DIAGNOSTIC
REPAIR
MANUAL

50 Hz and 60 Hz Air-Cooled Product with Evolution™ or Nexus™ Control

STANDBY GENERATORS

FREQUENTLY ASKED QUESTIONS:

Q: Do I have to supply the generator with the 100% loaded BTU rated fuel supply and pipe size?
A: Yes, the generator needs the 100% loaded BTU fuel rating to start, run and handle loads. The fuel pipe must be sized for 100% load, regardless of the load.

Q: What distance does the gas regulator need to be from the generator?
A: Distance is best practices per the regulator manufacturer's instruction to assure proper operation of the regulator and also to meet code.

Q: Can I use a fuel shut off valve that is not "Full Flow Rated"?
A: No, it must be a Full Flow Rated valve and must also match the required fuel pipe ID dimensions.

Q: Do pipe elbows, tees, drip legs, etc. affect gas pipe size and flow?
A: Yes, they are restrictions to gas flow. You must add *2.5ft. (.76m)* per each elbow, tee, etc. to the overall calculated distance from the source to the generator.

Q: Can I leave the unit on the shipping pallet and install it?
A: No, it must be installed per local jurisdiction, code and the instructions as outlined by Generac.

Q: Can the generator be mounted indoors or in a structure?
A: No, it is designed, manufactured and sold for outdoor use only!

Q: Can I run the Main AC and Control Wires in the same conduit?
A: Yes, this wiring can be run in the same conduit if the appropriate rated wire and insulation is used and it meets code.

Q: Can the Transfer Switch be mounted outdoors?
A: Only if it's a NEMA 3R rated transfer switch.

QUICK REFERENCE GUIDE (EVOLUTION CONTROLLERS)

Problem	LED	Things to Check	Active Alarm	Solution
Unit running in AUTO but no power in house.	GREEN	Check MLCB.	NONE	Check MLCB if the MLCB is in the ON position contact the servicing dealer.
Unit shuts down during operation.	RED	Check the LED's/Screen for alarms.	HIGH TEMPERATURE	Check ventilation around the generator, intake, exhaust and rear of generator. If no obstruction contact serving dealer.
Unit shuts down during operation.	RED	Check the LED's/Screen for alarms.	OVERLOAD REMOVE LOAD	Clear alarm and remove household loads from the generator. Put back in AUTO and restart.
Unit was running and shuts down, attempts to restart.	RED	Check the LED's/Screen for alarms.	RPM SENSE LOSS	Clear alarm and remove household loads from the generator. Put back in AUTO and restart. It may be a fuel issue so contact the servicing dealer.
Unit will not start in AUTO with utility loss.	NONE	See if screen says unit not activated.	NOT ACTIVATED	Refer to activation section in owners manual.
Unit will not start in AUTO with utility loss.	GREEN	Check screen for start delay countdown.	None	If the start up delay is greater than expected, contact servicing dealer to adjust from 2 to 1500 seconds.
Unit will not start in AUTO with utility loss.	RED	Check the LED's/Screen for alarms.	LOW OIL PRESSURE	Check Oil Level/Add Oil Per Owners Manual. If oil level is correct contact servicing dealer.

QUICK REFERENCE GUIDE
(EVOLUTION CONTROLLERS - CONTINUED)

Problem	LED	Things to Check	Active Alarm	Solution
Unit will not start in AUTO with utility loss.	RED	Check the LED's/Screen for alarms.	RPM SENSE LOSS	Clear alarm. Check the battery using the control panel under the MAIN menu using the BATTERY MENU option. If it states battery is GOOD contact servicing dealer. If it states CHECK BATTERY replace the battery.
Unit will not start in AUTO with utility loss.	RED	Check the LED's/Screen for alarms.	OVERCRANK	Check fuel line shutoff valve is in the ON position. Clear alarm. Attempt to start the unit in MANUAL. If it does not start or starts and runs rough, contact servicing dealer.
Unit will not start in AUTO with utility loss.	RED	Check the LED's/Screen for alarms.	OVERLOAD REMOVE LOAD	Clear alarm and remove household loads from the generator. Put back in AUTO and restart.
Unit will not start in AUTO with utility loss.	RED	Check the LED's/Screen for alarms.	FUSE PROBLEM	Check the 7.5 Amp fuse. If it is bad replace it with an ATO 7.5 Amp fuse, if not contact servicing dealer.
Unit will not start in AUTO with utility loss.	RED	Check the LED's/Screen for alarms.	OVERSPEED	Contact servicing dealer.
Unit will not start in AUTO with utility loss.	RED	Check the LED's/Screen for alarms.	UNDERVOLTAGE	Contact servicing dealer.
Unit will not start in AUTO with utility loss.	RED	Check the LED's/Screen for alarms.	UNDERSPEED	Contact servicing dealer.
Unit will not start in AUTO with utility loss.	RED	Check the LED's/Screen for alarms.	STEPPER OVERCURRENT	Contact servicing dealer.
Unit will not start in AUTO with utility loss.	RED	Check the LED's/Screen for alarms.	MISWIRE	Contact servicing dealer.
Unit will not start in AUTO with utility loss.	RED	Check the LED's/Screen for alarms.	OVERVOLTAGE	Contact servicing dealer.
Yellow LED illuminated in any state.	YELLOW	Check the screen for additional information.	LOW BATTERY	Clear alarm. Check the battery using the control panel under the MAIN menu using the BATTERY MENU option. If it states battery is GOOD contact servicing dealer. If it states CHECK BATTERY replace the battery.
Yellow LED illuminated in any state.	YELLOW	Check the screen for additional information.	BATTERY PROBLEM	Contact servicing dealer.
Yellow LED illuminated in any state.	YELLOW	Check the screen for additional information.	CHARGER WARNING	Contact servicing dealer
Yellow LED illuminated in any state.	YELLOW	Check the screen for additional information.	SERVICE A	Perform SERVICE A maintenance, hit ENTER to clear.
Yellow LED illuminated in any state.	YELLOW	Check the screen for additional information.	SERVICE B	Perform SERVICE B maintenance, hit ENTER to clear.
Yellow LED illuminated in any state.	YELLOW	Check the screen for additional information.	Inspect Battery	Inspect Battery, hit ENTER to clear.

SAFETY

Throughout this publication, DANGER, WARNING, and CAUTION blocks are used to alert the operator to special instructions concerning a particular service or operation that might be hazardous if performed incorrectly or carelessly. Observe them carefully. Their definitions are as follows:

⚠DANGER

Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

(000001)

⚠WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

(000002)

⚠CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

(000003)

Four commonly used safety symbols accompany the DANGER, WARNING and CAUTION blocks. The type of information each indicates follows:

This symbol points out important safety information that, if not followed, could endanger personal safety and/or property of others.

This symbol points out potential explosion hazard.

This symbol points out potential fire hazard.

This symbol points out potential electrical shock hazard.

These "Safety Alerts" alone cannot eliminate the hazards that they signal. Strict compliance with these special instructions plus "common sense" are major accident prevention measures.

READ THIS MANUAL THOROUGHLY

This diagnostic manual has been written and published by Generac to aid our dealers' technicians and company service personnel when servicing the products described herein.

It is assumed that these personnel are familiar with the servicing procedures for these products, or like or similar products manufactured and marketed by Generac, and that they have been trained in the recommended servicing procedures for these products, including the use of common hand tools and any special Generac tools or tools from other suppliers.

Generac could not possibly know of and advise the service trade of all conceivable procedures by which a service might be performed and of the possible hazards and/or results of each method. We have not undertaken any such wide evaluation. Therefore, anyone who uses a procedure or tool not recommended by Generac must first satisfy themselves that neither his nor the products safety will be endangered by the service procedure selected.

All information, illustrations and specifications in this manual are based on the latest product information available at the time of publication.

When working on these products, remember that the electrical system and engine ignition system are capable of violent and damaging short circuits or severe electrical shocks. If you intend to perform work where electrical terminals could be grounded or touched, the battery cables should be disconnected at the battery.

Any time the intake or exhaust openings of the engine are exposed during service, they should be covered to prevent accidental entry of foreign material. Entry of such materials will result in extensive damage when the engine is started.

During any maintenance procedure, replacement fasteners must have the same measurements and strength as the fasteners that were removed. Metric bolts and nuts have numbers that indicate their strength. Customary bolts use radial lines to indicate strength while most customary nuts do not have strength markings. Mismatched or incorrect fasteners can cause damage, malfunction and possible injury.

Note: Special Notes appear in bold type throughout this publication. While not pertaining to safety, they emphasize procedures, circumstances or specifications that require special attention.

REPLACEMENT PARTS

When servicing this equipment, it is extremely important that all components be properly installed and tightened. If improperly installed and tightened, sparks could ignite fuel vapors from fuel system leaks.

Some of the terminology used in this manual may appear differently for product manufactured by the factory and branded under another label.	
Generac Name	**Honeywell Name**
QuietTest	WhisperCheck
Nexus/Evolution Controller	Sync 1.0/Sync 2.0 Controller
Nexus Smart Switches	Sync Transfer Switches with Load Shedding Capability
Nexus Wireless Remote Monitors	Sync Wireless Remote Monitors
Nexus Smart Switches	Sync Smart Switches
Service Rated Switches	
Non-Service Rated Switches	

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60 HZ – GENERATOR WITH EVOLUTION CONTROLLER									
Unit	**8 kW**	**11 kW**	**13 kW**	**14 kW**	**15 kW**	**16 kW**	**17 kW**	**20 kW**	**22 kW**
Rated Voltage	240								
Rated Max. Continuous Load Current (Amps) 240 Volts (LP/NG)	33.3/29.2	41.6/37.5	54.2/54.2	58.3/54.2	62.5/62.5	66.6/66.6	70.8/66.6	83.3/75.0	91.6/86.3
Main Line Circuit Breaker	35 Amp	50 Amp	55 Amp	60 Amp	60 Amp	65 Amp	65 Amp	90 Amp	100 Amp
Model Identification Resistor	074523D	092918Z	097751H	0A1030T	097751M	067650M	0A1031D	097752P	0A1029S
Phase	1								
Rated AC Frequency	60 Hz								
Battery Requirement	Group 26R, 12 Volts and 525 CCA Minimum								
Weight (unit only in lbs.)	360/163.3	407/184.6	435/197.3	435/197.3	471/213.6	471/213.6	437/198.2	451/204.6	526/238.6
Enclosure	Steel	Steel	Steel	Steel	Steel	Steel	Steel/ Aluminum	Aluminum	Aluminum
Normal Operating Range	This unit is tested in accordance to UL 2200 standards with an operating temperature of 20° F (-29° C) to 122°F. (50° C). For areas where temperatures fall below 32° F (0° C), a cold weather kit is highly recommended. When operated above 77° F (25° C) there may be a decrease in engine power. (Please reference the engine specifications section).								

These generators are rated in accordance with UL 2200, Safety Standard for Stationary Engine Generator Assemblies and CSA-C22.2 No. 100-04 Standard for Motors and Generators.

* Natural Gas ratings will depend on specific fuel Btu/joules content. Typical derates are between 10-20% off the LP gas rating.
** Circuits to be moved must be protected by same size breaker: For example, a 15 amp circuit in the main panel must be a 15 amp circuit in the transfer switch.

50 HZ – GENERATOR WITH EVOLUTION CONTROLLER			
Unit	**8 kVA**	**10 kVA**	**13 kVA**
Rated Voltage	110/220		
Rated Max. Continuous Load Current (Amps) 220 Volts (LP/NG)	36.4/31.8	45.5/45.5	59/59
Main Line Circuit Breaker	35 Amp	50 Amp	65 Amp
Model Identification Resistor	15K0	21K0	31K6
Phase	1		
Rated AC Frequency	50 Hz		
Battery Requirement	Group 26R, 12 Volts and 525 CCA Minimum		
Weight (unit only in lbs.)	387/175.4	425.5/193	445/201.8
Enclosure	Steel	Steel	Steel
Normal Operating Range	This unit is tested in accordance to UL 2200 standards with an operating temperature of 20° F (-29° C) to 122°F. (50° C). For areas where temperatures fall below 32° F (0° C), a cold weather kit is highly recommended. When operated above 77° F (25° C) there may be a decrease in engine power. (Please reference the engine specifications section).		

60 HZ – STATOR WINDING RESISTANCE VALUES / ROTOR RESISTANCE*							
	8 kW	**11 kW**	**13kW/14 kW**	**15 kW**	**16 &17 kW**	**20 kW**	**22 kW**
Power Windings: Across 11 & 22	0.1584-0.1840	0.1584-0.1840	0.1227-0.1425	0.0758-0.0881	0.0720-0.0837	0.0421-0.0489	0.0361 - 0.0419
Power Windings: Across 11&44	0.3168-0.3680	0.3168-0.3680	0.2454-0.2850	0.1050-0.1220	0.1440-0.1674	0.0824-0.0978	0.0722 - 0.0838
Power Windings: Across 33 & 44	0.1584-0.1840	0.1584-0.1840	0.1227-0.1425	0.0758-0.0881	0.0720-0.0837	0.0421-0.0489	0.0361 - 0.0419
Sensing Windings: Across 11 & 44	0.3538-.4112	0.3538-0.4112	0.2824-0.3280	0.1050-0.1220	0.197-0.229	0.137-0.1594	0.1526 - 0.1772
Excitation Windings: Across 2 & 6	0.5517-0.6413	0.5517-0.6414	0.8506-0.9885	0.7093-0.8243	0.7093-0.8243	0.6121-0.7114	0.6392 - 0.7429
Rotor Resistance	4.96-5.76	4.97-5.76	7.22-8.39	8.39-9.72	8.37-9.72	9.54-11.10	10.25 - 11.92

* Resistance values shown are based on new windings at 20° C. Actual readings may vary based on type of meter used and any other components or connections included in the circuit being tested.

50 HZ – STATOR WINDING RESISTANCE VALUES / ROTOR RESISTANCE			
	8 kVA	**10 kVA**	**13 kVA**
Power Windings: Across 11 & 22	0.1752 - 0.2036	0.0823 - 0.0957	0.0589 - 0.0685
Power Windings: Across 11 & 44	0.3504 - 0.4072	0.164 - .1914	0.1178 - 0.137
Power Windings: Across 33 & 44	0.1752 - 0.2036	0.0823 - 0.0957	0.0589 - 0.0685
Sensing Windings: Across 11 & 44	0.3504 - 0.4072	0.1646 - 0.1914	0.1178 - 0.1370
Stator Resistance - DPE 2-6	0.6933 - 0.8057	0.7412 - 0.8614	0.6933 - 0.8057
Rotor Resistance	6.82 - 7.93	8.28 - 9.62	9.54 - 11.10

GENERATOR EXERCISE CHARACTERISTICS					
Generator Size	**8 kW**	**11 kW**	**16 kW / 20 kW**	**22 kW**	**50 Hz (8 / 10 / 13 kVA)**
Low Speed Exercise	n/a *	n/a * ~	2400 rpm	1950 rpm	n/a *
Exercise Frequency Options	Weekly/Bi-Weekly/ Monthly	Weekly/Bi-Weekly/ Monthly	Weekly/Bi-Weekly/ Monthly	Weekly/Bi-Weekly/ Monthly	Weekly/Bi-Weekly/Monthly
Exercise Time Length	12 minutes	12 minutes	5 minutes	5 minutes	12 minutes

* Exercises at 3600 rpm
~ Private label may vary

ENGINE WITH EVOLUTION CONTROLLER				
Model	**8 kW**	**11 kW**	**13/14/15/16/17 kW**	**20/22 kW**
Type of Engine	GH-410	GT-530	GT-992	GT-999
Number of Cylinders	1	2	2	2
Displacement	410cc	530cc	992cc	999cc
Cylinder Block	Aluminum w/Cast Iron Sleeve			
Recommended Spark Plug	RC14YC	BPR6HS	RC14YC	RC12YC
Spark Plug Gap	0.76 mm (0.030 inch)	0.76 mm (0.030 inch)	1.02 mm (0.040 inch)	0.76 mm (0.030 inch)
Compression Pressure	190 psi +/- 10-15%	150 psi +/- 10-15%	165 psi +/- 10-15%	160 psi +/- 10-15%
Starter	12 VDC			
Oil Capacity Including Filter	Approx. 1.5 Qts/1.4L	Approx. 1.7 Qts/1.6L	Approx. 1.9 Qts/1.8L	Approx. 1.9 Qts/1.8L
Recommended Oil Filter	Part # 070185F			
Recommended Air Filter	Part # 0E9371A	Part # 0E9371A	Part # 0J8478	Part # 0J8478
Engine power is subject to and limited by such factors as fuel Btu/joules content, ambient temperature and altitude. Engine power decreases about 3.5 percent for each 1000 feet (304.8 meters) above sea level and will decrease about 1 percent for each 6 ° C (10 ° F) above 15 ° C (60 ° F) ambient temperature.				

FUEL CONSUMPTION WITH EVOLUTION CONTROLLER				
Unit	**Natural Gas***		**LP Vapor****	
	1/2 Load	**Full Load**	**1/2 Load**	**Full Load**
7/8 kW	78/2.21	121/3.43	0.87/3.29	1.42/5.37
10/11 kW	124/3.51	195/5.52	1.18/4.45	1.92/7.28
13/13 kW	157/4.45	255/7.22	1.64/6.2	2.95/11.15
14/14 kW	177/5.01	279/7.9	1.85/6.99	3.07/11.61
15/15 kW	185/5.24	296/8.38	1.83/6.91	3.19/10.82
16/16 kW	193/5.47	296/8.38	1.9/7.2	3.19/12.07
16/17 kW	193/5.47	312/8.83	1.99/7.53	3.57/13.53
18/20 kW	205/5.8	308/8.72	2.08/7.87	3.85/14.57
22 kW	184/5.21	281/7.96	2.16/8.16	3.68/13.99

* Natural gas is in cubic feet per hour/cubic meters per hour

**LP is in gallons per hour/liters per hour

***Values given are approximate

IMPORTANT: ALL UNIT SPECIFICATIONS ARE SUBJECT TO CHANGE.

GENERATOR WITH NEXUS CONTROLLER								
Unit	8 kW	10 kW	13 kW	14 kW	15 kW	16 kW	17 kW	20 kW
Rated Max. Continuous Power Capacity (Watts*)	7,000 NG 8,000 LP	9,000 NG 10,000 LP	13,000 NG 13,000 LP	13,000 NG 14,000 LP	15,000 NG 15,000 LP	16,000 NG 16,000 LP	16,000 NG 17,000 LP	18,000 NG 20,000 LP
Rated Voltage	240							
Rated Voltage at No-Load (NG) Older controller P/N 0H6680A Newer controller P/N 0H6680B	250-254 240-244							
Rated Max. Continuous Load Current (Amps) 240 Volts (LP/NG)	33.3/29.2	41.6/37.5	54.2/54.2	58.3/54.2	62.5/62.5	66.6/66.6	70.8/66.6	83.3/75.0
Main Line Circuit Breaker	35 Amp	45 Amp	55 Amp	60 Amp	65 Amp	65 Amp	65 Amp	100 Amp
Circuits*** 50A, 240V	-	-	1	-	1	1	1	-
40A, 240V	-	1	1	1	1	1	1	-
30A, 240V	1	1	-	-	-	-	-	-
20A, 240V	1	-	1	1	1	1	1	-
20A, 120V	3	3	4	6	5	5	5	-
15A, 120V	3	5	4	4	5	5	5	-
Phase	1							
Number of Rotor Poles	2							
Rated AC Frequency	60 Hz							
Power Factor	1							
Battery Requirement	Group 26R, 12 Volts and 525 CCA Minimum							
Weight (unit only in lbs)	340	387/353	439	439	455/421	439	455/421	450
Enclosure	Steel	Steel/Aluminum	Steel	Steel	Steel/Aluminum	Steel	Steel/Aluminum	Aluminum
Normal Operating Range	This unit is tested in accordance to UL 2200 standards with an operating temperature of 20° F (-29° C) to 122°F. (50° C). For areas where temperatures fall below 32° F (0° C), a cold weather kit is highly recommended. When operated above 77° F (25° C) there may be a decrease in engine power. (Please reference the engine specifications section).							

* Maximum wattage and current are subject to and limited by such factors as fuel Btu content, ambient temperature, altitude, engine power and condition, etc. Maximum power decreases about 3.5 percent for each 1,000 feet above sea level; and also will decrease about 1 percent for each 6 C (10 F) above 16 C (60 F) ambient temperature.

** Load current values shown for 120 volts are maximum TOTAL values for two separate circuits. The maximum current in each circuit must not exceed the value stated for the 240 volts.

*** Circuits to be moved must be protected by same size breaker. For example, a 15 amp circuit in the main panel must be a 15 amp circuit in the transfer switch.

STATOR WINDING RESISTANCE VALUES / ROTOR RESISTANCE*								
	8 kW	10 kW	13 kW	14 kW	15 kW	16 kW	17 kW	20 kW
Power Winding: Across 11 & 22	0.1660-0.1930	0.1895-0.2203	0.1003-0.1165	0.1003-0.1165	0.0746-0.0866	0.0746-0.0866	0.0746-0.0866	0.0415-0.0483
Power Winding: Across 33 & 44	0.1660-0.1930	0.1895-0.2203	0.1003-0.1166	0.1003-0.1166	0.0746-0.0866	0.0746-0.0866	0.0746-0.0866	0.0415-0.0483
Sensing Winding: Across 11 & 44	0.378-.4392	0.425-0.4938	0.2484-0.2887	0.2484-0.2888	0.197-0.229	0.197-0.229	0.197-0.229	0.137-0.1594
Excitation Winding: Across 2 & 6	1.0318-0.1930	1.0935-1.2708	0.876-1.017	0.876-1.018	0.780-0.906	0.780-0.906	0.780-0.906	0.7318-0.8504
Rotor Resistance	6.30-7.32	6.30-7.32	7.58-8.80	7.58-8.81	8.37-9.72	8.37-9.72	8.37-9.72	9.54-11.10

* Resistance values shown are based on new windings at 20° C. Actual readings may vary based on type of meter used and any other components or connections included in the circuit being tested.

IMPORTANT: ALL UNIT SPECIFICATIONS ARE SUBJECT TO CHANGE.

ENGINE WITH NEXUS CONTROLLER				
Model	**8 kW**	**10 kW**	**13/14/15/16/17 kW**	**20 kW**
Type of Engine	GH-410	GT-530	GT-992	GT-999
Number of Cylinders	1	2	2	2
Rated Horsepower @ 3,600 rpm	14.8	18	32	36
Displacement	407cc	530cc	992cc	999cc
Cylinder Block	Aluminum w/Cast Iron Sleeve			
Valve Arrangement	Overhead Valves			
Ignition System	Solid-state w/Magneto			
Recommended Spark Plug	RC14YC	BPR6HS	RC14YC	RC12YC
Spark Plug Gap	0.76 mm (0.030 inch)	0.76 mm (0.030 inch)	1.02 mm (0.040 inch)	0.76 mm (0.030 inch)
Compression Ratio	8.6:1	9.5:1	9.5:1	9.5:1
Starter	12 VDC			
Oil Capacity Including Filter	Approx. 1.5 Qts	Approx. 1.7 Qts	Approx. 1.9 Qts	Approx. 1.9 Qts
Recommended Oil Filter	Part # 070185F			
Recommended Air Filter	Part # 0G3332	Part # 0E9581	Part # 0C8127	Part # 0G5894
Operating RPM	3,600			

FUEL CONSUMPTION WITH NEXUS CONTROLLER				
Model #	**Natural Gas***		**LP Vapor****	
	1/2 Load	**Full Load**	**1/2 Load**	**Full Load**
7/8 kW	77	140	0.94/34	1.68/62
9/10 kW	102	156	1.25/46	1.93/70
13/13 kW	156	220	1.55/57	2.18/80
13/14 kW	156	220	1.56/58	2.30/84
15/15 kW	171	244	1.49/54	2.35/85
16/16 kW	183	261	1.59/58	2.51/91
16/17 kW	183	261	1.61/59	2.57/94
18/20 kW	206	294	1.89/69	2.90/106

* Natural gas is in cubic feet per hour.

**LP is in gallons per hour/cubic feet per hour.

Values given are approximate.

IMPORTANT: ALL UNIT SPECIFICATIONS ARE SUBJECT TO CHANGE.

ECOGEN™ GENERATOR WITH NEXUS CONTROLLER	
Unit	**6 kW**
Rated Voltage	120 V (240V Capable with Conversion)
Rated Max. Continuous Load Current (Amps) 120 Volts (LP only)	50 (25 @ 240 VAC)
Main Line Circuit Breaker	50 Amp (25 after conversion)
Phase	1
Rated AC Frequency	60 Hz
Battery Requirement	Group 26R, 12 Volts and 525 CCA Minimum
Weight (unit only in lbs.)	387/175.5
Enclosure	Steel
Normal Operating Range	This unit is tested in accordance to UL 2200 standards with an operating temperature of 20° F (-29° C) to 122°F. (50° C). For areas where temperatures fall below 32° F (0° C), a cold weather kit is highly recommended. When operated above 77° F (25° C) there may be a decrease in engine power. (Please reference the engine specifications section).

ECOGEN™ - STATOR WINDING RESISTANCE VALUES / ROTOR RESISTANCE	
	6 kW
Power Windings: Across 11 & 22	0.2124 - 0.2468
Power Windings: Across 33 & 44	0.2124 - 0.2468
Sensing Windings: Across 11 & 44	0.4248 - 0.4936
Stator Resistance - DPE 2-6	1.59 - 1.84
Rotor Resistance	10.81

IMPORTANT: ALL UNIT SPECIFICATIONS ARE SUBJECT TO CHANGE.

ECOGEN™ ENGINE WITH NEXUS CONTROLLER	
Model	**6 kW**
Type of Engine	Generac OHVI
Number of Cylinders	2
Displacement	530cc
Cylinder Block	Aluminum w/Cast Iron Sleeve
Recommended Spark Plug	BPR6HS
Spark Plug Gap	0.76 mm (0.030 inch)
Starter	12 VDC
Oil Capacity Including Filter	Approx. 1.7 Qts/1.6L
Recommended Oil Filter	Part # 070185F
Oil Reservoir Capacity	4.2 Qts./4.0L
Recommended Air Filter	Part # 0E9371A
Operating RPM	2,600
Engine power is subject to and limited by such factors as fuel Btu/joules content, ambient temperature and altitude. Engine power decreases about 3.5 percent for each 1000 feet (304.8 meters) above sea level and will decrease about 1 percent for each 6 ° C (10 ° F) above 15 ° C (60 ° F) ambient temperature.	

IMPORTANT: ALL UNIT SPECIFICATIONS ARE SUBJECT TO CHANGE.

MAJOR FEATURES

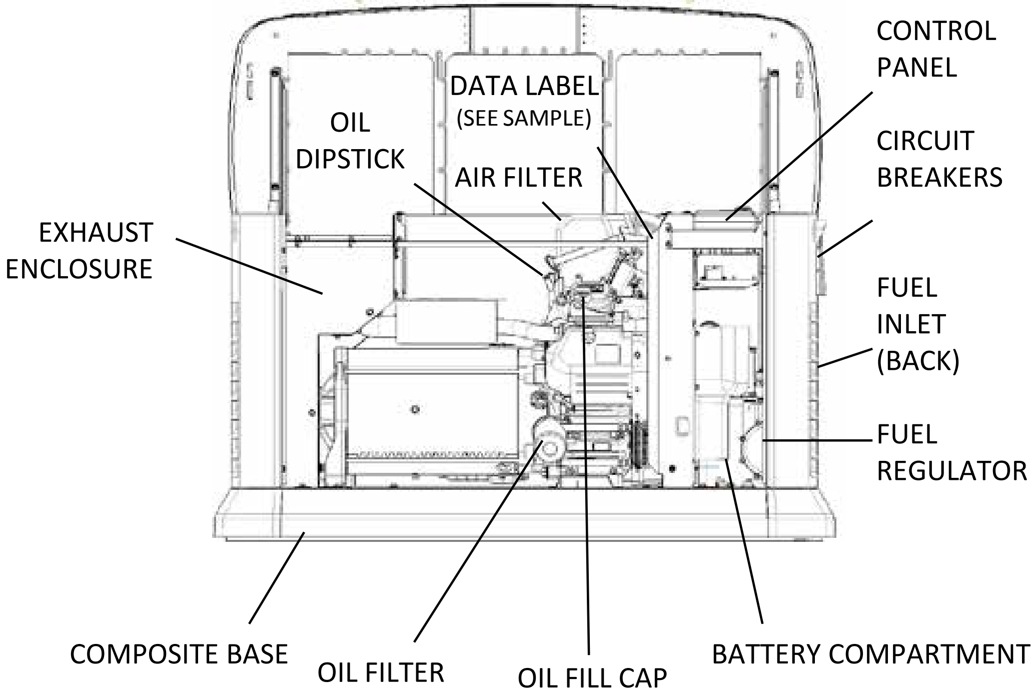


Figure 1. Generator Major Features (Typical)

IMPORTANT: ALL UNIT SPECIFICATIONS ARE SUBJECT TO CHANGE.

PART 1 - GENERAL INFORMATION

INTRODUCTION

This diagnostic repair manual has been prepared especially for familiarizing service personnel with the testing, troubleshooting and repair of the air-cooled product that utilizes the Evolution/Nexus controllers. Every effort has been expended to ensure that the information and instructions in the manual are both accurate and current. However, the manufacturer reserves the right to change, alter or otherwise improve the product at any time without prior notification.

The manual has been divided into several PARTS. Each PART has been divided into SUBSECTIONS and each subsection consists of several sub headings.

It is not the manufacturer's intent to provide detailed disassembly and reassembly of the entire Residential product line. It is the manufacturer's intent to (a) provide the service technician with an understanding of how the various assemblies and systems work, (b) assist the technician in finding the cause of malfunctions, and (c) effect the expeditious repair of the equipment.

PARTS

Part 1 – Provides the basic understanding of the generator as well as basic installation information and operating instructions.

Part 2 – Provides the basics of the AC alternator design and the AC troubleshooting portion of the manual.

Part 3 – Provides the troubleshooting and diagnostic testing procedure for:
- Pre-packaged 10,12,14,16 circuit EZ Switch™ transfer switches
- RTSY service and non service entrance rated transfer switches with load management systems.

Part 4 – Provides the troubleshooting and diagnostic testing procedure for engine related problems on the Nexus™ and Evolution™ Controllers.

Part 5 – Provides the basic operational and system function testing to ensure proper operation of the unit.

Part 6 – Provides detailed step-by-step instructions for the replacement of the rotor/stator and engine.

Part 7 – Illustrates all of the electrical and wiring diagrams for the various kW ranges and transfer switches.

Data Plate

The data plate that is affixed to the generator contains important information pertaining to the unit, including its model number, serial number, amperage rating, and voltage rating. The information from this data plate may be required when requesting information, ordering parts, etc.

Serial Number

Used for specific unit identification and warranty tracking purposes.

GENERATOR IDENTIFICATION

The air-cooled product utilizes four different engines over various kW ranges. It is important to know the size of the engine before attempting a repair because some testing procedures will be different from engine to engine.

410cc Engine 8 kW Nexus/Evolution

- Overhead Valve
- Single Cylinder
- Evolution/Nexus™ Controllers

530cc Engine 10 kW Nexus / 11 kW Evolution

- Overhead Valve
- Twin Cylinders
- Evolution/Nexus™ Controllers

992cc Engine 12-17 kW Nexus / 13-17 kW Evolution

- Overhead Valve
- Twin Cylinders
- Evolution/Nexus™ Controllers

999cc Engine 20/22 kW Nexus/Evolution

- Overhead Valve
- Twin Cylinders
- Evolution/Nexus™ Controllers

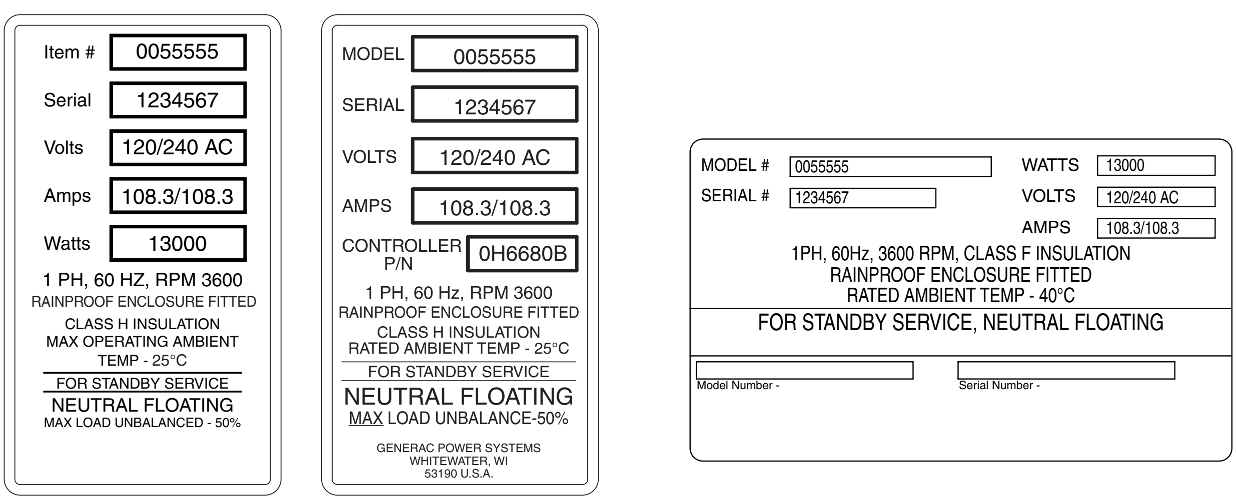


Figure 2. Typical Data Plates

THE FUEL SUPPLY

Natural gas is the primary fuel source utilized for the operating, testing and adjusting of units with air-cooled engine. When it is necessary, it is possible to convert units with air-cooled engines to use liquid propane vapor (LPV). See Section 1.4 "Reconfiguring the Fuel System" for the conversion procedure.

LPV gas is usually supplied as a liquid in high-pressure tanks. The air-cooled product requires a "vapor withdrawal" type of fuel supply system when Liquid Propane (LP) gas is used. The "vapor withdrawal" system utilizes the gaseous fuel vapors that form at the top of the supply tank.

The pressure at which LP is delivered to the Generator may vary considerably, depending on ambient temperatures. In cold weather, supply pressures may drop to "zero". In warm weather, extremely high gas pressures may be encountered. A primary regulator is required to maintain correct gas supply pressures.

Evolution Units

Required fuel pressure for natural gas is 3.5 inches to 7 inches water column (0.12 to 0.25 psi); and for liquid propane, 10 inches to 12 inches of water column (0.36 to 0.43 psi).

Nexus Units

Required fuel pressure for natural gas is 5 inches to 7 inches water column (0.18 to 0.25 psi); and for liquid propane, 10 inches to 12 inches of water column (0.36 to 0.43 psi).

Note: To maintain proper fuel pressure a primary regulator is required.

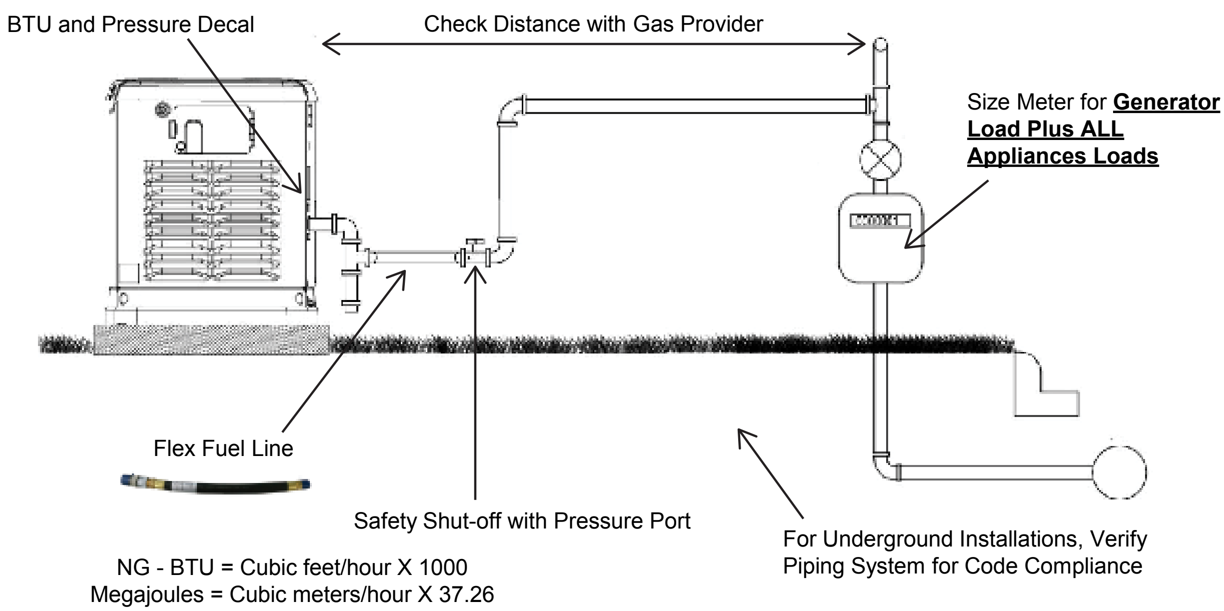
⚠ DANGER!

LP and Natural Gas are both highly explosive. Gaseous fuel lines must be properly purged and tested for leaks before this equipment is placed into service and periodically thereafter. Procedures used in gaseous fuel leakage tests must comply strictly with applicable fuel gas codes. Do not use flame or any source of heat to test for gas leaks. No gas leakage is permitted. LP gas is heavier than air and tends to settle in low areas. Natural gas is lighter than air and tends to settle in high places. Even the slightest spark can ignite these fuels and cause an explosion.

Use a flexible length of hose between the Generator fuel connection and rigid fuel lines is required. This will help prevent line breakage that might be caused by vibration or if the Generator shifts or settles. The flexible fuel line must be approved for use with gaseous fuels.

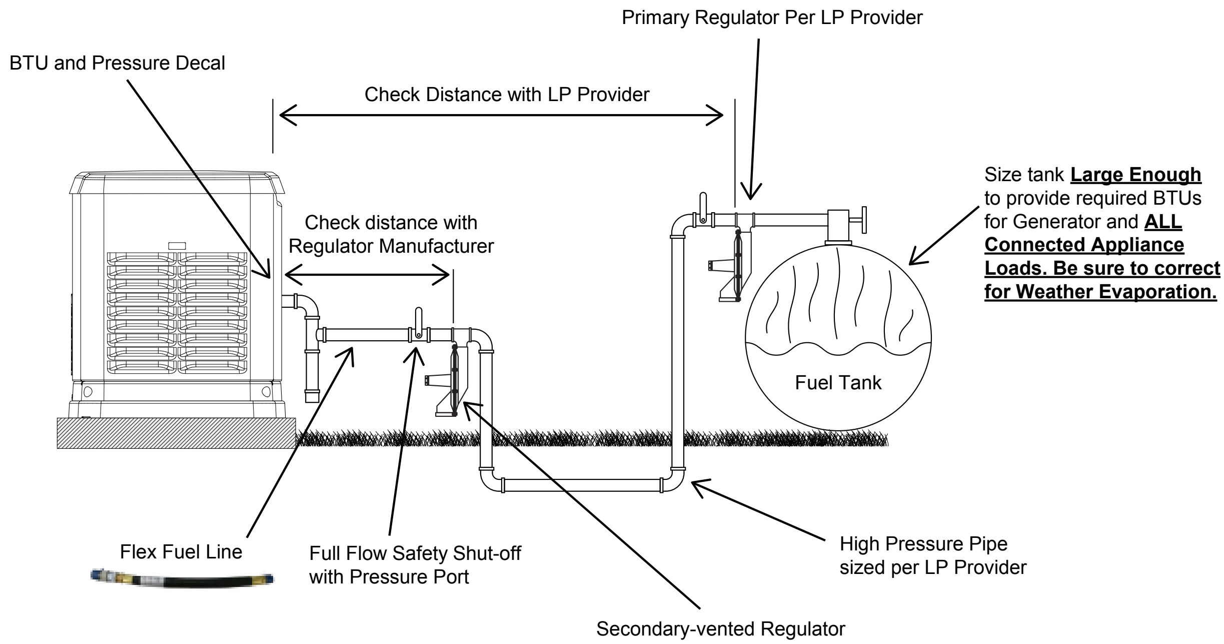
Flexible fuel line should be kept as straight as possible between connections. The offset for flexible fuel lines is ten (10) degrees. Exceeding the offset can cause the fittings to crack.

NATURAL GAS FUEL INTERCONNECTIONS



Size gas pipe with Pipe Sizing Guide or to local codes.

Figure 3. Typical Natural Gas Fuel Installation



LP - BTU = Cubic feet/hour X 2500
Megajoules = Cubic meters/hour X 93.15

Size gas pipe from secondary regulator with Pipe Sizing Guide or to local codes.

Figure 4. Typical LP Fuel Installation

INTRODUCTION

It is the responsibility of the installer to ensure that the generator installation was performed properly. A careful inspection must be performed when the installation is complete. All applicable codes, standards, and regulations pertaining to such installations must be strictly complied with. In addition, regulations established by the Occupational Safety and Health Administration (OSHA) must be complied with as well.

Prior to initial startup of the unit, the installer must ensure that the generator has been properly prepared for use. This includes the following:

- An adequate supply of the correct fuel must be available for generator operation.
- The engine must be properly serviced with the recommended oil.
- With liquid propane (LP), use only the “vapor withdrawal” system. This type of system uses the vapors formed above the liquid fuel in the storage tank.

The engine has been fitted with a fuel carburetion system that meets the specification of the 1997 California Air Resources Board for tamper-proof dual fuel systems. The unit will run on natural gas or LP, but it has been factory set and tested to run on natural gas. When the change from natural gas to LP is needed, the fuel system needs to be re-configured. See Section 1.4 “Reconfiguring the Fuel System” for further information.

Recommended fuels should have a British Thermal Unit (BTU) content of at least 1,000 BTUs per cubic feet for natural gas; or at least 2,520 BTUs per cubic feet for LP. Ask the fuel supplier for the BTU content of the fuel.

Recommended fuel pressures for natural gas and liquid propane vapor (LPV) are as follows:

	LPV- All	NG-Nexus	NG-Evolution
Minimum Water Column	10 in.	5 in.	3.5 in.
Maximum Water Column	12 in.	7 in.	7 in.

Note: All pipe sizing, construction and layout must comply with NFPA 54 for natural gas applications and NFPA 58 for liquid propane applications. After installation, verify that the fuel pressure NEVER drops below the minimum requirements.

Prior to installation of the generator, the installer should consult local fuel suppliers or the fire marshal to check codes and regulations for proper installation. Local codes will mandate correct routing of gaseous fuel line piping around gardens, shrubs and other landscaping to prevent any damage.

Special considerations should be given when installing the unit where local conditions include flooding, tornados, hurricanes, earthquakes and unstable ground for the flexibility and strength of piping and their connections.

Use an approved pipe sealant or joint compound on all threaded fittings.

Table 1. Typical Fuel Pipe Sizing

NOTE: These are approximate values, use the appropriate spec sheet and/or owner’s manual for specific values.

Natural Gas							
Table values are maximum pipe run in feet							
KW	0.75"	1"	1.25"	1.5"	2"	2.5"	3"
7-8	55	200	820				
10	20	85	370	800			
13-14	10	50	245	545			
15-17		40	190	425			
20		20	130	305	945		

Liquid Propane Vapor							
Table values are maximum pipe run in feet							
KW	0.75"	1"	1.25"	1.5"	2"	2.5"	3"
7-8	165	570					
10	70	255	1000				
13-14	45	170	690				
15-17	25	130	540				
20	15	115	480				

Notes:

- Pipe sizing is based on 0.5 inch water pressure drop
- Sizing includes a nominal number of elbows and tees
- Please verify adequate service and meter sizing

DANGER!

Gaseous fuels such as natural gas and LPV are highly explosive. Even the slightest spark can ignite such fuels and cause an explosion. No leakage of fuel is permitted. Natural gas, which is lighter than air, tends to collect in high areas. LP gas is heavier than air and tends to settle in low areas.

Note: Code requires a minimum of one approved manual shutoff valve installed in the gaseous fuel supply line. The valve must be easily accessible. Local codes determine the proper location.

Fuel Consumption

The fuel consumption rate for individual kW ranges are listed in the Specifications sections at the front of this manual. *Standard Fuel Consumption Rates.*

RECONFIGURING THE FUEL SYSTEM - MODELS WITH EVOLUTION CONTROLLERS

The generator was configured for natural gas operation at the factory. Switching over to LP vapor is a simple procedure.

Note: the orange fuel conversion knob is located on the top of the fuel mixer on the V-twin engine and under the fuel mixer on the single cylinder engine.

Push downward and turn the valve towards the marked fuel source arrow until it stops. If needed, tap fuel pin lightly toward mixer body. When converting to LP, fuel knob will rotate 180° while sliding into the mixer body.

Note: When reconfiguring the fuel system, the appropriate fuel type must also be selected in the Evolution Controller. Follow the Navigation Menu Map to make the change.

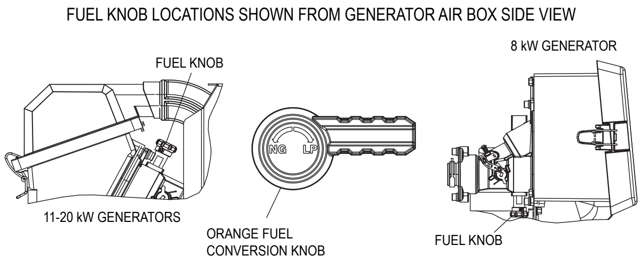


Figure 5. Fuel Selector

IMPORTANT NOTE: THE EVOLUTION CONTROLLED MODELS MAY START AND RUN LIKE NORMAL WITH THE IMPROPER FUEL SELECTED! VERIFY THE CORRECT FUEL IS SELECTED!

RECONFIGURING THE FUEL SYSTEM - MODELS WITH NEXUS CONTROLLERS

8 kW, 410cc Engine

To reconfigure the fuel system from NG to LP, follow these steps:

Note: The primary regulator for the propane supply is NOT INCLUDED with the generator. A fuel pressure of 10 to 12 inches of water column (0.36 to 0.43 psi) to the fuel inlet of the generator MUST BE SUPPLIED.

1. Turn off the main gas supply (if connected).
2. Open the roof and remove the door.
3. Remove the battery (if installed).
4. Take the plastic T-handle fuel selector in the poly bag supplied with the generator.
5. Locate the selector knob on the air box cover, behind the yellow air filter door and power bulge. The unit comes from the factory in the NG (Natural Gas) position. Grasping the T-handle, insert the pin end into the hole in the selector knob and **pull out** to overcome spring pressure and then twist clockwise 90 degrees and allow the selector to return in once aligned with the LP (Liquid Propane) position.
6. Save this tool with the Owner's Manual.
7. Install the battery, door and close the roof.
8. Reverse the procedure to convert back to natural gas.

Figure 6. Fuel Selector

Note: Use an approved pipe sealant or joint compound on all threaded fittings to reduce the possibility of leakage.

10, 13, 14, 15, 16, 17 and 20 kW, V-twin Engines

To reconfigure the fuel system from NG to LP, follow these steps:

Note: The primary regulator for the propane supply is NOT INCLUDED with the generator. A fuel pressure of 10 to 12 inches of water column (0.36 to 0.43 psi) to the fuel inlet of the generator MUST BE SUPPLIED.

1. Open the roof.
2. **For 10 kW units:** Loosen clamp and slide back the air inlet hose.
   - Slide fuel selector on carburetor out towards the back of the enclosure (Figures 7 and 8).
   - Return the inlet hose and tighten clamp securely.
3. **For 13, 14, 15, 16, 17 and 20 kW units:** remove the air cleaner cover.
   - Slide the selector lever towards the back of the enclosure (Figures 9 and 10).
   - Re-install the air cleaner cover and tighten the two thumb screws.

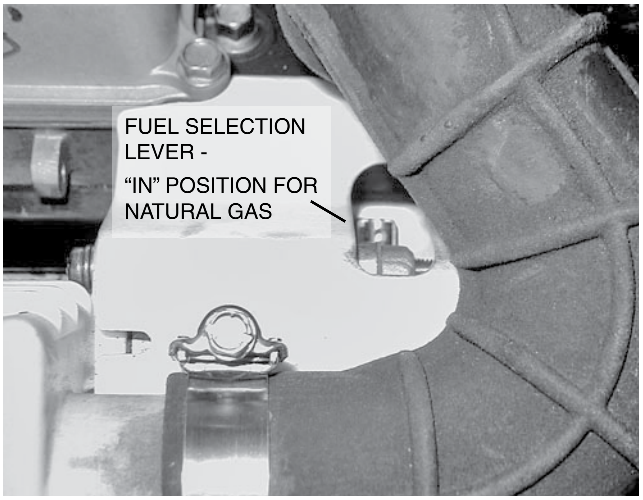


Figure 7. 10 kW, GT-530 (Inlet Hose Slid Back)

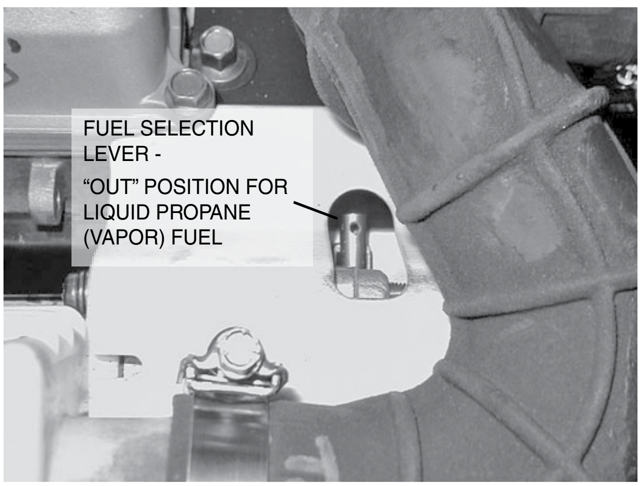


Figure 8. 10 kW, GT-530 (Inlet Hose Slid Back)

3. Close the roof.
4. Reverse the procedure to convert back to natural gas.

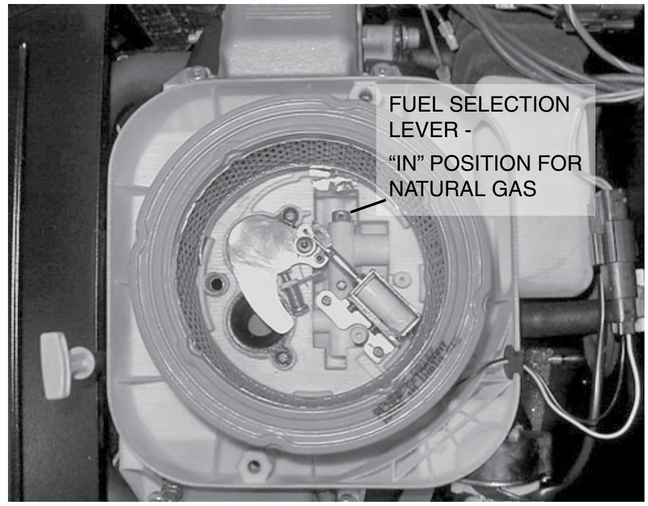


Figure 9. 13, 14, 15, 16, 17, & 20 kW, GT-990/GT-999 (Airbox Cover Removed)

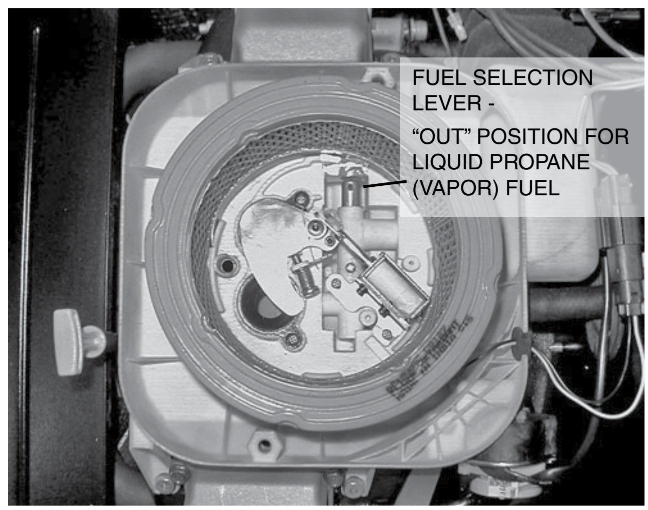


Figure 10. 13, 14, 15, 16, 17, & 20 kW, GT-990/GT-999 (Airbox Cover Removed)

METERS

Devices used to measure electrical properties are called meters. Meters are available that allow one to measure (a) AC voltage, (b) DC voltage, (c) AC frequency, and (d) resistance In ohms. The following apply:

- To measure AC voltage, use an AC voltmeter.
- To measure DC voltage, use a DC voltmeter.
- Use a frequency meter to measure AC frequency In “Hertz” or “cycles per second”.
- Use an ohmmeter to read circuit resistance, in “ohms”.
- Use a Diode tester for testing diode component(s)

THE VOM

A meter that will permit both voltage and resistance to be read is the “volt-ohm-milliammeter” or “VOM”.

Some VOMs are of the “analog” type (not shown). These meters display the value being measured by physically deflecting a needle across a graduated scale. The scale used must be Interpreted by the user.

“Digital” VOMs (Figure 11) are also available and are generally very accurate. Digital meters display the measured values directly by converting the values to numbers.

Note: Standard AC voltmeters react to the AVERAGE value of alternating current. When working with AC, the effective value is used. For that reason a different scale is used on an AC voltmeter. The scale is marked with the effective or “rms” value even though the meter actually reacts to the average value. That is why the AC voltmeter will give an Incorrect reading if used to measure direct current (DC).

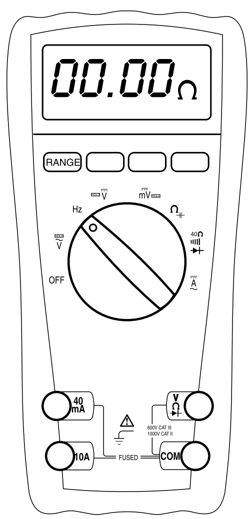


Figure 11. Digital VOM

MEASURING AC VOLTAGE

An accurate AC voltmeter or a VOM may be used to read the generator’s AC output voltage. The following guidelines apply:

1. Always read the generator’s AC output voltage at the unit’s rated operating speed and AC frequency.
2. The generator’s rated AC output voltage is 237 to 244 VAC and is adjustable.
3. Only an AC voltmeter may be used to measure AC voltage. DO NOT USE A DC VOLTMETER FOR THIS PURPOSE.

DANGER!

Generators produce high and dangerous voltages. Contact with high voltage terminals will result in dangerous and possibly lethal electrical shock.

MEASURING DC VOLTAGE

A DC voltmeter or a VOM may be used to measure DC voltages. Always observe the following rules:

1. Always observe correct DC polarity.
   a. Some VOMs may be equipped with a polarity switch.
   b. On meters that do not have a polarity switch, DC polarity must be reversed by reversing the test leads.
2. Before reading a DC voltage, always set the meter to a higher voltage scale than the anticipated reading. If in doubt, start at the highest scale and adjust the scale downward until correct readings are obtained.
3. The design of some meters is based on the “current flow” theory while others are based on the “electron flow” theory.
   a. The “current flow” theory assumes that direct current flows from the positive (+) to the negative (-).
   b. The “electron flow” theory assumes that current flows from negative (-) to positive (+).

Note: When testing generators, the “current flow” theory is applied. That is, current is assumed to flow from positive (+) to negative (-).

MEASURING AC FREQUENCY

The generator’s AC output frequency is proportional to Rotor speed. Generators equipped with a 2-pole Rotor must operate at 3600 rpm to supply a frequency of 60 Hertz. Units with 4-pole Rotors must run at 1800 rpm to deliver a 60 Hertz output.

MEASURING CURRENT

Clamp-On

To read the current flow, in AMPERES, a clamp-on ammeter may be used. This type of meter indicates current flow through a conductor by measuring the strength of the magnetic field around that conductor. The meter consists essentially of a current transformer with a split core and a rectifier type instrument connected to the secondary. The primary of the current transformer is the conductor through which the current to be measured flows. The split core allows the Instrument to be clamped around the conductor without disconnecting it.

Current flowing through a conductor may be measured safely and easily. A line-splitter can be used to measure current in a cord without separating the conductors.

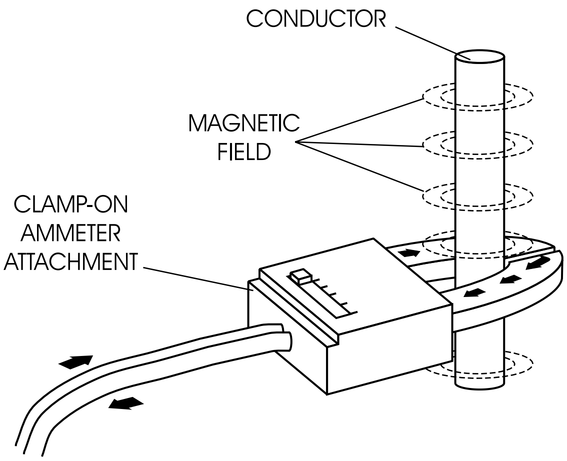


Figure 12. Clamp-On Ammeter

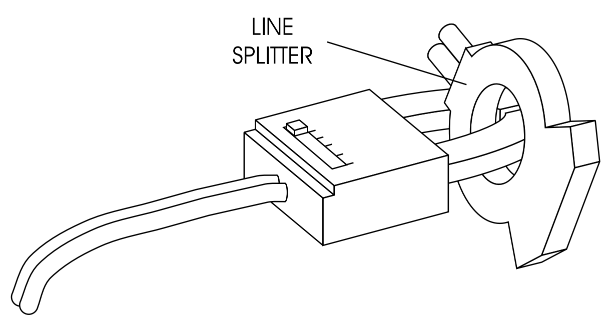


Figure 13. A Line-Splitter

Note: If the physical size of the conductor or ammeter capacity does not permit all lines to be measured simultaneously, measure current flow in each individual line. Then, add the Individual readings.

In-Line

Alternatively, to read the current flow in AMPERES, an in-line ammeter may be used. Most Digital Volt Ohm Meters (VOM) will have the capability to measure amperes.

This usually requires the positive meter test lead to be connected to the correct amperes plug, and the meter to be set to the amperes position. Once the meter is properly set up to measure amperes the circuit being measured must be physically broken. The meter will be in-line or in series with the component being measured.

In Figure 14 the control wire to a relay has been removed. The meter is used to connect and supply voltage to the relay to energize it and measure the amperes going to it.

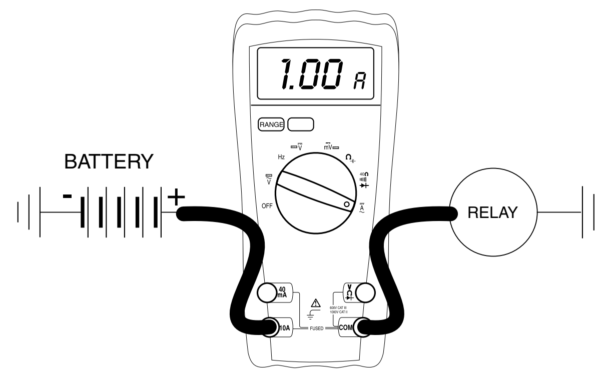


Figure 14. A VOM as an In-line Amp Meter

MEASURING RESISTANCE

The volt-ohm-milliammeter may be used to measure the resistance in a circuit. Resistance values can be very valuable when testing coils or windings, such as the Stator and Rotor windings, or checking a wire for an open or grounded condition.

When testing Stator windings, keep in mind that the resistance of these windings is very low. Some meters are not capable of reading such a low resistance and will simply read CONTINUITY.

If proper procedures are used, the following conditions can be detected using a VOM:

- A “short-to-ground” condition in any Stator or Rotor winding, or a short to ground on a specific control wire.
- Shorting together of any two parallel Stator windings.
- Shorting together of any two isolated Stator windings.
- An open condition in any Stator or Rotor winding, or an open in a control wire.

Component testing may require a specific resistance value or a test for INFINITY or CONTINUITY. Infinity is an OPEN condition between two electrical points, which would read as no resistance, or OL (Open Line) on a VOM. Continuity is a closed condition between two electrical points, which would be indicated as very low resistance (000.000) or "ZERO" on a VOM.

ELECTRICAL UNITS

Ampere

The rate of electron flow in a circuit is represented by the AMPERE. The ampere is the number of electrons flowing past a given point at a given time. One AMPERE is equal to just slightly more than 6.241×10^{18} electrons per second.

With alternating current (AC), the electrons flow first in one direction, then reverse and move in the opposite direction. They will repeat this cycle at regular intervals. A wave diagram, called a "sine wave" shows that current goes from zero to maximum positive value, then reverses and goes from zero to maximum negative value. Two reversals of current flow is called a cycle. The number of cycles per second is called frequency and is usually stated in "Hertz".

Volt

The VOLT is the unit used to measure electrical PRESSURE, or the difference in electrical potential that causes electrons to flow. Very few electrons will flow when voltage is weak. More electrons will flow as voltage becomes stronger. VOLTAGE may be considered to be a state of unbalance and current flow as an attempt to regain balance. One volt is the amount of Electromotive Force (EMF) that will cause a current of 1 ampere to flow through 1 ohm of resistance.

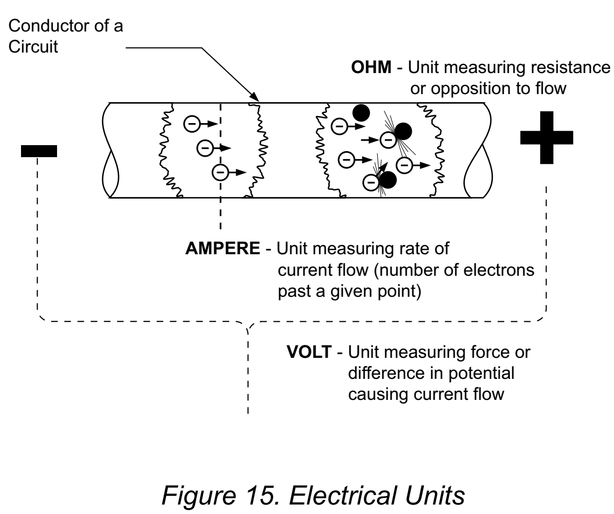


Figure 15. Electrical Units

Ohm

The OHM is the unit of RESISTANCE. In every circuit there is a natural resistance or opposition to the flow of electrons. When an EMF is applied to a complete circuit, the electrons are forced to flow in a single direction rather than their free or orbiting pattern. The resistance of a conductor depends on (a) its physical makeup, (b) its cross-sectional area, (c) its length, and (d) its temperature. As the conductor's temperature increases, its resistance increases in direct proportion. One (1) ohm of resistance will permit one (1) ampere of current to flow when one (1) volt of EMF is applied.

OHM'S LAW

A definite and exact relationship exists between VOLTS, OHMS and AMPERES. The value of one can be calculated when the value of the other two are known. Ohm's Law states that in any circuit the current will increase when voltage increases but resistance remains the same, and current will decrease when resistance Increases and voltage remains the same.

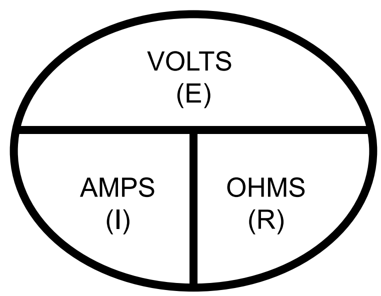


Figure 16. Ohm's Law

If AMPERES is unknown while VOLTS and OHMS are known, use the following formula:

$$\text{AMPERES} = \frac{\text{VOLTS}}{\text{OHMS}}$$

If VOLTS is unknown while AMPERES and OHMS are known, use the following formula:

$$\text{VOLTS} = \text{AMPERES} \times \text{OHMS}$$

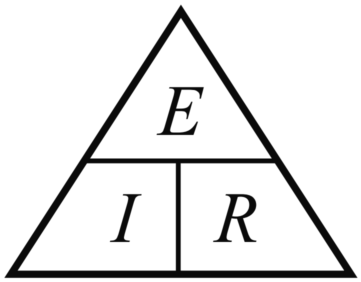
If OHMS is unknown but VOLTS and AMPERES are known, use the following:

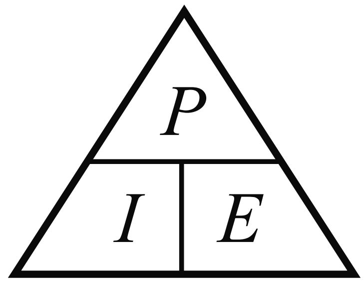
$$\text{OHMS} = \frac{\text{VOLTS}}{\text{AMPERES}}$$

Table 2. Electrical formulas

TO FIND	KNOWN VALUES	1-PHASE	3-PHASE
KILOWATTS (kW)	Volts, Amps, Power Factor	$\frac{E \times I}{1000}$	$\frac{E \times I \times 1.73 \times PF}{1000}$
kVA	Volts, Amps	$\frac{E \times I}{1000}$	$\frac{E \times I \times 1.73}{1000}$
AMPS	kW, Volts, Power Factor	$\frac{kW \times 1000}{E}$	$\frac{kW \times 1000}{E \times 1.73 \times PF}$
WATTS	Volts, Amps, Power Factor	Volts x Amps	E x I x 1.73 x PF
NO. OF ROTOR POLES	Frequency, RPM	$\frac{2 \times 60 \times \text{Frequency}}{\text{RPM}}$	$\frac{2 \times 60 \times \text{Frequency}}{\text{RPM}}$
FREQUENCY	RPM, No. of Rotor Poles	$\frac{\text{RPM} \times \text{Poles}}{2 \times 60}$	$\frac{\text{RPM} \times \text{Poles}}{2 \times 60}$
RPM	Frequency, No. of Rotor Poles	$\frac{2 \times 60 \times \text{Frequency}}{\text{Rotor Poles}}$	$\frac{2 \times 60 \times \text{Frequency}}{\text{Rotor Poles}}$
kW (required for Motor)	Motor Horsepower, Efficiency	$\frac{HP \times 0.746}{\text{Efficiency}}$	$\frac{HP \times 0.746}{\text{Efficiency}}$
RESISTANCE	Volts, Amps	$\frac{E}{I}$	$\frac{E}{I}$
VOLTS	Ohm, Amps	I x R	I x R
AMPERES	Ohms, Volts	$\frac{E}{R}$	$\frac{E}{R}$

E = VOLTS   I = AMPS   R = RESISTANCE (OHMS)   PF = POWER FACTOR





Term	Symbol	Measurement
Current	I	Amps
Wattage	P	Watts
Voltage	E	Volts
Resistance	R	Ohms

Constant	Shift	Result
Voltage E	Resistance Increase ↑	Current Decrease ↓
Resistance R	Voltage Decrease ↓	Current Decrease ↓
Resistance R	Voltage Increase ↑	Current Increase ↑
Current I	Resistance Decrease ↓	Voltage Decrease ↓
Current I	Resistance Increase ↑	Voltage Increase ↑
Voltage E	Resistance Decrease ↓	Current Increase ↑

VISUAL INSPECTION

When it becomes necessary to test or troubleshoot an alternator, it is a good practice to complete a thorough visual inspection. Remove the access covers and look closely for any obvious problems. Look for the following:

- Burned or broken wires, broken wire connectors, damaged mounting brackets, etc.
- Look for loose or frayed wiring insulation, loose or dirty connections.
- Check that all wiring is well clear of rotating parts.
- Verify that the Generators voltage output matches Utility voltage.
- Look for foreign objects, loose nuts, bolts and other fasteners.
- Clean the area around the Generator. Clear away paper, leaves, snow, and other objects that might blow against the Generator and obstruct its air openings.
- Insulation Resistance

The insulation resistances of stator and rotor windings are a measurement of the integrity of the insulating material that separates the electrical windings from the Generator steel core. This resistance can degrade over time or due to such contaminates as dust, dirt, oil, grease and especially moisture. In most cases, failures of stator and rotor windings are due to a break down in the insulation. In many cases, a low insulation resistance is caused by moisture that collects while the Generator is shut down. When problems are caused by moisture buildup on the windings, this can usually be corrected by drying the windings. Cleaning and drying the windings can usually eliminate dirt and moisture that has built up in the Generator windings.

THE MEGOHMMETER

Introduction

A Megohmmeter often called a “megger”, consists of a meter calibrated in megohms and a power supply. Set the “megger” to a voltage setting of 500 volts when testing stators and rotors.

⚠ WARNING!

- **DO NOT EXCEED 500 VOLTS**
- **DO NOT APPLY VOLTAGE LONGER THAN 1 SECOND**
- **FOLLOW THE “MEGGER” MANUFACTURERS INSTRUCTIONS CAREFULLY**

Testing Stator Insulation

⚠ WARNING!

Warning: Megger HIGH voltages could cause damage to other components on the Generator. Take the proper precautions before testing.

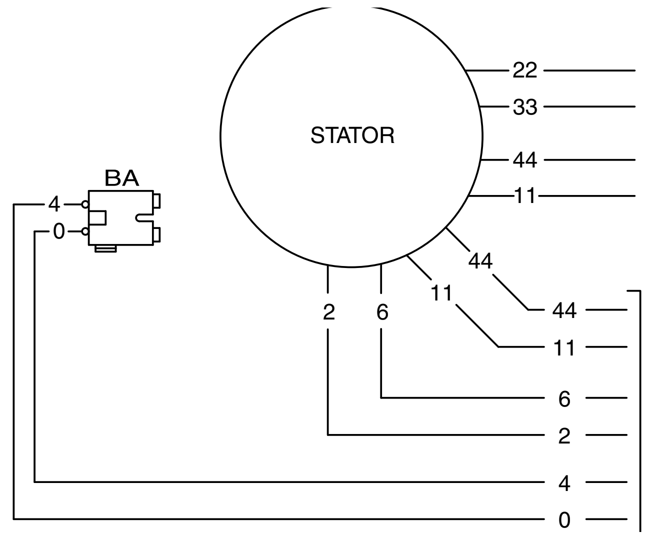


Figure 17. Typical Stator Output Leads

Isolate all stator leads (Figure 17) and connect all the stator leads together.

Use a megger power setting of 500 volts. Connect one megger test lead to the junction of all the stator leads, the other test lead to frame ground on the stator can. Read the number of megohms on the meter.

To calculate the MINIMUM acceptable megger readings use the following formula:

$$\text{MINIMUM INSULATION RESISTANCE (in “Megohms”)} = \frac{\text{GENERATOR RATED VOLTS}}{1000} + 1$$

Example: Generator is rated at 120 VAC. Divide “120” by “1000” to obtain “0.12”. Then add “1” to obtain “1.12” megohms. Minimum insulation resistance for a 120 VAC stator is 1.12 megohms.

$$\frac{120}{1000} + 1 = 1.12 \text{ megohms}$$

If the stator insulation resistance is less than the calculated minimum resistance, clean and dry the stator. Then, repeat the test. If resistance is still low, replace the stator.

Use the Megger to test for shorts between isolated windings as outlined in “Stator Insulation Tests.”

Testing Rotor Insulation

Apply a voltage of 500 volts across the rotor positive slip ring (nearest the rotor bearing), and a clean frame ground (i.e. the rotor shaft).

⚠ WARNING!

- DO NOT EXCEED 500 VOLTS
- DO NOT APPLY VOLTAGE LONGER THAN 1 SECOND
- FOLLOW THE "MEGGER" MANUFACTURERS INSTRUCTIONS CAREFULLY

ROTOR MINIMUM INSULATION RESISTANCE:

1.5 megohms

CLEANING THE GENERATOR

Caked or greasy dirt may be loosened with a soft brush or a damp cloth. A Vacuum system may be used to clean up loosened dirt. Dust and dirt may also be removed using dry, low-pressure air (25 psi maximum).

⚠ CAUTION!

Do not use sprayed water to clean the Generator. Some of the water will remain on the Generator windings and terminals and may cause very serious problems.

DRYING THE GENERATOR

The procedure for drying an alternator is as follows:

1. Open the Generator main circuit breaker.

⚠ WARNING!

Generator should have no electrical loads applied while drying.

2. Disconnect all wires in a manner that allows the alternator to be completed disconnected.
3. Provide an external source to blow warm, dry air through the Generator interior (around the rotor and stator windings.

⚠ CAUTION!

Do not exceed 185 ºF (85 ºC).

4. Re-connect stator lead.
5. Start the Generator and let it run for 2 or 3 hours.
6. Shutdown the Generator and repeat the insulation resistance tests.

OPERATING INSTRUCTIONS

Figure 18. Evolution Controller Panel

Figure 19. Nexus Controller Panel

⚠WARNING!

With the controller set to AUTO mode, the engine may crank and start at any time without warning. Such automatic starting occurs when Utility power source voltage droops below a preset level or during the normal exercise cycle. To prevent possible injury that might be caused by such sudden starts, always set the controller to OFF mode and remove the fuse before working on or around the Generator or transfer switch. Then, place a "DO NOT OPERATE" tag on the Generator panel and on the transfer switch.

AUTO-OFF-MANUAL Mode

AUTO Mode – Selecting this mode activates fully automatic system operation. It also allows the unit to automatically start and exercise the engine at predetermined intervals with the setting of the exercise timer (see Section 5.2 "Setting the Exercise Timer").

OFF Mode – This mode shuts down the engine. This mode also prevents automatic operation.

MANUAL Mode – Set the controller to MANUAL mode to crank and start the engine. Transfer to standby power will not occur unless there is a Utility failure.

7.5 Amp Fuse

This fuse protects the controller as well as the DC components against overload. If the fuse element has melted open due to an overload, engine cranking or running will not be possible. Should a fuse replacement become necessary, use only an identical 7.5 amp replacement fuse.

Note: On Evolution units with firmware version 1.12 and newer, the unit can still start and run with the fuse removed. Disconnect the negative battery cable from the battery to prevent unit operation.

USER INTERFACE

Exercise Time

The generator is equipped with an internal exercise timer. Once set, the generator will start and exercise at predetermined intervals, on the day of the week and the time of day specified. During this exercise period, the unit runs for a preset time and then shuts down. Transfer of loads to the generator output does not occur during the exercise cycle unless Utility is lost. See Section 5.2 for information on setting the exercise time.

Note: The exerciser will only work with the AUTO-OFF-MANUAL switch in the AUTO position.

Activation Wizard

When battery power is applied to the generator during the installation process, the controller will light up. However, if the generator is not activated it will NOT run in the auto mode in the event of a power outage. Activating the generator is a simple one-time process that is guided by the controller screen prompts. Once the product is activated, the controller will not prompt you again, even if the battery is disconnected. See Section 5.2 for the activation wizard procedure.

Installation Wizard

During the initial setup of the controller, an interconnection self-test will load on the screen.

Upon power up, this controller will go through a system self test which will check for the presence of Utility voltage on the DC circuits. If the installer mistakenly connects the AC Utility sense wires onto the DC terminal block the controller may be rendered inoperable. If the self-test failed and detected Utility voltage on the DC circuits, the controller will display a warning message and lock out the generator, preventing damage to the controller. The problem must be corrected and power to the controller must be cycled for this warning message to clear. Utility voltage on N1 and N2 must be present inside the generator control panel for the self-test to begin. Each time power to the controller is cycled the self-test will check for correct wiring.

⚠ WARNING!

Damage caused by improper wiring of the control wires is not warrantable!

Time and Date

After the successful completion of the installation wizard, the controller will prompt the user to set the minimum settings to operate. The prompts are as follows: current date, current time, exercise time, and exercise day. These settings may be changed at any time utilizing the "EDIT" menu. See Section 4.1 for "Menu Navigation"

Note: Maintenance interval initialization will take place when the exercise time is set.

If power to the controller is interrupted, the Installation Wizard will operate when power has been restored. The prompts that will follow will depend upon the controller and firmware version.

Note: To test the Generator prior to installation, press the "ENTER" key to avoid setting up the exercise time. This will ensure that when the customer powers up the unit, the controller will prompt the consumer to enter the exercise time.

Low Speed Exercise

This feature, when enabled, allows the generator to exercise at a pre-defined exercise speed. Low speed exercise can be disabled from the "EDIT" menu. See Section 4.1 "Menu Navigation".

Note: This is a standard feature on certain units, and optional on some other units. See specification section for RPM values.

Note: if the generator is running under low speed exercise and utility fails, the generator will return to normal operating speed and transfer to standby. If the generator is running under low speed exercise and utility fails but the generator shuts down, check fuel conversion.

Display Interface Menus

The LCD display is as detailed below

- The "Home" page is the default page and will display if no keys are pressed for 30 seconds. This page normally shows the current status and the current time and date. It will also display the highest priority active Alarm and/or Warning along with the backlight flashing when one of these events occurs. In the case of multiple Alarms or Warnings, the controller will only display the first message. To clear an Alarm or Warning, see Section 4.2 "Protection Systems."
- The display backlight is normally off. If the user presses any key, the backlight will come on automatically and remain on for 30 seconds after the last key is pressed.
- The "Main Menu" page will allow the user to navigate to all other pages or sub-menus by using the UP/DOWN and Enter keys. Each press of the Escape key takes you back to the previous menu until the main menu is reached. This page displays the following options:

Nexus	History, Status, Edit, and Debug
Evolution	System, Date/Time, Battery, Sub Menus, History, Maint, Edit, Dealer

See Section 4.1 - "Menu System."

TO SELECT AUTOMATIC OPERATION

The following procedure applies only to those installations which utilize an air-cooled generator in conjunction with a transfer switch. Residential transfer switches do not have intelligent circuits of their own. PCB logic in the controller controls the automatic operation of the transfer switch and the generator.

To select automatic operation when a transfer switch is installed along with a home standby generator, the procedure is as follows.

1. Ensure the CONTACTOR in the transfer switch is in the "Utility" position. If needed, manually actuate the switch contacts to the "Utility" position. See Section 5.1 for specific instructions.
2. Ensure Utility voltage is available to the UTILITY terminals N1 and N2.
3. Actuate the generator main line circuit breaker (MLCB) to its "Closed" position.
4. Set the generator controller to the AUTO mode.

Following the procedure of Steps 1 through 4, a dropout in Utility voltage below a preset level will result in automatic generator cranking and start-up. Following startup, and with no controller faults present, the transfer switch will actuate to the "Standby" position.

MANUAL OPERATION

Transfer to "Standby" and Manual Startup

To transfer electrical loads to the generator and to start the Generator manually, the procedure is as follows:

1. On the generator, set the controller to the OFF mode.
2. On the generator, set the main line circuit breaker (MLCB) to the "Open" Position.
3. Locate a means of Utility disconnect and set it to the OFF position.
4. Manually actuate the CONTACTOR to the "Standby" position. See Section 5.1 for specific instructions.
5. On the generator, set the controller to the MANUAL mode.

⚠ WARNING!

Engine will crank and start!

6. Let the engine warm up and stabilize for a minute or two at no-load. Set the generators MLCB to the “Closed” position. Generator voltage is available to the transferred electrical loads.

Retransfer Back to “Utility” and Manual Shutdown

To shutdown the generator and retransfer electrical loads back to the “Utility” position, the procedure is as follows:

1. Set the generator's MLCB to its “Open” position.
2. Allow the generator to run at no-load for several minutes to cool.
3. Set the generator's controller to the OFF mode.
4. Locate a means of Utility disconnect and set it to the OFF mode.
5. Manually actuate the CONTACTOR to the “Utility” position.
6. Restore Utility voltage to the transfer switch, by the means that was utilized in Step 4.
7. Set the generator controller to AUTO mode.

With the generator in AUTO mode, a dropout in Utility voltage below a preset level will result in automatic generator cranking and start-up. Following startup, the transfer switch will actuate to the “Standby” position.

INTRODUCTION

When the generator is installed in conjunction with a transfer switch, either manual or automatic operation is possible. See Section 5.1 for the manual transfer and engine startup, manual shutdown and re-transfer, and full automatic operation procedure.

UTILITY FAILURE

Initial Conditions

The generator is in AUTO mode, ready to run, and the CONTACTOR is in the "Utility" position. When Utility fails (below 65% of nominal*), a five (5) second line interrupt delay time is started*. If the Utility is still not present when the timer expires, the engine will crank and start. Once started a five (5) second engine warm-up timer will start.

When the warm-up timer expires the controller will transfer load to the generator. If Utility voltage is restored (above 80% of nominal*) at any time between the initiation of the engine start and when the generator is ready to accept load, (five second warm-up time has not elapsed), the controller will complete the start cycle and run the generator through its normal cool down cycle; however the CONTACTOR will remain in the "Utility" position.

*** Fixed on Nexus controllers, adjustable on Evolution controllers.**

CRANKING

When the controller is in the AUTO position it will cyclic crank the engine 5 times as follows: 16 second crank, 7 second rest, 16 second crank, 7 second rest followed by 3 additional cycles of 7 second cranks followed by 7 second rests.

Choke Operation (Nexus controller units only)

- The 990/999cc engines have an electric choke in the air box that is controlled automatically via the controller.
- The 530cc engines have an electric choke on the divider panel air inlet hose, control is done automatically via the controller.
- The 410cc engines have a choke inside the inlet of the air box. Control is done automatically via the controller.

NOTE: Evolution controller units do not have a choke

Failure to Start

Failure to start is defined as any of the following occurrences during cranking.

1. Not reaching starter dropout within the specified crank cycle.

Note: Starter dropout is defined as 4 cycles at 1,000 RPM

2. Reaching starter dropout, but then not reaching 2200 rpm within 15 seconds. After which the controller will go into a rest cycle for 7 seconds, then continue the rest of the crank cycle.

Note: During a rest cycle the start and fuel outputs are de-energized and the magneto output is shorted to ground.

CRANKING CONDITIONS

The following notes apply during the crank cycle.

1. Starter motor will not engage within 5 seconds of the engine shutting down.
2. The fuel output will not be energized with the starter.
3. The starter and magneto outputs will be energized together.
4. Once the starter energizes, the controller will begin looking for engine rotation. If it does not see an RPM signal within 3 seconds it will shut down and latch out on "RPM Sensor loss".

Note: Evolution units will preset the throttle before engaging starter.

5. Once the controller sees an RPM signal it will energize the fuel solenoid, drive the throttle open, and continue the crank sequence. The fuel solenoid does not activate earlier because if the engine does not crank, this would potentially fill the engine/exhaust up with fuel. It may take up to 3 seconds to detect cranking on the engine with a magneto RPM measurement. This would result in 3 seconds of fuel being delivered, increasing the chances of a backfire.
6. The starter motor will disengage when speed reaches starter dropout.
7. If the generator does not reach 2200 rpm within 15 seconds, re-crank cycle will occur.
8. If the engine stops turning between starter dropout and 2200 RPM the board will go into a rest cycle for 7 seconds then re-crank (if additional crank cycles exist).
9. Once started the generator will wait for a hold off period before starting to monitor oil pressure and oil temperature. See Section 4.2 "Engine Protective Devices".
10. During a manual crank attempt, if the controller is changed from MANUAL mode to OFF mode, the crank attempt will abort.
11. During automatic crank attempt, if the Utility returns, the cranking cycle does NOT abort, but continues until complete. Once the engine starts, it will run for one minute then shut down.

LOAD TRANSFER PARAMETERS

The transfer of load when the generator is running is dependent upon the operating mode as follows:

Manual

- No transfer to Standby when Utility is present.
- Transfer to Standby will occur if Utility fails (below 65% of nominal) for 10 consecutive seconds.
- Transfer back to Utility when Utility returns for 15 consecutive seconds. The engine will continue to run until removed from the Manual mode.

Auto

- Transfer to standby will occur if Utility fails (below 65% of nominal*) for five (5) consecutive seconds*.
- A five (5) second engine warm-up timer will initialize.
- Transfer back to the "Utility" position if Utility subsequently returns.
- Transfer to the "Standby" position if Utility is still not present.
- Transfer back to Utility once Utility returns (above 80% of nominal*) for 15 seconds.
- Transfer back to Utility, if present, if the generator is shut down for any reason (such as the switch turned to the OFF position or a shutdown alarm 0.
- After transferring back to Utility the engine will shut down, after a one (1) minute cool-down timer expires.

*** Fixed on Nexus controllers, adjustable on Evolution controllers.**

Exercise

- Exercise will not function if the generator is already running in either Auto or Manual mode.
- During exercise, the controller will only transfer if Utility fails during exercise for 10 seconds, and will follow the steps outlined above for Auto operation.

UTILITY RESTORED

The generator is running, CONTACTOR in "Standby", running in Utility failure. When the Utility returns (above 80% of nominal*), a 15 second return to Utility timer will start. At the completion of this timer, if the Utility supply is still present and acceptable, the control will transfer the load back to the Utility and run the engine through a one (1) minute cool down period and then shut down. If Utility fails for three (3) seconds during this cool down period, the control will transfer load back to the generator and continue to run while monitoring for Utility to return.

*** Fixed value on Nexus controllers, adjustable on Evolution controllers.**

INTRODUCTION

Performing proper maintenance on a Generator will ensure proper function during a Utility failure. Once a Generator has failed, it is already too late. Ensuring the proper oil changes and inspections have been completed at the specified times will help keep the Generator reliable.

MAINTENANCE MESSAGE

When a maintenance period expires, a warning message will be displayed. Pressing the Enter key will cause the alert to reset and will prompt the user to confirm the action. Resetting will clear the alert and reset the maintenance counters for all warnings annunciated. The history log will record the alert. The maintenance counter will not accumulate without battery voltage. Once restored, a prompt will appear for the user to set the time and date. The new date and time will adjust the maintenance counters accordingly.

Only one alert will appear on the display at any one time. With the acknowledgement of the first alert, the next active alert will be displayed

Message Interval

Table 3. Nexus Message Intervals

"Inspect Battery"	1 Year
"Change Oil & Filter"	200 Hours or 2 years
"Inspect Air Filter"	200 Hours or 2 years
"Change Air Filter"	200 Hours or 2 years
"Inspect Spark Plugs"	200 Hours or 2 years
"Change spark Plugs"	400 Hours or 10 years

Table 4. Evolution Message Intervals

"Inspect Battery"	1 Year
"Schedule A"	200 Hours or 2 years
"Schedule B"	400 Hours

Resetting Maintenance Intervals

When a complete maintenance inspection has been completed before a specific alert was generated, it is possible to reset the intervals to prevent future alerts from occurring for maintenance that was just performed. To reset the intervals proceed to Section 4.1 "Menu Navigation" for further information

With the resetting of the intervals, all maintenance counters will start from the current time and date of the Generator.

Engine Oil

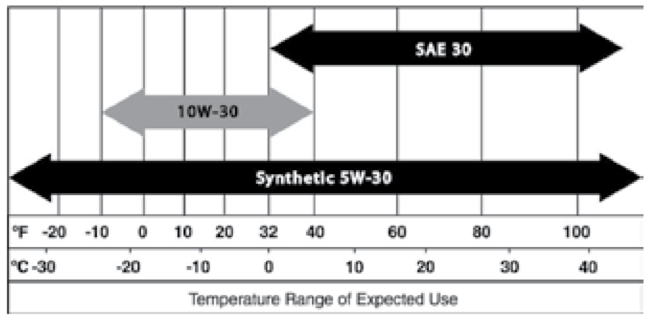
Modern oils play vital functions in protecting the engine. Lubricating oil acts to reduce friction and wear, cool engine parts, seal combustion chambers, clean engine components, and inhibit corrosion. See Tables 3 and 4 for specific inspection items and intervals.

Engine Oil Recommendations

All oil should meet minimum American Petroleum Institute (API) Service Class SJ, SL or better. Do not use special additives. Select the oil's viscosity grade according to the expected operating temperature. Refer to Table 5.

- SAE 30 ➤ Above 32 ºF
- 10W-30 ➤ Between 40 ºF and -10 ºF
- Synthetic 5W-30 ➤ all temperature ranges

Table 5.



Note: Follow the recommendations in the Owner's Manual for the unit being serviced.

⚠ CAUTION!

Any attempt to crank or start the engine without the recommended oil may result in an engine failure.

AIR FILTER

Air is necessary for successful combustion in the engine. Clean air (almost 100% pure) is critical to engine survival and vital to its performance. There are operational signs when an air filter has become completely plugged. The engine begins to lose power, and fuel consumption increases. Black smoke may blow from the exhaust. Continued operation with a plugged air filter may cause severe damage to the engine.

SPARK PLUGS

Good spark is essential to properly maintaining the engine. Although replacement may not be required, inspection of the plugs during routing maintenance is critical. Always verify that spark plugs are gapped according to the specifications. Improperly gaped spark plugs will effect the operation of the engine.

See "Specifications" for specific spark plug gaps.

VISUAL INSPECTION

During all service intervals, a proper visual inspection must be conducted to ensure proper function, airflow, and to prevent fire hazards.

Air inlet and outlet openings in the Generator compartment must be open and unobstructed for continued proper operation. This includes such obstructions as high grass, weeds, brush, leaves, and snow.

WARNING!

The exhaust from this product gets extremely hot and remains hot after shutdown. High grass, weeds, brush and leaves must remain clear of the exhaust. Such materials may ignite and burn from the heat of the exhaust system.

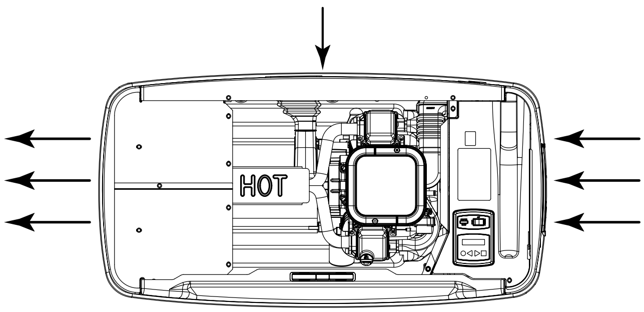


Figure 20. Cooling Vent Locations

CORROSION PROTECTION

Periodically wash and wax the enclosure using automotive type products. Frequent washing is recommended in salt water/coastal areas. Spray engine linkages with a light oil such as WD-40.

VALVE CLEARANCE

Proper valve clearance is vital to ensuring longevity of the engine. Based on the maintenance schedule of the unit, check the engine valve clearance and adjust as necessary. Checking of the engine valve clearance thereafter periodically will increase reliability of the Generator. **Refer to Test 63 for Specification and adjustment procedure.**

Some symptoms of an engine with valves in need of adjustment are:

- Hard starting
- Smoke out of the exhaust
- Rough running
- Lack of horse power

BATTERY

Performing proper battery maintenance at the required intervals will allow for proper starting of the Generator during a power outage. Some common things to look for and check during maintenance are:

- Inspect the battery posts and cables for tightness and corrosion. Tighten and clean as necessary.
- Check the battery fluid level of unsealed batteries and, if necessary, fill with Distilled Water only. Do not use tap water in batteries.
- Have the state of charge and conditions checked. This should be done with an automotive-type battery hydrometer, or electronic tester.

Note: See Test 45 for further testing the state of a battery.

WIRELESS MONITOR

A small wireless device (about the size of a credit card) provides a basic approach to wireless monitoring; however, the device only provides three basic alerts.

Figure 21. Wireless Monitor

The green LED (Generator OK) indicates that either:

- The controller on the generator is set to the Auto mode, no alarms are present, and the generator is ready to start and run or is running.

Or:

- The controller on the generator is set to the Manual mode, the engine is running and no alarms are active.

When active, the green LED will flash once every 10 seconds.

The yellow LED (Maintenance Needed) indicates that either a GENERATOR WARNING is present or generator maintenance is required. The generator will not be prevented from running when the yellow LED is on. When active, the yellow LED will flash once every two (2) seconds.

The red LED (Contact Dealer) indicates any one of the following conditions:

- The controller on the generator is in the Off mode.
- The generator has not been registered
- A generator alarm is present.
- The controller has been powered up, but the start up wizard procedure has not been completed.

If a generator alarm is present the generator will not start and run in the event of a utility loss, or will be automatically shut down if the engine is already running. When active, the red LED will flash once every second.

The internal buzzer will sound once every 30 seconds when the red LED is on. The buzzer can be silenced by briefly pressing and releasing the Pair/Reset button; the buzzer will pulse twice to indicate it has been silenced. The buzzer will not reactivate until a new alarm has been detected.

The wireless monitor display unit updates the status of its LED's every 30 to 60 seconds. To conserve power and extend battery life, the LEDs are not lit continuously: instead they are briefly flashed as indicated above.

WIRELESS BASIC TROUBLESHOOTING.

Pairing the Generator Transceiver with the Display Unit

1. See Figure 23 for the location of the “Pair/Reset” button on the display unit.

   Place the display unit against the generator transceiver as shown in Figure 22, then immediately press and hold the “Pair/Reset” button on the display unit
2. Once the yellow LED begins flashing (after about three seconds), indicating the modules are in pairing mode, release the “Pair/Reset” button on the display unit and move the display unit away from the generator transceiver.
3. The Yellow LED will continue to flash during the pairing process.
4. Once the two modules have successfully paired up the yellow LED will stop flashing and the green LED will begin flashing.
5. Press and release the Pair/Reset button to complete the pairing process. At this time the green LED will stop flashing and the display unit will enter its normal mode of operation.

Note: If the controller is still in the off mode the red LED will begin to flash to indicate the generator is in alarm mode. Do not confuse this flashing red LED with the “failure to pair” described below.

Figure 22. Place the Display Unit Against the Generator Transceiver

NOTE: The magnets in the display unit activate a magnetic reed switch in the generator transceiver in step 21. The relative positioning of the two units needs to be as shown in Figure 22 to activate the magnetic reed switch.

Figure 23. Location of Pair/Reset Button

6. Proceed with the "Re-Assemble the Generator" section
7. If the two modules fail to pair up within 30 seconds, the yellow LED will stop flashing and the red LED will begin to flash. If this happens proceed as follows:

- Press and release the Pair/Reset button to stop the red LED from flashing.
- Check that good non-rechargeable AAA 1.5V batteries are installed.
- Check the wiring to make sure all the plugs are fully inserted.
- Repeat the pairing process from Step 1.

Results

1. If the link is established, discontinue troubleshooting.
2. If the link continues to fail, replace the wireless remote and transmitter.

WIRELESS ADVANCED MODULE

Figure 24. Wireless Advanced Module

The wireless display system consists of two identical radio transceivers, one mounted near the Generator and the other (the one with the display), should be in a convenient viewing location. The system has a "line of sight" range of about 300 feet but this will be reduced if the signal has to go through walls, floors, etc.

NOTE: Some building materials may completely block the passage of the signal. For example: steel beams, metal siding, foil radiant barrier insulation.

The display is intended to show the status of the generator and warn you if the system is in an alarm state. It also provides the following additional functions:

- An independent (of the generator Alarm Log) time/date stamped history of Generator events such as starting and stopping.
- Allows remote starting and stopping of the generator.
- Facility to set an exercise time and day from the display.
- A separate battery backed clock (with date) which is synchronized to the generator clock. If power is removed from the generator, the time and date will automatically be restored from this clock.
- Ability to add extra displays.
- Graphing capability.

WIRELESS ADVANCED FEATURES

One of the most commonly used features on the device is the ability to test the functions of the generator. The "TEST" menu provides the option to remotely start, start and transfer, and stop the generator. This feature only works when the controller is set to AUTO mode and Utility voltage is available.

Note: The remote cannot disable or prevent the Generator from running; the only method to disable the generator is by cycling the controller to the OFF mode.

Some operational rules apply when using the "TEST" feature and are not due to product failure:

- The Generator can only be shutdown if it was started via the remote. It will not respond to the command if running in a Utility failure.
- When the command has been given for a start and transfer to occur the Generator will stay running until the "STOP" command has been given. The generator will then run for a 1 minute cool down period.

WIRELESS ADVANCED TROUBLESHOOTING.

Resynchronizing the Radio After Battery Disconnection or In the Event of Loss of Communication

If the battery is ever disconnected from the generator, the radio system will stop working and WILL NOT AUTOMATICALLY resynchronize. To resynchronize the system, follow the steps (similar to installation) shown below:

1. Ensure the display unit has working batteries fitted into it.
2. Take the display unit to the generator and turn the display unit off using the slide switch on the side of the unit.
3. Open the generator lid and turn the generator controller to the "Off" mode.
4. Remove the large enclosure panel from the front of the enclosure.

5. Locate the radio connector under the generator display panel. It is the closest one to you as you are facing the generator; it has a white connector with gray cable going to it. It has a locking tab that needs to be squeezed to remove it. Remove the connector by squeezing the tab and pulling the connector down. As the locking mechanism is a tight fit, you may need a pliers to help release it.
6. Turn on the display unit and go to the RADIO menu.
7. Select “RESET RADIO” and IMMEDIATELY (within 5 seconds) put the connector back into the controller (that you removed in Step 5).
8. The display unit will start searching for the generator. Up to one minute will pass while the remote unit and generator synchronize. Once the generator is found, the radio link has been re-established and the settings will be remembered.
9. Re-fit the front enclosure panel and close the lid.
10. Turn the controller to the Auto mode
11. Return the display unit to its original location and re-connect it to the wall transformer. Turn it off and back on again (this is just to get it out of sleep mode which it may have entered on battery power).

Results

1. If the link is established, discontinue troubleshooting.
2. If the link fails to establish, repeat Steps 5-8 using a different channel.
3. If the link continues to fail, replace the wireless remote and transmitter.

MOBILE LINK™

MOBILE LINK TROUBLESHOOTING.

Problem	Cause	Correction
All LEDs off	1. No power to Mobile Link unit.	1. Check the 5 Amp fuse located on the yellow harness wire.
		2. Check harness is connected to battery properly. Yellow to (+) Battery/ Black to (-) Battery.
		3. Reseat connector to Mobile Link.
		4. Replace cable.
Top LED off	1. Unit not enrolled.	1. Enroll Mobile Link at www.StandbyStatus.com.
		2. Verify Mobile Device Number is enrolled at www.StandbyStatus.com and enrolled number matches Mobile Device Number (MDN) of the Mobile Link unit.
Middle LED flashing	1. Poor connection.	1. Reseat connector at generator controller and Mobile Link.
		2. Replace cable.
Bottom LED off	1. No cellular network connection.	1. Check cellular coverage in your area.
		2. Mobile Link in “Suspended” mode. Contact Customer Service for assistance at 1-888-436-3722.
Bottom LED flashing	1. Cellular connection pending.	1. Network connection established. Awaiting server response.
	2. Server may be down.	2. Wait for problem to resolve itself.*

* The Mobile Link will retry several times before resting and retrying later. The full retry cycle lasts for about one (1) hour and includes several resets of the internal cellular modem. When these resets occur, the Mobile Link will indicate a loss of the cellular network connection until it is reestablished. If the end of the retry cycle has been reached without successfully completing communication with the server, the Mobile Link will rest for an hour, and then start another retry cycle. This rest period can be interrupted by switching the generator from OFF to AUTO. The Mobile Link will continue this cycle until it successfully connects to the server and receives a response.

DIAGNOSING MOBILE LINK COMMUNICATION TO CONTROLLER

A flashing middle LED on the Mobile Link controller indicates a loss of communication between the Mobile Link unit and the generator controller.

The problem can be the generator controller, the Mobile Link controller, or the harness between the two units.

To determine the problem, perform voltage checks according to the charts below. This will help determine whether the Mobile Link controller or the generator controller is at fault.

Three wires are used to communicate between the Mobile Link controller and the generator controller. The SHLD wire is connected to the Mobile Link controller only. There are two communication wires (Wires 387 and 388) connected between the two controllers.

First, verify that the harness is plugged in correctly and that the generator starts and runs properly. If the harness is plugged in correctly and there is still no communication, disconnect both ends of the harness. Perform a continuity test on the wires in the harness to verify that they are not shorted between one another.

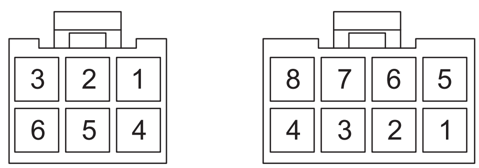
There are four charts. Charts 1 and 2 are used with all connectors connected while back probing each wire to battery ground (-) and to battery positive (+).

Charts 3 and 4 determine the voltage output from each unit while the other end of the harness is disconnected.

If all LEDs are on and Mobile Link is communicating normally, then the power wire (13A), ground wire (0), and fuse to the Mobile Link unit are good.

If no LEDs are illuminated on the Mobile link unit, verify that the power wire (13A), ground wire (0), and fuse to the Mobile Link Unit are good.

All views are from the backside of the connector.



Mobile Link Connector **Evolution Connector**

Chart 1 – Back Probe at Mobile Link connector (All connectors plugged in) All voltages +/- .5 volts		
	DVOM Neg lead on Battery NEG	**DVOM Pos lead on Battery POS**
Pin 1, Wire SHLD	0 VDC	Battery Voltage
Pin 2, Wire 388	- 4.2 to - 5.6 VDC Fluctuating	18.0 to 19.2 VDC Fluctuating
Pin 3, EMPTY	EMPTY	EMPTY
Pin 4, Wire 0	0 VDC	13.77 VDC
Pin 5, Wire 387	-5.8 to -6.8 VDC Fluctuating	22.33 VDC
Pin 6, Wire 13A	Battery Voltage	0 VDC

Chart 2 – Back Probe at Evolution Controller (All connectors plugged in) All voltages +/- .5 volts		
	DVOM Neg lead on Battery NEG	**DVOM Pos lead on Battery POS**
Pin 7, Wire 388	- 4.4 to - 5.3 VDC Fluctuating	18.3 to 19.4 VDC Fluctuating
Pin 8, Wire 387	- 6.0 to - 6.8 VDC Fluctuating	19.8 to 20.5 VDC Fluctuating

Chart 3 – Back Probe at Mobile Link connector (Mobile Link connector unplugged) All voltages +/- .5 volts		
	DVOM Neg lead on Battery NEG	**DVOM Pos lead on Battery POS**
Pin 1, Wire SHLD	0 VDC	0 VDC
Pin 2, Wire 388	0 VDC	13.76 VDC
Pin 3, EMPTY	EMPTY	EMPTY
Pin 4, Wire 0	0 VDC	13.77 VDC
Pin 5, Wire 387	- 8.56 VDC	22.33 VDC
Pin 6, Wire 13A	Battery Voltage	0 VDC

If no voltages are indicated based on this chart the controller is at fault.

Chart 4 – Back Probe at Evolution Controller (Mobile link plugged in Evolution connector unplugged) All voltages +/- .5 volts		
	DVOM Neg lead on Battery NEG	**DVOM Pos lead on Battery POS**
Pin 7, Wire 388	- 5.5 VDC	19.3 VDC
Pin 8, Wire 387	0 VDC	13.7 VDC

If no voltages are indicated based on this chart the Mobile Link unit is at fault.

WIRELESS LOCAL MONITOR

The Wireless Local Monitor consists of one transceiver, mounted on the generator, and a display unit, placed in a convenient viewing location within the home or business. The system has a "line of sight" range of about 600 feet, but this will be reduced when the signal has to pass through walls, floors, etc., of a typical installation. With this remote monitoring system, the status of the generator can be checked easily from within the home or business.

The generator transceiver and display unit are shipped from the factory paired. These units are pre-paired to ensure communication and prevent cross-communication from other devices in the area.

Note: Some building materials may completely block the passage of the signal, for example, steel beams, metal siding and foil radiant barrier insulation.

- The Wireless Local Monitor indicates the generator status via three lights - Green, Yellow or Red.
- The Test button performs a Signal Strength Test.
- The Battery Status Indicator provides low battery status.
- The Buzzer gives an audible warnings in conjunction with Yellow or Red lights.

Generator Compatibility

- This unit can be installed on all 2008 and later air-cooled home standby units with an LCD display and all 2010 and later liquid-cooled gaseous fuel standby units. The unit can also be used on 2013 and later Evolution controlled liquid-cooled diesel fuel standby units.
- For liquid-cooled units, an additional adapter harness is required (model 006665-0).
- Maximum ambient temperature rating: 122 °F / 50 °C.

Signal Strength Test

The display unit is equipped with a Signal Strength Test Mode. Press the Test button for five (5) seconds to enter the Signal Strength Test Mode. The Green, Yellow and Red lights will alternately light for a short period to indicate transition from Status mode to the Signal Strength Test Mode. The unit will be in this mode for 30 seconds. During the Signal Strength Test:

- Green - Good Signal Strength
- Yellow - Marginal Signal Strength
- Red - No Signal Strength

After 30 seconds, the unit will automatically exit the Signal Strength Test Mode. When this happens, the indicators alternately light to signal the transition back to Status Mode.

Note: Extended or frequent use of the Signal Strength Test may deplete battery life.

Note: The display unit will still work if the signal strength is yellow but battery life may be reduced.

Signal Strength Test Quick Reference Chart

Signal Strength Test is active - Display unit button must be pressed for more than 5 seconds - Display unit lights will go from providing current generator status to a rotating light pattern to signal a change in function to a Signal Strength Test Mode. It will repeat the rotating light pattern when it exits Signal Strength Test Mode.

Green Light	Yellow Light	Red Light	Meaning
ON	OFF	OFF	Strong signal from Transceiver unit to Display unit.
OFF	ON	OFF	Weak signal from Transceiver to Display unit.
OFF	OFF	ON	No signal from Transceiver to Base unit.

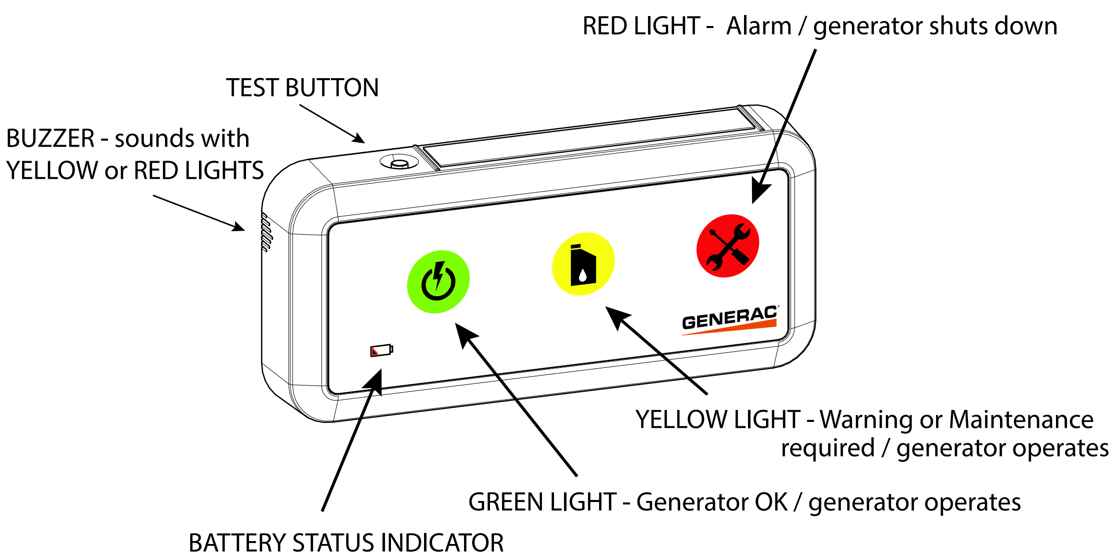


Figure 25. Wireless Local Monitor Functions

WIRELESS LOCAL MONITOR GENERAL OPERATION

The normal state of the display unit is to have no lights active. This indicates that the generator has no problems. When any problems occur, the lights will indicate the problem based on the information in this section.

Generator Transceiver Status Light

The generator transceiver has a green status light that indicates it has power and is communicating with the display unit. This light can be viewed inside the generator compartment, through the wire loom opening when the generator lid is raised.

- Solid light Green light - power present / communication established
- Flashing Green light - power present / no communication

Display Unit Green Light (Generator OK or RUNNING)

During normal operation, if the generator is in AUTO mode and does not have any maintenance actions, warnings or alarms active, no lights will be illuminated.

To verify the status of the generator, the Test button can be pressed to show the status. If the generator is set to AUTO mode and no alarms or warnings are present, the green light will illuminate when the Test button is pressed.

The green light will flash every five (5) seconds when the generator is running either in AUTO or MANUAL mode.

Display Unit Yellow Light (Maintenance Needed OR Warning Active)

The yellow light indicates either:

- Generator warning is present
- Generator maintenance is required.

The generator will not be prevented from running when the yellow light is on.

When active and the generator is not running, the yellow light will flash once every five (5) seconds. If the generator is running with a yellow light active, both the green and yellow lights will flash once every five (5) seconds.

The internal buzzer will sound once every four (4) hours for one (1) second when the yellow light is active. During a period of inactivity, the buzzer may be silenced by briefly pressing and releasing the Test button; the buzzer will pulse twice to indicate it has been silenced. The buzzer will not reactivate until a new alarm has been detected.

NOTE: If the button is pressed while the buzzer is sounding, it may not be silenced.

Display Unit Red Light (Check Generator Status, Call Dealer If Necessary)

The red light indicates either:

- The AUTO/OFF/MANUAL button on the generator is in the OFF mode
- A generator alarm is present.

If a generator alarm is present, the generator will not start and run in the event of a utility loss or will be automatically shut down if the engine is already running.

When active, the red light will flash once every five (5) seconds.

The internal buzzer will sound once every hour for five (5) seconds when the Red light is on. During a period of inactivity, the buzzer can be silenced by briefly pressing and releasing the Test button; the buzzer will pulse twice to indicate it has been silenced. The buzzer will not reactivate until a new alarm has been detected.

NOTE: If the button is pressed while the buzzer is sounding, it may not be silenced.

Low Battery Indicator

The battery status indicator will flash every five (5) seconds, and the buzzer will sound every 15 minutes when a low battery is detected. The batteries should be replaced immediately.

Once the batteries are replaced, check the status of the generator by pressing the Test button to verify operation.

During a period of inactivity, the buzzer can be silenced by briefly pressing and releasing the Test button; the buzzer will pulse twice to indicate it has been silenced. The buzzer will not reactivate until a new alarm has been detected.

TROUBLESHOOTING

Problem	Possible Causes	Possible Corrective Actions
Generator transceiver light not illuminated	The transceiver is not receiving power. Connection to generator transceiver may not be made.	Check that the harness transceiver connection is made properly at the transceiver and controller.
	The transceiver is not receiving power. Fuse has failed, been damaged or is removed from generator controller.	Check and replace fuse.
	The transceiver is not receiving power. Generator battery is disconnected.	Check generator battery connections.
Generator transceiver light flashing	The transceiver is not in communication with the display unit.	Install or replace batteries. Display unit may be out of range.
Display unit -yellow and red lights are flashing	The generator transceiver is not communicating with the generator.	Check the wiring harness and connections between the Generator control panel and the transceiver.
Display Unit – All lights flashing (Communication lost between Generator Transceiver and Display unit)	Display unit is out of range with generator transceiver.	Check range status by performing the Signal Strength Test and move display unit closer to generator until range is acceptable.
	Generator transceiver is not communicating with generator controller or is not receiving power.	Check that the connection to the transceiver is made properly.
		Check that the connection to the controller is made properly.
	The transceiver is not receiving power. Fuse has failed, been damaged or is removed from generator controller.	Check and replace fuse.
	The transceiver is not receiving power. Generator battery is disconnected.	Check generator battery connections.
Display Unit – No lights illuminate when button pressed	Dead batteries.	Check and replace batteries.
Battery - Battery life is less than expected	Low signal strength.	Perform the Signal Strength Test and relocate to a location with higher signal strength, if necessary.
Low signal strength	Signal reduced due to travel through various mediums, such as, metal siding, tinted or filtered windows, brick, multiple walls or atmospheric conditions.	Perform the Signal Strength Test and relocate to a location with higher signal strength, if necessary.

QUICK REFERENCE CHART

Green Light	Yellow Light	Red Light	Battery Status Indicator	Buzzer	Meaning
—	—	—	Flash every 5 seconds	1 second every 15 minutes	Replace batteries in Display unit. Remove batteries to silence buzzer.
OFF	OFF	Flash every 5 seconds	—	5 seconds every hour	Generator will not run. Alarm condition reported. Press Test button to silence buzzer. Buzzer will re-activate with new warning.
Flash every 5 seconds	Flash every 5 seconds	OFF	—	1 second every 4 hours	Generator is running with warning. Press Test button to silence buzzer. Buzzer will re-activate with new warning.
OFF	Flash every 5 seconds	OFF	—	1 second every 4 hours	Generator is not running, but will if needed. Generator warning reported. Press Test button to silence buzzer. Buzzer will re-activate with new warning.
OFF	Flash every 5 seconds	Flash every 5 seconds	—	OFF	The generator transceiver is not communicating with the generator controller.
Flash every 5 seconds	OFF	OFF	—	OFF	Generator running normally.
ON	OFF	OFF	—	OFF	Generator is standing by, ready to run. No issues reported.*
Flash every 3 seconds	Flash every 3 seconds	Flash every 3 seconds	—	OFF	Display unit has lost contact with Transceiver unit.

* Display unit button must be pressed to obtain this status.

NAVIGATION

To get to the Main Menu from any other display, press the "ESCAPE" key one or more times. The Main Menu is shown in Figure 27. The menu system diagram is shown in Figure 36.

There are four selection and navigation keys below the display. The "ESCAPE" key will cause the display to move back toward the main menu. The "ENTER" key is used to activate a menu or accept a value when it is changed. The UP and DOWN triangle keys perform a number of different functions depending on which screen of a menu you are in. With them you can move to the next choice (the menu to be selected will flash on and off); they will act as the left and right arrows to move between the various editable menus; in an editable menu they will increase or decrease a value or change the choice (i.e. from Yes to No). See Figure 36 for the Basic Menu System Diagram.

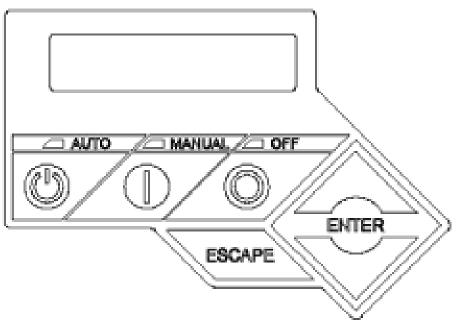


Figure 26. Evolution Display and Navigation Buttons

MAIN MENU

There are 4 selections in the Main Menu: System, Date/Time, Battery, Sub Menus.

SYSTEM	DATE/TIME
BATTERY	SUB MENUS

Figure 27. Evolution Display Main Menu

System

Selecting System returns the the Main Display.

Battery

Selecting the Battery Menu will display the battery condition.

Date/Time

Selecting the Date/Time Menu will display the current date and time.

Sub Menus

Selecting Sub Menus displays the following Sub Menu screen.

HISTORY	MAINT
EDIT	DEALER

Figure 28. Evolution Sub Menu

History

The History Menu will display two history logs: Alarm Log and Run Log.

- Alarm Log: displays the last 50 alarm conditions. They are in date time order, numbered from 1 to 50; 1 is the most recent. Use the (up triangle image) and the (down triangle image) to move from alarm to alarm. Each alarm lists the Date, Time of trigger, and the description of the alarm.
- The Run Log will display the last 50 Run events. It will display the date and time as well as a brief description of the event; for instance Running – Utility Lost; Stopped – Auto.

```
History
Alarm Log    Run Log
```

Figure 29. History Menu

```
1  09/15/10  04:55:22
   Under Voltage
```

Figure 30. Alarm Log Display.

Use the up and down keys to move from the most recent Alarm (1) to the oldest (50).

```
1  09/15/10  04:55:22
   Stopped
```

Figure 31. Run Log Display.

Use the up and down keys to move from the most recent Run event (1) to the oldest (50).

Maint

The Maint Menu will display three selections: Maint. Log, Run Hours, and Scheduled.

MAINT:	Run Hrs
Maint Log	Scheduled

Figure 32. Maint Menu.

Edit

Selecting the Edit Menu allows access to edit the following sections: Language, Fuel Selection, Cold Smart Start (firmware version 1.14 and above), Current Date/Time, Exercise Time, Exercise Frequency, and Firmware Update.

Table 6. Cold Smart Start Parameters

Node	8 - 20 kW	22 kW
Cold Smart Start (2015-02) and Ambient Temp display screen	X	X
Temperature Threshold	50 ºF	20 ºF
Default Setting	Yes	Yes

Run Hrs

View the amount of actual run hours on the unit.

Scheduled

View when the next scheduled maintenance is due.

Maint Log

Review the history of the maintenance recorded on the unit.

EVOLUTION DEALER MENU

DEALER:	DISPLAY
DEALER EDIT	TEST

Figure 33. Evolution Dealer Menu

Dealer

The Dealer Menu will display three selections: Display, Dealer Edit, and Test.

Display

The Display Menu will display eleven choices: Battery Voltage, Charging Status, Run Hours, Output Volts, Output Frequency (Hz), Engine Speed (RPM), Utility Input Volts, Ambient Temperature (ºF), Firmware Hardware, Bootloader EEPROM, Command, and Node Hz Volts. Use the UP and DOWN triangle keys to move:

Dealer Edit

The Dealer Edit Menu will display nine selections: Startup Delay, Run Hours, Util Volts Low Value, Util Recovery Volts, Calibrate Current 1, Calibrate Current 2, Calibrate Volts, 2-Wire Start Select, and Reset Maintenance. These are editable selections within this menu selection.

Test

Provides four test tools integral to the control panel: Inputs, Outputs, Display, and QT-Test.

- INPUTS provides a way to see the status of the 8 input channels that the control panel monitors. See Table 6 for the list of inputs the control panel monitors. Each input represents an open or closed set of contacts, and will display either a 0 or 1 character. The 0 character represents an open contact; a 1 character represents a closed contact. The Inputs screen is a handy way to tell if the control is seeing a valid input from a particular source. This screen will also display Utility voltage.
- OUTPUT provides a way to see the status or the output relays the control panel uses to make things happen (like crank and run and transfer). See Table 6 for the list of output channels. Each channel represents a relay with a character of either 0 or 1. The 0 character represents a relay that is de-energized (OFF); a 1 represents a relay that is energized (ON). The outputs screen is a handy way to tell if the control is telling the generator to start, or transfer, etc. This screen will also display the Generator Output voltage.
- Display provides two flashing bars that test the display LEDs. As the bars flash on and off you can readily tell if the display has a bad area, if an area does not turn on it means those LEDs are not working. The control panel would require replacement to correct a bad display.
- QT-Test is only available on enabled units. It provides a way to test the Quiet Test mode of the generator. When tested the generator will run at a lower RPM during the test. Note that for the unit to perform an actual weekly Quiet Test Exercise, it must be enabled in the Exercise Time editing menu.

Note: This is a standard feature on certain units, and optional on some other units.

Note: To perform the QT test controller must be in AUTO mode and Utility must be present to unlock the sub test menu.

```
INPUTS: Utility   240
0  1  0  0  0  0  1  0
```

Figure 34. Test Inputs Display

Inputs are numbered from left to right (1-8).

0 indicates an Input is OFF

1 indicates an Input is ON

For instance, in Figure 34 Inputs 2 and 7 are ON (Low Oil Pressure and the Auto switch).

This indicates the unit is shut down and in Automatic.

```
OUTPUTS: Gen    0
0  0  0  0  0  0  0  0
```

Figure 35. Test Outputs Display

Outputs are numbered from left to right (1-8).

0 indicates the Output is OFF

1 indicates the Output is ON

For instance, in Figure 35 there are no Outputs ON which indicates the unit is shut down.

Table 7. Digital Inputs and Outputs

Position	Digital Inputs	Digital Outputs
1	Not Used	Not Used
2	Low Oil Pressure	Not Used
3	High Temperature	Not Used
4	Not Used	Battery Charger Relay
5	Wiring Error Detect	Fuel
6	Not Used	Starter
7	Auto	Ignition
8	Manual	Transfer

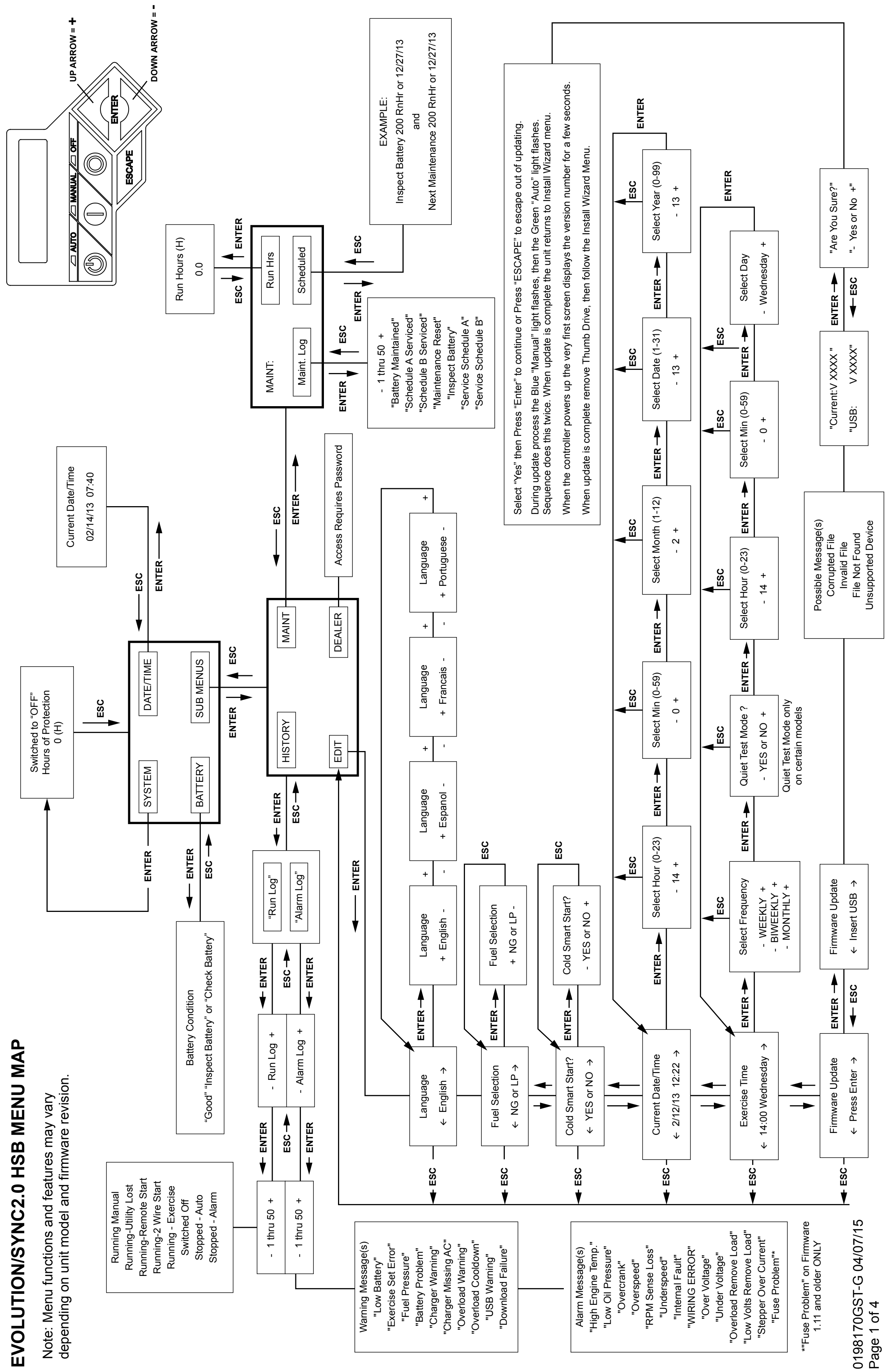
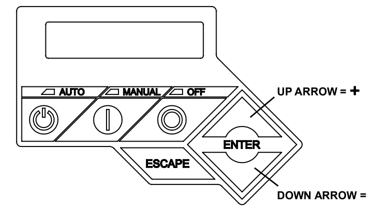


Figure 36. Evolution Menu System Diagram



EVOLUTION/SYNC2.0 HSB ACTIVATION

Note: Menu functions and features may vary depending on unit model and firmware revision.

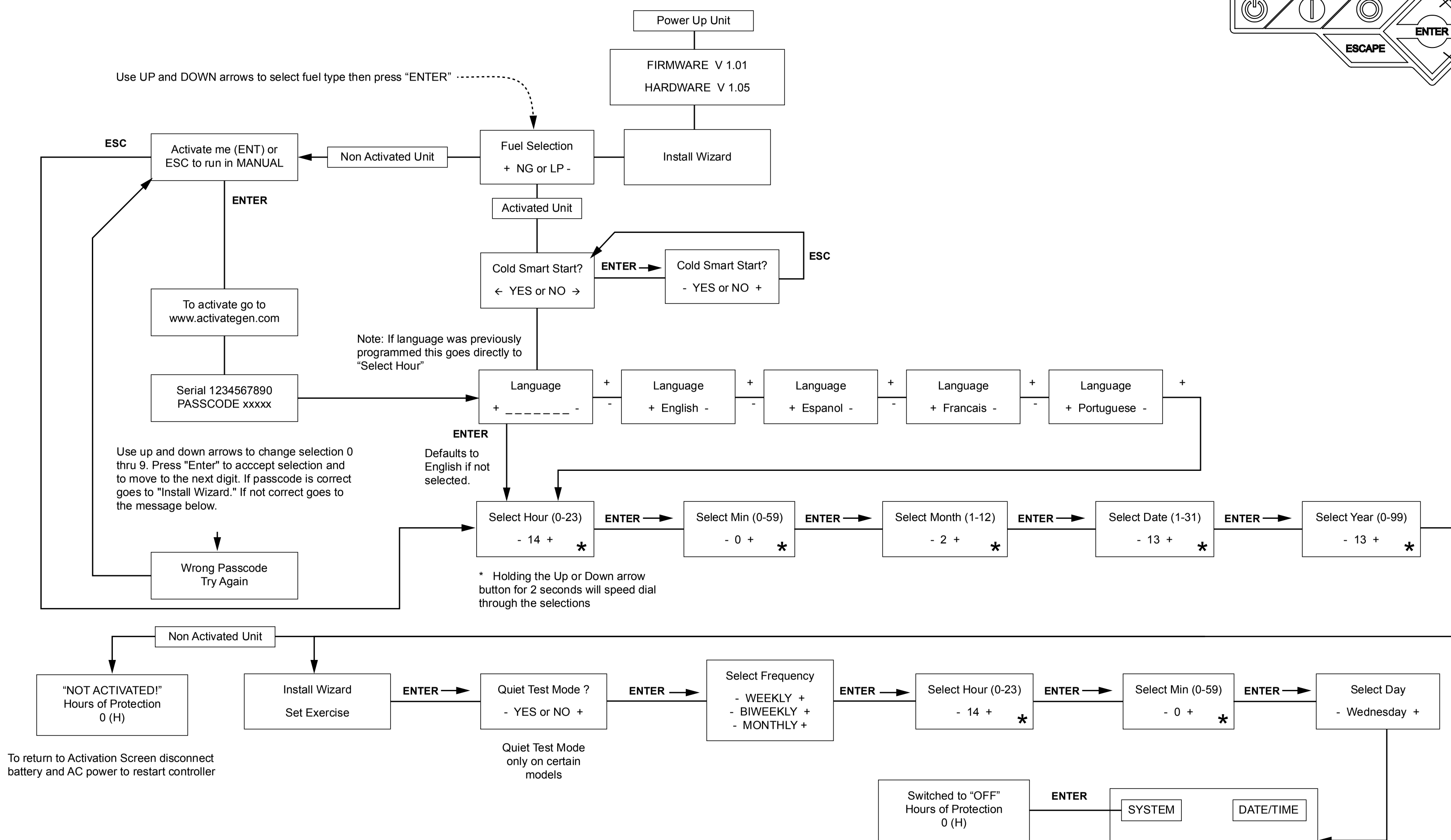


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Figure 37. Evolution Activation and Install Wizard Menu

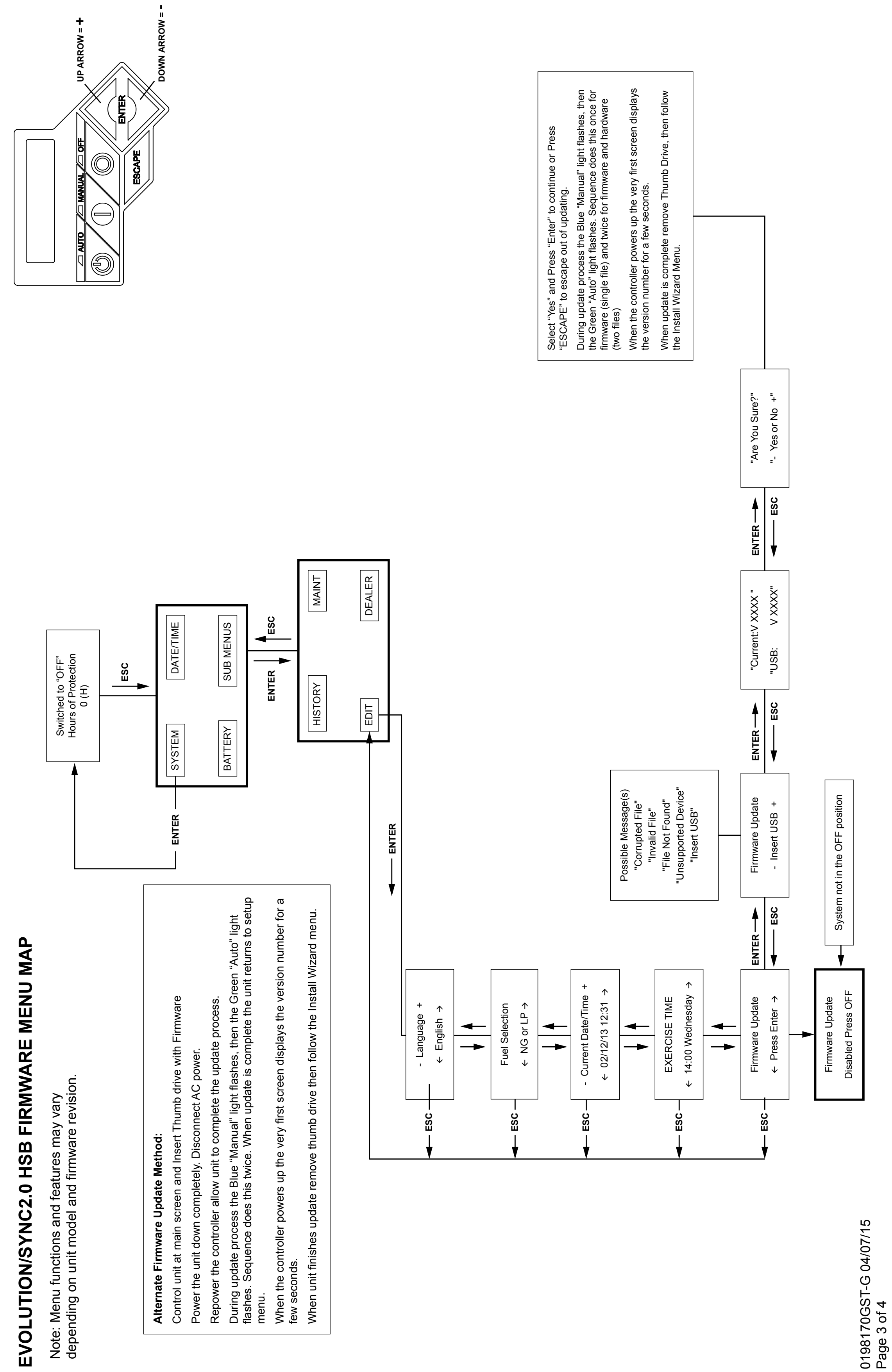


Figure 38. Evolution Menu System Diagram

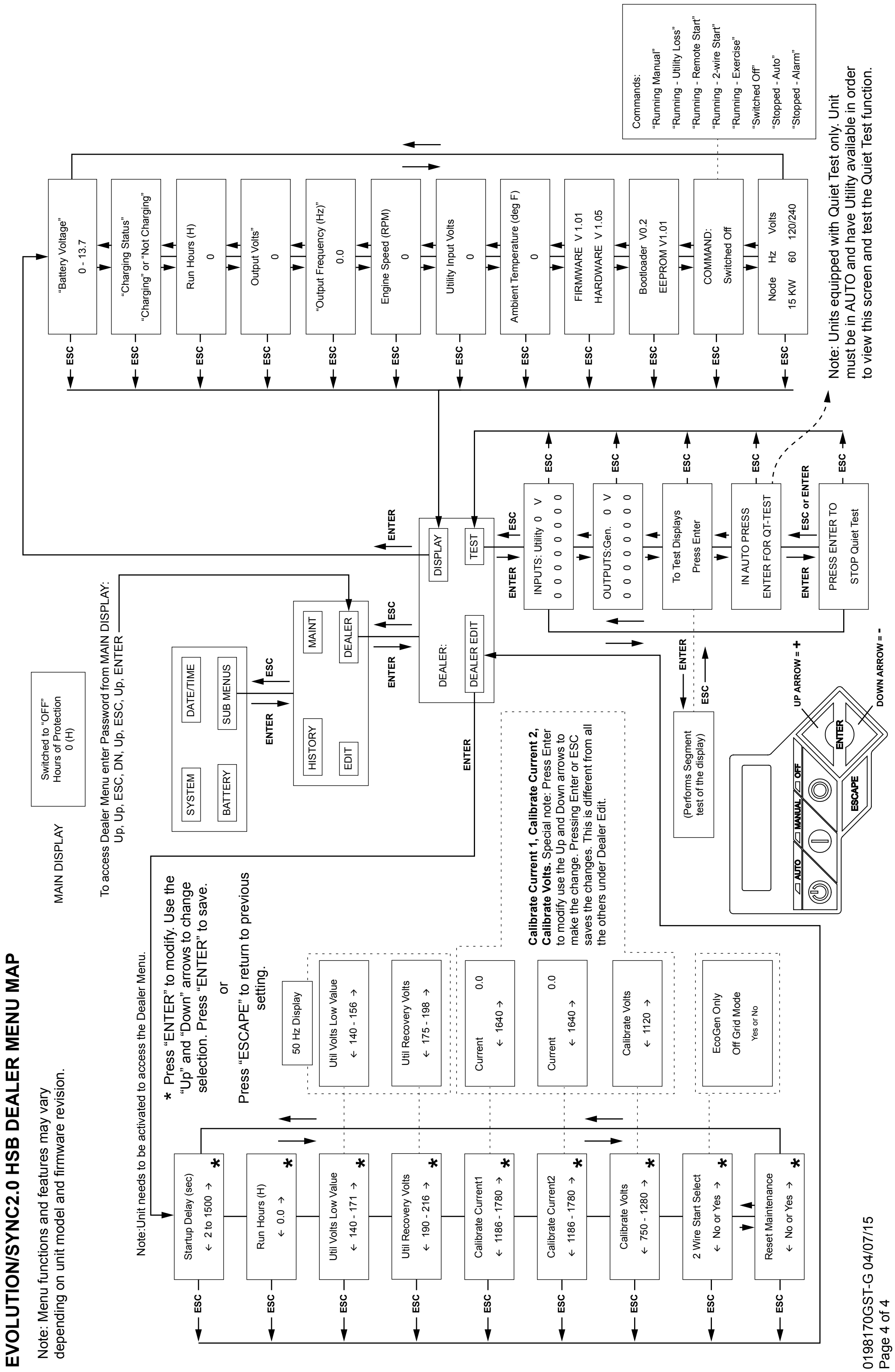


Figure 39. Evolution Dealer Menu Diagram

To get to the Main Menu from any other display, press the “ESC” key one or more times. The Main Menu is shown in Figure 41. There are four sub-menus, each with its own set of sub-menus. The menu system diagram is shown in Figure 50.

There are four selection and navigation keys below the display. The “Escape” key will cause the display to move back toward the main menu. The “Enter” key is used to activate a menu or accept a value when it is changed. The UP and DOWN triangle keys perform a number of different functions depending on which screen of a menu you are in: with them you can move the flashing curser to the next choice (the menu to be selected will flash on and off); they will act as the left and right arrows to move between the various Edit menus; in an Edit menu they will increase or decrease a value or change the choice (i.e. from Yes to No). See Figure 50 for the Basic Menu System Diagram.

Figure 40. Nexus Display and Navigation Buttons

MAIN MENU

There are 4 selections in the Main Menu: History, Status, Edit, and Debug.

```
History    Status
  Edit     Debug
```

Figure 41. Nexus Display Main Menu

History

The History Menu will display two history logs: Alarm Log and Run Log.

- Alarm Log: displays the last 50 alarm conditions. They are in date time order, numbered from 1 to 50; 1 is the most recent. Use the (up triangle image) and the (down triangle image) to move from alarm to alarm. Each alarm lists the Date, Time of trigger, and the description of the alarm.
- The Run Log will display the last 50 Run events. It will display the date and time as well as a brief description of the event; for instance Running – Utility Lost; Stopped – Auto.

```
History
Alarm Log    Run Log
```

Figure 42. History Menu

```
1  09/15/10  04:55:22
   Under Voltage
```

Figure 43. Alarm Log Display.

Use the up and down keys to move from the most recent Alarm (1) to the oldest (50).

```
1  09/15/10  04:55:22
   Stopped
```

Figure 44. Run Log Display.

Use the up and down keys to move from the most recent Run event (1) to the oldest (50).

Status

The Status Menu will display four choices: State, Display, Command, and Versions. Use the up and down triangle keys to move:

- State will display the current state of the panel along with the current date, time and day. See Figure 50 for the complete list of possible Status messages which will be displayed.
- Command will display the current command. See Figure 50 for the list of possible commands which will be displayed.
- Versions will display the version of Software and Hardware of the panel.
- Display will provide up to five generator parameters: Run Hours, RPM, Hz, Battery, and Hours Under Load (if enabled).
  - Run Hours will display the total number of hours the generator has run (in 0.0 Hours format)
  - RPM will display the Engine Speed (in RPM)
  - Hz will display the generator output frequency (in 0.0 Hz format)
  - Battery will display the battery voltage (i.e. 12.9)
  - Hours Under Load will provide the total number of hours the unit has actually provided power

```
STATUS: State Display
 Command    Versions
```

Figure 45. Status Menu

```
Display:     Run Hours
 RPM     Hz    Battery
```

Figure 46. Display Menu

Edit

Provides the means to edit five of the operating parameters of the unit: Exercise Time, Current Time, Frequency, Language, Startup Delay, and Reset Maintenance. To access the editing screens go to the Edit menu and press the "Enter" button. One of the above menus will appear. Use the UP and DOWN triangle buttons to move from menu to menu. When you are in the menu you want to change press the "Enter" button. Then use the UP and DOWN triangle buttons to change the value. When you have reached the value you want press the "Enter" button. If you want to get out of a choice without changing it simply press the "ESC" button.

- Exercise Time will go through 4 selections: Quiet Test Mode (Yes/No), Select Hour, Select Minute, and Select Day. When you are through the unit will be programmed to perform a weekly exercise.
- Current Time will go through 5 selections: Select Hour, Select Minute, Select Month, Select Date, Select Year. The current time must be set to enable the exercise and maintenance functions of the panel.
- Frequency is not enabled at this time.
- Language provides three choices: English, Francais, and Espanol.
- Startup Delay provides a way to change the time delay between when Utility fails and when the Generator starts and transfers. It is adjustable from 10 to 30 seconds.
- Reset Maintenance will reset the Maintenance warning clock.

Debug

Provides four test tools integral to the control panel: Inputs, Outputs, Display, and QT-Test.

- TEST Inputs provides a way to see the status of the 8 input channels that the control panel monitors. See Table 7 for the list of inputs the control panel monitors. Each input represents an open or closed set of contacts, and will display either a 0 or 1 character. The 0 character represents an open contact; a 1 character represents a closed contact. The Inputs screen is a handy way to tell if the control is seeing a valid input from a particular source.
- TEST Output provides a way to see the status or the output relays the control panel uses to make things happen (like crank and run and transfer). See Table 7 for the list of output channels. Each channel represents a relay with a character of either 0 or 1. The 0 character represents a relay that is de-energized (OFF); a 1 represents a relay that is energized (ON). The outputs screen is a handy way to tell if the control is telling the generator to start, or transfer, etc.
- Display provides two flashing bars that test the display LEDs. As the bars flash on and off you can readily tell if the display has a bad area, if an area does not turn on it means those LEDs are not working. The control panel would require replacement to correct a bad display.
- QT-Test is only available on the 17-20 kW units. It provides a way to test the Quiet Test mode of the generator. When tested the generator will run at a lower RPM during the test. Note that for the unit to perform an actual weekly Quiet Test Exercise, it must be enabled in the Exercise Time editing menu.

```
TEST: Inputs  Outputs
 Display      QT-Test
```

Figure 47. Debug Menu

```
 INPUTS: Utility  240
0  1  0  0  0  0  1  0
```

Figure 48. Test Inputs Display

Inputs are numbered from left to right (1-8).

0 indicates an Input is OFF

1 indicates an Input is ON

For instance, in Figure 48 Inputs 1 and 7 are ON (Low Oil Pressure and the Auto switch).

This indicates the unit is shut down and in Automatic.

```
 OUTPUTS: Gen    0
0  0  0  0  0  0  0  0
```

Figure 49. Test Outputs Display

Outputs are numbered from left to right (1-8).

0 indicates the Output is OFF

1 indicates the Output is ON

For instance, in Figure 49 there are no Outputs ON which indicates the unit is shut down.

Table 8. Digital Inputs and Outputs

Position	Digital Inputs	Digital Outputs
1	Not Used	Not Used
2	Low Oil Pressure	Not Used
3	High Temperature	Not Used
4	Not Used	Battery Charger Relay
5	Wiring Error Detect	Fuel
6	Not Used	Starter
7	Auto	Ignition
8	Manual	Transfer

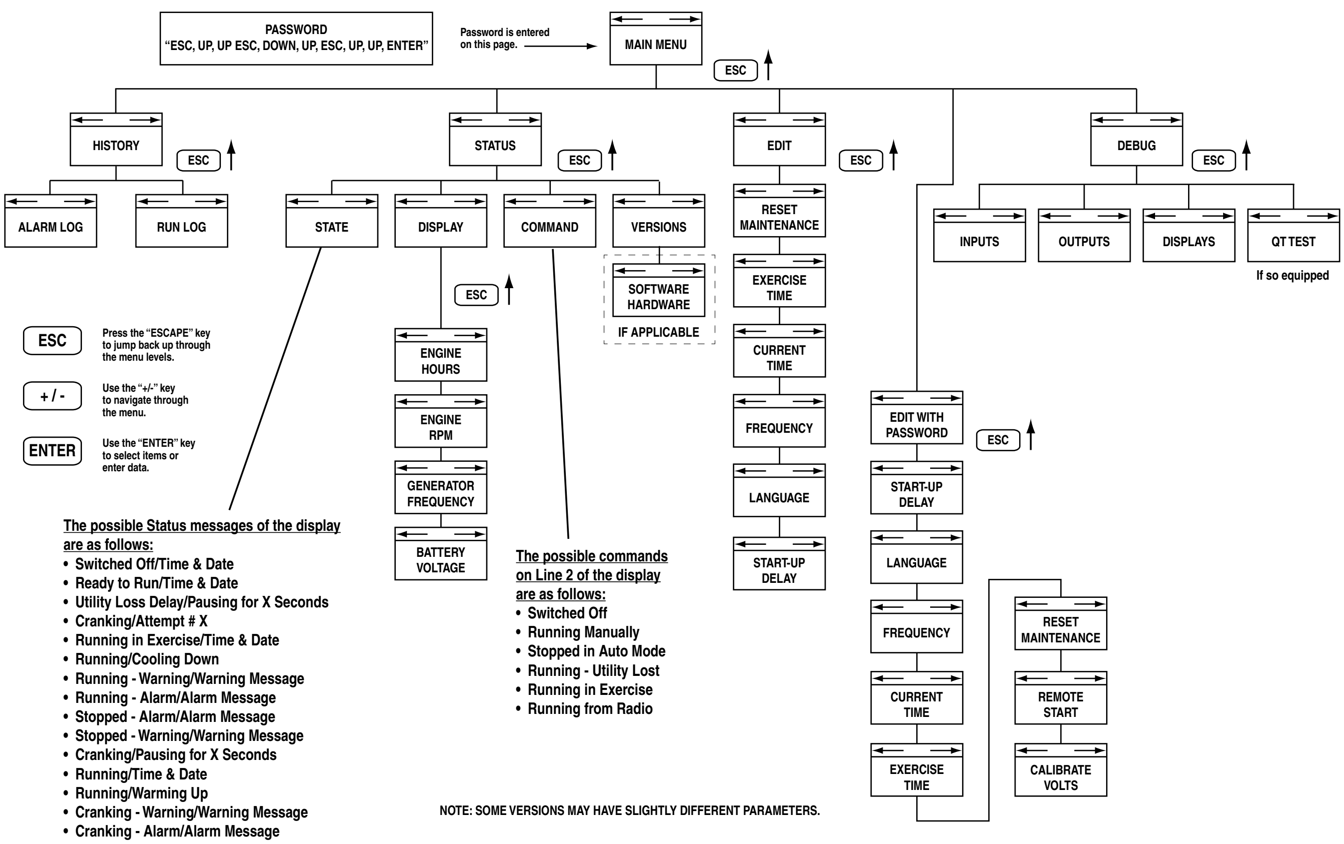


Figure 50. Nexus Menu System Diagram

INTRODUCTION

This section familiarizes the service technician with the manufacturer recommended procedures for the testing and evaluation of various problems that can occur on the standby generators with air-cooled engines. It is highly recommended that you read these introductory tips before you attempt to troubleshoot any of the three main generator components: AC Generator, Air Cooled Engine, Transfer Switch. The Troubleshooting Flow Charts provide the simplest, quickest, systematic means to troubleshoot the typical problems that might occur during the lifetime of the unit. If you use the flow charts and perform the indicated tests, you will be able to identify the faulty component, which can then be repaired or replaced as necessary.

The test procedures in each section do require a basic knowledge of electricity and electrical safety, hand tool skills, and use of Volt-Ohm-Meters.

RECOMMENDED TOOLS

In addition to the normal hand tools required, some test procedures may require the use of specialized test equipment. At a minimum you must have a meter that measures AC voltage and frequency, DC voltage and current, and has the ability to record Minimum / Maximum values (digital multi meters [DMM] are recommended), standard meter test leads, a set of piercing probe leads , and a set of pin probe leads for the AMP connector pins. The manufacturer carries a set of acceptable piercing probes (PN 0G7172), or other suppliers piercing probes may be used. Fluke provides a high quality piercing probe, PN AC89, which is highly recommended. The manufacturer also carries a set of flexible pin leads for use with the AMP connector plugs (PN 0J09460SRV).

For engine troubleshooting you will need a good manometer which measures low pressure in Inches of Water Column (IN W.C or IN H20). An ignition spark tester is also a handy tool to have when working with air-cooled engines.

Testing and troubleshooting methods covered in each section are not exhaustive. No attempt has been made to discuss, evaluate and advise the home standby service trade of all conceivable ways in which service and trouble diagnosis must be performed. Accordingly, anyone who uses a test method not recommended herein must first satisfy himself that the procedure or method he has selected will jeopardize neither his nor the products safety, and will not cause damage to any connectors or components.

TROUBLESHOOTING REMINDERS AND TIPS

The most important step in troubleshooting is identifying the actual problem. Use the History capability of the Nexus panel to help you identify what the panel is seeing. Use the Alarm Log to view the faults that caused the Warning or Alarm Shutdown. The date-time stamp provides the date and time (to the second) that the alarm event occurred. If there are several alarms that all have the same date-time stamps, go to the first in the series of alarms for that time. Some failures can cause a cascading series of faults to occur, one right after the other. Compare the Alarm Log and the Run Log to each other to see the operational sequence of events.

For instance: If the unit shut down on ALARM - Low Oil Pressure, look to see what time it started. If it started at 8/20/10 14:27:30 (2:27 pm), and shut down on low oil pressure on 8/30/10 10:15:22 (10:15 am), then the most likely cause of the loss of oil pressure was low oil level. The unit ran, providing power, for 10 days straight (approximately 234 hours). This would be validated by simply checking the oil level of the unit. These are air-cooled 4 cycle engines and will use oil while running. If run for extended periods of time (several weeks for instance) they will require periodic shut-down to check oil level and do a general inspection. Just think of leaving your lawn mower running at full RPM for several weeks; what would it do?

The next step is to determine the applicable flow chart to use to help diagnose the problem. Use the flow chart index for the part of the generator you are working with. If it is problem with voltage, use Section 2 – AC Generators; for engine problems use Section 4 – Engine/DC Control; for a problem with the transfer switch, use Section 3 – Transfer Switch. The index for each will help you clarify the problem and the flow chart to use. In each flow chart start at the top and use the test indicated to verify whether a component or control item is working properly or not. At the end of each test follow the "good" or "bad" arrows and perform the next test.

It is always good practice to continue to ask questions during the troubleshooting process. When evaluating a problem, these questions may help identify the problem quicker.

- What is it doing? (low voltage; not cranking; not transferring; etc)
- What should it do? (run and start; transfer; shutdown; etc)
- Does the same thing happen each time?
- When is it happening?
- What could or would cause this?
- What type of test will either prove or disprove the cause of the fault?

IMPORTANT NOTE CONCERNING CONNECTORS

A number of the tests require the use of a volt-meter and a set of test probes.

It is very easy to damage the female pins in the connectors on the control panel (AMP connectors) and the C1 connector (Molex connector) which goes to the alternator can.

DO NOT ATTEMPT TO PUSH VOM PROBE TIPS INTO THE CONNECTOR PINS OF ANY AMP or MOLEX CONNECTORS. Doing so will damage the female pin which will create further problems. Use the correct probes on the correct wire to check for the appropriate voltages, or use the flexible pin leads, available from the manufacturer (PN 0J09460SRV) to work with the AMP connector plugs. Another alternative is to use approved back probes from the back side of the connector.

PART 2 - AC GENERATORS

⚠ **IMPORTANT! CLEAR ANY FAULTS IN THE CONTROLLER BEFORE PROCEEDING WITH ANY RUNNING DIAGNOSTIC STEPS!**

INTRODUCTION

The alternator contained within the Generator is a revolving field (rotor) type with a stationary armature (stator), and excitation to the field provided through brushes and slip rings (direct excitation). The Generator may be used to supply electrical power for the operation of 120 and/or 240 VAC, 1-phase, 60 Hz, AC loads.

ENGINE-GENERATOR DRIVE SYSTEM

The air-cooled engine is directly coupled to the rotor internally. Both the engine and the rotor operate at 3600 rpm to provide a 60 HZ AC output.

ALTERNATOR ASSEMBLY

The standard alternator consists of three basic components: a rotor, stator, and brush assembly. The rotor assembly provides the magnetic field which will induce a voltage into the stator assembly. The brush assembly provides the electrical connection to the rotor, which allows for excitation voltage and current to create the needed magnetic field.

Rotor

Operating the 2-pole rotor at 3600 rpm will supply a 60 HZ AC frequency. The term “2-pole” means the rotor has a single north magnetic pole and a single south magnetic pole. Held in place with a single through bolt, the tapered rotor shaft mounts to the tapered crankshaft of the engine. As the rotor rotates its lines of magnetic flux cut across the stator assembly windings and induces a voltage into the stator windings. The rotor shaft has a positive and negative slip ring, with the positive slip ring nearest the rear-bearing carrier. The bearing is pressed onto the end of the rotor shaft.

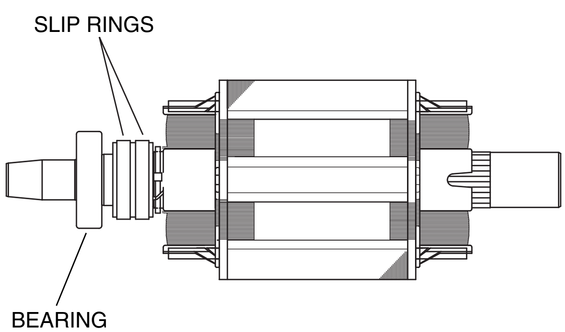


Figure 51. Rotor

Stator

The stator houses a dual power winding and an excitation winding. Coming from the stator there are typically Eight (8) stator leads as shown in Figure 52.

An adapter molded into the engine block and a rear-bearing carrier support the stator can. Four stator bolts connect the rear bearing carrier and the stator can to the engine.

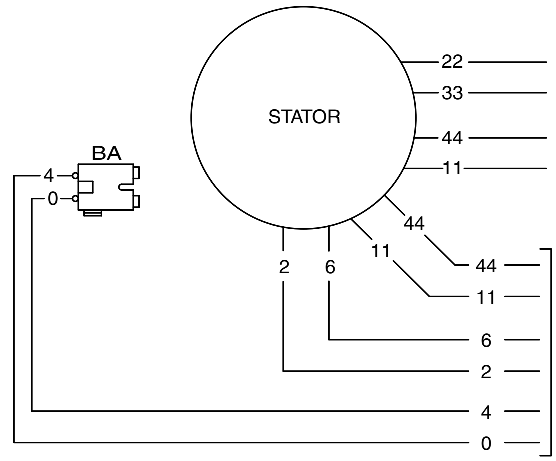


Figure 52. Stator Output Leads

Brush Holder and Brushes

Attached to the rear-bearing carrier, the brush holder and brushes allow for the electrical connection to the rotor. Positive and negative brushes are retained in the brush holder, with the positive brush riding on the slip ring nearest the rotor bearing.

Wire 4 connects to the positive brush and Wire 0 to the negative brush.

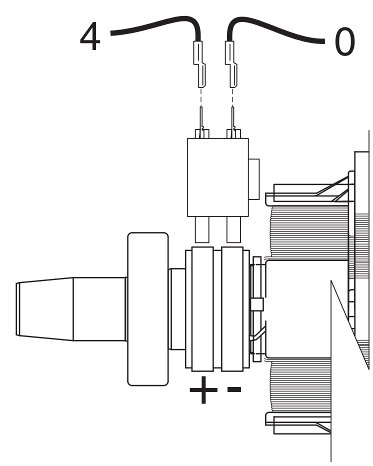


Figure 53. Brush Holder and Brushes

OTHER AC GENERATOR COMPONENTS

Located within the Generator control panel enclosure are the Nexus controller, connection points, SCR, and Main Line Circuit Breaker (MLCB).

Voltage Regulator

The Automatic Voltage Regulator (AVR) is an integral component of the main controller. The AVR receives unregulated AC output voltage from the stator excitation winding (DPE) through Wires 2 and 6. The AVR gates the AC voltage to DC, and regulates it based on the sensed voltage output of the stator. The regulated DC field excitation voltage is then delivered to the rotor windings through Wires 0 and 4, the brushes and slip rings. The voltage regulator senses the AC output voltage of the alternator through Wires 11 and 44.

The control panel provides both Under-voltage and Over-voltage fault protection. During an over or under-voltage fault condition the control panel will shut the unit down and display the applicable Alarm.

EVOLUTION CONTROLLER (WHEN IN AUTO)

- **Under-voltage** – If the generator voltage falls below 80% of rated (192V for a 240V unit) for 5 seconds or continuously for 10 seconds, generator will recrank 3 times, then shut down and an ALARM will display.
- **Over-voltage** – If the generator voltage rises above 130% of rated (312V for a 240V unit) for 5 seconds or continuously for 1/5 of a second, the generator will shut down and an ALARM will display.

NEXUS CONTROLLER

- **Under-voltage (0H6680A Nexus Controller)** – If the Generator voltage falls below 60% of rated (144V for a 240V unit) for more than 5 seconds, the generator will shut down and an ALARM will display.
- **Under-voltage (0H6680B Nexus Controller through Rev B)** – If the Generator voltage falls below 85% of rated (204V for a 240V unit) for more than 10 seconds, the generator will shut down and an ALARM will display.
- **Under-voltage (0H6680B Nexus Controller rev C and greater)** –

  Manual:

  Cranking – If the starter disengages before a voltage has developed in the stator, the controller will initiate a shutdown alarm for "under-voltage."

  Running – If the Generator is running and voltage output has been gone for 10 seconds, the controller will initiate a shutdown alarm for "under-voltage."

  Auto:

  Cranking – If the starter disengages before a voltage has developed in the stator, the controller will shutdown, pause for 15 seconds (countdown displayed), and re-crank 3 additional times. If after three crank attempts and the no voltage output continues, the controller will initiate a shutdown alarm for "under-voltage."

  Running – If the Generator is running and voltage output has been gone for 10 seconds, the controller will initiate a shutdown, pause 10 seconds, and re-crank 3 times additional times. If after three crank attempts and the no voltage output continues, the controller will initiate a shutdown for "under-voltage."

Note: The 3 crank attempts are cumulative. For example, if the unit took two under-voltage re-cranks at startup, it would only allow one additional re-crank for under-voltage.

- **Over-voltage** – If the Generator voltage rises above 110% of rated (264V on a 240V unit) for greater than 3 seconds, or if the Generator voltage rises above 130% of rated (312V on a 240V unit) for greater than 0.2 seconds, the generator will shutdown and an ALARM will display.

Main Line Circuit Breaker

The main line circuit breaker protects the Generator against electrical overload. See the "Specifications" section for specific amperage ratings.

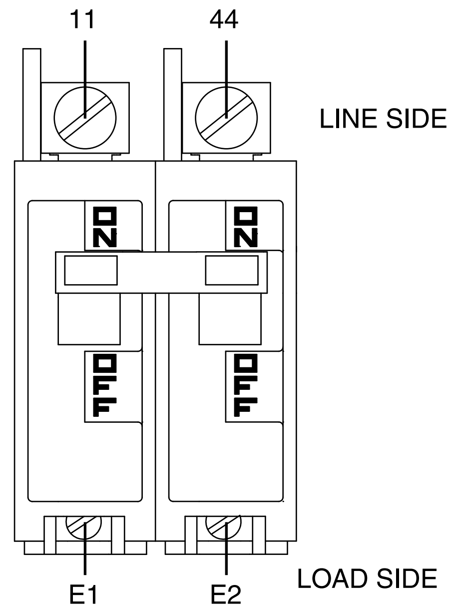


Figure 54. Main Line Circuit Breaker

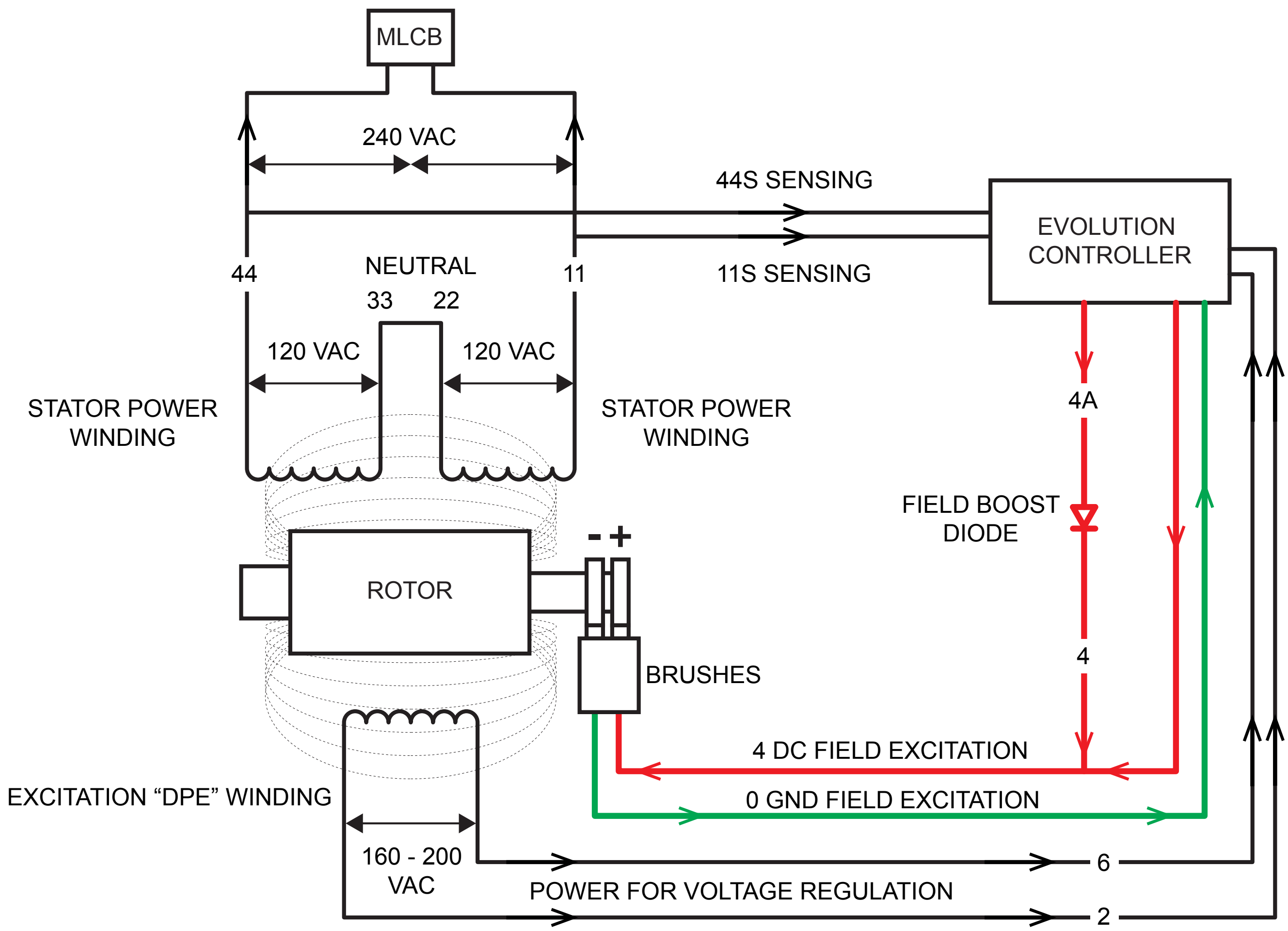


Figure 55. Evolution Voltage Regulator Schematic

Notes: ____

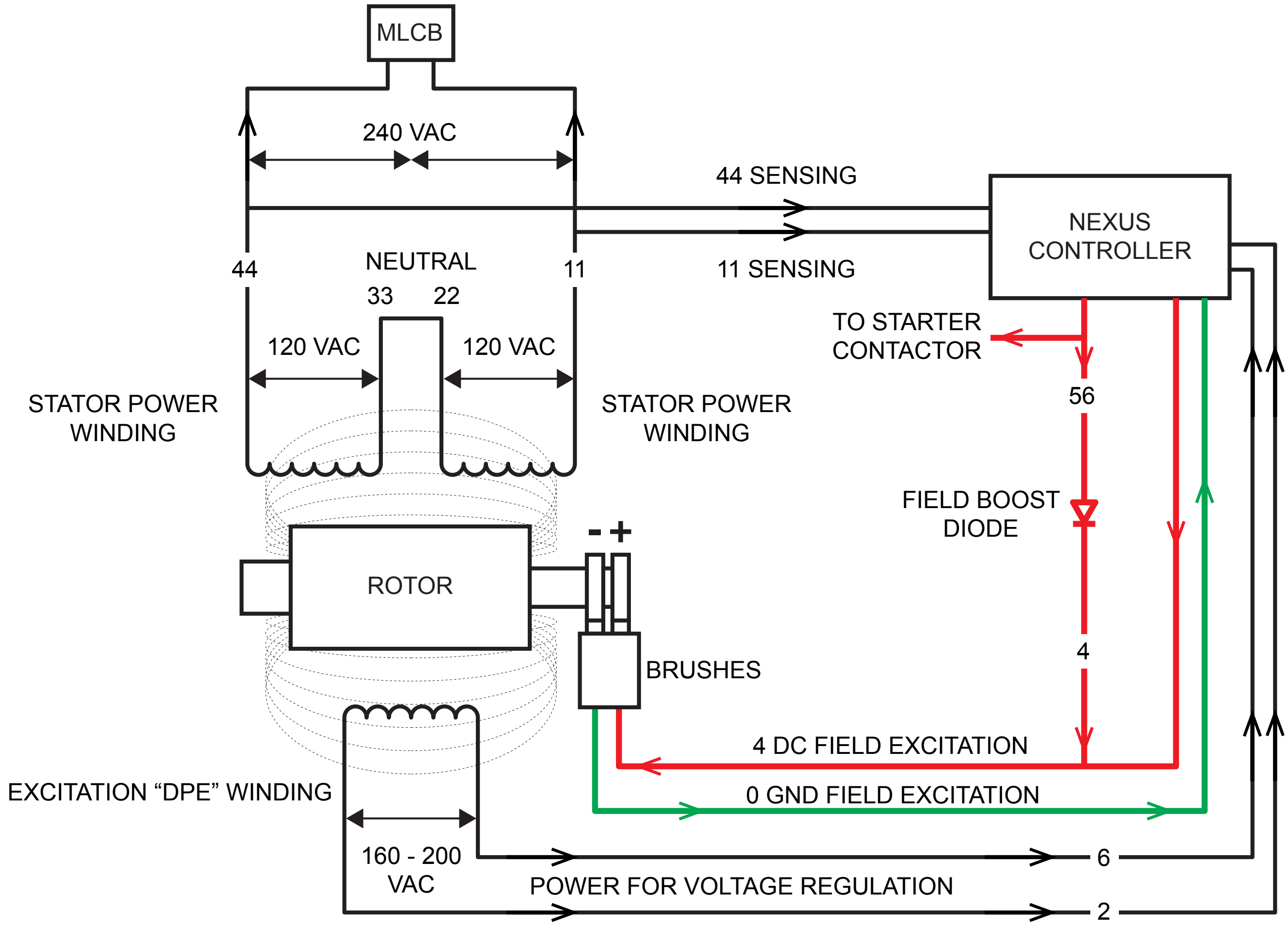


Figure 56. Nexus Voltage Regulator Schematic

Notes: ______________________________

FIELD BOOST

During the engine's crank cycle, the control panel provides battery voltage (12 VDC) on Wire 56 to energize the starter contactor relay (SCR). On a Nexus controller system, Wire 56 also connects to Wire 4 (positive field voltage) through a field boost diode. The Evolution controller has a dedicated field flash output on Wire 4A which flows through the field boost diode to Wire 4.

The Evolution field boost system is shown schematically in Figure 57. The Nexus field boost system is shown schematically in Figure 58.

Nexus units

Field boost voltage is available only while the crank relay is energized (i.e. during the engine crank cycle).

Evolution units

Evolution units have a dedicated field flash relay with logic that is separate from the start circuit. Depending on the firmware version, the field flash will turn on and off depending on engine speed and system voltage.

Firmware versions up to 1.11: Field boost turns on at 2200 rpm. Field boost shuts off after 10 seconds, or when voltage is 88 VAC, whichever comes first.

Firmware versions 1.12 and newer: Field boost turns on at 2200 rpm. Field boost shuts off when system voltage reaches 80% of nominal (192 VAC on a 240V generator). This firmware version will allow the generator to run up to four additional minutes before shutting down on undervoltage. This will allow sufficient time for the unit to make a positive connection between the brushes and slip rings and build proper system voltage. The firmware also allows for two to four* additional attempts of 15 seconds each following an unsuccessful four minute cycle.

** Number of additional attempts depends on the unit.*

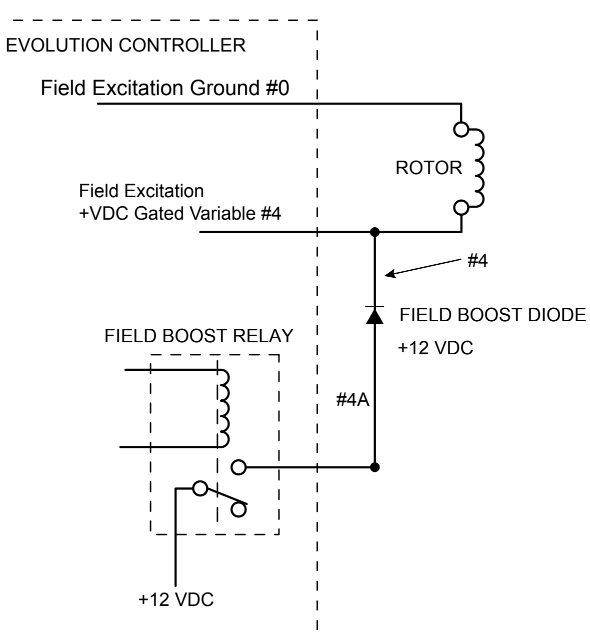


Figure 57. Evolution Field Boost Circuit

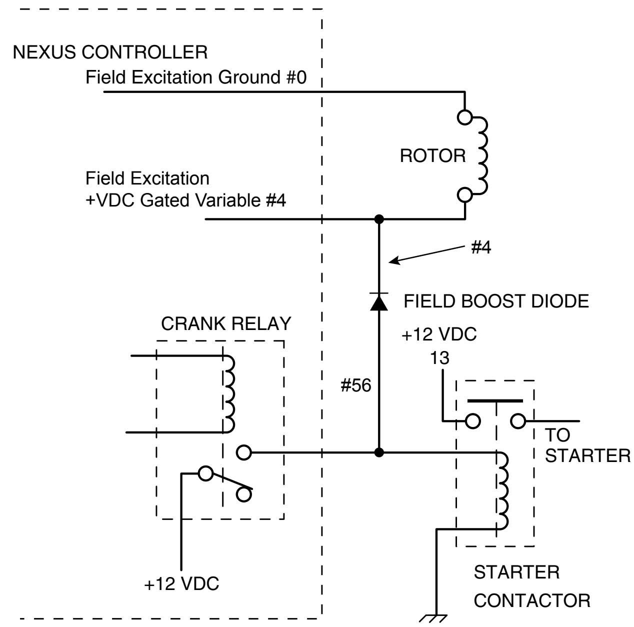


Figure 58. Nexus Field Boost Circuit

OPERATION

Engine Cranking

When the engine is cranking (Evolution 2200 rpm), field boost voltage causes the rotor to magnetize. The rotor magnetic field induces a voltage into the stator AC power windings, and the stator excitation (DPE) windings. During cranking, field boost magnetism is capable of creating approximately one-half the unit's rated voltage.

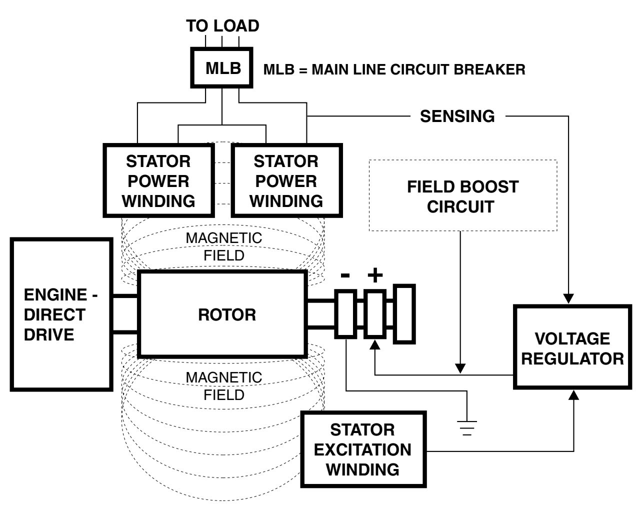


Figure 59. Operating Diagram

Field Excitation

The AC voltage from the DPE winding provides power to the AVR. The AVR gates and converts the AC voltage to DC voltage, and provides the regulated variable DC voltage to the rotor through Wires 4 and 0. When the starter disengages (cranking stopped), the AVR continues to provide excitation voltage to the rotor.

The AVR senses the AC output voltage through Sensing Wires 11 and 44 (11S & 44S for Evolution), which are connected to the main power leads (11 and 44) in the stator can. The AVR will continue to increase excitation voltage to the rotor until the desired AC output voltage is reached. It will continue to “regulate” excitation voltage as necessary to provide a constant AC output voltage to the load.

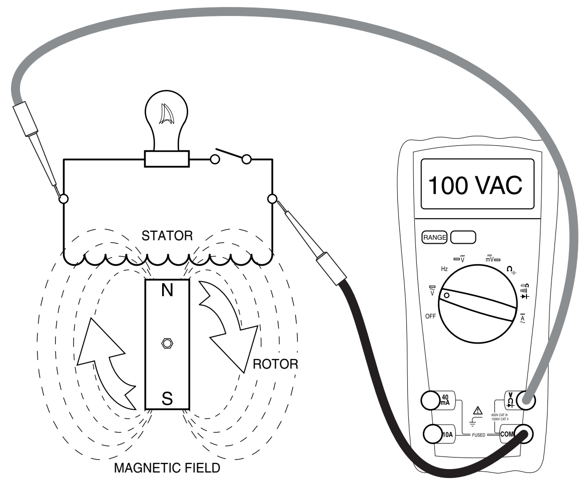


Figure 60. Low Field Excitation Voltage = Low Magnetic Lines of Flux = Low AC Output.

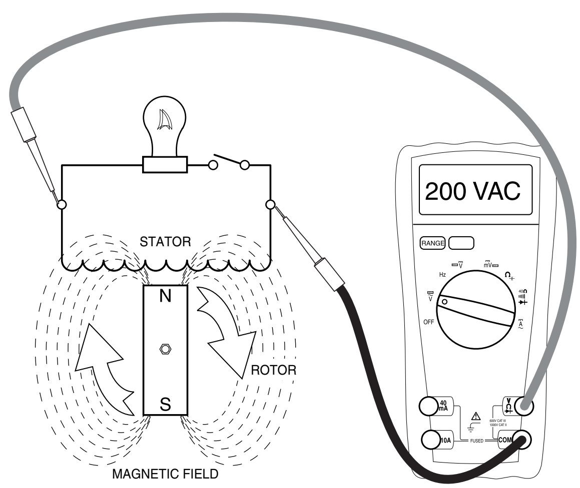


Figure 61. Increased Field Excitation Voltage = Increased Magnetic Lines of Flux = Increased AC Output Voltage.

The regulated excitation from the regulator is delivered to the rotor windings through Wire 4 and the positive brush and slip ring. This results in current flowing through the field windings to the negative slip ring and brush, and then to ground.

The greater the current flow through the windings the more concentrated the lines of flux around the rotor become. The more concentrated the lines of flux around the rotor, which cut across the stationary stator windings, the greater the voltage induced into the stator. Refer to Figures 60 and 61.

Initially, the AC power windings output voltage “sensed” by the AVR is low. The AVR reacts by increasing the excitation voltage (and hence current flow) to the rotor until AC output voltage increases to a preset level. The AVR then maintains the voltage at this level. For example, if voltage exceeds the desired level, the AVR will decrease excitation. Conversely, if voltage drops below the desired level, the AVR responds by increasing excitation.

AC Power Winding Output

When electrical loads are connected across the AC power windings to complete the circuit, current flows through the circuit powering the loads.

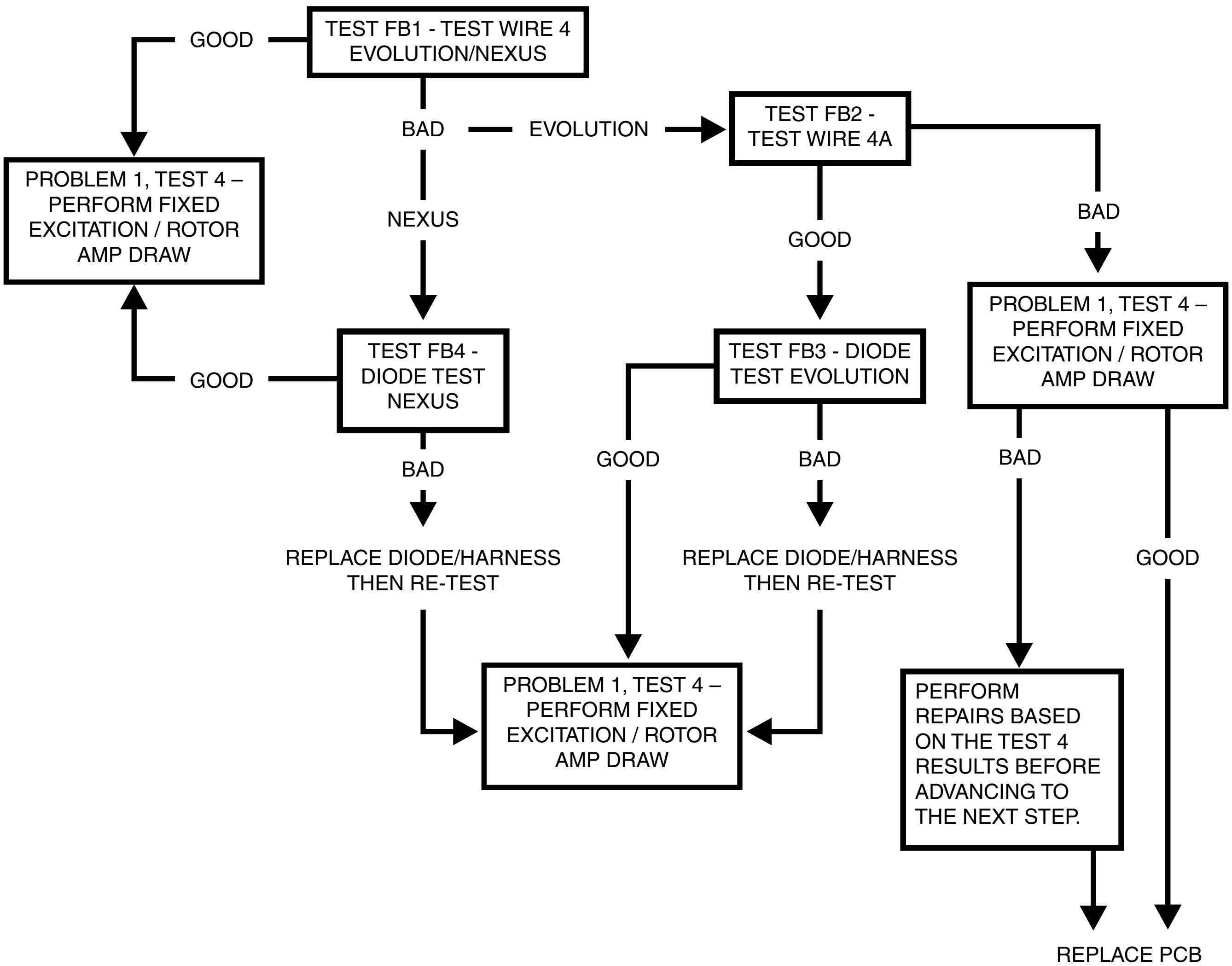
As load changes this will result in a corresponding change in voltage; as load demand increases the voltage will tend to drop; as load demand decreases the voltage will tend to increase. The AVR changes excitation to provide a constant output voltage with minimal increase or decrease during load changes. Frequency is also affected during load changes. However, frequency is a function of rotor speed (engine RPM); the engine electronic governor (integral to the control panel) will respond to any engine speed changes to maintain a stable, isochronous, frequency output based on the specifications of the unit.

The Automatic Voltage Regulator and the Electronic Governor work together to provide output voltage regulation of +/- 1% voltage regulation and +/- 0.25% steady state, isochronous, frequency (speed) regulation.

INTRODUCTION

Use the "Flow Charts" in conjunction with the detailed instructions in Section 2.4. Test numbers and/or verbiage used in the flow charts correspond to the numbered tests and/or verbiage in Section 2.4. The first step in using the flow charts is to identify the correct problem on the following pages. For best results, perform all tests in the exact sequence shown in the flow charts.

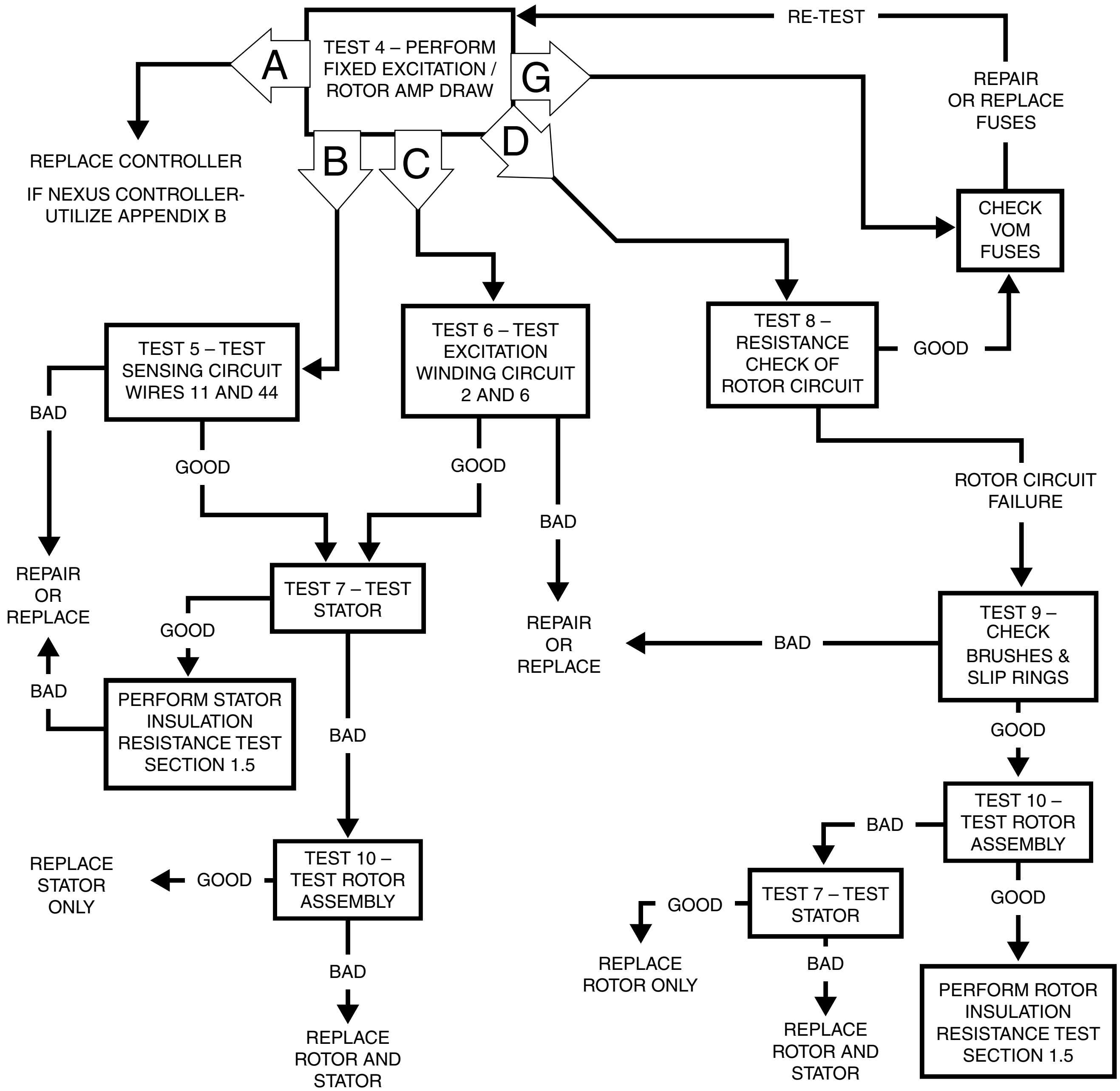
Field Boost Circuit Test - Evolution/Nexus



IMPORTANT! CLEAR ANY FAULTS IN THE CONTROLLER BEFORE PROCEEDING WITH ANY RUNNING DIAGNOSTIC STEPS!

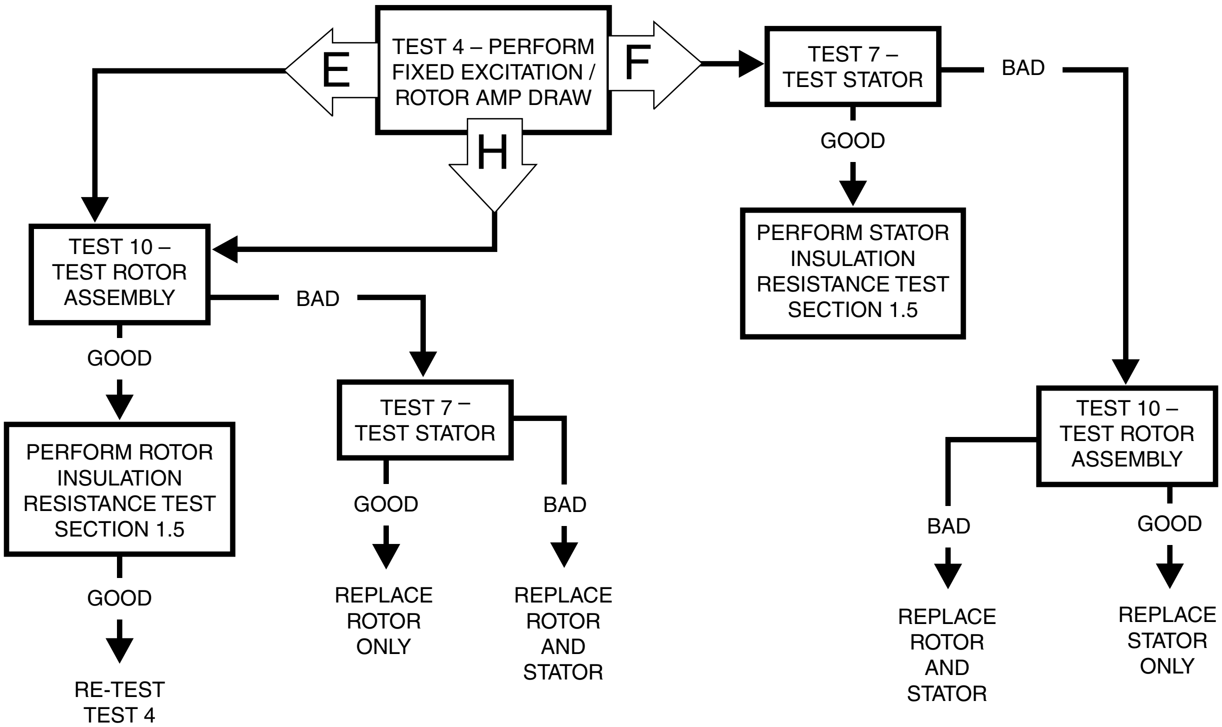
Problem 1 – Generator Shuts Down for Under Voltage

Note: Perform FBCT "Field Boost Circuit Test" PRIOR to performing Test 4. After performing "Field Boost Circuit Test" in it's entirety, compare the results with the "Test 4 Results Table" to determine letter code result A through H on this page and the next.

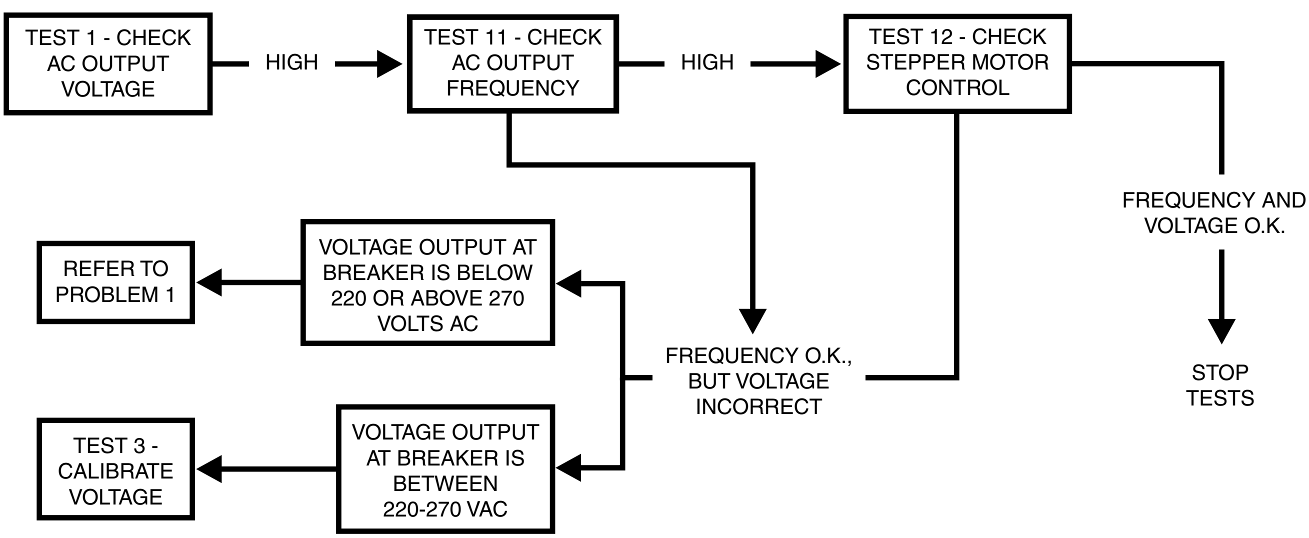


⚠ **IMPORTANT! CLEAR ANY FAULTS IN THE CONTROLLER BEFORE PROCEEDING WITH ANY RUNNING DIAGNOSTIC STEPS!**

Problem 1 – Generator Shuts Down for Under Voltage (Continued)

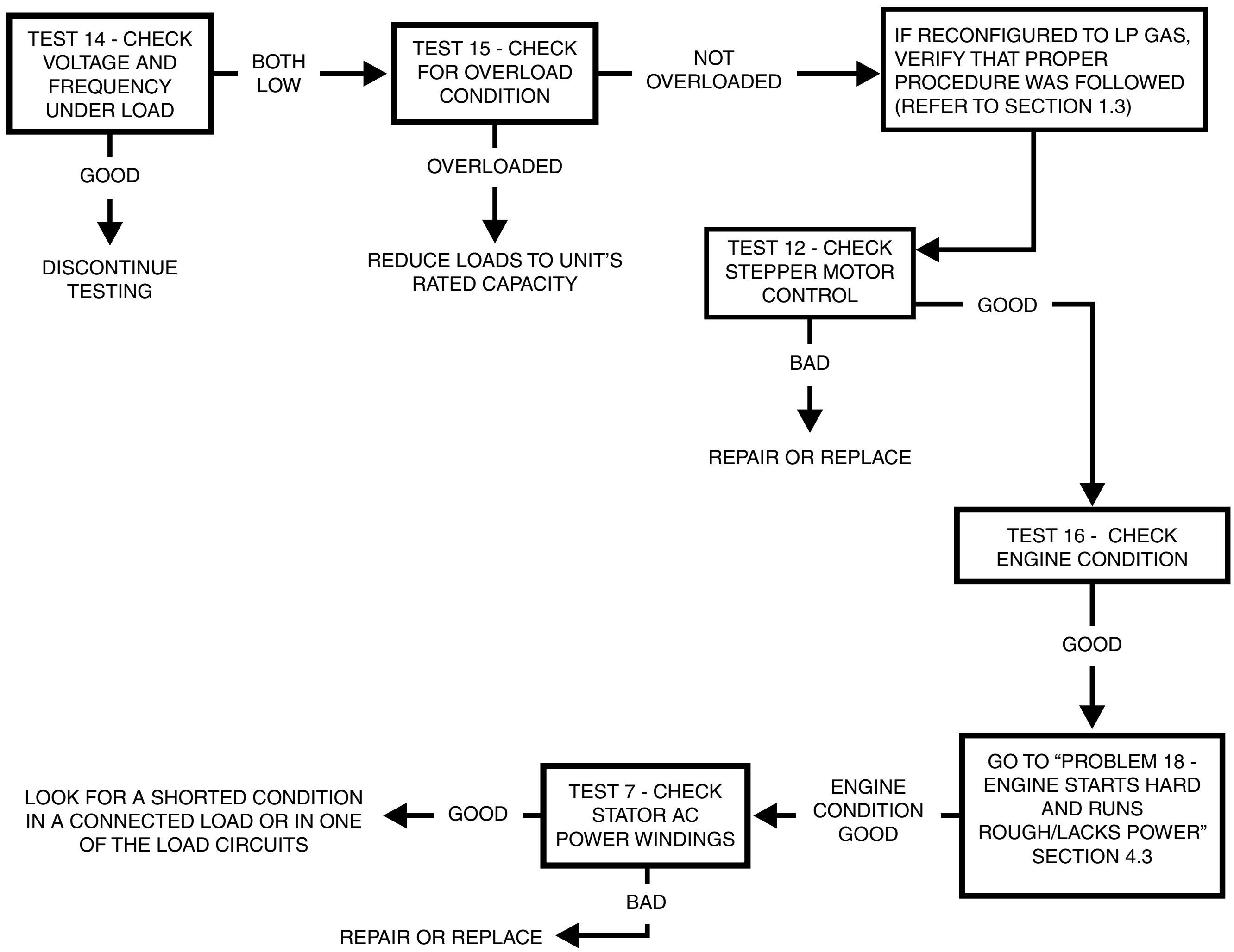


Problem 2 – Generator Produces High Voltage

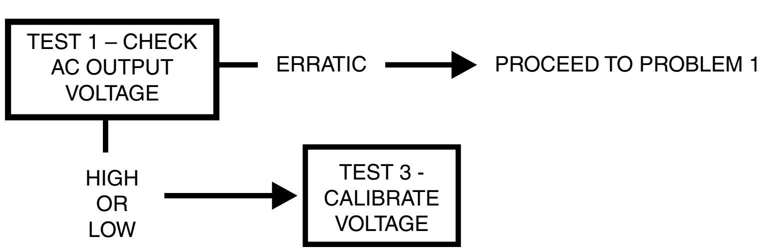


IMPORTANT! CLEAR ANY FAULTS IN THE CONTROLLER BEFORE PROCEEDING WITH ANY RUNNING DIAGNOSTIC STEPS!

Problem 3 – Voltage and Frequency Drop Excessively When Loads Are Applied



Problem 4 – Unstable Voltage or Incorrect Output Which is Not Triggering a Shutdown



⚠ **IMPORTANT! CLEAR ANY FAULTS IN THE CONTROLLER BEFORE PROCEEDING WITH ANY RUNNING DIAGNOSTIC STEPS!**

NOTES

For General Troubleshooting Guidelines refer to Section 1.12

IMPORTANT

If the unit is not equipped with a C1 Connector – disregard C1 data!

Use wire numbers only and disregard any specific “J” Connector references. Utilize the wire numbers and controller pin out chart in Appendix “A” per specific connector styles!

If any steps result in replacing a Controller, utilize Appendix “B”

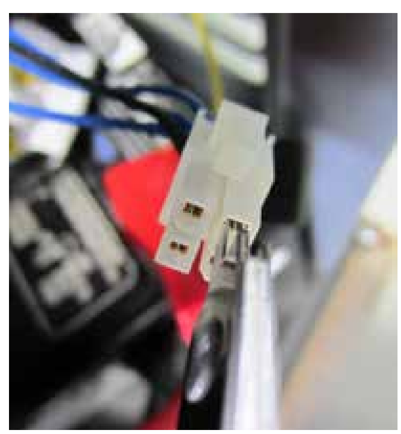
PROBING AND PIN EXTRACTION

If probing and/or back-probing results in a "BAD" condition, before condemning the controller, remove the pin/plug in question and verify the pin/plug is not distorted, bent and/or not making electrical contact! Repair as needed!

Back-Probing Molex Connector

Molex Pin Extractor Tool Part# 0K4445

Probing AMP Connector



Using Molex Pin Extractor Tool

EVOLUTION E-CODES

DISPLAYED ALARM	ALARM/ WARN-ING	E-CODE BREAK-DOWN	DESCRIPTION	Notes
Controller Fault	ALARM		**No E-code on HSB**	Replace Controller
Overcrank	ALARM	1100	**Condition - Engine Cranks but will not Start** Unit turns over but will not start. Controller is receiving signal on Wire 18.	Problem 17
Overspeed	ALARM	1200	**Prolonged** Over 72 Hz for 3 seconds. Possible cause: Stepper motor/mixer body assembly issue.	Test 12
Overspeed	ALARM	1205	**Instantaneous** Over 75 Hz for .1 second (100 milliseconds). Possible cause: Stepper motor/mixer body assembly issue.	Test 12
Low Oil Pressure	ALARM	1300	**Occurred while running** The default Extended alarm for low oil pressure. Check oil level and pressure.	Test 61
High Temperature	ALARM	1400	**Condition - Air Flow Impeded / Flow Issue** Check the inlet/outlet for debris.	Test 62
RPM Sensor	ALARM	1501	**Twin Cylinder+Running** Twin Cylinder Running faults to RPM sensor loss. Possible Causes: air pocket in fuel line, dirty fuel, missing ignition pulse (loss of one of the primary coils).	Test 50 and Test 64
RPM Sensor	ALARM	1505	**Twin Cylinder+Cranking** Twin Cylinder Cranking faults to RPM sensor loss Possible Cause: starter motor issue, missing ignition pulse (loss of one of the primary coils).	If engine cranks, Test 64. If engine does not crank, Problem 15.
RPM Sensor	ALARM	1511	**Single Cylinder+Running** Single Cylinder Running with Low Fuel Pressure faults to RPM sensor loss Possible Causes: air pocket in fuel line,dirty fuel.	Test 50 and Test 64
RPM Sensor	ALARM	1515	**Single Cylinder+Cranking** Single Cylinder Cranking faults to RPM sensor loss Possible Cause: starter motor issue.	If engine cranks, Test 64. If engine does not crank, Problem 15.
Underspeed	ALARM	1600	**Condition - Unit is Overloaded** Unit is Overloaded slowing engine speed, fuel supply low or throttle control problem.	Problem 1, Test 50 or Test 12
Overvoltage	ALARM	1800	**Prolonged Over-Voltage**	Problem 2
Undervoltage	ALARM	1900	**Prolonged Under-Voltage** Undervoltage due to loss of voltage for some time (10+ seconds).	Test 5
Undervoltage	ALARM	1901	**Instantaneous** Undervoltage due to sudden loss of voltage.	Problem 1
Undervoltage	ALARM	1902	**Both Zero Crosses missing** Undervoltage due to faulty excitation winding,or zero cross circuit,or circuit in general. Possible cause: loose wiring, field boost hardware failure	Problem 1
Undervoltage	ALARM	1906	**Single Zero Cross missing** Undervoltage due to faulty excitation winding, zero cross circuit, or circuit in general. Possible cause: field boost hardware failure	Problem 1

EVOLUTION E-CODES

DISPLAYED ALARM	ALARM/ WARN-ING	E-CODE BREAK-DOWN	DESCRIPTION	Notes
Wiring Error	ALARM	2099	Customer connection low voltage and high voltage wires are crossed.	Check customer connection in generator
Overload Remove Load	ALARM	2100	**Overloaded - Default (Output Current Method)** Unit is overloaded, one of the two CTs is detecting an overload condition. Check transfer switch loadshed functionality. (Change load dynamics or utilize loadshed).	Remove Load
Undervoltage Overload	ALARM	2299	Unit was overloaded and attempted to start with a large load connected. The unit can not ramp up the generator voltage to its normal target voltage value if it starts with a large load connected	Remove Load
Stepper Overcurrent	ALARM	2399	Current flow in stepper coil(s) above specification	Test 12
Fuse Problem*	ALARM	2400	**Missing / Damaged Fuse** The 7.5 amp Controller Fuse is missing or blown (open).	Test 44
Low Battery	WARNING		Condition->Battery less than 12.1 Volts for 60 seconds	Test 45
Battery Problem	WARNING		Condition->More than 16 Volts of battery voltage or 600 milliamperes or more of charge current at the end of an 18 hour charge	Test 45
Charger Warning	WARNING		Less than 12.5 volts of battery voltage at the end of a 18 hour charge	Problem 22
Charger Missing AC	WARNING		AC power is missing from the battery charger input	Problem 22

**Firmware version 1.11 and older only*

ADDITIONAL CODES FOR 8 KW UNITS ONLY

DISPLAYED ALARM	ALARM/ WARN-ING	E-CODE BREAK-DOWN	DESCRIPTION	Notes
Overcrank	ALARM	1101	**Engine/Starter Problem** Limiting number of cranking cycles to protect the starter motor.	If the engine has tried to crank for 10 times unsuccessfully, this will trigger.
Underspeed	ALARM	1603	**Underspeed** The engine never comes up to 3700 RPM.	Check fuel selection and fuel supply
Overload Remove Load	ALARM	2102	**Overloaded** Unit recranks 5 times when load is applied, engine dies (0 RPM) and has low voltage (< 180V)	Check for Overloaded condition on unit. Inspect stepper motor operation.
Overload Remove Load	ALARM	2103	**Overloaded** Unit has run and attempted to accept load 10 times, could not accept due to overload condition	Check for Overloaded condition on unit

INTRODUCTION

This section familiarizes the service technician with acceptable procedures for the testing and evaluation of various problems that can occur on the standby generators with air-cooled engines. Use this section in conjunction with Section 2.3, “Troubleshooting Flow Charts.” The numbered tests in this section correspond with those of Section 2.3.

Some test procedures in this section may require the use of specialized test equipment, meters or tools. Most tests can be performed with an inexpensive Volt-Ohm-Milliammeter (VOM). An AC frequency meter is required where frequency readings must be taken. To measure AC loads it is acceptable to use a clamp-on ammeter.

Testing and troubleshooting methods covered in this section are not exhaustive. No attempt has been made to discuss, evaluate and advise the home standby service trade of all conceivable ways in which service and trouble diagnosis must be performed. Accordingly, anyone who uses a test method not recommended herein must first satisfy himself that the procedure or method he has selected will jeopardize neither his nor the product's safety.

SAFETY

Service personnel who work on this equipment should be aware of the dangers of such equipment. Extremely high and dangerous voltages are present that can kill or cause serious injury. Gaseous fuels are highly explosive and can ignite by the slightest spark. Engine exhaust gases contain deadly carbon monoxide gas that can cause unconsciousness or even death. Contact with moving parts can cause serious injury. The list of hazards is seemingly endless.

When working on this equipment, use common sense and remain alert at all times. Never work on this equipment while you are physically or mentally fatigued. If you do not understand a component, device or system, do not work on it.

AC TROUBLESHOOTING

It is always good practice to continue to ask questions during the troubleshooting process. When evaluating the problem asking some of these questions may help identify the problem quicker.

- What is the generator supposed to do?
- What fault (Alarm) is shutting the generator down?
- Is the fault a symptom of another problem?
- Does the generator have the same fault consistently?
- When does the fault occur?
- After the fault occurred what was displayed in the LCD?
- Why would this happen?
- How would this happen?
- What type of test will either prove or disprove the cause of the fault?

TEST 1 – CHECK AC OUTPUT VOLTAGE

Discussion

Use a Volt-Ohm-Milliammeter (VOM) to check the Generators output voltage. Test output voltages at the unit’s main circuit breaker (MLCB) terminals. Refer to the unit’s Data Plate for rated line-to-line and line-to-neutral voltages.

⚠ DANGER!

Use extreme caution during this test. The Generator will be running. High and dangerous voltages will be present at the test terminals. Connect meter test clamps to the high voltage terminals while the Generator is shut down. Stay clear of power terminals during the test. Make sure the meter clamps are securely attached and will not shake loose.

Procedure

1. Set the Volt-Ohm-Milliammeter (VOM) to measure AC voltage.
2. With the engine shut down, connect the meter test leads across the load terminals of the Generators MLCB. This will measure line-to-line voltage. See Figure 62.

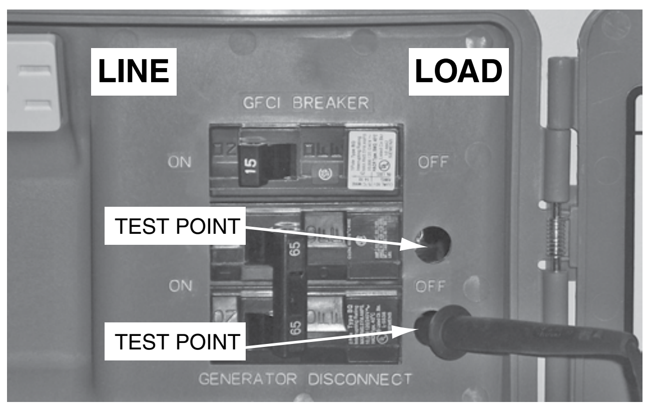


Figure 62. Test 2 Test Points

3. Set the MLCB to the “Open” position. Ensure that all electrical loads are disconnected from the Generator.
4. Set the controller to the MANUAL mode.

Note: AC under and over-voltage shut downs have a 10 second delay.

5. Set the MLCB to the “Closed” position. Measure and record the voltage.
6. Set the controller to the OFF mode.

Results

1. If the VOM indicated approximately 240-244 VAC, the output voltage is good.
2. If the VOM indicated any other readings the voltage is BAD. Refer back to the flow chart.

Note: "Residual" voltage may be defined as the voltage produced by rotor residual magnetism alone. The amount of voltage induced into the stator AC power windings by residual voltage alone will be approximately 2 to 16 VAC, depending on the characteristics of the specific Generator. If a unit is supplying residual voltage only, either excitation current is not reaching the rotor or the rotor windings are open and the excitation current cannot pass. On current units with air-cooled engines, "field boost" current flow is available to the rotor only during engine cranking.

TEST 3 – CALIBRATE VOLTAGE

Discussion

When voltage output is too high, it is possible to adjust voltage output of the generator. To access this menu a password will be required to be entered into controller. Replacement controllers do not require calibration unless output is not within the specifications. (Refer to the Specifications section in the front of this manual.)

Procedure

1. Set Volt-Ohm-Meter (VOM) to measure AC voltage.
2. Set up the VOM to measure output voltage on the breaker.
3. Open the Main Line Circuit Breaker (MLCB) on the generator.
4. On the controller, press the ESC key until the main menu is present. (Refer to the Menu Navigation found in Section 1.10)
5. While at this screen proceed to enter the appropriate password:

For Evolution:

UP, UP, ESC, DOWN, UP, ESC, UP, ENTER

For Nexus:

ESC, UP, UP, ESC, DOWN, UP, ESC, UP, UP, ENTER

6. After the password has been entered, proceed to the EDIT menu for Nexus controller, DEALER EDIT for Evolution controller.
7. Press the down arrow key until the screen indicates CALIBRATE VOLTAGE and press ENTER.
8. After pressing enter, a value will appear on the screen.

Note: The default setting from the factory for calibration is 1024.

The Evolution controller can be adjusted from 750-1280.

The Nexus controller could be adjusted from 700-1300.

9. Set controller to the MANUAL mode.
10. While the unit is running, use the UP or DOWN arrows to adjust the calibration setting. A higher value will create a lower voltage at the breaker. A lower value will create a higher voltage at the breaker.

⚠ WARNING!

Calibration factor must NOT be adjusted below 990 or above 1040. Adjusting outside of this window could result in damage to the machine. The Evolution controller can be adjusted from 750-1280. Nexus controller is adjustable from 700-1300.

11. Once a desired output voltage has been achieved, press ENTER to save the new setting.

Note: The Calibration Setting will reset to being a password protected option after the controller is left idle.

Verification

While the unit is running, verify that the output voltage at the breaker is consistent within 5 volts to what the controller displays in the TEST menu (Evolution) or DEBUG menu (Nexus) under OUTPUTS in the TEST section (Refer to Section 1.10 Menu Navigation).

Results

1. If during the verification process the output voltage at the breaker and the display match and the calibration setting was not adjusted outside of the window, stop testing.
2. If a correct voltage output was not achieved using the window specified, perform the Field Boost Test (FBT) and then refer to "Problem 1 – Test 4 Fixed Excitation / Rotor Amp Draw Test."

FIELD BOOST CIRCUIT TESTS EVOLUTION AND NEXUS TEST FB1 - TEST WIRE 4

Discussion

This test is to verify that Wire 4 is receiving field flash voltage during startup of the generator.

Note: See "Field Boost" in Section 2.2 for analysis of Nexus and Evolution field boost parameters.

Procedure

1. Locate Wire 4 on back of control panel. Disconnect the wire harness connector from the control panel.
2. Insert the red meter lead adapter into the back of the wire harness on Wire 4 (on Nexus units equipped with the **Black AMP** style connector, the connector must be disconnected to perform the test).
3. Place black lead on a good common ground or negative post on the engine battery.
4. Clear all faults and place generator in the manual mode and start engine.

5. Measure and record field flash voltage.

Note: See "Field Boost" in Section 2.2 for analysis of Nexus and Evolution field boost parameters.

Results

1. If approximately 12 VDC was measured field flash is passing through the field boost diode. Test is good. Go back to flow chart for next test.
2. If 0 voltage was measured test is bad, proceed back to the field boost circuit test.

TEST FB2 - TEST WIRE 4A EVOLUTION

Discussion

To verify that the field flash is working properly.

Procedure

1. Set VOM to measure DC voltage.
2. Locate Wire 4A on back of control panel. Leave harness connector connected to control panel.
3. Insert red back probe into connector that contains Wire 4A.
4. Touch black probe lead to the battery negative post.
5. Clear all faults on the control panel and place into manual mode.
6. Measure and record field flash voltage.

Note: See "Field Boost" in Section 2.2 for analysis of Nexus and Evolution field boost parameters.

7. Record measurements.

Results

If approximately 12 VDC (engine battery voltage) was measured during field flash, the control board is good. Refer back to the flow chart.

If 0 VDC was measured during field flash, refer back to the flow chart.

TEST FB3 - DIODE TEST EVOLUTION

Discussion

To verify that the field flash diode is working properly.

Procedure

1. Remove 7.5 amp from control panel
2. Place the VOM to the diode check function (preferred). If the VOM does not have a diode check selection, use the resistance or "Ohms" selection.
3. Locate Wire 4A wire harness connector and disconnect from control panel.
4. With test probe, insert the **black** lead into the BACK of the wire harness on Wire 4A.
5. Locate Wire 4 wire harness connector and disconnect from control panel.
6. With test probe, insert the **red** lead into the BACK of the wire harness on Wire 4.
7. Record reading.

Test Point	Results	
OHMS Test		Ohms
Diode Test		VDC

Note: Leave wire harness/harnesses unplugged.

8. Locate Wire 4A.
9. With test probe, insert the **red** lead into the BACK of the wire harness on Wire 4A.
10. Locate Wire 4.
11. With test probe, insert the **black** lead into the BACK of the wire harness on Wire 4.
12. Record reading.

Test Point	Results	
OHMS Test		Ohms
Diode Test		VDC

Results

1. If a reading of OL for Diode or OHMS test was recorded in Step 7 and approximately 0.5 Volts (in Diode setting) or approximately 2.07M OHMS (in Ohms setting) was recorded in Step 12, the diode is good. Replace 7.5 amp fuse and wire harness/harnesses into proper receptacles. Refer back to flow chart.
2. If readings of INFINITY (OL) on Step 7 and INFINITY on Step 12, Diode or wire is bad (open), wire harness/diode needs to be repaired/replaced.
3. If readings of approximately 0.5 Volts (in Diode setting) or CONTINUITY (Resistance in "Ohms" setting) in Step 7 and Step 12, Diode is bad (shorted), diode needs to be repaired/replaced.

TEST FB4 - DIODE TEST NEXUS

Discussion

To verify that the field flash diode is working properly.

Required Tools

- VOM and meter lead adapters P/N 0J09460SRV

Procedure

1. Remove 7.5 amp fuse from control panel
2. Place the VOM to the diode check function (preferred). If the VOM does not have a diode check selection, use the resistance or “OHMS” selection.
3. Locate Wire 56 at the SCR and disconnect from the SCR. Also disconnect the controller harness connector containing Wire 56.
4. Insert Red test lead probe to Wire 56 disconnected from the SCR.
5. Locate Wire 4 wire harness connector and DISCONNECT from the control panel.
6. With the test probe insert Black lead into Wire 4 connection of harness connector.

NOTE: AMP style connectors must probed from the front using the proper adapter. WHITE Molex connectors must be back probed using the proper probe adapter.

7. Record reading:

Test Point	Results	
OHMS Test		Ohms
Diode Test		VDC

Note: Leave wire harness/harnesses unplugged.

8. Locate Wire 56 – SCR connection.
9. With test probe connect Black lead into Wire 56 of SCR connection.
10. Locate Wire 4.
11. With the test probe insert RED lead into Wire 4 connection of harness connector.

NOTE: AMP style connectors must probed from the front using the proper adapter. WHITE Molex connectors must be back probed using the proper probe adapter.

12. Record reading.

Test Point	Results	
OHMS Test		Ohms
Diode Test		VDC

Results

1. If the reading recorded at Step 7 for OHMS is approximately 1.8M and for the Diode test is 0.5 VDC, PLUS the reading recorded at Step 12 for OHMs is INFINITY (OL) and Diode test is INFINITY (OL) the diode and wiring is good. Refer back to the flow chart.
2. If both OHMS and Diode readings of INFINITY (OL) on Step 7 and INFINITY (OL) on Step 12, Diode or wire is bad (open), wire harness/diode needs to be repaired or replaced.
3. If readings of approximately 0.5 Volts (in Diode setting) or CONTINUITY (Resistance in "Ohms" setting) in Step 7 and Step 12, the Diode is bad (shorted) and needs to be repaired/replaced.

TEST 4 – FIXED EXCITATION TEST/ROTOR AMP DRAW TEST

Discussion

Supplying a fixed DC current to the rotor will induce a magnetic field in the rotor. With the generator running, this should create a proportional voltage output from the stator windings. With the use of the MIN/MAX feature of a Volt-Ohm-Meter (VOM), it is possible to capture the maximum output of a particular winding before faulting out on under-voltage.

Under-voltage Alarm – When the controller is set in the MANUAL mode the following logic is used to trigger the alarm “under-voltage”:

- Cranking – If the starter disengages before a voltage has developed in the stator the controller will initiate a shutdown alarm for “under-voltage.”

Note: For further information about under-voltage shutdowns, refer to Section 2.1 “Description and Components.”

Table 9 has been provided to record the results of the following procedure. These results may be required when requesting factory support. Additional copies of Table 9 can be found in Appendix C “Supplemental Worksheets” at the back of this manual.

Table 9. Test 4 Results Worksheet

Test Point	Results	
Wires 2 and 6 Voltage		VAC
Wires 11 and 44 Voltage		VAC
Static Rotor Amp Draw		Amps
Running Rotor Amp Draw		Amps
Column Identified		

Required Tools

- A Volt-Ohm-Meter (VOM) equipped with a MIN/MAX feature
- Meter test leads that are capable of measuring voltage inside a connector without damaging the socket. A set of black and red test leads for this application are available from the manufacturer. Contact your nearest servicing dealer for more information.

Note: It is not recommended to use any testing device other than the manufacturer's approved test lead adapters (P/N 0J09460SRV).

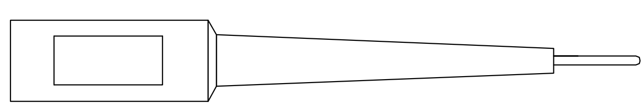


Figure 63. Narrow Test Probe

Note: These adapters are to be used on the Nexus controller with AMP connectors (front socket test points) and The Nexus/Evolution controllers with white Molex connectors (back-probe only).

Table 10. TEST 4 Results – Fixed Excitation Test/Rotor Amp Draw Test (8-20 kW)

Results:	Size	A	B	C	D	E	F	G	H
Voltage Results Wire 2 & 6	ALL	Above 50 VAC	Above 50 VAC	Below 50 VAC	Zero or Residual Volts	Below 50 VAC	Below 50 VAC	Above 50 VAC	Below 50 VAC
Voltage Results Wire 11 & 44	ALL	Above 50 VAC	Below 50 VAC	Above 50 VAC	Zero or Residual Volts	Below 50 VAC	Below 50 VAC	Above 50 VAC	Below 50 VAC
Static Rotor Amp Draw	8 kW	1.76-2.05	1.76-2.05	1.76-2.05	Zero Current Draw	Above 2.5A	1.76-2.05	Zero Current Draw	1.76-2.05
	10 kW	1.76-2.05	1.76-2.05	1.76-2.05		Above 2.5A	1.76-2.05		1.76-2.05
	12 kW	1.46-1.70	1.46-1.70	1.46-1.70		Above 2.3A	1.46-1.70		1.46-1.70
	14 kW	1.46-1.70	1.46-1.70	1.46-1.70		Above 2.3A	1.46-1.70		1.46-1.70
	15 kW	1.33-1.54	1.33-1.54	1.33-1.54		Above 2.3A	1.33-1.54		1.33-1.54
	16 kW	1.33-1.54	1.33-1.54	1.33-1.54		Above 2.3A	1.33-1.54		1.33-1.54
	17 kW	1.33-1.54	1.33-1.54	1.33-1.54		Above 2.3A	1.33-1.54		1.33-1.54
	20 kW	1.16-1.36	1.16-1.36	1.16-1.36		Above 2.0A	1.16-1.36		1.16-1.36
	22 kW	1.00-1.17	1.00-1.17	1.00-1.17		Above 2.0A	1.00-1.17		1.00-1.17
Running Rotor Amp Draw	8 kW	1.76-2.05	1.76-2.05	1.76-2.05	Zero Current Draw	Above 2.5A	1.76-2.05	Zero Current Draw	Above 2.5A
	10 kW	1.76-2.05	1.76-2.05	1.76-2.05		Above 2.5A	1.76-2.05		
	12 kW	1.46-1.70	1.46-1.70	1.46-1.70		Above 2.3A	1.46-1.70		
	14 kW	1.46-1.70	1.46-1.70	1.46-1.70		Above 2.3A	1.46-1.70		
	15 kW	1.33-1.54	1.33-1.54	1.33-1.54		Above 2.3A	1.33-1.54		
	16 kW	1.33-1.54	1.33-1.54	1.33-1.54		Above 2.3A	1.33-1.54		
	17 kW	1.33-1.54	1.33-1.54	1.33-1.54		Above 2.3A	1.33-1.54		
	20 kW	1.16-1.36	1.16-1.36	1.16-1.36		Above 2.0A	1.16-1.36		
	22 kW	1.00-1.17	1.00-1.17	1.00-1.17		Above 2.0A	1.00-1.17		

Note: Actual values measured may vary by as much as .5 amps; depending on the type and quality of meter used, the condition of the unit, and how good the connection is between the test leads and test points.

← ***MATCH RESULTS WITH LETTER AND REFER TO FLOW CHART IN SECTION 2.3 "Problem 1"*** →

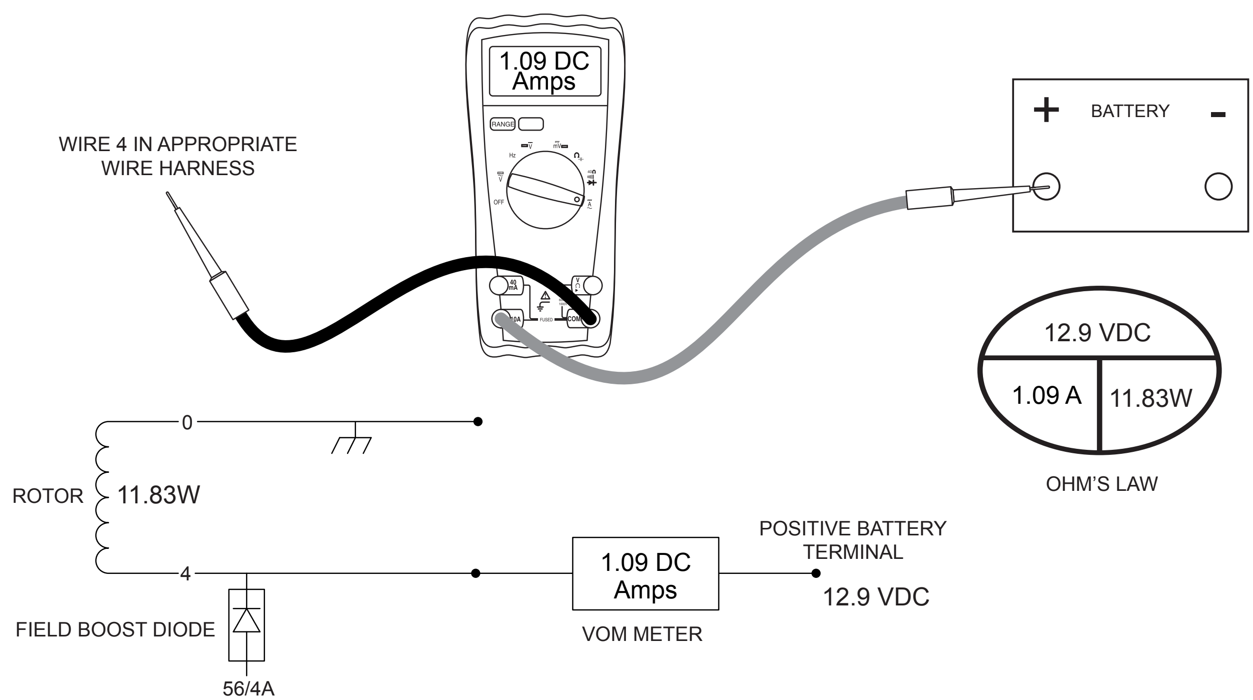


Figure 64. Rotor Amp Draw Test

VOM Setup

Below is an excerpt taken from a Fluke 117 multi-meter owners manual. **Note: Some meters may differ.**

RANGE – When you turn the Meter on, it defaults to Autorange and Auto is displayed.

1. To enter the Manual Range mode, press RANGE. Manual is displayed.
2. In the Manual Range mode, press RANGE to increment the range. After the highest range, the Meter wraps to the lowest range.

Note: You cannot manually change the range in the MIN MAX AVG or Display HOLD modes.

If you press RANGE while in MIN MAX AVG or Display Hold, the Meter beeps twice, indicating an invalid operation, and the range does not change.

3. To exit Manual Range, press RANGE for at least 1 second or turn the rotary switch. The Meter returns to Autorange and Auto is displayed.

MIN/MAX – The MIN MAX AVG recording mode captures the minimum and maximum input values (ignoring overloads), and calculates a running average of all readings. When a new high or low is detected, the Meter beeps.

- Put the Meter in the desired measurement function and range.
- Press MIN MAX to enter MIN MAX AVG mode.
  MIN MAX and MAX are displayed and the highest reading detected since entering MIN MAX AVG is displayed.
- Press MIN MAX to step through the low (MIN), average (AVG), and present readings.
- To pause MIN MAX AVG recording without erasing stored values, press HOLD. HOLD is displayed.
- To resume MIN MAX AVG recording, press HOLD again.
- To exit and erase stored readings, press MIN MAX for at least one second or turn the rotary switch.

Procedure: Fixed Excitation Test

STOP! Have you performed the FBCT (Field Boost Circuit Test)? If yes, then begin with Step 1.

1. Remove the 7.5 amp fuse from the controller.
2. Locate and **DISCONNECT** the appropriate harness connector with Wires 2 and 6 from the controller.

Note: During this procedure, DO NOT reconnect this connector to the controller!

3. Set VOM to measure AC voltage.
4. Using the scale feature of the VOM, set to the first available scale greater than 100 (i.e. “600”).

Note: Refer to the manufactures owners manual for specific information on using manual scaling.

5. Set meter to MIN/MAX.

Note: Refer to the manufactures owners manual for specific information on using the MIN/MAX feature.

Figure 65.

6. Using the approved meter test probes, connect one meter test lead to appropriate harness pin with (Wire 6) and the other meter test lead to appropriate harness pin with (Wire 2).
7. Re-install the 7.5 amp fuse.
8. Set the controller to the MANUAL mode.
9. Measure and record the voltage indicated between Wires 2 and 6 as indicated by the VOM.
10. Acknowledge and reset the “under-voltage” present on the controller; leave controller in the OFF mode.
11. Re-locate meter test probes to the appropriate harness pin for Wire 11 (11S on Evolution) and the appropriate harness pin for Wire 44 (44S on Evolution).
12. Set the controller to the MANUAL mode.
13. Measure and record the voltage indicated between Wire 11/11S and 44/44S as indicated by the VOM.
14. Acknowledge and reset the “under-voltage” present on the controller; leave controller in the OFF mode.

Procedure: Rotor Amp Draw

1. Disengage the MIN/MAX feature and manual scale on the VOM.
2. Set VOM to measure DC amperage.
3. Ensure the connector (previously disconnected in the Fixed Excitation Test) has NOT been reconnected.

Note: Consult the meters documentation for proper setup procedure. See Section 1.4 “Measuring Current” for further information.

4. Connect the black (negative) meter test lead to the appropriate harness pin with Wire 4 and the red (positive) test lead to the positive battery terminal.
5. Measure and record the static rotor amp draw.
6. Set the controller to the MANUAL mode.
7. Measure and record the running rotor amp draw.
8. Acknowledge and reset the “under-voltage” present on the controller; leave controller in the OFF mode.

Results

1. Using the values recorded in the above procedure, compare the results to Table 10 “Results – Fixed Excitation Test/Rotor Amp Draw Test”. Determine the appropriate lettered column to use and refer back to the flow chart. The rotor amp draws

area calculated amp draw and actual amperage readings may vary depending on the resistance of the rotor.

Note: To calculate rotor amp draw take the battery voltage applied, divided by the actual resistance reading of the rotor. Rotor resistance can be measured between Wires 4 and 0 in the appropriate harness.

12.9 VDC/12.3 Ohms = 1.05 DC Amps

Example

Model	17 kW
Wires 2 and 6 Voltage	53 VAC
Wires 11 and 44 Voltage	31 VAC
Static Rotor Amp Draw	1.09 Amp
Running Rotor Amp Draw	1.10 Amp

These results match Column B in the chart. Refer back to Problem 1 and follow letter "B".

TEST 5 – TEST SENSING CIRCUIT WIRES 11 AND 44

Discussion

The voltage regulator (internal to the controller) requires a reference voltage in order to regulate at a specific voltage and to recognize if the alternator is producing voltage. The alternator may be producing a voltage, but if the voltage regulator cannot "sense" the voltage, it will fault out for under-voltage. This test will verify the integrity of the sensing circuit.

Required Tools

- Meter test leads that are capable of measuring voltage inside a connector without damaging the socket. A set of black and red test leads for this application are available from the manufacturer. Contact your nearest servicing dealer for more information. See Figure 63.

Note: It is not recommended to use any testing device other than the manufacturer's approved test lead adapters.

Procedure

1. Remove the 7.5 amp fuse from the control panel.
2. Remove the controller and the cover to expose the lower harness connections.
3. Disconnect the appropriate harness connector from the controller.
4. Set the Volt-Ohm-Milliammeter (VOM) to measure resistance.

Note: Stator winding resistance values are very low and some VOMs will not read such a low resistance, and will simply indicate different ranges of resistance. The manufacture recommends a high quality digital type meter capable of reading a very low resistance.

5. Connect one meter test lead to the appropriate harness pin with (Wire 11 on Nexus or 11S on Evolution) and the other meter test lead to the NEUTRAL connection. Measure and record the resistance.
6. Connect one meter test lead to the appropriate harness pin with (Wire 44 on Nexus or 44S on Evolution) and the other meter test lead to the NEUTRAL connection. Measure and record the resistance.
   a. If the meter indicated a resistance value of less than 0.2 ohms in Steps 5 and 6, stop testing and refer back to the flow chart (Good).
   b. If the meter indicated OPEN in Steps 5 or 6, proceed to Step 7.
7. Disconnect the lower bulkhead C1 connector (if unit is equipped.) (Figure 66).
8. Connect one meter test lead to C1 (if unit is equipped) to the appropriate harness pin with Wire 11 and the other meter test lead to the NEUTRAL connection, measure and record the resistance.
9. Connect one meter test lead to C1 (if unit is equipped) to the appropriate harness pin with Wire 44 and the other meter test lead to the NEUTRAL connection, measure and record the resistance.

Results

1. If the meter indicated a resistance value of less than 0.2 ohms in Steps 5 through 9, refer back to flow chart (Good).

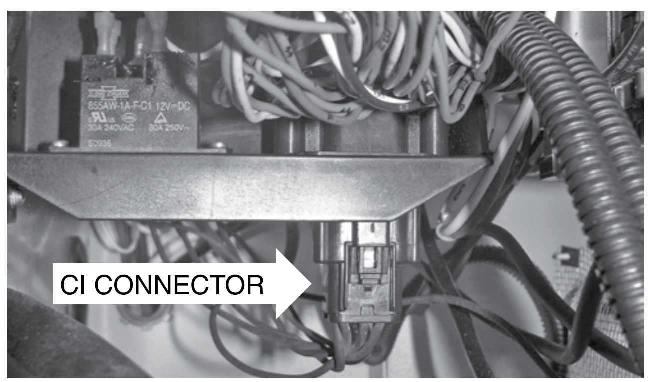


Figure 66. C1 Connector (if unit is equipped)

2. If the meter indicated a resistance value of OPEN in Step 5 and a value less than 0.2 ohms in Step 8, repair or replace Wire 11 between the controller and the C1 connector (if unit is equipped).
3. If the meter indicated a resistance value of OPEN in Step 6 and a value less than 0.2 ohms in Step 9, repair or replace Wire 44 between the controller and the C1 connector (if unit is equipped).
4. If the meter indicated OPEN in either Step 8 or Step 9, proceed to Test 7 "Test Stator."

TEST 6 – TEST EXCITATION WINDING CIRCUIT 2 AND 6

Discussion

The voltage regulator (internal to the controller) requires an unregulated voltage from the stator in order to supply excitation power to the regulator. The regulator supplies DC field excitation current to the rotor. The alternator may be producing this voltage, but if the voltage is not being supplied to the regulator, it will fault out for under-voltage. This test will verify the integrity of the Excitation (DPE) winding inside the stator and connections to the voltage regulator.

Required Tools

- Meter test leads that are capable of measuring voltage inside a connector without damaging the socket. A set of black and red test leads for this application are available from the manufacturer. Contact your nearest servicing dealer for more information. See Figure 63.

Note: It is not recommended to use any testing device other than the manufactures approved test lead adapters.

Procedure

1. Remove the 7.5 amp fuse from the control panel.
2. Expose the controller lower harness connections by removing the controller mounting hardware.
3. Disconnect the harness connector containing Wires 2 and 6 from the controller.
4. Set the Volt-Ohm-Meter (VOM) to measure resistance.
5. Connect one meter test lead to the harness pin with Wire 2 and the other meter test lead to the harness pin with Wire 6. Measure and record the resistance.
   a. If the meter indicated a resistance value consistent with the values found in the table in the front of the manual, stop testing and refer back to the flow chart (Good).
   b. If the meter indicated an OPEN, proceed to Step 6.
6. Disconnect the lower bulkhead C1 connector (if unit is equipped). On Evolution units locate the STR connector and disconnect.
7. On the harness connector (disconnected in Step 6) that leads to the stator, connect one meter test lead to Wire 2 and the other meter test lead to Wire 6. Measure and record the resistance.

Results

1. If the meter indicated a resistance value consistent with the values found in the table in the front of the manual, stop testing and refer back to the flow chart (Good).
2. If the meter indicated a resistance value of OPEN in Step 5, but a resistance value consistent with the values found in the table in the front of the manual in Step 7, repair or replace Wire 2 and/or 6 between the controller and the connector (C1 Connector on Nexus, STR Connector on Evolution). Measure Ohms between Wire 2 and 2, or Wire 6 and 6 to confirm which wire is open.
3. If the meter indicated a resistance value of OPEN or a resistance value inconsistent with the values found in the table in the front of the manual in Step 5 and Step 7, replace the stator.

TEST 7 – TEST THE STATOR WITH A VOM

Discussion

This test will use a Volt-Ohm-Milliammeter (VOM) to test the stator windings for the following faults:

- An OPEN circuit condition
- A “short-to-ground” condition
- A short circuit between windings

Table 14 (next page) has been provided to record the results of the following procedure. These results may be required when requesting factory support.

Additional copies of Table 14 can be found in Appendix C “Supplemental Worksheets” at the back of this manual.

Note: It is the recommendation of the factory to perform this test procedure using piercing probes on the wire side of the connector. Testing inside the connector itself can cause unneeded damage to the unit resulting in poor or loose connections.

Procedure: Resistance Test

1. Disconnect Wires 11 and 44 from the main line circuit breaker (MLCB).
2. Disconnect Wires 22 and 33 from the NEUTRAL connection and separate the leads.
3. Disconnect the Stator connector or proper controller connector on the harness (C1 Connector on Nexus, STR Connector on Evolution).

Note: C1 connector is not installed on all generators. Do alternative testing on wire harness using specific wire numbers.

4. Make sure all of the disconnected leads are isolated from each other and are not touching the frame during the test.
5. Set the VOM to measure resistance.
6. Measure and record the resistance values for each set of windings between the A and B test points as shown in Table 11. Record the results in Table 14.

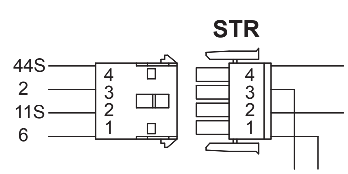


Figure 67. Stator Connector Pin Locations (if unit is equipped)

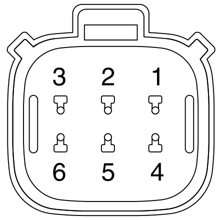


Figure 68. C1 Bulkhead Connector Pin Locations (if unit is equipped)

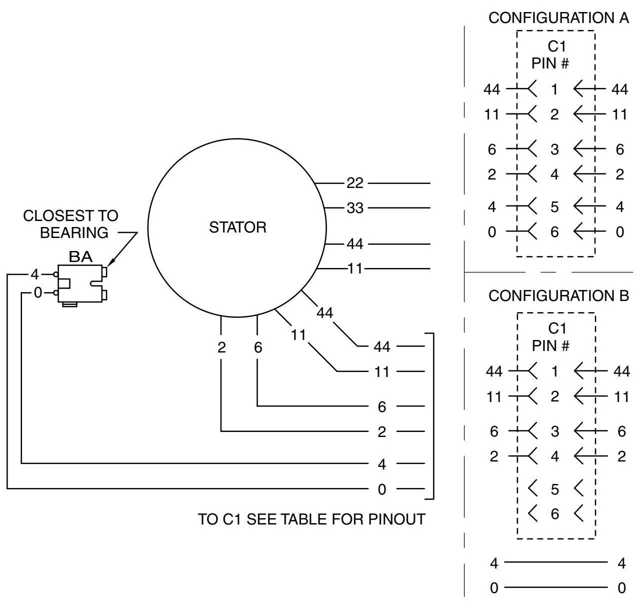


Figure 69. Stator Lead Connections

Table 11. Test Points

Test Point A	Test Point B
Stator Lead Wire 11	Stator Lead 22
Stator Lead Wire 33	Stator Lead 44
C1 Pin 2 Wire 11	Stator Lead 22
C1 Pin 1 Wire 44	Stator Lead 33
C1 Pin 3 Wire 6	C1 Pin 4 Wire 2

Test Windings for a Short to Ground

7. Make sure all stator leads are isolated from each other and are not touching the frame.
8. Measure and record the resistance values for each set of windings between the A and B test points as shown in Table 12. Record the results in Table 14.

Table 12. Test Points

Test Point A	Test Point B
Stator Lead 11	Ground
Stator Lead 44	Ground
C1 Pin 1 Wire 44	Ground
C1 Pin 2 Wire 11	Ground
C1 Pin 4 Wire 2	Ground

Test For A Short Circuit Between Windings

9. Measure and record the resistance values for each set of windings between the A and B test points as shown in Table 13. Record the results in Table 14.

Table 13. Test Points

Test Point A	Test Point B
C1 Pin 4 Wire 2	C1 Pin 2 Wire 11
C1 Pin 4 Wire 2	C1 Pin 1 Wire 44
C1 Pin 4 Wire 2	Stator Lead Wire 11
C1 Pin 4 Wire 2	Stator Lead Wire 44
Stator Lead 11	C1 Pin 1 Wire 44
Stator Lead 11	Stator lead Wire 44

Table 14. Test 7 Stator Results

Test Point A	Test Point B	Results
Resistance Tests		
Stator Lead Wire 11	Stator Lead 22	
Stator Lead Wire 33	Stator Lead 44	
C1 Pin 2 Wire 11	Stator Lead 22	
C1 Pin 1 Wire 44	Stator Lead 33	
C1 Pin 3 Wire 6	C1 Pin 4 Wire 2	
Shorts to Ground		
Stator Lead 11	Ground	
Stator Lead 44	Ground	
C1 Pin 1 Wire 44	Ground	
C1 Pin 2 Wire 11	Ground	
C1 Pin 4 Wire 2	Ground	
Shorted Condition		
C1 Pin 4 Wire 2	C1 Pin 2 Wire 11	
C1 Pin 4 Wire 2	C1 Pin 2 Wire 44	
C1 Pin 4 Wire 2	Stator Lead Wire 11	
C1 Pin 4 Wire 2	Stator Lead Wire 44	
Stator Lead 11	C1 Pin 1 Wire 44	
Stator Lead 11	Stator lead Wire 44	

Note: These results may be needed when requesting factory support.

Note: Stator winding resistance values are very low and some VOMs will not read such a low resistance, and will simply indicate CONTINUITY. The manufacturer recommends a high quality digital type meter capable of reading a very low resistance.

Results

1. Resistance Test: If the VOM indicated a very high resistance or INFINITY, the windings are open or partially open.
2. Grounded Condition: Any resistance value other than INFINITY indicates a grounded winding.
3. Shorted Condition: Any resistance value other than INFINITY indicates a shorted winding.

Note: Read Section 1.5, "Testing, Cleaning and Drying" carefully. If the winding tests good, perform the insulation resistance test. If the winding

fails the insulation resistance test (using a megohm-meter), clean and dry the stator as outlined in Section 1.5. Then, repeat the insulation resistance test. If the winding fails the second resistance test (after cleaning and drying), replace the stator assembly.

TEST 8 – RESISTANCE CHECK OF ROTOR CIRCUIT

Discussion

During the rotor amp draw test in Test 4, if the amp draw was zero, then an OPEN circuit should be present on Wires 4 and 0. This test will verify if the readings were accurate and verify the field boost circuit.

Identify C1 Connector (if unit is equipped) wiring configuration. Refer to Figure 69.

Configuration A: follow Steps 1-11

Configuration B: follow Steps 1-6

Note: if the unit does not have a C1 connector refer to the appropriate pin at the controller connector.

Procedure

Note: For Evolution units perform Steps 1 - 6a

1. Remove the 7.5 amp fuse from the control panel.
2. Remove the cover and controller to expose the lower harness connections.
3. Disconnect the harness connector from the controller
4. Set the Volt-Ohm-Milliammeter (VOM) to measure resistance.
5. Connect one meter test to lead to the appropriate harness pin with (Wire 4) and connect the other meter test lead to the appropriate harness pin with (Wire 0), measure and record the resistance.
6. Connect one meter test to lead to the appropriate harness Wire 4 and connect the other meter test lead to a ground connection. Measure and record the resistance.
   a. If the meter indicated the correct Rotor resistance values as stated in the front of the manual, proceed to Step 9.
   b. If the meter indicated INFINITY, proceed to Step 7.
7. If testing C1 Configuration A (if unit is equipped), locate and disconnect the bulkhead C1 connector. If testing C1 Configuration B (if unit is equipped), stop test and refer to Test 8 Results.
8. Connect one meter test lead to C1 (if unit is equipped) to the appropriate harness pin with Wire 4 and connect the other meter test lead to C1 (if unit is equipped) to the appropriate harness pin with Wire 0, measure and record the resistance. If the VOM indicated INFINITY, stop testing and refer back to flow chart (Rotor Circuit Failure).
9. Locate the starter contactor relay (SCR) and disconnect Wire 56 (blue wire).
10. Disconnect the harness connector from the controller.
11. Connect one meter test lead to the disconnected Wire 56 and connect the other meter test lead to the appropriate harness pin with Wire 4. Measure and record the resistance.

Results

Refer to the front of this manual for correct Rotor resistance values.

1. If the VOM indicated the correct resistance values in Steps 5, 6, 8, and 11, refer back to flowchart (Good).
2. If the VOM indicated INFINITY in Step 8, refer back to flowchart (Rotor Circuit Failure).
3. If the VOM indicated the correct resistance in Step 8 and indicated INFINITY in Step 5, repair or replace Wires 4 and 0 between the C1 (if unit is equipped) and the J5 connector.
4. If the VOM indicated the correct resistance in Step 8 and indicated INFINITY in Step 5, but indicated the correct resistance in Step 6, repair or replace Wire 0 between the J5 connector and the ground connection.
5. If the VOM indicated the correct resistance in Step 5 and indicated INFINITY in Step 11, replace the harness (Field Boost Circuit Failure).

TEST 9 – CHECK BRUSHES AND SLIP RINGS

Discussion

The brushes and slip rings function to provide an electrical connection for excitation current from the stationary components to the rotating rotor. Made of a special long lasting material, brushes seldom wear out or fail. However, slip rings can develop a tarnish or film that can inhibit or offer a resistance to the flow of current. Such a non-conducting film usually develops during non-operating periods. Broken or disconnected wiring can also cause loss of excitation current to the rotor.

Refer to Figure 69 to identify the C1 Connector (if unit is equipped) wiring configuration of the unit being tested. Follow steps for Configuration A or Configuration B accordingly.

Procedure

1. Disassemble the Generator until the brushes and slip rings are exposed. Refer to Section 6.1 “Major Disassembly.”
2. Inspect the brush wires and verify they are secured and properly connected.
3. Inspect the brush assembly for excessive wear, or damage.
4. Inspect the rotor slip rings. If their appearance is dull or tarnished, polish with a fine grade abrasive material.

⚠ WARNING!

Do not use metallic grit to polish slip rings. This may cause irreversible damage to the rotor.

5. Wire 0, located on the negative brush terminal, provides an electrical connection to ground for the rotor and the voltage regulator. To test this wire for an OPEN condition, remove Wire 0 from the brush assembly.
6. For C1 Configuration A (if unit is equipped) disconnect the bulkhead connector C1 inside the control panel. For C1 Configuration B (if unit is equipped) disconnect the harness connector from the controller and isolate Wire 0 from the ground stud.
7. Set Volt-Ohm-Milliammeter (VOM) to measure resistance.
8. For C1 Configuration A (if unit is equipped) connect one meter test lead to Wire 0 at the brush assembly and connect the other meter test lead to C1 Pin 6. For C1 Configuration B (if unit is equipped) connect one meter test lead to Wire 0 at the brush assembly and connect the other meter test lead to the Wire 0 disconnected in Step 6.

- If the VOM indicated INFINITY, repair or replace Wire 0 between the negative slip ring and C1 (if unit is equipped) Pin 6 (Configuration A) or the ground stud (Configuration B).
- If the VOM indicated CONTINUITY, continue to Step 9.

9. Wire 4, located on the positive brush terminal, provides an electrical connection for excitation current to flow between the rotor and the voltage regulator. To test this wire for an OPEN condition, remove Wire 0 from the brush assembly.
10. For C1 Configuration A (if unit is equipped) connect one meter test lead to Wire 4 at the brush assembly and connect the other meter test lead C1 (if unit is equipped) Pin 5. For C1 Configuration B (if unit is equipped) connect one meter test lead to Wire 4 a the brush assembly and connect the other meter test lead to appropriate controller connector.

- If the VOM indicated INFINITY, repair or replace Wire 4 between the positive slip ring and C1 (if unit is equipped) Pin 6 (Configuration A) or the appropriate controller connector (Configuration B).
- If the VOM indicated CONTINUITY, continue to Step 11.

11. Connect one meter test lead to Wire 4 at the brush assembly and connect the other meter test lead to frame ground.

- If the VOM indicated CONTINUITY, repair or replace Wire 4 between the positive slip ring and C1 Pin 6 (Configuration A) or Pin 13 (Configuration B).
- If the VOM indicated INFINITY, continue to Step 12.

12. Connect one meter test lead to Wire 0 at the brush assembly and connect the other meter test lead to a ground connection.

- If the VOM indicated INFINITY , repair or replace Wire 0 between the positive slip ring and the control panel ground connection.
- If the VOM indicated CONTINUITY, refer back to flow chart.

Results

1. Repair, replace, or reconnect wires as necessary.
2. Replace any damage slip rings or brush holder.
3. Clean and polish slip rings as required.

TEST 10 – TEST ROTOR ASSEMBLY

Discussion

A rotor having open windings will cause loss of excitation current flow and as a result generator AC output voltage will drop to “residual” voltage. A “shorted” rotor winding can result in a low voltage condition.

Procedure

1. Remove the brush assembly from the slip rings to prevent interaction.
2. Set a Volt-Ohm-Milliammeter (VOM) to measure resistance.
3. Connect one meter test lead to the positive slip ring (nearest the rotor bearing) and the common test lead to the negative slip ring, measure and record the resistance.
4. Connect one meter test lead to the positive slip ring and connect the other meter test lead to a ground connection. Measure and record the resistance.

Results

1. Compare the resistance measured in Step 3 with the “Specifications”, replace rotor as required.
2. If the VOM indicated CONTINUITY in Step 4, replace the rotor assembly.

TEST 11 – CHECK AC OUTPUT FREQUENCY

Discussion

The generator AC frequency is proportional to the operating speed of the rotor. The 2-pole rotor will supply a 60 Hertz AC frequency at 3600 RPM.

Note: Engine Speed is in direct correlation to frequency (Hertz). The controller monitors Wire 18 to maintain proper frequency.

Tools Required

- A meter that is capable of measuring AC frequency.

Procedure

1. See Figure 66, connect an accurate AC frequency meter across the Wires 11 and 44 Terminals of the generator main line circuit breaker (MLCB).

2. Set the controller to the MANUAL mode.
3. Let engine stabilize. Measure and record the frequency.

Results

1. If the meter indicated 59-61 Hertz, refer back to flow chart.
2. If the meter indicated a value outside the accepted range, refer back to flow chart.

TEST 12 – CHECK STEPPER MOTOR CONTROL

Procedure: V-Twin and Single Cylinder

Note: Nexus Only Steps 1-3 and 7-10.

1. Remove air cleaner cover to access Stepper motor and/or visually see throttle plates.
2. Physically move the throttle and verify the Stepper motor, linkage and throttle do not bind in any way, if any binding is felt repair or replace components as needed. The Stepper motor will have resistance as it moves through its travel.
3. Physically and visually move the throttle to the closed position by pulling the Stepper motor arm towards the idle stop. See Figures 70-73 for Evolution units, or Figures 74-76 for Nexus units.
4. Set the controller to the MANUAL mode.
5. Observe and record the Stepper motor's movement.
   a. On Nexus, it should open.
   b. On Evolution, it should cycle Open, Closed, and then go to the Mid-point (which is the small venturi starting position). See the picture sequence.
6. Set the controller to the OFF mode.
7. Physically move the throttle to the open position by pulling the Stepper motor arm away from the idle stop.
8. Set the controller to the MANUAL mode.
9. Observe and record the Stepper motor's movement.
10. Set the controller to the OFF mode.
11. If no movement was seen in Steps 5 or 9 (Nexus) remove the controller and verify the six pin connector on the controller is seated properly, remove the connector and then replace it and test again. If problems persist, proceed to Step 12.
12. Set Volt-Ohm-Milliammeter (VOM) to measure resistance.

Note: Press down with the meter leads on the connectors exposed terminals, do not probe into the connector.

13. Connect the meter test leads across points A and B as shown in Table 15 and compare to the specified value.

Table 15. Stepper Motor Testing - Evolution and Nexus

Test Point A	Test Point B	Resistance Value
Red wire	Orange wire	approx. 10-11Ω
Red wire	Yellow wire	approx. 10-11Ω
Red wire	Brown wire	approx. 10-11Ω
Red wire	Black wire	approx. 10-11Ω
Red wire	Ground	INFINITY

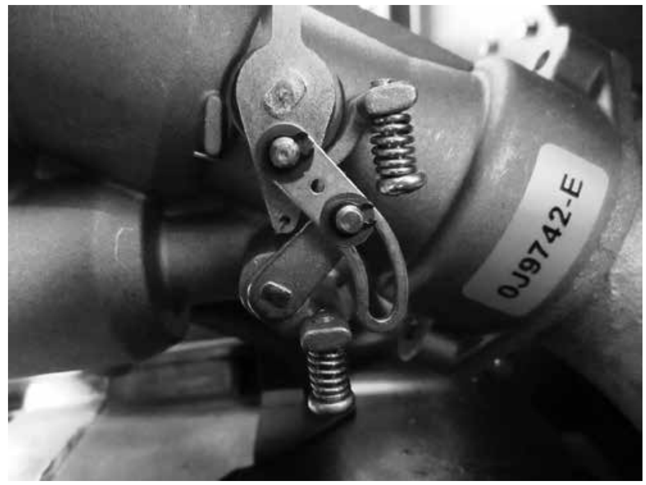


Figure 70. Evolution Stepper Motor Starting Position and/or Mid-point

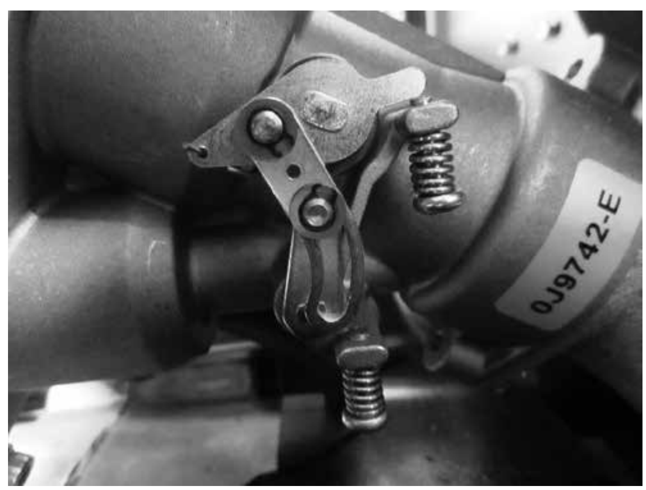


Figure 71. Evolution Stepper Motor Wide Open = Opens Both Venturis

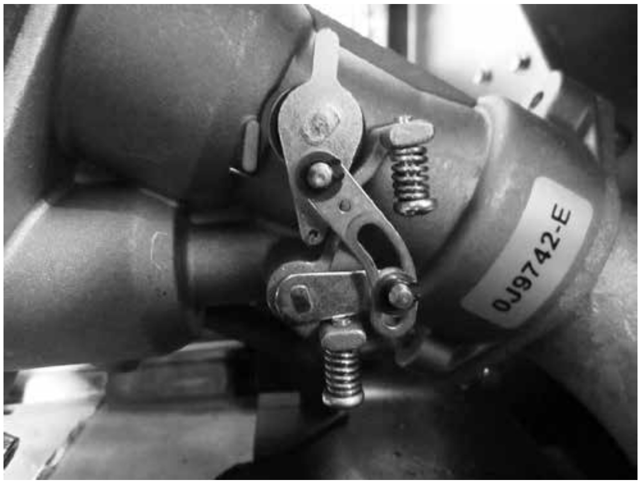


Figure 72. Evolution Stepper Motor Closed – Closes Both Venturis

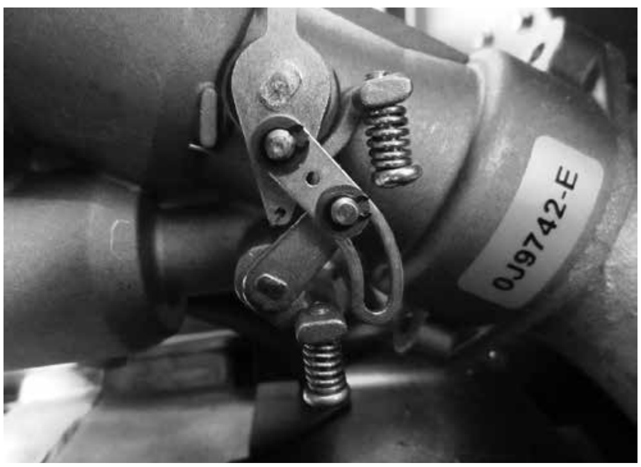


Figure 73. Evolution Stepper Motor Mid-point = Starting Point, Smaller Venturi Wide Open

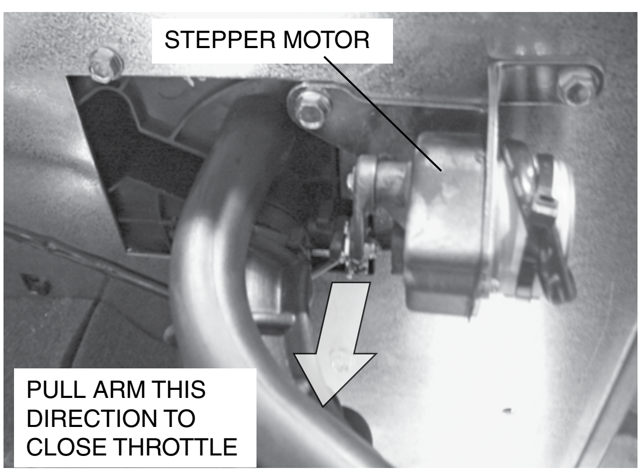


Figure 74. Throttle Positions Nexus 8 kW Units

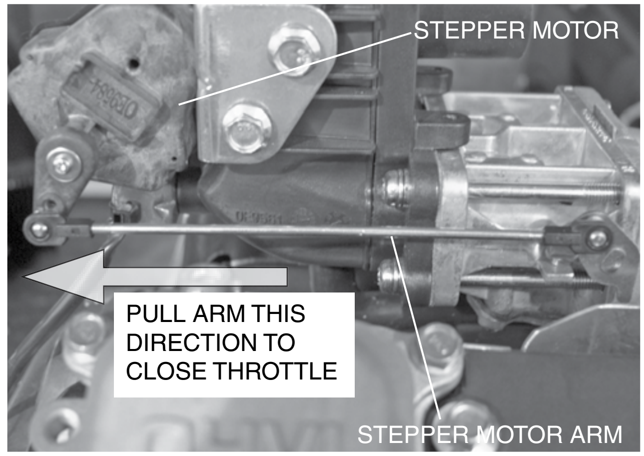


Figure 75. Throttle Positions Nexus 9/10 kW Units

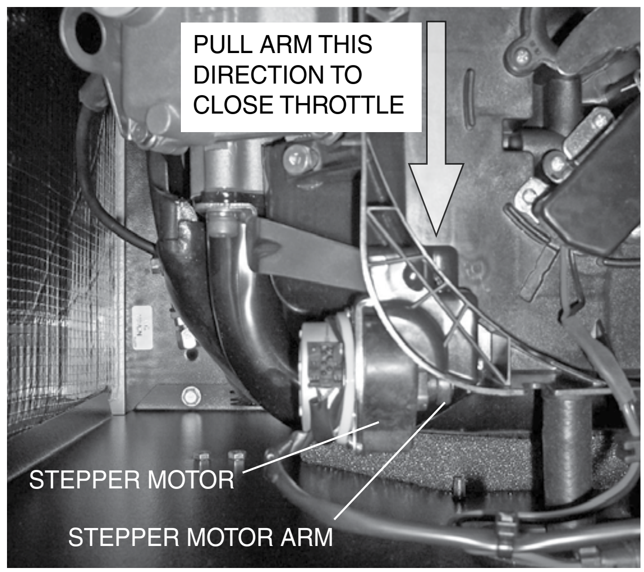


Figure 76. Throttle Positions Nexus 12-20 kW Units

Results

1. If the Stepper motor in Step 5 moved to the wide-open position, the closed position in Step 9, and the VOM indicated CORRECT resistance values, refer back to flow chart.
2. If the Stepper motor failed to change the throttle position in Steps 5 or 9, replace Stepper motor.
3. If the Stepper motor in Step 5 moved to the wide-open position, the closed position in Step 9, and the VOM indicated INCORRECT resistance values, replace Stepper motor.

TEST 14 – CHECK VOLTAGE AND FREQUENCY UNDER LOAD

Discussion

It is possible for the Generator AC output frequency and voltage to be good at no-load, but they may drop excessively when electrical loads are applied. This condition, in which voltage and frequency drop excessively when loads are applied can be caused by (a) overloading the Generator, (b) loss of engine power or performance, or (c) a shorted condition in the stator windings or in one or more connected loads.

Procedure

1. Set Volt-Ohm-Milliammeter (VOM) to measure AC voltage.
2. Connect an accurate AC frequency meter and an AC voltmeter across the stator AC power winding leads.
3. Start the engine, let it stabilize and warm-up.
4. Apply electrical loads to the Generator equal to the rated capacity of the unit. Measure and record the frequency and the voltage.

Results

1. If the VOM indicated 60 Hz and approximately 248 VAC during full load, discontinue testing.
2. If the VOM indicated a frequency and voltage that dropped while under full load, refer back to flow chart.

TEST 15 – CHECK FOR AN OVERLOAD CONDITION

Discussion

An “overload” condition is one in which the Generator rated wattage/amperage capacity has been exceeded. To test for an overload condition on an installed unit, the recommended method is to use an ammeter. See Section 1.4 “Measuring Current.”

Procedure

1. Connect the clamp-on ammeter to the Generator according to the ammeter's manufacturer specifications.
2. Transfer all normal electrical loads to the Generator, measure and record the amperage.

Results

1. If the ammeter indicated amperage readings that were ABOVE the unit’s specified ratings, reduce loads to the unit's rated capacity.
2. If the ammeter indicated amperage readings that were BELOW the unit’s specified ratings, but RPM and frequency dropped excessively refer back to flowchart.

TEST 16 – CHECK ENGINE CONDITION

Discussion

If engine speed and frequency drop excessively under load, the engine may be underpowered. An underpowered engine can be the result of a dirty air cleaner, loss of engine compression, faulty fuel settings, or incorrect ignition timing, etc. A decrease in available horsepower will proportionally lead to a decrease in kW.

Procedure

For engine testing, troubleshooting, and repair procedures refer to Section 1.4. For further engine repair information, refer to the appropriate engine service manuals.

TEST 17 – CALIBRATING CURRENT TO THE EVOLUTION CURRENT TRANSFORMERS

Discussion

The Evolution monitors load (current) through two Current Transformers (CT) mounted in the AC connection box area. The CT’s provide an AC output signal proportional to the current flowing in the load leads 11 and 44.

CT1 and CT2 have identical functions, diagnostic procedures and calibration process. CT1 wire circuits 398A and 399A monitor the current flow on Wire 11. CT2 wire circuits 398B and 399B monitor the current flow on Wire 44. The Evolution control panel is used to calibrate the CT’s. A password is required to access the Dealer Edit menu when performing calibrations.

Procedure

1. Hook up a load bank to the output circuit of the generator. This can be done at the MLCB or at the Transfer Switch.
2. Place the Amp meter over the circuit being checked. CT1 “Current Calibration1” – Wire 11 and CT2 “Current Calibration2” – Wire 44.
3. Start the generator and allow it to warm up for 10 seconds.
4. Place a load on the generator that matches the rated output of the generator.
5. Select the correct Current Calibration display menu under the Dealer Edit menu.
6. Press “Enter” to view both the generator’s output and the calibration value of that CT.
7. Adjust up or down the generator display to match the Amp meter’s calibrated reading.(Use the controllers UP and DOWN arrows to make adjustments)
8. Once the display panel’s reading matches the amp meter, press the “Enter” button to save the new calibration. Repeat the process for CT2 Current Calibrations.

9. When both calibration adjustments are correct, remove the load from the generator and allow the generator and load bank to cool before shutting down.

Results

With loads applied, CT1 - Wires 398A/399A and CT2 - Wires 398B/399B deliver approximately 0- 1.5 VAC based on percentage of Amps (load). Approximate Values (when back-probed at connector):

25 Amps = 0.380 mVAC
50 Amps = 0.755 mVAC
75 Amps = 1.133 VAC
100 Amps = 1.510 VAC

⚠ WARNING!

WARNING! Shock Hazard: Unplugged (Unburdened) CT's should never be handled with primary current applied!

PART 3 - TRANSFER SWITCH

⚠ **IMPORTANT! CLEAR ANY FAULTS IN THE CONTROLLER BEFORE PROCEEDING WITH ANY RUNNING DIAGNOSTIC STEPS!**

INTRODUCTION

The “V-Type” CONTACTOR is available in 100 through 200 Amp ratings at 250 volts maximum. It is available in 2-pole configuration (single phase only).

The Generator controls automatic transfer operation of the transfer switch.

ENCLOSURE

The transfer switch enclosure is a National Electrical Manufacture’s Association (NEMA) type 1. Based on NEMA Standard 250, the following standard applies

- NEMA 1 – Enclosures constructed for indoor use to provide a degree of protection against incidental contact with the enclosed equipment and to provide a degree of protection against falling dirt.

TRANSFER SWITCH CONTACTOR

The basic 2-pole CONTACTOR consists of a pair of moveable LOAD contacts, a pair of stationary UTILITY contacts, and a pair of stationary STANDBY contacts. The LOAD contacts connect the UTILITY contacts by a utility closing coil or to the STANDBY contacts using the standby closing coil. See Figures 77 and 78. In addition, the LOAD contacts can be moved to either the “Utility” or “Standby” position by means of a manual transfer handle. The closing coils are energized and actuated by the voltage source from the side to which the load is being transferred. I.e. If the CONTACTOR is in the “Utility” position, the standby closing coil will energize utilizing Standby voltage.

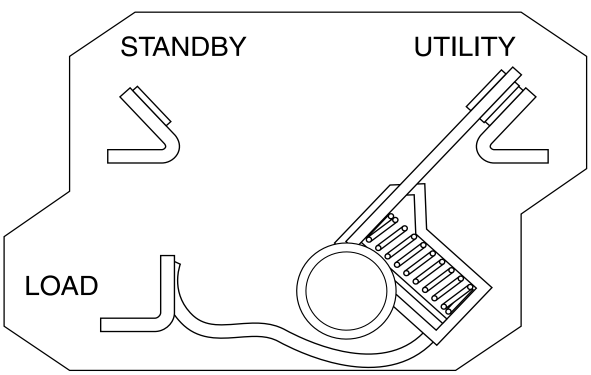


Figure 77. Load Connected to Utility Power Source

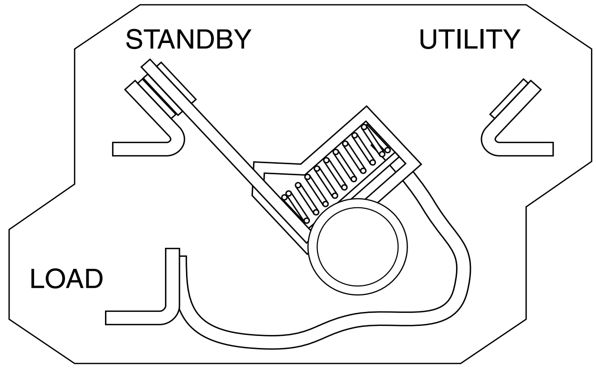


Figure 78. Load Connected to Standby Power Source

Utility Closing Coil C1

See Figure 79. The utility closing coil (C1) utilizes rectified Utility source power to actuate the LOAD contacts to the “Utility” position. When energized, the coil will move the LOAD contacts to an “over center” position. The coil and the spring force will complete the transfer to “Utility.” The bridge rectifier, which changes the Utility source alternating current (AC) to direct current (DC), is sealed in the coil wrappings. If either the coil or the bridge rectifier replacement becomes necessary replace the coil assembly.

Standby Closing Coil C2

The standby closing coil (C2) utilizes rectified Standby source power to actuate the LOAD contacts to their “Standby” position. Energizing the coil moves the LOAD contacts to an “over center” position. The coil and the spring force will complete the transfer to “Standby”. If either the coil or the bridge rectifier replacement becomes necessary replace the coil assembly.

Limit Switches SW2 and SW3

The LOAD contacts mechanically actuate the limit switches. When the LOAD contacts connect to the UTILITY contacts, the limit switch (SW2) opens the Utility circuit to C1 and the limit switch (SW3) closes the Standby circuit to standby closing coil (C2). The limit switches “arm” the system for transfer back to the opposite source. An open condition in SW2 will prevent retransfer to “Utility”. An open condition in SW3 will prevent transfer to the “Standby.”

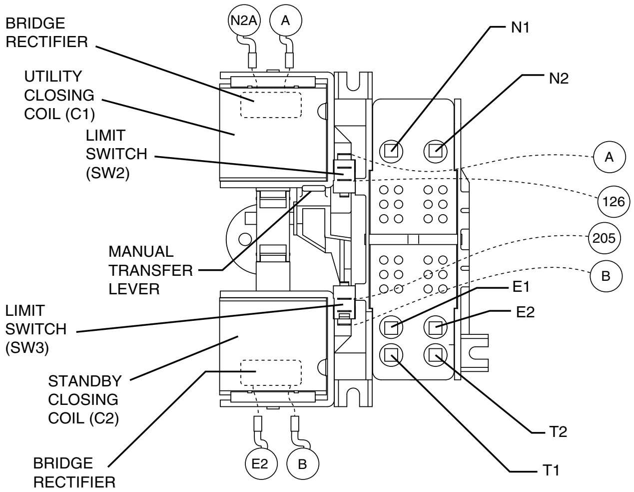


Figure 79. The “V-Type” Transfer Mechanism

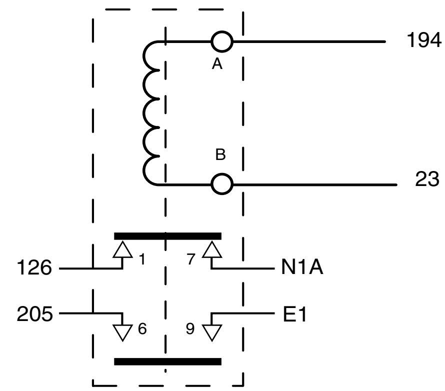


Figure 80. Typical Transfer Relay Schematic

TRANSFER RELAY

Transfer relay operation is controlled by the controller mounted on the generator set. Figure 80 shows the transfer relay electrical schematic. The transfer relay operates as follows:

1. Generator battery voltage (12 volts DC) is available to the transfer relay coil from the controller, via Wire 194 and Relay Terminal A.
   a. The 12 VDC circuit is completed through the transfer relay coil and back to the controller via Wire 23.
   b. The controller’s logic holds the Wire 23 circuit open to ground (Normally Open circuit) and the relay is de-energized.
   c. When de-energized, the relay contacts are in their normal condition (one set open, N.O.; and one set closed, N.C.)
   d. The normally closed relay contacts deliver Utility source power to the utility closing circuit of the transfer switch.
   e. The normally open relay contacts will deliver Standby source power to the transfer switch standby closing circuit only when the Transfer Relay is energized by the control panel.
2. During automatic system operation, when the Generator controller “senses” that Utility source voltage has dropped out, the controller will initiate a ten second “Line Interrupt Delay” timer; at the end of the factory default ten second delay the controller will crank and start the engine.
3. When the circuit board “senses” that the engine has started (via Wire 18 from the magneto circuit), the controller will initiate a ten second “Engine Warm-up Timer.”
4. When the “engine warm-up timer” has timed out, the controller’s logic closes the Wire 23 circuit to ground.
   a. The transfer relay energizes.
   b. The relay's normally closed contacts open and its normally open contacts close.
   c. When the normally open contacts close, Standby source power is delivered to the standby closing coil and transfer to “Standby” occurs.
5. When the controller “senses” that Utility source voltage has been restored (nominal for 15 seconds), the Wire 23 circuit will open from ground.
   a. The transfer relay will de-energize, its normally closed contacts will close and its normally open contacts will open.
   b. When the normally closed relay contacts close, utility source voltage is delivered to the utility closing coil to energize that coil.
   c. Transfer back to UTILITY occurs.

NEUTRAL LUG

The Generator is equipped with an UNGROUNDED neutral. The neutral lug in the transfer switch is isolated from the switch enclosure.

MANUAL TRANSFER HANDLE

The manual transfer handle is retained in the transfer switch enclosure by means of a wing nut and stud. Use the handle to manually move the CONTACTOR to the "Utility" or "Standby" position.

Instructions on use of the manual transfer handle are located in Section 5.1 "Operational Tests and Adjustments".

CUSTOMER CONNECTIONS

During system installation, the control wires must be properly landed between the generator and transfer switch. See Figure 82 *"A Typical Interconnection Drawing."*

Utility N1 and N2

N1 and N2 provide the Utility voltage-sensing signal to the controller. The controller utilizes the sensing circuit as follows:

- If Utility source voltage should drop below the set nominal value for ten seconds (default), the controller's logic will initiate automatic cranking and startup. The controller will transfer the switch to the Standby position after a five second engine warm-up timer.

Load T1

Wire T1, connected to the Load side of the CONTACTOR, provides 120 VAC for the battery charging circuit (the battery charge is an integral component of the controller). The charger maintains battery voltage anytime the load terminals have voltage available.

Control 194, 23

Wire 194 and 23 provide control of the transfer relay by the controller. Wire 194 provides continuous DC voltage to the transfer switch. Wire 23 is held open from ground by the controller's logic until a Utility failure is "sensed".

FUSE HOLDER

The fuse holder holds three fuses, designated as fuses F1, F2, and F3.

Figure 81. Fuse

Fuses F1, F2

These two fuses protects the N1 and N2 circuit against overload.

Fuse F3

This T1 fuse protects the battery charger against overload.

Fuse F4

This T2 fuse protects the battery charger against overload (50 Hz only).

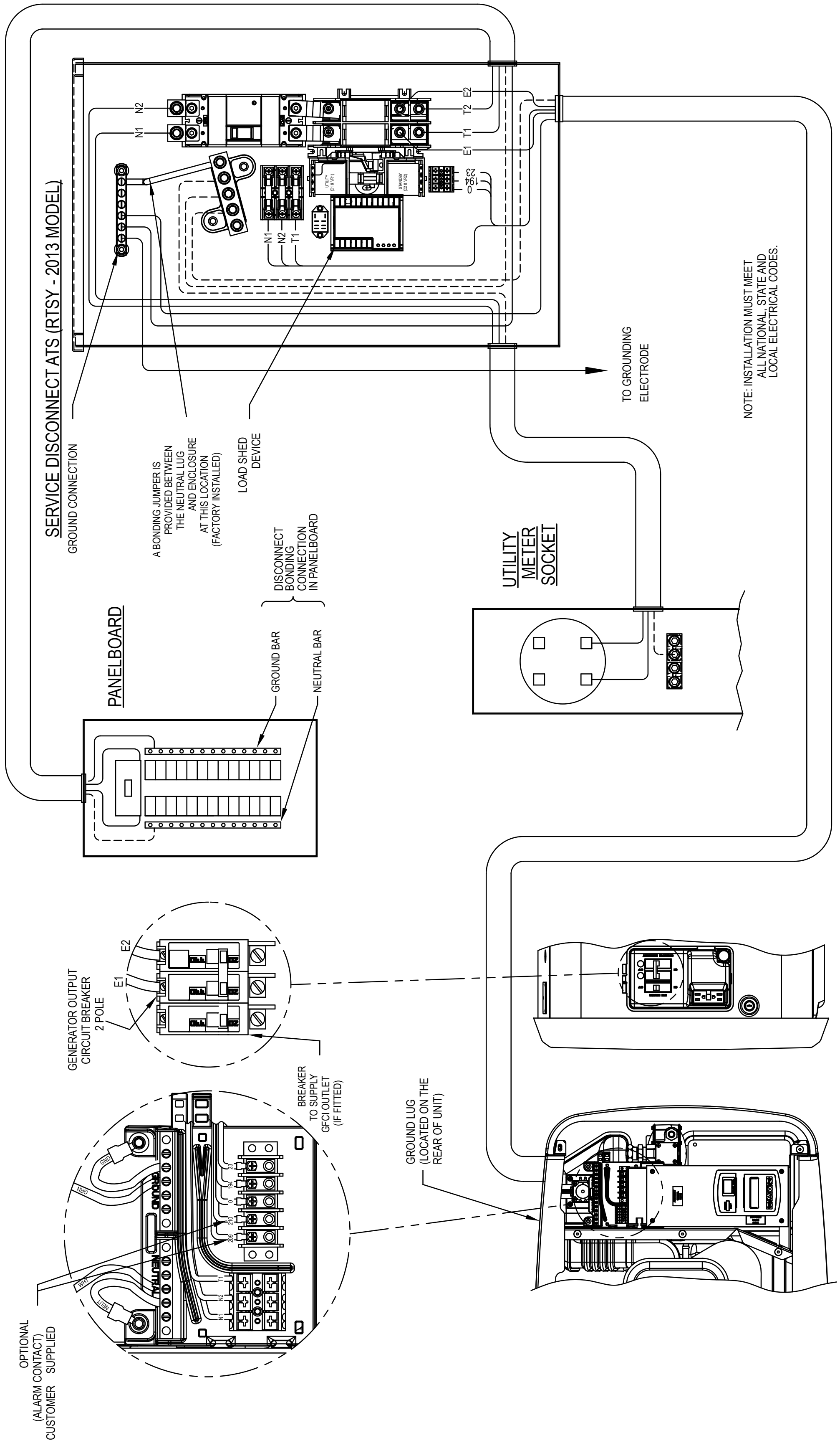


Figure 82. A Typical Interconnection Drawing

LOAD SHED MODULE OPERATION LSM 120 VOLT ONLY AND OPCB 24/120 VOLT MODULE

The Load Shed Modules are designed to prevent an overload on the generator when it is supplying the customer loads. Up to six loads can be managed by the load shed module; 2 air conditioner loads and 4 other loads. The load shed module manages the loads by "shedding" the connected loads in the event of a drop in generator frequency (overload). Loads to be "shed" are grouped in 4 priority levels on the load shed module.

Priority 1 and 2 has connections for both one air conditioner and one contactor. Both an air conditioner and a contactor can be used at the same time if desired. To control an air conditioner, no additional equipment is required. Internal relays interrupt the thermostat 24 VAC control signal to disable the air conditioner load.

Priority 3 and 4 have connections for one contactor only.

Four LEDs, located on the load shed module, will indicate when a load priority level is enabled.

Any loads, including central air conditioners, can be controlled via a contactor that must be purchased separately. Up to four contactors can be controlled by the load shed module.

The LSM (120 volt only) supplies the 120 VAC to energize each contactor coil.

The OPCB supplies, depending on configuration, either 120 VAC OR with Optional 24 volt transformer kit supply 24 V to each contactor.(Note you cannot mix 120 volt contactors with 24 volt can only be one or the other on the OPCB system)

Generator overload condition is determined by generator frequency. Loads are shed when the frequency is <58 Hz for 3 seconds or <50 Hz for ½ Second (For 60Hz).

The load shed modules and the OPCB modules have a TEST button which forces the unit to act as if an overload has occurred. This button operates even when the transfer signal is inactive.

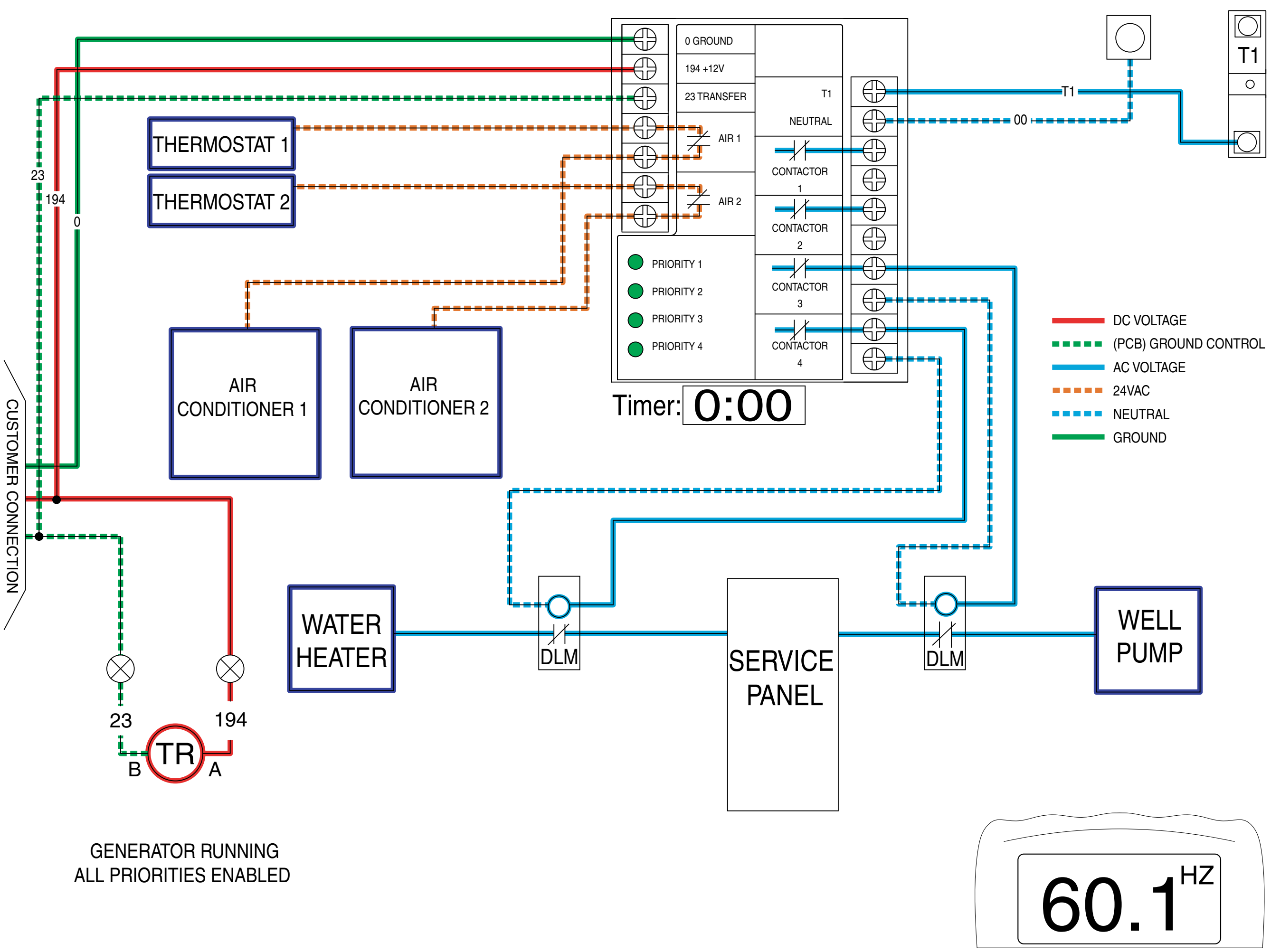


Figure 83.

Figure 84. LSM TEST *Button*

NOTE: The following sequence is for the LSM 120 volt module ONLY.

The 4 green status LEDs will indicate when a load priority level is enabled.

All loads are enabled when the transfer signal is off. (ATS in Utility position).

If the transfer signal is pulled low (Active) all loads are enabled until an overload is detected.

When an overload is detected all loads are disabled.

Generator overload condition is determined by generator frequency. Loads are shed when the frequency is <58 Hz for 3 seconds or <50 Hz for ½ second (For 60Hz).

After 5 minutes priority 1 loads are enabled.

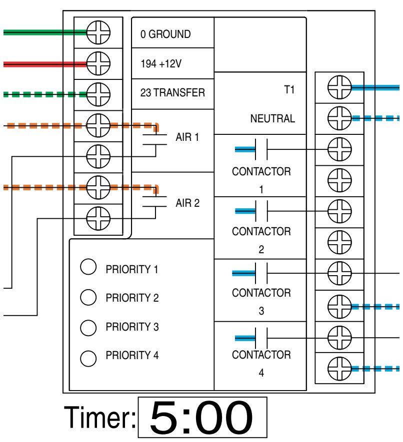
After another 30 seconds Priority 2 load is enabled.

After another 30 seconds Priority 3 load is enabled.

After another 30 seconds Priority 4 load is enabled.

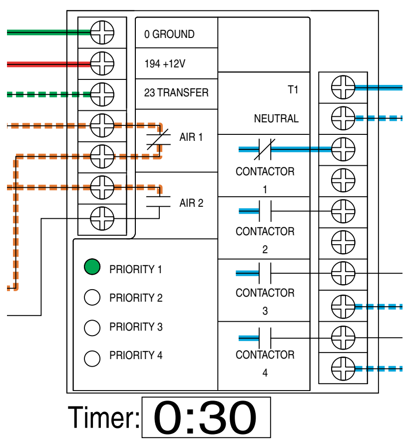
If an overload is detected within 30 seconds of a level being enabled, all loads are disabled again and the sequence repeats. However, the level that caused the overload and all levels higher will not be enabled again for 30 minutes. After 3 attempts to enable the faulting priority this level and all other higher levels will be locked out.

Figures 83 thru 93 follow the sequence of operation when an overload condition occurs on Priority Circuit 3. After a 30 minute timer expires, Priority 3 is activated. If the frequency is still OK then Priority 4 is enabled after another 30 second timer expires.



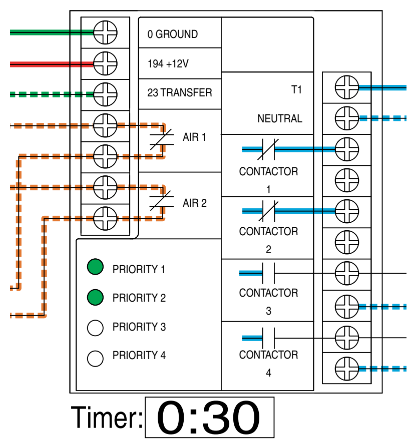
GENERATOR RUNNING
OVERLOAD DETECTED, WAITING 5 MIN

Figure 85.



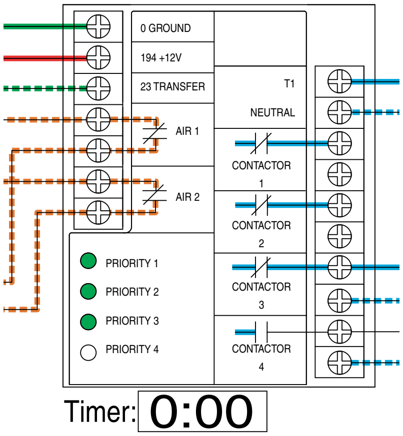
GENERATOR RUNNING
PRIORITY ONE ENABLED, WAITING 30 SEC

Figure 86.



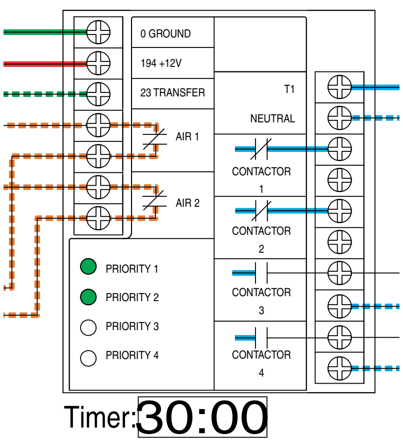
GENERATOR RUNNING
PRIORITY TWO ENABLED, WAITING 30 SEC

Figure 87.



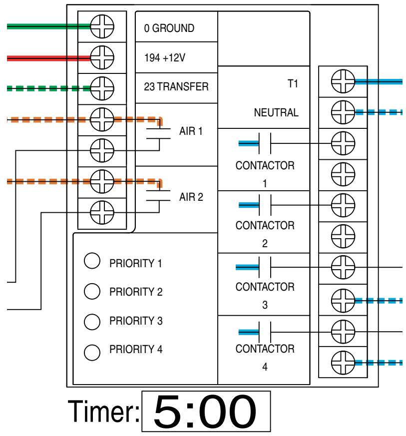
GENERATOR RUNNING
ENABLING PRIORITY THREE, OVERLOAD

Figure 88.



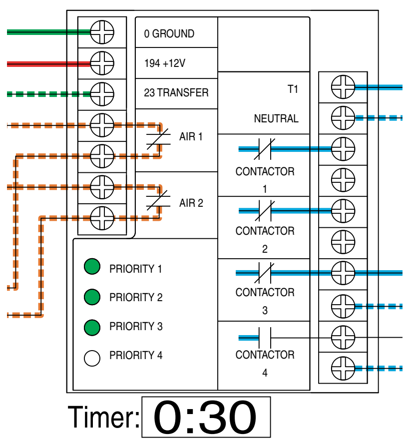
GENERATOR RUNNING
HOLDING AT PRIORITY 2, WAITING 30 MIN

Figure 89.



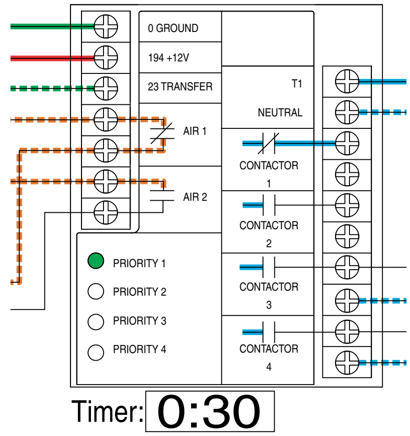
GENERATOR RUNNING
OVERLOAD DETECTED WAITING 5 MIN

Figure 90.



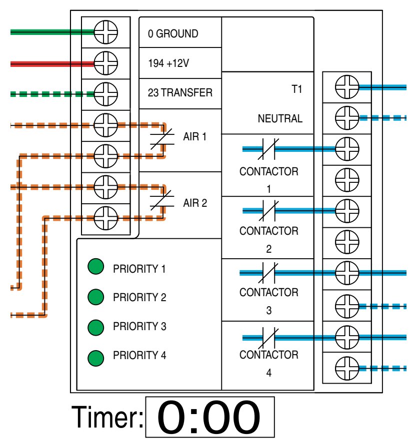
GENERATOR RUNNING
30 MIN EXP, ENABLING PRIORITY THREE

Figure 91.



GENERATOR RUNNING
PRIORITY ONE ENABLED, WAITING 30 SEC

Figure 92.



GENERATOR RUNNING
ALL PRIORITIES RESTORED

Figure 93.

LOAD SHED MODULE OPERATION OPCB 24/120 VOLT MODULE

The Overload Prevention Control Board (OPCB) can control an air conditioner (24 VAC) directly or a separate contactor (24 VAC or 120 VAC operating coil) which can control any load connected to it.

The OPCB can be powered from either a 24 VAC or 120 VAC power supply. The 24 VAC supply is from a Class 2 transformer which can be purchased from the manufacturer.

NOTE: When utilizing the optional 24 VAC configuration, the power supply transformer (Class 2) must have connections to the LOAD and NEUTRAL connection at the OPCB. Remember to limit each output to 1 Amp.

NOTE: Do NOT mix 120 VAC and 24 VAC contactors. The OPCB must be wired with one or the other. You cannot intermix.

Generator overload condition is determined by generator frequency. Loads are shed when the frequency is <58 Hz for 3 seconds or <50 Hz for ½ Second (For 60Hz).

The OPCB load shed module has a TEST button which forces the unit to act as if an overload has occurred. This button operates even when the transfer signal is inactive.

A TEST button is provided on the bottom of the OPCB to test the operation of the tested functions. The TEST button will work when the ATS is in the Utility or the Generator position.

1. Turn on the Utility supply to the ATS.
2. Press the TEST button on the OPCB.
3. Verify that all of the connected loads to be "shed" become disabled. The method of verification will depend on the type of load.
4. After five (5) minutes verify AC 1 and Load 1 are energized Status LED AC 1 and Load 1 is ON.
5. After another 15 seconds, verify AC 2 and Load 2 are energized. Status LED AC 2 and Load 2 are ON.

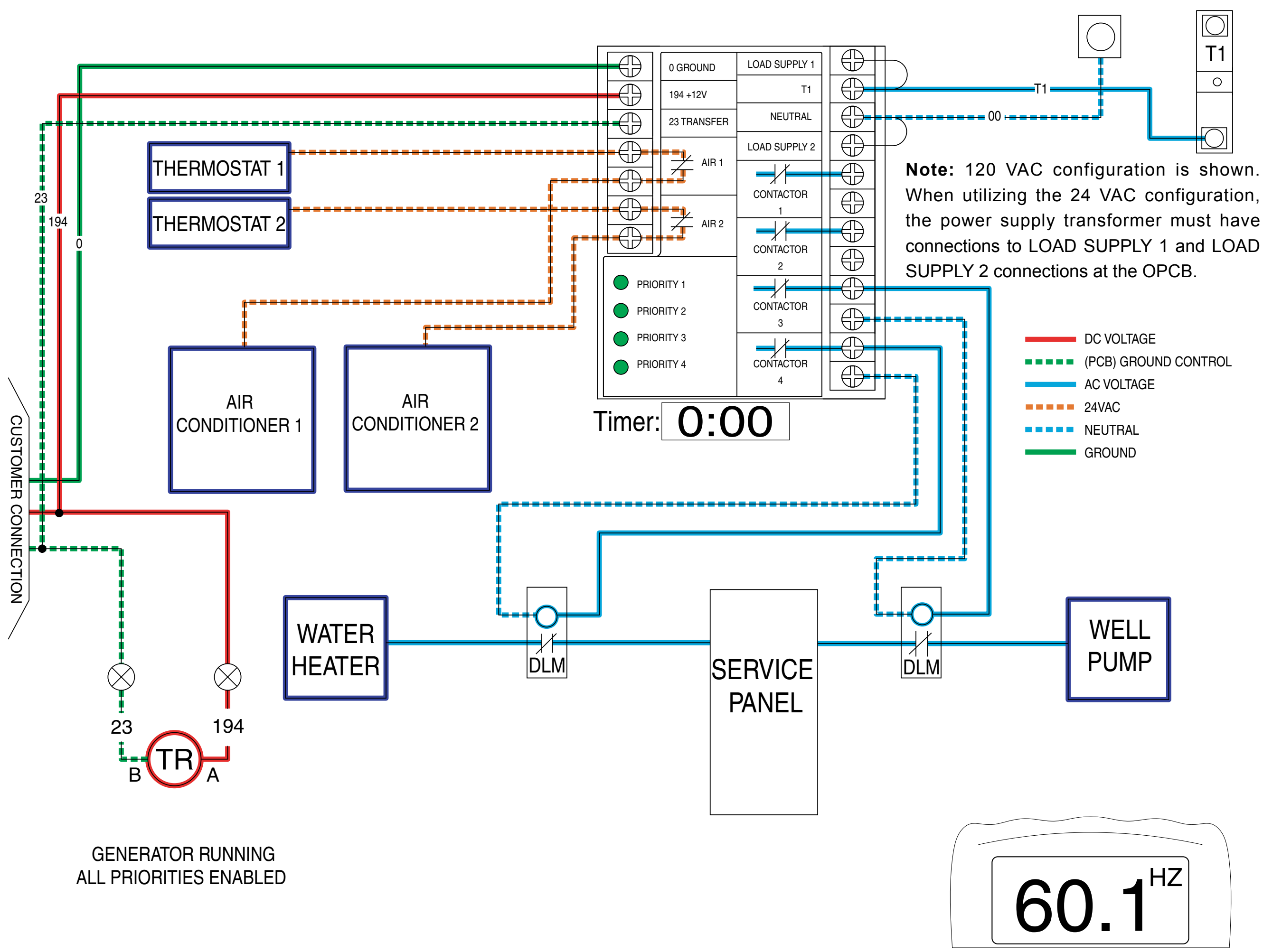


Figure 94.

6. After another 15 seconds, verify Load 3 is energized. Status Load 3 is ON.
7. After another 15 seconds, verify Load 4 is energized. Status Load 4 is ON.

Figure 95. OPCB TEST *Button*

NOTE: The following sequence is for the OPCB 24/120 volt module.

The 4 green status LEDs will indicate when a load priority level is enabled.

All loads are enabled when the transfer signal is off. (ATS in Utility position).

If the transfer signal is pulled low (Active) all loads are enabled until an overload is detected.

When an overload is detected all loads are disabled.

Generator overload condition is determined by generator frequency. Loads are shed when the frequency is <58 Hz for 3 seconds or <50 Hz for ½ second (For 60Hz).

After 5 minutes Priority 1 loads are enabled.

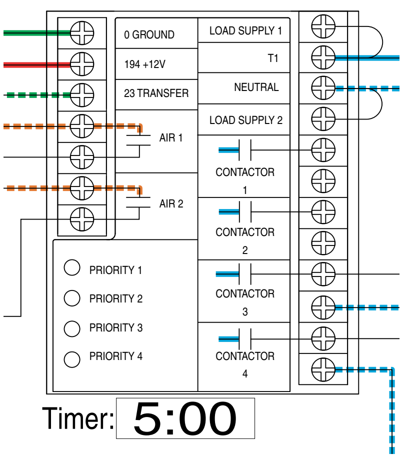
After another 15 seconds Priority 2 load is enabled.

After another 15 seconds Priority 3 load is enabled.

After another 15 seconds Priority 4 load is enabled.

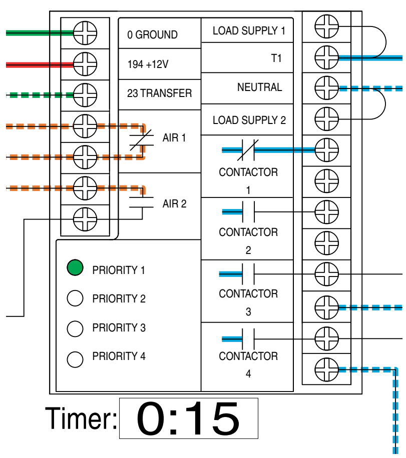
If an overload is detected within 15 seconds of a priority being enabled, that load is then locked out. The sequence will continue until all load levels have been checked (Temporarily bypassing the faulting level). The level that caused the overload will not be enabled/tested again for 30 minutes. After a total of three attempts to enable the faulting priority this load priority will remain locked out.

Figures 94 thru 102 follow the sequence of operation when an overload condition occurs on example Priority Circuit 3. After a 30 minute timer expires, Priority 3 is activated. If the frequency is still OK then all priorities will remain active.



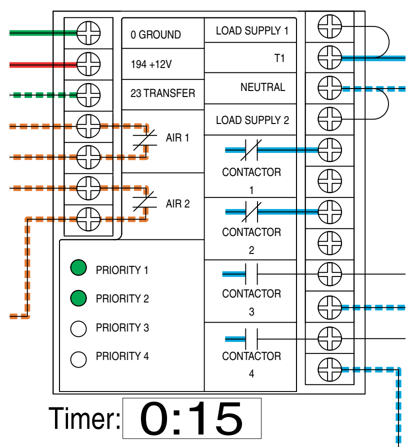
GENERATOR RUNNING
OVERLOAD DETECTED, WAITING 5 MIN

Figure 96.



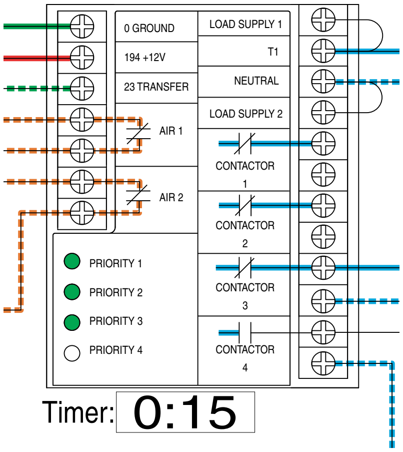
GENERATOR RUNNING
PRIORITY ONE ENABLED, WAITING 15 SEC

Figure 97.



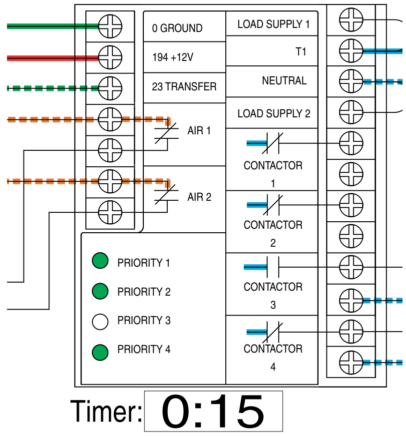
GENERATOR RUNNING
PRIORITY TWO ENABLED, WAITING 15 SEC

Figure 98.



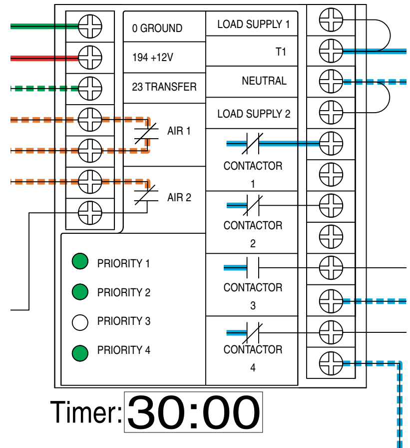
GENERATOR RUNNING
ENABLING PRIORITY THREE, OVERLOAD

Figure 99.



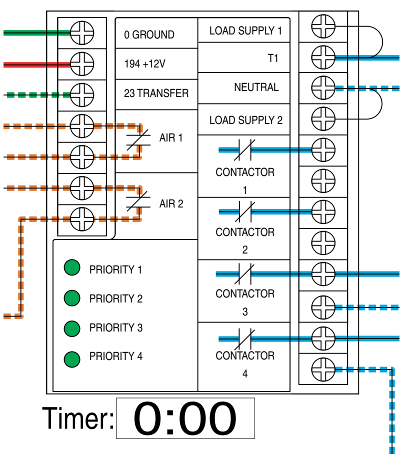
GENERATOR RUNNING
OVERLOAD DETECTED ATTEMPTING PRIORITY 4

Figure 100.



GENERATOR RUNNING
PRIORITY FOUR ENABLED, WAITING 30 MIN

Figure 101.



GENERATOR RUNNING
ALL PRIORITIES RESTORED
AFTER 30 MINUTES

Figure 102.

Note: After all priorities are enabled and the generator frequency is within limits all priorities will remain on. In this example Priority 3 was the faulty circuit. The controller would attempt 2 more times to enable Priority 3. If not successful, the OPCB module would continue to lock out the faulting priority until utility is restored or unit is reset. If the unit is reset during generator operation, the testing sequence would begin again.

POWER SUPPLY CONNECTIONS FOR CONTACTORS

The Overload Prevention Control Board (OPCB) can be powered from either a 24 VAC or 120 VAC power supply. The 24 VAC supply is from a class 2 transformer that can be purchased from the manufacturer. Mounting holes are provided in the enclosure subplate for mounting of the transformer. The 120 VAC supply is fused at 5 amps and is factory connected to OPCB terminals labeled “T1” and “Neutral.”

24 VAC Supply

Transformer connections are made as shown in Figure 106.

- Blue wire - OPCB “LOAD SUPPLY 1” terminal
- Black wire - OPCB “T1” terminal
- White wire - OPCB “NEUTRAL” terminal
- Yellow wire - OPCB “LOAD SUPPLY 2” terminal

120 VAC Supply

Install the following jumpers on the OPCB (Figure 107).

- Load Supply 1 to T1
- Load Supply 2 to Neutral

CONTROL OF A SEPARATE CONTACTOR

A separate contactor relay module can be purchased from the manufacturer. If a different relay is used it must have a 120 VAC coil voltage. The LSM supplies fused (5A) 120 VAC to energize the coils of the relay contactors (contactor 1, 2, 3 or 4).

1. Mount the contactor module and connect the load to the main contacts.
2. Connect the contactor coil to the desired LSM (Contactor 1, 2, 3 or 4) terminals on the terminal strip.
3. Connect additional load shedding contactors in a similar fashion.

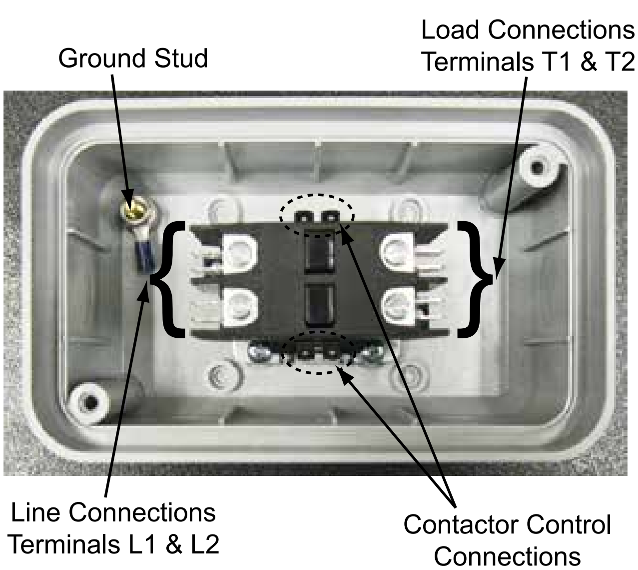


Figure 103.

POWER MANAGEMENT MODULE

The PMM is for use with the Overload Prevention Control Board (OPCB).

The Power Management Module (PMM) 24 VAC contactor is NOT supplied with the transfer switch. It can be purchased separately from the manufacturer.

The OPCB is mounted in the transfer switch. The OPCB provides 24 VAC to the PMM contactor operating coil. These PMM contactor coil connections are made at the OPCB terminal strip.

Figure 104. Power Management Module

Figure 105. PMM Starter Kit

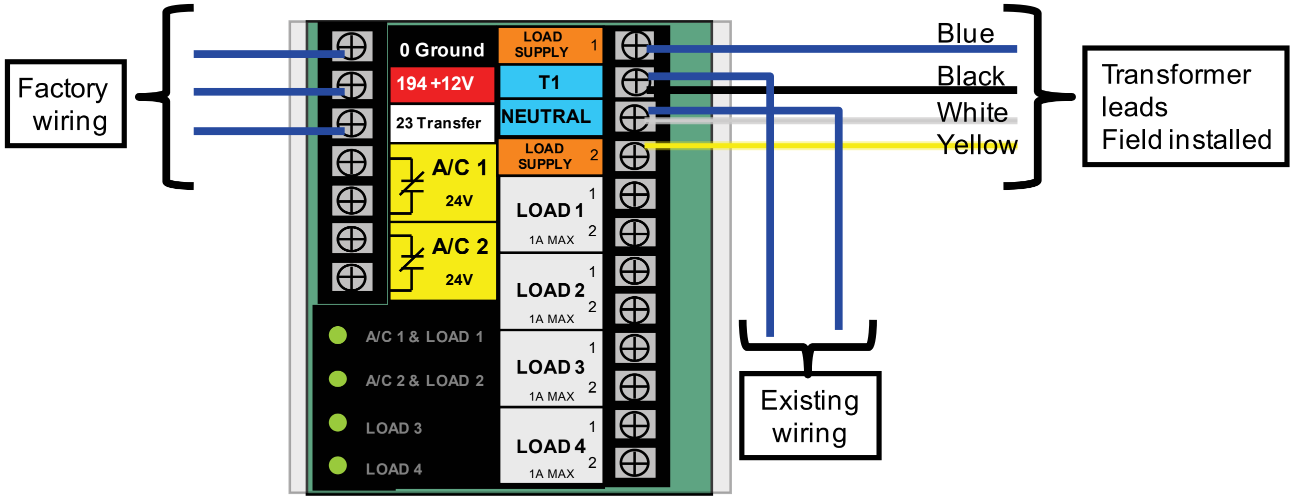


Figure 106. 24 VAC Supply Connections

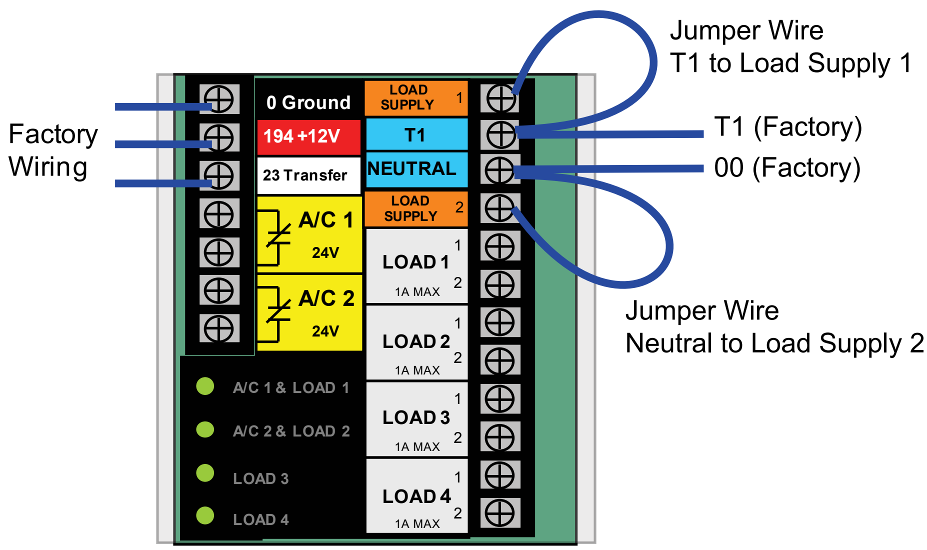


Figure 107. 120 VAC Supply Connections

SMART MANAGEMENT MODULE (SMM)

Description

The Smart Power Management System is designed to optimize the performance of a standby generator. The system can consist of up to 8 individual Smart Management Modules (SMM). Unlike other load management systems that depend on another control device, the SMM modules are actually self-aware and operate autonomously.

Frequency is the true measure of generator engine performance and does not need to factor in increased ambient temperatures, elevation changes or generator fuel type. The modules monitor the frequency (Hz) of the power being produced by a standby generator and if it falls below a certain threshold, the module will automatically follow a power management algorithm to ensure that the generator is not overloaded.

The modules can be set to a load priority between 1 and 8 or be set in a lock out only mode for loads that do not need to run during a power outage, which reduces the necessary size of the generator for a more cost effective solution.

UNDERSTANDING THE SMART MANAGEMENT MODULE

Priority Dial (A) – Sets module priority.

NOTE: PRIORITY MUST BE DIFFERENT for each module in an installation. Priority sets the order in which loads recover from a load shed event. Recovery time from a load shed event is five minutes for Priority 1. Each priority after Priority 1 waits an additional 15 seconds after the initial recovery time. See Table 1.

Lockout Switch (B) – Prevents load from operating when system is operating under generator power. See Table 2.

NOTE: Recovery time is based on priority dial settings. See Table 1.

Test Button (C) – Disables contactor output for a specified time.

LED (D) – Provides module status. See Table 3.

Contactor (E) – Controlled by a smart controller in module. Contactor remains CLOSED until generator power is required. Upon generator activation, controller moves to OPEN to handle overload conditions.

NOTE: When the system is on generator power, the contactor is also opened during lockout switch ACTIVE state.

Mounting Holes (F) – Internal enclosure mounting holes provide clean and sturdy mounting.

Priority Decal (G) – Provided for recording priority of each module in installation. This decal should be installed on the electrical panel.

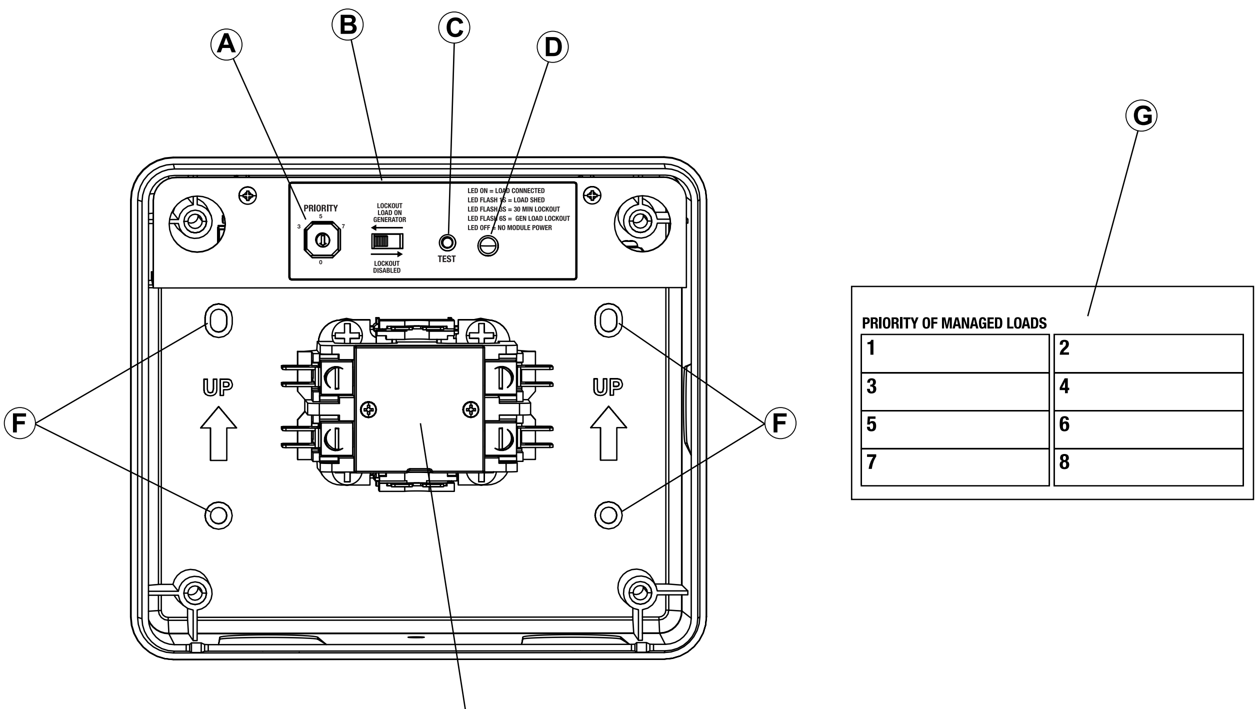


Figure 108. Smart Management Module Features

Table 16. Priority Dial Settings

Priority	Recovery Time
1	5 minutes
2	5 minutes 15 seconds
3	5 minutes 30 seconds
4	5 minutes 45 seconds
5	6 minutes
6	6 minutes 15 seconds
7	6 minutes 30 seconds
8	6 minutes 45 seconds
9	Not Used
0	Not Used

Table 17. Lockout Switch Settings

Lockout Switch Position	Mode	Function
ON	GENERATOR	Power is NOT available on module output (contactor output). Contactor is OPEN.
ON	UTILITY	Power is available on module output (contactor output). Contactor is CLOSED.
OFF	GENERATOR	Module operates with standard load shed logic. Contactor is OPEN or CLOSED per logic.
OFF	UTILITY	Power is available on module output (contactor output). Contactor is CLOSED.

Table 18. LED States

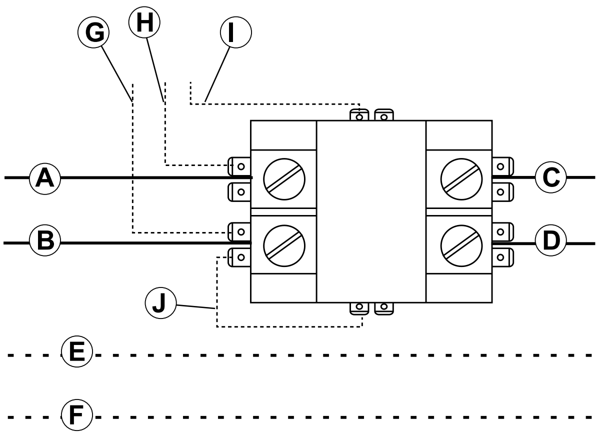
State	Led State	Mode	Note
Shed	1 second flash (1 On – 1 Off)	Generator	Module detected an overload and shed its load. This state only occurs in generator mode, or during a first time utility power up for five minutes of initial operation.
Lockout (30 minutes)	3 second flash (3 On – 3 Off)	Generator	Module detected an overload while trying to recover from a shed situation. It identified the offending load and disabled operation for 30 minutes to allow other loads to operate. This state only occurs in generator mode.
Lockout Switch Active	6 second flash (6 On – 6 Off)	Generator	Module output is disabled and there is no power to the appliance while in generator mode. Lockout switch must be ON. See Table 2.
Lockout Switch Active	ON	Utility	Lockout Switch operates in generator mode only. It has no function in utility mode. LED is solid, indicating contactor is CLOSED and load is connected. Lockout switch must be ON. See Table 2.
Normal	ON	Generator or Utility	Indicates contactor is CLOSED and appliance has power. This is the default in utility mode. It is the normal operating state in generator mode when an overload is not detected.
Test	1 second flash	Generator or Utility	Test button triggers a typical shed condition and overrides all other states except generator lockout switch ACTIVE state.

Table 19. Electrical Specifications

Input Voltage	240 VAC
Current Rating	50A resistive, 40A inductive
Locked Rotor Amp Rating	240A
Motor Rating	3HP
Contactor Coil Voltage	240 VAC

Table 20. Enclosure Specifications n

Input Voltage	240 VAC
Current Rating	50A resistive, 40A inductive



Legend	
A	Red (240 VAC - Line)
B	Black (240 VAC - Line)
C	Red (240 VAC - Load)
D	Black (240 VAC - Load)
E	White - Neutral (as required)
F	Green - Ground (as required)
G	Black - Factory (PCB)
H	Red - Factory (PCB)
I	Blue - Factory (PCB)
J	Blue - Factory (Jumper)

Figure 109. Smart Management Module Connections

SETTING PRIORITIES

High priority 240 VAC loads should be set to the highest priorities so those loads recover first, in the event of generator overload.

NOTE: The highest priority and first load to activate is Priority 1. The last load to activate is Priority 8.

Setting priority determines timing for 3 scenarios:

- Order in which loads recover
- Delay time until power returns during an outage
- Delay time for post load shed recovery

An example configuration is shown below. Configurations will vary depending on customer prioritization of loads:

Priority 1 - Baseboard heat

Priority 2 - Air conditioner

Priority 3 - Range

Priority 4 - Dryer

Priority 5 - Non-essential circuits

Priority 6 - Pool pump or hot tub

Priority 7 - Other circuits

Priority 8 - Other circuits

1. Set the priority of each SMM module as desired (using the example configuration for reference).
2. Apply priority decal in a suitable location on electrical panel to record chosen priority designations.
3. Record priorities on decal.

Most installations will require the lockout switch will be DISABLED. When performing a whole house backup with a generator not sized to manage all household loads, SMM's can be used to disable appliances or circuits during an outage. For non-essential loads that will not be used on generator power, set lockout switch to ENABLED.

TESTS

Utility Test

1. Turn utility power ON and enable all module feeding circuits.
2. Verify LED begins to flash at one second intervals.
3. All contactors will close after five minutes. LED will illuminate, and stay ON.
4. Wait 30 seconds after contactor closes, then press TEST button and verify module load shed. LED will flash at one second intervals.
5. Wait five minutes, plus predefined priority set time for module to recover.
6. Contactor will CLOSE and LED will illuminate, and stay ON.

Generator Test

1. Simulate a utility loss by turning main line circuit breaker (MLCB - service disconnect) to OFF while generator is in AUTO.
2. All modules will lose power and LEDs will disable.
3. Generator will power on after preset delay.
4. All LEDs will flash when generator transfers.
5. Allow each module to enable output per its priority setting.
6. After predefined priority time elapses, each contactor will CLOSE and LED will illuminate and stay ON.
7. Once LED stays ON, press TEST button and verify load shed occurs.
8. Once load shed occurs, LED will flash at one second intervals.
9. Allow time for each module to enable contactor output per priority setting.
10. After predefined priority set time, each contactor will CLOSE and LED will illuminate and stay ON.

NOTE: Depending on load size, the SMM module may immediately go into load shed mode or lockout during test. In this event, remove one or more higher priority loads to allow testing of each module.

Generator Test with Lockout Switch Enabled (perform if Lockout Switch Enabled on any loads)

1. Simulate a utility loss by turning MLCB (service disconnect) to OFF while generator is in AUTO.
2. All modules will lose power and LEDs will disable.
3. Generator should power on after preset delay.

NOTE: For modules with lockout switch enabled, LEDs will flash at six second intervals and load will remain disabled while in generator power.

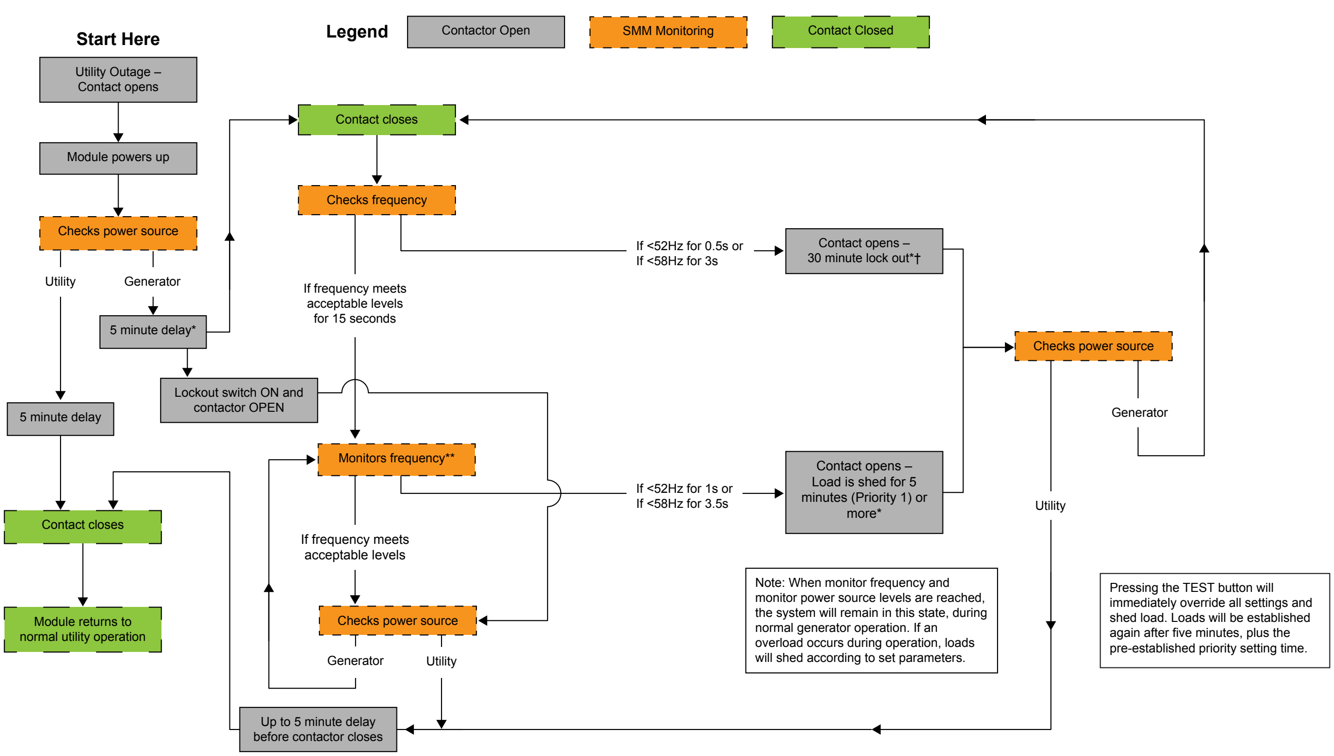
Return to Utility Test

1. Return utility power by setting the MLCB (service disconnect) to ON.
   a. All modules should begin flashing at one second intervals.
   b. All modules will recover in five minutes (including units with lockout switch enabled).

TROUBLESHOOTING

See troubleshooting flowcharts.

SMM Functionality Flow Chart



* Each priority setting above Priority 1 will increase delay time in 15 second increments, starting with 15 seconds at Priority 2.
** If the frequency drops below acceptable levels for the pre-determined durations, all modules will shed.
† During lock out, the module will continuously monitor power source. If utility returns before the 30 minute lock out is satisfied, the module will allow five minutes to elapse from utility return time, and then close the contact.

Note 1: If the frequency is under 58 Hz when a module attempts to close the contactor after a shed, the module will wait another 5minutes plus Priority delay before attempting to enable.
Note 2: The "Checks power source" block monitors frequency and will change state, Generator or Utility, after it detects 1 minute of stable operation in the new state.

000105b

UTILITY SOURCE VOLTAGE AVAILABLE

Figure 110 is a schematic representation of the transfer switch with Utility source power available. The circuit condition is briefly described as follows:

- Utility source voltage is available to terminal lugs N1 and N2 of the CONTACTOR; the transfer switch is in the "Utility" position and Utility voltage is available to T1 and T2, customer load.
- Utility source voltage is available to the limit switch (SW2) via the normally closed transfer relay contacts (1 and 7) and Wire 126; however, SW2 is open and the circuit to the utility closing coil is open.
- Utility voltage "sensing" signals are delivered to controller on the Generator, via Wire N1A, and a 5 amp fuse (F1). The second line of the Utility voltage "sensing" circuit is via Wire N2A, and a 5 amp fuse (F2).

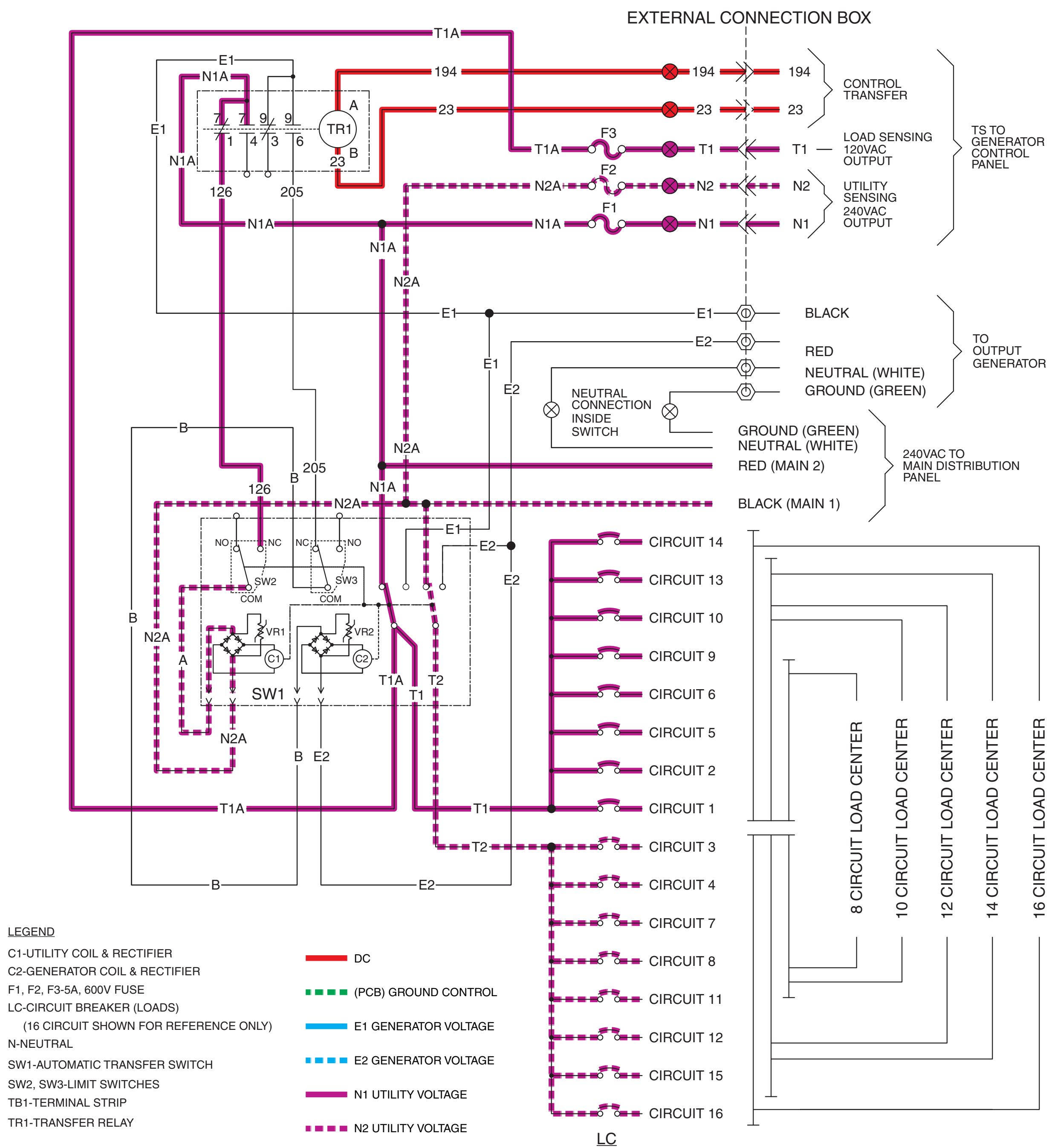


Figure 110. Utility Source Voltage Available

UTILITY SOURCE VOLTAGE FAILURE

If Utility source voltage should drop below 65% of nominal voltage for ten seconds, the controller will initiate engine start. After the generator starts a five second engine warm-up timer is initiated. During this warm-up the generator is running at rated frequency and voltage. Figure 111 is a schematic representation of the transfer switch with the Generator running with voltage available to the transfer switch.

Generator voltage is available on CONTACTOR terminals E1 and E2.

- The controller's logic is holding Wire 23 open from ground.
- Generator voltage from terminal E2 is available at the standby coil (C2); generator voltage from Terminal E1 is available to the transfer relay at Pin 9. The transfer relay is not energized so E1 voltage will not go through the N.O. contact (9 & 6) to Wire 205.

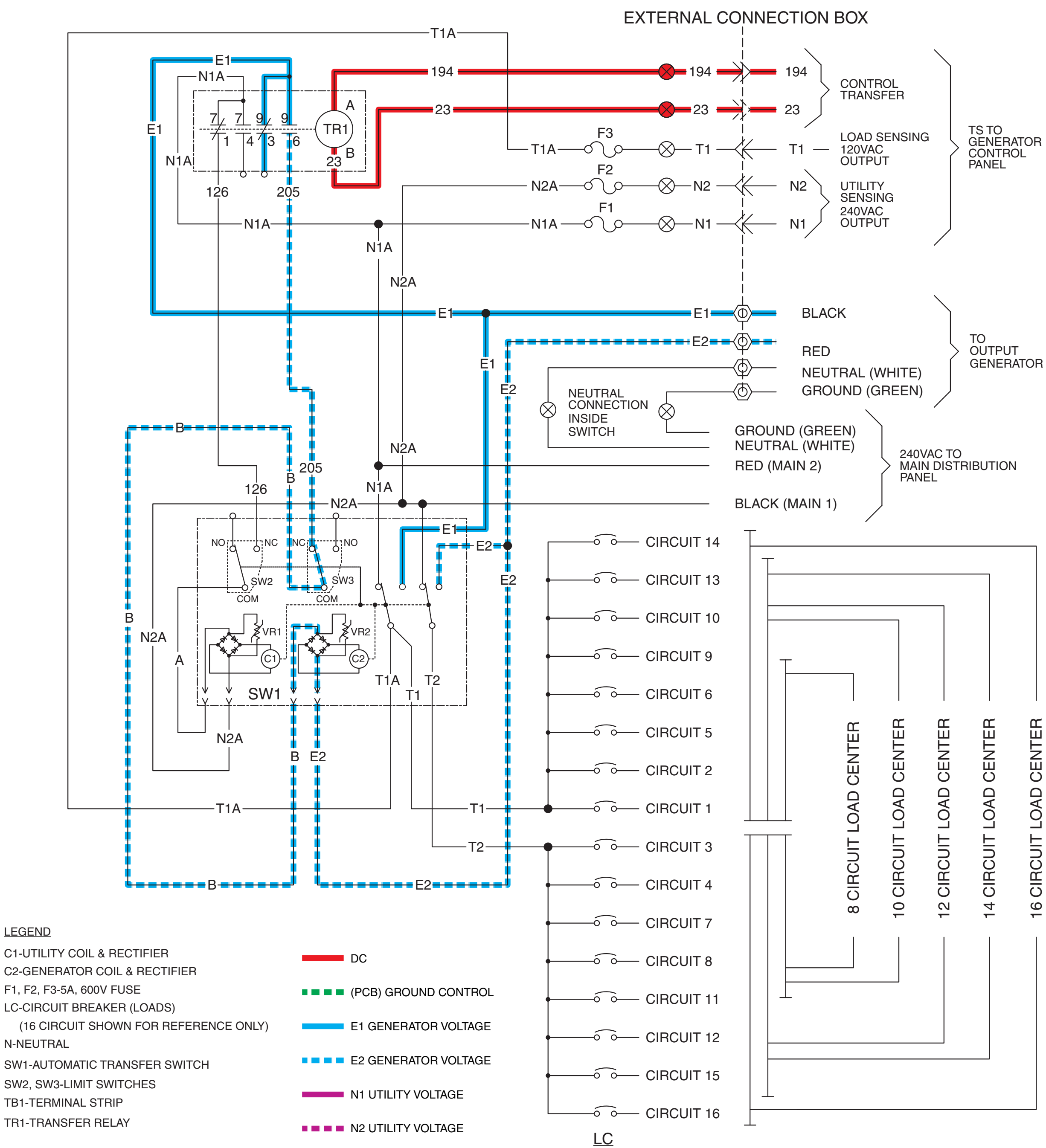


Figure 111. Utility Source Voltage Failure

TRANSFERRING TO STANDBY

12 VDC is delivered to the transfer relay through Wire 194 and back to the controller through Wire 23. When the five second engine warm-up timer expires, the controller will take Wire 23 to ground which will energize the Transfer Relay. The N.O. and N.C. relay contacts will change states. This will connect generator voltage from E1 at Pin 9 to Wire 205; the voltage will go through the N.C contact of SW3. Voltage from both E1 and E2 will be available at the C2 coil; this voltage will pass through the rectifier in the coil; the coil will then energize.

Generator voltage is now delivered to the standby closing coil (C2), via Wire E1 and E2, the now closed TR1 contacts, Wire 205, the limit switch (SW3), Wire B, and a bridge rectifier. The standby closing coil energizes and the main current carrying contacts of the transfer switch are actuated to the “Standby” position.

- As the main contacts move toward the “Standby” position, limit switch SW2 closes (Utility Coil). When the contacts are in the "Standby" position, a mechanical interlock actuates SW3 to its open position. When SW3 opens the C2 coil de-energizes.
- Generator voltage is now available to the LOAD terminals (T1 and T2) of the transfer switch and 120 VAC is also supplied to the controller on Wire T1 for the battery charger. (220 VAC on T1 and T2 50 Hz only

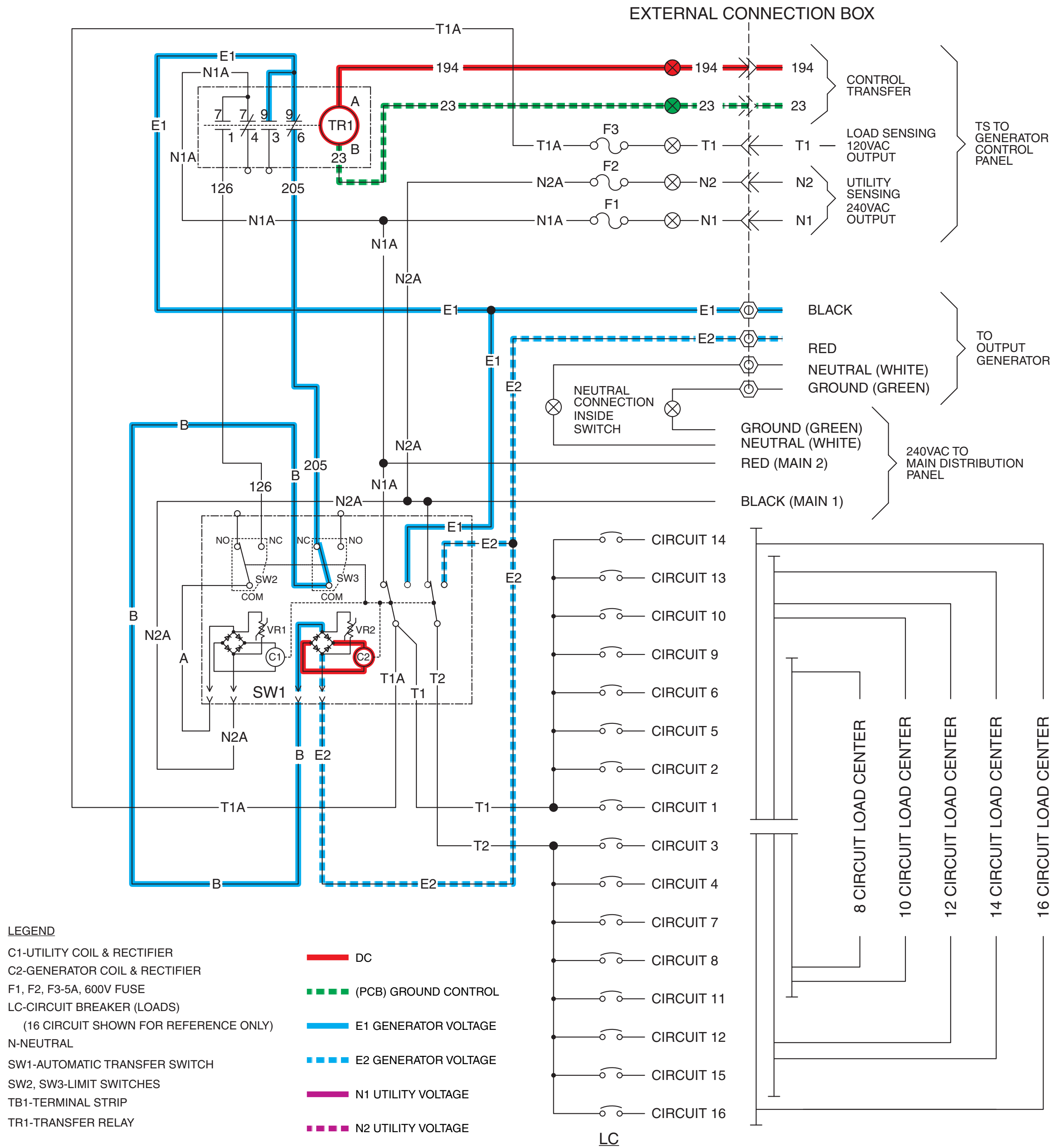


Figure 112. Transferring to Standby

TRANSFERRED TO STANDBY

When the standby coil (C2) energizes it pulls the CONTACTOR to an “over center” position towards the “Standby” position, the transfer switch mechanically snaps to that position. Upon closure of the main contacts to the “Standby” position limit switches SW2 and SW3 mechanically actuate to “arm” the circuit for re-transfer to “Utility” position. When SW3 changes it opens the circuit providing voltage to the Standby closing coil (C2). Voltage from the Generator, connected through T1 and T2, provide power to customer connected loads.

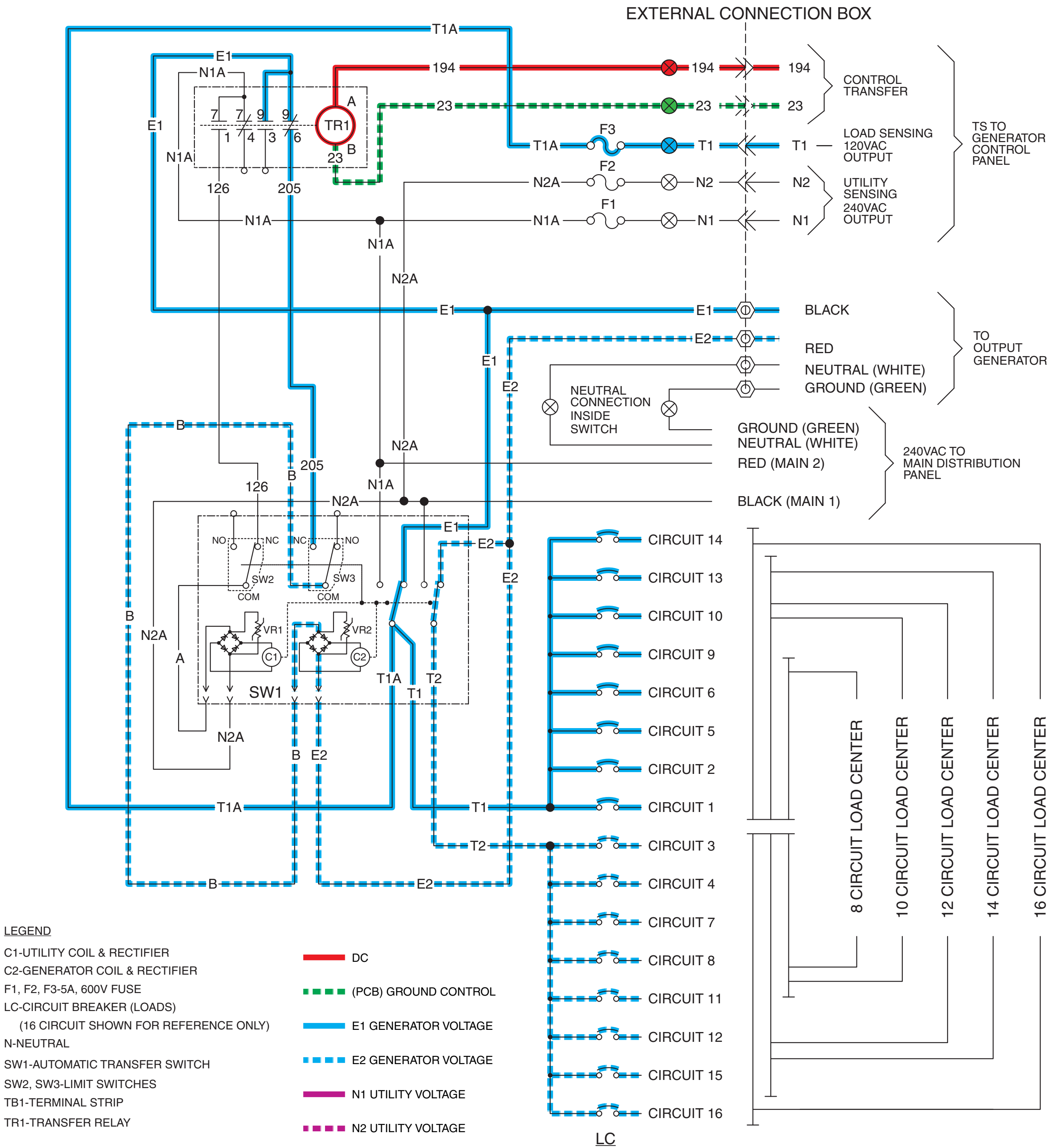


Figure 113. Transferred to Standby

UTILITY RESTORED

Utility voltage is restored and available to terminals N1 and N2. The Utility voltage is "sensed" by the controller and, if it is above 75% of nominal for 15 consecutive seconds, a transfer back to Utility will occur.

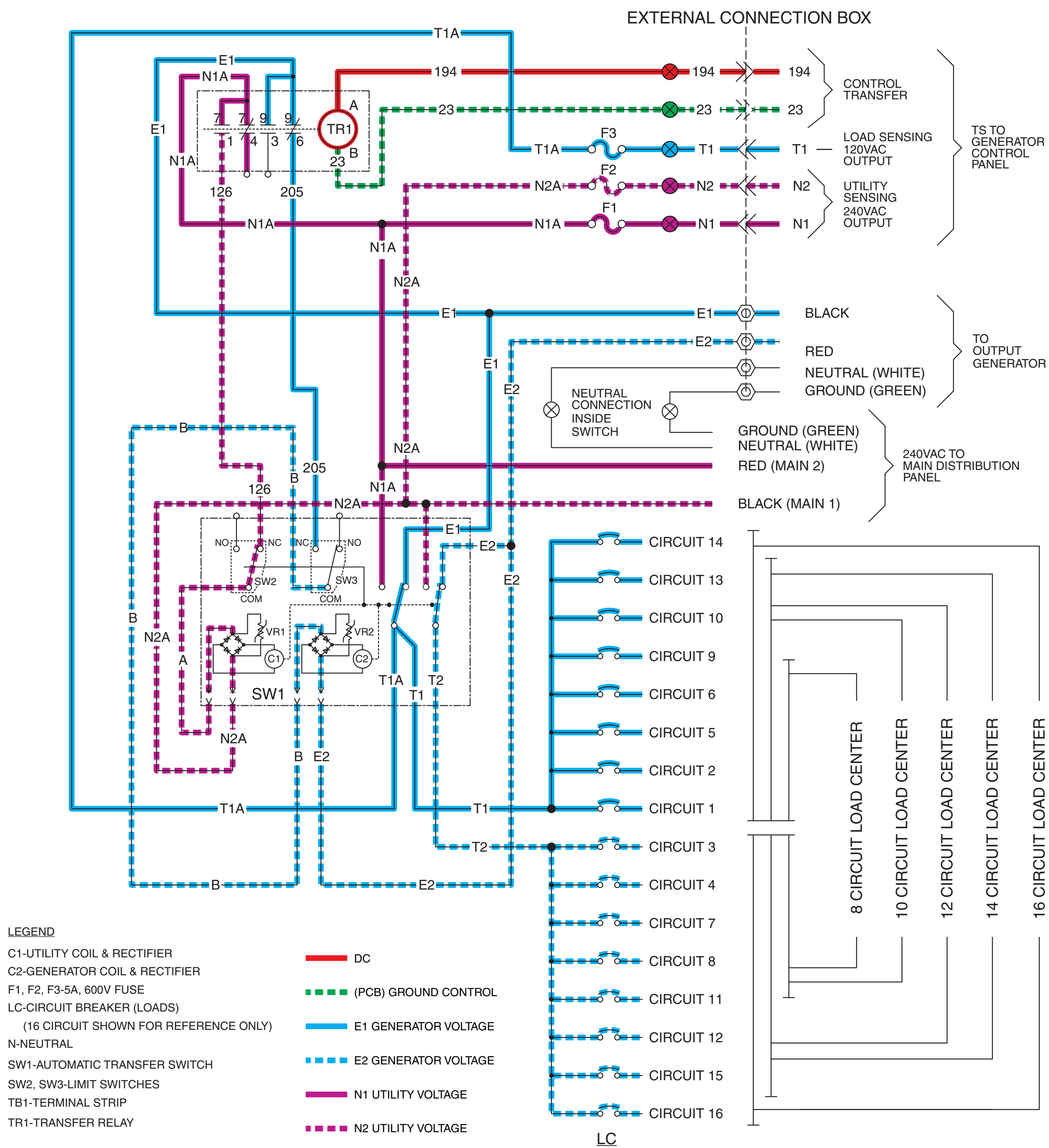


Figure 114. Utility Restored

UTILITY RESTORED, TRANSFERRING BACK TO UTILITY

After the 15 second return to utility delay expires, the controller will open the Wire 23 circuit from ground. The transfer relay (TR1) de-energizes, the N.O. and N.C. contacts change state. Utility voltage is delivered to the utility closing coil (C1) through Wires N1A and N2A, the normally closed contacts (1 and 7) , Wire 126, and limit switch (SW2) . With utility voltage applied to both sides of the utility closing coil (C1), the rectifier in the coil causes the coil to energize.

When the TR1 relay de-energizes its utility side contacts close. Utility voltage is then delivered to the utility closing coil (C1), via Wire N1A and N2A, the closed TR1 contacts, Wire 126, limit switch (SW2), and a bridge rectifier.

- The C1 coil energizes and moves the main contacts to their “Utility” Position; the LOAD terminals are now powered by Utility.
- Movement of the main contacts to the “Utility” position actuates the limit switches. SW2 opens and SW3 moves to the Standby source side.

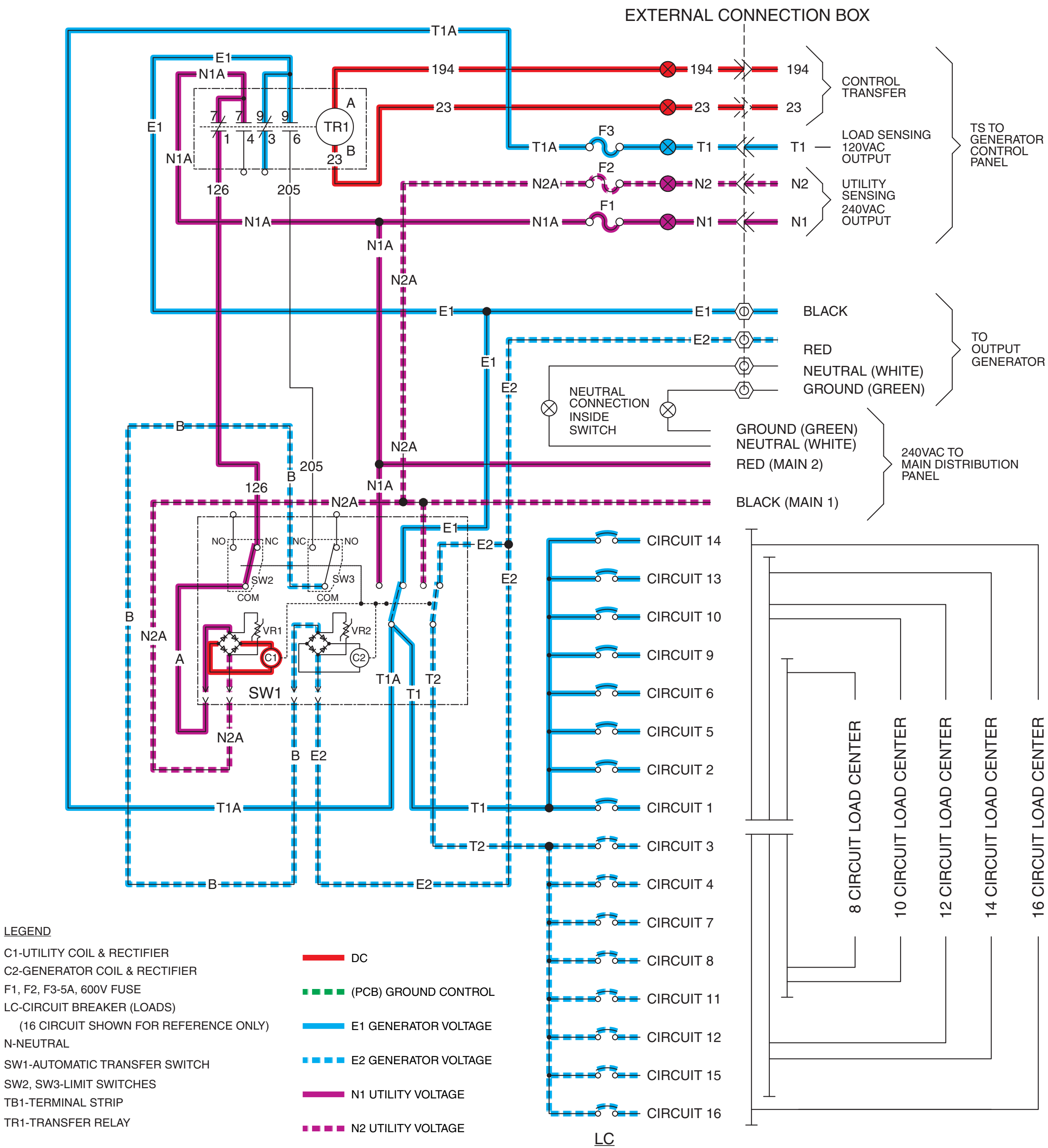


Figure 115. Utility Restored, Transferring back to Utility

UTILITY RESTORED, TRANSFERRED BACK TO UTILITY

As the utility closing coil pulls the transfer switch to an "over center" position, the switch mechanically snaps to the "Utility" position. Upon closure of the contacts to Utility, the limit switches (SW2 and SW3) mechanically actuate to "arm" the circuit for the next transfer to Standby. When switch SW2 changes states, the circuit providing voltage to the utility transfer coil is opened, and the coil de-energizes.

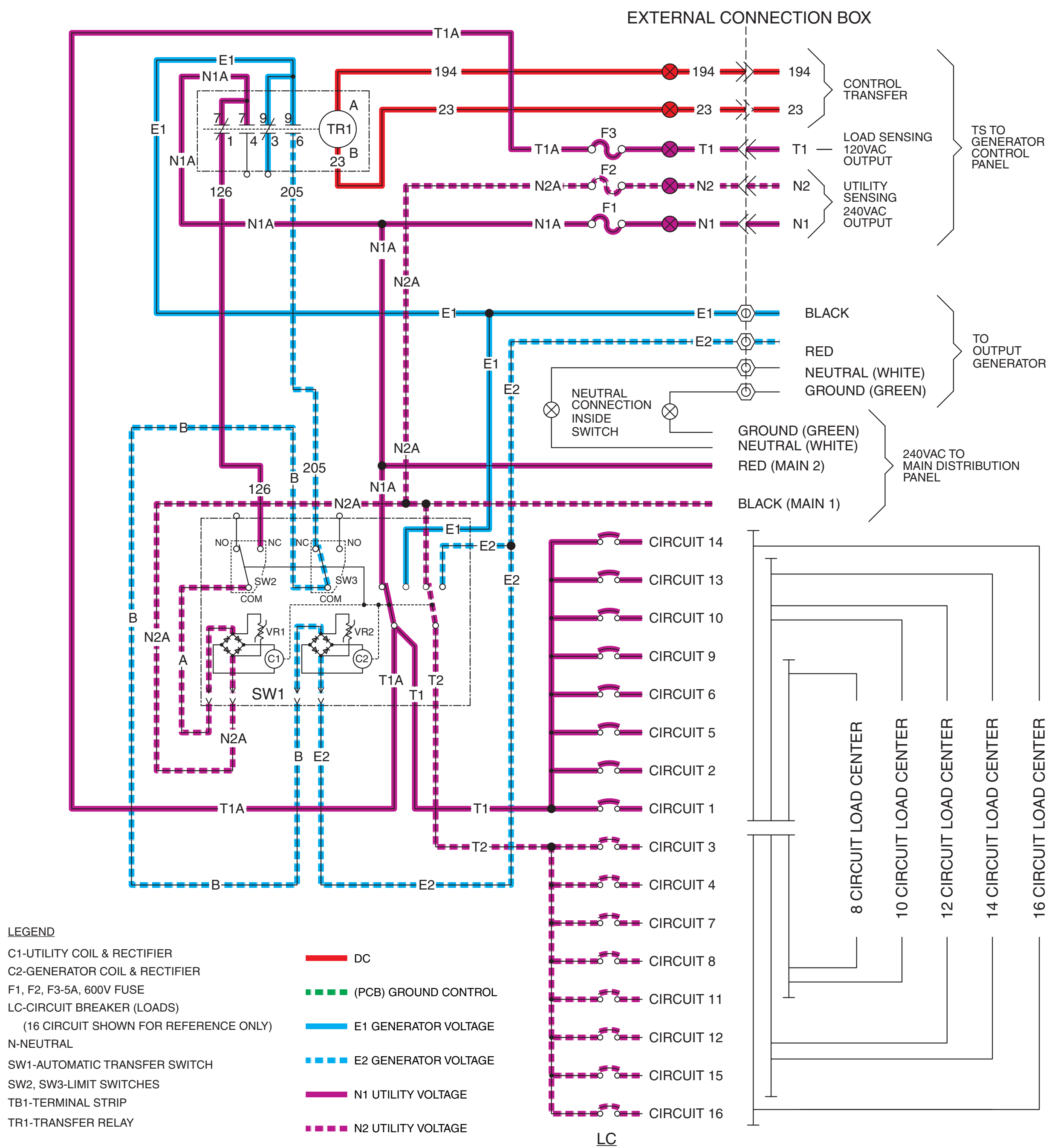


Figure 116. Utility Restored, Transferred back to Utility

TRANSFERRED BACK TO UTILITY, GENERATOR SHUTDOWN

When the transfer switch returns to the "Utility" position the controller will shut the generator down after the one minute engine cool-down timer expires.

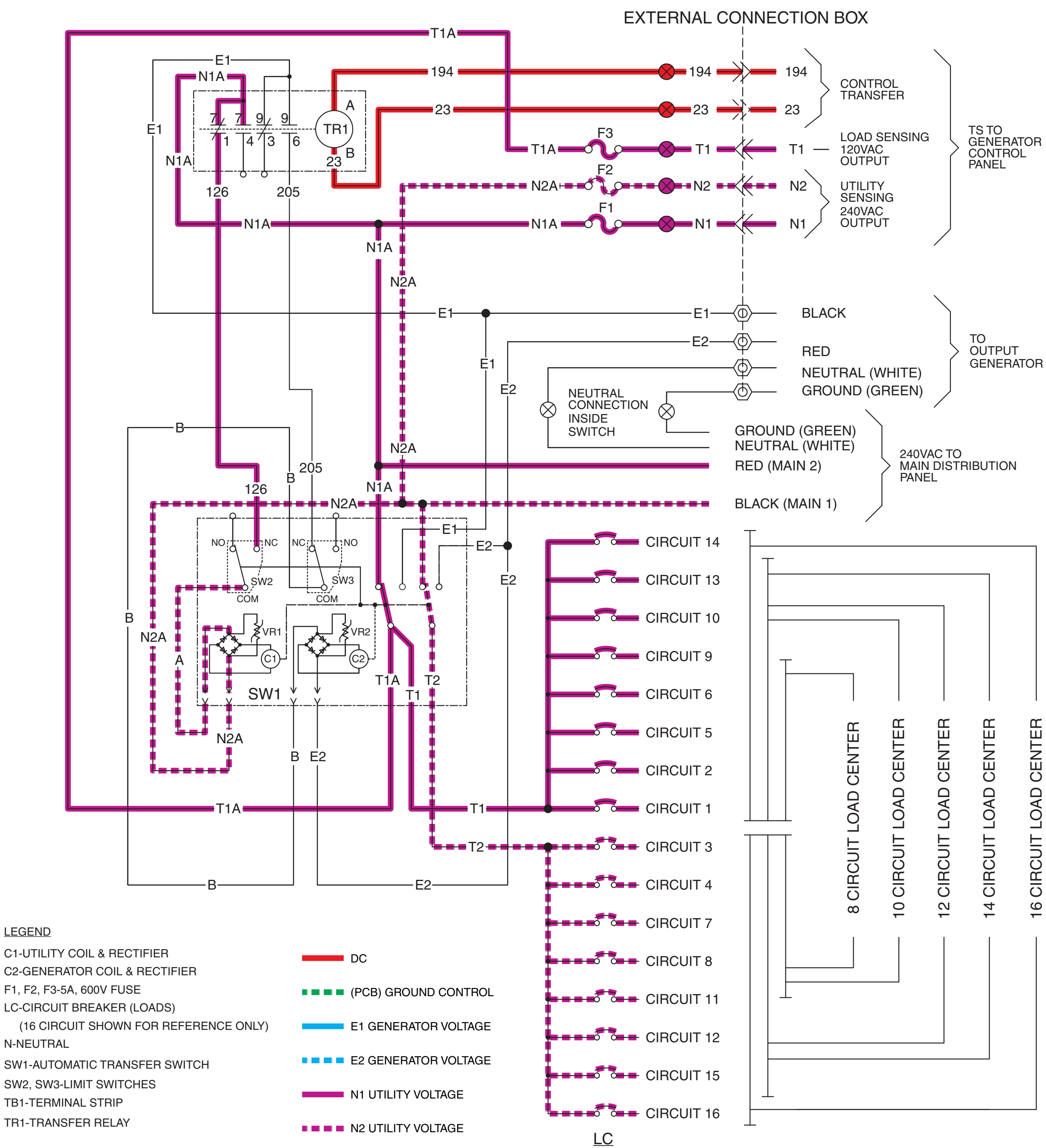
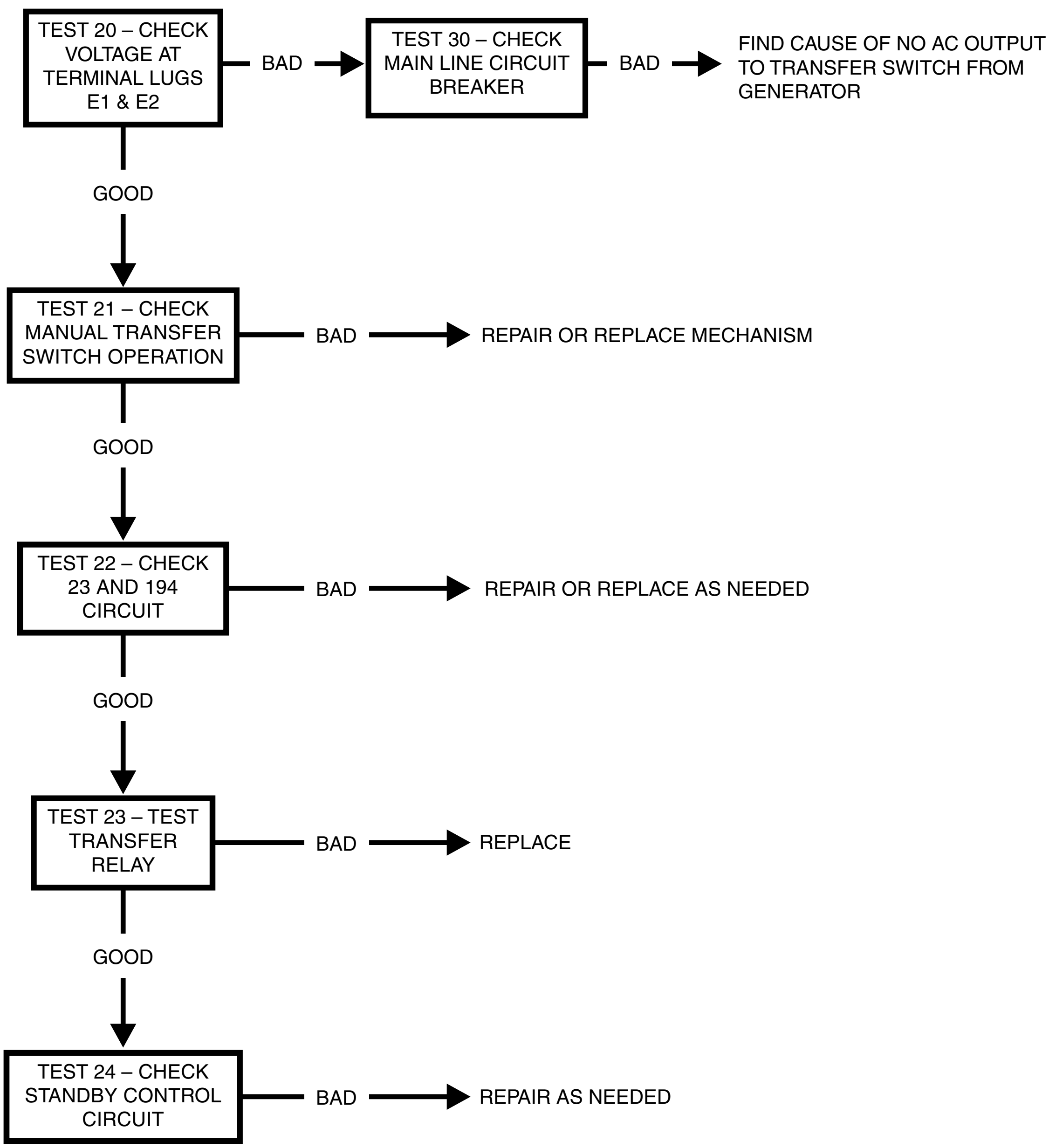


Figure 117. Transferred back to Utility, Generator Shutdown

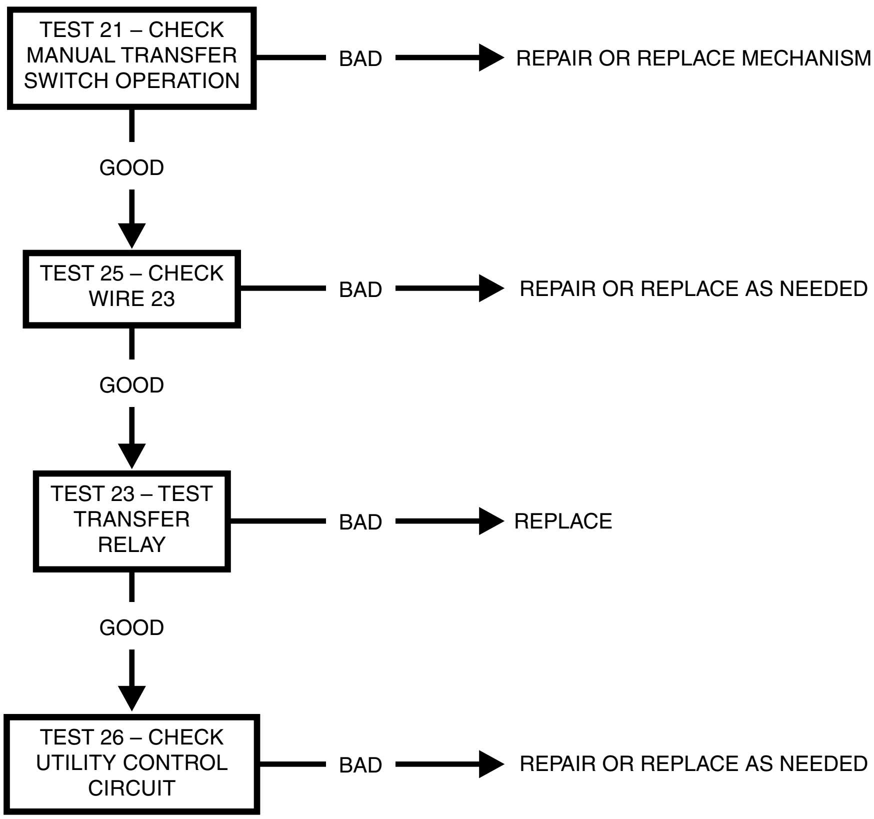
INTRODUCTION

Use the “Flow Charts” in conjunction with the detailed instructions in Section 3.4. Test numbers used in the flow charts correspond to the numbered tests in Section 3.4. The first step in using the flow charts is to identify the correct problem on the following pages. For best results, perform all tests in the exact sequence shown in the flow charts.

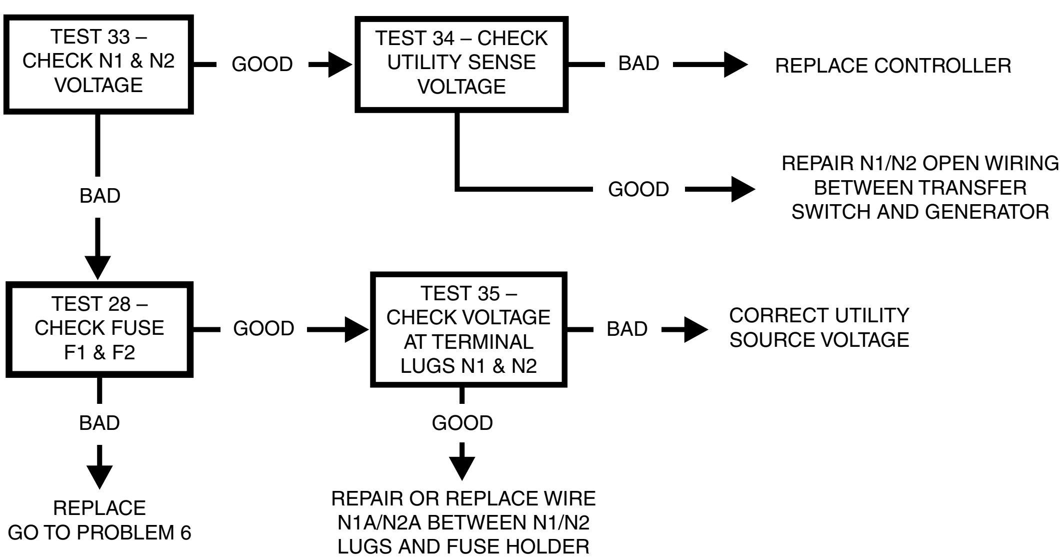
Problem 6 — With Controller in Automatic Mode and Utility Failed, Generator Runs but Transfer to Standby Does Not Occur



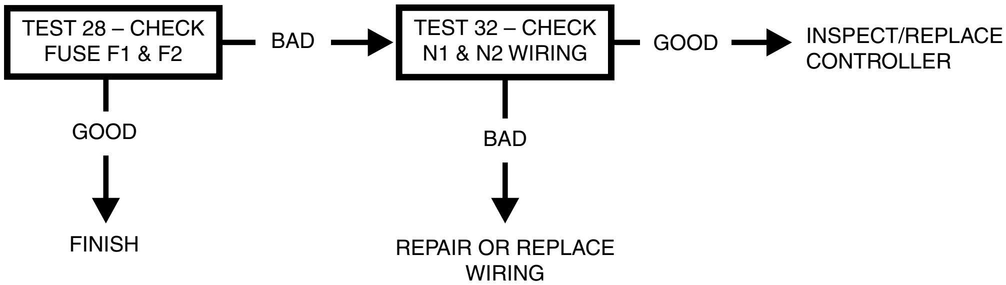
Problem 7 – In Automatic Mode, Generator Starts When Loss of Utility Occurs, Generator Shuts Down When Utility Returns But There is No Retransfer to Utility Power
Or
Generator Transfers to Standby During Exercise or in Manual Mode



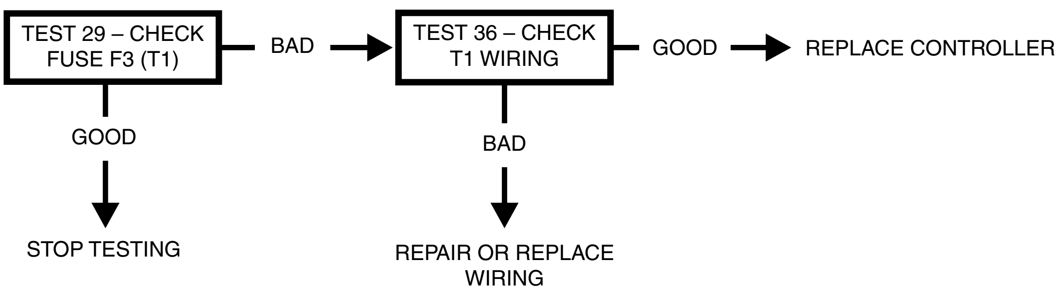
Problem 8 – Unit Starts and May or May Not Transfer When Utility Power is On



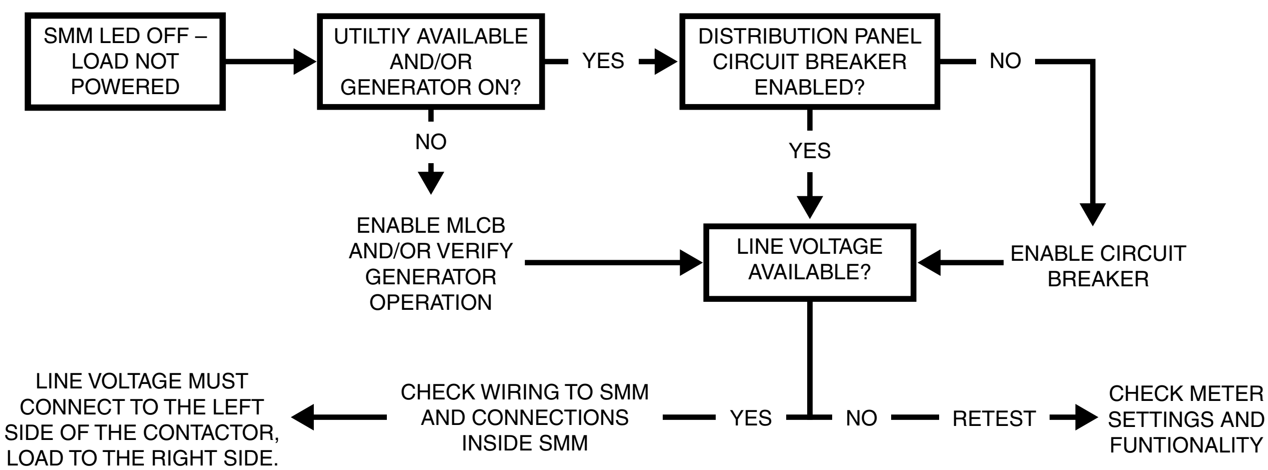
Problem 9 – Blown F1 or F2 Fuse



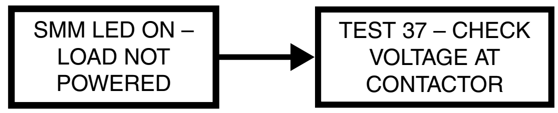
Problem 10 – Blown T1 Fuse



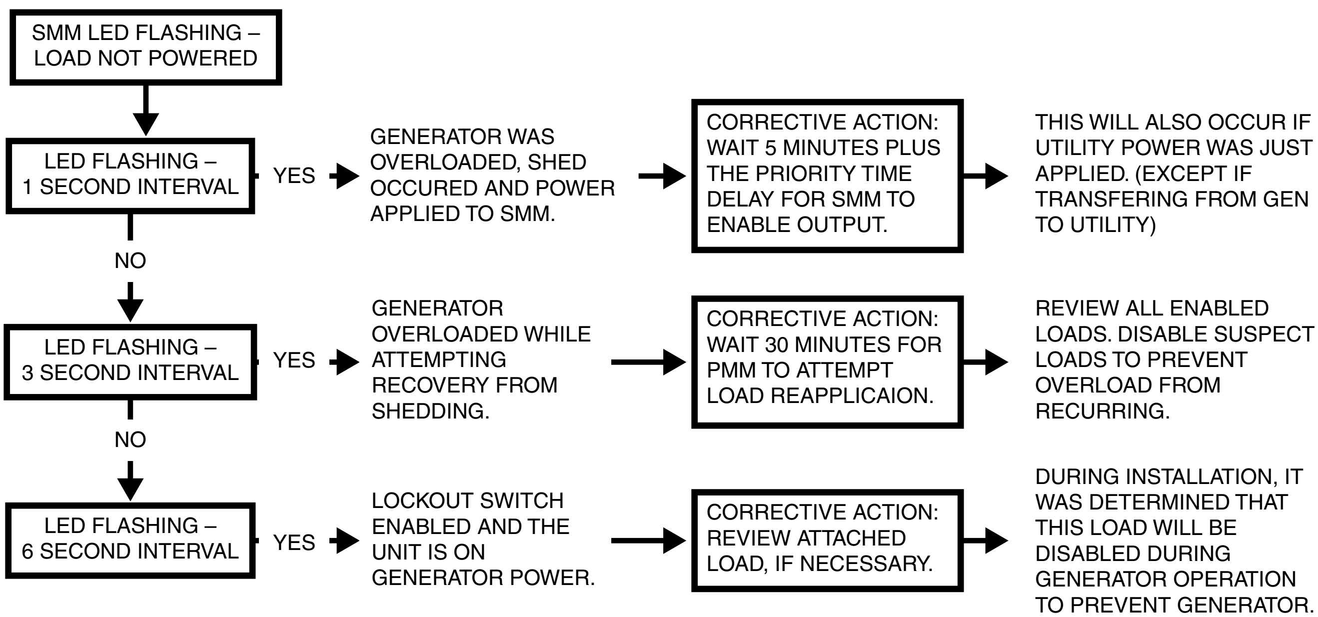
SMM Problem 1 – Load Management Module (SMM) LED is OFF, Load Not Powered



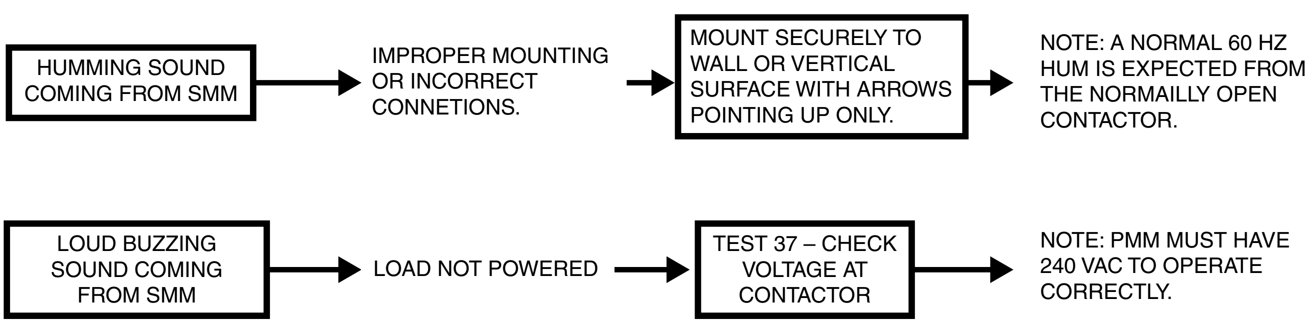
SMM Problem 2 – Load Management Module (SMM) LED is ON, Load Not Powered



SMM Problem 3 – Load Management Module (SMM) LED is Flashing, Load Not Powered



SMM Problem 4 – Load Management Module (SMM) is Humming or Buzzing



NOTES

For General Troubleshooting Guidelines refer to Section 1.12

IMPORTANT

Use wire numbers only and disregard any specific “J” Connector references. Utilize the wire numbers and controller pin out chart in Appendix “A” per specific connector styles.

If any steps result in replacing a Controller, utilize Appendix “B”

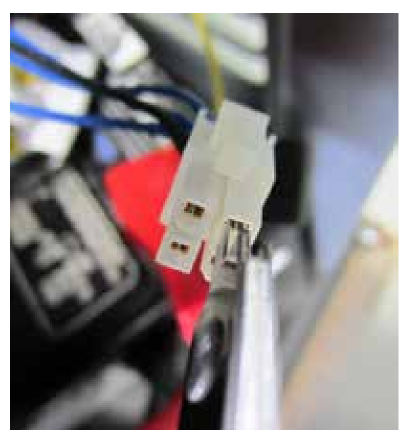
PROBING AND PIN EXTRACTION

If probing and/or back-probing results in a "BAD" condition, before condemning the controller, remove the pin/plug in question and verify the pin/plug is not distorted, bent and/or not making electrical contact! Repair as needed!

Back-Probing Molex Connector

Molex Pin Extractor Tool Part# 0K4445

Probing AMP Connector



Using Molex Pin Extractor Tool

EVOLUTION E-CODES

DISPLAYED ALARM	ALARM/ WARN-ING	E-CODE BREAK-DOWN	DESCRIPTION	Notes
Controller Fault	ALARM		**No E-code on HSB**	Replace Controller
Overcrank	ALARM	1100	**Condition - Engine Cranks but will not Start** Unit turns over but will not start. Controller is receiving signal on Wire 18.	Problem 17
Overspeed	ALARM	1200	**Prolonged** Over 72 Hz for 3 seconds. Possible cause: Stepper motor/mixer body assembly issue.	Test 12
Overspeed	ALARM	1205	**Instantaneous** Over 75 Hz for .1 second (100 milliseconds). Possible cause: Stepper motor/mixer body assembly issue.	Test 12
Low Oil Pressure	ALARM	1300	**Occurred while running** The default Extended alarm for low oil pressure. Check oil level and pressure.	Test 61
High Temperature	ALARM	1400	**Condition - Air Flow Impeded / Flow Issue** Check the inlet/outlet for debris.	Test 62
RPM Sensor	ALARM	1501	**Twin Cylinder+Running** Twin Cylinder Running faults to RPM sensor loss. Possible Causes: air pocket in fuel line, dirty fuel, missing ignition pulse (loss of one of the primary coils).	Test 50 and Test 64
RPM Sensor	ALARM	1505	**Twin Cylinder+Cranking** Twin Cylinder Cranking faults to RPM sensor loss Possible Cause: starter motor issue, missing ignition pulse (loss of one of the primary coils).	If engine cranks, Test 64. If engine does not crank, Problem 15.
RPM Sensor	ALARM	1511	**Single Cylinder+Running** Single Cylinder Running with Low Fuel Pressure faults to RPM sensor loss Possible Causes: air pocket in fuel line,dirty fuel.	Test 50 and Test 64
RPM Sensor	ALARM	1515	**Single Cylinder+Cranking** Single Cylinder Cranking faults to RPM sensor loss Possible Cause: starter motor issue.	If engine cranks, Test 64. If engine does not crank, Problem 15.
Underspeed	ALARM	1600	**Condition - Unit is Overloaded** Unit is Overloaded slowing engine speed, fuel supply low or throttle control problem.	Problem 1, Test 50 or Test 12
Overvoltage	ALARM	1800	**Prolonged Over-Voltage**	Problem 2
Undervoltage	ALARM	1900	**Prolonged Under-Voltage** Undervoltage due to loss of voltage for some time (10+ seconds).	Test 5
Undervoltage	ALARM	1901	**Instantaneous** Undervoltage due to sudden loss of voltage.	Problem 1
Undervoltage	ALARM	1902	**Both Zero Crosses missing** Undervoltage due to faulty excitation winding,or zero cross circuit,or circuit in general. Possible cause: loose wiring, field boost hardware failure	Problem 1
Undervoltage	ALARM	1906	**Single Zero Cross missing** Undervoltage due to faulty excitation winding, zero cross circuit, or circuit in general. Possible cause: field boost hardware failure	Problem 1

EVOLUTION E-CODES

DISPLAYED ALARM	ALARM/ WARN-ING	E-CODE BREAK-DOWN	DESCRIPTION	Notes
Wiring Error	ALARM	2099	Customer connection low voltage and high voltage wires are crossed.	Check customer connection in generator
Overload Remove Load	ALARM	2100	**Overloaded - Default (Output Current Method)** Unit is overloaded, one of the two CTs is detecting an overload condition. Check transfer switch loadshed functionality. (Change load dynamics or utilize loadshed).	Remove Load
Undervoltage Overload	ALARM	2299	Unit was overloaded and attempted to start with a large load connected. The unit can not ramp up the generator voltage to its normal target voltage value if it starts with a large load connected	Remove Load
Stepper Overcurrent	ALARM	2399	Current flow in stepper coil(s) above specification	Test 12
Fuse Problem*	ALARM	2400	**Missing / Damaged Fuse** The 7.5 amp Controller Fuse is missing or blown (open).	Test 44
Low Battery	WARNING		Condition->Battery less than 12.1 Volts for 60 seconds	Test 45
Battery Problem	WARNING		Condition->More than 16 Volts of battery voltage or 600 milliamperes or more of charge current at the end of an 18 hour charge	Test 45
Charger Warning	WARNING		Less than 12.5 volts of battery voltage at the end of a 18 hour charge	Problem 22
Charger Missing AC	WARNING		AC power is missing from the battery charger input	Problem 22

**Firmware version 1.11 and older only*

ADDITIONAL CODES FOR 8 KW UNITS ONLY

DISPLAYED ALARM	ALARM/ WARN-ING	E-CODE BREAK-DOWN	DESCRIPTION	Notes
Overcrank	ALARM	1101	**Engine/Starter Problem** Limiting number of cranking cycles to protect the starter motor.	If the engine has tried to crank for 10 times unsuccessfully, this will trigger.
Underspeed	ALARM	1603	**Underspeed** The engine never comes up to 3700 RPM.	Check fuel selection and fuel supply
Overload Remove Load	ALARM	2102	**Overloaded** Unit recranks 5 times when load is applied, engine dies (0 RPM) and has low voltage (< 180V)	Check for Overloaded condition on unit. Inspect stepper motor operation.
Overload Remove Load	ALARM	2103	**Overloaded** Unit has run and attempted to accept load 10 times, could not accept due to overload condition	Check for Overloaded condition on unit

INTRODUCTION

This section familiarizes the service technician with acceptable procedures for the testing and evaluation of various problems that can occur on pre-packaged transfer switches. Use this section in conjunction with Section 3.3, "Troubleshooting Flow Charts." The numbered tests in this section correspond with those of Section 3.3.

Some test procedures in this section may require the use of specialized test equipment, meters or tools. Most tests can be performed with an inexpensive volt-ohm-meter (VOM). An AC frequency meter is required, where frequency readings must be taken. To measure AC loads it is acceptable to use a clamp-on ammeter.

Testing and troubleshooting methods covered in this section are not exhaustive. No attempt has been made to discuss, evaluate and advise the home standby service trade of all conceivable ways in which service and trouble diagnosis must be performed. Accordingly, anyone who uses a test method not recommended herein must first satisfy himself that the procedure or method he has selected will jeopardize neither his nor the product's safety.

SAFETY

Service personnel who work on this equipment should be aware of the dangers of such equipment. Extremely high and dangerous voltages are present that can kill or cause serious injury. Gaseous fuels are highly explosive and can ignite by the slightest spark. Engine exhaust gases contain deadly carbon monoxide gas that can cause unconsciousness or even death. Contact with moving parts can cause serious injury. The list of hazards is seemingly endless.

When working on this equipment, use common sense and remain alert at all times. Never work on this equipment while you are physically or mentally fatigued. If you do not understand a component, device or system, do not work on it.

TRANSFER SWITCH TROUBLESHOOTING

It is always good practice to continue to ask questions during the troubleshooting process. When evaluating the problem asking some of these questions may help identify the problem quicker.

- What is the transfer switch doing?
- What was the transfer switch supposed to do?
- Does the transfer switch have the same fault consistently, and when does it occur?
- Who is controlling it?
- Exactly what is occurring?
- When is it happening?
- Why would this happen?
- How would this happen?
- What type of test will either prove or disprove the cause of the fault?

TEST 20 – CHECK VOLTAGE AT TERMINAL LUGS E1 AND E2

Discussion

In automatic mode to transfer to the "Standby" position, the standby closing coil (C2) energizes utilizing generator output. Transfer to "Standby" cannot occur unless generator voltage is available to the transfer switch.

If the generator is not producing the correct voltage it will shutdown on an under or over-voltage alarm and thus will not be running.

Two procedures have been provided in the event that the generator is already running in a Utility failure. It is not required to complete both procedures.

⚠ DANGER!

Be careful! Dangerously high voltages are present at terminal lugs E1 and E2 when the generator is running. Avoid contact with high voltage terminals or dangerous and possible lethal electrical shock may result. Do not perform this voltage test while standing on wet or damp ground, while barefoot, or while hands or feet are wet.

Procedure: Generator Running in Utility Failure, Switch did not Transfer

1. Set Volt-Ohm-Milliammeter (VOM) to measure AC voltage.
2. If the Generator engine has started automatically (due to a Utility failure) and is running, check the position of the Generator main line circuit breaker. The circuit breaker must be set to its "Closed" position. After confirming that the Generator main circuit breaker is set to the "Closed" position, verify the voltage at the transfer switch CONTACTOR terminal lugs E1 and E2 with an accurate AC VOM. The meter should indicate generator line-to-line voltage.

Procedure: Generator Shutdown

1. Set the controller to the OFF mode.
2. Set Volt-Ohm-Milliammeter (VOM) to measure AC voltage.
3. Disconnect Utility voltage from the transfer switch.
4. Verify the CONTACTOR is in the "Utility" position.
5. Verify the Generator main line circuit breaker (MLCB) is in the "Closed Position".
6. Set the controller to the MANUAL mode.
7. If transfer to the "Standby" position does NOT occur, check the voltage across terminal lugs E1 and E2. The VOM should indicate generator line-line voltage.

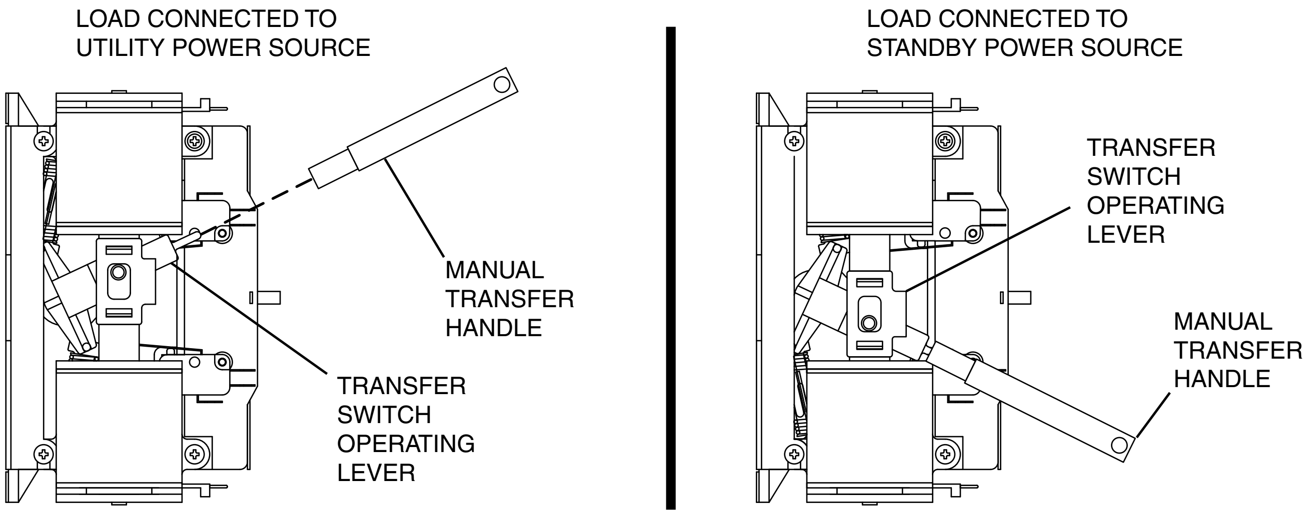


Figure 118. Manual Transfer Switch Operation

Results

1. If normal transfer to the “Standby” position occurs, discontinue testing.
2. If transfer to the “Standby” position did NOT occur but the Generator continued to run for longer than 10 seconds, and the VOM did not indicate voltage across E1 and E2, proceed to Test 1 “Check AC output voltage” and Test 2 “Check Main Line Circuit Breaker.”
3. If transfer to the “Standby” position did NOT occur and the VOM indicated voltage across E1 and E2 this test is GOOD; refer to back to flow chart.
4. If transfer to the “Standby” position did NOT occur and Generator faulted on under-voltage, refer to Problem 1 “Generator Shuts Down for Under-voltage.”

TEST 21 – CHECK MANUAL TRANSFER SWITCH OPERATION

Discussion

In automatic operating mode, when Utility source voltage drops below a preset level, the engine should crank and start. On engine startup, an “engine warm-up timer” on the Generator should start timing. After the timer has expired (about 15 seconds), the transfer relay (TR1) energizes to deliver generator source voltage to the standby closing coil terminals. If generator voltage is available to the standby closing coil terminals, but transfer to Standby does not occur, the cause of the failure may be (a) a failed standby closing coil and/or bridge rectifier, or (b) a seized or sticking actuating coil or load contact. This test will help you evaluate whether any sticking or binding is present in the CONTACTOR.

Procedure

1. Set the generator main line circuit breaker (MLCB) to the “Open” position.
2. Set the controller to the OFF mode.
3. Disconnect Utility from the transfer switch.

⚠ DANGER!

Do not attempt manual transfer switch operation until all voltage to the switch have been disconnected. Failure to turn off all power voltage supplies may result in extremely hazardous and possibly lethal electrical shock.

4. Locate the manual transfer handle inside the switch enclosure.
5. Insert the un-insulated end of the handle over the transfer switch-operating lever. Refer to Figure 118.
   a. Manually actuate the CONTACTOR lever to the “Utility” position.
   b. Actuate the operating lever down to the “Standby” position.
6. Repeat Step 5 several times. When the CONTACTOR lever is moved slight force should be needed until the lever reaches its center position. As the lever moves past its “over center” position, an over-center spring should snap the movable LOAD contacts against the stationary STANDBY or UTILITY contacts.
7. Actuate the CONTACTOR to the “Utility” position.

Results

1. If there is no evidence of binding, sticking, or excessive force required the test is GOOD; refer back to the flow chart.
2. If evidence of sticking, binding, excessive force is required to move the CONTACTOR, find cause of binding or sticking and repair or replace damaged components.

TEST 22 – CHECK 23 AND 194 CIRCUIT

Discussion

Note: There are three variations of Transfer Relays (TR1) used in production. See the figures in Test 23 for identification.

An OPEN circuit in the switch control wiring will prevent a transfer from occurring. Terminal “A” or “7” or “13” of the transfer relay (TR1) connects to Wire 194. Terminal “B” or “8” or “14” connects to Wire 23. Wire 194 provides 12 VDC to Terminal “A” or “7” or “13”, and the Controller holds Wire 23 open from ground. With Wire 23 open from ground TR1 is de-energized.

Reference: De-energized TR1 relay voltage checks:

- Wire 194 to Ground = 12 VDC
- Wire 194 to Wire 23 = 0 VDC
- Wire 23 to Ground =12 VDC

Table 22. TR1 Relay Terminal Connections

Relay	Coil Resistance	Wire 194	Wire 23	Wire N1A	Wire 126	Wire E1	Wire 205
Clear Square	120 Ohms	A	B	7	1	9	6
Clear Rectangle	160 Ohms	7	8	5	1	6	4
Yellow Rectangle	163 Ohms	13	14	9	1	12	8

Procedure/Results

1. Disconnect and isolate Wire 23 at the transfer switch terminal strip coming from the Generator. Set the Generator's controller to AUTO mode; simulate a Utility failure.
2. Once the Generator is running, connect a jumper wire from ground to Wire 23 located at the terminal strip. Listen and visually watch for the energizing of the TR1 relay and for the transfer to Standby.
   a. If the TR1 relay visually and audibly energized and the CONTACTOR transferred to the “Standby” position, stop testing, proceed to Test 25 “Check Wire 23”.
   b. If the transfer relay did not energize, continue to Step 3.
   c. If the TR1 relay visually and audibly energized and the CONTACTOR did not transfer to the “Standby” position, proceed to Test 23 “Test Transfer Relay.”
3. Set the Generator's controller to the OFF mode.
4. Set Volt-Ohm-Milliammeter (VOM) to measure DC voltage.
5. Connect the negative (-) test lead to ground in the transfer switch. Connect the positive (+) test lead to Wire 194 at the terminal strip located in the transfer switch.
   a. If voltage is present, proceed to Step 6.
   b. If voltage is not present, proceed to Step 17.
6. Connect the positive (+) test lead to Wire 23 at the terminal strip located in the transfer switch. Connect the negative (-) test lead to a ground in the transfer switch.
   a. If voltage is present, proceed to Step 9.
   b. If voltage is not present, proceed to Step 7.
7. Set VOM to measure resistance.
8. Remove Wire 23 and Wire 194 going to the TR1 relay from the terminal strip. Connect the meter test leads across Wire 23 and Wire 194 (going to the relay).
   a. The VOM should indicate TR1 coil resistance indicated in Table 22.
   b. If coil resistance is not measured, remove Wire 23 and Wire 194 from the TR1 relay. Measure across the TR1 terminal connections indicated in Table 22.
   c. If coil resistance is measured, repair or replace Wire 23 or Wire 194 between the terminal strip and the TR1 relay.
   d. If coil resistance is not measured, replace TR1 relay and retest.

Note: Re-connect wires before proceeding to Step 9.

9. Connect the negative (-) test lead to the ground lug in the Generator control panel. Connect the positive (+) test lead to Wire 23 in the Generator at the customer connection terminal strip.
   a. If voltage is present, proceed to Step 10.
   b. If voltage is not present, repair wiring between transfer switch and Generator control panel.
10. Simulate a power failure (Open Utility Service Breaker) with the controller in the AUTO mode. Approximately 10 seconds after starting, navigate to the controller's digital output screen.
11. Digital Output 8 is the Wire 23 output from the controller. Refer to Figure 124.
12. If Output 8 shows a “1” then the control board is grounding Wire 23.
    a. If Output 8 did not change replace the controller.
    b. If Output 8 did change, proceed to next step.
13. Locate and disconnect the appropriate harness connector from the controller.
14. Set the VOM to measure resistance.
15. Connect one meter test lead to pin for Wire 23 on the connector. Connect the other meter test lead to pin for Wire 194. VOM should indicate Coil resistance shown in Table 22.
    a. If the VOM indicated correct resistance, repair or replace the Wire 23 connection.
    b. If the VOM indicated INFINITY, repair or replace Wire 23 between harness connector and the Generator terminal strip.
    c. If resistance is not within specification, proceed to Test 23 – “Test Transfer Relay.”
16. Set VOM to measure DC voltage.

17 Connect the negative (-) test lead to the ground lug in the Generator control panel. Connect the positive (+) test lead to Wire 194 at the terminal strip in the Generator control panel.

a. If voltage is present, repair Wire 194 between the Generator terminal strip and transfer switch terminal strip.

b. If voltage is not present, proceed to Step 18.

18. Locate and disconnect the proper connector from the controller.
19. Set VOM to measure resistance.
20. Connect one meter test lead to Wire 194 at the Generators customer connection terminal strip. Connect the other meter test lead to the proper pin at the controller connector.
21. Continuity should be measured.

a. If continuity is not measured, repair pin connection and/or Wire 194 between the connector and terminal strip.

b. If continuity is measured, proceed to Step 24.

22. Remove the Generator fuse.
23. Reconnect the controller connector.
24. Re-install the fuse.
25. Disconnect Wire 194 from the Generator's terminal strip.
26. Set VOM to measure DC voltage.
27. Connect one meter test lead to Wire 194. Connect the other meter test lead to a clean frame ground, 12 VDC should be measured.

a. If 12 VDC is not measured, replace the controller.

b. If 12 VDC is measured, a short exists on Wire 194 or the TR1 relay. Repair or replace as needed

TEST 23 – TEST TRANSFER RELAY

Discussion

In automatic mode, transfer to Standby will not occur until the transfer relay (TR1) energizes. When TR1 relay energizes, Generator voltage is available to operate the standby closing coil. Without Generator source voltage available, the closing coil will remain de-energized and transfer to the "Standby" position will not occur. This test will determine if the TR1 relay is functioning normally.

Note: There are three variations of Transfer Relays (TR1) used in production. See the following figures for identification.

Procedure

1. Disconnect all wires from the TR1 relay to prevent interaction. See Figures 119, 120, and 121 for Transfer Relay wiring configurations.
2. Set the Volt-Ohm-Milliammeter (VOM) to measure resistance.
3. With the wires disconnected, connect the VOM test leads across relay Terminals where Wires 194 and 23 were, (reference Figures 119, 120, and 121). Measure and record the resistance.

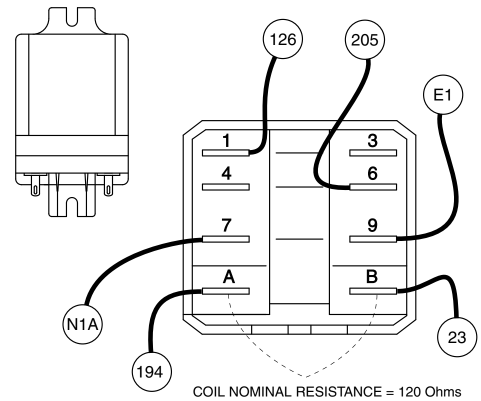


Figure 119. Vertical Mounted "Clear" Transfer Relay Test Points

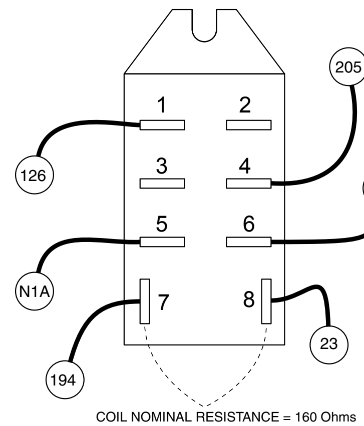


Figure 120. Horizontal Mounted "Clear" Transfer Relay Test Points

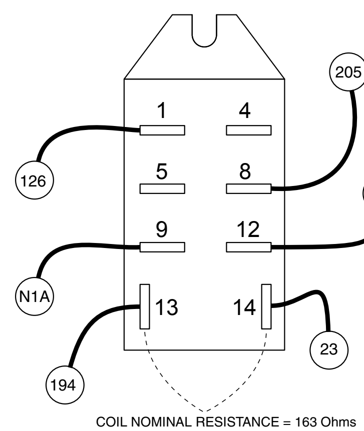
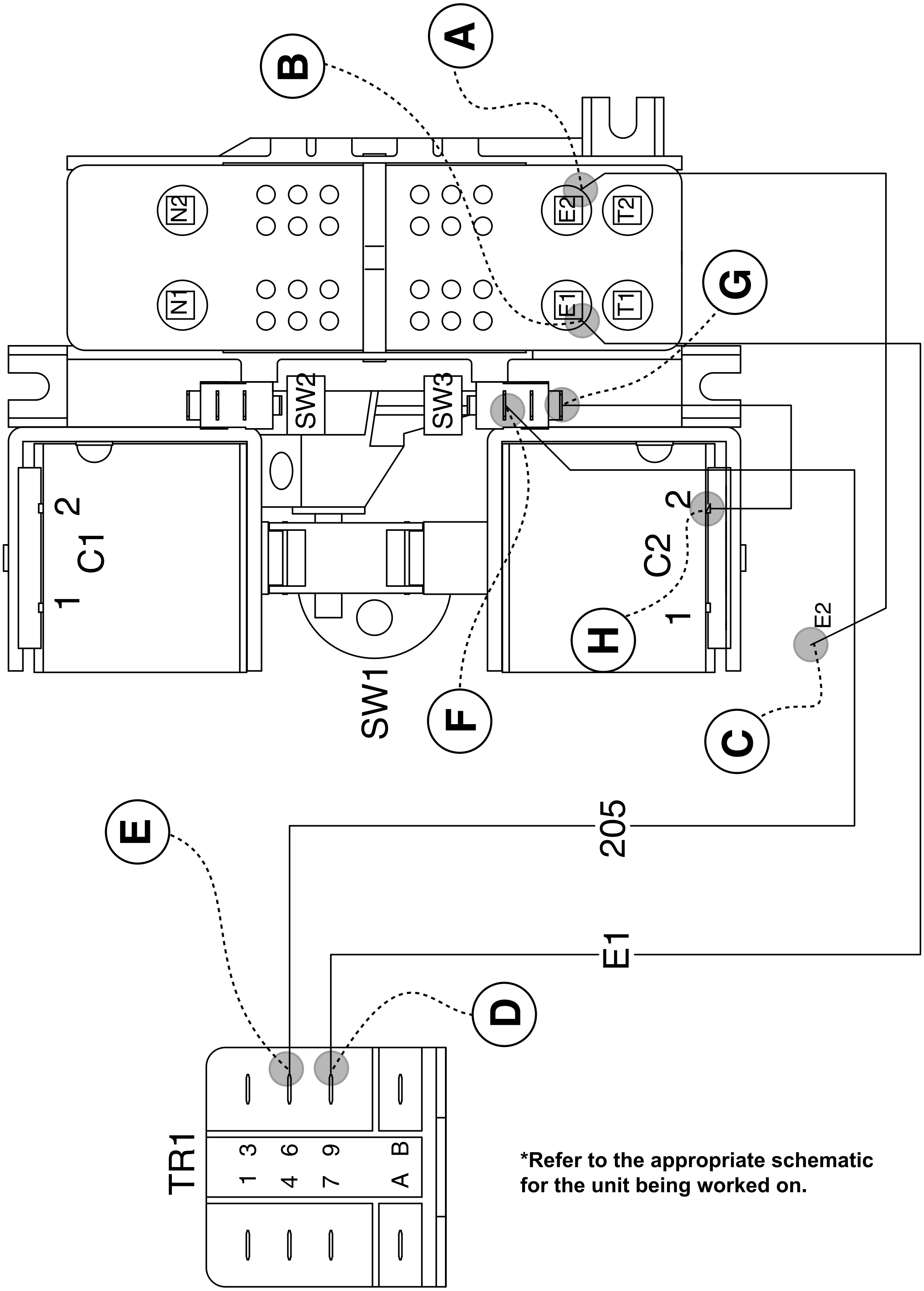


Figure 121. Horizontal Mounted "Yellow" Transfer Relay Test Points

4. Using jumper wires, connect one fused jumper wire from the positive post of the battery to the relay terminal that had Wire 194 and connect the other jumper wire from the negative post of the battery to the relay terminal that had Wire 23. See figures for reference.



***Refer to the appropriate schematic for the unit being worked on.**

*Figure 122. Typical Standby Control Circuit Test Points**

5. Connect the VOM test leads across relay Terminals per tables 23, 24, and 25 based on the TR1 relay being tested. Measure and record the resistance Energized and De-energized.
   a. Energize the relay. The meter should indicate either INFINITY or CONTINUITY according to the appropriate table.
   b. De-energize the relay. The VOM should indicate CONTINUITY or INFINITY according to the appropriate table.
6. Repeat Step 5 across relay Terminals 7 and 1.

Table 23. Vertical Mounted "Clear" Transfer Relay

CONNECT VOM TEST LEADS ACROSS	DESIRED METER READING	
	ENERGIZED	DE-ENERGIZED
Terminals 6 and 9	Continuity	Infinity
Terminals 1 and 7	Infinity	Continuity
Terminals A and B		120 Ohms

Table 24. Horizontal Mounted "Clear" Transfer Relay OMRON®

CONNECT VOM TEST LEADS ACROSS	DESIRED METER READING	
	ENERGIZED	DE-ENERGIZED
Terminals 4 and 6	Continuity	Infinity
Terminals 1 and 5	Infinity	Continuity
Terminals 7 and 8 (Coil)		160 Ohms

Table 25. Horizontal Mounted "Yellow" Transfer Relay IDEC®

CONNECT VOM TEST LEADS ACROSS	DESIRED METER READING	
	ENERGIZED	DE-ENERGIZED
Terminals 8 and 12	Continuity	Infinity
Terminals 1 and 9	Infinity	Continuity
Terminals 13 and 14 (Coil)		163 Ohms

Results

1. Compare the results with Table 23, 24 or 25 according to the type of relay being tested. If the relay tests good, refer back to flow chart.
2. Replace relay if found defective.

TEST 24 – TEST STANDBY CONTROL CIRCUIT

Discussion

Refer to Figure 122. The standby coil (C2) requires 240 VAC to energize. When the transfer relay energizes, 240 VAC is applied to the C2 coil. Once energized, the coil will pull the CONTACTOR down to the "Standby" position. Once in the "Standby" position, the limit switch (SW3) will open, removing AC voltage from the C2 coil.

Procedure/Results

1. Measure between the E2 terminal and Terminal 2 of the C2 coil, the VOM should indicate 240 VAC.
   a. If 240 VAC was NOT measured, Continue testing.
   b. If 240 VAC was measured, replace the C2 coil.
2. Set the Volt-Ohm-Milliammeter (VOM) to measure AC voltage.
3. Verify the CONTACTOR is in the "Utility" position.
4. Remove Wire E2 from the C2 coil.
5. Set the controller to AUTO mode. Turn off Utility power supply to the transfer switch, simulating a utility failure. The Generator should start and the transfer relay should energize.
6. Measure across lugs E1 and E2, the VOM should indicate 240 VAC.
   a. If 240 VAC was NOT measured, go back to Test 20.
   b. If 240 VAC was measured, proceed to Step 7.
7. Measure for the voltage on Wire E2 from the lug to 1 of the C2 coil (Wire E2 previously removed from the coil) and B, the VOM should indicate 240 VAC.
   a. If 240 VAC was NOT measured, repair or replace Wire E2.
   b. If 240 VAC was measured, proceed to Step 8.
8. Measure between the E2 lug and terminal number 9 on the TR1, the VOM should indicate 240 VAC.
   a. If 240 VAC was NOT measured, repair or replace Wire E1.
   b. If 240 VAC was measured, proceed to Step 9.
9. Measure between the E2 terminal and terminal 6 of the TR1, the VOM, the VOM should indicate 240 VAC.
   a. If 240 VAC was NOT measured, replace transfer relay.
   b. If 240 VAC was measured, proceed to Step 10.
10. Measure between the E2 terminal and the top terminal of SW3 the VOM should indicate 240 VAC.
    a. If 240 VAC was NOT measured, repair or replace Wire 205.
    b. If 240 VAC was measured, proceed to Step 11.
11. Measure between the E2 terminal and the bottom terminal of the SW3, the VOM should indicate 240 VAC.
    a. If 240 VAC was NOT measured, verify the limit switch (SW3) is wired correctly, proceed to Test 27 – Test Limit Switches.
    b. If 240 VAC was measured, proceed to Step 12.
12. Measure between the E2 terminal and terminal 2 of the C2 coil, the VOM should indicate 240 VAC.
    a. If 240 VAC was NOT measured, repair or replace Wire B.
    b. If 240 VAC was measured, replace the C2 coil.

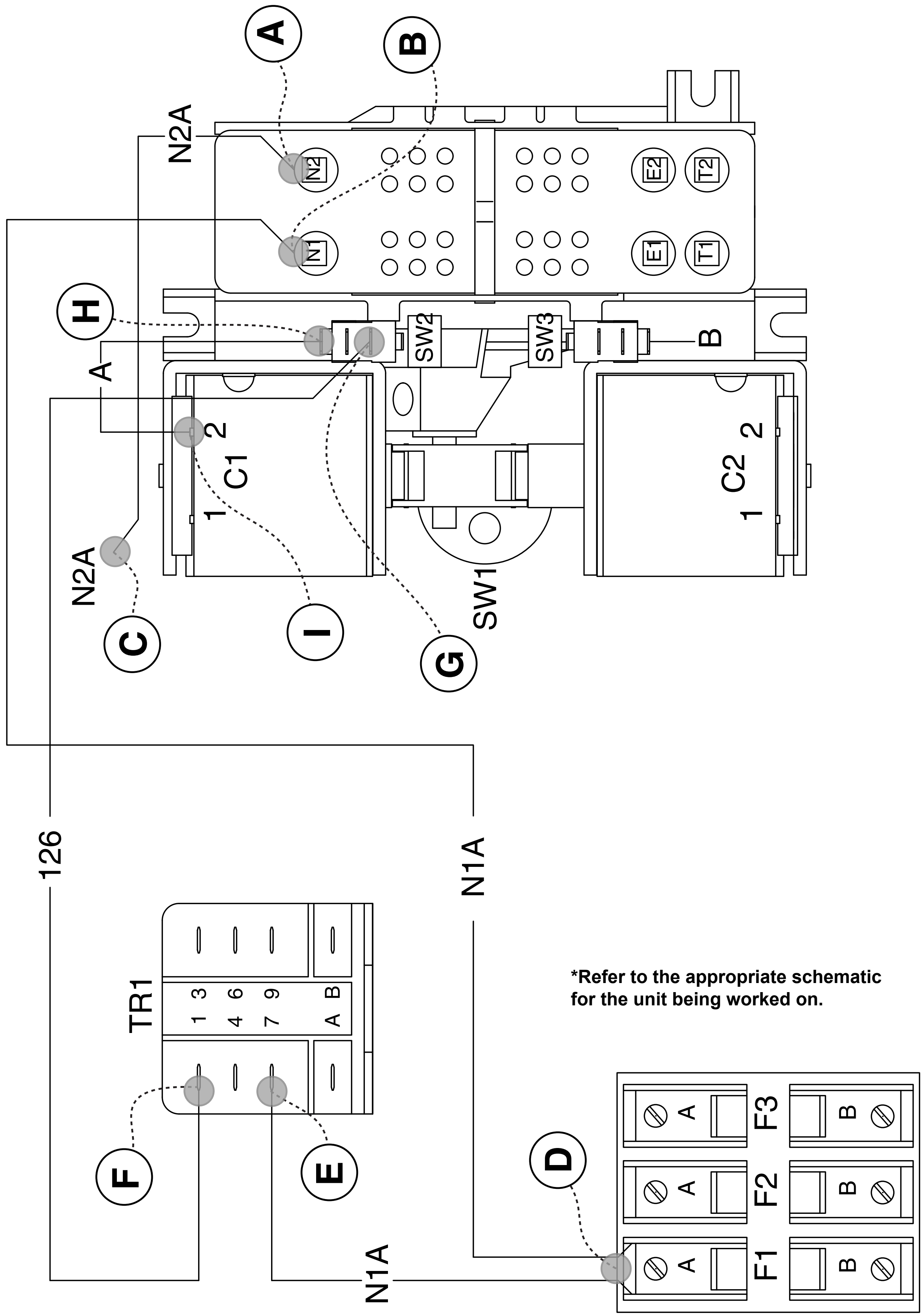


Figure 123. Typical Utility Control Circuit Test Points

TEST 25 – CHECK WIRE 23

Discussion

The controller located in the generator is responsible for grounding Wire 23 in order to initiate a transfer. When Wire 23 closes to ground the transfer relay (TR1) energizes. To initiate a transfer back to Utility the TR1 relay must de-energize. If the TR1 relay is staying energized, a faulty Wire 23 could be the cause.

Procedure/Results

1. Set the Volt-Ohm-Milliammeter (VOM) to measure DC voltage.
2. Set the controller to the OFF mode.
3. Connect the positive meter test lead to Wire 194 and connect the negative meter test lead to Wire 23 located in the customer connection in the transfer switch.
   a. If 0 VDC was measured, proceed to Step 4.
   b. If 12 VDC was measured, proceed to Step 6.
4. Set the controller to the AUTO mode. Verify Utility is Present.
5. Connect the positive meter test lead to Wire 194 and connect the negative meter test lead to Wire 23 located in the transfer switch.
   a. If 12 VDC was measured, proceed to Step 6.
   b. If 0 VDC was measured, proceed to Step 9.
6. Access the Output screen shown below via the menu system based on the controller you are working with.

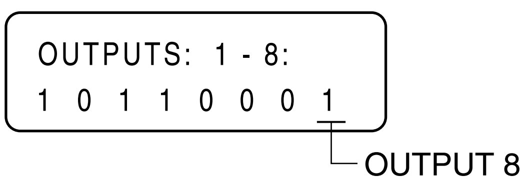


Figure 124. The Output Screen

7. Digital Output 8 is the Wire 23 output from the controller. Refer to Figure 124.
8. If Output 8 shows a "1" then the control board is grounding Wire 23.
9. Locate the terminal strip in the generator control panel. Disconnect Wire 23 coming in from the transfer switch (customer side, see Figures 125 or 126).
10. Connect the positive meter test lead to Wire 194 at the terminal strip in the generator and connect the negative meter test lead to Wire 23 just removed from the terminal strip in Step 9 (Customer Side).
    a. If 0 VDC was measured, proceed to Step 11.
    b. If 12 VDC was measured, a short to ground exists on Wire 23 between the generator and transfer switch. Repair or replace Wire 23 as needed between the generator control panel and transfer switch relay (TR1).
11. Continue to have Wire 23 disconnected on the customer side.
12. Disconnect the appropriate controller connector from the controller.
13. Set VOM to measure resistance.
14. Connect one meter test lead to Wire 23 connected at the terminal strip (see Figures 125 or 126) and connect the other meter test lead to a clean frame ground.
    a. If INFINITY or OPEN was measured, replace the controller.
    b. If CONTINUITY was measured, Wire 23 is shorted to ground. Repair or replace Wire 23 between the controller connector and the Generator terminal strip.

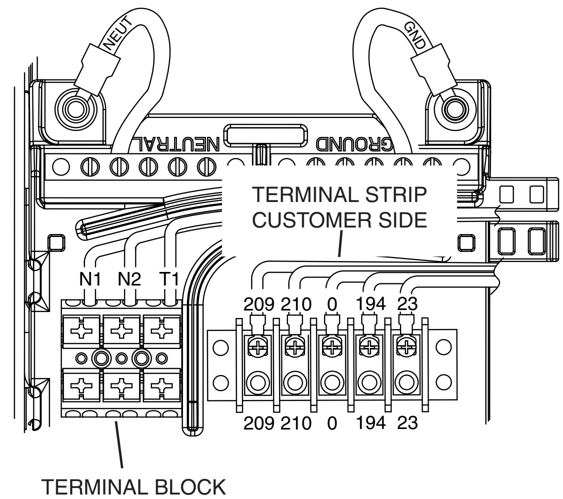


Figure 125. Nexus Transfer Relay Test Points

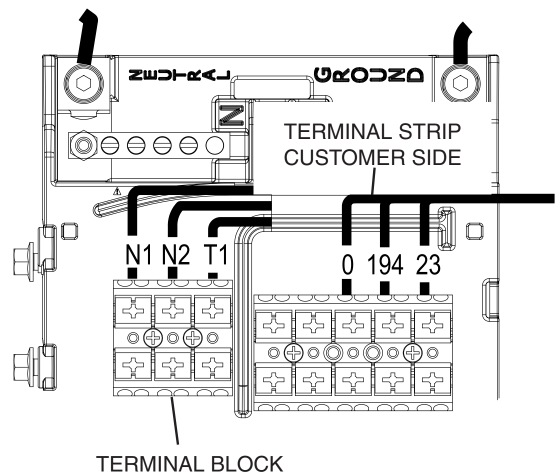


Figure 126. Evolution Transfer Relay Test Points

15. Reconnect controller connector disconnected in Step 12. Connect negative meter lead to Wire 0 in transfer switch customer connection block and positive lead to Wire 194. Verify 12 VDC is present. Move positive meter lead from 194 to 23 in the same terminal block and verify 12 VDC is

available. Reconnect Wire 23 at transfer switch customer connection and verify 12 VDC is still present. Now connect negative volt meter lead to Wire 0 at the generator customer connection and touch Wire 23 that was disconnected from the generator connection block in Step 9.

a If 12 VDC is measured on the end of Wire 23 this wire from transfer switch to generator is good, reconnect all connections and return to the flow chart.

b. If 0 VDC was measured then Wire 23 is OPEN from transfer switch to generator. Repair broken wire.

TEST 26 – TEST UTILITY CONTROL CIRCUIT

Discussion

Refer to Figure 123. The utility coil (C1) requires 240 VAC to energize. When the transfer relay (TR1) de-energizes, 240 VAC is applied to the C1 coil. Once energized, the coil will pull the CONTACTOR up to the “Utility” position. Once in the “Utility” position, the limit switch (SW2) will open, removing AC voltage from the C1 coil.

Procedure

Refer to Figure 123.

1. Set the controller to the OFF mode. Disconnect Wire 194 from the transfer switch terminal strip.
2. Set Volt-Ohm-Milliammeter (VOM) to measure AC voltage.
3. Disconnect Utility supply voltage from the transfer switch.
4. Verify the transfer switch is in the “Standby” position.
5. Turn on Utility supply voltage to the transfer switch.
   a. If transfer to Utility occurs, the transfer relay (TR1) was energized preventing a re-transfer to Utility. Proceed to Test 25 “Check Wire 23 Circuit”.
   b. If transfer to Utility does NOT occur, proceed to Step 7.
6. Remove two wires from the utility coil and check for 240 VAC.
   a. If 240 VAC is measured check utility coil for continuity.
   b. If 240 VAC is not measured proceed to Step 9.
7. Checking coil continuity:.
   a. If continuity is measured proceed to Step 8.
   b. If there is no continuity, replace the coil.
8. Measure the voltage across point C (Wire N2A previously removed and B, the VOM should indicate 240 VAC.
   a. If 240 VAC was NOT measured, repair or replace Wire N2A.
   b. If 240 VAC was measured, proceed to Step 9.
9. Measure for voltage between the N2 lug and the F1 terminal A, the VOM should indicate 240 VAC.
   a. If 240 VAC was NOT measured, repair or replace Wire N1A.
   b. If 240 VAC was measured, proceed to Step 10.
10. Measure for voltage from the N2 lug and Terminal 7 of the TR1, the VOM should indicate 240 VAC.
    a. If 240 VAC was NOT measured, repair or replace Wire N1A.
    b. If 240 VAC was measured, proceed to Step 11.
11. Measure for voltage between the N2 lug and terminal 1 of the TR1, the VOM should indicate 240 VAC.
    a. If 240 VAC was NOT measured, replace transfer relay.
    b. If 240 VAC was measured, proceed to Step 12.
12. Measure for voltage between the N2 lug and the bottom terminal of the SW2, the VOM should indicate 240 VAC.
    a. If 240 VAC was NOT measured, repair or replace Wire 126.
    b. If 240 VAC was measured, proceed to Step 13.
13. Measure for voltage between the N2 lug and the top terminal of the SW2, the VOM should indicate 240 VAC.
    a. If 240 VAC was not measured, verify the limit switch (SW2) is wired correctly and proceed to Test 27 “Test Limit Switches”.
    b. If 240 VAC was measured, proceed to Step 14.
14. Measure for voltage between the N2 lug and terminal 2 of the C1 coil, the VOM should indicate 240 VAC.
    a. If 240 VAC was not measured, repair or replace Wire A.
    b. If 240 VAC was measured, replace the C1 coil.

TEST 27 – TEST LIMIT SWITCHES

Discussion

Wired to the normally CLOSED contacts, the limit switches provide a means to interrupt the transfer circuits. When the CONTACTOR changes position, the limit switches contacts change state to become OPEN.

Procedure

With the controller in the OFF mode, the generator main circuit breaker “Open”, and Utility Voltage disconnected from the transfer switch, test limit switches SW2 and SW3 as follows.

1. To prevent interaction, disconnect Wire 126 and Wire A from the limit switch (SW2) terminals.
2. Set the Volt-Ohm-Milliammeter (VOM) to measure resistance.
3. Connect the VOM meter test leads across the two outer terminals on SW2 from which the wires were disconnected.
4. Manually actuate the CONTACTOR to the “Standby” position, measure and record the resistance.
5. Manually actuate the CONTACTOR to the “Utility” position, measure and record the resistance.
6. Repeat Step 4 and 5 several times and verify the VOM reading at each switch position.

7. To prevent interaction, disconnect Wire 205 and Wire B from the limit switch (SW3) terminals.
8. Connect the VOM meter test leads across the two outer terminals on SW3 from which the wires were disconnected.
9. Manually actuate the CONTACTOR to the “Standby” position, measure and record the resistance.
10. Manually actuate the CONTACTOR to the “Utility” position, measure and record the resistance.
11. Repeat Step 4 and 5 several times and verify the VOM reading at each switch position.

Coil Nominal Resistance is 480-520k ohms

Results

1. If the VOM indicated CONTINUITY in Step 4 and 10 and INFINITY in Step 5 and 9 the limit switches are good, refer back to flowchart.
2. If the VOM did NOT indicate CONTINUITY in Step 4 or 10 and INFINITY in Step 5 or 9 the limit switch(es) are bad, repair or replace appropriate switch(es).

TEST 28 – CHECK FUSES F1 AND F2

Discussion

Fuses F1 and F2 are connected in series with the N1 and N2 circuits, respectively. A blown fuse will open the applicable circuit and will result in (a) generator startup and transfer to the “Standby”, or (b) failure to re-transfer back to utility source.

Procedure

1. On the generator panel, set the controller to the OFF mode.
2. Disconnect Utility from the transfer switch.
3. Remove fuse F1 and F2 from the fuse holder. (see Figure 129).
4. Inspect and test fuses for an OPEN condition with a Volt-Ohm-Milliammeter (VOM) set to measure resistance, CONTINUITY should be measured across the fuse.

Results

1. Replace blown fuse(s) as needed.

TEST 29 – CHECK FUSE F3

Discussion

Connected in series with Load Wire T1, F3 provides 120 VAC to the generator to operate the battery charger. A blown fuse will result in a possible dead battery situation.

Procedure

1. On the generator panel, set the controller to the OFF mode.
2. Disconnect Utility from the transfer switch.
3. Remove fuse F3 from the fuse holder.
4. Inspect and test fuses for an OPEN condition with a Volt-Ohm-Milliammeter (VOM) set to measure resistance, CONTINUITY should be measured across the fuse.

Results

1. Replace blown fuse as needed.

TEST 30 – CHECK MAIN CIRCUIT BREAKER

Discussion

Often the most obvious cause of a problem is over-looked. If the Generator main line circuit breaker (MLCB) is set to “Open”, the electrical loads will not receive power. If the connected loads are not receiving voltage a possible cause could be, the MLCB has failed OPEN.

Procedure

The Generator Main Line Circuit Breaker (MLCB) is located underneath the control panel side cover. If loads are not receiving power, make sure the breaker is set to the “Closed” position. If you suspect the beaker has failed, test it as follows.

1. Set the Volt-Ohm-Milliammeter (VOM) to measure resistance.
2. With the Generator shutdown, disconnect all wires from the MLCB terminals, to prevent interaction.

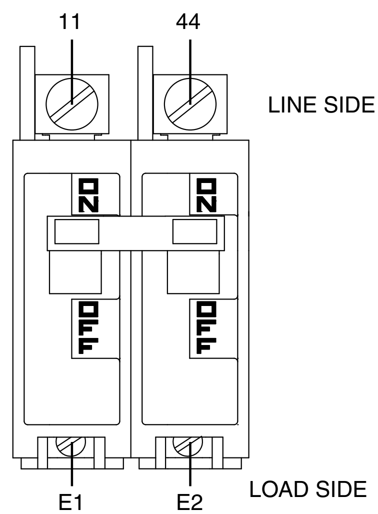


Figure 127. Main Line Circuit Breaker

3. Connect one meter test lead to the Wire 11 terminal on the breaker and the other test lead to the E1 terminal. See Figure 127.
4. Set the breaker to its “Closed” position; the VOM should indicate CONTINUITY.
5. Set the breaker to its “Open” position; the VOM should indicate INFINITY.

6. Repeat Step 4 and 5 with the VOM meter leads connected across the Wire 44 terminal and the E2 terminal.

Results

1. If the circuit breaker tests good, refer back to the flow chart.
2. If the breaker failed Steps 4 or 5, replace the breaker.

TEST 32 – CHECK N1 AND N2 WIRING

Discussion

A shorted Wire N1 or N2 to ground can cause fuse F1 or F2 to blow.

Procedure

1. On the generator panel, set the controller to the OFF mode.
2. Turn off the utility power supply to the transfer switch, using whatever means provided.
3. Remove fuses F1, F2, and F3 from the fuse holder.
4. Remove the generator control panel cover. Disconnect the connector that supplies the controller T1 located in the control panel.
5. Set VOM to measure resistance.
6. Connect the positive meter test lead to Wire N1 at the terminal block in the control panel.
   a. Connect the negative meter lead to the ground lug. INFINITY should be measured.
   b. Connect the negative meter lead to Wire 23 at the terminal strip. INFINITY should be measured.
   c. Connect the negative meter lead to Wire 194 at the terminal strip. INFINITY should be measured.
   d. Connect the negative meter lead to Wire 0 at the terminal strip. INFINITY should be measured.
   e. Connect the negative meter lead to Wire N2 at the terminal block. INFINITY should be measured.
   f. Connect the negative meter lead to the neutral connection. INFINITY should be measured.
7. Connect the positive meter test lead to Wire N2 at the terminal block in the control panel.
   a. Connect the negative meter lead to the ground lug. INFINITY should be measured.
   b. Connect the negative meter lead to Wire 23 at the terminal strip. INFINITY should be measured.
   c. Connect the negative meter lead to Wire 194 at the terminal strip. INFINITY should be measured.
   d. Connect the negative meter lead to Wire 0 at the terminal strip. INFINITY should be measured.
   e. Connect the negative meter lead to the neutral connection. INFINITY should be measured.

Results

If a short is indicated in Step 6 or Step 7, repair wiring and re-test.

TEST 33 – CHECK N1 AND N2 VOLTAGE

Discussion

Loss of utility source voltage to the generator will initiate a startup and transfer by the generator. Testing at the control panel terminal block will divide the system in two, thereby reducing troubleshooting time.

Procedure

1. Set the controller to the OFF mode.
2. Set a VOM to measure AC voltage.
3. See Figure 128. Connect one test lead to Wire N1 at the terminal block in the generator control panel. Connect the other test lead to Wire N2. Utility line-to-line voltage should be measured.

Results

Refer to Flow Chart.

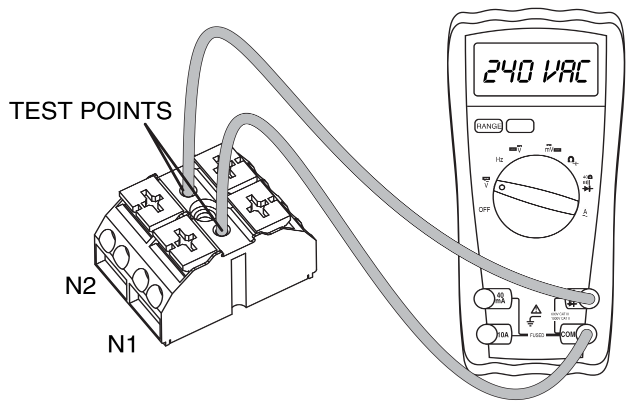


Figure 128. Terminal Block Test Points

TEST 34 – CHECK UTILITY SENSING VOLTAGE AT THE CIRCUIT BOARD

Discussion

If the generator starts and transfer to STANDBY occurs in the automatic mode when acceptable UTILITY source voltage is available at the terminal block, the next step is to determine if sensing voltage is reaching the controller.

Note: The System Ready LED will flash in AUTO or UTILITY LOST will display on the panel.

Procedure

1. Set the controller to the OFF mode.
2. Disconnect the harness connector from the controller.

3. Set a VOM to measure AC voltage.
4. Connect one meter test lead to Wire N1. Connect the other meter test lead to Wire N2. Approximately 240 VAC should be measured.

Results

1. If voltage was measured in Step 4 and the pin connections are good, replace the circuit board.
2. If voltage was NOT measured in Step 4, repair or replace Wire N1/N2 between connector and terminal block.

TEST 35 – CHECK UTILITY SENSE VOLTAGE

The N1 and N2 terminals in the transfer switch deliver utility voltage "sensing" to a circuit board. If voltage at the terminals is zero or low, standby generator startup and transfer to the "Standby" source will occur automatically as controlled by the circuit board. A zero or low voltage at these terminals will also prevent retransfer back to the "Utility" source.

Procedure

With utility source voltage available to terminal lugs N1 and N2, use a VOM to test for utility source line-to-line voltage across terminal locations N1 and N2 terminals. Normal line-to-line utility source voltage should be indicated.

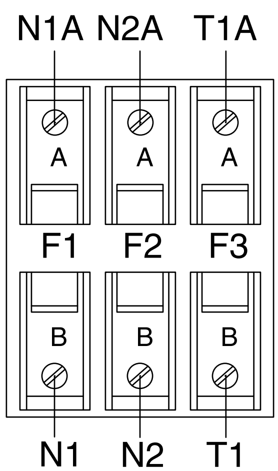


Figure 129. Transfer Switch Fuse Block

Results

1. If voltage reading across the N1 and N2 terminals is zero or low, refer to Flow Chart.
2. If voltage reading is good, refer to Flow Chart.

TEST 36 – CHECK T1 WIRING

Discussion

If the T1 wiring is shorted to ground can cause the F3 fuse to blow.

Procedure

1. Set the controller to the OFF mode.
2. Remove F1, F2, and F3 from the fuse holder in the transfer switch.
3. Disconnect the proper controller harness connector that has Wire T1 in it from the controller.
4. Set the Volt-Ohm-Milliammeter (VOM) to measure resistance.
   a. Connect one meter test lead to T1 on the customer connection in the Generator and the other meter lead to ground. Measure and record the resistance.
   b. Connect one meter test lead to T1 on the customer connection in the Generator and the other meter test lead to Wire 194. Measure and record the resistance.
   c. Connect one meter test lead to T1 on the customer connection in the Generator and the other meter test lead to Wire 23. Measure and record the resistance.
   d. Connect one meter test lead to T1 on the customer connection in the Generator and the other meter test lead to Wire N1. Measure and record the resistance.
   e. Connect one meter test lead to T1 on the customer connection in the Generator and the other meter test lead to Wire N2. Measure and record the resistance.

Results

1. If the VOM indicated INFINITY in Steps 4a through 4e, replace the controller.
2. If the VOM indicated CONTINUITY, repair or replace the wiring in the appropriate circuit.

TEST 37 – TEST SMM CONTACTOR LINE, LOAD AND CONTROL

Discussion

The SMM Load Shed Module (integral to load shedding) requires line voltage from either the utility or the generator for it to operate. If line voltage is present, but the SMM is still not operating, this test will confirm the proper operation of the contactor.

Required Tools

- Meter test leads that are capable of measuring voltage.
- Phillips screwdriver.

Procedure

1. Remove the four (4) screws securing the cover to the SMM Load Shed Module.
2. Ensure the LED is ON, but not flashing.
   a. If the LED is OFF or flashing in any interval, return to the flowchart.
3. Set the VOM (Volt-Ohm-Meter) to measure AC volts.

4. Place the meter leads across the line (input) terminals and record the voltage.
5. Place the meter leads across the load (output) terminals and record the voltage.

Results

1. If the meter indicated less than approximately 240 VAC in Step 4, stop testing and check source voltage coming from the circuit breaker.
2. If the meter indicated approximately 240 VAC in Step 4, but not in Step 5, replace the contactor.

PART 4 - ENGINE/DC CONTROL

⚠ **IMPORTANT! CLEAR ANY FAULTS IN THE CONTROLLER BEFORE PROCEEDING WITH ANY RUNNING DIAGNOSTIC STEPS!**

INTRODUCTION

This section will familiarize the reader with the various components that make up the Engine and DC Control systems.

Topics covered in this section are:

- Customer Connections
- Controller
- Menu System Navigation
- LED Display
- Battery Charger
- AUTO-OFF-MANUAL
- 7.5 Amp Fuse
- Starter Contactor Relay
- Common Alarm Relay
- Connector Pin Descriptions

CUSTOMER CONNECTION

The terminals of this terminal strip connect to identically numbered terminals in the transfer switch. The terminal block provides the electrical connection for the controller.

The terminal block provides the following connection points:

- UTILITY N1 (Utility Sensing)
- UTILITY N2 (Utility Sensing)
- LOAD T1 (Internal Battery Charger) - 60 Hz Unit
- LOAD T2 (Internal Battery Charger) - 50 Hz Unit
- Wire 194 (Transfer Relay)
- Wire 23 (Transfer Relay)

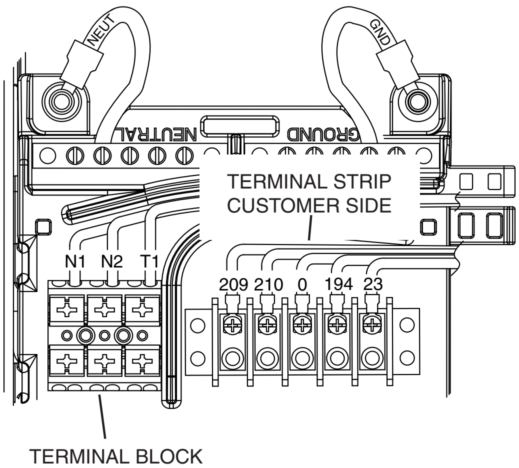


Figure 130. Nexus Customer Connections

CONTROLLER

The controller is responsible for all standby electric system operations including (a) engine startup, (b) engine running, (c) automatic transfer, (d) automatic re-transfer, and (e) engine shutdown. In addition, the controller performs the following functions:

- Automatic voltage regulation (See Section 2.1 “Descriptions and Components).
- Starts and exercises the generator once every seven days.
- Automatic engine shutdown in the event of low oil pressure, high oil temperature, over speed, no RPM sense, over crank, or low battery.
- Maintains proper battery charge.

Terminal Numbering Decal		Wire Numbers
A	**YELLOW #1 & #2**	N1 & N2 - 240 VAC - Sensing for Utility Dropout and Pickup
B	**WHITE #3**	T1 - Fused 120 VAC for Battery Charger (see NOTE)
C	**BLACK #3**	0 - DC (-) Common Ground Wire
D	**RED #4**	194 - DC (+) 12 VDC for Transfer Controls
E	**WHITE #5**	23 - Transfer Control Signal Wire

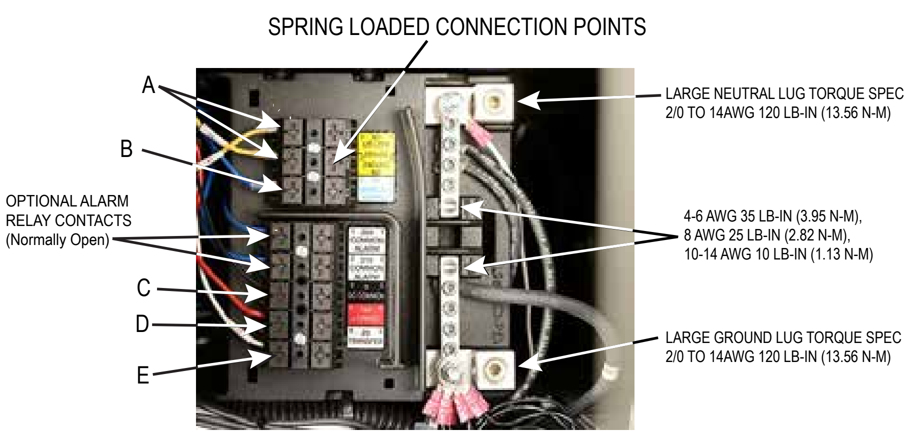


Figure 131. Evolution Control Wiring - 60 Hz (found behind control board)

The controller harness connectors are used to interconnect the controller with the various circuits of the DC and AC systems. Connector pin locations, numbers, associated wires and circuit functions are listed in the appropriate appendix in the back of this diagnostics manual.

To control the Generator the controller utilizes digital inputs and outputs. See Table 26 for the specific position and function. See “Menu Navigation” to view state of output or input.

Table 26. Digital Inputs and Outputs

Position	Digital Inputs	Digital Outputs
1	Not Used	Not Used
2	Low Oil Pressure	Not Used
3	High Temperature	Not Used
4	Not Used	Battery Charger Relay
5	Wiring Error Detect	Fuel
6	Not Used	Starter
7	Auto	Ignition
8	Manual	Transfer

⚠ DANGER!

The Generator engine will crank and start when the 7-day exerciser is set. The unit will also crank and start every 7 days thereafter, on the day and at the time the exerciser was set for.

LED DISPLAY

Located next to the circuit breaker access panel on the generator, the LED Display provides a visually annunciating the Generators status. The LED Display has three LED, a red, a yellow, and a green.

- Red LED- Illuminates during an Alarm condition or when the controller is set to OFF mode.
- Yellow LED- Illuminates when the controller generates a Maintenance Alert and attention is required.
- Green LED- Illuminates when the system is ready to respond to a Utility failure.

BATTERY CHARGER

The charger operates at one of three battery charging voltage levels depending on ambient temperature.

- 13.5 VDC at High Temperature
- 14.1 VDC at Normal Temperature
- 14.6 VDC at Low Temperature

The battery charger is powered from a 120 VAC Load connection through a fuse (F3) in the transfer switch. This 120 VAC source must be connected to the Generator in order to operate the charger.

Note: 50 Hz units use fuses F3 and F4 and a 220 VAC supply to the battery charger.

During a Utility failure, the charger will momentarily be turned off until the Generator is connected to the Load. During normal operation, the battery charger supplies all the power to the controller; the Generator battery is not used to supply power.

Terminal Numbering Decal		Wire Numbers
A	**YELLOW #1 & #2**	N1 & N2 - 240 VAC - Sensing for Utility Dropout and Pickup
B	**WHITE #3**	T1 - Fused 120 VAC for Battery Charger (see NOTE)
C	**WHITE #4**	T2 - Fused 120 VAC for Battery Charger (see NOTE)
D	**BLACK #3**	0 - DC (-) Common Ground Wire
E	**RED #4**	194 - DC (+) 12 VDC for Transfer Controls
F	**WHITE #5**	23 - Transfer Control Signal Wire

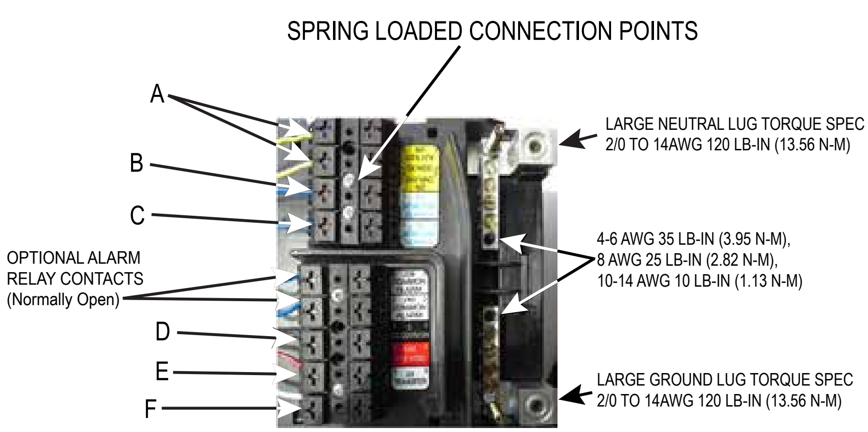


Figure 132. Evolution Control Wiring - 50 Hz (found behind control board)

The battery charger will begin its charge cycle when battery voltage drops below approximately 12.6V. The charger provides current directly to the battery dependent on temperature, and the battery is charged at the appropriate voltage level for 18 hours. At the end of the 18 hour charge period battery charge current is measured when the Generator is off. If battery charge current at the end of the 18 hour charge time is greater than a pre-set level, or the battery open-circuit voltage is less than approximately 12.5V, an “Inspect Battery” (Nexus) or “Charger Warning” (Evolution) warning is raised. If the engine cranks during the 18 hour charge period, then the 18 hour charge timer is restarted.

At the end of the 18 hour charge period the charger does one of two things. If the temperature is less than approximately 40 ºF the battery is continuously charged at a voltage of 14.1V (i.e. the charge voltage is changed from 14.6V to 14.1V after 18 hours). If the temperature is above approximately 40 ºF then the charger will stop charging the battery after 18 hours.

The battery has a similar role as that found in an automobile application. It sits doing nothing until it either self-discharges below 12.6V or an engine crank occurs (i.e. such as occurs during the weekly exercise cycle). If either condition occurs the battery charge will begin its 18 hour charge cycle.

AUTO-OFF-MANUAL

This feature permits the operator to (a) select fully automatic operation, (b) start the Generator manually, or (c) stop the engine and prevent the automatic startup. The Nexus controller has a 3-position switch. The Evolution controller has Off-Manual-Auto Mode buttons. The See Figure 133 or 134 for the location of the switch or push buttons.

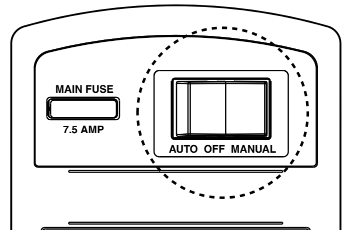


Figure 133. Nexus Auto-Off-Manual Switch

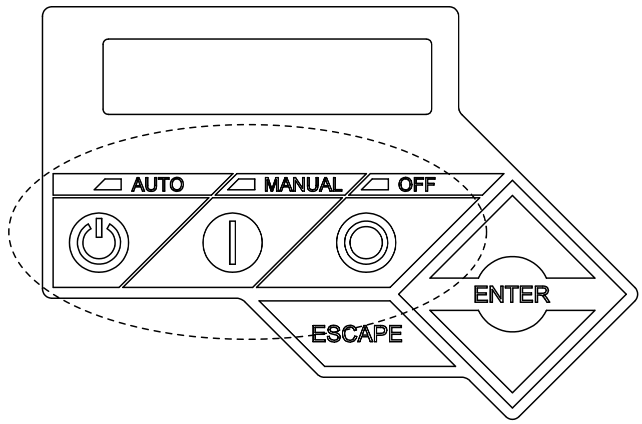


Figure 134. Evolution controller Off-Manual-Auto Buttons

FUSE

The fuse protects the controller against excessive current. If the fuse has blown, engine cranking and operation will not be possible. Should fuse replacement become necessary, use only an equivalent 7.5 amp replacement fuse.

Table 27. Circuit Pin Descriptions

Evolution	Nexus	Wire ID	Circuit Function
Y	Y	0	Common Ground (DC) DC Field Excitation Ground
Y	Y	00	Neutral Connection for T1 (battery charger)
Y	Y	2	DPE Winding (AC Excitation power)
Y	Y	4	DC (+) Field Excitation
Y	N	4A	DC (+) Field Excitation (Before Field Boost Diode)
Y	Y	6	DPE Winding (AC Excitation power)
N	Y	11	240 VAC Generator Voltage Sensing
Y	N	11S	240 VAC Generator Voltage Sensing
Y	Y	13	12 VDC un-fused for the controller
Y	Y	14	12 VDC output for engine run condition. Used for fuel solenoid on all controller units and choke solenoid operation on Nexus controllers only
Y	Y	18	Ignition Shutdown: The controller grounds Wire 18 for ignition shutdown and receives a reference signal for speed control while cranking and running
Y	Y	23	Switched to ground (internally) to energize the Transfer Relay

Evolution	Nexus	Wire ID	Circuit Function
N	Y	44	240 VAC Generator Voltage Sensing
Y	N	44S	240 VAC Generator Voltage Sensing
Y	Y	56	12 VDC output to starter contactor relay/solenoid
Y	Y	85	High temperature shutdown: Shutdown occurs when Wire 85 is grounded by contact closure in the oil temperature switch
Y	Y	86	Low oil pressure shutdown: Shutdown occurs when Wire 86 is grounded by loss of oil pressure in the LOP switch
N	Y	90	Switched to ground for choke solenoid operation
Y	Y	178	Two-wire Start Return
Y	Y	183	Two-wire Start Input
Y	Y	194	Provides 12 VDC to the transfer relay (TR1)
Y	Y	209	Common Alarm Relay Output
Y	Y	210	Common Alarm Relay Output
Y	Y	387	RS-232 Port 1 Rx
Y	Y	387A	RS-232 Port 2 Rx
Y	Y	388	RS-232 Port 1 Tx
Y	Y	388A	RS-232 Port 2 Tx
Y	Y	389	RS-232 Port 1 Gnd
Y	Y	389A	RS-232 Port 2 Gnd
Y	N	398A	Generator Current Sense A2
Y	N	398B	Generator Current Sense B2
Y	N	399A	Generator Current Sense A1
Y	N	399B	Generator Current Sense B1
Y	Y	817	Grounded by the controller to turn on System Ready (Green) LED
Y	Y	818	Grounded by the controller to turn on Alarm (Red) LED
Y	Y	819	Grounded by the controller to turn on the Maintenance (Yellow) LED
Y	Y	820	Positive voltage (5VDC) for status LEDs
N	Y	J1	Model ID Resistor
Y	Y	N1	240 VAC Utility sensing voltage
Y	Y	N2	240 VAC Utility sensing voltage
Y	N	R1	Model ID Resistor
Y	N	R3	Model ID Resistor
Y	Y	T1	120 VAC for Battery Charger
Y	N	T2	240 VAC for Battery Charger
Y	Y	Red	Stepper Power
Y	Y	Orange	Stepper Motor B2 coil
Y	Y	Yellow	Stepper Motor B1 coil
Y	Y	Brown	Stepper Motor A2 coil
Y	Y	Black	Stepper Motor A1 coil

Figure 135. Typical 7.5 Amp Fuse

STARTER CONTACTOR RELAY/SOLENOID

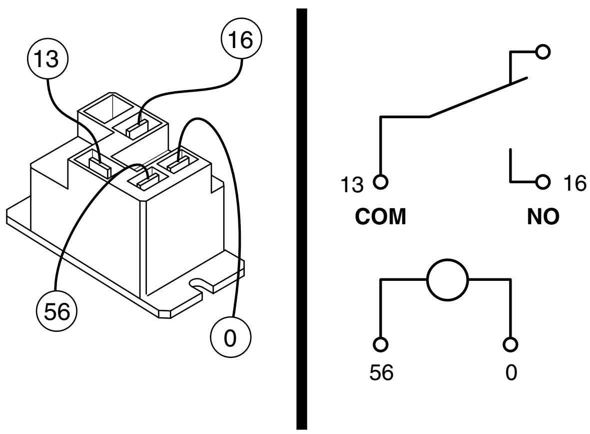


Figure 136. Starter Contactor Relay (V-twin Units)

V-Twin Models

The starter contactor relay (SCR) provides a safe and controlled method of energizing the solenoid located on the starter. The controller is responsible for energizing the relay when the start command is given. Refer to Figure 136.

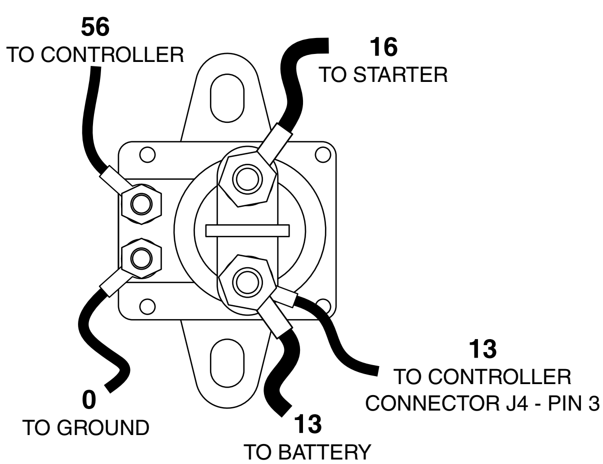


Figure 137. The Starter Contactor (Single Cylinder Units)

Single Cylinder Models

The Starter Contactor (SC) is located in the engine compartment and is mounted against the firewall. The SC provides the electrical connection to safely engage the starter. See Figure 137.

COMMON ALARM RELAY

The common alarm relay provides a set of contacts to drive a customer provided external alarm indication. When the control is powered up, if there are no Alarms, the relay contacts will be OPEN. Any ALARM (not warning) will trigger the common alarm relay to operate, closing the contacts. The connections are made to the generator customer connection terminal strip at Terminals 1 and 2 (Wires 209 and 210).

Specifications

Contact Rating:	10A at 250 VAC	5A at 30 VDC

Note: Contact rating is for resistive load only

CIRCUIT PIN DESCRIPTIONS

Table 27 provides the physical Wire ID and circuit functions.

MENU SYSTEM NAVIGATION

To get to the MENU, use the “ESC” key from any page. It may need to be pressed several times before getting to the menu page. The currently selected menu is displayed as a flashing word. Navigate to the desired menu item by using the +/- keys. When the desired menu item is flashing, press the ENTER key. Depending on the menu selected, there may be a list of choices presented. Use the same navigation method to select the desired screen (refer to the Menu System diagram, Figure 138 or 139). Refer to Section 1.10 “Evolution Control Panel Menu System Navigation” or Section 1.11 “Nexus Control Panel Menu System Navigation” for additional information.

Changing Settings (Edit Menu)

To change a setting, such as display contrast, go to the EDIT menu and use the +/- keys to navigate to the setting to change. Once this setting is displayed (e.g. Contrast), press the ENTER key to go into the edit mode. Use the +/- keys to change the setting, press the ENTER key to store the new setting.

Note: If the ENTER key is not pressed to save the new setting, it will only be saved temporarily. The next time the battery is disconnected, the setting will revert back to the old setting.

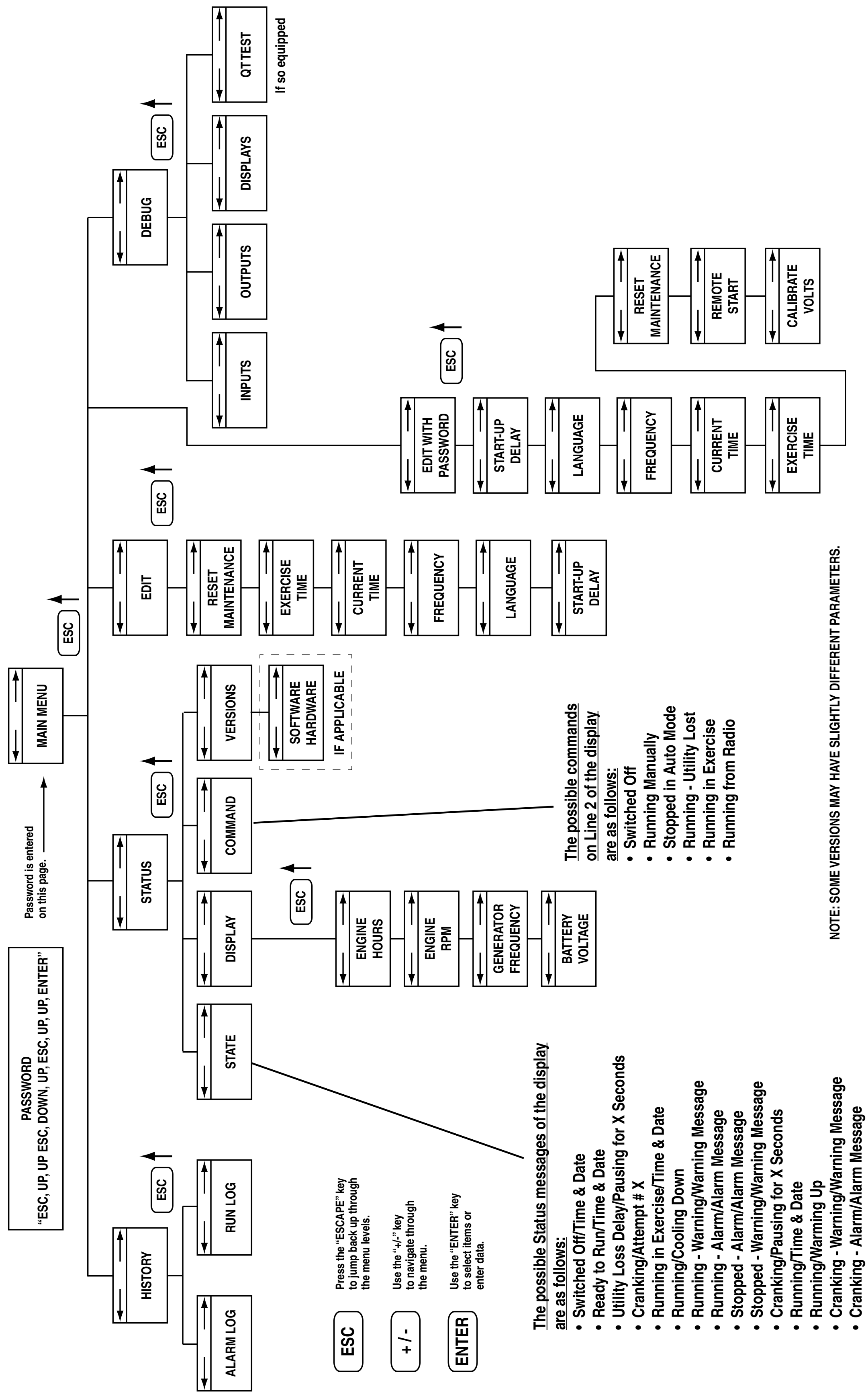


Figure 138. Nexus Menu System Diagram

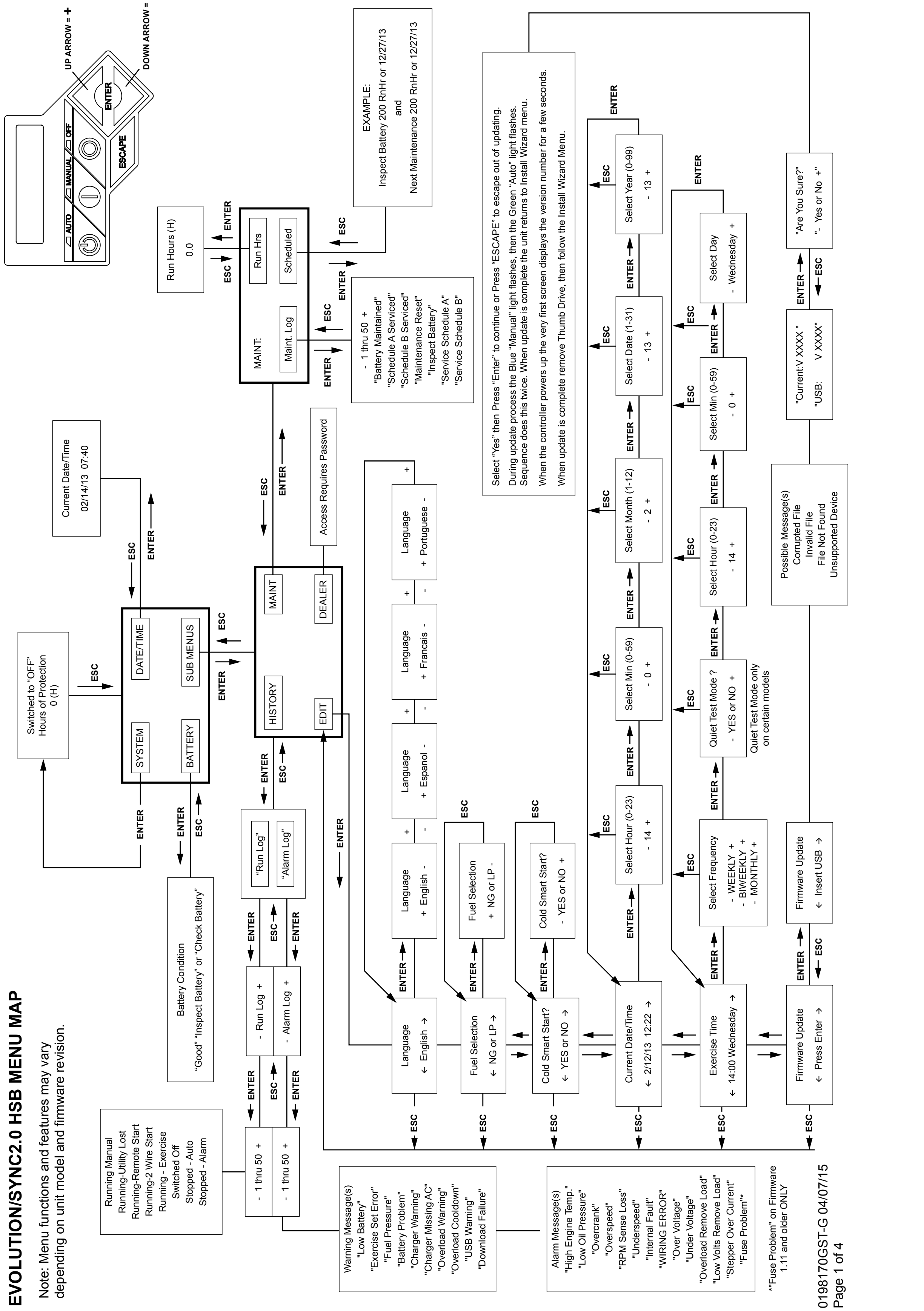


Figure 139. Evolution Menu System Diagram

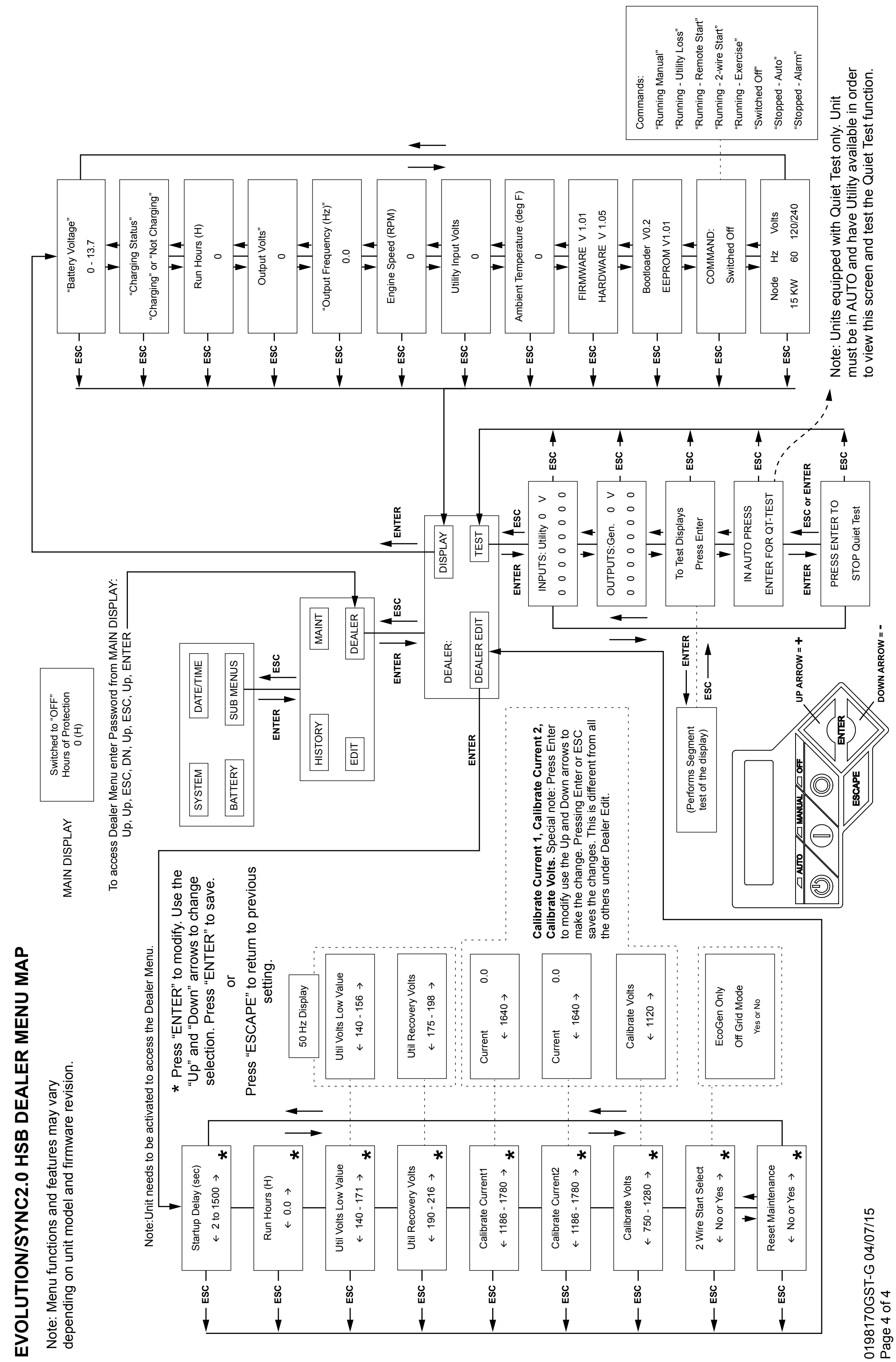


Figure 140. Evolution Dealer Menu System Diagram

NOTES

INTRODUCTION

Standby power generators will often run unattended for long periods. Such operating parameters as (a) battery voltage, (b) engine oil pressure, (c) engine temperature, (d) engine operating speed, and (e) engine cranking and startup are not monitored by an operator during automatic operation. Because engine operation will not be monitored, the use of engine protective safety devices is required to prevent engine damage in the event of a problem. On Evolution models there are alarm codes programmed to display when certain conditions exist. These codes are displayed where they apply in the headings below and elsewhere in this manual.

LOW BATTERY WARNING

The controller will continually monitor the battery voltage and display a "Low Battery" message if the battery voltage falls below 12.1 VDC. After a 60 second delay, a fault code will be set. The fault will remain until repaired.

No other action is taken on a low battery condition. The warning will automatically clear if the battery voltage rises above 12.4 VDC.

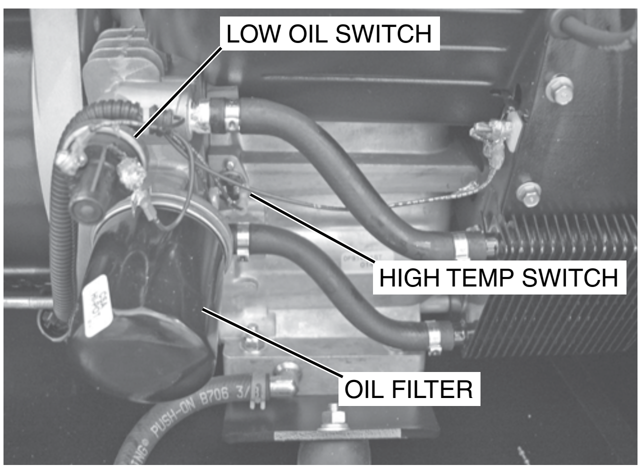


Figure 141. Engine Protective Switches

LOW OIL PRESSURE
(EVOLUTION E-CODE 1300)

See Figure 141. An oil pressure switch is mounted on the oil filter adapter. This switch has normally closed contacts that are held open by engine oil pressure during cranking and startup. Should oil pressure drop below approximately 5 psi, the switch contacts will close. On closure of the switch contacts, the Wire 86 circuit from the controller will be connected to ground. The controller's logic will then de-energize a "run relay" (internal to the controller). The run relay's contacts will then open and then the 12 VDC run circuit will then be terminated. This will result in closure of the fuel shutoff solenoid and loss of engine ignition.

HIGH TEMPERATURE SWITCH
(EVOLUTION E-CODE 1400)

The contacts of this switch (Figure 141) close if the temperature should exceed approximately 293º F (144 ºC), initiating an engine shutdown. The Generator will automatically restart and the fault on the LCD display will reset once the temperature has returned to a safe operating level.

OVERSPEED

During engine cranking and operation the controller receives AC voltage and frequency signals from the ignition magneto via Wire 18. Should the speed exceed approximately 72 Hz (4320 RPM), the controller's logic will de-energize the "run relay" (internal to the controller). The relay contacts will open terminating engine ignition and closing the fuel shutoff solenoid; the engine will then shut down. This feature protects the engine and alternator against damaging over speeds. During cranking the RPM signal generated by the magnetos is used to terminate engine cranking.

RPM SENSOR FAILURE
(EVOLUTION E-CODE 1501, 1505, 1511, 1515)

During cranking if the board does not see a valid RPM signal within three (3) seconds it will shutdown and latch out on "RPM Sensor Loss."

During running if the RPM signal is lost for one full second the controller will shutdown the engine, wait 15 seconds, then re-crank the engine.

If an RPM signal is not detected within the first three (3) seconds of cranking, the controller will shut down the engine down and latch out on "RPM Sensor Loss."

- If the RPM signal is detected the engine will start and run normally. If the RPM signal is subsequently lost again, the controller will try one re-crank attempt before latching out and the LCD displays "RPM Sensor Loss."

Note: A common cause of RPM Sensor Loss fault is the lack of engine cranking; this could be a faulty crank circuit or a faulty starter.

OVERCRANK
(EVOLUTION E-CODE 1100)

This feature prevents the Generator from damaging itself when it continually attempts to start and another problem, such as no fuel supply, prevents it from starting. The unit will crank and rest for a preset time limit. Then, it will stop cranking and the LCD screen will indicate an "Overcrank" condition.

Note: If the fault is not repaired, the overcrank fault will continue to occur.

The system will control the cyclic cranking as follows: 16 second crank, seven (7) second rest, 16 second crank, seven (7) second rest followed by three (3) additional cycles of seven (7) second cranks followed by seven (7) second rests.

Choke Operation (Nexus controller only)

1. The 990/999cc engines have an electric choke in the air box that is automatically controlled by the electronic control board.
2. The 530cc engines have an electric choke on the divider panel air inlet hose that is automatically controlled by the electronic control board.
3. The 410cc engines have a choke behind the air box that is automatically controlled by the electronic control board.

Failure to Start

This is defined as any of the following occurrences during cranking.

1. Not reaching starter dropout within the specified crank cycle. Starter dropout is defined as four (4) cycles at 1,500 RPM (1,800 RPM for 8 kW units).
2. Reaching starter dropout, but then not reaching 2200 RPM within 15 seconds. In this case the control board will go into a rest cycle for seven (7) seconds, then continue the rest of the crank cycle.
3. During a rest cycle the start and fuel outputs are de-energized and the magneto output is shorted to ground.

Cranking Conditions

The following notes apply during the cranking cycle.

1. Starter motor will not engage within five (5) seconds of the engine shutting down.
2. The fuel output will not be energized with the starter.
3. The starter and magneto outputs will be energized together.
4. Once the starter is energized the control board will begin looking for engine rotation. If it does not see an RPM signal within three (3) seconds it will shut down and latch out on RPM sensor loss.
5. Once the control board sees an RPM signal it will energize the fuel solenoid, drive the throttle open and continue the crank sequence.
6. Starter motor will disengage when speed reaches starter dropout.
7. If the generator does not reach 2200 RPM within 15 seconds, re-crank cycle will occur.
8. If engine stops turning between starter dropout and 2200 RPM, the board will go into a rest cycle for seven (7) seconds then re-crank (if additional crank cycles exist).
9. Once started, the generator will wait for a hold-off period before starting to monitor oil pressure and oil temperature (refer to the Alarm Messages section for hold-off times).
10. During cranking, if the controller is in the OFF mode, cranking stops immediately.
11. During Auto mode cranking, if the Utility returns, the cranking cycle does NOT abort but continues until complete. Once the engine starts, it will run for one (1) minute, and then shut down.

UNDER-FREQUENCY

After starting, if the generator stays under a set frequency for more than 30 seconds, it will shutdown.

Table 28. Evolution Under-frequency Shutdown Settings

Unit Hertz	Shutdown Frequency
50 Hz	40 Hz
60 Hz	55 Hz

Table 29. Nexus Under-frequency Shutdown Settings

Unit Hertz	Shutdown Frequency
50 Hz	40 Hz
60 Hz with 0H6680A Controller	50 Hz
60 Hz with 0H6680B Controller	55 Hz

CLEARING AN ALARM

When the generator is shut down due to a latching alarm, the controller must be set to the OFF mode and the “Enter” key pressed to unlatch any active fault and clear the corresponding fault alarm message.

Table 30. Evolution Warnings and Alarm Parameters

Description	Hold-off Time	Duration Time	Continuous or 2 looks	Upper threshold	Lower threshold	Lockout Type
Low Oil Pressure	5 seconds	8 seconds	2 looks	Digital input	Digital input	Hard Lockout
RPM Sensor Loss	3 seconds 4 sec (8 kW only)	1.1 seconds	Continuous	Timed signal loss	Timed signal loss	2 Recrank, Hard Lockout
Wiring error	0 seconds	7.5% of 100 ms	100 ms sample periods	7.50%	None	Hard Lockout
High temp.	10 seconds	1 second	2 looks	Digital input	Digital input	Auto Reset
Underspeed	5 seconds	30 seconds	Continuous	None	55 Hz/3300 RPM	Hard Lockout
Underspeed 50 Hz	5 seconds	30 seconds	Continuous	None	40 Hz/2400 RPM	Hard Lockout
Overspeed Instant 50 Hz	0 seconds	.1 second	Continuous	62.5 Hz/3750 RPM	None	Hard Lockout
Overspeed Slow 50 Hz	0 seconds	3 seconds	Continuous	60Hz/3600 RPM	None	Hard Lockout
Overspeed Instant	0 seconds	.1 second	Continuous	75 HZ/4500 RPM	None	Hard Lockout
Overspeed Slow	0 seconds	3 seconds	Continuous	72 HZ/4320 RPM	None	Hard Lockout
Undervoltage Fast*	10 seconds	2 seconds	Continuous	None	15 Volts or no zero crosses detected	2 Recrank, Hard Lockout
Undervoltage Slow*	5 seconds	10 seconds	Continuous	None	80% of nominal	2 Recrank, Hard Lockout
Overvoltage fast *	5 seconds	1/5 second	Continuous	130% nominal	None	Hard Lockout
Overvoltage slow *	5 seconds	3 seconds	Continuous	110% nominal	None	Hard Lockout
Stepper Overcurrent	0 seconds	Instant	Continuous	NA	NA	Hard Lockout
Fuse Problem	0 seconds	75% of 100ms	Continuous	NA	NA	Hard Lockout
Overload Alarm	0 seconds	20 seconds	Continuous	102% rated current	NA	Hard Lockout
Overload Undervoltage	5 seconds	10 seconds	Continuous	NA	80% of nominal after Overload Alarm	Hard Lockout
Low Battery	60 seconds	As long as battery is <12.1 VDC	Continuous	NA	12.1 V or less	Warning
Battery Problem	0 seconds	NA	Continuous	> 16V immediate OR > 600mA for 5 sec after 18hr charge cycle		Warning
Charger Warning	0 seconds	NA	Continuous	NA	12.5 V at end of charge cycle	Warning
Charger Missing AC	15 seconds	As long as AC is missing	Continuous except cranking	NA	NA	Warning
Overcrank	0 seconds	5 attempts	NA	NA	NA	Hard Lockout

INTRODUCTION

The “Operational Analysis” is intended to familiarize the service technician with the operation of the DC and AC control system. A thorough understanding of how the system works is essential to sound and logical troubleshooting.

UTILITY SOURCE VOLTAGE AVAILABLE

Refer to Figure 144. The circuit condition with the controller set to the AUTO mode and with Utility source power available can be briefly described as follows:

- Utility source voltage is available to the transfer switch Terminal Lugs N1 and N2 and the CONTACTOR is in the “Utility” position.
- Utility voltage is available to the controller via Wire N1 and N2 (see Figure 142).
- Load voltage (120 VAC) is available to the controller via Wire T1 for Battery Charger. (220 VAC on T1 and T2 50 Hz only)
- The controller is shown in the AUTO mode. Battery voltage is available to the circuit board via Wire 13, the 7.5 amp fuse (F1). Wire 194 provides 12 VDC to the transfer relay in the transfer switch. (see Figure 143).
- Wire 820 supplies 5 VDC to the Tri-Light Annunciator and Wire 817 for the Green System Ready LED is gated to ground.

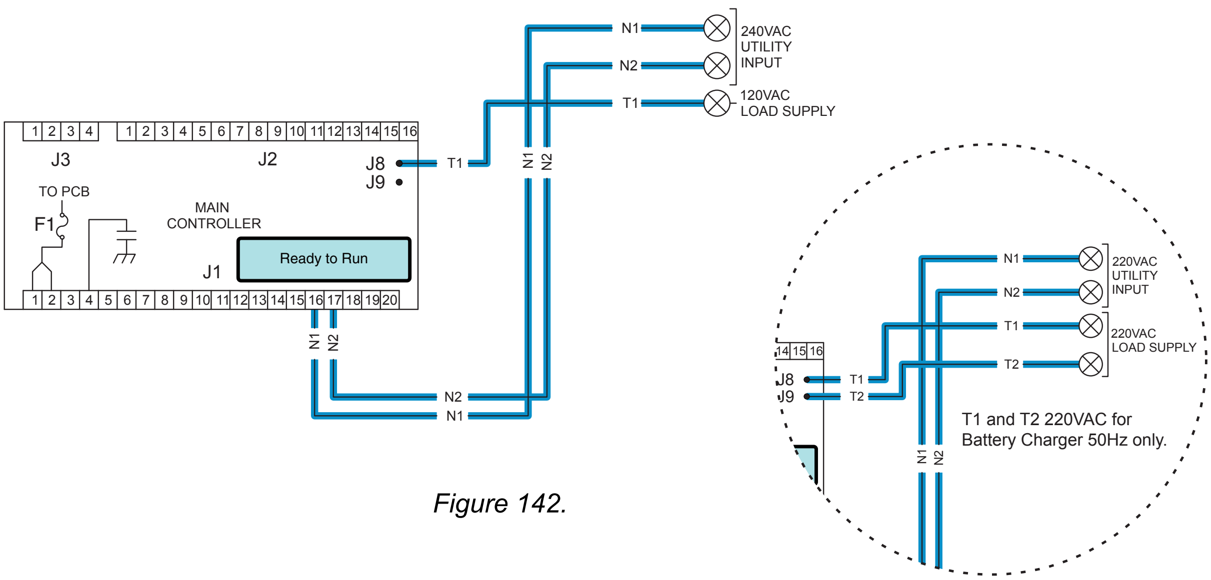


Figure 142.

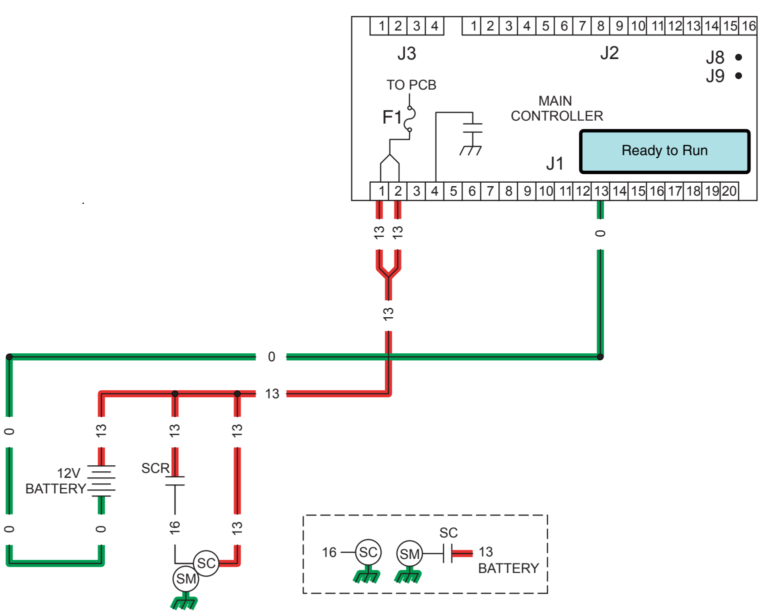
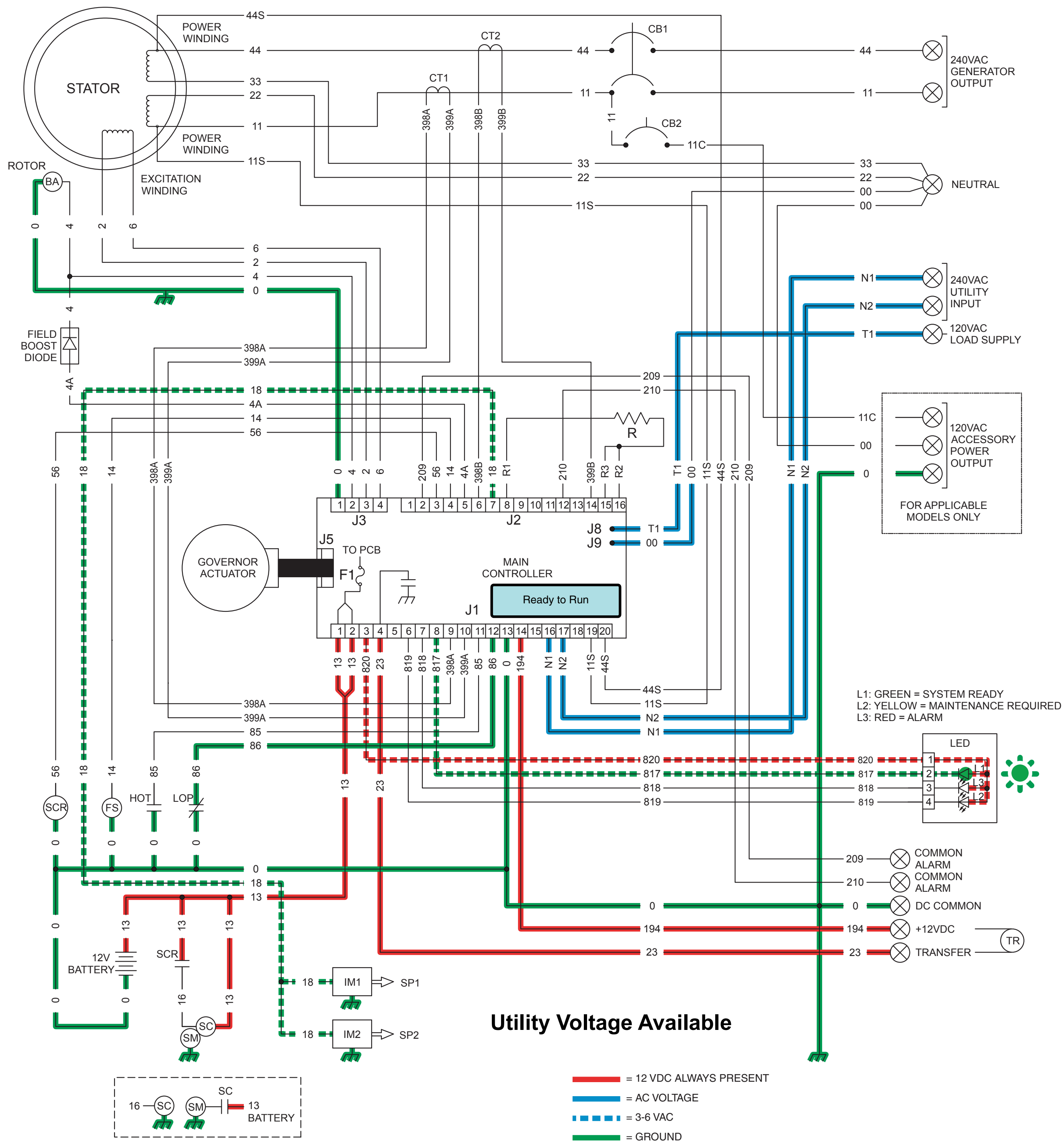


Figure 143.



LEGEND

BA - BRUSH ASSEMBLY	LED - LED BOARD
CB1 - CIRCUIT BREAKER (MAIN OUTPUT)	LOP - LOW OIL PRESSURE SWITCH
CB2 - CIRCUIT BREAKER (GFCI)	R - RESISTOR
CT_ - CURRENT TRANSFORMER	SC - STARTER CONTACTOR
FS - FUEL SOLENOID	SCR - STARTER CONTROL RELAY
HOT - HIGH OIL TEMPERATURE SWITCH	SM - STARTER MOTOR
IM_ - IGNITION MODULE	SP_ - SPARK PLUG

- = 12 VDC ALWAYS PRESENT
- = AC VOLTAGE
- = 3-6 VAC
- = GROUND
- = PCB GROUND CONTROL
- = 12 VDC DURING CRANKING ONLY
- = 12 VDC DURING ENGINE RUN CONDITION
- = HIGH VOLTAGE IGNITION SPARK
- = DC FIELD EXCITATION
- = 5 VDC TO LED

Figure 144. Utility Source Voltage Available

INITIAL DROPOUT OF UTILITY SOURCE VOLTAGE

Refer to Figure 146. Should a Utility power failure occur, circuit condition may be briefly described as follows:

- The controller continually monitors for acceptable Utility voltage via N1 and N2. Should Utility voltage drop below approximately 65% (adjustable, see chart) of the nominal source voltage, a programmable timer on the controller will turn on.
- In Figure 145, the 10-second timer (factory default, but adjustable from 2-1500 seconds) is still timing and engine cranking has not yet begun.

Utility Dropout	
Factory Default	**Adjustable Dropout**
60 Hz = 156 VAC	60 Hz = 140-171 VAC
50 Hz = 142 VAC	50 Hz = 140-156 VAC

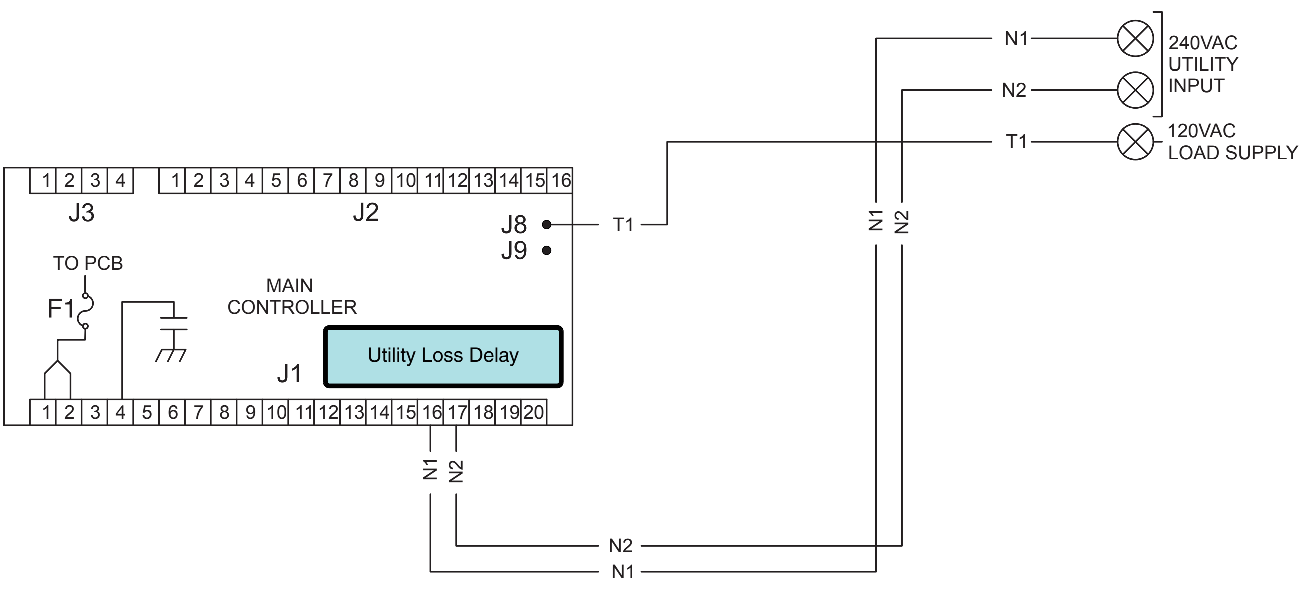


Figure 145.

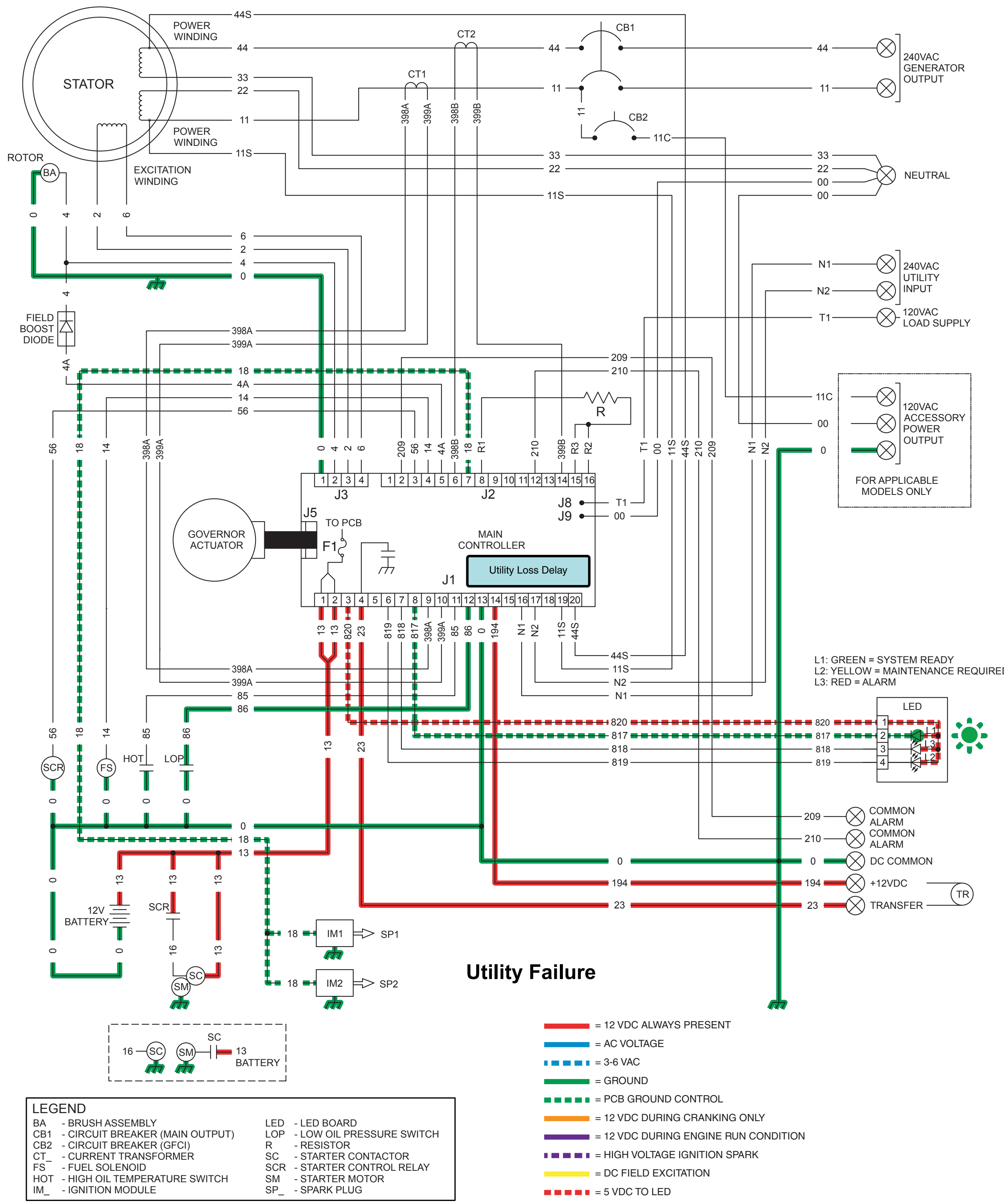


Figure 146. Initial Dropout of Utility Source Voltage

UTILITY VOLTAGE FAILURE AND ENGINE CRANKING

- After the controller's adjustable programmed timer has timed out, if Utility voltage is still below the programmed utility drop out level, the controller's logic will energize the internal crank relay followed by the internal run relay.
- When the internal crank relay energizes, 12 VDC is delivered to the starter contactor relay (SCR) via Wire 56. When the SCR energizes, its contacts close and battery voltage is delivered to a starter contactor (SC). When the SC energizes, its contacts close and battery voltage is delivered to the starter motor (SM); the engine is now cranking.
- A 12 VDC power supply is delivered to the stepper motor via the Red Wire and the other wires are gated to ground by the controller to open the throttle position.

Note: The stepper motor will cycle the mixer to a full open throttle position (which opens both venturis), back to a closed position and then to the starting position of opening the throttle of the small venturi.

- With the engine cranking, a pulsing AC speed reference signal is generated by the magneto(s) and is delivered to the controller through Wire 18. If a valid signal is received, the controller will energize the internal run relay and deliver 12 VDC on Wire 14. The fuel solenoid energizes (mechanically opens) and fuel is available to the engine.

Note: If the controller does not see a RPM signal, it will not energize Wire 14/Fuel Solenoid.

- With ignition and fuel flow available the engine RPM will begin to increase.

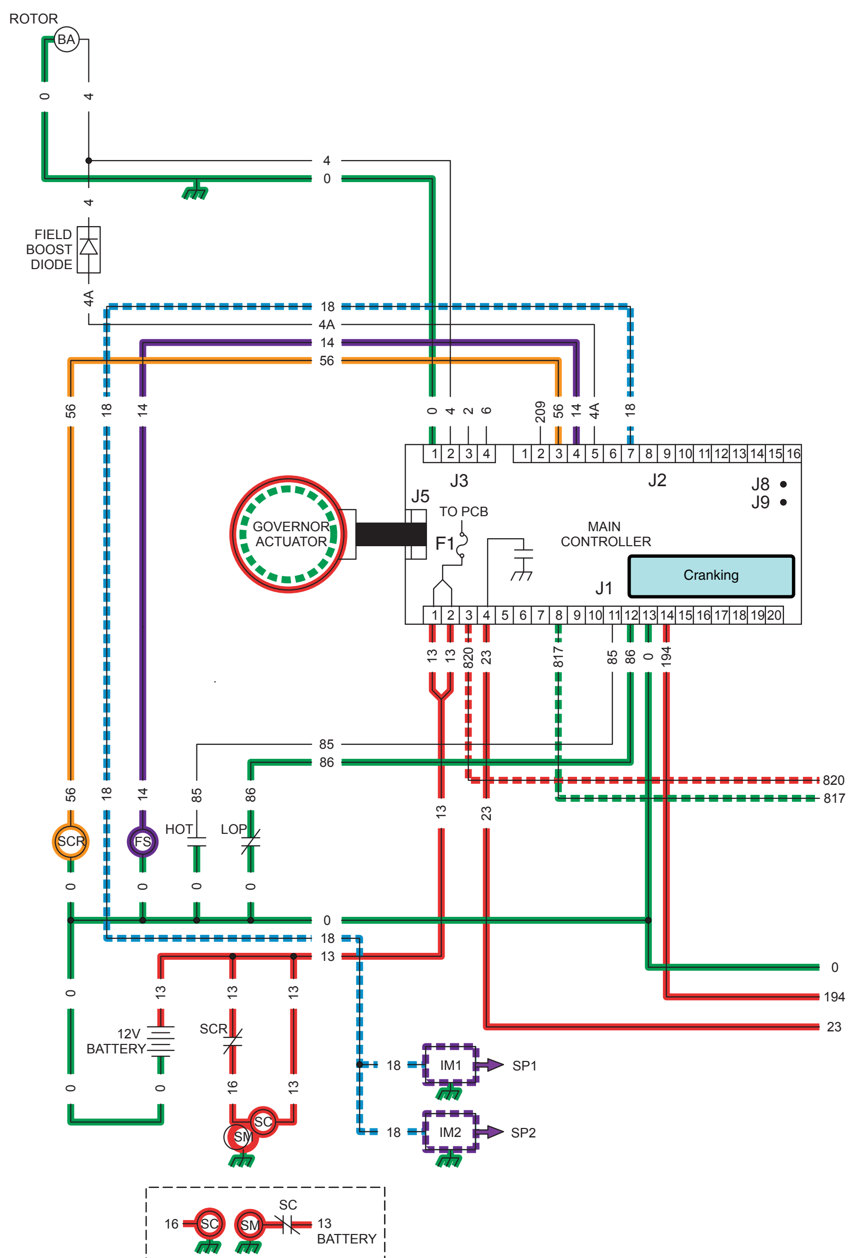


Figure 147.

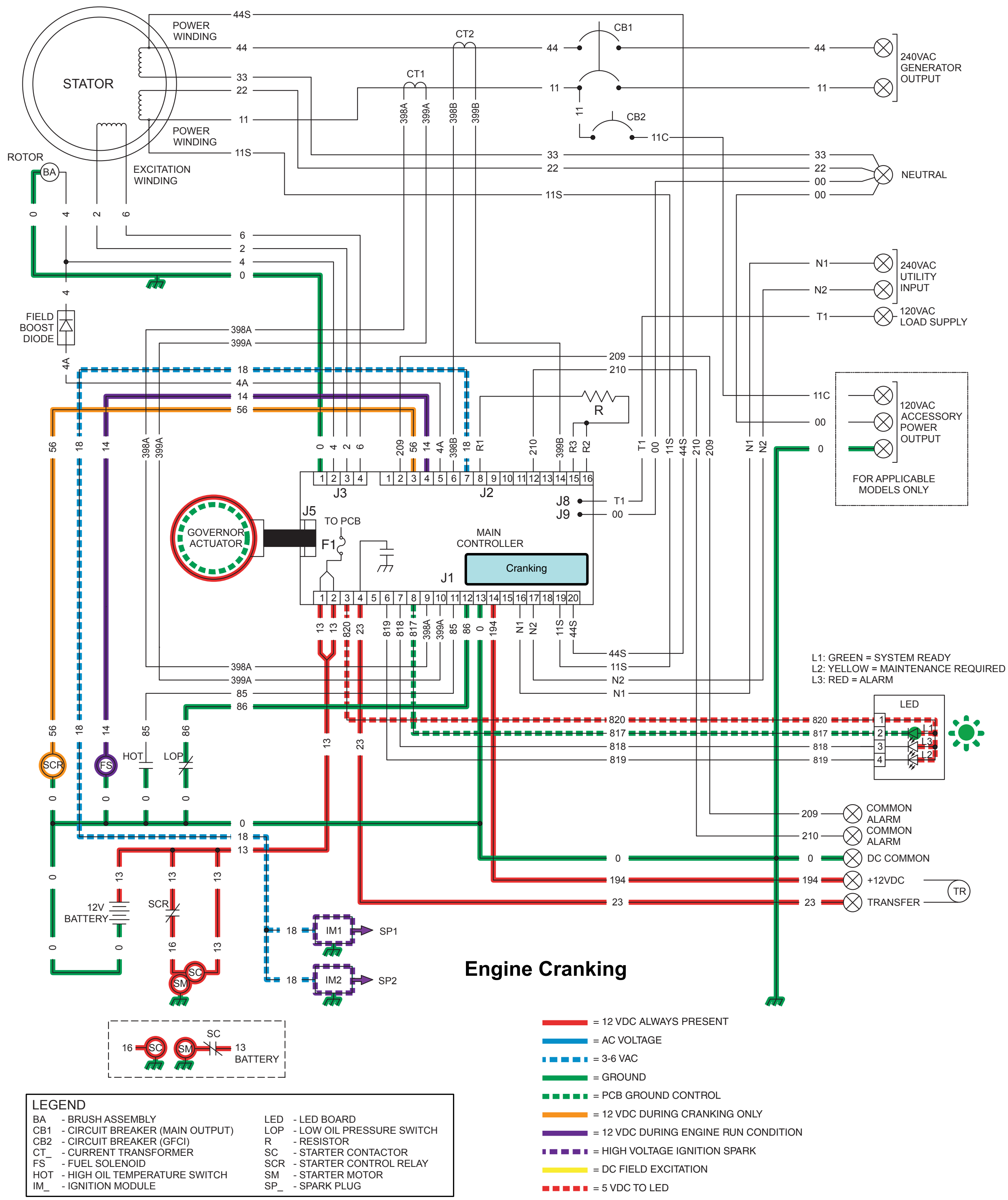


Figure 148. Utility Voltage Failure and Engine Cranking

ENGINE STARTUP AND RUNNING

With the fuel solenoid open and ignition occurring, the engine starts. Engine startup and running may be briefly described as follows:

- The ignition magneto(s) deliver a speed reference signal to the controller via Wire 18. Once the controller determines that the engine is running, the controller:
  (a) terminates cranking at approximately 1500 RPM (V-twin) and 1800 RPM (single cylinder).
  (b) energizes a field flash relay in the controller at 2200 RPM which delivers 12 VDC on Wire 4A through a field boost diode and to the rotor via Wire 4. The field boost will continue for a pre-determined time, or until 88 VAC (240 VAC sensing) is achieved, whichever occurs first.

Note: See "Field Boost" in Section 2.2 for analysis of Evolution field boost parameters.

  (c) also at 2200 RPM the hold off timers activate and the 5 second "warm-up timer" goes active.

- The "engine warm-up timer" will run for 5 seconds. When this timer finishes timing, the controller's logic will initiate a transfer to the "Standby" position. As shown in the next series, the timer is still running and transfer has not yet occurred.
- Generator AC output is available to the transfer switch Terminal Lugs E1 and E2 and to the normally open contacts of the transfer relay. However, the transfer relay is de-energized and its contacts are open.

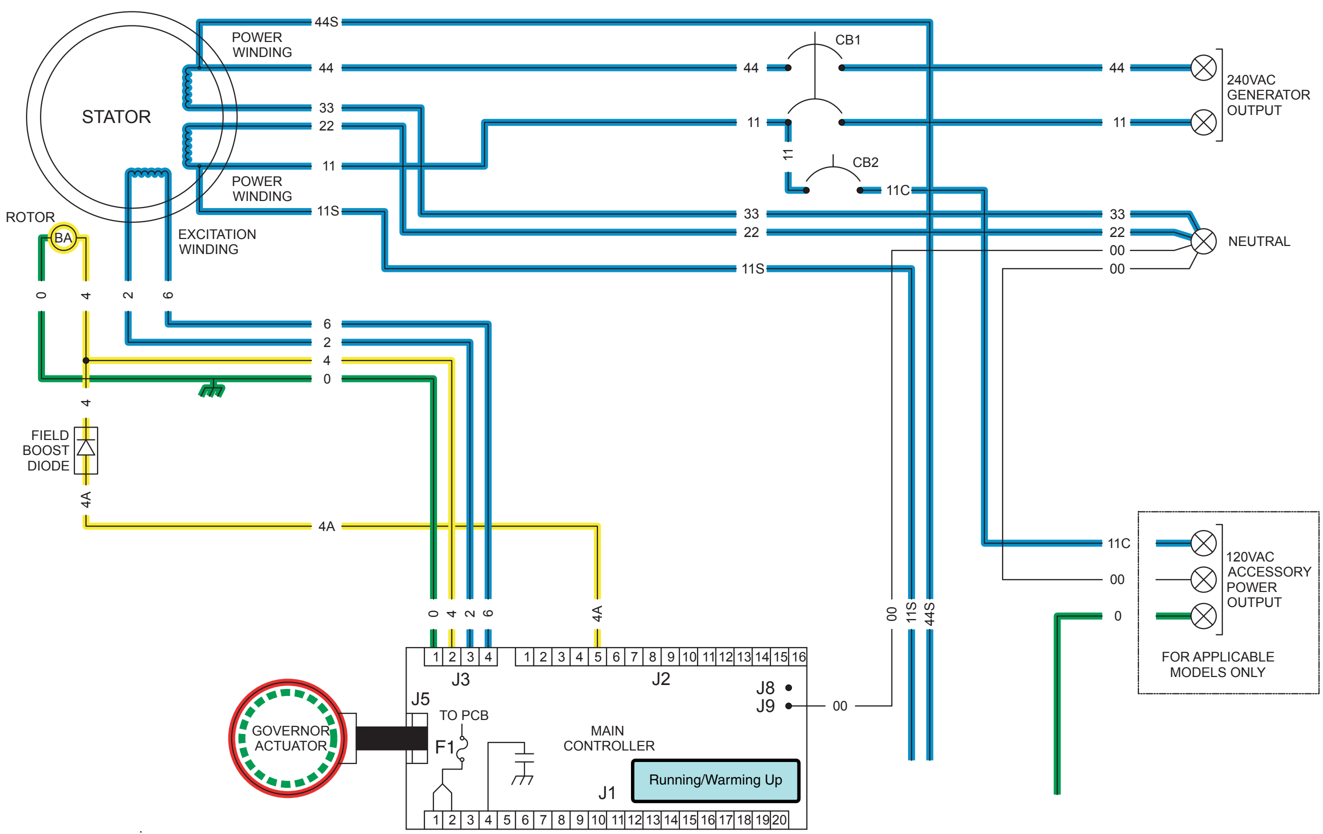
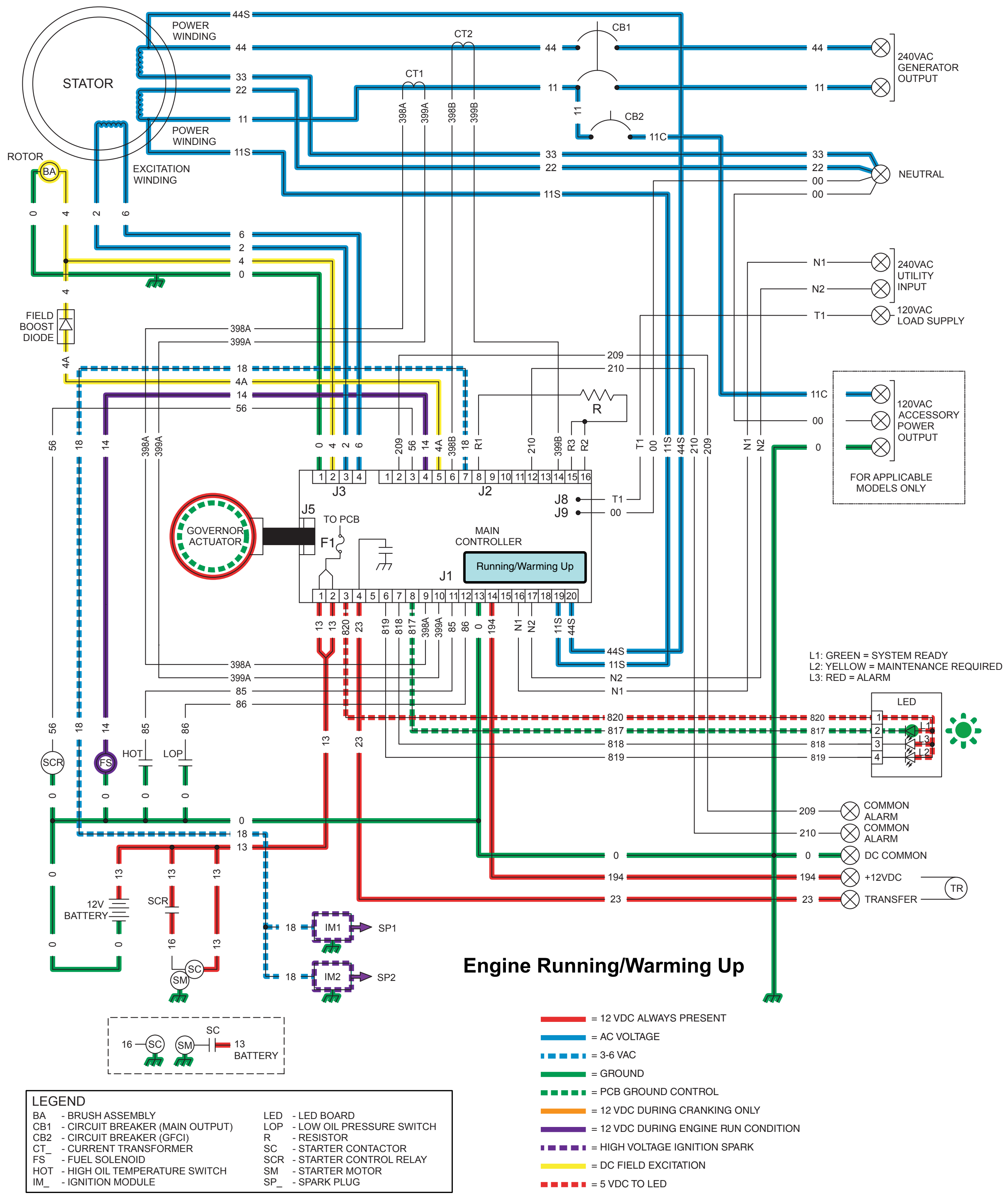


Figure 149.



LEGEND

BA	- BRUSH ASSEMBLY	LED	- LED BOARD
CB1	- CIRCUIT BREAKER (MAIN OUTPUT)	LOP	- LOW OIL PRESSURE SWITCH
CB2	- CIRCUIT BREAKER (GFCI)	R	- RESISTOR
CT_	- CURRENT TRANSFORMER	SC	- STARTER CONTACTOR
FS	- FUEL SOLENOID	SCR	- STARTER CONTROL RELAY
HOT	- HIGH OIL TEMPERATURE SWITCH	SM	- STARTER MOTOR
IM_	- IGNITION MODULE	SP_	- SPARK PLUG

Figure 150. Engine Startup and Running

TRANSFER TO STANDBY

In Figure 152 the Generator is running, the controller's “engine warm-up” timer has expired and generator AC output is available to the transfer switch Terminal Lugs E1 and E2 and to the open contacts on the transfer relay. Transfer to Standby may be briefly described as follows:

- 12 VDC is delivered to the transfer relay coil (TR1 - Terminal A) via Wire 194. The 12 VDC circuit is completed back to the controller via Wire 23 (TR1 - Terminal B). However, the controller’s logic holds Wire 23 open from ground and the TR1 relay is de-energized.
- When the “engine warm-up timer” expires, the controller will take Wire 23 to ground. The TR1 relay energizes and its normally open contacts close (standby position).
- While running, the pulsing AC speed reference from the ignition magneto(s) to the controller via Wire 18 will be used for the following functions:

  (a) governor speed control to maintain frequency through different loads

  (b) overspeed

  (c) underspeed
- With no, or a light load, the stepper motor will control the throttle position of the smaller venturi. As the load demand increases and with the smaller venturi nearly wide open, it will start to open the larger venturi as needed for load/fuel demand.
- With loads applied, CT1 - Wires 398A/399A and CT2 - Wires 398B/399B deliver approximately 0- 1.5 VAC based on percentage of Amps (load).

  Approximate Values (when back-probed at connector):

  25 Amps = 0.380 mVAC

  50 Amps = 0.755 mVAC

  75 Amps = 1.133 VAC

  100 Amps = 1.510 VAC

  WARNING!

Shock Hazard: Unplugged (Unburdened) CT's should never be handled with primary current applied!

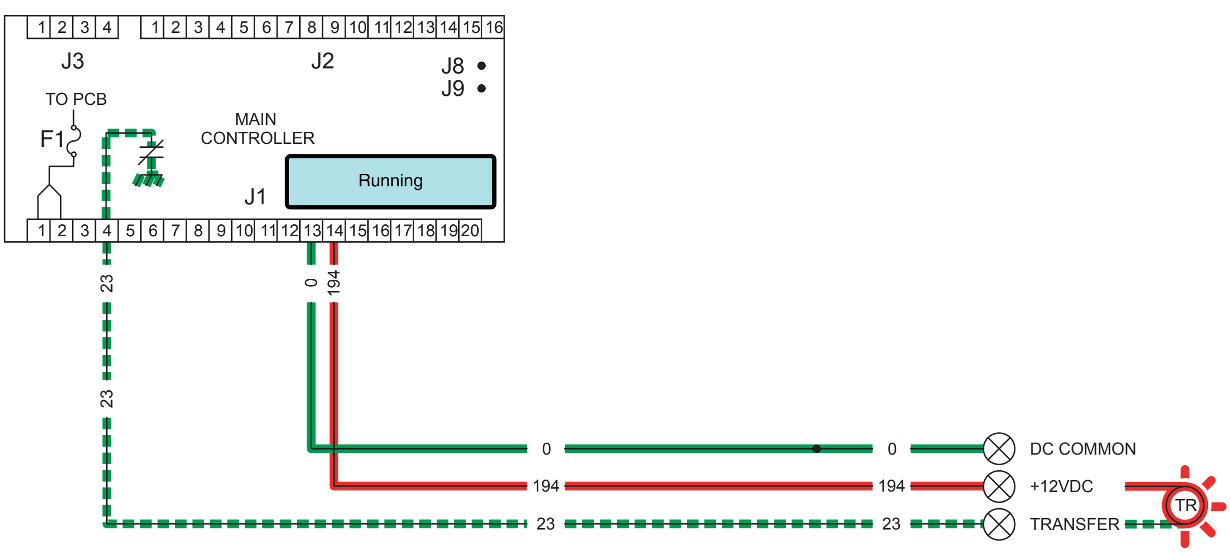
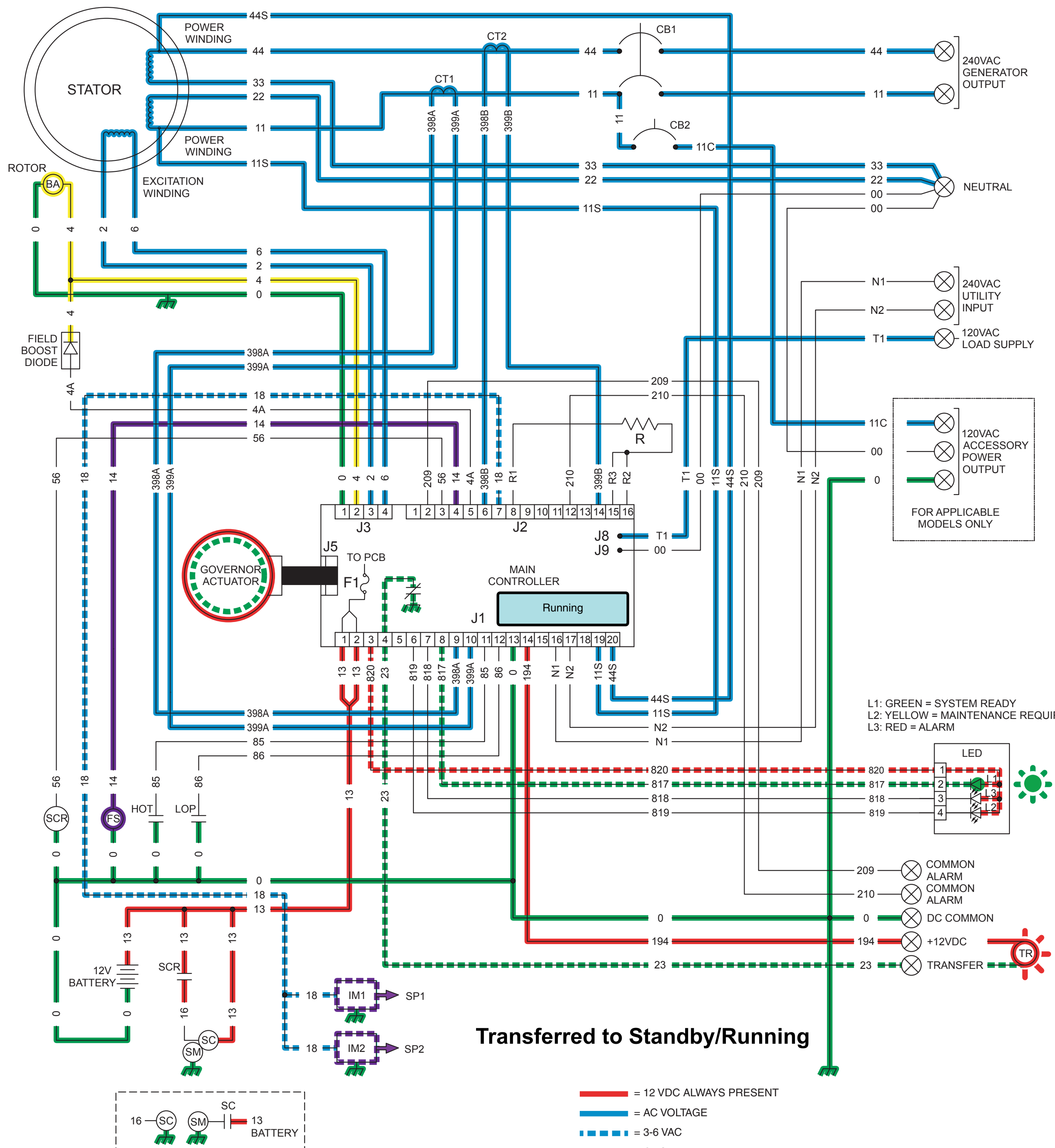


Figure 151.



= 12 VDC ALWAYS PRESENT
= AC VOLTAGE
= 3-6 VAC
= GROUND
= PCB GROUND CONTROL
= 12 VDC DURING CRANKING ONLY
= 12 VDC DURING ENGINE RUN CONDITION
= HIGH VOLTAGE IGNITION SPARK
= DC FIELD EXCITATION
= 5 VDC TO LED

LEGEND

BA - BRUSH ASSEMBLY	LED - LED BOARD
CB1 - CIRCUIT BREAKER (MAIN OUTPUT)	LOP - LOW OIL PRESSURE SWITCH
CB2 - CIRCUIT BREAKER (GFCI)	R - RESISTOR
CT_ - CURRENT TRANSFORMER	SC - STARTER CONTACTOR
FS - FUEL SOLENOID	SCR - STARTER CONTROL RELAY
HOT - HIGH OIL TEMPERATURE SWITCH	SM - STARTER MOTOR
IM_ - IGNITION MODULE	SP_ - SPARK PLUG

Figure 152. Transfer to Standby

UTILITY VOLTAGE RESTORED AND RE-TRANSFER TO UTILITY

The Load is powered by Generator voltage. On restoration of Utility voltage, the following events will occur:

- On restoration of Utility voltage above 75% (programmable, see chart for range) of the nominal rated voltage, a “re-transfer time delay” on the controller starts timing. The timer will run for 15 seconds.
- At the end of the 15 seconds, the “re-transfer time delay” will stop timing. The controller will open the Wire 23 circuit from ground and the transfer relay (TR1) will de-energize.
- The generator continues to run in its cooling down mode.

Note: If utility fails during the cool-down timer cycle for 5 seconds, the controller will transfer back to standby.

Utility Pickup	
Factory Default	**Adjustable Pickup**
60 Hz = 190 VAC	60 Hz = 190-216 VAC
50 Hz = 175 VAC	50 Hz = 175-198 VAC

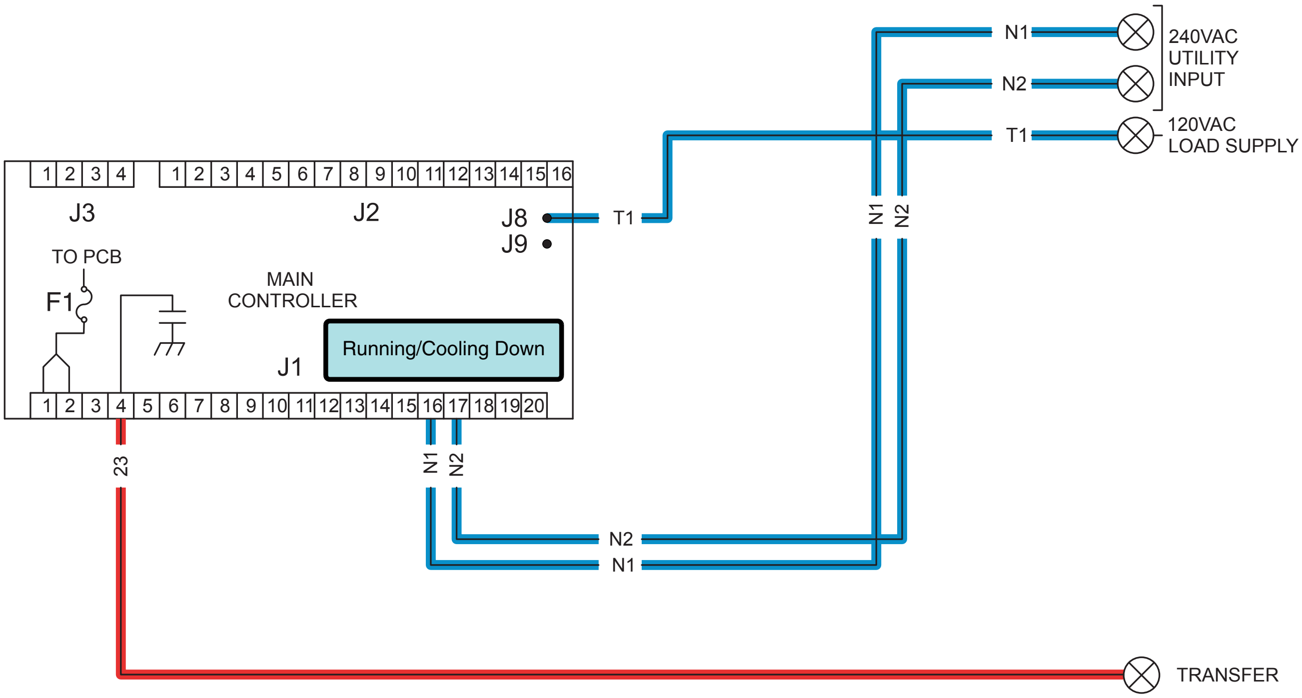


Figure 153.

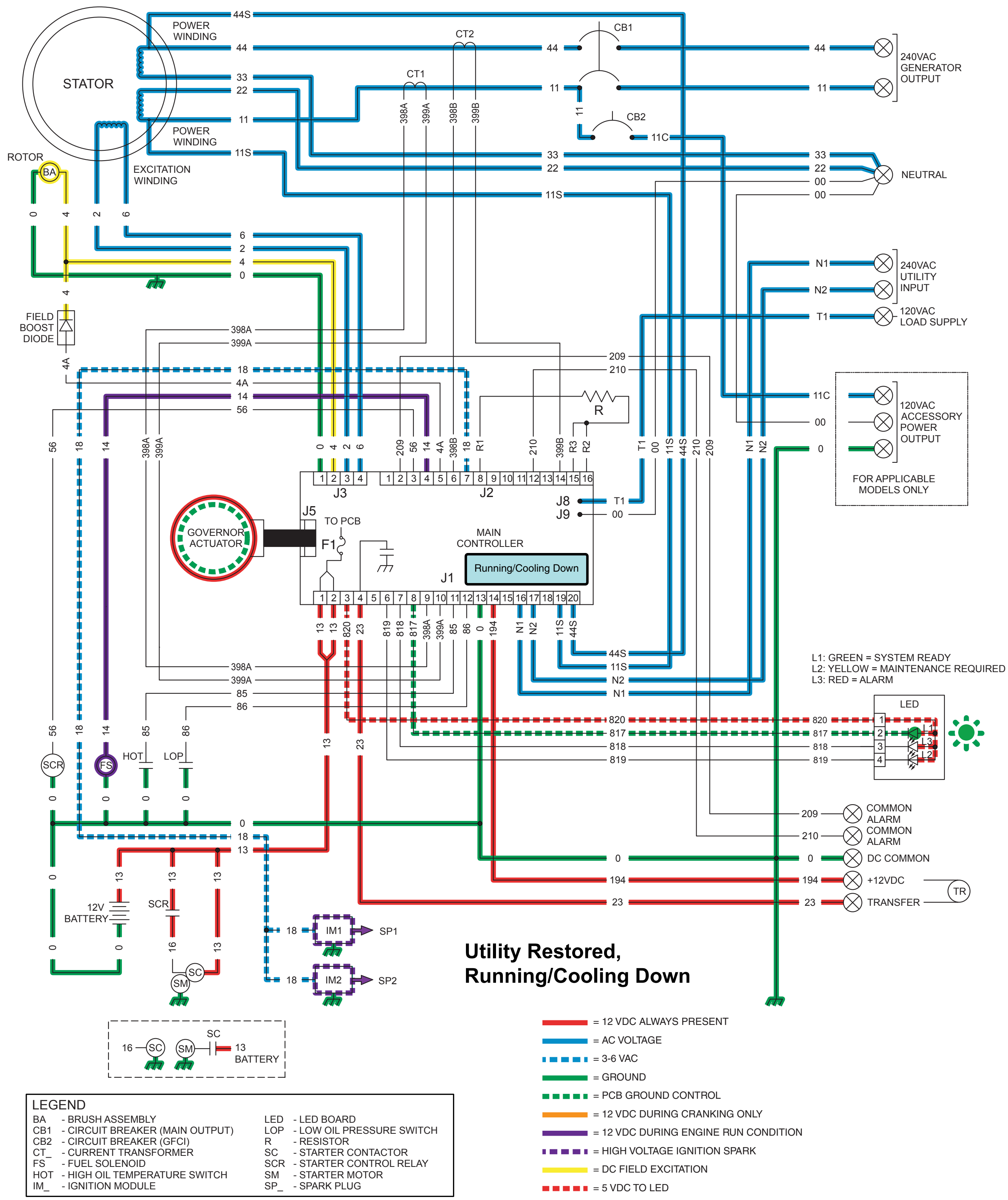


Figure 154. Utility Voltage Restored and Re-transfer to Utility

ENGINE SHUTDOWN

Following re-transfer back to the Utility source an "engine cool-down timer" on the controller starts timing. When the timer has expired (approximately one minute), the controller will de-energize the internal run relay removing fuel from the engine. The following events will occur:

- Wire 14 (run circuit) will de-energize and the fuel solenoid will close to terminate the fuel supply to the engine.
- The controller's logic will connect the engine's ignition magnetos to ground via Wire 18. Ignition will terminate.
- Without fuel flow and without ignition the engine will shut down.

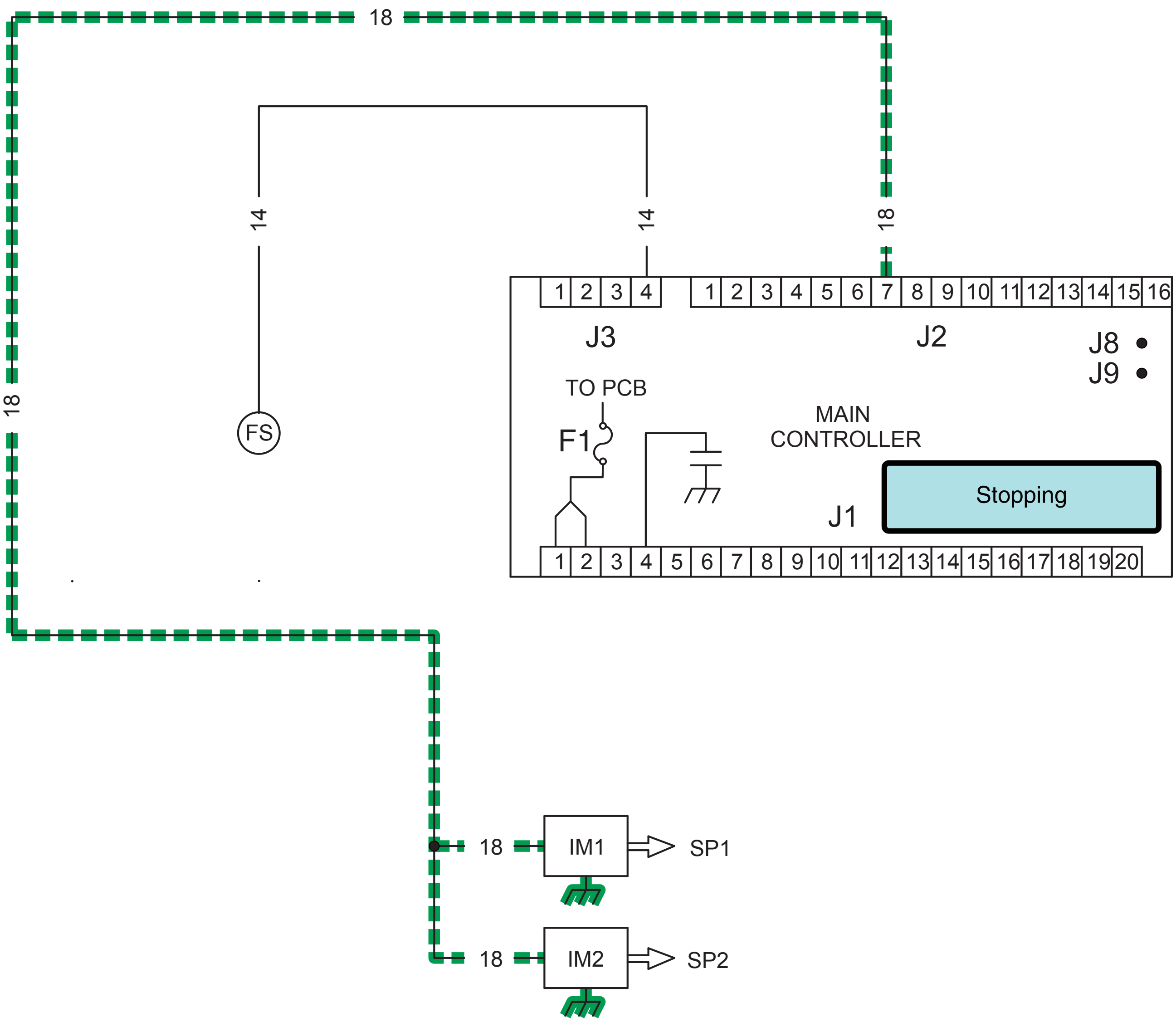


Figure 155.

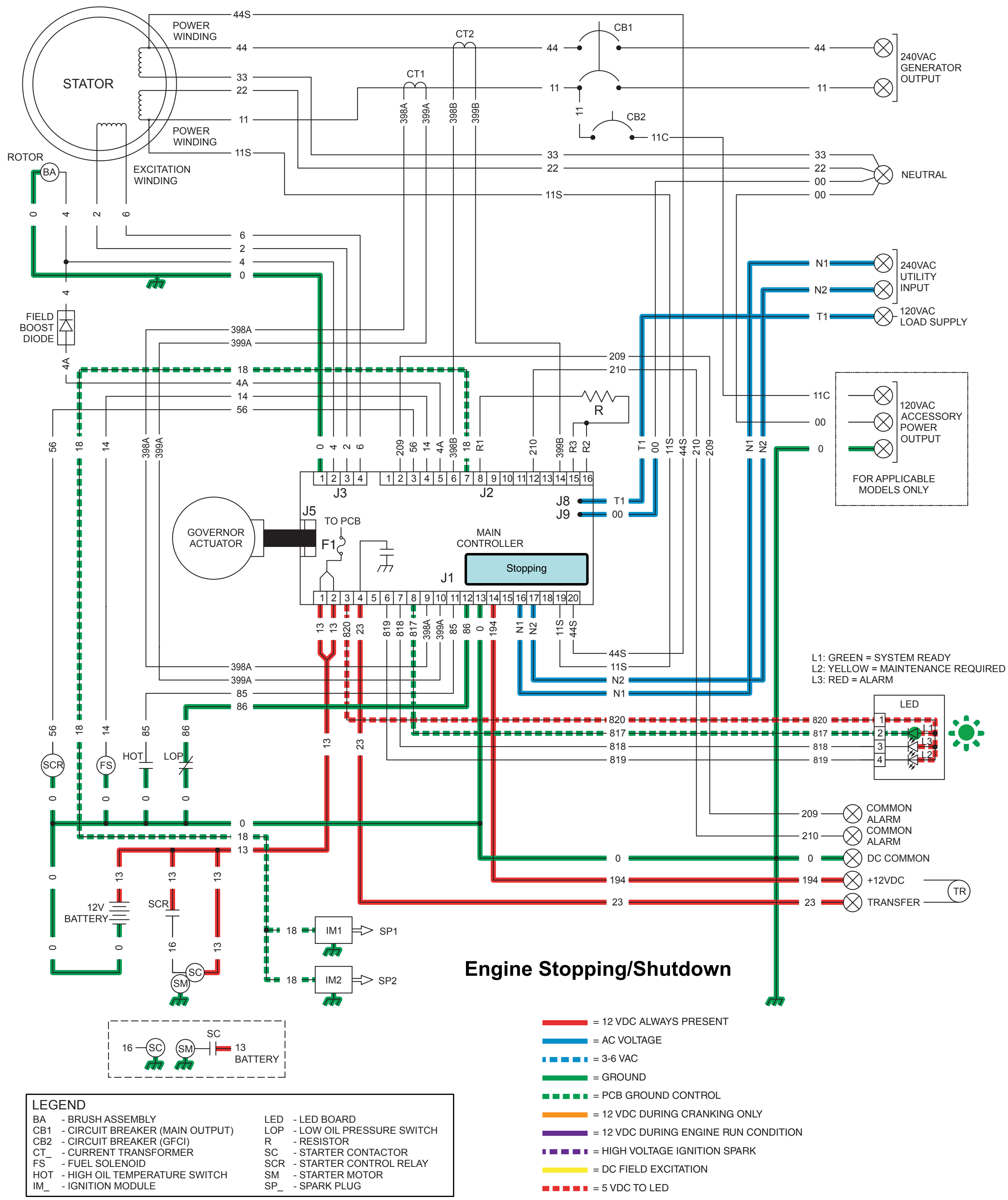


Figure 156. Engine Shutdown

INTRODUCTION

The “Operational Analysis” is intended to familiarize the service technician with the operation of the DC and AC control system. A thorough understanding of how the system works is essential to sound and logical troubleshooting. The control system illustrations on the following pages represent a 17 kW unit.

UTILITY SOURCE VOLTAGE AVAILABLE

Refer to Figure 159. The circuit condition with the controller set to the AUTO mode and with Utility source power available can be briefly described as follows:

- Utility source voltage is available to the transfer switch Terminal Lugs N1 and N2 and the CONTACTOR is in the “Utility” position.
- Utility voltage is available to the controller via Wire N1 and N2 (see to Figure 157).
- Battery voltage is available to the controller via Wire 13 when a Battery is installed (see Figure 158).

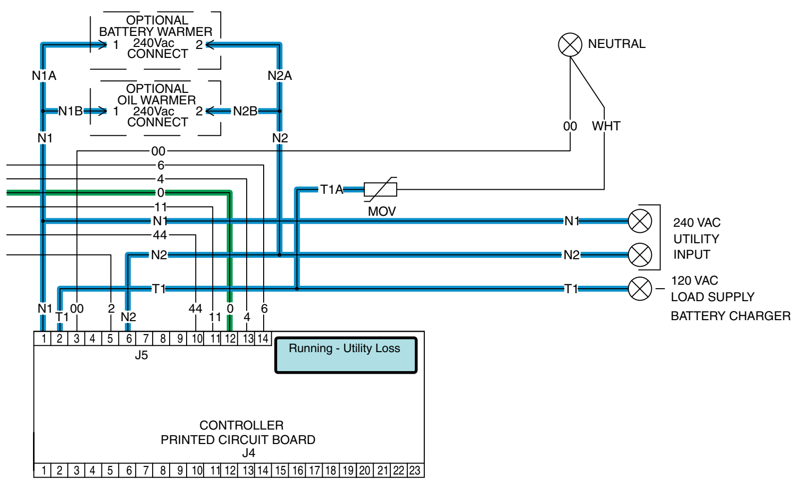


Figure 157.

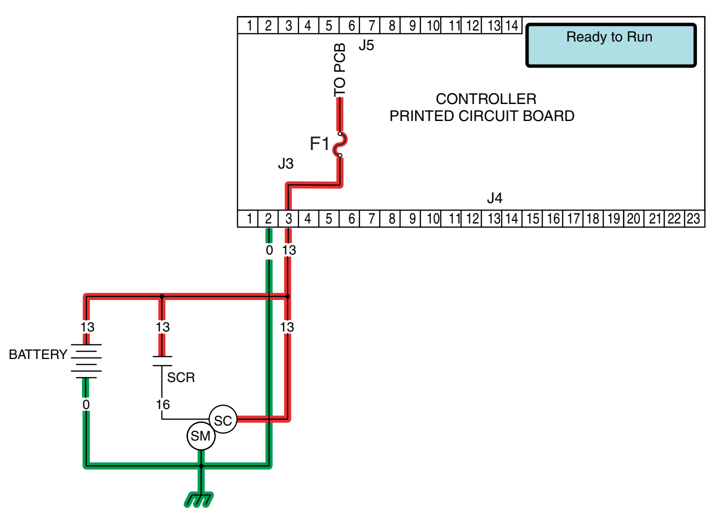


Figure 158.

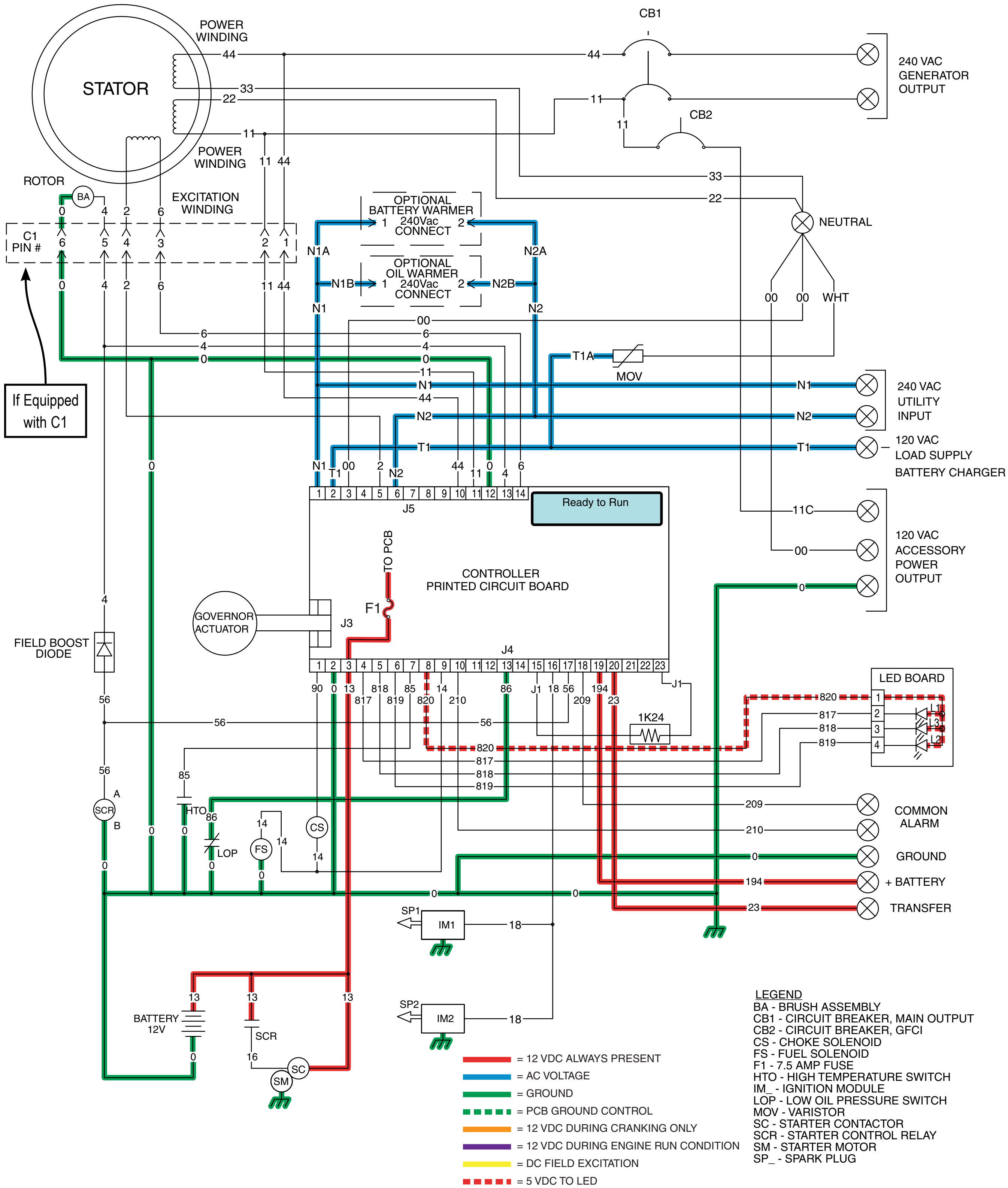


Figure 159. Utility Source Voltage Available

INITIAL DROPOUT OF UTILITY SOURCE VOLTAGE

Refer to Figure 161. Should a Utility power failure occur, circuit condition may be briefly described as follows:

- The controller continually monitors for acceptable Utility voltage via N1 and N2. Should Utility voltage drop below approximately 65% of the nominal source voltage, a programmable timer on the controller will turn on.
- In Figure 160, the 10-second timer is still timing and engine cranking has not yet begun.
- The controller is shown in the AUTO mode. Battery voltage is available to the circuit board via Wire 13, the 7.5 amp fuse (F1). Wire 194 provides 12 VDC to the transfer relay in the transfer switch.

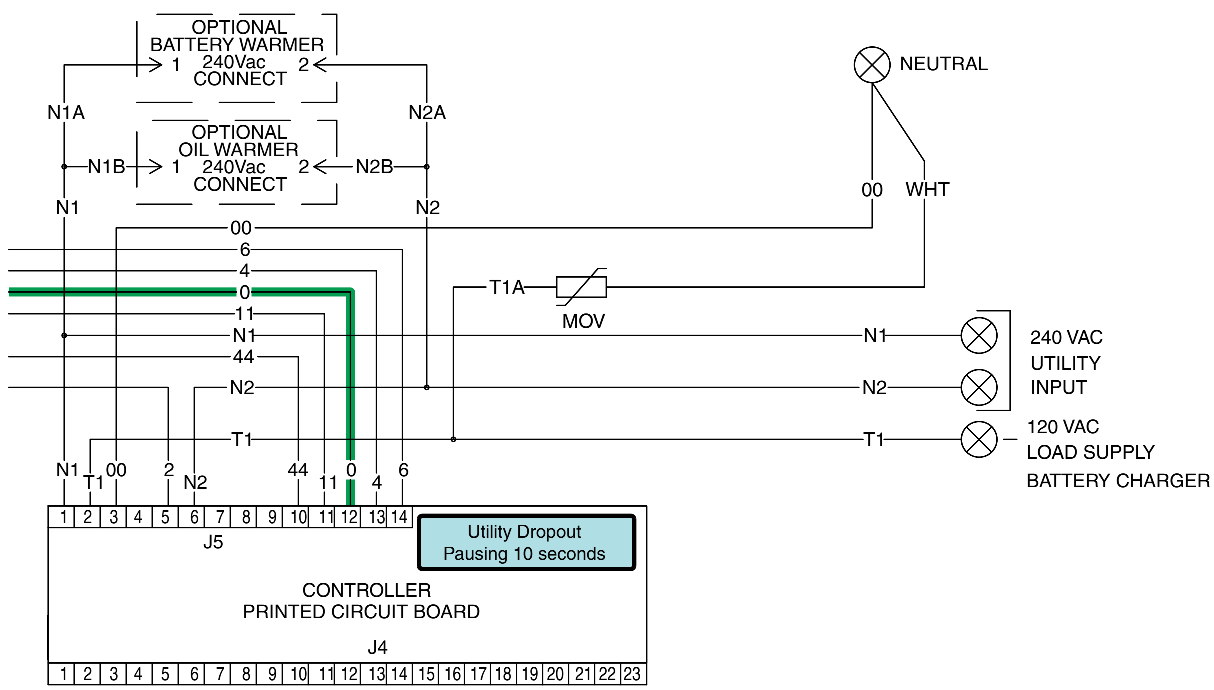


Figure 160.

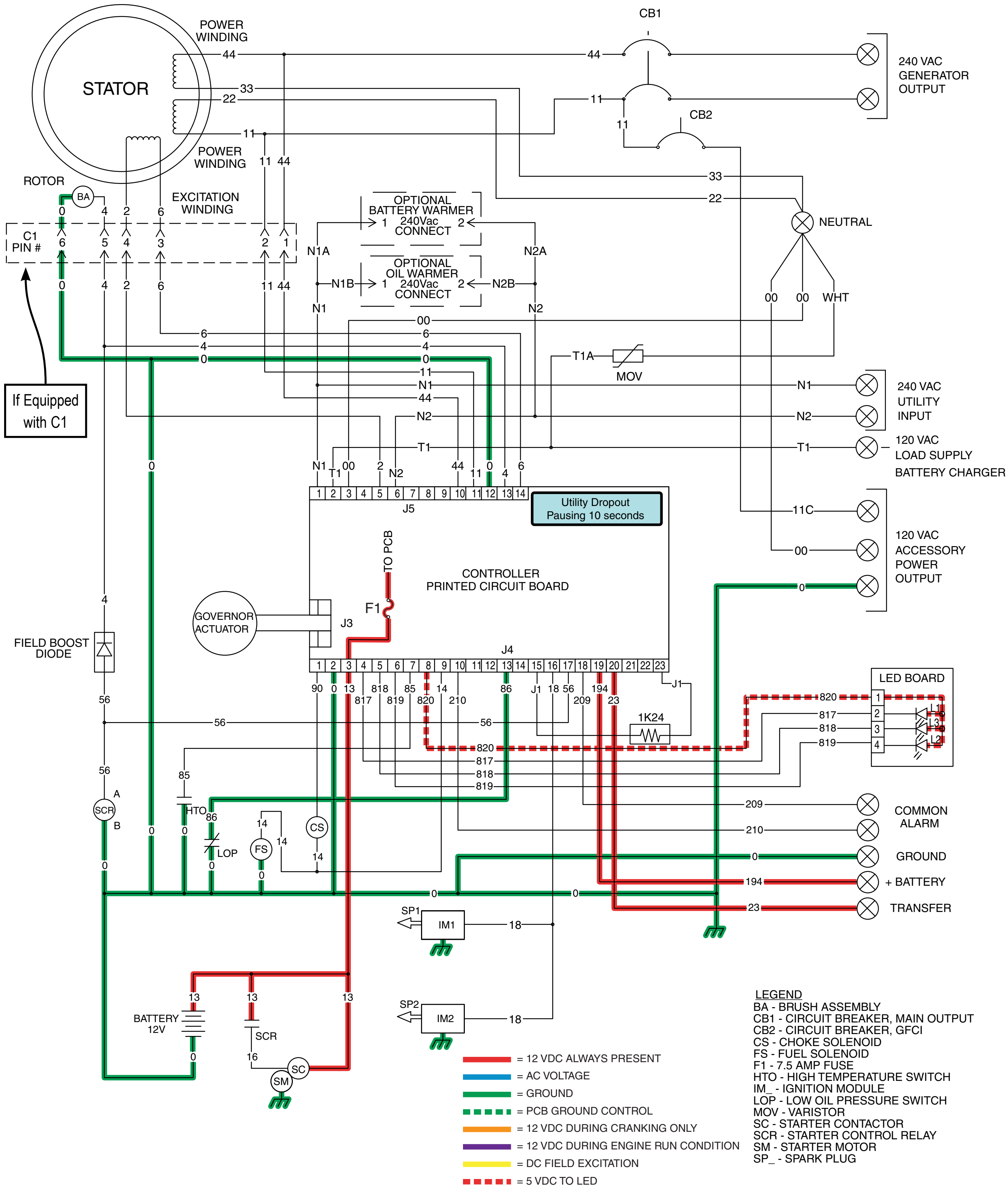


Figure 161. Initial Dropout of Utility Source Voltage

UTILITY VOLTAGE FAILURE AND ENGINE CRANKING

- After the controller's 10-second timer has timed out, if Utility voltage is still below 65% of nominal, the controller's logic will energize the internal crank relay followed by the internal run relay.
- When the internal crank relay energizes 12 VDC is delivered to the starter contactor relay (SCR) via Wire 56. When the SCR energizes its contacts close and battery voltage is delivered to a starter contactor (SC). When the SC energizes its contacts close and battery voltage is delivered to the starter motor (SM); the engine is now cranking.
- With the engine cranking a speed reference signal is generated by the magnetos and is delivered to the controller through Wire 18. If a valid signal is received, the controller will energize the internal run relay and deliver 12 VDC on Wire 14. The fuel solenoid energizes (opens) and fuel is available to the engine. The choke solenoid (CS) (Nexus Only) begins to operate and the controller grounds Wire 90, energizing the choke solenoid cyclically curing cranking, and continuously while running.
- During Cranking 3-5 VDC is supplied to the rotor for field flash via a field boost diode connected in parallel with Wire 56.
- With ignition and fuel flow available the engine will start.

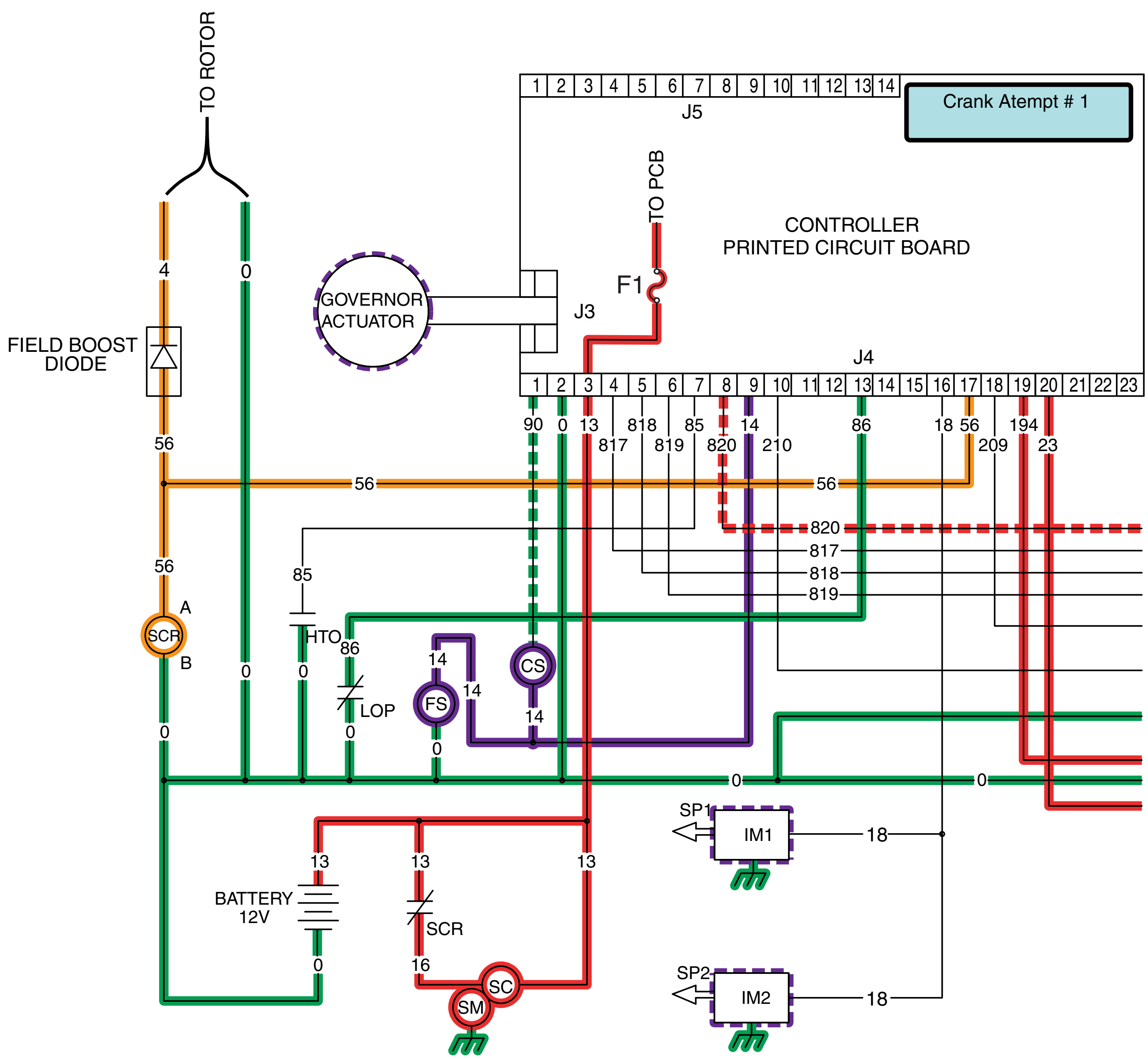


Figure 162.

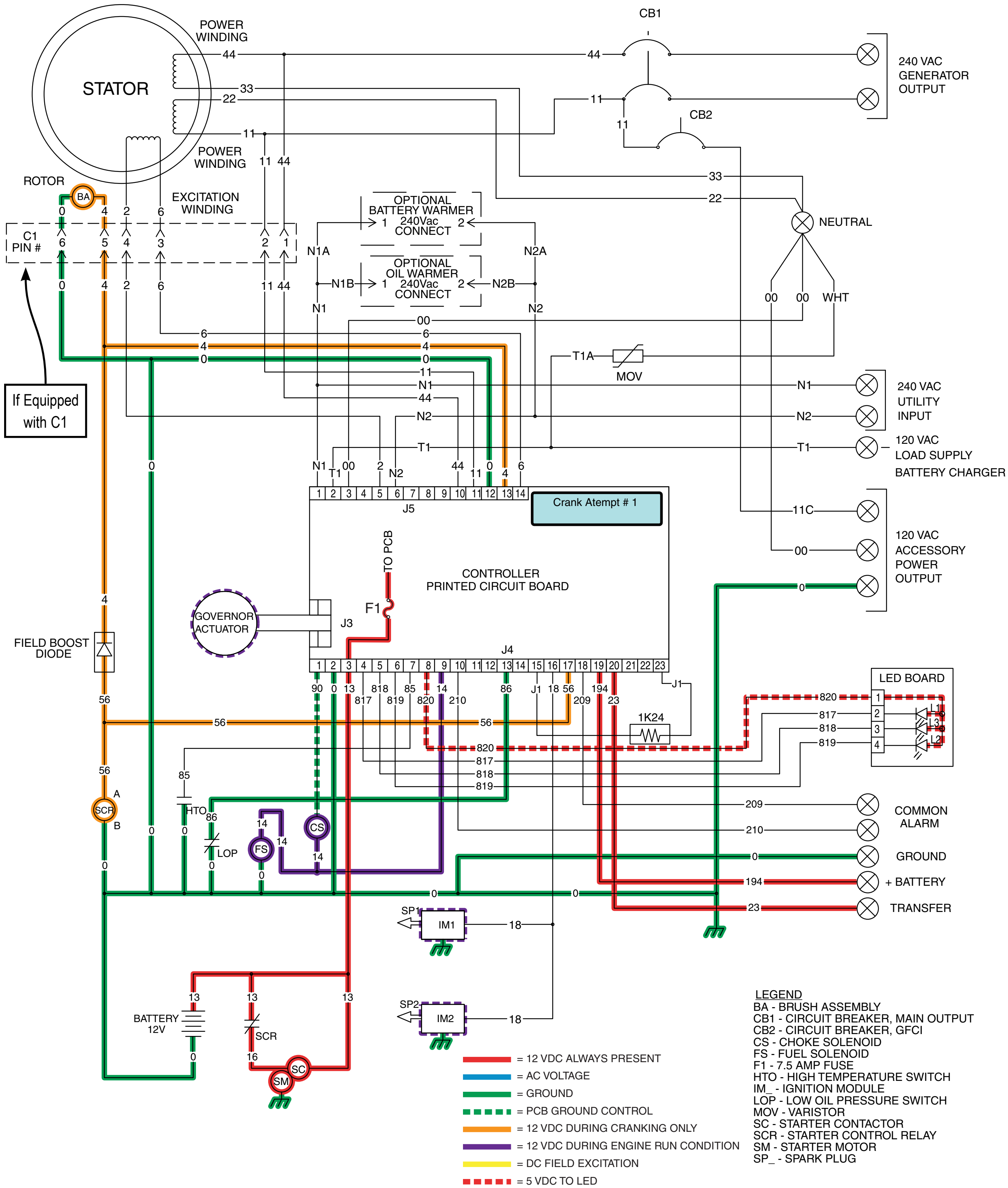


Figure 163. Utility Voltage Failure and Engine Cranking

ENGINE STARTUP AND RUNNING

With the fuel solenoid open and ignition occurring, the engine starts. Engine startup and running may be briefly described as follows:

- The ignition magnetos deliver a speed reference signal to the controller via Wire 18. Once the controller determines that the engine is running, the controller (a) terminates cranking, (b) continuously energizes the choke solenoid (open position), and (c) turns on an "engine warm-up timer".

Note: On 8 kW and 10 kW units the choke is de-energized to the open position (Wire 90 open from ground).

- The "engine warm-up timer" will run for 5 seconds. When this timer finishes timing the controller's logic will initiate a transfer to the "Standby" position. As shown in Figure 164, the timer is still running and transfer has not yet occurred.
- Generator AC output is available to the transfer switch Terminal Lugs E1 and E2 and to the normally open contacts of the transfer relay. However, the transfer relay is de-energized and its contacts are open.

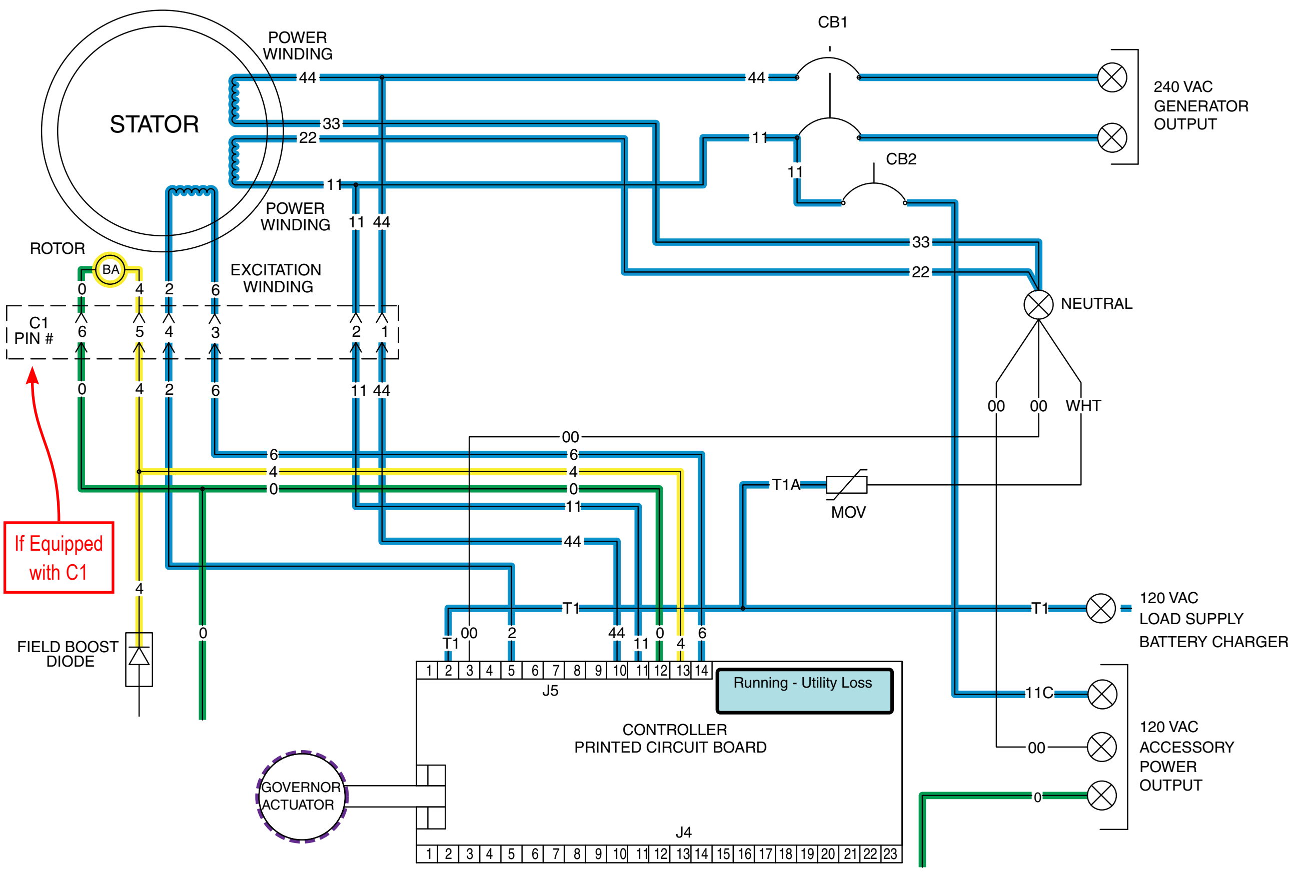


Figure 164.

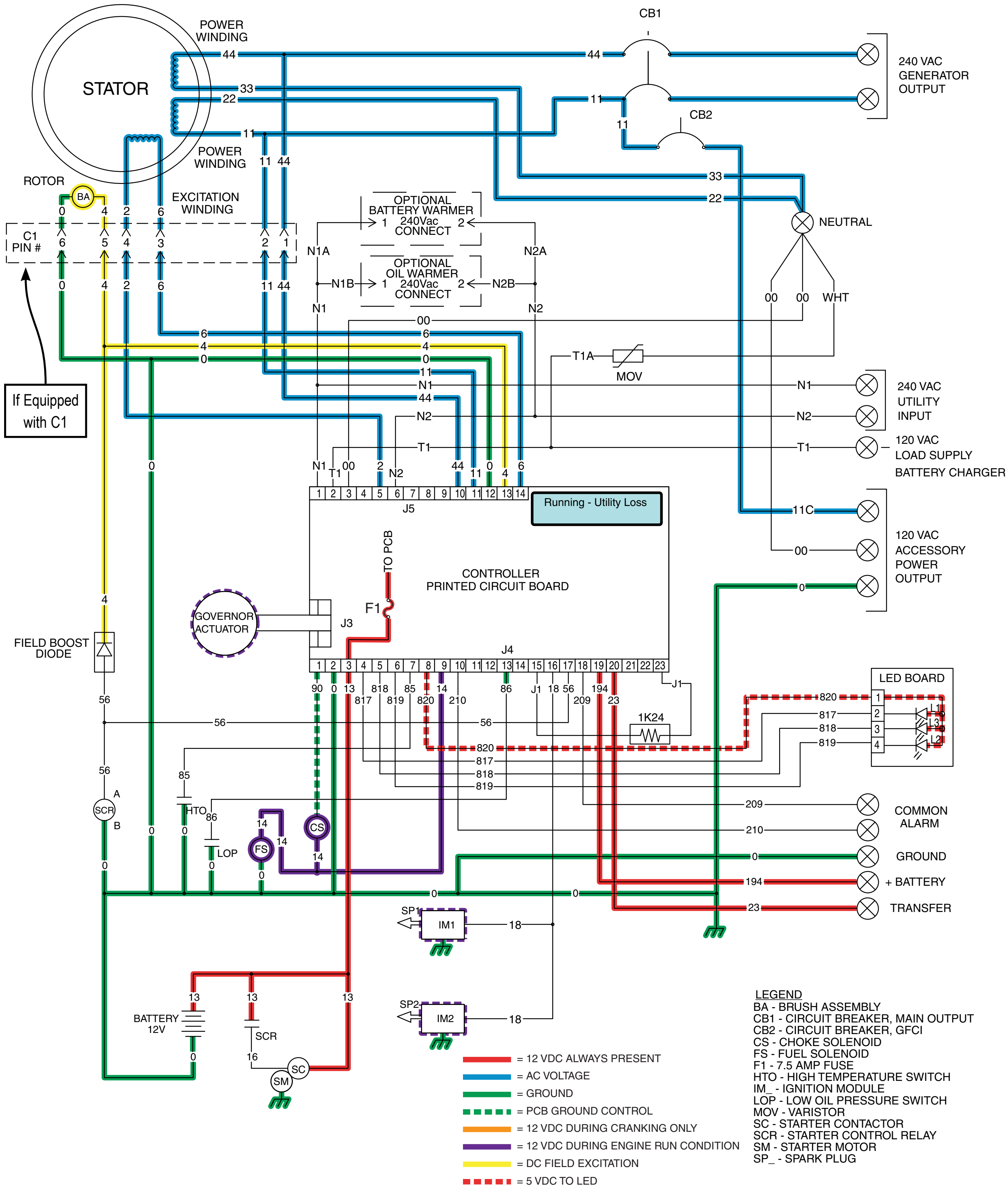


Figure 165. Engine Startup and Running

TRANSFER TO STANDBY

In Figure 167 the Generator is running, the controller's "engine warm-up" timer has expired and generator AC output is available to the transfer switch Terminal Lugs E1 and E2 and to the open contacts on the transfer relay. Transfer to Standby may be briefly described as follows:

- 12 VDC is delivered to the transfer relay coil (TR1 - Terminal A) via Wire 194. The 12 VDC circuit is completed back to the controller via Wire 23 (TR1 - Terminal B). However, the controller's logic holds Wire 23 open from ground and the TR1 relay is de-energized.
- When the "engine warm-up timer" expires, the controller will take Wire 23 to ground. The TR1 relay energizes and its normally open contacts close (standby position).
- Generator voltage is now delivered to the standby closing coil (C2), via Wire E1 and E2, the now closed TR1 contacts, Wire 205, the limit switch (SW3), Wire B, and a bridge rectifier. The standby closing coil energizes and the main current carrying contacts of the transfer switch are actuated to the "Standby" position.
- As the main contacts move to the "Standby" position, a mechanical interlock actuates SW3 to its open position and limit switch (SW2) to the "Utility" position. When SW3 opens the C2 coil de-energizes.
- Generator voltage is now available to the LOAD terminals (T1 and T2) of the transfer switch.

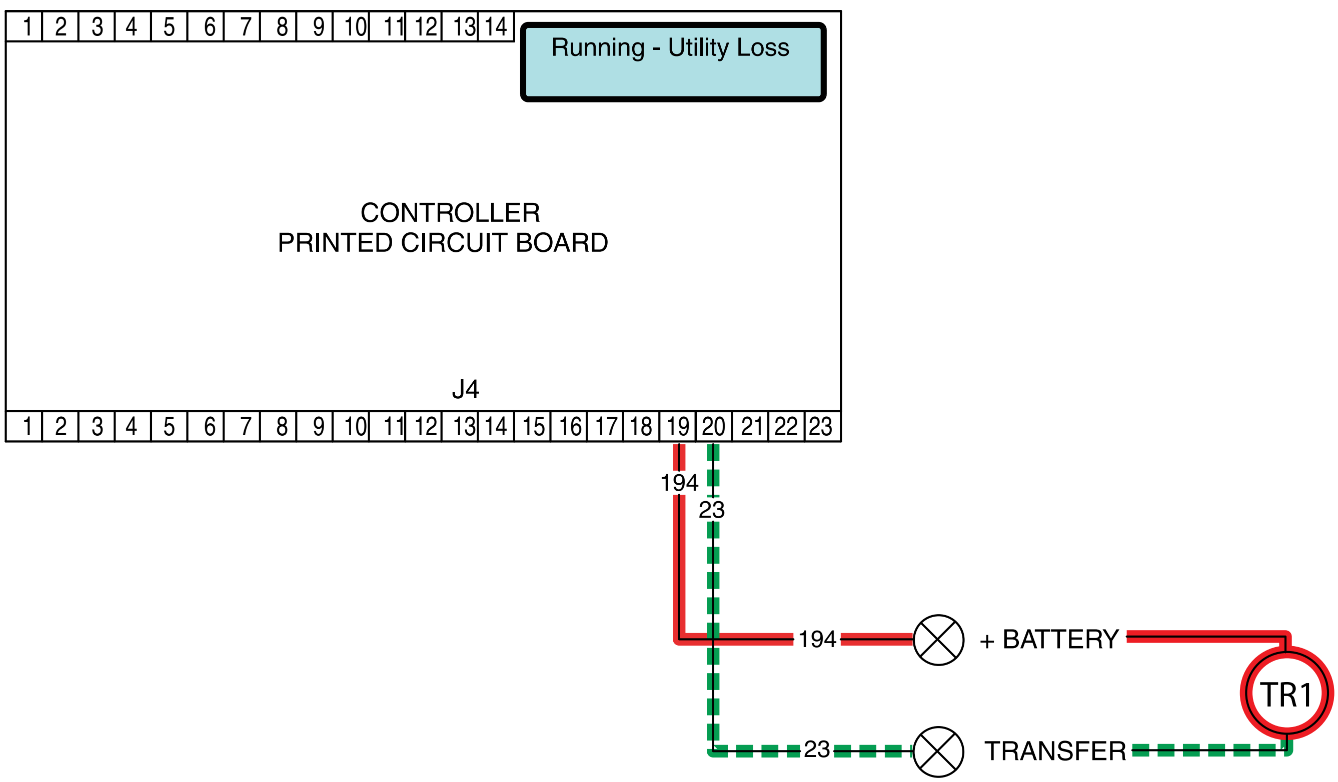


Figure 166.

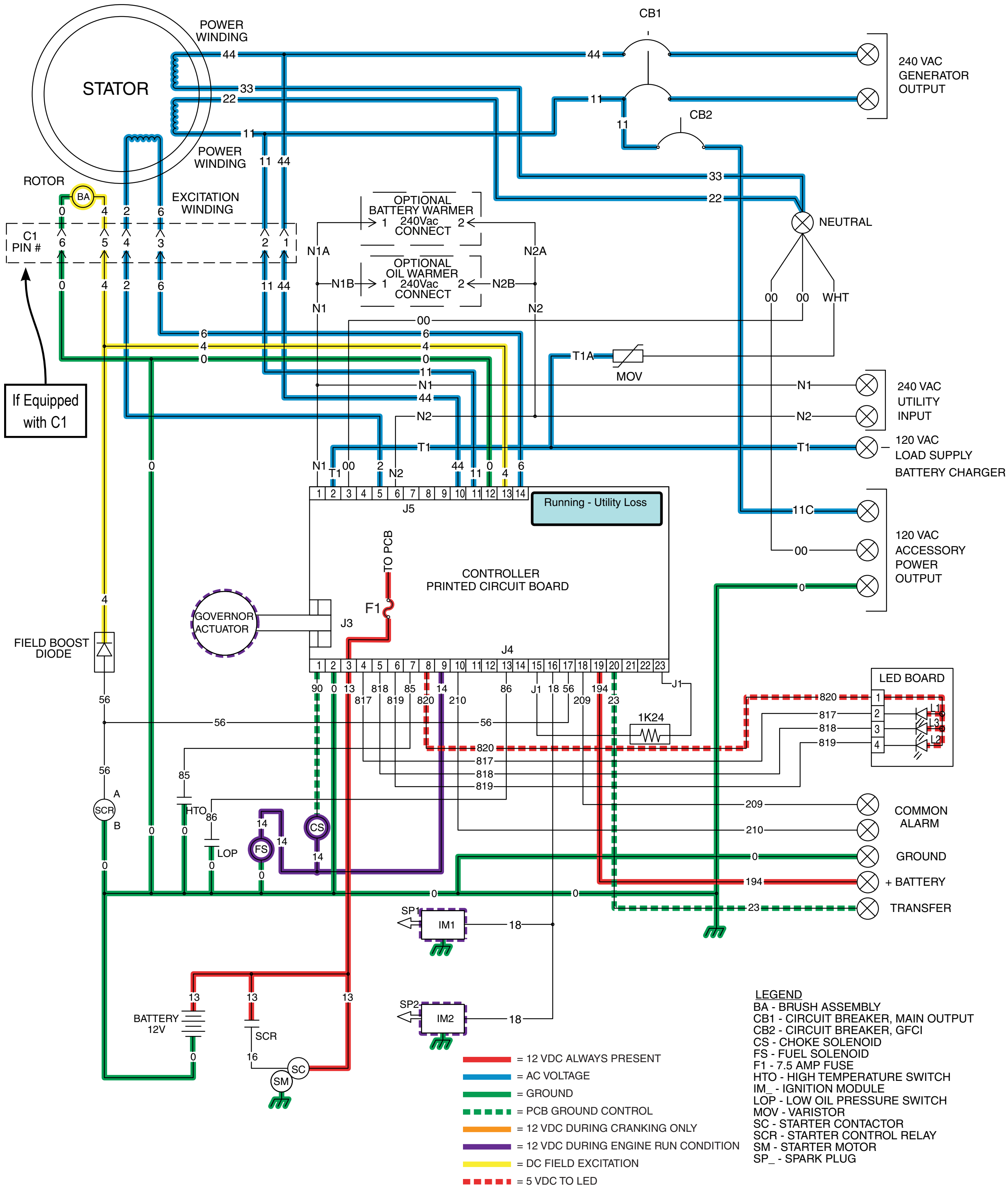


Figure 167. Transfer to the Standby

UTILITY VOLTAGE RESTORED AND RE-TRANSFER TO UTILITY

The Load is powered by Generator voltage. On restoration of Utility voltage, the following events will occur:

- On restoration of Utility voltage above 75% of the nominal rated voltage, a "re-transfer time delay" on the controller starts timing. The timer will run for 15 seconds.
- At the end of the 15 seconds, the "re-transfer time delay" will stop timing. The controller will open the Wire 23 circuit from ground and the transfer relay (TR1) will de-energize.
- When the TR1 relay de-energizes its utility side contacts close. Utility voltage is then delivered to the utility closing coil (C1), via Wire N1A and N2A, the closed TR1 contacts, Wire 126, limit switch (SW2), and a bridge rectifier.
- The C1 coil energizes and moves the main contacts to their "Utility" Position; the LOAD terminals are now powered by Utility.
- Movement of the main contacts to the "Utility" position actuates the limit switches. SW2 opens and SW3 moves to the Standby source side.
- The generator continues to run.

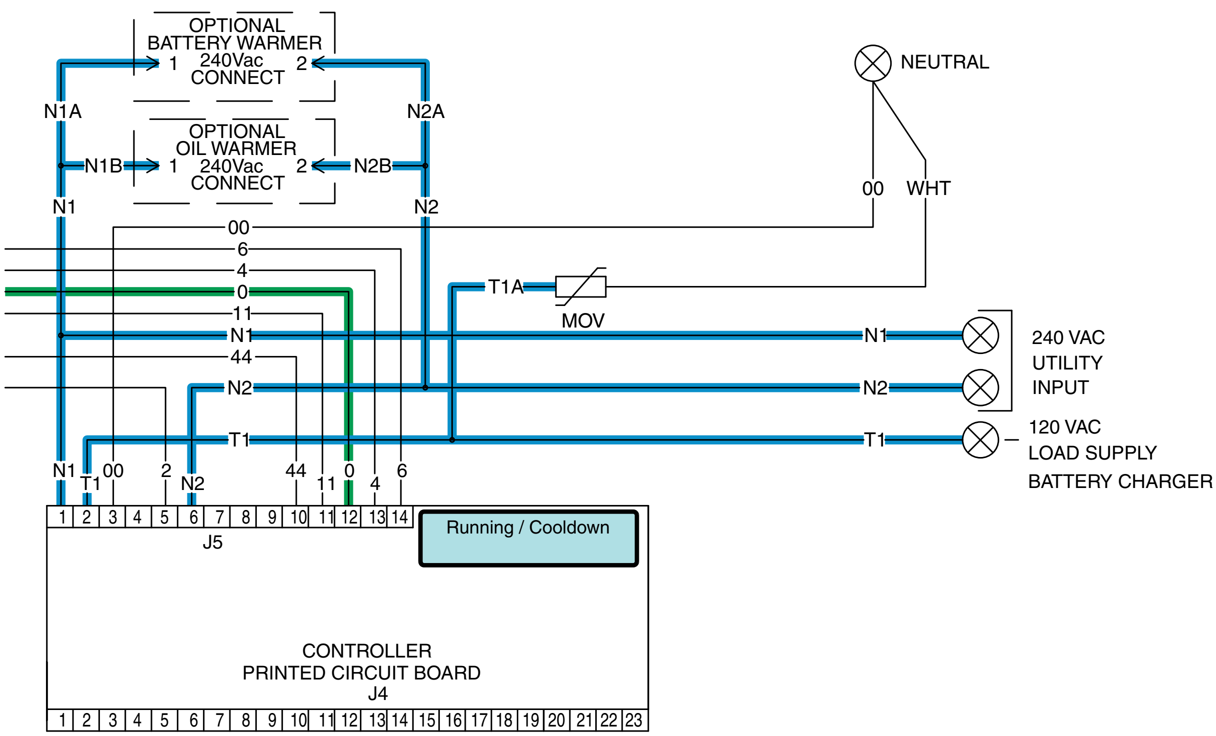


Figure 168.

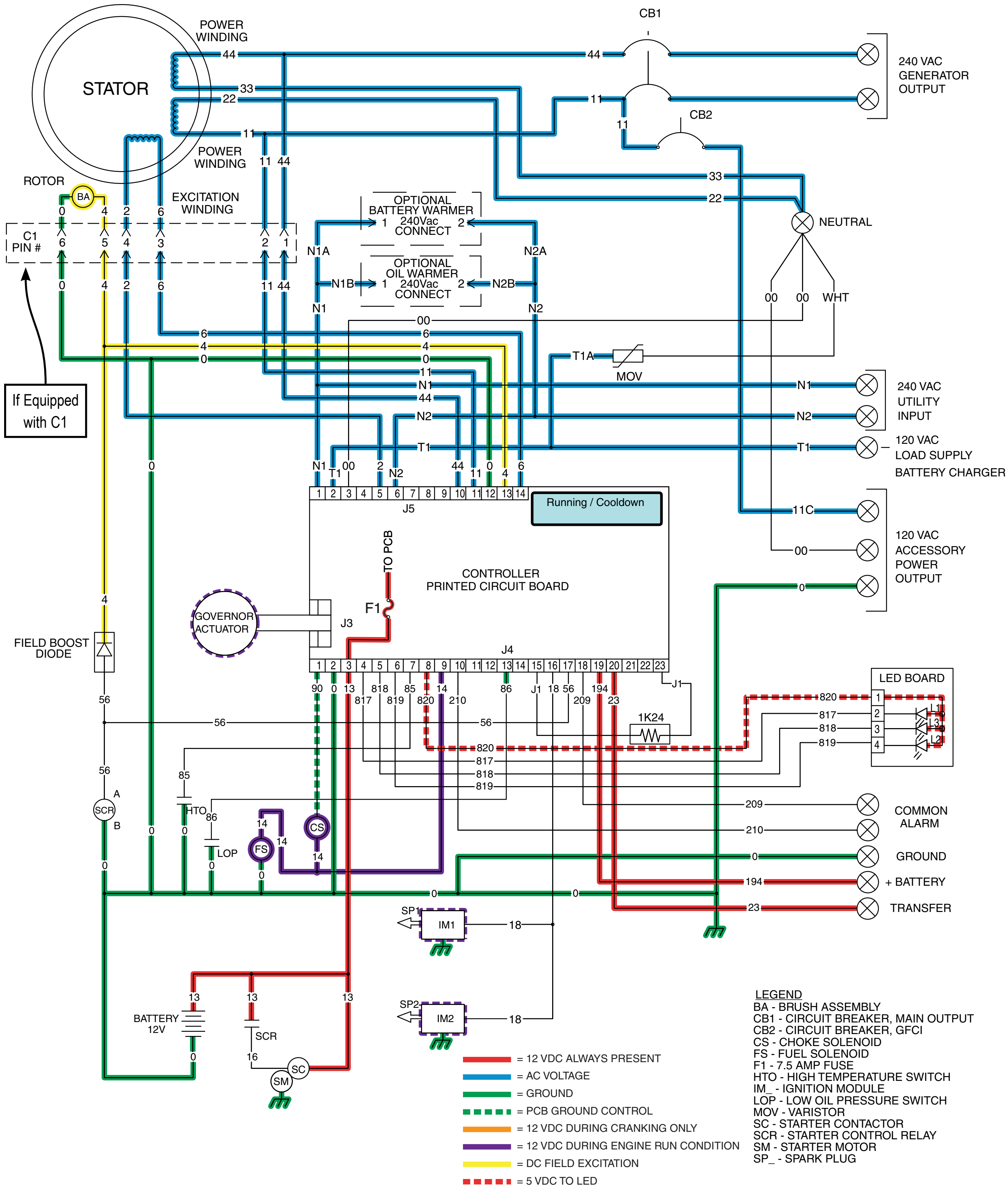


Figure 169. Utility Voltage Restored and Re-transfer to Utility

ENGINE SHUTDOWN

Following re-transfer back to the Utility source an "engine cool-down timer" on the controller starts timing. When the timer has expired (approximately one minute), the controller will de-energize the internal run relay removing fuel from the engine. The following events will occur:

- The DC circuit to Wire 14 and the fuel solenoid will open. The fuel solenoid will de-energize and close to terminate the fuel supply to the engine.
- The controller's logic will connect the engine's ignition magnetos to ground via Wire 18. Ignition will terminate.
- Without fuel flow and without ignition the engine will shut down.

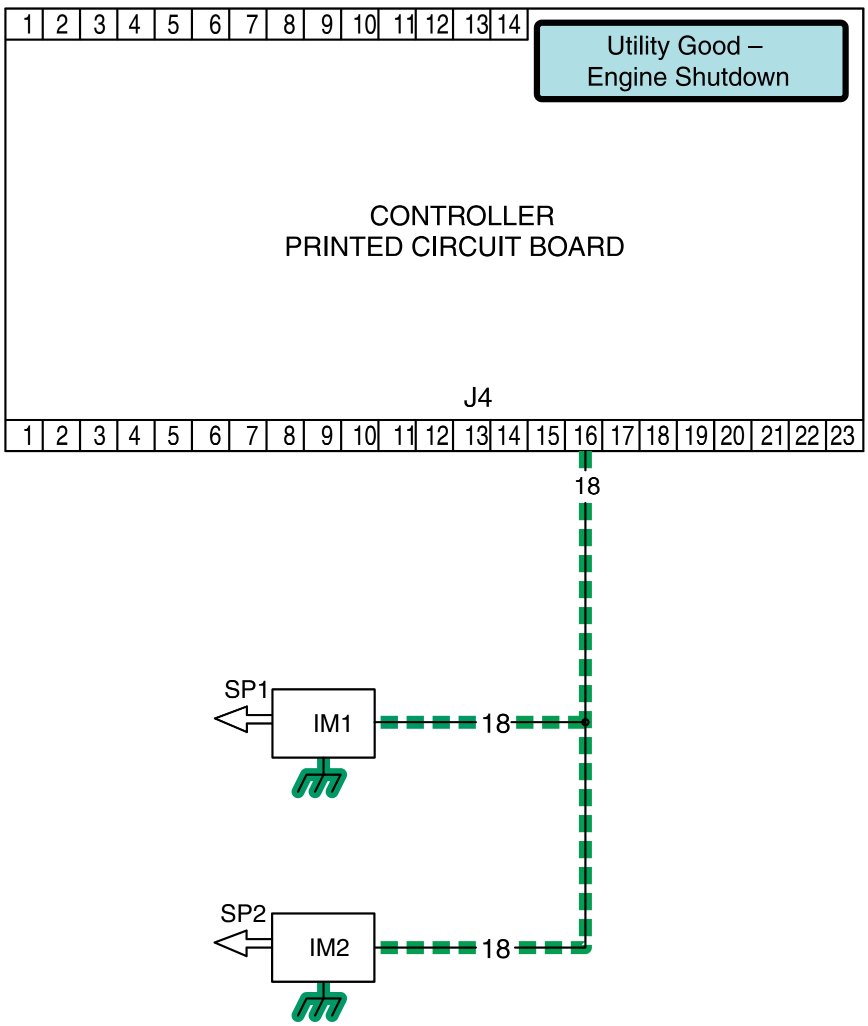


Figure 170.

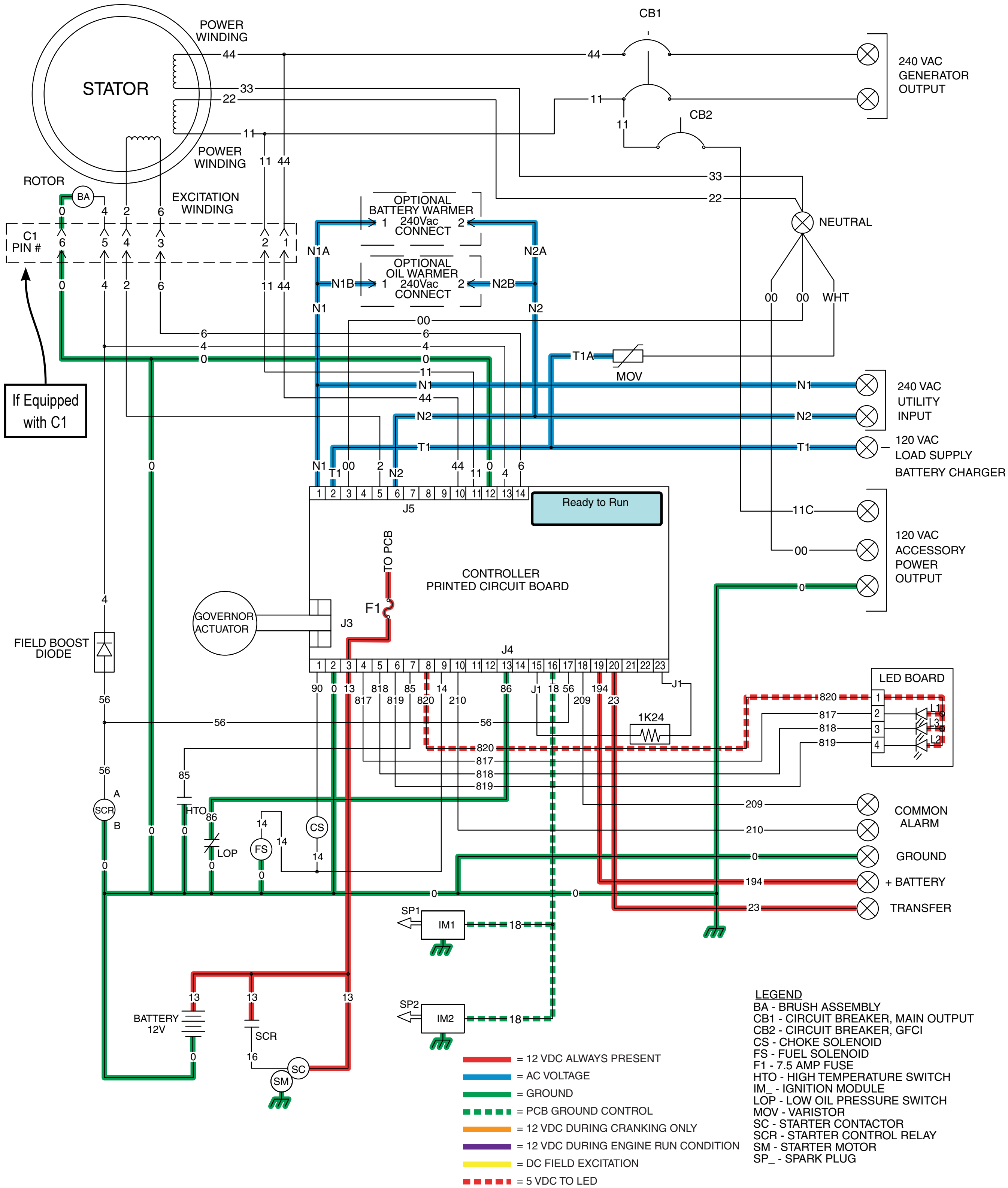
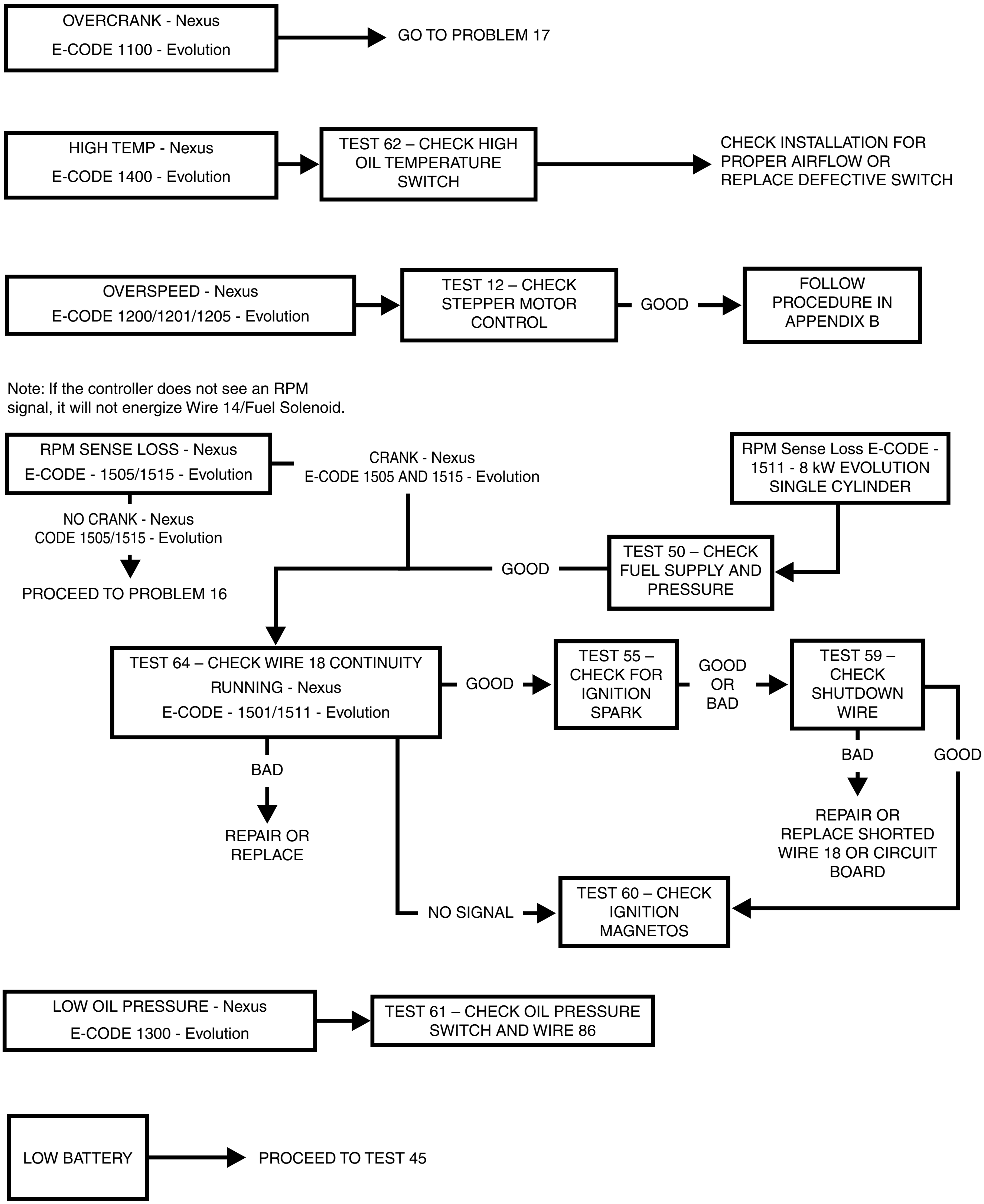


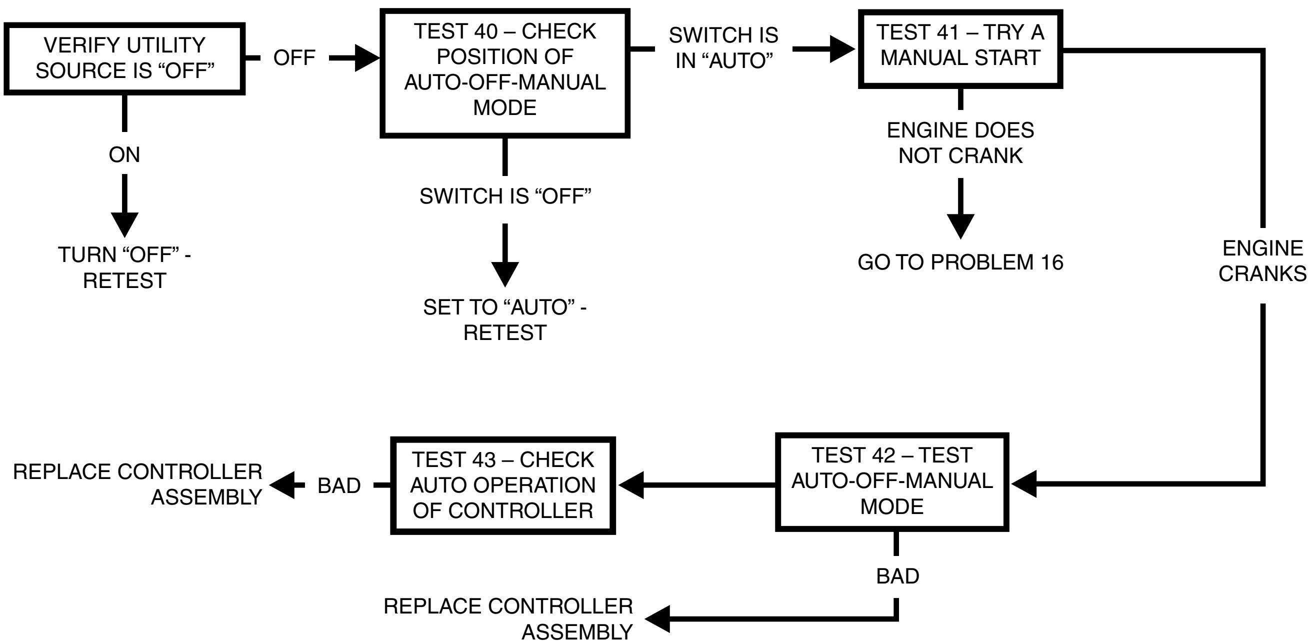
Figure 171. Engine Shutdown

Problem 14 – Shutdown Alarm/Fault Occurred During Crank Attempt, Start or Run



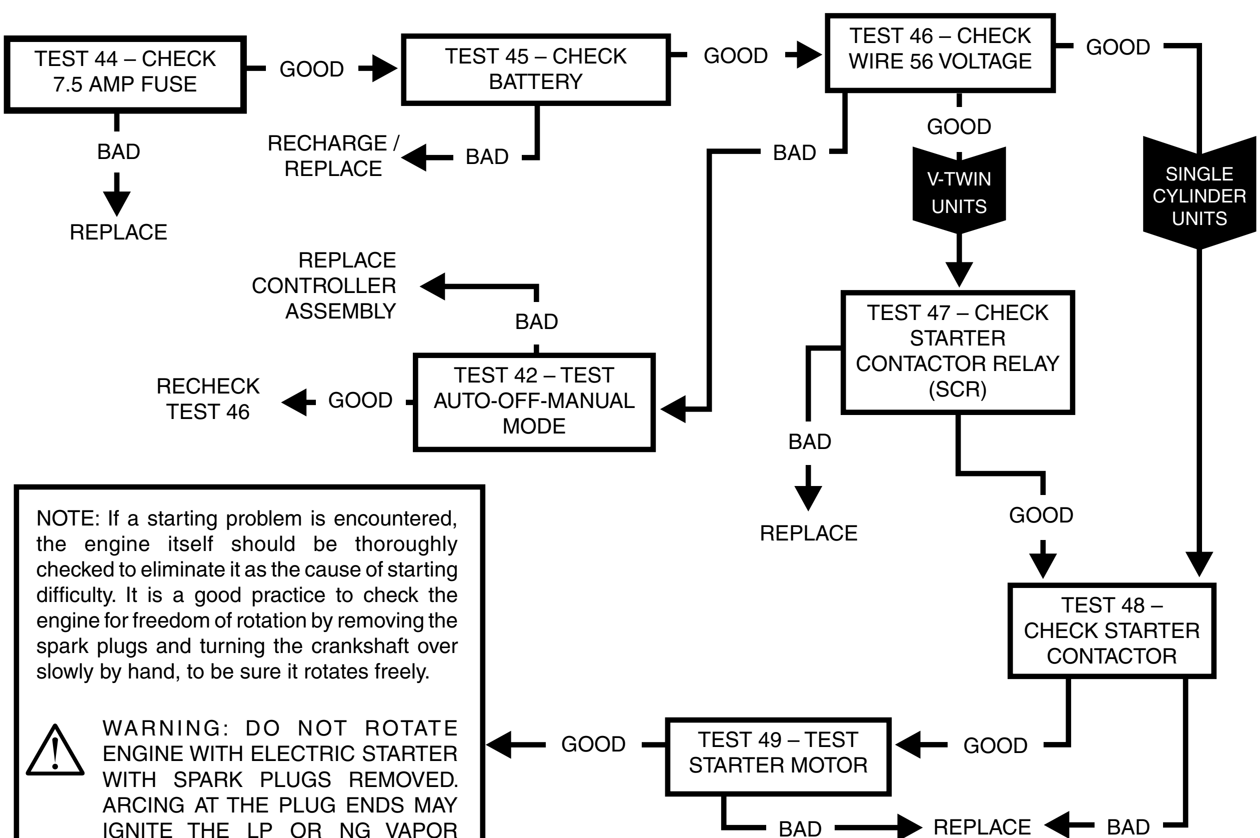
⚠ **IMPORTANT! CLEAR ANY FAULTS IN THE CONTROLLER BEFORE PROCEEDING WITH ANY RUNNING DIAGNOSTIC STEPS!**

Problem 15 – Engine Will Not Crank When Utility Power Source Fails



⚠ IMPORTANT! CLEAR ANY FAULTS IN THE CONTROLLER BEFORE PROCEEDING WITH ANY RUNNING DIAGNOSTIC STEPS!

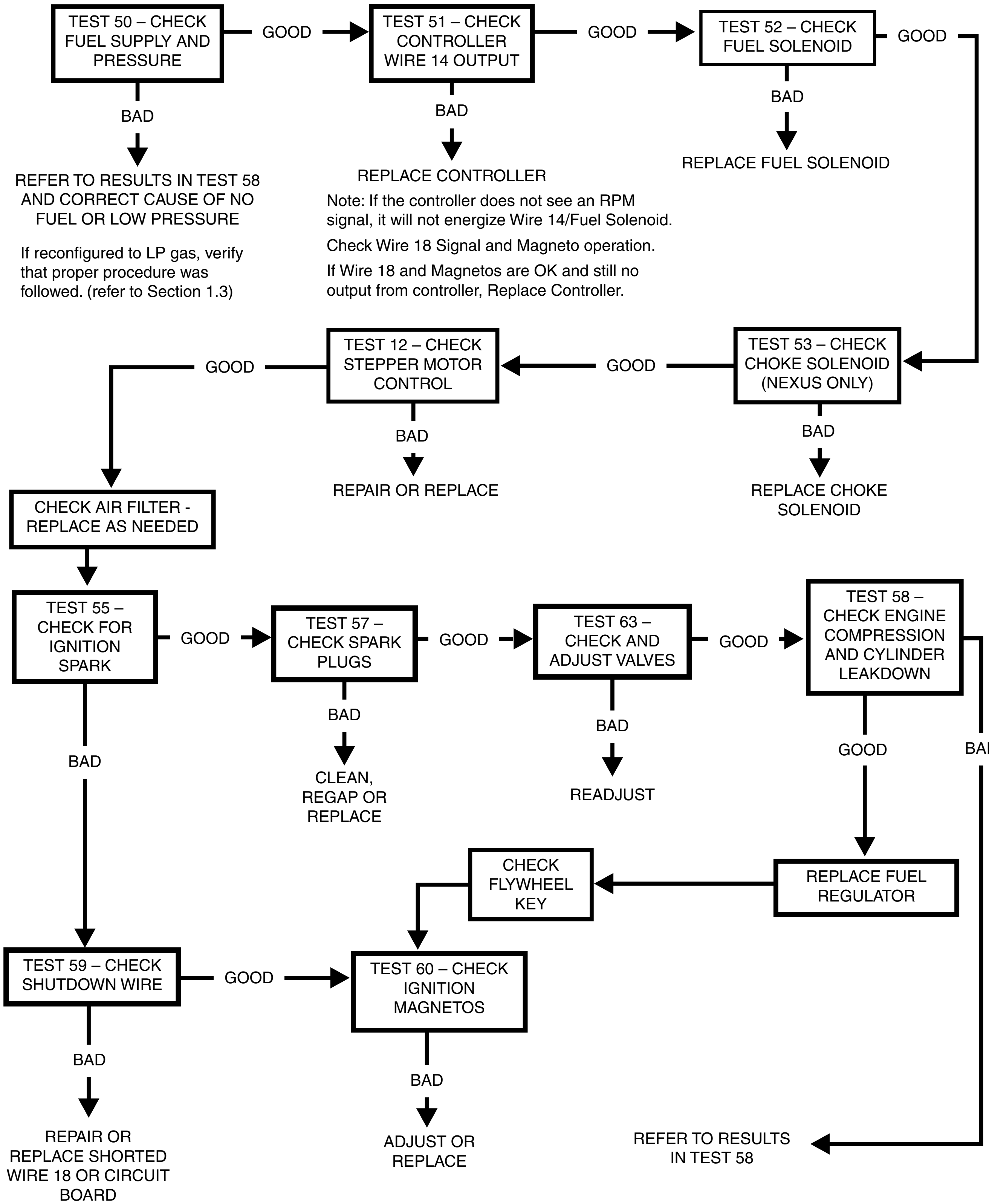
Problem 16 – Engine Will Not Crank When CONTROLLER Switch is Set to “MANUAL” MODE



NOTE: If a starting problem is encountered, the engine itself should be thoroughly checked to eliminate it as the cause of starting difficulty. It is a good practice to check the engine for freedom of rotation by removing the spark plugs and turning the crankshaft over slowly by hand, to be sure it rotates freely.

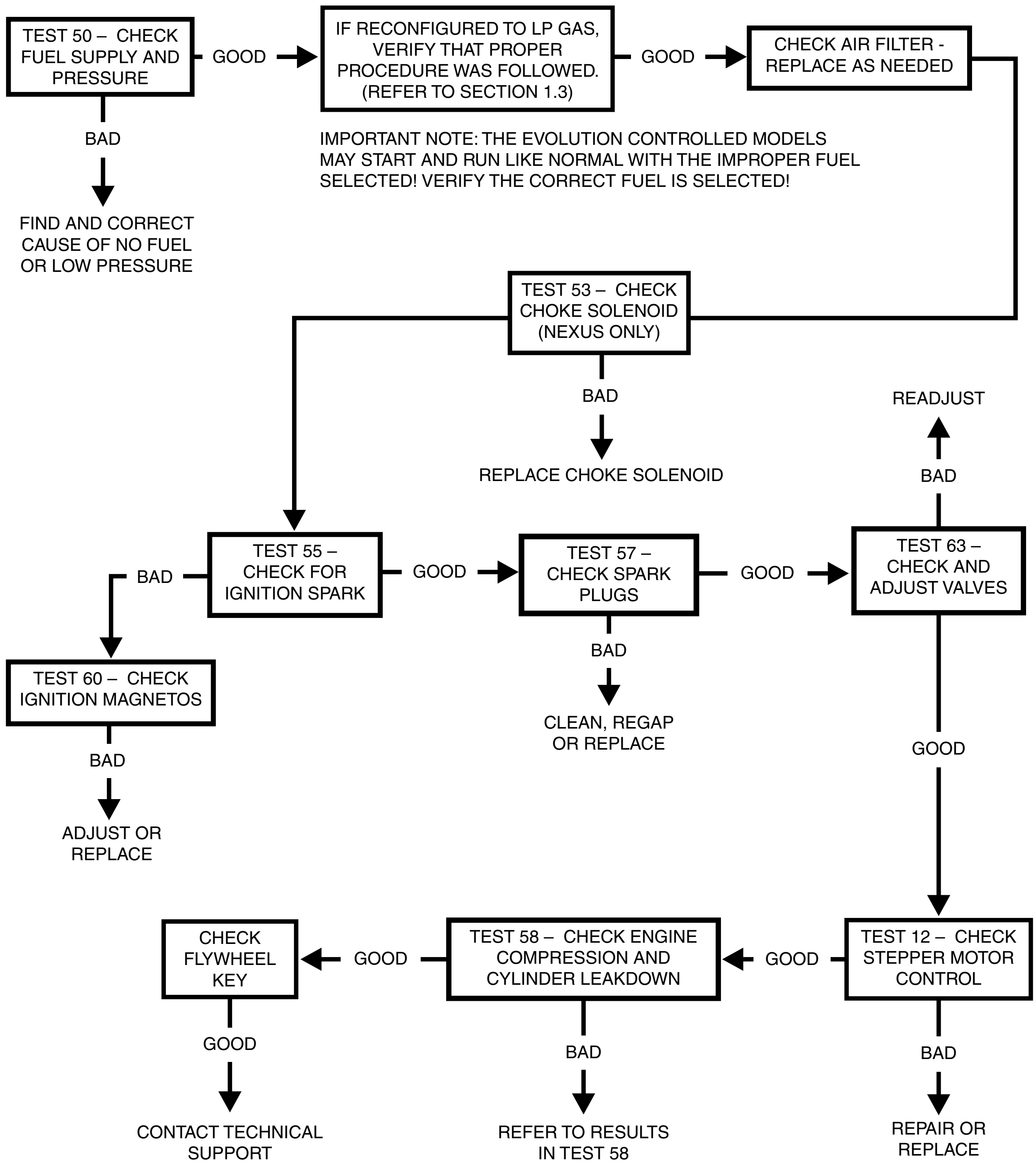
WARNING: DO NOT ROTATE ENGINE WITH ELECTRIC STARTER WITH SPARK PLUGS REMOVED. ARCING AT THE PLUG ENDS MAY IGNITE THE LP OR NG VAPOR EXITING THE SPARK PLUG HOLE.

Problem 17 – Engine Cranks but Will Not Start



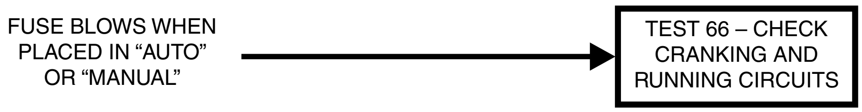
⚠ **IMPORTANT! CLEAR ANY FAULTS IN THE CONTROLLER BEFORE PROCEEDING WITH ANY RUNNING DIAGNOSTIC STEPS!**

Problem 18 – Engine Starts Hard and/or Runs Rough / Lacks Power / Backfires / Hunting / Erratic Operation



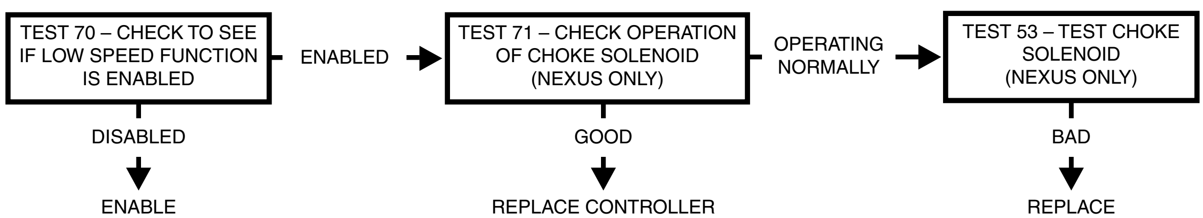
⚠ **IMPORTANT! CLEAR ANY FAULTS IN THE CONTROLLER BEFORE PROCEEDING WITH ANY RUNNING DIAGNOSTIC STEPS!**

Problem 19 – 7.5 Amp Fuse (F1) Blown (Evolution E-Code 2400)



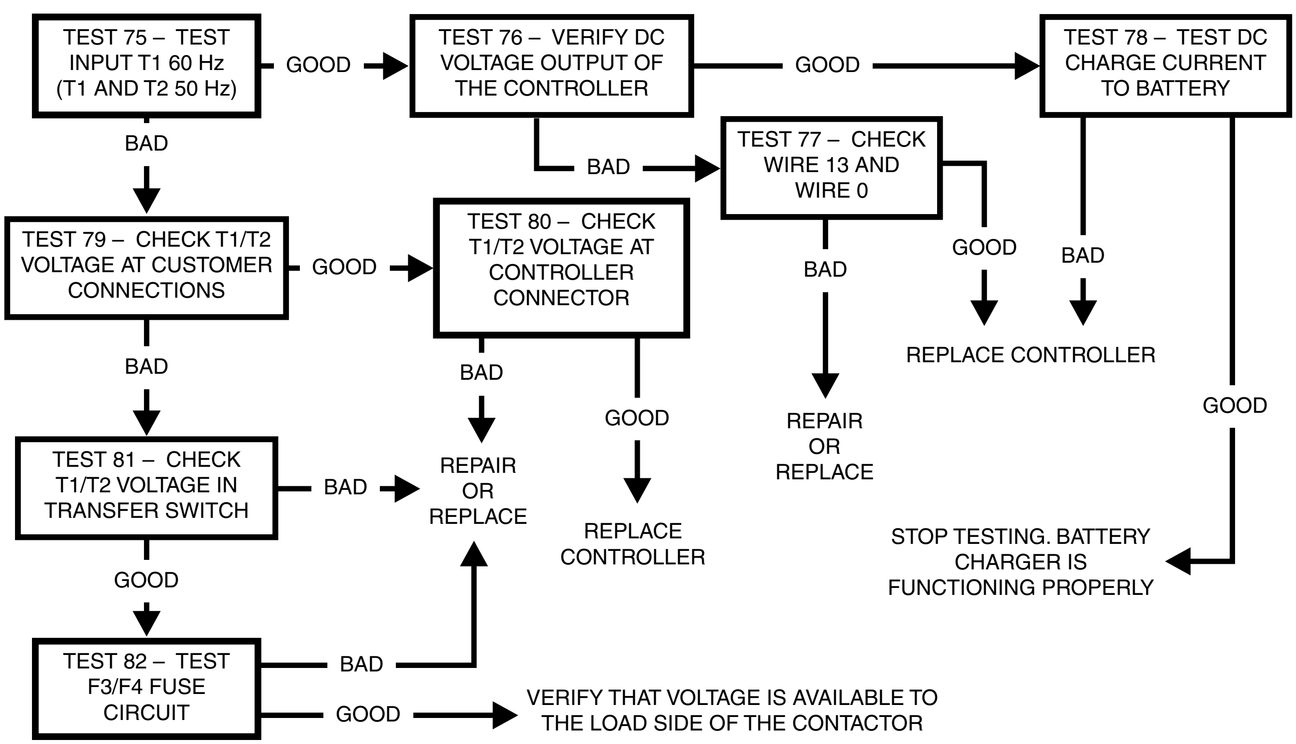
Problem 20 – Generator Will Not Exercise

Problem 21 – No Low Speed Exercise



Problem 22 – Battery is Dead

Note: T1 = 60 Hz, T1 & T2 = 50 Hz



⚠ IMPORTANT! CLEAR ANY FAULTS IN THE CONTROLLER BEFORE PROCEEDING WITH ANY RUNNING DIAGNOSTIC STEPS!

For General Troubleshooting Guidelines refer to Section 1.12

IMPORTANT

Use wire numbers only and disregard any specific “J” Connector references. Utilize the wire numbers and controller pin out chart in Appendix “A” per specific connector styles.

If any steps result in replacing a Controller, utilize Appendix “B”

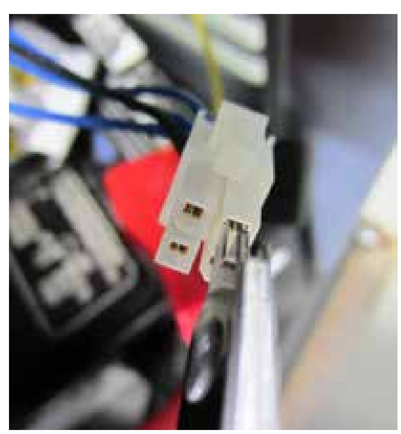
PROBING AND PIN EXTRACTION

If probing and/or back-probing results in a "BAD" condition, before condemning the controller, remove the pin/plug in question and verify the pin/plug is not distorted, bent and/or not making electrical contact! Repair as needed!

Back-Probing Molex Connector

Molex Pin Extractor Tool Part# 0K4445

Probing AMP Connector



Using Molex Pin Extractor Tool

EVOLUTION E-CODES

DISPLAYED ALARM	ALARM/ WARN- ING	E-CODE BREAK- DOWN	DESCRIPTION	Notes
Controller Fault	ALARM		**No E-code on HSB**	Replace Controller
Overcrank	ALARM	1100	**Condition - Engine Cranks but will not Start** Unit turns over but will not start. Controller is receiving signal on Wire 18.	Problem 17
Overspeed	ALARM	1200	**Prolonged** Over 72 Hz for 3 seconds. Possible cause: Stepper motor/mixer body assembly issue.	Test 12
Overspeed	ALARM	1205	**Instantaneous** Over 75 Hz for .1 second (100 milliseconds). Possible cause: Stepper motor/mixer body assembly issue.	Test 12
Low Oil Pressure	ALARM	1300	**Occurred while running** The default Extended alarm for low oil pressure. Check oil level and pressure.	Test 61
High Temperature	ALARM	1400	**Condition - Air Flow Impeded / Flow Issue** Check the inlet/outlet for debris.	Test 62
RPM Sensor	ALARM	1501	**Twin Cylinder+Running** Twin Cylinder Running faults to RPM sensor loss. Possible Causes: air pocket in fuel line, dirty fuel, missing ignition pulse (loss of one of the primary coils).	Test 50 and Test 64
RPM Sensor	ALARM	1505	**Twin Cylinder+Cranking** Twin Cylinder Cranking faults to RPM sensor loss Possible Cause: starter motor issue, missing ignition pulse (loss of one of the primary coils).	If engine cranks, Test 64. If engine does not crank, Problem 15.
RPM Sensor	ALARM	1511	**Single Cylinder+Running** Single Cylinder Running with Low Fuel Pressure faults to RPM sensor loss Possible Causes: air pocket in fuel line,dirty fuel.	Test 50 and Test 64
RPM Sensor	ALARM	1515	**Single Cylinder+Cranking** Single Cylinder Cranking faults to RPM sensor loss Possible Cause: starter motor issue.	If engine cranks, Test 64. If engine does not crank, Problem 15.
Underspeed	ALARM	1600	**Condition - Unit is Overloaded** Unit is Overloaded slowing engine speed, fuel supply low or throttle control problem.	Problem 1, Test 50 or Test 12
Overvoltage	ALARM	1800	**Prolonged Over-Voltage**	Problem 2
Undervoltage	ALARM	1900	**Prolonged Under-Voltage** Undervoltage due to loss of voltage for some time (10+ seconds).	Test 5
Undervoltage	ALARM	1901	**Instantaneous** Undervoltage due to sudden loss of voltage.	Problem 1
Undervoltage	ALARM	1902	**Both Zero Crosses missing** Undervoltage due to faulty excitation winding,or zero cross circuit,or circuit in general. Possible cause: loose wiring, field boost hardware failure	Problem 1
Undervoltage	ALARM	1906	**Single Zero Cross missing** Undervoltage due to faulty excitation winding, zero cross circuit, or circuit in general. Possible cause: field boost hardware failure	Problem 1

EVOLUTION E-CODES

DISPLAYED ALARM	ALARM/ WARN-ING	E-CODE BREAK-DOWN	DESCRIPTION	Notes
Wiring Error	ALARM	2099	Customer connection low voltage and high voltage wires are crossed.	Check customer connection in generator
Overload Remove Load	ALARM	2100	**Overloaded - Default (Output Current Method)** Unit is overloaded, one of the two CTs is detecting an overload condition. Check transfer switch loadshed functionality. (Change load dynamics or utilize loadshed).	Remove Load
Undervoltage Overload	ALARM	2299	Unit was overloaded and attempted to start with a large load connected. The unit can not ramp up the generator voltage to its normal target voltage value if it starts with a large load connected	Remove Load
Stepper Overcurrent	ALARM	2399	Current flow in stepper coil(s) above specification	Test 12
Fuse Problem	ALARM	2400	**Missing / Damaged Fuse** The 7.5 amp Controller Fuse is missing or blown (open).	Test 44
Low Battery	WARNING		Condition->Battery less than 12.1 Volts for 60 seconds	Test 45
Battery Problem	WARNING		Condition->More than 16 Volts of battery voltage or 600 milliamperes or more of charge current at the end of an 18 hour charge	Test 45
Charger Warning	WARNING		Less than 12.5 volts of battery voltage at the end of a 18 hour charge	Problem 22
Charger Missing AC	WARNING		AC power is missing from the battery charger input	Problem 22

**Firmware version 1.11 and older only*

ADDITIONAL CODES FOR 8 KW UNITS ONLY

DISPLAYED ALARM	ALARM/ WARN-ING	E-CODE BREAK-DOWN	DESCRIPTION	Notes
Overcrank	ALARM	1101	**Engine/Starter Problem** Limiting number of cranking cycles to protect the starter motor.	If the engine has tried to crank for 10 times unsuccessfully, this will trigger.
Underspeed	ALARM	1603	**Underspeed** The engine never comes up to 3700 RPM.	Check fuel selection and fuel supply
Overload Remove Load	ALARM	2102	**Overloaded** Unit recranks 5 times when load is applied, engine dies (0 RPM) and has low voltage (< 180V)	Check for Overloaded condition on unit. Inspect stepper motor operation.
Overload Remove Load	ALARM	2103	**Overloaded** Unit has run and attempted to accept load 10 times, could not accept due to overload condition	Check for Overloaded condition on unit

INTRODUCTION

This section familiarizes the service technician with acceptable procedures for the testing and evaluation of various problems that can occur on the standby generators with air-cooled engines. Use this section in conjunction with Section 4.4, “Troubleshooting Flow Charts.” The numbered tests in this section correspond with those of Section 4.4.

Some test procedures in this section may require the use of specialized test equipment, meters or tools. Most tests can be performed with an inexpensive volt-ohm-meter (VOM). An AC frequency meter is required where frequency readings must be taken.

Testing and troubleshooting methods covered in this section are not exhaustive. No attempt has been made to discuss, evaluate and advise the home standby service trade of all conceivable ways in which service and trouble diagnosis must be performed. Accordingly, anyone who uses a test method not recommended herein must first satisfy himself that the procedure or method he has selected will jeopardize neither his nor the products safety.

Figure 172 shows the Volt-Ohm-Milliammeter (VOM) in two different states. The left VOM indicates an OPEN circuit or INFINITY. The right VOM indicates a dead short or CONTINUITY. Throughout the troubleshooting, refer back to Figure 172 as needed to understand what the meter is indicating about the particular circuit that was tested.

Note: CONTINUITY is equal to .01 ohms of resistance or a dead short.

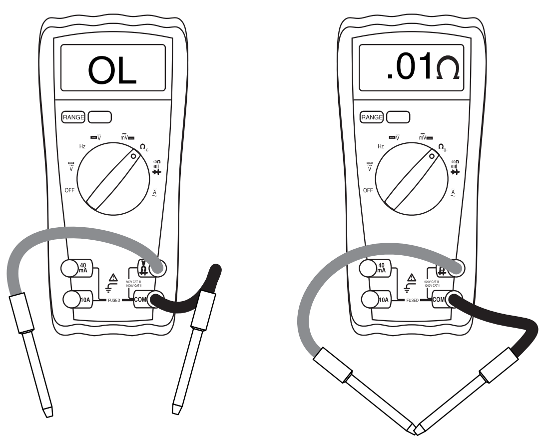


Figure 172.

SAFETY

Service personnel who work on this equipment should be aware of the dangers of such equipment. Extremely high and dangerous voltages are present that can kill or cause serious injury. Gaseous fuels are highly explosive and can ignite by the slightest spark. Engine exhaust gases contain deadly carbon monoxide gas that can cause unconsciousness or even death. Contact with moving parts can cause serious injury. The list of hazards is seemingly endless.

When working on this equipment, use common sense and remain alert at all times. Never work on this equipment while you are physically or mentally fatigued. If you do not understand a component, device or system, do not work on it.

ENGINE/DC TROUBLESHOOTING

It is always good practice to continue to ask questions during the troubleshooting process. When evaluating the problem asking some of these questions may help identify the problem quicker.

- What is the generator doing?
- What is the fault that the generator is shutting down for?
- After the fault occurred, what was the LCD displaying?
- Is there another Alarm in the log just previous to the shutdown?
- Is the fault causing the shutdown a symptom of another problem?
- Does the generator have the same fault consistently, and when does it occur?
- What was the generator supposed to do?
- Who is controlling it?
- Exactly what is occurring?
- When is it happening?
- Why would this happen?
- How would this happen?
- What type of test will either prove or disprove the cause of the fault?

TEST 40 – CHECK POSITION OF AUTO-OFF-MANUAL MODE

Discussion

If the system is to operate automatically, the generator's controller must be set to the AUTO mode. The Generator will not crank and start on occurrence of a Utility failure unless the switch is in the AUTO mode. In addition, the Generator will not exercise every seven (7) days as programmed unless the switch is in AUTO mode.

Procedure

With the controller set to the AUTO mode, test automatic operation. Testing of automatic operation can be accomplished by turning off the Utility power supply to the transfer switch. When the Utility power is turned off the Generator should crank and start. Following startup, transfer to the “Standby” position should occur. Refer to Section 1.7.

Results

1. If normal automatic operation is obtained, discontinue tests.
2. If the engine does not crank when Utility power is turned off refer back to the flow chart.

TEST 41 – TRY A MANUAL START

Discussion

The first step in troubleshooting for an “engine won’t crank” condition is to determine if the problem is related to automatic operations only or if the engine will not crank manually either.

Procedure

1. Set the controller to the OFF mode.
2. Set the main line circuit breaker (MLCB) to the “Open” position.
3. Set the controller set to the MANUAL mode.
   a. The engine should crank cyclically through its “crank-rest” cycles until it starts.
   b. Let the engine stabilize and warm up for a few minutes after it starts.

Results

1. If the engine cranks manually, but does not crank automatically, refer back to flow chart.
2. If the engine does not crank manually proceed to Problem 16.

TEST 42 – TEST THE FUNCTION OF THE AUTO-OFF-MANUAL MODE

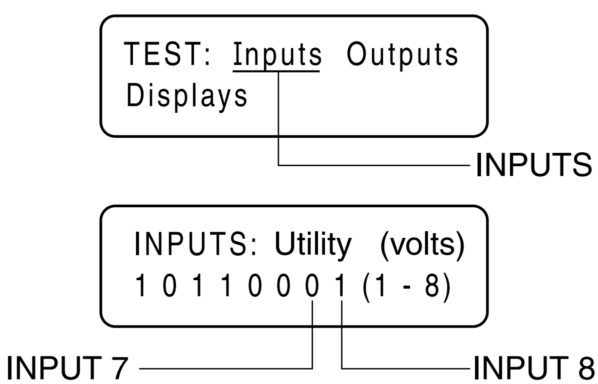


Figure 173. The Input Screens

Procedure

1. Navigate to the Input Screen using the menu system for the controller being worked on.
2. With the Inputs Screen displayed, place the controller to the AUTO mode. If the controller reads the auto input from the switch, Input 7 will change from “0” to “1”. See Table 27 in Section 4.1 for a description of the Inputs.
3. With the Inputs Screen displayed place the controller to the MANUAL mode. If the controller reads an input from the Switch, Input 8 will change from “0” to “1”.
4. With the controller in the OFF mode, both inputs will read zero.

Results

1. If controller failed either Step 2 or Step 3, replace the controller assembly.
2. If the controller passed Step 2 and Step 3, refer back to flow chart.

TEST 43 – TEST AUTO OPERATIONS OF CONTROLLER EVOLUTION AND NEXUS

Discussion

Initial Conditions: The generator is in AUTO mode, ready to run, and voltage is being supplied by Utility. When Utility fails (below 65% of nominal), a 10 second (optionally programmable) line interrupt delay time is started. If the Utility is still gone when the timer expires, the engine will crank and start. Once started a ten (10) second “engine warm-up timer” will be initiated. When the warm-up timer expires, the controller will transfer the load to the generator. If Utility voltage is restored (above 75% of nominal) at any time from the initiation of the engine start until the Generator is ready to accept a load (5 second warm-up time has not elapsed), the controller will complete the start cycle and run the generator through its normal cool down cycle; however, the voltage will remain on the Utility source.

Procedure

1. Place the generator controller in the Auto mode.
2. Simulate a power failure by opening the Utility supply breaker. If the generator cranks and starts and the switch transfers, close the Utility supply breaker to return utility power. Within 15 seconds the unit should transfer back to the Utility position and enter into a Cool Down mode for one minute, then shut down. If the Generator performs this sequence of events the test is good; STOP.
3. If the Generator does not perform the sequence of events listed in the above discussion, diagnose based on the symptom or Alarms displayed.

Results

Refer back to the flow chart

TEST 44 – CHECK 7.5 AMP FUSE
EVOLUTION ALARM CODE 2400

Note: Use the Alarm Log in the control panel to help troubleshoot various problems. For instance, if the unit does not crank the control panel will display “Stopped-Alarm RPM Sensor Loss.” If the Fuse is bad and the unit attempts to crank the alarm log will display “Inspect Battery” first, and then “Stopped-Alarm RPM Sense Loss.”

Discussion

The 7.5 amp fuse is located on the generator control console. A blown fuse will prevent battery power from reaching the circuit board with the same result as setting the controller to OFF mode; the display and menus will remain active but the unit will not be able to crank or run.

Procedure

Remove and inspect the 7.5 amp fuse (F1). Visually inspect the fuse and fuse element. If the fuse element looks good, or if it cannot be visually inspected, test the fuse for an open with a VOM or Continuity Tester.

Results

1. If the fuse if good, refer back to the Flow Chart.
2. If the fuse is bad, it should be replaced. Use only an identical 7.5 amp replacement fuse.
3. If fuse continues to blow, proceed to Problem 19 Flow Chart.

TEST 45 – CHECK BATTERY AND CABLES

Discussion

Battery power is used to (a) crank the engine and (b) to power the circuit board. Low or no battery voltage can result in failure of the engine to crank, either manually or during automatic operation. The battery charger in the control panel is not designed to recharge a dead battery. As well, if there is a loose connection or corrosion associated with a wire (positive or negative), battery voltage may be present, but because of the high resistance, will not allow current to flow. Electrical voltage drop varies according to current flow. Unless the circuit is operated so current flows through it, voltage drop cannot be measured. So, to properly measure voltage drop, a crank attempt will need to be performed. This test will determine whether the battery, battery cables, or both are at fault.

Procedure

A. Perform Starter Circuit Voltage Drop Test:

1. Remove the T1 fuse from the Transfer Switch.
2. Set a Volt-Ohm-Meter (VOM) to measure DC voltage.
3. Connect the red meter test lead to the positive battery post and connect the black meter test lead to the negative battery post.
   a. If battery voltage is 12.1 VDC or below, proceed to Step C or Step D.
   b. If battery voltage is 12.2 VDC or above, proceed to next step. (For this test, battery voltage should be at least 12.2 VDC)
4. Turn off the fuel source and remove the #14 wire from the fuel solenoid to inhibit any possible startup.
5. Refer to Figure 174 battery post and starter connections and perform a voltage drop test as indicated. Note: Single Cylinder units have a bulkhead mounted starter solenoid.
6. Set the controller to the MANUAL mode; measure and record the voltage.
7. Record readings from test points V1, V2 and V3 as depicted in Figure 174. Although resistance-free connections, wires and cables would be ideal, most of them will contain at least some voltage drop. The maximum voltage readings you should see are as follows:
   a. 0.00-0.10 VDC across a connection
   b. 0.10-0.20 VDC on a ground connection
   c. 0.20-0.30 VDC across a wire or cable (V1, V2)
   d. 0.20-0.30 VDC across a switch or starter contactor
   e. 0.40-0.50 VDC across the entire circuit
8. If voltage drop is greater than the above, based on the circuit or component, proceed to Step B. If voltage drop is within the above, based on the circuit or component, proceed to Step C or D.

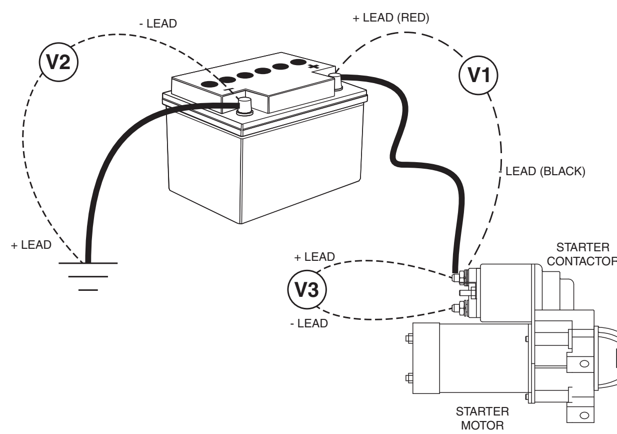


Figure 174. Starter Circuit Voltage Drop Test

B. Inspect Battery Cables, Terminals and Connections:

1. Inspect battery cables and battery posts.
2. If cable clamps or terminals are corroded, clean away all corrosion.
   a. If corrosion cannot be cleaned or eliminated, replace the component in question.
3. Make sure all cable clamps are tight. The red battery cable from the starter contactor (SC) must be securely attached to the positive (+) battery post; the black cable from the frame ground stud must be tightly attached to the negative (-) battery post.

C. Perform a load test on the Battery: (All Lead-Acid Type Batteries)

1. Remove 7.5 amp fuse from the Controller.
2. Remove the T1 fuse from the Transfer Switch.
3. Disconnect both negative and positive cables.

Note: Use of a quality Conductance Battery Tester is highly recommended.

Note: Disconnect negative cable first.

4. Using a lead acid battery load tester test the load capability of the battery.

5. Follow the load tester's manufacturer's instructions carefully.
6. Reconnect both positive and negative cables.

Note: Reconnect positive cable first.

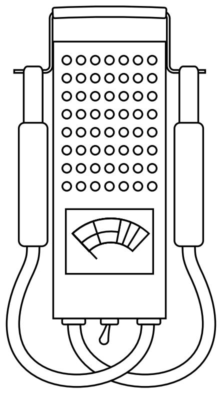


Figure 175. A Typical Battery Load Tester

Note: Use of a quality Conductance Battery Tester is also recommended.

D. Test Battery State of Charge: (Non-Maintenance Free Battery Only)

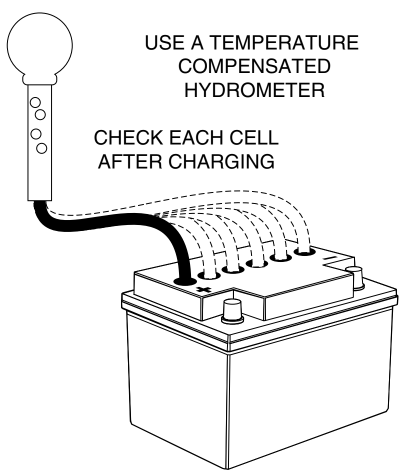
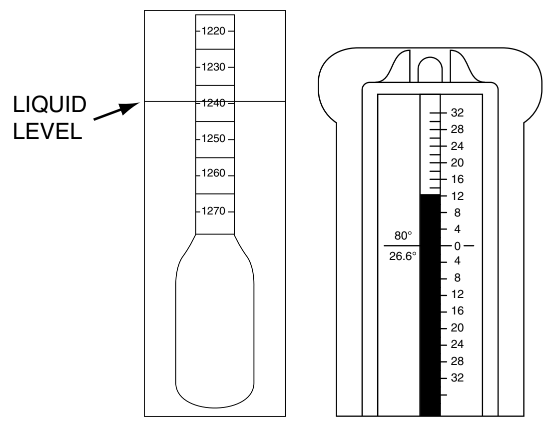


Figure 176. Using a Battery Hydrometer

1. Use an automotive type battery hydrometer to test battery state of charge.
2. Follow the hydrometer manufacturer's instructions carefully. Read the specific gravity of the electrolyte fluid in all battery cells.
3. If cells are low, distilled water can be added to refill cell compartment.
4. If the hydrometer does not have a "percentage of charge" scale, compare the reading obtained to the following:
   a. An average reading of 1.260 indicates the battery is 100% charged.
   b. An average reading of 1.230 means the battery is 75% charged.
   c. An average reading of 1.200 means the battery is 50% charged.
   d. An average reading of 1.170 indicates the battery is 25% charged.
5. Test Battery Condition:
   a. If the difference between the highest and lowest reading cells is greater than 0.050 (50 points), battery condition has deteriorated and the battery should be replaced.
   b. However, if the highest reading cell has a specific gravity of less than 1.230, the test for condition is questionable. Recharge the battery to a 100 percent state of charge, and then repeat the test for condition.

Results from Step C or Step D

1. If the VOM indicated less than 10.5 VDC in Step C, remove the battery and recharge with an automotive battery charger.
2. If battery fails tests in step C or D, replace with a new battery.
3. If battery condition is good, refer back to flow chart.



Cell #	Specific Gravity	
1	1.255	
2	1.260	HIGH READING
3	1.235	35 POINTS DIFFERENCE
4	1.250	
5	1.240	LOW READING
6	1.225	

Figure 177. Reading a Battery Hydrometer

TEST 46 – CHECK WIRE 56 VOLTAGE

Discussion

During an automatic start or when starting manually, an internal crank relay energizes. Each time the crank relay energizes, the controller should deliver 12 VDC to a start contactor relay (SCR), or starter contactor (SC) and the engine should crank. This test will verify (a) that the crank relay on the controller is energizing, and (b) that the controller is delivering 12 VDC to the SCR relay or the SC.

Note: If the unit does not crank the Alarm Log will display, "Stopped-Alarm RPM Sense Loss."

Procedure

1. Set the Volt-Ohm-Milliammeter (VOM) to measure DC voltage.
2. Locate and disconnect Wire 56 from the SCR on V-Twin units and the SC on single cylinder units.
3. Connect one meter test lead to Wire 56 and the other meter test lead to the battery negative terminal.
4. Set the controller to MANUAL mode. Observe the meter, the VOM should indicate battery voltage. If battery voltage was measured, stop testing and refer back to the flow chart. If voltage was NOT measured, proceed to Step 5.

Note: If controller is in an Alarm State, digital output will not change. Be sure to clear the fault prior to performing Step 5.

5. Navigate to the Digital Output Screen using the menu system for the controller being worked on.
   a. Digital Output 6 is Wire 56 output from the board. Refer to Figure 178.
6. Set the controller to the MANUAL mode and observe digital output Number 6. If the controller is working correctly output Number 6 will change from a "0" to a "1", observe and record the change in state.
   a. Nexus Controller - Move to MANUAL position to view change of state.
   b. Evolution Controller - Hold button down to view change of state.
7. Set a VOM to measure resistance.
8. Remove 7.5 amp fuse.
9. Disconnect the harness connector from the controller.
10. Remove Wire 56 from the starter contactor relay (V-twin units) or from the starter contactor (single cylinder units).
11. Connect one meter test lead to disconnected Wire 56 and connect the other test lead to the controller side of the harness (Wire 56), measure and record the resistance.

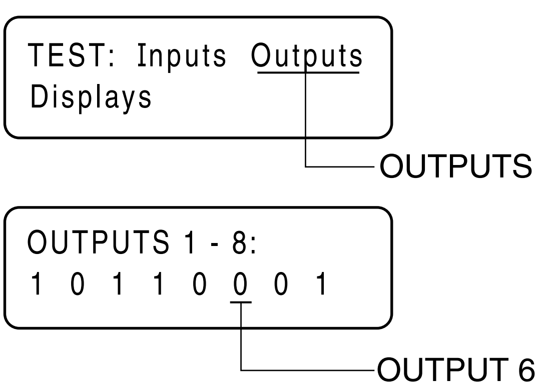


Figure 178. The Output Screens

Results

1. If the VOM indicated battery voltage in Step 4, refer back to the flow chart.
2. If the Digital Output in Step 5 did not change, replace the controller.
3. If the VOM did NOT indicate CONTINUITY in Step 11, repair or replace Wire 56 between the controller side of the harness and the relay or contactor.

TEST 47 – TEST STARTER CONTACTOR RELAY (V-TWIN ONLY)

Discussion

The starter contactor relay (SCR) located in the control panel must energize for cranking to occur. Once energized the normally open contacts of the SCR will close and battery voltage will be available to Wire 16 and to the starter contactor (SC).

Procedure

1. Set a Volt-Ohm-Milliammeter (VOM) to measure DC voltage.
2. Disconnect Wire 13 from the SCR located in the control panel.
3. Connect the positive meter test lead to Wire 13 and connect the negative meter test lead to a common ground. Measure and record the voltage.
4. Reconnect Wire 13 to the SCR.
5. Disconnect Wire 16 from the SCR.

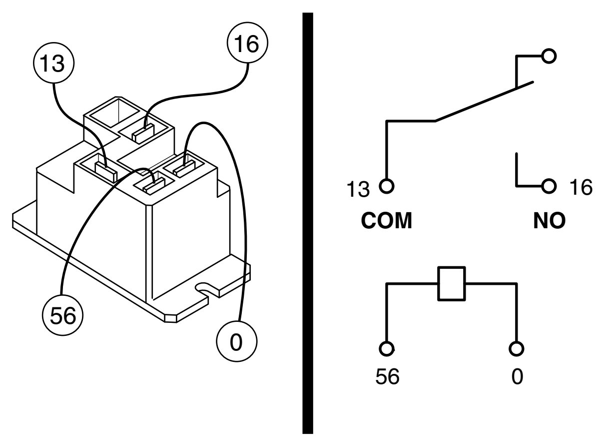


Figure 179. Starter Contactor Relay (V-twin Units)

6. Connect the positive meter test lead to the SCR terminal from which Wire 16 was removed and connect the negative meter test lead to a common ground.
7. Set the controller to the MANUAL mode. Measure and record the voltage.
8. Set the VOM to measure resistance.

9. Remove Wire 56 and Wire 0 from the SCR. Measure and record the resistance at the TERMINALS where Wire 56 and Wire 0 were removed. If resistance was not measured replace the SCR. If resistance was measured go to Step 10.
10. Disconnect Wire 0 from the SCR.
11. Connect one meter test lead to Wire 0 and connect the negative meter test lead to common ground, measure and record the resistance.

Results

1. If battery voltage was NOT measured in Step 3, repair or replace Wire 13 between the SCR and the SC.
2. If battery voltage was NOT measured in Step 7 and CONTINUITY was measured in Step 11, replace the SCR.
3. If CONTINUITY was NOT measured in Step 11, repair or replace Wire 0.
4. If battery voltage was measured in Step 6 and CONTINUITY was measured in Step 11, refer back to flow chart.

TEST 48 – TEST STARTER CONTACTOR

Discussion

The coil in the starter contactor (SC) must energize and its normally open contacts close or the engine will not crank. This test will determine if the SC is working.

Procedure

Carefully inspect the starter motor cable that runs from the battery to the starter motor. Cable connections must be clean and tight. If connections are dirty or corroded, remove the cable and clean cable terminals and terminal studs. Replace any cable that is defective or badly corroded.

Refer to Figure 180 and 181 for Test Points

1. Set Volt-Ohm-Milliammeter (VOM) to measure DC voltage.
2. Connect the positive meter test lead to the positive post of the battery and connect the negative meter test lead to the negative post of the battery. The VOM should indicate battery voltage. This measure will be a reference during the testing procedure.
3. Connect the positive meter test lead to Test Point 1 and connect the negative meter test lead to a common ground. Measure and record the voltage.
4. Connect the positive meter test lead to Test Point 2 and connect the negative meter test lead to a common ground.
5. Set the controller to the MANUAL mode; measure and record the voltage at Test Point 2 (Wire 16). The contactor should energize.

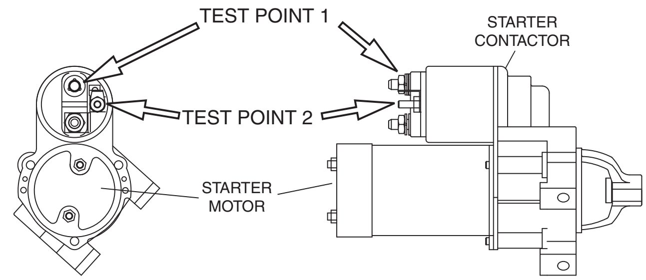


Figure 180. The Starter Contactor (V-twin Units)

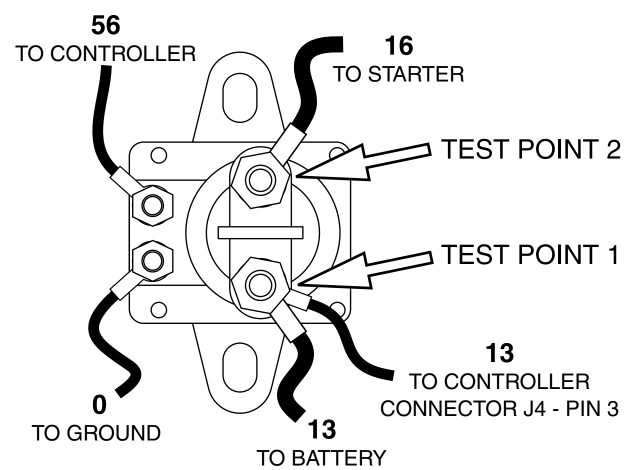


Figure 181. The Starter Contactor (Single Cylinder Units)

Results for Single Cylinder

1. If battery voltage was indicated in Steps 3 and 5, measure the resistance between test point 2 and starter motor. If no resistance is measured, repair or replace Wire 16. If resistance is measured, refer back to the flow chart.
2. If battery voltage was indicated in Step 3, but not in Step 5, replace the starter contactor.

Results for V-Twin Only

3. If the VOM did not indicate battery voltage in Step 5, measure the resistance on Wire 16 at the SCR and the contactor. If no resistance is measured, repair or replace Wire 16 between the SCR and the contactor.

TEST 49 – TEST STARTER MOTOR

Conditions Affecting Starter Motor Performance

1. A binding or seizing condition in the starter motor bearings.
2. A shorted, open or grounded armature.
   a. Shorted armature (wire insulation worn and wires touching one another). Will be indicated by low or no RPM.

b. Open armature (wire broken) will be indicated by low or no RPM and excessive current draw.
c. Grounded armature (wire insulation worn and wire touching armature lamination or shaft). Will be indicated by excessive current draw or no RPM.

3. A defective starter motor switch.
4. Broken, damaged or weak magnets.
5. Starter drive dirty or binding.

Discussion

Test 46 verified that the circuit board is delivering DC voltage to the starter contactor relay (SCR). Test 47 verified the operation of the SCR. Test 48 verified the operation of the starter contactor (SC). Another possible cause of an "engine won't crank" problem is a failure of the starter motor.

Procedure

The battery should have been checked prior to this test and should be fully charged.

Set a VOM to measure DC voltage (12 VDC). Connect the meter positive (+) test lead to the starter contactor stud which has the small jumper wire connected to the starter. Connect the common (-) test lead to the starter motor frame.

Set the controller to its "MANUAL" mode and observe the meter. Meter should indicate battery voltage, starter motor should operate and engine should crank.

Results

1. If battery voltage is indicated on the meter but motor did NOT operate, remove and test the starter motor for proper operation independent of the engine.
2. If battery voltage was indicated and the starter motor tried to engage (pinion engaged), but engine did NOT crank, check for mechanical binding of the engine or rotor.

If engine turns over slightly, go to Test 63 "Check and Adjust Valves." If valve clearance is too loose the valves will not fully open which could slow down cranking of the engine.

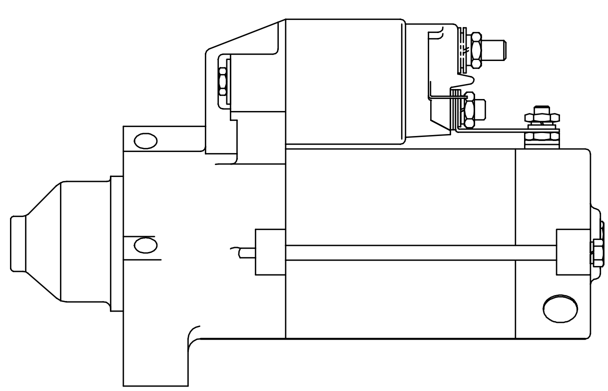


Figure 182. Starter Motor (V-Twin Engines)

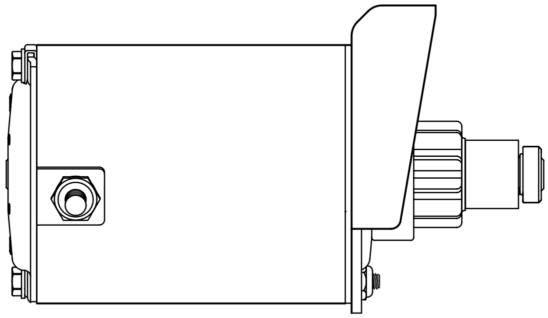


Figure 183. Starter Motor (Single Cylinder Engines)

Checking The Pinion

When the starter motor is activated, the pinion gear should move and engage the flywheel ring gear. If the pinion does not move normally, inspect the pinion for binding or sticking.

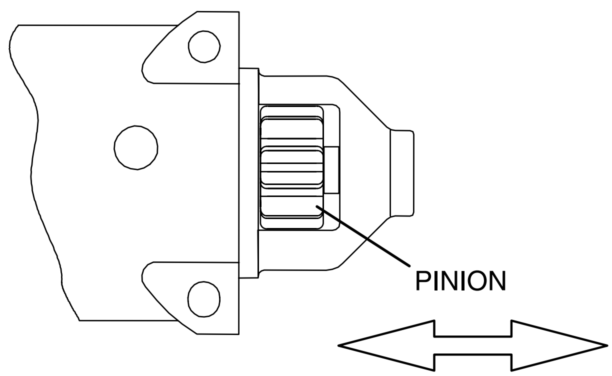


Figure 184. Check Pinion Gear Operation (V-Twin)

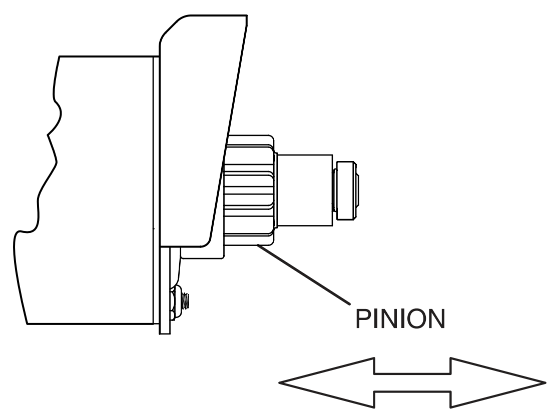


Figure 185. Check Pinion Gear Operation (Single Cylinder)

TEST 50 – CHECK FUEL SUPPLY AND PRESSURE

Discussion

The air-cooled generator was factory tested and adjusted using natural gas as a fuel. If desired, LP (propane) gas may be used. However, when converting to propane, some minor adjustments are required. The following conditions apply for a unit to operate correctly:

- An adequate gas supply and sufficient fuel pressure must be available or the engine will not start.
- Minimum recommended gaseous fuel pressure at the generator fuel inlet connection is 5 inches water column (Nexus) or 3.5 inches (Evolution) for natural gas (NG) or 10 inches water column for LP gas on Nexus and Evolution.
- Maximum gaseous fuel pressure at the generator fuel inlet connection is 7 inches water column for natural gas or 12 inches water column for LP gas.
- When propane gas is used, only a “vapor withdrawal” system may be used. This type of system utilizes the gas that forms above the liquid fuel. The vapor pressure must be high enough to ensure engine operation.
- The gaseous fuel system must be properly tested for leaks following installation and periodically thereafter. No leakage is permitted. Leak test methods must comply strictly with gas codes.

⚠ DANGER!

Gaseous fuels are highly explosive. Do not use flame or heat to test the fuel system for leaks. Natural gas is lighter than air, and tends to settle in high places. LP (propane) gas is heavier than air, and tends to settle in low areas. Even the slightest spark can ignite these gases and cause an explosion.

Procedure

A water manometer or a gauge that is calibrated in “ounces per square inch” may be used to measure the fuel pressure. Fuel pressure at the inlet side of the fuel solenoid valve should be between 3.5-7 inches (Evolution) or 5-7 inches (Nexus) water column for natural gas (NG), or 10-12 inches water column for LP gas.

1. See Figures 186, 187 or 188 for the gas pressure test point on the fuel regulator. The fuel pressure can be checked at Port 1 on all fuel regulators, and at Port 3 on 12-20 kW units.
2. With the manometer connected properly, crank the engine. Nominal fuel pressure should be measured. If pressure is not measured while cranking refer back to flow chart.

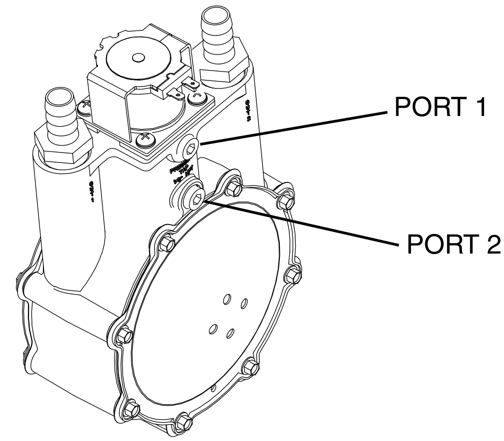


Figure 186. (8 kW) Gas Pressure Test point

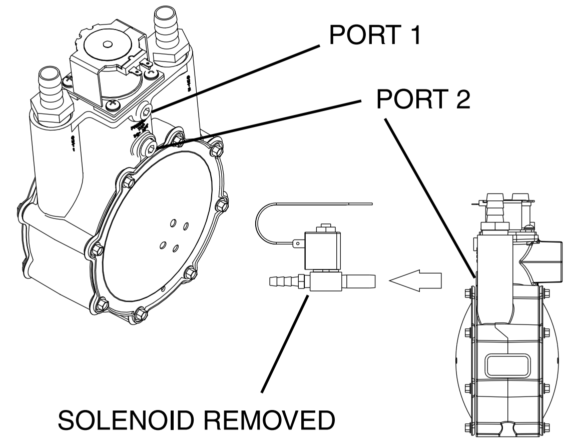


Figure 187. (10 kW) Gas Pressure Test point

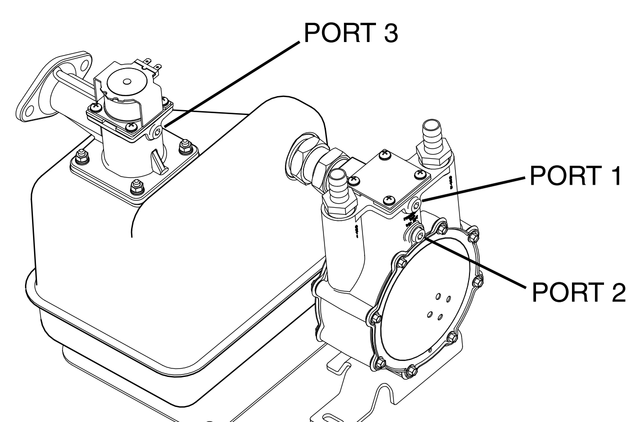


Figure 188. (12-20 kW) Gas Pressure Test point

Note: Where a primary regulator is used to establish fuel inlet pressure, adjustment of that regulator is usually the responsibility of the fuel supplier or the fuel supply system installer.

12-20 kW Units Only

Note: The test port (Port 3) below the fuel solenoid may be used to take a fuel pressure reading before the fuel solenoid. Consistent pressure should be measured at this port both while the generator is running and when the generator is off.

Results

1. If fuel supply and pressure are adequate, but engine will not start refer back to the flow chart.
2. If generator starts but runs rough or lacks power, repeat the above procedure with the generator running and under load. The fuel supply system must be able to maintain between 3.5-7 inches (Evolution) or 5-7 inches (Nexus) water column for natural gas (NG), or 10-12 inches water column for LP gas. If proper fuel supply and pressure is maintained, refer to Problem 18 Flow Chart.

NOTE: If pressure is above specifications correct/ adjust supply regulator to generator to maintain proper fuel pressure. On Nexus units no more than a 1" drop in fuel pressure from No Load to Full Load operation while staying within specifications.

TEST 51 – CHECK CONTROLLER WIRE 14 OUTPUTS

Discussion

During any crank attempt, the controllers crank relay and run relays both are energized. When the run relay energizes, its contacts close and 12 VDC is delivered to the Wire 14 circuit and to the fuel solenoid. The solenoid energizes open to allow fuel flow to the engine. This test will determine if the controller is working properly.

Procedure

1. Set the controller to OFF mode.
2. Set a Volt-Ohm-Milliammeter (VOM) to measure DC voltage.
3. Disconnect Wire 14 from the fuel solenoid (FS).
4. Connect the positive test lead to the disconnected Wire 14 from Step 3 and connect the negative test lead to a clean frame ground.
5. Set the controller to the MANUAL mode. The meter should indicate battery voltage.
   a. If battery voltage is indicated, refer back to flow chart.
   b. If battery voltage is not measured, proceed to Step 6.
6. Navigate to the Digital Output display using the menu system for the controller being worked on.

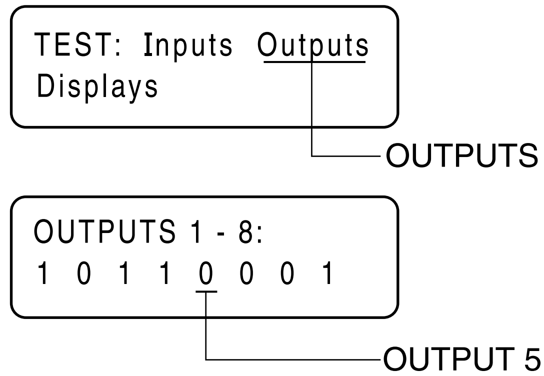


Figure 189. The Output Screens

7. Output 5 is Wire 14 out from the controller. If the controller is functioning properly, Output 5 will change from a “0” to a “1” while the unit is cranking.
   a. If the VOM did NOT indicate voltage in Step 5 and output did not change in Step 7, replace the controller.
   b. If the VOM did NOT indicate voltage in Step 5 and the output in Step 7 changed, proceed to Step 11.
8. Disconnect the 7.5 amp Fuse.
9. Disconnect the appropriate harness connector from the controller.
10. Set a VOM to measure resistance.
11. Connect one meter test lead to Wire 14 that was disconnected in Step 3 and connect the other meter test lead to Wire 14 at the controller side of the harness connector (Wire 14). See "Appendix A" for proper wire and connector pin identification.
    a. If the VOM indicated CONTINUITY repeat Step 5 and then retest.
    b. If CONTINUITY is not measured, repair or replace Wire 14 between the controller harness connector and the fuel solenoid.

Results

Refer back to flow chart.

TEST 52 – CHECK FUEL SOLENOID

Discussion

In Test 67, if battery voltage was delivered to Wire 14, the fuel solenoid should have energized open. This test will verify whether or not the fuel solenoid is operating.

Fuel Solenoid FS1 Nominal Resistance	15-16 ohms
Fuel Solenoid FS2 Nominal Resistance	29 ohms

Procedure: 8 and 12-20 kW Units

1. Install a manometer to Port 2 on the fuel regulator. See Figure 186 or Figure 188.
2. Set the controller to MANUAL mode.
3. Proper gas pressure should be measured during cranking. If gas pressure is measured, the fuel solenoid is operating. If gas pressure is not measured, repair or replace the fuel solenoid.

Procedure: 10 kW Units

1. Remove the hose from fuel solenoid (FS2) and install a manometer to Port 2 on the fuel regulator. See Figure 187.
2. Set the controller to MANUAL mode.
3. Proper gas pressure should be measured during cranking. If gas pressure is measured, both fuel solenoids are operating. Discontinue testing.
4. If gas pressure was not measured in Step 3, remove fuel solenoid FS2 and install a manometer to the bottom port of the fuel regulator.
5. Set the controller to MANUAL mode.
6. Proper gas pressure should be measured during cranking. If gas pressure is measured, fuel solenoid FS1 is operating. Replace fuel solenoid FS2. If gas pressure is not measured, repair or replace fuel solenoid FS1.

Results

If fuel pressure was measured in any of the preceding tests it indicates that the fuel solenoid is operating properly. Refer back to the flow chart for the next test.

TEST 53 – CHECK CHOKE SOLENOID (NEXUS ONLY)

Discussion

12-20 kW: The automatic choke cycles open and closed during cranking and stays energized (choke open) during running. For low speed exercise the choke will remain closed. A plate is utilized which covers the throttle bores. When de-energized the choke is closed.

10 kW: Utilize a throttle plate located in the choke housing. The choke is open when the solenoid is de-energized and closed when it is energized. Refer to Figure 192 for assembly and location.

8 kW: A choke solenoid (CS), located on the air box, energizes only during cranking to assist starting. When energized the solenoid is closed.

6 kW EcoGen: A choke solenoid (CS) is located below the air box and only energizes during cranking to assist starting. When energized, the solenoid is closed.

Procedure: 10-20 kW / EcoGen 6 kW

1. Refer to Figure 192 for the 10 kW location and Figures 190 and 191 for the 12-20 kW Choke location and operation. Turn off the fuel supply to the generator. Set the controller to the MANUAL mode. While cranking, the choke solenoid should pull the choke plate open cyclically. The duration of the cycle will vary depending on its position in the crank cycle sequence. Refer to Table 31 for crank durations. If the choke solenoid does not pull in, verify that the choke can be manually opened. There should be no binding or interference.

Table 31. Crank Cycle Sequence

1=CHOKED 0=OPEN	***Note: The first second of each crank cycle is equal to two (2) revolutions of the engine.***															
	Seconds															
Crank Cycle 1	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
10 kW/EcoGen 6 kW	0	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1
12 kW-20 kW	0	1	1	0	0	1	1	1	0	0	0	1	1	1	1	1
Crank Cycle 2	Seconds															
10 kW/EcoGen 6 kW	1	1	1	0	1	1	1	1	0	0	1	1	1	1	1	1
12 kW-20 kW	0	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1
Crank Cycle 3	Seconds															
10 kW/EcoGen 6 kW	0	0	0	0	1	1	1									
12 kW-20 kW	0	0	1	1	1	1	1									
Crank Cycle 4	Seconds															
10 kW/EcoGen 6 kW	0	1	1	1	1	1	1									
12 kW-20 kW	0	1	0	0	0	0	0									
Crank Cycle 5	Seconds															
10 kW	0	1	1	1	1	0	0									
12 kW-20 kW	0	0	0	0	1	1	1									

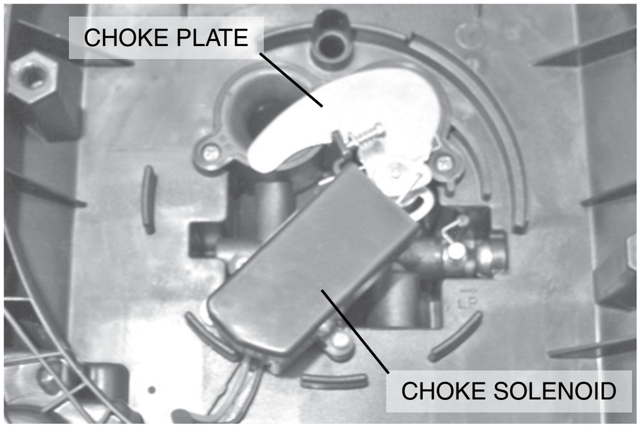


Figure 190. Solenoid De-Energized, Choke Closed 12-20 kW Units

2. Disconnect the choke solenoid.
3. Set a Volt-Ohm-Milliammeter (VOM) to measure DC voltage.
4. Refer to Figure 193. Connect the positive meter test lead to Pin 1 (Wire 14) of the female side of the CS connector going to the control panel and connect the negative meter test lead to Pin 2 (Wire 90).
5. Set the controller to MANUAL mode. While cranking, the VOM should indicate battery voltage cyclically.
   a. If the VOM did NOT indicate battery voltage, verify CONTINUITY of Wire 90 between the connector and controller side of Wire 90 and verify CONTINUITY of Wire 14 between the connector and controller side of Wire 14. Repair or replace any wiring as needed.
   b. If the VOM indicated a cyclical battery voltage proceed to Step 6.

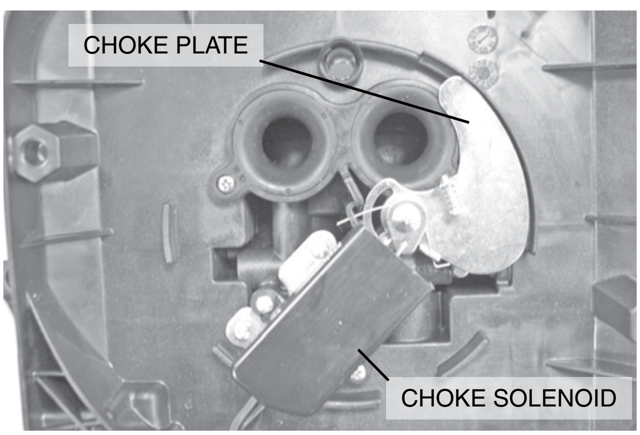


Figure 191. Solenoid Energized, Choke Open 12-20 kW Units

6. Set a VOM to measure resistance.
7. Connect one meter test lead to Pin 1(Wire 14) on the male side of the CS connector and the other meter test lead to Pin 2 (Wire 90), measure and record the resistance.
8. Reconnect the choke solenoid.

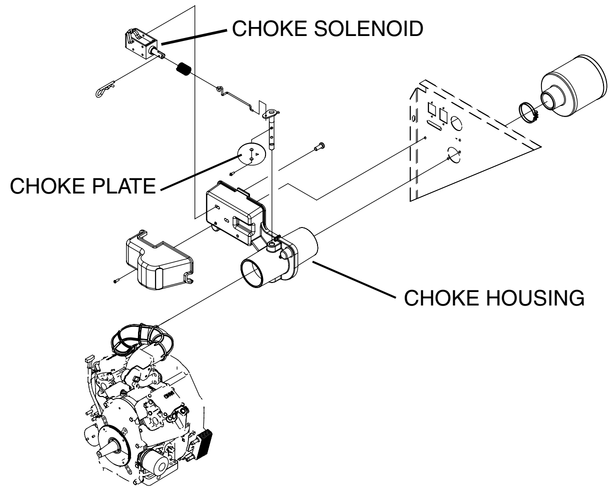


Figure 192. Exploded View Showing Location of Choke Plate - 10 kW Units

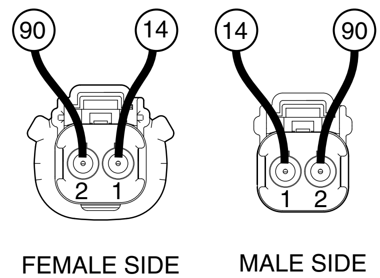


Figure 193. C3 Choke Solenoid Connector

9. With the generator running at a rated speed of approximately 60 Hz, verify that the choke is energized and holding the choke plate open. (On 10 kW units De-energized is Open)
10. Repeat Step 2; however, once the unit starts, manually hold the choke open while taking the voltage measurement.

Results

1. If the VOM did NOT indicate battery voltage in Step 5 and wire CONTINUITY was good, replace the controller.
2. If the VOM did NOT indicate approximately 3.7 ohms(10 kW units and 6-7 ohms (EcoGen 6 kW units) in Step 7, replace the choke solenoid.

Procedure: 8 kW

1. Refer to Figure 194 for location and function of choke solenoid. Turn off the fuel supply to the generator. Set the AUTO-OFF-MANUAL switch to the MANUAL position. While cranking, the choke solenoid should pull the choke plate closed. If the choke solenoid does not pull in, verify that the choke can be manually opened. There should be no binding or interference.

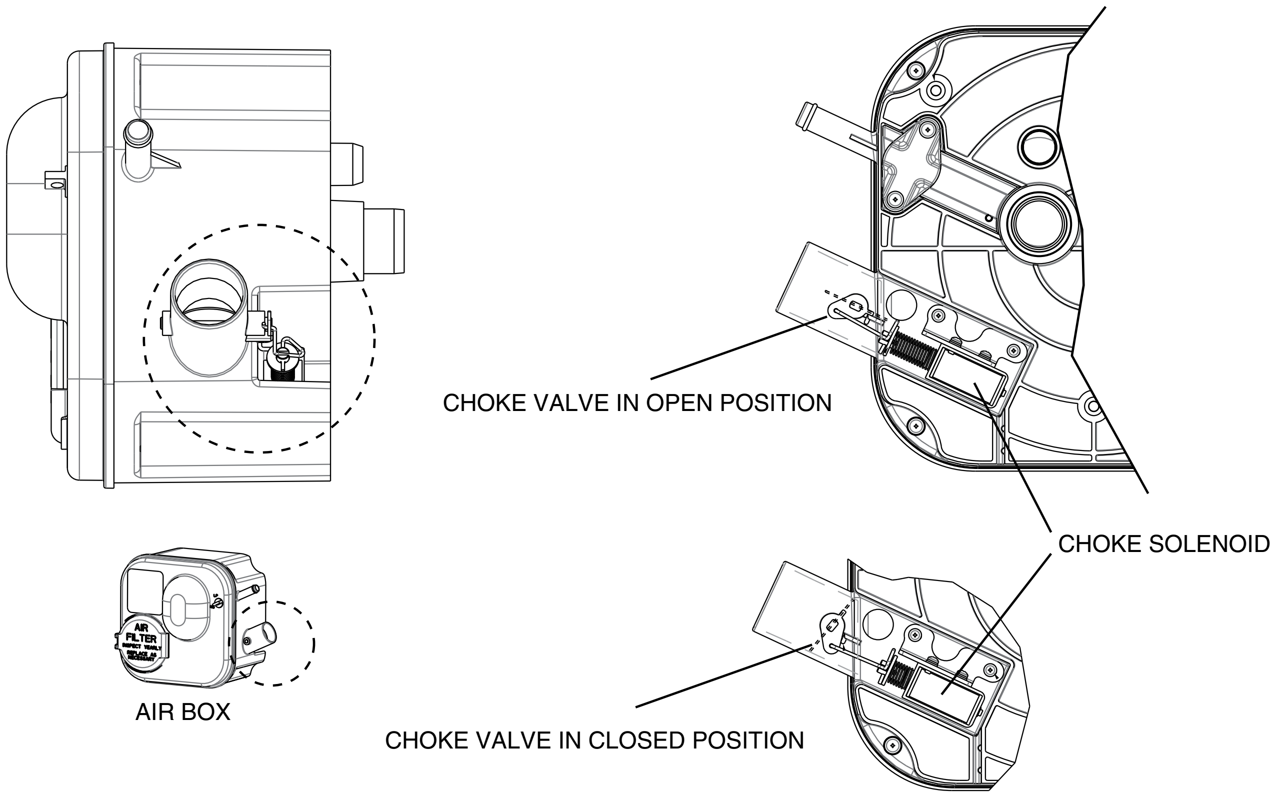


Figure 194. 8 kW Choke Solenoid

2. Disconnect the choke solenoid.
3. Set a Volt-Ohm-Milliammeter (VOM) to measure DC voltage.
4. Refer to Figure 195. Connect the positive meter test lead to Pin 1 (Wire 56) of the female side of the CS connector going to the control panel and connect the negative meter test lead to Pin 2 (Wire 90).

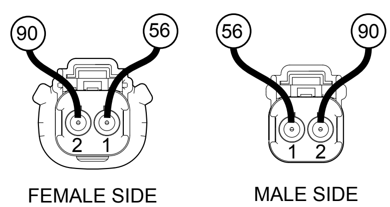


Figure 195. CS Choke Solenoid Connector

5. Set the controller to MANUAL mode. While cranking, the VOM should indicate battery voltage.
   a. If the VOM did NOT indicate battery voltage, verify CONTINUITY of Wire 90 between the connector Pin 1 J4 (Wire 90) and verify CONTINUITY of Wire 14 between the connector Pin 9 J4 (Wire 56). Repair or replace any wiring as needed.
   b. If the VOM indicated battery voltage, proceed to Step 6.
6. Set a VOM to measure resistance.
7. Connect one meter test lead to Pin 1(Wire 56) on the male side of the CS connector and the other meter test lead to Pin 2 (Wire 90), measure and record the resistance.
8. Reconnect the choke solenoid.
9. With the generator running at a rated speed of approximately 60 Hz, verify that the choke is de-energized and the choke plate is open.

Results

1. If the VOM did NOT indicate battery voltage in Step 5 and wire CONTINUITY was good, replace the controller.
2. If the VOM did NOT indicate approximately 3.7 ohms (10 kW units) and 6-7 ohms (EcoGen 6 kW units) in Step 7, replace the choke solenoid.

TEST 55 – CHECK FOR IGNITION SPARK

Discussion

If the engine cranks but will not start, one cause might be that an ignition system failure has occurred. A special spark tester can be used to check for ignition spark.

When using this style spark tester (shown in Figure 196) the adjustment screw must be set to the proper distance for the style of ignition system being tested. For the Magneto system used on the HSB single and twin cylinder engines set the distance of the adjustment screw tip at the 10K. When performing the test monitor the gap for proper spark and color.

The cranking system and engine must be in proper working order to insure accurate results.

Figure 196. Spark Tester

Procedure

1. Turn off the fuel supply to the generator.
2. Remove spark plug leads from the spark plugs.
3. Attach the clamp of the spark tester to the engine cylinder head. Refer to Figure 197.
4. Attach the spark plug lead to spark tester terminal.
5. Set the controller to the MANUAL mode.
6. While the engine is cranking, observe the spark tester. If spark jumps the tester gap, you may assume the engine ignition system is operating satisfactorily.

Note: The engine flywheel must rotate at 350 RPM (or higher) to obtain a good test of the solid-state ignition system.

Figure 197. Checking Ignition Spark

7. To determine if an engine miss is ignition related, connect the spark tester in series with the spark plug wire and spark plug (Figure 198). Then, crank and start the engine. A spark miss will be readily apparent. If spark jumps the spark tester gap regularly, but the engine miss continues, the problem is in the spark plug or in the fuel system.

V-Twin Only

8. Repeat Step 1 through 7 on the second cylinder.

Note: A sheared flywheel key may change ignition timing but sparking will still occur across the spark tester gap.

Figure 198. Checking Engine Miss

Results

1. If no spark or very weak spark occurs, proceed to Test 59.
2. If spark is present and the engine still will not start, proceed to Test 57.
3. When checking for engine miss, if sparking occurs at regular intervals, but an engine miss continues, proceed to Test 57.
4. When checking for engine miss, if a spark miss is readily apparent, proceed to Test 60.

TEST 57 – CHECK CONDITION OF SPARK PLUGS

Discussion

If the engine will not start and Test 55 indicated good ignition spark, some possible causes could be fouled or damaged electrodes. An engine miss may also be caused by defective spark plug(s).

Procedure

1. Remove spark plug(s) and inspect for any visible damage, refer to Figure 199 for types of engine related spark plug problems.
2. Replace any spark plug having burned electrodes or cracked porcelain.
3. Refer to Figure 200. Using a wire feeler gauge set the gap on new or used spark plugs as per Table 32.

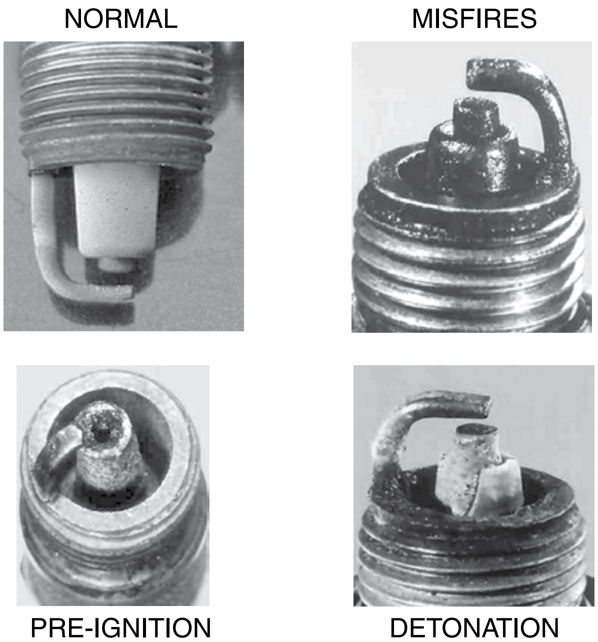


Figure 199. Spark Plug Conditions

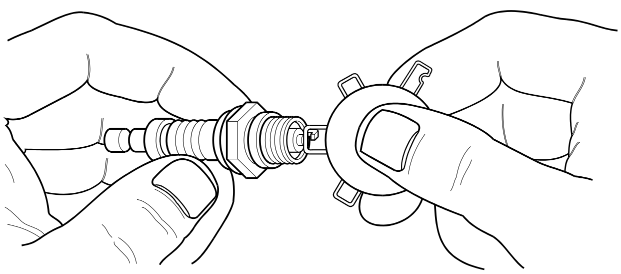


Figure 200. Checking Spark Plug Gap

Results

1. Clean, re-gap or replace plugs as necessary, re-test.
2. If spark plugs are good, refer back to flow chart.

Table 32.

Engine Size	kW Rating	Plug Gap	Recommended Plug	Manufacture
410 cc	8	0.030 inch	RC12YC	Champion
530 cc	10	0.030 inch	BPR6HS	NGK
990 cc	12-17	0.040 inch	RC14YC	Champion
999 cc	20	0.030 inch	RC12YC	Champion

TEST 58 – CHECK ENGINE / COMPRESSION TEST / CYLINDER LEAK DOWN TEST

Introduction

Performing the following test procedures will accurately diagnose some of the most common problems:

- Will not start
- Lack of power
- Runs Rough
- Vibration
- Overheating
- High Oil Consumption

CHECK COMPRESSION

Discussion

Lost or reduced engine compression can result in a failure of the engine to start, or a rough operation. One or more of the following will usually cause loss of compression:

- Blown or leaking cylinder head gasket.
- Improperly seated or sticking-valves.
- Worn piston rings or cylinder (This will also result in high oil consumption).

For air-cooled engines, the minimum allowable compression pressure for a cold engine is typically 150 PSI. Compression values are based on accurate process and proper procedure. However, testing has proven that an accurate indication of compression in the cylinder can be obtained by using the following procedure.

Note: Battery and Starting System must be in good condition to get accurate results.

NOTE: Valve Adjustment is critical to proper compression testing. Make certain valve adjustment is correct before proceeding with test.

Procedure

1. Shut off the fuel supply to the unit
2. Remove both spark plugs.
3 Place a jumper wire from the spark plug boot wire terminal to ground, OR ground wire 18 at the magneto lead connects to harness connection to disable spark.
4. Unplug the stepper motor connector from the controller and open the throttle to wide open.
5. Insert a compression gauge into the cylinder.
6. Crank the engine until there is no further increase in pressure.
7. Record the highest reading obtained.
8. Repeat the procedure for the remaining cylinder if applicable and record the highest reading.

Note: See Specifications on Page 7 for acceptable compression values.

Results

The difference in pressure between the two cylinders should not exceed 25 percent. If the difference in compression is greater that 25 percent, loss of compression in the lowest reading cylinder is indicated.

***Example 1:** If the pressure reading of cylinder #1 is 165 PSI and of cylinder #2 is 160 PSI the difference is 5 PSI. Divide "5" by the highest reading (165) to obtain the percentage of 3.0 percent.*

CYLINDER LEAK DOWN TEST

Discussion

The Cylinder Leak Down Tester checks the sealing (compression) ability of the engine by measuring air leakage from the combustion chamber. Compression loss can present many different symptoms. This test is designed to detect the section of the engine where the fault lies before disassembling the engine. Figure 201 represents a standard Tester available on the market.

Note: Refer to the Tool Manufacturer's instructions for variations of this procedure.

Procedure

1. Shut off the fuel supply.
2. Remove the spark plug(s) from the cylinder.
3. Gain access to the generator fan assembly. (Refer to Section 6.1 – Major Disassembly) Remove the valve cover.
4. Rotate the engine crankshaft until the piston reaches top dead center (TDC) on the cylinder you are working on. In this position, both the intake and exhaust valves will be closed. If the engine is not properly positioned at TDC the results of the test may be inaccurate at diagnosing a problem.

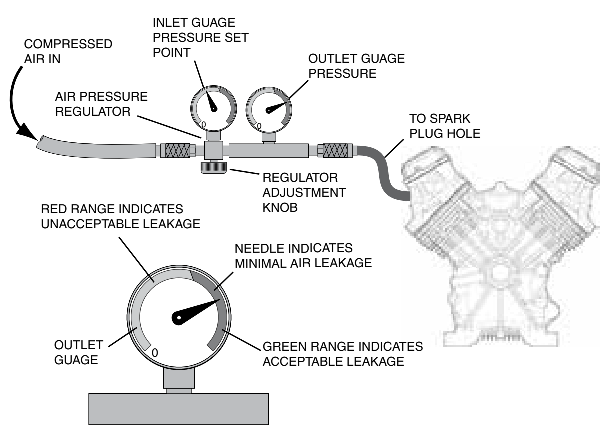


Figure 201. Cylinder Leakdown Tester

5. Attach cylinder leak down tester adapter to spark plug hole.
6. Connect an air source of 90 PSI to the cylinder leak down tester. (Note check manufacture of the tool for proper setting)
7. Monitor the flywheel/generator fan for rotation from top dead center as you apply air in the next step.
8. Adjust the regulated pressure on the gauge to the manufactures setting for the tool that you are using—typically 90 psi. Be sure flywheel/fan has not rotated.
9. Read the gauge on the tester for cylinder percent of leakage. A leakage of 20 percent is normally acceptable. Use good judgment, and listen for air escaping at the carburetor (air intake), the exhaust, the side of the head where head and block join, and the crankcase breather. This will determine where the fault lies.
10. Repeat Steps 1 through 9 on remaining cylinder if applicable.

Results

Replace cylinder head if:

- Air escapes through the air intake or carburetor – Possible intake valve issue.
- Air escapes through the exhaust or muffler – Possible exhaust valve issue.

Inspect gasket surfaces and or replace head gasket if:

- Air escapes between the cylinder head and block.

Call Technical Support if:

- Air escapes through the crankcase breather or dipstick tube.

TEST 59 – CHECK SHUTDOWN WIRE

Discussion

The controller uses Wire 18 for two purposes: first, to measure engine RPM; second, to shutdown the engine. The controller's logic during a shutdown will apply a ground to Wire 18. Wire 18 is connected to the Ignition Magneto(s). The grounded magneto will not be able to produce spark.

Procedure

1. Disconnect Wire 18 at the bullet connector (Evolution units and Nexus single cylinder units). On Nexus V-twin units, remove Wire 18 from the stud located above the oil cooler. See the following figures for the location of the Wire 18 connectors on the various units.

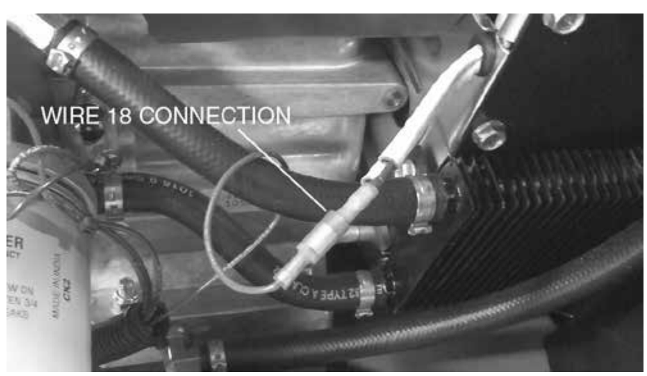


Figure 202. Wire 18 Connection Evolution V-Twin Units

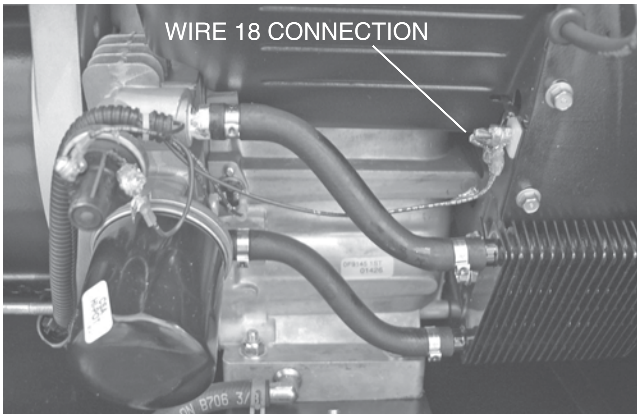


Figure 203. Wire 18 Connection Nexus V-Twin Units

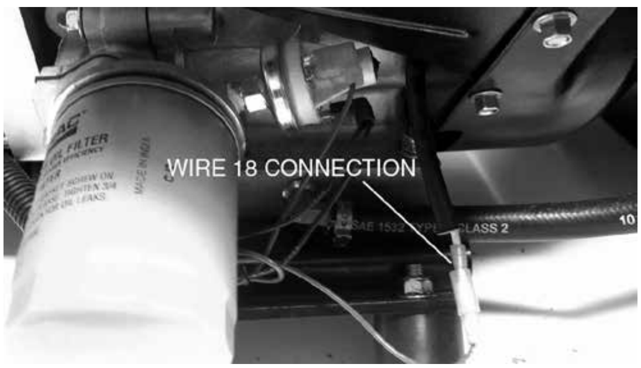


Figure 204. Wire 18 Connection Evolution Single Cylinder Units

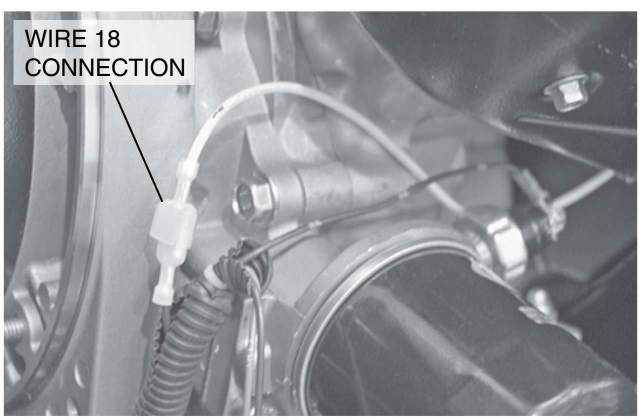


Figure 205. Wire 18 Connection Nexus Single Cylinder Units

2. Depending on engine type, do the following:
   a. On V-twin units, remove Wire 56 from the starter contactor relay (SCR). Utilizing a jumper wire, jump 12 VDC from the positive battery terminal to the terminal on the SCR from which Wire 56 was removed. The generator will start cranking. As it is cranking, repeat Test 55 – "Check for Ignition Spark." Reconnect Wire 56 when done.
   b. On single cylinder units, connect a jumper wire from the stud to which Wire 56 is connected on the starter contactor (SC) and 12 VDC from the positive battery terminal. The generator will start cranking. As it is cranking, repeat Test 55.
3. With Wire 18 removed, if spark is now present, proceed to check for a short to ground (Steps 4 through 7).
4. Disconnect the harness connector from the controller.
5. Set the Volt-Ohm-Milliammeter (VOM) to measure resistance.
6. Connect one meter test lead to Wire 18 (disconnected in Step 1) and connect the other meter test lead to a clean frame ground, measure and record the resistance.
7. Reconnect disconnected wires and connectors.

Results

1. If the VOM indicated CONTINUITY to ground in Step 6, repair or replace shorted ground Wire 18 between the engine and the controller connector.
2. If the VOM indicated INFINITY to ground in Step 6, replace the control board and re-test for spark.
3. If ignition (spark) was not present in Step 2 with Wire 18 disconnected, proceed to Test 60.

TEST 60 – CHECK AND ADJUST IGNITION MAGNETOS

Discussion

In Test 55, a spark tester was used to check for engine ignition. If sparking or weak spark occurred, one possible cause might be the ignition magneto(s). This test consists of checking values across the primary and secondary windings of the magneto and adjusting the air gap between the ignition magneto(s) and the flywheel. The flywheel and flywheel key will also be checked during this test. A diode is installed in the primary winding inside the coil. This is done to inhibit a spark occurring on both magnetos at the same time. With the diode located in the Primary circuit (except for the single cylinder engine) one must use the Diode check to verify the Primary circuit on the Twin cylinder engines.

Procedure: Testing Magnetos

1. On Nexus V-twin generators, (refer to Figure 203) remove Wire 18 from the stud located above the oil cooler. On Evolution V-twin generators and Evolution and Nexus single cylinder generators, (refer to Figures 202, 204 and 205) disconnect Wire 18 at the bullet connector.
2. Disconnect spark plug wires from the spark plugs on cylinder one and two.
3. Set VOM to measure resistance when performing resistance checks and to Diode function when performing the Diode test.

4. Follow the chart connections and note readings on VOM to chart.

Note: readings are approximate.

5. Secondary Resistance Check: Connect a meter lead to the spark plug wire and connect the other meter lead to battery ground. Record your readings and using the chart, locate your engine configuration and compare your readings to the chart. Please note readings are approximate.
6. Primary Resistance and Diode Check: Connect the meter lead to the bolt connector or male bullet connector where Wire 18 was disconnected in Step 1. Connect the other meter lead to the spark plug wire or to ground following the chart below. This step is testing the diodes in both magnetos on Twin engines ONLY to ensure they are still functioning, on single cylinders will be resistance only.
7. Repeat Steps 5 and 6 on Cylinder Two. If readings are not measured, replace the magnetos.

Note: It is recommended to replace Magnetos in pairs.
Note: Readings can change based on supplier changes. Check GENservice or contact Generac for updates.

Resistance with Wire 18 disconnected			
Magneto Wire Diagnostics		**V-Twins**	**Single Cyl**
POS Test Lead	**NEG Test Lead**	**Ohms**	**Ohms**
To Magneto	To Ground	1.5-2.5 M	.5-1.0
To Ground	To Magneto	OL	3.0
To Magneto	To Plug Wire	1.5-2.5 M	10-11 K
To Plug Wire	To Magneto	OL	10-11 K
To Plug Wire	To Ground	7-14 K	9-16 K
Diode Test		**V-Twins**	**Single Cyl**
POS Test Lead	**NEG Test Lead**	**VDC**	**VDC**
To Magneto	Ground	0.5-0.6	N/A
Ground	To Magneto	OL	N/A

Resistance with Wire 18 connected		
AC Voltage Wire 18 Backprobed	**VAC**	**VAC**
Cranking	3-5	1.5-2
Running @ 3600 rpm	14-20	7-8.5
Running @ 3000 rpm	11.5-16.5	5.8-7
Frequency	**Hz**	**Hz**
Cranking	13-17	35-45
Running @ 3600 rpm	120	60
Running @ 3000 rpm	100	50

Procedure: Adjusting Magneto Flywheel Gap

Note: The air gap between the ignition magneto and the flywheel on single cylinder engines is not adjustable. Proceed directly to Step 10 for single cylinder engines. For V-twin engines, proceed as follows:

1. See Figure 206. Rotate the flywheel (by hand) until the magnet is under the module (armature) laminations.
2. Place a 0.008-0.012 inch (0.20-0.30 mm) non metallic thickness gauge between the flywheel magnet and the module laminations.

Note: A business card is approximately 0.010 inch thick.

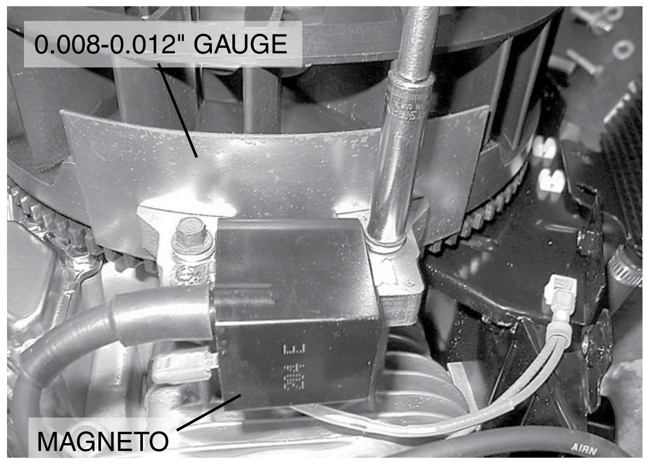


Figure 206. Setting Ignition Magneto (Armature) Air Gap

3. Loosen the mounting screws and let the magnet pull the magneto down against the thickness gauge.
4. Tighten both mounting screws.
5. To remove the thickness gauge, rotate the flywheel (manually).
6. Repeat the above procedure for the second magneto.
7. Repeat Test 55 and check for spark across the spark tester gap.
   a. A spark test may be conducted with unit dissembled by following this procedure.
   b. Battery must be connected.
   c. The harness connector must be connected to the controller.
   d. Remove Wire 56 from the SCR located beneath the controller.

⚠WARNING!

Make sure all debris is cleared from the engine compartment and all body parts are clear from flywheel before proceeding.

   e. Refer to Test 55 to check for spark.

f. Utilizing a jumper wire, connect a wire to the 194 terminal block. Connect the other end to where Wire 56 was disconnected in Step 7d. The engine should crank once the jumper from 194 is connected.

8. If spark was not indicated, replace magnetos.

Note: If gap is only adjusted, ensure to properly test the magnetos by cranking the engine over before reassembly occurs. Spark should be present on both cylinders before reassembly should be completed.

9. If air gap was not out of adjustment, test ground wires.
10. Set a VOM to the measure resistance.
11. Disconnect the engine wire harness from the ignition magnetos (Figure 207).
    a. On Nexus V-twin generators, remove Wire 18 from the stud located above the oil cooler. See Figure 203.
    b. On Evolution V-twin generators and Evolution and Nexus single cylinder generators, (refer to Figures 202, 203 and 204) disconnect Wire 18 at the bullet connector.

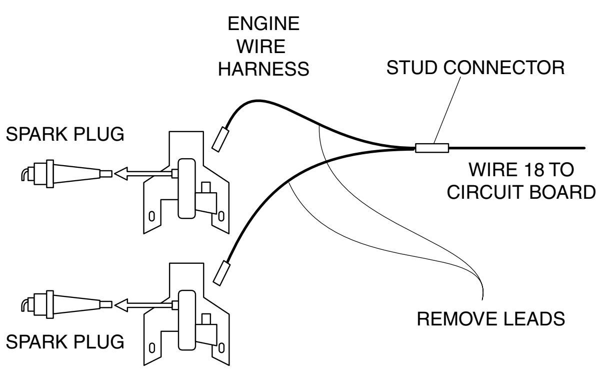


Figure 207. Engine Ground Harness

12. Connect one meter test lead to one of the wires removed from the ignition magneto(s). Connect the other test lead to frame ground. INFINITY should be measured. If CONTINUITY is measured, replace the shutdown harness.
13. Now check the flywheel magnet by holding a screwdriver at the extreme end of its handle and with its point down. When the tip of the screwdriver is moved to within 3/4 inch (19 mm) of the magnet, the blade should be pulled in against the magnet.
14. For rough running or hard starting engines check the flywheel key. The flywheel's taper is locked on the crankshaft taper by the torque of the flywheel nut. A keyway is provided for alignment only and theoretically carries no load.

Note: If the flywheel key becomes sheared or even partially sheared, ignition timing can change. Incorrect timing can result in hard starting or failure to start.

15. As stated earlier, the armature air gap is fixed for single cylinder engine models and is not adjustable. Visually inspect the armature air gap and hold down bolts.

Results

If sparking still does not occur after adjusting the armature air gap, testing the ground wires and performing the basic flywheel test, replace the ignition magneto(s).

Procedure, Replacing Magnetos:

1. Follow all steps of the Major Disassembly procedures that are located in Section 6.
2. Once the magnetos are visible, make note to how they are connected.

Note: Each magneto has its own part number. Verify the part number prior to installation.

3. Cylinder one is the back cylinder (Figure 208) and cylinder two is the front cylinder (Figure 209).

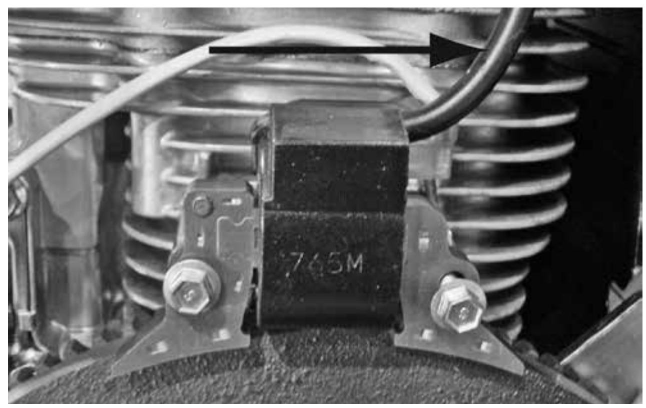


Figure 208. Cylinder One (Back, Short)

4. When installing new magnetos there will be one with a short plug wire and one with a longer plug wire (Figure 210).

Note: Magneto gap to flywheel needs to be 0.010 inch.

5. Long plug wire (B) will be installed on front cylinder (number two).
6. Short plug Wire (A) will be installed on back cylinder (number one).

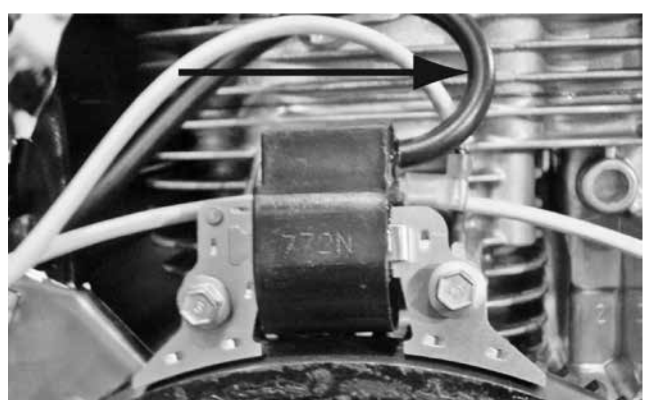


Figure 209. Cylinder Two (Front, Long)

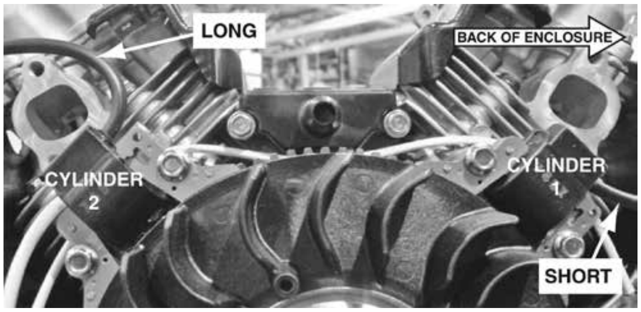


Figure 210.

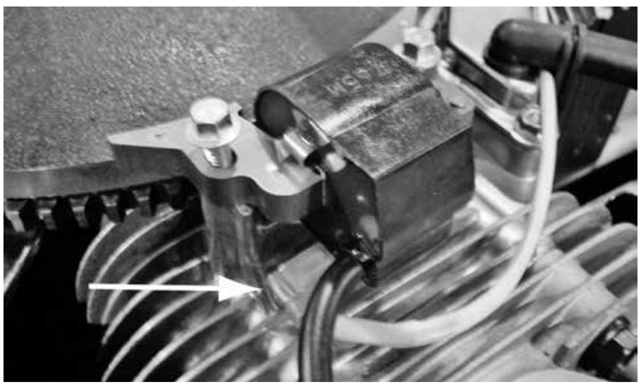


Figure 211.

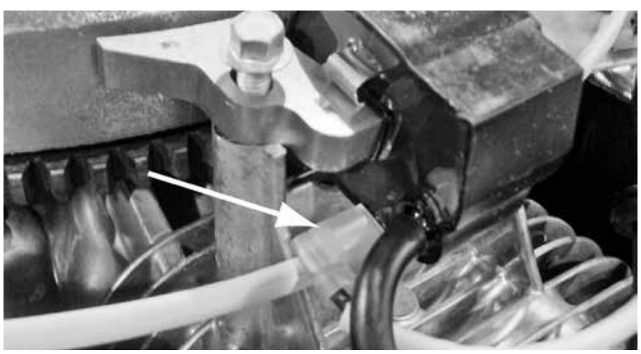


Figure 212.

7. Verify installation of magnetos correctly by ensuring both spark plug wires point to the back of the enclosure and shutdown terminals are nearest cylinder head as shown in Figures 211 and 212.

TEST 61 – CHECK OIL PRESSURE SWITCH AND WIRE 86 (EVOLUTION E-CODE 1300)

Discussion

If the oil pressure switch contacts have failed in their closed position, the engine will crank and start, however shutdown will occur within about 5 (five) to 10 (ten) seconds. If the engine cranks and starts, then shuts down almost immediately with a Shutdown-Alarm Low Oil Pressure, the cause may be one or more of the following:

- Low engine oil level.
- Low oil pressure.
- A defective oil pressure switch.

Procedure

1. Navigate to the Digital inputs display screen of the controller being worked on.

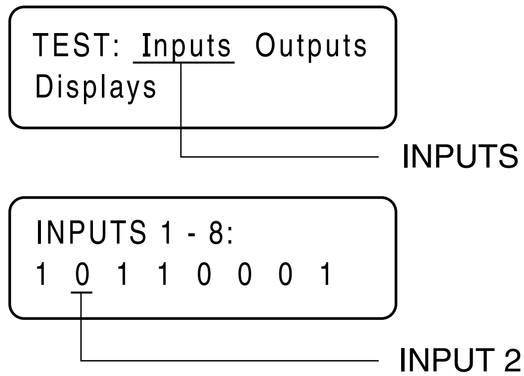


Figure 213. The Input Screens

   a. Digital Input 2 is Wire 86 from the Low Oil Pressure switch to the board. Refer to Figure 213.
   b. Set the controller to the MANUAL mode.
   c. Observe Input 2 for a change from "1" to "0". A change from "1" to "0" indicates that the control board sensed the LOP switch change states. If the generator still shuts down, replace controller.
   d. If the input did change states, the oil pressure switch is good. An intermittent oil pressure problem may still be present and should be checked with a mechanical gauge as in Step 4.
2. Check engine crankcase oil level.
   a. Check engine oil level.
   b. If necessary, add the recommended oil to the dipstick FULL mark. DO NOT OVERFILL ABOVE THE FULL MARK.
3. With oil level correct, try starting the engine.
   a. If engine still cranks and starts, but then shuts down, go to Step 4.
   b. If engine cranks and runs normally, discontinue tests.
4. Do the following:
   a. Disconnect Wire 86 and Wire 0 from the oil pressure switch terminals. Remove the switch and install an oil pressure gauge in its place.
   b. Start the engine while observing the oil pressure reading on the gauge.
   c. Note the oil pressure.
      (1) Normal oil pressure is approximately 35-40 psi with engine running. If normal oil pressure is indicated, go to Step 5 of this test.

(2) If oil pressure is below about 4.5 psi, shut engine down immediately. A problem exists in the engine lubrication system.

Note: The oil pressure switch is rated at 10 psi for V-twin engines, and 8 psi for single cylinder engines.

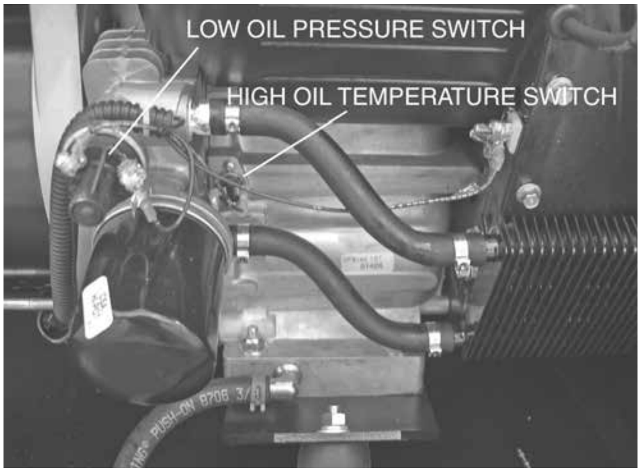


Figure 214. Oil Pressure Switch

5. Remove the oil pressure gauge and reinstall the oil pressure switch. Do NOT connect Wire 86 or Wire 0 to the switch terminals.
   a. Set a VOM to measure resistance.
   b. Connect the VOM test lead across the low oil pressure (LOP) switch terminals. With the engine shut down, the VOM should indicate CONTINUITY. If INFINITY was measured, replace the LOP switch.
   c. With the VOM still connected to the LOP switch, set the AUTO-OFF-MANUAL switch to the MANUAL position. The VOM should indicate INFINITY once the engine has had a chance to build pressure.
6. Set the VOM to measure DC voltage.
   a. Disconnect Wire 86 at the low oil pressure switch.
   b. Connect the black meter test lead to a good ground, and the red meter test lead to Wire 86. Approximately 3.3 VDC should be measured.

   If 3.3 VDC is not measured, go to Step 7 and check continuity on Wire 86 from the LOP switch back to the J4 connector.
7. Keep the VOM set to measure resistance.
   a. Disconnect the appropriate harness Connector from the controller and disconnect Wire 86 and Wire 0 from the LOP switch.
   b. Connect one meter test lead to the disconnected Wire 86 and connect the other meter test lead to Wire 86. The VOM should indicate CONTINUITY. If CONTINUITY was not measured repair or replace Wire 86 between the LOP switch and the controller harness connector.
   c. With Wire 86 still disconnected from the LOP switch and the controller harness connector, connect one meter test lead to disconnected Wire 86 and the other meter test lead to a clean frame ground. The VOM should indicate INFINITY. If CONTINUITY was measured a short to ground exists on Wire 86. Repair or replace as needed.

Results

1. If the switch operated properly and proper oil pressure was measured, and Wires 86 and 0 tested good, and/or the Input would not change on the controller, replace the controller.

TEST 62 – CHECK HIGH OIL TEMPERATURE SWITCH
(EVOLUTION E-CODE 1400)

Discussion

If the temperature switch contacts have failed in a closed position, the engine will fault out on “OVERTEMP”. If the unit is in an overheated condition, the switch contacts will close at 293° F. This will normally occur from inadequate airflow through the generator.

Procedure

1. Verify that the engine has cooled down (engine block is cool to the touch). This will allow the contacts in the High Oil Temperature Switch to open.
2. Check the installation and area surrounding the generator. There should be at least three feet of clear area around the entire unit. Make sure that there are no obstructions preventing cooling air from entering or exiting the enclosure.
3. Disconnect Wire 85 and Wire 0 from the High Oil Temperature Switch.
4. Set a VOM to measure resistance. Connect the test leads across the switch terminals. The meter should read INFINITY (0L).
5. If the switch tested good in Step 4, and a true overtemperature condition has not occurred, check Wire 85 for a short to ground. Remove harness connector from the controller. Set the VOM to measure resistance. Connect one test lead to Wire 85 (disconnected from High Oil Temperature Switch). Connect the other test lead to a clean frame ground. INFINITY should be measured.

Testing High Oil Temperature Switch

6. Remove the High Oil Temperature Switch.
7. Immerse the sensing tip of the switch in oil as shown in Figure 215, along with a suitable thermometer.
8. Set a VOM to measure resistance. Then, connect the VOM test leads across the switch terminal and the switch body. The meter should read INFINITY.
9. Heat the oil in the container. When the thermometer reads approximately 283°-305° F. (139°-151° C.), the VOM should indicate CONTINUITY.

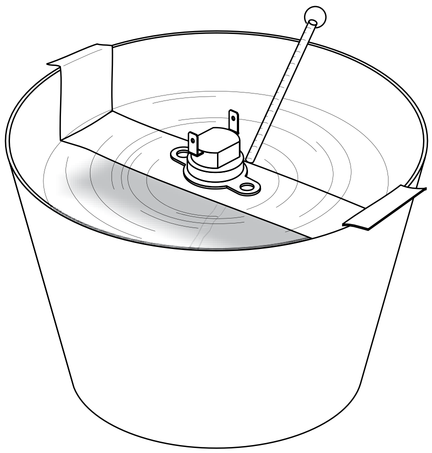


Figure 215. Testing the Oil Temperature Switch

Results

1. If the switch fails Step 4, or Steps 8-9, replace the switch.
2. If INFINITY was NOT measured in Step 5, repair or replace Wire 85 between the Circuit Board and the High Oil Temperature Switch.

TEST 63 – CHECK AND ADJUST VALVES

Discussion

Improperly adjusted valves can cause various engine related problems including, but not limited to, hard starting, rough running and lack of power. The valve adjustment procedure for both the single cylinder and the V-twin engines is the same.

Procedure: Intake and Exhaust

Make sure that the piston is at Top Dead Center (TDC) of it's compression stroke (both valves closed). The valve clearance should be 0.05-0.1 mm (0.002-0.004 in.) cold.

Check and adjust the valve to rocker arm clearance as follows:

1. Remove the four (4) screws from the rocker cover.
2. Remove the rocker cover and rocker cover gasket.
3. Loosen the rocker arm jam nut. Use a 10 mm allen wrench to turn the pivot ball stud and check the clearance between the rocker arm and the valve stem with a flat feeler gauge (see Figure 216).
4. When the valve clearance is correct, hold the pivot ball stud with the allen wrench and tighten the rocker arm jam nut. Torque the jam nut to 174 inch pounds. After tightening the jam nut, recheck the valve clearance to make sure it did not change.
5. Re-install the rocker cover gasket, rocker cover and the four (4) screws. Torque screws to appropriately.

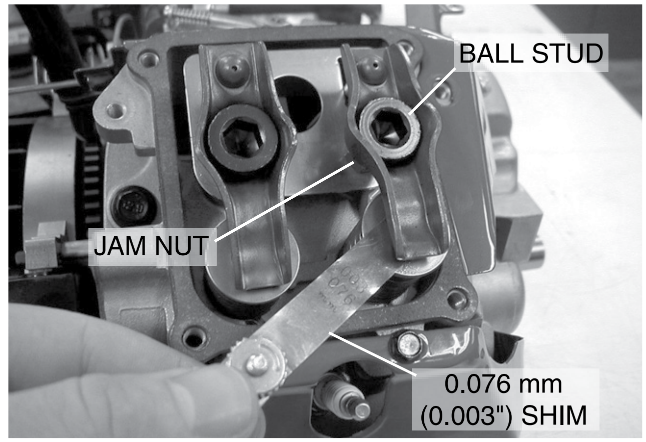


Figure 216.

Results

Adjust valve clearance as necessary, then retest.

TEST 64 – CHECK WIRE 18 CONTINUITY

Discussion

During cranking and running, the controller receives a pulse from the ignition magneto(s) via Wire 18. When cranking this signal has an AC voltage of approximately 3-6 Volts on V-twin engines, approximately 2-3 Volts on single cylinder. If the controller does not receive this signal, the unit will shut down due to no RPM sensing.

Procedure: V-Twin Engine and Single Cylinder Engine

1. Set the Volt-Ohm-Milliammeter (VOM) to measure AC voltage.
2. On a Nexus V-twin unit, connect one meter test lead to Wire 18 at the stud connector shown in Figure 217 and connect the other meter test lead to a clean frame ground. On Evolution V-twin and single cylinder units and the Nexus single cylinder units back probe the harness connector (Figure 218).

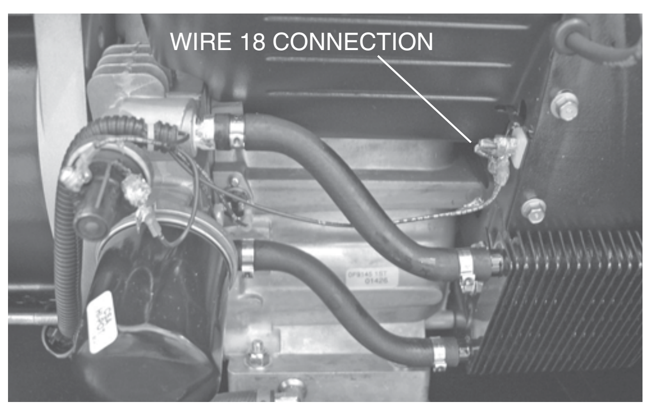


Figure 217. Wire 18 Connection Nexus V-Twin Units

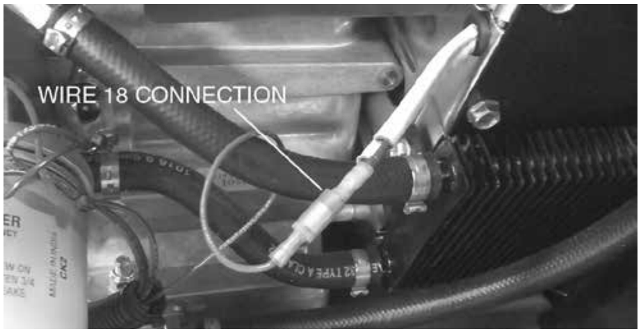


Figure 218. Wire 18 Connection Evolution V-Twin and Single Cylinder Units and Nexus Single Cylinder Units

3. Set the controller to the MANUAL mode.
4. While unit is cranking measure and record the voltage.
   a. If the VOM indicated approximately 3-6 VAC for V-twin or 2-3 VAC for single cylinder, proceed to Step 6.
   b. If the VOM did NOT indicate the appropriate voltage, go to the next step.
5. Disconnect Wire 18 from the stud on the Nexus V-twin unit. On the Evolution V-twin and single cylinder units, or Nexus single cylinder unit, disconnect Wire 18 from magneto sensing lead.
   a. Connect one meter test lead to a clean frame ground and connect the other meter test lead to the magneto lead terminal.
   b. Set the controller to MANUAL mode and while unit is cranking measure and record the voltage.
   c. If the VOM indicated approximately 3-6 VAC for twin and 2-3 VAC for single, proceed to Step 6
   d. If the VOM did NOT indicate the appropriate voltage, go back to the flow chart (Problem 14) and follow "No Signal" (Test 60).
6. Set the VOM to measure resistance.
7. Disconnect the harness connector containing Wire 18 from the controller.
8. Connect one meter test lead to a clean frame ground and connect the other meter test lead to Wire 18.
   a. If the VOM indicated low resistance (.01), check for a short to ground in the Wire 18 circuit.
   b. If the VOM indicated 0/L OPEN circuit proceed to Step 9.
9. Connect one meter test lead to harness side of Wire 18 that went to the magneto and connect the other meter test lead to Wire 18 at the controller connector.
   a. If the VOM indicated CONTINUITY, refer back to the flow chart (Problem 14, RPM Sense Loss).
   b. If the VOM indicated INFINITY repair or replace Wire 18 between the magneto connector and the controller connector.

TEST 65 – TEST EXERCISE FUNCTION

Discussion

The following parameters must be met in order for the weekly exercise to occur:

- Exercise Time set in controller and controller set to AUTO mode.

Procedure: 8 kW-14 kW

Note: Make a record of the date and time the generator is set to exercise.

1. Record the current date and time of the unit.
2. Press the "ESC" key until the main menu is displayed.
3. Navigate to the Exercise settings screen of the controller being worked on.
4. Press "Enter".
5. Adjust exercise time to 5 minutes ahead of the date and time noted in Step 1.
6. Return to the Main Display where "READY TO RUN" is displayed. The controller must be in AUTO mode for the unit to exercise.
7. Watch the generator display and note the time. When the date and time reaches the time that was programmed for exercise, the unit will display "Running in Exercise" if the exercise feature is working properly.

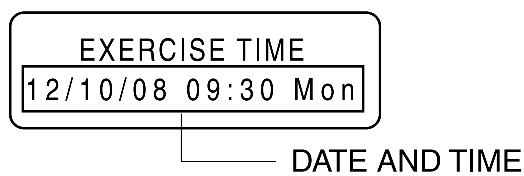


Figure 219. The Exercise Screen

Evolution Procedure: 15-20 kW (11-20 kW Honeywell™)

Utility voltage must be present.

1. Set the controller to the AUTO mode.
2. Enter the Dealer Password to enter the Dealer Edit Menu.
3. Select "Test."
4. Press ENTER.
5. Press arrow key until "IN AUTO PRESS ENTER FOR QT-TEST" is displayed.
6. Press ENTER.
7. The generator should start and run the low speed exercise.
8. To stop test press ENTER.

Nexus Procedure: 17-20 kW

Utility voltage must be present.

1. Set the controller to the AUTO mode.

2. Press the “ESC” key until the main menu is displayed.
3. Press the right arrow key until “Debug” begins to flash.
4. Press “Enter.”
5. Press the right arrow key until “QT Test” beings to flash.
6. Press “Enter.”
7. The generator should start and run its normal exercise period.

Results

1. In all models, if the unit starts in MANUAL mode, but fails to exercise without any ALARMS present, replace the controller.

TEST 66 – TEST CRANKING AND RUNNING CIRCUITS

Discussion

This test will check all of the circuits that are “Hot” with battery voltage and which could cause the Main Fuse to blow. Refer to Table 33 throughout the procedure for the known resistance values of components.

Figure 220 shows the Volt-Ohm-Milliammeter (VOM) in two different states. The left VOM indicates an OPEN circuit or INFINITY. The right VOM indicates a dead short or CONTINUITY. Throughout the troubleshooting, refer back to Figure 220 as needed to understand what the meter is indicating about the particular circuit that was tested.

Note: CONTINUITY is equal to .01 ohms of resistance or a dead short.

Table 33. Components Resistance Values

Starter Contactor	8Ω
Starter Contactor Relay	155Ω
Main Fuel Solenoid	15 - 16Ω
10 kW Fuel Solenoid 2	30Ω
Transfer Relay	90Ω
Choke Solenoid	3 - 4Ω

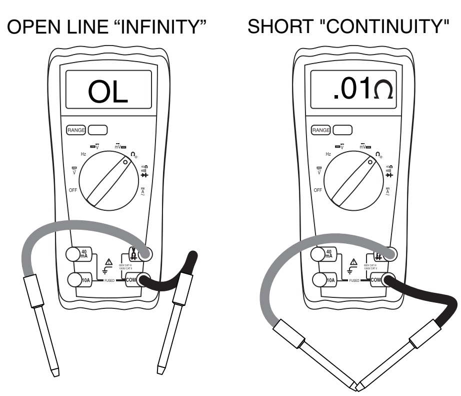


Figure 220.

Procedure

1. Set a Volt-Ohm-Milliammeter (VOM) to measure resistance.
2. Disconnect the harness from the controller.
3. Connect one meter lead to a clean frame ground and connect the other meter test lead to each of the following tests points in Table 34, measure and record the resistance.

Table 35 has been provided to record the results of this test. Additional copies of this table can be found in Appendix C “Supplemental Worksheets” at the back of this manual.

Table 34. Resistance Measurements (Nexus only)

Test Point	Pin Location	Circuit	8 kW	10 kW-20 kW
1	*	Wire 14	16Ω	16Ω
2	*	Wire 56	4Ω	155Ω
3	*	Wire 194	OPEN	OPEN
* Use Appendix A for pin locations				

Results

1. Compare the results of Step 3 with Table 34 according to the different kW range.
   a. If the VOM indicates less than 16 ohms at Test Point 1 proceed to Test 67.
   b. If the VOM indicates less than 4 Ohms (8 kW) or less than 155 Ohms (10-20 kW) at Test Point 2 proceed to Test 68.
   c. If the VOM indicated CONTINUITY at Test Point 3 proceed to Test 69.
   d. If the VOM indicated proper resistance values at all Test Points, replace the controller.

Table 35. Test 66 Results

Test Point	Pin Location	Circuit	Result
1	*	Wire 14	
2	*	Wire 56	
3	*	Wire 194	
* Use Appendix A for pin locations			

TEST 67 – TEST RUN CIRCUIT

Discussion

Wire 14 provides 12 VDC during cranking and running. If the VOM indicated less than 15 Ohms in the previous test, one of the possible causes could be a faulty relay or solenoid.

Procedure: 8 kW

1. Set a Volt-Ohm-Milliammeter (VOM) to measure resistance.
2. Disconnect Wire 14 from the fuel solenoid (FS).
3. Connect one meter test lead to the FS terminal from which Wire 14 was removed. Connect the other meter test lead to the ground terminal, measure and record the resistance.

Results

1. If the VOM indicated less than 15 ohms of resistance in Step 3, a short exists within the fuel solenoid. Repair and replace as needed.

Procedure: 10 kW

1. Set a Volt-Ohm-Milliammeter (VOM) to measure resistance.
2. Disconnect Wire 14 from the fuel solenoid (FS), fuel solenoid 2 (FS2, if equipped), and the choke solenoid (CS).
3. Connect one meter test lead to the FS terminal from which Wire 14 was removed. Connect the other meter test lead to the ground terminal, measure and record the resistance.
4. Connect one meter test lead to the FS2 terminal from which Wire 14 was removed. Connect the other meter test lead to the ground terminal, measure and record the resistance.

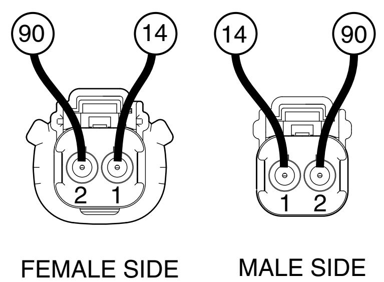


Figure 221. C3 Choke Solenoid Connector (Nexus only)

5. Refer to Figure 221 in reference to the CS connector. On the male side connect one meter test lead to Pin 1 and the other meter test lead to Pin 2, measure and record the resistance.

Results

1. If the VOM indicated less than 15 ohms in Step 3, replace the FS solenoid.
2. If the VOM indicated less than 30 ohms in Step 4, replace the FS2 solenoid.
3. If the VOM indicated less than 3 ohms in Step 5, replace the CS solenoid.
4. Refer to Table 33 and if the VOM indicated the correct resistance for the component, a short to ground exists on Wire 14. Repair or replace Wire 14 as needed.

Procedure: 12 kW-20 kW

1. Set a Volt-Ohm-Milliammeter (VOM) to measure resistance.
2. Disconnect Wire 14 from the fuel solenoid (FS) and the choke solenoid (CS).
3. Connect one meter test lead to the FS terminal from which Wire 14 was removed. Connect the other meter test lead to the ground terminal, measure and record the resistance.
4. Refer to Figure 221 in reference to the CS connector. On the male side, connect one meter test lead to Pin 1 and the other meter test lead to Pin 2, measure and record the resistance.

Results

1. If the VOM indicated less than 15 ohms in Step 3, replace the FS solenoid.
2. If the VOM indicated less than 3 ohms in Step 4, replace the CS solenoid.
3. Refer to Table 33 and if the VOM indicated the correct resistance for the component, a short to ground exists on Wire 14. Repair and replace Wire 14 as needed.

TEST 68 – TEST CRANK CIRCUIT

Discussion

Wire 56 provides 12 VDC during cranking only. If the VOM indicated less than 8 ohms (8 kW) at the start contactor or less than 155 ohms (10-20 kW) at the start contactor relay in the previous test, one of the possible causes could be a faulty relay or solenoid.

Procedure: 8 kW

1. Set a Volt-Ohm-Milliammeter (VOM) to measure resistance.
2. Disconnect Wire 56 from the starter contactor (SC) and on Nexus units disconnect the choke solenoid (CS).
3. Connect one meter test lead to the SC terminal from which Wire 56 was removed. Connect the other meter test lead to the ground terminal, measure and record the resistance.
4. Refer to Figure 222 in reference to the CS connector. On the male side, connect one meter test lead to Pin 1 and the other meter test lead to Pin 2, measure and record the resistance.

Results

1. If the VOM indicated less than 8 ohms of resistance in Step 3, a short exists. Repair or replace as needed.
2. If the VOM indicated less than 3 ohms in step 4 replace the CS.

Procedure: 10 kW-20 kW

1. Set a Volt-Ohm-Milliammeter (VOM) to measure resistance.
2. Disconnect Wire 56 and 0 from the starter contactor relay (SCR).
3. Connect one meter test lead to the SCR terminal from which Wire 56 was removed. Connect the other meter test lead to the terminal from which Wire 0 was removed, measure and record the resistance.
4. Refer to Figure 222 in reference to the CS connector. On the male side, connect one meter test lead to Pin 1 and the other meter test lead to Pin 2, measure and record the

resistance.

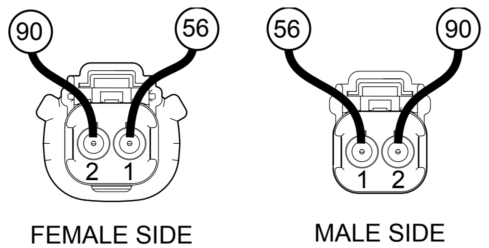


Figure 222. CS Choke Solenoid Connector

Results

1. If the VOM indicated less than 155 ohms in Step 3, replace the SCR relay.
2. If the VOM indicated less than 3 ohms in Step 4, replace the CS solenoid.
3. Refer to Table 33 . If the VOM indicated the correct resistance for the component, a short to ground exists on Wire 56. Repair and replace Wire 56 as needed.

TEST 69 – TEST TRANSFER RELAY CIRCUIT

Discussion

Wire 194 provides 12 VDC for the transfer relay (TR1). If the VOM indicated CONTINUITY in the previous test, one of the possible causes could be a faulty relay.

Procedure

1. Set a Volt-Ohm-Milliammeter (VOM) to measure resistance.
2. Disconnect Wire 194 and 23 from TR1 relay located inside the transfer switch.
3. Connect one meter test lead to terminal "A" on the relay and connect the other meter test lead to terminal "B", measure and record the resistance.

Results

1. If the VOM indicates less than 90 ohms of resistance in Step 3, a short exists. Repair and replace as needed.

TEST 70 – CHECK TO SEE IF LOW SPEED FUNCTION IS ENABLED
(AVAILABLE ONLY ON CERTAIN MODELS)

Discussion

Some generators are equipped with a low speed exercise function. When enabled, the low speed exercise function allows the generator to exercise at 2400 rpm. If it is disabled it will exercise at its 3600 rpm during exercise.

Procedure – Evolution (If equipped)

1. From the main display enter the Edit Menu using the menu map.
2. Arrow up or down until "Exercise" Time is displayed.
3. Press ENTER.
4. "Quiet Test Mode? Yes or No" will be displayed. Be sure "Yes" is displayed. If not, change selection to Yes.
5. Press ENTER to save change.
6. Return to Main Display.

Procedure – Nexus

Navigate to the Set Exercise display screen of the controller being worked on and check to see if the exercise function is enabled.

Results

Enable the exercise function if it is not already enabled. Refer back to flow chart.

TEST 71 – CHECK OPERATION OF THE CHOKE SOLENOID (NEXUS ONLY)

Discussion

The choke solenoid should be closed when it is in low speed exercise.

Procedure

1. Remove the air box cover and filter from the engine.
2. Refer to test 65 for Test Exercise Function.
3. When the generator starts and the display reflects that it is exercising, confirm that the choke solenoid is fully closed over one port.

Results

1. If the solenoid did not close, confirm that utility voltage is present. If the generator believes that there is a power outage it will run at full speed until utility is returned.
2. If the solenoid did not close during low speed (quiet test) exercise, and Utility power was available, refer back to Test 53.

TEST 75 – TEST 120 VOLT INPUT (T1) 60 HZ 240 VOLT INPUT (T1 - T2) 50 HZ

Discussion

The controller requires 120 VAC (60 HZ Unit) or 240 VAC (50 HZ Unit) supplied from the LOAD side of the CONTACTOR in the transfer switch to function properly. When the circuit is supplied to the controller it will allow the controller to remain ON, but in a disabled mode where it will not crank or function properly.

Procedure

Note: "Inspect Battery" alarm may appear while performing this test procedure. Ignore this alarm, it is a symptom of the test procedure.

1. Locate the 7.5 amp fuse on the controller.
2. Remove the fuse and observe the LCD screen.

Results

1. If the controller remained illuminated or continued to show its status after the fuse was removed, the 120 VAC (60 Hz) or 240 VAC (50 Hz) input is good.
2. If the controller powered down when the fuse was removed, the controller is not getting the 120 VAC (60 Hz) or 240 VAC (50 HZ) input. Return to the flow chart (Test 79).

TEST 76 – VERIFY DC VOLTAGE OF THE CONTROLLER

Discussion

The battery voltage of the unit can be viewed within the "Display" (Evolution) or "Status" (Nexus) menu of the controller. This test procedure will verify battery voltage to the controller.

Procedure

Use the Navigation Menu MAP for the controller you are working on.

Results

1. If the battery voltage indicated on the display is greater than 12 VDC, the connections to the controller from the battery are good. Refer back to flow chart.
2. If the battery voltage indicated on the display is 0 VDC, the connections to the controller are bad. Refer back to flow chart.
3. If the battery voltage indicated on the display is between 1 VDC to 11 VDC, check cables and connections, or charge or replace the battery.

TEST 77 – CHECK WIRE 13 AND WIRE 0

Discussion

The previous test indicated that battery voltage was not available to the controller and it was operating only off of the 120 VAC input from T1.

Procedure

1. Set Volt-Ohm-Milliammeter (VOM) to measure DC voltage.
2. Remove the 7.5 Amp fuse from the controller.
3. Connect one meter lead to the left side of the fuse holder where the fuse was previously connected. Connect the other meter test lead to a clean frame ground. Measure and record the voltage.
4. Disconnect the appropriate harness connector from the controller.
5. Connect one meter test lead to harness connector pin for Wire 13 and the other meter test lead to harness connector pin for Wire 0. Measure and record the voltage.

Results

1. If the VOM indicated battery voltage in Steps 3 and 5, replace the controller.
2. If the VOM indicated battery voltage in Step 3, but did NOT indicate battery voltage in Step 5, replace or replace Wire 0 between the harness connector and the ground stud.

TEST 78 – TEST DC CHARGE CURRENT TO THE BATTERY

Discussion

Previous testing has verified the 120 VAC input connection and the battery connection. This test procedure will determine if there is a negative draw on the battery or a positive one, which will indicate successful operation of the charger.

Procedure

Note: A "Low Battery" or "Inspect Battery" alert may be generated during this test procedure. It will not effect the results of the test and can be acknowledged when testing is complete.

1. Set the controller to the MANUAL mode and crank the engine for 2 -3 seconds.
2. Set the controller to the OFF mode.
3. Disconnect the negative cable battery.
4. Set the Volt-Ohm-Milliammeter (VOM) to measure DC amperage.

Note: Consult the meters owner's manual to ensure proper setup of meter and that the internal fuse is good before proceeding.

3. Connect the positive (red) meter test lead to the negative battery post and connect the negative (black) meter test lead to disconnected negative battery cable. Measure and record the amperage.

Results

1. If the VOM indicated positive DC amperage between 50 milliamps to 2.5 amps, stop testing. The charger is functioning properly.
2. If the VOM indicated negative DC amperage, replace the controller.

Figure 223. Positive DC Amps

Figure 224. Negative DC Amps

TEST 79 – CHECK T1 VOLTAGE AT CUSTOMER CONNECTIONS

Procedure

1. Set a Volt-Ohm-Milliammeter (VOM) to measure AC Voltage.
2. Connect one meter test lead to the T1 Terminal block at the customer connections in the generator. Connect the other meter test lead to the NEUTRAL connection. Measure and record the voltage.

Results

1. If the VOM indicated 120 VAC, proceed to check voltage at the J5 connector, refer back to flow chart.
2. If the VOM indicated less than 120 VAC or 0, refer back to flow chart.

TEST 80 – CHECK T1/T2 VOLTAGE AT CONTROLLER CONNECTOR

If 120 VAC was available on the customer connection block between T1 and neutral for 60 Hz units, or 240 VAC between T1 and T2 for 50 Hz units, the problem may be an open wire or bad connector at the controller harness connection.

Procedure

1. Disconnect the controller connector at the control panel.
2. Set the VOM to measure AC voltage.
   a. For 60 Hz units check the voltage at the controller harness connector pin between Wire T1 and the neutral connection on the customer connection block. If Voltage is present, proceed to Step 3. If voltage is not present check the T1 wire from the customer connection block to the controller harness connector.
   b. For 50 Hz units check the voltage at the controller harness connector pins between T1 and the neutral connection, then between T2 and the neutral connection on the customer connection block. If voltage is not present check the T1/T2 wires from the customer connection block to the controller harness connector. If Voltage is present, replace the controller.
3. For 60 Hz units only, check the voltage between Wire 00 of the controller harness connector pin and T1 at the customer connection block. If voltage is present inspect and repair the connection pins at controller harness connector. If voltage is not available, check the 00 wire from the customer connection block to the controller harness connector.
4. If 120 VAC is present between T1 and 00 of the controller harness connector, and the pins are in good condition, then the fault lies in the controller itself. Replace the controller.

TEST 81 – CHECK T1/T2 VOLTAGE IN TRANSFER SWITCH

Discussion

If voltage was not present in the generator, the most likely cause is a blown T1/T2 fuse or an open wire.

Procedure

1. Set the VOM to measure AC voltage.
2. Connect one meter test lead to the bottom side of the T1 fuse holder (T1/T2 for 50 Hz units) and the other meter test lead to the NEUTRAL connection. Measure and record the voltage.

Results

1. If the VOM indicated proper voltage, repair or replace faulty wire between the Generator and the Fuse Holder.
2. If the VOM indicated less than proper voltage or 0, refer back to the flow chart.

TEST 82 – TEST F3 FUSE CIRCUIT

Procedure

1. Set a Volt-Ohm-Milliammeter (VOM) to measure AC voltage.
2. Connect one meter test lead to the top side of the T1 fuse holder and connect the other test lead to the NEUTRAL connection. Measure and record the voltage.
   a. If the VOM indicated 120 VAC, proceed to Step 3.
   b. If the VOM indicated less than 120 VAC or 0, verify that Load voltage is available to the LOAD side of the CONTACTOR.

3. On the generator panel, set the AUTO-OFF-MANUAL switch to the OFF position.
4. Disconnect Utility from the transfer switch.
5. Remove fuse F3 from the fuse holder. (see Figure 225).
6. Inspect and test fuses for an OPEN condition with a Volt-Ohm-Milliammeter (VOM) set to measure resistance, CONTINUITY should be measured across the fuse.

Results

1. Replace blown fuse as needed and proceed to Problem 10 "Blown T1 Fuse."

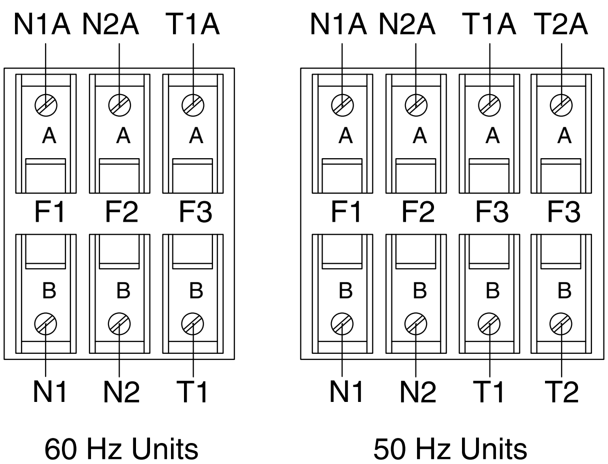


Figure 225. Transfer Switch Fuse Block

PART 5 - OPERATIONAL TESTS

INTRODUCTION

Following home standby electric system installation and periodically thereafter, the system should be tested. Functional tests of the system include the following:

- Manual transfer switch operation.
- System voltage tests.
- Generator Tests Under Load.
- Testing automatic operation.

Before proceeding with functional tests, read instructions and information on tags or decals affixed to the generator and transfer switch. Perform all tests in the exact order given in this section.

MANUAL TRANSFER SWITCH OPERATION

"W/V-Type" Transfer Switches

1. On the generator panel, set the CONTROLLER to the OFF mode.
2. Turn OFF the utility power supply to the transfer switch using whatever means provided (such as a "Utility" main line circuit breaker).
3. Set the generator main line circuit breaker to OFF (or open).

⚠ DANGER!

Be sure to turn off all power voltage supplies to the transfer switch before attempting manual operation. Failure to turn off power voltage supplies to the transfer switch may result in dangerous and possibly lethal electrical shock.

4. Remove the manual transfer handle from the enclosure.
5. Place open end of the manual transfer handle over transfer switch operating lever.
6. To connect LOAD terminal lugs to the utility power source, move, the handle upward.
7. To connect LOAD terminals to the standby power source, move the handle downward.
8. Actuate the switch to UTILITY and to MANUAL several times. Make sure no evidence of binding or interference is felt.
9. When satisfied that manual transfer switch operation is correct, actuate the main contacts to their UTILITY position (Load connected to the utility power supply).

ELECTRICAL CHECKS

Complete electrical checks as follows:

1. Set the generator main circuit breaker to its OFF (or open) position.
2. Set the generator AUTO-OFF-MANUAL switch to the OFF position.
3. Turn off all loads connected to the transfer switch Terminals T1 and T2.
4. Turn on the utility power supply to the transfer switch using the means provided (such as a utility main line circuit breaker).

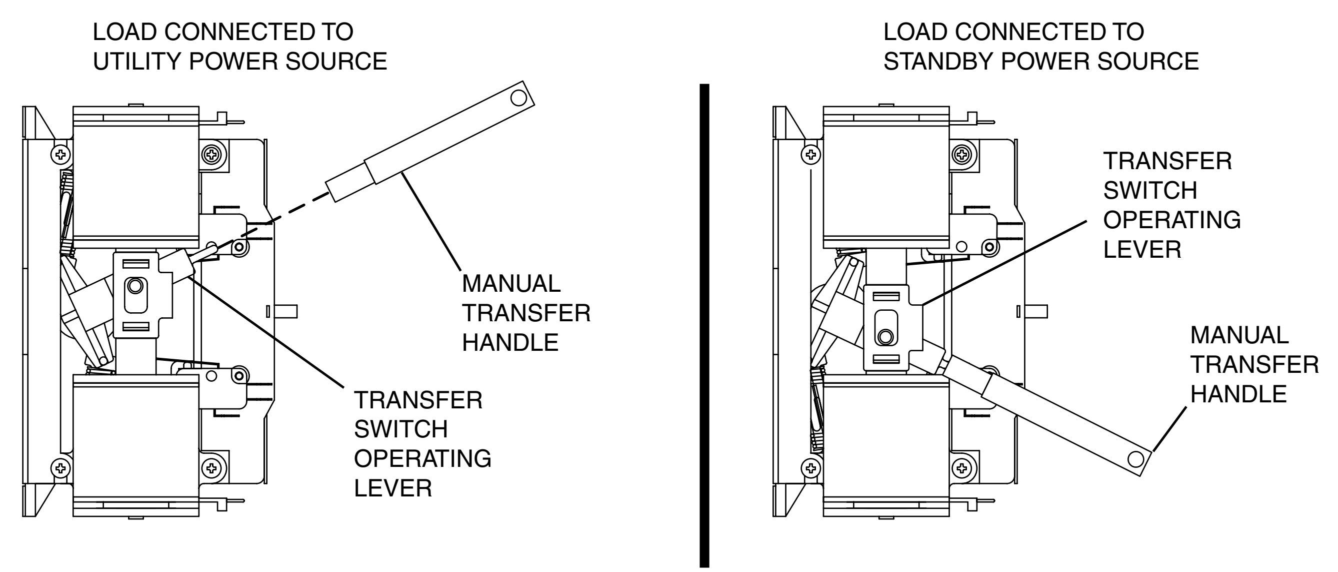


Figure 226. Manual Operation "V-Type" Switch

SETTING THE EXERCISE TIME

This generator is equipped with a configurable exercise timer. There are two settings for the exercise timer. One is Day/Time. Once it is set, the generator will start and exercise for the period defined, on the day of the week and at the time of day specified. During this exercise period, the unit runs for approximately 5 or 12 minutes, depending on the model, and then shuts down. The other is for the exercise frequency (how often the exercise will take place). It can be set to WEEKLY, BIWEEKLY or MONTHLY. If monthly is chosen, the date of the month must be selected and the generator will exercise on that day each month. Transfer of loads to the generator output does not occur during the exercise cycle unless utility power is lost.

After the Activation process has been completed, an installation wizard will prompt the user to set the minimum settings to operate. These settings are simple: “Current Time/Date” and “Exercise Day/Time”.

The exercise settings can be changed at any time via the “EDIT” menu (See Section 4.1 “Menu Navigation”). If the 12 volt battery is disconnect or the fuse removed, the Installation Assistant will operate upon power restoration. The only difference being that the display will only prompt the customer for the current time and date.

If the installer tests the Generator prior to installation, press the “ENTER” key to avoid setting the exercise time. This will ensure that the customer will still be prompted to enter an exercise time when the unit is first powered up.

The exerciser will only work in the AUTO mode and will not work unless this procedure is performed. The current date/time will need to be reset every time the 12 volt battery is disconnected and then reconnected, and/or when the fuse is removed.

Refer to appropriate Menu Map in Section 4.1 menu navigation.

ACTIVATION PROCESS

When battery power is applied to the Generator during the installation process, the controller will light up. However, the Generator still needs to be activated before it will automatically run in the event of a power outage.

Activating the Generator is a simple, one-time process that is guided by the controller screen prompts. Once the product is activated, the controller screen will not prompt you again, even if you disconnect the Generator battery.

The five digit activation code can be obtained by two methods. The first is via the internet at www.activategen.com. The second is by dialing 1-888-9ACTIVATE (922-8482). In both cases, a passcode is issued to enter in the controller. See Figure 227 (next page) for detailed instructions of the process.

Activation Chart (See Activation Menu Page 44

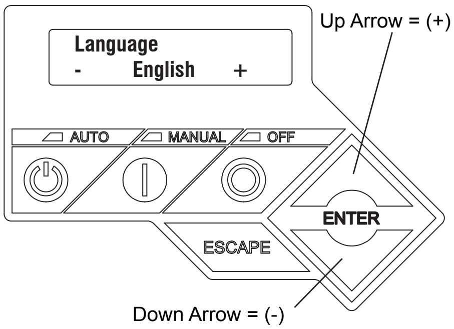
Display Reads: 	**Generator Active** is displayed on the LCD screen when the unit is first powered up. After displaying firmware and hardware version codes, as well as other system information, the Installation Wizard is launched, and the Language screen is displayed. Use the ARROW keys to scroll to desired language. Press ENTER.	If the wrong language is selected, it may be changed later using the Edit menu.
Display Reads: **Activate me (ENT) or** **ESC to run in manual**	Press ENTER.	Press the ESCAPE key to abort the activation sequence. NOT ACTIVATED is displayed and the generator will run in manual mode only. Disconnect and reconnect the negative battery cable to restart the activation routine. If power is removed after a successful activation, no data is lost, but the time and date must be updated.
Display Reads: **To Activate go to** **www.activategen.com**	Go to **www.activategen.com** or call 1- 888-9ACTIVATE (922-8482, US & CA only) if activation passcode is not available. If activation pass code is available, wait a few seconds for the next display.	
Display Reads: **Serial 123456789** **Passcode XXXXX +/-**	Use ARROW keys to increment or decrement the digit to correspond to the first number of the pass code. Press ENTER. Repeat step to enter remaining digits.	Press the ESCAPE to return to preceding digits if a correction becomes necessary. If attempts to enter the activation code are unsuccessful, check the number against the code given on activategen. com. If it is correct, contact 1-888-9ACTIVATE (922-8482, US & CA only).

Figure 227. Activation Process

PART 6 - DISASSEMBLY

FRONT ENGINE ACCESS

Safety

1. Set the controller to OFF mode.
2. Remove the 7.5 amp main fuse. See Figure 228.
3. Remove the N1 and N2 fuse from the transfer switch.

Figure 228. Remove 7.5 Amp Fuse

4. Turn off fuel supply to the generator and remove the flex-line from the fuel regulator.
5. Remove Utility power from the Generator.
6. Remove front door.
7. Remove battery from the generator.

Front Engine Access

1. **Remove Controls Cover:** Using a Torx T-27 socket or 5/32" Hex Allen socket remove two bolts and ground washer from the controls cover. Remove the controls cover. See Figure 229.

Figure 229.

2. **Remove Nexus controller:** Using a 10 mm socket remove the three bolts holding the control panel in place. There are two bolts on the side of the divider panel and the third directly underneath the support bracket. See Figure 230.

Figure 230.

3. **Remove Evolution controller:** Using a 1/4" socket, remove the screw that is directly underneath the support bracket and then slide the controller back to line up the tabs on the controller with the openings on the divider wall. See Figure 231

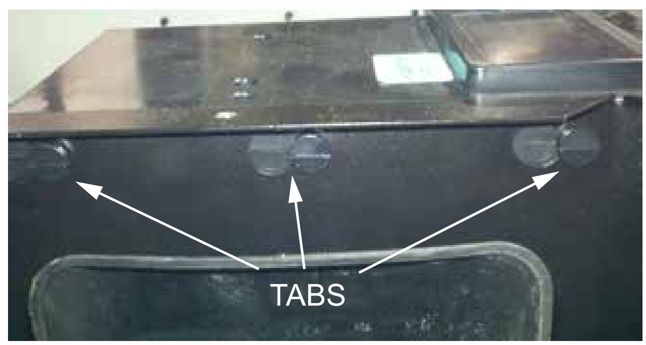


Figure 231. Tabs on Evolution Controller

4. **Remove control harnesses:** Disconnect all connectors and remove the controller. See Figure 232.

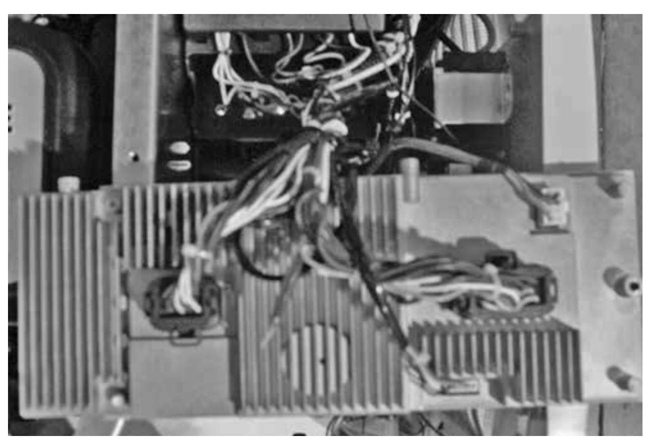


Figure 232.

5. **Remove Stator Wires:** Remove all wires from the main circuit breaker, remove the neutral and ground wires from landing lugs. See Figure 233.
6. **Remove Control Wires:** Remove Wires N1, N2, T1, 0, 194, 23, GFCI Outlet, and unit status lights from the control box. See Figure 234.

Figure 233.

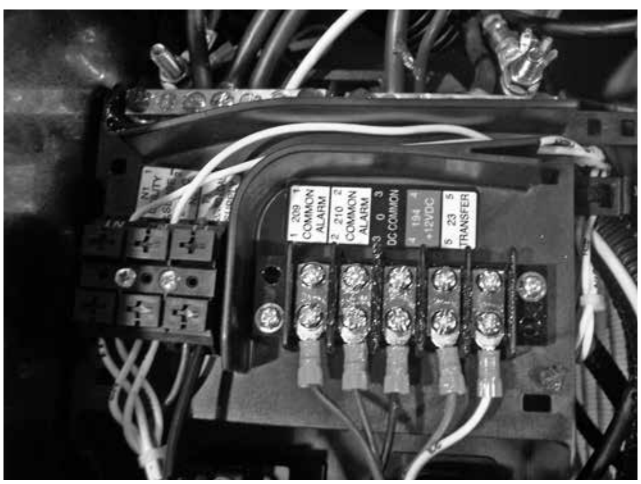


Figure 234.

7. **Remove controller mounting box on Nexus controllers:** On units with Nexus controllers, you will need an 8 mm socket remove the two screws from the rear of the controller mounting box. Using a 10 mm socket remove the two bolts from under the front of the controller mounting box. See Figure 235.

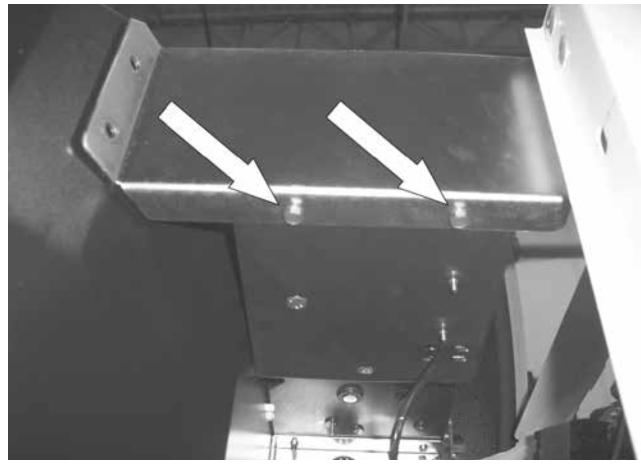


Figure 235.

8. **Remove engine intake baffle:** Using a 10 mm socket remove the two bolts from the engine intake baffle. Pull baffle toward you carefully, there are tabs holding the backside of the baffle to the divider panel. See Figure 236.

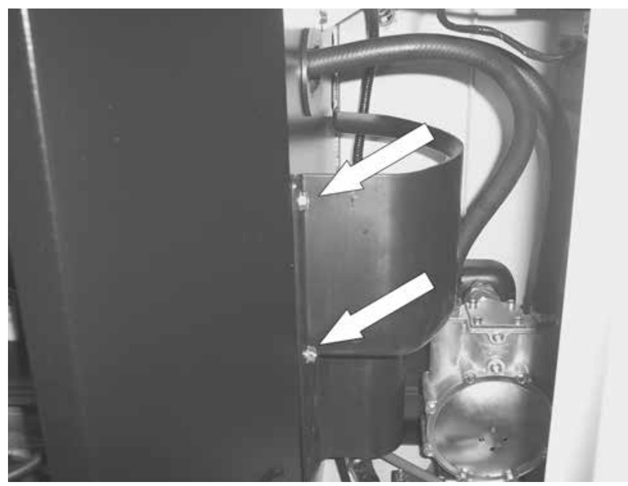


Figure 236.

9. **Loosen side panel:** Using a 10 mm socket remove the two bolts from the base of the enclosure side panel. See Figure 237.
10. **Unbolt enclosure side panel mounting bracket:** Using a 10 mm socket remove the two bolts from the enclosure side panel mounting bracket. See Figure 238.

Figure 237.

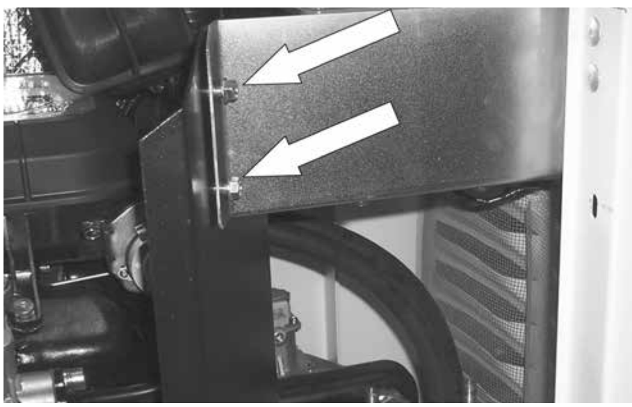


Figure 238.

11. **Remove fuel regulator:** Remove the two fuel hoses at the top of the regulator. Using a 10 mm socket remove one 10 mm bolt from the base of the plenum and one 10 mm bolt from the base of the fuel regulator. Flex the enclosure side out to allow for room to remove the regulator assembly. See Figure 239.

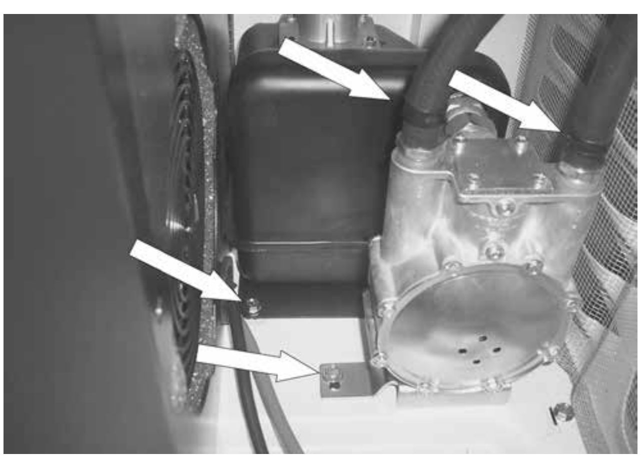


Figure 239.

12. **Remove engine divider panel:** Using a 10 mm socket remove the rear 10 mm bolt from the base of the enclosure. See Figure 240. Remove the front 10 mm bolt from the base of the enclosure. See Figure 241.

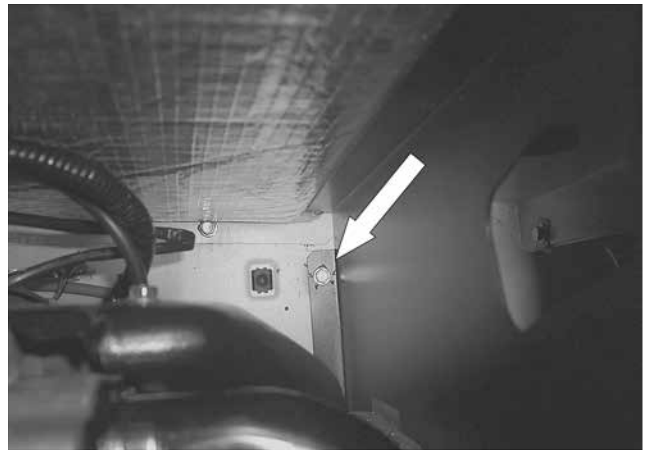


Figure 240.

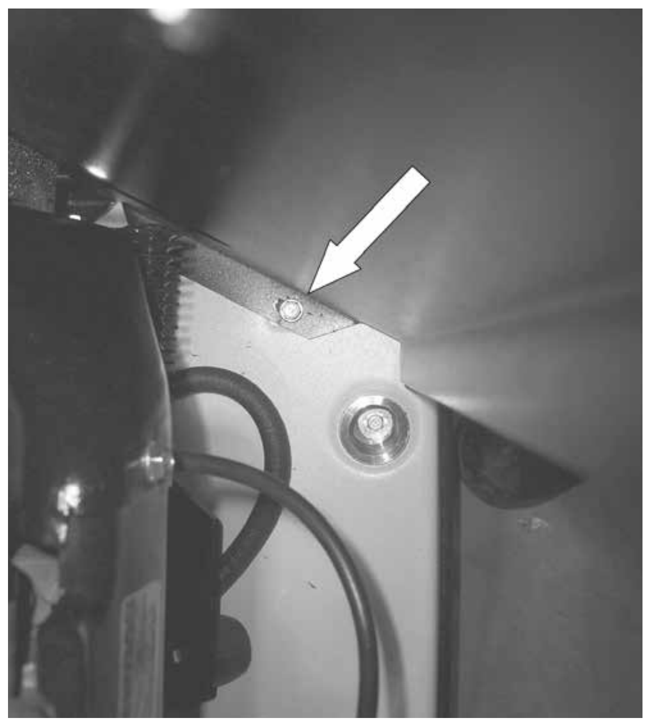


Figure 241.

13. **Remove Air Box on Nexus units:** Using a 6 mm Allen wrench remove the four intake manifold socket head cap screws. See Figure 242. Using a 4 mm allen wrench, remove the four airbox allen head shoulder bolts. While removing the airbox remove the four rubber washers. See Figure 244.

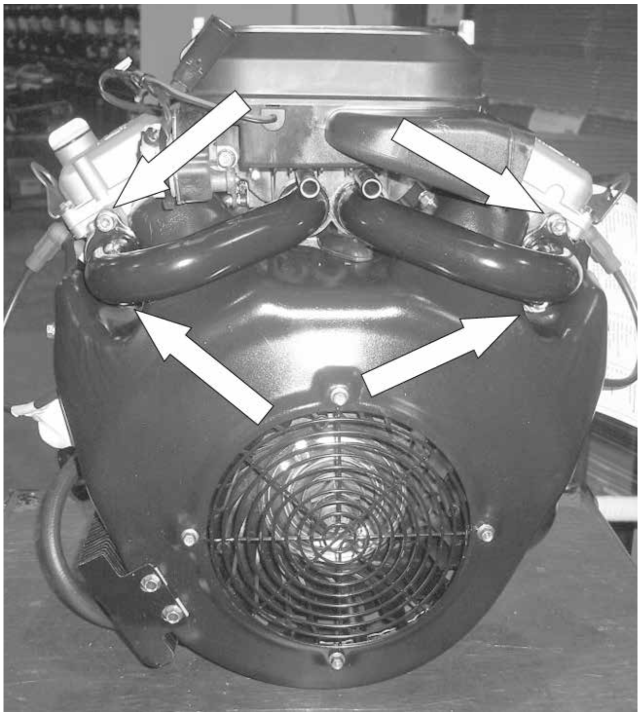


Figure 242. Nexus intake manifold

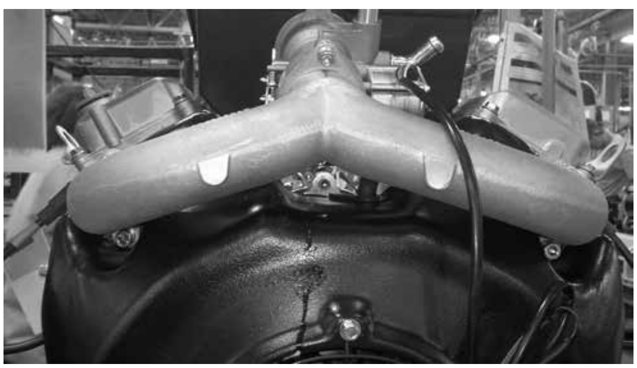


Figure 243. Evolution intake manifold

Figure 244. Nexus air box

Figure 245. Evolution air box

14. **Unbolt Oil Cooler:** Using a 10 mm socket remove the two 10 mm bolts from the front of the oil cooler. See Figure 246. Remove the two 10 mm bolts from the rear of the oil cooler. See Figure 247.

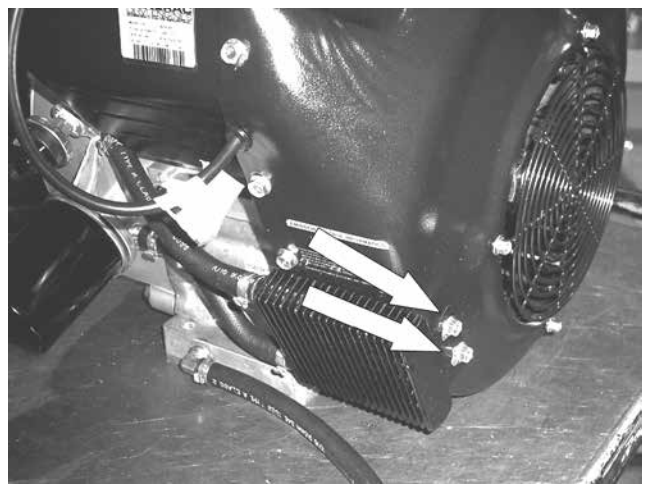


Figure 246.

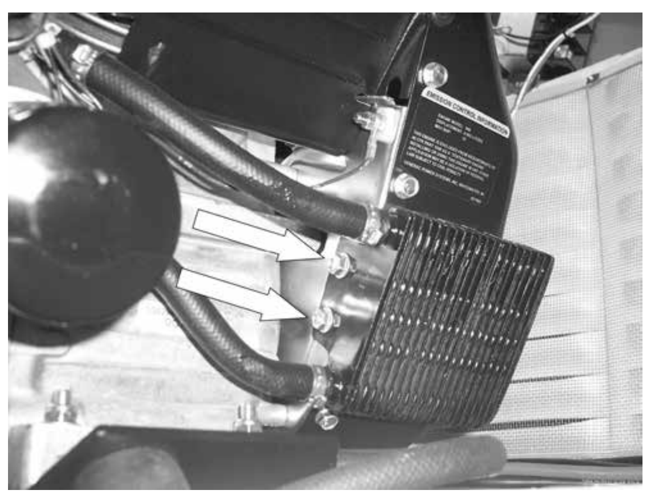


Figure 247.

15. **Remove Blower Housing:** Using a 4 mm Allen wrench remove one button head cap screw from top of blower housing. Using a 10 mm socket remove one 10 mm bolt from the top of the blower housing. See Figure 248. Using a 10 mm socket remove four 10 mm bolts from the right-side of the blower housing, (see Figure 249) and four 10 mm bolts from the left-side of the blower housing. See Figure 250. Remove blower housing.

Figure 248.

Figure 249.

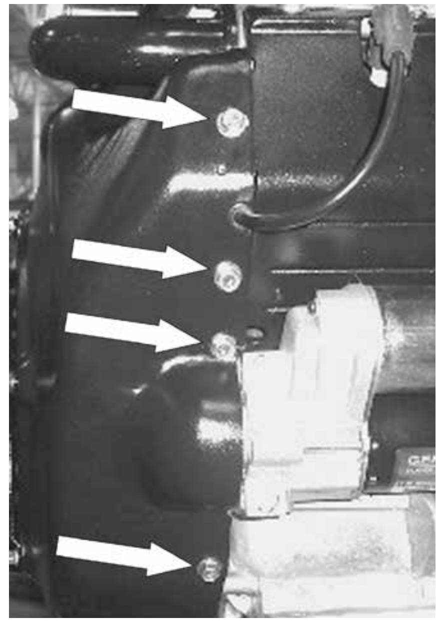


Figure 250.

MAJOR DISASSEMBLY

Safety:

1. Set the controller to OFF mode.
2. Remove the 7.5 amp main fuse. See Figure 251.
3. Remove the N1 and N2 fuses from the transfer switch.

Figure 251. Remove 7.5 Amp Fuse

4. Turn off fuel supply to the generator and remove the flex-line from the fuel regulator.
5. Remove Utility power from the Generator.
6. Remove front door.
7. Remove battery from the generator.

Stator/Rotor/Engine Removal:

1. **Remove Top Exhaust Enclosure Covers:** Using a 10 mm socket, remove the nine bolts from the exhaust top covers. Remove covers. See Figure 252.

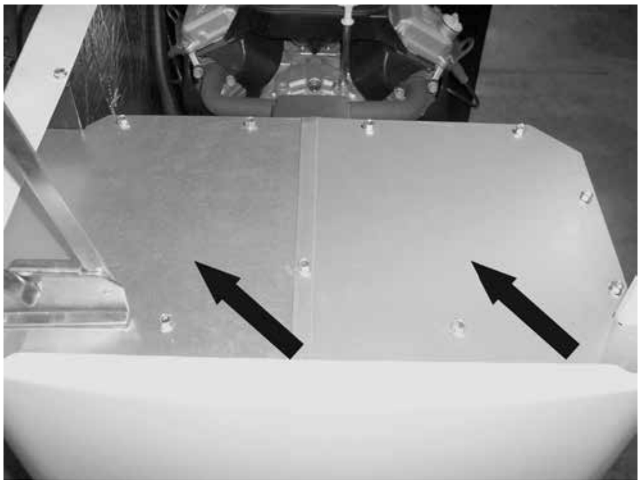


Figure 252.

2. **Remove Side Exhaust Enclosure Cover:** Using a 10 mm socket, remove the five bolts from the exhaust side cover. Remove side covers. See Figure 253.

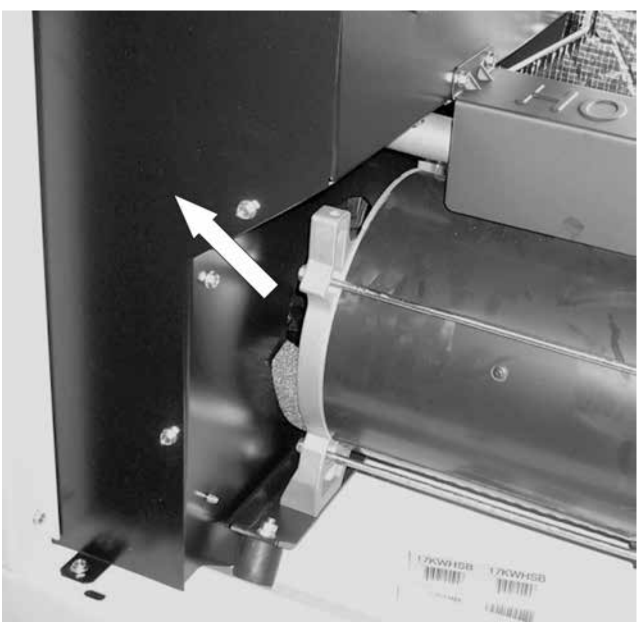


Figure 253.

3. **Remove Exhaust Flex Cover:** Using a 10 mm socket, remove the two bolts from the exhaust flex pipe cover. Remove the cover. See Figure 254.

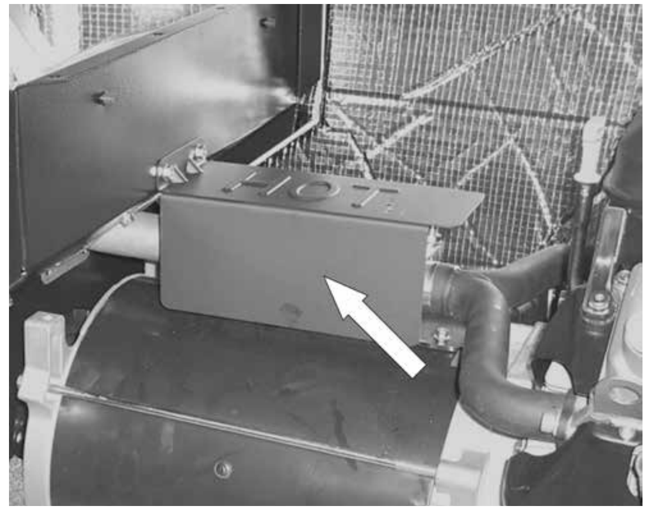


Figure 254.

4. **Remove Exhaust Flex Pipe:** Using a ½” socket remove the front and rear muffler clamp. Slide exhaust flex toward engine completely exposing the muffler flange. See Figure 255.

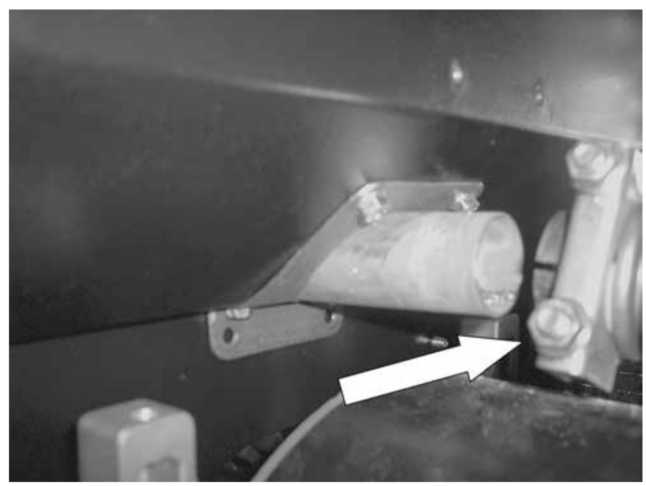


Figure 255.

5. **Muffler Assembly:** Depending on the clamp, use a ½” or 10 mm socket to remove the muffler clamp and flex pipe. Leave muffler attached to the divider panel. See Figure 256.

Figure 256.

6. **Remove Left-side enclosure:** Using a 10 mm ratchet wrench remove the horizontal 10 mm bolt that connects the side panel to the back panel. Using a 10 mm socket, remove three bolts from the base of the enclosure. See Figure 257. Using a 10 mm socket and wrench remove the top hinge bolt and loosen the bottom bolt. See Figure 258. Holding the roof, remove the bottom hinge bolt, remove the side panel by sliding it forward then re-install the hinge bolt.

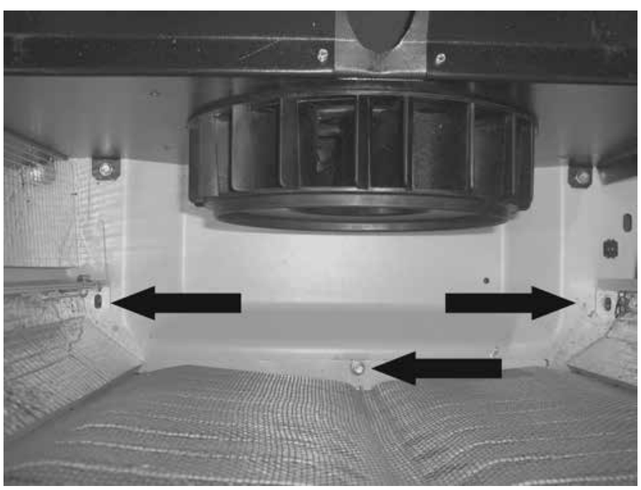


Figure 257.

Note: Shown with muffler removed to reveal the fastener location. Leave muffler connected during removal process.

Figure 258.

Note: Shown with muffler removed to reveal the fastener location. Leave muffler connected during removal process.

7. **Remove Fan Housing Cover:** Using a 10 mm socket remove four bolts from the fan housing cover (if equipped). Remove the fan housing cover. See Figure 259.

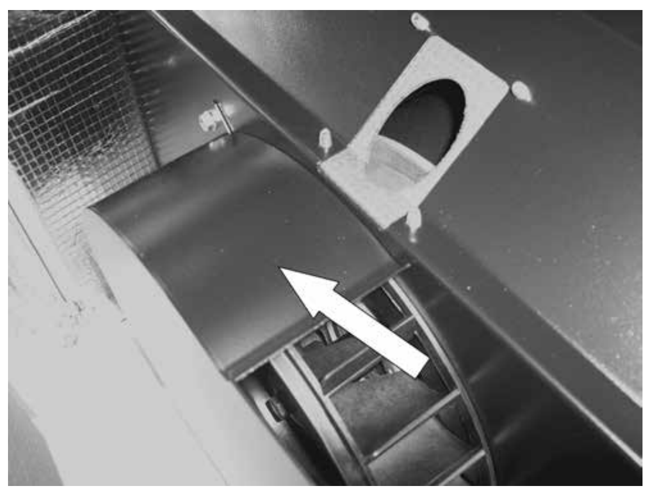


Figure 259.

8. **Remove Rotor Bolt:** Using a 9/16” socket, remove rotor bolt. Figure 260.

Note: After removing the rotor bolt, install a 12 mm x 1.75 mm cap screw in the end of the rotor shaft (Figure 261). This will be used in conjunction with the puller in the following step.

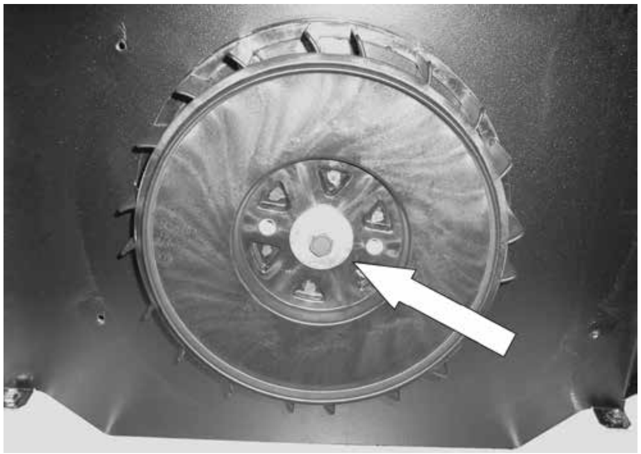


Figure 260.

Figure 261.

9. **Remove Fan:** Attach a vibration dampener or suitable puller to the fan using two M8 x 1.25 bolts. Remove the fan from the rotor. Figure 262.

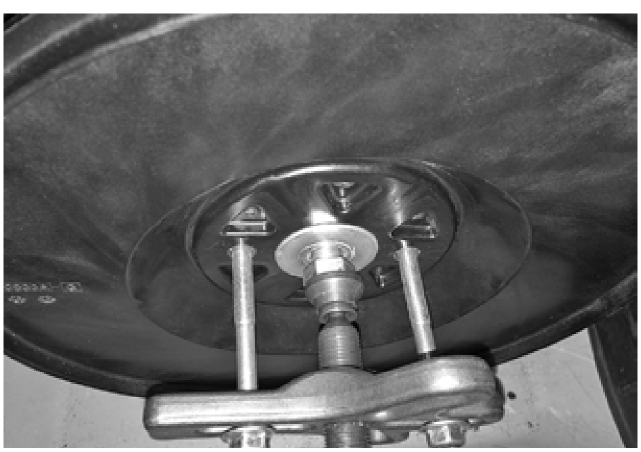


Figure 262.

Figure 263.

10. **Remove Alternator Divider Panel:** Depending on the unit, use a 10 mm socket or 4 mm allen wrench to remove two bottom base bolts. Use a T27 torx driver to remove one top rear bolt. Remove the panel. See Figure 264.

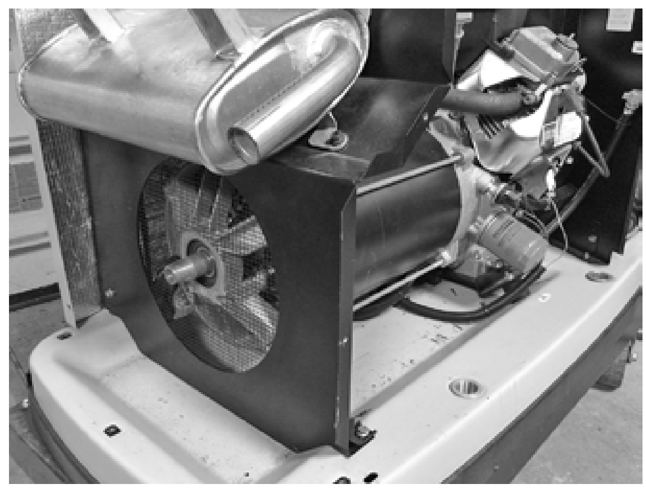


Figure 264.

11. **Remove Brushes:** Use a 7 mm socket to remove brushes. See Figure 265.

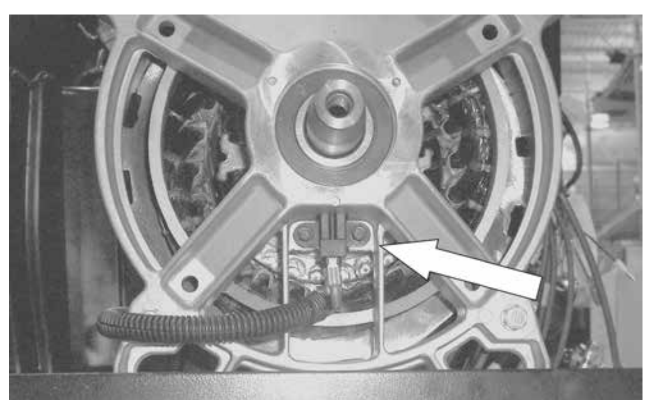


Figure 265. Brushes on Nexus Unit

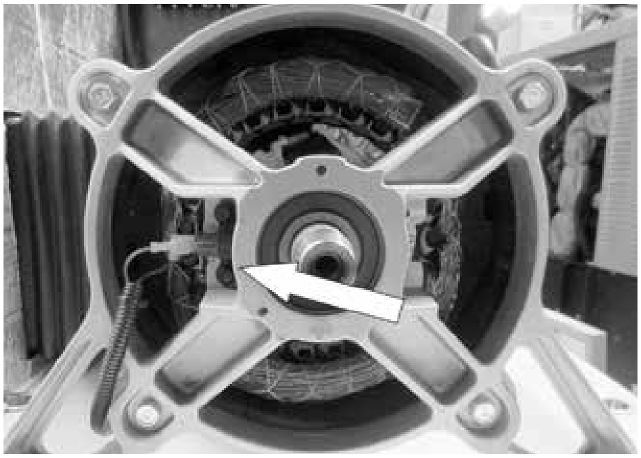


Figure 266. Brushes on Evolution Unit

12. **Remove Brush Wires:** Using a side cutters remove the tie wraps securing the brush wires to the outside of stator. See Figure 267.

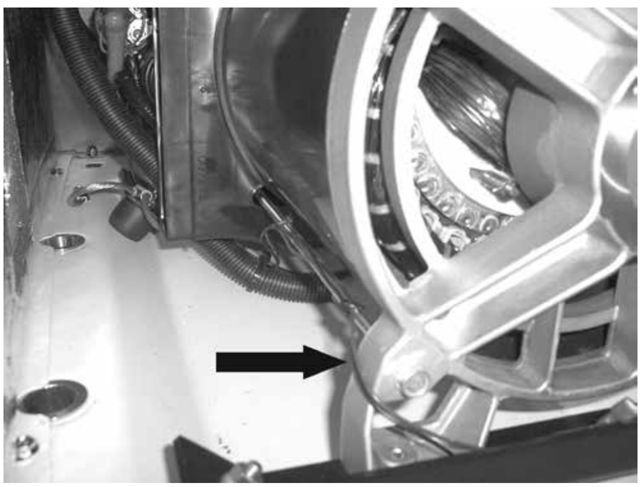


Figure 267.

13. **Remove Controls Cover:** Using a Torx T-27 socket or 5/32" Hex Allen socket remove two bolts and ground washer from the controls cover. Remove the controls cover. See Figure 268.

Figure 268.

14. **Remove Stator Wires:** Remove all connectors from the controller, remove all wires the common neutral and ground wires from landing lugs, and remove wires from main beakers. See Figure 269.

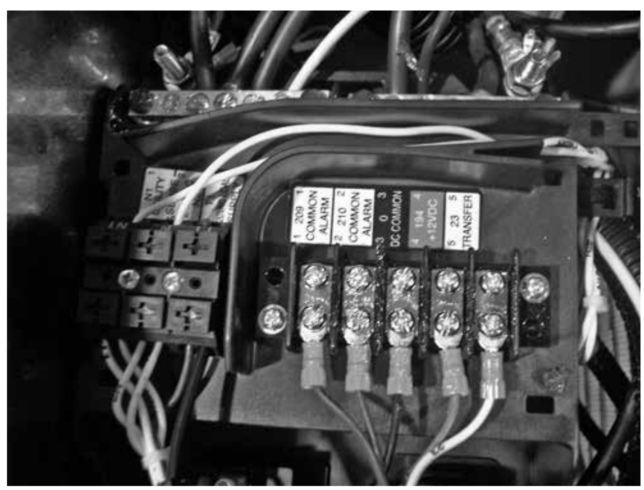


Figure 269.

15. **Alternator Air Intake Bellows Removal:** Remove alternator intake bellows. See Figure 270.

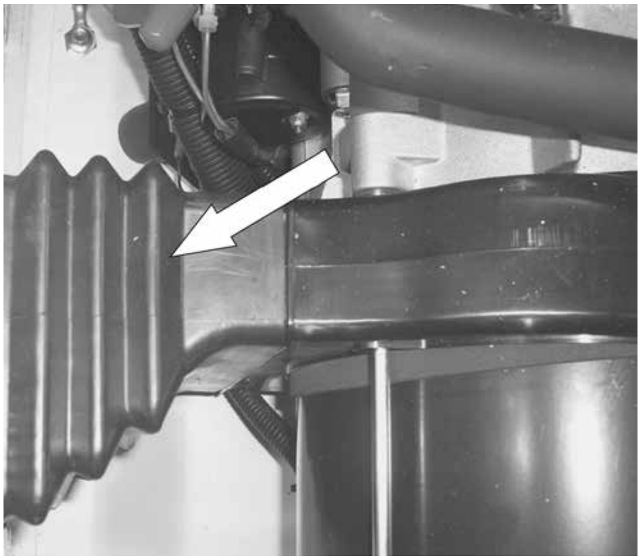


Figure 270.

16. **Rear Bearing Carrier Removal:** Using a 13 mm socket, remove the two nuts from the alternator mounting bracket rubber mounts. Lift the back end of the alternator up and place a 2"x 4" piece of wood under the engine*. See Figure 273. Using a 13 mm socket, remove the four stator hold down bolts. See Figure 272. Using a small rubber mallet remove the rear bearing carrier. See Figure 273. Remove stator. See Figure 274.

Note: On Evolution product there is a center engine mount and clamping screw (Figure 271). This clamping screw must be loosened before lifting the alternator up to set the wood block in place.

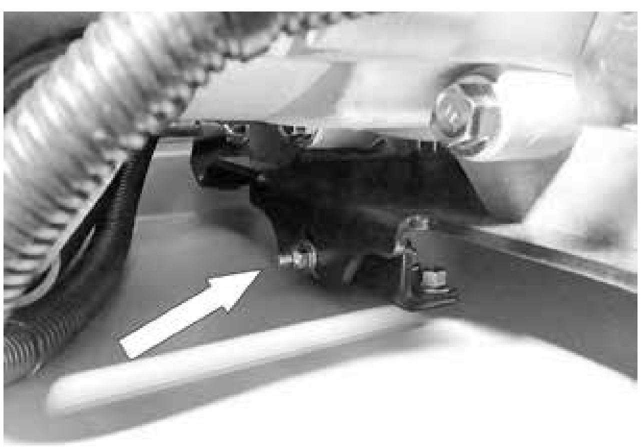


Figure 271.

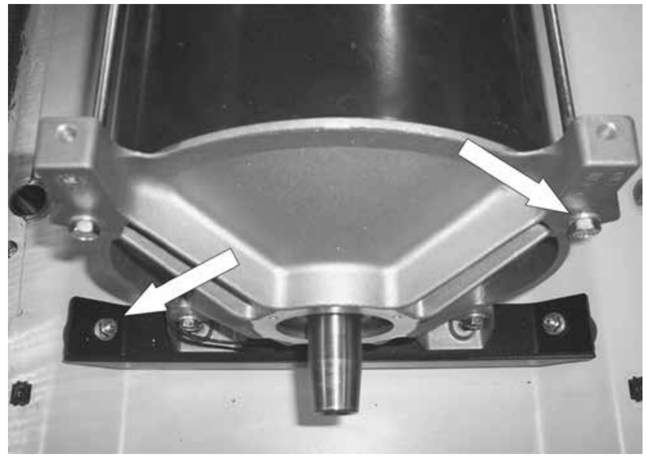


Figure 272.

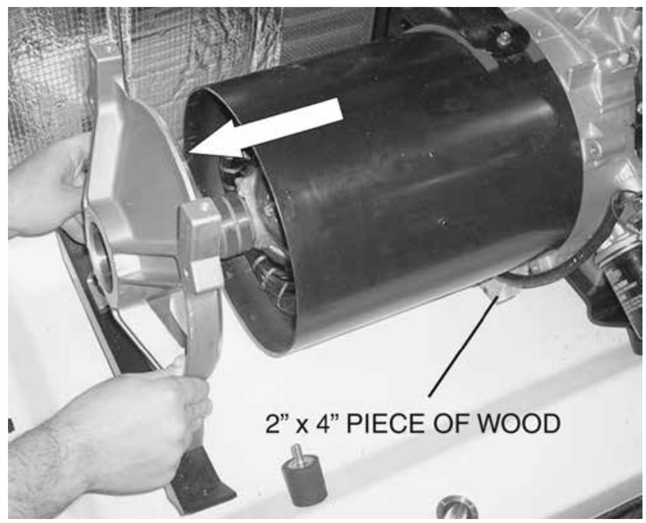


Figure 273.

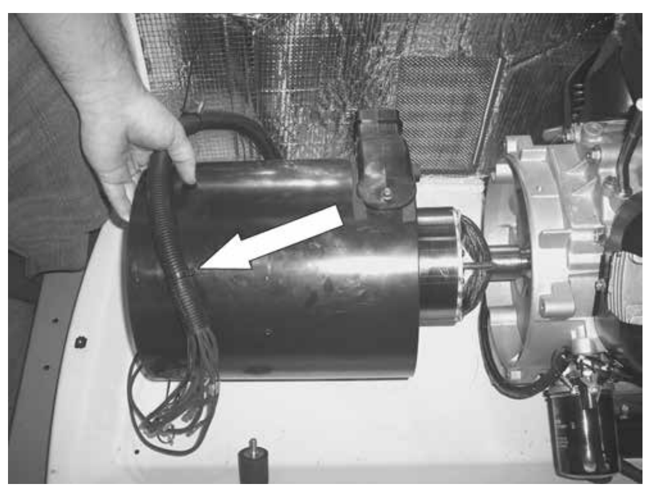


Figure 274.

17. **Rotor Removal:**
   a. Cut 0.5 inches* from the rotor bolt. Slot the end of the bolt to suit a flat blade screwdriver.
   b. Slide the rotor bolt back through the rotor and use a screwdriver to screw it into the crankshaft. Be sure to thread in a minimum of 3/8" to ensure enough threads for puller cap screw
   c. Use a 3” M12x1.75 cap screw to screw into rotor.
   d. Apply torque to the 3” M12x1.75 cap screw until taper breaks free from crankshaft. See Figure 275.

   *All models.

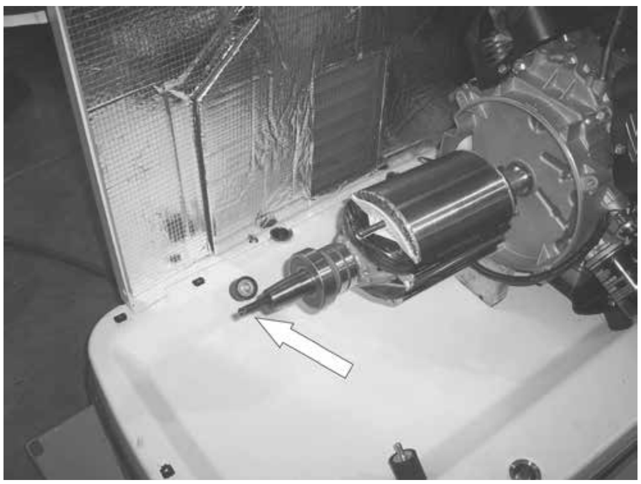


Figure 275.

18. **Remove Engine:** Using a 13 mm socket, remove the two engine mount nuts with ground wires. See Figure 276.

Figure 276.

19. **Remove Engine:** Using proper lifting equipment remove the engine. See Figure 277.

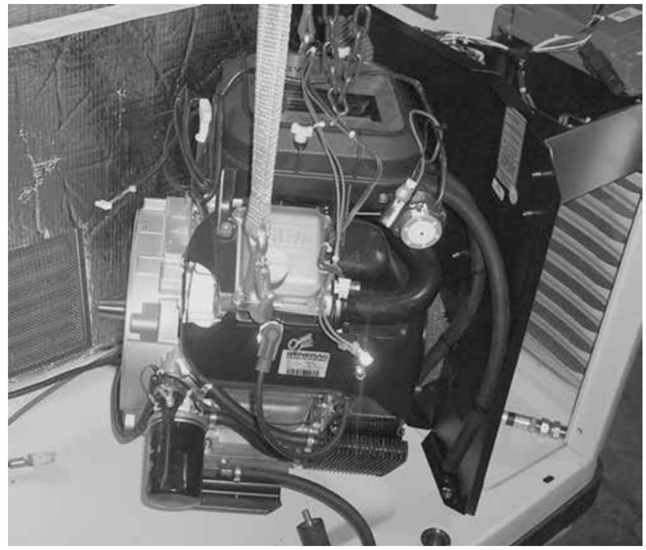


Figure 277.

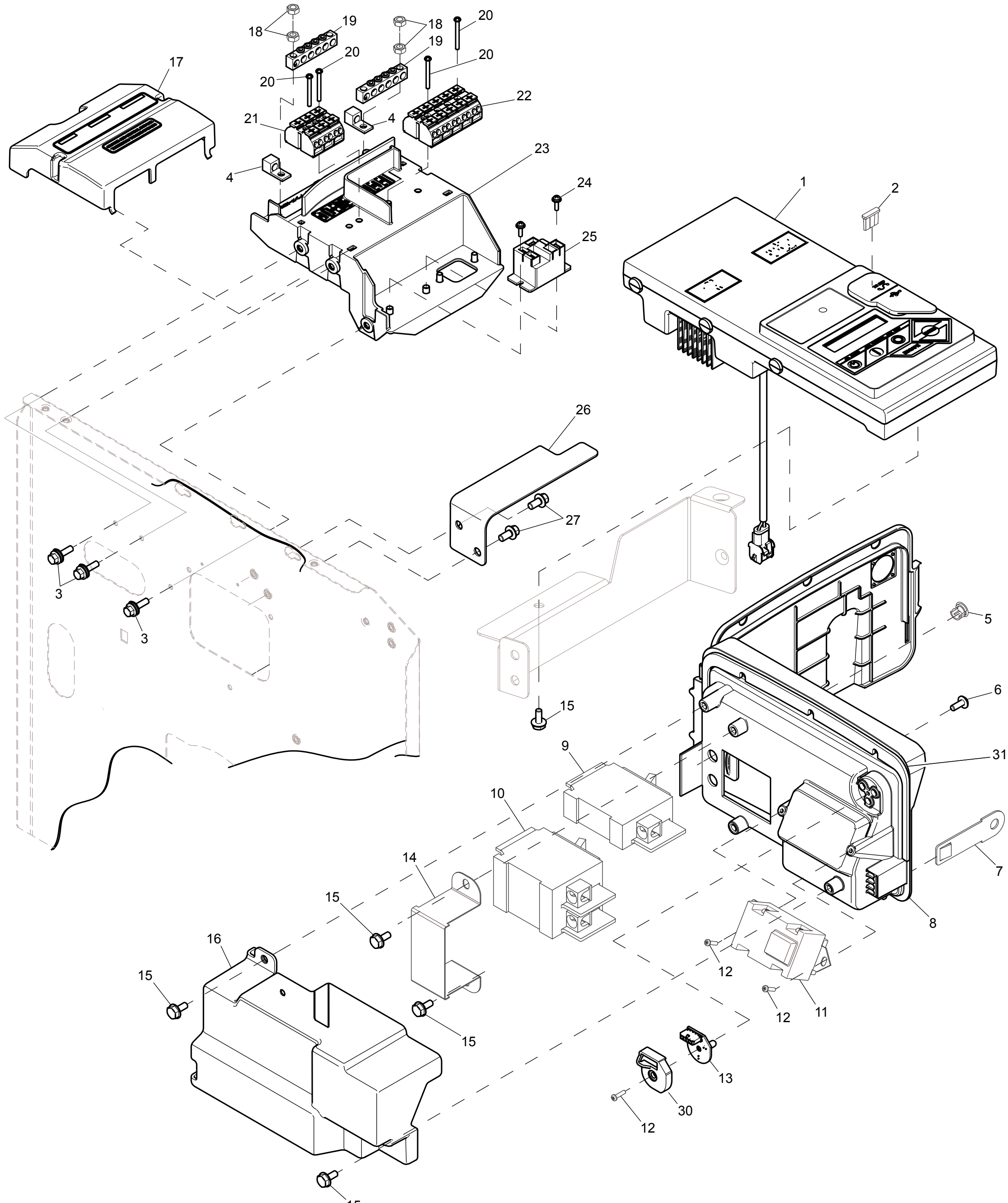
TORQUE REQUIREMENTS (UNLESS OTHERWISE SPECIFIED)

Stator Bolts	72-84 **in-lbs** (6 ft-lbs)
Rotor Bolt	30 ft-lbs
Engine Adaptor	25 ft-lbs
Exhaust Manifold	18 ft-lbs
M5-0.8 Taptite Screw Into Aluminum	25-50 **in-lbs**
M5-0.8 Taptite Screw Into Pierced Hole	25-50 **in-lbs**
M6-1.0 Taptite Screw Into Aluminum	50-96 **in-lbs**
M6-1.0 Taptite Screw Into Pierced Hole	50-96 **in-lbs**
M6-1.0 Taptite Screw Into Weldnut	50-96 **in-lbs**
M8-1.25 Taptite Screw Into Aluminum	12-18 ft-lbs
M8-1.25 Taptite Screw Into Pierced Hole	12-18 ft-lbs
M6-1.0 Nylok Nut Onto Weld Stud	16-65 **in-lbs**
M6-1.0 Nylok Nut Onto Hinge Stud	30-36 **in-lbs**

Note: torques are dynamic values with ±10% tolerance unless otherwise noted.

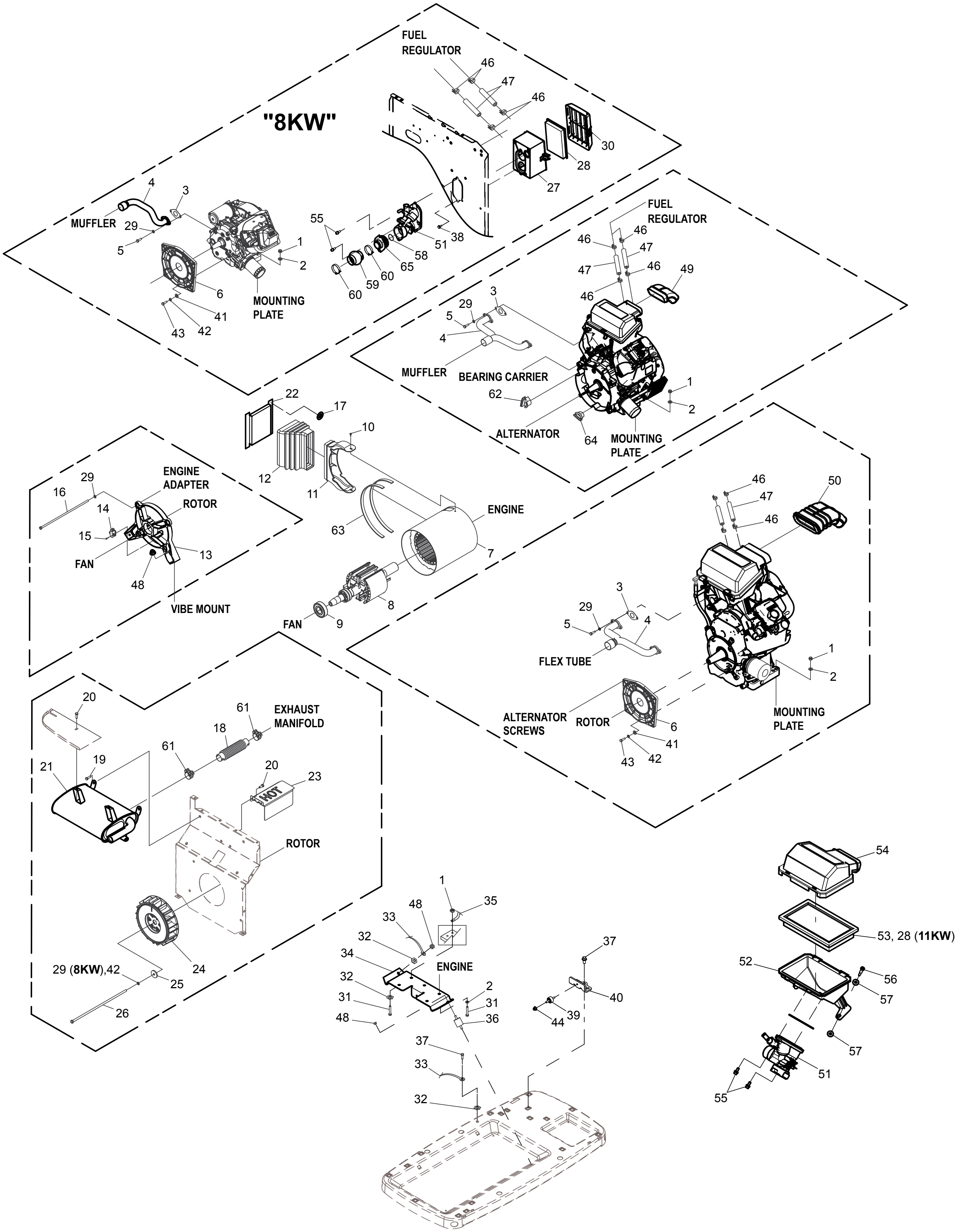
NOTES

Control Panel – Evolution Units



ITEM	QTY.	DESCRIPTION
1	1	ASSY CONTROLLER
2	REF	FUSE ATO TYPE 7.5AMP (BROWN)
3	3	SCREW HHFC M5-0.8X12 W/PATCH
4	2	LUG SLDLSS #2-#14 AL
5	2	PLUG PLASTIC DOME 7/16" - HSB
6	3	SCREW PPHTF #10-16 X 1/2 B
7	1	EYE HASP CNTRL PANEL
8	1	CONTROL BOX
	1	CONTROL BOX (17-20KW)
9	1	CB 0015A 1P 120V S BQ1 LB (17-20KW)
10	1	CB 0035A 2P 240V S BQ2 LB (8KW)
	1	CB 0050A 2P 240V S BQ2 LB (11KW)
	1	CB 0055A 2P 240V S BQ2 LB (13KW)
	1	CB 0060A 2P 240V S BQ2 LB (14KW)
	1	CB 0065A 2P 240V S BQ2 LB (17KW)
	1	CB 0090A 2P 240V S BQ2 LB (20KW)
11	1	OUTLET, 15A GFCI DUPLEX WHITE (17-20KW)
12	1	SCREW HH HI-LO M4 X 10MM
	3	SCREW HH HI-LO M4 X 10MM (17-20 KW)
13	1	ASSY PCB TRI LED DISPLAY
14	1	CB BRACKET CONTROL BOX 2P BQ
15	5	SCREW REDUCED HH HI-LO M6X10M
16	1	SHIELD CIRCUIT BREAKER BOX
17	1	COVER CUST CONNECT
18	4	NUT HEX M5-0.8 G8 CLEAR ZINC
19	2	GROUND BAR (4) 4-14 AWG CONN
20	4	SCREW PPHM M3-0.5 X 30
21	1	TERM BLOCK 3P UL 12-20AWG
22	1	TERM BLOCK 5P UL 12-20AWG LBL
23	1	CUSTOMER CONN SHELF
24	2	SCREW PPHM M3-0.5 X 16 SEMS (11-20KW)
25	1	RELAY 12V 25A SPST (11-20KW)
26	1	BACK CONTROLLER SUPPORT BRACKET
27	2	SCREW HHTT M6-1.0 X 12 ZINC
28	1	HARNESS (8KW) (NOT SHOWN)
	1	HARNESS (11-20KW) (NOT SHOWN)
29	1	RESISTOR (NOT SHOWN)
30	1	COVER, LED
31	1	GASKET, CIRCUIT BREAKER BOX

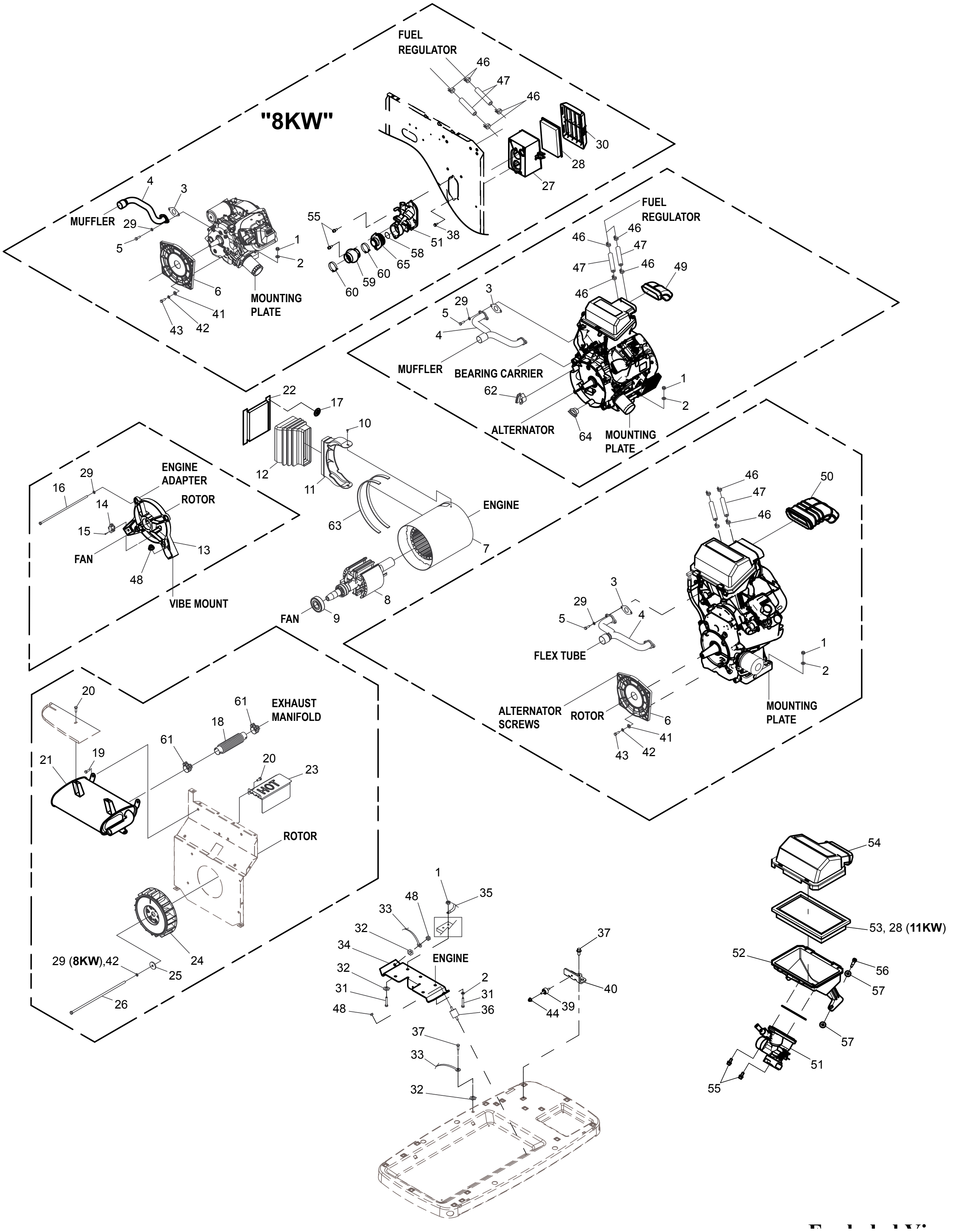
Generator – Evolution Units



ITEM	QTY.	DESCRIPTION
1	4	NUT HEX LOCK M8-1.25 NY INS
2	6	WASHER FLAT 5/16-M8 ZINC
3	1	GASKET, EXHAUST (8 KW)
	2	GASKET EXHAUST GT530 (11 KW)
	2	GASKET,EXHAUST PORT
4	1	EXHAUST MANIFOLD (8 KW)
	1	MANIFOLD (11KW)
	1	MANIFOLD
5	2	SCREW SHC M8-1.25 X 20 C12.9 (8 KW)
	4	SCREW SHC M8-1.25 X 20 C12.9
6	1	ADAPTOR, ENGINE (8 KW, 11 KW)
7	1	STATOR (8 KW, 11 KW)
	1	STATOR (13-14 KW)
	1	STATOR (16-17 KW)
	1	STATOR (20 KW)
8	1	ROTOR (8 KW)
	1	ROTOR (11 KW)
	1	ROTOR (13-14 KW)
	1	ROTOR (16-17 KW)
	1	ROTOR (20 KW)
9	1	BRG 1.1811-2.8346
10	2	SCREW HHTT M6-1.0 X 10 YEL CHR
11	1	DUCT - ALT AIR - 10" CAN - HSB
12	1	ALT AIR IN BELLOWS
13	1	CARRIER REAR BEARING MACHINED
14	1	ASSEMBLY 2 BRUSH
15	2	SCREW HHTT M5-0.8 X 16
16	4	SCREW IHHC M8-1.25 X 325 G8.8 (8 KW, 11 KW)
	4	SCREW IHHC M8-1.25 X 335 G8.8 (13-17KW)
	4	SCREW IHHC M8-1.25 X 390 G8.8 (20 KW)
17	4	WASHER SELF LOCKING 1"DIA 12GA
18	1	FLEX PIPE (8 KW, 11 KW)
	1	EXH FLEX 1-3/4"
19	4	SCREW HHTT M8-1.2 X 12 BP
20	4	SCREW HHTT M6-1.0 X 12 ZINC
21	1	MUFFLER (8 KW)
	1	MUFFLER (11 KW)
	1	MUFFLER (13-20 KW)
22	1	LOUVER SCREEN, ALT AIR IN
23	1	FLEX COVER (8 KW, 11 KW)
	1	FLEX PIPE COVER (13 - 20KW)

ITEM	QTY.	DESCRIPTION
24	1	FAN EXHAUST (13-20 KW)
	1	FAN EXHAUST (8 KW, 11 KW)
25	1	WASHER FLAT .406ID X 1.62OD (8 KW)
	1	WASHER FLAT .344ID X 1.62OD
26	1	SCREW IHHC 5/16-24 X 14-1/2 G8 (8 KW)
	1	SCREW IHHC 3/8-24 X 14-3/8 G5 (11 KW)
	1	SCREW IHHC 3/8-24 X 15.50 (13-17 KW)
	1	SCREW IHHC 3/8-24 X 17.50 (20 KW)
27	1	BASE AIR BOX
28	1	FILTER AIR HSB (8-11 KW)
29	8	WASHER LOCK M8-5/16
	7	WASHER LOCK M8-5/16 (8 KW)
30	1	AIR BOX COVER (8 KW)
31	4	SCREW HHC M8-1.25 X 45 C8.8 (8 KW)
	4	SCREW HHC M8-1.25 X 50 C8.8
32	3	WASHER LOCK SPECIAL 5/16
33	1	EARTH STRAP
34	1	410 ENG MOUNTING BRKT (8 KW)
	1	530 ENG MOUNTING BRKT (11 KW)
	1	990 ENG MOUNTING BRKT (15-20 KW)
35	1	CABLE BATT BLK #6 30.0" NEG
36	4	VIB MNT
37	4	SCREW HHTT M8-1.2 X 16 YC
38	3	SCREW REDUCED HH HI-LO M6 X 10MM (8 KW)
39	1	VIB MNT .50 X 1.0 X M6X1.00
40	1	POWERHEAD BRACKET
41	4	WASHER FLAT 3/8-M10 ZINC (8-11 KW)
42	4	WASHER LOCK 3/8 (8 KW)
	5	WASHER LOCK 3/8 (11 KW)
	1	WASHER LOCK 3/8
43	4	SCREW HHC 3/8-16 X 1-1/4 G5 (11 KW)
44	1	NUT FLANGE M6-1.0 NYLOK
45	1	CABLE BATT RED #6 38.5" POS (NOT SHOWN)
46	4	CLAMP HOSE BAND .75
47	3 FT	HOSE LP 1/2" ID-THERMOID
48	4	NUT FLANGE 5/16-18 NYLOK
49	1	SNORKEL ELBOW TO AIR BOX (13-20 KW)
50	1	AIRBOX INTKE SNRKL 530CC (11 KW)
51	1	ASSY MIXER HSB (8 KW)
	1	ASSY MIXER HSB (11 KW)
	1	ASSY MIXER HSB (13/14KW)

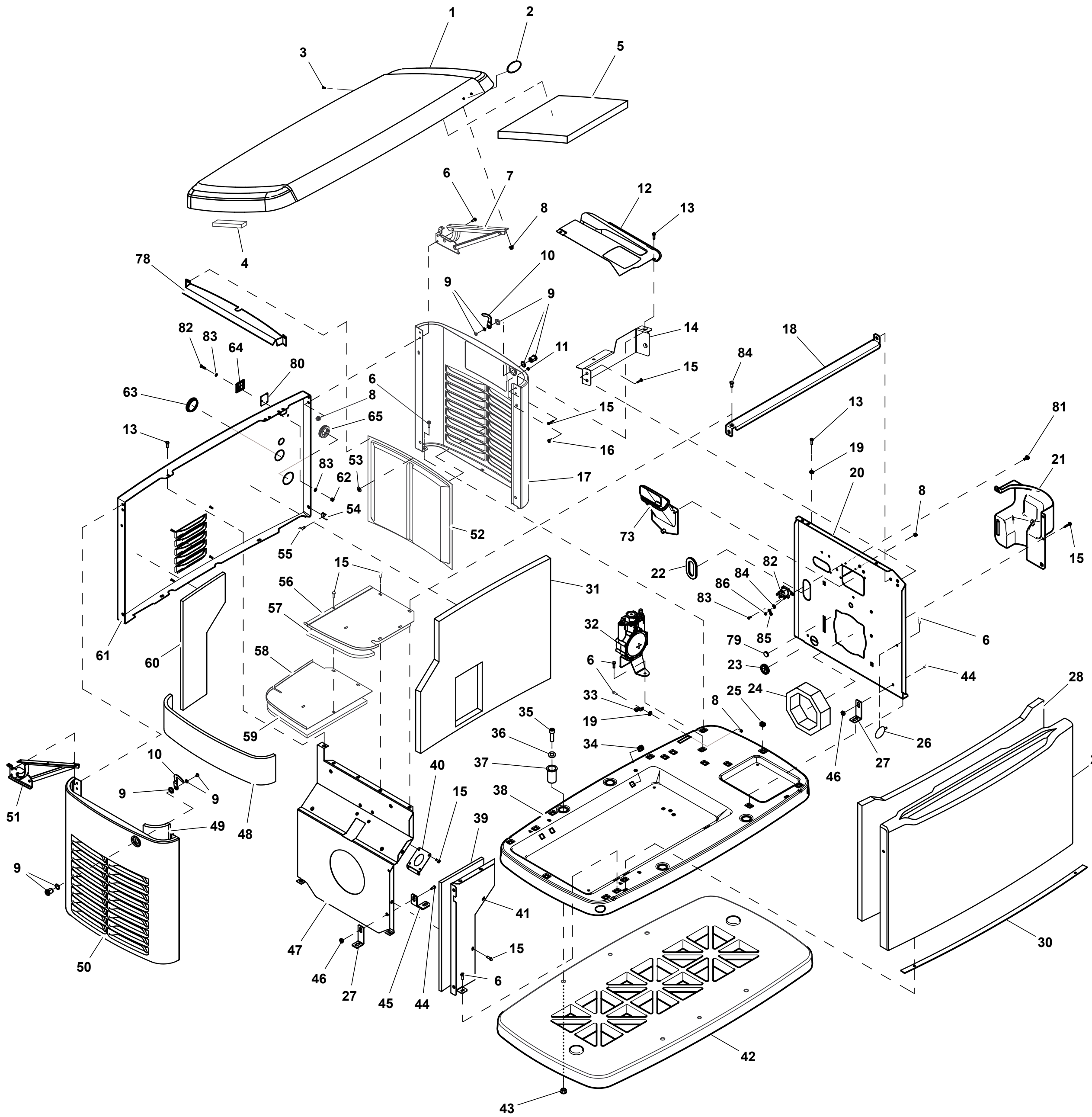
Generator – Evolution Units (Continued)



ITEM	QTY.	DESCRIPTION
	1	ASSY MIXER HSB (15/17KW)
	1	ASSY MIXER HSB (20KW)
52	1	AIR BOX BASE (11 KW)
	1	AIR BOX BASE (13-20 KW)
53	1	FILTER AIR ELEMENT (15-20 KW)
54	1	COVER AIR BOX (11 KW)
	1	AIRBOX HSB (13-20 KW)
55	4	SCREW SHC M6-1.0 X 16LG SEMS (11-20 KW)
56	2	SCREW SHLDR(8MM) M6-1.0 X 29 (11-20 KW)
57	4	WASHER,RUBBER 1/4" X 1/8" THK (11-20 KW)
58	1	O-RING 1-3/4 X 1/16 (8 KW)
59	1	BELLOWS HSB (8 KW)
60	2	CLAMP HOSE BAND 1.63(8 KW)

ITEM	QTY.	DESCRIPTION
61	2	CLAMP BAND DIA 36-39MM (8-11 KW)
	2	CLAMP BAND DIA 42.7-46.7MM (13-20 KW)
62	1	PLUG, GEARCOVER ADAPTOR
63	2.6 FT	TAPE, FOAM 1/16" x 1/2"
64	1	PLUG, GEARCOVER ADAPTOR-SMALL
65	1	ADAPTOR MIXER AIR INTAKE

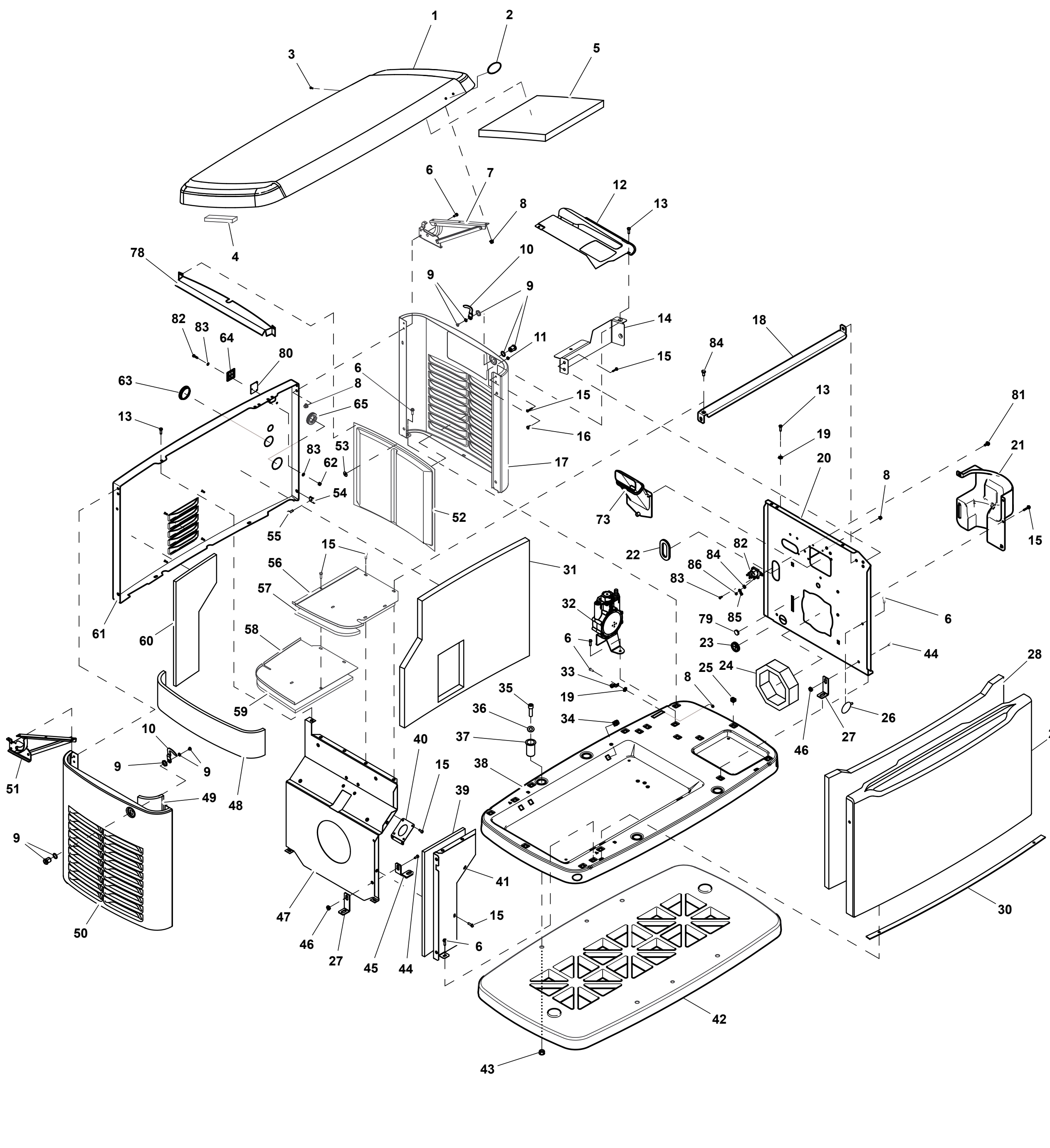
Enclosure – Evolution Units



ITEM	QTY.	DESCRIPTION
1	1	ROOF ASSY GALV BISQUE
	1	ROOF ASSY GALV GREY
	1	ROOF ASSY ALUMINUM GREY
	1	ROOF ASSY ALUMINUM BISQUE
2	1	BADGE HOLDER - OVAL
3	1	PLUG 6.35 BLACK
4	10.5 FT	GASKET, EXTRUDED TRIM
5	3	FOAM, ENCLOSURE ROOF 1.00" THK
6	20	SCREW HHFC M6-1.0 X 20 G8.8 (8-11 KW)
	21	SCREW HHFC M6-1.0 X 20 G8.8
7	1	HINGE ASSY INTAKE END
8	9	NUT FLANGE M6-1.0 NYLOK (11-20 KW)
	11	NUT FLANGE M6-1.0 NYLOK (8 KW)
9	2	1/4 TURN LOCKING LATCH
10	2	1/4 TURN LATCH PAWL
11	2	NUT TOP LOCK FL M6-1.0
12	1	CONTROLLER FACIA
	1	CONTROLLER FACIA (8-11 KW)
13	5	SCREW SWT 1/4-20 X 5/8
14	1	BRACKET CTRL PNL FRONT (8-11 KW)
	1	BRACKET CTRL PNL FRONT (13-20 KW)
15	23	SCREW HHTT M6-1.0 X 12 ZINC
16	2	SPACER DOOR
17	1	END PANEL, INTAKE
18	1	CROSS SUPPORT HSB (8-11 KW)
	1	CROSS SUPPORT HSB(13-20 KW)
19	2	WASHER LOCK SPECIAL 1/4"
20	1	PL ENG DIVIDER W/START 410 HSB (8 KW)
	1	PANEL ENGINE DIVIDER HSB (11 KW)
	1	PANEL ENGINE DIVIDER HSB (13-20 KW)
21	1	INTAKE BAFFLE
22	2	GROMMET OVAL 31.75 X 50.8
23	1	GROMMET, 38.1 DIA. CROSS SLIT
24	1	FOAM DUCT, ENGINE DIVIDER (8 KW)
	1	FOAM DUCT, ENGINE DIVIDER (11 KW)
	1	FOAM DUCT, ENGINE DIVIDER
25	17	PANEL CLIP, M6-1.00 EXPANSION
26	1	PUSHBUTTON WIRE TIE
27	4	BRACKET EXH PNL (17 KW ALUM)
	2	BRACKET EXH PNL (20 KW)
28	1	FOAM, FRONT PANEL
29	1	ENCLOSURE FRONT PANEL

ITEM	QTY.	DESCRIPTION
30	1	GASKET, HSB DOOR SEAL
31	1	FOAM, BACK PANEL
32	1	ASSY REGULATOR (8-11 KW)
	1	ASSY PRESSURE STABILIZER REG (13-17 KW)
	1	ASSY PRESSURE STABILIZER REG
33	1	LUG SLDLSS #2-#8 X 17/64 CU
34	6	PANEL CLIP - 5/16-18 EXPANSION
35	4	SCREW SHC 3/8-16 X1.25 W/PATCH
36	4	WASHER FLAT 3/8-M10 ZINC
37	4	BUSHING, HSB ENCLOSURE BASE
38	1	ENCLOSURE, BASE
39	1	FOAM, FRONT EXHAUST SHIELD (13-17 KW)
	1	FOAM, FRONT EXHST SHIELD (8, 11, 20 KW)
40	1	GASKET EXHAUST (8 KW)
	1	GASKET EXHAUST (11 KW)
	1	GASKET EXHAUST (13-17 KW)
	1	GASKET EXHAUST (20 KW)
41	1	FRONT EXHAUST SHIELD (13-17 KW)
	1	FRONT EXHAUST SHIELD (8, 11, 20 KW)
42	1	PAD MTG BASE W/HEX POCKETS
43	4	NUT HEX 3/8-16 STEEL
44	4	SCREW HHFC M6-1.0 X 12 G8.8 (17 KW ALUM, 20 KW)
45	2	BRACKET L HSB DIVIDER PNL (20 KW)
46	4	NUT HEX FL WHIZ M6-1.0 (17 KW ALUM, 20 KW)
47	1	EXHST DVDR PNL (8-11 KW)
	1	PANEL, EXHAUST DIVIDER (17 KW ALUMINUM)
	1	PANEL, EXHAUST DIVIDER (20 KW)
48	1	FOAM, EXHAUST END PANEL
49	2	FOAM, EXHAUST END PANEL SIDES
50	1	ENCL END PANEL, EXHAUST SIDE
51	1	HINGE ASSY EXHAUST END
52	2	SCREEN - HSB LOUVERS
53	16	WASHER SELF LOCKING-.106 STUD
54	2	CLIP U M6-1.0
55	2	SCREW HHFC M6-1.0 X 14 G8.8
56	1	COVER, FRONT EXHAUST ENCLOSURE
57	1	FOAM, TOP FRONT EXHAUST COVER
58	1	COVER, BACK EXHAUST ENCLOSURE

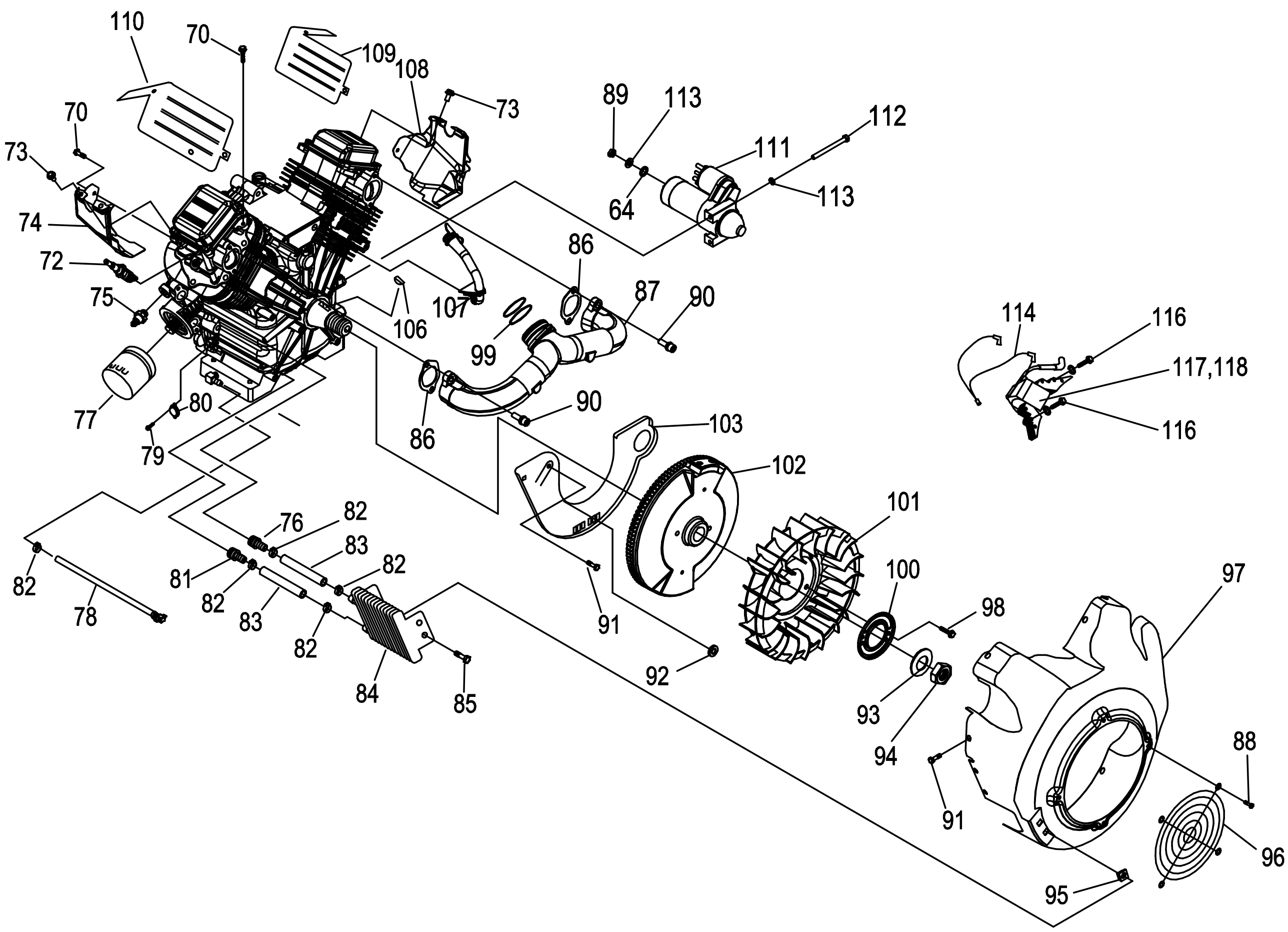
Enclosure – Evolution Units (Continued)



ITEM	QTY.	DESCRIPTION
59	1	FOAM, TOP BACK EXHAUST COVER
60	1	FOAM, BACK PANEL, MUFFLER COMP
61	1	ENCL BACK PNL HSB
62	3	NUT HEX LOCK M4-0.7 NY INS
63	1	PLUG STEEL 1.750
64	1	COVER PLATE - RF MONITOR HOLES
65	1	GROMMET FUEL LINE 3/4"
66	1	BOX ASSEMBLY-CUSTOMER CONN
67	5	HEX NUT #10-32STEEL
68	1	SCREW HHC M6-1.0 X 16 C8.8
69	1	HARN GEN-EXT CONBOX (8-11 KW)
	1	HARN GEN-EXT CONBOX (13-17 KW)
70	2	WASHER FLAT M5
71	5	WASHER LOCK #10
72	2	SCREW PPHM #10-32 X 1
73	1	SNORKEL ENGINE AIR INTAKE
74	1	POWER BLOCK
75	1	WASHER LOCK EXT 1/4 STL
76	1	WASHER LOCK M6-1/4
	3	WASHER LOCK M6-1/4

ITEM	QTY.	DESCRIPTION
77	1	NUT HEX M6-1.0 G8 CLEAR ZINC
78	1	DEFLECTOR
79	1	PLUG PLASTIC 0.687"
80	1	GASKET, RF COVER
81	3	SCREW REDUCED HH HI-LO M6 X 10MM (8 KW)
82	1	CONTACTOR, STARTER SOLENOID (8 KW)
83	2	SCREW HHC M6-1.0 X 12 G8.8 (8 KW)
84	2	WASHER LOCK M6-1/4 (8 KW)
85	1	WIRE ASSY SC TO SM 08 HSB (8 KW)
86	2	NUT HEX 1/4-20 STEEL (8 KW)

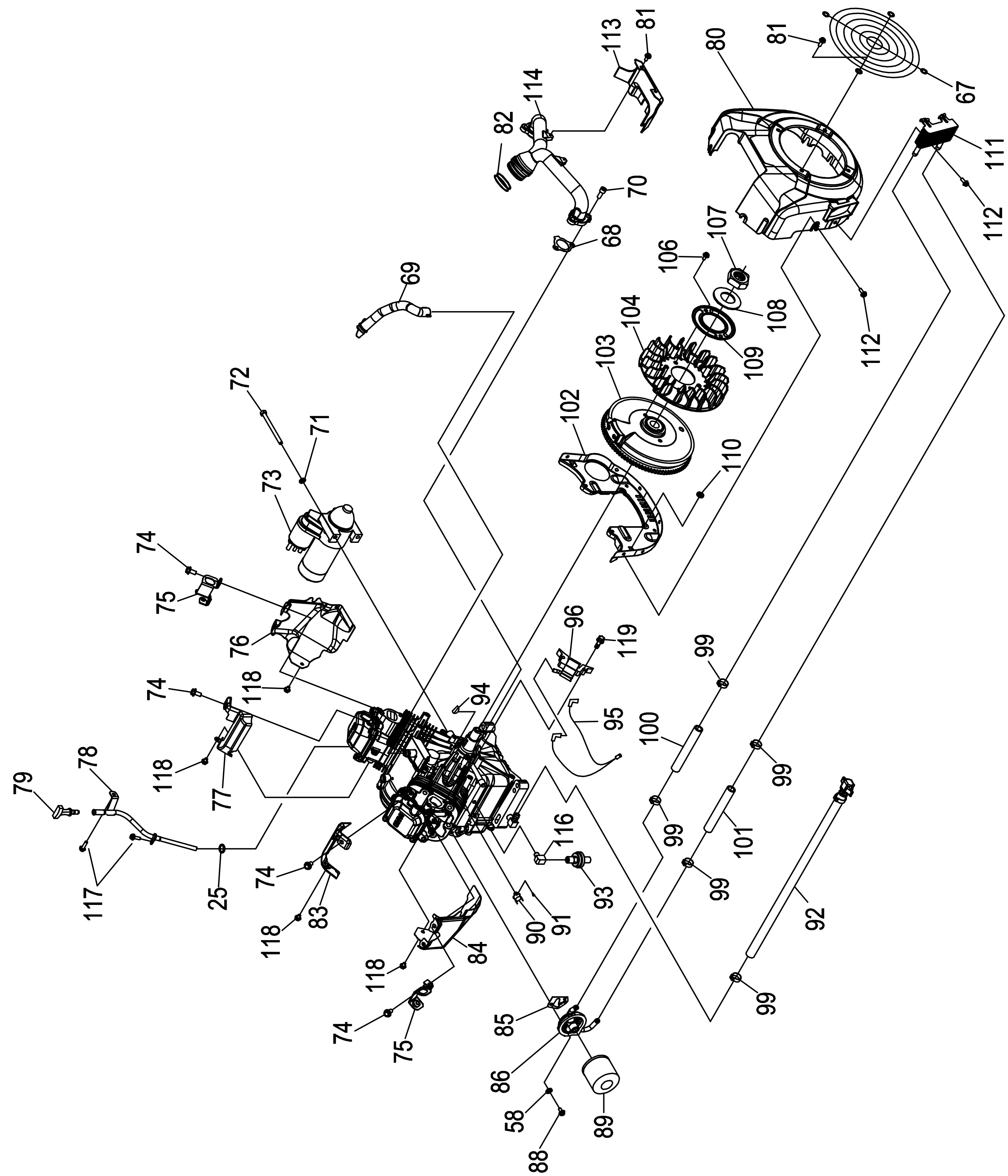
Engine, GN990/999 – Evolution Units



ITEM	QTY.	DESCRIPTION
64	1	WASHER FL AT M8 – 5/ 16
70	4	SCREW M6 -1 .0 X 1 2
72	2	SPARK PLUG , RCY14 .040 ”GAP (1 3,1 4,16,17 kW)
	2	SPAR KPLUG , RC12 .040” GAP (20 kW)
73	2	SCREW TAPTIT E M5 – 0.8 X 8
74	1	WRAPPER, L OWER CYLI NDER 2 ZINC
75	1	SWI TCH, O IL PR ESS
76	1	EXT ENDED B ARBED ST R ¼ NPT X 3 /8
77	1	OIL FI LT ER, 90mm
78	1	ASSY, O IL DRAIN HO SE O RG
79	2	SCREW M3 – 0.5 X 6 SEMS
80	1	SWI TCH, T HERMAL 293 F
81	1	BARBED STRAIGHT 1/4 NPT X 3/ 8
82	5	CLAMP, HO SE OET IK ER STEPL ESS 18.5mm
83	2	HOSE 3 /8" 300PSI 6" LG O IL
84	1	COO LER, O IL
85	4	SCREW PL ASTITE 1/ 4-15 X 3/ 4
86	2	GASKET , MA NIF OL D / PO RT
87	1	MANIF OL D I NT GT H999 2X
88	4	SCREW, HHT T M6-1 x 1 0 L ONG
89	1	NUT, HEX LO CK M5-0.8 Z INC
90	4	SCREW SH C M8 – 1.2 5 X 30 SEMS
91	14	SCREW TAPTIT E M6–1X12 CL EAR Z INC
92	1	GRO MMET 3/ 16 X 1 /16

ITEM	QTY.	DESCRIPTION
93	1	WASHER, 25 MM I. D.
94	1	NUT, HEX M24
95	4	NUT, GRO MMET 1/ 4 PL UG
96	1	GUAR D, FAN
97	1	HOUSING, BLO WER NG COO LER
98	2	SCREW HHFCS M8 – 1. 25 X 1 0 G 8.8
9 9	2	O-RI NG 1-3/ 4 X 1/ 16
100	1	PLAT E, FAN
101	1	FAN, NYLO N
102	1	ASSY, F LYW HEEL (13,1 4,1 6,1 7Kw)
	1	ASSY, F LYW HEEL (20Kw)
103	1	PLAT E, BACKI NG WITH CUT O UT
106	1	KEY, WO ODRUF F 4 X 19 D
107	1	HOSE B REATHER
108	1	WRAPPER, L OWER CYLI NDER 1 ZINC
109	1	WRAPPER, UPPER CYL INDER 1 Z INC
110	1	WRAPPER, UPPER CYL INDER 2 Z INC
111	1	START ER MOT OR HEAR REDUCED 1KW
112	2	SCREW HHC M8 – 1.25 X 85 G 8.8
113	3	WASHER LO CK M8 – 5/ 16
114	1	ASSEMBL Y, GRO UND WI RE
116	4	SCREW TAPTIT E M6 – 1.0 X 2 0 Z IN C
117	1	ASSY, IG N CO IL W / DIO DE, CYLI NDER 1
118	1	ASSY, IG N CO IL W / DIO DE, CYLI NDER 2
119	1	NUT HEX L OC K M 5X 0.8

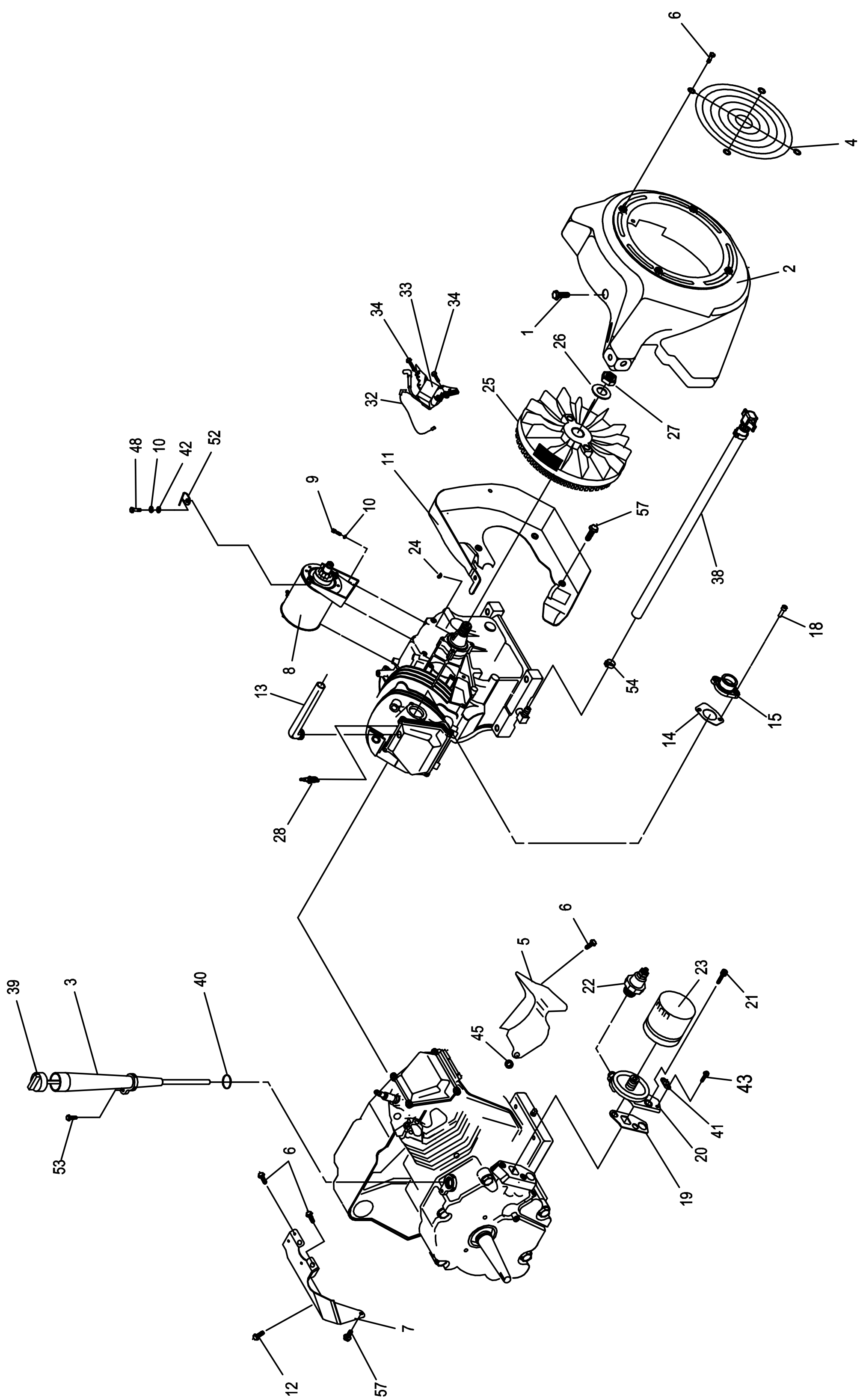
Engine, GN530 – Evolution Units



ITEM	QTY.	DESCRIPTION
58	1	O-RI NG 3/ 8 X 1/ 2
67	1	GUARD , FAN
68	2	GASKET INTAKE
69	1	BREATHER HOSE
70	4	SCREW SHC M8 – 1.2 5 X 20 SEMS
71	2	WASHER LOCK M8 – 5/ 16
72	2	SCREW HHC M8 – 1. 25 X 85
73	1	STARTER MOTOR
74	6	SCREW HHFC M8 – 1 .25 X 14
75	2	LIFTING HOOK
76	1	WRAPPER OUTER CYLINDER 1 CLEAR ZINC
77	1	WRAPPER INNER CYLINDER 1 CLEAR ZINC
78	1	TUBE, DIPSTI CK GT H 5 30
79	1	ASSY, DIPSTI CK /T EXT
80	1	BLOWER HOUSING
81	6	SCREW HHFC M6-1. 0 X 10 G8. 8
82	3	O-RING 1-3/ 4 X 1-16
83	1	WRAPPER INNER CYLINDER 2 CLEAR ZINC
84	1	WRAPPER O TER CYLINDER 2 CLEAR ZINC
85	1	GASKET , OIL FILTER ADAPTER
86	1	ASSY, DIRECT OIL COOLER ADAPTER
88	3	SCREW HHC M6 – 1. 0 X 30 SEMS
89	1	OIL FILTER
90	1	THERMAL SWITCH
91	2	SCREW PPHM M3 -0.5 X 6 SEMS

ITEM	QTY.	DESCRIPTION
92	1	ASSY OIL DRAIN HOSE
93	1	OIL PRESSURE SWITCH HOBBS 5PSI
94	1	KEY, WOODRUFF 4 X 19 D
95	1	ASSY, GROUNDING WIRE
96	1	ASSY IGNITION COIL CYLINDER 1
97	1	ASSY IGNIION COIL CYLINDER 2
99	5	CLAMP, HOSE OETIKER STEPLESS 18.5mm
100	1	HOSE 3 /8”I D X 6” 300DEG
101	1	HOSE 3 /8”I D X 7. 25 300DEG
102	1	BACKING PLATE, GT-530 ZI NC
103	1	ASSY, FLYWHEEL & RING GEAR
104	1	FAN, FLYWHEEL, 2 0 FIN, 218. 8 OD
106	2	SCREW HHFCS M8 – 1. 25 X 1 2 C8 .8
107	1	NUT HEX M20 – 1. 5
108	1	WASHER BELV – 2 0 X 2. 2
109	1	PLAT E, FAN
110	1	GROMMET 3/ 16 X 1 /16
111	1	OIL COOLER
112	13	SCREW HHFC M6 – 1 .0 X 1 4
113	1	CENTER BAFFLE
114	1	INTAKE MANIFOLD
116	1	ELBOW - 1/ 8” NPT
117	6	SCREW, HHFC M6 -1.0 x 12
118	3	SCREW, HHFCS M6-1 x 12 CLEAR ZINC
119	4	SCREW, HHC M6-1 x 25 SEMS

Engine, GN410 – Evolution Units

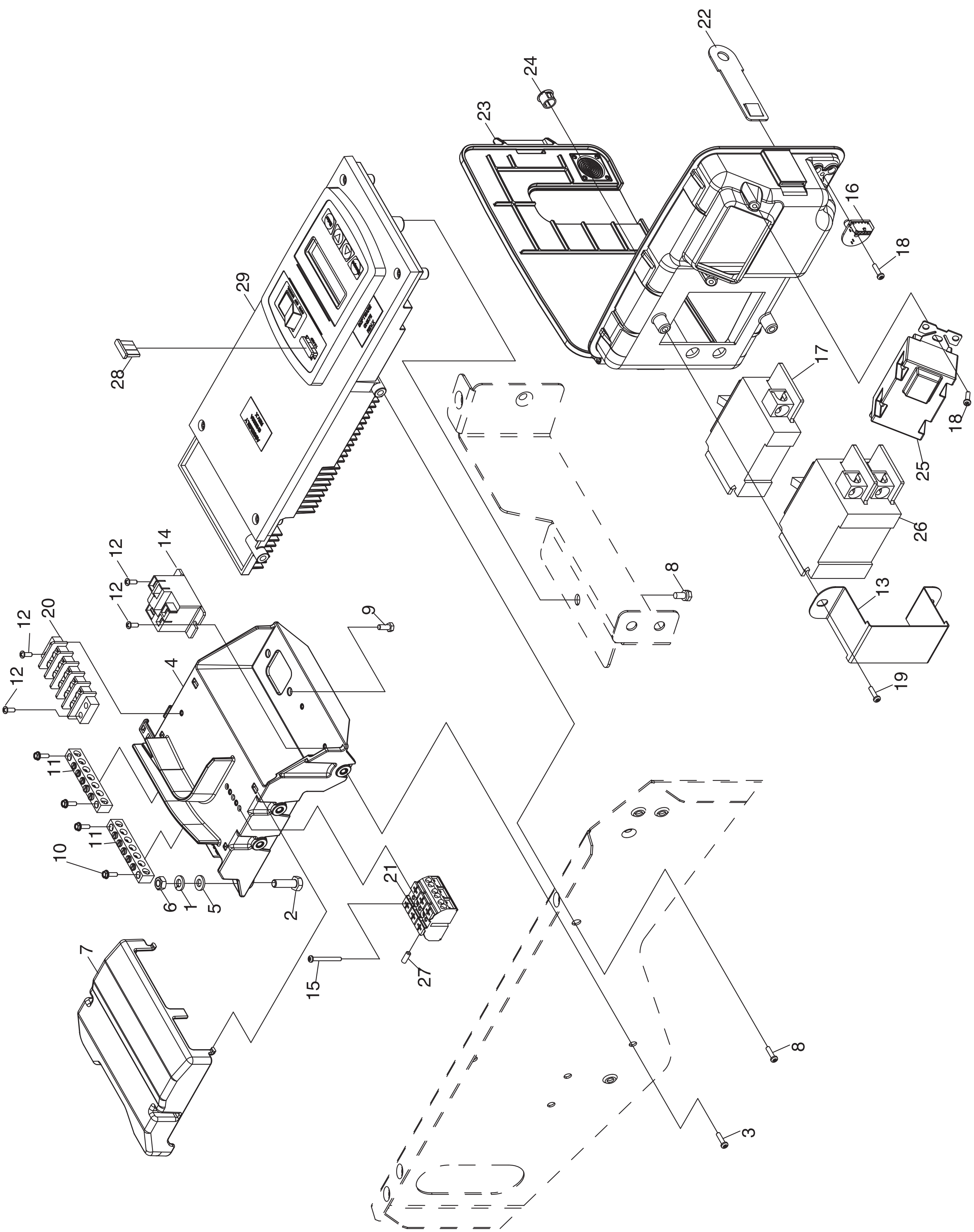


ITEM	QTY.	DESCRIPTION
1	7	SCREW, TAPTITE M6-1.0X8 YELLOW CHROME
2	1	HOUSING, BLOWER GH410 BLACK
3	1	TUBE 410GH OIL FILL/CHECK
4	1	GUARD, FAN
5	1	WRAPPER, BOTTOM
6	6	SCREW, TAPTITE M6-1X10 YELLOW CHROME
7	1	WRAPPER, TOP
8	1	ASSY, STARTER
9	2	SCREW SHC M8-1.2 5 X 40 C8.8
10	3	WASHER, LOCK M8 -5/16
11	1	BACKPLATE, L/F D/F
12	1	SCREW, HHTT 5/16”-18 X ½” SEMI-GIMLET
13	1	BREATHER HOSE
14	1	GASKET, INTAKE ADAPTER
15	1	ADAPTER INTAKE PLASTIC
16		
17		
18	2	FLANGE HEAD SCREW, M6 -1.0 X 2 0 G8.8 ZP
19	1	GASKET,OIL FILTR ADAPTER
20	1	ADAPTER, OIL FILTER
21	2	SCREW, SHC M8-1.25 X 3 0 G12.9
22	2	SWITCH, OIL 5 PSI

ITEM	QTY.	DESCRIPTION
23	1	OIL FILTER
24	1	KEY, WOODRFF 4 X 19D
25	1	FLYWHEEL WITH RING GEAR 27 DEGREE
26	1	WASHER,BELV-2 0 X 2.2
27	1	NUT, HEX - FLYWHEEL
28	1	SPARKPLUG
32	1	ASSEMBLY, WIRE
33	1	ASSEMBLY, IGNITION COIL ADVANCE W/ DIODE
34	2	SCREW HHFC M6 -1 .0 X 2 5 FTH G8
38	1	ASSY OIL DRAIN HOSE
39	1	DIPSTICK, GTH41 0
40	1	O-RING 9/16 X 3/4 X 3/3 2
41	1	SWITCH, THERMAL 293F
42	1	WASHER FLAT 5 /16 - M8
43	2	SCREW, M3 -0.5 X 6 SEMS
45	1	GOMMET
48	1	SCREW HHC M8-1.25 x 2 0
52	1	ENGINE LIFT HOOK
53	1	SCREW HHFCS M6-1.0X10 G8 .8
54	1	CLAMP,HOSE OETIKER STEPLESS 17
57	5	SCREW HHFC M6 -1 .0 X 1 2

* = NOT SHOWN IN EV

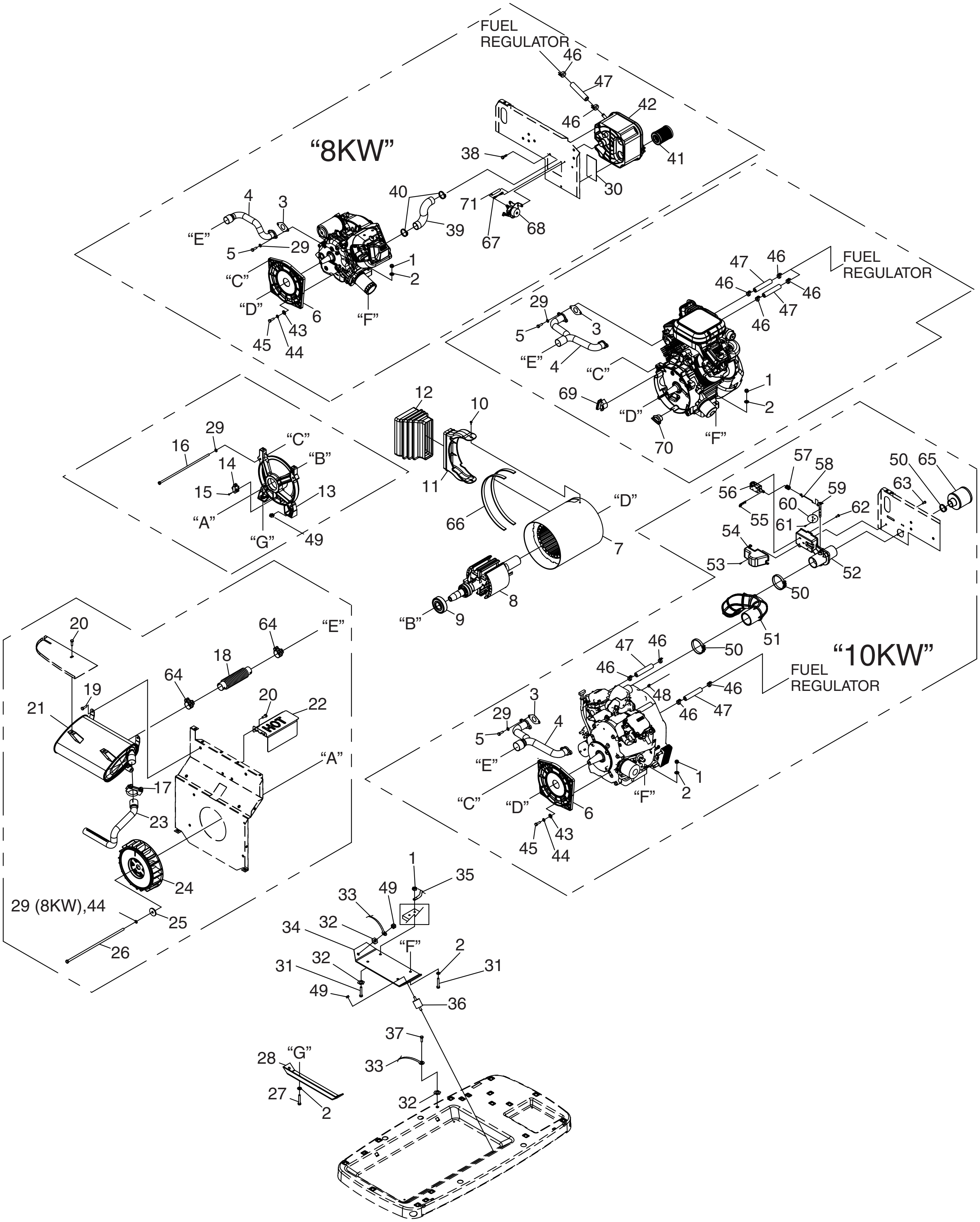
Control Panel – Nexus Units



ITEM	QTY.	DESCRIPTION
1	2	WASHER LOCK M6-1/4
2	2	SCREW HHC M6-1.0 X 30 C8.8
3	3	SCREW HHFC M5-0.8X12 W/PATCH
4	1	BRACKET CUSTOMER CONNECT
5	2	WASHER FLAT M6
6	2	NUT HEX M6 X 1.0 G8 YEL CHR
7	1	COVER CUSTOMER CONNECT
8	3	SCREW HHFC M6-1X12 8.8 W/PATCH
9	2	SCREW HHSP #10X3/8 HI-LO
10	4	SCREW HHC M4-0.7 X 25 SEMS
11	2	GROUND BAR
12	2	SCREW PPHM M3-0.5 X 12 SEMS (8 kW)
	4	SCREW PPHM M3-0.5 X 12 SEMS (10 kW, 13kW, 14kW, 16kW, 17 kW, & 20 kW)
13	1	CB BRACKET CONTROL BOX
14	1	RELAY 12V 25A SPST (10 kW, 13kW, 14kW, 16kW, 17 kW, & 20 kW)
15	2	SCREW PPHM M3-0.5 X 30
16	1	ASSY PCB TRIP LED DISPLAY
17	1	CB 0015A 1P 120V S BQ1 LB (16kW, 17 kW & 20 kW)
18	3	SCREW HH HI-LO M4X10MM (16kW, 17 kW & 20 kW)
	1	SCREW HH HI-LO M4X10MM (8 kW, 10 kW, 13kW, & 14kW)
19	2	SCREW REDUCED HH HI-LO M6X10MM

ITEM	QTY.	DESCRIPTION
20	1	BLOCK TERM 5POS 20A
21	1	TERM BLOCK 3P UL 12-20AWG
22	1	EYE HASP CNTRL PANEL
23	1	ASSY CONTROL BOX (8 kW, 10 kW, 13kW, & 14kW)
24	2	PLUG PLASTIC DOME 7/16"
25	1	OUTLET, 15A GFCI DUPLEX WHITE (16kW, 17 kW & 20 kW)
26	1	CB 0035A 2P 240V S BQ2 LB (8 kW)
	1	CB 0045A 2P 240V S BQ2 LB (10 kW)
	1	CB 0055A 2P 240V S BQ2 LB (13kW)
	1	CB 0060A 2P 240V S BQ2 LB (14kW)
	1	CB 0065A 2P 240V S BQ2 LB (17 kW)
	1	CB 0100A 2P 240V S BQ2 LB (20 kW)
27	1	CAP LOCKOUT
28	REF	FUSE, ATO TYPE 7.5AMP (BROWN)
29	1	ASSY CNTR PROGRAMMED
30	1	HARNESS (NOT SHOWN)

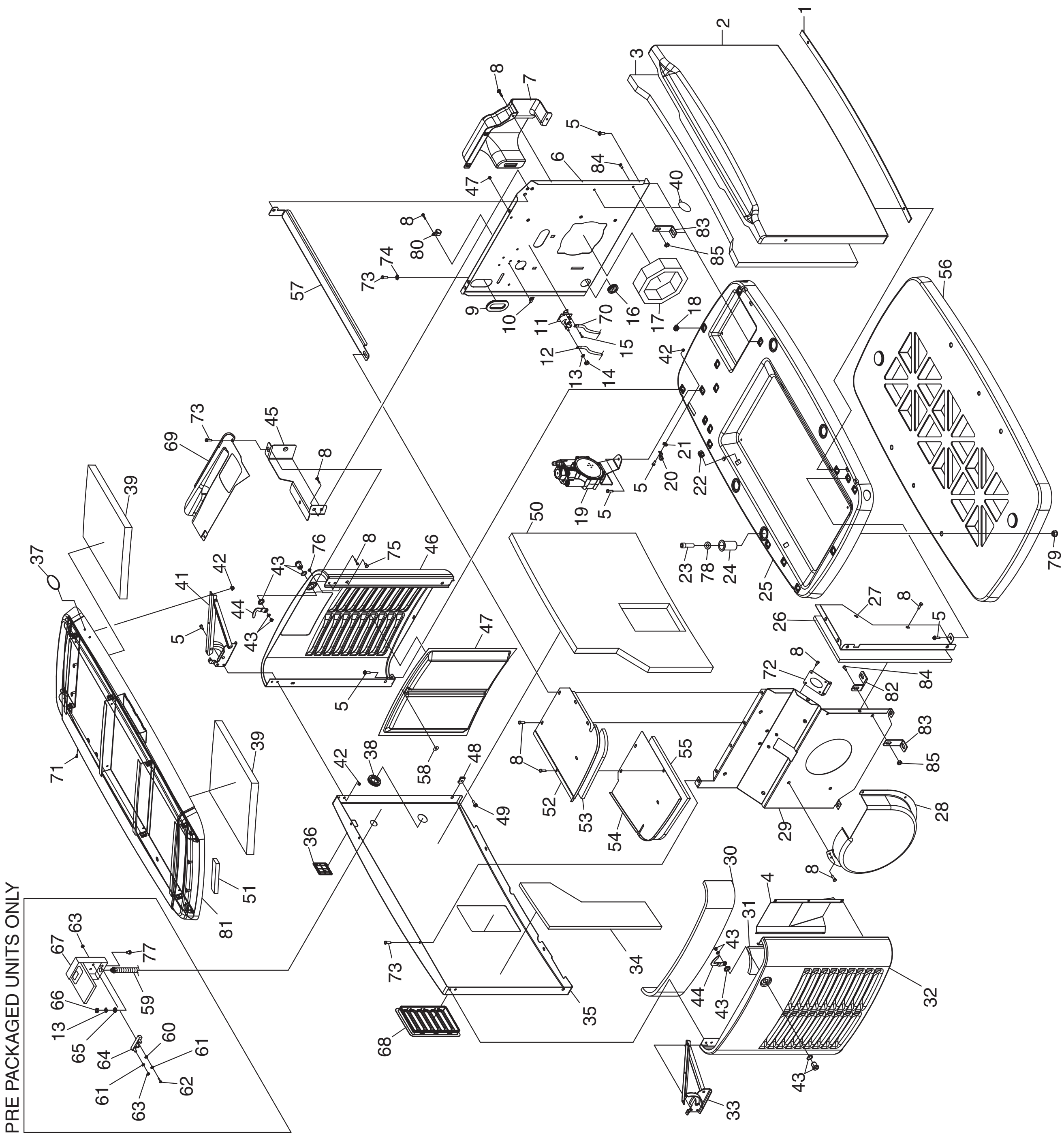
Generator – Nexus Units



ITEM	QTY.	DESCRIPTION
1	4	NUT LOCK HEX M8-1.25 NYLON INSERT
2	8	WASHER FLAT M8-5/16
3	1	GASKET, EXHAUST (8KW)
	2	GASKET, EXHAUST (10KW)
	2	GASKET, EXHAUST
4	1	MANIFOLD, EXHAUST
5	AR	SCREW SHC M8-1.25 X 20
6	1	ENGINE ADAPTOR (8KW & 10KW)
7	1	STATOR
8	1	ROTOR
9	1	BEARING
10	2	SCREW HHTT M6-1.0 X 10
11	1	ALTERNATOR AIR IN DUCT
12	1	ALTERNATOR AIR IN BELLOWS
13	1	BEARING CARRIER
14	1	ASSEMBLY BRUSH HOLDER
15	2	SCREW HHTT M5-0.8 X 16
16	4	BOLT, IHHCS M8-1.25
17	1	U-BOLT 5/16” X 1.62” WITH SADDLE
18	1	FLEX PIPE
19	4	SCREW HHTT M8-1.2 X 12
20	4	SCREW TAPTITE M6-1.0 X 12
21	1	MUFFLER
22	1	FLEX COVER
23	1	TAIL PIPE
24	1	FAN, CURVED BLADE
25	1	WASHER FLAT .406 ID X 1.62 OD
26	1	BOLT IHHC
27	2	SCREW HHC 5/16-18 X 1-1/4” G5
28	1	BRACKET, ALTERNATOR MOUNTING
29	AR	WASHER LOCK M8-5/16
30	1	GASKET, AIR CLEANER (8KW ONLY)
31	4	SCREW HHC M8-1.25
32	3	5/16 SPECIAL LOCK WASHER
33	1	EARTH STRAP 3/8 X 3/8
34	1	BRACKET ENGINE MOUNTING
35	1	CABLE, #6 30” BLACK BATTERY
36	4	RUBBER MOUNT
37	1	SCREW HHTT M8-1.25 X 16
38	4	SCREW PLASTITE 1/4-15 X 3/4” (8KW ONLY)

ITEM	QTY.	DESCRIPTION
39	1	AIR IN SNORKEL (8KW ONLY)
40	2	BAND HOSE CLAMP n35.05 (8KW ONLY)
41	1	AIR FILTER (8KW ONLY)
42	1	AIR BOX (8KW ONLY)
43	4	WASHER FLAT 3/8 (8KW & 10KW)
44	AR	WASHER LOCK 3/8
45	4	BOLT HHC 3/8-16 X 1.25” (8KW & 10KW)
46	AR	HOSE CLAMP 3/4” ID
47	1	HOSE RES 1/2 LP GAS
48	1	CLAMP HOSE .38-.87
49	6	NUT FLANGE 5/16-18 NYLOK
50	3	CLAMP HOSE #24 B1.06-2.00 (10KW ONLY)
51	1	HOSE, INTAKE (10KW ONLY)
52	1	CHOKE HOUSING (10KW ONLY)
53	2	SCREW PPPH HI-LO #6/1/2 W/ #5HD (10KW ONLY)
54	1	BOOT, CHOKE SOLENOID (10KW ONLY)
55	1	COTTER PIN (10KW ONLY)
56	1	SOLENOID, 6 VOLTS DC (10KW ONLY)
57	1	SPRING-CHOKE RETURN (10KW ONLY)
58	1	LINKAGE, CHOKE (10KW ONLY)
59	1	ASSEMBLY, CHOKE SHAFT (10KW ONLY)
60	1	VALVE, CHOKE (10KW ONLY)
61	2	SCREW PFHM M3-0.5 X (10KW ONLY)
62	2	SCREW PPHM #4-40 X 3/8 SEMS (10KW ONLY)
63	3	SCREW PPPH HI-LO #14-15 X 1/2 (10KW ONLY)
64	2	BAND CLAMP DIA 36-39MM
65	1	AIR CLEANER (10KW ONLY)
66	2.6 FT	TAPE ELEC UL FOAM 1/8 X 1/2
67	1	THROTTLE ROD (8KW ONLY)
68	1	ASSY STEPPER MOTOR (8KW ONLY)
69	1	PLUG, GEAR COVER (13KW – 20KW)
70	1	PLUG, GEAR COVER – SMALL (13KW – 20KW)
71	1	SPRING, ANTI-LASH (8KW ONLY)

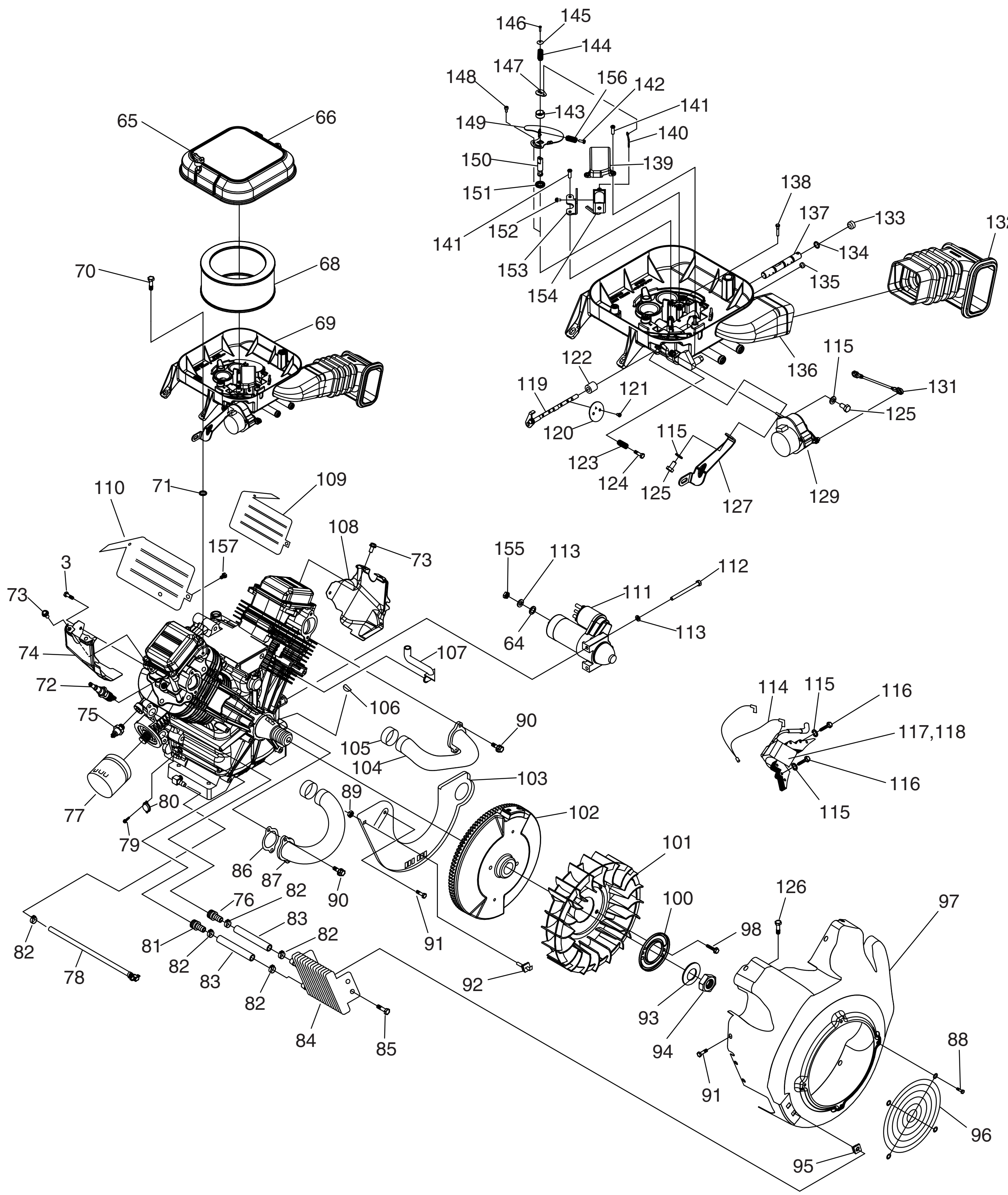
Enclosure – Nexus Units



ITEM	QTY.	DESCRIPTION
1	1	GASKET, DOOR SEAL
2	1	ENCLOSURE FRONT PANEL
3	1	FOAM, FRONT PANEL ENCLOSURE
4	1	EXHAUST BAFFLE (13KW-20KW)
5	AR	SCREW HHFC M6-1.0 X 20 (8KW, 10KW)
6	1	PANEL, ENGINE DIVIDER
7	1	BAFFLE, INTAKE
8	AR	SCREW TAPTITE M6-1.0X12
9	AR	GROMMET OVAL 31.75 X 50.8
10	1	MOUNTING CLIP
11	1	CONTACTOR, STARTER (8KW)
12	1	CABLE, #6 RED BATTERY 38.5”
13	AR	WASHER, LOCK M6-1/4”
14	1	NUT HEX 1/4-20 (8KW ONLY)
15	2	SCREW HHC, M6-1.0 X 12 (8KW)
16	1	GROMMET, n38.1 CROSS SLIT
17	1	GASKET, ENGINE DIVIDER
18	17	PANEL CLIP, M6-1.00
19	1	REGULATOR ASSEMBLY
20	1	LUG SLDLSS #2-#8 X 17/64 CU
21	1	LOCK WASHER, SPECIAL 1/4
22	4	PANEL CLIP, 5/16-18
23	4	SCREW, SHC-3/8-16 WITH LOCKING PATCH
24	4	BUSHING
25	1	ENCLOSURE, BASE
26	1	FOAM, FRONT EXHAUST SHIELD
27	1	FRONT EXHAUST SHIELD
28	1	SCROLL, FAN (8KW, 10KW)
29	1	PANEL, EXHAUST DIVIDER
30	1	FOAM, EXHAUST END PANEL
31	2	FOAM, EXHAUST END PANEL SIDES
32	1	ENCLOSURE, EXHAUST SIDE PANEL
33	1	HINGE ASSEMBLY – LEFT SIDE
34	1	FOAM, BACK EXHAUST COMPARTMENT
35	1	ENCLOSURE, BACK PANEL
36	1	RF COVER PLATE, PLASTIC
37	1	BADGE HOLDER - OVAL
38	1	GROMMET, n38.1 CROSS SLIT WITH HOLE
39	3	1.00” THICK FOAM, ENCLOSURE ROOF
40	1	PUSHBUTTON WIRE TIE
41	1	HINGE ASSEMBLY – RIGHT SIDE
42	AR	NUT, LOCKING FLANGE M6-1.00
43	2	1/4 TURN LOCKING HATCH
44	2	LATCH PAWL
45	1	BRACKET, CONTROL PNL FRONT

ITEM	QTY.	DESCRIPTION
46	1	ENCLOSURE END PANEL
47	2	SCREEN
48	2	U-CLIP, M6-1.00
49	2	SCREW HHFC M6-1.0 X 14
50	1	FOAM, ENCLOSURE BACK PANEL
51	11 FT	GASKET, EXTRUDED TRIM
52	1	COVER, FRONT TOP EXHAUST
53	1	FOAM, FRONT TOP EXHAUST COVER
54	1	COVER, BACK TOP EXHAUST
55	1	FOAM, BACK TOP EXHAUST COVER
56	1	MOUNTING PAD
57	1	CROSS SUPPORT
58	12	WASHER, SELF LOCKING
59	1	HARNESS GENERATOR TO EXTERNAL CONNECTION BOX
60	2	WASHER FLAT M5
61	5	WASHER LOCK #10
62	2	SCREW PPHM#10-32 X 1
63	5	NUT HEX #10-32
64	1	POWER BLOCK
65	1	WASHER SHAKEPROOF EXT 1/4 STEEL
66	1	NUT HEX M6-1.0
67	1	EXTERNAL CONNECTION BOX
68	1	LOUVER, SNAP IN
69	1	CONTROL PANEL FASCIA
70	1	WIRE ASSY, CNTRL TO STARTER (8KW ONLY)
71	1	PLUG 6.35 BLACK
72	1	GASKET, EXHAUST DIVIDER
73	AR	SCREW SWT 1/4-20 X 5/8
74	1	1/4 SHAKEPROOF WASHER
75	2	THREADED SPACER M6-1.0
76	2	NUT TOP LOCK FLANGE M6-1.0
77	1	SCREW HHC, M6-1.0 X 16
78	4	WASHER FLAT 3/8
79	4	NUT, HEX 3/8-16
80	1	CLAMP STL/VNL (8KW)
81	1	ENCLOSURE ROOF ASSY, GALV.
82	2	BRACKET, EXHAUST (20KW ONLY)
83	AR	BRACKET, L
84	4	SCREW HHFC M6-1.0 X 12 (16kW, 17 kW ALUM, 20 kW)
85	4	NUT HEX FL WHIZ M6-1.0 (16kW, 17 kW ALUM, 20 kW)

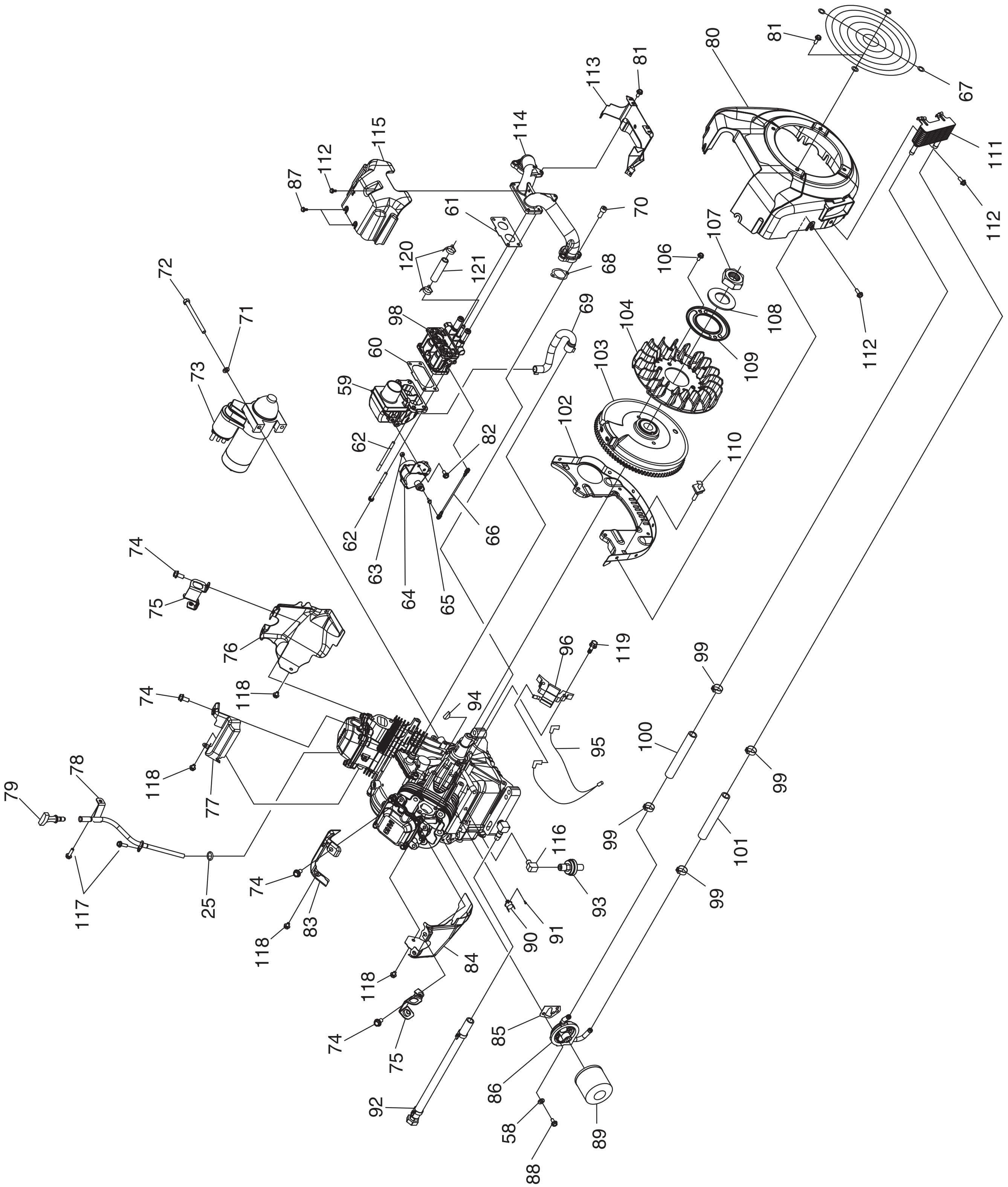
Engine, GN990/999 – Nexus Units



ITEM	QTY.	DESCRIPTION
64	1	WASHER FLAT M8 – 5/16
65	2	KNOB, AIR CLEANER ORG
66	1	COVER, AIRBOX NG/LP
68	1	ELEMENT, AIR CLEANER
69	1	ASSY, MIXER / AIRBOX 990
70	4	SCREW SHLDR(8MM) M6-1.0 X 21
71	4	WASHER,RUBBER 1/4" X 1/8" THICK
72	2	SPARKPLUG
73	2	SCREW TAPTITE M5 – 0.8 X 8
74	1	WRAPPER, LOWER CYLINDER 2 ZINC
75	1	SWITCH, OIL PRESS
76	1	EXTENDED BARBED STR ¼ NPT X 3/8
77	1	OIL FILTER, 90mm
78	1	ASSY, OIL DRAIN HOSE ORG
79	2	SCREW M3 – 0.5 X 6 SEMS
80	1	SWITCH, THERMAL 293F
81	1	BARBED STRAIGHT 1/4NPT X 3/8
82	5	CLAMP, HOSE OETIKER STEPLESS 18.5mm
83	2	HOSE 3/8" 300PSI 6" LG OIL
84	1	COOLER, OIL
85	4	SCREW PLASTITE 1/4-15 X 3/4
86	2	GASKET, MANIFOLD / PORT
87	1	MANIFOLD CYLINDER 2
88	4	SCREW, HHTT M6-1 x 10 LONG
89	1	NUT, HEX LOCK M5-0.8 ZINC
90	4	SCREW SHC M8 – 1.25 X 20 SEMS
91	13	SCREW TAPTITE M6–1X12 CLEAR ZINC
92	1	ASSY,GROUND WIRE CONNECTOR
93	1	WASHER, 25MM I.D.
94	1	NUT, HEX M24
95	4	NUT, GROMMET 1/4 PLUG
96	1	GUARD, FAN
97	1	HOUSING, BLOWER NG COOLER
98	2	SCREW HHFCS M8 – 1.25 X 10 G8.8
99		
100	1	PLATE, FAN
101	1	FAN, NYLON
102	1	ASSY, FLYWHEEL
103	1	PLATE, BACKING WITH CUT OUT
104	1	MANIFOLD CYLINDER 1
105	2	SLEEVE, RUBBER
106	1	KEY, WOODRUFF 4 X 19D
107	1	HOSE BREATHER
108	1	WRAPPER, LOWER CYLINDER 1 ZINC
109	1	WRAPPER, UPPER CYLINDER 1 ZINC
110	1	WRAPPER, UPPER CYLINDER 2 ZINC
111	1	STARTER MOTOR HEAR REDUCED 1KW

ITEM	QTY.	DESCRIPTION
112	2	SCREW HHC M8 – 1.25 X 85 G8.8
113	3	WASHER LOCK M8 – 5/16
114	1	ASSEMBLY, GROUND WIRE
115	2	WASHER LOCK M6 – 1/4
116	4	SCREW TAPTITE M6 – 1.0 X 20 ZINC
117	1	ASSY, IGN COIL W/DIODE, CYLINDER 1
118	1	ASSY, IGN COIL W/DIODE, CYLINDER 2
119	1	ASSY, THROTTLE SHAFT
120	2	THROTTLE VALVE
121	4	SCREW PPHM M3 – 0.5 X 5
122	1	COVER, DUST, MIX/AIRBOX
123	1	SPRING, IDLE ADJUST
124	1	SCREW PPHM M5 – 0.58 X 20
125	2	SCREW HHC M6 – 1.0 X 12
126	1	SCREW BHSC M6-1.0 X 12 SS
127	1	BRACKET, STEPPER MOTOR
129	1	ASSY,CONTROLLER GTH990 HSB
131	1	ASSY, THROTTLE ROD
132	1	BELLOWS, INTAKE
133	1	EXPANSION PLUG
134	3	#10 O-RING
135	1	PLUG, MANIFOLD
136	1	ASSY, AIR BOX BASE
137	1	PIN, FUEL SELECTOR
138	1	PIN, FUEL SEL STOP
139	1	SOLENOID COVER
140	1	LINKAGE, CHOKE
141	4	SCREW PPPH HI-LO #6 X 1/2
142	1	SCREW PHTT M3 – 0.5 X 8
143	1	RETAINER, CHOKE RETURN SPRING
144	1	SPRING, CHOKE RETURN
145	1	WASHER, BELLEVILLE SPRING
146	1	SCREW PPHM M2 – 0.4 X 8
147	1	CHOKE ARM
148	1	SCREW SHOULDER M3 – 0.5 X 6
149	1	VALVE, CHOKE
150	1	SHAFT, CHOKE
151	1	SEAL, GOVERNOR ARM
152	2	SCREW PHM #4 – 40 X 1/4
153	1	BRACKET, SOLENOID
154	1	SOLENOID, 6VDC
155	1	NUT HEX M8 – 1.25 YELLOW ZINC
156	1	SPRING, CHOKE VALVE ADJUST
157	1	SCREW, BHSC M6-1.0 x 12

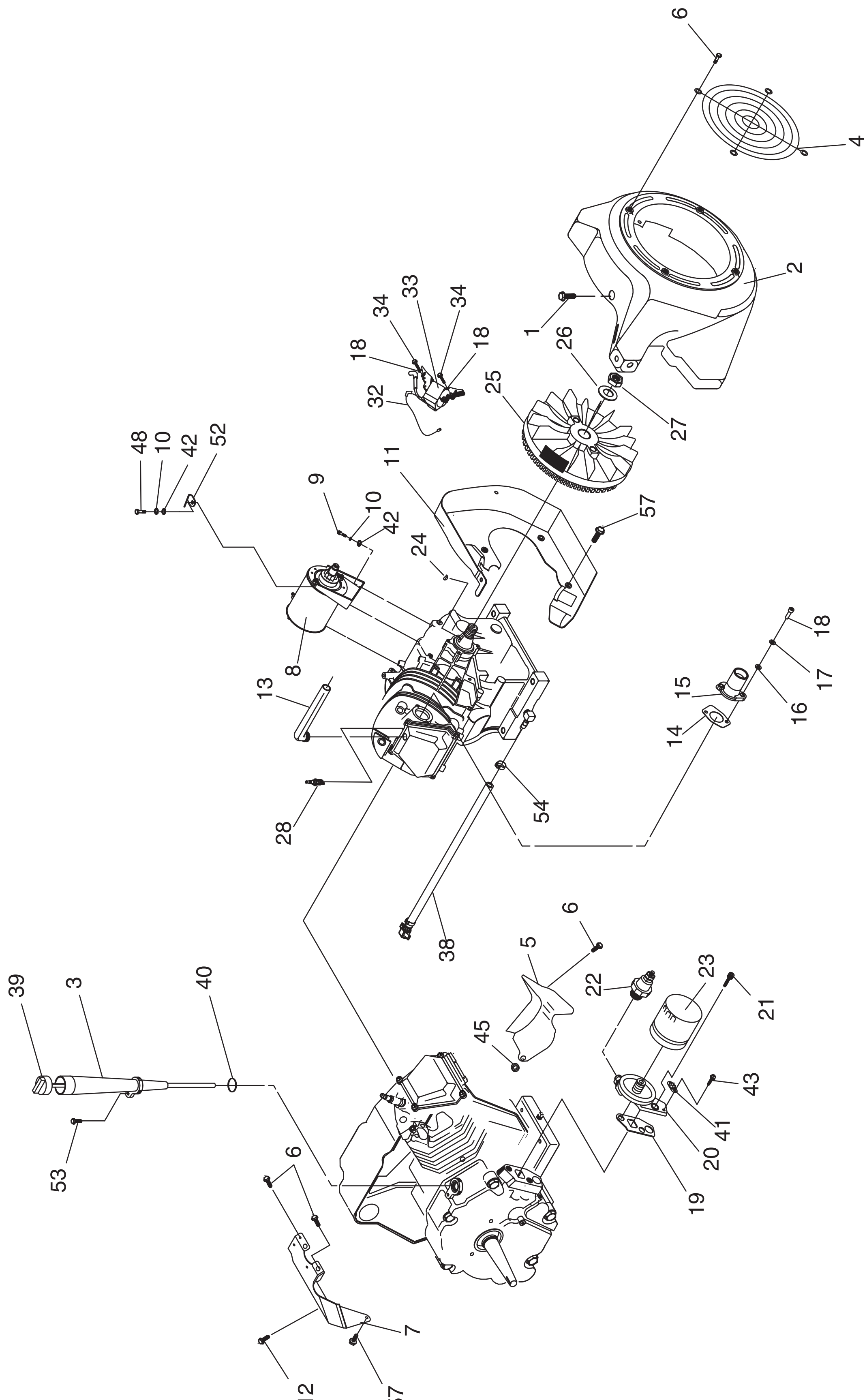
Engine, GN530 – Nexus Units



ITEM	QTY.	DESCRIPTION
58	3	WASHER LOCK M6-1/4
59	1	INTAKE ADAPTER
60	1	GASKET, AIRBOX TO CARB/MIXER
61	1	GASKET, MANIFOLD TO CARB/MIXER
62	4	BOLT, CARB MOUNT M6 – 1.0 X 85
63	1	NUT HEX LOCK M3 – 0.5
64	1	ASSY, CONTROLLER
65	1	BALL STUD, 10 MM
66	1	ASSY, THROTTLE ROD
67	1	GUARD, FAN
68	2	GASKET INTAKE
69	1	BREATHER HOSE
70	4	SCREW SHC M8 – 1.25 X 20 G12.9
71	2	WASHER LOCK M8 – 5/16
72	2	SCREW HHC M8 – 1.25 X 85
73	1	STARTER MOTOR
74	6	SCREW HHFC M8 – 1.25 X 14
75	2	LIFTING HOOK
76	1	WRAPPER OUTER CYLINDER 1 CLEAR ZINC
77	1	WRAPPER INNER CYLINDER 1 CLEAR ZINC
78	1	TUBE, DIPSTICK GTH 530
79	1	ASSY, DIPSTICK /TEXT ORG
80	1	BLOWER HOUSING
81	6	SCREW HHFC M6-1.0 X 10 G8.8
82	3	SCREW HHFC M6-1.0 X 8 G8.8
83	1	WRAPPER INNER CYLINDER 2 CLEAR ZINC
84	1	WRAPPER OUTER CYLINDER 2 CLEAR ZINC
85	1	GASKET, OIL FILTER ADAPTER
86	1	ASSY, DIRECT OIL COOLER ADAPTER
87	2	SCREW PLASTITE HI-LOW #10X3/8
88	3	SCREW HHC M6 – 1.0 X 25
89	1	OIL FILTER

ITEM	QTY.	DESCRIPTION
90	1	THERMAL SWITCH
91	2	SCREW PPHM M3-0.5 X 6 SEMS
92	1	ASSY OIL DRAIN HOSE ORG
93	1	OIL PRESSURE SWITCH HOBBS 5PSI
94	1	KEY, WOODRUFF 4 X 19D
95	1	ASSY, GROUNDING WIRE
96	1	ASSY IGNITION COIL CYLINDER 1
	1	ASSY IGNITION COIL CYLINDER 2
97		
98	1	ASSY, MIXER DUAL FUEL
99	4	CLAMP, HOSE OETIKER STEPLESS 18.5mm
100	1	HOSE 3/8”ID X 6” SAE J30R9
101	1	HOSE 3/8”ID X 7.25 SAE J30R9
102	1	BACKING PLATE, GT-530 ZINC
103	1	ASSY, FLYWHEEL & RING GEAR
104	1	FAN, FLYWHEEL, 20 FIN, 218.8 OD
106	2	SCREW HHFCS M8 – 1.25 X 12 C8.8
107	1	NUT HEX M20 – 1.5
108	1	WASHER BELV – 20 X 2.2
109	1	PLATE, FAN
110	1	ASSY, GROUND WIRE CONNECTOR
111	1	OIL COOLER
112	13	SCREW HHFC M6 – 1.0 X 14
113	1	CENTER BAFFLE
114	1	INTAKE MANIFOLD
115	1	FRONT COVER
116	1	ELBOW - 1/8” NPT
117	2	SCREW, HHFC M6-1.0 x 12
118	4	SCREW, HHFCS M6-1 x 12 CLEAR ZINC
119	4	SCREW, HHC M6-1 x 25 SEMS
120	1	CLAMP HOSE .38-.87
121	1.5	HOSE 1/4 ID LPG 350PSI UL21

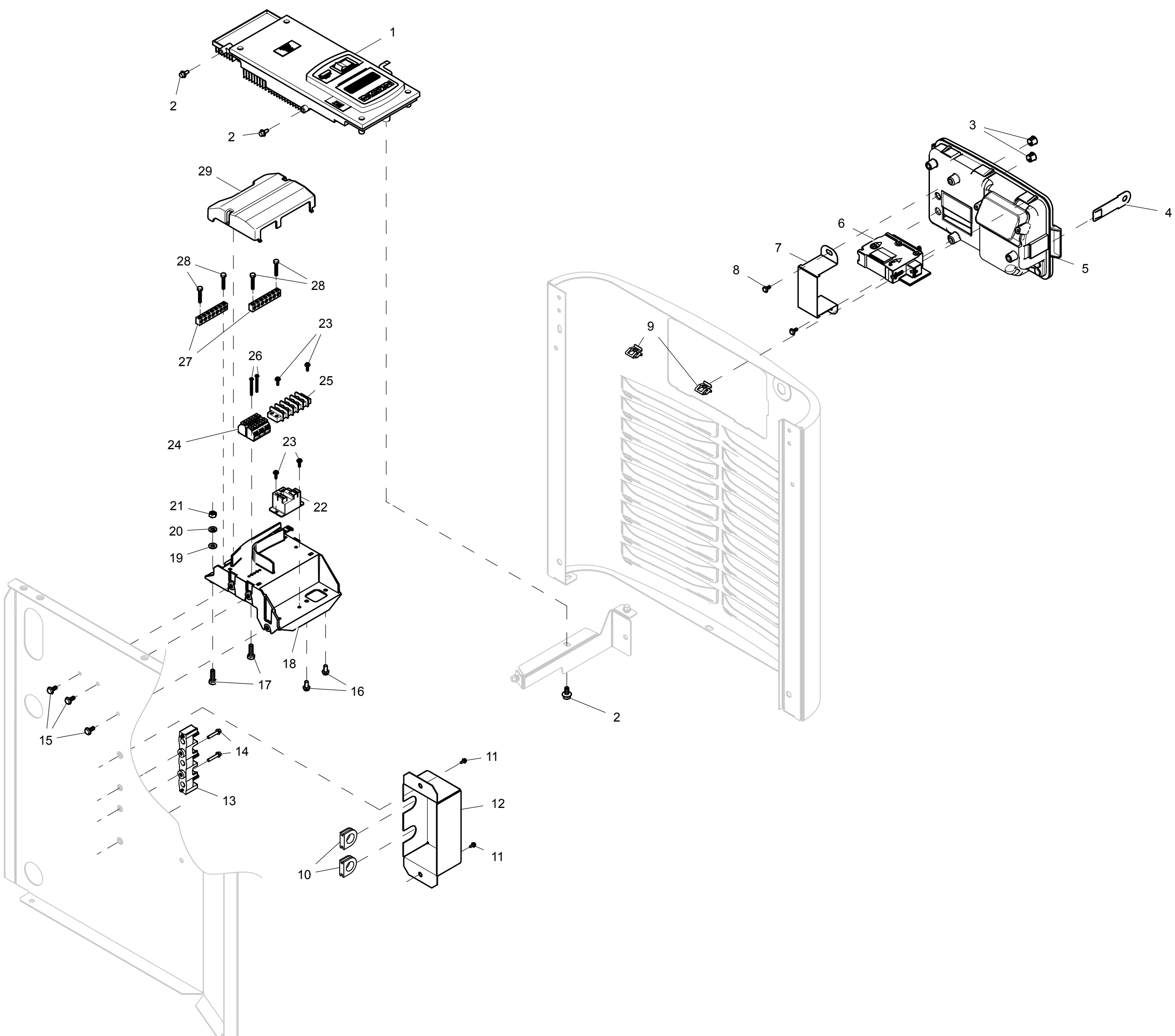
Engine, GN410 – Nexus Units



ITEM	QTY.	DESCRIPTION
1	7	SCREW, TAPTITE M6-1.0X8 YELLOW CHROME
2	1	HOUSING, BLOWER GH410 BLACK
3	1	TUBE 410GH OIL FILL/CHECK
4	1	GUARD, F AN
5	1	WRAPPER, BOTTOM
6	6	SCREW, TAPTITE M6-1X10 YELLOW CHROME
7	1	WRAPPER, TOP
8	1	ASSY, START ER
9	2	SCREW SHC M 8-1.25 X 40 C8.8
10	3	WASHER, LOCK M8-5/16
11	1	BACKPLATE, L/F D/F
12	1	SCREW, HHTT 5/16”-18 X ½” SEMI-GIMLET
13	1	BREATHER HOSE
14	1	GASKET, INTAKE ADAPTER
15	1	ASSY THROTTLE BODY
16	2	WASHER, F LAT M6
17	4	WASHER, LOCK M6-1/4
18	4	SCREW, SHC M6-1.0 X 20 G12.9
19	1	GASKET,OIL F ILTR ADAPTER
20	1	ADAPTER, OIL FILTER
21	2	SCREW, SHC M8-1.25 X 30 G12.9
22	1	SWITCH, OIL 5 PSI

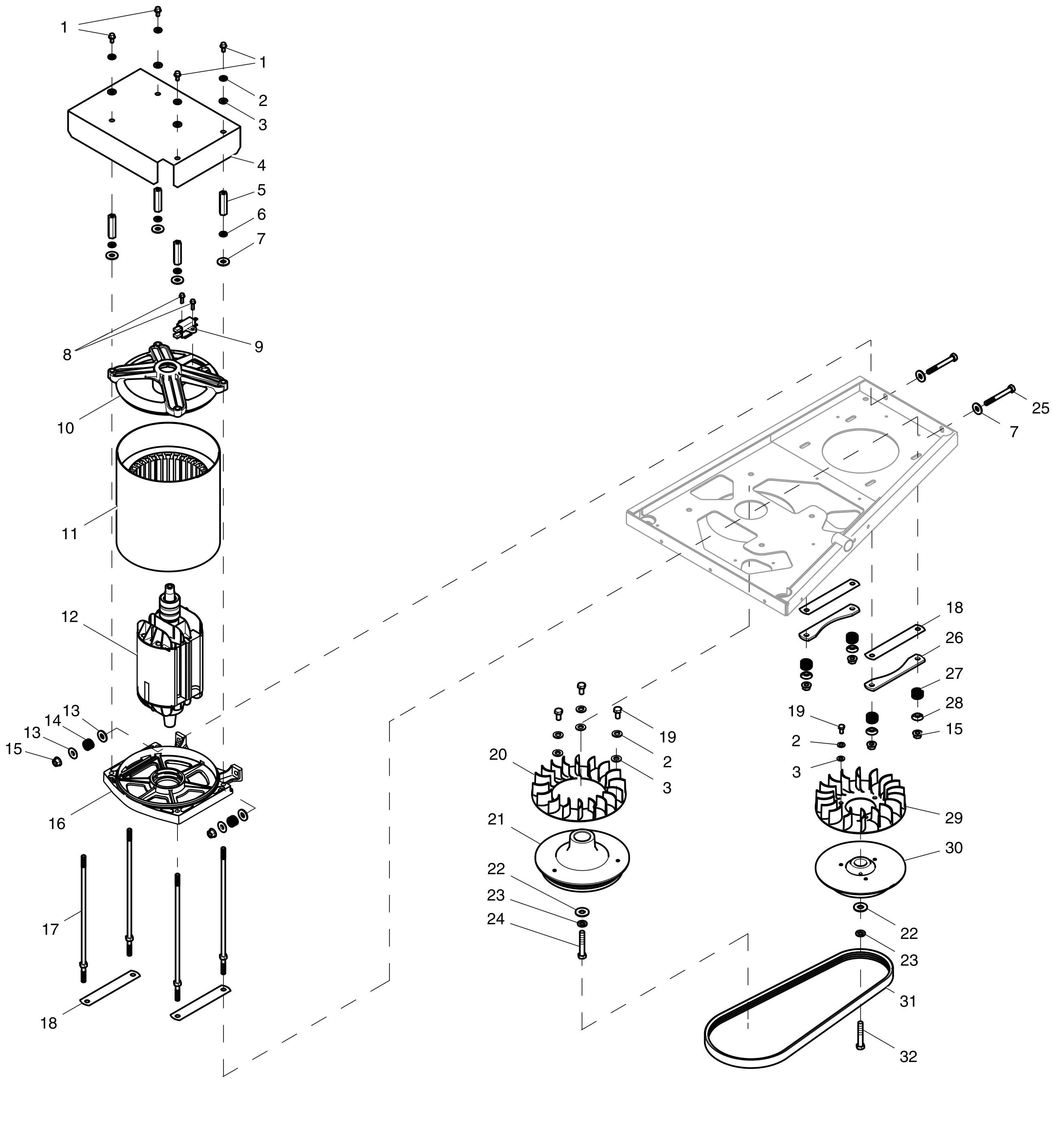
ITEM	QTY.	DESCRIPTION
23	1	OIL FILTER
24	1	KEY, WOODRFF 4 X 19D
25	1	FLYWHEEL WITH RING GEAR 27 DEGREE
26	1	WASHER,BELV-20 X 2.2
27	1	NUT , HEX - FLYWHEEL
28	1	SPARKPLUG
32	1	ASSEMBLY, WIRE
33	1	ASSEMBLY, IGNIT ION COIL ADVANCE W/ DIODE
34	2	SCREW HHFC M6-1.0 X 25 FTH G8
38	1	ASSY OIL DRAIN HOSE
39	1	DIPSTICK, GT H410
40	1	O-RING 9/16 X 3/4 X 3/32
41	1	SWITCH, THERMAL 293F
42	3	WASHER FLAT 5/16 - M8
43	2	SCREW, M3-0.5 X 6 SEMS
45	1	GOMMET
48	1	SCREW HHC M8-1.25 x 20
52	1	ENGINE LIF T HOOK
53	1	SCREW HHFCS M6-1.0X10 G8.8
54	1	CLAMP,HOSE OETIKER STEPLESS 17
57	5	SCREW HHFC M6-1.0 X 12

Control Panel – EcoGen Units



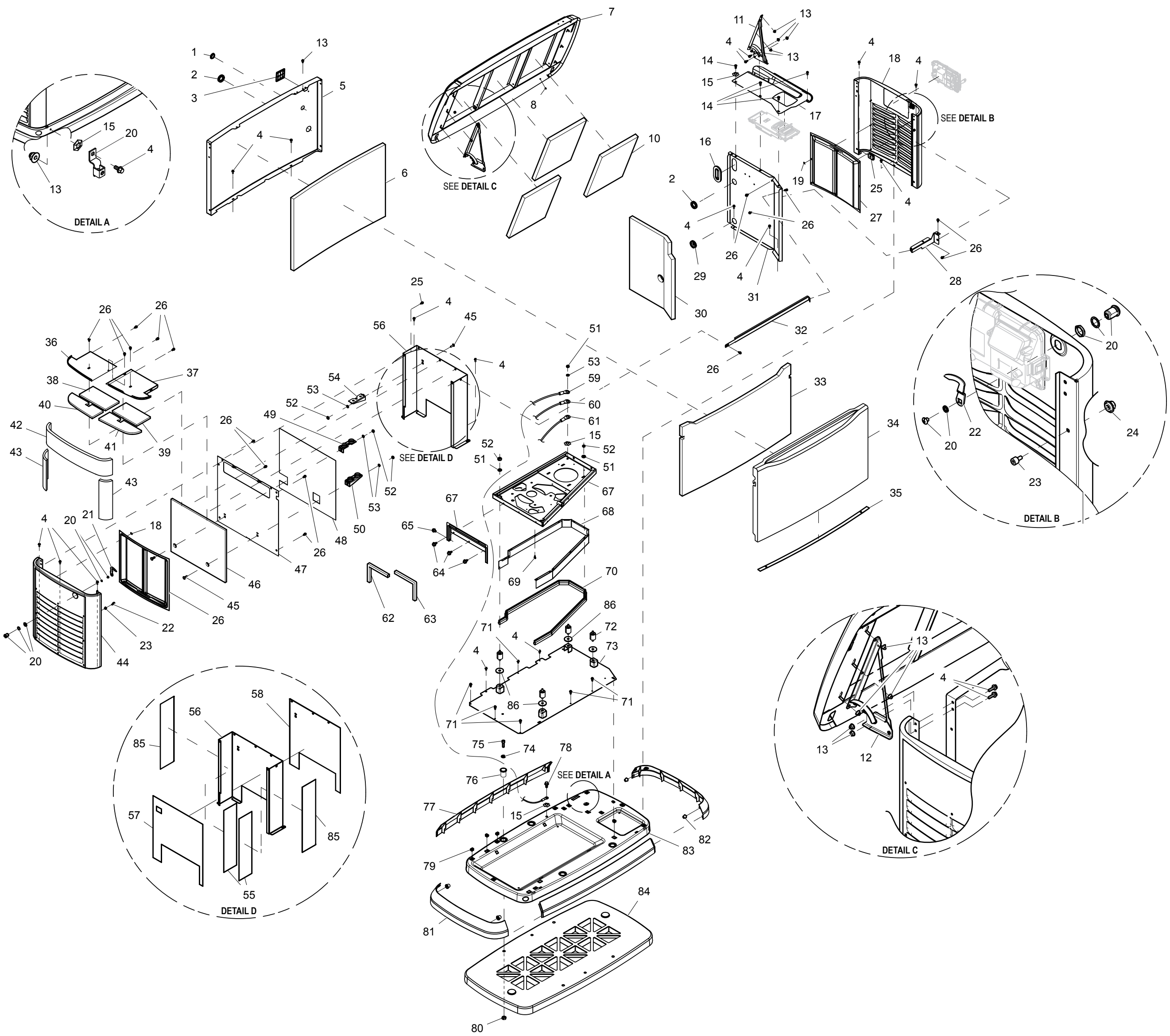
ITEM	QTY.	DESCRIPTION
1	1	ASSY CNTR HSB PROGRAMMED
2	3	SCREW HHFC M6-1X12 8.8 W/PATCH
3	2	PLUG PLASTIC DOME 7/16" - HSB
4	1	EYE HASP CNTRL PANEL 2008 HSB
5	1	ASSY EXT CTRL BOX HSB 6KW
6	1	CB 0050A 1P 120V S BQ1 LB
7	1	CB BRACKET CONTROL BOX 2P BQ
8	2	SCREW REDUCED HH HI-LO M6X10MM
9	2	SPEED CLIP - "U" TYPE
10	2	GROMMET, HORSE SHOE
11	2	SCREW HHTT M6-1.0 X 12 ZINC
12	1	POWER BLOCK COVER
13	1	POWER BLOCK
14	2	SCREW HHTT M5-0.8 X 25 BP
15	3	SCREW HHFC M5-0.8X12 W/PATCH
16	2	SCREW HHSP #10 X 3/8 HI-LOW
17	2	SCREW HHC M6-1.0 X 20 C8.8
18	1	BRACKET CUST CONNECT '10 HSB
19	2	WASHER FLAT M6
20	2	WASHER LOCK M6-1/4
21	2	NUT HEX M6-1.0 G8 CLEAR ZINC
22	1	RELAY 12V 25A SPST
23	4	SCREW PPHM M3-0.5 X 12 SEMS SC
24	1	TERM BLOCK 3P UL 12-20AWG LBL
25	1	BLOCK TERM 20A 5 X 6 X 1100V
26	2	SCREW PPHM M3-0.5 X 30
27	2	GROUND BAR (5)4-14 AWG CONN
28	4	SCREW HHC M4-0.7 X 25 SEMS
29	1	COVER CUST CONNECT '10 HSB

Generator – EcoGen Units



ITEM	QTY.	DESCRIPTION
1	4	SCREW HHC M6-1.0 X 16 C8.8
2	10	WASHER LOCK M6-1/4
3	10	WASHER FLAT 1/4-M6 ZINC
4	1	COVER ALTERNATOR
5	4	STANDOFF 1/2" HEX
6	4	WASHER LOCK M8-5/16
7	6	WASHER FLAT 5/16-M8 ZINC
8	2	SCREW HHTT M5-0.8 X 16
9	1	ASSEMBLY, BRUSH HOLDER
10	1	UPPER BEARING CARRIER
11	1	STATOR 6.5KW 60 HZ 120V
12	1	ROTOR ASSEMBLY 6.5KW
13	4	WASHER, SPRING CENTR
14	2	TENSION SPRING
15	6	NUT TOP LOCK FL M8-1.25
16	1	LOWER BEARING CARRIER
17	4	STUD, 530 STATOR
18	4	SLIDE, NYLON
19	6	SCREW HHC M6-1.0 X 12 G8.8
20	1	FAN, ENGINE PULLEY
21	1	PULLEY, ENGINE
22	2	WASHER FLAT 3/8 G8
23	2	WASHER LOCK M10
24	1	SCREW HHC 3/8-24 X 2-1/4 G8
25	2	SCREW HHC M8-1.25 X 70 C8.8
26	2	SUPPORT, SLIDE
27	4	SPRING, GEN. MOUNT
28	4	WASHER, SPRNG CENTER
29	1	FAN, ALTERNATOR PULLEY
30	1	PULLEY, ALTERNATOR
31	1	BELT V-RIBBED 4L X 43.75" LG
32	1	SCREW HHC 3/8-24 X 1 1/4 G8

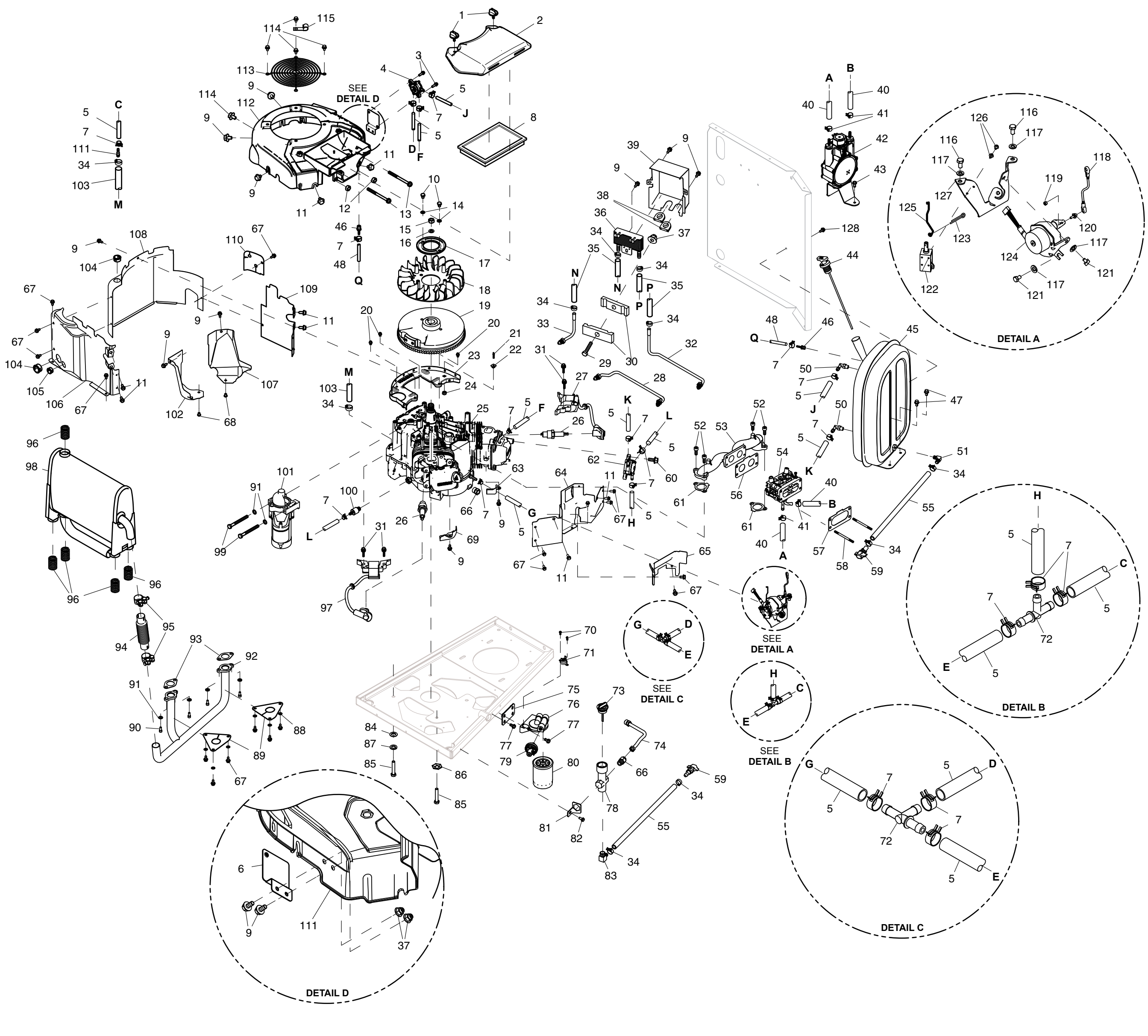
Enclosure – EcoGen Units



ITEM	QTY.	DESCRIPTION
1	1	PLUG STEEL 1.0625
2	2	GROMMET, 38.1 CROSS SLIT W HOLE
3	1	RF COVER PLATE-PLASTIC-BISQUE
4	18	SCREW HHFC M6-1.0 X 20 G8.8
5	1	BACK PANEL, ENCLOSURE
6	1	FOAM, BACK PANEL, ENCLOSURE
7	1	ROOF ASSY GALV BISQUE
8	1	PLUG 6.35 BLACK
10	3	FOAM, ENCLOSURE ROOF 1.00" THK
11	1	HINGE ASSY INTAKE END
12	1	HINGE ASSY EXHAUST END
13	9	NUT FLANGE M6-1.0 NYLOK
14	5	SCREW SWT 1/4-20 X 5/8
15	4	WASHER LOCK SPECIAL 5/16
16	1	GROMMET OVAL 31.75 X 50.8
17	1	CONTROL PANEL FASCIA, 14-20 HSB
18	1	ENCLOSURE END PANEL
19	16	WASHER SELF LOCKING-.106 STUD
20	1	LUG SLDLSS #2-#8 X 17/64 CU
21	2	1/4 TURN LOCKING LATCH
22	2	1/4 TURN LATCH PAWL
23	2	SPACER 2008 HSB DOOR
24	2	NUT TOP LOCK FL M6-1.0
25	1	CLIP U M6-1.0
26	19	SCREW HHTT M6-1.0 X 12 ZINC
27	2	SCREEN - HSB LOUVERS
28	1	BRKT CTRL PNL FRONT
29	1	GROMMET, 38.1 DIA. CROSS SLIT
30	1	FOAM, ENGINE DIVIDER PANEL
31	1	PANEL, ENGINE DIVIDER
32	1	CROSS SUPPORT
33	1	FOAM, FRONT PANEL
34	1	ENCLOSURE FRONT PANEL
35	1	GASKET, HSB DOOR SEAL
36	1	TOP EXHAUST COVER BACK
37	1	TOP EXHAUST COVER FRONT
38	1	FOAM TOP EXHAUST COVER BACK INSIDE
39	1	FOAM TOP EXHAUST COVER FRONT INSIDE
40	1	FOAM TOP EXHAUST COVER BACK OUTSIDE
41	1	FOAM TOP EXHAUST COVER FRONT OUTSIDE
42	1	FOAM, EXHAUST END PANEL
43	2	FOAM, EXHAUST END PANEL SIDES

ITEM	QTY.	DESCRIPTION
45	3	BOLT CARR 5/16-18 X 1
46	1	FOAM, EXH DIVIDER PANEL,OUTSIDE
47	1	EXHAUST DIVIDER PANEL
48	1	MAT, EXH DIVIDER PANEL, INSIDE
49	1	BRACKET, MUFFLER SUPPORT LOWER REAR
50	1	BRACKET, MUFFLER SUPPORT LOWER FRONT
51	4	WASHER FLAT 5/16-M8 ZINC
52	7	NUT HEX 5/16-18 STEEL
53	3	WASHER LOCK M8-5/16
54	1	BRACKET, MUFFLER SUPPORT UPPER
55	2	MAT, EXHAUST ENCLOSURE, SIDE
56	1	EXHAUST ENCLOSURE
57	1	MAT, EXHAUST ENCLOSURE, INSIDE
58	1	MAT, EXH DIVIDER PANEL, OUTSIDE
59	1	EARTH STRAP 14.20MM
60	1	GREEN WIRE FROM CONTROL PANEL
61	1	CABLE BATT BLK #6 30" NEG
62	1	GASKET DUCT AIR OUT OPP SIDE
63	1	GASKET DUCT AIR OUT
64	3	SCREW HWHS 1/4-20 X 1/2 ZYC
65	1	SCREW CRIMPTITE 10-24 X 3/8
66	1	DUCT ASSEMBLY AIR OUT
67	1	FRAME MOUNTING WELDMENT
68	1	LOWER BLOWER HOUSING
69	11	SCREW HHTR #10-32 X 9/16
70	4.8 Feet	EDGE TRIM W/ 3/4" HOLLOW CYL.
71	9	SCREW HHSD 1/4-20 X 3/4 JS500
72	4	VIB MNT 1.5X1.38X5/16-18 DR 45
73	1	MOUNTING PLATE ASM, FRAME
74	4	WASHER FLAT 3/8-M10 ZINC
75	4	SCREW SHC 3/8-16 X1.25 W/PATCH
76	4	BUSHING, HSB ENCLOSURE BASE
77	2	FASCIA-FRONT/BACK 2008 HSB BISQUE
78	1	SCREW HHTT M8-1.2 X 16 YC
79	15	PANEL CLIP, M6-1.00 EXPANSION
80	4	NUT HEX 3/8-16 STEEL
81	2	FASCIA-END 2008 HSB BISQUE
82	4	BUMPER, HSB FASCIA
83	1	ENCLOSURE BASE
84	1	PAD MOUNTING BASE
85	2	MAT, EXHAUST ENCLOSURE, OUTSIDE
86	4	WASHER FLAT .406ID X 1.62OD

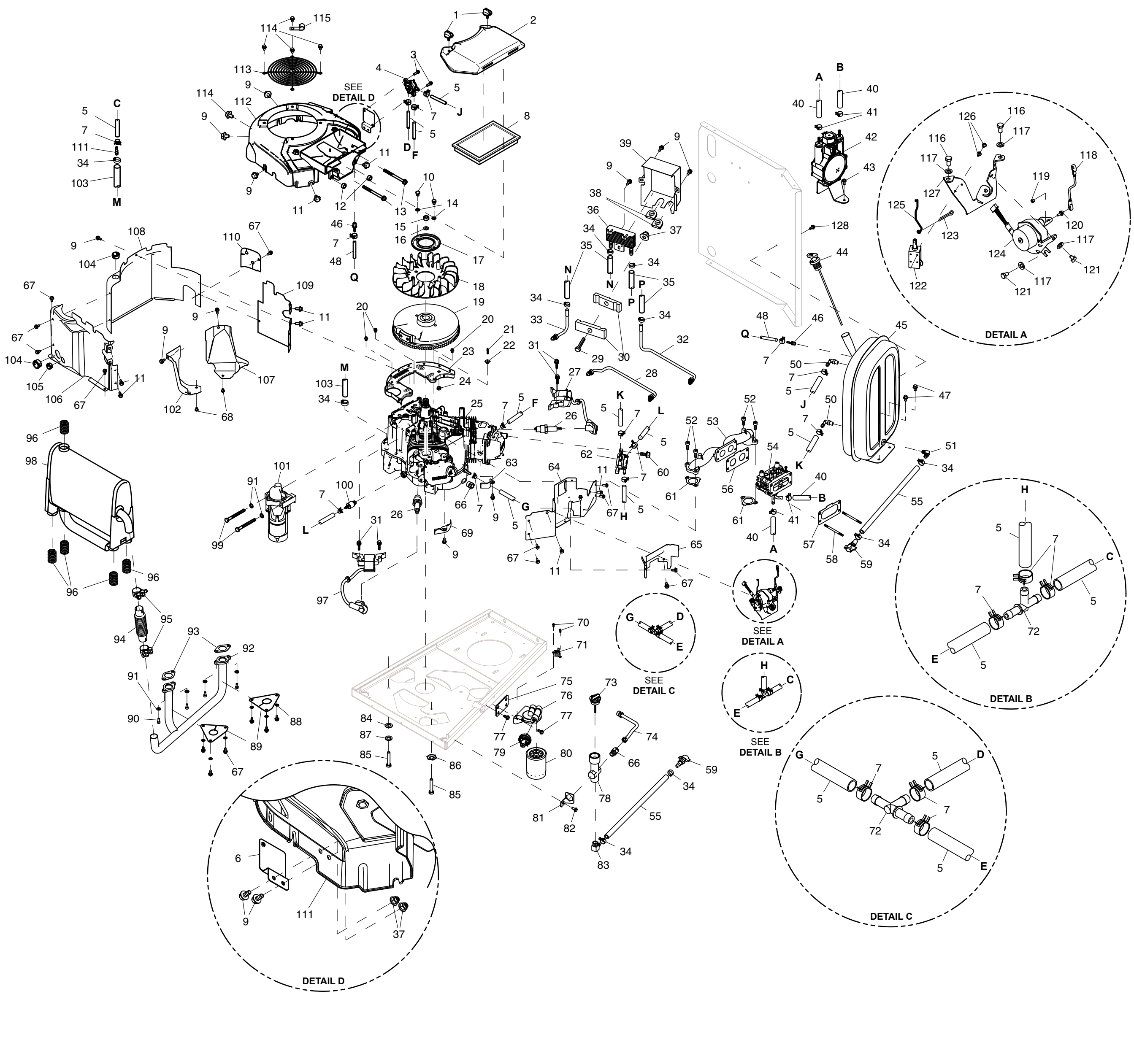
Power Head – EcoGen Units



ITEM	QTY.	DESCRIPTION
1	2	KNOB, 1/4 TURN GV530 AIRBOX 20
2	1	COVER AIRBOX GTV530
3	2	SCREW HHTT M5-0.8 X 16
4	1	PUMP, IMPULSE
5	8.25 FT	HOSE 1/4" VITON HIGH TEMP OIL
6	1	BRACKET SCAVENGE PUMP
7	20	CLAMP HOSE BAND SPRING .38
8	1	FILTER AIR HSB MY 2012
9	11	SCREW HHFC M6-1.0 X 12 G8.8
10	2	SCREW HHC M8-1.25 X 12 C8.8
11	8	SCREW HHFC M8-1.25 X 14 W/M10
12	2	NUT HEX M6-1.0 G8 CLEAR ZINC
13	2	BOLT, CARB MOUNT M6 X 1.0
14	2	WASHER LOCK INT M8 SS
15	1	NUT HEX M20-1.5 G8 YEL CHR
16	1	WASHER, BELV-20 X 2.2
17	1	PLATE, FAN GV-990
18	1	FAN, FLYWHEEL GT530,GLS FILLED
19	1	ASSY, FLYWHEEL & RING GEAR 29D
20	4	SCREW HHTT M6-1.0 X 10 YEL CHR
21	1	SCREW CONNECTOR
22	1	GND POST GROMMET 3/8SQ NYL6-6
23	1	BACK PLATE, GT-530 ZINC
24	1	NUT HEX M5-0.8 G8 CLEAR ZINC
25	1	BLOCK GTV530 LP
26	2	SPARK PLUG
27	1	ASSY, IGNITION COIL GTV-530
28	1	OIL LINE, ENG TO FILTER
29	1	SCREW HHC M6-1.0 X 30 C8.8
30	2	CLAMP, OIL LINE
31	4	SCREW HHC M6-1 X 25 SEMS G8.8
32	1	OIL LINE, FILTER/COOLER
33	1	OIL LINE, ENG TO COOLER
34	10	CLAMP, HOSE OETIKER STPLSS 18.5
35	2	HOSE 3/8"ID 300DEG X 4.5" LG
36	1	OIL COOLER, GT530
37	3	NUT FLANGE M6-1.0 NYLOK
38	2	GROMMET, HORSE SHOE
39	1	DUCT OIL COOLER GV530
40	8 FT	HOSE 5/16 ID TYP1 SNGL HTR
41	4	CLAMP HOSE BAND .53
42	1	ASSY REGULATOR GTV530
43	1	SCREW HHFC M6-1.0 X 20 G8.8
44	1	ASSEMBLY, CAP & FLAT DIPSTICK

ITEM	QTY.	DESCRIPTION
45	1	RESERVOIR OIL
46	2	BARBED STR 1/8NPT X 3/16
47	2	SCREW HHSD 1/4-20 X 3/4 JS500
48	1.2 FT	HOSE, FUEL 3/16 30R7
50	2	LUG PAR SPL N/I 16-14 X .16 CU
51	1	BARBED EL 90 1/8NPT X 3/8
52	4	SCREW SHC M8-1.25 X 20 C12.9
53	1	MANIFOLD INTAKE GTV530
54	1	MIXER GTV530 2V-LP
55	2	HOSE 3/8"ID 300DEG X 16.0"LG
56	1	GASKET, MANIFOLD TO CARB/MIXER
57	1	GASKET, AIRBOX TO MIXER
58	2	STUD M6-1.0 X 100 G5 ZINC
59	2	ASSY OIL DRAIN FITTING, ORANGE
60	2	SCREW HHFC M6-1.0 X 14 G8.8
61	2	GASKET INTAKE GT530
62	1	PUMP IMPULSE ROUND
63	1	WRAPPER INNER CYL 2 530
64	1	WRAPPER VALLEY BOTTOM GV530
65	1	WRAPPER, ENG VALLEY, UPPER
66	2	3/8NPT TO INVTD FLR 3/8OD STRT
67	20	SCREW CRIMPTITE 10-24 X 1/2
68	4	SCREW BHSC M6-1 X 8MM BLACK
69	1	WRAPPER INNER CYL 1 530
70	2	SCREW PPHM M3-0.5 X 8
71	1	SWITCH THERMAL 284F
72	2	BARBED TEE 1/4 W ORIFICE
73	1	ASSEMBLY, CAP & DIPSTICK
74	1	OIL DRAIN LINE
75	1	BRACKET, OIL FILTER ADAPTER MTG
76	1	OIL FILTER SUPPORT
77	4	SCREW HHTT M8-1.2 X 12 BP
78	1	OIL DRAIN / DIPSTICK TUBE 530
79	1	SW OIL PRESS 5PSI 1/8-27 NC
80	1	OIL FILTER 90 LOGO-OHVI
81	1	BRACKET, OIL CHECK TUBE 530
82	1	SCREW HWHS 1/4-20 X 1/2 ZYC
83	1	BARBED EL 90 3/8NPT X 3/8
84	3	WASHER FLAT 5/16-M8 ZINC
85	4	SCREW HHC 5/16-18 X 1-3/4 G5
86	1	WASHER LOCK SPECIAL 3/8
87	3	WASHER LOCK M10
88	6	WASHER FLAT #10 ZINC
89	2	GASKET, EXH BASE, 530

Power Head – EcoGen Units (continued)

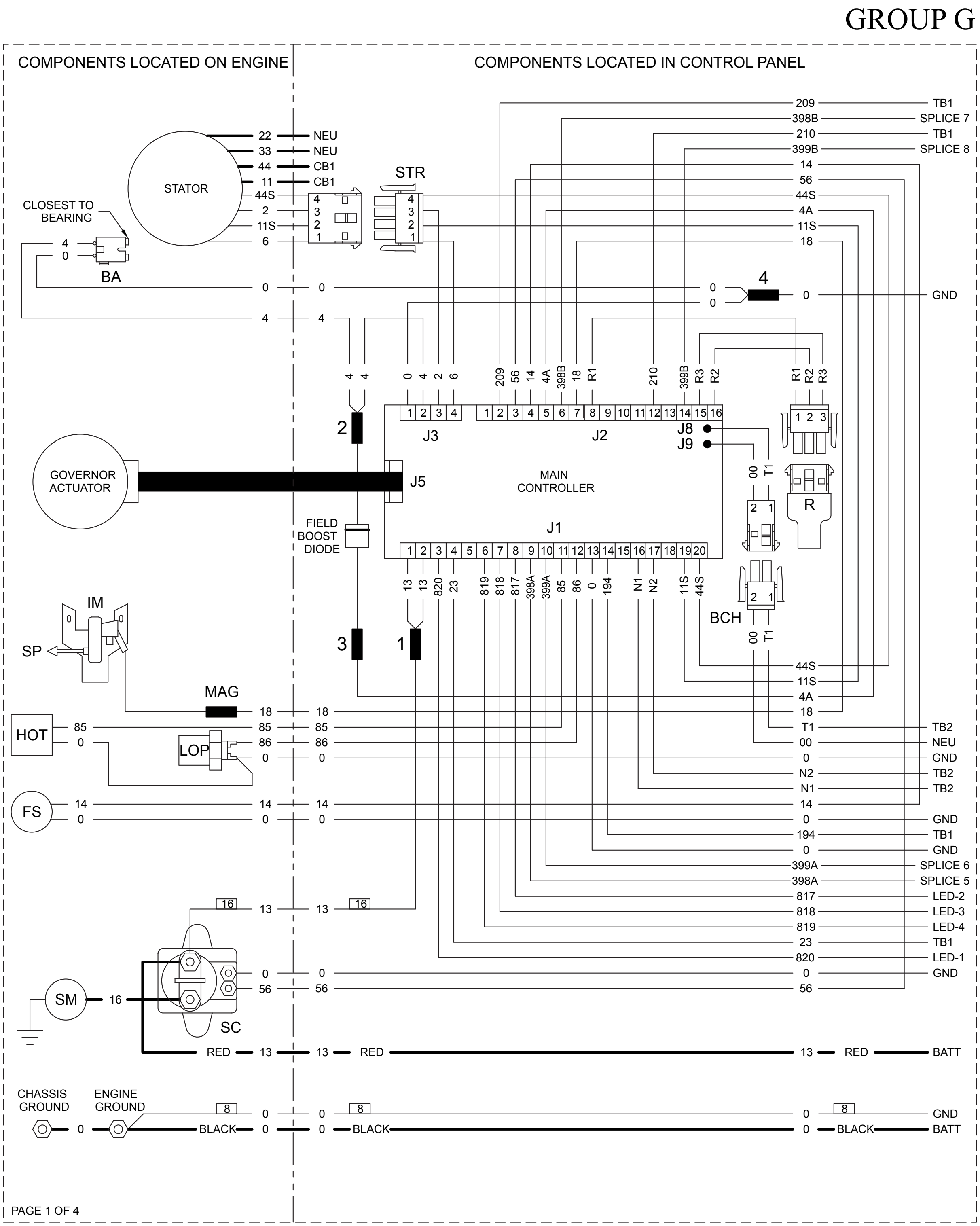


ITEM	QTY.	DESCRIPTION
90	4	SCREW SHC M8-1.25 X 18 C8.8
91	13	WASHER LOCK M8-5/16
92	1	EXHAUST MANIFOLD, GV530
93	2	GASKET EXHAUST GT530
94	1	EXHAUST FLEX
95	2	CLAMP BAND DIA 26-28MM
96	5	ISOLATION SPRING
97	1	ASSY, IGNITION COIL GTV-530
98	1	MUFFLER, GV530
99	2	SCREW HHC M8-1.25 X 85 C8.8
100	1	CHECK VALVE 1/4NPT X 1/4
101	1	STARTER MOTOR GEAR REDUCED 1KW
102	1	SHIELD WRAPPER CYL 1
103	1 FT	HOSE 3/8" BRAIDED-WRAPPED
104	1	BUSHING SNAP SB-1093-937
105	2	BUSHING SNAP SB-875-11
106	1	WRAPPER, STARTER SIDE GV530
107	1	SHIELD WRAPPER CYL 2
108	1	WRAPPER, ENGINE BACK GV530
109	1	WRAPPER, OIL ADAPTER SIDE
110	1	COVER OIL LINES
111	1	FTG BARBED ADPTR 3/8-1/4 NYLON
112	1	BLOWER HOUSING ASM GV530
113	1	GUARD, FAN 6.5KW HSB
114	5	SCREW HHFCS M6-1.0 X 10 G8.8
115	1	CLIP-J VINYL COAT .375 ID
116	2	SCREW HHC M6-1.0 X 12 G8.8
117	4	WASHER LOCK M6-1/4
118	1	ASSY GOVERNOR ROD GT530
119	1	NUT HEX LOCK M3-0.5 NY INS
120	1	BALL STUD, 10 MM
121	2	SCREW HHC M6-1.0 X 10 C8.8
122	1	SOLENOID, CHOKE
123	1	PIN COTTER 3/32 X 1/2
124	1	CONTROLLER ASSY - 530 ECO GEN
125	1	ROD, CHOKE CONTROL-530 ECO-GEN
126	2	SCREW PPHM #4-40 X 1/4 SEMS
127	1	BRACKET, CONTROL SUPPORT-530
128	1	SCREW HHTT M6-1.0 X 25 ZINC

Notes

PART 7 - ELECTRICAL DATA

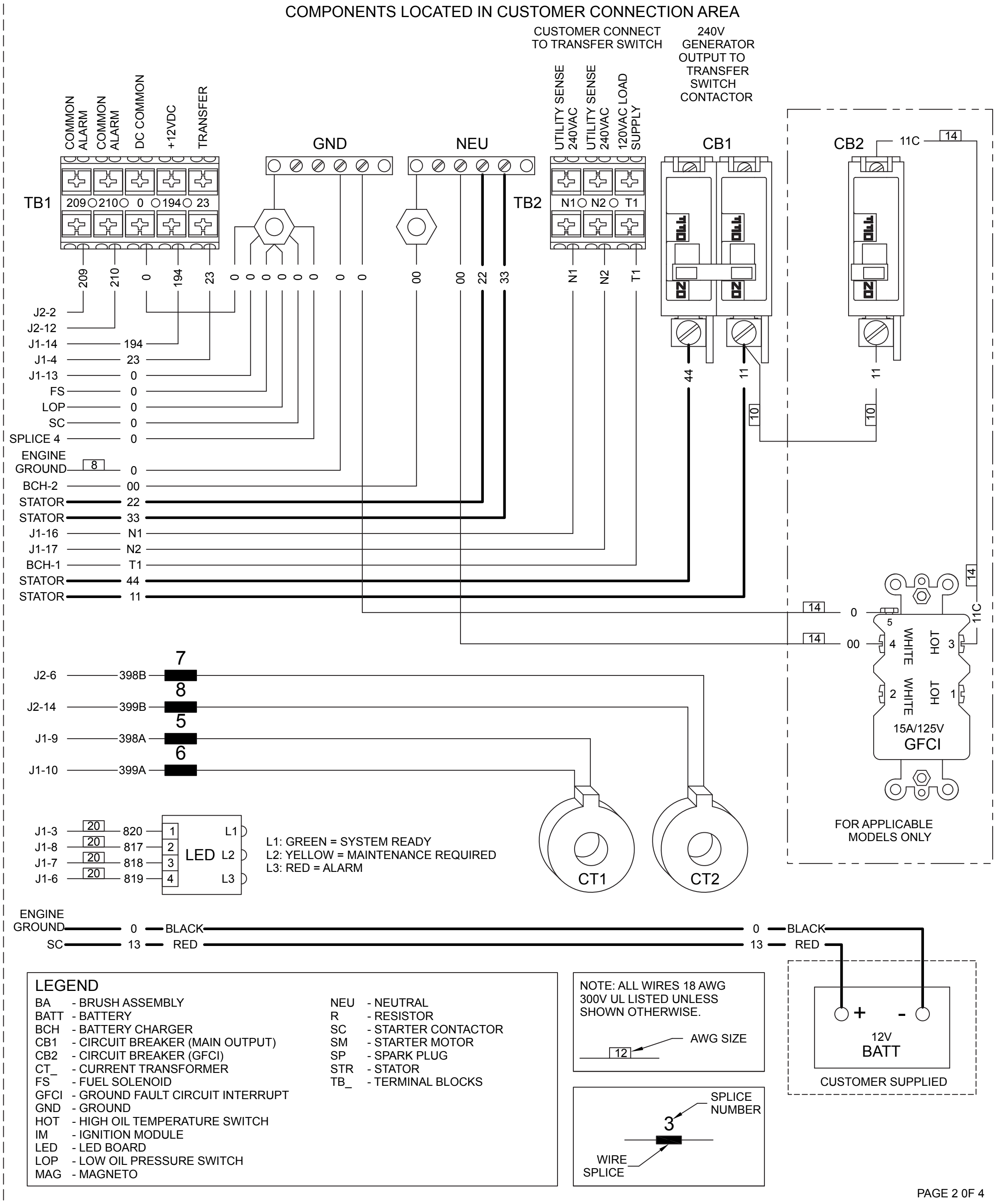
Wiring Diagram – Drawing 0K2945-E



WIRING - DIAGRAM
REVISION: J-7579-E
8KW 2013 AIR COOLED HSB
DATE: 1/21/14
PAGE 1 OF 4
DRAWING #: 0K2945

Wiring Diagram – Drawing 0K2945-E

GROUP G



LEGEND

BA	BRUSH ASSEMBLY	NEU	NEUTRAL
BATT	BATTERY	R	RESISTOR
BCH	BATTERY CHARGER	SC	STARTER CONTACTOR
CB1	CIRCUIT BREAKER (MAIN OUTPUT)	SM	STARTER MOTOR
CB2	CIRCUIT BREAKER (GFCI)	SP	SPARK PLUG
CT_	CURRENT TRANSFORMER	STR	STATOR
FS	FUEL SOLENOID	TB_	TERMINAL BLOCKS
GFCI	GROUND FAULT CIRCUIT INTERRUPT		
GND	GROUND		
HOT	HIGH OIL TEMPERATURE SWITCH		
IM	IGNITION MODULE		
LED	LED BOARD		
LOP	LOW OIL PRESSURE SWITCH		
MAG	MAGNETO		

NOTE: ALL WIRES 18 AWG 300V UL LISTED UNLESS SHOWN OTHERWISE.

AWG SIZE 12

SPLICE NUMBER 3

WIRE SPLICE

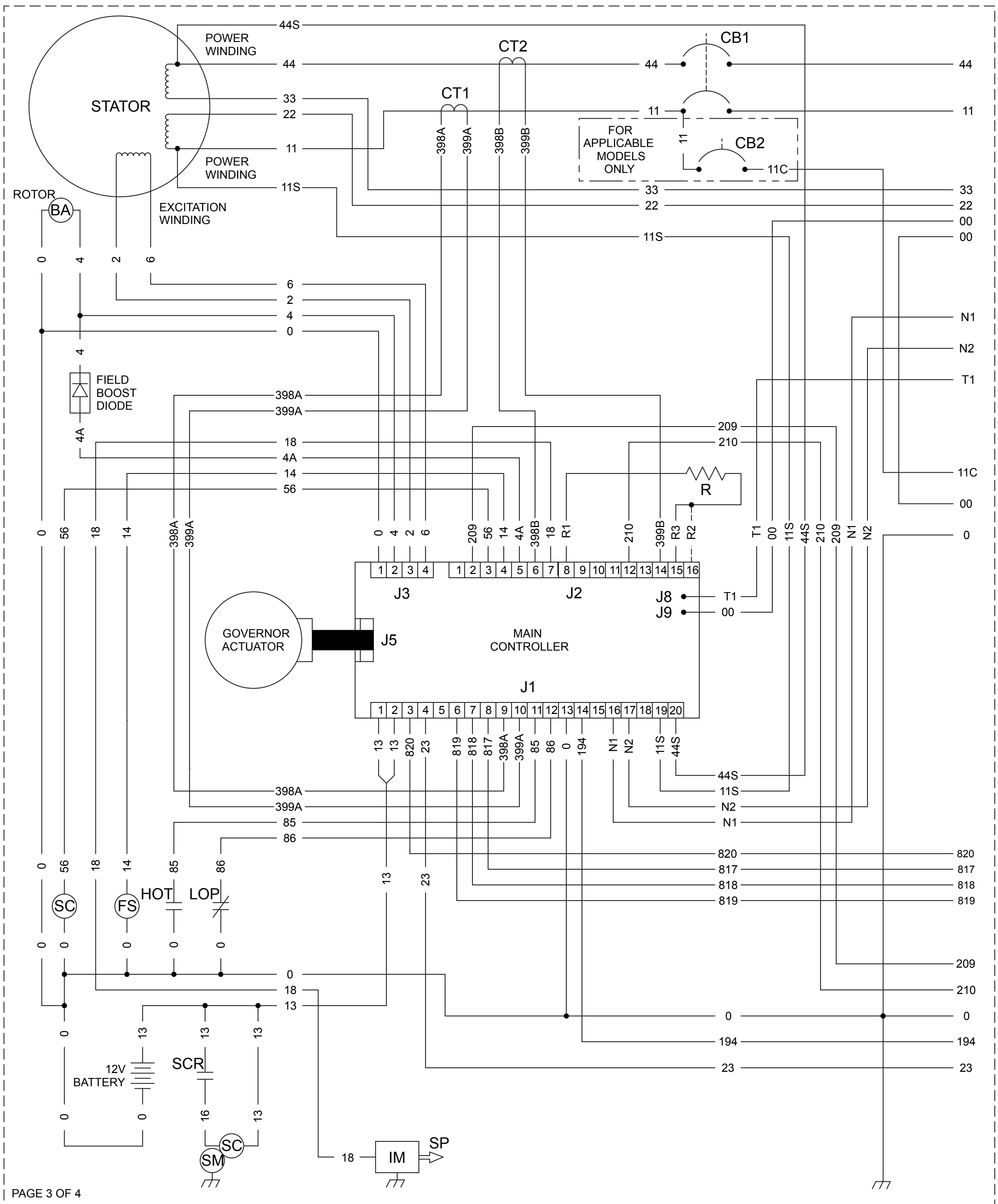
PAGE 2 0F 4

WIRING - DIAGRAM
8KW 2013 AIR COOLED HSB
DRAWING #: 0K2945

REVISION: J-7579-E
DATE: 1/21/14
PAGE 2 OF 4

Wiring Diagram – Drawing 0K2945-E

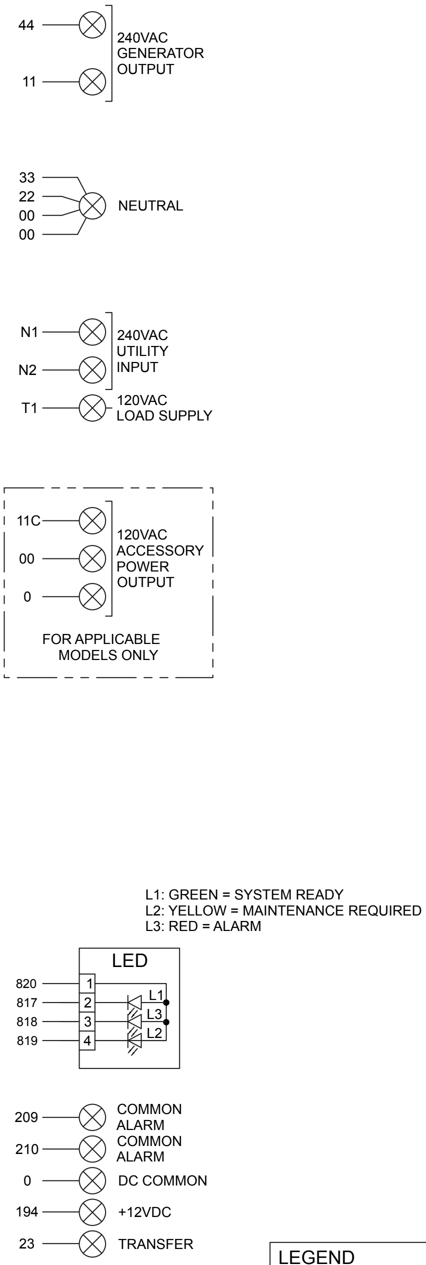
GROUP G



SCHEMATIC - DIAGRAM
8KW 2013 AIR COOLED HSB
REVISION: J-7579-E
DATE: 1/21/14
PAGE 3 OF 4
DRAWING #: 0K2945

Wiring Diagram – Drawing 0K2945-E

GROUP G



LEGEND

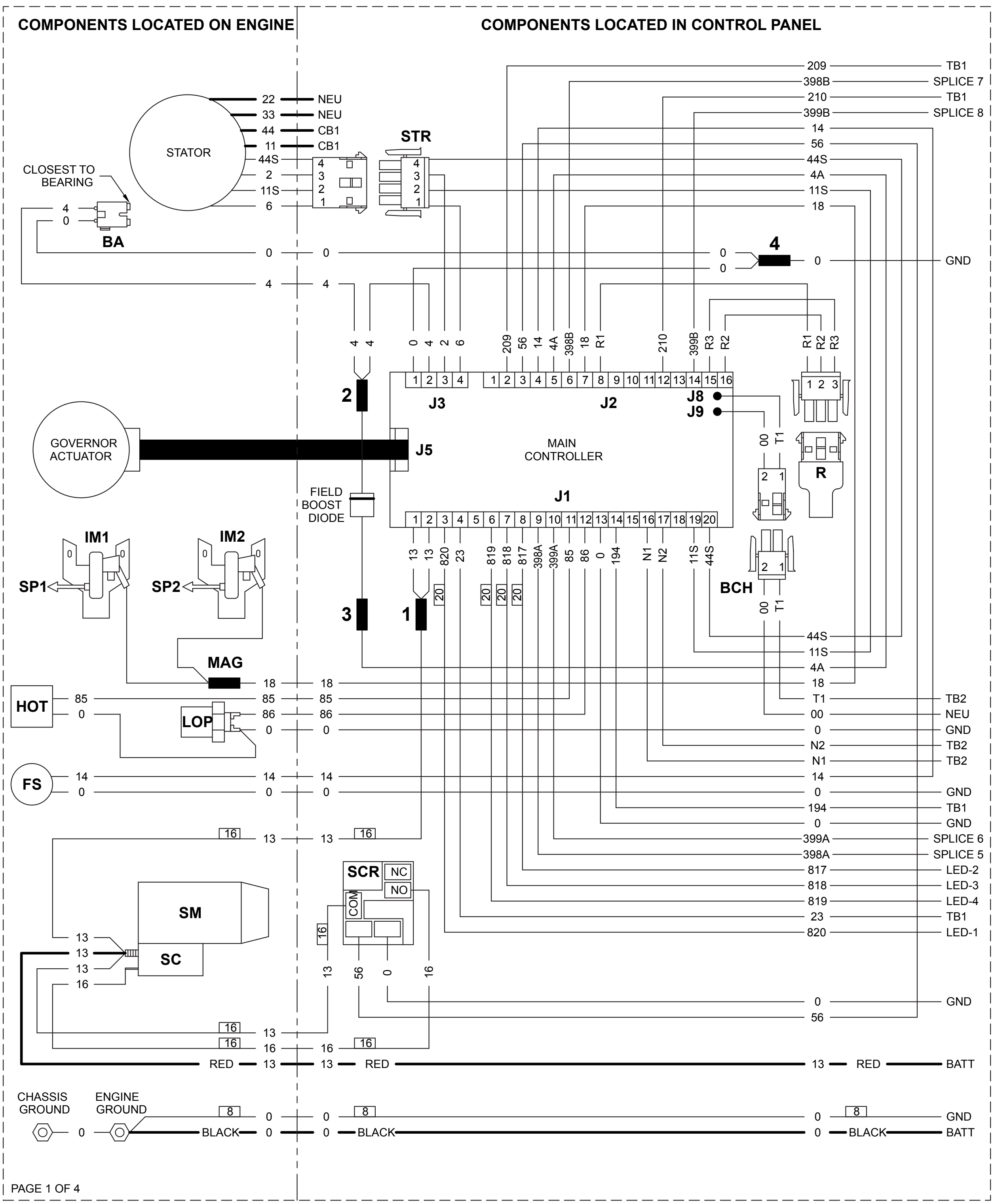
BA	- BRUSH ASSEMBLY	LED	- LED BOARD
CB1	- CIRCUIT BREAKER (MAIN OUTPUT)	LOP	- LOW OIL PRESSURE SWITCH
CB2	- CIRCUIT BREAKER (ACCESSORY POWER)	R	- RESISTOR
CT_	- CURRENT TRANSFORMER	SC	- STARTER CONTACTOR
FS	- FUEL SOLENOID	SCR	- STARTER CONTROL RELAY
HOT	- HIGH OIL TEMPERATURE SWITCH	SM	- STARTER MOTOR
IM_	- IGNITION MODULE	SP_	- SPARK PLUG

PAGE 4 OF 4

SCHEMATIC - DIAGRAM
8KW 2013 AIR COOLED HSB
REVISION: J-7579-E
DATE: 1/21/14
PAGE 4 OF 4
DRAWING #: 0K2945

Wiring Diagram – Drawing 0J9961-D

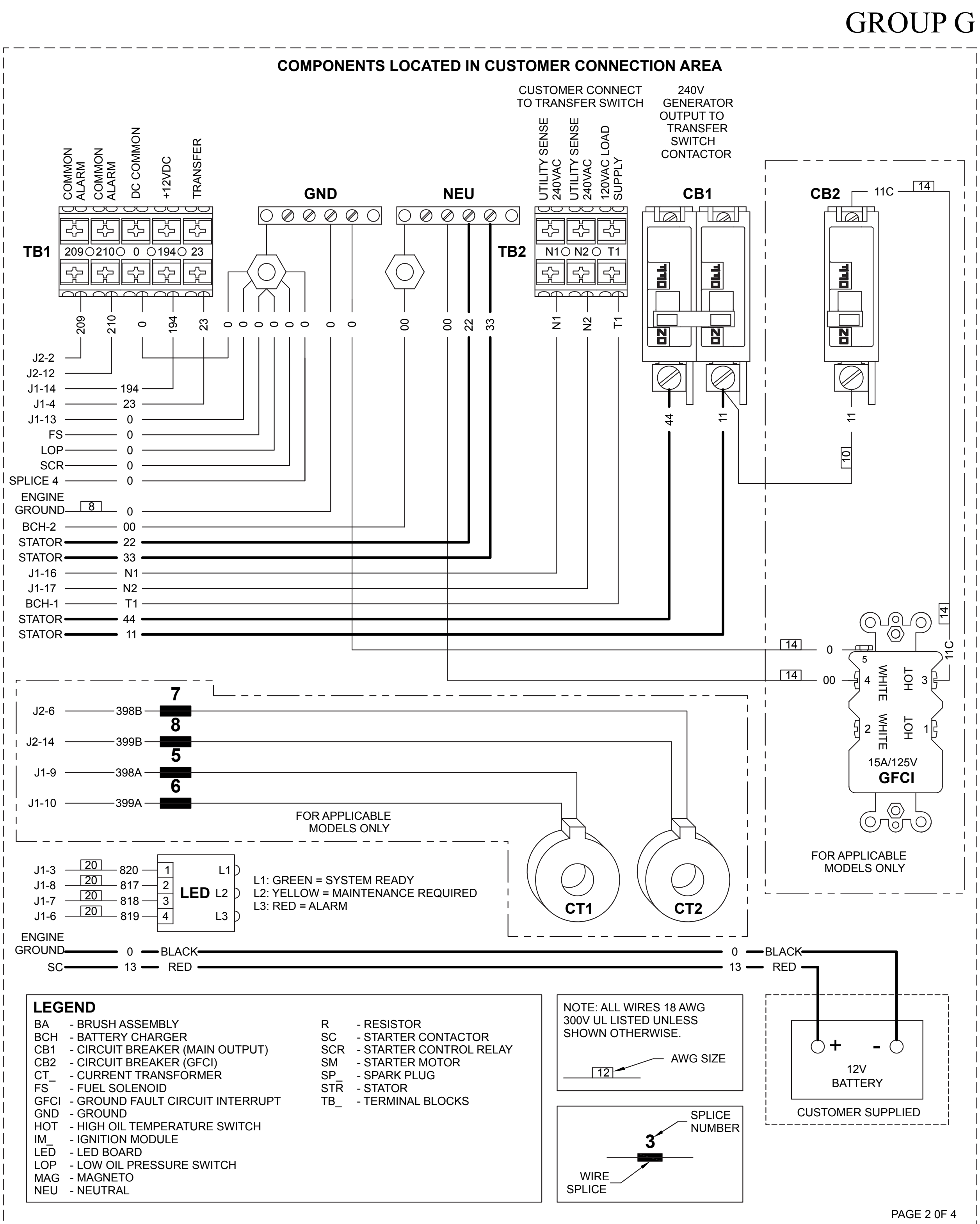
GROUP G



WIRING - DIAGRAM
2013 AIR COOLED HSB 60HZ
DRAWING #: 0J9961

REVISION: J-5714-D
DATE: 6/19/13
PAGE 1 OF 4

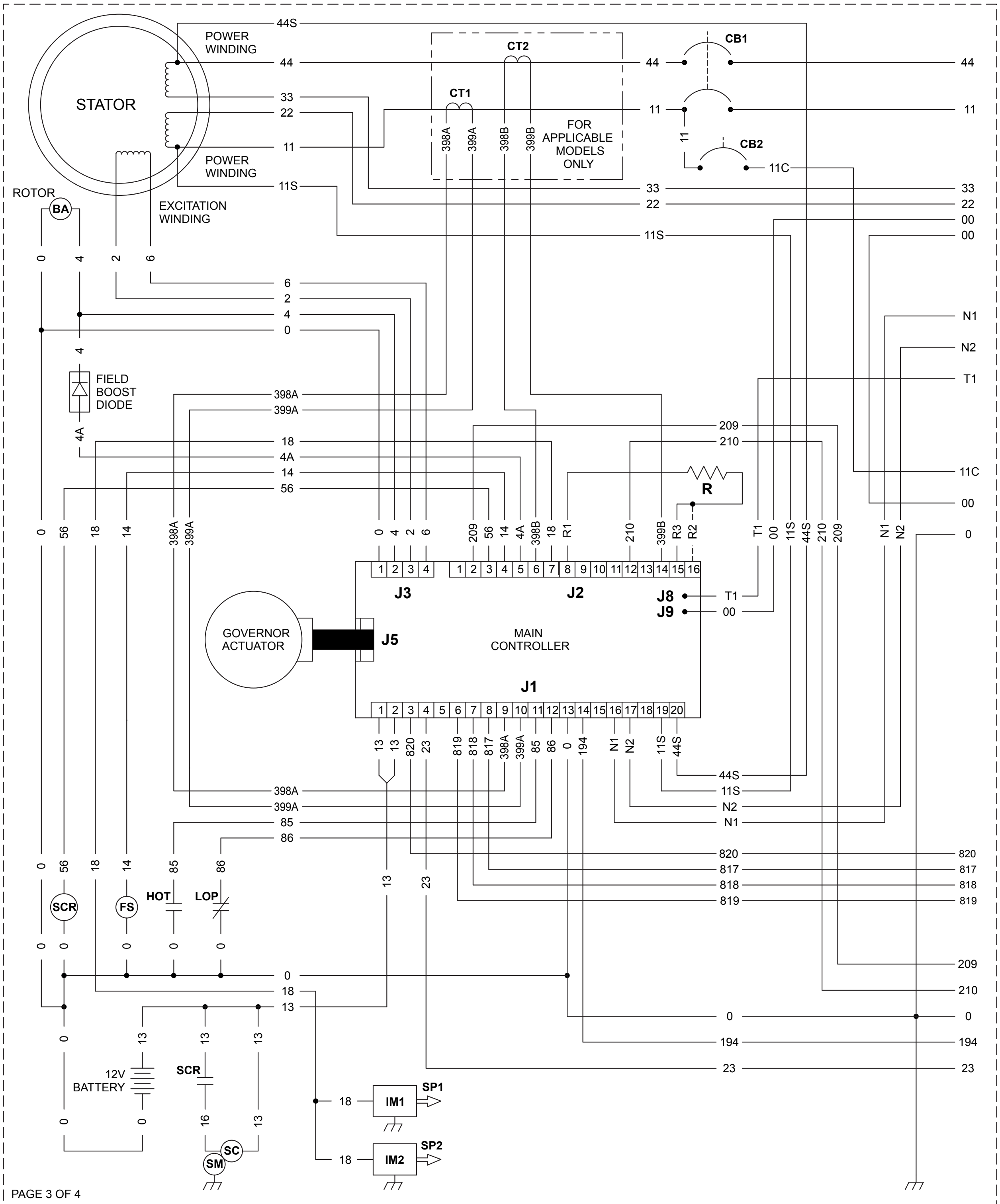
Wiring Diagram – Drawing 0J9961-D



WIRING - DIAGRAM
REVISION: J-5714-D
2013 AIR COOLED HSB 60HZ
DATE: 6/19/13
PAGE 2 OF 4
DRAWING #: 0J9961

Electrical Schematic – 0J9961-D

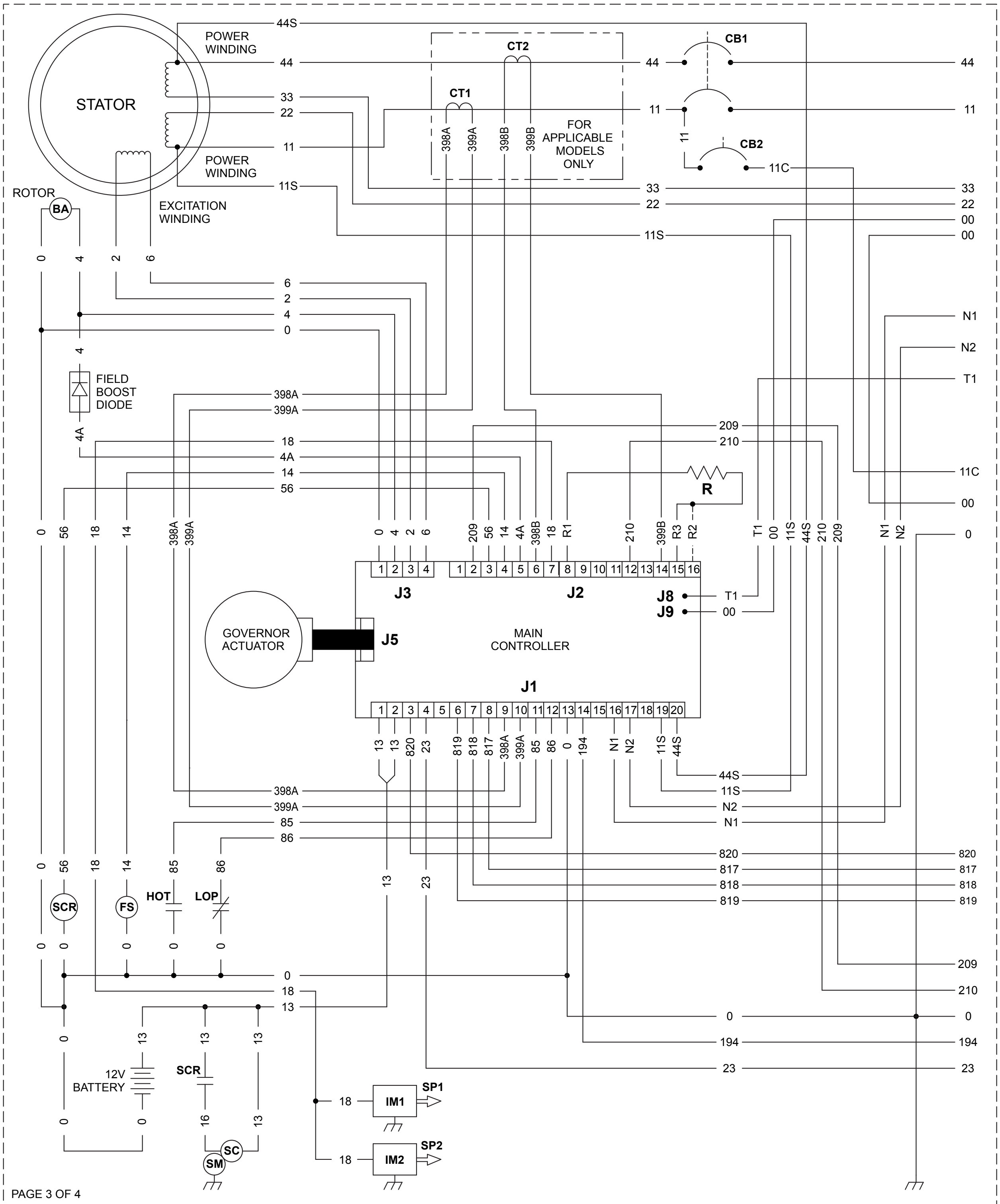
GROUP G



SCHEMATIC - DIAGRAM
2013 AIR COOLED HSB 60HZ
DRAWING #: 0J9961
REVISION: J-5714-D
DATE: 6/19/13
PAGE 3 OF 4

Electrical Schematic – Drawing 0J9961-D

GROUP G



SCHEMATIC - DIAGRAM

REVISION: J-5714-D

2013 AIR COOLED HSB 60HZ

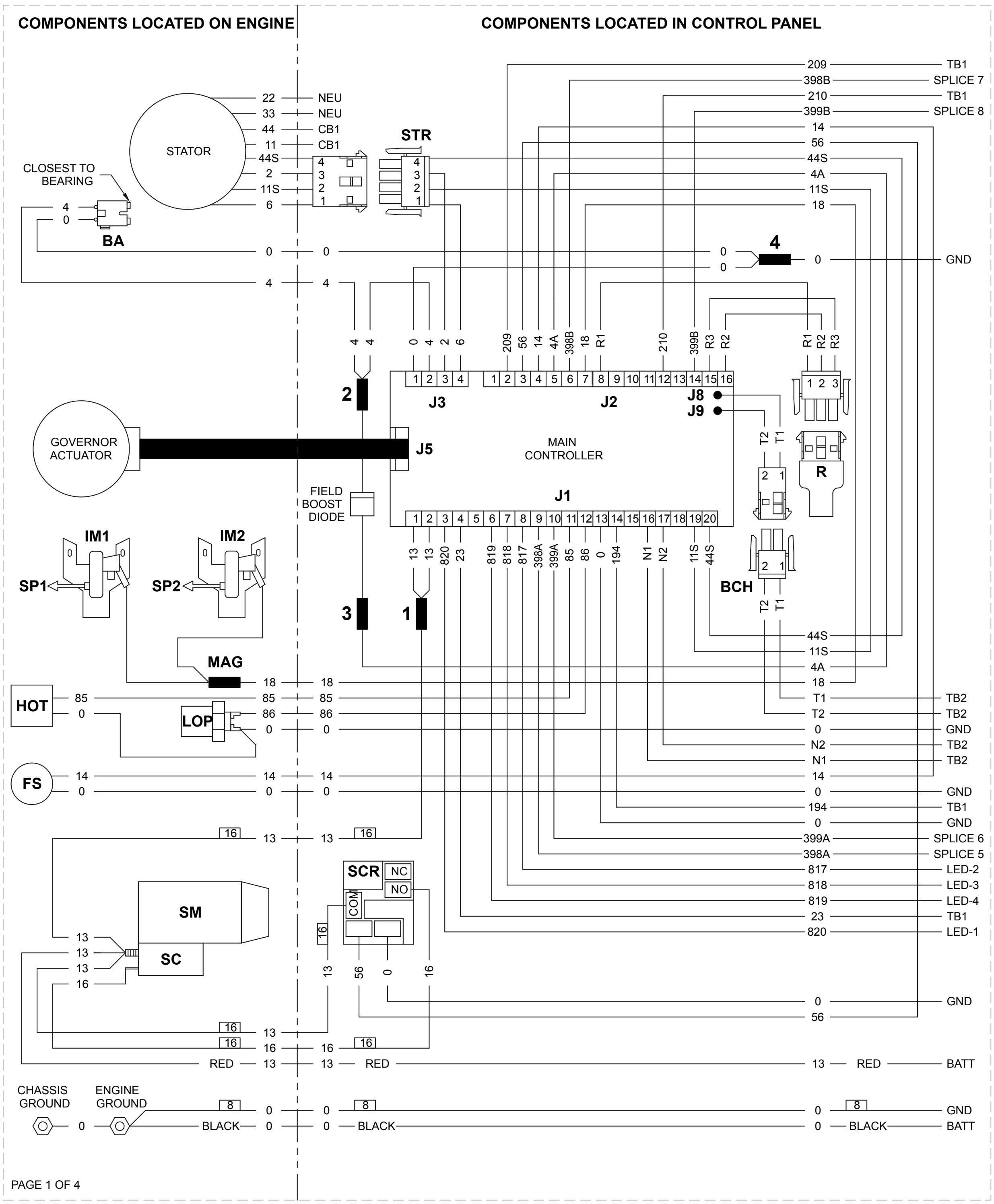
DATE: 6/19/13

PAGE 3 OF 4

DRAWING #: 0J9961

Wiring Diagram – Drawing 0K0302-D

GROUP G

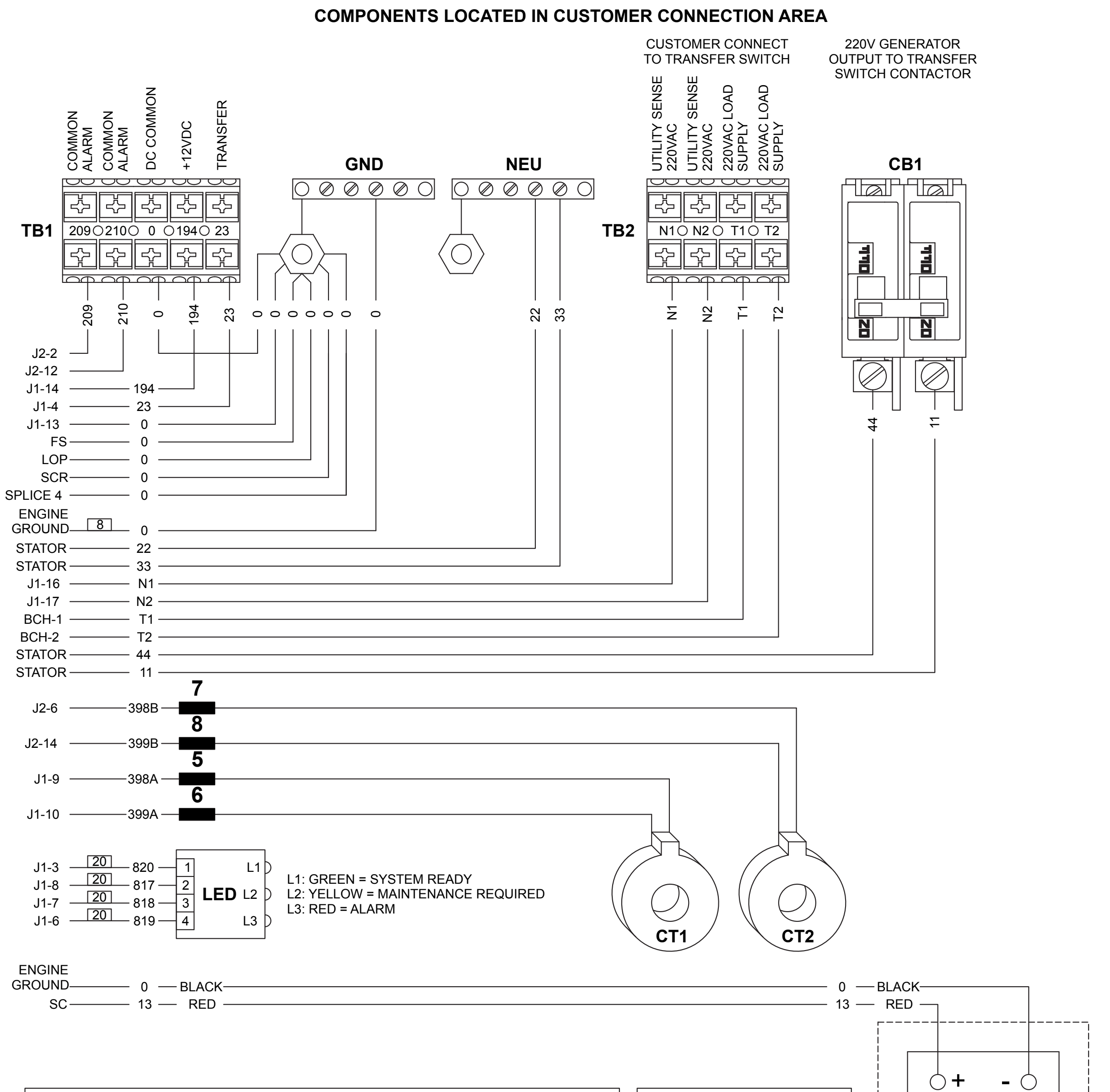


WIRING - DIAGRAM
2013 AIR COOLED HSB 50HZ
DRAWING #: 0K0302

REVISION: J-5462-C
DATE: 5/28/13
PAGE 1 OF 4

Wiring Diagram – Drawing 0K0302-D

GROUP G



LEGEND

BA	- BRUSH ASSEMBLY	SC	- STARTER CONTACTOR
BCH	- BATTERY CHARGER	SCR	- STARTER CONTROL RELAY
CB1	- CIRCUIT BREAKER (MAIN OUTPUT)	SM	- STARTER MOTOR
CT_	- CURRENT TRANSFORMER	SP_	- SPARK PLUG
FS	- FUEL SOLENOID	STR	- STATOR
GFCI	- GROUND FAULT CIRCUIT INTERRUPT	TB_	- TERMINAL BLOCKS
GND	- GROUND		
HOT	- HIGH OIL TEMPERATURE SWITCH		
IM_	- IGNITION MODULE		
LED	- LED BOARD		
LOP	- LOW OIL PRESSURE SWITCH		
MAG	- MAGNETO		
NEU	- NEUTRAL		
R	- RESISTOR		

NOTE: ALL WIRES 18 AWG 300V UL LISTED UNLESS SHOWN OTHERWISE.

12 — AWG SIZE

3 — SPLICE NUMBER; WIRE SPLICE

PAGE 2 0F 4

WIRING - DIAGRAM
2013 AIR COOLED HSB 50HZ
DRAWING #: 0K0302

REVISION: J-5462-C
DATE: 5/28/13
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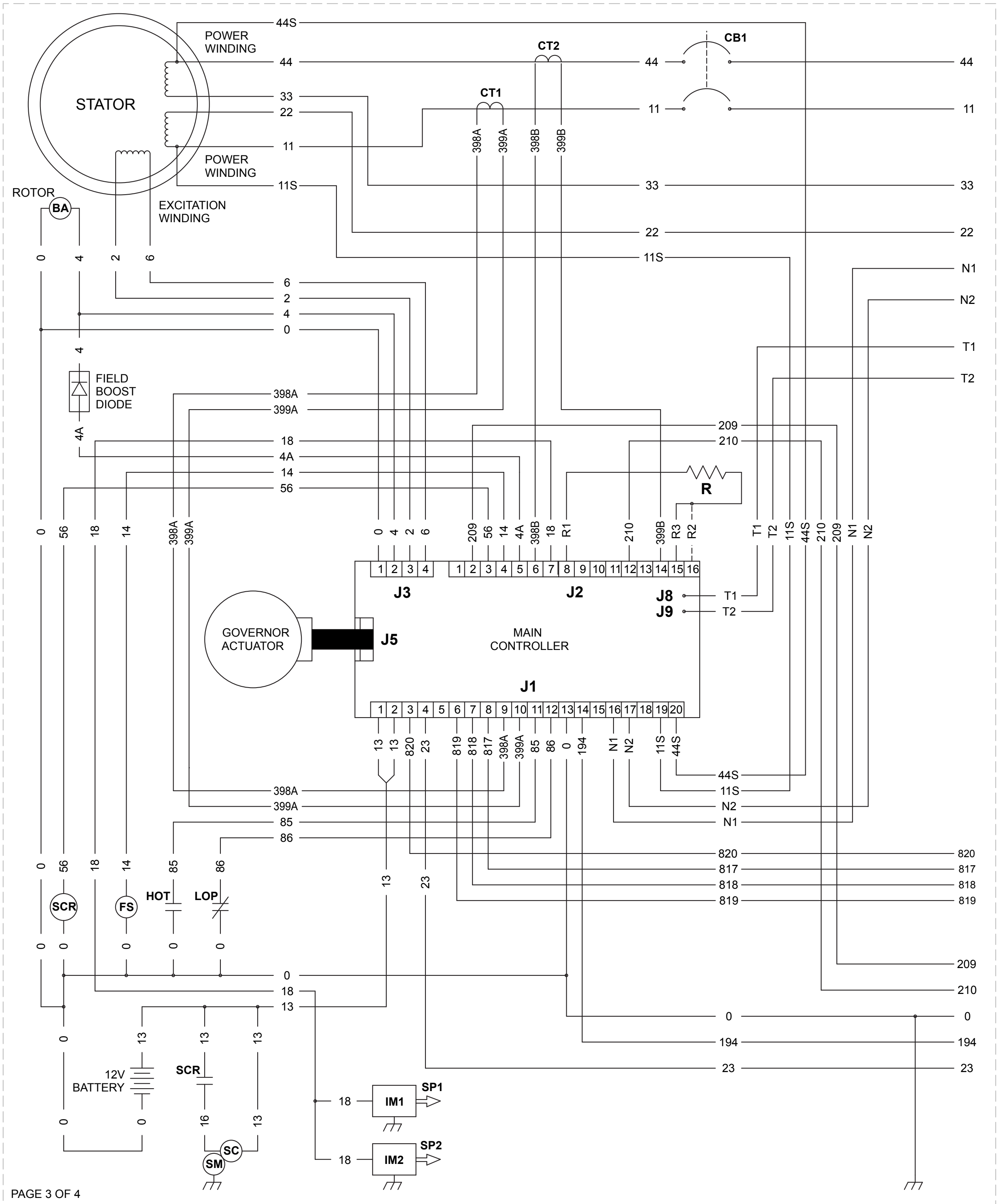
Electrical Schematic – Drawing 0K0302-D

GROUP G



SCHEMATIC - DIAGRAM
2013 AIR COOLED HSB 50HZ
DRAWING #: 0K0302

REVISION: J-5462-C
DATE: 5/28/13
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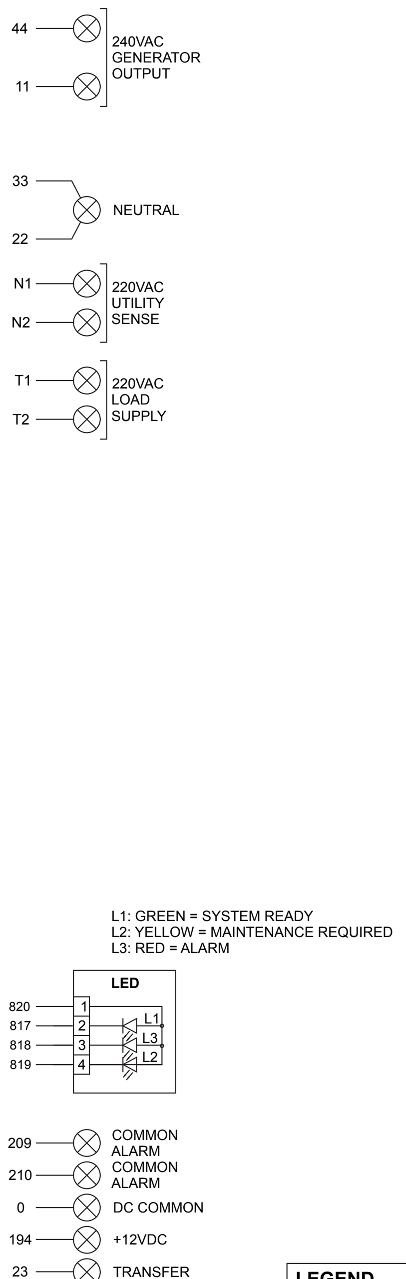
Electrical Schematic – Drawing 0K0302-D

GROUP G



LEGEND

BA	- BRUSH ASSEMBLY	LOP	- LOW OIL PRESSURE SWITCH
CB1	- CIRCUIT BREAKER (MAIN OUTPUT)	R	- RESISTOR
CT_	- CURRENT TRANSFORMER	SC	- STARTER CONTACTOR
FS	- FUEL SOLENOID	SCR	- STARTER CONTROL RELAY
HOT	- HIGH OIL TEMPERATURE SWITCH	SM	- STARTER MOTOR
IM_	- IGNITION MODULE	SP_	- SPARK PLUG
LED	- LED BOARD		

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SCHEMATIC - DIAGRAM
2013 AIR COOLED HSB 50HZ
DRAWING #: 0K0302

REVISION: J-5462-C
DATE: 5/28/13

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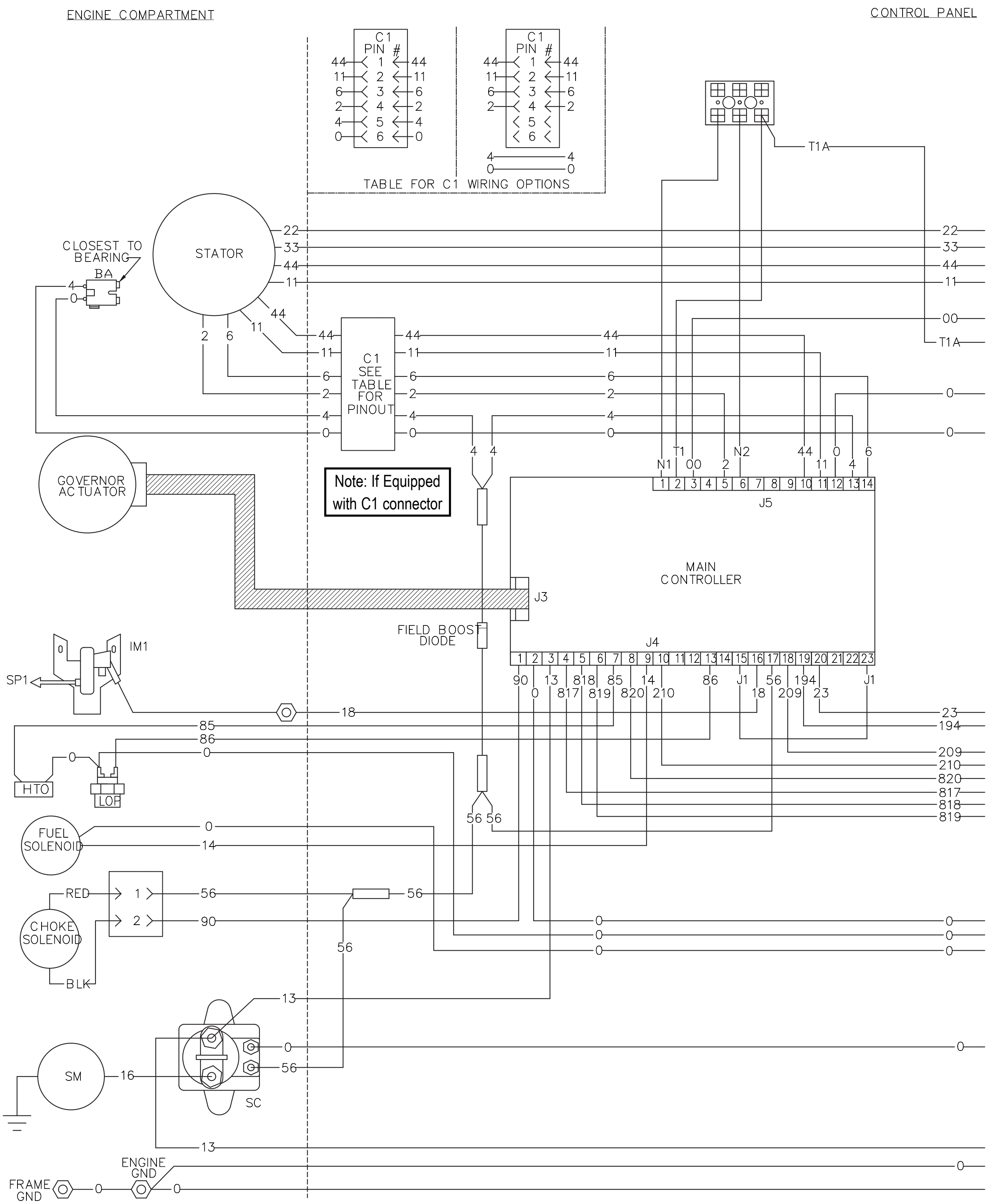
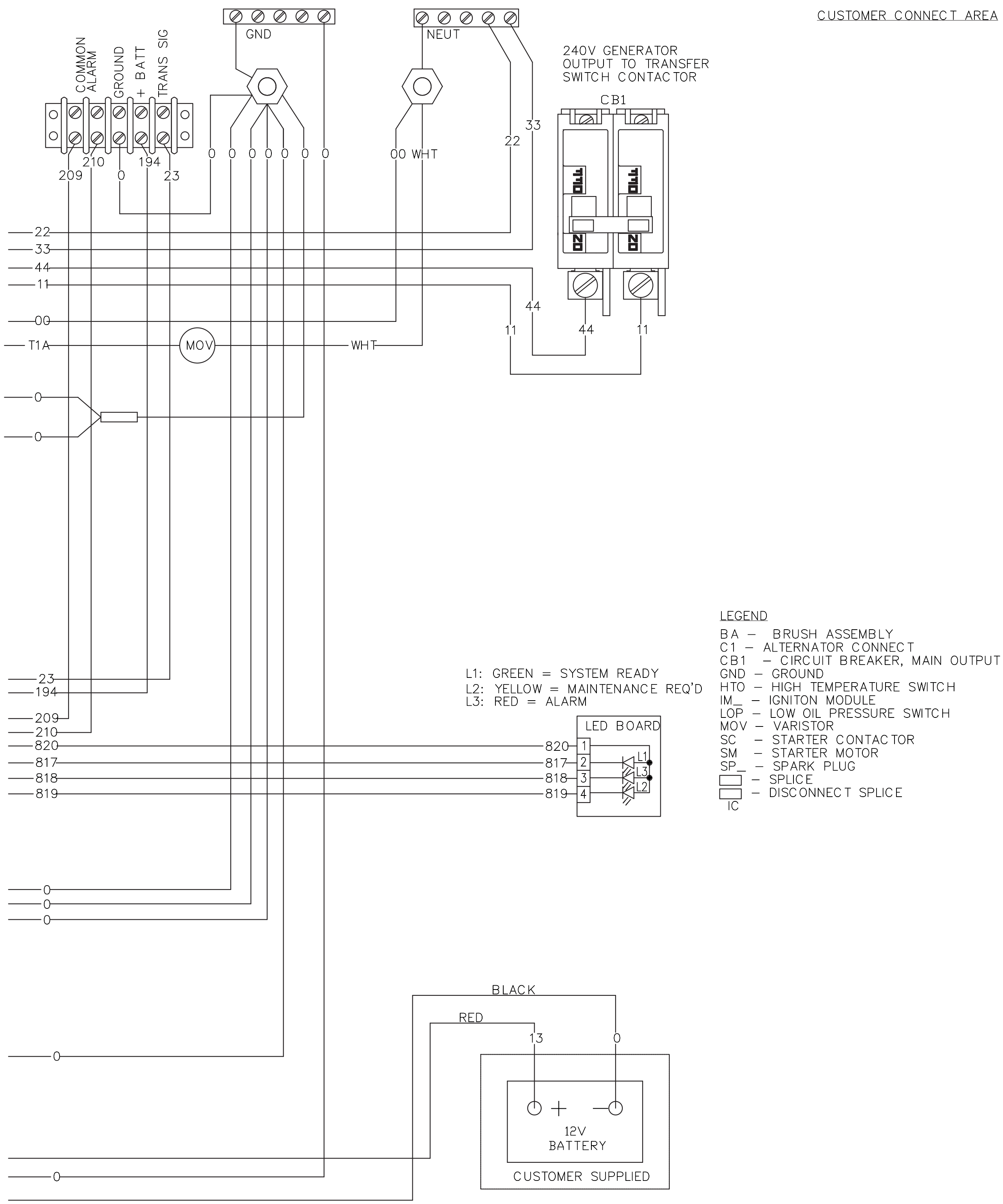
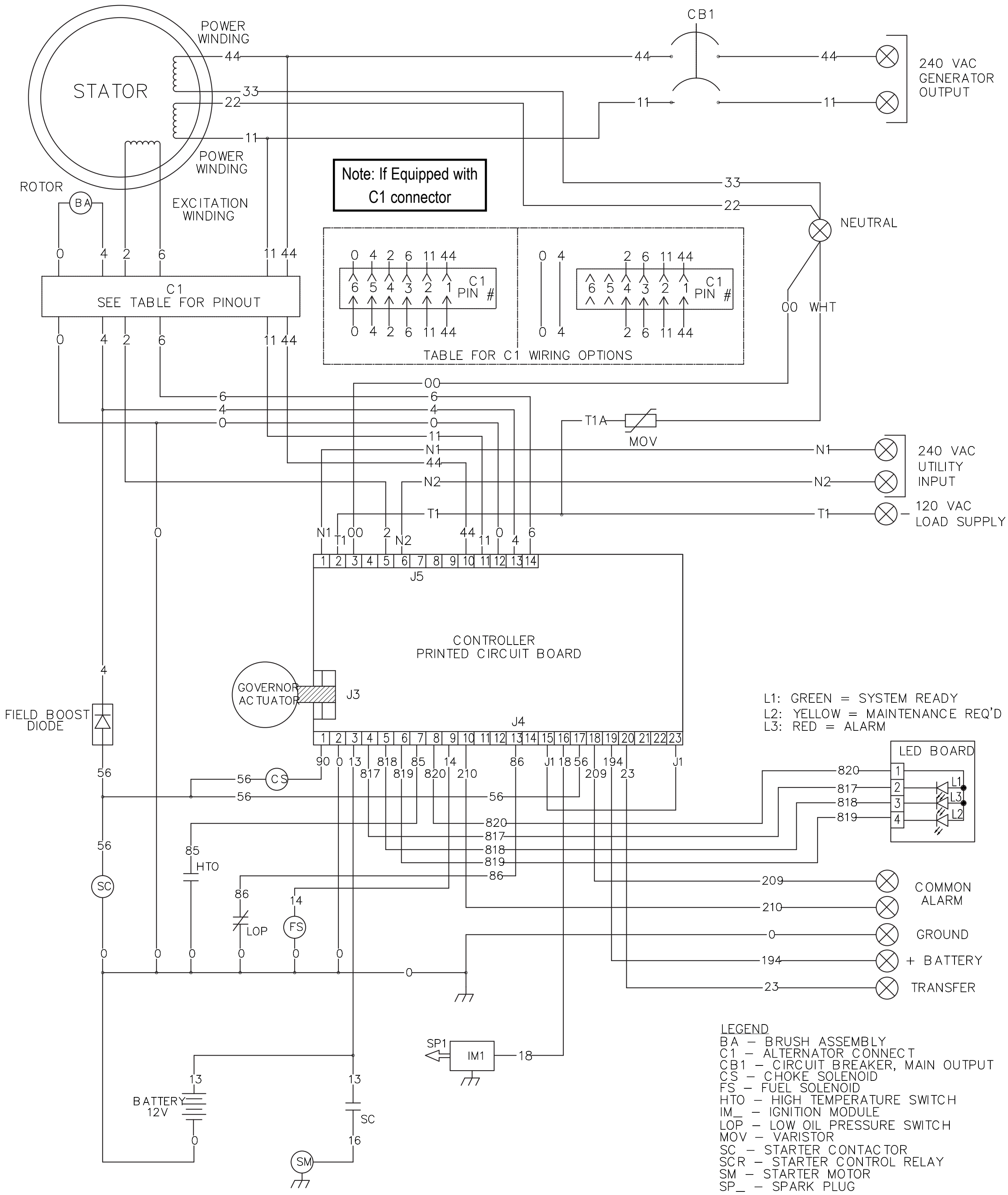
Wiring Diagram – Drawing 0H6912-B



Wiring Diagram – Drawing 0H6912-B

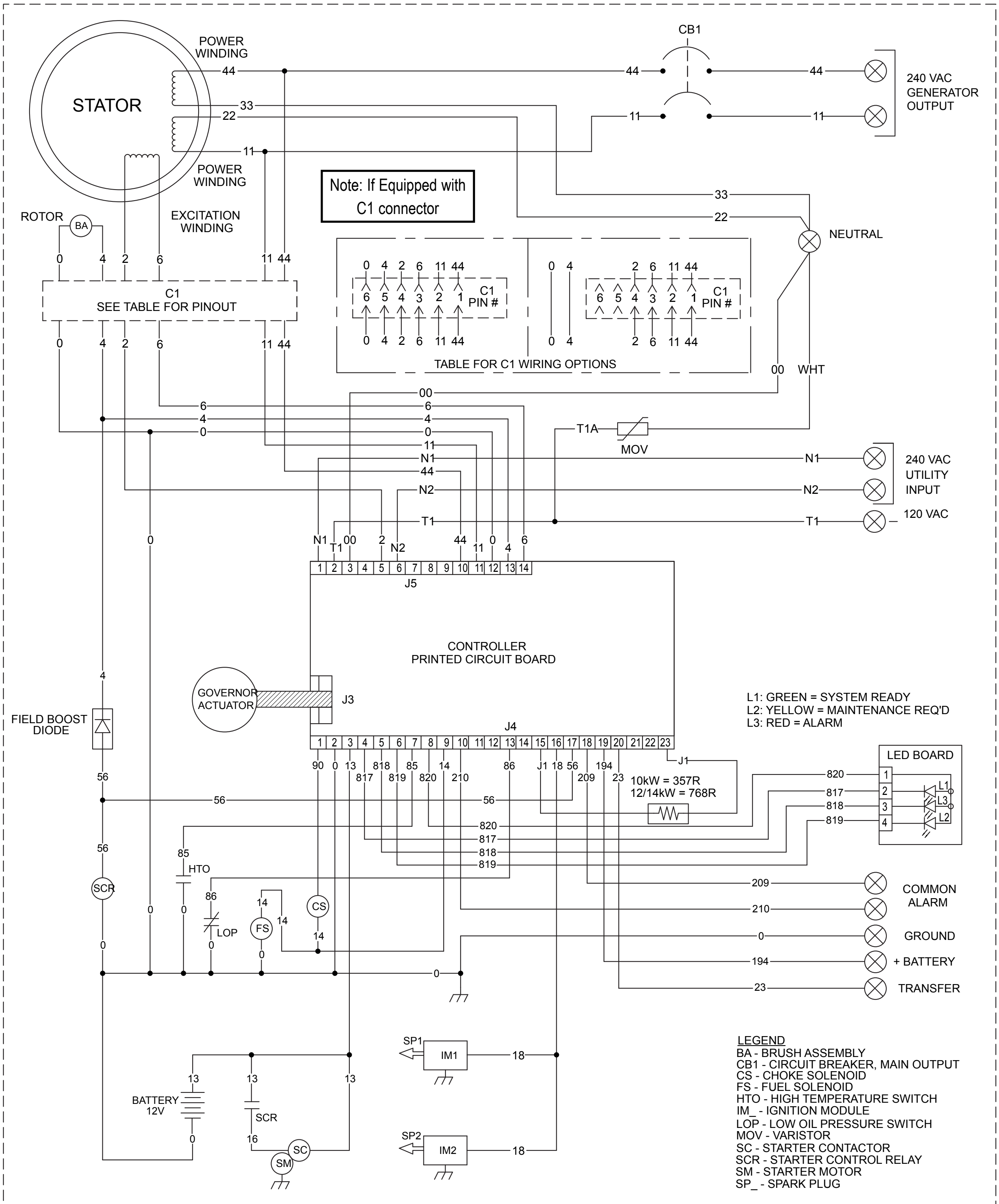


Electrical Schematic – 0H6912-B (shown with amp-seal style connectors.)



Electrical Schematic – Drawing 0H7358-C (shown with amp-seal style connectors.)

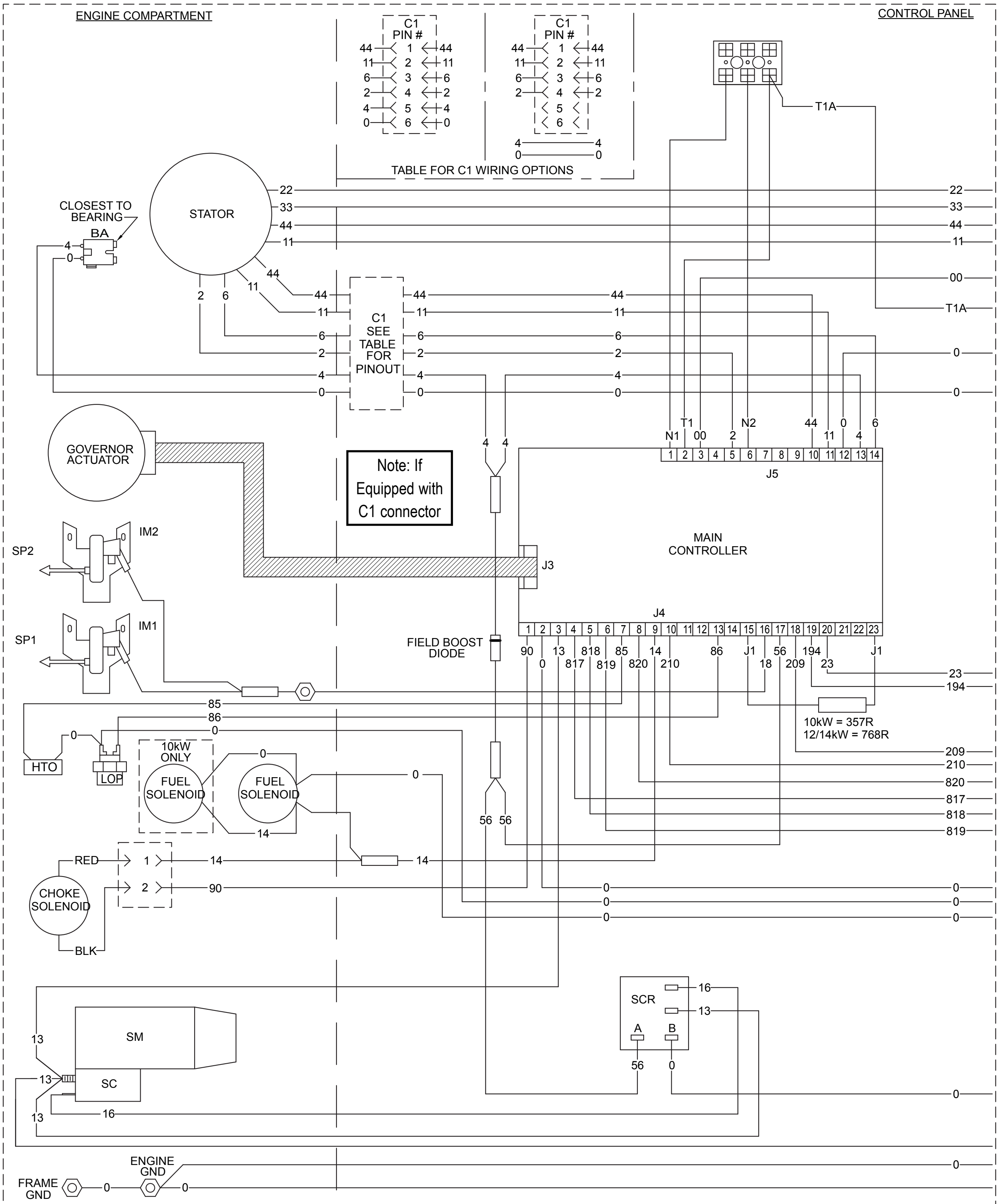
GROUP G



WIRING - DIAGRAM
REVISION: -C-
WD/SD 10-12/14KW AIRCOOLED HSB
DATE: 01/11/11
DRAWING #: 0H7358

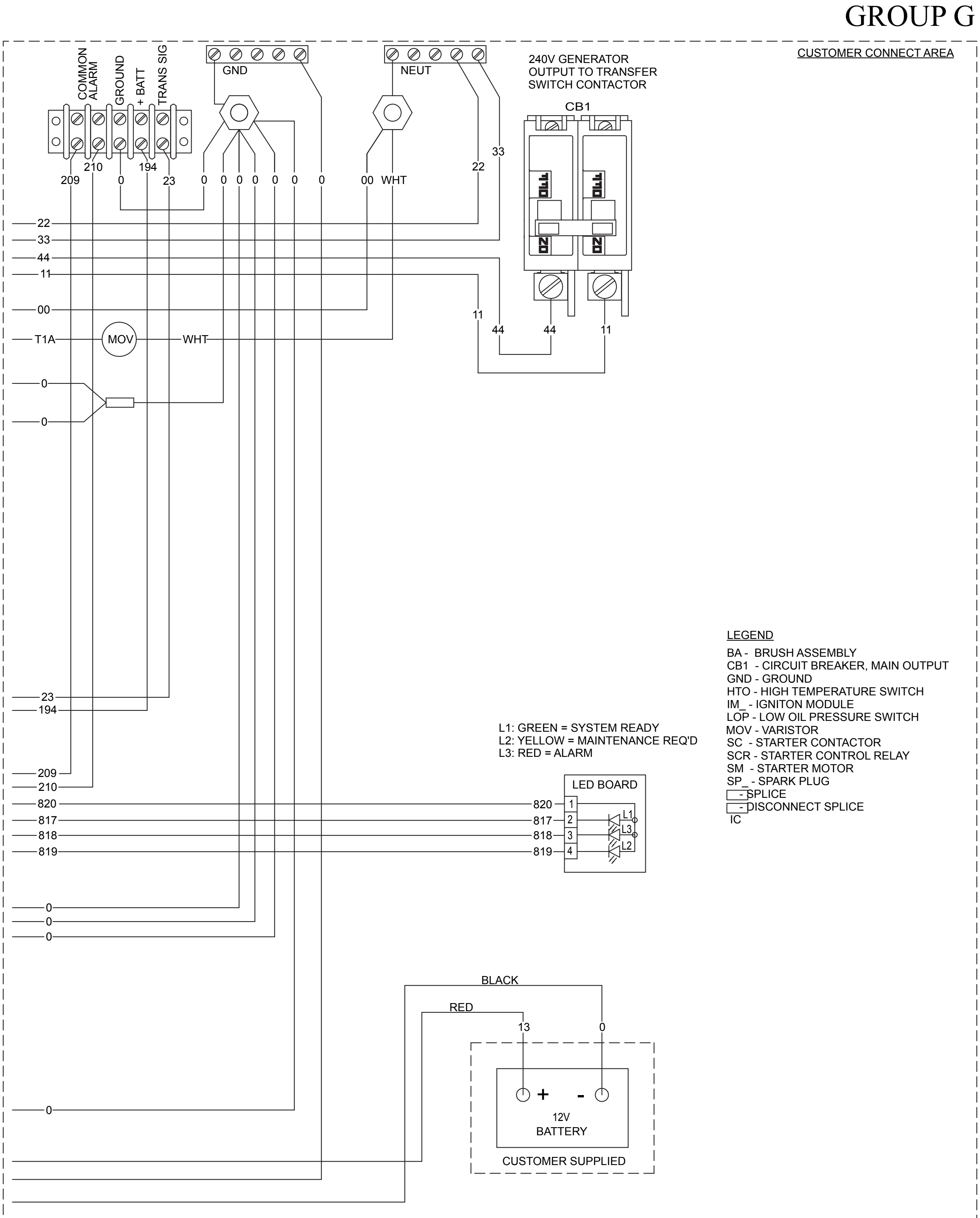
Wiring Diagram – Drawing 0H7358-C (shown with amp-seal style connectors.)

GROUP G



WIRING - DIAGRAM
WD/SD 10-12/14KW AIRCOOLED HSB
DRAWING #: 0H7358
REVISION: -C-
DATE: 01/11/11

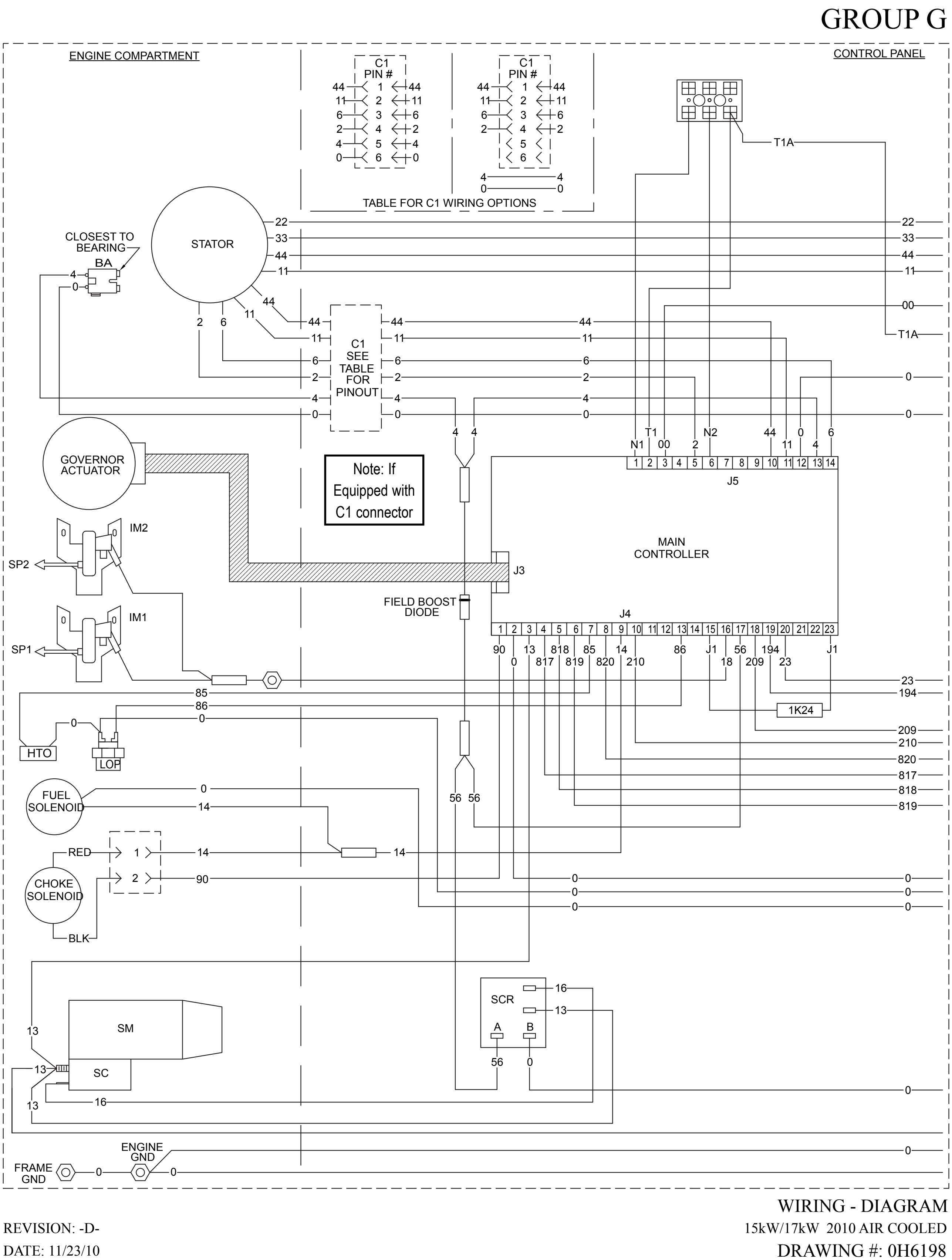
Wiring Diagram – Drawing 0H7358-C (shown with amp-seal style connectors.)



WIRING - DIAGRAM
WD/SD 10-12/14KW AIRCOOLED HSB
DRAWING #: 0H7358

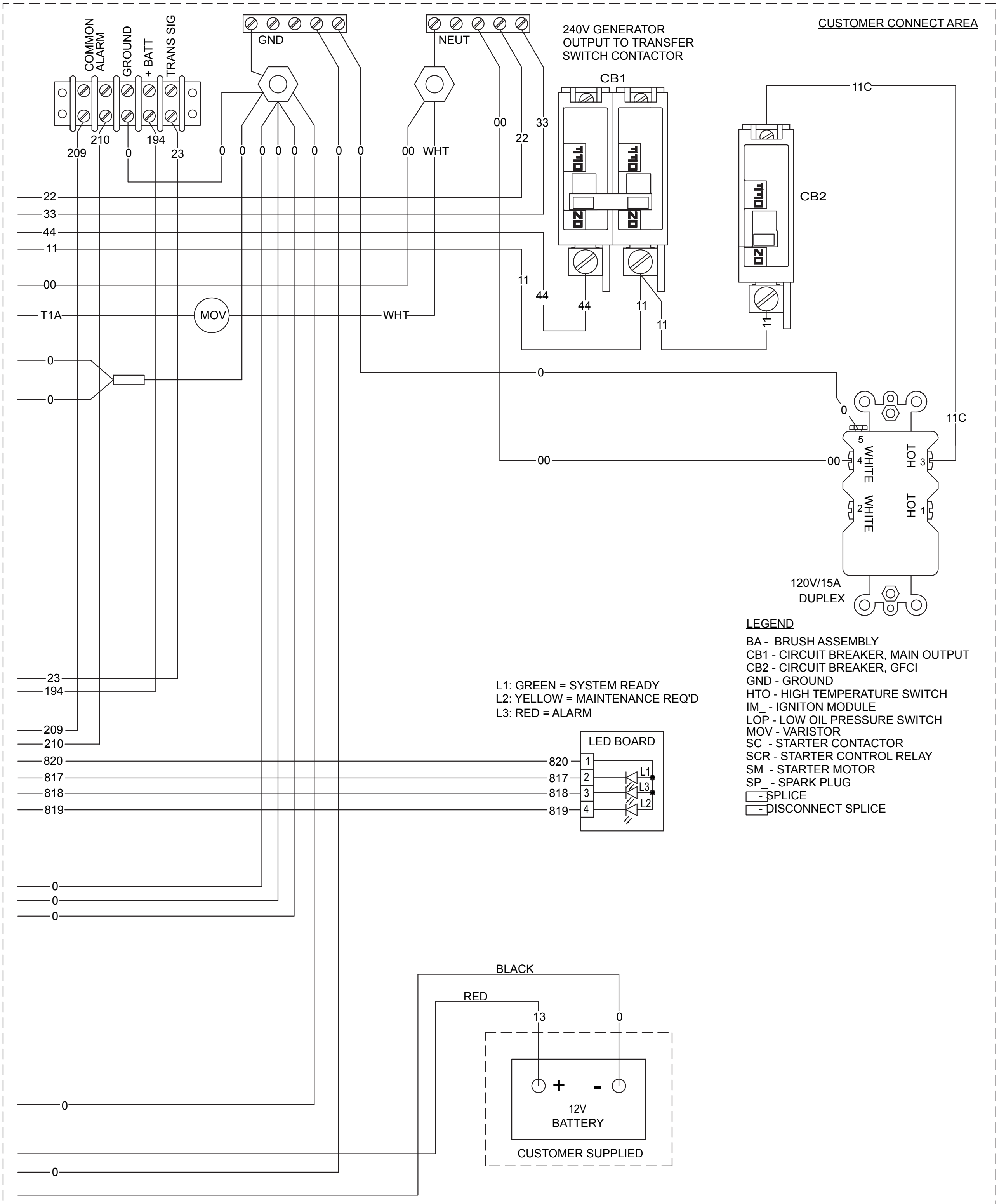
REVISION: -C-
DATE: 01/11/11

Wiring Diagram – Drawing 0H6198-D (shown with amp-seal style connectors.)



Wiring Diagram – Drawing 0H6198-D (shown with amp-seal style connectors.)

GROUP G

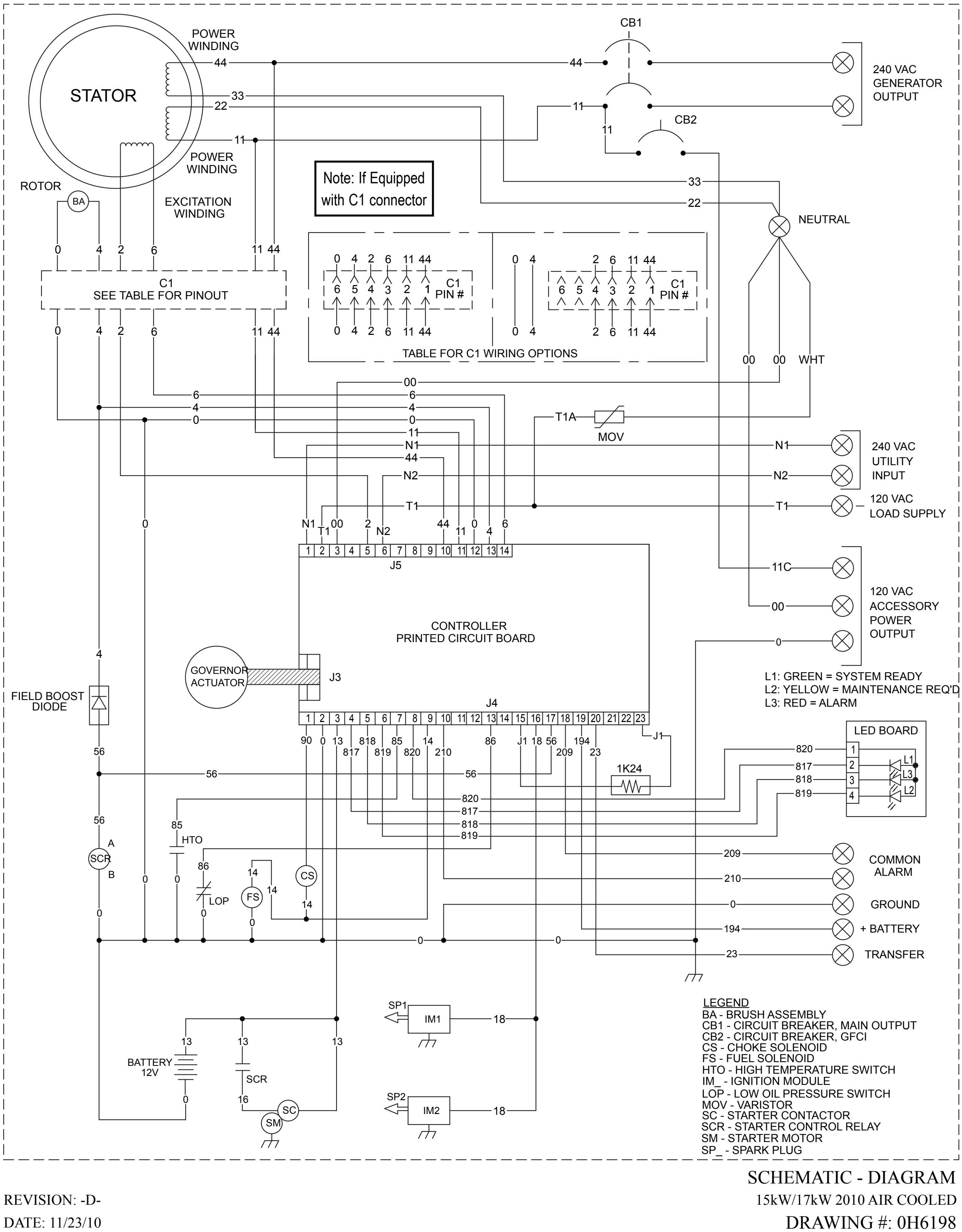


WIRING - DIAGRAM
15kW/17kW 2010 AIR COOLED
DRAWING #: 0H6198

REVISION: -D-
DATE: 11/23/10

Electrical Schematic – Drawing 0H6198-D (shown with amp-seal style connectors.)

GROUP G

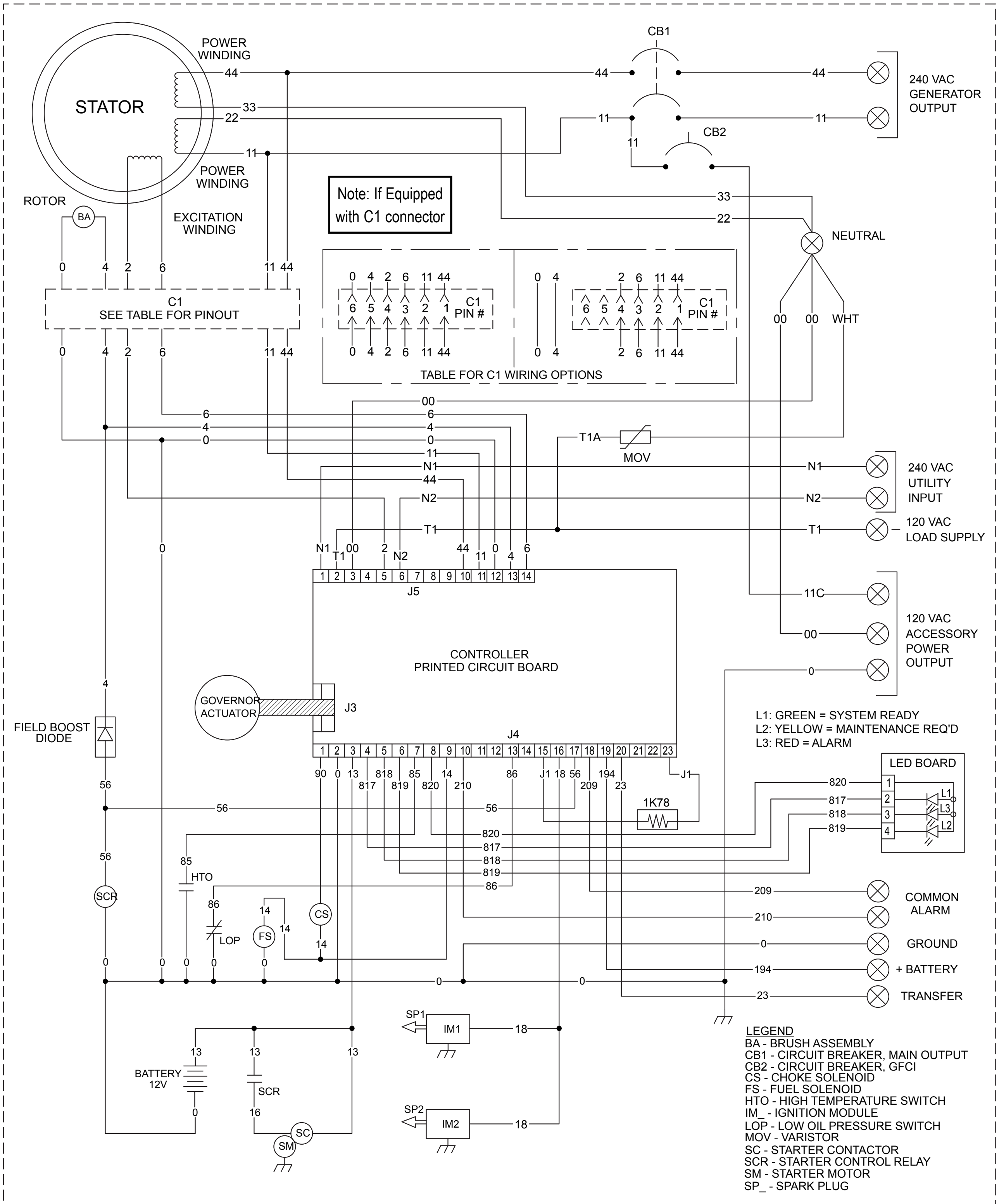


REVISION: -D-
DATE: 11/23/10

SCHEMATIC - DIAGRAM
15kW/17kW 2010 AIR COOLED
DRAWING #: 0H6198

Electrical Schematic – Drawing 0H7570-B (shown with amp-seal style connectors.)

GROUP G



SCHEMATIC - DIAGRAM

REVISION: -B-

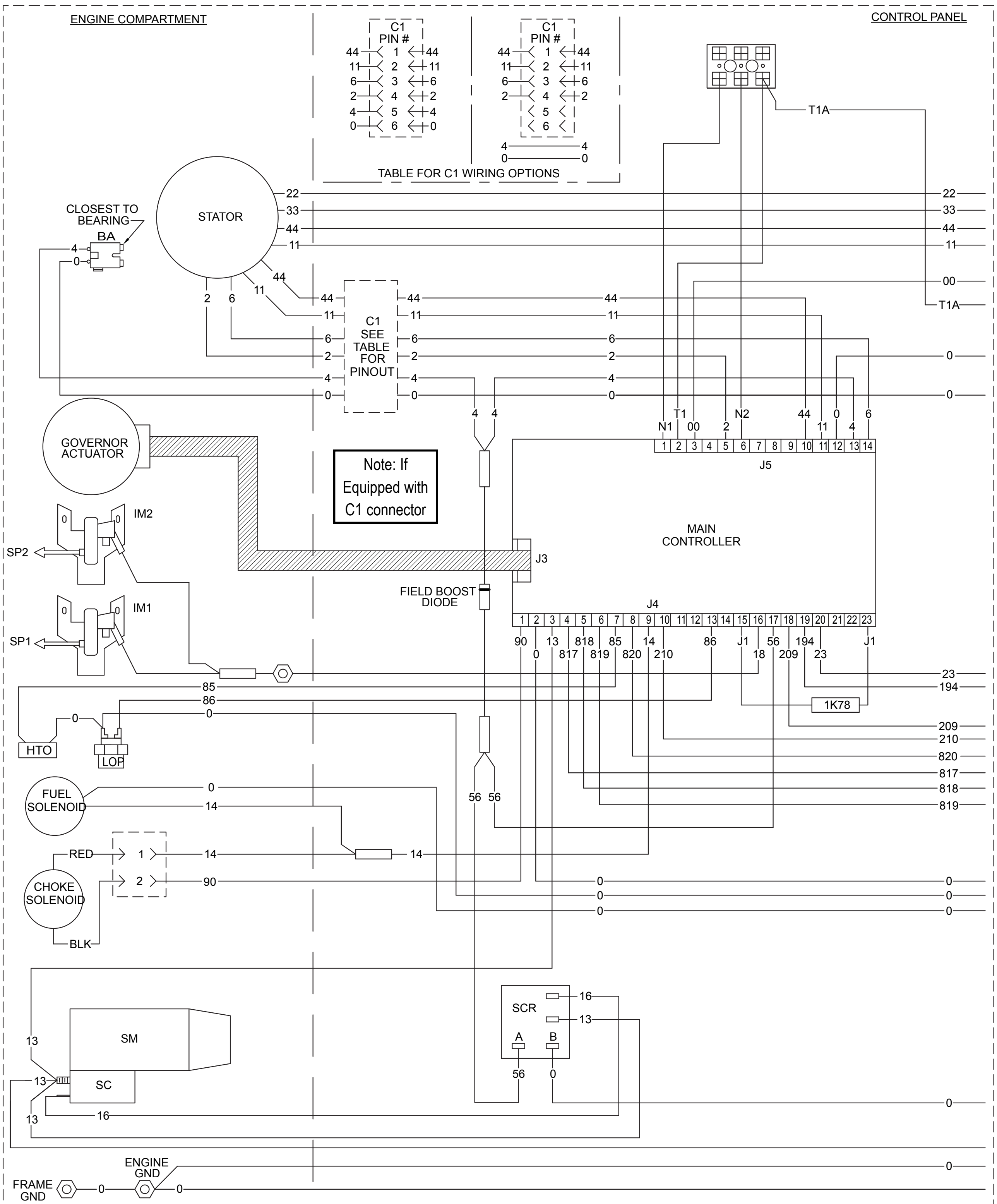
20kW 2010 AIR COOLED

DATE: 10/26/10

DRAWING #: 0H7570

Wiring Diagram – Drawing 0H7570-B (shown with amp-seal style connectors.)

GROUP G

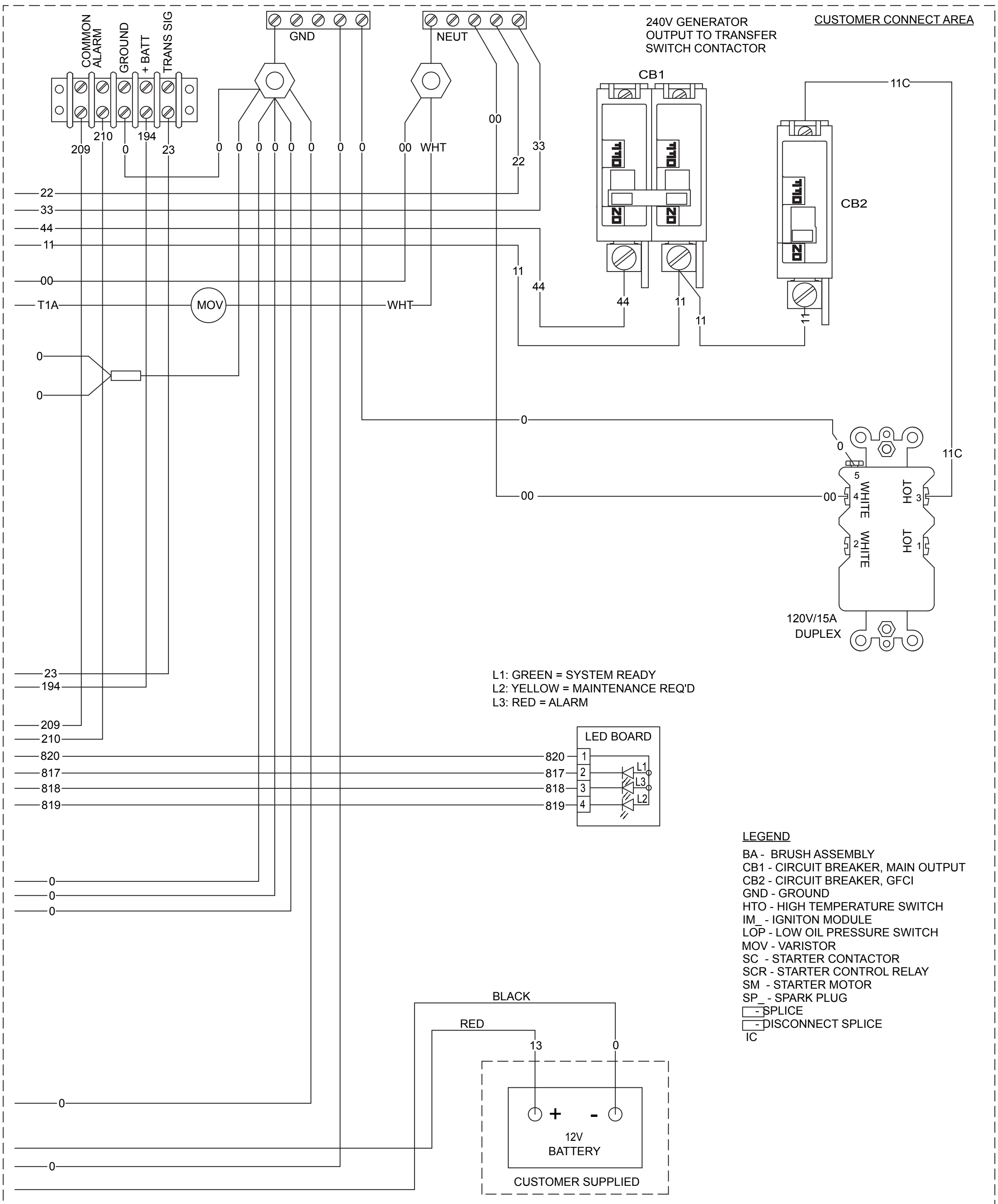


WIRING - DIAGRAM
20kW 2010 AIR COOLED
DRAWING #: 0H7570

REVISION: -B-
DATE: 10/26/10

Wiring Diagram – Drawing 0H7570-B (shown with amp-seal style connectors.)

GROUP G



REVISION: -B-

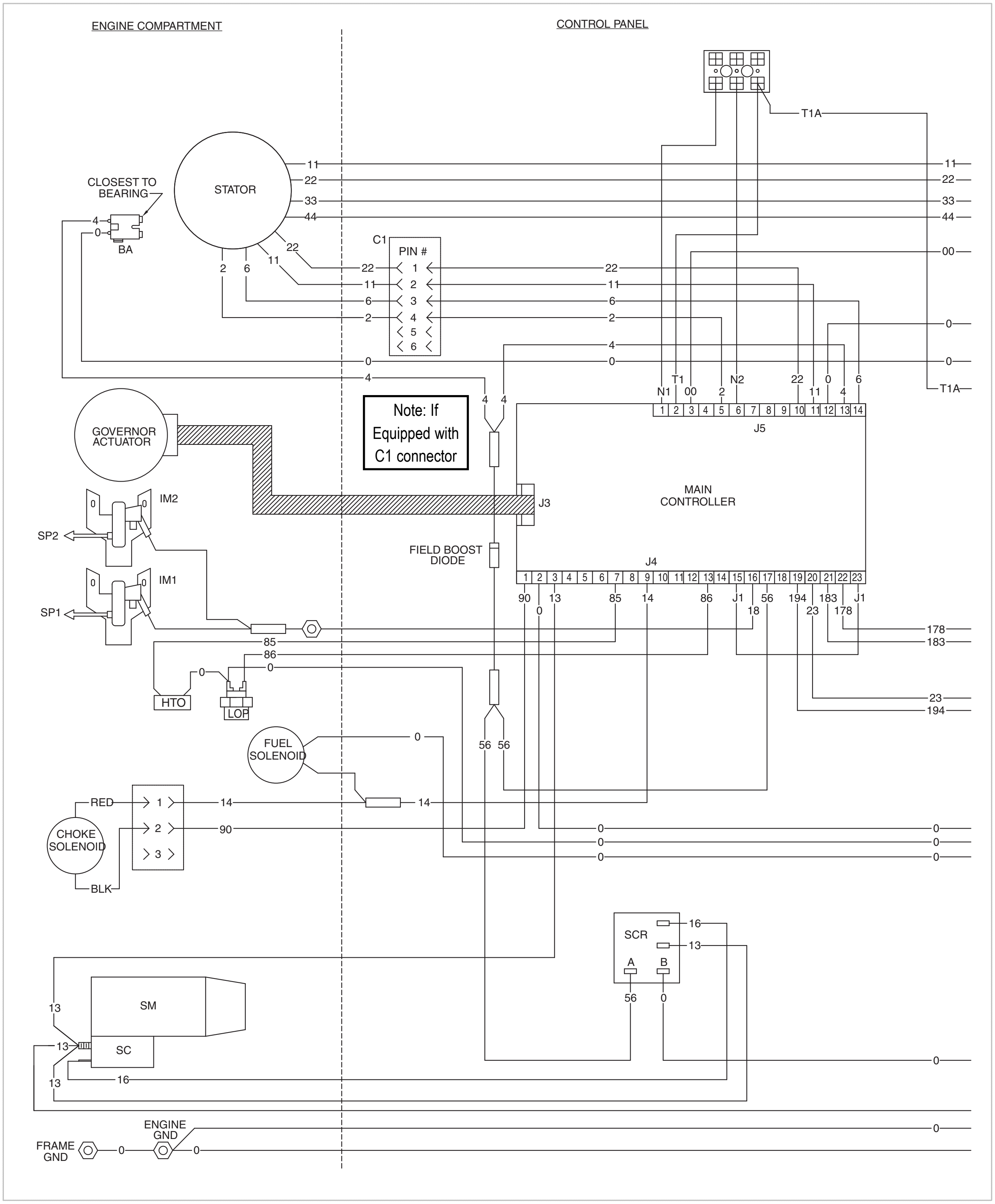
DATE: 10/26/10

WIRING - DIAGRAM

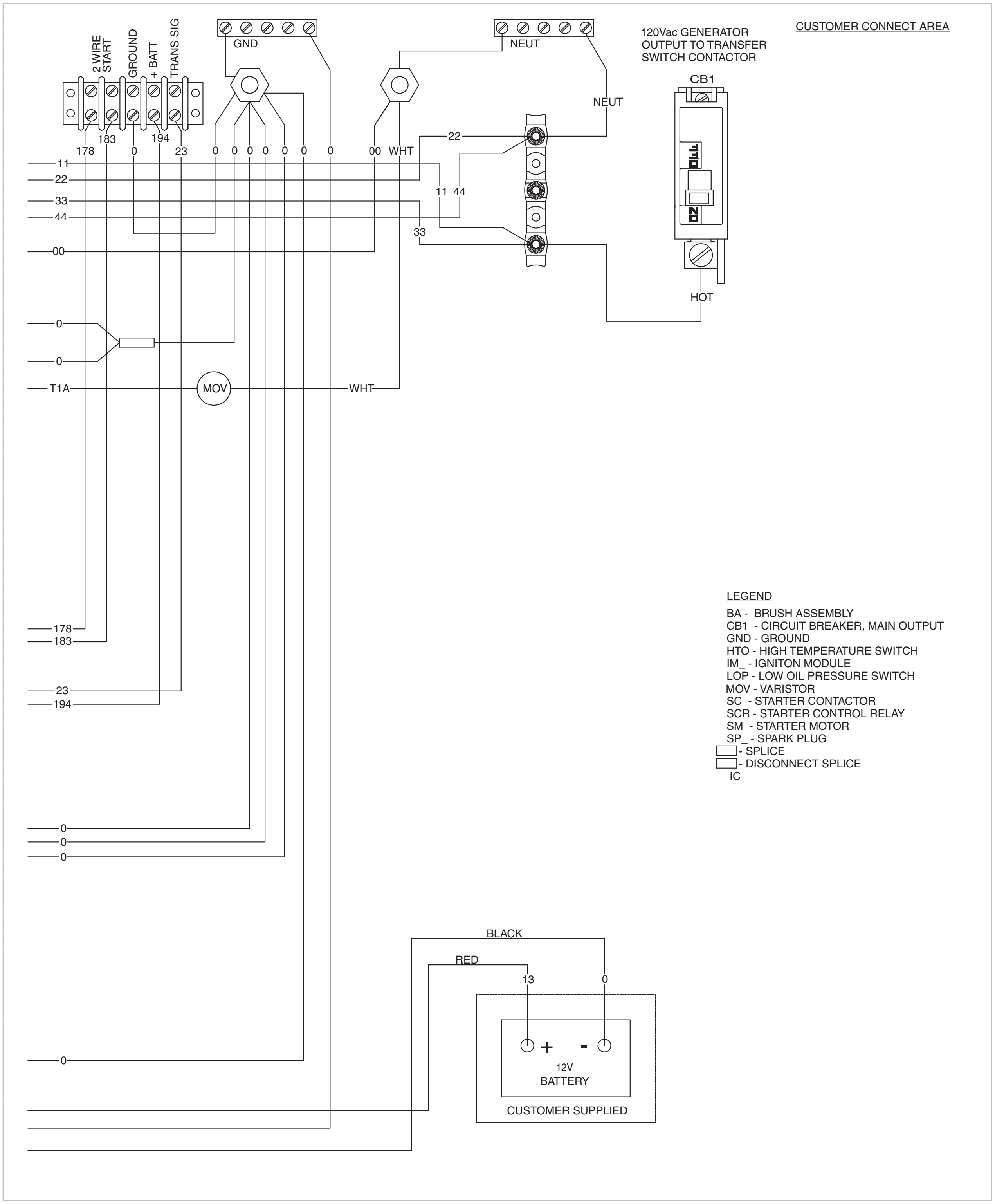
20kW 2010 AIR COOLED

DRAWING #: 0H7570

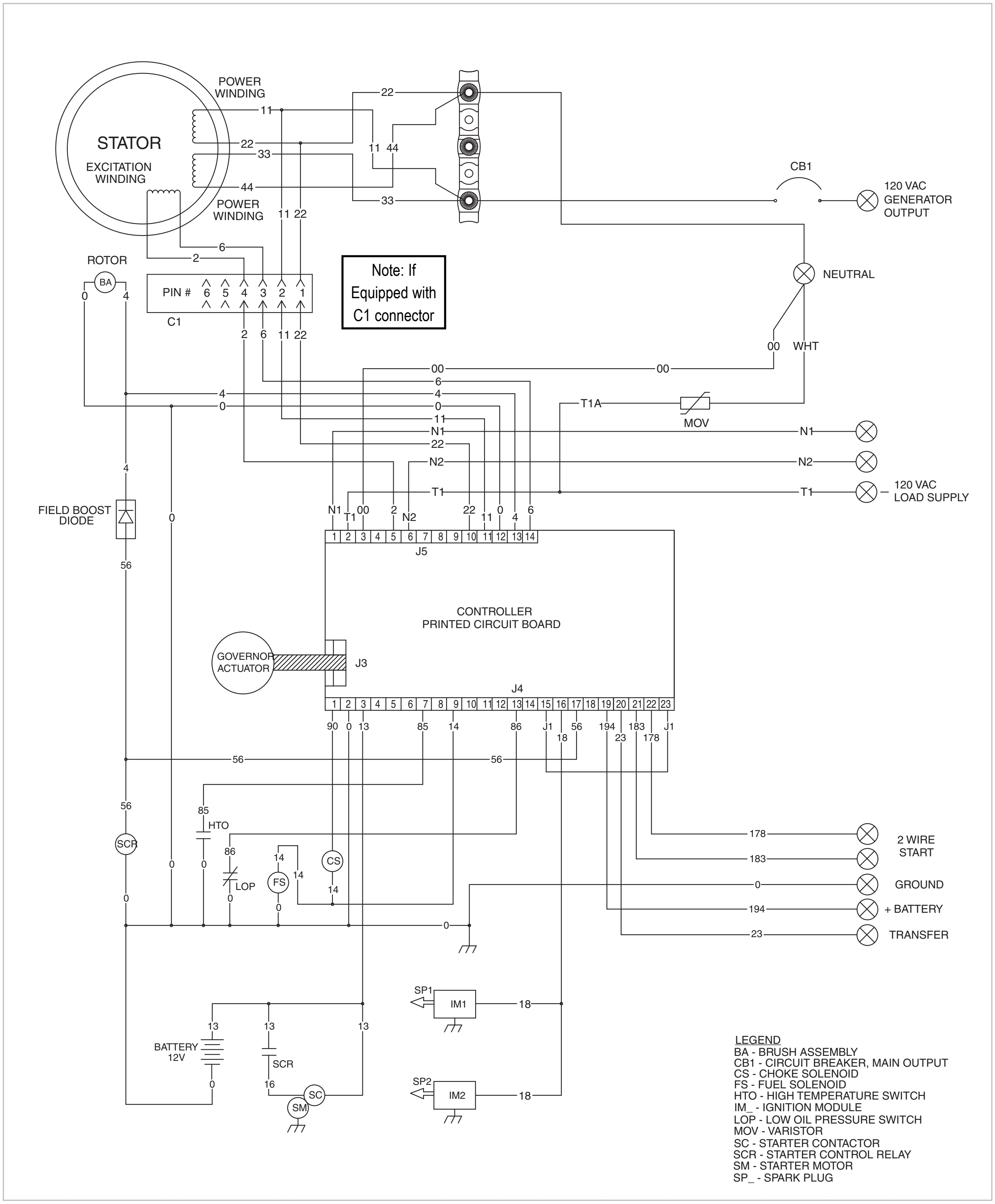
Wiring Diagram – Drawing 0H5813-B (shown with amp-seal style connectors.)



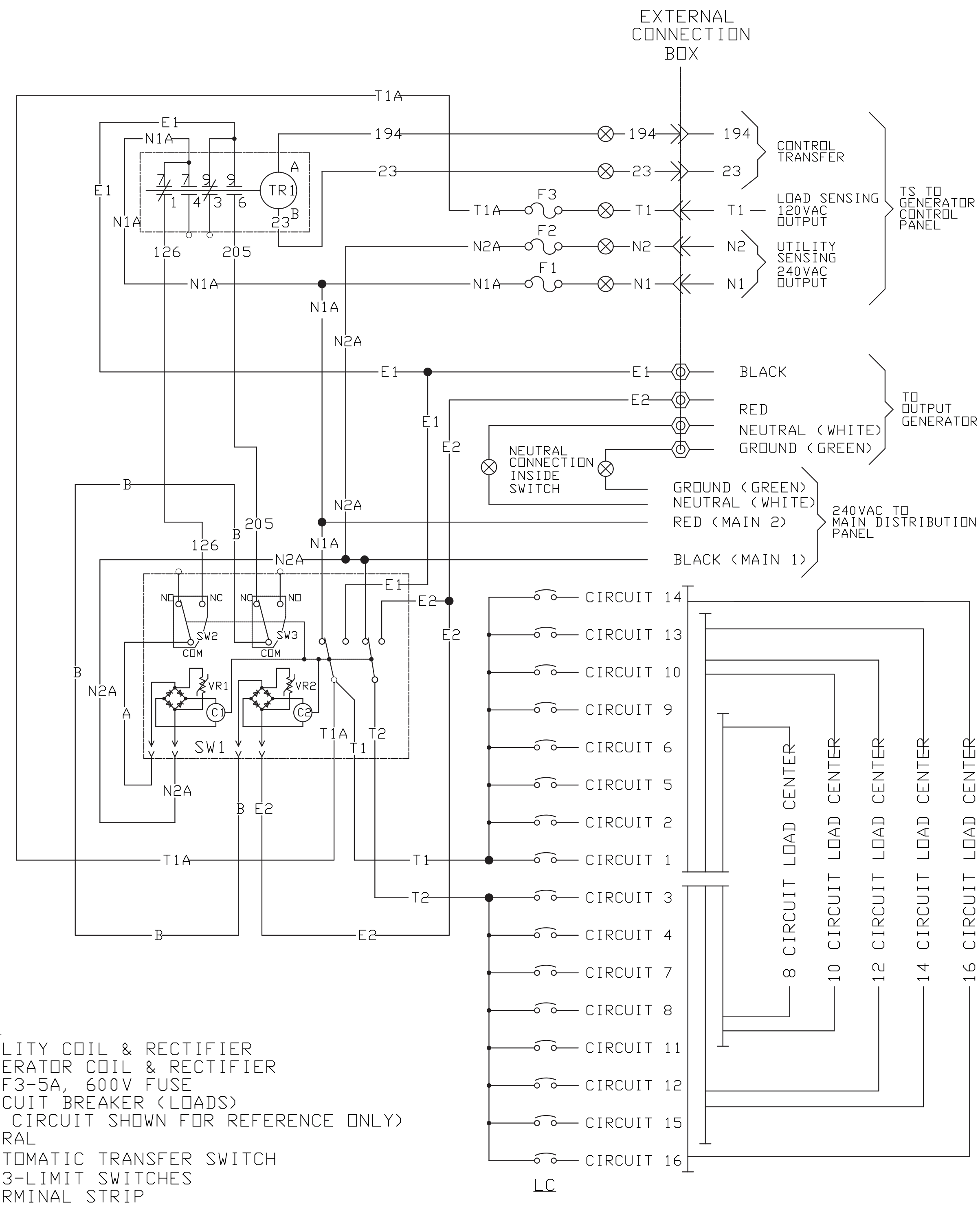
Wiring Diagram – Drawing 0H5813-B (shown with amp-seal style connectors.)



Electrical Schematic – Drawing 0H5813-B (shown with amp-seal style connectors.)

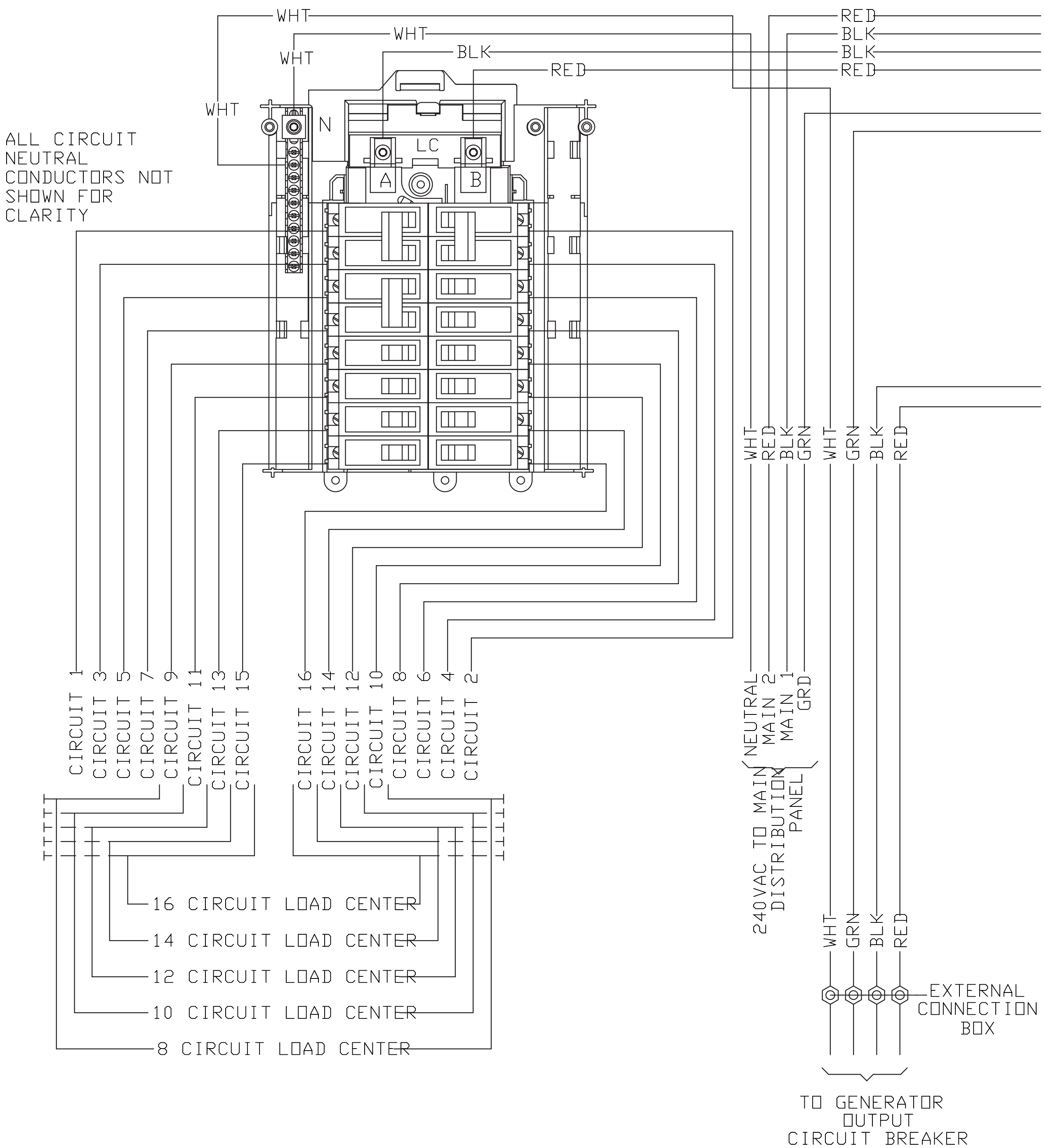


Electrical Schematic – Drawing 0H6386-B

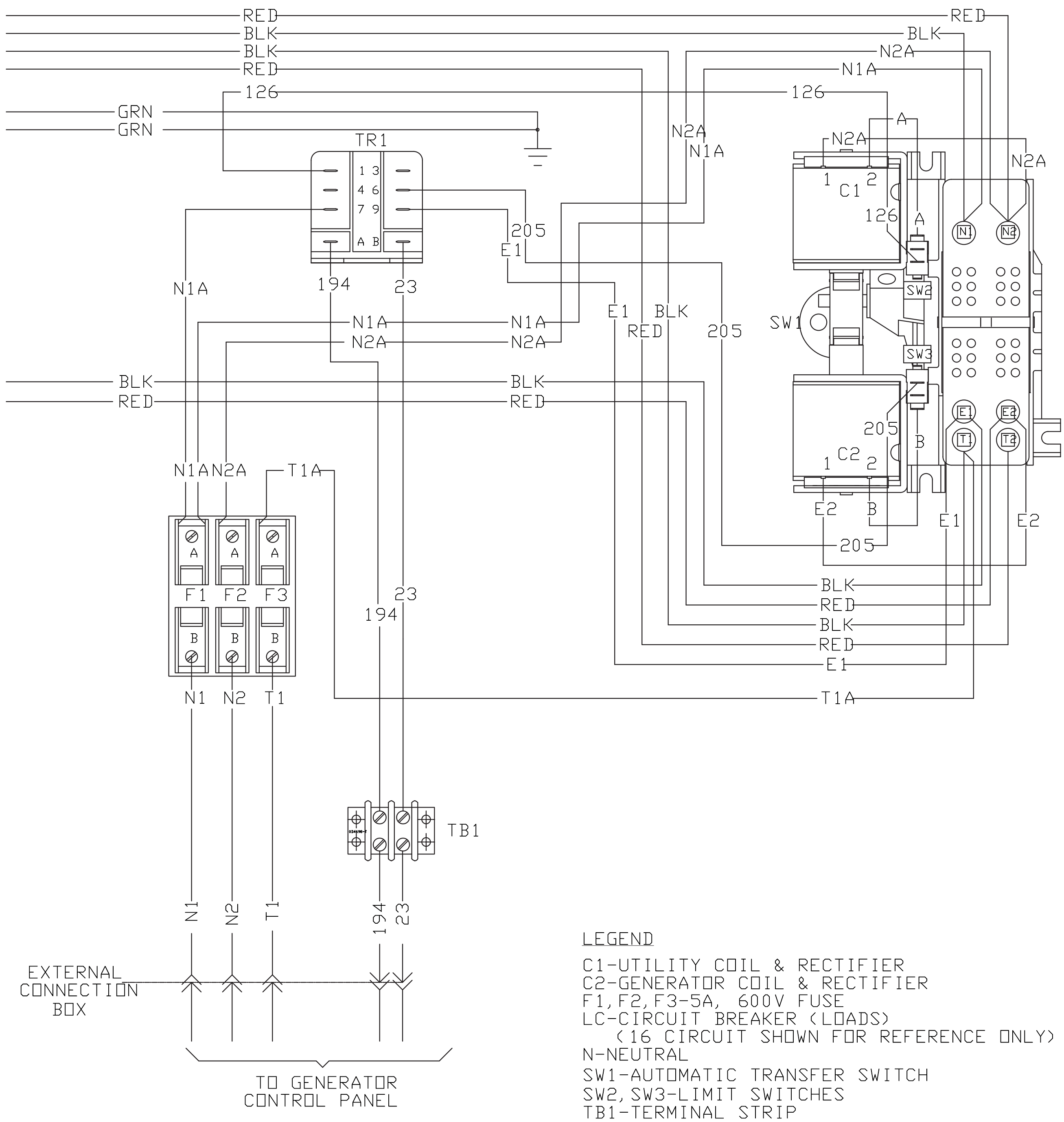


LEGEND
C1-UTILITY COIL & RECTIFIER
C2-GENERATOR COIL & RECTIFIER
F1, F2, F3-5A, 600V FUSE
LC-CIRCUIT BREAKER (LOADS)
(16 CIRCUIT SHOWN FOR REFERENCE ONLY)
N-NEUTRAL
SW1-AUTOMATIC TRANSFER SWITCH
SW2, SW3-LIMIT SWITCHES
TB1-TERMINAL STRIP
TR1-TRANSFER RELAY

Wiring Diagram – Drawing 0H6385-A

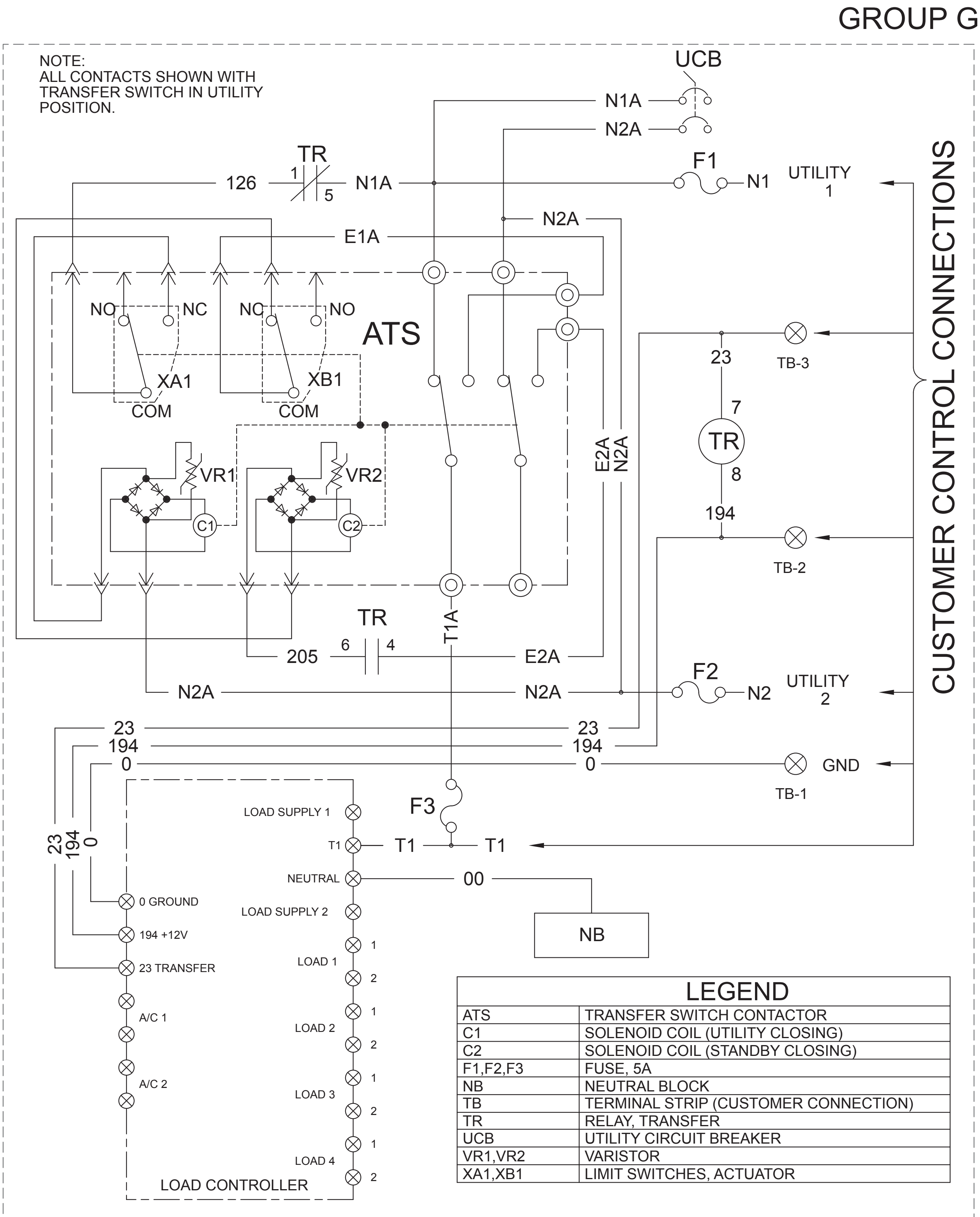


Wiring Diagram – Drawing 0H6385-A



LEGEND
C1-UTILITY COIL & RECTIFIER
C2-GENERATOR COIL & RECTIFIER
F1,F2,F3-5A, 600V FUSE
LC-CIRCUIT BREAKER (LOADS)
(16 CIRCUIT SHOWN FOR REFERENCE ONLY)
N-NEUTRAL
SW1-AUTOMATIC TRANSFER SWITCH
SW2,SW3-LIMIT SWITCHES
TB1-TERMINAL STRIP
TR1-TRANSFER RELAY

Electrical Schematic – Drawing 0K0135-C

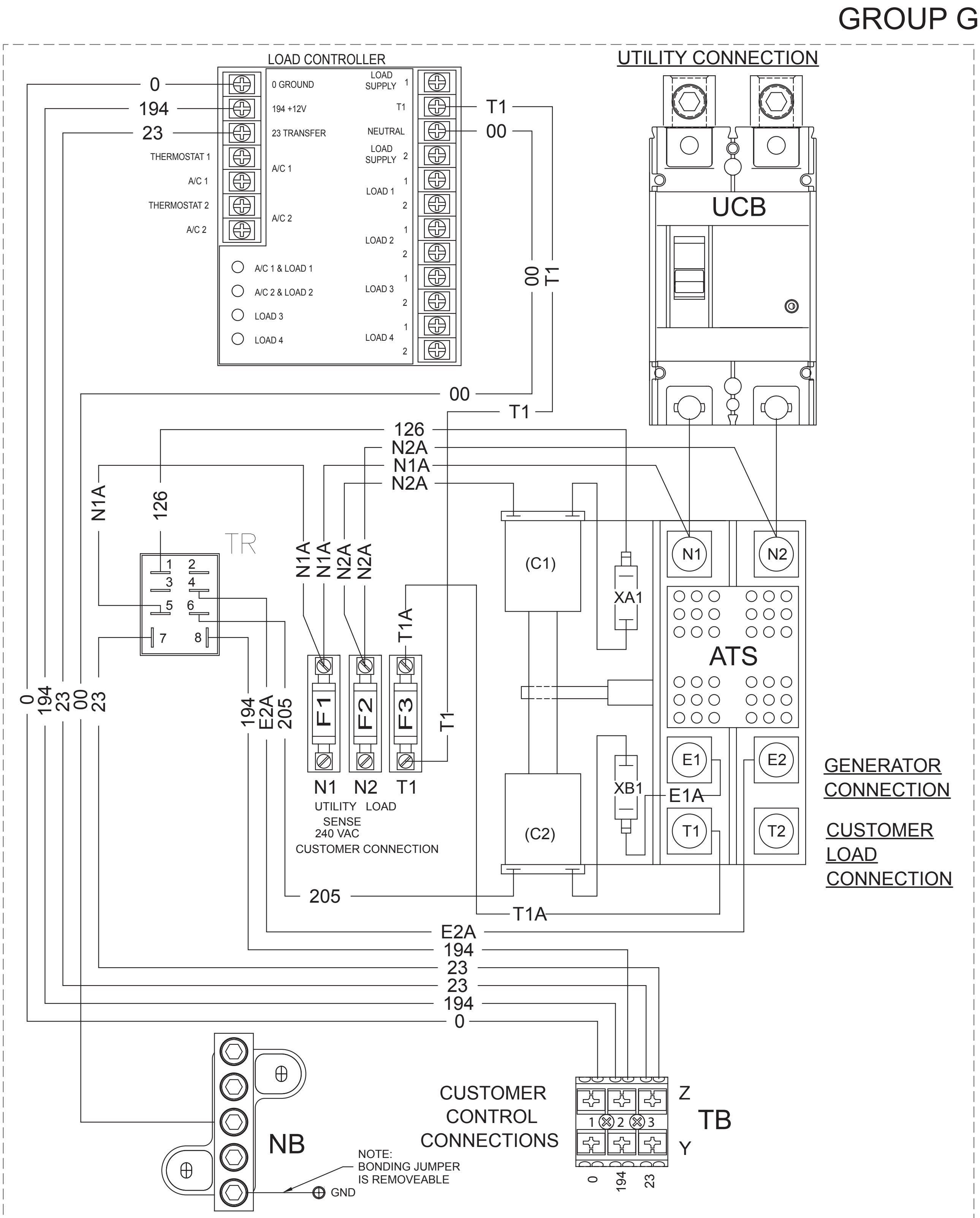


LEGEND	
ATS	TRANSFER SWITCH CONTACTOR
C1	SOLENOID COIL (UTILITY CLOSING)
C2	SOLENOID COIL (STANDBY CLOSING)
F1,F2,F3	FUSE, 5A
NB	NEUTRAL BLOCK
TB	TERMINAL STRIP (CUSTOMER CONNECTION)
TR	RELAY, TRANSFER
UCB	UTILITY CIRCUIT BREAKER
VR1,VR2	VARISTOR
XA1,XB1	LIMIT SWITCHES, ACTUATOR

SCHEMATIC - DIAGRAM
RTSY 2013
DRAWING #: 0K0135

REVISION: J-5049-C
DATE: 4/22/13

Electrical Schematic – Drawing 0K0135-C



WIRING - DIAGRAM
RTSY 2013
REVISION: J-5049-C
DATE: 4/22/13
DRAWING #: 0K0135

Notes

APPENDIX A - CONTROLLER IDENTIFICATION

EVOLUTION CONTROLLER

Figure 278 – Evolution Air-cooled Panel has 3 Molex style connectors on the back (J1, J2, & J3), one actuator connector (J5), the battery charger connector (J8 & J9), and a connector socket for the remote annunciator(s) (optional accessory).

Figure 278. Evolution Air-cooled Panel

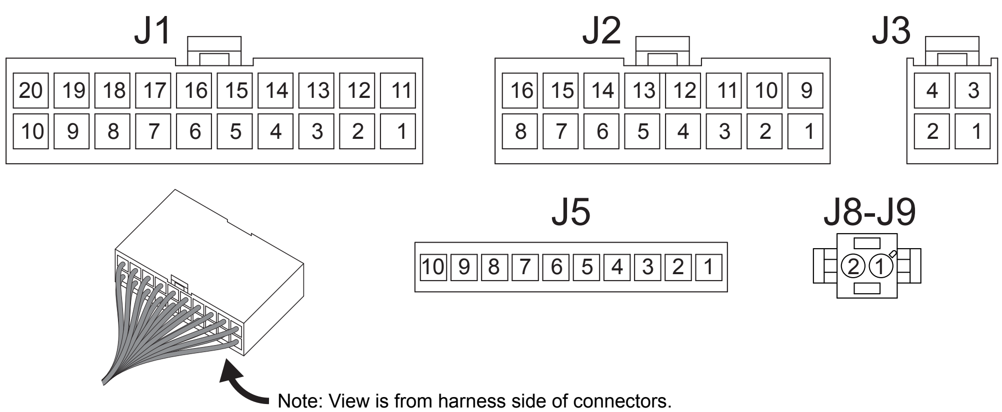


Figure 279. Evolution Connectors (Harness End)

Table A-1 - Evolution Connector Pin Descriptions and Pinout

Pin	Wire	Circuit Function
J1 Connector		
J1-1	13	12 VDC un-fused for the controller
J1-2	13	12 VDC un-fused for the controller
J1-3	820	Positive voltage (5VDC) for status LEDs
J1-4	23	Switched to ground (internally) to energize the Transfer Relay
J1-5	178	Not Used, Optional - 2-Wire Start (return)
J1-6	819	Grounded by the controller to turn on the Maintenance (Yellow) LED
J1-7	818	Grounded by the controller to turn on Alarm (Red) LED
J1-8	817	Grounded by the controller to turn on System Ready (Green) LED
J1-9	398A	Generator Current Sense A2
J1-10	399A	Generator Current Sense A1
J1-11	85	High temperature shutdown: Shutdown occurs when Wire 85 is grounded by contact closure in the oil temperature switch
J1-12	86	Low oil pressure shutdown: Shutdown occurs when Wire 86 is grounded by loss of oil pressure in the LOP switch

Pin	Wire	Circuit Function
J1-13	0	Common Ground (DC) DC Field Excitation Ground
J1-14	194	Provides 12 VDC to the transfer relay (TR1)
J1-15	-	Not Used - UL Required Spacing
J1-16	N1	240 VAC Utility sensing voltage
J1-17	N2	240 VAC Utility sensing voltage
J1-18	-	Not Used - UL Required Spacing
J1-19	11S	240 VAC Generator Voltage Sensing
J1-20	44S	240 VAC Generator Voltage Sensing
J2 Connector		
J2-1		
J2-2	209	Common Alarm Relay Output
J2-3	56	12 VDC output to starter contactor relay/solenoid
J2-4	14	12 VDC output for engine run condition. Fuel solenoid supply voltage.
J2-5	4A	DC (+) Field Excitation (Before Field Boost Diode)
J2-6	398B	Generator Current Sense B2
J2-7	18	Ignition Shutdown: The controller grounds Wire 18 for ignition shutdown and receives a reference signal for speed control while cranking and running
J2-8	R1	Model ID Resistor
J2-9	-	Not Used
J2-10	-	Not Used
J2-11	183	Not Used, Optional - 2-Wire Start
J2-12	210	Common Alarm Relay Output
J2-13	-	Not Used
J2-14	399B	Generator Current Sense B1
J2-15	R3	Model ID Resistor
J2-16	R2	Model ID Resistor
J3 Connector		
J3-1	0	Common Ground (DC) DC Field Excitation Ground
J3-2	4	DC (+) Field Excitation
J3-3	2	DPE Winding (AC Excitation power)
J3-4	6	DPE Winding (AC Excitation power)
J5 Connector		
J5-1	-	Not Used
J5-2	-	Not Used
J5-3	-	Not Used
J5-4	-	Not Used
J5-5	-	Not Used
J5-6	Red	Stepper Power
J5-7	Orange	Stepper Motor B2 Coil
J5-8	Yellow	Stepper Motor B1 Coil
J5-9	Brown	Stepper Motor A2 Coil
J5-10	Black	Stepper Motor A1 Coil
J8-J9 Connector		
1	T1	120 VAC Power for the Battery Charger
2	00	Neutral Connection for T1 (battery charger)

NEXUS CONTROLLER

There are currently three styles of Nexus Air-cooled control panel. The difference in the styles is how the wires are connected to the panel. The different panel part numbers, connection types, and images of each are shown on the following pages.

Figure 280 – Nexus Air-cooled Panel part number 0H6680 (A) or (B) has two Amp-Seal style connectors on the back (J4 & J5), one actuator connector (J3), and a connector socket for the remote wireless annunciator (optional accessory).

Figure 280. Nexus Air-cooled Panel Part Number 0H6680 (A) or (B)

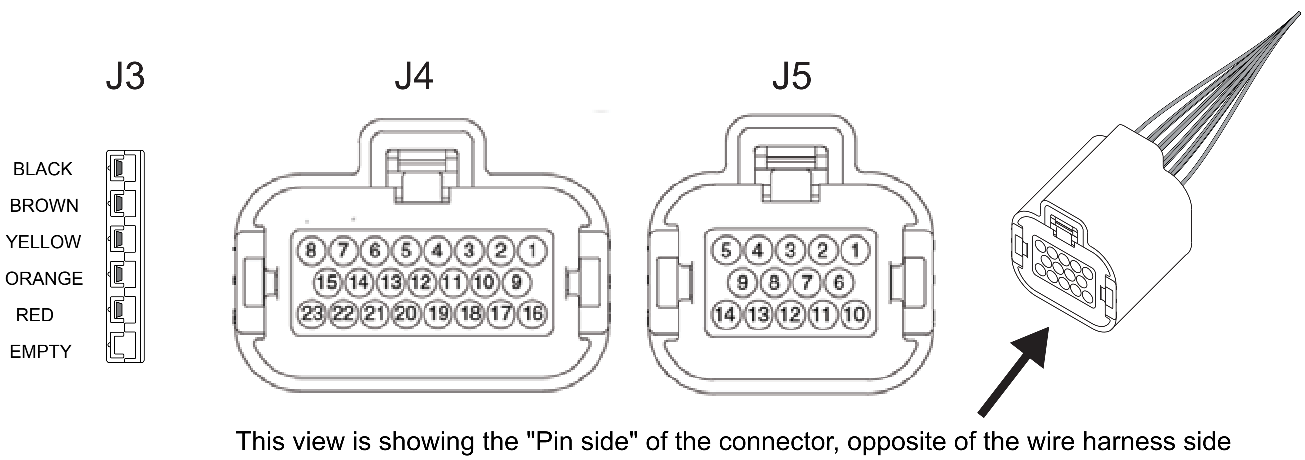


Figure 281. J3, J4 and J5 connectors, harness end.

Table A-2 - J3 Connector Pin Descriptions and Pinout

PIN	WIRE	CIRCUIT FUNCTION
1	Black	Stepper Motor A1 Coil
2	Brown	Stepper Motor A2 Coil
3	Yellow	Stepper Motor B1 Coil
4	Orange	Stepper Motor B2 Coil
5	Red	Stepper Power
6	Empty	

Table A-3 - J4 Connector Pin Descriptions and Pinout

PIN	WIRE	CIRCUIT FUNCTION
1	90	Switched to ground for choke solenoid operation
2	0	Common Ground (DC)
3	13	12 VDC un-fused for the controller
4	817	Grounded by the controller to turn on System Ready (Green) LED
5	818	Grounded by the controller to turn on Alarm (Red) LED
6	819	Grounded by the controller to turn on the Maintenance (Yellow) LED
7	85	High temperature shutdown: Shutdown occurs when Wire 85 is grounded by contact closure in the oil temperature switch
8	820	Positive voltage (5VDC) for status LED's
9	14	12 VDC output for engine run condition. Used for fuel solenoid and choke solenoid operation on V-Twin Models
10	210	Common Alarm Relay Output
11		Not used
12		Not used
13	86	Low oil pressure shutdown: Shutdown occurs when Wire 86 is grounded by loss of oil pressure in the LOP switch
14		Not used
15	JMP 1	Installed in series with a resistor to identify the kW to the controller
16	18	Ignition Shutdown: The controller grounds Wire 18 for ignition shutdown and receives a reference signal for speed control while cranking and running
17	56	12 VDC output to starter contactor relay/solenoid
18	209	Common Alarm Relay Output
19	194	Provides 12 VDC to the transfer relay (TR1)
20	23	Switched to ground (internally) to energize the Transfer Relay
21		Not used
22		Not used
23	JMP 1	Installed in series with a resistor to identify the kW to the controller

Table A-4 - J-5 Connector Pin Descriptions and Pinout

PIN	WIRE	CIRCUIT FUNCTION
1	N1	240VAC Utility sensing voltage
2	T1	120 VAC power for the battery charger
3	00	Neutral Connection for T1 (battery charger)
4		Not used
5	2	DPE Winding (AC excitation power)
6	N2	240VAC Utility sensing voltage
7		Not used
8		Not used
9		Not used
10	44	240VAC Generator voltage sensing
11	11	240VAC Generator voltage sensing
12	0	DC Field excitation ground
13	4	DC (+) Field excitation voltage
14	6	DPE Winding (AC excitation power)

Figure 282 – Nexus Air-cooled Panel part number 0H6680 (D) has 4 Molex/ETC style connectors on the back (J5, J8, J9 & J10), one actuator connector (J3), the battery charger connector (J11 & J12), and a connector socket for the remote wireless annunciator (optional accessory).

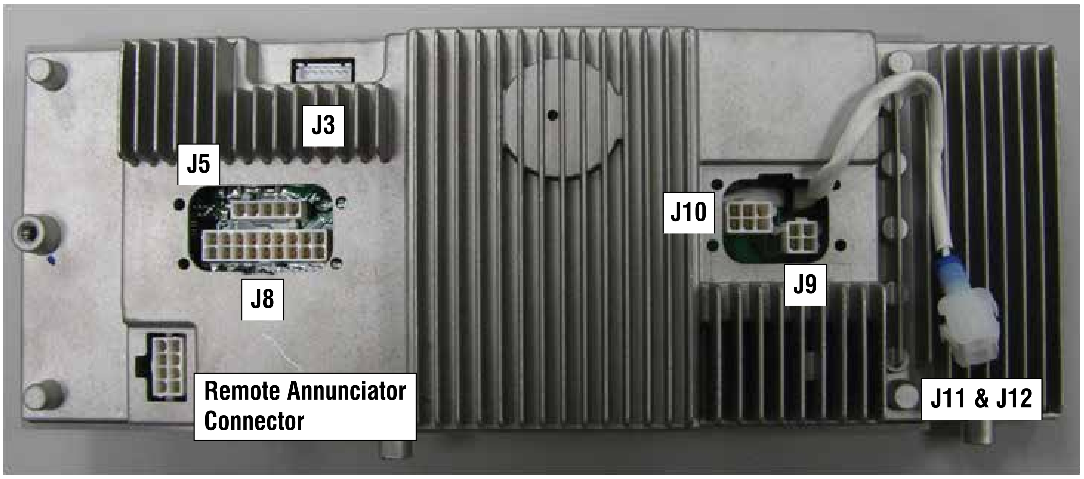


Figure 282. Nexus Air-cooled Panel Part Number 0H6680 (D)

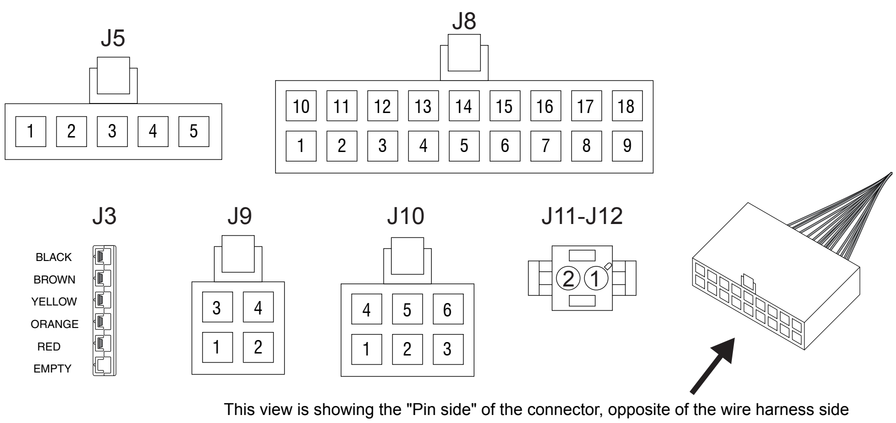


Figure 283. J3, J5, J8, J9, J10 and J11-J12 connectors, harness end.

Table A-5 - J3 Connector Pin Descriptions and Pinout

PIN	WIRE	CIRCUIT FUNCTION
1	Black	Stepper Motor A1 Coil
2	Brown	Stepper Motor A2 Coil
3	Yellow	Stepper Motor B1 Coil
4	Orange	Stepper Motor B2 Coil
5	Red	Stepper Power
6	Empty	

Table A-6, J5 Connector Pin Descriptions and Pinout

PIN	WIRE	CIRCUIT FUNCTION
1	209	Common Alarm Relay Output
2	194	Provides 12 VDC to the transfer relay (TR1)
3	23	Switched to ground (internally) to energize the Transfer Relay
4		Not used
5		Not used

Table A-7, J8 Connector Pin Descriptions and Pinout

PIN	WIRE	CIRCUIT FUNCTION
1	820	Positive voltage (5VDC) for status LED's
2	JMP 1	Installed in series with a resistor to identify the kW to the controller
3	86	Low oil pressure shutdown: Shutdown occurs when Wire 86 is grounded by loss of oil pressure in the LOP switch
4	0	Common Ground (DC)
5	JMP 1	Installed in series with a resistor to identify the kW to the controller
6	56	12 VDC output to starter contactor relay/solenoid
7	14	12 VDC output for engine run condition. Used for fuel solenoid and choke solenoid operation on V-Twin Models
8	18	Ignition Shutdown: The controller grounds Wire 18 for ignition shutdown and receives a reference signal for speed control while cranking and running
9	90	Switched to ground for choke solenoid operation
10	85	High temperature shutdown: Shutdown occurs when Wire 85 is grounded by contact closure in the oil temperature switch
11		Not used
12	819	Grounded by the controller to turn on the Maintenance (Yellow) LED
13	818	Grounded by the controller to turn on Alarm (Red) LED
14	817	Grounded by the controller to turn on System Ready (Green) LED
15		Not used
16	210	Common Alarm Relay Output
17		Not used
18	13	12 VDC un-fused for the controller

Table A-8, J9 Connector Pin Descriptions and Pinout

PIN	WIRE	CIRCUIT FUNCTION
1	6	DPE Winding (AC excitation power)
2	11	240VAC Generator voltage sensing
3	2	DPE Winding (AC excitation power)
4	44	240VAC Generator voltage sensing

Table A-9, J-10 Connector Pin Descriptions and Pinout

PIN	WIRE	CIRCUIT FUNCTION
1	4	DC (+) Field excitation voltage
2	0	DC (-) Field excitation ground
3	N1	240VAC Utility sensing voltage
4		Not used
5		Not used
6	N2	240VAC Utility sensing voltage

Table A-10, J11-J12 Connector Pin Descriptions and Pinout

PIN	WIRE	CIRCUIT FUNCTION
1	T1	120 VAC power for the battery charger
2	00	Neutral Connection for T1 (battery charger)

Figure 284 - Nexus Air-cooled Panel part number 0H6680 (T) has 3 Amp/Tyco style connectors on the back (J4, J5 & J6) the actuator connector (J3), and a connector socket for the remote wireless annunciator (optional accessory).

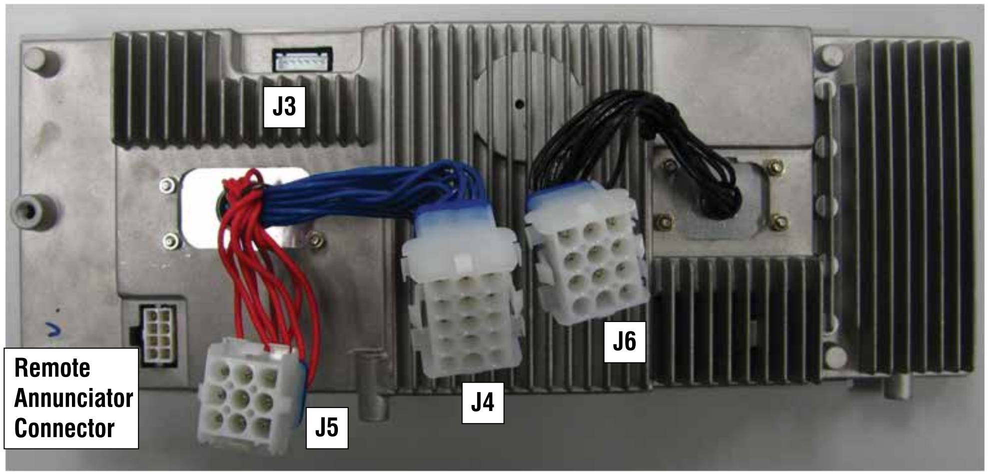


Figure 284. Nexus Air-cooled Panel Part Number 0H6680 (T)

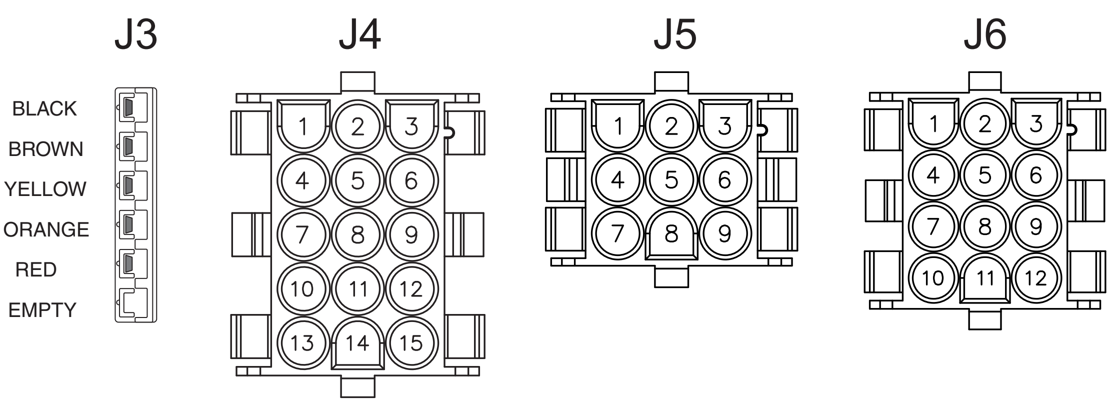


Figure 285. J4 Connector Pin, harness end.

Table A-11 - J3 Connector Pin Descriptions and Pinout

PIN	WIRE	CIRCUIT FUNCTION
1	Black	Stepper Motor A1 Coil
2	Brown	Stepper Motor A2 Coil
3	Yellow	Stepper Motor B1 Coil
4	Orange	Stepper Motor B2 Coil
5	Red	Stepper Power
6	Empty	

Table A-12, J4 Connector Pin Descriptions and Pinout

PIN	WIRE	CIRCUIT FUNCTION
1	90	Switched to ground for choke solenoid operation
2	0	Common Ground (DC)
3	13	12 VDC un-fused for the controller
4	817	Grounded by the controller to turn on System Ready (Green) LED

5	818	Grounded by the controller to turn on Alarm (Red) LED
6	819	Grounded by the controller to turn on the Maintenance (Yellow) LED
7	85	High temperature shutdown: Shutdown occurs when Wire 85 is grounded by contact closure in the oil temperature switch
8	820	Positive voltage (5VDC) for status LED's
9	14	12 VDC output for engine run condition. Used for fuel solenoid , and choke solenoid operation on V-Twin Models
10	210	Common Alarm Relay Output
11		
12		
13	86	Low oil pressure shutdown: Shutdown occurs when Wire 86 is grounded by loss of oil pressure in the LOP switch
14		
15		

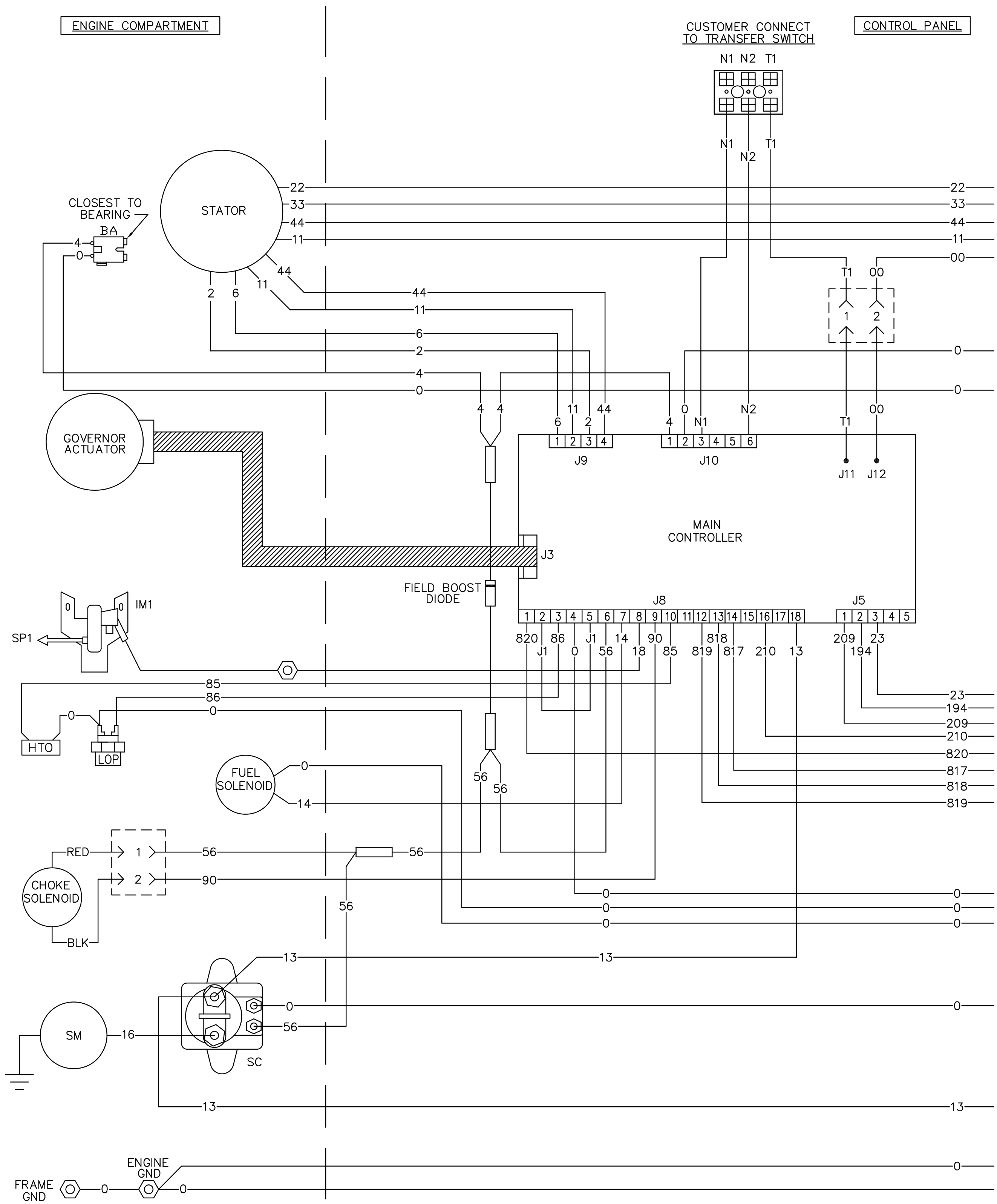
Table A-13, J5 Connector Pin Descriptions and Pinout

PIN	WIRE	CIRCUIT FUNCTION
1	JMP 1	Installed in series with a resistor to identify the kW to the controller
2	18	Ignition Shutdown: The controller grounds Wire 18 for ignition shutdown and receives a reference signal for speed control while cranking and running
3	56	12 VDC output to starter contactor relay/solenoid
4	209	Common Alarm Relay Output
5	194	Provides 12 VDC to the transfer relay (TR1)
6	23	Switched to ground (internally) to energize the Transfer Relay
7		
8		
9	JMP 1	Installed in series with a resistor to identify the kW to the controller

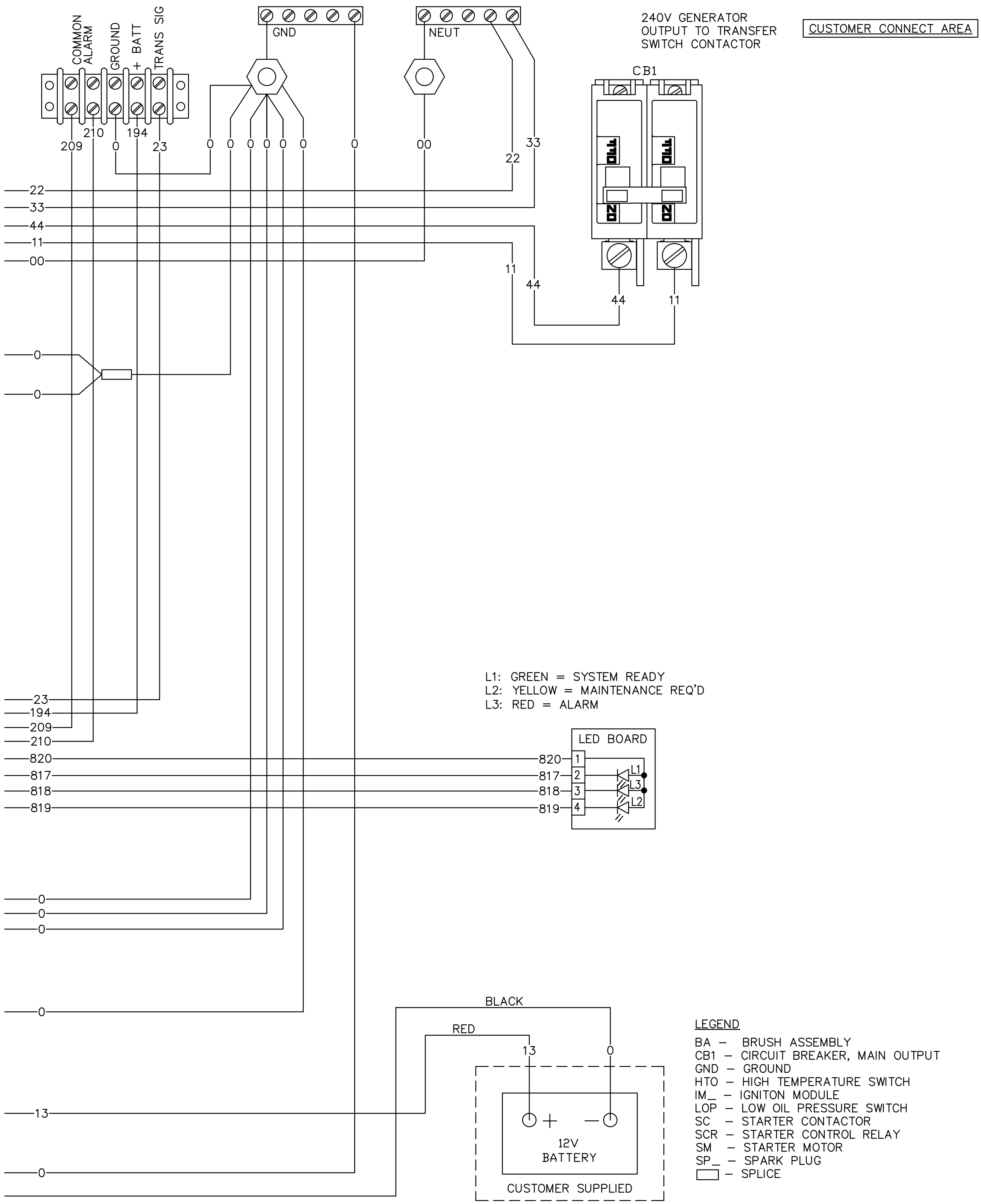
Table A-14, J6 Connector Pin Descriptions and Pinout

PIN	WIRE	CIRCUIT FUNCTION
1	N1	240VAC Utility sensing voltage
2	T1	120 VAC power for the battery charger
3	00	Neutral Connection for T1 (battery charger)
4	2	DPE Winding (AC excitation power)
5	N2	240VAC Utility sensing voltage
6	44	240VAC Generator voltage sensing
7	11	240VAC Generator voltage sensing
8	0	DC (-) Field excitation voltage
9	4	DC (+) Field excitation voltage
10	6	DPE Winding (AC excitation power)
11		
12		

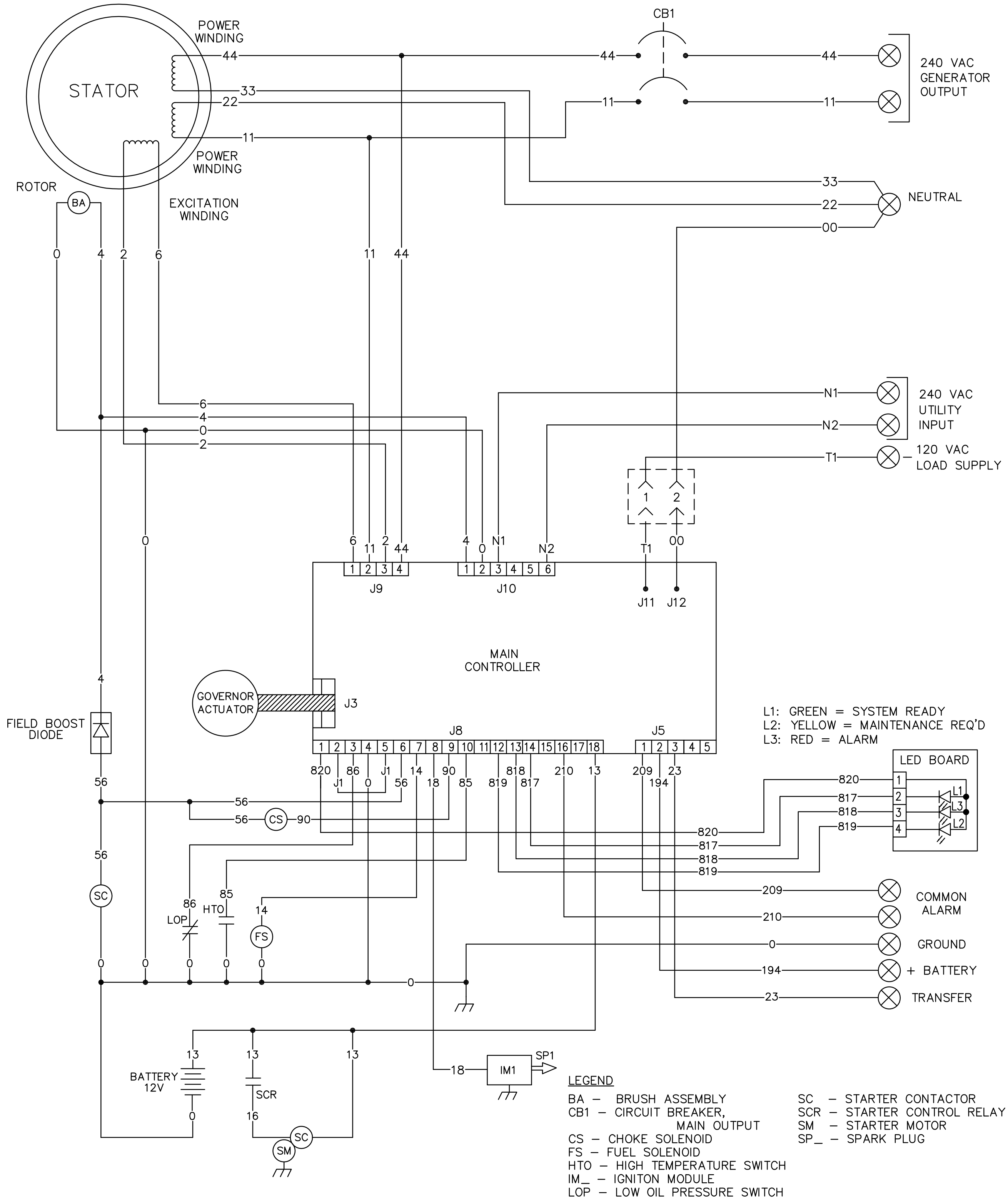
Wiring Diagram – Drawing 0J2999-A (shown with Molex style connectors.)



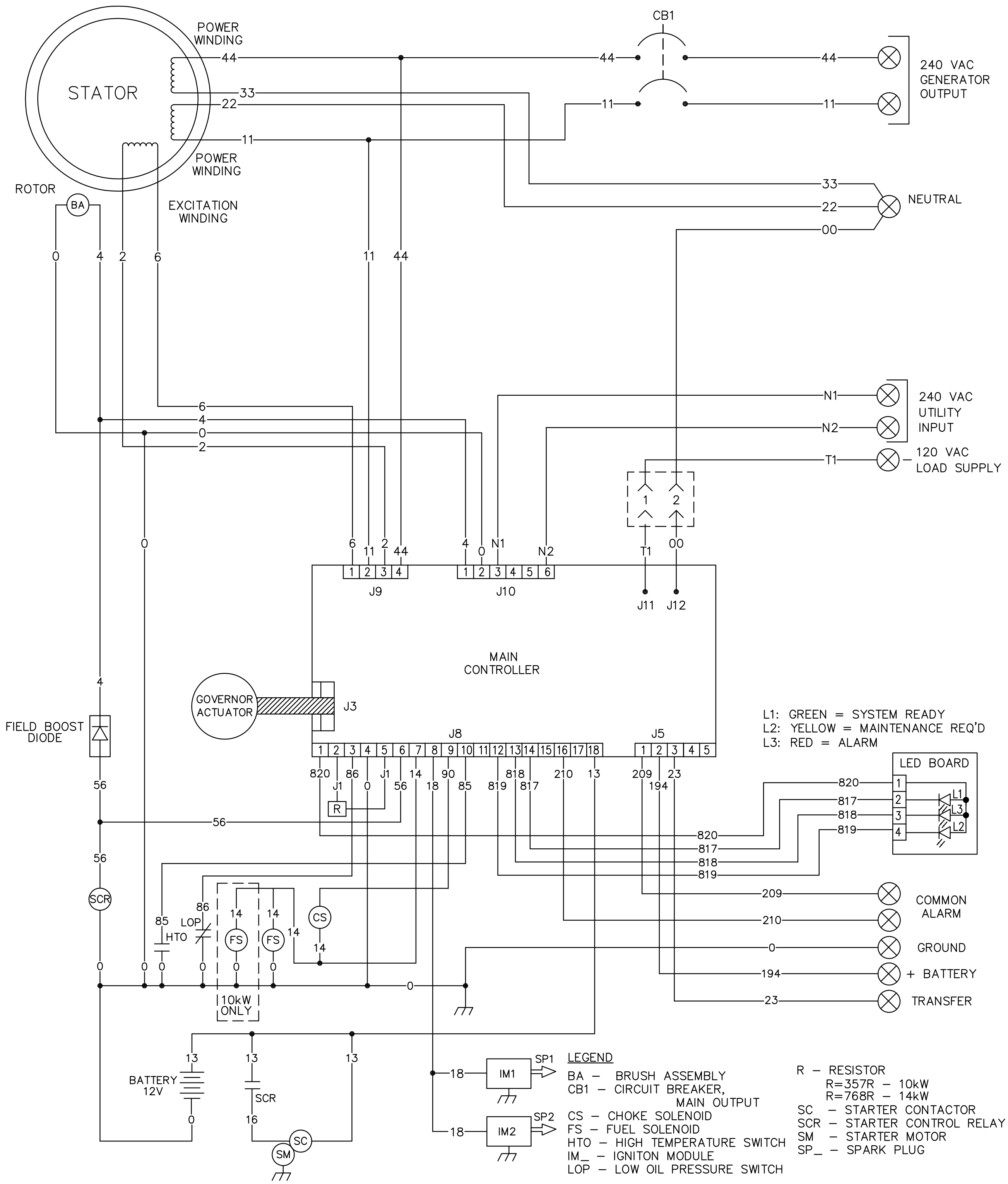
Wiring Diagram – Drawing 0J2999-A (shown with Molex style connectors.)



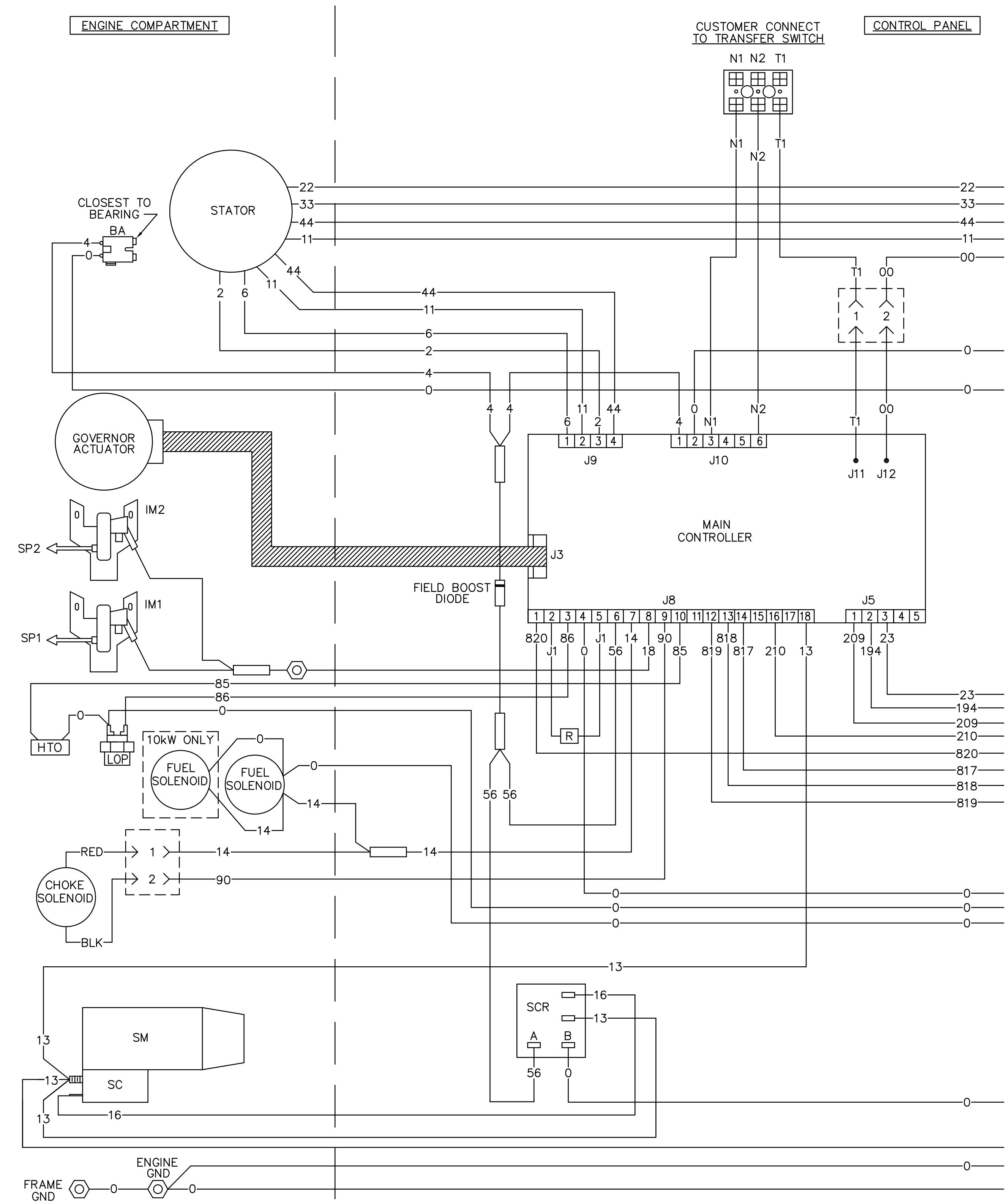
Electrical Schematic – Drawing 0J2999-A



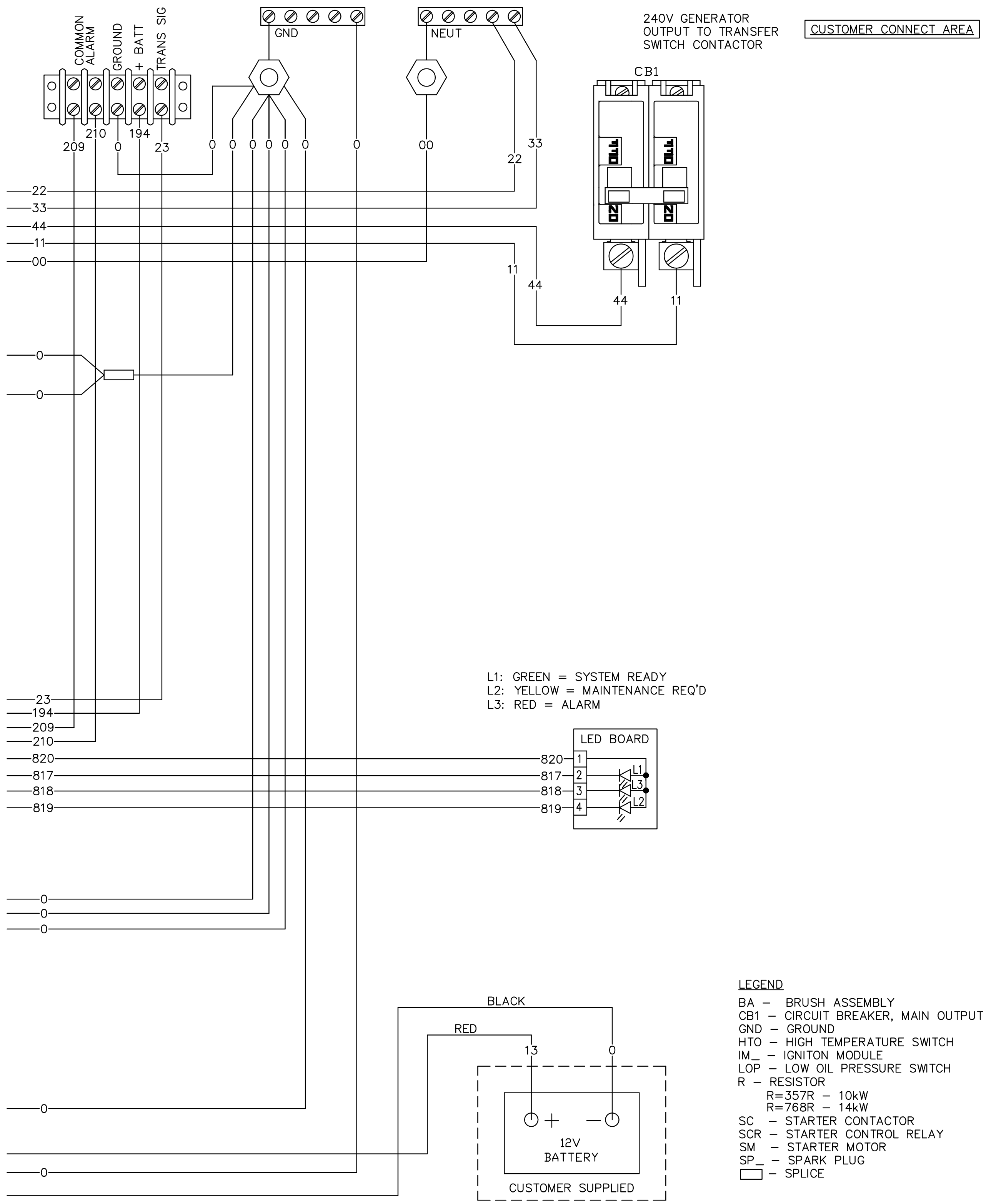
Wiring Diagram – Drawing 0J3000-A (shown with Molex style connectors.)



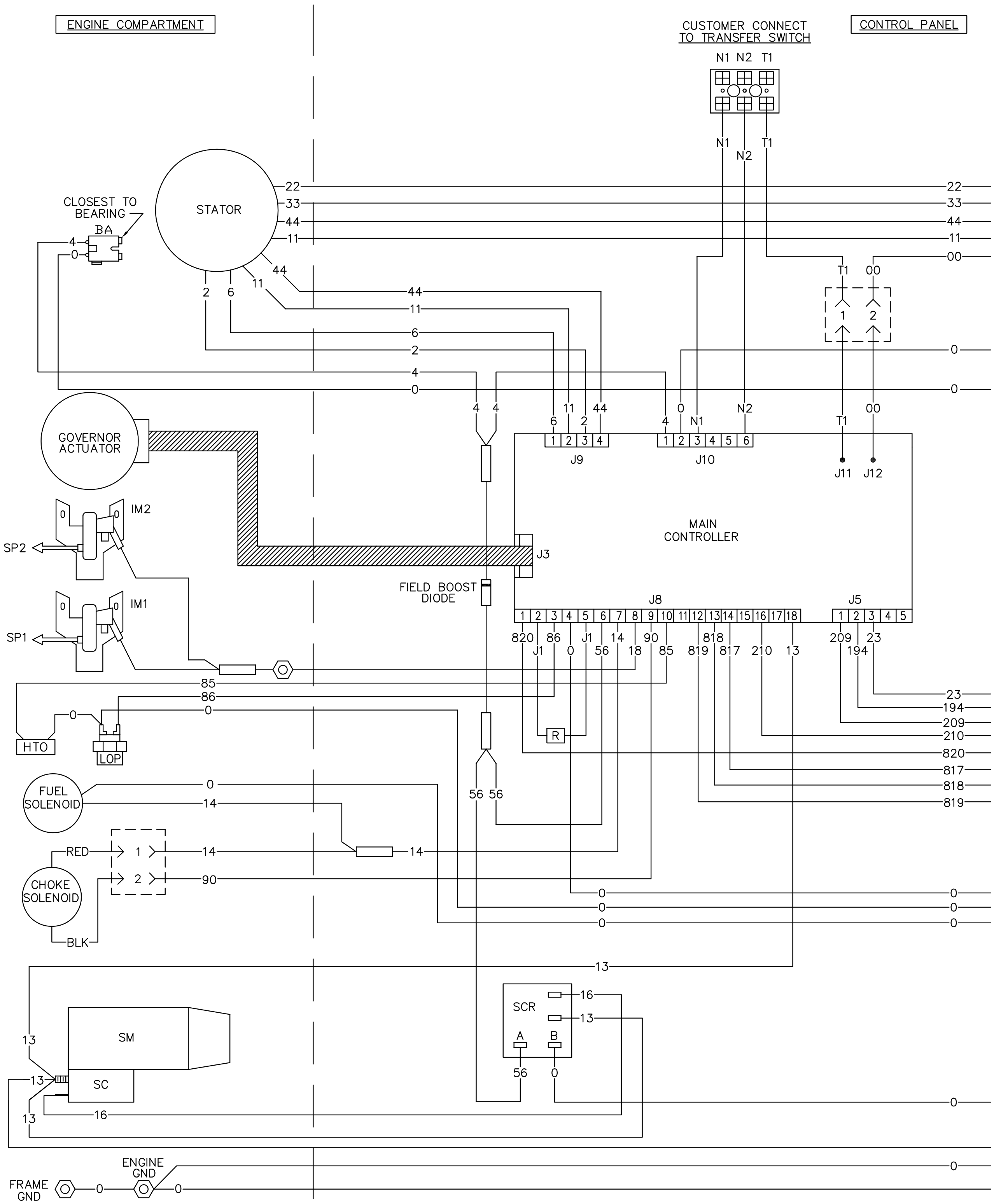
Wiring Diagram – Drawing 0J3000-A (shown with Molex style connectors.)



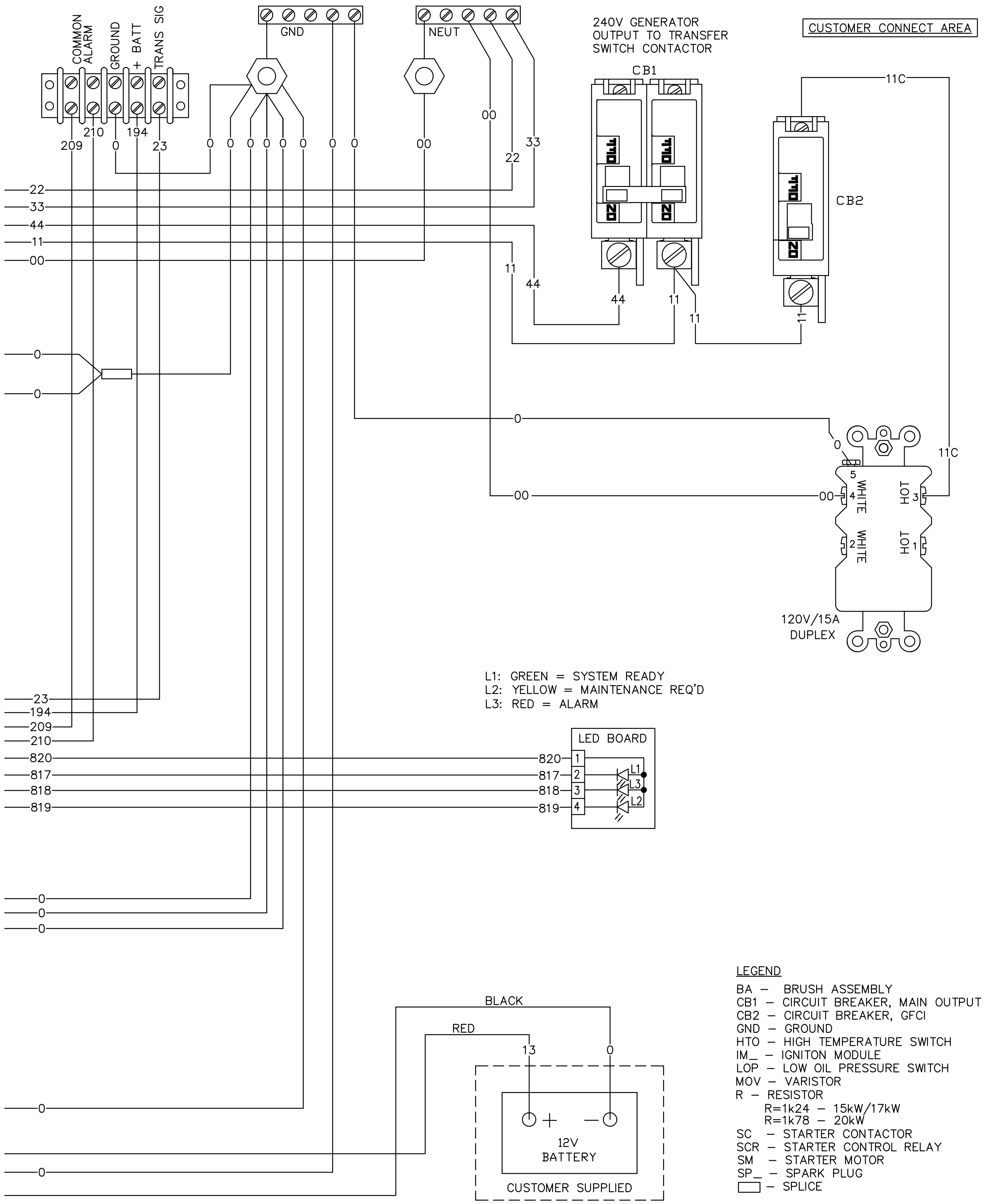
Electrical Schematic – Drawing 0J3000-A (shown with Molex style connectors.)



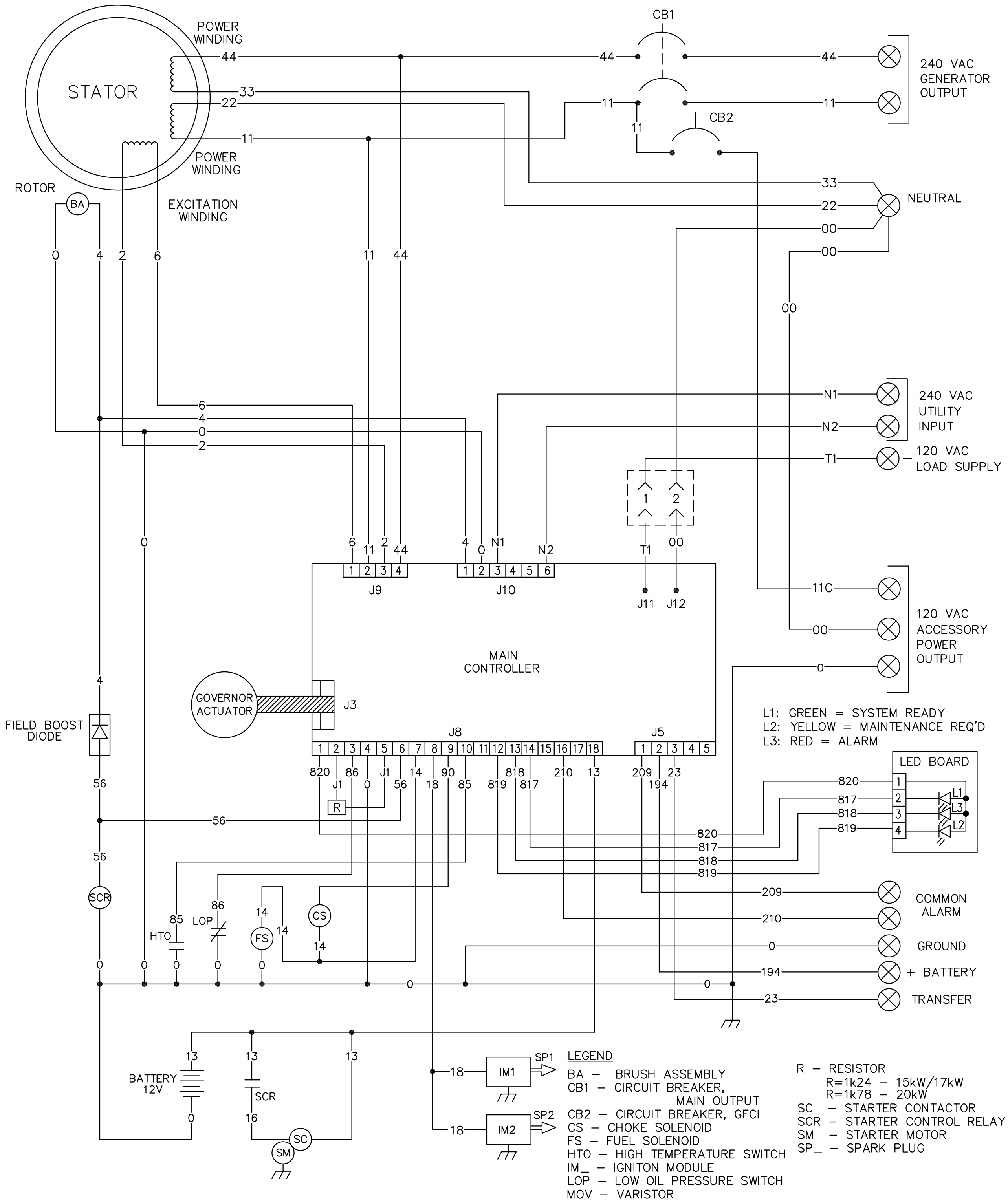
Wiring Diagram – Drawing 0J3001-A (shown with Molex style connectors.)



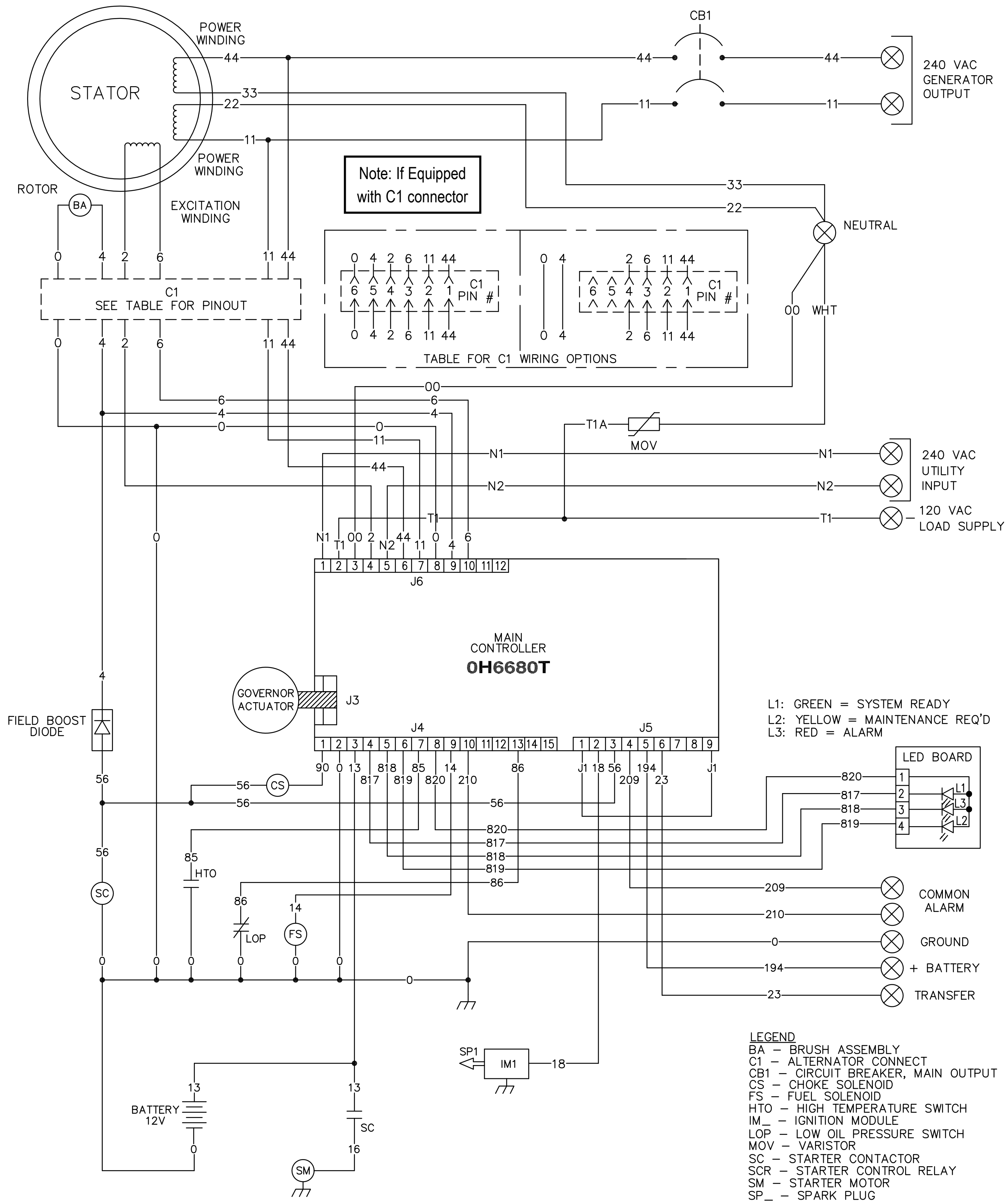
Wiring Diagram – Drawing 0J3001-A (shown with Molex style connectors.)



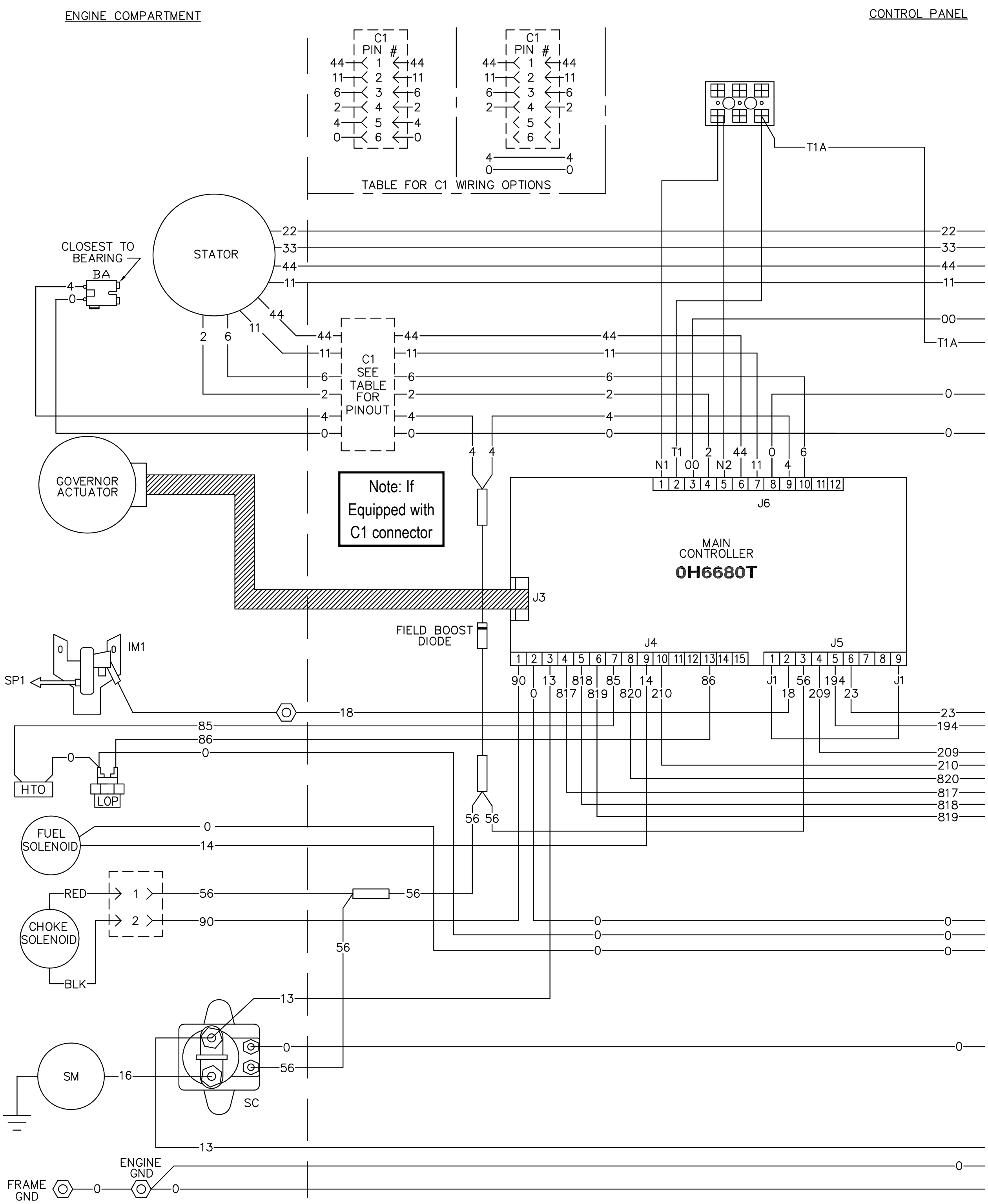
Wiring Diagram – Drawing 0J3001-A (shown with Molex style connectors.)



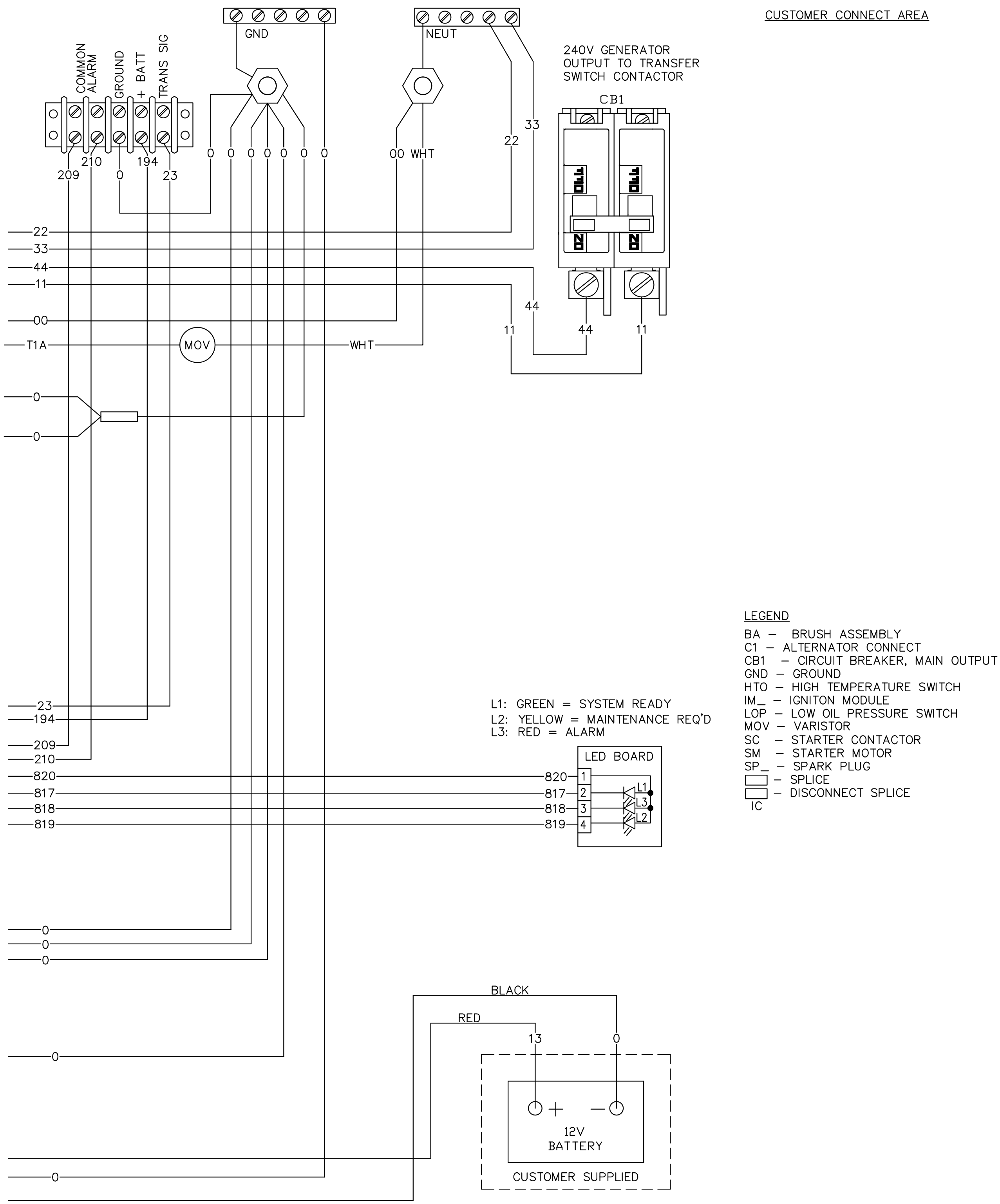
Wiring Diagram – Drawing 0J6765-A



Wiring Diagram – Drawing 0J6765-A



Electrical Schematic – Drawing 0J6765-A



Notes

APPENDIX B - CONTROLLER TROUBLESHOOTING STEPS

The procedure provided in this appendix should be performed FIRST when troubleshooting any air cooled unit.

Tools needed for the steps in these procedures are: a battery load tester; a calibrated VOM with voltage, Hz, Ohm and Diode check functions; Generac Test Probes part number 0J09460SRV (these test probes must be used when checking voltage and resistance on connector plugs).

The specific wiring diagram for the unit being worked on should always be used. There are several representative wiring diagrams included in this manual (see part 7 and Appendix A). Always use the correct pin-out diagram for the control panel being serviced; see Appendix-A for proper identification of the control panels and their respective pin-out charts.

If the following procedure is used consistently it will increase the technicians effectiveness at discerning the correct procedure to use for almost any fault the unit may experience.

1. Using the Alarm and Event Log sheet provided in this Appendix (on the following page), record the 10 most recent Alarm Log events and Run Log events recorded in the panel. Instructions for how to access the Alarm Log and Run Log are contained in this manual in Section 1.10. REMINDER: This Alarm/Event Log table must be filled out and submitted with any warranty claim for an Evolution or NEXUS controlled air-cooled unit.

2. If the most recent shutdown alarm sequence contains one or more of the below listed faults then use the remainder of this procedure to identify the cause. **If the most recent shutdown alarm sequence does NOT contain one or more of these faults, proceed by identifying the fault and use the appropriate section of this diagnostic manual to diagnose and correct the problem.**

   FAULTS

   - Undervoltage Shutdown
   - Overspeed Shutdown
   - No Transfer on Loss of Utility (using Generac Transfer Switches)
   - No Lights/Display on Controller Screen

3. Using the Flow chart(s) provided in this appendix, and the corresponding table for recording readings, follow the flow chart and record the values found in the appropriate table. It is critical that you use the correct wiring diagram and pinout for the unit being diagnosed. See Appendix-A of this manual to identify the different panel types (connector styles) and the corresponding connector pin-out charts.

IMPORTANT: When following a circuit fault and recording voltages or resistances, always start at the controller connection (verify correct wire and pin). **Use only the recommended probe tip for connecting to the connector pins; normal meter probe lead tips will damage the connector pins.** Some models may have one or more additional connectors in the circuit, if there is no reading at the connector at the controller, proceed to the next connector point (if applicable). Always begin at the connector on the controller (or as directed in the flow chart). If readings are not obtained at that point then check at the next connector (verify correct wire and pin), and so on down the circuit.

Date: ______________________________ Unit SN: ___________________________________

Control Assembly Number & Revision: _________________ Software Number & Revision: _______________
Software Version: __________________ Hardware Version: (from panel display): _______________

The controller assembly number/rev & software number/rev can be found on the labels on the face of the controller.

The controller software & hardware version can be found in the display menu. Use the proper Navigation Menu Map to locate the information.

Alarm log example
1. 09/15/10 04:55:22
Under Voltage - Error Code 1902

Run log example
1. 09/15/10 04:55:22
Stopped

Alarm log

1. ______________ ________________
____
2. ______________ ________________
____
3. ______________ ________________
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4. ______________ ________________
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5. ______________ ________________
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6. ______________ ________________
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7. ______________ ________________
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8. ______________ ________________
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9. ______________ ________________
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10. ______________ ________________
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Run log

1. ______________ ________________
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2. ______________ ________________
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3. ______________ ________________
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4. ______________ ________________
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5. ______________ ________________
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6. ______________ ________________
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7. ______________ ________________
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8. ______________ ________________
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9. ______________ ________________
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10. ______________ ________________
____

Log Sheet

IMPORTANT SAFETY NOTE: When checking for voltages while cranking the unit, the MLCB at the unit must be OPEN and the Fuel must be SHUT OFF.

Record the values found during the troubleshooting procedure in the appropriate table.

Under Voltage Fault - Table 1 – Appendix B Flow Chart Page 1

1A - ______________________ Vdc - Battery Voltage Check. If less than 12.5 Vdc perform the battery charger test Appendix B Flow Chart page 5.
1B - ______________________ Vdc - Field Boost Diode Check (less than 1V, good)
1C - ______________________ Ohms – Field Boost Diode Check (infinity, good)

If the diode is bad, and the harness is replaced submit the completed Log Sheet and Table 1 of this form with the warranty claim. Test the unit after the harness is replaced.

1D - ______________________ Ohms - Wire 4 to Ground. If there are multiple connector points, start at the controller connector (correct wire and pin) and record the value. If there is no reading at that point, move to the corresponding wire/pin at the next connector.

Under Voltage Fault - Table 2 – Appendix B Flow Chart Page 2

2A-1 - ____________________ Vdc – Battery voltage while cranking 1st test (3-5 seconds, fuel OFF)
2A-2 - ____________________ Vdc – Battery voltage while cranking 2nd test (3-5 seconds, fuel OFF)

If the battery voltage on the second crank test drops below 9.0 Vdc you must clean/check the battery connections and load test the battery. If the unit is operating in cold weather and does NOT have the appropriate cold weather kit, it must be installed.

2B - ______________________ Ohms - Wire 4 to Ground. If there are multiple connector points, start at the controller connector (correct wire and pin) and record the value. If there is no reading at that point, move to the corresponding wire/pin at the next connector.
2C - ______________________ VAC – Measure between wire 11-44 at MLCB, breaker Open, unit running. At this point, if the generator voltage is good, test the unit against the load. Place generator in AUTO, Close the MLCB, Open Utility and let the generator run against the load for 5 minutes. Submit all of the diagnostic information recorded so far (Log Sheet and Tables 1 & 2 on this form) to warranty with the claim for the diagnostic time (0.5 hours). If the generator output voltage is bad, continue as directed in the flow chart.
2D - ______________________ Ohms - Wire 0 to Negative Brush Connection. If there are multiple connector points, start at the controller connector (verify correct wire and pin) and record the value. If there is no reading at that point, move to the corresponding wire/pin at the next connector.
2E - ______________________ Ohms - Wire 4 to Positive Brush Connection. If there are multiple connector points, start at the controller connector (verify correct wire and pin) and record the value. If there is no reading at that point, move to the corresponding wire/pin at the next connector.

The results of 2D and 2E will determine if there is an open in the harness. If the harness is replaced, submit the Log Sheet and Table 2 of this form with the claim.

2F - ______________________ Brush condition and alignment
2G ______________________ Ohms – between positive and negative slip ring (brushes lifted)
2G-1 - ____________________ Ohms – Between positive slip ring and rotor shaft (brushes lifted)
2G-2 - ____________________ Ohms – Between negative slip ring and rotor shaft (brushes lifted)

The results of 2G will determine if the rotor is good. Readings of 6 to 16 Ohms between the slip rings indicates the rotor is good. The reading from slip ring to ground should indicate open.

Stator Short Test - Table 3 – Appendix B Flow Chart Page 3

3A - ______________________ VAC – Between wires 2 & 6 at connector while cranking (fuel OFF, MLCB Open). If there are multiple connector points, start at the controller connector (verify correct wire and pin) and record the value. If there is no reading at that point, move to the corresponding wire/pin at the next connector.
3B - ______________________ VAC – Between wires 11 & 44 at MLCB while cranking (fuel OFF, MLCB Open)
3C - ______________________ VAC – Between wires 11 & 44 at the controller connector while cranking (fuel OFF, MLCB Open). If there are multiple connector points, start at the controller connector (verify correct wire and pin) and record the value. If there is no reading at that point, move to the corresponding wires/pins at the next connector.

Stator Test - Table 4– Appendix B Flow Chart Page 4

4A - ______________________ Ohms – Between wires 2 & 6 at connector on controller. If there are multiple connector points, start at the controller connector (verify correct wire and pin) and record the value. If there is no reading at that point, move to the corresponding wires/pins at the next connector.

If this test shows wire 2 & 6 open at the last connector going to the stator, replace the stator.

4B - ______________________ Ohms – Between wires 11 at MLCB and Neutral (MLCB Open)
4B-1 - ____________________ Ohms – Between wires 11 & 22
4C - ______________________ Ohms – Between wires 44 at MLCB and Neutral (MLCB Open)
4C-1 - ____________________ Ohms – Between wires 44 & 33

If the resistance between either 11 & 22, or 44 & 33, shows open, the stator needs to be replaced.

4D - ______________________ Ohms – Between wires 11 & 44 at connector on controller. If there are multiple connector points, start at the controller connector (verify correct wire and pin) and record the value. If there is no reading at that point, move to the corresponding wires/pins at the next connector.

If the resistance between sensing wires 11 and 44 (going to the controller connector) shows open at the last connection point going into the stator, the stator needs to be replaced.

Battery Charger Test - Table 5 – Appendix B Flow Chart Page 5

1A - ______________________ Vdc – Battery Voltage less than 12.5 volts
5A - ______________________ VAC – T1 to Neutral at WAGO connections on generator
5B - ______________________ VAC – T1 to Neutral at controller connector
5C - ______________________ Battery Load test

If utility power is available to the control panel, and all connections between the controller and the battery are clean and tight, the battery voltage (charged and not-loaded) should remain above 12.5 volts. If the battery is going bad the charger will not be able to keep the battery voltage above 12.5 volts. Only a battery load test will reveal this.

Overspeed Alarm Test - Table 6 – Appendix B Flow Chart Page 6

6A - ______________________ Hz –

No Lights or Display on Controller Test - Table 7 – Appendix B Flow Chart Page 7

7A - ______________________ Vdc – Battery Voltage
7B - ______________________ Ohms – Measure between wire 0 at controller connector and battery ground cable (disconnected from battery).
7C - ______________________ Ohms – Measure between wire 13 at controller connector and battery positive cable (disconnected from battery).

If the fuse is good, and the battery voltage is good, and all of the connections from the battery to the controller are clean and tight, the controller display should light up. If it does not, replace the control panel.

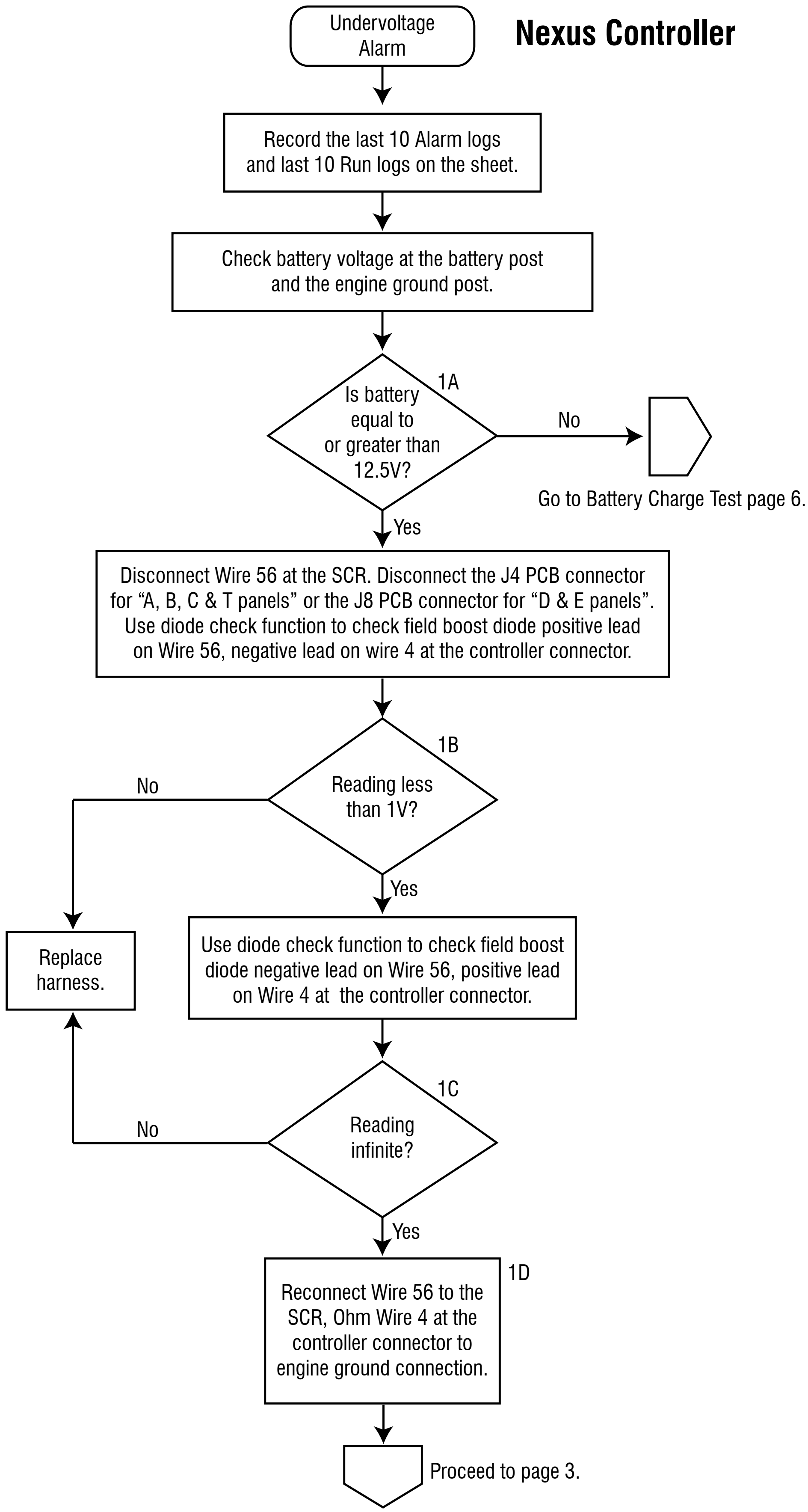
No Transfer on Utility Loss with Generator Running in Auto - Table 8– Appendix B Flow Chart Page 8

8A - ______________________ VAC – Measure voltage between E1 and E2 at the transfer switch.
8B - ______________________ VAC – Measure voltage at the generator MLCB on the load side (between E1 and E2).

If generator voltage is present on the generator side of the MCLB, and not on the load side (E1 & E2 to the transfer switch), there may be a breaker fault or a connection problem. Check the breaker and wiring to the switch.

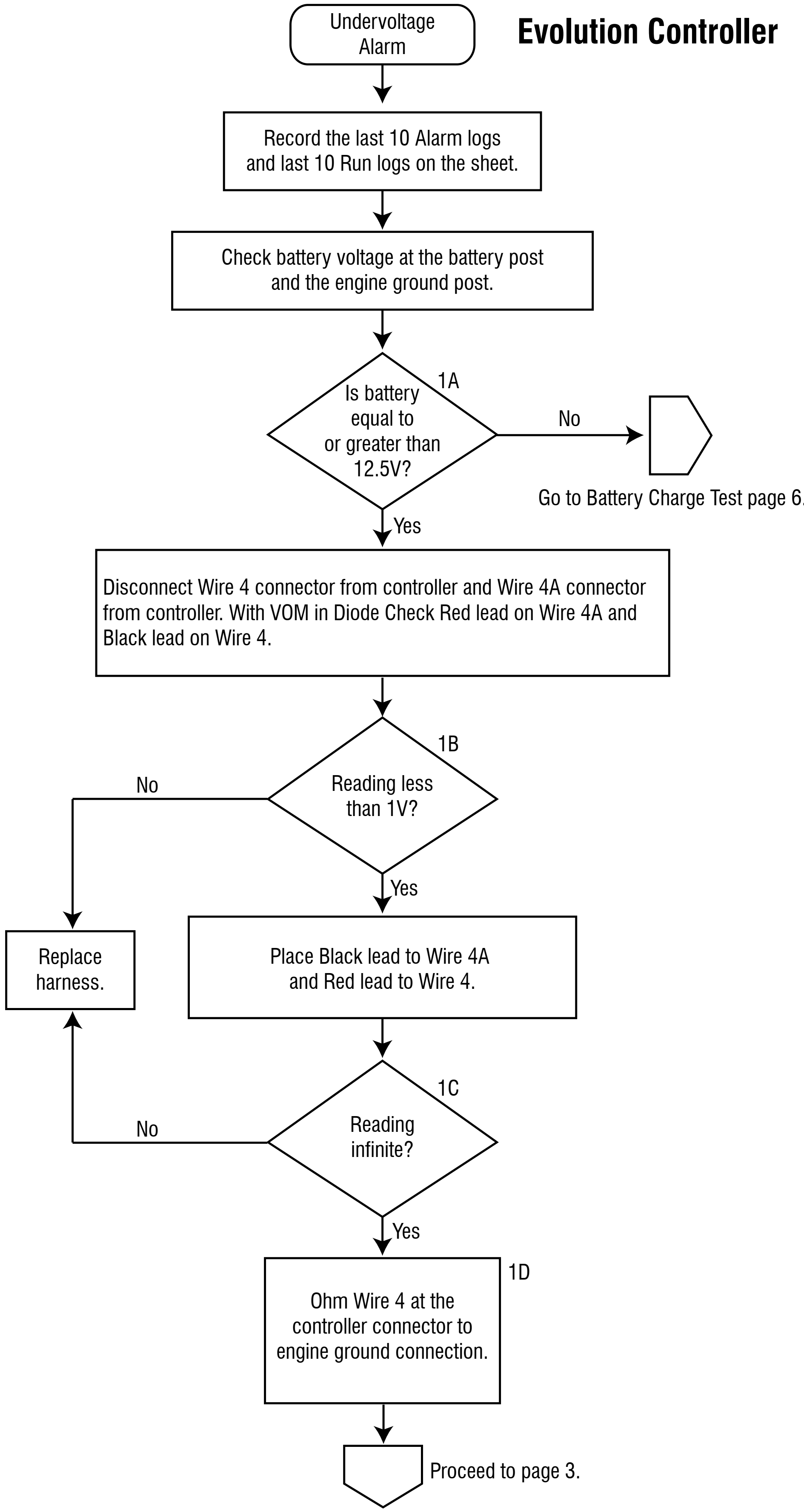
8C - ______________________ Vdc – Measure the voltage between wires 194 and 23 at the WAGO connection block with the generator in auto and running.
8D - ______________________ Vdc – Measure the voltage between wires 194 and 23 at the Transfer switch connection block with the generator in auto and running. If the voltage is present the problem is in the transfer switch. Refer to the appropriate transfer switch diagnostic manual for further troubleshooting.
8E - ______________________ Ohms – Measure between wire 194 at the WAGO connection and the controller connection.
8F - ______________________ Ohms – Measure between wire 23 at the WAGO connection and the controller connection.

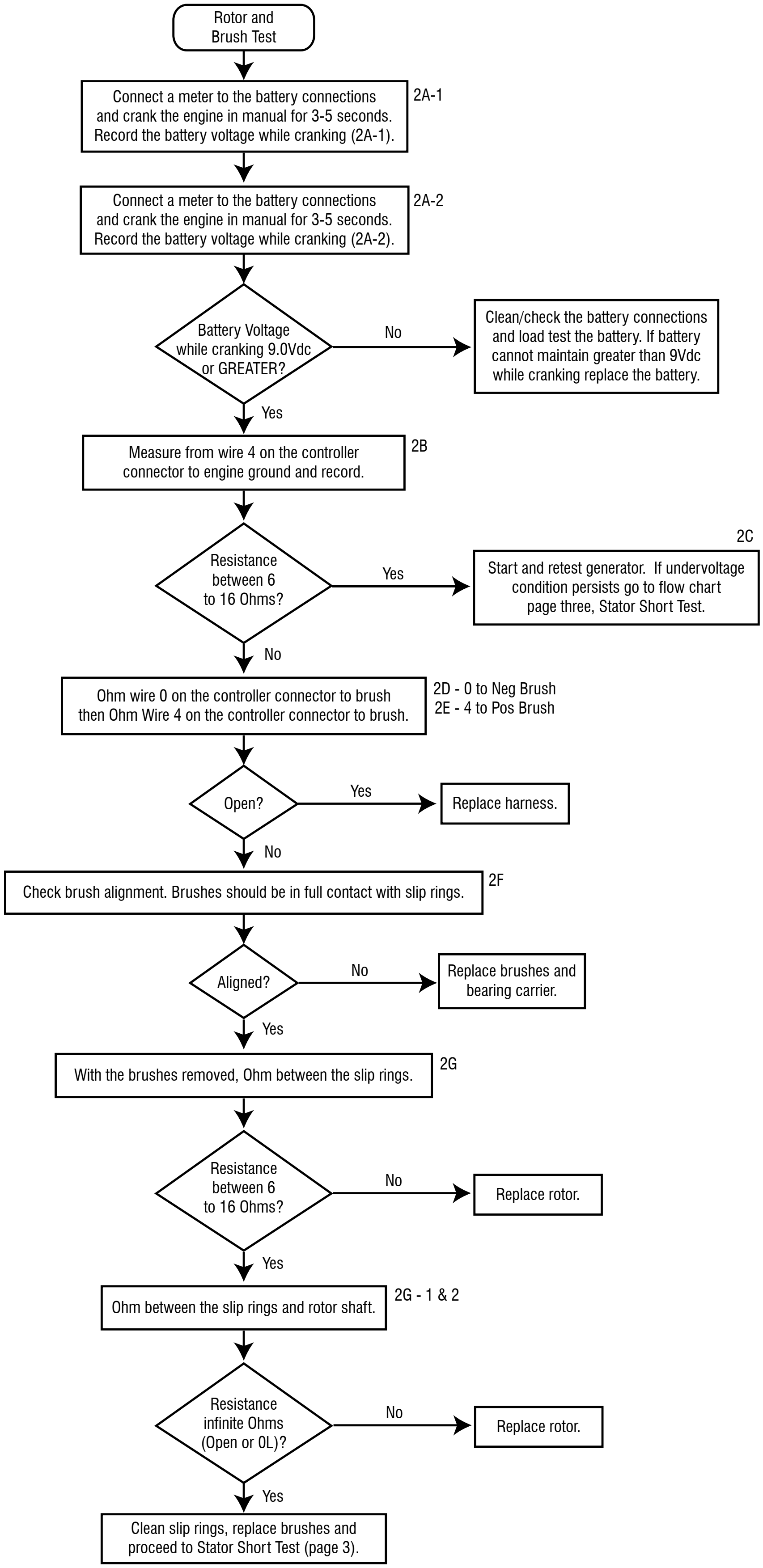
Nexus Controller

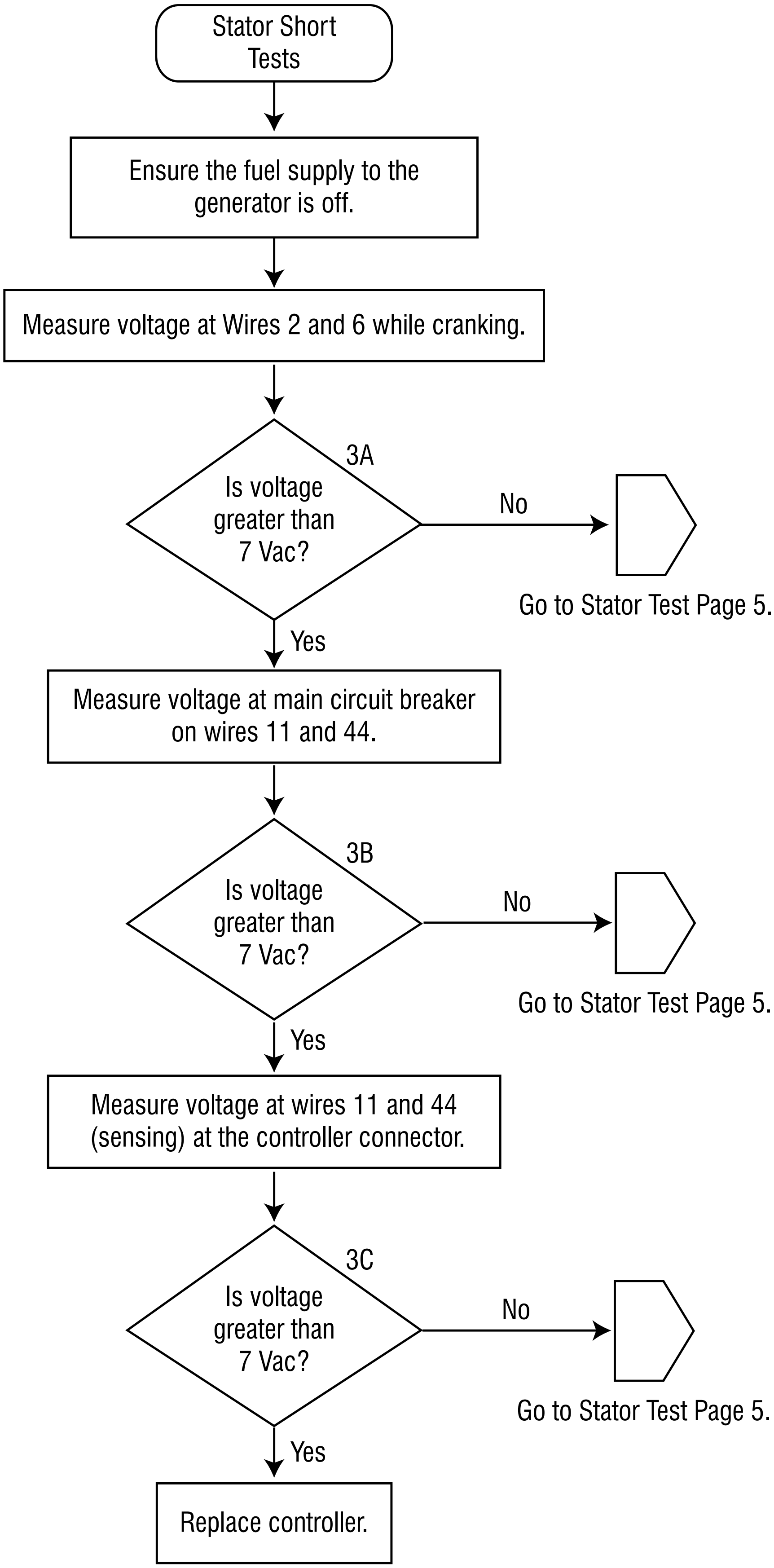


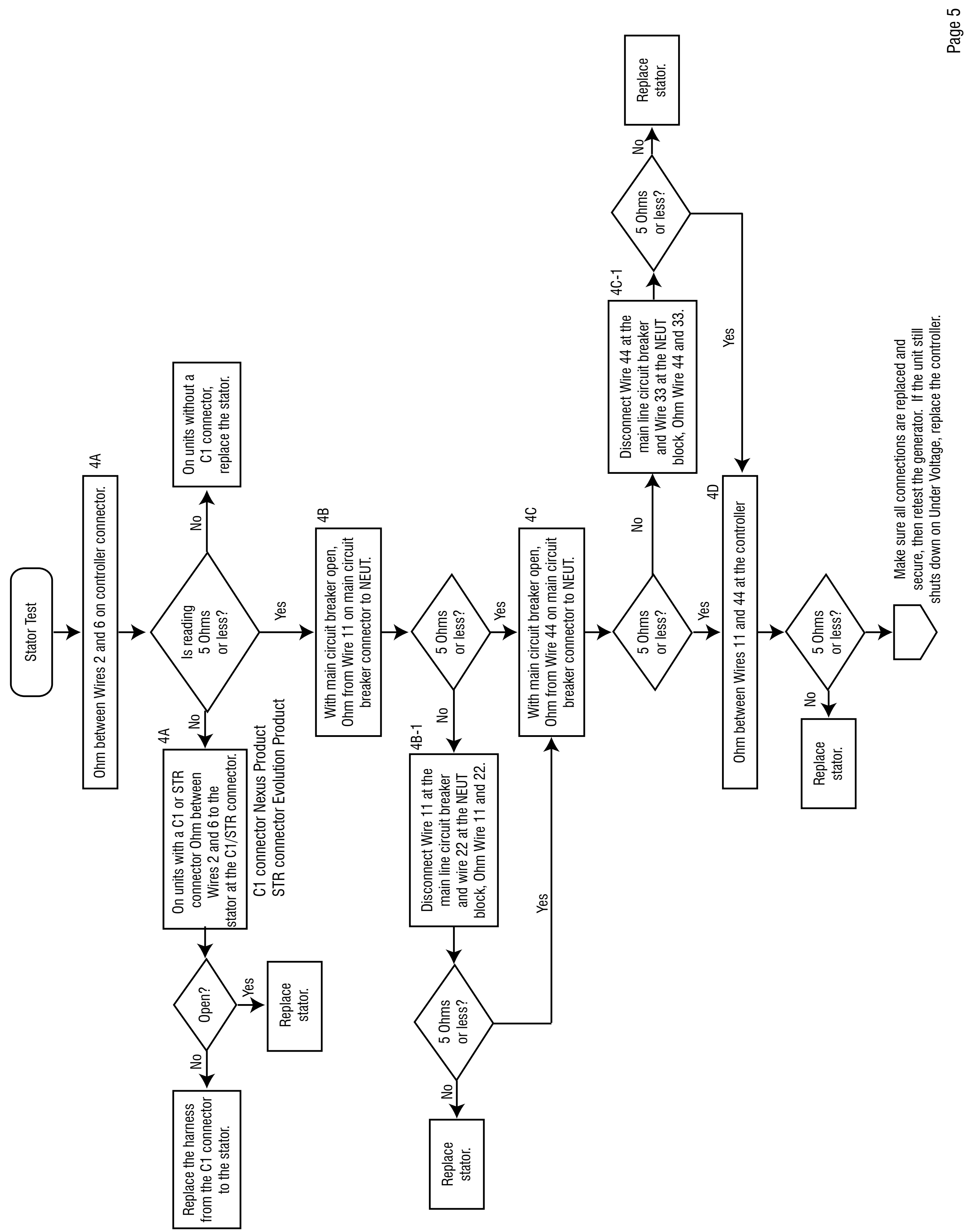
Page 1

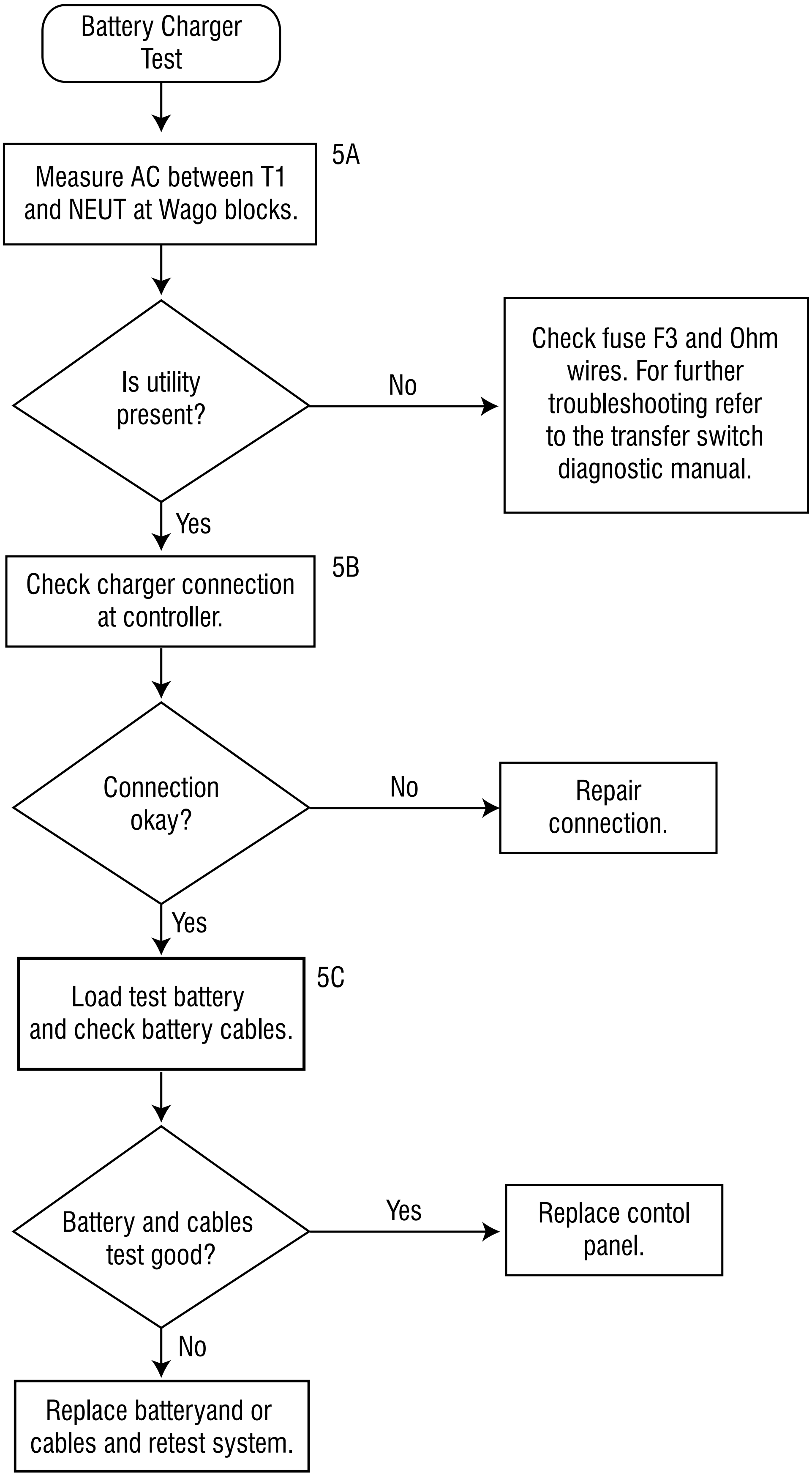
Evolution Controller



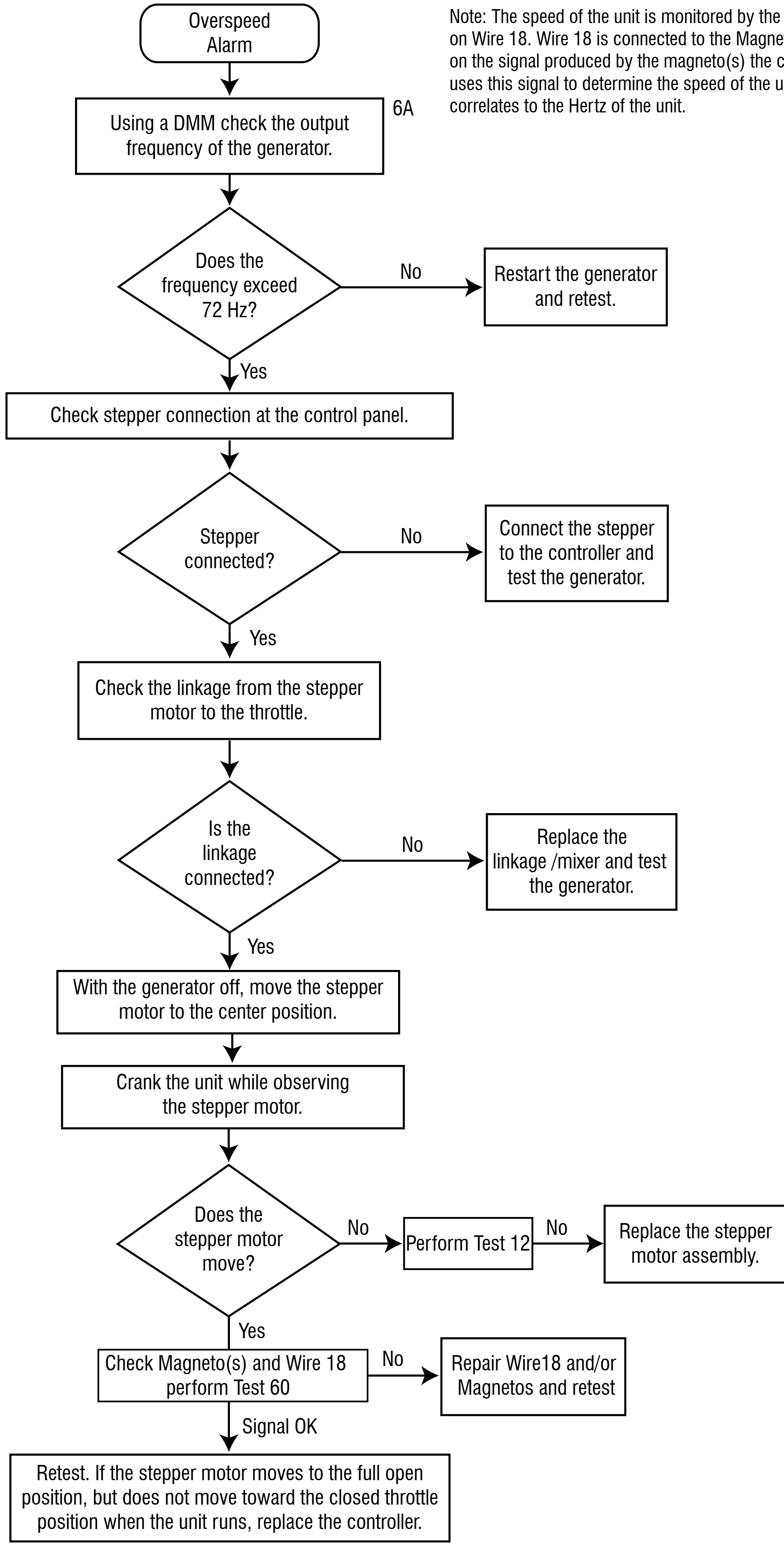

Rotor and Brush Test
Connect a meter to the battery connections and crank the engine in manual for 3-5 seconds. Record the battery voltage while cranking (2A-1).
2A-1
Connect a meter to the battery connections and crank the engine in manual for 3-5 seconds. Record the battery voltage while cranking (2A-2).
2A-2
Battery Voltage while cranking 9.0Vdc or GREATER?
No
Clean/check the battery connections and load test the battery. If battery cannot maintain greater than 9Vdc while cranking replace the battery.
Yes
Measure from wire 4 on the controller connector to engine ground and record.
2B
Resistance between 6 to 16 Ohms?
Yes
2C
Start and retest generator. If undervoltage condition persists go to flow chart page three, Stator Short Test.
No
Ohm wire 0 on the controller connector to brush then Ohm Wire 4 on the controller connector to brush.
2D - 0 to Neg Brush
2E - 4 to Pos Brush
Open?
Yes
Replace harness.
No
Check brush alignment. Brushes should be in full contact with slip rings.
2F
Aligned?
No
Replace brushes and bearing carrier.
Yes
With the brushes removed, Ohm between the slip rings.
2G
Resistance between 6 to 16 Ohms?
No
Replace rotor.
Yes
Ohm between the slip rings and rotor shaft.
2G - 1 & 2
Resistance infinite Ohms (Open or 0L)?
No
Replace rotor.
Yes
Clean slip rings, replace brushes and proceed to Stator Short Test (page 3).

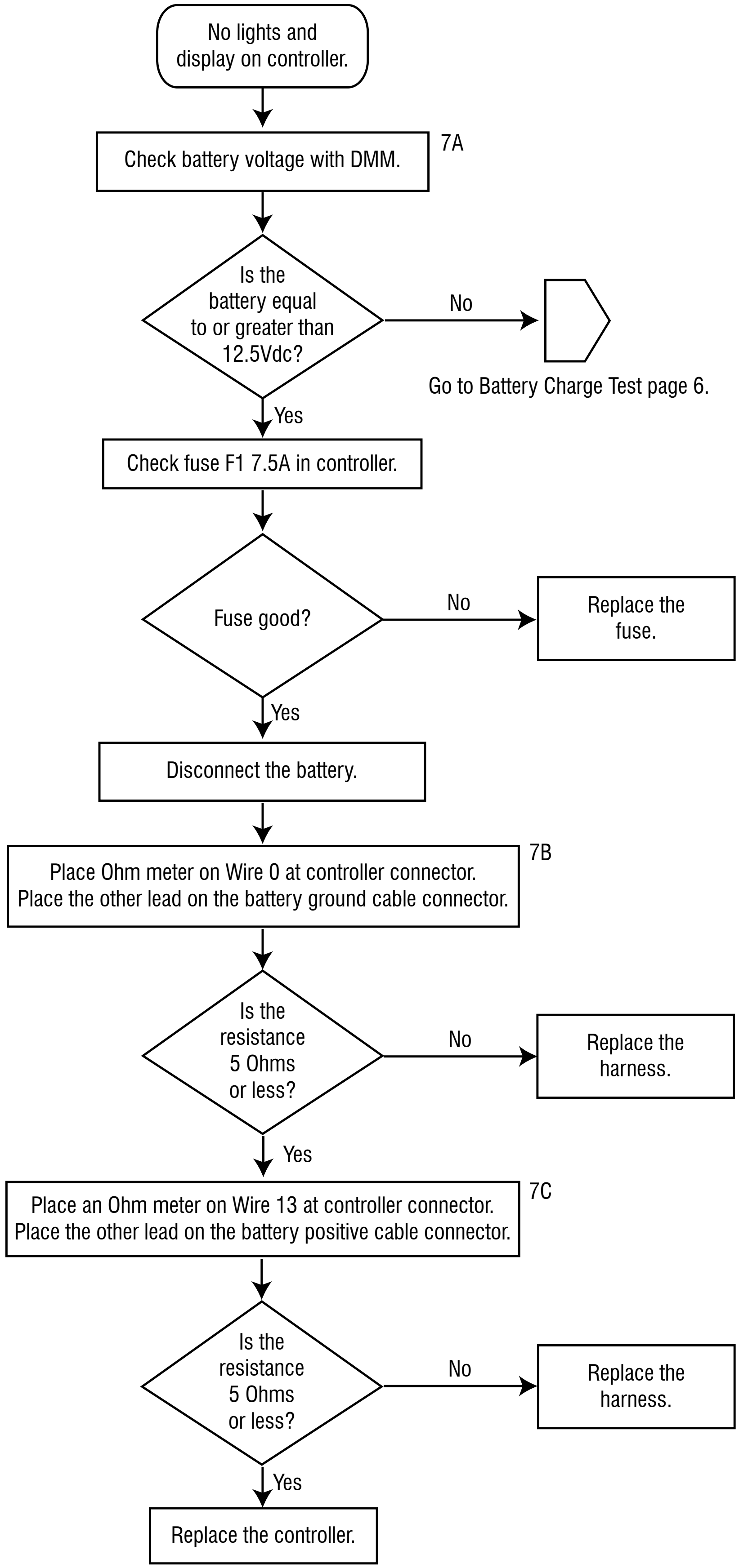

Stator Short Tests
Ensure the fuel supply to the generator is off.
Measure voltage at Wires 2 and 6 while cranking.
3A
Is voltage greater than 7 Vac?
No
Go to Stator Test Page 5.
Yes
Measure voltage at main circuit breaker on wires 11 and 44.
3B
Is voltage greater than 7 Vac?
No
Go to Stator Test Page 5.
Yes
Measure voltage at wires 11 and 44 (sensing) at the controller connector.
3C
Is voltage greater than 7 Vac?
No
Go to Stator Test Page 5.
Yes
Replace controller.

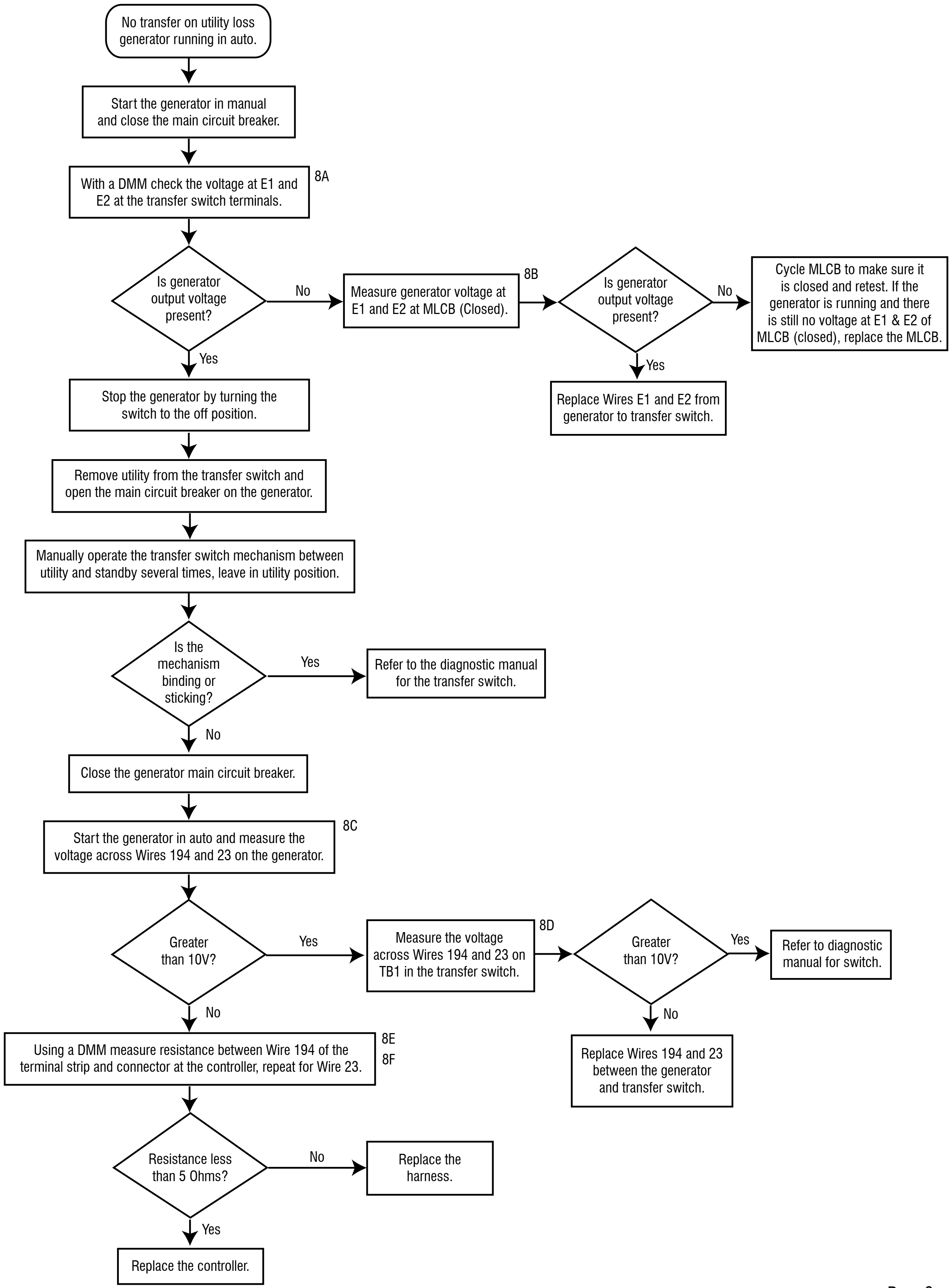

Page 5
Stator Test
4A
Ohm between Wires 2 and 6 on controller connector.
Is reading 5 Ohms or less?
No
On units without a C1 connector, replace the stator.
No
4A
On units with a C1 or STR connector Ohm between Wires 2 and 6 to the stator at the C1/STR connector.
C1 connector Nexus Product
STR connector Evolution Product
Open?
Yes
Replace stator.
No
Replace the harness from the C1 connector to the stator.
Yes
4B
With main circuit breaker open, Ohm from Wire 11 on main circuit breaker connector to NEUT.
5 Ohms or less?
No
4B-1
Disconnect Wire 11 at the main line circuit breaker and wire 22 at the NEUT block, Ohm Wire 11 and 22.
5 Ohms or less?
No
Replace stator.
Yes
Yes
4C
With main circuit breaker open, Ohm from Wire 44 on main circuit breaker connector to NEUT.
5 Ohms or less?
No
4C-1
Disconnect Wire 44 at the main line circuit breaker and Wire 33 at the NEUT block, Ohm Wire 44 and 33.
5 Ohms or less?
No
Replace stator.
Yes
Yes
4D
Ohm between Wires 11 and 44 at the controller
5 Ohms or less?
No
Replace stator.
Make sure all connections are replaced and secure, then retest the generator. If the unit still shuts down on Under Voltage, replace the controller.


Battery Charger Test
5A
Measure AC between T1 and NEUT at Wago blocks.
Is utility present?
No
Check fuse F3 and Ohm wires. For further troubleshooting refer to the transfer switch diagnostic manual.
Yes
5B
Check charger connection at controller.
Connection okay?
No
Repair connection.
Yes
5C
Load test battery and check battery cables.
Battery and cables test good?
Yes
Replace contol panel.
No
Replace batteryand or cables and retest system.

Note: The speed of the unit is monitored by the controller on Wire 18. Wire 18 is connected to the Magnetos. Based on the signal produced by the magneto(s) the controller uses this signal to determine the speed of the unit which correlates to the Hertz of the unit.




No lights and display on controller.
Check battery voltage with DMM.
7A
Is the battery equal to or greater than 12.5Vdc?
No
Go to Battery Charge Test page 6.
Yes
Check fuse F1 7.5A in controller.
Fuse good?
No
Replace the fuse.
Yes
Disconnect the battery.
Place Ohm meter on Wire 0 at controller connector. Place the other lead on the battery ground cable connector.
7B
Is the resistance 5 Ohms or less?
No
Replace the harness.
Yes
Place an Ohm meter on Wire 13 at controller connector. Place the other lead on the battery positive cable connector.
7C
Is the resistance 5 Ohms or less?
No
Replace the harness.
Yes
Replace the controller.


No transfer on utility loss generator running in auto.
Start the generator in manual and close the main circuit breaker.
With a DMM check the voltage at E1 and E2 at the transfer switch terminals.
8A
Is generator output voltage present?
No
Measure generator voltage at E1 and E2 at MLCB (Closed).
8B
Is generator output voltage present?
No
Cycle MLCB to make sure it is closed and retest. If the generator is running and there is still no voltage at E1 & E2 of MLCB (closed), replace the MLCB.
Yes
Replace Wires E1 and E2 from generator to transfer switch.
Yes
Stop the generator by turning the switch to the off position.
Remove utility from the transfer switch and open the main circuit breaker on the generator.
Manually operate the transfer switch mechanism between utility and standby several times, leave in utility position.
Is the mechanism binding or sticking?
Yes
Refer to the diagnostic manual for the transfer switch.
No
Close the generator main circuit breaker.
Start the generator in auto and measure the voltage across Wires 194 and 23 on the generator.
8C
Greater than 10V?
Yes
Measure the voltage across Wires 194 and 23 on TB1 in the transfer switch.
8D
Greater than 10V?
Yes
Refer to diagnostic manual for switch.
No
Replace Wires 194 and 23 between the generator and transfer switch.
No
Using a DMM measure resistance between Wire 194 of the terminal strip and connector at the controller, repeat for Wire 23.
8E
8F
Resistance less than 5 Ohms?
No
Replace the harness.
Yes
Replace the controller.

APPENDIX C - SUPPLEMENTAL WORKSHEETS

Table 9
Test 4 Results

Test 4 Results, Serial #________________________		
Test Point	Results	
Wires 2 and 6 Voltage		VAC
Wires 11 and 44 Voltage		VAC
Static Rotor Amp Draw		Amps
Running Rotor Amp Draw		Amps
Column Identified		

Test 4 Results, Serial #________________________		
Test Point	Results	
Wires 2 and 6 Voltage		VAC
Wires 11 and 44 Voltage		VAC
Static Rotor Amp Draw		Amps
Running Rotor Amp Draw		Amps
Column Identified		

Test 4 Results, Serial #________________________		
Test Point	Results	
Wires 2 and 6 Voltage		VAC
Wires 11 and 44 Voltage		VAC
Static Rotor Amp Draw		Amps
Running Rotor Amp Draw		Amps
Column Identified		

Test 4 Results, Serial #________________________		
Test Point	Results	
Wires 2 and 6 Voltage		VAC
Wires 11 and 44 Voltage		VAC
Static Rotor Amp Draw		Amps
Running Rotor Amp Draw		Amps
Column Identified		

Test 4 Results, Serial #________________________		
Test Point	Results	
Wires 2 and 6 Voltage		VAC
Wires 11 and 44 Voltage		VAC
Static Rotor Amp Draw		Amps
Running Rotor Amp Draw		Amps
Column Identified		

Test 4 Results, Serial #________________________		
Test Point	Results	
Wires 2 and 6 Voltage		VAC
Wires 11 and 44 Voltage		VAC
Static Rotor Amp Draw		Amps
Running Rotor Amp Draw		Amps
Column Identified		

Test 4 Results, Serial #________________________		
Test Point	Results	
Wires 2 and 6 Voltage		VAC
Wires 11 and 44 Voltage		VAC
Static Rotor Amp Draw		Amps
Running Rotor Amp Draw		Amps
Column Identified		

Test 4 Results, Serial #________________________		
Test Point	Results	
Wires 2 and 6 Voltage		VAC
Wires 11 and 44 Voltage		VAC
Static Rotor Amp Draw		Amps
Running Rotor Amp Draw		Amps
Column Identified		

Table 14
Test 7 Stator Results

Test 7 Stator Results, Serial #______________________		
Test Point A	Test Point B	Results
Resistance Tests		
Stator Lead Wire 11	Stator Lead 22	
Stator Lead Wire 33	Stator Lead 44	
C1 Pin 2 Wire 11	Stator Lead 22	
C1 Pin 1 Wire 44	Stator Lead 33	
C1 Pin 3 Wire 6	C1 Pin 4 Wire 2	
Shorts to Ground		
Stator Lead 11	Ground	
Stator Lead 44	Ground	
C1 Pin 1 Wire 44	Ground	
C1 Pin 2 Wire 11	Ground	
C1 Pin 4 Wire 2	Ground	
Shorted Condition		
C1 Pin 4 Wire 2	C1 Pin 2 Wire 11	
C1 Pin 4 Wire 2	C1 Pin 2 Wire 44	
C1 Pin 4 Wire 2	Stator Lead Wire 11	
C1 Pin 4 Wire 2	Stator Lead Wire 44	
Stator Lead 11	C1 Pin 1 Wire 44	
Stator Lead 11	Stator lead Wire 44	

Test 7 Stator Results, Serial #______________________		
Test Point A	Test Point B	Results
Resistance Tests		
Stator Lead Wire 11	Stator Lead 22	
Stator Lead Wire 33	Stator Lead 44	
C1 Pin 2 Wire 11	Stator Lead 22	
C1 Pin 1 Wire 44	Stator Lead 33	
C1 Pin 3 Wire 6	C1 Pin 4 Wire 2	
Shorts to Ground		
Stator Lead 11	Ground	
Stator Lead 44	Ground	
C1 Pin 1 Wire 44	Ground	
C1 Pin 2 Wire 11	Ground	
C1 Pin 4 Wire 2	Ground	
Shorted Condition		
C1 Pin 4 Wire 2	C1 Pin 2 Wire 11	
C1 Pin 4 Wire 2	C1 Pin 2 Wire 44	
C1 Pin 4 Wire 2	Stator Lead Wire 11	
C1 Pin 4 Wire 2	Stator Lead Wire 44	
Stator Lead 11	C1 Pin 1 Wire 44	
Stator Lead 11	Stator lead Wire 44	

Test 7 Stator Results, Serial #______________________		
Test Point A	Test Point B	Results
Resistance Tests		
Stator Lead Wire 11	Stator Lead 22	
Stator Lead Wire 33	Stator Lead 44	
C1 Pin 2 Wire 11	Stator Lead 22	
C1 Pin 1 Wire 44	Stator Lead 33	
C1 Pin 3 Wire 6	C1 Pin 4 Wire 2	
Shorts to Ground		
Stator Lead 11	Ground	
Stator Lead 44	Ground	
C1 Pin 1 Wire 44	Ground	
C1 Pin 2 Wire 11	Ground	
C1 Pin 4 Wire 2	Ground	
Shorted Condition		
C1 Pin 4 Wire 2	C1 Pin 2 Wire 11	
C1 Pin 4 Wire 2	C1 Pin 2 Wire 44	
C1 Pin 4 Wire 2	Stator Lead Wire 11	
C1 Pin 4 Wire 2	Stator Lead Wire 44	
Stator Lead 11	C1 Pin 1 Wire 44	
Stator Lead 11	Stator lead Wire 44	

Test 7 Stator Results, Serial #______________________		
Test Point A	Test Point B	Results
Resistance Tests		
Stator Lead Wire 11	Stator Lead 22	
Stator Lead Wire 33	Stator Lead 44	
C1 Pin 2 Wire 11	Stator Lead 22	
C1 Pin 1 Wire 44	Stator Lead 33	
C1 Pin 3 Wire 6	C1 Pin 4 Wire 2	
Shorts to Ground		
Stator Lead 11	Ground	
Stator Lead 44	Ground	
C1 Pin 1 Wire 44	Ground	
C1 Pin 2 Wire 11	Ground	
C1 Pin 4 Wire 2	Ground	
Shorted Condition		
C1 Pin 4 Wire 2	C1 Pin 2 Wire 11	
C1 Pin 4 Wire 2	C1 Pin 2 Wire 44	
C1 Pin 4 Wire 2	Stator Lead Wire 11	
C1 Pin 4 Wire 2	Stator Lead Wire 44	
Stator Lead 11	C1 Pin 1 Wire 44	
Stator Lead 11	Stator lead Wire 44	

Table 35

Test 66 Results

Test Point	Pin Location	Circuit	Result
1	*	Wire 14	
2	*	Wire 56	
3	*	Wire 194	
* Use Appendix A for pin locations			

Test Point	Pin Location	Circuit	Result
1	*	Wire 14	
2	*	Wire 56	
3	*	Wire 194	
* Use Appendix A for pin locations			

Test Point	Pin Location	Circuit	Result
1	*	Wire 14	
2	*	Wire 56	
3	*	Wire 194	
* Use Appendix A for pin locations			

Test Point	Pin Location	Circuit	Result
1	*	Wire 14	
2	*	Wire 56	
3	*	Wire 194	
* Use Appendix A for pin locations			

Test Point	Pin Location	Circuit	Result
1	*	Wire 14	
2	*	Wire 56	
3	*	Wire 194	
* Use Appendix A for pin locations			

Test Point	Pin Location	Circuit	Result
1	*	Wire 14	
2	*	Wire 56	
3	*	Wire 194	
* Use Appendix A for pin locations			

Test Point	Pin Location	Circuit	Result
1	*	Wire 14	
2	*	Wire 56	
3	*	Wire 194	
* Use Appendix A for pin locations			

Test Point	Pin Location	Circuit	Result
1	*	Wire 14	
2	*	Wire 56	
3	*	Wire 194	
* Use Appendix A for pin locations			

Test Point	Pin Location	Circuit	Result
1	*	Wire 14	
2	*	Wire 56	
3	*	Wire 194	
* Use Appendix A for pin locations			

Test Point	Pin Location	Circuit	Result
1	*	Wire 14	
2	*	Wire 56	
3	*	Wire 194	
* Use Appendix A for pin locations			

Test Point	Pin Location	Circuit	Result
1	*	Wire 14	
2	*	Wire 56	
3	*	Wire 194	
* Use Appendix A for pin locations			

Test Point	Pin Location	Circuit	Result
1	*	Wire 14	
2	*	Wire 56	
3	*	Wire 194	
* Use Appendix A for pin locations			

Test Point	Pin Location	Circuit	Result
1	*	Wire 14	
2	*	Wire 56	
3	*	Wire 194	
* Use Appendix A for pin locations			

Test Point	Pin Location	Circuit	Result
1	*	Wire 14	
2	*	Wire 56	
3	*	Wire 194	
* Use Appendix A for pin locations			

Test Point	Pin Location	Circuit	Result
1	*	Wire 14	
2	*	Wire 56	
3	*	Wire 194	
* Use Appendix A for pin locations			

Test Point	Pin Location	Circuit	Result
1	*	Wire 14	
2	*	Wire 56	
3	*	Wire 194	
* Use Appendix A for pin locations			

Generator Failure Analysis

Date: ___________________________________

Serial #: _________________________________

Failed Part #: _____________________________

Describe the symptoms of the fault:

____

____

____

____

Fill in the test number performed during troubleshooting and indicate if it passed or failed. If it failed the test, describe what part of the test failed.

Problem # ____________________

1.) Test #	**2.) Test #**	**3.) Test #**
Pass ❑ Fail ❑	Pass ❑ Fail ❑	Pass ❑ Fail ❑
Reason:	Reason:	Reason:
4.) Test #	**5.) Test #**	**6.) Test #**
Pass ❑ Fail ❑	Pass ❑ Fail ❑	Pass ❑ Fail ❑
Reason:	Reason:	Reason:
7.) Test #	**8.) Test #**	**9.) Test #**
Pass ❑ Fail ❑	Pass ❑ Fail ❑	Pass ❑ Fail ❑
Reason:	Reason:	Reason:
Summary of why generator failed or which part was no longer operational.		

Generator Failure Analysis

Date: ________________________________

Serial #: ______________________________

Failed Part #: __________________________

Describe the symptoms of the fault:

____

____

____

____

Fill in the test number performed during troubleshooting and indicate if it passed or failed. If it failed the test, describe what part of the test failed.

Problem # __________________

1.) Test #	**2.) Test #**	**3.) Test #**
Pass ❑ Fail ❑	Pass ❑ Fail ❑	Pass ❑ Fail ❑
Reason:	Reason:	Reason:
4.) Test #	**5.) Test #**	**6.) Test #**
Pass ❑ Fail ❑	Pass ❑ Fail ❑	Pass ❑ Fail ❑
Reason:	Reason:	Reason:
7.) Test #	**8.) Test #**	**9.) Test #**
Pass ❑ Fail ❑	Pass ❑ Fail ❑	Pass ❑ Fail ❑
Reason:	Reason:	Reason:
Summary of why generator failed or which part was no longer operational.		

Generator Failure Analysis

Date: ________________________________

Serial #: ______________________________

Failed Part #: ___________________________

Describe the symptoms of the fault:

____

____

____

____

Fill in the test number performed during troubleshooting and indicate if it passed or failed. If it failed the test, describe what part of the test failed.

Problem # ____________________

1.) Test #	**2.) Test #**	**3.) Test #**
Pass ❑ Fail ❑	Pass ❑ Fail ❑	Pass ❑ Fail ❑
Reason:	Reason:	Reason:
4.) Test #	**5.) Test #**	**6.) Test #**
Pass ❑ Fail ❑	Pass ❑ Fail ❑	Pass ❑ Fail ❑
Reason:	Reason:	Reason:
7.) Test #	**8.) Test #**	**9.) Test #**
Pass ❑ Fail ❑	Pass ❑ Fail ❑	Pass ❑ Fail ❑
Reason:	Reason:	Reason:
Summary of why generator failed or which part was no longer operational.		

Generator Failure Analysis

Date: ______________________________

Serial #: ____________________________

Failed Part #: _________________________

Describe the symptoms of the fault:

____

____

____

____

Fill in the test number performed during troubleshooting and indicate if it passed or failed. If it failed the test, describe what part of the test failed.

Problem # ________________

1.) Test #	**2.) Test #**	**3.) Test #**
Pass ❑ Fail ❑	Pass ❑ Fail ❑	Pass ❑ Fail ❑
Reason:	Reason:	Reason:
4.) Test #	**5.) Test #**	**6.) Test #**
Pass ❑ Fail ❑	Pass ❑ Fail ❑	Pass ❑ Fail ❑
Reason:	Reason:	Reason:
7.) Test #	**8.) Test #**	**9.) Test #**
Pass ❑ Fail ❑	Pass ❑ Fail ❑	Pass ❑ Fail ❑
Reason:	Reason:	Reason:

Summary of why generator failed or which part was no longer operational.

Generator Failure Analysis

Date: ______________________________

Serial #: ____________________________

Failed Part #: _________________________

Describe the symptoms of the fault:

____

____

____

____

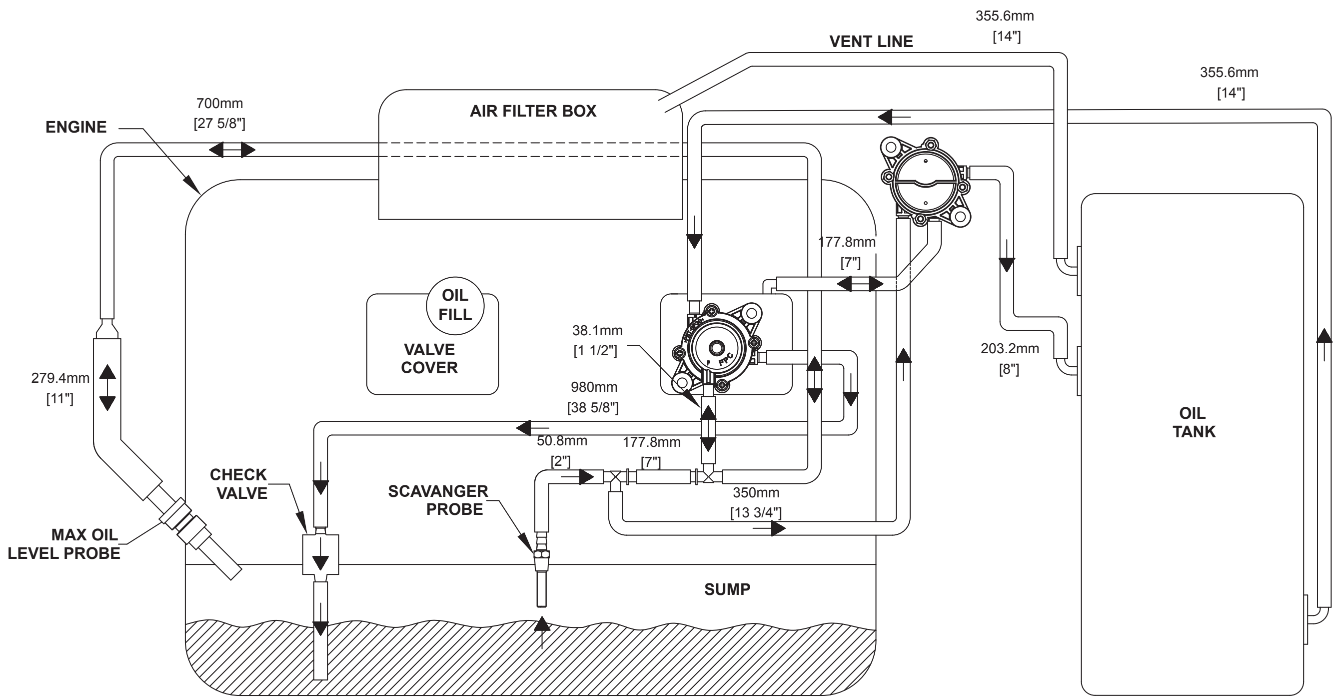
Fill in the test number performed during troubleshooting and indicate if it passed or failed. If it failed the test, describe what part of the test failed.

Problem # ____________________

1.) Test #	**2.) Test #**	**3.) Test #**
Pass ❑ Fail ❑	Pass ❑ Fail ❑	Pass ❑ Fail ❑
Reason:	Reason:	Reason:
4.) Test #	**5.) Test #**	**6.) Test #**
Pass ❑ Fail ❑	Pass ❑ Fail ❑	Pass ❑ Fail ❑
Reason:	Reason:	Reason:
7.) Test #	**8.) Test #**	**9.) Test #**
Pass ❑ Fail ❑	Pass ❑ Fail ❑	Pass ❑ Fail ❑
Reason:	Reason:	Reason:
Summary of why generator failed or which part was no longer operational.		

NOTES

APPENDIX D - ECOGEN DRAWINGS



Pump 1 – 0H7726

- Draws oil from reservoir tank to replenish sump
- Pulse is controlled by the scavenger probe and the max oil probe

Pump 2 – 0F6263 (New Style)

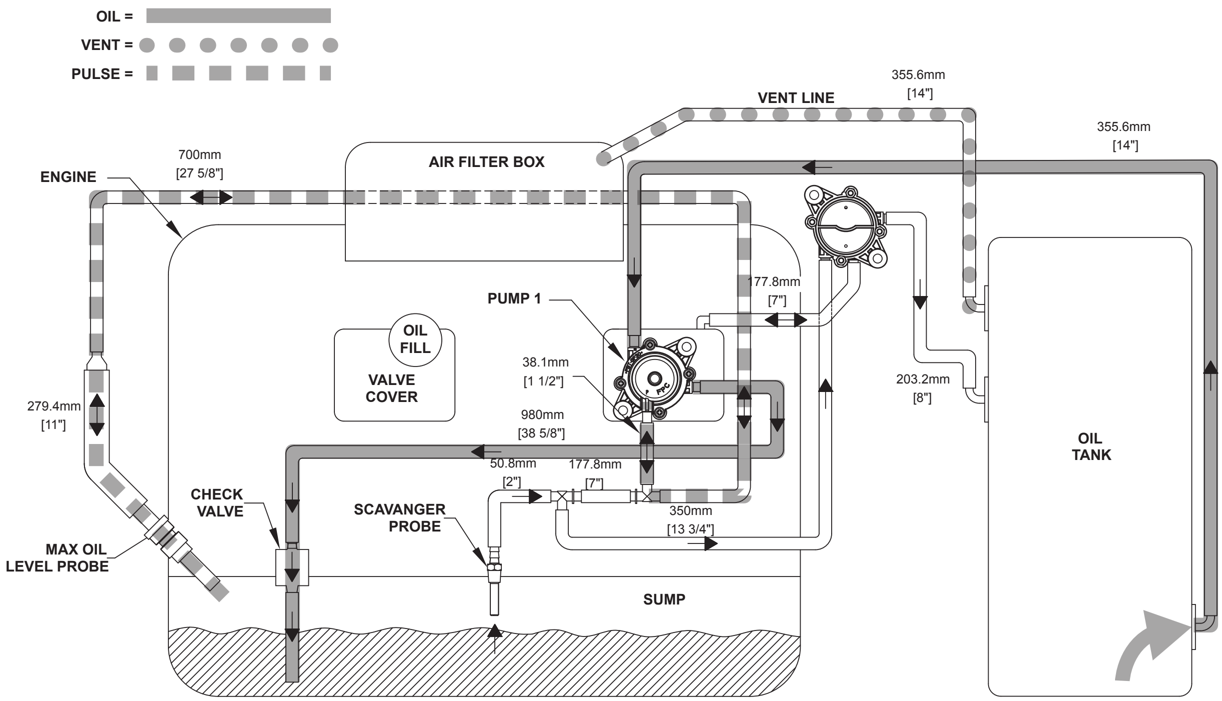
- Draws oil from engine crankcase to the reservoir tank
- Scavenger probe must be submerged to operate properly

Caution: Incorrect routing of the hoses in the oil make-up circuit can cause the crankcase to fill with excessive amounts of oil. Inspect for proper hose routing to the pumps and if necessary, follow the procedures identified in the Service information bulletin (SIB13-09-EcoGen).

Pump 2 – 0C4147 (Old Style)

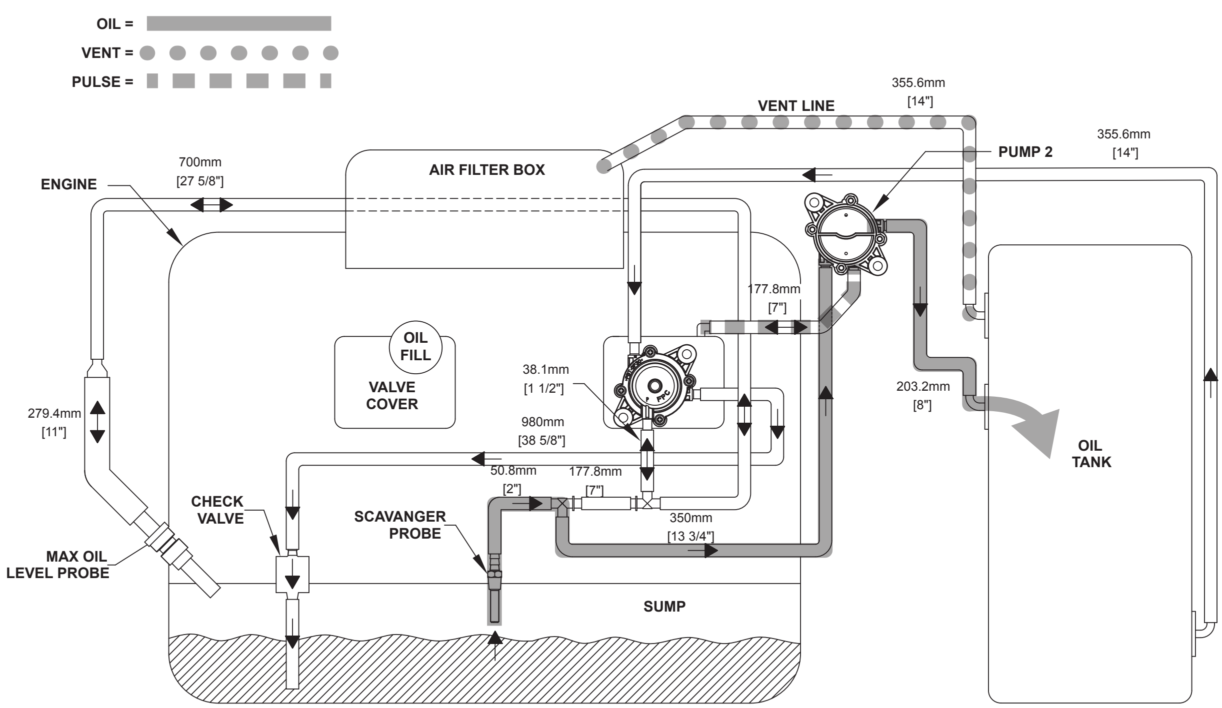
- Draws oil from engine crankcase to the reservoir tank
- Scavenger probe must be submerged to operate properly

Pump 1 Operation

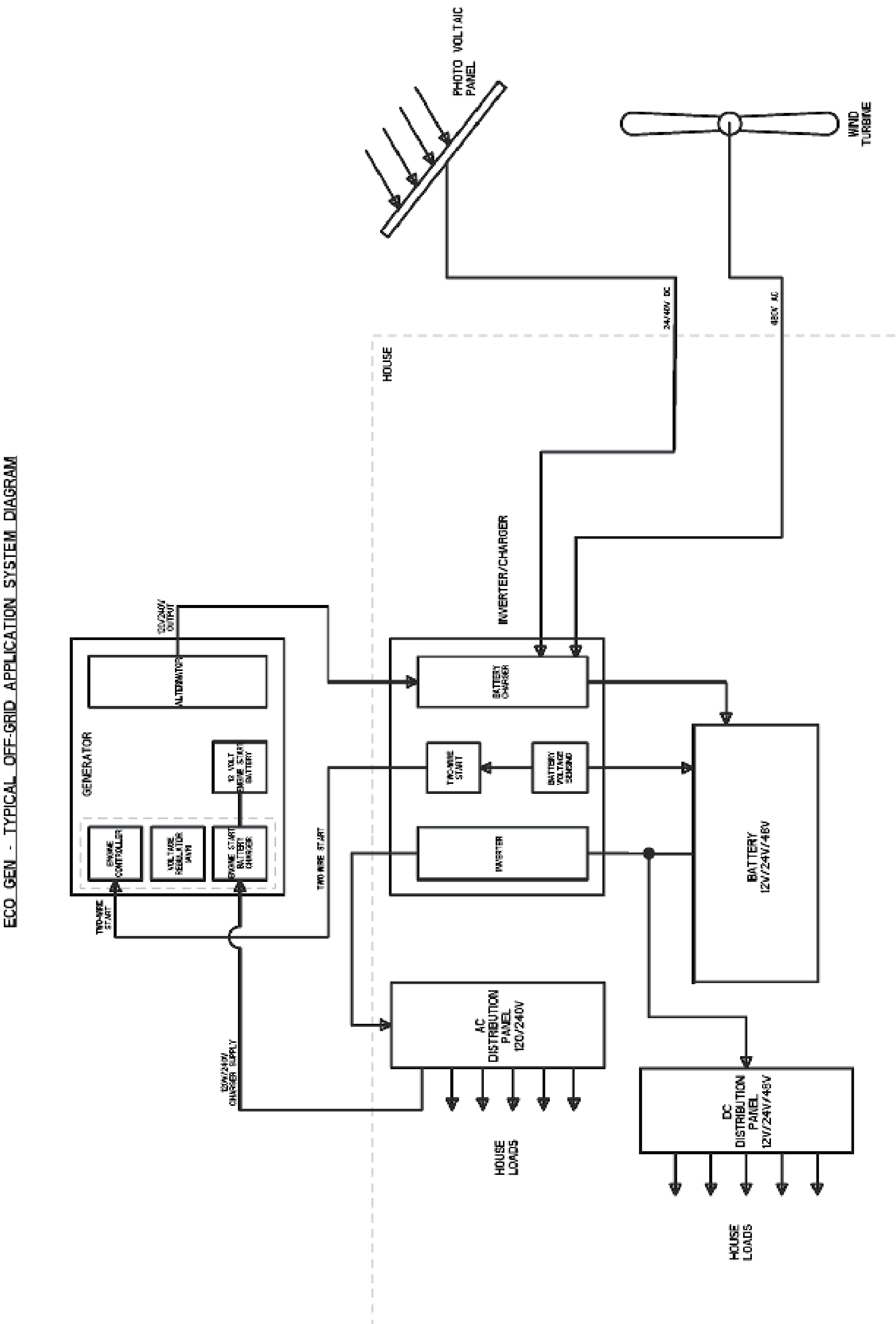


Pump 1 draws oil from reservoir tank to replenish sump with the pulse being controlled by the scavenger probe and the max oil level probe. When the scavenger and max oil probes are submersed in oil, the pulse to pump 1 is stopped.

Pump 2 Operation



Pump 2 draws oil from engine crankcase to the reservoir tank, essentially keeping the crankcase full. The scavenger probe must be submerged in the crankcase oil for it to pull oil from the crankcase. This stops the flow of oil from the reservoir tank to the engine crankcase.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HOUSE
INVERTER/CHARGER
BATTERY CHARGER
TWO-WIRE START
BATTERY VOLTAGE SENSING
INVERTER
BATTERY 12V/24V/48V
GENERATOR
ALTERNATOR
120/240V OUTPUT
12 VOLT ENGINE START BATTERY
ENGINE CONTROLLER
ENGINE START BATTERY CHARGER
TWO-WIRE START
AC DISTRIBUTION PANEL 120/240V
DC DISTRIBUTION PANEL 12V/24V/48V
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