Murata Power Solutions

OBSOLETE

# NNL10 Series

Non-Isolated DC/DC Converters

## FEATURES

- RoHS compliant
- Industry standard footprint
- Short circuit protection
- High efficiency
- Under voltage lock out
- Output voltage trimming
- Operating temperature range -40ºC to 85ºC
- 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 3.0-5.5V or 10.0-14.0V intermediate bus where isolation is not required. The series has been recognized by Underwriters Laboratory (UL) to UL 60950, file number E179522 applies.

## SELECTION GUIDE[1]

| Recommended Alternative | Order Code[2] | | Nominal Input Voltage | Output Voltage | Output Current Min.Load | Output Current Full Load | Max. Output Power | Nominal Efficiency |
|---|---|---|---|---|---|---|---|---|
| | | | V | V | A | A | W | % (Min.) |
| Recommended alternative: OKY-T/10-W5P-C >> click here to download the data sheet | NNL10-1C | | 4.0 | 0.9 | 0 | 10 | 9 | 79.7 |
| | NNL10-2C | | 4.0 | 1.0 | 0 | 10 | 10 | 81.8 |
| | NNL10-3C | | 4.0 | 1.2 | 0 | 10 | 12 | 84.3 |
| | NNL10-4C | | 4.0 | 1.5 | 0 | 10 | 15 | 86.5 |
| | NNL10-5C | | 4.0 | 1.8 | 0 | 10 | 18 | 88.2 |
| | NNL10-6C | | 4.0 | 2.0 | 0 | 10 | 20 | 89.2 |
| | NNL10-7C | | 4.0 | 2.5 | 0 | 10 | 25 | 91.2 |
| | NNL10-8C | | 4.0 | 3.3 | 0 | 10 | 33 | 92.1 |
| Recommended alternative: OKY2-T/10-W5P-C >> click here to download the data sheet | With DCOK | NNL10-9C | 4.0 | 0.9 | 0 | 10 | 9 | 79.7 |
| | | NNL10-10C | 4.0 | 1.0 | 0 | 10 | 10 | 81.8 |
| | | NNL10-11C | 4.0 | 1.2 | 0 | 10 | 12 | 84.3 |
| | | NNL10-12C | 4.0 | 1.5 | 0 | 10 | 15 | 86.5 |
| | | NNL10-13C | 4.0 | 1.8 | 0 | 10 | 18 | 88.2 |
| | | NNL10-14C | 4.0 | 2.0 | 0 | 10 | 20 | 89.2 |
| | | NNL10-15C | 4.0 | 2.5 | 0 | 10 | 25 | 91.2 |
| | | NNL10-16C | 4.0 | 3.3 | 0 | 10 | 33 | 92.1 |

## INPUT CHARACTERISTICS

| 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

| 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 capacitance | | | | 10,000 | | µF |

1. 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.
2. If components are required in tape and reel format suffix order code with -R, e.g. NNL10-10C-R.

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

RoHS COMPLIANT 2002/95/EC

For full details go to www.murata-ps.com/rohs

## ABSOLUTE MAXIMUM RATINGS

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

## GENERAL CHARACTERISTICS[1]

| Parameter | | 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) | 2.6 | | | V |
| | | | | 100 | µA |
| | Module off | | | 0.3 | V |
| | | | | -500 | µA |
| MTTF | | TBA | | | kHrs |

## TEMPERATURE CHARACTERISTICS[1]

| Parameter | Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| Operation | See thermal performance characteristics | -40 | | 85 | °C |
| Storage | | -55 | | 125 | °C |
| Over temperature protection | Substrate temperature | | 115 | | °C |

## APPLICATION NOTES

### 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.

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

$$R_{TRIM\text{-}UP} = \frac{24.080}{|\Delta V_{OUT}|} - R_{INTERNAL}\ K\Omega$$

$$V_{TRIM\text{-}UP} = 0.8 - \left[\frac{\Delta V_{OUT} \times R_{INTERNAL}}{30.100}\right]$$

$\Delta V_{OUT}$ 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.

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

$$V_{TRIM\text{-}DOWN} = 0.8 + \left[\frac{|\Delta V_{OUT}| \times R_{INTERNAL}}{30.100}\right]$$

The trim pin should be left disconnected if not used.

Fig.1

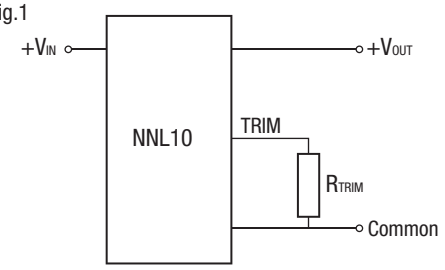
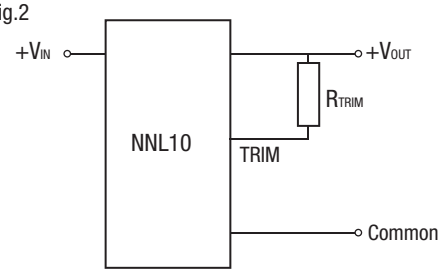



Fig.2




| $R_{INTERNAL}$ VALUES | |
|---|---|
| $V_{OUT\ SET}$ (V) | $R_{INTERNAL}$ (kOhm) |
| 0.9 | 5.1 |
| 1.0 | 30.1 |
| 1.2 | 59 |
| 1.5 | 100 |
| 1.8 | 100 |
| 2.0 | 100 |
| 2.5 | 78.7 |
| 3.3 | 59 |

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

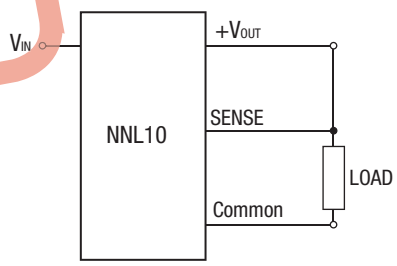
## APPLICATION NOTES (continued)

### Remote Sense



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

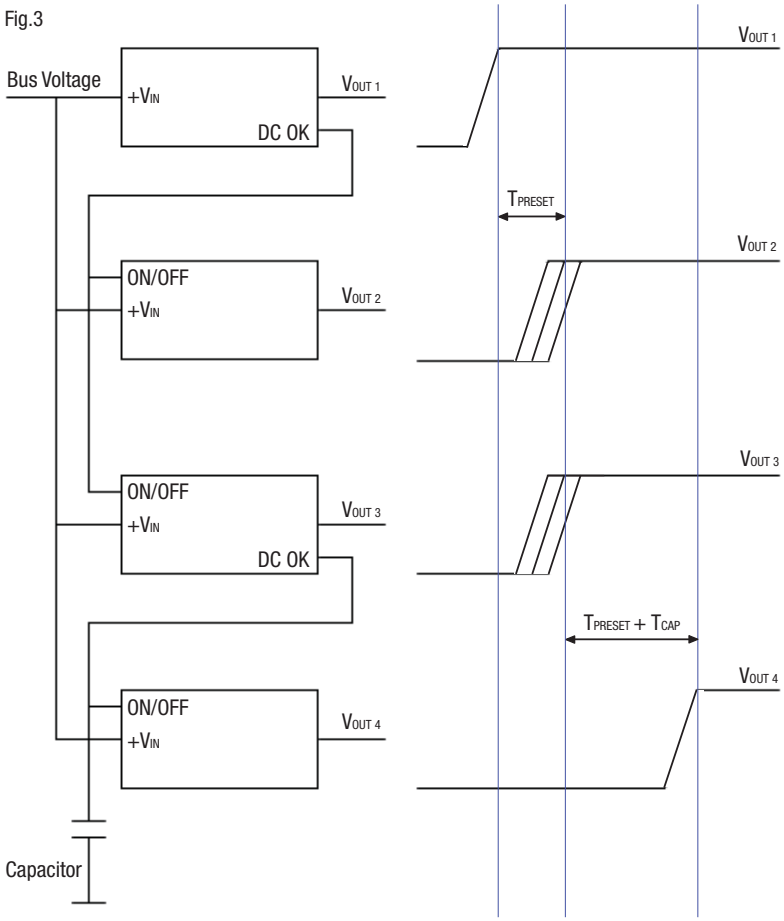
To simplify output sequencing, the NNL10 series offers an optional single wire interconnection that performs this function. Using this connection, up to four devices can be 'daisy chained' together, with the 'DC OK' signal from one converter signifying that the next converter can be enabled. A capacitor, 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 3 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.

| $V_{IN}$ | Capacitor | Delay |
|---|---|---|
| 3.0$V_{DC}$ | 0.22µF | 1.8ms |
| 5.5$V_{DC}$ | 0.22µF | 0.6ms |

Fig.3




## RoHS COMPLIANCE INFORMATION

RoHS COMPLIANT 2002/95/EC

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. This series has a Moisture Sensitivity Level (MSL) 2.

For further information, please visit www.murata-ps.com/rohs

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

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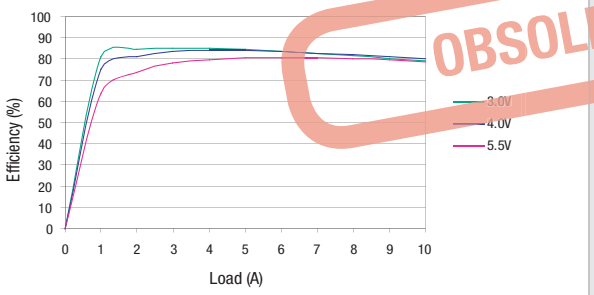
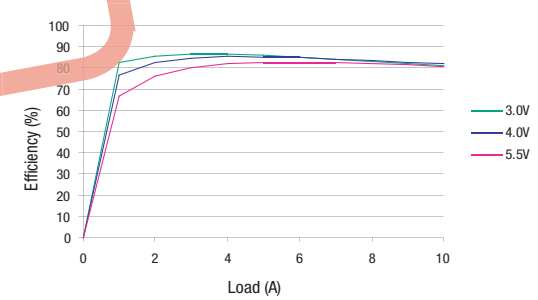
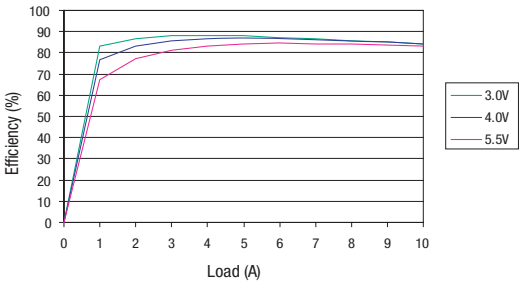
### $V_{OUT}$ = 0.9V



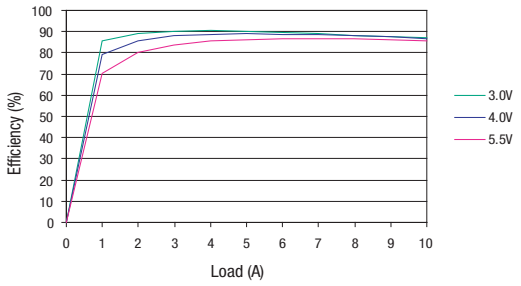

### $V_{OUT}$ = 1.0V



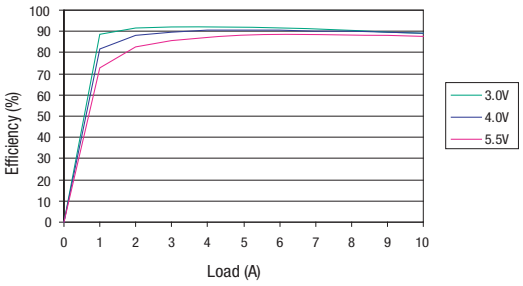

### $V_{OUT}$ = 1.2V



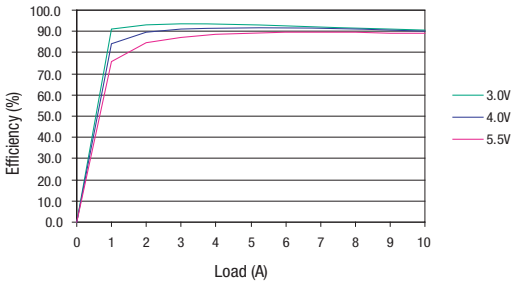

### $V_{OUT}$ = 1.5V



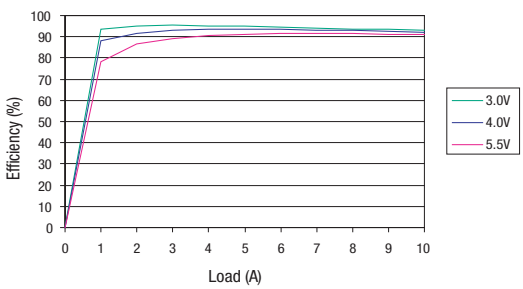

### $V_{OUT}$ = 1.8V



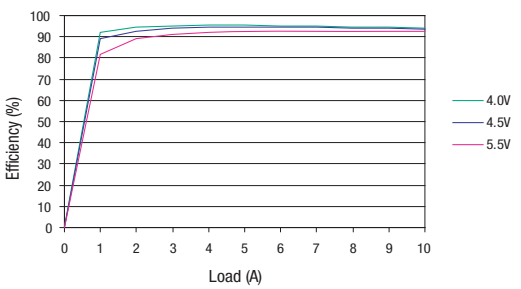

### $V_{OUT}$ =2.0V




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

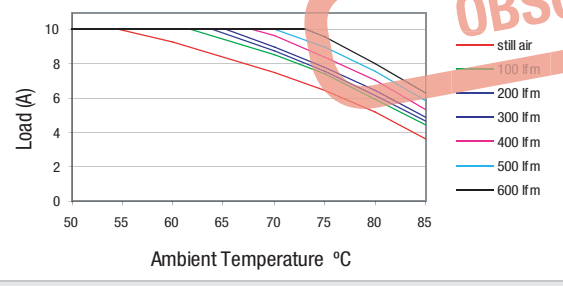



### $V_{OUT}$ = 3.3V

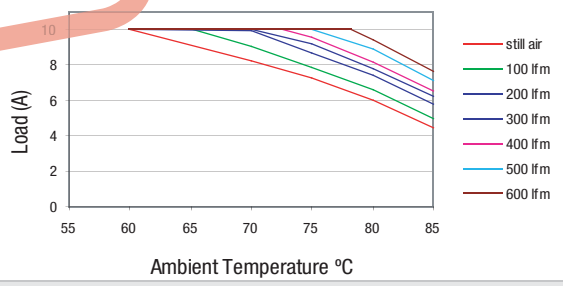


## THERMAL DERATING GRAPHS (NNL10 $V_{NOM}$ = 4.0$V_{DC}$)

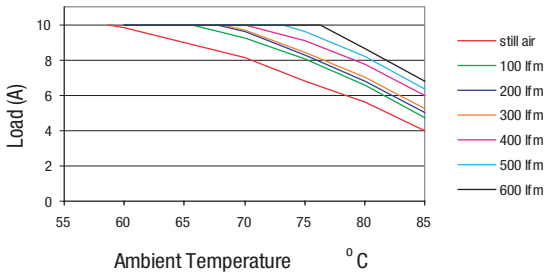
### $V_{OUT}$ = 0.9V



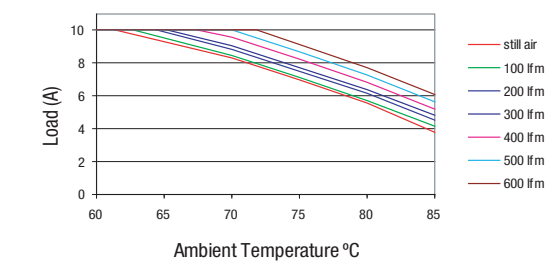

### $V_{OUT}$ = 1.0V



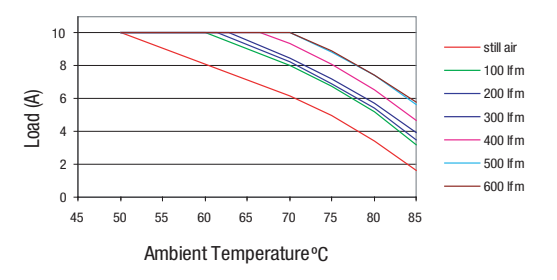

### $V_{OUT}$ = 1.2V



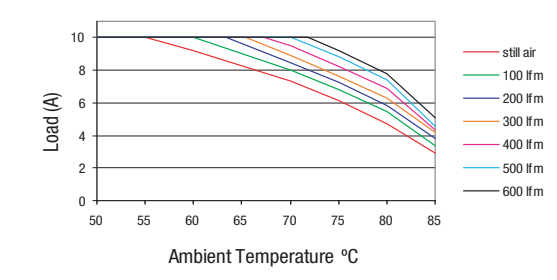

### $V_{OUT}$ = 1.5V



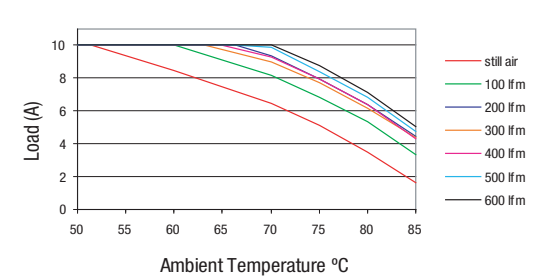

### $V_{OUT}$ = 1.8V



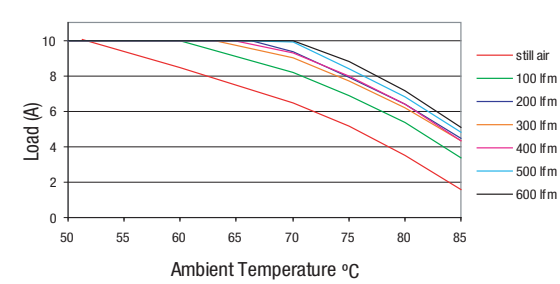

### $V_{OUT}$ =2.0V




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



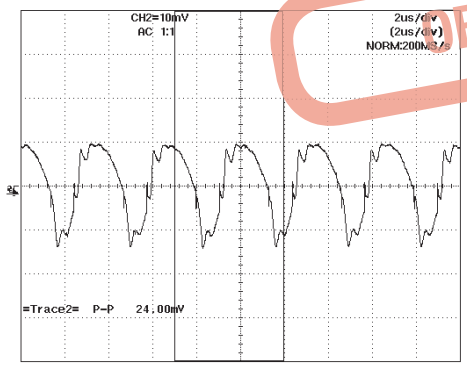

### $V_{OUT}$ =3.3V



## TYPICAL CHARACTERISTICS

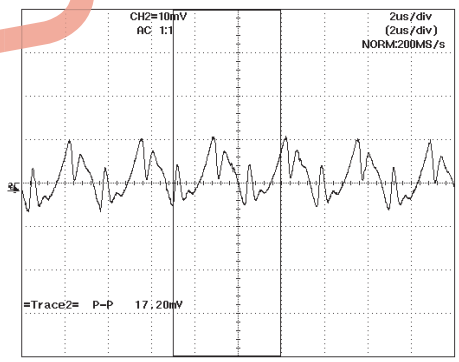
### OUTPUT RIPPLE & NOISE

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

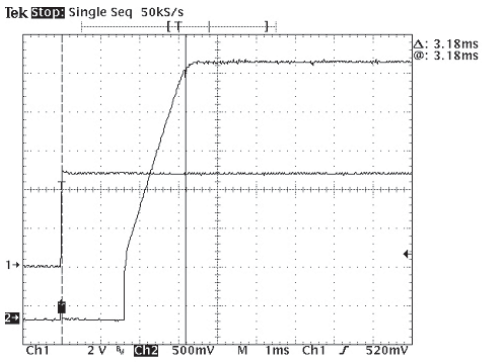





$V_{IN}$ = 4.0$V_{DC}$ $V_{OUT}$ = 0.9$V_{DC}$ $I_{OUT}$ = 10.0A

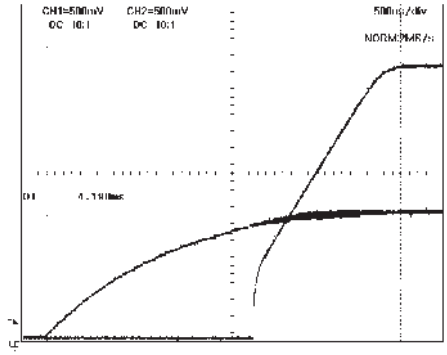



### START-UP FROM APPLICATION OF $V_{IN}$



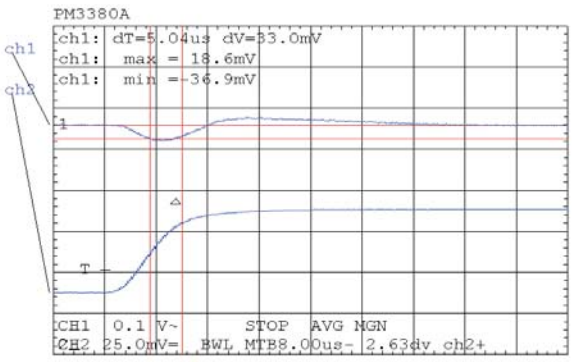

### START-UP USING REMORE ON/OFF

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

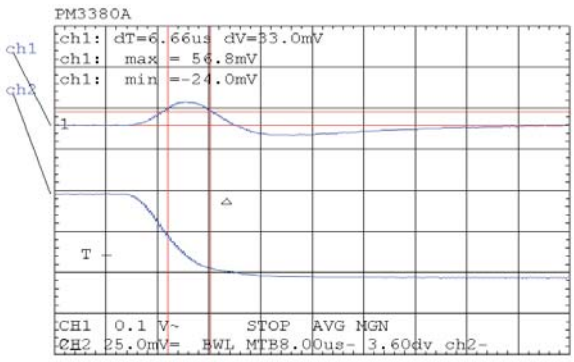



### TRANSIENT RESPONSE

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

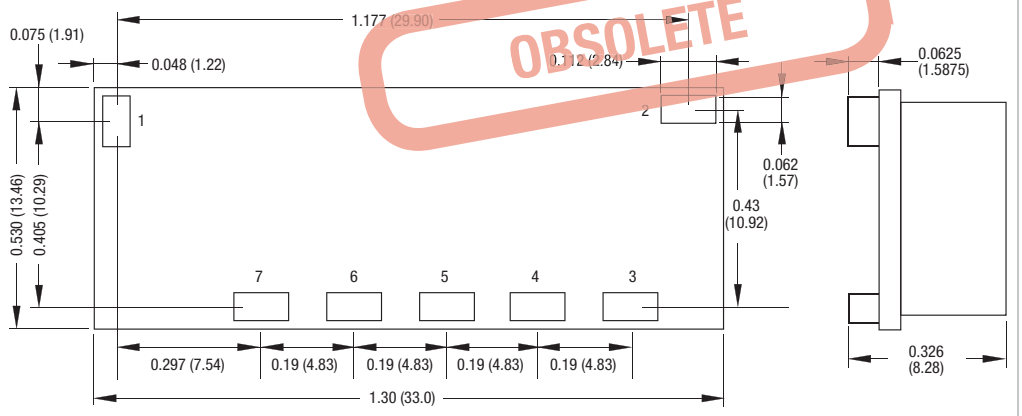



$V_{IN}$ = 4.0$V_{DC}$ $V_{OUT}$ = 3.3$V_{DC}$ $I_{OUT}$ Change = 100-50%



## MECHANICAL DIMENSIONS

### SURFACE MOUNT PACKAGE STYLE (BOTTOM VIEW)



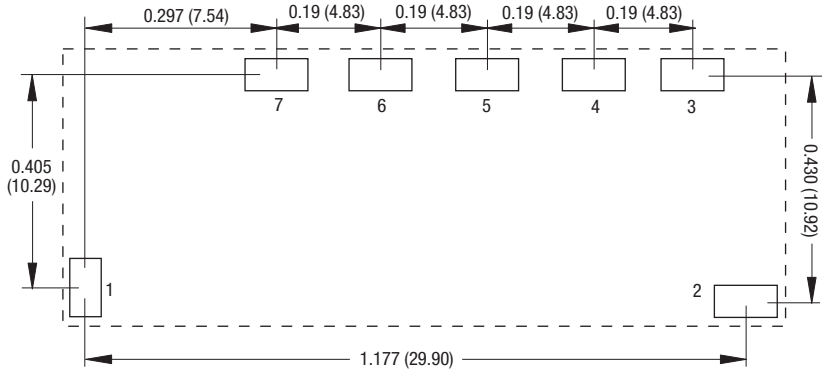

Weight: 5.7g

### PIN CONNECTIONS

| Pin | Function |
|---|---|
| 1 | On/Off |
| 2 | $+V_{IN}$ |
| 3 | DC OK* |
| 4 | Common |
| 5 | $+V_{OUT}$ |
| 6 | TRIM |
| 7 | SENSE |

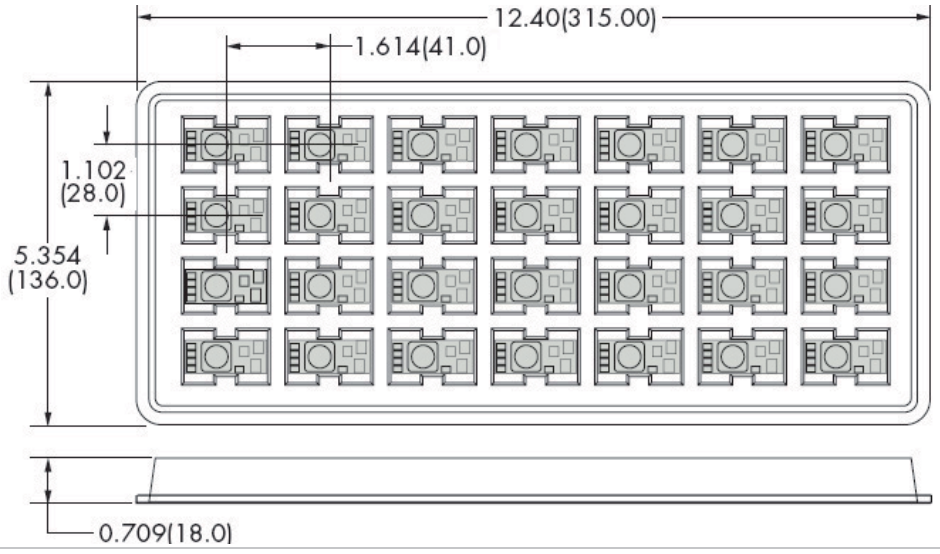
* Pin 3 (DC OK) is an optional pin feature which allows multiple NNL10 DC/DC converters to have sequenced outputs when used in conjunction with Remote ON/OFF pin (see application note for futher information).

### RECOMMENDED PAD LAYOUT

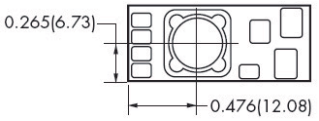



PAD SIZE
MIN: 0.140 X 0.095 (3.556 X 2.413)
MAX: 0.165 X 0.110 (4.19 X 2.79)

### TRAY DIMENSIONS (TOP VIEW)




### PICK-UP POINT

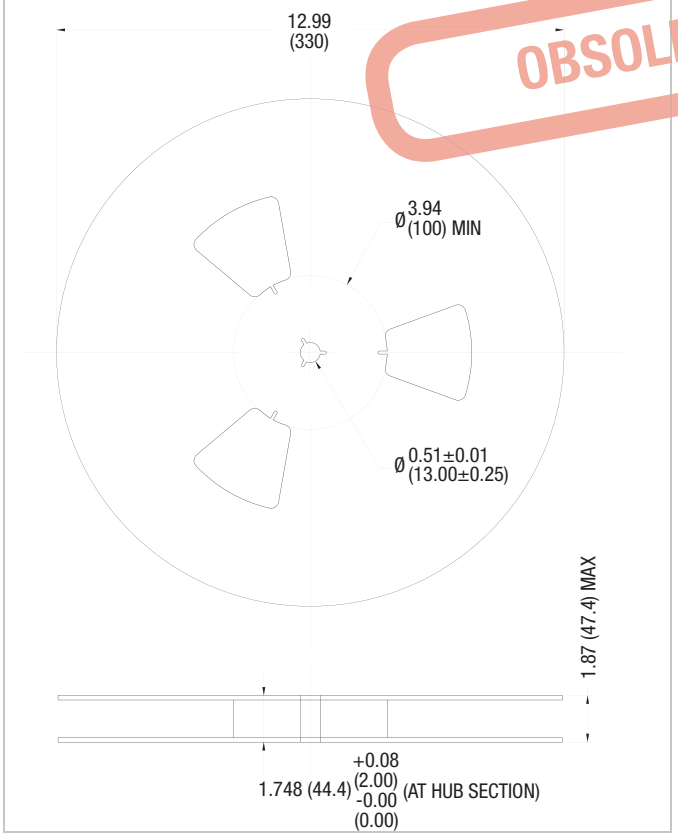



Tray quantity: 28
All dimensions ±0.0138 (0.35)

Unless otherwise stated all dimensions in inches (mm) ±0.01 (0.25).

## TAPE & REEL SPECIFICATIONS

### REEL OUTLINE DIMENSIONS

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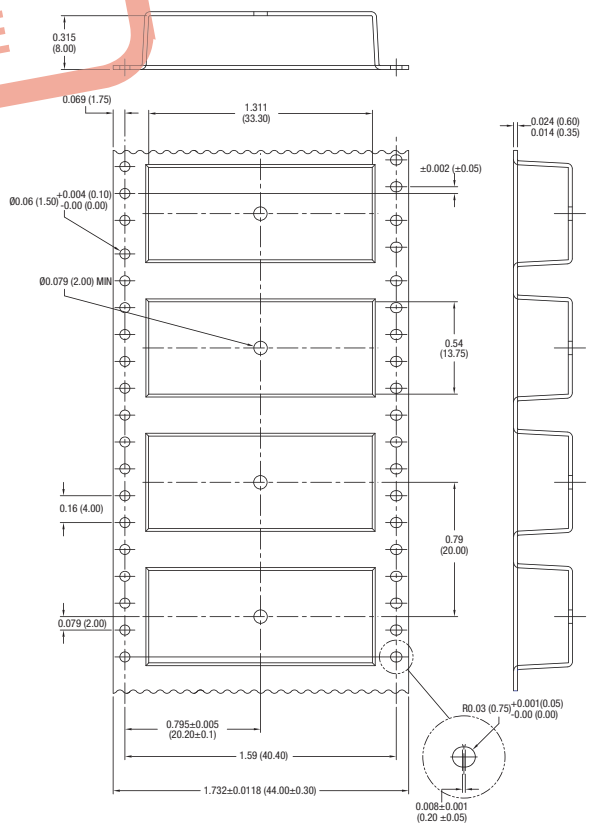
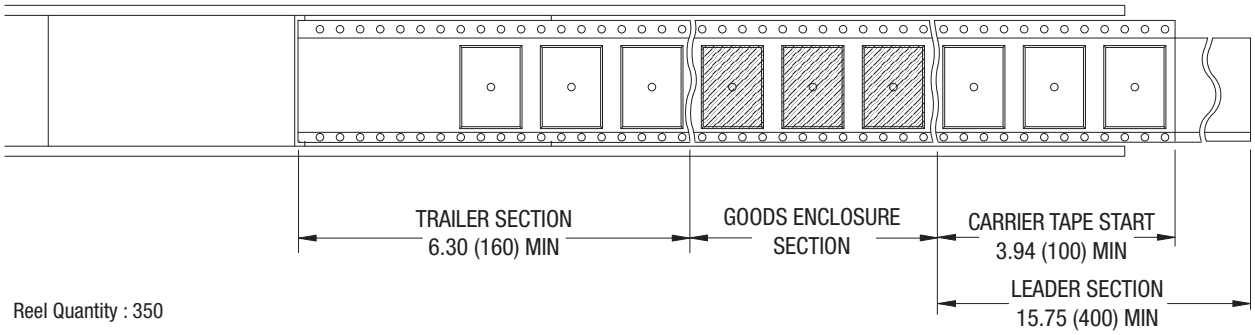
### TAPE OUTLINE DIMENSIONS




### REEL PACKAGING DETAILS




Reel Quantity : 350

Murata Power Solutions, Inc.
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ISO 9001 and 14001 REGISTERED

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