



## FEATURES

- RoHS compliant
- Efficiency up to 84%
- Wide temperature performance at full 2 Watt load, -40°C to 85°C
- UL 94V-0 Package material
- Lead frame technology
- 5V & 12V Input
- 5V, 9V, 12V & 15V Output
- Internal SMD construction
- Dual isolated output
- 1kVDC Isolation
- MTTF up to 2.17 million hours
- Power density 1.61W/cm<sup>3</sup>
- No heatsink required
- Custom solutions available
- Multi layer ceramic capacitors

## DESCRIPTION

The NTH series of miniature surface mounted DC/DC converters employ leadframe technology and transfer moulding techniques to bring all of the benefits of IC style packaging to hybrid circuitry. The component lead termination of this product range is lead-free compatible, therefore the converter can be soldered in a lead-free soldering process. Co-planarity of the lead positions is based upon IEC 191-6:1990. The devices are suitable for all applications where high volume production is envisaged.

# NTH Series

## Isolated 2W Dual Output SM DC/DC Converters

### SELECTION GUIDE

| Order Code <sup>1</sup> | Nominal Input Voltage | Output Voltage | Output Current | Input Current at Rated Load | Efficiency | Isolation Capacitance | MTTF <sup>2</sup> |
|-------------------------|-----------------------|----------------|----------------|-----------------------------|------------|-----------------------|-------------------|
|                         | V                     | V              | mA             | mA                          | %          | pF                    | kHrs              |
| NTH0505MC               | 5                     | ±5             | ±200           | 500                         | 80         | 27                    | 2175              |
| NTH0509MC               | 5                     | ±9             | ±111           | 494                         | 81         | 34                    | 913               |
| NTH0512MC               | 5                     | ±12            | ±83            | 488                         | 82         | 39                    | 465               |
| NTH0515MC               | 5                     | ±15            | ±67            | 476                         | 84         | 37                    | 257               |
| NTH1205MC               | 12                    | ±5             | ±200           | 208                         | 80         | 35                    | 675               |
| NTH1209MC               | 12                    | ±9             | ±111           | 201                         | 83         | 57                    | 472               |
| NTH1212MC               | 12                    | ±12            | ±83            | 198                         | 84         | 66                    | 315               |
| NTH1215MC               | 12                    | ±15            | ±67            | 198                         | 84         | 63                    | 204               |

### INPUT CHARACTERISTICS

| Parameter                | Conditions                            | Min. | Typ. | Max. | Units  |
|--------------------------|---------------------------------------|------|------|------|--------|
| Voltage range            | Continuous operation, 5V input types  | 4.5  | 5    | 5.5  | V      |
|                          | Continuous operation, 12V input types | 10.8 | 12   | 13.2 |        |
| Reflected ripple current | 5V input types                        |      | 40   |      | mA p-p |
|                          | 12V input types                       |      | 30   |      |        |

### OUTPUT CHARACTERISTICS

| Parameter                    | Conditions                                     | Min. | Typ. | Max. | Units  |
|------------------------------|--|------|------|------|--------|
| Rated power <sup>3</sup>     | T <sub>A</sub> = -40°C to 85°C                 |      |      | 2.0  | W      |
| Voltage set point accuracy   | NTHXX05, 10% to 100% load                      | -5.0 |      | 7.5  | %      |
|                              | All other variants, 10% to 100% load           | -5.0 |      | 5.0  |        |
| Line regulation              | High V <sub>IN</sub> to low V <sub>IN</sub>    |      | 1.0  | 1.2  | %/%    |
| Load regulation <sup>2</sup> | 10% load to rated load, 5V output types        |      | 5.0  | 10   | %      |
|                              | 10% load to rated load, all other output types |      | 3.0  | 10   |        |
| Ripple & noise               | BW=DC to 20MHz, 5V output types                |      | 150  | 200  | mV p-p |
|                              | BW=DC to 20MHz, 9V output types                |      | 100  | 150  |        |
|                              | BW=DC to 20MHz, 12V output types               |      | 80   | 150  |        |
|                              | BW=DC to 20MHz, 15V output types               |      | 70   | 150  |        |

### ISOLATION CHARACTERISTICS

| Parameter              | Conditions                | Min. | Typ. | Max. | Units |
|------------------------|---------------------------|------|------|------|-------|
| Isolation test voltage | Flash tested for 1 second | 1000 |      |      | VDC   |
| Resistance             | Viso= 500VDC              | 1    | 10   |      | GΩ    |

### GENERAL CHARACTERISTICS

| Parameter           | Conditions          | Min. | Typ. | Max. | Units |
|---------------------|---------------------|------|------|------|-------|
| Switching frequency | All 5V input types  |      | 95   |      | kHz   |
|                     | All 12V input types |      | 90   |      |       |

### ABSOLUTE MAXIMUM RATINGS

|   |       |
|---|-------|
| Internal power dissipation                  | 550mW |
| Input voltage V <sub>IN</sub> , NTH05 types | 7V    |
| Input voltage V <sub>IN</sub> , NTH12 types | 15V   |

1. If components are required in tape and reel format suffix order code with -R, e.g. NTH0505MC-R.

2. Calculated using MIL-HDBK-217F with nominal input voltage at full load.

3. See derating graph.

All specifications typical at T<sub>A</sub>=25°C, nominal input voltage and rated output current unless otherwise specified.



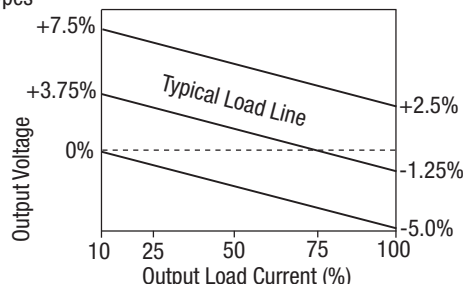
For full details go to  
[www.murata-ps.com/rohs](http://www.murata-ps.com/rohs)

### TEMPERATURE CHARACTERISTICS

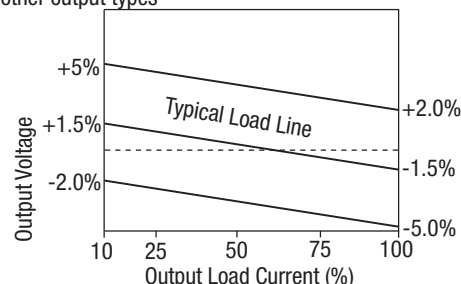
| Parameter                           | Conditions             | Min. | Typ. | Max. | Units |
|-------------------------------------|------------------------|------|------|------|-------|
| Specification                       | All output types       | -40  |      | 85   | °C    |
| Storage                             |                        | -55  |      | 125  |       |
| Case temperature rise above ambient | 5V output types        |      | 30   |      |       |
|                                     | All other output types |      | 25   |      |       |
| Cooling                             | Free air convection    |      |      |      |       |

### TOLERANCE ENVELOPE

5V output types



All other output types



The voltage tolerance envelope shows typical load regulation characteristics for this product series. The tolerance envelope is the maximum output voltage variation due to changes in output loading.

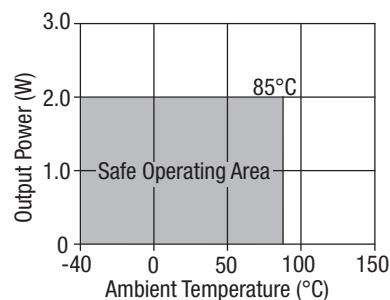
### RoHS COMPLIANCE INFORMATION



This series is compatible with RoHS soldering systems with a peak reflow solder temperature of 245°C and time above liquidus of 217°C for 60 seconds. The pin termination finish on this product series is Gold, plating thickness 0.1 microns minimum. The series is backward compatible with Sn/Pb soldering systems.

For further information, please visit [www.murata-ps.com/rohs](http://www.murata-ps.com/rohs)

### TEMPERATURE DERATING GRAPH



### TECHNICAL NOTES

#### ISOLATION VOLTAGE

'Hi Pot Test', 'Flash Tested', 'Withstand Voltage', 'Proof Voltage', 'Dielectric Withstand Voltage' & 'Isolation Test Voltage' are all terms that relate to the same thing, a test voltage, applied for a specified time, across a component designed to provide electrical isolation, to verify the integrity of that isolation.

Murata Power Solutions NTH series of DC/DC converters are all 100% production tested at their stated isolation voltage. This is 1kVDC for 1 second.

A question commonly asked is, "What is the continuous voltage that can be applied across the part in normal operation?"

For a part holding no specific agency approvals, such as the NTH series, both input and output should normally be maintained within SELV limits i.e. less than 42.4V peak, or 60VDC. The isolation test voltage represents a measure of immunity to transient voltages and the part should never be used as an element of a safety isolation system. The part could be expected to function correctly with several hundred volts offset applied continuously across the isolation barrier; but then the circuitry on both sides of the barrier must be regarded as operating at an unsafe voltage and further isolation/insulation systems must form a barrier between these circuits and any user-accessible circuitry according to safety standard requirements.

#### REPEATED HIGH-VOLTAGE ISOLATION TESTING

It is well known that repeated high-voltage isolation testing of a barrier component can actually degrade isolation capability, to a lesser or greater degree depending on materials, construction and environment. The NTH series has toroidal isolation transformers, with no additional insulation between primary and secondary windings of enameled wire. While parts can be expected to withstand several times the stated test voltage, the isolation capability does depend on the wire insulation. Any material, including this enamel (typically polyurethane) is susceptible to eventual chemical degradation when subject to very high applied voltages thus implying that the number of tests should be strictly limited. We therefore strongly advise against repeated high voltage isolation testing, but if it is absolutely required, that the voltage be reduced by 20% from specified test voltage.

This consideration equally applies to agency recognized parts rated for better than functional isolation where the wire enamel insulation is always supplemented by a further insulation system of physical spacing or barriers.

### APPLICATION NOTES

#### Minimum load

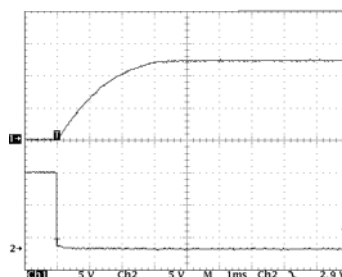
The minimum load to meet datasheet specification is 10% of the full rated load across the specified input voltage range. Lower than 10% minimum loading will result in an increase in output voltage, which may rise to typically double the specified output voltage if the output load falls to less than 5%.

#### Capacitive loading and start up

Typical start up times for this series, with a typical input voltage rise time of 2.2 $\mu$ s and output capacitance of 10 $\mu$ F, are shown in the table below. The product series will start into a capacitance of 47 $\mu$ F with an increased start time, however, the maximum recommended output capacitance is 10 $\mu$ F.

|           | Start-up time<br>$\mu$ s |
|-----------|--------------------------|
| NTH0505MC | 1026                     |
| NTH0509MC | 3625                     |
| NTH0512MC | 5750                     |
| NTH0515MC | 8330                     |
| NTH1205MC | 691                      |
| NTH1209MC | 2645                     |
| NTH1212MC | 3285                     |
| NTH1215MC | 6120                     |

Typical Start-Up Wave Form

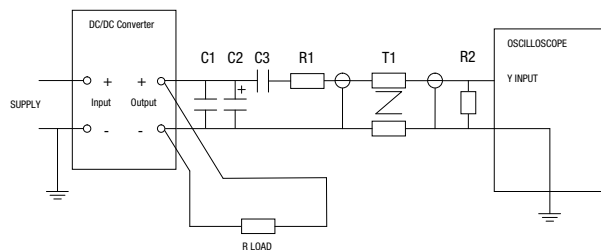


#### Ripple & Noise Characterisation Method

Ripple and noise measurements are performed with the following test configuration.

|  |  |
|--|--|
| C1   | 1 $\mu$ F X7R multilayer ceramic capacitor, voltage rating to be a minimum of 3 times the output voltage of the DC/DC converter  |
| C2   | 10 $\mu$ F tantalum capacitor, voltage rating to be a minimum of 1.5 times the output voltage of the DC/DC converter with an ESR of less than 100m $\Omega$ at 100 kHz |
| C3   | 100nF multilayer ceramic capacitor, general purpose  |
| R1   | 450 $\Omega$ resistor, carbon film, $\pm$ 1% tolerance   |
| R2   | 50 $\Omega$ BNC termination  |
| T1   | 3T of the coax cable through a ferrite toroid  |
| RLOAD  | Resistive load to the maximum power rating of the DC/DC converter. Connections should be made via twisted wires  |
| Measured values are multiplied by 10 to obtain the specified values. |  |

#### Differential Mode Noise Test Schematic



### APPLICATION NOTES (continued)

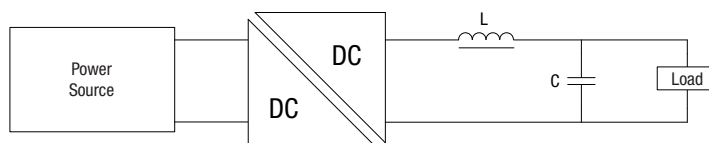
#### Output Ripple Reduction

By using the values of inductance and capacitance stated, the output ripple at the rated load is lowered to 5mV p-p max.

##### Component selection

**Capacitor:** It is required that the ESR (Equivalent Series Resistance) should be as low as possible, ceramic types are recommended. The voltage rating should be at least twice (except for 15V output), the rated output voltage of the DC/DC converter.

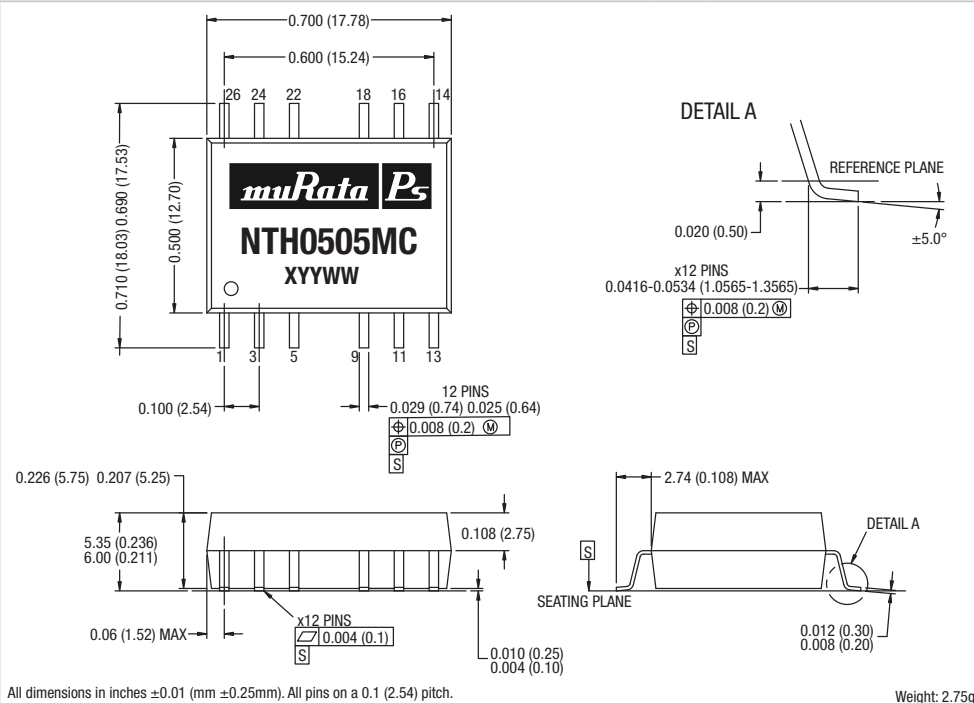
**Inductor:** The rated current of the inductor should not be less than that of the output of the DC/DC converter. At the rated current, the DC resistance of the inductor should be such that the voltage drop across the inductor is <2% of the rated voltage of the DC/DC converter. The SRF (Self Resonant Frequency) should be >20MHz.



|           | Inductor   |        |              | Capacitor  |
|-----------|------------|--------|--------------|------------|
|           | L, $\mu$ H | SMD    | Through Hole | C, $\mu$ F |
| NTH0505MC | 10         | 82103C | 11R103C      | 4.7        |
| NTH0509MC | 22         | 82223C | 11R223C      | 2.2        |
| NTH0512MC | 47         | 82473C | 11R473C      | 1          |
| NTH0515MC | 220        | 82474C | 11R474C      | 0.22       |
| NTH1205MC | 10         | 82103C | 11R103C      | 4.7        |
| NTH1209MC | 22         | 82223C | 11R223C      | 2.2        |
| NTH1212MC | 47         | 82473C | 11R473C      | 1          |
| NTH1215MC | 220        | 82474C | 11R474C      | 0.22       |

## PACKAGE SPECIFICATIONS

## MECHANICAL DIMENSIONS

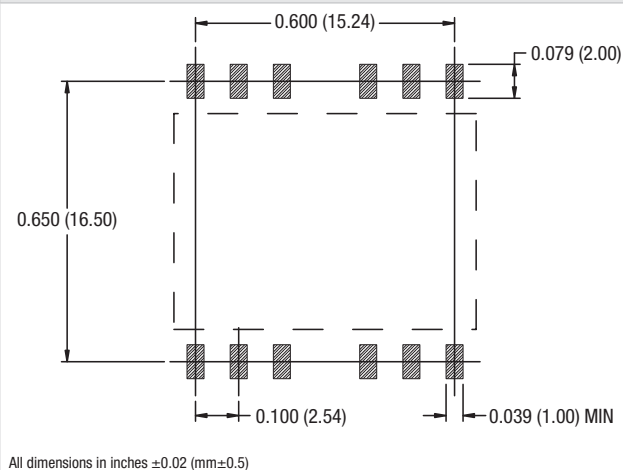


## PIN CONNECTIONS

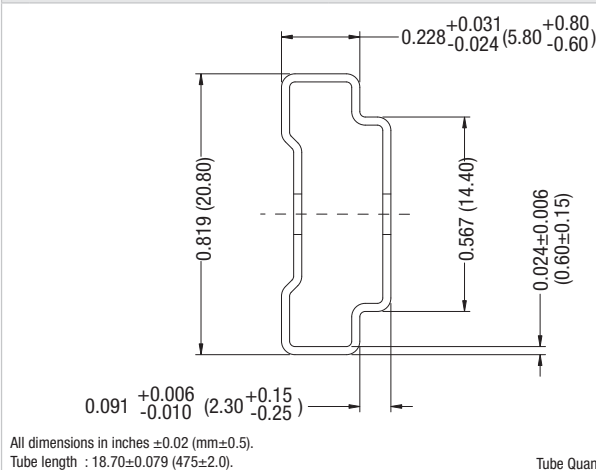
| Pin | Function          |
|-----|-------------------|
| 1   | -V <sub>IN</sub>  |
| 3   | +V <sub>IN</sub>  |
| 5   | NA                |
| 9   | -V <sub>OUT</sub> |
| 11  | OV                |
| 13  | +V <sub>OUT</sub> |
| 14  | NA                |
| 16  | NA                |
| 18  | -V <sub>OUT</sub> |
| 22  | NC                |
| 24  | NA                |
| 26  | NA                |

NA - Not available for electrical connection.  
NC - No internal electrical connection.

## RECOMMENDED FOOTPRINT DETAILS

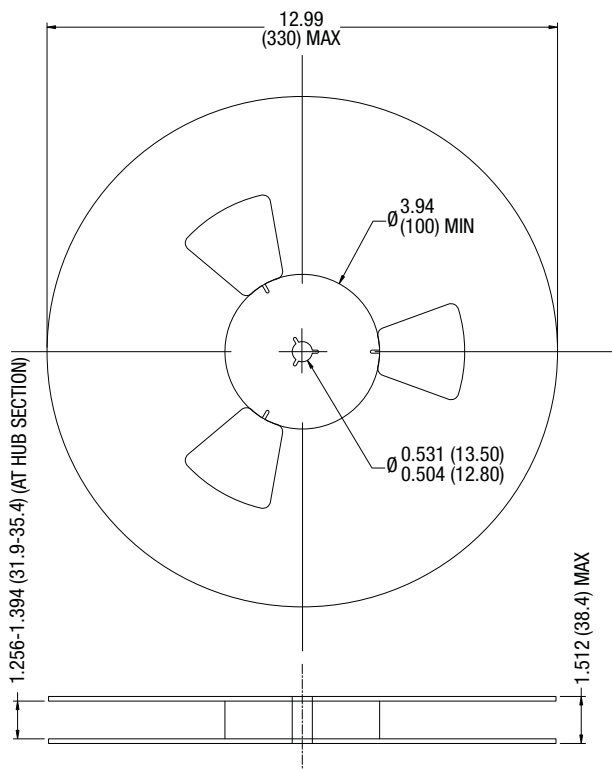


### TUBE OUTLINE DIMENSIONS



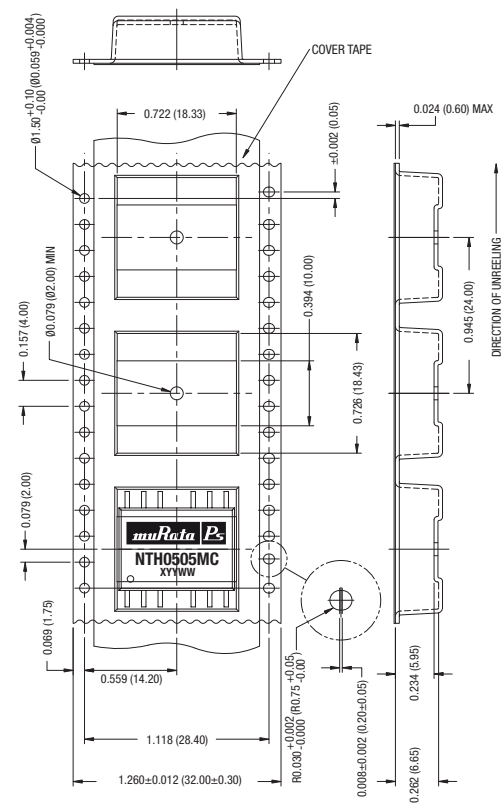
**TAPE & REEL SPECIFICATIONS**

**REEL OUTLINE DIMENSIONS**



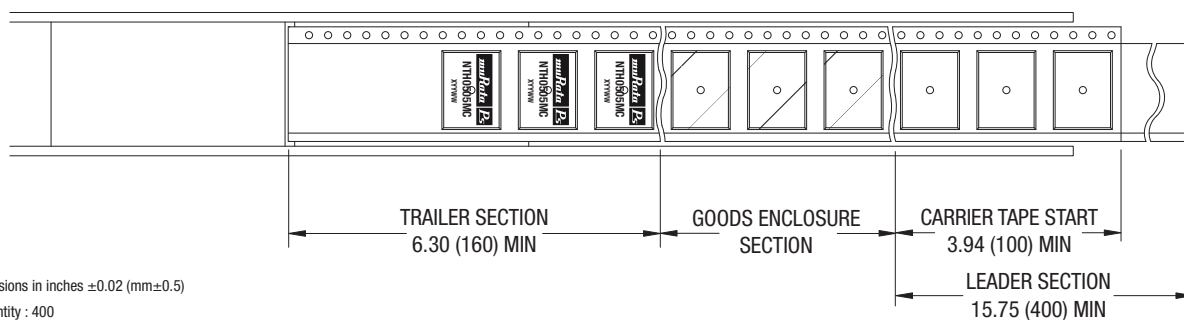
All dimensions in inches  $\pm 0.02$  (mm  $\pm 0.5$ )

**TAPE OUTLINE DIMENSIONS**



All dimensions in inches  $\pm 0.02$  (mm  $\pm 0.5$ )

**REEL PACKAGING DETAILS**



All dimensions in inches  $\pm 0.02$  (mm  $\pm 0.5$ )

Reel Quantity : 400

Murata Power Solutions, Inc.  
11 Cabot Boulevard, Mansfield, MA 02048-1151 U.S.A.  
ISO 9001 and 14001 REGISTERED



This product is subject to the following [operating requirements](#) and the [Life and Safety Critical Application Sales Policy](#):

Refer to: <http://www.murata-ps.com/requirements/>

Murata Power Solutions, Inc. makes no representation that the use of its products in the circuits described herein, or the use of other technical information contained herein, will not infringe upon existing or future patent rights. The descriptions contained herein do not imply the granting of licenses to make, use, or sell equipment constructed in accordance therewith. Specifications are subject to change without notice.

© 2014 Murata Power Solutions, Inc.