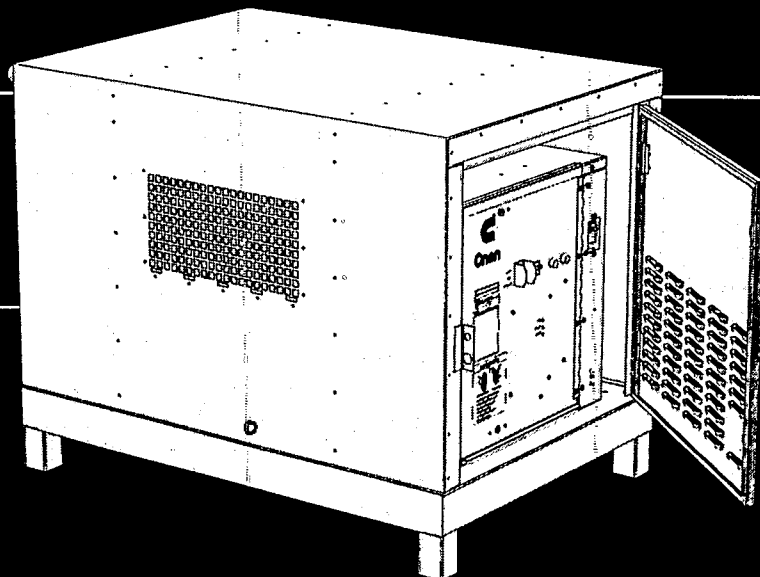




Operator's and Installation Manual

GCAA, GCAB, GCAC







Printed in U. S. A.

965-0102
7-97

Thank you for purchasing a DC generator set designed and manufactured by Libby International, Inc. Your generator set will be supported by the Onan Distributor Network. This manual is intended to be used only with the generator set with which this manual was delivered. Please take time to record the serial number of the generator set and the engine data included below.

Generator Set Serial Number	
Alternator Serial Number	
Engine Serial Number	
Engine Type Number	
Engine Code Number	

	WARNING	
The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.		

	WARNING	
The engine oil from this product contains chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.		

This generator set is to be used for stationary applications only. Non-stationary applications may be in violation of state and federal regulations.

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Safety Precautions

This manual contains instructions for installation, operation, and routine maintenance for DC Stationary Generator Sets. Information should be read and understood before attempting any installation, procedure or test. Follow all instructions to help obtain safe and effective use of the equipment. The generator set should be installed, operated and maintained only by experienced, qualified personnel adhering to all warnings, cautions, and procedures contained in this manual. If you have questions specific to your application contact your authorized Onan distributor.



The generator set is an electrical power generating device which poses risks of injury or death if improperly installed, operated or maintained. To help prevent accidents, all personnel using or servicing this equipment must read this manual and be aware of the potential dangers of improper installation, operation and maintenance. The types of safety precautions used in this manual are described below.

	DANGER	
Danger indicates a hazard present which <u>will</u> cause death, severe personal injury, or substantial property damage if warning is disregarded or ignored.		

	WARNING	
Warning indicates a hazard present which <u>can</u> cause death, severe personal injury, or substantial property damage if warning is disregarded or ignored.		

CAUTION		
Caution indicates a hazard present which <u>will</u> or <u>can</u> cause moderate to minor personal injury or property damage if caution is disregarded or ignored.		



EXHAUST SYSTEM

	WARNING	
Carbon monoxide can cause severe nausea, fainting or death. The exhaust system must be leak proof, properly directed, and routinely inspected.		

Carbon monoxide can cause severe nausea, fainting or death. Never operate the generator set inside a building. Never operate in any area where exhaust gas could accumulate and seep back inside an occupied area. Avoid breathing exhaust fumes when working on or near the generator set. Carbon monoxide is particularly dangerous in that it is an odorless, colorless, tasteless, nonirritating gas. Be aware that it can cause death if inhaled for even a short period of time. Some state agencies have determined that exhaust gas can cause cancer, birth defects, and other reproductive harm.



Safety Precautions

ACCIDENTAL STARTING

	WARNING	
Accidental starting can cause severe personal injury or death. Disconnect battery cables before working on generator set (negative lead first and reconnect last).		

Accidental starting can cause severe personal injury or death. Turn generator set Master switch to OFF position, disconnect power to battery charger, and remove battery cables (negative lead first and reconnect last) to disable generator set before working on any equipment connected to generator set. The generator set can be started by remote start/stop switch unless these precautions are followed.

ENGINE BACKFIRE/FLASH FIRE



	WARNING	
Fire can cause severe personal injury or death. Do not smoke or permit flame, spark, or arc to occur near fuel or fuel system.		

A flash fire can cause severe personal injury or death. Do not smoke or permit flame, spark, pilot light, arcing switch or equipment near carburetor, fuel line, fuel filter, fuel pump, or other potential sources of spilled fuel or fuel vapors, or areas with shared ventilation.

A sudden backfire can cause severe personal injury or death. Do not start or operate generator set with air cleaner removed.

Do not use ether as a starting aid.

MOVING PARTS



	WARNING	
Moving parts can cause severe personal injury or death. Do not operate generator set without all guards, screens and covers in place.		

Exposed moving parts can cause severe personal injury or death. Keep hands, feet, hair, jewelry, and clothing away from belts and pulleys when unit is running. Replace guards, covers, and screens before operating generator set.

Flying projectiles can cause severe personal injury or death. Retorque all crankshaft and rotor hardware after servicing. When making adjustments or servicing generator set, do not loosen crankshaft hardware or rotor hardware. If rotating crankshaft manually, direction should be clockwise only. Turning crankshaft bolt or rotor hardware counterclockwise can loosen hardware and result in serious personal injury from hardware flying off engine while unit is running.

Safety Precautions

FUEL SYSTEM

	WARNING	
Explosive fuel vapors can cause severe personal injury or death. Use extreme care when handling, storing, or using fuels.		

Explosive fuel vapors can cause severe personal injury or death. All fuels are highly explosive in a vapor state. Use extreme care when handling, storing, and using fuels. Store fuel in a fresh air ventilated area away from heating equipment, pilot lights, flame, spark producing or arc producing equipment, and out of the reach of children. Never add fuel to the tank while the engine is running, since spilled fuel may ignite on contact with hot parts or from ignition spark. Do not smoke, permit flame, pilot light, arcing switch or equipment, or spark to occur near potential sources of spilled fuel or fuel vapors, or in areas with shared ventilation. Keep fuel lines and connections tight and in good condition. Do not replace flexible fuel lines with rigid lines. Flexible sections are used to avoid breakage due to vibration. If any fuel leakage or fuel accumulation is evident, or electrical sparks are noted, **DO NOT OPERATE GENERATOR SET**. Have system repaired before resuming generator set operation.



Explosive fuel vapors can cause severe personal injury or death. Additional precautions must be taken when using the following fuels:

Liquefied Petroleum Gas (Propane) - Adequate ventilation is mandatory. Propane vapor is heavier than air; install gas detectors low in room. Inspect detectors often. Do not install generator set or propane tank near window wells, sumps, or other low-lying areas.

Natural Gas - Adequate ventilation is mandatory. Natural gas rises; install gas detectors high in room. Inspect detectors often. Vapors can accumulate under the housing of the generator set.

Explosive fuel vapors can cause severe personal injury or death. Fuel leakage can cause an explosion. Check propane vapor gas or natural gas fuel system for leakage using a soap-water solution with the fuel system test pressurized to 6-8 ounces per square inch (8-14 inches water column). Do not use test solutions that contain ammonia or chlorine, since the soap will not bubble for an accurate leakage test.



HAZARDOUS VOLTAGE

	WARNING	
Hazardous voltage! Touching uninsulated live parts inside the controller assembly can result in severe personal injury or death. Take care not to touch uninsulated live parts. Stand on a dry wooden platform or rubber insulating mat. Make sure your clothing and shoes are dry, remove jewelry and use tools with insulated handles.		

Hazardous voltage can cause severe personal injury or electrocution. Generator set contains more than one live circuit. Disconnect all sources of power, including utility, other generator sets, battery (negative cable first), etc., before servicing, to avoid injury or electrocution.

Safety Precautions

BATTERIES

	WARNING	
<p>Batteries give off flammable gas. Do not smoke or use open flame when performing maintenance. Flames and explosion can cause injury or death.</p>		

Battery gas is explosive. Wear safety glasses and do not smoke while servicing batteries. When disconnecting or reconnecting battery cables, always disconnect the negative (-) battery cable first and reconnect it last to reduce arcing.

Battery acid will cause burns to unprotected skin.

HAZARDOUS NOISE

CAUTION
<p>Hazardous noise can cause loss of hearing. Always wear hearing protection when working near an operating generator set. Never operate set without a muffler or with a faulty exhaust system.</p>

GENERAL PRECAUTIONS

In addition to specific safety precautions, the following general safety precautions apply.

- Make sure that equipment is properly connected to earth ground.
- Have an ABC-rated fire extinguisher readily available and in working order when operating or maintaining equipment.
- Make sure another person capable of rendering first aid and resuscitation is present when performing any service or maintenance on this equipment.
- When moving or lifting equipment, use only lifting and handling devices appropriately rated for the task.
- Remove rings, watches and jewelry, and loose or damp clothing, and tie back loose hair, which may cause burns or electrical shock, or could get caught in moving parts when performing maintenance on this equipment.
- Observe specific manufacturer's warning labels and safety directives when using any cleaners or chemicals on this equipment. Some cleaners and chemicals can have adverse effects on skin, eyes, and respiratory tract. In addition, these products can damage the equipment if applied or used in a way not recommended. Consult a bioenvironmental engineer or applicable Material Safety Data Sheet (MSDS) for specific precautions, protective equipment and ventilation requirements. Cleaners and chemicals should be stored only in approved safety containers.

Safety Precautions

- Do not tamper with governor springs, links or other parts to increase engine speed.
- Do not check for spark with spark plug(s) removed.
- Do not touch hot muffler, cylinder, or fins which can cause burns.
- Do not operate engine without a muffler. Inspect periodically and replace if worn or leaking. If engine is equipped with a muffler deflector, inspect periodically and if necessary replace with correct deflector.
- Do not start engine with air cleaner or air cleaner cover removed.

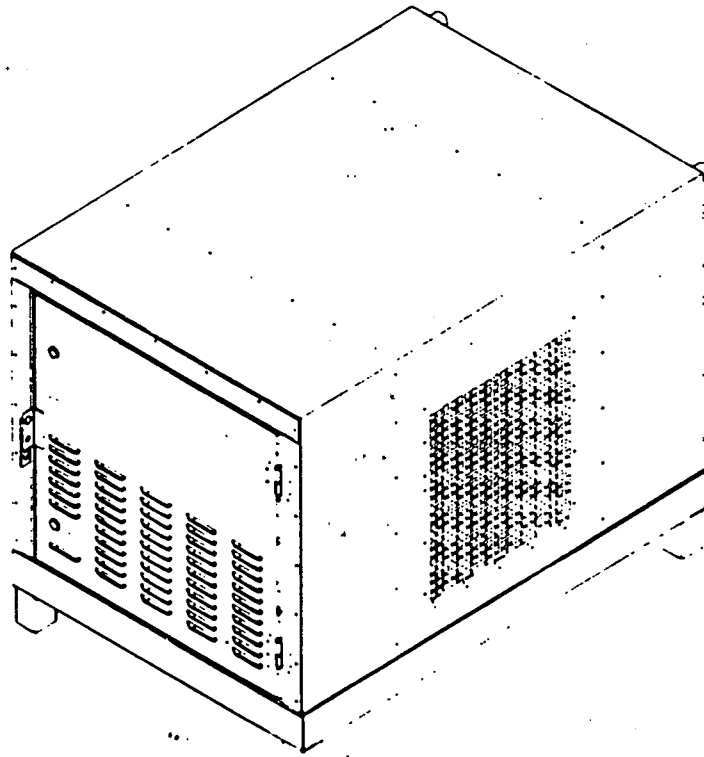


Figure 101. Generator Set (Front View)

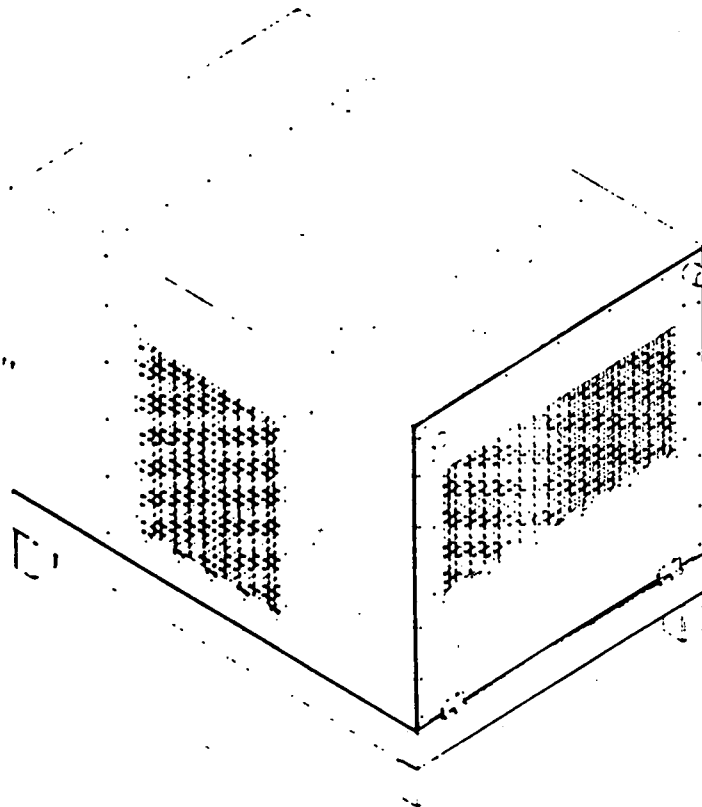


Figure 102. Generator Set (Rear View)



Section 100: General Information

101 DESCRIPTION

These generator sets were designed to provide backup 24 VDC or 48 VDC electrical power in the event of a main power failure.

Each generator set consists of a high efficiency, brushless, bearingless alternator, driven by an air cooled, overhead valve, gaseous fuel engine (natural gas or propane). The generator set is mounted on a skid base. A weather protective enclosure covers the entire generator set. Output power is delivered through a state-of-the-art controller system. The generator set is designed for standby operation in a permanent outdoor installation. Operation is fully automatic under normal conditions. The equipment may be controlled manually, either locally or from a remote location.

Generator sets are available in 24 VDC and 48 VDC versions. In addition, three engine fuel configurations are available; natural gas, propane, and a dual fuel version which incorporates provisions for both natural gas and propane.

	WARNING	
Automatic startup of the generator set while performing maintenance or service can cause severe personal injury or death. Push the control switch to OFF and disconnect the negative (-) battery cable from the battery to prevent the generator set from starting.		

102 THEORY OF OPERATION

Table 101 shows the factory set operational set points of your generator set. These will be helpful as you read through the theory of operation sequence outlined in Sections 102.1 and 102.2.

Table 101. Factory Set Operational Set Points

Factory Preset Functions		
Function	24 Volt Units	48 Volt Units
Trigger Voltage	25 Volts	50 Volts
Time Delay Start	30 Seconds	30 Seconds
Time Delay Warm-Up	45 Seconds	45 Seconds
Set Point Voltage	26.0 Volts	52.0 Volts
Time Delay Stop	15 Minutes	15 Minutes
Low Voltage Alarm	21.5 Volts	43 Volts
High Voltage Alarm	29.5 Volts	59 Volts

There are two modes of operation within the controller. The generator set controller assembly monitors the AC power into the equipment connected to the generator set and the output voltage of DC power supplies contained within that equipment. In the event of a commercial AC power failure, or if the attached equipment's DC power supply voltage falls below a preset level, the generator set will operate automatically to provide DC power. When the generator set is on line, the set operates

in parallel with DC power supplies within the attached equipment. When AC power or the DC power supply returns to normal, the generator set will continue to run for approximately fifteen minutes to recharge the starting battery and cool the engine before shutting down.

In normal operation, the generator set monitors both the commercial AC power and the voltage of the DC load (battery). If either the commercial AC power fails or the DC voltage at the load (battery) falls below a factory preset level, the generator set will start and run automatically to provide DC power to the load (battery).

102.1 Commercial AC Power Failure

The commercial AC power input is used by the generator set to provide engine block heating, engine starting battery trickle charging, and monitoring of commercial AC power availability. When the commercial AC power fails, the generator set controller recognizes the loss of AC power and begins a time delay sequence of approximately 30 seconds. This time delay is called Time Delay Start. If the AC power returns before the expiration of the time delay start, the generator set will remain in standby mode, continuing to monitor the AC power.

When the AC power remains off for more than 30 seconds, the generator set will initiate a start sequence to begin cranking the engine. After the engine has started, the controller begins a time delay warm-up period of approximately 45 seconds. This time delay prepares the engine for load assumption by allowing the engine to begin warm-up.

After the time delay warm-up period has expired, the generator set controller will slow down the engine until the generator output DC voltage matches the DC load (battery) voltage. At that time the generator set controller will close its output contactor and begin increasing engine speed until the factory set output set point is reached. The generator set will then operate to maintain the DC load (battery) voltage at the output voltage set point until the AC power returns.

Upon return of AC power the controller slows the engine and opens the output contactor, but does not stop the engine. The controller continues to monitor the AC power for 15 minutes. If the AC power is stable for 15 minutes, the controller will shut down the engine and automatically reset for the next loss of AC power. If the AC power fails during this time delay stop, the controller resets the time delay to assure AC power availability for a minimum of 15 minutes..

102.2 DC Load (Battery Voltage)

The controller also monitors the DC load (battery) voltage. If this voltage falls below a factory preset value, the generator set will start and run to maintain the DC load (battery) at the output voltage set point of the generator set. Even if AC power is available, the generator set will start and maintain the connected DC load (battery).

When the controller recognizes that the load voltage (battery) has fallen below a factory preset value, it initializes a 30 second time delay start. If the DC load voltage rises above the preset value, the generator set will remain in standby mode. Should the time delay start expire, the generator set will start and run.

After the engine has started, the controller begins a time delay warm-up period of approximately 45 seconds. This time delay prepares the engine for load assumption by allowing the engine to begin warm-up.

After the time delay warm-up period has expired, the controller will slow down the engine until the generator output DC voltage matches the DC load (battery) voltage. At that time, the generator set controller will close its output contactor and begin increasing engine speed until the factory set output voltage set point is reached. The generator set will then operate to maintain the load (battery) voltage at the output voltage set point.

The controller monitors the DC load (battery) voltage. When the DC load voltage increases 1 volt DC above the factory output voltage set point, the controller slows the engine and opens the output contactor, but does not stop the engine. The controller continues to monitor the DC load voltage for 15 minutes. If the DC load (battery) voltage remains 1 volt DC above the regulation point, the controller will shut down the engine and automatically reset for the next occurrence.

103 SPECIFICATIONS

Refer to Table 102 for generator set specifications.

Table 102. Generator Set Specifications

Equipment Size	3 kW	4.5 kW	5.5 kW
Engine			
Manufacturer and Model	Briggs & Stratton Vanguard 185400	Briggs & Stratton Vanguard 294400	Briggs & Stratton Vanguard 350400
Type	Single cylinder, 4-cycle, air cooled	V-twin, 4-cycle, air cooled	V-twin, 4-cycle, air cooled
Displacement	18.0 cubic inches	29.3 cubic inches	34.7 cubic inches
Lubricating Oil	SAE 30 API Grade SE, SF, or SG	SAE 30 API Grade SE, SF, or SG	SAE 30 API Grade SE, SF, or SG
Oil Capacity	2-1/2 pints	1-1/2 quarts (1-3/4 quarts w/filter)	1-1/2 quarts (1-3/4 quarts w/filter)
Oil Filter	None required.	Briggs & Stratton 492932 or 5049	Briggs & Stratton 491056 or 492932
Air Filter Element	Briggs & Stratton 710266	Briggs & Stratton 394018	Briggs & Stratton 394018
Air Filter Pre-Cleaner	Briggs & Stratton 710268	Briggs & Stratton 272490	Briggs & Stratton 272490
Spark Plug	Briggs & Stratton 491055	Briggs & Stratton 491055	Briggs & Stratton 491055
Spark Plug Gap	.030 inch	.030 inch	.030 inch
Generator			
Power Output	3.0 kilowatts	4.5 kilowatts	5.5 kilowatts
Voltage	24 VDC 2-wire or 48 VDC 2-wire	24 VDC 2-wire or 48 VDC 2-wire	24 VDC 2-wire or 48 VDC 2-wire
Battery			
Battery 12 Volt	BCI Grp Size U1, Type GT-X, 300 CCA @ 0°F	BCI Group MF26/70 675 CCA @ 0°F	BCI Group MF26/70 675 CCA @ 0°F
Physical Characteristics			
Length	41 inches	41 inches	41 inches
Width	28 inches	28 inches	32 inches
Height	31 inches	31 inches	37 inches
Weight (Dry)	325 pounds	350 pounds	450 pounds
Operating temperature	-20°F to +115°F	-20°F to +115°F	-20°F to +115°F

104 LIFTING

Figure 103 shows the recommended lifting locations of the generator set.

⚠	WARNING	⚠
Generator set is heavy. Use a properly rated lifting device to move or install.		

⚠	WARNING	⚠
Generator set enclosure is heavy. Use appropriate number of personnel to lift or remove enclosure.		

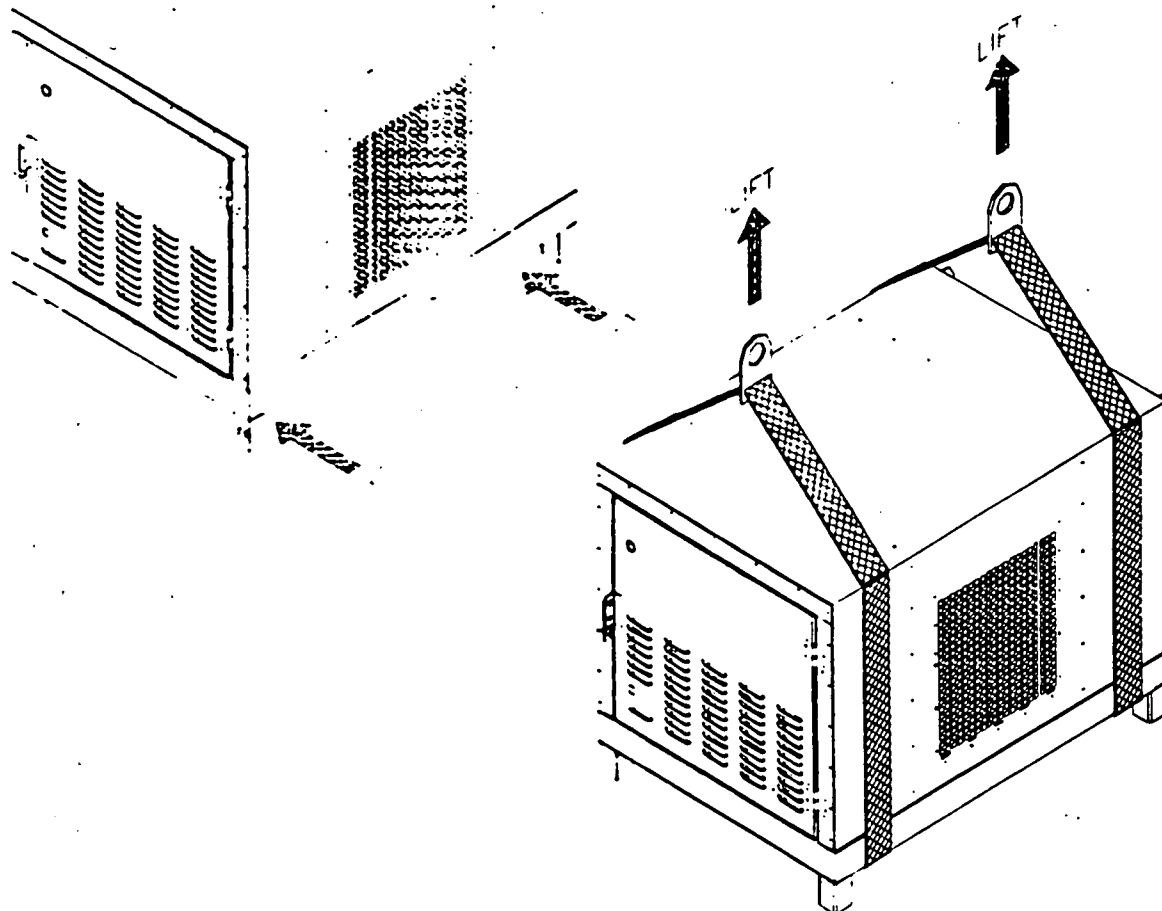


Figure 103. Generator Set Lifting Locations

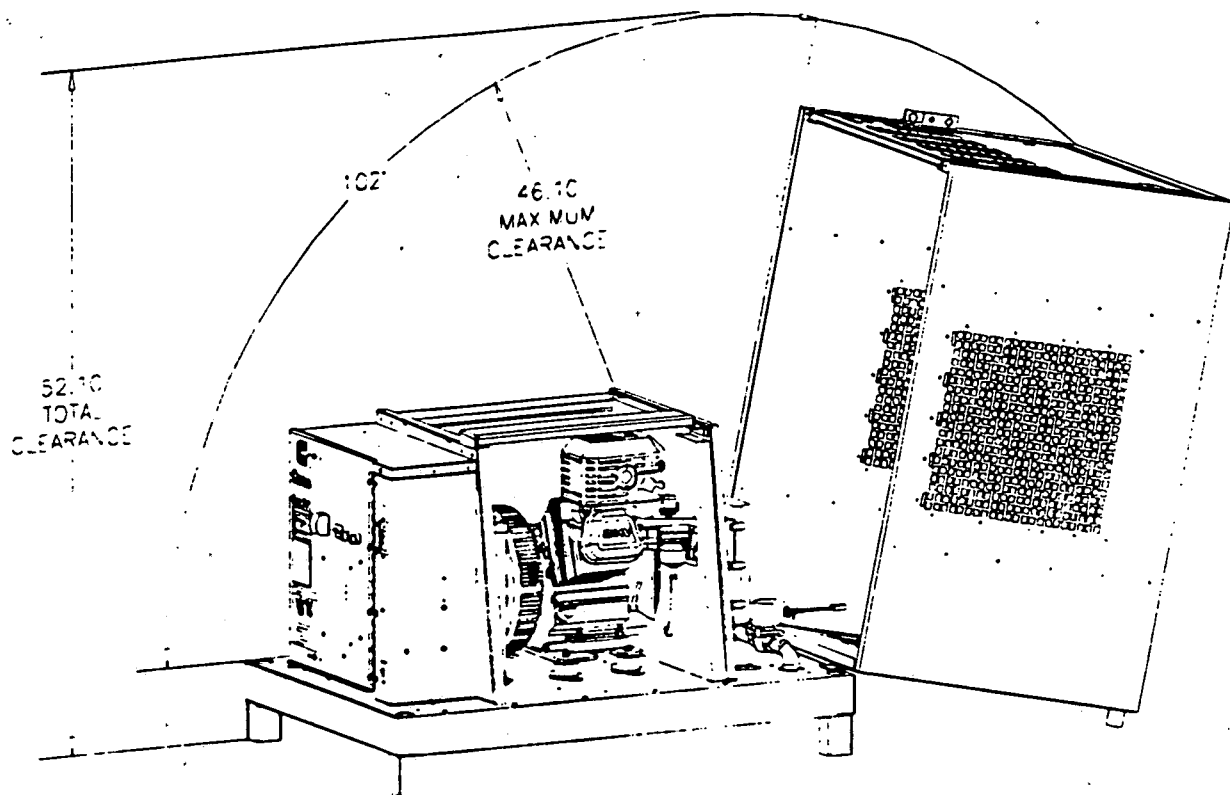


Figure 200. Generator Set Housing- 3 kW and 4.5 kW

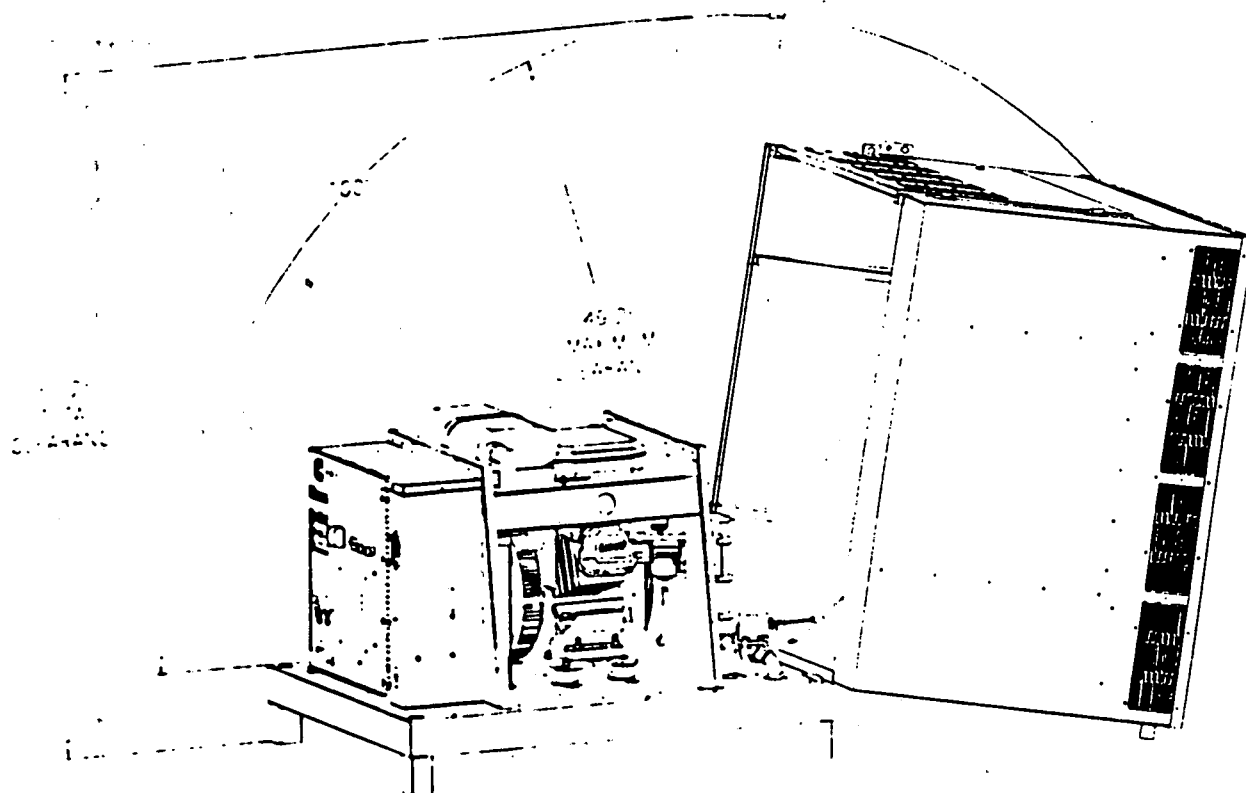




Figure 201. Generator Set Housing - 5.5 kW

Section 200: Installation

201 INSTALLATION



Install generator set in accordance with local, state and federal codes. As a minimum, installation shall meet the requirements found in the following documents.

- ANSI/NFPA-37 Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines
- ANSI/NFPA-54 National Fuel Gas Code
- ANSI/NFPA-58 Standard for the Storage and Handling of Liquefied Petroleum Gases
- ANSI/NFPA-70 National Electrical Code

	WARNING	
<p>Improper application or installation of a generator set can result in severe personal injury or death, and property damage. Application must be made by a professional engineer and installation by those qualified in the required electrical and mechanical trades. The emergency/standby power system must comply with all applicable codes.</p>		

Local codes and ordinances may have additional requirements that must be met. Contact your local authority having jurisdiction prior to beginning installation. Minimum requirements for proper installation include the following. For additional information see Figures 416, 417, and 418.

- Install the generator set at a site that can be kept clean, dry and not subject to flooding.
- Allow a minimum of three feet clearance on all sides of the generator set.
- If the generator set is installed near an occupiable building or enclosure, it must be installed at least five feet away from openings such as windows or doors, and three feet from combustible material or fences.
- Do not install the generator set indoors or where poisonous exhaust gas or explosive fuel fumes could accumulate.
- Locate the generator set as close to the battery (load) as possible. Keep load wiring as short as possible and avoid coiling excess wire or cable.

	WARNING	
<p>Generator set is heavy. Use a properly rated lifting device to move or install.</p>		



The generator set enclosure is designed to allow access to the controller assembly without opening the entire cover. Access is gained by releasing the two Belcore type 216 latches located on the enclosure door. The door has been designed to lift off the enclosure, providing complete access to the generator set controller.



202 FUEL CONNECTION



This generator set has been factory calibrated to operate from either propane vapor (LPG) or natural gas. The generator set identification plate has been marked to indicate the fuel type to connect to the generator set. Fuel lines used to connect the generator set to the fuel supply should be at least Schedule 40 black iron pipe. Local codes may impose other requirements. Consult your local authority having jurisdiction.

The generator set is designed to operate with fuel delivery pressures from 8 inches of water column to 14 inches of water column, with 11 inches of water column optimal. Verify fuel supply pressure availability prior to installing the generator set. The fuel inlet connection of the generator set is a 3/4 inch NPTF connection.

Note: Gas piping in contact with earth or other material that could corrode the piping shall be protected against corrosion in an approved manner. Gas piping installation shall comply with the requirements in ANSI/NFPA-54 (1996), National Fuel Gas Code, Part 3, paragraph 3.1.3.

	WARNING	
<p>Gaseous fuels are flammable and explosive and can cause severe personal injury or death. Do not smoke if you smell gas or are near fuel tanks or fuel-burning equipment or are in a area sharing ventilation with such equipment. Keep flames, sparks, pilot lights, electrical arcs and arc-producing equipment and all other sources of ignition well away. Keep a type ABC fire extinguisher handy.</p>		
<p>ANSI/NFPA-58 requires all persons handling and operating propane to be trained in proper handling and operating procedures.</p>		

	WARNING	
<p>High gas supply pressure can cause gas leaks which can lead to fire and severe personal injury or death. Gas supply pressure must be adjusted to specifications by qualified personnel.</p>		

	WARNING	
<p>Gaseous fuel leaks into an inadequately ventilated space can lead to explosive accumulations of gas. Natural gas rises when released into the air and can accumulate under overhanging hoods and inside housings and buildings. Propane sinks when released into the air and can accumulate inside housings and basements and other below-grade spaces. Precautions must be taken to prevent gas leaks and the accumulation of gaseous fuel in the event of a leak.</p>		

202.1 Natural Gas Installation

The generator set requires an adequate fuel supply to operate correctly. The length of the fuel supply pipe from the gas service entrance to the generator set must be known to determine the correct fuel pipe size. Refer to Table 201 to find the fuel supply requirement for your generator set. The fuel consumption table below shows the fuel requirements for natural gas.

Table 201. Natural Gas Fuel Consumption (Cu. Ft/Hour)

Applicable Model Numbers	kW	Natural Gas
GCAA-24, GCAA-48 / D2030, D4030	3 kW	78 Cu. Ft/Hr
GCAB-24, GCAB-48 / D2045, D4055	4.5 kW	106 Cu. Ft/Hr
GCAC-24, GCAC-48 / D2055, D4055	5.5 kW	125 Cu. Ft/Hr

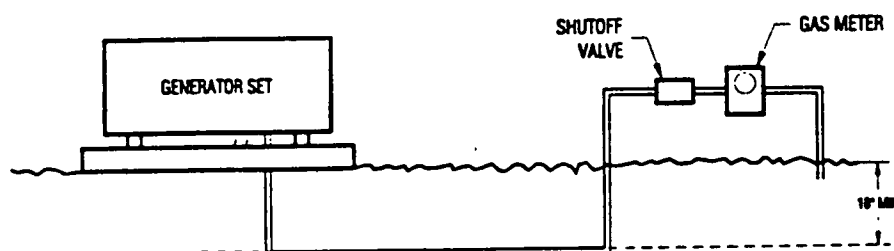


Figure 202. Typical Natural Gas Installation

Using Table 202, find the distance your generator set will be located from the service entrance, then follow that distance across left to right (horizontally) until you find the fuel delivery value given in Table 201. When the fuel delivery value falls between two columns, use the larger value. Then follow the table up (vertically) to find the correct fuel supply pipe size for your application.

Table 202. Nominal Iron Pipe Size Fuel Delivery Values (Cu.Ft/Hr)

Dis- tance (Ft)	Pipe Size							
	0.25	0.375	0.5	.75	1	1.25	1.5	2
10	43	95	175	360	680	1400	2100	3950
20	29	65	120	250	465	950	1460	2750
30	24	52	97	200	375	770	1180	2200
40	20	45	82	170	320	660	990	1900
50	18	40	73	151	285	580	900	1680
60	16	36	66	138	260	530	810	1520
70	15	33	61	125	240	490	750	1400
80	14	31	57	118	220	460	690	1300
90	13	29	53	110	205	430	650	1220
100	12	27	50	103	195	400	620	1150
125	11	24	44	93	175	360	550	1020
150	10	22	40	84	160	325	500	950
175	9	20	37	77	145	300	460	850
200	8	19	35	72	135	280	430	800

It is important to consider other loads operated from the fuel supply pipe. Other loads, such as space heating and water heating equipment, must also be determined to correctly size the fuel pipe. Use the total load requirement of the fuel supply line to determine your fuel supply pipe size.

202.2 Propane Gas Installation

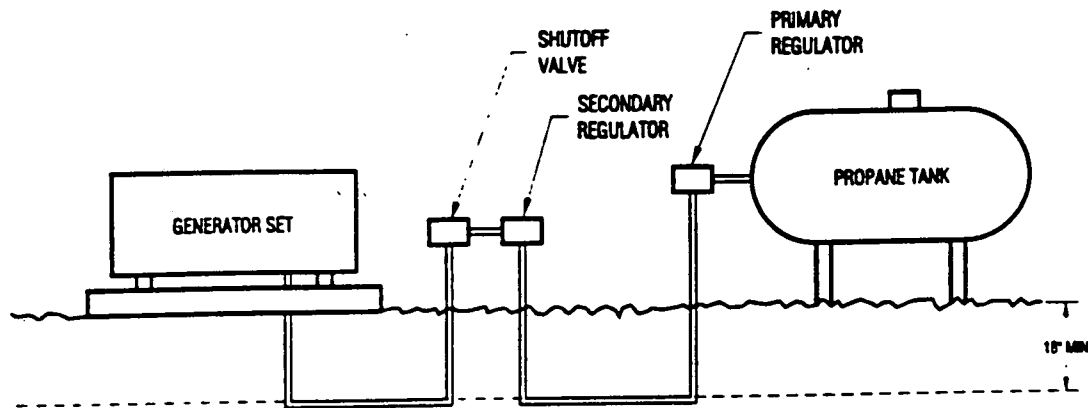


Figure 203. Typical Propane Gas Installation

If your generator set operates from propane vapor fuel, you must supply a propane tank for the fuel supply. To assist in proper selection of the propane fuel tank the following guidelines should be followed.

- Propane tanks are sized by the number of gallons of water they will hold, not the amount of propane they will hold.
- Propane tanks are generally filled to only 80% of their water capacity.
- Low ambient temperatures will affect the amount of fuel available from the propane tank.
- Approximately 60% of the propane fuel (in gallons) filled in the tank can be effectively used.
- Propane tanks must be fitted with a pressure reducing regulator before connection to the generator set to prevent fuel system damage.
- Propane tanks must be located at least 3 feet from any source of combustion (including the generator set), and 10 feet from sources of combustion if the tank is larger than 125 gallons.

For most applications, a 500 gallon propane tank should supply enough fuel. If your application requires another tank size, a simple calculation can be made to determine the correct tank size.

Using the full load fuel consumption data for propane found in Table 203, calculate the number of hours you wish to have the generator set provide backup power. To that number add 16 hours to account for routine exercise and periodic maintenance runs. This is the total amount of propane the generator set will require. Now calculate the tank size by dividing the fuel required first by 0.8, then dividing that value by 0.6; this is your required tank size.

Where: Ts - Tank size in gallons of water
RT - Run time required
FC - Fuel consumption from Table 203

The formula looks like this: $T_s = ((RT + 16) * FC) / 0.8 / 0.6$

Example: Your application requires the 4.5 kW generator set to operate for 100 hours.
Using the formula given:

$$T_s = ((100 + 16) * 1.3) / 0.8 / 0.6 = 314 \text{ gallons}$$

Since the closest propane tank trade size available is 500 gallons, you will select a 500 gallon tank for your application.

Table 203. Fuel Consumption - 100% Load

Generator Set Size	3 kW	4.5 kW	5.5 kW
Lbs/Hr	3.6	5.6	6.6
Gal/Hr	0.9	1.3	1.6
BTU/Hr	78,700	122,400	144,300

203 MOUNTING REQUIREMENTS

For security, the generator set has four mounting locations inside the closed housing. See Figures 204, 205 and 206. Determine how you will be mounting your generator set. There are two suggested ways in which to permanently mount the generator set.

- J-bolts protruding from the concrete pad, or
- Concrete anchors that are pressed into holes drilled in the mounting pad.

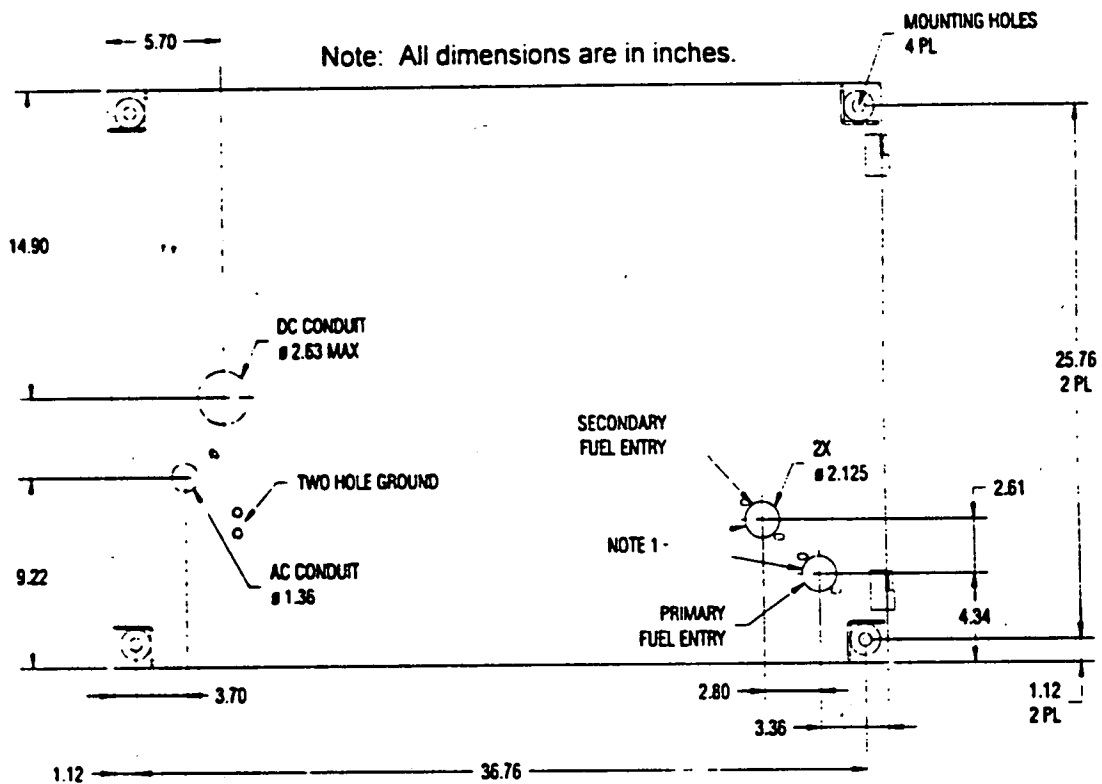


Figure 204. Generator Set Mounting Locations - 3 kW

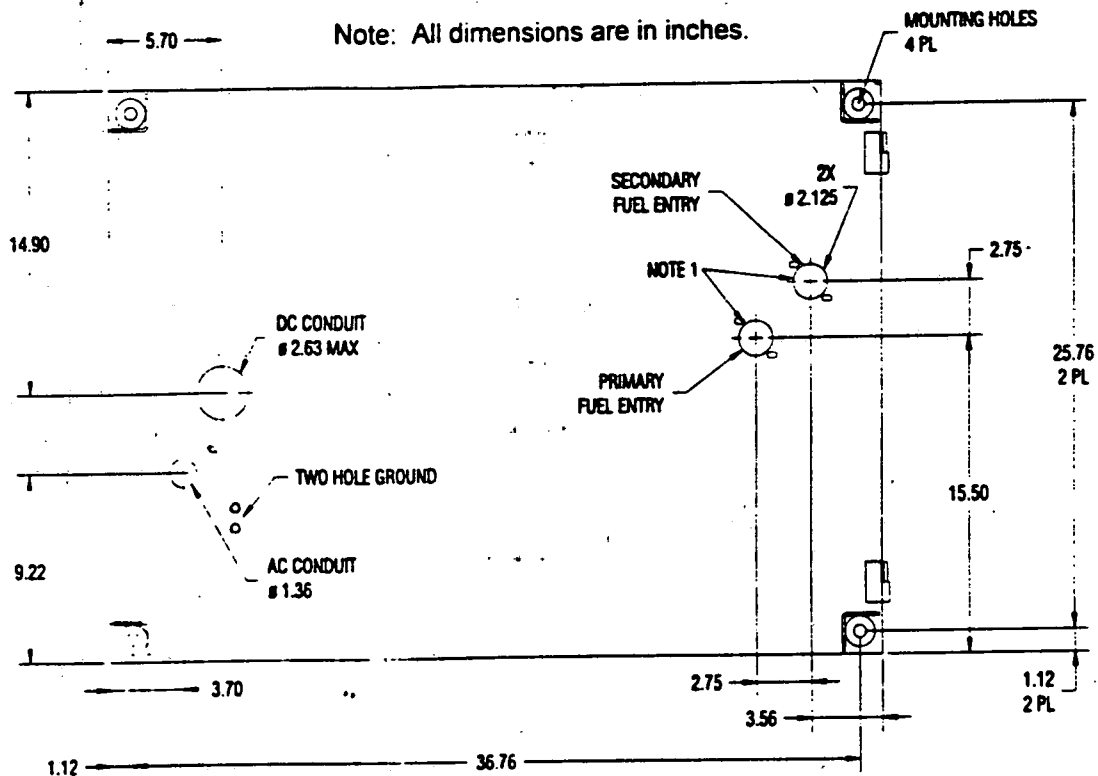


Figure 205. Generator Set Mounting Locations - 4.5 kW

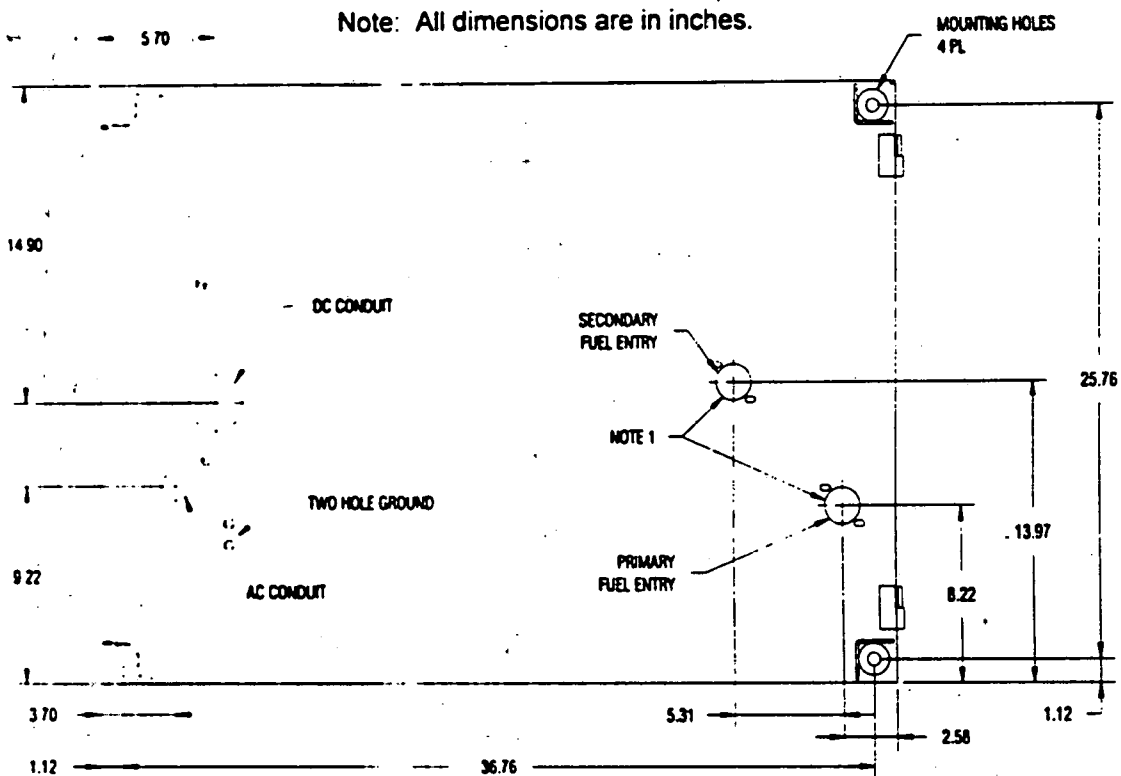


Figure 206. Generator Set Mounting Locations - 5.5 kW

- Recommended fuel line for all generator sets is 3/4 inch Schedule 40 black iron pipe. Terminate fuel line at the generator set end with 3/4 inch nipple.
- Gas piping in contact with earth or other material that could corrode the piping shall be protected against corrosion in an approved manner. Gas piping installation shall comply with the requirements in ANSI/NFPA-54 (1996), National Fuel Gas Code, Part 3, paragraph 3.1.3.

203.1 Concrete Pad Mounting

Your generator set should be installed on a mounting pad that meets the following requirements.

- Pad must be level within $\pm 2^\circ$ in any direction and flat within $\pm 1/8$ inch.
- Pad must be strong enough to support the weight of the generator set plus any other equipment on the pad.
- Soil conditions vary by location. The pad should be large enough to allow for soil compaction. A concrete pad 4' long X 3' wide X 3.5 inch thick should allow for most soil conditions. Your local authority having jurisdiction may have additional requirements.
- Determine what conduits and fuel supply connections will be made through the pad.
- Minimum clearance between generator set and structures or other equipment is 3 feet.

203.2 Mounting Hardware

Suggested hardware for installation on the concrete pad is shown in Table 204.

Table 204. Mounting Hardware Recommendations

Qty	Hardware
4 each	Concrete anchor, 1/2-13, ITW Red Head RM-12 or equivalent
4 each	Threaded rod, 1/2-13 x 4 inches
4 each	Flat Washer, 1/2 inch
4 each	Lock washer, 1/2 inch
4 each	Hex nut, 1/2-13
1 each	Anchor set tool

204 ELECTRICAL INSTALLATION

Note: Electrical installation must comply with applicable sections of ANSI/NFPA-70, National Electrical Code, and all federal, state and local codes. Consult your local authority having jurisdiction.

The generator set requires both AC and DC power connections. In accordance with the National Electrical Code, conductors used for these power inputs must be in separate conduits. The skid base provides knockouts for separation of the two separate conduit entries. See Figures 204 through 207.

In addition to the AC and DC power connections, the generator set provides operational information in the form of contact closures. These information points allow you to be informed when your generator set is operating (run contact) or has failed (alarm contact). These contacts are accessible on a terminal strip located inside the controller assembly. If you plan to use these contacts in your system, refer to Figure 207 for location of terminal strip TB2, and Figure 209 for TB2 terminal strip marking and terminal locations.

Alarm and control wiring can be installed in a separate conduit. However, if the insulation class of the alarm wiring is equivalent to or greater than the DC load conductors, you can use the same conduit as the DC output conductors.

⚠
WARNING
⚠

Hazardous voltage!

Touching uninsulated live parts inside the controller assembly can result in severe personal injury or death. Take care not to touch uninsulated live parts. Stand on a dry wooden platform or rubber insulating mat. Make sure your clothing and shoes are dry, remove jewelry and use tools with insulated handles. Make sure all AC and DC power is disconnected before making connections inside the controller.

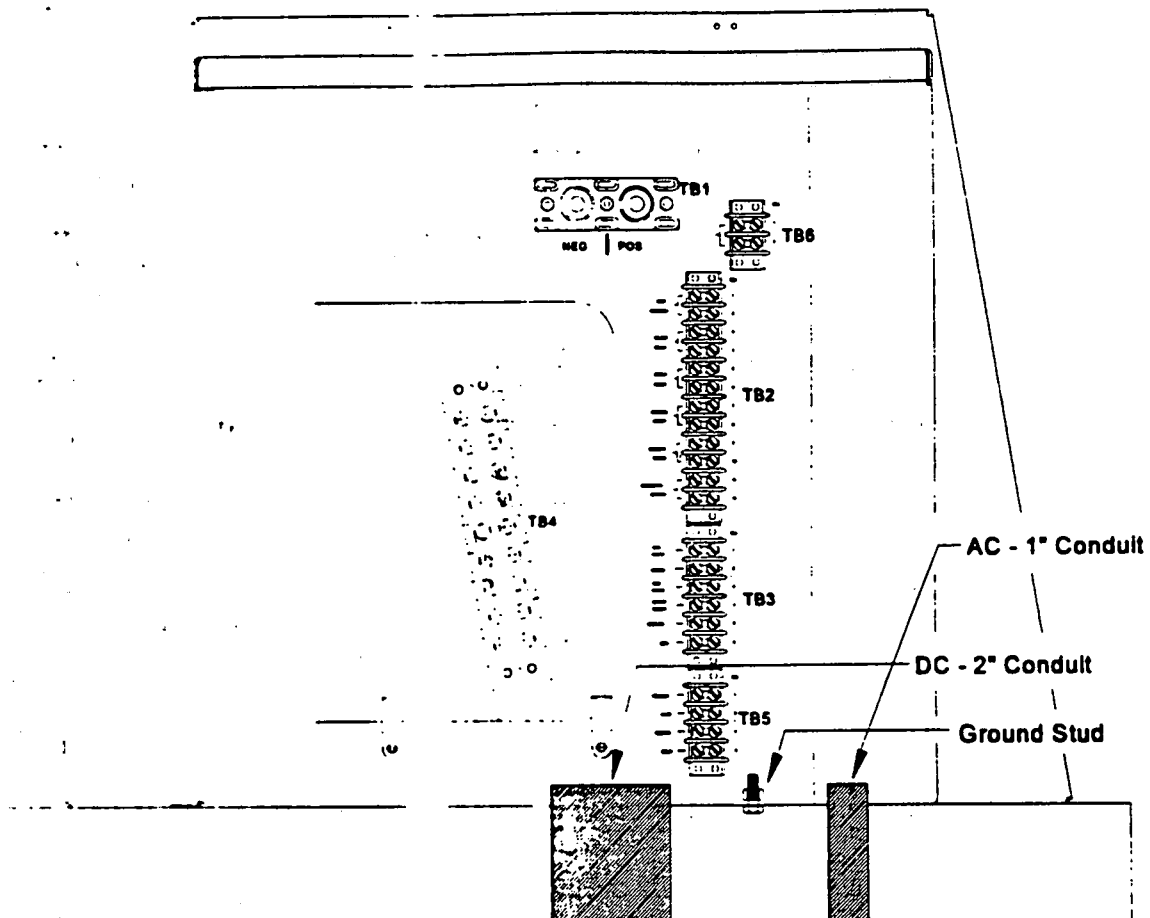


Figure 207. Conduit Entry Locations

204.1 Power Connections

CAUTION

Polarity sensitive components.

Verify proper polarity listed on identification plate of equipment before applying power.

Generator sets are designed to power the connected DC load (battery) voltage and to maintain the connected battery at a predetermined voltage. The current available from each model is listed in Table 205. The conductors used between the generator set and the connected load must be adequately sized for both the current available from the generator set and the total conductor length (loop). The total loop distance of the conductor must be determined to minimize the voltage drop between the generator set and the DC load (battery). The loop distance is the total length of both the positive and negative conductors. Once the loop distance has been determined refer to Table 206 to find the conductor size recommendation for your generator set. (Also see paragraph 206.3, Cable Kit Options.)

Table 205. Output Currents

24 Volt Models	Watts (kW)	Amperes	48 Volt Models	Watts (kW)	Amperes
GCAA-24 / D2030	3000 (3.0)	150	GCAA-48 / D4030	3000(3.0)	70
GCAB-24 / D2045	4500 (4.5)	200	GCAB-48 / D4045	4500 (4.5)	100
GCAC-24 / D2055	5500 (5.5)	250	GCAC-48 / D4055	5500 (5.5)	125

Table 206. Conductor Sizes

Cable Type & Usage	Loop	3 kW	4.5 kW	5.5 kW
24 VDC power cable	25 Ft	1 AWG	2/0 AWG	250 mcm
24 VDC power cable	50 Ft	2/0 AWG	4/0 AWG	250 mcm
24 VDC power cable	100 Ft	4/0 AWG	250 mcm	500 mcm
48 VDC power cable	25 Ft	4 AWG	1 AWG	1/0 AWG
48 VDC power cable	50 Ft	2 AWG	1/0 AWG	2/0 AWG
48 VDC power cable	100 Ft	2/0 AWG	4/0 AWG	4/0 AWG

The generator set DC output power connection is located at terminal board TB1. Refer to Figure 207 for location of terminal board TB1, and Figure 208 for TB1 terminal locations. TB1 provides 3/8 inch studs for the DC output. DC load conductors should be terminated with 3/8 inch crimp type eyelets. The use of aluminum single barrel lugs is not recommended due to increased maintenance. To install the DC power conductors, remove the stud hardware provided and place the 3/8 inch eyelet over the stud. Replace the stud hardware and torque nut to 20 pounds foot.

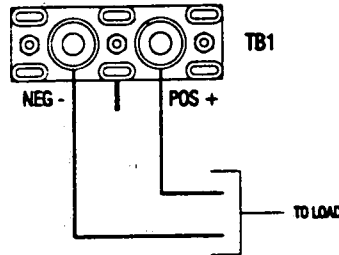


Figure 208. Terminal Board TB1 Terminal Locations

204.2 Remote Voltage Regulation Sensing Conductors

The generator set has the ability to regulate its output voltage from both an internal point (the output studs) and a remote voltage point (the load battery). This feature also allows the generator set to compensate for DC load conductor voltage drop up to 1 volt DC. Using the Remote Voltage Sensing (RVS) feature is not required for operation of the generator set.

For applications requiring the RVS feature, a pair of wires must be connected between the generator set and the DC load (battery). Since these conductors carry none of the output current, 24 to 18 gauge twisted pair wire can be used. Carol C0454 or Belden Beldfoil conductors are recommended. The RVS connections are available at terminal board TB2. See Figure 207. (Also see para. 206.3.) Figure 209 shows the details of TB2 including the RVS connection points.

⚠ WARNING ⚠

Hazardous voltage!

Touching uninsulated live parts inside the controller assembly can result in severe personal injury or death. Take care not to touch uninsulated live parts. Stand on a dry wooden platform or rubber insulating mat. Make sure your clothing and shoes are dry, remove jewelry and use tools with insulated handles. Make sure all AC and DC power is disconnected before making connections inside the controller.

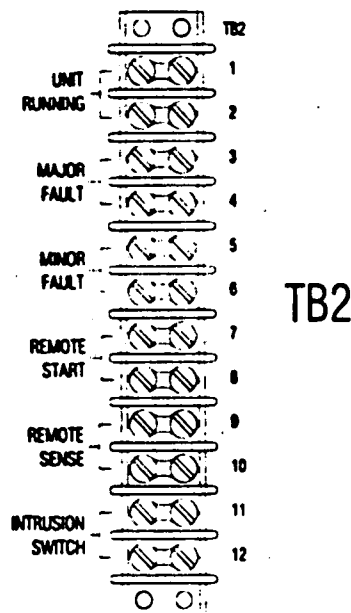


Figure 209. Terminal Board TB2 Terminal Locations

204.3 AC Power Connections

The generator set requires AC power for engine block heating, engine starting battery trickle charging and monitoring AC power availability. In accordance with the National Electrical Code, this AC power input must not be installed in the same conduit entry as the DC load conductors. A separate conduit entry point is installed in the generator set controller. Figure 207 shows the location of the AC conduit entry. Terminal board TB3 is provided as the connection point for the AC power input to the generator set. Refer to Figure 207 for location of TB3. Figure 210 details the connection points on TB3.

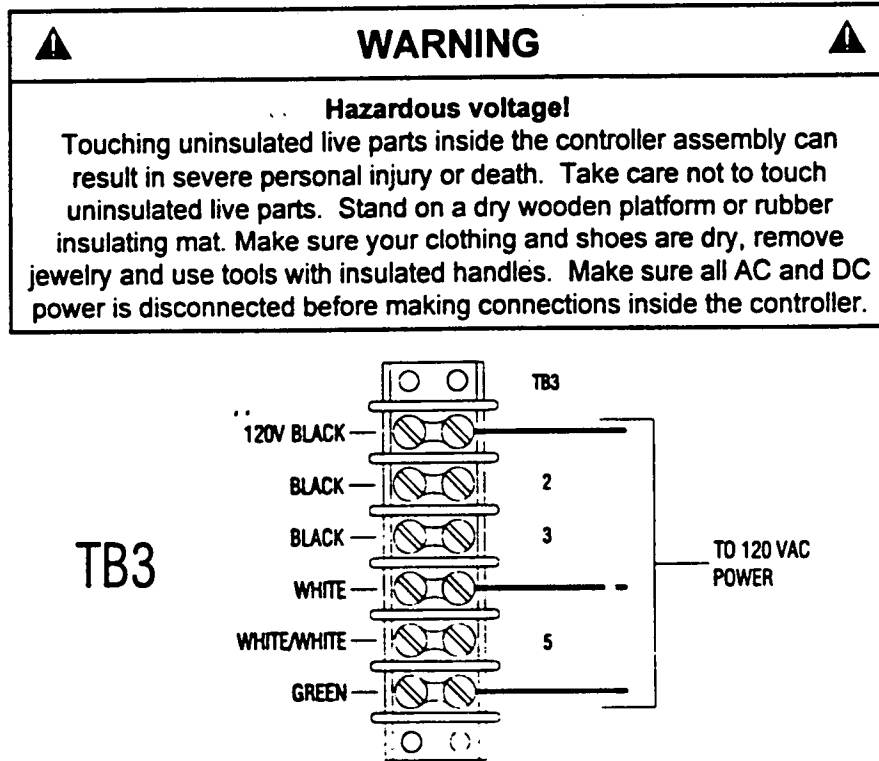


Figure 210. Terminal Board TB3 Terminal Locations

204.4 Bus Battery Thermal Protection

To protect the DC load (battery) from potential thermal runaway conditions, the generator set can automatically lower its output voltage to an appropriate value, or inhibit its operation when extreme battery temperatures are encountered. A contact closure across TB6-1 and TB6-2 will enable this feature.

This feature protects the DC load (battery) in two ways should the contact closure be present. If the generator set is not running, the contact closure at TB6 will inhibit the generator set from starting. If the generator set is running and supplying the DC load (battery), the contact closure will cause the generator set to automatically lower the output voltage set point to 24 or 48 volts, depending on the system. Contact closure provided between TB6-1 and TB6-2 will enable this function. This contact closure originates in the connected DC load (battery) control. This contact should be provided when the DC load (battery) temperature exceeds 167°F. This feature will help prevent thermal runaway conditions that may occur in some types of valve regulated lead acid batteries (VRLA batteries). A contact closure across TB6-1 and TB6-2 will enable this function. Temperature sensing is provided by equipment installed by your DC load (battery) cabinet provider and is not supplied by either Libby International or Onan Corporation. Contact your equipment provider for additional information.

TB6 is located inside the generator set controller, directly above TB2. See Figure 207.

204.5 Grounding

The generator set requires proper equipment grounding. Refer to ANSI/NFPA-70, National Electrical Code for grounding requirements. The size of the equipment grounding conductor is dependent on the current rating of the DC generator set. Table 207 is provided to assist in proper selection of the grounding conductor. (Reference ANSI/NFPA-70, Table 250-95).

Table 207. Grounding Conductor Sizes - All DC Generator Set Models

DC Current	Equipment Grounding Conductor Size
100 Amps	6 AWG
200 Amps	4 AWG
300 Amps	2 AWG

A 1/4 inch grounding stud is located within the controller assembly of the generator set. Refer to Figure 207 for location of the grounding stud. Terminate the grounding conductor with a crimp type 1/4 inch eyelet. To connect the eyelet to the grounding stud, remove the supplied hardware and place the eyelet on the grounding stud. Replace the hardware and torque the nut to 20 pounds-inch.

205 REMOTE MONITORING AND CONTROL

The generator set provides remote monitoring and control features that are user accessible. These functions are not required for proper operation of the set. Table 208 identifies each of these features and its location on TB2. Refer to Figure 207 for the location of TB2.

Table 208. Remote Monitoring and Control Features

Feature	Connection Points	Description
Run Alarm	TB2-1 and TB2-2	When generator set is running and contactor is closed, TB2-1 is common to TB2-2 (normally open contact).
Major Fault (Alarm)	TB2-3 and TB2-4	If a major fault condition occurs in generator set, TB2-3 is common to TB2-4 (normally open contact).
Minor Fault (Alarm)	TB2-5 and TB2-6	If a minor fault condition occurs in generator set, TB2-5 is common to TB2-6 (normally open contact).
Remote Start	TB2-7 and TB2-8	Connecting TB2-7 to TB2-8 through a remote switch will cause the generator set engine to start.
Remote Sense	TB2-9 and TB2-10	TB2-9 is connected to the positive terminal of the generator set load battery. TB2-10 is connected to the negative terminal of the generator set load battery. These connections allow the generator set to regulate at the battery.
Intrusion Alarm	TB2-11 and TB2-12	When the generator set access door is closed, the Intrusion alarm contact is open. When the access door is opened, the Intrusion alarm contact closes, connecting TB2-11 to TB2-12.

205.1 Alarms

Four separate alarm types are provided on the generator set.

- Run
- Major Fault
- Minor Fault
- Intrusion

These alarms provide information about the status of the set. The four alarm types are separated into three categories: 1) Normal operation, 2) Unit fault or problem, and 3) Intrusion or enclosure door open.

205.1.1 Run Alarm

When the generator set is running and providing power to the connected DC load (battery), a contact closure at TB2-1 to TB2-2 will occur. This indicates the generator set is running and providing power to the connected DC load (battery).

205.1.2 Major Fault Alarm

If the generator set exhibits an abnormal condition that requires shutdown or termination of normal operation, a major fault alarm contact closure will occur. A contact closure between TB2-3 and TB2-4 is provided to indicate such an occurrence. A red LED will illuminate on the control of the generator set to locally indicate the alarm.

Major fault alarms that will cause the generator set to shut down include:

- Engine Stop (Low Oil Pressure)
- Overcrank
- Circuit Breaker Trip
- Engine or Heat Sink Overtemperature
- Overspeed
- Overvoltage
- Low DC Voltage

To reset a major fault alarm, the AUTO/OFF/MANUAL switch must be placed in the OFF position. This will clear the alarm indication and reset the control for normal operation.

205.1.3 Minor Fault Alarm

A minor fault alarm occurs when a condition exists that is abnormal but does not require immediate shutdown of the generator set. A warning (or notification) of the condition occurs in the form of a contact closure and yellow LED indication. A contact closure between TB2-5 and TB2-6 is provided to indicate such an occurrence.

Minor fault alarms monitored by the generator set include:

- Loss of primary fuel (dual fuel)
- Loss of Remote Voltage Sensing (no LED is lit)
- Remote start/manual
- Low DC load (battery) voltage start-up

A minor fault alarm does not require a manual reset. This type of alarm is simply a warning of a potentially serious condition. When the monitored condition returns to a normal state, the alarm automatically resets itself.

205.1.4 Intrusion Alarm

When the enclosure door of the generator set is opened, an alarm is forwarded. This is called an intrusion alarm. The intrusion alarm is separate and unique. It does not interfere with the operation of the generator set, and is provided as a means to indicate when the enclosure is opened. A contact closure between TB2-11 and TB2-12 will occur when the enclosure door is open. No visual alarm is given (no LED is lit) with this alarm. This alarm resets whenever the enclosure door is closed.

For servicing, the intrusion alarm can be manually turned off (defeated). This is accomplished by pushing the actuator of the intrusion alarm slightly to the left and pulling. The actuator will pull out slightly, opening the alarm contacts. There is no need to return the actuator to the normal position, since the enclosure door will reset the switch when it is closed. See Figure 211 for location of the intrusion contacts and actuator.

205.2 Remote Start

The generator set can be started remotely through a two-wire start system (contact closure). An external start signal (contact closure) across TB2-7 and TB2-8 will cause the generator set to start and run. As long as the contact closure is present at TB2, the generator set will run. When the contact closure is opened, a 15 minute time delay will occur before the generator set will shut down.

Remote Start is only available when the AUTO/OFF/MANUAL switch is in the AUTO position.

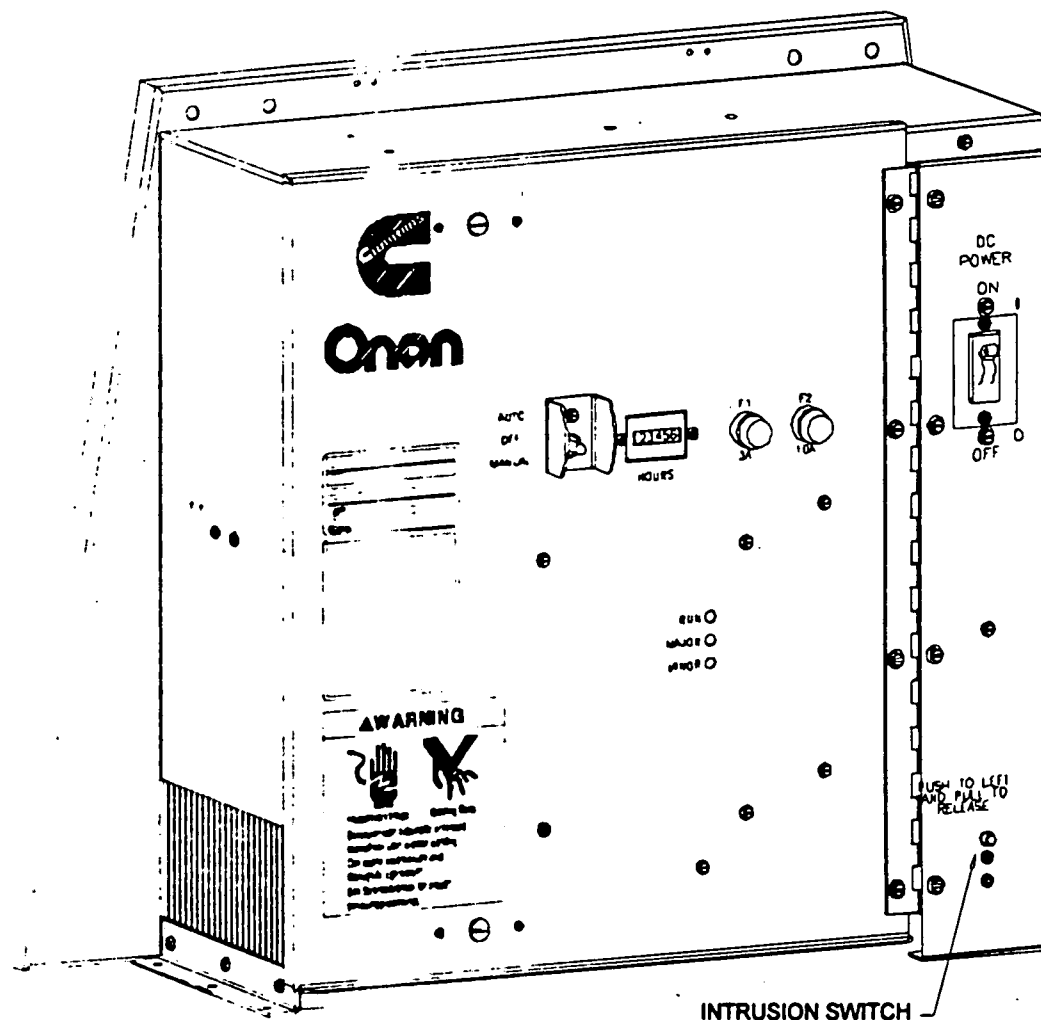


Figure 211. Intrusion Contacts and Actuator Locations

206 AVAILABLE OPTIONS

206.1 Exercise Clock Option

The exercise clock option automatically starts and runs the generator set to test system functions and help provide reliable operation. The clock is user programmable for over a seven day period. The exercise clock can be programmed for up to 14 exercise periods. User programmable features of the exercise clock option are:

- Day of Exercise
- Time of Exercise
- Duration of Exercise
- Up to 14 Exercise periods

206.2 Voltage and Amperage Meter Options

The generator set can be fitted with three different voltage and amperage meter options including:

- Volt /Ammeter
- Ammeter
- Volt Meter

These meters are factory installed on the controller door to provide the user with generator set voltage and/or amperage readings while the set is in operation.

206.3 Cable Kit Options

Optional cable kit contents for 24 VDC systems are shown in Table 209. Optional cable kit contents for 48 VDC systems are shown in Table 210.

Table 209. Optional Cable Kit Contents - 24 VDC Systems

Qty	Cable Type and Usage	Length	3 kW 24V	4.5 kW 24V	5.5 kW 24V
25 Foot Loop			Part Numbers:		
			0187-5210 / 135-9856-1	0187-5216 / 135-9856-7	0187-5222 / 135-9856-13
2 ea	24 VDC power cable	13 Ft	1 AWG	2/0 AWG	250 mcm
1 ea	Ground cable	13 Ft	4 AWG	4 AWG	2 AWG
7 ea	Shielded twisted pair cable	25 Ft	18/2 AWG	18/2 AWG	18/2 AWG
1 ea	AC power cable	25 Ft	14/3 AWG	14/3 AWG	14/3 AWG
50 Foot Loop			Part Numbers:		
			0187-5211 / 135-9856-2	0187-5217 / 135-9856-8	0187-5223 / 135-9856-14
2 ea	24 VDC power cable	25 Ft	2/0 AWG	4/0 AWG	250 mcm
1 ea	Ground cable	25 Ft	4 AWG	4 AWG	2 AWG
7 ea	Shielded twisted pair cable	50 Ft	18/2 AWG	18/2 AWG	18/2 AWG
1 ea	AC power cable	50 Ft	14/3 AWG	14/3 AWG	14/3 AWG

Table 209. Optional Cable Kit Contents - 24 VDC Systems (Continued)



Qty	Cable Type and Usage	Length	3 kW 24V	4.5 kW 24V	5.5 kW 24V
100 Foot Loop		Part Numbers	0187-5212 / 135-9856-3	0187-5218 / 135-9856-9	0187-5224 / 135-9856-15
2 ea	24 VDC power cable	50 Ft	4/0 AWG	250 mcm	500 mcm
1 ea	Ground cable	50 Ft	4 AWG	4 AWG	2 AWG
7 ea	Shielded twisted pair cable	75 Ft	18/2 AWG	18/2 AWG	18/2 AWG
1 ea	AC power cable	100 Ft	12/3 AWG	12/3 AWG	12/3 AWG

Table 210. Optional Cable Kit Contents - 48 VDC Systems

Qty	Cable Type and Usage	Length	3 kW 48V	4.5 kW 48V	5.5 kW 48V
25 Foot Loop		Part Numbers:	0187-5213 / 135-9856-4	0187-5219 / 135-9856-10	0187-5210 / 135-9856-1
2 ea	48 VDC power cable	13 Ft	4 AWG	1 AWG	1/0 AWG
1 ea	Ground cable	13 Ft	6 AWG	6 AWG	4 AWG
7 ea	Shielded twisted pair cable	25 Ft	18/2 AWG	18/2 AWG	18/2 AWG
1 ea	AC power cable	25 Ft	14/3 AWG	14/3 AWG	14/3 AWG
50 Foot Loop		Part Numbers:	0187-5214 / 135-9856-5	0187-5220 / 135-9856-11	0187-5211 135-9856-2
2 ea	48 VDC power cable	25 Ft	2 AWG	1/0 AWG	2/0 AWG
1 ea	Ground cable	25 Ft	6 AWG	6 AWG	4 AWG
7 ea	Shielded twisted pair cable	50 Ft	18/2 AWG	18/2 AWG	18/2 AWG
1 ea	AC power cable	50 Ft	14/3 AWG	14/3 AWG	14/3 AWG
100 Foot Loop		Part Numbers:	0187-5215 / 135-9856-6	0187-5221 / 135-9856-12	0187-5212 / 135-9856-3
2 ea	48 VDC power cable	50 Ft	2/0 AWG	4/0 AWG	4/0 AWG
1 ea	Ground cable	50 Ft	6 AWG	6 AWG	4 AWG
7 ea	Shielded twisted pair cable	75 Ft	18/2 AWG	18/2 AWG	18/2 AWG
1 ea	AC power cable	100 Ft	12/3 AWG	12/3 AWG	12/3 AWG



Section 300: Operation



301 INITIAL START-UP AND OPERATION

	WARNING	
Automatic startup of the generator set while performing maintenance or service can cause severe personal injury or death. Push the control switch to OFF and disconnect the negative (-) battery cable from the battery to prevent the generator set from starting.		

After installation of the generator set is complete, a short operational test should be performed. This testing verifies operation of both the generator set and the load with the set. Before the first start-up of the generator set, you must take a few simple steps for proper connection.

When shipped from the factory, the generator set Master switch is in the OFF position, the circuit breaker is turned OFF and the engine starting battery is disconnected.



	WARNING	
Hazardous voltage! Touching uninsulated live parts inside the controller assembly can result in severe personal injury or death. Take care not to touch uninsulated live parts. Stand on a dry wooden platform or rubber insulating mat. Make sure your clothing and shoes are dry, remove jewelry and use tools with insulated handles. Make sure all AC and DC power is disconnected before making connections inside the controller.		

	WARNING	
Batteries give off flammable gas. Do not smoke or use open flame when performing maintenance. Flames and explosion can cause severe personal injury or death.		

	WARNING	
Battery acid will cause burns to unprotected skin.		

Verify the polarity of the DC load (battery) connections before applying DC voltage to the generator set or turning the circuit breaker ON. Polarity should be verified at both the output studs (TB1) and the RVS connections (TB2-9 and TB2-10) if used. The polarity of the generator set can be found on the set identification plate.

Verify that the generator set is properly grounded. See paragraph 204.5. Make sure equipment ground conductors are properly attached and all connections tight.

	WARNING	
<p>The engine oil from this product contains chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.</p>		

Before start-up, check the engine oil level and refill if required. Oil level should not be overfilled; add engine oil carefully. See Table 102, Generator Set Specifications.

Note: Too much oil can cause high oil consumption, high operating temperatures, and oil foaming. Too little oil can cause severe engine damage. Keep oil level between the Full and Add marks on the dipstick.

Connect the POSITIVE post of the engine cranking battery first, then the NEGATIVE post. Apply a small amount of non-conductive grease to both posts to prevent corrosion.

Turn ON or connect the DC load (battery) voltage to the generator set. Again, check the polarity of the DC load (battery) connections. The output circuit breaker can now be turned ON. AC voltage connection to the generator set can now be turned ON.

In order to verify operation of the generator set, place the Master switch in the MANUAL position, and allow the unit to operate through its normal sequence.

Place the Master switch in the AUTO position.

302 DESCRIPTION OF CONTROLS

The generator set is equipped with a three-position Master switch with specific functions assigned to each position. These functions are:

- **AUTO** - This is the normal position of the Master switch. When in the AUTO mode, the generator set will automatically start and run if DC power is required. In the AUTO position, the generator set continuously monitors both the AC and DC voltage as well as the unit operation while running. All installed safety devices are monitored. Alarm contacts are held open. The user has the ability to start the unit remotely through the Remote Start feature.
- **OFF** - In the OFF position, the generator set is disabled; power to the control board is shut off and the unit will not operate. Both a major fault and a minor fault alarm contact closure will be present at TB2. The Remote Start function will not operate in the OFF position.

CAUTION
<p>Failure to push the control switch to AUTO before leaving the site will render the generator set unavailable for automatic standby service.</p>

- **MANUAL** - In the MANUAL position, the generator set will start and run. When the DC load (battery) voltage is at or below the output regulation set point, the output contactor will close to maintain the connected DC load (battery).

In the MANUAL position, the circuit breaker tripped feature is disabled so the circuit breaker can be turned off. This allows for manual operation of the generator set for load testing and service. The Remote Start feature is also disabled in the MANUAL position.

- Major fault and minor fault alarms will occur when in the MANUAL mode.

Controls and indicators are shown in Figure 301 and described in Table 301.

Table 301. Controls and Indicators

Control/Indicator	Description
Master Switch	Primary generator set control switch. When Master switch is in the AUTO position, generator set operation is fully automatic. Generator set may be operated manually by placing the switch in the MANUAL position. Placing the switch in the OFF position shuts down the generator set.
Circuit Breaker	Controls DC output from generator set and provides overload protection. Generator set provides DC power to load equipment when circuit breaker is in the ON position.
Hour Meter	Indicates total generator set operating time.
Green LED	Indicates normal generator set operation when illuminated.
Red LED	Indicates generator set major fault when illuminated.
Yellow LED	Indicates generator set minor fault when illuminated.

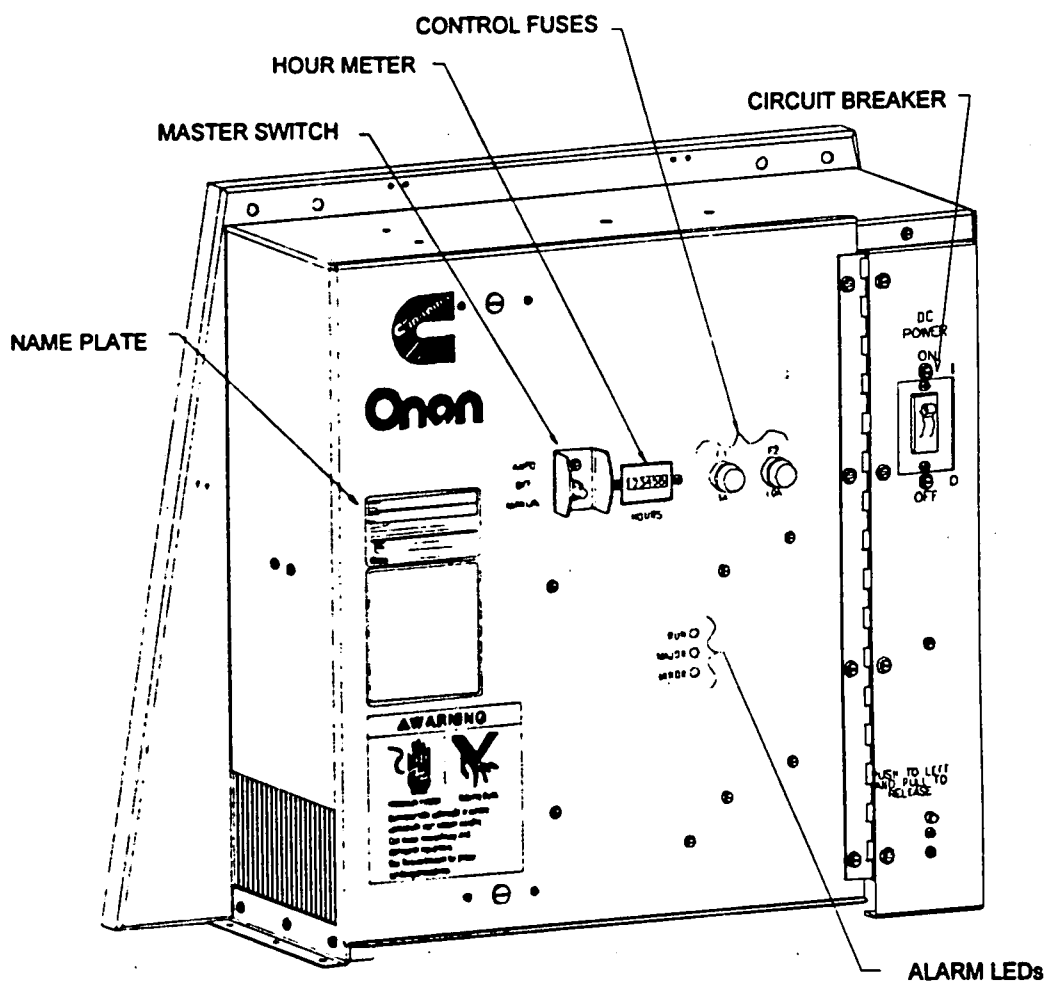




Figure 301. Controls and Indicators



Section 400: Maintenance

401 PERIODIC MAINTENANCE

	WARNING	
Automatic startup of the generator set while performing maintenance or service can cause severe personal injury or death. Push the control switch to OFF and disconnect the negative (-) battery cable from the battery to prevent the generator set from starting.		

The generator set requires periodic maintenance. By routinely performing maintenance items you help provide safe and reliable operation of the generator set. Maintenance of the generator set involves the entire set, from changing the engine oil to periodic load testing.



402 ENGINE PREVENTIVE MAINTENANCE

	WARNING	
Generator set enclosure is heavy. Use appropriate number of personnel to lift or remove enclosure.		

For maintenance, the entire enclosure can be opened allowing access to the generator set. Enclosure latches are located above the controller assembly and must be released prior to opening the enclosure.

Note: Remove the enclosure door prior to opening the enclosure.

Once the enclosure latches are released, open the enclosure carefully until it rests on the front enclosure bumpers. This may require you to lift the enclosure from the side of the generator set, rather than the enclosure door end.

	WARNING	
Falling equipment or equipment parts can cause serious personal injury and cause damage to equipment.		

Do not allow enclosure to fall open. This may cause damage to the generator set or the generator set mounting.

CAUTION	
Surfaces of the enclosure may be HOT to the touch.	

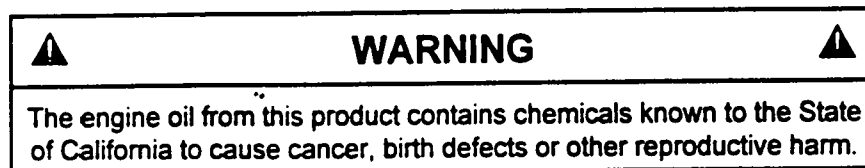
Use caution when opening the enclosure. Surfaces of the enclosure may be HOT to the touch. When lifting the enclosure use the enclosure door frame as the lifting point. If you cannot lift the enclosure alone, get help. Use appropriate number of personnel to lift and/or remove enclosure.

The enclosure can be lifted off the generator set base to allow access to other generator set components.

The generator set must be maintained and serviced by qualified personnel. However, there are simple maintenance steps you can take to help prevent equipment failure.

- Keep the interior of the generator set clean and free from accumulations of dust, dirt and debris that can interfere with generator set operation and can cause fire.
- Wipe up any oil spills or drips with a dry cloth. This will help prevent collection of dirt within the enclosure which can cause the set or controls to overheat, and can be a fire hazard.
- Check the engine oil level at least once a week or after operation of the generator set. Refill the oil level as required.
- To check the oil level properly, first remove the dipstick from the engine, wipe with a clean dry cloth, then reinsert the dipstick and tighten. The dipstick of the generator set can then be removed and the oil level verified. Remember, the dipstick must be tightened when checking the oil level.

402.1 3 kW Oil Drain



There are two dipstick locations on the 3 kW generator sets, near the back of the engine block. Either dipstick can be used to check engine oil level. See Figures 401 and 402.

An oil drain valve has been fitted to assist in proper oil collection and ease of an oil change. See Figure 402. The oil drain valve is permanently attached to the engine block. The valve has a 3/8 inch hose barb fitting for attachment of an oil drain hose. This hose must be at least 12 inches long so that oil is drained away from the base of the generator set. You are responsible for disposing of engine oil in accordance with local environmental laws.

Note: Used oil disposal may be regulated in your locality. Make sure local codes are considered when disposing of used oil.

Clean engine oil can be added to the engine through dipstick locations. Do not overfill the engine with oil. Oil capacity of the generator set can be found in Table 102, Generator Set Specifications.

Note: Too much oil can cause high oil consumption, high operating temperatures, and oil foaming. Too little oil can cause severe engine damage. Keep oil level between the Full and Add marks on the dipstick.

402.2 4.5 and 5.5 kW Oil and Filter Service

Figure 403 shows the dipstick location for 4.5 kW and 5.5 kW units. These units are fitted with a full flow, spin-on oil filter that also requires periodic servicing. Refer to Figure 404 for oil filter location on 4.5 kW and 5.5 kW generator sets.

The oil drain valve fitted to these models is also permanently attached and must not be removed. The valve is designed with a 3/8 inch NPTF for attachment of a 12 inch pipe nipple. A plug has been installed to prevent inadvertent drainage of the engine oil. This plug must be removed prior to attaching the oil drain nipple. A 12 inch nipple should be long enough to drain the engine oil away from the base of the generator set. You are responsible for collecting and returning engine oil in accordance with local environmental laws.

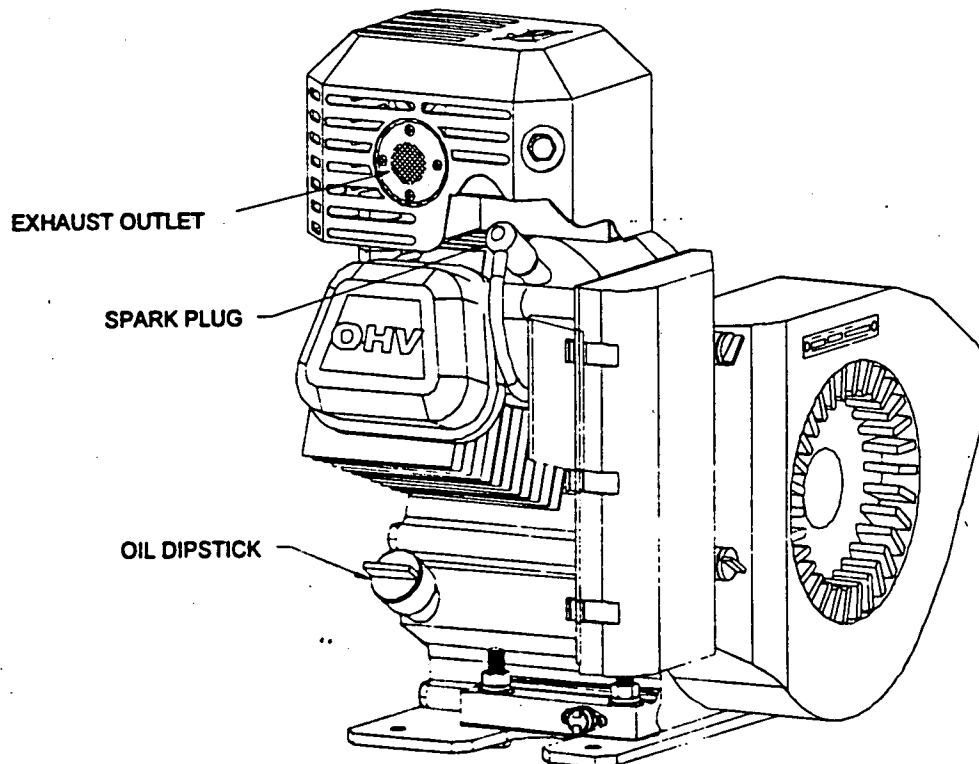


Figure 401. 3 kW Dipstick Location - Cylinder Side View

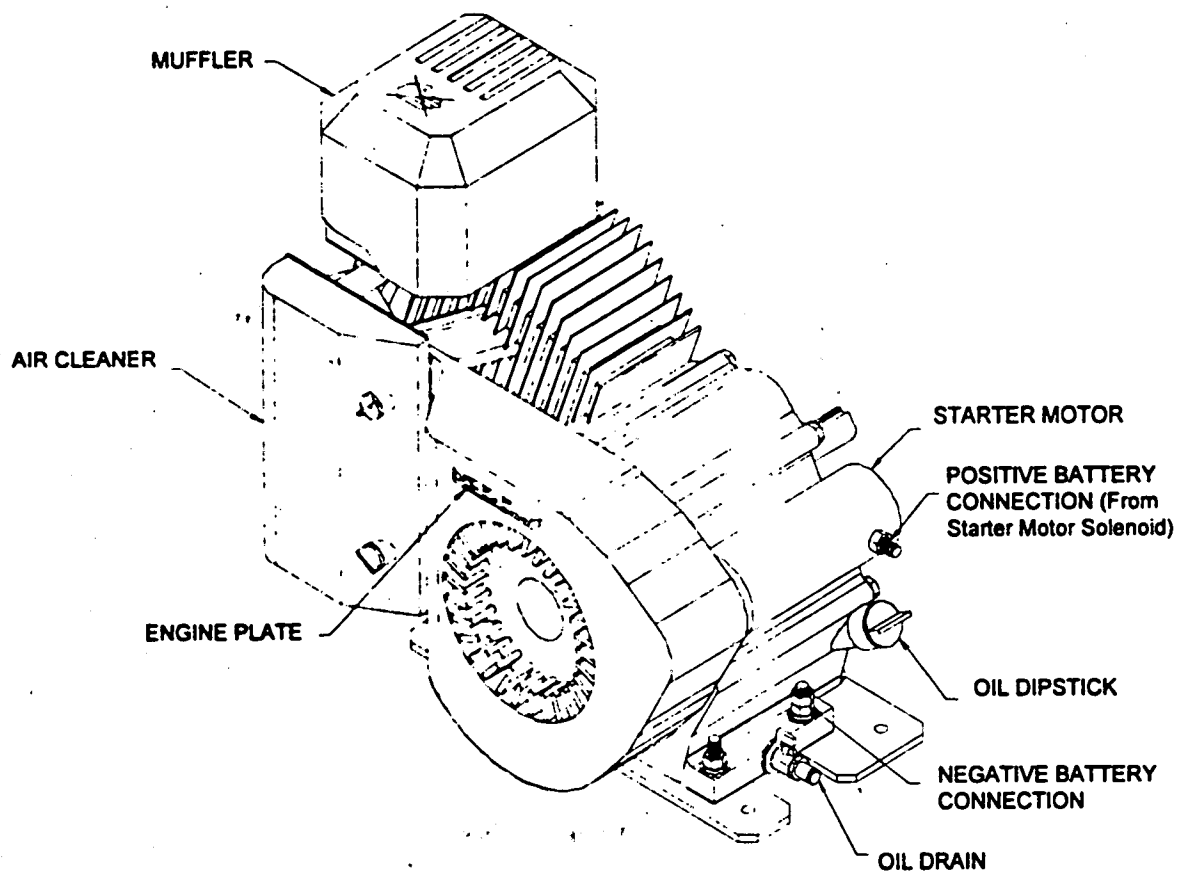


Figure 402. 3 kW Dipstick and Oil Drain Valve Locations - Starter Side View



Note: Used oil and oil filter disposal may be regulated in your locality. Make sure local codes are considered when disposing of used oil and oil filter.



Clean engine oil is added through the engine valve cover or the dipstick tube. Do not overfill the engine with oil. Oil capacity of the generator set can be found in Table 102, Generator Set Specifications.

Note: Too much oil can cause high oil consumption, high operating temperatures, and oil foaming. Too little oil can cause severe engine damage. Keep oil level between the Full and Add marks on the dipstick.

A new engine oil filter should be installed at least once a year. Carefully remove the oil filter to minimize the amount of oil spillage. Wipe up any oil spills with a clean cloth to prevent accumulation of dirt and debris. When installing the new oil filter, a thin film of oil should be spread over the filter seal surface. Do not overtighten the oil filter to the engine. An overtightened oil filter will be difficult to remove and can cause serious deformation of the oil filter mounting base.

402.3 Spark Plug Service

	WARNING	
<p>Automatic startup of the generator set while performing maintenance or service can cause severe personal injury or death. Push the control switch to OFF and disconnect the negative (-) battery cable from the battery to prevent the generator set from starting.</p>		

	WARNING	
<p>Hazardous voltage!</p> <p>Touching uninsulated live parts inside the controller assembly can result in severe personal injury or death. Take care not to touch uninsulated live parts. Stand on a dry wooden platform or rubber insulating mat. Make sure your clothing and shoes are dry, remove jewelry and use tools with insulated handles. Make sure all AC and DC power is disconnected before making connections inside the controller.</p>		

Spark plugs installed in the generator set should be changed annually or after 100 hours of operation. Figure 406 shows the location of the 3 kW engine spark plug and Figures 407 and 408 show the locations of the 4.5 and 5.5 kW spark plugs. Both spark plugs should be changed on V-Twin powered generator sets when required.

Spark plugs should be gapped prior to installation and torqued to 180 pounds-inch. Refer to Table 102, Generator Set Specifications, for spark plug gap requirements.

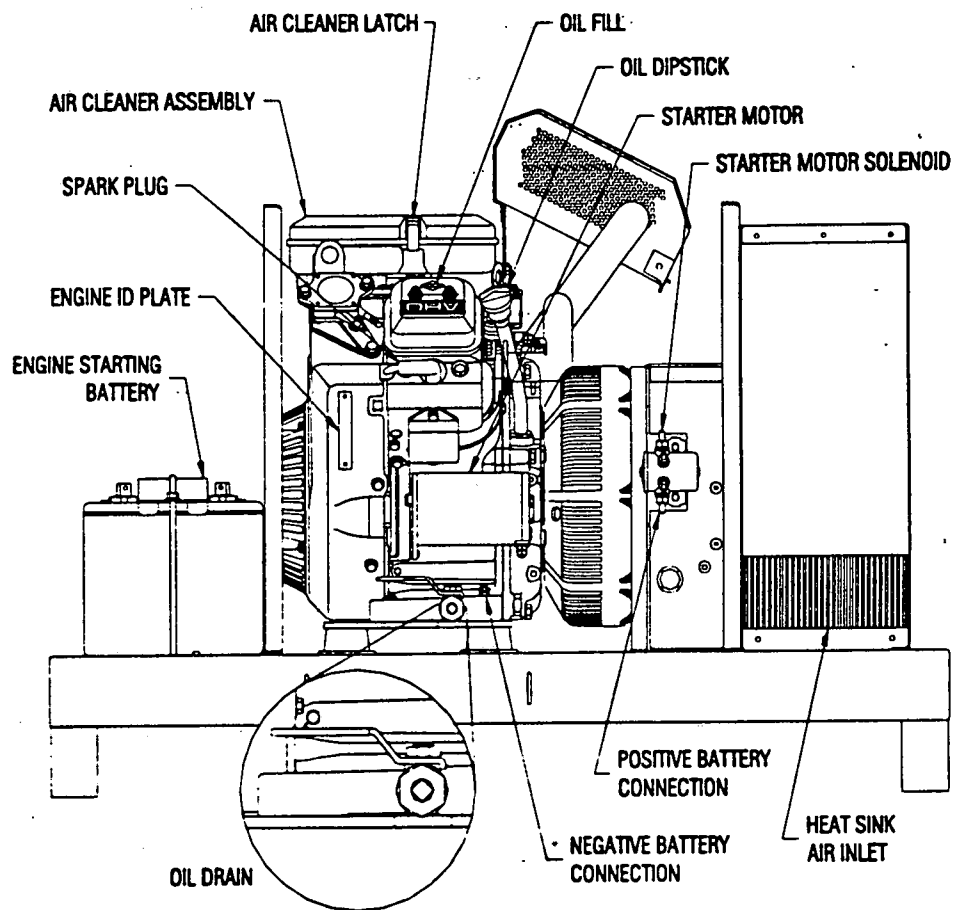


Figure 403. Dipstick and Oil Drain Locations - 4.5 kW and 5.5 kW Generator Sets

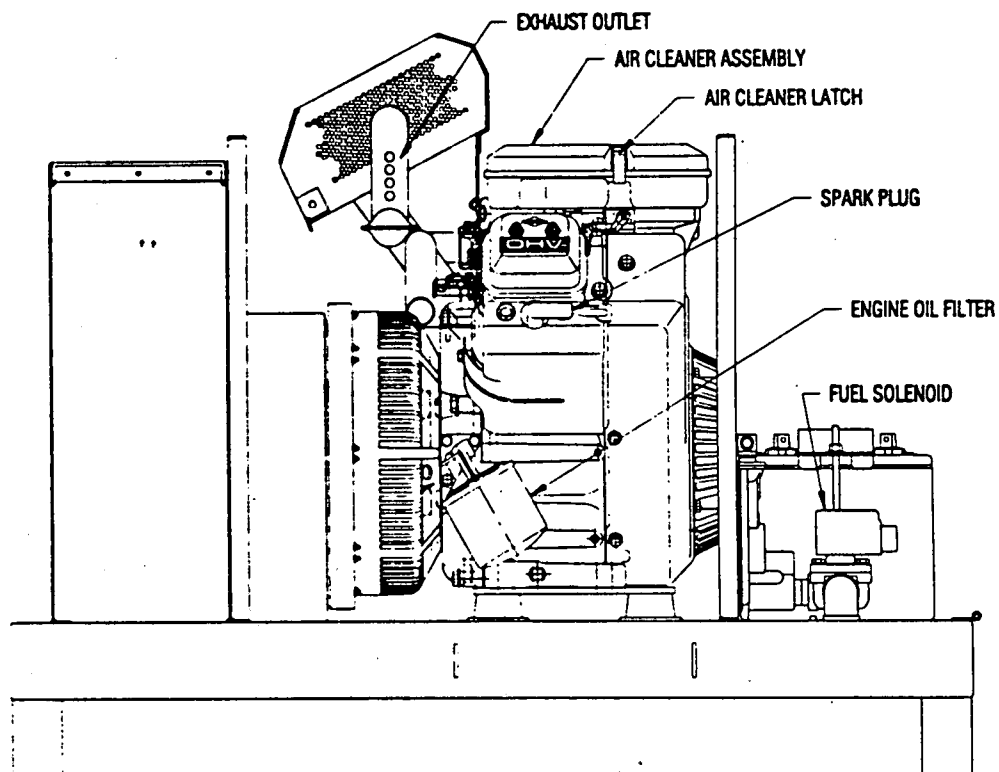




Figure 404. Oil Filter Location - 4.5 kW and 5.5 kW Generator Sets

	WARNING	
<p style="text-align: center; font-weight: bold; margin: 0;">Hazardous voltage!</p> <p style="margin: 0;">Touching uninsulated live parts inside the control panel can result in severe personal injury or death. Take care not to touch uninsulated live parts. Stand on a dry wooden platform or rubber insulating mat. Make sure your clothing and shoes are dry, remove jewelry and use tools with insulated handles. Make sure all AC and DC power is disconnected before making connections inside the controller.</p>		

Your generator set must be maintained and serviced by qualified personnel. However, there are simple maintenance steps you can take to help prevent equipment failure.

- Keep the interior of the generator set clean and free from accumulations of dust, dirt and debris which can interfere with set operation and can be a fire hazard.
- The heat sink air intake area on the controller assembly should be kept free from accumulations of airborne dust and lint. Low pressure compressed air can be periodically blown through the heat sink to remove these contaminants.
- Keep controller assembly interior clean through periodic vacuuming of the interior. Do not use compressed air to clean the interior of the controller assembly since small metal chips can be attracted to the alternator magnets.

404 PERIODIC MAINTENANCE REQUIREMENTS

Refer to Table 401 for periodic maintenance requirements. Refer to Figures 405 through 410 for engine component locations.

Table 401. Periodic Maintenance Requirements

Maintenance Interval	Procedure
50 hours or 12 months	Change engine oil.
Annually or 100 hours	Replace oil filter (when fitted).
	Replace air filter element.
	Replace spark plug(s).
	Check valve lash.
Biannually (2 years)	Replace battery.

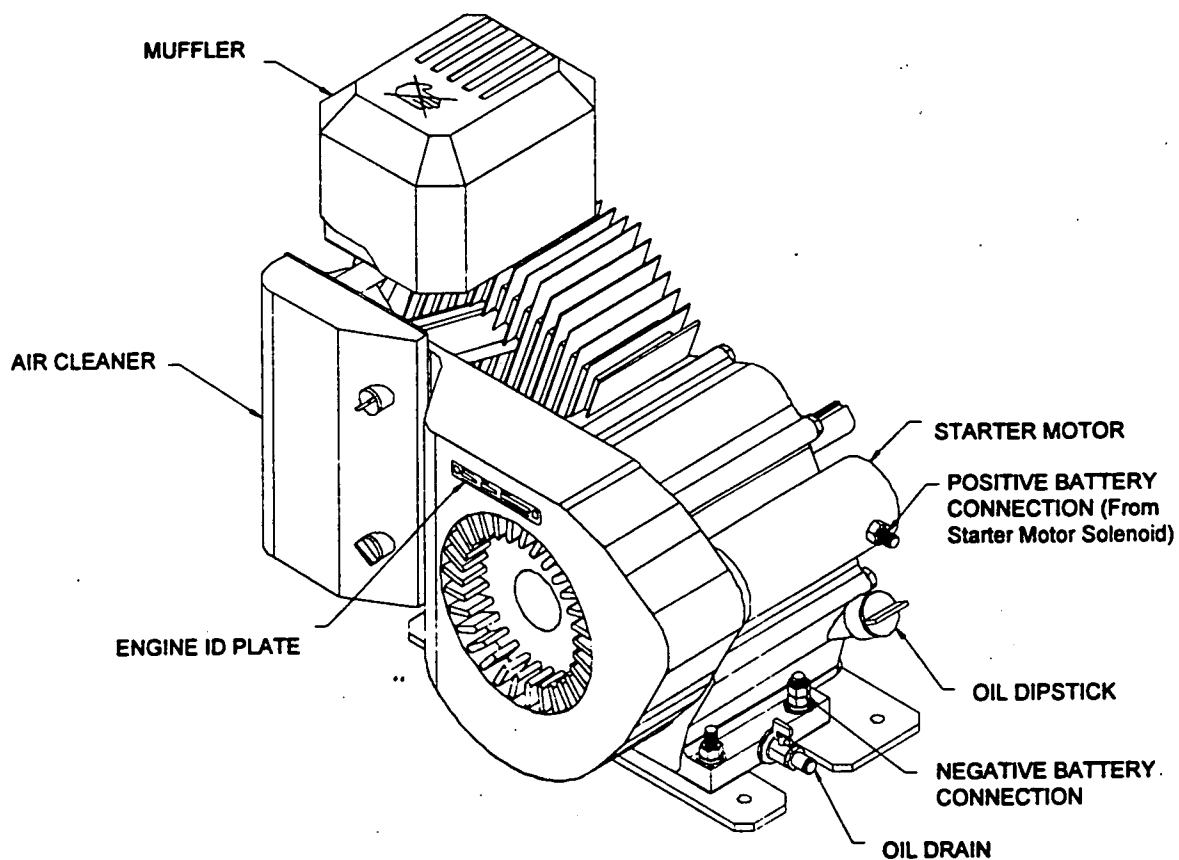


Figure 405. 3 kW Generator Set Component Locations - Starter Side

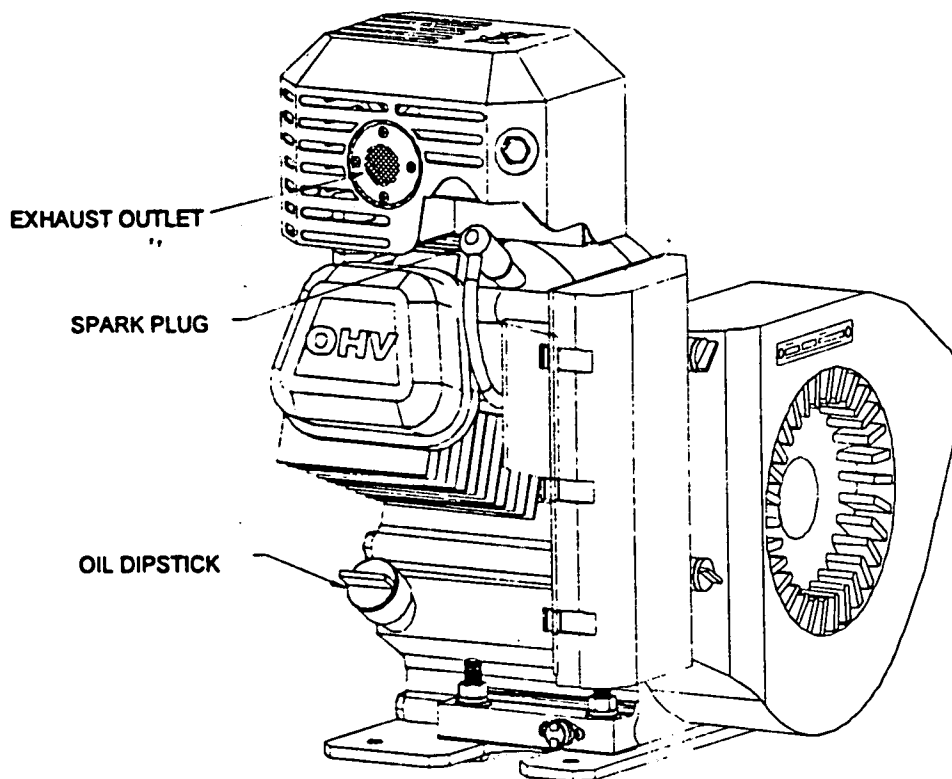


Figure 406. 3 kW Generator Set Component Locations - Cylinder Side

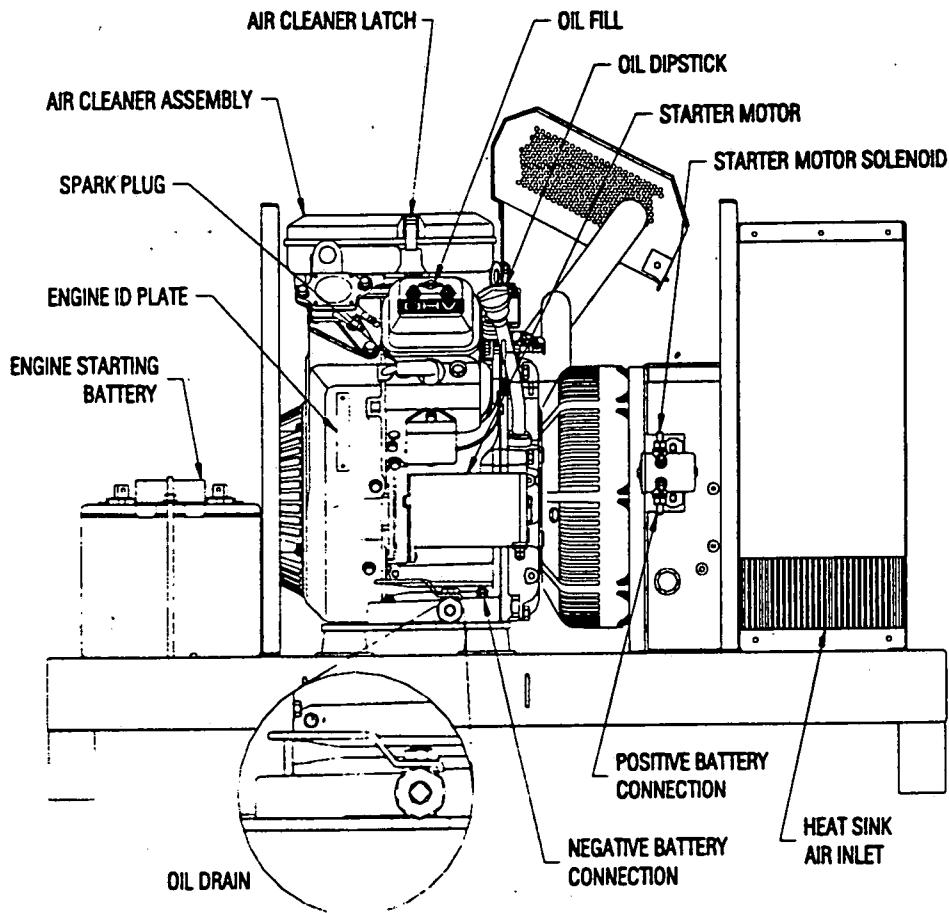


Figure 407. 4.5 kW Generator Set Component Locations - Left Side

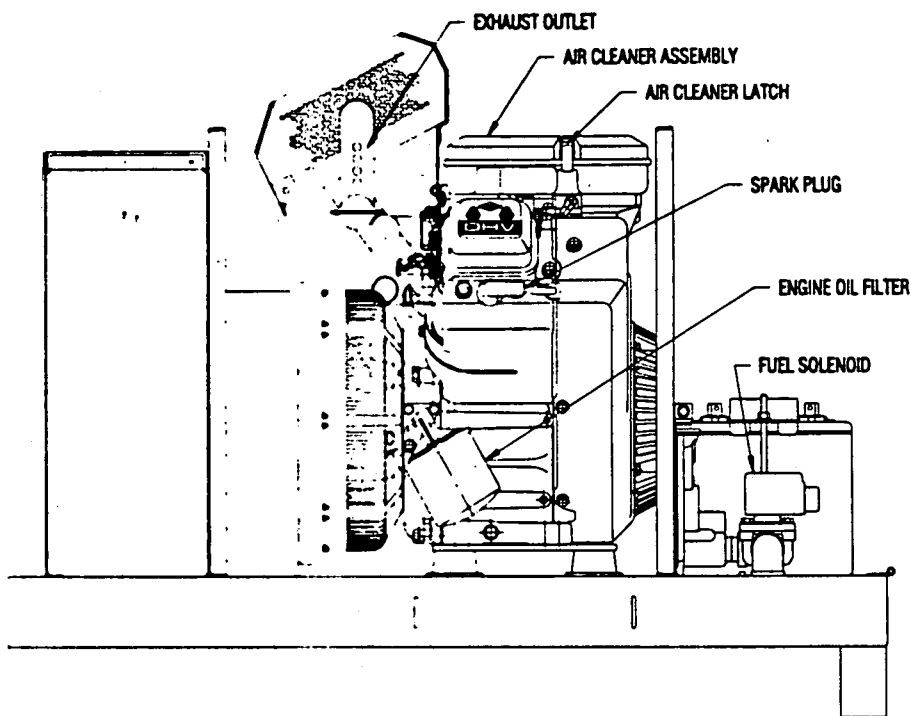


Figure 408. 4.5 kW Generator Set Component Locations - Right Side

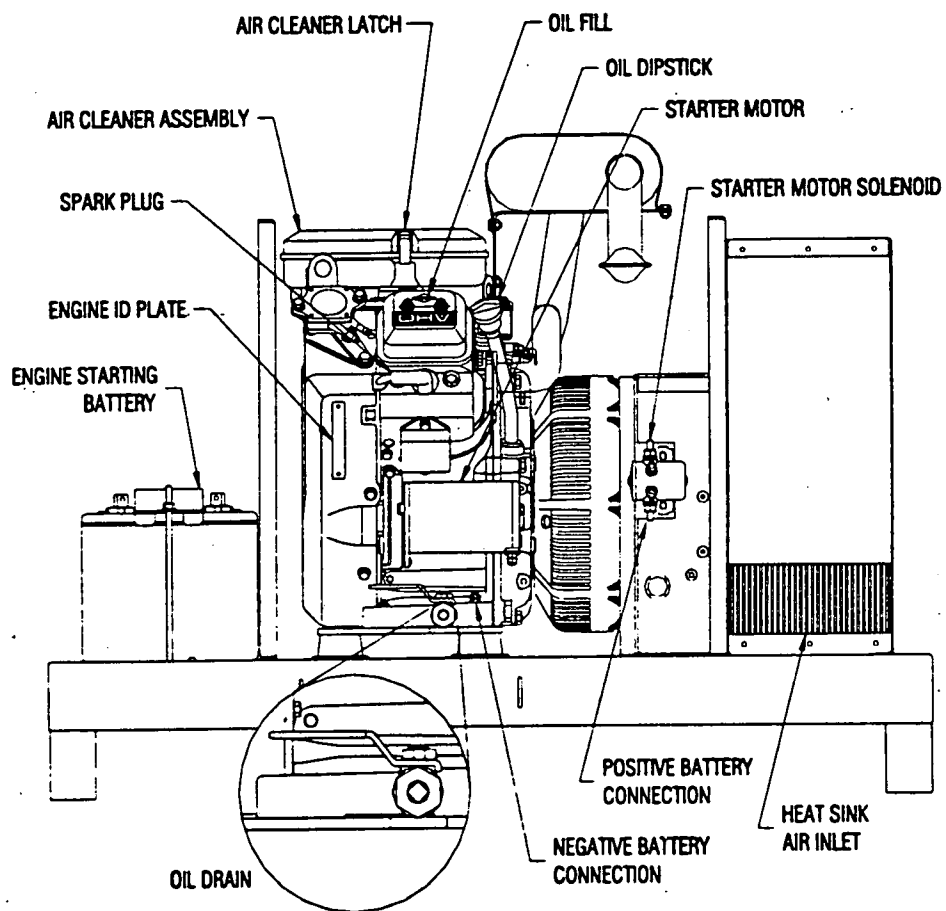


Figure 409. 5.5 kW Generator Set Component Locations - Left Side

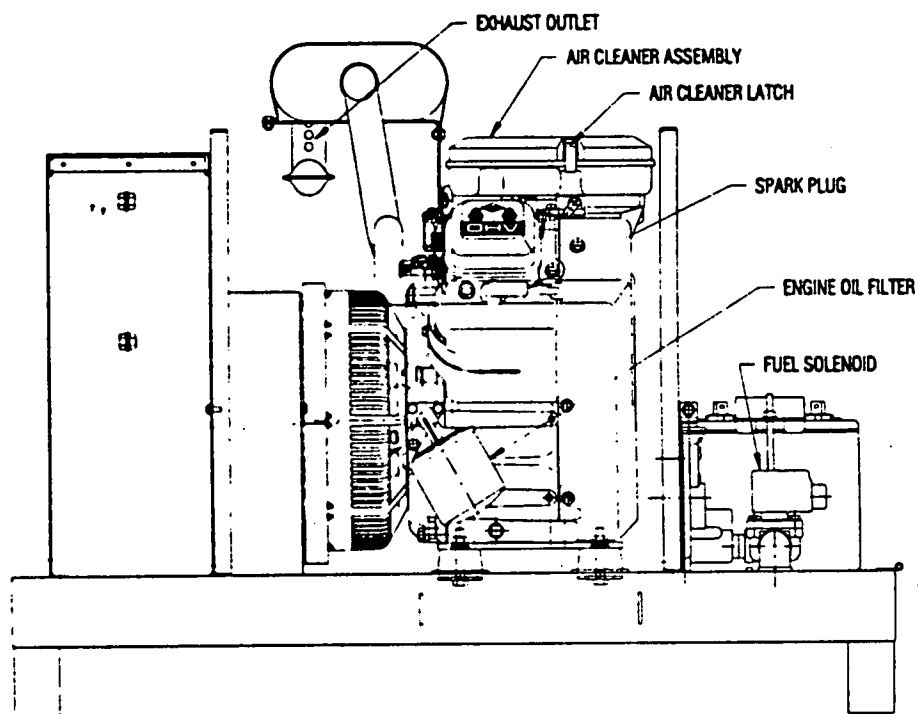


Figure 410. 5.5 kW Generator Set Component Locations - Right Side

If the generator set fails to operate, Table 402 is provided to assist in troubleshooting and correcting the occurrence. Observe any alarm lights indicated by the major/minor alarm indications located on the controller. Placing the MANUAL/OFF/AUTO switch in the OFF position will clear the alarm and reset the controller. You must correct the alarm condition prior to returning the generator set back to service. If the problem cannot be identified, consult an Authorized Onan Distributor.



	WARNING	
<p>Some generator set service procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform generator set service.</p>		

Table 402. Troubleshooting

Problem	Corrective Action
Engine will not crank.	a. Recharge or replace battery. b. Clean and tighten positive (+) and negative (-) cable connections at the battery and the engine (Figures 405 through 410).
Engine cranks but will not start.	a. Verify fuel line shutoff valve is in OPEN position. b. Verify proper engine oil level. c. Secure spark plug lead(s) on the spark plug(s). d. Replace spark plug(s).
No DC power output.	Verify circuit breaker is in ON position.
Circuit breaker trips when load is applied.	Turn all load equipment OFF. Reset circuit breaker. Turn load equipment ON, one load at a time, starting with smallest load.
Minor fault alarm light ON.	a. Verify availability of primary fuel source. b. Verify DC load (battery) voltage.
Major fault alarm light ON.	a. Check and refill engine oil level as required. b. Reset circuit breaker to ON position. c. Verify DC load (battery) voltage is above 43 VDC. d. Verify DC load (battery) voltage is less than 59 VDC. e. Verify engine throttle moves freely. f. Check that air inlets for engine and heat sink are free of debris or other obstructions.
Generator runs but does not assume load. Run light is not on.	Verify DC load (battery) voltage is at or below the output set point voltage.

The Reference Designation Chart, Table 403, is an easy reference guide to the callouts on the Schematic Wiring Diagrams, Figures 411, 412 and 413.

Table 403. Reference Designation Chart

Reference Designation	Description
A1	Telecom Control
B1	Starter Motor
B2	Motor, Step Geared, 30:1
BT1	Battery, 12 Volt
C1	Capacitor
CB1	Circuit Breaker
CB1-AUX	(Circuit Breaker)
CR1	Rectifier Module
CT1	Current Transformer, 800:1
D1	Diode Module
D2	Diode
D3	Diode
D4	Diode
D5	Diode
FAN	Fan, Engine Cooling, 12 VDC
F1	Fuse, 10 Amp or 20 Amp
F2	Fuse, 3 Amp
F3	Fuse, 10 Amp or 20 Amp
FC	Battery Float Charger 12VDC
G1	Alternator, 3 Phase
G2	Battery Charger
G2-VR	G2 Voltage Regulator
HM	Hour Meter, 8 - 32 VDC, 2.2W
HP	Heater Pad, Engine
J1 - J10	Receptacles
J12	Receptacle, 2-Position
J13	Receptacle, 2-Position
J14	Receptacle, 2-Position
J15	Receptacle, 2-Position
J16	Receptacle, 2-Position
J17	Receptacle, 2-Position
K1	Contactor,DCPower,12V 200Amp
K2	Contactor, DC Power 12V 80Amp
K3	Relay, 30 Amp,2-Pole,Panel Mount

Reference Designation	Description
L1	Solenoid Valve, Nat Gas
L4	Solenoid, Gas Reg, 12VDC
P1	Plug, 10-Position
P2	Plug, 3-Position
P3	Plug, 2-Position
P4	Plug, 7-Position
P5	Plug, 2-Position
P6	Plug, 4 -Position
P7	Plug, 6-Position
P8	Plug, 4-Position
P9	Plug, 12-Position
P10	Plug, 6-Position
P12	Plug, 2-Position
P13	Plug, 2-Position
P14	Plug, 2-Position
P15	Plug, 2-Position
P16	Plug, 2-Position
P17	Plug, 2-Position
R1	Resistor, 500 Ohm, 10W
R2	Resistor, 10 Ohm 1W
R3	Resistor, Metal Film
R5	Resistor, 7.5 Ohm, 25 Watt
S1	Switch, Master, 3-Position, 4-pole
S3	Switch, Oil Pressure
S4	Switch, Door Interlock
S5	Switch, Temp
S6	Thermostat, Overtemp
S7	Thermostat, Fan ON/OFF
TB1	Terminal Board, Power, 2-Stud
TB2	Terminal Block
TB3	Terminal Block
TB4	Terminal Block
TB5	Terminal Block
TB6	Terminal Block

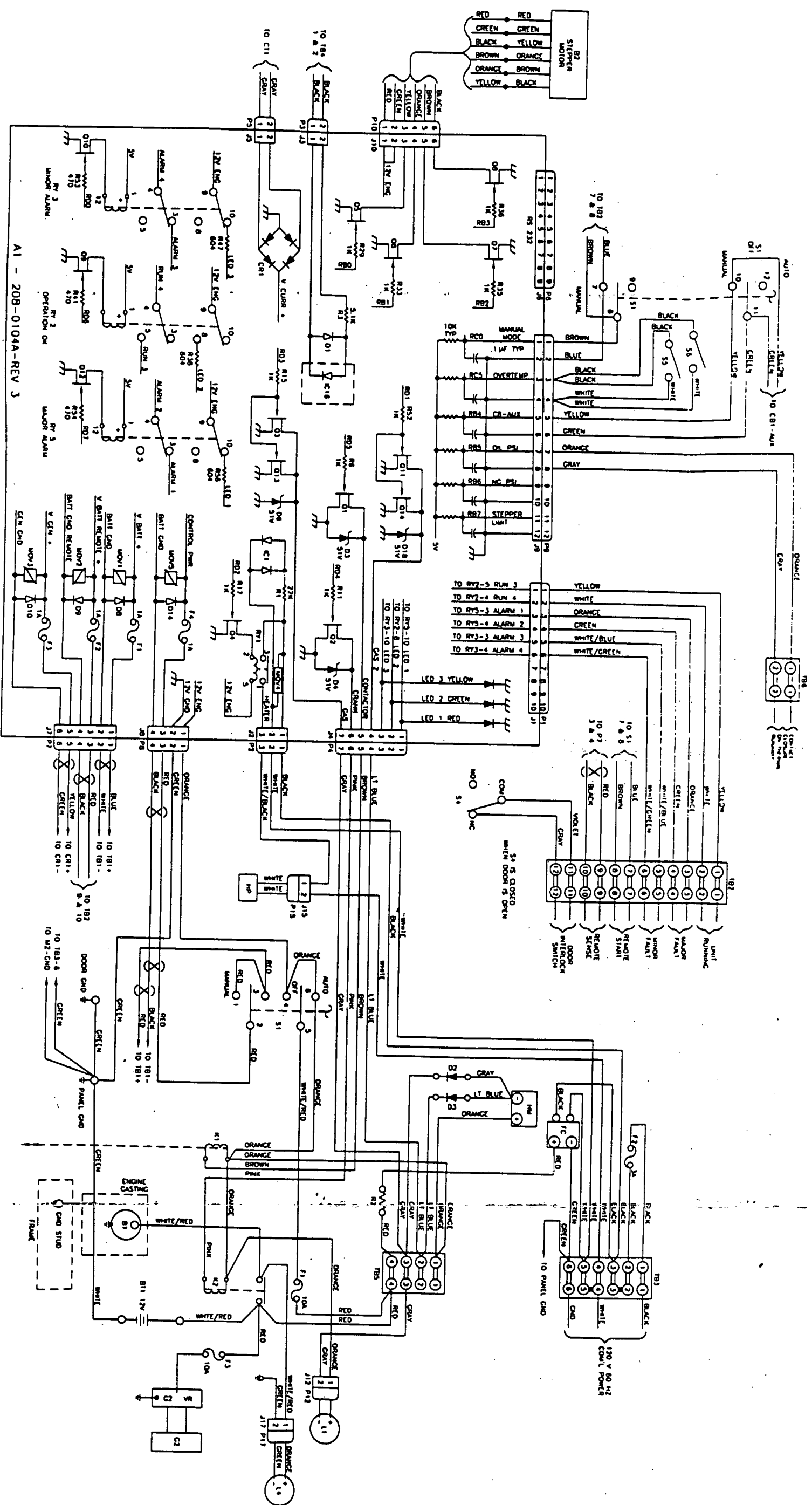


Figure 411. Schematic Wiring Diagram - 3 kW
Models: GCAA-24, GCAA-48 /
D2030, D4030

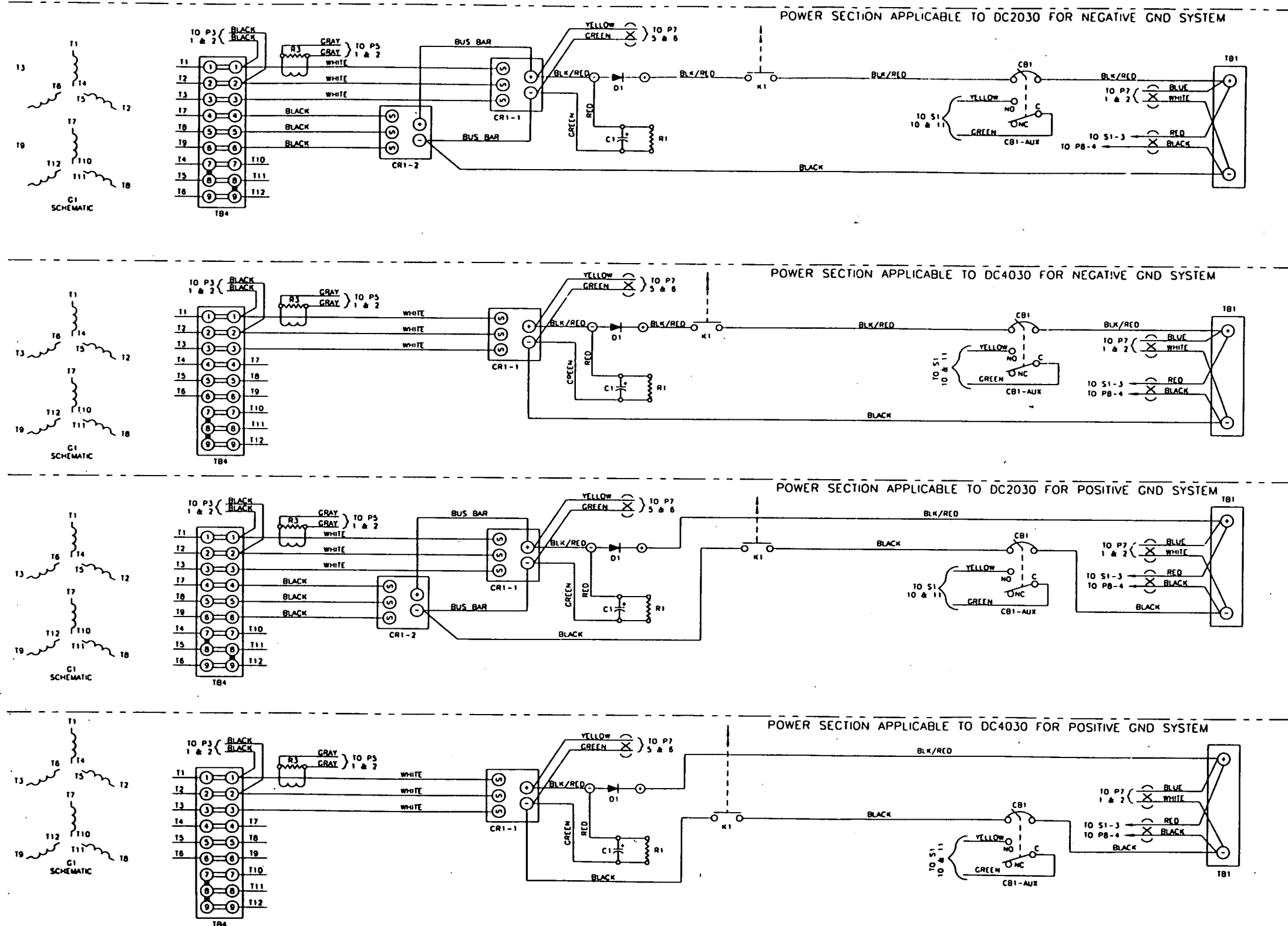


Figure 411. Schematic Wiring Diagram - 3 kW
Models: GCAA-24, GCAA-48 /
D2030, D4030

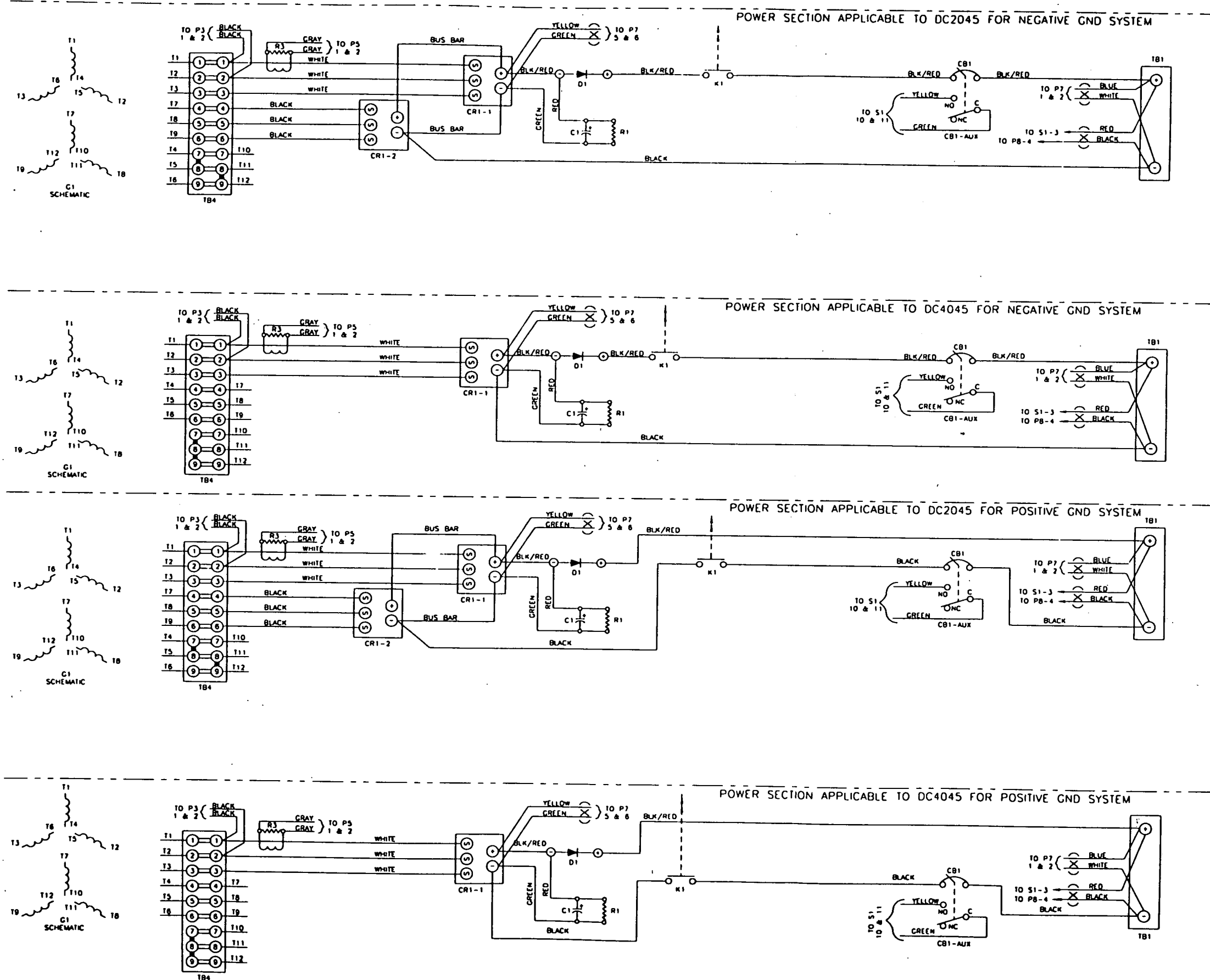


Figure 412. Schematic Wiring Diagram - 4.5 kW
Models: GCAB-24, GCAB-48 /
D2045, D4045

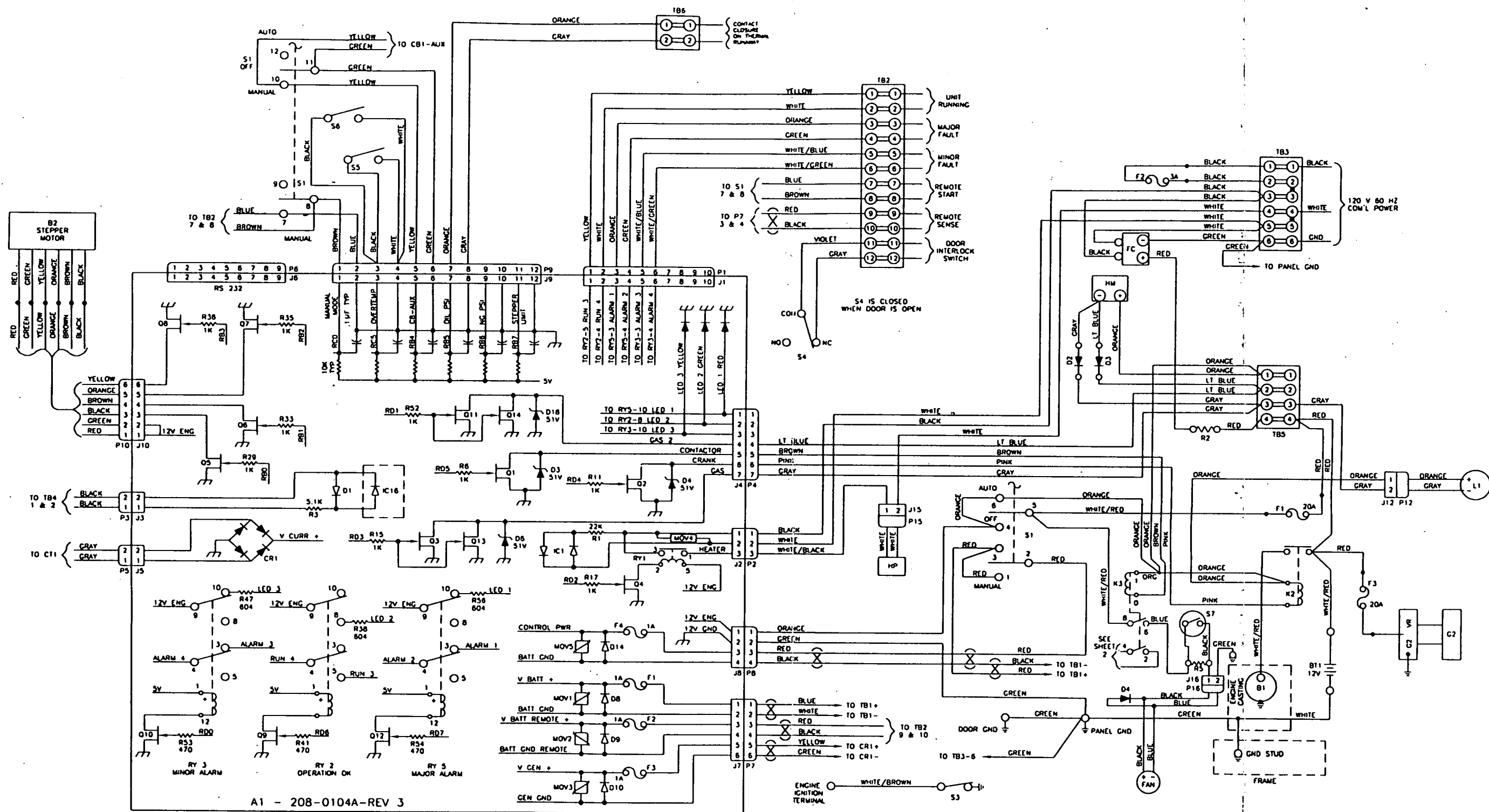


Figure 413. Schematic Wiring Diagram - 5.5 kW Models: GCAC-24, GCAC-48 / D2055, D4055

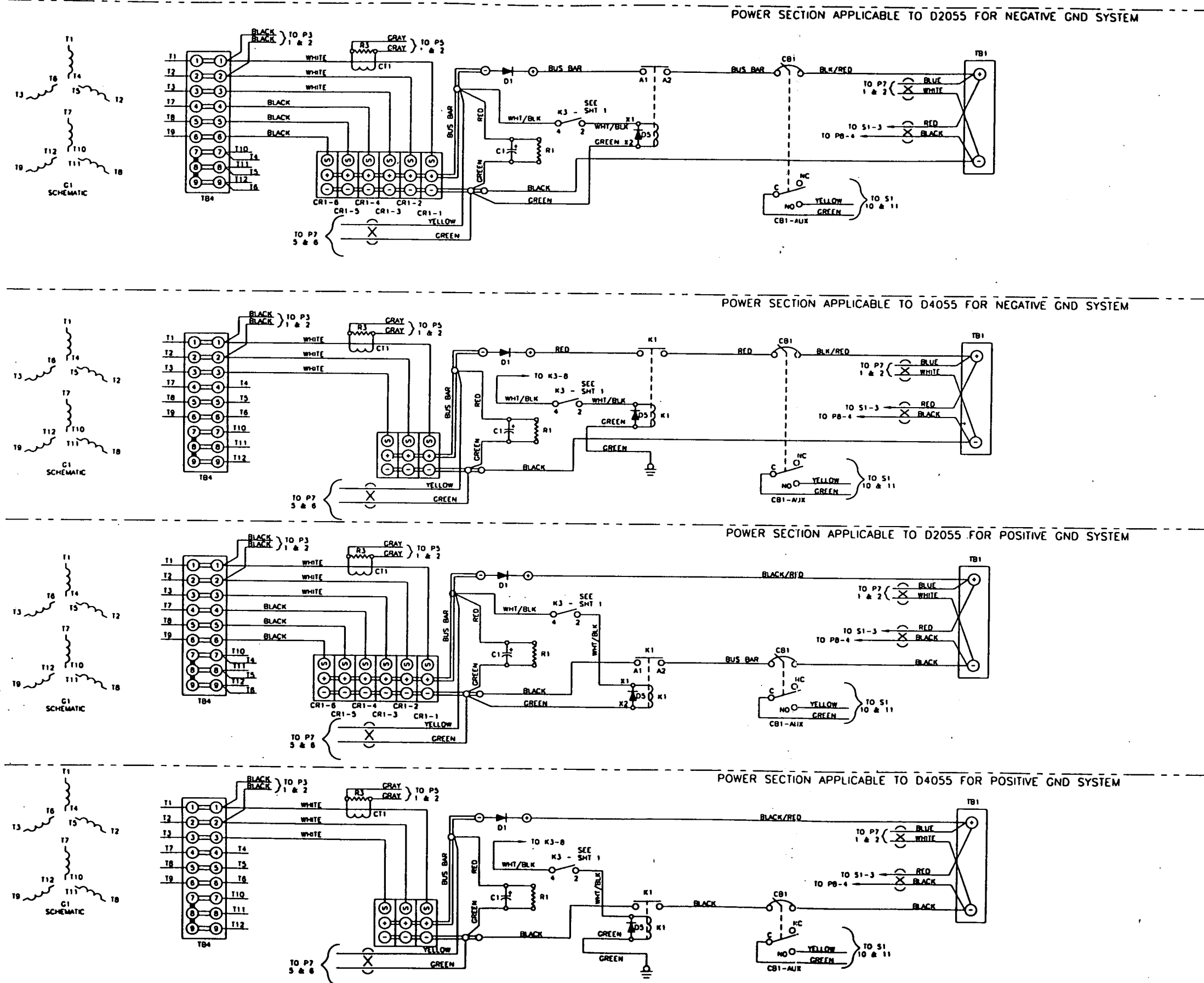


Figure 413. Schematic Wiring Diagram - 5.5 kW
Models: GCAC-24, GCAC-48 /
D2055, D4055

NOTES:

1. Applicable Standards/Specifications:
ANSI Y14.5M-1982, Dimensions and Tolerances.
2. Dimensions in [brackets] are in centimeters.
3. 325 Pounds (dry).
4. For Electrical Notes, see Page 3 of 3.
5. Do not block inlet and outlet grills.

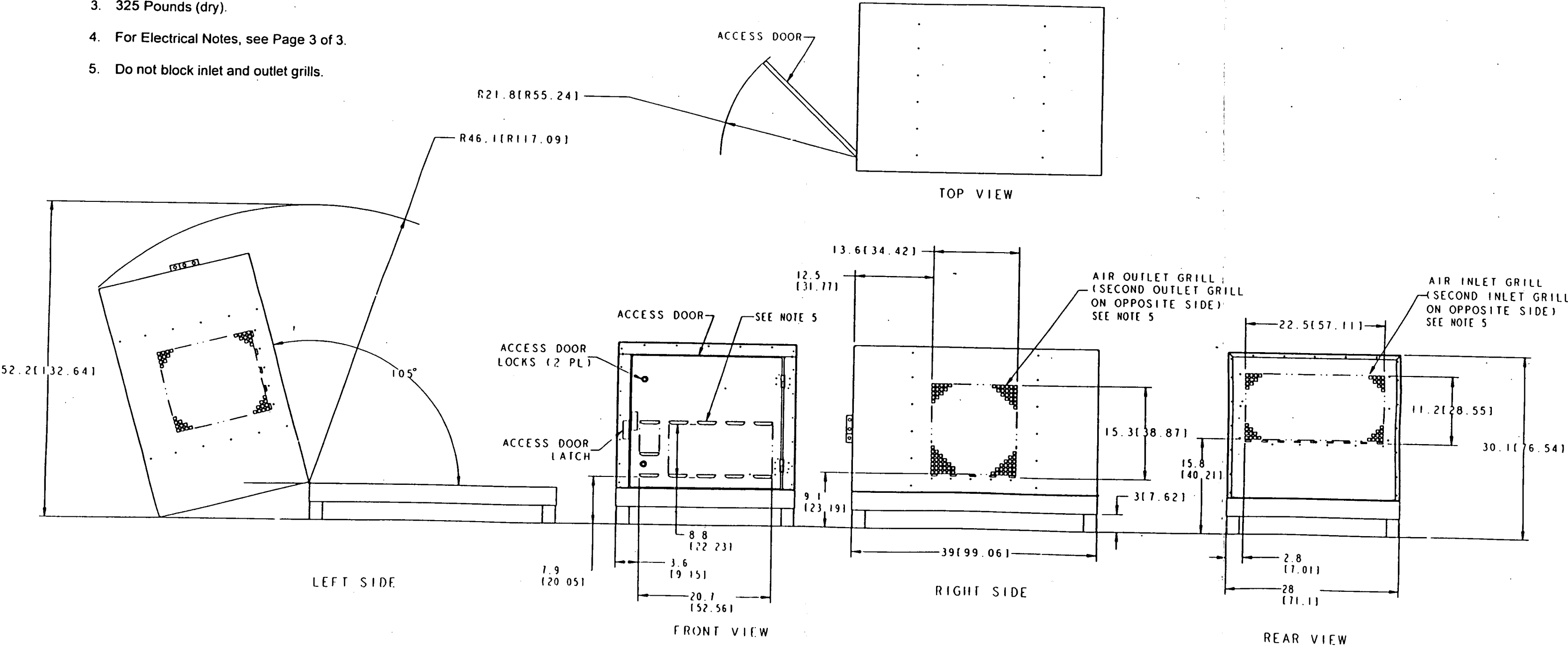
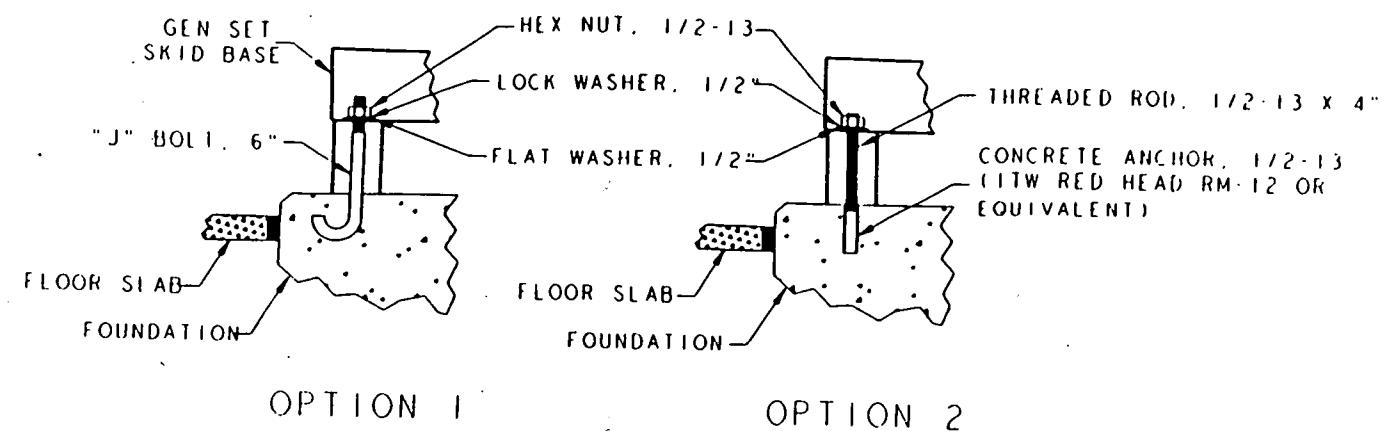


Figure 414. Generator Set Outline - 3 kW
Models: GCAA-24, GCAA-48 /
D2030, D4030



VIEW A
SCALE 1/4

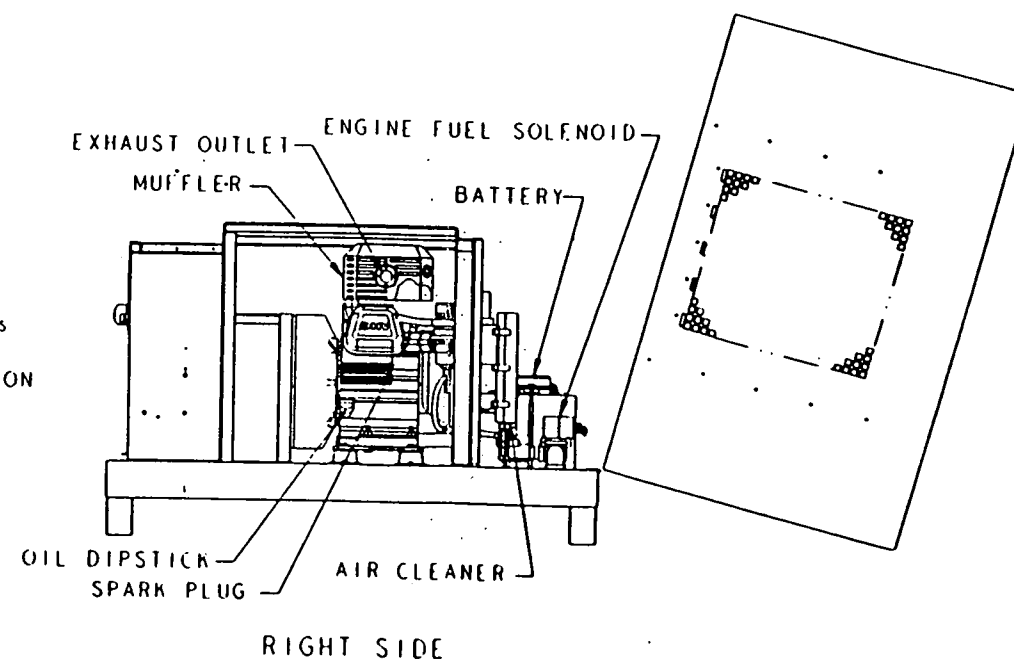
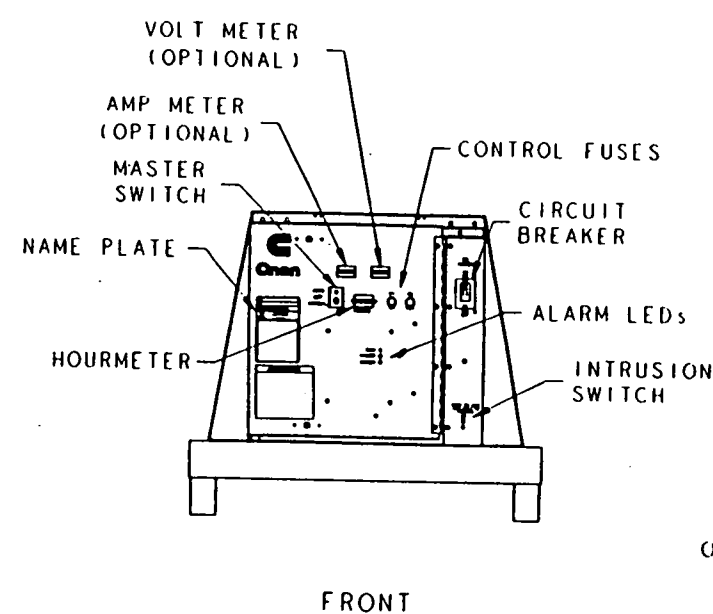
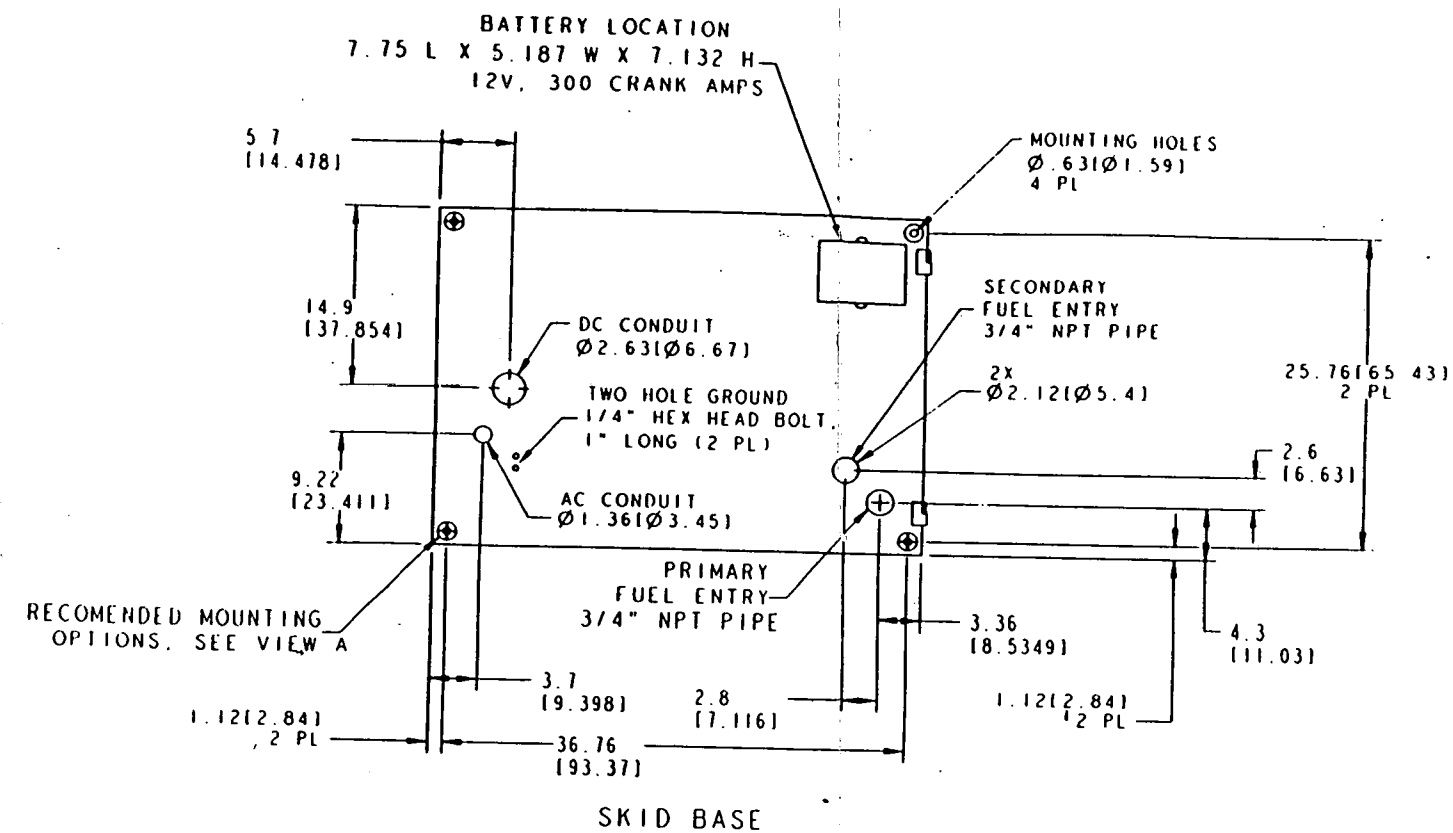


Figure 414. Generator Set Outline - 3 kW
Models: GCAA-24, GCAA-48 /
D2030, D4030

NOTES:

- 1. Applicable Standards/Specifications:
ANSI Y14.5M-1982, Dimensions and Tolerances.
- 2. Dimensions in [brackets] are in centimeters.
- 3. 350 Pounds (dry).
- 4. For Electrical Notes, see Page 3 of 3.
- 5. Do not block inlet and outlet grills.

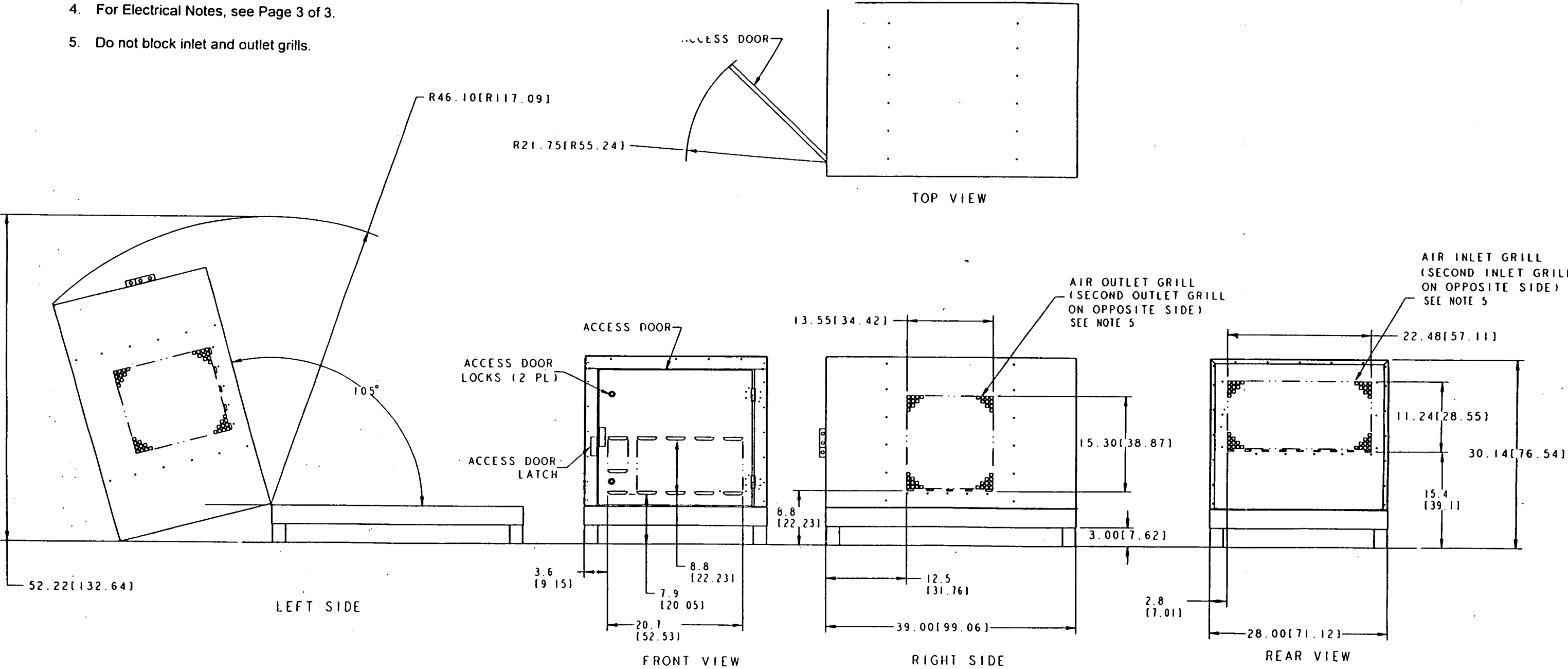


Figure 415. Generator Set Outline - 4.5 kW
Models: GCAB-24, GCAB-48 /
D2045, D4045

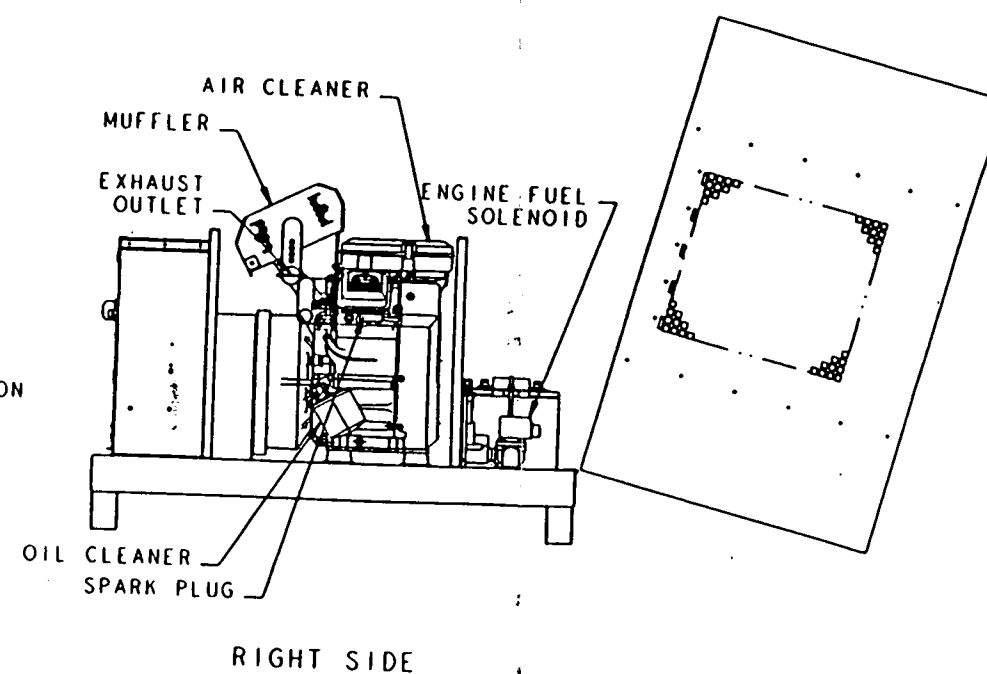
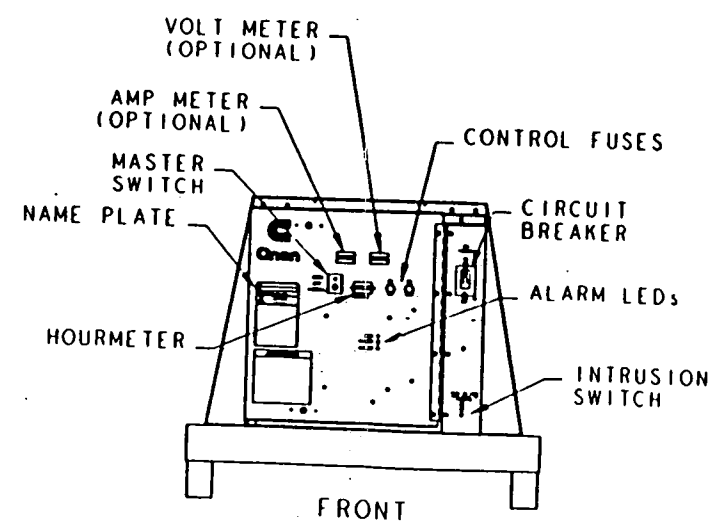
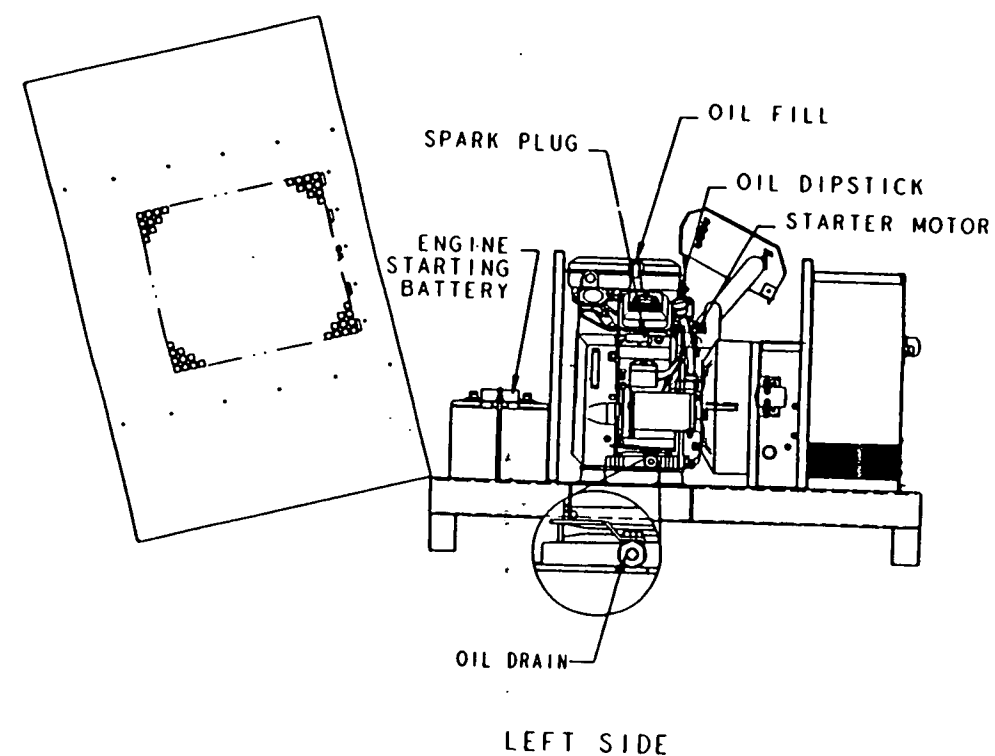
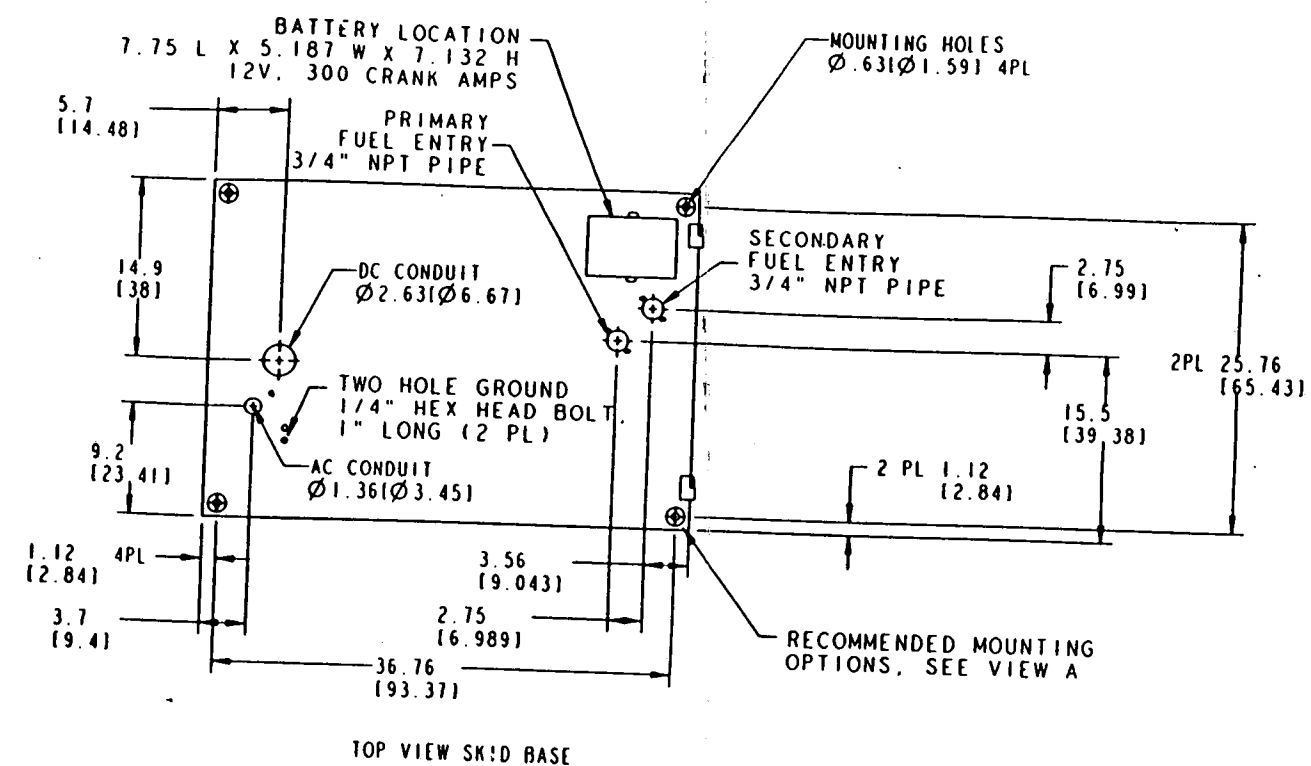
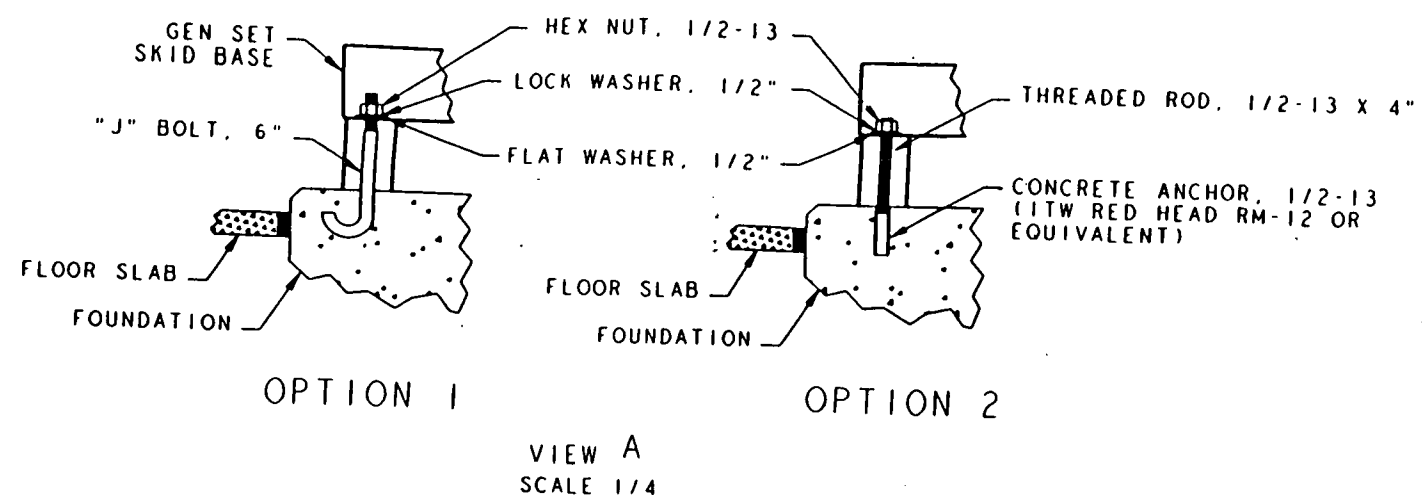
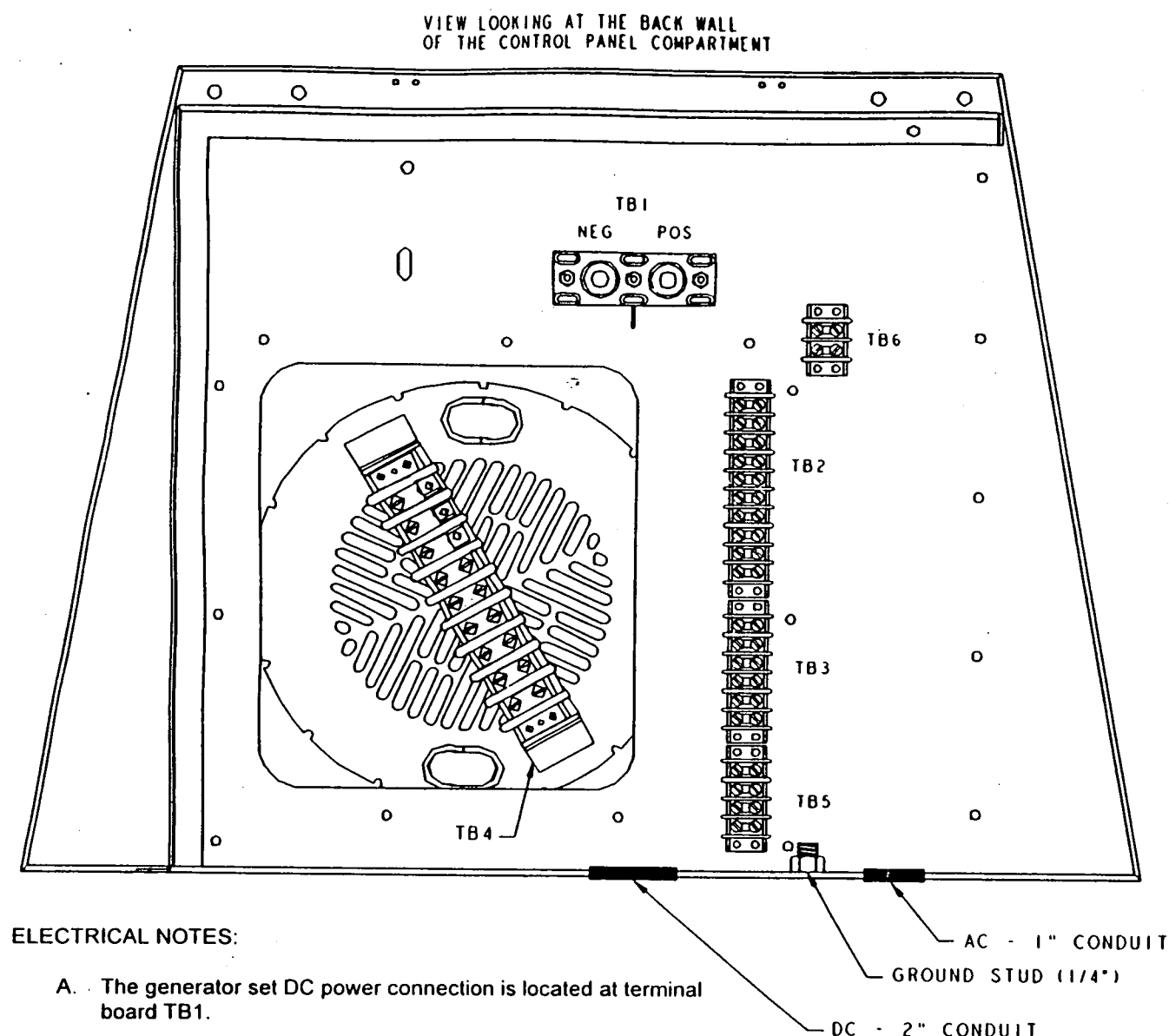


Figure 415. Generator Set Outline - 4.5 kW
Models: GCAB-24, GCAB-48 /
D2045, D4045



ELECTRICAL NOTES:

- The generator set DC power connection is located at terminal board TB1.
- DC load conductors should be terminated with 3/8 inch crimp type eyelets.
- The use of aluminum single barrel lugs is not recommended due to increased maintenance.
- To install the DC power connectors, remove the stud hardware provided and place the 3/8 inch eyelet over the stud. Replace the stud hardware and torque nut to 20 pounds/foot.
- Available output current is 200 Amps, 24 VDC and 100 Amps, 48 VDC. Recommended minimum cable sizes are given below for various cable lengths (total loop length of positive and negative cable).

LOOP LENGTH	CABLE SIZE
24 VDC, 25 FT	2/0 AWG
24 VDC, 50 FT	4/0 AWG
24 VDC, 100 FT	250 mcm
48 VDC, 25 FT	1 AWG
48 VDC, 50 FT	1/0 AWG
48 VDC, 100 FT	4/0 AWG

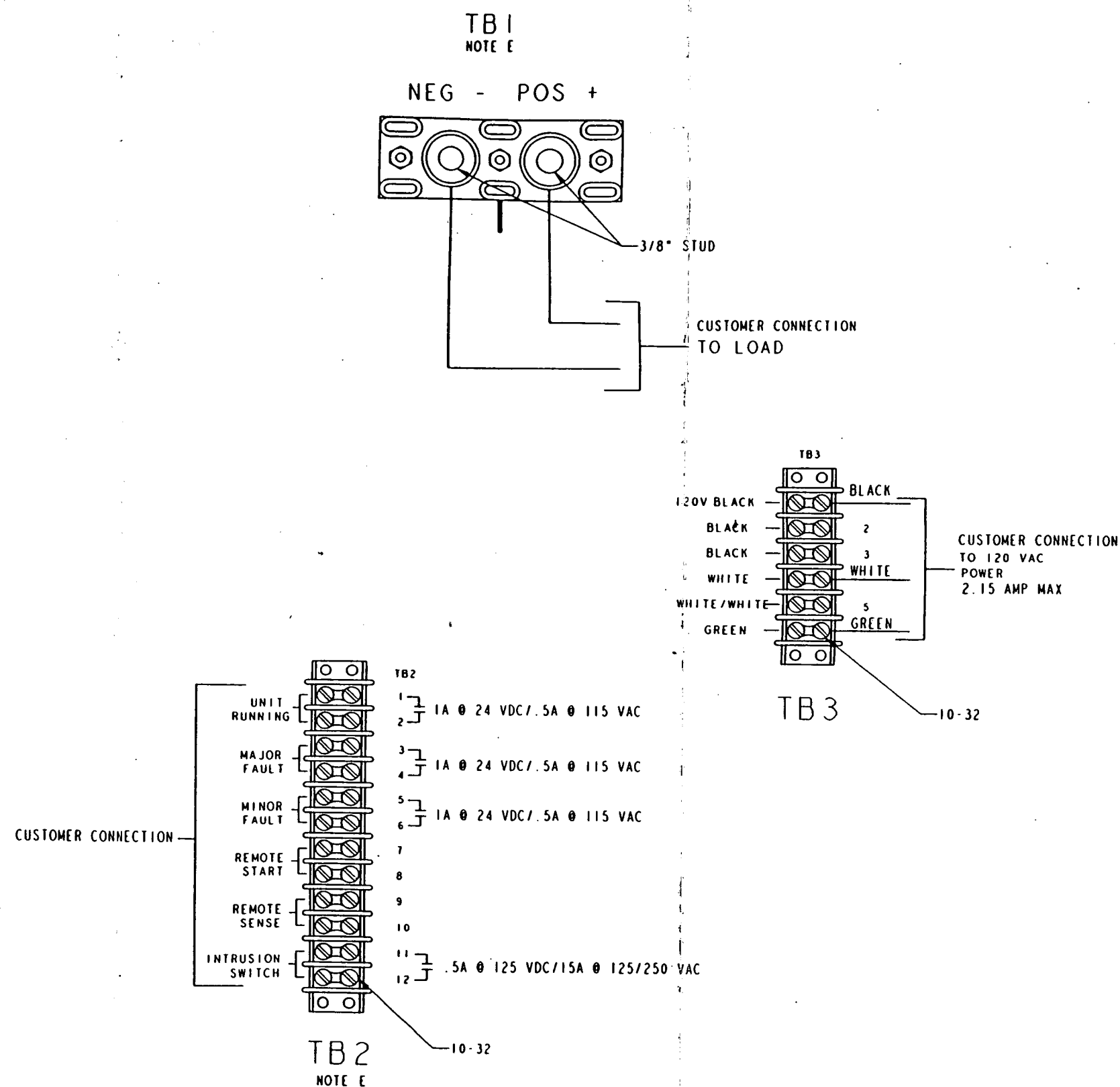


Figure 415. Generator Set Outline - 4.5 kW
Models: GCAB-24, GCAB-48 /
D2045, D4045

NOTES:

- 1. Applicable Standards/Specifications:
ANSI Y14.5M-1982, Dimensions and Tolerances.
- 2. Dimensions in [brackets] are in centimeters.
- 3. 450 pounds (dry).
- 4. For Electrical Notes, see Page 3 of 3.
- 5. Do not block inlet and outlet grills.

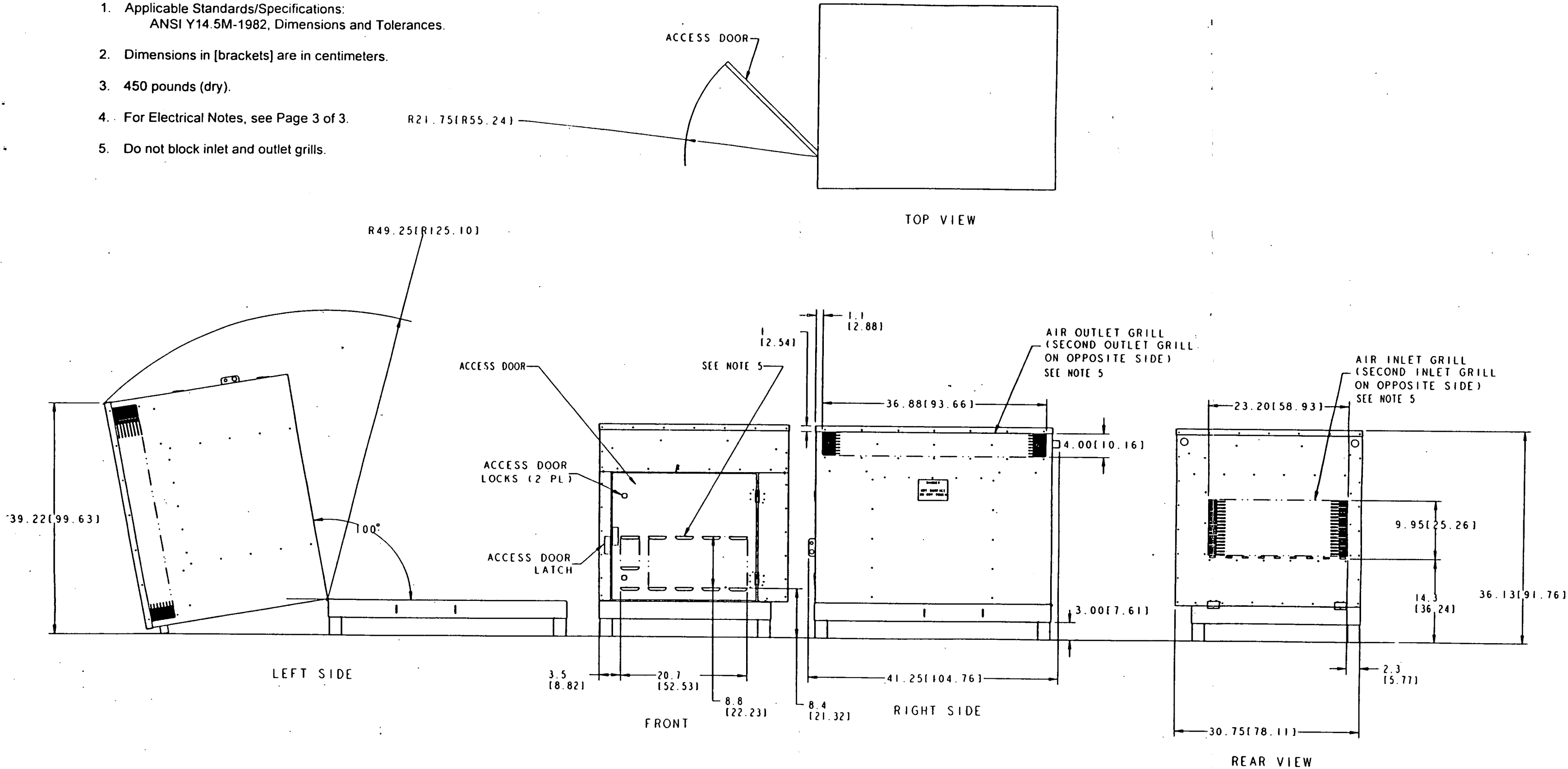
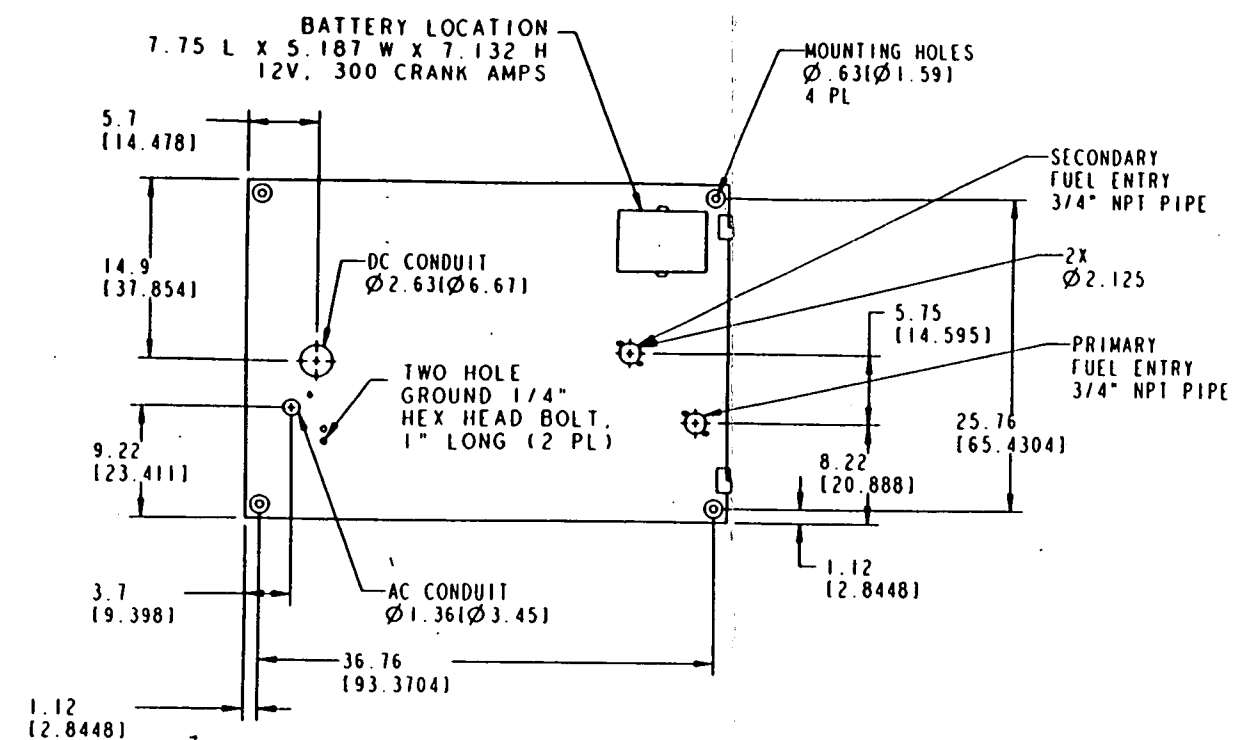
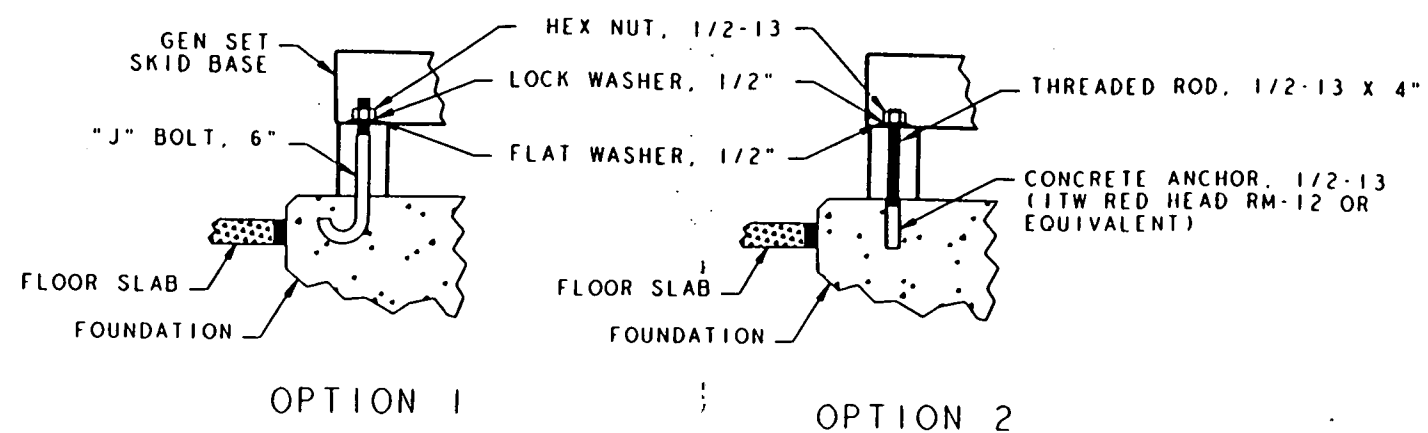


Figure 416. Generator Set Outline - 5.5 kW
Models: GCAC-24, GCAC-48 /
D2055, D4055



TOP VIEW
SKID BASE

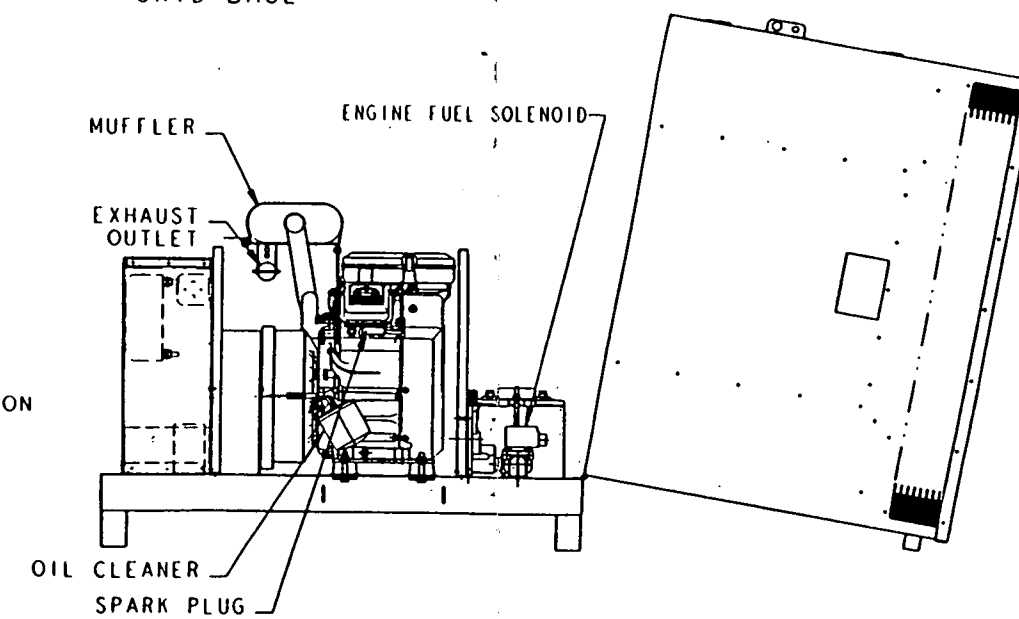
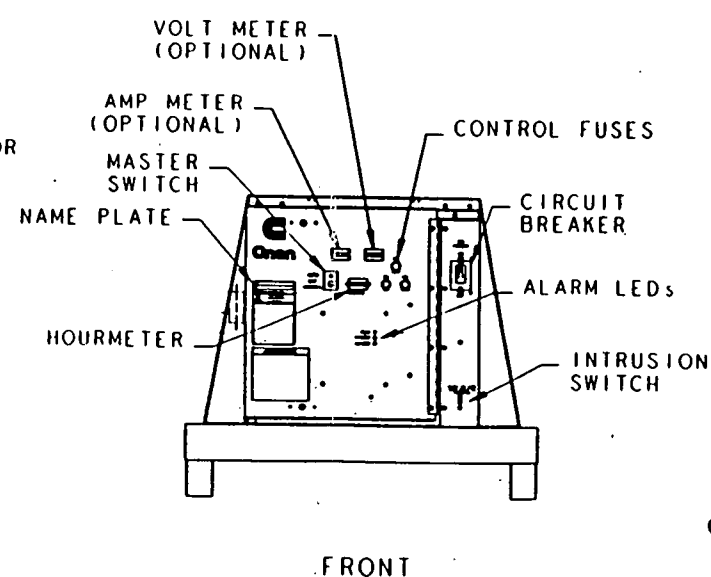
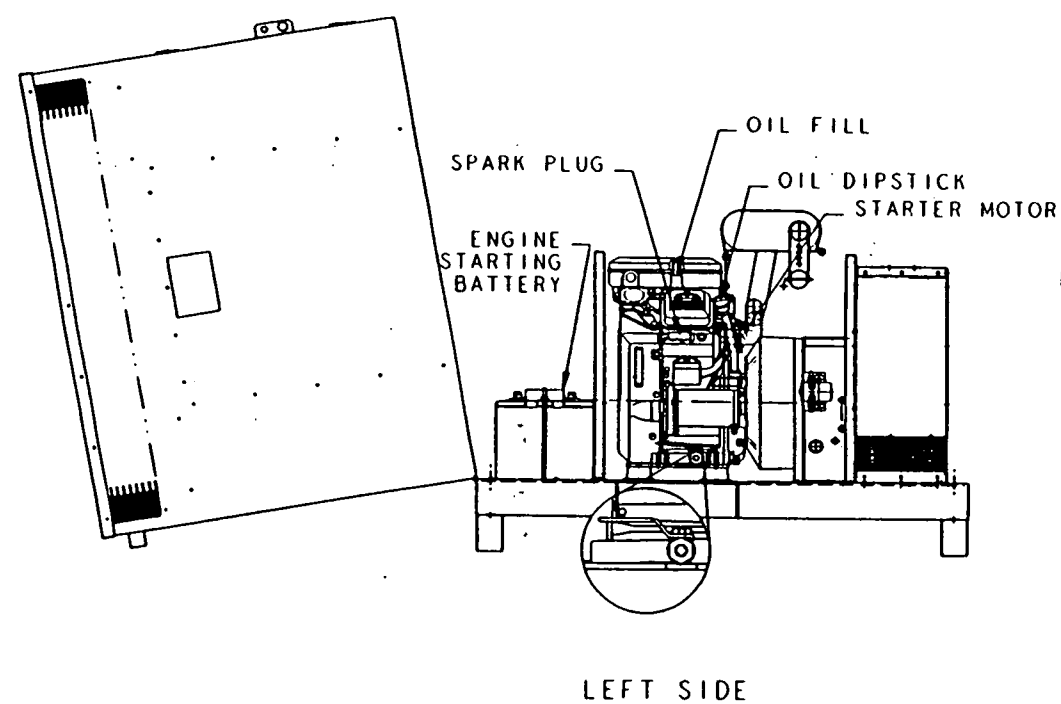
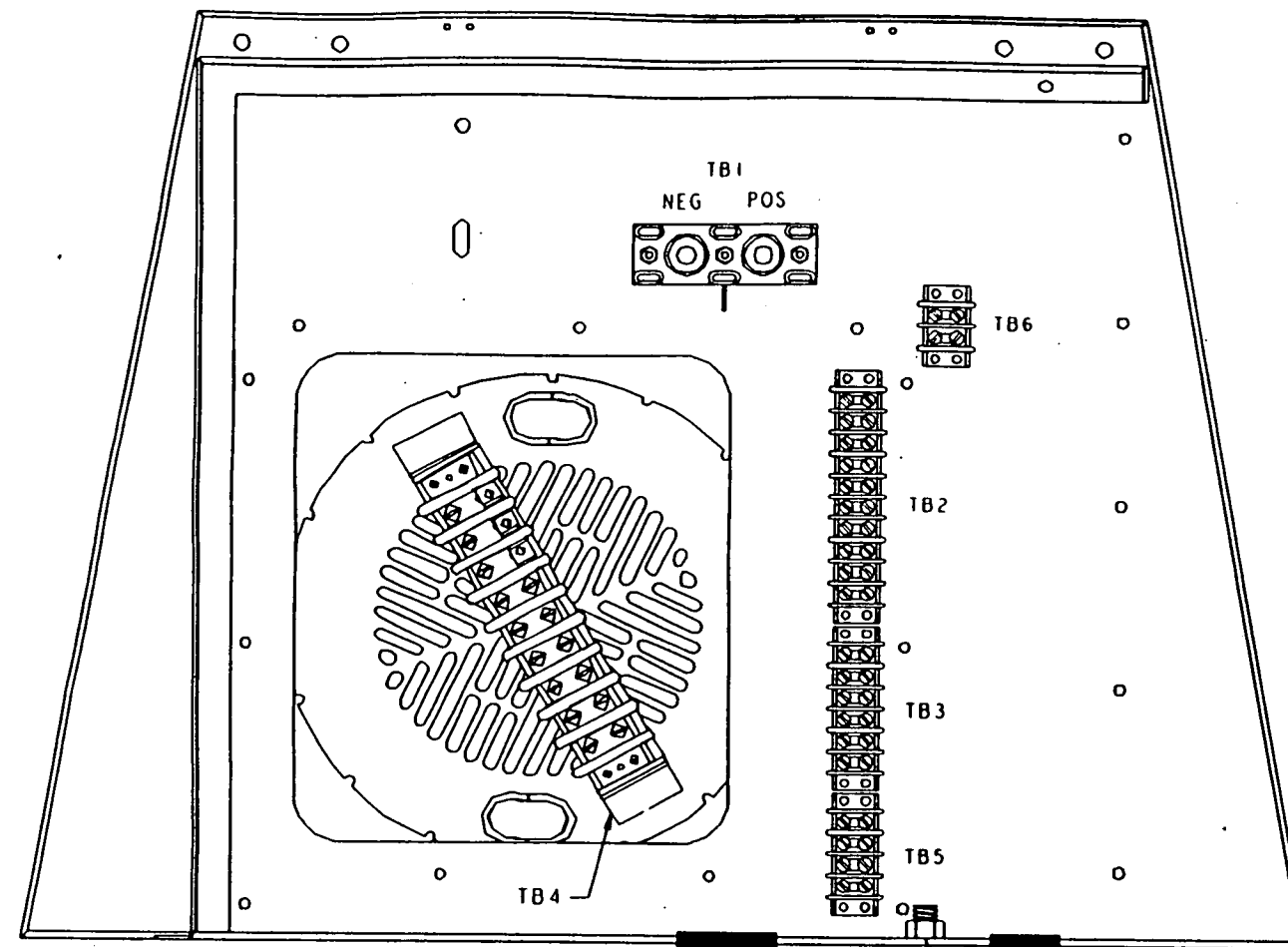


Figure 416. Generator Set Outline - 5.5 kW
Models: GCAC-24, GCAC-48 /
D2055, D4055

VIEW LOOKING AT THE BACK WALL
OF THE CONTROL PANEL COMPARTMENT



ELECTRICAL NOTES:

- A. The generator set DC power connection is located at terminal board TB1.
- B. DC load conductors should be terminated with 3/8 inch crimp type eyelets.
- C. The use of aluminum single barrel lugs is not recommended due to increased maintenance.
- D. To install the DC power connectors, remove the stud hardware provided and place the 3/8 inch eyelet over the stud. Replace the stud hardware and torque nut to 20 pounds/foot.
- E. Available output current is 250 Amps, 24 VDC and 125 Amps, 48 VDC. Recommended minimum cable sizes are given below for various cable lengths (total loop length of positive and negative cable).

LOOP LENGTH	CABLE SIZE
24 VDC, 25 FT	250 mcm
24 VDC, 50 FT	250 mcm
24 VDC, 100 FT	500 mcm
48 VDC, 25 FT	1/0 AWG
48 VDC, 50 FT	2/0 AWG
48 VDC, 100 FT	4/0 AWG

AC-1" CONDUIT
GROUND STUD (1/4")
DC-2" CONDUIT

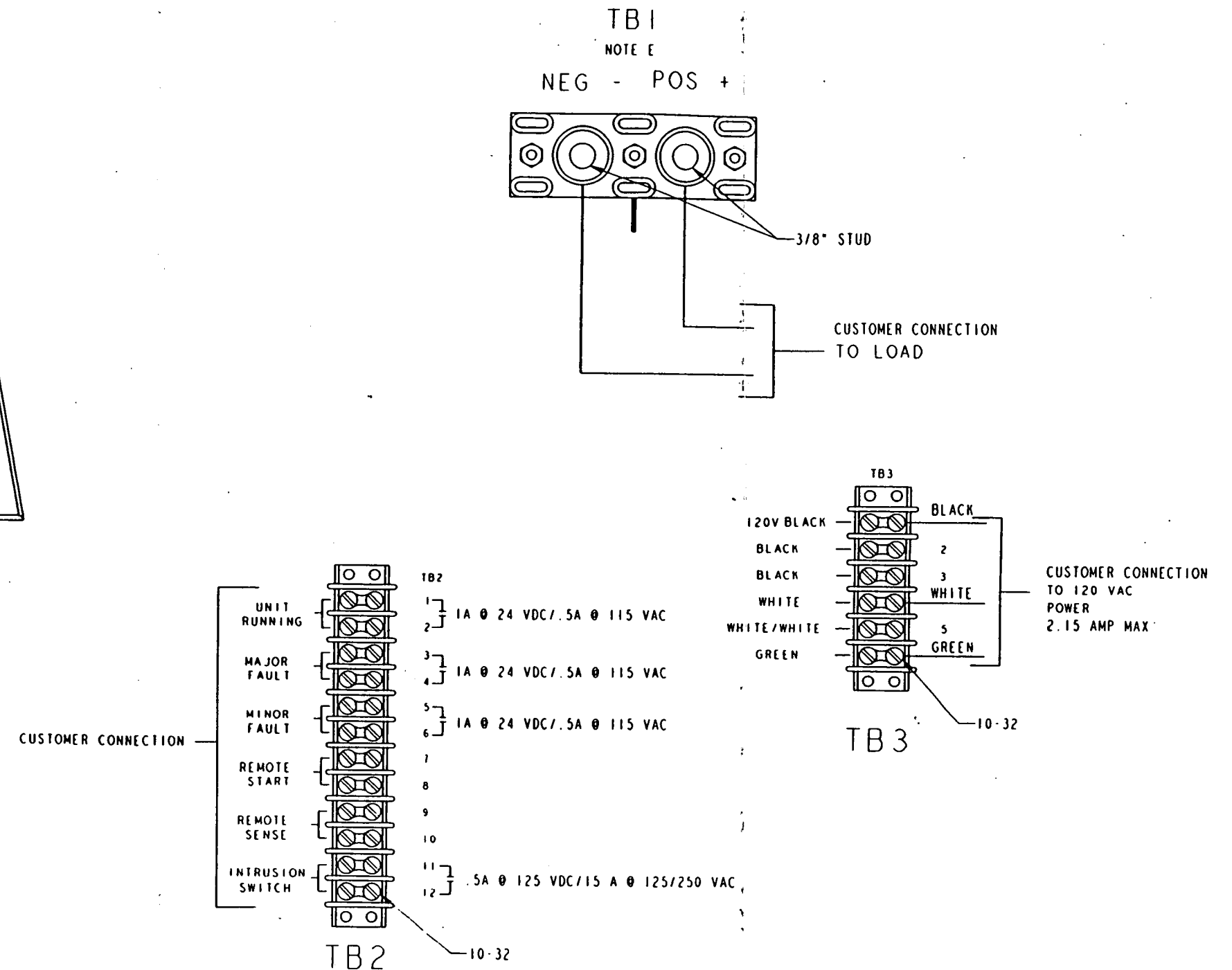


Figure 416. Generator Set Outline - 5.5 kW
Models: GCAC-24, GCAC-48 /
D2055, D4055

Section 500: Definitions

501 DEFINITIONS

- **DC Load (battery)** - The generator set is designed to maintain a battery at a preset voltage. The battery, however, may be connected to equipment that represents the actual load.
- **Factory Set** - Operational parameters that cannot be changed other than at the factory. These would include: Time delay(s), output voltage, and trigger voltage.
- **Intrusion Alarm** - An independent alarm that is forwarded when the enclosure door is opened. This alarm can be defeated (turned off) for routine maintenance and service.
- **Load Conductors** - Wire or cable connecting the generator set to the load.
- **Major Fault Alarm** - A condition that is outside the normal operation of the generator set. This condition will cause the generator set to stop operation and forward an alarm.
- **Minor Fault Alarm** - A condition that is outside the normal operation of the generator set. This condition, while abnormal, does not require the generator set to stop, but is an alarm forwarded to indicate the abnormal condition.
- **Output Contactor** - A high current relay within the generator set that closes prior to the generator set delivering power to the DC load (battery).
- **Output Studs** - The connection point for the load conductors within the generator set. This connection point is a pair of threaded studs located at TB1.
- **Output Voltage Set Point** - The voltage at which the generator set will maintain the DC load (battery). This voltage is also called the output voltage or set point voltage. The voltage is factory set and cannot be adjusted in the field.
- **Remote Voltage Sense** - A feature that allows the generator set to regulate its output voltage at a remote point such as the battery posts or DC bus. This feature will increase the output voltage of the generator set to maintain the set point voltage at the DC load (battery), eliminating the voltage drop in the output load conductors.
- **Synchronize** - An operation of the generator set controller that causes the generator set output to match the DC load (battery) voltage prior to output contactor closure.
- **Time Delay Start** - An intentional delay that inhibits engine start avoiding unnecessary starting of the generator set for short term AC power outages or DC voltage dips. This delay is factory set at 30 seconds.
- **Time Delay Warm-up** - An intentional delay after start-up of the generator set to allow the engine to begin warming up before accepting load. This delay is factory set at 45 seconds.
- **Trigger Voltage** - The voltage at which the generator set initiates the time delay start sequence prior to assuming the load.
- **Walk-Into-Load** - An operation of the generator set controller that slowly increases the speed of the engine (current) until the output voltage set point is reached. This causes the load to be assumed by the generator set slowly, allowing for a controlled current delivery to the DC load (battery).



Onan Corporation
1400 73rd Avenue N.E.
Minneapolis, MN 55432
Telex: 275477
Fax: 612-574-8087

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