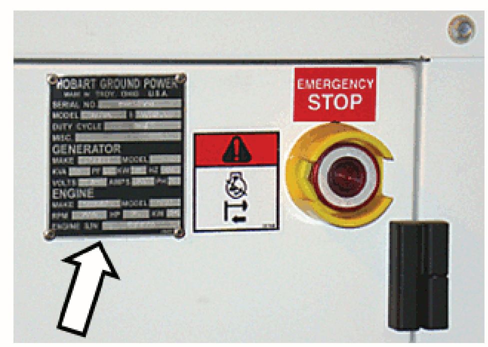
Preventive Maintenance

This is a brief list of replacement filters for 180CU20 (500181A) ground power unit. This is provided as a quick reference chart for the maintenance technician or diesel mechanic in charge of routine preventative maintenance for the ground power unit.

Generator Model Number

Identify your generator model number by looking on the data plate, which is located on the control box door near the emergency stop.



Filter Part Numbers

The table below lists the filter part numbers for your generator set. You can also order sets of filters as kits, which are listed on the next page. Pictures of the filters are on pages 3 and 4.

Filters	Hobart Part Number	Models Where Used
Oil Filter	286897-035	All
Fuel Filter Element	286897-034	All
Fuel Water Separator (Pre-Filter) Element	286897-033	All
Primary Air Filter Replacement Element	290828	All
Secondary Air Filter Replacement Element	290829	All
Lubricity/Fuel Water Separator Element	286897-031	All 500181A specifications ***except*** the 500181A-006 & -106 (special configuration)
Fuel Filter (w/ Fuel Heater Option) Element	286897-032	500181A-006 & 106 (special configuration)

Filter Kits

Preventative Maintenance kits are for generator sets with 500 hours of operation from last performed maintenance.

Kit	Hobart Part Number	Models Where Used
Preventative Maintenance Kit This kit includes: • Engine Oil Filter (286897-035) • (2) Lubricity/Fuel Water Separator Elements (286897-031) • Fuel Water Separator (Pre-Filter) Element (286897-033) • Fuel Filter Element (286897-034)	290300-008	All 50081A specifications ***except*** the 500181A-006 & -106 (special configuration)
Preventative Maintenance Kit This kit includes: • Engine Oil Filter (286897-035) • Fuel Filter (w/ Fuel Heater Option) Element (286897-032) • Fuel Water Separator (Pre-Filter) Element (286897-033) • Fuel Filter Element (286897-034)	290300-010	**Only** for the 500181A-006 & -106 (special configuration)

Hobart Ground Power - Supply Contact Information

Hobart Ground Power has a supply staff that is able to help with the quote and sale of parts. Our helpful supply staff is also able to provide delivery information for the customer.

Contact the Hobart Ground Power supply department staff for all maintenance parts:

e-mail: hgpparts@itwgsegroup.com

call (inside USA) 800-422-4166

call (other countries) 937-332-5050

Filter Pictures

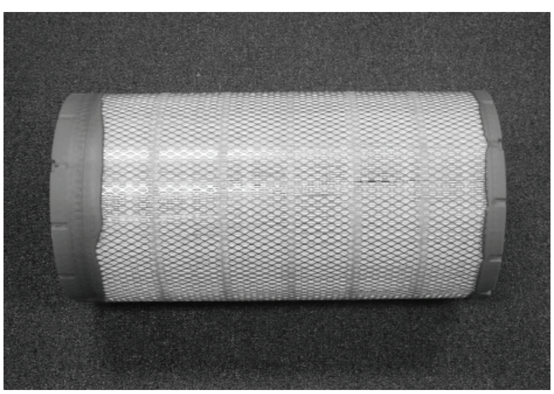
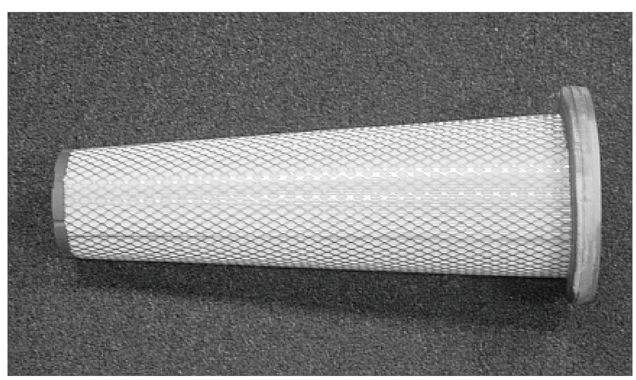
Replacement Oil and Fuel Filter Elements

	
Oil Filter (286897-035)	**Fuel Filter Element (286897-034)**

	
Fuel Water Separator Element (286897-033)	**Fuel Filter Element (286897-032)**

Lubricity Filter Element (286897-031)

Replacement Air Filter Elements

	
Primary Air Filter Replacement Element (290828)	**Secondary Air Filter Replacement Element (290829)**

OM-2162A
05/31/2011 – Original
01/12/2012 – Revision 1

Operation and Maintenance Manual
with
Illustrated Parts List
for
180CU20

180 kVA, 3 Phase, 115/200 Volt, 400 Hz. Generator Set

Series 500181A

Hobart Ground Power
Troy, Ohio 45373
U.S.A.
http://www.hobartgroundpower.com

HOBART GROUND POWER

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.

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Wet-Stacking in Generator Set

Diesel Engines

All diesel engines operated for extended periods under light load may develop a condition commonly referred to as wet-stacking. This condition results from the accumulation of unburned fuel in the exhaust system. It is recognizable by fuel oil wetness around the exhaust manifold, pipes, and muffler. Liquid fuel, in the form of droplets, may be spewed from the exhaust outlet.

Wet-stacking is common, and may be expected in diesel engines operated under light load. Light loads do not allow the engine to reach the most efficient operating temperature for complete combustion of fuel. The unburned fuel collects in the exhaust system to create the wet condition known as wet-stacking.

To alleviate wet-stacking in lightly loaded engines, it is recommended that the machine be connected to a load bank after each 200 hours of use and operated under full rated load for one hour. This will burn away and evaporate the accumulation of fuel in the exhaust system. This clean-out procedure should be considered as a regular maintenance operation for machines operated under light loads. The time schedule of 200 hours may be changed as required to suit each user’s particular needs and operating conditions.

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

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 and 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.

WARNING

CALIFORNIA PROPOSITION 65 - DIESEL ENGINES. Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects and other reproductive harm.

1) General

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

2) Shock Prevention

Bare conductors, terminals in the output circuit, or ungrounded, electrically live equipment can fatally shock a person. Have a certified electrician verify that the equipment is adequately grounded and learn what terminals and parts are electrically **HOT**. Avoid hot spots on machine. Use proper safety clothing, procedures, and test equipment.

The electrical resistance of the body is decreased when wet, permitting dangerous currents to flow through it. When inspecting or servicing equipment do not work in damp areas. Stand on a dry rubber mat or dry wood, and use insulating gloves when dampness or sweat cannot be avoided. Keep clothing dry, and never work alone.

a) Installation and Grounding of Electrically Powered Equipment

Equipment driven by electric motors *(rather than by diesel or gasoline engines)* 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 and use correctly mating receptacles.

b) Output Cables and Terminals

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

3) Service and Maintenance

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

a) Shut off all power at the disconnecting switch, or line breaker, or by disconnecting battery, before inspecting or servicing the equipment.

b) Lock switch OPEN (or remove line fuses) so that power cannot be turned on accidentally.

c) Disconnect power to equipment if it is out of service.

d) If troubleshooting must be done with the unit energized, have another person present who is trained in turning off the equipment and providing or calling for first aid.

4) Fire And Explosion Prevention

Fire and explosion are caused by electrical short circuits, combustible material near engine exhaust pipes, misuse of batteries and fuel, or unsafe operating or fueling conditions.

a) Electrical Short Circuits and Overloads

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.

b) Batteries

Batteries may explode and/or give off flammable hydrogen gas. Acid and arcing from a ruptured battery can cause fires and additional failures. When servicing, do not smoke, cause sparking, or use open flame near the battery.

c) Engine Fuel

Use only approved fuel container or fueling system. Fires and explosions can occur if the fuel tank is not grounded prior to or during fuel transfer. Shut unit **DOWN** before opening fuel tank cap. **DO NOT** completely fill tank, because heat from the equipment may cause fuel expansion overflow. Remove all spilled fuel **IMMEDIATELY**; including any that penetrates the unit. After clean-up, open equipment doors and blow fumes away with compressed air.

5) Toxic Fume Prevention

Carbon monoxide - Engine exhaust fumes can kill and cause health problems. Pipe or vent the exhaust fumes to a suitable exhaust duct or outdoors. Never locate engine exhausts near intake ducts of air conditioners.

6) 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 trouble-shooting and adjustment. Do not remove guards while equipment is operating.

7) 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. **CALL EMERGENCY RESCUE SQUAD IMMEDIATELY.**

8) 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 the 180CU20, 400 Hz Generator Set manufactured by Hobart Ground Power in Troy, Ohio USA.

The purpose of this manual is to provide information and instructions to experienced operators, electricians, and mechanics that 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. Please read the instructions before starting the unit.

1) Organization of this Manual

The manual contains four chapters plus an appendix. Each chapter contains as many sections as required. Each new section starts with page 1. Each page is identified by chapter, section and page number, which are located in the lower, outside corner.

When information located in another portion of the manual is referred to, its location is identified by a chapter and section. For example, "see Voltage Regulator Adjustments in Section 2-3" means that you should find the Voltage Regulator Adjustments topic in Chapter 2, Section 3. If a chapter and section are not indicated in a reference, the referenced material is located in the same section as the reference.

The next section, the Table of Contents, provides an overview of the manual. Also, the first page of each section, where appropriate, contains the contents for that section.

2) Company Contact Information

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

Write:	Hobart Ground Power Service Department 1177 Trade Road East Troy, Ohio 45373 U.S.A.	
E-Mail :	service@itwgsegroup.com	
Web Page :	http://www.hobartgroundpower.com	
Phone Numbers	**Inside U.S.A.**	**International**
Parts	(800) 422-4166	(937) 332-5050
Service	(800) 422-4177	(937) 332-5060
FAX	(800) 367-4945	(937) 332-5121

3) Terminology

Canopy: The sheet metal enclosure, identified as a canopy, provides protection for the engine, generator and electrical controls. The canopy reduces the operational noise level in the immediate area of the machine.

Engine Control Module (ECM): This module is part of the engine. It controls the engine functions, monitors the sensors, and reports engine faults.

Generator and Generator Set: The term "generator set" refers to entire unit including the engine, the generator, and the electronic controls. The term "generator" refers only to the power-generating unit that is turned by the engine.

Line-Drop Compensation: The voltage at the aircraft will be less than the voltage at the generator due to voltage losses ("line-drop") in the output cable. The voltage losses are directly proportional to the output current. The generator set compensates for these losses by raising or lowering the generator output voltage, depending on the output current, to provide the correct voltage to the aircraft.

Transformer-Rectifier (TR): This is a generator option for supplying a 28.5 VDC option.

4) Abbreviations

This manual uses the following abbreviations:

A, or AMP	-	Ampere
AC	-	Alternating current
Ay.	-	Assembly
DC	-	Direct current
ECM	-	Engine Control Module
Fig.	-	Figure
ft.	-	feet
ft-lbs	-	foot-pounds
GPU	-	ground power unit (this generator set)
hd.	-	Head
hex	-	Hexagon
HP	-	Horsepower
Hz	-	Hertz (cycles-per-second)
I.D.	-	Inside diameter or Identification
in.	-	Inch
lb.	-	Pound
kVA	-	Kilovolt-ampere
N-m		Newton-meters
No.	-	Number
Ref	-	Reference
T-R	-	Transformer-rectifier
V	-	Volt
VAC	-	Volts AC
VDC	-	Volts DC

5) Related Documentation

a) Engine Documentation

Cummins manufactures the engine used in this generator set. They produce the following documentation:

- Operation and Maintenance Manual
  Cummins Bulletin # 4021518
  Included with this generator set
- Parts Catalog
  Cummins Bulletin #4056552
  Not included – purchase separately from Cummins

b) Hobart Documentation

(1) Diagrams

Hobart provides the following diagrams for your generator set. These are located in the Appendix of this manual:

Diagram Number	Diagram Description
291619, rev. 0	Diagram, Schematic & Connection
289022, rev. 2	Diagram, Connection, Control Box
289002, rev. 6	Diagram, Connection, Power Module
289013, rev. 3	Diagram, Connection, Switch Box
289011, rev. 7	Diagram, Connection, Transformer-Rectifier

Contact Hobart Ground Power if copies of these drawings or manuals are not with this manual (unless otherwise noted above).

(2) Additional Manuals

Some of the available options include user manuals. Where appropriate, those manuals are included in the appendix of this document. These include:

TO-328: Installation and Operating Instructions for the Service Tool Software

TO-329: Operation and Instruction Manual for the CAN-Bus Meter

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Table of Contents

The column on the right shows the Chapter – Section / Page Number.

Front

Preventive Maintenance .... **Front Pocket**

Warranty
Warranty Statement 1
Wet Stacking in Generator Set 3
Unusual Service Conditions 3

Safety Warnings
General 1
Shock Prevention 1
Service and Maintenance 2
Fire and Explosion Prevention 2
Toxic Fume Prevention 3
Bodily Injury Prevention 3
Medical and First Aid Treatment 3
Equipment Precautionary Labels 3

Introduction
Organization of this Manual 1
Company Contact Information 1
Terminology 2
Abbreviations 2
Related Documentation 3

Table of Contents

Chapter 1: Description/Operation

Section 1: Description **1-1/1**
Part Numbers 1-1/3
Specifications 1-1/4
Component Parts 1-1/6
Optional Equipment 1-1/10
Engine Description 1-1/11
Generator Description 1-1/15
Control Electronics 1-1/16
Power Module Panel Assembly 1-1/27
Transformer-Rectifier Assembly Components 1-1/29

Section 2: Preparation for Use, Storage or Shipping **1-2/1**
Preparation for Use 1-2/1
Preparation for Storage 1-2/5
Preparation for Shipment 1-2/6

Section 3: Operation ... 1-3/1
Pre-Start Inspection ... 1-3/1
Operator Controls ... 1-3/2
Engine Operation ... 1-3/3
AC Power Operation ... 1-3/4
DC Operation (optional) ... 1-3/6
Simultaneous AC and DC Operation ... 1-3/6

Chapter 2: Servicing / Troubleshooting

Section 1: Maintenance Inspection/Check ... 2-1/1
Maintenance Schedule ... 2-1/1
Inspection / Check ... 2-1/4
Lamps, Circuit Breakers, and Fuses ... 2-1/11

Section 2: Maintenance Procedures ... 2-2/1
Lubrication ... 2-2/2
Air Cleaner Maintenance ... 2-2/5
Engine Fuel Selection ... 2-2/7
Engine Fuel System ... 2-2/8
Engine Cooling System ... 2-2/11
Generator Maintenance ... 2-2/14
Drive Belt ... 2-2/14

Section 3: Adjustments / Tests ... 2-3/1
Tools and Equipment ... 2-3/2
Generator Meters, Controls, and Circuit Boards ... 2-3/3
Testing the 400 Hz. Generator Set ... 2-3/8
Generator Set Adjustments ... 2-3/14
Generator and Exciter Tests ... 2-3/15
Transformer-Rectifier Tests ... 2-3/16
Adjusting the Transformer-Rectifier ... 2-3/18

Section 4: Troubleshooting Procedures ... 2-4/1
General Troubleshooting Information ... 2-4/2
Interpreting Fault Codes ... 2-4/3
Symptoms Tables ... 2-4/9
Commands and Fault Codes Tables ... 2-4/20

Chapter 3: Overhaul / Major Repair

Section 1: Rebuilding the Generator 3-1/1
Company Contact Information 3-1/2
Generator Overview 3-1/3
Tools and Supplies 3-1/4
Generator Disassembly 3-1/6
Generator Reassembly 3-1/18

Chapter 4: Illustrated Parts List

Section 1: Introduction 4-1/1
Which Parts are Included 4-1/1
Explanation of the Parts List Columns 4-1/1

Section 2: Numerical Index 4-2/1

Section 3: Illustrated Parts List 4-3/1
Figure 1: General Assembly 4-3/2
Figure 2: Labels and Reflectors 4-3/4
Figure 3: Frame Assembly 4-3/6
Figure 4: Canopy Assembly 4-3/8
Figure 5: Canopy Doors 4-3/10
Figure 6: Internal Components 4-3/12
Figure 7: Control Box Door Panel Assembly 4-3/14
Figure 8: Control Box Interior Components 4-3/16
Figure 9: Pushbutton Switches 4-3/18
Figure 10: 400 Hz. Power Module Assembly 4-3/20
Figure 11: Cooling System Components 4-3/22
Figure 12: Engine Ground Plate and Cables 4-3/24
Figure 13: Fuel System Components 4-3/26
Figure 14: Engine Exhaust Components 4-3/28
Figure 15: 12 VDC Battery System 4-3/30
Figure 16: Air Cleaner Components 4-3/32
Figure 17: Engine Components 4-3/34
Figure 18: Engine Electrical Panel Components 4-3/36
Figure 19: Generator Assembly 4-3/38
Figure 20: Transformer-Rectifier Assembly (DC Option) 4-3/40
Figure 21: DC Output Contactor (DC Option) 4-3/42

Appendix A: Additional Information

Optional Manuals (where applicable)

TO-328 (for 500181A -005, -105, and -107)
TO-329 (for 500181A -005 and -105)

Diagrams (all models)

291619: Diagram, Schematic & Connection
289022: Diagram, Connection, Control Box
289002: Diagram, Connection, Power Module
289013: Diagram, Connection, Switch Box
289011: Diagram, Connection, Transformer-Rectifier

Chapter 1: Description/Operation

Section 1: Description

This manual describes a 180-kVA generator set manufactured by Hobart Ground Power, Troy, Ohio 45373. This generator system is designed to provide ground power for maintenance and startup of aircraft having 115/200-V, 400-Hz, three-phase electrical systems. Some generator models with the TR option also provide 28.5 volts DC for aircraft having those requirements.
This section includes the following information:

1) Part Numbers 3

2) Specifications 4

- a) Physical Specifications.....4
- b) AC Generator Specifications.....4
- c) Generator Protective System Specifications.....4
- d) DC Output Specifications (with optional TR unit).....5
- e) Engine Specifications.....5
- f) Normal Engine Operating Characteristics.....5

3) Component Parts.....6

- a) External Components.....6
- b) Orientation.....7
- c) Right Side Components.....8
- d) Left Side Components.....9

4) Optional Equipment 10

5) Engine Description.....11

- a) Electrical System (Cummins).....11
- b) Lubricity Additive Fuel Filters (Cummins).....11
- c) Oil Filter (Cummins).....11
- d) Electronic Control Module (Cummins).....11
- e) Engine Cooling Fan.....11
- f) Battery Disconnect Switch.....11
- g) Shut Down/Reset Protective Systems.....12
- h) Emergency Shutdown/Reset Switch.....12
- i) Coolant high temperature shutdown system.....12
- j) Oil pressure shutdown system.....12
- k) Radiator and Charge-Air-Cooler (CAC).....12
- l) Air cleaner.....12

m) Engine Faults 13
n) Cold Weather Starting System 14
6) Generator Description 15
7) Control Electronics 16
a) Engine Gauges 17
b) Generator Gauges 18
c) Operator's Pushbutton Switches 19
d) Control Box Interior Components 20
(1) Circuit breakers (CB1, CB4, CB7) 21
(2) Control Power Supply (PS1) 21
(3) Digital Control PC Board [CTL] (A3) 22
(4) Engine Interface PC Board [EIB] (A2) 23
(5) Engine Specific PC Board [ESB] (A1) 24
(6) Voltage regulator PC board [REG] (A4) 24
(7) Transformer-Rectifier PC Board [TRB] (A404) 26
8) Power Module Panel Assembly 27
a) Load Contactors 28
b) Current transformers (CT1-CT6) 28
9) Transformer-Rectifier Assembly Components 29

1) Part Numbers

The model number of your generator set is 180CU20, which is a large family of 180 kVA generators. The more specific part number (or spec number) is the combination of the Series number (500181A) and a dash number, which indicates the specific configuration. Table 1 shows the part number variations covered in this manual.

Part Number	Mounting	Generator Meters	AC Outputs	28.5 V DC Output	Fuel Tank
500181A-001	Trailer	Analog	2	--	Stainless
500181A-002	Fixed/Truck	Analog	2	--	Stainless
500181A-003	Trailer	Digital	2	Yes	Stainless
500181A-004	Fixed/Truck	Analog	2	Yes	Stainless
500181A-005 (Special Configuration)	Trailer	Digital	2	--	Stainless
500181A-006 (Special Configuration)	Trailer	Analog	2	--	Stainless
500181A-101	Trailer	Analog	2	--	Composite
500181A-102	Fixed/Truck	Analog	2	--	Composite
500181A-103	Trailer	Analog	2	Yes	Composite
500181A-104	Fixed/Truck	Analog	2	Yes	Composite
500181A-105 (Special Configuration)	Trailer	Digital	2	--	Composite
500181A-106 (Special Configuration)	Trailer	Analog	2	--	Composite
500181A-107 (Special Configuration)	Trailer	Digital	2	--	Composite

Table 1: Series 500181A Generator Part Number Descriptions

To identify the generator set part number (series and dash number), refer to the data plate located on the control box door near the emergency stop.

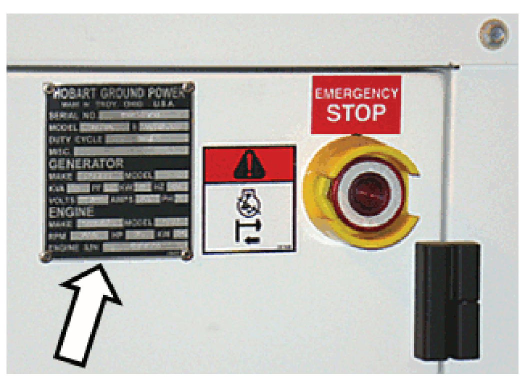


Figure 1: Model Identification

2) Specifications

a) Physical Specifications

Physical	Basic Unit (Fixed Mount)	With Trailer
Length	124 in. (3150 mm)	196 in. (4978 mm) Tow-bar Extended
Width	62 in. (1575 mm)	78 in. (1981 mm)
Height	66 in. (1676 mm)	76 in. (1930 mm)
Weight (Full of Fuel)	7800 lb. (3538 kg.)	8300 lb. (3765 kg.)
Weight with 28.5 VDC T-R	8100 lb. (3674 kg.)	8600 lb. (3901 kg.)

b) AC Generator Specifications

Output power rating	180 kVA (144 kW)
Output voltage	115 / 200 VAC, three-phase
Rated load capacity	522 Amps
Frequency	400 +/- 2 Hz at all output loads
Power factor	0.8
Duty Cycle	100%
Operating speed	2000 RPM
Overload capacity, both outputs 125% rated load	652 Amps
Output cable size	2/0 AWG

c) Generator Protective System Specifications

Condition	Trip Point	Time Delay
Over voltage	126 volts	1-second
	140 volts	160 milliseconds
	180 volts	50 milliseconds
Under voltage	any voltage below 100 volts	7 seconds
Over frequency	420 Hz to 480 Hz	5 seconds
	above 480 Hz	immediate
Under frequency	380 Hz. or less	7-seconds
Output overload	125% load of 90 kVA on either output or 125% of 180 kVA on both outputs combined	approximately 5 minutes
	150% load	30 seconds
	200% load	10 seconds

d) DC Output Specifications (with optional TR unit)

Output Voltage	28.5 VDC
Amps (Continuous)	600 A
Amps (Peak/Starting/Overload)	2700 A for 2 seconds 2000 A for 10 seconds 1500 A for 30 seconds 1200 A 90 seconds 750 A 600 seconds

e) Engine Specifications

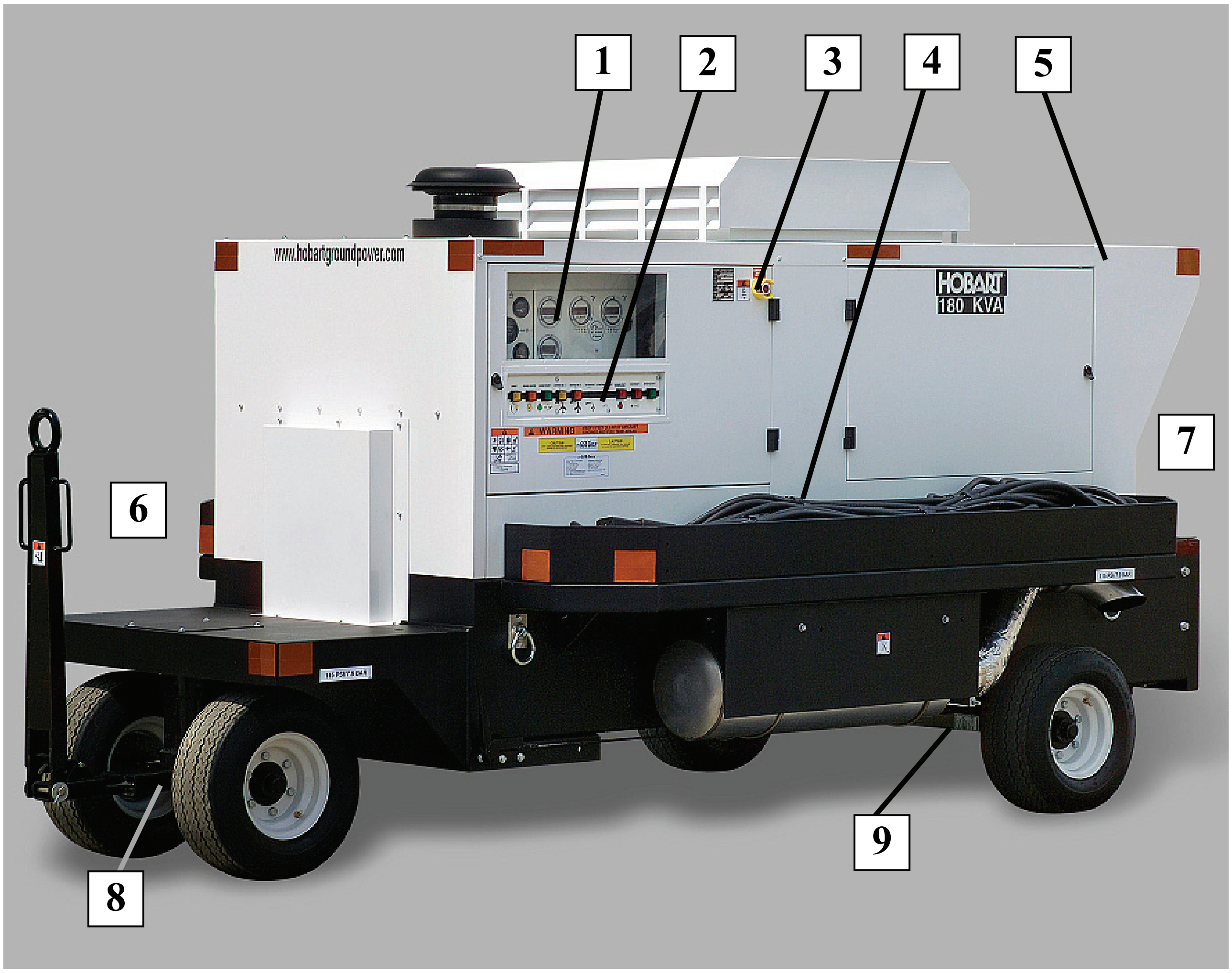
Manufacturer	Cummins Engine Company
Model No.	QSL9.0
Type	6 cylinder, 4 cycle diesel, electronic controlled
Bore and Stroke	4.49 in. x 5.69 in. (114 mm x 145 mm)
Displacement	543 in^3 (8.9 L)
Horsepower	325 hp (242 kW)
Idle speed	1000 ± 50 rpm
High speed limiting	2350 ± 75 rpm
Normal governed speed	2000 rpm
Firing Order	1-5-3-6-2-4
Electrical system	12 VDC
Ground	Negative
Lubricating oil capacity (w/ filter)	24 quarts (22.7 liters)
Coolant capacity system	59 quarts (55.8 liters)

f) Normal Engine Operating Characteristics

Engine oil pressure (warm and at rated speed 2000 RPM)	45 to 90 PSI (445 to 621 kPa)
Engine coolant temperature (normal operation)	160 to 200º F (71 to 93º C)

3) Component Parts

a) External Components



1. Control Panel
2. Operator's Pushbutton Panel
3. Emergency Stop Switch (S28)
4. Output Cable Location
5. Canopy
6. Generator End
7. Radiator End
8. Front Axle Assembly
9. Rear Axle Assembly
10. Exhaust Outlet (Not Shown)

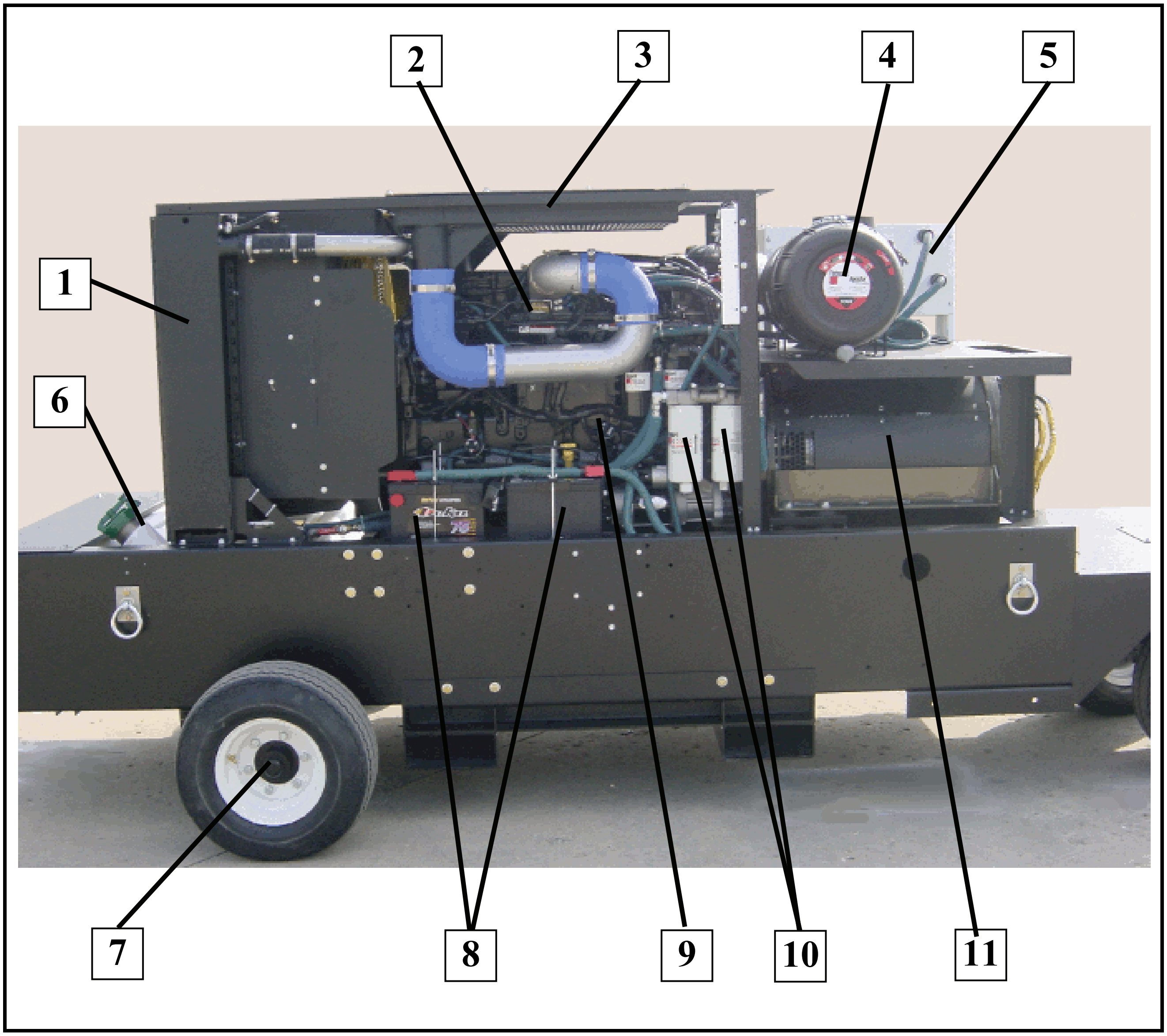
Figure 2: External Components

b) Orientation

For purpose of orientation, the radiator is considered to be at the REAR of the unit. The generator and controls are at the FRONT. RIGHT and LEFT are determined by standing at the REAR end facing the machine. Thus, the control box is mounted on the LEFT FRONT side of the unit.

Figure 3: Orientation

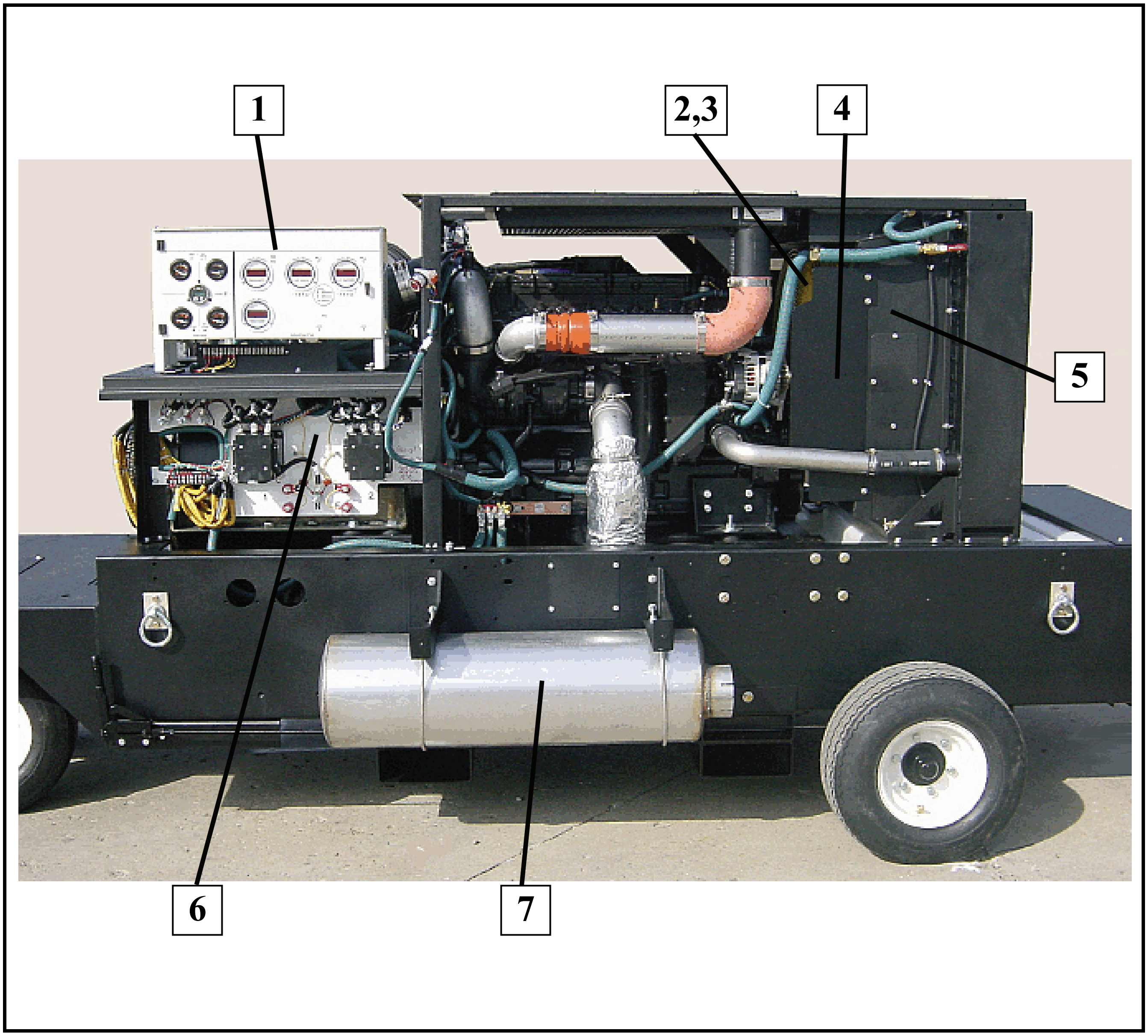
c) Right Side Components



1. Radiator
2. Air Intake Heater (BH1)
3. Charge-Air-Cooler
4. Air Cleaner
5. Control Box
6. Fuel Tank (filler neck)
7. Rear Axle
8. 12 VDC Batteries (BT1, BT2)
9. Cummins QSL 9.0 Engine
10. Lubricity Filters
11. Generator

Figure 4: Right Side Components

d) Left Side Components



1. Control Box
2. Engine Cooling Fan
3. Fan Guard
4. Alternator Fan/Belt Guard
5. Radiator Fan Shroud
6. Dual Output Power Module
7. Exhaust Muffler
8. Exhaust Muffler Shield (Not Shown)
9. Exhaust Piping (Not Shown)

Figure 5: Left Side Components

4) Optional Equipment

The following is a list of options available for the 180CU20, 400 Hz. Generator Set. This chart contains the description, part number, and document number (if applicable) of the option/feature.

Description	Part Number	Document Number
Trailer, with Tongue Actuated Brakes/Cable Trays	Standard	TO-257
Trailer, with Lever Actuated Brakes/Cable Trays	No Number	TO-241
Kit, Noise Reduction	287911	n/a
Kit, Spotlight	289064	n/a
Kit, Block Heater, 120V	289261-007	n/a
Kit, Block Heater, 240V	-	n/a
Kit, Fire Extinguisher, 5 lb. Carbon Dioxide	283012	TO-252
Kit, Pin Hitch	381441	381441
Kit, Pintle Hitch	76A1361	76A1361
Kit, Fixed Mounting	287892	n/a
Support, Fork Lift Assembly	290797	n/a
Kit, Tie-Down	284706	n/a
Kit, Unit Operating, Non-Flashing Beacon*	288909-XXX	n/a
Kit, Low Fuel, Flashing/Non-Flashing Beacon*	289065-XXX	n/a
Kit, Low Fuel Strobe Beacon*	Call Factory	n/a
Drawbar, 1-1/2” Eye	286944	n/a
T-Handle Latch (as required)	287542-002	n/a
Wheel Chocks	287609	n/a
Kit, Clearance Lights	288912	TO-297
Kit, Transformer-Rectifier, 28 VDC	Call Factory	OM-2136
Service Tool Installation and Operation Manual	-	TO-328
Kit, Can-Bus Meter	290090	TO-329

* – A large number of variations exist under this part number. Call the factory for details.

n/a – Not Available, call the factory for details.

5) Engine Description

The basic diesel engine is a fuel injection, 6-cylinder, electronically controlled engine rated at 325 horsepower. Items marked “Cummins” are supplied by the engine manufacturer. Refer to the engine operation manual for more details on those items. All other items are added by Hobart.

a) Electrical System (Cummins)

The 12 VDC electrical generating and starting system includes an alternator, voltage regulator, starter with solenoid switch and a battery disconnect switch.

b) Lubricity Additive Fuel Filters (Cummins)

The lubricity fuel filter is a spin-on disposable type, located on the interior bulkhead located in the middle of the unit, on the right-hand side. The lubricity fuel filter’s primary function, other than remove contaminants from the fuel, is to automatically add a lubricity additive to the fuel. Although, the engine manufacturer does not recommend low lubricity fuels, this additive can extends the life of the fuel pump.

CAUTION

The use of low lubricity fuels can shorten life and/or damage the engine’s fuel pump. Only diesel fuel is recommended by the engine manufacturer.

c) Oil Filter (Cummins)

The engine oil filter is a spin-on, full-flow type, located on the right side of the engine near the front.

d) Electronic Control Module (Cummins)

The electronic control module (ECM) is a pre-programmed engine control module, mounted directly to the engine block.

e) Engine Cooling Fan

The engine fan blows air outward through the radiator, rather than pulling the air inward as a conventional fan does.

f) Battery Disconnect Switch

The battery disconnect switch is located on the right side of the GPU and is mounted to the center support. This switch allows the user to remove battery power from the whole machine. This switch should be turned off whenever the GPU is stored. This switch can also be used as an emergency shutdown switch if for some reason the emergency shutdown/reset switch (S28) does not shut the unit down.

g) Shut Down/Reset Protective Systems

In addition to the other devices provided by the engine manufacturer, the factory also added an engine shutdown/reset feature.

h) Emergency Shutdown/Reset Switch

The emergency shutdown switch has two purposes. One is to reset the starting circuit following a failed starting sequence. The other is to provide instant manual shut off of the generator set by disconnecting power to the ECM through the control box. It is located on the left side of the generator set near the control box.

To operate the Emergency Shutdown/Reset Switch:

- Push the button in until the engine stops or until button travel stops
- Pull the button back out to reset

i) Coolant high temperature shutdown system

The coolant temperature shutdown system consists of a factory supplied temperature switch. The microprocessor on the Engine Interface Board (EIB) PC Board monitors the switch and will stop the engine if the temperature reaches 230º F (110º C).

j) Oil pressure shutdown system

The oil pressure shutdown system consists of a factory supplied oil pressures switch. The microprocessor on the Engine Interface Board (EIB) PC Board monitors the switch and will stop the engine if the oil pressure is under 12 PSI (82.7 kPA).

k) Radiator and Charge-Air-Cooler (CAC)

The radiator and charge-air-cooler is a two-piece type designed for long periods of operation without servicing. Refer to Section 2-1 for servicing procedure.

l) Air cleaner

The diesel engine air cleaner is so constructed that air enters through its cylindrical body and then is filtered in the process before being passed onto the engine turbocharger assembly. An air cleaner service indicator device is mounted to an intake air pipe between the air cleaner and the turbo inlet. As the air cleaner becomes filled with dust, dirt, and carbon, the intake system airflow becomes increasingly restricted. This restriction causes a diaphragm inside the indicator to move toward an electrical contact. When the maximum allowable restriction level is reached, the circuit closes and the air cleaner indicator fault appears on the control panel fault display to warn the operator that the air cleaner must be changed. The electrical indicator automatically resets when the restriction level drops sufficiently.

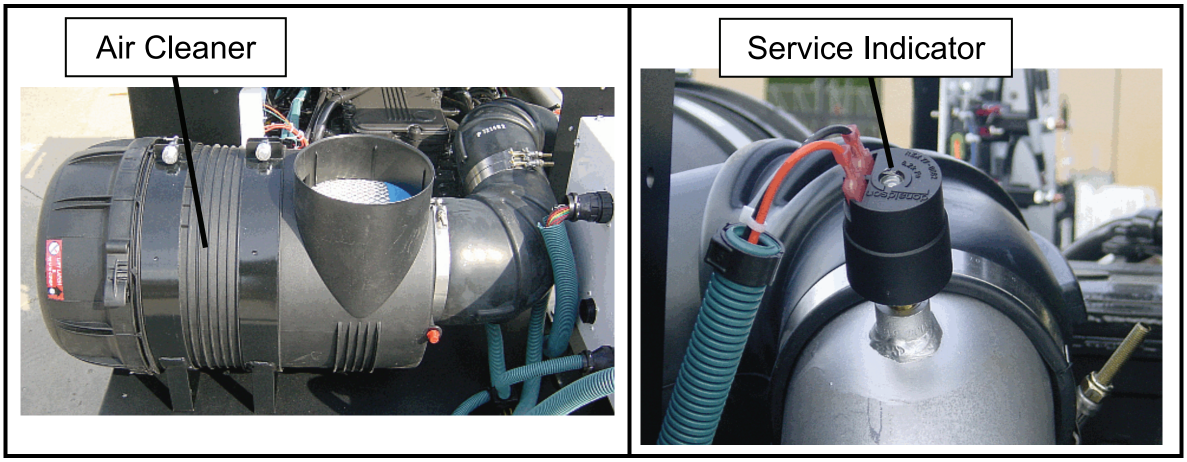


Figure 6: Air Cleaner and Service Indicator

m) Engine Faults

The following table lists the engine faults, which may occasionally occur. Column two explains the system response to the fault, and column three give the preferred method of returning the generator set to service once the problem is solved. Refer to Chapter 2 for more details on all other faults.

Engine Fault Condition	What Occurs	How To Reset
Over temperature or low oil pressure	Shuts down the engine and displays the appropriate fault code	Press the engine stop button to reset the fault code and reset the protective system.
Low fuel warning and shutdown	Turns on the low-fuel indication on the fault code meter (FUEL). The GPU is programmed at the factory to warn at 1/4 tank and to shutdown at 1/8 tank.	The low fuel fault indicating function must be reset by pressing the engine stop button. Fuel must be added prior to attempting another engine start.
Clogged air cleaner or other restriction in the combustion air inlet	Turns on the air restriction indication on the fault code meter (Air).	Press the engine stop button. The restriction must be removed prior to attempting another engine start.

Table 2: Engine Faults

n) Cold Weather Starting System

The intake air heater (shown below), located on the intake manifold, is used for starting the engine at very cold temperatures. This cold weather starting system is a fully automatic once engaged by the operator (Chapter 1, Section 3). The intake air heater (or grid heater, shown as "BH1" on the schematic) is energized or de-energized from a power relay controlled by the ECM. The amount of time the air intake heaters stay on, in the preheat phase, is a function of the intake manifold temperature at start up. The pre-heat time increases with colder intake manifold temperatures to a maximum duration of 30 seconds. During cranking, the intake air heater is turned off to allow maximum current to be used by the starter.

Attempting to start a cold engine without first warming the engine can result in excessive white smoke exhaust, and the engine may be hard to start.

CAUTION

Never use an ether start system in conjunction with the air intake heater.

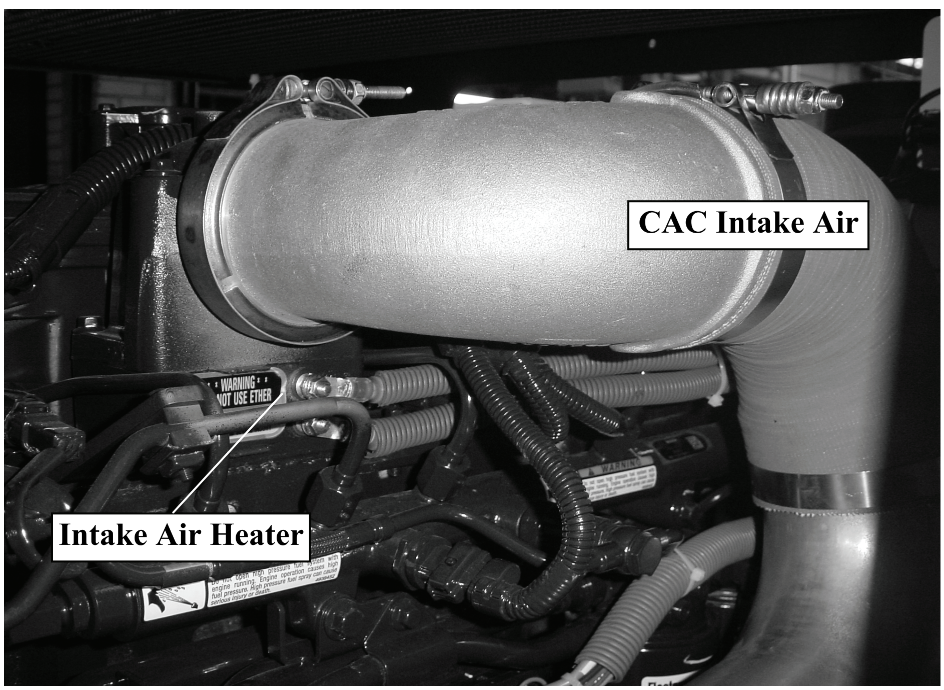


Figure 7: Air Intake Heater

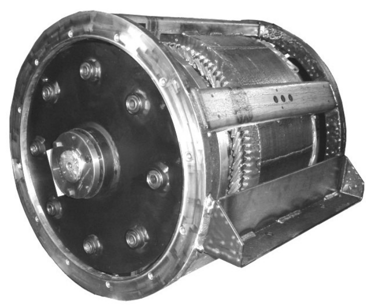
Cummins supplies the heating elements. Hobart supplies the associated relay and fuses (on the engine E-Panel).

6) Generator Description

The 400 Hz generator is a brushless, revolving field, three-phase, alternating current type. The generator set covered by this manual is a dual-bearing type. The front end of the rotor shaft extends forward beyond the front bearing and is attached to the engine flywheel by a flexible coupling assembly. The rear end of the rotor shaft extends rearward beyond the rear bearing and into the exciter stator housing. The exciter rotor is mounted on this shaft extension with a key and is secured by a washer and 1/2-13 thread cap screw.

A rectifier with six diodes is mounted on the exciter rotor and converts exciter AC output to DC for excitation of the generator revolving fields. The voltage regulator PC board (REG) controls the exciter DC output to the generator fields and consequently the generator output.

A centrifugal, radial-blade fan, which is part of the flexible coupling assembly, draws cooling air over all internal windings. Air enters at the exciter end and is discharged at the drive end. The complete generator assembly is bolted to the engine flywheel housing.



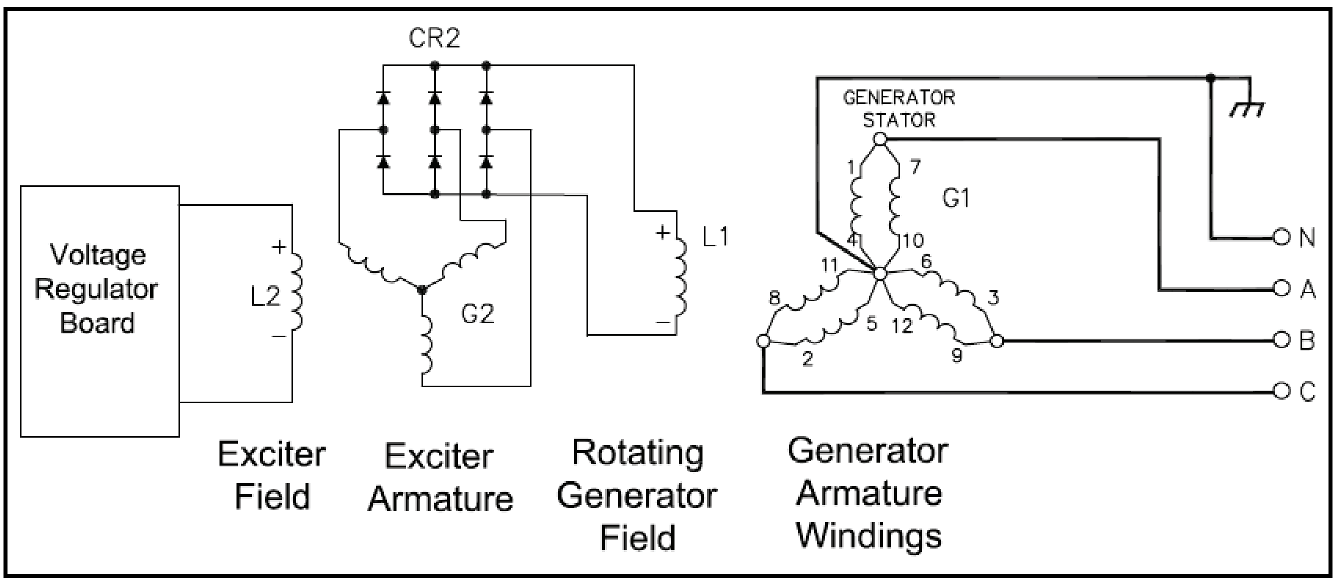
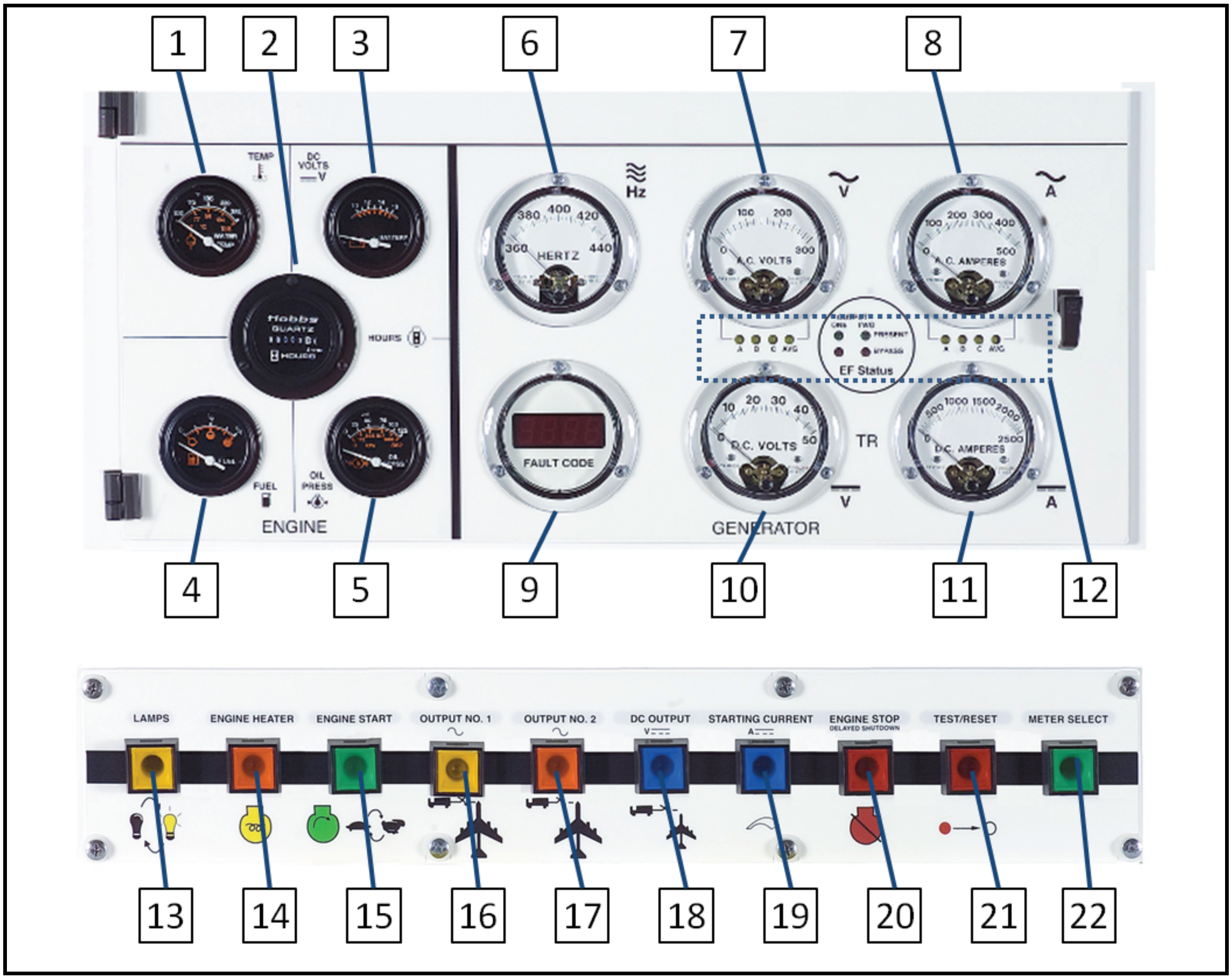


Figure 8: Generator

7) Control Electronics

The control box is a sheet metal enclosure that houses the engine and generator controls and monitoring equipment.



1. Engine Coolant Temperature Gauge (M24)
2. Running Time Meter (M4)
3. Battery Voltmeter (M5)
4. Fuel Gauge (M13)
5. Oil Pressure Gauge (M25)
6. Frequency Meter (M3)
7. AC Generator Voltmeter (M2)
8. AC Generator Ammeter (M1)
9. Fault Code Meter (M6)
10. DC Voltmeter *[Optional with TR]*
11. DC Ammeter *[Optional with TR]*
12. Front LED Display (A5)

13. Panel Light Switch (S74)
14. Air Intake Heater Switch (S79)
15. Engine Start Switch (S24)
16. AC Output No. 1 Switch (S75)
17. AC Output No. 2 Switch (S275)
18. DC Output Switch (S430) *[Optional with TR]*
19. DC Starting Current Switch (S431) *[Optional with TR]*
20. Engine Stop Switch (S76)
21. Test/Reset Switch (S77)
22. Meter Selector Switch (S3)

Figure 9: Control Panel Door

a) Engine Gauges

The engine gauges are mounted on the left side of the control panel door.

Gauge	Function	Description
Engine coolant temperature gauge (M24)	Indicates engine coolant temperature in the range of 100-280 º F (38-138º C)	Connected by a wire to a water temperature sensor installed in the engine cooling system
Engine voltmeter (M5)	Shows the voltage on the 12 VDC battery system.	Graduated 10 V to 16 V
Engine fuel gauge (M13)	Indicates fuel level in tank	Connects to a sending unit in the fuel tank. On when the engine is running. To check the fuel level when the unit is not running, press the panel light LAMPS pushbutton switch.
Engine oil pressure gauge (M25)	Indicates engine oil pressure in the range of 0 to 125 PSI (0 to 862 kPA)	Connects by a wire to an oil pressure sensor installed in the engine lubricating system
Engine hour meter (M4)	Indicates the engine's running time up to 9999.9 hours.	Functional only when the engine is running
CAN Bus Meter (optional)	Replacement option for a conventional hour meter (M4)	Refer to technical options manual TO-329 in the appendix if your generator set uses this option.

b) Generator Gauges

The generator gauges are mounted on the right side of the control panel door. The meters shown in the figure and described here are all analog, but digital meters are available as an option.

Gauge	Function	Description
Frequency Meter (M3)	Indicates generator output frequency	The meter range is 360 to 440 Hz (cycles per second).
AC Voltmeter (M2)	Indicates the generator output voltage in each phase-to-neutral (A-N, B-N and C-N) or phase-to-phase (A-B, B-C and C-A) as selected by the METER SELECT switch	The voltmeter scale is 0 to 300 V.
AC Ammeter (M1)	Indicates the generator output current in each phase (A, B and C) as selected by the METER SELECT switch	The ammeter scale is 0 to 520 A.
Fault Code Meter (M6)	Displays codes to indicate engine faults such as over temperature, air cleaner restriction, low oil pressure, or low fuel and generator problems such as over voltage, under frequency, or output overload	Chapter 2, Section 4 contains troubleshooting tables with the complete list of fault codes, possible causes, and corrective actions.
Front LED Display (A5)	Indicates which voltage (A-N, A-B, etc…) and amperage are shown on the meters. Also shows EF status (present or bypassed)	This EF BY-PASS indicator serves to warn the operator that if the plug interlock system was by-passed, any exposed cable may be live.
DC Voltmeter [Optional with TR]	Displays the transformer-rectifier's output voltage (0 to 50 VDC)	Refer to Appendix A for more information if your unit has the DC output option
DC Ammeter [Optional with TR]	Displays the DC output current (0 to 2500 A)	Refer to Appendix A for more information if your unit has the DC output option

c) Operator's Pushbutton Switches

The switches are located below the gauges. Some of the switches have internal lights that function as indicators.

Switch	Function
LAMPS (Yellow - S74)	This button turns on the meter lights. It also activates the fuel gauge when the engine is not running.
ENGINE HEATER (Orange - S79)	This button activates the manifold air intake heater, which is a standard cold starting aid. The heater typically stays on for a period of approximately 30 seconds, which is indicated by the light on the pushbutton. When the light goes out, the engine is ready to start. Refer to the "Cold Weather Starting System" above and to Section 1-3.
ENGINE START (Green - S24)	When the engine is off, pressing the ENGINE START switch starts the engine and brings it to idle speed (1000 RPM). When the engine is running at idle speed, pressing this button takes the engine to run speed (2000 RPM) and activates the generator. Pressing the button again returns the engine to idle speed and deactivates the generator. The indicator flashes at idle speed and remains on steady at run speed.
OUTPUT NO. 1 (Yellow - S75) OUTPUT NO. 2 (Orange - S275)	The OUTPUT pushbutton switches control the output contactors. When an output is turned on (contactor closed), the indicating light within the switch turns on, indicating that power is available at the plug. When the load contactor opens for any reason, the light turns OFF.
DC OUTPUT (Blue - S430) [Optional with TR]	The DC OUTPUT pushbutton switch controls the DC output contactor. When an output is turned on (contactor closed), the indicating light within the switch turns on, indicating that power is available at the plug. When the load contactor opens for any reason, the light turns OFF.
STARTING CURRENT (Blue - S431) [Optional with TR]	When the STARTING CURRENT pushbutton switch is pressed, the BLUE indicator light turns on and the fault code meter displays the present current limiting setting. To change the setting, hold the button in. The setting increments in 100 A steps up to 2500 A and then starts over from 200 A. Release the button when the desired setting is displayed.
ENGINE STOP (Red - S76)	When the ENGINE STOP pushbutton switch is pressed, the red indicator blinks. Then a three to five minute delay permits the turbo and other engine components to cool evenly. After the delay, power is disconnected from the engine ECM causing the engine to shut down.
TEST/RESET (Red - S77)	When the fault code meter displays a fault, press the TEST/RESET to reset the fault. Pressing the TEST/RESET pushbutton switch can also test the operation of the fault code meter. Do not perform a meter test while powering a load because the test opens the contactors during the test cycle.
Meter Select pushbutton switch (Green - S3)	This switch works with the LED indicators located below the generator voltmeter and ammeter. Use the switch with the voltmeter to select phase-to-neutral voltages (A-N, B-N, or C-N) or phase-to-phase voltages (A-B, B-C, or A-C) or averages (AVG). Use the switch with the ammeter to select current in any of the phases (A, B, or C) or average (AVG).

d) Control Box Interior Components

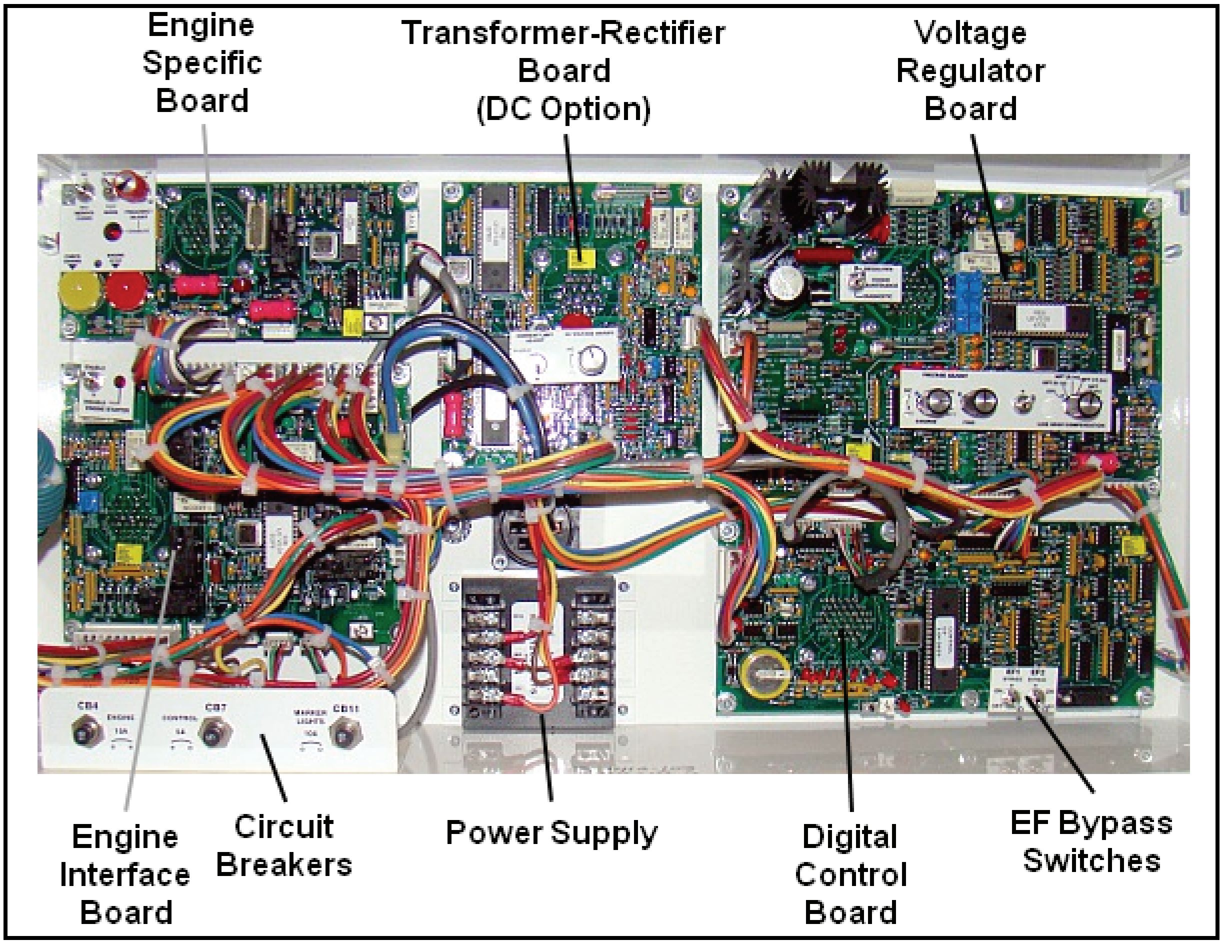


Figure 10: Control Box Interior Components

(1) Circuit breakers (CB1, CB4, CB7)

Breaker	Rating	Function
ENGINE (CB4)	10 A	Protects the 12 VDC engine electrical and fault circuits
CONTROL (CB7)	5 A	Protects the 12 VDC control system
MARKER LIGHTS (CB 11)	10 A	Protects the 12 VDC lighting system

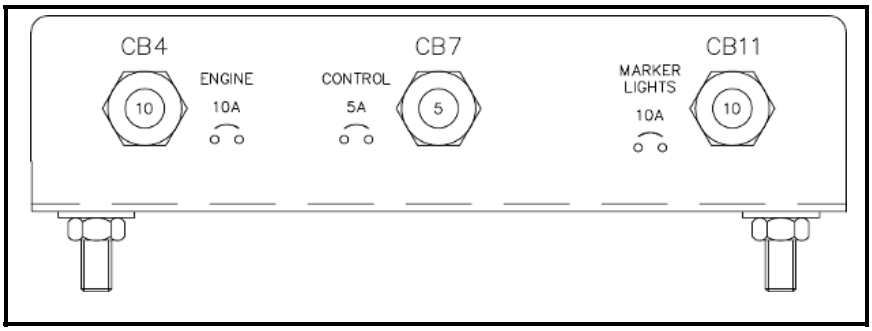


Figure 11: Circuit Breakers

(2) Control Power Supply (PS1)

The power source supplies the +5 VDC and –12 VDC power for the control system.

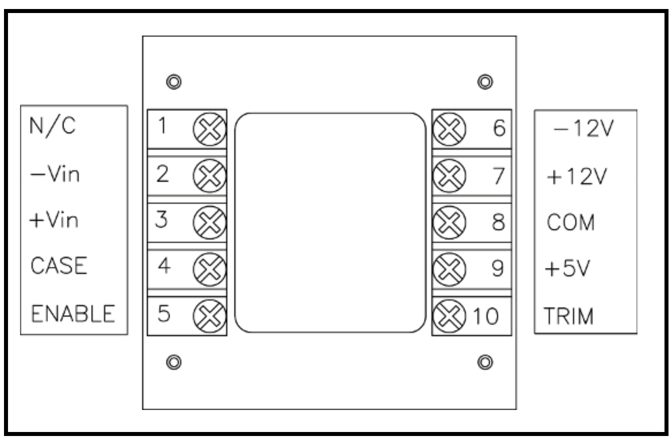


Figure 12: Control System Power Source

(3) Digital Control PC Board [CTL] (A3)

The digital control PC board is the center for all communications throughout the entire control system. The Digital Control PC Board interprets the pushbutton panel commands and communicates the commands to the appropriate areas (i.e. other PC boards) in the control system. The digital control PC board also controls the real time clock, monitors the over/under voltage and overload protection, controls the pushbutton panel indicator lights, drives the generator output meters, monitors the EF bypass switches, and communicates with the optional service tool.

The control board contains two EF Bypass switches: EF1 BYPASS for Output 1 and EF2 BYPASS for Output 2. These provide a means of bypassing the 28 VDC interlock circuit for that contactor when supplying power to a load bank or to an aircraft not equipped with a plug interlock system.

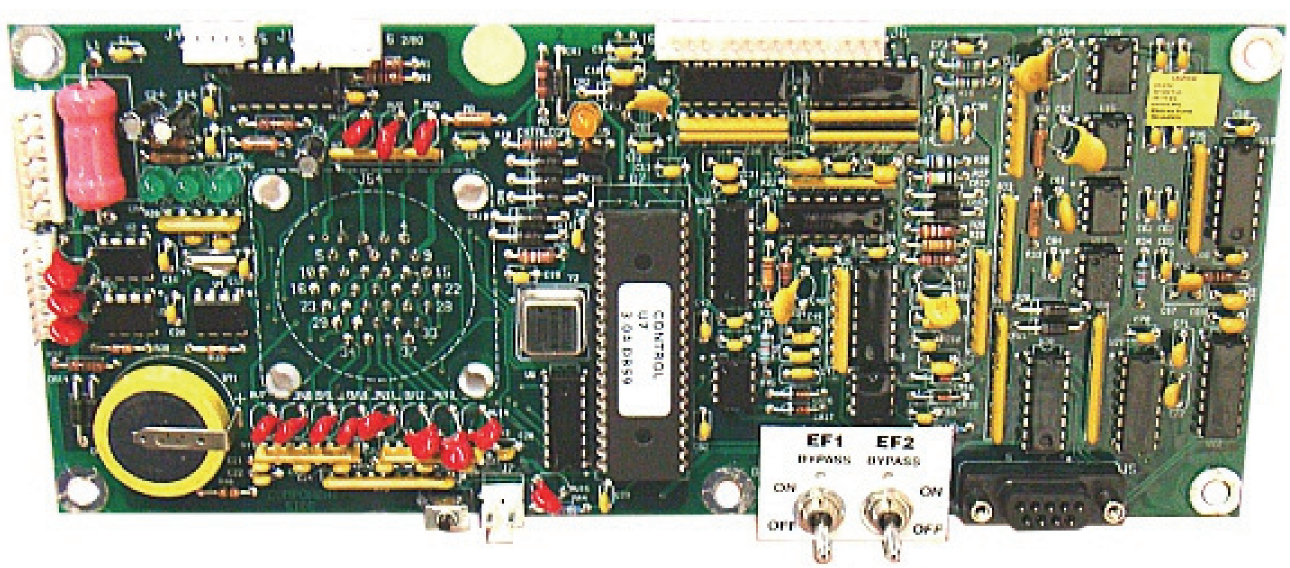


Figure 13: Digital Control PC Board

The service tool connector is located on the lower right side of the board next to the EF Bypass switches. This connector is used with the optional Service Tool software for monitoring the operation of the generator set.

(4) Engine Interface PC Board [EIB] (A2)

The EIB monitors coolant temperature, oil pressure, battery voltage, and fuel tank level. The EIB is also responsible for the monitoring the warning switches for high coolant temperature, low oil pressure, high air restriction, and low coolant level (optional). When and engine fault is detected, the EIB sends the information to the control board (CTL).

The EIB also controls the power distribution in the control system, hour meter, lights, and the engine starter operation.

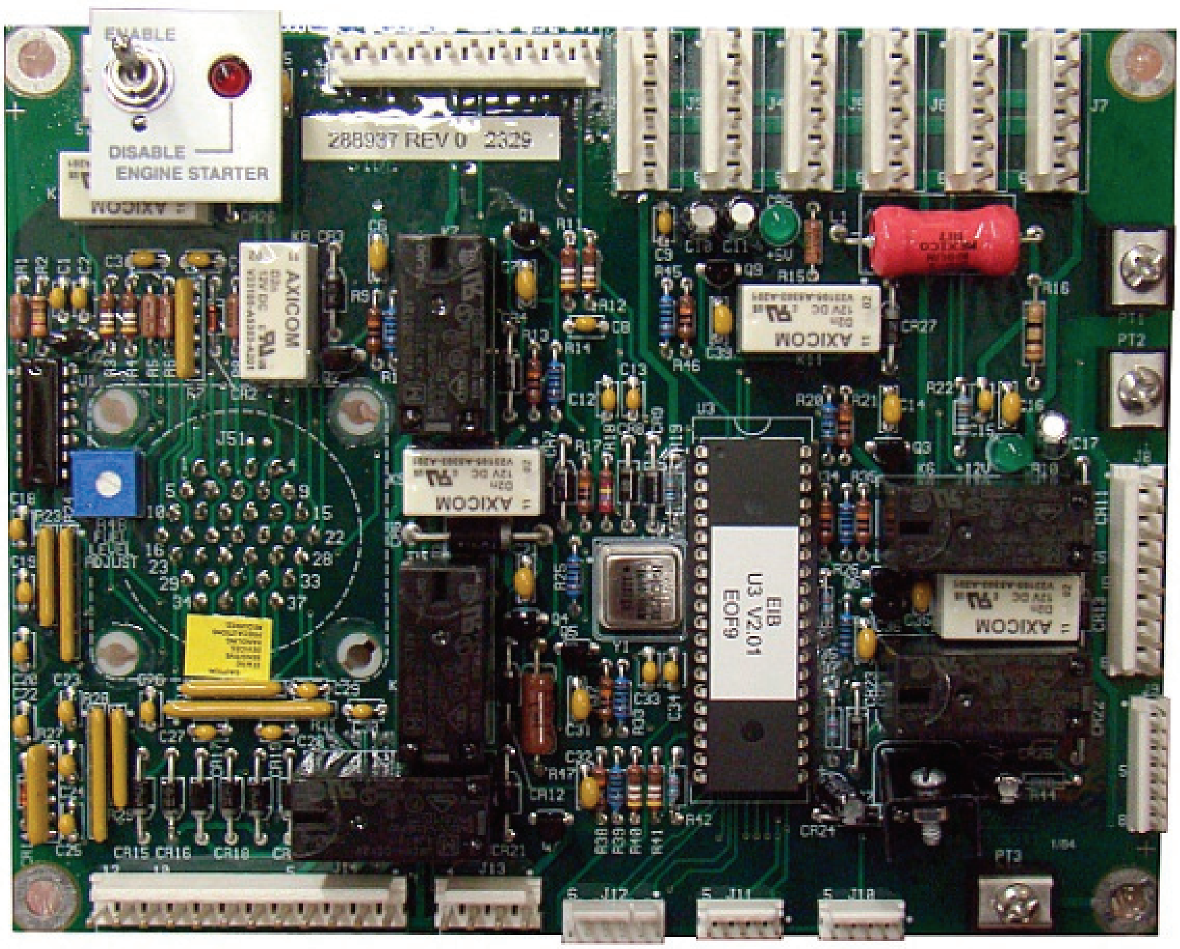


Figure 14: Engine Interface PC Board

(5) Engine Specific PC Board [ESB] (A1)

The ESB is unique to the engine model used in the generator set. The ESB is the primary interface between the control system and the engine's electronic control module (ECM). When the CTL senses the engine start button has been pressed it signals to the ESB, which then communicates to the engine control module what mode of operation is required (idle or rated speed).

The ESB contains a FREQUENCY ADJUST potentiometer and a FREQUENCY ADJUST ENABLE/DISABLE switch. These allow the output frequency to be manually adjust for testing the over/under frequency fault limits of the generator set system. The ESB also contains the DATA REQUEST button and diagnostic indicator lights for reading the engine's ECM diagnostic error codes.

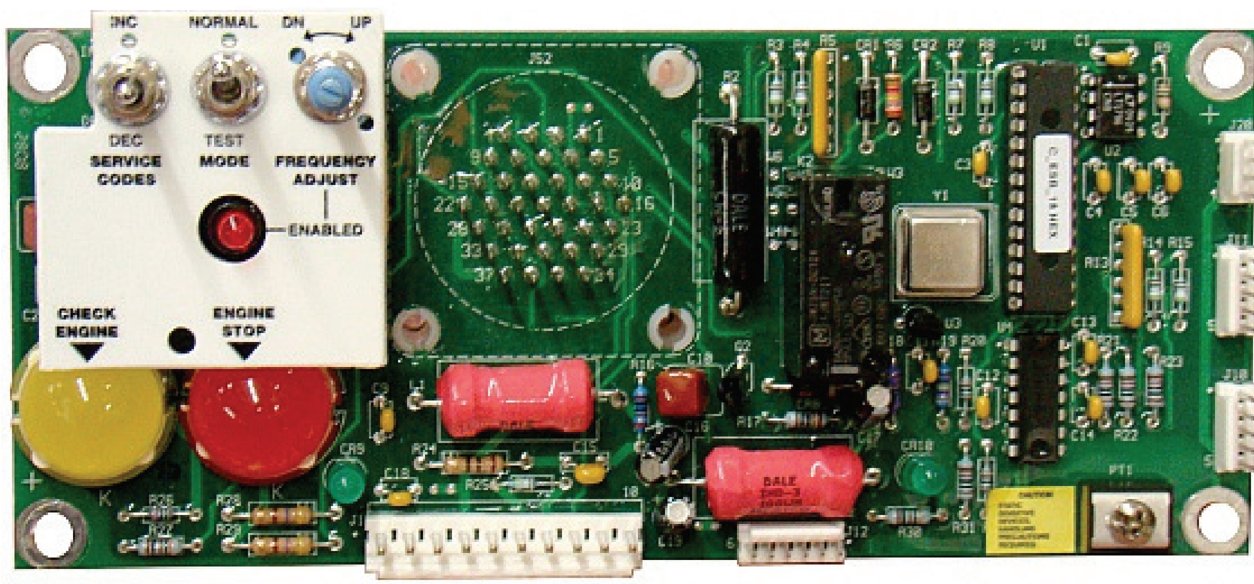


Figure 15: Engine Specific PC Board

(6) Voltage regulator PC board [REG] (A4)

This voltage regulator PC board is designed to provide voltage regulation for a three-phase, four-wire, 115/200-volt, 400-Hz brushless alternator. This regulator provides field excitation power as required to meet varying alternator load conditions to hold the alternator voltage constant. In addition, the voltage regulator PC board circuitry provides line drop compensation.

The voltage regulator board receives its drive power from the output of the generator. Circuits on the voltage regulator board rectify the generator output and apply a controlled amount of power to the generator's exciter field. When the generator is first started, it has a small output resulting from residual magnetism. With the exciter winding driven from this output, the generator output voltage increases. When the generator reaches the required voltage, the voltage regulator limits the exciter drive to maintain that voltage. If the generator output voltage varies due to change in load, the voltage regulator compensates by changing the drive to the exciter coil.

The voltage regulator board also provides line-drop compensation. Since the voltage losses in the output cables are proportional to the output current, the voltage regulator board monitors the output currents and makes slight changes in the generator output voltage accordingly so the voltage will be constant at the aircraft or other load. The line-drop compensation potentiometer may be adjusted to match exactly the voltage drop of the power cables carrying the load current.

The voltage regulator board also provides under/over frequency protection, EF signal monitoring, and lost neutral detection. When a problem is detected, the voltage regulator board signals the control board that a fault has occurred. The control board issues the appropriate command that corresponds to the fault.

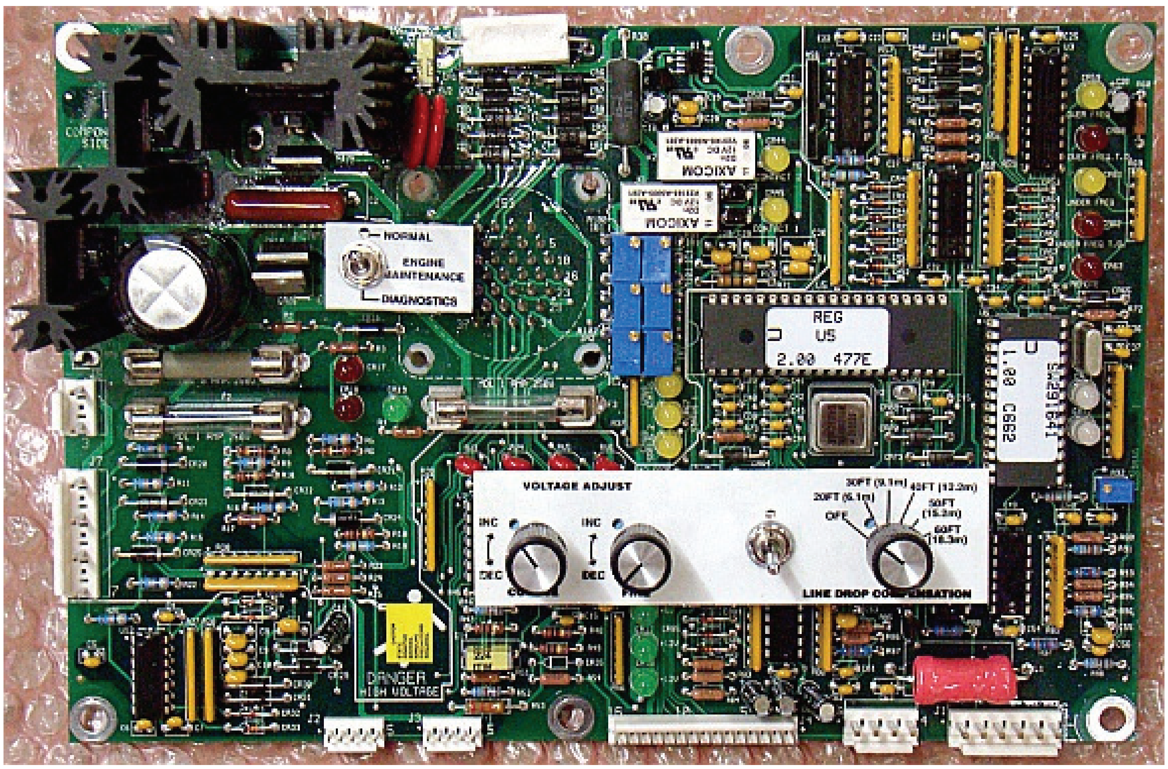


Figure 16: Voltage Regulator PC Board

The REGULATED/DIAGNOSTIC switch provides a means of troubleshooting the Voltage Regulator board. This is a three-position switch:

- In the Normal (up) position, the generator output voltage is regulated by the PC board for 115/200 VAC output.
- In the Maintenance (center) position, no current is supplied to the generator exciter. In this condition, the generator produces a low-level, unregulated voltage of approximately 30 VAC due to the residual magnetism of the exciter.

- In the Diagnostic (down) position, the system applies a constant 12 VDC to the exciter field while the generator turns at the rated RPM. Use this setting to help determine if a power output malfunction is caused by a defective generator or by a defective voltage regulator.

(7) Transformer-Rectifier PC Board [TRB] (A404)

The TRB PC Board is only used when the optional 28.5 VDC transformer-rectifier assembly is installed (refer to Appendix A if this option is installed). The TR monitors the output voltage, output current, controls the input and output contactors, and monitors all fault events associated with the DC output.

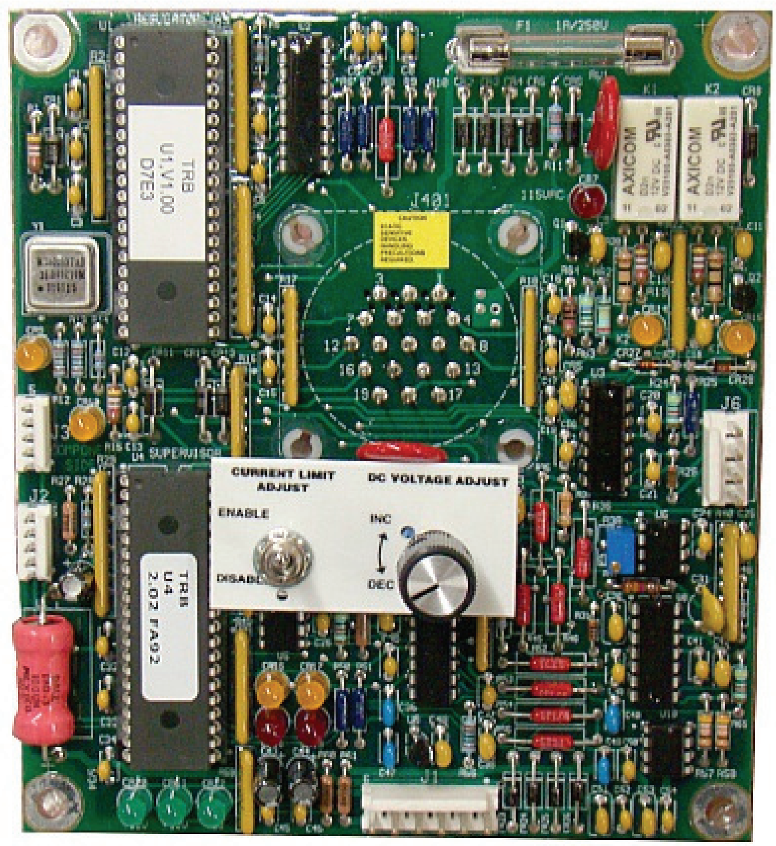


Figure 17: Transformer-Rectifier PC Board

8) Power Module Panel Assembly

The power module panel assembly, sometimes referred to as the contactor panel, is located at the left front of the machine under the control box. The panel assembly provides a means of connecting and disconnecting generator output to and from the load (aircraft).

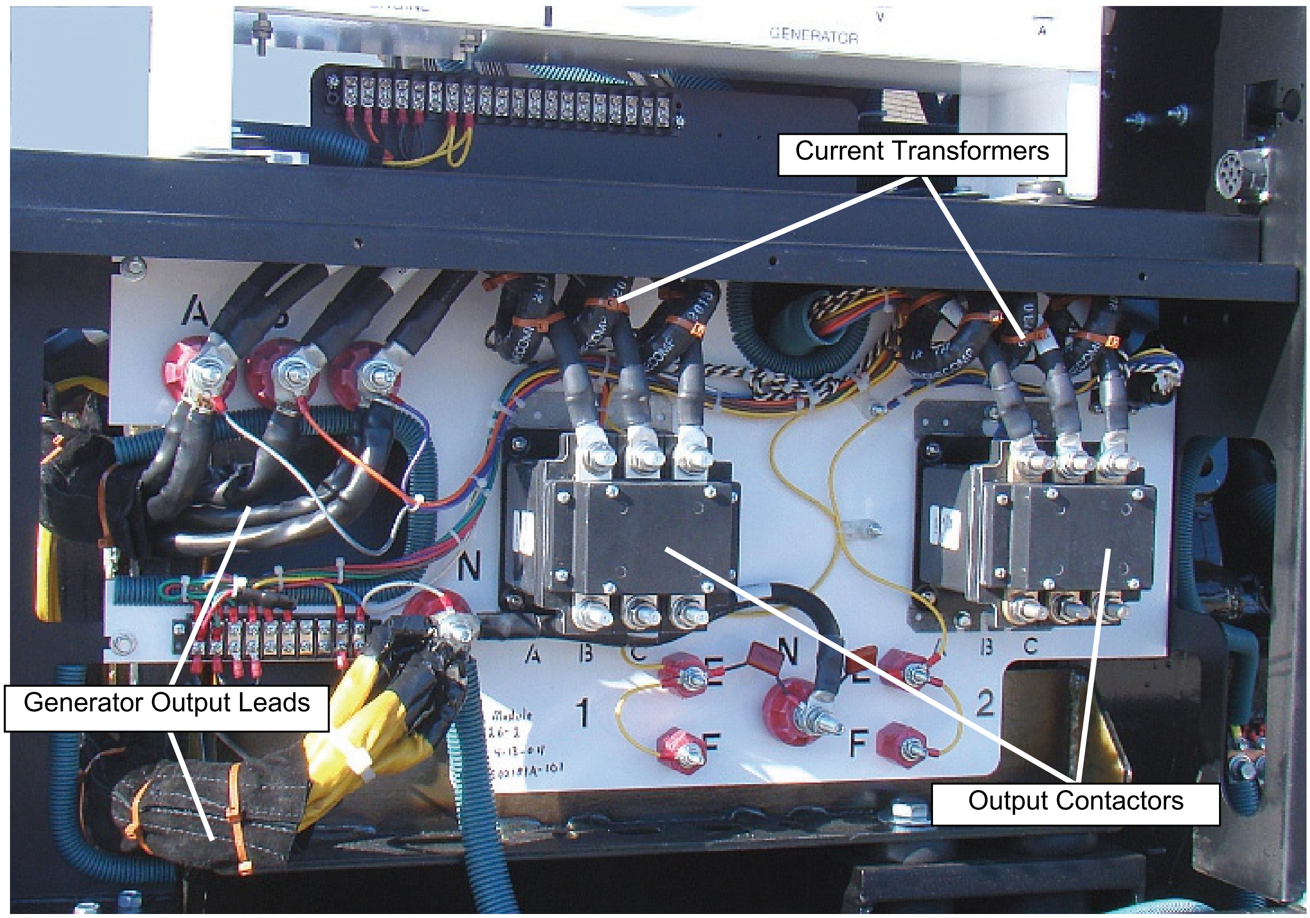


Figure 18: Output Power Module Components

a) Load Contactors

The load contactors, when turned on, connect the generator output to the load. Each contactor contains a magnetic operating coil and four sets of contacts. The three larger contacts conduct the three-phase AC generator output. The Digital Control PC Board (CTL) uses fourth contact set, which is smaller, to monitor the function of the contactor.

The generator set output cables connects to the power panel. The phase leads connect to the contactor output terminals, and the neutral lead connects to the “N” terminal next to the contactor.

b) Current transformers (CT1-CT6)

The current transformers are torroidal coils that encircle each generator output line. The signals from the current transformers provide information about the magnitude and phase of current flowing from generator to load. The control circuitry uses this information to monitor and control the line-drop compensation, ammeter, and overload circuit.

- Line-Drop Compensation

  The line drop (voltage loss) in the output cable is proportional to the output current. The voltage regulator uses the output current information to raise or lower the generator output voltage with current change to maintain a constant voltage at the load.

- Generator Output Ammeter

  The generator output AC ammeter is actually a voltmeter calibrated to indicate output current. the Voltage Regulator PC Board (REG) processes the signals from the current transformers and provides a drive signal to operate the generator output AC ammeter.

- Output Overload

  Overload sensing circuits monitor the signals from the current transformer to protect against an output overload. When there is overload on the output for more than 5 minutes (load exceeding 326 amperes per output or 125% of rated load), the control circuitry opens both output contactors.

  The following table shows the overload protection characteristics:

Overload	**Time Delay Before Opening Output Contactors**
125% load of 90 kVA on either output or 125% of 180 kVA on both outputs combined	approximately 5 minutes
150% load	30 seconds
200% load	10 seconds

NOTE: The overload protective system will function when any phase carries 123% to 127% of rated load. All times are plus or minus 25% and are non-adjustable.

9) Transformer-Rectifier Assembly Components

The Transformer-Rectifier unit (T-R) provides a regulated output voltage of 28.5V DC. Input power is provided to the DC components from the 115/200 volt, 400 Hz generator set through an input contactor. The output contactor provides DC power to the load. If during DC operation, AC power is required, the DC output voltage will no longer be regulated once the AC output contactor is closed. The AC voltage regulator will take over regulating the AC output voltage. The DC voltage will drop during full load applications when the simultaneous operation is used.

- Transformer Assembly (T401)

  This transformer assembly steps down the generator's output (115/200 VAC, 3 phase, 400 Hz) to 25 VAC. The smaller voltage is rectified by the six diode rectifiers, located on the heat sink assembly.

- Heat Sink / Diode Assembly (CR402-CR407)

  This assembly rectifies the AC voltage from transformer assembly, providing unfiltered 28.5V DC. A DC shunt connected to the heat sink assembly measures the DC output current.

- Input Contactor (K401)

  The input contactor applies the generator output power to the input of the transformer assembly.

- Output Contactor (K402)

  The output contactor connects the output of the 28.5 VDC power supply to the output cables. The contactor is located on the right side under the T-R Assembly.

- DC Inductor / Filter Assembly (L401)

  The DC inductor filters the raw 28.5 VDC from the diode assembly and provides low ripple 28.5 VDC output.

- Pre-Load Resistors (R402-R404)

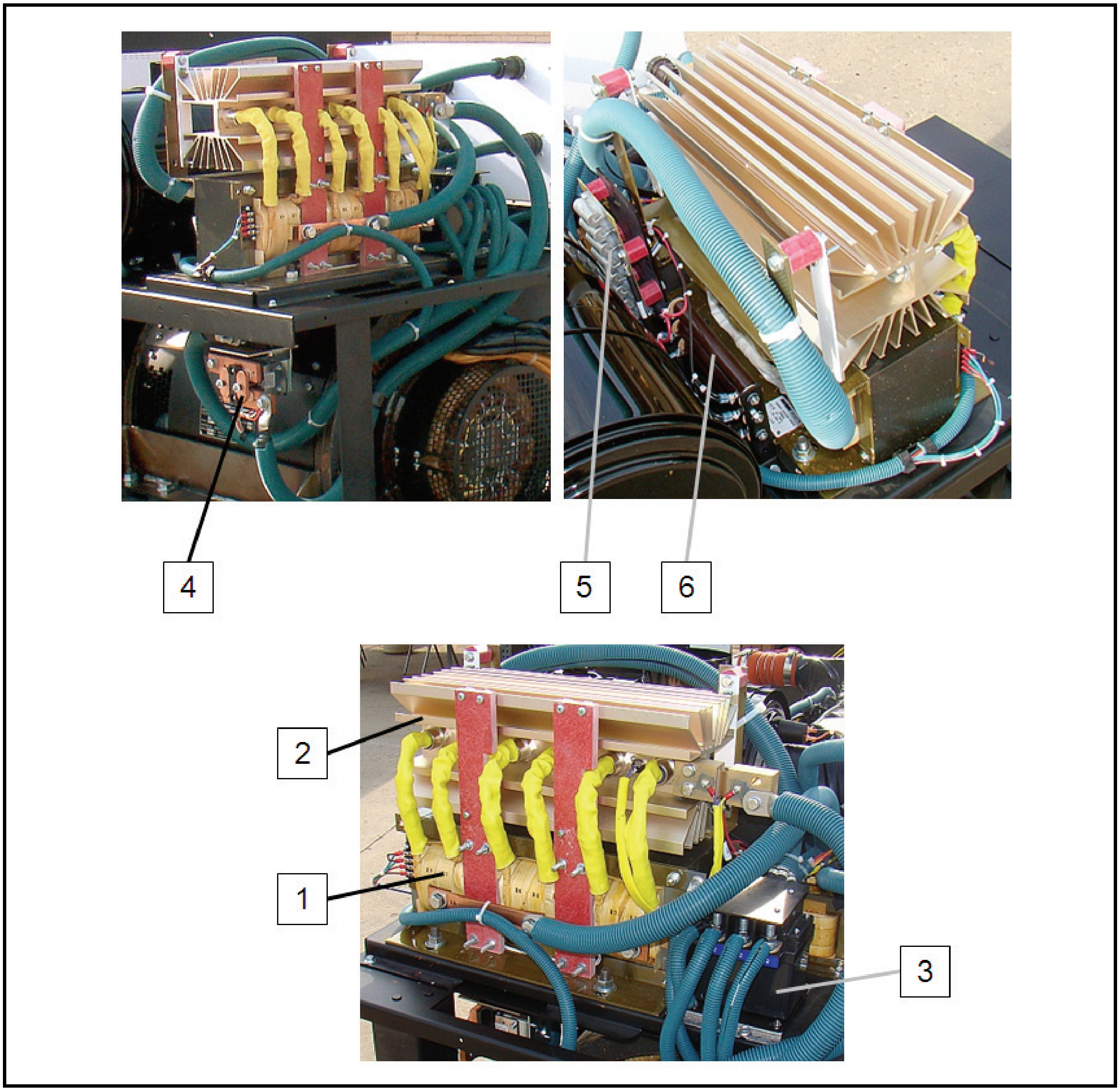
  The three 10-ohm, 100-Watt pre-load resistors provide a minimum output load on the DC output.

- Capacitor PC Board (A401)

  The DC capacitor PC board works with the DC inductor as a filter to produce a low ripple 28.5 VDC output voltage.

- Control Interlock Kit (Optional)

  This optional assembly is used for applications requiring a safety interlock signal being sent back from the aircraft before closing the output contactor to delivery power to the load. See Chapter 4, Section 3 for details of the assembly and Chapter 5 for schematics and connection diagrams.



1. Transformer Assembly (T401)
2. Heat Sink / Diode Assembly (CR402-CR407)
3. Input Contactor (K401)
4. Output Contactor (K402)
5. DC Inductor / Filter Assembly (L401)
6. Pre-Load Resistors (R402-R404)
7. Capacitor PC Board (A401)

Figure 19: Transformer-Rectifier Components

Section 2: Preparation for Use, Storage, or Shipping

This section contains the following topics:

1) Preparation for Use 1
a) Inspection/Check 1
b) Install the AC Output Cables 3
c) Install the DC Output Cable (optional) 4
2) Preparation for Storage 5
a) General 5
b) Temporary Storage 5
c) Long Term Storage (Over 30 Days) 6
3) Preparation for Shipment 6

1) Preparation for Use

a) Inspection/Check

Inspect the unit thoroughly prior to operation:

1. Remove blocking, banding, ties, and other securing material.
2. Inspect exterior for shipping damage such as broken lights, damaged sheet metal, etc.
3. Open all canopy doors and inspect interior for foreign material such as rags, tools, shipping papers, etc.
4. Check fuel, coolant, oil hoses and connections for visible leaks. Visually inspect the compartment floor and ground surface under the unit for signs of leakage. Correct any leaks by tightening hose clamps, tube fitting, etc., as required.
5. Check the security of the generator set retaining components.
6. Turn on the battery disconnect switch. It is located on the right side of the generator set.
7. Check the fuel level. Press the “LAMPS” push-button button to energize the fuel gauge when the engine is stopped. Fuel is supplied from a customer-furnished source.

NOTE: For recommended fuel specifications, refer to the Engine Manufacturers Operation and Maintenance Manual provided with this manual.

8. Check the engine coolant. Remove radiator cap to check coolant level. Coolant level should be at the bottom of the filler neck.

CAUTION

BE SURE the cooling system antifreeze solution is adequate to protect below the lowest temperature expected.

NOTE: For antifreeze protection, use a solution of 50% permanent antifreeze (Ethylene glycol) and 50% clean water.

Lubricating oil capacity (w/ filter)	24 quarts (22.7 liters)
Coolant capacity system	59 quarts (55.8 liters)

Table 1: Engine Oil and Coolant Capacities

9. Check the engine lubricating oil level. The oil gauge rod has "H" high mark and "L" low-level marks to indicate the operating lubrication oil supply. Oil level should be kept as near the high mark as possible, without going over it. See Table 1 for capacity.

CAUTION

NEVER operate the engine with oil level below the "L" level mark or above the "H" level mark.

NOTE: See the Engine Manufacturer's Operation Maintenance Manual for oil recommendations.

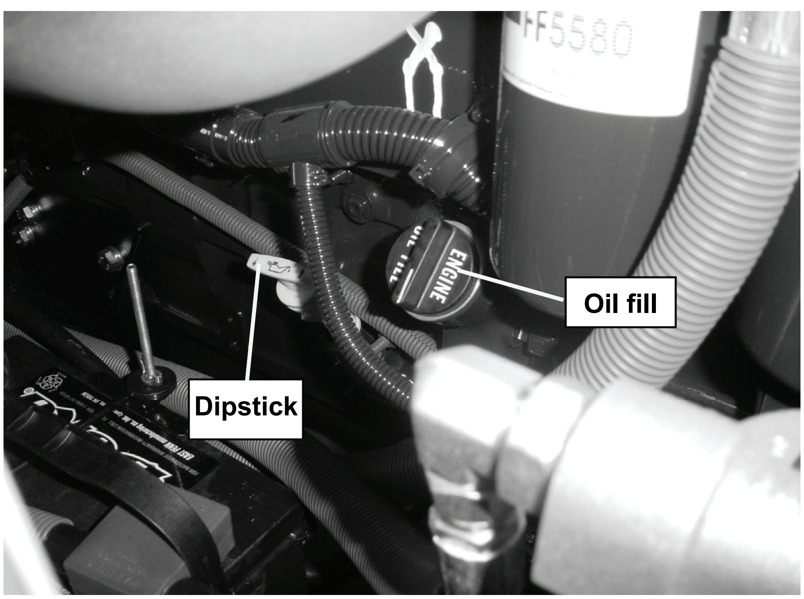


Figure 1: Oil Fill and Oil Level Check Locations

10. Check the batteries. Inspect the batteries for proper connection of the terminals and check the electrolyte level (if possible). Service or replace if necessary.

b) Install the AC Output Cables

The output cables are normally shipped with the generator set, and they are already connected. Follow the instructions in this section if you did not order cables with your generator set.

The AC output cables connect to the load contactors, which are located on the power module assembly (left side of the unit beneath the engine control panel).

The conductor size recommended for AC output cables is 2/0 AWG. Use No. 12 size for control (E and F) terminals. Large cables (A, B, C, and N) should be equipped with terminals having at least a 3/8-inch diameter mounting hole. Mounting hole in small leads (E and F) should be at least 1/4-inch diameter.

To install AC output cables proceed as follows:

1. Open control box door of the generator set and remove the lower panel.
2. Remove Plexiglas cover in front of the power module assembly.
3. Remove the cover panel on the cable tray covering the cable clamps.
4. Loosen screws on cable clamps.
5. Route cables through cable clamps, and up to the load side of the load contactor(s).
6. Connect the phase cable terminal lugs to the appropriate terminal studs on the contactor(s): cable lug “A” to terminal stud “A”, “B” to “B”, and “C” to “C”.
7. Connect the cable’s neutral terminal lug securely to the neutral (ground) stud on the power module assembly.
8. Connect the “E” and “F” cables to the “E” and “F” studs on the power module assembly.
9. Tighten clamp screws securely, but avoid damage to cable insulation.
10. Replace Plexiglas cover panel, lower panel, and close canopy door.

c) Install the DC Output Cable (optional)

Customers that order the DC option normally order the DC output cable with it. For those customers, the generator set is shipped with the cable already connected. Follow the instructions in this section if you did not order a DC cable for your generator set.

1. For normal aircraft service, use cables having 4/O AWG conductors.
2. Pass the free ends of the cable through the canopy via the supplied hole and bracket in the frame assembly (See Figure 3).
3. Connect the cable to the output contactor, located under the TR assembly on the right side (See Figure 4).

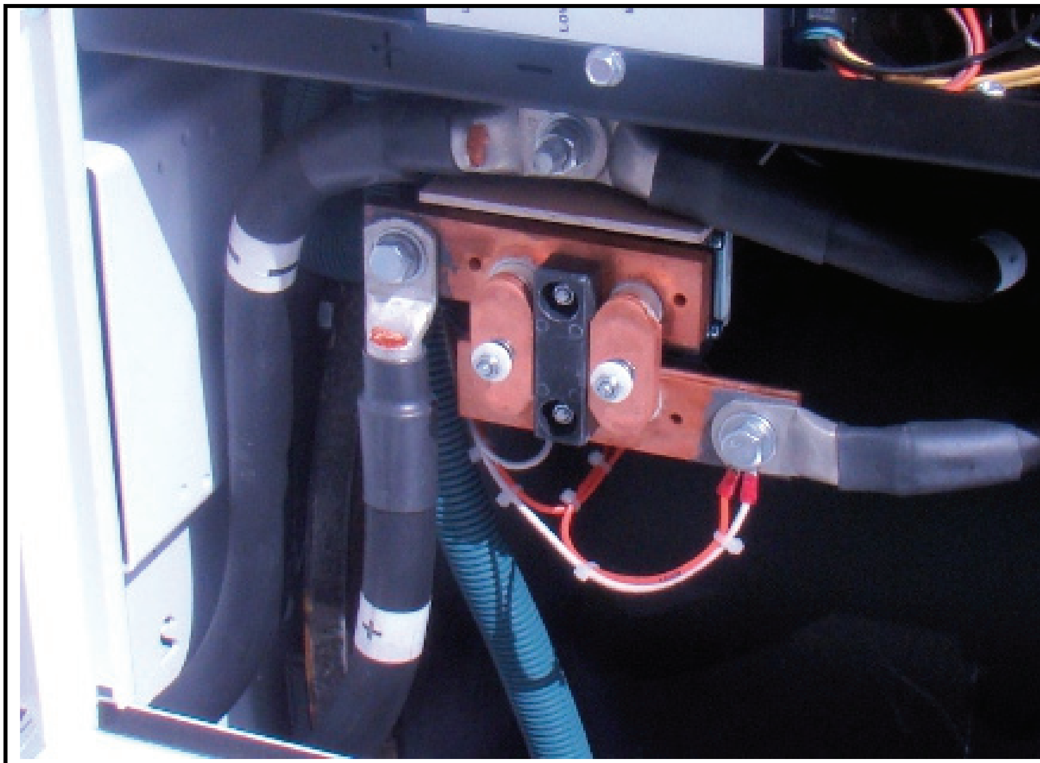


Figure 2: Output Cable Connection

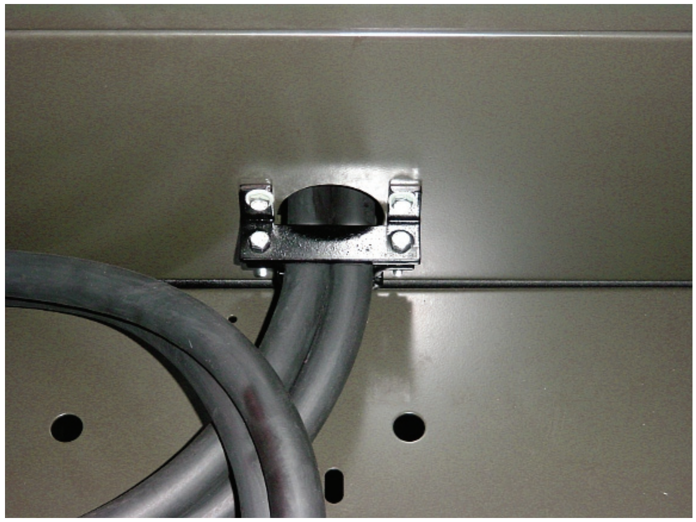


Figure 3: Lower Panel Assembly

2) Preparation for Storage

When a generator set is to be stored or removed from operation, special precautions should be taken to protect the internal and external parts from rust, corrosion, and gumming in the engine fuel system.

a) General

- Turn off the battery master disconnect switch.
- Prepare the unit for storage as soon as possible after being removed from service.
- The unit should be stored in a dry location.
- Moisture-absorbing chemicals (Hobart part number 76A1354-001) are available for use where excessive dampness is a problem; however, the unit must be completely packaged and sealed if moisture-absorbing chemicals are to be effective.

b) Temporary Storage

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

1. Lubricate the unit completely in accordance with instructions in Section 2-2. This will include changing engine oil, and all filter elements.
2. Start the engine and operate for about two minutes to coat all internal engine components with new oil.

NOTE: Do not drain the fuel system or crankcase after this run.

3. Make certain the cooling system antifreeze solution is adequate to protect below the lowest temperatures expected during the storage period. Be sure the solution is thoroughly mixed.
4. Clean the exterior of the engine. Dry with clean rags and compressed air.
5. Seal all engine openings. Use a waterproof, vapor proof material that is strong enough to resist puncture damage from air pressures.

c) Long Term Storage (Over 30 Days)

To protect the generator and other electrical components, the complete unit should be packaged using moisture proof packaging material and sealing material. Place containers of moisture-absorbing chemicals (Hobart part number 76A1354-001) in the unit before packaging. The unit may be stored for long periods with no special preparation if it is possible to operate the engine once each week. When starting once a week, proceed as follows:

1. Make certain the cooling system is adequately protected.

WARNING

Ensure adequate ventilation before starting the engine.

2. Start the engine and operate under full load until coolant temperature has reached at least 176ºF (80ºC).
3. While the engine is running, ensure that normal operating controls are in good working condition before shutdown and storage.
4. Turn off the battery disconnect switch.

If weekly operation is not possible, contact the nearest engine manufacturer distributor for instructions.

3) Preparation for Shipment

- Turn off the battery master disconnect switch.
- During long shipments, vibration, jolting, etc may loosen the generator set retaining hardware.

CAUTION

When shipping the unit, provide sufficient retaining materials to ensure the generator set cannot roll out or off the vehicle in which it is being transported.

NOTE: To secure the generator set, use strong banding or a strong steel bar welded or bolted across the front of the generator set frame.

Section 3: Operation

This section provides information and instructions for the safe and efficient operation of the equipment. This section contains the following topics:

1) Pre-Start Inspection 2
2) Operator Controls 2
3) Engine Operation 3
a) Engine Starting Procedure 3
b) Failed Starting Procedure 4
c) Emergency Stop 4
4) AC Power Operation 4
a) Power Delivery 4
b) Fault during Power Delivery 5
c) Failed Power Delivery 5
d) Discontinue Power Delivery with Unit Shutdown 5
5) DC Operation (optional) 6
a) Normal Power Delivery 6
b) Current Limiting Power Delivery 6
c) Discontinue Power Delivery 6
6) Simultaneous AC and DC Operation 6

NOTE: Read ALL of the operating instructions before attempting to operate the equipment.

WARNING

To prevent hearing loss, use ear protection equipment when working close to this equipment.

1) Pre-Start Inspection

a) Be sure the fuel shutoff valve on the unit is open. See Chapter 4-3, Figure 13 for the valve location.

b) Ensure 12 VDC power is available to the engine starting system. Check to make sure the battery disconnect switch is in the ON position. See Chapter 4-3, Figure 15 for the switch location.

c) Check the engine and generator compartments to make certain they are free of rags or other foreign materials.

d) Make certain there is sufficient lubricating oil and coolant in the engine.

e) Inside the control box, check that all circuit breakers are reset.

f) Check the circuit boards in the control box for the following switch settings. For switch locations, refer to Chapter 1, Section 1, in the specified figures.

PC Board	Figure	Switch	Required Setting
Engine Interface Board	14	Starter Enable/Disable	Enabled
Engine Specific Board	15	Frequency Adjust	Disabled
Digital Control Board	13	EF1 Bypass	Bypass
Voltage Regulator Board	16	Regulated/Diagnostic	Normal

2) Operator Controls

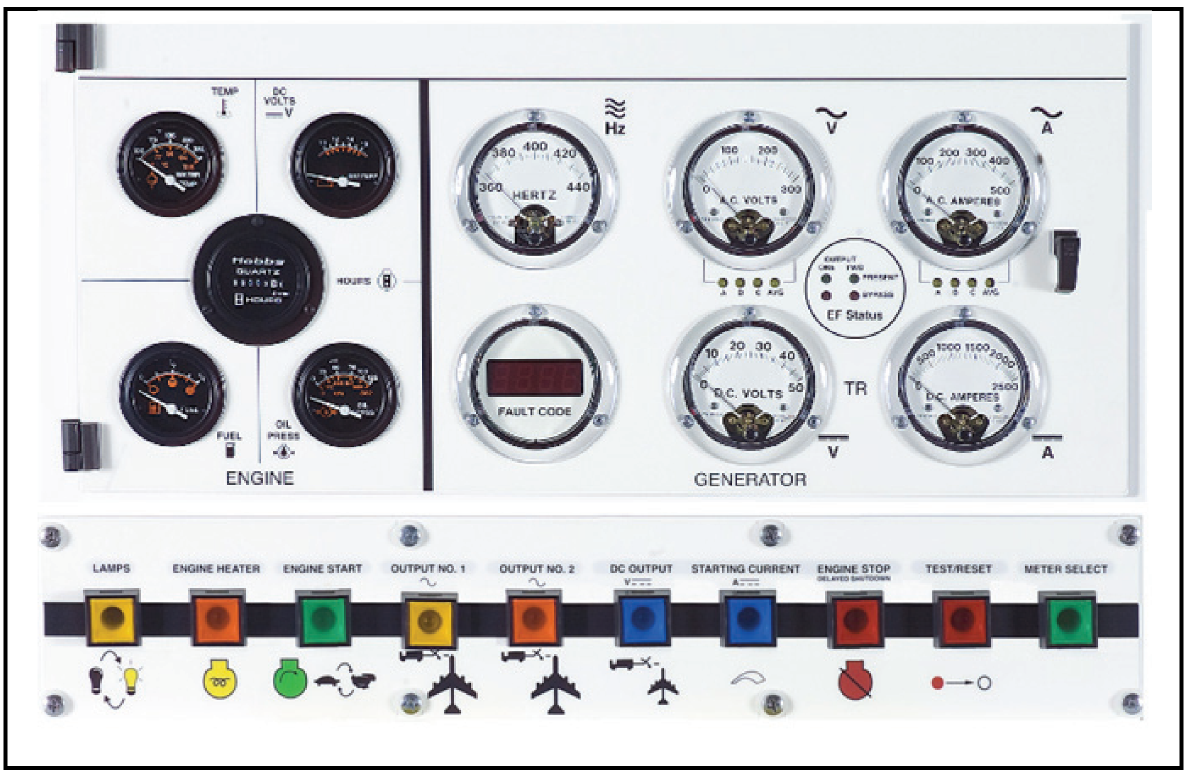


Figure 1: Operator Controls

3) Engine Operation

a) Engine Starting Procedure

Follow the steps below to start the engine:

CAUTION

When starting engine for the first time, refer to operating instructions in the engine manufacturer's operation manual. The engine manufacturer's operation manual is provided with this manual.

1. If illumination is required, press LAMPS pushbutton switch one time. Pressing this button switch also activates the fuel gauge.
2. On days when the ambient temperatures are below 60° F (16° C), press the ENGINE HEATER pushbutton to engage the air intake heater prior to starting the engine. The light in the button turns on when the intake heater is engaged (if the light does not illuminate, the engine is ready to start). When the light turns off, the engine is ready to start.

CAUTION

Never use an ether start system in conjunction with the air intake heater.

3. Press the green ENGINE START pushbutton switch and hold until engine starts. The engine will start at idle speed, and the green light in the ENGINE START pushbutton switch will flash to indicate that power is available to the engine's ECM circuit.

CAUTION

- Do not attempt to bring the engine to rated speed for at least 5 seconds after it starts.
- To prevent damage to the starting motor, do not engage the starting motor for more than 30 seconds. Wait two (2) minutes between each attempt to start.
- If the engine fires sufficiently to disengage the starter gear but does not start, allow the starting motor to come to a complete stop before attempting to engage the starter again, then press the start pushbutton switch.
- To eliminate the possibility of wet stacking, do not allow the engine to idle for long periods. For more information on wet stacking, refer to the Warranty section near the front of this manual.

Note: If the engine fails to start, refer to the "Failed Starting Procedure" section on the next page.

4. Check oil pressure to make certain that it is normal, and observe all other engine instruments for normal operation.
5. Allow engine to idle and warm for 3 - 5 minutes before bringing it up to rated speed.

b) Failed Starting Procedure

If the engine fails to start within 5 seconds, the control system automatically disables the starting motor and indicates a low oil pressure fault. The emergency stop switch must be pressed to reset the control system and allow another starting attempt.

Follow these steps to reset the control system:

1. Push the red EMERGENCY STOP BUTTON on the control box door to the right of the control panel.
2. Pull the red EMERGENCY STOP BUTTON back out before the next attempt to start the generator set.
3. Wait two (2) minutes between each attempt to start.
4. If the engine fails to start after four attempts, inspect the unit to determine the cause. Refer to "Pre-start Inspection" above.

c) Emergency Stop

Press the EMERGENCY STOP BUTTON, located on the control box door to the right of the control panel. When pushed, this button instantly shuts the generator set off and must be pulled back out to reset itself before restarting the generator set.

CAUTION

Do not use the **EMERGENCY STOP BUTTON** as a normal shutdown device. Damage to the engine turbo charger may result without proper cooling time. Use the **ENGINE STOP** pushbutton for all normal engine shutdowns.

4) AC Power Operation

a) Power Delivery

"Power Delivery" refers to delivering electric power to an aircraft, load bank, or other equipment.

1. Press the ENGINE START pushbutton switch a second time to bring engine from idle speed to rated speed. The ECM immediately increases the engine speed to 2000 RPM and maintains it. The voltage build-up will occur automatically. The green indicating light in the ENGINE START pushbutton switch now glows continuously to indicate the engine is running at rated speed.
2. Check the generator instruments. The frequency meter should indicate exactly 400 Hz. With the METER SELECT pushbutton switch set to read any line-to-neutral position, (A-N, B-N, or C-N), the voltmeter should read 115 volts. With the METER SELECT pushbutton switch set to any line-to-line position, (A-B, B-C, or C-A), the voltmeter should read 200 volts.
3. The final step in delivering power is closing one or both of the load contactors. When the instruments indicate satisfactory frequency and voltage values, close either (or both) load contactor by momentarily pressing the OUTPUT NO. 1 or OUTPUT NO. 2 pushbutton switch. The yellow or orange indicating light of the pushbutton switch that is pressed will glow continuously to indicate that the load contactor is closed and power is available at the aircraft.

4. Early in the power delivery, check the output voltage and current in each of the three phases. If the load is changing, monitor the gauges until the load conditions stabilize.

b) Fault during Power Delivery

CAUTION

NEVER press the test/reset pushbutton switch while power is being delivered.
The contactors will open and power to the aircraft will be suddenly interrupted.

A condition of over-voltage, under-voltage, under-frequency, over-frequency, or overload in the output circuit will automatically open the load contactor and display a fault code to signal the operator which of the above faults caused the protective monitor system to operate. After the fault has been corrected, press the TEST/RESET pushbutton switch to reset the protective relay system. Proceed with power delivery by operating the load contactor pushbutton switch.

c) Failed Power Delivery

CAUTION

The generator set must be shut down to diagnose the failed power delivery problems.
Only licensed technicians should work on this generator set.

If the engine starts but power cannot be delivered to the load, make sure the REGULATED/DIAGNOSTIC switch (located on the Voltage Regulator PC board) is set to NORMAL. Refer to Chapter 1, Section 1, Figure 17 for the location of the switch.

If the contactor indicating light turns off approximately two (2) seconds after the OUTPUT pushbutton switch is released, and the fault code meter displays an EF1 or EF2 fault code, this indicates that the aircraft is not supplying the 28.5 VDC interlock signal to the plug interlock circuit. Correct the condition and again press the OUTPUT NO. 1 or OUTPUT NO. 2 pushbutton switch.

If the aircraft (or load bank) does not have the 28.5 VDC signal, set the EF BYPASS ON/OFF switch for that output to the ON position. Refer to Chapter 1, Section 1, Figure 13 for locations of the EF Bypass switches.

See section 2-4 for other No. 1 and/or No. 2 Load Contactor Operating Circuit for additional troubleshooting procedures.

d) Discontinue Power Delivery with Unit Shutdown

Push an OUTPUT pushbutton switch to open the corresponding contactor. The indicating light (yellow or orange depending on the contactor used) turns OFF immediately to indicate that the load contactor has opened and power is no longer being delivered to the aircraft. The engine will remain at rated speed.

Push the red ENGINE STOP pushbutton switch once to bring the engine down to idle speed. This will begin the automatic shutdown sequence to shut off the engine, gauges, lights, etc., after approximately 3 - 5 minutes.

Wait until the engine is at idle speed before disconnecting the output cable from the aircraft.

5) DC Operation (optional)

This section describes the operation of the optional DC unit. The DC output voltage value, which is controlled by a potentiometer on the Transformer-Rectifier Board (TRB), need only be set once. The voltage level remains the same for all future operations, even when the unit is shut down or the battery is disconnected. It may, however, be changed as often as desired.

Note: The DC output voltage is only regulated when operating DC alone without an AC output. If AC and DC are operated together, only the AC voltage is regulated.

a) Normal Power Delivery

1. Connect the output cable plug connector to the aircraft receptacle. Be sure connector is mated fully and securely.
2. The engine should be running at rated speed (2000 RPM) and generating 115/200 VAC. If not, reference the engine starting procedure above.
3. Press “DC OUTPUT” push button to close the DC output contactor. The blue “DC OUTPUT” lamp glows to indicate that DC power is being delivered to the aircraft.

b) Current Limiting Power Delivery

If current limiting is required for starting an aircraft, set the current limit as follows:

1. Press the “STARTING CURRENT” push button to activate and view the present current limiting value. Continue to hold the button down to increase the setting.
2. Each time the “STARTING CURRENT” push button is pressed the current limiting will be viewed and increased by 100 A until it reaches the maximum setting of 2500 A. At that time the current limiting will reset to the beginning and start the 100 A increments again. Set the current limit to the desired setting.

c) Discontinue Power Delivery

1. Press “DC OUTPUT” push button to open the DC output contactor. The blue “DC OUTPUT” lamp turns off to indicate that DC power has been removed from the aircraft.
2. Disconnect the output cable connector from the aircraft receptacle and store properly in the GPU’s cable tray.

6) Simultaneous AC and DC Operation

If both 28.5 VDC and 400-Hz AC power must be delivered at the same time, the operation of the controls remains the same. However, the DC output voltage will not be regulated when the AC voltage contactor is closed and is supplying power.

When both AC and DC are being used and a fault condition occurs, the system’s response to the fault is given priority over all operations.

Chapter 2: Service and Troubleshooting

Section 1: Maintenance Inspection/Check

To ensure that the generator set is always ready for operation, follow the recommended maintenance schedule to discover and correct any defects before they result in serious damage to components or failure of the equipment.

WARNING

STOP operations at once if a serious or possibly dangerous fault is discovered.

1) Maintenance Schedule

A periodic maintenance schedule should be established and maintained. A suggested schedule is provided on the following pages. It may be modified, as required to meet varying operating and environmental conditions.

a) Maintenance Schedule Check Sheet

Use a maintenance schedule check sheet such as the one in the engine manufacture's operation manual. The check sheet will provide a record and serve as a guide for establishment of a schedule to meet the customer's maintenance requirements for his specific operation.

b) Interval Periods

The schedule is based on both hours of operation and calendar intervals. Perform all services on whichever-comes-first basis.

For example, in normal operation the oil change period, based on hours of operation, will be reached long before the three months calendar period. The calendar period is included to make certain services are performed regularly when the equipment is stored, or being operated infrequently. Lubricating oil standing in engines that are stored or used very little may tend to oxidize and may require changing although it is not dirty.

The following chart shows the maintenance intervals. The next section shows the required work for each interval.

Symbol	Hourly Interval	Calendar Interval
AR (As Required)		
BR (Break In)	50-150 hours	Once
A	10 hours	Daily
B	250 hours	3 Months
C	500 hours	6 Months
D	1000 hours	1 Year
E	1500	1.5 Years
F	2000	2 Years

c) Suggested Maintenance Schedule

Hourly Interval	**AR**	**50-150**	**10**	**250**	**500**	**1000**	**1500**	**2000**
Calendar Interval		**Once**	**Daily**	**3 Mo.**	**6 Mo.**	**1 Yr.**	**1.5 Yr.**	**2 Yr.**
Symbol	**AR**	**BR**	**A**	**B**	**C**	**D**	**E**	**F**
Engine								
Change Air Cleaner Cartridge	X							
Check Coolant Hose and Clamps	X							
Check Crankcase Oil Level			X					
Drain Fuel Pre-Filter Elements			X					
Check Coolant Level			X					
Check for Leaks and Correct		X	X					
Check Air Cleaner Indicator			X					
Check Exhaust System	X		X					
Charge-Air-Cooler (CAC) and Piping				X				
Change Lubricity & Fuel Filter Elements		X			X			
Check Fuel Pump				X				
Check Radiator Core and Hoses				X				
Check Oil Pressure and Record				X				
Change Crankcase Oil		X			X			
Change Oil Filter Element		X			X			
Check Engine and Generator Mounts		X			X			
Check Coolant, Additive-Concentration		X			X			
Check Fan Hub and Drive Pulley						X		
Check Hose Clamps on Air Intake Side	X					X		
Check Belts Conditions and Tensioner						X		
Check and/or Adjust Valve Clearance						X		
Check Water Pump		X				X		
Steam Clean Engine		X					X	
Clean Fuel System							X	
Check Alternator							X	

Maintenance Schedule (Sheet 1 of 2)

Hourly Interval	**AR**	**50-150**	**10**	**250**	**500**	**1000**	**1500**	**2000**
Calendar Interval		**Once**	**Daily**	**3 Mo.**	**6 Mo.**	**1 Yr.**	**1.5 Yr.**	**2 Yr.**
Symbol	**AR**	**BR**	**A**	**B**	**C**	**D**	**E**	**F**
Engine (continued)								
Check Starter							X	
Check Vibration Damper								X
Check Cooling and CAC systems								X
Flush and Change Coolant								X
Check Fan Mounting				Spring & Fall				
Clean Cooling System				Spring & Fall				
Check Hoses				Spring & Fall				
Clean Electrical Connections				Spring & Fall				
Check Thermostats and Seals				Fall				
Electrical (12 VDC System)								
Check All Lights			X					
Check Battery Voltage			X					
Clean Battery Terminals	X			X				
Check Wiring and Connections					X			
Check All Engine Meters			X					
Electrical (400-Hz System)								
Check E-F By-Pass Operation				X				
Check Output Cable and Connectors			X					
Check Volt, Amp & Frequency Meters			X					
Check and/or Adjust Output Voltage	X				X			
Inspect Wiring and Connectors					X			
Clean and Inspect Generally					X			

Maintenance Schedule (Sheet 2 of 2)

d) Additional Information

The rest of this section (2-1) provides general information about the maintenance tasks required for each interval.

Refer to Section 2-2 for more detailed instructions.

Refer to Section 2-3 for adjustment and test procedures.

2) Inspection/Check

This section describes inspections, checks, and maintenance procedures in general terms. For more specific and detailed information, refer to Sections 2-2 and 2-3, when applicable.

a) "AR" Checks and Operations (As Required)

System	Items	Description
Engine	Change Air Cleaner	Replace the air filter when the fault code meter shows the "Air" code. These filters should not be washed because washing breaks down the material inside the filters.
	Tighten Hose Clamps	Check and tighten, as required, all coolant hose clamps, air intake hose clamps and exhaust clamps.
	Check Hoses	Check all coolant hoses, air intake hoses and exhaust pipes for leaks.
	Check Battery Terminals	Anytime the compartment doors are opened for any reason, visually check battery cable connectors and battery posts. If the cables show corrosion, disconnect the cables and clean battery posts and connectors with a wire brush or battery post-cleaning tool. Coat the posts and connectors with a light film of petroleum lubricant before reconnecting cables to the batteries.
Electrical (400 Hz System)	Check Output Voltage	Check the output voltage and be sure it is set for 115 VAC ± 1 V. Adjustment can be made using the fine adjustment located on the Voltage Regulator PC Board (REG).

b) "BR" Checks and Operations (Break-In Period, Once After 50-150 hrs.)

The following procedures are precautionary measures taken on most new engines. If a problem occurs with any of the following issues, be sure to recheck it after the next 50-150 hours.

System	Items	Description
Engine	Check for Leaks	Check for leaks and correct. This involves an overall inspection of the engine and may require some maintenance if leaks are found. Refer to the engine manufacturer's operations manual for assistance.
	Change Fuel Filter Elements	Change all fuel filter elements. Metal shavings from the new fuel tank can clog the filter.
	Change Oil	Change crankcase oil. New engines often release metal shavings more frequently. Therefore, the crankcase oil must be changed as a precautionary measure.
	Change Oil Filter	Change the oil filter element. The oil filter should be changed with the oil.
	Check Engine and Generator Mounts	Check engine and generator mounts to ensure they are properly installed and they have not worked loose. (Torque is set at 122 N-m, 90 ft-lb.).
	Check Coolant	Check coolant additive concentration. Refer to the engine manufacturer's operations manual for assistance.

	Steam Clean Engine	Steam clean the engine to free it of oil and dirt to prevent uneven engine cooling “hot spots”. The oil and dirt can also fall into the engine and fuel system when covers are removed during repair work.
	Inspect Water Pump	Inspect the water pump weep hole for indication of a steady leak. If a steady flow of coolant or oil is observed, replace the water pump with a new or rebuilt unit. Refer to the engine manufacturer’s operations manual for assistance.

c) “A” Checks and Operations (10 Hours or Daily)

System	Items	Description
Engine	Check Oil	Check oil level daily with oil gauge dipstick. Oil level should not be checked until 3 to 5 minutes after engine shutdown. Keep oil level as near the upper bar as possible. CAUTION: Do not overfill. Do not operate the engine with oil level below the lower bar or above the upper bar on the dipstick.
	Drain Fuel Lubricity Filter/Pre-Filter Element	To extend the life of the fuel pump and injectors, drain about a cup of fuel from the fuel pre-filter element to remove water and sediment before starting the engine each day. Provide a container for catching drained fuel. Open the drain valve on the fuel/water filter. Refer to the following figure. Drain the filter until clear fuel is visible. Tighten the drain valve. Safely dispose of drained fuel. Purge air from fuel system if necessary. BE SURE to prime and bleed the fuel system after draining the filters, replacing filter element, or if the fuel tank has run empty. Failure to do so can cause engine-starting problems.
	Check Coolant Level	Check coolant level daily or at each fuel fill interval. Investigate for cause of any coolant loss. WARNING: Cooling system is pressurized. To avoid personal injury, DO NOT remove radiator cap when engine is hot.
	Check for Leaks	At each daily start-up, check for coolant, fuel, and oil leaks. Coolant leaks may be more noticeable when components are cold. Observe pumps, hoses, fittings, gasket connections, etc., for signs of leakage. Correct as required.
	Check Air Cleaner Indicator	At each daily start-up, observe the Fault meter on the control panel. If the display shows “air”, change the air cleaner filter.
	Check Exhaust System	Visually inspect muffler and exhaust pipes for rust and signs of approaching failure. Listen for any gasket or joint leaks. Warning: A leaking and defective exhaust system could be a fire hazard.
Electrical System (12 VDC)	Check All Lights	Check all indicating lights to be sure they will operate when they should. If any light fails to operate, check both the lamp and its protective circuit breaker. Refer to the lists of lamps and circuit breakers at the end of this section.

	Check Engine Battery Voltage	Observe the 12-VDC engine voltmeter each time the engine is started to be sure the alternator is functioning correctly and charging the batteries. If the batteries need to be replaced, be sure the replacements meet the specifications for cold cranking amps (CCA) and Reserve Capacity. Refer to section 4-3 for the battery part number.
	Check Engine Meters	Check the operation of all the engine meters.
Electrical (400 Hz System)	Check Output Cables and Connectors	Check the output cable plug connection for damaged insulation and contacts each time the connector is detached from the aircraft.
	Check Meters	Check the operation of voltmeter, ammeter and frequency meter each time the unit is started.

Figure 1: Fuel Pre-Filters/Lubricity Filters and Drain

d) "B" Check and Operations (250 Hours or 3 Months)

System	Items	Description
Engine	Charge-Air-Cooler and Piping	Inspect the charge-air-cooler for dirt and debris blocking the fins. Check for cracks, holes, or other damage. Inspect the pipes and hoses for leaks, holes, cracks, or loose connections. Tighten the hose clamps if necessary.
	Check and Record Oil Pressure	After each oil change, check and record oil pressure at idle speed after oil has warmed to approximately 140º F. Record oil pressure under identical conditions at each oil change interval. A comparison of pressure at idle speed with previous readings will give an indication of progressive wear of oil pump, bearings, shafts, etc. Investigate any abnormal change in pressure readings.
	Check Radiator Core and Hoses	Inspect the radiator core for dirt and debris blocking the fins. Clean as necessary. Check for cracks, holes, or other damage.
	Check Fuel Pump	Inspect the fuel injection pump mounting nuts for loose are damaged hardware. **Warning:** Be careful whenever you are inspecting the fuel system. The common rail fuel system is under very high pressure. Failure to comply with common rail fuel system safety procedures could result in injury or death.
Electrical (12 VDC system)	Check Batteries	Check battery terminals and clean if necessary.
Electrical (400 Hz System)		Check the operation of the E-F bypass system.

e) "C" Checks and Operations (500 Hours or 6 Months)

System	Items	Description
Engine	Check Engine and Generator Mounts	Check engine and generator mounting bolts to ensure they are properly installed have not worked loose. (Torque is set at 122 N-m, 90 ft-lb.). **Caution:** An unstable or loosely mounted engine can create hazardous environment and may also damage equipment.
	Change oil and oil filters	
	Change all fuel filters.	
	Check Coolant	The cooling system protective liquid (nitrite-, amine- and phosphate free) provides effective protection against corrosion, cavitation, and freezing. See engine manufacturer's operation manual for ordering and mixture details.
Electrical (12 VDC system)	Wiring	Inspect all cables and leads for worn or damaged insulation.
	Connections	Inspect connectors for damage or corrosion.

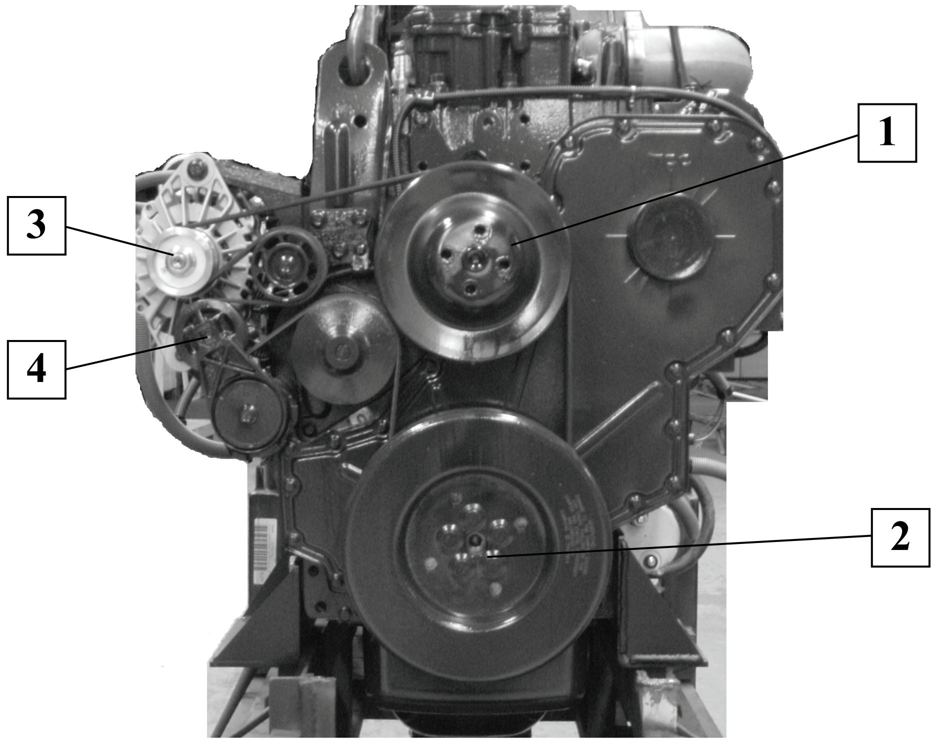
Electrical (400 Hz System)	Protective Monitoring Circuits	Check operation of all protective monitoring circuits to make certain they will function if a fault should occurs in the output circuit. Procedures for testing these circuits are contained in the Adjustment/Test section of this manual (Section 2-3).
	Inspect Wiring and Connections	Check all cables, leads, and wiring for broken, worn and damaged insulation. Check all connections for tightness.
	Clean and inspect generally	

f) "D" Checks and Operations (1000 Hours or 1 Year)

System	Items	Description
Engine	Check Fan Hub and Drive Pulley	Inspect for loose bolts or worn features. Tighten bolts and replace parts if necessary. Refer to the engine manufacturer's operations and maintenance manual for assistance and the most update to date information.
	Check Hose Clamps on Air Intake Side	Be sure that all clamps are properly secured to prevent leaks and all hose are in good condition.
	Check Belt Condition and Tensioner	Refer to the engine manufacturer's operations and maintenance manual for assistance and the most update to date information.
	Check and/or Adjust Valve Clearance	Refer to the engine manufacturer's operations and maintenance manual for assistance and the most up-to-date information.
	Check Water Pump	Inspect the water pump weep hole for indication of a steady leak. If a steady flow of coolant or oil is observed, replace the water pump with a new or rebuilt unit. Refer to the engine manufacturer's operations manual for assistance.

g) "E" Checks and Operations (1500 Hours or 1.5 Year)

System	Items	Description
Engine	Steam Clean Engine	There are several reasons why the engine exterior should be kept clean. Dirt on the outside will enter fuel and oil filter cases and rocker housings when covers are removed, unless dirt is removed first. A clean engine will run cooler and develop fewer hot-spots. Steam cleaning is one of the most satisfactory methods of cleaning and engine; however, there are some cautions to be observed: **Warning:** Exercise care to avoid injury and damage to eyes and skin. **Cautions:** • If a cleaning compound is used, select one that is free from acid and will not remove paint. • Protect (or remove) all electrical accessories such as voltage regulator, alternator, and electrical wiring. • Seal all openings. • DO NOT use a flammable solvent. • DO NOT use mineral spirits or solvents on a hot engine. • Remove or protect bottom panel of unit (belly pan) to protect insulation.
	Clean Fuel System	See engine manufacturer's operation manual for instructions.
	Check Alternator and Starter	The alternator and starter on this particular engine require no periodic lubrication.



1. Fan Pulley
2. Vibration Damper
3. Alternator
4. Belt Tensioner

Figure 2: Engine Accessories

h) "F" Checks and Operations (2000 Hours or 2 Years)

System	Items	Description
Engine	Check Vibration Damper	Check vibration damper for looseness, wobble, chunking and streaking. Also, verify the hub bolts are tightened to the engine manufacturer's specifications. Refer to the engine manufacturer's operations and maintenance manual for assistance and the most update to date information.
	Check Charge-Air-Cooler and Radiator Systems	Check for damaged hoses and loose or damaged hose clamps. Check the radiator for leaks, damage, and build up of dirt in the fins. Clean or replace as necessary.
	Flush cooling system and change coolant	

i) Seasonal Maintenance Checks Spring/Fall (Engine)

System	Items	Description
Engine	Check Fan Mounting	Check fan to be sure it is securely mounted. Check for fan wobble and/or broken/cracked blades. Check fan hub and crankshaft pulley for secure mounting.
	Cooling System	Check cooling system each spring and fall. Clean if necessary.
	Check All Hoses	In addition to daily checks of hoses for leaks, inspect hoses thoroughly each time the cooling system is cleaned and serviced. Inspect for signs of deterioration and collapse. Inspect for cracks and cuts. Inspect for cutting and deformation caused by hose clamps. Replace hoses as required.
	Thermostat	Check thermostat and seals each fall when servicing the cooling system.

3) Lamps, Circuit Breakers, and Fuses

a) Lamps

Light Identification	Location	Lamp (Bulb) Type
Instrument Panel Lights	Switch Panel	67
Engine Start Indicator	Switch Panel	1815
Engine Stop Indicator	Switch Panel	1815
No. 1 Load Contactor Indicator	Switch Panel	1815
No. 2 Load Contactor Indicator	Switch Panel	1815
Test/Reset Indicator	Switch Panel	1815
Pre-heater Indicator	Switch Panel	1815
Clearance Lights (optional)	Canopy Top	57
Engine Gauge Lights	Inside Each Gauge	53

Lamp Identification Chart

b) Circuit Breakers

Item Protected	Location	Quantity	Size
Engine Circuit and Instrument Panel	Inside Control Box	1	10 A
Controls	Inside Control Box	1	5 A
Marker Lights (optional)	Inside Control Box	1	10 A

Circuit Breaker Identification Chart

c) Fuses

Item Protected	Location	Quantity	Size
Engine Air Intake Heater	Top of Inside Bulkhead	1	100 A
Load Contactor Circuit	Voltage Regulator PCB	1	1 A
Voltage Regulator PCB	Voltage Regulator PCB	1	1 A
Field Voltage Circuit	Voltage Regulator PCB	1	5 A
Transformer-Rectifier [Optional]	Transformer-Rectifier PCB	1	1 A

Fuse Identification Chart

Section 2: Maintenance Procedures

Section 1 of this Servicing chapter provides a maintenance schedule and general descriptions of the maintenance steps. This section provides more details.

WARNING

STOP operations at once if a serious or possibly dangerous fault is discovered.

This section contains the following topics:

1) Lubrication **2**
- a) Lubrication Specifications 2
- b) Changing Engine Oil 3

2) Air Cleaner Maintenance **5**
- a) Air Cleaner Specifications 6
- b) Changing the Air Filter 6
- c) Disposal 6

3) Engine Fuel Selection **7**
- a) Fuel Quality 7
- b) Cold Weather Operation 7

4) Engine Fuel System **8**
- a) Fuel Tank 8
- b) Fuel Water Separator (Pre-Filter) 8
- c) Primary Fuel Filter 8
- d) Engine Lubricity Additive Fuel Filters 9
- e) Fuel Pump 10
- f) Fuel Return 10

5) Engine Cooling System **11**
- a) Radiator Cap 11
- b) Coolant 11
- c) Draining the Cooling System 12
- d) Flushing the Cooling System 12
- e) Cleaning the Radiator Core 12
- f) Fan Belt 13
- g) Filling the Cooling System 13
- h) Thermostat 13

6) Generator Maintenance **14**

7) Drive Belt **14**

1) Lubrication

Proper lubrication is one of the most important steps in good maintenance procedure. Proper lubrication means the use of correct lubricants and adherence to a proper time schedule.

Only the engine requires lubrication. The generator, generator controls, and instruments do not require lubrication. Recommendations regarding engine lubrication have been taken from the engine manufacturer's "Operation and Maintenance Manual" and incorporated here to make them more readily available to operators and maintenance personnel.

a) Lubrication Specifications

<table>
<tr><td colspan="2">Check Level</td><td colspan="2">Daily or after every 10 hours of use</td></tr>
<tr><td colspan="2">Change Oil and filter</td><td colspan="2">Change oil and the oil filter after the first 50 to 150 hours of use
Then at 500 hour or 6 month intervals
More frequently under severe operating conditions such as: low engine temperatures or high oil temperatures</td></tr>
<tr><td rowspan="8">Oil Specification</td><td>Class</td><td colspan="2">API Class CCMC
Use oil specification API CF-4, HT/HS Viscosity 3.7cP minimum.
Refer to the engine manufacturer's operation manual for more lubricating oil information.</td></tr>
<tr><td rowspan="6">Viscosity</td><td>AMBIENT TEMPERATURE CONDITIONS</td><td>VISCOSITY</td></tr>
<tr><td>0ºF (-18ºC) and above for most climates</td><td>SAE 15W40 (Preferred)</td></tr>
<tr><td>-10ºF to +50ºF (-23ºC to +10ºC) Winter conditions</td><td>SAE 10W30</td></tr>
<tr><td>-20ºF to +50ºF (-29ºC to +10ºC) Arctic Conditions</td><td>SAE 5W30</td></tr>
<tr><td>-20ºF and below to +50ºF (-29ºC and Below to +10ºC)</td><td>SAE 0W30</td></tr>
<tr><td colspan="2">For operation at temperatures consistently below -13ºF (-25ºC), refer to the engine manufacturer's operation manual.</td></tr>
<tr><td>Synthetic Oils</td><td colspan="2">See the engine manufacturer's operations manual for usable synthetic oils and instructions.</td></tr>
<tr><td>Capacity</td><td colspan="3">24 quarts (22.7 liters)</td></tr>
<tr><td>Filters</td><td colspan="3">Oil Filter Replacement -- Hobart No. 286897-035
Oil Filter Replacement – Cummins No. LF9009</td></tr>
<tr><td>Grease, General Purpose</td><td colspan="3">Specification: MIL-G-3545 (Excludes those of sodium or soda soap thickness.)</td></tr>
</table>

b) Changing Engine Oil

Change the engine oil after the first 50 - 150 hrs. and every 500 hrs of engine operation thereafter. The generator set is equipped with an hour meter to record actual engine operating time.

The ideal time to change engine oil is soon after a power delivery run, when the engine is at operating temperature. If lubricating oil is drained immediately after the unit has been run for some time, most of the sediment will be in suspension and will drain readily.

Change the oil filter element each time the oil is changed.

CAUTIONS

- High ash oils may produce harmful deposits on valves that can cause valve burning.
- Do not use solvents as flushing oils in running engines.
- If bearing metal particles are found on the oil filter element or in the shell, the source should be determined before a failure.
- Determine source of moisture, internal leaks, defective seals, gaskets, etc.

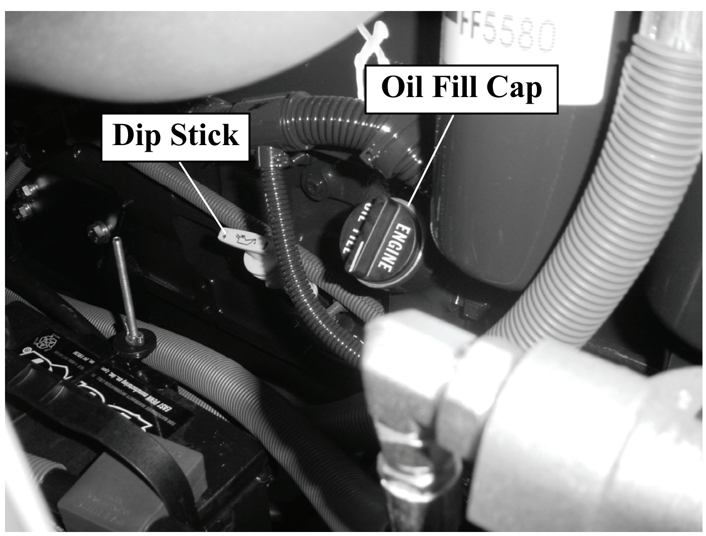


Figure 1: Lubrication System

Change oil as follows:

1. Provide an open container for catching the old oil below the oil drain plug. Container capacity must be greater than 30 quarts (28.4 liters).
2. The oil drain tube can be attained though a hole in the access panel underneath the generator set.
3. Open the drain valve located in the bottom of the oil pan.
4. While oil is draining, change the oil filter element. See instructions below.

a) Provide a container for catching spilled oil from the filter.

b) Remove the oil filter by twisting counter-clockwise and inspect it.

c) Make sure the gasket is not stuck to the filter head. If it is, remove it before installing a new filter.

d) Fill the new filter with clean lubricating oil before installation.

e) Apply a light coating of lubricating oil to the gasket-sealing surface and install the filter. DO NOT over tighten the filter.

5. Close drain valve located in the bottom of the oil pan.
6. Use the oil refill tube to refill the crankcase with new, clean oil that meets engine manufacturer's recommendations.

NOTE: Use a funnel to fill the oil crankcase to help prevent spills.

CAUTION

- Always use clean containers, funnels, etc.
- Remember to close the drain plug valve and install the new oil before starting the engine.

7. Start the engine and check the oil pressure at once. Allow the engine to idle for 5 minutes, check for leaks, then stop the engine.
8. After the engine has been stopped for about 5 minutes, recheck the oil level. Add oil, if required, to bring the level up to the high bar on the oil dipstick.

Engine Accessories Lubrication

Alternator	Most alternators contain sealed bearings and require no periodic lubrication, however, check to make certain there are no lubrication points on your particular alternator.
Starter	Most starting motors are lubricated at assembly and should be re-lubricated only when the starter is removed and disassembled, however, inspect the starter to make certain it has no lubrication points.
Water pump	The water pump is packed at assembly and requires no periodic lubrication. Replace pump if signs of lubricant leakage are found.
Fan pulley	The fan hub is also lubricated at assembly and requires no periodic lubrication. Replace hub if lubricant is leaking.

2) Air Cleaner Maintenance

The air cleaner assembly, shown in the figure below, contains two air filter elements. A definite time schedule for cleaning or changing the air filters cannot be determined because of varying operating conditions.

To remove the air cleaner filters from the air cleaner housing, unscrew the plastic cover at the end of the air cleaner housing. Air filters may be inspected either at prescribed service intervals or at any time deemed necessary.

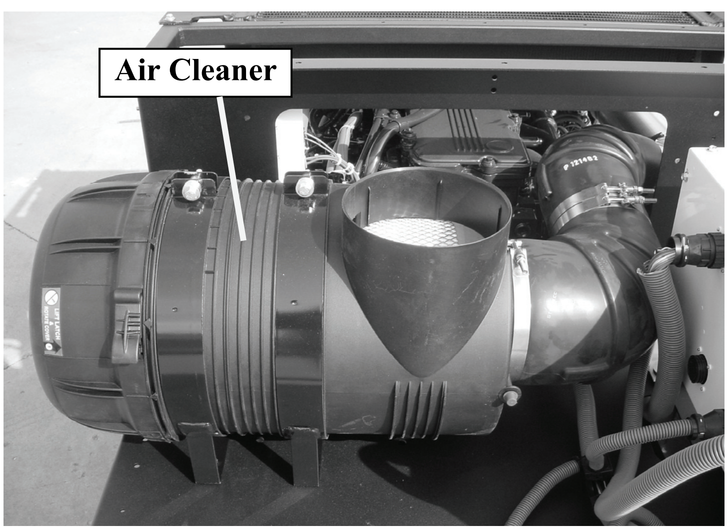


Figure 2: Air Cleaner Assembly

a) Air Cleaner Specifications

Inspections	Make periodic checks of air cleaner inlet screen for obstructions. If any obstructions are present, remove them. Check outlet connection for proper seal.
Changes	Change the air cleaner filter when the fault code meter on the control panel shows the "Air" fault.
Replacement Filters	Primary filter element: Hobart part no. 290828 Secondary filter element: Hobart part no. 290829

b) Changing the Air Filter

1. Unscrew the plastic end of the air cleaner housing.
2. Remove end cover of housing.
3. Pull out air filter elements and replace.
4. Replace end cover on housing, making certain that the filters are centered in the housing.
5. Screw the plastic end of the air cleaner housing back on.

c) Disposal

These air cleaner filters are disposable and should be discarded when dirty. Normal trash pick-up should be acceptable. Never burn the air filter for disposal.

3) Engine Fuel Selection

a) Fuel Quality

The quality of fuel oil used in the diesel engine is a major factor in engine performance and life. Fuel oil must be clean, completely distilled, stable and non-corrosive.

CAUTIONS

- Due to the precise tolerances of diesel injection systems, it is extremely important that the fuel be kept clean and free of dirt or water. Dirt or water in the system can cause severe damage to both the injection pump and the injection nozzles.
- The use of low lubricity fuels can shorten life and/or damage the engine's fuel pump. The engine manufacturer recommends only diesel fuel.

Use commercially available ultra-low sulfur diesel (ULSD) fuel with less than 0.005% sulfur content. Using ULSD reduces emissions of sulfur compounds, oxides of nitrogen, and particulate matter. If the sulfur content is higher than 0.005%, change the engine oil more frequently (See engine manufacturer's operation manual).

In general, fuels meeting the properties of ASTM designation D 975 (grades 1-D and 2-D) have provided satisfactory performance. For more information regarding the selection of fuel to use, refer to publication "Engine Requirements—Lubricating Oil, Fuel, and Filters" available from authorized engine manufacturer's service outlets.

b) Cold Weather Operation

In cold weather, diesel fuel forms wax crystals, which can restrict flow and clog filters. Fuel oil suppliers approach this problem several ways. Some provide a specially refined product, while others may use flow-improving additives or winter blends. Winter blended fuel will likely contain kerosene or 1-D fuel, which provide good cloud point temperatures but results in a lighter fuel with lower heat content. These fuels may be used, but they may result in reduced engine power and/or higher fuel consumption.

In most cases, using a fuel additive can provide adequate resistance to cold. For further assistance, contact an engine manufacturer's service representative.

4) Engine Fuel System

The fuel system consists of six primary components: Fuel tank, Fuel Water Separator (Pre-Filter), Primary Fuel Filter, Fuel Pump, Lubricity Additive Fuel Filters, and the Fuel Return Line. The following are maintenance procedures for each of these items.

a) Fuel Tank

Be sure that no foreign objects are permitted in the fuel tank. The fuel tank must be removed and flushed out if objects are found in the Fuel Water Separator (Pre-Filter) or Lubricity Additive Fuel Filters.

b) Fuel Water Separator (Pre-Filter)

The Fuel Water Separator (Pre-Filter) is attached to the QSL 9.0 engine. Its primary function is to remove foreign material and extract water from the fuel before it enters the fuel filter.

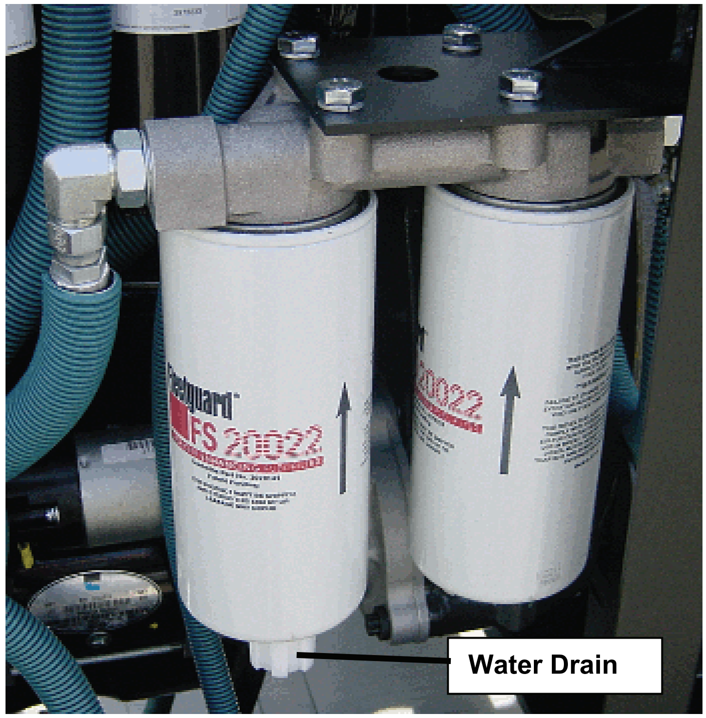
Drain	Daily	1. Open the drain valve by unscrewing the knob on the bottom of the first filter. 2. Drain the accumulated water and contaminants. 3. Close drain valve.
Replace	after every 500 hours of operation.	1. Apply a coating of clean fuel or motor oil to the new O-ring and element seal. 2. Spin the filter onto the fuel filter element.
Replacement Part Numbers	Hobart Part No. 286897-033 Cummins Part No. FS19732	

c) Primary Fuel Filter

The Primary Fuel Filter is attached to the QSL 9.0 engine. Its function is to remove foreign material that made it past the Fuel Water Separator (Pre-Filter) before it enters the fuel pump. .

Replace	after every 500 hours of operation.
Replacement Part Numbers	Hobart Part No. 286897-034 Cummins Part No. FF5580

d) Engine Lubricity Additive Fuel Filters



Engine Lubricity Additive Fuel Filters
Figure 3

The Engine Lubricity Additive Fuel Filters are remotely mounted to the bulkhead of the unit. Its primary function is to add lubrication to the fuel, but it will also extract water from the fuel before it enters the fuel filters.

CAUTION
When installing new element, do not over tighten it; mechanical tools may distort or crack filter head.

Drain	Daily	1. Open drain valve by unscrewing the knob on the bottom of the filters. 2. Drain accumulated water and contaminants. 3. Close drain valves.
Replace	After every 500 hours of operation.	1. Apply a coating of clean fuel or motor oil to the new O-ring and element seal. 2. Spin the filters onto the fuel filter element.
Replacement Part Numbers	For all 500181A specifications **except** -006 and -106 (2 required)	Hobart Part No. 286897-031 Cummins Part No. FS20022
	Only for 500181A -006 and -106 (1 required)	Hobart Part No. 286897-032

e) Fuel Pump

The fuel pump supplies high pressure to the fuel system so the diesel fuel can circulate freely. A consistent check of the fuel pressure is necessary. This should be done by a trained professional because of the high-pressure common-rail fuel system. Loss in fuel pressure in the fuel line may indicate a faulty fuel pump.

WARNING

Be careful whenever you are inspecting the fuel system. The common-rail fuel system is under very high pressure. Failure to comply with common-rail fuel system safety procedures could result in injury or death.

f) Fuel Return

The fuel return is a fuel line (tube) that takes unused fuel from the engine, and delivers it to the fuel tank. No maintenance is required.

5) Engine Cooling System

Cooling system service requires more than maintaining the proper coolant level in the radiator and protecting the system against freezing. Water should by clean and free of any corrosive chemicals such as chloride, sulfate, and acids. It should be kept slightly alkaline with a pH value in the range of 8.0 to 9.5. Any water, which is suitable for drinking, can be used in the engine when properly treated as described in engine manufacturer's operation manual. The engine manufacturer's representative should be consulted regarding the selection of satisfactory brand, permanent-type antifreeze for use in the cooling system.

a) Radiator Cap

Pressure Rating	A pressure relief valve is built into the radiator cap. It is designed to open at a pressure of approximately 15 psi (103.4 Kpa).
Radiator Cap Removal	To remove, turn the cap to the left (counterclockwise) to the safety stop. When all pressure is released, press down on the cap and continue to turn until the cap is free to be removed. **WARNING:** To avoid the risk of burns when removing cap from a very hot radiator, do not turn cap past safety stop until the pressure or steam has escaped.
Radiator Cap Installation	When installing the cap, be sure it is turned clockwise as far as it will go so that the pressure-retaining valve will be functional. **CAUTIONS:** • To avoid engine damage, allow the engine to cool before adding coolant. • Do not attempt to repair the valve in a radiator cap in case of failure. Replace with a new cap.

b) Coolant

The preparation and maintenance of the coolant solution is important to engine life and is completely covered in the engine manufacturer's operation manual. For information regarding coolant specifications, testing equipment, antifreeze, etc., refer to engine manufacturer's operation manual that accompanies the equipment manufacturer's manual or consult the local engine manufacturer's representative.

Check level and hoses	Daily
Coolant System Capacity	59 quarts (55.8 liters)
Type	Select permanent type antifreeze known to be satisfactory for use with chromate corrosion resistor. When it is not known if the antifreeze is satisfactory for use with chromate resistor, check with local engine manufacturer's representative for a list of compatible antifreezes.
Testing	Check the solution with a reliable tester when in doubt about antifreeze protection.

CAUTIONS

- **DO NOT** use methanol or alcohol as antifreeze.
- **DO NOT** mix brands or type of antifreeze. A solution containing two or more types of antifreeze is impossible to test accurately.
- Never use soluble oil in the cooling system.

c) Draining the Cooling System

To drain the cooling system, proceed as follows:

1. Remove radiator cap.
2. Place a drain pan with at least 80 quarts (75.7 liters) capacity under radiator to catch coolant.
3. Place the radiator drain hose that comes off the two radiator drain valves, into the drain pans.
4. Open the radiator drain valves.
5. Allow the system to drain completely. Be sure the drain valves do not clog during draining.
6. When the system is completely drained, close the drain valves.

d) Flushing the Cooling System

Flushing the cooling system should be a yearly maintenance procedure. The flushing process forces clean water through the engine block to remove expired coolant and other contaminants.

e) Cleaning the Radiator Core

Blow out accumulated dirt from the radiator core air passages, using water. Bent or clogged radiator fins often cause engine overheating. When straightening bent fins, be careful not to damage the tubes or to break the bond between fins and tubes.

NOTE: Direct the water in a reverse direction to normal air flow. Normal flow on this installation is from the engine compartment outward.

f) Fan Belt

Check fan belt condition and tension every 500 hours or 6 months of use.

g) Filling the Cooling System

The preparation and monitoring of coolant in liquid-cooled engines is especially important because corrosion, cavitation, and freezing can lead to engine damage. For coolant system protection details, refer to the engine manufacturer's operations manual.

(1) Install coolant

1. Remove radiator cap. Be sure that both radiator drain valves are closed.
2. Open the ball valve that runs from the surge tank to the side tank of the radiator.
3. Pour coolant into radiator very slowly until it reaches the bottom of fill neck. Allow time for trapped air to escape from the system then continue filling until the coolant level remains at the bottom of the fill neck.
4. Close the ball valve that runs from the surge tank to the side tank of the radiator.
5. Start the engine, bring it up to rated speed, and allow the thermostat to open. Add coolant as trapped air escapes from the system and the coolant level falls.
6. Continue to check coolant level until all trapped air escapes. Add coolant if needed to fill to the bottom of fill neck. Install radiator cap.

(2) Inspection/Check

1. Check system for evidence of leaks.
2. Inspect all hoses. Install new hoses as necessary. Tighten hose clamps as required.
3. Check the condition of fan and water pump belts. Replace belts if necessary.

NOTE: It is good practice to attach a card, indicating the cooling system contents and date serviced, to the radiator filler neck.

h) Thermostat

Check the thermostat each fall or as required. Refer to engine manufacturer's operations manual for recommended instructions.

6) Generator Maintenance

The 400 Hz generator requires no maintenance or service other than periodic cleaning. The unit is brushless and has bearings that are permanently lubricated and sealed. The generator itself requires no adjustment. Adjustment procedures for generator controls are covered in Section 2-3.

To clean the generator, use compressed air or a good, SAFE commercial cleaner. Do not steam clean the generator because the use of steam and harsh chemical compounds may damage to insulation and other generator components.

CAUTION

Do not use a flammable solvent. Be sure the unit is completely dry before operating.

7) Drive Belt

The engine cooling fan, alternator, and water pumps are driven by one serpentine belt, which must be replaced if worn or damaged.

Note: All driven assemblies must be securely mounted in operating position before checking belt tension.

CAUTION

Checking the tension and changing the serpentine belt should only be performed with the engine off.

Check belt tension every 1000 hours, or once year, whichever comes first. A belt that is too tight is destructive to bearings of the driven part. A loose belt will slip and cause inefficient operation of the part being driven as well as wear to the belt.

CAUTION

Inspect and replace the belt if it has unacceptable cracks, is frayed, or has pieces of material missing.

To check the belt tension, manually depress the belt with an index finger to determine the amount of belt deflection obtained. When a force is applied at a point halfway between pulleys on the longest span of a belt, there should be no more than 1/2 inch of deflection attained.

Refer to the engine manufacturer's operation manual for checking belt tension and changing worn belts.

Section 3: Test and Adjustment

This section provides instructions for testing and adjusting the generator set after major repair, major parts replacements, or overhaul.

This section includes the following topics:

1) Tools and Equipment 2
2) Generator Meters, Controls and Circuit Boards 3
3) Testing the 400 Hz. Generator Set 8
a) Pre-operational Test Procedures 8
b) Operational Test Procedures 8
c) EF Signal Tests 9
d) ECM Check 10
e) Meter Tests 10
f) Over-Voltage Tests 11
g) Under-Voltage Tests 11
h) Under-Frequency Test 12
i) Over-Frequency Test 12
j) ECM Fault Tests 13
k) Re-checking the entire unit after testing 13
4) Generator Set Adjustments 14
a) Generator Adjustments 14
b) Voltage Regulator Adjustments 14
(1) Output Voltage Adjustment 14
(2) Line-Drop Compensation Adjustment 14
(3) Voltage Regulator Tests 14
c) Engine Adjustments 15
5) Generator and Exciter Tests 15
a) Coil Resistance Tests 15
b) Exciter Armature Diode Test 16
6) Transformer – Rectifier Tests (for units with the DC option) 16
a) Test Preparation 16
b) Power Delivery Test 16
c) Current Limiting / Soft Starting Control 17
d) Over-Voltage Protection 17
e) Under-Voltage Protection 17
f) Overload Protection 17
g) Temperature Overload Protection 18
h) Silicon Diode Tests 18
i) Control Interlock Kit (Optional) 18
7) Adjusting the Transformer-Rectifier (for units with DC option) 18

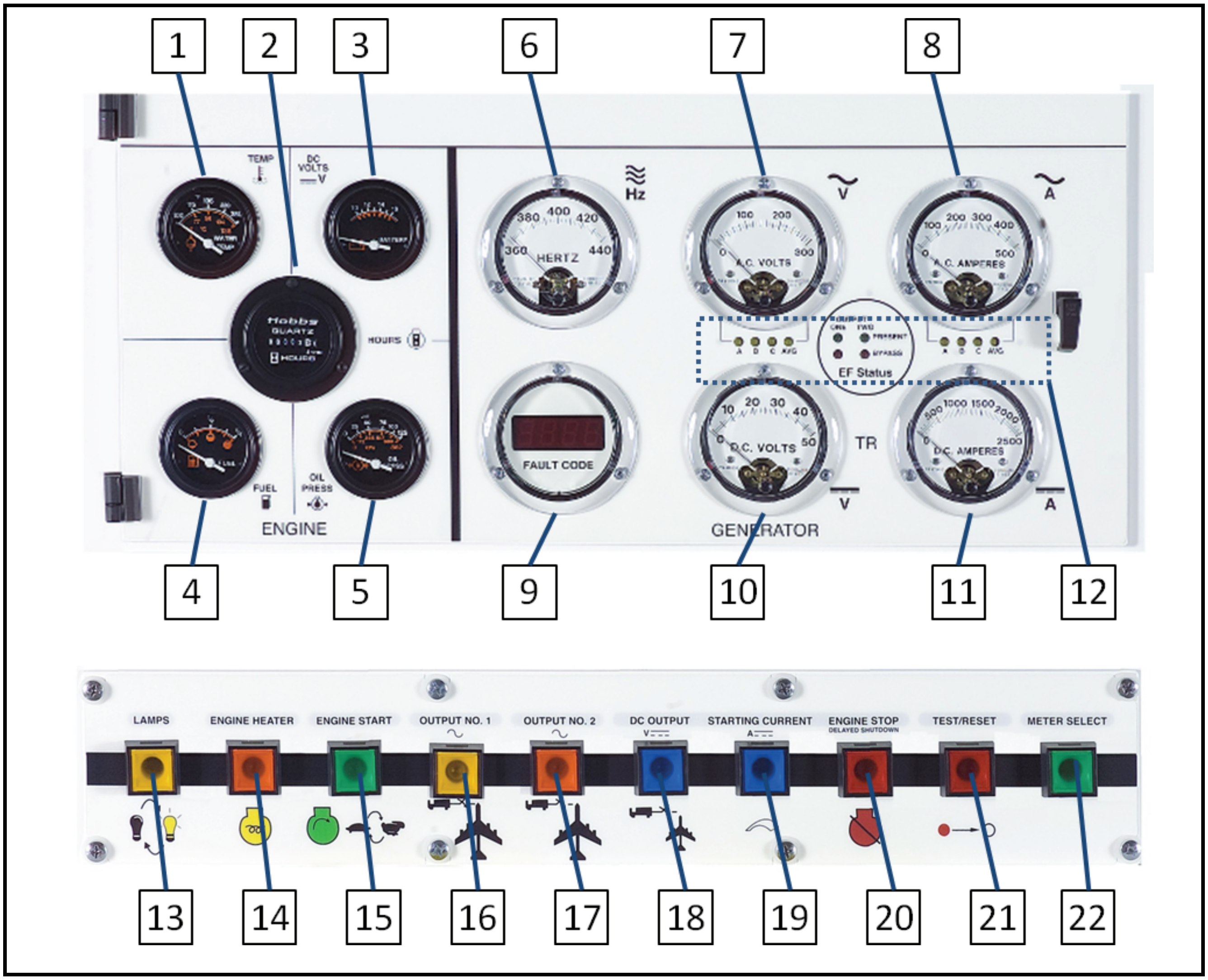
1) Tools and Equipment

This section requires the following tools or equipment for tests and adjustments:

Device	Specification	Purpose
Load Bank	Capable of handling full generator output. If your load bank does not generate an EF Interlock signal, you will also need a source of 24 volts (such as a power supply or two 12-volt batteries in series)	Test generator output and test EF Interlock circuit
Voltmeter	Capable of measuring up to 50 VDC and up to 400 VAC	Test generator meters and output
Ammeter	Clamp-on type to measure up to 600 Amps	Test generator ammeter
Frequency meter	Measure 400 Hz. accurately	Test generator frequency meter
Ohmmeter	With diode test capability	Testing exciter armature diodes
Kelvin Bridge		Read very low resistances for testing generator windings
Strobe light		Measure generator RPM
Stopwatch		Measure response time of protective circuits

2) Generator Meters, Controls and Circuit Boards

Refer to the following diagrams when locating the items specified in the instructions.



1. Engine Coolant Temperature Gauge (M24)
2. Running Time Meter (M4)
3. Battery Voltmeter (M5)
4. Fuel Gauge (M13)
5. Oil Pressure Gauge (M25)
6. Frequency Meter (M3)
7. AC Generator Voltmeter (M2)
8. AC Generator Ammeter (M1)
9. Fault Code Meter (M6)
10. DC Voltmeter *[Optional with TR]*
11. DC Ammeter *[Optional with TR]*
12. Front LED Display (A5)

13. Panel Light Switch (S74)
14. Air Intake Heater Switch (S79)
15. Engine Start Switch (S24)
16. AC Output No. 1 Switch (S75)
17. AC Output No. 2 Switch (S275)
18. DC Output Switch (S430) *[Optional with TR]*
19. DC Starting Current Switch (S431) *[Optional with TR]*
20. Engine Stop Switch (S76)
21. Test/Reset Switch (S77)
22. Meter Selector Switch (S3)

Figure 1: Control Panel Door

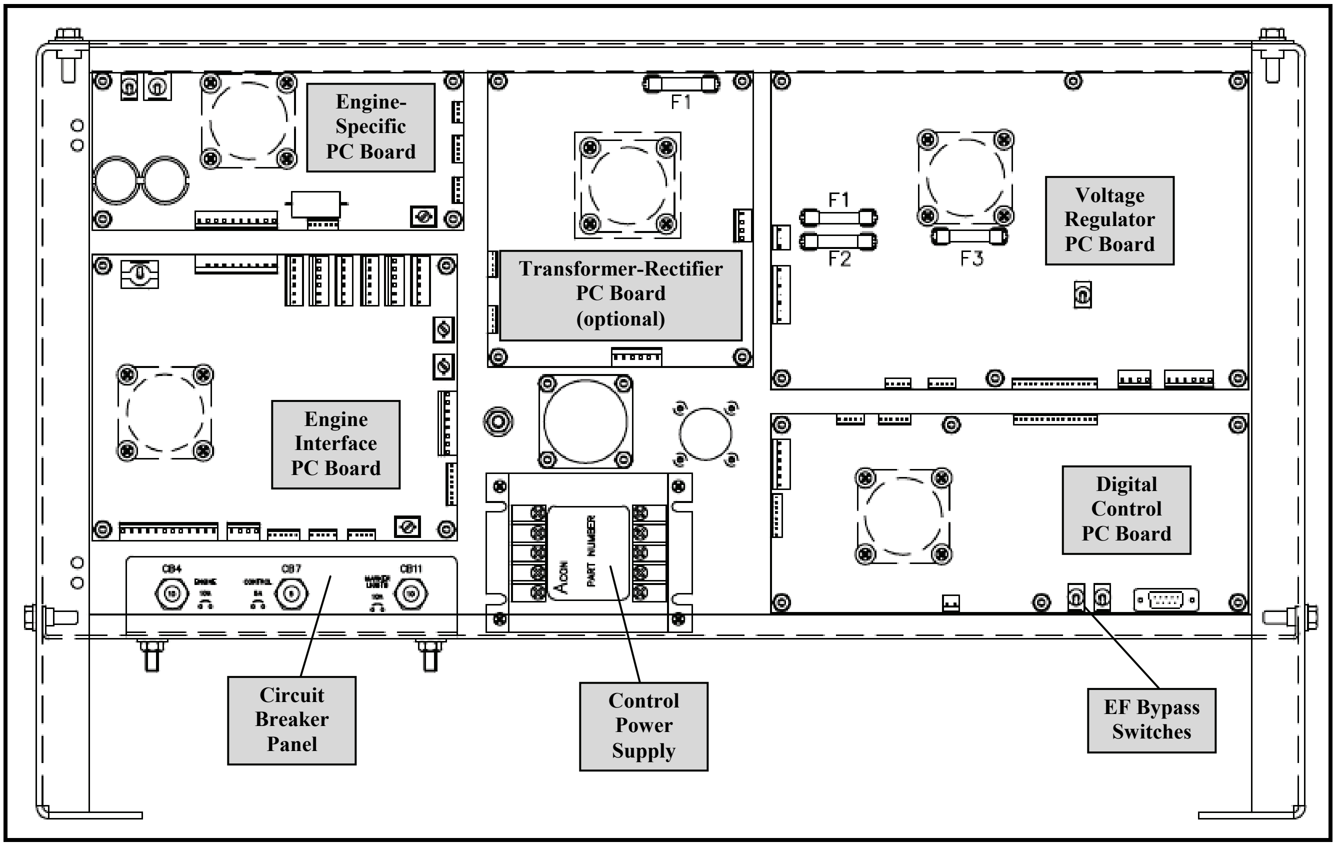


Figure 2: Control Box Interior Components

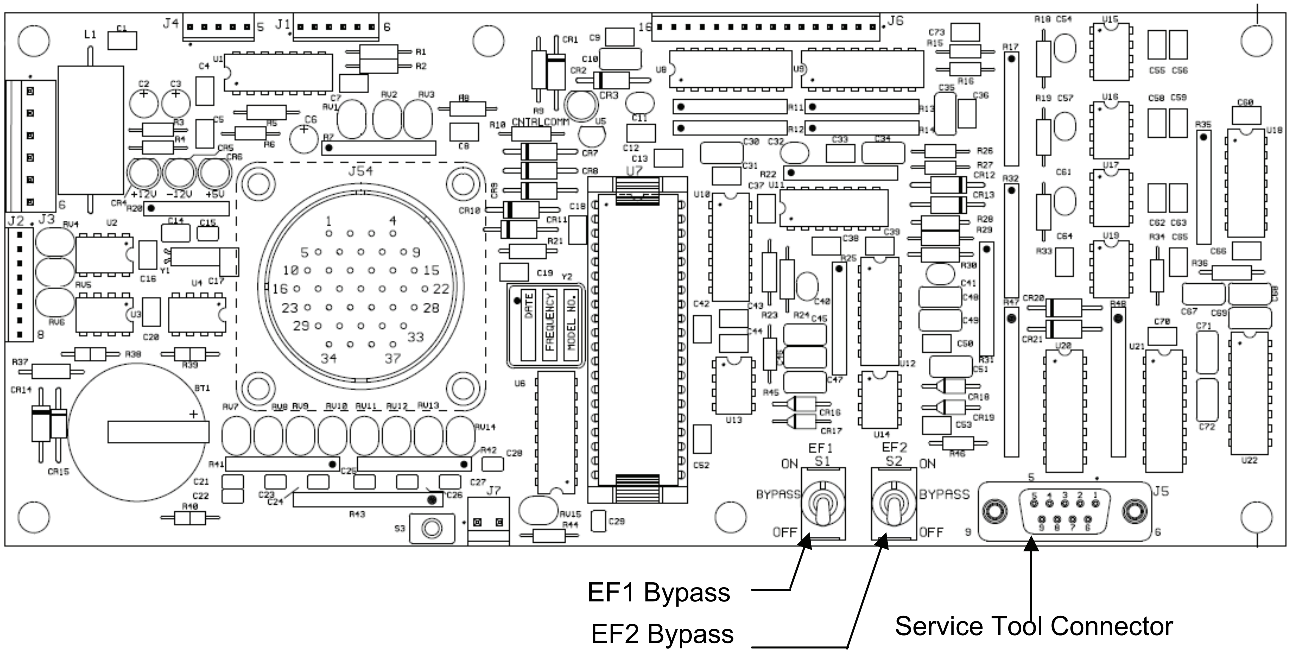


Figure 3: Digital Control PC Board

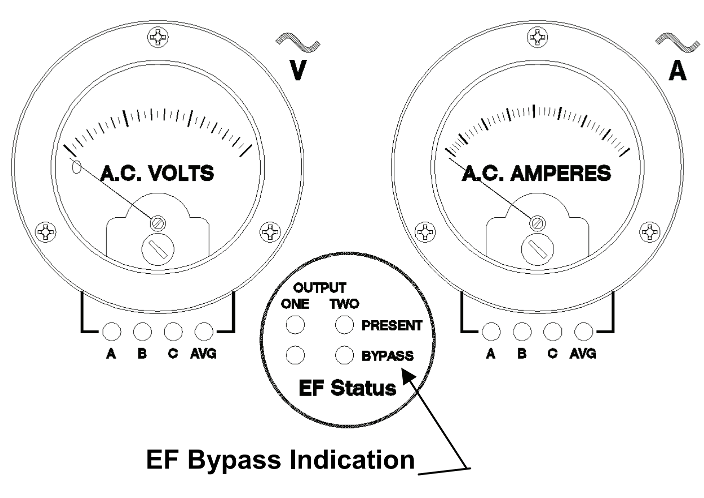


Figure 4: EF Bypass Indication

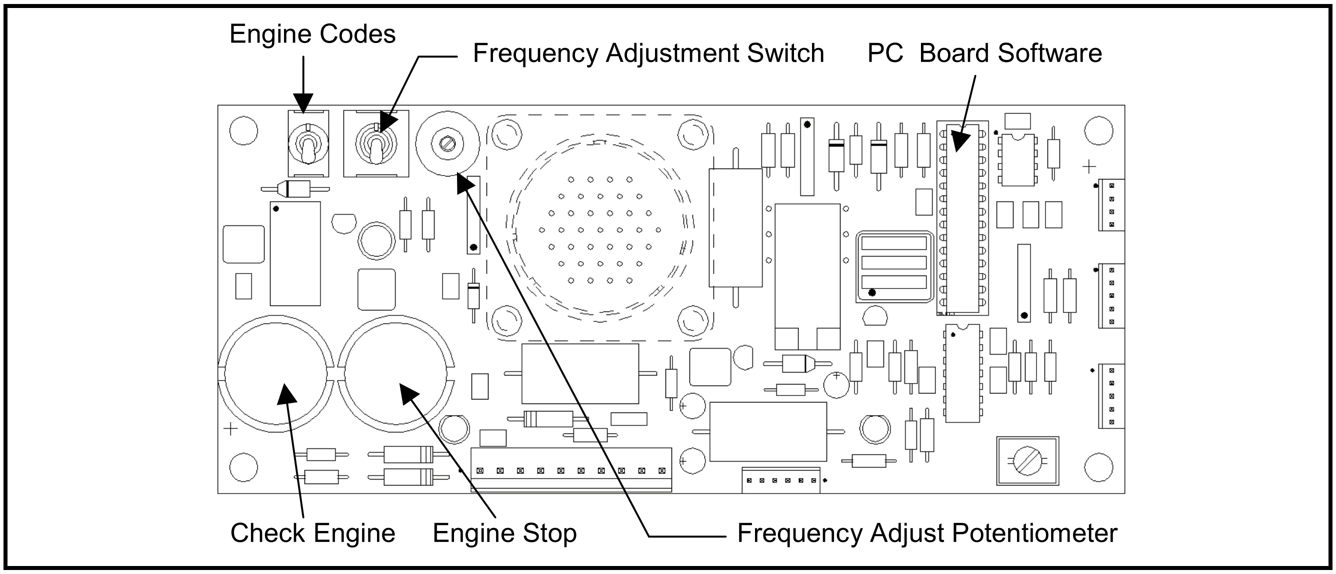


Figure 5: Engine Specific PC Board

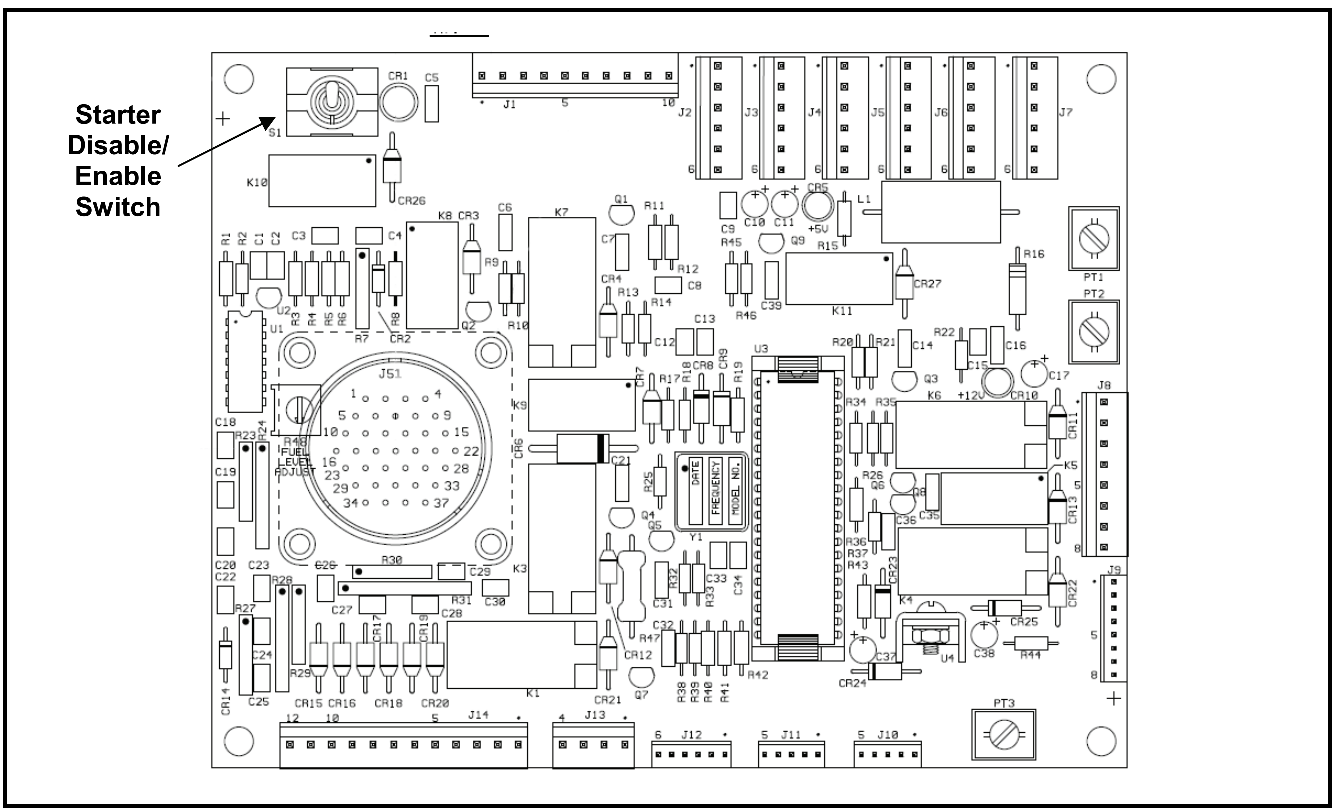


Figure 6: Engine Interface PC Board

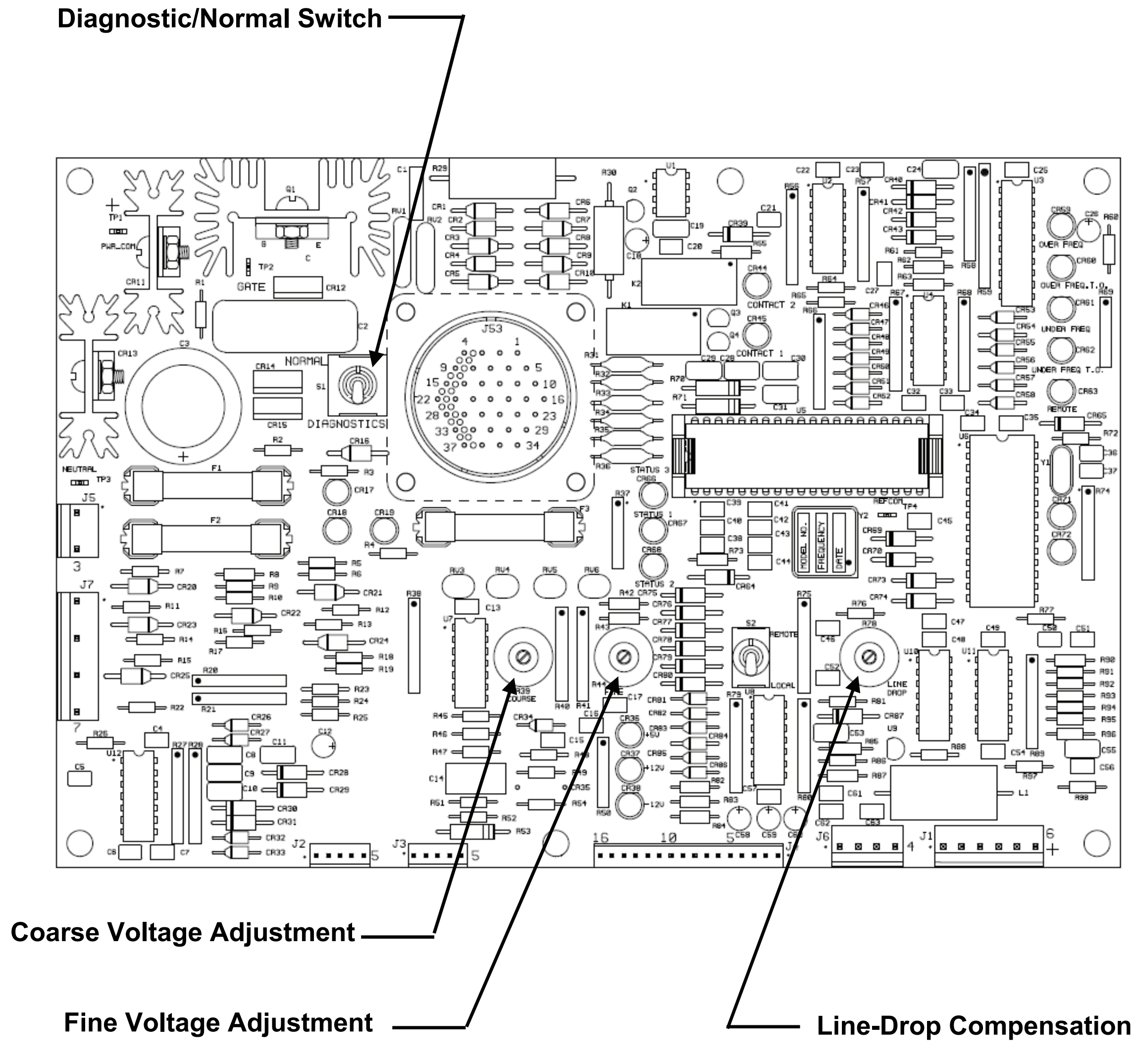


Figure 7: Voltage Regulator PC Board

3) Testing the 400 Hz. Generator Set

This section requires the following tools or equipment:

a) Pre-operational Test Procedures

1. Connect cables from the generator output terminals to a load bank. Use cables of the same size and length as those to be used in service. Be sure the generator output N cable is grounded.
2. Check engine oil level. Oil should be at high bar on the dipstick.
3. Check radiator coolant level (see Section 2-2).
4. Check tension of drive belt (see Section 2-2).
5. Inspect for oil, fuel, and coolant leaks.
6. Press the control panel **LAMPS** pushbutton switch. If panel lights operate, this indicates that the panel lights circuit breaker, switch, and lamps are good.
7. Press the **TEST/RESET** pushbutton switch. If fault code display lights up, the control circuit breaker (Figure 2) is good.
8. Inspect all wiring, and terminals.
9. Inspect the equipment to be certain no damage will result from starting the engine.

b) Operational Test Procedures

For these instructions, refer to the diagram of the Voltage Regulator PC Board (Figure 7).

1. Start the engine in accordance with instructions in Section 1-3.
2. Check operation of engine instruments; ammeter, coolant temperature indicator, oil pressure gauge and hour meter (all shown in Figure 1).
3. Check that the engine idle speed is 1000 +/- 25 RPM.

Note: A stroboscope may be required for this check.

4. Again, check for oil, fuel, and coolant leaks and correct any leaking condition.
5. Position switches and controls for automatic voltage regulation and power delivery according to the following table. Refer to the figures in this section.

PC Board	Figure	Switch	Required Setting
Engine Interface Board	6	Starter Enable/Disable	Enabled
Engine Specific Board	5	Frequency Adjust	Disabled
Digital Control Board	3	EF1 and EF2 Bypass	Bypass
Voltage Regulator Board	7	Regulated/Diagnostic	Normal

Note: If the coarse voltage-adjustment potentiometer on the Voltage Regulator PC Board (Figure 7) has been disturbed, set it at center position (halfway between full clockwise position and full counterclockwise position).

6. Press the ENGINE START pushbutton switch a second time to bring the engine up to rated speed and energize the generator. If the engine comes up to rated speed and the voltmeter indicates approximately 115 V, the engine ECM and excitation circuits are functioning.

Note: After generator overhaul or repair, the Regulated/Diagnostic switch on the Voltage Regulator PC Board (Figure 7) must be placed in the DIAGNOSTIC position for 3 to 5 seconds to re-magnetize the exciter. Then return the switch to the REGULATED position after voltage has built-up.

7. If the engine speed is properly set, frequency meter should indicate 400 Hz.
8. Use the fine voltage-adjustment potentiometer (Figure 7) to adjust voltage to 115 V.
9. While observing the AC voltmeter, turn the coarse voltage-adjustment potentiometer (Figure 7) to full clockwise position. The maximum voltage should be 134 volts or higher.
10. While observing the AC voltmeter, turn the coarse voltage-adjustment potentiometer (Figure 7) to full counterclockwise position. The minimum voltage should be 95 volts or higher.
11. Reset the output voltage to 115 V.

c) EF Signal Tests

This test requires a load bank that can generate at 28.5 volt EF Interlock signal. If your load bank does not have that capability, connect a source of 24 VDC power (two twelve-volt batteries connected in series) to terminals N, F (or E) at the output terminal panel. Connection polarity is important. Connect plus (+) to terminals E or F, and minus (-) to terminal N.

For these instructions, refer to the diagrams of the Digital Control PC Board (Figure 3) and the Control Panel LEDs (Figure 4).

If your generator set has two outputs, perform these tests using Output 1 and then repeat these steps for Output 2.

1. Configure the load bank to apply a light load to the generator.
2. On the Digital Control Board, place the EF Bypass switch in BYPASS / OFF position.
3. Turn the load bank EF signal ON.
4. Press the control panel Output pushbutton switch to close the contactor. The light in the pushbutton switch should turn on.
5. Turn the load bank EF signal OFF. The load contactor should open immediately, the indicating light within the pushbutton switch should go off, and the fault code display should indicate an EF warning.
6. Press the TEST/RESET pushbutton to reset the fault.
7. Verify that when the EF Bypass switch is in the BYPASS / ON position or the BYPASS / OFF position, that the appropriate LED indication on the control panel display (Figure 4) is correct.
8. Place EF Bypass switch in BYPASS / ON position. The corresponding Control Panel LED (Figure 4) should also indicate the bypass mode.
9. Press the Output pushbutton switch. The light in the pushbutton switch should turn on and remain on when the pushbutton switch is released. This indicates that EF bypass switch is functioning correctly.
10. Place the EF Bypass switch to BYPASS / OFF position. The load contactor should open immediately, the light within the Output pushbutton switch should go off, and the fault code display should indicate an EF warning. The corresponding LED should also indicate the EF present mode.
11. Reset the fault by pressing the TEST/RESET pushbutton.
12. Repeat these steps for Output 2 (if applicable)

d) ECM Check

If your generator set has two outputs, perform these tests using Output 1 and then repeat these steps for Output 2.

1. In EF bypass mode, apply 1/3 to 1/2 load at the load bank and allow the unit to run for 15 to 30 minutes. Observe operation of all monitoring instruments.
2. Increase load at the load bank to full load.
3. Check operation of the engine ECM by observing the frequency meter when generator is switched from no load to full load, and vice versa. Use the No. 1 contactor control pushbutton switch to apply and remove load several times. Steady-state frequency droop should be no more than 1 Hz.
4. Follow instructions under the “Generator Set Adjustment” topic later in this section to set the voltage regulator line-drop compensation for the length and size of cable being used.
5. Check voltage regulator, at intervals, from no load to full load. Observe and note voltage at various loads. Steady-state voltages should vary no more than +/- 1% from normal output voltage.
6. Operate the output circuit of the unit no less than 10 minutes under full load. The overload protection must not trip.
7. Operate the output circuit of the unit at 125% load (325 amperes) for 5 minutes immediately following the full load run. The overload device MUST trip within 5 minutes, and the fault code display should read 70.18 indicating an overload condition in OUTPUT NO 1 (Reference fault chart in Section 2-4).
8. Reset the fault by pressing TEST/RESET pushbutton.
9. Repeat these steps for Output 2 (if applicable)

e) Meter Tests

Connect calibrated test meters as indicated in the table below:

Test	Test Meter Connection	Test Procedure	Meter Error Limits
Voltmeter	Connect to the terminals of AC voltmeter on the control panel	Select phases with the METER SELECT switch. The voltage should be: • 115 volts line-to-neutral (one phase LED lit) • 200 volts line-to-line (two phase LEDs lit)	Under 2% of full scale
Ammeter	Clamp around an AC output cable conductor	Check currents for various loads.	Under 4% of full scale
Frequency Meter	Connect to the terminals of the frequency meter on the control panel	Check frequency at any load.	Under 1% of full scale

f) Over-Voltage Tests

When the protective system detects and over voltage condition, it should open the load contactor and display fault code 70.16. The time required for the circuit to trip depends on the voltage:

- At 125 volts, the circuit trips after a 1-second time delay.
- At 140 volts, the circuit trips within 160 milliseconds.
- At 180 volts, the circuit trips within 50 milliseconds.

1. With the unit running at a normal load, adjust the coarse voltage-adjustment potentiometer (Figure 7) on the voltage regulator clockwise to increase voltage until the over-voltage sensing circuit actuates the protective monitor.
2. If the load contactor does not open under the conditions described in step (a), refer to the Troubleshooting Chart in Section 2-4.
3. Return unit to normal operating conditions by adjusting the coarse voltage-adjustment potentiometer (turning it counterclockwise) and pressing TEST/RESET button switch to clear the fault code.

g) Under-Voltage Tests

When the protective system detects and over voltage condition, it should open the load contactor and display fault code 70.17.

1. With the unit running at a normal load, adjust the coarse voltage-adjustment potentiometer (Figure 7) on the voltage regulator counterclockwise to decrease voltage until the under-voltage sensing circuit actuates the protective monitor.
2. Return unit to normal operation by adjusting coarse voltage-adjustment potentiometer for normal output voltage and pressing the **TEST/REST** pushbutton switch to clear the fault code.
3. With the unit running at normal load, use the coarse voltage-adjustment potentiometer on the voltage regulator to reduce the voltage to 104 volts. The load contactor should NOT open.
4. Using a stopwatch, reduce voltage in increments of 1 volt, with a time delay of 7 seconds between steps. At a setting of 100 volts, the load contactor will open and the fault code will appear after a 7-second time delay.
5. If the load contactor does not open under the conditions described, refer to the Troubleshooting Chart in Section 2-4.
6. If the under voltage circuit performs satisfactorily, return unit to normal operation by adjusting coarse voltage-adjustment potentiometer for normal output voltage and pressing the **TEST/REST** pushbutton switch to clear the fault code.

h) Under-Frequency Test

If the frequency is 380 Hz or less for more than seven seconds, the under-frequency protective monitor should open the load contactor and display **70.23** on fault code display. Follow these steps to test the under-frequency monitor:

1. While the unit is operating normally under load, set the **Frequency Adjust** switch on the Engine Specific PC Board (Figure 5) to TEST. Use the Frequency Adjust potentiometer to adjust frequency to 400 HZ.
2. Reduce frequency in steps of 1 Hz, with a time delay of 7 seconds between steps.
3. If the protective circuit opens the load contactor and displays fault 70.23 on the fault code display after 7 seconds, at 380 Hz or less, all components of the system are functioning properly.
4. If the load contactor is not opened at 380 Hz or less after 7 seconds, refer to Troubleshooting Chart in Chapter 2, Section 4.
5. Return unit to normal operating condition by setting the frequency adjust switch to NORMAL and pressing TEST**/RESET** button switch to clear fault code.

i) Over-Frequency Test

If the frequency is between 420 Hz and 440 Hz for more than five seconds, the over-frequency sensing circuit should open the load contactor and display **70.22** on fault code display.

At any frequency value exceeding 440 Hz, the over-frequency circuit should immediately open the load contactor and display **70.22** on fault code display..

To check the under frequency protective components, proceed as follows:

1. While the unit is operating normally under load, set the Frequency Adjust switch to TEST. Use the Frequency Adjust potentiometer to adjust frequency to 400 HZ.
2. Increase frequency in steps of 1 Hz, with a time delay of 5-7 seconds between steps.
3. If the protective circuit opens the load contactor and displays fault 70.22 on the fault code after 5 seconds at 426 Hz, all components of the system are functioning properly.
4. If the load contactor is not opened at 426 Hz after 5 seconds, refer to Troubleshooting Chart in Chapter 2, Section 4.
5. Return unit to normal operating condition by setting the frequency adjust switch to NORMAL and pressing TEST/RESET button switch to clear fault code.

   NOTE: If the generator is operating under load at this point, use the OUTPUT pushbutton to open the contactors.

j) ECM Fault Tests

For these instructions, refer to the diagrams of the Engine Specific PC Board (Figure 5) and the Engine Interface PC Board (Figure 6).

1. Set the STARTER ENABLE/DISABLE switch to DISABLE. DISABLE prevents the engine from starting, while still supplying 12 VDC to the control system for checking the ECM faults.
2. Press the green ENGINE START pushbutton switch. Although the engine is not running, the green light in the ENGINE START switch flashes to indicate that power is available to the engine ECM.

If no active codes are recorded, both the Engine Stop and Check Engine lamps on the Engine Specific PC Board will turn on and stay on.

If active codes are recorded, both lamps will turn on briefly and then begin to flash one code of the recorded faults. The fault code flashes in the following sequence:

- First, a Check Engine (yellow) lamp flashes.
- After a short pause, the number of the recorded fault code flashes in the Engine Stop (red) lamp. There is a 1- or 2-second pause between each number.
- When the number has finished flashing in the red lamp, the yellow lamp turns on again.
- The fault code repeats in the same sequence.

  The lamps flash each fault code 3 times before advancing to the next code.

- To display the next fault code, move the Engine Codes Switch (Figure 6) momentarily to the UP position.
- To display the previous fault code, move the Engine Codes Switch (Figure 6) momentarily to the DOWN position.
- If only one fault is recorded, the QSB control system will continuously display the same fault code when the Engine Codes Switch is moved to either the UP or DOWN position.

3. See engine manufacture's manual for code meanings.

k) Re-checking the entire unit after testing

1. With the engine running at normal rated speed, check the entire unit for vibration and for any parts that may have become loosened during the above checks. Tighten any loose hardware as required.
2. Check engine oil pressure at rated speed (2000 RPM). The oil pressure gauge should indicate at least 44.9 psi (3.1 bar) when engine is hot.
3. Also at rated speed, check the engine coolant temperature. The temperature gauge should indicate in the range of 180° to 190° F (82º to 88º C), depending upon operating conditions.

WARNING

If a metal sounding rod is used to detect bearing noises, exercise extreme care to avoid injury from moving components.

4. Check 400 Hz generator bearings. Use a stethoscope or metal sounding rod to listen for unusual noises. If using a metal rod, place on end on the generator housing and hold the other end near the ear. Hold the rod with three fingers and use the index finger and thumb to form a sounding chamber between the rod and the ear. Do NOT allow the rod to touch the ear. Listen for grinding or pounding sounds, which would indicate a defective bearing. An engine noise may be

telegraphed to the generator and misinterpreted as a generator noise. Contact the equipment manufacturer if in doubt of bearing serviceability.

4) Generator Set Adjustments

a) Generator Adjustments

The generator itself does not require any adjustments.

b) Voltage Regulator Adjustments

When a voltage regulator is first put into service, or when output (generator-to-aircraft) cables are changed, the regulator may require adjustments of output voltage value and line-drop compensation. To make these adjustments, use the controls on the Voltage Regulator PC Board (Figure 7).

(1) Output Voltage Adjustment

For the following adjustment, the generator set must be running at rated speed (2000 RPM), under no-load conditions.

1. Use the fine voltage-adjustment potentiometer to adjust the output voltage. Turn the potentiometer adjustment clockwise to increase generator output voltage, and counterclockwise to decrease voltage.
2. Observe the output voltage as indicated by the voltmeter, located on the control panel of the generator set.
3. Set output voltage at 115-V AC line-to-neutral (200-VAC line-to-line).

(2) Line-Drop Compensation Adjustment

Use the line-drop compensation potentiometer to set the line-drop compensation. Turning the potentiometer knob clockwise increases the magnitude of the compensation, and turning the potentiometer knob counterclockwise decreases the magnitude (A graduated nameplate for specified cable lengths is included for quick reference.). To adjust the line-drop compensation, proceed as follows:

1. Connect the generator set output cables to a load. Load the generator set with the largest available three-phase load of rated power factor not exceeding the maximum rating of the generator set.
2. Measure output voltage at the load end of the cables. If the load voltage rises or drops more than 1% at the load end of the cables, decrease or increase the line-drop compensation until the regulation is flat (115 VAC line-to-neutral and 200 VAC line-to-line).
3. If the line-drop compensation adjustments have affected the no-load voltage output, adjust the fine voltage-adjustment potentiometer to the desired value.

(3) Voltage Regulator Tests

After completing the adjustments, re-test the voltage regulator as follows:

1. Connect a voltmeter at the load end of the generator output cables.
2. Operate the generator set at no-load and observe voltage reading.
3. Operate the generator set under load and observe voltage reading.
4. Voltage under load and no load should vary no more than 1% at the load end of the cables.

c) Engine Adjustments

- Exhaust valve adjustment – refer to the engine manufacturer's operation manual
- Fuel injector timing adjustment – refer to the engine manufacturer's operation manual
- Engine idle speed adjustment – factory set to 1000 RPM, +/- 25 RPM. If adjustment is required, contact the local engine distributor.
- Engine speed limiting – factory set to 2350 RPM. If adjustment is required, contact the local engine distributor.
- Fan and alternator belt adjustment – refer to Section 2-1 and the engine manufacturer's manual

5) Generator and Exciter Tests

a) Coil Resistance Tests

The generator fields and exciter stator may be tested with a Kelvin bridge. This is a double-bridge type instrument required for the very low resistances encountered in this test.

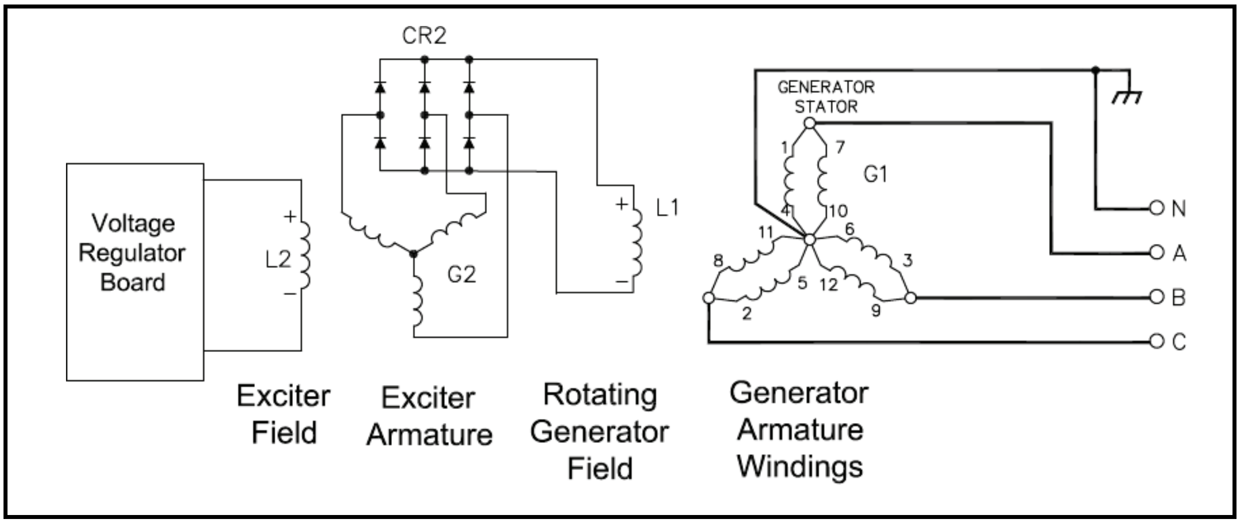


Figure 8: Generator Windings

Take readings when unit is cold and in an ambient temperature of 70 ºF (21ºC.).

1. Disconnect generator stator leads at the output module panel.
2. Disconnect the two black exciter field leads from terminal block mounted on output module panel.
3. Check resistance and compare to the values in the table.

Test Connection	Resistance (Ohms)
Generator Stator Phase A to N	0.0021
Generator Stator Phase B to N	0.0021
Generator Stator Phase C to N	0.0021
Exciter Stator Field (L2)	29
A - B, B - C, C - A Exciter Armature (G2)	0.019
Generator Revolving Field (L1)	2.2

Generator and Exciter Winding Resistances

b) Exciter Armature Diode Test

Use an ohmmeter that has a diode test position (usually has a diode symbol).

1. Disconnect exciter windings from diode lead(s).
2. Hold one ohmmeter lead point on the threaded end of the diode. Hold the other lead point on the wire terminal end.
3. Observe and note the indicated resistance.
4. Now reverse the lead connection on the diode.
5. Again, observe and note the ohmmeter indicated resistance.

If a very high resistance was indicated with the leads connected one way and a low, readable resistance was indicated with the leads connected the opposite way, the diode may be considered good.

6) Transformer – Rectifier Tests (for units with the DC option)

The 28.5-VDC transformer-rectifier is an optional add-on to the GPU. The following test procedures may be used for testing the T-R following repair, or for just checking performance.

a) Test Preparation

1. Connect the T-R to a load bank.
2. Start the GPU per the operating procedures in Chapter 1, Section 3.

b) Power Delivery Test

1. Press “DC OUTPUT” pushbutton to close the DC output contactor. The blue “DC OUTPUT” lamp turns on, indicating that DC power is being delivered to the load bank.
2. Observe the DC voltmeter on the control panel, under no load for accuracy. It should indicate approximately 28.5 VDC.
3. With the GPU connected to a load bank, place a 600 A load on the GPU. Observe the DC voltmeter and ammeter for accuracy.
4. Press “DC OUTPUT” pushbutton to open the DC output contactor. The blue “DC OUTPUT” lamp turns off, indicating that DC power has been removed from the load bank.

c) Current Limiting / Soft Starting Control

1. Press the "STARTING CURRENT" pushbutton to activate the current limiting and set the limit to 1500 A.
2. Press the "DC OUTPUT" pushbutton to close the contactors to apply the load to the load bank. Observe the ammeter; the current should stay below 1500 A.
3. Discontinue the power delivery.

d) Over-Voltage Protection

1. Press "DC OUTPUT" pushbutton to close the DC output contactor. The blue "DC OUTPUT" lamp turns on, indicating that DC power is being delivered to the load bank.
2. Adjust the voltage adjustment potentiometer on the TRB PC Board to range of 32-34 VDC.
3. Within 7 to 9 seconds after the trip voltage is reached, the contactor opens and the fault code meter displays the over-voltage fault code, "70.28".
4. Reset the voltage back to 28.5 VDC.

e) Under-Voltage Protection

1. Press "DC OUTPUT" pushbutton to close the DC output contactor. The blue "DC OUTPUT" lamp turns on, indicating that DC power is being delivered to the load bank.
2. Adjust the voltage adjustment potentiometer on the TRB PC Board to less than 20 VDC.
3. Within 7 to 9 seconds after the trip voltage is reached, the contactor opens and the fault code meter displays the under-voltage fault code, "70.29".
4. Reset the voltage back to 28.5 VDC.

f) Overload Protection

1. Press the "STARTING CURRENT" pushbutton to activate the current limiting and set the limit to 1500 A.
2. Press "DC OUTPUT" pushbutton to close the DC output contactor. The blue "DC OUTPUT" lamp turns on, indicating that DC power is being delivered to the load bank.
3. The contactor should open in 30 seconds. The fault code meter shows "70.30".
4. Discontinue power delivery and let the cables cool for 2-3 minutes.
5. Press the "STARTING CURRENT" pushbutton to activate the current limiting and set the limit to 2000 A.
6. Press "DC OUTPUT" pushbutton to close the DC output contactor. The blue "DC OUTPUT" lamp turn on, indicating that DC power is being delivered to the load bank.
7. The contactor should open in 10 seconds. The fault code meter shows "70.30".
8. Discontinue power delivery and let the cables cool for 2-3 minutes.

g) Temperature Overload Protection

1. Press “DC OUTPUT” pushbutton to close the DC output contactor. The blue “DC OUTPUT” lamp turns on, indicating that DC power is being delivered to the load bank.
2. Remove one wire from the thermostat switch located on the right side of the T-R heat sink. This opens the switch, thus simulating an over temperature fault. The fault code meter displays “70.44”

h) Silicon Diode Tests

1. Shut the GPU completely down removing all power from the system.
2. Disconnect diode leads.
3. Use a good quality ohmmeter, place one ohmmeter lead on the threaded end of the diode and the other lead on the diode lead and the record value.
4. Reverse the ohmmeter leads and record the value.
5. The diode may generally be considered good if one reading is infinite or very high and the other reading is extremely low.

i) Control Interlock Kit (Optional)

1. With the output cable sitting in the cable tray, start the GPU and bring the engine to rated speed.
2. Close the output contactor by pressing the “DC OUTPUT” pushbutton. The output contactor should open immediately with an “EF3” warning displayed on the fault code meter.
3. Using a 28 VDC power source, apply a 28 VDC signal to the control socket of the output cable (small socket).
4. Close the output contactor by pressing the “DC OUTPUT” pushbutton. The output contactor should stay closed.
5. Remove the 28 VDC power source, and the contactor should open with an “EF3” warning.

7) Adjusting the Transformer-Rectifier (for units with DC option)

The T-R is designed to be adjustment free. No adjustments are required other than periodically checking the output voltage and adjusting the TRB PC board potentiometer as necessary.

Section 4: Troubleshooting Procedures

This section provides information to help diagnose common faults and malfunctions for all major system components.

WARNING

Exercise extreme care to avoid contact with high voltage leads and components.
High voltage can kill!

CAUTION

Maintenance personnel must be very careful when performing terminal-to-terminal checks to be certain the proper terminals are being used, especially when using jumper leads. Damage to electrical components may result from the application of improper voltage and current.

This section contains the following information:

1) General Troubleshooting Information ... 2
- a) Using This Section ... 2
- b) Equipment for Troubleshooting ... 2
- c) Replacement Parts ... 2
- d) Circuit Boards ... 2
- e) Generator Set Information ... 3

2) Interpreting Fault Codes ... 3
- a) Control Monitoring ... 3
- b) Fault Code Display ... 5
- c) Fault Modes ... 6
- d) Command Modes ... 7
- e) Viewing Fault Code History ... 8

3) Symptoms Tables ... 9
- a) Engine Controls ... 9
- b) Generator Excitation Circuits ... 12
- c) Load Contactor Operating Circuits ... 13
- d) Protective Circuits ... 15
- e) Generator ... 17
- f) T-R Controls and Components (DC option) ... 18

4) Commands and Fault Codes Tables ... 20
- a) GPU Commands ... 20
- b) Faults ... 21

1) General Troubleshooting Information

a) Using This Section

The generator set's control system continually monitors the system operation and provides fault codes on the operator panel if it detects a problem. The next subsection describes how to interpret the fault codes, and the last subsection contains a fault code table, which provides the meanings and suggested remedies for each of the codes.

This section also contains tables of symptoms for problems you may encounter with your generator set. Use these tables if the problem does not produce a fault code or if you need more information about a problem that produces fault codes.

Always check connections and leads to a component suspected of being faulty. The troubleshooting information in this section assumes that connections and wiring have already been checked and that power has not been lost because of defective wiring or connections.

b) Equipment for Troubleshooting

A good quality electrical multi-meter is the only instrument required for troubleshooting. At least two jumper leads with alligator or similar clips will be required. The engine electrical system may be used as a 12 VDC power source.

c) Replacement Parts

Chapter 4 of this manual contains an illustrated parts list. The parts diagrams show the parts that are considered serviced parts. To order replacement parts, refer to the Hobart part numbers listed in the tables with each diagram.

d) Circuit Boards

Figure 1 shows the circuit boards (PC Boards) that control the generator set. Some of the troubleshooting information in this section references the circuit boards or control on those boards. These are located in the control box behind the gauges. If required, replace these boards as complete assemblies. The components on these boards are not individually replaceable.

Circuit Board Name	**Abbreviation**
Voltage Regulator Board	REG
Control Board	CTL
Engine Specific Board	ESB
Engine Interface Board	EIB
LED Board	LED
Transformer-Rectifier Board (with DC option)	TRB

e) Generator Set Information

Section 1-1 contains specifications for the engine, generator, and control system.

The engine manufacturer's maintenance manual contains detailed engine information.

The appendix of this manual contains schematics and connection diagrams.

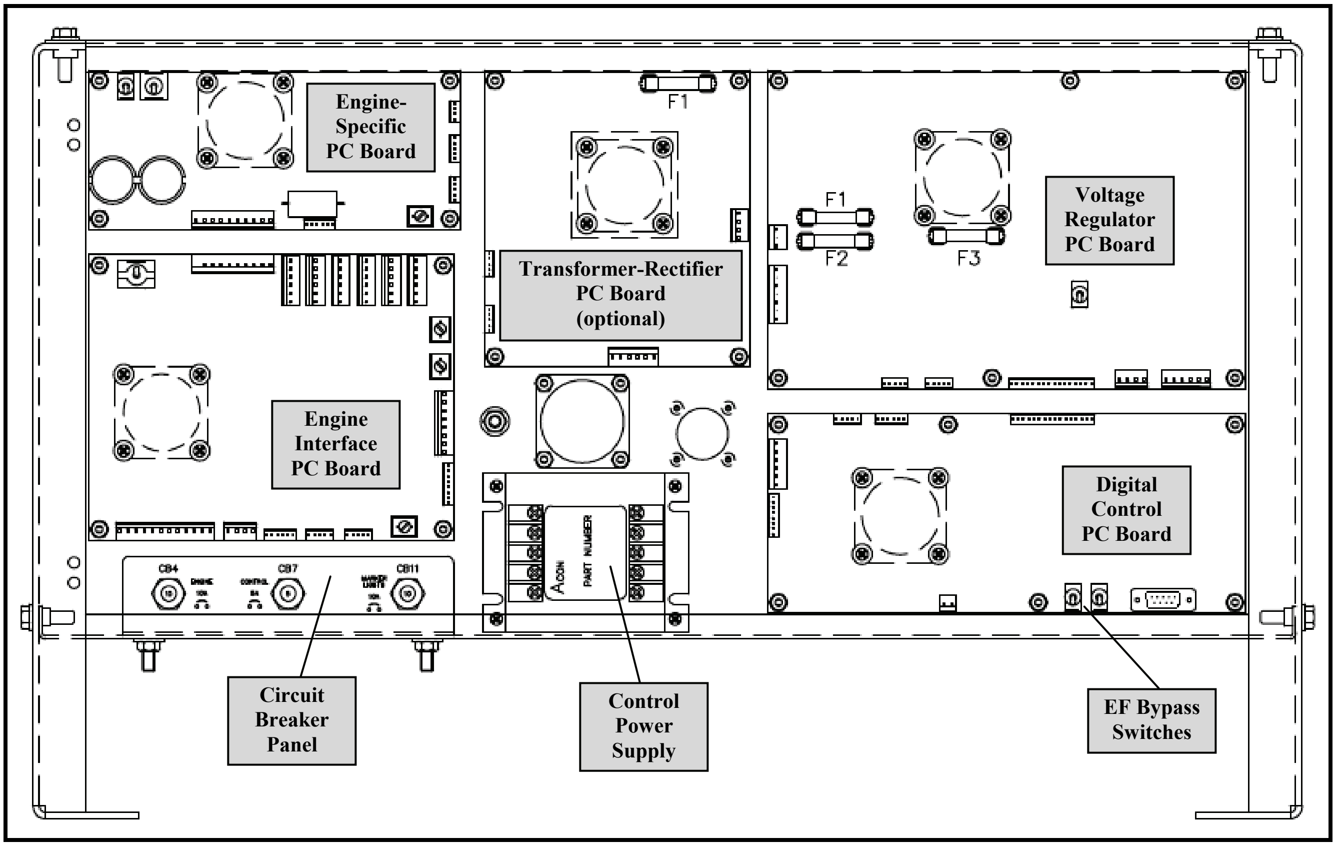


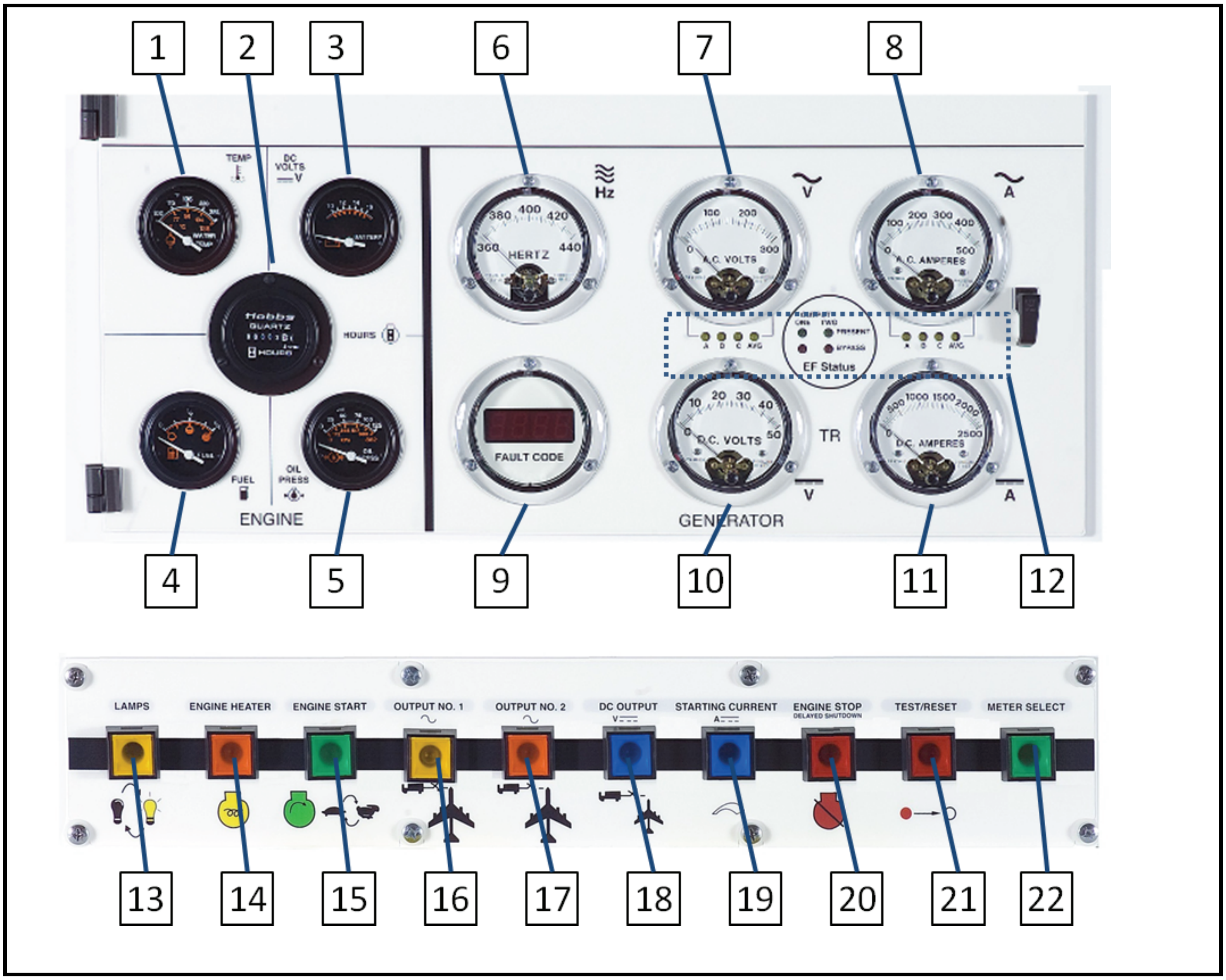
Figure 1: Control Box Interior Components

2) Interpreting Fault Codes

a) Control Monitoring

The generator set control system performs complete diagnostic testing and continuous monitoring of all critical circuits and operating electrical values. If the control system senses a problem with one of the circuits or if any of the electrical values exceeds its safe operating limit, the control system can shut the generator set down, or it may allow the generator set to continue operation, depending on the severity of the condition.

When a problem is detected, the system displays the fault as a code on the fault code meter, which is located on the operator panel. Figure 2 shows the location of the fault code meter.



1. Engine Coolant Temperature Gauge (M24)
2. Running Time Meter (M4)
3. Battery Voltmeter (M5)
4. Fuel Gauge (M13)
5. Oil Pressure Gauge (M25)
6. Frequency Meter (M3)
7. AC Generator Voltmeter (M2)
8. AC Generator Ammeter (M1)
9. Fault Code Meter (M6)
10. DC Voltmeter *[Optional with TR]*
11. DC Ammeter *[Optional with TR]*
12. Front LED Display (A5)

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13. Panel Light Switch (S74)
14. Air Intake Heater Switch (S79)
15. Engine Start Switch (S24)
16. AC Output No. 1 Switch (S75)
17. AC Output No. 2 Switch (S275)
18. DC Output Switch (S430) *[Optional with TR]*
19. DC Starting Current Switch (S431) *[Optional with TR]*
20. Engine Stop Switch (S76)
21. Test/Reset Switch (S77)
22. Meter Selector Switch (S3)

Figure 2: Control Panel Door

b) Fault Code Display

Use the numbers that appear in the **FAULT CODE** display to troubleshoot the GPU. The first two digits on the left side of the Fault Code represent the Command, and the two digits on the right side of the Fault Code represent the Fault Condition.

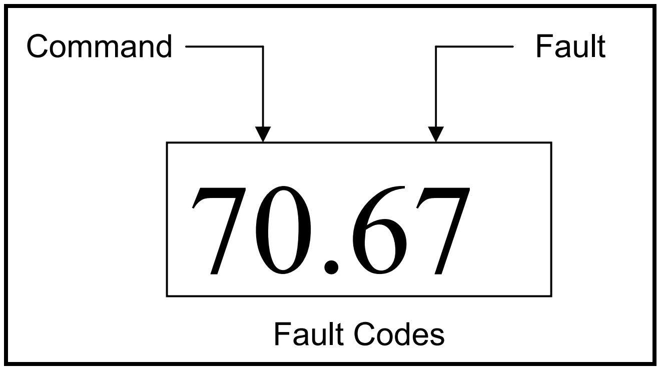

Figure 3: Fault Meter Display

The fault number represents the actual problem that was detected, and the command number represents what the system was doing when the fault occurred. While the fault number is the most important for troubleshooting, understanding the commands can be useful for complex problems.

This manual includes the decimal when referring to commands and faults to help distinguish them. In the example above, the command is “70.” and the fault is “.67”.

c) Fault Modes

Faults result when any of the fault limits are exceeded, when an internal problem occurs, or under certain conditions that would cause injury to personnel or damage to an aircraft or the GPU. Faults are also stored in memory as event records. The fault limits and conditions are preset at the factory.

To reset the system after a fault, press the **TEST/RESET** pushbutton or shut down the GPU.

The number associated with the fault provides an indication of the severity of the problem. For example, faults .01 through .09 just result in warnings, while faults .60 through .79 completely shut down the generator set. Table 1 shows the ranges of fault numbers and their associated fault modes.

Fault #	Fault Mode Name	Fault Mode Description
.01 \ .09	Warnings (no operation changes)	Warning faults have no effect on the operation of the GPU. An example is an intake air restriction fault due to a dirty filter. Although the GPU continues to operate, the fault appears on the fault code display.
.10 \ .39	Run Mode (minor faults)	Run mode faults remove power from the aircraft but do not change the operating speed of the engine. An example is an over-voltage fault. Although the contactors open and remove power from the aircraft, the engine remains at rated speed, and the fault code meter shows the command and fault code.
.40 \ .59	Idle Mode (moderate faults)	Idle mode faults remove power from the aircraft and drop the operating speed of the engine to the idle setting. A possible example (depending on customer configuration) is a high temperature fault. The contactors open and remove power from the aircraft, the engine drops to its idle speed, and the fault code meter shows the command and fault code.
.60 \ .79	Stop Mode (major faults)	Stop mode faults remove power form the aircraft and shut the engine down. An example is a low oil pressure fault. The contactors open to remove power from the aircraft, the engine shuts down, and the fault code meter shows the command and fault code.
.80 \ .99	Special Configuration (reserved)	These fault codes are reserved for special customer configurations. Contact the factory for information.

Table 1 : Fault Modes

d) Command Modes

Like the faults, the command codes are also grouped. Table 2 shows the system modes and the associated command codes.

Code	Mode Name	Description
01. \ 39.	Self-Test Mode	When power is first applied to the control circuit, the GPU performs complete self-diagnostics of the internal circuitry. When a fault is detected during the self-test, the fault code display shows the current **COMMAND** and detected **FAULT**.
40.	Engine Start Mode	When the **ENGINE START** push-button is activated, the engine's starter and the engine's ECM are energized.
50.	Engine Idle Mode	When the engine is first started, the system enters the idle mode. The **ENGINE START** push-button flashes indicating the engine is in the idle mode.
70.	Engine Run Mode	After the engine has been warmed up properly in the Engine Idle Mode, pressing the **ENGINE START** push-button again brings the GPU up to rated speed. In the Engine Run Mode, the **ENGINE START** push-button light is on continuously. The GPU is now ready for aircraft loading.
80.	Engine Shutdown Mode	When shutting the GPU down, pressing the **ENGINE STOP** push-button starts the 3-5 minutes delayed shutdown period. The **ENGINE STOP** push-button flashes and the engine returns to idle speed. The shutdown period is required to sufficiently cool the engine's turbocharger.
90.	Engine Stop Mode	After the 3-5 minutes delayed shutdown period, the engine stops running.
99.	System Off Mode	In this mode, the power has been removed from the GPU's entire control system.

Table 2: Command Groups

e) Viewing Fault Code History

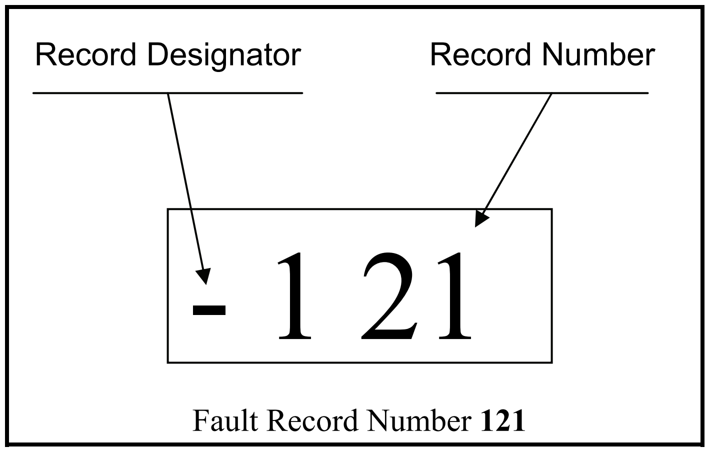

Figure 4: Fault Record Number

To assist in troubleshooting, you can view all previous fault codes stored in the control system's memory The Fault Meter Display shows the codes starting with the last (most recent) fault code and scrolling backward through all previous fault codes. Follow these steps to view the previous fault codes:

1. If required, pull the **EMERGENCY STOP** button out.
2. Press the **LAMPS** pushbutton to turn on the control box lights.
3. Press the **TEST/RESET** pushbutton and hold for 2 to 3 seconds until the data record number appears on the display.
4. Release the **TEST/RESET** pushbutton and the display will alternate between the fault record number and the fault code.
5. To continue scrolling backward through the previous fault codes, press and release the **TEST/RESET** pushbutton again and the previous fault record number and fault code will be displayed as described in Step 4.
6. Repeat Step 5 to continue scrolling backward. Once the first fault record is reach, the scrolling will stop. To begin again, press the **LAMPS** pushbutton to turn off the control box lights and repeat Steps 2 through 5.

3) Symptoms Tables

a) Engine Controls

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
Engine Controls		
1. The engine will not start. The starter will not crank the engine.	**a.** Battery discharged or loose battery or ground connection	Check the voltage across batteries. Voltage should be approximately 12.8 volts DC. Check all battery terminals. Be sure 12.8 volts DC is reaching the solenoid input terminal.
	b. Electrical defect in starter	Briefly connect a large-capacity jumper cable (No. 1/0 minimum) between the hot side of starter solenoid and the starter input terminal. If starter does not crank engine, proceed to step **c.** If starter does crank engine, proceed to step **e.**
	c. Mechanical defect in starter	Remove the starter motor from engine and apply 12 VDC to test it. If it does not operate, it is defective. Replace it. If starter motor does operate, proceed to step **d**.
	d. Internal seizure	Attempt to hand crank engine with a ¾-inch square drive on a long flex handle on crankshaft pulley. If engine cannot be turned one complete revolution, internal seizure is indicated. Remove engine and contact the engine manufacturer and/or nearest dealer.
	e. Defective starter solenoid	Briefly connect a large capacity jumper cable (No. 1/0 minimum) between the auxiliary solenoid terminals (one on each side). If the engine does not crank, replace starter solenoid. If engine cranks, proceed to step **f** below.
	f. Defective auxiliary starter solenoid	Briefly connect a small lug jumper on front of the auxiliary solenoid to the battery terminal of the auxiliary starter. If the engine does not crank, replace auxiliary starter solenoid. If the engine cranks, proceed to step **g** below.
	g. Defective EIB Board	Replace the EIB board.
	h. Defective engine start button	Depress the button and check the continuity between button contacts. If no continuity exists, replace the button. If there is continuity, replace the EIB board.

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy

Engine Controls (continued)

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
2. Engine will not start. Cranking speed low.	**a.** Low battery output	Check the battery and recharge or replace
	b. Loose starting circuit connections or faulty cables	Check all connections and cables. Tighten or replace as required.
	c. Improper lubricating oil viscosity	Check the oil. Refer to Section 2-2. Remove and replace the oil as necessary.
3. Engine cranks, but will not start.	**a.** No fuel or insufficient fuel level in tank. Low FUEL indication appears 3 seconds after cranking is initiated.	Fill the fuel tank if it is low or empty. If necessary, fill the fuel pre-filter with fuel. If engine will not start after priming the filter, fuel pump trouble is indicated. If engine starts and stops after a short time, trouble between fuel source and suction side of the pump is indicated. Check and/or remedy as follows.
	b. Fuel shutoff valve closed.	Open the shutoff valve on fuel tank.
	c. Loose connections, damaged hoses or fuel lines between tank and fuel pump	Tighten all fittings and connections. Replace any damaged hoses or fuel links.
	d. Plugged or defective filter.	Check or replace fuel filters. Also check the gaskets for leaking or damaged condition.
	e. Defective EIB board.	Replace EIB board.
4. Engine cranks, but will not start. Over-temperature indication appears immediately.	**a.** Defective or incorrectly wired high temperature switch, located on the top of the engine block.	Check the wiring to the high temperature switch (refer to schematic), and see that wiring is correct. If wiring is correct, remove wires and check resistance between terminals C and N.O. A resistance of less than 10 ohms indicates a defective switch. Replace switch if defective.
	b. Defective EIB board	Replace EIB board.
5. Engine is hard to start. Cranking speed is normal, and fuel supply is adequate.	**a.** Low compression, which may be caused by any one of following: Sticking or burned exhaust valves, worn or broken compression rings, leaking cylinder head gasket, or improper valve clearance adjustment.	Check the compression in accordance with instructions in the engine manufacturer's operation manual. Overhaul the engine to make repairs as necessary.

Trouble, Symptom, Condition		Probable Cause	Test, Check, and/or Remedy
Engine Controls (continued)			
6. Engine starts. Stops after a few seconds by automatic shutdown.	**a.**	Shutdown circuit may have functioned normally to stop engine because of low lubricating oil pressure or due to a defective oil pressure switch.	Restart the engine and observe oil pressure gauge. If oil pressure is 12 psi or more, disconnect wire from oil pressure switch terminal N.C. Restart engine. If engine continues to run, oil pressure switch is defective. Replace oil pressure switch. If engine stops, check for following malfunctions:
	b.	Defective EIB board	Replace EIB board.
7. All panel and clearance lights are either always ON or always OFF.	**a.**	Marker light circuit breaker, (CB1) will not close.	Replace marker lights circuit breaker (CB1) if defective.
	b.	Defective CTL board	Replace CTL board.
8. Engine either goes from rated speed to idle speed, or shuts down.	**a.**	Low fuel was detected or the EIB board could be defective.	Check the fuel level. Replace EIB board.
9. Engine has slow response time.	**a.**	Engine needs tune-up	Perform an engine tune-up. Refer to engine manufacturer's operation manual.
10. Engine "misses" or runs unevenly.	**a.**	Insufficient fuel	Check low fuel level in accordance with engine manufacturer's operation manual. Repair or replace parts as required.
	b.	Faulty injector	Check injectors in accordance with engine manufacturer's operation manual. See causes of low compression listed under ENGINE CONTROLS.
	c.	Low compression pressure	Check compression in accordance with engine manufacturer's operation manual. See causes of low compression listed under ENGINE CONTROLS.
	d.	Air in fuel system	Check all fittings to be sure they are tight and the thread sealant is still present. Tighten the fittings and add new thread sealant as required.
11. Engine lacks power	**a.**	Improper engine adjustments and gear train timing	"Tune-up" engine in accordance with engine manufacturer's operation manual.
	b.	Insufficient fuel	Check low fuel level in accordance with engine manufacturer's operation manual. Repair or replace parts as required.
	c.	Insufficient inlet air due to damaged or dirty air cleaner	Check air cleaner
	d.	Restricted exhaust system	Check exhaust pipes for restrictions. Check muffler for clogged condition. Replace as required.

b) Generator Excitation Circuits

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
Generator Excitation Circuits		
1. No (or low) generator output voltage in all phases. Generator operating at 400 Hz.	**a.** Defective generator or excitation circuit	On REG place Regulated/ Diagnostic switch in Diagnostic position. This applies 12 VDC from battery to exciter field, which should produce an indicated output voltage of 100 +/- 20 VAC line to neutral. If voltage produced is within this range, the generator is good, and trouble is in voltage regulator circuit. Proceed to Step **b**.
	b. Defective voltage regulator (REG)	Connect a properly working REG board to regulator wiring assembly, avoid short circuiting bottom of properly working REG board. Then start generator set and perform tests and adjustments according to instructions in Section 2-3. If generator set works properly with a properly working REG board temporarily connected, shut off generator set and replace defective REG board with one that is properly working (preferably, same REG board used for this troubleshooting check).
	c. Open fuse on REG	Check fuses thoroughly. Replace fuses if defective.
	d. Defective connector at voltage regulator, or defective wiring from regulator to exciter field	Disconnect the exciter wires at terminal strip. Using jumper leads with clip terminals, connect 12 VDC to wires. If generator will produce at least 80 VAC, replace or repair connector and wiring between voltage regulator and exciter field as required.

c) Load Contactor Operating Circuits

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
Load Contactor Operating Circuits **Output 1: Contactor K1, Pushbutton switch S75** **Output 2: Contactor K201, Pushbutton switch S275**		
1. Load contactor will not close when the corresponding Output pushbutton switch is held in closed position. Generator is running at normal voltage.	**a.** Blow contactor fuse (F3) on regulator board.	Check the fuse and replace if blown. If it blows again, check the contactor.
	b. Defective wiring or connections	Check all wiring and connections in load contactor circuits.
	c. Defective REG board	After making certain that the output pushbutton switch is working, measure the DC output voltage at contactor coil. If the voltage measured isn't approximately 90 VDC, replace REG.
		Replace REG board with a board known to be operating properly. If contactor still doesn't close, proceed to step **d**.
	d. Defective Output pushbutton switch	At rated speed, measure the voltage across the switch. The voltage should read approximately 5 VDC. Press the switch again, and the voltage should go to 0 V. If voltage does not go to 0 V, replace the switch.
	e. Defective coil in load contactor	Disconnect leads at load contactor terminals V and W. Check coil resistance between these terminals. Resistance should be approximately 600 ohms. If coil is defective, replace complete load contactor.

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy

Load Contactor Operating Circuit (Continued)

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
2. Load contactor closes when output pushbutton switch is held in CLOSED position. Opens immediately when switch is released.	**a.** The plug interlock EF circuit on CTL board could be defective	Place the EF Bypass switch in the ON position. If load contactor remains closed, proceed to step **b.**
	b. 28.5 VDC is not reaching the plug interlock EF circuit from aircraft for following reasons:	Proceed as follows to find the cause of this malfunction.
	c. Generator-to-aircraft cable connector defective or not plugged into aircraft receptacle connector.	Inspect cable connector plug thoroughly for damaged E and F terminals. Be sure plug is fully mated with aircraft receptacle connector and making good contact.
	d. Aircraft rejecting power	Check aircraft on-board electrical equipment and controls.
	e. Defective contacts in N.O. auxiliary pushbutton switch mounted on right side of contactor.	Connect a jumper lead between terminals of N.O. auxiliary switch. If load contactor will now remain closed, replace N.O. auxiliary switch or complete load contactor.
3. Load contactor opens during power delivery. No fault indicated.	**a.** A fault has developed in load contactor holding circuit.	If load contactor cannot be closed by operation of output pushbutton switch, check circuit in accordance with instructions in Trouble, Symptom, Condition 1. If the load contactor can be closed, but opens as soon as power accepted switch is released, check for trouble under Trouble 2, above.
	b. Cable accidentally disconnected from aircraft.	Reconnect cable.

d) Protective Circuits

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
Protective Circuit		
NOTE: Protective monitoring is not completely functional until the load contactor is CLOSED. Since it is not advisable to vary voltages for test purposes while delivering power to an aircraft, connect the generator set to a load bank for trouble shooting protective circuits. To avoid repetition, it will be assumed that "**TEST/RESET**" push-button switch has been pressed and the load contactor has been closed before commencing each test.		
1. Load contactor opens during power delivery. Over voltage fault indicated.	**a.** Over-voltage condition may have been result of a sudden drop in load, or possible tampering with REG potentiometer, and may have been a normal action.	Press "**TEST/RESET**" push-button switch and resume power delivery. Observe voltmeter to be certain voltage is normal 115 VAC. Adjust to normal if necessary. If load contactor is opened again and the fault code meter indicates an over-voltage condition, proceed to step **b**.
	b. Defective CTL board	Use REG potentiometer to reduce voltage to 110 VAC. Observe the voltmeter and gradually increase voltage with potentiometer. If sensing circuit CTL board functions to open load contactor at any value less than 125 VAC, it is defective. Replace CTL board.
2. Load contactor opens during power delivery. Under voltage fault indicated.	**a.** Under-voltage condition may have been result of a sudden shock load, or possible tampering with REG potentiometer, and may have been a normal action.	Press "**TEST/RESET**" push-button switch and resume power delivery. Observe voltmeter to be certain voltage is normal 115 VAC. Adjust to normal if necessary. If load contactor is opened again and the fault code meter indicates an under-voltage condition, proceed to step **b**.
	b. Defective CTL board	Use REG potentiometer to reduce voltage to 100 VAC. Observe the voltmeter and gradually decrease voltage with potentiometer. If sensing circuit CTL board functions to open load contactor at any value great than 100VAC, it is defective. Replace CTL board.

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy

Protective Circuit (continued)

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
3. Load contactor opens during power delivery. Over frequency fault indicated.	**a.** Frequency adjust switch is enabled.	Set frequency adjust switch to DISABLE
	b. Defective REG board	If over-frequency faults continue after engine's ECM is proven to be good, and an over-frequency condition does not exist, replace REG board.
4. Load contactor opens during power delivery. Under frequency fault indicated.	**a.** Frequency adjust switch is enabled	Set frequency adjust switch to DISABLE
	b. Defective REG board	If under-frequency faults continue after engine's ECM is proven to be good, and an under-frequency condition does not exist, replace REG board.
5. Load contactor opens during power delivery. Overload fault indicated.	**a.** There may have been an overload condition.	Observe ammeter. Check for abnormal overload condition and correct. If overload device functions to open load contactor when an overload does not exist, proceed to step B.
	b. Defective CTL board	Replace CTL board.

e) Generator

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
Generator		
1. No (or low) voltage output	**a.** Shorted diode in exciter rectifier (CR2)	Check diodes in accordance with Section 2-3. If diodes are good, proceed to step B.
	b. Open or shorted exciter rotor winding (G2)	Use ohmmeter to check for open or shorted condition diodes in accordance with Section 2-3. If exciter rotor windings are good, proceed to step C.
	c. Open or shorted exciter field windings (L2)	Check field resistance. See Section 2-3 for normal values.
	d. Open or shorted generator rotor windings (L1)	Check resistance with ohmmeter to determine if open or short circuited diodes in accordance with Section 2-3
2. Generator operates single phase.	**a.** Open or short circuited winding in generator stator (G1)	Check stator-winding resistances. See Section 2-3 for normal values.
3. Generator overheats	**a.** Loose connection causing high resistance.	Check all output connections. Look for discoloration caused by heat. Tighten or replace as required.
	b. Improper or blocked ventilation.	Check for foreign material (rags, etc.) blocking airflow. Provide adequate ventilation.
	c. Generator stator windings short circuited.	Check stator windings. See Section 2-3.
4. Unbalanced output	**a.** Loose connection in output circuit.	Check all output connections. Discolored connectors indicate a loose connection. Tighten or replace as required.
	b. Open or short circuited phase	Check stator windings in accordance with Section 2-3. Repair or replace as required.
	c. Defective connection in output circuit.	Check plug and receptacle connectors at aircraft. Tighten, repair, or replace as required.
	b. Break or cut in output cable assembly.	Inspect. Repair or replace as required.
	c. Unbalanced load	Check aircraft 400-Hz components.

f) T-R Controls and Components (DC option)

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
T-R Controls and Components		
1. Input AC and Output DC contactor will not close when "**DC OUTPUT**" push button S431 is pressed. Engine running normally, AC voltage normal, no load applied to output cable.	**a.** Defective push button switch	At rated speed, measure the voltage across the switch. The voltage should read approximately 5 VDC. Press the switch again and the voltage should go to 0 V. If voltage does not go to 0 V, the switch is defective and needs to be replaced.
	b. Defective load contactor Fault Codes Display • "**70.46**" for input contactor • "**70.31**" for output contactor	Check all wire connections or replace with a known good contactor. If the above works correctly, see Step "c".
	c. Defective TRB PC Board	Replace TRB PC board with a board known to be operating properly. If contactor still doesn't close, contact the factory for further information.
2. Load contactor K402 opens during power delivery. The engine is still running at rated speed or has returned to idle.	**a.** Defective load contactor. Fault Codes Display • "**70.46**" for input contactor • "**70.31**" for output contactor	Check all wire connections or replace with a known good contactor. If the above works correctly, see Step "c".
	b. Contactor opening could have been normal because of an over/under-voltage condition. Fault Codes Display • "**70.28**" for over-voltage • "**70.29**" for under-voltage	Resume operation and closely observe voltmeter and fault code gauge for evidence of over/under-voltage condition. If contactor opens and no over/under-voltage condition exists, proceed to Step c.
	c. Contactor opening could have been normal because of an overload or over temperature condition. Fault Codes Display • "**70.30**" for overload • "**70.44 or 70.45**" for over temperature	Resume operation and closely observe fault code gauge for evidence of and overload or over temperature condition. If contactor opens and neither condition applies, proceed to Step d.
	d. Defective TRB PC Board	Replace TRB PC board with a board known to be operating properly. Resume power delivery. If contactor still opens, contact the factory for further information.

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy

T-R Controls and Components (continued)

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
2. (continued)	**e.** Interlock signal not being received from the aircraft	Be sure the output cable is properly inserted into the aircraft receptacle and try again. Verify 28 VDC is on the DC+ connection of the GPU and/or being sent from the aircraft. If aircraft is sending signal but not being received at the GPU DC+ and the cable is properly inserted into the aircraft receptacle, verify the K403 relay is operating. If K403 relay is operating, replace output cable. If all the above appears to be working, replace the TRB board.
3. "STARTING CURRENT" push button sets the current limit, but the system is not current limiting.	**a.** Defective push button switch	At rated speed, measure the voltage across the switch. The voltage should read approximately 5 VDC. Press the switch again, and the voltage should go to 0 V. If voltage does not go to 0 V, replace the switch.
	b. Defective TRB PC Board	Replace TRB PC board with a board known to be operating properly. If current limiting is still not operating, contact the factory.
4. "STARTING CURRENT" push button does not increment the current limiting values.	**a.** Defective push button switch	At rated speed, measure the voltage across the switch. The voltage should read approximately 5 VDC. Press the switch again, and the voltage should go to 0 V. If voltage does not go to 0 V, replace the switch.
	b. Defective TRB PC Board	Replace TRB PC board with a board known to be operating properly. If contactor still doesn't close, contact the factory.

4) Commands and Fault Codes Tables

a) GPU Commands

Cmd Code	Name	Description
00. _ _	Invalid Command	
01. _ _	ENGINE SELF-TEST CMD	All boards test the communication between each other.
40. _ _	ENGINE START MODE	Engine starter and engine's ECM is activated.
50. _ _	ENGINE IDLE MODE	Engine idles at approximately 1000 RPM
55. _ _	ENGINE RAMP UP	Period when engine goes from idle to rated speed.
63. _ _	REG TEST OUTPUT FREQUENCY	Check for 400 Hz. output frequency.
68. _ _	CTL TEST OUTPUT	Checks the CTL communications.
70. _ _	ENGINE RUN MODE	The engine is at rated speed and ready for aircraft load.
75. _ _	ENGINE RAMP DOWN	Period when engine goes from rated to idle speed.
80. _ _	ENGINE DELAYED SHUTDOWN MODE	Allows the turbocharger to cool properly.
90. _ _	ENGINE STOP MODE	Engine is brought to a complete stop.
99. _ _	System Off Mode	All electrical circuits have been turned off.

HOBART GROUND POWER

b) Faults

Fault Code	Name	Possible Cause(s)	Corrective Action
Air	EIB AIR RESTRICTION FAULT	Air filter is obstructed or dirty. Bad air restriction indicator	Check for obstructions. Change air filter cartridge or air restriction indicator.
FUEL	EIB LOW FUEL WARNING	Fuel tank level is below ¼ tank.	Fill fuel tank.
_ _.00	Invalid Fault		
_ _.03	CTL MEMORY FAULT	CTL board defective	Replace the CTL board.
_ _.04	REG EF1 LOSS FAULT	EF1 voltage signal not present CTL board defective	Switch the EF1 switch to “ON” Check cable contacts. Replace the CTL board.
_ _.05	REG EF2 LOSS FAULT	EF2 voltage signal not present CTL board defective	Switch the EF2 switch to “ON” Check cable contacts. Replace the CTL board.
_ _.06	TRB EF3 LOSS FAULT	EF3 voltage signal not present TRB board defective K403 relay defective Defective Output Cable	Check cable/aircraft connection. Place a 28 VDC signal of DC+ at output cable and at GPU. Replace defective components.
_ _.16	CTL OUTPUT OVER VOLTAGE FAULT	Voltage set too high LDC set too high CTL board defective	Adjust voltage or the LDC on the REG board. Replace CTL board.
_ _.17	CTL OUTPUT UNDER VOLTAGE FAULT	Voltage set too low CTL board defective	Adjust voltage on the REG board. Replace CTL board.
_ _.18	CTL OUTPUT 1 OVERLOAD FAULT	Overload on Output 1	Reset and restart GPU.
_ _.19	CTL OUTPUT 2 OVERLOAD FAULT	Overload on Output 2	Reset and restart GPU.
_ _.20	CTL MACHINE OVERLOAD FAULT	Total overload on Output 1 & 2	Reset and restart GPU.
_ _.21	CTL OUTPUT VOLTAGE IMBALANCE FAULT	Open or broken sense line Load not balanced	Repair sensing wire. Check load imbalance and correct as required.
_ _.22	REG OUTPUT OVER FREQ FAULT	Defective engine ECM Defective REG board	Replace engine ECM. Replace REG board.
_ _.23	REG OUTPUT UNDER FREQ FAULT	Defective engine ECM Defective REG board	Replace engine ECM. Replace REG board.

Fault Code	Name	Possible Cause(s)	Corrective Action
_ _.24	REG CONTACTOR1 FAULT	Defective output contactor Defective REG board	Replace output contactor. Replace REG board.
_ _.25	REG CONTACTOR 2 FAULT	Defective output contactor Defective REG board	Replace output contactor. Replace REG board.
_ _.26	CTL DC OVER VOLTAGE FAULT	Defective CTL board	Replace CTL board.
_ _.27	CTL DC UNDER VOLTAGE FAULT	Defective CTL board	Replace CTL board.
_ _.28	TRB OUTPUT OVER VOLTAGE FAULT	Voltage set too high TRB board defective	Reset and restart GPU. Replace TRB board.
_ _.29	TRB OUTPUT UNDER VOLTAGE FAULT	Voltage set too low. TRB board defective	Reset and restart GPU. Replace TRB board.
_ _.30	TRB OUTPUT OVERLOAD FAULT	DC load over rating of GPU	Reset and restart GPU.
_ _.31	TRB DC CONTACTOR FAULT	Defective output contactor Defective TRB board	Replace output contactor. Replace TRB board.
_ _.32	REG EF1 VOLTAGE TOO HIGH FAULT	EF voltage being sent from aircraft on output 1 to the GPU is too high. Output cable is defective.	Reset and restart GPU. Check output cable.
_ _.33	REG EF2 VOLTAGE TOO HIGH FAULT	EF voltage being sent from aircraft on output 2 to the GPU is too high. Output cable is defective.	Reset and restart GPU. Check output cable.
_ _.34	TRB AC CONTACTOR FAULT	Defective input contactor. Defective TRB board	Replace input contactor. Replace TRB board.
_ _.40	CTL ID FAULT	Defective CTL board	Replace CTL board.
_ _.41	TRB ID FAULT	Defective TRB board Defective or missing ID resistor	Replace TRB board. Replace or install ID resistor.
_ _.42	ESB ID FAULT	Defective ESB board	Replace ESB board.
_ _.43	REG ID FAULT	Defective REG board	Replace REG board.
_ _.44	TRB HEATSINK OVERTEMP FAULT	Obstructed cooling air path Defective thermal switch	Clear air obstruction. Replace switch.
_ _.45	TRB TRANSFORMER OVERTEMP FAULT	Obstructed cooling air path Defective thermal switch	Clear air obstruction. Replace switch.
_ _.46	TRB INPUT CONTACTOR FAULT	Defective input contactor Defective TRB board	Replace input contactor. Replace TRB board.
_ _.47			

Fault Code	Name	Possible Cause(s)	Corrective Action
_ _.48	GEN ID FAULT	The REG board cannot find the generator. Defective REG board	Check for ID R2 on TB1. Check for broken wire on ID R2 on TB1. Replace REG board.
_ _.49	CTL POWER MODULE ID FAULT	Call Factory	Call Factory
_ _.50	TRB SELF-TEST FAULT	TRB board defective	Replace TRB board.
_ _.55	EIB LOW FUEL FAULT	Fuel tank level is below $^1/_8$ tank.	Fill fuel tank.
_ _.60	CTL COMM FAULT	Defective CTL board	Replace CTL board.
_ _.61	EIB COMM FAULT	Defective EIB board	Replace EIB board.
_ _.62	ESB COMM FAULT	Defective ESB board	Replace ESB board.
_ _.63	REG COMM FAULT	Defective REG board	Replace REG board.
_ _.64	TRB COMM FAULT	Defective TRB board	Replace TRB board.
_ _.66	EIB LOW ENGINE COOLANT FAULT	Engine coolant level is too low. Engine is loosing coolant.	Refill radiator. Check for leaks and replace defect components.
_ _.67	EIB ENGINE OVERTEMP FAULT	Engine is over-heated. Coolant level is too low. Radiator is dirty or obstructed. Defective EIB board Defective temperature switch	Let engine cool then restart. Check coolant level and add. Clean radiator. Replace EIB board. Replace switch.
_ _.68	EIB LOW OIL PRESSURE FAULT	Engine oil level is too low. Defective EIB board Defective oil pressure switch	Check oil level and add. Replace EIB board. Replace switch.

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Chapter 3: Overhaul/Major Repair

Section 1: Rebuilding the Generator

This chapter describes how to completely rebuild the generator. Please read the entire chapter before starting.

This chapter includes the following topics:

1) Company Contact Information 2
2) Generator Overview 3
3) Tools and Supplies 4
4) Generator Disassembly 6
a) Accessing the Generator 6
b) Generator Removal 8
c) Flexible Coupling Removal 10
d) Exciter Armature Removal 12
e) Bearing Removal 15
5) Generator Reassembly 18
a) Bearing Installation 18
b) Exciter Armature Installation 18
c) Flexible Coupling Service 20
d) Bushing Replacement 21
e) Flexible Coupling Installation 21
f) Engine and Generator Reassembly 25
g) Run-in and Periodic Check 26

Figure 1: Generator Components ... 3
Figure 2: Slide Hammer Puller ... 5
Figure 3: Component Removal Required for Access to Generator ... 7
Figure 4: Generator Mounting Bolts ... 8
Figure 5: Supporting the Generator with a Hoist ... 9
Figure 6: Bolts That Attach Generator to Engine ... 9
Figure 7: Coupling Assembly ... 10
Figure 8: Hub and Bushing ... 11
Figure 9: Rubber Bushing Alignment ... 11
Figure 10: Exciter Armature Assembly ... 12
Figure 11: Exciter Armature Detail ... 14
Figure 12: Exciter Housing Screws ... 15
Figure 13: Screws in the Threaded Holes ... 15
Figure 14: Exciter Housing Removal ... 16
Figure 15: Generator Rotor Removal ... 16
Figure 16: Removing the Bearings ... 17
Figure 17: Bearing Support Inspection ... 17
Figure 18: Exciter Armature Installation ... 19
Figure 19: Rubber Bushing Installation ... 21
Figure 20: Flexible Coupling Installation ... 22
Figure 21: Engine Measurement ... 23
Figure 22: Generator Measurement ... 24

1) Company Contact Information

If you need assistance or need to order parts, contact Hobart or your Hobart distributor.

Write: Hobart Ground Power
Service Department
1177 Trade Road East
Troy, Ohio 45373
U.S.A.

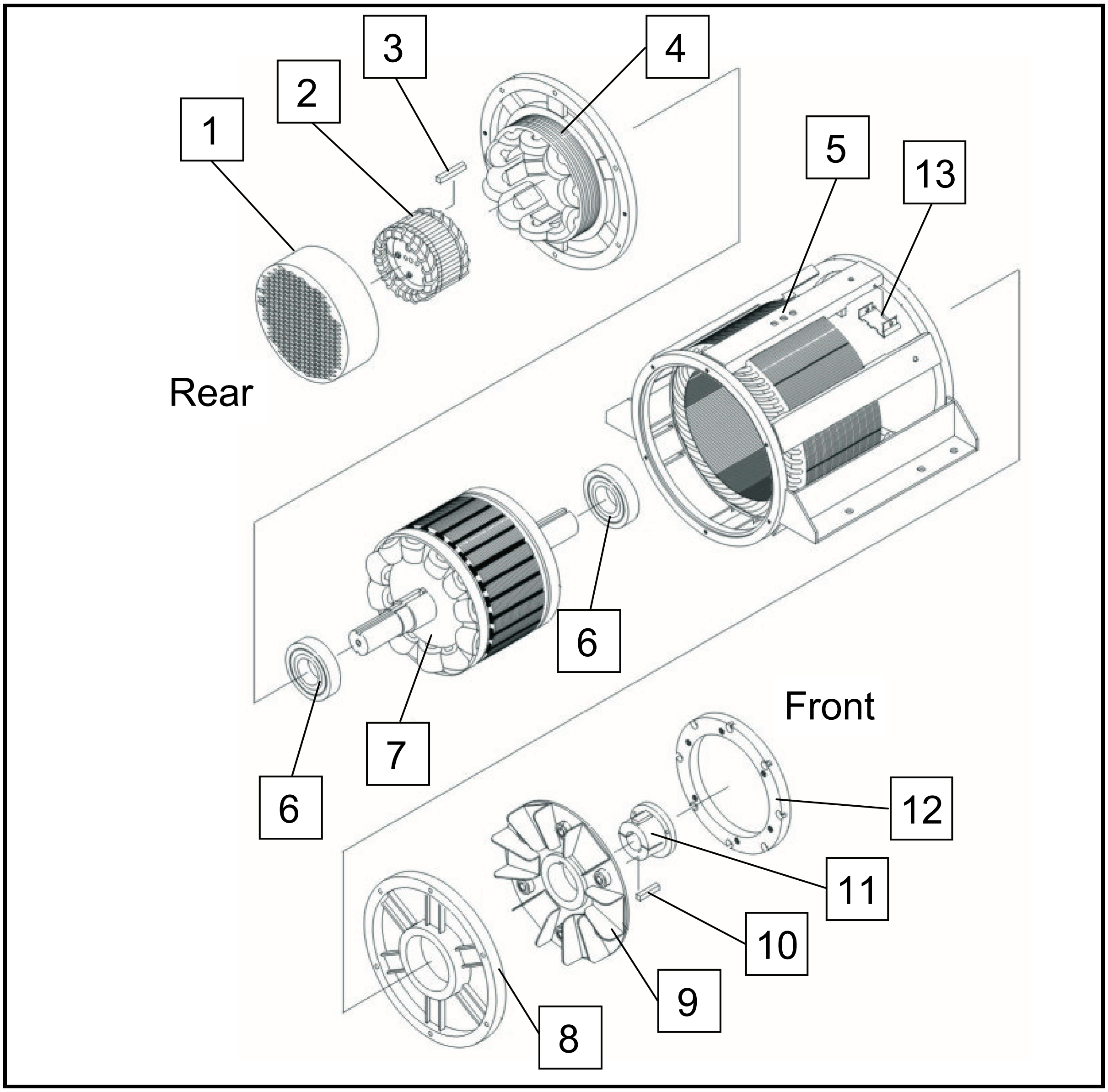
E-Mail : service@itwgsegroup.com

Web Page : http://www.itwgsegroup.com

Phone Numbers	**Inside U.S.A.**	**International**
Parts	(800) 422-4166	(937) 332-5050
Service	(800) 422-4177	(937) 332-5060
FAX	(800) 367-4945	(937) 332-5121

2) Generator Overview

The diagram below shows the main components of the generator.



1. Exciter Cover
2. Exciter Armature
3. Exciter Key
4. Exciter Housing and Coils
5. Generator Housing and Coils
6. Bearing
7. Generator Rotor
8. Front Bearing Support
9. Flexible Coupling
10. Coupling Key
11. Split Taper Bushing
12. Flywheel Adapter Ring*
13. Generator Air Deflector

* The larger engines do not require a flywheel adapter ring.

Figure 1: Generator Components

The engine side of the generator is considered the front. The exciter end of the generator is the rear.

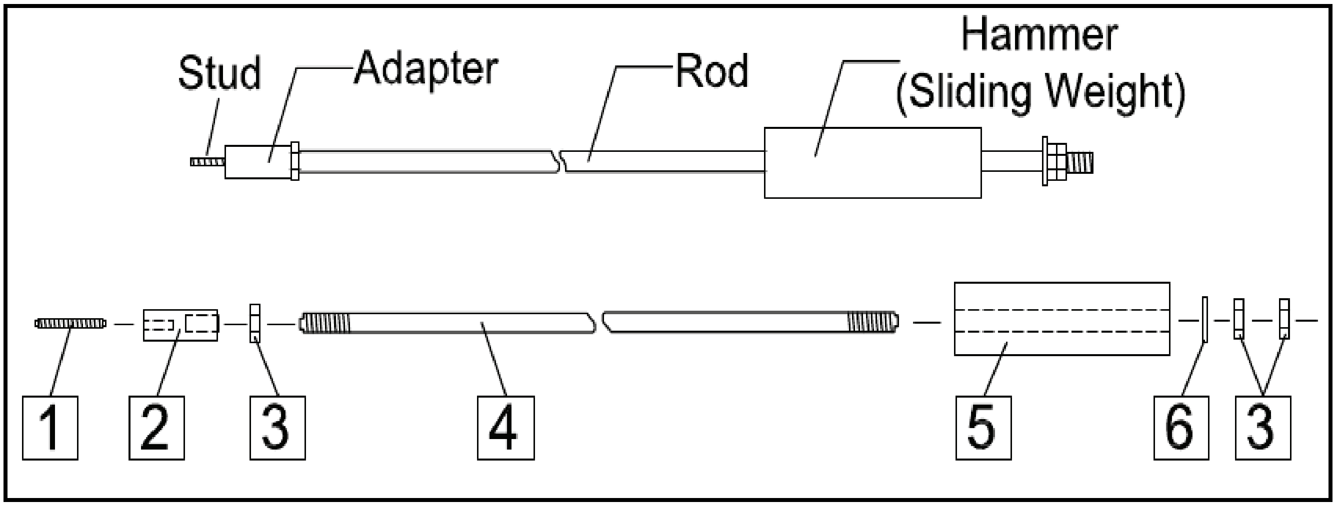
3) Tools and Supplies

In addition to standard wrenches, the following equipment is helpful for rebuilding the generator:

Item	Specification	Application
Bolts (2 required)	M10-1.5 x 127 mm long, fully threaded, hex-head	Used to remove the exciter armature and the exciter housing
Torque wrenches	Up to 100 ft-lbs (136 N-m)	Generator reassembly
Hoist	Lift at least 2000 pounds (907 kg)	Required if you are going to remove the generator
Lift ring	Hold at least 2000 pounds (907 kg)	Used to remove generator from engine and remove rotor from generator
Bolt	M12-1.75 x 80 mm	Attach lift ring to generator
Rotating fixture	Hold at least 2000 pounds (907 kg)	To hold the generator frame securely while allowing you to rotate the generator so the shaft is vertical
Gear puller	Hydraulic	To remove the bearings from the generator shaft
Oven	At least 275 ºF (135 ºC)	Required to heat new bearings for installation
Bore gauge	Typical measurement in range from 5.9055 to 5.9062 inches	Measure bearing support brackets
Wood blocks	N/A	Hold the generator rotor forward during reassembly
Pry bar	N/A	Prevents the generator from rotating while loosening or tightening screws
Electrical joint compound	Burndy Penetrox™ or equivalent	Exciter armature field lead connections
Primer	Loctite® 7471™ Primer T™	Exciter machine key
Adhesive	Loctite® 242™	Exciter machine key and exciter bolt
Stud	M6-1.0 x 40 mm or longer	Used to hold and remove the exciter armature key. In some cases, removal may require a slide hammer puller, described on the next page.
Steel rule and square with steel rule (1 each)	At least 12”	Measurements from engine and generator mounting surfaces

The slide hammer puller is used to remove the threaded machine key, which keeps the exciter armature from spinning on the generator armature shaft. The machine key is attached with adhesive. While you can usually remove the key without this puller, some keys require a puller for removal.

You may have such a puller in your equipment inventory. If not, the figure below illustrates the components and dimensions for fabricating such a tool. Slide hammer pullers are also commercially available. The machine key has a tapped hole with a M6-1 thread, so the slide hammer puller must have an adapter to accommodate that.



1. Stud, M6-1.0 x 40 mm or longer, Class 8.8 or higher
2. Adapter, M6-1 to 1/2-13, 3/4" Round CR Steel
3. Nut, 1/2-13 Hex, Steel (3 required)
4. Rod, 1/2" Round, CR Steel, 1/2-13 threads
5. Hammer, 2" O.D., 0.578 I.D., CR Steel
6. Washer, Flat, 1/2" Steel

Figure 2: Slide Hammer Puller

4) Generator Disassembly

The generator must be removed from the generator set in order to replace the front bearing. If you are only replacing the rear bearing or servicing the exciter, the generator can remain in place.

WARNING

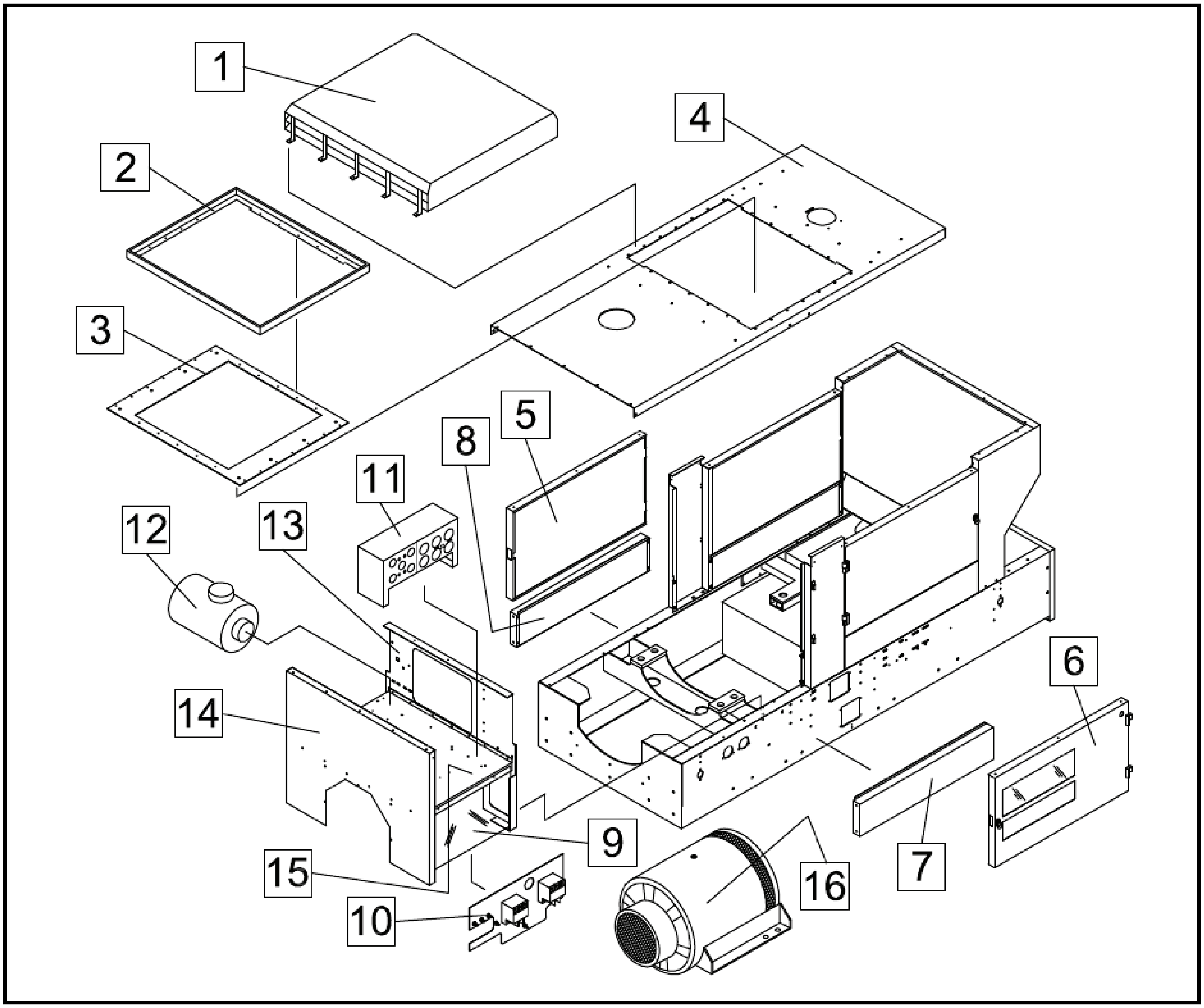
Before starting removal of the generator assembly, position the front section of the generator set under a hoist that is capable of lifting at least 2000 pounds (907 kg), which is the weight of the generator assembly.

a) Accessing the Generator

The diagram on the next page shows the generator set components that must be removed before removing the generator. The numbers in parentheses in these steps refer to the numbered parts in the drawing.

1. Disconnect battery leads from the generator set or turn the battery disconnect switch to the "off" position.
2. Remove top charge air cooler hood (1).
3. Remove bottom charge air cooler hood (2) and bottom charge air cooler gasket (3).
4. If a transformer-rectifier (T-R) assembly is mounted on the generator set, remove T-R assembly.
5. Disconnect clearance light wires from the top canopy (4), if installed.
6. Remove top canopy panel (4).
7. Remove the left front (5) and right front (6) doors.
8. Remove the right front lower panel (8) and left front lower panel (7).
9. Disconnect the clear power module cover (9) from the angle bracket on the frame and loosen cable clamps to so that the aircraft cables can be disconnected from the load contactors on the power module (10).
10. Disconnect plug connectors from the back of the control box (11).
11. Remove the control box (11).
12. Remove the air cleaner (12) and the pipe/hoses connecting it to the engine.

    Note: Cover the turbo inlet while the air cleaner is removed.
13. Remove the generator stator leads from the power module (10).
14. Route wire harness through the bulkhead panel (13) towards the engine compartment, so that the front canopy panel (14), the control box support panel (15), power module assembly (10), and the bulkhead panel (13) can be lifted off the unit in a one piece assembly.
15. Remove the generator cover (16).



1. Top Charge Air Cooler Hood
2. Bottom Charge Air Cooler Hood
3. Bottom Charge Air Cooler Hood Gasket
4. Canopy Top Assembly
5. Right Front Door
6. Control Box Door (Left Front Door)
7. Left Front Lower Panel
8. Right Front Lower Panel
9. Power Module Cover
10. Power Module Assembly
11. Control Box Assembly
12. Air Filter Assembly
13. Bulkhead Panel
14. Front Canopy Panel
15. Control Box Support
16. Generator Cover

Figure 3: Component Removal Required for Access to Generator

b) Generator Removal

WARNING

To prevent personal injury, keep fingers and hands clear of generator assembly until the armature is blocked to prevent rotation.

1. Remove the four 5/8 - 11 x 4-1/2 bolts that mount the generator assembly to the frame of the generator set.

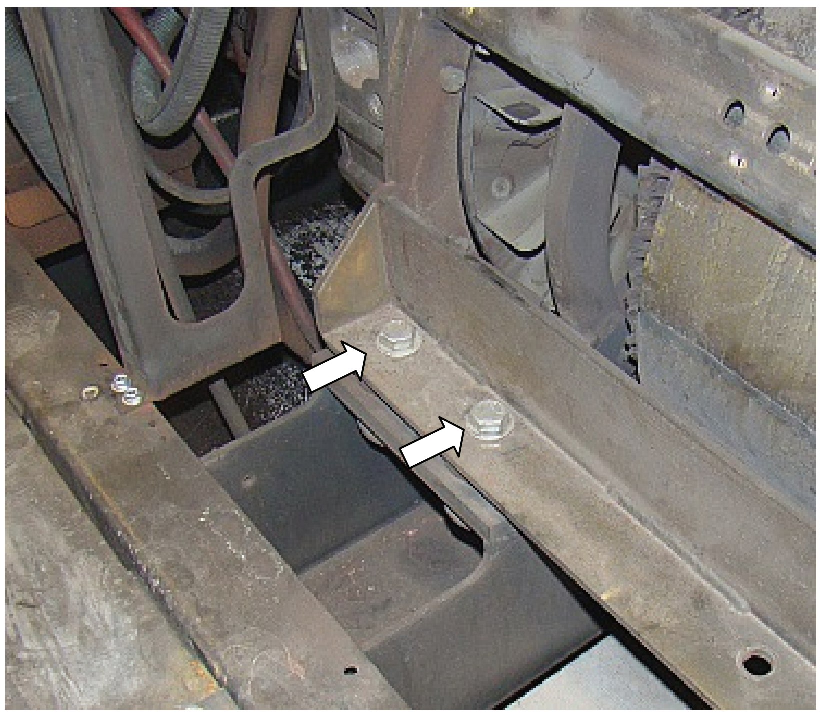


Figure 4: Generator Mounting Bolts

2. Support the engine at the flywheel housing with wooden blocks or second hoist if available.
3. Using the hoist, support the generator assembly. For lifting convenience, the top of the generator housing has an M12-1.75 threaded hole. Using a M12-1.75 bolt, attach a lift ring to the top of the generator and attach the hoist chain as shown in the following figure.

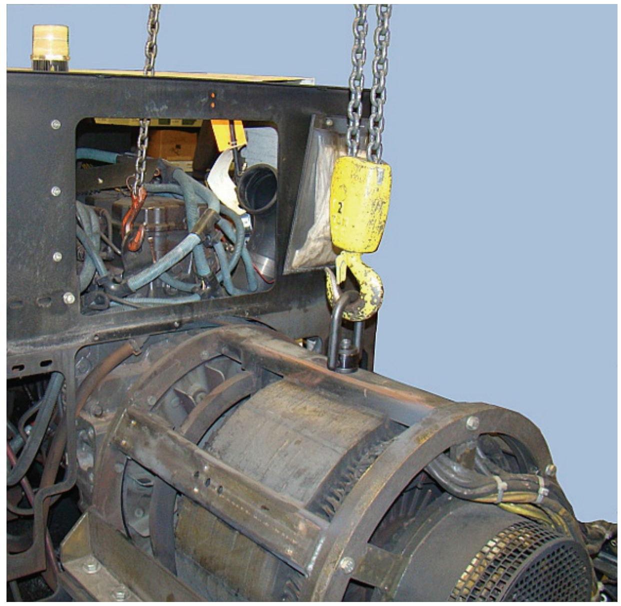


Figure 5: Supporting the Generator with a Hoist

4. Remove the eight (8) bolts that hold the generator coupling to the engine flywheel. Use a pry bar against the fan blades to keep the fan from moving.

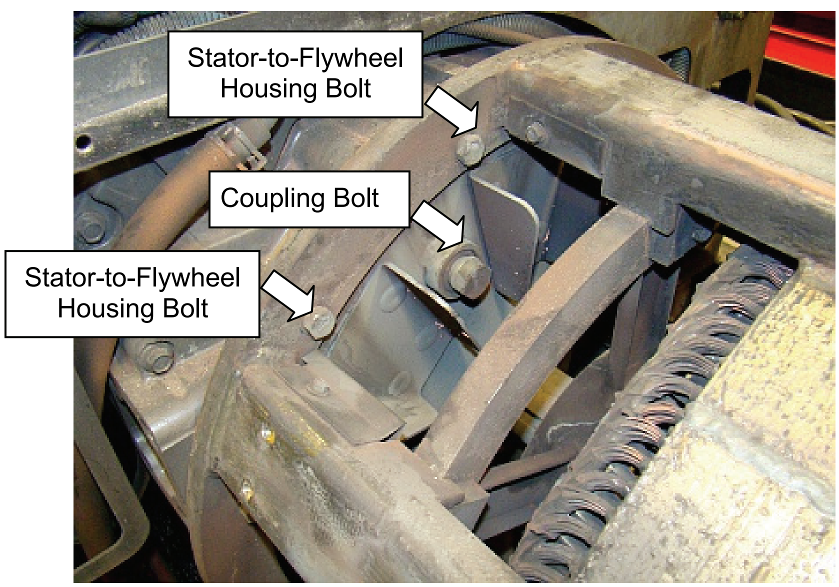


Figure 6: Bolts That Attach Generator to Engine

5. Remove the 12 stator-to-flywheel bolts that hold the generator body to the engine.
6. Carefully lift the generator away from the engine.

c) Flexible Coupling Removal

The primary function of the flexible coupling assembly is to couple a Hobart 2000 RPM Generator to a diesel engine. The flexible coupling assembly compensates for slight misalignment between the engine and the generator, due to manufacturing tolerances. A tapered bushing and hub secures the coupling to the generator shaft.

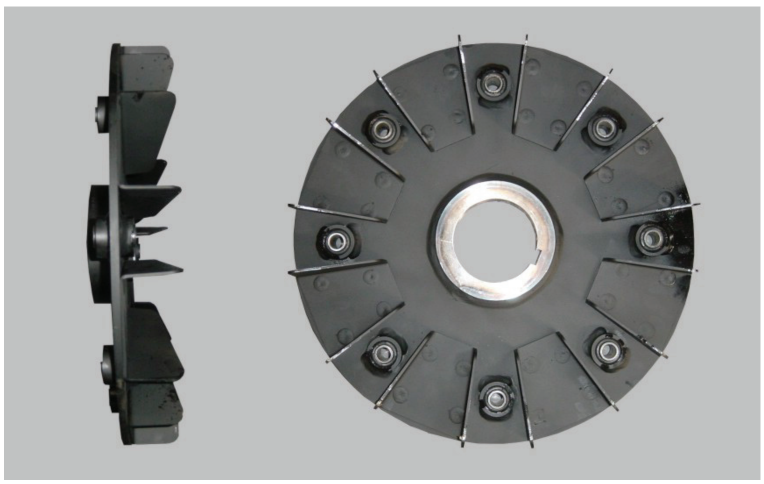
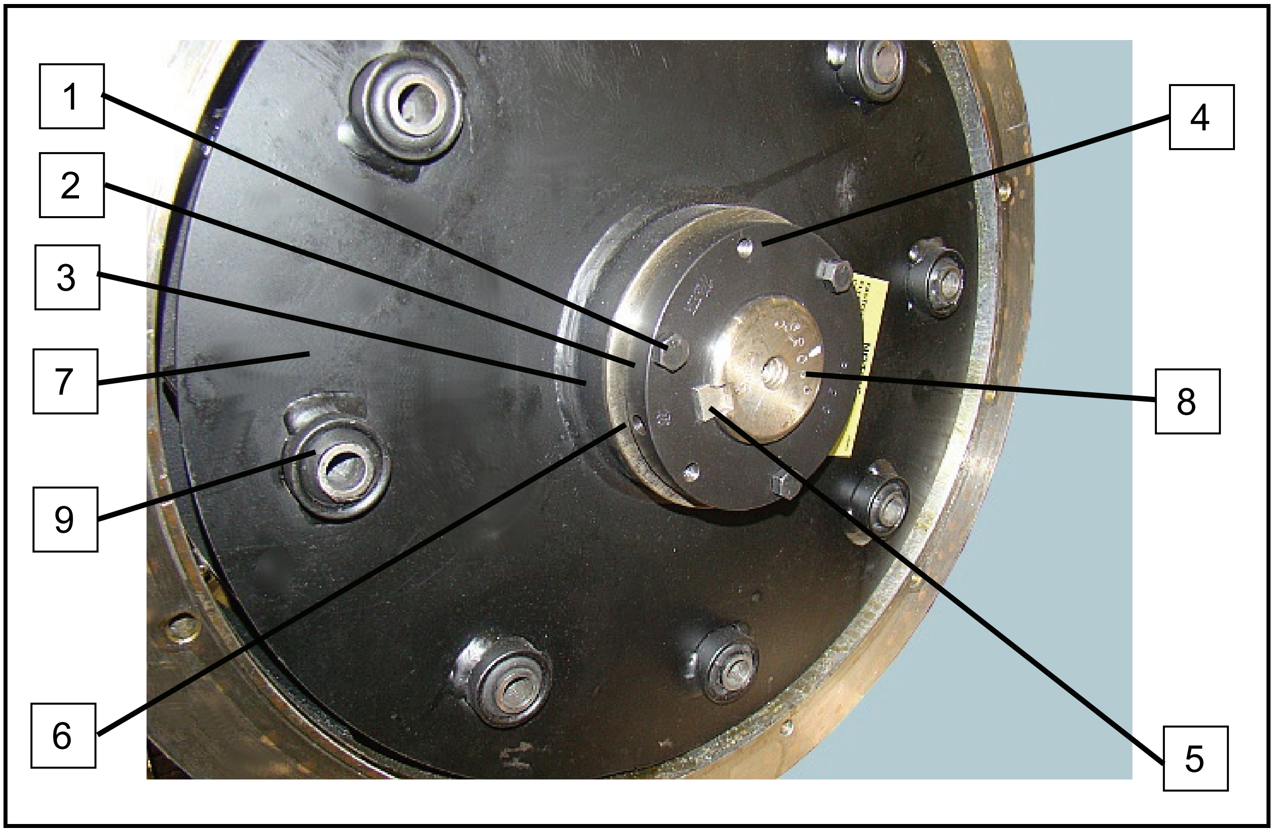


Figure 7: Coupling Assembly

1. Refer to the following figure. Using a socket wrench, remove the three 3/8-16 bolts that secure the bushing to the hub.
2. Using a 3/16-inch Allen wrench, loosen the setscrew in the bushing to release pressure on the key.
3. To separate the bushing from the hub, lubricate two of the 3/8-16 bolts and insert them into the two threaded holes in the bushing flange. With socket wrench, screw these bolts into the bushing, alternating from bolt to bolt until the bushing loosens in the hub.
4. When the bushing is loose in the hub, use a mallet to GENTLY tap the bushing out of the hub.
5. Slide the coupling assembly off the shaft and remove the key.
6. Inspect the coupling assembly components carefully as follows:
   a) Check for deformed fan blades and damage to the disk.
   b) Check the rubber exposed at both ends of the bushings for signs of deterioration.
   c) Check hub and bushing for cracks, evidence of galling, and rust pits. Light rust is permissible on the bushing and the tapered bore of the hub.
   d) Check the shaft for any damage or deformation where the coupling was mounted.
   e) Check the alignment of the rubber bushings to make sure that the dimension illustrated in second figure below is maintained.



1. Bolt, 3/8-16 UNC (3)
2. Taper Lock Bushing
3. Taper Lock Hub
4. Tapped holes (2)
5. Key
6. Setscrew
7. Fan/Coupling Disk
8. Generator Shaft
9. Rubber bushings (8)

Figure 8: Hub and Bushing

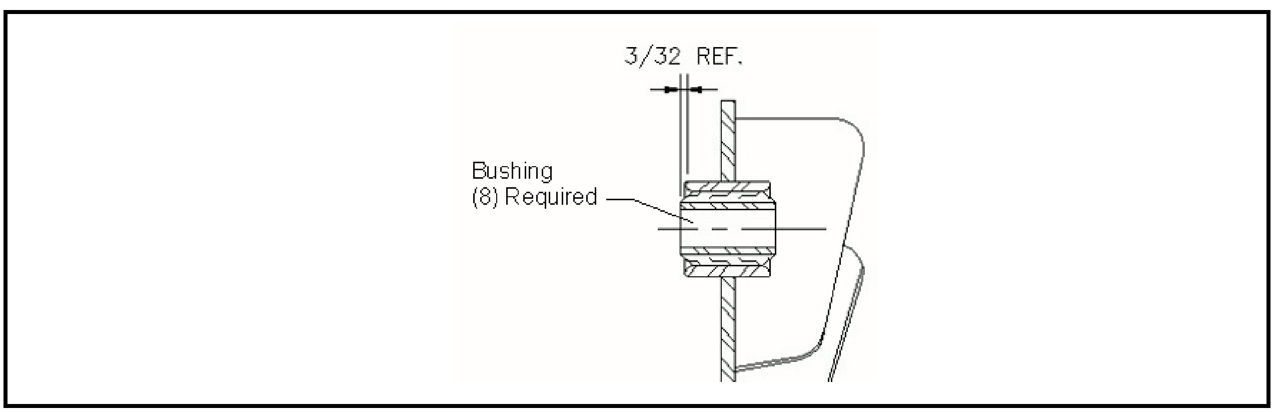


Figure 9: Rubber Bushing Alignment

d) Exciter Armature Removal

The exciter armature is the shaft-mounted, revolving, three-phase windings of the exciter. It is mounted on the rear portion of the main generator shaft, which extends rearward, beyond the rear generator bearing, into the exciter housing (See Figure 1).

The exciter armature may need to be removed to replace the exciter armature itself or to replace the rear generator bearing. The exciter and rear main bearing can be removed without removing the generator from the generator set.

The exciter armature is mounted on the main generator armature shaft with a 3/8-inch square machine key and an M12-1.75 hex head cap screw in the center of the diode mounting plate. The exciter armature has two M10-1.5 tapped holes in its diode mounting plate to accommodate pulling it off the shaft.

Once the threaded machine key is removed, no other special tools are required for removing the exciter from the generator shaft. This can be done using the two M10-1.5 fully threaded hex-head bolts. Instructions for doing this are provided in this manual.

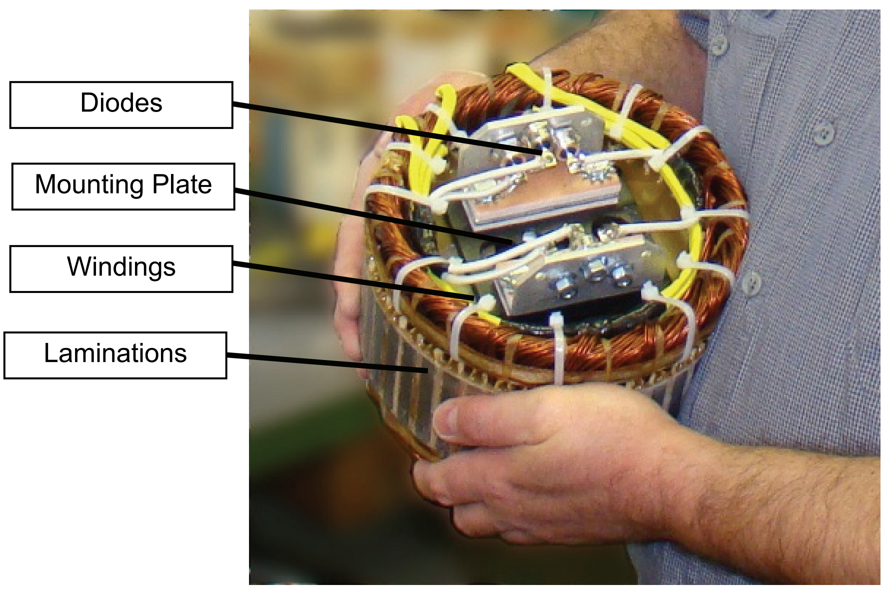


Figure 10: Exciter Armature Assembly

Follow these steps to remove the exciter armature:

1. If required (if the generator was not removed from the generator set), remove the exciter cover from the end canopy.
2. Remove exciter armature cover from the end of the generator.
3. Place a block bar (pry bar) into the generator fan assembly to keep the generator armature from rotating.
4. Remove the exciter housing cover as required.
5. Remove the M12-1.75 cap screw, which holds the exciter armature and the exciter key fastener tab on the generator shaft.

6. With the screw and tab removed, you can see the exciter key and the threaded holes in the exciter mounting plate.
7. Disconnect the two rectifier-to-generator field leads, which are terminated with ring terminals. Remove the screws, nuts, and washers on the rectifier mounting plate to disconnect the leads.
8. Exercise care to prevent damage to the leads. Remove kinks in the two generator leads as much as possible so that the exciter armature will be able to slide over these leads.
9. Remove the exciter key by threading an M6-1.0 screw into the threaded hole and pulling the key out. If necessary, remove the exciter key with the slide hammer puller:
10. If you do need to use the puller, first thread only the stud into the key. Attachment of the assembled puller to the key in one operation is not recommended because the weight and bulk of the assembly make threading the stud into the key rather clumsy. This could result in cross threading and damage to key and stud. It is safer and easier to attach as follows:
    a) Refer to the slide hammer puller figure. Thread the stud (1) into adapter (2) until it bottoms, then thread this assembly (1) and (2) into the key until stud bottoms in key threads. Tighten securely.
    b) Attach the puller adapter to the rest of the puller.

WARNING

Be very careful during removal process (slide-hammering) to avoid injury to hands.

    c) Position the hammer at adapter end of rod.
    d) Quickly move hammer to outer end of rod with a rapid, slinging motion. **HOLD** the hammer through the entire motion. If hammer is allowed to slide free on the rod, the stud could be **DAMAGED** or **BROKEN.**
    e) Repeat step (c) and (d) as required to loosen key, then remove key and slide-hammer puller. After the key is removed, apply penetrating oil in the armature and shaft keyways.

CAUTION

When removing the exciter armature, be careful not to damage the field leads.

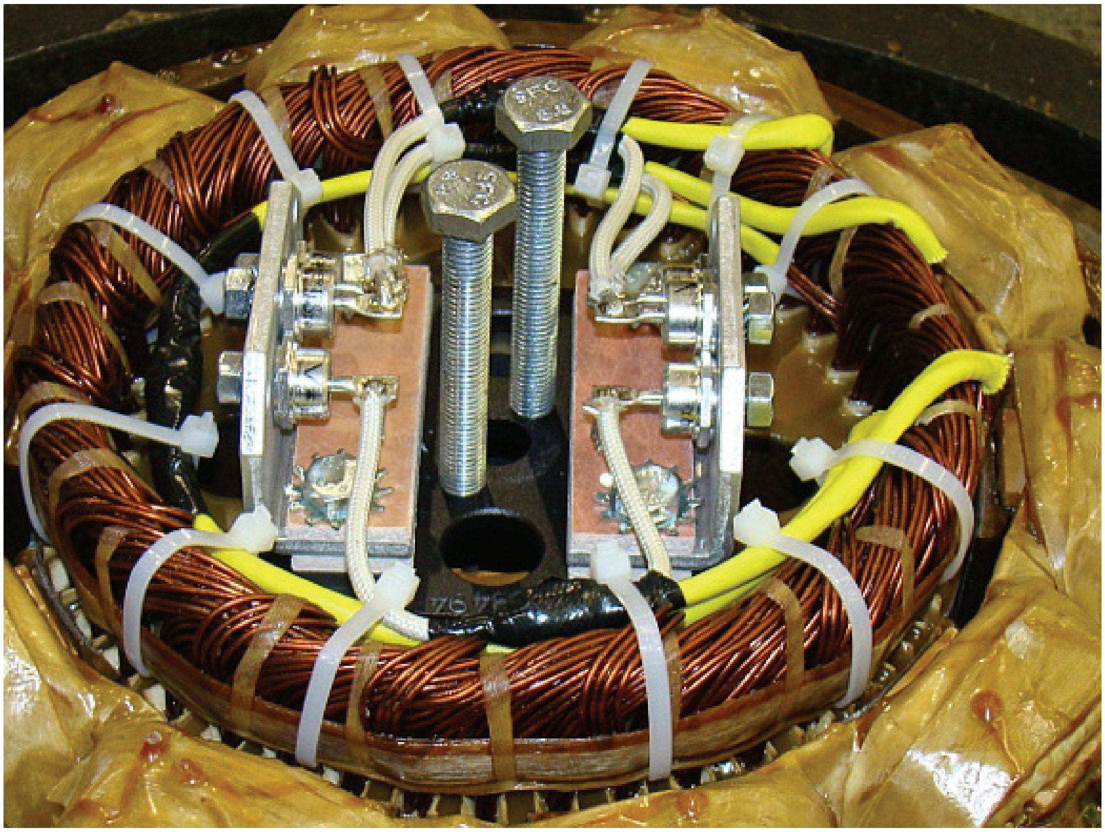


Figure 11: Exciter Armature Detail

11. To remove the armature, insert two M10-1.5 hex-head bolts into the threaded holes in the exciter armature mounting plate to force the exciter armature off the shaft. Turn each of the two screws a few turns at a time until the exciter armature is loose enough to be removed by hand.

e) Bearing Removal

1. Using a 19 mm socket wrench, remove the six screws that hold the exciter housing.

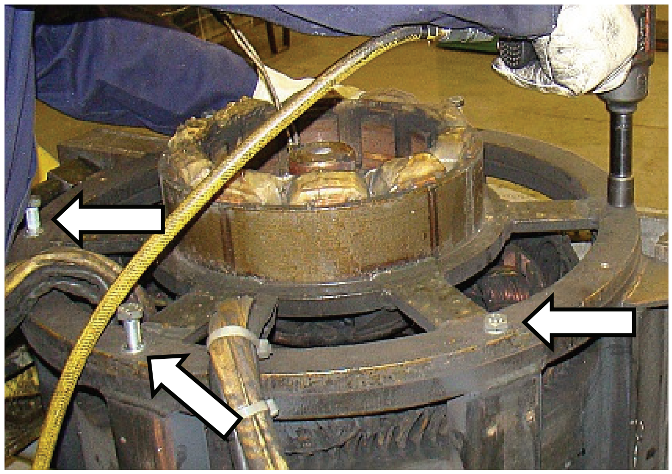


Figure 12: Exciter Housing Screws

2. Loosen the exciter housing by running two M10 screws into the threaded holes shown in the figure below.

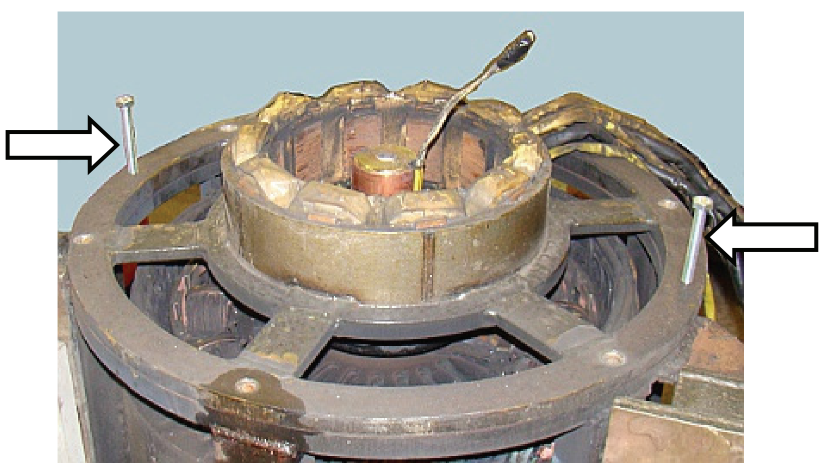


Figure 13: Screws in the Threaded Holes

3. Move the generator leads out of the way by tie wrapping them together and bending them so they extend straight back from the generator (parallel with the generator feet).
4. Remove the exciter housing. You can attach lift hooks at the two threaded holes or lift it directly.

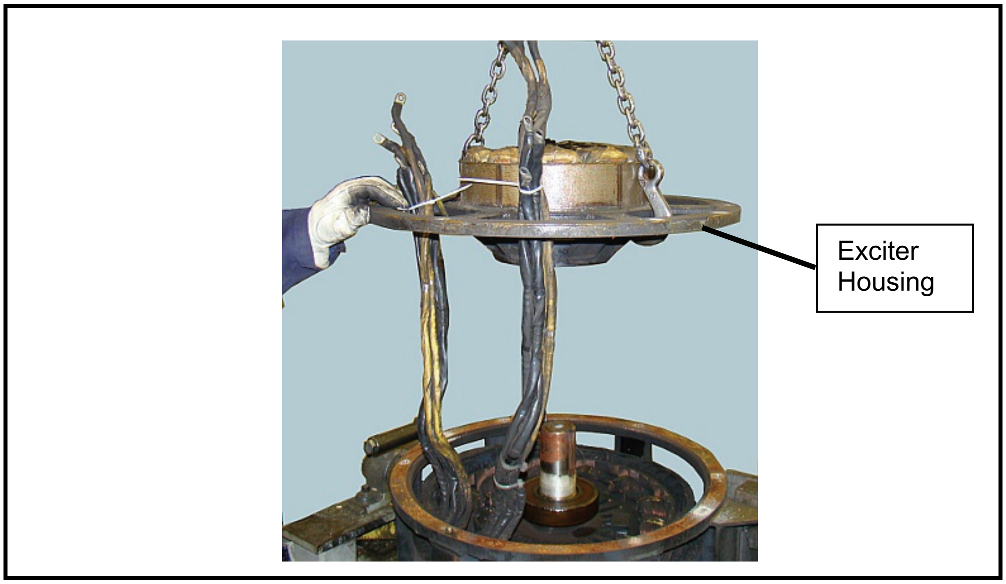


Figure 14: Exciter Housing Removal

5. To remove the generator rotor, attach a swivel lifting ring to the end of the shaft using an M12 screw. Then, using a lift, pull the rotor out of the stator housing.

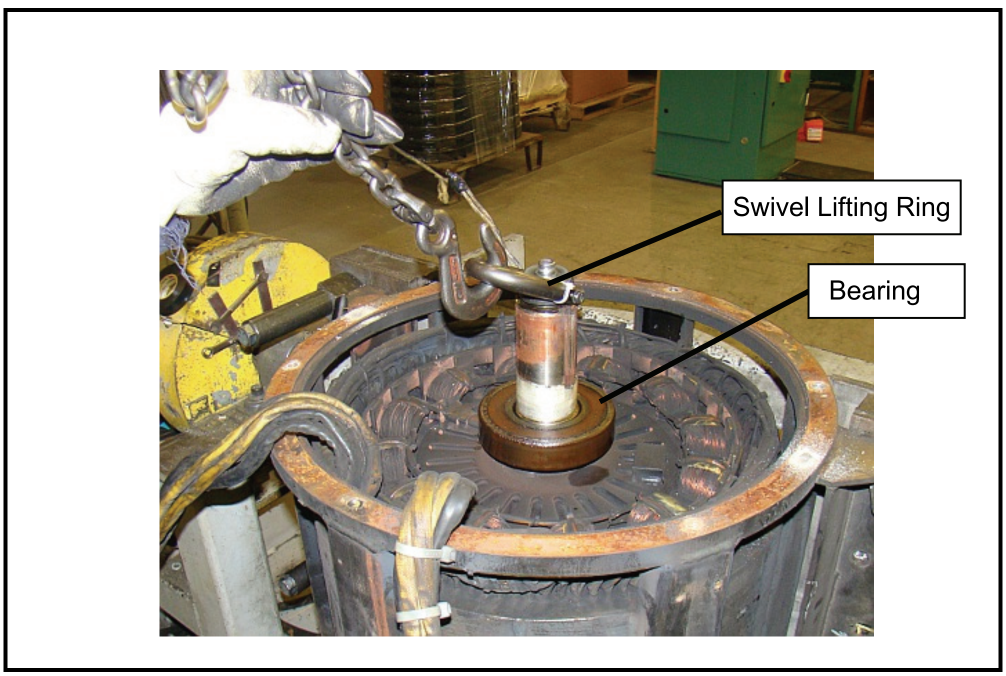


Figure 15: Generator Rotor Removal

6. To remove the bearings, use a hydraulic gear puller. Observe standard safety practices when using the gear puller.

Figure 16: Removing the Bearings

7. Clean the generator shaft and exciter armature bore. Remove all rust, corrosion, and dirt.
8. Using a bore gauge, measure the inside diameter of the bearing bracket (front bearing) and the exciter housing (rear bearing). The acceptable range is 5.9055 to 5.9062 inches.

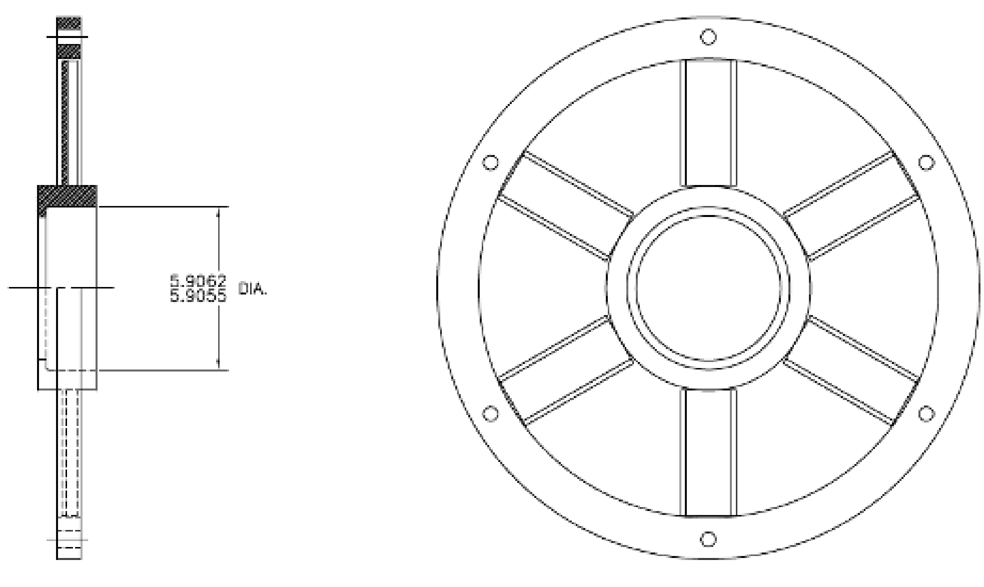


Figure 17: Bearing Support Inspection

5) Generator Reassembly

Reassemble the rest of the generator in the reverse order of disassembly. The following sections provide some of the details.

a) Bearing Installation

1. Obtain two replacement bearings. They are identical. Use only replacement bearings from **Hobart Ground Power - Part Number W10072-068.**
2. Expand the two bearings by heating them in an oven. The oven temperature should be 275 ºF (135 ºC), and the heating time is 20 to 25 minutes.
3. Using gloves for protection from the heat, remove the bearings from the oven, one at a time, and place them on the generator shaft. Push the bearing all the way on the shaft toward the coils. You should be able to hear the distinct sound of the bearing's inner race hitting metal.
4. Reinstall the generator rotor.

b) Exciter Armature Installation

1. Make certain that the revolving field leads are tucked into the 1/2" keyway, which is opposite from the 3/8" keyway in the generator shaft.
2. Route the revolving field leads through exciter armature hole, which is opposite the keyway.
3. Align the armature keyway with the key in the shaft and start the armature on the shaft.
4. The next step depends on how the exciter armature fits on the generator shaft.
   - If the exciter armature-to-generator shaft fit is such that the exciter armature may be pushed on by hand:
     a) Push the exciter armature on very slowly while another mechanic carefully watches and pulls field leads through hole in the exciter armature diode mounting plate.
     b) Continue installation until the diode mounting plate contacts the end of the generator shaft.
   - If the exciter armature cannot be pushed on by hand, use a M12-1.75 hex-head bolt and M12-1.75 nut to push the exciter armature onto the generator shaft. Refer to the figure on the next page.
     a) Put the exciter armature on slowly and at the same time pull field leads through the hole in the diode mounting plate.
     b) Screw the nut onto the bolt until it is near the head of the bolt.
     c) Insert the bolt through the hole in the center of the armature mounting plate as far as it will go, and screw it into the end of the armature shaft.
     d) Screw the nut up against the diode mounting plate.
     e) Continue turning the nut until the diode mounting plate contacts the end of the generator shaft.
     f) After installation, remove the bolt and nut.

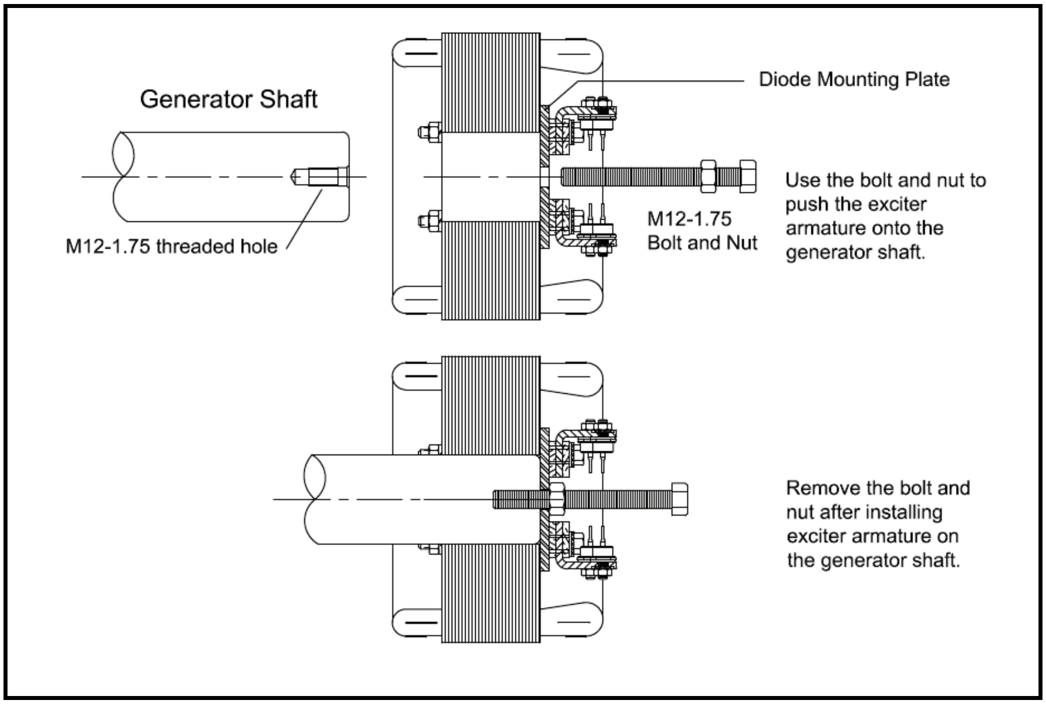


Figure 18: Exciter Armature Installation

5. Attach the field leads to the diode mounting plates.
6. Use Burndy Penetrox™ electrical joint compound on the connections.
7. Tighten the screws to **36 in-lbs or 3.0 ft-lbs (4.1 N-m)**.
8. Clean the exciter machine key thoroughly.
9. Apply Loctite® 7471™ Primer T™ to the sides of the machine key. Do not over-prime – a thin film is best. Allow to dry three or four minutes. You can thread an M6-1.0 screw into the key to hold it.
10. Apply Loctite® 242™ adhesive to the sides of the machine key. A thin film of 0.005 to 0.010 inch thick is adequate and desirable.
11. Ensure that the exciter armature keyway is aligned with the generator shaft keyway.
12. Insert the unthreaded end of the key into the keyway and then tap lightly until the threaded end is flush with the end of the shaft.
13. Put the exciter key fastener tab in place with the end of the tab resting against the key.
14. Apply Loctite® 242™ to the M12-1.75 screw, and screw it into the generator shaft to secure the exciter armature.
15. Using a torque wrench, tighten the bolt to **72 ft-lbs (98 N-m)**.

c) Flexible Coupling Service

If the coupling requires service, you can order kits from Hobart:

Kit	Hobart Part Number	Contents
Coupling Kit	288481	Flexible coupling with factory-installed rubber bushings
Bushings Kit	290863	Rubber bushings (8), lubricant, and instructions

When ordering parts from Hobart, be sure to include all pertinent information from the unit's identification plate:

- Specification number: **500181A-xxx** (include the full dash number)
- Model number: **180CU20**
- Unit rating: **180 kVA**
- Serial number (important)

If you have any questions concerning your Hobart equipment, contact our Service Department by mail, telephone, e-mail, or FAX. Refer to the first page of this chapter for contact information.

d) Bushing Replacement

Follow these steps if you are replacing only the bushings:

1. Press out all the old bushings.
2. Clean each bushing socket thoroughly, removing all traces of old rubber. DO NOT scratch or deform the bore of the bushing socket.
3. Shake the container of lubricant well before using.
4. Pour the lubricant into a small, shallow dish.
5. Roll each bushing in the lubricant to coat it thoroughly.
6. Press the bushing into a socket from the engine side (not the fan blade side).
7. Repeat step 4 until all new bushings are installed.

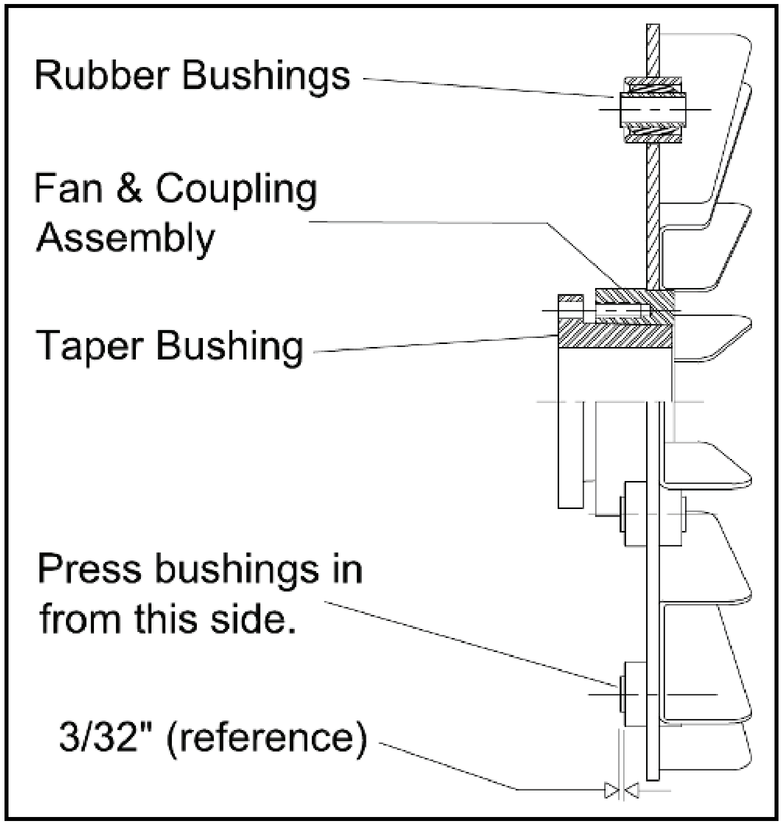


Figure 19: Rubber Bushing Installation

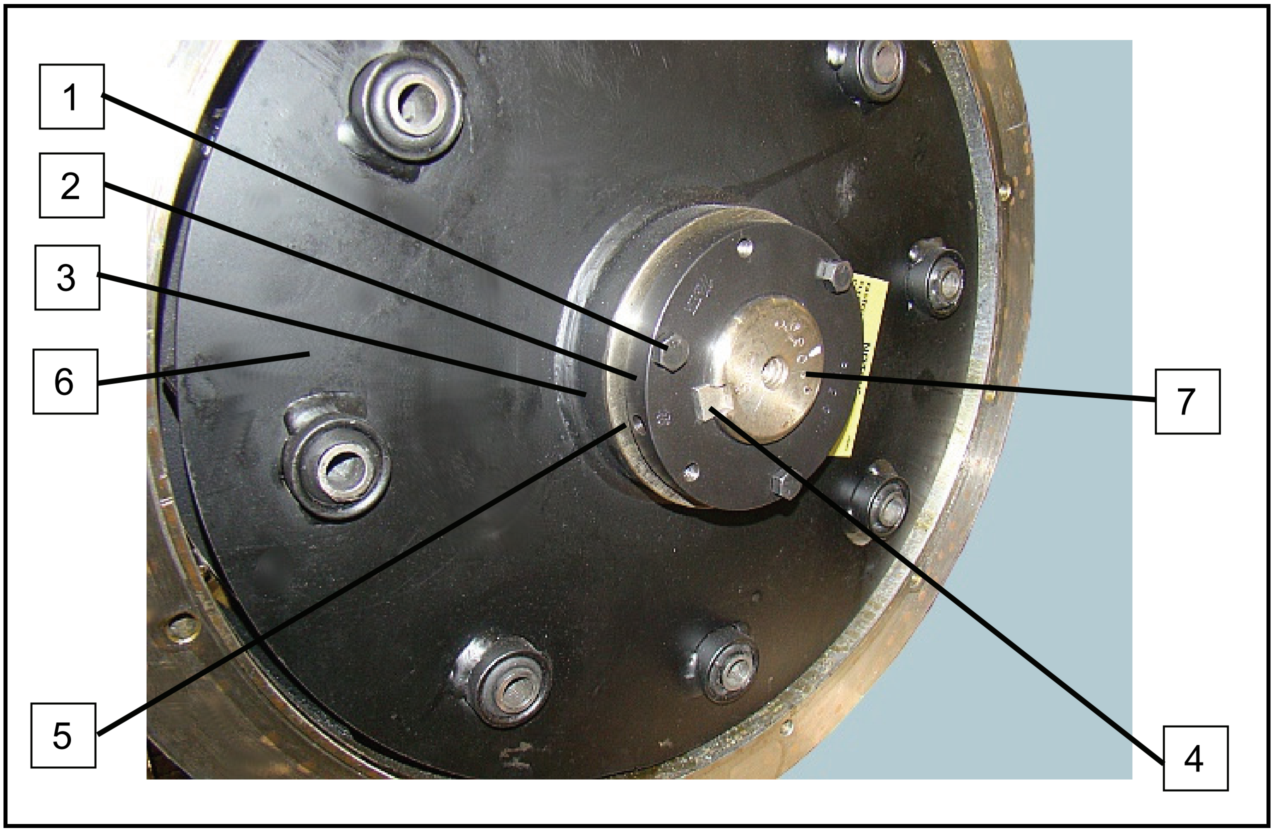
e) Flexible Coupling Installation

WARNING

To prevent personal injury, keep fingers and hands clear of generator assembly until the armature is blocked to prevent rotation.

CAUTION

Improper installation of the coupling assembly can result in serious damage to the equipment. Follow these installation instructions exactly.



1. Bolt, 3/8-16 UNC (3)
2. Taper Lock Bushing
3. Taper Lock Hub
4. Key
5. Setscrew
6. Fan/Coupling Disk
7. Generator Shaft

Figure 20: Flexible Coupling Installation

This procedure ensures that the flexible coupling on the generator will be the correct distance away from the engine flywheel or flywheel adapter ring (if used). On the generator, the rubber bushings extend beyond the front mounting surface. On the engine, the adapter ring is recessed from the mounting surface. When the coupling is correctly installed, the distance that the bushings extend should match the distance that the adapter ring is recessed.

1. Thoroughly clean the shaft, the bore, and the tapered bushing, making sure these parts are free of dirt and grit.

CAUTION

Do not lubricate any of the surfaces listed above. Lubrication of these surfaces can cause the coupling to fail and damage the generator set. Slight traces of rust are permissible on the surfaces.

2. Lubricate the three 3/8-16 bolts **SPARINGLY** and start them into the three (unthreaded) holes finger-tight. Do not get any lubricant on the bushing or generator shaft.

3. Slide the generator rotor forward (toward the engine) as far as it will go.
4. Using a wooden block or wedge, block the rotor to maintain this forward position throughout the installation procedure, being careful not to damage any components of the rotor or exciter.

CAUTION

Do not rotate the armature while this block is installed.

5. Install the key in the shaft keyway.
6. Place the taper bushing in the coupling hub.
7. Slide the coupling with bushing onto the shaft over the installed key until the bushing is approximately flush with the end of the shaft.
8. Using a 3/16-inch Allen wrench, tighten the setscrew in the bushing to apply pressure on the key.
9. On the engine, measure the distance between the mounting surface and the surface of the flywheel or flywheel adapter ring (if used). Refer to the figure below.

   Record measured distance: ______________

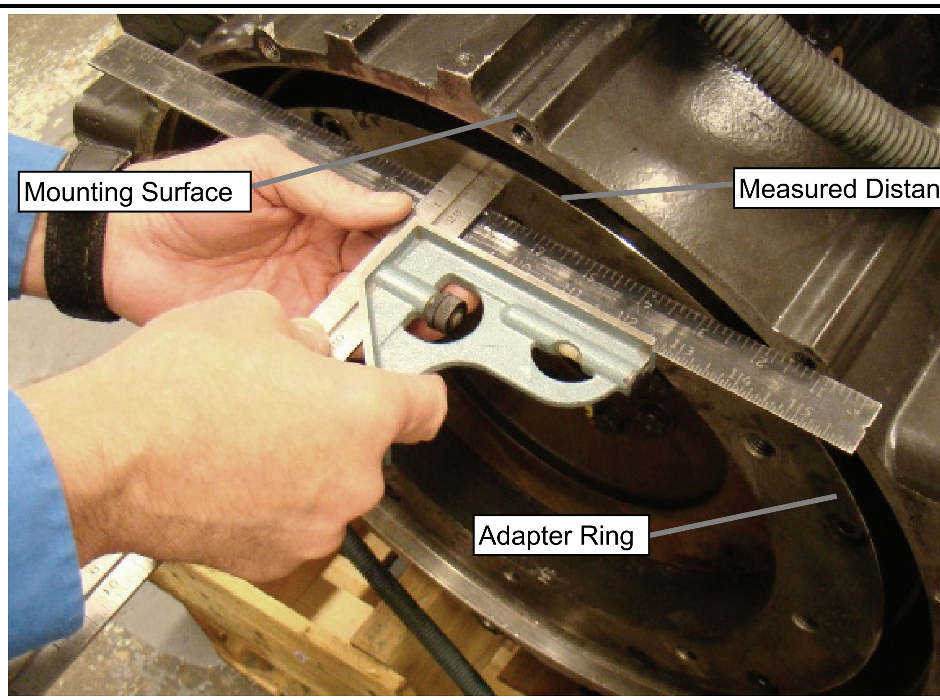


Figure 21: Engine Measurement

10. On the generator, place a straight edge across two adjacent bushings and measure the distance from the bushings to the mounting face (see figure).

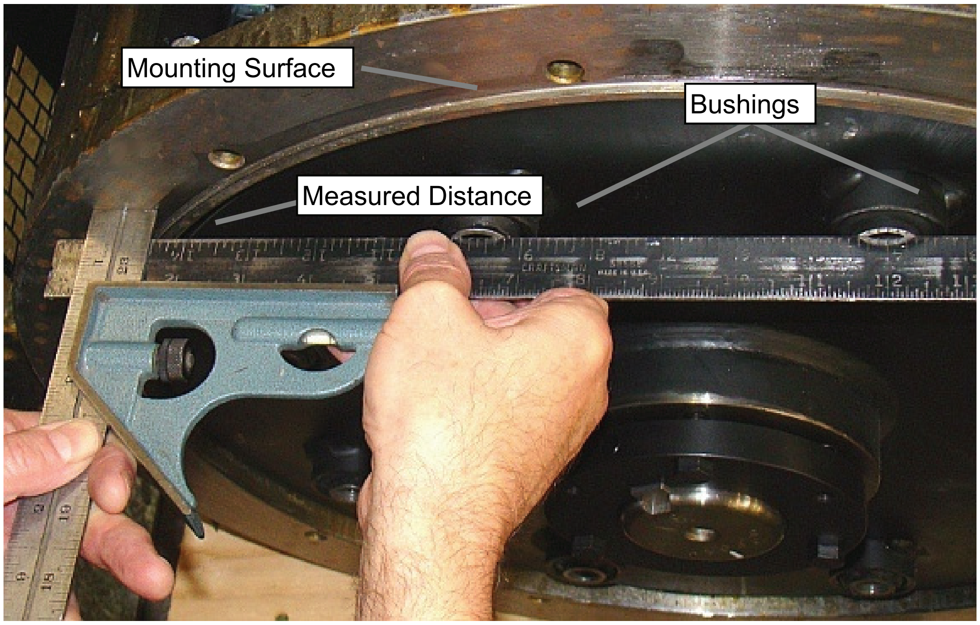


Figure 22: Generator Measurement

11. Slide the coupling assembly on the shaft until this dimension is 1/16-inch (1.6 mm) **LESS** than the dimension recorded for the engine above. The flexible coupling will be pulled forward 1/16-inch (1.6 mm) when the 3/8-16 bolts are completely tightened.
12. Tighten the 3/8-16 bolts alternately and evenly as follows:
    f) Block the coupling against clockwise rotation with a bar.
    g) Set a torque wrench to **30 foot-pounds (41 N-m)** and tighten all three bolts to that value.
    h) Repeat step b) until the bolts can no longer be tightened.
13. Recheck the generator measurement (shown in the figure above) to make sure that it now matches the engine measurement that was recorded earlier.
14. Remove the wood block used to hold the rotor in the forward position.

f) Engine and Generator Reassembly

Hardware summary for engine and generator reassembly:

Location	Torque	Hardware	Qty.	Hobart Part No.
Generator to Bell Housing	50 ft-lbs (68 N-m)	Screw, 7/16-14 x 1-1/2, Grade 5, HHCS	12	W11099-005
		Washer, 7/16, Lock	12	W11254-007
Generator to Adapter Ring	100 ft-lbs (136 N-m)	Screw, M16-2.0 X 65 mm Lg., HHCS	8	288484-001
		Washer, M16, Lock	8	281930-011
Generator Shock Mount	90 ft-lbs (122 N-m)	Washer, Shock Mount	4	480628
		Screw, 5/8-11 x 4.50” Lg., HHCS	4	W11102-008
		Nut, 5/8-11, Hex	4	W11280-012
		Washer, 5/8, Lock	4	W11254-010
		Washer, 5/8, Flat, 1.31 O.D.	4	W11242-027
Generator Cover	N/A	Screw, ¼ -20 x .50” Lg., HHC-TF	6	W11236-004
Generator Lead Cover	N/A	Cloth wrap over generator leads	2	291180

Installation of the generator assembly is essentially a reversal of the procedure used to remove the generator: re-mounting of the generator to the engine and frame, and the remounting of the assemblies that were removed to gain access to the generator.

1. Support engine at flywheel housing with wooden blocks or with a second hoist if available.
2. Using the hoist, support the generator assembly and lower it carefully and slowly into position for attachment to the engine.
3. Insert the generator-to-bell-housing bolts through the generator flange, engaging the tapped holes in the flywheel housing. Tighten these to **50 ft-lbs (68 N-m)**.
4. Use a bar to block the rotation of the generator and insert the coupling bolts (generator-to-adapter-ring bolts) with lock washers through the bushings from the fan side of the coupling. Tighten the coupling bolts to **100 ft-lbs (136 N-m)**.
5. Reinstall the four 5/8 - 11 x 4-1/2 bolts, shock mount washers, lock washers, and nuts that mount the generator assembly to the frame of the generator set. Tighten these to **90 ft-lbs (122 N-m)**.
6. Install the generator cover on the generator assembly, using the six 1/4 - 20 x 1/2 screws.

g) Run-in and Periodic Check

1. Move the generator set to a suitable test area and operate it for a 2-hour run-in with a half-power load (approximately 90 kVA).
2. Shut down the engine after 2 hours and re-torque all coupling bolts to **100 ft-lbs (136 N-m)** to compensate for normal torque relaxation.
3. Return the unit to normal service.
4. After 200 hours of operation, check all coupling bolts with a torque wrench set at **100 ft-lbs (136 N-m)**.
5. Return the unit to normal service.
6. After each additional 2,000 hours of operation (or every year), recheck all coupling bolts to maintain the same torque value.

Chapter 4: Illustrated Parts List

Section 1: Introduction

The illustrated parts list identifies, describes, and illustrates main assemblies, subassemblies, and detail parts of the 500181A series generator set manufactured by Hobart Ground Power Division, Troy, Ohio, USA.

The purpose of this list is to provide parts identification and descriptive information to service and maintenance personnel for procuring spare parts.

This illustrated parts list chapter contains the following sections:

- Section 1 – Introduction (this section): Information about the parts lists located in Section 3 of this chapter
- Section 2 – Numerical Index: A list of all parts, in order by part number, with references to the figures in Section 3 in which they appear
- Section 3 – Parts List: Diagrams on the left-hand pages that show the location of parts and charts on the opposite (right-hand) pages that list the part number, description, and other information, as explained below

1) Which Parts Are Included

The parts lists include the parts that are considered field-replaceable units (FRUs). These parts lists do not include the following items:

- Standard hardware items such as nuts, screws, washers, and other fasteners that are available commercially
- Bulk items such as wire, cable, sleeving, tubing, etc., which are commercially available
- Permanently attached parts, which lose their identity by being welded, soldered, riveted, etc., to other parts, weldments, or assemblies

2) Explanation of the Parts List Columns

The chart below shows an example of the parts list forms. The form has six standard columns.

FIGURE -	ITEM NO.	HOBART PART NO.	DESCRIPTION	EFF	QTY.
9 -	1		12 VDC Battery Components (See Figure 14)		Ref.
	2	288910	Support, Battery Tray		1
*		289239	…Pad, Battery Tray		1
	3	285102-001	Current, Transformer		1
*	4	290145	Sensor, Coolant Level		1
	5	288914	Board, PC, T-R	C,D,J,K	1
*	6	7J422-000	Clamp, Cable	A,B,F,G,H,M	4

Sample Parts List

The **figure number**, shown in the first column on the left, shows the number of the illustration that identifies the parts. An asterisk (*) in this column indicates that the item is not shown on the diagram.

The **item number** column shows the number of the part called out in the diagram. Parts that are subassemblies of numbered parts are generally not identified on the diagram and not given an item number. The numerical index (Chapter 4, Section 2) combines the figure and item numbers to assist the user in finding the illustration of a part when the part number is known. For example, "1-3" refers to the part for Figure 1, Item 3.

All part numbers appearing in the **Hobart Part No.** column are Hobart part numbers. Hobart part numbers are generally either six digits or six digits with three dash numbers. Items that do not have part numbers are reference assemblies rather than physical parts.

The **Description** column contains the identifying names for the parts. An indentation of the part name (starting with three dots …) indicates that the part is component of the non-indented assembly listed above it.

The **Eff** (effective) 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, some parts 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. If the part has no letter code in the EFF column, that part is used on all models.

EFF Code	Part & Dash Number	Mounting	Generator Meters	AC Outputs	28.5 V DC Output	Fuel Tank
A	500181A-001	Trailer	Analog	2	--	Stainless
B	500181A-002	Fixed/Truck	Analog	2	--	Stainless
C	500181A-003	Trailer	Digital	2	Yes	Stainless
D	500181A-004	Fixed/Truck	Analog	2	Yes	Stainless
E	500181A-005 (Special Configuration)	Trailer	Digital	2	--	Stainless
F	500181A-006 (Special Configuration)	Trailer	Analog	2	--	Stainless
G	500181A-101	Trailer	Analog	2	--	Composite
H	500181A-102	Fixed/Truck	Analog	2	--	Composite
J	500181A-103	Trailer	Analog	2	Yes	Composite
K	500181A-104	Fixed/Truck	Analog	2	Yes	Composite
L	500181A-105 (Special Configuration)	Trailer	Digital	2	--	Composite
M	500181A-106 (Special Configuration)	Trailer	Analog	2	--	Composite
N	500181A-107 (Special Configuration)	Trailer	Digital	2	--	Composite

The **Qty.** 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. "Ref." in this column indicates that the item is a reference assembly and not a single replaceable part.

Section 2: Numerical Index

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

FIGURE – ITEM NO.	HOBART PART NO.
9-	040201
10-8	050988
11-	056534
6-	056535
11-	056535
1-24	100GH121
13-4	12CW2077-003
19-3	180696-003
7-7	181358
21-	201673-004
20-15	280022
16-11	280732-006
16-6	280732-007
1-	280763
15-1	281881-004
20-	281971-002
10-11	282089-011
10-4	282130-001
20-9	282130-001
3-7	282562
13-14	282562
2-13	282658
1-2	282667
1-	282727
16-10	282918
16-9	282919
10-2	283154-001
18-4	283154-001
7-11	283167
5-6	283597
4-7	283647
2-8	283714-003
5-5	283824
11-11	283873
8-11	283978-001
8-10	283978-002
1-23	284359
9-7	284475-001
16-7	284925
9-3	285029-001
9-25	285030-001
9-13	285030-002
9-19	285030-003
9-16	285030-004
9-22	285030-005
9-4	285031-001
9-5	285032-001
9-6	285033
9-9	285034-001
10-13	285102-001
1-7	285125
7-	285172
7-15	285172
10-5	286266
20-8	286266
20-12	286266
20-4	286603
20-2	286604
7-8	286699-001
21-1	286810-001
21-3	286849
17-1	286850
13-9	286897-031
13-1	286897-033
13-2	286897-034
6-	286897-035
1-1	286956
1-	286956-001
9-26	287038-001
18-3	287144-002
18-2	287145-002
1-15	287376

FIGURE – ITEM NO.	HOBART PART NO.	FIGURE – ITEM NO.	HOBART PART NO.
1-17	287377	1-20	287892
17-	287419	7-6	287908
6-	287438	17-5	287909
2-10	287459	10-7	288078-001
2-18	287460	20-14	288092
2-19	287460	20-10	288095-001
2-20	287461	21-5	288099
2-21	287462	20-13	288117
2-16	287463	11-	288123-001
2-22	287464	20-7	288147
2-9	287465	2-6	288300
2-5	287466	18-5	288331
2-23	287467	18-1	288333
1-14	287491	20-3	288404
3-15	287506	19-4	288440
5-4	287526-002	19-7	288447-002
5-3	287542-001	19-12	288457
5-3	287542-002	19-13	288458
2-11	287696	6-9	288460-002
4-1	287701	19-8	288461
5-1	287701	19-	288480
4-10	287703	19-9	288481
5-	287738-001	19-1	288486
3-	287738-003	19-15	288491
4-	287738-004	19-2	288494
4-	287738-012	8-	288605
4-	287738-013	3-17	288693
4-	287738-014	6-18	288693
3-	287738-015	1-	288694
3-	287738-025	1-	288695
4-	287738-027	1-19	288696
5-	287738-028	1-21	288697
3-	287738-029	1-	288698
3-	287738-030	12-1	288723
3-	287738-031	8-4	288745
3-	287738-032	9-29	288771
4-	287785	9-28	288772
4-	287793	9-27	288773
4-	287794	8-	288791
15-9	287796	7-13	288806
4-9	287800	8-	288813

FIGURE – ITEM NO.	HOBART PART NO.	FIGURE – ITEM NO.	HOBART PART NO.
7-14	288814-001	20-1	289007
8-8	288818-001	20-	289008-001
7-	288820	20-16	289010
10-9	288829	6-2	289012-002
10-10	288832	6-	289012-004
7-3	288836-001	9-	289014
7-4	288836-002	9-2	289015
7-14	288858-001	7-2	289017
7-11	288858-002	6-1	289019-014
7-12	288858-003	6-	289019-015
7-16	288858-004	6-	289019-016
2-14	288862	6-	289019-017
2-15	288866	8-7	289026
2-24	288872	8-9	289059
8-	288875	8-	289060
8-	288876	8-13	289072
4-11	288878	8-12	289073
3-1	288879	2-26	289127
4-2	288880	15-4	289149
5-2	288880	15-2	289151
5-7	288881	15-3	289153
10-12	288892-001	13-12	289188
10-15	288892-013	11-	289200-002
6-21	288895	3-5	289223-001
8-	288896	15-6	289223-001
3-6	288910	3-4	289224
15-7	288910	15-5	289224
8-14	288914	19-14	289226
2-4	288917-002	19-5	289229
2-25	288918-002	3-	289239
8-5	288937	15-8	289239
8-6	288940B	3-13	289479
17-	288973-001	3-9	289577
8-3	288992	6-	289593-001
8-2	288993	9-11	289601-001
8-1	288994	9-23	289601-003
7-1	288995	9-24	289601-003
7-5	288999-001	9-12	289601-004
9-1	289004	9-14	289601-005
21-2	289005	9-15	289601-005
20-11	289006	9-17	289601-006

FIGURE – ITEM NO.	HOBART PART NO.	FIGURE – ITEM NO.	HOBART PART NO.
9-18	289601-006	11-12	290625
9-20	289601-007	11-14	290626
9-21	289601-007	11-15	290627
1-11	289606	11-17	290628
1-18	289607	16-13	290633
1-10	289663	4-12	290634
2-12	289678	13-	290640
3-12	289690	16-14	290647-001
3-11	289693	16-16	290648-001
2-1	289842-001	16-2	290649
6-15	290067	16-4	290652-001
9-10	290080	16-15	290652-001
3-10	290081	16-3	290655-001
7-19	290090	14-1	290657
7-	290093	14-5	290665
7-	290095	17-	290676
11-3	290145	13-	290680
7-	290179	13-3	290692
2-27	290216	13-7	290693
11-1	290223	13-8	290694
10-14	290227	2-28	290695
13-	290267	17-9	290696
11-2	290365	17-7	290697
6-	290404	17-8	290704
1-	290466	14-2	290708
1-	290467	17-10	290715
1-	290468	16-1	290717
1-	290474	14-3	290724
1-	290475	6-	290726
6-	290556	6-	290727
6-	290557	4-	290729
6-	290577	4-	290730-001
4-4	290591	4-	290730-002
3-14	290593	4-	290730-003
3-2	290596	4-	290730-004
6-19	290596	4-	290730-005
11-	290597-002	5-	290730-006
11-	290597-003	11-4	290731
11-	290597-006	3-3	290733
11-13	290598	6-20	290733
11-16	290599	11-5	290745

FIGURE – ITEM NO.	HOBART PART NO.
13-	290746
13-	290747
13-	290748
13-15	290750
1-	290751
1-	290753
14-	290754
16-5	290755
13-13	290757
13-11	290758
11-9	290761
16-8	290762
11-8	290764
4-6	290768
4-5	290769
4-14	290770
4-15	290771
13-10	290772
4-13	290773
11-7	290776
14-4	290777
16-12	290778
1-	290779
13-15	290780
4-	290781
13-	290782
4-8	290785
16-	290828
16-	290829
15-12	290832
3-18	290835
6-	290835
2-29	290836
2-30	290837
2-32	290838
2-33	290842
6-14	290850
12-2	290850
18-6	290850
2-34	290858
13-	290861
17-6	290864
17-11	290865
2-17	290885
3-16	291175
6-17	291175
19-16	291180
14-6	291257
2-3	291609
15-11	291611
4-3	291617
10-1	291625
6-3	291626-002
10-	291626-002
6-13	291630
12-3	291630
1-16	291678
5-8	291679
5-	291681
5-	291682
5-	291683
5-	291684
20-17	400435
9-8	400613-004
7-18	400641-015
7-17	400642-008
13-5	400819-003
10-6	401911-010
2-7	402987
4-	403091-008
4-	403127
17-4	403782-002
17-2	403809-001
20-6	404044-004
14-	404154-018
12-6	405548
2-35	408665-001
2-2	408665-002
1-	408781-001
19-	480290
3-	480603-001
6-	480603-001

FIGURE – ITEM NO.	HOBART PART NO.
13-	486719-014
18-7	489658-007
7-9	494134-001
15-10	494295
10-3	76A1131
12-	76A1131
12-	76A1132
13-	76A1132
2-31	76B1148
20-	77A1107
20-	77A1108
20-	77A1109
1-8	77A1157
7-10	78A1117-002
17-3	78B1118-002
1-22	7J422-000
2-36	82A1070
19-10	85B1039
19-11	85C1004-001
21-4	A25
11-	W10051-007
19-6	W10072-068
17-	W10750-001
13-6	W10760-003
11-	W10869-005
6-	W10869-014
17-	W10910-000
20-5	W10931-003
21-	W11097-002
21-	W11097-008
8-	W11166-002
8-	W11166-009
21-	W11242-010
21-	W11254-006
17-	W7814-004
7-12	W8105A-009
12-4	W9360-289
12-5	W9407-446

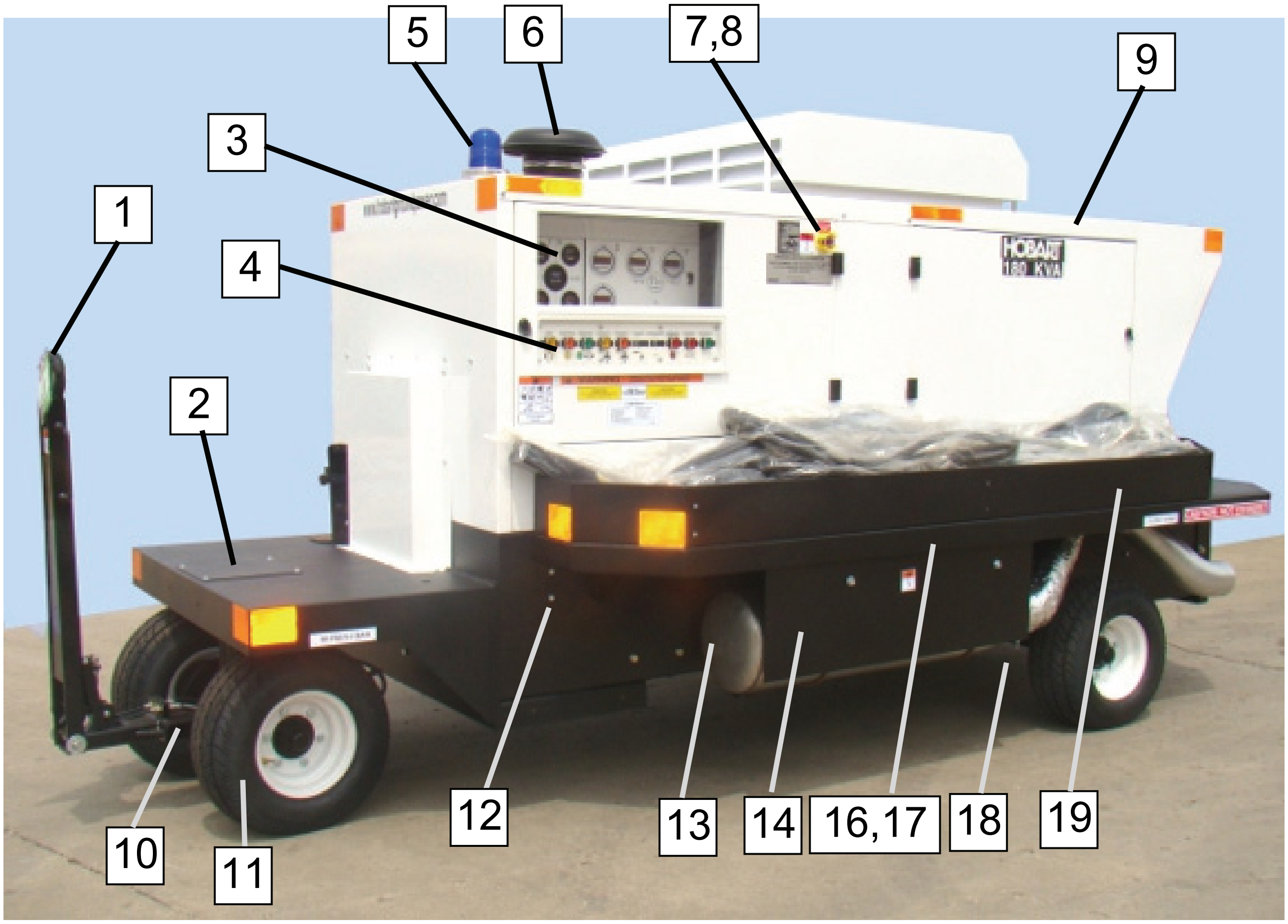
Section 3: Illustrated Parts List

This section contains the following illustrations:

Figure 1: General Assembly ... 2
Figure 2: Labels and Reflectors ... 4
Figure 3: Frame Assembly ... 6
Figure 4: Canopy Assembly ... 8
Figure 5: Canopy Doors ... 10
Figure 6: Internal Components ... 12
Figure 7: Control Box Door Panel Assembly ... 14
Figure 8: Control Box Interior Components ... 16
Figure 9: Pushbutton Switches ... 18
Figure 10: 400 Hz. Power Module Assembly ... 20
Figure 11: Cooling System Components ... 22
Figure 12: Engine Ground Plate and Cables ... 24
Figure 13: Fuel System Components ... 26
Figure 14: Engine Exhaust Components ... 28
Figure 15: 12 VDC Battery System ... 30
Figure 16: Air Cleaner & Intake Air Components ... 32
Figure 17: Engine Components ... 34
Figure 18: Engine Electronic Panel Components ... 36
Figure 19: Generator Assembly ... 38
Figure 20: Transformer-Rectifier Assembly (DC Option) ... 40
Figure 21: DC Output Contactor (DC Option) ... 42

Parts having an asterisk (*) in the first column of the parts list are not shown in the illustration.

For more information about this section, refer to Section 4-1. For information about abbreviations used in this manual, refer to the Introduction.



Fixed Mount Bracket

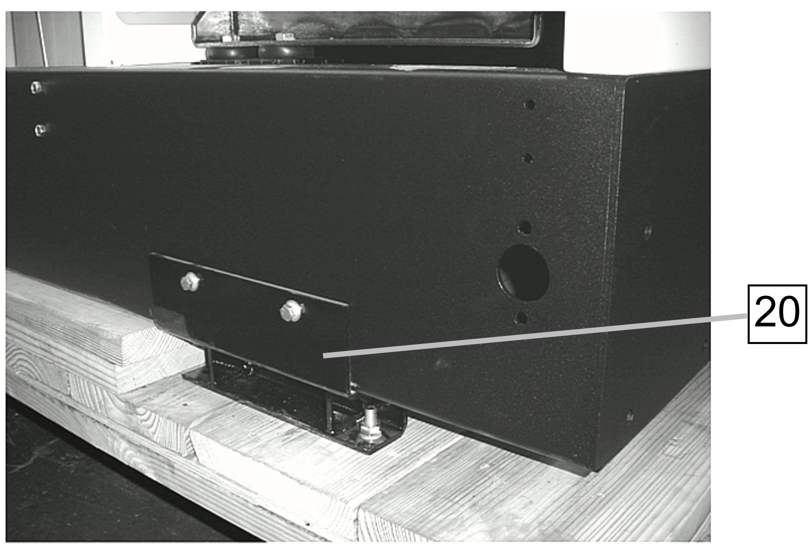


Figure 1: General Assembly

FIGURE – ITEM NO.		HOBART PART NO.	DESCRIPTION	EFF	QTY.
1-	1	286956	Draw Bar	A,C,E,G,J,L,N	1
		286956-001	Draw Bar (Tow Bar Interlock)	F,M	1
	2	282667	Bracket, 5th Wheel Assembly	A,C,E,F,G,J,L,M,N	1
*		282727	…Plate, Cover, Pivot Arm	A,C,E,F,G,J,L,M,N	1
*		280763	…Plate, Bearing	A,C,E,F,G,J,L,M,N	1
*		408781-001	…Pin, Spring	A,C,E,F,G,J,L,M,N	2
	3		Control Box Door (See Figure 7)		Ref.
	4		Pushbutton Switches (See Figure 9)		Ref.
	5		Low Fuel Beacon (optional)		Ref.
	6		Weather Hood (See Figure 16)		
	7	285125	Guard, Mushroom Button	A,B,C,D,E,G,H,J,K,L,N	1
		290779	Guard, Mushroom Button	F,M	1
	8	77A1157	Switch, Maintained, Push-Pull	A,B,C,D,E,G,H,J,K,L,N	1
		290468	Switch, Maintained, Push-Pull (Lockable)	F,M	1
		290466	…Block, Contact, E-Stop	F,M	1
		290467	…Base, Mounting, E-Stop	F,M	1
		290474	…Washer, Spacer, E-Stop, Front	F,M	1
		290475	…Washer, Spacer, E-Stop, Back	F,M	1
	9		Canopy Assembly (See Figure 4)		Ref.
	10	289663	Front, Axle	A,C,F,G,J,M,N	1
		290751	Axle, No Brakes, Heavy Duty, Front	E,L	1
	11	289606	Tire, 20.5 x 8.00 – 10, Assembly	A,C,E,F,G,J,L,M,N	4
	12		Frame Assembly (See Figure 3)		Ref.
	13		Exhaust Components (See Figure 14)		Ref.
	14	287491	Shield, Heat, Tray, Cable	A,C,E,F,G,J,L,M,N	1
*	15	287376	Bumper, Side (right)	A,C,E,F,G,J,L,M,N	1
	16	291678	Bumper Assembly with Exhaust Guard	A,C,E,F,G,J,L,M,N	1
*	17	287377	Support, Fender	A,C,E,F,G,J,L,M,N	4
	18	289607	Rear, Axle	A,C,F,G,J,M,N	1
		290753	Axle, With Brakes, Heavy Duty, Rear, Assembly	E,L	1
	19	288696	Tray, Cable, Left	A,C,E,F,G,J,L,M,N	1
*		288694	…Panel, Cable Guide	C,J	1
*		288695	…Cover, Cable	C,J	1
	20	287892	Mount, Stationary	B,D,H,K	4
*	21	288697	Tray, Cable, Right	A,C,E,F,G,J,L,M,N	1
*		288698	…Cover, DC Cable	A,E,F,G,L,M,N	1
*		288694	…Panel, Cable Guide	A,C,E,F,G,J,L,M,N	1
*		288695	…Cover, Cable	A,C,E,F,G,J,L,M,N	1
*	22	7J422-000	Clamp, Cable (under cable tray)	A,B,F,G,H,M,N	4
*			Clamp, Cable (when DC is supplied)	C,D,J,K	5
*	23	284359	Clamp, Strain Relief	E,L	2
*	24	100GH121	Cable Clamp Mounting Bracket	A,B,F,G,H,M,N	2
*			Cable Clamp Mounting Bracket	C,D,J,K	3

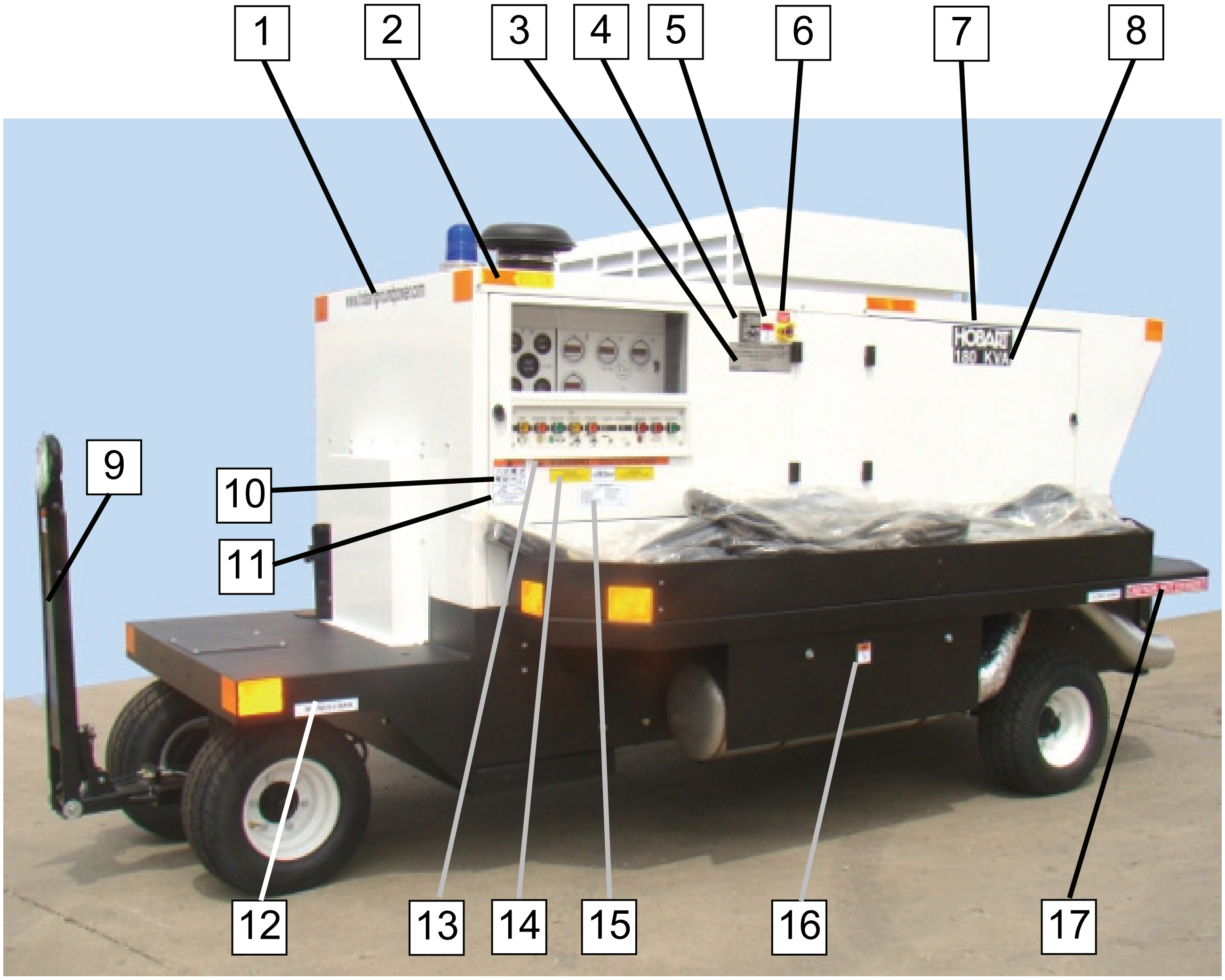


Figure 2: Labels and Reflectors

FIGURE – ITEM NO.		HOBART PART NO.	DESCRIPTION	EFF	QTY.
2-	1	289842-001	Label, www.hobartgroundpower.com	A,B,C,D,F,G,H,J,K,M,N	1
	2	408665-002	Reflector, Amber		32
	3	291609	Label, Tier 4 TPEM		1
	4	288917-002	Label, I.D.		1
	5	287466	Label, Emergency Stop		1
	6	288300	Label, Legend, Emergency Stop		1
	7	402987	Label, Hobart		3
	8	283714-003	Label, kVA Rating		2
*	9	287465	Label, Warning Drawbar	A,C,E,F,G,J,L,M,N	2
	10	287459	Label, General Warnings		1
	11	287696	Label, Hearing Protection		1
	12	289678	Label, Tire Pressure	A,C,E,F,G,J,L,M,N	4
	13	282658	Label, Warning Clearance		1
	14	288862	Label, Caution, Engine Speed		1
	15	288866	Label, Support Center		1
	16	287463	Label, Hot Muffler		2
	17	290885	Label, Caution: Hot Exhaust		1
*	18	287460	Label, High Voltage	A,B,E,F,G,H,L,M,N	1
*	19	287460	Label, High Voltage	C,D,J,K	2
*	20	287461	Label, Fuel		1
*	21	287462	Label, Radiator		1
*	22	287464	Label, Moving Parts		2
*	23	287467	Label, Glow Plug		2
*	24	288872	Label, Command & Fault		1
*	25	288918-002	Label, Options (Inside Control Box)		1
*	26	289127	Label, Option Terminal Block		1
*	27	290216	Label, Low Emission		1
*	28	290695	Label, Oil Replenishment System	F,M	1
*	29	290836	Label, Radiator Fill Rate		1
*	30	290837	Label, Cables Supplied	E,L	1
*	31	76B1148	Label, Diesel Fuel	A,B,C,D,E,G,H,J,K,L,N	1
*	32	290838	Label, Diesel Fuel Only	F,M	1
*	33	290842	Label, Open-Closed, Ball Valve		1
*	34	290858	Label, Radiator Fill Instructions		1
*	35	408665-001	Reflector, Red *(on back)*		20
*	36	82A1070	Nameplate, ID		1

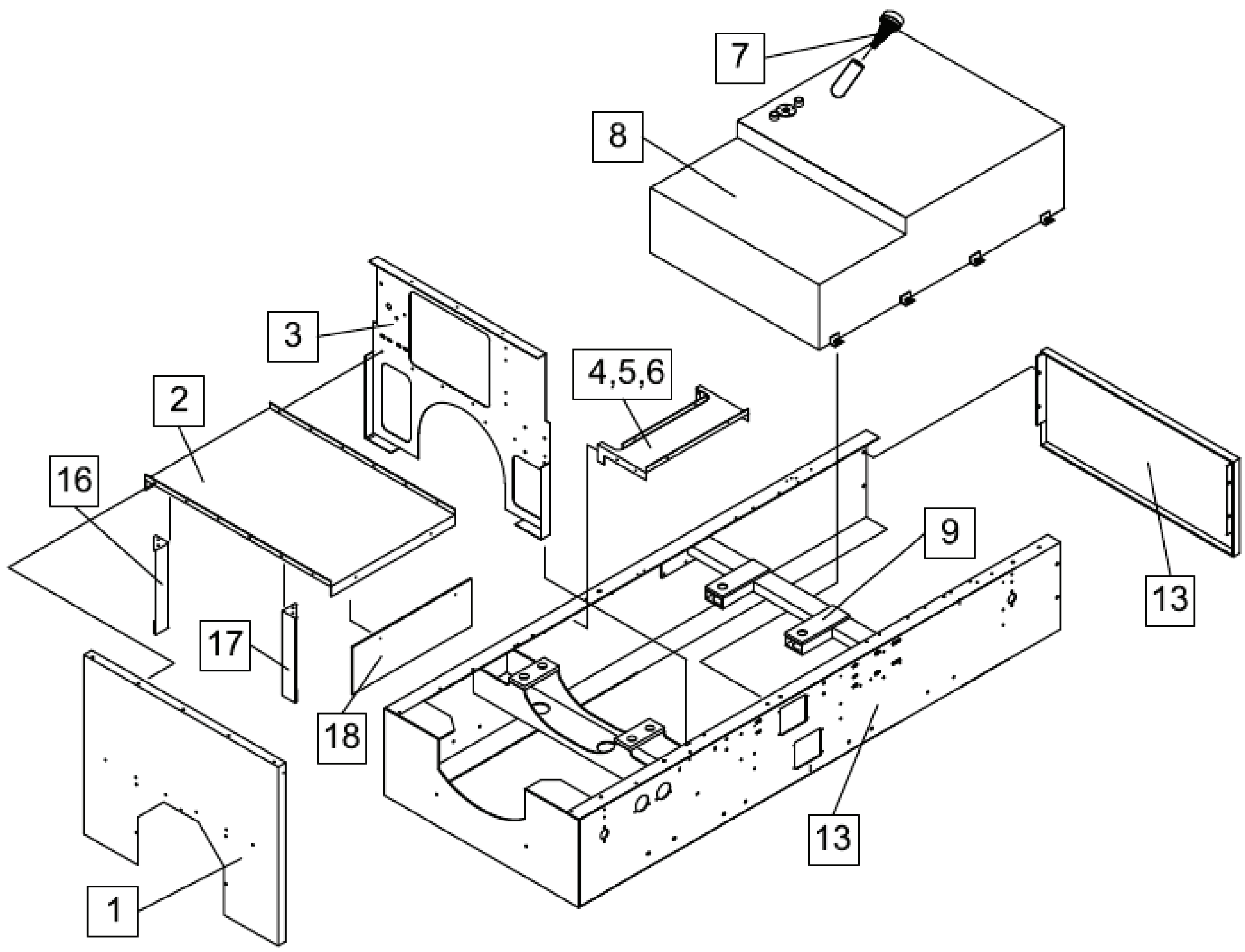


Figure 3: Frame Assembly

FIGURE – ITEM NO.		HOBART PART NO.	DESCRIPTION	EFF	QTY.
3 -	1	288879	Panel, Front Canopy		1
*		287738-025	…Insulation, Top		1
*		287738-029	…Insulation, Left Center		1
*		287738-030	…Insulation, Left		1
*		287738-031	…Insulation, Right Center		1
*		287738-032	…Insulation, Right		1
	2	290596	Support, Control Box		1
	3	290733	Panel, Bulkhead, Center		1
	4	289224	Tray, Battery		1
	5	289223-001	Battery Tray, Bracket, Right		1
	6	288910	Support, Battery Tray		1
*		289239	…Pad, Battery Tray		1
	7	282562	Cap, Fuel		1
	8		Tank, Fuel (see Figure 13)		Ref.
	9	289577	Support, Engine, Front		1
*		480603-001	…Mount, Shock, Engine		2
*	10	290081	Panel, Bottom, Belly Pan		1
*		287738-003	…Insulation, Bottom, Panel		1
*		287738-015	…Insulation, Noise, Bottom, Generator		2
*	11	289693	Cover, Bottom, Baffle		1
*	12	289690	Baffle, Bottom, Belly Pan		1
	13	289479	Frame, Mounting		1
*	14	290593	Frame, Mounting, Plate		1
*	15	287506	Cover, Frame, Exhaust		2
	16	291175	Leg, Control Box Support, Left		1
	17	288693	Leg, Control Box Support, Right		1
	18	290835	Cover, Power Module		1

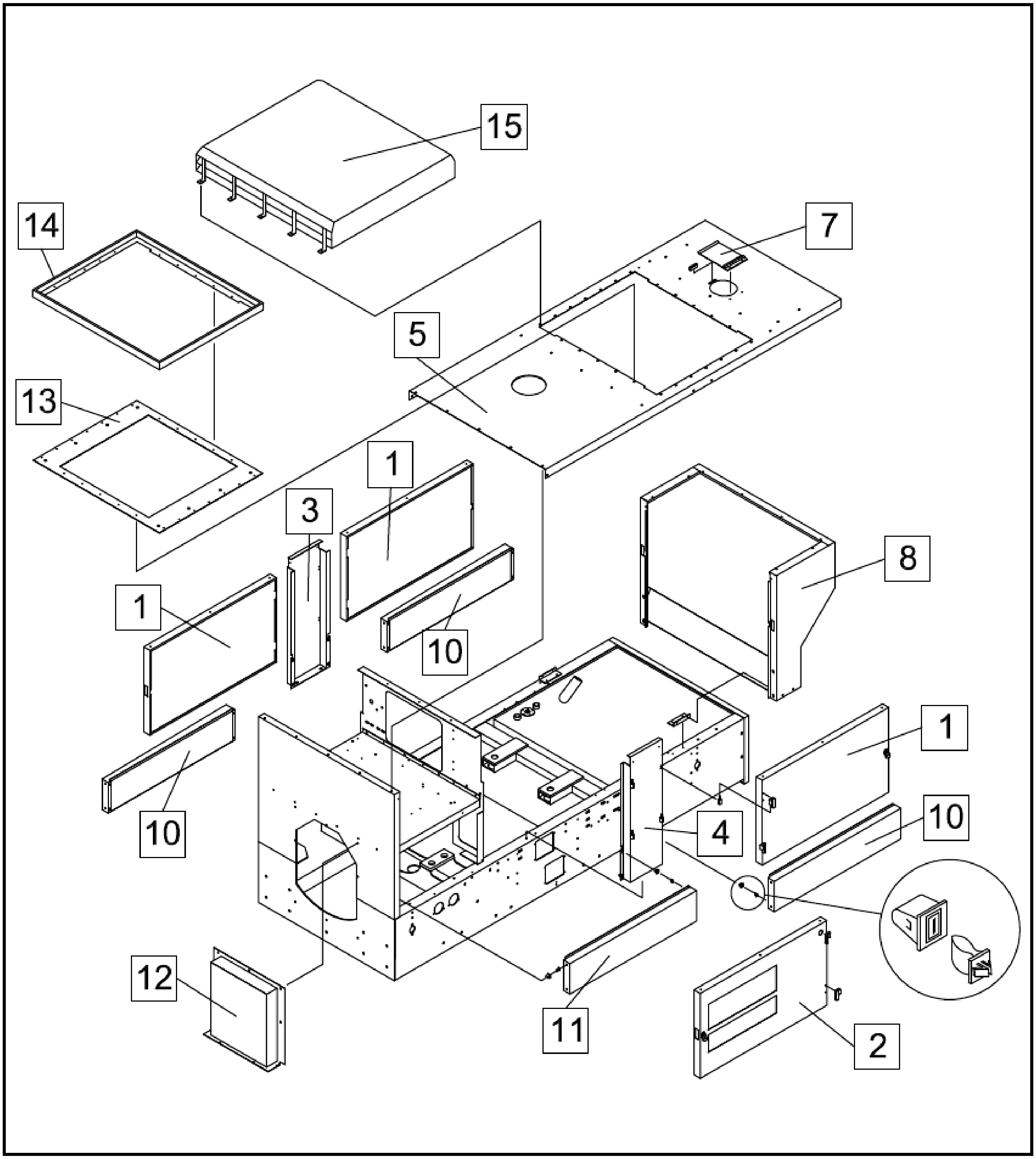


Figure 4: Canopy Assembly

FIGURE – ITEM NO.		HOBART PART NO.	DESCRIPTION	EFF	QTY.
4 -	1	287701	Door, Assembly (see Figure 5)		3
	2	288880	Door, Control Box (see Figure 5)		1
	3	291617	Panel, Support, Door, MD		1
*		290730-001	…Insulation, Noise, Support, Door		1
	4	290591	Panel, Support, Door		1
*		290730-002	…Insulation, Noise, Support, Door		1
*		290730-003	…Insulation, Heat Shield, Support, Door		1
	5	290769	Top, Canopy Assembly		1
*		290730-004	…Insulation, Noise, Canopy Top, Front		1
*		290730-005	…Insulation, Noise, Canopy Top, Rear		1
*	6	290768	Frame, Mount, CAC		1
	7	283647	Door, Radiator Access		1
		403127	…Catch, Magnetic		1
	8	290785	Kit, Plenum, Reduction, Noise		Ref.
		290729	Plenum, Reduction, Noise		1
*		287738-012	…Insulation, Noise, Plenum, Rear		1
*		287738-013	…Insulation, Noise, Plenum, Left		1
*		287738-014	…Insulation, Noise, Plenum, Right		1
*		287793	…Bracket, Mounting Plenum		2
*		287794	…Door, Access, Fuel, Cap		1
*		403127	…Catch, Magnetic		1
*	9	287800	Screen, Plenum		1
	10	287703	Panel, Side, RR, RF & LR		3
*		287738-004	…Insulation, Noise, Lower Panel (RR, RF & LR)		3
*		287785	…Fastener, Panel, Access		12
	11	288878	Panel, Side, Left Front		1
*		287738-027	…Insulation, Noise Lower Panel (LF)		1
*		403091-008	…Plug, Hole, Plastic, 1.75		1
*		287785	…Fastener, Panel, Access		4
	12	290634	Cover, Opening, Front Canopy	A,C,E,F,G,J,L,M,N	1
*		290781	Cover, Opening, Front Canopy	B,D,H,K	1
	13	290773	Mat, Rubber, Hood		1
	14	290770	Hood, Bottom		1
	15	290771	Hood, Top		1

A,C,E,F,G,J,L,M,N are trailer-mount
B,D,H,K are fixed/truck-mount

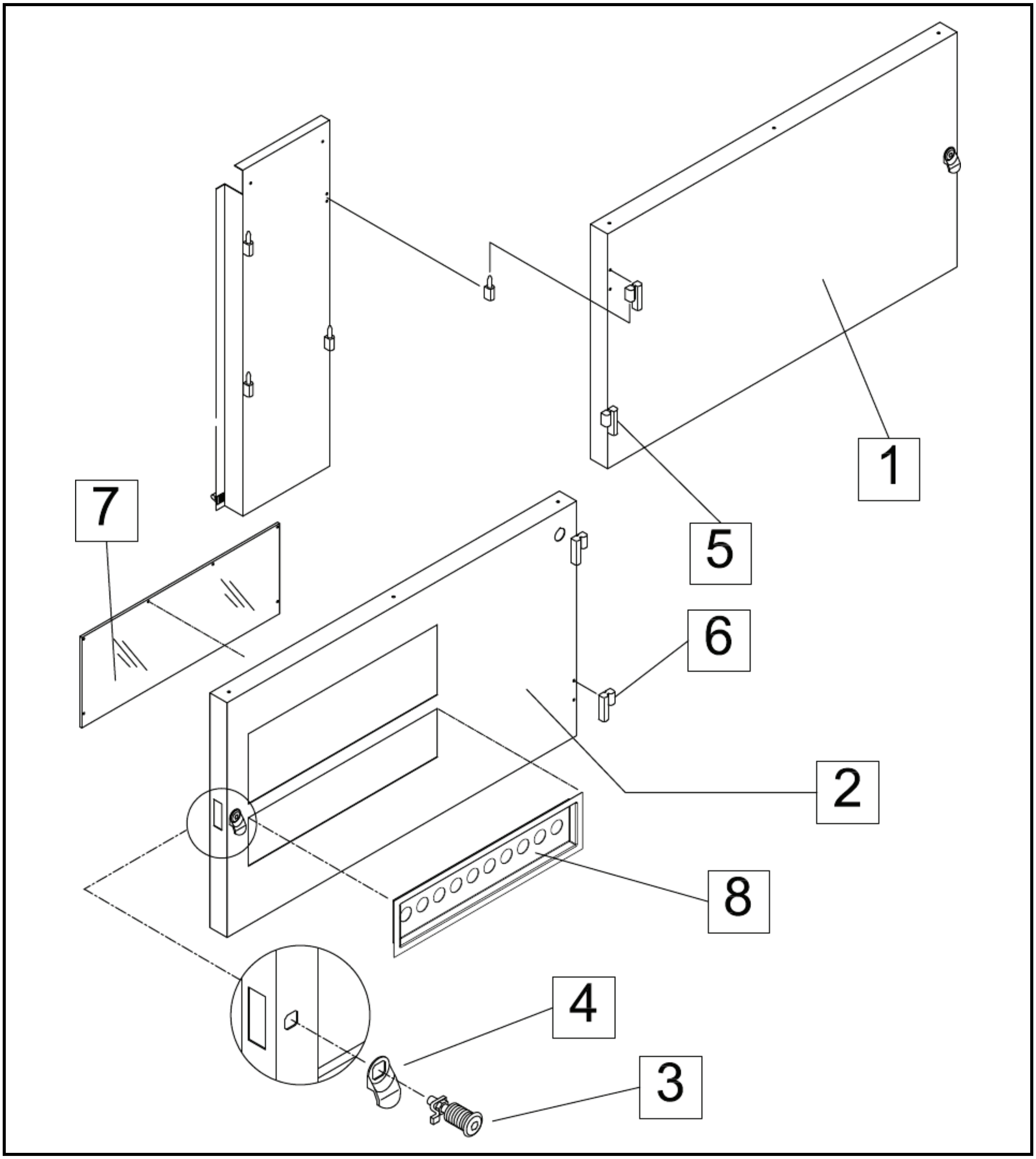
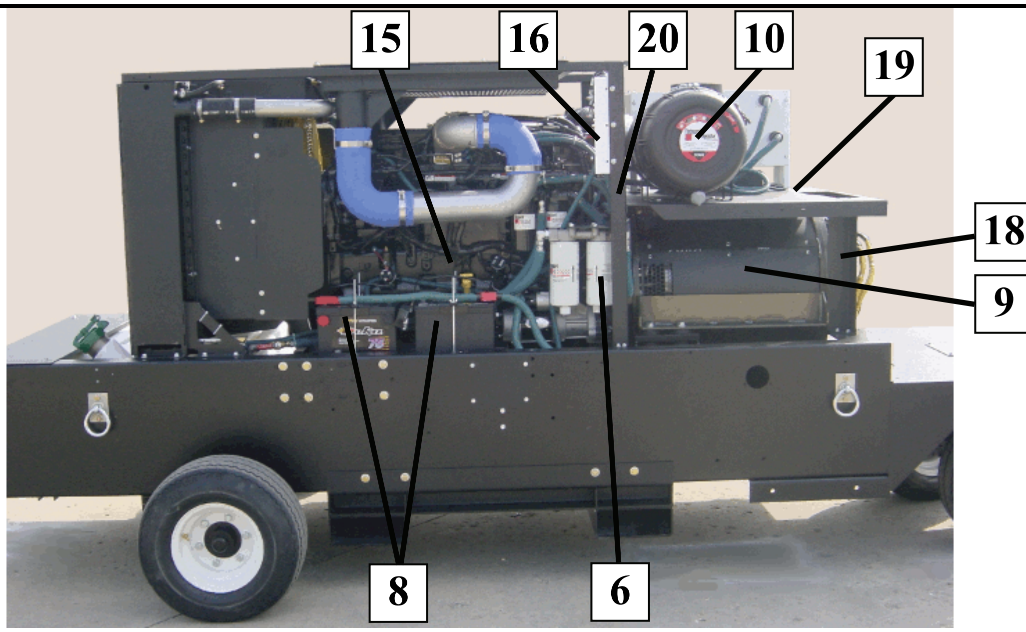
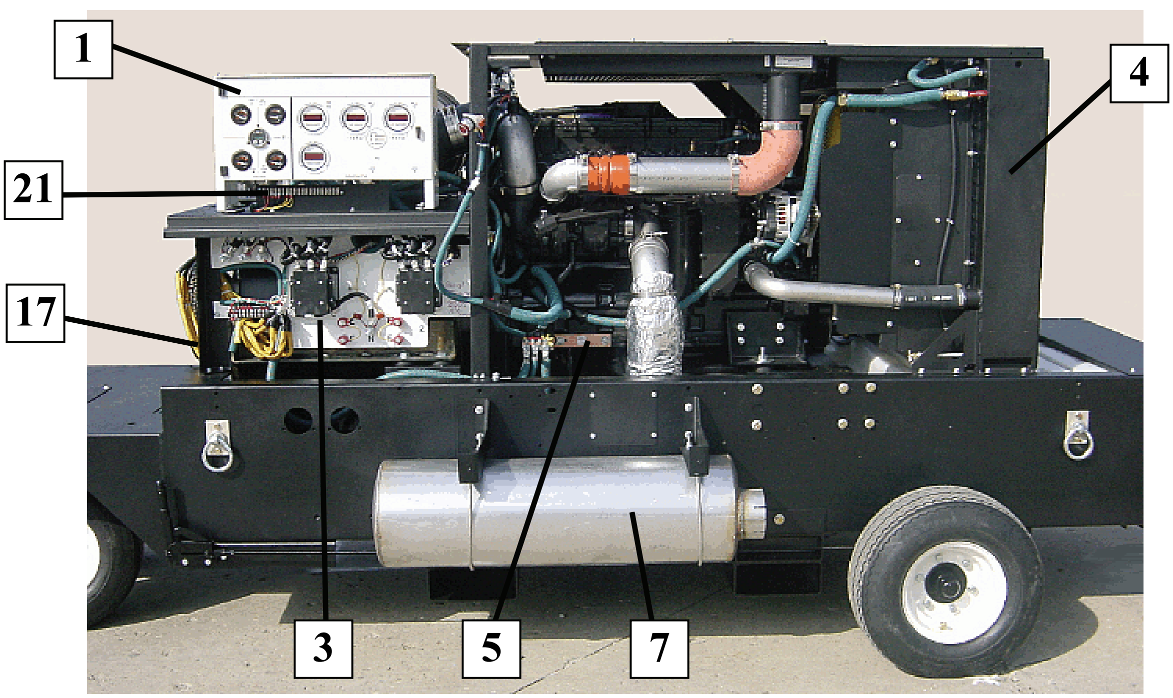


Figure 5: Canopy Doors

FIGURE – ITEM NO.		HOBART PART NO.	DESCRIPTION	EFF	QTY.
5 -	1	287701	Door, Assembly		3
*		287738-001	…Insulation, Noise, Door (RR and LR)		2
*		290730-006	…Insulation, Noise, Door, Right		1
	2	288880	Door, Control Box		1
*		287738-028	…Insulation, Noise, Door		1
	3	287542-001	Latch, Door	All except E,L	4
	3	287542-002	Latch, Door, T-Handle, Lockable	E,L	4
	4	287526-002	Tab, Pull, Door Latch	All except E,L	4
	5	283824	Hinge, RH Access Door		4
	6	283597	Hinge, LH Access Door		4
	7	288881	Window, Control Side Door		1
	8	291679	Guard, Button		1
*		291681	…Channel, Bottom, Button Guard		1
*		291682	…Channel, Left, Button Guard		1
*		291683	…Channel, Right, Button Guard		1
*		291684	…Shim, Button Guard		1



Right Side



Left Side

Figure 6: Internal Components

FIGURE – ITEM NO.		HOBART PART NO.	DESCRIPTION	EFF	QTY.
6 -			**Left Side**		
	1	289019-014	Control Box Assembly [No T-R] (See Figures 7 & 8)	A,B,F,G,H ,M	Ref.
		289019-015	Control Box Assembly [With T-R] (See Figures 7 & 8)	C,D,J,K	Ref.
		289019-016	Control Box Assembly [Digital generator meters)	N	Ref.
		289019-017	Control Box Assembly [Special] (See Figures 7 & 8)	E,L	Ref.
*		289593-001	…Mount, Rubber		4
*	2	289012-002	Control Switch Panel Assembly [2 Outputs & No T-R] (See Figure 9)	A,B,E,F,G ,H,L,M,N	1
*		289012-004	Control Switch Panel Assembly [2 Outputs & T-R] (See Figure 9)	C,D,J,K	1
	3	291626-002	400 Hz. Power Module Components (See Figure 10)		1
*		290835	…Cover, Power Module		1
	4		Cooling System Components (See Figure 11)		Ref.
	5		Engine Ground Plate and Cables (See Figure 12)		Ref.
	6		Fuel System Components (See Figure 13)		Ref.
	7		Engine Exhaust Components (See Figure 14)		Ref.
			Right Side		
	8		12 VDC Battery Components (See Figure 15)		Ref.
	9	288460-002	Generator Assembly (See Figure 19)		Ref.
*		480603-001	…Mount, Shock, Generator		4
*		290404	…Ring, Spacer, Flex Coupling		1
	10		Air Cleaner Components (See Figure 16)		Ref.
*	11		Engine Components (See Figure 17)		Ref.
*		290557	…Mount, Engine, Right, Assembly		1
*		290556	…Mount, Engine, Left, Assembly		1
*		290577	…Support, Engine, Front		1
*		480603-001	…Mount, Shock, Engine		2
*	12		Drain, Blow-by		Ref.
*		056535	… Hose, 3/8”, I.D.		46 in.
*			…Clamp, Hose (Supplied by Cummins)		1
*	13	291630	Wire Harness, Engine		1
*	14	290850	Wire Harness, Engine Electronics		1
	15	290067	Engine, Cummins, QSL9.0, 325 HP		1
*		290726	Connection, Exhaust Outlet, Cobra Head		1
*		290727	Clamp, V-Band		1
*		286897-035	…Engine Oil Filter, Replacement		Ref.
*		287438	…Valve, Oil, Drain		1
*		056535	… Hose, 3/8”, I.D.		24”
*		W10869-014	…Clamp, Hose		1
	16		Engine Electronic Panel Components (See Figure 18)		Ref.
			Miscellaneous		
	17	291175	Leg, Control Box Support, Left		1
	18	288693	Leg, Control Box Support, Right		1
	19	290596	Support, Control, Box		1
	20	290733	Panel, Bulkhead, Center		1
	21	288895	Support, Option Terminal Block		1

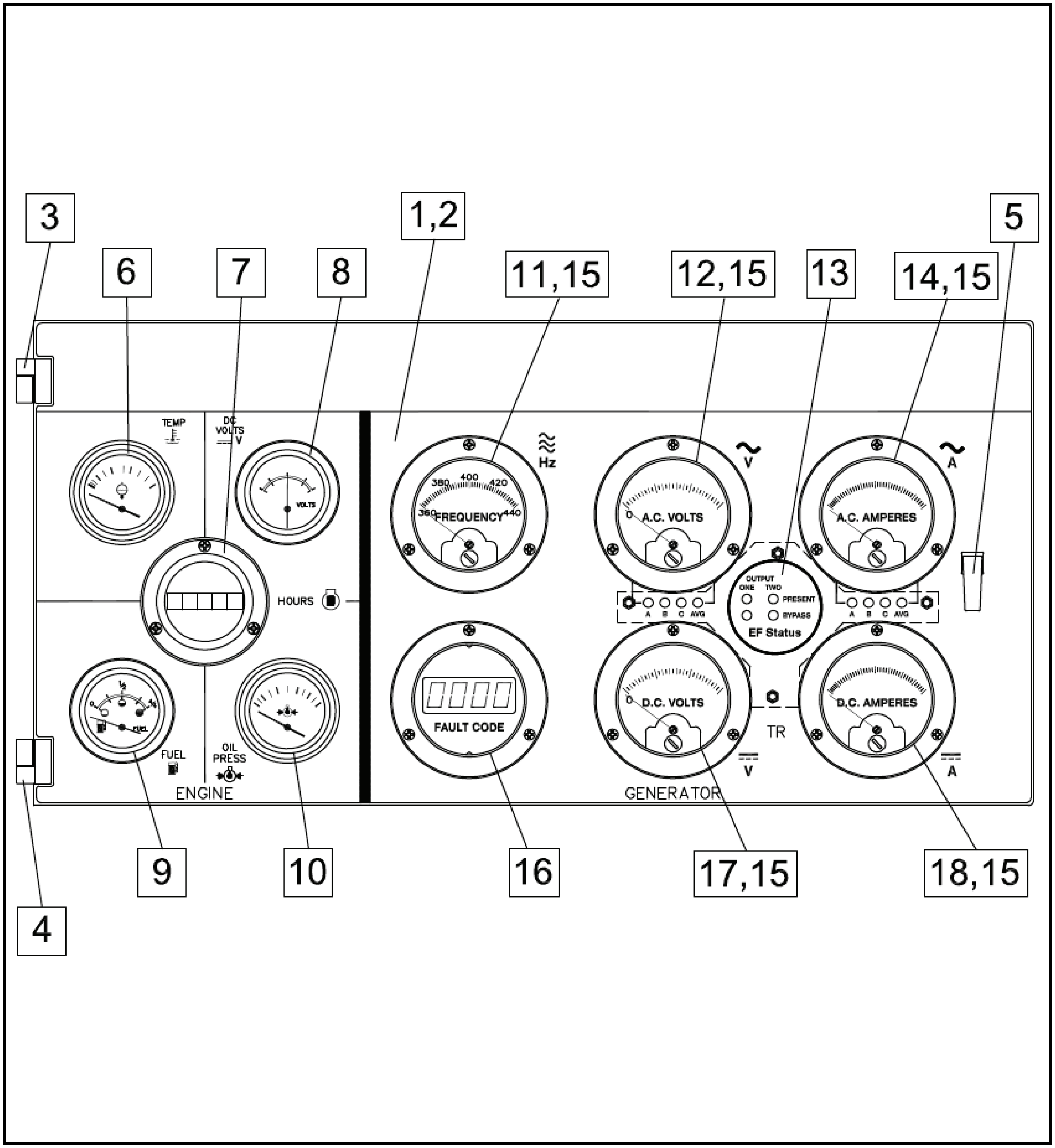


Figure 7: Control Box Door Panel Assembly

FIGURE – ITEM NO.		HOBART PART NO.	DESCRIPTION	EFF	QTY.
7 -		**289018-015**	**Door, Control Panel, Assembly [No T-R]**	**A,B,F,G,H,M**	**1**
		289018-016	**Door, Control Panel, Assembly [With T-R]**	**C,D,J,K**	**1**
		289018-017	**Door, Control Panel, Assembly [Special]**	**N**	**1**
		289018-018	**Door, Control Panel, Assembly [Special]**	**E,L**	**1**
	1	288995	Panel, Door, Control Box		1
	2	289017	Label, Control Box		1
	3	288836-001	Hinge, Offset Top		1
	4	288836-002	Hinge, Offset, Bottom		1
	5	288999-001	Latch, Control Box		1
	6	287908	Gauge, Water Temperature		1
	7	181358	Meter, Running Time	All except E,L	1
	8	286699-001	Voltmeter, Battery		1
	9	494134-001	Gauge, Fuel Level		1
	10	78A1117-002	Gauge, Oil Pressure		1
	11	283167	Meter, Frequency	All except E,L,N	1
	11	288858-002	Meter, Frequency, Digital	E,L,N	1
	12	W8105A-009	Voltmeter, AC	All except E,L,N	1
	12	288858-003	Voltmeter, AC, Digital	E,L,N	1
	13	288806	Board, P.C., Front Panel, Led		1
		288820	…Gasket, LED PC Board		1
	14	288814-001	Ammeter, AC	All except E,L,N	1
	14	288858-001	Ammeter, AC, Digital	E,L,N	1
*	15	285172	Light, Strip	A,B,E,F,G,H,L,M	3
*		285172	Light, Strip	C,D,J,K	5
	16	288858-004	Meter, Fault, Digital		1
	17	400642-008	Voltmeter, DC	C,D,J,K	1
	18	400641-015	Ammeter, DC	C,D,J,K	1
*	19	290090	Kit, Meter, CAN-Bus	E,L	Ref.
*		290093	…Meter, CAN-Bus	E,L	1
*		290095	…Harness, CAN-Bus	E,L	1
*		290179	…Plug, Hole, CAN-Bus	E,L	3

C,D,J,K have T-R Option (DC output)
E,L,N have digital generator meters
E,L have a CAN-Bus meter instead of an hour meter

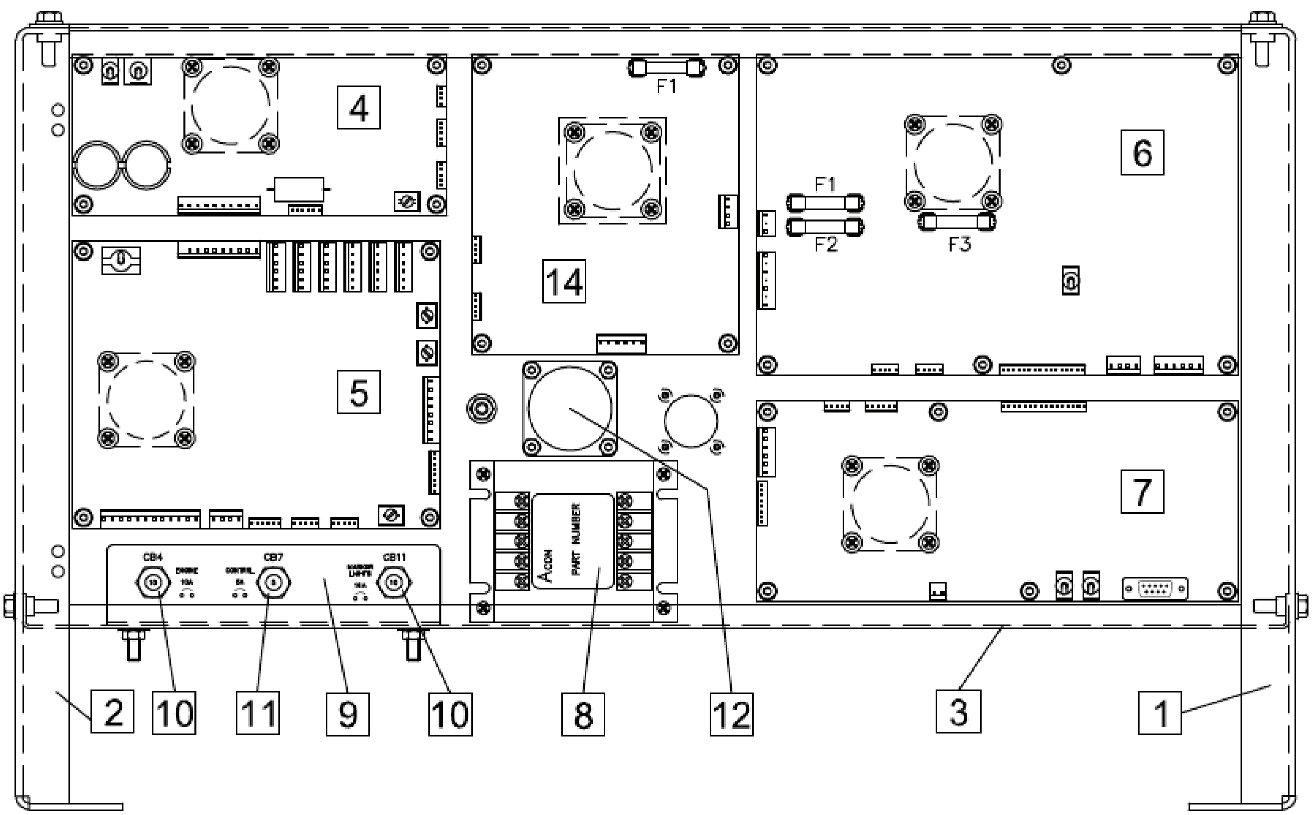


Figure 8: Control Box Interior Components

FIGURE – ITEM NO.		HOBARTPART NO.	DESCRIPTION	EFF	QTY.
8 -	1	288994	Side, Left, Control Box		1
	2	288993	Side, Right, Control Box		1
	3	288992	Wrapper, Control Box		1
	4	288745	Board, PC, ESB		1
*		288813	…Label, ESB [Engine Control]		1
	5	288937	Board, PC, EIB		1
*		288791	…Label, EIB [Starter Control]		1
	6	288940B	Board, PC, Regulator		1
*		288876	…Label, Regulator [Generator Control]		1
		288896	…Label, Regulator [LDC & Voltage Control]		1
		W11166-009	…Fuse, 1 A, 250 V		2
		W11166-002	…Fuse, 5 A, 250 V		1
	7	289026	Board, PC, Digital Controls		1
*		288875	…Label, Control [EF Bypass Control]		1
	8	288818-001	Power Supply		1
		288605	…Support, Power Supply		1
	9	289059	Support, Circuit Breakers		1
		289060	…Label, Circuit Breakers		1
	10	283978-002	Circuit Breaker, 10A		2
	11	283978-001	Circuit Breaker, 5A		1
*	12	289073	Harness, Wire		1
*	13	289072	Harness, Wire, DC	C,D,J,K	1
	14	288914	Board, PC, T-R	C,D,J,K	1
		W11166-009	…Fuse, 1 A, 250 V	C,D,J,K	1

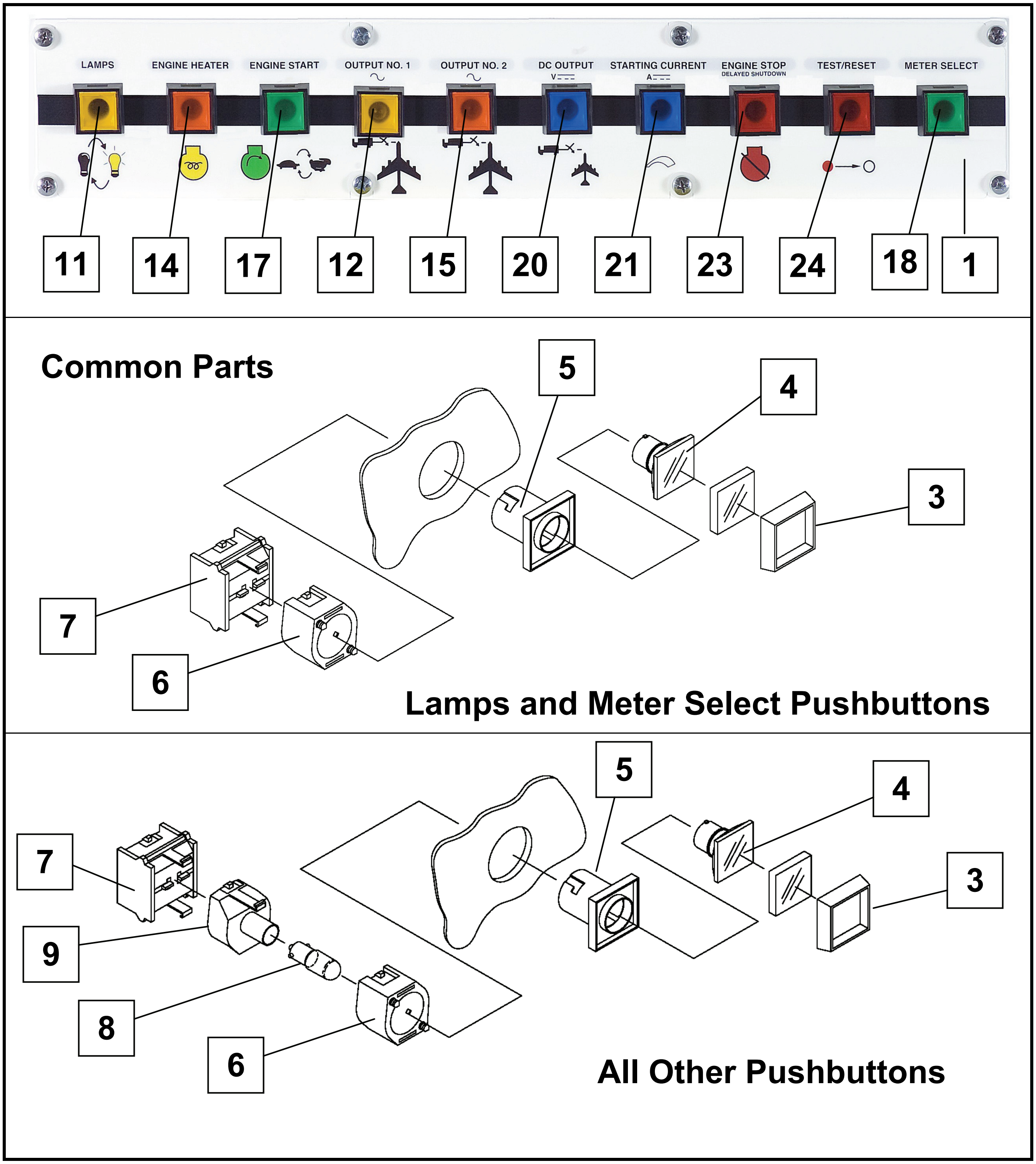


Figure 9: Pushbutton Switches

FIGURE – ITEM NO.		PART NO.	DESCRIPTION	EFF	QTY.
9 -	1	289004	Switch Panel		1
		289014	…Switch Panel Label		1
*		040201	…Strip, Gasket, Neoprene		66 in.
*	2	289015	Switch Panel Wire Harness		1
			Common Pushbutton Parts		
	3	285029-001	Bezel Frame		1
	4	285031-001	Lens Holder		1
	5	285032-001	Sleeve Actuator		1
	6	285033	Mounting Flange		1
	7	284475-001	Switch, Contact Block		1
	8	400613-004	Type 1815 Bulb		1
	9	285034-001	Lamp Holder		1
*	10	290080	Contact Block Cover		1
	11	289601-001	***Lamps Pushbutton***		1
	12	289601-004	***Output # 1 Pushbutton***		1
	13	285030-002	Yellow Lens		1
	14	289601-005	***Pre-heater Pushbutton***		1
	15	289601-005	***Output # 2 Pushbutton***		1
	16	285030-004	Orange Lens		1
	17	289601-006	***Engine Start Pushbutton***		1
	18	289601-006	***Meter Select Pushbutton***		1
	19	285030-003	Green Lens		1
	20	289601-007	***DC Output Pushbutton***	C,D,J,K	1
	21	289601-007	***Current Pushbutton***	C,D,J,K	1
	22	285030-005	Blue Lens	C,D,J,K	1
	23	289601-003	***Engine Stop Pushbutton***		1
	24	289601-003	***Test/Reset Pushbutton***		1
	25	285030-001	Red Lens		1
			Other Parts		
	26	287038-001	Plug, Hole (when switch is not installed)		1
	27	288773	Panel, Switch Box		1
*	28	288772	Wrapper, Switch Box		1
*	29	288771	Top, Switch Box		2

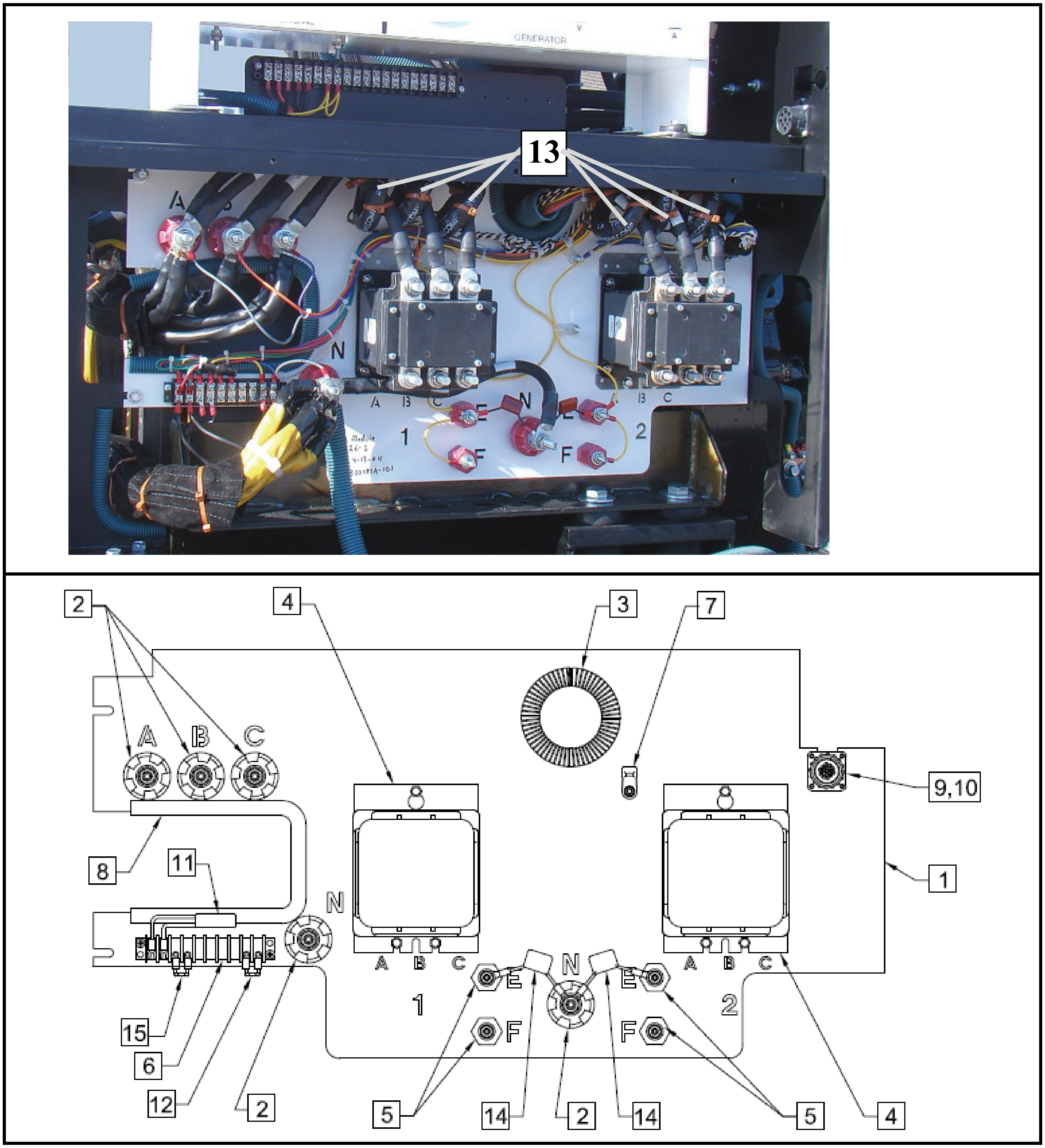


Figure 10: 400 Hz. Power Module Assembly

FIGURE – ITEM NO.	PART NO.	DESCRIPTION	EFF	QTY.
10 -	**291626-002**	**Power Panel Module Assembly**		Ref.
1	291625	Panel, Power Module		1
2	283154-001	Standoff, 3/8-16		5
3	76A1131	Tubing, Z-flex, 1/2		0.79 ft.
4	282130-001	Contactor, Line, 3-Pole		2
5	286266	Standoff, Short, 1/4-20, (E, F)		4
6	401911-010	Block, Terminal		1
7	288078-001	Tie, Screw Mount		1
8	050988	Trim, .12, Black, Alum, Vinyl (PVC)		18 in.
9	288829	Harness, Wire, Power Module		1
		…(No. 101) “A” Stator Terminal to “K1”, # 1 Output		1
		…(No. 102) “B” Stator Terminal to “K1”, # 1 Output		1
		…(No. 103) “C” Stator Terminal to “K1”, # 1 Output		1
		…(No. 110) “N” Stator Terminal to “N”, Neutral		1
10	288832	Harness, Wire, 2nd Output		1
		…(No. 104) “A” Stator Terminal to “K201”, # 2 Output		1
		…(No. 105) “B” Stator Terminal to “K201”, # 2 Output		1
		…(No. 106) “C” Stator Terminal to “K201”, # 2 Output		1
11	282089-011	Diode, Flyback, Assembly		1
12	288892-001	Resistor Assembly, 1K		1
13	285102-001	Current, Transformer		6
14	290227	Capacitor, Noise Suppression		2
15	288892-013	Resistor, ID, 180 KVA		1

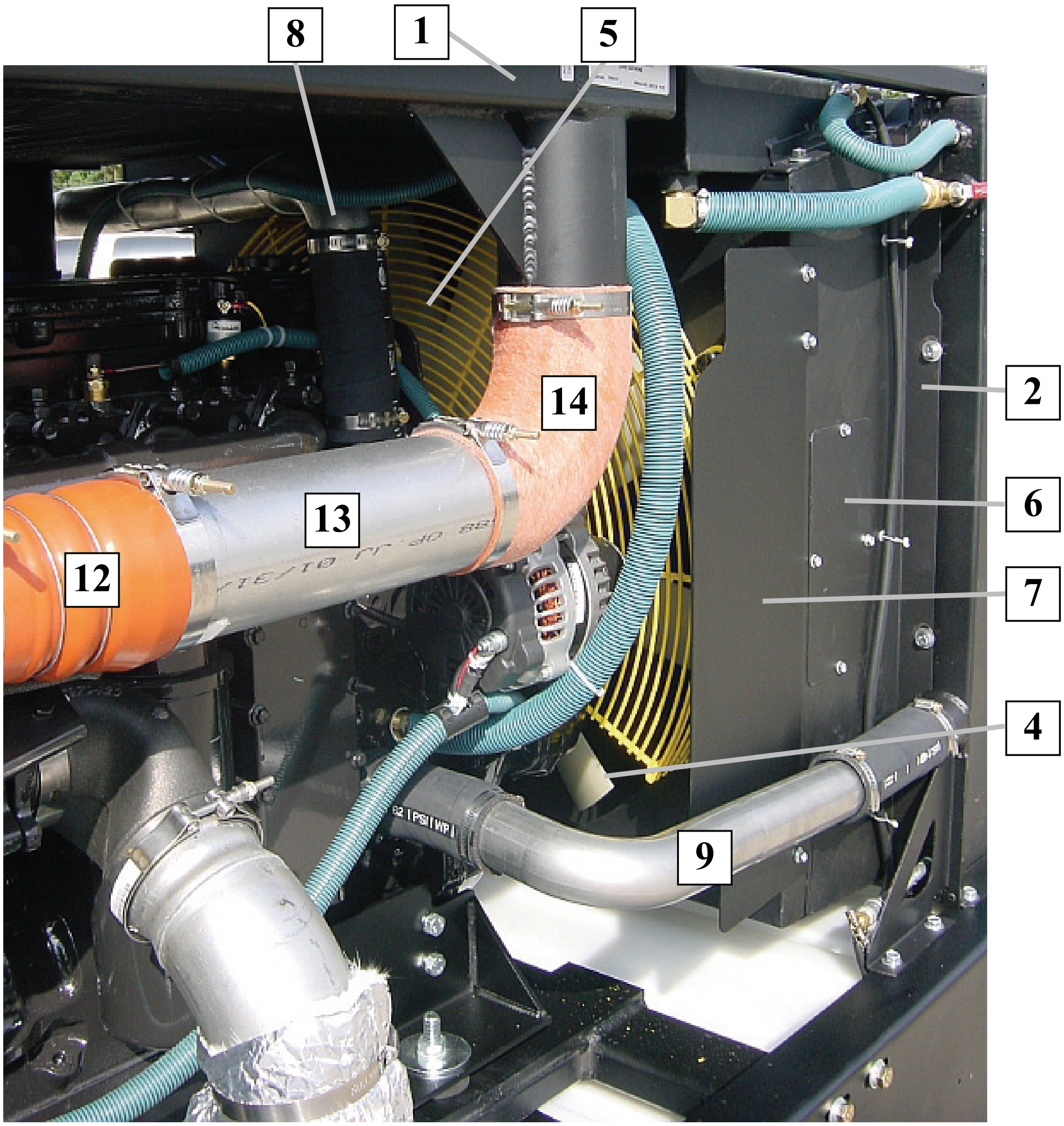


Figure 11: Cooling System Components

FIGURE – ITEM NO.		PART NO.	DESCRIPTION	EFF	QTY.
11 -	1	290223	Radiator Assembly		1
	2	290365	Charge-Air-Cooler Assembly		1
*	3	290145	Sensor, Coolant Level		1
*	4	290731	Fan, Cooling, 28”		1
	5	290745	Guard, Spiral, Fan		1
	6		Shroud, Fan		Ref.
	7	290776	Guard, Fan Belt		2
	8	290764	Tube, Radiator, Upper		1
		W10869-005	…Clamp, Hose (2 $^5/_{16}$” – 3 ¼”)		4
		289200-002	…Hose, Radiator, Straight, 2.25 O.D.		16”
	9	290761	Tube, Radiator, Lower		1
		W10869-005	…Clamp, Hose (2 $^5/_{16}$” – 3 ¼”)		4
		289200-002	…Hose, Radiator, Straight, 2.25 O.D.		16”
*	10		Line, De-Aeration		Ref.
*		288123-001	…Connector, Male		2
*		056534	…Hose, ¼”, I.D.		40”
*		W10051-007	…Clamp, Hose ($^7/_{32}$” – $^5/_8$”)		2
*	11	283873	Valve, Drain, Radiator		2
*		056535	…Hose, 3/8” I.D., Low Pressure		60”
*		W10051-007	…Clamp, Hose ($^7/_{32}$” – $^5/_8$”)		2
	12	290625	Hose, Adaptor, 3.5” to 4.0”		1
*		290597-002	…Clamp, T-Bolt, Floating Bridge, 3.75”		1
		290597-003	…Clamp, T-Bolt, Floating Bridge, 4.25”		1
	13	290598	Pipe, Turbo to CAC		1
	14	290626	Hose, CAC, 90º Elbow, 4” I.D., Hot		1
		290597-003	…Clamp, T-Bolt, Floating Bridge, 4.25”		2
*	15	290627	Hose, CAC, 90º Elbow, 4” I.D., Cold		1
*		290597-006	…Clamp, T-Bolt, Floating Bridge, 4.25”		2
*	16	290599	Pipe, CAC to Intake		1
*	17	290628	Hose, CAC, 90º Elbow, 4” I.D., Cold, 19”		1
*		290597-006	…Clamp, T-Bolt, Floating Bridge, 4.25”		2

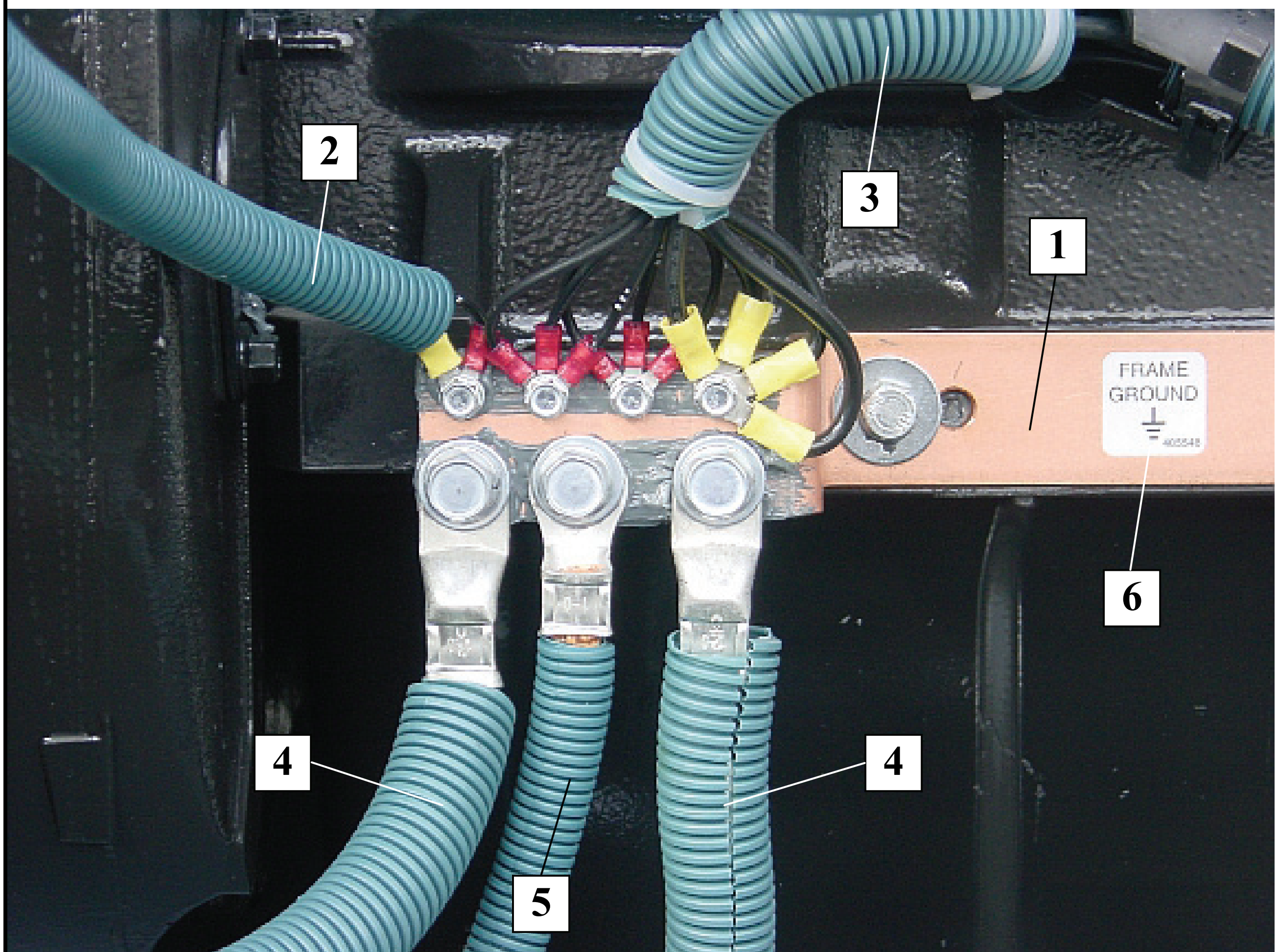


Figure 12: Engine Ground Plate and Cables

FIGURE – ITEM NO.		PART NO.	DESCRIPTION	EFF	QTY.
12 -	1	288723	Plate, Ground		1
	2	290850	Harness, Wire, Engine, Electronic		1
	3	291630	Harness, Engine		1
	4	W9360-289	Cable, #111, Power Mod. To Ground		2
		76A1132	…Tubing, Z-Flex, 3/4”		90”
	5	W9407-446	Cable, Engine to Ground		1
		76A1131	…Tubing, Z-Flex, 1/2”		16”
	6	405548	Label, Frame Ground		1

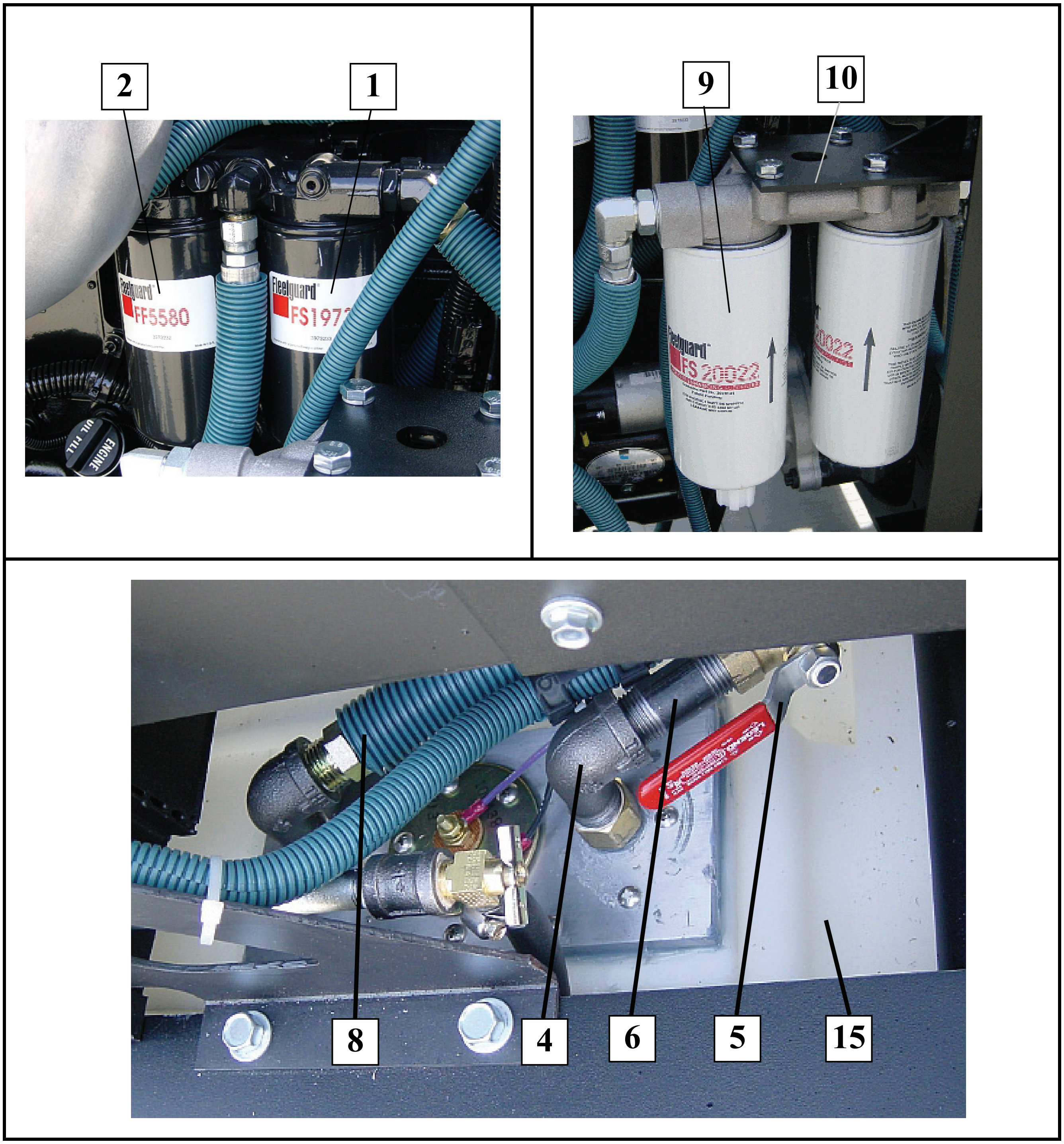
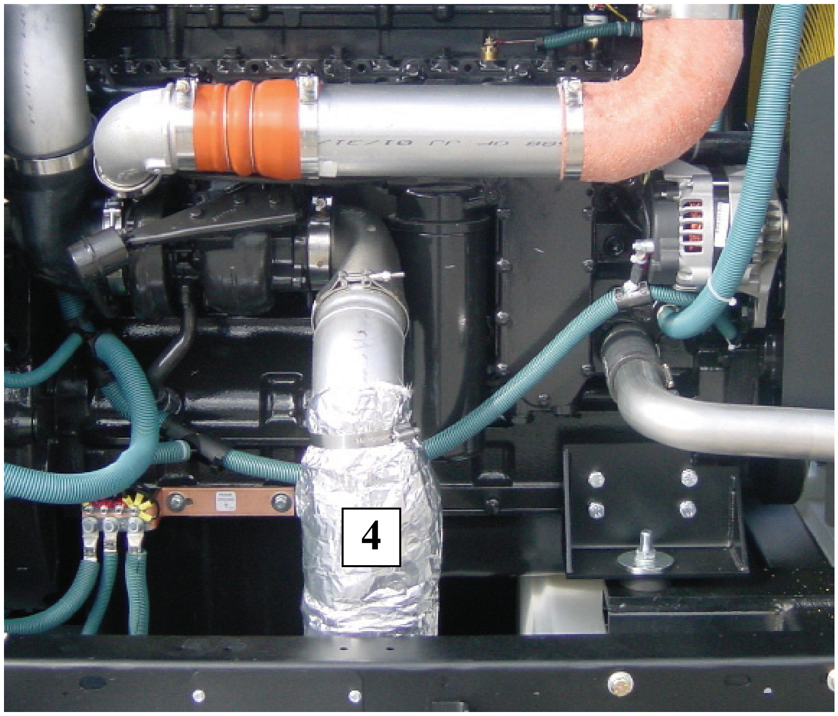


Figure 13: Fuel System Components

FIGURE – ITEM NO.		PART NO.	DESCRIPTION	EFF	QTY.
13 -	1	286897-033	Filter, Fuel Water Separator [Supplied by Cummins]		Ref.
	2	286897-034	Filter, Fuel [Supplied by Cummins]		Ref.
*	3	290692	Line, Fuel, Tank to Lubricity Filter		1
	4	12CW2077-003	Elbow, 1/2” NPT, ST., 90°		2
	5	400819-003	Valve, Ball, 1/2” NPT		1
	6	W10760-003	Nipple, Pipe, 1/2”		1
		76A1132	Tubing, Z-Flex, 3/4” I.D.		38”
*	7	290693	Line, Fuel, Lubricity Filters to Fuel Filters		1
		76A1132	Tubing, Z-Flex, 3/4” I.D.		20”
	8	290694	Line, Fuel, Return		1
		76A1132	Tubing, Z-Flex, 3/4” I.D.		48”
	9	286897-031	Filter, Lubricity Fuel	All except F,M	Ref. (2)
	10	290772	Lubricity Filter, Bracket	All except F,M	1
*	11	290758	Filter, Fuel	F,M	1
*	12	289188	Bracket, Mount, Fuel Filter	F,M	1
*	13	290757	Heater, Fuel	F,M	1
*		290782	Adaptor, Elbow, 90 Degree	F,M	2
*	14	282562	Cap, Fill, Fuel, Diesel Green		1
	15	290780	Tank, Fuel, 125 Gallon, Stainless (See Figure 3)	A thru F	1
		486719-014	…Sender, Gauge, Fuel, 12V		1
	15	290750	Kit, Fuel Tank, Composite (See Figure 3)	G thru N	Ref.
		290746	…Belly Pan, Fuel, Tank, 125 Gallon	G thru N	1
		290680	…Tank, Fuel, Composite, 125 Gallon	G thru N	1
		486719-014	…Sender, Gauge, Fuel, 12V		1
		290747	…Strap, Support, Fuel Tank, 125 Gallon	G thru N	1
		290748	…Strap, Mounting, Fuel Tank, 125 Gallon	G thru N	1
		290267	…Rubber, Strap, Fuel Tank	G thru N	1
		290861	…Shield, Heat	G thru N	1
		290640	…Bracket, Shield, Heat	G thru N	1



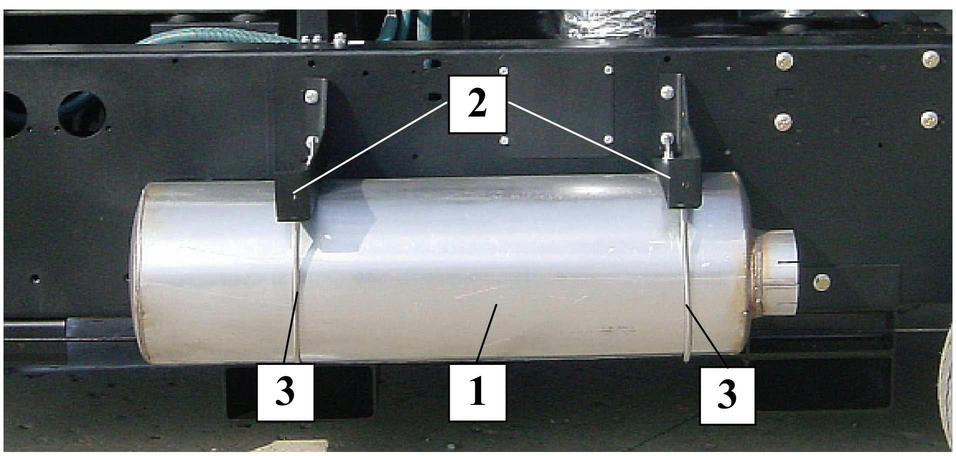


Figure 14: Engine Exhaust Components

FIGURE – ITEM NO.		PART NO.	DESCRIPTION	EFF	QTY.
14 -	1	290657	Muffler, Exhaust		1
	2	290708	Bracket, Muffler Support		2
	3	290724	Clamp, Muffler Mounting		2
	4	290777	Pipe, Turbo, Assembly		1
		290754	Clamp, V-Band, Exhaust		1
		404154-018	Clamp, Pipe, 5”, I.D.		1
*	5	290665	Shield, Heat, Muffler	A,C,E,F,G,J,L,M,N	1
*	6	291257	Pipe, Exhaust, Muffler Outlet, Assembly	A,C,E,F,G,J,L,M,N	1
		404154-018	Clamp, Pipe, 5”, I.D.	A,C,E,F,G,J,L,M,N	1

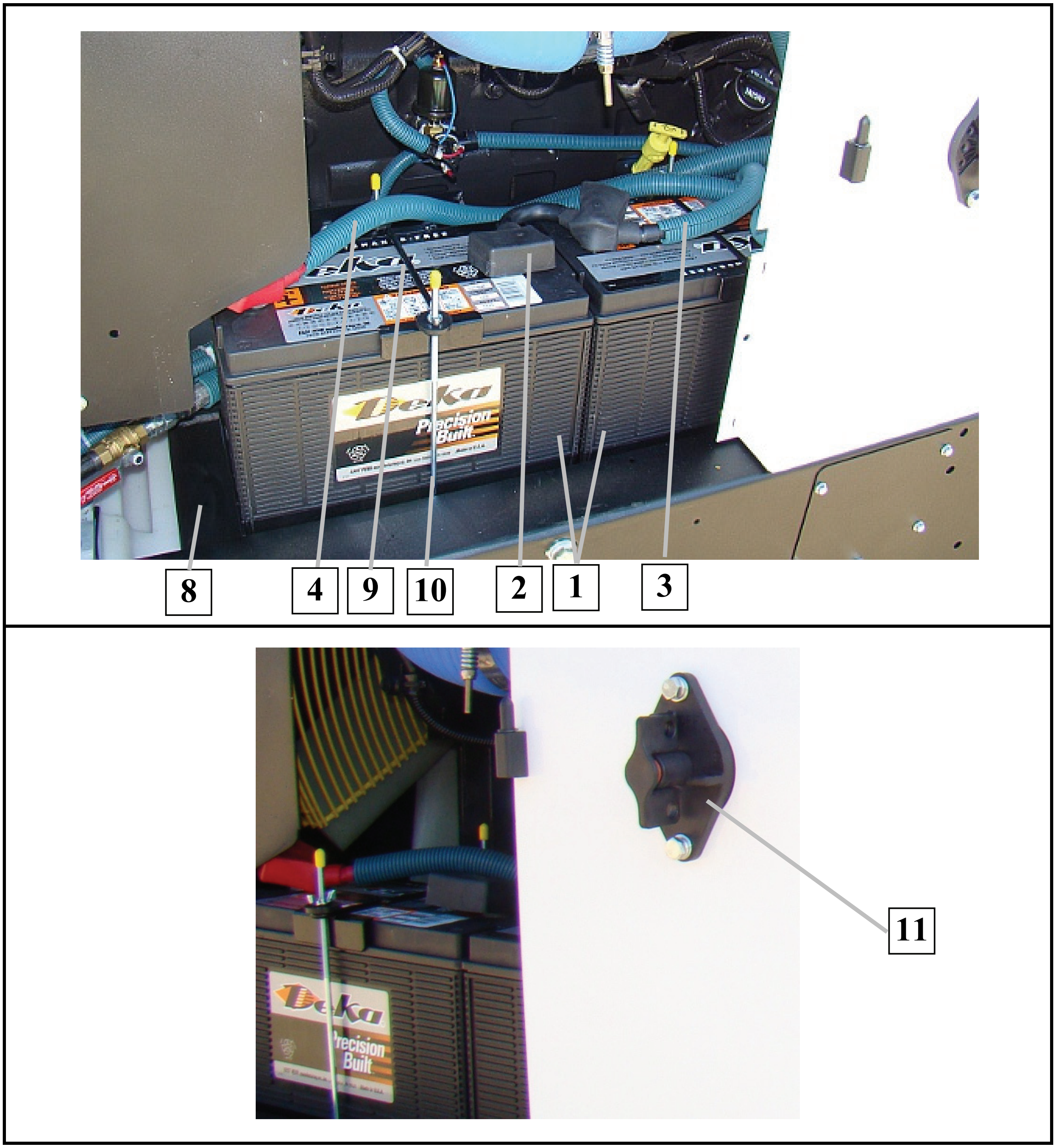


Figure 15: 12 VDC Battery System

FIGURE – ITEM NO.		PART NO.	DESCRIPTION	EFF	QTY.
15 -	1	281881-004	Battery, 12 V		2
	2	289151	Cable, Battery, Negative		1
	3	289153	Cable, Battery, Negative		1
	4	289149	Cable, Battery, Positive		2
*	5	289224	Tray, Battery		1
*	6	289223-001	Bracket, Battery Tray, Right		1
*	7	288910	Support, Battery Tray		1
	8	289239	Pad, Battery Tray		1
	9	287796	Hold Down, Battery		2
	10	494295	Bolt, Hold Down, Battery		2
	11	291611	Disconnect Switch, Battery, 2000A, Lock Out		1
*	12	290832	Cable, Disconnect Switch, Starter		1

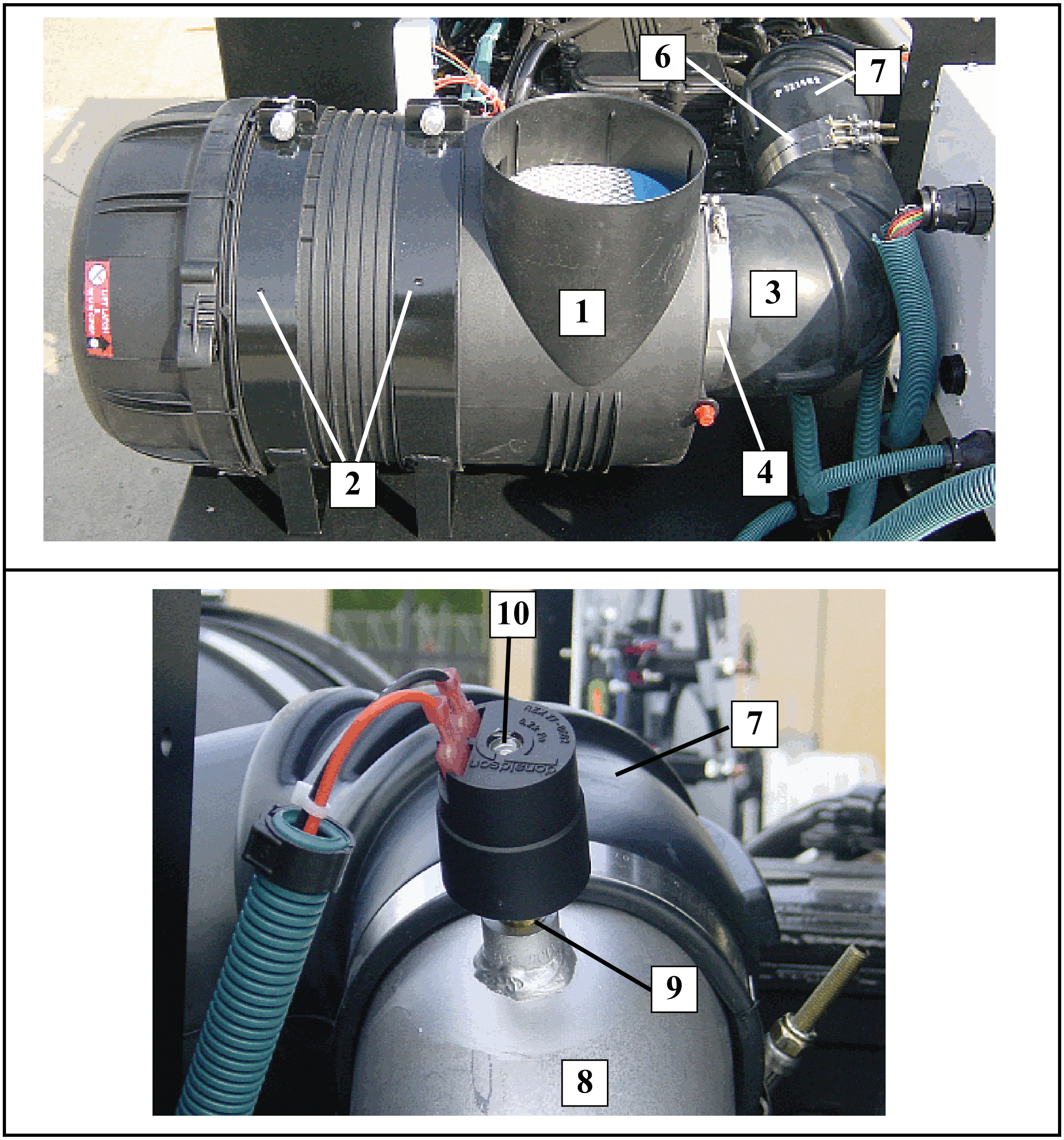


Figure 16: Air Cleaner & Intake Air Components

FIGURE – ITEM NO.		PART NO.	DESCRIPTION	EFF	QTY.
16 -	1	290717	Filter, Air		1
*		290828	…Element, Primary, Replacement		Ref. (1)
*		290829	…Element, Secondary, Replacement		Ref. (1)
	2	290649	Bracket, Mounting		2
	3	290655-001	Elbow, Reducing 90º (7” to 5”)		1
	4	290652-001	Clamp, Hose (7.25”-7.76”)		1
*	5	290755	Pipe, Connector, Air Inlet, 5” O.D.		1
	6	280732-007	Clamp, T-Bolt (5 5/16” – 5 5/8”)		2
	7	284925	Reducer, Rubber, 90º Elbow		1
	8	290762	Pipe, Elbow, Air Inlet		1
	9	282919	Adaptor, Indicator		1
	10	282918	Indicator, Restriction, Electric		1
*	11	280732-006	Clamp, T-Bolt (4 5/16” – 4 5/8”)		4
*	12	290778	Elbow, Rubber, Cobra Head (Supplied by Cummins)		Ref.
*	13	290633	Intake, Air, Extension		1
*	14	290647-001	Adaptor, Hump Hose		1
*	15	290652-001	Clamp, Hose		2
*	16	290648-001	Hood, Weather		1

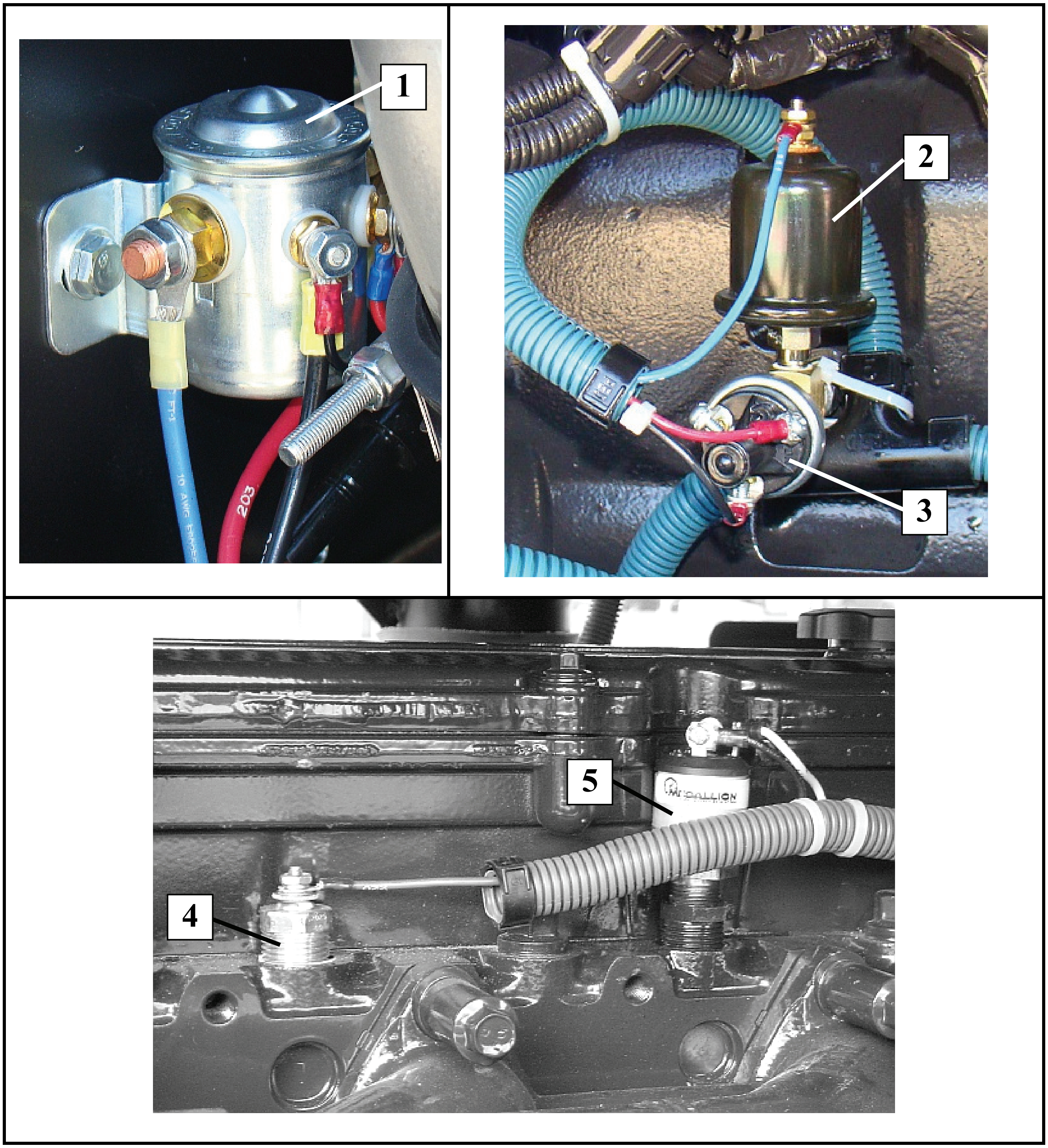


Figure 17: Engine Components

FIGURE – ITEM NO.		PART NO.	DESCRIPTION	EFF	QTY.
17 -	1	286850	Starter Solenoid		1
		288973-001	…Diode, Starter Solenoid, Assembly		1
	2	403809-001	Switch, Oil Pressure		1
	3	78B1118-002	Sender, Oil Pressure		1
		287419	…Adapter, M10-1.0 x 1/8 NPTF		1
		W10910-000	…Fitting, Tee		1
		W10750-001	…Nipple, Pipe, 1/8”		1
	4	403782-002	Switch, Shutdown, 210° F		1
		W7814-004	…Adapter, 3/8” x 1/2” NPT		1
	5	287909	Sender, Water Temperature		1
*	6	290864	System, Oil Replenishment	F,M	1
*	7	290697	Bracket, Support, Oil Replenishment	F,M	1
*		290676	…Bumper, Rubber	F,M	2
*	8	290704	Bracket, Sight Glass, Oil Management	F,M	1
*	9	290696	Bracket, Switch and Lights, Oil Management	F,M	1
*	10	290715	Board, P.C., Oil Management	F,M	1
*	11	290865	Harness, Wire, Oil Replenishment System	F,M	1

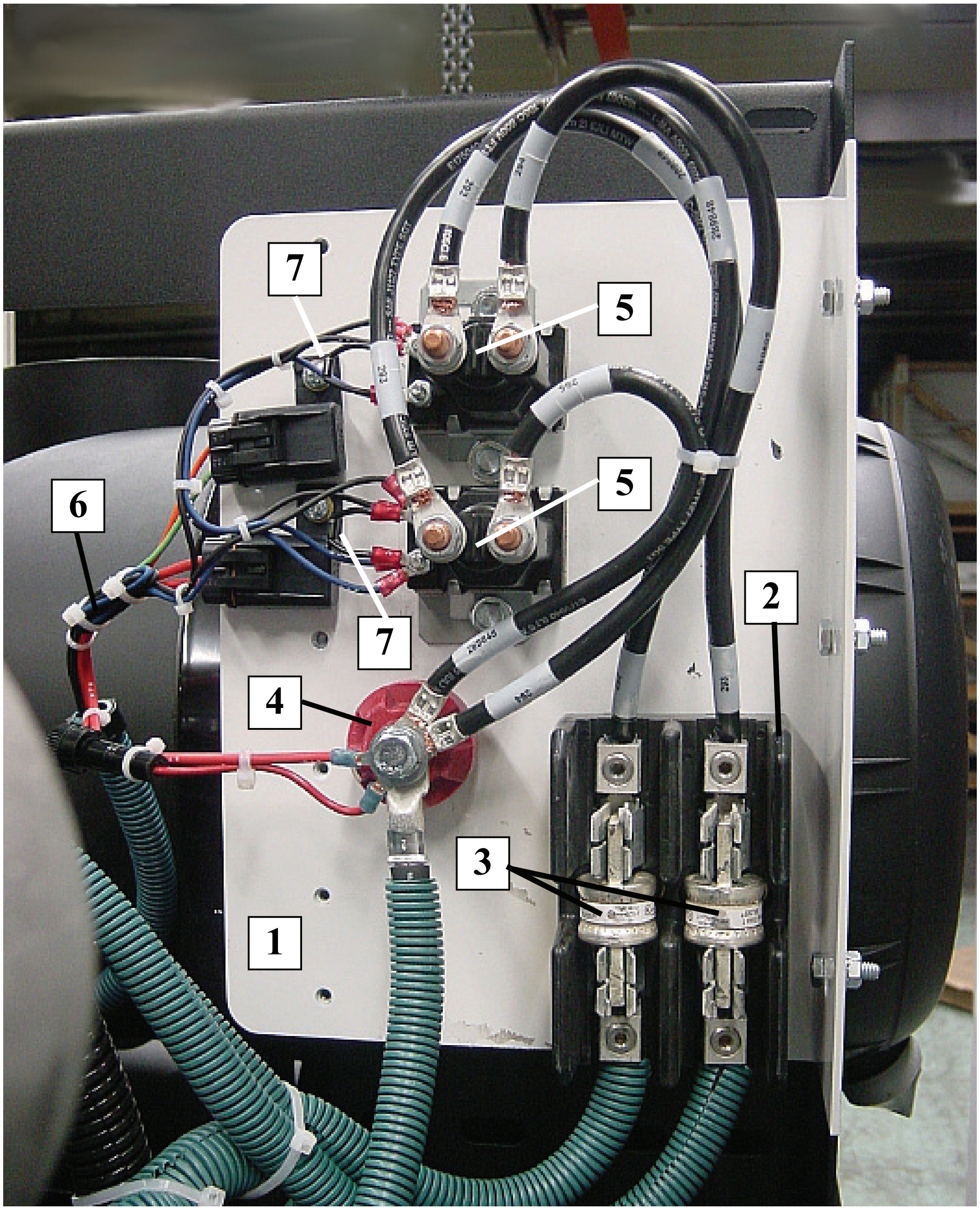


Figure 18: Engine Electronic Panel Components

FIGURE – ITEM NO.		PART NO.	DESCRIPTION	EFF	QTY.
18 -	1	288333	Panel, “E” Engine, Parts		1
	2	287145-002	Holder, Fuse		1
	3	287144-002	Fuse, Fast Acting		2
	4	283154-001	Insulator, Standoff		1
	5	288331	Relay, Grid Heater, Power		2
	6	290850	Harness, Wire, Engine, Electronic		1
	7	489658-007	Diode, Assembly		2

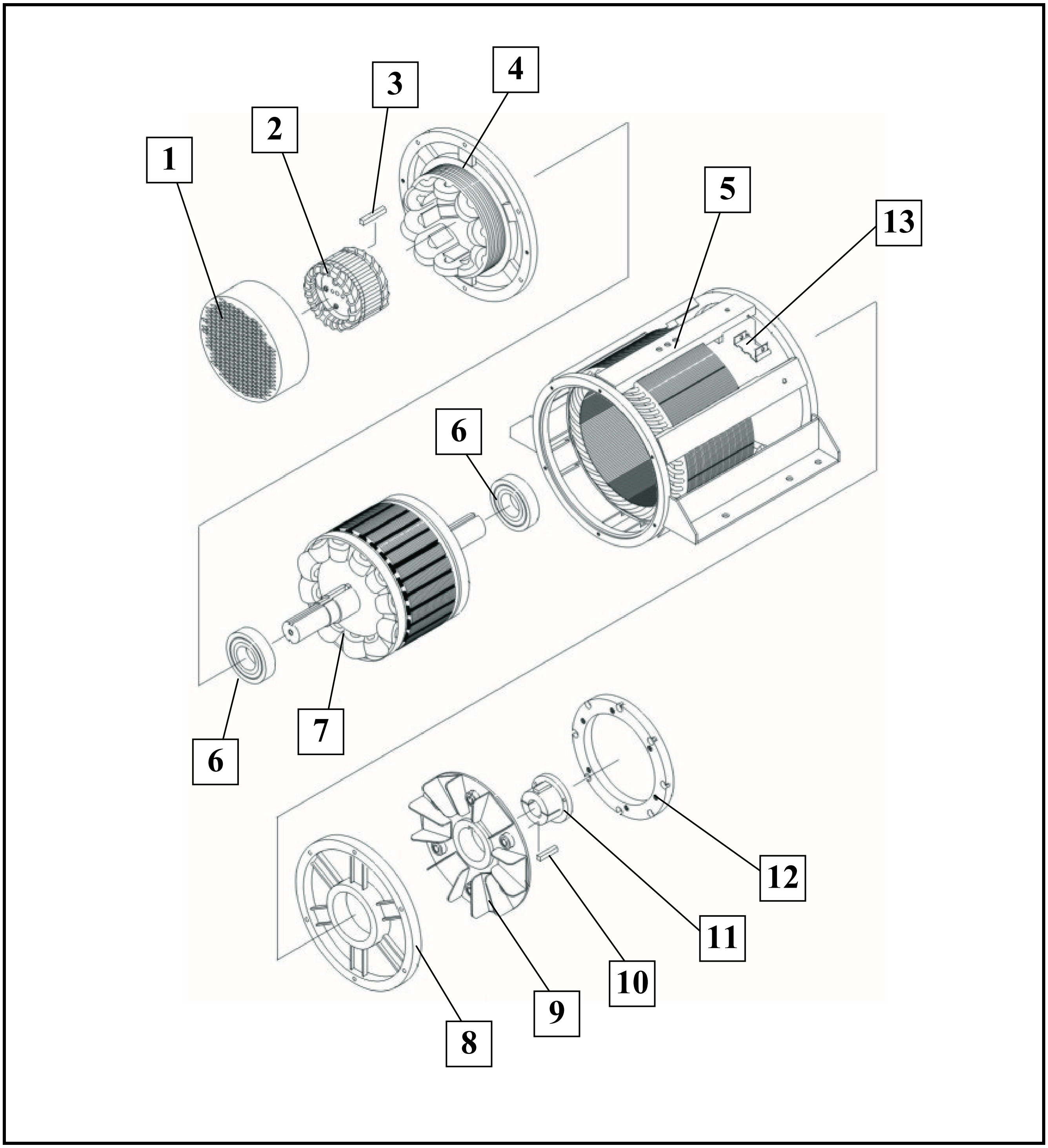


Figure 19: Generator Assembly

FIGURE – ITEM NO.		PART NO.	DESCRIPTION	EFF	QTY.
19 -	1	288486	Exciter Cover		1
	2	288494	Exciter Armature		1
	3	180696-003	Exciter Key		1
	4	288440	Exciter Housing and Coils Assembly		1
	5	289229	Generator Housing and Coils Assembly		1
	6	W10072-068	Bearing		2
	7	288447-002	Generator Rotor		1
	8	288461	Front Bearing Support		1
	9	288481	Flexible Coupling Kit		1
		288480	…Fan & Coupling Weldment		1
		480290	…Coupling Bushing		8
	10	85B1039	Coupling Key		1
	11	85C1004-001	Split Taper Bushing		1
	12	288457	Flywheel Adapter Ring (not used with this engine)		Ref.
	13	288458	Generator Air Deflector		6
*	14	289226	Generator Cover		1
*	15	288491	Tab, Fastener, Exciter Key		1
*	16	291180	Generator Lead, Cover (cloth wrap)		2

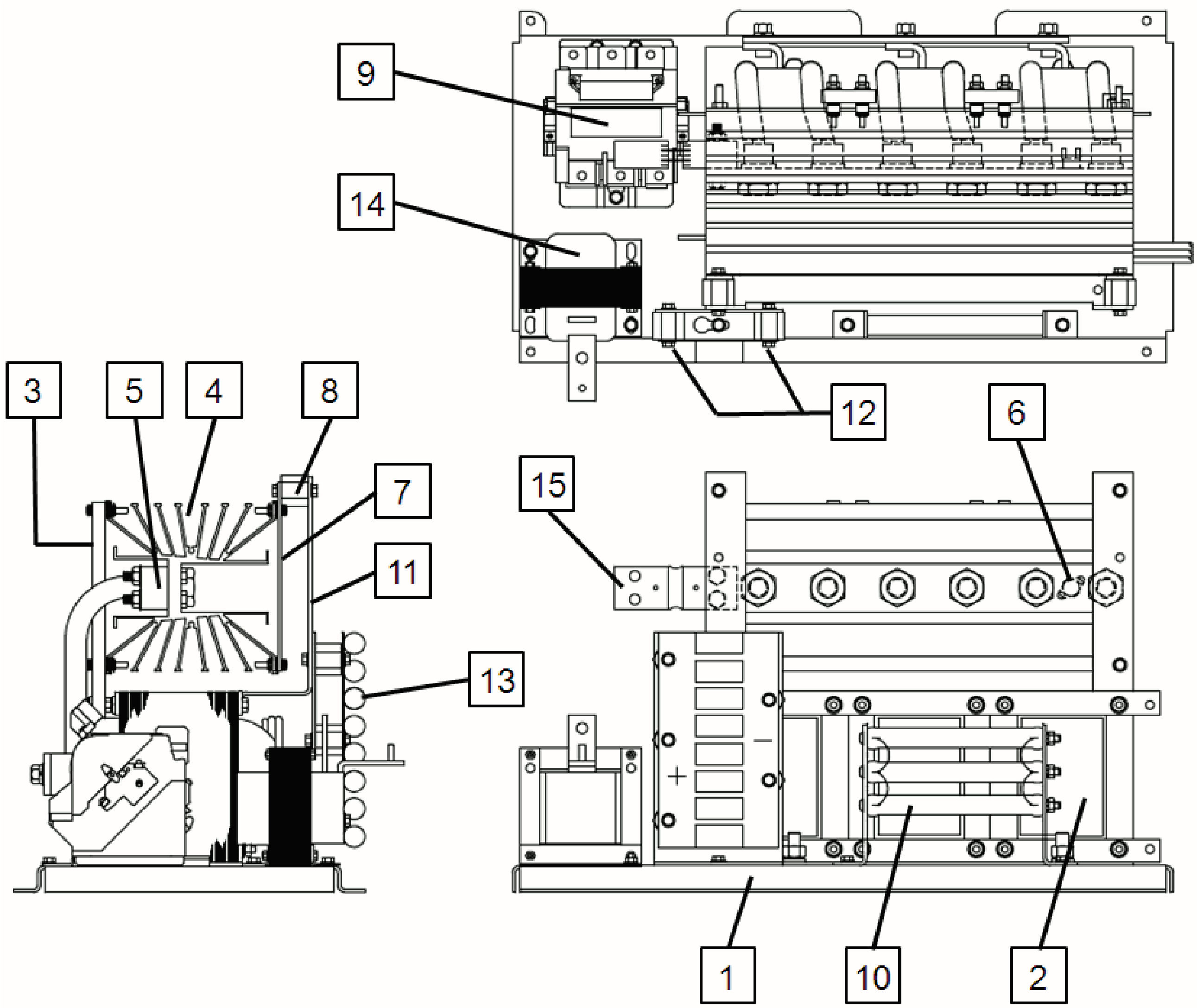


Figure 20: Transformer-Rectifier Assembly (DC Option)

FIGURE – ITEM NO.		PART NO.	NOMENCLATURE	EFF	QTY.
20 -		289008-001	**Transformer-Rectifier Assembly**		Ref.
	1	289007	Support, Internal, Transformer-Rectifier		1
	2	286604	Transformer, 28.5 VDC		1
		281971-002	Resistor Assembly, 1 K ohm, 1 W		1
	3	288404	Support, Heat Sink		1
	4	286603	Heat Sink, Extruded		1
	5	W10931-003	Diode, Silicon, 275 A, Positive Base		1
	6	404044-004	Thermostat		1
	7	288147	Bracket, Heat Sink		2
	8	286266	Standoff, Short		2
	9	282130-001	Contactor, Input		1
*		77A1107	…Label “A”		1
*		77A1108	…Label “B”		1
*		77A1109	…Label “C”		1
	10	288095-001	Resistor, Preload, Ay.		1
	11	289006	Support, PC Board		1
	12	286266	Standoff, Short		5
	13	288117	Capacitor, TR, PC Board		1
	14	288092	Choke, DC		1
	15	280022	Shunt, 800 A, 50 mV		1
*	16	289010	Harness, Wire and Cable		1
*	17	400435	Nameplate, 28 Volts		1

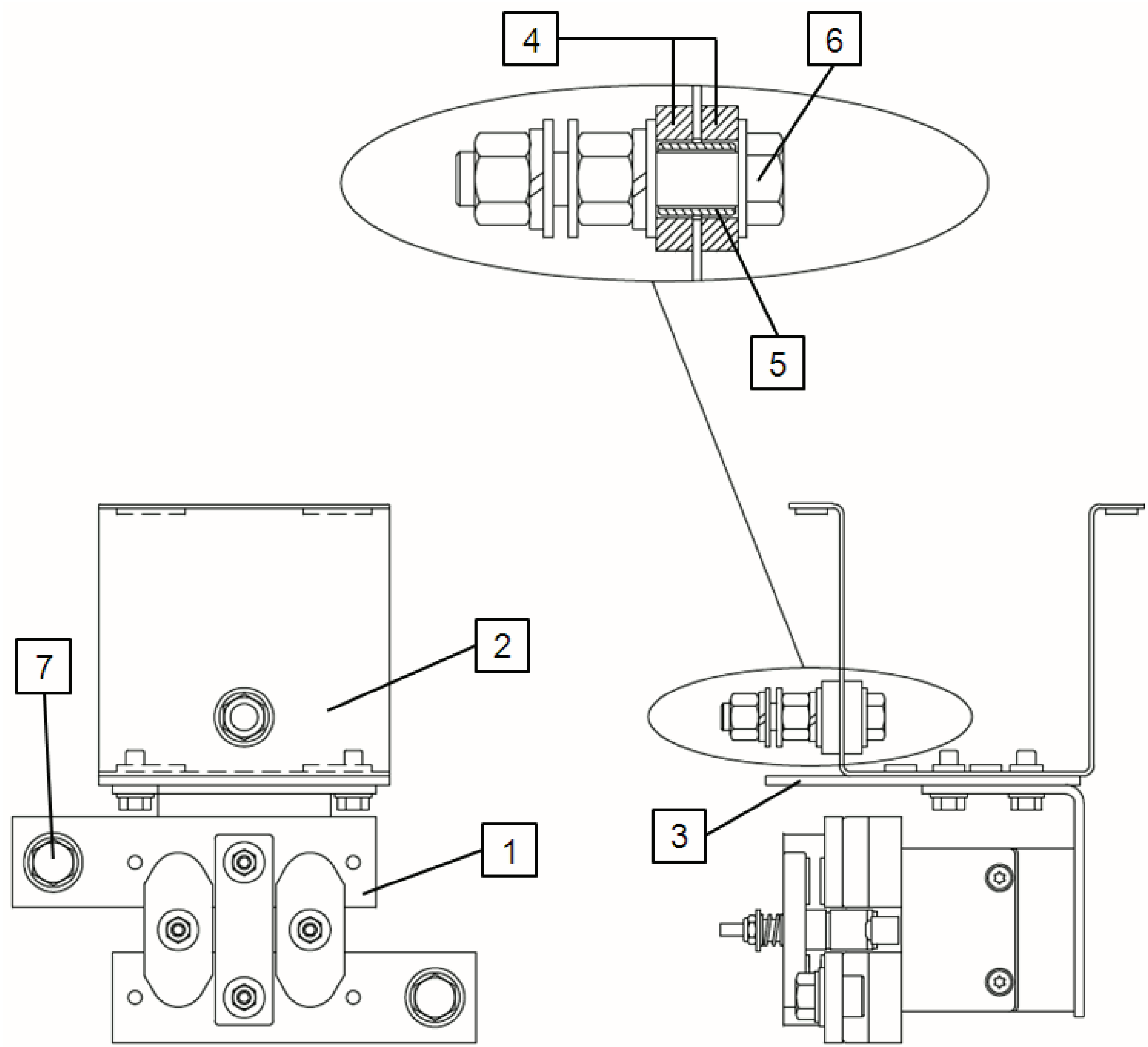


Figure 21: DC Output Contactor (DC Option)

FIGURE – ITEM NO.		PART NO.	NOMENCLATURE	EFF	QTY.
21 -	1	286810-001	Contactor, DC, 800 A, 24 VDC		1
		201673-004	…Diode Assembly		1
	2	289005	Bracket, Mtg., Contactor		1
	3	286849	Insulator, Contactor		1
	4	A25	Washer, Insulating		2
	5	288099	Bushing, Insulating		1
	6		Output Stud		Ref.
		W11097-008	…Screw, 3/8-16 X 2, HHC		1
		W11242-010	…Washer, 3/8, Flat		6
		W11254-006	…Washer, 3/8, Lock		2
		W11254-006	…Nut, 3/8-16, Hex		2
	7		Contactor Studs		Ref.
		W11097-002	…Screw, 3/8-16 X 1.0, HHC, ST.		2
		W11242-010	…Washer, 3/8, Flat		2
		W11254-006	…Washer, 3/8, Lock		2

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HOBART
GROUND POWER

TO-328
Original – 052308

INSTALLATION

and

OPERATING INSTRUCTIONS

for

Hobart Ground Power
Service Tool Software

Optional software for most of the Hobart 400 Hz. ground power products

Hobart Ground Power
Troy, Ohio 45373
U.S.A.

Description and Instruction

1) General

This manual covers the installation and operating instructions for a PC based Hobart service tool software used to interrogate the ground power units manufactured by **Hobart Ground Power, Troy, Ohio 45373, U.S.A.** This is optional software only supplied upon requested.

2) Description and Operation

The service tool software was designed to give the user another method of troubleshooting their equipment, as well as, a tool for recording the actual usage of the GPU (i.e. data logging). The software is designed to run on a standard IBM type computer system under a Windows 95, 98, 2000, or XP operating environment. The computer should also be equipped with a RS232 serial port for connection to the GPU. A USB to serial port converter cable could also be used, if compatible. Hobart does not guaranteed that the software will work with all computers, please check with your IT department if you experience connection issues.

The following is a list of some of the ground power units that the service tool can be used on. Contact the factory for capability issues if your ground power unit is not on the list.

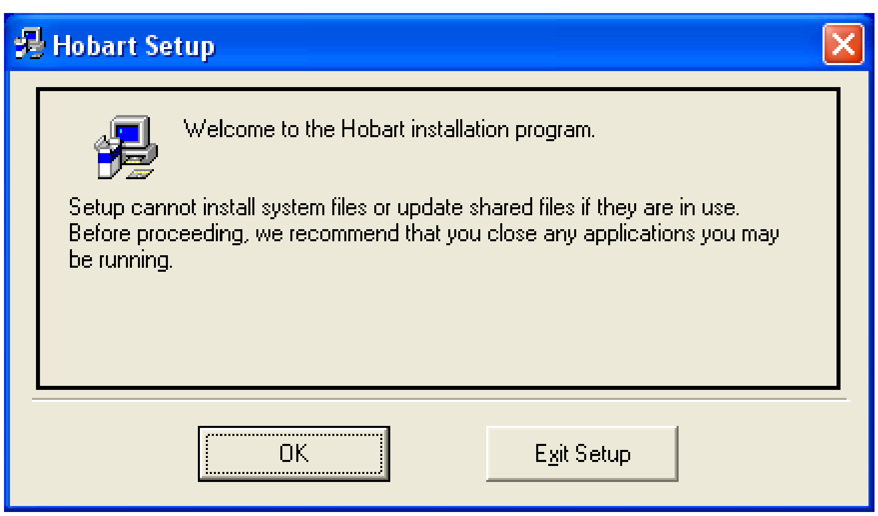
PoWerMaster ADV Solid State Converter, Model Series 30SX200 to 180SX200
Engine / Generator Model Series: 60CU24 (EPA Tier 2 engines and up) with or without 28.5 VDC T-R
Engine / Generator Model Series: 90CU20 to 180CU20 with or without 28.5 VDC T-R
Engine / Generator Model Series: 90DZ20 to 180DZ20 with or without 28.5 VDC T-R

3) Installation Instructions

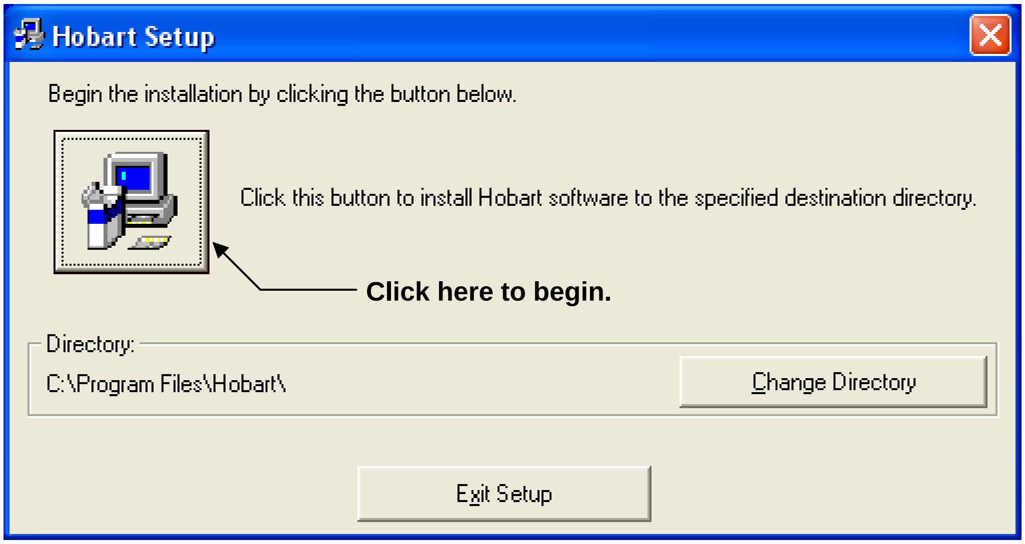
a) Insert CD into CD Drive

b) Execute Setup.exe from your CD Drive to install the software on your computer.

c) Follow the on screen instructions below.

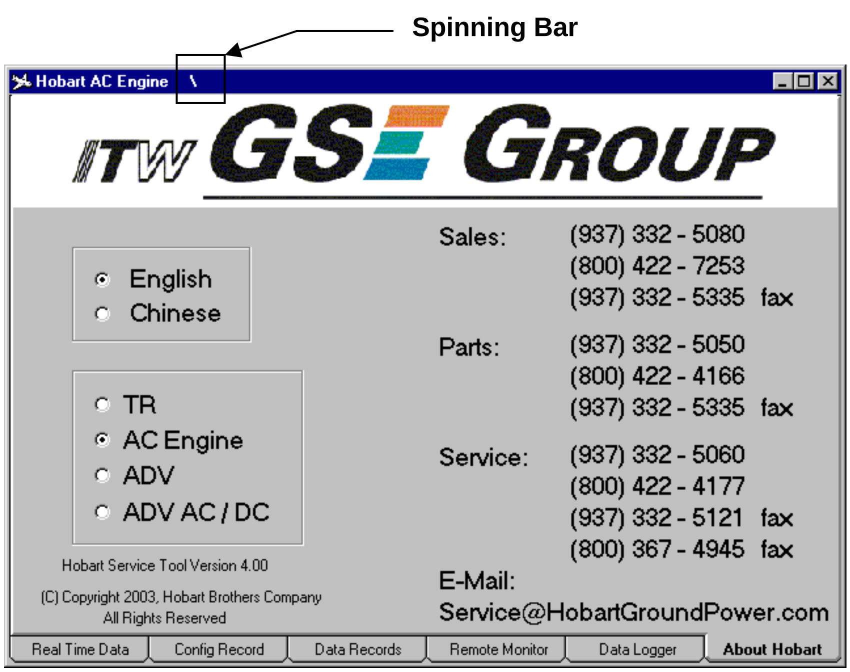


Introduction Screen



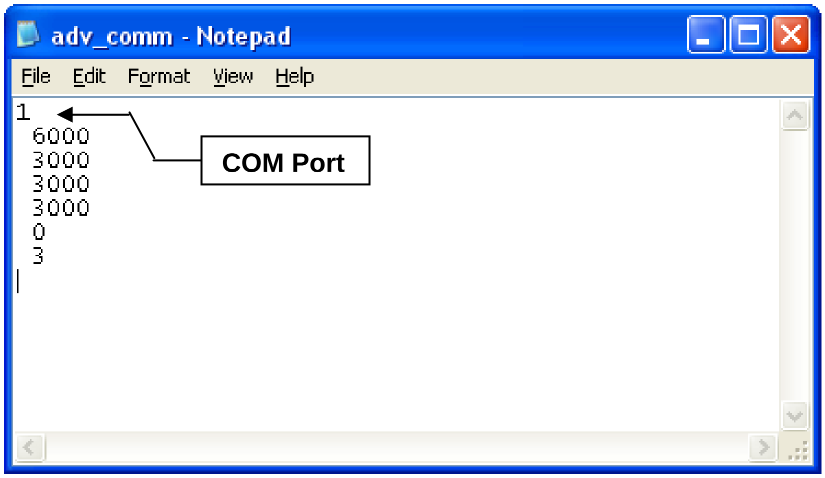
Installation Screen

d) Connect the serial cable to the computer and to the GPU (via the CTL PCB located in the control box). Press the "**ENGINE START**" pushbutton to activate the control system and the engine's ECM bringing the engine to idle speed. If the software is running correctly, the screen will look as follows, with a spinning bar at the top of the window.



Initial Opening Screen

e) It may be necessary to change the COM Port the software is using. The COM Port number can be changed, by editing file "C:\adv_comm.txt". The COM Port number is the first line in the "C:\avd_comm.txt" file. Notepad can be used to make this change and resaved.

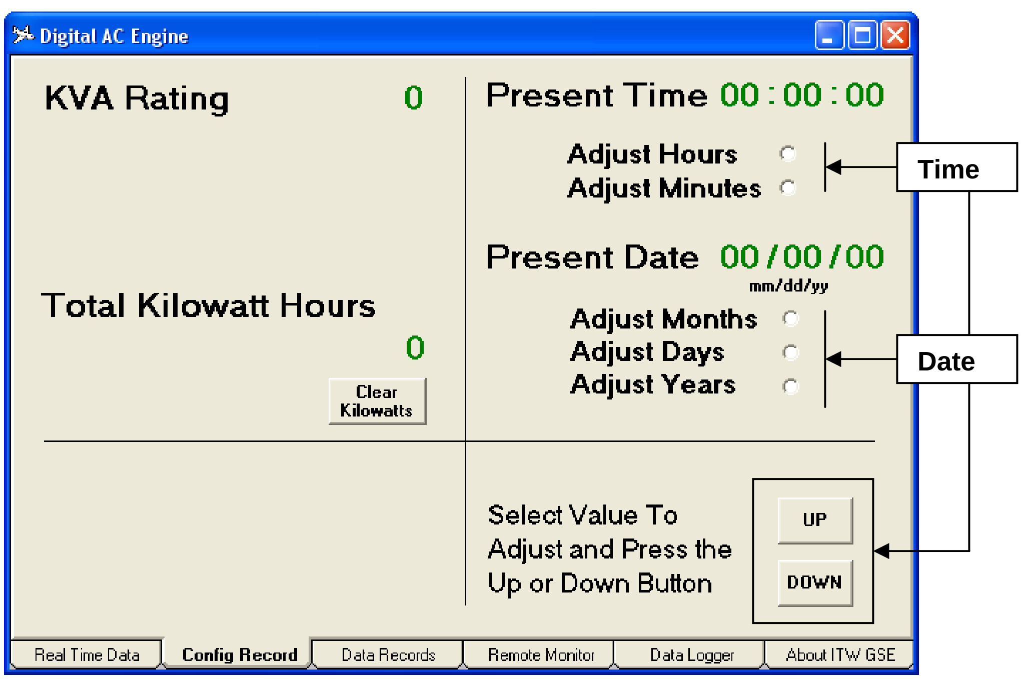


COM Port Change (if necessary)

4) Operating Instructions

a) Initial Setup Screen

Set the initial opening screen for the type of ground power unit and voltage output the service tool will be connected to for monitoring and/or troubleshooting.

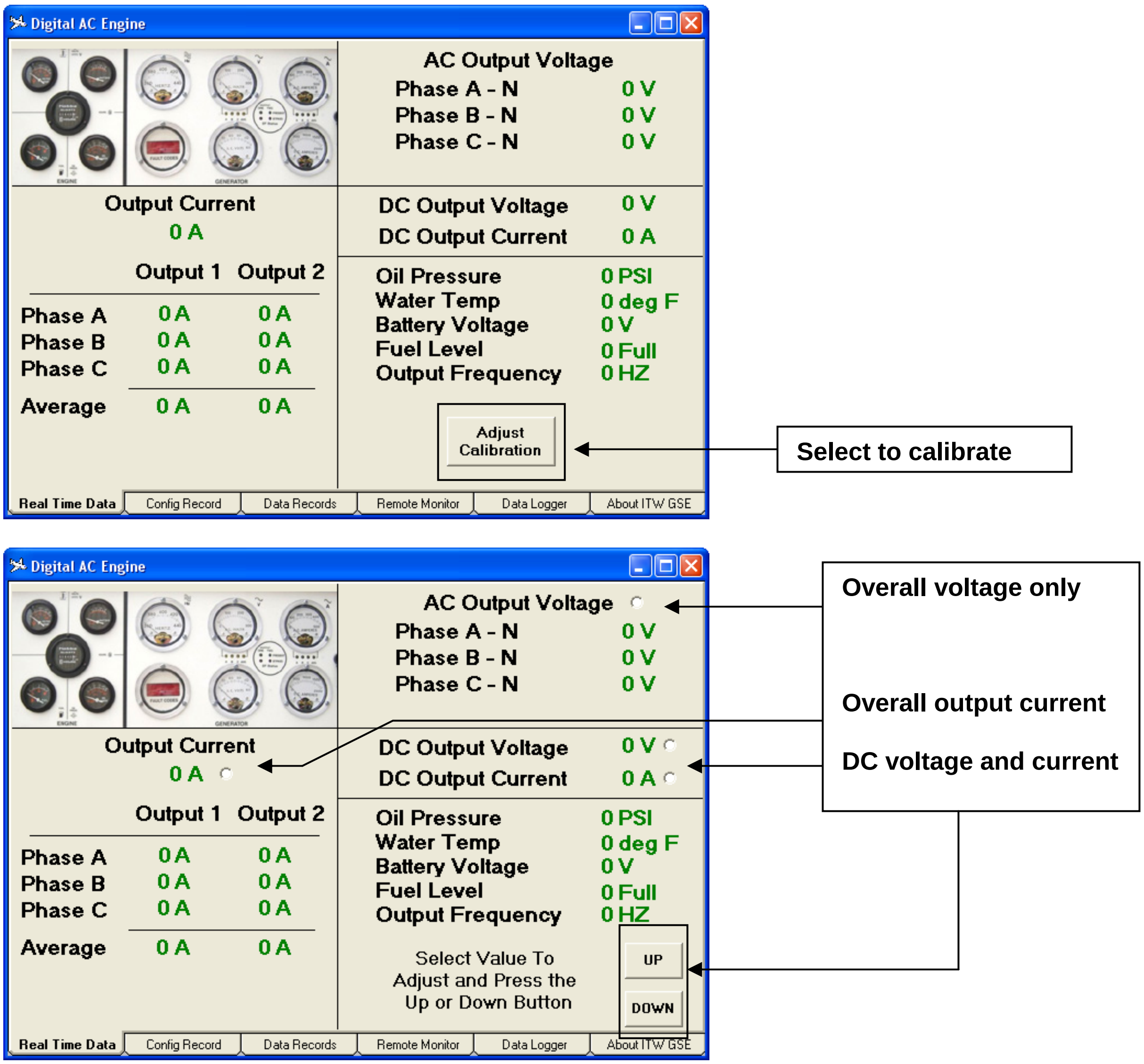


Configuration Record Screen

b) GPU Configuration Record Setup Screen

This screen can be used to set the time and date stamp information for the data and fault code records and also identifies the kVA rating of the ground power unit. The date and time should have been set at the factory, but if a new CTL PCB was installed, the time and date settings may need to be reset.

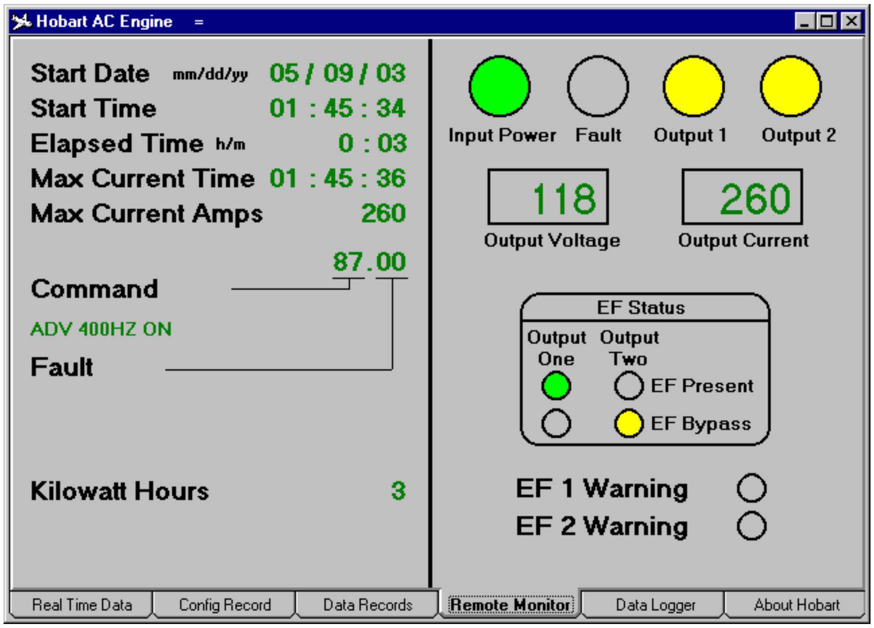
Choose the portion that needs adjusted and then press the either the “UP” and “DOWN” buttons to set the time and date.



Real Time Data Screen

c) Real Time Data and Remote Monitor Screens

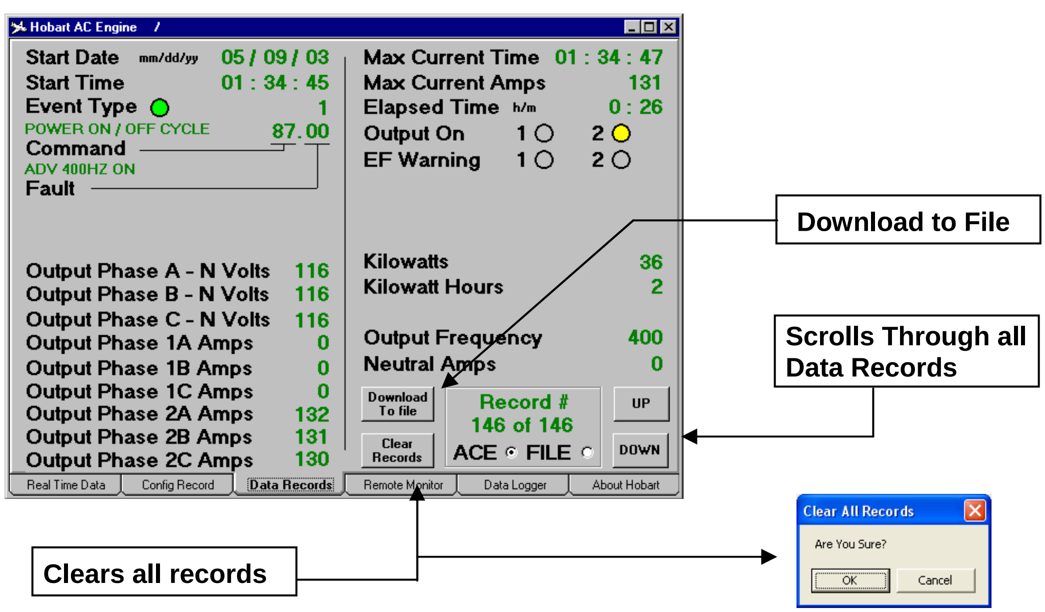
These screens can be used to monitor real time data from a remote location. The real time data screen can also be used to calibrate the output voltages and the output current readings. The remote screen identifies the pushbuttons and indicator lights activated during operation, as well as, displaying the generator meter readings.



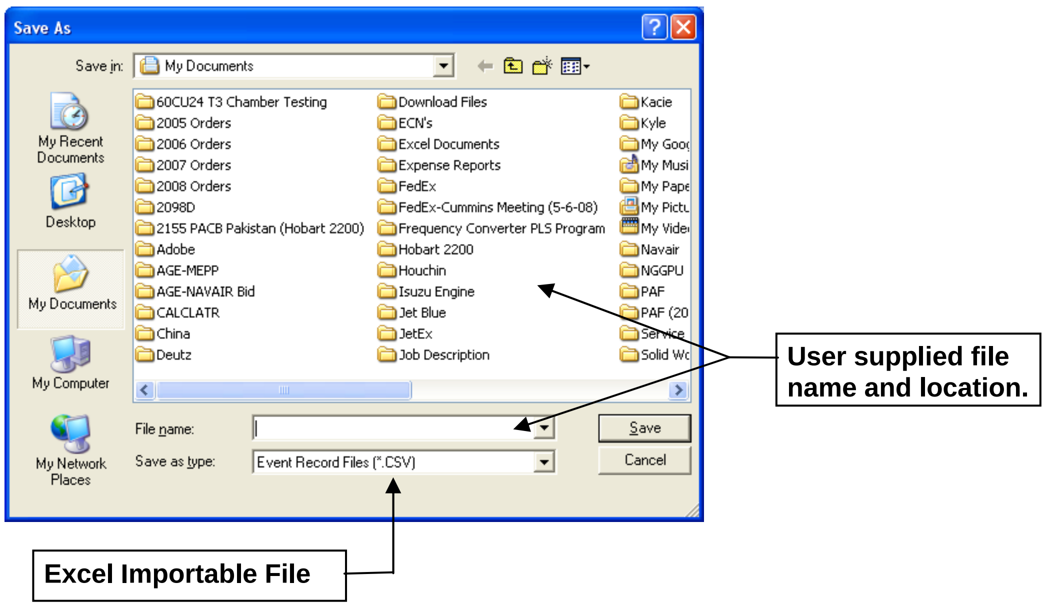
Remote Monitoring Screen

d) Data Records Screen

This screen can be used as an interrogation tool to 1) troubleshooting a current fault code, 2) troubleshoot reoccurring fault codes, or 3) check out the past operating data and performance. This screen allows the user to clear all data records, if necessary.



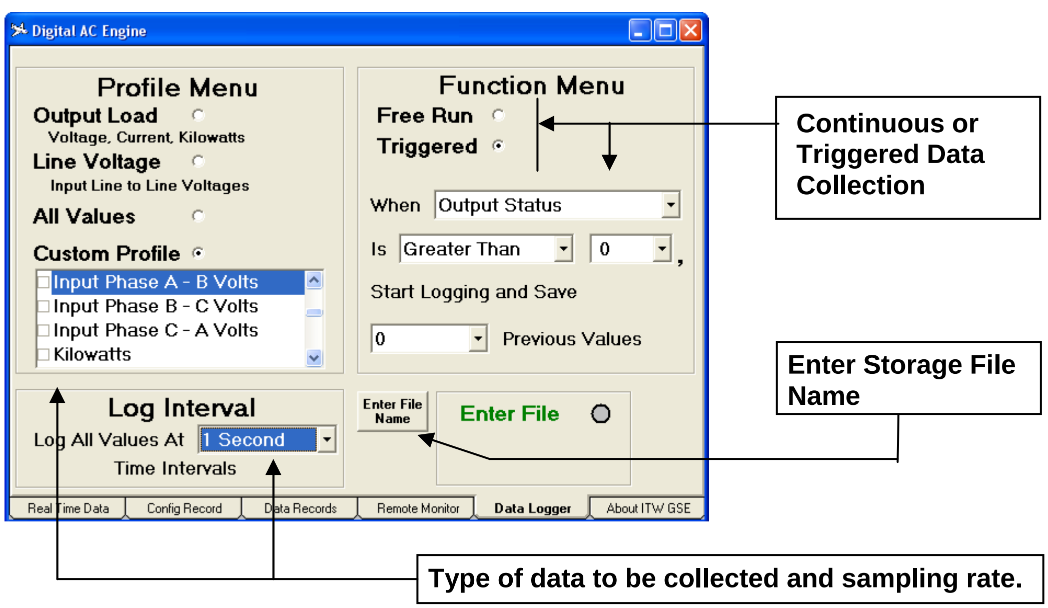
Data Records Screen



Data Records and Data Logger "Download to File" Screen

e) Data Logger Screen

This screen can be used as another interrogation tool to monitor the operating conditions in different applications (i.e. track aircraft power usage over time).

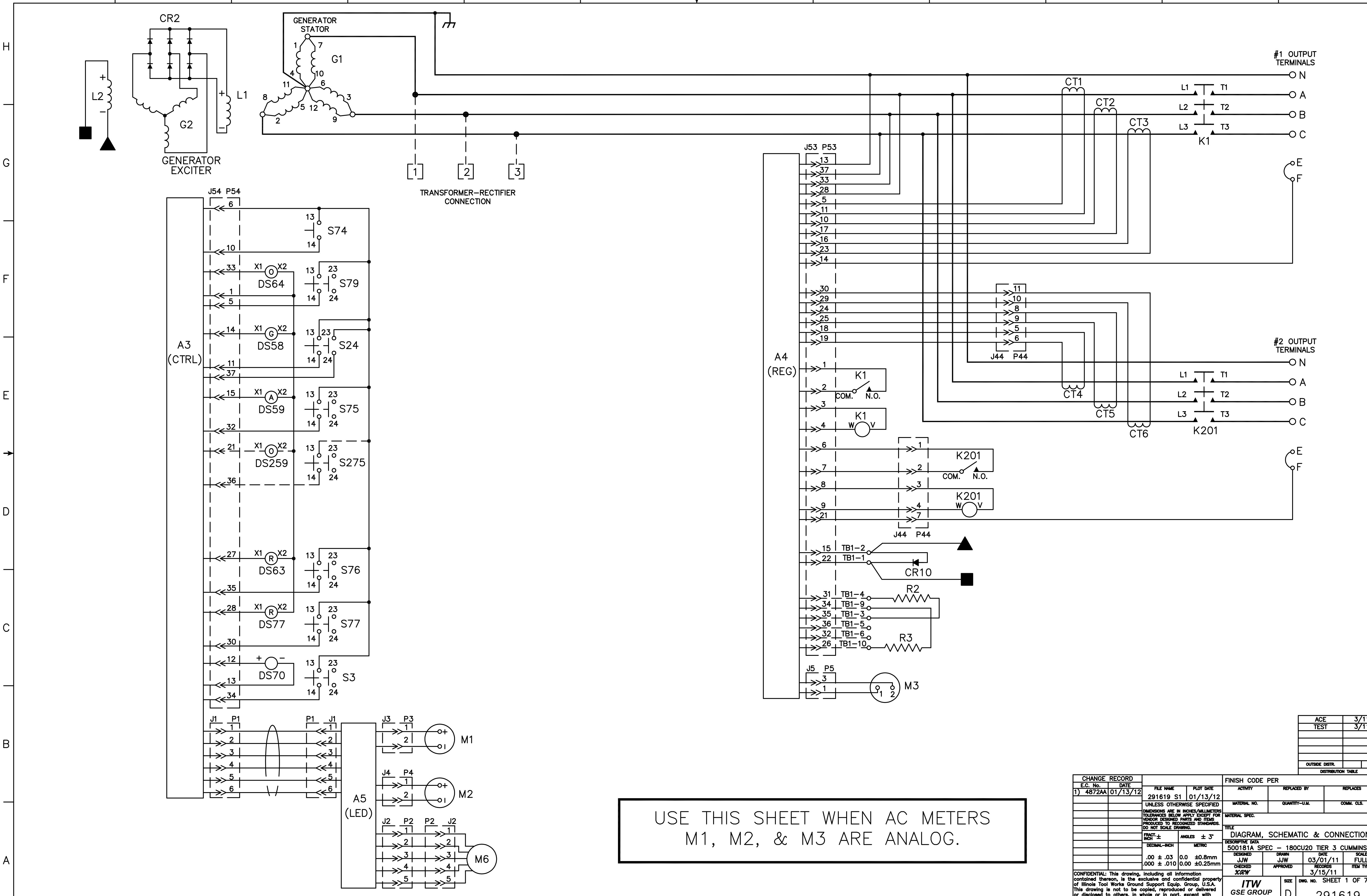


Data Logger Screen

5) Customer Service

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 Brothers Company Service Department 1177 Trade Square 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



USE THIS SHEET WHEN AC METERS M1, M2, & M3 ARE ANALOG.

CHANGE RECORD	
E.C. No.	DATE
1) 4872AA	01/13/12

FILE NAME: 291619 S1 — PLOT DATE: 01/13/12

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. INCH ± — ANGLES ± 3°

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

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FINISH CODE PER

TITLE: DIAGRAM, SCHEMATIC & CONNECTION

DESCRIPTIVE DATA: 500181A SPEC – 180CU20 TIER 3 CUMMINS

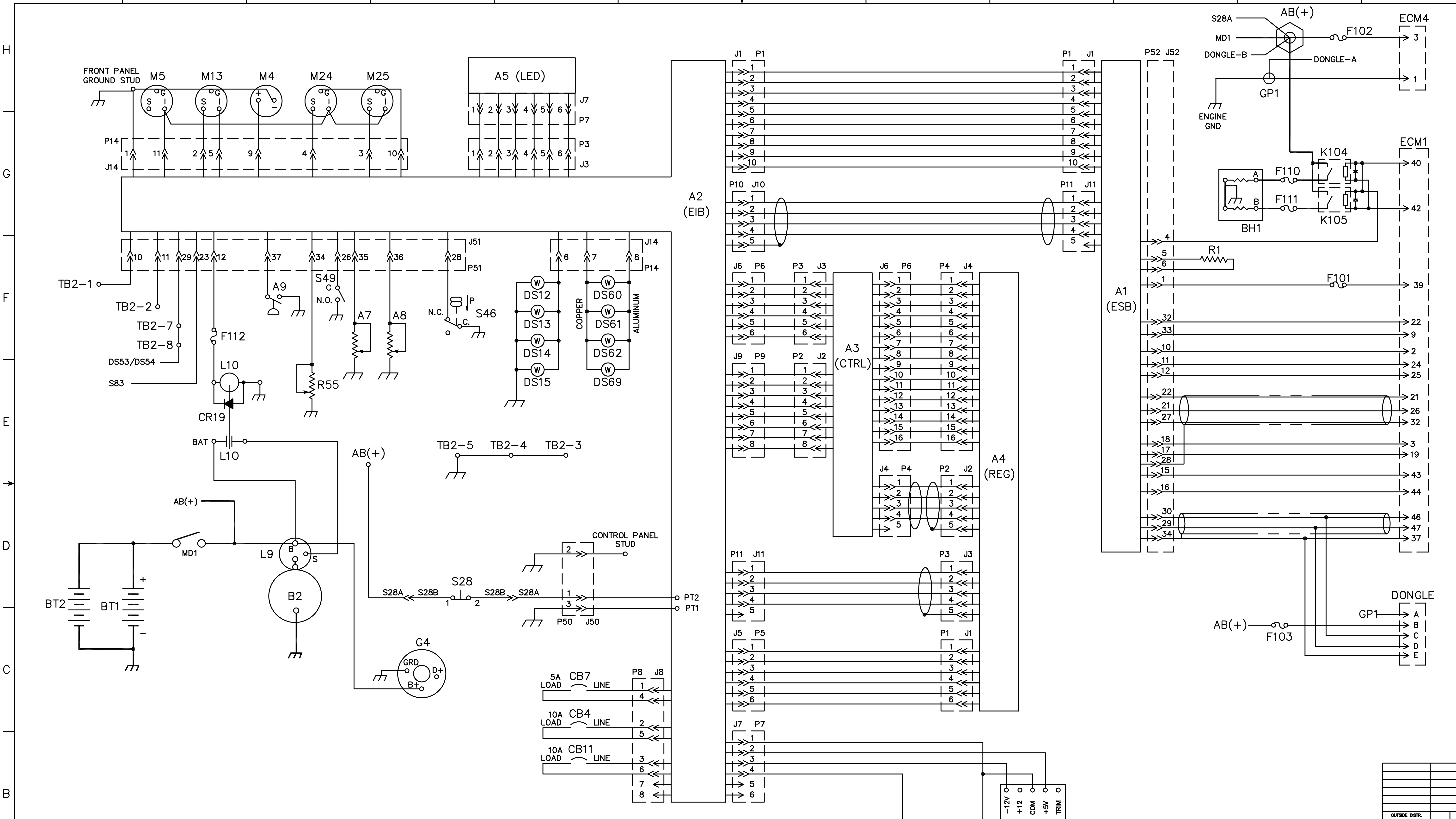
DESIGNED	DRAWN	DATE	SCALE
JJW	JJW	03/01/11	FULL
CHECKED	APPROVED	RECORDS	ITEM TYPE
XXW		3/15/11	

ITW GSE GROUP U.S.A.

SIZE D — DWG. NO. 291619 — SHEET 1 OF 7

ACE	3/11
TEST	3/11

OUTSIDE DISTR. — DISTRIBUTION TABLE



CHANGE RECORD

E.C. No.	DATE
1) 4872AA	01/13/12

FILE NAME	PLOT DATE
291619 S1	01/13/12

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. INCH ± | ANGLES ± 3°

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

FINISH CODE PER

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

MATERIAL SPEC.

TITLE
DIAGRAM, SCHEMATIC & CONNECTION

DESCRIPTIVE DATA
500181A SPEC – 180CU20 TIER 3 CUMMINS

DESIGNED	DRAWN	DATE	SCALE
JJW	JJW	03/01/11	FULL
CHECKED	APPROVED	RECORDS	ITEM TYPE
KRW		3/15/11	

ITW GSE GROUP U.S.A. | SIZE D | DWG. NO. 291619 | SHEET 2 OF 7

OUTSIDE DISTR.
DISTRIBUTION TABLE

LEGEND

A1	BOARD, P.C., ENGINE SPECIFIC BOARD (ESB)
A2	BOARD, P.C., ENGINE INTERFACE BOARD (EIB)
A3	BOARD, P.C., CONTROL BOARD (CTRL)
A4	BOARD, P.C., REGULATOR BOARD (REG)
A5	BOARD, P.C., LED BOARD (LED)
A7	SENSOR, WATER TEMPERATURE
A8	SENSOR, OIL PRESSURE
A9	SENSOR, AIR CLEANER SERVICE
AB(+)	AUX. POSITIVE BATTERY TERMINAL
B2	STARTER, ENGINE, 12 V.
BH1	GRID HEATER
BT1, BT2	BATTERY, 12 V.
CL1	SENSOR, COOLANT LEVEL
CB4	CIRCUIT BREAKER, ENGINE ELECTRICAL, 10 A.
CB7	CIRCUIT BREAKER, CONTROL CIRCUIT, 5 A.
CB11	CIRCUIT BREAKER, MARKER LIGHTS, 10 A.
CR2	RECTIFIER, GENERATOR REVOLVING FIELD
CR10	DIODE, FLYBACK, EXCITER
CR19	DIODE, FLYBACK, AUXILIARY STARTER SOLENOID
CT1–CT3	TRANSFORMER, CURRENT, #1 OUTPUT
CT4–CT6	TRANSFORMER, CURRENT, #2 OUTPUT (WHEN FURNISHED)
DS12	LIGHT, VOLTMETER, BATTERY (WHITE)
DS13	LIGHT, OIL PRESSURE GAUGE (WHITE)
DS14	LIGHT, TEMPERATURE GAUGE (WHITE)
DS15	LIGHT, FUEL GAUGE (WHITE)
DS58	INDICATOR, PUSHBUTTON, ENGINE START (GREEN)
DS59	INDICATOR, PUSHBUTTON, OUTPUT NO. 1 (AMBER)
DS60	LIGHT, STRIP, FREQUENCY METER
DS61	LIGHT, STRIP, AMMETER
DS62	LIGHT, STRIP, VOLTMETER
DS63	INDICATOR, PUSHBUTTON, DELAYED ENGINE SHUTDOWN (RED)
DS64	INDICATOR, PUSHBUTTON, PRE–HEATER (ORANGE)
DS69	LIGHT, STRIP, FAULT METER
DS70	LIGHT, STRIP, SWITCH BOX
DS77	INDICATOR, PUSHBUTTON, TEST/RESET (RED)
DS259	IND., PUSHBUTTON, OUTPUT NO. 2 (ORANGE) (WHEN FURNISHED)
ECM	CONNECTOR, ELECTRONIC CONTROL MODULE 1
ECM2	CONNECTOR, ELECTRONIC CONTROL MODULE 2 (DONGAL)
ECM4	CONNECTOR, ELECTRONIC CONTROL MODULE 4
F101	FUSE, "E" ENGINE, 5A.
F102	FUSE, POWER, ECM, 30A.
F103	FUSE, DONGAL, 1A.
F110	FUSE, AIR INTAKE, HEATER #1, 125A.
F111	FUSE, AIR INTAKE, HEATER #2, 125A.
G1	GENERATOR, STATOR
G2	EXCITER, ARMATURE GENERATOR
G4	ALTERNATOR, ENGINE, 12 V.
GP1	GROUND PLATE
J44	RECEPTACLE, POWER MODULE, 2ND OUTPUT
J50	RECEPTACLE, POWER
J51	RECEPTACLE, ENGINE INTERFACE (EIB)
J52	RECEPTACLE, ENGINE SPECIFIC PCB (ESB)
J53	RECEPTACLE, REGULATOR PCB (REG)
J54	RECEPTACLE, CONTROL PCB (CTRL)
K1	CONTACTOR, #1 A.C. OUTPUT
K104	RELAY, AIR INTAKE, HEATER #1
K105	RELAY, AIR INTAKE, HEATER #2
K201	CONTACTOR, #2 A.C. OUTPUT (WHEN FURNISHED)
L1	FIELD, REVOLVING, GENERATOR
L2	FIELD, EXCITER, GENERATOR
L9	SOLENOID, STARTER
L10	SOLENOID, STARTER, AUXILIARY
M1	AMMETER, A.C. GENERATOR
M2	VOLTMETER, A.C. GENERATOR
M3	FREQUENCY METER
M4	RUNNING TIME METER, ENGINE–GENERATOR
M5	VOLTMETER, BATTERY
M6	GAUGE, FAULT CODE
M7	CAN–BUS METER
M13	GAUGE, FUEL, ELECTRIC
M24	GAUGE, WATER TEMPERATURE
M25	GAUGE, OIL PRESSURE
MD1	MASTER DISCONNECT SWITCH
P44	PLUG, 2ND OUTPUT (WHEN FURNISHED)
P50	PLUG, POWER
P51	PLUG, ENGINE INTERFACE BOARD
P52	PLUG, ENGINE SPECIFIC BOARD
P53	PLUG, REGULATOR PCB TO POWER MODULE
P54	PLUG, CONTROL BOARD
PS1	POWER SUPPLY
R1	RESISTOR, ENGINE I.D., 1K, 1/4 W, 1%
R2	RESISTOR, GENERATOR/KVA, I.D.
R3	RESISTOR, POWER MODULE I.D.
R55	SENDER, ELECTRIC FUEL GAUGE
S3	SWITCH, METER SELECTOR
S24	SWITCH, ENGINE START
S28	SWITCH, PUSHBUTTON, EMERGENCY STOP
S28A	SWITCH. EMERGENCY STOP, MALE CONNECTOR
S28B	SWITCH, EMERGENCY STOP, FEMALE CONNECTOR
S46	SWITCH, LUBE OIL PRESSURE ENGINE
S49	SWITCH. HIGH TEMPERATURE, ENGINE
S74	SWITCH, PUSHBUTTON, LAMPS AND FUEL CHECK
S75	SWITCH. PUSHBUTTON, OUTPUT NO. 1
S76	SWITCH, PUSHBUTTON, ENGINE STOP & ENGINE FAULT RESET
S77	SWITCH, PUSHBUTTON, TEST/RESET
S79	SWITCH, PUSHBUTTON, PRE–HEATER
S83	SWITCH. LOW COOLANT, (WHEN FURNISHED)
S275	SWITCH. PUSHBUTTON, OUTPUT NO. 2 (WHEN FURNISHED)
TB1	TERMINAL BLOCK, POWER MODULE
TB2	TERMINAL BLOCK, OPTIONS

CHANGE RECORD

E.C. No.	DATE
1) 4872AA	01/13/12

FILE NAME 291619 S3 PLOT DATE 01/13/12

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.-INCH ± ANGLES ± 3°

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

FINISH CODE PER — ACTIVITY — REPLACED BY — REPLACES — MATERIAL NO. — QUANTITY–U.M. — COMM. CLS. — MATERIAL SPEC.

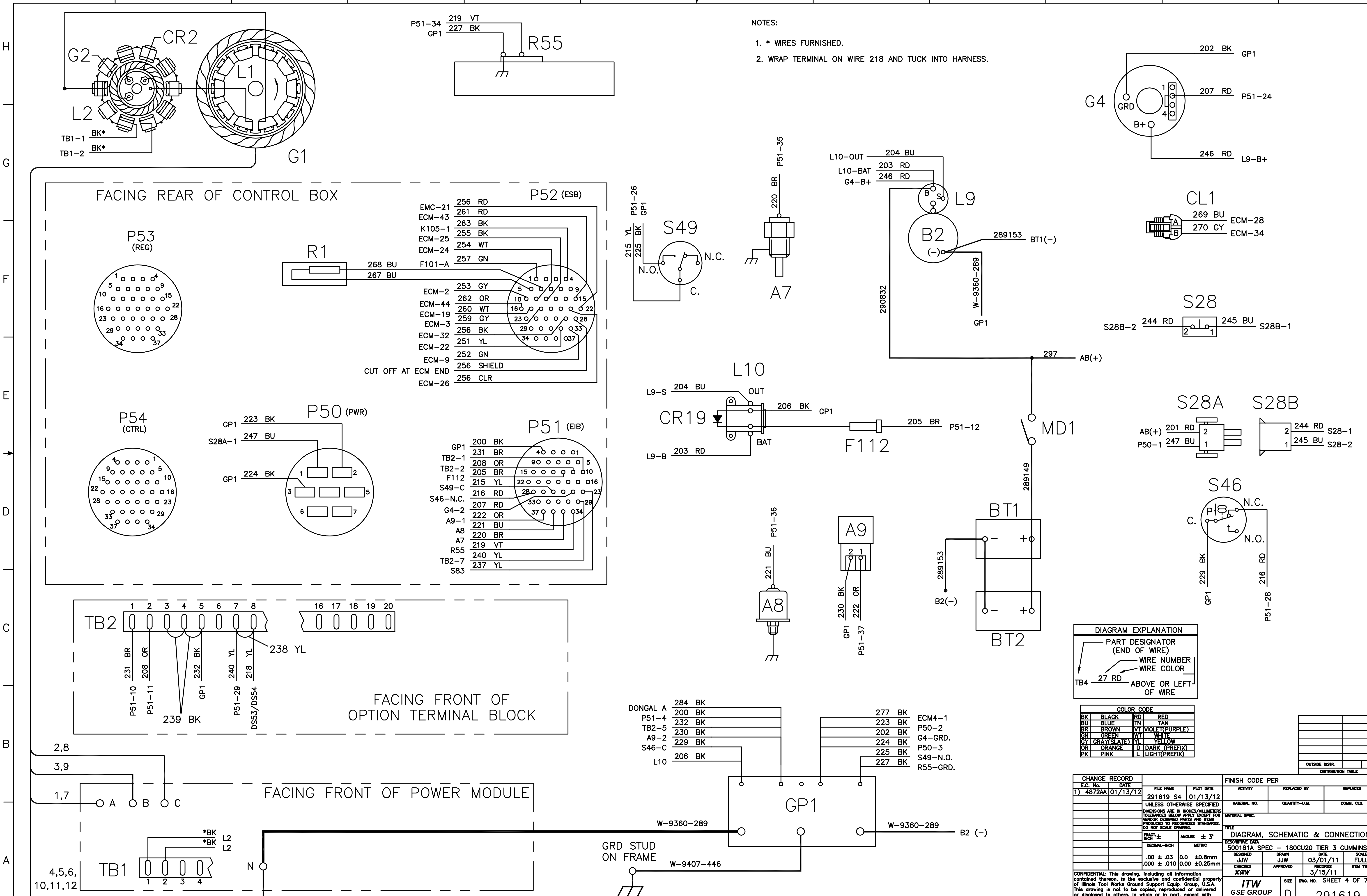
OUTSIDE DISTR. DISTRIBUTION TABLE

TITLE DIAGRAM, CONNECTION, CONTROL BOX

DESCRIPTIVE DATA 500181A SPEC – 180CU20 TIER 3 CUMMINS

DESIGNED	DRAWN	DATE	SCALE
JJW	JJW	03/01/11	FULL
CHECKED	APPROVED	RECORDS	ITEM TYPE
XXW		3/15/11	

ITW GSE GROUP U.S.A. SIZE D DWG. NO. 291619 SHEET 3 OF 7


NOTES:
1. * WIRES FURNISHED.
2. WRAP TERMINAL ON WIRE 218 AND TUCK INTO HARNESS.
FACING REAR OF CONTROL BOX
FACING FRONT OF OPTION TERMINAL BLOCK
FACING FRONT OF POWER MODULE
P52 (ESB)
P53 (REG)
P54 (CTRL)
P50 (PWR)
P51 (EIB)
G1
G2
CR2
L1
L2
R55
R1
S49
A7
L9
B2
G4
CL1
S28
S28A
S28B
S46
L10
CR19
F112
MD1
BT1
BT2
A8
A9
GP1
TB1
TB2
GRD STUD ON FRAME
W-9360-289
W-9407-446
DIAGRAM EXPLANATION
PART DESIGNATOR (END OF WIRE)
WIRE NUMBER
WIRE COLOR
ABOVE OR LEFT OF WIRE
TB4 27 RD
COLOR CODE
BK BLACK
BU BLUE
BR BROWN
GN GREEN
GY GRAY(SLATE)
OR ORANGE
PK PINK
RD RED
TN TAN
VT VIOLET(PURPLE)
WT WHITE
YL YELLOW
D DARK (PREFIX)
L LIGHT(PREFIX)
CHANGE RECORD
E.C. No. DATE
1) 4872AA 01/13/12
FILE NAME 291619 S4
PLOT DATE 01/13/12
UNLESS OTHERWISE SPECIFIED
DIAGRAM, SCHEMATIC & CONNECTION
500181A SPEC – 180CU20 TIER 3 CUMMINS
DESIGNED JJW
DRAWN JJW
DATE 03/01/11
SCALE FULL
RECORDS 3/15/11
ITW GSE GROUP U.S.A.
SIZE D
DWG. NO. 291619
SHEET 4 OF 7
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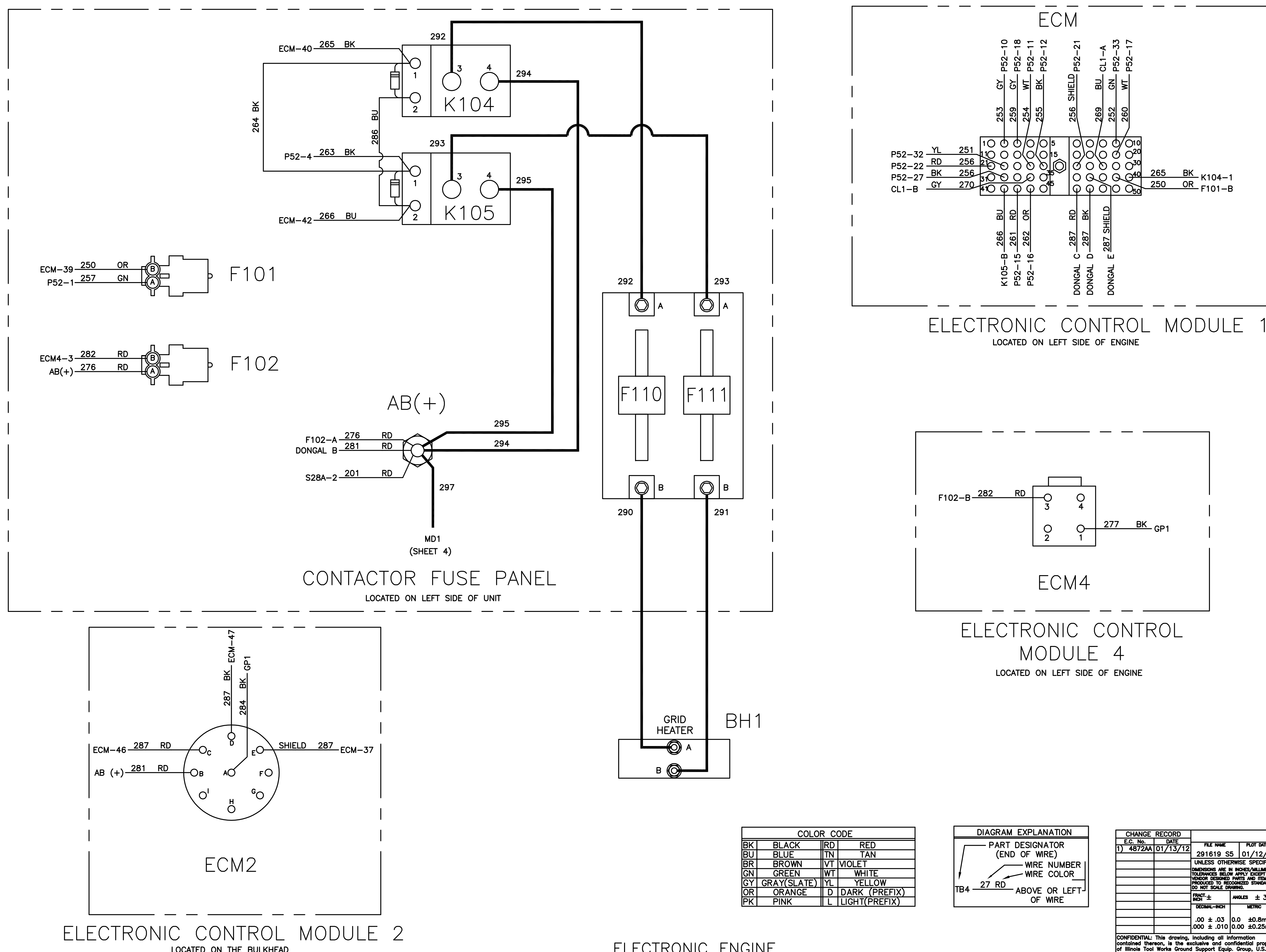

ELECTRONIC ENGINE

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) 4872AA	01/13/12

FILE NAME: 291619 S5 PLOT DATE: 01/12/13

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. INCH ± ANGLES ± 3°
DECIMAL-INCH / METRIC
.00 ± .03 0.0 ±0.8mm
.000 ± .010 0.00 ±0.25mm

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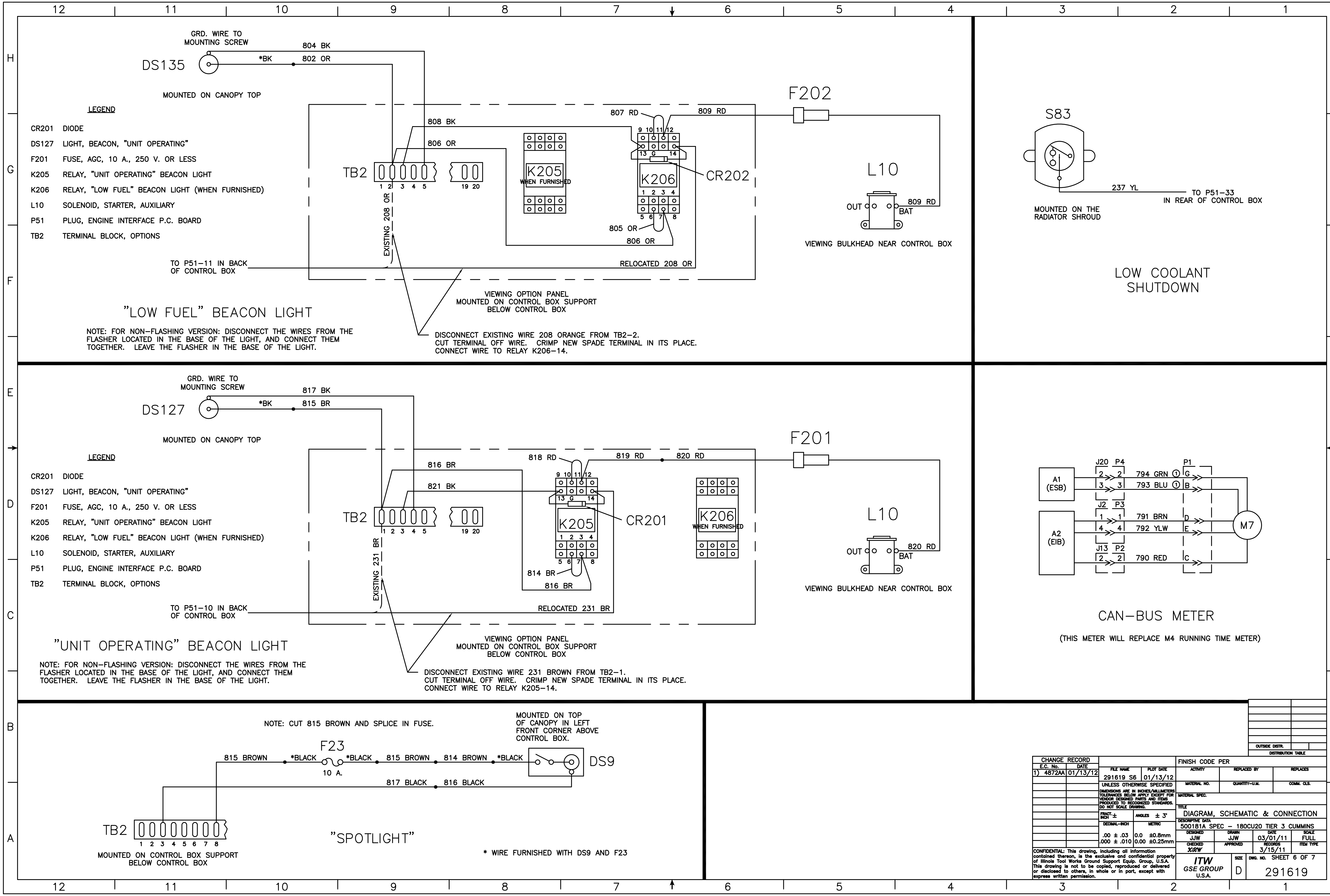
FINISH CODE PER
ACTIVITY | REPLACED BY | REPLACES
MATERIAL NO. | QUANTITY-U.M. | COMM. CLS.
MATERIAL SPEC.

TITLE: DIAGRAM, SCHEMATIC & CONNECTION
DESCRIPTIVE DATA: 500181A SPEC - 180CU20 TIER 3 CUMMINS

DESIGNED	DRAWN	DATE	SCALE
JJW	JJW	03/01/11	FULL
CHECKED	APPROVED	RECORDS	ITEM TYPE
XXW		3/15/11	

ITW GSE GROUP U.S.A.
SIZE D DWG. NO. 291619 SHEET 5 OF 7

OUTSIDE DISTR. / DISTRIBUTION TABLE


"LOW FUEL" BEACON LIGHT
DS135
GRD. WIRE TO MOUNTING SCREW
MOUNTED ON CANOPY TOP
804 BK
*BK
802 OR
808 BK
806 OR
807 RD
809 RD
F202
TB2
1 2 3 4 5
19 20
K205
WHEN FURNISHED
K206
CR202
9 10 11 12
13 G 14
1 2 3 4
5 6 7 8
805 OR
806 OR
EXISTING 208 OR
RELOCATED 208 OR
TO P51-11 IN BACK OF CONTROL BOX
L10
OUT
BAT
809 RD
VIEWING BULKHEAD NEAR CONTROL BOX
VIEWING OPTION PANEL MOUNTED ON CONTROL BOX SUPPORT BELOW CONTROL BOX
DISCONNECT EXISTING WIRE 208 ORANGE FROM TB2-2. CUT TERMINAL OFF WIRE. CRIMP NEW SPADE TERMINAL IN ITS PLACE. CONNECT WIRE TO RELAY K206-14.
NOTE: FOR NON-FLASHING VERSION: DISCONNECT THE WIRES FROM THE FLASHER LOCATED IN THE BASE OF THE LIGHT, AND CONNECT THEM TOGETHER. LEAVE THE FLASHER IN THE BASE OF THE LIGHT.
LEGEND
CR201 DIODE
DS127 LIGHT, BEACON, "UNIT OPERATING"
F201 FUSE, AGC, 10 A., 250 V. OR LESS
K205 RELAY, "UNIT OPERATING" BEACON LIGHT
K206 RELAY, "LOW FUEL" BEACON LIGHT (WHEN FURNISHED)
L10 SOLENOID, STARTER, AUXILIARY
P51 PLUG, ENGINE INTERFACE P.C. BOARD
TB2 TERMINAL BLOCK, OPTIONS
LOW COOLANT SHUTDOWN
S83
MOUNTED ON THE RADIATOR SHROUD
237 YL
TO P51-33 IN REAR OF CONTROL BOX
"UNIT OPERATING" BEACON LIGHT
DS127
GRD. WIRE TO MOUNTING SCREW
MOUNTED ON CANOPY TOP
817 BK
*BK
815 BR
816 BR
821 BK
818 RD
819 RD
820 RD
F201
TB2
1 2 3 4 5
19 20
K205
CR201
9 10 11 12
13 G 14
1 2 3 4
5 6 7 8
814 BR
816 BR
K206
WHEN FURNISHED
EXISTING 231 BR
RELOCATED 231 BR
TO P51-10 IN BACK OF CONTROL BOX
L10
OUT
BAT
820 RD
VIEWING BULKHEAD NEAR CONTROL BOX
VIEWING OPTION PANEL MOUNTED ON CONTROL BOX SUPPORT BELOW CONTROL BOX
DISCONNECT EXISTING WIRE 231 BROWN FROM TB2-1. CUT TERMINAL OFF WIRE. CRIMP NEW SPADE TERMINAL IN ITS PLACE. CONNECT WIRE TO RELAY K205-14.
NOTE: FOR NON-FLASHING VERSION: DISCONNECT THE WIRES FROM THE FLASHER LOCATED IN THE BASE OF THE LIGHT, AND CONNECT THEM TOGETHER. LEAVE THE FLASHER IN THE BASE OF THE LIGHT.
LEGEND
CR201 DIODE
DS127 LIGHT, BEACON, "UNIT OPERATING"
F201 FUSE, AGC, 10 A., 250 V. OR LESS
K205 RELAY, "UNIT OPERATING" BEACON LIGHT
K206 RELAY, "LOW FUEL" BEACON LIGHT (WHEN FURNISHED)
L10 SOLENOID, STARTER, AUXILIARY
P51 PLUG, ENGINE INTERFACE P.C. BOARD
TB2 TERMINAL BLOCK, OPTIONS
CAN-BUS METER
(THIS METER WILL REPLACE M4 RUNNING TIME METER)
A1 (ESB)
A2 (EIB)
J20 P4
J2 P3
J13 P2
P1
794 GRN ①
793 BLU ①
791 BRN
792 YLW
790 RED
G B D E C
M7
"SPOTLIGHT"
NOTE: CUT 815 BROWN AND SPLICE IN FUSE.
F23
10 A.
815 BROWN
*BLACK
*BLACK
815 BROWN
814 BROWN
*BLACK
817 BLACK
816 BLACK
DS9
MOUNTED ON TOP OF CANOPY IN LEFT FRONT CORNER ABOVE CONTROL BOX.
TB2
1 2 3 4 5 6 7 8
MOUNTED ON CONTROL BOX SUPPORT BELOW CONTROL BOX
* WIRE FURNISHED WITH DS9 AND F23
CHANGE RECORD
E.C. No. DATE
1) 4872AA 01/13/12
FILE NAME 291619 S6
PLOT DATE 01/13/12
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.-INCH ± ANGLES ± 3°
DECIMAL-INCH METRIC
.00 ± .03 0.0 ±0.8mm
.000 ± .010 0.00 ±0.25mm
FINISH CODE PER
ACTIVITY REPLACED BY REPLACES
MATERIAL NO. QUANTITY-U.M. COMM. CLS.
MATERIAL SPEC.
OUTSIDE DISTR.
DISTRIBUTION TABLE
TITLE
DIAGRAM, SCHEMATIC & CONNECTION
DESCRIPTIVE DATA
500181A SPEC - 180CU20 TIER 3 CUMMINS
DESIGNED JJW
DRAWN JJW
DATE 03/01/11
SCALE FULL
CHECKED
APPROVED
RECORDS 3/15/11
ITEM TYPE
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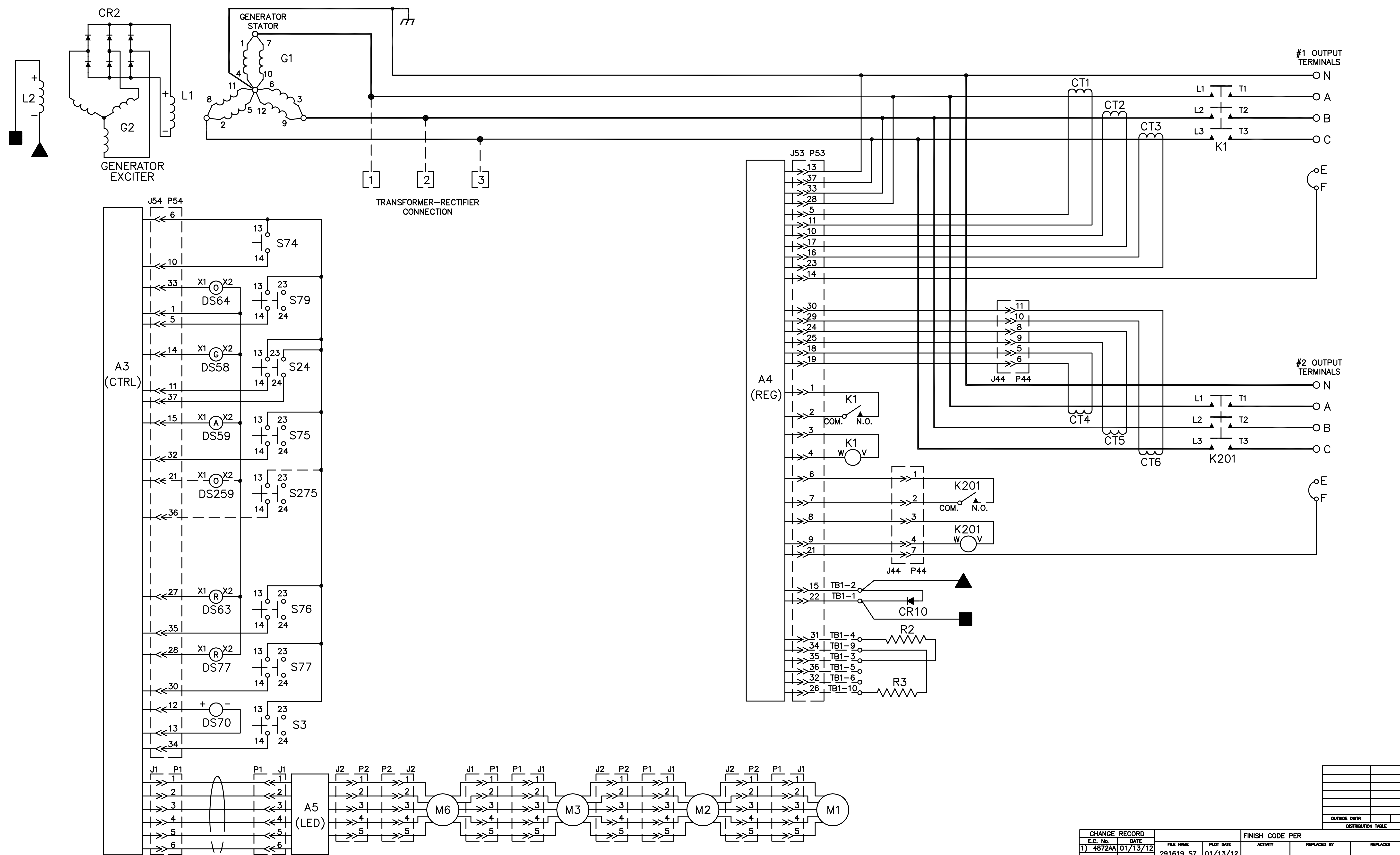
ITW GSE GROUP U.S.A.
SIZE D
DWG. NO. 291619
SHEET 6 OF 7



USE THIS SHEET WHEN AC METERS
M1, M2, & M3 ARE DIGITAL.

CHANGE RECORD	
E.C. No.	DATE
1) 4872AA	01/13/12

FILE NAME	PLOT DATE
291619 S7	01/13/12

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. INCH ± ANGLES ± 3°

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

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OUTSIDE DISTR. DISTRIBUTION TABLE

FINISH CODE PER

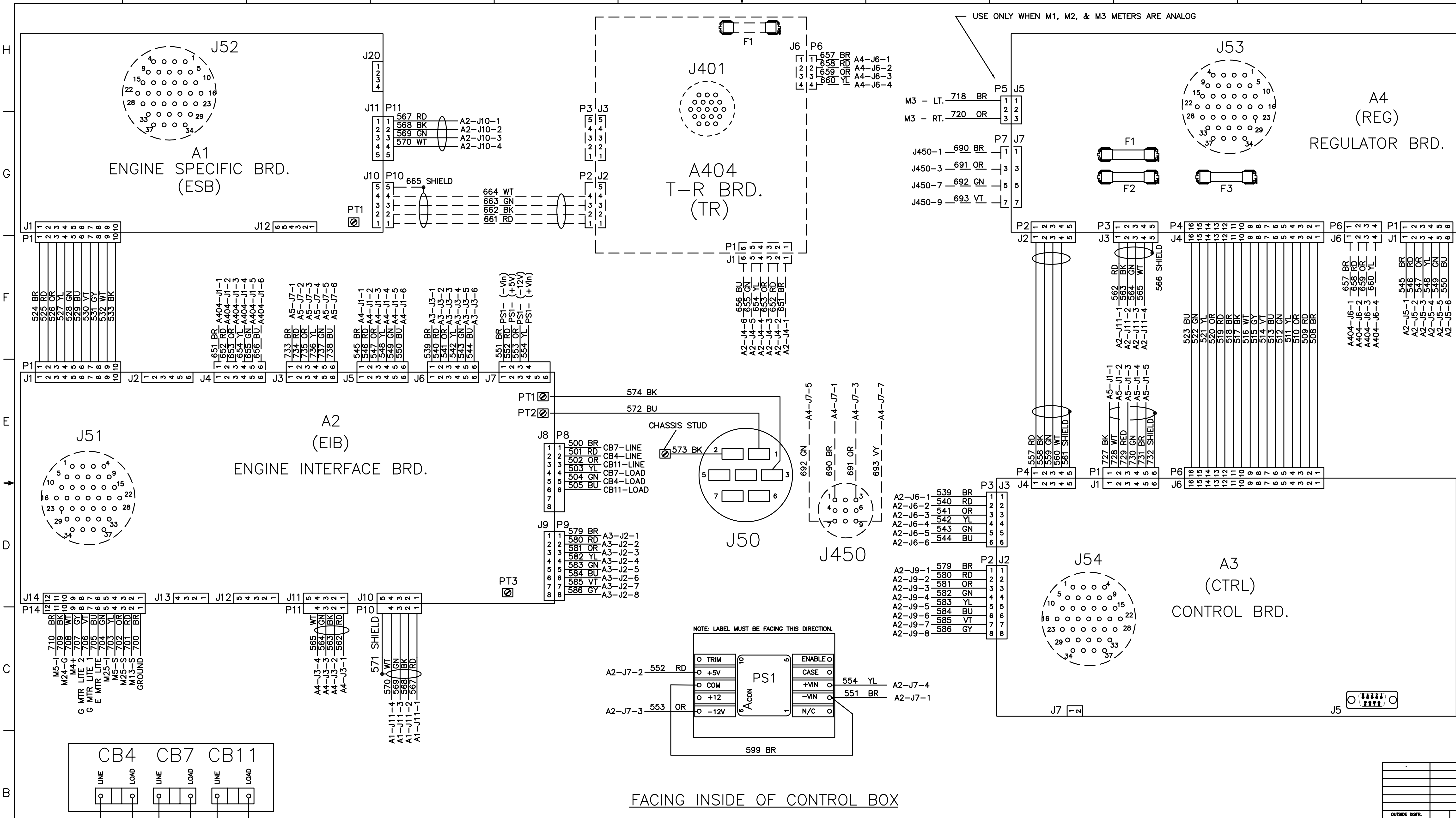
ACTIVITY	REPLACED BY	REPLACES
MATERIAL NO.	QUANTITY–U.M.	COMM. CLS.

MATERIAL SPEC.

TITLE
DIAGRAM, SCHEMATIC & CONNECTION
DESCRIPTIVE DATA
500181A SPEC – 180CU20 TIER 3 CUMMINS

DESIGNED	DRAWN	DATE	SCALE
JJW	JJW	03/01/11	FULL
CHECKED	APPROVED	RECORDS	ITEM TYPE
XXRW		3/15/11	

ITW GSE GROUP U.S.A.
SIZE D DWG. NO. SHEET 7 OF 7
291619



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) 3226AA	4/6/04
2) 3257AA	05/10/04

FILE NAME 289022S1 PLOT DATE 05/10/04
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. INCH ± ANGLES ± 3°
DECIMAL-INCH .00 ± .03 .000 ± .010 METRIC 0.0 ±0.8mm 0.00 ±0.25mm

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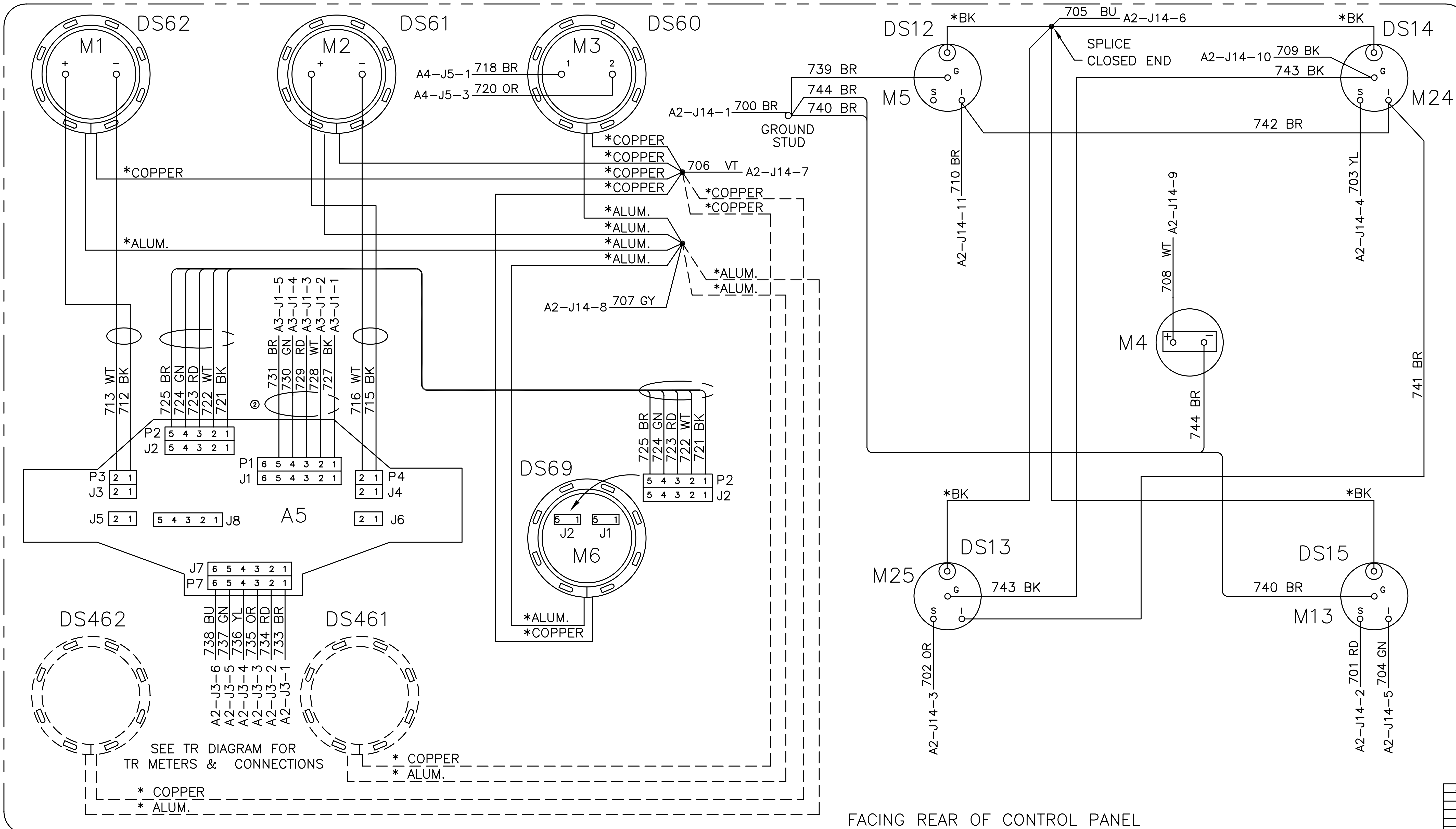
FINISH CODE PER 910176: NONE
TITLE DIAGRAM, CONNECTION, CONTROL BOX
DESIGNED RPH DRAWN RPH DATE 12/17/03 SCALE FULL
RECORDS 2/26/04
HOBART® TROY, OHIO 45373 U.S.A.
SIZE D DWG. NO. SHEET 1 OF 4 289022



NOTES:

1. * WIRES FURNISHED

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

USE THIS SHEET WHEN AC METERS
M1, M2, & M3 ARE ANALOG.

CHANGE RECORD	
E.C. No.	DATE
1) 3226AA	4/6/04
2) 3257AA	05/10/04

FILE NAME: 289022S2 PLOT DATE: 05/10/04

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. INCH ± ANGLES ± 3°

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

FINISH CODE PER 910176: NONE

ACTIVITY | REPLACED BY | REPLACES

MATERIAL NO. | QUANTITY–U.M. | COMM. CLS.

MATERIAL SPEC.

TITLE: DIAGRAM, CONNECTION, CONTROL BOX

DESCRIPTIVE DATA

DESIGNED RPH | DRAWN RPH | DATE 12/17/03 | SCALE FULL

CHECKED | APPROVED | RECORDS 2/26/04 | ITEM TYPE

HOBART TROY, OHIO 45373 U.S.A. | SIZE D | DWG. NO. 289022 | SHEET 2 OF 4

ACE (s) TEST

OUTSIDE DISTR. DISTRIBUTION TABLE

LEGEND

A1	BOARD, P.C., ENGINE SPECIFIC (ESB)
A2	BOARD, P.C., ENGINE INTERFACE (EIB)
A3	BOARD, P.C., CONTROL (CTRL)
A4	BOARD, P.C., REGULATOR (REG)
A5	BOARD, P.C., LED (LED)
A404	BOARD, P.C., TRANSFORMER–RECTIFIER (TR) (WHEN FURNISHED)
CB4	CIRCUIT BREAKER, ENGINE ELECTRICAL, 10 A.
CB7	CIRCUIT BREAKER, CONTROL CIRCUIT, 5 A.
CB11	CIRCUIT BREAKER, MARKER LIGHTS, 10 A.
DS12	LIGHT, VOLTMETER, BATTERY (WHITE)
DS13	LIGHT, OIL PRESSURE GAUGE (WHITE)
DS14	LIGHT, TEMPERATURE GAUGE (WHITE)
DS15	LIGHT, FUEL GAUGE (WHITE)
DS60	LIGHT, STRIP, FREQUENCY METER
DS61	LIGHT, STRIP, AC AMMETER
DS62	LIGHT, STRIP, AC VOLTMETER
DS69	LIGHT, STRIP, FAULT METER
DS461	LIGHT, STRIP, DC AMMETER (WHEN FURNISHED)
DS462	LIGHT, STRIP, DC VOLTMETER (WHEN FURNISHED)
F1 ON A4	FUSE, 5 A., 250 V.
F2 ON A4	FUSE, 1 A., 250 V.
F3 ON A4	FUSE, 1 A., 250 V.
F1 ON A404	FUSE, 1 A., 250 V. (WHEN FURNISHED)
J50	RECEPTACLE, POWER
J51	RECEPTACLE, ENGINE INTERFACE (EIB)
J52	RECEPTACLE, ENGINE SPECIFIC (ESB)
J53	RECEPTACLE, REGULATOR (REG)
J54	RECEPTACLE, CONTROL (CTRL)
J401	RECEPTACLE, TRANSFORMER–RECTIFIER (WHEN FURNISHED)
J450	RECEPTACLE, REMOTE VOLTAGE SENSING (WHEN FURNISHED)
M1	AMMETER, A.C. GENERATOR
M2	VOLTMETER, A.C. GENERATOR
M3	FREQUENCY METER
M4	RUNNING TIME METER, ENGINE–GENERATOR
M5	VOLTMETER, BATTERY
M6	GAUGE, FAULT CODE
M13	GAUGE, FUEL ELECTRIC
M24	GAUGE, WATER TEMPERATURE
M25	GAUGE, OIL PRESSURE
1	
1	
PS1	POWER SUPPLY

ACE (s)	
TEST	
OUTSIDE DISTR.	

DISTRIBUTION TABLE

CHANGE RECORD	
E.C. No.	DATE
1) 3226AA	4/6/04
2) 3257AA	05/10/04

FILE NAME	PLOT DATE
289022S3	05/10/04

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

FINISH CODE PER 910176: NONE

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

MATERIAL SPEC. –

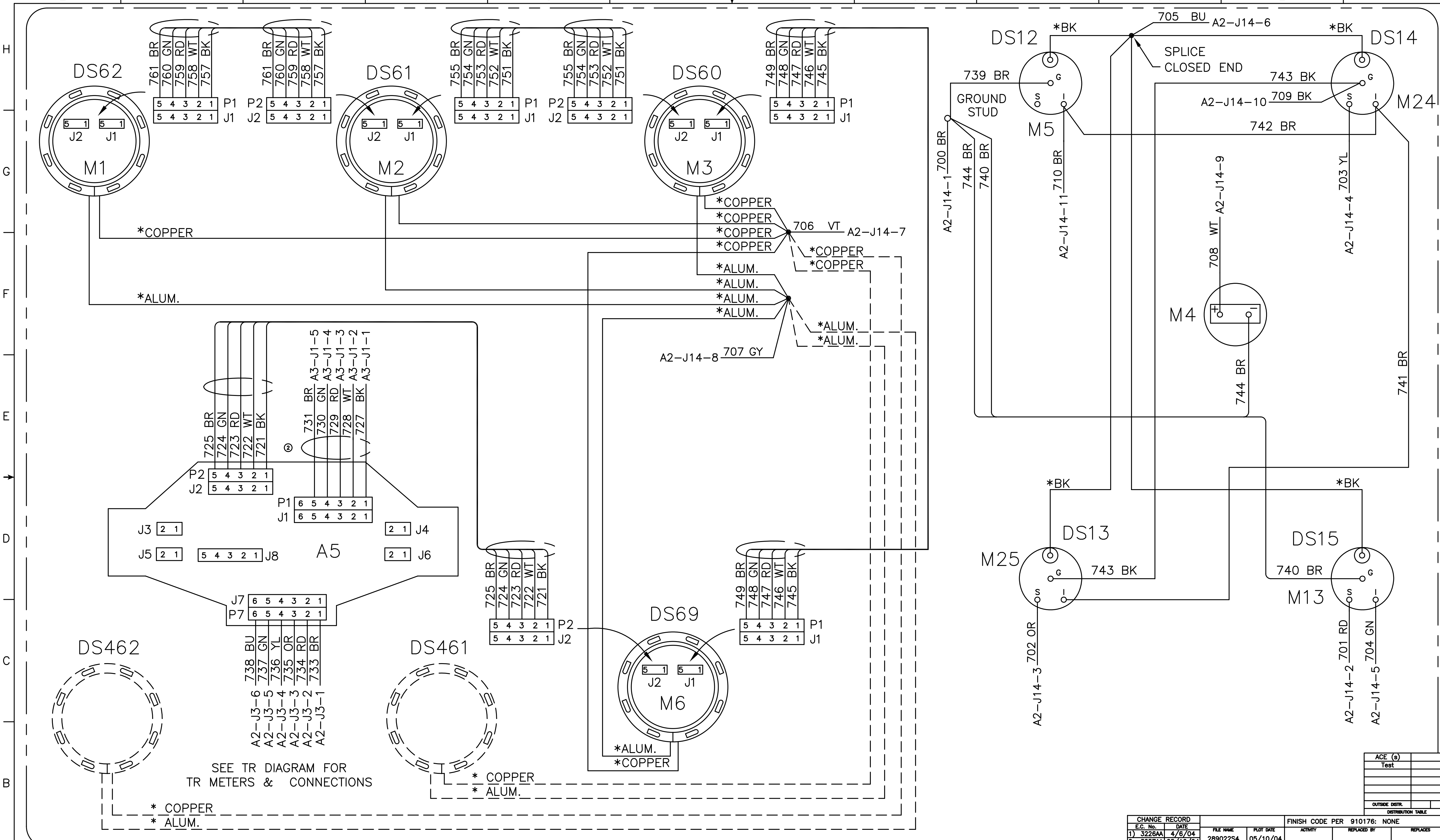
TITLE: DIAGRAM, CONNECTION, CONTROL BOX

DESCRIPTIVE DATA: 90/120 DIGITAL CONTROLS

DESIGNED	DRAWN	DATE	SCALE
RPH	RPH	2/23/04	FULL
CHECKED	APPROVED	RECORDS 2/26/04	ITEM TYPE

HOBART® TROY, OHIO 45373 U.S.A.

SIZE C — DWG. NO. 289022 — SHEET 3 OF 4 — 1



FACING REAR OF CONTROL PANEL

USE THIS SHEET WHEN AC METERS M1, M2, & M3 ARE DIGITAL.

NOTES:

1. * WIRES FURNISHED

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) 3226AA	4/6/04
2 3257AA	05/10/04

FILE NAME	PLOT DATE
289022S4	05/10/04

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. INCH ± ANGLES ± 3°

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

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FINISH CODE PER 910176: NONE

ACTIVITY | REPLACED BY | REPLACES
MATERIAL NO. | QUANTITY-U.M. | COMM. CLS.
MATERIAL SPEC.

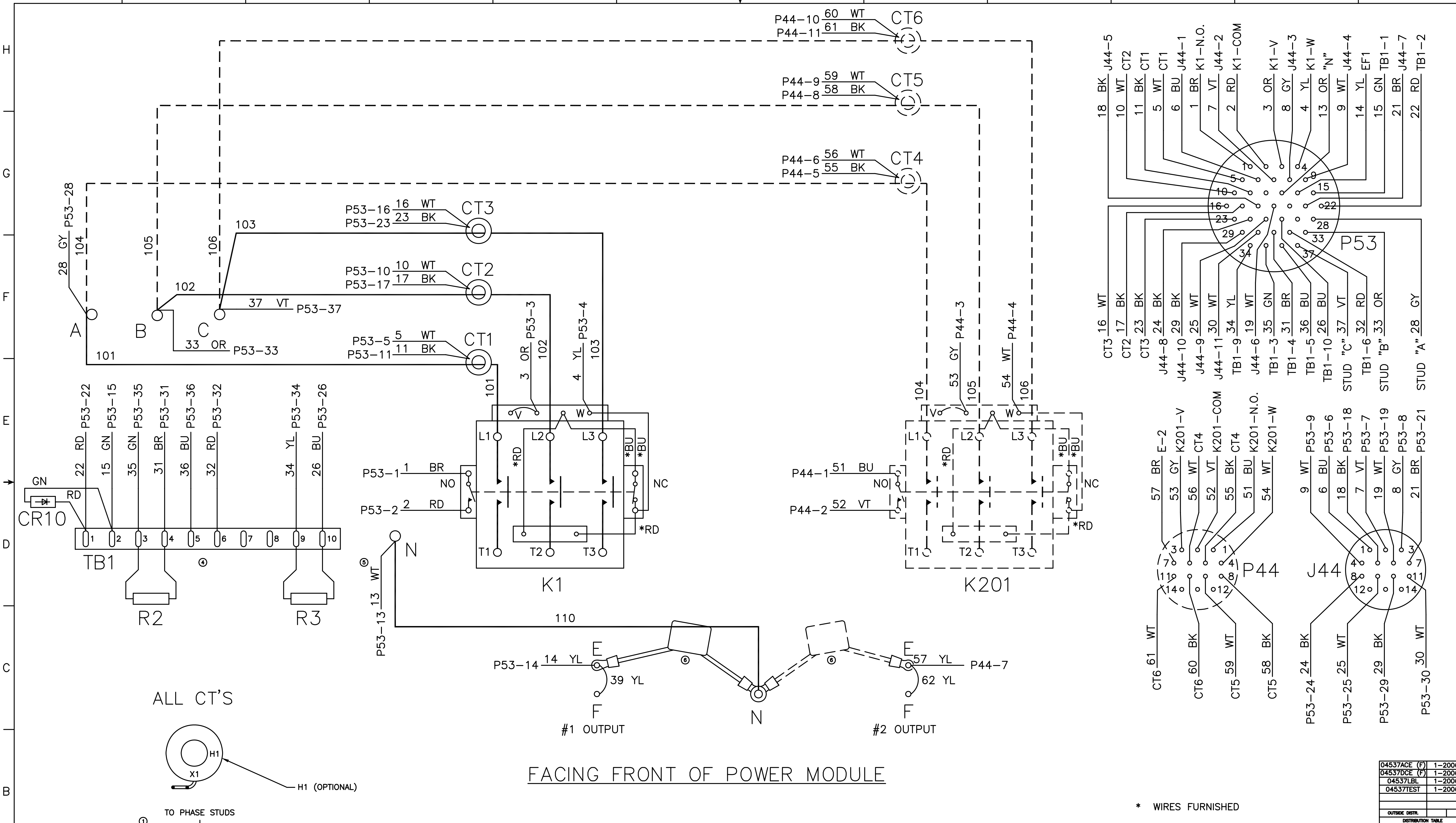
TITLE: DIAGRAM, CONNECTION, CONTROL BOX

DESIGNED	DRAWN	DATE	SCALE
RPH	RPH	4/6/04	FULL
CHECKED	APPROVED	RECORDS	ITEM TYPE

HOBART® TROY, OHIO 45373 U.S.A. | SIZE D | DWG. NO. 289022 | SHEET 4 OF 4

ACE (s) Test

OUTSIDE DISTR. | DISTRIBUTION TABLE



FACING FRONT OF POWER MODULE

* WIRES FURNISHED

DIAGRAM EXPLANATION

- PART DESIGNATOR (END OF WIRE)
- WIRE NUMBER
- WIRE COLOR
- ABOVE OR LEFT OF WIRE

TB4 — 27 RD

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)

CHANGE RECORD	
E.C. No.	DATE
1) 3212AA	2/18/04
2) 3246AA	4/28/04
3) 3317AA	8/12/04
4) 3451AA	2/18/05
5) 3637AA	1/31/06
6) 3864AA	04/18/07

04537ACE (F)	1-2006
04537DCE (F)	1-2006
04537LBL	1-2006
04537TEST	1-2006

FILE NAME: 289002 — PLOT DATE: 04/18/07

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. INCH ± — ANGLES ± 3°

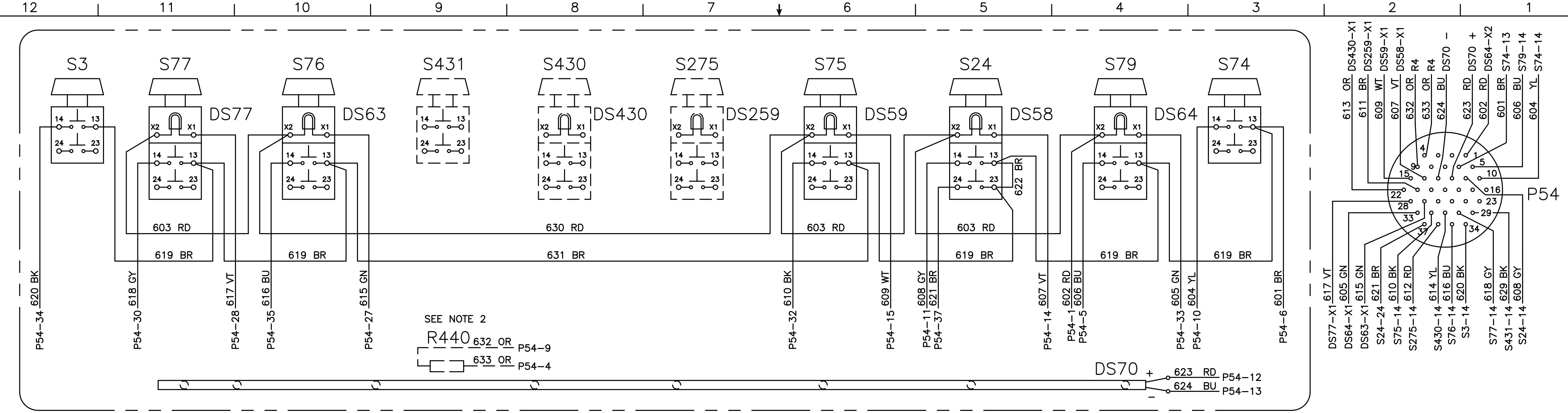
DECIMAL-INCH: .00 ± .03, .000 ± .010 — METRIC: 0.0 ±0.8mm, 0.00 ±0.25mm

FINISH CODE PER 910176: NONE

TITLE: DIAGRAM, CONNECTION, POWER MODULE

DESIGNED: RPH — DRAWN: RPH — DATE: 10/2/03 — SCALE: FULL — RECORDS: 11/17/03

ITW GSE GROUP U.S.A. — SIZE: D — DWG. NO. 289002 — SHEET 1 OF 1



FACING REAR OF SWITCH BOX

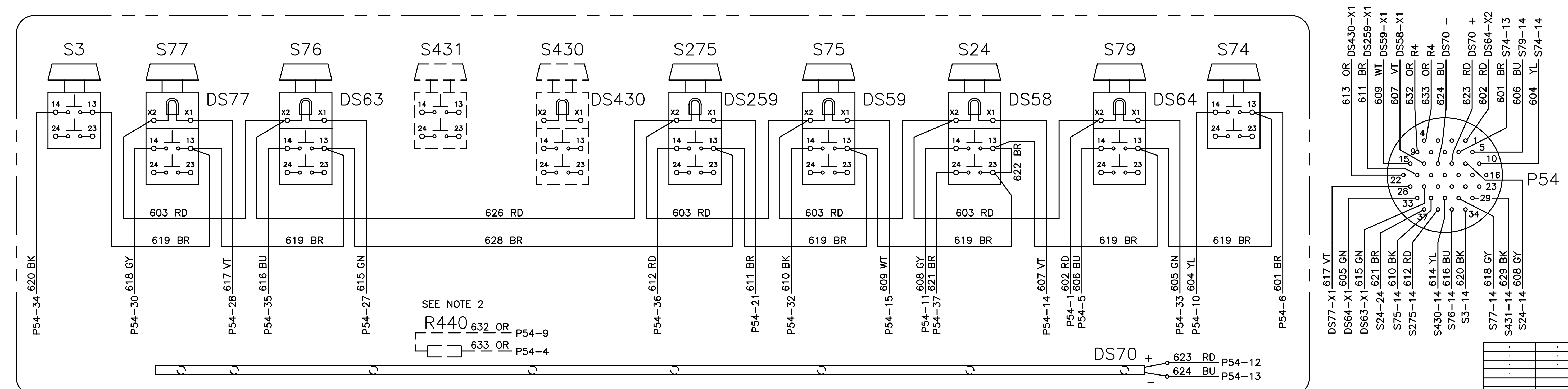
1 A.C. OUTPUT

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

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

① NOTE 2:
REMOVE RESISTOR R440 FROM HARNESS BY CUTTING WIRES 632 & 633. INSULATE ENDS OF WIRES WITH SHRINK TUBING.



FACING REAR OF SWITCH BOX

2 A.C. OUTPUTS

NOTES:

② 1. TIE ANY UNUSED WIRES INTO HARNESS AFTER REMOVING TERMINAL AND INSULATING END OF WIRE WITH SHRINK TUBING.

LEGEND

DS58	INDICATOR, PUSHBUTTON, ENGINE START (GREEN)
DS59	INDICATOR, PUSHBUTTON, #1 OUTPUT (YELLOW)
DS63	INDICATOR, PUSHBUTTON, DELAYED ENGINE SHUTDOWN (RED)
DS64	INDICATOR, PUSHBUTTON, PRE-HEATER, (ORANGE)
DS77	INDICATOR, PUSHBUTTON, TEST/RESET, (RED)
DS259	INDICATOR, PUSHBUTTON, #2 OUTPUT (ORANGE) (WHEN FURNISHED)
DS430	INDICATOR, PUSHBUTTON, DC OUTPUT, (BLUE), (WHEN FURNISHED)
①③R440	RESISTOR, 1K, T-R I.D.
S3	SWITCH, METER SELECTOR
S24	SWITCH, ENGINE START
S74	SWITCH, PUSHBUTTON, LAMPS & FUEL CHECK
S75	SWITCH, PUSHBUTTON, #1 OUTPUT
S76	SWITCH, PUSHBUTTON, ENGINE STOP, DELAYED SHUTDOWN
S77	SWITCH, PUSHBUTTON, TEST/RESET
S275	SWITCH, PUSHBUTTON, #2 OUTPUT, (WHEN FURNISHED)
S430	SWITCH, PUSHBUTTON, DC OUTPUT, (WHEN FURNISHED)
S431	SWITCH, PUSHBUTTON, DC, STARTING CURRENT, (WHEN FURNISHED)

CHANGE RECORD	
E.C. No.	DATE
1) RPH	2/12/04
2) 3226AA	4/6/04
3 3261AA	05/11/04

FILE NAME 289013S1 — PLOT DATE 05/11/04

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. INCH ± — ANGLES ± 3°

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

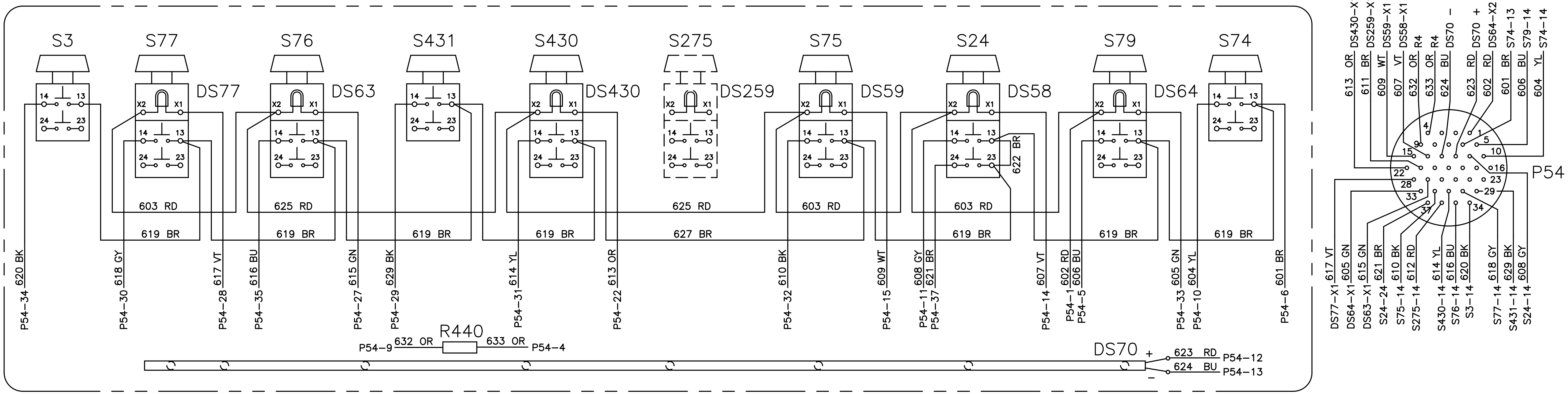
FINISH CODE PER 910176: NONE

TITLE: DIAGRAM, CONNECTION, SWITCH BOX

DESIGNED RPH — DRAWN RPH — DATE 12/12/03 — SCALE FULL — RECORDS 02/11/04

HOBART® TROY, OHIO 45373 U.S.A.

SIZE D — DWG. NO. 289013 — SHEET 1 OF 2

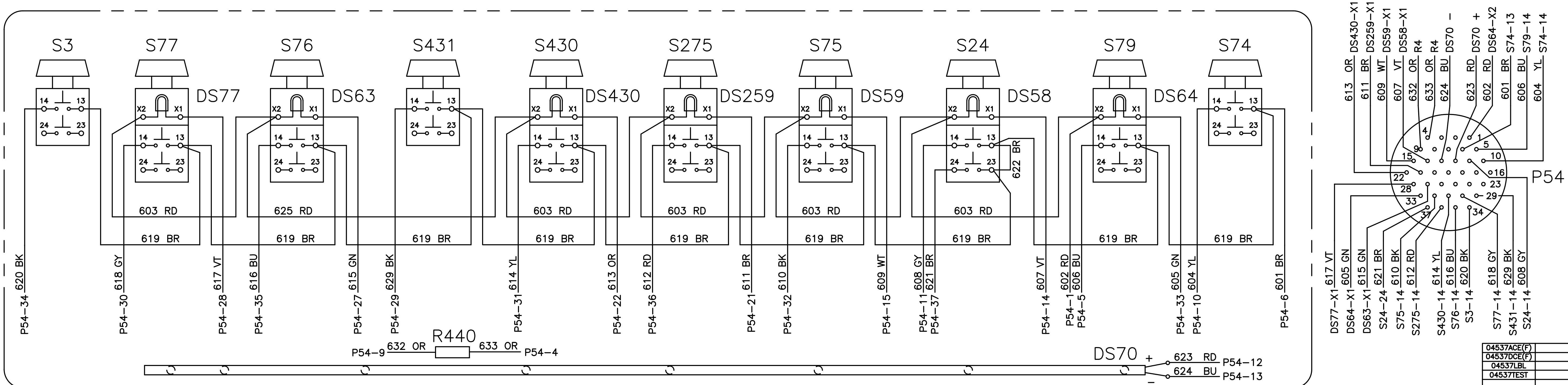


FACING REAR OF SWITCH BOX
1 A.C. & 1 D.C. OUTPUT

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



FACING REAR OF SWITCH BOX
2 A.C. & 1 D.C. OUPUT

NOTES:

1. TIE ANY UNUSED WIRES INTO HARNESS AFTER REMOVING TERMINAL AND INSULATING END OF WIRE WITH SHRINK TUBING.

LEGEND

DS58	INDICATOR, PUSHBUTTON, ENGINE START (GREEN)
DS59	INDICATOR, PUSHBUTTON, #1 OUTPUT (YELLOW)
DS63	INDICATOR, PUSHBUTTON, DELAYED ENGINE SHUTDOWN (RED)
DS64	INDICATOR, PUSHBUTTON, PRE-HEATER, (ORANGE)
DS77	INDICATOR, PUSHBUTTON, TEST/RESET, (RED)
DS259	INDICATOR, PUSHBUTTON, #2 OUTPUT (ORANGE) (WHEN FURNISHED)
DS430	INDICATOR, PUSHBUTTON, DC OUTPUT, (BLUE), (WHEN FURNISHED)
③R440	RESISTOR, 1K, T-R I.D.
S3	SWITCH, METER SELECTOR
S24	SWITCH, ENGINE START
S74	SWITCH, PUSHBUTTON, LAMPS & FUEL CHECK
S75	SWITCH, PUSHBUTTON, #1 OUTPUT
S76	SWITCH, PUSHBUTTON, ENGINE STOP, DELAYED SHUTDOWN
S77	SWITCH, PUSHBUTTON, TEST/RESET
S79	SWITCH, PUSHBUTTON, PREHEATER
S275	SWITCH, PUSHBUTTON, #2 OUTPUT, (WHEN FURNISHED)
S430	SWITCH, PUSHBUTTON, DC OUTPUT, (WHEN FURNISHED)
S431	SWITCH, PUSHBUTTON, DC, STARTING CURRENT, (WHEN FURNISHED)

CHANGE RECORD	
E.C. No.	DATE
1) RPH	2/12/04
2) 3226AA	4/6/04
3) 3261AA	05/11/04

FILE NAME	PLOT DATE
289013S2	05/11/04

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. INCH ± ANGLES ± 3°
DECIMAL-INCH .00 ± .03 .000 ± .010 METRIC 0.0 ±0.8mm 0.00 ±0.25mm

04537ACE(F)
04537DCE(F)
04537LBL
04537TEST
OUTSIDE DISTR.
DISTRIBUTION TABLE

FINISH CODE PER 910176: NONE

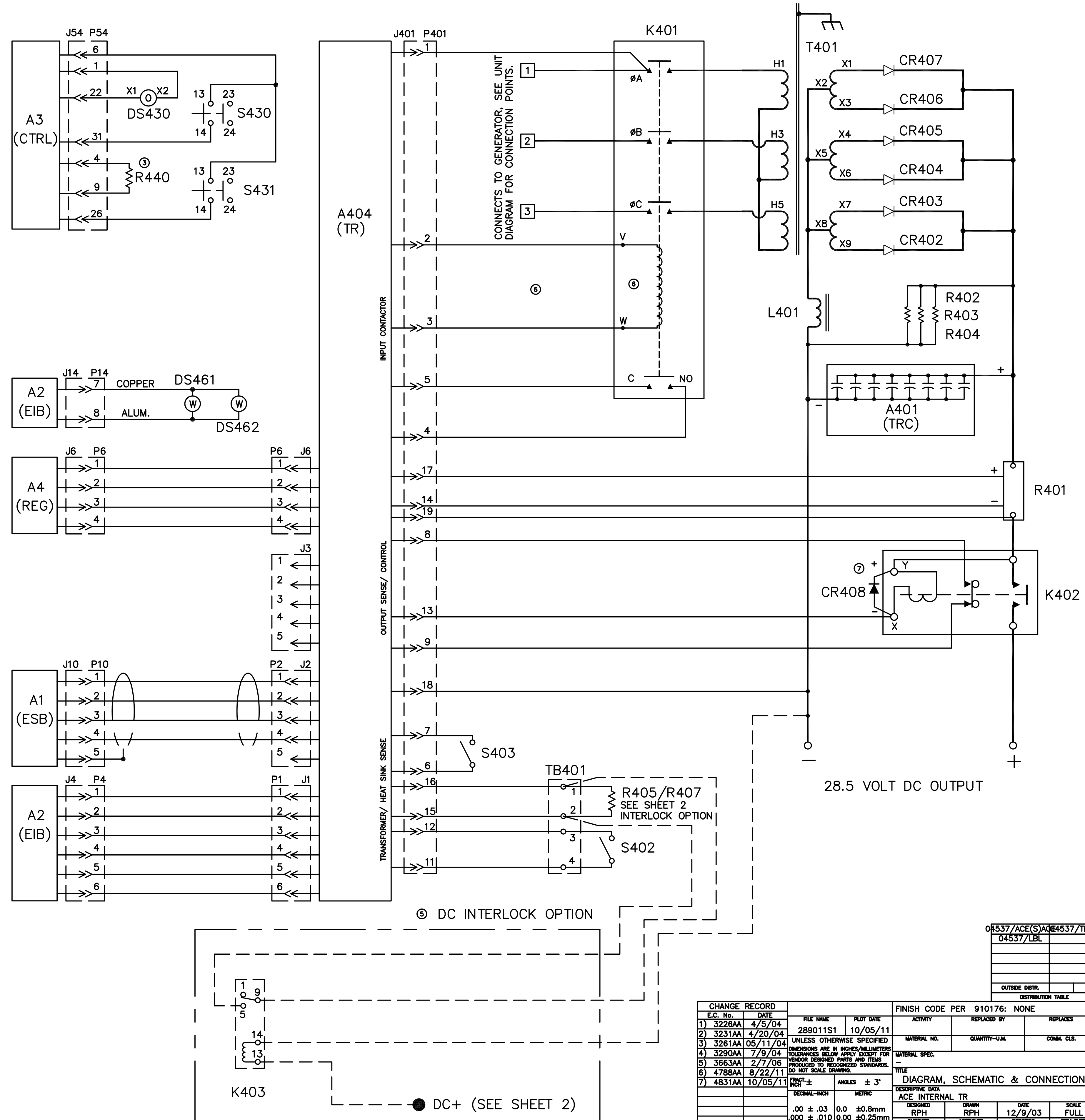
TITLE: DIAGRAM, CONNECTION, SWITCH BOX

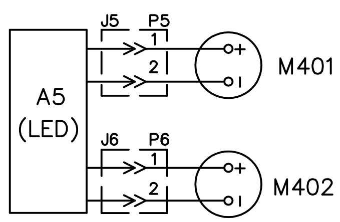
DESIGNED RPH | DRAWN RPH | DATE 12/12/03 | SCALE FULL
RECORDS 02/11/04

HOBART® TROY, OHIO 45373 U.S.A. | SIZE D | DWG. NO. SHEET 2 289013

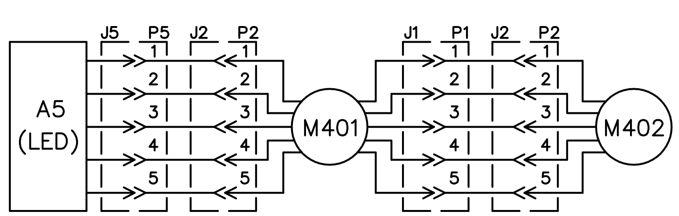
LEGEND

	A1	BOARD, P.C., ENGINE SPECIFIC (ESB)
	A2	BOARD, P.C., ENGINE INTERFACE (EIB)
	A3	BOARD, P.C., CONTROL (CTRL)
	A4	BOARD, P.C., REGULATOR, (REG)
	A5	BOARD, P.C., LED (LED)
	A401	BOARD, P.C., TR CAPACITOR (TRC)
	A404	BOARD, P.C., TRANSFORMER–RECTIFIER (TR)
⑥		
	CR402–CR407	DIODE, SILICON, 275 A., POSITIVE BASE
⑦	CR408	DIODE, FLYBACK
⑤	DC+	28.5 VDC INTERLOCK CABLE CONNECTION (OPTIONAL)
	DS430	INDICATOR, PUSHBUTTON, 28.5 VDC ON (BLUE)
	DS461	LIGHT, STRIP, DC AMMETER (WHITE)
	DS462	LIGHT, STRIP, DC VOLTMETER (WHITE)
	K401	CONTACTOR, AC INPUT, TR
	K402	CONTACTOR, DC OUTPUT
⑤	K403	RELAY, 28.5 VDC INTERLOCK
	L401	INDUCTOR, DC
	M401	AMMETER, DC
	M402	VOLTMETER, DC
	R401	SHUNT, HEAT SINK
	R402–R404	RESISTOR, PRELOAD, 100W., 10 OHM
	R405	RESISTOR, I.D. TRANSFORMER (1K OHM)
⑥		
⑤	R407	RESISTOR, I.D. TRANSFORMER (511 OHM)
③	R440	RESISTOR, TR I.D. 1K OHM
⑥		
	S402	SWITCH, THERMAL, 28.5 VDC TRANSFORMER
	S403	SWITCH, THERMAL HEAT SINK
	S430	SWITCH, PUSHBUTTON, 28.5 VDC (BLUE)
	S431	SWITCH, PUSHBUTTON, DC STARTING CURRENT, (BLUE)
	T401	TRANSFORMER, 28.5 VDC
	TB401	TERMINAL BLOCK, 28.5 VDC TRANSFORMER





ANALOG DC METER CONNECTIONS



DIGITAL DC METER CONNECTIONS

CHANGE RECORD	
E.C. No.	DATE
1) 3226AA	4/5/04
2) 3231AA	4/20/04
3) 3261AA	05/11/04
4) 3290AA	7/9/04
5) 3663AA	2/7/06
6) 4788AA	8/22/11
7) 4831AA	10/05/11

FILE NAME: 289011S1 — PLOT DATE: 10/05/11

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. INCH ± — ANGLES ± 3°

DECIMAL–INCH: .00 ± .03, .000 ± .010 — METRIC: 0.0 ±0.8mm, 0.00 ±0.25mm

04537/ACE(S)ACE4537/TEST 04537/LBL

FINISH CODE PER 910176: NONE

TITLE: DIAGRAM, SCHEMATIC & CONNECTION

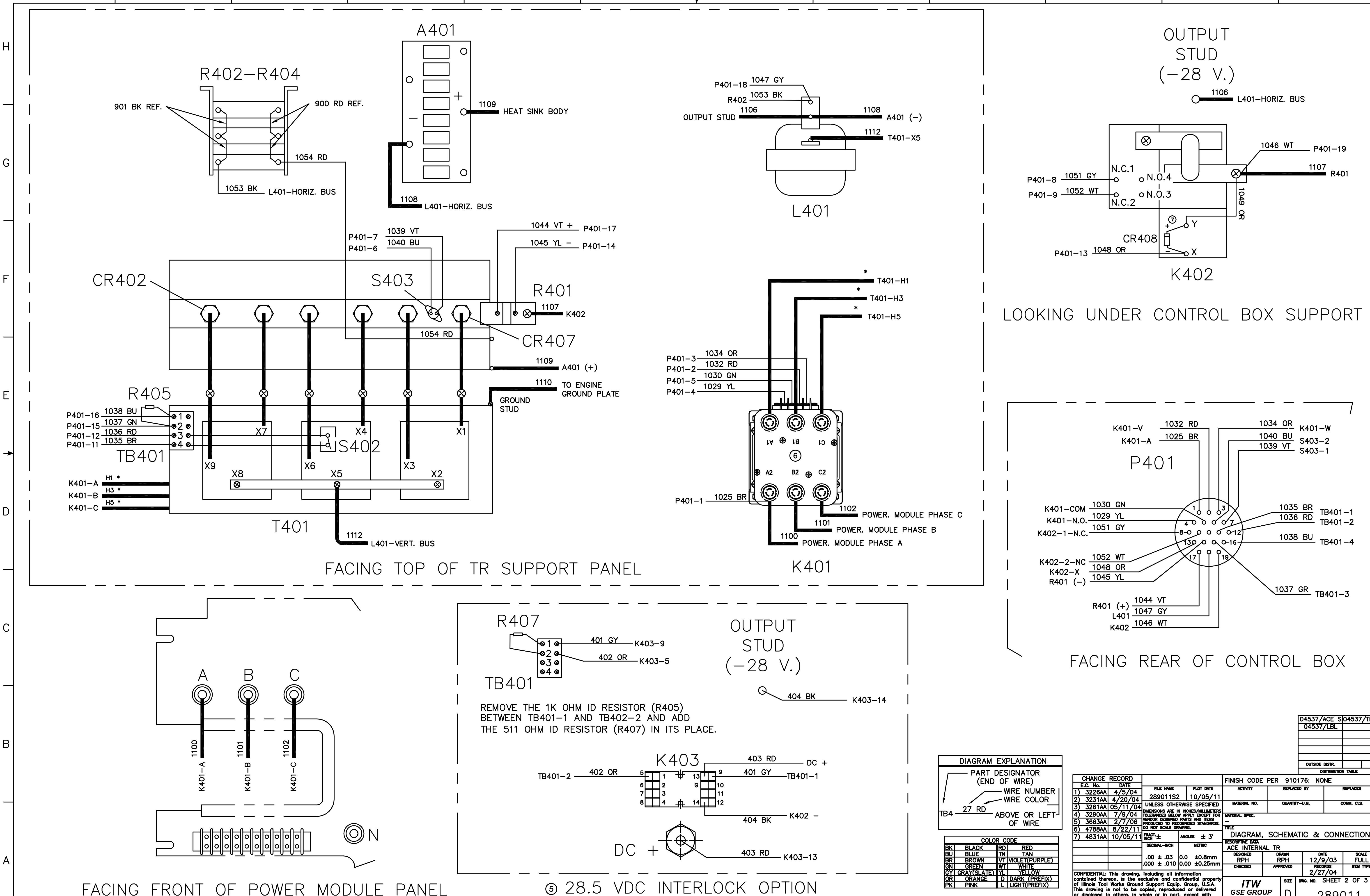
DESCRIPTIVE DATA: ACE INTERNAL TR

DESIGNED: RPH — DRAWN: RPH — DATE: 12/9/03 — SCALE: FULL

RECORDED: 2/27/04

ITW GSE GROUP U.S.A.

SIZE: D — DWG. NO. 289011 — SHEET 1 OF 3



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

04537/ACE S	04537/TEST
04537/LBL	

OUTSIDE DISTR.
DISTRIBUTION TABLE

CHANGE RECORD	
E.C. No.	DATE
1) 3226AA	4/5/04
2) 3231AA	4/20/04
3) 3261AA	05/11/04
4) 3290AA	7/9/04
5) 3663AA	2/7/06
6) 4788AA	8/22/11
7) 4831AA	10/05/11

FILE NAME: 289011S2 | PLOT DATE: 10/05/11

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. INCH ± | ANGLES ± 3°

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

FINISH CODE PER 910176: NONE

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

MATERIAL SPEC. –

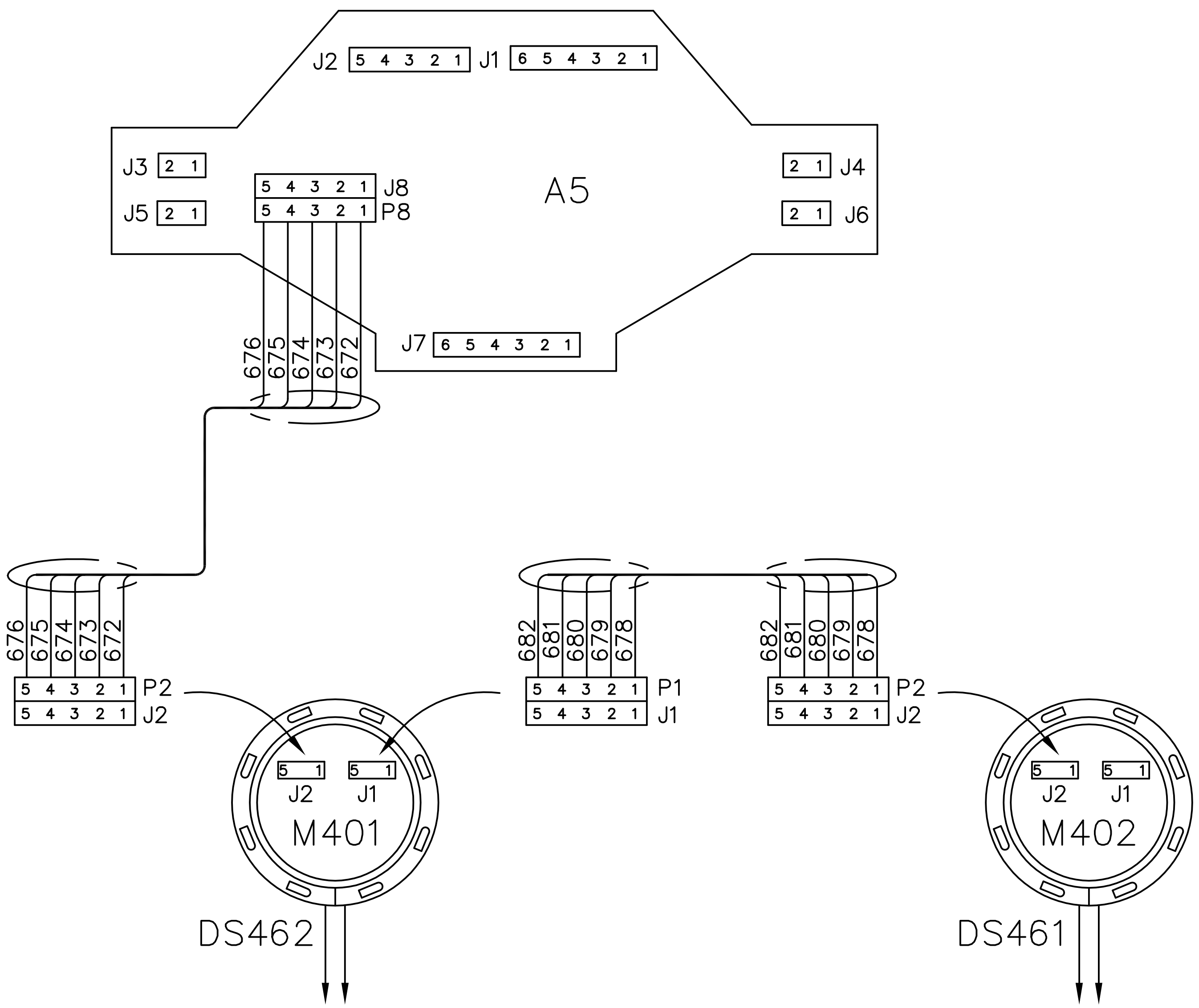
TITLE
DIAGRAM, SCHEMATIC & CONNECTION

DESCRIPTIVE DATA
ACE INTERNAL TR

DESIGNED	DRAWN	DATE	SCALE
RPH	RPH	12/9/03	FULL
CHECKED	APPROVED	RECORDS 2/27/04	ITEM TYPE

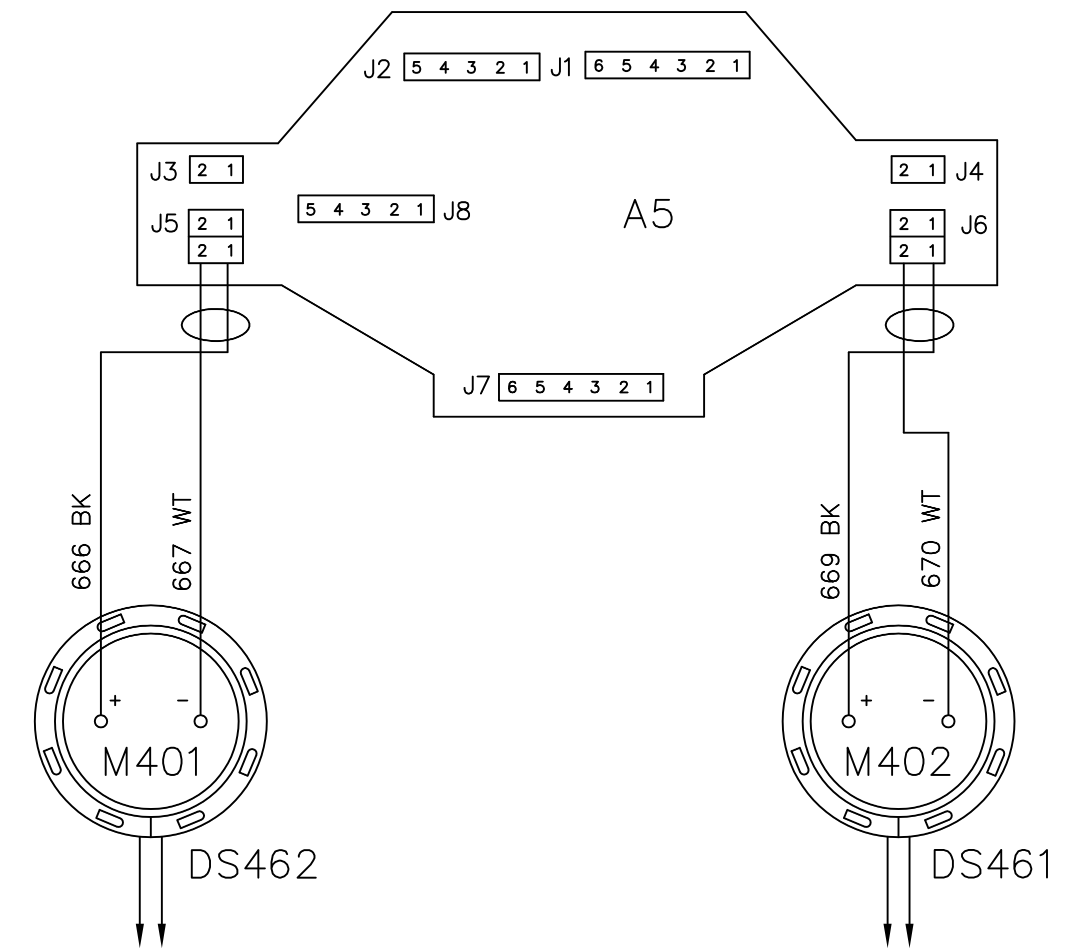
ITW GSE GROUP U.S.A. | SIZE D | DWG. NO. 289011 | SHEET 2 OF 3

①



FACING REAR OF CONTROL PANEL

DIGITAL METER CONNECTIONS FOR TR METERS



FACING REAR OF CONTROL PANEL

ANALOG METER CONNECTIONS FOR TR METERS

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)
TB4 27 RD
WIRE NUMBER
WIRE COLOR
ABOVE OR LEFT OF WIRE

CHANGE RECORD	
E.C. No.	DATE
1) 3226AA	4/5/04
2) 3231AA	4/20/04
3) 3261AA	05/11/04
4) 3290AA	7/12/04
5) 3663AA	2/7/06
6) 4788AA	8/22/11
7) 4831AA	10/05/11

FILE NAME: 289011S3 — PLOT DATE: 10/05/11

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. INCH ± — ANGLES ± 3°

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

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04537/ACE S A	04537/ TEST
04537/ LBL	
OUTSIDE DISTR.	
DISTRIBUTION TABLE	

FINISH CODE PER 910176: NONE

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

MATERIAL SPEC. —

TITLE: DIAGRAM, SCHEMATIC & CONNECTION

DESCRIPTIVE DATA: ACE INTERNAL TR

DESIGNED	DRAWN	DATE	SCALE
RPH	RPH	4/5/04	FULL
CHECKED	APPROVED	RECORDS	ITEM TYPE

ITW GSE GROUP U.S.A. — SIZE D — DWG. NO. 289011 — SHEET 3 OF 3 — ①