HANDOUT: MEP805/815B

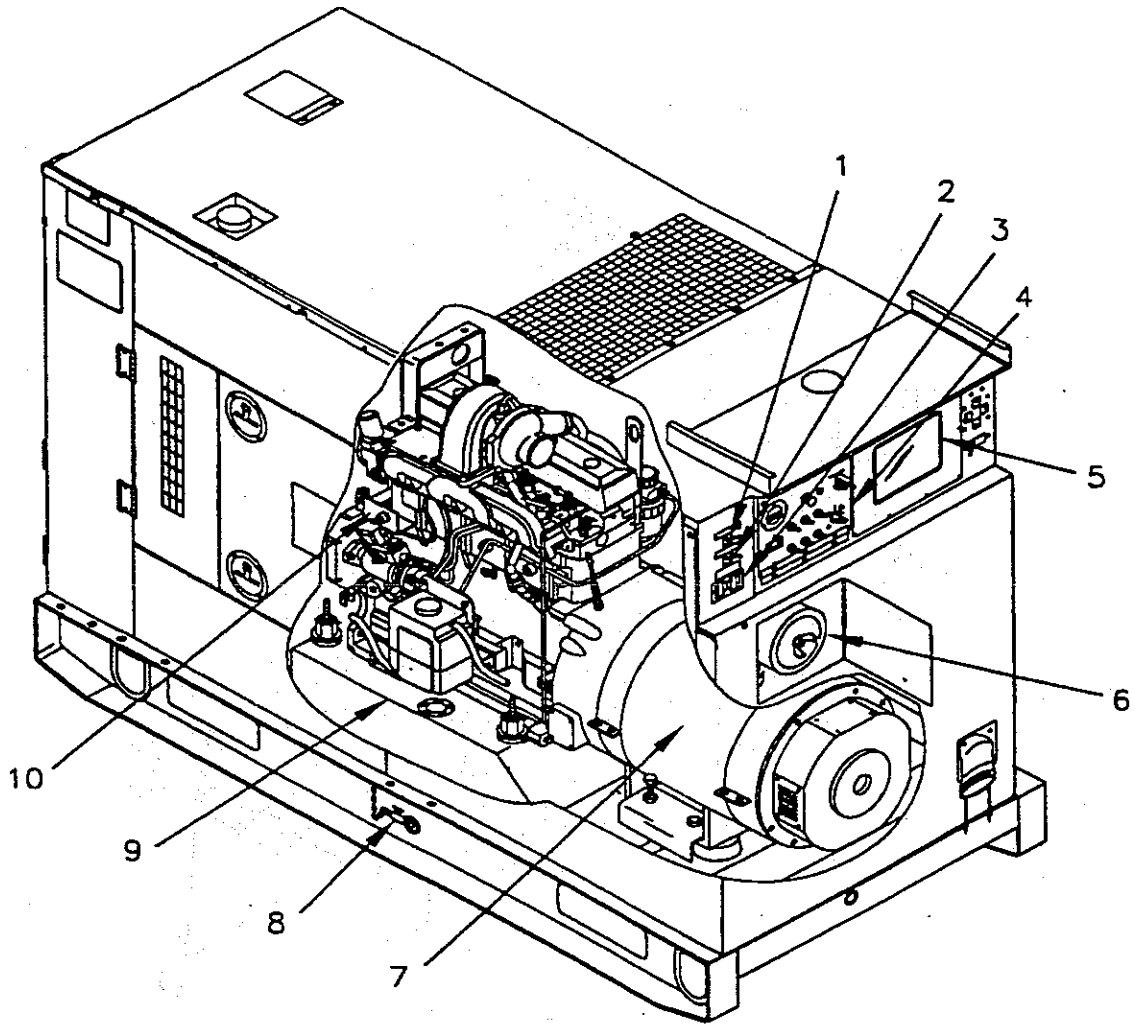
Technical Training

Aerospace Ground Equipment Specialist
Power Production Specialist
Refrigeration Specialist

MEP 805/815B, 30kW Generator Set (TQG) Tables, Flow Charts and Diagrams

April 2003

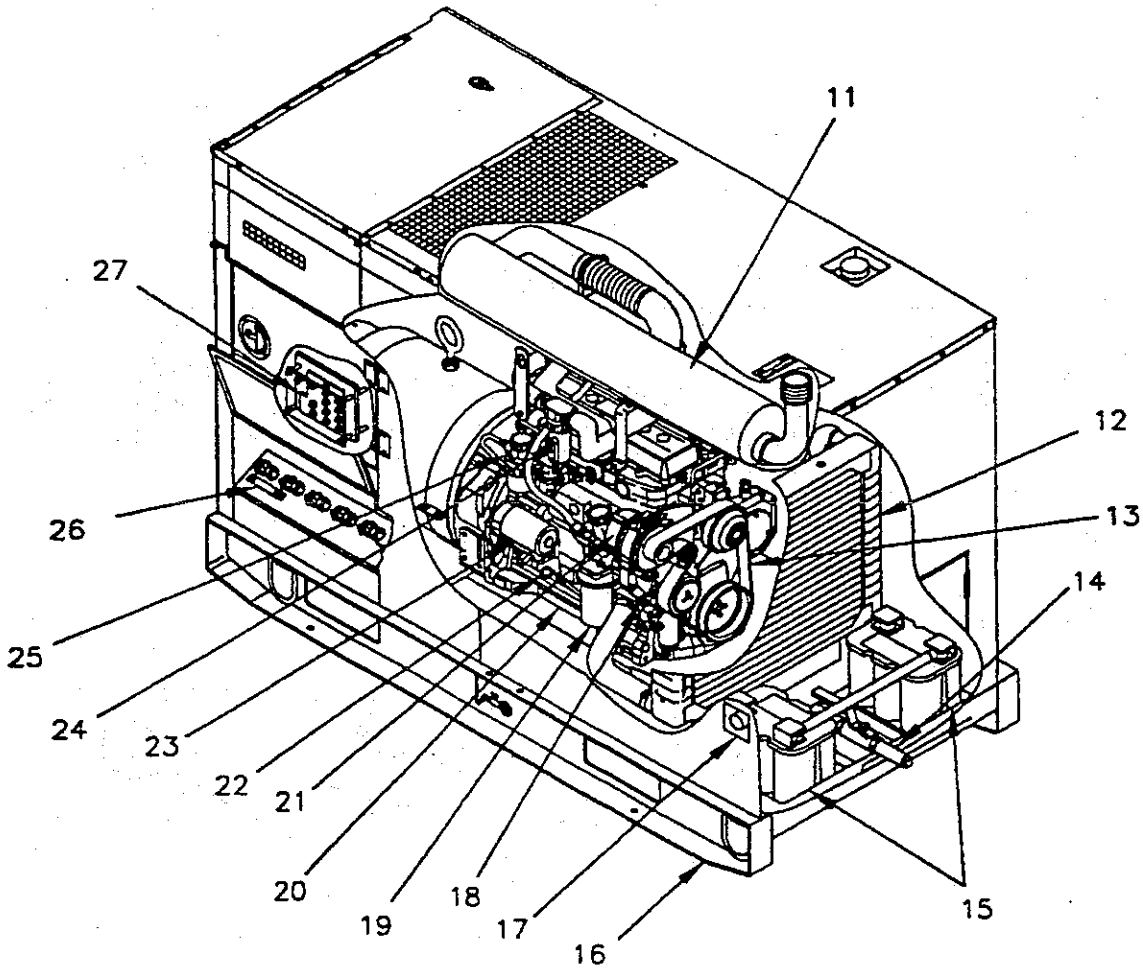
Air Force Engineering and Technical Services (AFETS)
3rd Combat Communications Support Squadron
Tinker Air Force Base, Oklahoma 73145-8600



LEGEND:
1. COMMUNICATION PORT
2. PARALLELING RECEPTACLE
3. CONVENIENCE RECEPTACLE
4. DCS CONTROL PANEL ASSEMBLY
5. COMPUTER INTERFACE MODULE
6. AIR CLEANER ASSEMBLY
7. AC GENERATOR
8. FUEL DRAIN VALVE
9. FUEL TANK
10. DEAD CRANK SWITCH

(CONTINUED ON SHEET 2)

FIGURE 1-30. 30 KW GENERATOR SET COMPONENTS (SHEET 1 OF 2)



LEGEND:
(CONTINUED FROM SHEET 1)

11. MUFFLER
12. RADIATOR
13. FAN BELT
14. OIL DRAIN VALVE
15. BATTERY (2)
16. SKID BASE
17. NATO SLAVE RECEPTACLE
18. WATER PUMP
19. OIL FILTER
20. ENGINE
21. BATTERY CHARGING ALTERNATOR
22. DIPSTICK
23. STARTER
24. CRANKCASE BREATHER FILTER ASSEMBLY
25. FUEL FILTER/WATER ASSEMBLY
26. LOAD OUTPUT TERMINAL BOARD
27. VOLTAGE RECONNECTION TERMINAL BOARD

FIGURE 1-30. 30 KW GENERATOR SET COMPONENTS (SHEET 2 OF 2)

1.17 LOCATION AND DESCRIPTION OF MAJOR COMPONENTS.

NOTE

All locations (Figure 1-30) referenced herein are given facing the control box side (rear) of the generator set.

1.17.1 COMMUNICATION RECEPTACLE (1). The COMMUNICATION RECEPTACLE is used to connect a remote PC to the DCS control box to facilitate remote operation and monitoring of the generator set.

1.17.2 PARALLELING RECEPTACLE (2). The PARALLELING RECEPTACLE is used to connect the paralleling cable between two generator sets of the same size and mode to operate in parallel.

1.17.3 CONVENIENCE RECEPTACLE (3). The CONVENIENCE RECEPTACLE is a 120VAC receptacle use to operate small plug-in type equipment.

1.17.4 DCS Control Panel Assembly (4). The DCS control panel is located at the rear of the generator set and contains the CIM, switches, and connectors used to control and monitor generator set operation.

1.17.5 Computer Interface Module (CIM) (5). The CIM is located in the DCS control box and contains controls and indicators for operating the generator set.

1.17.6 Air Cleaner Assembly (6). The air cleaner assembly is located on the left side behind the AIR CLEANER ACCESS door. It consists of a dry-type, disposable paper filter and canister. The air cleaner assembly features a dust collector which traps large dust particles. The air cleaner assembly has a restriction indicator which will pop up during operation when the air cleaner requires servicing.

1.17.7 AC Generator (7). The AC generator is a single bearing, drip-proof, synchronous, brushless, three phase, air-cooled generator. The generator is coupled directly to the rear of the diesel engine.

1.17.8 Fuel Drain Valve (8). The fuel drain valve is located on the left side of the skid base. It allows personnel to drain the fuel tank for maintenance.

1.17.9 Fuel Tank (9). The 23 gallon (87.05 liter) fuel tank is located in the front of the generator set below the engine and between the skid base members. The fuel tank has sufficient capacity to enable the generator set to operate for at least 8 hours without refueling.

1.17.10 DEAD CRANK Switch (10). The DEAD CRANK switch is located in the engine compartment on the left side. The switch allows the engine to be turned over without starting for maintenance purposes.

1.17.11 Muffler (11). The muffler and exhaust tubing are connected to the turbocharger on the engine. The exhaust exits from the top of the generator set housing. Gases are exhausted upward.

1.17.12 Radiator (12). The radiator is located at the front of the generator set. It acts as a heat exchanger for engine coolant.

1.17.13 Fan Belt (13). The fan belt is located in the engine compartment on the front of the engine. The belt drives the fan, water pump, and battery charging alternator.

1.17.14 Oil Drain Valve (14). The oil drain valve is located at the front of the skid base. It allows personnel to drain engine oil for maintenance.

1.17.15 Batteries (15). Two batteries are located at the front of the generator set. The batteries are maintenance free, 12 volt type. After starting, the generator set is capable of operating with batteries removed. A diode, located behind the control panel, protects the generator set if the batteries are incorrectly connected.

1.17.16 Skid Base (16). The skid base supports the generator set. It has fork lift access openings and cross members for short distance movement. The skid base has provisions in the bottom for installation of the generator set on a trailer.

1.17.17 NATO SLAVE RECEPTACLE (17). The NATO SLAVE RECEPTACLE is located on the right side (front) of the generator set. It is a NATO receptacle used for remote battery connection.

1.17.18 Water Pump (18). The water pump is located on the front of the engine. The pump circulates engine coolant through the engine block and the radiator.

1.17.19 Oil Filter (19). The oil filter is located in the engine compartment on the left side. The filter removes impurities from engine oil.

1.17.20 Engine (20). The generator is powered by a four cylinder, four cycle, fuel injected, turbocharged, liquid-cooled diesel engine which occupies the front half of the generator set. The engine is also equipped with a fuel filter/water separator, oil filter, and air cleaner assembly. Protection devices automatically stop the engine during conditions of high coolant temperature, low oil pressure, no fuel, overspeed, and overvoltage.

1.17.21 Battery Charging Alternator (21). The battery charging alternator is located on the right side of the engine. It is capable of maintaining the batteries in a state of full charge in addition to providing the required 24 VDC control power.

1.17.22 Dipstick (22). The dipstick is located in the engine compartment on the left side. The dipstick shows the level of oil in the engine drain pan.

1.17.23 Starter (23). The starter is located on the left side of the engine. The electric cranking motor mechanically engages the engine flywheel in order to start the diesel engine.

1.17.24 Crankcase Breather Filter Assembly (24). The crankcase breather filter assembly is located in the engine compartment on the right side. The filter element removes oil particles and contaminants from air as it passes from the crankcase to engine air intake.

1.17.25 Fuel Filter/Water Separator (25). The fuel filter/water separator is located in the engine compartment on the right side. The element removes impurities and water from the diesel fuel.

1.17.26 Load Output Terminal Board (26). The load output terminal board is located on the right side (rear) of the generator set. Four AC output terminals are located on the board. The are marked L1, L2, L3, and L0. A fifth terminal, marked GND, is located next to the output terminals and serves as equipment ground for the generator set. A removable, solid copper bar is connected between the L0 and GND terminals.

1.17.27 Voltage Reconnection Terminal Board (27). The voltage reconnection terminal board is located on the right side (rear) of the generator set. The board allows reconfiguration from 120/208 to 240/416 VAC output.

TABLE 1-1. TABULATED DATA

	MEP-805B	MEP-815B
1. Generator Set:		
a. National Stock Number	6115-01-461-9335	6115-01-462-0290
b. Overall Length	79.7 in. (202.5 cm)	79.7 in. (202.5 cm)
c. Overall Width	35.7 in. (90.8 cm)	35.7 in. (90.8 cm)
d. Overall Height	55 in. (139.7 cm)	55 in. (139.7 cm)
e. Dry Weight (less Basic Issue Items List)	2732 lb. (1239.2 kg)	2732 lb. (1239.2 kg)
f. Wet Weight	2931 lb. (1329.5 kg)	2931 lb. (1329.5 kg)
2. Engine:		
a. Manufacturer	John Deere	John Deere
b. Model	4045TF151	4045TF151
c. Type	Four cylinder, four cycle, Turbocharged diesel	Four cylinder, four cycle, turbocharged diesel
d. Displacement	239 cu. in. (3.9 liters)	239 cu. in. (3.9 liters)
e. Altitude Degradation, 4000 ft. (1220 m) to 8000 ft. (2440 m)	3.5% per 1000 ft. (305 m)	3.5% per 1000 ft. (305 m)
f. Firing Order	1, 3, 4, 2	1, 3, 4, 2
g. Cold Weather Starting Aid System Use	40°F (4°C) or below	40°F (4°C) or below
h. Valve Tappet Clearance Adjustment:		
Hot or Cold (Intake)	0.014 in. (0.35 mm)	0.014 in. (0.35 mm)
Hot or Cold (Exhaust)	0.018 in. (0.45 mm)	0.018 in. (0.45 mm)
3. Cooling System:		
a. Type	Pressurized radiator and Pump	Pressurized radiator and pump
b. Capacity	15.5 qts. (14.7 liters)	15.5 qts. (14.7 liters)
c. Normal Operating Temperature	170-200°F (77-93°C)	170-200°F (77-93°C)
d. Temperature Indicating System Voltage Rating	24 VDC	24 VDC
4. Lubricating System:		
a. Type	Full flow, circulating pressure	Full flow, circulating pressure
b. Oil Pump Type	Positive displacement gear	Positive displacement gear
c. Normal Operating Pressure	25-60 psi (172-414 kPa)	25-60 psi (172-414 kPa)
d. Oil Filter Type	Full flow, spin-on replacement element	Full flow, spin-on replacement element
e. Capacity	15 qts. (14.2 liters)	15 qts. (14.2 liters)
f. Pressure Indicating System Voltage Rating	24 VDC	24 VDC
5. Fuel System:		
a. Type of Fuel	DF-1, DF-2, DF-A, JP5, JP8	DF-1, DF-2, DF-A, JP5, JP8
b. Fuel Tank Capacity	23 gal. (87.05 liters)	23 gal. (87.05 liters)
c. Fuel Consumption Rate	2.60 gal. (9.8 liters) per Hour	2.75 gal. (10.4 liters) per hour
d. Auxiliary Fuel Pump:		
(1) Voltage Rating	24 VDC	24 VDC
(2) Delivery Pressure	5.0-6.5 psi (34.5-65.5 kPa) (max.)	5.0-6.5 psi (34.5-65.5 kPa) (max.)
e. Injection Fuel Pump		
(1) Manufacturer	Stanadyne	Stanadyne
(2) Model	DB4429-5281	DB4429-5281

TABLE 1-1. TABULATED DATA (continued)

	MEP-805B	MEP-815B
5. Fuel System (continued);		
f. Electric Actuator		
(1) Manufacturer	Governors of America	Governors of America
(2) Model	ADC100-24	ADC100-24
6. Engine Starting System:		
a. Batteries	Two 12 volt, connected in series	Two 12 volt, connected in series
b. Starter:		
(1) Manufacturer	Denso	Denso
(2) Model	RE 40595	RE 40595
(3) Voltage Rating	24 VDC	24 VDC
(4) Drive Type	Gear reduction	Gear reduction
c. Battery Charging Alternator:		
(1) Manufacturer	Bosch	Bosch
(2) Model	9 120 060 039	9 120 060 039
(3) Rating	42 amps at 24 VDC	42 amps at 24 VDC
(4) Protective Fuse	30 amps	30 amps
7. AC Generator:		
a. Manufacturer	Marathon Electric	Marathon Electric
b. Type	Rotating field, synchronous	Rotating field, synchronous
c. Load Capacity	30 kW	30 kW
d. Model	88-21007	88-21008
e. Current Ratings:		
(1) 120/208 volt connection	60 Hz: 104 amps 50 Hz: 86 amps	104 amps
(2) 240/416 volt connection	60 Hz: 52 amps 50 Hz: 43 amps	52 amps
f. Power Factor	0.8	0.8
g. Cooling	Fan cooled	Fan cooled
h. Drive Type	Direct coupling	Direct coupling
i. Duty Classification	Continuous	Continuous
8. Digital Control System:		
a. DCS Load Sharing Synchronizer:		
(1) Manufacturer	Governors of America	Governors of America
(2) Model	LSS100	LSS400
b. DCS Speed Control Unit:		
(1) Manufacturer	Governors of America	Governors of America
(2) Model	ESD5551	ESD5551
c. I/O Interface Module		
(1) Manufacturer	Governors of America	Governors of America
(2) Model	TCM100	TCM400
d. Backplane Module		
(1) Manufacturer	Governors of America	Governors of America
(2) Model	TCM102	TCM102
e. Automatic Voltage Regulator		
(1) Manufacturer	Governors of America	Governors of America
(2) Model	AVR100	AVR400

TABLE 1-2. PERFORMANCE CHARACTERISTICS

	MEP-805B	MEP-815B
1. Voltage:		
a. Voltage wave form deviation factor	5% (max.)	5% (max.)
Singe voltage harmonics	2% (max.)	2% (max.)
b. Voltage unbalance	5% of rated voltage (max.)	5% of rated voltage (max.)
c. Phase balance voltage	1% of rated voltage (max.)	1% of rated voltage (max.)
d. Voltage modulation	1% (max.)	1% (max.)
e. Voltage regulation	1% (max.)	1% (max.)
f. Short-term stability (30 seconds)	1% of rated voltage	1% of rated voltage
g. Long-term stability (4 hours)	2% of rated voltage	2% of rated voltage
h. Voltage drift (60°F [16°C] in 8-hour period)	±1% (max.)	±1% (max.)
i. Dip and rise for rated load	15% of rated voltage (max.)	12% of rated voltage (max.)
Recovery time	0.5 seconds	0.5 seconds
j. Dip for low power factor load	30% of no-load voltage (max.)	25% of no-load voltage (max.)
Recovery time	0.7 seconds 95% of no-load voltage	0.7 seconds 95% of no-load Voltage
k. Adjustment range VAC	50 Hz	400 Hz
120/208V connection	190-213V	195-229V
240/416V connection	380-426V	395-458V
	60 Hz	
120/208V connection	197-240V	
240/416V connection	395-480V	
2. Frequency:		
a. Regulation	0.25% of rated frequency	0.25% of rated frequency
b. Short-term steady-state stability (30 seconds)	0.5% of rated frequency	0.5% of rated frequency
c. Long-term steady-state stability (4 hours)	1% of rated frequency	1% of rated frequency
d. Frequency drift (60°F [16°C] in 8 hour period)	0.5% (max.)	0.5% (max.)
e. Undershoot with application of load	4% of rated frequency (max.)	1.5% of rated frequency (max.)
Recovery time	2 seconds	1 second
f. Overshoot with application of load	4% of rated frequency (max.)	1.5% of rated frequency (max.)
Recovery time	2 seconds	1 second
g. Adjustment range	48-52 Hz, not below 45 Hz for 50 Hz operation	390-420 Hz, not below 370 Hz or above 430 Hz

Setpoints for MCII TQG with DCS

Generator Set Shutdowns				
Parameter	**Requirement**	**Actual Trippoint**	**Warning**	**Notes**
Oil Pressure	15 ± 3 psig	15 psig	25 psig	
Coolant Temperature	225 ± 5°F	239°F	229°F	Changed during FAT
Fuel Level	4 minutes run time at full load	7%	25%	
Overspeed	2200±40 rpm	2200 rpm	None	Corresponds to 73.3 Hz or 440 Hz
Overvoltage	153±3VAC (127%)	153VAC (120%)	132VAC (110%)	Must not actuate under 120 msec or longer than 1.25 seconds
Contactor Trips				
Short Circuit	50 millisec	50 millisec	None	Short circuit defined as 425±25% of rated current or greater
Overload	110% no trip, 130%-8±2 min, follows inverse time principle for increasing current	Time (min) / CIM Embedded Overload Trip Percent Current: 30.0 / 111%; 8.0 / 130%; 4.0 / 170%; 1.0 / 230%; 0.25 / 290%; 0.05 / 350%	>100%	
Undervoltage	<48VAC Instantaneous Trip <99VAC 6±2 seconds	<48VAC Instantaneous Trip <99VAC 6 seconds	108VAC (90%)	
Reverse Power	20±3% rated load	20±3% rated load	None	
Other Setpoints				
Parameter	**Requirement**	**Actual Trippoint**	**Warning**	**Notes**
Auxiliary Fuel Pump	As needed	ON at 55% falling OFF at 70% rising	None	

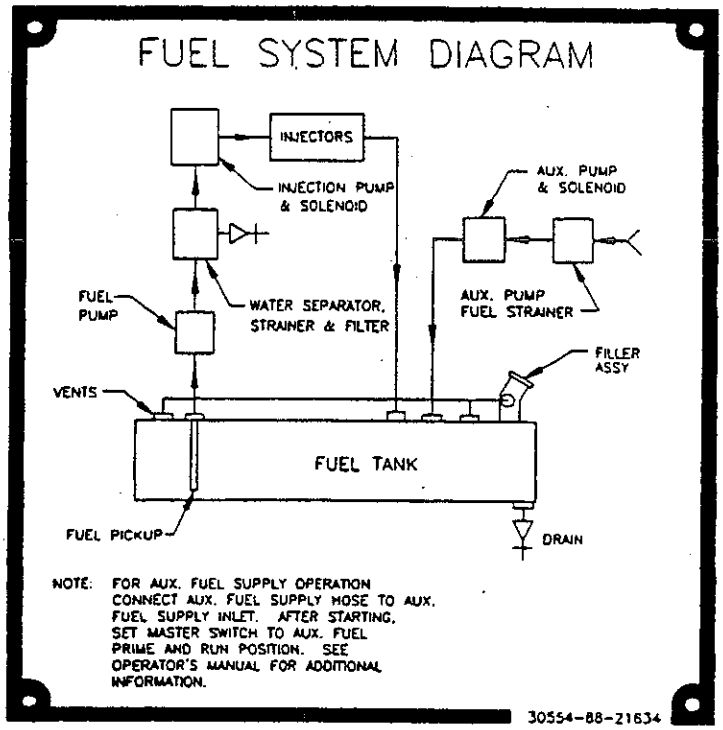


FIGURE 1-16. FUEL SYSTEM DIAGRAM PLATE

NOTES

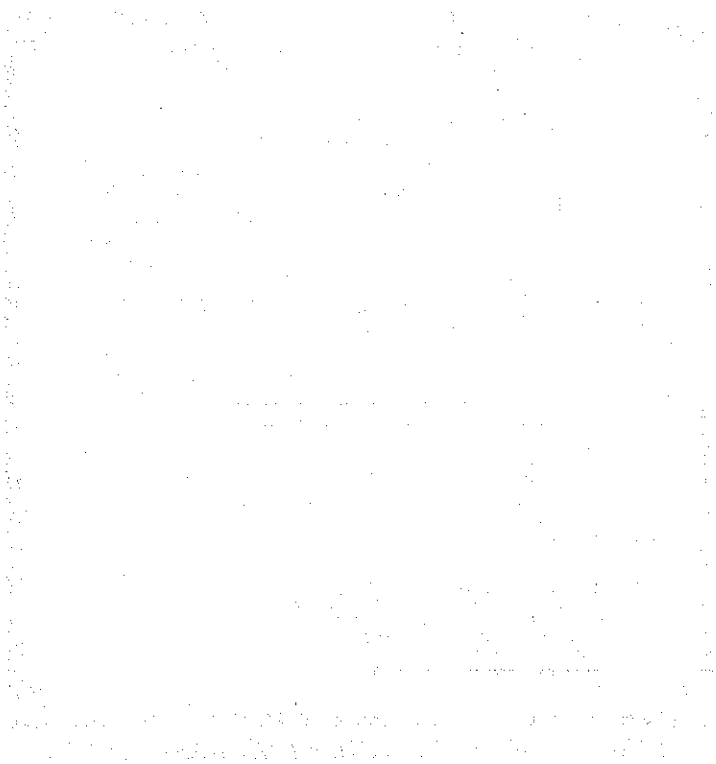


TABLE 1-1. TABLE OF SPECIFICATIONS

Model	John Deere TO4045TF150
Type	EPA compliant four cylinder, four cycle, turbocharged diesel
Bore	4.19 in. (106 mm)
Stroke	5.00 (127.0 mm)
Displacement	276 cu in. (4.5 liters)
Compression Ratio	17.0:1
Firing Order	1-3-4-2
Width	23.5 in. (598 mm)
Height	38.6 in. (980 mm)
Length	33.9 in. (861 mm)
Weight	872 lbs (396 kg)
Injection Pump/Governor	Stanadyne Model DB4
Injection Starting Pressure	
New	3,660 psi (25,200 kPa) min
Used	3,330 psi (22,950 kPa) min
Cylinder Compression Pressure	350 psi (2400 kPa) min
Lubrication System Capacity	14.0 qts (13 liters)
Coolant System capacity (engine only)	15.5 qts. (14.7 liters)
Alternator	Bosch 28 volt DC - 45 amp
Starter	Nippon-Denso 24 volt DC - 4.5 kw

1.11 DATA PLATES.

Refer to Table 1-2 for the engine option codes. The engine option codes data plate is affixed to the top of the rocker arm cover (4, Figure 1-1). These codes indicate which of the engine options were installed on your engine at the factory. These codes are important when parts and service are required. The engine option code includes an engine base code (1, Figure 1-2) which identifies the basic engine installed. The engine option code consists of a four-digit number. The first two digits of each code identify a specific group, such as alternators. The last two digits of each code identify one specific option provided on your engine, such as 12-volt, 55-amp alternator. If an engine is ordered without a particular component, the last two digits of that functional group option code will be 99, 00, or XX.

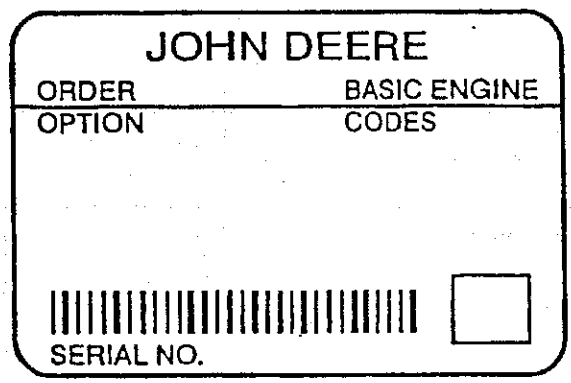


FIGURE 1-2. OPTION CODE LABEL

TABLE 1-2. ENGINE OPTIONS CODES - 4 CYLINDER, 4.5 LITER		
ENGINE BASE CODE: 2116F		
OPTION CODES	DESCRIPTION	REMARKS
1103	Rocker Arm Cover	
1214	Oil Filler Neck	
1302	Crankshaft Pulley	
1404	Flywheel Housing	
1503	Flywheel	
1677	Fuel Injection Pump	
1701	Air Inlet	
1936	Oil Pan	
2002	Water Pump	
2112	Thermostat Cover	
2201	Thermostat	
2301	Fan Drive	
2485	Fan Belt	
2599	Fan	Not installed on engine at factory.
2699	Engine Coolant Heater	Not installed on engine at factory.
2803	Exhaust Manifold	
2999	Ventilator System	Not installed on engine at factory.
3044	Starting Motor	
3110	Alternator	
3516	Fuel Filter	
3601	Front Plate	
3702	Fuel Transfer Pump	
3999	Thermostat Housing	Not installed on engine at factory.
4020	Oil Dipstick	
4199	Belt Driven Front Auxiliary Drive	Not installed on engine at factory.
4399	Starting Aid	Not installed on engine at factory.
4401	Timing Gear Cover with Gears	
4502	Balancer Shaft	
4601	Cylinder Block With Liners and Camshaft	
4701	Crankshaft and Bearings	

TABLE 1-2. ENGINE OPTIONS CODES - 4 CYLINDER, 4.5 LITER – CONT.		
ENGINE BASE CODE: 2116F		
OPTION CODES	DESCRIPTION	REMARKS
4803	Connecting Rods and Pistons	
4901	Valve Actuating Mechanisms	
5002	Oil Pump	
5102	Cylinder Head With Valves	
5501	Shipping Stand	
5602	Paint Option	
5707	Water Pump Inlet	
5904	Oil Cooler	
6099	Add-on Auxiliary Drive Pulley	Not installed on engine at factory.
6212	Alternator Mounting	
6499	Exhaust Elbow	Not installed on engine at factory.
6524	Turbocharger	
6699	Temperature Switch	Not installed on engine at factory.
6799	Electronic Tachometer Sensor	Not installed on engine at factory.
6901	Engine Serial Number Plate	
7499	Air Conditioner Compressor Mounting	Not installed on engine at factory.
7699	Oil Pressure Switch	Not installed on engine at factory.
8604	Fan Pulley	
8799	Automatic Belt Tensioner	Not installed on engine at factory.
8803	Oil Filter	

Section I. PRINCIPLES OF OPERATION

2.1. INTRODUCTION.

This section contains functional descriptions of the engine systems and how they are connected to the end item.

2.2. COOLING SYSTEM.

The cooling system consists of a radiator, hoses, a thermostat, a belt driven fan, a water pump, and cooling jackets within the engine. The water pump forces coolant through passages (coolant jackets) in the engine block and oil cooler where coolant absorbs heat from the engine. When the coolant temperature is below operating temperature, the thermostat is closed and coolant is bypassed to the water pump inlet. As coolant temperature increases to 180E F (82E C), the thermostat fully opens, shutting off all bypass flow and providing full flow through the radiator. Air forced through the fins of the radiator by the fan cools the coolant pumped through the radiator. Items are added to the engine to monitor coolant temperature and to warn if temperature exceeds a predetermined value.

2.3. LUBRICATION SYSTEM.

The pressure lubrication system consists of a positive displacement gear-driven pump, filter strainer in the suction pipe, full flow oil filter, oil cooler, oil pressure regulating valve, and oil bypass valve. Additionally, the oil cooler and oil filter have their own bypass valve. The pump draws lubrication oil from the crankcase through a strainer and a suction line. The oil is then pumped through an oil line to the oil cooler, oil filter, and through the main oil gallery of the cylinder block. From the oil gallery, oil is forwarded under pressure to the main bearings and spray jets to cool the pistons. Drilled cross passages in the crankshaft distribute oil from the main bearings to connecting rod bearings and camshaft bearings. A drilled passage from the rear camshaft bearing through the cylinder block and cylinder head supplies lubricating oil to the rocker arm shaft. A turbocharger oil supply line provides lubricating oil to the shaft of the turbocharger. Items are added to monitor oil pressure and to warn the operator or stop the engine if pressure drops to a dangerously low value.

2.4. FUEL SYSTEM.

The fuel system consists of an external fuel tank, fuel supply pump, fuel filter, fuel injection pump, fuel injectors, and piping. The fuel supply pump draws fuel from the tank and pressurizes it. This pressure permits the fuel to flow through the fuel filter and charge the transfer pump of the fuel injection pump. With the fuel injection pump charged with fuel by the fuel supply pump, the fuel injection pump plungers pressurize the fuel to approximately 3,660 psi (25,200 kPa). Delivery (pressure) lines are used to route this high pressure fuel to the fuel injection nozzles. Fuel enters the injection nozzle at a pressure which easily overcomes the pressure required to open the nozzle valve. When the nozzle valve opens, fuel is forced out through the orifices in the nozzle tip and atomizes as it enters the combustion chamber. The fuel that is not used by the injectors and injection pump is returned to the fuel tank via an excess fuel return line.

2.5. ELECTRICAL SYSTEM.

The electrical system consists of external mounted batteries, starter, battery charging alternator, and related relays and switches for control of the system. Battery power supplied to the starter during the start cycle energizes the starter which engages the ring gear of the flywheel causing the engine to turn over. When engine start is complete, the starter is deenergized and disengages from the flywheel. The battery charging alternator is belt driven. It is a 45 ampere, 28 VDC alternator that when operating supplies voltage to recharge the batteries and maintain them at a full state of charge.

ENGINE COMPONENTS

1. Lifting Lug
2. Turbocharger
3. Intake Manifold
4. Rocker Arm Cover
5. Coolant Outlet
6. Battery Charging Alternator
7. Fan Pulley
8. Oil Fill Tube
9. Fan Drive Belt
10. Oil Filter and Cooler
11. Crankshaft Pulley
12. Oil Pan
13. Dipstick
14. Fuel Supply Pump
15. Starter
16. Fuel Filter
17. Exhaust Manifold
18. Flywheel Housing
19. Fuel Injection Pump
20. Coolant Intake

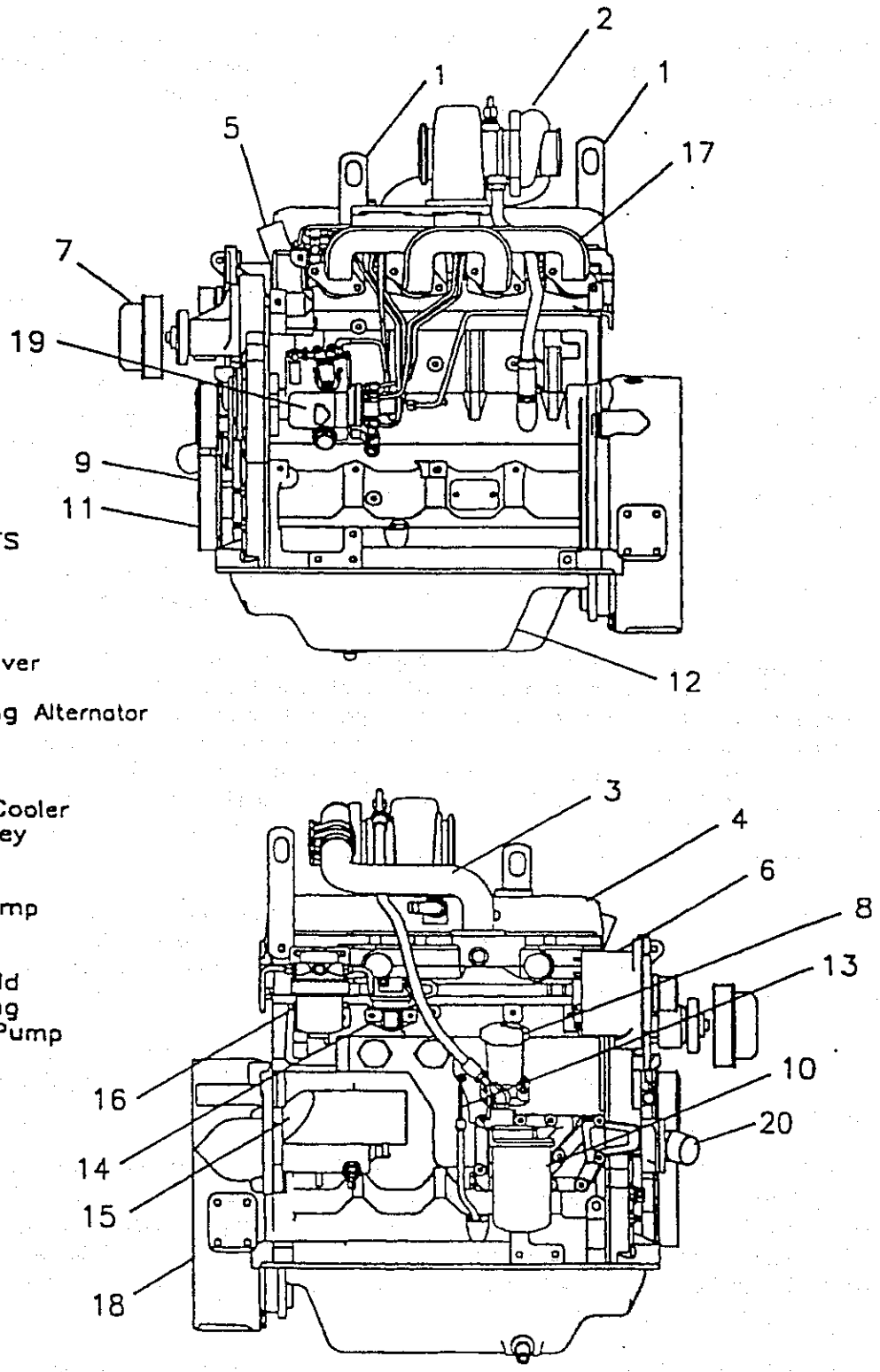


FIGURE 1-1. ENGINE COMPONENTS

Section II. EQUIPMENT DESCRIPTION AND DATA

1.8. GENERAL.

The diesel engine (Figure 1-1) is four cylinder, four cycle, fuel injected, turbocharged, and liquid cooled. The firing order is 1-3-4-2. The number one cylinder is toward the fan end of the engine. The serial number is found on top of valve cover. Rotation of engine is counterclockwise as viewed from rear of engine facing forward.

NOTE

All locations referenced herein are given from rear of engine facing forward.

1.9. DETAILED DESCRIPTION.

a. Turbocharger. A turbocharger, operated by exhaust gases, compresses intake air and routes it to the combustion chamber.

b. Camshaft. The camshaft is driven by an intermediate gear in the timing gear train which meshes with the crankshaft gear. Camshaft rotates in honed machined bores in cylinder block; no bushings are used. The camshaft lobes determine the time and rate of opening of each valve and actuates the fuel supply pump.

c. Intake and Exhaust Valves. Intake and exhaust valves are operated by cam followers, push rods, and rocker arm assembly. Valve seat inserts in cylinder head are used for intake and exhaust valves.

d. Crankshaft. The crankshaft is a one-piece, heat treated, steel forging which operates in replaceable two-piece main bearings. The rear thrust bearing has a flange on each side to support crankshaft thrust and to limit end play.

e. Cylinder Liners and Pistons. Cylinder liners are "wet" (surrounded by coolant) and are individually replaceable. O-rings are used to seal the connection between cylinder block and liners. Pistons are made of cast high-grade aluminum alloy with internal ribbing. The skirt is cam ground to allow for expansion when heated during operation. The piston crown has a cut-out swivel cup with a truncated cone in the center. Two compression rings and one oil control ring are used. The top compression ring is a keystone type ring. All piston rings are located above the piston pin. The hardened piston pins are fully-floating and held in position by means of retainer rings. Spray jets (piston cooling orifices) in cylinder block direct pressurized oil to lubricate piston pins and cool pistons. Connecting rods are forged steel and have replaceable bushing and bearing inserts.

f. Cooling System. The cooling system consists of a radiator, water pump, cooling fan, thermostat, and connecting hoses. The fan and water pump are both belt driven from the crankshaft pulley. The thermostats control engine temperature and are installed in top of engine. The function of the cooling system is to maintain a specific operating temperature of 180 to 220°F (82 to 104°C) for the engine.

g. Lubrication System. The lubrication system consists of oil pan (sump), a gear type pump, full flow spin-on oil filter with built-in bypass valve, oil cooler with built-in bypass valve, pressure regulating valve, bypass valve, and the internal passages.

h. Fuel System. The function of the fuel system is to inject a metered quantity of clean atomized fuel into the engine cylinders at a precise time near the end of the compression stroke of each piston. The fuel system consists of the fuel tank, fuel filter/water separator, fuel supply pump, fuel injection pump, and the fuel injectors. The fuel tank is not mounted on the engine. The fuel supply pump is mounted to the block and is driven by the camshaft. The fuel injection pump is mounted on the front plate and is driven by an intermediate gear in the timing gear train meshing with crankshaft gear.

i. Electrical System. The electrical system is 28VDC operation and consists of a battery charging alternator, starter, externally mounted batteries, and other items as required. The battery charging alternator is mounted on front of engine and is belt driven. When engine is operating, the battery charging alternator supplies 28VDC to recharge the batteries and maintain them at a full state of charge. The starter is mounted on the flywheel housing, and when energized, engages the ring gear of the flywheel to rotate the engine.

SECTION III. PRINCIPLES OF OPERATION

1.15 INTRODUCTION.

This section contains functional descriptions of the generator set. How the controls and indicators interact with the system is explained as well as the location and description of major components.

1.16 PRINCIPLES OF OPERATION.

1.16.1 Digital Control System (DCS).

1.16.1.1 The DCS is a closed-loop system providing the operator with real-time system status information and control. It includes automatic shutdown features if critical components fail to protect the generator set from damage and to prevent damaging output power and voltage levels. It includes a digital computer using software to process inputs from the generator set and from the operator. The DCS accepts operator commands to adjust various generator set parameters such as frequency and voltage. The DCS also facilitates operating two or more generator sets in parallel. The DCS can be operated at the generator set or from a remote location using an IBM-compatible personal computer (PC)

1.16.1.2 In the event that the computer operating software is lost or operating incorrectly, the software must be restored. Procedures are provided for TQG remote software restoration in Paragraph 2.13.2.

1.16.1.3 Eight major components or modules are included in the DCS: The DCS speed control unit, automatic voltage regulator, load sharing synchronizer, I/O interface module, backplane module, electric actuator, computer interface module (CIM), and keypad assembly. The DCS provides multiple, integrated functions as the controller of the fault, governor, and voltage regulation systems, as described below.

1.16.1.4 The CIM is the primary operator interface with the DCS. It is a self-contained IBM compatible computer with an AMD 486 processor running the Windows CE operating system. An internally lit Liquid Crystal Display (LCD) screen provides the operator with status displays and control capability. A cursor symbol on the display is controlled by the keypad assembly, which is a set of four arrow keys and a SELECT key to enter commands. The load sharing synchronizer is used when paralleling the generator set to a main bus or to another generator set. This module provides signals to the DCS speed control unit to adjust engine speed settings to maintain a match between the outputs of the two generator sets. The I/O interface module controls and interfaces with all the other components in the DCS. For example, it receives inputs from engine sensors and converts them for use by the CIM. Most of the DCS signals, including control panel inputs, are routed through this module. The status of the I/O interface module is indicated by a green HEARTBEAT light emitting diode (LED) which blinks at a rate of approximately two times per second to indicate the module is operational.

The backplane module is an installation point for three DCS modules and for the main electrical connectors from the AC generator. It connects the front panel switches and these DCs modules with the I/O interface module. This module simplifies the wiring inside the DCS control box by placing many interconnections onto one circuit board assembly. This module also includes diagnostic indicators for the DCS. The other DCS modules are discussed in paragraphs below.

1.16.2 Fault System.

1.16.2.1 The Fault System (Figure 1-19) protects the generator set and any connected load against the potential faults described below and provides an indication of any incurred fault. The following summary of the Fault System will assist in understanding the operation of other generator set systems. Additional details relating to specific protection devices are provided in the descriptions of the respective systems.

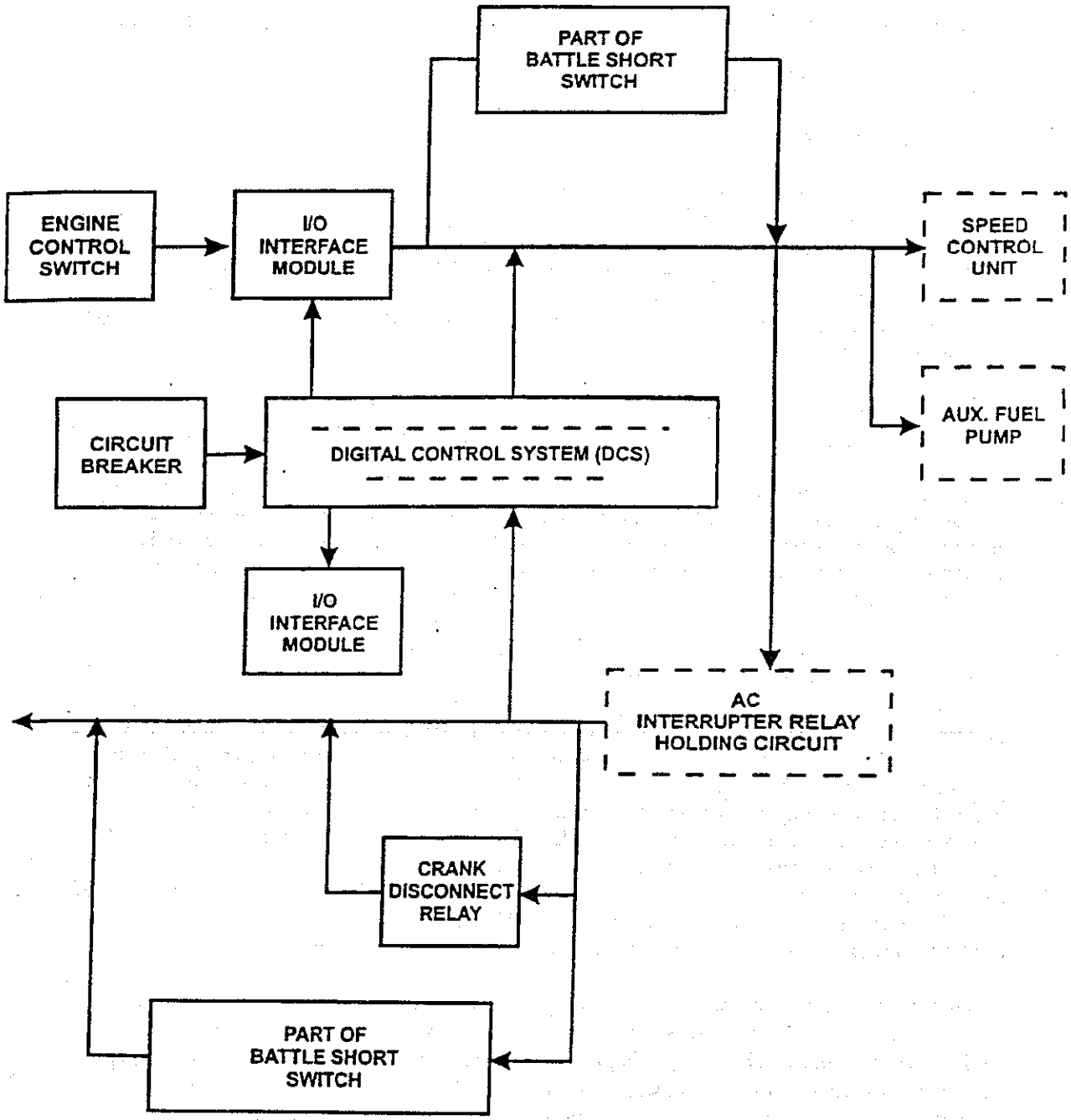


FIGURE 1-19. FAULT SYSTEM FLOW DIAGRAM

1.16.2.2 The Fault System consists of the CIM, I/O interface module, fuel level sender, oil pressure sender, coolant temperature sender, and BATTLE SHORT switch.

1.16.2.3 Inappropriate signals received from the senders by the I/O interface module will cause the CIM to display the fault, and a message describing the condition causing the fault, on the CIM display screen. Depending on the nature of the fault, the generator set will shut down or the operator will be warned that action must be taken to avoid shutdown.

1.16.2.4 Activation of the fault system will cause two events to occur. The AC interrupter relay will open and CONTACTOR POSITION status indicator on CIM display screen will indicate OPEN.

1.16.2.5 Although it is possible for more than one fault to occur at one time during operation, and for more than one fault to be displayed on the CIM display screen at a time, only the first fault to occur will cause a message to appear in the MESSAGES display area of the CIM display screen. Once the condition addressed in that message has been corrected by the operator, the operator will activate the FAULT RESET switch, and the next message will be displayed.

1.16.2.6 After the generator set engine has been started, the BATTLE SHORT switch may be used to override all potential faults except engine overspeed and short circuit.

1.16.3 Governor Control System.

1.16.3.1 The governor control system (Figure 1-20) includes the DCS speed control unit, electric actuator, DCS load sharing synchronizer, magnetic pickup, fuel injection pump, and FREQUENCY SELECT switch.

1.16.3.2 The electric actuator controls the output of the fuel injection pump in response to the electrical input from the DCS speed control unit. The DCS provides a signal representing the desired engine speed/generator frequency to the DCS speed control unit. A signal representative of the actual engine speed/generator frequency is sent to the DCS speed control unit by the magnetic pickup. Any change in engine speed from that selected by the operator, as sensed by the magnetic pickup, causes the DCS speed control unit to increase or decrease fuel injection pump output to maintain the desired speed. Generator set frequency and power output are indicated on the CIM display screen. The FREQUENCY SELECT switch is used to set the generator for 50 hertz or 60 hertz operating frequencies (MEP-805B only).

1.16.3.3 Twenty-four VDC power is supplied to the DCS speed control unit through the governor control power relay. The governor control power relay is controlled by the fault system. The DCS speed control units of two generator sets operating in parallel are interconnected by the paralleling cable.

1.16.4 Voltage Regulation System.

The Voltage Regulation System (Figure 1-21) consists of the automatic voltage regulator and power potential transformer. The automatic voltage regulator senses and controls generator output voltage which is operator adjustable within the design limits by use of the VOLTAGE ADJUST switch. The power potential transformer provides operating power to the automatic voltage regulator module. Generator output voltage is indicated on the CIM display screen.

1.16.5 Fuel System.

1.16.5.1 The Fuel System (Figure 1-22) includes a primary subsystem and an auxiliary subsystem.

1.16.5.2 The primary subsystem consists of fuel lines, fittings, fuel tank, fuel level sender, transfer pump, fuel filter/water separator, injection pump, DCS speed control unit, and injectors. The injection pump includes a 24 VDC fuel shutoff valve.

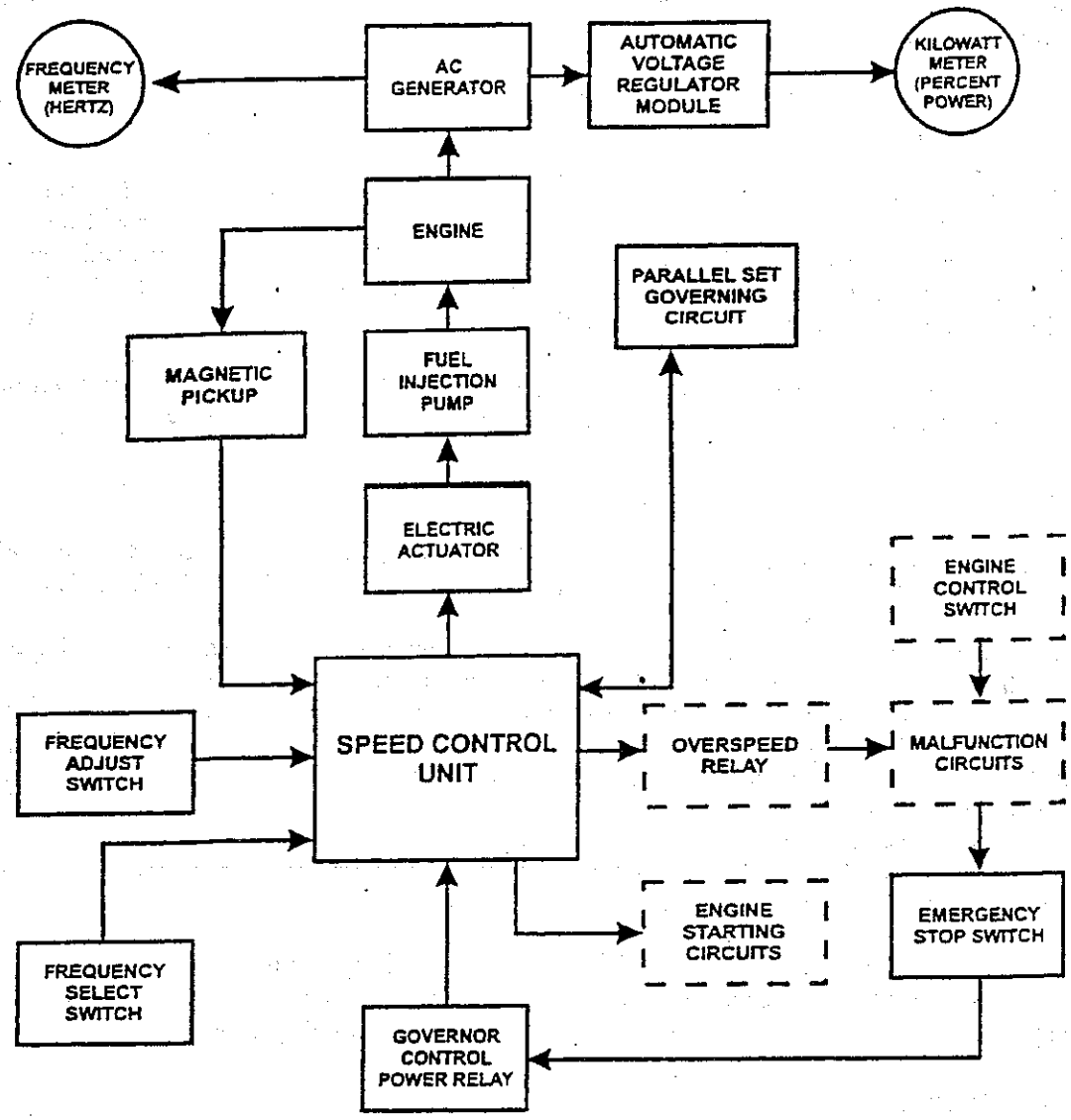


FIGURE 1-20. GOVERNOR CONTROL SYSTEM FLOW DIAGRAM

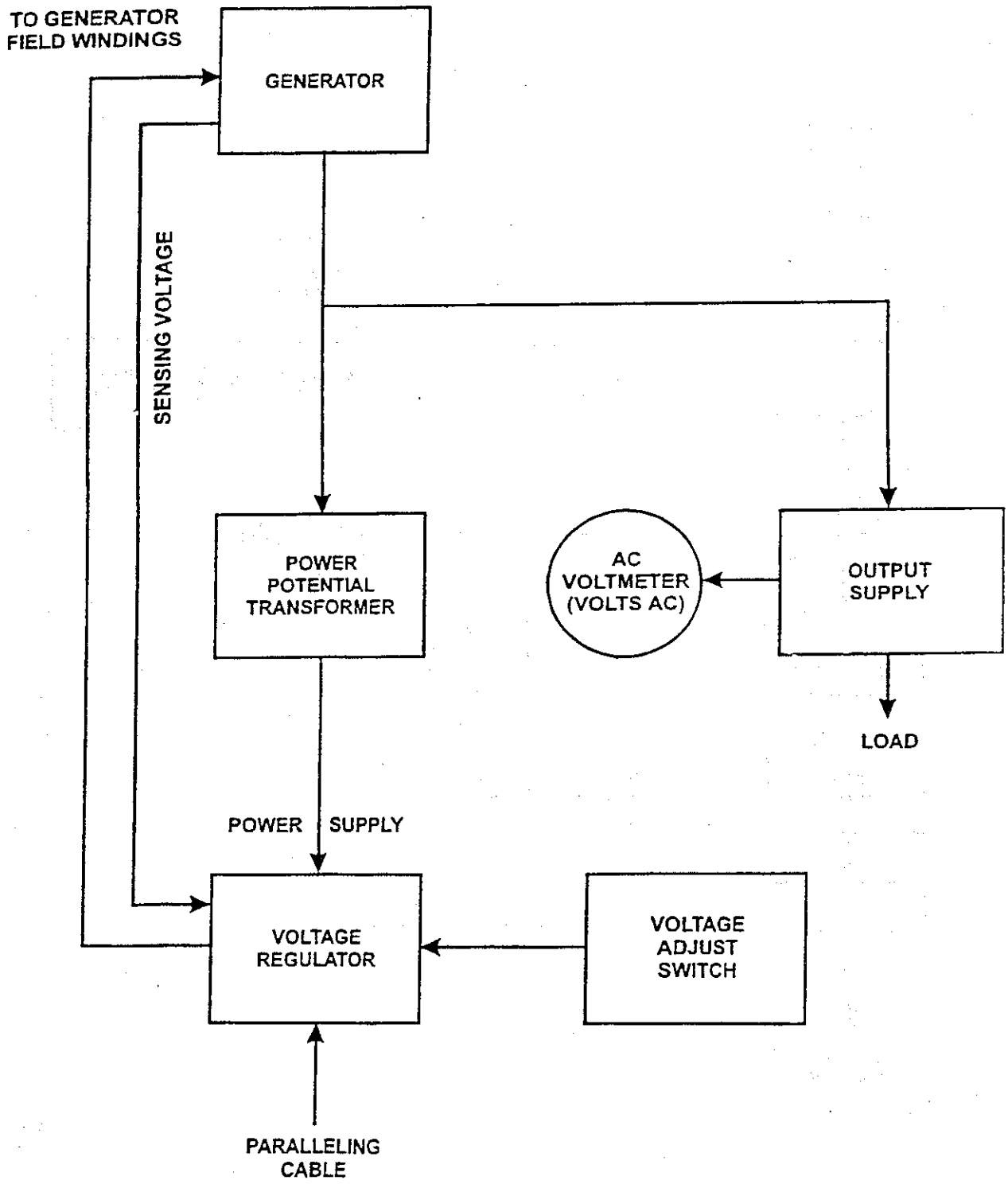


FIGURE 1-21. VOLTAGE REGULATION SYSTEM FLOW DIAGRAM

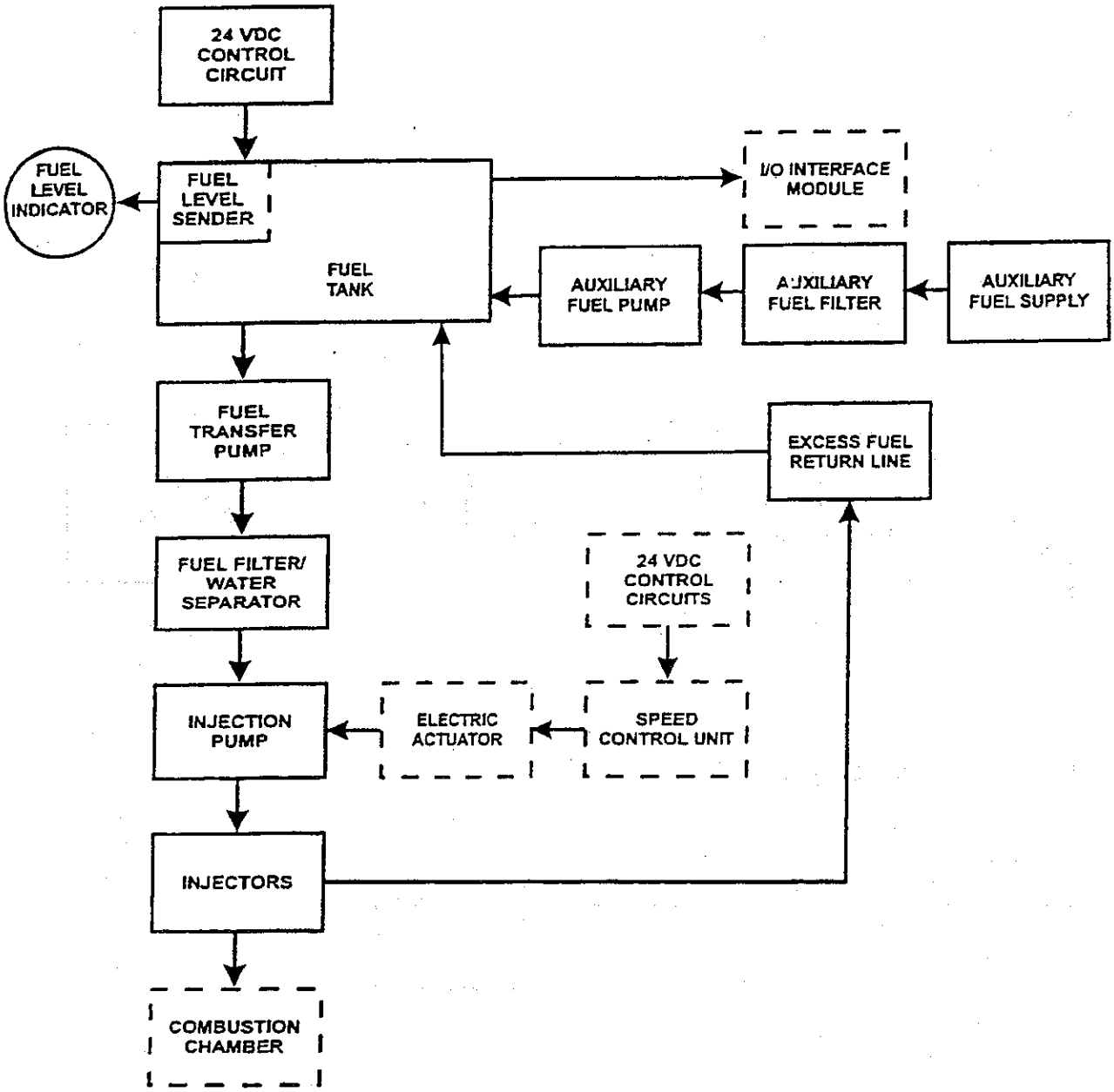


FIGURE 1-22. FUEL SYSTEM FLOW DIAGRAM

1.16.5.3 The injection pump output is controlled by the DCS speed control unit and electric actuator. The DCS speed control unit is energized whenever the ENGINE CONTROL switch is in the START position or either of the two RUN positions. With the engine cranking or running, fuel is drawn from the fuel tank by the transfer pump. After reaching the transfer pump, fuel passes through a fuel filter/water separator where water and small impurities are removed. The fuel then goes to the injection pump. With the governor system energized, the fuel is metered, pressurized and pushed through the injectors by the injection pump. Fuel is sprayed by the injectors into the diesel engine combustion chambers where it is mixed with air and ignited. Fuel that is not used by the injectors is returned to the fuel tank by an excess fuel return line. Power is removed from the DCS speed control unit, and the fuel is shut off whenever the ENGINE CONTROL switch is set to the OFF position. The DCS speed control unit is also de-energized by the fault system, paragraph 1.14.2. The CIM display screen FUEL LEVEL indicator displays the fuel level of the fuel tank from E (empty) to F (full) expressed as percent remaining.

1.16.5.4 The auxiliary subsystem consists of an auxiliary fuel supply, fuel lines, fittings, and an auxiliary fuel pump.

1.16.5.5 When the ENGINE CONTROL switch is set on PRIME & RUN AUX FUEL, it actuates the auxiliary fuel pump and transfers fuel from the auxiliary fuel supply to the fuel tank. The CIM shuts off the auxiliary fuel pump when the fuel tank is full and reactivates the pump as the level drops.

1.16.5.6 The 24 VDC control circuits provide control and power for indicators, fault system, DCS, and auxiliary fuel pump.

1.16.6 Mechanical System.

1.16.6.1 The mechanical system provides protection from the elements, structural integrity, transportability, noise suppression, and the cooling system for the generator set. The generator set cooling system is described separately below.

1.16.6.2 The mechanical system consists of the housing, insulation, air baffles, and skid base.

1.16.6.3 The generator set housing is insulated to provide "tactical quiet" noise suppression which makes detection of the generator set by it's audio signature more difficult under battle conditions. Air baffles allow for airflow to cool the generator set with as little impact as possible to the generator set's noise output.

1.16.6.4 The skid base provides a stable base for the generator set during operation and transport, and allows the generator set to be moved by forklift or mounted on a trailer.

1.16.7 Generator Set Cooling System.

1.16.7.1 The Generator Set Cooling System (Figure 1-23) includes air intake and exhaust grilles, baffles, and ducting within the generator set housing and the engine driven radiator cooling fan. The air intake grilles are located in panels on both sides of the generator set housing. The air exhaust grille is located in the housing top panel.

1.16.7.2 Air is drawn in through the air intake grilles and forced through the engine coolant radiator and out of the generator set through the exhaust grille by the radiator cooling fan. Most of the cooling air flows externally past the generator assembly and engine. Some cooling air is circulated internally through the generator assembly by a generator fan which is an integral part of the AC generator assembly. Baffles, ducting, and sound absorbing material are used to control the air flow through the generator set and to reduce sound transmission through the grilles.

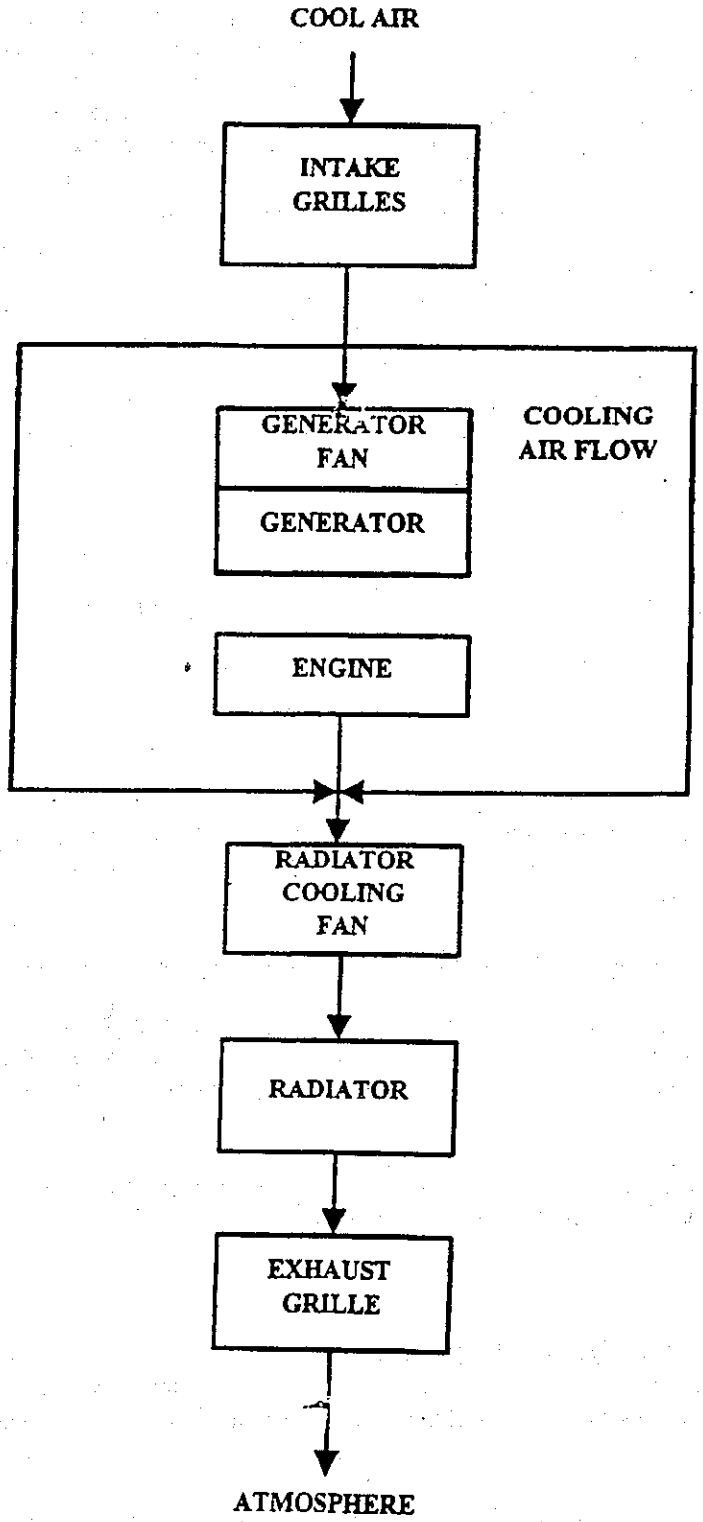


FIGURE 1-23. GENERATOR SET COOLING SYSTEM FLOW DIAGRAM

1.16.8 Engine Cooling System.

1.16.8.1 The Engine Cooling System (Figure 1-24) consists of a radiator, hoses, thermostat, coolant temperature sender, CIM display screen COOLANT TEMP indicator, water pump, oil cooler, cooling fan, and cooling jackets (part of engine).

1.16.8.2 The water pump forces coolant through passages (cooling jackets) in the engine block and cylinder head where the coolant absorbs heat from the engine. When the engine reaches normal operating temperature, the thermostat opens and the heated coolant flows through the upper radiator hose assembly into the radiator. The cooling fan circulates air through the radiator where the coolant temperature is reduced.

1.16.8.3 The DCS, in conjunction with the fault system, provides automatic shutdown in the event coolant temperature exceeds 230 ± 5°F (110 ± 3°C). The CIM display screen COOLANT TEMP indicator indicates the engine coolant temperature from 100°F to 250°F (38°C to 121°C).

1.16.8.4 The water pump also circulates coolant through the engine oil cooler to cool the engine oil.

1.16.9 Lubrication System.

1.16.9.1 The Engine Lubrication System (Figure 1-25) consists of an oil pan, dipstick, pump, oil cooler, oil sample valve, oil pressure sender, CIM display screen OIL PRESSURE indicator, oil drain valve, and filter.

1.16.9.2 The oil pan is a reservoir for engine lubricating oil. The dipstick indicates oil level in the pan. The oil level can be checked during engine operation. One side of the dipstick is used for checking oil level while the engine is running and the other side is used while the engine is shut down. The pump draws oil from the oil pan through a screen which removes large impurities. The oil then passes through tubes in the oil cooler. Engine coolant from the engine cooling system is circulated around the tubes to cool the oil. From the cooler, oil passes through a spin-on type filter where small impurities are removed. From the filter, oil is distributed to the engine and turbocharger moving parts and then returns to the oil pan. The oil pressure sender located in the engine block senses oil pressure. Oil pressure is displayed on the CIM display screen OIL PRESSURE indicator. An Army Oil Analysis Program (AOAP) sample valve located in the block allows oil samples to be taken while the engine is operating. The DCS automatically shuts off the engine if oil pressure drops below 15 ± 3 psi (103.4 ± 20.7 kPa).

1.16.10 Engine Air Intake and Exhaust System.

1.16.10.1 The Engine Air Intake and Exhaust System (Figure 1-26) consists of an air cleaner assembly, intake manifold, ether supply tank, ether solenoid valve, ETHER START switch, exhaust manifold, turbocharger, muffler, and crankcase breather filter. The air cleaner assembly includes a dust collector, filter element, restriction indicator, and dust evacuator valve.

1.16.10.2 Air is drawn into the dust collector and passes through the filter element. Airborne dirt is removed and trapped in the dust collector and filter element. Some dust can be removed from the dust collector by pinching the evacuator valve. The restriction indicator indicates when the filter should be serviced. Filtered air is drawn out of the filter through air intake tubes into the turbocharger where it is compressed and forced into the engine.

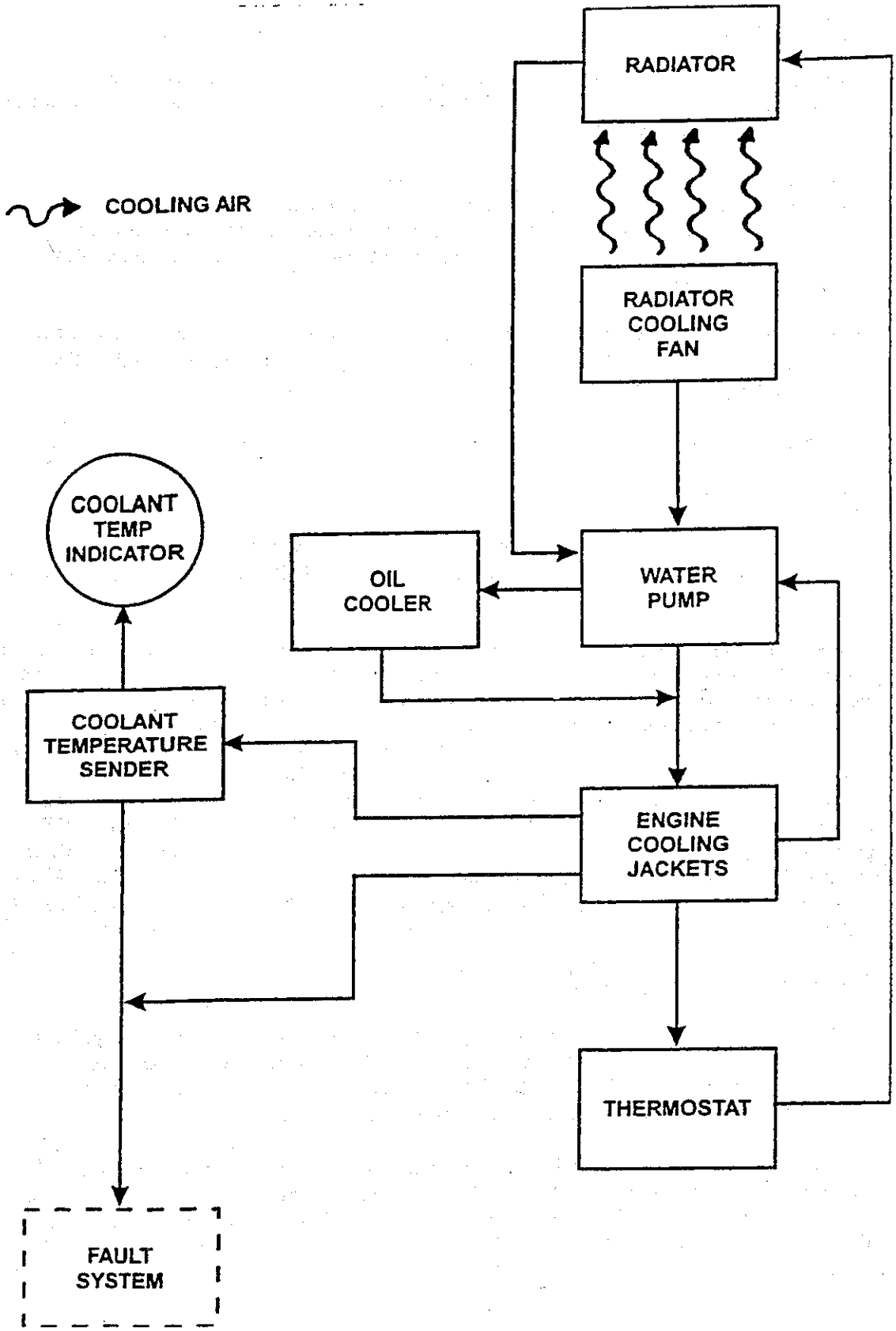


FIGURE 1-24. ENGINE COOLING SYSTEM FLOW DIAGRAM

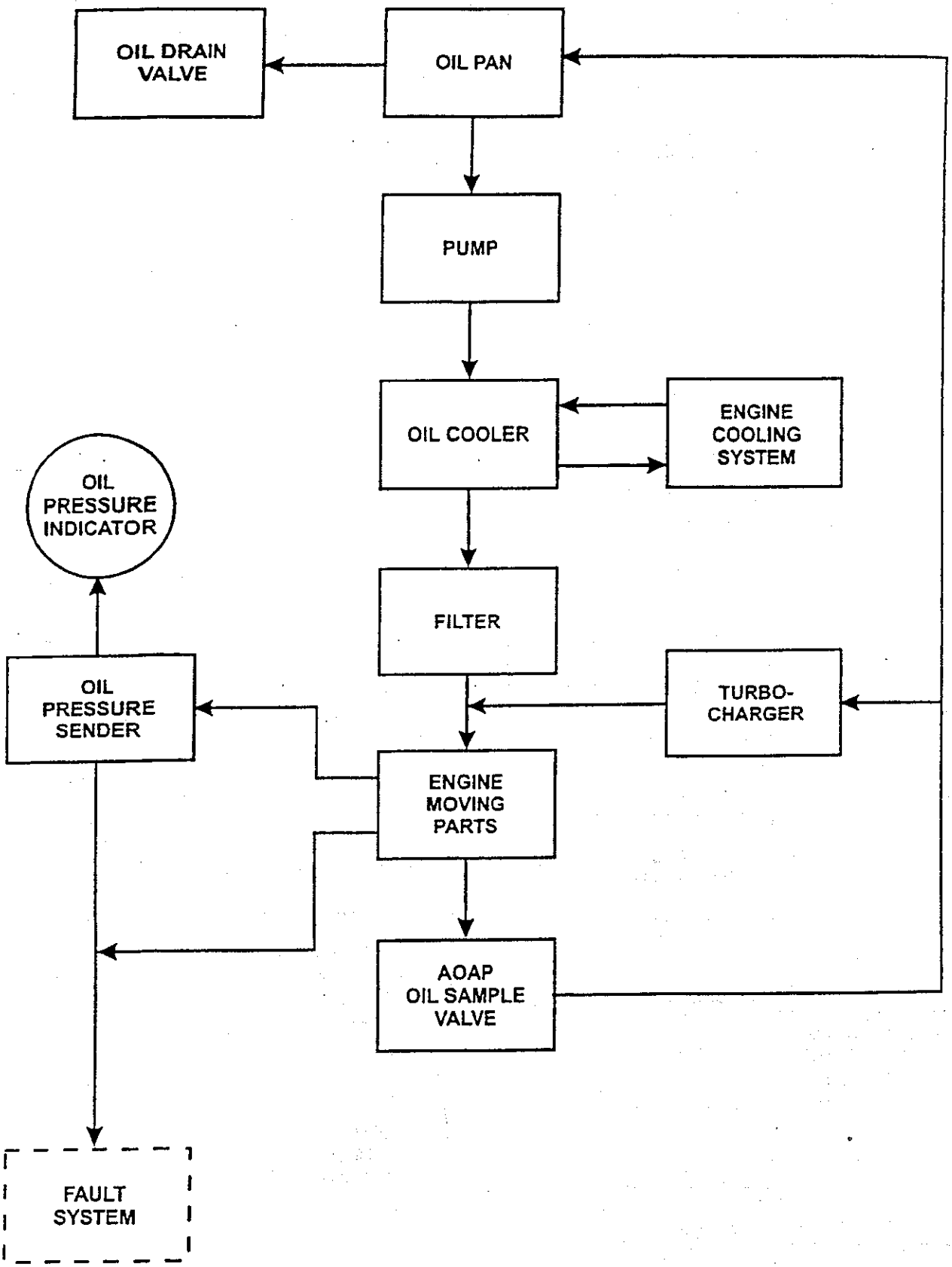


FIGURE 1-25. LUBRICATION SYSTEM FLOW DIAGRAM

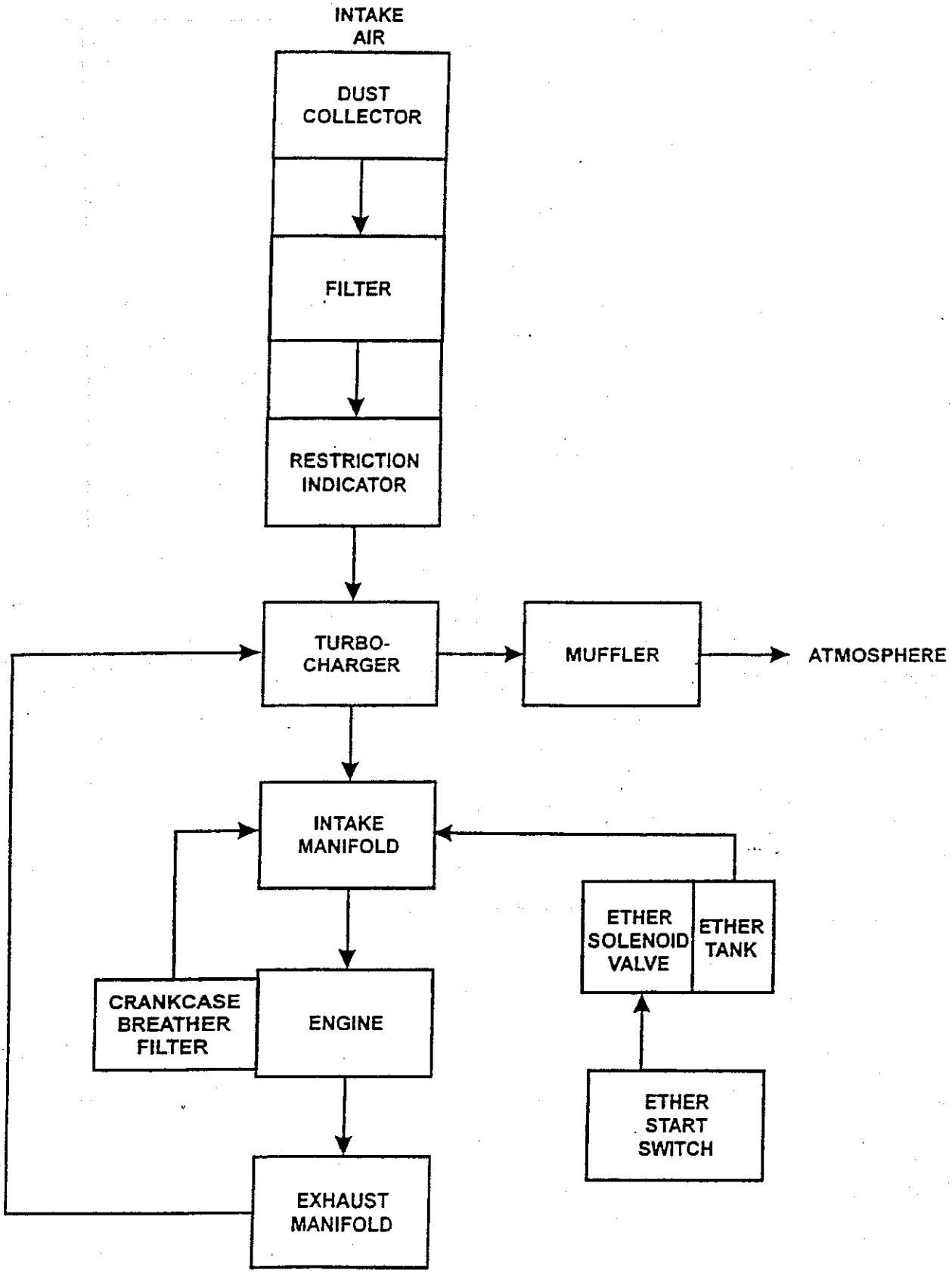


FIGURE 1-26. ENGINE AIR INTAKE AND EXHAUST SYSTEM FLOW DIAGRAM

1.16.10.3 Engine exhaust gases are expelled into the exhaust manifold and ported to the turbine of the turbocharger. The turbine drives the turbocharger compressor which compresses the intake air. Exhaust gases discharged by the turbocharger are channeled into the muffler that deadens the sound of the exhaust gases. Gases pass from the muffler through the muffler outlet and are vented upward from the generator set housing. A cover, which is held open by the pressure of the exhaust gases during operation, closes over the exhaust port to prevent rain, water, or other foreign matter from entering the exhaust port when the set is not in use. The cover is easily removed for connection of an exhaust pipe for indoor operation.

1.16.10.4 Combustion gases, which enter the crankcase, are filtered through the crankcase breather filter to remove oil droplets and are then recycled through the intake manifold.

1.16.10.5 An ether supply system is provided to improve engine starting when outside ambient air temperature is below 40°F (4°C). The ether system includes an ether supply tank, ether solenoid valve, ETHER switch, and piping from the solenoid valve to the intake manifold. The ether system is activated by turning the ENGINE CONTROL switch to START and momentarily holding the ETHER switch in the ON position while continuing to crank engine.

1.16.10.6 Air in the engine crankcase is drawn out the right side of the engine through a rubber hose and into the crankcase breather filter assembly. There the air swirls around, leaving oil particles in the removable filter, and leaves through a second rubber hose. The air then passes through this output hose into the engine air cleaner assembly output hose. That is, the filtered air from the crankcase enters the engine intake air flow downstream of the intake air filter. Engine intake air flow is then compressed with the turbocharger, enabling filtered crankcase air to be recycled into the engine intake air and used in the combustion process of the engine.

1.16.11 Output Supply System.

1.16.11.1 The Output Supply System (Figure 1-27) consists of the AC generator, ground fault circuit interrupter, CONVENIENCE RECEPTACLE, current transformer, voltage reconnection terminal board, AC circuit interrupter, load output terminals, AC CIRCUIT INTERRUPT switch, load sharing synchronizer, automatic voltage regulator, CIM display screen FREQ gage, VOLTAGE gage, and POWER gage.

1.16.11.2 Power created by the generator is supplied through the current transformer, voltage reconnection terminal board, and AC circuit interrupter to the load output terminals. The voltage reconnection terminal board allows configuration of the generator set for 120/208 volt connections or 240/416 volt connections. The AC CIRCUIT INTERRUPT switch closes and opens the AC circuit interrupter. This enables or interrupts power flow between the voltage reconnection terminal board and load output terminals. The voltage regulation system (paragraph 1.14.4) senses generator output voltage and provides a control signal to the generator exciter to maintain the desired generator output voltage. Generator output frequency is controlled by the governor control system (paragraph 1.14.3) and is read on the CIM display screen FREQ gage (Hz). The current transformer provides a reduced current signal to the DCS and CIM display screen GEN CURRENT indicators (amps AC). The CIM display POWER gage (kW) provides an indication of the power being used by the load. The GEN AMMETER indicates rated current in amps required by the load. The AC circuit interrupter will open and disconnect the load whenever any of the following faults occur: reverse power, undervoltage, overload, overspeed, low oil pressure, high water temperature, or short circuit.

1.16.11.3 The AC generator also provides 120 VAC power to the CONVENIENCE RECEPTACLE through the GROUND FAULT CIRCUIT INTERRUPTER.

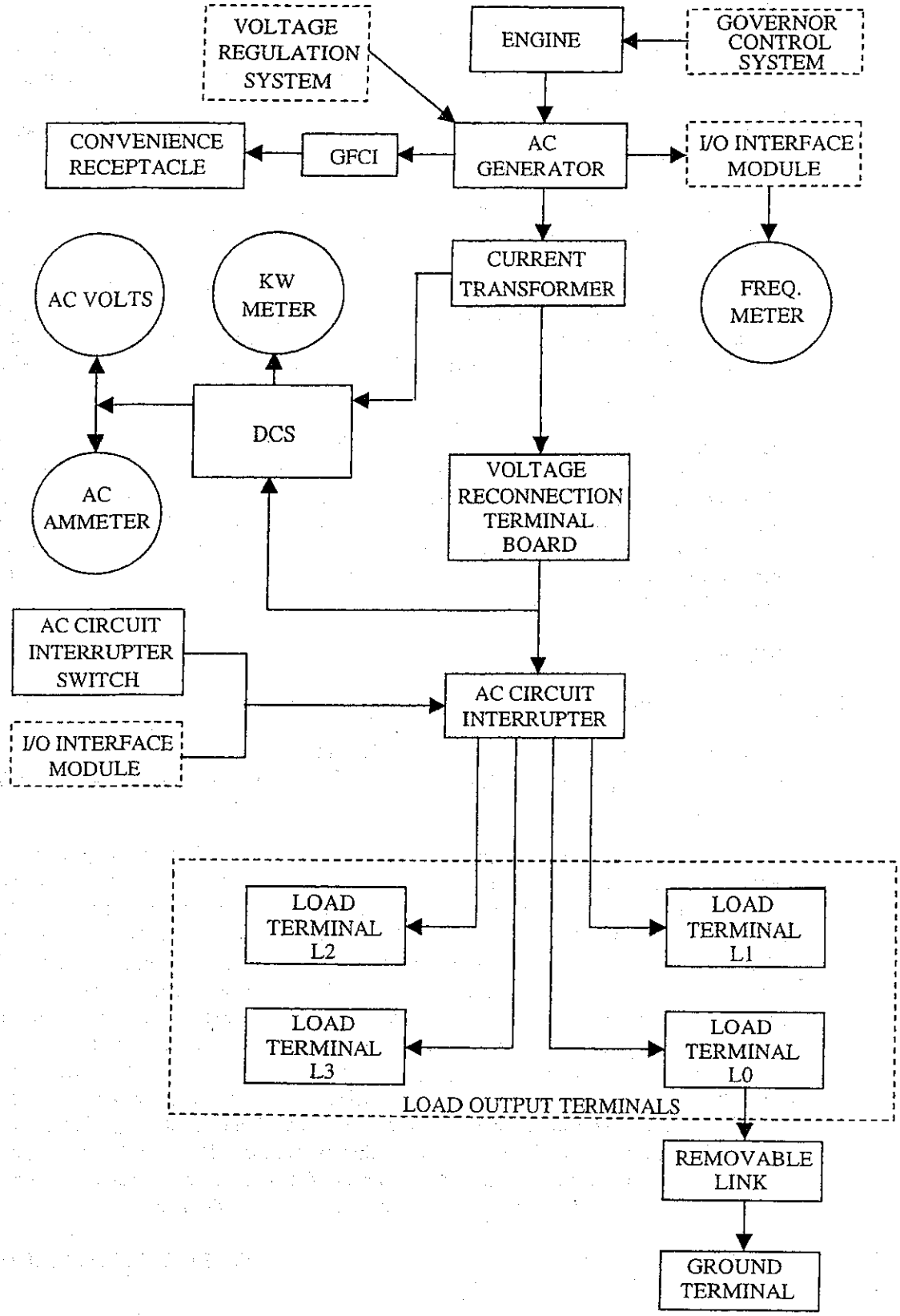


FIGURE 1-27. OUTPUT SUPPLY SYSTEM FLOW DIAGRAM

1.16.12 Generator Assembly.

1.16.12.1 General. Revolving field type generators have a DC field revolving within a stationary AC winding called the stator. See brushless generator schematic, Figure 1-28. AC power is distributed from the generator through leads connected to the stator windings. There are no sliding contacts between the AC winding and the load, therefore, great amounts of power may be drawn from this generator.

To energize the field, DC excitation must be applied to the generator field coils. The excitation current is supplied from a brushless exciter mounted on the generator shaft.

The brushless exciter is actually an AC generator with its output rectified through a full wave bridge circuit. This type of brushless exciter will provide the necessary excitation current. The generator set field flash circuit, activated during each engine start, applies voltage to the exciter stator to begin the voltage build-up process to energize the generator field.

The generator output voltage is controlled by controlling the alternating field current. This is accomplished by regulating the exciter field coil voltage. The exciter field coil voltage is regulated with a solid state type automatic voltage regulator.

1.16.12.2 Damper Bars. Damper bars are inserted through the field laminations and welded at the end to a solid copper plate. The damper windings provide stable parallel operation, reduce damping current losses, and limit the increase of third harmonic voltage with increase in load.

1.16.12.3 Brushless Exciter. The brushless exciter consists of an armature with a three-phase AC winding and rotating rectifier assembly within a stationary field.

The stationary exciter field assembly is mounted in the main generator frame. The exciter armature is press fit and keyed onto the shaft assembly. The rotating rectifier assembly slides over the bearing end of the generator rotor shaft and is secured with bolts and washers to an adapter hub which is shrunk on the generator shaft.

1.16.12.4 Rotating Rectifier Bridge. The rotating rectifier bridge consists of rectifying diodes mounted on a brass heat sink which is in turn mounted on an insulating ring. The entire assembly bolts to the adapter on the generator shaft. Therefore, the rotating rectifier assembly will rotate with the exciter armature eliminating the need for any sliding contacts between the exciter output and the alternator field.

1.16.12.5 Exciter Field. The exciter field on the high frequency exciter consists of laminated segments of high carbon steel which are fitted together to make up the field poles. The field coils are placed into the slots of the field poles.

1.16.12.6 Exciter Field Coil Voltage Source. Field coil DC voltage is obtained by rectifying the voltage from a phase to neutral line of the generator output, or other appropriate terminal, to provide the needed voltage reference.

The rectifier bridge is an integral part of the static regulator. The static regulator senses a change in the generator output and automatically regulates current flow in the exciter field coil circuit to increase or decrease the exciter field strength. An external adjust rheostat sized to be compatible with the regulator is used to provide adjustment to the regulator sensing circuit.

1.16.12.7 Balance. The rotor assembly is precision balanced to a high degree of static and dynamic balance. Balance is achieved with the balance lugs on the field pole tips. The balance will remain dynamically stable at speed in excess of the design frequencies.

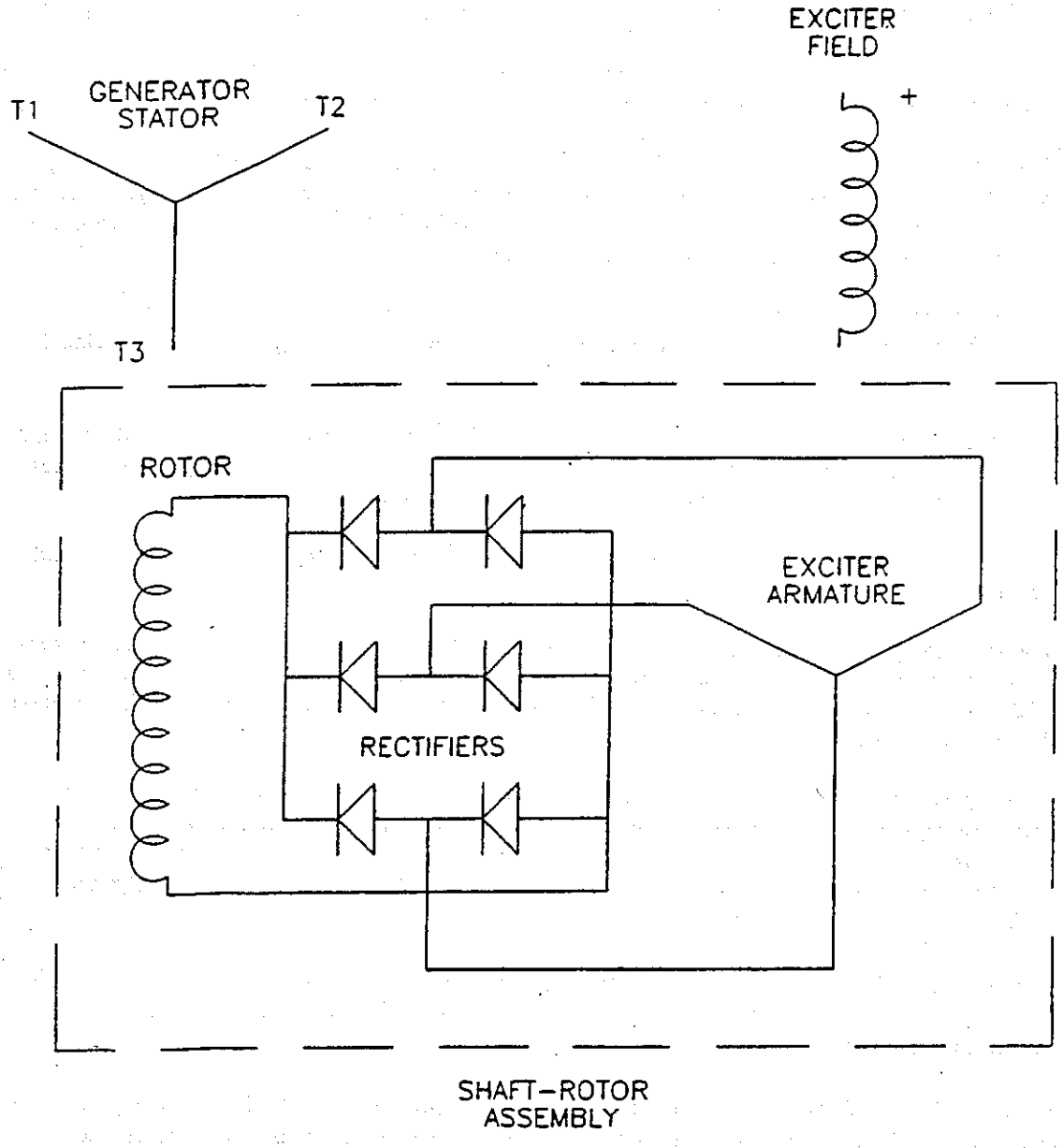


FIGURE 1-28. BRUSHLESS GENERATOR SCHEMATIC

1.16.12.8 Bearing. The generator rotor assembly is suspended on shielded, factory lubricated ball bearings. They are greased for life and do not require lubrication.

1.16.12.9 Stator Assembly. The stator assembly consists of laminations of steel mounted in a rolled steel frame. Random wound stator coils are fitted into the insulated slots.

1.16.13 Generator Set Controls.

1.16.13.1 Engine Starting System.

1.16.13.1.1 Engine starting is accomplished primarily with two 12 volt batteries, connected in series to provide 24 VDC power, and a starter (Figure 1-29). The starter includes a cranking motor and a solenoid. To permit engine starting, the DC CONTROL POWER circuit breaker must be pushed in, the DEAD CRANK switch must be in the NORMAL position, and the BATTLE SHORT switch must be in the OFF position. In addition, any ENGINE SHUTDOWN fault previously registered on the CIM display screen must have been corrected by activating the FAULT RESET switch.

When the ENGINE CONTROL switch is then placed in the START position, the starting circuits supply 24 VDC power to the starter. As the engine accelerates to approximately 900 RPM, the DCS speed control unit disconnects power from the starter.

1.16.13.1.2 When the ENGINE CONTROL switch is first moved to the START position, the control modules are energized. The Engine Starting System includes three control circuits. One starting control circuit energizes the K2 relay through closed switch contacts of the crank disconnect relay. The second starting control circuit signals the I/O interface module. With the K2 relay energized, power passes from the batteries through closed contacts of the K2 relay to energize the starter solenoid. With the starter solenoid energized, power passes from the starter solenoid to the cranking motor. The cranking motor then cranks the engine. Engine speed is sensed by the magnetic pickup which sends a signal to the DCS speed control unit. As the engine accelerates to approximately 900 RPM, the signal from the magnetic pickup causes the crank disconnect switch to open the crank disconnect relay. The open contacts break the circuit to the cranking relay and stop engine cranking. The third control circuit causes the field flash relay to be energized. When the ENGINE CONTROL switch is moved to one of the two RUN positions, all starting control circuits are de-energized. The other generator set control and instrument circuits remain energized.

1.16.13.1.3 The engine may be cranked without starting by use of the DEAD CRANK switch. With the DEAD CRANK switch in the CRANK position, the K2 relay coil is energized to initiate engine cranking without energizing any other starting or control functions.

1.16.13.1.4 The generator set can be started without batteries by connecting an external 24 VDC power source to the NATO/SLAVE RECEPTACLE. The generator set can also supply power to another set through the NATO/SLAVE RECEPTACLE.

1.16.13.1.5 The batteries are charged by the battery charging alternator which is belt driven by the engine. The CIM display screen BATTERY CHARGE ammeter indicates the charge/discharge rate of the batteries, from -60 amps to +60 amps. A sensor provides a DC voltage signal, which is directly proportional to the actual battery current flow, to the BATTERY CHARGE ammeter. Normal operating indication on the BATTERY CHARGE ammeter depends on the state of the charge in the batteries. A low charge, which may exist immediately after engine starting, will cause a high reading (indication toward CHARGE area). When the charge in the batteries has been restored, the indicator moves near zero. The battery charging system is protected from reverse polarity in the battery connections by a diode.

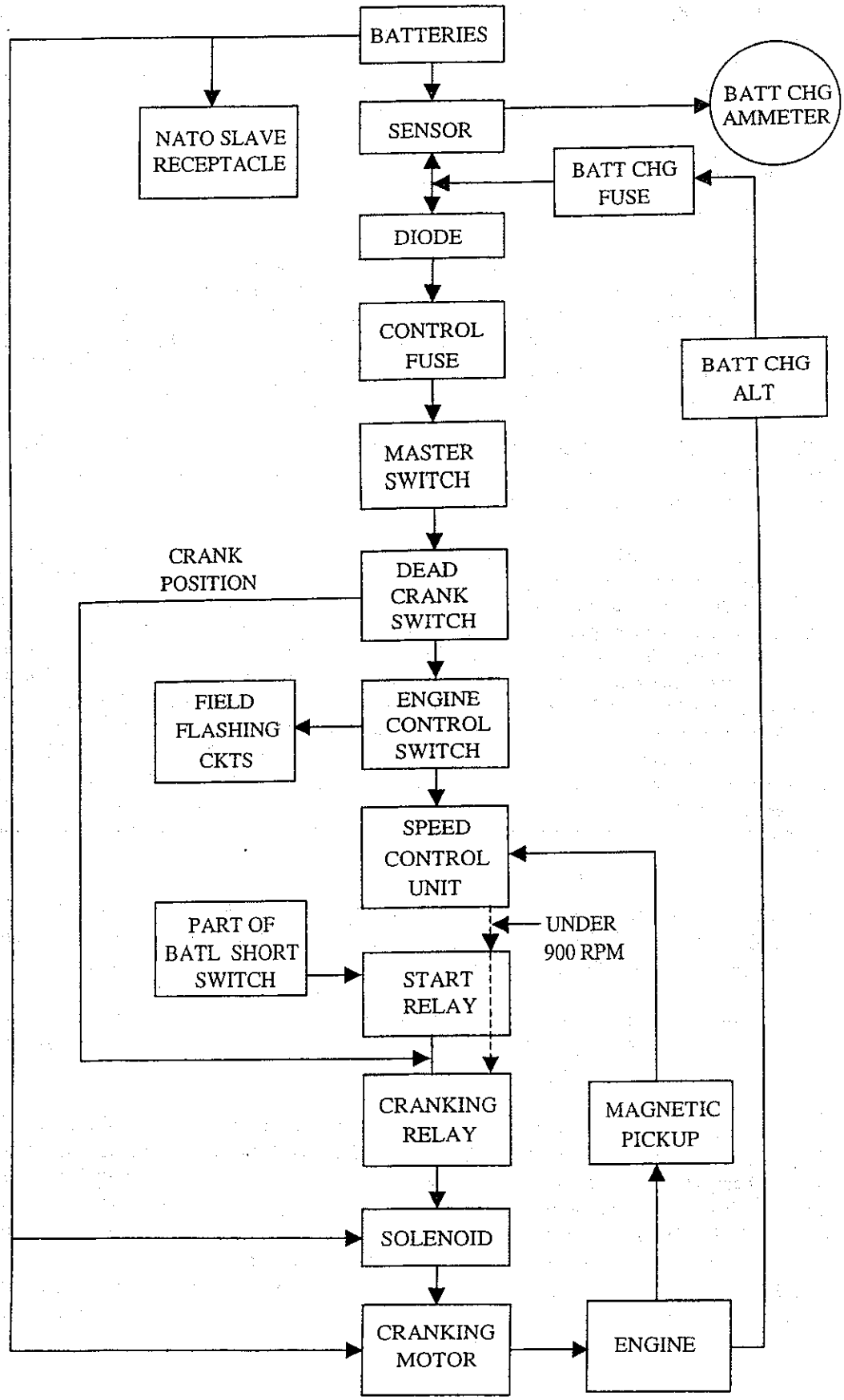


FIGURE 1-29. ENGINE STARTING SYSTEM FLOW DIAGRAM

1.16.13.2 Field Flash. This circuit provides current to the exciter field windings which sets up an electromagnetic field. The field current is necessary for the set to generate sufficient voltage for the automatic voltage regulator to begin controlling the output voltage of the generator set. The field flash circuit is maintained until the ENGINE CONTROL switch is released from the START position.

1.16.13.3 Operation. Placing the ENGINE CONTROL switch in the PRIME & RUN AUX FUEL positions keeps the DCS speed control unit energized, and fuel will be supplied to the fuel injection pump as long as no fault condition exists. During operation, the operator should periodically check the CIM display screen to ensure readings are in normal operating ranges. The VOLTAGE ADJUST and FREQUENCY ADJUST switches are adjusted as required to maintain desired frequency and voltage output.

1.16.13.4 Applying the Load. The load is applied by placing the AC CIRCUIT INTERRUPT switch in the CLOSED position. This is a momentary contact switch that returns to the neutral, or center, position. The AC circuit interrupter is energized by this momentary contact and a holding circuit keeps it closed, bringing the load on line.

1.16.13.5 Shutdown.

1.16.13.5.1 The AC circuit interrupter is disengaged by placing the AC CIRCUIT INTERRUPT switch in the OPEN position. This is a momentary contact switch which will break the AC circuit interrupter holding circuit and then return to the neutral, or center, position, disconnecting the load from the line.

1.16.13.5.2 The generator set should remain running for five minutes after disconnecting the load. During this five minute interval, oil circulates through the turbocharger, cooling it enough to be shut down.

1.16.13.5.3 When the ENGINE CONTROL switch is placed in the OFF position, all power is removed from the governor control circuit and the engine will stop.

1.16.13.5.4 The EMERGENCY STOP switch will remove power from the governor control circuit by de-energizing circuitry in the DCS. This will cause the engine to shut down. The EMERGENCY STOP switch will not be used as an alternative for routine shutdown procedures. When the generator set is stopped using the EMERGENCY STOP switch, some circuits remain energized causing a drain on the batteries until the ENGINE CONTROL switch is placed in the OFF position.

1.16.13.6 Paralleling.

1.16.13.6.1 The generator set is capable of being operated in parallel with one other set of the same model number. This capability is provided by the PARALLELING RECEPTACLE, paralleling cable, and the load sharing synchronizer.

1.16.13.6.2 The paralleling cable is used to interconnect the governor and automatic voltage regulator paralleling circuits of the two sets. Voltage and frequency of the two generator sets are synchronized by the DCS load sharing synchronizer. The permissive paralleling relay monitors the voltage phase relationship and prevents the AC circuit interrupter from closing when the units are not properly synchronized.

NOTES

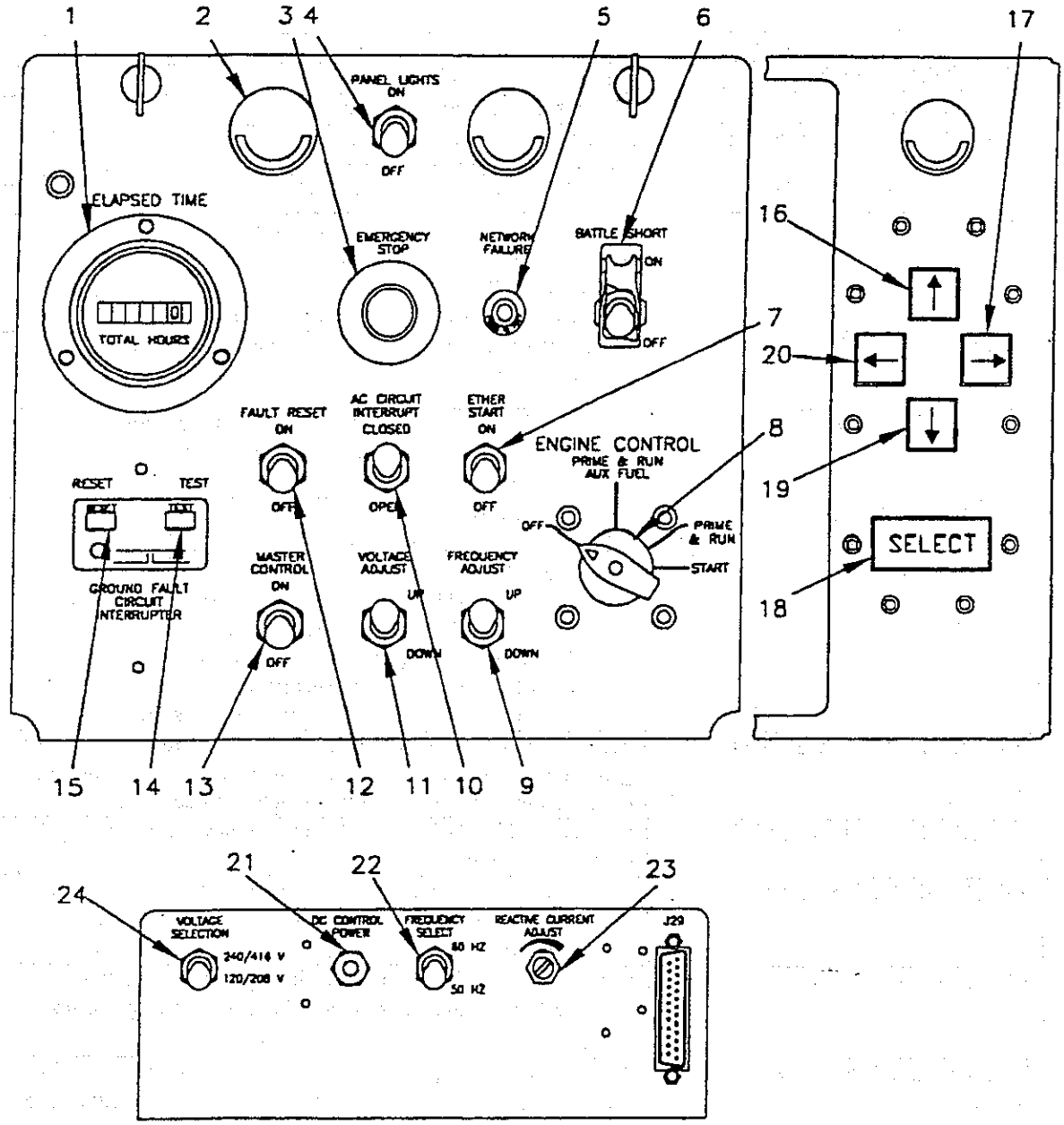


FIGURE 2-1. DCS CONTROLS AND INDICATORS

TABLE 2-1. DCS CONTROLS AND INDICATORS

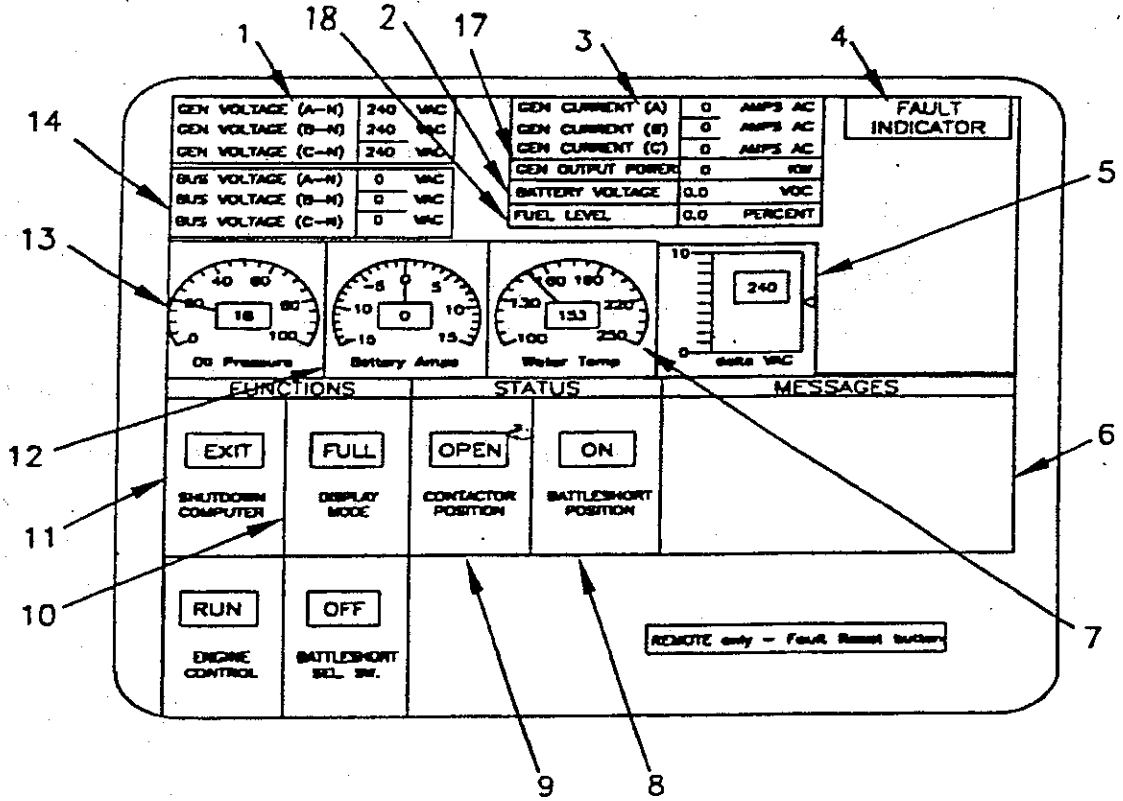
KEY	CONTROL OR INDICATOR	FUNCTION
1	ELAPSED TIME Meter	Indicates total engine operating hours.
2	Panel Lights	Illuminate DCS control panel.
3	EMERGENCY STOP Switch	Shuts down generator set when activated. Removes electrical power to governor controller and stops engine from operating.
4	PANEL LIGHTS Switch	Activates and deactivates panel lights.
5	NETWORK FAILURE Indicator	When illuminated indicates a failure between Computer Interface Module and Input/Output Module. Generator set will not continue to operate, and capability to monitor its operation and to make adjustments will be degraded or lost.
6	BATTLE SHORT Switch	Bypasses protective devices on generator set. Set will continue to operate until overvoltage occurs or fuel is exhausted.
7	ETHER START Switch	When held in ON position momentarily during engine cranking, activates ether cold weather starting system for starting engine at temperatures below 40°F (4°C).
8	ENGINE CONTROL Switch	Four position switch: OFF – de-energizes all circuits except panel lights and power to CIM. PRIME & RUN AUX FUEL – energizes generator set run circuits with auxiliary fuel pump operating. PRIME & RUN – energizes generator set run circuits with auxiliary fuel pump de-energized. START – energizes engine starter and flashes generator field.
9	FREQUENCY ADJUST Switch	Momentary-action toggle switch. Adjusts frequency output of generator set for each activation of the switch. Works in both directions to increase and decrease output frequency.
10	AC CIRCUIT INTERRUPT Switch	Opens and closes AC Circuit Interrupt Relay. Used during parallel operation.
11	VOLTAGE ADJUST Switch	Momentary-action toggle switch. Adjusts voltage output of generator set. Works in both directions to increase and decrease output voltage.
12	FAULT RESET Switch	Resets (turns off) fault indicators displayed on Computer Interface Module display screen. Will re-energize governor power.
13	MASTER CONTROL Switch	When placed in ON position, provides battery power to DCS. Should be first switch activated on panel. Generator set cannot be started unless switch is activated.
14	GROUND FAULT CIRCUIT INTERRUPTER TEST Switch	Tests GROUND FAULT CIRCUIT INTERRUPTER.
15	GROUND FAULT CIRCUIT INTERRUPTER RESET Switch	Resets GROUND FAULT CIRCUIT INTERRUPTER.
16	Keypad Up Arrow Pushbutton ↑	Moves cursor on CIM display screen in upward direction until released.
17	Keypad Right Arrow Pushbutton →	Moves cursor on CIM display screen to the right until released.
18	Keypad SELECT Pushbutton	When pressed, selects item on CIM display screen indicated by cursor.
19	Keypad Down Arrow Pushbutton ↓	Moves cursor on CIM display screen in downward direction until released.

TABLE 2-1. DCS CONTROLS AND INDICATORS (continued)

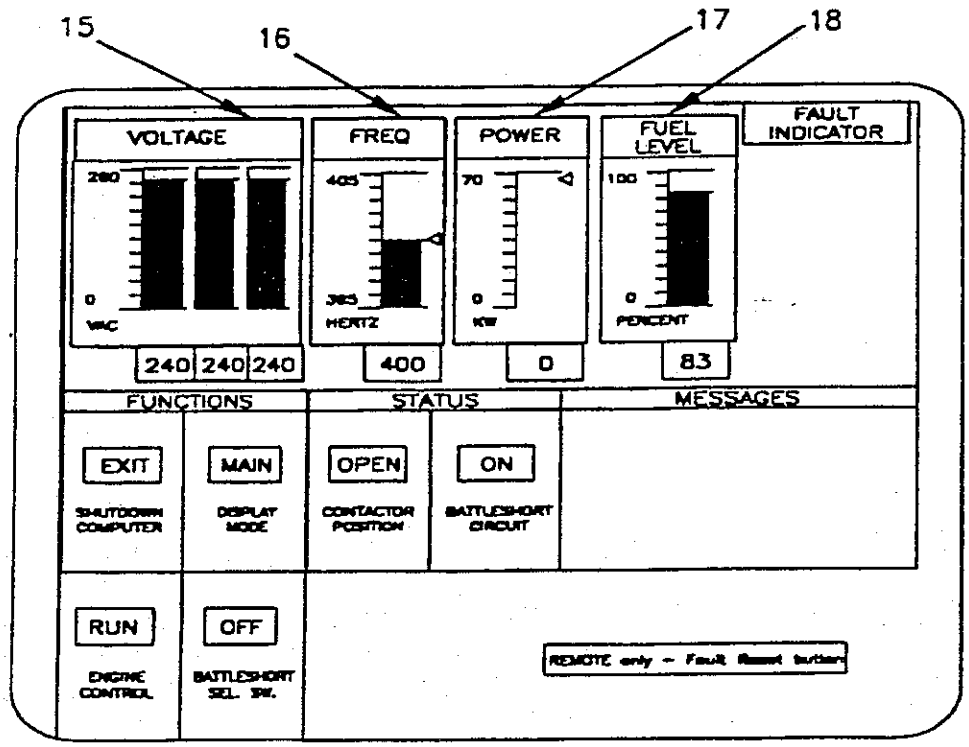
KEY	CONTROL OR INDICATOR	FUNCTION
20	Keypad Left Arrow Pushbutton ←	Moves cursor on CIM display screen to the left until released.
21	DC CONTROL POWER Fuse	Provides overcurrent protection for DC circuits.
22	FREQUENCY SELECT Switch (MEP-806B only)	Allows selection of 50 Hz or 60 Hz.
23	REACTIVE CURRENT ADJUST rheostat	Adjusts voltage droop when two generator sets are operated in parallel.
24	VOLTAGE SCALE Switch	Reports configuration of output voltage connection selected on voltage reconnection terminal board.

2.3 COMPUTER INTERFACE MODULE (CIM) DISPLAY SCREEN CONTROLS AND INDICATORS.

The Computer Interface Module (CIM) Display Screen displays most of the indicators for the generator set. Figure 2-2 shows the CIM display screen layout. Table 2-2 describes each control and indicator. Table 2-3 describes faults that may be displayed in the FAULT INDICATOR section of the CIM display screen and related operator messages that may be displayed in the MESSAGES section.



FULL DISPLAY MODE



MAIN DISPLAY MODE

FIGURE 2-2. CIM DISPLAY SCREEN CONTROLS AND INDICATORS

TABLE 2-2. CIM DISPLAY SCREEN CONTROLS AND INDICATORS

KEY	CONTROL OR INDICATOR	FUNCTION
1	GEN VOLTAGE indicators	Indicates generator output voltage for each of the three phases.
2	BATTERY VDC indicator	Indicates charge status of both generator set DC batteries (VDC).
3	GEN CURRENT indicators	Indicates generator output current (amps) for each of the three phases.
4	FAULT INDICATOR display	Displays fault indications as they occur. Specific warnings and instructions related to a fault are displayed simultaneously in the MESSAGES display. See Table 2-3 for the list of possible faults.
5	DELTA VAC gage	Indicates generator set output voltage versus bus voltage. Used prior to operating in parallel with another unit. Used to monitor system prior to parallel operation to ensure generator and bus voltage are balanced within 5 volts before closing contactor to bus.
6	MESSAGES display	Displays warnings and instructions in the form of operator messages related to faults displayed in FAULT INDICATOR display.
7	WATER TEMP virtual meter	Indicates generator set cooling system water temperature (°F).
8	BATTLE SHORT CIRCUIT status indicator	Indicates whether generator set is in battle short mode or not. ON indication means battle short circuit is energized.
9	CONTACTOR POSITION status indicator	Indicates whether contactor is open or closed.
10	DISPLAY MODE FULL/MAIN switch	When FULL/MAIN button is selected with the keypad, CIM display screen toggles between FULL and MAIN modes and button changes to show name of mode currently displayed.
11	SHUTDOWN COMPUTER EXIT button	When EXIT button is selected with the keypad, the DCS software shuts down so the CIM can be safely deactivated. This will also shut down the generator set if it is running.
12	BATTERY AMPS virtual meter	Indicates input current of generator set DC batteries (amps).
13	OIL PRESSURE virtual meter	Indicates engine oil pressure (psi).
14	BUS VOLTAGE indicators	Indicate voltage on output bus. The GEN VOLTAGE and BUS VOLTAGE indicators must match within five volts, each phase, to perform paralleling operation.
15	VOLTAGE gage	Indicates generator set voltage output (VAC).
16	FREQ gage	Indicates generator set frequency output (Hz).
17	POWER gage	Indicates generator set power output (kW).
18	FUEL LEVEL gage	Indicates amount of fuel in fuel tank (percent remaining).

NOTES

TABLE 2-3. FAULTS

NOTE: Maintainers can only check faults at their level.

FAULT	MESSAGE #	MESSAGE
CIRCUIT FAILURE - FUEL LEVEL	01	The fuel level signal is lower than the operating range. Check fuel level. Check fuel sensor and circuit. (Para. 4.11.5)
SHUTDOWN - LOW FUEL	02	Fuel level is abnormally low. Check fuel level. Verify fuel system lineup.
WARNING - LOW FUEL	03	Fuel level is abnormally low. Check fuel level. Verify fuel system lineup.
CIRCUIT FAILURE - FUEL LEVEL	04	The fuel level signal is higher than the operating range. Check fuel level. Check fuel sensor and circuit. (Para. 4.11.5)
CIRCUIT FAILURE - COOLANT TEMP	05	The coolant temperature signal is lower than the operating range. Check coolant level. Check coolant temperature sensor and circuit. (Para. 4.13.2)
	06	The coolant temperature is higher than the operating range. Check coolant level. Check coolant temperature sensor and circuit. (Para. 4.13.2)
WARNING - COOLANT TEMP	07	Coolant temperature is abnormally high. Check coolant level. Verify coolant system lineup. (Para. 3.3.5)
SHUTDOWN - COOLANT TEMP	08	Coolant temperature is abnormally high. Check coolant level. Verify coolant system lineup. (Para. 3.3.5)
CIRCUIT FAILURE - OIL PRESSURE	09	The oil pressure signal is lower than the operating range. Check oil pressure. Check oil pressure sensor and circuit.(Para. 4.13.1)
	10	The oil pressure signal is higher than the operating range. Check oil pressure. check oil pressure sensor and circuit.(Para. 4.13.1)
WARNING - LOW OIL	11	Oil pressure is abnormally low. Check oil. Verify lubricating system lineup. (Para. 3.3.8)
SHUTDOWN - LOW OIL	12	Oil pressure is abnormally low. Check oil. Verify lubricating system lineup. (Para. 3.3.8)
WARNING - OVERVOLTAGE	13	Generator voltage is abnormally high. Adjust VOLTAGE ADJUST switch. (Para. 2.11.1 j)
SHUTDOWN - OVERVOLTAGE	14	Generator voltage is abnormally high. Adjust VOLTAGE ADJUST switch. (Para. 2.11.1 j)
WARNING - OVERSPEED	15	Generator frequency is abnormally high. Adjust FREQUENCY ADJUST switch. (Para. 2.11.1 j)
SHUTDOWN - OVERSPEED	16	Generator frequency is abnormally high. Adjust FREQUENCY ADJUST switch. (Para. 2.11.1 j)
WARNING - UNDERVOLTAGE	17	Generator voltage is abnormally low. Adjust VOLTAGE ADJUST switch. (Para. 2.11.1 j)
CONTACTOR TRIP - UNDERVOLTAGE	18	Generator voltage is abnormally low. Adjust VOLTAGE ADJUST switch. (Para. 2.11.1 j)
WARNING - OVERLOAD	19	System load is abnormally high. Reduce load to within generator set ratings. (Para. 2.11.1 n and o)

TABLE 2-3. FAULTS (continued)

FAULT	MESSAGE #	MESSAGE
CONTACTOR TRIP - OVERLOAD	20	System load is abnormally high. Reduce load to within generator set ratings. (Para. 2.12)
CONTACTOR TRIP - REVERSE POWER	21	Load share device sensed reverse power conditions. Verify load share device setpoints are correct.
CONTACTOR TRIP - SHORT CIRCUIT	22	System load was abnormally high. Reduce load to within generator set ratings.

2.4 DIAGNOSTIC CONTROLS AND INDICATORS.

The DCS load sharing synchronizer, DCS speed control unit, automatic voltage regulator, backplane module, and I/O interface module are equipped with indicators used as diagnostic tools in troubleshooting. Some of the DCS modules also include controls that are set at installation and may need to be adjusted during troubleshooting. Figure 2-3 shows the locations of the controls and indicators on the DCS modules. Table 2-4 describes each control and indicator.

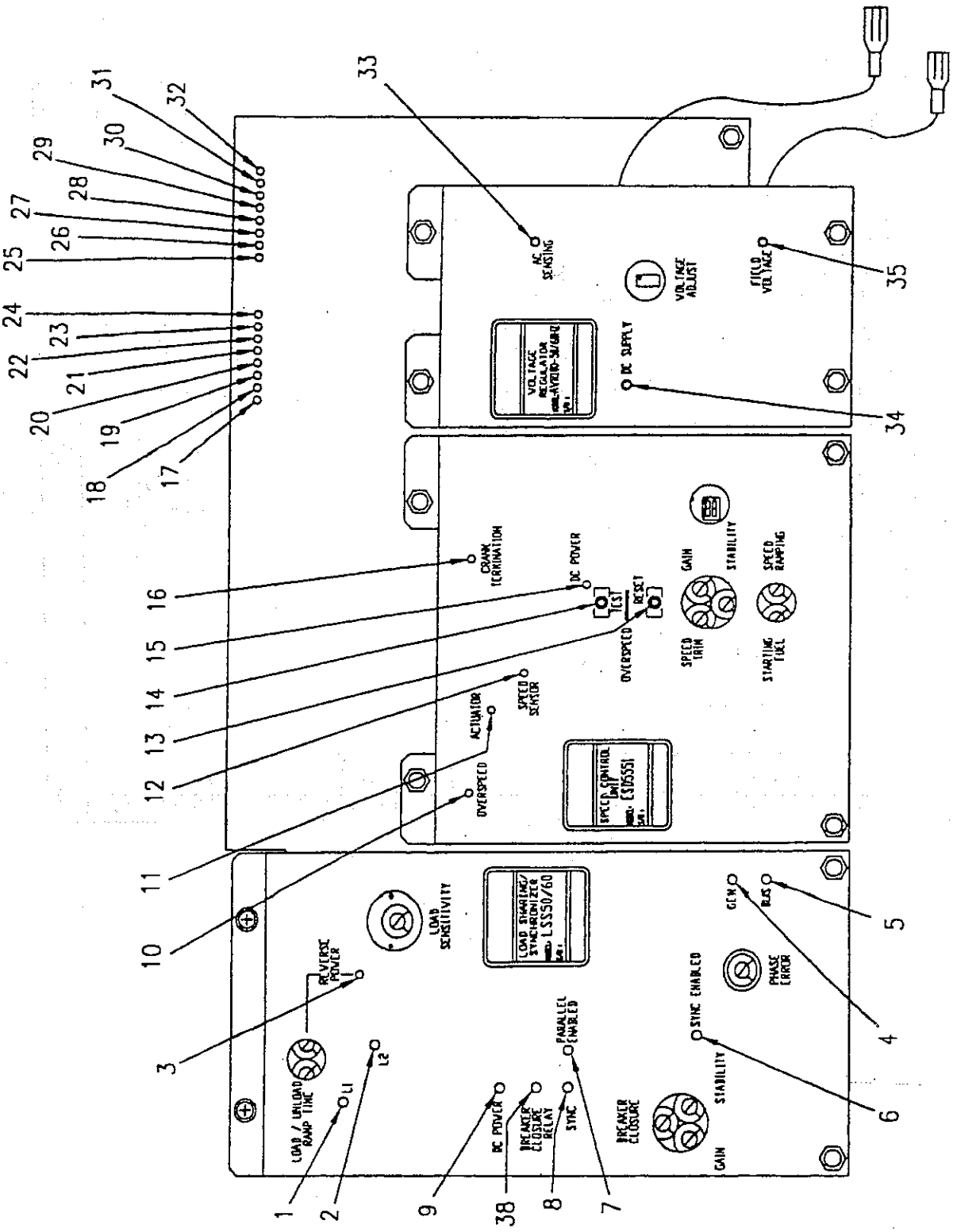


FIGURE 2-3. DIAGNOSTIC CONTROLS AND INDICATORS (SHEET 1 OF 2)

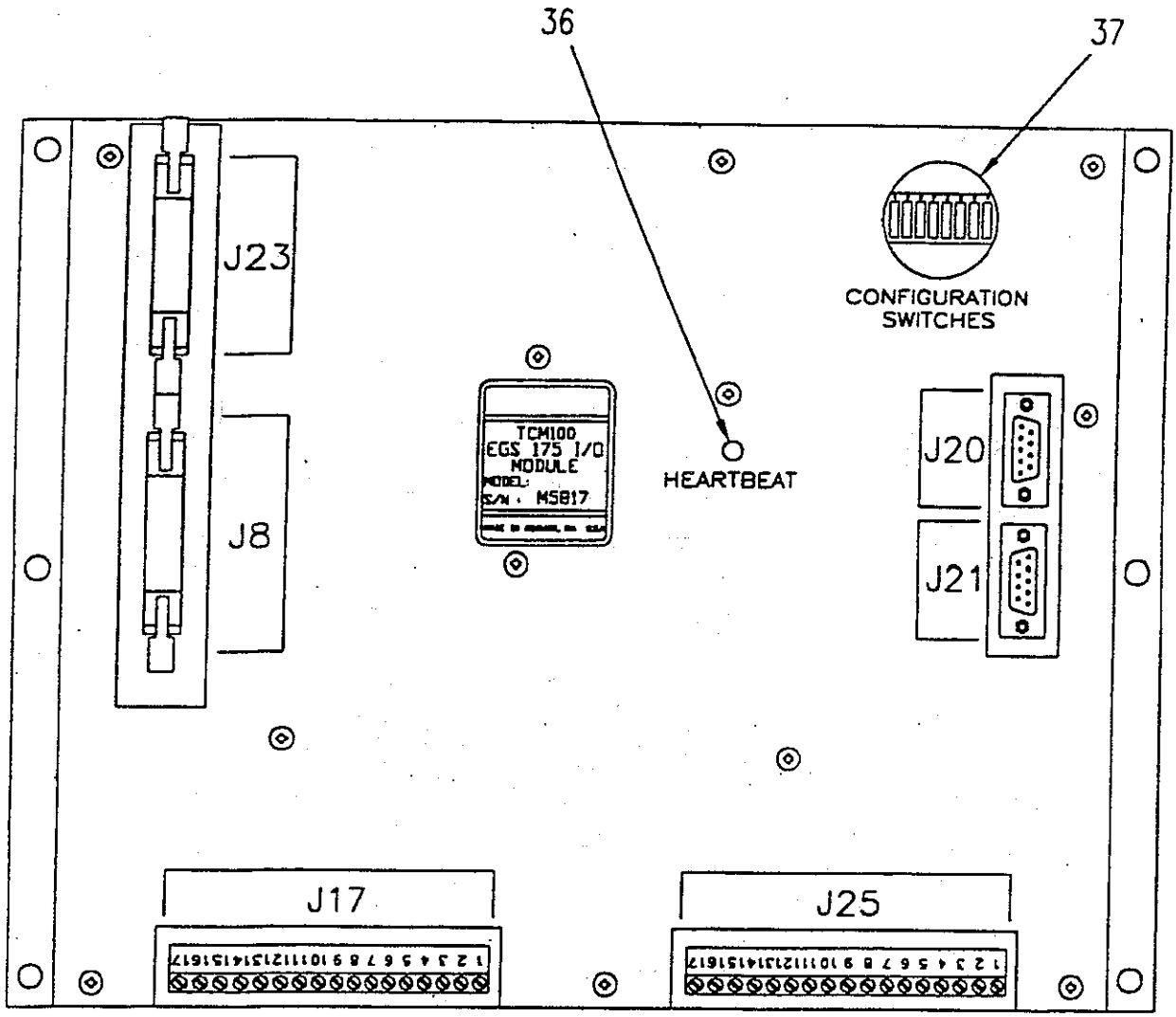


FIGURE 2-3. DIAGNOSTIC CONTROLS AND INDICATORS (SHEET 2 OF 2)

TABLE 2-4. DIAGNOSTIC CONTROLS AND INDICATORS

KEY	CONTROL OR INDICATOR	FUNCTION
DCS LOAD SHARING SYNCHRONIZER		
1	L1 indicator (green LED)	This indicator is lit when the load sharing control is making transition from zero power output up to a power output in a load sharing (paralleling) condition. Normally, this LED is lit only during the load sharing (paralleling) period.
2	L2 indicator (green LED)	This indicator is lit only when zero power from the generator set is reached before the breaker is opened. It indicates when the I/O interface module is calling for the generator to go to zero power output before the generator breaker is opened automatically by the I/O interface module.
3	REVERSE POWER (red LED)	This indicator is lit when a reverse power situation exists. The I/O interface module has been notified to remove the generator set from service (open the breaker).
4	GEN indicator (green LED)	This indicator is normally lit when the generator set is operating (engine is running). When lit, the LED indicates the module is receiving AC power from the generator.
5	BUS indicator (green LED)	This indicator is normally lit only when the generator set is running and the main breaker is closed. It is also lit when another generator set is connected to the main breaker and its breaker is closed. When lit, the LED indicates AC power is being received from the bus (the output of the generator set main breaker) into the module. The indicator is not lit if the bus has failed, and when this module is not being used.
6	SYNCH ENABLED indicator (green LED)	This indicator is lit only when the I/O interface module requests synchronizing the output power of the generator set with a second generator set and the paralleling cable has been connected between the two sets. In addition, the AC CIRCUIT INTERRUPT switch on the primary set has been previously moved to the CLOSED position. This indicator is lit only during the synchronizing period.
7	PARALLEL ENABLE indicator (green LED)	This indicator will be lit when the I/O interface module has closed the main breaker. That is, the I/O interface module has commanded the DCS load sharing synchronizer to close the connection with the paralleling cable and begin parallel operation of the two generator sets.
8	SYNCHRONIZED indicator (green LED)	This indicator will be lit when the generator is in synch with the bus. When this LED is lit, the DCS load sharing synchronizer has signaled the I/O interface module that paralleling may occur.
9	DC POWER indicator (green LED)	This indicator is normally lit only when the generator set is operating (engine is running). It is off at all other times. When lit, the LED indicates the internal DC supply of the module is operating (i.e., the module is receiving DC power from the generator set, and the module is properly converting the power into its own operating voltage(s).

TABLE 2-4. DIAGNOSTIC CONTROLS AND INDICATORS (continued)

KEY	CONTROL OR INDICATOR	FUNCTION
SPEED CONTROL UNIT		
10	OVERSPEED indicator (red LED)	This indicator is normally off, even when the generator set is operating. When the LED is lit, an engine overspeed condition has occurred (the flywheel RPM sensor has sent the speed control unit a value which is defined as out-of-tolerance). The indicator will remain lit until either of two events has occurred: (1) The OVERSPEED RESET pushbutton has been manually activated, or (2) the generator set (engine) has been stopped and the DC power is reset.
11	ACTUATOR indicator (green LED)	This indicator is normally lit when the electric actuator (on the injection fuel pump) has power applied to it. The LED will be lit when the engine is operating or when the engine is being cranked (started). If the indicator is off while the engine is operating, it can mean: (1) the electric actuator has failed, (2) the connection between the actuator and the module has failed, or (3) the module has malfunctioned or failed.
12	SPEED SENSOR indicator (green LED)	This indicator is normally lit when the engine is operating. The indicator lit/off function is directly related to the signal from the speed sensor connected to the flywheel. If the indicator is off, but the engine is operating, this indicates the engine RPM signal is not being received. This can be caused by sensor failure or by a failure in the connection to the sensor.
13	OVERSPEED RESET pushbutton	If the OVERSPEED indicator is lit and the engine has stopped, this switch may be used to attempt to reset the overspeed protection system. If the OVERSPEED indicator turns off when the switch is activated, the protection system is reset, and the engine may be restarted. (The conclusion is that no problem exists with engine speed.) If after restarting the OVERSPEED indicator comes on again and the engine stops, there is a problem with engine speed control.
14	OVERSPEED TEST pushbutton	This switch is used to test one of the protective systems of the generator set: engine overspeed protection. Pressing this switch while the engine is running at rated speed will activate the overspeed protection system, thereby stopping the engine.
15	DC POWER indicator (green LED)	This indicator is normally lit when the engine is operating. It indicates the internal DC power in the module is operating.
16	CRANK TERMINATION (green LED)	This indicator is normally lit when the engine is operating. When the engine is being started, the indicator will remain off until engine speed exceeds 900 RPM and the cranking relay returns to its normal (non-energized) state. If the indicator remains off and the engine starter continues operation, this is an indication of a failure in the starter assembly or of the cranking relay.
BACKPLANE MODULE		
17	LED 16 (red) indicator	(not assigned)
18	LED 15 (red) indicator	(not assigned)
19	LED 14 (red) indicator	Fault indication. If indicator is lit, indicates a fault has occurred. If off, indicates normal running condition.

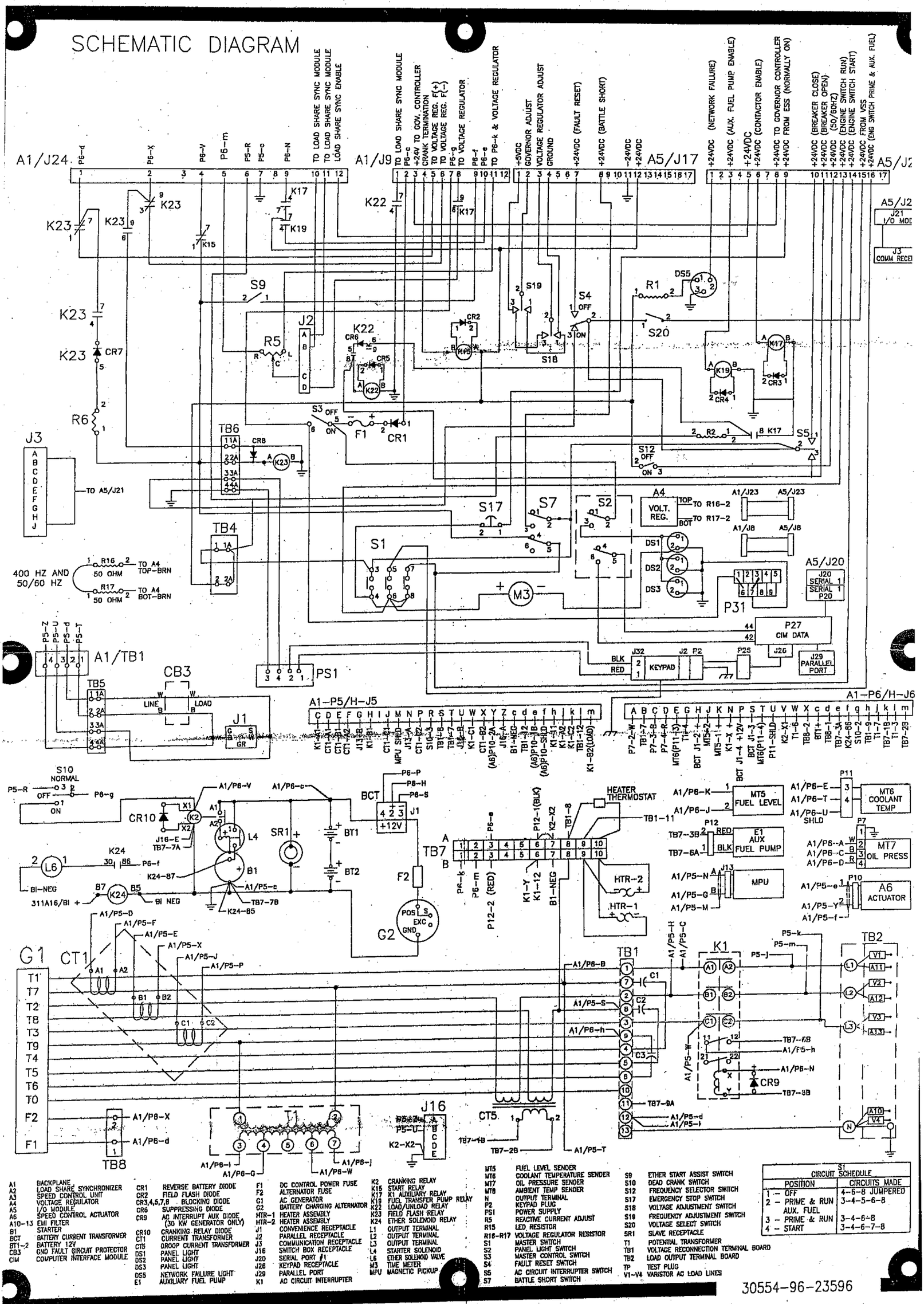
TABLE 2-4. DIAGNOSTIC CONTROLS AND INDICATORS (continued)

KEY	CONTROL OR INDICATOR	FUNCTION
BACKPLANE MODULE (continued)		
20	LED 13 (red) indicator	Short circuit indication. If indicator is lit, indicates a short circuit condition affecting generator set output has been detected.
21	LED 12 (green)	(not assigned)
22	LED 11 (green)	Remote display connection. Indicator blinks on and off when remote display is properly connected. If not lit, indicates no remote display connection has been made.
23	LED 10 (green)	Data validity from remote display. Indicator blinks on and off to indicate remote data is being received properly. If not lit, remote data is not being received properly. If not lit, can also indicate no remote display function has been connected.
24	LED 9 (green)	Status of the main generator power bus. If indicator is lit, the bus is energized (voltage is present), and voltage is available for paralleling operation. If not lit, indicates the generator set is operating in a stand-alone mode.
25	LED 8 (red)	(not assigned)
26	LED 7 (red)	Network failure. If indicator is lit, indicates the CIM is not communicating with the I/O interface module. If not lit, indicates the CIM is communicating properly.
27	LED 6 (red)	Emergency stop. If indicator is lit, indicates the EMERGENCY STOP switch has been activated. If not lit, indicates normal running condition.
28	LED 5 (red)	CMOS voltage. If indicator is lit, indicates voltage necessary for CMOS device operation is ~~too low~~ Sufficient. If not lit, CMOS device voltage source is ~~sufficient~~ Too Low.
29	LED 4 (green)	(not assigned)
30	LED 3 (green)	Heartbeat. If indicator is blinking on and off, indicates proper operation of this module. If not lit, indicates module has no power applied or has failed.
31	LED 2 (green)	(not assigned)
32	LED 1 (green)	If indicator is lit, fuel pump is operating. If not lit, fuel pump is not operating.
AUTOMATIC VOLTAGE REGULATOR		
33	AC SENSING (green LED)	This indicator is normally lit, indicating the AC sensor is sending the proper signal to this module.
34	DC SUPPLY indicator (green LED)	This indicator is normally lit, indicating that the module's internal DC supply is operating. The source for input power to this module is the AC output of the generator set. Therefore, the indicator will not be lit until the generator set is providing power output to a load.
35	FIELD VOLTAGE (green LED)	This indicator is normally lit. It indicates field voltage is present, which means the generator is developing AC power.

TABLE 2-4. DIAGNOSTIC CONTROLS AND INDICATORS (continued)

KEY	CONTROL OR INDICATOR	FUNCTION
I/O INTERFACE MODULE		
36	HEARTBEAT (green LED)	This indicator is normally blinking on and off when DC power has been applied to the module. It is also normally blinking when the generator set is operating (engine running) and the module is functioning properly. If the indicator is either steady-state lit or steady-state off, but the CIM has been turned on and the engine is operating, this is an indication that there is a problem in the I/O interface module.
37	DIP Switch Assembly (8 positions)	These switches define the configuration of the generator set for the CIM. The generator set configuration is defined in two ways: its output power (kW) rating and its frequency rating. These switches must be set to a specified configuration prior to the module's use in the generator set. Unless these switches are properly set (and remain so), the generator set can experience a malfunction. For the MEP-806B, all switches are set to OFF. For the MEP-816B, Switch 5 is set to ON and all the other switches to OFF. (Ref Figure 4-31)

SCHEMATIC DIAGRAM



A1	BACKPLANE	CR1	REVERSE BATTERY DIODE	F1	DC CONTROL POWER FUSE	K2	CRANKING RELAY	MT5	FUEL LEVEL SENDER
A2	LOAD SHARE SYNCHRONIZER	CR2	FIELD FLASH DIODE	F2	ALTERNATOR FUSE	K15	START RELAY	MT6	COOLANT TEMPERATURE SENDER
A3	SPEED CONTROL UNIT	CR3,4,5,7,8	BLOCKING DIODE	G1	AC GENERATOR	K17	K1 AUXILIARY RELAY	MT7	OIL PRESSURE SENDER
A4	VOLTAGE REGULATOR	CR6	SUPPRESSING DIODE	G2	BATTERY CHARGING ALTERNATOR	K19	FUEL TRANSFER PUMP RELAY	MT8	AMBIENT TEMP SENDER
A5	I/O MODULE	CR9	AC INTERRUPT AUX DIODE (30 KW GENERATOR ONLY)	HTR-1	HEATER ASSEMBLY	K22	LOAD/UNLOAD RELAY	N	OUTPUT TERMINAL
A6	SPEED CONTROL ACTUATOR	CR10	CRANKING RELAY DIODE	HTR-2	HEATER ASSEMBLY	K23	FIELD FLASH RELAY	P2	KEYPAD PLUG
A10-13	EMI FILTER	CT1	CURRENT TRANSFORMER	J1	CONVENIENCE RECEPTACLE	K24	ETHER SOLENOID RELAY	PS1	POWER SUPPLY
B1	STARTER	CT5	DROOP CURRENT TRANSFORMER	J2	PARALLEL RECEPTACLE	L1	OUTPUT TERMINAL	R5	REACTIVE CURRENT ADJUST
BCT	BATTERY CURRENT TRANSFORMER	DS1	PANEL LIGHT	J3	COMMUNICATION RECEPTACLE	L2	OUTPUT TERMINAL	R15	LED RESISTOR
BT1-2	BATTERY 12V	DS2	PANEL LIGHT	J16	SWITCH BOX RECEPTACLE	L3	OUTPUT TERMINAL	R16-R17	VOLTAGE REGULATOR RESISTOR
CB3	GND FAULT CIRCUIT PROTECTOR	DS3	PANEL LIGHT	J20	SERIAL PORT #1	L4	STARTER SOLENOID	S1	MASTER SWITCH
CIM	COMPUTER INTERFACE MODULE	DS5	NETWORK FAILURE LIGHT	J26	KEYPAD RECEPTACLE	L6	ETHER SOLENOID VALVE	S2	PANEL LIGHT SWITCH
		E1	AUXILIARY FUEL PUMP	J29	PARALLEL PORT	M3	TIME METER	S3	MASTER CONTROL SWITCH
				K1	AC CIRCUIT INTERRUPTER	MPU	MAGNETIC PICKUP	S4	FAULT RESET SWITCH
								S5	AC CIRCUIT INTERRUPTER SWITCH
								S7	BATTLE SHORT SWITCH
								S9	ETHER START ASSIST SWITCH
								S10	DEAD CRANK SWITCH
								S12	FREQUENCY SELECTOR SWITCH
								S17	EMERGENCY STOP SWITCH
								S18	VOLTAGE ADJUSTMENT SWITCH
								S19	FREQUENCY ADJUSTMENT SWITCH
								S20	VOLTAGE SELECT SWITCH
								SR1	SLAVE RECEPTACLE
								T1	POTENTIAL TRANSFORMER
								TB1	VOLTAGE RECONNECTION TERMINAL BOARD
								TB2	LOAD OUTPUT TERMINAL BOARD
								TP	TEST PLUG
								V1-V4	VARISTOR AC LOAD LINES

S1 CIRCUIT SCHEDULE

POSITION	CIRCUITS MADE
1 – OFF	4-6-8 JUMPERED
2 – PRIME & RUN AUX. FUEL	3-4-5-6-8
3 – PRIME & RUN	3-4-6-8
4 – START	3-4-6-7-8

30554-96-23596

WIRING DIAGRAM

A1	BACKPLANE
A2	LOAD SHARE SYNCHRONIZER
A3	SPEED CONTROL UNIT
A4	VOLTAGE REGULATOR
A5	I/O MODULE
A6	SPEED CONTROL ACTUATOR
A10–13	EMI FILTER
B1	STARTER
BCT	BATTERY CURRENT TRANSFORMER
BT1–2	BATTERY 12V
CB3	GND FAULT CIRCUIT PROTECTOR
CIM	COMPUTER INTERFACE MODULE
CR1	REVERSE BATTERY DIODE
CR2	FIELD FLASH DIODE
CR3,4,5,7,8	BLOCKING DIODE
CR6	SUPPRESSING DIODE
CR9	AC INTERRUPTER AUX DIODE (30 KW GENERATOR ONLY)
CR10	CRANKING RELAY DIODE
CT1	CURRENT TRANSFORMER
CT5	DROOP CURRENT TRANSFORMER
DS1	PANEL LIGHT
DS2	PANEL LIGHT
DS3	PANEL LIGHT
DS5	NETWORK FAILURE LIGHT
E1	AUXILIARY FUEL PUMP
F1	DC CONTROL POWER FUSE
F2	ALTERNATOR FUSE
G1	AC GENERATOR
G2	BATTERY CHARGING ALTERNATOR
HTR–1	HEATER ASSEMBLY
HTR–2	HEATER ASSEMBLY
J1	CONVENIENCE RECEPTACLE
J2	PARALLEL RECEPTACLE
J3	COMMUNICATION RECEPTACLE
J16	SWITCH BOX RECEPTACLE
J20	SERIAL PORT #1
J26	SERIAL PORT #2
J29	PARALLEL PORT
K1	AC CIRCUIT INTERRUPTER
K2	CRANKING RELAY
K15	START RELAY
K17	K1 AUXILIARY RELAY
K19	FUEL TRANSFER PUMP RELAY
K22	LOAD/UNLOAD RELAY
K23	FIELD FLASH RELAY
K24	ETHER SOLENOID RELAY
L1	OUTPUT TERMINAL
L2	OUTPUT TERMINAL
L3	OUTPUT TERMINAL
L4	STARTER SOLENOID
L6	ETHER SOLENOID VALVE
M3	TIME METER
MPU	MAGNETIC PICKUP
MT5	FUEL LEVEL SENDER
MT6	COOLANT TEMPERATURE SENDER
MT7	OIL PRESSURE SENDER
MT8	AMBIENT TEMP SENDER
N	OUTPUT TERMINAL
PS1	POWER SUPPLY
P20	SERIAL PORT #1
P27	CIM DATA
P32	KEYPAD CONNECTOR
R5	REACTIVE CURRENT ADJUST
R15	LED RESISTOR
R16–R17	VOLTAGE REGULATOR RESISTOR
S1	MASTER SWITCH
S2	PANEL LIGHT SWITCH
S3	MASTER CONTROL SWITCH
S4	FAULT RESET SWITCH
S5	AC CIRCUIT INTERRUPTER SWITCH
S7	BATTLE SHORT SWITCH
S9	ETHER START ASSIST SWITCH
S10	DEAD CRANK SWITCH
S12	FREQUENCY SELECTOR SWITCH
S17	EMERGENCY STOP SWITCH
S18	VOLTAGE ADJUSTMENT SWITCH
S19	FREQUENCY ADJUSTMENT SWITCH
S20	VOLTAGE SELECT SWITCH
SR1	SLAVE RECEPTACLE
T1	POTENTIAL TRANSFORMER
TB1	VOLTAGE RECONNECTION TERMINAL BOARD
TB2	LOAD OUTPUT TERMINAL BOARD
TP	TCST PLUG
V1–V4	VARISTOR AC LOAD LINES