General Description

Integrating the operation of onsite generators, utility services, automatic transfer switches, generator controls, and distribution equipment into a fully functioning system requires the engineering expertise and dedication to quality that is Kohler paralleling switchgear.

Kohler’s PD series digital paralleling switchgear provides an industry-leading platform for command and control of multiple power sources. Designed to be integrated with Kohler generator sets or combined with other major brands of generation equipment, the PD series delivers outstanding reliability along with the most intuitive user interface in the industry.

The PD series is extremely flexible. Incorporating Kohler’s patented mode configuration technology, the owner may select from a variety of operational parameters and sequences without any additional cost. In addition to the digital control interface, the PD series may be constructed with any of the more traditional metering, control, and other component requirements based on an engineer’s or owner’s preferences (see ED options).

The PD Series paralleling controls are available in:

- PD-200: UL 891 listed and labeled switchboard
- PD-300: UL 1558 listed and labeled switchgear
- PD-400: UL listed and labeled medium voltage switchgear

Standard Features

- 15 in. color graphical user interface (touch screen), Windows® CE-based
- Digital real (kW) and reactive (kVAR) load sharing
- Digital synchronizer
- User-definable generator management
- User-definable load add/shed control
- Modbus RS485 and TCP/IP communications connections
- Internal web server
- Complete system metering, annunciation, settings, and control functions through touch screen
- Event monitoring and logging
- Power trend measurements

Available Applications

- Emergency standby
- Prime power
- Base load (peak shave)
- Import/export mode (peak shave)
- Isolate (interruptible rate)

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System Configurations

PD-200 Series

The PD-200 series product offering is UL 891 listed and allows for extreme flexibility in design while providing a strong standard for safety and performance. Features include:

- **PD series digital system control standard**
- **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**
- **Transfer switches can be mounted in switchgear lineup**
- **Bus ratings through 10,000 amps/200 kA withstand**
- **Complete selection of breaker manufacturers, trip options, and power monitoring**
- **NEMA 1, NEMA 3R walk-up and walk-in available**

PD-300 Series

Offering the highest standard in bus withstand and breaker ratings, the PD-300 series is listed under UL 1558. Featuring drawout breakers as standard, the PD-300 series is designed with reliability and serviceability in mind. Features include:

- **PD series digital system control standard**
- **UL 1066 drawout breakers for generator sets, utility, and distribution**
- **Complies with ANSI C37.20.1**
- **Bus ratings through 6,000 amps/200 kA withstand**
- **Complete selection of breaker manufacturers, trip options, and power monitoring**
- **NEMA 1, NEMA 3R walk-up and walk-in available**

Legend

- 25 Synchronizer
- 27 Undervoltage
- 28 Reverse Power
- 40 Loss of Excitation
- 52 Circuit Breaker
- 59 Overvoltage
- 81O Overfrequency
- 81U Underfrequency
- 86 Lockout Relay
- 87 Bus Differential Relay
- AF Amp Frame
- AT Amp Plug
- CT Current Transformer
- GT Generator Transformer
- PT Potential Transformer
- PLC Programmable Logic Controller
- LC Load Controller
- CT Current Transformer
- PT Potential Transformer
- CT Current Transformer
- GT Generator Transformer
- PT Potential Transformer
System Configurations, continued

PD-400 Series

Medium voltage generation applications continue to grow with distributed generation and large standby systems leading the way. Available through 26 kV, the PD-400 series utilizes the strength of the digital control system combined with utility grade protective relays for a complete system solution. Features include:

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

ED200, 300, and 400 Series

Kohler Power Systems seeks to provide the widest selection of products available in the market as well as meeting the diverse needs of our customers. With this goal in mind, we offer the ED paralleling series.

Combining the PD series controls with more traditional features, the ED series is available in all configurations. With the ED product line, the customer may choose from a wide variety of options including:

- Analog meters
- Window light annunciators
- Selector switches, pushbuttons, etc.
- Sync scope, lights on swing panel
- Hot standby/redundant PLC’s
- Woodward or similar synchronizing and load sharing components

In most cases, the ED product is designed with the same PLC logic and touch screen interface allowing system setup and monitoring while also providing the user with a more traditional interface.

Kohler’s desire to provide the owner with the system they want, rather than a standard off-the-shelf product, drives our engineers to bring ideas to the table to improve, simplify, and ensure the reliability of your system.
PD series paralleling switchgear is extremely versatile and can be configured for on the fly operational mode change. Kohler’s patented field configurable operation modes can allow the owner to select a system that will provide soft-load closed transition emergency operation today and extended parallel/peak shave in the future without significant modifications.

Typical applications for the PD series include:

**Standby**

**ATS Start**

A start signal from an automatic transfer switch or other control device starts all generator sets. The generators synchronize and connect to the paralleling bus.

**Utility Breaker Sensing**

In many systems, transfer switches are not present. When the utility fails, the utility breaker opens. The PLC logic starts the generator sets and connects them to the generator set paralleling bus. When the required number of generator sets are online, the tie breaker closes.

**Return of Utility**

After utility power is restored, the return-to-utility sequence starts. Several options are available for return of utility power.

- **ATS Transfer:** Standard, delayed transition or closed transition switches can restore the load to the utility source.
- **Circuit Breaker Transfer:** Where a system does not employ automatic transfer switches, the system breakers can effect transfer in multiple modes:
  - **Open Transfer:** The tie breaker opens and, after a time delay, the utility breaker closes.
  - **Soft Transfer:** The generator bus synchronizes to the utility. When synchronized, the utility breaker closes. The switchgear soft-unloads the generator sets and then opens the generator bus tie breaker.

**Prime Power**

A system-start signal starts all generator sets. The generator sets synchronize and connect to the generator set paralleling bus.

**Isolate (Interruptible Rate)**

A system-start signal starts all generator sets. The generator sets synchronize and connect to the generator set paralleling bus. With all generator sets online, the generator bus synchronizes to the utility and the generator bus tie breaker closes. The generator sets ramp up to assume system load. When the power flow across the utility breaker reaches a preset level, the utility breaker opens.

**Base Load Generators (Peak Shave)**

A system-start signal starts the generator sets. The generator sets synchronize and connect to the generator set paralleling bus. With all generator sets connected, the generator bus parallels to the utility and the generator bus tie breaker closes. The generator sets soft-load to a preset, user-adjustable kW level.

Generator set output remains constant and utility power fluctuates to supply the difference between the generator set output and the load requirement. When the generator set output exceeds the system load requirements, the excess power is exported to the utility.

**Import/Export (Peak Shave)**

A system-start signal starts the generator sets. The generator sets synchronize and connect to the generator paralleling bus. With all generator sets connected, the generator bus parallels to the utility and the generator bus tie breaker closes. The generator sets soft-load to a preset, user-adjustable kW power flow across the utility breaker. The power flow to the utility remains constant and the generator set power output fluctuates to meet the requirements of the load.

If the import/export level is positive, the system imports a set power level from the utility; if the import/export level is negative, the system exports a set power level to the utility.

If the load requirement exceeds the generator set rating, the generator set produces its rated power and the utility supplies the difference.
The PD series of digital switchgear incorporates a high resolution touch screen interface (HMI) to provide control and monitoring of all system parameters in one strategic location. Unlike older style switchgear that requires significant panel space for each generator set’s analog metering, annunciation, and control switches, the PD series locates components in less than one third the traditional space. This approach leads to a more reliable system through wiring and component reduction as well as a more user-friendly interface. Rather than setting system parameters through special programmers, small input screens and multiple analog devices scattered throughout the lineup, the user works from a single location for all operations.

The operator interface is configured in a user-friendly tab format with direct access to multiple levels of control and monitoring and runs in Windows® CE environment. Screen programs are held on a standard PC card that is simple to upgrade as future customer requirements develop. User programming is performed through a password-protected pop-up keypad available on all screens. Each system includes:

**System One Line Diagram**

The one line overview screen displays system status through animation, color indications, system feedback, and operating parameters. The screen includes:

**Breaker Status:** System breakers including generator paralleling, utility, distribution and tie breakers (as provided), and other customer-specified system protective devices. Color indications include open, closed, energized, deenergized, tripped, load shed active, and automatic/manual control.

**Generator Sets:** Generator running or offline, individual generator voltage, frequency, current, kilowatts, power factor, total generator bus kilowatts, and master control annunciator windows (indications/alarms).

**Utility Feeders:** In systems where the PD series is interfacing with a utility feed, the customer's utility is included in the system one line. This may be a single or multiple feeders based on the specific system layout and operational requirements. Parameters for the utility monitored include: voltage, frequency, current, kilowatts, power factor, and protective relay operation.

**System Operation:** Master control and annunciation indicators are included on the system one line screen. These are project specific and would include operational mode (such as emergency system ready, base load operation, peak shave operation, soft-load, or open transition mode selected). Major system time delays such as retransfer to utility are displayed when active and system security and operational interface control are accessed through this screen. The system features as standard: multiple level password protection, time and date stamping of events, and communications network monitoring.

Standard on all systems is a front-mounted interface portal containing a power receptacle and a CAT 5 connection. These can be used for field programming, testing, or use of a laptop as a temporary screen should there be an issue with the unit-mounted touch screen. All controls are accessible through a standard web browser such as Internet Explorer®.

Windows® is a registered trademark of Microsoft®.
Generator Control

The generator set control screen provides a graphical interface to a specific generator set’s operation. Simple and complete, the generator control screen provides a familiar environment for operators while incorporating digital benefits. The generator control screen includes:

- Generator and bus monitoring of voltage and frequency for manual paralleling
- Generator output monitoring
- Digital sync-scope and phase/voltage differential indications
- Generator control switch with five positions: automatic, run open (no load test), run closed (load test), off (cool down), shutdown
- Synchronizer control switch with three positions: automatic, check (manual paralleling), and off
- Speed and voltage adjust switches: up/down adjustments with digital indication of setting for manual paralleling
- Generator set alarms:
  - Displays pre and shutdown alarms for the generator set being monitored
  - Displays recorded alarm events for that generator
  - Includes reset switch for alarms, as well as interface monitoring for the Decision-Maker 550 engine-mounted controller for projects where that device is used

The user may move from one generator to another through the push of a single button.

Generator Monitoring

Detailed electrical and mechanical data for each generator is gathered on this screen. When paired with the 550 engine-mounted controller, over 400 points are available for each engine generator should the customer desire extended data. Standard information is represented in bar graph and digital readouts and includes:

- Generator Electrical: voltage (3-phase), frequency, kilowatts, current (3-phase), power factor
- Generator Mechanical: water temperature, oil pressure, engine speed, battery voltage
- General Information: number of starts, running time, percentage loaded, sync-scope, sync-lights and voltage/phase indications, sync-active indication, generator pre and shutdown alarms

The bar graph displays are color coded to indicate normal operation and pre and shutdown values, with these values displayed for customer monitoring. Analog meter representations are also available at the press of a button.
Generator Management

A standard feature of the PD series, generator management allows the system to decide the appropriate number of generators required to feed the load. With user-definable parameters, this management system can be configured to:

- Start the required number of generators for certain operations
- Run the generators in available mode for a preset period of time
- Optimize the number of running generators, shutting down those that are not required
- Bring additional capacity online based on load requirements

The system will then monitor total installation requirements and automatically bring generators online and offline as needed.

Load Management

Another standard feature of the PD series, and one that is often overlooked in specifications, is load management/load shedding. A multiple generator system must have the ability to add and remove loads depending on available generators and system requirements. The digital interface allows the user to select not only which loads are grouped into priorities (normally priorities 1 through 4) but when to bring them online after system start, when to remove those loads, and how to choose these actions through the number of generators available, operational mode, and generator monitoring of under frequency or kilowatt demand.

Event Log

Each PD-series product provides monitoring of system events including alarms, operation, and system-setting changes. A minimum of 500 events are logged and date/time stamped providing the user and service personnel with valuable information.
Communications

Each PD system is constructed with an integrated web server allowing remote monitoring and control through any ethernet network. The PD network is integrated with the generator-mounted controllers, transfer switches, and other devices to provide the owner with remote data, monitoring, and control of his entire power system without the need for expensive custom software packages. The system screens may be viewed through any major web browser and are identical to those featured on the system touch screens.

Modbus® is Kohler’s standard protocol providing the industries’ widest selection of compatible components as well as an open protocol for integration into existing systems.

Modbus® is utilized between generator sets, transfer switches, and other devices to monitor and control the system. Internal to the switchgear, Modbus® Plus is used to gain speed on the inter-PLC data network. A Modbus® port is available for external communications.

Additional Features

All Kohler paralleling switchgear is designed specifically for your project. Thousands of additional features and components can be incorporated. A sampling of those available are:

Controls:
- Power quality metering
- Transfer switch control screens
- SCADA systems

Low Voltage:
- Integrated breaker metering networks
- Insulated bus, isolated bus
- Seismic zone 4 construction

Medium Voltage:
- Distribution or station class lightning arrestors
- Station battery systems

Structure:
- Special environmental requirements for location, temperature, and humidity
- Complete walk-in switchgear houses with HVAC

Kohler’s strength is the ability to design a complete, integrated system for your installation. Working with the engineer, contractor, and owner, the project team will be with you from concept to acceptance to ensure a smooth installation and, teamed with our distributors, to provide future service on the complete system.

Modbus® is a registered trademark of Schneider Electric.

Availability is subject to change without notice. Kohler Co. reserves the right to change the design or specifications without notice and without any obligation or liability whatsoever. Contact your local Kohler® generator set distributor for availability.