CATERPILLAR®

FORM NO. SENR5203

FOR USE IN SERVICE MANUAL:
ELECTRIC SET GENERATORS,
SENR7958

Service Manual

SR4 Generator Mounted Control Panel For Spark Ignited (SI) Engines

4P4780

Important Safety Information

Most accidents involving product operation, maintenance and repair are caused by failure to observe basic safety rules or precautions. An accident can often be avoided by recognizing potentially hazardous situations before an accident occurs. A person must be alert to potential hazards. This person should also have the necessary training, skills and tools to perform these functions properly.

Improper operation, lubrication, maintenance or repair of this product can be dangerous and could result in injury or death.

Do not operate or perform any lubrication, maintenance or repair on this product, until you have read and understood the operation, lubrication, maintenance and repair information.

Safety precautions and warnings are provided in this manual and on the product. If these hazard warnings are not heeded, bodily injury or death could occur to you or other persons.

The hazards are identified by the "Safety Alert Symbol" and followed by a "Signal Word" such as "WARNING" as shown below.

⚠ WARNING

The meaning of this safety alert symbol is as follows:

Attention! Become Alert! Your Safety is Involved.

The message that appears under the warning, explaining the hazard, can be either written or pictorially presented.

Operations that may cause product damage are identified by NOTICE labels of the product and in this publication.

Caterpillar cannot anticipate every possible circumstance that might involve a potential hazard. The warnings in this publication and on the product are therefore not all inclusive. If a tool, procedure, work method or operating technique not specifically recommended by Caterpillar is used, you must satisfy yourself that it is safe for you and others. You should also ensure that the product will not be damaged or made unsafe by the operation, lubrication, maintenance or repair procedures you choose.

The information, specifications, and illustrations in this publication are on the basis of information available at the time it was written. The specifications, torques, pressures, measurements, adjustments, illustrations, and other items can change at any time. These changes can affect the service given to the product. Obtain the complete and most current information before starting any job. Caterpillar dealers have the most current information available. For a list of the most current publication form numbers available, see the Service Manual Contents Microfiche, REG1139F.

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SAFETY

⚠ WARNING

When servicing or repairing electric power generation equipment, do the following:

a. Make sure the unit is off–line (disconnected from utility and/or other generators power service), and either locked out or tagged "DO NOT OPERATE".

b. Make sure the generator engine is stopped.

c. Make sure all batteries are disconnected.

d. Make sure all capacitors are discharged.

When power generation equipment must be in operation to make tests and/or adjustments, high voltage and current are present. Make sure the testing equipment is designed for and correctly operated for the high voltage and current tests being made. Improper test equipment may fail and present a high voltage shock hazard to its user.

⚠ WARNING

Do not connect generator to a utility electrical distribution system, unless it is isolated from the system. Electrical feedback into the distribution system can occur and could cause personal injury or death.

Open and secure main distribution system switch or, if the connection is permanent, install a double throw transfer switch to prevent electrical feedback. Some generators are specifically approved by a utility to run in parallel with the distribution system and isolation may not be required. Always check with your utility as to the applicable circumstances.

SAFETY

⚠ WARNING

Improper performance of lubrication or maintenance procedures is dangerous and could result in injury or death. Read and understand the lubrication and maintenance procedures, recommended by Caterpillar, that are outlined in the OPERATION GUIDE and/or OWNER'S MANUAL for this product before performing any lubrication or maintenance.

Do not operate this product unless you have read and understood the instructions. Improper operation is dangerous and could result in injury or death.

The servicemen or mechanic may be unfamiliar with many of the components and systems of this product. This makes it important to use caution when performing service work. A knowledge of the system and/or components is important before the removal or disassembly of any component.

Because of the size of some components, the serviceman or mechanic should check the weights noted in this Manual. Use proper lifting procedures when removing any components.

Following is a list of basic precautions that should always be observed.

1. Read and understand all Warning plates and decals before operating, lubricating or repairing this product.
2. Make sure the work area around the product is made safe and be aware of hazardous conditions that may exist.
3. Always wear protective glasses and protective shoes when working. In particular, wear protective glasses when a hammer or sledge is used for pounding to make repairs. Use welders gloves, hood/goggles, apron and other protective clothing appropriate to the welding job being performed. Do not wear loose-fitting or torn clothing. Remove all rings from fingers when working on machinery.
4. If an engine must be started to make pressure or speed checks, be sure all guards and shields are installed. To help prevent an accident caused by parts in rotation, work carefully around machinery that has been put into operation.
5. If an engine has been running and the coolant is hot, loosen the filler cap slowly and let the pressure out of the cooling system, before any caps, plugs or lines are removed or disconnected.
6. Corrosion inhibitor contains alkali. Avoid contact with eyes. Avoid prolonged or repeated contact with skin. Do not take internally. In case of contact, immediately wash skin with soap and water. For eyes, flush with large amounts of water for at least 15 minutes. CALL PHYSICIAN. KEEP OUT OF REACH OF CHILDREN.
7. Do not smoke when an inspection of the battery electrolyte level is made. Never disconnect any charging unit circuit or battery circuit cable from the battery when the charging unit is operating. A spark can cause an explosion from the flammable vapor mixture of hydrogen and oxygen that is released from the electrolyte through the battery outlets. Do not let electrolyte solution make contact with skin or eyes. Electrolyte solution is an acid. In case of contact, immediately wash skin with soap and water. For eyes, flush with large amounts of water for at least 15 minutes. CALL PHYSICIAN. KEEP OUT OF REACH OF CHILDREN.
8. Disconnect battery and discharge any capacitors before starting any repair work. Hang "Do Not Operate" tag in the Operator's compartment or on the controls.
9. Do not work on anything that is supported only by lift jacks or a hoist. Always use blocks or proper stands to support the product before performing any service work.
10. Relieve all pressure in air, oil or water systems before any lines, fittings or related items are disconnected or removed. Be alert for possible pressure when disconnecting any device from a system that utilizes pressure. Do not check for pressure leaks with your hand. High pressure oil or fuel can pierce the skin.

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⚠ WARNING

11. Never bend a fuel injection line, or install a line which has been bent. Keep the fuel injection lines and connections clean. Be sure to install caps and covers anytime a line is removed or disconnected.

12. During service work, do not hit the fuel injection lines with wrenches or other tools. When lines are installed, use the correct torque to tighten connections and be sure all clamps and dampers are correctly installed.

13. Make sure all fuel injection lines and pressure oil lines have enough clearance to prevent contact with any other component. Do not put any fuel or oil lines close to a hot component.

14. To avoid back injury use a hoist or get help when lifting components which weigh 50 lb. (23 kg) or more. Make sure all chains, hooks, slings, etc., are in good condition and are of the correct capacity. Be sure hooks are positioned correctly. Lifting eyes are not to be side loaded during a lifting operation.

15. To avoid burns, be alert for hot parts on products which have just been stopped and hot fluids in lines, tubes and compartments.

16. Be careful when removing cover plates. Gradually back off the last two bolts or nuts located at opposite ends of the cover or device and pry cover loose to relieve any spring or other pressure, before removing them completely.

17. Be careful when removing filler caps, breathers and plugs on the product. Hold a rag over the cap or plug to prevent being sprayed or splashed by liquids under pressure. The danger is even greater if the product has recently been stopped because fluids can be hot.

18. Always use tools that are in good condition and be sure you understand how to use them before performing any service work. Use only Caterpillar replacement parts.

19. Reinstall all fasteners with same part number. Do not use a lesser quality fastener if replacements are necessary.

20. Repairs which require welding should be performed only with the benefit of the appropriate reference information and by personnel adequately trained and knowledgeable in welding procedures. Make reference to "Techniques of Structural Repair Course" form number JEG03719. Determine type of metal being welded and select correct welding procedure and electrodes, rods or wire to provide a weld metal strength equivalent at least to that of parent metal.

21. Before doing electrical work, disconnect battery. Do not damage wiring during removal operations. Reinstall the wiring so it is not damaged nor will it be damaged in operation by contacting sharp corners, or by rubbing against some object or hot surface. Do not connect wiring to a line containing fluid.

22. Be sure all protective devices including guards and shields are properly installed and functioning correctly before starting a repair. If a guard or shield must be removed to perform the repair work, use extra caution. After the repair is completed, reinstall any guard or shield that was removed.

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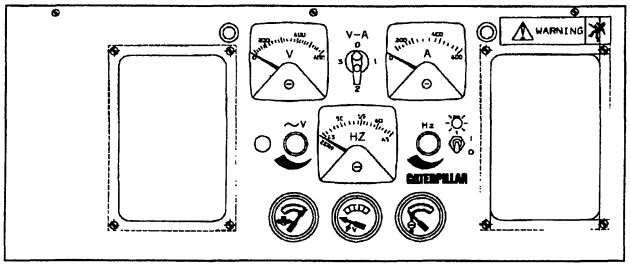
Identification



Control Panel

The control panel is located on top of the generator regulator housing.

The control panel has a fourteen character model number located on the nameplate. The nameplate is inside the panel. The model number of the control panel is based on panel options and generator ratings. The model number is defined further by the following charts.

MODEL SB3CA13AASDPV1

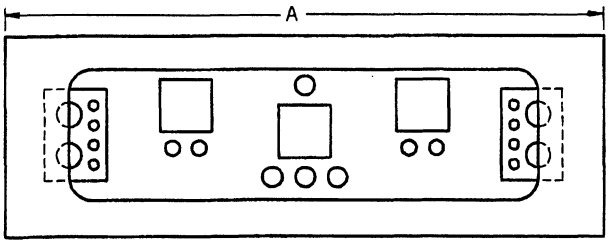
FIRST CHARACTER — TENTH CHARACTER

Sample Model Number

1. An "S" as the first character of the model number indicates that the control panel is for top mounting on the SR–4 generator.

2. The second character of the model number indicates the generator frame size and panel type. The frame size determines the physical dimensions of the control panel.

SECOND CHARACTER					
	PANEL TYPE	GENERATOR FRAME SIZE	PANEL DIMENSIONS		
			A	B	C
2	STANDARD	440/580	698.5	304.8	304.8
2	STANDARD	680/800	698.5	304.8	304.8
3	DUSTPROOF	440/580	714.4	338.1	352.4
3	DUSTPROOF	680/800	714.4	338.1	352.4



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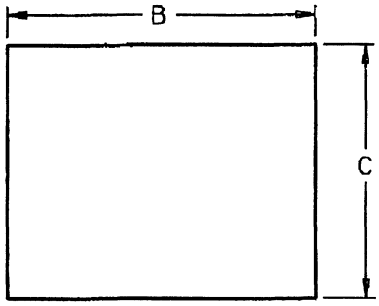

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3. The third character of the model number specifies the voltmeter.

THIRD CHARACTER		
	AC VOLTMETER	
	QTY	SCALE
2	1	0 – 300 VOLTS
3	1	0 – 600 VOLTS
4	1	0 – 750 VOLTS

4. The fourth character of the model number specifies the ammeter and current transformers, based on generator output voltage and kW.

FOURTH CHARACTER											
	GENERATOR EKW RATING AT–VOLTAGES (L–L, RMS):										
	200 VAC	208 VAC	220 VAC	240 VAC	300 VAC	380 VAC	400 VAC	416 VAC	440 VAC	480 VAC	600 VAC
C	20EKW	25EKW	25EKW	25EKW	35EKW	45EKW	45EKW	50EKW	50EKW	55EKW	70EKW
D	35	35	35	40	50	65	70	75	75	85	105
E	45	50	50	55	70	90	95	100	105	115	140
F	70	75	75	85	105	135	140	150	155	170	215
G	95	100	105	115	140	180	190	200	210	230	285
H	140	150	155	170	215	270	285	300	315	345	430
J	190	200	210	230	285	365	385	400	420	460	575
K	240	250	265	285	360	455	480	500	530	575	720
L	285	300	315	345	430	545	575	600	635	690	865
M	360	375	395	430	540	685	720	750	795	865	1080
N	480	500	530	575	720	915	960	1000	1060	1155	1445
P	600	625	660	720	900	1145	1205	1250	1325	1445	1805
R	720	750	795	865	1080	1370	1445	1500	1590	1735	2165
S	960	100	1060	1155	1445	1830	1925	2005	2120	2310	2890

FOURTH CHARACTER					
	AMMETER (TRANSFORMER RATED)			CURRENT TRANSFORMERS	
				ROUND	SQUARE
	QTY	SCALE	QTY	RATIO	RATIO
C	1	0 – 100 AMPS	3	100:5	—
D	1	0 – 150 AMPS	3	150:5	—
E	1	0 – 200 AMPS	3	200:5	—
F	1	0 – 300 AMPS	3	300:5	—
G	1	0 – 400 AMPS	3	400:5	—
H	1	0 – 600 AMPS	3	600:5	—
J	1	0 – 800 AMPS	3	800:5	800:5
K	1	0 – 1000 AMPS	3	1000:5	1000:5
L	1	0 – 1200 AMPS	3	1200:5	1200:5
M	1	0 – 1500 AMPS	3	1500:5	1500:5
N	1	0 – 2000 AMPS	3	2000:5	2000:5
P	1	0 – 2500 AMPS	3	2500:5	2500:5
R	1	0 – 3000 AMPS	3	3000:5	3000:5
S	1	0 – 4000 AMPS	3	4000:5	4000:5

NOTE: Square current transformers to be supplied if fifth character of control panel model number is D through G (3412 and 3500 package generator sets). Round current transformer to be supplied with all other engine sales models.

5. The fifth character of the model number specifies the package generator set on which the panel will be installed.

FIFTH CHARACTER	
	PACKAGE GENERATOR SET
A	3306
B	3406
C	3408
D	3412
E	3508
F	3512
G	3516

6. The sixth character of the model number specifies the type of engine control, cycle crank and cooldown timer options, if required.

SIXTH CHARACTER			
	GOVERNOR OPTION	ENGINE CONTROL OPTIONS	
		CYCLE CRANK TIMER	COOLDOWN TIMER
M	MANUAL	NOT COMPATIBLE	NOT COMPATIBLE
1	AUTOMATIC (SINGLE CRANK)	NOT REQUIRED	NOT REQUIRED
2	AUTOMATIC (W/CYCLE CRANK)	REQUIRED	NOT REQUIRED
3	AUTOMATIC (W/COOLDOWN)	NOT REQUIRED	REQUIRED
4	AUTOMATIC (W/CYCLE CRANK AND COOLDOWN)	REQUIRED	REQUIRED

7. The seventh character of the model number specifies the control panel mounted governor options, if required.

SEVENTH CHARACTER					
	GOVERNOR OPTION	GOVERNOR TYPE	QTY	GOVERNOR SWITCH GP.	GOVERNOR GP–ELECTRONIC
X	NONE	2301A LOAD SHARE	1	NOT REQUIRED	NOT REQUIRED
1	GOVERNOR SWITCH	PSG	1	REQUIRED	NOT REQUIRED
2	2301 GOVERNOR (W/PRE–REGULATOR	2301 SPEED SENSING	1	NOT REQUIRED	REQUIRED
3	CAT DIGITAL ELECTRONIC SI FUEL SYSTEM	SPEED SENSING	1	NOT REQUIRED	REQUIRED
4	1724/8290 GOVERNOR	ELECTRONIC SPEED SENSING	1	NOT REQUIRED	REQUIRED

NOTE: Above characters 3 and 4 are not compatible if the control panel model number eighth character is L or R.

8. The eighth character of the model number specifies either the alarm module, synchronizing light module or synchronizing light module with generator reverse power protection option, if required.

EIGHTH CHARACTER	
	MODULE TYPE
X	COVER PLATE
A	ALARM (NFPA–99)
B	ALARM (NFPA–110)
L	SYNC. LIGHTS
R	SYNC. LIGHTS WITH REVERSE POWER RELAY

NOTE: Reverse power relay shall be set at approximately 15% of generator rating.

9. The ninth character of the model number specifies the auxiliary relay option, if required.

NINTH CHARACTER	
	MODULE GROUP – RELAY
X	NOT REQUIRED
A	REQUIRED

NOTE: The auxiliary relay is not available if the sixth character of the control panel model number is M (manual start/stop control).

10. The tenth character of the model number specifies the SI Engine Control Shutdown Option.

TENTH CHARACTER		
	QTY	COMPONENT
X	1	PLUG BUTTON
S	1	SI ENGINE CONTROL SHUTDOWN OPTION

11. The eleventh character of the model number specifies the DC voltmeter option, if required.

ELEVENTH CHARACTER		
	QTY	COMPONENT
X	1	PLUG BUTTON
S	1	DC VOLTMETER

12. The twelfth character of the model number specifies the optional panel illumination light group, if required.

TWELFTH CHARACTER		
	QTY	COMPONENT
	1	PLUG BUTTON
X	2	PLUG BUTTON
P	1	PANEL LIGHT GROUP

13. The thirteenth character of the model number is for future use.

14. The fourteenth character of the model number specifies the change level of the chart to which the control panel was built.

Abbreviations

AM	Ammeter
ADS	Engine Combustion Air Damper Position Switch
ADT	Arming Delay Timer
ALM	Alarm Module
ALS	Alarm Silence Push Button
ALT	Alternator
AR	Arming Relay
ASV	Air Start Solenoid Valve
AUX	Auxiliary Relay (Crank Termination)
AVS	Ammeter Voltmeter Phase Selector Switch
AWG	American Wire Gauge
BATT	Battery
BCF	Battery Charger Failure Switch
BCL	Battery Charger Failure Lamp
C	Common
CB	Circuit Breaker
CCM	Cycle Crank Module
CDM	Engine Cooldown Timer Module
CT	Current Transformer
CTR	Crank Termination Relay
D	Diode
DCV	DC Voltmeter
ECS	Engine Control Switch
EFL	Engine Failure Light
EG	Electronic Governor
EGA	Electronic Governor Actuator
ENFR	Engine Failure Relay
ESPB	Emergency Stop Push Button
ESS	Electronic Speed Switch
F	Fuse
FCR	Fuel Control Relay
FM	Frequency Meter
FMR	Frequency Meter Resistor
GEN	Generator
GS	Governor Switch
GSM	Governor Synchronizing Motor
GSOV	Gas Shut-Off Valve
HWTAS	High Water Temperature Alarm Switch
IC	Remote Start/Stop Initiate Contact
L	Load Leads
LOLAS	Low Oil Level Alarm Switch
LOPAS	Low Oil Pressure Alarm Switch
LTS	Lamp Test Switch
LWLAS	Low Water Level Alarm Switch
LWTAS	Low Water Temperature Alarm Switch
LWTL	Low Water Temperature Light
MAN	Manual
MCB	Main Circuit Breaker
MPU	Magnetic Speed Pickup
NC	Normally Closed
NO	Normally Open
OCL	Overcrank Light
OCR	Overcrank Relay
OCT	Overcrank Timer
OP	Oil Pressure
OPG	Oil Pressure Gage
OPL	Oil Pressure Light
OPR	Oil Pressure Relay
OPS	Oil Pressure Switch
OSL	Overspeed Light
OSR	Overspeed Relay
PIL	Panel Illumination Light
PLS	Panel Light Switch
POT	Potentiometer
PR	Pre-Regulator
PS	Pinion Solenoid
PWM	Analog To PWM Converter
RAN	Remote Annuciator
RPL	Reverse Power Light
RPR	Reverse Power Relay
RPSR	Reverse Power Slave Relay
RR	Run Relay
SBCT	Series Boost Current Transformer
SBM	Series Boost Module
SEC	Second
SESL	SI Engine Control Shutdown Light
SHTC	Circuit Breaker Shunt Trip Coil
SIEC	SI Engine Control
SIG	Signal
SL	Synchronizing Light
SLM	Synchronizing Light Module
SLR	Synchronizing Light Resistor
SM	Starting Motor
SMMS	Starting Motor Magnetic Switch
SMR	Starting Motor Relay
SP	Speed Adjust Potentiometer
SR	Slave Relay
SS	Synchronizing Switch
T	Generator Line Leads
TD	Time Delay Relay
TSC	Transfer Switch Position Indicating Contact
VAR	Voltage Adjust Rheostat
VM	AC Voltmeter
VR	Voltage Regulator
WT	Water Temperature
WTG	Water Temperature Gage
WTL	Water Temperature Light
WTR	Water Temperature Relay
WTS	Water Temperature Switch
WTSU	Water Temperature Sending Unit
XDUCER	Transducer
Z	Zener Diode

Symbols

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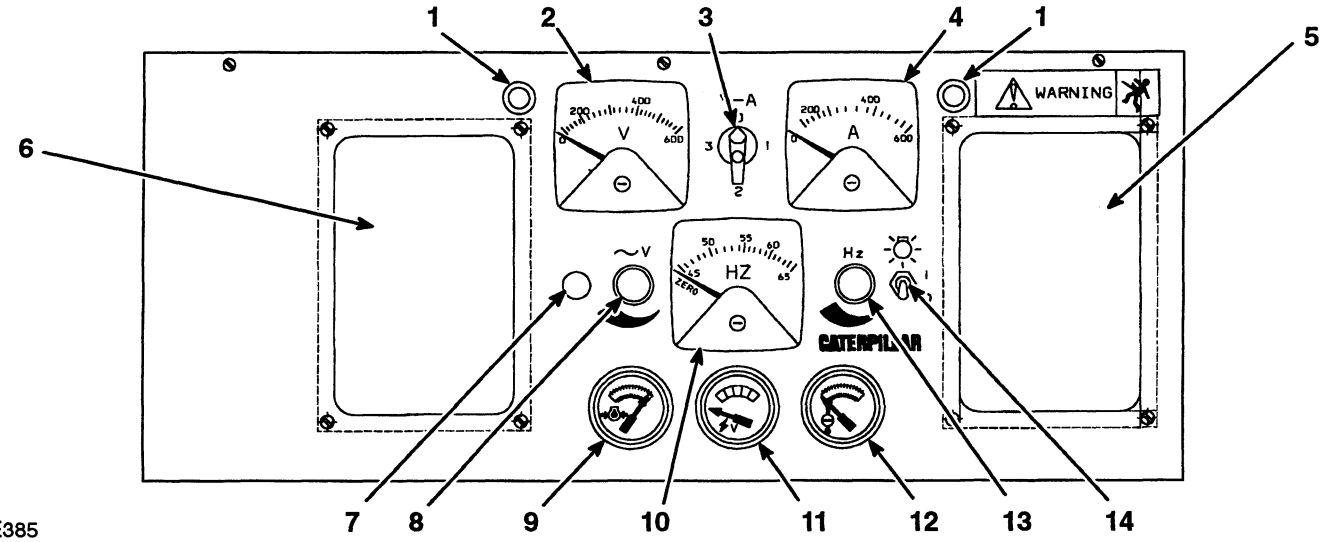
Location Of Components

NOTE: For schematics and wiring diagrams, refer to the Schematics And Wiring Diagrams section in this manual.

NOTE: For specifications on components located on the engine, refer to the Engine Service Manual.



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Control Panel
(1) Panel light (PL). (2) AC voltmeter (ACV). (3) Ammeter voltmeter phase selector switch (AVS). (4) AC ammeter (ACA). (5) Optional modules. (6) Start/Stop modules. (7) SI Engine control shutdown light (SESL). (8) Voltage adjust rheostat (VAR). (9) Oil pressure gauge (OPG). (10) Frequency meter (FM). (11) DC voltmeter (DCV). (12) Water temperature gauge (WTG). (13) Governor switch (GS) or Speed adjustment potentiometer (SP). (14) Panel light switch (PLS).

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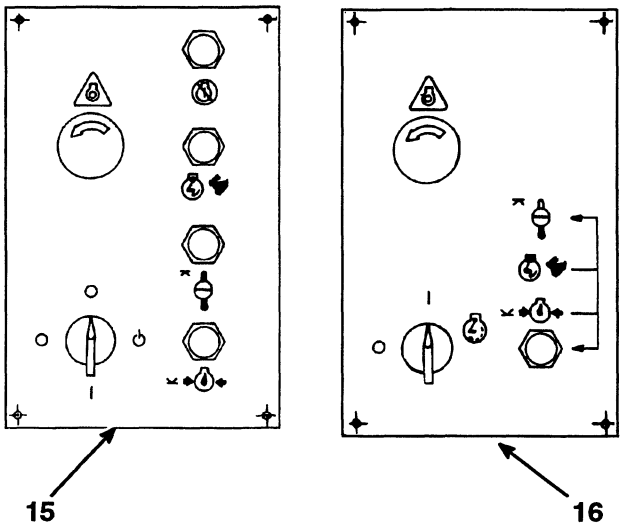
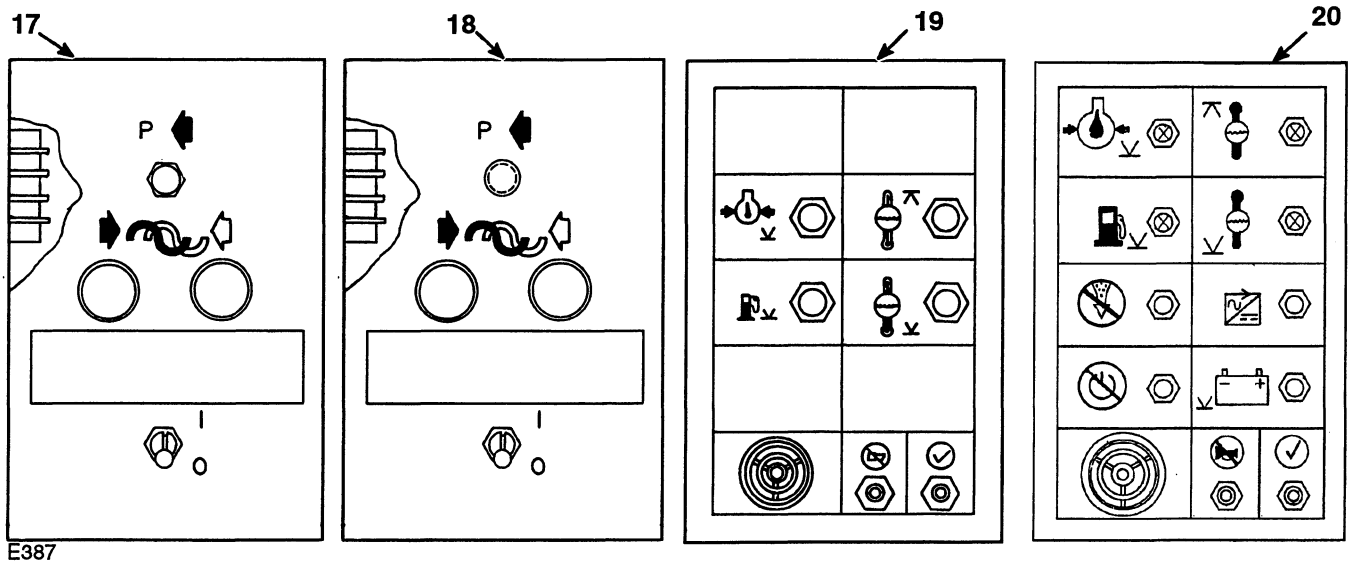
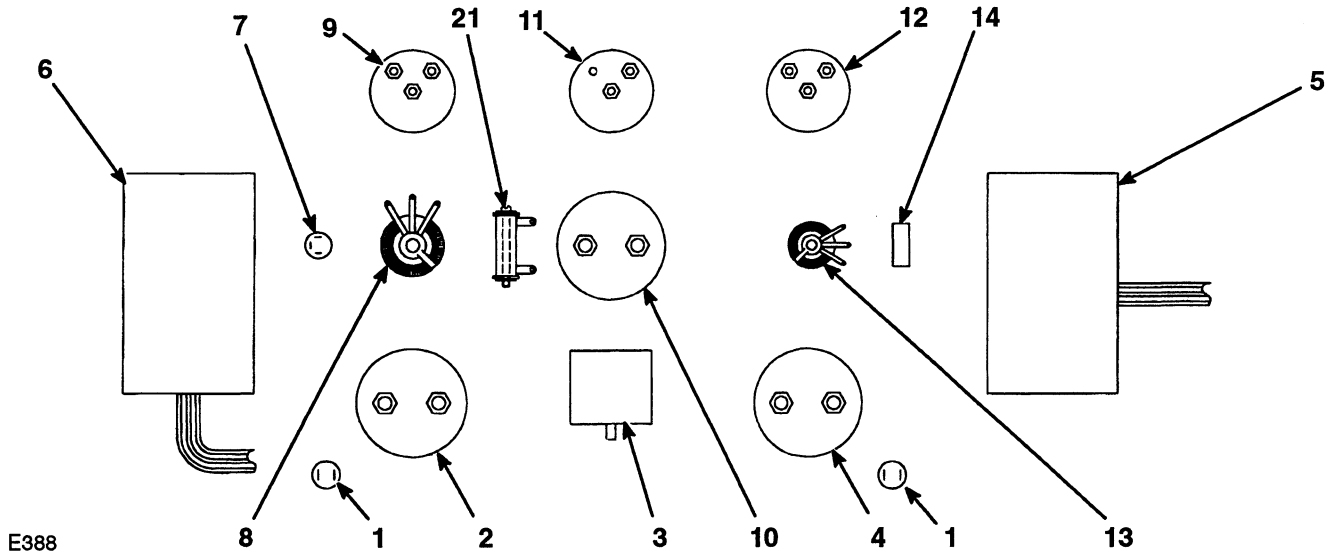


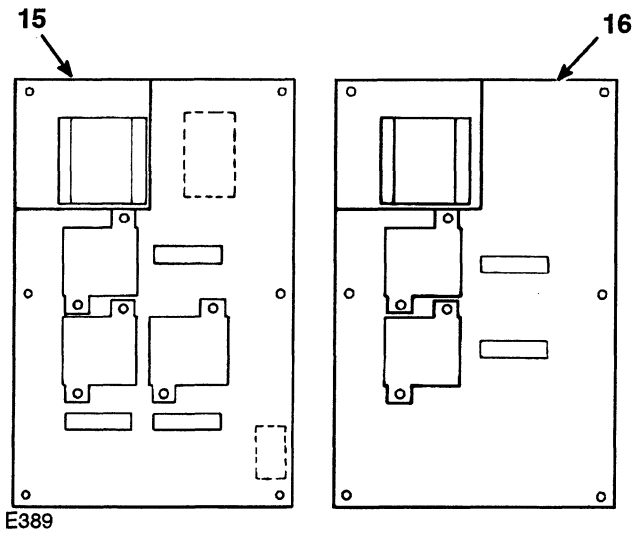
Start/Stop Modules
(15) Automatic Start/Stop module. (16) Manual Start/Stop module.



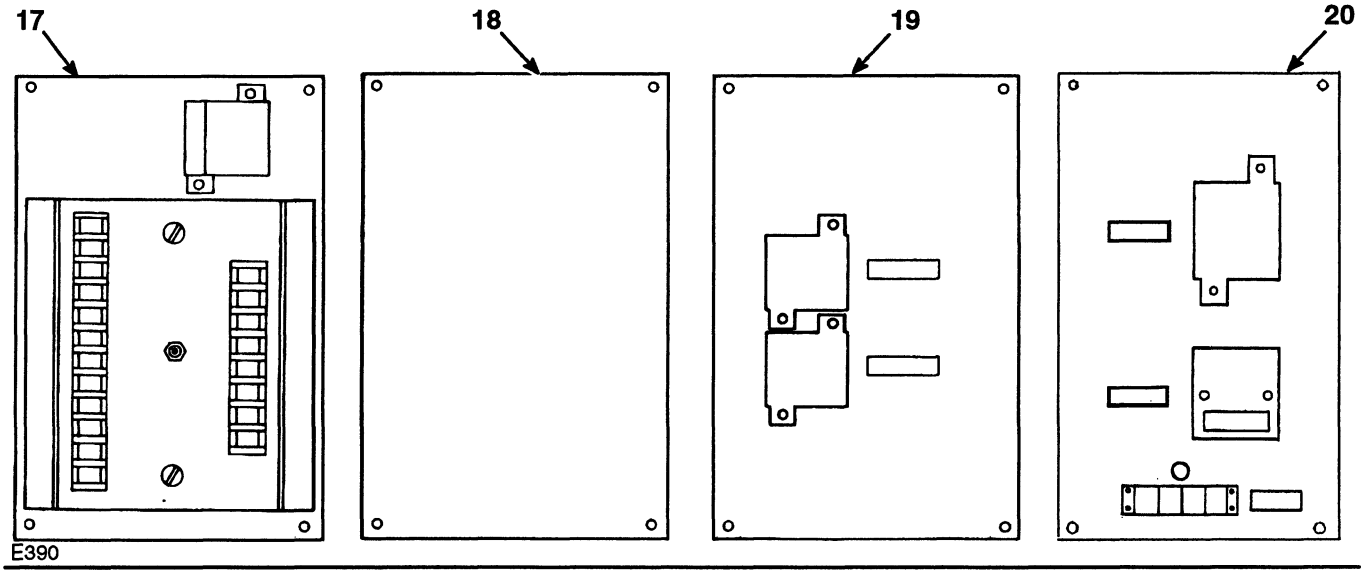
Optional Modules
(17) Synchronizing lights module (with reverse power relay). (18) Synchronizing lights module. (19) Alarm module, NFPA 99. (20) Alarm module, NFPA 110.



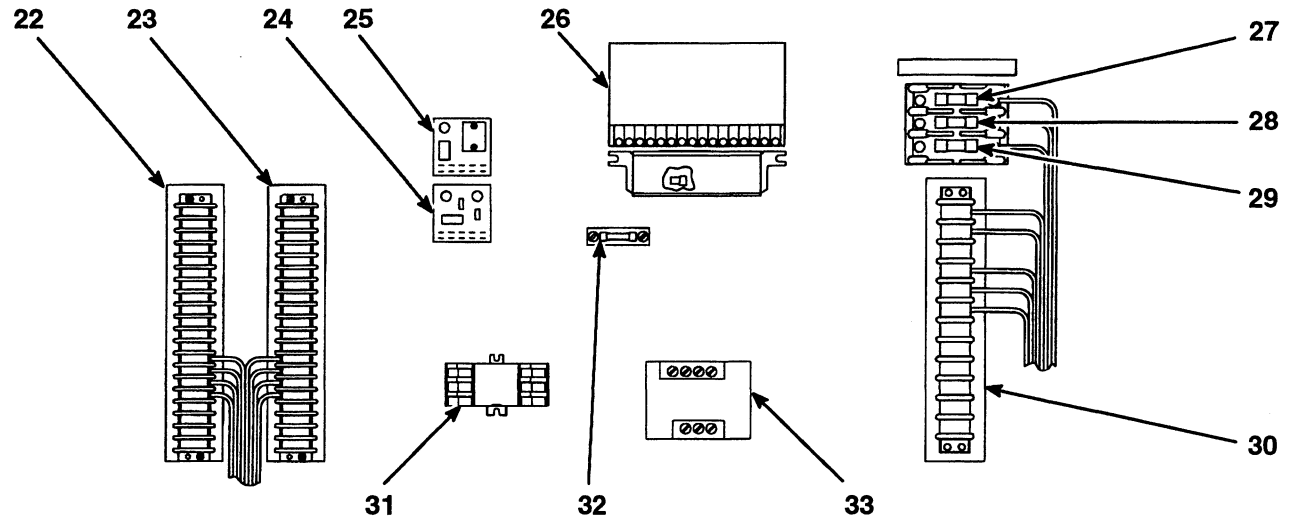
Control Panel Door (Rear View)
(1) Panel light (PL). (2) AC voltmeter (ACV). (3) Ammeter voltmeter phase selector switch (AVS). (4) AC ammeter (ACA). (5) Optional modules. (6) Start/Stop modules. (7) SI Engine control shutdown light (SESL). (8) Voltage adjust rheostat (VAR). (9) Oil pressure gauge (OPG). (10) Frequency meter (FM). (11) DC voltmeter (DCV). (12) Water temperature gauge (WTG). (13) Governor switch (GS) or Speed adjustment potentiometer (SP). (14) Panel light switch (PLS). (21) Frequency meter resistor (FMR).



Start/Stop Modules (Rear View)
(15) Automatic Start/Stop module. (16) Manual Start/Stop module.



Optional Modules (Rear View)
(17) Synchronizing lights module (with reverse power relay). (18) Synchronizing lights module. (19) Alarm module, NFPA 99. (20) Alarm module, NFPA 110.



Subpan
(22) Terminal board A (TBA). (23) Terminal board B (TBB). (24) Cycle crank module (CCM). (25) Cooldown module (CDM). (26) Electronic governor (EG). (27) Fuse 1 (F1). (28) Fuse 2 (F2). (29) Fuse 3 (F3). (30) Terminal board C (TBC). (31) Auxiliary relay (AUX). (32) Fuse 9 (F9). (33) Pulse width modulated speed signal converter (PWM).

Standard Components

For abbreviations list, and schematics and wiring diagrams refer to the section Schematic And Wiring Diagrams in this manual.

Ammeter–Voltmeter Phase Selector Switch

The ammeter–voltmeter phase selector (AVS) switch has four positions. Positions 1, 2 and 3 allows the operator to check generator output current and voltage for each of the phases 1, 2 and 3 respectively. AC current and AC voltage are checked on the AC ammeter (ACA) and AC voltmeter (ACV) respectively. There is no reading when the AVS switch is in position 0.

AC Ammeter

The AC ammeter (ACA) gives an indication, in amperes, of the current from each phase of the generator to the load. The AVS connects the ammeter to the current transformers (CT1, CT2 or CT3) on phases (T1, T2 or T3) respectively. The CT's transform the actual line current, in its respective phase lead, to a level (approximately 0 to 5 amperes) within the input range of the ammeter. The ammeter is calibrated to give an indication of the actual current flow in one phase of the generator.

AC Voltmeter

AC voltmeter (ACV) shows the potential difference (voltage) between phases T1–T2, T2–T3 or T3–T1 at positions 1, 2 or 3 respectively of the AVS.

Frequency Meter

The frequency meter (FM) shows the frequency in hertz (cycles per second) of the electricity made when the generator set is in operation. There is a direct relation between the frequency of the generator and the rpm of the engine, as shown in the following formula:

$$\text{freq (hertz)} = \frac{\text{number of generator poles x engine rpm}}{120}$$

Voltage Adjustment Rheostat

Voltage adjust rheostat (VAR) is used to adjust the voltage output of the generator. This rheostat takes the place of the voltage level rheostat located on the generator voltage regulator assembly.

NOTE: On generators equipped with a generator mounted control panel, the jumper wire on the regulator terminals four and terminal seven must be removed to allow proper operation with the panel mounted rheostat.

REFERENCE: Form No. SENR7968, SR–4 Generator; Operation Of Generator; Regulator Adjustment.

Oil Pressure Gauge

Oil pressure gauge (OPG) shows engine lubrication pressure in both kPa and psi. As soon as the engine starts and switch ESS (CT) closes, the oil pressure gauge is connected to battery voltage. There is a relation between the current flow in this circuit and the engine oil pressure read on the gauge. The oil pressure sending unit (OPSU) controls the current flow by a change in resistance according to the change in engine oil pressure.

Water Temperature Gauge

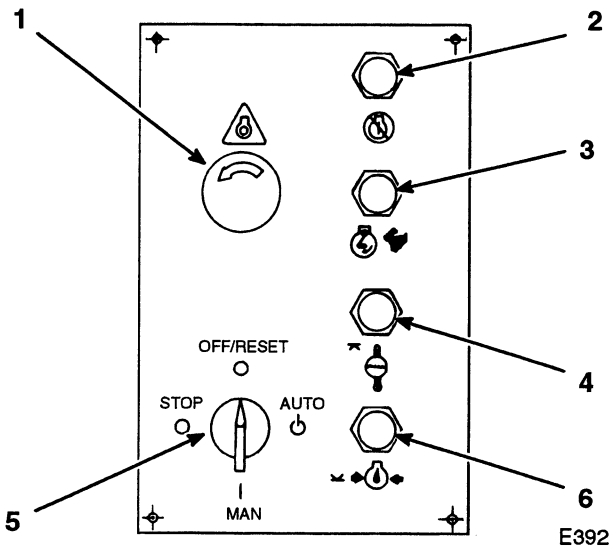
Water temperature gauge (WTG) shows the engine coolant temperature in both centigrade (°C) and Fahrenheit (°F). As soon as the engine starts and switch ESS (CT) closes, the water temperature gauge is connected to battery voltage. There is a relation between the current flow in this circuit and the coolant temperature read on the gauge. The water temperature sending unit (WTSU) controls the current flow by a change in resistance according to the change in coolant temperature.

Optional Components

For abbreviations list, and schematics and wiring diagrams refer to the section Schematic And Wiring Diagrams in this manual.

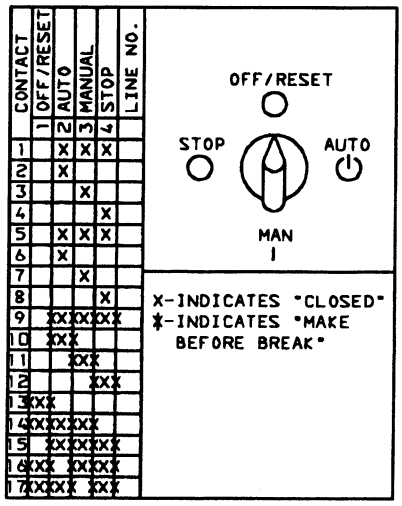
Automatic Start/Stop Module

This start/stop module has an engine control switch (ECS); an emergency stop pushbutton (ESPB) and four fault light indicators (OCL, OSL ,WTL and OPL).



(1) Emergency stop pushbutton (ESPB). (2) Overcrank light (OCL). (3) Overspeed light (OSL). (4) Water temperature light (WTL). (5) Engine control switch (ECS). (6) Low oil pressure light (OPL).

Engine Control Switch



Engine Control Switch (ECS)

The engine control switch can be turned to four positions:

STOP position – When turned to this position from the AUTO or MAN positions, the contacts (9 and 10) (line 27) and (9 and 11) (line 26) open. When open the circuit to the run relay (RR) (line 25) is opened, this de–energizes RR and shuts down the engine. The ECS (5) also closes contacts (5 and 8) (line 29). This will keep battery (B+) to fault relays and fault lights that may have energized under a fault shut down condition. The engine control switch should be kept in the STOP position while a fault is being corrected.

OFF/RESET position – If a fault occurs, the engine will automatically shut down and light the correct shut down fault light. After the fault is corrected, the ECS (5) is turned to the OFF/RESET position to reset the fault relay and turn off the fault light. Power is still available to panel illumination lights and the fault lamp test circuit. This position can also be used for normal shutdown of the engine.

AUTO position – For standby application, the ECS (5) is turned to the AUTO position. In this position, the engine starts when a remote initiating contact (IC) (line 28) closes. This signals for an automatic start. When the IC contacts open, the engine will shut down, or if equipped with an optional cooldown timer the engine will run for the timer period then shut down.

MAN position – This position starts the engine. If a fault should occur, the panel will automatically shut the engine down and indicate the fault.

Emergency Stop Push Button

This button is red in color. It is used to shutdown the engine in an emergency. If ESPB (1) is used, overspeed light (3) will light. OSL (3) and any other fault lights cannot be reset by way of the engine control switch while ESPB (1) is pushed in. After ESPB (1) is pushed in, it will remain pushed in until reset.

⚠ WARNING

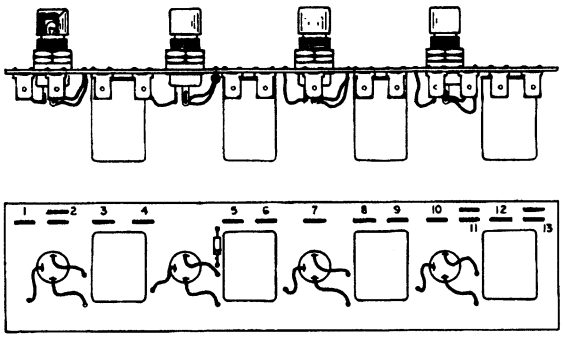
To prevent personal injury due to accidental starting of the engine, disconnect the batteries before doing maintenance or repair work.

To reset ESPB (1), rotate the knob in the direction shown on ESPB (1). The button will then move out from the panel.

NOTE: Before starting, check ESPB (1) mounted on the engine junction box. It has to be in the reset position also.

NOTE: The ESPB should not be used for normal shut downs.

Four Light Fault Board



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Four Light Fault Board

There are four fault indicator lights and relays mounted on a printed circuit board assembly. This board is mounted in the automatic start/stop control module. If the engine should overcrank, overspeed, have a coolant temperature above the upper limit or have oil pressure below the low limit, one of the four lights will light. At the same time, the engine will be signaled to shutdown.

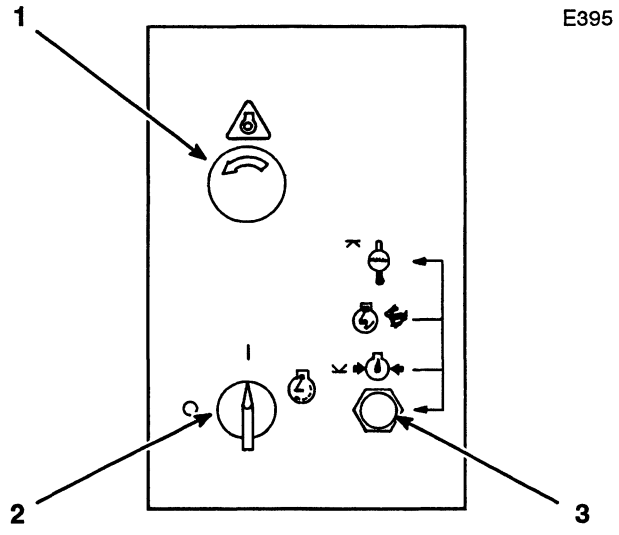
The light(s) remains lit with the ECS in the STOP position. It also remains lit and cannot be reset if the emergency stop push button (ESPB) is pushed in.

To reset the fault light(s), turn the ECS to the OFF/RESET position.

NOTE: If the fault is due to overspeed, the air shutoff solenoid (on the engine) and the speed switch (in the junction box) must be reset before starting the engine.

Each fault light indicator is a combination light and test button. A particular fault lamp can be tested by pushing in on the indicator light.

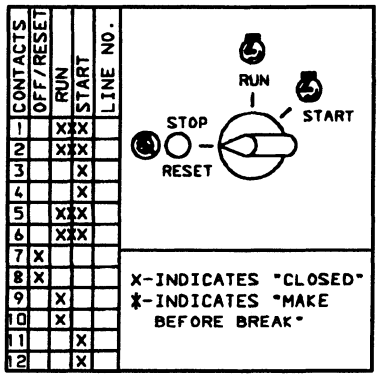
Manual Start/Stop Module



(1) Emergency stop pushbutton (ESPB). (2) Engine control switch (ECS). (3) Engine failure light (EFL).

The manual start/stop module has an emergency stop pushbutton (1), an engine control switch (2) and an engine failure light (3).

Engine Control Switch



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Engine Control Switch (ECS)

The ECS (2) can be turned to three positions:

START position – This position is used to crank the engine. As soon as the engine starts and oil pressure is seen on the gauge, the ECS (2) is released and a spring returns the switch from the START to the RUN position.

NOTE: The ECS (2) should be held in the start position until oil pressure is enough to de–arm the oil pressure failure circuit. Even though the ECS (2) is held in the START position, crank termination will automatically occur when the engines reaches 400 rpm.

RUN position – This position is for normal operation after crank termination. In this position, the engine fault circuits are armed. If a fault occurs and the engine shuts down, the ECS (2) should be left in the RUN position until the fault is corrected.

STOP/RESET position – Under normal operation, this ECS (2) position is used to shut down the engine. When the engine shuts down due to a fault, the ECS (2) is turned to this position to reset the engine failure light (EFL) and permit an engine restart. In all positions, there is power to test the EFL and turn on the optional panel illumination lights.

Emergency Stop Push Button

This button is red in color. It is used to shutdown the engine in an emergency.

⚠ WARNING

To prevent personal injury due to accidental starting of the engine, disconnect the batteries before doing maintenance or repair work.

To reset the ESPB, rotate the knob in the direction shown on the ESPB. The button will then move out from the panel.

NOTE: Before starting, check the ESPB mounted on the engine junction box. It has to be in the reset position. When ESPB was used to shut down the engine, the air shutoff has to be reset.

NOTE: The ESPB should not be used for normal shut downs.

Engine Failure Light

In the manual start/stop module there is only one engine failure light (EFL) indicator. It will light for high water temperature, overspeed and low oil pressure. At the same time, the engine will shut down.

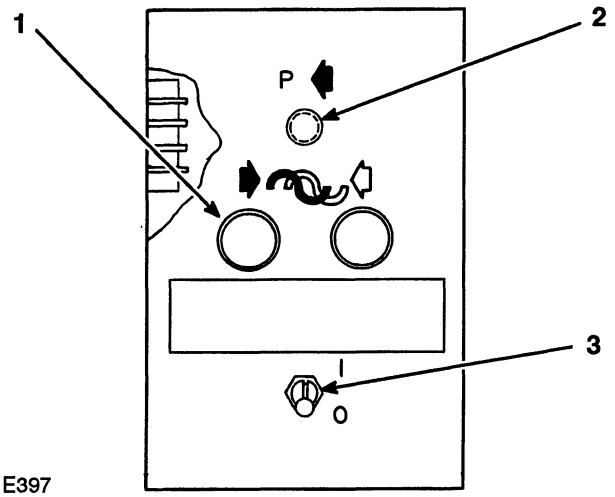
After the engine has shut down, the EFL indicator remains lit as long as the ECS remains in the RUN position.

When the fault has been corrected, turn the ECS to the STOP/RESET position to reset the EFL indicator.

NOTE: If the fault is due to overspeed, both the air shutoff solenoid (on the engine) and the speed switch (in the junction box) must be reset before starting the engine..

NOTE: The EFL indicator is a combination light and test button. It can be tested by pushing in on the indicator light.

Synchronizing Lights Module



E397

Synchronizing Lights Module
(1) Synchronizing lights. (2) Plug. (3) Synchronizing switch.

The optional synchronizing lights module is located on the right side of the panel door (same location as for the optional alarm module). The synchronizing lights module is not used when the panel is equipped with either the optional 2301 governor or 2301 governor with pre–regulator.

Synchronizing lights (1) are used as an aid in paralleling units. Each light has one lead connected to the load and the other lead connected to the generator output. Together, they indicate when the voltages are in phase so the breaker can be closed to put the generator on line.

NOTE: For a complete explanation on how to parallel two units, make reference to form number SEBU6051, Operation and Maintenance SR–4 and SRCR Generators.

NOTE: For connection of the synchronizing light module and connection of resistor taps in the module, make reference to the section, Schematics And Wiring Diagrams.

Installation Of Synchronizing Module

⚠ WARNING

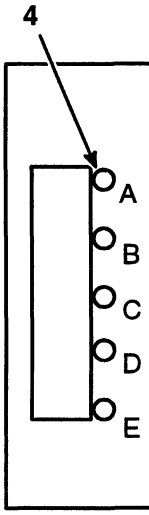
To avoid electrical shock and personal injury, all on line generator sets must be shutdown before installing or repairing the synchronizing module.

Make an orderly shutdown of all generators connected to the system. Then connect synchronizing module wires to the terminals as follows:

Load lead wire L1 to control panel terminal (L1).
Load lead wire L3 to control panel terminal (L3).
Wire T11 to the load side of fuse F11.
Wire T12 to the load side of fuse F12.
Wire T13 to the load side of fuse F13.

The customer is responsible for providing proper wire and fusing to connect L1 and L3 to the load side of the generator output circuit breaker. (Refer to the AC Schematic).

Adjust the connection of wires T11 and T13 on synchronizing resistors (SLR1) and (SLR2) respectively as required for your particular generator AC voltage. Refer to the chart that follows and the section, Point To Point Wiring Diagrams.



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VOLTAGE LINE TO LINE	SYNCHRONIZING RESISTOR TAP SETTING CHART
208	USE E–D 1760 Ω
240	USE E–C 2400 Ω
300	USE E–B 5600 Ω
380	USE E–B 5600 Ω
400	USE E–B 5600 Ω
416	USE E–A 7200 Ω
480	USE E–A 7200 Ω
600	USE OHMITE #0215 10,000 Ω 25 WATT

Synchronizing Resistor Tap Connection Chart
(4) Resistor taps.

NOTE: Remove the synchronizing module cover for access to the resistor taps.

EXAMPLE: For a generator with 400 volts line to line, T11 and T13 should be connected to tap B on the respective SLR.

Synchronizing Lights Module (With Reverse Power Relay)

For schematics and wiring diagrams, refer to the Schematics And Wiring Diagrams section in this manual.

NOTE: The synchronizing lights module (with reverse power relay) option looks and operates the same as the module without the reverse power relay with the exception of:

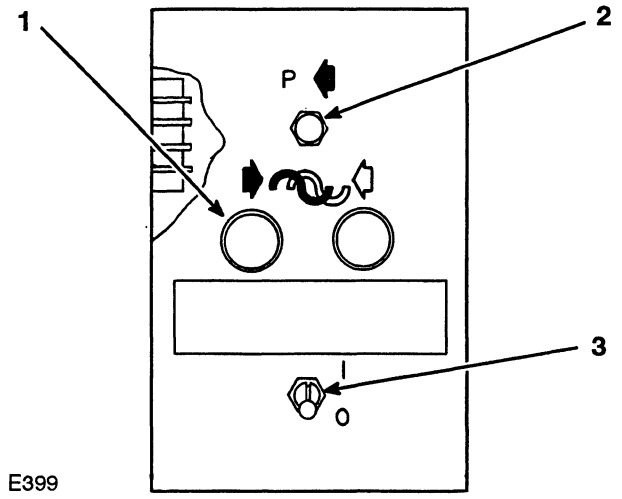
the reverse power relay (RPR) mounted on the back of the module.

the reverse power fault light (RPL) mounted on the front of the panel.

For information on the synchronizing lights module, make reference to the previous section on the Synchronizing Lights Module.

Introduction

The reverse power relay (RPR) provides system protection when the generator set is operating in parallel with another unit. If for some reason the engine loses power, the other unit in parallel will attempt to motorize (drive electrically) the engine and generator. Instead of power flowing OUT of the generator, power flows IN. This makes the generator a motor. This reverse flow of power could overload the other generators and the whole system.



Synchronizing Lights Module, With Reverse Power Relay
(1) Synchronizing lights. (2) Lens. (3) Synchronizing switch.

The reverse power relay (RPR) is a single phase relay which is energized by power flowing in only one direction (power into the generator instead of out). In a reverse power fault, the relay (RPR) (located on AC Schematic) closes its contact across RPR (5 and 6) (line 49) (located on DC schematic). This will cause the engine to shut down and the generator to be taken off line.

After the reverse power fault is corrected, the RPR and fault light must be reset by turning the engine control switch (ECS) to the RESET position.

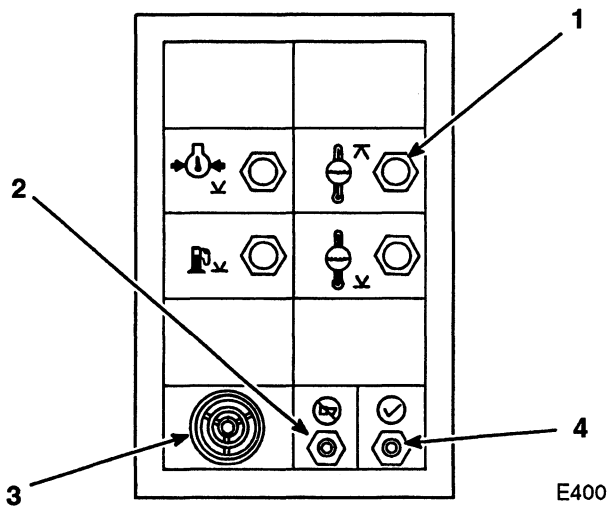
The operation of the RPR can be tested by pushing the test button on the RPR while the generator is on load. The generator must be on line with at least 15% of rated kW.

⚠ WARNING

To avoid personal injury from electrical shock, be careful not to touch the high voltage terminal while adjusting the reverse power relay.

The relay trip point is field adjustable, but is normally factory set at approximately 15% of the generator rated kW.

Alarm Module



Alarm Module (NFPA 99 shown)
(1) Preliminary alarm lights (PAL). (2) Alarm silence pushbutton (ADS). (3) Alarm. (4) Lamp test switch (LTS).

NOTE: Reference the section, Schematics And Wiring Diagrams for the Alarm Module schematics.

The alarm module is an attachment located in the right side of the control panel. The purpose of the alarm module is to warn the operator of an engine condition before the condition gets bad enough to cause an engine shutdown or prevent the engine from starting. It will not shutdown the engine.

NFPA 99 Alarm Module

The NFPA 99 alarm module activates its warning system for conditions listed in the chart.

	Engine Mounted Contactor	Alarm Light
Low (Idle) Oil Pressure	LOPAS 1	LOPL
Low (Rated RPM) Oil Pressure[1]	LOPAS 2	LOPL
High Water Temperature	HWTAS	HWTL
Low Water Temperature	LWTAS	LWTL

[1] Used with electronic speed switch, oil pressure step switch [ESS (OPSS)] is optional.

When an alarm condition occurs, the proper alarm switch (located on the engine) closes to complete the circuit which will light the respective warning light and power the audible alarm.

The audible alarm can be manually silenced by pushing the alarm disconnect switch (ADS) (line 13). When pushed, the switch ADS closes the circuit and energizes the alarm disconnect relay (ADR) (line 12). When energized, the relay ADR opens and closes its contacts across the following terminals:

ADR (7 and 4) (line 12) – This contact closes to lock in relay ADR.

ADR (7 and 1) (line 11) – This contact opens to de–energize (silence) the audible alarm.

NOTE: The ADR will remain locked in until the condition which triggered the alarm is fixed. When fixed, the warning light(s) will go out and de–energize relay ADR. This causes contacts ADR (7 and 4) to open and contacts ADR (7 and 1) to close. Contacts ADR (7 and 1) close so the alarm is armed for the next condition(s).

Except for the low lube oil pressure alarm light (LOPL), all alarm circuits are armed all of the time. The LOPL is armed when the time delay relay (TDR) (line 4) energizes and closes contacts TDR (4 and 7) (line 6). Relay TDR energizes after the following occurs:

The engine, after reaching 400 rpm, closes the engines electronic speed switch (ESS) crank termination (CT) (line 4) and provides power to the time delay timer (TD).

After the adjustable 90 second delay elapses, the time delay timer (TD) energizes the time delay relay (TDR).

If the LOPL is armed (approximately 90 seconds after crank termination) and initial oil pressure is not built–up, the auxiliary switch (LOPAS 1) (line 5) remains closed to complete the circuit to fault indicators LOPL (line 6) and ALM (line 11).

A second optional low oil pressure auxiliary switch (LOPAS 2) (line 6) works in combination with an oil pressure step switch ESS (OPSS). At a certain engine speed the ESS (OPSS) starts a 90 second time delay, after which it closes. If oil pressure is not enough to have opened switch (LOPAS 2) then LOPAS 2 completes the circuit to the low oil pressure indicator (LOPL) (line 6) and the ALM (line 11).

The engine failure relay (ENFR) has a contact across normally open contacts ENFR (9 and 6) (line 11) to allow use of the audio alarm (ALM) (line 11) in case of an engine overspeed or an overcrank fault.

NOTE: This does not cause any of the warning lights on the alarm module to light.

When the engine has a normal shutdown. The ESS (CT) opens to cut power to timer (TD). The TD prevents relay TDR from energizing which opens the contacts TDR (4 and 7) (line 6) and keeps the alarm system from activating.

NOTE: If an automatic start/stop module is used, then the arming relay (AR) has a normally open contacts ADR (6 and 9) (line 5) placed between control panel terminals 18 and 70 (line 6). These contacts will close when relay AR in the automatic start/stop module is energized.

NFPA 110 Alarm Module

The NFPA 110 alarm module activates its warning system for conditions listed in the chart. The module will operate properly only when used with an automatic start/stop module.

NOTE: If the NFPA 110 alarm module is used with a manual start/stop module, the low lube oil pressure alarm light (LOPL) and audible alarm (ALM) will indicate a fault on startup and will turn off if the oil pressure builds to the proper level.

	Engine Mounted Contactor	Alarm Light
Low Battery Voltage	From Bat. Charger	LBVL
Low (Idle) Oil Pressure	LOPAS 1	LOPL
Low (Rated RPM) Oil Pressure[1]	LOPAS 2	LOPL
High Water Temperature	HWTAS	HWTL
Low Water Temperature	LWTAS	LWTL

[1] Used with electronic speed switch, oil pressure step switch [ESS (OPSS)] is optional.

When an alarm condition occurs, the proper alarm switch (located on the engine) closes to complete the

circuit which will light the respective warning light and power the audible alarm.

The audible alarm can be manually silenced by pushing the alarm disconnect switch (ADS) (line 23). When pushed, the switch ADS closes the circuit and energizes the alarm disconnect relay (ADR) (line 23). When energized, the relay ADR opens and closes its contacts across the following terminals:

ADR (7 and 4) (line 22) – This contact closes to lock in relay ADR.

ADR (7 and 1) (line 21) – This contact opens to de–energize (silence) the audible alarm.

NOTE: The ADR will remain locked in until the condition which triggered the alarm is fixed. When fixed, the warning light(s) will go out and de–energize relay ADR. This causes contacts ADR (7 and 4) to open and contacts ADR (7 and 1) to close. Contacts ADR (7 and 1) close so the alarm is armed for the next condition(s).

Except for the low lube oil pressure alarm light (LOPL), all alarm circuits are armed all of the time. The LOPL is armed when the arming relay (AR) located in the automatic stop/start module energizes and closes contacts AR (6 and 9) (line 6).

If the LOPL is armed (approximately 90 seconds after crank termination) and initial oil pressure is not built–up, the auxiliary switch (LOPAS 1) (line 5) remains closed to complete the circuit to fault indicators LOPL (line 6) and ALM (line 11).

A second optional low oil pressure auxiliary switch (LOPAS 2) (line 6) works in combination with an oil pressure step switch ESS (OPSS). At a certain engine speed the ESS (OPSS) starts a 90 second time delay, after which it closes. If oil pressure is not enough to have opened switch (LOPAS 2) then LOPAS 2 completes the circuit to the low oil pressure indicator (LOPL) (line 6) and the ALM (line 11).

The engine failure relay (ENFR) has a contact across normally open contacts ENFR (9 and 6) (line 21) to allow use of the audio alarm (ALM) (line 21) in case of an engine overspeed or an overcrank fault.

NOTE: This does not cause any of the warning lights on the alarm module to light.

When the engine has a normal shutdown. The relay (AR) de–energizes opening contacts AR (6 and 9) and keeps the alarm system from activating.

Governor Switch

NOTE: The optional governor switch is available on control panels using the Caterpillar Hydra–Mechanical or PSG governors equipped with synchronizing motors.

After crank termination, the governor switch (GS) is enabled (allowed to operate), permitting a change in engine rpm (generator frequency). Move the switch up to increase rpm, down to decrease rpm. The governor switch makes it possible to adjust the engine speed (generator frequency) from the front of the control panel.

Speed Potentiometer

The speed adjust potentiometer (SP) is used with the optional 2301 and 1724/8290 governors to control engine speed. It's mounted in the panel in the location used by the governor switch in Hydra–Mechanical or PSG governor units. See section 2301 Governor, 2301 Governor With Pre–Regulator, and 1794/8290 Isochronous Governor. The engine speed can be adjusted up or down by turning the potentiometer.

2301 Governor, 2301 Governor With Pre–Regulator And 1724/8290 Isochronous Governor

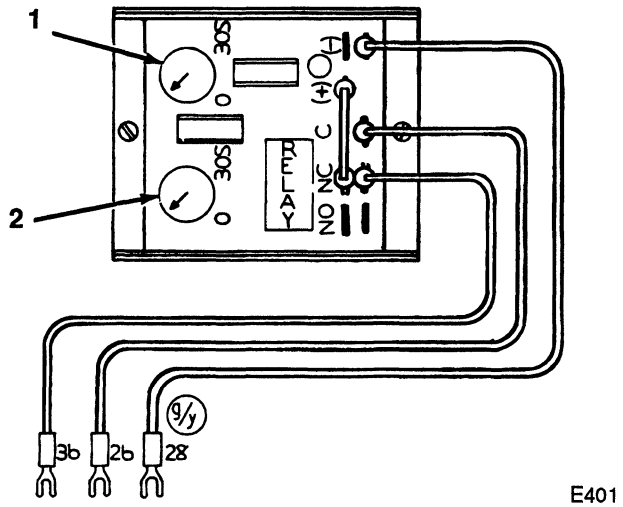
These options provide a control panel mounted 2301 governor or a 1724/8290 Isochronous Speed Control Governor and are available for non–paralleling applications only. The 2301 option also provides a fuse (F4) or an optional pre–regulator which are mounted inside the control panel. The pre–regulator filters the B+ power to the 2301, preventing it from being damaged by voltage spikes. The pre–regulator should be used in abrasive environments where poor battery maintenance, loose battery terminals, or 32 VDC Nicad battery systems are likely.

The 2301 governor and the 1724/8290 Isochronous Governor have a speed potentiometer which is mounted in the panel front (in place of the optional governor switch).

Power (B+) is provided by the manual or automatic control panel at panel terminal (5), whenever the engine starts and runs.

For complete operation and troubleshooting information on the 2301 governor, refer to the module 2301 Electric Governors For Generator Set And Industrial Engines, Form No. SENR2928.

Cycle Cranking Module



E401

Cycle Cranking Module
(1) Crank. (2) Rest

The cycle cranking module (CCM) is only provided with automatic start–stop panels.

NOTE: Jumper between terminals (26 and 36) on terminal board B (TBB) must be removed when the CCM is installed. Reference the section, Schematics And Wiring Diagrams.

The cycle cranking module (CCM) (line 6) has a relay and a timer. This attachment is used to cycle crank and rest the starting motor (SM). The relay controls the circuit to the starting motor magnetic switch (SMMS) which controls the circuit to the SM. The cycle timer controls the relay. The overcrank timer (OCT) (line 9) controls the time that the CCM is activated.

When run relay (RR) (line 25) contact (8 and 5) closes, battery positive is applied to CCM (line 6) from terminal (36). This activates the timer. The timer's normally closed (N.C.) contact stays closed. This allows the engine starting motor magnetic switch (SMMS) to energize and to activate the starting motor. When the cranking time is over, as set by the cranking potentiometer (1), the N.C. timer contact opens. This de–energizes the SMMS and the starting motor. The contact remains open through rest period. The rest period is set by timer rest potentiometer (2). When the rest period has expired, the N.C. timer contact closes again for a crank period. This cycle repeats until any of the following happens:

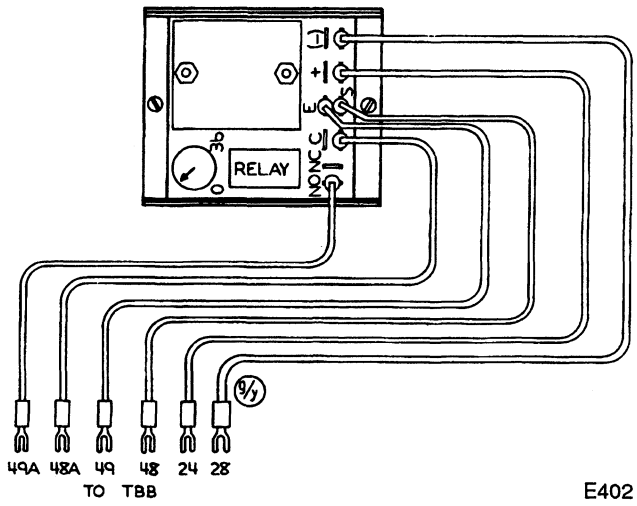
1. Electronic speed switch termination ESS (CT) opens the circuit, indicating that the engine is running.

2. Emergency stop pushbutton (ESPB) is pushed to open the circuit.

3. Run relay (RR) contact (8 and 5) (line 8) opens due to an overcrank fault or by turning the ECS to the OFF or STOP position.

NOTE: The crank potentiometer (P1) and the rest potentiometer (P2) are each adjusted to 10 seconds at the factory.

Cooldown Timer Module



E402

Cooldown Timer Module

The optional cooldown timer module (CDM) is available for auto start–stop panels. It allows the engine to run without load after the initiating contact (IC) (line 28) has opened across panel terminals (48 and 49) (line 28). This allows the engine to cooldown before shutdown.

NOTE: jumpers 49A to 49 and 48A to 48 on TBB must be removed upon installation of the CDM.

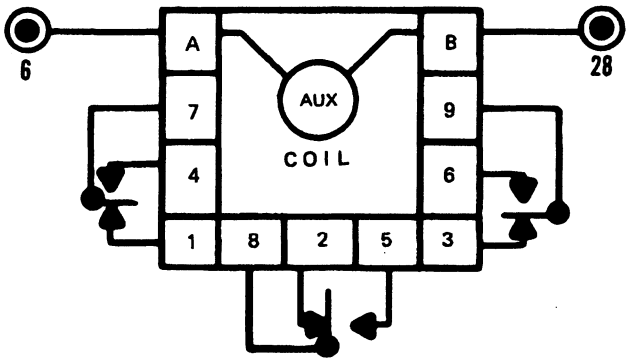
When the contact (IC) closes, the CDM output relay energizes to close its normally open (N.O.) contact (line 27) across panel terminals (48A and 49A).

When the contact (IC) opens, the CDM starts a time delay. The CDM relay remains energized during the time delay. When the time delay is finished, CDM relay contact across (48A and 49A) opens to de–energize the run relay (RR) and shutdown the engine. This delay is adjustable up to 36 minutes.

Panel Lights

Two optional panel illumination lights are located on each side at the top of the panel door. They are turned ON and OFF by the panel light switch (PLS), which is located on the right side of the panel door. The panel lights can be operated at any time regardless of engine control switch position or engine status.

Auxiliary Relay Module



E403

Auxiliary Relay Module

The optional auxiliary relay module (AUX) (line 23) is available in auto start–stop panels. On normal start–up, electronic speed switch (ESS) crank termination (CT) closes to energize the AUX relay. The auxiliary relay module has normally open contacts (7 and 4), (8 and 5) and (9 and 6) and normally closed contacts (7 and 1), (8 and 2) and (9 and 3). Each contact is rated 10 amps at 28 VDC or 120 VAC. Contacts (2 and 8) and (8 and 5) are wired out to generator housing terminal strip points A1, A2 and A3 for easy customer access.

Engine Control Shutdown Light

The optional engine control shutdown light (ECSL) is located on the left side of the control panel. It is available only on 3500 low emission engines. Its purpose is to provide a warning light on the control panel which will indicate when the Caterpillar Inc. Electronic SI Engine Control (SIEC) has shutdown the engine. The ECSL is deactivated when the SIEC is de–activated.

DC Voltmeter

The optional DC voltmeter (DCV) is used when the generator set engine is equipped with an alternator charging circuit. The DCV indicates the charging voltage to the battery. The DC voltmeter is turned on when the engine control switch is in the AUTO or MAN positions on the Auto Start–Stop Modules. On the Man Start–Stop module the DC voltmeter is on when the engine control switch is in the RUN position.

Energize To Run Engine System

Introduction

This control panel (part number 4P4780) is being produced to provide an SI control panel for SI generator set packages.

This panel (4P4780) provides the capability of changing from a manual start/stop panel to an automatic start/stop panel by simply switching modules and reconnecting some wiring at the control panel terminal strip. Also the panel can be equipped with the 2301 governor, the Caterpillar Inc. Digital Electronic SI Fuel System, or 1724/8290 governor mounted inside of the panel. The panel can be used on energize to run systems only.

The uses of the generator mounted control panel are:

To help control the electric power made by the generator set.

To monitor the operation of the generator set.

To help protect the generator set engine from damage caused by low oil pressure, high coolant temperature, overspeed and overcrank.

To help with the transfer of electrical load to and from the generator set.

To help manually parallel two or more units onto the same bus.

Automatic Start/Stop Control Panel

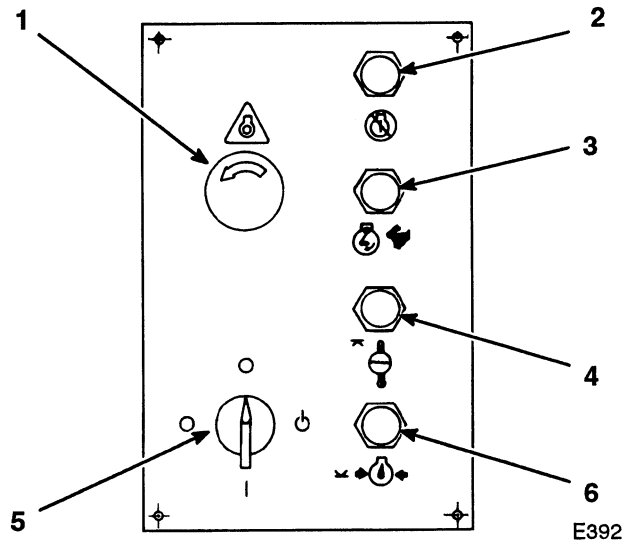
For abbreviations list, and schematics and wiring diagrams refer to the section Schematic And Wiring Diagrams in this manual.

The automatic start/stop system is normally used for standby operation. The generator set must start, pick up the load, operate at load, and stop after the load is removed. An automatic transfer switch controls the transfer of load to and from the generator set. When normal (commercial or utility supplied) power has a failure, initiating contactor (IC) which is part of the automatic transfer switch, closes. This will begin the automatic start sequence. When the engine starts, the control panel instruments will show voltage and frequency. The automatic transfer switch will transfer the load to the generator set when voltage and frequency reach approximately rated value. When normal power returns, the automatic transfer switch will transfer the load back to normal power and the initiating contactor (IC) will open. This will begin the automatic stop sequence. The generator set will also stop automatically if the engine has a monitored failure.

NOTE: For specifications on components located on the engine, make reference to the Engine Service Manual.

The automatic start/stop panel will shut down the generator set when a monitored engine fault occurs. At the same time, it will indicate by a fault lamp whether the fault is due to high water temperature, low oil pressure, overcrank or overspeed.

The automatic start/stop panel can be used on engine systems that are energized to run (ETR) only.



(1) Emergency stop pushbutton (ESPB). (2) Overcrank light (OCL). (3) Overspeed light (OSL). (4) High water temperature light (WTL). (5) Engine control switch (ECS). (6) Low oil pressure light (OPL).

Engine Start–Up

The engine can be started (and shut down) with the engine control switch (ECS) in the following positions:

1. In the AUTO position, start–up and shut down depends on the closing and opening respectively of a remote start initiating contact (IC) (line 27) (except in the case of a fault where shut down is automatic).

2. In the MAN position, start–up depends on the operator turning the engine control switch (ECS); likewise, the operator must turn the engine control switch (ECS) to the STOP position to

shut the engine down (except in the case of a fault where shut down is automatic).

NOTE: The emergency stop pushbutton (ESPB) located on the engine junction box [as well as on the control panel (line 23)] must be in the RESET position for proper operation of the panel.

Prior To Crank Termination

With the engine control switch (ECS) in the MAN position or AUTO (IC closed) position, the circuit is complete to run relay (RR) (line 25). Relay RR energizes to close contacts across RR (8 and 5) (line 8), RR (6 and 9) (line 25) and RR (7 and 4) (line 36) and open the contact across RR (3 and 9) (line 22).

RR (8 and 5) – Normally open (N.O.) contact across RR (8 and 5) (line 8) closes to complete the starting circuit through the electronic speed switch–crank termination ESS (CT); through the engine junction box mounted emergency stop pushbutton (ESPB) to starting motor magnetic switch (SMMS). Switch SMMS energizes to close its contact and energize the pinion solenoid (PS). Solenoid PS closes its contact to engage the starting motor. When the contact across RR (8 and 5) closes, it also energizes the overcrank timer (OCT) (line 9). After the engine cranks for approximately 30 seconds (90 seconds with cycle cranking) without the engine starting, OCT will energize the overcrank fault relay (OCR) (line 9). Make reference to the section, Engine Does Not Start.

RR (6 and 9) – Normally open (N.O.) contact across RR (6 and 9) (line 25) closes to complete a circuit through ESS (CT) (11 and 12); through diode (D3); through the engine mounted ESPB; through the water temperature switch (WTS); across RR (6 and 9) (line 25); and through the control panel ESPB contacts (8 and 7) (line 25). At this point in the start–up, the current flows through arming relay contacts (2 and 8) (line 33) to slave relay (SR1). SR1 energizes and closes its contacts (1 and 3) to energize the fuel solenoid (FS). This provides fuel for start–up.

RR (7 and 4) – N.O. contact across RR (7 and 4) (line 36) closes to arm the arming delay timer (ADT).

After Crank Termination

Once the engine has started and reached approximately 400 rpm, the ESS (CT) contacts (11 and 12) will open to terminate cranking. Contacts ESS (CT) (10 and 11) will close to energize the arming delay timer (ADT) (line 36) which begins timing. In addition, another current path is now provided through ESS (CT) contacts (11 and 10), diode (D2), ESS (OS) contacts (8 and 9), engine ESPB contacts (1 and 2), water temperature switch (WTS) and through to RR contacts (6 and 9) (line 25) to the oil pressure switch (OPS1).

Assuming the engine has adequate oil pressure, the current flow will continue through OPS1 contacts (1 and 2), through ESS (OPSS) contacts (l4 and 15) down to SR1. Approximately 10 seconds after crank termination, the ADT (line 36) will time out and energize arming relay (AR) (line 36). Relay (AR) then opens its contacts (2 and 8) (line 33) and closes AR contacts (7 and 4) (line 17). At this point, the panel is armed for an oil pressure fault shutdown and all current flow to keep the fuel turned on is through the (OPS1).

However, 9 seconds after the engine speed has increased beyond the electronic speed switch (ESS) oil pressure step switch (OPSS) set point, the ESS (OPSS) contact (14 and 15) will open and (14 and 13) will close. At this point, the engine oil pressure must be high enough to close the optional oil pressure switch (OPS2) contacts (1 and 2) to keep SR1 and fuel solenoid (FS) energized or the engine will shutdown on a low oil pressure fault.

If the optional OPS2 was not supplied, a jumper will be provided in place of OPS2. This will also complete the circuit to SR1 to keep the FS energized and the engine running.

With ECS in the AUTO or MAN positions, the ECS contact across ECS (6 and 5) (line 28), ECS (8 and 5) (line 30) or ECS (7 and 5) (line 29) respectively provides a path for current to latch in one of the fault relays (OCR, OPR, WTR or OSR) should a fault occur.

As the engine starts and ESS senses a speed of 400 rpm through the magnetic speed pickup (MPU), the ESS opens the starting motor circuit through the opening of crank termination switch contact across ESS (CT) (11 and 12). At the same time, ESS (CT) contact across ESS (11 and 10) closes to arm circuits containing the following components:

Oil pressure switch (OPS1)

ESPB

Arming relay (AR)

Low oil pressure alarm switch (LOPAS 1)

Electronic speed switch – overspeed [ESS (OS)]

Slave relay (SR2)

Slave relay (SR1)

Engine Shutdown

With the engine control switch (ECS) in the AUTO position, shutdown occurs when the remote initiating contact (IC) (line 28) opens. With the ECS in the MAN position, engine shutdown occurs when the operator turns the ECS to the STOP position.

When either the IC opens (automatic) or ECS contact across (9 and 11) (line 26) opens (manual), run relay (RR) (line 25) de–energizes to open contacts across RR (8 and 5), RR (6 and 9) and RR (7 and 4) and close the contact across RR (3 and 9).

RR (8 and 5) – N.O. contact across RR (8 and 5) (line 8) opens so that the SMMS does not energize the starting circuit when the ESS (CT) switch closes on shutdown of the generator set.

RR (6 and 9) – N.O. contact across RR (6 and 9) (line 25) opens to de–energize the slave relay (SR1), which in turn opens its contact across SR1 (1 and 3), to de–energize the fuel solenoid (FS). Also, the contact across RR (6 and 9) opens to de–energize the oil pressure fault circuit through OPS1, ESS (OPSS) and OPS2.

RR (7 and 4) – N.O. contact across RR (7 and 4) (line 36) opens to de–energize the arming relay (AR) (line 36) and reset the arming delay timer (ADT) (line 36). Relay AR (line 36) opens its contact across AR (7 and 4) (line 17) to keep the oil pressure fault relay (OPR) (line 17) and fault light (OPL) (line 18) from indicating a fault on normal start–up.

Fault Circuit Operation

Oil Pressure Fault (At Engine Speeds Below Oil Step Speed Setting)

For normal system operation, make reference to section Engine Start–Up.

During a normal start–up when initial engine oil pressure is at least 140 kPa (20 psi) and engine speed is below that of the ESS (OPSS) speed step setting, the contacts RR (6 and 9) (line 25) close to complete two current paths to energize slave relay (SR1) and the fuel solenoid (FS). One path is through contacts AR (2 and 8) (line 33). The other path is through oil pressure switch (OPS1) terminals (1 and 2) and electronic speed switch (ESS) oil pressure step switch (OPSS) terminals (14 and 15).

At start–up when oil pressure is less than 140 kPa (20 psi), (OPS1) remains closed across terminals (1 and 3). Arming delay timer (ADT) (line 36) keeps the arming relay (AR) (line 36) from energizing for 10 seconds after crank termination. After the 10 second delay, relay (AR) closes its contacts AR (7 and 4) (line 17) which completes the circuit to the oil pressure fault relay (OPR) (line 17) and the fault light (OPL). Also, the contacts AR (2 and 8) (line 33) open to de–energize the relay (SR1). This de–energizes the fuel solenoid (FS) shutting off fuel to the engine.

When relay (OPR) (line 17) energizes, its contacts OPR (line 18) close to latch in the relay (OPR). Also, its contacts OPR (line 43) close to energize engine fault relay (ENFR) (line 46). Relay (ENFR) opens the normally closed contacts ENFR (8 and 2) (line 26) which de–energizes relay (RR). With relay (RR) de–energized, its contacts open to provide another circuit to shut the engine down.

The normally closed contacts (RR) (6 and 9) (line 25) open to maintain the open circuit to relay (SR1).

The contacts RR (8 and 5) (line 8) open to keep the starting motor circuit from energizing when the ESS crank termination switch (CT) closes across terminals ESS (11 and 12) (after the engine stops).

The contacts RR (7 and 4) (line 36) open to de–energize the arming relay (AR) (line 36). With relay (AR) de–energized, the contacts AR (7 and 4) (line 17) open to make possible another start–up. The contacts AR (2 and 8) (line 33) close so relay (SR1) can be energized at engine restart.

⚠ WARNING

To prevent personal injury due to accidental starting of the engine, disconnect the batteries before doing maintenance or repair work.

To again start the engine, do the following steps:

1. Turn engine control switch (ECS) to STOP.

2. Correct the low oil pressure fault (see the engine service manual).

4. Rotate the ECS to OFF/RESET position which opens the circuit across ECS terminals (6 and 5) (line 28), (7 and 5) (line 29) and (8 and 5) (line 30). This allows relay (OPR) (line 17) to de–energize. The contacts OPR (line 18) open shutting off the light (OPL). Also, contacts OPR (line 44) open to de–energize the relay (ENFR). The contacts ENFR (8 and 2) (line 26) now close to allow restart.

4. The system is ready to start if the engine control switch (ECS) is turned to MAN or AUTO.

Oil Pressure Fault (At Engine Speeds Above Oil Step Speed Setting)

For normal system operation, make reference to section Engine Start–Up.

Under the fault condition of the engine operating above the ESS (OPSS) engine step speed setting without the required oil pressure, current flows as follows:

Through ESS crank termination terminals (CT) (11 and 10); through ESS overspeed terminals (OS) (8 and 9); through emergency stop pushbutton terminals (ESPB) (1 and 2) and through water temperature switch (WTS) to contacts RR (6 and 9) (line 25) of the control panel. From the contacts RR (6 and 9), current can flow one or two directions. Through the contacts AR (2 and 8) (line 33) to relay (SR1) [if the 10 second time delay has not elapsed from the arming relay delay (ADT) (line 36)] and/or through oil pressure switch (OPS1). In this fault, oil pressure is sufficient to close switch (OPS1), but is not enough to close the optional oil pressure switch (OPS2). Once the step speed setting of ESS (OPSS) has been passed and the speed remains above this setting, switch (OPS2) has 9 seconds to close before ESS (OPSS) closes its contacts (14 and 13) to complete the circuit through the now closed contacts AR (7 and 4) (line 17) to the oil pressure fault relay (OPR) (line 17) and fault light (OPL) (line 18). In addition, once ESS (OPSS) opens its contacts (14 and 15), it will immediately open the circuit that keeps relay (SR1) energized.

When relay (OPR) energizes, its contacts (line 18) close to latch in relay (OPR).

Also, the contacts OPR (line 44) close to energize engine fault relay (ENFR) (line 46). The contacts ENFR (8 and 2) (line 26) open which de–energizes relay (RR). With relay (RR) de–energized, its contacts open to maintain the engine shutdown.

The contacts RR (6 and 9) (line 25) open to maintain the open circuit to relay (SR1).

The contacts RR (8 and 5) (line 8) open to keep the starting motor circuit from energizing when the ESS crank termination switch (CT) closes across ESS terminals (11 and 12) (after the engine stops).

The contacts RR (7 and 4) (line 36) open to de–energize the arming relay (AR) (line 36). With relay (AR) de–energized, the contacts AR (7 and 4) (line 17) open so that the engine control switch (ECS) can clear the fault indicators (OPR) and (OPL) at restart. The contacts AR (2 and 8) (line 33) close so relay (SRI) can be energized engine restart.

⚠ WARNING

To prevent personal injury due to accidental starting of the engine, disconnect the batteries before doing maintenance or repair work.

To again start the engine, do the following steps:

1. Turn engine control switch (ECS) to STOP.

2. Correct the low oil pressure fault (see the engine service manual).

3. Rotate the ECS to OFF/RESET position which opens the circuit across ECS terminals (6 and 5) (line 28), (7 and 5) (line 29) and (8 and 5) (line 30). This allows relay (OPR) (line 17) to de–energize. Contacts OPR (line 18) open shutting off the light (OPL). Contacts OPR (line 44) also open to de–energize relay (ENFR). Contacts ENFR (8 and 2) (line 26) now close to allow restart.

4. The system is ready to start if engine control switch (ECS) is turned to MAN or AUTO.

Water Temperature Fault

For normal system operation, make reference to section, Engine Start–Up.

When engine coolant temperature becomes too high, the normally open water temperature switch (WTS) closes. This results in engine shutdown as follows:

1. The open side of the switch (WTS) cuts off current through the contact across RR (6 and 9) (line 25); through switch (OPS1); through switch ESS (OPSS); through a jumper (or optional oil pressure switch OPS2) and diode (D4) to de–energize slave relay (SR1). SR1 opens its normally open contact to de–energize the fuel solenoid (FS) and shut the engine down. No current at switches (OPS1) and (OPS2) also prevents the oil pressure fault relay (OPR) from energizing when switches (OPS1) and (OPS2) close during engine shutdown.

2. On the closed side of the water temperature switch (WTS), current flows to and energizes the water temperature relay (WTR) (line 20) and water temperature fault light (WTL). WTL contact (line 21) closes to lock in WTR. The normally open (N.O.) WTR contact (line 45) closes to energize the engine failure relay (ENFR) (line 46). With ENFR energized. the contact across ENFR (8 and 2) (line 26) opens to de–energize run relay (RR) (line 25). With RR de–energized, the contact across RR (8 and 5) (line 8) opens to

keep the starting motor circuit from energizing when the electronic speed switch (ESS) crank termination (CT) closes across terminals (11 and 12) (after engine stops).

⚠ WARNING

To prevent personal injury due to accidental starting of the engine, disconnect the batteries before doing maintenance or repair work.

To clear the fault and ready the system for starting, do the following:

1. Turn engine control switch (ECS) to STOP position.

2. Determine the cause of the high water temperature problem and repair. Allow engine temperature to cool so WTS will reset.

3. Make sure red ESPB has been reset (button out) on both the engine junction box and generator control panel.

4. Turn ECS to OFF/RESET position to de–energize the fault relay (WTR) and fault light (WTL).

5. The system is ready to start if engine control switch (ECS) is turned to MAN or AUTO.

Engine Overspeed Fault

For normal system operation, make reference to section Engine Start–Up.

When engine speed increases above the overspeed setting (118% of rated speed) of the electronic speed switch (ESS), the overspeed switch contact ESS (OS) will close across terminals ESS (7 and 8) and open across terminals ESS (8 and 9). When ESS (OS) closes across terminals ESS (7 and 8), the following occurs:

1. ESS (OS) latches itself in the closed position.

2. Current flows through diode (D12) to energize the engine failure relay (ENFR) (line 46). ENFR opens normally closed contact across ENFR (8 and 2) (line 26) which de–energizes run relay (RR) (line 25). With RR de–energized, the contact across RR (8 and 5) (line 8) opens to keep the starting motor circuit from energizing when the ESS crank termination (CT) closes across terminals ESS (11 and 12) (after engine stops).

3. Current flows to the overspeed fault relay (OSR) (line 31) and to the fault light (OSL) (line 32). OSR energizes to close the OSR contact (line 32) which latches in OSR. The OSR contact (line 46) closes to also energize ENFR. This is necessary because as soon as the engine stops, ESS (CT) closes across terminals ESS (11 and 12) and cuts off current through ESS (OS). This in turn cuts off current to ENFR (line 46).

When ESS (OS) opens across terminals ESS (8 and 9) the following occurs:

1. Current is stopped from flowing through emergency stop pushbutton (ESPB) terminals (1 and 2); through the water temperature switch (WTS); through contact RR (6 and 9) (line 25); through oil pressure switch (OPS1); through ESS oil pressure step switch (OPSS); through a jumper or (OPS2) and through diode (D4) to de–energize slave relay (SR1). With SR1 de–energized, the normally open contact across SR1 (1 and 3) opens to de–energize the fuel solenoid (FS).

⚠ WARNING

To prevent personal injury due to accidental starting of the engine, disconnect the batteries before doing maintenance or repair work.

To clear the fault and ready the system for starting, do the following:

1. Turn the engine control switch (ECS) to the STOP position.

2. Determine the cause of the overspeed problem and repair.

3. Manually reset the air shut–off lever (at top of air inlet housing).

4. Push the reset on the ESS (located in engine junction box) to open the overspeed switch ESS (OS).

5. Make sure red ESPB has been reset (button out) on both the engine junction box and generator control panel.

6. Turn ECS to OFF/RESET position to de–energize the fault relay (OSR) and fault light (OSL).

7. Turn ECS to AUTO or MAN for start up.

Engine Does Not Start

If the engine does not start in approximately 30 seconds, overcrank timer (OCT) (line 8 will let current flow to the overcrank relay (OCR) (line 8) and the overcrank light (OCL) (line 9). OCR will close its contact (line 9) to lock in the OCR. At the same time OCR closes its contact (line 43) which allows the engine failure relay (ENFR) (line 46) to energize. ENFR opens its contact across ENFR (8 and 2) (line 26) which de–energizes the run relay (RR) (line 25). RR then opens its contact across RR (8 and 5) (line 8) which causes the starting motor magnetic switch (SMMS) to de–energize. SMMS opens its contact causing the pinion solenoid (PS) to de–energize. PS opens its contact causing the starting motor to shutdown.

⚠ WARNING

To prevent personal injury due to accidental starting of the engine, disconnect the batteries before doing maintenance or repair work.

To again start the engine, do the following steps:

1. Turn the engine control switch (ECS) to the STOP position.

2. Correct the overcrank fault (see engine service manual).

3. Rotate the ECS to OFF/RESET position which opens the circuit across ECS terminals (16 and 5) (line 28). This allows the OCR (line 8) to de–energize. OCR contact (line 9) opens and shuts off the light OCL. Also, OCR contact (line 43) opens to de–energize the relay ENFR. The contact across ENFR (8 and 2) (line 26) now closes to allow restart.

4. Turn ECS to AUTO or MAN for start–up.

Emergency Stop Pushbutton

The emergency stop pushbutton (ESPB) is a red, mushroom shaped button which is located on both the engine junction box and the generator control panel. Either button will shut the engine down or prevent it from starting when pushed in.

The ESPB on the junction box shuts the engine down as follows:

When pushed in, ESPB creates an open circuit across terminals (1 and 2) to open the starting motor circuit. Another open circuit across terminals (1 and 2), de–energizes slave relay (SR1) which opens its normally open contact to de–energize the fuel solenoid (FS). This shuts–off fuel to the engine.

ESPB contacts (3 and 4) also provide a current path to energize OSR (line 31) and turn ON the OSL (line 32) in the control panel. Another set of ESPB contacts (3 and 4) prevent OSL from being reset by the ECS until ESPB is reset.

The ESPB on the generator panel shuts down the engine as follows:

When pushed in, ESPB creates an open circuit across ESPB contacts (7 and 8) (line 25) to de–energize SR1 and shut–off fuel to the engine. There is also an open across ESPB terminals (1 and 2) (line 26) which de–energizes run relay (RR) (line 25). RR opens normally open contact across RR (8 and 5) (line 8) to open the starting motor circuit.

ESPB contacts (6 and 5) (line 33) also provide a current path to energize OSR (line 31) and turn on the OSL (line 32) in the control panel. Another set of ESPB contacts (3 and 4) (line 30) prevent OSL from being reset by the ECS until ESPB is reset.

⚠ WARNING

To prevent personal injury due to accidental starting of the engine, disconnect the batteries before doing maintenance or repair work.

Before starting the system, do the following:

1. Turn the engine control switch (ECS) to the STOP position.

2. Correct any faults that may have been the cause of the emergency shutdown.

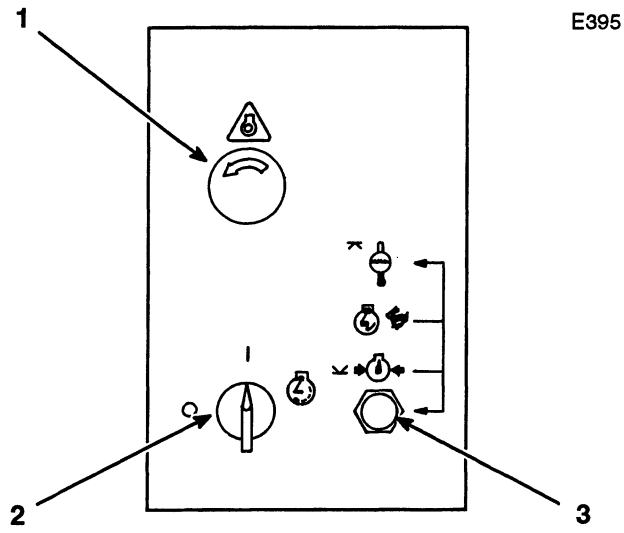
3. Manually reset the air shut–off lever (at the top of the air inlet housing).

4. Make sure red ESPB has been reset (button out) on both the engine junction box and generator control panel. Turn the button the direction shown to reset.

5. Turn ECS to OFF/RESET position to de–energize the OSR and OSL.

6. Turn ECS to AUTO or MAN for start–up.

Manual Start/Stop Control Panel



(1) Emergency stop pushbutton (ESPB). (2) Engine control switch (ECS). (3) Engine failure light (EFL).

For abbreviations list, and schematics and wiring diagrams refer to the section Schematic And Wiring Diagrams in this manual.

Engine Start–Up

Engine Control Switch Turned And Held In START Position

NOTE: In the Manual Start/Stop control panel, the Engine Control Switch (ECS) has a spring return from START position to RUN position.

In the START position, the engine control switch (ECS) contact closes across ECS (3 and 4) (line 9). The starting motor circuit is then energized through electronic start switch–crank termination ESS (CT) terminals (11 and 12); through emergency stop pushbutton (ESPB) (engine mounted) contacts (1 and 2); through ECS contacts (3 and 4) (line 9); through ESPB (panel mounted) contacts (1 and 2) (line 9) to starting motor magnetic switch (SMMS). SMMS energizes to close its contact and energizes the pinion solenoid (PS). PS closes its contact to energize the starting motor (SM).

In the START position, ECS also closes across contacts (5 and 6) (line 15) to arm the engine failure relay (ENFR) circuit.

In the START position ECS also closes across contacts (1 and 2) (line 25) and (11 and 12) (line 26). The fuel solenoid circuit is energized starting at ESS (CT) (11 and 12); through diode (D3); through ESPB (engine mounted junction box) contacts (1 and 2); through water temperature switch (WTS) contact; through engine failure relay (ENFR) contact (2 and 8) (line 25) and through ECS contacts (1 and 2) (line 25) to ESPB (panel mounted) contacts (8 and 7). At this point. current initially flows through ECS contacts (11 and 12) to slave relay (SR1). SR1 then closes its contacts (1 and 3) to energize the fuel solenoid (FS). This allows fuel for engine combustion.

As soon as engine low idle oil pressure comes up (check oil pressure gauge), current also flows in a parallel path from ESPB contacts (7 and 8) (line 25) through oil pressure switch (OPS1) contacts (1 and 2) and through ESS oil pressure step switch (OPSS) contacts (14 and 15) to SR1 (which should be already energized).

When the engine reaches approximately 400 rpm. ESS (CT) closes across contacts (11 and 10) (line 17). Besides opening the starting circuit, current flows through the ESS overspeed switch (OS) contacts (8 and 9); through ESPB contacts (1 and 2) and on through the paths described above. Also, through ESS (CT) contacts (11 and 10), the oil pressure relay (OPR) circuit is armed.

ECS Released To RUN Position

When ECS switch is released from the START position to the RUN position, ECS contacts across (3 and 4) (line 9) open to de–arm the starting motor circuit.

In the RUN position, ECS remains closed across contacts (1 and 2) (line 25) to keep the SR1 energized and in turn the fuel solenoid (FS) as described in the above section. ECS Turned And Held In Start Position.

NOTE: The electronic speed switch–oil pressure step switch ESS (OPSS) is a switch which starts a 9 second delay [after reaching a step speed while accelerating to rated engine speed] before closing one set and opening another set of contacts. The step speed setting is adjusted according to the rated engine speed. For example, an engine rated at 1800 rpm has its ESS (OPSS) adjusted to 1125 rpm. When the engine accelerates past 1125 rpm, the ESS (OPSS) starts a 9 second delay before it opens across terminals ESS (14 and 15) and closes across terminals ESS (14 and 13).

Once the engine speed reaches the ESS (OPSS) step speed, ESS (OPSS) will delay 9 seconds before closing across contacts (14 and 13) and opening across (14 and 15). Current then flows through a jumper or across an optional high idle oil pressure switch (OPS2) to keep SR1 energized and in turn the fuel solenoid (FS).

In the RUN position, ECS contacts (11 and 12) are open to remove this parallel circuit to SR1, used during START.

In the RUN position, ECS contacts (9 and 10) (line 17) close to arm the oil pressure fault relay (OPR) circuit. If OPS2 fails to close across its contacts (1 and 2) within 9 seconds after the step speed setting is passed and/or OPS1 fails to close before the ECS is released from START to RUN, then OPR (line 17) will energize to initiate engine shutdown. (Make reference to the following fault sections for further information).

Engine Normal Stop

The operator stops the engine by turning the engine control switch (ECS) to the OFF/RESET position from the RUN position.

When turned to OFF/RESET from the RUN position, ECS contacts across (1 and 2) (line 25) open to stop the flow of current through ESPB (8 and 7); through OPS1 (1 and 2): through ESS (OPSS) (14 and 13) and through OPS2 (1 and 2) to SRI which de–energizes. When SRI de–energizes, it opens its contact (1 and 3) to de–energize the fuel solenoid (FS) which shuts off fuel to the engine.

After the engine shuts down, the switch ESS (CT) opens across (11 and 10) and closes across (11 and 12) to allow for restart.

Emergency Stop Pushbutton

The emergency stop pushbutton (ESPB) is a red, mushroom shaped button located on both the engine junction box and the generator control panel. Either button will shut the engine down or prevent it from starting when pushed in.

NOTE: The emergency stop pushbutton should not be used for normal shutdown.

The ESPB on the engine junction box shuts the engine down as follows:

When pushed in, ESPB opens across terminals (1 and 2) (line 9) to open the starting motor circuit. ESPB also opens across terminals (8 and 7) (line 25) to open the circuit from ESS (CT) (11 and 10) through ESS (OS) (8 and 9); WTS; ENFR (2 and 8) (line 25); ECS (1 and 2) (line 25); ESPB (panel mounted) contacts (8 and 7) (line 24); OPS1 (1 and 2); ESS (OPSS) (14 and 13) and through OPS2 (1 and 2) to SR1. SR1 then de–energizes to open its contacts and de–energize the fuel solenoid (FS). This shuts off the fuel to the engine.

When pushed in, ESPB closes across terminals (3 and 4) (line 23) to close the circuit from ESS (CT) (11 and 10) to slave relay (SR2). SR2 energizes to close its contacts (1 and 3) to energize the air shutoff solenoid (ASOS). ASOS shuts off air for combustion. At the same time, the circuit is completed from SR2 through diode (D11) to energize the engine failure relay (ENFR) (line 14) and turn ON the engine failure light (EFL) (line 15). ENFR closes across its contacts (7 and 4) (line 15) to complete a circuit through ECS contacts (5 and 6) (line 15) to latch relay (ENFR) and the light (EFL).

The ESPB on the generator mounted panel (when pushed in) shuts down the engine as follows:

When pushed in, ESPB opens across its terminals (1 and 2) (line 9) to open the starting motor circuit.

When pushed in, ESPB opens across its terminals (8 and 7) to open the circuit (as described in engine mounted ESPB) to SR1. SR1 de–energizes to open its contacts (1 and 3) and de–energize the fuel solenoid (FS).

When pushed in, ESPB closes across (5 and 6) (line 32) to complete a circuit from ESS (CT) (11 and 10) to SR2. SR2 energizes to close its contacts (1 and 3) and energize ASOS. This shuts off combustion air to the engine. With contacts ESPB (5 and 6) closed, current also flows through diode (D11) (line 28) to energize ENFR (line 14) and turn ON the engine failure light (EFL) (line 15). ENFR closes across its contacts (7 and 4) (line 15) to complete a circuit through ECS contacts (5 and 6) (line 15) to latch ENFR and EFL.

⚠ WARNING

To prevent personal injury due to accidental starting of the engine, disconnect the batteries before doing maintenance or repair work.

Before starting the engine, do the following:

1. Turn the engine control switch (ECS) to the OFF/RESET position.

2. Correct any faults that may have been the cause of an emergency shutdown.

3. Manually reset the air shut–off lever (at the top of the air inlet housing).

4. Make sure the ESPB has been reset (button out) on both the engine junction box and generator control panel. Turn the button in the direction shown to reset.

5. Turn and hold the ECS in the START position until normal oil pressure is seen on the oil pressure gauge.

Fault Circuit Operation

Low Oil Pressure Fault (OPS1)

For normal operation, make reference to the section, engine Start–Up.

Depending on engine speed during start–up, the electronic speed switch (ESS) – crank termination (CT) will be:

closed across contacts (11 and 12), providing a current path through diode (D3) to emergency stop pushbutton (ESPB) terminals (1 and 2) (1f engine speed is less than 400 rpm).

closed across contacts (11 and 10) providing a current path through ESS–overspeed switch (OS) contacts (8 and 9) to ESPB terminals (1 and 2) (If engine speed is equal to or greater than 400 rpm).

Regardless of initial oil pressure and engine speed (as long as engine control switch (ECS) is held in the START position) the engine will start and run. From ESPB terminals (1 and 2), current flows through the water temperature switch (WTS) through normally closed (N.C.) engine failure relay (ENFR) contacts (2 and 8) (line 25) through ECS contacts (1 and 2) (line 25) through ESPB (panel mounted) terminals (8 and 7) (line 25) through ECS contacts (12 and 11) (line 26) to slave relay (SR1). SR1 energizes to close its contacts (1 and 3) and energize the fuel solenoid (FS). This provides fuel to the engine.

If at this point the ECS is released from the START to RUN position and there is not enough initial oil pressure to close oil pressure switch (OPS1) across contacts (1 and 2), then the opening of ECS contacts (11 and 12) (line 26) will de–energize SR1 and FS. This shuts off fuel to the engine, resulting in engine shutdown.

With oil pressure below the activation pressure of OPS1, contacts OPS1 (1 and 3) are closed. The current path will be through ECS contacts (9 and 10) (line 17) to oil pressure relay (OPR). OPR energizes to close its contact (5 and 8) (line 18). If ESS (CT) has closed across its contacts (11 and 10) to arm the circuit to OPR contacts (5 and 8) through diode (D13) (line 19) to engine failure relay (ENFR) (line 14) and engine failure light (EFL) (line 15). ENFR energizes to close its contacts (7 and 4) (line 15) which latches ENFR and EFL through ECS contacts (5 and 6) (line 15).

When the ECS is turned to the OFF/RESET position from the RUN position, ENFR and light EFL de–energize to allow restart.

Low Oil Pressure Fault (OPS2) (Optional)

For normal operation, make reference to the section, Engine Start–Up.

Once the engine is started and ECS has been released from the START to the RUN position, initial oil pressure is enough to close oil pressure switch (OPS1) across its contacts (1 and 2). This keeps slave relay (SR1) energized through electronic speed switch (ESS) oil pressure step switch (OPSS) contacts (14 and 15). However, as engine speed increases past the oil pressure step switch speed setting, ESS (OPSS) initiates a 9 second delay before closing across contacts (14 and 13) and opening across (14 and 15).

At the end of the 9 second delay, ESS (OPSS) closes across contacts (14 and 13) to complete the circuit to oil pressure switch (OPS2) and opens across ESS (OPSS) (14 and 15) to stop current flow to SR1. If at this point, the oil pressure is not at least 240 kPa (40 psi), OPS2 remains closed across contacts (1 and 3) to stop current now to SR1. SR1 then de–energizes to open across contacts (1 and 3) and de–energize the fuel solenoid (FS). This shuts off fuel to the engine and in turn the engine shuts down.

At the same time, current flows through OPS2 contacts (1 and 3) and ECS contacts (9 and 10) (line 17) to oil pressure relay (OPR). OPR energizes to close its contact (5 and 8) (line 18) and latch OPR; also current flows through diode (D13) (line 19) to engine failure relay (ENFR) (line 14) and engine failure light (EFL) (line l5). ENFR energizes to close its contacts (7 and 4) (line 15) which latches ENFR and EFL through ECS contacts (5 and 6) (line 15).

When the ECS is turned to the OFF/RESET position from the RUN position, ENFR and light (EFL) de–energize to allow restart.

Water Temperature Fault

When the engine coolant temperature becomes too high, the normally open water temperature switch (WTS) opens across its normally closed (N.C.) contact. This opens the circuit to slave relay (SR1). SR1 de–energizes to open its contacts (1 and 3) and de–energize the fuel solenoid (FS). This shuts off fuel to engine which in turn shuts down.

Also WTS closes across its normally open (N.O.) contact to energize the engine failure relay (ENFR)

(line 14) and engine failure light (EFL) (line 15). ENFR energizes to close its contact (7 and 4) (line 15) which latches ENFR and EFL through ECS contacts (5 and 6) (line 15).

Turn the ECS to the OFF/RESET position from the RUN position. ENFR and light EFL will de–energize to allow restart after the engine cools down and the fault has been corrected.

Overspeed Fault – ESS

For normal operation. make reference to the section, engine Start–Up.

When engine speed increases above the overspeed setting (118% of rated speed) of the electronic speed switch (ESS), the overspeed switch ESS (OS) will close across contacts (8 and 7) and open across contacts (8 and 9).

When ESS (OS) opens across contacts (8 and 9), this opens the circuit to slave relay (SR1). SR1 de–energizes to open its contacts (1 and 3) to de–energize the fuel solenoid (FS). This shuts off fuel to the engine which in turn shuts down the engine.

At the same time, ESS (OS) closes across terminal (8 and 7) which energizes slave relay (SR2). SR2 in turn closes its contact to energize the air shutoff solenoid (ASOS). ASOS shuts off air for combustion. Also, current flows through diode (D11) (line 30) to engine failure relay (ENFR) (line 14) and engine failure light (EFL) (line 15). ENFR energizes to close its contact (7 and 4) (line 15) which latches ENFR and EFL through ECS contacts (5 and 6) (line 15).

Turn the ECS to the OFF/RESET position from the RUN position. ENFR and light EFL will de–energize to allow restart after the following:

1. overspeed fault has been corrected.

2. the air shut–off lever has been manually reset (at the top of the air inlet housing).

3. manually reset the overspeed button on the ESS module.

Schematics And Wiring Diagrams

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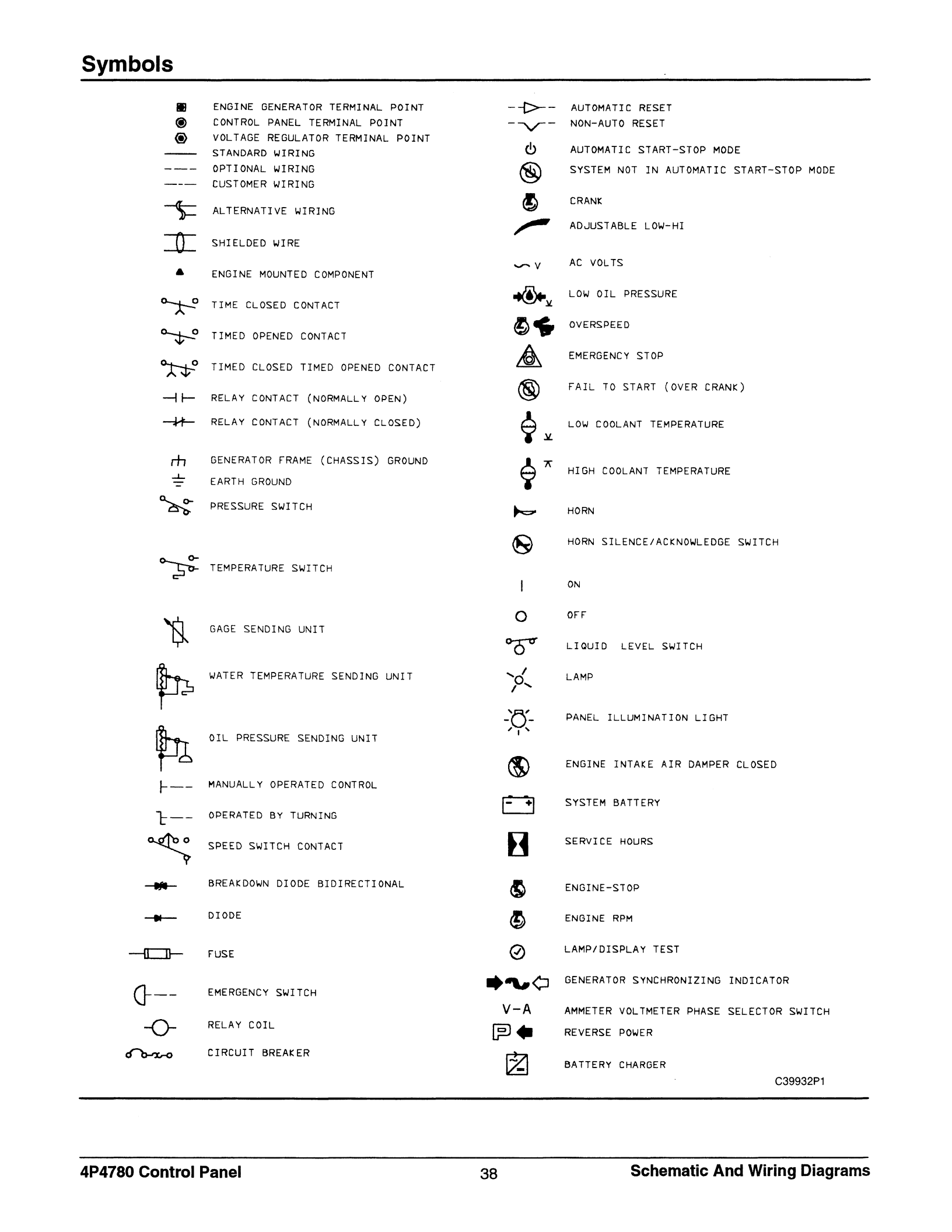
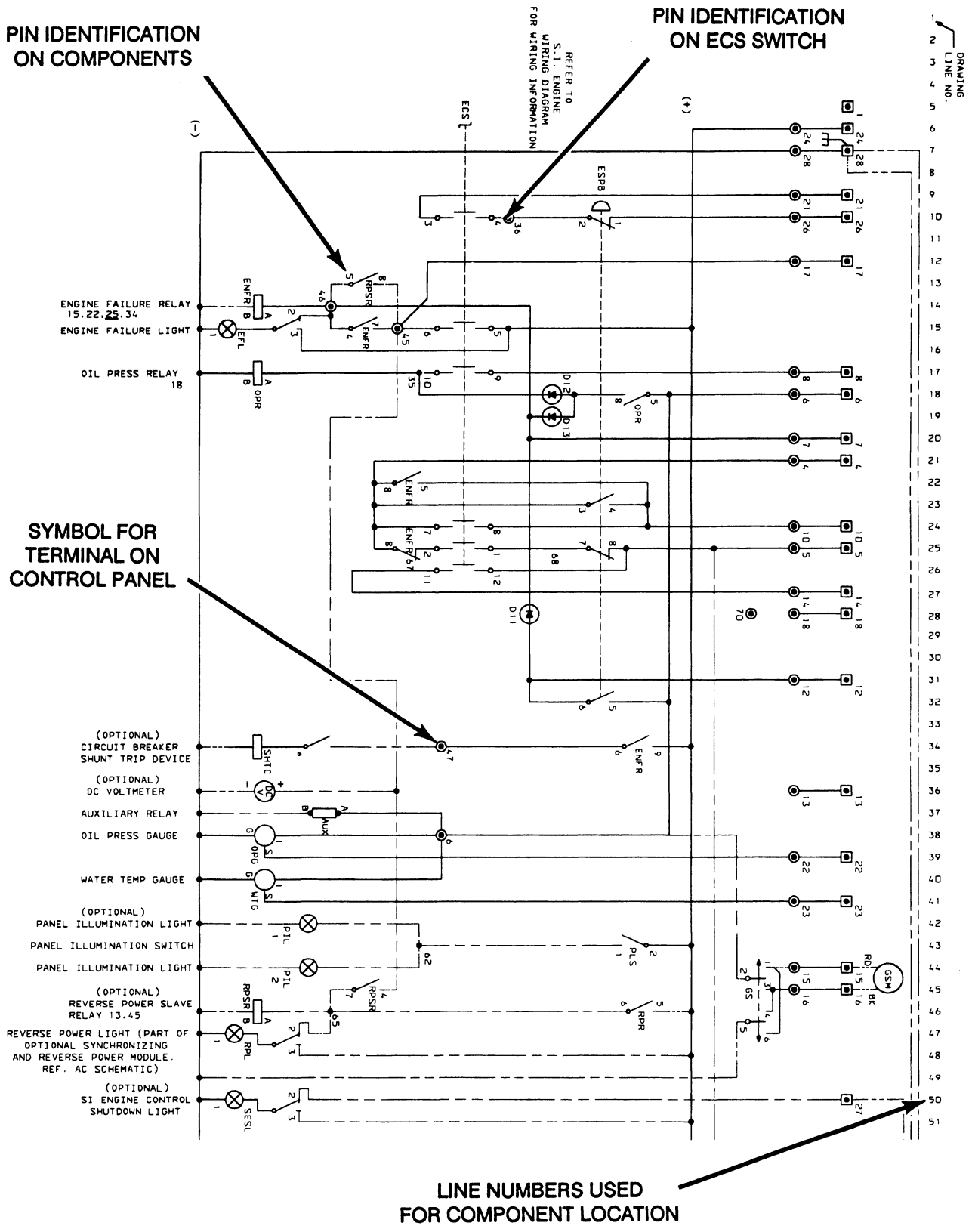
Abbreviations

AM	Ammeter
ADS	Engine Combustion Air Damper Position Switch
ADT	Arming Delay Timer
ALM	Alarm Module
ALS	Alarm Silence Push Button
ALT	Alternator
AR	Arming Relay
ASV	Air Start Solenoid Valve
AUX	Auxiliary Relay (Crank Termination)
AVS	Ammeter Voltmeter Phase Selector Switch
AWG	American Wire Gauge
BATT	Battery
BCF	Battery Charger Failure Switch
BCL	Battery Charger Failure Lamp
C	Common
CB	Circuit Breaker
CCM	Cycle Crank Module
CDM	Engine Cooldown Timer Module
CT	Current Transformer
CTR	Crank Termination Relay
D	Diode
DCV	DC Voltmeter
ECS	Engine Control Switch
EFL	Engine Failure Light
EG	Electronic Governor
EGA	Electronic Governor Actuator
ENFR	Engine Failure Relay
ESPB	Emergency Stop Push Button
ESS	Electronic Speed Switch
F	Fuse
FCR	Fuel Control Relay
FM	Frequency Meter
FMR	Frequency Meter Resistor
GEN	Generator
GS	Governor Switch
GSM	Governor Synchronizing Motor
GSOV	Gas Shut-Off Valve
HWTAS	High Water Temperature Alarm Switch
IC	Remote Start/Stop Initiate Contact
L	Load Leads
LOLAS	Low Oil Level Alarm Switch
LOPAS	Low Oil Pressure Alarm Switch
LTS	Lamp Test Switch
LWLAS	Low Water Level Alarm Switch
LWTAS	Low Water Temperature Alarm Switch
LWTL	Low Water Temperature Light
MAN	Manual
MCB	Main Circuit Breaker
MPU	Magnetic Speed Pickup
NC	Normally Closed
NO	Normally Open
OCL	Overcrank Light
OCR	Overcrank Relay
OCT	Overcrank Timer
OP	Oil Pressure
OPG	Oil Pressure Gage
OPL	Oil Pressure Light
OPR	Oil Pressure Relay
OPS	Oil Pressure Switch
OSL	Overspeed Light
OSR	Overspeed Relay
PIL	Panel Illumination Light
PLS	Panel Light Switch
POT	Potentiometer
PR	Pre-Regulator
PS	Pinion Solenoid
PWM	Analog To PWM Converter
RAN	Remote Annuciator
RPL	Reverse Power Light
RPR	Reverse Power Relay
RPSR	Reverse Power Slave Relay
RR	Run Relay
SBCT	Series Boost Current Transformer
SBM	Series Boost Module
SEC	Second
SESL	SI Engine Control Shutdown Light
SHTC	Circuit Breaker Shunt Trip Coil
SIEC	SI Engine Control
SIG	Signal
SL	Synchronizing Light
SLM	Synchronizing Light Module
SLR	Synchronizing Light Resistor
SM	Starting Motor
SMMS	Starting Motor Magnetic Switch
SMR	Starting Motor Relay
SP	Speed Adjust Potentiometer
SR	Slave Relay
SS	Synchronizing Switch
T	Generator Line Leads
TD	Time Delay Relay
TSC	Transfer Switch Position Indicating Contact
VAR	Voltage Adjust Rheostat
VM	AC Voltmeter
VR	Voltage Regulator
WT	Water Temperature
WTG	Water Temperature Gage
WTL	Water Temperature Light
WTR	Water Temperature Relay
WTS	Water Temperature Switch
WTSU	Water Temperature Sending Unit
XDUCER	Transducer
Z	Zener Diode

Symbols

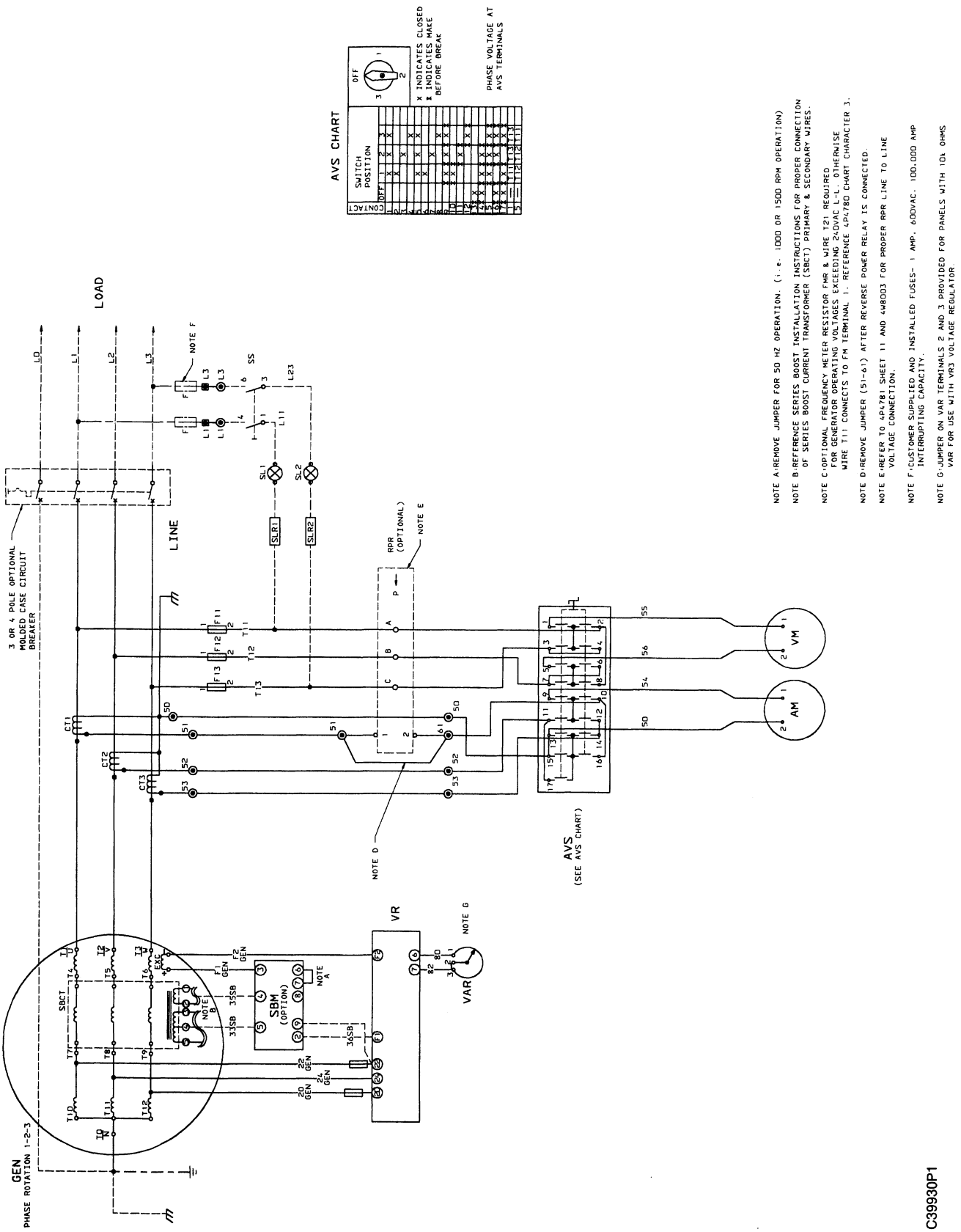


C39932P1

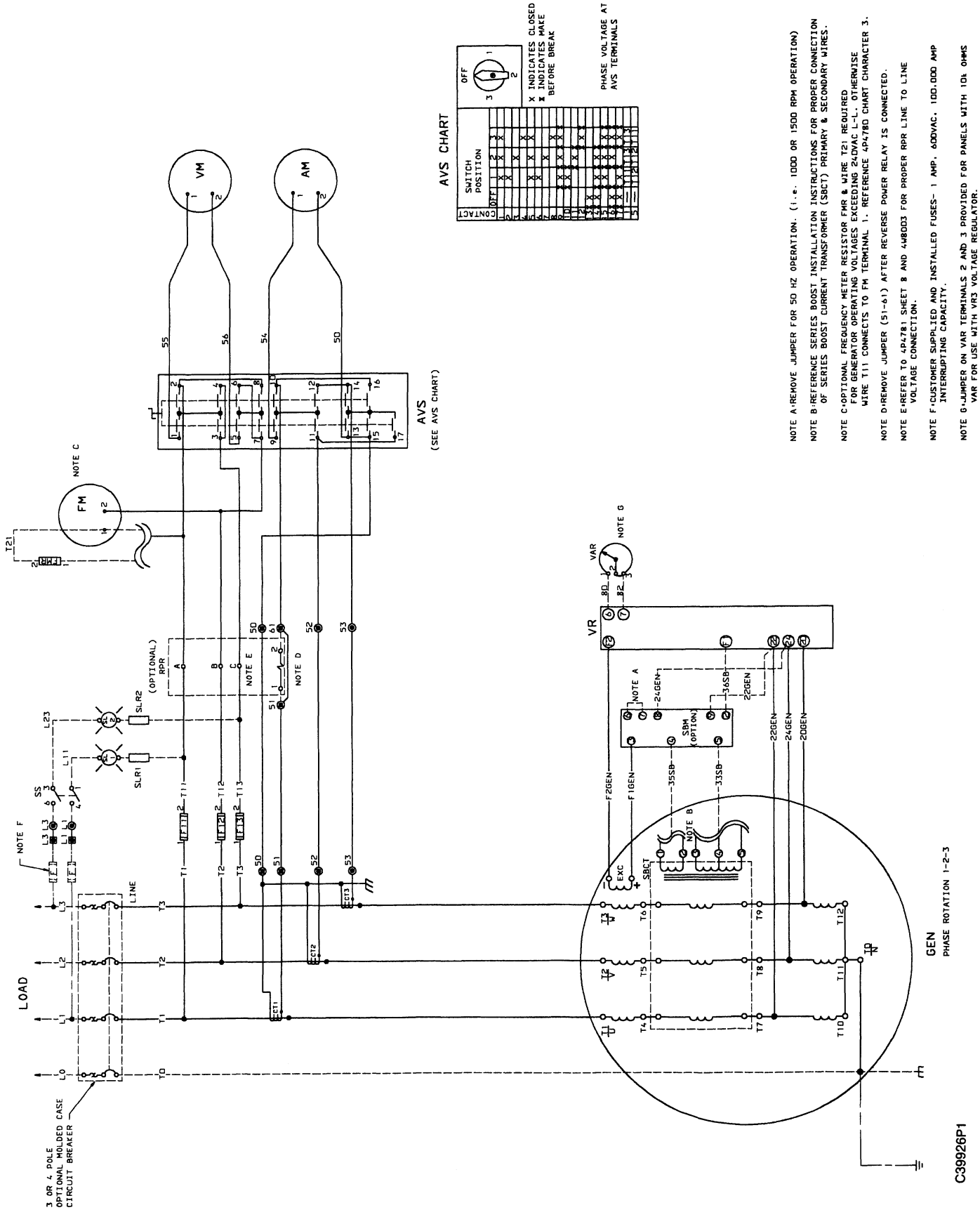

PIN IDENTIFICATION ON COMPONENTS
PIN IDENTIFICATION ON ECS SWITCH
SYMBOL FOR TERMINAL ON CONTROL PANEL
LINE NUMBERS USED FOR COMPONENT LOCATION
DRAWING LINE NO.
REFER TO S.I. ENGINE WIRING DIAGRAM FOR WIRING INFORMATION
ECS
(-)
(+)
ESPB
ENGINE FAILURE RELAY 15,22,25,34
ENGINE FAILURE LIGHT
OIL PRESS RELAY 18
(OPTIONAL) CIRCUIT BREAKER SHUNT TRIP DEVICE
(OPTIONAL) DC VOLTMETER
AUXILIARY RELAY
OIL PRESS GAUGE
WATER TEMP GAUGE
(OPTIONAL) PANEL ILLUMINATION LIGHT
PANEL ILLUMINATION SWITCH
PANEL ILLUMINATION LIGHT
(OPTIONAL) REVERSE POWER SLAVE RELAY 13,45
REVERSE POWER LIGHT (PART OF OPTIONAL SYNCHRONIZING AND REVERSE POWER MODULE. REF. AC SCHEMATIC)
(OPTIONAL) SI ENGINE CONTROL SHUTDOWN LIGHT
ENFR
RPSR
EFL
OPR
SHTC
AUX
OPG
WTG
PIL
PLS
RPR
RPL
SESL
GSM
D11
D12
D13
70
68
GS

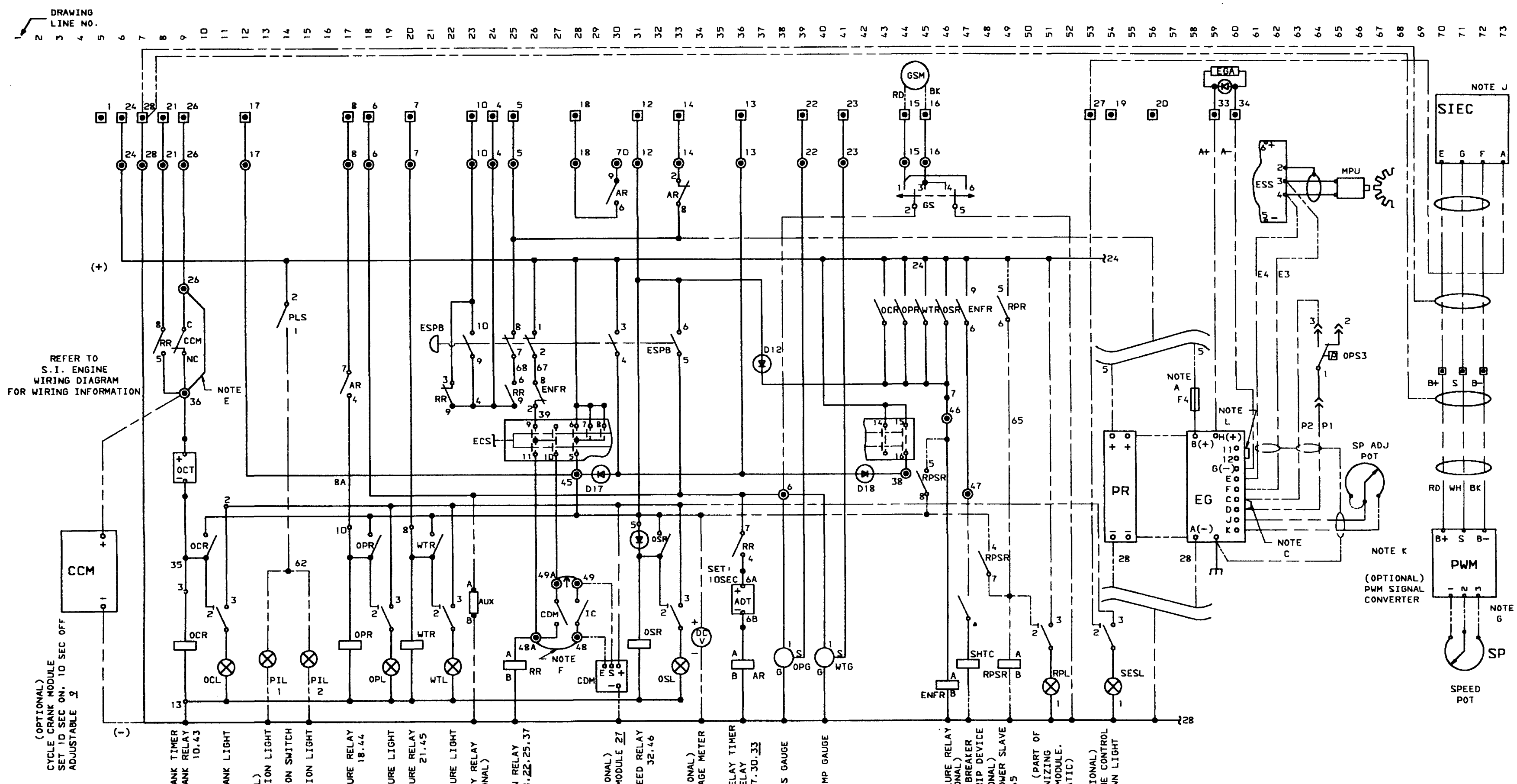
C39925P2

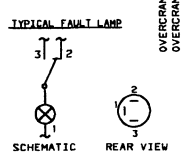
AC Schematic (IEC) – With Voltage Regulator Series Boost Option



AC Schematic (JIC) – With Voltage Regulator Series Boost Option

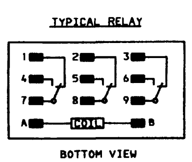


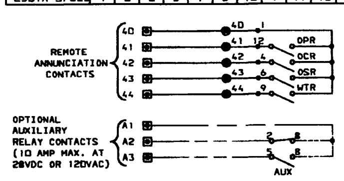




GOVERNOR TERMINAL CHART (NOTE B)

GOVERNOR	A	B	C	D	E	F	G	H	J	K
	TERMINAL DESIGNATION CROSS REFERENCE									
2301 SPEED	1	2	10	9	7	8	5	6	11	12
1724 8290	2	1	10	9	5	6	3	4	7	8
2301A SPEED	1	2	2	5	7	8	10	9	11	12





REFERENCE: ABBREVIATIONS & SYMBOLS ON SHEET 1.

NOTE A: A FUSE (F4) OR AN OPTIONAL PRE-REGULATOR (PR) (F/U/W 2301 SPEED SENSING CONTROL ONLY) WILL BE PROVIDED WITH EACH ELECTRONIC GOVERNOR OPTION. 2301 ELECTRONIC GOVERNOR CONTROLS USE BUSSMAN AGC-3/4 FUSE. 8290 ELECTRONIC GOVERNOR CONTROLS USE BUSSMAN AGC-10 FUSE.

NOTE B: REFERENCE CHART 4P4780 CHARACTER 7 FOR CONTROL PANEL MOUNTED GOVERNOR OPTIONS.

NOTE C: REMOVE JUMPER FROM ELECTRIC GOVERNOR TERMINALS C AND D IF OPTIONAL OPS3 IS PROVIDED. REFERENCE GOVERNOR TERMINAL CHART FOR TERMINAL DESIGNATION OF SPECIFIC GOVERNOR CONTROLS.

NOTE E: CONTROL PANEL TERMINAL STRIP JUMPER 26 TO 36 MUST BE REMOVED WHEN CYCLE CRANK MODULE IS INSTALLED.

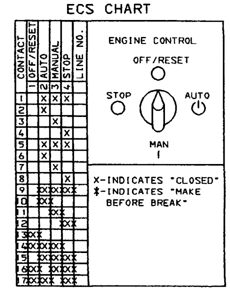
NOTE F: CONTROL PANEL TERMINAL STRIP JUMPERS 48 TO 48A AND 49 TO 49A MUST BE REMOVED WHEN COOLDOWN MODULE IS ADDED.

NOTE J: INTERCONNECT WIRE TS-27 WILL NOT BE PROVIDED F/U/W E369 (3406 LEAN BURN ENGINE).

NOTE K: PWM SIGNAL CONVERTOR F/U/W CATERPILLAR DIGITAL ELECTRONIC FUEL SYSTEM CONTROL IS NOT COMPATIBLE WITH WOODWARD ELECTRONIC GOVERNOR CONTROLS.

NOTE L: JUMPER PROVIDED ON WOODWARD 8290 ELECTRONIC GOVERNOR CONTROLS ONLY.

ECS CHART



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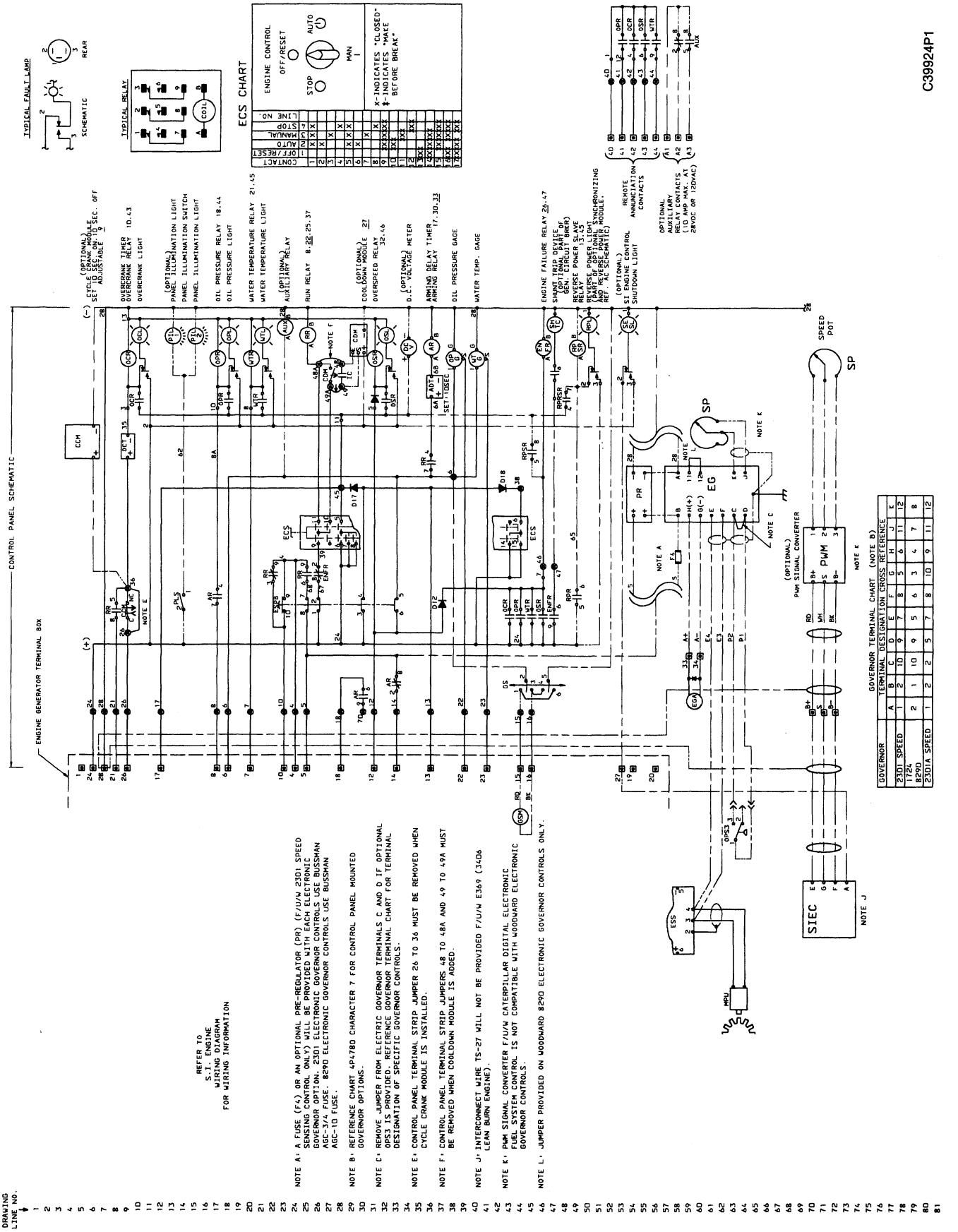
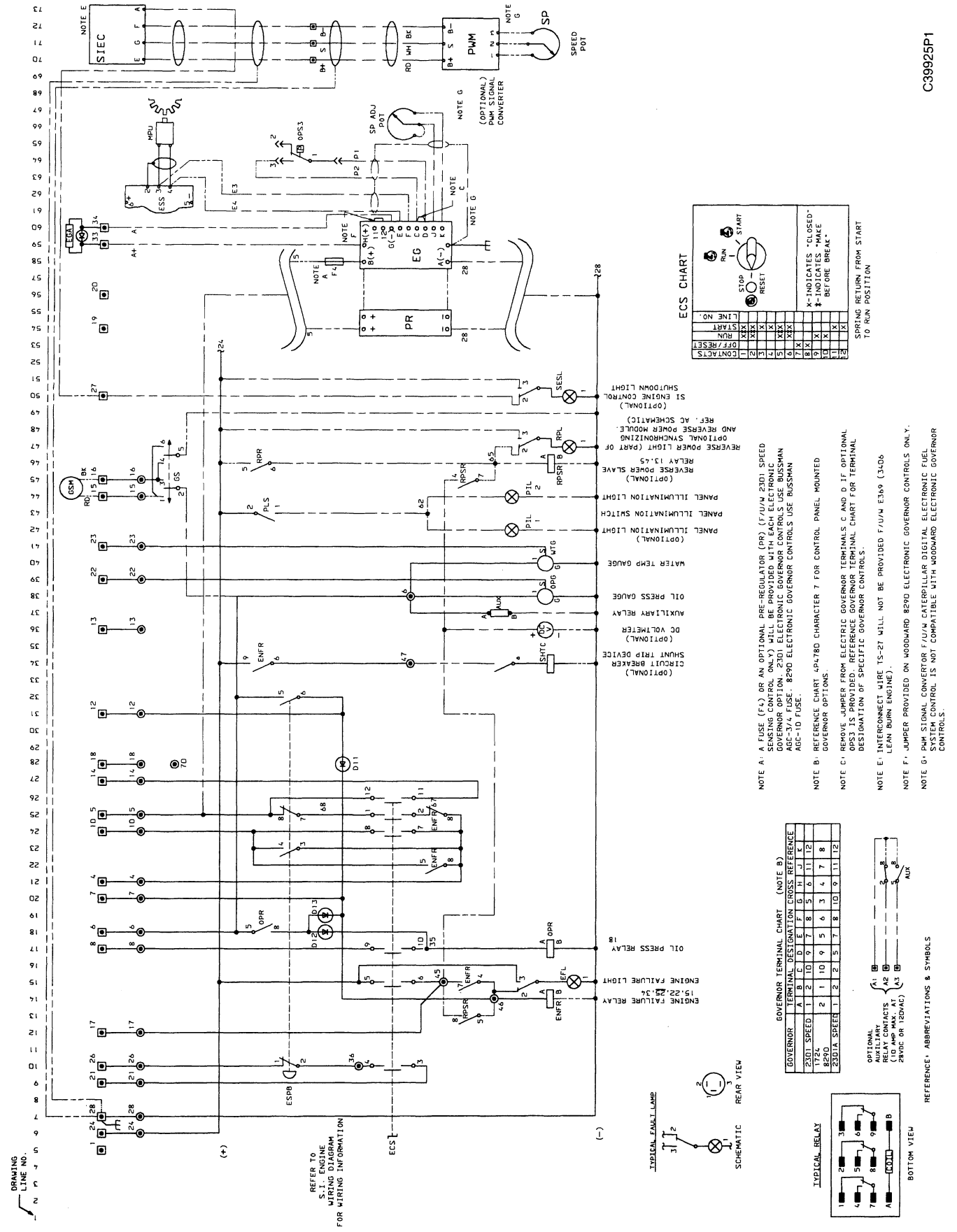
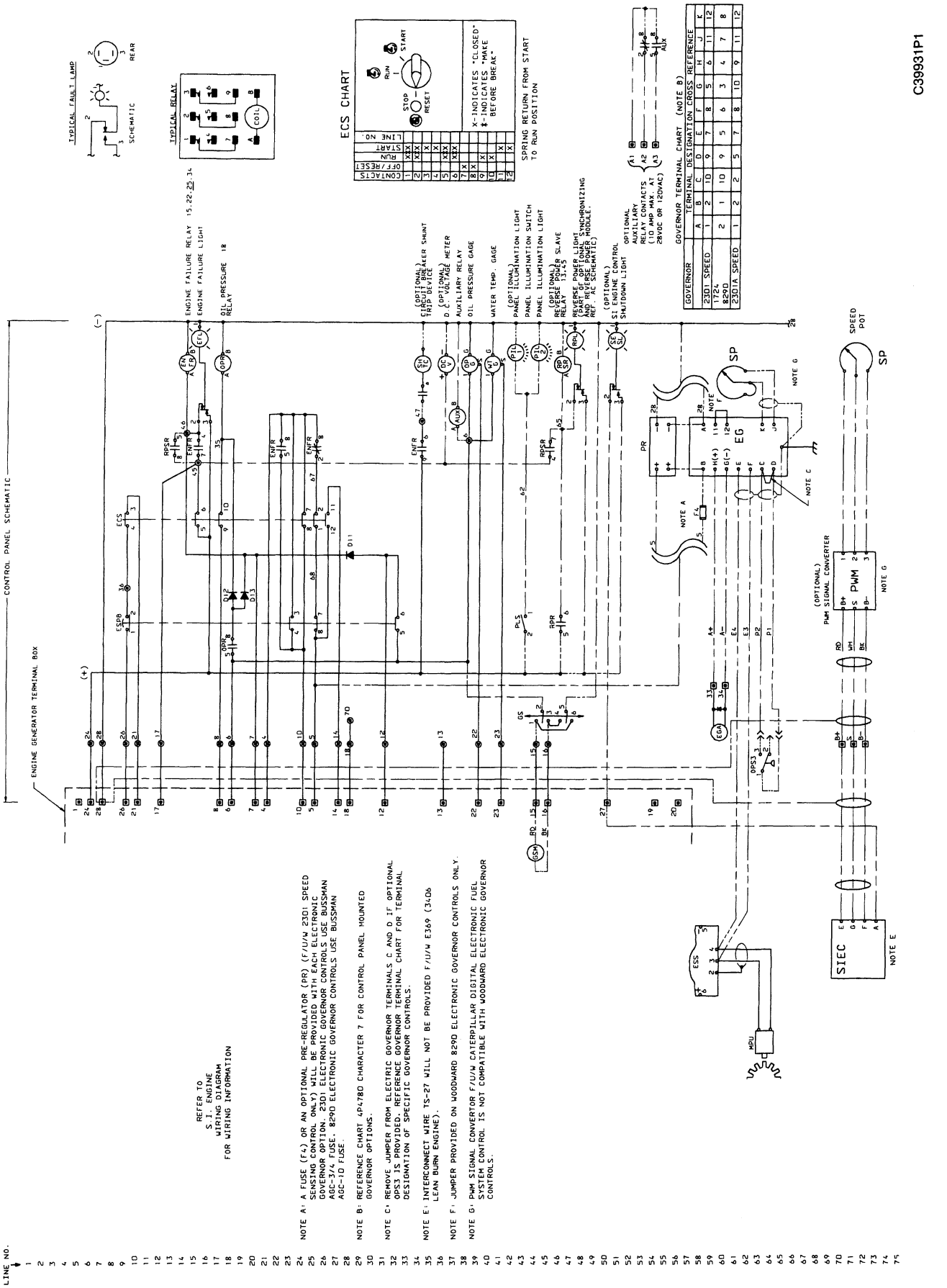
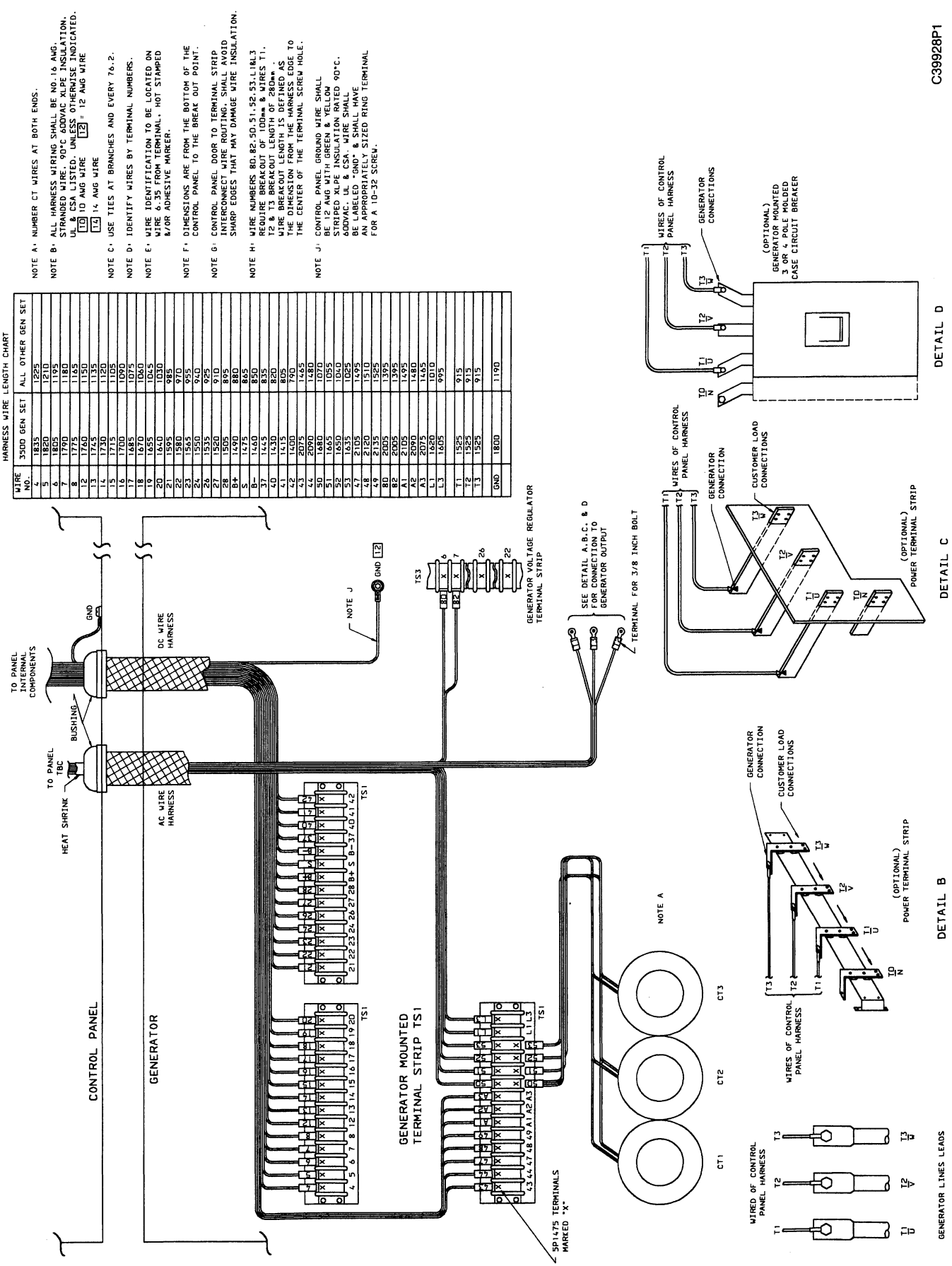
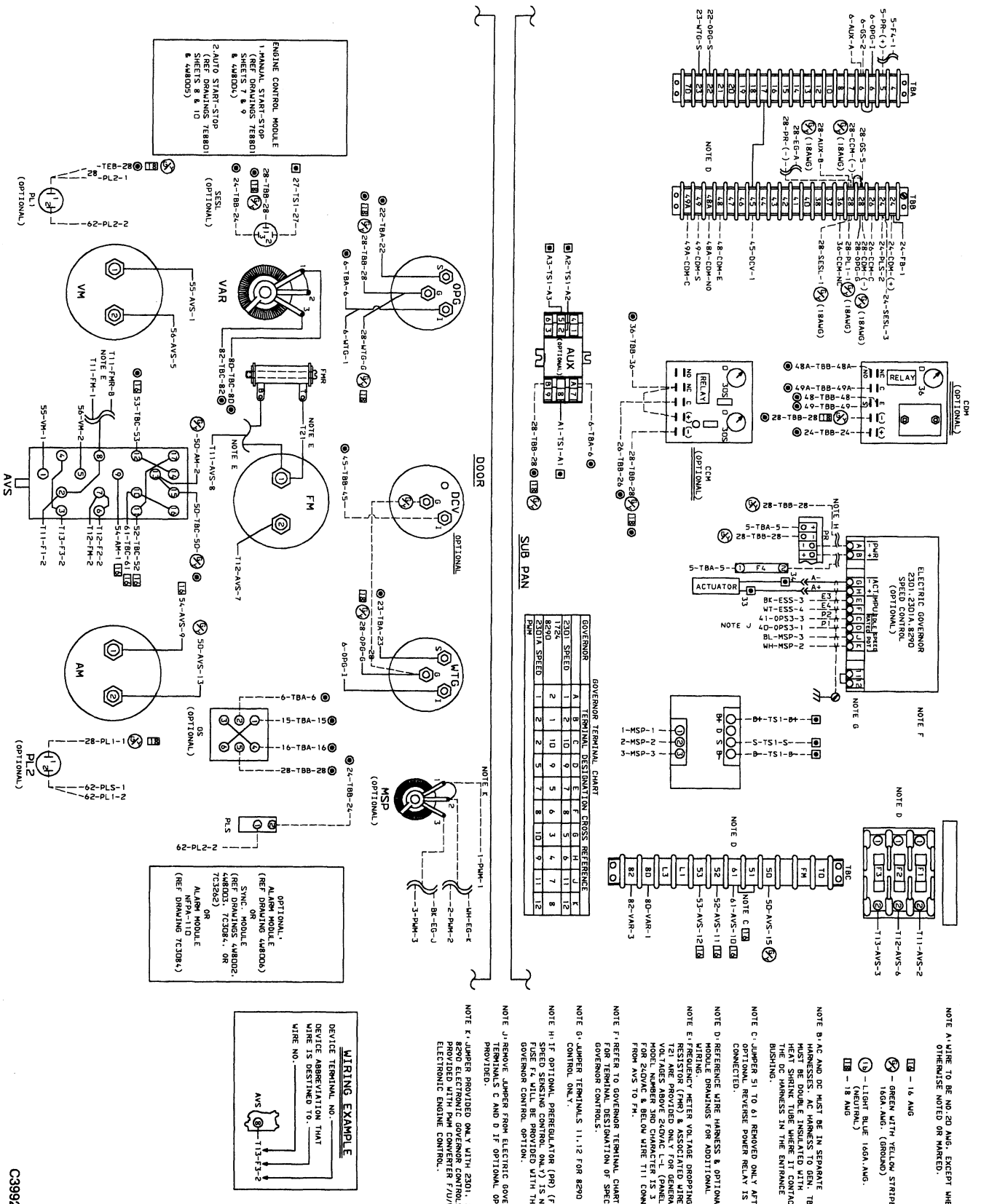

C39924P1
CONTROL PANEL SCHEMATIC
ENGINE GENERATOR TERMINAL BOX
ECS CHART
TYPICAL FAULT LAMP
TYPICAL RELAY
REFER TO S.I. ENGINE WIRING DIAGRAM FOR WIRING INFORMATION
NOTE A: A FUSE (F+) OR AN OPTIONAL PRE-REGULATOR (PR) (F/U/W 2301 SPEED SENSING CONTROL ONLY) WILL BE PROVIDED WITH EACH ELECTRONIC GOVERNOR OPTION. 2301 ELECTRONIC GOVERNOR CONTROLS USE BUSSMAN AGC-3/4 FUSE. 8290 ELECTRONIC GOVERNOR CONTROLS USE BUSSMAN AGC-10 FUSE.
NOTE B: REFERENCE CHART 4P4780 CHARACTER 7 FOR CONTROL PANEL MOUNTED GOVERNOR OPTIONS.
NOTE C: REMOVE JUMPER FROM ELECTRIC GOVERNOR TERMINALS C AND D IF OPTIONAL OPS3 IS PROVIDED. REFERENCE GOVERNOR TERMINAL CHART FOR TERMINAL DESIGNATION OF SPECIFIC GOVERNOR CONTROLS.
NOTE E: CONTROL PANEL TERMINAL STRIP JUMPER 26 TO 36 MUST BE REMOVED WHEN CYCLE CRANK MODULE IS INSTALLED.
NOTE F: CONTROL PANEL TERMINAL STRIP JUMPERS 48 TO 48A AND 49 TO 49A MUST BE REMOVED WHEN COOLDOWN MODULE IS ADDED.
NOTE J: INTERCONNECT WIRE TS-27 WILL NOT BE PROVIDED F/U/W E369 (3406 LEAN BURN ENGINE).
NOTE K: PWM SIGNAL CONVERTER F/U/W CATERPILLAR DIGITAL ELECTRONIC FUEL SYSTEM CONTROL IS NOT COMPATIBLE WITH WOODWARD ELECTRONIC GOVERNOR CONTROLS.
NOTE L: JUMPER PROVIDED ON WOODWARD 8290 ELECTRONIC GOVERNOR CONTROLS ONLY.
GOVERNOR TERMINAL CHART (NOTE B)
GOVERNOR | TERMINAL DESIGNATION CROSS REFERENCE
2301 SPEED
1724
8290
2301A SPEED


C39925P1
SIEC
PWM
SP
SPEED POT
(OPTIONAL) PWM SIGNAL CONVERTER
MPU
SP ADJ POT
EG
PR
ECS CHART
CONTACTS
OFF/RESET
RUN
START
LINE NO.
RUN
STOP
RESET
X-INDICATES "CLOSED"
#-INDICATES "MAKE BEFORE BREAK"
SPRING RETURN FROM START TO RUN POSITION
SI ENGINE CONTROL SHUTDOWN LIGHT (OPTIONAL)
REVERSE POWER LIGHT (PART OF OPTIONAL SYNCHRONIZING AND REVERSE POWER MODULE. REF. AC SCHEMATIC)
REVERSE POWER SLAVE RELAY 13,45 (OPTIONAL)
PANEL ILLUMINATION LIGHT
PANEL ILLUMINATION SWITCH
PANEL ILLUMINATION LIGHT (OPTIONAL)
WATER TEMP GAUGE
OIL PRESS GAUGE
AUXILIARY RELAY
DC VOLTMETER (OPTIONAL)
CIRCUIT BREAKER SHUNT TRIP DEVICE (OPTIONAL)
OIL PRESS RELAY
ENGINE FAILURE LIGHT
ENGINE FAILURE RELAY 15,22,25,34
REFER TO S.I. ENGINE WIRING DIAGRAM FOR WIRING INFORMATION
ESPB
ECS
(+)
(-)
DRAWING LINE NO.
TYPICAL FAULT LAMP
SCHEMATIC
REAR VIEW
GOVERNOR TERMINAL CHART (NOTE B)
GOVERNOR
TERMINAL DESIGNATION CROSS REFERENCE
2301 SPEED
2301A SPEED
8280
OPTIONAL AUXILIARY RELAY CONTACTS (10 AMP MAX. AT 28VDC OR 120VAC)
TYPICAL RELAY
BOTTOM VIEW
NOTE A: A FUSE (F4) OR AN OPTIONAL PRE-REGULATOR (PR) (F/U/W 2301 SPEED SENSING CONTROL ONLY) WILL BE PROVIDED WITH EACH ELECTRONIC GOVERNOR OPTION. 2301 ELECTRONIC GOVERNOR CONTROLS USE BUSSMAN AGC-3/4 FUSE. 8290 ELECTRONIC GOVERNOR CONTROLS USE BUSSMAN AGC-10 FUSE.
NOTE B: REFERENCE CHART 4P4780 CHARACTER 7 FOR CONTROL PANEL MOUNTED GOVERNOR OPTIONS.
NOTE C: REMOVE JUMPER FROM ELECTRIC GOVERNOR TERMINALS C AND D IF OPTIONAL OPSJ IS PROVIDED. REFERENCE GOVERNOR TERMINAL CHART FOR TERMINAL DESIGNATION OF SPECIFIC GOVERNOR CONTROLS.
NOTE E: INTERCONNECT WIRE TS-27 WILL NOT BE PROVIDED F/U/W E369 (3406 LEAN BURN ENGINE).
NOTE F: JUMPER PROVIDED ON WOODWARD 8290 ELECTRONIC GOVERNOR CONTROLS ONLY.
NOTE G: PWM SIGNAL CONVERTOR F/U/W CATERPILLAR DIGITAL ELECTRONIC FUEL SYSTEM CONTROL IS NOT COMPATIBLE WITH WOODWARD ELECTRONIC GOVERNOR CONTROLS.
REFERENCE: ABBREVIATIONS & SYMBOLS


C39931P1
CONTROL PANEL SCHEMATIC
ENGINE GENERATOR TERMINAL BOX
ECS CHART
SPRING RETURN FROM START TO RUN POSITION
X-INDICATES "CLOSED"
#-INDICATES "MAKE BEFORE BREAK"
GOVERNOR TERMINAL CHART (NOTE B)
SPEED POT
(OPTIONAL) PWM SIGNAL CONVERTER
SIEC
MPU
NOTE A: A FUSE (F4) OR AN OPTIONAL PRE-REGULATOR (PR) (F/U/W 2301 SPEED SENSING CONTROL ONLY) WILL BE PROVIDED WITH EACH ELECTRONIC GOVERNOR OPTION. 2301 ELECTRONIC GOVERNOR CONTROLS USE BUSSMAN AGC-3/4 FUSE. 8290 ELECTRONIC GOVERNOR CONTROLS USE BUSSMAN AGC-10 FUSE.
NOTE B: REFERENCE CHART 4P4780 CHARACTER 7 FOR CONTROL PANEL MOUNTED GOVERNOR OPTIONS.
NOTE C: REMOVE JUMPER FROM ELECTRIC GOVERNOR TERMINALS C AND D IF OPTIONAL OPS3 IS PROVIDED. REFERENCE GOVERNOR TERMINAL CHART FOR TERMINAL DESIGNATION OF SPECIFIC GOVERNOR CONTROLS.
NOTE E: INTERCONNECT WIRE TS-27 WILL NOT BE PROVIDED F/U/W E369 (3406 LEAN BURN ENGINE).
NOTE F: JUMPER PROVIDED ON WOODWARD 8290 ELECTRONIC GOVERNOR CONTROLS ONLY.
NOTE G: PWM SIGNAL CONVERTOR F/U/W CATERPILLAR DIGITAL ELECTRONIC FUEL SYSTEM CONTROL IS NOT COMPATIBLE WITH WOODWARD ELECTRONIC GOVERNOR CONTROLS.
REFER TO S.I. ENGINE WIRING DIAGRAM FOR WIRING INFORMATION
DRAWING LINE NO.


NOTE A: NUMBER CT WIRES AT BOTH ENDS.
NOTE B: ALL HARNESS WIRING SHALL BE NO.16 AWG, STRANDED WIRE, 90°C 600VAC XLPE INSULATION. UL & CSA LISTED. UNLESS OTHERWISE INDICATED. 10 10 AWG WIRE 12 = 12 AWG WIRE 14 14 AWG WIRE
NOTE C: USE TIES AT BRANCHES AND EVERY 76.2.
NOTE D: IDENTIFY WIRES BY TERMINAL NUMBERS.
NOTE E: WIRE IDENTIFICATION TO BE LOCATED ON WIRE 6.35 FROM TERMINAL, HOT STAMPED &/OR ADHESIVE MARKER.
NOTE F: DIMENSIONS ARE FROM THE BOTTOM OF THE CONTROL PANEL TO THE BREAK OUT POINT.
NOTE G: CONTROL PANEL DOOR TO TERMINAL STRIP INTERCONNECT WIRE ROUTING SHALL AVOID SHARP EDGES THAT MAY DAMAGE WIRE INSULATION.
NOTE H: WIRE NUMBERS 80,82,50,51,52,53,L1&L3 REQUIRE BREAKOUT OF 100mm & WIRES T1, T2 & T3 BREAKOUT LENGTH OF 280mm. WIRE BREAKOUT LENGTH IS DEFINED AS THE DIMENSION FROM THE HARNESS EDGE TO THE CENTER OF THE TERMINAL SCREW HOLE.
NOTE J: CONTROL PANEL GROUND WIRE SHALL BE 12 AWG WITH GREEN & YELLOW STRIPED XLPE INSULATION RATED 90°C. 600VAC. UL & CSA. WIRE SHALL BE LABELED "GND" & SHALL HAVE AN APPROPRIATELY SIZED RING TERMINAL FOR A 10-32 SCREW.
NOTE F&H HARNESS WIRE LENGTH CHART
WIRE NO. | 3500 GEN SET | ALL OTHER GEN SET
4 1835 1225
5 1820 1210
6 1805 1195
7 1790 1180
8 1775 1165
12 1760 1150
13 1745 1135
14 1730 1120
15 1715 1105
16 1700 1090
17 1685 1075
18 1670 1060
19 1655 1045
20 1640 1030
21 1595 985
22 1580 970
23 1565 955
24 1550 940
26 1535 925
27 1520 910
28 1505 895
84 1490 880
5 1475 865
8 1460 850
37 1445 835
40 1430 820
41 1415 805
42 1400 790
43 2075 1465
44 2090 1480
50 1680 1070
51 1665 1055
52 1650 1040
53 1635 1025
47 2105 1495
48 2120 1510
49 2135 1525
80 2005 1395
82 2005 1395
A1 2105 1495
A2 2090 1480
A3 2075 1465
L1 1605 1010
L3 1605 995
T1 1525 915
T2 1525 915
T3 1525 915
GND 1800 1190
TO PANEL INTERNAL COMPONENTS
GND
BUSHING
TO PANEL TBC
HEAT SHRINK
DC WIRE HARNESS
AC WIRE HARNESS
NOTE J
GND 12
TS3
GENERATOR VOLTAGE REGULATOR TERMINAL STRIP
SEE DETAIL A,B,C, & D FOR CONNECTION TO GENERATOR OUTPUT
TERMINAL FOR 3/8 INCH BOLT
CONTROL PANEL
GENERATOR
GENERATOR MOUNTED TERMINAL STRIP TS1
TS1
NOTE A
CT1
CT2
CT3
SP1475 TERMINALS MARKED "X"
WIRES OF CONTROL PANEL HARNESS
GENERATOR CONNECTIONS
(OPTIONAL) GENERATOR MOUNTED 3 OR 4 POLE MOLDED CASE CIRCUIT BREAKER
DETAIL D
GENERATOR CONNECTION
CUSTOMER LOAD CONNECTIONS
(OPTIONAL) POWER TERMINAL STRIP
DETAIL C
DETAIL B
WIRED OF CONTROL PANEL HARNESS
GENERATOR LINES LEADS
DETAIL A
C39928P1

Wiring Diagram – Main Chassis With Options



NOTE A: WIRE TO BE NO. 20 AWG, EXCEPT WHERE OTHERWISE NOTED OR MARKED.

16 – 16 AWG

(G) – GREEN WITH YELLOW STRIPE 16GA. AWG. (GROUND)

(L) – LIGHT BLUE 16GA. AWG. (NEUTRAL)

18 – 18 AWG

NOTE B: AC AND DC MUST BE IN SEPARATE HARNESSES. AC HARNESS TO GEN. TB MUST BE DOUBLE INSULATED WITH HEAT TUBE WHERE IT CONTACTS THE DC HARNESS IN THE ENTRANCE BUSHING.

NOTE C: JUMPER 51 TO 61 REMOVED ONLY AFTER OPTIONAL REVERSE POWER RELAY IS CONNECTED.

NOTE D: REFERENCE WIRE HARNESS & OPTIONAL MODULE DRAWINGS FOR ADDITIONAL WIRING.

NOTE E: FREQUENCY METER VOLTAGE DROPPING RESISTOR (FMR) & ASSOCIATED WIRE T12 ARE PROVIDED ONLY FOR GENERATOR VOLTAGES ABOVE 240VAC L-L (PANEL MODEL NUMBER 3RD CHARACTER IS 3 OR 4). FOR 240VAC & BELOW WIRE T11 CONNECTS FROM AVS TO FM.

NOTE F: REFER TO GOVERNOR TERMINAL CHART FOR TERMINAL DESIGNATION OF SPECIFIC GOVERNOR CONTROLS.

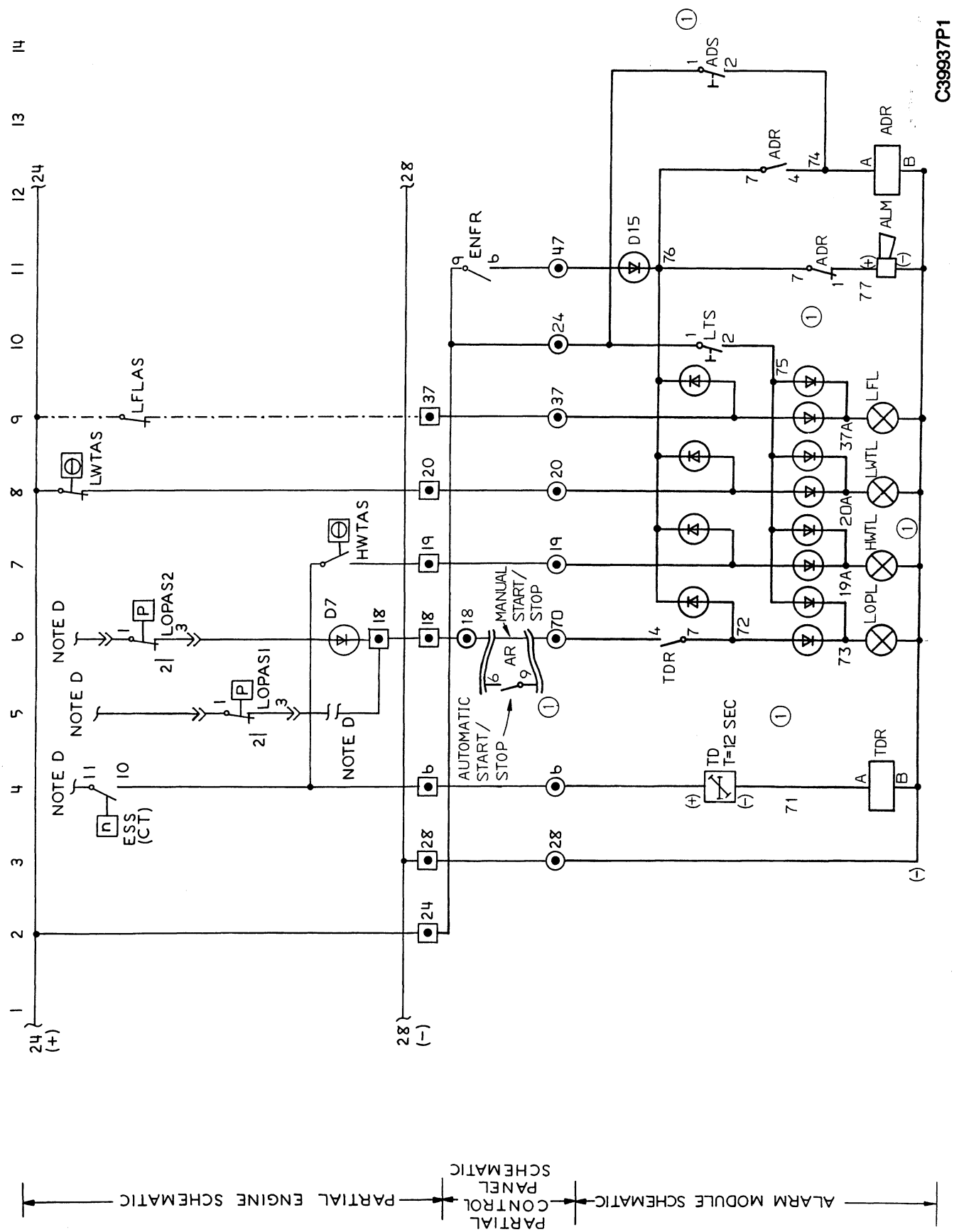
NOTE G: JUMPER TERMINALS 11-12 FOR 8290 CONTROL ONLY.

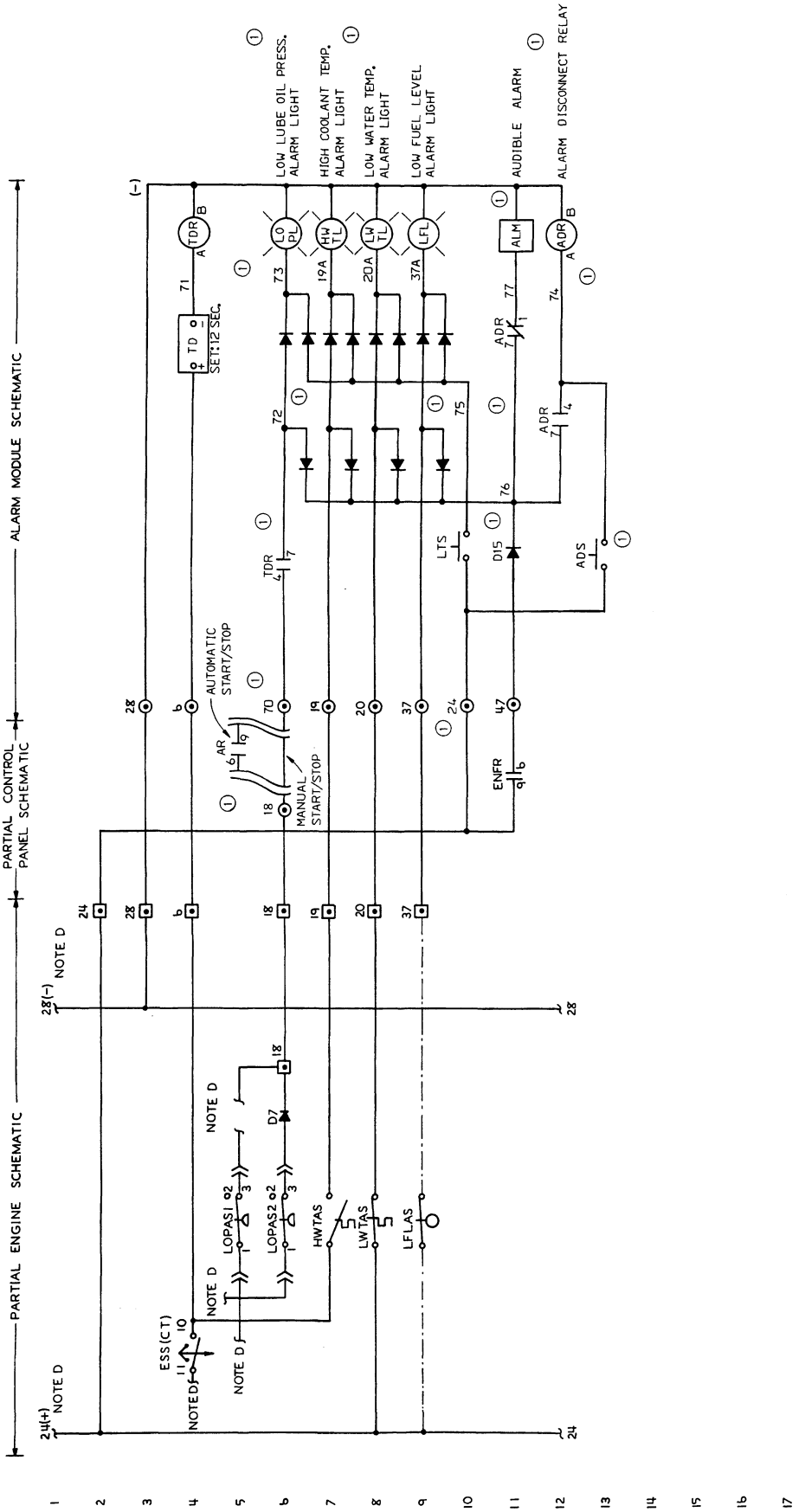
NOTE H: IF OPTIONAL PREREGULATOR (PR) (F/U/W 2301 SPEED SENSING CONTROL ONLY) IS NOT PROVIDED, FUSE F4 WILL BE PROVIDED WITH THE ELECTRONIC GOVERNOR CONTROL OPTION.

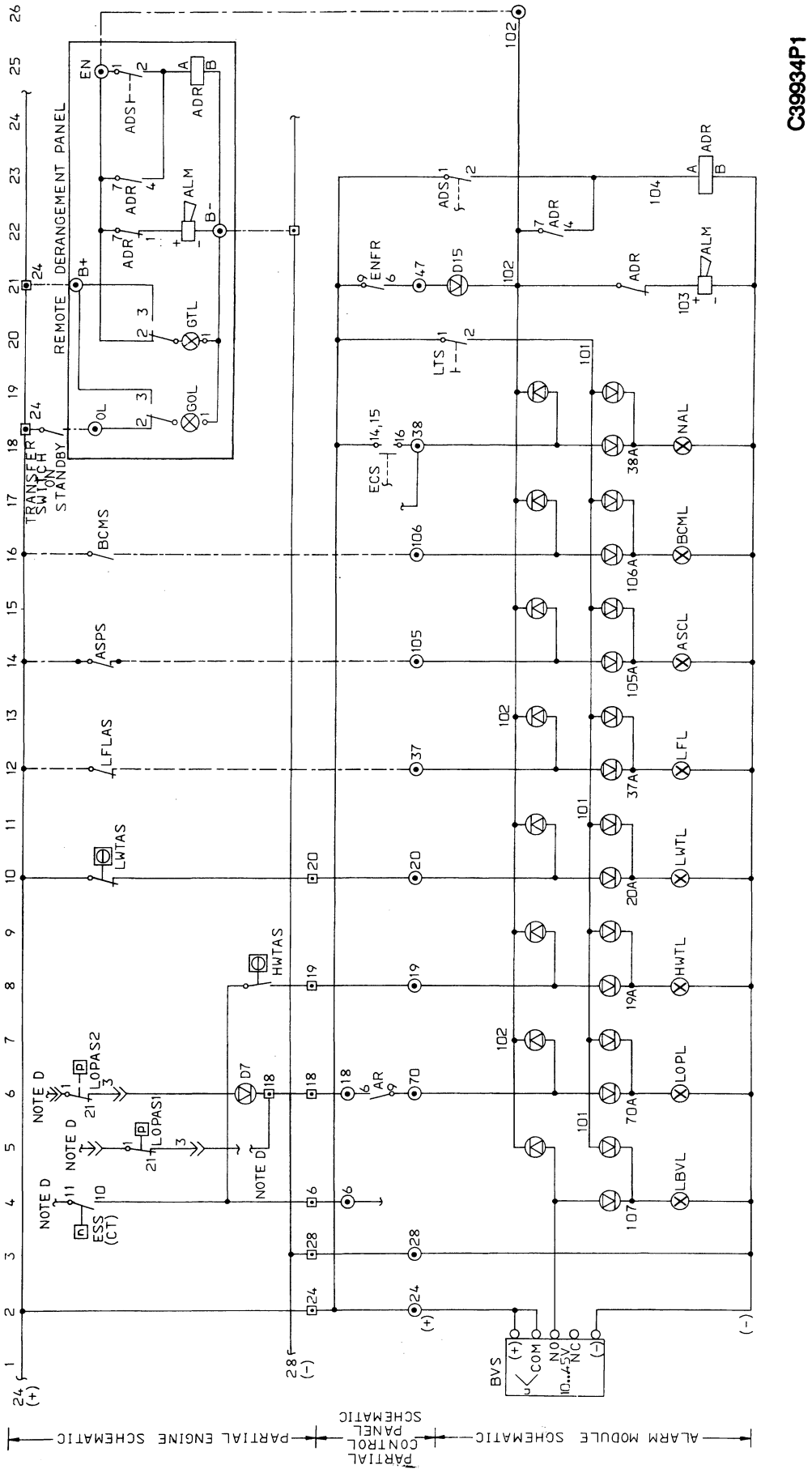
NOTE J: REMOVE JUMPER FROM ELECTRIC GOVERNOR TERMINALS C AND D IF OPTIONAL OPSS IS PROVIDED.

NOTE K: JUMPER PROVIDED ONLY WITH 2301, 2301A, OR 8290 ELECTRONIC GOVERNOR CONTROLS. NO JUMPER PROVIDED WITH PWM CONVERTER F/U/W SI ELECTRONIC ENGINE CONTROL.

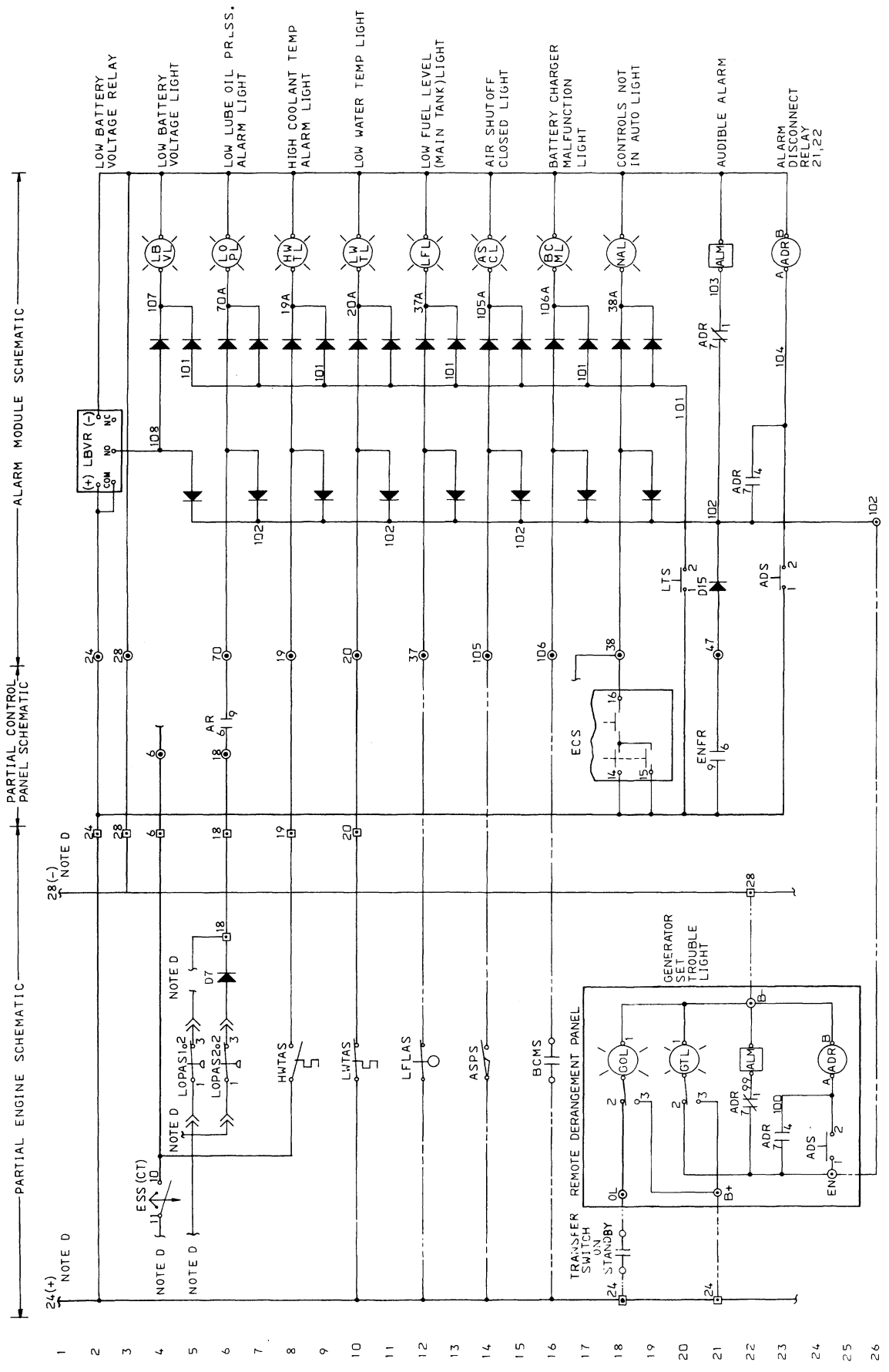
Schematic – Alarm Module (NFPA 99) (IEC)




C39936P1
PARTIAL ENGINE SCHEMATIC
PARTIAL CONTROL PANEL SCHEMATIC
ALARM MODULE SCHEMATIC
LOW LUBE OIL PRESS. ALARM LIGHT
HIGH COOLANT TEMP. ALARM LIGHT
LOW WATER TEMP. ALARM LIGHT
LOW FUEL LEVEL ALARM LIGHT
AUDIBLE ALARM
ALARM DISCONNECT RELAY
AUTOMATIC START/STOP
MANUAL START/STOP
TD SET:12 SEC.
LOPAS1
LOPAS2
HWTAS
LWTAS
LFLAS
ESS(CT)
ENFR
LTS
ADS
NOTE D


C39934P1
REMOTE DERANGEMENT PANEL
TRANSFER SWITCH STANDBY
EN
ADS
ADR
ALM
GTL
GOL
OL
B+
B-
BCMS
ASPS
LFLAS
LWTAS
HWTAS
ESS (CT)
LOPAS1
LOPAS2
NOTE D
D7
AR
ENFR
D15
LTS
ECS
NAL
BCML
ASCL
LFL
LWTL
HWTL
LOPL
LBVL
BVS
COM
NO
NC
5V
(+)
(-)
ALARM MODULE SCHEMATIC
PARTIAL CONTROL PANEL SCHEMATIC
PARTIAL ENGINE SCHEMATIC

Schematic – Alarm Module (NFPA 110) (JIC)



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