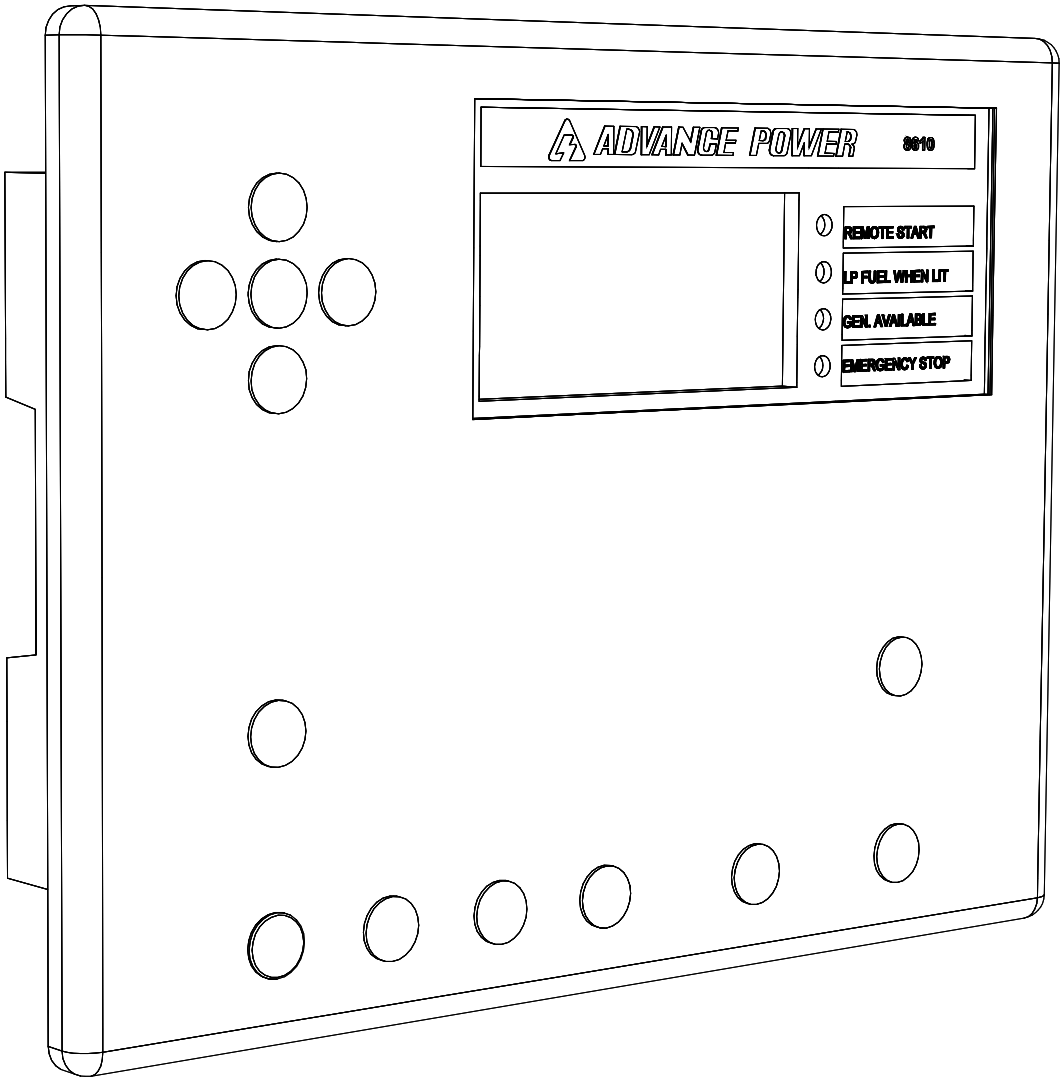
WINCO®
GENERATORS
AN AMERICAN COMPANY

DSE8610

SUPPLEMENTAL MANUAL



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SAFETY INFORMATION

This engine generator set has been designed and manufactured to allow safe, reliable performance. Poor maintenance, improper or careless use can result in potentially deadly hazards; from electrical shock, exhaust gas asphyxiation, or fire. Please read all safety instructions carefully before installation or use. Keep these instructions handy for future reference. Take special note and follow all warnings on the unit labels and in the manuals.

CALIFORNIA PROPOSITION 65

WARNING: This product contains crude oil, gasoline, diesel fuel and other petroleum products, Antifreeze to which can expose you to chemicals including toluene and benzene, Ethylene glycol (ingested) which are known to the State of California to cause cancer, birth defects or other reproductive harm and developmental issues. For more information go to www.P65Warning.ca.gov.

SAFETY DEFINITIONS

DANGER

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

WARNING

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

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

DANGER: ELECTRICAL SHOCK

The output voltage present in this equipment can cause fatal electric shock. This equipment must be operated by a responsible person.

A. Do not allow anyone to operate the generator without proper instruction.
B. Guard against electric shock.
C. Avoid contact with live terminals or receptacles.
D. Use extreme care if operating this unit in rain or snow.
E. Use only three-pronged grounded receptacles and extension cords.
F. Be sure the unit is properly grounded, installation must meet the national electrical code.

DANGER: DEADLY EXHAUST GAS

Exhaust fumes from any gasoline engine contain carbon monoxide, an invisible, odorless and deadly gas that must be mixed with fresh air.

A. Operate only in well ventilated areas.
B. Never operate indoors including attached garages
C. Never operate the unit in such a way as to allow exhaust gases to seep back into closed rooms (i.e. through windows, walls, floors).

DANGER: FIRE HAZARD

Gasoline and other fuels present a hazard of possible explosion and/or fire.

A. Do not refuel when the engine is running or hot.
B. Keep fuel containers out of reach of children.
C. Do not smoke or use open flame near the generator set or fuel tank.
D. Keep a fire extinguisher nearby and know its proper use. Fire extinguishers rated ABC by NFPA are appropriate.
E. Store fuel only in an approved container, and only in a well ventilated area.
F. Follow local codes for closeness to combustible material.

CAUTION: NOISE HAZARD

Excessive noise is not only tiring, but continual exposure can lead to loss of hearing.

A. Use hearing protection when working around this equipment for long periods of time.
B. Keep your neighbors in mind when using this equipment.

CAUTION

Keep the generator and surrounding area clean.

A. Remove all grease, ice, snow or materials that create slippery conditions around the unit.
B. Remove any rags or other materials that could create a potential fire hazard.
C. Carefully clean up any gas or oil spills before starting the unit.
D. Do Not use the generator area as a storage closet.

CAUTION

All service, including the installation or replacement of service parts, should be performed only by a qualified technician.

A. Use only factory approved repair parts.
B. Do not work on this equipment when fatigued.
C. Never remove the protective guards, covers, or receptacle panels while the engine is running.
D. Use extreme caution when working on electrical components. High output voltage from this equipment can cause serious injury or death.
E. Always avoid hot mufflers, exhaust manifolds, and engine parts. They can cause severe burns instantly.
F. The use of the engine-generator set must comply with all national, state, and local codes.

INTRODUCTION

The DSE8610 controller on your WINCO generator is a powerful tool allowing this generator set to synchronize to other sources of power expanding the potential uses of this generator set. This manual, in combination with the base generator manual, contains important information to safely and successfully install your generator.

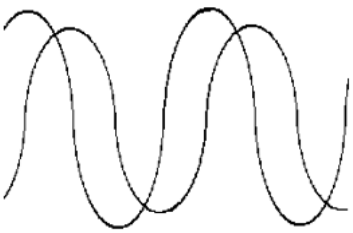
SYNCHRONIZING

Before two or more A.C. supplies can be 'closed' together in parallel, the frequency, voltage and phase of the supplies must be matched as closely together as possible. Collectively, frequency and voltage matching are known as synchronization.

Additionally, the phase rotation of the supplies must be the same, i.e. L1, L2, L3 (Counterclockwise rotation) or L3, L2, L1 (Clockwise rotation). The DSE synchronizing and load sharing modules will check the phase rotation. If this is wrong, the controller cannot act, apart from notifying the operator with an alarm condition. The fault must be corrected before synchronizing of the supplies can be attempted.

Synchronization is achieved first by adjusting the engine speed and generator voltage to get the frequency and voltage of the generator closely matched to that of the bus / mains supply.
Then the phase angle of the supplies is monitored until it is within an acceptable 'window' before the supplies can be closed together in parallel.

In the example below, the two supplies (shown by the two sine waves) have very similar frequencies (seen as the distance between the "peaks" of the waves). However, they have very different voltages (overall heights of the waves) and the supplies are not in phase (the two supply waves are not "on top" of each other).



Typically, a frequency difference (called slip frequency) of 0.1Hz, a voltage difference of 5% and a phase angle of 5° will allow for satisfactory paralleling of the supplies.

Once the supplies are closed in parallel, the phase of the supplies will not alter, they are 'locked' in parallel together.

WARNING:

Attempting to close the supplies in parallel when they are not in sync can result in damage to the generating set system. For example, if synchronizing (using two gen sets) is effected 120° out of phase, the coupling torque can be as high as 12 times full load torque, depending on the ratio of engine and generator inertias.
(Source: Diesel Generator Handbook LLJ Mahon)

ACTIVE POWER SHARING

Once these supplies are closed in parallel with each other, the power will be shared between the supplies depending upon the generating set characteristics.

Control over the set's active power is achieved by controlling the amount of fuel into the engine.

Instructing the governor to increase fuel to the engine will have little or no effect on engine speed because the generator is "tied" to the other supply. Instead, the generator will supply more power to the load. This in turn decreases the amount of power provided by the other supples. This is known as Kilowatt (kW) control.

This can be taken a step further, by paralleling multiple generating sets, all operating isochronously (zero droop). Utilizing an active load-sharing controller such as the DSE8660, precise changes can be made to the amount of power supplied to the load by each generating set. This is achieved by altering the amount of fuel supplied to the engine, and monitoring the amount of power supplied by the set.

Each controller can communicate with the others, passing information regarding the amount of power supplied by the set.

REACTIVE POWER SHARING

Again, consider two identical generating sets closed together in parallel.

Adjusting the amount of field excitation in one of the generators has the effect of that generator supplying more or less of the reactive power to the load, matched by an equal drop in the reactive power supplied by the other generator.

Reactive power is the power user to supply inductive or capacitive load.

Uses of reactive power control include:

1. Where multiple generators are used in parallel with each other, the reactive power is equalized between the sets, removing circulating currents caused by imbalance in the reactive power (VAr) supplied by the paralleled generating sets. This circulating current can generate heat in the alternator windings. If left unchecked, excess circulating current can also damage the alternator windings.

2. Power factor control or VAr control. This feature maintains a specific power factor where one generating set is used in parallel with the mains supply. This is normally used so that the generator maintains its VAr to keep its output at the site load's average power factor level, to minimize demands on the mains supply.

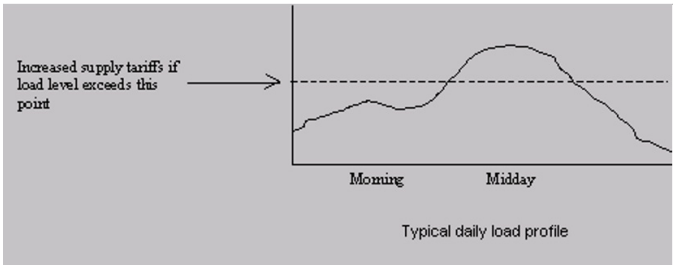
SUITABLE APPLICATIONS

CONTINUOUS PARALLEL OPERATION

Utilities have many tariffs based upon the customer's load demand. In some cases, the tariffs can dramatically increase during certain times of the day if a specific load level is exceeded.

IMPORTANT: This application requires generator sets that meet EPA prime emission standards.

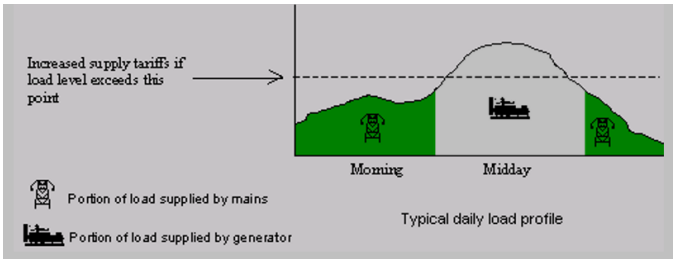
In this following example, the customer is charged more for his electricity in the hours around midday, as his load level places his power usage into the next charging tariff.



In some cases, it can be more cost effective for the customer to provide an alternative power supply during this time of higher tariff. There are a number of possibilities open to the customer:

1. During the time of high load level a single (or multiple) generator(s) could be started, and then used to power the load using a 'no break' transfer. This genset supply must be capable of supplying the entire load during this time of high usage.

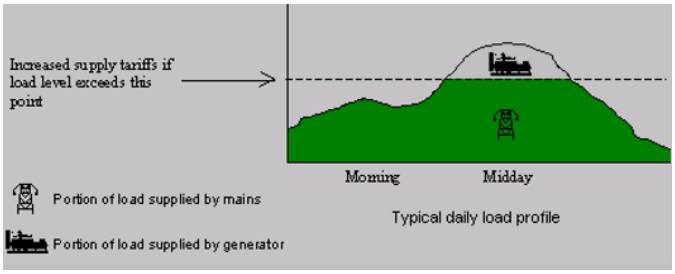
   The drawback of this system is that the power produced by a generator is normally more expensive than utility power. By powering the entire load by generator and disconnecting the utility the total price per kw may be highest.



2. A peak lopping system uses a DSE8610 (up to 32 sets). In this situation variable Peak Lopping or true import/ export can be achieved.

   The DSE8660 will monitor the site load levels and vary the generator(s) power production. This can be used to ensure the set is used at its economic load level, and prevents the system exporting power.

   It can also be used to hold the mains usage to a certain level (DSE Mains Mode), helping to avoid higher utility tariffs or supplementing the mains supply on a site with limited supply available.



True peak lopping & import/export control

WARNING:

It is recommended that the mains decoupling is enabled in the DSE module when paralleling a generating set with the mains.
Additional equipment of this type is normally specified by the local Electricity Supply Company to protect against the generator feeding the mains grid in the case of a mains failure. If in doubt, refer to the local Electricity Supply Company for advice.

MULTIPLE SET PRIME POWER

Two or more sets are used to provide power to the load, sharing power equally as a percentage of the sets full load rating. Sets are automatically started and stopped depending upon load levels allowing economic use of the available generators.

IMPORTANT: This application requires generator sets that meet EPA prime power emission standards.

MULTIPLE SET STANDBY TO MAINS SUPPLY

Two or more sets are used to provide power to the load, sharing power equally as a percentage of the sets full load rating. Sets are automatically started or stopped depending upon load levels allowing economic use of the available generators.

This configuration also increases total reliability of the system by allowing for redundant generator sets to power load in the case of scheduled maintenance or breakdown. Combining smaller generator sets also may be more economical than buy a large generator set capable of power the entire load.

IMPORTANT: This application can use generator sets that meet EPA standby emission standards

SOFTWARE INSTALLATION

For a successful installation of a synchronizing generator set some parameters are site specific. The DSE software is free to download and will allow a technician to optimize the controller parameters from the factory settings.

WARNING:

Changes to the parameters in the control should only be completed by a competent technician. Improper configuration and operations of parallel units can result in injury or death.

In order to download and install the DSE Configuration Suite, go to www.deepseaelectronics.com and create a User Account. You will receive a confirmation email when your account has been approved. Proceed to follow DSE's installation instructions.

INSTALLATION INSTRUCTIONS

This manual contains general installation guidelines. For a proper installation refer to the generator specification sheet, outline drawings, operator's manuals and the applicable codes for specific details on your installation. Many advanced features are only addressed in the Deep Sea operation manuals.

For a successful installation a clear understanding of the type of synchronization strategy your application requires is essential. The components of your installation will change accordingly.

GENERATOR INSTALLATION

Install the generator sets in accordance with their operator's manuals and local code. When using multiple generator sets make sure that the layout of the installation allows access to all of the generator sets for maintenance and refueling. The DSE8610 systems can be used to synchronize up to 32 generator sets in one system.

COMMUNICATION WIRING

For proper synchronization of multiple generator sets all DSE8610
controllers have to be in serial communication.

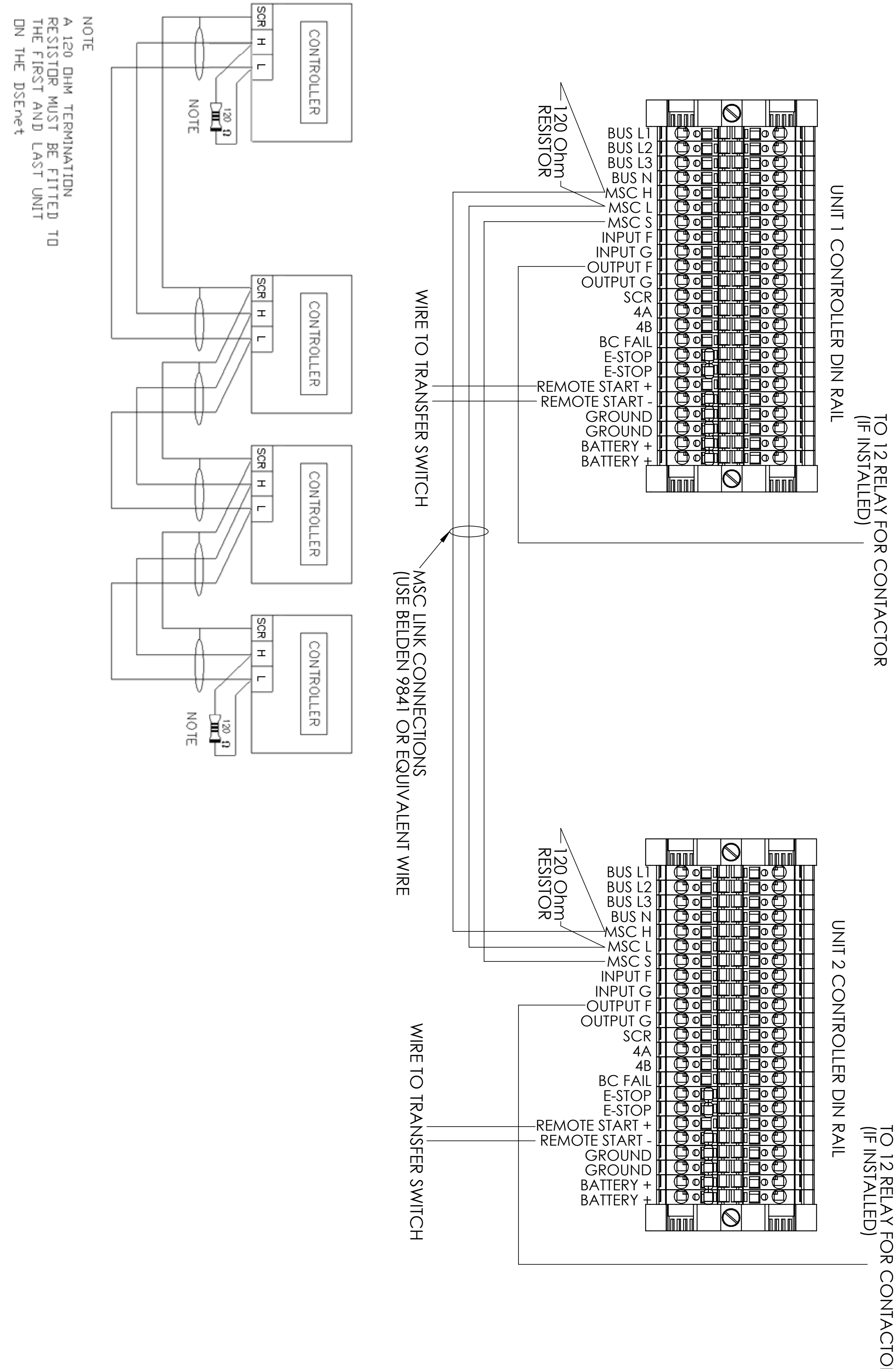
All of the DSE8610 controllers in a synchronization application require reliable communications. The following cable specifications are recommended by the manufacturer.

Description	Specification
Cable Characteristics	Two core screened and shielded twisted pair
Recommended Cable	Belden 9841 or equivalent
Max. Cable Resistance	0.050Ω/m
Max. Cable capacitance (between conductors)	75 pF/m
Max. Cable capacitance (conductor to shield)	110 pF/m
Termination Resistors (one at each end of cable run)	120Ω 4W (supplied loose with controller)
Max. Cable Length	250 m (3/4 mile) when using Belden 9841

NOTE: For additional cable length, the DSE124 CAN & MSC Extender is available. For more information, refer to DSE Publication: 057-116 DSE124 Operator Manual.

Parameter value connection type - Twin conductors with screen. Ensure screen is connected to SCR terminal of every controller on the bus.

CONTROL WIRING



AC WIRING

Depending upon the type of application your AC wiring will change. These systems can be as complex as desired but care must be taken to properly understand your application and the required functional and safety components.

CONTINUOUS PARALLEL OPERATION

This application uses one or more generators to synchronize to the utility grid normally to provide peak shaving benefits. The AC output of the generator is joined to the utility grid in accordance with local code. Before starting the installation it is essential to communicate with the local power company and the local authority having jurisdiction to clearly understand local requirements for generator synchronization.

Synchronizing a generator to the utility grid must be done carefully to avoid creating conditions that can result in injury or equipment damage. If the utility power fails, a means for disconnecting the generator from the utility must be in place. Failure to do this will result in grid back-feeding. The risks of back-feeding are as follows:

1. It is always illegal to back-feed the grid during a utility failure.
2. Linesmen attempting to repair the grid will be in danger or not have access to the lines since they are live.
3. The generator when it supplies the entire grid won't be able to maintain required frequency and voltage ranges.
4. Protective devices may not be capable of providing protection to people in the case of back-fed power.
5. When the utility returns it will be out of sync with the generator and result in damage to the equipment.

In a traditional generator application the transfer switch is used to provide protection against back-feeding. In a synchronization application since both the utility and the generator have to be connected to load simultaneously a transfer switch cannot be used. Synchronized generators use a process called Mains Decoupling to prevent back-feeding. Consult with the local authorities for clear guidance on the method of mains decoupling required for your specific application.

In order to detect a loss of utility power under voltage and frequency alarms are supplemented with Rate of Change of Frequency (ROCOF) or Vector Shift (VS). These methods of monitoring depend upon the stability of the utility power source. Some jurisdictions specify one or the other or both methods of detection to be employed.

Change of Frequency (ROCOF)
- Slower to react than Vector Shift.
- Normal frequency changes on the utility can lead to nuisance trips.
- May not trip if the load level after mains failure is close to the load level before the mains failure.

Vector Shift (VS)
- Typically will respond to a utility failure faster than ROCOF.
- Sensitive to faults other than a full utility failure.
- Not sensitive to normal changes in frequency.
- May not trip if the load level before and after a utility failure are close to constant.

The DSE8610 has a mains decoupling capability built into the controller for some applications. Some applications may require an independent device to perform this function.

Once a loss of mains is detected there are three strategies to safely prevent unsafe conditions.

1. Disconnect Mains
   This strategy requires a motorized breaker or other utility disconnect method to be installed in the utility input before the synchronization bus. Upon the detection of the utility failure this breaker will be opened isolating the generator from the utility grid.

   This is an optional way to achieve decoupling. The advantage of this selection is that the generator will continue to power the load during a utility outage. In order to be successful the generator must be able to power the full utility load or load shedding devices must be installed to switch the facility to emergency circuits only to properly match available power to the system.

2. Disconnect Generator
   Upon the detection of a utility failure the DSE8610 and contactor on your generator can be configured to open disconnecting the generator. This option is configurable from base generator purchases and should be used if the generator set is not sized sufficiently to power the load without the utility.

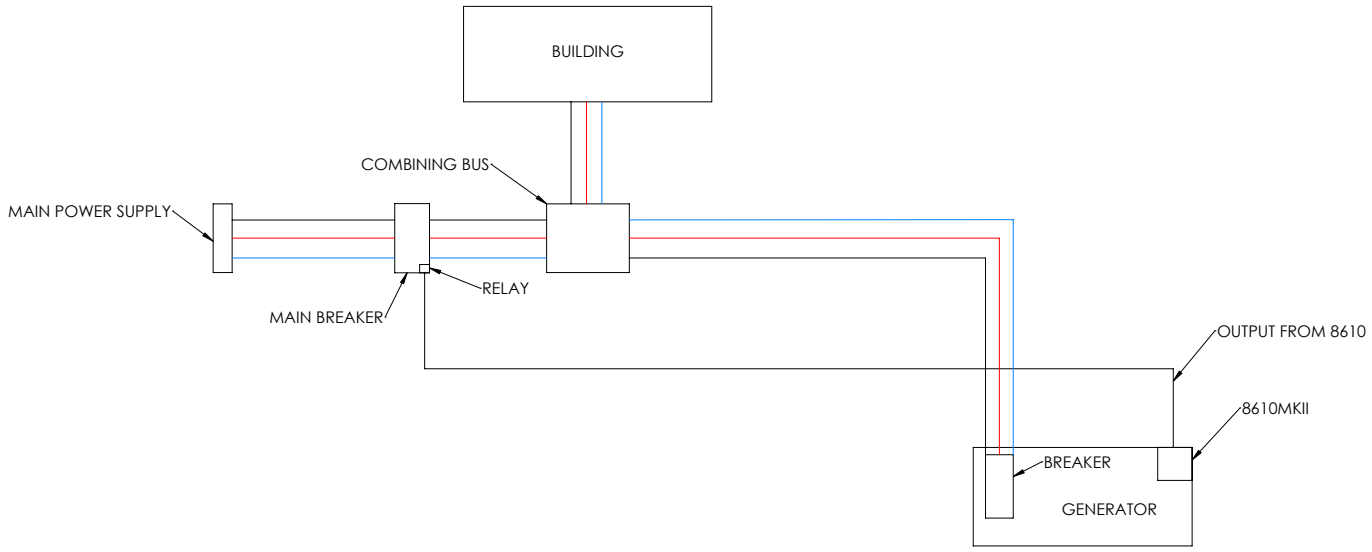
3. Disconnect Both
   Upon failure a disconnect device from the utility and the contactor on the generator are opened disconnecting both from the utility supply.

   Whenever mains decoupling is tripped the system must be reset manually. It is recommended to design ways to monitor for this condition into the system.

The paralleling of two or more supplies requires that the switching of the supplies be performed as close to zero phase as possible. The check sync feature of the DSE synchronizing and load sharing controller can accurately measure the phase, and when within the 'check sync' window can issue the load switching closure signal within a few milliseconds. However, there will be a delay in the actual operation and physical movement of the switching device that must be minimized and taken into account when designing and commissioning any paralleling system.

Your generator set comes equipped with a synchronizing contactor specified at the factory for this application. In some types of installations it may be necessary to add an additional switching device and the following principles must be considered. The DSE8610 controller will provide a 12 or 24 VDC output signal depending upon the DC voltage of the underlying generator set. This information is available on the base specification sheet.

MAINS DECOUPLING
(Optional)



CHOOSING A LOAD SWITCHING DEVICE

It is typically considered that load switching for parallel supplies be performed within 5 supply cycles of the close signal being given to ensure the phase or the supplies has not changed too greatly after the closing signal has been given.

	Cycle time	Max. Load Switch Closing Time
50Hz System	20.0 ms	100 ms
60Hz System	16.7 ms	83 ms

NOTE: The closing time of any load switching device slave relays should also be taken into account. For instance, plug in relays typically used in generating set control panels have an operation time of 10ms-20ms.

NOTE: If fitting a mains (utility) 'Breaker' with a trip position, it is recommended to fit one equipped with auxiliary contacts to indicate the "tripped" position. This can be fed into an input configured to "auxiliary mains failure" so that the module is 'informed' of mains (utility) supply breaker tripping should this occur. This is particularly important when the module is operating in parallel with the mains (utility) supply.

WARNING:

Manually operated breakers CANNOT be used as they cannot be operated within the required closing time.

CONTACTORS

Contactors normally operate fast enough for paralleling applications, Review the contactor's specifications to verify that it can consistently operated within proper parameters.

CHARGED SPRING BREAKERS

In general, charged spring breakers will operate much faster than contactors. Charged spring breakers 'pre-charge' a large spring device within the breaker, so that when breaker operation is required, the spring is 'released' which operates the closing action of the device.

AIR CIRCUIT BREAKERS (ACBS)

A.C.B.'s normally operate fast enough for paralleling applications but care should be taken to choose an A.C.B. that the manufacturer specifies be fast enough for use in paralleling applications.

MOTOR OPERATED BREAKERS

Some types of motor operated breakers are not suitable for paralleling operations due to the excessive amount of time that the breaker takes to motor into position before the closing process can be completed. Care should be taken to choose a motor operated breaker that the manufacturer specifies be fast enough for use in paralleling applications. See previous table.

MULTIPLE SET PRIME POWER

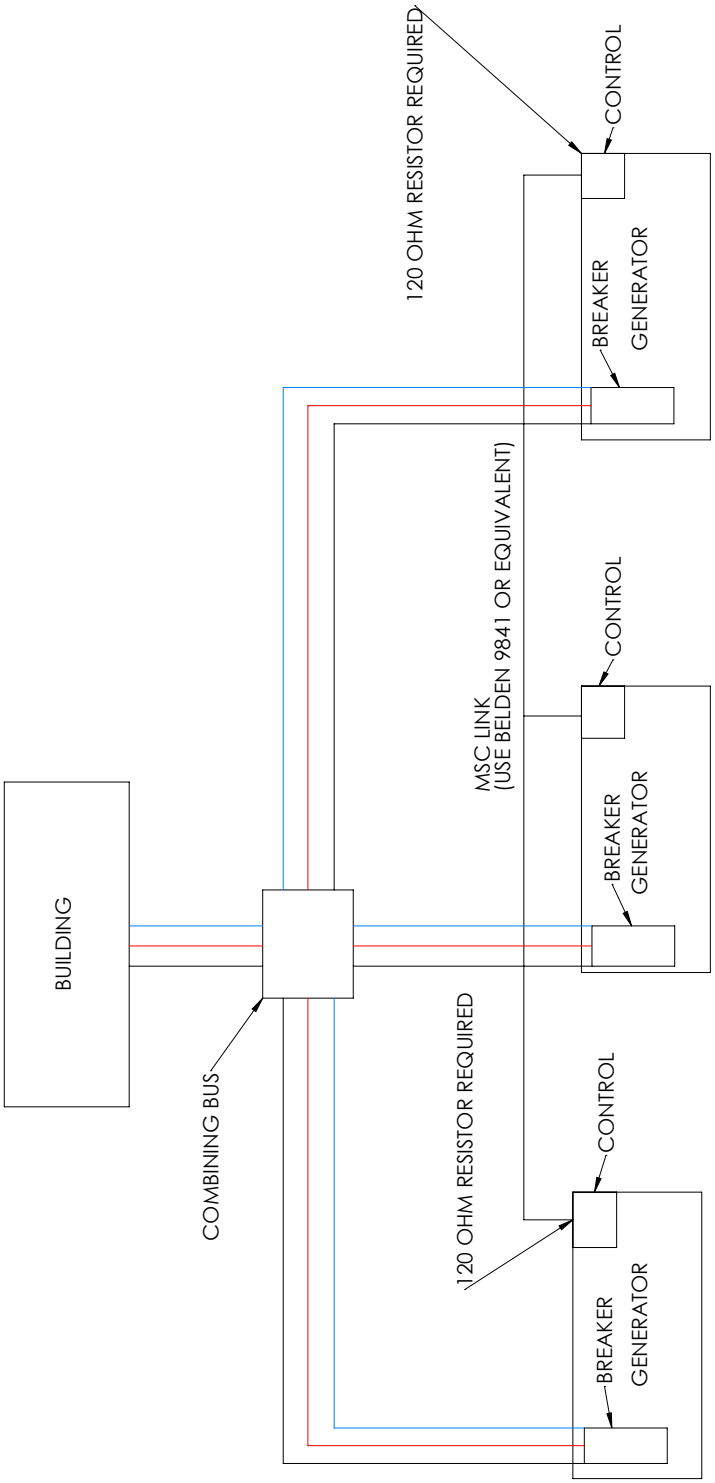
The AC wiring for multiple set prime power is fairly straight forward. A combining bus will join the generators before supplying the load. Since there is not utility source mains decoupling does not need to be addressed.

MULTIPLE SET STANDBY

The AC wiring for standby applications is similar to a normal standby configuration. An automatic transfer switch is added into the system and used to isolate the utility and generator supplies. The mechanical interlock of the switch prevents the need for more complex mains decoupling techniques.

Careful consideration needs to be taken to determine how to transfer the load at start up to the generator system. Two main strategies can be used.

MULTIPLE UNITS PRIME POWER



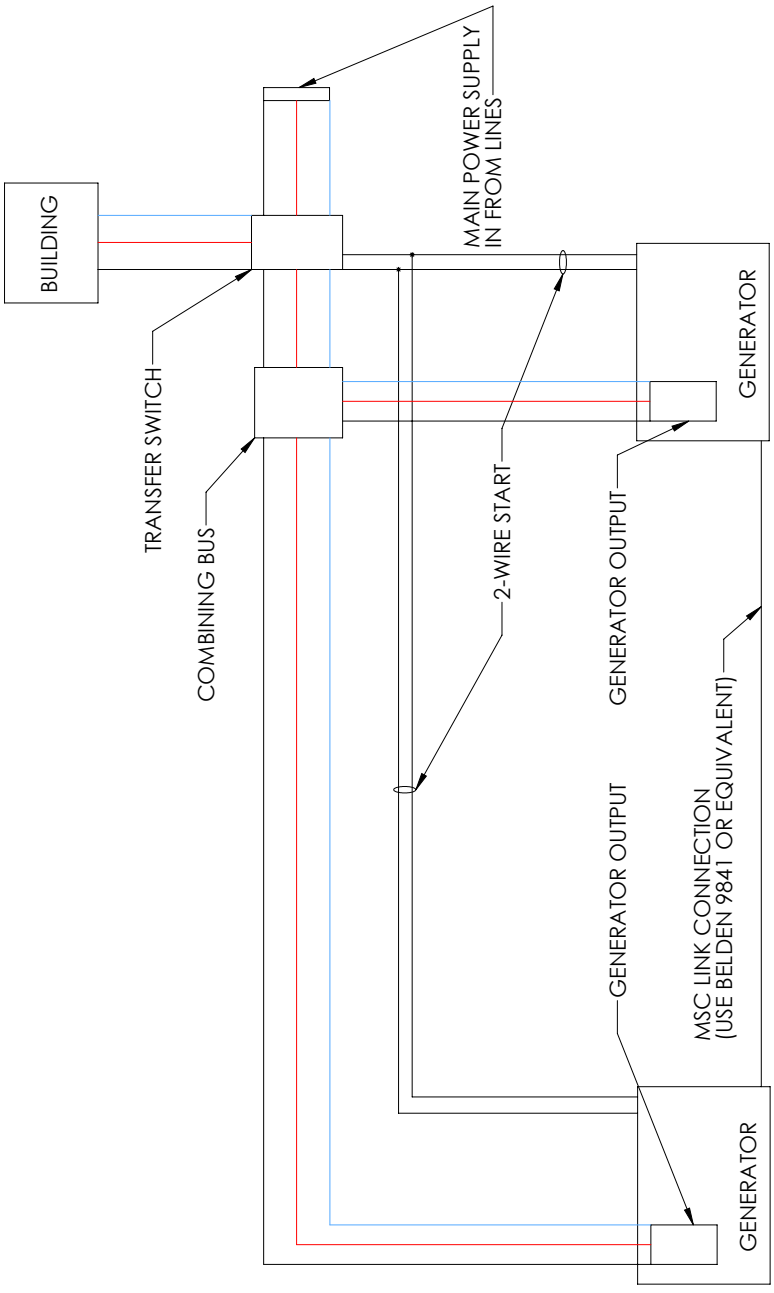
PARALLEL STANDBY WITH TRANSFER SWITCH ONLY

This configuration is the simplest and most economical way to provide utility back-up. Upon power failure all of the generators will start. The first generator to be ready to supply load will close its synchronizing contactor and power the bus. The other generators in the system will now start synchronizing to the first generator. Once synchronized, the other generators close their contactors and supply the bus.

As soon as the first generator supplies the bus the transfer switch will start its transfer delay timer. At the end of the transfer delay the transfer switch will switch to the generators regardless of whether or not the synchronization is complete. If synchronization is incomplete and load transfers the on-line generators may be overloaded causing a shutdown that can only be cleared manually.

Best practices for this configuration consist of increasing the transfer delay in the transfer switch to 30-60 seconds and then shutting down the generators if they fail to synchronize in a time frame shorter than the transfer delay. This shutdown also has to be manually reset but doesn't include the risk of an overload.

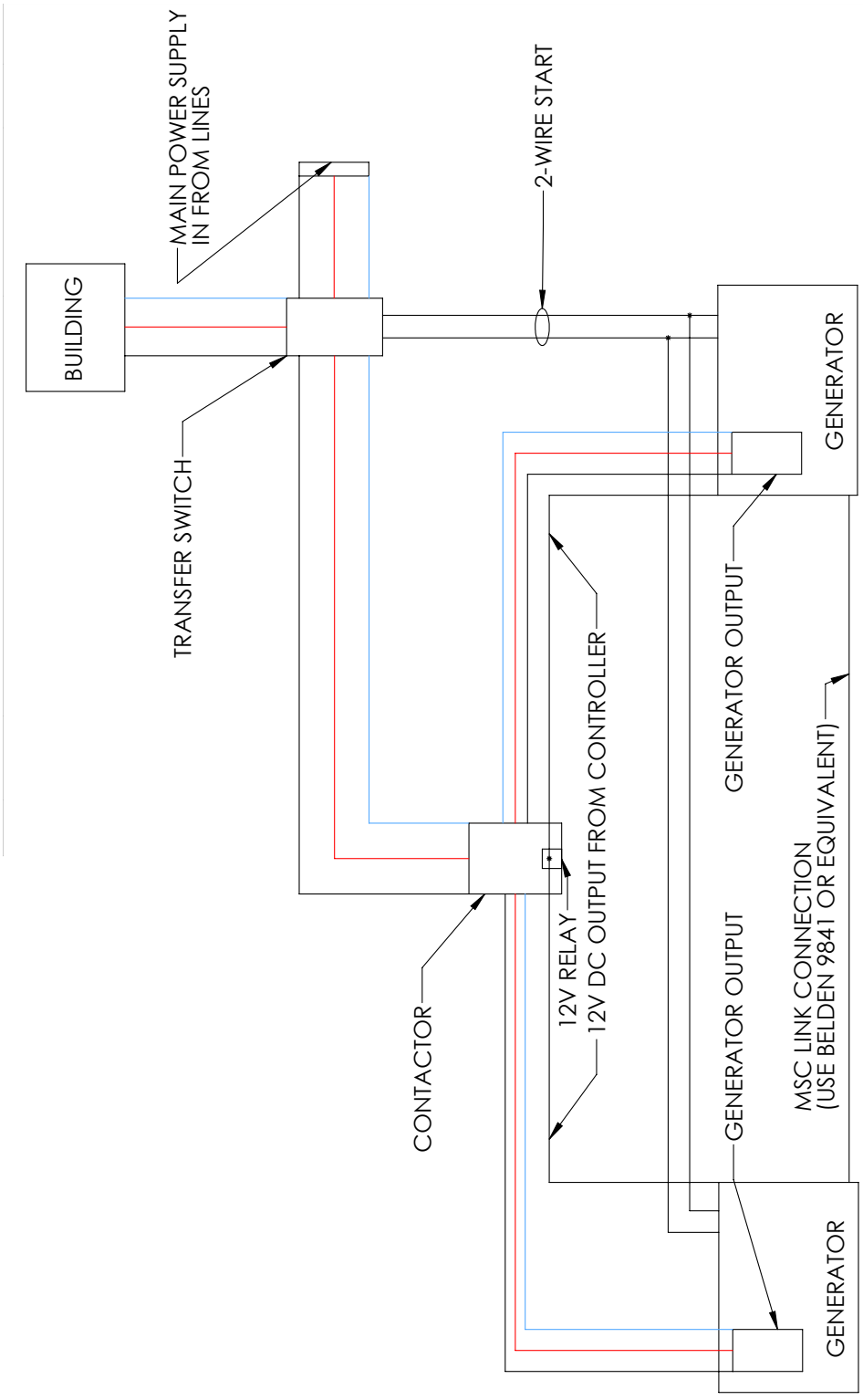
PARALLEL UNITS



PARALLEL STANDBY WITH TRANSFER SWITCH & COMBINING CONTACTOR

In this configuration an additional contactor is installed between the combining bus and the transfer switch. Power is not supplied to the transfer switch until all generators are on-line and synchronized.

PARALLEL UNITS 3RD CONTACTOR



SETTING START CONDITIONS

These generator sets can be programmed to start under a wide range of conditions. The following is designed to provide some examples but shouldn't be considered comprehensive. This system can be configured to start with internal or external commands. It is also possible that in some applications both internal and external start commands will be used within the same system.

INTERNAL COMMANDS

This type of start command will generally be less common. the DSE8610 has a robust scheduler in it that can schedule complete times to start the system on daily, weekly, or monthly schedules. This is configured from DSE configuration suite software. This configuration is useful when the need for generator power is consistent and predictable. An example may be a generator system that powers a job site that starts and stops at the same time each day during the week.

The start command can also be given manually from the face of the DSE8610 on any of the generators in the system. This type of system is best for systems where the generator is the only power supply and will be running continuously except during scheduled maintenance.

The DSE8610 can be programmed to balance the hours or match load. In these cases the DSE8610's in the system will be starting and stopping based upon preprogrammed criteria designed to conserve fuel and equipment life. Programming options are discussed in the optimization section of this manual.

EXTERNAL COMMANDS

The DSE8610 is equipped with a two wire start capability. This can be controlled by any switching device commonly available on a wide variety of equipment. When using a two wire start system it is recommended to wire the start command into each of the generators control panels allowing each generator to identify the start command simultaneously in order to come onto line more reliably and rapidly. The following list gives some examples of how 2-wire start capability may be used:

- Automatic Transfer Switch for utility failure in standby systems.
- Utility control for peak shaving systems.
- If a generator is used to supplement available utility power for a specific pieces of equipment the start sequence of the load equipment can signal the generator to come on line in anticipation of the additional load.

The DSE8610 in advanced applications can also receive start commands over RS485 or RS232 systems. These types of integrations are not covered in detail in this manual.

TWO-WIRE START

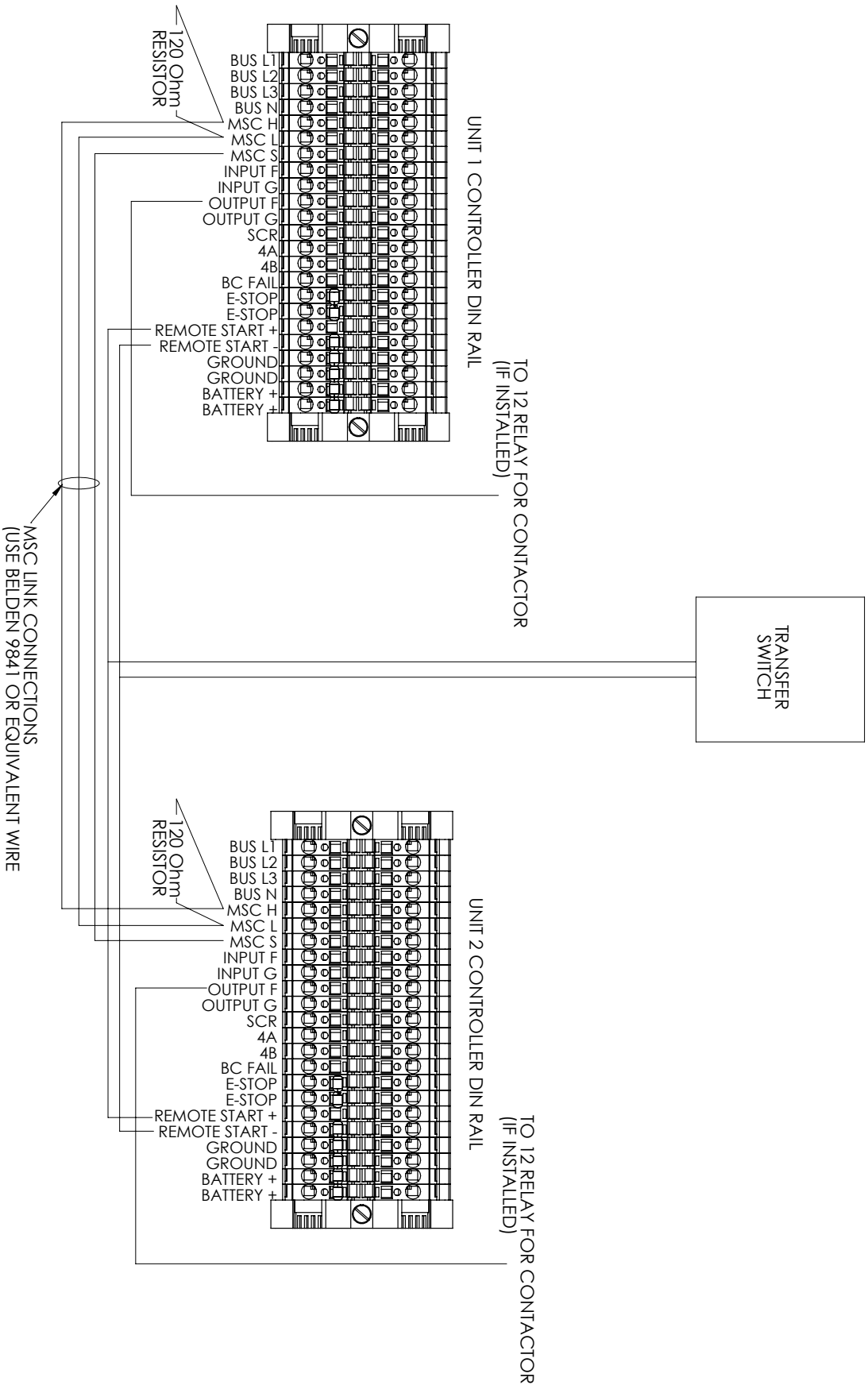
Each DSE8610 control has a terminal for two wire start signals. This allows the generator set to be started by any device that has the ability to close a dry contact.

When starting from a remote start signal it is necessary to wire each generator in the system to receive the start signal.

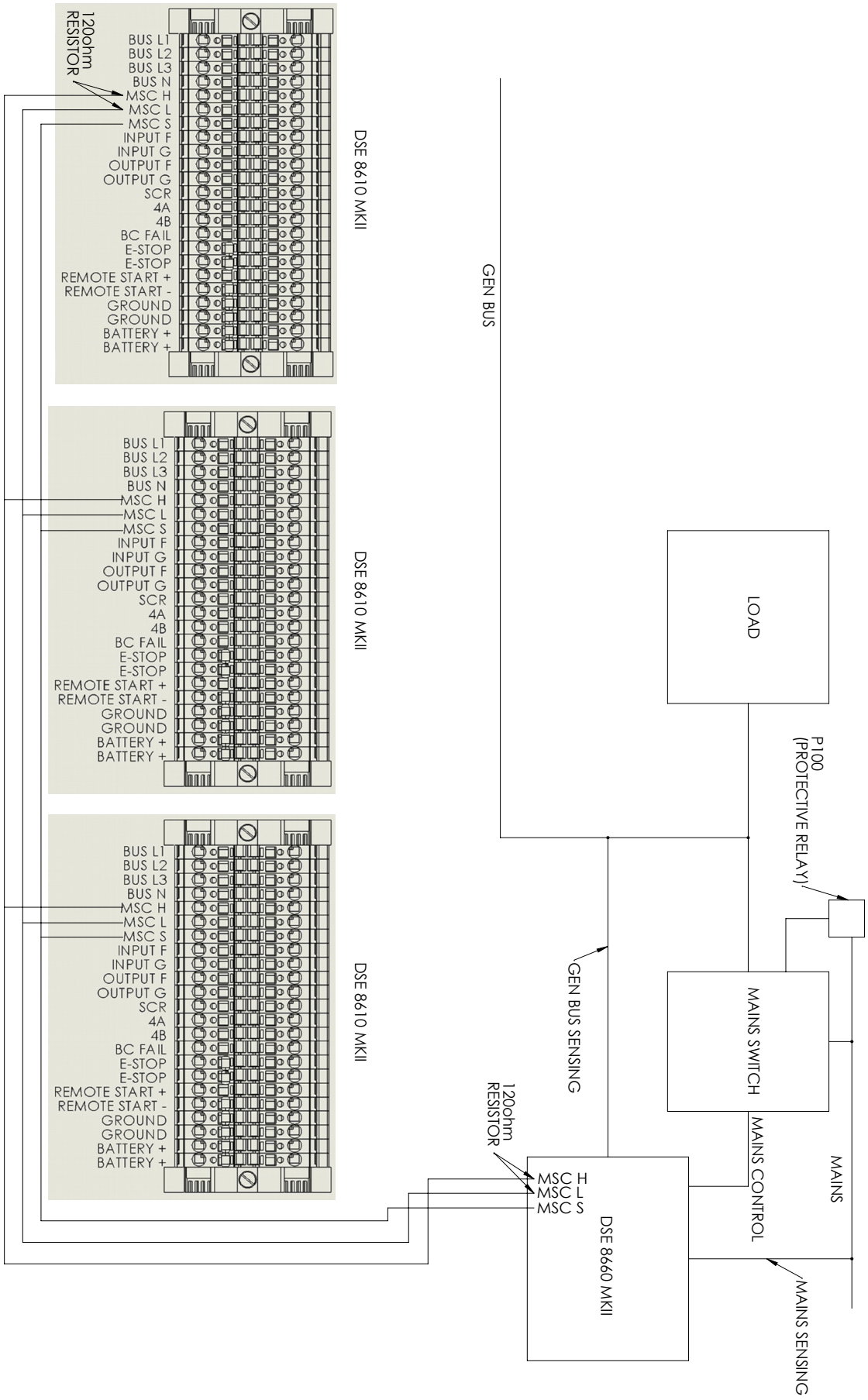
SYSTEM

The DSE8660 optional controller can be added to the system. This controller can act as a master receiving the start signal and controlling all other gen-sets through serial communication.

DSE8610 2-WIRE START



DSE8660 WITH MULTIPLE UNITS



OPTIMIZATION

LOAD DEMAND SCHEME

The Load Demand Scheme is used by the DSE8610 controller and allows the generator sets to start and stop automatically depending upon load levels. Additionally the scheme can also be used to provide generator set redundancy (i.e. n+1 system).

START/STOP ON LOAD DEMAND

1. Starting sequence (all sets initially or as required)

2. Use remote start or load demand input.

3. Run Priority.

4. Balance engine hours

5. The highest priority set that is not running monitors the genset CT's. If the bus load exceeds the calling for more sets to run value; then the set will start, parallel and share load.

6. The lowest priority set that is running monitors the bus load level. This set calculates what the bus loading will be after it ramps off the bus. If the bus loading will be below the calling for less sets value; the set will ramp off load and stop.

7. If a set fails and the bus load rises too high, another set is started. This can also be used to give redundancy (n+1 system).

PRIORITY

1. Starting and stopping on load demand requires that the generators are given priority numbers. Usually these numbers are unique to the generator. If two generators are given the same priority number, they will both start and stop together as if they are one single set.

2. The Balance Engine Hours feature allows for the automatic changing of the run priority based upon the number of engine hours logged in the controller. When the difference between running hours of one set and another exceed the set point, the priorities change, with the sets performing a no break changeover while they swap duty.

Example of balancing engine hours.
Set balance engine hours to 12 hrs on two sets.

1. Two new sets both with zero hours are given the start on load demand signal. Both sets synchronize and parallel together. The load is low, so priority two will stop.

2. Set 1 runs for 12 hours. It is now 12 hours more than set 2 (with zero hours), so set 2 starts and parallels with set and ramps to take all the load, then set 1 stops.

3. Set 2 now runs for 12 hours so is the same as set 1. Set 2 continues to run for 12 more hours (total 24hrs) so is now 12 hours more than set1 (with 12hours) so set1 starts and takes over from set 2.

4. Set 1 and 2 now alternate every 24hrs (they swap over every time the hours of one is 12 more than the other), keeping their running time within 12 hours of the other set.

CALCULATIONS

1. Calling for more sets : The highest priority set that is not running will start when the bus exceeds the More Sets value. This is a simple calculation and should be considered with the requirements of the site load in mind.

   For instance : If one set is running on load at 80% (let's assume this is 80kW load) there is only 20kW left of capacity on the set so the setting of 80% is only suitable if there are no remaining loads to be energized that exceed 20kW. The more sets value will need to be a lower value in this case. In the reverse situation, this also means that is the site is made up of many small loads, the more sets figure may be set to a higher value.

2. Calling for less sets : The lowest priority set that is running believes that all the running sets are the same size so calculations are based upon the size of this set.

3. Where all the sets are the same size, the calculations are a little easier to understand, although the calculation is exactly the same.

   The settings of the Highest Priority Set are not used in the load demand scheme. The highest priority set will run continuously so its settings are not followed. (Until this set's priority is changed so that it is no longer the priority set). It is the set joining or leaving the system whose settings are used.

4. Care must be taken when performing this operation with different sized sets. When a lower priority set is larger than a higher priority set, incorrect settings could cause this set to ramp off load, leaving the smaller set with high load levels, and call for the next set to start. This results in sets continuously starting and stopping for the same load level.

5. There are two ways to perform this calculation:

   A. We know the load level that should be remaining when the lowest priority set stops :

   The percentage for calling for less sets is calculated as :

$$\frac{\text{Required kW remaining on the bus} * 100}{(\text{number of sets on the bus-1}) * \text{capacity of the lowest priority running set}}$$

EXAMPLE: 3 sets on bus, 125kW each. Want to stop set 3 when this would result in the remaining bus level being 200kW. less sets setting =	200 * 100 (3-1) * 125	= 80%
With a setting of 80%, set 3 will stop when doing so would leave the other 2 generators at 80% load. 80% of each generator is 100kW so the bus is left at 200kW as required.		

B. We know the percentage load we require to be left on the bus when the lowest priority set stops :

The percentage for calling for less sets is calculated as :

(percentage of the bus required * capacity of the bus after the lowest priority running set has stopped)

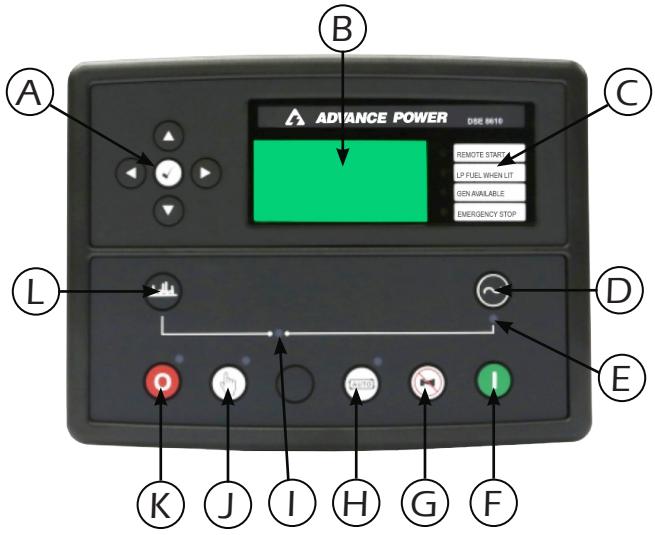
(number of sets on the bus-1) * capacity of the lowest priority running set

EXAMPLE: 3 sets on bus, 50kW, 100kW, 250kW each. Want to stop set 3 when this would result in the remaining bus level being 75% of its capacity less sets setting =	75% OF 150 (3-1) * 250	= 23%(rounded up from 22.5%)
With a setting of 23%, set 3 will stop when doing so would leave the other 2 generators at 23% of the capacity of set 3 each. As set 3 is 250kW, this value is 57.5kW x 2 (2 sets). So the remaining sets will share 115kW. This is 77% of the remaining capacity of 150kW. We required 75%, this minor change from 75% that we required is accounted for by the fact we rounded up from 22.5% to 23% as the module can only be set in increments of 1%.		

Example of correct settings: Assume set 1 is 50kW and set 2 is 100kW. Set 1 is priority. Both sets are running on load and as load decreases we want set 2 to stop when this would leave 30kW on set 1.
This is 30% of set 2 so the setting for less sets must be 30%. When the load drops low enough, set 2 ramps off load, leaving set 1 at 30% of the value of set 2. This is 30kW as set 2 is 100kW.

Example of incorrect settings: Assume set 1 is 50kW and set 2 is 100kW. Set 1 is priority. Both sets are running on load and as load decreases we want set 2 to stop when this would leave 50% on set 1. We mistakenly configure the less sets value in set 2 to 50%. This would cause set 2 to ramp off the load when the load would leave 50% of set 2's capacity on the bus. This would leave 50kW (50% of set 2 is 50kW) on set 1. As set 1 is only 50kW, this makes set 1s load at 100% of capacity. This will cause set 2 to start again, to lower the loading on set 1. This cycle will continue, with set 2 starting and stopping continuously with no change in load.

DSE8610 MKII LAYOUT



A: Menu navigation buttons.
B: Main status and instrumentation display.
C: Four configurable LEDs.
D: Close generator (manual module only).
E: Generator Available LED. On when the generator is within limits and able to take load.
F: Start engine (when in manual mode).
G: Mute alarm/Lamp test.
H: Select Auto mode.
I: Close Generator LED. On when the generator is required to be on load.
J: Select Manual mode.
K: Select Stop mode.
L: Open generator (manual mode only).

NOTE: "Generator on load" LED has two modes of operation depending upon the configuration of the controllers digital inputs.

1. Digital input configured for "Generator closed auxiliary" – The LED illuminates when the generator closed auxiliary input is active –
   The LED shows the state of the auxiliary contact.
2. There is NO input configured for "Generator closed auxiliary" (factory default setting) – The LED illuminates when the DSE8610 gives the loading signal to the generator – The LED shows the state of the DSE8610s loading request.

DSENET® EXPANSION MODULES

NOTE: A maximum of twenty expansion modules can be connected to the DSE8610 MKII.

ITEM	Max No. Supported	Description
	10	Model DSE2548 expansion LED module provides additional LED indications, internal sounder and remote lamp test/alarm mute for use with the controller.

TROUBLE SHOOTING TABLES

STARTING

UNIT IS INOPERATIVE - READ/WRITE CONFIGURATION DOES NOT OPERATE

1. Make sure power switch on the control panel is turned on.
2. Check the battery and wiring to the unit.
3. Check the DC supply.
4. Check the DC fuse.

UNIT SHUTS DOWN

1. Check DC supply voltage is not above 35V or below 9V.
2. Check the operating temperature is not above 70°C.
3. Check the DC fuse.

FAIL TO START IS ACTIVATED AFTER PRE-SET NUMBER OF ATTEMPTS TO START

1. Check wiring of fuel solenoid.
2. Check fuel.
3. Check battery supply.
4. Check battery supply is present on the fuel output of the module.
5. Check the speed-sensing signal is present on the module's inputs.
6. Refer to engine manual.

CONTINUOUS STARTING OF GENERATOR WHEN IN THE AUTO MODE

1. Check that there is no signal present on the "Remote Start" input.
2. Check configured polarity is correct.

GENERATOR FAILS TO START ON RECEIPT OF REMOTE START SIGNAL

1. Check Start Delay timer has timed out.
2. Check signal is on "Remote Start" input. Confirm correct configuration of input is configured to be as "Remote Start"

PRE-HEAT INOPERATIVE

1.Check wiring to engine heater plugs.
2. Check battery supply.
3. Check battery supply is present on the Pre-heat output module.
4. Check Pre-heat configuration is correct.

STARTER MOTOR INOPERATIVE

1. Check wiring to starter solenoid.
2. Check battery supply.
3. Check battery supply is present on the Starter output of module.
4. Ensure oil pressure switch or sensor is indicating the "low oil pressure" state to the controller.

LOADING

ENGINE RUNS BUT GENERATOR DOES NOT TAKE LOAD

1. Check warm up timer has timed out.
2. Ensure generator load inhibit signal is not present on the module inputs.
3. Check connections to the switching device.

Note that the set does not take load in Manual Mode unless there is an active load signal.

INCORRECT READING ON ENGINE GAUGES- FAIL TO STOP ALARM WHEN ENGINE IS AT REST

1. Check engine is operating correctly.
2. Check that sensor is compatible with the module and that the module configuration is suited to the sensor.

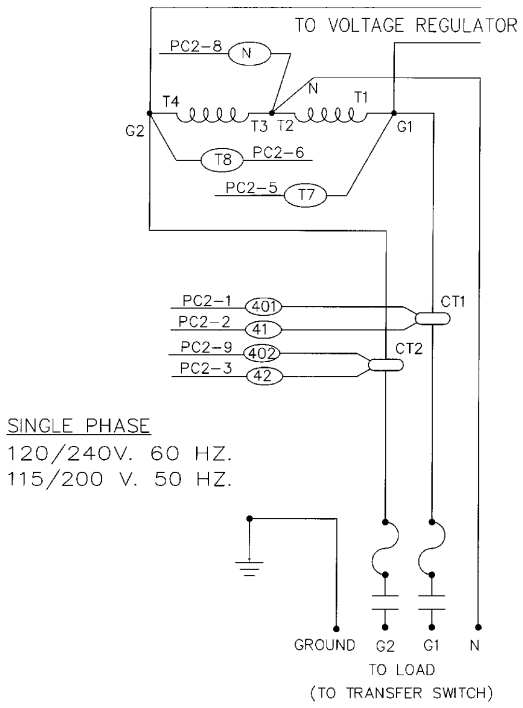
SYNC CHECKS

1. Start additional generator and close the dead bus. Ensure generator is running at 60 Hz.
2. Set the generator nominal frequency on the non-running genset to 60.1 Hz. Start generator. While the generator is running with the circuit breaker open, measure voltage Phase A to Phase A across the paralleling breaker. Watch the volt meter while also watching the digital sync scope on the display. When the sync scope indicated the generator is in phase with the bus, verify the voltmeter reads low voltage.
3. Repeat step 2. measuring voltage Phase B to Phase B across the paralleling breaker and ensure low voltage is measured when the digital sync scope shows the generator is in phase with the bus.

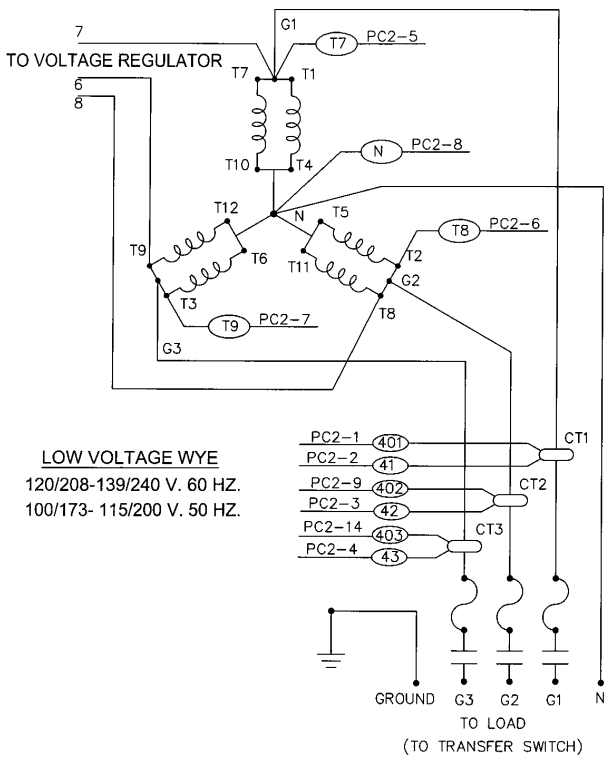
AC WIRING

Note: Some custom features and machines may have additional items wired in that are not included in these specifications.

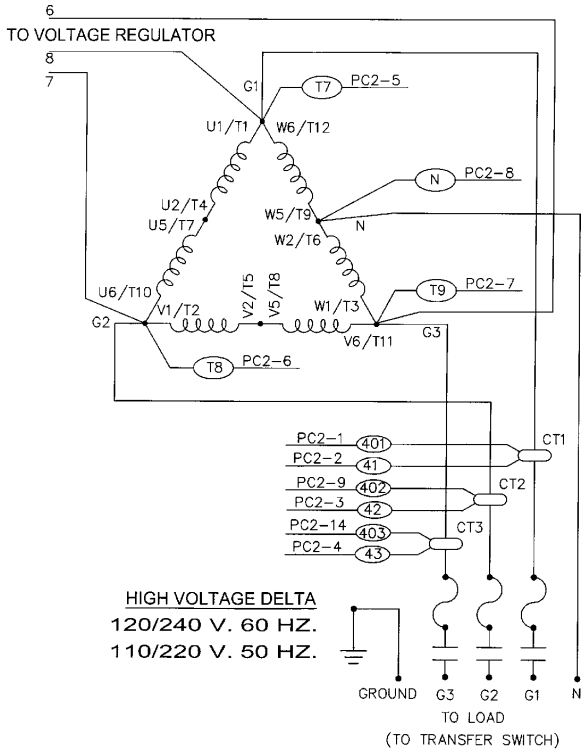
SINGLE PHASE 120/240V



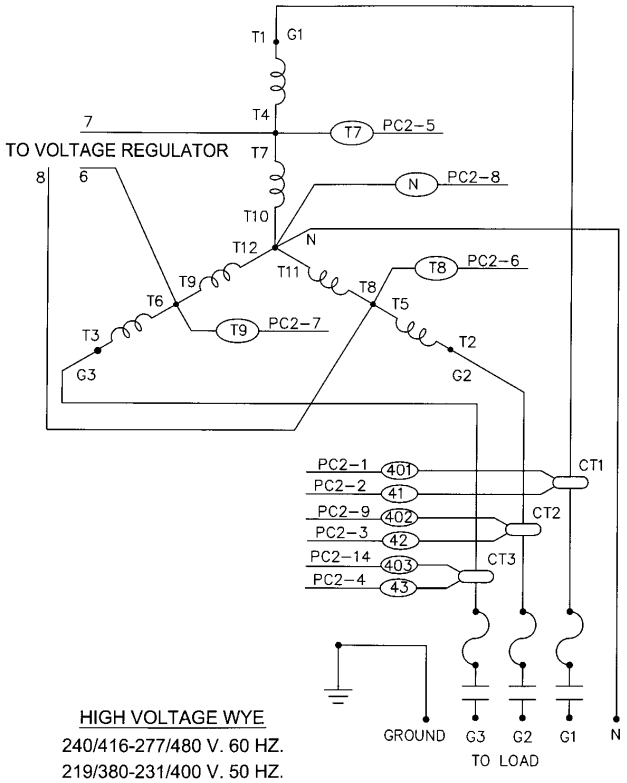
THREE PHASE - LOW WYE 120/208V



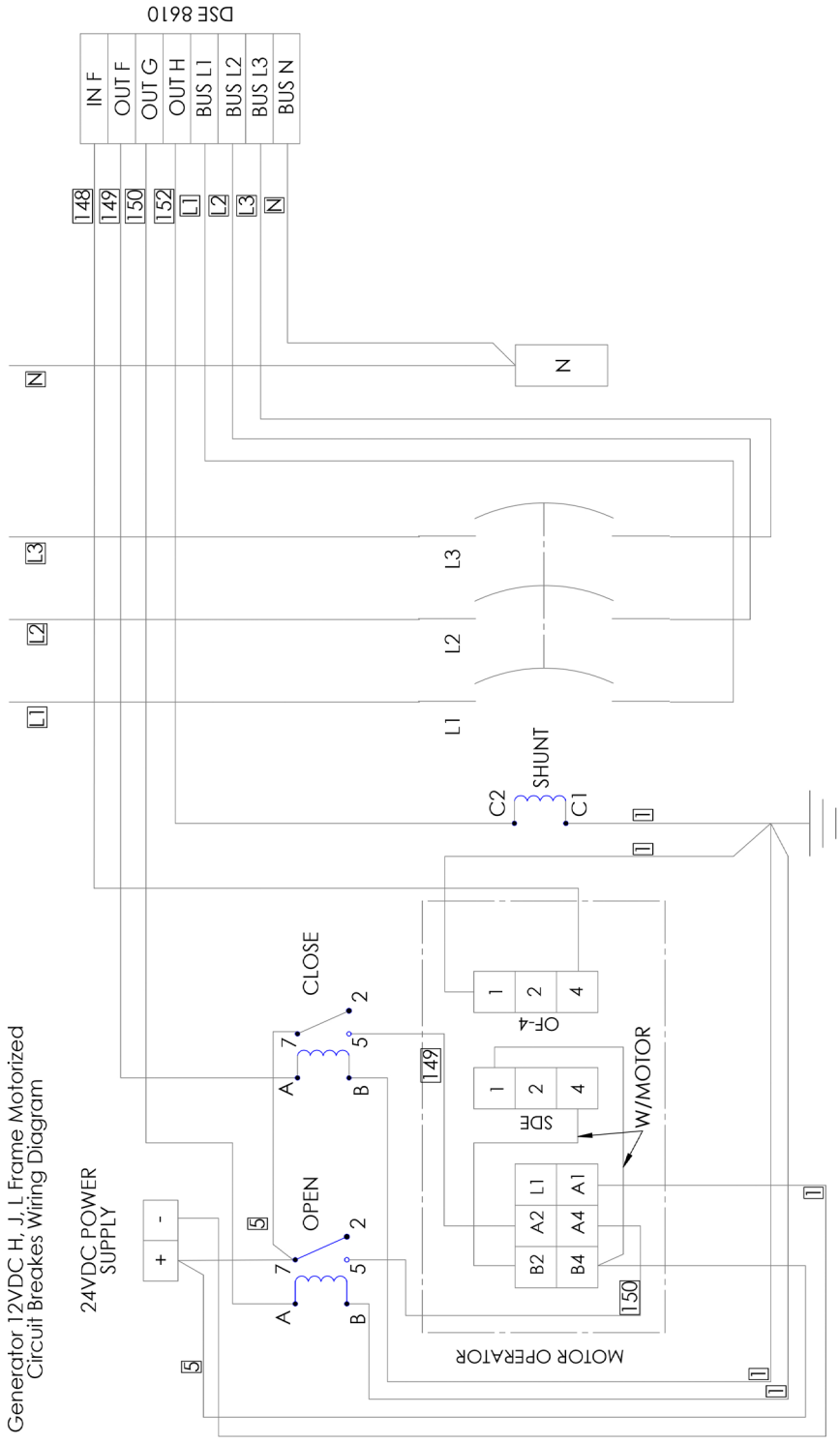
THREE PHASE DELTA 120/240V

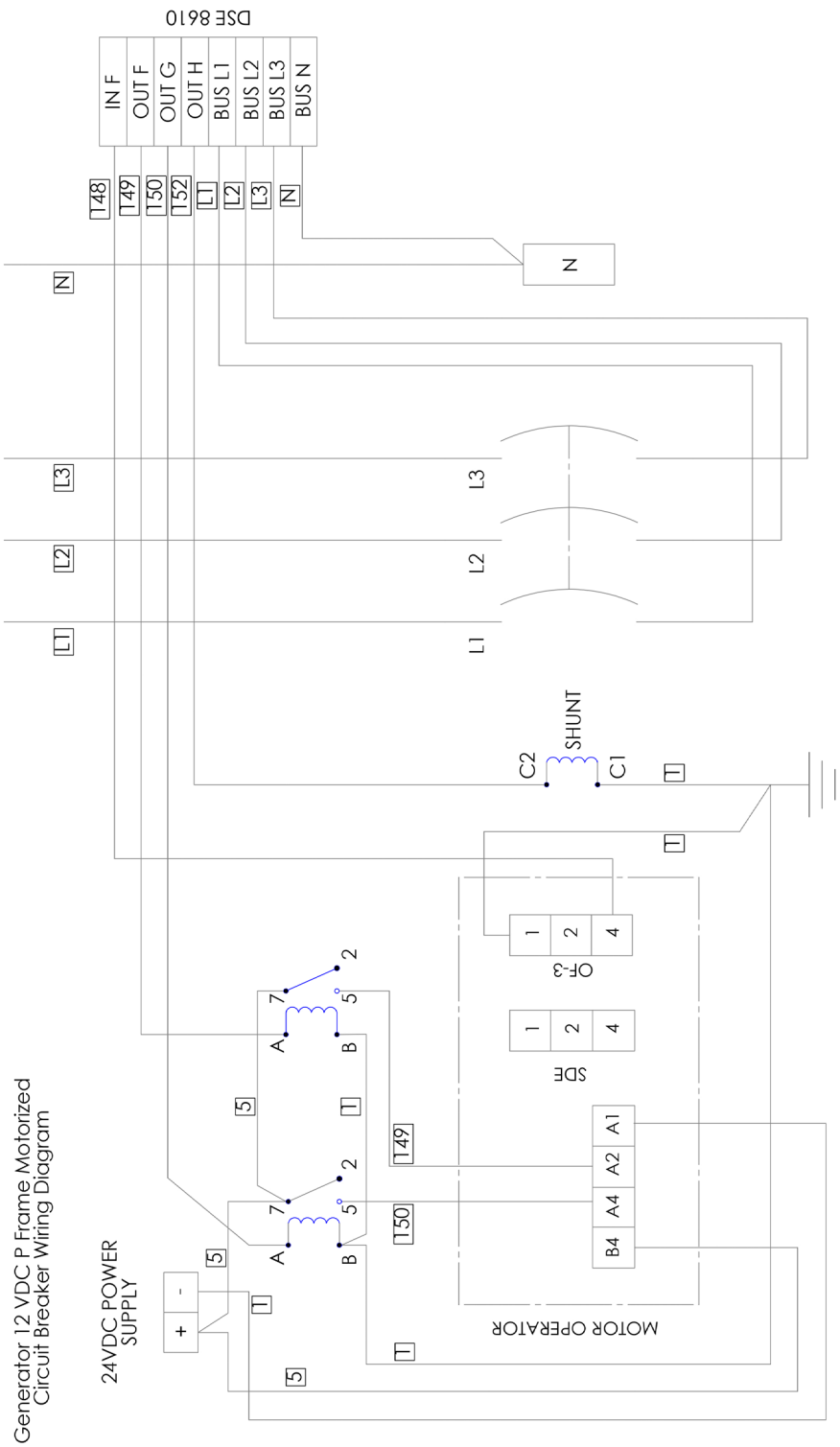


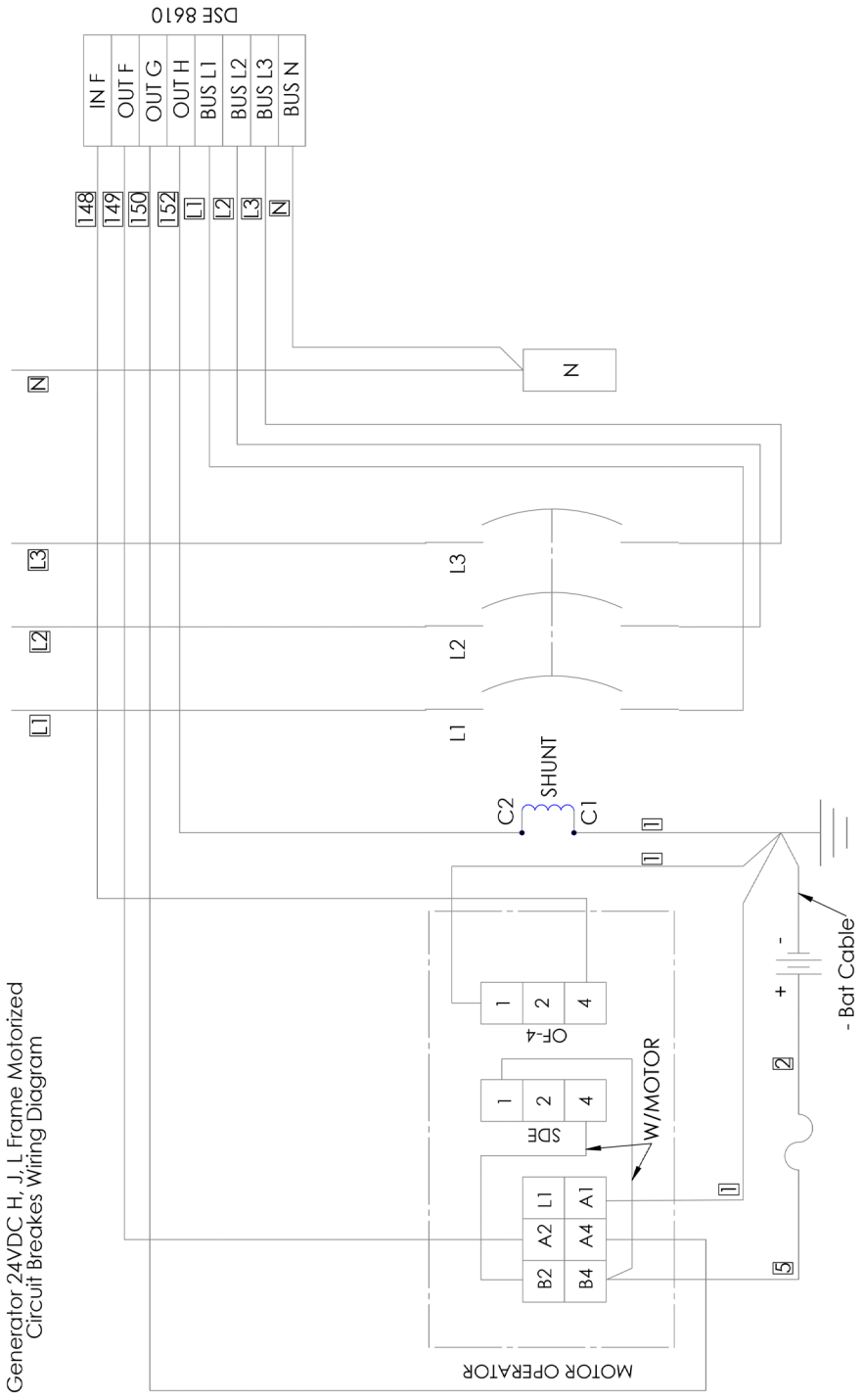
THREE PHASE - HIGH WYE 277/480V

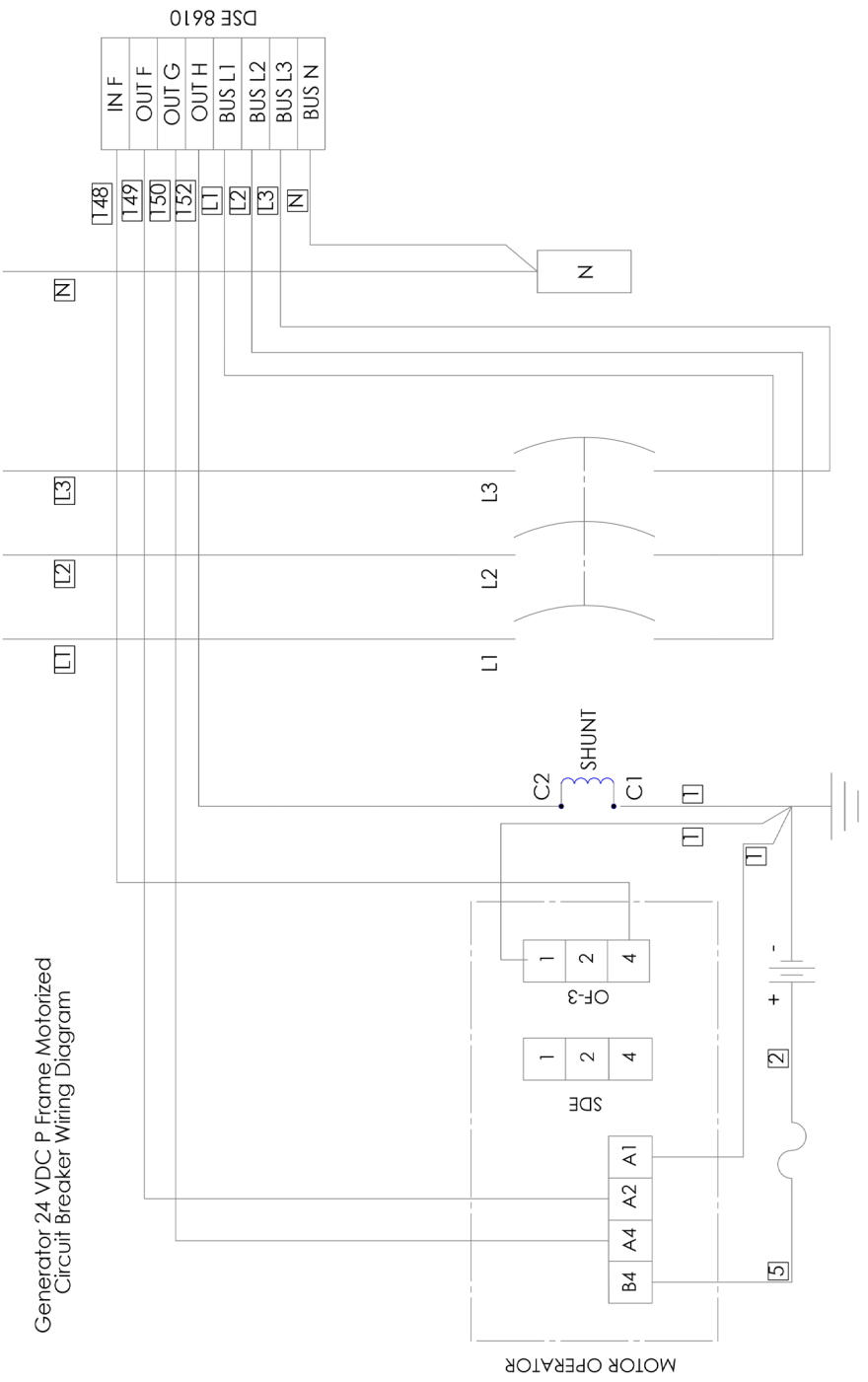


WIRING SCHEMATICS




Generator 12 VDC P Frame Motorized
Circuit Breaker Wiring Diagram
24VDC POWER
SUPPLY
+
-
MOTOR OPERATOR
A1
A2
A4
B4
SDE
OF-3
SHUNT
C2
C1
DSE 8610
IN F
OUT F
OUT G
OUT H
BUS L1
BUS L2
BUS L3
BUS N
148
149
150
152
L1
L2
L3
N
T
5
7
2
A
B


Generator 24VDC H, J, L Frame Motorized
Circuit Breakes Wiring Diagram
DSE 8610
IN F
OUT F
OUT G
OUT H
BUS L1
BUS L2
BUS L3
BUS N
148
149
150
152
L1
L2
L3
N
N
L3
L2
L1
SHUNT
C2
C1
1
1
- Bat Cable
-
+
2
5
1
W/MOTOR
$DE
OF-4
1 2 4
1 2 4
L1 A1
A2 A4
B2 B4
MOTOR OPERATOR


Generator 24 VDC P Frame Motorized
Circuit Breaker Wiring Diagram
DSE 8610
IN F
OUT F
OUT G
OUT H
BUS L1
BUS L2
BUS L3
BUS N
148
149
150
152
L1
L2
L3
N
N
L3
L2
L1
SHUNT
C2
C1
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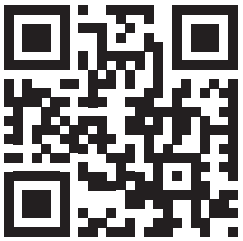
MOTOR OPERATOR



WINCO®
GENERATORS
AN AMERICAN COMPANY

225 S. CORDOVA AVE • LE CENTER, MN 56057
Sales: 507-357-6821 • sales@wincogen.com
Service: 507-357-6831 • service@wincogen.com
www.wincogen.com