# NON-ISOLATED DC/DC CONVERTERS
## 3 – 15V Input / 1.8V Output / 16A

bel POWER PRODUCTS

**BP06SRDC-16D180**

**SRDC-16D180 Module** **RoHS Compliant**

- Nonisolated
- Industry standard pinout
- Fixed frequency
- High efficiency means less power dissipation
- High power density
- Optimized for cost
- Remote on/off
- Programmable undervoltage lockout (UVLO)
- Over current and short circuit protection
- Two phase operation
- Non-latching over temperature shutdown protection



## Description

The Bel SRDC-16D180 module is one in a series of non-isolated, DC/DC power converters that operate from a wide input range of 3V minimum to 15V maximum. This converter is available with 1.8V output. It uses a low profile, surface mount DIP package for ease of layout and space savings. 16A maximum output is also provided. Standard features include remote on/off, over current and short circuit protection, programmable UVLO and output voltage adjust. Optional features include two-wire remote sense or single-ended remote sense with a good power signal. This module also makes use of adaptive positioning to improve transient response performance. It may be used almost anywhere low voltage silicon is employed and a 3 to 15V source is available. Typical applications include file servers, routers, line cards and other computing and communications equipment.

## Applications

- Telecommunications
- Networking
- Computers and peripherals

## Options

- Double-ended remote sense
- Power good signal and single-ended sense

## Part Number Selection

| Output Voltage | Input Voltage | Max. Output Current | Max. Output Power | Typical Efficiency | Part Number | Part Number Power Good Signal & Remote Sense | Part Number Double-ended Remote Sense |
|---|---|---|---|---|---|---|---|
| 1.8V | 3 - 15V | 16A | 29W | 86% | SRDC-16D180 | SRDC-16D18S | SRDC-16D18D |

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## Absolute Maximum Ratings

| Parameter | Symbol | Min | Typical | Max | Unit |
|---|---|---|---|---|---|
| Continuous Input Voltage | Vin | -0.3 | | 15 | V |
| Output Enable Terminal Voltage[1] | Vouten | -0.3 | | 6 | V |
| Ambient Temperature | Tamb | 0 | | 70 | °C |
| Storage Temperature | Tstor | -40 | | 105 | °C |

Note: Use beyond the maximum ratings may cause a reliability degradation of the DC/DC converter or may permanently damage the device.

1. The enable pin performs two functions, remote on/off and programmable under voltage lockout. The factory set UVLO point is 3.0V typical, but can be adjusted upward with the addition of a single external resistor located from the enable pin to ground. Turning the converter on and off is accomplished using an open collector/drain device as a switch. The enable pin is internally pulled up to Vin through a 12.1K resistor and the pin's logic is active high.

## Input Specifications

| Parameter | Symbol | Min | Typical | Max | Units |
|---|---|---|---|---|---|
| Operating Input Voltage | Vin | 3.1 | | 15 | V |
| Input Current (Vin=3.3V) | Iin | | | 10.8 | A |
| Input Current (Vin=5.0V) | Iin | | | 7 | A |
| Input Current (Vin=12.0V) | Iin | | | 3.2 | A |
| No Load Input Current (Vin=3.3V) | Iin | | | 200 | mA |
| No Load Input Current (Vin=5.0V) | Iin | | | 150 | mA |
| No Load Input Current (Vin=12.0V) | Iin | | | 110 | mA |
| Input Reflected Ripple Current[1] | | | | 50 | $mA_{rms}$ |
| Input Reflected Ripple Current (P-P)[1] | | | | 100 | mApk |
| $I^2t$ Inrush Current Transient | | | | 0.1 | $A^2s$ |
| Turn On Voltage Threshold[2] | | | 2.92 | | V |
| Turn Off Voltage Threshold | | 2.8 | 2.85 | 2.90 | V |

Note: Input capacitance 100µF/16V, ESR = 0.03 Ω max at 100kHz @ 25° C.
1. With simulated source impedance of 500nH, 5Hz to 20MHz.
2. UVLO is adjustable by terminating on/off pin to ground per the termination resistance table on page 7.

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## Output Specifications

| Parameter | Symbol | Min | Typical | Max | Units |
|---|---|---|---|---|---|
| Output Voltage Set Point | Vout | 1.80 | 1.82 | 1.85 | V |
| Load Regulation (Droop Impedance) | Rout | 2 | 2.5 | 3 | mΩ |
| Line Regulation<br>Input Voltage 3.1V to 15V | | | 15 | 25 | mV |
| Line Regulation<br>Input Voltage 5V ±20% | | | 3 | 10 | mV |
| Regulation Over Temperature<br>0° - 70° C | | | 10 | 25 | mV |
| Output Ripple and Noise[1] | | | 25 | 40 | mVp-p |
| Output Ripple and Noise[1] | | | 10 | 20 | mVrms |
| Output Current Range | Iout | 0 | | 16 | A |
| Output DC Current Limit | Ioutlim | 18 | | 22 | A |
| Turn on Time<br>Vin to Vout or on/off to Vout | Ton | | 8 | 10 | ms |
| Overshoot at Turn On | | | 0 | 1 | % |
| Output Capacitance | Cout | 100 | | 2200 | µF |

Note: All specifications are typical at nominal input, full load at 25° C unless otherwise stated.

1. 0 - 20MHz BW, 0.1µF ceramic cap on output.

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## Output Specifications

| Parameter | Symbol | Min | Typical | Max | Units |
|---|---|---|---|---|---|
| **Transient Response** [2] **(**Vin=3.3V) | | | | | |
| ΔV 50% to 100% of Max Load | | | 60 | 75 | mV |
| Settling Time | Ts | | 100 | 120 | µs |
| ΔV 100% to 50% of Max Load | | | 60 | 75 | mV |
| Settling Time | Ts | | 100 | 120 | µs |
| **Transient Response** [2] **(**Vin=5.0V) | | | | | |
| ΔV 50% to 100% of Max Load | | | 100 | 120 | mV |
| Settling Time | Ts | | 100 | 120 | µs |
| ΔV 100% to 50% of Max Load | | | 100 | 120 | mV |
| Settling Time | Ts | | 100 | 120 | µs |
| **Transient Response** [2] **(**Vin=12.0V) | | | | | |
| ΔV 50% to 100% of Max Load | | | 135 | 150 | mV |
| Settling Time | Ts | | 100 | 120 | µs |
| ΔV 100% to 50% of Max Load | | | 135 | 150 | mV |
| Settling Time | Ts | | 100 | 120 | µs |

Note: All specifications are typical at nominal input, full load at 25° C unless otherwise stated.

2. di/dt = 1A/1µS, Ta = 25° C with a 560µF oscon cap on output.

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## General Specifications

| Parameter | Symbol | Min | Typical | Max | Units |
|---|---|---|---|---|---|
| Efficiency[1] (Vin=3.3V) | η | 85 | 86 | | % |
| Efficiency[2] (Vin=5.0V) | η | 83 | 84 | | % |
| Efficiency[3] (Vin=12.0V) | η | 80 | 81 | | % |
| Switching Frequency | Fsw | 495 | 550 | 605 | kHz |
| Output Voltage Trim Range[4] | | 90 | | 110 | % |
| Remote Sense Compensation (when option specified) | | | | 300 | mV |
| Weight | | | 16 | | g |

1. Vin=3.3V, full load and Ta=25° C.
2. Vin=5.0V, full load and Ta=25° C.
3. Vin=12.0V, full load and Ta=25° C.
4. See graph on page 7.

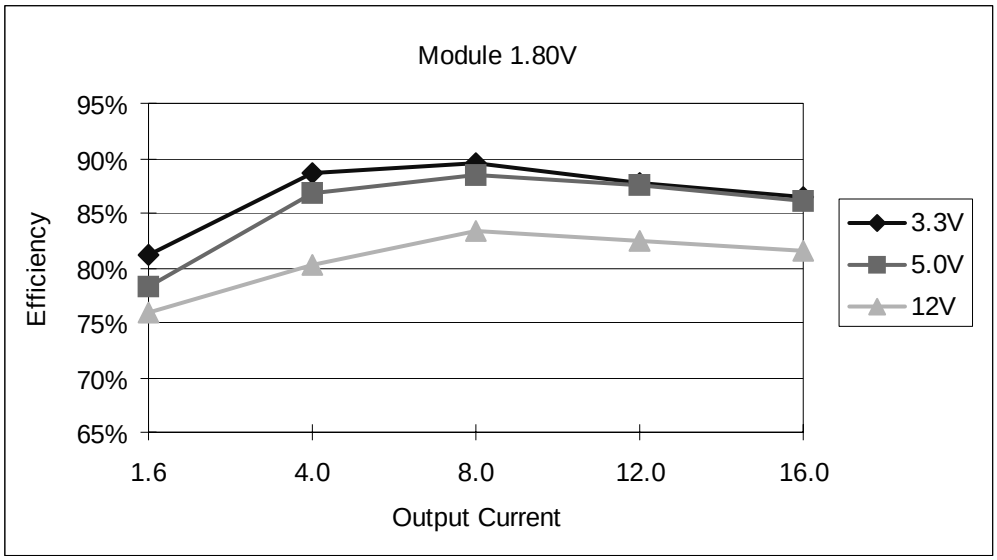
## Control Specifications

| Parameter | Symbol | Min | Typical | Max | Units |
|---|---|---|---|---|---|
| Remote On/Off Open Circuit Voltage (Vin=3.3V) | Vouten | | | 1.4 | V |
| Remote On/Off Open Circuit Voltage (Vin=5.0V) | Vouten | | | 2.1 | V |
| Remote On/Off Open Circuit Voltage (Vin=12.0V) | Vouten | | | 5.1 | V |
| Remote On/Off Impedance Limitation (pin pulled up to +Vin) | Renable | | | 11.5 | kΩ |
| Signal Low (Unit Off) | | -0.3 | | 0.3 | V |
| Signal High (Unit On) | | 1.5 | | 5.5 | V |
| Power Good Levels (when option specified) | Vpg | | | | |
| Signal Low | | | 0.18 | 0.4 | V |
| Current Sink | | | | 4 | mA |
| Signal High (signal is open collector) | | 4.8 | | 5 | V |
| Under Voltage Threshold Vout rising | | | 1.66 | | V |
| Under Voltage Threshold Vout falling | | | 1.62 | | V |

Note: On/off pin designed to work with an open collector/drain switch.

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## Efficiency Data

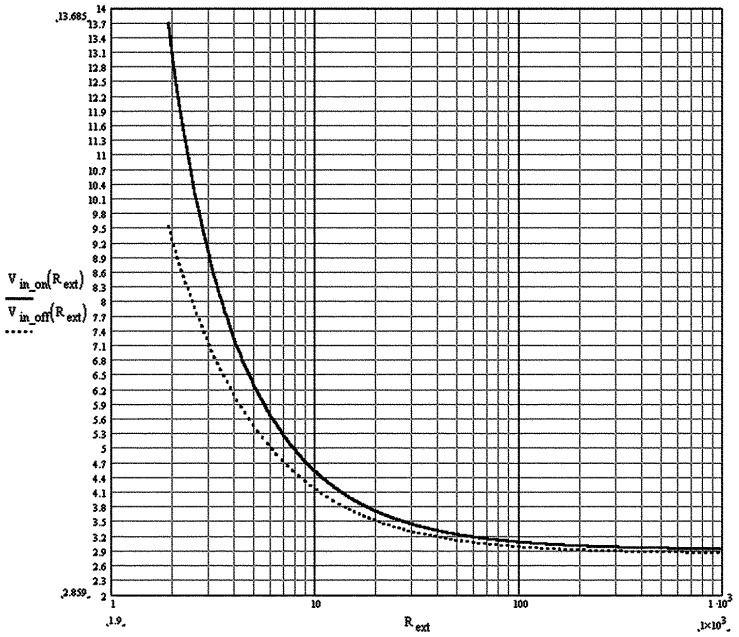



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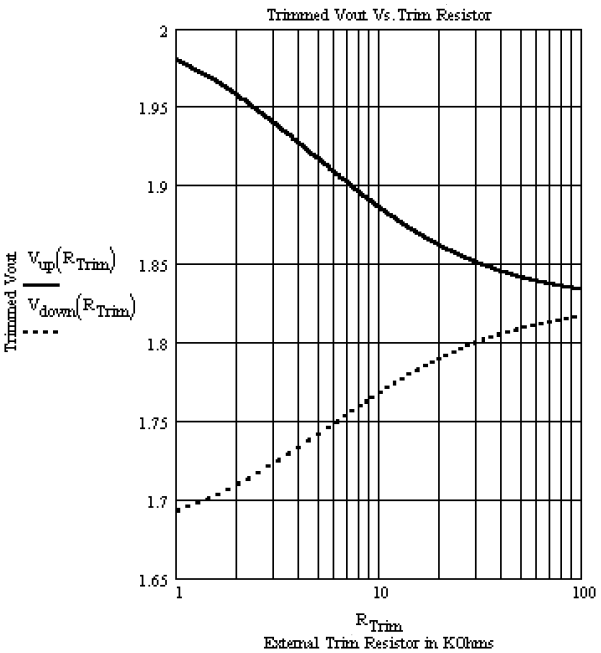
## Termination Resistance

| Termination Resistance | Rising Vin UVLO | Falling Vin UVLO |
|---|---|---|
| Open Circuit | 2.92V | 2.85V |
| 10.2K Ω | 4.50V | 4.14V |
| 5.36K Ω | 6.06V | 5.28V |
| 4.75K Ω | 6.50V | 5.60V |
| 3.48K Ω | 8.00V | 6.58V |
| 3.01K Ω | 9.00V | 7.14V |
| 2.49K Ω | 10.5V | 8.00V |
| 2.37K Ω | 11.0V | 8.26V |

## UVLO




## Output Voltage Trim Range



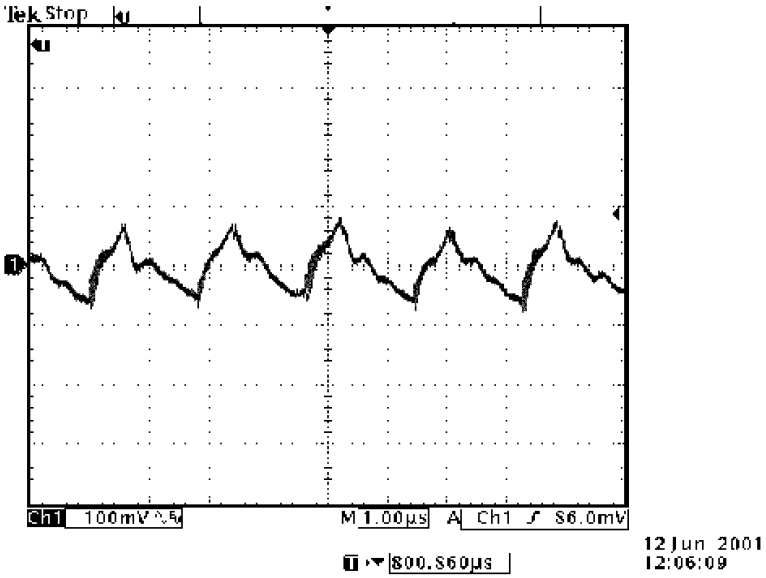

$V_{up}(10^9) = 1.825$ $V_{down}(10^9) = 1.825$

Trimmed Vout for Various K-Ohm E96 Resistor Values

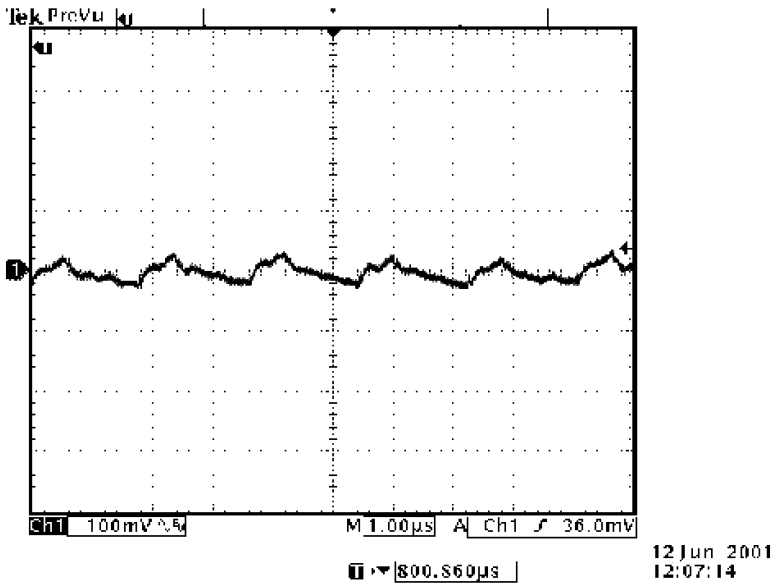
| | |
|---|---|
| $V_{up}(30.1) = 1.851$ | $V_{down}(30.1) = 1.8$ |
| $V_{up}(12.1) = 1.879$ | $V_{down}(12.1) = 1.774$ |
| $V_{up}(10) = 1.886$ | $V_{down}(10) = 1.768$ |
| $V_{up}(5.11) = 1.916$ | $V_{down}(5.11) = 1.742$ |
| $V_{up}(4.32) = 1.924$ | $V_{down}(4.32) = 1.735$ |
| $V_{up}(3.83) = 1.93$ | $V_{down}(3.83) = 1.731$ |
| $V_{up}(3.01) = 1.941$ | $V_{down}(3.01) = 1.722$ |
| $V_{up}(2.87) = 1.943$ | $V_{down}(2.87) = 1.721$ |
| $V_{up}(2.67) = 1.946$ | $V_{down}(2.67) = 1.718$ |
| $V_{up}(2.00) = 1.958$ | $V_{down}(2.00) = 1.709$ |
| $V_{up}(1.00) = 1.98$ | $V_{down}(1.00) = 1.692$ |
| $V_{up}(0) = 2.012$ | $V_{down}(0) = 1.67$ |

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## Ripple and Noise




Ripple and noise at full load and 12.0Vdc input, and Ta=25° C

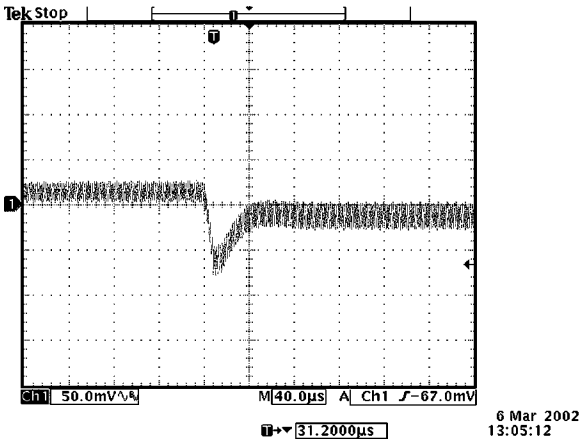



Ripple and noise at full load and 12.0Vdc input, and Ta=25° C with 560 µF external cap

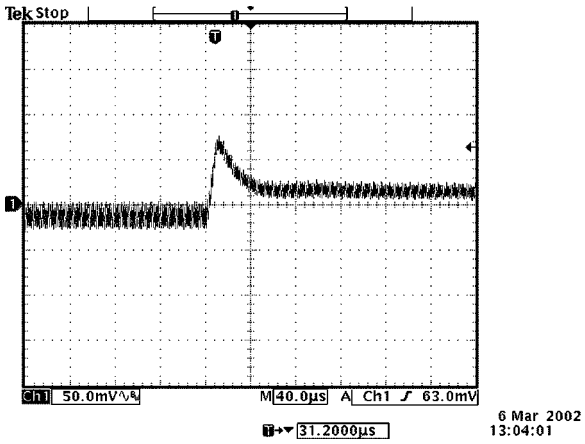
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## Transient Response

Transient response: di/dt = 1.0A/µS

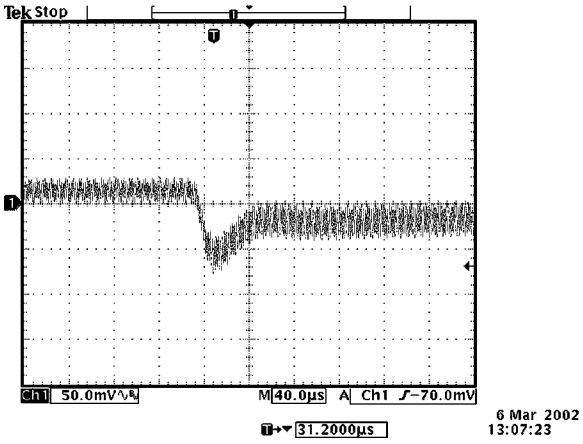



Vout=1.8V
50% to 100% load transients at 12.0V input and Ta=25° C

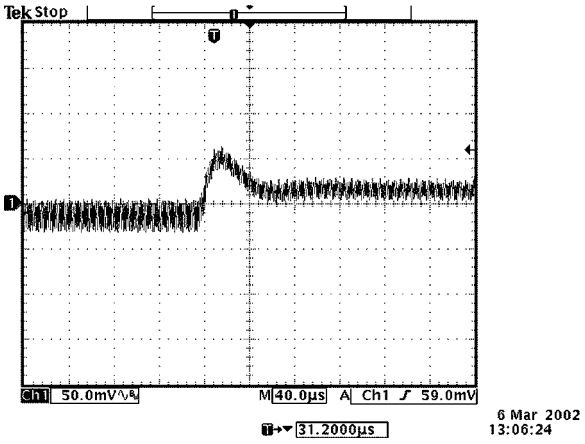



Vout=1.8V
100% to 50% load transients at 12.0V input and Ta=25° C

Transient response: di/dt = 1.0A/µS, external load capacitance 560µF



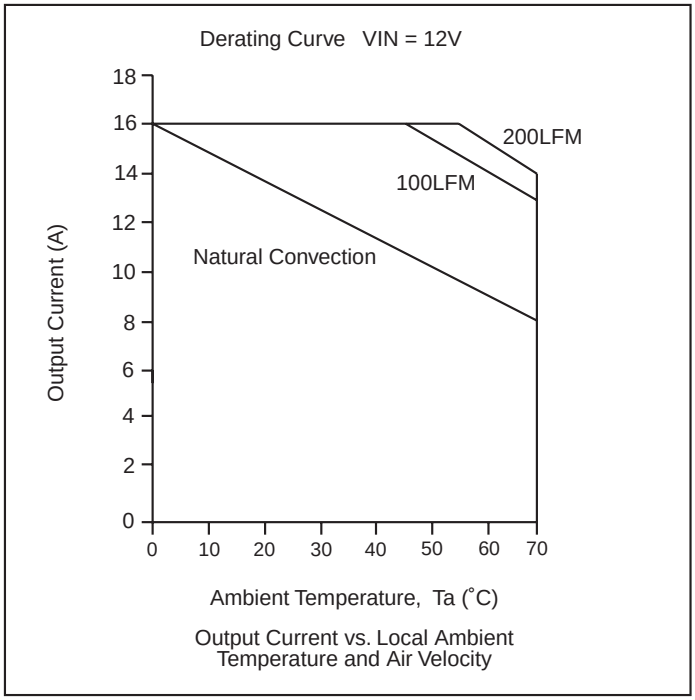

Vout=1.8V
50% to 100% load transients at 12.0V input and Ta=25° C



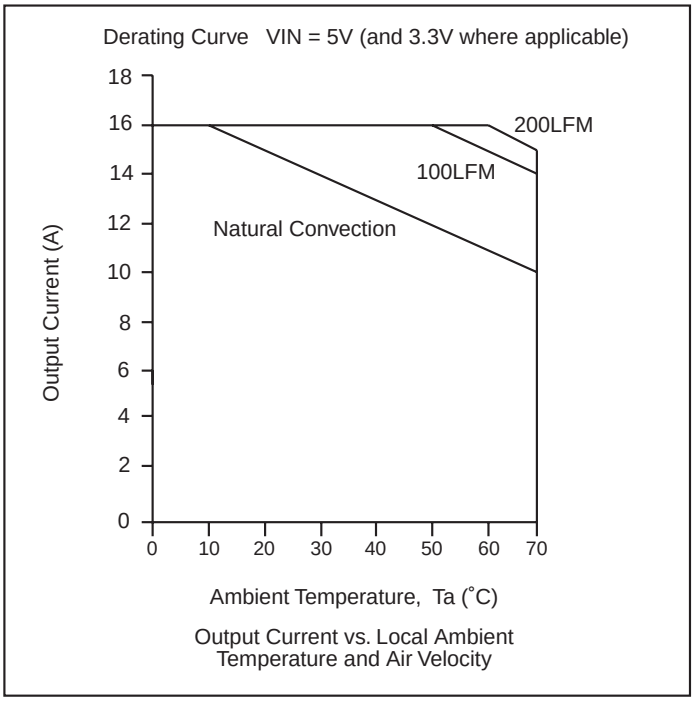

Vout=1.8V
100% to 50% load transients at 12.0V input and Ta=25° C

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## Thermal Considerations



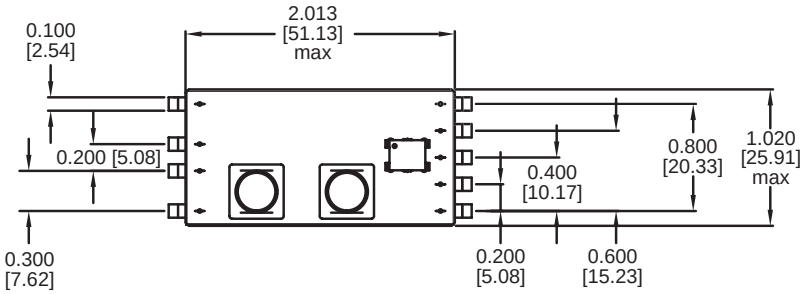

Output Current vs. Local Ambient Temperature and Air Velocity

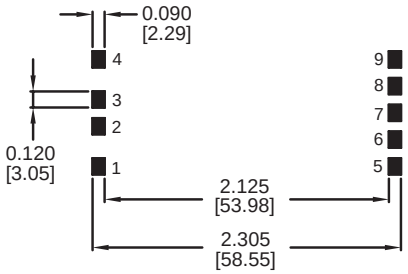



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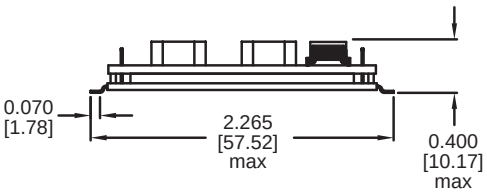
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## Mechanical




Recommended PCB Pad Layout




Dimensions are in inches [millimeters].
Standard dimension tolerance is ±0.005 [0.13] unless otherwise noted.

| Pin | Function |
|---|---|
| 1 | Control Ground |
| 2 | On/Off Control |
| 3[1] | No Connection |
| 4[2] | No Connection |
| 5 | +Vo |
| 6 | Trim |
| 7 | Power Ground |
| 8 | Power Ground |
| 9 | +Vin |

1. Pin 3 not used on module S7DC-16D180, used for - sense on S7DC-16D18D and used for power good signal on the S7DC-16D18S module.

2. Pin 4 not used on module S7DC-16D180, used for + sense on both the S7DC-16D18S and S7DC-16D18D modules.

**RoHS Compliance**
Complies with the European Directive 2002/95/EC, calling for the elimination of lead and other hazardous substances from electronic products. These parts are not however compatible with the higher temperatures associated with lead free solder processes and must be soldered using a reflow profile with a peak temperature of no more than 240ºC.

RoHS 2002/95/EC

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