General Description

The generators provide power in the event of a loss of utility service or provide power to supplement the utility. Multiple generators are paralleled together for redundancy, power requirements, efficiency or space constraints.

A typical single utility - multiple generator system consists of one switchgear line-up with a load bus and a generator paralleling bus separated by a tie breaker. During a power outage, the entire facility is transferred to generator power using breakers in the switchgear.

Available Transition Types

- Open transfer
- Closed transfer
  - Fast (under 100 msec.)
  - Soft (ramp transfer at a user adjustable kW/sec. rate)

Available Modes of Operation

- Emergency standby
- System test
- Peak shave
  - Base load mode
  - Import mode
  - Interruptible mode

Standard Features

- User definable load management
- User definable generator management
- Isochronous real (kW) load sharing
- Isochronous reactive (kVAR) load sharing

User Interface

- Complete system metering, annunciation, settings and control using touchscreen
- Electrical and mechanical metering of the generator set
- Event and alarm logging
- 15 in. touchscreen standard. Optional larger sizes are available.

Communication and Controls

- Status and metering data available via Modbus® TCP/IP
- Optional manual control, front panel metering and status indication is available.

Available UL Listings

- UL891 - Switchboard
- UL1558 - Switchgear
- UL Listed medium voltage

Modbus® is a registered trademark of Schneider Electric.
Typical Sequence of Operation

The following are typical sequences for a single utility - multiple generator system. Other sequences and derivations from these sequences are available.

Note: Any systems that parallel with the utility typically require permission and coordination with the utility.

Loss of Utility Power

When utility power is lost, the utility breaker opens and all available generators start. The first generator to reach rated speed and voltage closes to the generator paralleling bus. The generator main breaker will close based on one of the following options.

Option 1 – Emergency Power Available to Selected Loads as soon as One Generator is Online

Lower priority loads may be required to shed to prevent the first on generator from being overloaded. The remaining generators synchronize to the paralleling bus. As additional generators connect to the bus, lower priority loads are signaled to add. This option is typically used when the generators are feeding life safety loads per NEC 701.

Option 2 – Generators are Aggregated

After the first generator is online, the remaining generators synchronize to the paralleling bus. When the number of online generators reach a user adjustable setpoint (typically when enough generator capacity satisfies all the connected load), the generator main breaker closes.

Return of Utility Power

When utility power returns, a utility return timer starts. When this timer expires, the system will return to utility power. The transfer back will be one of the following methods.

Open Transfer

The load is disconnected from one source before being connected to another. The generator main breaker opens and the open transfer timer starts. When this timer expires, the utility breaker closes.

Closed Transfer

The source from which the load is being transferred and the source to which the load is being transferred are connected together. The time the two sources will be connected together will vary depending on the type of transfer desired or allowed.

Fast Transfer

The generator bus synchronizes to the utility across the utility breaker. When synchronized, the utility breaker closes and the generator main breaker opens within 100 ms of the utility breaker closing.

Soft (Ramp) Transfer

The generator bus synchronizes to the utility across the utility breaker. When synchronized, the utility breaker closes. The load is transferred from the generator back to the utility at a user-adjustable kW/sec. When the generators reach their unloaded setpoint, the generator main breaker opens.

System Test

The system can be tested with or without facility load. An optional load bank breaker can be added to the paralleling bus to enable testing of the parallel generators under load without connecting to building load.

Test without Facility Load

When the operator initiates the test, all available generators start. The first generator to reach rated speed and voltage closes to the generator paralleling bus. After the first generator is online, the remaining generators synchronize and connect to the paralleling bus. The generator main breaker remains open. If the system has a load bank breaker on the generator paralleling bus and a load bank is connected, load can be applied to the generators.

Test with Facility Load (Storm Mode)

When the operator initiates the test, all available generators start. The first generator to reach rated speed and voltage closes to the generator paralleling bus. After the first generator is online, the remaining generators synchronize and connect to the paralleling bus. When all available generators are connected to the generator paralleling bus, the transfer from utility power to generator power will be accomplished using one of the following types of transfers:
Open Transfer
The load is disconnected from one source before being connected to another. The utility breaker opens and the open transfer timer starts. When this timer expires, the utility breaker closes.

Closed Transfer
The source from which the load is being transferred and the source to which the load is being transferred are connected together. The time the two sources will be connected together will vary depending on the type of transfer desired or allowed.

Fast Transfer
The generator bus synchronizes to the utility across the generator main breaker. When synchronized, the generator main breaker closes and the utility breaker opens within 100 ms of the generator main breaker closing.

Soft (Ramp) Transfer
The generator bus synchronizes to the utility across the generator main breaker. When synchronized, the generator main breaker closes. The load is transferred from the utility to the generator at a user-adjustable kW/sec. When the utility reaches the unloaded setpoint, the utility breaker opens.

The transfer back to utility power after the test is the same as the return to utility power.

Peak Shave
Peak shaving is used to reduce your facility’s electrical power consumption during periods of high demand on the power utility. A peak shave system can remain paralleled to the utility or it can remove your facility’s loads from the utility and place them on generator power.

Base Load Mode
The generators remain paralleled to the utility producing power at a preset base load setpoint. If the base load setpoint is greater than the facility load, the extra power is exported to the utility.

When Base Load Mode is initiated, all available generators start. The first generator to reach rated speed and voltage closes to the generator paralleling bus. After the first generator is online, the remaining generators synchronize and connect to the paralleling bus. When the required number of generators are online to support the base load setpoint, the generator bus synchronizes to the utility, when synchronized, one of the generator main breakers closes and the generators ramp to the base load setpoint.

Import Mode
The generators remain paralleled to the utility producing power and maintaining a preset kW level flowing in from the utility. The generator output varies to support the load and maintain the fixed amount of power flowing in from the utility. If the load is high, the maximum generator output is limited to the high kW load limit setpoint.

When Import Load Mode is initiated, all available generators start. The first generator to reach rated speed and voltage closes to the generator paralleling bus. After the first generator is online, the remaining generators synchronize and connect to the paralleling bus. When the required number of generators are online to support the total system load minus the import level setpoint, the generator bus synchronizes to the utility, when synchronized, the generator main breaker closes and the generators ramp to maintain the import mode setpoint.

Interruptible (Isolate) Mode
The generators parallel to utility, the facility load is transferred from the utility to the generators as described in Test with Facility Load.
Standard Features

Load Management
Each load is assigned a priority level. Load management determines when priority levels are signaled to disconnect (shed) and reconnect (add). When multiple generators are online, load management matches the load to the generator capacity. The system controls feeder breakers, transfer switches or dry contacts for interface to a building management system.

Load Add
Loads can be added based on the following considerations:

- **Generator bus capacity**: Loads are added based on the kW capacity of the bus and a preset kW demand of the load.
- **Number of generators online**: Loads are added based on how many generators are connected to the bus. This is most effective in systems with the same size generators.

Load Shed
A load shed event can be triggered by:

- **Generator Failure**: Loads are shed based on the number of failed generators.
- **kW overload**: When the load on the generators reaches the overload setpoint, low-priority loads are sequentially shed until the load falls below the overload setpoint or as a block of preset loads.
- **Underfrequency**: Underfrequency is often an indication that the generators are fully loaded and cannot supply additional power to the load. When the bus frequency reaches its underfrequency setpoint, preset loads are shed.

Generator Management
Generator management optimizes the number of online generators based on the load's kW demand, starting and stopping generators as required. Generators are sequenced on in order of operator-assigned priority and taken off in reverse priority. Operator-defined setpoints determine the percent load level and time delay at which the generator will be brought on or taken offline.

Control Architecture

Standard
As a standard, every Kohler system is designed to be fully functional in the unlikely event of a touchscreen failure. If the touchscreen fails, the operator, using hardwired switches can:

- Place all automatic controls in Auto.
- Start the generators and initiate the auto synchronization process.

Option 1
This option contains all the features of the standard system and provides the ability to synchronize and parallel (load share) the generators if both the touchscreen and/or the PLC fails.

Option 2
This option contains all the features of Option 1 and provides the ability to manually synchronize the generators using hardwired speed and voltage adjust switches and the ability to parallel (load share) the generators if both the touchscreen and/or the PLC fails.
Operator Interface
With basic knowledge of paralleling switchgear, the operator can navigate the system simply and intuitively without reading a manual. The intuitive interface eliminates fear of operational errors by clearly showing “if this, then that” before a sequence is initiated.

Right Information at the Right Time
By providing pertinent information on each screen, the operator always knows the reaction to an action.

Example of Control: Generator Screen
- Used to monitor and manually control the generator.
- Contains typical controls such as the generator AUTO/OFF/RUN ONLINE/RUN OFFLINE switches and generator synchronizer control switch.
- Shows generator status and metering information.

Example of Control: Transfer to Utility Screen
- Used to monitor and manually initiate the transfer from generator power to utility power.
- Top half of screen shows power source metering and an active single-line diagram.
- Lower half of screen contains the controls and displays current status of the sequence embedded in an active flowchart of the sequence of operation.

Example of Setup: System Status
- An example of the user configuration and setup screens available.
- Allows the user to define parameters and timers used to determine a loss of utility power and set other time delays in the system.

Example of Setup: Generator Management
- Used to monitor and configure generator management mode.
- User sets all parameters associated with generator management and can enable or disable this mode of operation.
- Right side of screen graphically displays settings and current state of the system.
PD-2000 SERIES
The PD-2000 Series is UL 891 listed and allows extreme flexibility in design while providing a strong standard for safety and performance.

- Rear access standard, front access available
- Shallow depth (36-42 in.) available
- UL 489 fixed or drawout breakers for generator sets, utility and distribution
- Molded-case breakers available for distribution
- Bus ratings through 10,000 amps/150 kA withstand
- Complete selection of breaker trip options
- Complete selection of power monitoring options
- NEMA 1, NEMA 3R available

PD-3000 SERIES
Offering the highest standard in bus withstand and breaker ratings, the PD-3000 Series is UL 1558 listed. The series is designed with reliability and serviceability in mind.

- Drawout breakers standard
- UL 1066 drawout breakers for generator sets, utility and distribution
- Complies with ANSI C37.20.1
- Bus ratings through 10,000 amps/200 kA withstand
- Complete selection of breaker trip options
- Complete selection of power monitoring options
- NEMA 1, NEMA 3R available

PD-4000 SERIES
Available through 15 kV, the PD-4000 Series provides a complete solution by utilizing the strength of the digital control system combined with utility grade protective relays.

- UL MV switchgear listing through 15 kV
- Complies with ANSI metal-clad switchgear requirements
- Bus and breaker ratings through 3000 amps
- Complete selection of protective relay options, power monitoring, neutral grounding resistors and control battery systems
- NEMA 1, NEMA 3R shelter aisle available
## PD-Series Features

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<th>PD-3000</th>
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<tr>
<td>Low voltage switchboard (UL/cUL 891)</td>
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<tr>
<td>Low voltage switchgear (UL/cUL 1558)</td>
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<td>Medium voltage metal-clad switchgear (UL/cUL listed)</td>
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<td>NEMA 3R</td>
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<td>Short-circuit rating up to 200 kA</td>
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<td>Parallel up to 32 generators</td>
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<td>Customizable controls, relays and metering</td>
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