LBC Series

3-phase PSU / Battery Charger

The Power Supply Unit (PSU) consists of a ruggedized battery charger, with a 3-phase input for 400 / 480 VAC (line to line) and with an output suitable for 110 V battery charging and supplying DC loads.

AC-DC stage to convert the 3-phase input voltage to a bus voltage with battery charging capability. Emphasis is given on high reliability and long life. Inside the shelf, two or three active current shared paralleled and independent power units are used, safeguarding reliability and partial redundancy of the system.

The PSU includes DSP, which enables monitoring of electrical parameters (including input voltage of all 3 phases) and controlling the PSU from system controller. Internal CAN bus is used for command, monitoring and diagnostic information that is supplied to the shelf controller and to the external supervising system. External communication is provided by either CAN or Ethernet communication.

The LBC series is a highly versatile battery charger which adapts easily to the different requirements of rolling stock on-board power grids and vehicle control systems.
The firmware is programmed according customer required parameters, depending on type of battery, charging characteristic, specific monitoring, controlling and communication requirements.

Key Features & Benefits

- Shelf comprises of 2-3 power units, 1 control board and cable harness
- Output power up to 12 kW
- 400 / 480 Vrms 3-phase 50/60 Hz input voltage range (no neutral) with PF > 0.94
- High power density 6.8 W/in^3 per unit
- 92% typical efficiency
- Parallel operation with active current sharing
- Nominal output voltage for 110V battery (adjustable 80 – 137.5 VDC)
- -40 to 70°C of operating ambient temperature
- CAN bus / Ethernet Interface
- Compliant to Railway standards EN 50155, EN 50121-3-2, EN 50533, EN 45545 (HL3), NFPA 130

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Please read our datasheet & drawing disclaimer here.

1. MODEL SELECTION

MODEL	POWER	BATTERY VOLTAGE	COMMUNICATION
LBC8000-1110SxxxG *	8000 W	110 V	CAN or Ethernet
LBC12000-1110SxxxG *	12000 W	110 V	CAN or Ethernet

* For details regarding finished good part number, please, contact the factory

2. INPUT SPECIFICATIONS

PARAMETER	DESCRIPTION / CONDITION
Input Voltage	Nominal: 400 - 480 Vrms (line to line without neutral) / 230 – 277 Vrms (line to ground) Permitted variation: 350 – 528 Vrms / 202 – 305 Vrms
Input Frequency	50 – 60 Hz, permitted variation: 42 – 63 Hz
Input Current	≤14 A (LBC8000) / 21 A (LBC12000) at 350 Vrms from each phase Inrush current <190 A (>1 min. cooling period), I-THD typ. 33 %
Fuse	3 x 20 A, Fast acting, in each power unit (2 or 3 power units inside the shelf)

3. OUTPUT

PARAMETER	DESCRIPTION / CONDITION
Output Voltage	80-137.5VDC (depending on operating condition and specific battery charging characteristic)
Output Power Rating	8000 / 12000 W
Output Current	73 / 110 A
Efficiency	Typically, 92% at load above 40%
Voltage Setting Accuracy	± 1%
Line / Load regulation	±0.5% / ±0.3%
Transient Response	±5% at load variation 10-100% and back; recovery time <4 ms or ±3% at load variation 50-100% and back; recovery time <1.5 ms
Ripple	<1.5% of Vout_nom (BW 20 MHz)

4. PROTECTION SPECIFICATIONS

PARAMETER	DESCRIPTION / CONDITION
Protection	Over temperature protection, Input under and over voltage protection, Output under and over voltage protection, over current / short circuit protection

5. FUNCTION

PARAMETER	DESCRIPTION / CONDITION	NOTES
Vbat = 30 – 77 V	Battery Low: warning Battery_Low, consumers should be in OFF state, charging with Ich = nom	Warning by comm. bus (Ethernet or CAN)
Vbat = 77 – 128 V	Battery Normal: charging with Ich = nom according to characteristics	Up to Vch = max @Tbatt
Charging characteristics	Vch_max = f (TB1, TB2): typ. -3 mV / K /cell (curve adjustable according to specific battery), Boost and Floating modes possible	Default Ich_nom = 21 A, customizable
Failure effect	Charging continues with reduced performance by defective: power modules (redundancy when power reserve), external communication failure, battery temperature sensor failure	When sensor failed, then Vch = min @Tmax
Battery test*	Checked battery connection and battery voltage, default once after turn-on (repetition on request, e.g. once per 12 hours)	Performed when AC available

* During battery test, the voltage can drop down to 80 V. If the battery is not connected, the charger will go to the Safe mode (Safe mode default Vch = 105 V, customizable).

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6. LED SIGNALING

6.1 CONTROL UNIT

LED NAME	SYMBOL	COLOR	STATUS	OPERATING CONDITIONS
STATUS	⎓	Green	ON Blinking slowly OFF	Charger ready for use Input line ON, Battery not connected Input line not connected
BATTERY CURRENT	I_{ch}	Green / Chartreuse / Yellow	ON Blinking slowly OFF	G-Charging / Ch-Current <±2 A / Y-Discharging Over the working range Icharge ÷ Idischarge Charger Inhibited or Battery not connected
OT / FAIL	⚠	Yellow	ON Blinking slowly Blinking fast	Over Temperature or Fail (e.g. Overload) Safe mode (reduced voltage) Inhibit activated

6.2 POWER UNIT

LED NAME	SYMBOL	COLOR	STATUS	OPERATING CONDITIONS
AC-OK	~	Green	ON Blinking slowly OFF	AC input voltage within operation range Over/under voltage Input line not connected
DC-OK	⎓	Green / Chartreuse / Yellow	ON Blinking slowly	Output current: G 0-33% / CH 33-66% / Y 66-100% Green/Yellow Over/under voltage, disabled, inhibited, or internal error
OT / FAIL	⚠	Yellow	ON Blinking slowly Blinking fast	Over Temperature conditions inside the unit Fan fail Communication error

6.3 ETHERNET CONNECTOR

LED NAME	SYMBOL	COLOR	STATUS	OPERATING CONDITIONS
Data Activity	●	Green	Blinking OFF	Data is sensed thru the port No data
Operating	●	Green	ON OFF	Communication line connected Communication line broken

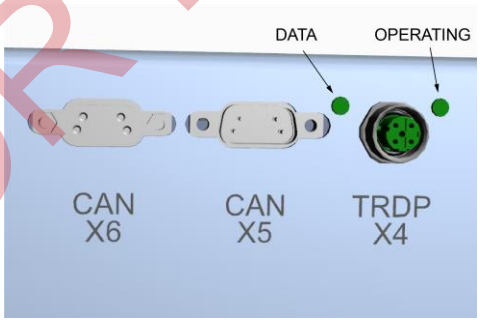

Figure 1. Ethernet connector X4 LED positions

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7 SAFETY, REGULATORY AND EMI SPECIFICATIONS

PARAMETER	DESCRIPTION / CONDITION		CRITERION
Safety	CE Declaration of Conformity		
Emissions Requirements	Radiated Emissions (EN 50121-3-2) Conducted Emissions (EN 50121-3-2)	EMW-06	
Immunity Requirements	Electrostatic Discharge (IEC/EN 61000-4-2)	Level 4: ±6 kV contact ±8 kV air	Criterion B
	Radiated Electromagnetic Field (IEC/EN 61000-4-3)	10 – 20 V/m 10 kHz – 6 GHz	Criterion A
	Electrical Fast Transient (EFT)/Burst (IEC 61000-4-4)	Level 3: ±2 kV	Criterion A
	Surge Immunity (IEC/EN 61000-4-5)	Level 3: ±1 kV DM ±2 kV CM	Criterion B
	RF Conducted Immunity (IEC/EN 61000-4-6)	Level 3: 10 V, 150 kHz – 80 MHz	Criterion A
Useful Life Assessment	>5 years life at ambient temperature of +55°C Fan – externally accessible for a potential replacement, no need to open the unit cover		
Other standards	EN 50155	Railway applications – Electronic equipment	
	EN 45545, HL3	Railway applications – Fire protection on railway vehicles	
	NFPA 130	Fixed guideway transit and passenger rail systems	
	EN 50533 (except ambiguous chapter 4.7)	Railway applications – Three-phase train line voltage characteristics	
	IEC 61375-2-3	Electronic railway equipment – Train communication network (TCN)	
	ISO 11898-1	Road vehicles – Controller area network (CAN) – Part 1: Data link layer and physical signallg	
	ISO 9001:2015	Quality management system	
	ISO 14001:2015	Environmental management system	
	IRIS / ISO-TS 22163:2017	Railway applications - Quality management system	
	EN 50325-4 (CiA301)	CAN open application layer	

8 ENVIRONMENTAL SPECIFICATION

PARAMETER	DESCRIPTION / CONDITION
Humidity	According to IEC 60068-2-78 operating range 10%RH-90%RH
Operating Temperature	-40°C° to +55°C (for models with Suffix S505G or higher) Linear power derating to 75% of Io nom from +55°C to +70°C Battery OTP (Icharge = 0) @ TB1, TB2 >50°C (back at 45°C)
Storage Temperature	-40 to +85°C
Vibration	IEC61373, operating, class B, 5-150 Hz, functional test, long life test
Acoustic noise emission	ISO 9296, ISO 7779, ISO 9295, Lwa = 65.6 dB-A @ full load, 25°C
Shock	IEC61373, non-operating, class B, single half-sine pulse 30/30/50 m/s^2

9 CONNECTORS

PARAMETER	CONDITIONS / DESCRIPTION	TYPE / MATING PART
Input Connector X1	4-pin terminal block	4-pin terminal block HDFK 10-HV/Z (Phoenix Contact) / Wires, max. 10 mm2, torque max. 2 Nm
Output Connector X2	3-pin terminal block	3-pin terminal block HDFK 50/Z / UW50/S * (Phoenix Contact) / Wires, max. 50 mm2, torque 3-5 Nm / 6-8 Nm *
Signal Connector X3	15-pin Combicon MSTBA 2.5	Combicon MSTB2.5/15-GF-1776825, male (Phoenix Contact) / Combicon MSTB2.5/15-STF-1786967 or FKCN2.5/15-STF-1733084, female (Phoenix Contact)
Ethernet Comm. Connector X4	4-pin M12 D-Coding Female **	4-pin M12 D-coded female 1534630 (Phoenix Contact) / 4-pin M12 D-coded male 1521258 (Phoenix Contact)
CAN Comm. Connector X5	9-pin D-SUB Male ***	9-pin D-SUB male (Harting) / 9-pin D-SUB female
CAN Comm. Connector X6	9-pin D-SUB Female ***	9-pin D-SUB female (Harting) / 9-pin D-SUB male

* For models with Suffix S505G or higher ** Not equipped with CAN option *** Not equipped with ETH option

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9.1 INPUT AC CONNECTOR X1 – PINOUT

SIGNAL NAME	PIN #	TYPE	RECOMMENDED WIRES	ABSOLUTE V MAX ABSOLUTE I MAX
Earth	⏚	Earth / Chassis	4 mm²	528 Vrms (line to line) 14/21 Arms (per line)
AC Line 1	L1	Input Power AC Fused	4 mm²	
AC Line 2	L2	Input Power AC Fused	4 mm²	
AC Line 3	L3	Input Power AC Fused	4 mm²	

9.2 OUTPUT and BATTERY CONNECTOR X2 – PINOUT

SIGNAL NAME	PIN #	TYPE	SIGNAL REFERENCE	RECOMMENDED WIRES	V MAX I MAX
Consumer +	1	Output Power DC	Common -	16/25 mm²	137.5 VDC 73/110 A
BAT +	2	Output Power DC	Common -	16/25 mm²	
Common -	3	Output Power DC		16/25 mm²	

9.3 SIGNAL CONNECTOR X3 – PINOUT

SIGNAL NAME	PIN #	TYPE	SIGNAL REFERENCE	LOW LEVEL HIGH LEVEL	V MAX I MAX
VBsense1	1	Battery Voltage Sense 1	X2, Pin 3		138 V
VBsense2	2	Battery Voltage Sense 2	X2, Pin 3		138 V
VBsense3	3	Battery Voltage Sense 3	X2, Pin 3		138 V
VBsense4	4	Battery Voltage Sense 4	X2, Pin 3		138 V
VBsense5	5	Battery Voltage Sense 5	X2, Pin 3		138 V
N.C. / VBsense6 *	6	Battery Voltage Sense 6 *	X2, Pin 3		138 V
TB1H	7	Temperature sensor 1 High ****	TB1L	Cannot withstand battery voltage!	3.3 V
TB1L	8	Temperature sensor 1 Low		Cannot withstand battery voltage!	3.3 V
TB2H	9	Temperature sensor 2 High ****	TB2L	Cannot withstand battery voltage!	3.3 V
TB2L	10	Temperature sensor 2 Low		Cannot withstand battery voltage!	3.3 V
GRS	11	Signal Ground **			
INH ***	12	Inhibit, pull high to inhibit	X2, Pin 3	Floating - 110 V	138 V
P_LIM ***	13	Power Limitation, pull high to limit	X2, Pin 3	Floating - 110 V	138 V
FA FB	14 15	Floating relay contact (normally open) Open when in fault condition, which can be defined in the Configuration file			0.4A@138Vdc

* For models with Suffix S505G or higher ** Do not connect *** On request: Optional use for unit address setting
**** For 103AT-11, Semitec or similar (NTC 10k@25°C, function R/T can be customized)

9.4 ETHERNET CONNECTOR X4 – PINOUT

SIGNAL NAME	PIN #	TYPE	SIGNAL REFERENCE	NOTE	V MAX I MAX
TxData+	1	Communication Data		10/100 Mbit	
RxData+	2	Communication Data		10/100 Mbit	
TxData-	3	Communication Data		10/100 Mbit	
RxData-	4	Communication Data		10/100 Mbit	

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9.5 CAN-BUS CONNECTOR X5, X6 – PINOUT

SIGNAL NAME	PIN #	TYPE	SIGNAL REFERENCE	NOTE	V MAX I MAX
CAN +	7	Communication Data	CAN-		
CAN -	2	Communication Data	CAN+		
GND	3	Power Supply_return		Do not use-only for servicing	
+5V	9	Power Supply	GND	Do not use-only for servicing	5.5 V / 100 mA

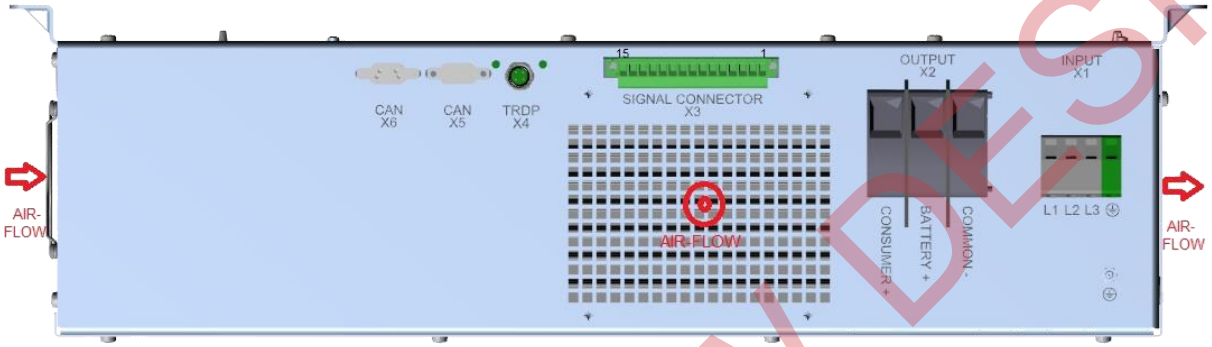

Figure 2. Connector Positions

Keep min. 10 cm free space around all airflow openings! Ensure sufficient external ventilation (do not use recirculated-air mode).

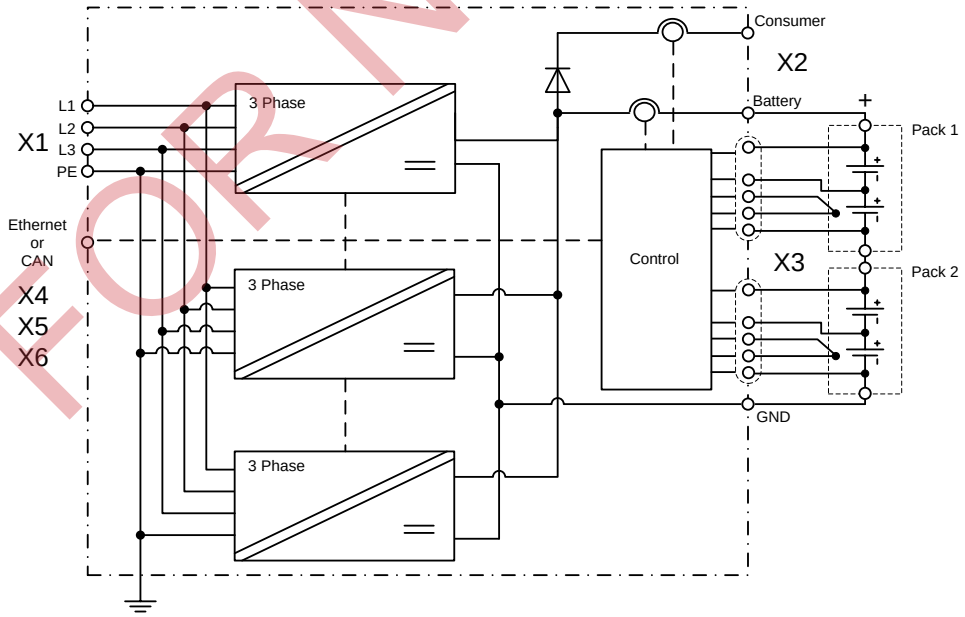

Figure 3. Connectors placement and Block Diagram of Battery Charger Rack

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10 MECHANICAL SPECIFICATIONS

PARAMETER	CONDITIONS / DESCRIPTION	
Rack Dimensions (W x D x H)	2 - 3 PSU inside the shelf with Control Unit and distribution)	347/406 x 600 x 166 mm 13.7/16 x 23.6 x 6.5 in
Weight	23.5 kg (LBC8000) / 29.7 kg (LBC12000)	
Cooling	Forced airflow - externally accessible serviceable fans (maximal power dissipation ~ 900 W)	
Insulation	Input to output Input to chassis Output to chassis Comm. signals to chassis	4.0 kVDC 2.0 kVDC 600 VDC 750 VDC
Recommended mounting position	Vertical (connectors on top)	
Enclosure	IP20	

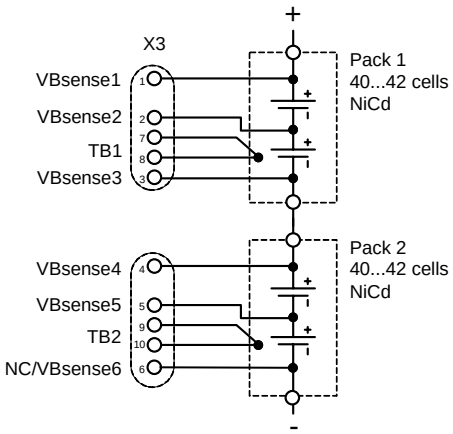

Figure 4. Battery pack sensing
(Temperature sensors TB integrated in battery pack)

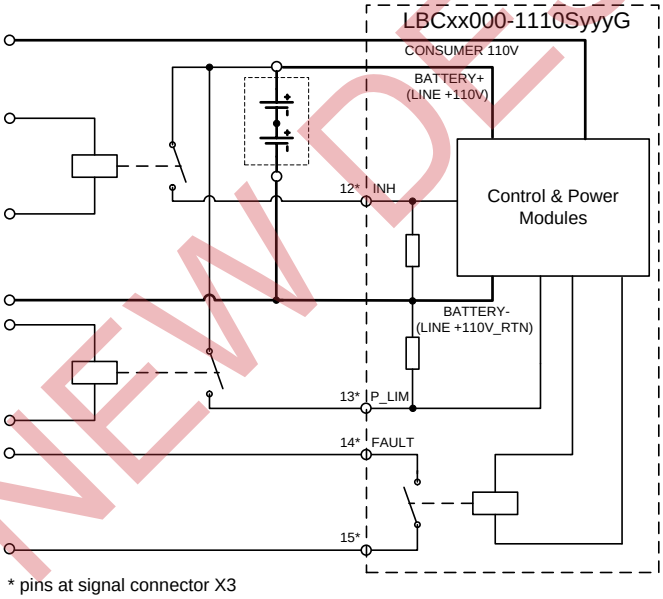

Figure 5. Static signals, connection example

This is a generic datasheet valid for all LBC basic models (see notes for exceptions). For HW and FW details / modifications of a specific model, consult the customer specific datasheet (file name: model_name.sp_revision), which describes the deviation between models, the battery specification and charging current (set in the Configuration file), connection diagram, communication protocol and the signal specification.

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For more information on these products consult: powersupport@belf.com

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