

## APPLICATION NOTE 202

# Battery Precharge Sequence for 30B3 and 125B2 PCS

### 1.0 PURPOSE AND SCOPE

This application note details the battery precharge control sequence for use with Ideal Power's ("IPWR") 30B3-4XF, 30B3-4DF (30B3) and 125B2-4F (125B2) power conversion systems (PCS). Implementing this precharge control sequence as described below minimizes battery in-rush currents, prolonging contactor life. Ideal Power strongly recommends that this precharge sequence be implemented in your controller system software. This document assumes that the reader is already familiar with the 30B3 and/or 125B2 Modbus Interface, and that manual control of the PCS contactors is the default contactor management scheme.

Additionally, this document assumes that the PCS is wired to a 480 Vac grid connection, and configured to operate in grid-following mode. The precharge sequence detailed below is NOT supported in microgrid applications. Contact Ideal Power at [support@idealphpower.com](mailto:support@idealphpower.com) for technical support as required.

Note that this precharge sequence supports the 30B3 and 125B2 product families. IPWR has developed separate documentation for the IBC-30, which utilizes a different family of Control Methods.

### 2.0 OVERVIEW

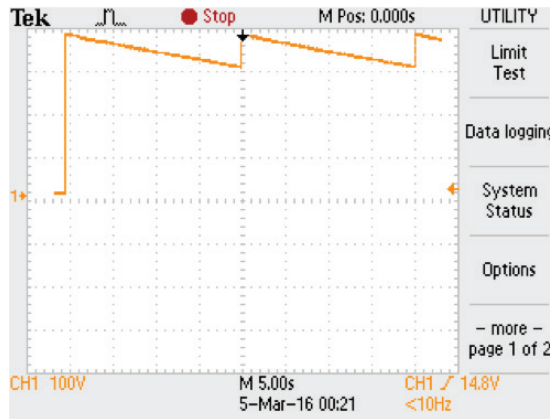
This application note details how to precharge port DC3. Battery in-rush currents can be minimized by matching battery stack voltage with DC3 port voltage. This is achieved by precharging DC3's line capacitors from AC1, using a DC current Control Method, while AC1's Control Method = NET. The DC3 target output voltage is set using the p3\_v\_ll\_max\_limit register 312 to ~2.5% above your target battery stack voltage. If you have a battery connected to DC2 (30B3-4DF), utilize the same precharge sequence, but utilize DC2 registers, in your precharge sequence.

With battery contactors open, execute the code sequence detailed in Section 3.0 of this document. The PCS will charge its DC3 output line capacitors to the target voltage, and then trip out, due to an overvoltage fault ("D30V") condition. The DC output voltage will then slowly decay for 20 seconds, until the system restarts, and again charges the DC3 line caps to the target voltage noted.

The 20 second timeout is the converter's default system restart clock for internal fault conditions, such as D30V.

The precharge sequence exploits this recurring waveform: command your site controller to close the battery contactors 1 to 3 seconds after launching the precharge sequence. Use a lab scope to adjust your contactor closure timing as necessary to best match the DC3 output to your battery voltage. Once the battery contactors are closed, the sawtooth immediately stops, and you will observe battery fixed voltage on both the PCS front panel display, and your scope.

**DIAGRAM 1.**  
**30B3-4DF DC3**  
**Precharge**  
**Output**  
**Waveform,**  
**relative to**  
**Earth Ground**



### 3.0 CONTROL SEQUENCE

1. Set register 409 (contactor\_control) to 1632 (0x0660): this command closes DC3 contactors (125B2-4F and 30B3-4xF), and both DC2 and DC3 contactors (30B3-4DF).

*Closing the converter's contactor first, ensures that target output voltages are balanced on DC3, and protects the contactors from in-rush currents.*

2. Set register 405 (reconnect\_timer\_1) to 20: this command sets reconnect timer 1 to 20 seconds.

3. Set register 428 (system\_op\_mode) to 1: this command enables the PCS auto-start feature.

*The factory default is 0 (user\_start and user-stop active), which requires that user\_start be set to 1 after each new Control Method assignment is made, or after a fault is encountered. In the automatic mode, the PCS will transfer power immediately after a correct command is entered; and if a fault occurs, it will automatically countdown and restart after 20 seconds.*

4. Set register 312 (p3\_v\_ll\_max\_limit) to your target battery stack voltage + 2.5%.

5. Set register 325 p3\_v\_ll\_min\_limit) to 0.

*Otherwise, you will experience a D3UV fault (DC voltage low), when you launch the precharge sequence.*

6. Set register 304 (p3\_control\_method) to 769 (0x301) (DC Current Method).

7. Set register 104 (p1\_control\_method) to 1 (NET Control Method).

8. Set register 305 (p3\_parameter1\_set\_point) to 200.

*This command sets the DC current from port 3 to 2 A and will charge the internal capacitors to 1000 Vdc within 80 ms. Once the targeted DC port voltage is reached the 30B3-4DF sawtooth waveform as described above will result. Due to larger (4x) DC line capacitors, the 125B2-4F converter output will decay at a far slower rate than that shown in Diagram 1. In Diagram 1, for 30B3-4DF, observe this waveform on a lab scope to determine best timing and voltage match.*

9. When battery and decaying DC line capacitor voltages match: close your battery contactors. Note that within 20 seconds or so, you will be charging the battery with a current of 2 A, unless you idle the ports immediately, as described below.

10. Set register 104 (p1\_control\_method) to 0 (IDLE Control Method).

11. Set register 304 (p3\_control\_method) to 0 (IDLE Control Method).

12. Optional: if you manage the converter using the user\_start and user\_stop registers, set system\_op\_mode back to 0, to re-enable this feature.

13. Restore register 428 (system\_op\_mode) to its original value, register 312 (p3\_v\_ll\_max\_limit) to your maximum battery voltage, and register 325 (p3\_v\_ll\_min\_limit) to your minimum batteries voltage to protect the batteries.

*Batteries and PCS now have voltages matched and all contactors closed: charge/discharge power flows may now commence.*

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