## FEATURES

- RoHS compliant
- Industry standard footprint
- Short circuit protection
- High efficiency
- Under voltage lock out
- Fully adjustable output voltage
- Operating temperature range -40°C to 85°C
- SMD Construction
- UL60950 recognized

## DESCRIPTION

The NNL05 series is part of a range of non-isolated, cost effective DC/DC converters offering high precision output voltages from a nominal 3.0-5.5V or 10.0-14.0V intermediate bus where isolation is not required. Currently available in SMD format and packaged in stackable trays or tape and reel packaging. The product range has been recognized by the Underwriters Laboratory (UL) to UL60950, file number E179522 applies.

### SELECTION GUIDE

| Order Code[1] | Input Voltage | Output Voltage | Output Current | | User Select Voltage | Efficiency |
|---|---|---|---|---|---|---|
| | | | Min. Load | Full Load | | |
| | V (nom.) | V | A | A | $V_{OUT}$ | % (Min.) |
| NNL05-9C[2] | 4 | Adjustable between 0.75 & 3.3 | 0 | 5.0 | 0.75 | 78 |
| | | | | | 1.2 | 83 |
| | | | | | 1.5 | 85 |
| | | | | | 1.8 | 87 |
| | | | | | 2.5 | 90 |
| | | | | | 3.3 | 94 |
| NNL05-10C[2] | 12 | Adjustable between 0.75 & 5.0 | 0 | 5.0 | 0.75 | 71 |
| | | | | | 1.2 | 78 |
| | | | | | 1.5 | 80 |
| | | | | | 1.8 | 83 |
| | | | | | 2.5 | 85 |
| | | | | | 3.3 | 87 |
| | | | | | 5.0 | 90 |

### INPUT CHARACTERISTICS[1]

| Parameter | Conditions | | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| Voltage range | NNL05-9C $V_{OUT}$ < 2.75V | | 3.0 | | 5.5 | V |
| | NNL05-9C $V_{OUT}$ > 3.0V | | 4.0 | | 5.5 | |
| | NNL05-10C | | 10.0 | | 14.0 | |
| Under voltage lock out | NNL05-9C | Turn on threshold | | 2.11 | | V |
| | | Turn off threshold | | 1.96 | | |
| | NNL05-10C | Turn on threshold | 7.85 | | 8.25 | |
| | | Turn off threshold | 7.75 | | 8.20 | |
| Reflected ripple current | NNL05-9C | | | 12.0 | | mA p-p |
| | NNL05-10C | | | 20.0 | | |
| Input no load current | NNL05-9C | $V_{IN}$ = 5.5V $V_{OUT}$ = 0.75V | | 70 | | mA |
| | | $V_{IN}$ = 5.5V $V_{OUT}$ = 3.3V | | 100 | | |
| | NNL05-10C | $V_{IN}$ = 12.0V $V_{OUT}$ = 0.75V | | 15 | | |
| | | $V_{IN}$ = 12.0V $V_{OUT}$ = 5.0V | | 75 | | |
| Input standby current | Module Disabled | | | 5.0 | | mA |

### OUTPUT CHARACTERISTICS

| Parameter | Conditions | | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| Rated current | TA = −40°C to 85°C (see thermal performance characteristics) | | | | 5.0 | A |
| Voltage set point accuracy | Using 1% tolerance resistor | | -3.0 | | +2.0 | % |
| Line regulation | Low line to high line | NNL05-9C | | | 1.0 | % |
| | | NNL05-10C | | | 0.1 | |
| Load regulation | 0% load to 100% load | NNL05-9C | | | 1.0 | % |
| | | NNL05-10C | | | 0.2 | |
| Ripple & noise | BW = DC to 20MHz with 1µF ceramic and 10µF tantalum capacitors | NNL05-9C | | 30 | | mV p-p |
| | | NNL05-10C 0.75V | | 9 | | |
| | | NNL05-10C 5.0V | | 20 | | |
| Transient response | NNL05-9C $I_{OUT}$ = 2.5A–5.0A–2.5A | Peak deviation | | 60 | | mV |
| | | Settling time | | 25 | | µs |
| | NNL05-10C $I_{OUT}$ = 2.5A–5.0A–2.5A | Peak deviation | | 70 | | mV |
| | | Settling time | | 35 | | µs |
| Current limit inception | | | | 9.0 | | A |

1. If components are required in tape and reel format suffix order code with -R, e.g. NNL05-9C-R.

2. A 330µF low ESR capacitor, approx 17mΩ at 100kHz to 300kHz must be fitted at the input to the NNL DC/DC converter to ensure stability under all the operating conditions.

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

## ABSOLUTE MAXIMUM RATINGS

| | | |
|---|---|---|
| Short circuit protection | | Continuous |
| Input voltage V$_{IN}$ | NNL05-9C | 6.0V |
| | NNL05-10C | 15.0V |
| Trim voltage | NNL05-9C | -0.35V to V$_{OUT}$ |
| | NNL05-10C | -0.3V to V$_{OUT}$ |
| Remote on/off | NNL05-9C | -0.35V to 6.0V |
| | NNL05-10C | -0.3V to +V$_{OUT}$ |
| Minimum load | | 0% |

## GENERAL CHARACTERISTICS[1]

| Parameter | Conditions | | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| Switching frequency | | | | 300 | | kHz |
| Start delay | NNL05-9C | | | 5.0 | | ms |
| | NNL05-10C | | | 7.0 | | |
| Remote on/off | NNL05-9C | Module on (or pin unconnected) | 0 | | 0.5 | V |
| | | | | | -0.4 | mA |
| | | Module off | 2.6 | | V$_{IN}$ | V |
| | | | 1.0 | | | mA |
| | NNL05-10C | Module on (or pin unconnected) | 0 | | 0.5 | V |
| | | | | | -0.4 | mA |
| | | Module off | 2.5 | | V$_{IN}$ | V |
| | | | 0.125 | | 1.0 | mA |

## TEMPERATURE CHARACTERISTICS[1]

| Parameter | Conditions | | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| Operation | See thermal performance characteristics | | -40 | | 85 | °C |
| Storage | Absolute Max. internal temperature | | -55 | | 125 | °C |
| Over temperature protection | Operates at substrate temperature | NNL05-9C | | 110 | | °C |
| | | NNL05-10C | | 118 | | |

## OUTPUT VOLTAGE ADJUSTMENT

The trimming (adjust) input on the device allows output voltage adjustment from 0.75V to 3.3Vdc (NNL05-9C) or 5.0 (NNL05-10C) by using a resistor as shown in fig.1 or by applying a voltage between trim and common pins as shown in fig.2.

To calculate the resistor value for NNL05-9C:

$$R_{TRIM} = \left[ \frac{21070}{V_{OUT} - 0.7525} - 5110 \, \Omega \right]$$

To calculate the resistor value for NNL05-10C:

$$R_{TRIM} = \left[ \frac{10500}{V_{OUT} - 0.7525} - 1000 \, \Omega \right]$$

To calculate V$_{TRIM}$ for NNL05-9C:
$$V_{TRIM} = (0.7 - 0.1698 \times \{V_{OUT} - 0.7525\})$$

To calculate V$_{TRIM}$ for NNL05-10C:
$$V_{TRIM} = (0.7 - 0.0667 \times \{V_{OUT} - 0.7525\})$$

Tables 1 & 2 provide R$_{TRIM}$ and V$_{TRIM}$ Values for the most commonly required output voltages.

Fig.1



Fig.2



| Table 1: NNL05-9C R$_{TRIM}$ & V$_{TRIM}$ | | |
|---|---|---|
| V$_{OUT}$ SET (V) | R$_{TRIM}$ (kΩ) | V$_{TRIM}$ (V) |
| 0.75 | Open | Open |
| 1.2 | 41.71 | 0.624 |
| 1.5 | 22.98 | 0.573 |
| 1.8 | 14.96 | 0.505 |
| 2.5 | 6.93 | 0.403 |
| 3.3 | 3.15 | 0.267 |

| Table 2: NNL05-10C R$_{TRIM}$ & V$_{TRIM}$ | | |
|---|---|---|
| V$_{OUT}$ SET (V) | R$_{TRIM}$ (kΩ) | V$_{TRIM}$ (V) |
| 0.75 | Open | Open |
| 1.2 | 22.46 | 0.670 |
| 1.5 | 13.05 | 0.650 |
| 1.8 | 9.024 | 0.630 |
| 2.5 | 5.009 | 0.583 |
| 3.3 | 3.122 | 0.530 |
| 5.0 | 1.472 | 0.4166 |

1. Specifications typical at T$_A$ =25°C, nominal input voltage and rated output current unless otherwise specified.
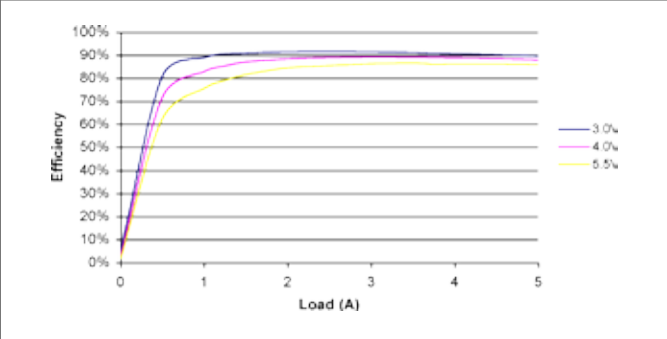
## EFFICIENCY v LOAD GRAPHS (NNL05-9C)

**V_OUT = 3.3V**
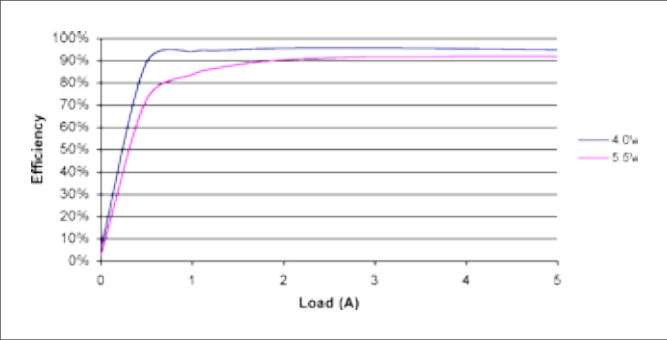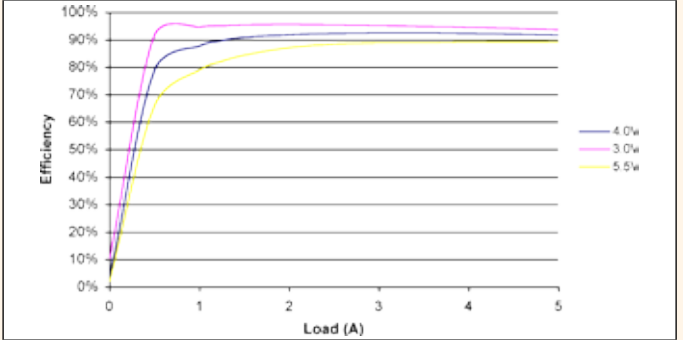


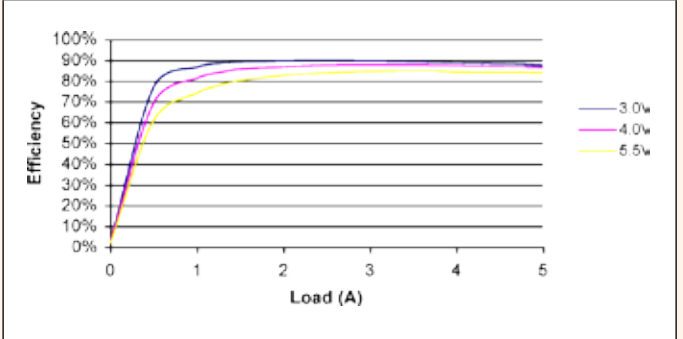**V_OUT = 2.5V**
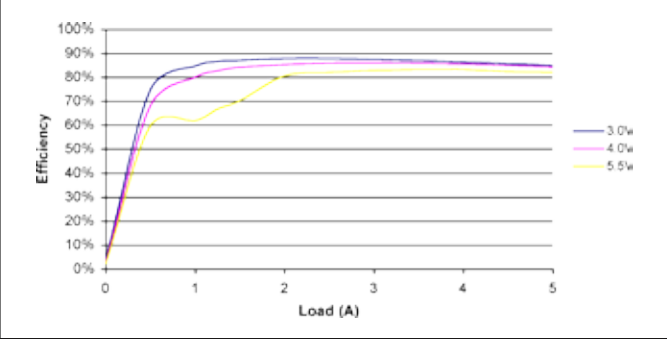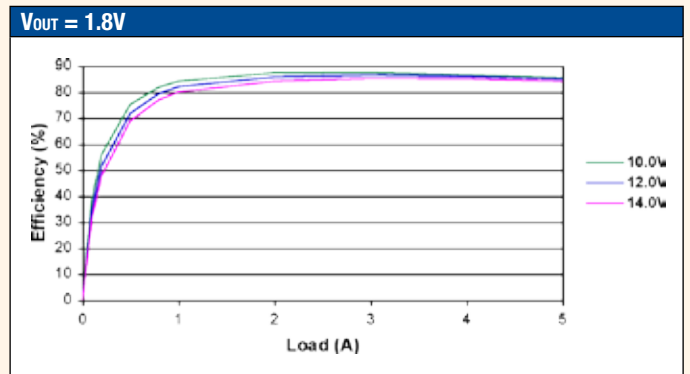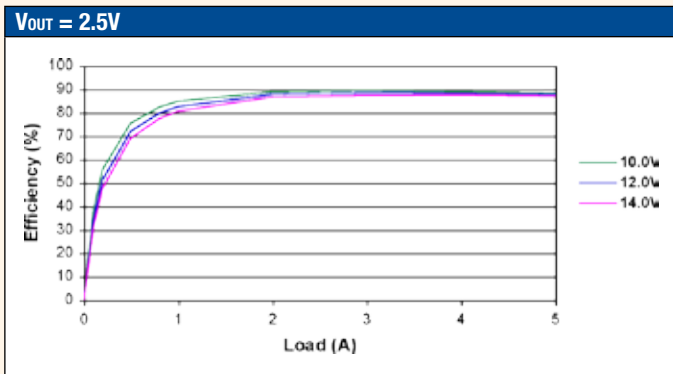


**V_OUT = 1.8V**



**V_OUT = 1.5V**



**V_OUT = 1.2V**



**V_OUT = 0.75V**

## EFFICIENCY v LOAD GRAPHS (NNL05-10C)

**V_OUT = 5.0V**



**V_OUT = 3.3V**



**V_OUT = 2.5V**



**V_OUT = 1.8V**



**V_OUT =1.5V**



**V_OUT =1.2V**



**V_OUT =0.75V**

## C&D TECHNOLOGIES
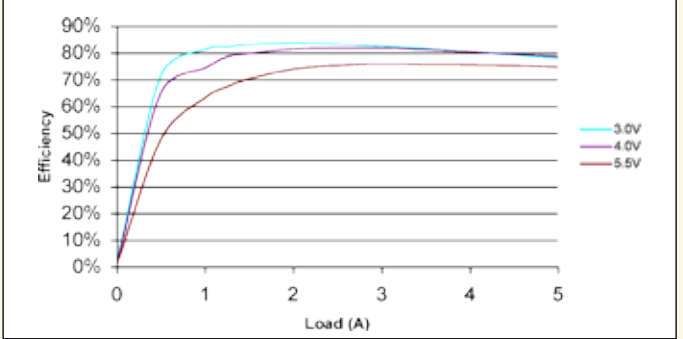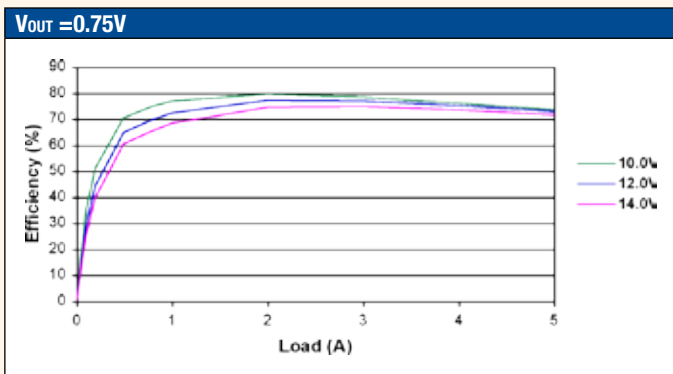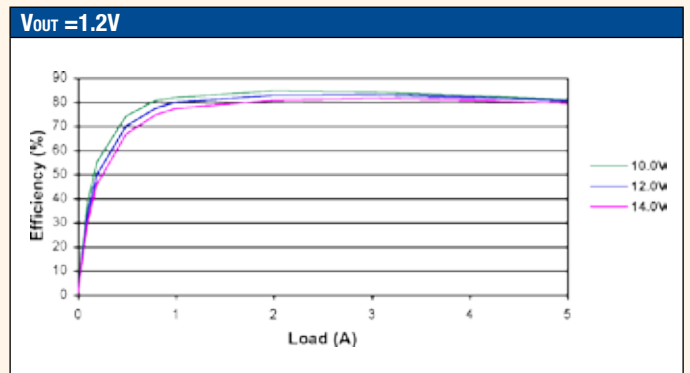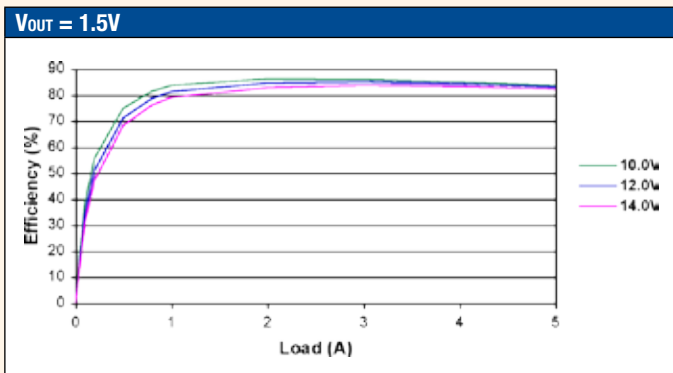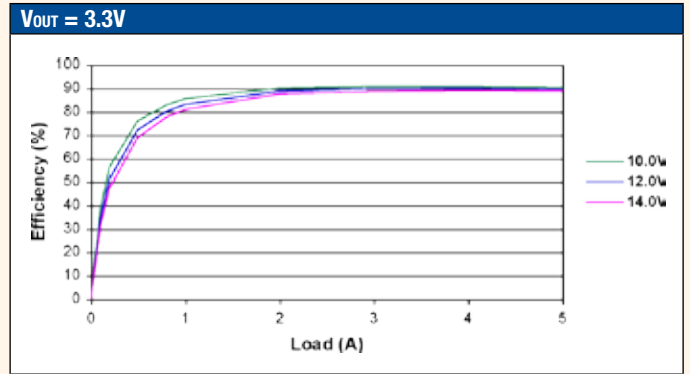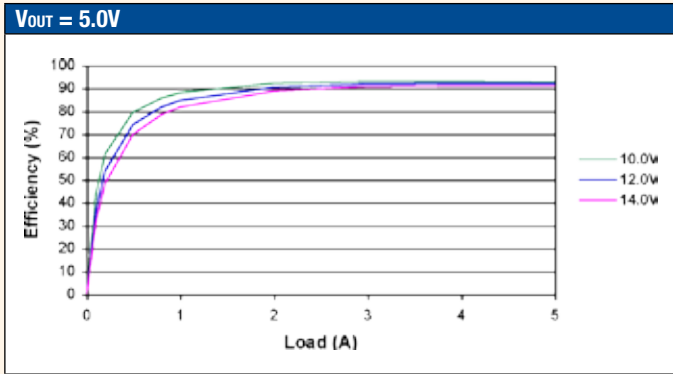
### THERMAL DERATING GRAPHS (NNL05-9C)
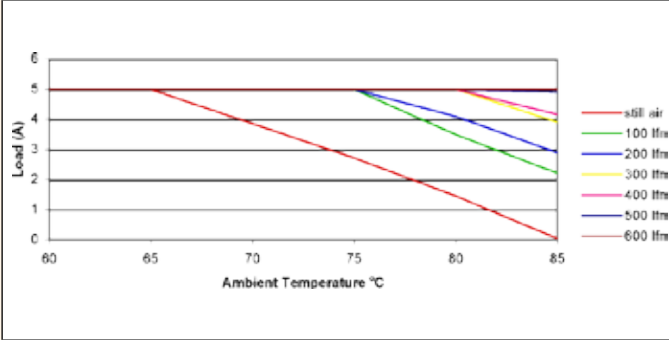
#### $V_{OUT} = 3.3V$
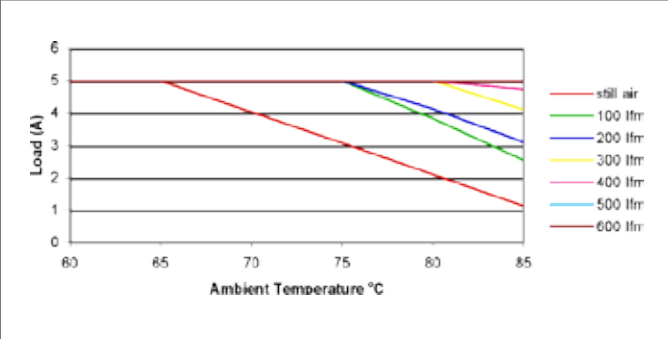


#### $V_{OUT} = 2.5V$
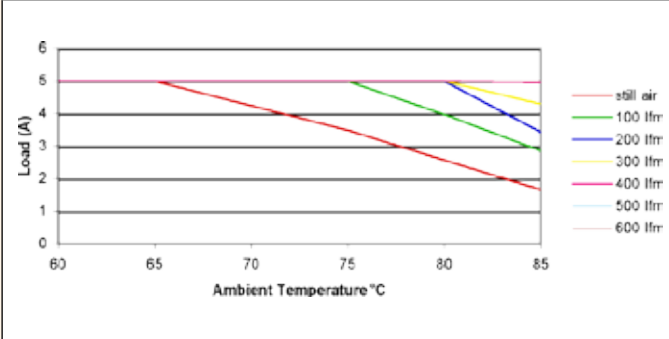


#### $V_{OUT} = 1.8V$
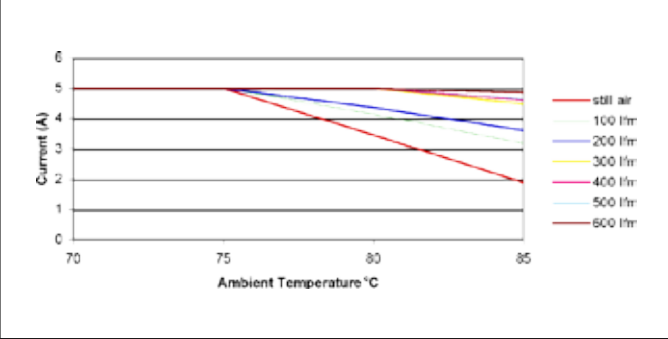


#### $V_{OUT} = 1.5V$
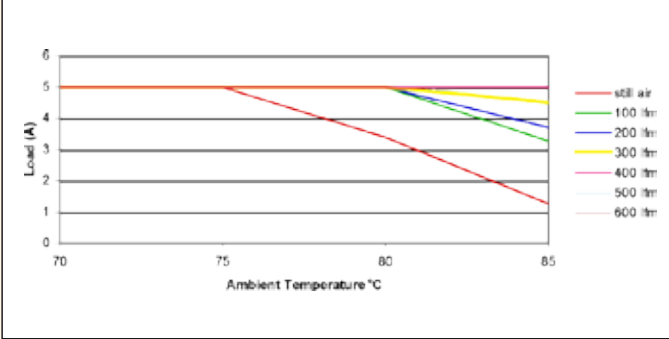


#### $V_{OUT} = 1.2V$



#### $V_{OUT} = 0.75V$



All derating graphs shown are for an input voltage, $V_{IN} = 5.5V$

## THERMAL DERATING GRAPHS (NNL05-10C)

### V$_{OUT}$ = 5.0V
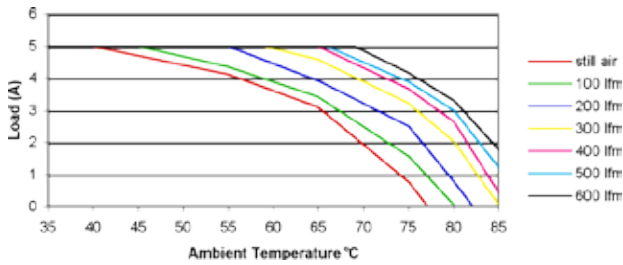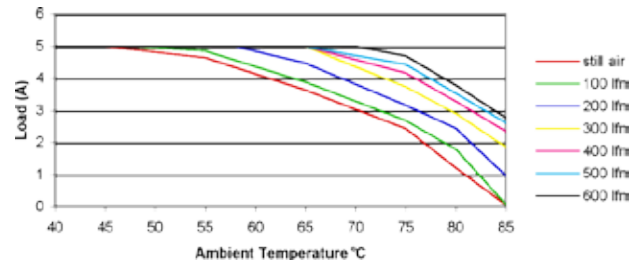


### V$_{OUT}$ = 3.3V



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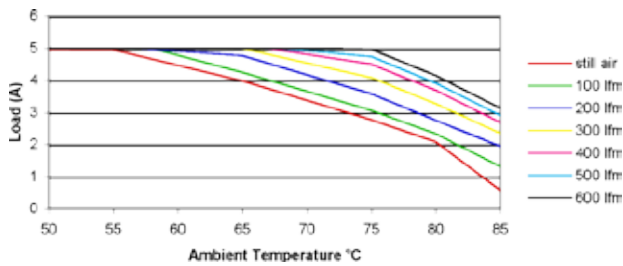


### V$_{OUT}$ = 1.8V
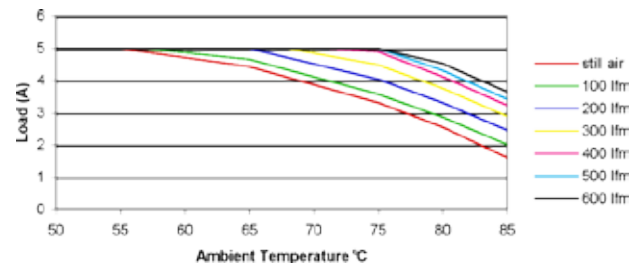


### V$_{OUT}$ = 1.5V
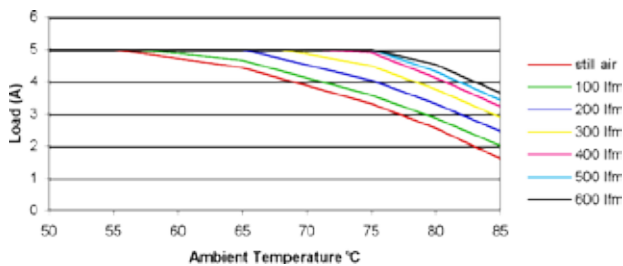


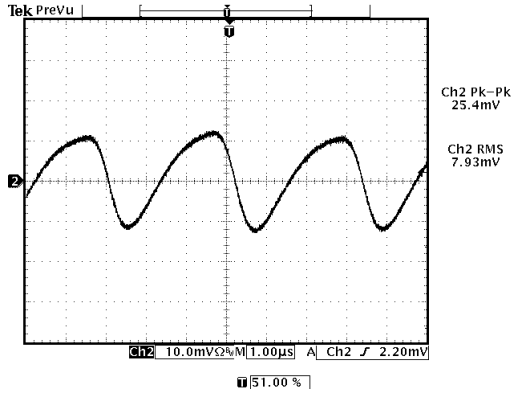### V$_{OUT}$ =1.2V
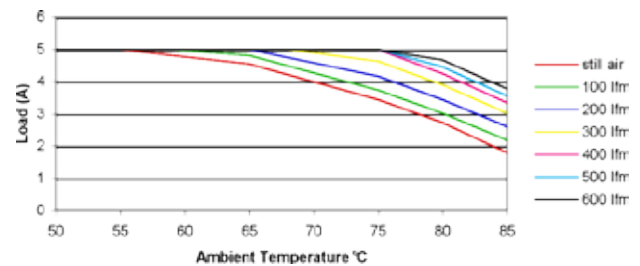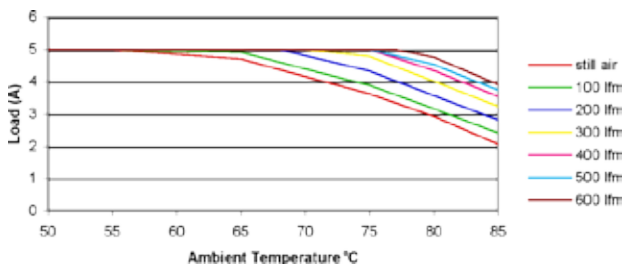


### V$_{OUT}$ =0.75V



All derating graphs shown are for an input voltage, V$_{IN}$ = 14.0V

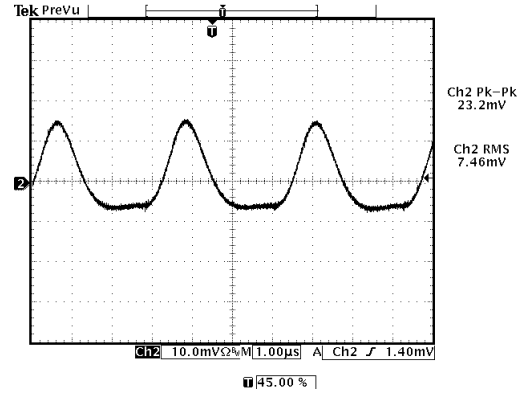## CHARACTERISTIC GRAPHS (NNL05-9C)

### TYPICAL OUTPUT RIPPLE & NOISE

$V_{IN}$ = 5.0VDC  $V_{OUT}$ = 3.3V  $I_{OUT}$ = 5.0A
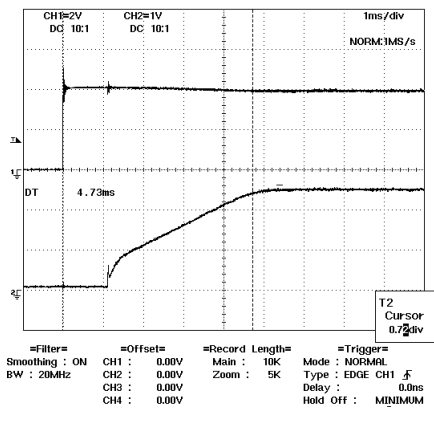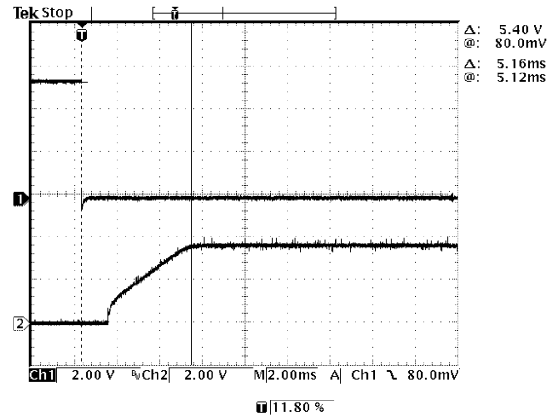


### TYPICAL OUTPUT RIPPLE & NOISE

$V_{IN}$ = 5.0VDC  $V_{OUT}$ = 0.75V  $I_{OUT}$ = 5.0A



### TYPICAL START-UP FROM APPLICATION OF VIN
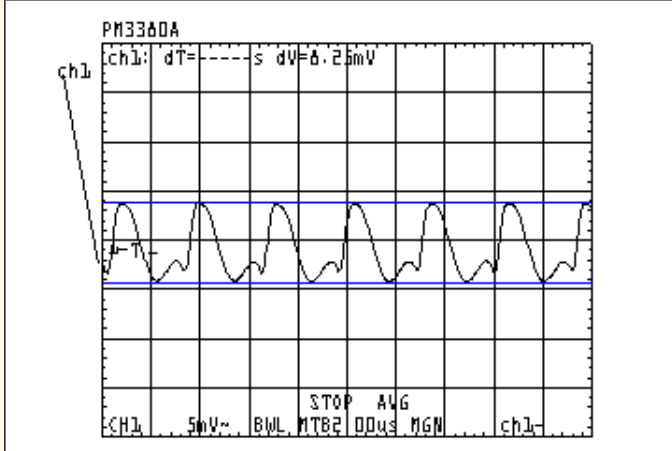


### TYPICAL START-UP USING REMOTE ON/OFF



## MTTF

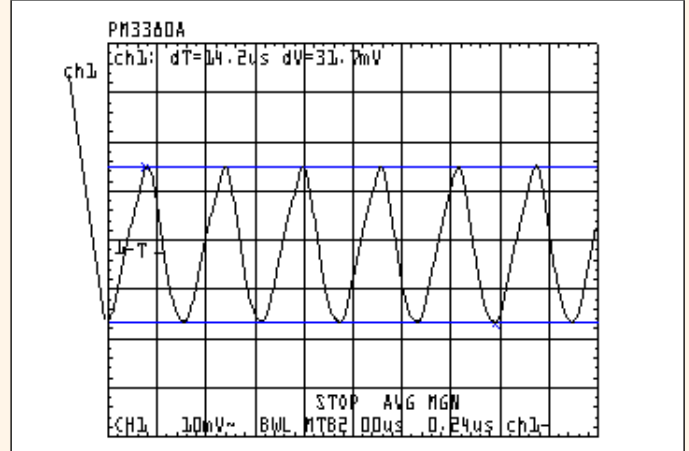MTTF figures calculated by MIL-HDBK-217F ground benign. Ambient temperature 25°C, airflow 200LFM.

|  | Conditions | MTTF (Hrs) |
|---|---|---|
| NNL05-9C | $V_{IN}$ = 5.5V, $V_{OUT}$ = 3.3V | 995057 |
| NNL05-10C | $V_{IN}$ = 12.0V, $V_{OUT}$ = 5.0V | 420454 |

## CHARACTERISTIC GRAPHS (NNL05-10C)
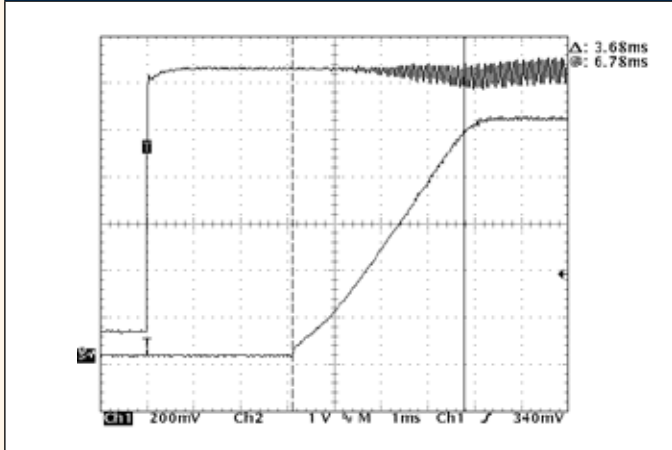
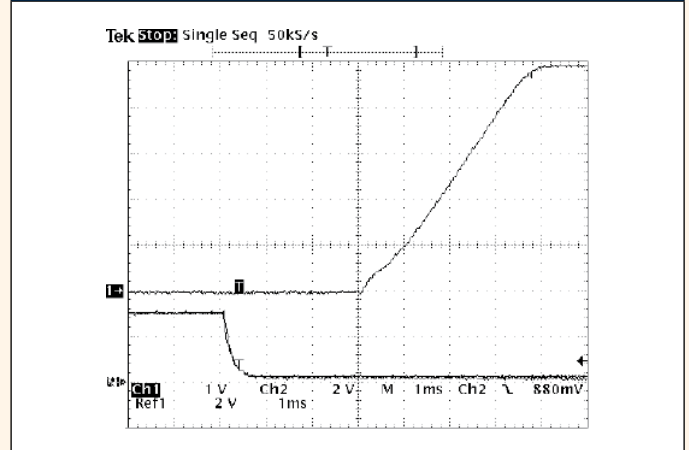### TYPICAL OUTPUT RIPPLE & NOISE (0.75V OUTPUT)



### TYPICAL OUTPUT RIPPLE & NOISE (5.0V OUTPUT)



### TYPICAL START-UP FROM APPLICATION OF VIN



### TYPICAL START-UP USING REMOTE ON/OFF

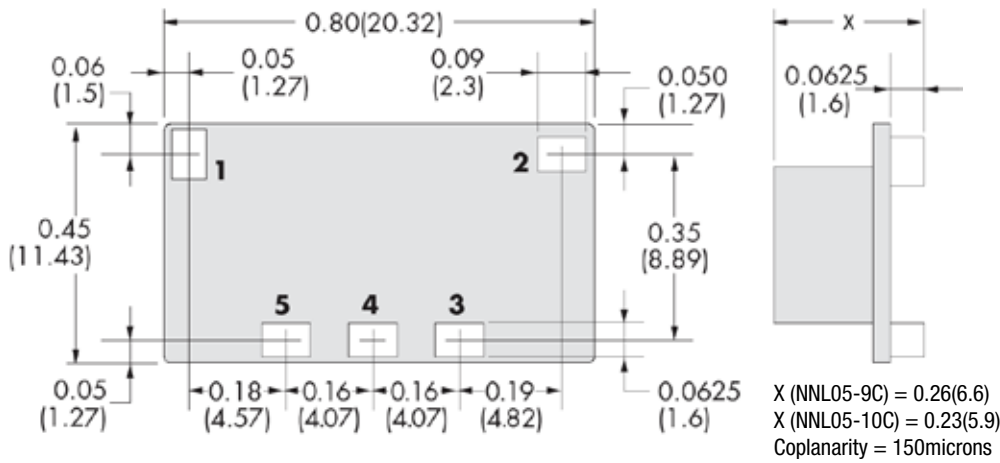

### RoHS COMPLIANCE INFORMATION



This series is compatible with RoHS soldering systems with a peak reflow solder temperature of 245ºC. The pin termination finish on this product series is Matte Tin over Nickel Preplate. The series is backward compatible with Sn/Pb soldering systems. The NNL05-9 has a Moisture Sensitivity Level (MSL) 1. The NNL05-10 has a Moisture Sensitivity Level (MSL) 2.

For further information, please visit www.cd4power.com/rohs

## MECHANICAL DIMENSIONS
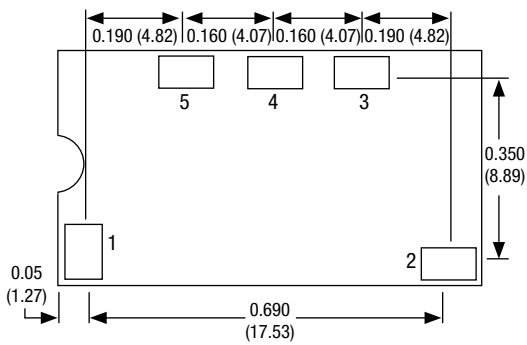
### SURFACE MOUNT PACKAGE STYLE (BOTTOM VIEW)

0.80(20.32)
0.06 (1.5)
0.05 (1.27)
0.09 (2.3)
0.050 (1.27)
X
0.0625 (1.6)
0.45 (11.43)
0.35 (8.89)
0.05 (1.27)
0.18 (4.57)
0.16 (4.07)
0.16 (4.07)
0.19 (4.82)
0.0625 (1.6)

X (NNL05-9C) = 0.26(6.6)
X (NNL05-10C) = 0.23(5.9)
Coplanarity = 150microns

### PIN CONNECTIONS

| Pin | Function |
|-----|----------|
| 1 | On/Off |
| 2 | $+V_{IN}$ |
| 3 | Common |
| 4 | Trim |
| 5 | $+V_{OUT}$ |

### PACKAGE WEIGHT

| | |
|-----------|------|
| NNL05-9C | 2.3g |
| NNL05-10C | 2.7g |

### RECOMMENDED PAD LAYOUT

0.190 (4.82)
0.160 (4.07)
0.160 (4.07)
0.190 (4.82)
0.350 (8.89)
0.05 (1.27)
0.690 (17.53)

Pad size:
MIN: 0.120 x 0.095 (3.048 x 2.413)
MAX: 0.135 x 0.110 (3.429 x 2.794)

### TRAY DIMENSIONS (TOP VIEW)

12.40(315.00)
0.846(21.5)†
0.768(19.5)†
1.102† (28.0)
5.354 (136.0)
0.709(18.0)
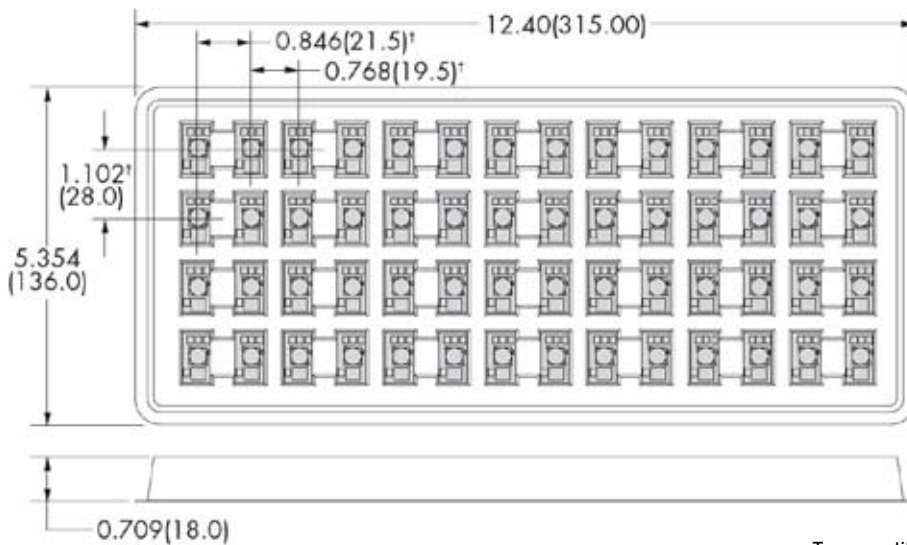
Tray quantity: 56
† +0.020(0.5)
   -0.00(0.0)

### PICK-UP POINT NNL05-9

0.246 (6.24)
0.379 (9.63)
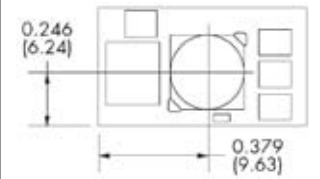
### PICK-UP POINT NNL05-10

0.2935 (7.4549)
0.434 (11.0236)
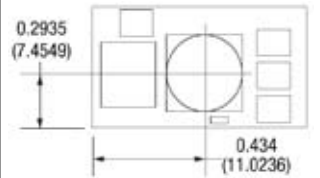
Unless otherwise stated all dimensions in inches(mm) ±0.01(0.25).

# C&D TECHNOLOGIES

## TAPE & REEL SPECIFICATIONS

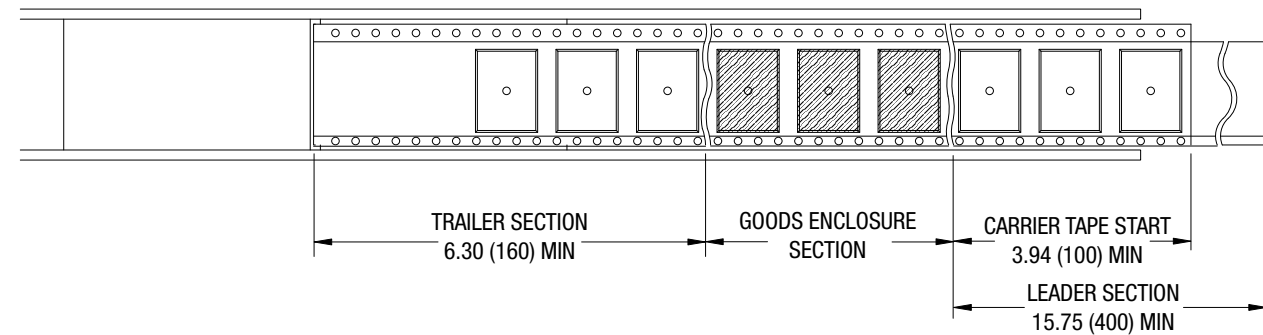### REEL OUTLINE DIMENSIONS
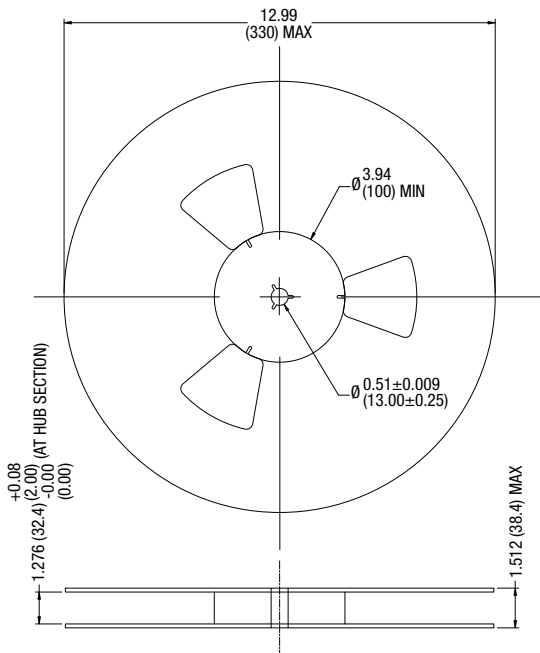


### TAPE OUTLINE DIMENSIONS



### REEL PACKAGING DETAILS



TRAILER SECTION
6.30 (160) MIN

GOODS ENCLOSURE SECTION

CARRIER TAPE START
3.94 (100) MIN

LEADER SECTION
15.75 (400) MIN

Reel Quantity : 500

## C&D TECHNOLOGIES