

**APM402****Kohler® APM402 Controller****General Description and Function**

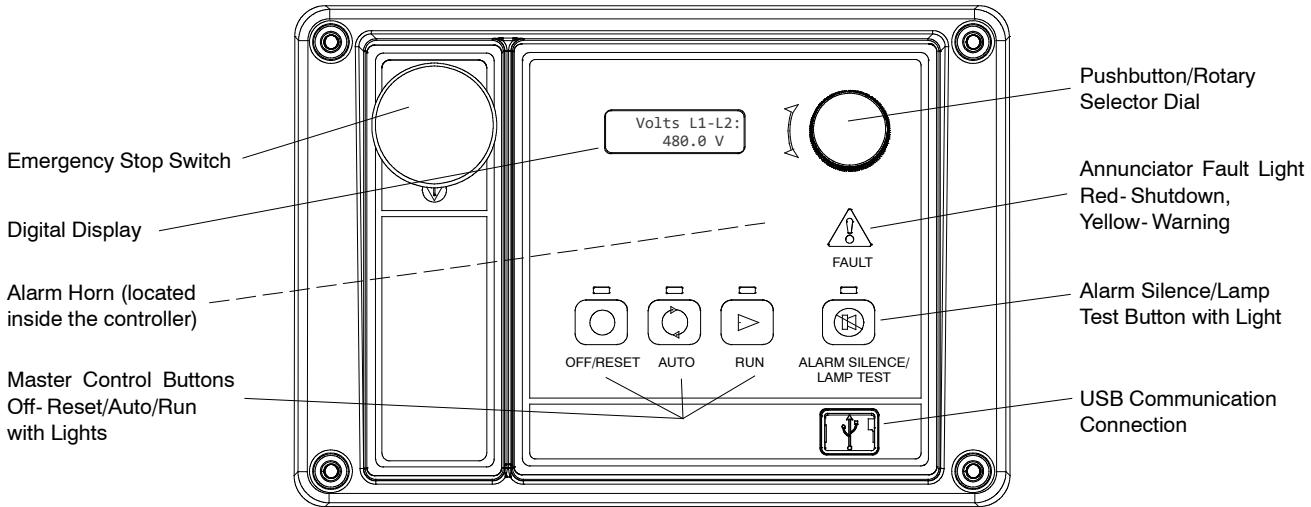
The APM402 generator set controller provides advanced control, system monitoring, and system diagnostics for optimum performance.

The APM402 controller meets NFPA 110, Level 1 when equipped with the necessary accessories and installed per NFPA standards.

The APM402 controller uses a patented hybrid voltage regulator and unique software logic to manage alternator thermal overload protection features normally requiring additional hardware. Additional features include:

- A digital display and pushbutton/rotary selector dial provide easy local access to data.
- Measurements selectable in metric or English units.
- The controller can communicate directly with a personal computer via a network or serial configuration using SiteTech™ or Monitor III software.
- The controller supports Modbus® protocol. Use with serial bus or Ethernet networks. (Ethernet requires an external Modbus®/Ethernet converter module.)
- Scrolling display shows critical data at a glance.
- Digital display of power metering (kW and kVA).
- Integrated hybrid voltage regulator providing  $\pm 0.5\%$  regulation.
- Built-in alternator thermal overload protection.

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## User Interface Controls and Components

- Emergency stop switch
- Backlit LCD digital display with two lines of 12 characters (see *User Interface Displays for menus*)
- Alarm horn indicates generator set shutdown and warning faults
- Environmentally sealed membrane keypad with three master control buttons with lights
  - Off/Reset (red)
  - Auto (green)
  - Run (yellow)
- Pushbutton/rotary selector dial for menu navigation
  - Rotate dial to access main menus
  - Push dial and rotate to access sub menus
  - Press dial for 3 seconds to return to top of main menu
- Announcer fault light
  - System shutdown (red)
  - System warning (yellow)
- Alarm silence/lamp test button
  - Alarm silence
  - Lamp test
- USB and RS-485 connections
  - Allows software upgrades
  - Provides access for diagnostics
  - PC communication using SiteTech™ or Monitor III software
- Dedicated user inputs
  - Remote emergency stop switch
  - Remote 2-wire start for transfer switch
  - Auxiliary shutdown
- Integrated hybrid voltage regulator
- Auto-resettable circuit protection mounted on circuit board.
- One relay output standard. Optional five relay output available.
- One analog and three digital inputs standard. Optional two inputs available.

## NFPA 110 Requirements

In order to meet NFPA 110, Level 1 requirements, the generator set controller monitors the engine/generator functions/faults shown below.

- Engine functions:
  - Overcrank
  - Low coolant temperature warning
  - High coolant temperature warning
  - High coolant temperature shutdown
  - Low oil pressure shutdown
  - Low oil pressure warning
  - High engine speed
  - Low fuel (level or pressure) \*
  - Low coolant level
  - EPS supplying load
  - High battery voltage
  - Low battery voltage
- General functions:
  - Master switch not in auto
  - Battery charger fault \*
  - Lamp test
  - Contacts for local and remote common alarm
  - Audible alarm silence button
  - Remote emergency stop \*

\* Function requires optional input sensors or kits and is engine dependent, see Controller Displays as Provided by the Engine ECM.

## User Interface Displays

The listing below has • denoting main menus and ◦ denoting sub-menus.

- Overview
  - Software version
  - Active shutdowns and warnings (if any are present)
  - Engine run time, total hours
  - Average voltage line-to-line
  - Frequency
  - Average current
  - Coolant temperature
  - Fuel level or pressure \*
  - Oil pressure
  - Battery voltage
- Engine Metering
  - Engine speed
  - Oil pressure
  - Coolant temperature
  - Battery voltage
- Generator Metering
  - Total power, VA
  - Total power, W
  - Rated power, %
  - Voltage, L-L and L-N for all phases
  - Current, L1, L2, L3
  - Frequency
- GenSet Information
  - Generator set model number
  - Generator set serial number
  - Controller serial number
- GenSet Run Time
  - Engine run time, total hours
  - Engine loaded, hours
  - Number of engine starts
  - Total energy, kWh
- GenSet System
  - System voltage
  - System frequency, 50 or 60 Hz
  - System phase, single or three (wye or delta)
  - Power rating, kW
  - Amp rating
  - Power type, standby or prime
  - Measurement units, metric or English (user selectable)
  - Alarm silence, always or auto only (NFPA 110)
  - Manual speed adjust \*
- GenSet Calibration
  - Voltage, L-L and L-N for all phases
  - Current, L1, L2, L3
  - Reset calibration
- Voltage Regulation
  - Adjust voltage, ±10%
- Digital Inputs
  - Input settings and status
- Digital Outputs
  - Output settings and status
- Analog Inputs
  - Input settings and status
- Event Log
  - Event history (stores up to 1000 system events)
- Selector Switch (requires initial activation by SiteTech™)

## Controller Features

- **AC Output Voltage Regulator Adjustment.** The voltage adjustment provides a maximum of  $\pm 10\%$  of the system voltage.
- **Alarm Silence.** The controller can be set up to silence the alarm horn only when in the AUTO mode for NFPA-110 application or Always for user convenience.
- **Alternator Protection.** The controller provides generator set overload and short circuit protection matched to each alternator for the particular voltage/phase configuration.
- **Automatic Restart.** The controller automatic restart feature initiates the start routine and recrank after a failed start attempt.
- **Common Failure Relay.** This relay is integrated on the controller circuit board. Contacts are rated 2 amps at 32 VDC or 0.5 amp at 120 VAC.
- **Communication.** Controller communication is available.
- **Cyclic Cranking.** The controller has programmable cyclic cranking.
- **ECM Diagnostics.** The controller displays engine ECM fault code descriptions to help in engine troubleshooting.
- **Engine Start Aid.** The starting aid feature provides control for an optional engine starting aid.
- **Event Logging.** The controller keeps a record (up to 1000 entries) for warning and shutdown faults. This fault information becomes a stored record of system events and can be reset.
- **Historical Data Logging.** Total number of generator set successful starts is recorded and displayed.
- **Integrated Hybrid Voltage Regulator.** The voltage regulator provides  $\pm 0.5\%$  no-load to full-load regulation with three-phase sensing.
- **Lamp Test.** Press the alarm silence/lamp test button to verify functionality of the indicator lights.
- **LCD Display.** Adjustable contrast for improving visibility.
- **Measurement Units.** The controller provides selection of English or metric displays.
- **Power Metering.** Controller digital display provides kW and kVA.
- **Programming Access (USB).** Provides software upgrades and diagnostics.
- **Remote Reset.** The remote reset function resets faults and allows restarting of the generator set without going to the master control switch off/reset position.
- **Remote Monitoring Panel.** The controller is compatible with the Kohler® Remote Serial Annunciator.
- **Run Time Hourmeter.** The generator set run time is displayed.
- **Time Delay Engine Cooldown (TDEC).** The TDEC provides a time delay before the generator set shuts down.
- **Time Delay Engine Start (TDES).** The TDES provides a time delay before the generator set starts.
- **Voltage Selection Menu.** This menu provides the capability of quickly switching controller voltage calibrations. Requires initial activation using SiteTech™ software. **NOTE:** Generator set output leads require voltage reconnection.

## Controller Functions

The following chart shows which functions cause a warning or shutdown. All functions are available as relay outputs.

**Warning** causes the fault light to show yellow and sounds the alarm horn signaling an impending problem.

**Shutdown** causes the fault light to show red, sounds the alarm horn, and stops the generator set.

	Warning Function	Shutdown Function
<b>Engine Functions</b>		
Critically high fuel level *	○	
ECM communication loss		●
ECM diagnostics	●	●
Engine over speed		●†
Engine start aid active		
Engine under speed		●
Fuel tank leak *	○	○
High battery voltage	●	
High coolant temperature	●	●†
High fuel level *	○	
Low battery voltage	●	
Low coolant level		●
Low coolant temperature	●	
Low cranking voltage	●	
Low engine oil level *	○	○
Low fuel level (diesel models) *	○	○
Low fuel pressure (gas models) *	○	
Low oil pressure	●	●†
No coolant temperature signal		●
No oil pressure signal		●
Overcrank		●†
Speed sensor fault	●	
<b>General Functions</b>		
Alarm horn silenced		
Analog inputs	○	○
Battery charger fault *	●	
Chicago code active *		
Common fault (includes †)		●
Common warning	●	
Digital inputs	○	○
Emergency stop		●†
Engine cooldown (delay) active		
Engine start delay active		
Engine started		
Engine stopped		
EPS supplying load		
Generator running		
Input/output communication loss	●	
Internal failure		●
Master switch not in auto	●	
NFPA 110 alarm active		
Remote start		
System ready		
<b>Generator Functions</b>		
AC sensing loss	●	●
Alternator protection		●
Ground fault input *	●	
kW overload		●
Locked rotor		●
Overfrequency		●
Oversupply (each phase)		●
Underfrequency		●
Undervoltage (each phase)		●

● Standard function

○ Available user function

\* Function requires optional input sensors or kits and is engine dependent; see Controller Displays as Provided by the Engine ECM.

† Items included with common fault shutdown



KOHLER CO., Kohler, Wisconsin 53044 USA  
Phone 920-457-4441, Fax 920-459-1646  
For the nearest sales and service outlet in the  
US and Canada, phone 1-800-544-2444  
KOHLERPower.com

Controller Displays as Provided by the Engine ECM	Engine Manufacturer (and Model)						
	Kohler Diesel (KDI M, TM*)	Kohler Diesel (KDI TCR)	Kohler Gas (KG2204, KG2204T)	Kohler Gas (KG6208, KG6208T, KG10V08, KG10V08T)	GM and PSI/Doosan	John Deere	Volvo
Intake air pressure							D
Intake air Temperature		D		D	D	D	D
Coolant level			D	D	D	D	D
Coolant temperature		D	C/S/D	C/S/D	C/S/D	C/S/D	C/S/D
Crankcase pressure							D
ECM battery voltage	S		S/D	S	S		
Engine speed	C/S/D	C/S/D	C/S/D	C/S/D	C/S/D	C/S/D	C/S/D
Fuel pressure		D		C/S/D	C/S/D	C/S <sup>†</sup>	C/S/D
Fuel temperature		D				S/D	S
Oil level				S <sup>†</sup>	S <sup>†</sup>	S <sup>†</sup>	S <sup>†</sup>
Oil pressure		C/S/D	D	C/S/D	C/S/D	C/S/D	C/S/D
Oil temperature			S				SD

C = Value displayed on controller, S = Value displayed in Site Tech, D = ECU diagnostic is supported

\* Electronic governor and ECM are optional on KDI M and TM engines.

† Controller uses local analog input to obtain this information.

**Note:** REOZMD/ROZMC (Mitsubishi engines) have an ECM but do not send signals to the generator set controller.

**Note:** See the generator set specification sheet for engine model identification.

## Controller Specifications

- Power source with circuit protection: 12- or 24-volt DC
- Power drain: 200 millamps at 12 VDC or 100 millamps at 24 VDC
- Humidity range: 5% to 95% noncondensing
- Operating temperature range: -40°C to +70°C (-40°F to +158°F)
- Storage temperature range: -40°C to +85°C (-40°F to +185°F)
- Standards:
  - CE Directive
  - NFPA 99
  - NFPA 110, Level 1
  - CSA 282-09
  - UL 508
  - ASTM B117 (salt spray test)
- Panel dimensions—W x H, 229 x 160 mm (9.0 x 6.3 in.)

## Communication and PC Software Available Options

Refer to G6-76 Monitor III Software and the communication literature for additional communication and PC software information including Modbus® communication.

- Monitor III Software for Monitoring and Control (Windows®-based user interface)**
- Converter, Modbus®/Ethernet.** Supports a power system using controllers accessed via the Ethernet. Converter is supplied with an IP address by the site administrator. Refer to G6-79 for converter details.
- Converter, RS-232/RS-485.** Supports a power system using controllers accessed via a serial (RS-232) connection.

## APM402 Available Options

- Float/Equalize Battery Charger** available with 6 or 10 amp output for 12 or 24V DC voltage output. The 10 amp model provides NFPA 110 charging and alarming capability.
- Manual Speed Adjust** available for applications using closed transition ATS. Adjustment range for 60 Hz: 1751-1849 rpm (58.2-61.8 Hz) and for 50 Hz: 1451-1549 rpm (48.2-51.8 Hz).
- Prime Power Switch** prevents battery drain during generator set non-operation periods and when the generator set battery cannot be maintained by an AC battery charger.
- Remote Emergency Stop Switch** available as a wall mounted panel to remotely shut down the generator set.
- Remote Monitoring Panel.** The Kohler® Remote Serial Announcer (RSA) enables the operator to monitor the status of the generator set from a remote location, which may be required for NFPA 99 and NFPA 110 installations, and up to four Automatic transfer switches.
- Run Relay** provides a relay indicating that the generator set is running.
- Shunt Trip Wiring** provides relay outputs to trip a shunt trip circuit breaker and to signal the common fault shutdowns. Contacts rated at 10 amps at 28 VDC or 120 VAC.
- Two Input/Five Output Module** provides a generator set mounted panel with two inputs and five relay outputs.

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