

# BCV200-700-8

## 20 kW Combo Unit System

The Bel Power Solutions BCV200-700-8 is a 20 kW combo unit system consisting of three subsystems: 15 kW bidirectional inverter/charger, 4 kW down converter (12 V), 1 kW down converter (24 V).

This all-in-one eMobility unit combines three products, creating a convenient and compact solution that helps reduce cabling.

The inverter/charger powers up to 15 kW in either direction. Features include high efficiency, high reliability, low total harmonic distortion (AC), low output voltage noise (DC), and excellent dynamic response to load/input changes.



### FEATURES

- Up to 15 kW Power in Charge and Export Mode
- Typical Efficiency 92 %
- Charge Mode
  - AC Input 100 – 240 VAC
  - HV Output 450 – 850 VDC
- Export Power Mode:
  - Output 120/240 VAC (Split phase), 50/60 Hz
- 4 kW Down Converter - 12 V Output (CAN adjustable)
- 1 kW Down Converter - 24 V Output (CAN adjustable)
- Over temperature, Output Over voltage & Over current Protection
- CAN bus serial interface
- SAE J1939 Compliant CAN Control and Monitoring
- SAE J1455 Compliant Environmental Standards
- IP67 and IP6K9K Rating

### APPLICATIONS

- Hybrid and Electric Vehicles
- Medium through heavy duty, on and off highway vehicles

## 1. MODEL SELECTION

| MODEL          | DESCRIPTION                            |
|----------------|--|
| BCV200-700-8   | Combo Unit System                      |
| BCV200-CON-KIT | Mating cable harness and connector kit |

## 2. INVERTER CHARGER SUBSYSTEM

### 2.1 AC SIDE CHARGE MODE INPUT

| PARAMETER             | DESCRIPTION / CONDITIONS   | MIN       | NOM   | MAX        | UNIT             |
|-----------------------|--|-----------|-------|------------|------------------|
| Input Voltage         | Nominal operating range<br>Absolute operating range  | 100<br>90 | 230   | 240<br>264 | VAC              |
| Input Current         | Charge mode:   |           |       | 70         | A <sub>RMS</sub> |
| Input Frequency       |  | 47        | 50/60 | 63         | Hz               |
| Leakage Current       | at 264 VAC, 63 Hz  |           |       | 10         | mA               |
| Line Harmonic Current | EN 61000-3-12, 120 VAC and 240 VAC,<br>P <sub>HV</sub> = 450 VDC * 32 ADC and P <sub>HV</sub> = 850 VDC * 17.6 ADC                       | 16        |       |            | A <sub>RMS</sub> |
| Power Factor          | V <sub>AC,IN</sub> = 240 V <sub>RMS</sub> ,<br>P <sub>HV</sub> = 450 VDC * 32 ADC and 850 VDC * 17.6 ADC                                 | 0.95      |       |            |                  |
| Inrush Current        | Pre-charge mechanism   |           |       |            |                  |
| Efficiency            | at V <sub>AC,IN</sub> = 240 V <sub>RMS</sub> , V <sub>HV</sub> = 750 VDC (nom), I <sub>HV</sub> = 20 ADC,<br>T <sub>COOLANT</sub> = 20°C |           | 92    |            | %                |

**NOTE:** The BCV200-700-8 has been specifically designed and tested to be connected to an EVSE charger or directly to the public grid. Any alternative proposals such as the use of generators must be discussed with Bel Tech Support as validation and compatibility tests may be required.

### 2.2 AC SIDE EXPORT MODE OUTPUT

| PARAMETER                 | DESCRIPTION / CONDITIONS  | MIN          | NOM      | MAX          | UNIT             |
|---------------------------|---|--------------|----------|--------------|------------------|
| Output Voltage            | Split-phase 120 / 240 VAC   | 2x 110       | 2x 120   | 2x 128       | VAC              |
| Output Current            | Export mode:<br>Phase - L1, L2<br>Neutral - N   |              | 60<br>40 |              | A <sub>RMS</sub> |
| Output Power              | at 450 – 850 VDC / 240 VAC  |              |          | 14.4         | kVA              |
| Frequency                 | CAN selectable 50 or 60 Hz<br>Mode: 50 Hz<br>Mode: 60 Hz  | 49.9<br>59.9 | 50<br>60 | 50.1<br>60.1 | Hz               |
| Efficiency                | at V <sub>HV</sub> = 750 VDC (nom), 850 VDC (max),<br>I <sub>AC,OUT1</sub> = I <sub>AC,OUT2</sub> = 55 AAC, T <sub>COOLANT</sub> = 20°C                                       |              | 92       |              | %                |
| Load Step Response        | Load Step 1<br>6 A <sub>RMS</sub> to 30 A <sub>RMS</sub> and back<br>Load Step 2<br>30 A <sub>RMS</sub> to 60 A <sub>RMS</sub> and back<br>Voltage deviation<br>Response time | -30 %        | 0        | +30 %<br>4   | VAC<br>ms        |
| Total Harmonic Distortion | at 450 – 850 VDC, Load 0 – 60 A <sub>RMS</sub>  |              |          | 3            | %                |
| Turn On/Off Delay         | Export Mode:<br>Turn-On Delay<br>Turn-Off Delay   |              |          | 3<br>1       | s                |

## 2.3 HV SIDE

| PARAMETER         | DESCRIPTION / CONDITIONS  | MIN | NOM  | MAX      | UNIT        |
|-------------------|---|-----|------|----------|-------------|
| Output Power      |   |     |      | 15       | kW          |
| Output Type       | DC current source with 100/120 Hz sine wave ripple component                                  |     |      |          |             |
| Output Voltage    | Not regulated; depends on battery voltage   | 450 | 750  | 850      | VDC         |
| Output Current    | Average output charging current adjustable via CAN<br>Including AC ripple component (AC + DC) |     |      | 32<br>42 | ADC<br>ARMS |
| Ripple            | 100/120 Hz  | 0   |      | 40       | APK         |
| Input Capacitance |   |     | 32.5 |          | μF          |

## 2.4 PROTECTIONS

| PARAMETER                                    | DESCRIPTION / CONDITIONS  | MIN | NOM       | MAX       | UNIT             |
|--|---|-----|-----------|-----------|------------------|
| AC Over Current Protection                   | Export mode: 2 s overload<br>Output phase voltage reduced to the 70 V <sub>RMS</sub>                          |     |           | 120<br>60 | ARMS             |
| AC Over Voltage Protection                   | at 264 V <sub>RMS</sub> , Hysteresis 5 V <sub>RMS</sub>   | 265 | 270       | 275       | V <sub>RMS</sub> |
| AC Under Voltage Protection                  | at 90 V <sub>RMS</sub>  |     | 83<br>88  | 85<br>90  | V <sub>RMS</sub> |
| HV Over Current Protection                   | CAN adjustable  |     |           | 32        | A                |
| HV Over Voltage Protection                   | Latch type, CAN adjustable, max. OVP duration 1 ms  | 450 |           | 850       | VDC              |
| HV Under Voltage Protection                  | UVP duration 1 s, hysteresis 20 VDC   |     | 430       |           | VDC              |
| Input & Output Fuse Protection               | AC input fuse: EVSE circuit breaker - Type C  |     | 100       |           | A                |
|  | AC output fuse: N/A   |     |           |           |                  |
|  | HV input fuse (900 VDC minimum):<br>Aux_Supply_12 V fuse: all 12 V shall be fused by external automotive fuse |     | 50<br>7.5 |           | A<br>A           |
| Over Temperature Protection                  | Converter shutdown at T <sub>COOLANT</sub> higher than  | 60  |           |           | °C               |
| Appliance Leakage Current Interrupter (ALCI) | Trip range (>30 ms inverter shut down)<br>Maximum turn off delay from ALCI trip point                         | 20  |           | 30<br>30  | mA<br>ms         |

## 3. 12 V DOWN CONVERTER

| PARAMETER                           | DESCRIPTION / CONDITIONS   | MIN | NOM | MAX  | UNIT |
|-------------------------------------|--|-----|-----|------|------|
| Output Voltage                      | Adjustable by CAN  | 9   | 12  | 14.4 | V    |
| Output Current                      | Adjustable by CAN  | 0   |     | 278  | A    |
| Continuous Power                    |  | 0   |     | 4000 | W    |
| Efficiency                          | at V <sub>OUT12</sub> = 14.4 V, V <sub>HV</sub> = 750 V, I <sub>OUT12</sub> = 278 A            |     | 90  |      | %    |
| Remote Sense                        | at V <sub>OUT12</sub> = 14.4 V cable drop at maximum load                                      |     |     | 0.5  | V    |
| Turn On/Off Delay                   | Rise time (C <sub>ext</sub> = 0 μF)  |     |     | 300  | ms   |
|                                     | Power-on-delay<br>(From applying of HV voltage + CAN & signal enables to V <sub>o</sub> = 90%) |     |     | 2    | s    |
| <b>V<sub>OUT12</sub> PROTECTION</b> |  |     |     |      |      |
| Output Over Current Protection      | Constant current   | 278 |     |      | A    |
| Output Over Voltage Protection      | Maximum OV duration 1 ms   | 17  |     |      | V    |
| Output Under Voltage Protection     | Maximum UV duration 1 s  |     |     | 8    | V    |
| Reverse Polarity Protection         | According to SAE J1455   |     |     |      |      |
| Fuse Protection                     | No internal fuse on V <sub>OUT12</sub> output  |     |     |      |      |



## 4. 24 V DOWN CONVERTER

| PARAMETER                       | DESCRIPTION / CONDITIONS  | MIN  | NOM | MAX      | UNIT    |
|---------------------------------|---|------|-----|----------|---------|
| Output Voltage                  | Adjustable by CAN   | 18   | 24  | 28.8     | V       |
| Output Current                  | Adjustable by CAN   | 0    |     | 34.7     | A       |
| Continuous Power                |   | 0    |     | 1000     | W       |
| Efficiency                      | at $V_{OUT24} = 28.8$ V, $V_{HV} = 750$ V, $I_{OUT24} = 34.7$ A   |      | 89  |          | %       |
| Turn On/Off Delay               | Rise time ( $C_{ext} = 0$ $\mu$ F)<br>Power-on-delay<br>(From applying of HV voltage + CAN & signal enables to $V_o = 90\%$ ) |      |     | 300<br>2 | ms<br>s |
| V <sub>OUT24</sub> PROTECTION   |   |      |     |          |         |
| Output Over Current Protection  | Constant current  | 34.7 |     |          | A       |
| Output Over Voltage Protection  | Maximum OV duration 1 ms  | 29   |     |          | V       |
| Output Under Voltage Protection | Maximum UV duration 1 s   |      |     | 16       | V       |
| Reverse Polarity Protection     | According to SAE J1455  |      |     |          |         |
| Fuse Protection                 | No internal fuse - electronic current limitation  |      |     |          |         |

## 5. MONITORING AND CONTROL SIGNALS

| PARAMETER           | DESCRIPTION / CONDITIONS  |
|---------------------|---|
| IGN (Key Switch)    | CAN communication enable<br>Level High = Enable   |
| Control Pilot       | Function and levels according to SAE J1772<br>Duty cycle accuracy $\pm 2\%$ in range 20 – 96%.<br>Duty cycle accuracy $-2/+5\%$ in range 10 – 20%.  |
| Proximity Detection | Function and levels according to SAE J1772  |
| VBAT                | 12 V battery voltage input (typ. input current 4.5 A, max 6 A). Used to supply internal aux converter.<br>Input protected against reverse connected battery by serial diode.                            |
| EVSE_WAKE_OUT       | Energy taken from VBAT.<br>High side switch to wake VCU (Vehicle Control Unit) and other vehicle control modules.<br>Output is protected by resettable PTC fuse.  |
| CAN_BAUD_RATE       | CAN bus speed; CAN speed settings is detected only at start up when 12 V voltage is applied.<br>500 kbit/s – signal not connected / left floating<br>250 kbit/s – signal grounded; connected to 12V_RTN |

## 6. ENVIRONMENTAL SPECIFICATIONS

| PARAMETER             | DESCRIPTION / CONDITIONS  | MIN        | NOM | MAX           | UNIT         |
|-----------------------|---|------------|-----|---------------|--------------|
| Operating Temperature | $T_{COOLANT}$ at full load<br>$T_{COOLANT}$ at 90% power derating                               | -30<br>-30 |     | +50<br>+60    | $^{\circ}$ C |
| Storage Temperature   |   | -40        |     | +85           | $^{\circ}$ C |
| Altitude              | SAE J1455, Operating:<br>Non-Operating: 18.6 kPa absolute pressure                              |            |     | 4000<br>12200 | m            |
| Humidity              | SAE J1455   |            |     |               |              |
| Thermal Shock         | SAE J1455, $T_{AMB} = -40^{\circ}$ C to $+85^{\circ}$ C (no coolant cycling)                    |            |     |               |              |
| Vibration             | Swept sine vibration MIL-STD-202G, corrected to 5G<br>Random vibration MIL-STD-202G & SAE J1455 |            |     |               |              |
| Protection            | IP67 and IP6K9K, when all matting connectors are installed,<br>and all unused pins are sealed.  |            |     |               |              |

## 7. COOLING SPECIFICATIONS

| PARAMETER                              | DESCRIPTION / CONDITIONS  |
|--|---|
| Cooling Type                           | Liquid cooled   |
| Inlet Coolant Temperature              | -30°C / +60°C (90% derating above +50°C)  |
| Coolant Medium / Mixture               | 50/50 ethylene glycol/distilled water with proper corrosion inhibitor                 |
| Coolant Volume In Cooling System       | 0.3 L   |
| Minimum / Maximum Coolant Flow         | 7 – 10 LPM, for short-term operation, 20% duty cycle, 15 LPM can be used              |
| Maximum Coolant Pressure               | 26 psig (1.8 bar)   |
| Typical Pressure Drop                  | 5.8 psig (0.4 bar) at coolant temperature +20°C                                       |
| Inlet/Outlet Cooling System Connection | 1/2" Barbed hose fittings   |
| Material Of Cooling System             | Fittings: Stainless steel AISI 304, FKM<br>Chassis: AlSi10Mg<br>Bottom cover: AlMg2.5 |

## 8. SAFETY, REGULATORY AND EMI SPECIFICATIONS

| PARAMETER                              | DESCRIPTION / CONDITIONS   | CLASS / LEVEL / CRITERION              |
|--|--|--|
| Radiated Emission                      | FCC15  | Class A                                |
| Conducted Emission                     | FCC15, CISPR 32  | Class A                                |
| Electrostatic Discharge                | IEC 61000-4-2  | Performance Criterion C                |
| Radiated Electromagnetic Field         | IEC 61000-4-3, SAE J1113/21  | Performance Criterion B<br>Status 3    |
| Electrical Fast Transient (EFT) /Burst | IEC 61000-4-4; Level 2 (± 5 kHz)   | Performance Criterion C                |
| Surge Immunity                         | IEC 61000-4-5; Level 3 surge (± 1 kV DM and ± 2 kV CM)   | Performance Criterion C                |
| RF Conducted Immunity                  | IEC 61000-4-6; Level 3 (10 V, 0.15...80 MHz, AM 80%, 1 kHz)  | Performance Criterion C                |
| Bulk Current Injection (BCI)           | ISO 11452-4; 1-400 MHz, 60 mA  | Class A                                |
| Capacitive Coupling Clamp (CCC)        | ISO 7637-3; -60 V, +40 V,  | Class A                                |
| Flicker Tests                          | IEC 61000-3-3  | Performance Criterion B                |
| Insulation (factory tested)            | AC Input to HV output:<br>AC Input to chassis:<br>HV Output to chassis:<br>Signals, 12 V Output and 24 V Output have negative terminal connected to chassis PE | 2500 VDC *<br>2500 VDC *<br>2500 VDC * |

\* Power transformers and safety insulation is designed to meet 4242 VDC (3000 VAC) between AC input and HV output and also between AC input or HV output and low voltage signals including 12 V and 24 V outputs.

## 9. CONNECTORS

| PARAMETER                          | DESCRIPTION / CONDITIONS                  | MANUFACTURER | MPN                                    |
|------------------------------------|---|--------------|--|
| AC Side Charge Connector*          | Inverter Charger side<br>Mating connector | Deutsch      | HDP24-24-7PN-C038<br>HDP26-24-7SN-C038 |
| AC Side Export Connector           | Inverter Charger side<br>Mating connector | Deutsch      | HDP24-24-9SE<br>HDP26-24-9PE-L015      |
| HV Power Connector                 | Inverter Charger side<br>Mating connector | Amphenol     | PL082X-61-6<br>PL182X-61-6             |
| V <sub>OUT12</sub> Power Connector | Inverter Charger side<br>Mating connector | Amphenol     | PL082X-301-10M8<br>PL182X-301-70       |
| Signal Connector                   | Inverter Charger side<br>Mating connector | Deutsch      | DRC13-24PA<br>DRC16-24SA               |

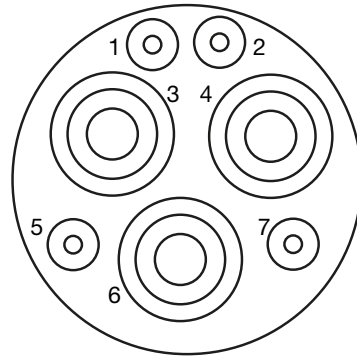
\* Connector will contain two signal pins for Control Pilot and proximity signals.



### 9.1 AC SIDE CHARGE CONNECTOR

| PIN | FUNCTION                  |
|-----|---------------------------|
| 1   | Control Pilot *           |
| 2   | Proximity*                |
| 3   | L2 or N - Input           |
| 4   | L1 - Input                |
| 5   | Not Used                  |
| 6   | PE (connected to chassis) |
| 7   | Not Used                  |

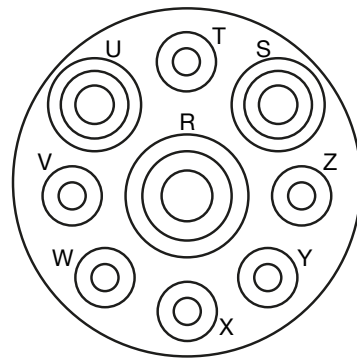
\* Function and levels according to SAE J1772;  
Insulated from AC side; Referenced to Vout12 RTN = PE



### 9.2 AC SIDE EXPORT CONNECTOR

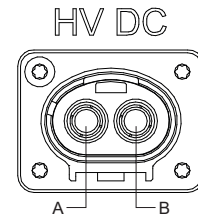
| PIN | FUNCTION                   |
|-----|----------------------------|
| R   | N - Output                 |
| S   | L1 - Output                |
| T   | PE*                        |
| U   | L2 - Output                |
| V   | PE* (connected to chassis) |
| W   | PE*                        |
| X   | PE*                        |
| Y   | PE*                        |
| Z   | PE*                        |

\* All PE terminals (T, V, W, X, Y, Z) shall be connected together to keep safety rating requirements.



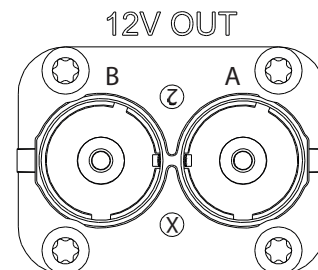
### 9.3 HV POWER CONNECTOR

Terminal A – HVDC + (High voltage positive)  
Terminal B – HVDC – (High voltage negative)



### 9.4 V<sub>OUT12</sub> POWER CONNECTOR

Terminal A – Vout12+  
Terminal B – Vout12- (Return - connected to chassis)



9.5 SIGNAL CONNECTOR

| PIN | FUNCTION          |   |
|-----|-------------------|---|
| 1   | Vout24+           | +24 V output  |
| 2   | Vout24+           | +24 V output  |
| 3   | Control Pilot Out | Copy of Control Pilot                                 |
| 4   | +SENSE Vout12     | Remote sense for Vout12                               |
| 5   | Reserved          | NA  |
| 6   | CAN_L_int         | Internal CAN - for production purpose, DO NOT CONNECT |
| 7   | Vout24+           | +24 V output  |
| 8   | Vout24+           | +24 V output  |
| 9   | VBAT              | 12 V supply of internal Bias                          |
| 10  | HVIL_OUT          | HVIL loop OUT   |
| 11  | IGN               | (Key Switch) Supply of CAN and Bias convertor enable. |
| 12  | CAN_H_int         | Internal CAN - for production purpose, DO NOT CONNECT |
| 13  | Vout24-           | 24 V and VBAT RTN (connected to chassis)              |
| 14  | Vout24-           | 24 V and VBAT RTN (connected to chassis)              |
| 15  | VBAT              | 12 V supply of internal bias                          |
| 16  | HVIL_IN           | HVIL loop IN  |
| 17  | CAN_BAUD_RATE     | Open – 500 kBit; Grounded – 250 kbit                  |
| 18  | CAN_H             | CAN Bus H   |
| 19  | Vout24-           | 24 V and VBAT RTN (connected to chassis)              |
| 20  | Vout24-           | 24 V and VBAT RTN (connected to chassis)              |
| 21  | Reserved          | NA  |
| 22  | -SENSE Vout12     | Remote sense for Vout12                               |
| 23  | EVSE_WAKE_OUT     | Signal to wake up Vehicle Control Unit (VCU module)   |
| 24  | CAN_L             | CAN Bus L   |

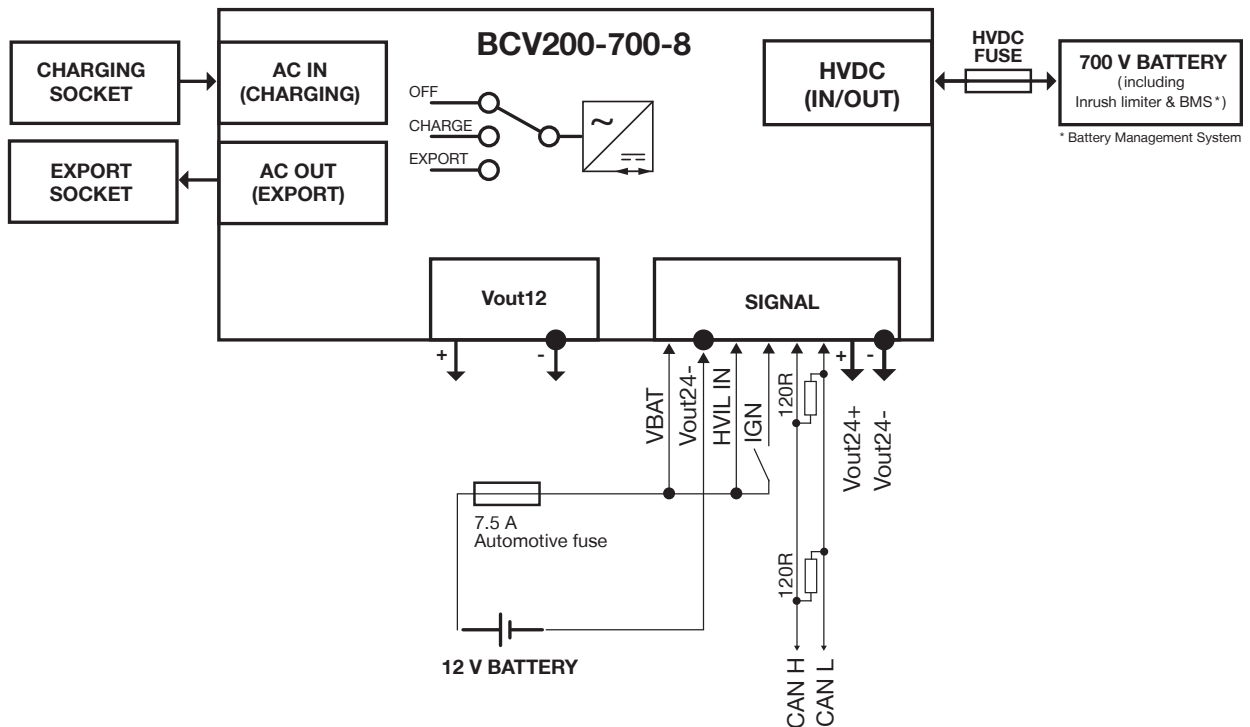
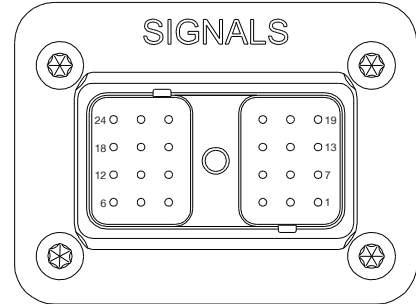


Figure 1. Schematic diagram



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## 10. MECHANICAL SPECIFICATIONS

| PARAMETER          | DESCRIPTION / CONDITIONS                | UNIT     |
|--------------------|---|----------|
| Dimensions         | 650 x 100 x 491<br>25.59 x 3.94 x 19.33 | mm<br>in |
| Weight             | 35.7                                    | kg       |
| Enclosure Material | Aluminum alloy, AISi10Mg                |          |

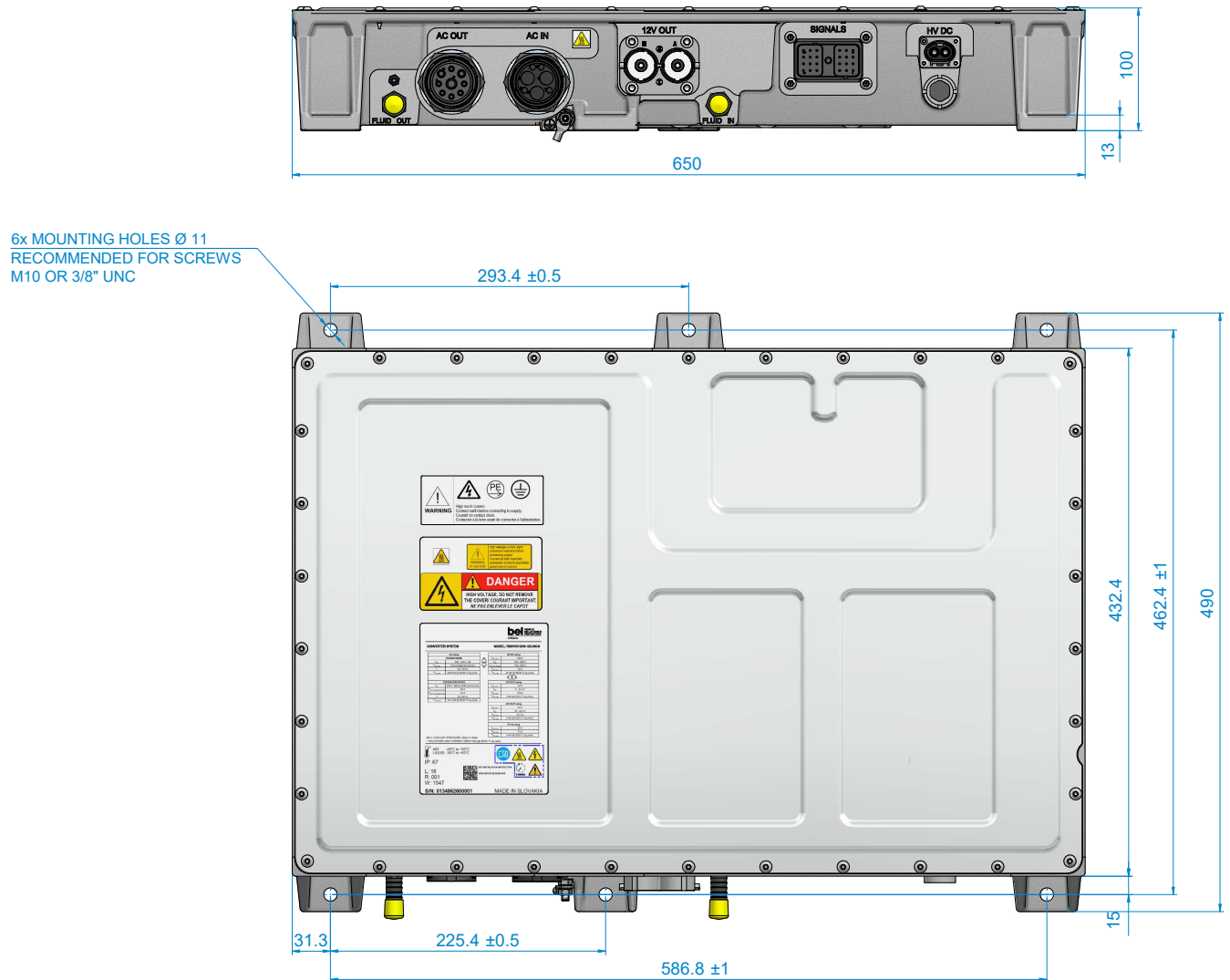


Figure 2. Mechanical Drawing

For more information on these products consult: [tech.support@psbel.com](mailto:tech.support@psbel.com)

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