



OPERATION & SERVICE MANUAL



**Models: 11-4290-0000
11-4090-0000
400Hz/28.5 VDC
Ground Power Unit**



05/2024 — Rev. 07

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REVISION	DATE	TEXT AFFECTED
01	10/2018	Original Release
02	03/2019	Added 10.3 Engine Replacement Parts
03	11/2019	Updated 13.0 Appendices
04	03/2020	Modified 5.3.2 Control Panel Software Settings, 5.4.3 Supplying 400 Hz Power to the Aircraft, 5.4.4 Supplying DC Power to the Aircraft, and 8.0 Trouble Shooting
05	07/2020	Modified Parts List
06	11/2022	Modified Parts List
07	05/2027	Added 1.6 Cold Weather Features, Modified 10.2 Recommended Spare Parts List

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This product can not be modified without the written approval of Tronair, Inc. Any modifications done without written approval voids all warranties and releases Tronair, Inc., its suppliers, distributors, employees, or financial institutions from any liability from consequences that may occur. Only Tronair OEM replacement parts shall be used.

1.0 PRODUCT INFORMATION

1.1 DESCRIPTION

Diesel Powered GPU, 400Hz / 28.5 VDC Output, Tier 4 final

1.2 MODEL & SERIAL NUMBER

See Nameplate on GPU or main controller

1.3 MANUFACTURER

TRONAIR, Inc.
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1.4 FUNCTION

The 11-4290-0000 (11-4090-0000) Ground Power Unit (GPU), is a diesel powered unit designed to serve as a 400Hz AC (28.5 volt DC) power source for parked aircraft. It can provide 115V/200V 90kVA AC power (28.5VDC, 600 amps continuous and up to 2000 amps peak) for aircraft servicing. (The 28.5V Current Limit (Soft Start) feature allows the user to select current limits for operations requiring current limit below the maximum output).

1.5 REQUIREMENTS

The GPU must run on ultra-low sulfur Diesel Fuel only! The fuel filter is a disposable spin on type and must be changed every 500 hours of running time.

1.6 COLD WEATHER FEATURES

- 12 V control and starting circuitry for easy cold weather starting
- Automated glow plug control
- 12 V block heater
- Insulated engine enclosure for cold weather starting and sound dampening

2.0 SAFETY INFORMATION



WARNING!

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

2.1 USAGE AND SAFETY INFORMATION

The GPU provides 115V/200V, 400Hz AC power and (28.5 Volts DC) for performing aircraft service and maintenance.

To insure safe operations please read the following statements and understand their meaning. Also refer to your equipment manufacturer's manual for other important safety information. This manual contains safety precautions, which are explained below. Please read carefully.



WARNING! — Warning is used to indicate the presence of a hazard that **can cause severe personal injury, death, or substantial property damage** if the warning notice is ignored.

CAUTION! — Caution is used to indicate the presence of a hazard that **will or can cause minor personal injury or property damage** if the caution notice is ignored.

2.2 EXPLANATION OF WARNING & DANGER SIGNS



WARNING! Accidental Starts! Always turn off and lock out the battery switch before servicing this GPU. Only qualified service personnel may service this equipment. Read and understand the technical manual before servicing this equipment.



WARNING! Rotating Parts! Keep hands, feet, hair, and clothing away from all moving parts to prevent injury. Never operate the GPU with doors open or panels and guards removed.



WARNING! Electrical Shock! Caution: This GPU produces voltages and current sufficient to cause burns and death by electric shock! Always inspect cables and plugs for damage before use. Do not use if damaged. Always turn DC power to off before connecting or disconnecting cables. The human body has decreased resistance when wet; keep hands, feet and clothes dry when operating electrical equipment. Do not open doors or remove panels while the GPU is running. High current electrical components will be exposed. Always turn off and lock out the battery switch before servicing this GPU.



WARNING! Hot Surfaces! Engine components such as turbo chargers, exhaust pipes, and mufflers will remain hot after the engine has been shut down. Allow engine to cool before servicing.



WARNING! Batteries! Batteries give off flammable hydrogen gas and can explode if ignited. When servicing, do not allow arcing, sparks, or open flame near the battery. Acid and arcing from a ruptured battery can cause fires and additional damage.



WARNING! Fuel Hazard! Use only approved containers for transferring fuel. Shut down GPU before refueling. Fires and explosions can occur if the fuel tank is not grounded. Ground fuel tank before and during fuel transfer. Clean up all fuel spills immediately.



WARNING! Carbon Monoxide! Engine exhaust fumes can kill. If indoors, always pipe or vent exhaust fumes to a suitable exhaust duct. Never locate engine exhaust near air conditioner intake ducts.



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

No Access for Unauthorized Persons! Only qualified personnel may service this equipment.

Read Operation Manual! Read and understand the operation manual before using this equipment. Failure to follow operating instructions could result in death or serious injury.

Read Technical Manual! Read and understand technical manual before servicing.

Lockout! Shut down engine. Turn off and lockout the battery switch before servicing. If working near the battery or the battery switch, also disconnect the negative battery cable on the battery.

Loud Noise Hazard! Ear protection must be worn while operating this equipment.

2.3 COMPONENT SAFETY FEATURES

- Sheet metal panels
- Maintenance locks on doors
- Scrub brake system

2.4 FUNCTIONAL SAFETY FEATURES

- Emergency shut off switch
- Timed engine shut down
- Over current protection circuit
- Over voltage protection circuit
- Cable interlock protection circuit
- Battery shut off switch

2.5 PERSONAL PROTECTION EQUIPMENT

- Safety glasses and ear protection must be worn when operating the GPU
- Additional equipment required by employer (gloves, vest, etc.)

2.6 SAFETY GUIDELINES

- Operator must be properly trained prior to operating the GPU
- Pre-operation check must be performed before each use. (Refer to operating instructions)
- AC and DC contactors must be OFF when connecting and disconnecting the cable from the aircraft
- Use emergency stop for emergency only. Normal shut down is accomplished by pressing power off. This allows the engine to cool for one minute at idle speed before shutting off. Unit will power down completely one minute after the engine shuts off
- Always shut the unit off, allow to cool and turn the battery switch to OFF before performing service or maintenance. If working near the battery or the battery switch, also disconnect the negative battery cable on the battery.

2.7 GENERAL COMMENTS

The GPU is intended to be operated by personnel trained in the proper use in conjunction with the aircraft maintenance manual.

The GPU must be used in accordance with the Technical and Operator Manuals and the intended aircraft.

3.0 PREPARATION PRIOR TO FIRST USE

3.1 GENERAL

Prior to operating the GPU, the user must become familiar with this Operator Manual.

3.2 PRE-USE INSPECTION

CAUTION!



A pre-use inspection must be carried out prior to each use to ensure safe operation of the GPU. Failure to carry out these procedures listed below may result in severe damage to the GPU or prevent efficient operation.

1. Unit..... Visually inspect outside of GPU for loose hardware, loose parts, frayed wires/cables and general appearance
2. Radiator..... Open side access door and ensure that fluid is present in the radiator overflow container. Service as required
3. Engine Hoses..... Check integrity of hoses and clamps for tightness
4. Fuel Level..... Turn power on and check fuel level on fuel gauge. Top up as required with fuel. Always fill DEF fluid when re-fueling
5. DEF fluid level Open access door next to fuel fill to check DEF fluid level (or check on main controller), refill DEF fluid tank
6. Engine Inspect all fuel lines and fittings for traces of fuel leakage. Visually inspect cylinder block, oil pan, and valve covers for oil leakage
7. Oil Level Remove dipstick to ensure oil level is at full mark. Replenish as required
8. Fan Belt..... Check belt for correct tension. Look for wear
9. Air Intake Filter Ensure that filter inlet is not restricted
10. Tires Check integrity of tires and tread wear and pressure
11. Brakes Check for proper operation

4.0 TRAINING

4.1 TRAINING REQUIREMENTS

The employer of the operator is responsible for providing a training program sufficient for the safe operation of the GPU.

4.2 TRAINING PROGRAM

The employer-provided operator training program should cover safety procedures concerning use of the GPU in and around the intended aircraft at the intended aircraft servicing location.

4.3 OPERATOR TRAINING

The operator training should provide the required training for safe operation of the GPU.

NOTE: Maintenance and Trouble Shooting are to be performed by a skilled and trained technician.

5.0 OPERATION

5.1 OPERATING PARAMETERS

- The user shall use the GPU in accordance with the aircraft manufacturer's instructions.
- The user shall operate the GPU in accordance with the Technical and Operator Manuals.
- The employer of the operator shall provide all necessary training.

5.2 NUMERICAL VALUES

5.2.1 Physical

Weight (Dry) 4000 lbs (1814 kg)
Width 79-1/8 in (201 cm)
Height 74-7/16 in (189 cm)
Length 113-1/2 in (288 cm)
Output Cable 30 ft (9.1 m) long (AC and DC)
Color Tronair Blue

5.2.2 Engine

Doosan D34 3.4 Liter turbocharged after cooled, 4 cylinder, 4 stroke diesel engine
Horsepower 121 hp (90.3 kW) at 2000 rpm
Electrical System 12 volt, negative ground
Capacities
- Lubricating oil 3.4 gal (12.8 liters) w/filter
- Coolant 1.41 gal (5.1 liters)(engine only)

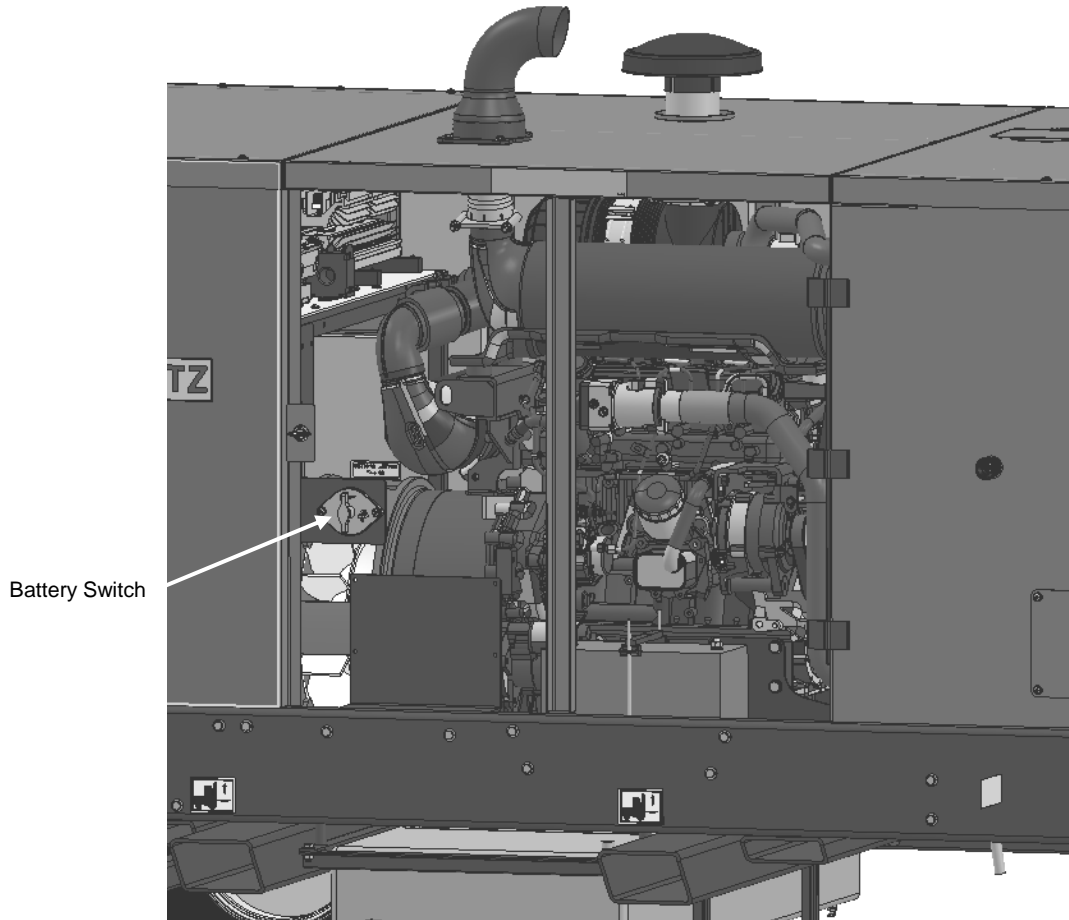
5.2.3 Alternator

Mecc Alte Synchronous Generator
Output Voltage 115/200 volts AC, 3 phase with neutral
Output Power 80 kW
- Power Factor 0.8
- Ambient Temp °C 40
- Temperature Rise °C 150
- Speed 2000 RPM
- Frequency 400HZ
- Excitation Externally regulated 66 volts DC, 4 amps
- Insulation Class H, IP21
- Single Bearing Sealed, pre-lubricated

5.2.4 Rectifier

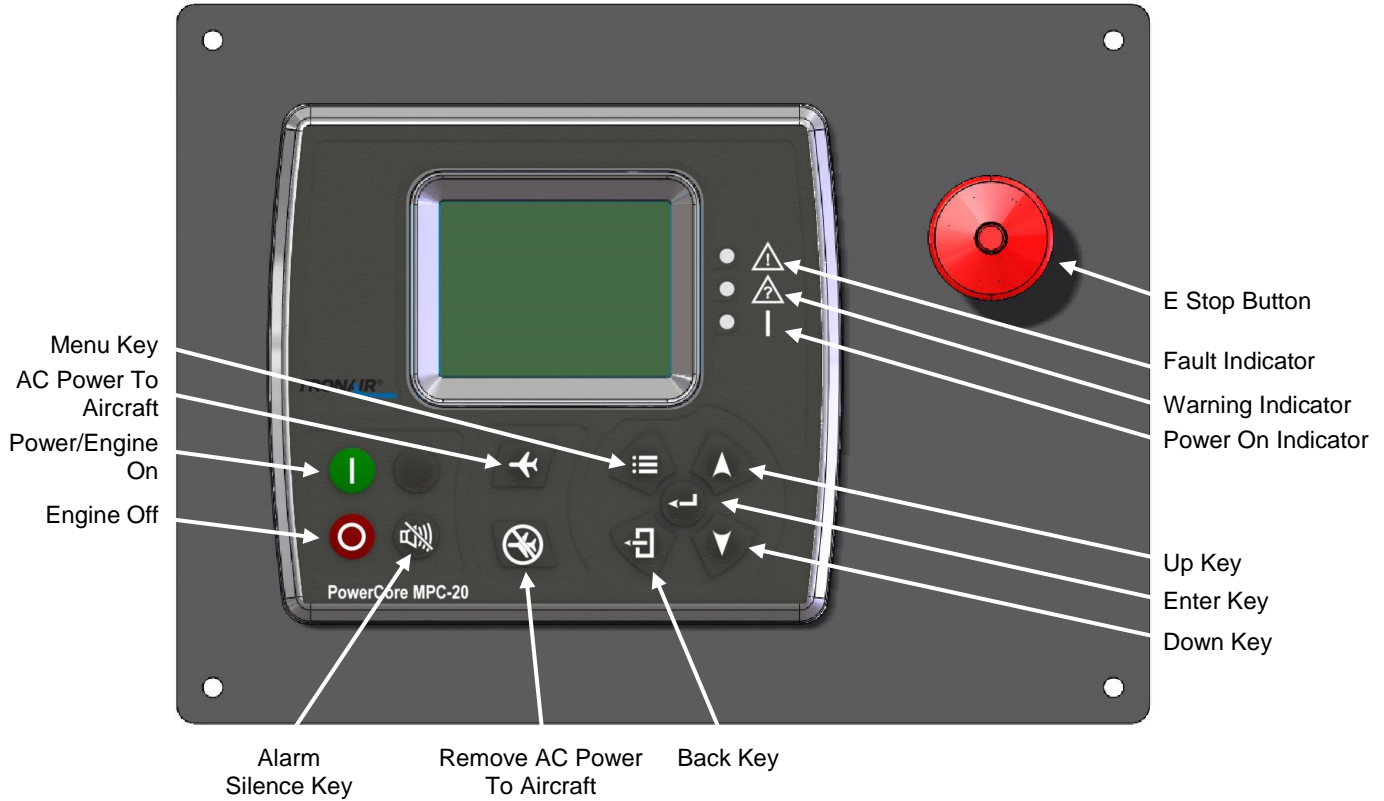
- 6 Pulse
- 6 SCRs
- Firing Board
- Voltage and Current Control Board
- RC ripple filtration

5.3 LOCATION & LAYOUT OF CONTROLS



Battery Switch (lockable), used to disconnect the engine battery power

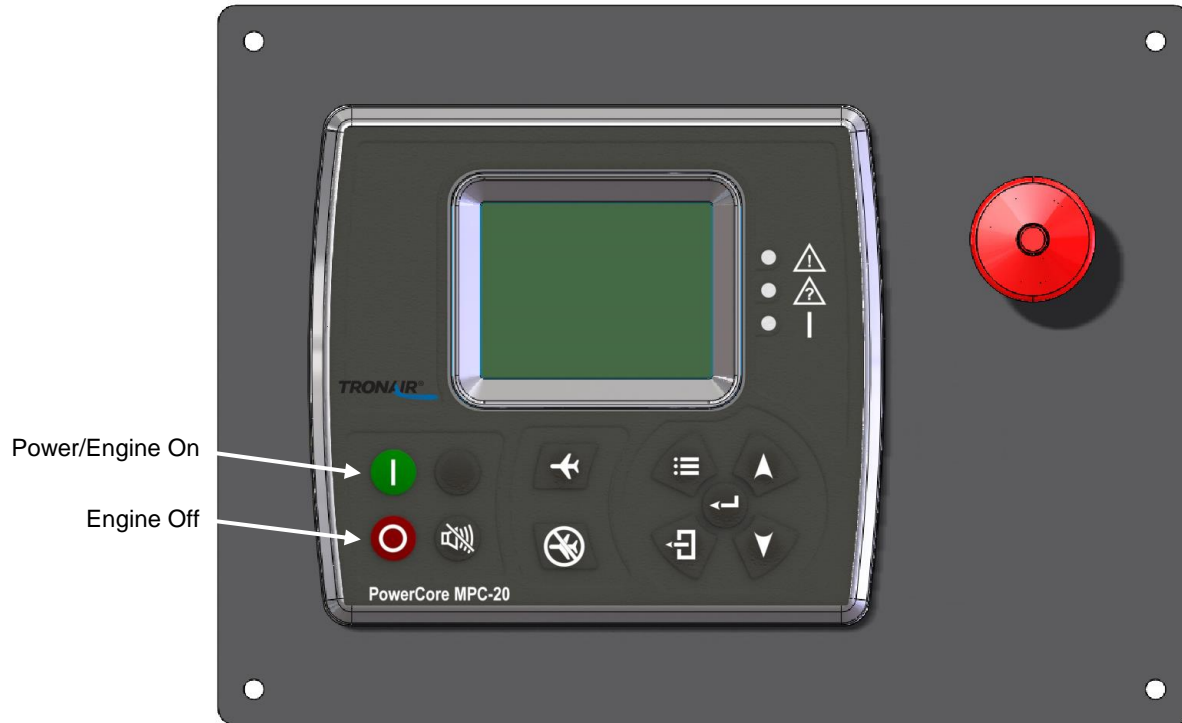
5.3.1 Control Panel (External)



OPERATOR BUTTONS

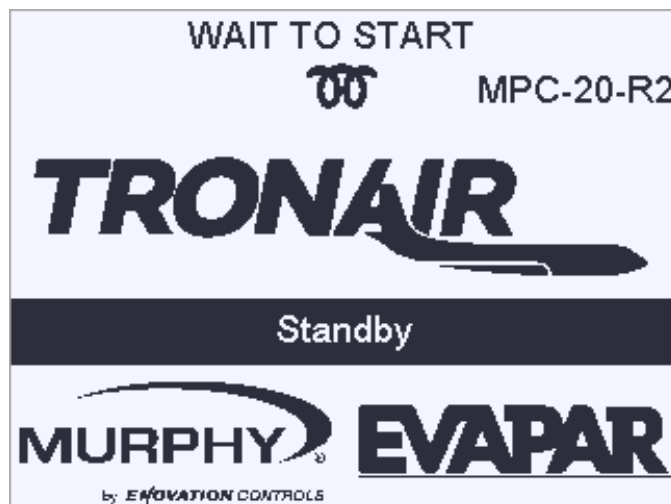
Description	Function
Power / Engine ON Key	Powers up unit, starts engine (15 second initial idle)
Engine OFF Key	Allows engine to idle for 1 minute before stopping, then 3 minute before unit shuts down (sleep mode)
Emergency STOP Button	Will immediately shut off power to the GPU and GPU will STOP Use for emergency only!
Airplane Power ON	Applies AC power to the aircraft cable
Airplane Power OFF	Removes AC power to the aircraft cable
Menu Key	Displays the password screen for changing unit settings
Alarm Silence Key	Clears warnings or faults once the condition is corrected
Back Key	Returns to the previous screen
Up Key	Moves the highlighted line up on the screen
Down Key	Moves the highlighted line down on the screen
Enter Key	Accepts the highlighted line on the screen
Fault Indicator	Illuminates when a system fault occurs (see screen for details)
Warning Indicator	Illuminates when a system warning occurs (see screen for details)
Power ON Indicator	Illuminates when the system is operating normally

5.3.1 Control Panel (External) *(continued)*



Press the Power / Engine ON Key to Power up the unit. Press the Power / Engine ON key to start the engine. Engine will idle for 15 seconds, then go to operating speed.

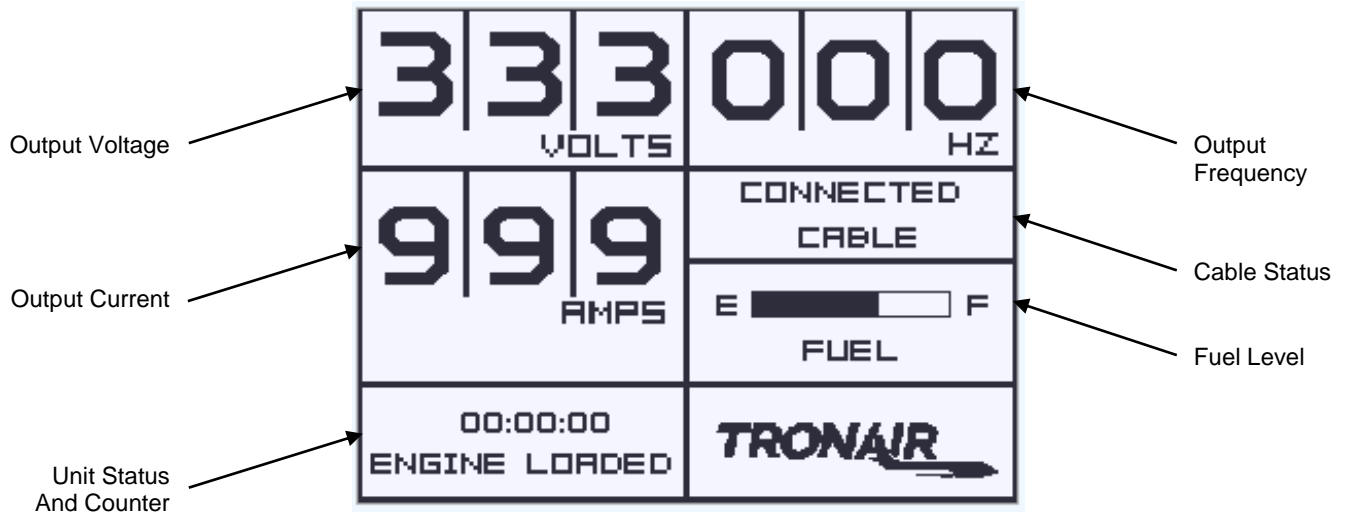
Power-Up Screen



Initial screen during power-up mode

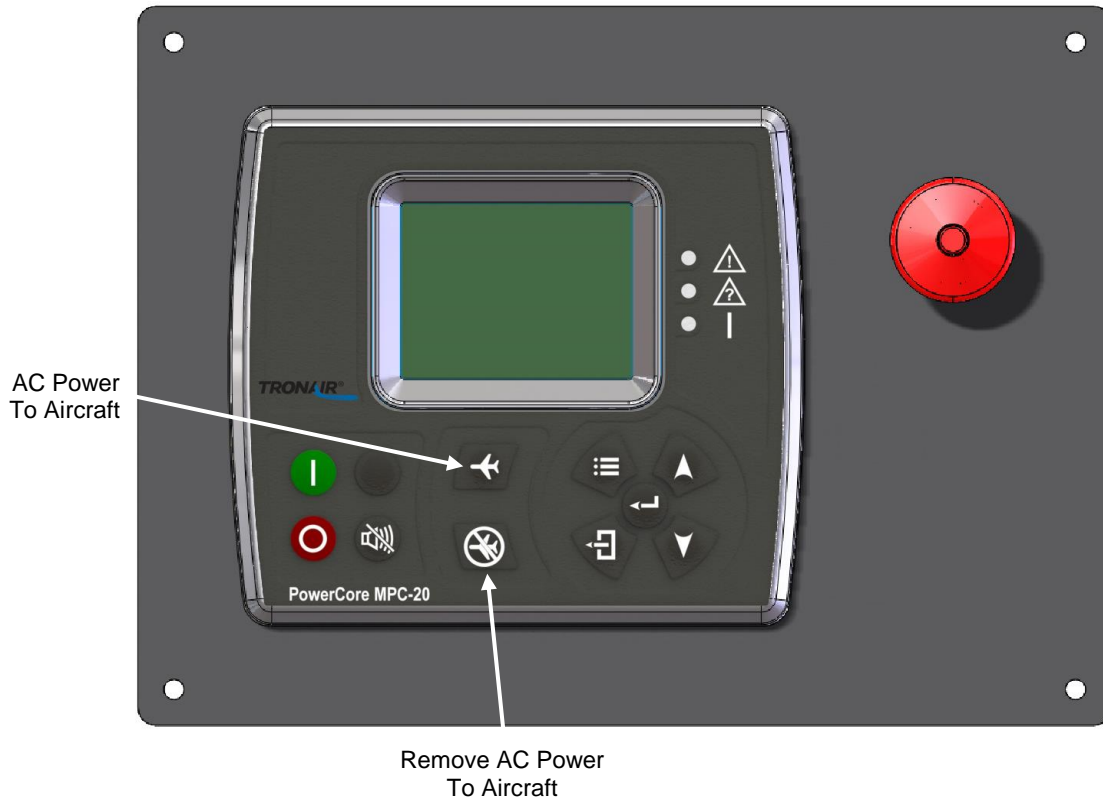
5.3.1 Control Panel (External) (continued)

**Main AC Screen
(Right Display)**



Main screen for 400Hz AC power operation


AC Power Screen (Right Display)



Press the "AC POWER TO AIRCRAFT" Key to energize AC cable, Press the "REMOVE POWER TO AIRCRAFT" Key to De-energize AC cable


5.3.1 Control Panel (External) *(continued)*

Generator Screen (Right Display)

PHASE A-B 192 VOLTS	PHASE A-NEUT 114 VOLTS
PHASE A-C 195 VOLTS	PHASE B-NEUT 111 VOLTS
PHASE B-C 192 VOLTS	PHASE C-NEUT 114 VOLTS
200V SETPOINT	115V SETPOINT
PHASE A 228 AMPS	POWER
PHASE B 222 AMPS	APPARENT 0 KVA
PHASE C 231 AMPS	REAL 0 KW
260A RATED	FACTOR 1.0
FREQUENCY 400 HZ	CONNECTED
400HZ SETPOINT	CABLE
00:00:00 STABILIZE	

Use the UP and DOWN Keys to access Generator, Engine, and GPU information screens

Engine Screen (Right Display)

1200 RPM TARGET: 1200	17 PSI OIL PRESSURE
30.0 % DEF	142 F EXHAUST GAS TEMP
	CONNECTED CABLE
00:00:00 STABILIZE	

Use the UP and DOWN Keys to access AC power, Engine, and GPU information screens

5.3.1 Control Panel (External) *(continued)***GPU Information (Right Display)**

SYSTEM INFORMATION	
200V/115V, 400Hz, 90kVA	
Model: 11-4090-0000	
Serial: 9999999999	
SW: 2.8.10071	
5000999999	
TRONAIR INC.	WWW.TRONAIR.COM
Swanton, OH	USA
1-800-426-6301	

Use the UP and DOWN Keys to access AC power, Engine, and GPU information screens

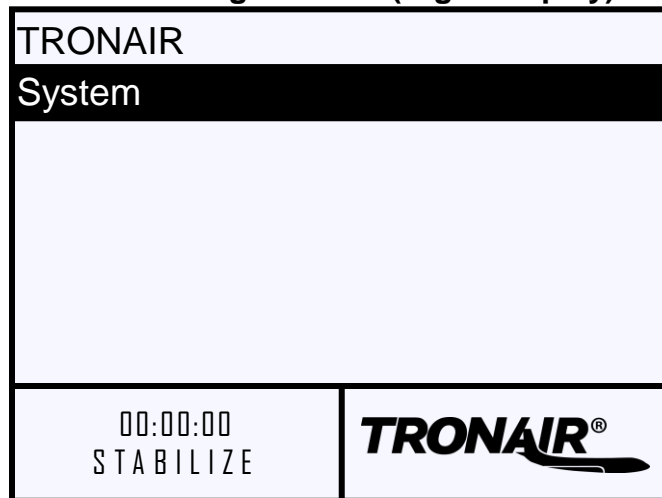
5.3.2 Control Panel Software Settings

Menu Screen (Right Display)



To enter the software settings, press the Menu Key
Enter password **0000**, press Enter Key after each 0

Settings Screen (Right Display)



Use the DOWN key to select SYSTEM
Press the ENTER key to view the units screen

5.3.2 Control Panel Software Settings *(continued)***Units Screen (Right Display)**

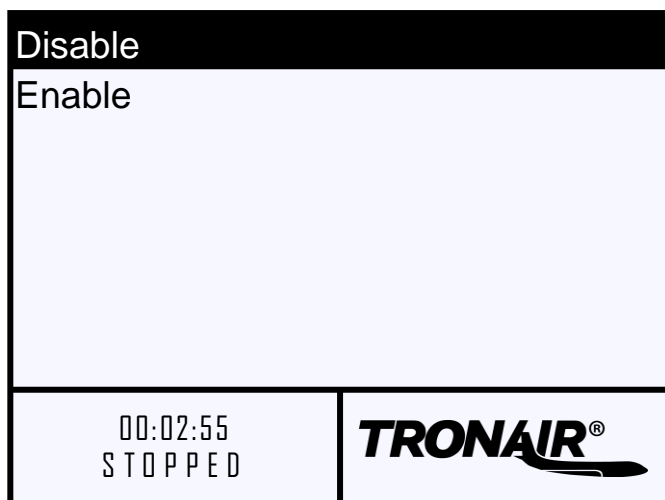
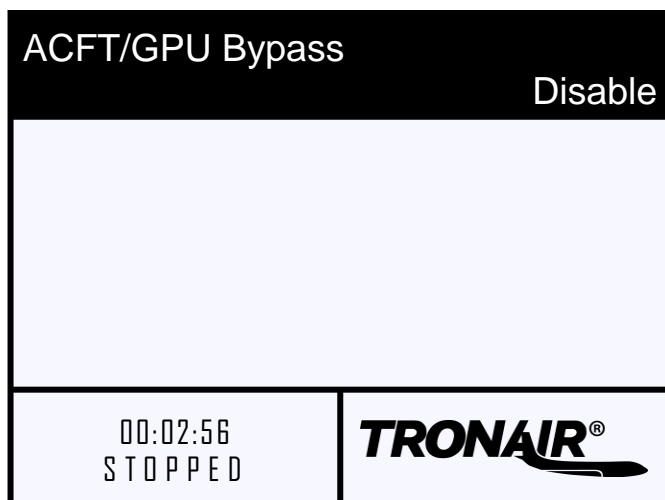
Date/Time	
Pressure Units	
Temperature Units	
Level Units	
Flow Units	
00:00:00 STABILIZE	TRONAIR

Use the UP and DOWN Keys to select the desired Units, press ENTER, change units, press ENTER to accept the change

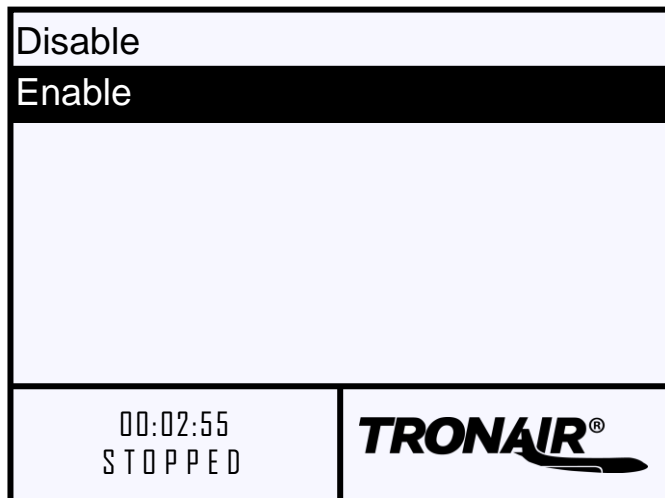
TRONAIR	
System	
00:00:00 STABILIZE	TRONAIR®

Use the UP key to select TRONAIR
Press the ENTER key

5.3.2 Control Panel Software Settings(*continued*)
At the ACFT/GPU prompt, press the ENTER key

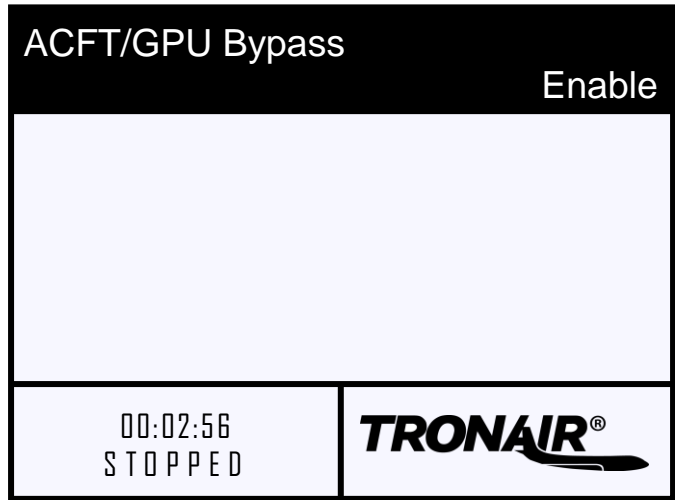


Use the Down Key, highlight the ENABLE prompt



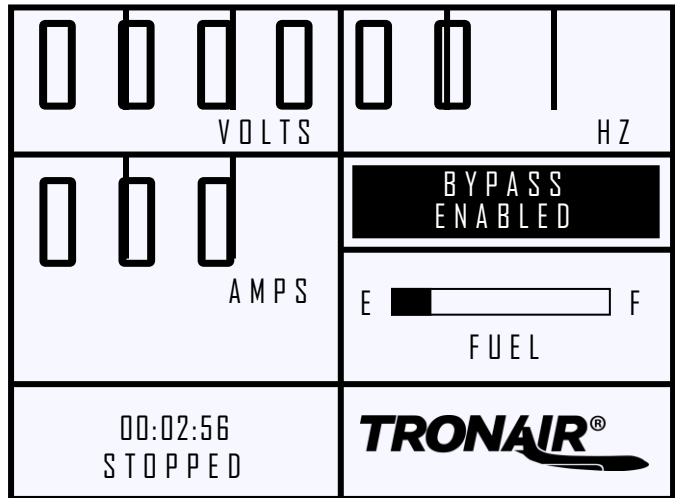
With ENABLE highlighted, press the ENTER key

5.3.2 Control Panel Software Settings(*continued*)
The ACFT/GPU screen should look like below



Press the BACK key until the main screen appears

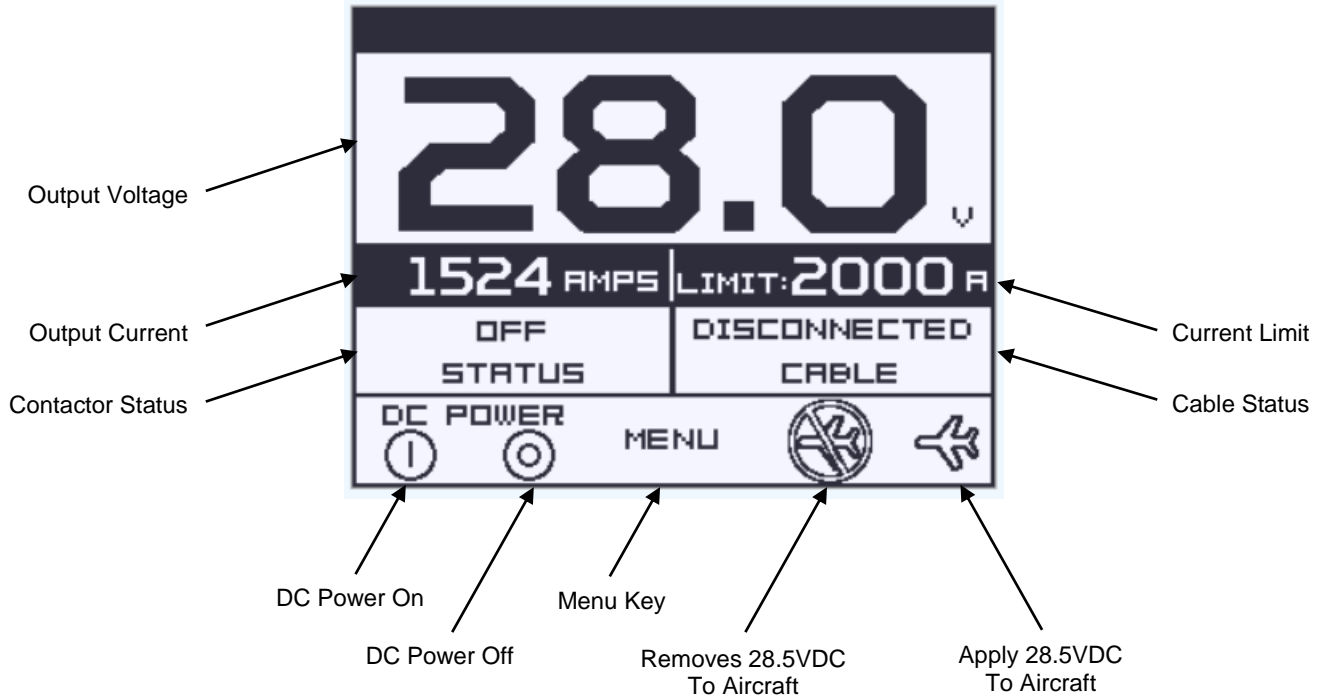
The Main screen should look like below, with BYPASS ENABLED flashing



The unit is ready to operate in 400Hz BYPASS mode

5.3.3 Control Panel (External) 28.5VDC Operation (11-4290-0000 ONLY)

**28.5VDC Main Screen
(Left Display)**

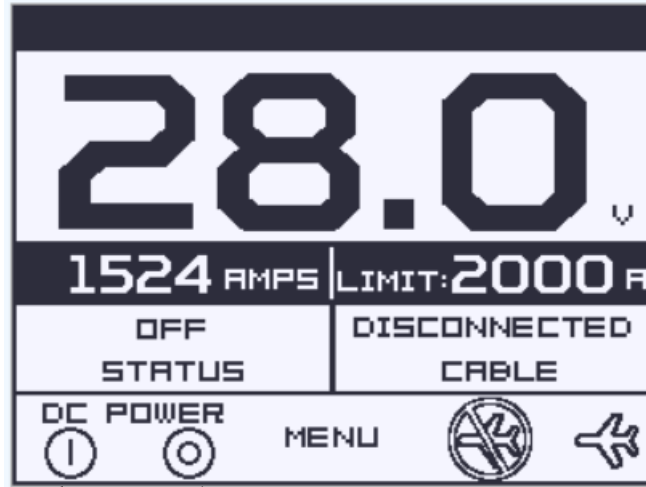


DISPLAY FUNCTION

Description	Function
Output Voltage	Displays the Output Voltage (at the cable end)
Output Current	Displays the Output Current (Amps)
Contactor Status	Reports the Condition of the Output Contactor
DC Power ON	Energizes the DC Power System (Disables the AC System when ON)
DC Power OFF	De-energizes the DC Power System
Menu Key	Displays the Menu Screen for Bypass or Current Limit
Apply 28.5VDC to Aircraft	Applies 28.5VDC to Aircraft Cable
Remove 28.5VDC to Aircraft	Removes 28.5VDC to Aircraft Cable
Cable Status	Reports the Condition of the Output Cable
Current Limit	Displays the Current limit Setting

5.3.3 Control Panel (External) 28.5VDC Operation (11-4290-0000 ONLY) (continued)

**28.5VDC POWER ON
(Left Display)**



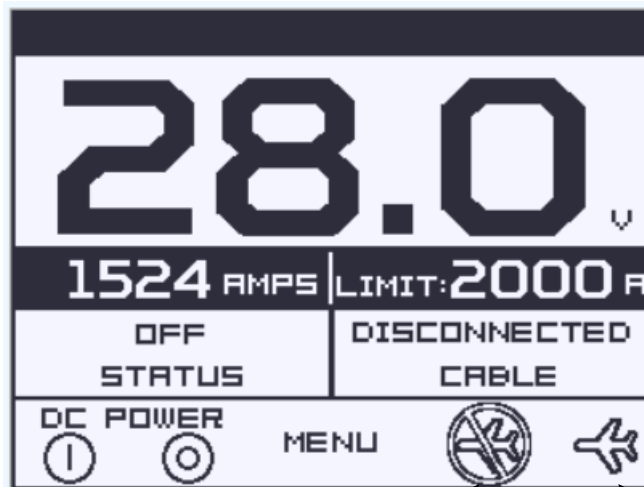
DC Power On Button

DC Power Off

DC Power is normally OFF when the unit is started. Press the DC Power ON Button to energize. (400Hz AC Power is disabled when the DC Power is energized)

Press the DC Power OFF Button to De-energize the DC power system.

**28.5VDC POWER ON
(Left Display)**



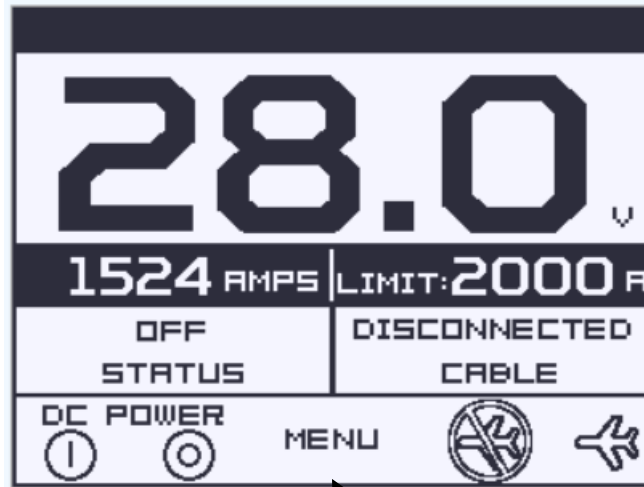
Remove 28.5VDC To Aircraft

Apply 28.5VDC To Aircraft

Press the "Apply 28.5VDC TO AIRCRAFT" Key to energize 28.5VDC cable, Press the "REMOVE 28.5VDC TO AIRCRAFT" Key to De-energize 28.5VDC cable

5.3.3 Control Panel (External) 28.5VDC OPERATION (11-4290-0000 ONLY) *(continued)*

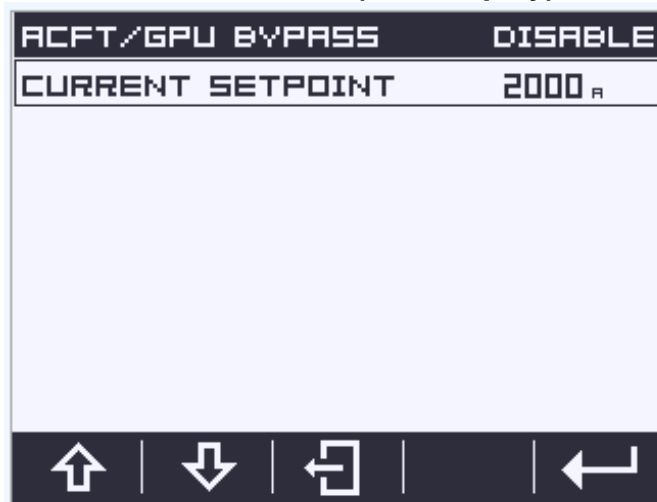
**28.5VDC POWER ON
(Left Display)**



28.5VDC Menu Key

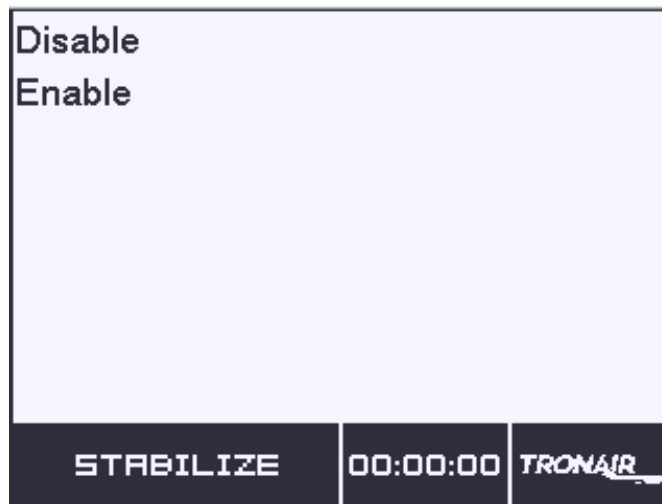
5.3.4 Control Panel Software Settings 28.5VDC Operation (11-4290-0000 ONLY)

Menu 28.5VDC (Left Display)



Use the UP and DOWN Keys to select the desired Menu item, press ENTER

Aircraft/GPU Bypass (Left Display)



Select either **Disable** or **Enable**, press Enter Key

When Enabled, the ACTF/GPU Bypass feature allows the DC aircraft cable interlock feature to be overridden. The DC aircraft cable will be live when the DC Power key is pressed.

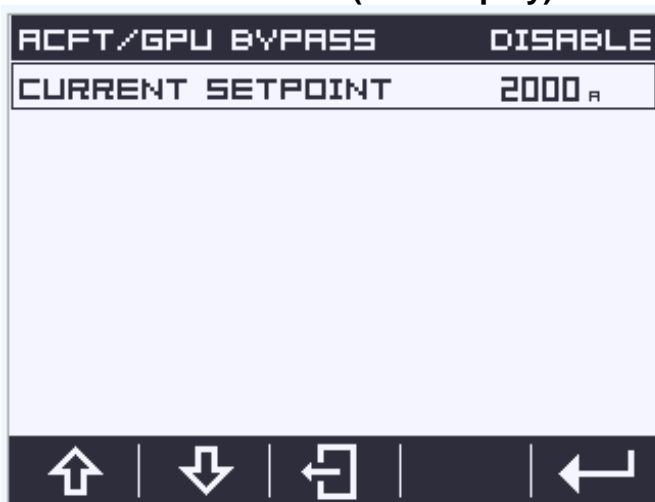


CAUTION!

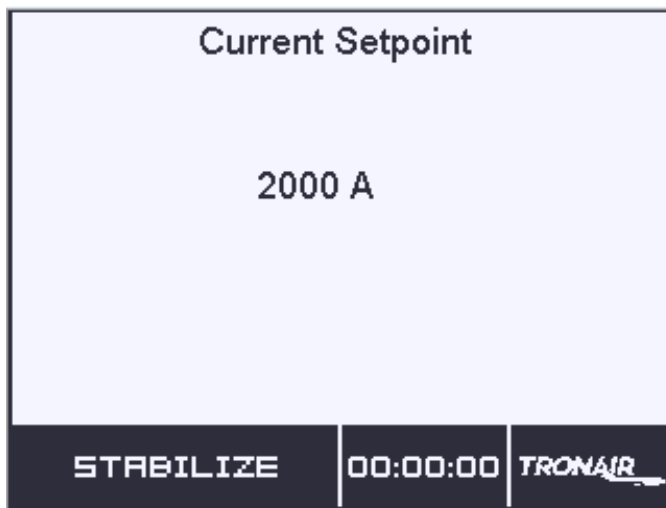
When the ACTF/GPU Bypass feature is in the enable mode the DC output cable will be live. Only trained, authorized personnel should use the equipment in this condition

5.3.4 Control Panel Software Settings 28.5VDC Operation (11-4290-0000 ONLY) *(continued)*

Menu 28.5VDC (Left Display)



Current Limit (Left Display)



Select **Current Limit Setpoint**, press Enter Key
Adjust the Current Limit (2000A should be used if no current limit is required), press Enter Key

5.4 START UP PROCEDURES

5.4.1 Pre-Use Inspection

CAUTION!



A pre-use inspection must be carried out prior to each use to ensure safe operation of the GPU. Failure to carry out these procedures listed below may result in severe damage to the GPU or prevent efficient operation.

1. Unit Appearance Visually inspect outside of GPU for loose hardware, loose parts, frayed wires/cables and general
2. Radiator..... Open side access door and ensure that fluid is present in the radiator overflow container. Service as required
3. Engine Hoses Check integrity of hoses and clamps for tightness
4. Fuel Level..... Turn power on and check fuel level on fuel gauge. Top up as required with fuel. Always fill DEF fluid when re-fueling
5. DEF fluid level Open access door next to fuel fill to check DEF fluid level (or check on main controller), refill DEF fluid tank
6. Engine Inspect all fuel lines and fittings for traces of fuel leakage. Visually inspect cylinder block, oil pan, and valve covers for oil leakage
7. Oil Level Remove dipstick to ensure oil level is at full mark. Replenish as required
8. Fan Belt..... Check belt for correct tension. Look for wear
9. Air Intake Filter Ensure that filter inlet is not restricted
10. Tires Check integrity of tires and tread wear and pressure
11. Brakes Check for proper operation

5.4.2 Starting Sequence

The following sequence must be followed in the order shown:

1. The GPU battery disconnect switch must be selected to the ON position.
2. Press Power / Engine ON button. This will power up the unit.
3. Depending on air temperature the Wait To Start will display. Press Power ON button.
4. Engine will idle for 15 seconds, then go to operating speed.



CAUTION!

Battery must be fully charged to supply sufficient voltage for starting.

- If any warnings or faults display on screen respond accordingly.
- Unit should display 115V ± 1 volts, and 400Hz± 1Hz

5.4.3 Supplying 400Hz Power to the Aircraft

1. Connect 400Hz cable to aircraft. Make sure that power plug is fully and correctly inserted into the aircraft receptacle.



CAUTION!

Consult aircraft technical manual for proper switch setting. Severe aircraft engine damage can occur if incorrect setting is used.

2. Press the AC POWER TO AIRCRAFT button. Display will say Contactor ON and Cable Connected.
3. The aircraft may now use AC power. The GPU will automatically compensate for voltage drop in the cable to supply the proper voltage within specification at the aircraft receptacle. Check all gauges for correct operation during use.
4. To disconnect the AC power, press the REMOVE POWER TO AIRCRAFT button.
5. To shut down the unit, press the ENGINE OFF button.
6. Unit will idle for 1 minute, and then shut off.
7. Unit will automatically power down in 3 minutes. Do not use emergency stop switch.
8. **Remove power plug from aircraft**
9. Stow 400Hz cable in cable tray.



CAUTION!

Unit MUST power down completely before turning off the battery switch.

5.4.4 Supplying DC Power to the Aircraft

1. Connect 28.5 VDC cable to aircraft. Make sure that power plug is fully and correctly inserted into the aircraft receptacle.



CAUTION!

Ensure that the current limit is in the correct setting for the aircraft to be started. Consult aircraft technical manual for proper switch setting. Severe aircraft engine damage can occur if incorrect setting is used.

Current limit setting (done in software) is only to be adjusted by competent maintenance personnel. Helicopters and some small jets and turbo prop aircraft will require a "limit" on peak power. Insure aircraft bypass is set to disable.

2. Press the DC POWER ON Button on the **Left Display**
3. Unit should display 28.5V ±0.2VDC
4. Press the APPLY 28.5VDC TO AIRCRAFT button. Display will say Contactor ON And Cable Connected.
5. The aircraft may now use DC power. During a start cycle, the DC voltage will fluctuate above and below 28.5 VDC. THIS IS NORMAL. The GPU will automatically compensate for the voltage drop in the cable to supply the starting voltage within specification at the aircraft receptacle. During the start, the Ammeter will show high amps initially and then quickly decay to show the continuing current draw.
6. Check all gauges for correct operation during the engine start cycle.
7. To disconnect the 28.5VDC power, press the REMOVE 28.5VDC POWER TO AIRCRAFT button.
8. To shut down the unit, press the ENGINE OFF button.
9. Unit will idle for 1 minute, and then shut off.
10. Unit will automatically power down in 3 minutes. **Do not use emergency stop switch.**
11. **Remove power plug from aircraft**
12. Stow DC plug and cable in cable tray.



CAUTION!

Unit **MUST** power down completely before turning off the battery switch.

5.4.5 Emergency Shut Down Procedure

In the event an emergency shut down is necessary, press the emergency stop switch located on the operator panel. The Emergency Stop button is for emergencies only.

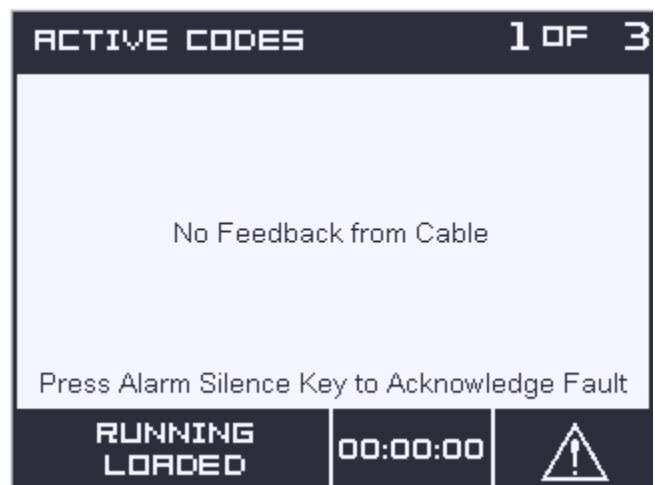


CAUTION!

Do not use for normal shut down. The Emergency Stop bypasses the timed cool down circuit and may cause engine damage.

5.5 INTERNAL FAULTS

- No Feedback from Cable
- Contactor Off
- Over Voltage
- Over Current
- Under Voltage
- SCR High Temperature
- No Fuel
- Low Fuel Level
- Low Oil Pressure
- Under Frequency
- High Engine Temp
- Over Crank
- Battery Low
- Battery High
- Emergency Stop Pressed
- Transformer High Temperature
- DEF Fluid Low
- Phase Loss



Internal Fault screen Example

6.0 PACKAGING AND STORAGE**6.1 PACKAGING REQUIREMENTS**

- a. Turn battery switch to OFF position
- b. Drain fuel
- c. Ensure fuel cap is secure
- d. Securely fasten doors
- e. Wrap for paint protection
- f. Strap unit in truck or shipping container using 4 cargo straps. Hook one strap through each tie-down ring on the front

NOTE: Use at least four (4) straps with a minimum 4,000 lbs (1814 kg) capacity each.

6.2 HANDLING

The unit is designed to be lifted using a forklift.

6.3 PACKAGING PROTECTION

No special packaging material for cushioning or suspension is required for shipments within the continental United States.

6.4 LABELING OF PACKAGING

Packaging should be labeled as follows:

**DO NOT DROP
THIS SIDE UP
DO NOT STACK** ↑

6.5 STORAGE COMPATIBILITY**6.5.1 Short Term Storage (less than 3 months)**

The following steps are recommended if the unit is to be placed out of services for three months or less. The unit should be prepared for storage as soon as possible after being removed from service.

1. Make sure that the mixed coolant is adequate for the lowest anticipated temperatures during time of storage.
2. Add oil to the FULL mark level on dip stick.
3. Drain a small portion of fuel from fuel tank by using the drain valve. This will remove any water that may have accumulated on the fuel tank.

NOTE: Do not drain the fuel system or crankcase.

4. Install new fuel filters.
5. Fill fuel tank to capacity. A full fuel tank prevents moisture laden air from entering the tank during the cool periods.
6. Close all access doors to minimize build-up of foreign particles in the unit.
7. Store unit in a building that is dry.
8. If the storage area has high humidity levels, place moisture absorbing chemicals inside the unit.

6.5.2 Long Term Storage

Special precautions are necessary to protect the GPU from rust and corrosion. It is recommended that the unit be stored in a building that is heated during winter months. Moisture absorbing chemicals should be placed inside the unit in climates where there is excessive dampness. Parts of the diesel requiring special attention are given below. The unit should be prepared for storage as soon as possible after being removed from service.

1. Drain the cooling system. Flush with clean water. Refill with 50/50 mix of water and antifreeze or mix according to ratio for temperature as recommended in the Doosan Operation and Maintenance Manual.
2. Circulate the coolant by operating the engine until the normal operating temperature is reached.
3. Stop the engine.
4. Drain the engine crankcase. Reinstall the drain plug. Install new lubricating oil filter element. Refill with high quality lubricating oil as recommended in the Doosan Operation and Maintenance Manual.
5. Drain the fuel tank of contaminants, fuel/water. Add additives, fill with fuel, and operate the engine for about ten minutes.

NOTE: Where biological contamination may be a problem, add a biocidal such as Biobor JF or equivalent to the fuel. Follow the biocidal manufacturer's concentration recommendations and observe all warnings and cautions.

6. Remove the spin-on fuel filters, discard, fill new filters with fuel and reinstall on the engine.
7. Remove and clean battery terminals and cables with baking soda-water solution, rinse with fresh water. Do not allow the soda water to enter the battery. Add distilled water to the electrolyte, if necessary fully charge the battery. Store the battery in a cool dry place (never below 32°F, or 0 degrees C). Keep the battery fully charged and check the specific gravity of the electrolyte regularly.
8. Seal all engine openings, including the exhaust outlets with moisture resistant tape. Use cardboard, plywood, or metal covers where practical.
9. Tag engine Control Panel "DO NOT RUN, READY FOR STORAGE".

7.0 TRANSPORTATION

1. Do not stack.
2. Unit is designed to be lifted with a fork lift.
3. Strap unit in truck or shipping container using 4 cargo straps. Hook one strap through each tie-down ring. Raise tow-bar into latch and block wheels.
4. Weight: 4,000 lbs (1814 kg)

8.0 TROUBLE SHOOTING

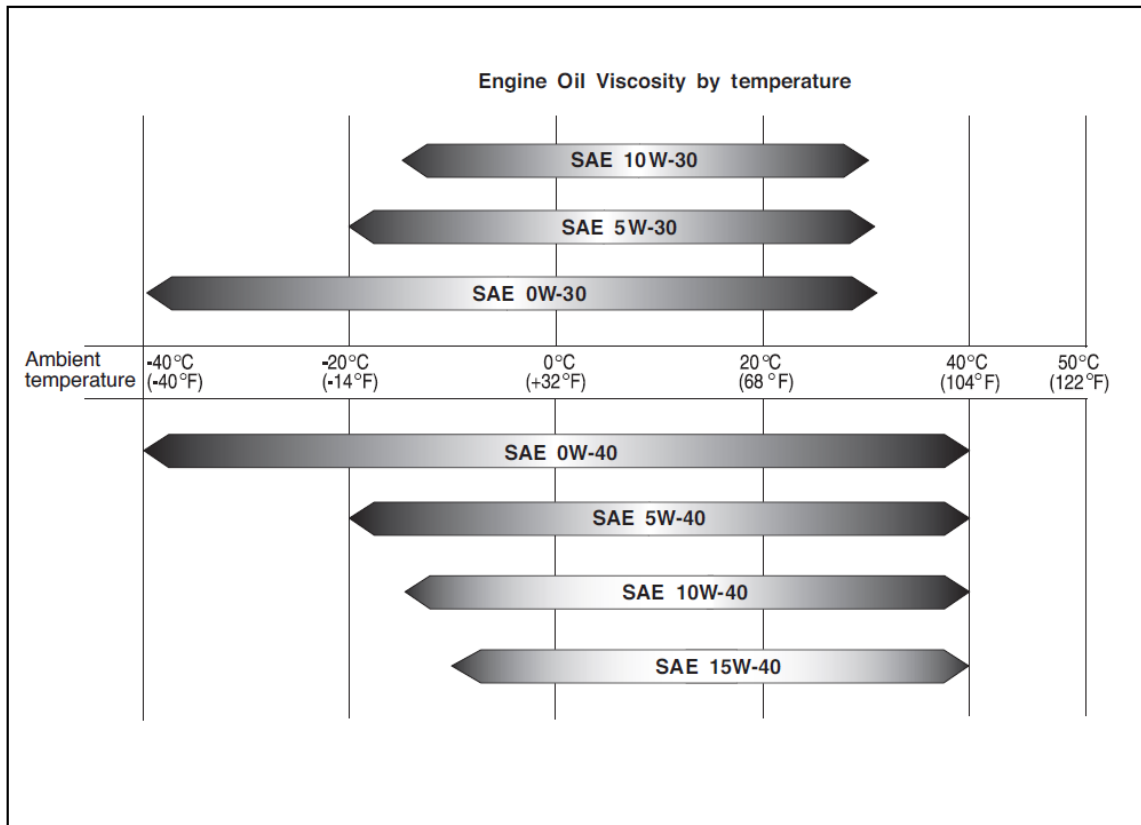
FAULT	POSSIBLE CAUSE	SOLUTION
No Power When "Power On" Switch is Pressed	Battery switch turned to off	Check, turn to on
	Loose battery terminals	Check, clean and tighten terminals
	Battery voltage low	Charge battery
Contactors Off	Contactors forced off	Attempted to operate 400Hz and 28.5VDC simultaneously
No Feedback from Cable	Damaged cable	Check continuity of Cable
	Not inserted fully into socket	Ensure cable is plugged all the way in
	Aircraft missing third pin	Change to Bypass Enable mode
Over Voltage	Large current drop	Large step load removed instantaneously
	AVR out of adjustment	Adjust voltage on AVR
	Damaged AVR / VCB	Replace AVR / VCB
	VCB out of adjustment	Adjust voltage on VCB
Over Current	Exceeding current rating	Limit required current
	Current limit set to low	Raise current limit adjustment
Under Voltage	AVR out of adjustment	Adjust voltage on AVR
	VCB out of adjustment	Adjust voltage on VCB
SCR High Temperature	SCR overheating	Let GPU cool down by removing load
	Damaged temp switch	Check continuity and replace switch if faulty
No Fuel	Damaged fuel sending unit	Check fuel sending unit, replace if faulty
	No fuel	Fill with diesel until fault clears
Low Fuel Level	Low fuel	Fill with diesel until fault clears
	Damaged fuel sending unit	Check fuel sending unit, replace if faulty
Low Oil Pressure	Low oil/No oil	Check engine oil. Add oil as necessary
High Engine Temp	Low coolant	Check coolant level when engine is cool. Add coolant as necessary
	Dirty radiator fins	Clean radiator of debris
	Broken fan belt	Replace
Over Crank	No fuel	Fill fuel tank
Battery Not Charged	Battery not charged	Charge battery
Battery Low	Loose battery connection	Check, clean and tighten terminals
	Low battery voltage	Check, using a multi-meter, Charge or replace if necessary
Battery High	Bad alternator	Check alternator output voltage, replace if necessary
Emergency Stop Pressed	Emergency stop has been pushed	Pull emergency stop out
Under Frequency	Large current load	Large step load added instantaneously
Transformer High Temperature	Transformer overheating	Let GPU cool down by removing 28.5VDC load
	Damaged temp switch	Check continuity and replace switch if faulty
DEF Fluid Low	Low DEF fluid	Fill with DEF fluid until fault clears
	Damaged DEF tank	Replace if faulty
Phase Loss	Bad Generator	Repair generator
	Loose sense wires	Check sense wire connections
DEF System Warning	Premature battery shut off	Allow the unit to power down completely before turning off the battery switch

9.0 MAINTENANCE

As with all Ground Support Equipment it is very important to provide proper preventative maintenance and service. This will increase the service life of the diesel engine, which can be expected to operate for 30,000 hours without a major overhaul (this may vary according to local operating conditions.) The following specifies consumable service requirements:

Fuel: Ensure that the correct diesel fuel ASTM D 975 is used. Refer to the Doosan Operation and Maintenance Manual (provided as a supplement to this manual) for other allowable fuels.

Engine Oil: 15W-40 (API CH-4) is suitable for most operating temperatures. However, lower viscosity oils can be used to aid starting at temperatures below -20° C (-4° F). The engine requires the use of low ash oil. Refer to engine Operation and Maintenance Manual for oil and viscosity recommendations.



CAUTION!



Do not over fill the engine as damage may occur. Always use the engine oil level dipstick to ensure the correct level. Always use the same brand of engine oil. When topping up the oil level always prevent dirt from entering by cleaning around the oil filler prior to filling. The engine oil level should be checked every 10 hours of operation.

9.0 MAINTENANCE (continued)

Cooling System: Use 50/50 ethylene glycol and diethylene glycol mixture. Refer to section 4 of the Deutz Operation and Maintenance Manual (provided as a supplement to this manual) for anti-freeze and water quality recommendations. Must meet ASTM D3306-00A Standard.

Ambient Temp. (°C)	Coolant (°C)	Antifreeze (%)
Above-10	85	15
-10	80	20
-15	73	27
-20	67	33
-25	60	40
-30	56	44
-40	50	50

Filters: Fuel/water filterChange every 500 hours or 6 months
 Engine oil filterChange every 500 hours or 6 months with oil change
 Air cleaner filter.....Check daily. Change when clog indicator shows clogged
 Fuel filter.....Change every 500 hours or 6 months

9.1 GENERAL (DAILY CHECKS)

Unit Appearance	Visually inspect outside of GPU for loose hardware, loose parts, frayed wires/cables and general
Radiator	Open side access door and ensure that fluid is present in the radiator overflow container. Service as required
Engine Hoses	Check integrity of hoses and clamps for tightness
Fuel Level	Turn power on and check fuel level on fuel gauge. Top up as required with fuel. Always fill DEF fluid when re-fueling
DEF fluid level	Open access door next to fuel fill to check DEF fluid level (or check on main controller), refill DEF fluid tank
Engine	Inspect all fuel lines and fittings for traces of fuel leakage. Visually inspect cylinder block, oil pan, and valve covers for oil leakage
Oil Level	Remove dipstick to ensure oil level is at full mark. Replenish as required
Fan Belt	Check belt for correct tension. Look for wear
Air Intake Filter	Ensure that filter inlet is not restricted
Tires	Check integrity of tires and tread wear and pressure
Brakes	Check for proper operation

9.2 SHORT TERM PREVENTIVE MAINTENANCE SCHEDULE

It is recommended to change the engine oil and filter after the first 50 hours of operation.

The following table is provided as a guide to for frequent service intervals. The Doosan Operation and Maintenance Manual (provided as a supplement to this manual) provides engine service interval information for daily, 250 hour, 500 hour, 1000 hour and 2000 hour intervals. See the Doosan Operation and Maintenance Manual.

Regular Inspection table

maintain the engine with optimum conditions and best performance for a long period and prevent unexpected accidents in advance.

General Conditions

Regular inspection and replacement according to the recommended regular inspection table allows you to

(◦ : Inspection and Adjustment, • : Replacement)

Check Points	Daily	Inspection interval (x 1,000 hours)									
		0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
Coolant system											
State of connection between cooler and coolant hose	◦										
Capacity and state of coolant ^a	◦	Replace every 1,200 hours ^b									
Cooling fan belt tension	◦										
Lubrication system											
Lubricating device and oil leakage	◦										
Capacity and condition of engine oil ^{cd}	◦	•	•	•	•	•	•	•	•	•	•
Engine oil filter	◦	•	•	•	•	•	•	•	•	•	•
Fuel system											
Fuel line and connection unit	◦										
Fuel volume	◦										
Water draining from water separator	◦										
Fuel injection time		Inspect and adjust if required									
Injector		Inspect and adjust if required									
Compression pressure		Inspect and adjust if required									
Intake/Exhaust system											
Air cleaner	◦	Clean and replace if required									
Throttle body cleaning	◦										
Intake line and connection unit	◦										
Exhaust line and connection unit	◦										
Emission state	◦										
Cylinder head											
Intake/Exhaust valve gap state			◦		◦		◦		◦		◦
Electric system											
Battery charging state	◦										
Various electric units	◦										

- a. Replenish coolant if required.
- b. Check coolant every 500 hours to maintain the concentration of antifreeze and additives.
- c. Replace it every 500 hours after the first 50 hours (Tier-4).
- d. Replace it every 250 hours after the first 50 hours (Tier-3).

10.0 PROVISION OF SPARES

10.1 SOURCE OF SPARE PARTS

Spare parts may be obtained from the manufacturer:

TRONAIR, Inc.

1 Air Cargo Pkwy East
Swanton, Ohio 43558 USA

Telephone: (419) 866-6301 or 800-426-6301

Fax: (419) 867-0634

E-mail: sales@tronair.com

Website: www.tronair.com

For Spare Parts, Operations & Service Manuals or Service Needs:
Scan the QR code or visit Tronair.com/aftermarket



10.2 RECOMMENDED SPARE PARTS LISTS

Reference the following page(s) for Replacement Parts and Kits available.

Recommended Spares:

- H-5272..... Glow Plug
- H-5273..... Alternator
- H-5262..... Oil Filter
- H-5274..... Fuel Filter
- H-5275..... Air Cleaner Element Secondary
- H-5276..... Air Cleaner Element Primary
- H-5277..... Injector Assembly
- H-5278..... Starter
- H-5279..... Water Pump Assembly
- H-5280..... Thermostat Assembly
- H-5281..... Auto Tensioner

11.0 IN SERVICE SUPPORT

Contact Tronair, Inc. for technical services and information. See Section **1.3 – Manufacturer**.

12.0 GUARANTEES/LIMITATION OF LIABILITY

Tronair products are warranted to be free of manufacturing or material defects for a period of one year after shipment to the original customer. This is solely limited to the repair or replacement of defective components. This warranty does not cover the following items:

- a) Parts required for normal maintenance
- b) Parts covered by a component manufacturers warranty
- c) Replacement parts have a 90-day warranty from date of shipment

If you have a problem that may require service, contact Tronair immediately. Do not attempt to repair or disassemble a product without first contacting Tronair, any action may affect warranty coverage. When you contact Tronair be prepared to provide the following information:

- a) Product Model Number
- b) Product Serial Number
- c) Description of the problem

If warranty coverage is approved, either replacement parts will be sent or the product will have to be returned to Tronair for repairs. If the product is to be returned, a Return Material Authorization (RMA) number will be issued for reference purposes on any shipping documents. Failure to obtain a RMA in advance of returning an item will result in a service fee. A decision on the extent of warranty coverage on returned products is reserved pending inspection at Tronair. Any shipments to Tronair must be shipped freight prepaid. Freight costs on shipments to customers will be paid by Tronair on any warranty claims only. Any unauthorized modification of the Tronair products or use of the Tronair products in violation of cautions and warnings in any manual (including updates) or safety bulletins published or delivered by Tronair will immediately void any warranty, express or implied.

The obligations of Tronair expressly stated herein are in lieu of all other warranties or conditions expressed or implied. **Any unauthorized modification of the Tronair products or use of the Tronair products in violations of cautions and warnings in any manual (including updates) or safety bulletins published or delivered by Tronair will immediately void any warranty, express or implied and Tronair disclaims any and all liability for injury (WITHOUT LIMITATION and including DEATH), loss or damage arising from or relating to such misuse.**

13.0 APPENDICES

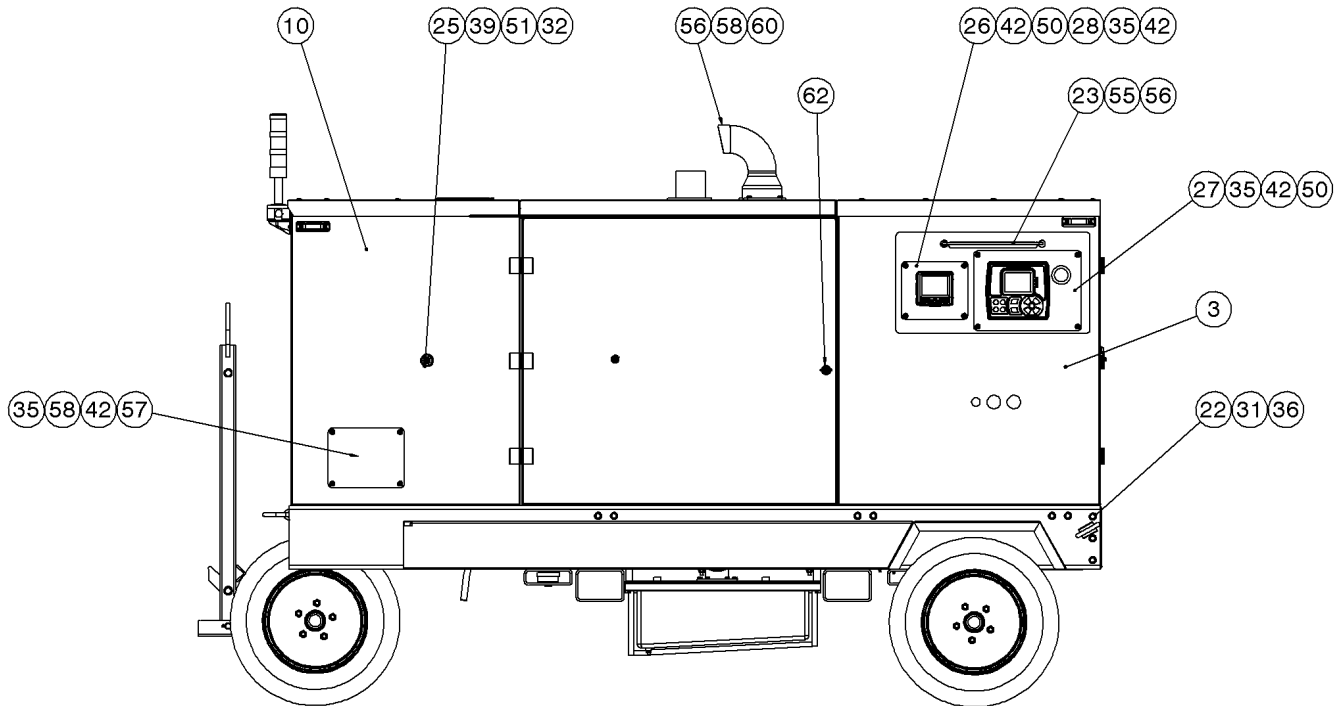
- APPENDIX I Wiring Schematics – INS-2804, INS-2485
- APPENDIX II Controller - Murphy MPC-20
- APPENDIX III Terminal Block Wiring
- APPENDIX IV Declaration of Conformity

Additional Documents

See Doosan for D34 Operation & Maintenance Manual

Parts List

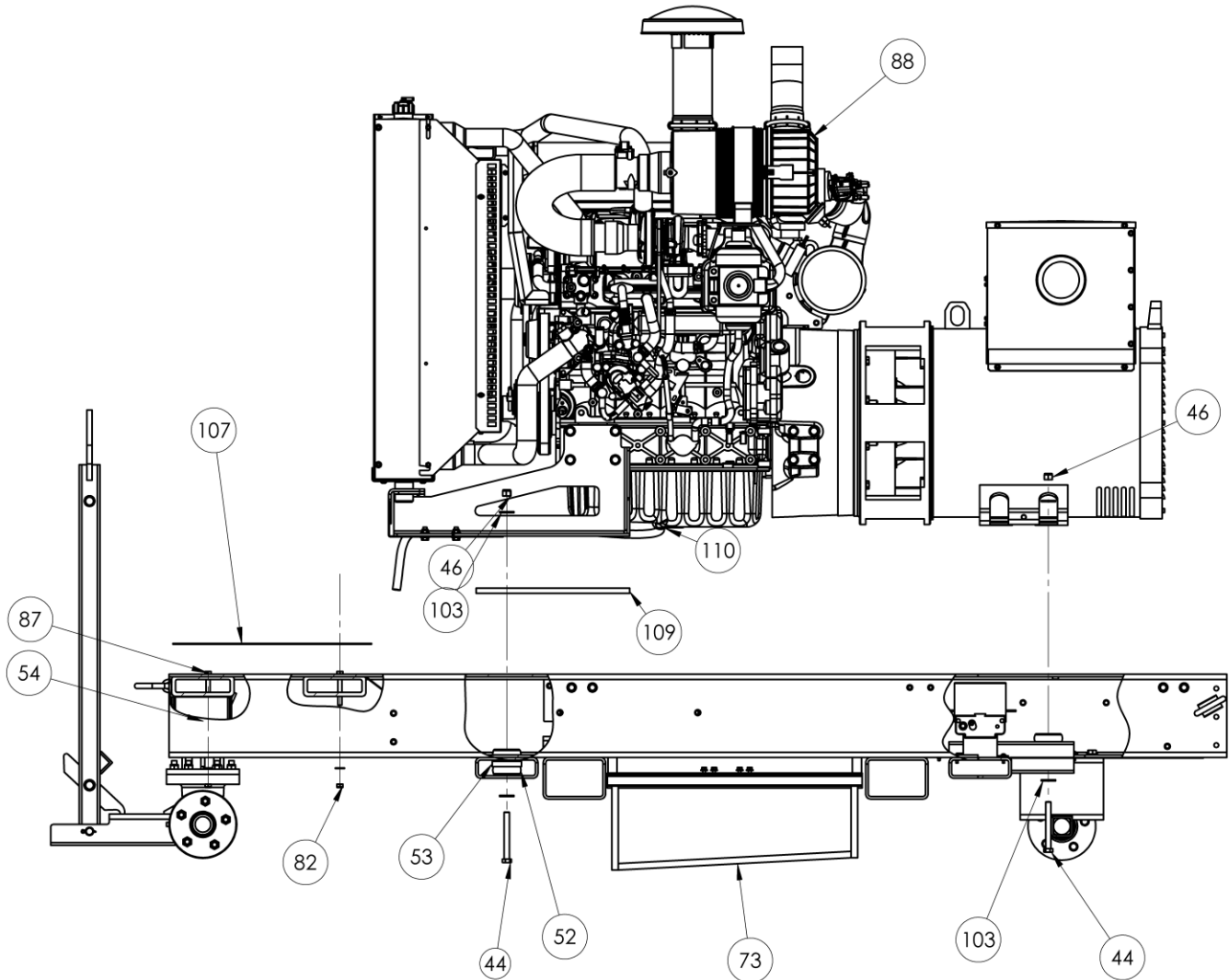
When ordering replacement parts/kits, please specify model, serial number and color of your unit.



Item	Part Number	Description	Qty
3	Z-9353-00	WELDMENT, CONTROLS PANEL (P)	1
10	Z-9362-00	WELDMENT, FRONT LOUVER (P)	1
22	G-1503-1070N	FLATWASHER. 3/8 SST NARROW	36
23	EC-3010	LIGHT ASSY, PANEL LED	1
25	H-3697	RUBBER DOOR HOLDER	2
26	S-3109-01	PLATE, CONTROL PANEL (P)	1
27	EC-3441-400	PANEL, CONTROLLER	REF
28	EC-3019	MODULE, MURPHY CONTROL	1
31	G-1112-107010	BOLT, 38-16 X 1.0" SST HEX HD	29
32	G-1202-1060	STOPNUT, 5/16-18 ELASTIC	2
35	G-1439-1050-S	NUTSERT, 1/4-20 OPEN END	52
36	G-1440-1070-S	NUTSERT, 3/8-16 OPEN END	8
39	G-1476-106010	SCREW, 5/16-18 X 1.0" LG. SST SOC BUTT. HD CAP	2
42	G-1497-105010	SCREW, 1/4-20 X 1.0" LG. SST ROUND HD PH	38
50	G-1503-1050N	FLATWASHER. 1/4 SST NARROW	44
51	G-1503-1060N	FLATWASHER. 5/16 SST NARROW	4
55	H-4213-05-010.5	TAP, VHB FOAM	1
56	H-4421	EXHAUST, VENTURI TUBE	1
57	S-3601-00	COVER, ACCESS (P)	2
58	G-1250-1050N	FLATWASHER. 1/4 NARROW	12
60	G-1100-105010	BOLT, 1/4-20 X 1.0" LG HEX HD GR 5	4
62	H-4100	LATCH, DOOR	2

Parts List

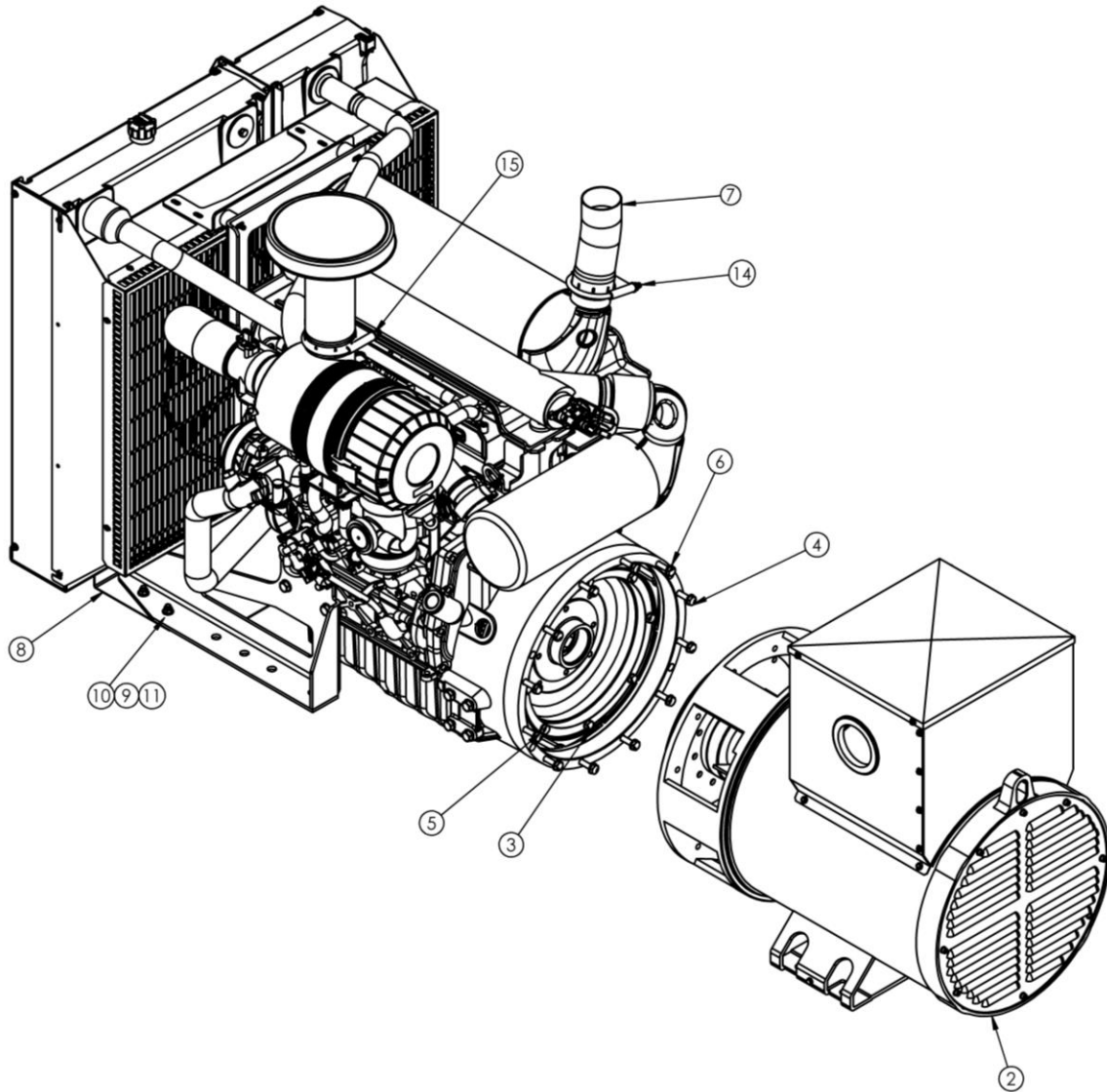
When ordering replacement parts/kits, please specify model, serial number and color of your unit.



Item	Part Number	Description	Qty
44	G-1100-109044	BOLT, 1/2-13 X 4-1/2 HEX HD GR 5	4
46	G-1202-1090	STOPNUT, 1/2-13 ELASTIC	4
52	H-4028	VMC ISOLATER	REF
53	J-6369-01	SPACER, ENGINE MOUNT	4
54	G-1503-1070N	FLATWASHER, 3/8 SST NARROW	42
73	Z-8904	ASSEMBLY, FUEL TANK	1
82	G-1501-1070	STOPNUT, 3/8-16 ELASTIC SS	12
87	G-1112-107030	BOLT, 3/8-16 X 3.0 SST HEX HD	8
88	Z-9371	ASSY, ENGINE AND ALTERNATOR	1
103	G-1250-1090W	FLATWASHER 1/2 WIDE	8
107	S-3106-00	BRACKET, FRONT LOUVER	1
109	J-6428-01	PLATE, ENGINE SPACER	2
110	H-4097	VALVE, DRAIN	REF

Parts List

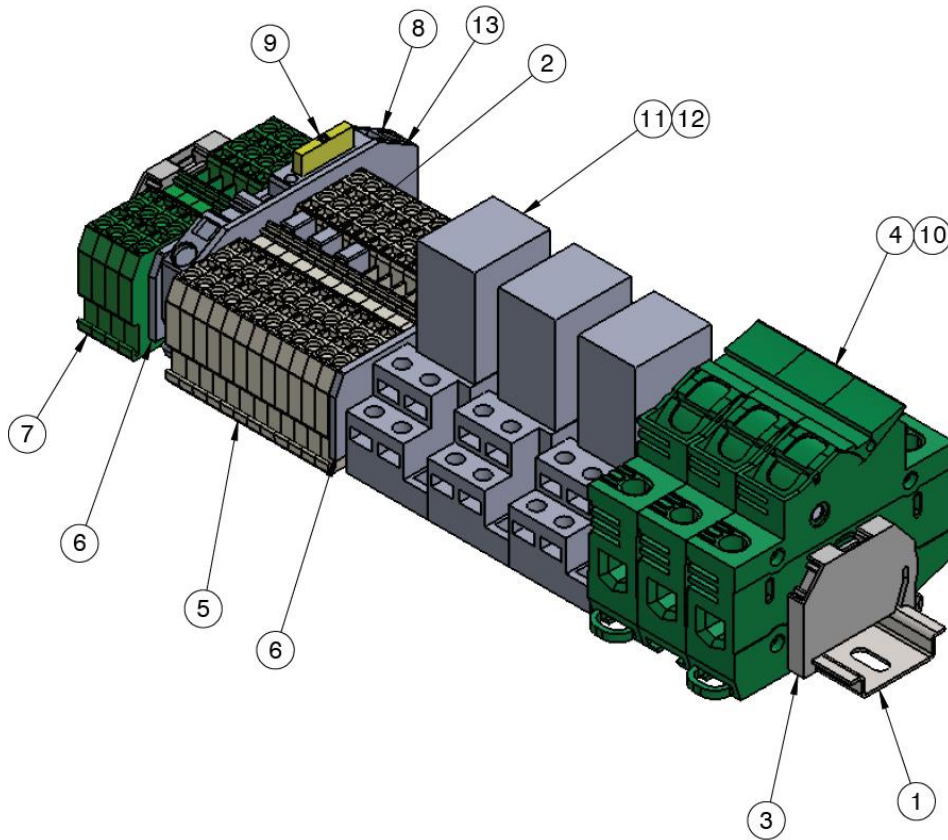
When ordering replacement parts/kits, please specify model, serial number and color of your unit.



Item	Part Number	Description	Qty
2	EC-3214	ALTERNATOR, MECC ALTE	1
3	G-1533-100025	BOLT, M10-1.5 X 25 MM LG CLASS 10.9	8
4	G-1533-100080	BOLT, METRIC, CLASS 10.9	12
5	G-1514-M100R	LOCKWASHER, M10 REGULAR	8
6	G-1513-1070N	FLATWASHER, 3/8 THRU HARD	12
7	H-4212	TUBE, EXHAUST	1
8	S-3447-00	PLATE, AIR DAM	1
9	G-1250-1070N	FLATWASHER, 3/8 NARROW	8
10	G-1100-107010	BOLT, 3/8-16 X 1.0 HEX HD GR 5	4
11	G-1202-1070	STOPNUT, 3/8-16 ELASTIC	4
14	H-1537-06	CLAMP, MUFFLER	1
15	H-1537-08	CLAMP, MUFFLER	1

Parts List

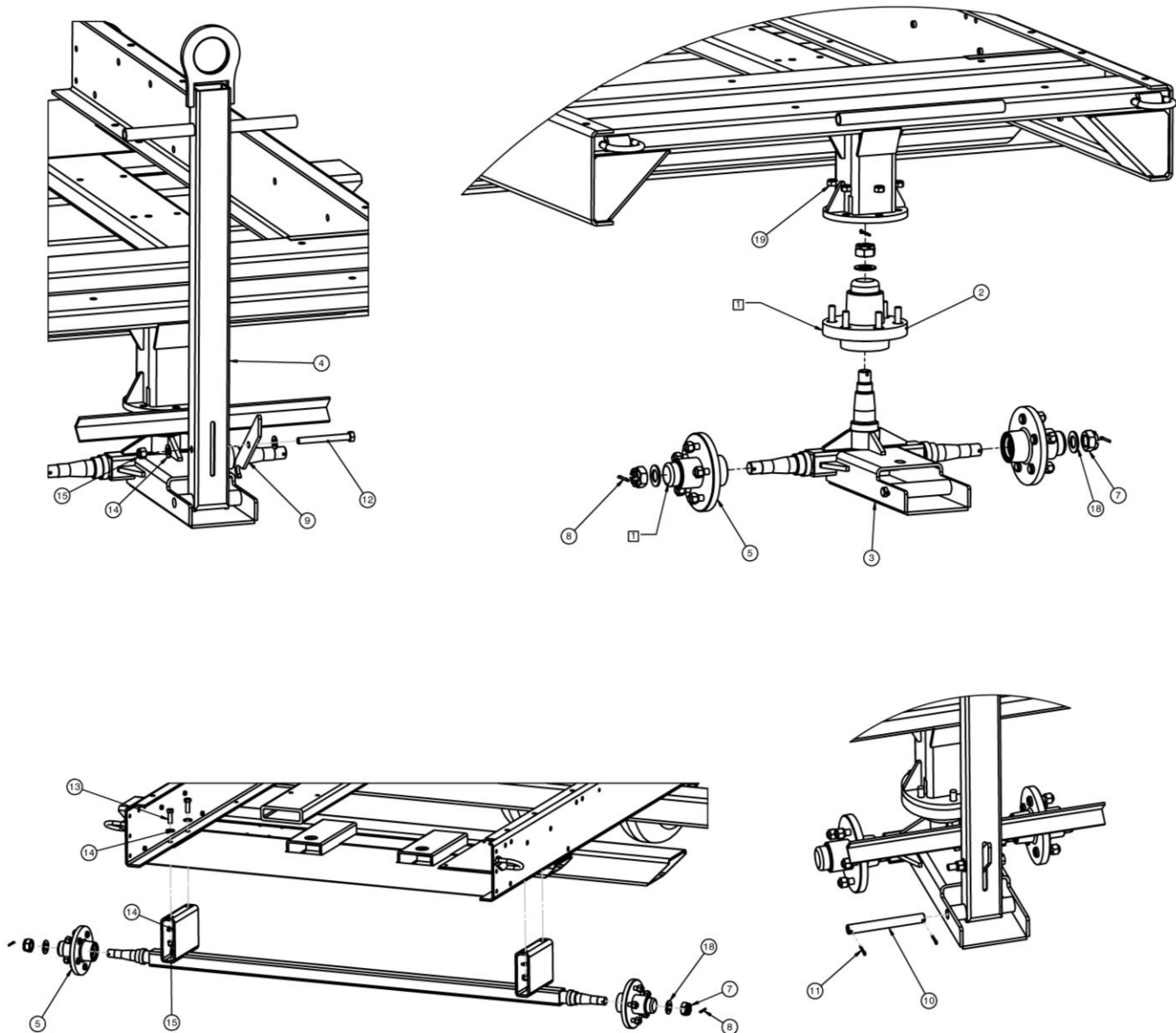
When ordering replacement parts/kits, please specify model, serial number and color of your unit.



Item	Part Number	Description	Qty
1	EC-1895-011.43	RAIL, DIN	1
2	EC-2072	JUMPER, 2 CONDUCTOR	4
3	13070	ANCHOR, DIN RAIL END	2
4	EC-2882	FUSEHOLDER	1
5	EC-2083	TERMINAL BLOCK, 4 COND LT GRAY	12
6	EC-2085	PLATE, END 4C TERMINAL BLOCK	2
7	EC-2923	BLOCK, TERMINAL GROUNDING	4
8	EC-2422	TERMINAL BLOCK, FUSE HOLDER	1
9	EC-2876	FUSE, BLADE AUTO 20A 32 VDC	1
10	EC-1675-12	FUSE, KTK-R SERIES	3
11	EC-1955	RELAY, COMPACT 12 VDC (DPDT)	3
12	13073	SOCKET, RELAY (DPDT)	3
13	EC-2423	PLATE, END FUSE HOLDER	1

Parts List

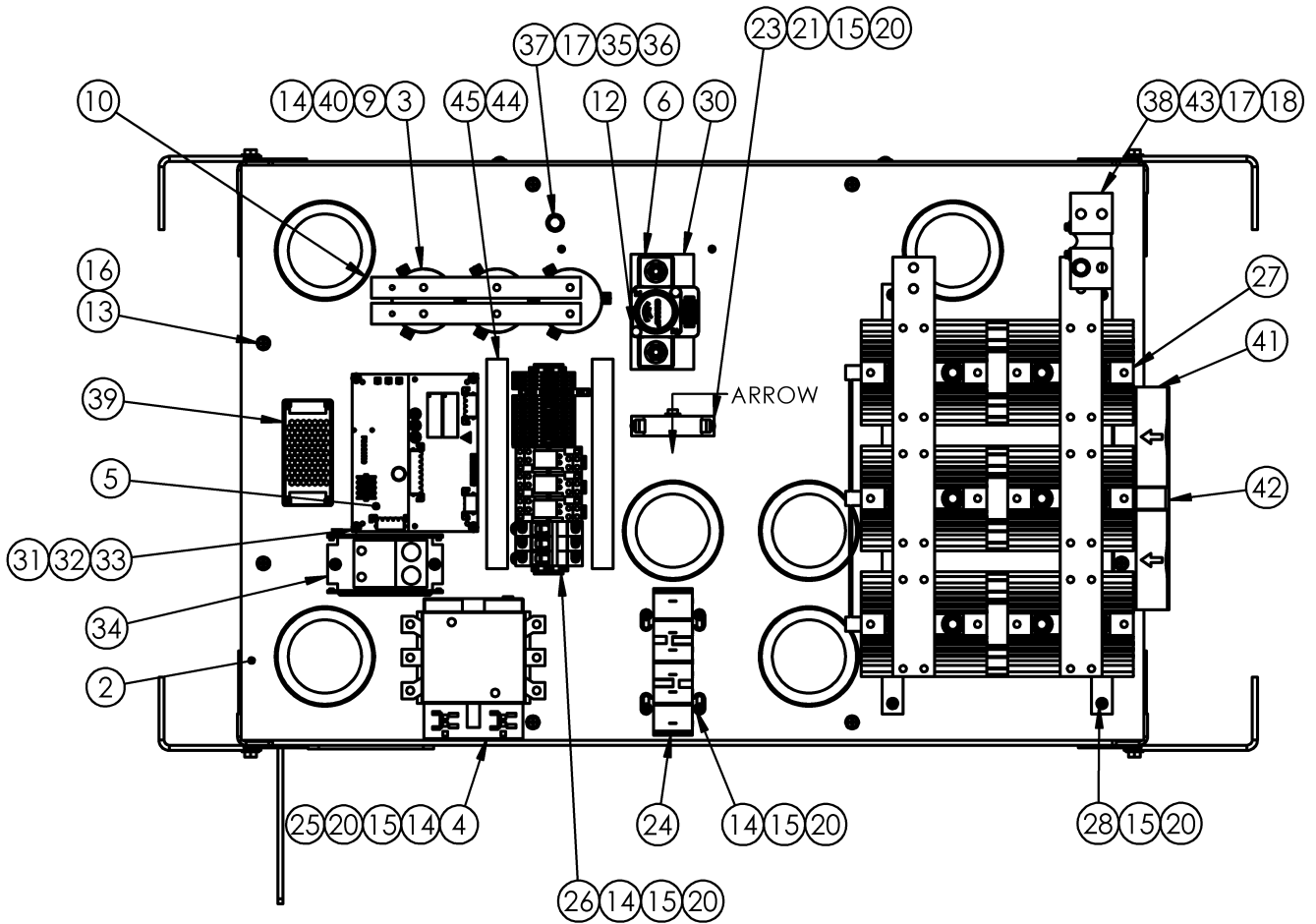
When ordering replacement parts/kits, please specify model, serial number and color of your unit.



Item	Part Number	Description	Qty
2	H-3200	HUB	1
3	Z-9179-00	WELDMENT, FRONT AXLE (P)	1
4	Z-9193-00	WELDMENT, TOWBAR RAIL (P)	1
5	H-3424	HUB, #3500	4
7	G-1230-01	NUT, AXLE 1	5
8	G-1301-05	PIN, 5/32 X 1-1/2 LG COTTER	5
9	J-3427	LEVER	1
10	R-2096	PIN, TOWBAR	1
11	G-1301-02	PIN, 1/8 X 1 LG COTTER	2
12	G-1100-109044	BOLT, 1/2-13 X 4-1/2" HEX HD GR 5	1
13	G-1100-109014	BOLT, 1/2-13 X .1-1/2" HEX HD GR 5	4
14	G-1250-1090N	FLATWASHER. 1/2 NARROW	10
15	G-1202-1090	STOPNUT, 1/2-13 ELASTIC	5
18	G-1283	WASHER, SPINDLE	5
19	G-1202-1095	STOPNUT, 1/2-20 ELASTIC	6

Parts List

When ordering replacement parts/kits, please specify model, serial number and color of your unit.



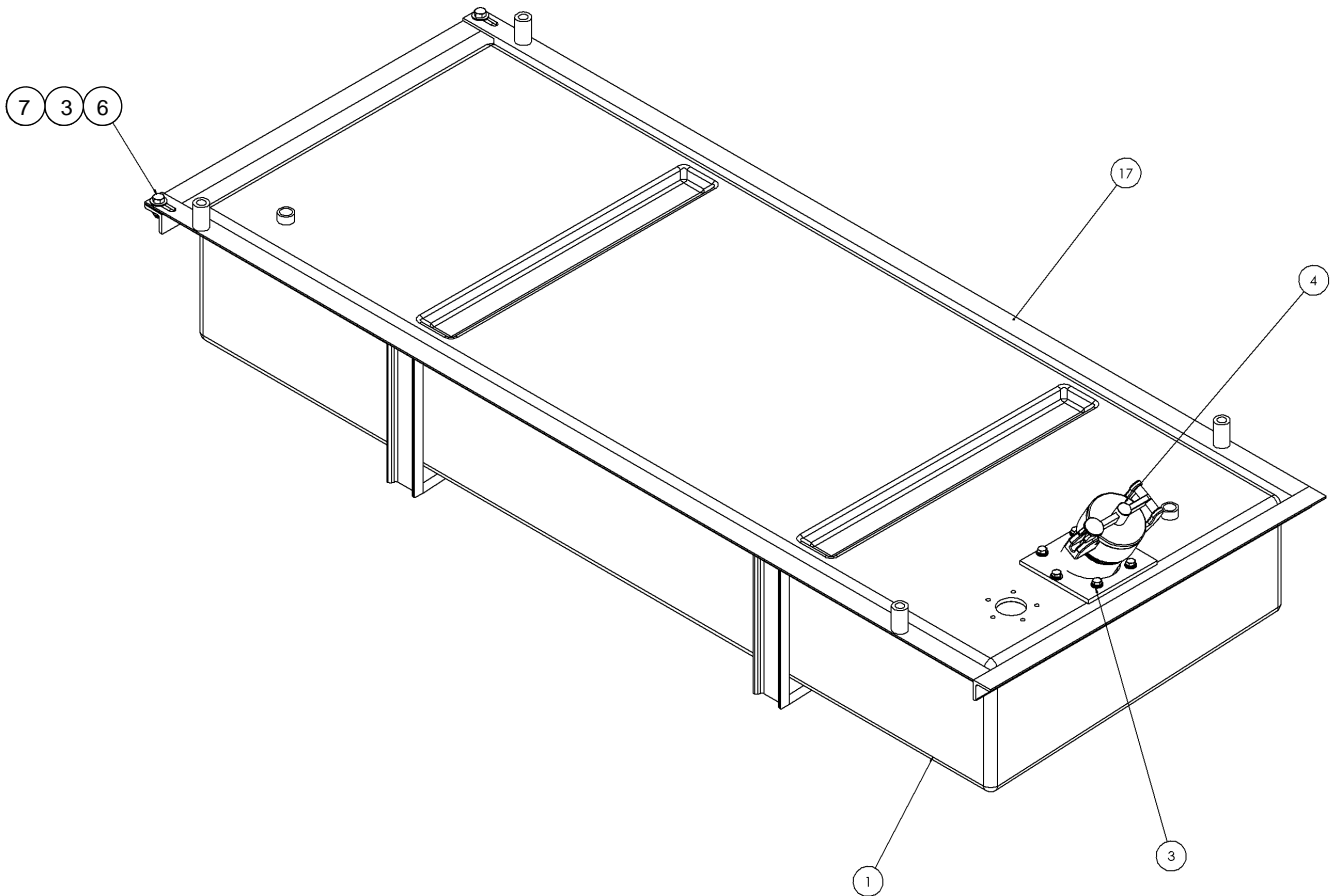
Parts List

When ordering replacement parts/kits, please specify model, serial number and color of your unit.

Item	Part Number	Description	Qty
2	S-3092	PLATE, SHELF	1
3	EC-2397	CAPACITOR, 60K UF, 50 VDC	3
4	13009	AC AND DC UNITS CONTACTOR	1
5	EC-3202	ASSY, FIRING BOARD	1
6	EC-3006	CONTACTOR, 600A, 12V	1
9	H-3480	CLAMP, MOUNTING CAPACITOR	3
10	H-4027	GROMMET, RUBBR, 4.75OD x 3.5ID	6
12	G-1100-105040	BOLT, 1/4-20 X 4.0" LG HEX HD GR 5	2
13	G-1159-105010	SCR, 1/4-20 RD HD CRS REC	10
14	G-1159-103506	SCREW, #10-32 X 3/4" LG. RD HEAD CROSS RECESS MACHINE	25
15	G-1250-1030N	FLATWASHER. #10 NARROW	24
16	G-1250-1050N	FLATWASHER. 1/4 NARROW	12
17	G-1250-1070N	FLATWASHER. 3/8 NARROW	12
18	G-1202-1070	STOPNUT, 3/8-16 ELASTIC	9
20	G-1440-1035-S	NUTSERT, 10-32 OPEN END	34
21	G-1159-103510	SCREW, #10-32 X 1.0" LG. RD HEAD CROSS RECESS MACHINE	4
23	EC-3008	SENSOR, CURRENT TRANSFORMER	1
24	EC-2867	TRANSFORMER, CURRENT 3-PHASE	1
25	EC-3020	COIL, CONTACTORCONTACTOR COIL LX9FG127SCHNEIDER ELECT	1
26	Z-9670	ASSEMBLY, DIN RAIL	1
27	EC-2128-M	SCRC PACK	1
28	G-1159-103514	SCREW, #10-32 X 1-1/2" LG. RD HEAD CROSS RECESS MACHINE	4
30	J-6610	SPACER, CONTACTOR	1
31	H-3419	ISOLATOR, STUD-PLATE MOUNT8-32	4
32	G-1250-1020N	FLATWASHER. #8 NARROW	8
33	G-1500-1020	NUT, 8-32 HEX S.S.	8
34	EC-2887	TERMINAL, POWER 1 BLOCK	1
35	G-1251-1070R	LOCKWASHER, 3/8 REGULAR	1
36	G-1207-1070	NUT, 3/8-16 JAM	1
37	G-1100-107007	BOLT, 3/8-16 X 7/8" HEX HD GR 5	1
38	13002	DC SHUNT	1
39	EC-3197	24V DC-DC CONVERTER	1
40	J-7164	BUSS BAR	2
41	EC-3004	FAN, GPU RACKFan, 12V DC, 4.72"x1.5" IP5531CC88	2
42	S-3592-00	BRACKET, FAN	1
43	G-1100-107020	BOLT, 3/8-16 X 2.0" HEX HD GR 5	1
44	EC-1710-06-10.0	DUCT, WIRING	2
45	EC-1711-03-10.0	COVER, WIRING DUCT	2

Parts List

When ordering replacement parts/kits, please specify model, serial number and color of your unit.



Item	Part Number	Description	Qty
1	H-3877	FUEL TANK, 35 GAL	1
3	G-1503-1070N	FLATWASHER. 3/8 SST NARROW	4
4	15253	FILL CAP LESS SCREEN (GREEN)	1
6	G-1112-107010	BOLT, 38-16 X 1.0" SST HEX HD	2
7	G-1501-1070	STOPNUT, 3/8-16 SST ELASTIC	2
17	Z-8903-00	WELDMENT, FUEL TANK CAGE	1

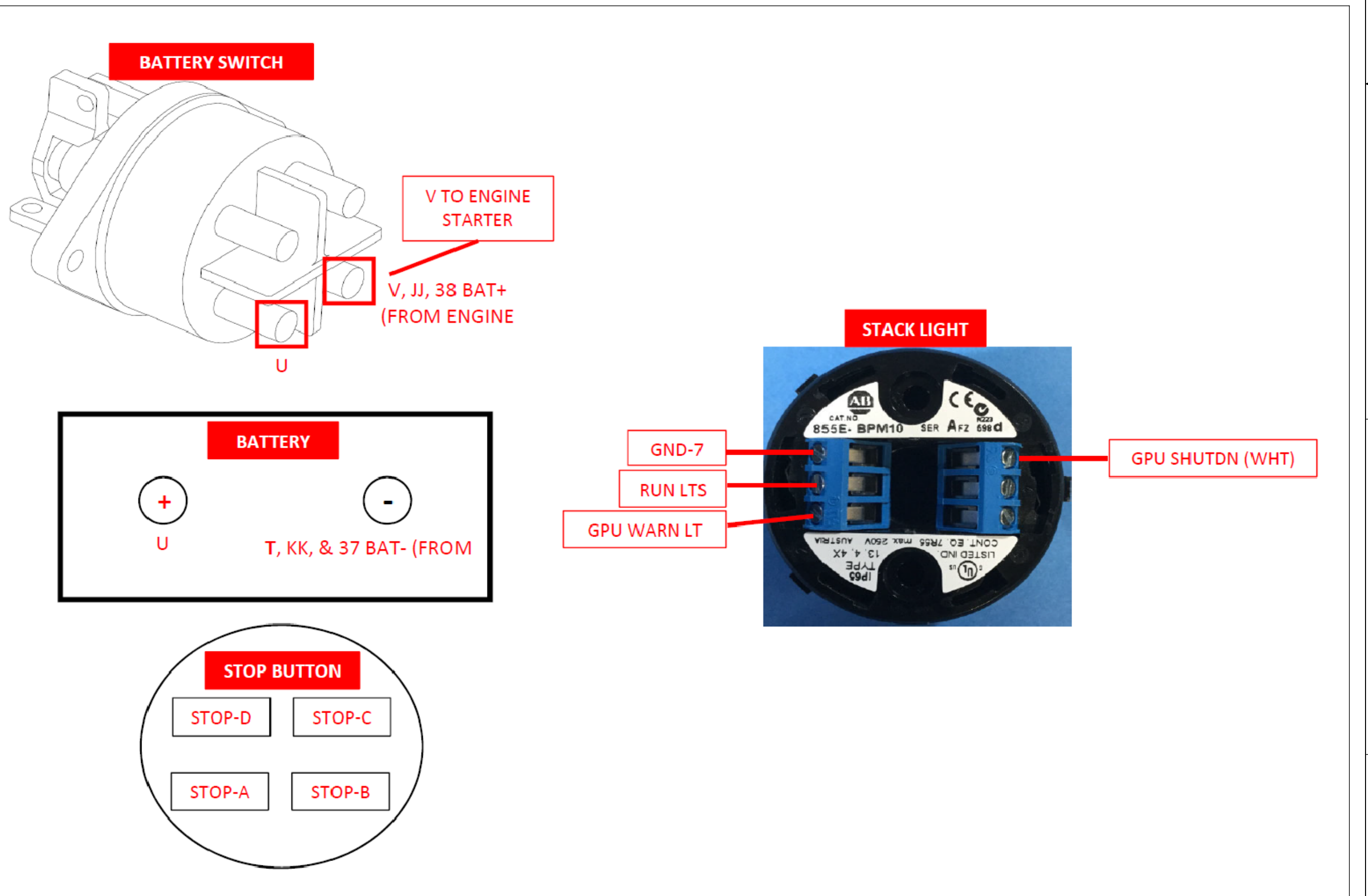
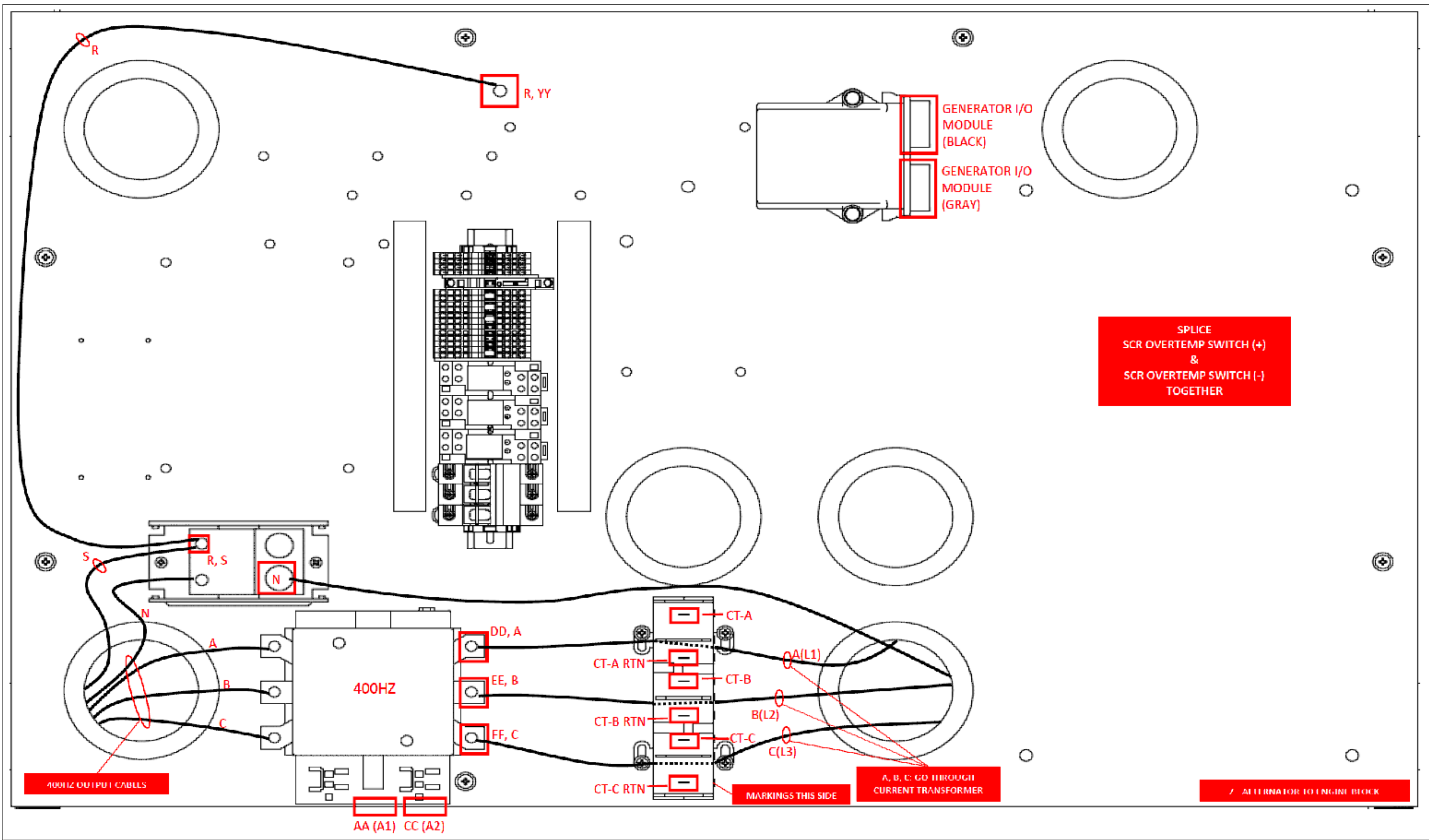
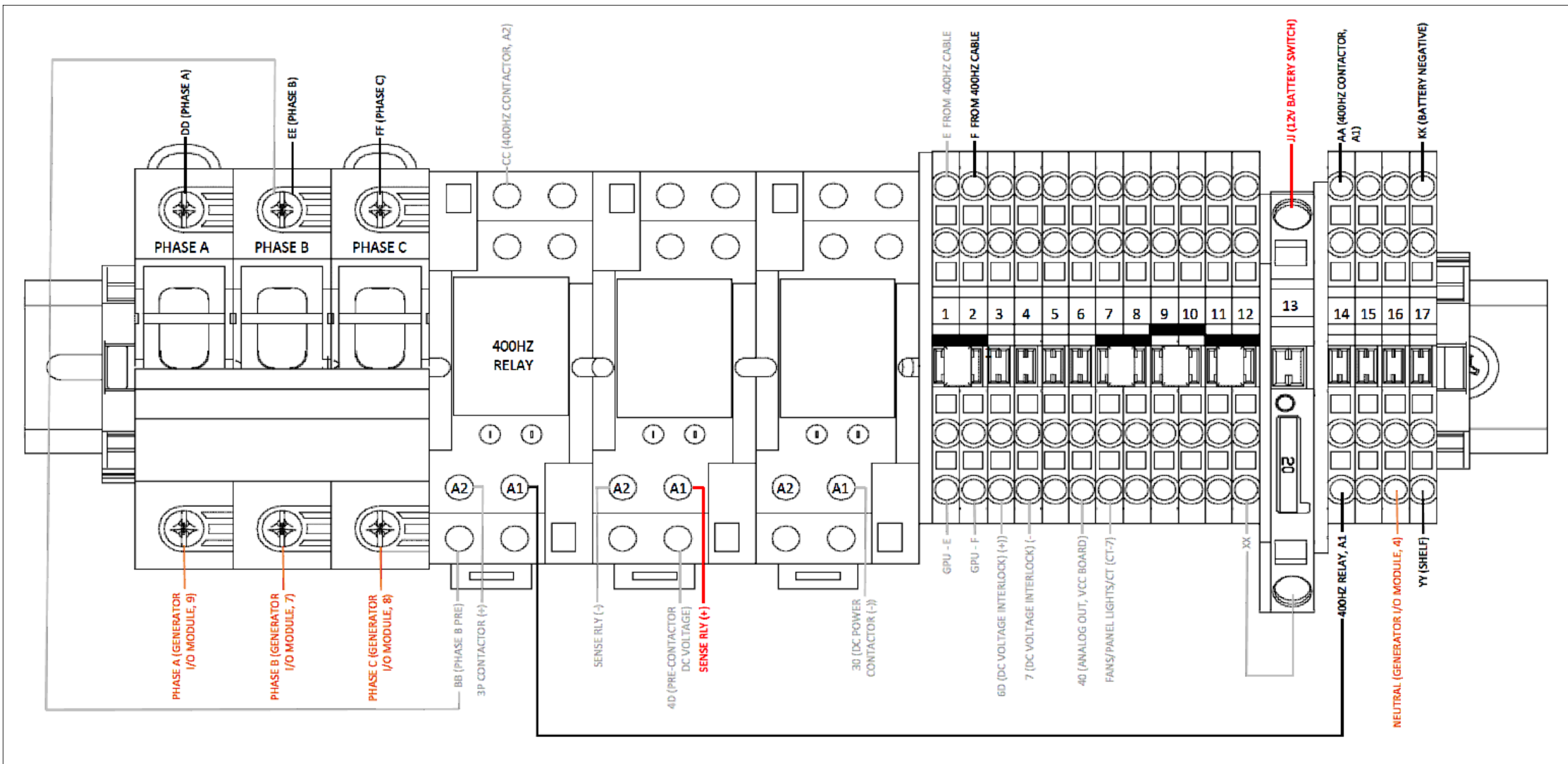


APPENDIX I

Wiring Schematics
INS-2804 – 11-4090-0000
INS-2485 – 11-4290-0000

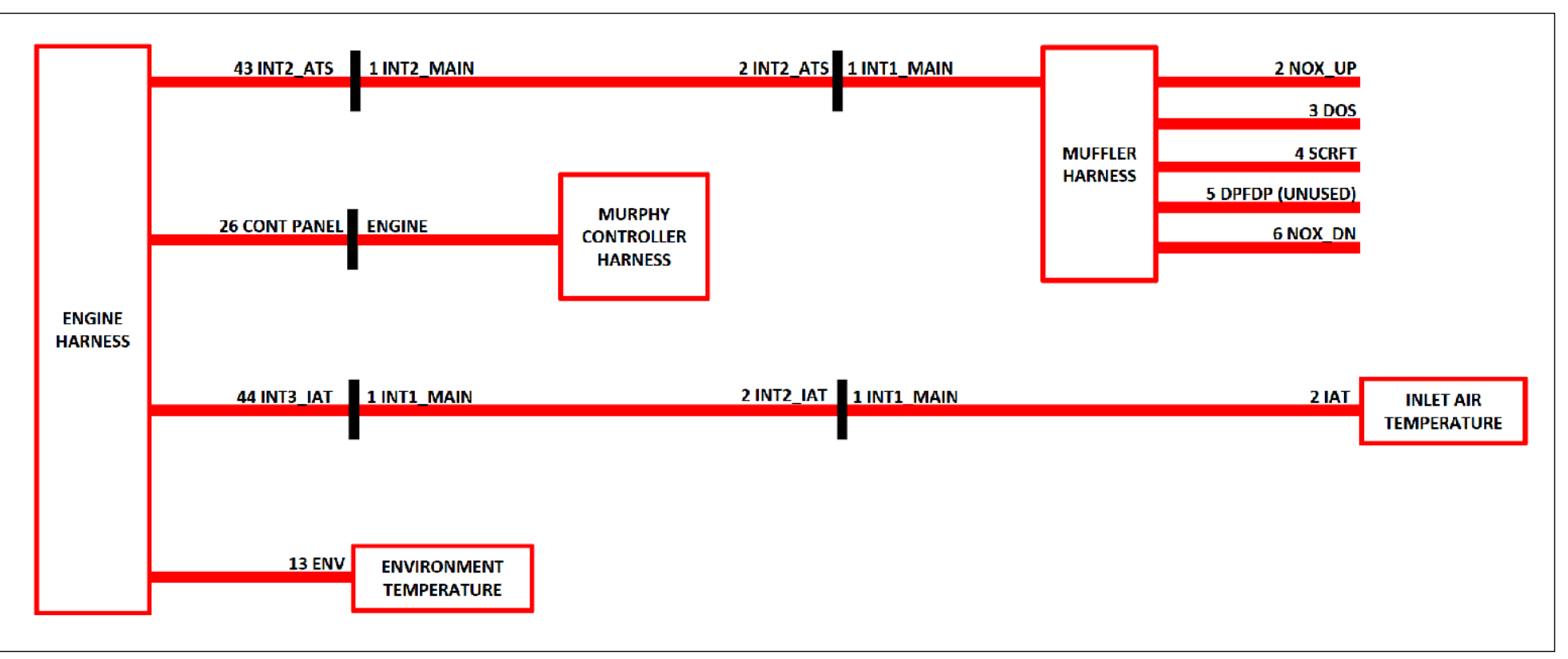
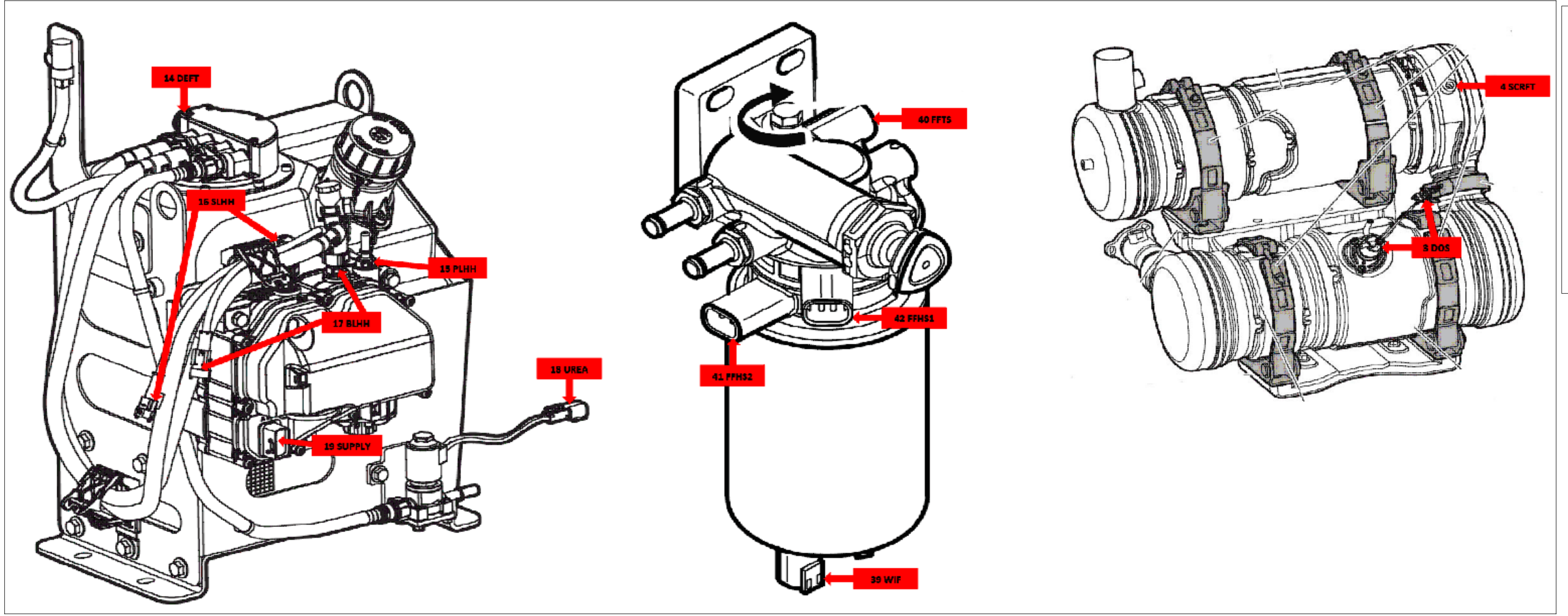
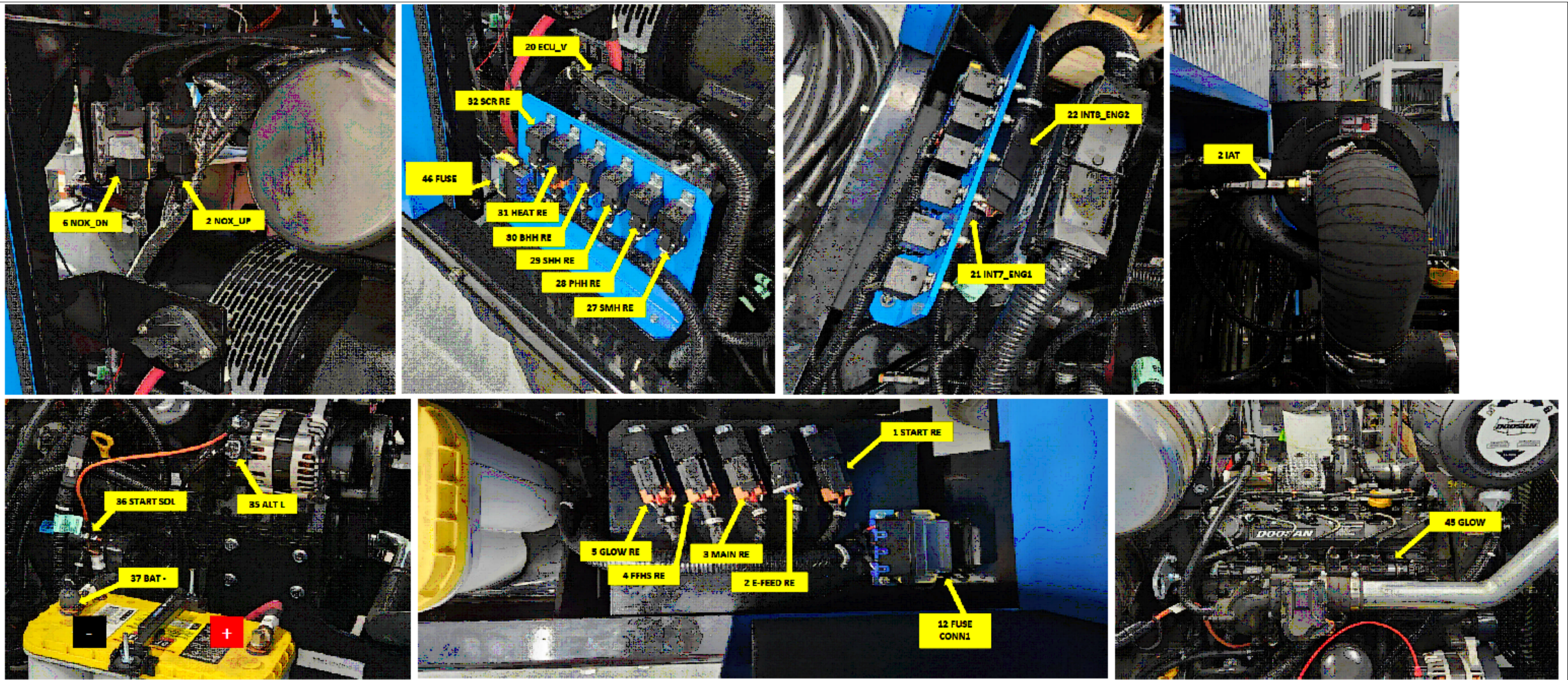
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REVISIONS					
REV	DESCRIPTION	EC#	DWN	CHK	DATE
A	ORIGINAL RELEASE	26475	-	-	09/12/23



MADE FROM	BREAK ALL SHARP EDGES AND CORNERS INTERPRET PER ASME Y14.5-2009	TRONAIR <small>AIRCRAFT GROUND SUPPORT EQUIPMENT</small>
MATERIAL N/A	DIMENSIONS IN INCHES AND TOLERANCES PER BELOW UNLESS OTHERWISE SPECIFIED: DIMENSION INCH [mm]: X [X] ± .1 [3] .XX [X] ± .03 [0.8] .XXX [XX] ± .010 [0.25] .XXXX [XXX] ± .0030 [0.076] FRACTION INCH [mm]: 1/XX [1/X] ± 1/16 [1.6] ANGULAR DEGREE [RADIAN]: X [XXX] ± .5 [0.01]	
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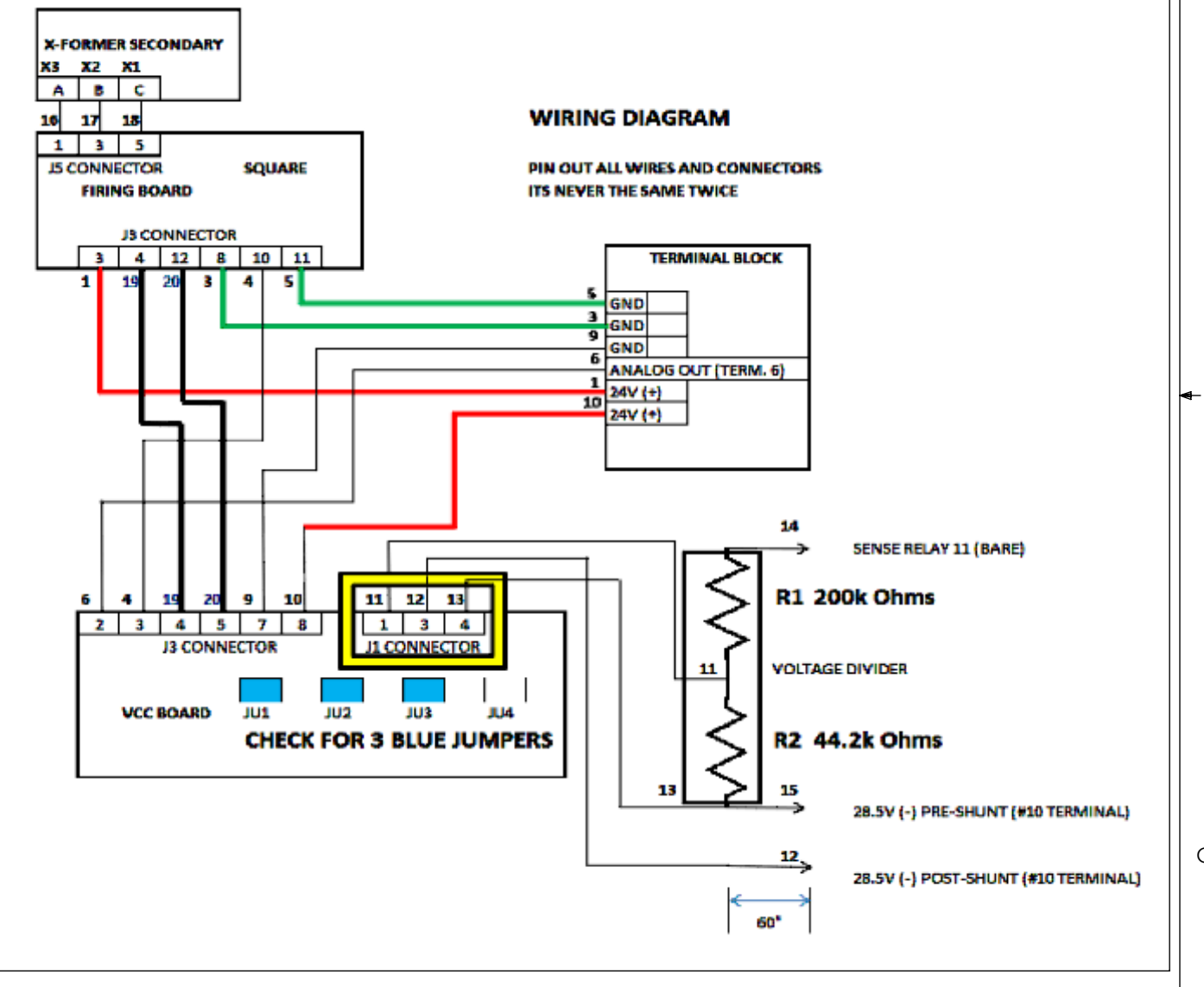
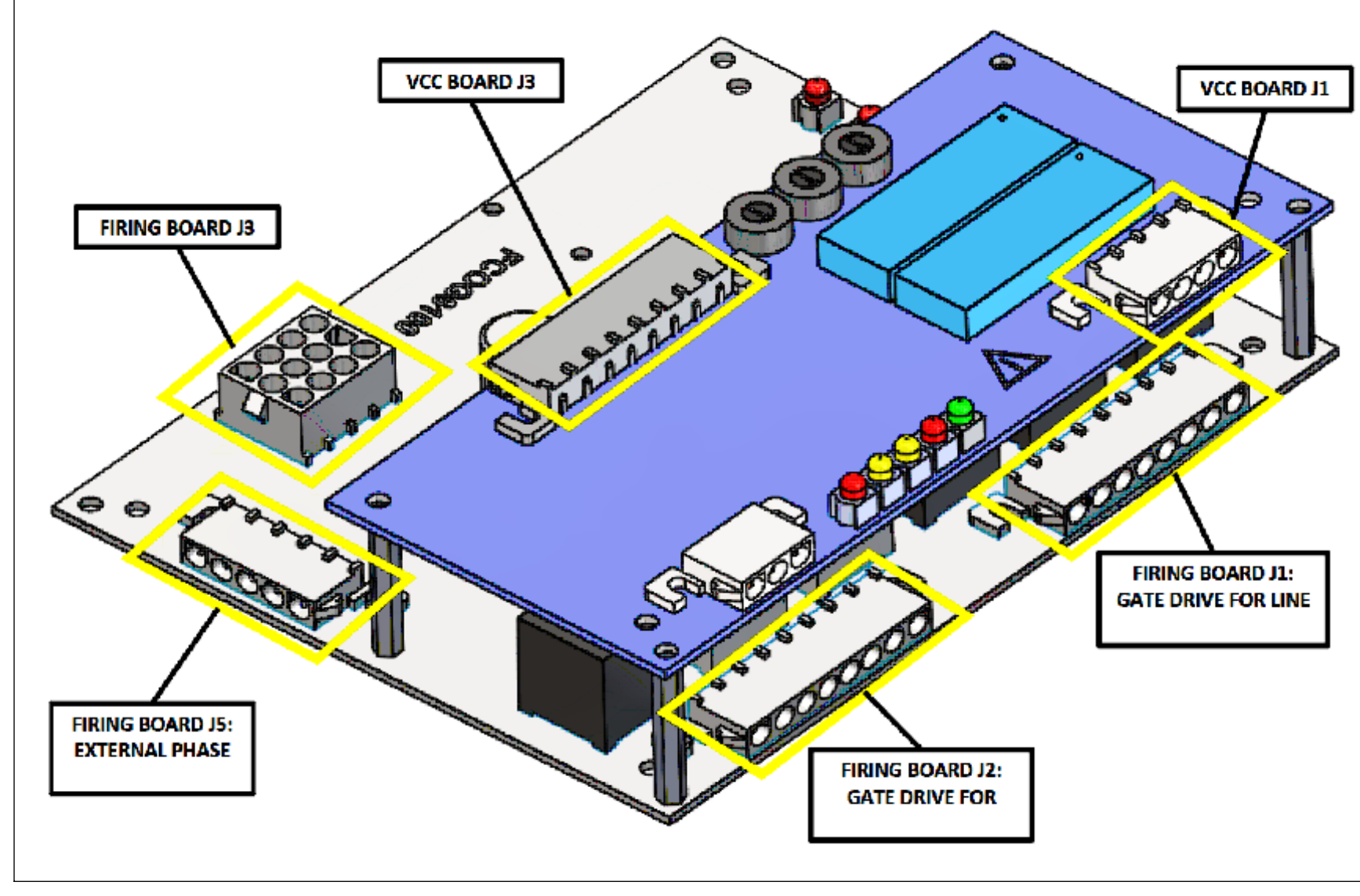
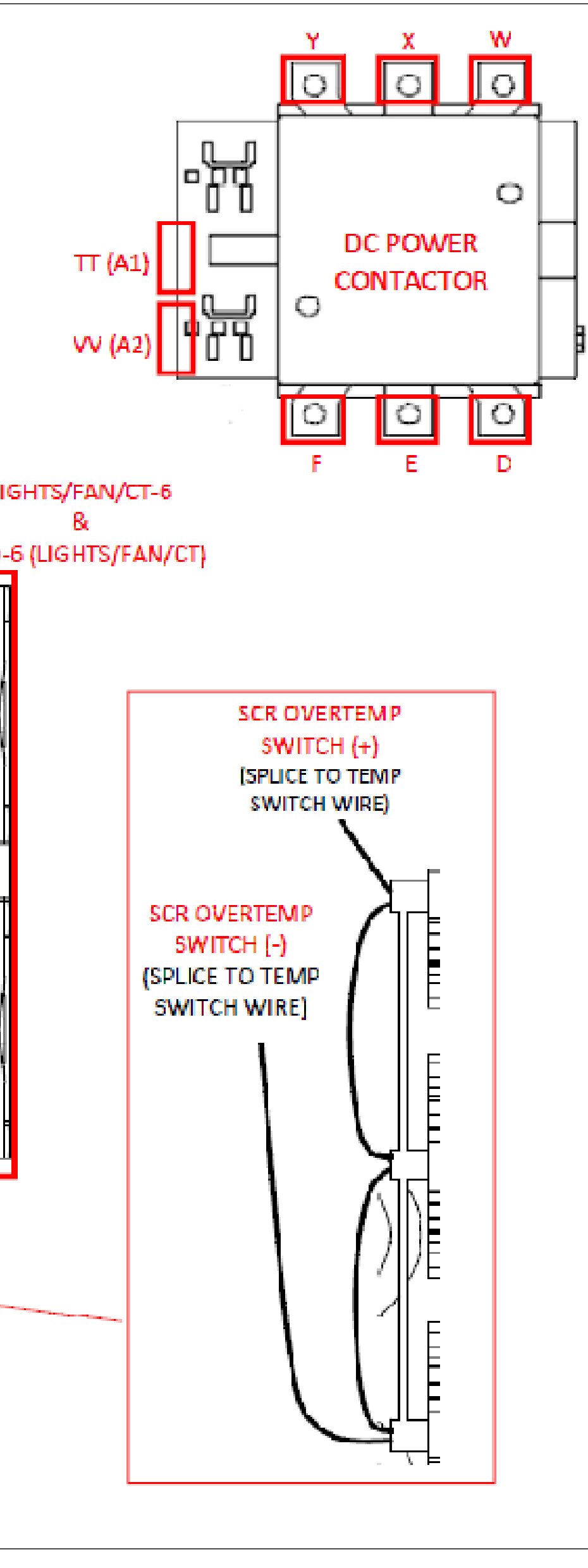
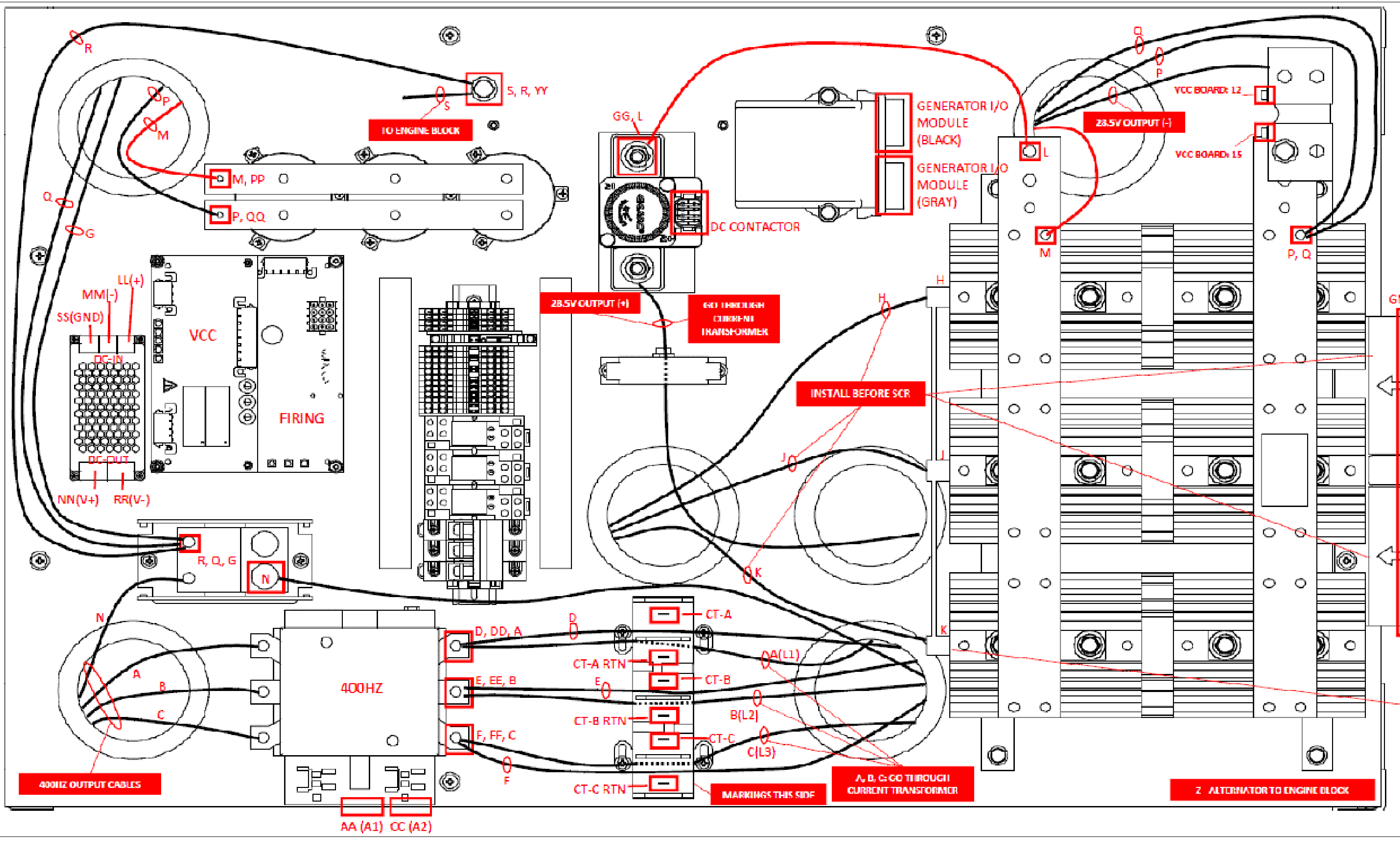
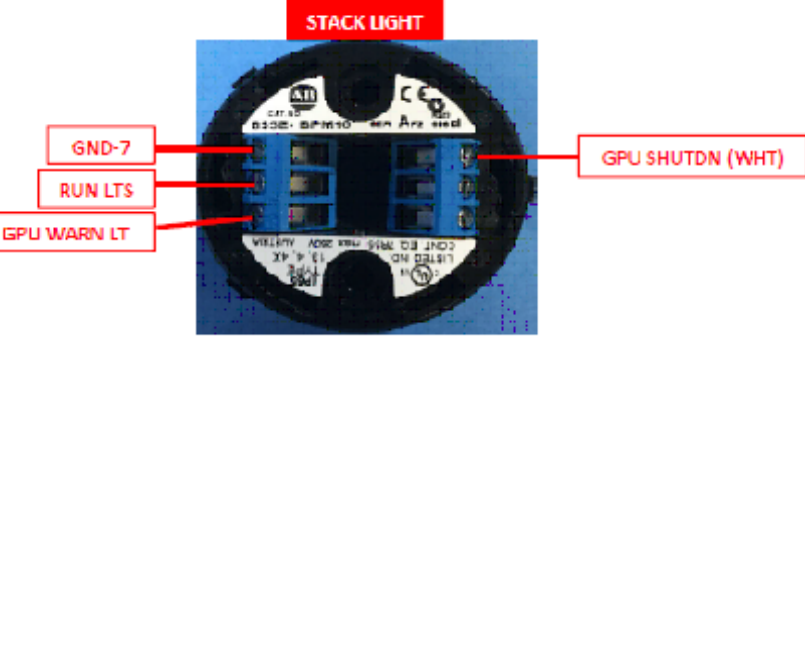
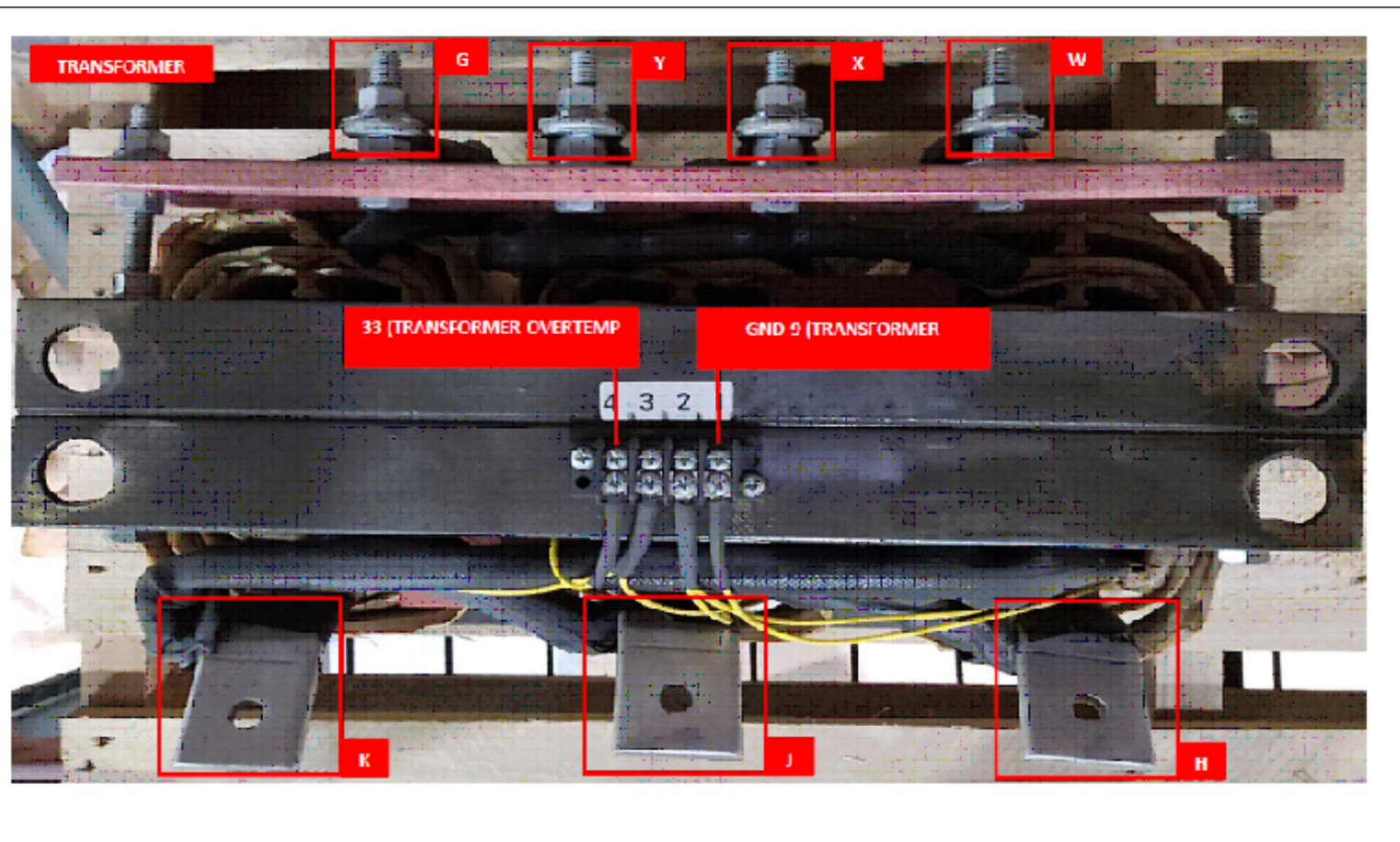
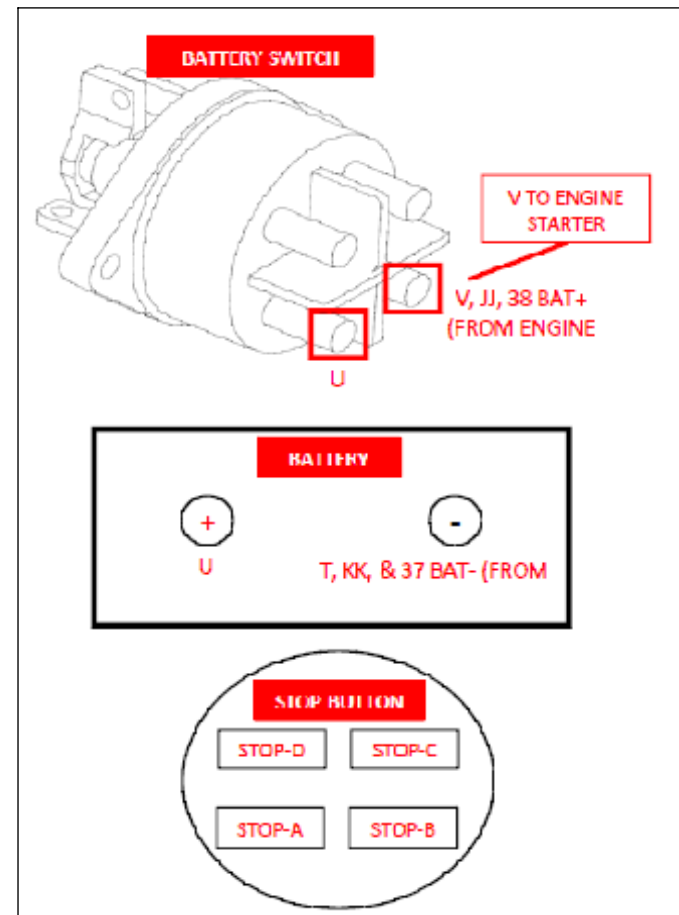
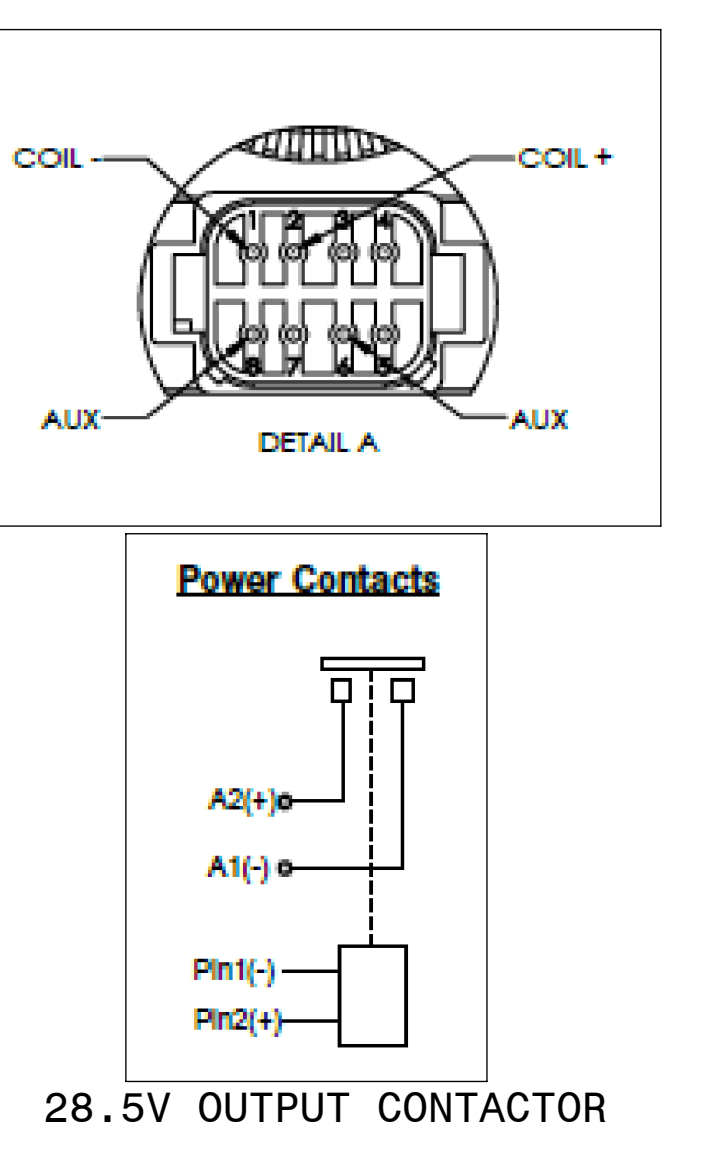
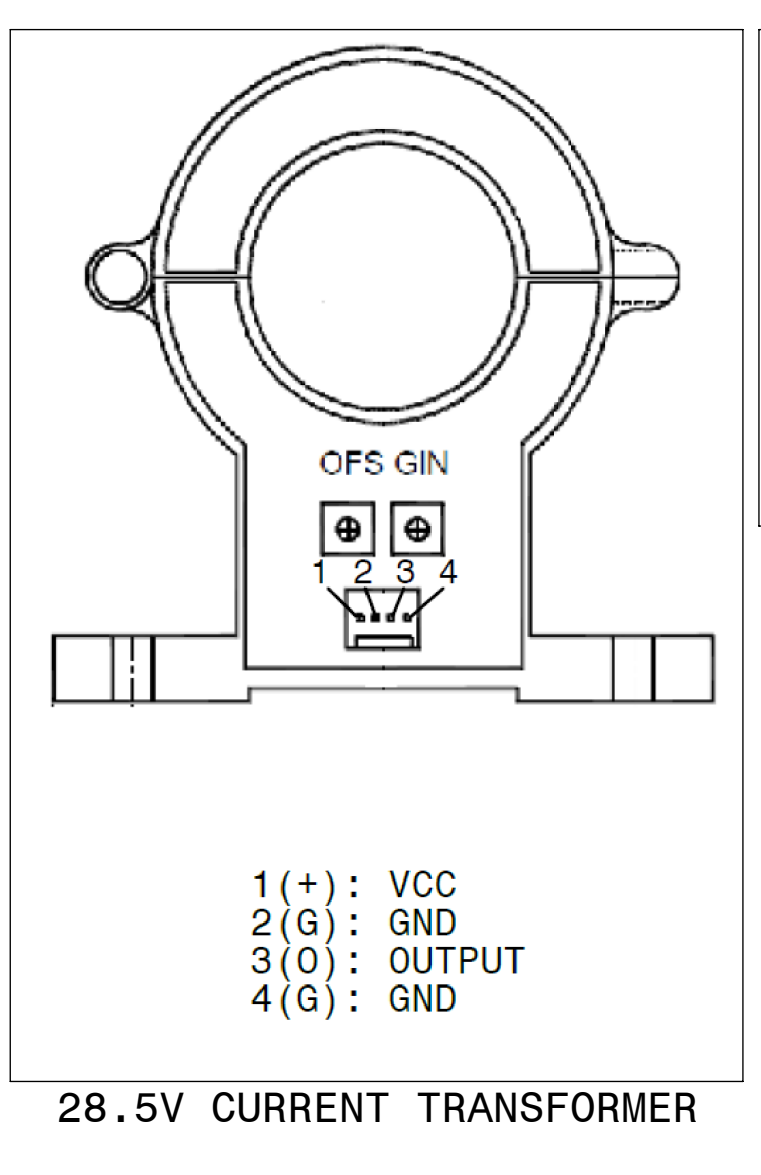
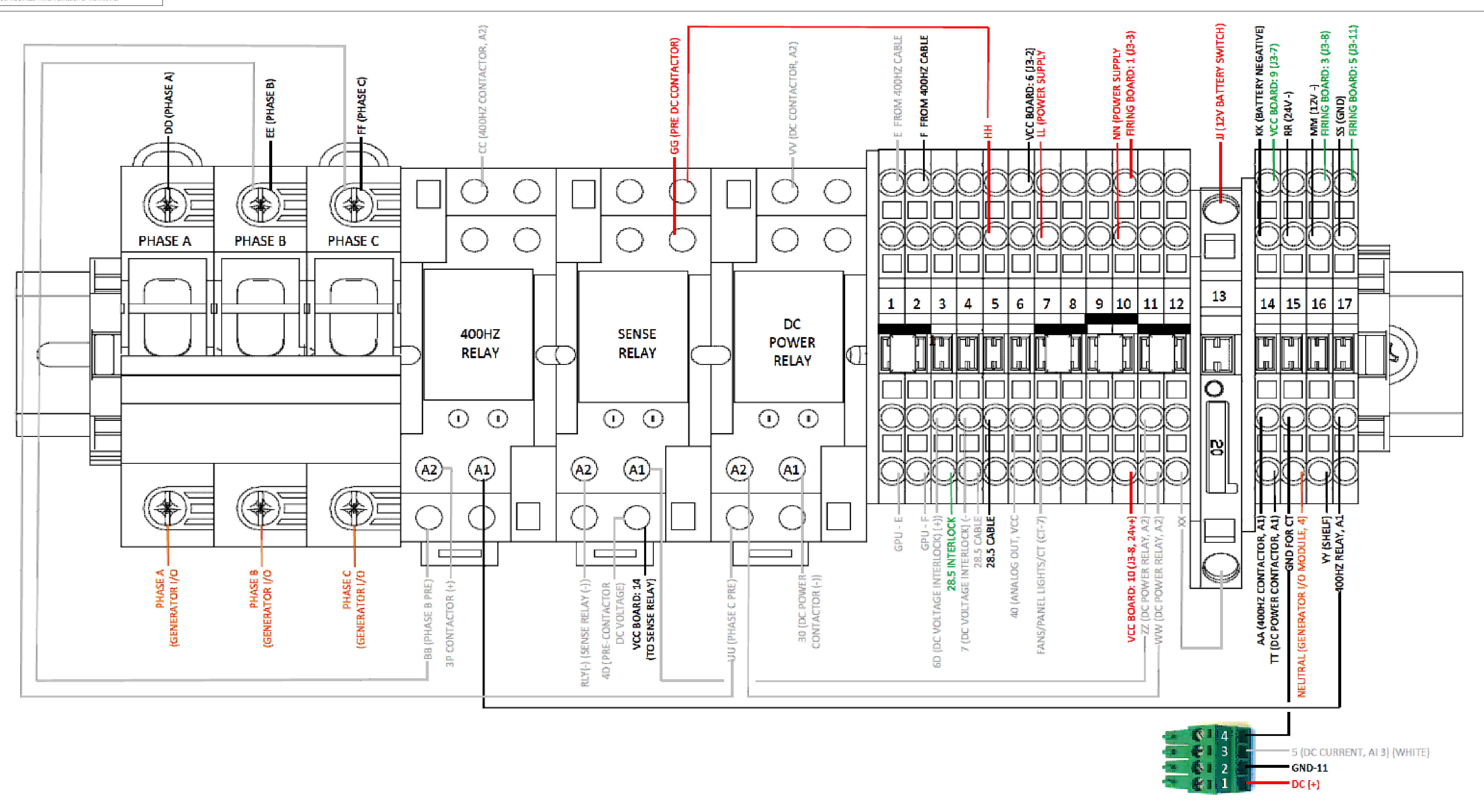
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- NOTES:
- UNUSED ENGINE HARNESS CONNECTIONS FOR TIER-4: 23 DIA, 24 INT4_REGEN, 25 INT5_PEDAL, 33 E-FEED, 34 INT6
 - UNUSED MUFFLER HARNESS CONNECTIONS FOR TIER-4: 5 DPFD

MADE FROM	BREAK ALL SHARP EDGES AND CORNERS INTERPRET PER ASME Y14.5-2009	TRONAIR AIRCRAFT GROUND SUPPORT EQUIPMENT	
MATERIAL N/A	DIMENSIONS IN INCHES AND TOLERANCES PER BELOW UNLESS OTHERWISE SPECIFIED: DIMENSION INCH [mm]: X [X] ± .1 [3] .XX [X] ± .03 [0.8] .XXX [XX] ± .010 [0.25] .XXXX [XXX] ± .0030 [0.076] FRACTION INCH [mm]: 1/XX [1/X] ± 1/16 [1.6] ANGULAR DEGREE [RADIAN]: X [XXX] ± .5 [0.01]	OWN BY NGL	DATE
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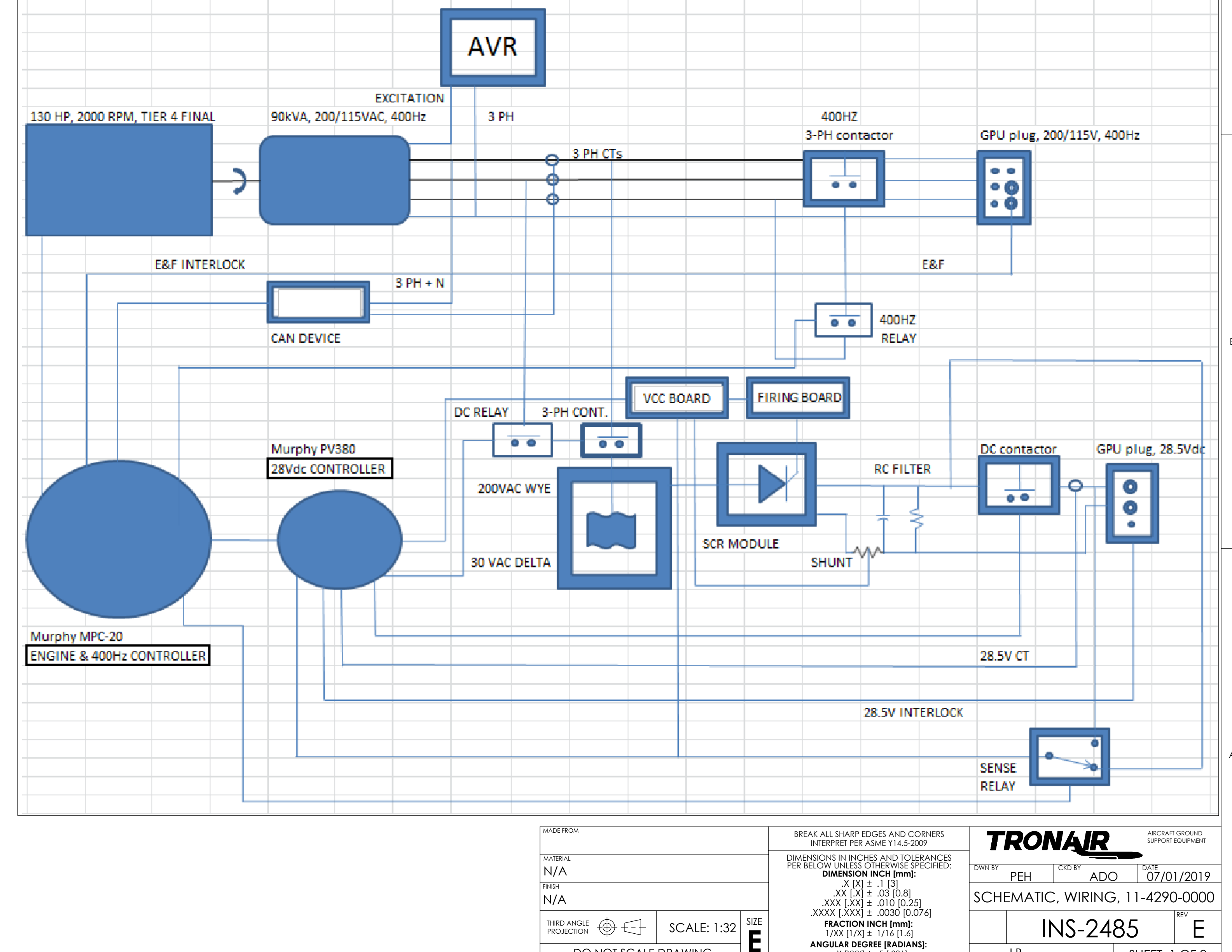
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C	UPDATED DRAWING	21176	PEH	XXX	02/27/2019
D	ADDED WIRE ZZ	21527	PEH	ADO	11/29/2019
E	UPDATED DRAWING	26475	NGL	KJY	8/7/2023



LARGE CABLES		left side		right side		comment
marking	wire size	length	heat shrink/color	from	to	
A	4/0	48	BLK	ALTERNATOR, PH A	1/2 STR 400HZ CONTACTOR	PHASE A L1
B	4/0	48	BLK	ALTERNATOR, PH B	1/2 STR 400HZ CONTACTOR	PHASE A L2
C	4/0	48	BLK	BATTERY BLOCK	1/2 STR 400HZ CONTACTOR	PHASE A L3
D	2/0	60	BLK	400HZ CONTACTOR, PH A	3/8 STR 45 DEG DC POWER CONTACTOR	PHASE A L1
E	2/0	60	BLK	400HZ CONTACTOR, PH B	3/8 STR 45 DEG DC POWER CONTACTOR	PHASE A L2
F	2/0	60	BLK	400HZ CONTACTOR, PH C	3/8 STR 45 DEG DC POWER CONTACTOR	PHASE A L3
G	2/0	48	BLK	400HZ CONTACTOR, PH C	3/8 STR 45 DEG DC POWER CONTACTOR	PHASE A L3
H	4/0	72	BLK	400HZ CONTACTOR, PH C	3/8 STR 45 DEG DC POWER CONTACTOR	PHASE A L3
I	4/0	72	BLK	400HZ CONTACTOR, PH C	3/8 STR 45 DEG DC POWER CONTACTOR	PHASE A L3
J	4/0	72	BLK	400HZ CONTACTOR, PH C	3/8 STR 45 DEG DC POWER CONTACTOR	PHASE A L3
K	4/0	72	BLK	400HZ CONTACTOR, PH C	3/8 STR 45 DEG DC POWER CONTACTOR	PHASE A L3
L	4/0	72	BLK	400HZ CONTACTOR, PH C	3/8 STR 45 DEG DC POWER CONTACTOR	PHASE A L3
M	6	60	RED	SCR (L)	3/8 STR CAPACITOR (L)	#R0
N	6	60	BLK	SCR (R)	3/8 STR CAPACITOR (R)	#R0
O	6	60	BLK	SCR (L)	3/8 STR CAPACITOR (L)	#R0
P	6	60	BLK	SCR (R)	3/8 STR CAPACITOR (R)	#R0
Q	6	60	BLK	SCR (L)	3/8 STR CAPACITOR (L)	#R0
R	6	60	BLK	SCR (R)	3/8 STR CAPACITOR (R)	#R0
S	4	108	BLK	BATTERY SWITCH (INT)	1/2 STR SHIELD	PHASE A L1, B
T	4/0	72	BLK	BATTERY SWITCH (INT)	1/2 STR SHIELD	PHASE A L1, B
U	4/0	72	BLK	BATTERY SWITCH (INT)	1/2 STR SHIELD	PHASE A L1, B
V	4/0	72	BLK	BATTERY SWITCH (INT)	1/2 STR SHIELD	PHASE A L1, B
W	2/0	65	BLK	DC POWER CONTACTOR	1/2 STR 45 DEG DC POWER CONTACTOR	PHASE A L1, B
X	2/0	65	BLK	DC POWER CONTACTOR	1/2 STR 45 DEG DC POWER CONTACTOR	PHASE A L1, B
Y	2/0	65	BLK	DC POWER CONTACTOR	1/2 STR 45 DEG DC POWER CONTACTOR	PHASE A L1, B
Z	6	60	BLK	DC POWER CONTACTOR	1/2 STR 45 DEG DC POWER CONTACTOR	PHASE A L1, B

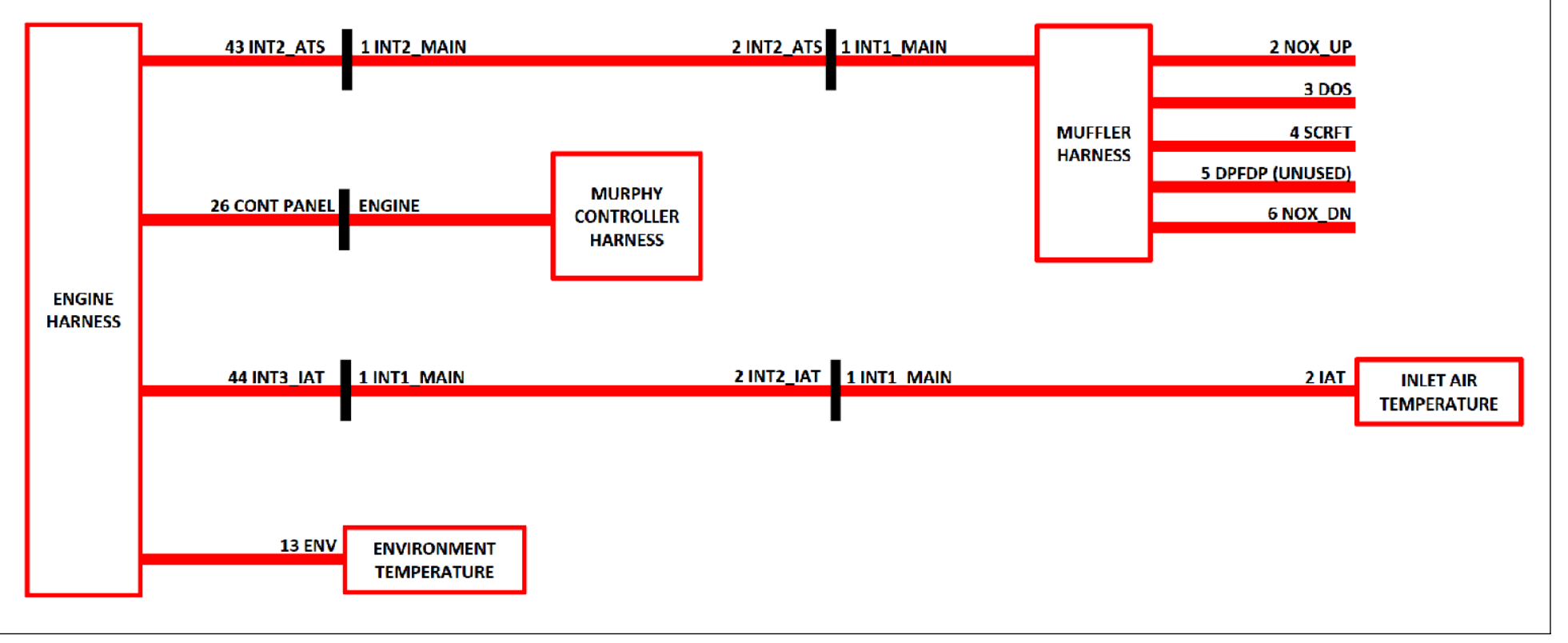
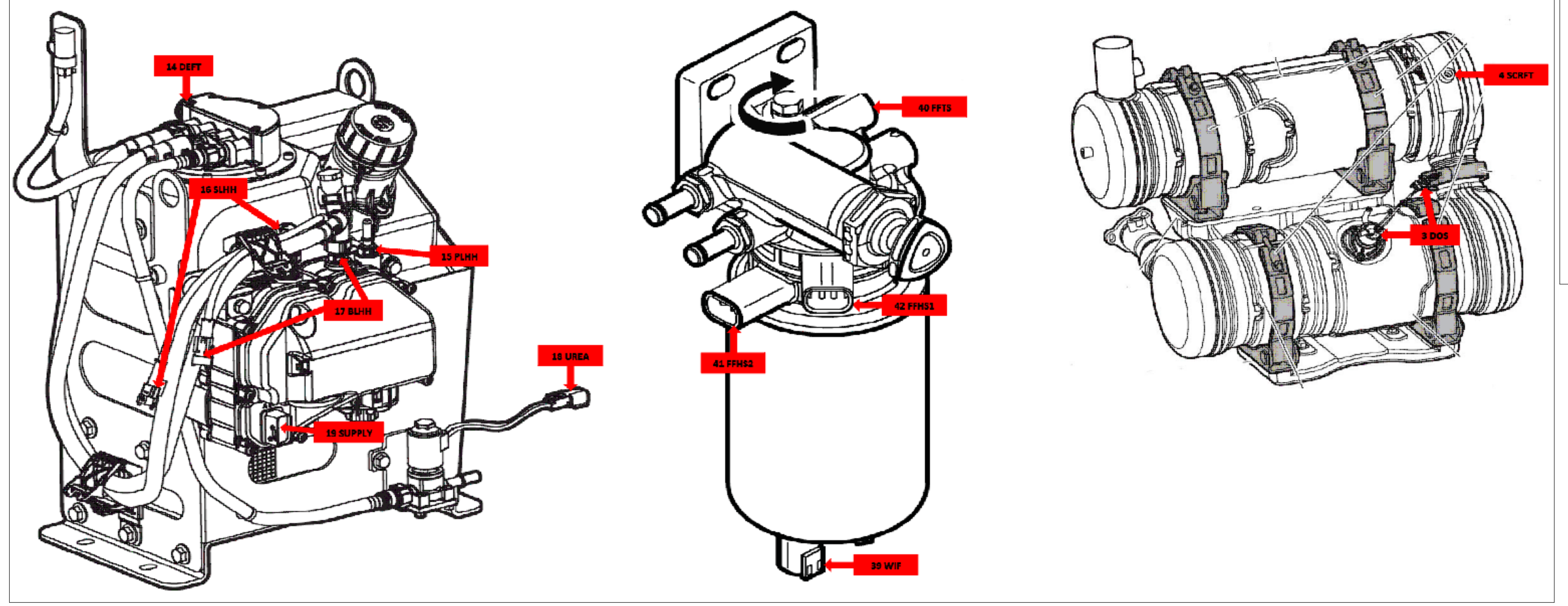
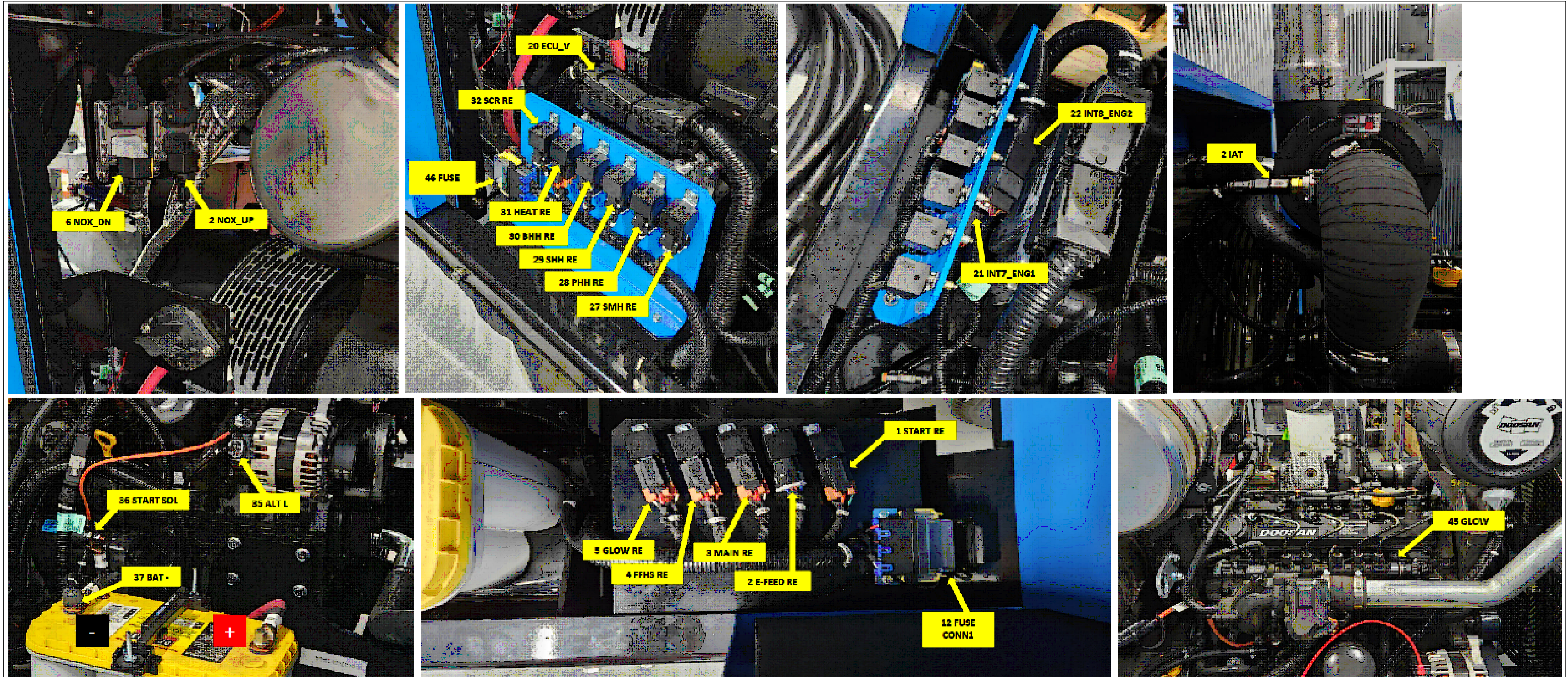
SMALL WIRES		left side		right side		comment
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BB	16	30	BLK	400HZ CONTACTOR, COIL	400HZ CONTACTOR, COIL	A1
CC	16	30	WHT	400HZ CONTACTOR, COIL	400HZ CONTACTOR, COIL	A1
DD	16	30	BLK	400HZ CONTACTOR, COIL	400HZ CONTACTOR, COIL	A1
EE	16	30	BLK	400HZ CONTACTOR, COIL	400HZ CONTACTOR, COIL	A1
FF	16	30	BLK	400HZ CONTACTOR, COIL	400HZ CONTACTOR, COIL	A1
GG	16	30	BLK	400HZ CONTACTOR, COIL	400HZ CONTACTOR, COIL	A1
HH	16	30	BLK	400HZ CONTACTOR, COIL	400HZ CONTACTOR, COIL	A1
II	16	30	BLK	400HZ CONTACTOR, COIL	400HZ CONTACTOR, COIL	A1
JJ	16	30	BLK	400HZ CONTACTOR, COIL	400HZ CONTACTOR, COIL	A1
KK	16	30	BLK	400HZ CONTACTOR, COIL	400HZ CONTACTOR, COIL	A1
LL	16	30	BLK	400HZ CONTACTOR, COIL	400HZ CONTACTOR, COIL	A1
MM	16	30	BLK	400HZ CONTACTOR, COIL	400HZ CONTACTOR, COIL	A1
NN	16	30	BLK	400HZ CONTACTOR, COIL	400HZ CONTACTOR, COIL	A1
OO	16	30	BLK	400HZ CONTACTOR, COIL	400HZ CONTACTOR, COIL	A1
PP	16	30	BLK	400HZ CONTACTOR, COIL	400HZ CONTACTOR, COIL	A1
QQ	16	30	BLK	400HZ CONTACTOR, COIL	400HZ CONTACTOR, COIL	A1
RR	16	30	BLK	400HZ CONTACTOR, COIL	400HZ CONTACTOR, COIL	A1
SS	16	30	BLK	400HZ CONTACTOR, COIL	400HZ CONTACTOR, COIL	A1
TT	16	30	BLK	400HZ CONTACTOR, COIL	400HZ CONTACTOR, COIL	A1
UU	16	30	BLK	400HZ CONTACTOR, COIL	400HZ CONTACTOR, COIL	A1
VV	16	30	BLK	400HZ CONTACTOR, COIL	400HZ CONTACTOR, COIL	A1
WW	16	30	BLK	400HZ CONTACTOR, COIL	400HZ CONTACTOR, COIL	A1
XX	16	30	BLK	400HZ CONTACTOR, COIL	400HZ CONTACTOR, COIL	A1
YY	16	30	BLK	400HZ CONTACTOR, COIL	400HZ CONTACTOR, COIL	A1
ZZ	16	30	BLK	400HZ CONTACTOR, COIL	400HZ CONTACTOR, COIL	A1

WIRE	LOCATION A	PIN	LENGTH	LOCATION B	PIN	COLOR
1	FIRING BOARD J3	1	48	28.5V CT	1	RED
2	FIRING BOARD J3	2	48	28.5V CT	2	RED
3	FIRING BOARD J3	3	48	28.5V CT	3	RED
4	FIRING BOARD J3	4	48	28.5V CT	4	RED
5	FIRING BOARD J3	5	48	28.5V CT	5	RED
6	FIRING BOARD J3	6	48	28.5V CT	6	RED
7	FIRING BOARD J3	7	48	28.5V CT	7	RED
8	FIRING BOARD J3	8	48	28.5V CT	8	RED
9	FIRING BOARD J3	9	48	28.5V CT	9	RED
10	FIRING BOARD J3	10	48	28.5V CT	10	RED
11	FIRING BOARD J3	11	48	28.5V CT	11	RED
12	FIRING BOARD J3	12	48	28.5V CT	12	RED
13	FIRING BOARD J3	13	48	28.5V CT	13	RED
14	FIRING BOARD J3	14	48	28.5V CT	14	RED
15	FIRING BOARD J3	15	48	28.5V CT	15	RED
16	FIRING BOARD J3	16	48	28.5V CT	16	RED
17	FIRING BOARD J3	17	48	28.5V CT	17	RED
18	FIRING BOARD J3	18	48	28.5V CT	18	RED
19	FIRING BOARD J3	19	48	28.5V CT	19	RED
20	FIRING BOARD J3	20	48	28.5V CT	20	RED
21	FIRING BOARD J3	21	48	28.5V CT	21	RED
22	FIRING BOARD J3	22	48	28.5V CT	22	RED
23	FIRING BOARD J3	23	48	28.5V CT	23	RED
24	FIRING BOARD J3	24	48	28.5V CT	24	RED
25	FIRING BOARD J3	25	48	28.5V CT	25	RED
26	FIRING BOARD J3	26	48	28.5V CT	26	RED
27	FIRING BOARD J3	27	48	28.5V CT	27	RED
28	FIRING BOARD J3	28	48	28.5V CT	28	RED
29	FIRING BOARD J3	29	48	28.5V CT	29	RED
30	FIRING BOARD J3	30	48	28.5V CT	30	RED



<p>SCALE: 1:32</p> <p>DO NOT SCALE DRAWING</p>	<p>TRONAIR</p> <p>SHEMATIC, WIRING, 11-4290-0000</p> <p>INS-2485</p>	<p>DATE: 02/01/2019</p> <p>DESIGNER: PEH</p> <p>CHECKER: ADO</p> <p>DATE: 02/01/2019</p> <p>DESIGNER: PEH</p> <p>CHECKER: ADO</p>
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MADE FROM	BREAK ALL SHARP EDGES AND CORNERS INTERPRET PER ASME Y14.5-2009	TRONAIR AIRCRAFT GROUND SUPPORT EQUIPMENT	
MATERIAL	DIMENSIONS IN INCHES AND TOLERANCES PER BELOW UNLESS OTHERWISE SPECIFIED: DIMENSION INCH [mm]: X [X] ± .1 [3] .XX [X] ± .03 [0.8] .XXX [XX] ± .010 [0.25] .XXXX [XXX] ± .0030 [0.076] FRACTION INCH [mm]: 1/XX [1/X] ± 1/16 [1.6] ANGULAR DEGREE [RADIAN]: X [XXX] ± .5 [0.01]	OWN BY	DATE
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DO NOT SCALE DRAWING	SIZE D	SCHEMATIC, WIRING, 11-4290-0000	
		INS-2485	
		WEIGHT: LB	SHEET 2 OF 2



APPENDIX II

**Controller
(Murphy MPC-20)**

Software Release: 2.8.10043



MPC-20

Engine Controller

Operations Manual

Software Release 2.8.10043

*Approved by CSA for non-hazardous locations (Group Safety Publication EIC 61010-1)
Products covered in this document comply with European Council electromagnetic compatibility directive 2004/108/EC and electrical safety directive 2006/95/EC.

00-02-0898
2015-10-29
Section 40

In order to consistently bring you the highest quality, full-featured products, we reserve the right to change our specifications and designs at any time.

Warranty - A limited warranty on materials and workmanship is given with this Murphy product.
A copy of the warranty may be viewed or printed by going to www.fwmurphy.com/warranty.



ENOVATION CONTROLS has made efforts to ensure the reliability of the MPC-20 and to recommend safe use practices in system applications. Please note that in any application, operation and controller failures can occur. These failures might result in full control outputs or other outputs that might cause damage to or unsafe conditions in the equipment or process connected to the MPC-20.

Good engineering practices, electrical codes and insurance regulations require that you use independent external protective devices to prevent potentially dangerous or unsafe conditions. Assume that the MPC-20 can fail with outputs full ON, outputs full OFF or that other unexpected conditions can occur.

Please read the following information before installing.

BEFORE BEGINNING INSTALLATION OF THIS MURPHY PRODUCT:

- A visual inspection of this product before installation for any damage during shipping is recommended.
- Disconnect all electrical power to the machine. Failure to disconnect all electrical power connections before welding can result in damage to the panel and/or its components.
- It is your responsibility to have a qualified technician install the unit and make sure installation confirms with local codes.
- Observe all Warnings and Cautions in each section of these instructions.
- The MPC-20 is designed for use in industrial environments. There might be potential difficulties in ensuring electromagnetic compatibility in other environments due to conducted as well as radiated disturbances.
- Please contact ENOVATION CONTROLS immediately if you have any questions.

IMPORTANT! False or improper use and operation of electronic products could be dangerous. It is required that point-of-operation guarding devices be installed and maintained. All such devices must meet OSHA and ANSI Machine safety standards. The manufacturer shall not accept any responsibility for installation, application or safety of systems.

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Introduction

This document is designed to support a user in getting familiar with the MPC-20 and how to navigate the interface, modify the settings when installing and operating the controller. The Quick Set Up guide assists with establishing the different functions in the MPC-20 System Controller. Before attempting to set up the controller, be sure to read and understand this manual in its entirety.

Murphy PowerCore 20 (MPC-20)

The Murphy PowerCore 20 Controller (MPC-20) is a general all-purpose manual/auto start and manual/auto throttling engine controller. The controller is purposed primarily for pump and irrigation applications. However, it is versatile and flexible enough to be used on many applications outside pump and irrigation. This is a powerful controller that supports J1939 CAN protocols for electronically governed engines as well as mechanical engines for fault and safety shutdowns.

The MPC-20 is flexible in many aspects. The flexibility consists of the ability to:

- use in most applications where auto start or auto throttling is required or desired.
- use the same controller on electronically governed J1939 and mechanical engines.
- use the same controller on 12VDC or 24VDC systems.
- use as auto start or manual start controller.
- use as manual throttle or auto throttle controller.
- change the input type for the analog inputs.
- use additional analog inputs as digital ground inputs.
- assign functions and actions to digital inputs.
- use digital inputs as battery or ground inputs.
- be mounted in all-weather environment.
- be customer-mounted in panel of choice.

Engine Application States

The MPC-20 Controller, while reprogrammable, follows a standard operating sequence. This operating sequence is a set of machine states that happen in a predetermined order. Machine states can be set to zero if not needed or adjusted to fit the application. The following states will be executed during the auto sequence, provided that the corresponding timer has not been set to 00:00:00 or the controller has not been placed in a manual mode of operation:

- Stabilize: This is a timed state to allow the controller to enable the ECU or any senders without warnings or errors. This timer can be disabled if set up for mechanical engine use.
- Stopped: This is a timed state where the engine is ready to be started manually or automatically.

- Standby: This is a timed state that will shut off the LCD backlight, heater and CAN transceiver to conserve power while the unit waits for a key press or an automatic start condition.
- Auto Start Delay: (**available in Auto mode only**) The auto start condition is ignored and must remain active throughout this delay, or the delay is reset to zero.
- Check Safe To Start: This is a non-timed state that will check to ensure the engine can start safely.
- Auto Stop Delay: (available in Auto Mode only) The auto stop condition is ignored and must remain active throughout this delay, or the delay is reset to zero.
- Minimum Run Time: This timer is only active using autostart and with all autostart types except local key and clock. Local stop key will also initiate the stop sequence before the timer expires, if pressed.
- ECU Stabilize Timer: This delay begins timing when the controller is powered up, Spindown or Standby delays have expired. During this delay, the ECU enable output is turned on. The ECU output turns off when the Standby, ETS or Spindown delays begin timing.
- Prestart Delay 1: (available in Auto Mode only) After an auto start condition has been accepted by the controller, this delay begins timing, and the prestart output turns on. When this delay expires, the output is turned off, and the auto sequence continues.
- *Prestart Delay 2 (precrank): (available in Auto Mode only) After an auto start condition has been accepted by the controller, this delay begins timing, and the prestart output turns on. When this delay expires, the output is turned off, and the auto sequence continues. During this delay, the controller checks for faults, J1939 com, etc.
- *Prestart Delay 2 (crank through): (available in Auto Mode only) After an auto start condition has been accepted by the controller, this delay begins timing, and the prestart output turns on. When this delay expires, the output remains on, and the auto sequence continues. The output turns off when the engine actually starts. During this delay, the controller checks for faults, J1939 com, etc.
- Crank: This is a timed state to try and start the engine.
- Crank Rest: This is a timed state to rest the starter between cranks in case the engine did not start during the crank state.
- False Start Check: This is a non-timed state that will ensure the engine stays above the crank cut RPM after cranking.
- Warm-up: (**available in Auto mode only**) This is a timed state that will allow the engine to change from idle to desired warm-up RPM after starting. Warm-up will only set as low as the minimum RPM set point.
- Line Fill 1: (**available in Auto mode only**) This is a timed state that will exit if the timer times out or the pressure set point for this state is reached.
- Line Fill 2: (**available in Auto mode only**) This is a timed state that will exit if the timer times out or the pressure set point for this state is reached.
- Running Loaded: This is a non-timed state that the controller will stay in until a stop condition occurs.

- **Cooldown: (available in Auto mode only)** This is a timed state that will allow the engine to run at a desired speed to cool down before allowing to go into a stopped state.
- **Energize to Stop:** This is a timed state that will control an output in order to stop the engine.
- **Spindown:** The time allotted for the engine to stop all revolutions and be in a stopped state with no frequency.
- **Post Crank Lockout Delay (setup):** This delay begins timing when the engine actually starts. During this delay, the selected function is ignored. When this delay expires, the selected function is armed. During the duration of this delay, the selected function can cycle from active to not active and not reset the delay.
- **Post Warmup Lockout Delay (setup):** This delay begins timing when the warmup delay expires. During this delay, the selected function is ignored. When this delay expires, the selected function is armed. During the duration of this delay, the selected function can cycle from active to not active and not reset the delay.
- **Bubble Lockout Delay (setup):** This delay begins timing when the selected function is active. If the selected function is removed during this delay, the delay resets to zero. If the selected function remains active throughout this delay, the selected action will occur.

User Interface

The keypad on the MPC-20 is comprised of 11 tactile buttons. This section describes the functions of each button.

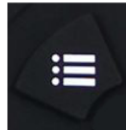


The buttons have the following functions:

- **Start Key** – Allows the operator to start sequence in Manual Mode or initiate an auto start sequence when in Auto Mode.
- **Stop Key** – Allows the operator to initiate the stop sequence in either mode of operation. A single button press in auto will initiate an auto stop. As a safety feature, when the stop button is pressed twice or held (in auto mode), the controller will skip the cool-down state and (upon shutting down) will place itself in manual mode to eliminate an auto crank condition. This happens if the autostart condition is still present.
- **Auto Key** – Allows the operator to change from Auto to Manual or Manual to Auto Mode by press-hold for 3 seconds.

- **Alarm Silence Key** – Allows the operator to silence the internal siren when an alarm or shutdown is present on the controller.
- **Manual Throttle Increase Key** – Allows the operator to manually increase the engine throttle in Manual Mode.
- **Manual Throttle Decrease Key** – Allows the operator to manually decrease the engine throttle in Manual Mode.
- **Menu Key** – Allows the operator to get into and out of the menus.
- **Back Key** – Allows the operator to move back one step while in the menu.
- **Enter Key** – Allows the operator to enter a value in the menu when selected and is used to acknowledge internal and external alarm/shutdowns.
- **Up Key** – Allows the operator to navigate up through the menu and page forward on the main pages.
- **Down Key** – Allows the operator to navigate down through the menu and page reverse on the main pages.

Accessing the Menu

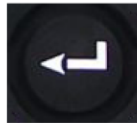


To access the MPC-20 menu, press the menu button:

The following screen will display to enter the password (3482):

Enter Password		
0000		
0.15 Hrs		
Stopped	Manual	00:29:55

The password will be entered right to left. Utilize the up and down arrows, and press the



Enter button after each correct number: . Entering this password will allow full

access to the menu. If you enter the wrong password, it will reset the display to 0000, allowing you to restart the entering process.

Main Menu

The MPC-20 controller is incredibly versatile within the menu structure. The operator is able to change many parameters and settings from the face without the need of a PC tool, if desired. The controller has to be in its stopped state in order to change a setting in the menu. (The Tier 4 menu is the exception). Described below are the main sections of the controller's menu.

Cycling power to the controller is recommended after making changes to set points.

(Main Menu, page 1)

System		
Engine Settings		
Advanced Engine Settings		
Throttle		
Input / Output		
0 % DEF	92 % Soot	0.00 Hrs
Stabilize	Manual	00:00:00

System

The controller System menu provides the operator with the ability to set the Date/Time, Units, Language, Brightness, Contrast, Service Reminders and several other system settings. Review System under the Menu Glossary section of this manual for a full list and definition of each setting.

Engine Settings

The Engine Settings menu allows the operator to establish common user-configurable parameters that would be changed from factory default settings when pairing the controller to an engine. This menu allows the operator to choose whether the engine is J1939 or mechanical; the engine's speed source; the minimum and maximum RPM the operator requires/allows the engine to run; the RPM step size; warm-up/cool-down settings; and other common engine settings. Review Engine Settings under the Menu Glossary section of this manual for a full list and definition of each setting.

Advanced Engine Settings

The Advanced Engine Settings menu allows the operator to set up the less common user-configurable parameters that are not in the Engine Settings menu and which would be changed from factory default settings when pairing the controller to an engine. This menu allows the operator to set items such as the J1939 address claim for the controller, ECU Source Address, ECU hour select, crank attempts, crank disconnect speed, clutch engage/disengage speed, run to destruct mode and other user-specific engine settings. Review Advanced Engine Settings under the Menu Glossary section of this manual for a full list and definition of each setting.

Throttle

The Throttle menu allows the operator to set up the items for throttling the engine such as throttle type, rate of RPM increase/decrease, throttle Inc/Dec pulse time, throttle RPM deadband and other parameters pertaining to throttling of the engine. Review Throttle under the Menu Glossary section of this manual for a full list and definition of each setting.

Input / Output

The Input/Output Menu allows the user to establish the I/O needed for the application. This includes Digital Inputs, Analog Inputs, Relay Outputs and Digital Outputs. This menu is tied to other aspects of the controller menu such as Auto Start Functions, Auto Throttling Methods, Analog inputs for Mechanical Engine setup, Warning / Shutdown functions and all outputs needed for starting/controlling the engine and alerting the user.

The Digital Inputs of this menu can be configured from the face of the controller to accept three types of inputs.

- High, B(+)
- Low, B(-)
- Open.

The Analog Inputs of this menu can be configured from the face of the controller to accept one of four types of senders without having to order a new controller or arrange jumpers on the hardware.

- Resistive
- 4-20mA
- 0-5VDC
- B(-) for additional Digital Inputs

The Outputs are configurable for the operator to choose which output function to use with the desired output type as shown below.

- Relay [10A, Form C]
- Digital Out [200mA, 5VDC]

- Digital Out [2A, B(+)]
- Digital Out [1A, B(-)]

NOTE: Although the functionality exists to set all analog and digital inputs to the same function, Enovation Controls strongly advises against this.

(Main Menu, page 2)

Application Configuration		
Start/Stop Timers		
Communication		
0 % DEF	92 % Soot	0.00 Hrs
Stabilize	Manual	00:00:00

Application Configuration

The Application Configuration menu is where an operator will set up the controller's Auto Start Functions and Auto Throttle Methods, if the intended use is as an auto start and/or auto throttling controller. Depending on which application is chosen in the menu, there are certain auto start functions and auto throttling methods hidden that are not pertinent to the application chosen. This automatic hiding feature allows for a simpler, more intuitive controller menu in the MPC-20. Review Application Configuration under the Menu Glossary section of this manual for the full list and definition of each setting.

Pump All Purpose

The Pump All Purpose application houses most all auto start functions and auto throttling methods of the controller. This application is the most versatile application thus requiring so many combinations of settings for the operator to choose.

The auto start functions and auto throttle methods to choose from are listed below.

Auto Start/Stop Functions

- Level Transducer (will require an Analog Input Setting)
- Flow Transducer (will require an Analog Input Setting)
- Single Contact
- Local Key Start
- Two Contact Maintained
- Two Contact Momentary
- Pressure Transducer (Will require an analog input setting)

Auto Throttle Methods

- Maximum RPM
- Pressure Transducer
- Level Transducer
- Flow Transducer
- Local Throttle Input (This feature throttles the engine proportionally between the minimum and maximum rpm set points.

Center Pivot / Linear Irrigation

The Center Pivot / Linear Irrigation application houses the auto start functions and auto throttle methods meant to be used on center pivot and linear movement irrigation applications.

The auto start functions and auto throttle methods to choose from are listed below.

Auto Start/Stop Functions

- Single Contact (will require a digital input for start and stop)
- Local Start Key
- Two Contact Maintained (will require a digital input for start and stop)
- Two Contact Momentary (will require a digital input for start and stop)

Auto Throttle Methods

- Maximum RPM
- Pressure Transducer (will require an analog input)
- Flow Transducer (will require an analog input)
- Local Throttle Input

Air Compressor

The Air Compressor application houses the auto start functions and auto throttle methods meant to be used on all engine-driven air compressor applications. The MPC-20 allows for the compressor to start/stop and maintain a desired pressure during operation.

The auto start functions and auto throttle methods to choose from are listed below.

Auto Start/Stop Functions

- Single Contact (will require a digital input for start and stop)
- Two Contact Maintained (will require a digital input for start and stop)
- Two Contact Momentary (will require a digital input for start and stop)
- Pressure Transducer (will require an analog input)

Auto Throttle Methods

- Maximum RPM
- Pressure Transducer (will require an analog input)
- Local Throttle Input

Hose Reel Irrigation

The Hose Reel Irrigation application houses the auto start functions and auto throttle methods meant to be used on hose reel irrigation systems. The MPC-20 allows for the hose reel pump to auto start with several methods, including the Local Key Start which may be the most used in this application. The key feature of this application is the auto throttling method. This feature allows the controller to manage the pump's throttle in order to maintain a pressure in the hose during irrigation.

The auto start functions and auto throttle methods to choose from are listed below.

Auto Start/Stop Functions

- Single Contact (will require a digital input for start and stop)
- Local Start Key
- Two Contact Maintained (will require digital inputs for start and stop)
- Two Contact Momentary (will require digital inputs for start and stop)

Auto Throttle Methods

- Maximum RPM
- Pressure Transducer (will require an analog input)
- Local Throttle Input

Frost Protection

The Frost Protection application houses the auto start functions and auto throttle methods meant to be used on frost protection systems. This application allows for wind machine, sprinkler or other forms of frost protection using single contact or a temperature transducer.

The auto start functions and auto throttle methods to choose from are listed below.

Auto Start/Stop Functions

- Single Contact (will require a digital input for start and stop)
- Temperature Transducer (will require an analog input for start and stop)

Auto Throttle Methods

- Maximum RPM

Start / Stop Timers

The Start/Stop Timers menu provides the operator the ability to add a countdown timer and start/stop times. The countdown timer allows for the operator to set a desired countdown time and walk away from the engine for a controlled shutdown when the timer expires. There are eight Start/Stop Timers the operator can choose from within this menu that allows for the specific day and hour the controller will start and stop utilizing the internal clock. Review Start/Stop Timers under Menu Glossary section of this manual for full list and definition of each setting.

Start / Stop timers work in conjunction with other Start / Stop types. If the engine is already running from another Start / Stop type when a Start / Stop timer occurs, the Start / Stop timer is

ignored. Once the engine is started by the Start / Stop timer, the timer has to expire for a controlled shutdown to occur.

Communication

The Communications menu allows the operator to choose the type of RS485 communications such as PVA Gauge, Modbus or Local Display. The menu also allows for the operator to choose the RS485 slave address, RS485 Serial setup and whether or not the controller uses the internal CAN terminating resistor. Review Communication under the Menu Glossary section of this manual for a full list and definition of each setting.

Start/Stop Settings

There are eight automatic start/stop types in the MPC-20. Each is detailed below:

Single Contact Start/Stop:

The Single Contact Start/Stop is when a remote contact closes and remains closed for auto start and re-opens for auto stop.

Two Contact Maintained Start/Stop (commonly known as Floats)

The Two Contact Maintained Start/Stop is when both contacts close for auto start and both contacts open for auto stop (not momentarily). This may also be reversed by altering menu settings.

Two Contact Momentary Start/Stop:

The Two Contact Momentary Start/Stop is when one contact closes momentarily for start and another contact closes momentarily for stop.

(Level, Pressure, Temperature or Flow) Transducer Start/Stop:

A transducer is used for auto throttling and start/stop. There are set points, allowing the operator to enter the appropriate values.

Local Start Key Start/Stop:

The Local Start Key Start/Stop is used to remove any other auto start/stop types within the controller if they are not needed, regardless if in auto or manual modes.

If an auto stop condition occurs during the warmup delay, the controller will enter an auto stop sequence.

Quick-Start Setup Guide

The following sections serve to provide a walk-through of the steps necessary for some of the various configurations and settings available on the MPC-20 Controller. **Cycling power to the controller is recommended after making changes to setpoints.**

Stepping through the Menu will be depicted as follows:

Menu/System/Contrast directs the operator to go into the Menu first, then look for a parameter titled System and press **[Enter]** to go into the System menu. Then look for a parameter titled Contrast and press **[Enter]** to go into the Contrast menu, etc.

Adjusting the Contrast if the screen is too dark/light

1. Access **Menu/System/Contrast**.
2. Utilize the Up and Down arrows to adjust the Contrast (values of 0 to 255), and press **[Enter]** when the desired number appears.
3. Press the **[Menu]** key to leave the Menu Setup screens.

NOTE: The following parameters all utilize the Application Configuration of **Pump All Purpose**. The MPC-20 will hide or display certain parameters that are specific to the Application Configuration chosen.

Setting the MPC-20 to Mechanical Engine

1. Access **Menu/Engine Settings/Engine Type/Mechanical/Speed Source**, and select either Alternator or Magnetic Pickup.
2. Press **[Back]** and down arrow to **Speed Calibration**, press **[Enter]**.
3. Utilize the Up and Down arrows to establish the appropriate number of flywheel teeth or engine alternator pulses, and press **[Enter]**.
4. Press the **[Back]** key twice, and down arrow to **Input/Output**, and press **[Enter]**.
5. Access **Analog Inputs** and assign one Analog input for Oil Pressure and one for Coolant Temperature. Press **[Enter]** to save the settings.
6. Press **[Back]** and access Relay and Digital Outputs.
7. Down arrow to DO1-6, and assign outputs to Crank, Excite Eng. Alternator and Fuel.
8. Press the **[Menu]** key to leave the Menu Setup screens.

Setting MPC-20 to J1939 Engine

1. Access **Menu/Engine Settings/Engine Type/J1939**.
2. Select J1939, and press **[Enter]**.
3. Ensure the engine is using TSC1 throttle or Inc/Dec inputs into the ECU.
4. Set the outputs for Crank, Excite Eng. Alternator, ECU Enable and Inc/Dec Throttling (if selected).
5. Ensure the analog inputs aren't set to oil pressure or coolant temp (disable or change to something else).
6. Press the **[Menu]** key to leave the Setup screens.

Setting MPC-20 to Auto Start on a Single Contact Input

1. Access **Menu/Application Configuration/Auto Start_Stop Function/Single Contact**.
2. Press **[Back]** once and select **Input / Output/Digital Inputs**.
3. Assign the Function of Single Contact Start/Stop to one of the Digital Inputs.
4. Press the **[Menu]** key to leave the Menu Setup screens.

Setting MPC-20 to Auto Start on Local Key

1. Access **Menu/Application Configuration/Auto Start_Stop Function/Local Start Key** and press **[Enter]**.
2. Press the **[Menu]** key to leave the Menu Setup screens.

Setting MPC-20 to Auto Start on Float Inputs

1. Access **Menu/Application Configuration/Auto Start_Stop Function**.
2. Highlight Single Contact, Two Contact Maintained or Two Contact Momentary and press **[Enter]**.
3. Press **[Back]** once and access **Input / Output/Digital Inputs**, and select a Digital Input to modify.
4. Assign the appropriate input for the selected AI.

NOTE: If Single Contact is chosen, only one digital input needs to be configured. If Two Contact (Maintained and Momentary) is chosen, two digital inputs need to be configured, one for start and one for stop.

5. Ensure the appropriate number of Digital Inputs is configured (as per the Note above) and press the **[Menu]** key to leave the Menu Setup screens.

Setting MPC-20 to Auto Start on Pressure

1. Access **Menu/Application Configuration/Auto Start_Stop Function/Pressure Transducer**, and press **[Enter]**.
2. Complete the parameters that apply (i.e., Maintain Pressure, High/Low Pressure, Start/Stop Pressure, etc.)
3. Press **[Back]** twice and access **Input_Output/Analog Inputs**.
4. Select an Analog Input to modify.
5. Assign the appropriate pressure input for the selected AI.
6. Press the **[Menu]** key to leave the Menu Setup screens.

Setting MPC-20 to Auto Start on Level

1. Access **Menu/Application Configuration/Auto Start_Stop Function/Level Transducer**. Press **[Enter]**.
2. Press **[Back]** once and access **Input_Output/Analog Inputs**, and select an Analog Input to modify.
3. Assign the appropriate level input for the selected AI.
4. Press the **[Menu]** key to leave the Menu Setup screens.

Setting MPC-20 to Auto Start on Flow

1. Access **Menu/Application Configuration/Auto Start_Stop Function/Flow Transducer**. Press **[Enter]**.
2. Press **[Back]** once and access **Input_Output/Analog Inputs**, and select an Analog Input to modify.
3. Assign the appropriate flow input for the selected AI.
4. Press the **[Menu]** key to leave the Menu Setup screens.

Setting MPC-20 to Auto Start on Clock

NOTE: Ensure the correct date and time are established in the System menu prior to establishing the Auto Start on Clock settings.

1. Access **Menu/Start_Stop Timers**, and select the first Start/Stop Timer.
2. Select Start Day 1 and then select the appropriate day or Daily.
3. Select Start Time 1 and establish the hour, minute and second to start.
4. Establish the Stop Day and Time as in steps 3-4.

NOTE: The MPC-20 Controller has the ability to establish eight different Start/Stop dates and times. If desired, repeat steps 3-5 for subsequent Timers.

Setting MPC-20 to Auto Start on Temperature

1. Access **Menu/Application Configuration/Frost Protection/Auto Start_Stop Function/Temperature Transducer**. Press **[Enter]**.
2. Press **[Back]** once and access **Temperature Transducer**.
3. Establish a Start and Stop Temperature, and press **[Back]** twice.
4. Access **Input_Output/Analog Inputs**, and select an Analog Input.
5. Assign the appropriate temperature input for the selected AI.
6. Press the **[Menu]** key to leave the Menu Setup screens.

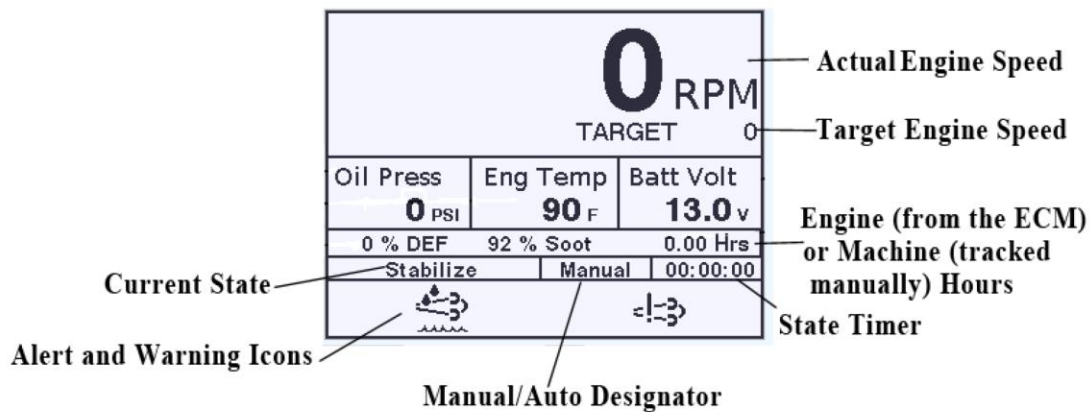
NOTE: If an auto stop condition occurs during the warmup delay, the controller will enter an auto stop sequence.

Setting MPC-20 to Stop the Engine from Utilizing the Countdown Timer

The MPC-20 will control the running of the engine until the chosen stop condition is met or until the Countdown timer runs out of time. Once set, the operator will be required to disable or change the timer in order to eliminate the countdown timer being active on every startup.

1. Access **Menu/Start_Stop Timers/Countdown Timer**.
3. Set the hours, minutes and seconds desired for the running of the engine, and press **[Enter]**.
4. Press the **[Menu]** key to leave the Menu Setup screens.

Screen Examples



MPC-20 Screens in order

<h1 style="margin: 0;">0</h1> <p style="margin: 0;">RPM</p> <p style="margin: 0;">TARGET 0</p>		
Oil Press 92 PSI	Eng Temp 82 F	Batt Volt 11.8 V
0.00 Hrs		
Stopped	Manual	00:28:48

This is the main screen, and it displays actual and target RPM, Oil Pressure, Engine Temperature, Battery Voltage, Engine Hours, Engine State and Mode of Operation.

Oil Temp 15 F	Fuel Level 40 %	% Load 0 %
Fuel Rate 37 gpm	Suction 0 PSI	Discharge 0 PSI
0.00 Hrs		
Stopped	Manual	00:29:55

This screen is the first six-up screen, and it displays Oil Temperature, Fuel Level, % Load, Fuel Rate, Suction and Discharge to the operator. If alternate parameters are desired, these may be changed within the free MPC-20 Software Configuration tool.

Sys Level 0.0 ft	Pump Oil 2 F	Pump Housing 2 F
	Ambient 2.5 F	Flow Rate 0 gpm
0.05 Hrs		
Stopped	Manual	00:29:54

This screen is the second six-up screen, and it displays to the operator System Level, Pump Oil, Pump Housing (temperature), Ambient (temperature) and Flow Rate (gpm). If alternate parameters are desired, these may be changed within the free MPC-20 Software Configuration tool.

ENG RPM 0	Dual Contact Start <input type="button" value="Inactive"/> Stop <input type="button" value="Inactive"/>	Throttle 0 %
Oil Press 92 PSI		
Eng Temp 82 F		
0.05 Hrs		
Stopped	Manual	00:29:55

This screen displays the auto start/stop type and will also illustrate the throttling method for the auto start/stop. This screen is set to display dual contact start (floats) and throttling to max RPM.

System Information		
Other		
21 / Mar / 14	Friday	03:19:59 PM
SW: 02 . 07 . 10176 . 03		
P/N: N / A		S/N:
		0.10 Hrs
Stopped	Manual	00:29:56

This screen displays the date, day, time, software version number, engine manufacturer, part number (if available) and serial number (if available). This page will assist Technical Services Support should their services be needed.

Digital Output Status		
DO 1	Not Used	Off
DO 2	Not Used	Off
DO 3	Not Used	Off
DO 4	Not Used	Off
DO 5	Throttle Decrease	Off
DO 6	Throttle Increase	Off
		0.10 Hrs
Stopped	Manual	00:29:56

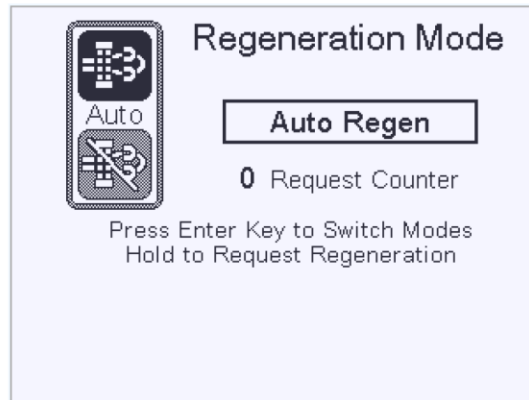
This screen will allow the operator to see what the digital output functions are set to without accessing the menu, and the active setting which informs the user of the output status.

Relay Status		
Relay 1	Crank	Off
Relay 2	ECU Enable	On
Relay 3	Common Alarm	Off
Relay 4	Not Used	Off
Relay 5	At Load (Clutch)	Off
Relay 6	Prestart 1 Delay	Off
		0.10 Hrs
Stopped	Manual	00:29:58

This screen will allow the operator to see what the relay status functions are set to without accessing the menu and the active setting which informs the user of the relay status.

Digital Input Status		
Dig. In 1	Disabled	Open
Dig. In 2	Auto Start Momentary /...	Open
Dig. In 3	Auto Stop Momentary /...	Open
Dig. In 4	Low Coolant Level	Open
Dig. In 5	Low Lube Oil Level	Open
Dig. In 6	Disabled	B-
		0.10 Hrs
Stopped	Manual	00:29:57

This screen will allow the operator to see what the digital input functions are set to without accessing the menu and the active setting which informs the user of the input status.










This screen displays the Regeneration Control for Tier 4 engines. Use the Enter button to change from Auto to Inhibit. With Auto Regen selected, hold the Enter button for Regeneration request.

Service Life Remaining		
Oil Life Remaining		248.9 Hrs
Oil Filter Life Remaining		248.9 Hrs
Belt Life Remaining		248.9 Hrs
Battery Life Remaining		248.9 Hrs
Fuel Filter Life Remaining		248.9 Hrs
Air Filter Life Remaining		248.9 Hrs
Overhaul Life Remaining		248.9 Hrs
		0.15 Hrs
Stopped	Manual	00:29:16

This screen provides a list of service reminders and the hours left until the internal alarm will display the services needed. When 0 hours is reached, the hours will continue to count down in negative numbers.

Warning and Shut-down Icons

The following icons can be displayed at the bottom of the MPC-20 screen to designate that a warning or shut-down situation has occurred:

Icon	Description
	Displays when High Exhaust System Temperature (HEST) is active and exhaust temperature is above normal operating condition.
	Low diesel exhaust fluid. Displays when the DEF is low.
	Displays when engine aftertreatment is in need of a regeneration. This is due to the aftertreatment filter reaching the engine manufacturer's set soot level for a regeneration to occur.
	Displays when the Engine ECU has inhibited a regeneration from occurring. This should also be shown when inhibiting regeneration selection is made in the menu.
	Displays when an emissions aftertreatment malfunction has occurred. Contact your local engine manufacturer's service department for direction.
	Displays when an active and unacknowledged DTC warning exists. The icon will only disappear if the fault has been acknowledged and is no longer active.
	Displays when an active (unacknowledged) DTC shutdown exists.

Icon Troubleshooting

The warnings and shutdowns internally generated by the controller will show an Internal Fault on the top of the screen when a fault is displayed. Check all fluid levels and pressures. Ensure the cooling system and engine are functioning properly.

The warnings and shutdowns the ECU generates will also be accompanied by a cause for the error. Consult with the engine manufacturer regarding fault codes shown on the screen.

Software Release: 2.8.10043

If everything checks out normal, consider checking the set points or the bypass timer(s) to ensure the ranges are within normal operating settings.

Menu Glossary

System

Date/Time: allows the setting of the controller's date and time.

Pressure Units: allows the selection of psi, kPa or BAR for pressure designation. **Factory set to PSI.**

Temperature Units: allows the selection of Fahrenheit or Celsius for temperature designation. **Factory set to Fahrenheit.**

Level Units: allows the selection of Feet or Meters for Level designation. **Factory set to Feet.**

Flow Units: allows the selection of gal/min (US), gal/min (UK) and lpm (Liters Per Minute) for flow designation. **Factory set to gal/min (US).**

Brightness: allows the backlight of the screen to be adjusted. **Factory set to 90.**

Contrast: allows the contrast of the screen to be adjusted. **Factory set to 150.**

Backlight Control: turns off (disables) or on (enables) the screen's backlight. **Factory set to Enable.**

Beeper: turns off (disables) or on (enables) the alarm beeper for the controller. **Factory set to Enable**

Standby Timer: setting this timer (HH:MM:SS) allows the screen the designated amount of time before the controller goes into Standby mode. **Factory set to 00:30:00.**

Service Reminders: when the service reminder is set to 0, the alarms will be disabled. However, the countdown will continue and will show the numbers as (-) numbers as it counts down past 0 for the following parameters: **All service reminders factory set to 250 Hrs.**

- Oil Life
- Oil Filter Life
- Belt Life
- Battery Life
- Fuel Filter Life
- Air Filter Life
- Overhaul Life
- Reset All

Stored Fault Codes: allows the operator to query the Engine ECU for review of its stored fault codes.

Auto / Manual: allows the controller to power up in either Manual or Auto Mode of operation depending on the selection chosen. **Factory set to Manual.**

Restore Factory Defaults: allows the operator to reset all menu settings set as defaults from the last configuration loaded in the controller.

View Alarm History: allows the viewing of stored alarms.

Clear Event History: allows the clearing of stored events (alarms).

Engine Settings

Engine Type: allows the selection between J1939 and Mechanical. If Mechanical is chosen, some parameters associated with J1939 will no longer appear in the menu. **Factory set to J1939.**

Engine Manufacturer: allows the selection of the specific Engine Manufacturer (i.e., Caterpillar, Cummins, John Deere, Deutz, Kubota, Yanmar, JCB, Volvo, FPT, Isuzu, Other). **Factory set to Other.**

Engine Emission: allows the selection of the emissions controls (i.e., Tier 3 or less, Interim Tier 4, or Tier 4 / EU Stage IIIA, IIIB). **Factory set to Tier 3 or Less.**

Tier 4 Regeneration: (only appears if Interim Tier 4 or Tier 4 / EU Stage IIIA, IIIB is chosen) allows the automatic running or inhibition of regeneration and/or the requesting of a regeneration. Note: Inhibiting the Regen may cause the engine to de-rate or shut down if the soot level is too high. Recommend leaving this setting in Auto Regen. The ECU may not allow the Regen request if certain parameters do not meet the engine manufacturer's requested levels. **Factory set to Auto Regen.**

Speed Source: allows the selection of the appropriate speed source of the engine (i.e., J1939, Alternator or Magnetic Pickup). **Factory set to J1939.**

Speed Calibration: allows the setting of the correct number of flywheel teeth or engine alternator pulses for mechanical engines. When Speed Source is set to J1939, the Speed Calibration menu is hidden. **Factory set to 150.0.**

Minimum Engine Speed: allows the setting of the lowest engine speed for continual operation. The controller will not allow the engine to throttle under the minimum engine speed. **Factory set to 700 RPM.**

Maximum Engine Speed: allows the setting of the highest engine speed for continual operation. The controller will not allow the engine to throttle above the maximum engine speed. **Factory set to 2000 RPM.**

RPM Step Size: allows the setting of the increments by which the RPM will increase or decrease. **Factory set to 25 RPM**

Warm-Up Speed: allows the setting of the speed of the engine during the warm-up phase. This speed setting must be at or above the minimum engine speed setting. **Factory set to 900 RPM.**

Warm-up Delay: allows the operator to set the desired warm-up time/delay for the engine. This is the length of time the engine will run at a lower speed for its warm-up cycle. **Factory set to 00.03.00.**

Cooldown Speed: allows the setting of the speed of the engine while it is cooling down. This speed setting must be at or above the minimum engine speed setting. **Factory set to 900 RPM.**

Cooldown Delay: allows the operator to set the desired cool down time/delay for the engine. This is the length of time the engine will run at a lower speed for its cool down cycle. **Factory set to 00.03.00.**

Warnings and Shutdowns: allows the settings of the parameters between which the following components will operate:

Low Fuel Level Shutdown: allows the operator to select the desired shutdown in the controller for Low Fuel to shut down the engine before running out of fuel. **Factory set to 5%**

Low Fuel Level Warning: allows the operator to select the desired warning in the controller for Low Fuel to alert the operator when fuel is low. **Factory set to 10%.**

High Battery Warning: allows the operator to select the desired warning in the controller for High Battery to alert the operator when the voltage of the battery is too high. **Factory set to 16.0 V.**

Low Battery Warning: allows the operator to select the desired warning in the controller for Low Battery to alert the operator when the voltage of the battery is too low. **Factory set to 10.0 V.**

Weak Battery Warning: allows the operator to select the desired warning in the controller for Weak Battery to alert the operator when the battery is becoming too weak to function. **Factory set to 11.0 V.**

Underspeed Shutdown: allows the operator to select the desired shutdown in the controller for Underspeed Shutdown to alert the operator when the engine is being shut down due to operating below the established minimum speed when in the running loaded state for this shutdown. **Factory set to 0 RPM.**

Overspeed Shutdown: allows the operator to select the desired shutdown in the controller for Overspeed Shutdown to alert the operator when the engine is being shut down due to operating above the established maximum speed when in the running loaded state for this shutdown. **Factory set to 2400 RPM.**

Advanced Engine Settings

J1939 Address Claim: allows the setting of the address for the controller used in the J1939 engine setting. **Factory set to 3.**

ECU Source Address: source address of the ECU being connected to. Normally set to 0, 1 or 2. **Factory set to 0.**

ECU Hour Select: choose from ECU Hours (engine hours reported by the ECU) or Internal (hours calculated internally by the MPC-20 (provided the RPM>50)). **Factory set to ECU Hours.**

Crank Attempts: format of 0.00 to 20.00. The number of times the engine will attempt to start before providing an overcrank shutdown. **Factory set to 3.**

Crank Disconnect Speed: the speed at which the crank will disconnect barring other input parameters. **Factory set to 500 RPM.**

Clutch Engage Speed: the speed at which the clutch will engage. **Factory set to 1200 RPM.**

Clutch Disengage Speed: the speed at which the clutch will disengage. **Factory set to 1000 RPM.**

Run to Destruct: choose from Enable or Disable. This setting will prevent the controller from shutting down the engine for any fault shutdown to allow a run to destruct condition. This setting is primarily used for marine or fire pump applications. **CAUTION: If enabled, the operator must manually select Disable to allow shutdowns and protect the engine.** **Factory set to Disable**

Timers: establish parameters for the:

Auto Start Delay: the auto start condition must remain active throughout this delay for an auto start to occur. If the auto start condition is removed during this delay, the delay is reset to zero. **Factory set to 00.00.03**

Auto Stop Delay: this auto stop condition must remain active throughout this delay for an auto stop to occur. If the auto stop condition is removed during this delay, the delay is reset to zero. **Factory set to 00.00.03**

Minimum Run Time: auto stop conditions are ignored during this delay. **Factory set to 00.00.00**

ECU Stabilize Timer: on startups, this delay allows the ECU to stabilize and broadcast on the CAN bus prior to actual cranking. **Factory set to 00.00.05**

Crank Time: this is the length of time the crank output is turned on during cycle cranking. **Factory set to 00.00.10**

Crank Rest: this is the length of time the crank output is turned off during cycle cranking. **Factory set to 00.00.10**

Prestart Delay 1: after an auto start condition has been accepted by the controller, this delay begins timing, and the prestart #1 output turns on. When this delay expires, the output is turned off, and the auto sequence continues. **Factory set to 00.00.00**

Prestart Delay 2: after an auto start condition has been accepted by the controller, this delay begins timing, and the prestart #2 output turns on. **Factory set to 00.00.00**

Prestart Delay 2 Mode: this setting determines if the prestart #2 output is active through the crank state or only through the prestart #2 state. Prestart functions are available in Manual mode. **Factory set to PreCrank.**

Energize to Stop Time: this delay begins timing and an output is turned on after an auto stop condition has been accepted by the controller. The output is turned off when this delay expires. **Factory set to 00.00.00**

Spindown Timer: this delay begins timing when there is no call to run and the engine speed is zero. No auto start functions will occur until this delay expires. **Factory set to 00.00.30**

Post Crank Lockout Setup: this is a setup for a delay that begins timing when the engine actually starts. During this delay, the selected functions (Warnings and Shutdowns) are ignored. When this delay expires, the selected functions are armed. During the duration of this delay, the selected functions can cycle from active to not active and not reset the delay.

- Post Crank Lockout Time. **Factory set to 00.00.30**
- Post Crank Lockout 1. **Factory set to Low Oil Pressure**
- Post Crank Lockout 2. **Factory set to Low Discharge Pressure.**
- Post Crank Lockout 3. **Factory set to Disabled.**
- Post Crank Lockout 4. **Factory set to Disabled.**
- Post Crank Lockout 5. **Factory set to Disabled.**

Post Warm-up Lockout Setup: this is a setup for a delay that begins timing when the warm-up delay expires. During this delay, the selected functions (Warnings and Shutdowns) are ignored. When this delay expires, the selected functions are armed. During the duration of this delay, the selected functions can cycle from active to not active and not reset the delay.

- Post Warm-up Lockout Time. **Factory set to 00.00.00**
- Post Warm-up Lockout 1. **Factory set to Disabled.**
- Post Warm-up Lockout 2. **Factory set to Disabled.**
- Post Warm-up Lockout 3. **Factory set to Disabled.**
- Post Warm-up Lockout 4. **Factory set to Disabled.**
- Post Warm-up Lockout 5. **Factory set to Disabled.**

Bubble Lockout Setup: this is a setup for a delay that begins timing when the selected functions are active. If the selected functions are removed during this delay, the delay resets to zero. If the selected functions remain active throughout this delay, the selected action for the parameter will occur.

Bubble Lockout Time. **Factory set to 00.00.00**
Bubble Lockout 1. **Factory set to Disabled.**
Bubble Lockout 2. **Factory set to Disabled.**
Bubble Lockout 3. **Factory set to Disabled.**
Bubble Lockout 4. **Factory set to Disabled.**
Bubble Lockout 5. **Factory set to Disabled.**

Warnings and Shutdowns: establish parameters for the:

Low Fuel Level Warning: sounds a warning when the fuel level reaches the set lower limit parameter. **Factory set to 10%**

Low Fuel Level Shutdown: shuts down the engine when the fuel level reaches the set lower limit parameter. **Factory set to 5%**

High Battery Warning: sounds a warning when the charge on the battery reaches the set higher limit parameter. **Factory set to 16.00 V.**

Low Battery Warning: sounds a warning when the charge on the battery reaches the set lower limit parameter. **Factory set to 10.00 V.**

Weak Battery Warning: sounds a warning when the charge on the battery reaches the set parameter for weakness. **Factory set to 11.00 v.**

LOP High Speed: the speed setting in which the Low Oil Pressure (LOP) will be active at high speed. **Factory set to 2000 RPM.**

LOP Warning/High Speed: the Low Oil Pressure (LOP) setting in which the controller will provide a warning if dropping below at high speed. **Factory set to 35.00 psi.**

LOP Shutdown/High Speed: the Low Oil Pressure (LOP) setting in which the controller will provide a shutdown if dropping below at high speed. **Factory set to 30.00 psi.**

Low Oil Pressure Warning: sounds a warning when the oil pressure reaches the set lower limit parameter for oil pressure. **Factory set to 15.00 psi.**

Low Oil Pressure Shutdown: shuts down the engine when the oil pressure reaches the set lower limit parameter for oil pressure. **Factory set to 10.00 psi.**

High Oil Temp Warning: sounds a warning when the oil temperature reaches the set higher limit parameter for oil temperature. **Factory set to 210 F.**

High Oil Temp Shutdown: shuts down the engine when the oil temperature reaches the set higher limit parameter for oil temperature. **Factory set to 225 F.**

High Oil Pressure Warning: sounds a warning when the oil pressure reaches the set higher limit parameter for oil pressure. **Factory set to 200.0 psi.**

High Oil Pressure Shutdown: shuts down the engine when the oil pressure reaches the set higher limit parameter for oil pressure. **Factory set to 200.00 psi.**

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High Engine Temp Warning: sounds a warning when the temperature of the engine reaches the set higher limit parameter for temperature. **Factory set to 210 F.**

High Engine Temp Shutdown: shuts down the engine when the temperature of the engine reaches the set higher limit parameter for temperature. **Factory set to 225 F.**

Low Engine Temp Warning: sounds a warning when the temperature of the engine reaches the set lower limit parameter for temperature. **Factory set to 32 F.**

Underspeed Shutdown: shuts down the engine when the speed reaches the set lower limit parameter for speed. **Factory set to 0 RPM.**

Overspeed Shutdown: shuts down the engine when the speed reaches the set higher limit parameter for speed. **Factory set to 2400 RPM.**

Throttle Menu

Throttle Type: allows the selection of J1939 TSC1, Pulse Inc/Dec or Analog 0-5VDC as the throttle type for the engine. **Factory set to J1939 TSC1.**

J1939 TSC1: this setting will be used when an electronic engine is used for J1939 Throttling. (Verify with Engine Dealer this type of throttling is accepted on the specific engine).

Pulse Inc/Dec: this setting will be used when throttling a mechanical engine, using a throttle actuator and also an electronic engine using digital pulses into the ECU for throttling.

Analog 0-5 VDC: this setting will be used for throttling an electronic engine utilizing 0-5V output.

Auto Throttle Type: **Factory set to NON PID Auto Throttle.**

NON PID Auto Throttle: this type does not use the P I D adjustments found in the Transducer setups in the Application menu.

PID Auto Throttle: this type does use the P I D adjustments found in the Transducer setups in the Application menu.

Target RPM Step Size: this is the step size of the target RPM when increasing and decreasing. The actual rate of change is much higher when throttling in auto vs. manually with the push buttons. **Factory set to 25 RPM.**

Throttle Deadband RPM: (only appears when Pulse Inc/Dec or Analog, 0-5 VDC is chosen for the Throttle Type) format of # RPM. Plus/minus value added to the target to provide a range of RPM during which the throttle is not active. No throttling will occur when the engine RPM is within the RPM deadband.

Throttle Inc/Dec Pulse: (only appears when Pulse Inc/Dec is chosen) format of # mS. The amount of time to pulse the throttle. Increase this value for faster engine response, decrease this value for slower engine response.

Throttle Inc/Dec Pulse Delay: (only appears when Pulse Inc/Dec is chosen) format of # mS. The amount of delay time before pulsing the throttle. Increase this value for slower engine response, decrease this value for faster engine response.

Throttle Inc Rate: the rate the engine is signaled to increase in RPM. **Factory set to 10 RPM/s.**

Throttle Dec Rate: the rate the engine is signaled to decrease in RPM. **Factory set to 10 RPM/s.**

Analog Minimum Value: (only appears when analog throttle type is chosen) The analog throttle output will not go lower than this setpoint. **Factory set to .50 V.**

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Analog Maximum Value: (only appears when analog throttle type is chosen) The analog throttle output will not go higher than this setpoint. **Factory set to 4.5 V.**

Input / Output Menu

Digital Inputs (1-6): for each of the digital inputs, the ability to select the following parameters exists:

Digital input 1. **Factory set to Disabled**
Digital Input 2. **Factory set to Auto Start Momentary/Maintained**
Digital Input 3. **Factory set to Auto Stop Momentary/Maintained**
Digital Input 4. **Factory set to Low Coolant Level**
Digital Input 5. **Factory set to Low Lube Oil Level**
Digital Input 6. **Factory set to Disabled**

Function:

Disabled
Single Contact Start/Stop
Auto Start Momentary / Maintained
Auto Stop Momentary / Maintained
Remote Alarm Acknowledge
Low Fuel Level
Fuel Leak
Fuel Filter Restriction
Low Lube Oil Level
Low Coolant Level
Remote Stop
Idle Engine
Water in Fuel
No Flow
Engine Over Speed
Crank Termination
Air Damper Closed
Air Filter Restriction
Battery Charger Fail
Oil Filter Restriction
Run To Destruct Override
User 1 through User 6
Speed 1 through Speed 5
Parking Brake (Kubota)
Neutral Switch (Kubota)

Active

B- (ground input to a function chosen above) **Factory Default**
B+ (battery positive to a function chosen above).
Open (sender/switch is open)

Action

Not Used
Warning
Shutdown **Factory Default**
Shutdown, Controlled (The input will initiate an auto stop. The input has to be inactive for the controller to accept a new auto start signal.)
Relay Control: used to control one of the relay outputs.

DI Speed Set points: used in place of Throttle Inc/Dec. Provides five throttle set points to which the engine will throttle. These speed inputs will override any other throttling type. When inputs are not active, any other throttling type in use will resume. Digital input 1 will override 2 through 4. Digital 2 will override 3 through 5, and so on.

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Analog Inputs (1-8): for each of the analog inputs, the ability to select the following parameters exists:

Analog input 1. **Factory set to Disabled**
Analog Input 2. **Factory set to Disabled**
Analog Input 3. **Factory set to Disabled**
Analog Input 4. **Factory set to Disabled**
Analog Input 5. **Factory set to Disabled**
Analog Input 6. **Factory set to Disabled**
Analog Input 7. **Factory set to Disabled**
Analog Input 8. **Factory set to Disabled**

Function:

Disabled
4-20 mA Oil Pressure
0-5V Oil Pressure
4-20mA Coolant Temp
0-5V Coolant Temp
4-20mA Fuel Level
0-5V Fuel Level
4-20mA Oil Temp
0-5V Oil Temp
4-20mA Suction Pressure
0-5V Suction Pressure
4-20mA Discharge Pressure
0-5V Discharge Pressure
4-20mA System Level
4-20mA Flow Rate
4-20mA Pump Oil Temperature
0-5V Pump Oil Temp
4-20mA Pump Housing Temp
0-5V Pump Housing Temp
4-20mA Ambient Temp
0-5V Ambient Temp
4-20mA Gear Box Pressure
0-5V Gear Box Pressure
0-5V Throttle Input
Datcon Oil Pressure
Murphy Oil Pressure
VDO5 Bar Oil Pressure
VDO7 Bar Oil Pressure
Murphy Coolant Temp
Datcon Coolant Temp
VDO Coolant Temp
Murphy Fuel Level
VDO Fuel Level
Datcon Fuel Level
Murphy Oil Temp
Datcon Oil Temp
VDO Oil Temp
Murphy Discharge Pressure
Murphy Suction Pressure
Datcon Pump Housing Temp
Murphy Pump Housing Temp
VDO Pump Housing Temp
Murphy Pump Oil Temperature
Datcon Pump Oil Temperature
VDO Pump Oil Temperature

Murphy PMK-400 Pressure
Analog.Digital1

Sensor Setup (only appears when the analog inputs are configured. This sets the range of sensors for 4-20mA or 0-5V senders).

Oil Pressure (0-5V) or (4-20mA)
Ambient Temp (0-5V) or (4-20mA)
Coolant Temp (0-5V) or (4-20mA)
Discharge Pressure (0-5V) or (4-20mA)
Fluid Pressure (0-5V) or (4-20mA)
Fuel Level (0-5V) or (4-20mA)
Oil Temp (0-5V) or (4-20mA)
Pump Housing Temp (0-5V) or (4-20mA)
Pump Oil Temp (0-5V) or (4-20mA)
Suction Pressure (0-5V) or (4-20mA) By raising the minimum value (5mA or 1V) in the sensor setup, a negative Suction Pressure can be read by the Controller.
Flow Rate (4-20mA)
Speed (4-20mA)
System Level (4-20mA)
Set mA per Ft

Relay (1-6) and Digital (1-6) Outputs: these same parameters are used for both the Relay and Digital Outputs.

Relay 1. **Factory set to Crank.**
Relay 2. **Factory set to ECU Enable.** The controller will not transmit on the CAN bus when this output is off.
Relay 3. **Factory set to Common Alarm.**
Relay 4. **Factory set to Not Used.**
Relay 5. **Factory set to At Load (Clutch).**
Relay 6. **Factory set to Prestart 1 Delay.**
DO1 (5V, 200mA). **Factory set to Not Used.**
DO2 (5V, 200mA). **Factory set to Not Used.**
DO3 (B+, 2A) **Factory set to Not Used.**
DO4 (B+, 2A). **Factory set to Not Used.**
DO5 (B-, 1A). **Factory set to Throttle Decrease.**
DO6 (B-, 1A). **Factory set to Throttle Increase.**

Not Used

Prestart 1 Delay Please see Timers on page 26.

Prestart 2 Delay Please see Timers on page 26.

Crank Please see Timers on page 26.

Fuel Please see Timers on page 26.

ECU Enable Used for enabling the ECU on electronic engines. This output is on anytime the controller is powered up or in the crank/run state. It's turned off if the controller is in the standby state.

Excite Engine Alternator Used for alternators requiring excite from battery. This output is turned on in the crank/run state.

At Load (Clutch) This output is turned on when the warm-up delay has expired and the engine reaches the clutch engage RPM set point. It is turned off during the cool down delay and the engine reaches the clutch disengage RPM set point.

Gov. Control This output turns on after the warmup delay expires and turns off when the cooldown delay begins timing.

Shutdown This output turns on when a fault shutdown occurs.

Common Alarm This output turns on when either a shut-down or a non shut-down warning occurs.

Remote Alarm This output turns on when either a shut-down or a non shut-down warning occurs.

Air Damper N/De-energized This output turns off during the energize to stop delay.

Not in Auto This output turns on when the controller is in the manual mode.

Air Damper N/Energized This output turns on during the energize to stop delay.

Energize to Stop Please see Timers on page 26.

Engine Running This output turns on after the engine actually starts and off when the engine stops.

Throttle Increase

Throttle Decrease The increase and decrease outputs are used for the pulse inc/dec throttling type.

Digital Input (1-6) A digital input can be assigned to turn on a digital output.

Analog (1-8) Digital An analog input configured to be a digital input can be assigned to turn on a digital output.

Application Configuration

Application

Pump All Purpose: The Pump All Purpose application houses most all auto start functions and auto throttling methods of the controller. This application is the most versatile application thus requiring so many combinations of settings for the operator to choose. **Factory Default**

Center Pivot / Linear Irrigation: The Center Pivot / Linear Irrigation application houses the auto start functions and auto throttle methods meant to be used on center pivot and linear movement irrigation applications.

Air Compressor: The Air Compressor application houses the auto start functions and auto throttle methods meant to be used on all engine-driven air compressor applications. The MPC-20 allows for the compressor to start/stop and maintain a desired pressure during operation.

Hose Reel Irrigation: The Hose Reel Irrigation application houses the auto start functions and auto throttle methods meant to be used on hose reel irrigation systems. The MPC-20 allows for the hose reel pump to auto start with several methods, including the Local Key Start which may be the most used in this application. The key feature of this application is the auto throttling method. This feature allows the controller to manage the pump's throttle in order to maintain a pressure in the hose during irrigation.

Frost Protection: The Frost Protection application houses the auto start functions and auto throttle methods meant to be used on frost protection systems. This application allows for wind machine, sprinkler or other forms of frost protection using single contact or a temperature transducer.

Auto Start / Stop Function

Single Contact (Center Pivot/Linear Irrigation, Air Compressor, Hose Reel Irrigation, Frost Protection)

Local Start Key (Center Pivot/Linear Irrigation, Hose Reel Irrigation)

Two Contact Maintained (Center Pivot/Linear Irrigation, Air Compressor, Hose Reel Irrigation) **Factory Default**

Two Contact Momentary (Center Pivot/Linear Irrigation, Air Compressor, Hose Reel Irrigation)

Pressure Transducer (Air Compressor, Hose Reel Irrigation)

Level Transducer (Pump All Purpose)

Flow Transducer (Pump All Purpose)

Temperature Transducer (Frost Protection)

Auto Throttle Method

Maximum RPM (Pump All Purpose, Center Pivot/Linear Irrigation, Air Compressor, Hose Reel Irrigation, Frost Protection) **Factory Default**

Pressure Transducer (Pump All Purpose, Center Pivot/Linear Irrigation, Air Compressor, Hose Reel Irrigation)

Level Transducer (Pump All Purpose)

Flow Transducer (Pump All Purpose, Center Pivot/Linear Irrigation)

Local Throttle Input - this is for use when an analog input is selected for 0-5V throttle input. (Pump All Purpose, Center Pivot/Linear Irrigation, Air Compressor, Hose Reel Irrigation)

Pressure Transducer

Maintain Pressure. The engine will be throttled between the min. and max. RPM set points to maintain this pressure. **Factory set to 0 psi.**

Deadband Pressure. This extends above and below the maintain set point, no throttling occurs while the pressure is in the deadband. **Factory set to 0 psi.**

Pressure Maintain. Suction / Discharge. Suction starts on high, stops on low. Suction throttles by decreasing the RPM below the deadband and increasing the RPM above the deadband. This is opposite of Discharge pressure. **Factory set to Discharge.**

Steady / Proportional. Steady throttles the engine to the max. RPM set point when starting and stopping on pressure. Proportional throttles the engine proportionally between the min. and max. RPM set points when starting and stopping on pressure. 0 psi must be selected in the maintain pressure for the steady/proportional features to work. **Factory set to Steady.**

Line Fill 1 Speed. The engine is throttled to this speed after warm-up to purge the line. **Factory set to 900 RPM.**

Line Fill 1 Delay. This is the time the engine is held at the Line Fill 1 speed. **Factory set to 00.00.00.**

Line Fill 1 Pressure. The engine is held at the Line Fill 1 Speed until either this pressure set point is reached or the Line Fill 1 Delay expires. **Factory set to 0 psi.**

Line Fill 2 Speed. The engine is throttled to this speed after warm-up to purge the line. **Factory set to 900 RPM.**

Line Fill 2 Delay. This is the time the engine is held at the Line Fill 1 speed. **Factory set to 00.00.00.**

Line Fill 2 Pressure. The engine is held at the Line Fill 1 Speed until either this pressure set point is reached or the Line Fill 1 Delay expires. **Factory set to 0 psi.**

Line Fill 2 features only available when Hose Reel is selected in the Applications menu.

Start Pressure. When the pressure reaches this set point, an auto start will occur. **Factory set to 0 psi.**

Stop Pressure. When the pressure reaches this set point, an auto stop will occur. **Factory set to 0 psi.**

Pressure P. Allows adjustment if using PID throttling. **Factory set to 0.020**

Pressure I. Allows adjustment if using PID throttling. **Factory set to 0.020**

Pressure D. Allows adjustment if using PID throttling. **Factory set to 0.001.**

Level Transducer

Maintain Level. The engine will be throttled between the min. and max. RPM set points to maintain this level. **Factory set to 0.0 ft.**

Deadband Level. This extends above and below the maintain set point, no throttling occurs while the level is in the deadband. **Factory set to 0.0 ft.**

Steady / Proportional. Steady throttles the engine to the max. RPM set point when starting and stopping on level. Proportional throttles the engine proportionally between the min. and max. RPM set points when starting and stopping on level. 0.0 ft must be selected in the maintain level for the steady/proportional features to work. **Factory set to Steady.**

Level Type. Empty / Fill. Empty starts on high, stops on low. Empty throttles by decreasing the RPM below the dead band, and increasing the RPM above the dead band. This is opposite of Fill. **Factory set to Empty.**

Start Level. When the level reaches this set point, an auto start will occur. **Factory set to 0.0 ft.**

Stop Level. When the level reaches this set point, an auto stop will occur. **Factory set to 0.0 ft.**

Level P. Allows adjustment if using PID throttling **Factory set to 0.020**

Level I. Allows adjustment if using PID throttling. **Factory set to 0.020**

Level D. Allows adjustment if using PID throttling. **Factory set to 0.001.**

Flow Transducer

Start Flow Rate. When the flow reaches this set point, an auto start will occur. **Factory set to 0 gpm.**

Stop Flow Rate. When the flow reaches this set point, an auto stop will occur. **Factory set to 0 gpm.**

Maintain Flow. The engine will be throttled between the min. and max. RPM set points to maintain this flow. **Factory set to 0 gpm.**

Steady / Proportional. Steady throttles the engine to the max. RPM set point when starting and stopping on flow. Proportional throttles the engine proportionally between the min. and max. RPM set points when starting and stopping on flow. 0 gpm must be selected in the maintain flow for the steady/proportional features to work. **Factory set to Steady.**

Deadband Flow. This extends above and below the maintain set point, no throttling occurs while the flow in the deadband. **Factory set to 0 gpm.**

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Flow Maintain Type. In / Out. Empty / Fill. In starts on low, stops on high. In throttles by increasing the RPM below the deadband and decreasing the RPM above the deadband. This is opposite of Out.

Factory set to Out.

Flow P. Allows adjustment if using PID throttling. **Factory set to 0.020**

Flow I. Allows adjustment if using PID throttling. **Factory set to 0.020**

Flow D. Allows adjustment if using PID throttling. **Factory set to 0.001.**

Temperature Transducer

Start Temperature. When the temperature drops to this set point, an auto start will occur. **Factory set to 32 F**

Stop Temperature. When the temperature rises to this set point, an auto stop will occur. **Factory set to 32 F.**

Warnings and Shutdowns

High Level Warning. **Factory set to 0.0 ft.**

High Level Shutdown. **Factory set to 0.0 ft.**

Low Level Warning. **Factory set to 0.0 ft.**

High Flow Warning. **Factory set to 0 gpm.**

High Flow Shutdown. **Factory set to 0 gpm.**

Low Flow Warning. **Factory set to 0 gpm.**

Low Flow Shutdown. **Factory set to 0 gpm.**

High Discharge Pressure Warning. **Factory set to 0.00 psi.**

High Discharge Pressure Shutdown. **Factory set to 0.00 psi.**

Low Discharge Pressure Warning. **Factory set to 0.00 psi.**

Low Discharge Pressure Shutdown. **Factory set to 0.00 psi.**

High Suction Pressure Warning. **Factory set to 0.00 psi.**

High Suction Pressure Shutdown. **Factory set to 0.00 psi.**

Low Suction Pressure Warning. **Factory set to 0.00 psi.**

Low Suction Pressure Shutdown. **Factory set to 0.00 psi.**

High Pump Housing Temp. Warning. **Factory set to 32 F.**

High Pump Housing Temp. Shutdown. **Factory set to 32 F.**

High Pump Oil Temp. Warning. **Factory set to 32 F.**

High Pump Oil Temp. Shutdown. **Factory set to 32 F.**

Start / Stop Timers

This section allows the setting of the timers to start and stop the engine. There are eight timers, each with a Start Day and a Stop Day, a Start Time and a Stop Time.

Countdown Timer: The countdown timer will be active upon every auto startup until the time is changed or disabled. It is used when it is desirable for a machine to run for a specific amount of time unmonitored and then shut itself off when that time has expired or when an alternate Stop condition has been met. Format of HH:MM:SS

Start / Stop Timer (1-8): each of the eight timers contains the ability to select from the following parameters:

Days of the week are factory set to Off.

Start and stop Times are factory set to 12.00.00 AM.

Start Day

Sunday

Monday

Tuesday

Wednesday

Thursday

Friday

Saturday

Daily

Off

Start Time: format of HH:MM:SS

Stop Day:

- Sunday
- Monday
- Tuesday
- Wednesday
- Thursday
- Friday
- Saturday
- Daily
- Off

Stop Time: format of HH:MM:SS

Communication

Communication Type:

PVA Gauge: this function will be used if utilizing PVA Gauges on the RS485 Modbus.

Modbus: this function will be used if using a SCADA or telemetry device for polling the Modbus register list. See Modbus Register Map. **Factory Default.**

Local Display: this function will be used to connect the display to a remote viewing application. This can be a program running on a PC or another MPC-20 set up as a remote viewer.

Slave Address. This is the Modbus slave node number. **Factory set to 1.**

Serial Setup.

Baudrate. **Factory set to 19200.**

Stopbits. **Factory set to 1.**

Parity. **Factory set to None.**

PV CAN Backlight Enable. **Factory set to Off.**

Can Termination. **Factory set to Enable.**

Modbus Registers

NOTE: The registers labeled Read/Write will allow the operator to change values through the Modbus as a temporary modification. If power is cycled to the MPC-20, the values changed via Modbus will revert back to the last value entered locally at the MPC-20.

REGISTER #	TYPE	DESCRIPTION
40001	Read Only	Current Engine Hours
40002	Read Only	Running Hours LSB.
40003	Read Only	Current RPM.
40004	Read Only	Modbus Voltage
40005	Read Only	Current Oil Pressure
40006	Read Only	Current Engine Temperature
40007	Read Only	Current Engine State:
		#0 ECU Stabilize Delay timing: (1) yes (0) no
		#1 Engine Stopped: (1) yes (0) no
		#2 Controller in Standby Mode: (1) yes (0) no
		#3 Prestart Delay 1 Timing: (1) yes (0) no
		#4 Check Safe to Start: (1) yes (0) no
		#5 Prestart 2 Delay Timing: (1) yes (0) no
		#6 Crank on: (1) yes (0) no

REGISTER #	TYPE	DESCRIPTION
		#7 Crank Rest: (1) yes (0) no
		#8 False Start Check: (1) yes (0) no
		#9 Warmup Delay Timing: (1) yes (0) no
		#10 Line Fill 1 Delay Timing: (1) yes (0) no
		#11 Line Fill 2 Delay Timing: (1) yes (0) no
		#12 Running Loaded: (1) yes (0) no
		#13 Cooldown Delay Timing: (1) yes (0) no
		#14 Energize to Stop Delay Timing: (1) yes (0) no
		#15 Spindown Delay Timing: (1) yes (0) no
40008	Read Only	Shutdown Status: The following is a description of the bits:
		Bit 0 Overspeed SD Status: (1) yes (0) no
		Bit 1 Underspeed SD Status: (1) yes (0) no
		Bit 2 Overcrank SD Status: (1) yes (0) no
		Bit 3 Low Oil Pressure SD Status: (1) yes (0) no
		Bit 4 High engine Temperature SD Status: (1) yes (0) no
		Bit 5 Low Fuel SD Status: (1) yes (0) no
		Bit 6 Low Discharge Pressure SD Status: (1) yes (0) no
		Bit 7 High Discharge Pressure SD Status: (1) yes (0) no
		Bit 8 Speed Signal Lost SD Status: (1) yes (0) no
		Bit 9 Low Lube Level SD Status: (1) yes (0) no
		Bit 10 Fuel Leak SD Status: (1) yes (0) no
		Bit 11 Fuel Filter Restriction SD Status: (1) yes (0) no
		Bit 12 Air Damper Closed SD Status: (1) yes (0) no
		Bit 13 Air Filter Restriction SD Status: (1) yes (0) no
		Bit 14 Oil Filter Restriction SD Status: (1) yes (0) no
		Bit 15 Remote Stop SD Status: (1) yes (0) no
40009	Read Only	Shutdown Status: The following is a description of the bits:
		Bit 0 Coolant Level SD Status: (1) yes (0) no
		Bit 1 High Level SD Status: (1) yes (0) no
		Bit 2 Low Level SD Status: (1) yes (0) no
		Bit 3 High Flow SD Status: (1) yes (0) no
		Bit 4 Low Flow SD Status: (1) yes (0) no
		Bit 5 High Pump Oil Temperature SD Status: (1) yes (0) no
		Bit 6 High Pump Housing Temperature SD Status: (1) yes (0) no
		Bit 7 Water in Fuel SD Status: (1) yes (0) no
		Bit 8 Low Suction SD Status: (1) yes (0) no
		Bit 9 High Suction SD Status: (1) yes (0) no
		Bit 10 High Engine Oil Pressure SD Status: (1) yes (0) no
		Bit 11 High Engine Oil Temperature SD Status: (1) yes (0) no
		Bit 12 Low Gear Box Pressure SD Status: (1) yes (0) no

REGISTER #	TYPE	DESCRIPTION
		Bit 13 High Gear Box Pressure SD Status: (1) yes (0) no
		Bit 14 Battery Charger Fail SD Status: (1) yes (0) no
		Bit 15 Red Lamp Status: (1) yes (0) no
40010	Read Only	Current Discharge Pressure. kPa
40011	Read Only	Current System Level. Feet
40012	Read / Write	Modbus Start Stop: (1) yes (0) no
40013	Read / Write	RPM Run Speed
40014	Read Only	Current Ambient Temperature. Celsius
40015	Read Only	Auto / Manual Mode: (1) Auto (0) Manual
40016 through 40037	Read Only	Reserved
40038	Read / Write	Pressure Start Engine. kPa
40039	Read / Write	Pressure Stop Engine. kPa
40040	Read / Write	Pressure Maintain Value. kPa
40041	Read / Write	Level Maintain Start. Feet
40042	Read / Write	Level Maintain Stop. Feet
40043	Read / Write	Level Maintain Value. Feet
40044	Read / Write	FlowRate.Start. Gpm
40045	Read / Write	FlowRate.Stop. Gpm
40046 through 40200	Read Only	Reserved
40201	Read Only	Version.App.1
40202	Read Only	Version.App.2
40203	Read Only	Version.App.3
40204	Read Only	Version.App.4
40205	Read Only	Version.Config.1
40206	Read Only	Version.Config.2
40207	Read Only	Version.Config.3
40208	Read Only	Serial Number
40210	Read Only	J1939.Engine.Catalyst Tank Level
40211	Read Only	J1939.Engine.Diesel Particulate Filter 1 Soot Load Percent.
40212	Read Only	J1939.Transmit.Diesel Particulate Filter Regeneration Inhibit Switch
40213	Read Only	J1939.Engine.Diesel Particulate Filter Active Regen Inhibited Due to Inhibit Switch
		#0 (LSB) Inhibited Due to Inhibit Switch: (1) yes (0) no
		#1 Reserved
		#2 Reserved
		#3 Reserved
		#4 Reserved
		#5 Reserved

REGISTER #	TYPE	DESCRIPTION
		#6 Reserved
		#7 Reserved
		#8 Reserved
		#9 Reserved
		#10 Reserved
		#11 Reserved
		#12 Reserved
		#13 Reserved
		#14 Reserved
		#15 (MSB) Reserved
40214	Read Only	State Timer.
40215	Read Only	Engine RPM Setpoint.
40216	Read Only	AllPurposeAutoStartFunction
		#0 Single Contact
		#1 Local Start Key
		#2 Two Contact Maintained
		#3 Two Contact Momentary
		#4 Pressure Transducer
		#5 Level Transducer
		#6 Flow Transducer
40217	Read/Write	Pressure Deadband. kpa
40218	Read/Write	Level Deadband. Feet
40219	Read/Write	Flow Deadband. US Gal/min
40220	Read/Write	Start Temperature. Celcius
40221	Read/Write	Stop Temperature. Celcius
40222	Read Only	Current Ambient Temperature. Celcius
40223	Read/Write	Maintain Flow. US Gal/min
40224	Read/Write	RPM Low Idle
40225	Read Only	Service Reminder: Air Filter Life.
40226	Read Only	Service Reminder: Air Filter Life Remaining.
40227	Read Only	Service Reminder: Battery Life.
40228	Read Only	Service Reminder: Battery Life Remaining.
40229	Read Only	Service Reminder: Belt Life.
40230	Read Only	Service Reminder: Belt Life Remaining.
40231	Read Only	Service Reminder: Fuel Filter Life.
40232	Read Only	Service Reminder: Fuel Filter Life Remaining.
40233	Read Only	Service Reminder: Oil Filter Life.
40234	Read Only	Service Reminder: Oil Filter Life Remaining.
40235	Read Only	Service Reminder: Oil Life.
40236	Read Only	Service Reminder: Oil Life Remaining.

REGISTER #	TYPE	DESCRIPTION
40237	Read Only	Service Reminder: Overhaul Life.
40238	Read Only	Service Reminder: Overhaul Life Remaining.
40239	Read Only	Current Fuel Level
40240	Read/Write	Save Changes to Modbus: (1) yes (0) no
40241	Read Only	Modbus EEPROM Saved: (1) yes (0) no
40242	Read Only	Warning Status: The following is a description of bits:
		#0 Low Fuel Warn Status: (1) yes (0) no
		#1 Fuel Leak Warn Status: (1) yes (0) no
		#2 Fuel Filter Restriction Warn Status: (1) yes (0) no
		#3 Low Lube Level Warn Status: (1) yes (0) no
		#4 Coolant Level Warn Status: (1) yes (0) no
		#5 Water in Fuel Warn Status: (1) yes (0) no
		#6 No Flow Warn Status: (1) yes (0) no
		#7 High Engine Oil Temperature Warn Status: (1) yes (0) no
		#8 Low Oil Pressure Warn Status: (1) yes (0) no
		#9 High Engine Temperature Warn Status: (1) yes (0) no
		#10 High Discharge Pressure Warn Status: (1) yes (0) no
		#11 Low Discharge Pressure Warn Status: (1) yes (0) no
		#12 High Suction Warn Status: (1) yes (0) no
		#13 Low Suction Warn Status: (1) yes (0) no
		#14 High Level Warn Status: (1) yes (0) no
#15 Low Level Warn Status: (1) yes (0) no		
40243	Read Only	Warning Status: The following is a description of bits:
		#0 High Flow Warn Status: (1) yes (0) no
		#1 Low Flow Warn Status: (1) yes (0) no
		#2 High Pump Oil Temperature Warn Status: (1) yes (0) no
		#3 High Pump Housing Temperature Warn Status: (1) yes (0) no
		#4 Low Gear Box Pressure Warn Status: (1) yes (0) no
		#5 High Gear Box Pressure Warn Status: (1) yes (0) no
		#6 Air Damper Closed Warn Status: (1) yes (0) no
		#7 Air Filter Restriction Warn Status: (1) yes (0) no
		#8 Oil Filter Restriction Warn Status: (1) yes (0) no
		#9 Low Engine Temperature Warn Status: (1) yes (0) no
		#10 High Engine Oil Pressure Warn Status: (1) yes (0) no
		#11 Battery Charger Fail Warn Status: (1) yes (0) no
		#12 Run To Destruct Warn Status: (1) yes (0) no
		#13 Battery High Warn Status: (1) yes (0) no
		#14 Battery Low Warn Status: (1) yes (0) no
#15 Amber Lamp Status: (1) yes (0) no		

Software Release: 2.8.10043

Slave Address: the Modbus Slave device address.

Serial Setup:

Baud Rate
9600
19200
38400
57600
115200
Stop Bits
0
1
2
Parity
None
Odd
Even

PV CAN Backlight Enable

Off
On

CAN Termination

Enable
Disable

PC Configuration Software

The MPC-20 controller is the first engine controller released utilizing Murphy's PowerVision Configuration Studio[®]. With PowerVision, engineering will be able to deliver quicker software updates with the flexibility of a software developer's environment. The new addition of PowerVision to this controller gives Enovation Controls the ability to provide a free-of-charge basic PC configuration program to change default parameters in the controller to all customers.

The simplified version of PowerVision that will be utilized to create the configuration for the MPC-20 Controller will be available via download from our website (Forum).

<http://forum.fwmurphy.com/viewforum.php?f=49>

Customers who require a developer's environment to change or add additional functionality in the controller may do so in their own time without waiting or paying non-recurring engineering fees (also referred to as NRE) to make the changes (requires purchase of full version of PowerVision Configuration Studio[®]).

Specifications

Electrical

Display: 3.8" Monochrome, Transflective, White Backlight LCD with Heater

Operating Voltage: 8-32 VDC, protected against reverse battery polarity and load-dump

Power Consumption: 18W max without 2 2A High-sides active, 146W max with 2 2A High-sides active

Communications

2-CAN: J1939 (only one supported in initial release)

USB: 2.0B (Only supported for programming)

Ethernet: (Not supported in initial release)

RS485: Modbus RTU

Connection: Delphi SICMA 90 way connector

Keyboard: 11 Tactile Feedback Buttons

Inputs

6-Digital Inputs: configurable (high/low)

8-Analog Inputs: configurable (4-20mA, 0-5V, resistive)

1-Frequency Input:

supporting Magnetic Pickup:

(2 Hz – 10 kHz, 3.6 VAC – 120 VAC)

Supporting Engine Alternator:

(2 Hz – 10 kHz, 4.5 VRMS – 90 VRMS)

Outputs

6-Relays: 10A, SPDT, Form C (30 VDC @ 10A max.), 40A maximum aggregate @ 85C

2-Low-side Outputs: 1A

2-High-side Outputs: 2A

2-5V Outputs: 200mA (to drive external relays)

1-Analog Output: 0-5V

Real-time clock: with battery backup

Environmental

Operating Temperature: -40°F to 185°F (-40°C to +85°C)

Storage Temperature: -40°F to 185°F (-40°C to +85°C)

Protection: IP 67 front and back, Panel seal is IP66 when used with Accessory Gasket

Emissions: SAE J1113

Immunity: SAE J1113

Vibration: Random vibration, 7.86 Grms (5-2000 Hz), 3 axis

Shock: ± 50G in axis

Mechanical

Case Material: Polycarbonate/ABS

Keypad/Gasket Material: Silicone

Software Release: 2.8.10043

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FM 28221 (Rosenberg, TX - USA)
FM 29422 (UK)



FM 523851 TS 16949 (China)

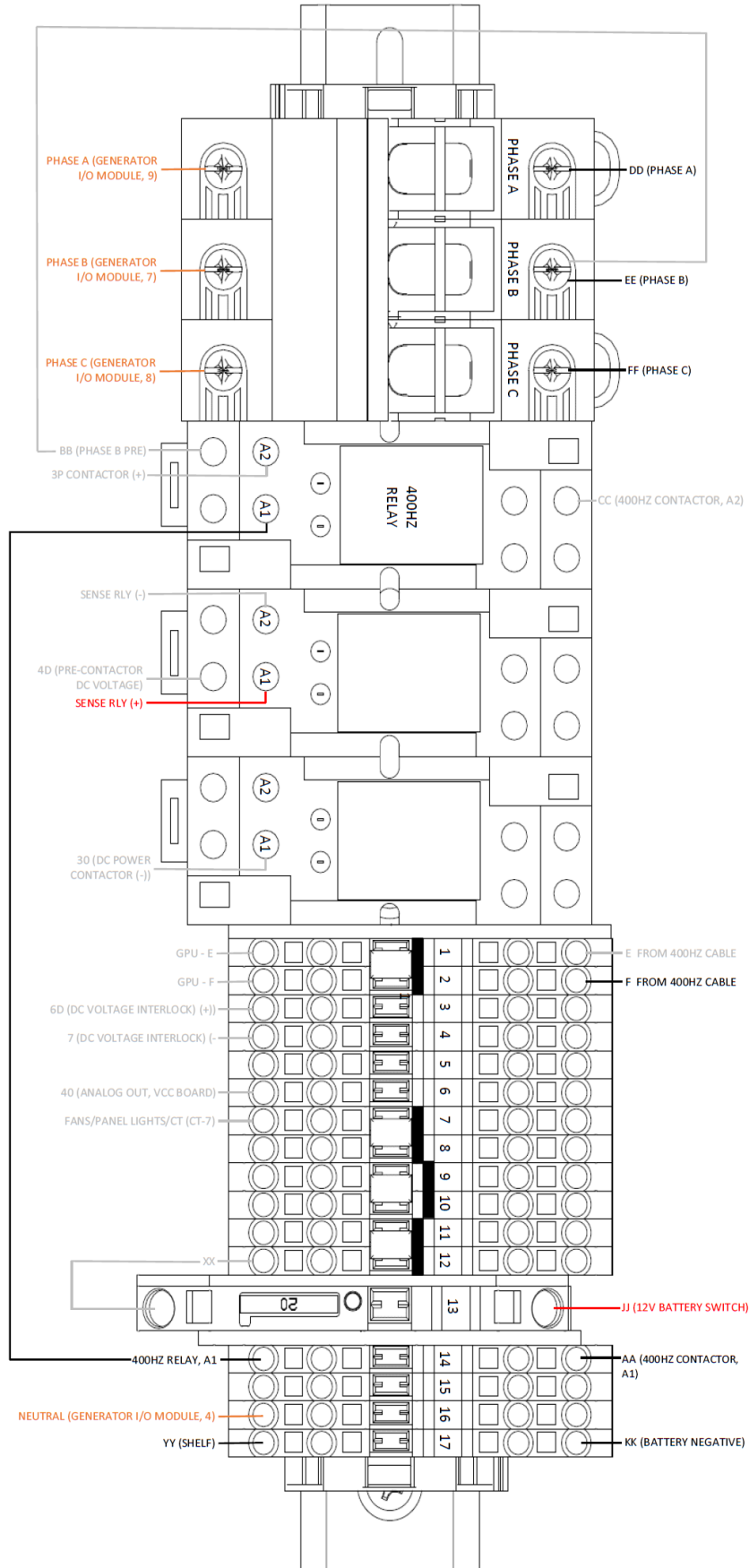
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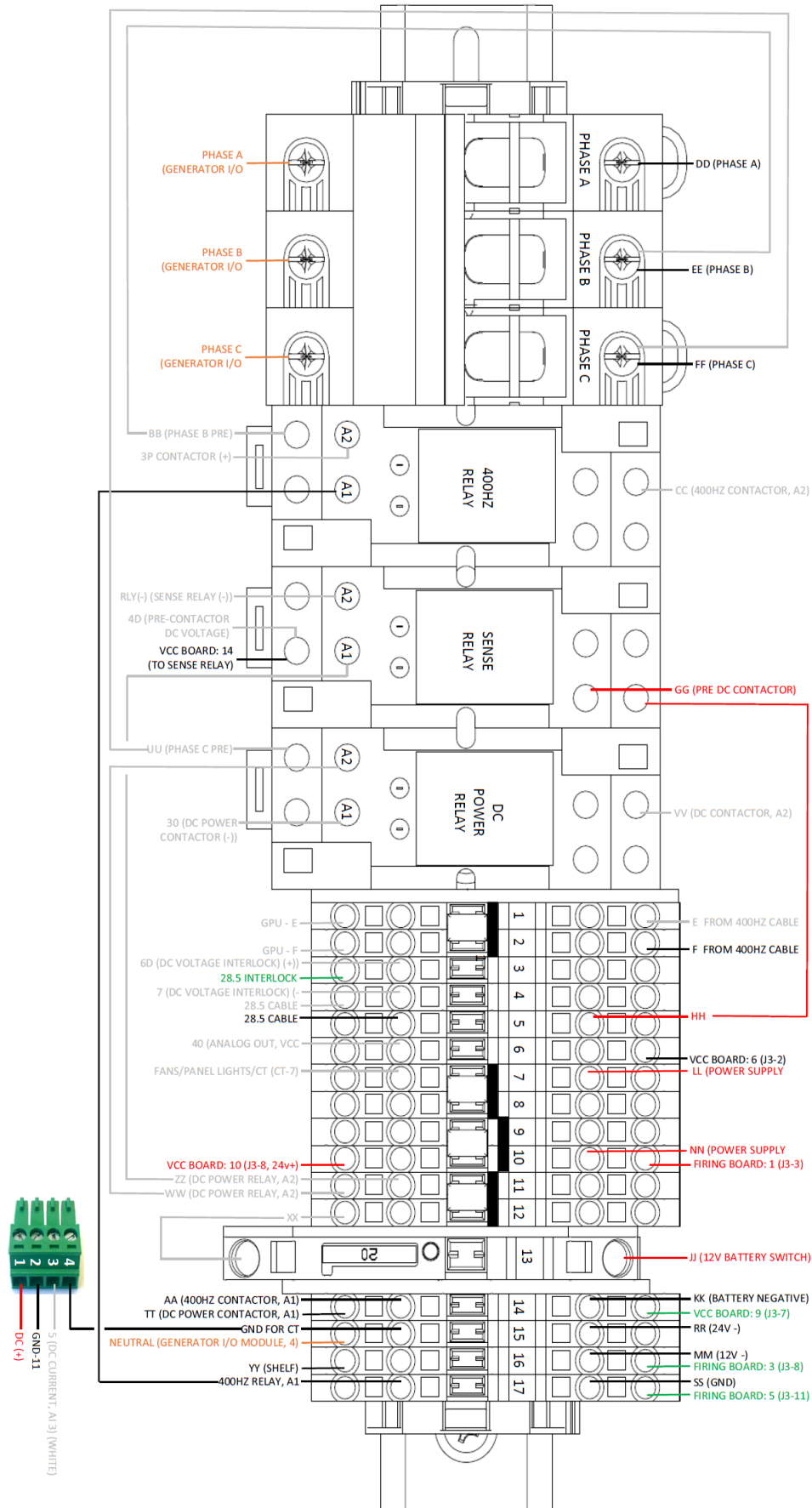
APPENDIX III

TERMINAL BLOCK WIRING

11-4090-0000 TERMINAL BLOCK WIRING



11-4290-0000 TERMINAL BLOCK WIRING





APPENDIX IV

Declaration of Conformity



Declaration of Conformity

The design, development and manufacture is in accordance with European Community guidelines

11-4290-0000 / 11-4090-0000
Ground Power Unit
(Diesel)

Relevant draft complied with by the machinery:
prEN 1915-1:1995

Relevant standards complied with by the machinery:
prEN 982:1996
prEN 60204-1:1997
HFPA/JIC T2.24.1-1990
ISO 4021:1997
ARP 1247B
NFPA 70/NEC 1999

Identification of person empowered to sign on behalf of the Manufacturer:

A handwritten signature in cursive script that reads "Patrick Finch". The signature is written in black ink and is positioned above a horizontal line.

Quality Assurance Representative