

350INVCH150-120-240-xG

Bidirectional Inverter Charger

The Bel Power Solutions 350INVCH150-120-240-xG is a 15 kW inverter charger that converts AC to DC voltages in charge mode and converts DC voltages to pure sine wave AC to power AC accessories. The liquid cooled inverter charger operates at 250-435 VDC and 120/240 VAC (50/60 Hz) split-phase.

The inverter charger powers up to 15 kW in either direction.

Features include very high efficiency, high reliability, low total harmonic distortion (AC), low output voltage noise (DC), and excellent dynamic response to load/input changes.



Key Features & Benefits

- Up to 15 kW Power in Charge and Export Mode
- 90 % Typical Efficiency
- Charge Mode Output 250-435 VDC
- Export Power Mode Output 120/240 VAC - 50/60 Hz
- J1939 Compliant CAN Control and Monitoring
- Over-temperature, Output Over-voltage and Over-current Protection
- SAE 1455 Complaint Environmental Standards
- IP65 and IP67 Rating

Applications

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



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1. MODEL SELECTION

| MODEL | DESCRIPTION |
|------------------------|---|
| 350INVCH150-120-240-8G | Inverter Charger |
| 350INVCH150-CON-KIT-8G | Connector Kit with 3m long HV DC cable attached to DC matting connector |
| 350INVCH150-CON-KIT-9G | Connector Kit including DC matting connector but without HV DC cable |

2. CHARGE MODE INPUT

| PARAMETER | DESCRIPTION / CONDITION | MIN | NOM | MAX | UNIT |
|--------------------------|---|-----------------|---------|-----|------|
| Input Voltage | Nominal Operating Range | 100 | 230 | 240 | VAC |
| | Absolute Operating Range | 90 | | 264 | |
| Input Current | Charge Mode: | | | 70 | Arms |
| | | @ 195 – 265 VAC | | 16 | |
| | @ 90 – 195 VAC | | | | |
| Frequency | | 47 | 50 / 60 | 63 | Hz |
| Input Line Under-voltage | Charge Mode: Inverter Shutdown | 83 | 85 | 88 | VAC |
| Input Capacitance | | | | 100 | μF |
| Leakage Current | @ 265 VAC, 60 Hz | | | 10 | mA |
| Line Harmonic Current | EN 61000-3-12 | | | | |
| Inrush Current | Pre-charge Mechanism | | | | |
| Power Factor | @ Vin = 240 VAC, Poset = 250 VDC*40 ADC and 435 VDC*34 ADC | 0.98 | | | |

3. CHARGE MODE OUTPUT

| PARAMETER | DESCRIPTION / CONDITION | MIN | NOM | MAX | UNIT |
|-------------------|---|---|--------|--------|------|
| Output Type | DC current source with 120 Hz sine wave ripple component | | | | |
| Output Voltage | Not regulated; depends on battery voltage | 250 | 375 | 435 | VDC |
| Output Current | Average output current adjustable via CAN | | | 40 | ADC |
| Output Power | @ 240 VAC / 250 VDC | | | 10 | kW |
| | @ 240 VAC / >375 VDC | | | 15 | |
| Efficiency | @ Vin = 240 VAC, Vo = 375 VDC Io = 40 ADC | 88 | 90 | | % |
| Static Regulation | Charge Mode: Set Point Accuracy @ Idcset = 30 A, Load in voltage Mode, Tcoolant = 25°C | | | + 1 | ADC |
| | | Thermal Drift after 15 min warm up period | - 0.05 | + 0.05 | |
| Turn-On/Off Delay | Charge Mode: Turn-On Delay | | | 3 | s |
| | | Turn-Off Delay | | 1 | |

4. EXPORT MODE INPUT

| PARAMETER | DESCRIPTION / CONDITION | MIN | NOM | MAX | UNIT |
|--------------------------|---|-----|-----|-----|------|
| Input Voltage | | 250 | 375 | 435 | VDC |
| Input Current | Average Input current | | | 40 | ADC |
| Input Line Under-voltage | Export Mode: Inverter shutdown | | | 240 | VDC |
| Inrush Current | External pre-charging circuit is required as part of battery management system. | | | | |
| Input Capacitance | | | | 400 | μF |

5. EXPORT MODE OUTPUT

| PARAMETER | DESCRIPTION / CONDITION | MIN | NOM | MAX | UNIT | |
|-------------------------------|--|------------------------------------|--------------|------------|--------------|----|
| Output Voltage | Split-phase 120 / 240 VAC | 2x 112 | 2x 120 | 2x 128 | VAC | |
| Output Current | Export Mode: Phase - L1, L2 Neutral - N | | | 60 40 | Arms | |
| Output Power | @ >375 VDC / 240 VAC | | | 14.4 | kVA | |
| Frequency | CAN selectable 50 or 60 Hz | Mode: 50 Hz Mode: 60 Hz | 49.9 59.9 | 50 60 | 50.1 60.1 | Hz |
| Efficiency | @ 250 VDC, 435 VDC, IAC1 = IAC2 = 60 Arms | 88 | 90 | | % | |
| Load Regulation | Export Mode: @ 250 VDC, 435 VDC | - 8 | 0 | + 8 | VAC | |
| Load Step Response | Load step 30 Arms IAC1 = IAC2 Minimum IAC1 = IAC2 = 6 Arms | Voltage deviation Response time | - 30% 0 | + 30% 4 | VAC ms | |
| Periodic and Random Deviation | Export Mode: @ 120 VAC / 60 Arms | - 3.5 | | + 3.5 | Vpk | |
| Total Harmonic Distortion | @ 250, 435 VDC; Load 0 – 60 Arms | | | 3 | % | |
| GFCI | Leakage current threshold @ 120 VAC, 60 Hz Reaction time | | 25 | 30 30 | mA ms | |
| Turn-On/Off Delay | Export Mode: Turn-On Delay Turn-Off Delay | | | 3 1 | s | |

6. PROTECTION SPECIFICATIONS

| PARAMETER | DESCRIPTION / CONDITION | MIN | NOM | MAX | UNIT |
|------------------------------------|---|-----|-----|-----------|------|
| Output Over-Current Protection | Export Mode: 10s Over-Load Phase - L1, L2 Neutral - N | | | 120 60 | Arms |
| Short Circuit Survival - Operating | Self-protecting; Hiccup mode | | | | |
| Output Over-Voltage Protection | Charge Mode: Latch type, CAN adjustable, max. OV Duration 1ms Export Mode: Latch type, max. OV Duration 8.33 ms | 250 | | 435 | VDC |
| Output Under-Voltage Protection | Charge Mode: Latch type, CAN adjustable, max. UV Duration 1.0 s Export Mode: UV Duration 1.0 s | 140 | | 150 | VAC |
| Over-Temperature Protection | Converter shutdown at T_coolant higher than | 250 | | 435 | VDC |
| Input Overvoltage Protection | Charge Mode: Export Mode: | 85 | | 95 | VAC |
| | | 65 | | | °C |
| | | 272 | | 288 | VAC |
| | | 432 | | 448 | VDC |

7. MONITORING AND CONTROL SIGNALS

| PARAMETER | DESCRIPTION / CONDITION |
|---------------------|---|
| IGN (Key Switch) | CAN communication enable Level High = Enable |
| Control Pilot | Function and levels according to SAE J1772 |
| Proximity Detection | Function and levels according to SAE J1772 |
| LED1 | PWM current source max 50mA. Supplied from battery voltage input (VBAT 12V) PWM controlled with CAN bus. |
| LED2 | PWM current source max 50mA. Supplied from battery voltage input (VBAT 12V) PWM controlled with CAN bus. |
| VBAT | 12V battery voltage input. Used to supply CAN bus communication |
| EVSE_WAKE_OUT | Energy taken from VBAT. Voltage level is approximately 1.5V below connected VBAT. High side output wake VCU and other vehicle control modules and/or relay coils. Wake output goes high when control pilot is active and goes low when CAN command from VCU is received or in sleep Mode. |
| LCD_SCL / LCD_SDA | I ² C for communication with display; 5V logic level; max 100kHz |
| GFCI_LED | PWM current source max 50mA for supply of LED (GFCI status) |
| GFCI_RST | If signal is pulled up to 12V for >5ms GFCI will reset |
| CAN_BAUD_RATE | CAN bus speed; Open – 500 kBit / Grounded – 250 kbit |

8. SAFETY, REGULATORY AND EMI SPECIFICATIONS

| PARAMETER | DESCRIPTION / CONDITION | CRITERION |
|--|--|-----------------------------------|
| Insulation | Signals to AC | Basic 2250 VDC |
| | Signals to DC | Basic 2500 VDC |
| | AC to DC | Reinforced 2500 VDC |
| | Signals RTN to PE | Electrically connected * |
| Radiated Emission | FCC15 | Class A |
| Conducted Emission | FCC15, CISPR 22, EN 55022 | Class A |
| Electrostatic Discharge | IEC 61000-4-2 | Performance Criterion B |
| Radiated Electromagnetic Field | IEC 61000-4-3, SAE J1113/21 | Performance Criterion B, Status 2 |
| Electrical Fast Transient (EFT) /Burst | IEC 61000-4-4; Level 2 (+/-2 kV, 5 kHz) | Performance Criterion B |
| Surge Immunity | IEC 61000-4-5; Level 3 surge (+/-1 kV DM and +/-2 kV CM) | Performance Criterion B |
| RF Conducted Immunity | IEC1000-4-6; Level 3 (10V, 0.15...80 MHz, AM 80%, 1 KHz) | Performance Criterion A |
| Flicker Tests | IEC 61000-3-3 | |
| Electrical Transient Conduction along Supply Lines | ISO 7637-2, ISO 16750-2 | |

* Due to referencing of Control Pilot and Proximity against PE/chassis (SAE J1772)

9. ENVIRONMENTAL SPECIFICATIONS

| PARAMETER | DESCRIPTION / CONDITION | MIN | NOM | MAX | UNIT |
|-----------------------|---|-----|-----|-------|------|
| Altitude | Non-Operating:18.6 kPa absolute pressure | | | 12200 | m |
| Operating Temperature | Liquid cooled: T_coolant with power derating | -40 | | +60 | °C |
| | (100% Full Power @ +50°C; 90% Full Power @ +60°C) | | | | |
| | T_ambient @ full load, with no power derating | -40 | | +85 | °C |
| Storage Temperature | | -40 | | +95 | °C |
| Humidity | SAE J1455 | | | | |
| Shock | SAE J1455, GMW-3172 | | | | |
| Vibration | SAE J1455, GMW-3172 | | | | |
| Protection | IP65 and IP67 / when all matting connectors are installed | | | | |

10. CONNECTORS

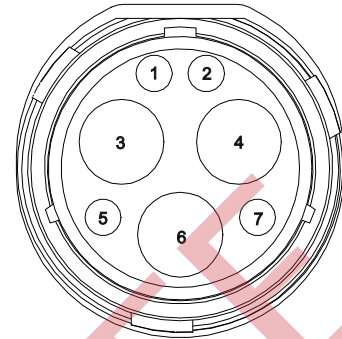
| PARAMETER | DESCRIPTION / CONDITION | MANUFACTURER | MPN |
|----------------------|-------------------------|----------------------|-----------------------|
| AC Input Connector | Inverter Charger side | MFG: Deutsch | HDP24-24-7PN-C038 |
| | Mating connector | MFG: Deutsch | HDP26-24-7SN-C038 |
| AC Output Connector | Inverter Charger side | MFG: Deutsch | HDP24-24-9SE |
| | Mating connector | MFG: Deutsch | HDP26-24-9PE-L015 |
| DC Power Connector * | Inverter Charger side | MFG: TE Connectivity | 1-2141272-1 (HVA-630) |
| | Mating connector | MFG: TE Connectivity | 2177140-3 |
| Signal Connector 1 | Inverter Charger side | MFG: TE Connectivity | 776087-5 |
| | Mating connector | MFG: TE Connectivity | 770680-5 |
| Signal Connector 2 | Inverter Charger side | MFG: TE Connectivity | 776087-1 |
| | Mating connector | MFG: TE Connectivity | 770680-1 |

* HVIL_In and HVIL_OUT signals are connected directly to SIGNAL 2 connector. Signals are insulated from HV DC side. Signals are insulated from 12V_RTN up to 60 VDC basic insulation.

10.1 AC INPUT CONNECTOR

| PIN | FUNCTION |
|-----|-----------------|
| 1 | Control Pilot* |
| 2 | Proximity* |
| 3 | L1 – Input |
| 4 | L2 or N - Input |
| 5 | Not Used |
| 6 | PE |
| 7 | Not Used |

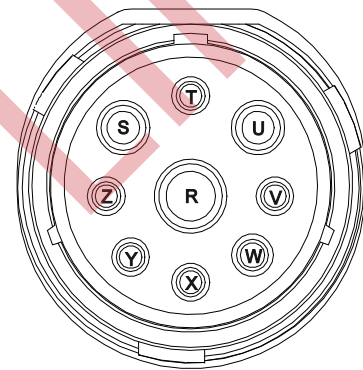
* Functions and levels according SAE J1772;
Insulated from AC side; Referenced to 12V_RTN



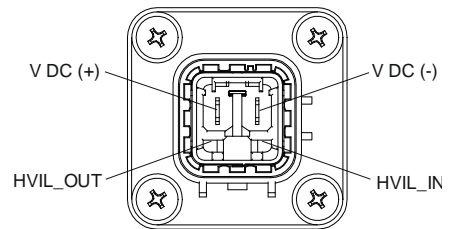
10.2 AC OUTPUT CONNECTOR

| PIN | FUNCTION |
|-----|-------------|
| R | N - Output |
| S | L1 - Output |
| T | PE* |
| U | L2 - Output |
| V | PE* |
| 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.

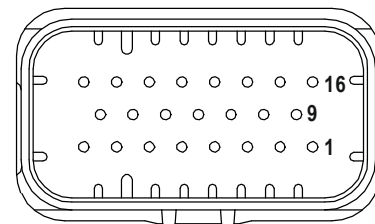


10.3 DC INPUT / OUTPUT CONNECTOR



10.4 SIGNAL 1

| PIN | NAME | FUNCTION | AMPS PER PIN |
|---------|-----------|---|--------------|
| 1 | LCD_SCL | I ² C_SCL for Display | 2 (AWG20) |
| 2 | LCD_SDA | I ² C_SDA for Display | 2 (AWG20) |
| 3 | GFCI_LED | GFCI status signal | 2 (AWG20) |
| 4 | GFCI_RST | Pin to connect external GFCI reset button (Button connected to +12V) | 2 (AWG20) |
| 5 | 12V_BAT | Connected to connector 2 pin 3 | 2 (AWG20) |
| 6 | 12V_RTN | Return for 12V battery and signals Connected with connector 2 pin 10 | 2 (AWG20) |
| 7 | SWITCH_IN | Loop to connector 2 pin 14 | 2 (AWG20) |
| 8 | ALARM_OUT | Loop from connector 2 pin 13 | 2 (AWG20) |
| 9 | IGN | Loop from connector 2 pin 12 | 2 (AWG20) |
| 10 - 23 | NA | | |



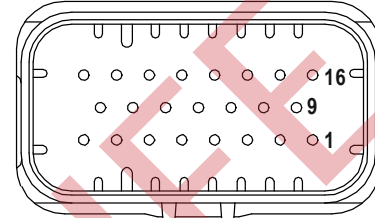
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10.5 SIGNAL 2

| PIN | NAME | FUNCTION | AMPS PER PIN |
|-------|---------------|---|--------------|
| 1 | LED_1 | Charger status LED1 | 2 (AWG20) |
| 2 | LED_2 | Charger status LED2 | 2 (AWG20) |
| 3 | VBAT | 12V battery voltage input | 2 (AWG20) |
| 4 | CANH_1 | CAN Bus H | 2 (AWG20) |
| 5 | CANL_1 | CAN Bus L | 2 (AWG20) |
| 6 | HVIL_1 | HVIL from DC connector (HVIL_IN) | 2 (AWG20) |
| 7 | HVIL_2 | HVIL from DC connector (HVIL_OUT) | 2 (AWG20) |
| 8 | CANH_2 | CAN Bus H (connected to pin 4) | 2 (AWG20) |
| 9 | CANL_2 | CAN Bus L (connected to pin 5) | 2 (AWG20) |
| 10 | 12V_RTN | Return for 12V battery and signals | 2 (AWG20) |
| 11 | EVSE_WAKE_OUT | Signal to wake up Vehicle Control Unit (VCU module) | 2 (AWG20) |
| 12 | IGN | (Key Switch) Supply of CAN and Bias converter enable. | 2 (AWG20) |
| 13 | ALARM_IN | Loop to connector 1 pin 8 | 2 (AWG20) |
| 14 | SWITCH_OUT | Loop from connector 1 pin 7 | 2 (AWG20) |
| 15 | EVSE_WAKE_OUT | Connected to pin 11 | 2 (AWG20) |
| 16 | NA | | 2 (AWG20) |
| 17 | CAN_BAUD_RATE | Open – 500 kBit; Grounded – 250 kbit | 2 (AWG20) |
| 18-23 | NA | | |



11. COOLING SPECIFICATIONS

| PARAMETER | DESCRIPTION / CONDITION |
|--|---|
| Cooling Type: | Liquid cooling |
| Coolant Medium/Mixture: | 50/50 Glycol/Water |
| Coolant Flow: | Min.11.4 LPM * |
| Max. coolant pressure: | 15 psi |
| Max. pressure drop: | 3 psi |
| Inlet/Outlet Coolant Connection: | SAE fittings with outer thread 1-14UNS for internal hose size $\geq 5/8"$ (e.g. Parker p/n: 10F5OMLOSS) |
| Material of fittings: | Stainless steel |
| Fittings provided with inverter charger: | 2pcs Parker p/n: 10F5OMLOSS or equivalent |

* A minimum flowrate 9 LPM is permissible at $T_{coolant} \leq 40^{\circ}\text{C}$.

12. MECHANICAL SPECIFICATIONS

| PARAMETER | CONDITIONS / DESCRIPTION |
|------------------------|--------------------------|
| Dimensions (W x H x D) | 605 x 160 x 344 mm |
| Weight | 36 kg |
| Enclosure Material | Aluminum alloy |

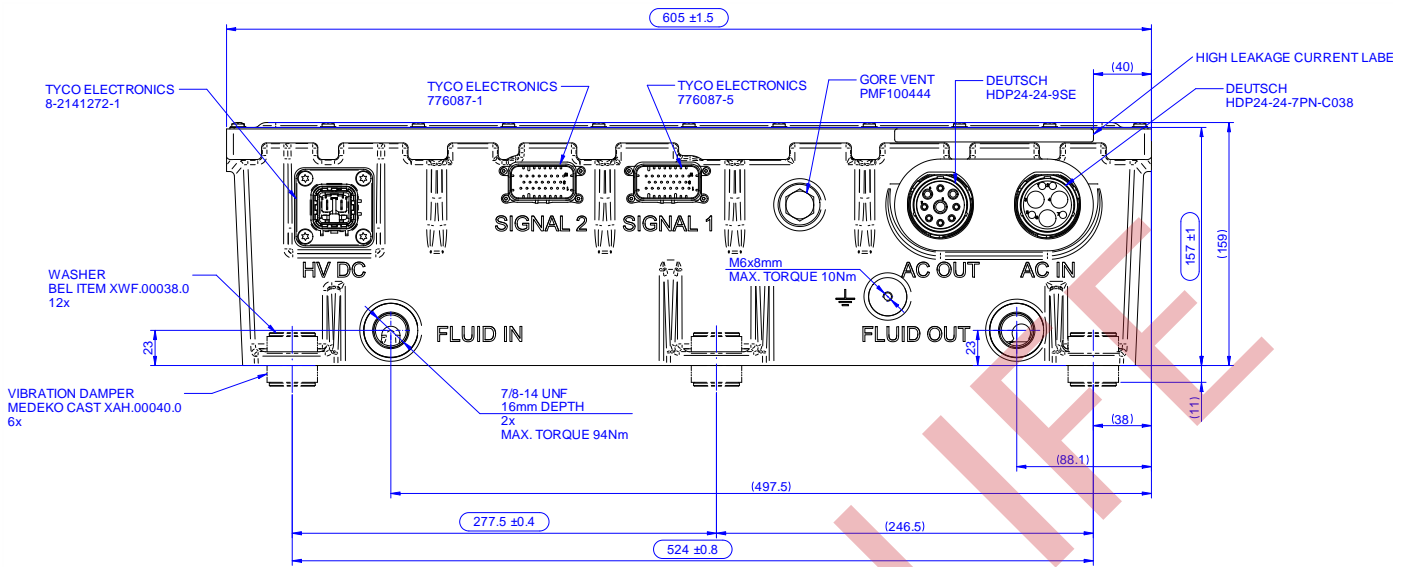


Figure 1. Mechanical Dimensions – Front View

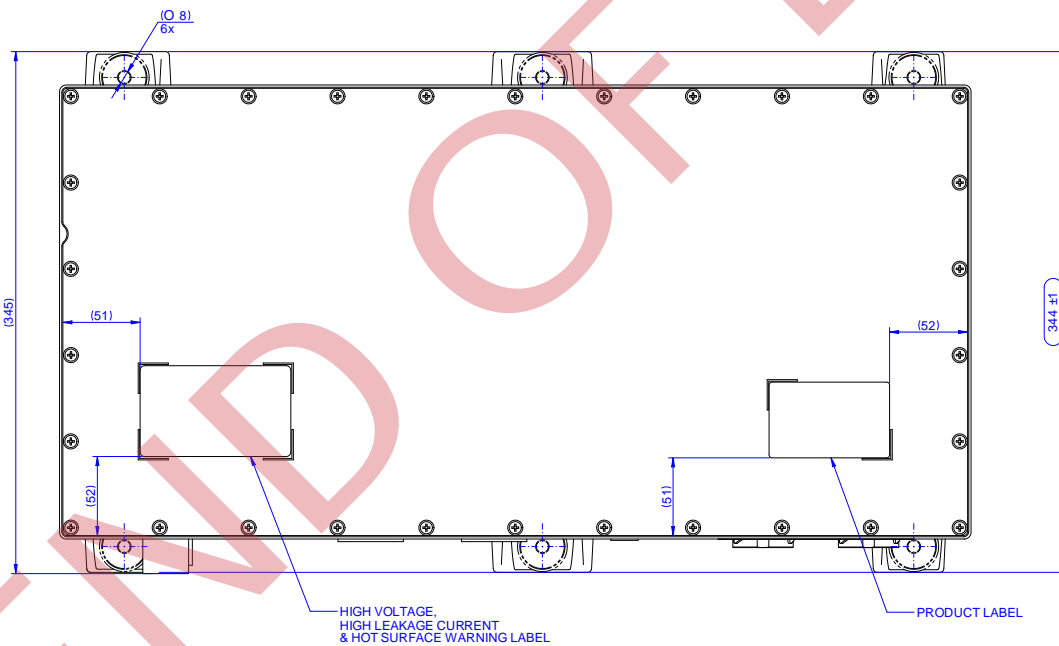


Figure 2. Mechanical Dimensions – Top View

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