POWER-GATE INSTALLATION INSTRUCTIONS
RB-Series Bi-Directional Relay, GEN 4.1 Large Package, v6

Congratulations on your POWER-GATE purchase! POWER-GATE is designed to provide years of trouble-free operation. Please read the instructions in their entirety prior to undertaking installation. Like any work performed around batteries, electrical circuits, vehicles, and moving parts, exercise caution to insure safe installation and use. If you are not familiar with batteries, electrical circuits, or basic auto/marine-electrical architecture, seek the assistance of a professional installer. Failure to install POWER-GATE correctly may cause poor performance, premature product failure, personal injury, or possibly damage to the vehicle or vehicle accessories.

***The manufacturer is not responsible for damage incurred due to improper installation*.**

PRE-INSTALLATION

PACKING LIST:

- POWER-GATE Relay
- Vinyl Post insulators (2)
- Nuts, 7/16 - 14 (2)
- Brass washers, (2)
- Ground ring terminal
- Installation sheet
- Control cable assembly (if needed)

WHAT YOU WILL NEED:

- Copper lugs for cable terminations
- Digital multi-meter
- 1/4 inch nut driver
- 7/16 inch nut driver or wrench (spanner)
- 7/16 inch torque wrench
- 16-20 AWG black wire for ground extension
- Wire stripper
- Lug crimper
- Soldering torch, solder, and flux

MOUNTING: Mount module on a flat surface. Failure to do so may cause "twisting" of the internal assembly and lead to mechanical breakdown.

CONNECTING LUGS TO CABLES

POWER-GATE™ is engineered to transfer electricity at peak performance levels approaching 99.9%. Unfortunately, most installers often overlook electrical joints between cables, lugs, and battery terminals. POWER-GATE™ is one part of a complete electrical *system*; cables and connection points require just as much attention as the connections to POWER-GATE™ itself.

- Cables should be flexible, free of oxidation, and coated with neoprene or some sort of insulation
- Cable cross-section should be appropriately sized for the distance and peak current being transferred.
- Lugs made of copper or silver-plated copper are good conductors.

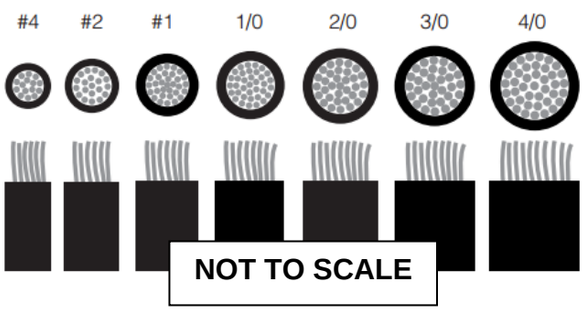
Creating a good joint between cables and connectors insures efficient transfer of electricity. Lugs should be soldered to cables; hand crimping *does not* provide enough compression for a good joint. To properly connect cable to lug:

1. Strip cable's insulation material exposing copper strands of cable.
2. "Tin" copper strands by first covering with solder flux. Heat copper strands with torch until solder melts into copper strands. The goal is to pre-saturate or solder-pot the copper strands with solder.
3. Insert solder slugs into lug barrel followed by tinned cable.
4. Use torch to heat lug and cable. When the solder slugs melt, molten solder from tinned cable and solder slugs will combine while inserting cable into lug.
5. Remove heat and allow lug and cable to cool.
6. Once cool, use heat shrink wrap or electrical tape to create moisture barrier between cable insulation and lug.

This method should produce a sound electrical joint. Later, use a digital multimeter to insure connection is efficient at elevated current.

CONNECTING CABLES TO POWER-GATE™

POWER-GATE™ does not use cooling fins commonly present on high-current switches. It is critical that cable connections to brass posts provide optimum surface area contact for two reasons: proper cooling and proper current conductivity.



Nut

Washer

Lug

Brass Flange

CRITICAL TORQUE VALUE

It is critical that a calibrated torque wrench is utilized when attaching nylon insert nuts to brass posts. Improper under-torque may cause unnecessary electrical resistance while improper over-torque may spin the brass assembly internally or possibly break off the brass post.

Use 15 Newton-meters on the 2 primary connection posts.

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It is critical that a calibrated torque wrench is utilized when attaching nylon insert nuts to brass posts. Improper under-torque may cause unnecessary electrical resistance while improper over-torque may spin the brass assembly internally or possibly break off the brass post.

Use 5 foot-pounds on the 2 primary connection posts.

INSTALLATION INSTRUCTIONS

Step 1 With engine off, remove all wires and cables from negative terminal of all batteries.

Step 2 Select desired location for POWER-GATE Relay; keep the following points in mind:

- Distance to the load (s) and battery.
- Easy access to POWER-GATE
- Footprint doesn't conflict with other wires, cables, reservoirs, rotating parts etc…
- Adequate distance from high-heat sources like exhaust manifold

Step 3 **Mount device on a flat surface** using the four mounting holes being careful not to exceed 5 foot-pounds of torque and appropriate hardware for your given installation. **Uneven twisting or torsional stress may cause damage to the internal electronics assembly.**

Step 4 Connect POWER-GATE ground wire (source negative) to good electrical ground (ex. battery negative terminal) **before proceeding to Step 5**.
Never remove relay ground from battery ground unless the battery is disconnected or device damage will occur.

Step 5 Connect cable(s) to POWER-GATE "Terminal 1." and "Terminal 2" as shown in the diagram and insulate appropriately. Torque nylon insert nut to 15 newton-meters

Step 6 Control or activation voltage is connected to pin 6 (Orange) of the control harness. Connect control cable assembly as shown in diagram and insulate appropriately.

If device is Autonomous, then disregard.

Step 7 If your device is configured with autonomous operation, it is designed to respond to system voltage automatically and is fitted with an **"on/off unit reset"** button which must be depressed to activate the device.

Step 8 **BEFORE RECONNECTING BATTERIES**, verify that your installation matches the diagram.

Step 9 Restore ground connections on battery.

HOW POWER-GATE™ FUNCTIONS

The POWER-GATE™ Module is an extremely efficient electrical switch.
When activated, it conducts more efficiently than the cables attached to it. Its operation is similar to other relays, but with three MAJOR differences: The contact voltage drop is extremely low and MOST importantly remains low with continued operation; the energy required to activate the relay is extremely low….less than 1% of most solenoid switches and electrical relays, and there is no arc when the switch opens or closes.

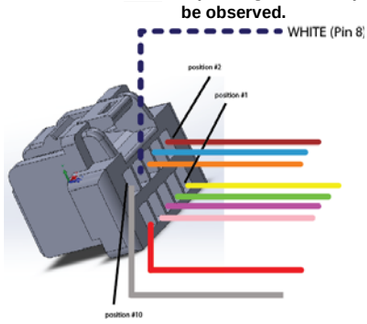
The GREEN *POWER OK LED* and will illuminate when the supply voltage is present.

The GREEN Relay *ON/OFF Status LED* will illuminate when the relay is closed. When the relay is closed, the MOSFET array is enhanced and current will flow between Terminals 1 and 2.

The RED *Fault LED* will illuminate when a fault condition is detected (over-voltage, under-voltage, over-current, short-circuit, and/or over-temperature).

The chart below illustrates how to use the diagnostic LEDS to determine relay state.

Note: depending on device programming, not all features and/or states may be observed.



Connector housing: Molex 503149-1000
Crimp Terminal: 502579-0100
Wires: 26 AWG, UL style 1007/1569
2 meter length
Wire-side to be cut, no stripping or tinning required

Pinout:

1 - not used	(Yellow)
2 - Override Trigger -	(Brown)
3 - Array On/Off Status	(Green)
4 - Override Trigger +	(Blue)
5 - Power OK	(Violet)
6 - Main Trigger +	(Orange)
7 - not used	(Pink)
8 - not used	(White)
9 - Fault	(Red)
10 - not used	(Grey)

All status lines are active-low and should be voltage-/current-limited to 36 V.

HARNESS EXPLANATION

Standard harness denoted.
For Specification Code Harness, see attached harness document.

Pins two and four (Brown and Blue) are used for device override functionality, if override functionality is programmed.

Pins three, five and nine are external status wires (LEDS, lamps, buzzer, external equipment interfacing, etc....)

ENABLE / RESET SWITCH

If necessary, your device is fitted with an Autonomous ON/OFF Unit Safety Switch. The device should be "enabled" only ***after*** installation is complete. If the device shuts down due to an over-current or short-circuit condition, ***after the condition is corrected***, the device may be reset by depressing the switch. When troubleshooting an over-current or short-circuit condition, always power-off the device.

OVERRIDE TRIGGER

During under-voltage and over-voltage conditions, the override trigger will force the relay closed. Attach any SPST switch between pins 2 and 4 on the control harness to utilize override trigger. The override trigger will NOT close the relay under the following conditions:

1. Over-current , short-circuit, or over-temperature fault conditions are present
2. Primary relay trigger is open
3. Override is not programmed for your device

POWER-GATE RELAY (GENERATION 4) DIAGNOSTIC TABLE

(some operating modes might not be applicable to your device)

OPERATING MODE	MAIN TRIGGER STATE	OVERRIDE TRIGGER STATE	UNDER- OR OVER-VOLTAGE PRESENT?	OVER-CURRENT, SHORT-CIRCUIT, OR CIRCUIT-BREAK PRESENT?	OVER-TEMPERATURE PRESENT?	RELAY STATE	POWER OK LED[1]	ON/OFF STATUS LED	FAULT LED
Normal On	Active	X	No	No	No	Closed	Steady on	Steady on	Steady off
Normal Off	Not active	X	No	No	No	Open	Steady on	Steady off	Steady off
Under- or Over-Voltage Fault	Not active	X	Yes	No	No	Open	Steady on	Steady off	Steady on
	X	Not active	Yes	No	No	Open	Steady on	Steady off	Steady on
	Active	Active	Yes	No	No	Closed	Steady on	Steady on	Steady on
Over-Current, Short-Circuit or Circuit-Break Fault[2,3]	Active	X	X	Yes	No	Open	Steady on	Steady off	see fault LED blink table
Over-Temperature	X	X	X	X	Yes	Open	Steady on	Steady off	see fault LED blink table
Sleep[4] (with no faults)	Active	X	No	No	No	Open (closed during wake-up pulse)	Off (on during wake-up pulse)	Off (on during wake-up pulse)	Off (off during wake-up pulse)
	Not active	X	No	No	No	Open (open during wake-up pulse)	Off (on during wake-up pulse)	Off (off during wake-up pulse)	Off (off during wake-up pulse)
Sleep[4] (with under- or over-voltage fault)	X	Not active	Yes	No	No	Open (open during wake-up pulse)	Off (on during wake-up pulse)	Off (off during wake-up pulse)	Off (on during wake-up pulse)
	Not active	X	Yes	No	No	Open (open during wake-up pulse)	Off (on during wake-up pulse)	Off (off during wake-up pulse)	Off (on during wake-up pulse)
Insufficient Input Voltage Fault	X	X	X	X	X	Open	Steady off	Steady off	Steady off

Notes:

1. When in full-power (i.e., not sleep) mode, the POWER OK LED will blink rapidly (~4 times per second) if the voltage on both power terminals — "SOURCE" and "LOAD" on a uni-directional relay (RY), "TERMINAL 1" and "TERMINAL 2" on a bi-directional relay (RB) — relative to the "SOURCE NEGATIVE" terminal falls below $V_{S,WARNON}$/$V_{Tx,WARNON}$ on a RY/RB device, respectively. The POWER OK LED will return to a steady-on state when one or both of the aforementioned terminal voltages rise above $V_{S,WARNOFF}$/$V_{Tx,WARNOFF}$ on a RY/RB device, respectively. If the relay is closed when the aforementioned terminal voltages fall below $V_{S,WARNON}$/$V_{Tx,WARNON}$ it will stay closed, but the over-current and short-circuit features will revert to a single level; if the relay is open, closing of the relay will be inhibited until one or both of the aforementioned terminal voltages rise above $V_{S,WARNOFF}$/$V_{TxWARNOFF}$. See device specification sheets located at perfectswitch.com for threshold values.

2. When the relay opens due to an over-current or short-circuit condition, a 10 second lockout period is initiated which will inhibit reset. During this period, any trigger state change will be ignored; after this period, the main trigger must be toggled in order to close the relay again. If the relay continues to trip into an over-current or short-circuit mode, the loads should be removed from the relay and analyzed for failures. Proper device operation can be checked by keeping the loads disconnected and triggering the relay on; if it no longer trips open, the relay is functioning properly, but if it trips into the short-circuit mode, the device is faulty and the manufacturer should be contacted.

3. When the relay opens due to a circuit-break fault, a minimum 10 second lockout period is initiated which will inhibit reset. During this period, any trigger state change will be ignored; after this period, reset is achieved in one of three ways, depending on a device's programming: 1) Toggle of the main trigger; 2) Limited auto-retry, reverting to main trigger toggle reset mode if circuit-break condition persists; 3) Unlimited auto-retry. Both auto-retry reset methods can be stopped by turning off the main trigger (except for during the 10 second lockout period). The auto-reset delay as specified by a user includes the 10 second lockout period (i.e., if a user wants a 30 second circuit-break reset delay, the delay begins immediately after device opening in response to the circuit-break fault, NOT after the lockout period).

4. "Wake-up pulse" is defined as an approximately 250 ms period of time when the relay wakes up from sleep to check for the appearance of sleep mode exit conditions. Usually this is due to a watchdog timer timeout, but could also be due to an under- or over-voltage reset, or a trigger state change. During the wake-up pulse period, if no exit conditions are present and the triggers do not change state, the user can expect the relay to enter the state it existed in just prior to entering the sleep mode, followed by re-entry into the sleep mode for the watchdog timer period (which is set to either 8 or 32 seconds by the manufacturer, but can be changed by customer request); this process would continue indefinitely until an exit condition is detected.

5. "X" stands for don't care condition.

6. Row shading is only for improved visibility.

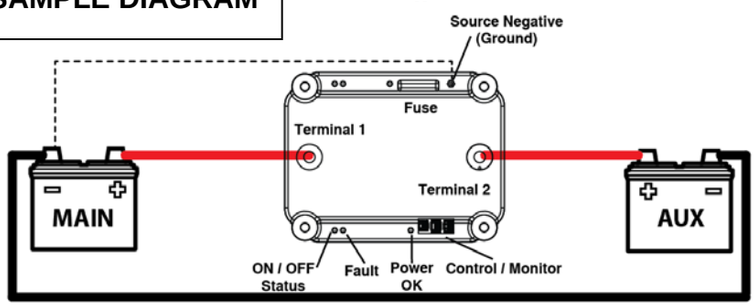
FAULT LED BLINK TABLE

OPERATING MODE	NUMBER OF BLINKS	BLINK ON-TIME	BLINK OFF-TIME	OFF-TIME BETWEEN BLINK SETS
Level 1 Over-Current	1	260 ms	260 ms	2 s
Level 2 Over-Current	2	260 ms	260 ms	2 s
Level 3 Over-Current	3	260 ms	260 ms	2 s
Level 4 Over-Current	4	260 ms	260 ms	2 s
Level 5 Over-Current	5	260 ms	260 ms	2 s
Level 6 Over-Current	6	260 ms	260 ms	2 s
Short-Circuit	7	260 ms	260 ms	2 s
Over-Temperature	N/A	130 ms	130 ms	N/A
Level 1 Circuit-Break	N/A	1 s	1 s	N/A
Level 2 Circuit-Break	N/A	500 ms	500 ms	N/A

Notes:

1. "N/A" = not applicable

SAMPLE DIAGRAM



RB-Series Relays

Never remove relay ground from system ground unless the battery is disconnected or damage will occur!

POWER-GATE™ is encapsulated with dielectric gel to provide rigidity, and protection from chemicals, dirt, moisture, and vibration.

SLEEP MODE

Sleep mode (if enabled) will minimize device power consumption during long periods of inactivity. In general, when the relay detects all of the following conditions are true, it will begin the user-defined sleep delay timer (if enabled):

1. All under-voltage (UV) features disabled OR a) no enabled UV delay timer(s) is (are) running and b) sensed voltage is below UV reset threshold.
2. All over-voltage (OV) features disabled OR no enabled OV delay timer(s) is (are) running.
4. All circuit-break (CB) features disabled OR no enabled CB delay timer(s) is (are) running.
4. No over-current (OI) delay timer(s) running.
5. No CB, OI, or short-circuit (SC) fault present.
6. No over-temperature (OT) fault present

Should at any time before sleep delay timer completion one or more of the preceding conditions become false, the sleep delay timer will be stopped and reset; it will not start again until all conditions are once again true. If the conditions remain true through sleep delay timer completion (or if the sleep delay timer is disabled), the relay will open (if closed), turn off all on-board LEDs and external status lines, and enter a low-power state (sleep mode) where power consumption is typically decreased by at least 90%. Once sleep mode has been entered, it can be exited in one of the following ways:

1. WATCHDOG TIMER METHOD: The device will wake up every ~8 seconds (or after a user-defined period) if the watchdog feature is enabled and check for an appropriate reset voltage (the terminal(s) that is (are) checked is (are) dependent upon user specifications). If a UV fault is present and the sensed voltage rises and stays above the UV reset threshold for the UV reset delay, the device will restart normal full-power operation. Alternatively, if either a) all UV features are disabled or b) one or more UV features are enabled but no UV fault is present, and the sensed voltage is greater than the UV wake-up threshold (which is usually equal to the UV reset threshold, but could a different user-defined value), the device will also restart normal full-power operation.
2. OVERRIDE TRIGGER METHOD: If a UV fault is present when the device is in sleep mode, activating the override trigger will temporarily wake-up the device as long as the main trigger is active as well. The device will immediately re-enter sleep mode when the override and/or main trigger are/is deactivated, unless the sensed voltage (see previous note) is above the UV reset threshold. Should that be the case, the device will restart normal full-power operation if the sensed voltage stays above the UV reset threshold for the UV reset delay or will re-enter the sleep mode if said voltage falls below the UV reset threshold.
3. MAIN TRIGGER METHOD: For devices that are programmed to only allow sleep mode entry when the main trigger is de-activated, reactivating the trigger will cause the device to immediately restart normal full-power operation.

The sleep mode can be configured to operate in a variety of ways. The above description represents the most common configurations, but your device may operate in a unique manner not detailed in this installation sheet; in that case, please refer to the manufacturer-provided sleep mode description based on the device's specification

POWER-GATE ONE-YEAR LIMITED WARRANTY

Perfect Switch, LLC. warrants the POWER-GATE against all defects in materials and workmanship for a period of one year from the date of the original purchase, subject to the following terms and conditions:
This warranty does not apply if the serial number or housing of the product has been removed or if the product has been subjected to physical abuse, improper installation, water damage, corrosion due to sea salt, road salts, or de-icing chemicals, transient voltage spikes, or modification.

To obtain warranty service, please contact the manufacturer for a Return Materials Authorization (RMA) number. The product must be returned, insured and shipping prepaid, to Perfect Switch, LLC at the address below, in its original packaging or a suitable equivalent, along with the purchaser's receipt and written description of the problem.

Perfect Switch, LLC's responsibility under this warranty is limited to repair or replacement of the product or refund of its purchase price, at the sole discretion of Perfect Switch, LLC. Perfect Switch, LLC. disclaims all other warranties, expressed or implied, including warranties of merchantability and fitness for any particular purposes whatsoever, and no other remedy shall be available including without limitation, incidental or consequential damages, loss of time, inconvenience, or commercial loss. In no event shall Perfect Switch, LLC's liability exceed the purchase price of the product in question.

Some states do not allow the exclusion or limitation of incidental or consequential damages

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