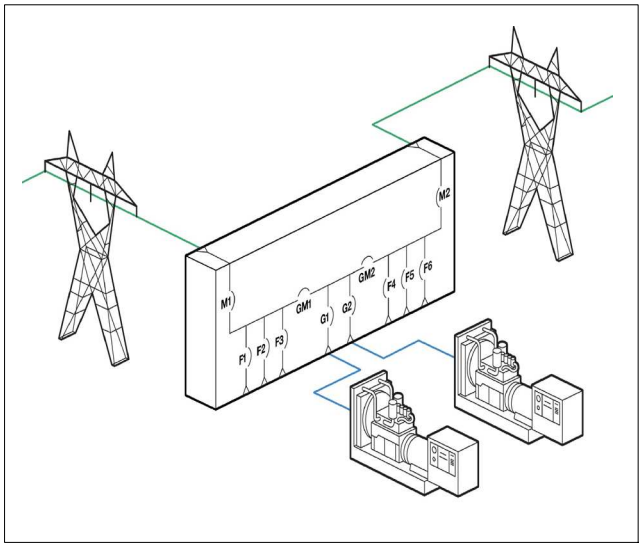
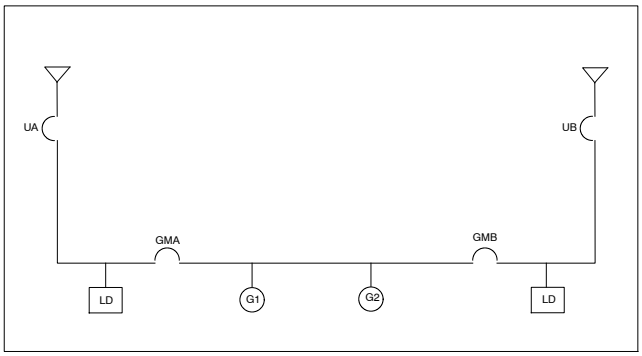
KOHLER

PD-Series

Dual Utility – Linear



Typical Dual Utility Multiple Generator System Shown with Optional Generator Bus Tie Breaker



Typical Single Line Shown without Optional Generator Bus Tie Breaker

General Description

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

A typical dual utility linear system consists of load “A” side, generator paralleling, and load “B” side separated by generator main (tie) breakers. 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

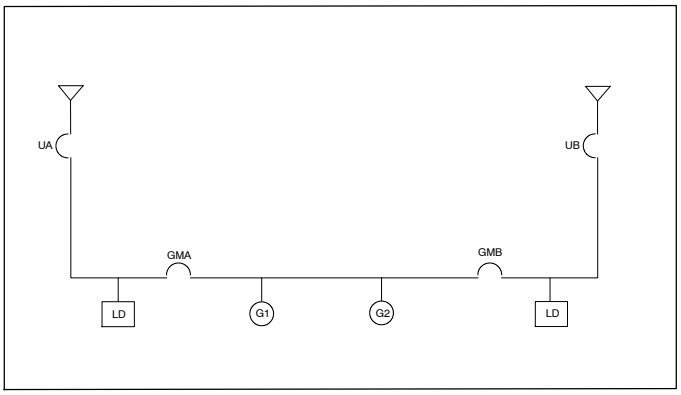
- UL891 - Switchboard
- UL1558 - Switchgear
- UL Listed medium voltage

Modbus® is a registered trademark of Schneider Electric.

Typical Sequence of Operation

The following are typical sequences for a dual utility linear 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 One Utility Only

If there is a loss of only one of the utility feeds, the system can be programmed to place that side on generator power, transfer all the loads to the remaining good utility, or transfer the entire system to generator power. The decision on how to respond to a loss of a single utility depends on:

- Do the loads on the A and B side need to see synchronized power?
- Can one utility support all the loads on the A and B side?
- Is the facility fed from two separate substations or is there one feed to the facility that is split between two utility sections?

Transfer Failed Utility Side to Generator Power (Transfer A or B Only to Generator Power)

When only one utility service fails, the utility breaker for the failed utility opens and 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 to the paralleling bus. When the number of online generators reach at user adjustable setpoint (typically when enough generator capacity satisfies all the connected load), the generator main breaker A (or B) closes feeding generator power to the loads on the failed utility bus.

Transfer Failed Utility Side to Remaining Good Utility (Transfer A+B to UA or UB)

When utility power is lost, the utility breaker opens and after an adjustable open transfer time delay expires, generator main breaker A and generator main breaker B close allowing both the A bus and B bus to be fed from the remaining good utility.

Loss of Both Utilities or Transfer Both Bus A and Bus B to Generator Power Due to a Loss of One Utility

When utility power is lost, both utility breakers open and 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 to the paralleling bus. When the number of online generators reach at user adjustable setpoint (typically when enough generator capacity satisfies all the connected load), generator main breaker A closes and a stable timer starts, when this timer expires, generator main breaker B closes supplying generator power to bus A and bus B.

Return of Utility Power – Both Bus A and Bus B on Generator 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. Generator main A breaker opens and the open transfer timer starts. When this timer expires, the utility A breaker closes. After utility A breaker is closed, generator main B breaker opens and the open transfer timer starts, when this timer expires, utility B 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 generators synchronize to utility A. When synchronized, utility A breaker closes and generator main breaker A opens within 100 ms of the utility A breaker closing. After bus A is back on utility power, the generators synchronize to utility B. When synchronized, utility B breaker closes and generator main breaker B opens within 100 ms of the utility B breaker closing.

Soft (Ramp) Transfer

The generators synchronize to utility A. When synchronized, utility A breaker closes. The load is transferred from generators back to the utility A at a user-adjustable kW/sec. When power flow across generator main A reaches its unloaded setpoint, generator main breaker A opens. After generator main breaker A is open, the generators synchronize to utility B. When synchronized, utility B breaker closes. The load is transferred from generators back to the utility B at a user-adjustable kW/sec. When power flow across generator main B reaches its unloaded setpoint, generator main breaker B opens.

After the generator main breakers are open, the generators will stop running after the cool down timer expires.

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 facility 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. Generator main breakers A and B remain 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. Utility breaker A opens and the open transfer timer starts. When this timer expires, generator main breaker A closes. After generator main A breaker is closed, utility breaker B opens and the open transfer timer starts. When this timer expires, generator main breaker B 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 generators synchronize to utility A. When synchronized, generator main A breaker closes and utility A breaker opens within 100 ms of generator main A breaker closing. After bus A generator power, the generators synchronize to utility B. When synchronized, generator main B breaker closes and utility breaker B opens within 100 ms of the generator main B breaker closing.

Soft (Ramp) Transfer

The generators synchronize to utility A. When synchronized, generator main A breaker closes. The loads on bus A are transferred from utility to generator at a user–adjustable kW/sec. When power flow across utility A breaker reaches its unloaded setpoint, utility A breaker opens. After utility breaker A is open, the generators synchronize to utility B. When synchronized, generator main B breaker closes. The loads on bus B are transferred from utility to generator at a user–adjustable kW/sec. When power flow across utility B reaches its unloaded setpoint, utility B breaker opens.

The transfer back to utility power after the test on facility load is done will be the same as return from a loss of 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. The system can only remain in parallel to one utility at a time.

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. The system can only remain in parallel to one utility at a time.

Interruptible (Isolate) Mode

The generator 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 several 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 generators 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

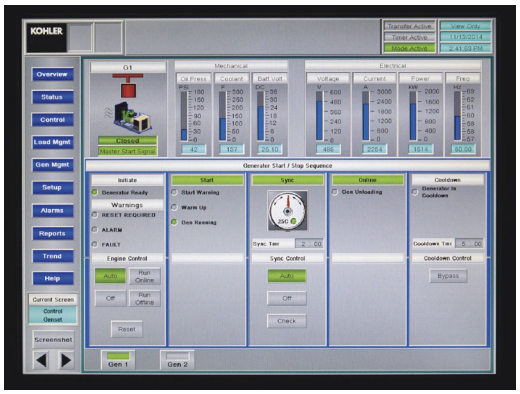
This option contains all the features of Option 1 and provides the ability to manually synchronize the generators using hardwired speed and voltage adjust switches and the ability to parallel (load share) the generators if both the touchscreen and/or the PLC fails.

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.

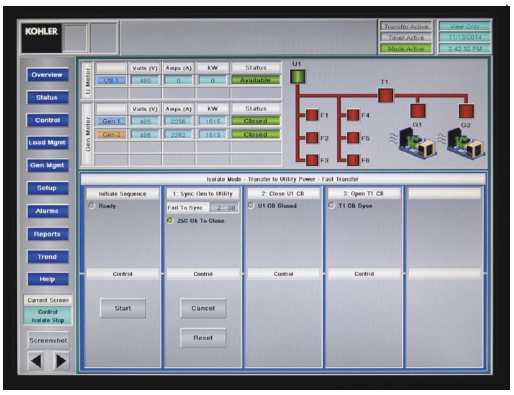
Right Information at the Right Time

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.

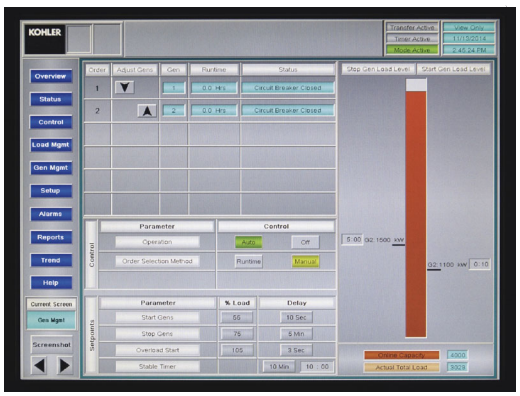


Example of Control: Transfer to Utility Screen

- 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.



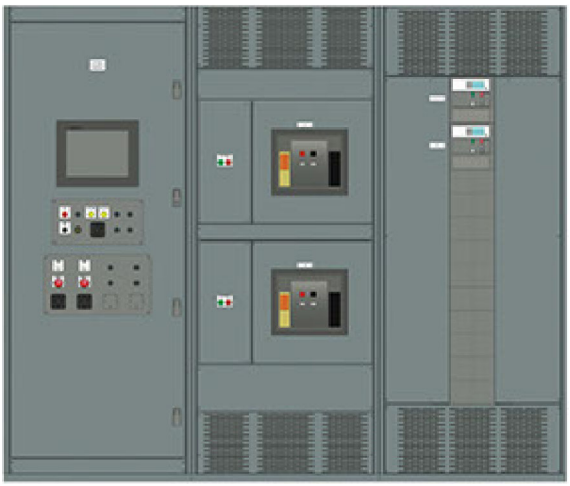
Example of Setup: Generator Management

- 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

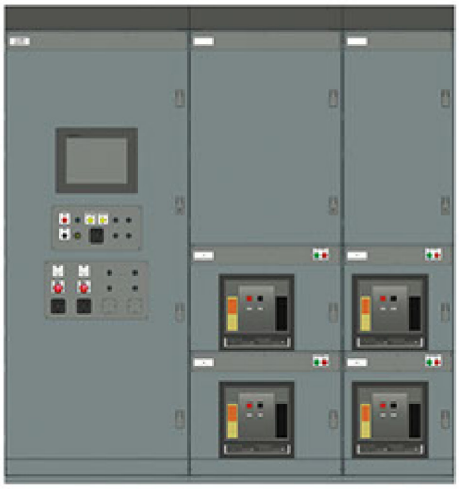


PD-2000 Series

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/ 200kA withstand
- Complete selection of breaker trip options
- Complete selection of power monitoring options
- NEMA 1, NEMA 3R available

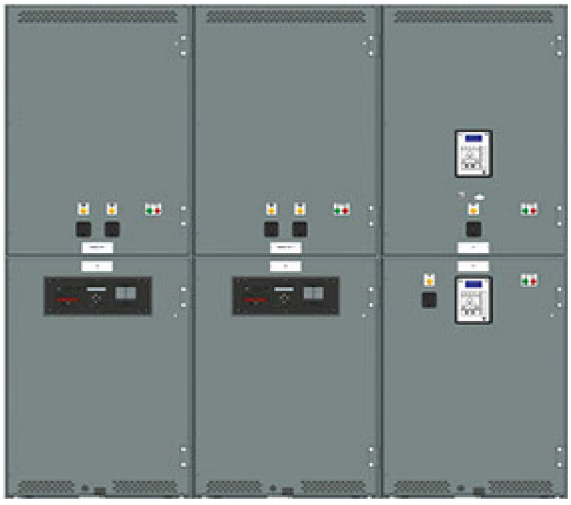


PD-3000 Series

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-4000 Series

PD-Series Features

PD-SERIES FEATURES	PD-2000	PD-3000	PD-4000
Low voltage switchboard (UL/cUL 891)	X		
Low voltage switchgear (UL/cUL 1558)		X	
Medium voltage metal-clad switchgear (UL/cUL listed)			X
NEMA 1	X	X	X
NEMA 3R	X	X	X
Short-circuit rating up to 200 kA		X	X
Short-circuit rating up to 150 kA	X		
Bus rating up to 10,000 A	X	X	
Bus rating up to 3000 A			X
Maximum voltage 600 V	X	X	
Maximum voltage 15 kV			X
60 Hz	X	X	X
50 Hz	X	X	X
Parallel up to 32 generators	X	X	X
15” color touch screen (optional touch screen sizes available)	X	X	X
Customizable controls, relays and metering	X	X	X

KOHLER

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