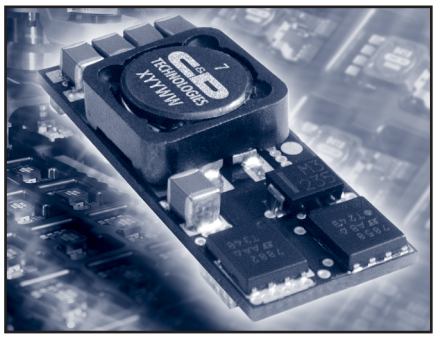
# NNL10 SERIES

Non-Isolated DC/DC Converters



## FEATURES

- Industry Standard Footprint
- Short Circuit Protection
- High Efficiency
- Under Voltage Lock Out
- Output Voltage Trimming
- Operating Temperature Range –40°C to 85°C
- SMD Construction
- Optional DC OK Signal
- Options available without Trim and Remote Sense Functionality

## DESCRIPTION

The NNL10 series is part of a range of non-isolated, cost effective DC/DC converters offering high precision output voltages from a nominal 3.0–5.5 or 10.0–14.0 intermediate bus where isolation is not required. Available in both SMD and SIP mechanical formats.

## SELECTION GUIDE[1]

| | | Nominal Input Voltage | Output Voltage | Output Current | | MAX Output Power | Nominal Efficiency |
|---|---|---|---|---|---|---|---|
| | | | | Min Load | Full Load | | Min |
| | Order Code | V | V | A | A | W | % |
| | **NNL10-1** | 4.0 | 0.9 | 0 | 10.0 | 9.0 | 79.7 |
| | **NNL10-2** | 4.0 | 1.0 | 0 | 10.0 | 10.0 | 81.8 |
| | **NNL10-3** | 4.0 | 1.2 | 0 | 10.0 | 12.0 | 84.3 |
| | **NNL10-4** | 4.0 | 1.5 | 0 | 10.0 | 15.0 | 86.5 |
| | **NNL10-5** | 4.0 | 1.8 | 0 | 10.0 | 18.0 | 88.2 |
| | **NNL10-6** | 4.0 | 2.0 | 0 | 10.0 | 20.0 | 89.2 |
| | **NNL10-7** | 4.0 | 2.5 | 0 | 10.0 | 25.0 | 91.2 |
| | **NNL10-8** | 4.0 | 3.3 | 0 | 10.0 | 33.0 | 92.1 |
| With DCOK | **NNL10-9** | 4.0 | 0.9 | 0 | 10.0 | 9.0 | 79.7 |
| With DCOK | **NNL10-10** | 4.0 | 1.0 | 0 | 10.0 | 10.0 | 81.8 |
| With DCOK | **NNL10-11** | 4.0 | 1.2 | 0 | 10.0 | 12.0 | 84.3 |
| With DCOK | **NNL10-12** | 4.0 | 1.5 | 0 | 10.0 | 15.0 | 86.5 |
| With DCOK | **NNL10-13** | 4.0 | 1.8 | 0 | 10.0 | 18.0 | 88.2 |
| With DCOK | **NNL10-14** | 4.0 | 2.0 | 0 | 10.0 | 20.0 | 89.2 |
| With DCOK | **NNL10-15** | 4.0 | 2.5 | 0 | 10.0 | 25.0 | 91.2 |
| With DCOK | **NNL10-16** | 4.0 | 3.3 | 0 | 10.0 | 33.0 | 92.1 |

## INPUT CHARACTERISTICS[1]

| Parameter | Conditions | MIN | TYP | MAX | Units |
|---|---|---|---|---|---|
| Voltage Range | $V_{NOM}$ = 4.0$V_{DC}$ $V_{OUT}$ < 2.75V | 3.0 | | 5.5 | V |
| | $V_{NOM}$ = 4.0$V_{DC}$ $V_{OUT}$ > 3.0V | 4.0 | | 5.5 | |
| Under Voltage Lock Out | Turn On Threshold $V_{NOM}$ = 4.0$V_{DC}$ | | 2.8 | | V |
| | Turn Off Threshold $V_{NOM}$ = 4.0$V_{DC}$ | | 2.7 | | |
| Reflected Ripple Current | | | 30 | | mA p-p |
| Input No Load Current | $V_{IN}$ = 5.5V $V_{OUT}$ = 0.9V | | 100 | | mA |
| | $V_{IN}$ = 5.5V $V_{OUT}$ = 3.3V | | 140 | | |
| Input Standby Current | $V_{IN}$ = 5.5V Module Disabled | | 1.5 | | mA |

## OUTPUT CHARACTERISTICS[1]

| Parameter | Conditions | | MIN | TYP | MAX | Units |
|---|---|---|---|---|---|---|
| Rated Current | $T_A$ = –40°C to 85°C (see thermal performance characteristics) | | | | 10.0 | A |
| Voltage Set Point Accuracy | | | | 1.0 | 2.0 | % |
| Line Regulation | Low line to high line | | | 0.5 | 1.0 | % |
| Load Regulation | 0% load to 100% load | | | | 0.55 | % |
| Ripple & Noise | BW = DC to 20MHz | | | 25 | 50 | mVp-p |
| Voltage Trim | | | -10 | | +10 | %$V_{OUT}$ |
| Remote Sense | | | | | 0.5 | V |
| Transient Response | $I_{OUT}$ = 5.0A–10.0A–5.0A, | Peak Deviation | | 100 | | mV |
| | $C_{OUT}$ = 1µF//10µF | Settling Time | | 70 | | µs |
| External Load Capaitance | | | | 10,000 | | µF |

1 Specifications typical at $T_A$ =25°C, nominal input voltage and rated output current unless otherwise specified.

Other customer specified options are available on request. Standard parts are supplied with Remote Sense and Voltage Trim functions. Please contact your sales representative or C&D Technologies account manager for further details.

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## GENERAL CHARACTERISTICS[1]

| Parameter | Conditions | MIN | TYP | MAX | Units |
|---|---|---|---|---|---|
| Switching Frequency | | | 300 | | kHz |
| Start Delay | From power on/remote off | | 4.0 | | ms |
| Remote On/Off | Module On (or pin unconnected) | 0 | | 0.3 | V |
| | | | | 100 | µA |
| | Module Off | 2.6 | | | V |
| | | | | -500 | µA |
| MTTF | | TBA | | | kHrs |

## ABSOLUTE MAXIMUM RATINGS

| | |
|---|---|
| Short circuit protection | Continuous |
| Remote Sense | $V_{OUT}$±0.5$V_{DC}$ |
| DC OK | -0.2Vdc to +17$V_{DC}$ 20mA |
| Remote ON/OFF | -0.2$V_{DC}$ to +17$V_{DC}$ |
| Trim | -0.3$V_{DC}$ to $V_{OUT}$ |
| Input Voltage $V_{IN}$ | 6.5$V_{DC}$ |
| Minimum load | 0% |

## ENVIRONMENTAL[1]

| Parameter | Conditions | MIN | TYP | MAX | Units |
|---|---|---|---|---|---|
| Operation | See thermal performance characteristics | –40 | | 85 | °C |
| Over Temperature Protection | Substrate temperature | | 115 | | °C |
| Storage | | –55 | | 125 | °C |

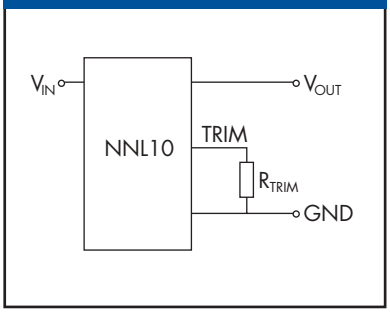
## OUTPUT VOLTAGE TRIMMING

The trimming input on the NNL10 allows output voltage adjustment by +/-10% of nominal output voltage by connection of a resistor or by application of a voltage to the Trim pin.

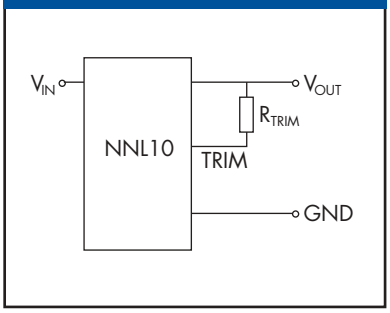
### $R_{INTERNAL}$ VALUES

| $V_{OUT\ SET}$ (V) | $R_{INTERNAL}$ (kOhm) |
|---|---|
| 0.9 | 5.1 |
| 1.0 | 30.1 |
| 1.2 | 59.0 |
| 1.5 | 100.0 |
| 1.8 | 100.0 |
| 2.0 | 100.0 |
| 2.5 | 78.7 |
| 3.3 | 59.0 |

### FIG.1




### FIG.2




To increase the output voltage, an external resistor (Fig. 1) or voltage source should be connected between the Trim pin and GND pin.

$$R_{TRIM-UP} = \frac{24.080}{|\Delta V_{OUT}|} - R_{INTERNAL}\ K\Omega \qquad V_{TRIM-UP} = 0.8 - \left[\Delta V_{OUT} \times \frac{R_{INTERNAL}}{30.100}\right]$$

ΔVout is the required change in output voltage in V

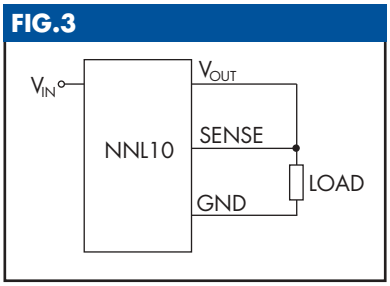
To decrease the output voltage, an external resistor (Fig. 2) or voltage source should be connected between the Trim pin and the $V_{OUT}$ pin.

$$R_{TRIM-DOWN} = \left[\left(\frac{V_{OUT} - 0.8}{|\Delta V_{OUT}|} - 1\right) \times 30.100\right] - R_{INTERNAL}\ K\Omega \qquad V_{TRIM-DOWN} = 0.8 + \left[|\Delta V_{OUT}| \times \frac{R_{INTERNAL}}{30.100}\right]$$

The trim pin should be left disconnected if not used.

## REMOTE SENSE

**FIG.3**




The remote sense function compensates for voltage drops from the output of the NNL10 to the load point by regulating the output voltage at the load point. The voltage drop must not exceed 0.5V, although Trim and remote sense functions can be used in combination with each other, the maximum voltage increase is 0.5V.

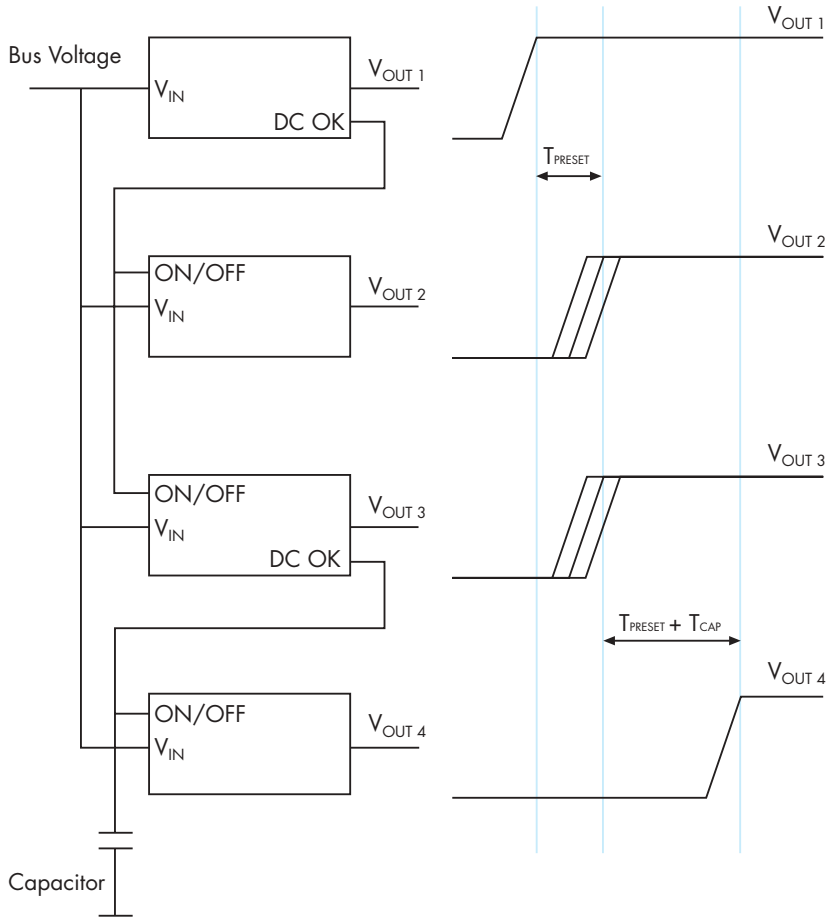
When increasing the output voltage the maximum output power of the NNL10 must not exceed the maximum output figures stated in the selection guide.

## OUTPUT SEQUENCING

To simplify output sequencing, the NNL10 series offers an optional single wire interconnection that performs this function. Using this connection, up to four devices can be 'daisy chained' together, with the 'DC OK' signal from one converter signifying that the next converter can be enabled. A capacitor, simply connected to the daisy chain link, provides a settable delay in the sequence of the converters starting.
Typical capacitor values and corresponding delays are shown in the table below.
Figure 4 shows a typical sequencing configuration, along with the voltage outputs that it produces. As well as reducing component count, making use of the 'built-in' sequencing capability means that only a single PCB track is required for a full sequencing solution.

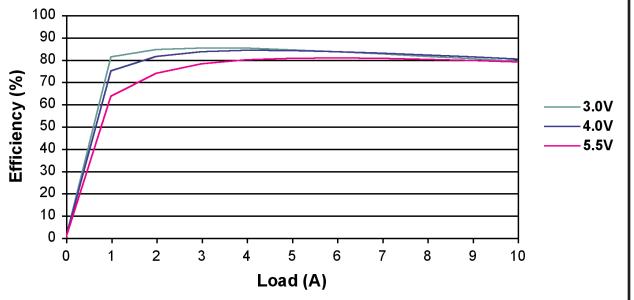
| VIN | Capacitor Value | Delay |
|---|---|---|
| 3.0VDC | 0.22µF | 1.8mS |
| 5.5VDC | 0.22µF | 0.6mS |

**FIG.4**

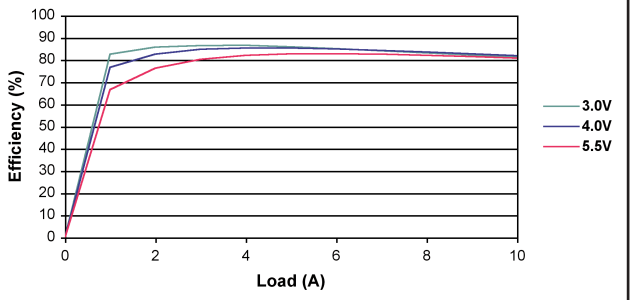


## EFFICIENCY v LOAD GRAPHS (NNL10 $V_{NOM}$ = 4.0VDC)

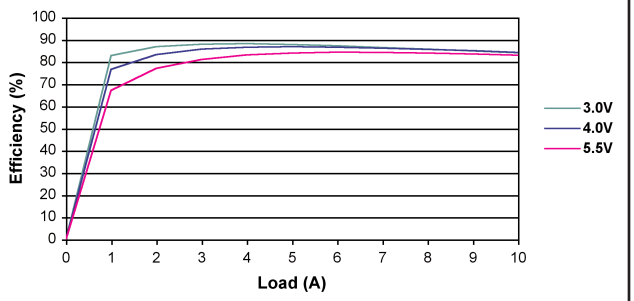
### $V_{OUT}$ = 0.9V



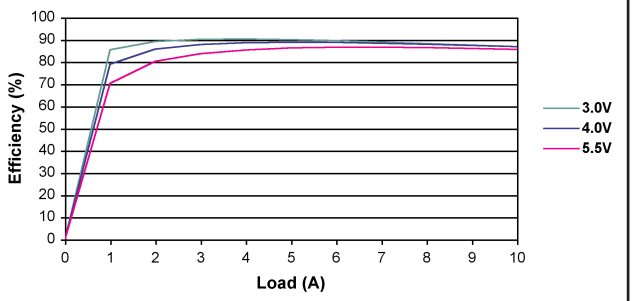

### $V_{OUT}$ = 1.0V



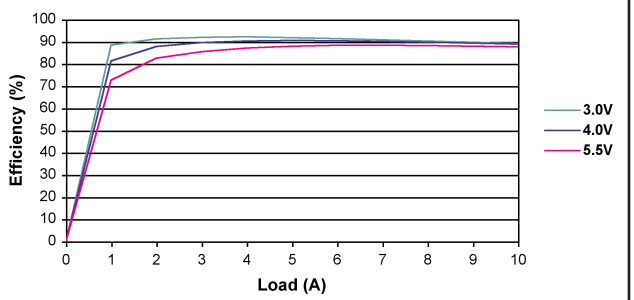

### $V_{OUT}$ = 1.2V



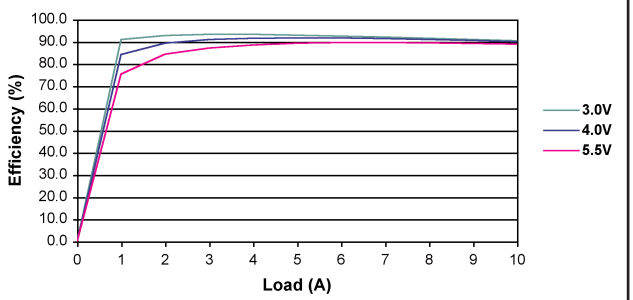

### $V_{OUT}$ = 1.5V



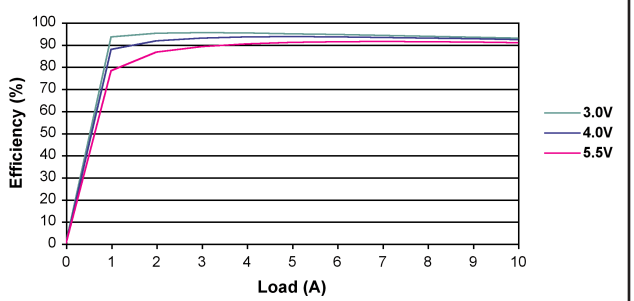

### $V_{OUT}$ = 1.8V



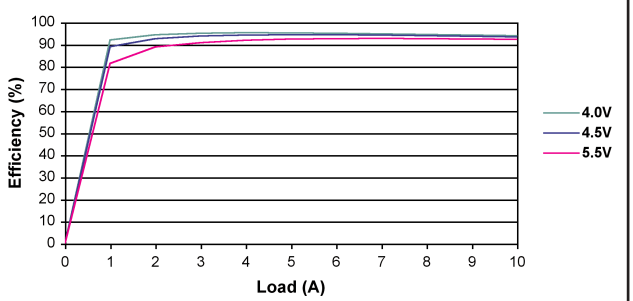

### $V_{OUT}$ = 2.0V




### $V_{OUT}$ = 2.5V

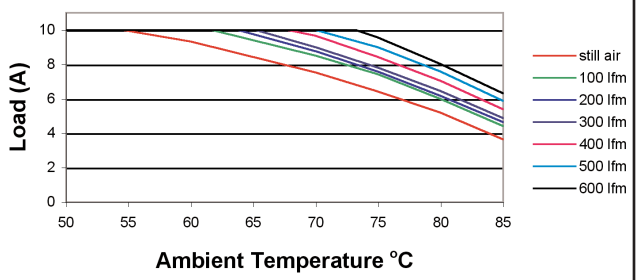



### $V_{OUT}$ = 3.3V

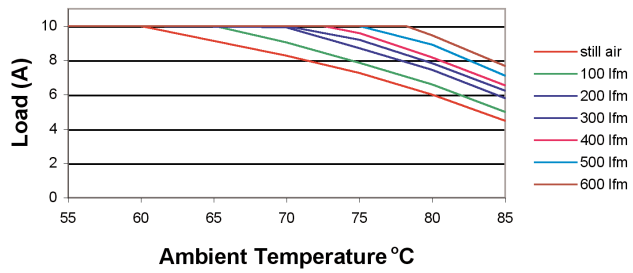


## THERMAL DERATING GRAPHS (NNL10 $V_{NOM}$ = 4.0VDC)

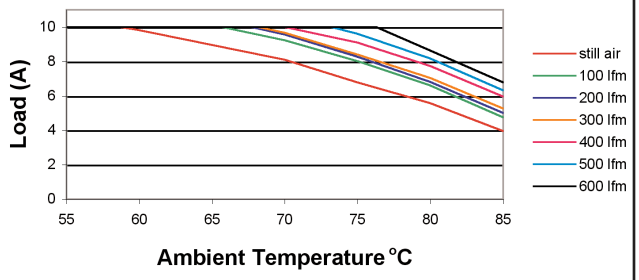
### $V_{OUT}$ = 0.9V



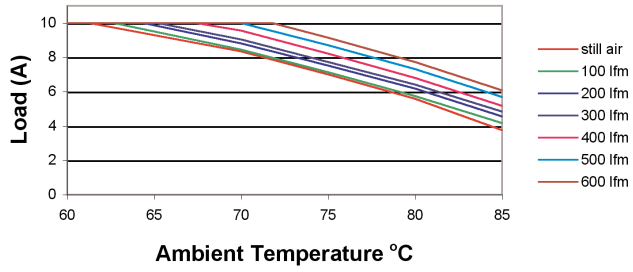

### $V_{OUT}$ = 1.0V



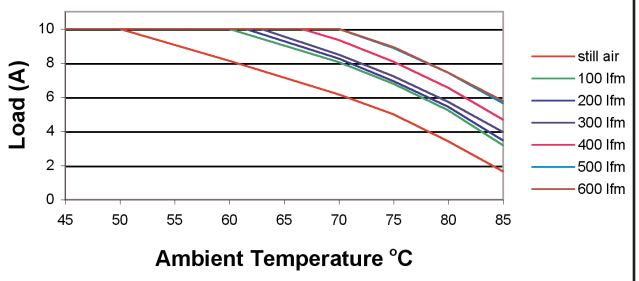

### $V_{OUT}$ = 1.2V



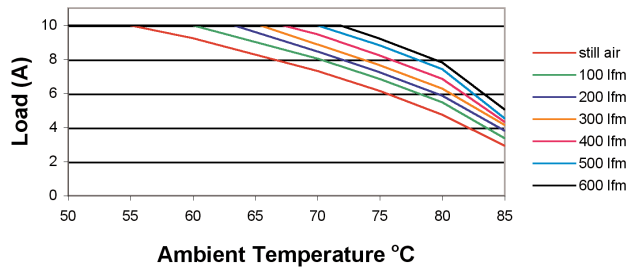

### $V_{OUT}$ = 1.5V



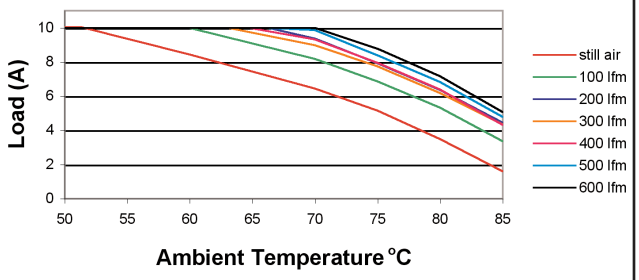

### $V_{OUT}$ = 1.8V



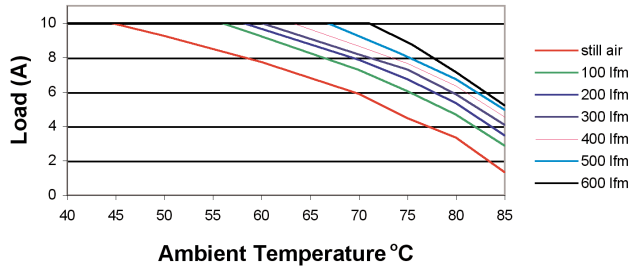

### $V_{OUT}$ = 2.0V




### $V_{OUT}$ = 2.5V



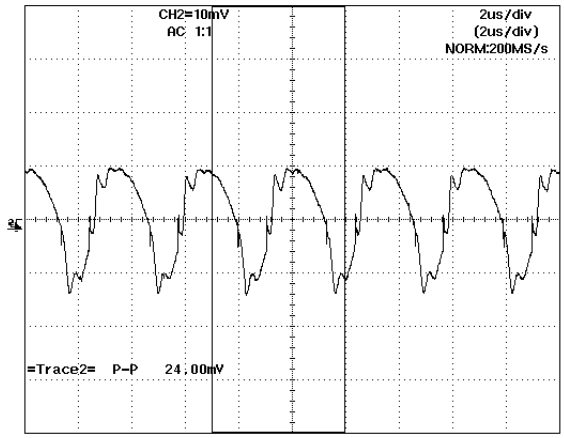

### $V_{OUT}$ = 3.3V



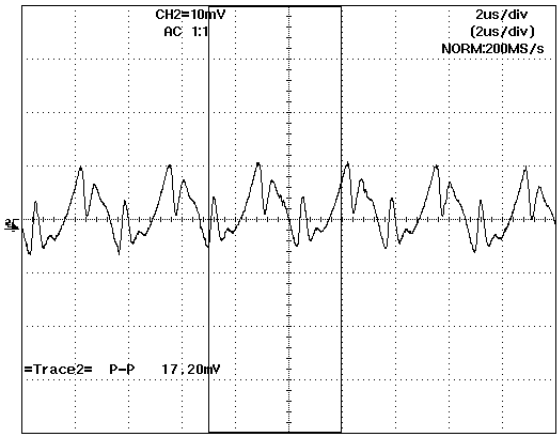
## TYPICAL CHARACTERISTICS

### OUTPUT RIPPLE & NOISE

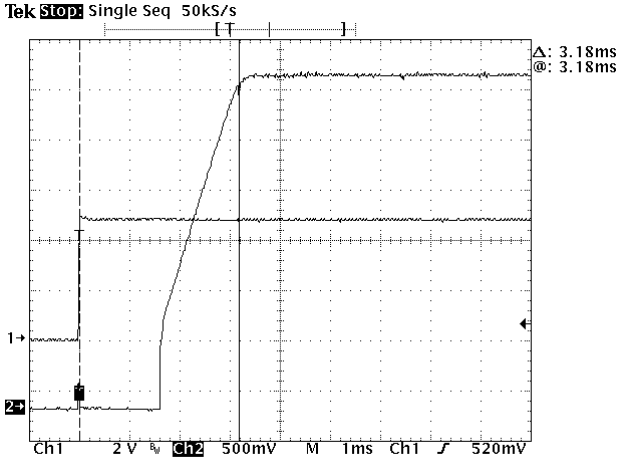
$V_{IN}$ = 4.75VDC $V_{OUT}$ = 3.3VDC $I_{OUT}$ = 10.0A




$V_{IN}$ = 4.0VDC $V_{OUT}$ = 0.9VDC $I_{OUT}$ = 10.0A

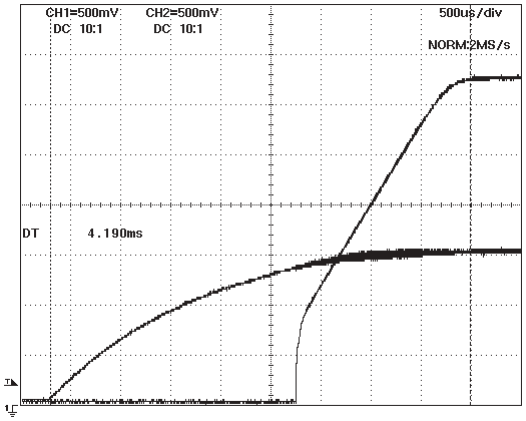



### START-UP FROM APPLICATION OF $V_{IN}$



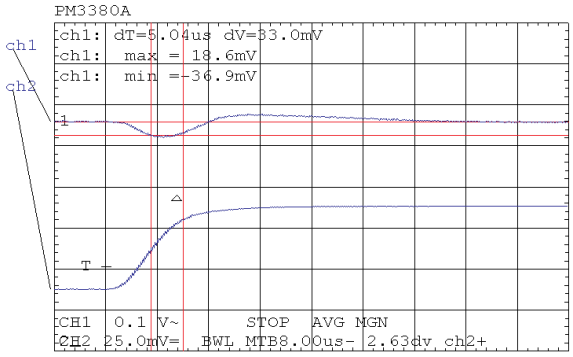

### START-UP USING REMOTE ON/OFF

Response when remote on/off driven from an open collector output.

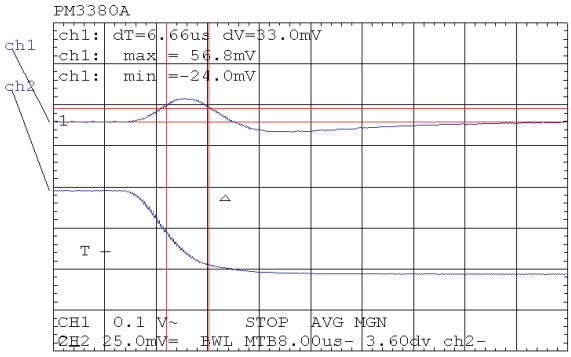



### TRANSIENT RESPONSE

$V_{IN}$ = 4.0VDC $V_{OUT}$ = 3.3VDC $I_{OUT}$ Change = 50-100%




$V_{IN}$ = 4.0VDC $V_{OUT}$ = 3.3VDC $I_{OUT}$ Change = 100-50%



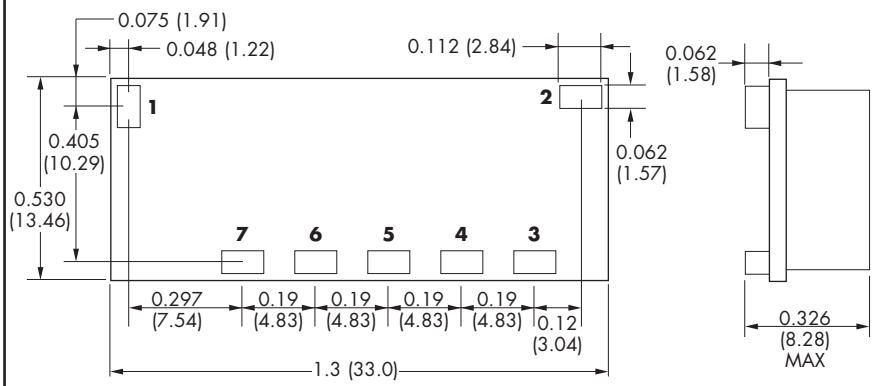
## PIN CONNECTIONS

| Pin Number | | | | | | |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| ON/OFF | $V_{IN}$ | DC OK* | GND | $V_{OUT}$ | TRIM | SENSE |

* Pin 6 (DC OK) is an optional feature which allows multiple NNL10 DC/DC Converters to have sequenced outputs when used in conjunction with the Remote ON/OFF pin (see application note for further information).

## MECHANICAL DIMENSIONS

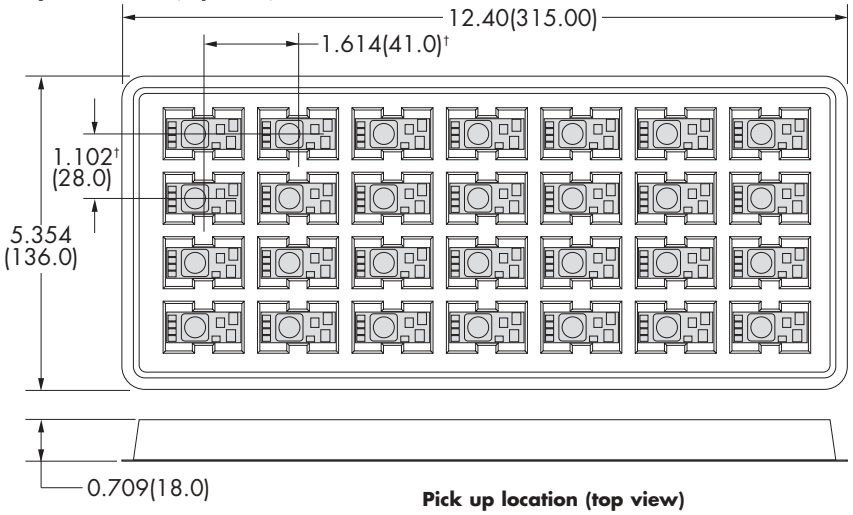
**SMD Package Style Bottom View**



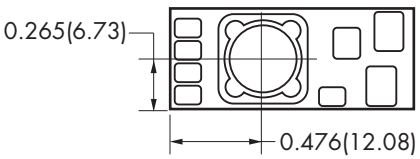

Unless otherwise stated all dimensions in inches(mm) ±0.01(0.25). Weight: 5.7g

## PACKAGING

**Tray Dimensions (top view)**




**Pick up location (top view)**




Tray quantity: 28

† +0.020(0.5)
−0.00(0.0)

Unless otherwise stated all dimensions in inches(mm) ± 0.014(0.35).



Instructions for use are available from: www.cdpoweronline.com

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