

POWER-GATE INSTALLATION INSTRUCTIONS

OR-Series Programmable GEN 4.1 v4

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:

- Two POWER-GATE bi-directional relay modules
- Harness
- Nylon insert nuts, 2 per module
- Brass washers, 2 per module
- Installation Guide

WHAT YOU WILL NEED:

- Copper lugs for cable terminations
- Drill and appropriate mounting hardware
- Digital multi-meter
- torque wrench
- 16 AWG black wire for ground extension
- Wire stripper
- Lug crimper
- Soldering torch, solder, and flux



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

CONNECTING LUGS TO CABLES

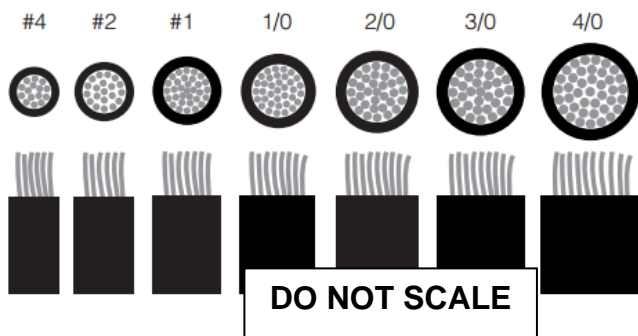
POWER-GATE™ is engineered to transfer electricity at peak performance levels approaching 99.9%. Unfortunately, most installers often overlook electrical joints between cables, lugs, and battery terminals. POWER-GATE™ is one part of a complete electrical system; cables and connection points require just 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.
- OR400 applications, use at least 2/0 cable.
- OR500 applications, use at least 3/0 cable.
- OR600 applications, use at least 4/0 cable.
- Don't guess the correct cable size.
- Lugs made of copper, silver-plated copper, or tin-plated copper are good conductors.

Creating a good joint between cables and connectors ensures efficient transfer of electricity. Lugs should be soldered to cables or hydraulically crimped with industry standard crimping equipment. 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 multi-meter 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 connection 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 5 foot-pounds on the 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

Step 6 appropriately. Torque nylon insert nut to 15 newton-meters 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.

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.

If device is Autonomous, then disregard.

HOW POWER-GATE™ FUNCTIONS

The POWER-GATE™ Programmable OR'ing configuration is comprised of two (2) bi-directional relays that communicate with each other via the supplied harness. Each device is individually programmed to create the requested functionality specific to the application.

When triggered, the Primary Source Relay will drive current to the load. When the Primary Source Relay is programmed to open, it ceases to conduct current and the Backup Relay will be commanded on, and the Backup relay will drive current to the load.

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.

HARNESS EXPLANATION

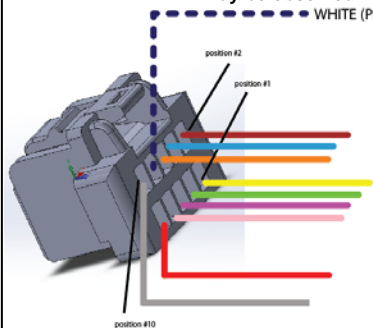
Standard harness denoted. For Specification Code Harness, see attached harness document.

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

Pins one, three, five and nine are LED status wires.

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.



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 | Color |
|-------------------------|----------|
| 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/50 mA

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 |
| 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:

- 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 $V_{S,WARNON}/V_{T,WARNON}$ 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 $V_{S,WARNOFF}/V_{T,WARNOFF}$ on a RY/RB device, respectively. If the relay is closed when the aforementioned terminal voltages fall below $V_{S,WARNON}/V_{T,WARNON}$ 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 $V_{S,WARNOFF}/V_{T,WARNOFF}$. See device specification sheets located at perfectswitch.com for threshold values.
- 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.
- 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).
- "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.
- "X" stands for don't care condition.
- Row shading is only for improved visibility.

POWER-GATE RELAY (GENERATION 4) FAULT LED BLINK TABLE

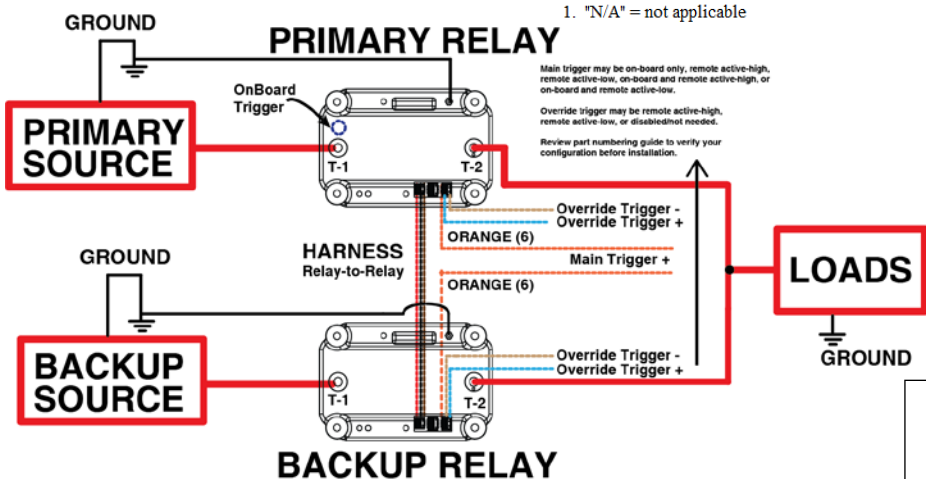
(circuit-break features may not be applicable to your device)

| 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:

- "N/A" = not applicable

SAMPLE DIAGRAM



BACKUP RELAY

SLEEP MODE

Sleep Mode (if enabled) will decrease power draw from the MAIN Battery during long periods of inactivity. A continuously resetting 24-hour timer determines when the device enters Sleep Mode. When all the following conditions occur concurrently, the device will enter Sleep Mode:

- (A) Relay open, or (B) Relay is closed with a load current of less than 5 amps
- Under-Voltage delay timer(s) not running, or have already timed out
- Over-Voltage delay timer(s) not running, or have already timed out
- Over-Current delay timer(s) not running
- No Over-Temperature conditions present

The Relay will exit Sleep Mode and re-start the 24-hour timer if any of the above conditions are false.

The Relay will not enter Sleep Mode during over-current or short-circuit fault conditions.

Once the 24-hour timer expires, the device will enter Sleep Mode for 10 seconds. Every 10 seconds, the device will check conditions 1 through 5 and if unchanged, the device will stay in Sleep Mode indefinitely. With respect to conditions 1 through 5, the device will wake from Sleep Mode and start the 24-hour timer if one or more conditions become false.

If either the trigger or override switch is toggled during Sleep Mode, the device will wake and the 24-hour timer will start.

LED's will be off when device is in Sleep Mode.

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.

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 deicing 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 of how long an implied warranty lasts, so the above limitations or exclusions may not apply to you.

This warranty gives you specific rights. You may have other legal rights which may vary from state to state. Perfect Switch, LLC, wants you to be satisfied with its products. Should you have any difficulties with the operation or performance of your POWER-GATE multi-battery accessory, please the manufacturer.

