

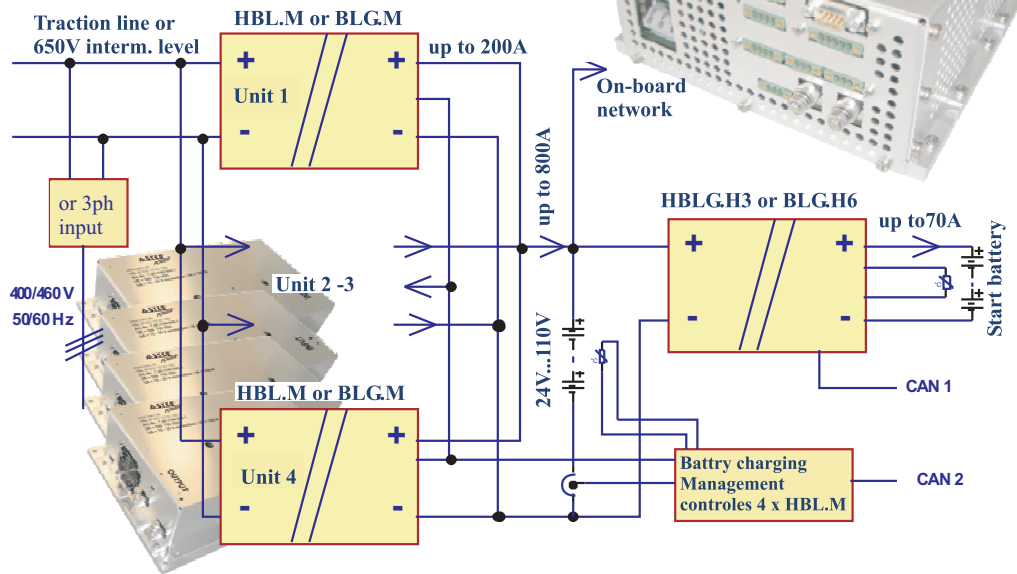
Intelligent start battery charging from low-voltage network

Generation of a separated voltage level for start operation

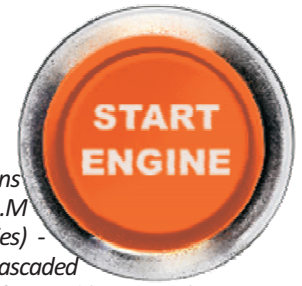
Start operations especially from 28V battery require short term currents of several thousands of amperes, and the duration as well as currents increase with decreasing temperature. Special batteries are used for this and the circuit for the start operation mostly is isolated from the battery supported on-board network to prevent major disturbances at the start sequence. SYKO finished the design work for the intelligent 1 KW (BLG.H3 series) and 2 KW (BLG.H6 series) battery charger for start operation in rolling stock on-board networks (24/36/72/110V) and now started the testing phase for 28V and 110V charging for high current batteries.

This application for battery charging is mostly based on customised demands and throughout a very interesting market field, which SYKO easily can handle with our standard thermal management for PCB-based high current technology. The solutions are compliant to the relevant railway standards and the functional operation is stable including the input voltage range of $\pm 30\%$ continuous and $\pm 40\%$ short term plus surge and burst disturbances.

Ambient temperatures $-40^{\circ}\text{C} \dots +60^{\circ}\text{C}$ are realised without fan operation or up to 70°C with fan operation to extend the MTBF. For An internal housekeeper supply secures functionality in all operational modes. This housekeeper generates all internal supply levels before activating the main power steps and additionally generates a floating, isolated auxiliary output (short circuit proof and regulated) of 24V (10-15 watt) at $\pm 50\%$ of the input on-board nominal voltage. The overall power is split up into current cascaded regulated strings in interleaving mode to be able to process high input and out currents. Replacement of diodes through latest FETs improves the overall efficiency, reduces the thermal loss about 12% and prevents hot spots as far as possible. EMC improvement is realised by using current and voltage resonant isolating stages is the way of an electronic transformer. With this the overshooting peaks on top of the current and voltage chopping curves are prevented. For the case that the charger is running under un-allowed over temperature all primary and secondary power steps are temperature monitored. Under and over voltage is monitored with amplitude and time hysteresis. With the by SYKO realised Average-current-mode "single-string-monitoring" the high current capable semiconductors work symmetric/balanced in the prior defined current range. Chopping currents are processed with foil and ceramic capacitors and the regulation circuit is dynamically supported with non-current stressed electrolytic capacitors. The battery management is processor regulated and the charging end voltage is functionally defined by on the battery's temperature. Different U/T-curves on different temperature sensors can be set by software. As long as the charging end voltage is not reached the output works in regulated short circuit operation.



Against the high voltage input applications (3Ph, 460 V, 650 V intermediate level/HBL.M series) or 750 V traction line (HBL.H series) - which can work up to 20kW in power cascaded parallel mode with up to 4 units and therefore need battery splitting current limitation because of the over all capacity (up to $>800\text{A}$) - the here described battery chargers only work for the fast energy conservation into the start-battery and therefore do not need current splitting function. Short circuit, related times and temperature is monitored.



Furthermore too low input voltage and/or PCB over temperature is signalled with floating relay contact as summer. Optional an isolated CAN-BUS interface and appropriate user interface are available. If the floating and polarity-independent Enable-input is not operated (constant current), the whole charger runs in sleep mode with 1mA current consumption from the supplying network and the start battery is discharged with only 0,5mA. The charger activates with 5 V or 10-70 respectively 15-154V and 2mA constant current. With an optional 24V auxiliary output customer sided an external cross plugging protection (10W-contactor necessary) with current limitation to the input capacitors can be supplied. The power part runs up integral without run-up over current. (Keep your supply network "clean" of peak currents). Without battery management the unit is available as a normal DC/DC converter with continuous or adjustable constant voltage, which can charge high-caps or to drive high value inductances. The standard compliance is supported by improves isolation. The principle diagram shows the capability of the tested 20kW on-board supply with intelligent on-board battery charging as well as the intelligent start-battery charging BLG.H3 or BLG.H6. Battery charging for mobile applications is the defined competence area of company SYKO.



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