

Wiring the Humless® Off-Grid Series – 12kWh Into a Home Breaker Panel For Use as a Backup Power Source

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Abstract—Although originally designed to work with “off-grid” applications, this white paper will describe the implementation of connecting the Humless® Off-Grid Series 12kWh in a grid-tied application for use as an automatic back-up power source. Installation shall utilize UL-compliant components for adherence to electrical-inspection criteria.

Keywords—power, back-up, transfer switch, alternative energy.

I. HUMLESS OFF-GRID INTRODUCTION:

The Humless® Off-Grid Series 12kWh is an off-grid power source capable of supplying a single phase 120 VAC pure sine-wave source at a maximum constant rate of 3.3kW. The primary power source is a 48 VDC LFP battery-bank with a 3,500+ charge-cycle endurance. This battery-bank can be charged via a wide voltage-range of multiple AC or DC sources. For a complete description of specifications and capabilities, please see the [current data sheet](#).

- Drop-in, simple, integrated power storage system
- Simultaneous charge & discharge
- Simultaneous VDC and VAC charge and discharge

II. OFF-GRID AND GRID-TIED APPLICATIONS:

The Humless® Off Grid Series 12kWh was originally designed to be used in an off-grid application as a primary 120 VAC source. The unit was also designed to accept an external 120 VAC source for battery charging. When in this state, the unit will automatically switch to “Bypass-Mode”. While in this mode, the unit will AC-charge the battery while passing the external 120 VAC to the unit’s 120 VAC output connectors. The unit’s internal DC/AC-Inverter will also revert to shut-down mode. The unit will remain in this state until the external 120 VAC source is removed. The Inverter will then resume working and 120 VAC will still remain on the 120 VAC output connectors.

In some cases it may be desirable to utilize the unit in a grid-tied application (home/garage/workshed) to be used as a “high-capacity UPS” (Uninterruptable Power Supply). This type of installation will require the use of certified or UL-compliant components that will pass electrical-inspection after professional installation. As of the writing of this white-paper, the Humless® Off-Grid Series 12kWh is not yet UL-compliant. However, when done correctly, the unit can be safely installed into a grid-tied application, much like any backup generator or other power-source while still maintaining safety compliance. We will now describe two ways of doing this.

III. SIMPLE INTALLATION METHOD (NO DELAY):

Figure-1 depicts the simplest way of doing this at the lowest cost. The relay used (P/N: 92S11A22D-120) is a UL-compliant 30 amp DPDT and will safely isolate the two power-sources from each other to eliminate any chance of “back-feed” from the unit to the grid (or vice-versa). The “common” relay contacts of K1 will connect to the breaker-panel that sources the desired load. When grid-power is present, K1 will be in its energized state, closing the N.O. contacts of K1 (which are connected to grid-power). AC-Charging of the Humless® Off-Grid-12kWh will also be accomplished while in this state. A loss of grid-power will de-energize K1 and close the N.C. contacts (which are connected to the Humless® Off-Grid-12kWh 120 VAC output connector). For added safety, a primary breaker (CB1) is also included between grid power and the switching circuit. This method is safe and cost effective and will supply instant power back-up to the load when grid-power is dropped off. However, it can be prone to creating potential transient-spike issues if grid-power were to “chatter” or repeatedly switch on and off quickly. It should also be noted that the transient-spike issues will be no greater than if the load was always connected to the “chattering” grid (as is the case in all of our standard homes). The next method will describe how to eliminate the transient-spike issue altogether.

IV. DELAY-BUFFERED INSTALLATION METHOD:

Figure-2 depicts roughly the same installation method but with the addition of an adjustable delay-relay (K2). This allows for a user adjustable delay (0.1 s to 100 h) to buffer the K1 switching time. This method will eliminate any transient-spike issues that might arise from chattering grid-power. The amount of relay delay time is determined by the user and will normally depend on the primary load being used. For instance, with high-current loads like compressors, pumps, heavy-duty motors, etc., a slightly longer delay might be desirable (0.5 to 10 sec.) to allow for induction and loads to dissipate before throwing the power back on again. With lesser-current loads like home-electronics, computers, etc., a shorter delay might be required (0.1 to 0.25 sec.) to prevent annoying resets or data-loss. The delay-relay used (P/N: TDR782XBXA-110A) is a relatively low-cost and widely available choice. Contact current (in this case 5 amps) really isn't an issue since the only load it will be sourcing is the K1 relay-coil. Both relays are DIN-rail compatible for quick and easy installation topologies. The associated DIN-hardware is included in the bill-of-materials at the end of this paper. It should also be noted that there are many certified UL-compliant components out there that will work just as well as long as the pertinent voltage and current specifications are met; this paper serves as a starting point and viable solution.

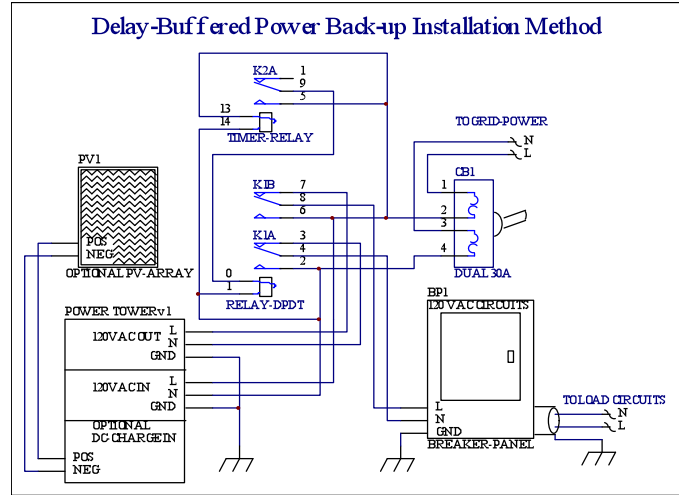


Figure-2: Delay-Buffered Simple Power Back-up Installation Method.

V. BILL OF MATERIALS (BOM):

The following Bill of Materials describes the components used for prototyping both installation methods. The components are common and available from a number of mail-order vendors (Mouser, Newark, etc.). As previously indicated, any substitutions can be made as long as specifications and safety-compliances are met or exceeded.

Designator:	Description:	MFR P/N:	MFR:
CB1	DUAL 30A	USER DEFINED	VARIOUS
K1	RELAY-DPDT	92S11A22D-120	MAGNECRAFT
K2	TIMER-RELAY	TDR782XBXA-110A	MAGNECRAFT
K1/K2 DIN RAIL	DIN RAIL	SPC10576	MULTICOMP
K2 SOCKET	K2 SOCKET	70-461-1	MAGNECRAFT

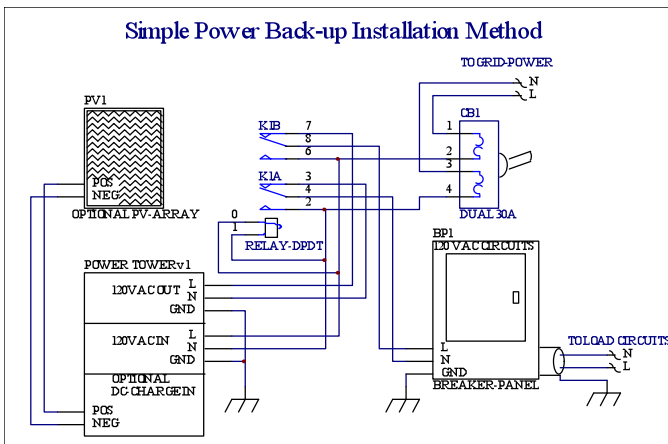


Figure-1: Simple Power Back-up Installation Method.

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