

# 350DNC40-12 Series

## DC-DC Converter

The Bel Power Solutions 350DNC40-12 Series is a 4 kW DC/DC converter that converts HVDC voltages in hybrid and electric vehicles to LVDC voltages suitable to power low voltage (12/24 VDC) accessories.

Liquid or convection cooled DC/DC converter operates at input voltages from 240 to 430 VDC and delivers power range up to 4000 W / 3300 W (liquid / convection cooled model).

Features include very high efficiency, high reliability, low output voltage noise, and excellent dynamic response to load/input changes.



### Key Features & Benefits

- Input voltage range: 240-430 VDC (300-450 VDC)
- Typical efficiency up to 93 %
- Up to 4 kW power (max. 16 kW)
- Full galvanic isolation between input and output
- Liquid or convection cooling
- CAN bus serial interface
- Adjustable output voltage
- Over temperature, output overvoltage and overcurrent protection, input and output reverse polarity protection
- Protection degree IP65 and IP67
- E-mark compliant

### Applications

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

## 1. MODEL SELECTION

| MODEL               | DESCRIPTION                                                                                      |
|---------------------|--------------------------------------------------------------------------------------------------|
| 350DNC40-12-8G      | Liquid cooled model                                                                              |
| 350DNC40-12-8S103G  | Liquid cooled model                                                                              |
| 350DNC40-12-CG      | Convection cooled model                                                                          |
| 350DNC40-CON-KIT-8G | Mating connectors kit – Signal connector housing and pins, HV connector assembled with 3 m cable |
| 350DNC40-CON-KIT-9G | Mating connectors kit - housing and pins                                                         |

## 2. INPUT SPECIFICATIONS

| PARAMETER               | DESCRIPTION / CONDITION                                                  | MIN        | NOM | MAX        | UNIT |
|-------------------------|--------------------------------------------------------------------------|------------|-----|------------|------|
| Input Voltage           | 350DNC40-12-8G / 350DNC40-12-CG<br>350DNC40-12-8S103G                    | 240<br>300 | 350 | 430<br>450 | VDC  |
| Input Current           | 350DNC40-12-8G / 350DNC40-12-CG<br>350DNC40-12-8S103G                    |            |     | 19<br>16   | ADC  |
| Efficiency              | @ Vin = 350 VDC, Vo = 14.4 V, I <sub>nom</sub> = 278 A                   | 92         |     |            | %    |
| Input Line Interruption | Converter shutdown 350DNC40-12-8G / 350DNC40-12-CG<br>350DNC40-12-8S103G |            |     | 240<br>300 | VDC  |
| Input Capacitance       |                                                                          |            | 30  |            | μF   |
| Inrush current          | External pre-charging circuit required                                   |            |     |            |      |

## 3. OUTPUT SPECIFICATIONS

| PARAMETER                     | DESCRIPTION / CONDITION                                                                                                                                                      | MIN     | NOM          | MAX            | UNIT         |
|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|--------------|----------------|--------------|
| Output Voltage                | Vo trimmed via CAN BUS, 10 bit res 350DNC40-12-8G / 350DNC40-12-CG<br>350DNC40-12-8S103G                                                                                     | 9       | 14.4<br>13.0 | 16             | VDC          |
| Output Current                | Liquid cooled model<br>Convection cooled model                                                                                                                               |         | 278<br>229   |                | ADC          |
| Output Power                  | Liquid cooled model<br>Convection cooled model                                                                                                                               |         |              | 4000<br>3300   | W            |
| Line Regulation               | V <sub>inmin</sub> - V <sub>inmax</sub> , @ 139 A, T <sub>coolant</sub> = 70°C                                                                                               | - 0.1   |              | + 0.1          | VDC          |
| Load Regulation               | I <sub>out</sub> 10 to 90% load, T <sub>coolant</sub> = 70°C                                                                                                                 | - 0.075 |              | + 0.075        | VDC          |
| Output Voltage Set Point      | @ 139A, T <sub>coolant</sub> = 25°C                                                                                                                                          | 14.35   | 14.4         | 14.45          | VDC          |
| Thermal Drift                 |                                                                                                                                                                              | - 0.05  |              | + 0.05         | %/°C         |
| Periodic and Random Deviation | @ 14.4 VDC / Nominal load (Differential Mode 20 MHz)<br>CAN high / low (Differential Mode 20 MHz)                                                                            |         |              | 280 *<br>300 * | mVp-p        |
| Transient Response            | Load step 1: 10 to 50 % and back<br>Load step 2: 50 to 100 % and back<br>Voltage over/under shoot:<br>Response time within 1 % of VoSET:                                     | -1000   |              | +1000<br>1000  | mV<br>μs     |
| Turn-on Overshoot             | V <sub>onom</sub> , <100 ms                                                                                                                                                  | 5       |              |                | %            |
| Redundant Parallel Operation  | Up to 4 converters operating in parallel                                                                                                                                     |         |              | 16             | kW           |
| Remote Sense                  | Cable Drop (V) @ Maximum Load                                                                                                                                                |         |              | 0.5            | V            |
| Turn-On Delay                 | Rise time (C <sub>ext</sub> = 0 μF)<br>Power-on-delay (From applying DC input voltage to Vo = 90 %)<br>Power-on-time from PS_WAKE UP (From PS_WAKE UP ON to Vo = 90% of nom) |         |              | 200<br>1<br>3  | ms<br>s<br>s |
| Turn-Off Timing               | PS_WAKEUP delay; (monotonic Vo fall)                                                                                                                                         | 0       |              | 100            | ms           |
| Capacitive Load               | @ 14.4 VDC                                                                                                                                                                   |         | 0            | 7200           | μF           |

\* With external capacitors 47 μF (Electrolytic cap) & 1 μF (X7R Ceramic cap) connected to measuring point

#### 4. PROTECTION SPECIFICATIONS

| PARAMETER                                    | DESCRIPTION / CONDITION                                                                        | MIN        | NOM        | MAX        | UNIT |
|----------------------------------------------|------------------------------------------------------------------------------------------------|------------|------------|------------|------|
| Output Over-Current Protection               | Constant current<br>Liquid cooled model<br>Convection cooled model                             |            | 285<br>235 |            | A    |
| Output Over-Voltage Protection               | Latch type, max. OV duration 1ms                                                               | 17         |            | 18         | V    |
| Output Under-Voltage Protection              | Max. UV duration 1s, than hiccup                                                               | 6          |            | 8          | V    |
| Over-Temperature Protection                  | Converter shutdown<br>Liquid cooled model<br>Convection cooled model                           | 80<br>50   |            |            | °C   |
| Input and Output Reverse Polarity Protection | Protective elements connected in series                                                        |            |            |            |      |
| Input Fuse Protection                        | DC Input: internal primary fuse                                                                |            | 25         |            | A    |
| Input Low Line Protection                    | Turn ON threshold<br>Turn OFF threshold                                                        | 250<br>235 | 255<br>240 | 260<br>245 | VDC  |
| Input Overvoltage Protection                 | Recovery: Vin re-cycling or PS_WAKEUP<br>350DNC40-12-8G / 350DNC40-12-CG<br>350DNC40-12-8S103G | 435<br>455 |            | 450<br>465 | V    |

#### 5. MONITORING AND CONTROL SIGNALS

| PARAMETER            | DESCRIPTION / CONDITION                                                     | CRITERION                                         |
|----------------------|-----------------------------------------------------------------------------|---------------------------------------------------|
| CAN BUS SAE J1939    | 250 kBit/s or 500 kBit/s available                                          |                                                   |
| Remote sense signals | Sense positive (+ SENSE)<br>Sense negative (- SENSE)                        | 0.5 V compensation                                |
| Address bits         | Internally pulled up to LOGIC HIGH (3.3 V, 100 kohm)                        | Adr. 0<br>Adr. 1                                  |
| PS_WAKEUP            | Logic input signal                                                          | +12 V                                             |
| HVIL function        | HVIL pins shorted internally                                                | Part of HV connector                              |
| CAN_SPEED            | CAN speed selection<br>Internally pulled up to LOGIC HIGH (3.3 V, 100 kohm) | Logic Low – 250 kBit/s<br>Logic High – 500 kBit/s |

#### 6. SAFETY, REGULATORY AND EMI SPECIFICATIONS

| PARAMETER                      | DESCRIPTION / CONDITION                                                          | CRITERION                                    |
|--------------------------------|----------------------------------------------------------------------------------|----------------------------------------------|
| Safety certification           | Report number: E13*10R00*10R05*13824*00                                          | E-mark**                                     |
| Insulation                     | Basic: 3000 VDC<br>Basic: 3000 VDC                                               | Input-to-Protective Earth<br>Input-to-Output |
| Radiated Emission              | UN ECE R10 4th Edition                                                           | ESA level                                    |
| Electrostatic Discharge        | IEC 61000-4-2                                                                    | Performance Criterion B                      |
| Radiated Electromagnetic Field | IEC 61000-4-3 (10 V/m),<br>SAE J1113/21(100 V/m)                                 | Performance Criterion B<br>Class B           |
| Electrical Fast Transient      | IEC 61000-4-4, Level 2 (+/-2 kV, 2.5 kHz)<br>ISO 7637-2; ISO 7637-3, ISO 16750-2 | Performance Criterion B                      |
| RF Conducted Immunity          | Level 3 (10 V, 0.15...80 MHz, AM 80%, 1kHz)                                      | Performance Criterion A                      |
| RF Disturbances Immunity       | SAE J1113-41<br>ISO11452-4 (1-400 MHz, 60 mA)                                    | Class A<br>Class B                           |

\*\* Excluding 350DNC40-12-8S103G model.

## 7. ENVIRONMENTAL SPECIFICATIONS

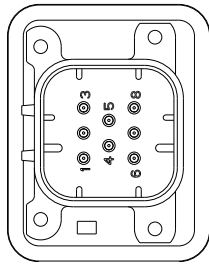
| PARAMETER             | DESCRIPTION / CONDITION                         | MIN | NOM | MAX   | UNIT |
|-----------------------|-------------------------------------------------|-----|-----|-------|------|
| Altitude              | Operating: 62 kPa absolute pressure             |     |     | 3600  | m    |
|                       | Non-Operating: 18.6 kPa absolute pressure       |     |     | 12200 |      |
| Operating Temperature | Liquid cooled: T_coolant with no derating       | -40 |     | +70   | °C   |
|                       | T_amb @ full load, with no power derating       | -40 |     | +85   |      |
|                       | Convection cooled: T_amb with no power derating | -40 |     | +45   |      |
| Storage Temperature   |                                                 | -40 |     | +95   | °C   |
| Humidity              | SAE J1455                                       |     |     |       |      |
| Shock                 | SAE J1455                                       |     |     |       |      |
| Vibration             | SAE J1455, MIL-STD-202G                         |     |     |       |      |

## 8. CONNECTORS

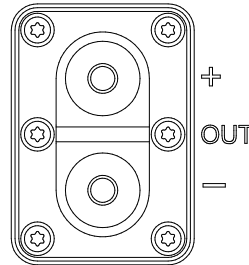
| PARAMETER                           | DESCRIPTION / CONDITION                   | MANUFACTURER | MPN              |
|-------------------------------------|-------------------------------------------|--------------|------------------|
| Input Connector (IN)                | High voltage connector with HVIL function | TYCO         | 2103124-1, KEY A |
| Output Connector (OUT)              | Male dual terminal thread M8              |              |                  |
| CAN BUS and Signal Interface (CTRL) | Panel mounted                             | TYCO         | 776276-1         |

| PIN | SIGNAL DESCRIPTION |
|-----|--------------------|
| 1   | PS_WAKEUP          |
| 2   | ADR0               |
| 3   | ADR1               |
| 4   | CAN_SPEED          |
| 5   | CAN_H              |
| 6   | CAN_L              |
| 7   | +SENSE             |
| 8   | -SENSE             |

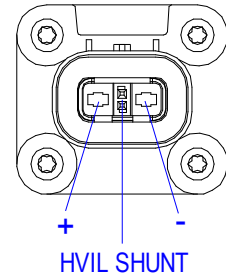
Signal Connector Pin Description



Signal Connector



Output Connector



Input Connector

## 9. COOLING SPECIFICATIONS

| PARAMETER                         | DESCRIPTION / CONDITION                  |
|-----------------------------------|------------------------------------------|
| Maximum Inlet Coolant Temperature | +70°C                                    |
| Coolant Medium/Mixture            | 50/50 Propylene or Ethylene Glycol/Water |
| Min. Coolant Flow                 | 0.0208 l/s (0.33 GPM)                    |
| Max. Coolant Flow                 | 0.1166 l/s (1.85 GPM)                    |
| Max. Coolant Pressure             | 20 psi                                   |
| Max. Pressure Drop                | 1 psi                                    |

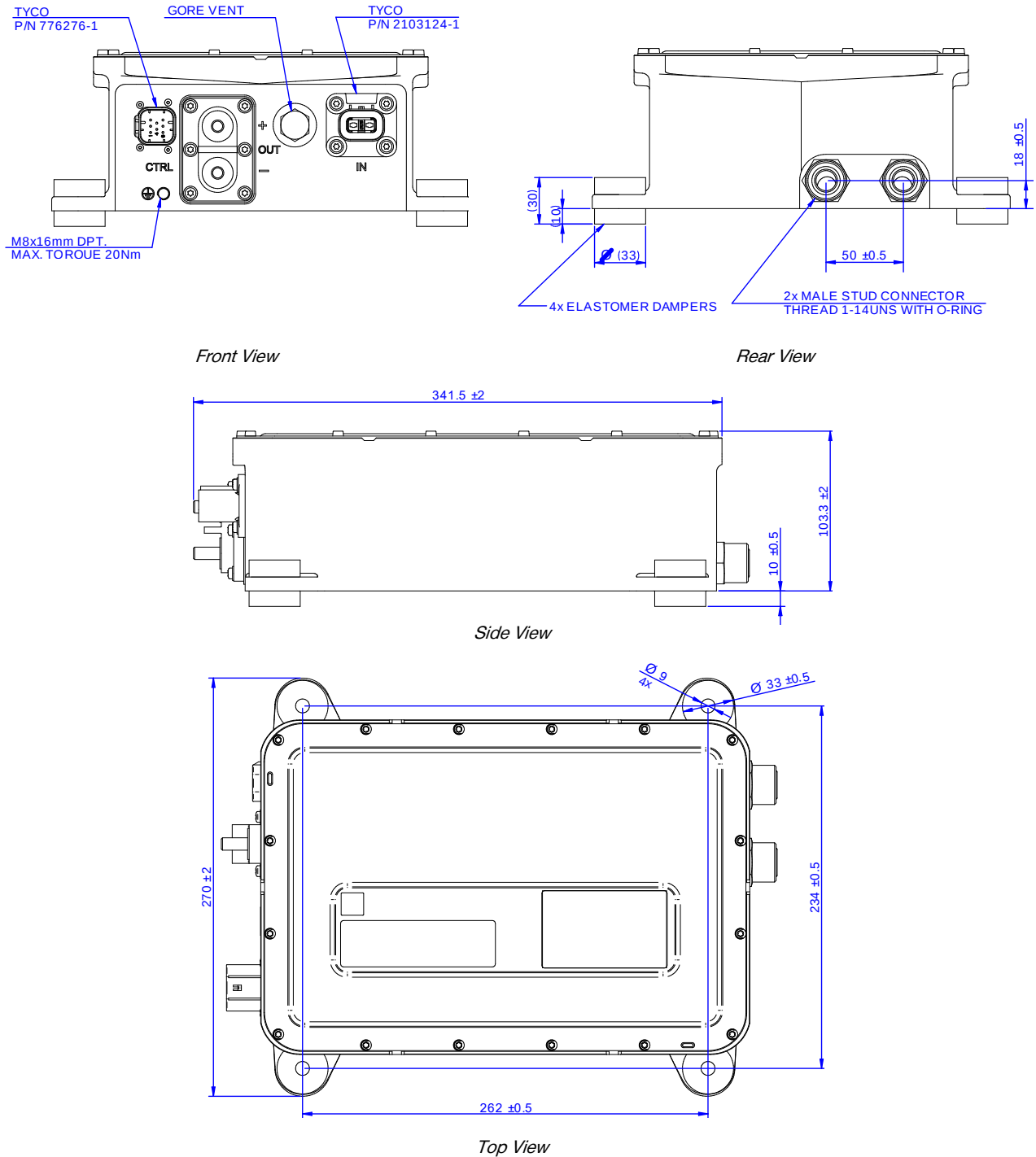
## 10. MECHANICAL SPECIFICATIONS

| PARAMETER              | LIQUID COOLED MODEL  | CONVECTION COOLED MODEL |
|------------------------|----------------------|-------------------------|
| Dimensions (W x H x D) | 270 x 113 x 341.5 mm | 350 x 187 x 341.5 mm    |
| Weight                 | 11 kg                | 22 kg                   |
| Enclosure              | IP65 and IP67        |                         |

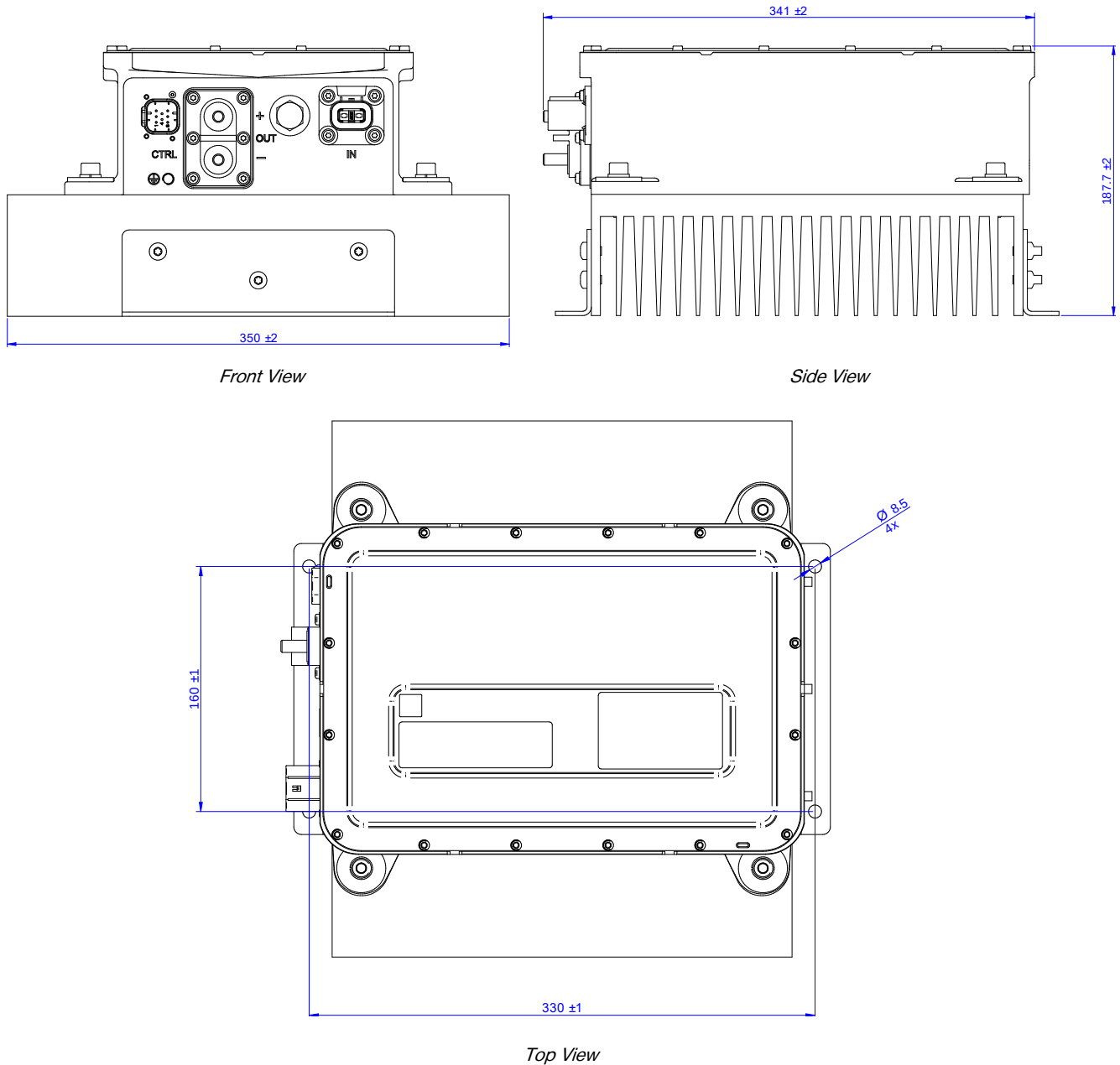
# 350DNC40-12 Series

5

## MECHANICAL DRAWINGS - LIQUID COOLED MODEL



## MECHANICAL DRAWINGS - CONVECTION COOLED MODEL



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