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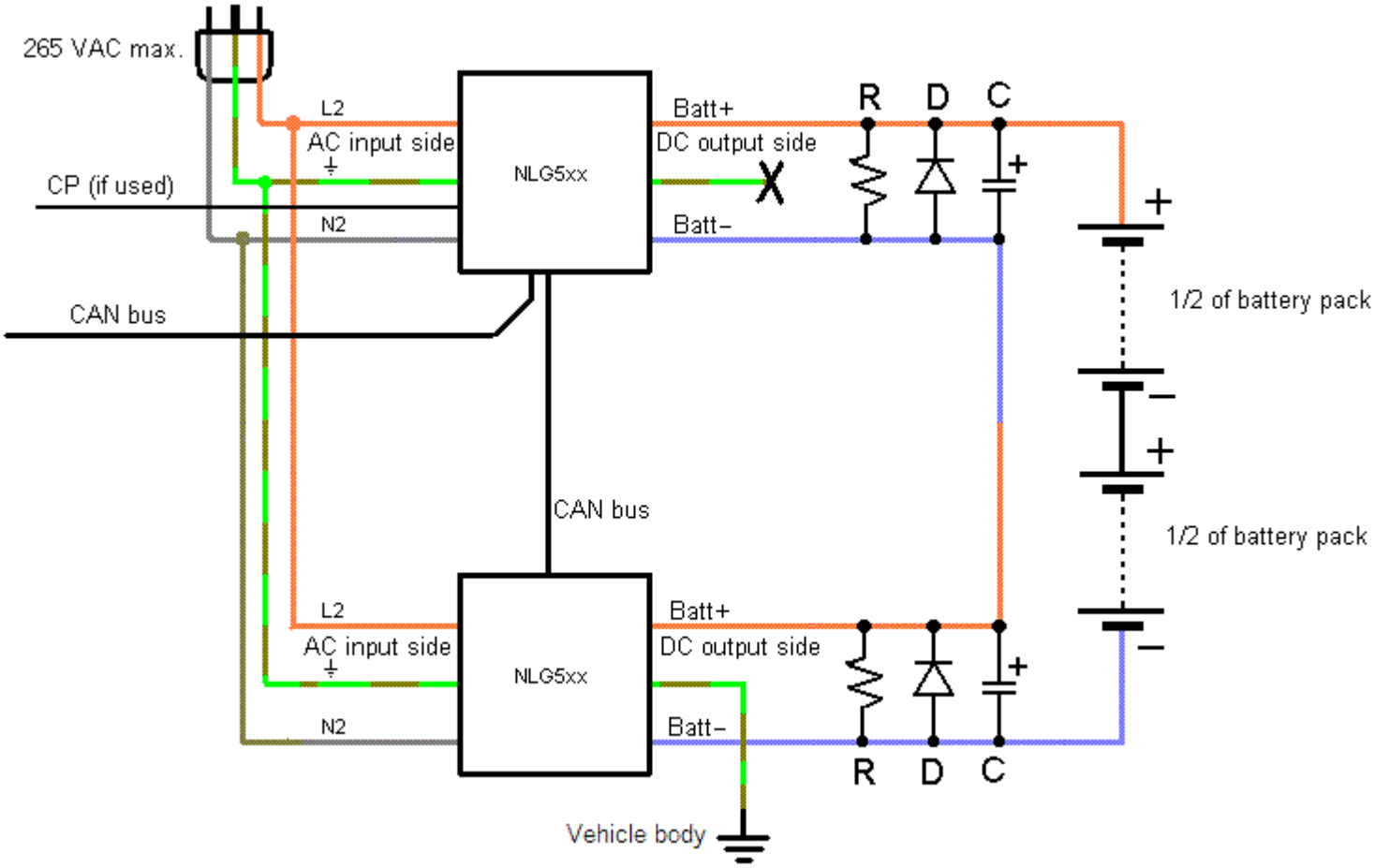
METRIC MIND CORPORATION
EV POWER ELECTRONICS

Series Connection of two BRUSA NLG5xx battery chargers without tap to the middle of the pack

Often maximum output voltage of a single charger is not enough to fulfill requirements for given battery, but the access to the electric al middle of the pack is not feasible - for instance if entire pack is constructed from the odd number of sealed modules.

The diagram below depicts generic schematic for connecting two chargers in series to double total output voltage (and output power along) of a single unit for this case"



Note that this is not complete electrical schematic as CP, CAN and other interface connections are not shown.

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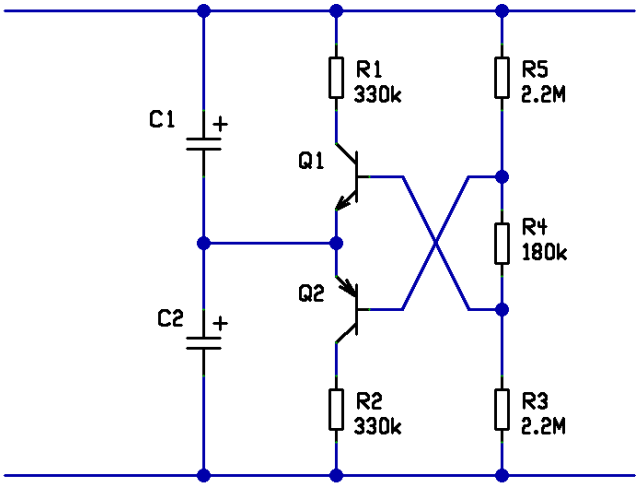
As in case with tapping electrical middle of the battery, each charger's conventional current flows out of positive lead and returns into the negative lead. As long as this is the case charger will charge just fine, it doesn't need to know that the current is injected and gets returned into another charger rather than directly into the battery. However, this presents problem with regulation stability since chargers expect to see low impedance load to stabilize very fast current regulation loop. Without connection to the electrical center of the battery pack this low impedance load for each charger is lost. Therefore to accomplish this a large capacitor should be connected to the output of each charger improving its dynamic response and allowing it to perceive the same type of load as a battery would present.

Capacitors value depends on the charging current. You will need to experiment to find minimum capacitance still providing good regulation stability. For charging currents up to 10A start with 2,000 uF electrolytic capacitors (observe voltage rating and consider capacity loss at low working temperature for typical aluminum electrolytics) and add 500 uF per each amp of charging current above 10A.

Diodes protect charger's output from reverse polarity in case a battery depletes below half of its nominal voltage and one of chargers quits while the other is still charging. Bleeding resistors maintain voltages on each capacitor about the same while chargers are idle. For this to work their value should dominate capacitor's leakage resistance by at least a factor of 10, but keep in mind that making them too low will keep discharging the pack. This good quality capacitors will allow to keep equalizing current to the minimum.



To avoid unnecessary power loss and discharging the pack a suggested C-balance circuit* can be deployed. It connects equalizing resistors R1 and R2 (by Q1 and Q2 respectively) to the capacitors C1 and C2 only when their voltage difference exceeds certain threshold set by R4, otherwise there is no current flowing and no power loss. As before, R1 and R2 are chosen to dominate leakage current.

This C-balance circuit may be subject to licensing requirement from Power Integrations - check www.powerint.com for details.

WARNING: for any type of connection always observe precharging requirements for initial connection to the battery, see application note MMC_006 for details. Failure to precharge charger's output may cause hardware damage and is not covered by warranty.

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