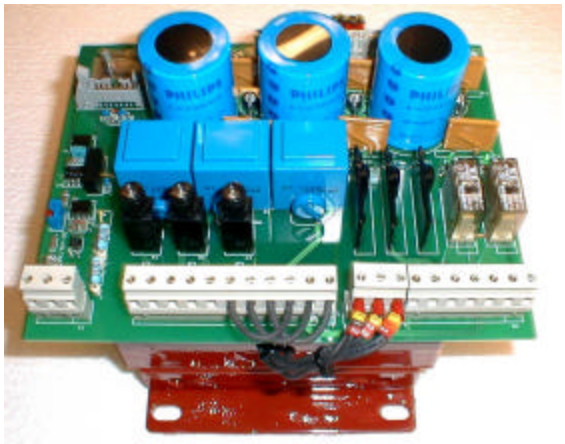
All interface modules are connected to the processor module by means of shielded multi-core cables. The cable connections are provided with mechanical lock. The primary functions of the above mentioned components are briefly described below.

a) Processor Module (Component A9)



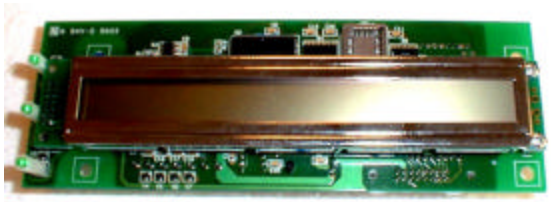
- DC-DC conversion to internal supply voltages ± 5, 12 and 17 VDC.
- Micro-controllers, performing I/O control functions, parameter monitoring and external communication by means of the display.
- Digital Signal Processors (DSP) performing regulation of output voltages, measurements of voltages, currents and calculations of RMS-values, mean values, and power consumption.

b) Aux. Module (Component A5)



- Transient protection of the converter's internal power supply (supply of processor module and interface)
- Over-current protection of the converter's internal power supply
- Isolated AC-DC supply to the processor module.
- Isolated AC-AC supply to relay module.
- Interface / drivers for operation of output contactors and / or input breakers (MCCBs)
- Interface for fans.
- Isolated DC conversion (DC watchdog). Makes it possible for the processor module to monitor the DC voltage and to give warning signal / to shut down the converter.
- Storage of energy to supply the processor module with voltage during mains failure of duration up to 40 ms.

c) Display/Keyboard Module (Component A10)

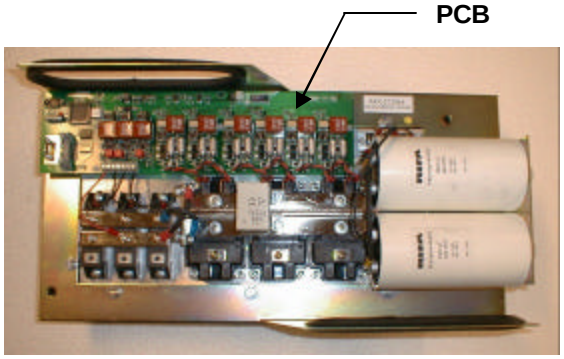


- Alpha-numeric display showing converter status.
- Reading of parameters / data chosen by the consumer / operator (voltages, currents, output power, temperature, date, time, hour counter etc.)
- Setup of parameters via keyboard interface.
- Unambiguous error description in clear language and investigation of error loggings.

d) I/O Module (Component A6)

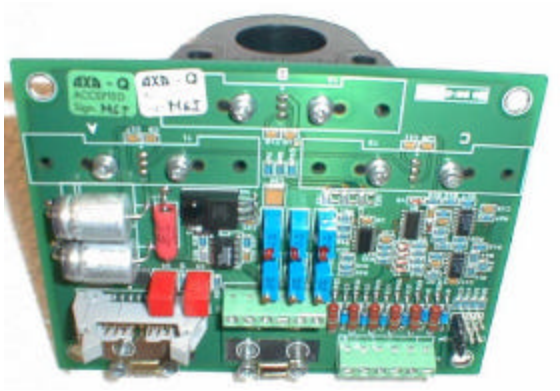
- 16 isolated input channels.
- 12 potential free output channels. The input channels are used for interlock, start, stop, lamp test, etc. The outlets are used for control of lamps, potential free contacts etc.

e) Thyristor / Gate Drive (DC/AC Module PCB)



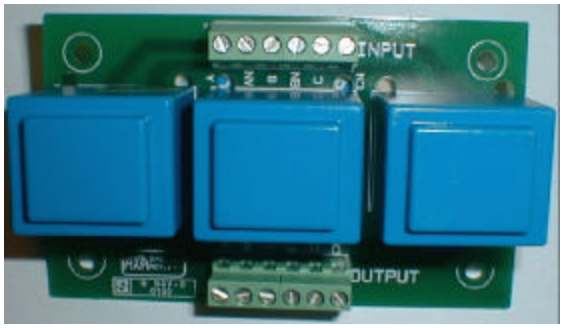
- Isolated IGBT-driver circuit.
- Dead time generators.
- Monitoring of supply voltage.
- Protection, fast IGBT-turn off in case of over currents, voltage errors or other errors reported by the actual module or by other modules in the converter.
- Supervision of heat sink temperature.

f) Output Feed Module (Component A8)



- Input for isolated voltage feed back from the output via module A14 below.
- AC current sensors.
- Resistors for termination of additional current transformers at output.

g) Voltage Module (Component A14)



- Galvanic Isolation of voltage feed back from output
- Adjustment of voltage feed back

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Section 1 Error Diagnostics

Overall Comments

As described for the display in alarm mode (Chapter 1, Section 4), the display provides extensive information in case of a failure in the converter or at it's input and output conditions.

In case of an error / alarm, the latest logged error information is automatically shown at the display. If for some reason, this is not the case, call up the latest logged error. In most cases, the displayed text or the error code provides the necessary information for correction of the error.

Before trying anything else it is recommended to perform at least one reset/restart of the converter, because:

- If the error was caused by an abnormality or related to external conditions, it is most likely not permanent.
- If the logged error has caused an internal damage, this damage is the problem to investigate or to correct. Such damage is found by the extensive routine checks carried out during reset/restart.

If the error persists after a reset/restart and it therefore necessary to check and repair the converter, PLEASE NOTE:

- that the DC capacitors remain charged to dangerous voltages. The discharge time is 5 minutes.
- that modules, including Printed Circuit Boards, with active components are sensitive to ESD.

In case that you need to contact HOBART in connection with any fault guidance, please inform us of the serial number of the GPU. The serial number can be found at the rating plate which is inside the front of the GPU.

Data Control Cables

Most failures in the GPU could be caused by bad connections and cable failures. Hence, for your convenience all control cables are equipped with the same 16-pole click-in connections at both ends. This means that they are compatible. Therefore you may use any control cable to verify if the cable should be the reason of the failure.

Defective Push Buttons

Press the push button in question and check that the corresponding LED on the I/O module (component A6) to see if it is lit. If this is not the case, check that voltage is supplied to the I/O module (LED H15 should be lit); otherwise check the fuse F1. If the corresponding LED is lit and if the GPU does not react when the push button is activated, the I/O module is defective and must be replaced.

1) Error Numbering / Grouping

The error codes are organized in groups. Each group contains up to 100 numbers and the error code consists of 4 digits.

xxyy	= 4 digit error code			
xx	= group number	:	type of error	
yy	= location number	:	location of error	(see Chapter 4, Figure 3)

Group numbers starts at 00 and ends at 99. Not all 100 location numbers within a group are necessarily used.

2) Display Readings / Causes / Suggestions

If the displayed error explanation does not provide sufficient information to get the converter into operation, the error code (see Chapter 1, Section 4, Figure 3) and this Chapter provide detailed information about the cause of the error and it also suggests corrective actions.

For all possible error codes, the following is described:
- Possible causes
- Test, measuring, repair or replacement suggestions

For convenience all examples of display alarm pictures in this section show the same date, time, log number and number of total loggings. The display alarm picture used is:

2001-08-20	08.00	ALARM	xxyy/001/0056
	TEXT DESCRIPTION OF ERROR		

How to read: On august the 20th, 2001, at 8 am an error was logged. The error code is group xxyy number xx, location number yy. This logging is the latest logging, number 001 out of 56 loggings in total (See Chapter 1, Section 4).

a) Error Log Initialization or Malfunctioning

(1) Error Code 0000 - 0099

Display alarm picture:

2001-08-20	08.00	ALARM	00yy/001/0056
NO ERRORS LOGGED YET			

Possible error causes:

This logging was done during a reset of the error log memory and is not considered as an error. It is overwritten when the error log memory is full (1000 errors).

Additional information on location numbers (yy) :

Only 00 used.

Recommended corrective actions :

None.

(2) Error Code 0100 - 0199

Display alarm picture:

2001-08-20	08.00	ALARM	01yy/001/0056
LOGGING WAS NOT COMPLETED SUCCESSFULLY			

Possible error causes:

- Logging of a detected error was interrupted due to disappearing internal supply voltage.
- Original error number lost.

Additional information on location numbers (yy) :

Only 00 used.

Recommended corrective actions :

- Try to restart the converter.

If the error persists after a reset, try in the following order:

- Replace processor module (Component A9)
- Replace Aux. module (Component A5)

b) Internal DC Supply (Control Voltage)

(1) Error Code 0200 - 0299

Display alarm picture:

2001-08-20	08.00	ALARM	02yy/001/0056
INTERNAL DC SUPPLY VOLTAGE ERROR			

Possible error causes:

- One or more of the internal DC voltages (-5V, 12V, 17V or 30V) are too low.
- Defective components at processor module or Aux. module input voltage low.
- DC/AC Module data cables connected incorrectly to processor module connector PCB.

Additional information on location numbers (yy) :

01 : -5V only
02 : 12V only
03 : -5V and 12V
04 : 17V only
05 : -5V and 17V
06 : 12V and 17V
07 : -5V, 12V and 17V
08 : 30V only
09 : -5V and 30V
10 : 12V and 30V
11 : -5V, 12V and 30V
12 : 17V and 30V
13 : -5V, 17V and 30V
14 : 12V, 17V and 30V
15 : -5V, 12V, 17V and 30V

Recommended corrective actions :

- Check DC/AC module data cable connections.
- Try to restart the converter.

If the error persists after a reset, try in the following order:

- Replace processor module (Component A9)
- Replace Aux. module (Component A5)

(2) Error Code 0300 - 0399

Display alarm picture:

2001-08-20	08.00	ALARM	03yy/001/0056
I/O MODULE SUPPLY VOLTAGE ERROR			

Possible error causes:

- Missing voltage at I/O module.
- Defective components at Aux. module.
- Defective components at processor module.

Additional information on location numbers (yy) :

Only of interest to the manufacturer

Recommended corrective actions :

- Reset the automatic fuse at the I/O module.

If the error persists after a reset, try in the following order:
- Verify that the voltage from the AUX module is present (3 x 20 VAC)
- Replace Aux. module (Component A5) in case the voltage is missing
- Replace processor module (Component A9)

c) Internal Communication Errors

(1) Error Code 0400 - 0699

Display alarm picture:

2001-08-20	08.00	ALARM	04yy/001/0056
DSP FAILURE – AC SOFTSTART NOT RUNNING			

2001-08-20	08.00	ALARM	05yy/001/0056
DSP FAILURE – INVERTER NOT RUNNING			

2001-08-20	08.00	ALARM	06yy/001/0056
INPUT VOLTAGE – PHASE SEQUENCE NOT FOUND			

Possible error causes:

- Defective components in processor module.
- Incorrect phase sequence in converter.
- Phase lost in converter.

Additional information on location numbers (yy) :

Only 00 in use.

Recommended corrective actions :

- Check phase sensitive connections throughout the converter.
- Verify all phase sensitive connections are secure.
- Try to restart the converter.

If the error persists after a reset, try in the following order:
- Replace processor module (Component A9)
- Replace Aux. Module (Component A5)

d) AC Input Voltage Error

(1) Error Code 0700 - 0899

Display alarm picture:

2001-08-20	08.00	ALARM	07yy/001/0056
INPUT VOLTAGE – FREQUENCY TOO HIGH			

2001-08-20	08.00	ALARM	08yy/001/0056
INPUT VOLTAGE – FREQUENCY TOO LOW			

Possible error causes:

- Input supply frequency above 65Hz or below 45Hz.
- Defective components in processor module.
- Defective Aux. module.
- Low input voltage.

Additional information on location numbers (yy) :

Only 00 used.

Recommended corrective actions :

- Try to restart the converter.

If the error persists after a reset, try in the following order:
- Measure input voltage and frequency, correct if necessary.
- Replace processor module (Component A9).
- Replace Aux. module (Component A5).

(2) Error Code 0900 - 0999

Display alarm picture:

2001-08-20	08.00	ALARM	09yy/001/0056
INPUT VOLTAGE – PHASE SEQUENCE WRONG			

Possible error causes:

- Wrong phase sequence, input voltage.
- Input voltage low.
- Defective components in processor module.
- Defective Aux. module.

Additional information on location numbers (yy) :

Only 00 used.

Recommended corrective actions :

In all cases measure and check input voltage, phase sequence and that all 3 phases are present.

- Try to restart the converter.

If the error persists after a reset, try in the following order:
- Check fuses F7-F9 at Aux. module (Component A5)
- Replace processor module (Component A9).
- Replace Aux. module (Component A5).

(3) Error Code 1000 - 1099

Display alarm picture:

2001-08-20	08.00	ALARM	10yy/001/0056
INPUT VOLTAGE TOO HIGH			

Possible error causes:

- Input voltage has passed upper limit (see specifications in Chapter 1, Section 2) for more than 20 ms.
- Temporary over-voltage.
- Defective Aux. module.
- Defective components in processor module.

Additional information on location numbers (yy) :

Over voltage measured at:

01	corresponding to	L1-L2
02	-	L2-L3
03	-	L1-L2 and L2-L3
04	-	L3-L1
05	-	L1-L2 and L3-L1
06	-	L2-L3 and L3-L1
07	-	L1-L2 and L2-L3 and L3-L1

Recommended corrective actions :

- Try to restart the converter.

If the error persists after a reset, try in the following order:

- Measure the input voltage, correct if not within limits and reset the converter.
- Replace Aux. module (Component A5).
- Replace processor module (Component A9).

(4) Error Code 1100 - 1399

Display alarm picture:

2001-08-20	08.00	ALARM	11yy/001/0056
INPUT VOLTAGE TOO LOW			

2001-08-20	08.00	ALARM	12yy/001/0056
INPUT PHASE LOW/FUSE BLOWN			

2001-08-20	08.00	ALARM	13yy/001/0056
INPUT VOLTAGE TOO LOW			

Possible error causes:

- Input voltage has been below the lower limit (according to specifications Chapter 1, Section 2) for more than 20 ms.
- Temporary under-voltage or defective input fuse at Aux. module (Component A5).
- Missing phase.
- Defective Aux. module.
- Defective processor module.

Additional information on location numbers (yy) :

11yy	Most likely under voltage	
01	corresponding to	L1-L2
02	-	L2-L3
04	-	L3-L1

12yy	Most likely defective fuse (F7-F9) at Aux. module (Component A5) or missing phase	
01	corresponding to	Fuse F7 or phase L1
02	-	Fuse F8 or phase L2
04	-	Fuse F9 or phase L3

13yy		
07	corresponding to	Low voltage on all 3 phases (only logged in black box)

Recommended corrective actions :

- Try to restart the converter.

If the error persists after a reset, try in the following order:

- Measure input voltage, correct if not within limits and reset the converter.
- Check fuses at Aux. module (Component A5), replace if necessary.
- Replace Aux. module (Component A5)
- Replace processor module (Component A9)

(5) Error Code 1400 - 1499

Display alarm picture:

2001-08-20	08.00	ALARM	14yy/001/0056
RECTIFIER SOFT START FAILURE			

Possible error causes:

- Temporary under-voltage / missing phase
- Defective processor module.

Additional information on location numbers (yy) :

Only 00 is used.

Recommended corrective actions :

- Try to restart the converter.

If the error persists after a reset, try in the following order:
- Check fuses at Aux. module (Component A5), replace if necessary.
- Replace processor module (Component A9)

e) DC Voltage Error (Power)

(1) Error Code 1500 - 1599

Display alarm picture:

2001-08-20	08.00	ALARM	15yy/001/0056
DC VOLTAGE < 350 V			

Possible error causes:

- The total voltage at DC capacitor bank has been below 350V for 30ms or more.
- Rectifier is not working.
- Defective capacitors (C1).
- Defective Aux. module.
- Defective components in processor module.

Additional information on location numbers (yy) :

01 : 350V > DC voltage ≥ 325V
02 : 325V > DC voltage ≥ 300V
03 : 300V > DC voltage ≥ 260V
04 : 260V > DC voltage

Recommended corrective actions :

- Try to restart the converter.

If the error persists after a reset, try in the following order:

- Exchange the DC/AC
- module(s)
- Replace Aux. module (Component A5)
- Replace processor module (Component A9)

(2) Error Code 1600 - 1699

Display alarm picture:

2001-08-20	08.00	ALARM	15yy/001/0056
DC VOLTAGE > 850 V			

Possible error causes:

- The total voltage at DC capacitor bank has been above 850V for 2ms or more. Eventually caused by energy flow towards converter during a No Break Power Transfer failure situation.
- Defective Aux. module.
- Defective components in processor module.

Additional information on location numbers (yy) :

01 : 850V < DC voltage ≤ 865V
02 : 865V < DC voltage ≤ 880V
03 : 880V < DC voltage ≤ 895V
04 : 895V < DC voltage

Recommended corrective actions :

- Try to restart the converter.

If the error persists after a reset, try in the following order:
- Replace Aux. module (Component A5)
- Replace processor module (Component A9)

(3) Error Code 1700 - 1799

Display alarm picture:

2001-08-20	08.00	ALARM	17yy/001/0056
DC CAPACITOR SHARING ERROR			

Possible error causes:

- The difference between the voltages of the DC capacitor battery's 2 parts has been more than 50 V for 30ms or more.
- Defective capacitor.
- Defective sharing resistor.
- Defective Aux. module.
- Defective components in processor module.

Additional information on location numbers (yy) :

Only 01 used.

Recommended corrective actions :

- Try to restart the converter.

If the error persists after a reset, try in the following order:
- Replace DC/AC module(s)
- Replace Aux. module (Component A5)
- Replace processor module (Component A9)

f) Errors Reported by DC/AC Modules

(1) Error Code 2000 - 2099

Display alarm picture:

2001-08-20	08.00	ALARM	20yy/001/0056
HIGH TEMPERATURE DC/AC MODULE: 1 2			

Module number only shown for erroneous DC/AC module(s)

Possible error causes:

- Over-temperature at DC/AC module(s).
- Fans not running or limited airflow.
- Defective DC/AC module.
- Defective components in processor module.

Additional information on location numbers (yy) :

Display shows all information.
Ref.: DC/AC module table (See Chapter 2, Section 1, Paragraph 3)

Recommended corrective actions :

- Check airflow / air filter.
- Check that fans are running properly; By-pass the fan as described in Chapter 3, Section 3 and Chapter 1, Section 4.

Note: Remember to reset the fan set-up value (back to 0)

If the fans are not running properly.
- Check the supply voltage to the fans.
- Replace Aux. module (Component A5).

Wait for DC/AC modules to cool down.
- Try to restart the converter.

If the error persists after a reset, try in the following order:
- Replace DC/AC module
- Replace processor module (Component A9)

(2) Error Code 2100 - 2199

Display alarm picture:

2001-08-20	08.00	ALARM	21yy/001/0056
GATE VOLTAGE ERROR DC/AC MODULE: 1 2			

Module number only shown for erroneous DC/AC module(s)

Possible error causes:

- Gate drive voltage has been temporarily or is permanently below limit, eventually caused by an earlier over-current.
- Defective DC/AC module.
- Defective components in processor module.

Additional information on location numbers (yy) :

- Ref.: DC/AC module table (See Chapter 2, Section 1, Paragraph 3)
- The error is also reported by the red LED (H1) at corresponding DC/AC module(s).

Recommended corrective actions :

- Try to restart the converter.

If the error persists after a reset, try in the following order:
- Replace DC/AC module(s)
- Replace processor module (Component A9)

g) Output Voltage Error

(1) Error Code 3000 - 3199

Display alarm picture:

2001-08-20	08.00	ALARM	30yy/001/0056
OUTPUT OVERVOLTAGE 1: U > 128V – 250ms			

2001-08-20	08.00	ALARM	31yy/001/0056
OUTPUT OVERVOLTAGE 2: U > 140V – 14ms			

Possible error causes:

The output voltage (Phase-Neutral) at the converter's output terminals has exceeded the displayed limit. Most likely due to:

- Defective output feed module.
- Defective voltage feed back module.
- Defective components in processor module.

Additional information on location numbers (yy) :

Over-voltage at Phase:

01	corresponding to	A only
02	-	B only
03	-	A and B
04	-	C only
05	-	A and C
06	-	B and C
07	-	A and B and C

Recommended corrective actions :

- Try to restart the converter.

If the error persists after a reset, try in the following order:

- Check that set-up value is within limits. If not correct.
- Replace output feed module (Component A8).
- Replace the voltage feed-back module (Component A14)
- Replace processor module (Component A9)

(2) Error Code 3500 - 3799

Display alarm picture:

2001-08-20	08.00	ALARM	35yy/001/0056
OUTPUT UNDERVOLTAGE 1: U < 100V – 300ms			

2001-08-20	08.00	ALARM	36yy/001/0056
OUTPUT OVERVOLTAGE 2: U < 90V – 50ms			

2001-08-20	08.00	ALARM	37yy/001/0056
OUTPUT OVERVOLTAGE 3: U > 70V – 10ms			

Possible error causes:

The output voltage (Phase-Neutral) at the converter's output terminals was below the displayed limit. Most likely due to an abrupt drop out of the mains supply combined with a heavy overload.

If this is not the case, the error may be due to:
- Defective output feed module.
- Defective voltage feed-back module.
- Defective components in processor module.
- Defective output filter.

Additional information on location numbers (yy) :

Under-voltage at Phase:

01	corresponding to	A only
02	-	B only
03	-	A and B
04	-	C only
05	-	A and C
06	-	B and C
07	-	A and B and C

Recommended corrective actions :

- Try to restart the converter.

If the error persists after a reset, try in the following order:
- Check that set-up value is within limits. If not correct.
- Replace output feed module (Component A8).
- Replace voltage feed-back module (Component A14).
- Replace processor module (Component A9).
- Check capacitors in output filter (Component C2-C4).

h) Output Current Error

(1) Error Code 4000 - 4499

Display alarm picture:

2001-08-20	08.00	ALARM	40yy/001/0056
OVERLOAD 1: 100% < I = 120% – 600s			

2001-08-20	08.00	ALARM	41yy/001/0056
OVERLOAD 2: 120% < I = 150% – 30s			

2001-08-20	08.00	ALARM	42yy/001/0056
OVERLOAD 3: 150% < I = 170% – 5s			

2001-08-20	08.00	ALARM	43yy/001/0056
OVERLOAD 4: 170% < I = 250% – 1s			

2001-08-20	08.00	ALARM	43yy/001/0056
OVERLOAD 5: I > 250%			

Possible error causes:

- Output current has been in the displayed range for the displayed time.
- Defective 400Hz distribution installation.
- Defective output feed module.
- Defective components in processor module.

Additional information on location numbers (yy) :

Overload at Phase:

01	corresponding to	A only
02	-	B only
03	-	A and B
04	-	C only
05	-	A and C
06	-	B and C
07	-	A and B and C

Recommended corrective actions :

- Remove overload and try to restart the converter.
- If the same error message keeps occurring, and there is no overload situation, the error is within the converter.
- Replace output feed module (Component A8).
- Replace processor module (Component A9)

(2) Error Code 4500 - 4599

Display alarm picture:

2001-08-20	08.00	ALARM	45yy/001/0056
SHORT CIRCUIT AT OUTPUT			

Possible error causes:

- DC/AC module current has exceeded the limit, most likely due to a short circuit in the output installation.
- Eventual over-current due to a failure at a No Break Power Transfer.
- Defective output feed module.
- Defective DC/AC module.
- Defective components in processor module.
- Internal 12V DC supply voltage is too low.

Additional information on location numbers (yy) :

- Ref.: DC/AC module table (See Chapter 2, Section 1, Paragraph 3)
- In special situations a gate voltage error (21yy) can occur simultaneously. If so, this error will also be displayed as an over-current, but it will be correctly reported by the LED (H1) situated on the respective DC/AC module.

Recommended corrective actions :

- Investigate and remove short circuit.
- Try to restart the converter.

If the error persists after a reset, try to remove the distribution / load (alternatively the voltage to the output contactor) and restart the converter.

If above solves the problem, the error is not within the converter. Examine and repair the 400 Hz distribution / load.

If the problem is still not solved, try in the following order:

- Exchange the output feed module (Component A8)
- Exchange the DC/AC module(s)
- Exchange the processor module (Component A9).

(3) Error Code 4600 - 4699

Display alarm picture:

2001-08-20	08.00	ALARM	46yy/001/0056
TRANSFORMER/FILTER CURRENT TOO LOW			

Possible error causes:

- DC/AC module current was too low during the 400 Hz softstart.
- Defective capacitor in output filter.
- Defective output feed module.
- Defective DC/AC module.
- Defective components in processor module.

Additional information on location numbers (yy) :

Ref.: DC/AC module table (See Chapter 2, Section 1, Paragraph 3)

Recommended corrective actions :

- Try to restart the converter.

If the error persists after a reset, call HOBART for further instructions or try in the following order:

- Replace defective capacitors in the output filter (Component C2-C4)
- Replace output feed module (Component A8)
- Replace DC/AC module(s)
- Replace processor module (Component A9)

(4) Error Code 4700 - 4799

Display alarm picture:

2001-08-20	08.00	ALARM	47yy/001/0056
TRANSFORMER/FILTER CURRENT TOO HIGH			

Possible error causes:

- DC/AC module current has exceeded the limit during the last part of the 400 Hz softstart, most likely due to short circuit in transformer/filter section or missing feedback voltage from the 400 Hz output.
- Defective DC/AC module.
- Defective output feed module
- Defective voltage feed back module
- Defective components in processor module.
- Internal 12V DC supply voltage is too low.

Additional information on location numbers (yy) :

- Ref.: DC/AC module table (See Chapter 2, Section 1, Paragraph 3)
- In special situations a gate voltage error (21yy) can occur simultaneously. If so, this error will also be displayed as an over-current, but it will be correctly reported by the LED (H1) situated on the respective DC/AC module.

Recommended corrective actions :

- Try to restart the converter.

If the error persists after a reset, call HOBART for further instructions or try in the following order:

- Replace DC/AC module(s)
- Replace output feed module (Component A8)
- Replace voltage feedback module (Component A14)
- Replace processor module (Component A9)
- Replace / check output filter.
- Replace / check output transformer.

(5) Error Code 4800 - 4899

Display alarm picture:

2001-08-20	08.00	ALARM	48yy/001/0056
TRANSFORMER TEMPERATURE TOO HIGH			

Possible error causes:

- Too high temperature in the output transformer.
- The fans are not running properly or the air flow is reduced.
- Defective thermal sensor.
- Defective components at AUX module.
- Defective components at processor module.

Additional information on location numbers (yy) :

The display shows all relevant information

Recommended corrective actions :

- Verify the proper airflow check air filter
- Verify that the fans are running properly. By-pass the fans as described in Chapter 1, Section 3 and Chapter 1, Section 4.

Note: Remember to re-set the fan set-up value (back to 0)

- Let the transformer cool down and verify the thermal sensor by short-circuiting the inlet of the AUX module (Component A5)
- Replace the AUX module
- Replace processor module (Component A9)

i) Undefined Error Codes

(1) Error Code1800-1999, 2200-2999
Error Code 3200-3499, 3800-3999
Error Code 4900-4999

Display alarm picture:

2001-08-20	08.00	ALARM	xxyy/001/0056
NOT A DEFINED NUMBER			

Possible error causes:

- Defects in processor module or display module.
- Temporary or permanent disturbance of communication.

Additional information on location numbers (yy) :

None

Recommended corrective actions :

- Try to restart the converter.

If the error persists after a reset, try in the following order:
- Replace processor module (Component A9)
- Replace display module (Component A10)
- If failure reoccurs call HOBART.

(2) Error Code 5600-9999

Display alarm picture:

2001-08-20	08.00	ALARM	xxyy/001/0056
2001-08-20	08.00	ALARM	xxyy/001/0056

Possible error causes:

The displayed error code exceeds the limit of definitions caused by either, defects in processor module or display module, or temporary or permanent disturbance of communication.

Additional information on location numbers (yy) :

None

Recommended corrective actions :

- Try to restart the converter.

If the error persists after a reset, try in the following order:
- Replace processor module (Component A9)
- Replace display module (Component A10)
- If failure reoccurs call HOBART.

3) Listing of DC/AC Module (if applicable)

The table below shows the relation between the location number (the two last digits in the error code) and the malfunctioning DC/AC module. The table is valid for the following group numbers:

20yy, 21yy

--yy	DC/AC-module(s) in question
01	1
02	2
03	1,2

The table below shows the relation between the location number (the two last digits in the error code) and the malfunctioning DC/AC module. The table is valid for the following group numbers:

45yy, 46yy, 47YY

20yy, 21yy

--yy	DC/AC-module(s) in question
01	1 (A)
02	2 (B)
03	1,2 (A,B)
04	3 (C)
05	1,3 (A,C)
06	2,3 (B,C)
07	1,2,3 (A,B,C)

4) Errors Related to Possible Options (Refer to Appendix A)

a) Earth Failure

(1) Error Code 5000-5099

Display alarm picture:

2001-08-20	08.00	ALARM	50yy/001/0056
EARTH/INSULATION FAILURE AT OUTPUT			

Possible error causes:

- The leakage current to earth at the outlet has passed the adjusted value.
- Defective measuring system.

Additional information on location numbers (yy) :

None

Recommended corrective actions :

- Verify that possible “z-wires” have been led through the measuring transformer (Component T11)
- Try to restart the converter.
- If the same error message keeps occurring, disconnect the load and the distribution and restart the converter.
- If the failure persists after disconnection of the load and the distribution, and in case that the LED H21 on the I/O module (Component A6) is not lit, the error is probably caused by a defective RCM relay (Component K1) or a defective measuring transformer.
- If H1 is lit, the error is probably caused by a defective I/O or a defective processor module (Component A5)

Note: This function can be disabled at the I/O module (refer to diagram)

b) Neutral Conductor Rupture

(1) Error Code 5100-5299

Display alarm picture:

2001-08-20	08.00	ALARM	51yy/001/0056
NEUTRAL CONDUCTOR RUPTURE OUTPUT 1			

2001-08-20	08.00	ALARM	52yy/001/0056
NEUTRAL CONDUCTOR RUPTURE OUTPUT 2			

Possible error causes:

- The 400 Hz neutral conductor in question is broken.
- Defective measuring system.

Additional information on location numbers (yy) :

None

Recommended corrective actions :

- Verify cables and cable connections.
- Try to restart the converter.
- If the failure persists and LED H16 (H17) on the I/O module (Component A6) is not lit, the error is probably caused by a defective NCR board (Component A11/A12)
- If H16 (H17) is lit, the error is probably caused by a defective I/O or a defective processor module (Component A5)

Note: This function can be disabled at the I/O module (refer to diagram)

c) Over-temperature in Optional Transformer

(1) Error Code 5500-5599

Display alarm picture:

2001-08-20	08.00	ALARM	55yy/001/0056
ADAPTATION TRANSFORMER OVERHEATED			

Possible error causes:

- Too high temperature in the adaptation transformer.
- The fans are not running properly or the air flow is reduced.
- Defective thermal sensor.
- Defective components at AUX module.
- Defective components at processor module.

Additional information on location numbers (yy) :

The display shows all relevant information

Recommended corrective actions :

- Verify the proper airflow and check air filter.
- Verify that the fans are running properly. By-pass the fans as described in Chapter 1, Section 3 and Chapter 1, Section 4.

Note: Remember to re-set the fan set-up value (back to 0)

- Let the transformer cool down and verify the thermal sensor by short-circuiting the inlet of the AUX module (Component A5)
- Replace the AUX module
- Replace processor module (Component A9)

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Section 1 Overhaul / Major Repair

1) General

Repair of the converter will consist primarily of part replacement. Most of the components used in the converter cannot be disassembled and repaired, and must be replaced if faulty. Additionally, inoperative PC boards cannot be repaired in the field, and must be replaced as a complete unit. PC boards may be returned to the factory for replacement. Contact Hobart Ground Power for part and replacement instructions.

2) Service Information and Factory Repair

Questions concerning the operation, repair, and/or servicing of this converter should be directed to the Service Department of Hobart Ground Power. When making such an inquiry, be sure to provide the Service Department with 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 converter since the unit uses modular components and plug-in type assemblies throughout the converter. For warranty information, refer to the warranty statement at the front of this manual or contact the Hobart Service Department.

When ordering parts from your Hobart Ground Power Distributor, be sure to include all pertinent information from the unit's identification plate: Specification No., Model No., and unit rating. If you have any questions concerning your Hobart Ground Power equipment, immediately contact our Service Department by mail, telephone, Email or FAX.

Write:	ITW GSE Group Hobart Ground Power Service Department 1177 Trade Road East Troy, Ohio 45373 U.S.A.
Call Inside U.S.A.:	(800) 422-4166 (Parts) (800) 422-4177 (Service)
Call From Foreign Countries:	(937) 332-5050 (Parts) (937) 332-5060 (Service)
FAX Inside U.S.A.	(800) 367-4945
FAX From Foreign Countries:	(937) 332-5121
E-Mail :	service@itwgsegroup.com
Web Page :	www.itwgsegroup.com

3) Workmanship

Perform all repairs in accordance with good electrical repair practices. All interconnecting lead connections to components must be made with proper wire terminations. Route all leads neatly and secure with wire ties, cable clamps, etc.

This converter was designed to use metric hardware wherever possible. However, some of the purchased components, such as contactors, switches, transformers, etc., may have standard size hardware (SAE). Hobart Ground Power does not recommend the use of standard size tools on metric hardware or vice versa. Where mentioned, use only the hardware sizes reference in this manual.

CAUTION	Use only metric tools to loosen or tighten metric hardware, and likewise, use only standard size tools to loosen or tighten standard size hardware. These fundamental practices will help to avoid insufficient tightening and rounding off corners. Use only the tools that are specified.

CAUTION	Use only the correctly sized hardware when reassembling parts on this converter. The majority of hardware for this unit is metric.

4) Converter Bridge Mount Removal and Installation

If extensive repairs are to be made to a unit which is mounted on a trailer or boarding bridge, it is suggested that the unit be removed and placed on a solid supporting structure of some kind.

WARNING	High voltages may be present inside the cabinet, even when the unit is off. Exercise extreme caution and read all warning labels or **FATAL SHOCK** may result.

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

b) Open the front door by turning the circuit breaker handle and turn the latch counterclockwise with the key(s) supplied with the converter.

c) Open the rear door and test the DC/AC Module DC Electrolytic Capacitors (Figure 1) with a voltmeter to be sure that they are fully discharged. If the capacitors are not discharged, close the converter door, wait at least 10 minutes, and test it again. Do not perform any work inside the converter while the capacitors remain charged.

d) Disconnect the three AC input leads at terminals L1, L2, and L3 of circuit breaker Q1 and the grounding wire at the grounding lug (Figure 2).

e) Remove the input cable from the unit.

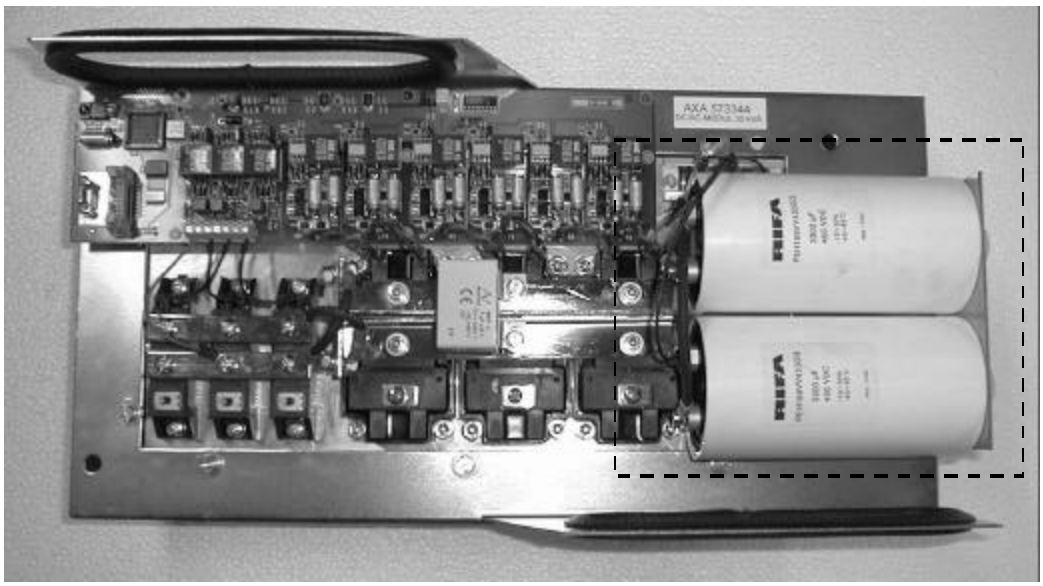
f) Disconnect the output cable from the output contactor. Disconnect the EF signal and remote control leads from the terminal strips near the contactor.

i) Be sure all leads are free and do not become entangled.

j) Carefully lower the converter to the ground or other flat surface.

k) Move the unit to a clear working area where it can be placed on a solid supporting structure.

l) Installation is in the reverse order of removal.



DC Electrolytic Capacitors
Figure 1

Input Cable Connections
Figure 2

5) Component Removal and Replacement

Most of the components in the converter are accessible and easily replaced when necessary.

a) Preparation

Before removing or replacing any component, follow these steps:

(1) Turn off input power at the source. Make sure that power cannot be inadvertently turned back on. The converter draws a small amount of input power even when the unit is off. Components and PC boards throughout the unit can be permanently damaged if anything is removed or replaced while input power is present. Therefore, always make sure input power is off before removing or installing any parts inside the unit.

WARNING

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

(2) Open the front door by turning the circuit breaker handle and turn the latch counterclockwise with the key(s) supplied with the converter.

(3) Open the rear door and test the DC/AC Module DC Electrolytic Capacitors (Figure 1) with a voltmeter to be sure that they are fully discharged. If the capacitors are not discharged, close the converter door, wait at least 10 minutes, and test it again. Do not perform any work inside the converter while the capacitors remain charged.

b) Component Removal and Replacement

(1) DC Electrolytic Capacitors [C1A, C2A, C1B, C2B]

The DC electrolytic capacitor bank is located on the DC/AC Module (Reference Figure 9 in Chapter 4, Section 3). After determining which capacitor is defective, proceed as follows to remove and replace it.

a Open the rear door and test the DC/AC Module DC Electrolytic Capacitors (Figure 1) with a voltmeter to be sure that they are fully discharged. If the capacitors are not discharged, close the converter door, wait at least 10 minutes, and test it again. Do not perform any work inside the converter while the capacitors remain charged.

b Remove the entire DC/AC module from the converter. This is done by removing the two (2) wing nuts fastening the module to the panel.

c Lay the DC/AC Module on a flat surface.

d Remove the wires that connect to the power resistor.

e Remove the bus bars screws.

f Remove the plastic fastening nuts.

WARNING

Capacitors are **POLARITY SENSITIVE**. Make certain that capacitors are installed **EXACTLY** as they were previously installed.

d Remove defective capacitor and replace it.

e Installation is in the reverse order of removal. Make certain that components are installed exactly as they were previously installed, and make certain that screws and nuts are tightened securely.

(2) Input SCR/Diode Module RV1A, RV2A, RV1B, & RV2B

The SCR/diode modules are located behind the rear door (Reference Figure 9 in Chapter 4, Section 3).

a Open the rear door and test the DC/AC Module DC Electrolytic Capacitors (Figure 1) with a voltmeter to be sure that they are fully discharged. If the capacitors are not discharged, close the converter door, wait at least 10 minutes, and test it again. Do not perform any work inside the converter while the capacitors remain charged.

b Remove the entire DC/AC module from the converter. This is done by removing the two (2) wing nuts fastening the module to the panel.

c Lay the DC/AC Module on a flat surface.

d Label and disconnect any wiring associated with the SCR/Diode module.

e Remove the bus bars and varistors.

f Remove the defective SCR/Diode module.

g Remove all traces of heat sink thermo-silicone grease/paste from the heat sink and SCR/Diode module.

h Apply new heat sink thermo-silicone grease/paste to the new SCR/Diode module.

i Installation is in the reverse order of removal. If necessary, verify wiring by referring to the pertinent connection diagram (See Chapter 5).

(3) IGBT Power Modules PM1A-PM3A, PM1B-PM3B

The IGBT's power modules are located behind the rear door (Reference Figure 9 in Chapter 4, Section 3).

a Open the rear door and test the DC/AC Module DC Electrolytic Capacitors (Figure 1) with a voltmeter to be sure that they are fully discharged. If the capacitors are not discharged, close the converter door, wait at least 10 minutes, and test it again. Do not perform any work inside the converter while the capacitors remain charged.

b Remove the entire DC/AC module from the converter. This is done by removing the two (2) wing nuts fastening the module to the panel.

c Lay the DC/AC Module on a flat surface.

d Label and disconnect any wiring associated with the IGBT power module.

e Remove the bus bars, snubber capacitor and varistors.

f Remove the defective IGBT power module.

g Remove all traces of heat sink thermo-silicone grease/paste from the heat sink and the IGBT power module.

h Apply new heat sink thermo-silicone grease/paste to the new SCR/Diode module.

i Installation is in the reverse order of removal. If necessary, verify wiring by referring to the pertinent connection diagram (See Chapter 5).

(4) Cooling Fans M1 & M2

The cooling fans are mounted behind air filter panel to the left of the control panel (Reference Figure 1 and 5 in Chapter 4, Section 3). To remove and install the fans follow these steps:

a Remove the air filter panel. Take special care in removing the panel so not to tear or damage the sealing gasket.

b Determine which cooling fan is defective.

c Label and remove any wiring associated with the defective fan.

d Remove the fan's four (4) mounting screws.

e Remove the defective fan and replace.

f Installation is in the reverse order of removal. If necessary, verify wiring by referring to the pertinent connection diagram (See Chapter 5).

Note: If the fan blades rotate in the wrong direction, reverse connection of any two fan input leads.

(6) Main Transformers T2

In the event of the main transformer failing, contact the Hobart Service Department for assistance.

(7) Reactor L1 / 12 Pulse Transformer T1

In the event of these transformers failing, contact the Hobart Service Department for assistance.

6) PC Board Removal and Replacement

The PoWerMaster EV converter has printed circuit (PC) boards in various locations, see Figure 3, 4 and 9 in Chapter 4, Section 3. They PC board in the converter are as follows:

- AUX-Module PC Board (A5)
- Processor PC Board (A9)
- Processor Connection PC Board (A25)
- Thyristor Gate Drive PC Board (A1)
- Output Feed PC Board (A8)
- I/O (Input/Output) Module PC Board (A6)
- Voltage Feedback PC Board (A14)
- RFI Output PC Board (RFI1)
- RFI Input PC Board (RFI2)
- Control Panel Display PC Board (A10)

Before inspecting, removing, or replacing any of the boards, follow these steps (a-c):

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 input power at the source. Make sure that power cannot be inadvertently turned back on. The converter draws a small amount of input power even when the unit is off. Components and PC boards throughout the unit can be permanently damaged if anything is removed or replaced while input power is present. Therefore, always make sure input power is off before removing or installing any parts inside the unit.

b) Open the front door by turning the circuit breaker handle and turn the latch counterclockwise with the key(s) supplied with the converter.

c) Open the rear door and test the DC/AC Module DC Electrolytic Capacitors (Figure 1) with a voltmeter to be sure that they are fully discharged. If the capacitors are not discharged, close the converter door, wait at least 10 minutes, and test it again. Do not perform any work inside the converter while the capacitors remain charged.

d) Remove and replace each board as follows.

(1) AUX-Module Control PC Board (A5)

The AUX Module PC Board is mounted behind the rear door. The board is mounted on the AUX-Module transformer with 4 nylon screws and spacers (located behind the PC board). To remove and replace this board, follow these steps:

a Open the rear door and test the DC/AC Module DC Electrolytic Capacitors (Figure 1) with a voltmeter to be sure that they are fully discharged. If the capacitors are not discharged, close the converter door, wait at least 10 minutes, and test it again. Do not perform any work inside the converter while the capacitors remain charged.

b Label and remove any wiring associated with the PC board.

c Remove the nylon screws. Be careful not to lose the spacers behind the PC board.

d Remove the PC board and replace.

e Installation is in the reverse order of removal. If necessary, verify wiring by referring to the pertinent connection diagram (See Chapter 5).

(2) Processor PC Board (A9)

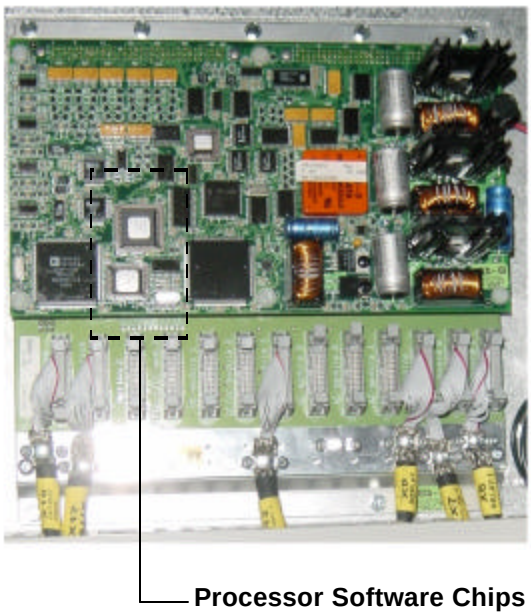
The Processor PC Board is mounted behind the rear door. The board is mounted on a connector board (A25) with 6 nylon screws. To remove and replace this board, follow these steps:

a Open the rear door and test the DC/AC Module DC Electrolytic Capacitors (Figure 1) with a voltmeter to be sure that they are fully discharged. If the capacitors are not discharged, close the converter door, wait at least 10 minutes, and test it again. Do not perform any work inside the converter while the capacitors remain charged.

b Label and remove any wiring associated with the PC board.

c Remove the nylon screws. Be careful not to lose the spacers behind the PC board.

d Remove the PC board and replace. Be sure to remove the two processor software chips and place them into the new PC board.



Processor Software Chips
Figure 3

e Installation is in the reverse order of removal. If necessary, verify wiring by referring to the pertinent connection diagram (See Chapter 5).

(3) Thyristor Gate Drive PC Board (A1)

The Thyristor Gate Drive PC board is located on the DC/AC Module behind the rear door. The board has six nylon screws tightening spacers that are fasten to the heat sink. To remove and replace this board, follow these steps:

a Open the rear door and test the DC/AC Module DC Electrolytic Capacitors (Figure 1) with a voltmeter to be sure that they are fully discharged. If the capacitors are not discharged, close the converter door, wait at least 10 minutes, and test it again. Do not perform any work inside the converter while the capacitors remain charged.

b Label and remove any wiring associated with the PC board.

c Remove the nylon screws. Be careful not to lose the spacers behind the PC board.

d Remove the PC board and replace. Install the PC board on the spacers and be sure the ground stud, on the PC board, is placed in the grounding stud (Figure 4) on the heat sink (apply a thermo-silicone grease/paste to the ground stud before installing the PC board to the ground stud).

e Installation is in the reverse order of removal. If necessary, verify wiring by referring to the pertinent connection diagram (See Chapter 5).

Thyristor Gate Drive PC Board Grounding Stud
Figure 4

(4) Processor Connection PC Board (A25)

The Processor Connection PC board is located behind the Main Processor PC board (A9), which is behind the rear door. The board has ten screws tightening it to galvanized internal panel. To remove and replace this board, follow these steps:

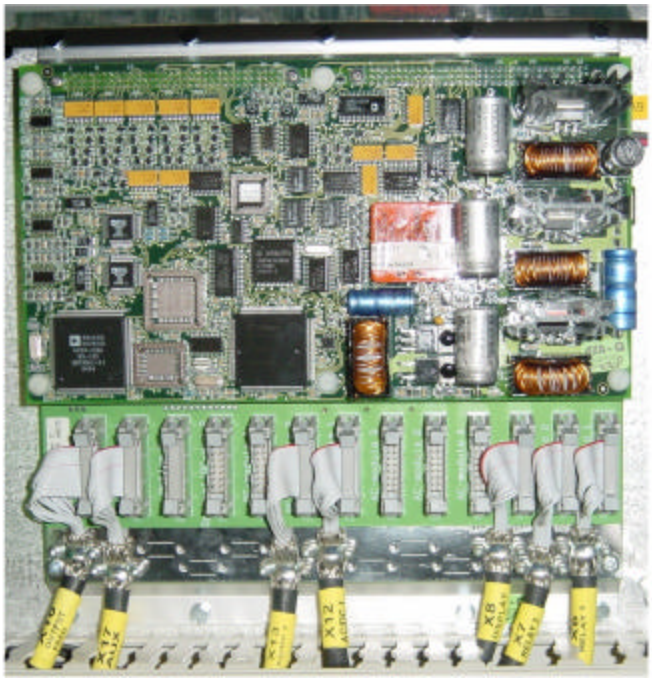
a Open the rear door and test the DC/AC Module DC Electrolytic Capacitors (Figure 1) with a voltmeter to be sure that they are fully discharged. If the capacitors are not discharged, close the converter door, wait at least 10 minutes, and test it again. Do not perform any work inside the converter while the capacitors remain charged.

b Clearly label each of the cables connected to the PC board, then disconnect each one by gently pulling the plug away from the board.

c Remove the mounting screws.

d Remove the PC board and replace. Be sure the place the cable connector (removed in step b) back in the Option 2 slot.

e Installation is in the reverse order of removal. If necessary, verify wiring by referring to the pertinent connection diagram (See Chapter 5).



Processor Connector Board PC Board Cable Connector
Figure 5

(5) Output Feed PC Board (A8)

The Output Feed PC Board is located behind the rear door. The board has 4 screws connecting it to the spacers on the mounting panel and 2 bolts tightening the mounting panel to the galvanized internal panel. To remove and replace this board, follow these steps:

a Open the rear door and test the DC/AC Module DC Electrolytic Capacitors (Figure 1) with a voltmeter to be sure that they are fully discharged. If the capacitors are not discharged, close the converter door, wait at least 10 minutes, and test it again. Do not perform any work inside the converter while the capacitors remain charged.

b Clearly label each of the cables connected to the PC board, pay special attention to the cable with multi-colored wires, then disconnect each one by gently pulling the plug away from the board.

c Remove the mounting panel screws to lift the entire assembly from the galvanized internal panel.

d Remove the cables from the DC/AC Module IGBT's and feed them through the current transformers under the PC board.

e Remove the PC board and replace.

f Installation is in the reverse order of removal. If necessary, verify wiring by referring to the pertinent connection diagram (See Chapter 5).

(6) I/O (Input/Output) Module PC Board (A6)

The I/O (Input/Output) Module PC Board is located behind the front door. The board is attached to a din-rail. To remove and replace this board, follow these steps:

a Open the rear door and test the DC/AC Module DC Electrolytic Capacitors (Figure 1) with a voltmeter to be sure that they are fully discharged. If the capacitors are not discharged, close the converter door, wait at least 10 minutes, and test it again. Do not perform any work inside the converter while the capacitors remain charged. Once the capacitors are discharged, open the front door to gain access to the PC board.

b Clearly label each of the cables and wire connectors to the PC board and remove from the PC board.

c Loosen the end supports on the din-rail and slide out of the way.

d To remove the PC board from the din-rail located the three tabs on the bottom of the assembly, behind the PC board. Pulling down (a flat screw driver will be required) on the tabs will release the assembly from the din-rail.

e Remove the PC board and replace. Not the locations of the switches on the red switch panel on the PC board. Be sure all switches on the new PC board are in the same location before installing.

f Installation is in the reverse order of removal. If necessary, verify wiring by referring to the pertinent connection diagram (See Chapter 5).

(7) Voltage Feedback PC Board (A14)

The Input Voltage Feedback PC Board is located behind the font door. The Voltage Feedback PC board has four (4) screws connecting it to spacers that are fastened to the galvanized internal panel. To remove and replace this board, follow these steps:

a Open the rear door and test the DC/AC Module DC Electrolytic Capacitors (Figure 1) with a voltmeter to be sure that they are fully discharged. If the capacitors are not discharged, close the converter door, wait at least 10 minutes, and test it again. Do not perform any work inside the converter while the capacitors remain charged. Once the capacitors are discharged, open the front door to gain access to the PC board.

b Clearly label each of the cables and wires connected to the PC board, pay special attention to the cable with multi-colored wires, then disconnect each one by gently pulling the plug away from the board.

c Remove the mounting screws.

d Remove the PC board and replace.

e Installation is in the reverse order of removal. If necessary, verify wiring by referring to the pertinent connection diagram (See Chapter 5).

(8) RFI Output PC Board (RFI2)

The RFI Output PC Board is located behind the font door above the output contactor. The RFI Output PC board has four (4) screws connecting it a spacer panel that is fastened to the galvanized internal panel. To remove and replace this board, follow these steps:

a Open the rear door and test the DC/AC Module DC Electrolytic Capacitors (Figure 1) with a voltmeter to be sure that they are fully discharged. If the capacitors are not discharged, close the converter door, wait at least 10 minutes, and test it again. Do not perform any work inside the converter while the capacitors remain charged. Once the capacitors are discharged, open the front door to gain access to the PC board.

b Clearly label and remove the wires connected to the output contactor.

c Remove the mounting screws.

d Remove the PC board and replace.

e Installation is in the reverse order of removal. If necessary, verify wiring by referring to the pertinent connection diagram (See Chapter 5).

(9) RFI Input PC Board (RFI1)

The RFI Input PC Board is located behind the font door above the input contactor. The RFI Input PC board has five (5) screws connecting it a spacer panel that is fastened to the galvanized internal panel. To remove and replace this board, follow these steps:

f Open the rear door and test the DC/AC Module DC Electrolytic Capacitors (Figure 1) with a voltmeter to be sure that they are fully discharged. If the capacitors are not discharged, close the converter door, wait at least 10 minutes, and test it again. Do not perform any work

inside the converter while the capacitors remain charged. Once the capacitors are discharged, open the front door to gain access to the PC board.

g Clearly label and remove the wires connected to the input contactor.

h Remove the mounting screws.

i Remove the PC board and replace.

j Installation is in the reverse order of removal. If necessary, verify wiring by referring to the pertinent connection diagram (See Chapter 5).

(10) Control Panel Display PC Board (A10)

The Control Panel Display PC Board is located directly behind the font door. The Control Panel Display PC board has four (4) screws connecting it to spacers on the control panel. To remove and replace this board, follow these steps:

a Open the rear door and test the DC/AC Module DC Electrolytic Capacitors (Figure 1) with a voltmeter to be sure that they are fully discharged. If the capacitors are not discharged, close the converter door, wait at least 10 minutes, and test it again. Do not perform any work inside the converter while the capacitors remain charged. Once the capacitors are discharged, open the front door to gain access to the PC board.

b Remove the two (2) connectors on each side of the PC board.

c Remove the mounting screws.

d Remove the PC board and replace. Be sure to remove the software chip and place it into the new PC board.

e Installation is in the reverse order of removal. If necessary, verify wiring by referring to the pertinent connection diagram (See Chapter 5).

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Section 1 Illustrated Parts List (Introduction)

1) General

The Illustrated Parts List identifies, describes, and illustrates main assemblies, subassemblies, and detail parts of a PoWerMaster EV Solid State Converter manufactured by ITW GSE Group, Hobart Ground Power.

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 H is arranged as follows:

Section 1 - Introduction
Section 2 - Manufacturer's Codes
Section 3 - Parts List
Section 4 - Numerical index

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:

(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) FACTORY PART NUMBER Column

All part numbers appearing in this column are Hobart 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 Hobart, will be identified as such in the "NOMENCLATURE" column. In case Hobart does not have an identifying part number for a purchased part, the "FACTORY PART NUMBER" column will reflect "No Number" and the vendor's number will be shown in the "NOMENCLATURE" column. Parts manufactured by Hobart 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. Hobart 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.

(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.

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. In case a manufacturer does not have a code, the full name of the manufacturer will be listed in the nomenclature column.

Code	Vendor's Name and Address
0E8J0	Emka Inc. 1961 Fulling Mill Rd. Middletown, PA 17057-3125
0G210	Ferroxcube Corp 360 Beinoris Dr, Wood Dale IL 60191
03UP2	Victory Sales Inc. 3077 E 98th St. Suite 135 Indianapolis IN 46280
1CW22	Hella Inc. 201 Kelly Dr. Peachtree City GA 30269
1N3T0	Semikron Inc. 11 Executive Dr. Hudson NH 03051
1SPJ9	Hobart Ground Power 1177 Trade Road East Troy, OH 45373
12687	Trilectron Industries 11001 U.S. Hwy. 41 North Palmetto, Florida 34221
2B664	All-Phase Electric Supply Co 1620 W Main St P.O. Box 149 Springfield OH 45501-0149
3A054	McMaster Carr Supply Co. 9630 Norwalk Blvd. Santa Fe Springs, CA 90670-2932
59993	International Rectifier Corp 233 Kansas St. El Segundo, CA 90245
U2391	Arcotronics Ltd United Kingdom NN12 6LX
62292	EBM Industries Inc. 110 Hyde Rd. P.O. Box 4009 Farmington, CT 06034-4009

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Section 3 Illustrated Parts List

1) Explanation of Parts List Arrangement

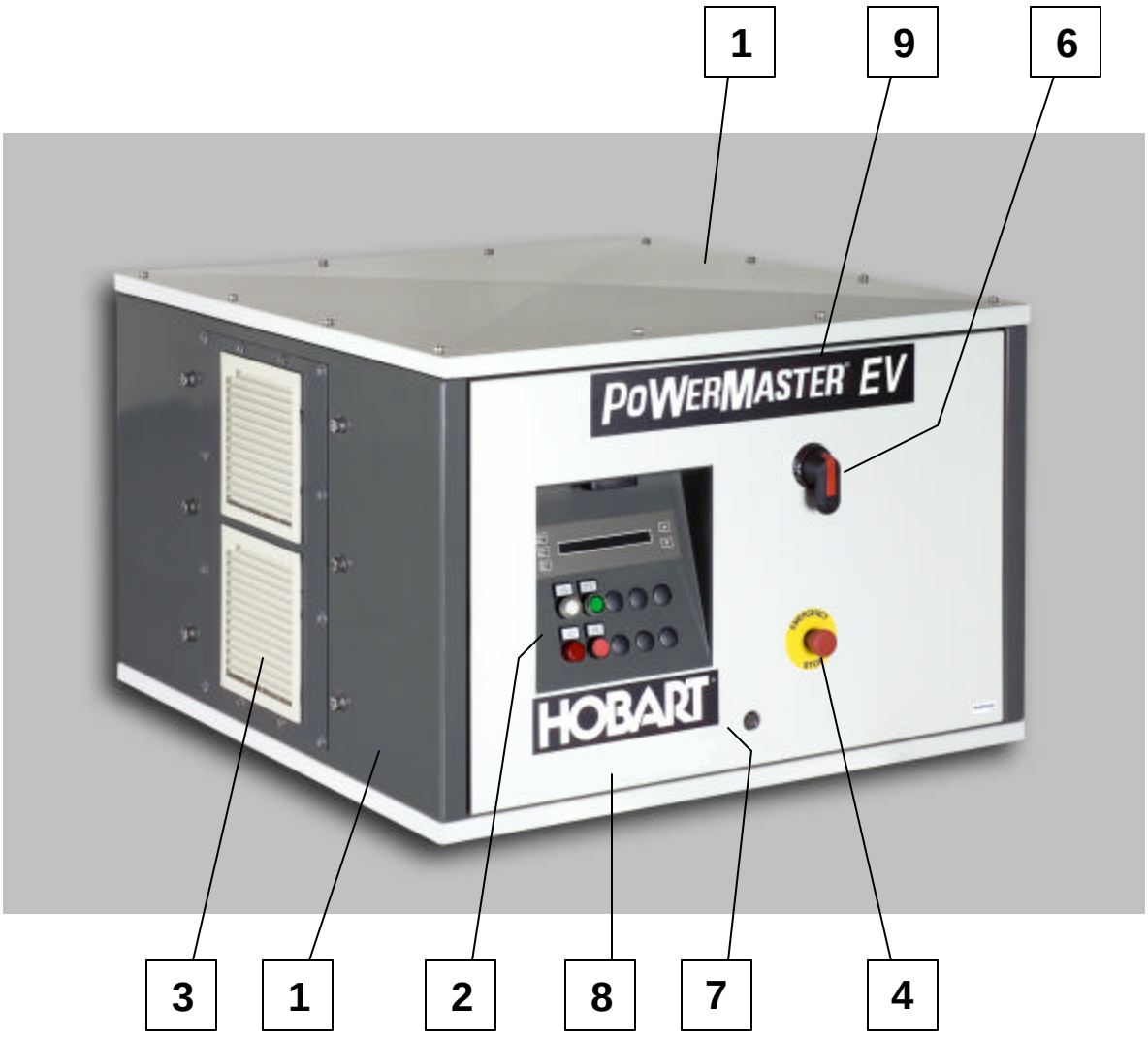
The parts list is arranged so that the illustration will appear on a left-hand page and the applicable parts list will appear on the opposite right-hand page. Unless the list is unusually long, the user will be able to look at the illustration and read the parts list without turning a page.

2) Symbols and Abbreviations

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

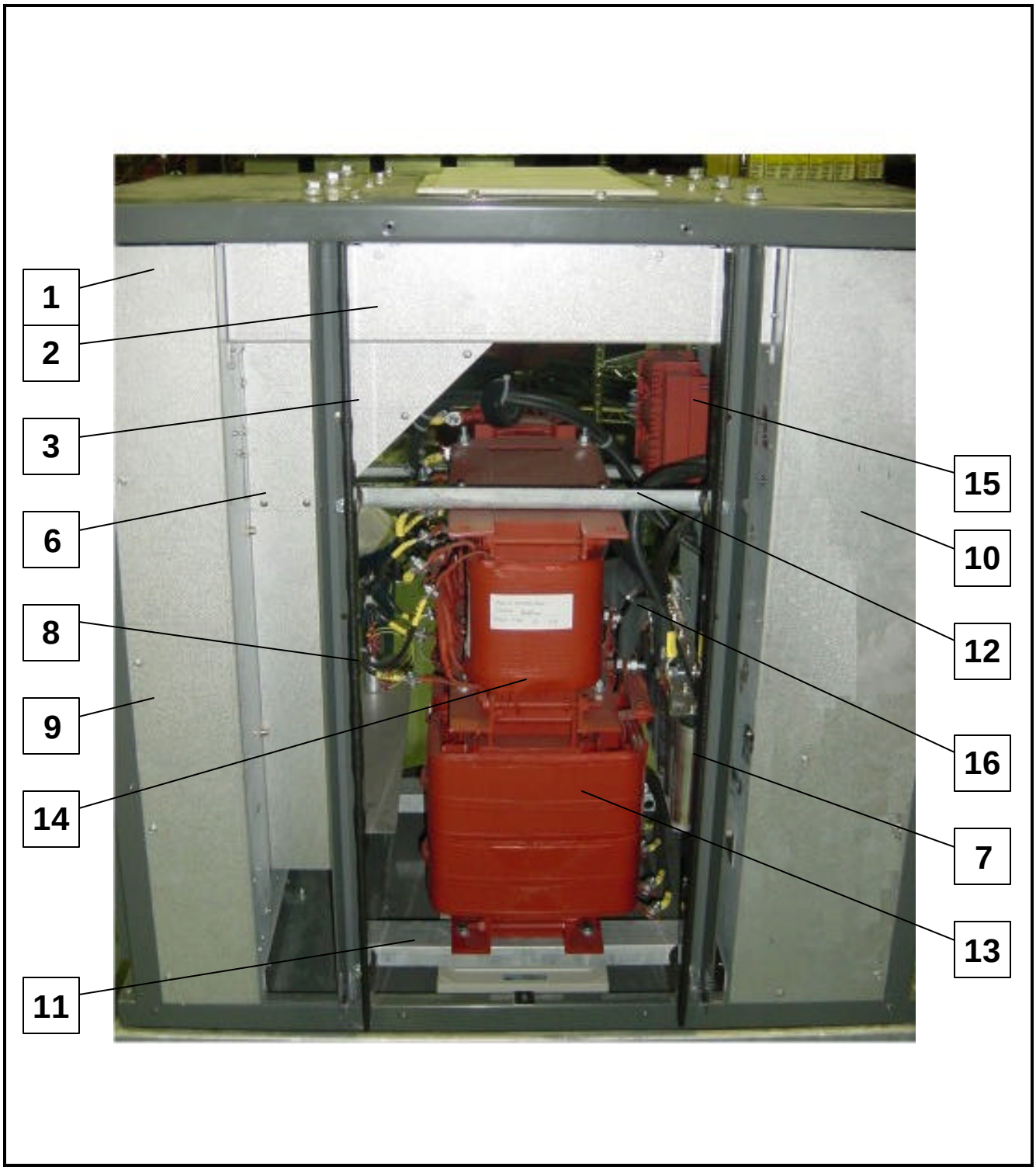
*	-	Item not illustrated (or shown)
A, or AMP	-	Ampere
AC	-	Alternating current
AR	-	As required
DC	-	Direct current
Fig.	-	Figure
hd.	-	Head
hex	-	Hexagon
Hz	-	Hertz (cycles-per-second)
I.D.	-	Inside diameter
IN	-	Inch
KVA	-	Kilovolt-ampere
uF	-	Microfarad
No.	-	Number
NHA	-	Next higher assembly
PRV	-	Peak reverse voltage
PSI	-	Pounds per square inch
Ref	-	Reference (the item has been listed previously)
RH	-	Right Hand
LH	-	Left Hand
TM	-	Technical Manual
T-R	-	Transformer-rectifier
V	-	Volt or used as a prefix indicating vendor code

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



General Assembly
Figure 1

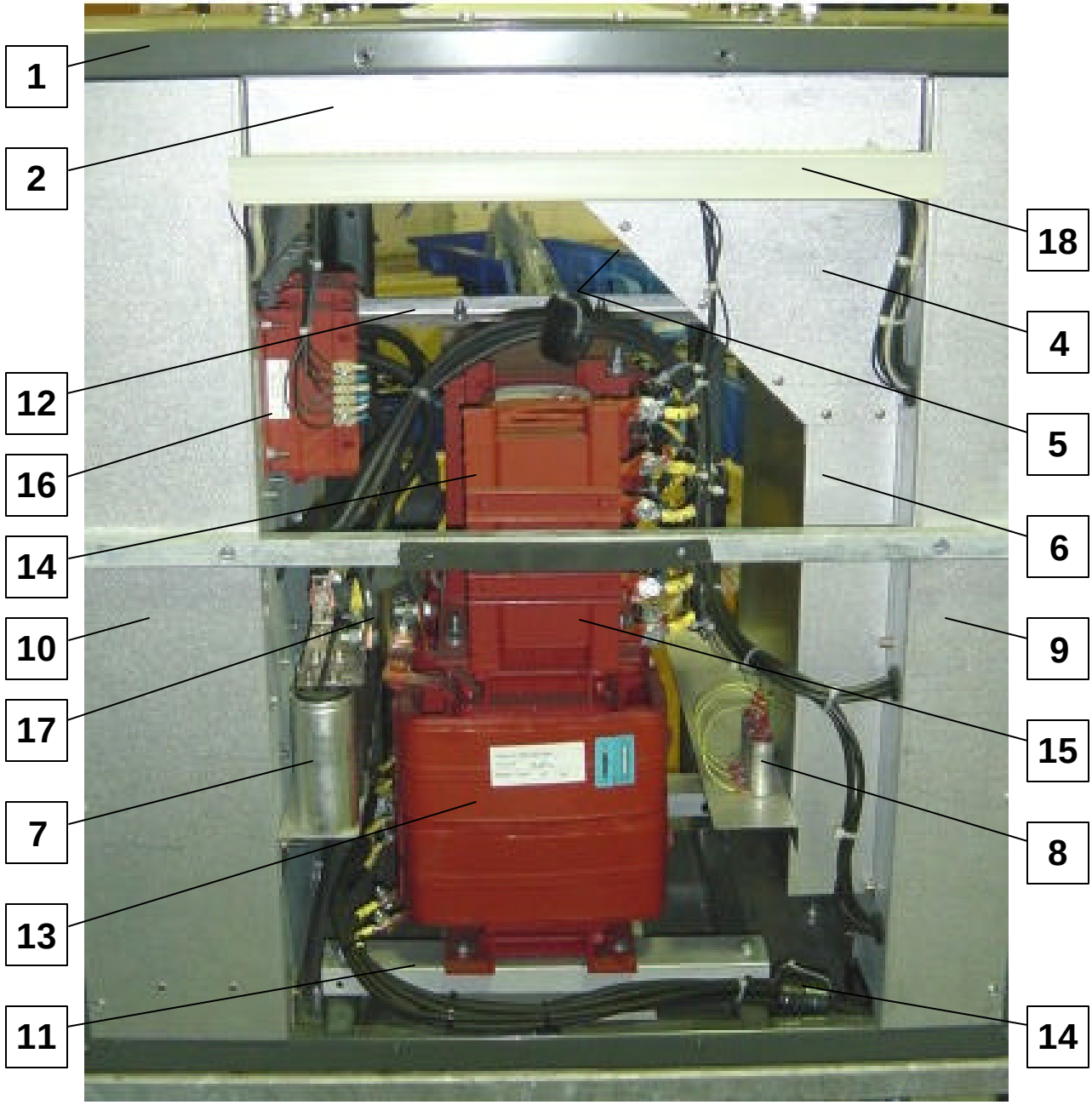
FIGURE ITEM NO.		FACTORY PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
1-	1		Frame and Exterior Panel Component Assembly (See Figure 10)		Ref.
	2		Control Panel Assembly (See Figure 6)		Ref.
	3	289748-001	Filter, Air		4
	4	289943-002	Pushbutton, Emergency Stop		Ref.
		289712-001	Pushbutton, Emergency Stop [S1]		1
			(V2B664 Allen-Bradley P/N 800EP-MTS44)		
		289715-001	…Latch, Mounting, Contact Block, N.C.		1
			(V2B664 Allen-Bradley P/N 800E-3LX01)		
		289714-001	…Block, Contact, N.C.		1
			(V2B664 Allen-Bradley P/N 800E-3X01)		
		289713-001	…Plate, Legend, E-Stop		1
			(V2B664 Allen-Bradley P/N 800E-16YE112)		
*	5	289780-001	Key, Door Latch		2
	6	289738-001	Contactor, Circuit Breaker [Q1]		1
			(V2B664 ABB# OT160E365J6290)		
	7	402987	Label, Hobart		2
	8	283714-004	Label, kVA Rating		1
	9	289829	Label, Trademark		1



Transformer Section Assembly
Figure 2A

FIGURE ITEM NO.		FACTORY PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
2A-	1	289500	Frame, Mounting		1
	2		Cooling Fan Box Assembly (See Figure 5)		Ref.
	3	289509	Panel, Air Duct, Left Hand Side		1
*	4	289510	Panel, Air Duct, Right Hand Side		1
*	5	289511	Panel, Air Duct, Back		1
	6	289507	Panel, Air Duct		1
	7		AC Filter Capacitor Bank [C2-C4] (See Figure 7)		Ref.
	8		DC Filter Capacitor Bank [C9-C11] (See Figure 8)		Ref.
	9		Power Module Panel (See Figure 3)		Ref.
	10		Input/Output Panel Assembly (See Figure 4)		Ref.
	11	289519	Bracket, Mounting, Transformer Channel		2
		289740-001	…Mounts, Shock		4
	12	289522	Bracket, Mounting, Transformer Angle		2
		289740-001	…Mounts, Shock		4
	13	289769-002	Transformer, 400 Hz. [T2]		1
	14	289658-001	Transformer, 12 Pulse [T1]		1
	15	289768-001	Transformer, Auto		1
	16	289742-001	Bus-Bar, Flexible		4
**	17	289799	Chart, Cable		Ref.
			Cable No. 500, C2 Bus-Bar to Q2-1L1		1
			Cable No. 501, C3 Bus-Bar to Q2-3L2		1
			Cable No. 502, C4 Bus-Bar to Q2-5L3		1
			Cable No. 503, C2-C4 Bus-Bar to “N” Bus-Bar		1
			Cable No. 508, T1-Z to L1-L1-Z		1
			Cable No. 509, T1-X to L1-L2-X		1
			Cable No. 510, T1-Y to L1-L3-Y		1
			Cable No. 511, T2-11 to PM1A-1		1
			Cable No. 512, T2-21 to PM2A-1		1
			Cable No. 513, T2-31 to PM3A-1		1
			Cable No. 517, T1-W1 to SCR3A-1		1
			Cable No. 518, T1-V1 to SCR2A-1		1
			Cable No. 519, T1-U1 to SCR1A-1		1
			Cable No. 520, T1-W2 to SCR3B-1		1
			Cable No. 521, T1-V2 to SCR2B-1		1
			Cable No. 522, T1-U2 to SCR1B-1		1
			Cable No. 531, T2-12 to PM1B-1		1
			Cable No. 532, T2-22 to PM2B-1		1
			Cable No. 533, T2-33 to PM3B-1		1

**** When ordering new cables, reference the cable chart and the cable number.**



Transformer Section Assembly
Figure 2B

FIGURE ITEM NO.		FACTORY PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
2B-	1	289500	Frame, Mounting		1
	2		Cooling Fan Box Assembly		Ref.
*	3	289509	Panel, Air Duct, Left Hand Side		1
	4	289510	Panel, Air Duct, Right Hand Side		1
	5	289511	Panel, Air Duct, Back		1
	6	289507	Panel, Air Duct		1
	7		AC Filter Capacitor Bank [C2-C4] (See Figure 7)		Ref.
	8		DC Filter Capacitor Bank [C9-C11] (See Figure 8)		Ref.
	9		Power Module Panel (See Figure 3)		Ref.
	10		Input/Output Panel Assembly (See Figure 4)		Ref.
	11	289519	Bracket, Mounting, Transformer Channel		2
		289740-001	…Mounts, Shock		4
	12	289522	Bracket, Mounting, Transformer Angle		1
		289740-001	…Mounts, Shock		2
	13	289769-002	Transformer, 400 Hz. [T2]		1
	14	289745-001	…Core, Ferrite *(V0G210 P/N T63/38/25/3C11)*		3
	15	289767-002	Reactor, AC [L1]		1
	16	289768-001	Transformer, Auto		1
	17	289742-001	Bus-Bar, Flexible		4
	18	286687-002	Channel and Cover, Wire		21.5 in.
**	19	289799	Chart, Cable		Ref.
			Cable No. 500, C2 Bus-Bar to Q2-1L1		1
			Cable No. 501, C3 Bus-Bar to Q2-3L2		1
			Cable No. 502, C4 Bus-Bar to Q2-5L3		1
			Cable No. 503, C2-C4 Bus-Bar to “N” Bus-Bar		1
			Cable No. 508, T1-Z to L1-L1-Z		1
			Cable No. 509, T1-X to L1-L2-X		1
			Cable No. 510, T1-Y to L1-L3-Y		1
			Cable No. 511, T2-11 to PM1A-1		1
			Cable No. 512, T2-21 to PM2A-1		1
			Cable No. 513, T2-31 to PM3A-1		1
			Cable No. 517, T1-W1 to SCR3A-1		1
			Cable No. 518, T1-V1 to SCR2A-1		1
			Cable No. 519, T1-U1 to SCR1A-1		1
			Cable No. 520, T1-W2 to SCR3B-1		1
			Cable No. 521, T1-V2 to SCR2B-1		1
			Cable No. 522, T1-U2 to SCR1B-1		1
			Cable No. 531, T2-12 to PM1B-1		1
			Cable No. 532, T2-22 to PM2B-1		1
			Cable No. 533, T2-33 to PM3B-1		1

**** When ordering new cables, reference the cable chart and the cable number.**

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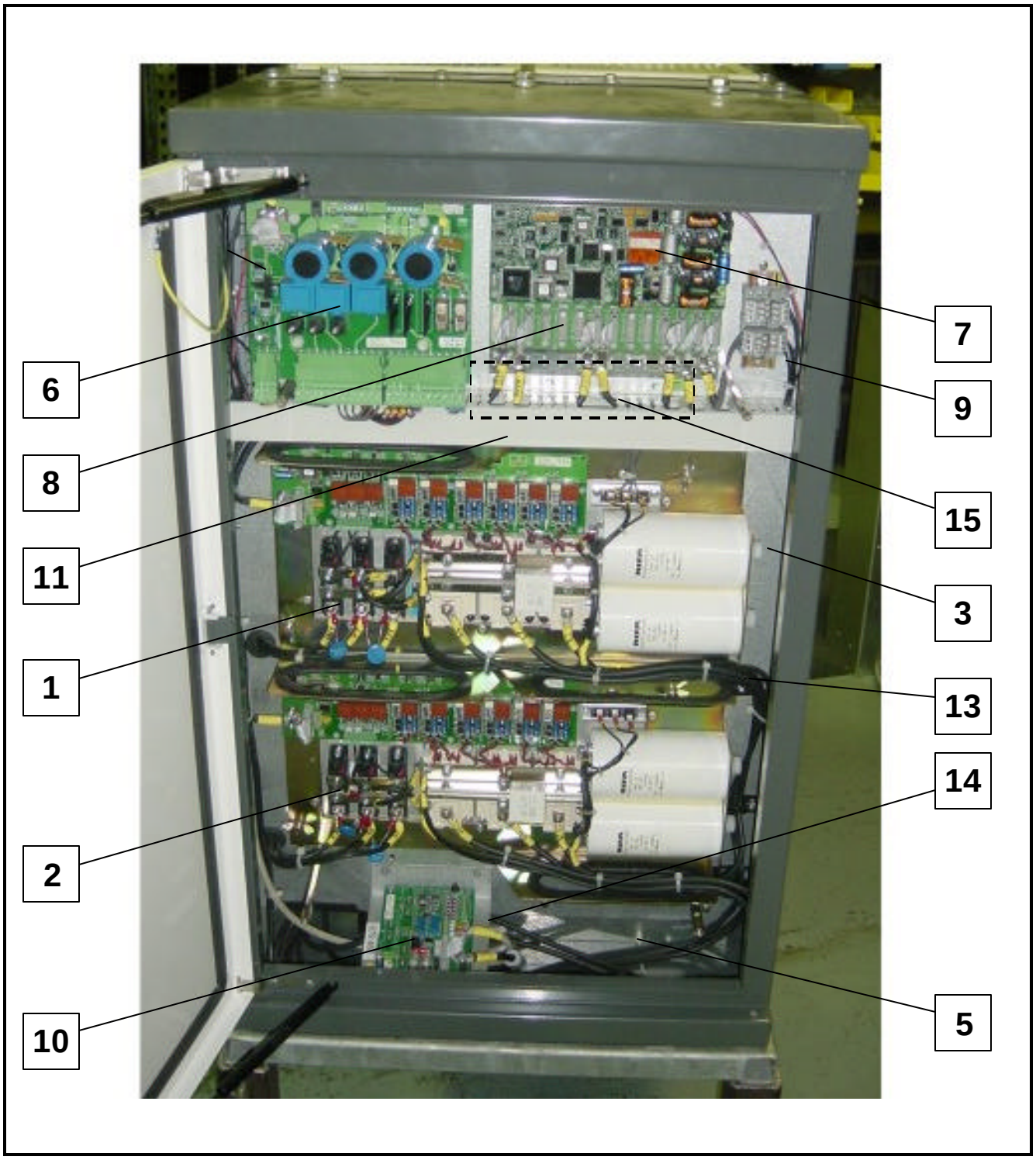
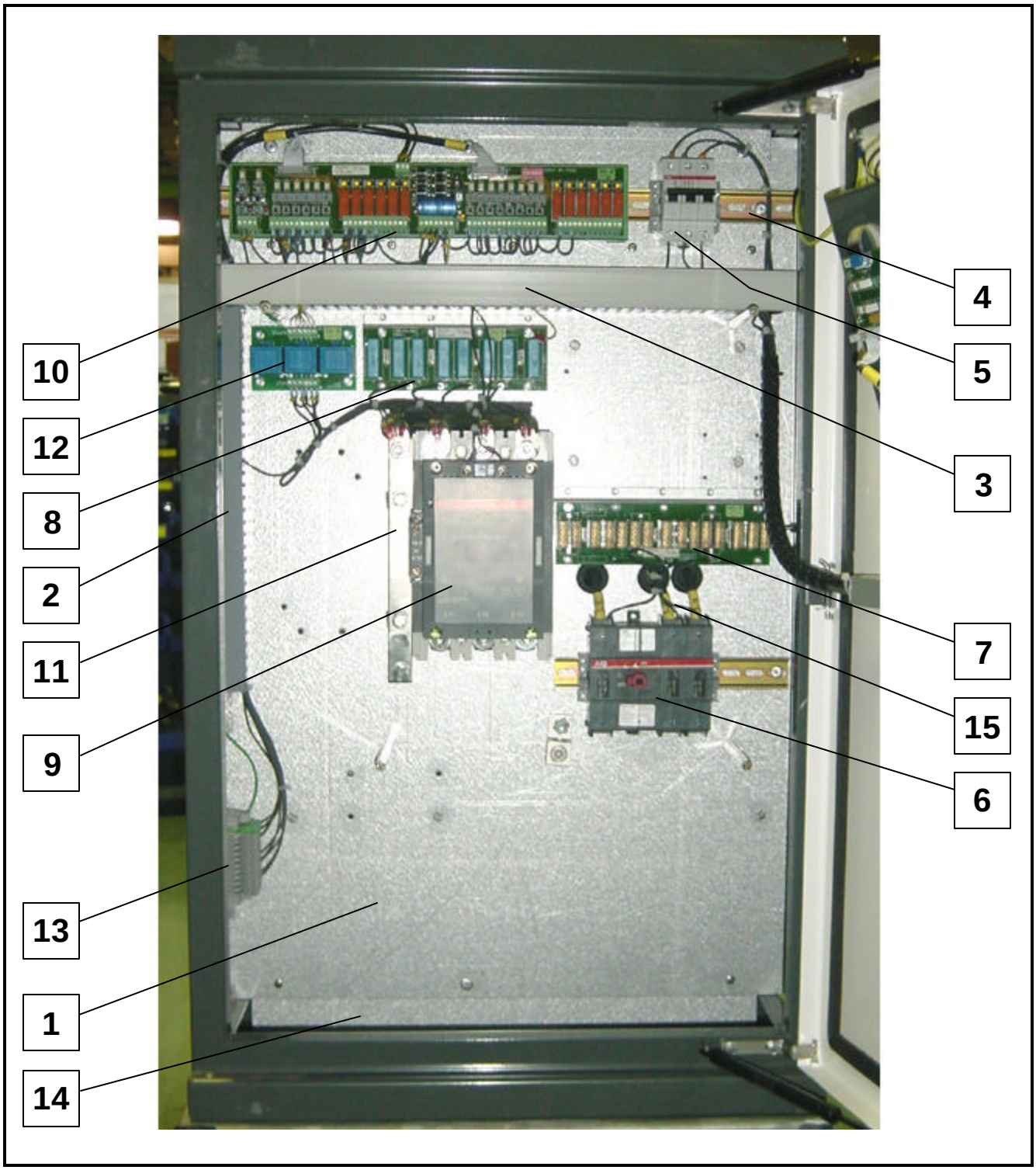


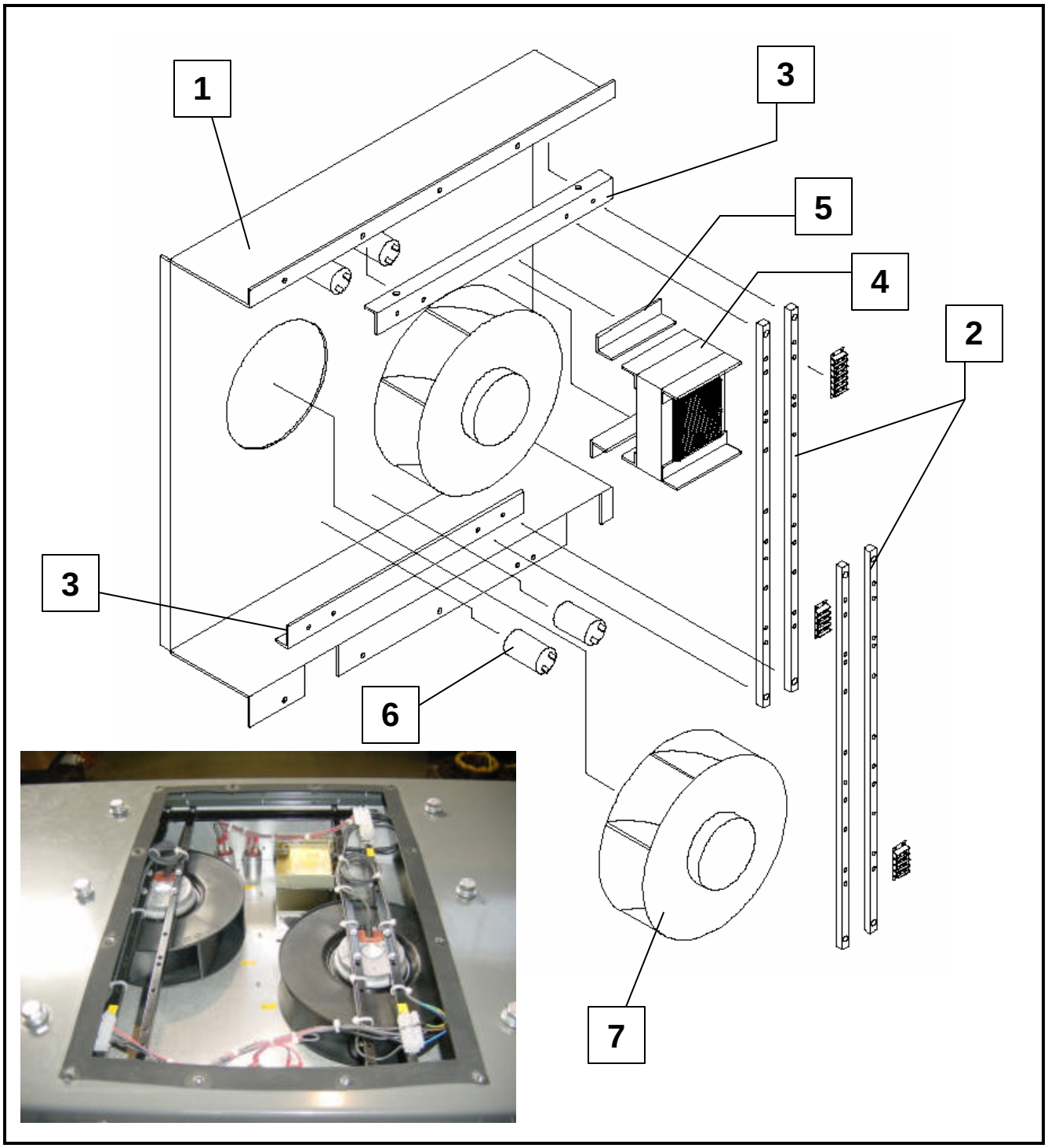
Power Module Panel Assembly
Figure 3

FIGURE ITEM NO.		FACTORYP ART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
3 -	1	289550-001	DC/AC1 Module Panel Assembly (See Figure 9)		Ref.
		289706-001	…Nut, Wing, M8-1.25		2
	2	289550-001	DC/AC2 Module Panel Assembly (See Figure 9)		Ref.
		289706-001	…Nut, Wing, M8-1.25		2
	3	289506	Panel, Modules Mounting		1
*		402037-012	…Grommet, Rubber, .875 in. I.D.		2
*		402037-036	…Grommet, Rubber, 1.12 in. I.D.		1
*	4	289620	Panel, UL, Long		1
	5	289619	Panel, UL, Short		1
	6	289657	Board, Aux-Module [A5]		1
		289656-001	…Transformer, Aux-Module [T50]		1
*		289711-001	…Spacer, M6, Polyamide		4
	7	289758	Board, Processor [A9]		1
	8	289819	Board, PC, Connection [A25]		1
	9	Call Factory	Block, 6 Station		1
		289791	…Label, Terminal Block		1
	10	289759	Board, Output Feed [A8]		1
		289533	…Panel, Output Feed		1
		289744-001	…Core, Ferrite [L5] *(V2B664 TDK P/N ZCAT2032-0930)*		1
*		284316-009	…Spacer, PCB, M5		2
*		284316-010	…Spacer, Panel, M5		4
	11	289687-001	Channel and Cover, Wiring		21.5 in.
*	12	289687-002	Channel and Cover, Wiring		6.5 in.
	13		Chart, Cable (Rectifier to DC/AC Module)		Ref.
			Cable No. 528 C2A-(+) to C2B-(+)		1
			Cable No. 529 PM3A-3 to PM3B-3		1
			Cable No. 530 PM3A-2 to PM3B-2		1
	14		Cable No. 400 A14 to A8		1
	15		Chart, Cable (Processor Connector PCB)		Ref.
			Cable No. 401 A8-X1 to A9-X18		1
			Cable No. 402 A5-X4 to A9-X17		1
			Cable No. 403 A1A-X2 to A9-X12		1
			Cable No. 404 A10-X5 to A9-X8		1
			Cable No. 405 A6-X8 to A9-X7		1
			Cable No. 406 A6-X9 to A9-X6		1
			Cable No. 407 A1B-X2 to A9-X13		1



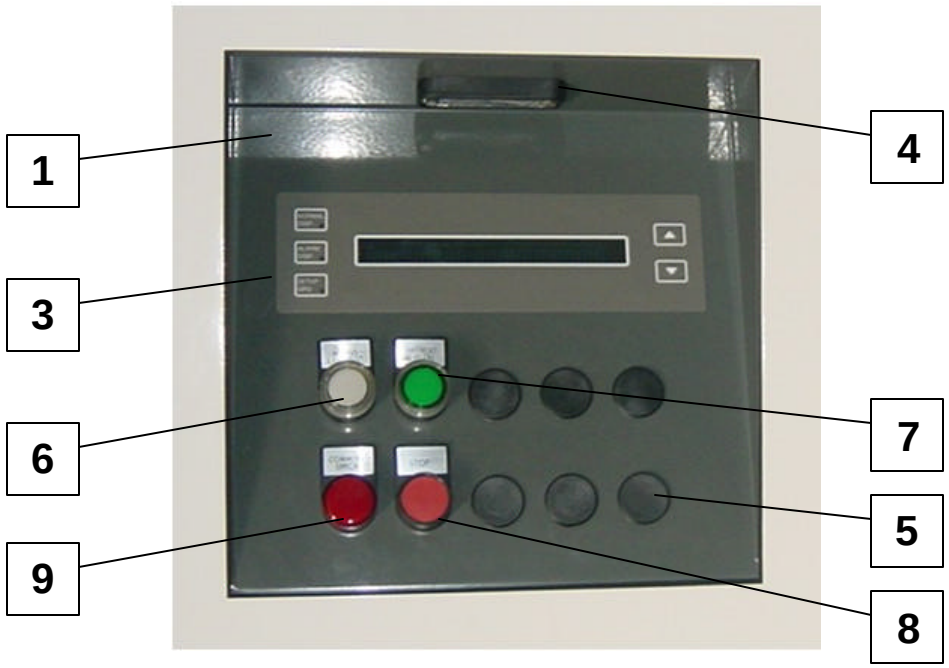
Input/Output Panel Assembly
Figure 4

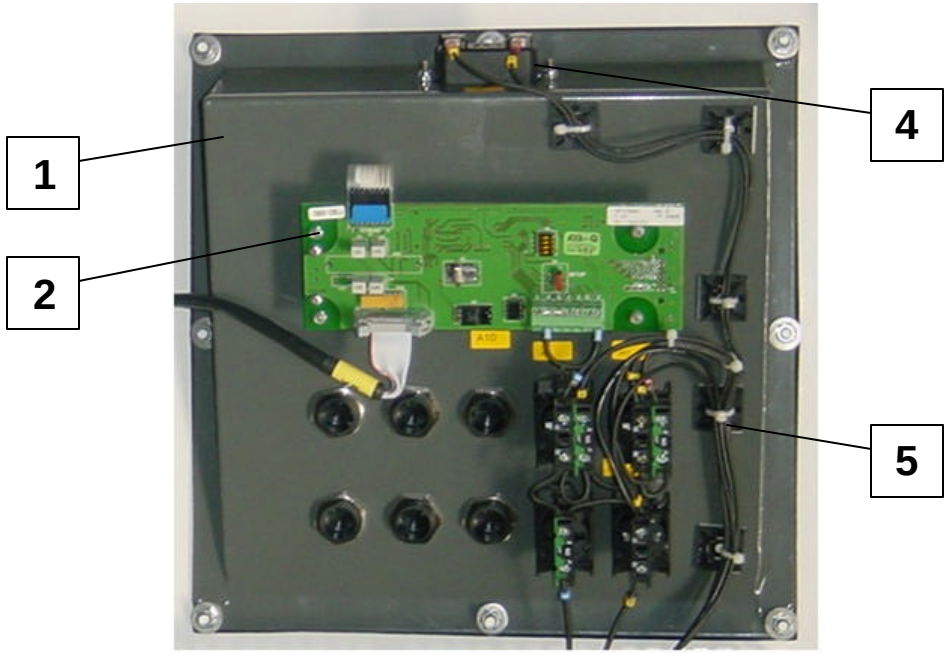
FIGURE ITEM NO.		FACTORYP ART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
4 -	1	289505	Panel, Contactor Mounting		1
*		402037-012	…Grommet, Rubber, .875 in. I.D.		3
*		402037-036	…Grommet, Rubber, 1.12 in. I.D.		1
	2	289687-001	Channel and Cover, Wiring		15 in.
	3	289687-003	Channel and Cover, Wiring		21.5 in.
	4	289737-002	Rail, Component Mounting (23 in.)		1
	5	289724-001	Breaker, Circuit, Small [Q10] *(V2B664 ABB# S 263-C 6)*		1
	6	289738-001	Contactor, Circuit Breaker [Q1] *(V2B664 ABB# OT160E365J6290)*		1
		289737-001	…Rail, Component Mounting (10 in.)		1
	7	289760	Board, Input RFI [RFI1]		1
		289512	…Bracket, RFI Input Board		1
	8	289761	Board, Output RFI [RFI2]		1
		289513	…Bracket, RFI Output Board		1
	9	289618-002	Contactor, Output [Q2] *(V2B664 ABB# A95-30-00)*		1
	10	289762	Board, I/O Module [A6]		1
	11	289526	Bus-Bar, Neutral		1
		289792-001	…Standoff, Insulation		2
	12	289763	Board, Voltage Feedback [A14]		1
*		284316-011	…Space, PCB, M4		4
	13	283066-002	Block, Terminal, 12 Station		1
*		289790	…Label, Terminal Block		1
	14	289620	Panel, UL, Long		2
	15		Chart, Cable		Ref.
			Cable No. 505 Q1-L1 to L1-L1		1
			Cable No. 506 Q1-L2 to L1-L2		1
			Cable No. 507 Q1-L3 to L1-L3		1



Cooling Fan Box Assembly
Figure 5

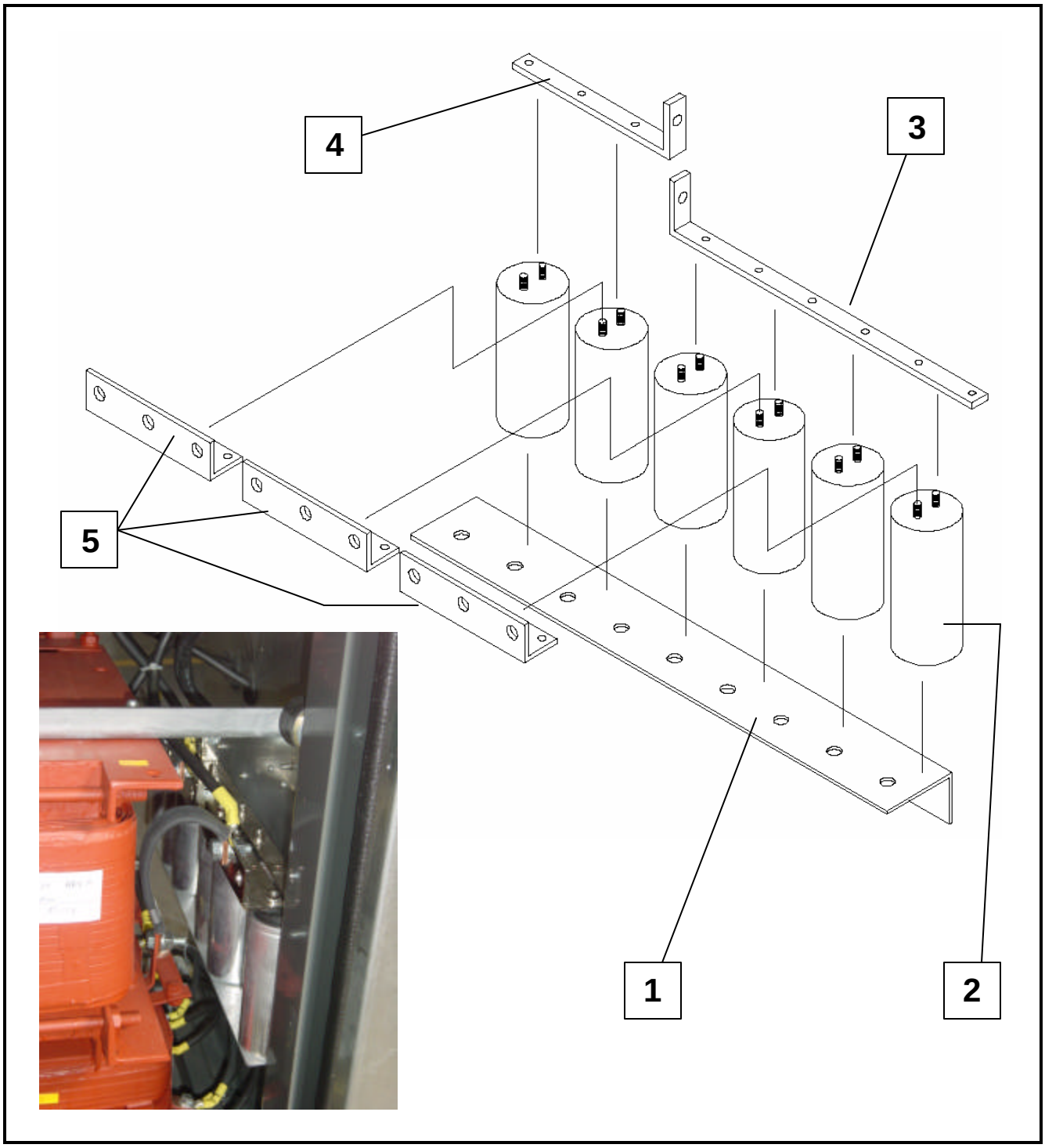
FIGURE ITEM NO.		FACTORY PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
5 -	1	289508	Box, Fan		1
*		402037-004	…Grommet, Rubber, .375 in. I.D.		1
	2	289515	Rail, Fan, Support		4
	3	289516	Bracket, Fan Rod Support		2
	4	289540-001	Transformer, Fan, Auto [T6]		1
	5	289517	Bracket, Transformer Mounting		2
	6	289538-001	Capacitors, Fan Motor [C5-C8] *(VU2391 # C87003064A)*		4
	7	289539-001	Fan, Radial [M1and M2] *(V62292 P/N R2E 225-BD 92-36)*		2
*	8	289703	Harness, Wire (for the entire GPU)		1
		289786-001	Holder, Wire Tie		6





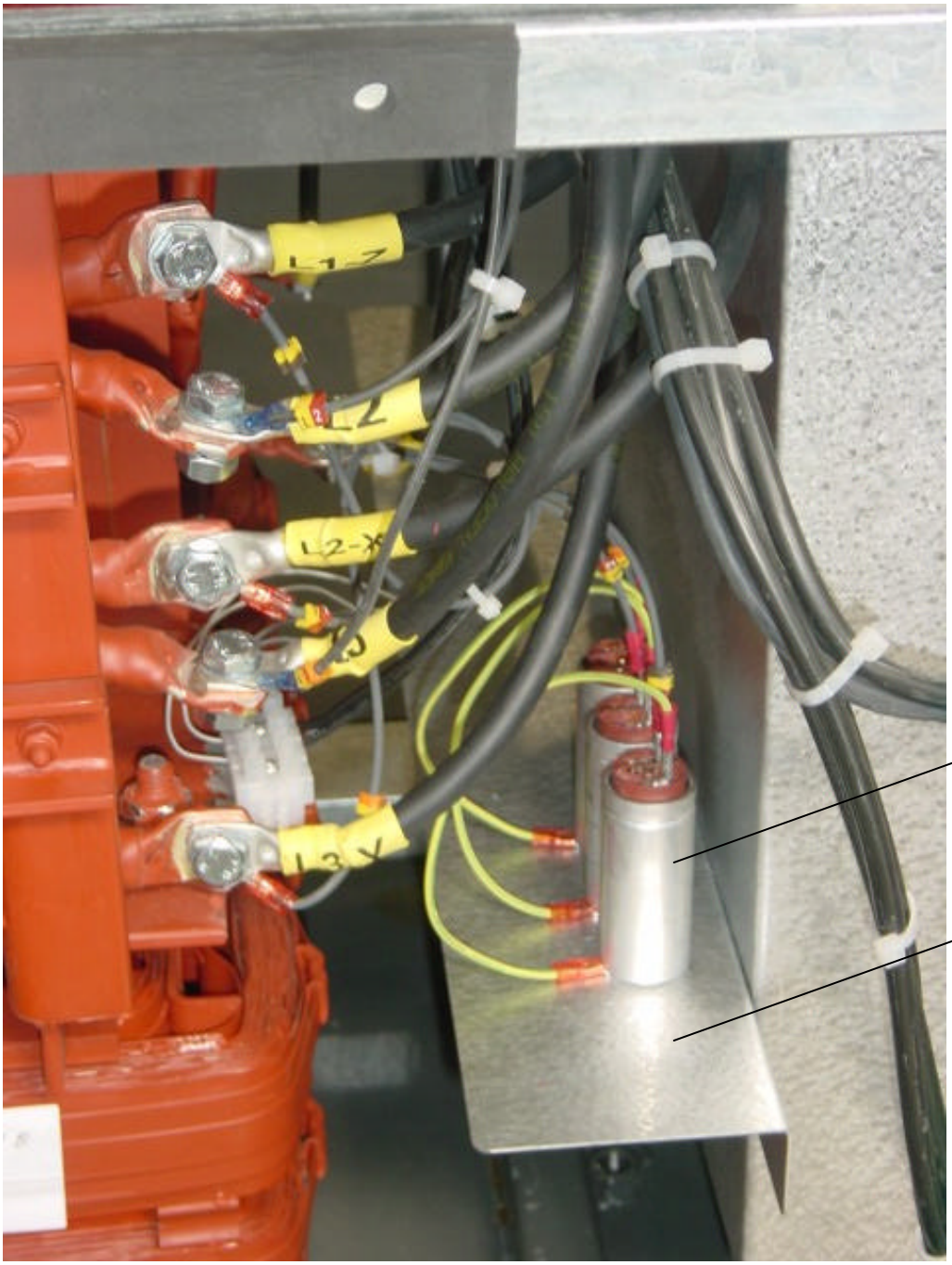
Control Panel Assembly
Figure 6

FIGURE ITEM NO.	FACTORY PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
6 - 1	289536	Panel, Control		1
*	289520	Gasket, Control Panel		1
2	289764	Board, Display and Interface [A10]		1
*	284316-008	Spacer, PCB		4
3	289787	Keyboard, Display		1
4	289735-001	Light, Instrumentation [H5] *(V1CW22 P/N 2KA 005 049-017)*		1
*	289736-001	…Bulb, Instrumentation Light		1
5	289720-001	Plug, Hole		6
6	289943-001	Pushbutton, White, “Mains Lamp Test” [S6, H1]		Ref.
	289721-001	…Element, Lamp, Mtg. Latch & Contact Block *(V2B664 Allen-Bradley P/N 800E-3DL0X10)*		1
	289716-002	…Pushbutton, White Illuminated *(V2B664 Allen-Bradley P/N 800EP-LF7)*		1
*	289723-001	…LED, White *(V3A054 P/N 6570T59)*		1
	289718-001	…Carrier, Legend Plate *(V2B664 Allen-Bradley P/N 800E-150)*		1
	289719-001	…Plate, Legend, “Mains Lamp Test” *(V2B664 Allen-Bradley P/N 800E-18BE-100)*		1
7	289943-004	Pushbutton, Green, “Start/Reset 1” [S2, H2]		Ref.
	289721-001	…Element, Lamp, Mtg. Latch & Contact Block *(V2B664 Allen-Bradley P/N 800E-3DL0X10)*		1
	289716-001	…Pushbutton, Green Illuminated *(V2B664 Allen-Bradley P/N 800EP-LF3)*		1
*	289723-002	…LED, Green *(V3A054 P/N 6570T66)*		1
	289718-001	…Carrier, Legend Plate *(V2B664 Allen-Bradley P/N 800E-150)*		1
	289719-002	…Plate, Legend, “Start/Reset 400 Hz. ON 1” *(V2B664 Allen-Bradley P/N 800E-18BE-100)*		1
8	289943-005	Pushbutton, Red, “Stop 1” [S3]		Ref.
	289716-003	…Pushbutton, Red *(V2B664 Allen-Bradley P/N 800EP-F4)*		1
	289715-002	…Latch, Mounting, Contact Block, N.O. *(V2B664 Allen-Bradley P/N 800E-3LX10)*		1
	289718-001	…Carrier, Legend Plate *(V2B664 Allen-Bradley P/N 800E-150)*		1
	289719-004	…Plate, Legend, “Stop 1” *(V2B664 Allen-Bradley P/N 800E-18BE-100)*		1
9	289943-003	Lamp, Fault Signal, “Common Error” [H3]		Ref.
	289717-001	…Light, Pilot, Operator, Red *(V2B664 Allen-Bradley P/N 800EP-P4)*		1
	289722-001	…Element, Lamp Mounting, Latch *(V2B664 Allen-Bradley P/N 800E-3DL0)*		1
	289723-003	…LED, Red *(V3A054 P/N 6570T63)*		1
	289718-001	…Carrier, Legend Plate *(V2B664 Allen-Bradley P/N 800E-150)*		1
	289719-003	…Plate, Legend, “Common Error” *(V2B664 Allen-Bradley P/N 800E-18BE-100)*		1
10	289703	Harness, Wire (for the entire GPU)		1
	289786-001	…Holder, Wire Tire		AR



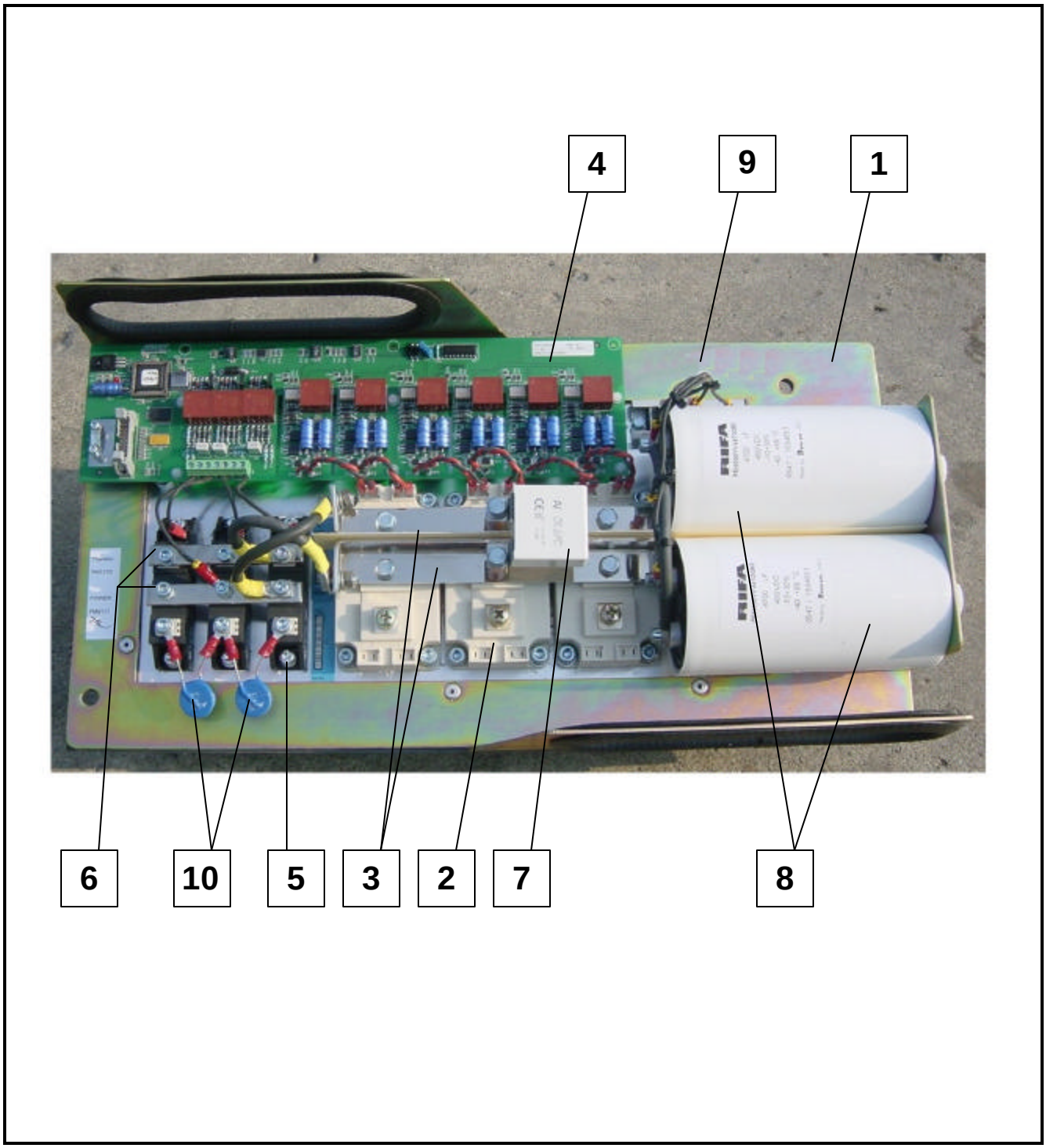
AC Filter Capacitor Bank Assembly
Figure 7

FIGURE ITEM NO.		FACTORYP ART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
7 -	1	289492	Bracket, AC Capacitor		1
	2	289535-001	Capacitor, AC Filter [C2-C4] *(VU2391 # C44AFGP6100ZG0J)*		9
	3	289527	Bus Bar, AC, Long		1
	4	289528	Bus Bar, AC, Short		1
	5	289529	Bus Bar, AC, Angle		3



DC Filter Capacitor Bank Assembly
Figure 8

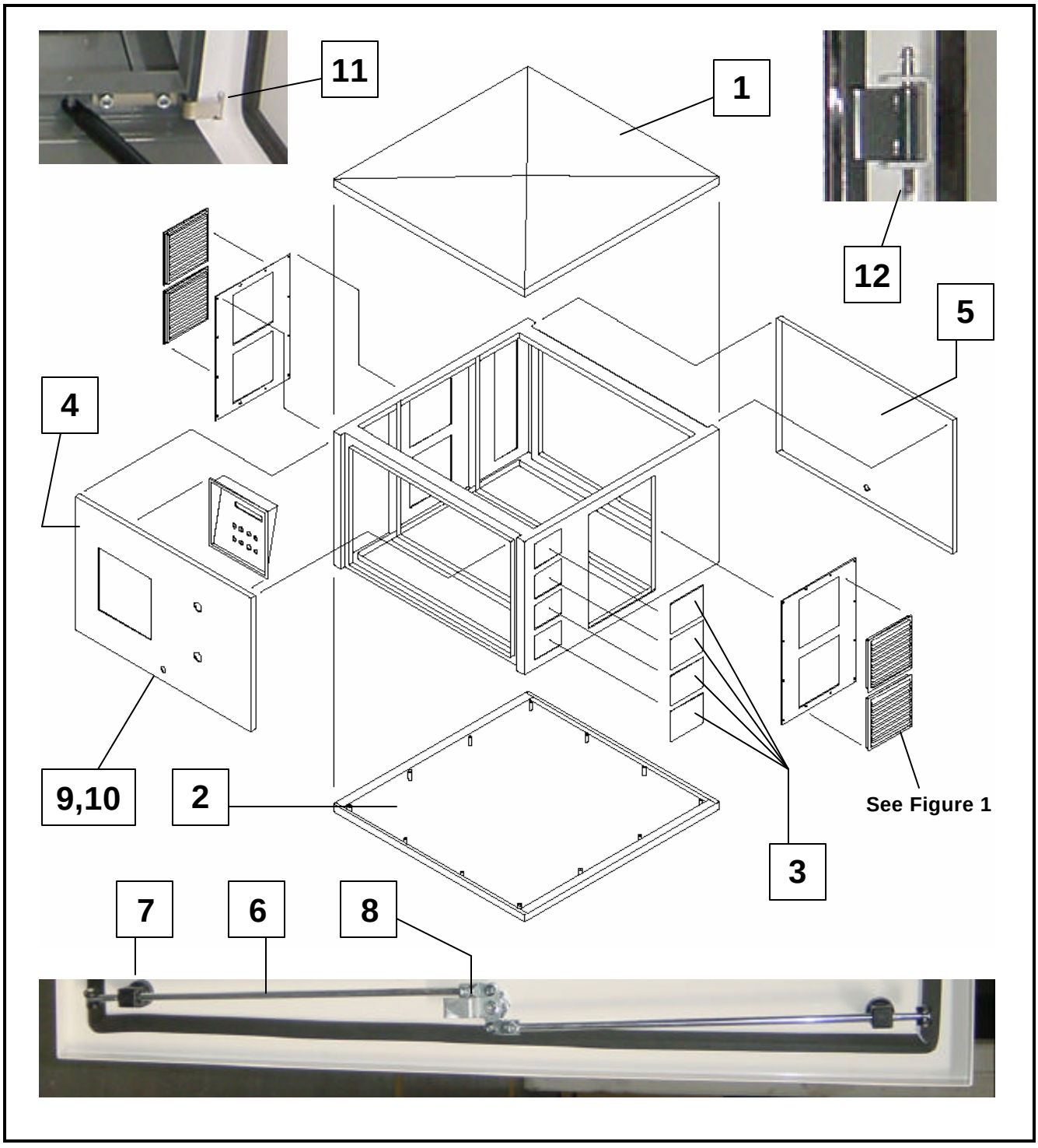
FIGURE ITEM NO.	FACTORYP ART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
8 - 1	289514	Bracket, Capacitor, Small		1
2	289537-001	Capacitor, Filter, Small [C9-C11] *(VU2391 # C44BPF13470ZB0J)*		3



DC/AC and Rectifier Module Panel Assembly
Figure 9

FIGURE ITEM NO.		FACTORYP ART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
9 -	1	289530	Panel, DC/AC Module		2
		289521	…Heat Sink, DC/AC Module		2
		289518	…Gasket, Rubber		2
	2	289746-001	Module, IGBT Transistor [PM1A-PM3A, PM1B-PM3B]		3
			(V1N3T0 P/N SKM200GB128D)		
	3	289494	Bus Bar, IGBT Transistor		2
		289785-001	…Insulation, Bus Bar		1
	4	289752	Board, Thyristor Gate Drive [A1A, A1B]		1
		284316-007	…Spacer, M/F, Polyamide, PCB		6
		284316-006	...Spacer, M/F, Steel, PCB		1
	5	289747-001	Module, Thyristor/Diode *(V59993 P/N IRKH 105/16)* [SCR1A-SCR3A, SCR1B-SCR3B]		6
	6	289532	Bus Bar, Thyristor/Diode		4
	7	289753-001	Capacitor, Snubber [C12A, C12B]		1
			(VU2391 # C4BHNBX4100ZAFJ)		
		289784-001	…Spacer, Snubber Capacitor		2
	8	289754-001	Capacitor, Electrolytic [C1A, C2A, C1B, C2B]		2
			(V03UP2 EVOX RIFA P/N PEH200YV447DQB2)		
		289757-001	…Nut, M12, Flange, Plastic		2
*	9	289755-001	Resistor, Power [R1A, R1B]		1
	10	289770-001	Varistor [RV1A, RV2A, RV1B, RV2B]		4
*	11	289709	Harness, Wire/Cable		1

Note: All parts directly connected to heat sink must have a thermal joint compound between the part and the heat sink (Hobart P/N 181830-001).



Frame and Exterior Panel Component Assembly
Figure 10

FIGURE ITEM NO.		FACTORYP ART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
10 -	1	289504	Panel, Top		1
*		289491	…Bracket, Support		1
*		289803-001	…Gasket, Rubber		155 in.
*		289760-001	…Screw, M6-1.0 x 46 mm Lg., Shoulder		12
*		289671-001	…Washer, Nylon, M8		12
	2	289501	Panel, Bottom		1
*		289832	…Channel, Support		1
*		289803-001	…Gasket, Rubber		155 in.
*		289760-001	…Screw, M6-1.0 x 46 mm Lg., Shoulder		12
*		289671-001	…Washer, Nylon, M8		12
	3	289493	Panel, Cable Entry		4
*		289490	…Gasket, Cable Entry Panel		4
	4		Front Door Assembly		Ref.
		289502	…Panel, Front Door		1
*		289803-002	…Gasket, Rubber		113 in.
*		289788-001	…Rod, Gas Damper		2
*		289789-001	…Ring, Retainer, M5, Gas Damper		4
		289687-001	…Channel and Cover, Wire		14 in.
	5		Rear Door Assembly		Ref.
		289503	…Panel, Rear Door		1
*		289803-002	…Gasket, Rubber		113 in.
*		289788-001	…Rod, Gas Damper		2
*		289789-001	…Ring, Retainer, M5, Gas Damper		4
			Door Latch Assemblies		Ref.
	6	289772-001	Rod, Latch, Door *(V0E8J0 P/N 1000-U144-02M-415)*		4
	7	289774-001	Support, Rod, Latch, Door *(V0E8J0 P/N 1001-U12)*		4
	8	289775-001	Cam, Door Latch *(V0E8J0 P/N 1000-U31)*		2
	9	289776-001	Pin, Door Latch *(V0E8J0 P/N 1000-U6)*		2
	10	289777-001	Housing, Door Latch *(V0E8J0 P/N 1000-U45-G)*		2
*		289778-001	…Seal. Door Latch *(V0E8J0 P/N 1000-24)*		2
*		289789-002	…Ring Retainer, M3 *(V3A054 P/N 98543A103)*		2
			Door Hinge Assemblies		Ref.
	11	289781-001	Hinge, Door		4
	12	289782-001	Pin, Door Hinge		2
			Plexi-glass Safety Covers		Ref.
*	13	289524	Cover, Front Protective		1
*		289534	…Spacer, Protective Cover		4
*	14	289523	Cover, Rear Protective		1
*		289534	…Spacer, Protective Cover		4

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Section 4 Numerical Index

1) 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. Thus, any part number beginning with the letter "A" would be located at or near the top of the index list. Likewise, a part number "9" would be listed near the end of the list and far below a part number "1000". The figure number and item number location of the part is directly opposite the part. If the part is used in more than one place, each location is listed commencing with the first location the part is listed.

FIGURE ITEM NO.	HOBART PART NO.	FIGURE ITEM NO.	HOBART PART NO.
4-13	283066-002	2A-11	289519
1-8	283714-004	2B-11	289519
9-	284316-006	6-	289520
9-	284316-007	9-	289521
6-	284316-008	2A-12	289522
3-	284316-009	2B-12	289522
3-	284316-010	10-14	289523
4-	284316-011	10-13	289524
2B-18	286687-002	4-11	289526
10-	289490	7-3	289527
10-	289491	7-4	289528
7-1	289492	7-5	289529
10-3	289493	9-1	289530
9-3	289494	9-6	289532
2A-1	289500	3-	289533
2B-1	289500	10-	289534
10-2	289501	10-	289534
10-	289502	7-2	289535-001
10-	289503	6-1	289536
10-1	289504	8-2	289537-001
4-1	289505	5-6	289538-001
3-3	289506	5-7	289539-001
2A-6	289507	5-4	289540-001
2B-6	289507	3-1	289550-001
5-1	289508	3-2	289550-001
2A-3	289509	4-9	289618-002
2B-3	289509	3-5	289619
2A-4	289510	3-4	289620
2B-4	289510	4-14	289620
2A-5	289511	3-	289656-001
2B-5	289511	3-6	289657
4-	289512	2A-14	289658-001
4-	289513	10-	289671-001
8-1	289514	10-	289671-001
5-2	289515	3-11	289687-001
5-3	289516	4-2	289687-001
5-5	289517	10-	289687-001
9-	289518	3-12	289687-002

FIGURE ITEM NO.	HOBART PART NO.	FIGURE ITEM NO.	HOBART PART NO.
4-3	289687-003	9-8	289754-001
5-8	289703	9-9	289755-001
6-10	289703	9-	289757-001
3-	289706-001	3-7	289758
3-	289706-001	3-10	289759
9-11	289709	4-7	289760
3-	289711-001	10-	289760-001
1-	289712-001	10-	289760-001
1-	289713-001	4-8	289761
1-	289714-001	4-10	289762
1-	289715-001	4-12	289763
6-	289715-002	6-2	289764
6-	289716-001	2B-15	289767-002
6-	289716-002	2A-15	289768-001
6-	289716-003	2B-16	289768-001
6-	289717-001	2A-13	289769-002
6-	289718-001	2B-13	289769-002
6-	289718-001	9-10	289770-001
6-	289718-001	10-6	289772-001
6-	289718-001	10-7	289774-001
6-	289719-001	10-8	289775-001
6-	289719-002	10-9	289776-001
6-	289719-003	10-10	289777-001
6-	289719-004	10-	289778-001
6-5	289720-001	1-5	289780-001
6-	289721-001	10-11	289781-001
6-	289721-001	10-12	289782-001
6-	289722-001	9-	289784-001
6-	289723-001	9-	289785-001
6-	289723-002	5-	289786-001
6-	289723-003	6-	289786-001
4-5	289724-001	6-3	289787
6-4	289735-001	10-	289788-001
6-	289736-001	10-	289788-001
4-	289737-001	10-	289789-001
4-4	289737-002	10-	289789-001
1-6	289738-001	10-	289789-002
4-6	289738-001	4-	289790
2A-	289740-001	3-	289791
2A-	289740-001	4-	289792-001
2B-	289740-001	2A-17	289799
2B-	289740-001	2B-19	289799
2A-16	289742-001	10-	289803-001
2B-17	289742-001	10-	289803-001
3-	289744-001	10-	289803-002
2B-14	289745-001	10-	289803-002
9-2	289746-001	3-8	289819
9-5	289747-001	1-9	289829
1-3	289748-001	10-	289832
9-4	289752	6-6	289943-001
9-7	289753-001	1-4	289943-002

FIGURE ITEM NO.	HOBART PART NO.	FIGURE ITEM NO.	HOBART PART NO.
6-9	289943-003		
6-7	289943-004		
6-8	289943-005		
5-	402037-004		
3-	402037-012		
4-	402037-012		
3-	402037-036		
4-	402037-036		
1-7	402987		

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Chapter 5 Manufacturer's Literature

Diagram Number	Diagram Description
289679, Rev. 0	Diagram, DC/AC Module
289680, Rev. 5	Diagram, Schematic and Connection
289681, Rev. 2	Layout, Dimensional and Component

Contact Hobart Ground Power if any of the above documentation is not within this manual (unless otherwise noted above).

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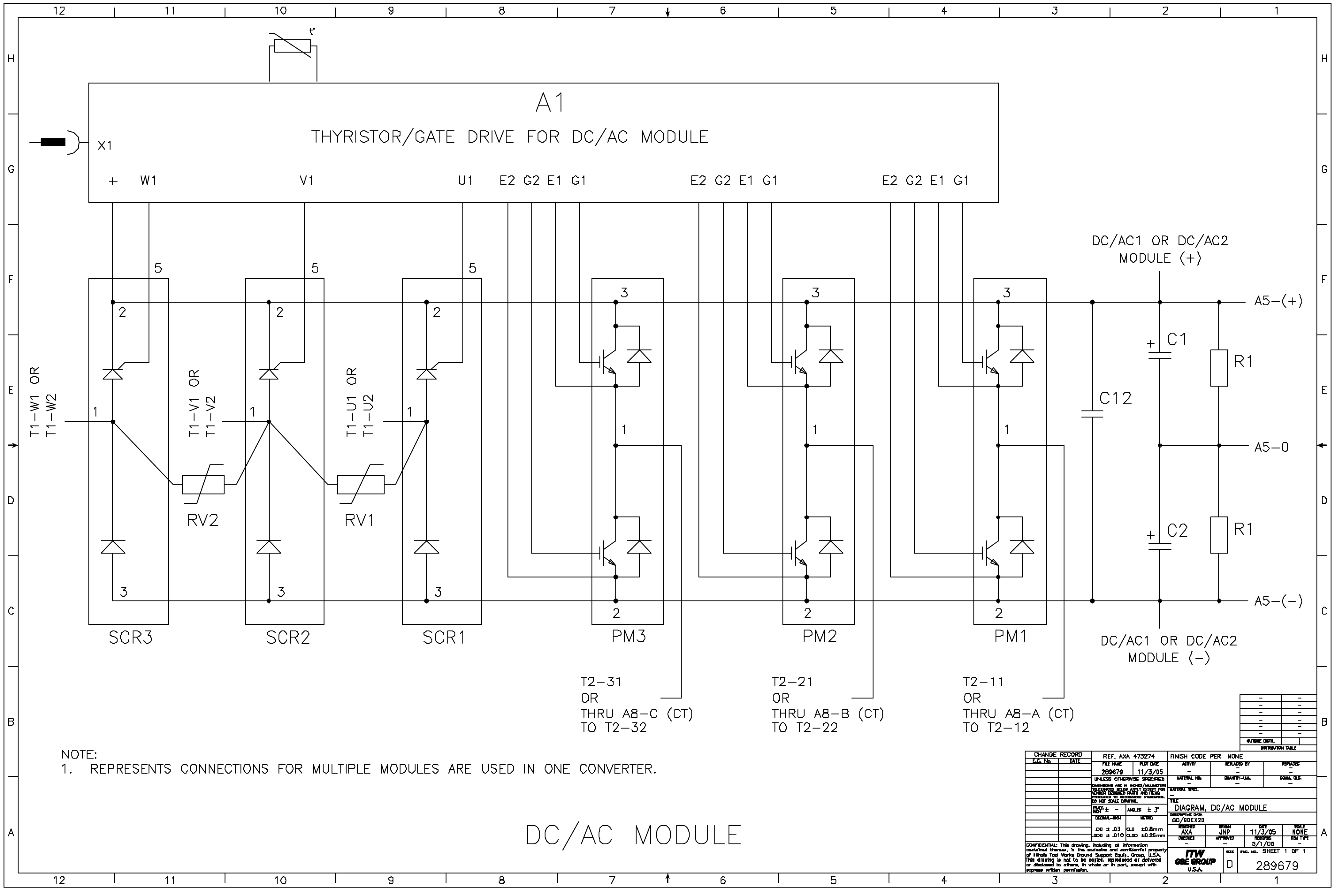

NOTE:
1. REPRESENTS CONNECTIONS FOR MULTIPLE MODULES ARE USED IN ONE CONVERTER.

DC/AC MODULE

CHANGE RECORD		REF. AXA 473Z74		FINISH CODE PER NONE			
ECN No.	DATE	FILE NAME	PLOT DATE	ACTIVITY	REVALIDATED BY	REPLACES
		289679	11/3/05	–	–	–
		UNLESS OTHERWISE SPECIFIED		MATERIAL No.	QUANTITY-UNIT	SIGNAL CLS.
		DIMENSIONS ARE IN INCHES/MILLIMETERS TOLERANCES BELOW APPLY EXCEPT FOR NOMINAL DESIGNED PARTS AND ITEMS PRODUCED TO RECOGNIZED STANDARDS. DO NOT SCALE DRAWING.		–	–	–
		MACH. ± –	ANGLES ± 3°	MATERIAL SPEC. –		
		DECIMALS-INCH	METRIC	TITLE DIAGRAM, DC/AC MODULE		
		.00 ± .03	0.0 ±0.8mm	DESCRIPTIVE DATA 80/90EX20		
		.000 ± .010	0.00 ±0.25mm	DESIGNED AXA	DRAWN JNP	DATE 11/3/05	SCALE NONE
				CHECKED –	APPROVED –	RELEASED 5/1/08	ITEM TYPE –

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SIZE D | DWG. NO. SHEET 1 OF 1 | 289679

INPUT TRANSFORMER
DC/AC MODULES
L4/L5
OUTPUT TRANSFORMER
RFI 2
INPUT
Q1
RFI 1
L3
L1
T1
DC/AC MODULE 1
DC/AC MODULE 2
T2
Q2
Q3
OUTPUT 1
OUTPUT 2
PE
INPUT VOLTAGE SETUP, PAGE 3
C9 C10 C11
COMMON MODE CHOKE
N OUTPUT 1 Page 2
N OUTPUT 2 Page 2
A B C N
UPS in
D C
ANALOG IN
MEASURING TRANSFORMERS
UPS OUT
A5 AUX MODULE
AC 21V IN
RELAY MODULE
A6 I/O- MODULE
INSTR. & REMOTE CONTROL
PAGE 2
A10 DISPLAY/ KEYBOARD MODULE
A8 OUTPUT FEED MODULE
A14 VOLT. FEED- BACK MODULE
WHITE
BROWN
YELLOW
GREEN
GREY
PINK
C2 C3 C4
FANS
CONTACTORS
TRANSFORMER
AUX3 AUX2 AUX1
PAGE 2
L2
T6
C5
C6
C7
C8
BLUE BLACK BROWN BLUE BLACK BROWN
M1
M2
X3 +/- POWER
X17 AUX-INTERFACE
X6 RELAY- BOARD 1
X7 RELAY- BOARD 2
X12 DC/AC MOD.1
X13 DC/AC MOD.2
X8 DISPLAY
X18 OUTPUT- FEED
X10 X11 X9 X14 X15 X16
RS232 X4
RS485 X5
F1
A9 PROCESSOR MODULE

CHANGE RECORD		REF. AXA 473.622		FINISH CODE PER NONE			
E.N. No.	DATE	FILE NAME	PLOT DATE	ASSY'D	REPLACED BY	REPLACES	
1) 3726AA	6/21/06	289680S1	6/4/07	–	–	–	
2) 3729AA	7/11/06	UNLESS OTHERWISE SPECIFIED		–	–	–	
3) 3802AA	12/7/06	DIMENSIONS ARE IN INCHES/MILLIMETERS		MATERIAL NO.	QUANTITY-Unit	ORIGL QTY.	
4) 3860AA	5/7/07	TOLERANCES BELOW APPLY EXCEPT FOR		–	–	–	
5) 3896AA	6/4/07	VENDOR DESIGNED PARTS AND ITEMS		MATERIAL SPEC.			
		PRODUCED TO ACCEPTABLE STANDARDS.		–			
		DO NOT SCALE DRAWING.		TITLE			
		FRACT. ± –	ANGLES ± 3°	DIAGRAM, SCHEMATIC AND CONNECTION			
		DECIMAL-INCH	METRIC	DESCRIPTIVE DATA			
		.00 ± .03	0.0 ±0.8mm	909X200 (HOBART 2200)			
		.000 ± .010	0.00 ±0.25mm	DESIGNED AXA	DRAWN JNP	DATE 11/3/05	SCALE NONE
				CHECKED –	APPROVED [illegible]	DATE 5/1/08	ITEM TYPE –

ITW GSE GROUP U.S.A.

SIZE D | DWG NO. 289680 | SHEET 1 OF 7

PROCESSOR MODULE A9/X6, PAGE 1 — X6 — X9

AUX MODULE A5/X7, PAGE 1 — Wo, Vo, Uo — X5 — U V W — SUPPLY

PROCESSOR MODULE A9/X7, PAGE 1 — X7 — X8

SW1

INPUT 1–8								OUTPUT 1–6						
1	2	3	4	5	6	7	8	01	02	03	04	05	06	
INTERLOCK OUTPUT 1	INTERLOCK OUTPUT 2	EMERGENCY STOP SWITCH	START/RESET 1	STOP 1	START/RESET 2	STOP 2	LAMP TEST	COMMON ERROR (LAMP)	400 Hz ON 1 (LAMP)	400 Hz ON 2 (LAMP)	400 Hz READY (LAMP)	400 Hz ON	400 Hz READY	COMMON ERROR

A6
I/O-MODULE

INPUT 9–16								OUTPUT 7–12					
9	10	11	12	13	14	15	16	07	08	09	010	011	012
NCR OUTPUT 1	NCR OUTPUT 2	90% SWITCH OUTPUT 1	90% SWITCH OUTPUT 2	GPU ENABLE	EARTH LEAKAGE FAILURE	(NOT DESIGNATED)	NUMBER OF OUTPUTS	INTERLOCK 1 PRESENT (LAMP)	INTERLOCK 2 PRESENT (LAMP)	PLUG INTERTED, 90% SIG. PRESENT	(NOT DESIGNATED)	(NOT DESIGNATED)	MAINS OK	MAINS FAILURE

INTERLOCK

28 VDC

SW1: INPUT BY-PASS

X1 N1 F1 N2 F2 X2 1 2 3 4 5 6 7 8 9 10 11 12 X3 13 14 15 16 17 18 19 20 21 22 23 24 25 X4 + + + − − − GND 26 27 28 29 30 31 32 33 34 35 35 37 38 39 40 41 X7 42 43 44 45 46 47 48 49 50 51 52 53 54

N 400 Hz 1 Page 1 — E/F 1 — E/F 2

N 400 Hz 2 Page 1

K1

TB1: 1 START/RESET 1 — 3 STOP 1 — 5 COMMON ERROR — 4 400 Hz ON 1 — 10 9 11 12 BRIDGE INTERLOCK — 8 8 — 2 7 INPUT AVAILABLE ②

TB20: 1 START/RESET 2 — 3 STOP 2 — 6 LAMP TEST ② — 4 400 Hz ON 2 — 5 2 ②

AUX3 Q3 A1 A2

AUX2 Q2 A1 A2

S1 S1 S2 (H2) S3 S4 (H4) S5 S6 (H1) H3 H2 (S2) H4 (S4) — H5 H1 (S6)

AUX1 Page 1 — EMERGENCY SWITCH — START/RESET 1 — STOP 1 — START/RESET 2 — STOP 2 — LAMP TEST — COMMON ERROR — 400 Hz ON 1 — 400 Hz ON 2 — INSTRU. LIGHT — MAINS

HIGH = 1 OUTPUT CONTACTOR + PLUG & PLAY
LOW = 2 OUTPUT CONTACTOR

S1 — ON — 1 2 3 4 5 6 7 8

SET DIP SWITCH #8 (RED BLOCK) ON I/O PCB TO OFF, WHEN SECOND OUTPUT IS FURNISHED.

CHANGE RECORD		
E.C. No.	DATE	
1) 37284A	8/21/06	
2) 37291A	7/11/06	
3) 36924A	12/7/06	
4) 38804A	5/7/07	
5) 38984A	5/4/07	

REF. AXA 473.822

FILE NAME	PLOT DATE
288680SZ	5/4/07

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES/MILLIMETERS
TOLERANCES UNLESS ABOVE DIRECT FOR VENDOR ORDERED PARTS AND ITEMS
PRESENTED TO RECOGNIZED STANDARDS.
DO NOT SCALE DRAWING

FRACT ± — ANGLES ± 5°

DECIMAL-INCH: .00 ± .05, .000 ± .010 — METRIC: 0.0 ±0.8mm, 0.00 ±0.25mm

FINISH CODE PER NONE

ACTIVITY	REPLACES W	REPLACED
–	–	–
MATERIAL NO.	QUANTITY-ILM.	COMM. ILS.
–	–	–

MATERIAL SPEC.
–

TITLE: DIAGRAM, SCHEMATIC AND CONNECTION

DESCRIPTIVE NOM.: 60/90SE200 POWERMASTER EV

DESIGNED	DRAWN	DATE	SCALE
AXA	JNP	11/3/05	NONE
CHECKED	APPROVED	RELEASED	TEST TYPE
–	–	5/1/06	–

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SIZE D — DWG NO. 289680 — SHEET 2 OF 7

OUTSIDE DISTR.	
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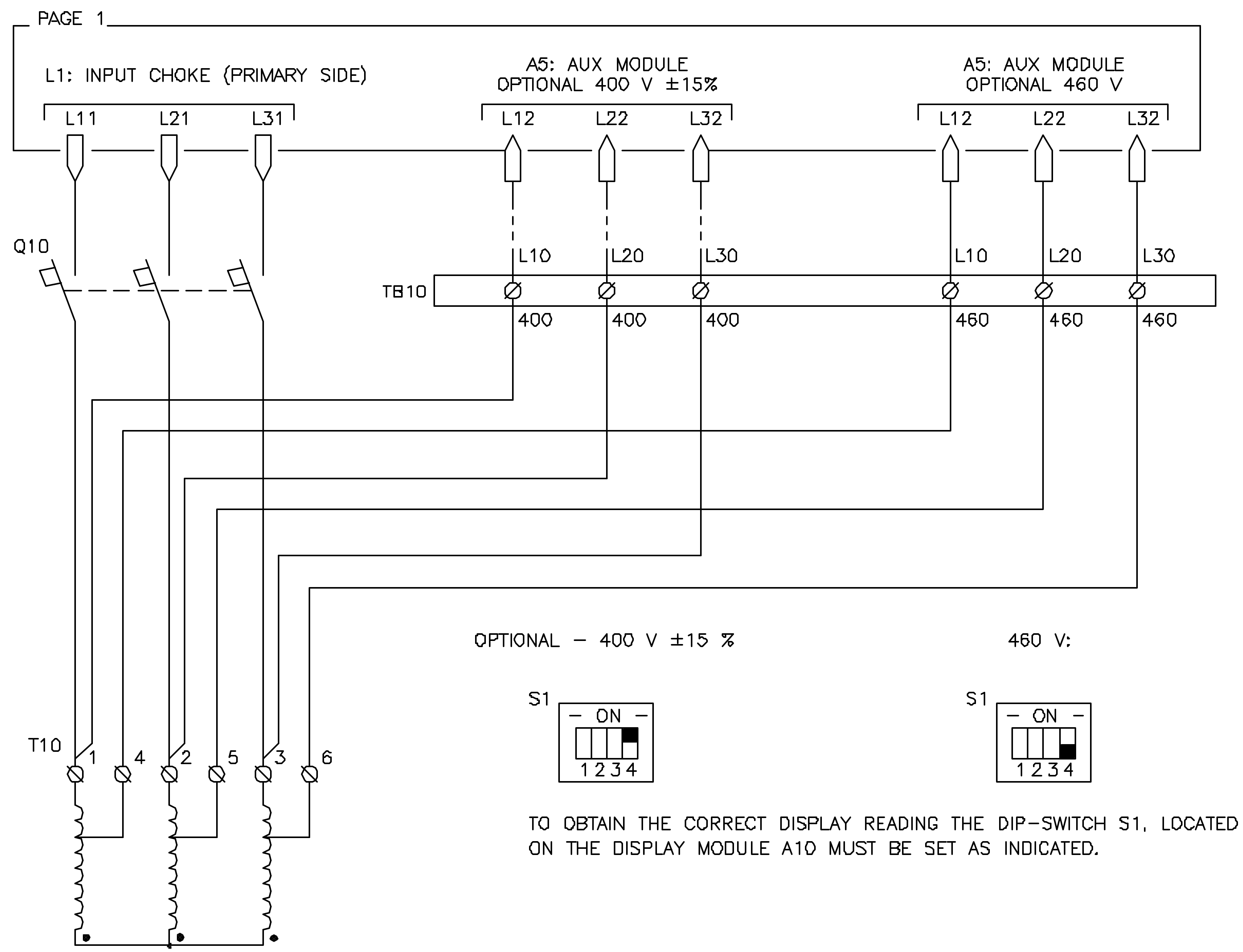
–	–

DISTRIBUTION TABLE



CHANGE RECORD	
E.G. No.	DATE
1) 3726AA	8/21/08
2) 3729AA	7/11/08
3) 3802AA	12/7/08
4) 3880AA	5/7/07
5) 3898AA	6/4/07

REF. AXA 473.622

FILE NAME 28868DS3 — PLOT DATE 6/4/07

UNLESS OTHERWISE SPECIFIED

ANGLES ± 3°

.00 ± .03 | 0.0 ±0.8mm
.000 ± .010 | 0.00 ±0.25mm

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FINISH CODE PER NONE

TITLE: DIAGRAM, SCHEMATIC AND CONNECTION

80/90SE200 POWERMASTER EV

DESIGNED AXA — DRAWN JNP — DATE 11/3/05 — SCALE NONE

REVISED 5/1/06

ITW GSE GROUP U.S.A.

SIZE D — DWG. NO. 289680 — SHEET 3 OF 7

LEGEND

A1A, A1B	PCB, THYRISTOR/ GATE DRIVE
A5	PCB, AUXILIARY
A6	PCB, I/O
A8	PCB, OUTPUT FEED
A9	PCB, PROCESSOR
A10	PCB, DISPLAY/KEYBOARD
A14	PCB, VOLTAGE FEEDBACK
A25	PCB, CONNECTOR FOR PROCESSOR
C1A, C2A	CAPACITOR, DC/AC1
C1B, C2B	CAPACITOR, DC/AC2
C2–C4	CAPACITOR, FILTER
C5–C8	CAPACITOR, FANS
C9–C11	CAPACITOR, FILTER, SMALL
C12A, C12B	CAPACITOR, SNUBBER
DC/AC1, DC/AC2	MODULE, INVERTER
F7–F9 ON A5	FUSE, 4 A., 450 V., FAST ACTING, 5mm x 25mm, CERAMIC
F1 ON A6	FUSE, 4 A., 450 V., FAST ACTING, 5mm x 25mm, CERAMIC
F1 ON A9	FUSE, 4 A., 250 V., FAST ACTING, 5mm x 20mm, CERAMIC
H1	LIGHT, MAINS LAMP TEST, (WHITE)
H2	LIGHT, 400 Hz. ON 1, (GREEN)
H3	LIGHT, COMMON ERROR, (RED)
H4	LIGHT, 400 Hz. ON 2, (GREEN), (WHEN FURNISHED)
H5	LIGHT, CONTROL PANEL, (CLEAR)
K1	RELAY, BRIDGE INTERLOCK
L1	CHOKE, INPUT, 400/460 V.
L2	CHOKE, COMMON MODE, OUTPUT FEED
L3	CHOKE, COMMON MODE, INPUT
L4,L5	CHOKE, COMMON MODE, OUTPUT TRANSFORMER
M1, M2	FANS, COOLING
PM1A–PM3A	MODULE, POWER, DC/AC1
PM1B–PM3B	MODULE, POWER, DC/AC2
Q1	CIRCUIT BREAKER, MAIN
Q2	CONTACTOR, OUTPUT 1
Q3	CONTACTOR, OUTPUT 2, (WHEN FURNISHED)
Q10	CIRCUIT BREAKER, SMALL
R1A, R1B	RESISTOR, DC/AC
RFI1	PCB, RADIO FREQ. INTERFERENCE, INPUT
RFI2	PCB, RADIO FREQ. INTERFERENCE, OUTPUT
RV1A, RV2A	VARISTOR, DC/AC1
RV1B, RV2B	VARISTOR, DC/AC2
S1	SWITCH, EMERGENCY, STOP
S2	SWITCH, START/RESET, 400 Hz. ON 1
S3	SWITCH, STOP 1
S4	SWITCH, START/RESET, 400 Hz. ON 2, (WHEN FURNISHED)
S5	SWITCH, STOP 2, (WHEN FURNISHED)
S6	SWITCH, MAINS LAMP TEST
SCR1A–SCR3A	MODULE, DIODE, DC/AC1
SCR1B–SCR3B	MODULE, DIODE, DC/AC2
T1	TRANSFORMER, INPUT
T2	TRANSFORMER, OUTPUT
T6	TRANSFORMER, FANS
T10	TRANSFORMER, VOLTAGE SELECTION
T50	TRANSFORMER, AUX. PCB
TB1	TERMINAL BLOCK, OUTPUT 1
TB10	TERMINAL BLOCK, VOLTAGE SELECTION
TB15–TB17	TERMINAL BLOCK, FANS
TB18	TERMINAL BLOCK, T2 THERMAL SWITCH
TB20	TERMINAL BLOCK, OUTPUT 2, (WHEN FURNISHED)

CHANGE RECORD		
E.C. No.	DATE	
1) 3726AA	6/21/06	
2) 3729AA	7/11/06	
3) 3802AA	12/7/06	
4) 3880AA	5/7/07	
5) 3898AA	6/4/07	

AXA# 473.522

FILE NAME: 289680S4 | PLOT DATE: 6/4/07

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES/MILLIMETERS
TOLERANCES BELOW APPLY EXCEPT FOR VENDOR DESIGNED PARTS AND ITEMS PRODUCED TO RECOGNIZED STANDARDS.
DO NOT SCALE DRAWING.

FRACT ± | ANGLES ± 3°
DECIMAL–INCH: .00 ± .03; .000 ± .010
METRIC: 0.0 ±0.8mm; 0.00 ±0.25mm

FINISH CODE PER NONE

ACTIVITY	REPLACED BY	REPLACES
MATERIAL NO.	QUANTITY–U.M.	COMM. CLS.

MATERIAL SPEC.: –

TITLE: DIAGRAM, SCHEMATIC & CONNECTION

DESCRIPTIVE DATA: 6D/80EX20

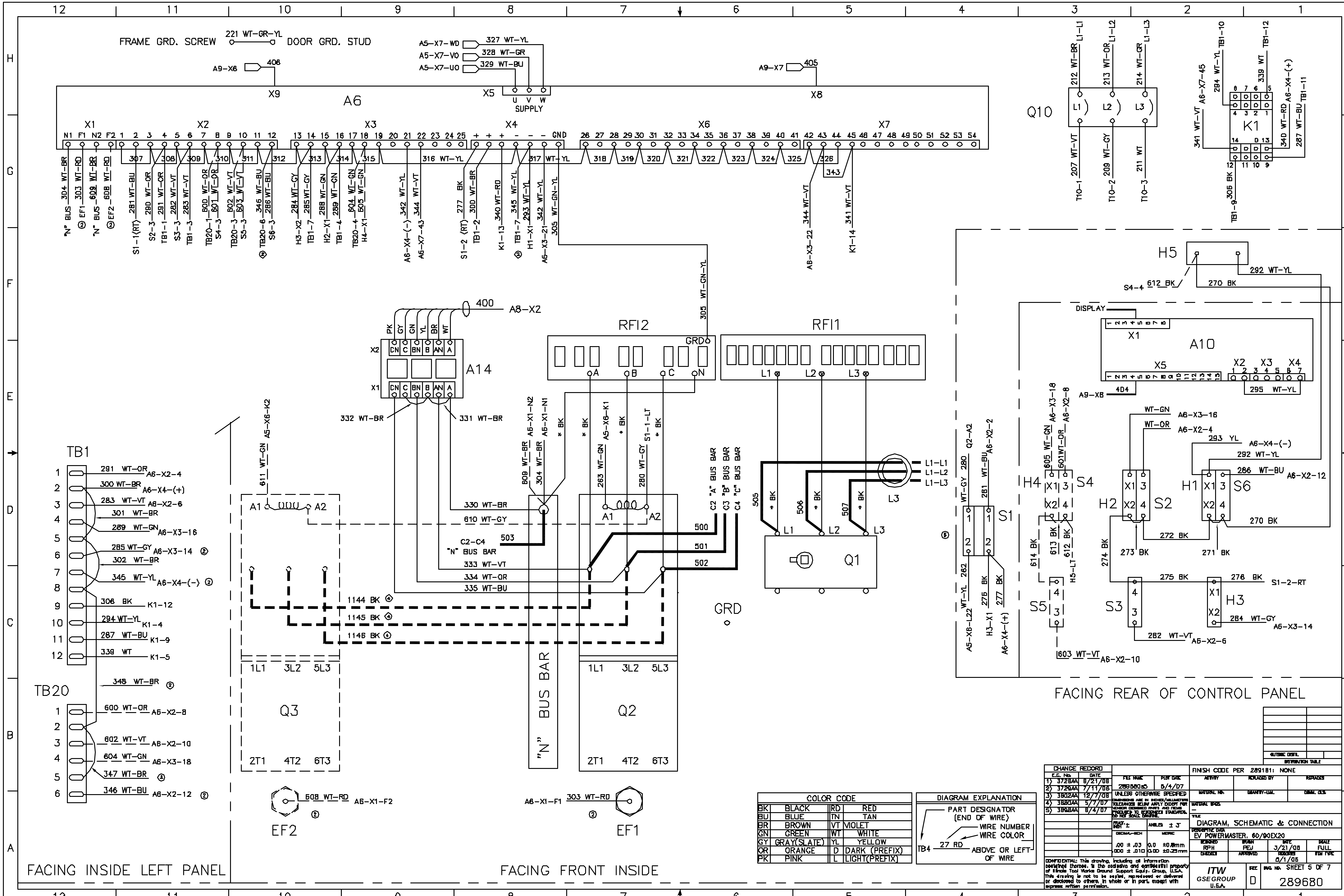
DESIGNED	DRAWN	DATE	SCALE
AXA	RPH	4/28/06	NONE
CHECKED	APPROVED	RECORDS 5/1/06	ITEM TYPE

OUTSIDE DISTR.

DISTRIBUTION TABLE

ITW GSE GROUP U.S.A.

SIZE C | DWG. NO. 289680 | SHEET 4 OF 7


FACING REAR OF CONTROL PANEL
FACING FRONT INSIDE
FACING INSIDE LEFT PANEL
FRAME GRD. SCREW
DOOR GRD. STUD
"N" BUS BAR
COLOR CODE
BK BLACK
BU BLUE
BR BROWN
GN GREEN
GY GRAY(SLATE)
OR ORANGE
PK PINK
RD RED
TN TAN
VT VIOLET
WT WHITE
YL YELLOW
D DARK (PREFIX)
L LIGHT(PREFIX)
DIAGRAM EXPLANATION
PART DESIGNATOR (END OF WIRE)
WIRE NUMBER
WIRE COLOR
ABOVE OR LEFT OF WIRE
CHANGE RECORD
FINISH CODE PER 289181: NONE
DIAGRAM, SCHEMATIC & CONNECTION
EV POWERMASTER, 60/90EX20
ITW GSEGROUP U.S.A.
SHEET 5 OF 7
289680

RIGHT SIDE PANEL — 223 WT-GN-YL — FRAME

LEFT SIDE PANEL — 224 WT-GN-YL — FRAME

FROM RIGHT SIDE

T10

1	206 WT-YL	TB10-L10-460
	207 WT-VT	Q10-L1
4	203 WT-BR	TB10-L1D-460
2	208 WT-GN	TB10-L20-460
	209 WT-GY	Q10-L2
5	204 WT-RD	TB10-L2D-460
3	210 WT-BU	TB10-L30-460
	211 WT	Q10-L3
6	205 WT-OR	TB10-L3D-460

FRONT WALL INSIDE CENTER SECTION

C2 — A — 5DD — Q2-1L1 — FLEX BUS T2-A ①

C3 — "N" BUS BAR — 503 N — FLEX BUS T2-N — B — 501 — Q2-3L2 — FLEX BUS T2-B ①

C4 — C — 502 — Q2-5L3 — FLEX BUS T2-C ①

L1-L2-X — 509 — SCR3A-1 — X — U1 — U2 — SCR1B-1 — 522

L1-L3-Y — 510 — SCR2A-1 — Y — V1 — V2 — SCR2B-1 — 521

L1-L1-Z — 508 — SCR3A-1 — Z — W1 — W2 — SCR3B-1 — 520

T1

FACING TRANSFORMER FROM REAR OF UNIT

TB16 — TB15

C7: 226 BK, 231 WT-BR

C8: 225 BK, 232 WT-BR

M1, M2

TB17: 234 WT-RD, 236 BK, 237 WT-BU, 235 BK, 240 BK, 233 WT-BR

C5: 230 WT-BR, 227 WT-RD

C6: 229 WT-BR, 228 BK

A5-X6-K4, A5-X6-L22, A5-X6-K5

T6

① INSIDE TOP OF UNIT

FLEX BUS C2-A, FLEX BUS C3-B, FLEX BUS C4-C

A5-X2-N — 337 WT-RD

A5-X2-A1 — 338 WT-BR

TB18

T2

N

FLEX BUS C2-C3-C4-N

12 11 22 21 32 31 "N" BUS

513 — PM3A-1

512 — PM2A-1

511 — PM1A-1

533 — THRU A8-C (CT)

532 — THRU A8-B (CT)

531 — THRU A8-A (CT)

L4/L5

FACING TRANSFORMER FROM FRONT OF UNIT

L1

L1 — 505 — Q1-L1 — 212 WT-BR — Q10-L1-TOP — 218 WT-GR-YL — C9

L1-Z — 508 — T1-Z — 215 WT-RD

L2 — 506 — Q1-L2 — 213 WT-OR — Q10-L2-TOP — 219 WT-GR-YL — C10

L2-X — 509 — T1-X — 216 WT-YL

L3 — 507 — Q1-L3 — 214 WT-OR — Q10-L3-TOP — 220 WT-GR-YL — C11

L3-Y — 510 — T1-Y — 217 WT-BU

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

DIAGRAM EXPLANATION

PART DESIGNATOR (END OF WIRE)

WIRE NUMBER

WIRE COLOR

TB4 — 27 RD — ABOVE OR LEFT OF WIRE

CHANGE RECORD	
E/C No.	DATE
1) 372BAA	8/21/08
2) 372DAA	7/11/08
3) 380ZAA	12/7/08
4) 388DAA	5/7/07
5) 380BAA	8/4/07

FILE NAME: 289680a5 — PLOT DATE: 8/4/07

UNLESS OTHERWISE SPECIFIED

DIMENSIONS ARE IN INCHES/MILLIMETERS. TOLERANCES BELOW APPLY EXCEPT FOR HOOKUP DESIGNED PARTS AND ITEMS PROCURED TO PUBLISHED STANDARDS. DO NOT SCALE DRAWING.

DECIMAL-INCH	METRIC
.00 ± .03	0.0 ±0.8mm
.000 ± .010	0.00 ±0.25mm

ANGLES ± 1°

FINISH CODE PER 289181: NONE

ACTIVITY	REPLACED BY	REPLACES

MATERIAL NO. — QUANTITY-LOT — ORIG. QTY.

MATERIAL SPEC: —

TITLE: DIAGRAM, SCHEMATIC & CONNECTION

DESCRIPTIVE DATA: EV POWERMASTER, 80/90EX20

DESIGNED	DRAWN	DATE	SCALE
RPH	PEU	3/21/08	FULL
CHECKED	APPROVED	RELEASED 5/1/05	ITW TYPE

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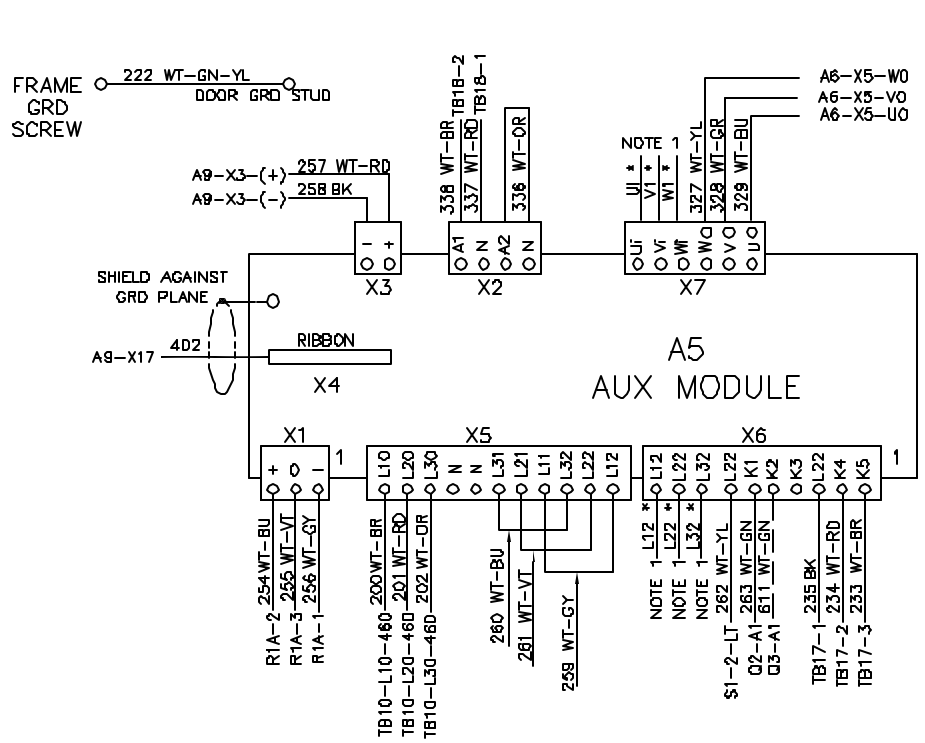
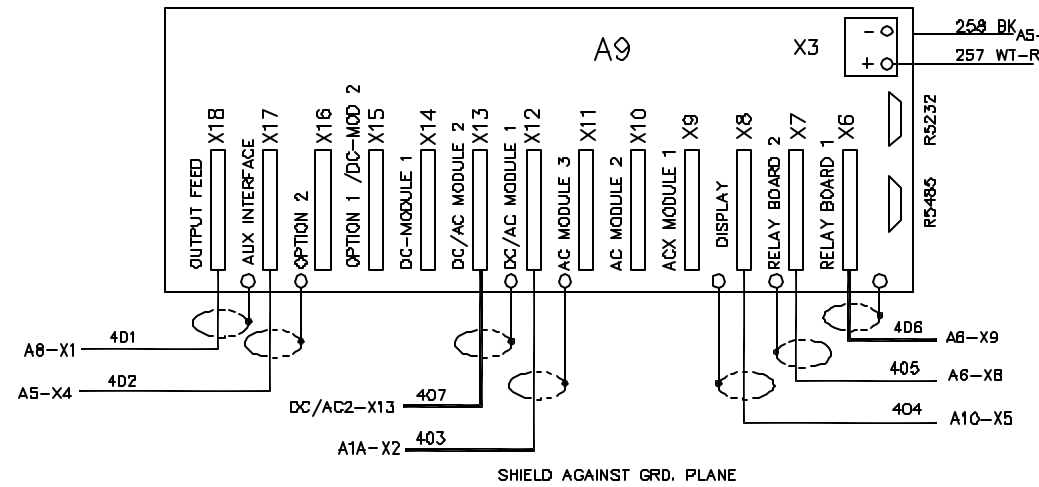
ITW GSE GROUP U.S.A. — SIZE D — DWG NO. 289680 — SHEET 6 OF 7

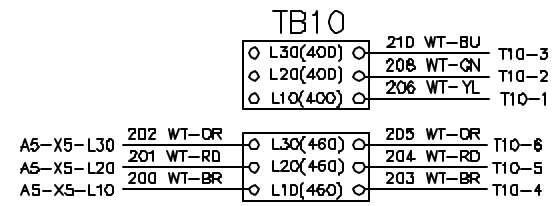
ELECTRIC DIAGRAM DISTRIBUTION TABLE

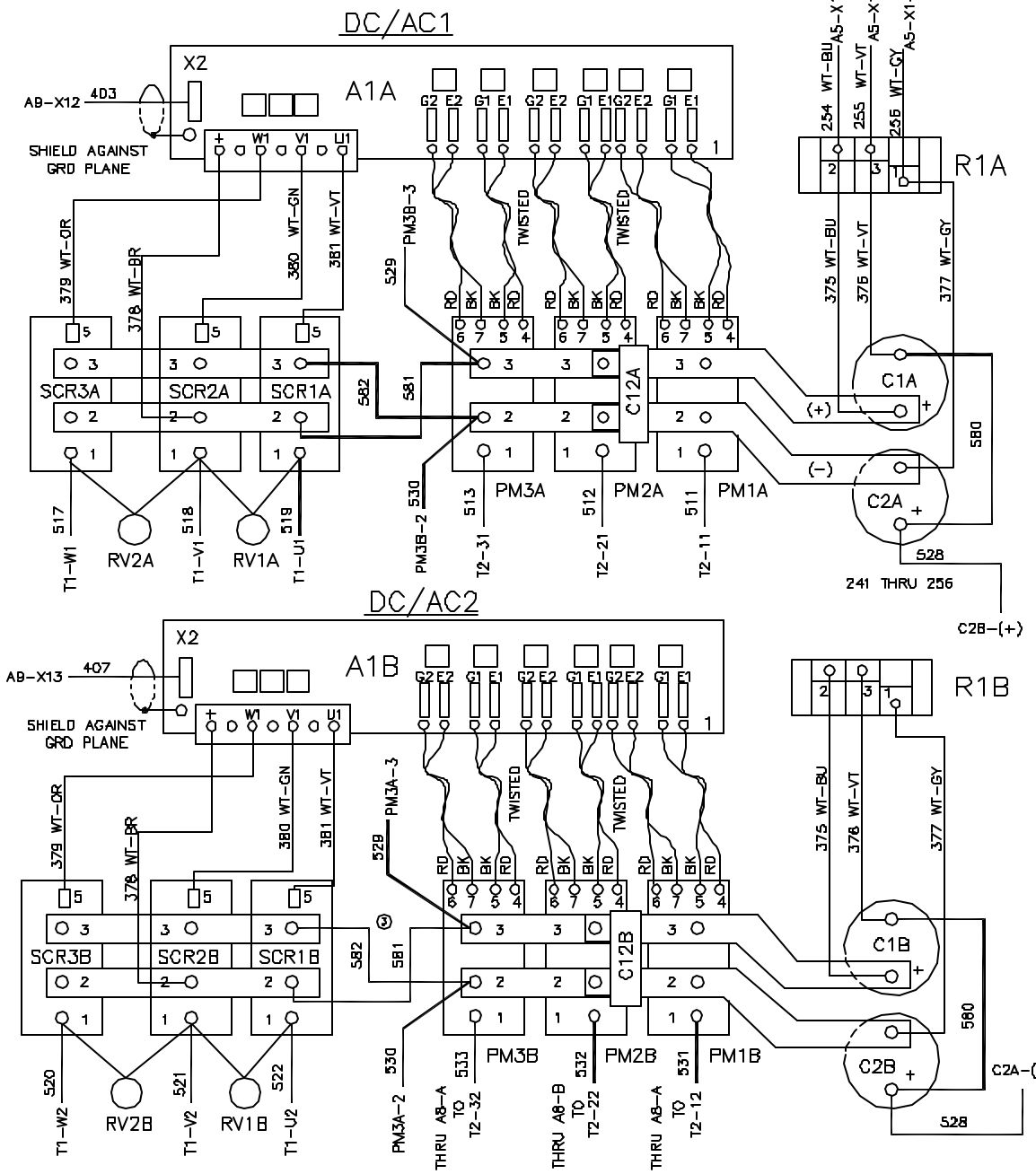


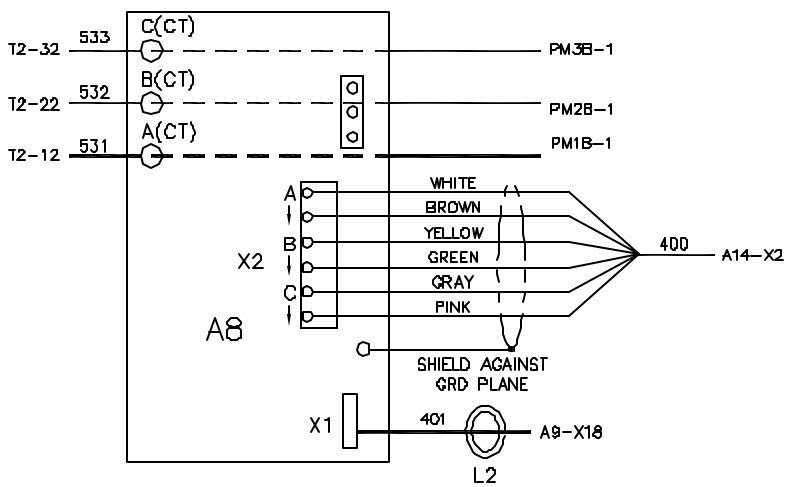
NOTE:

1. EACH CONNECTION IS A PAIR OF WIRES FROM XFMR UNDER A5









FACING INSIDE REAR OF UNIT

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

DIAGRAM EXPLANATION

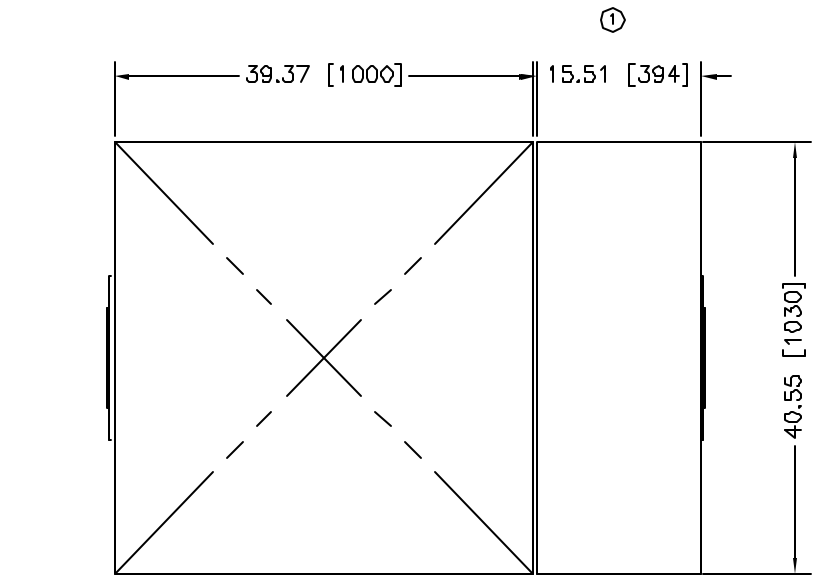
PART DESIGNATOR (END OF WIRE)
WIRE NUMBER
WIRE COLOR
TB4 27 RD ABOVE OR LEFT OF WIRE

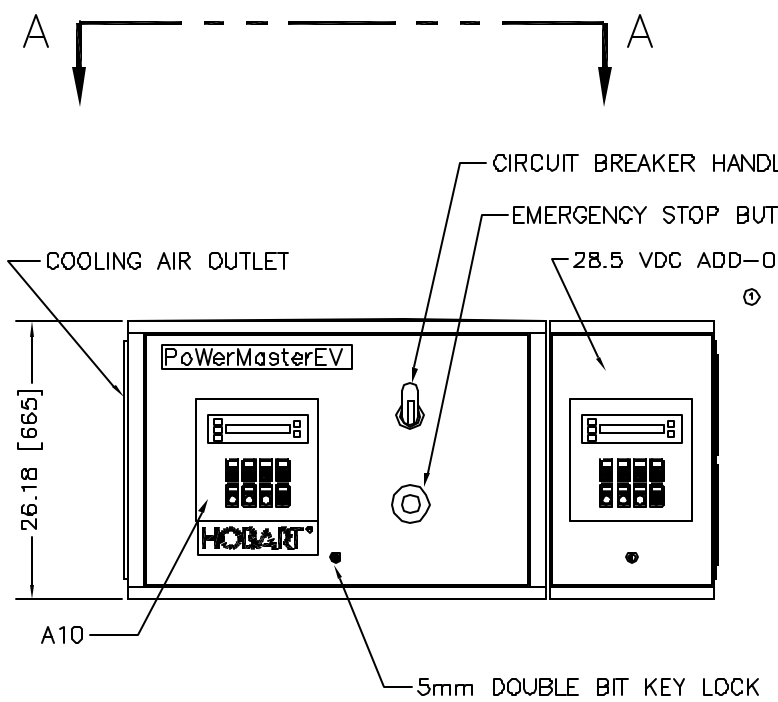
CHANGE RECORD		
E.C. No.	DATE	
1) 3720AA	5/21/06	
2) 3729AA	7/11/06	
3) 3802AA	12/7/06	
4) 3880AA	5/7/07	
5) 3898AA	6/4/07	

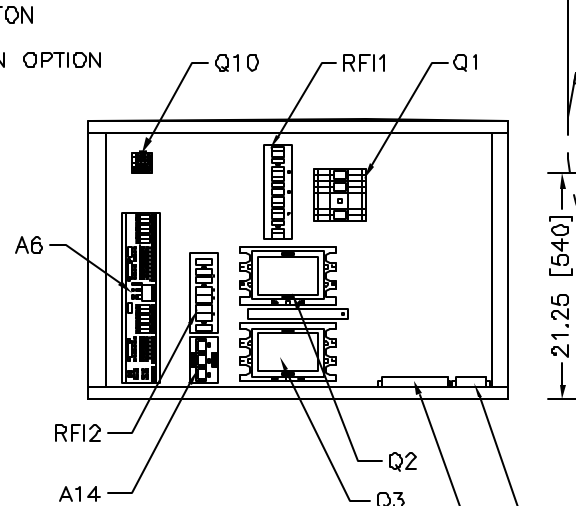
FILE NAME: 289680s7 PLOT DATE: 5/4/07
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES/MILLIMETERS
TOLERANCES BELOW ARE T.200PT PER
VENDOR DESIGNED PARTS AND ITEMS
TREATED TO ESTABLISHED STANDARDS.
DO NOT SCALE DRAWING.
MAT'L ± / ANGLES ± 3°
DECIMAL-INCH / METRIC
.00 ± .03 0.0 ±0.8mm
.000 ± .010 0.00 ±0.25mm

FINISH CODE PER 2891811 NONE
ACTIVITY | REVISED BY | REVISED
MATERIAL NO. | QUANTITY-UNIT | DECIMAL DES.
MATERIAL SPEC. —
TITLE
DIAGRAM, SCHEMATIC & CONNECTION
DESCRIPTIVE NAME
EV POWERMASTER, 60/90EX20
DESIGNED RPH | DRAWN PEJ | DATE 3/21/06 | SCALE FULL
CHECKED | APPROVED | RELEASED 5/1/06 | ITEM TYPE

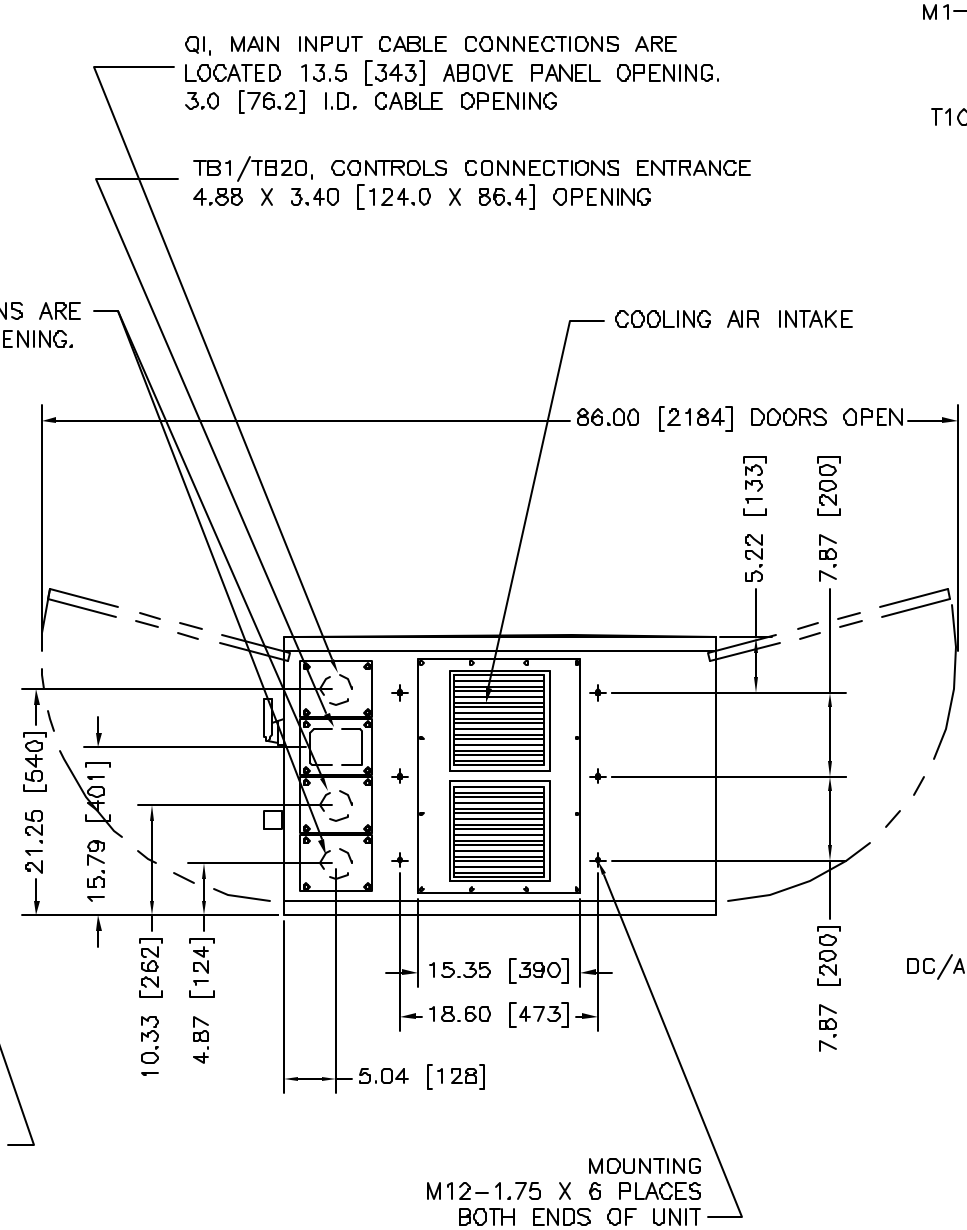
ITW GSE GROUP U.S.A. | SIZE D | DWG NO. 289680 | SHEET 7 OF 7



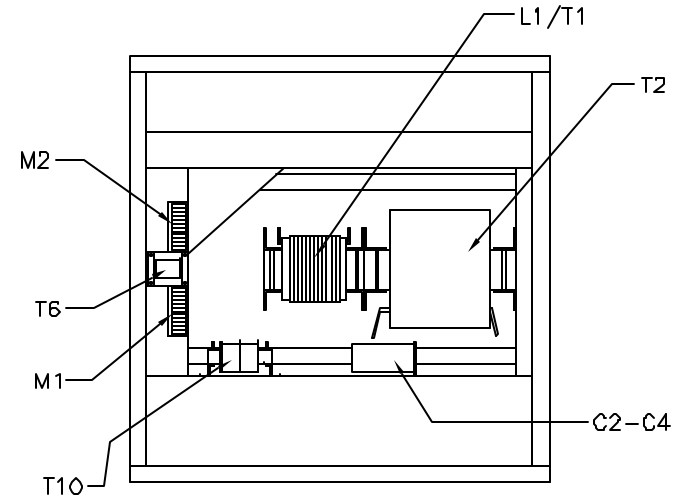




COMPONENT VIEW
FRONT DOOR



RIGHT SIDE VIEW



VIEW A-A
COMPONENT VIEW
IN CENTER

COMPONENT VIEW
REAR DOOR

NOTES:

1. INCHES [mm]
2. UNIT WEIGHT 1102 lbs. / 500 kg.
3. BASIC COMPONENT LISTING. SEE DIAGRAMS FOR COMPLETE LIST. SEE FOLLOWING SHEET FOR LEGEND.

CHANGE RECORD		REF. AXA 173.099		FINISH CODE PER NONE			
E.C. No.	DATE	FILE NAME	PLOT DATE	ACTIVITY	INITIATED BY	REVISED BY	REMARKS
1) 372944	7/11/06	28805151	7/11/06	–	–	–	–
2) TBD	6/6/07	UNLESS OTHERWISE SPECIFIED		MATERIAL NO.	QUANTITY-UNIT		DIMNL CLS.
		DIMENSIONS ARE IN INCHES/MILLIMETERS		–	–		–
		TOLERANCES BELOW APPLY EXCEPT FOR		MATERIAL SPEC.			
		VENDOR DESIGNED PARTS AND ITEMS		–			
		PRODUCED TO RECOGNIZED STANDARDS.		TITLE			
		DO NOT SCALE DRAWING.		LAYOUT, DIMENSIONAL/COMPONENT			
		DECIMAL-INCH	METRIC	DESCRIPTIVE DATA			
		.00 ± .03	0.0 ±0.8mm	60/80SE200 (POWERMASTER EV)			
		.000 ± .010	0.00 ±0.025mm	DESIGNED	DRAWN	DATE	SCALE
				AXA	JNP	11/3/05	1/8
				CHECKED	APPROVED	RELEASED	ITEM TYPE
				–	–	6/1/06	–

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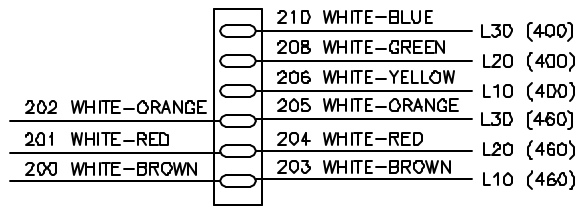
ITW GSE GROUP U.S.A.

SIZE D | DWG. NO. 289681 | SHEET 1 OF 2

LEGEND

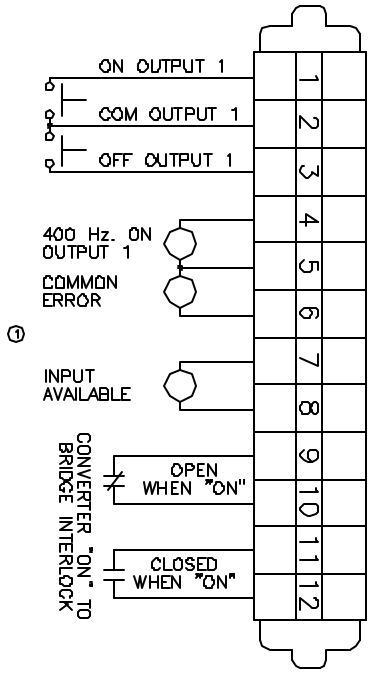
A5	PCB, AUXILIARY
A6	PCB, I/O
A8	PCB, OUTPUT FEED
A10	PCB, DISPLAY/KEYBOARD
A14	PCB, VOLTAGE FEEDBACK
A25	PCB, CONNECTOR FOR PROCESSOR
C2–C4	CAPACITOR, FILTER
L1	CHOKE, INPUT, 400/460 V.
M1, M2	FAN, COOLING
Q1	CIRCUIT BREAKER, MAIN
Q2	CONTACTOR, OUTPUT 1
Q3	CONTACTOR, OUTPUT 2, (WHEN FURNISHED)
Q10	CIRCUIT BREAKER, SMALL
RFI1	PCB, RADIO FREQ. INTERFERENCE, INPUT
RFI2	PCB, RADIO FREQ. INTERFERENCE, OUTPUT
T1	TRANSFORMER, INPUT
T6	TRANFORMER, FAN
T10	TRANSFORMER, VOLTAGE SELECTION
TB1	TERMINAL BLOCK, OUTPUT 1
TB10	TERMINAL BLOCK, 400/460V SELECTION
① TB20	TERMINAL BLOCK, LAMP TEST OUTPUT 2, (WHEN FURNISHED)

TB10
TERMINAL BLOCK



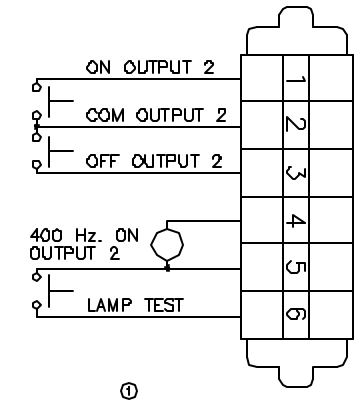
INPUT VOLTAGE SELECTION

REMOTE CONNECTIONS

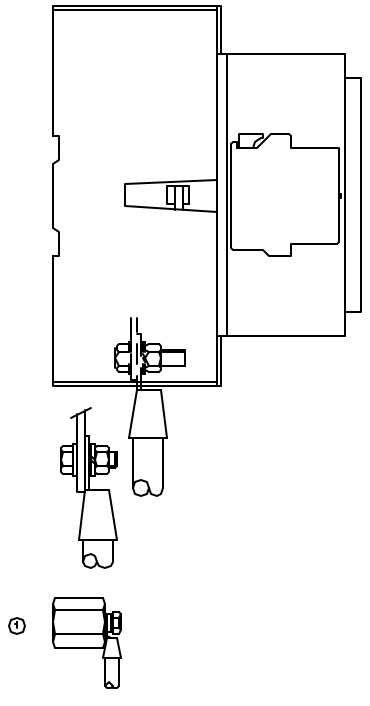


① TB1
TERMINAL BLOCK

FLAT BLADED SCREW DRIVER REQUIRED



① TB20
TERMINAL BLOCK

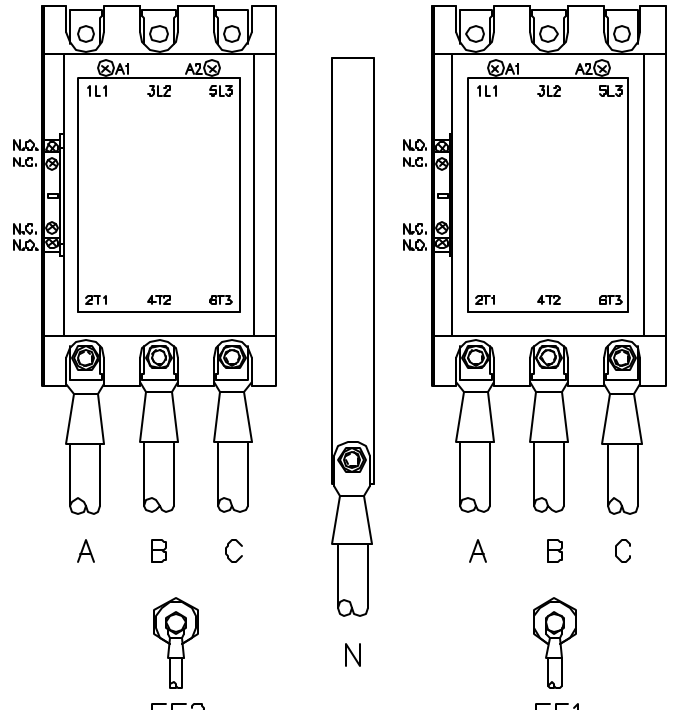


① E/F CONNECTIONS: 7/16 WRENCH REQUIRED

NEUTRAL CONNECTION: 13mm WRENCH AND SOCKET REQUIRED.

CONTACTOR CONNECTIONS: 9/16" WRENCH AND SOCKET WITH EXTENSION REQUIRED.

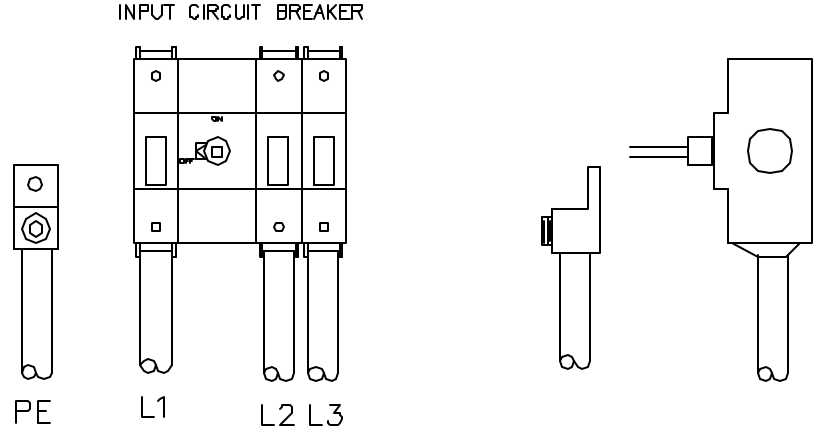
OUTPUT COVER PLATES: 10mm WRENCH AND SOCKET REQUIRED.



① ①

OUTPUT #2
(WHEN FURNISHED)

OUTPUT #1



CONTACTOR CONNECTIONS: #8 – 00 AWG [10–70mm²]
M4 ALLEN WRENCH REQUIRED.

PE CONNECTOR CONNECTION: #6–250mcm
5/16 [M8] ALLEN WRENCH REQUIRED.

INPUT COVER PLATES: 10mm WRENCH AND SOCKET REQUIRED.

INPUT CABLE CONNECTIONS

60/90 kVA AIRCRAFT CABLE CONNECTIONS

CHANGE RECORD			
E.C. No.	DATE		
1) 372BAA	7/11/05	FILE NAME	PLOT DATE
2) TBD	6/8/07	2888515Z	7/11/05

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES/MILLIMETERS
TOLERANCES BELOW APPLY EXCEPT FOR VENDOR ORDERED PARTS AND ITEMS PRODUCED TO RECOGNIZED STANDARDS. DO NOT SCALE DRAWING.

	DECIMAL-INCH	METRIC
FRACT ±	ANGLES ± 1°	
.00 ± .03	.0 ± 0.8mm	
.000 ± .010	.00 ± 0.25mm	

FINISH CODE PER 289181 NONE

ACTIVITY	REVISED BY	REMARKS

MATERIAL NO.	QUANTITY-UNIT	ORIGINAL DES.

MATERIAL SPEC.

TITLE
LAYOUT, DIMENSIONAL/ COMPONENT

DESCRIPTIVE DATA
60/90SE200

DESIGNED	DRAWN	DATE	SCALE
RPH	RPH	3/27/06	HALF
CHECKED	APPROVED	REVISED 5/1/06	ITEM TYPE

ELECTRONIC DRAFTING
REGISTRATION TABLE

ITW GSE GROUP U.S.A.

SIZE D | DWG. NO. 289681 | SHEET 2 OF 2

Appendix A Options

This converter is equipped with the following standard options (☒):

1) Portable Service Lamp, P/N 289877-001 ☐

A handheld lamp with 16.5 ft. (5 m) flexible cable mounted inside the GPU with power supplied from the GPU. The lamp can be used for inspection of all sections in the GPU. It automatically turns off when the front door is closed.

2) External Emergency Stop, P/N 289878-001 ☐

An external (remote mounted) emergency stop is used in case of a bridge mounted unit or in case of a unit placed in a building away from the point-of-use where it is not easy to get access to the emergency stop mounted on the GPU.

The external emergency stop is connected in series with the emergency stop at the GPU. When activated, it ensures that the GPU shutdown and cease voltage at the output. In case that several GPU's make up one system, we recommend to have one common external stop that cuts off the whole installation.

The emergency stop is delivered with 82 ft (25 m) of control cable.

3) Lockable Doors, P/N 289879-001 ☐

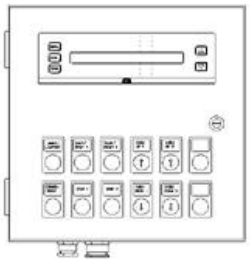
As a standard, the GPU is supplied with quarter-turn locks intended for a double bit 5 mm pin key. One key is supplied per converter.

On an optional basis, the GPU can be supplied with lockable swing handles on the front and on the back panel. The handle is locked by a profile cylinder according to DIN 18252 (depth = 40 mm). Each converter is supplied with 4 identical keys.

4) Remote Control Box Display – GPU with One Outlet, Cable Reel, and Display, P/N 289880-001 ☐

The control box is used for operation of the GPU if the GPU is placed away from the aircraft parking position (or placed under a bridge). Beside the display, from which all relevant information can be obtained, the control box is equipped with the following instrumentation:

Push buttons / indication lamps for:
Start / Reset
Stop
400 Hz On
Mains Lamp test
Cable hoist Up/Down



Height: 320 mm
Width: 320 mm
Depth: 120 mm

The control unit of the GPU can only communicate with one display at a time. Should you want to use the display on the GPU instead of the one in the control box, you should connect the control cable X8 to the plug of the Display Module (A10)

The control box is supplied with 82 ft. (25 m) of control cable.

5) Remote Control Box Display – GPU with Two Outlets, Cable Reel, and Display, P/N 289880-002 ☐

6) Remote Control Box Display – GPU with One Outlet, Cable Reel, and No Display, P/N 289880-003 ☐

7) Remote Control Box Display – GPU with Two Outlets, Cable Reel, and No Display, P/N 289880-004 ☐

8) Remote Control Box Display – GPU with One Outlet, No Cable Reel, and Display, P/N 289880-005 ☐

9) Remote Control Box Display – GPU with Two Outlets, No Cable Reel, and Display, P/N 289880-006 ☐

10) Remote Control Box Display – GPU with One Outlet, No Cable Reel, and No Display, P/N 289880-007 ☐

11) Remote Control Box Display – GPU with Two Outlets, No Cable Reel, and No Display, P/N 289880-005 ☐

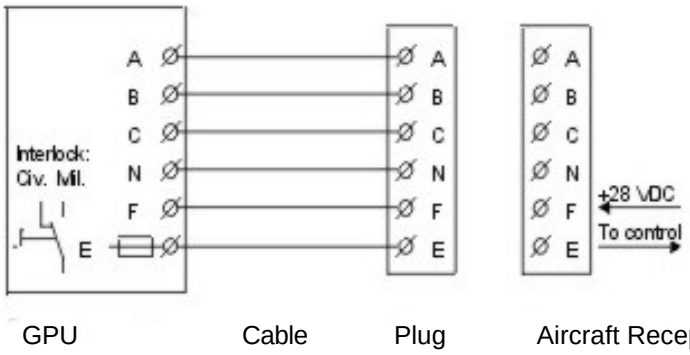
12) GPU Enable – P/N 289880-001 ☐

An option which can be used as interlock (i.e. key reader, boarding bridge, cable drum, pit flooded etc.). The option requires a constant closing function of the external signal providers. If the circuit is broken, the converter stops.

13) Military Interlock System, P/N 289882 ☐

To ensure personnel's health and safety, the converter is equipped with an interlock system. The configuration of the interlock system depends on whether the GPU is going to supply a civil or a military aircraft. In case of a civil aircraft, the aircraft supplies the 28 VDC interlock voltage, but in case of a military aircraft, the converter generates the interlock voltage.

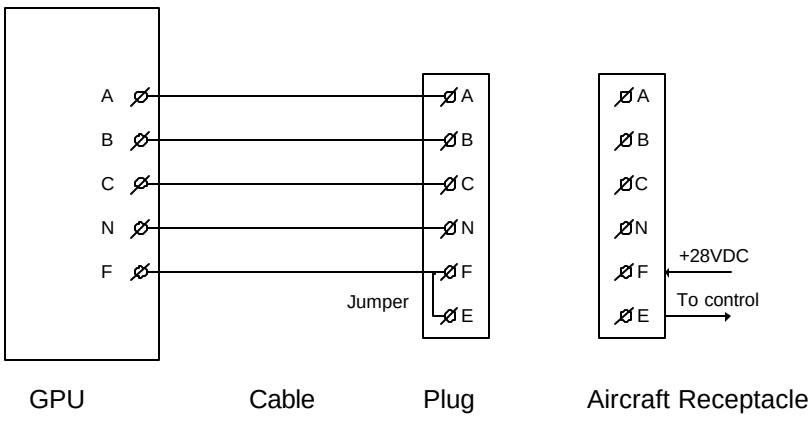
The military interlock system is designed as a separate 2 A supply as shown at figure below. Please notice that the E terminals are pre-fused with 2 A per outlet.



Military Interlock

Change over between the civil and the military interlock system is done by means of the selector switch that is placed behind the front door.

The civil interlock system is designed as shown at figure below.



Civil Interlock

14) Additional Output Contactor 30-45 kVA Units P/N 289883-001 ☐

Additional Output Contactor 60-90 kVA Units P/N 289883-002 ☐

Ground Power Units with ratings from 30 to 90 kVA are, as a standard, equipped with one output contactor. All models are, however, are prepared for an additional output contactor. Each contactor can transfer the nominal current of the GPU.

In case of more than two outlets, an external distribution board is required.

60-90 kVA Contactor Shown

15) Door Interlock, P/N 289884-001 ☐

This option ensures that the GPU passes into the stand-by mode in case one of the two doors are opened.

This function can be disabled at the I/O module

Note: Kindly notice that in stand-by mode parts of the GPU will still be left with voltage.

16) Indication Lamp for Interlock Present (1 Output), P/N 289885-001 ☐

A signal lamp at the operation panel indicates that the interlock signal from the aircraft is present.

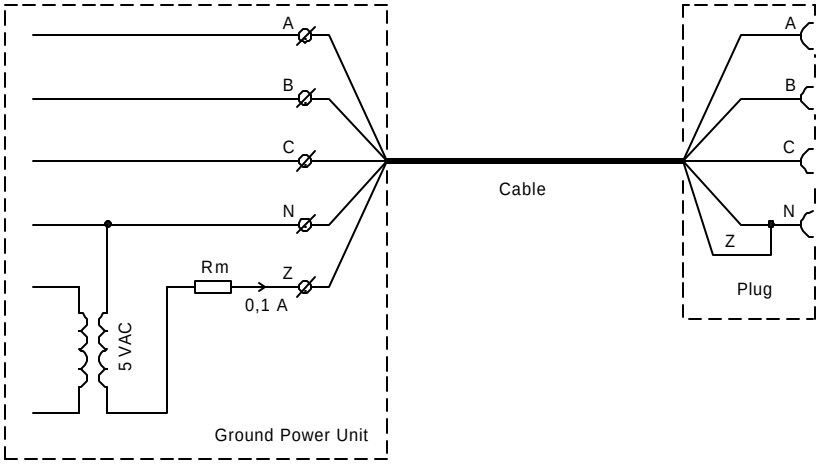
17) Indication Lamp for Interlock Present (2 Outputs), P/N 289885-002 ☐

A signal lamp at the operation panel indicates that the interlock signal from the aircraft is present.

18) Neutral Conductor Rupture, P/N 289886 ☐

A broken neutral conductor in the 400 Hz cable combined with an unbalanced aircraft load could lead to a destructive phase to neutral voltage in the aircraft and to hazardous voltages between the aircraft chassis and the ground level.

Unbalanced voltage at the aircraft plug due to a broken neutral would add a 400 Hz voltage to the 28VDC interlock voltage measured at the GPU. The GPU supervises the interlock signal and disconnects the output in case the injected AC voltage exceeds approximately 20 V. This type of error is recognised as an interlock failure by the GPU. Since the disconnection is a reaction against a heavy unbalanced voltage at the aircraft plug, this means that this type of supervision does not protect sensitive equipment in the aircraft. Therefore, Hobart offers a supervision of a rupture of the neutral conductor. This option is based on the supervision of an injected 50/60 Hz current in the neutral conductor. Please refer to the sketch below.



Sketch Showing the Functional Principle

The protection is based on the supervision of the current in the z-wire. If the GPU is provided with two outputs, the supervision can be made at both outputs.

The supervision can be disabled at the I/O module A6.

19) 28 VDC Add-on Module Adaptation Kit (30-90 kVA units) P/N 289887-001 ☐

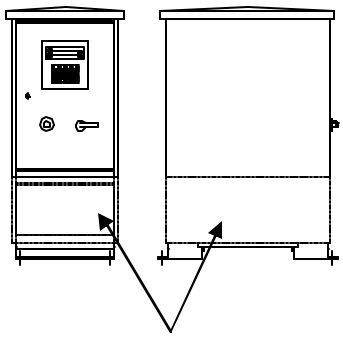
All Ground Power Units with ratings from 30 to 90 kVA can be connected to a 28 VDC Add-on Module. This requires only minor adaptations. The 30 to 90 kVA units require installation of an additional output contactor and minor modifications of the instrumentation.

20) Additional Base Module

P/N 289888-001 (Inside Use) ☐

P/N 289888-002 (Outside Use) ☐

Additional base module, which extends the height of the GPU by 18.00 in (457 mm). This option increases the weight of the GPU by 99 lb (45 kg).



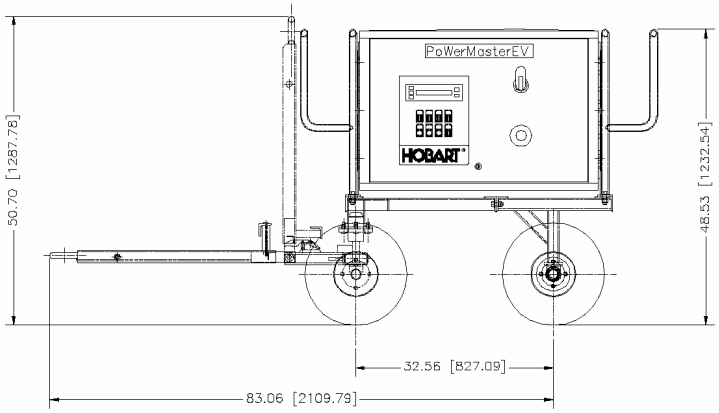
Add-on Module

21) Cavotec / Fladung Cable Reel, P/N 289826 ☐

- For bridge and point of use applications.
- Each cable reel is a single output only.

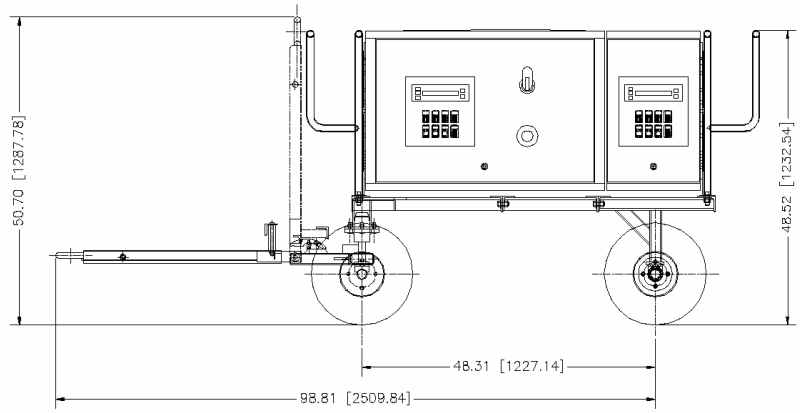
22) Trailer, P/N 290184-002 – AC Module Only ☐

This option increases the weight of the GPU by 200 lb (491 kg).



23) Trailer, P/N 290184-003 – AC and DC Module ☐

This option increases the weight of the GPU by 200 lb (491 kg).



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.