

## FEATURES

- Efficiency to 79%
- Wide temperature performance at full 1 Watt load, -40°C up to 105°C
- Single or dual outputs
- UL60950 recognised for functional insulation<sup>2</sup>
- Industry standard pinout
- Power sharing on dual outputs
- 3kVDC isolation (1 minute) 'Hi-Pot Test'
- 5V, 12V & 15V inputs
- 5V, 9V, 12V & 15V outputs
- Internal SMD construction
- No external components required
- MTTF up to 4.2 million hours
- No electrolytic or tantalum capacitors
- Pin compatible with MEV1, MEV3 & NMK series

## PRODUCT OVERVIEW

The NMV series of industrial temperature range DC-DC converters are the standard building blocks for on-board distributed power systems. They are ideally suited for providing local supplies on control system boards with the added benefit of 3kVDC galvanic isolation to reduce switching noise. Available in SIP and DIP with dual and single output pinout. All of the rated power may be drawn from a single pin provided the total load does not exceed 1 watt.

## SELECTION GUIDE

| Order Code    | Nominal Input Voltage |     | Output Voltage | Output Current | Input Current at Rated Load | Load Regulation (Typ) | Load Regulation (Max) | Ripple & Noise (Typ) |      | Ripple & Noise (Max) | Efficiency | Isolation Capacitance | MTTF <sup>1</sup> |                | Recommended Alternative |
|---------------|-----------------------|-----|----------------|----------------|-----------------------------|-----------------------|-----------------------|----------------------|------|----------------------|------------|-----------------------|-------------------|----------------|-------------------------|
|               | V                     | V   |                |                |                             |                       |                       | mA                   | mA   |                      |            |                       | %                 | mVp-p          |                         |
|               |                       |     |                |                |                             |                       |                       |                      |      |                      |            |                       |                   |                |                         |
| Recommended   |                       |     |                |                |                             |                       |                       |                      |      |                      |            |                       |                   |                |                         |
| In Production |                       |     |                |                |                             |                       |                       |                      |      |                      |            |                       |                   |                |                         |
| NMV0505DAC    | 5                     | 5   | 200            | 294            | 14.6                        | 15                    | 15                    | 17                   | 68   | 23                   | 4241       |                       |                   |                |                         |
| NMV0509DAC    | 5                     | 9   | 111            | 267            | 9.3                         | 10                    | 11.3                  | 15                   | 75   | 30                   | 3376       |                       |                   |                |                         |
| NMV0515DAC    | 5                     | 15  | 67             | 256            | 6.7                         | 7.3                   | 8.7                   | 11                   | 78   | 27                   | 1838       |                       |                   |                |                         |
| NMV0505SAC    | 5                     | 5   | 200            | 294            | 14.6                        | 15                    | 16                    | 23                   | 68   | 23                   | 4241       |                       |                   |                |                         |
| NMV0505TSAC   | 5                     | 5   | 200            | 240            | 7.7                         | 10                    | 20                    | 40                   | 74   | 30                   | 3785       | 76148                 |                   |                |                         |
| NMV0509SAC    | 5                     | 9   | 111            | 267            | 9.3                         | 10                    | 12                    | 15                   | 75   | 30                   | 3376       |                       |                   |                |                         |
| NMV0512SAC    | 5                     | 12  | 84             | 260            | 7.4                         | 8.0                   | 11                    | 15                   | 77   | 26                   | 2555       |                       |                   |                |                         |
| NMV0515SAC    | 5                     | 15  | 67             | 256            | 6.7                         | 7.3                   | 11                    | 14                   | 78   | 27                   | 1838       |                       |                   |                |                         |
| NMV1205DAC    | 12                    | 5   | 200            | 121            | 14.6                        | 15                    | 9.5                   | 14                   | 69   | 26                   | 2664       |                       |                   |                |                         |
| NMV1212DAC    | 12                    | 12  | 84             | 108            | 7.4                         | 8.0                   | 8                     | 19                   | 77   | 43                   | 1883       |                       |                   |                |                         |
| NMV1205SAC    | 12                    | 5   | 200            | 121            | 14.6                        | 15                    | 11                    | 16                   | 69   | 26                   | 2664       |                       |                   |                |                         |
| NMV1209SAC    | 12                    | 9   | 111            | 113            | 9.3                         | 10                    | 7.5                   | 14                   | 74   | 35                   | 2295       |                       |                   |                |                         |
| NMV1212SAC    | 12                    | 12  | 84             | 108            | 7.4                         | 8.0                   | 9                     | 22                   | 77   | 43                   | 1883       |                       |                   |                |                         |
| NMV1215SAC    | 12                    | 15  | 67             | 108            | 6.7                         | 7.3                   | 8.5                   | 17                   | 77   | 42                   | 1462       |                       |                   |                |                         |
| NMV1515SAC    | 15                    | 15  | 67             | 84             | 2.8                         | 4.0                   | 11                    | 13                   | 77   | 50                   | 941        |                       |                   |                |                         |
| NMV0505DC     | 5                     | ±5  | ±100           | 280            | 9.0                         | 10                    | 11                    | 14                   | 71.5 | 21                   | 3106       |                       |                   |                |                         |
| NMV0512DC     | 5                     | ±12 | ±42            | 256            | 6.8                         | 7.5                   | 6.7                   | 9                    | 78   | 26                   | 1579       |                       |                   |                |                         |
| NMV0515DC     | 5                     | ±15 | ±33            | 253            | 6.8                         | 8.5                   | 6                     | 9                    | 79   | 27                   | 1065       |                       |                   |                |                         |
| NMV0505SC     | 5                     | ±5  | ±100           | 280            | 9.0                         | 10                    | 11                    | 17                   | 71.5 | 21                   | 3106       |                       |                   |                |                         |
| NMV0509SC     | 5                     | ±9  | ±55            | 263            | 7.5                         | 8.5                   | 7                     | 9.4                  | 76   | 24                   | 2258       |                       |                   |                |                         |
| NMV0512SC     | 5                     | ±12 | ±42            | 256            | 6.8                         | 7.5                   | 6.7                   | 8                    | 78   | 26                   | 1579       |                       |                   |                |                         |
| NMV0512TSC    | 5                     | ±12 | ±42            | 240            | 4.9                         | 7                     | 15                    | 30                   | 78   | 50                   | 2655       | 11212                 |                   |                |                         |
| NMV0515SC     | 5                     | ±15 | ±33            | 253            | 6.8                         | 8.5                   | 6.3                   | 8.2                  | 79   | 27                   | 1065       |                       |                   |                |                         |
| NMV1205DC     | 12                    | ±5  | ±100           | 117            | 9.0                         | 10                    | 8.6                   | 12                   | 71   | 27                   | 2148       |                       |                   |                |                         |
| NMV1215DC     | 12                    | ±15 | ±33            | 110            | 6.8                         | 8.5                   | 5.5                   | 8                    | 76   | 41                   | 924        |                       |                   |                |                         |
| NMV1205SC     | 12                    | ±5  | ±100           | 117            | 9.0                         | 10                    | 10                    | 13                   | 71   | 27                   | 2148       |                       |                   |                |                         |
| NMV1209SC     | 12                    | ±9  | ±55            | 113            | 7.5                         | 8.5                   | 8                     | 11                   | 74   | 35                   | 1705       |                       |                   |                |                         |
| NMV1212SC     | 12                    | ±12 | ±42            | 111            | 6.8                         | 7.5                   | 6                     | 10                   | 75   | 42                   | 1287       |                       |                   |                |                         |
| NMV1215SC     | 12                    | ±15 | ±33            | 110            | 6.8                         | 8.5                   | 6.5                   | 13                   | 76   | 41                   | 924        |                       |                   |                |                         |
| NMV1512SC     | 15                    | ±12 | ±42            | 87             | 2.6                         | 3.0                   | 7.5                   | 9                    | 75   | 68                   | 789        |                       |                   |                |                         |
| NMV1515SC     | 15                    | ±15 | ±33            | 84             | 2.3                         | 3.0                   | 7.5                   | 9                    | 77   | 84                   | 522        |                       |                   |                |                         |
| Discontinued  |                       |     |                |                |                             |                       |                       |                      |      |                      |            |                       |                   |                |                         |
| NMV0512DAC    | 5                     | 12  | 84             | 260            | 7.4                         | 8.0                   | 10.5                  | 16                   | 77   | 26                   | 2555       |                       |                   | MEV1S0512DC    |                         |
| NMV1209DAC    | 12                    | 9   | 111            | 113            | 9.3                         | 10                    | 7                     | 8.5                  | 74   | 35                   | 2295       |                       |                   | MEV1S1209SC    |                         |
| NMV1215DAC    | 12                    | 15  | 67             | 108            | 6.7                         | 7.3                   | 8                     | 17                   | 77   | 42                   | 1462       |                       |                   | MEV1S1215DC    |                         |
| NMV1505SAC    | 15                    | 5   | 200            | 93             | 8.3                         | 10                    | 15.5                  | 17                   | 67   | 21                   | 2747       |                       |                   | MEV1S1505SC    |                         |
| NMV1512SAC    | 15                    | 12  | 84             | 85             | 3.3                         | 4.0                   | 11.2                  | 14                   | 75   | 45                   | 1365       |                       |                   | Contact Murata |                         |
| NMV0509DC     | 5                     | ±9  | ±55            | 263            | 7.5                         | 8.5                   | 7.5                   | 9                    | 76   | 24                   | 2258       |                       |                   | NKA0509SC      |                         |
| NMV1209DC     | 12                    | ±9  | ±55            | 113            | 7.5                         | 8.5                   | 6.5                   | 9                    | 74   | 35                   | 1705       |                       |                   | NKA1209SC      |                         |
| NMV1212DC     | 12                    | ±12 | ±42            | 111            | 6.8                         | 7.5                   | 6.2                   | 8.5                  | 75   | 42                   | 1287       |                       |                   | MEV1D1212SC    |                         |
| NMV1505SC     | 15                    | ±5  | ±100           | 91             | 5.5                         | 10                    | 11                    | 12                   | 69   | 39                   | 1941       |                       |                   | Contact Murata |                         |

1. Calculated using MIL-HDBK-217 FN2 and Telcordia SR-332 calculation model with nominal input voltage at full load.

2. The NMV0505TSAC & NMV0512TSC are pending recognition to UL62368-1.

All specifications typical at  $T_A=25^{\circ}\text{C}$ , 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)



### 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 |        |
|                          | Continuous operation, 15V input types | 13.5 | 15   | 16.5 |        |
| Reflected ripple current | NMV0505TSAC & NMV0512TSC              |      | 5    |      | mA p-p |
|                          | All other output types                |      | 20   | 40   |        |

### OUTPUT CHARACTERISTICS

| Parameter                  | Conditions                                         | Min.                     | Typ. | Max. | Units |
|----------------------------|----------------------------------------------------|--------------------------|------|------|-------|
| Rated Power                | T <sub>A</sub> =-40°C to 120°C, see derating graph |                          |      | 1    | W     |
| Voltage Set Point Accuracy | See tolerance envelope                             |                          |      |      |       |
| Line regulation            | High V <sub>IN</sub> to low V <sub>IN</sub>        | All output types         |      | 1.0  | %/%   |
|                            |                                                    | NMV0505TSAC & NMV0512TSC |      | 1.1  |       |

### ISOLATION CHARACTERISTICS

| Parameter              | Conditions                | Min. | Typ. | Max. | Units |
|------------------------|---------------------------|------|------|------|-------|
| Isolation test voltage | Flash tested for 1 minute | 3000 |      |      | VDC   |
| Resistance             | Viso= 1000VDC             | 10   |      |      | GΩ    |

### GENERAL CHARACTERISTICS

| Parameter           | Conditions      | Min. | Typ. | Max. | Units |
|---------------------|-----------------|------|------|------|-------|
| Switching frequency | NMV0505TSAC     |      | 55   |      | kHz   |
|                     | NMV0512TSC      |      | 60   |      |       |
|                     | 5V input types  |      | 120  | 135  |       |
|                     | 12V input types |      | 150  | 170  |       |
|                     | 15V input types |      | 90   | 110  |       |

### TEMPERATURE CHARACTERISTICS

| Parameter                      | Conditions               | Min. | Typ. | Max. | Units |
|--------------------------------|--------------------------|------|------|------|-------|
| Specification                  | NMV0505TSAC & NMV0512TSC | -40  |      | 105  | °C    |
|                                | All other output types   | -40  |      | 85   |       |
| Storage                        |                          | -50  |      | 125  |       |
| Case Temperature above ambient | NMV0505TSAC              |      | 16   |      |       |
|                                | NMV0512TSC               |      | 14   |      |       |
|                                | 5V output types          |      |      | 28   |       |
|                                | All other output types   |      |      | 25   |       |
| Cooling                        | Free air convection      |      |      |      |       |

### ABSOLUTE MAXIMUM RATINGS

|                                                 |                                                                                                                                                                    |
|-------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Lead temperature 1.5mm from case for 10 seconds | 260°C                                                                                                                                                              |
| Wave Solder                                     | Wave Solder profile not to exceed the profile recommended in IEC 61760-1 Section 6.1.3. Please refer to <a href="#">application notes</a> for further information. |
| Input voltage V <sub>IN</sub> , NMV05 types     | 7V                                                                                                                                                                 |
| Input voltage V <sub>IN</sub> , NMV12 types     | 15V                                                                                                                                                                |
| Input voltage V <sub>IN</sub> , NMV15 types     | 18V                                                                                                                                                                |

## TECHNICAL NOTES

## ISOLATION VOLTAGE

<sup>1</sup> '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 NMV series of DC-DC converters are all 100% production tested at their stated isolation voltage. This is 3kVDC for 1 minute.

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

The NMV has been recognised by Underwriters Laboratory for functional insulation, 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 NMV series has toroidal isolation transformers, with no additional insulation between primary and secondary windings of enamelled 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 recognised 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.

## SAFETY APPROVAL

The NMV series has been recognised by Underwriters Laboratory (UL) to UL 60950 for functional insulation. The NMV0505TSAC & NMV0512TSC are pending recognition to UL62368-1.

The NMV Series of converters are not internally fused so to meet the requirements of UL 60950 an anti-surge input line fuse should always be used with ratings as defined below.

NMV05xxxxC: 0.5A

NMV12xxxxC: 0.2A

NMV15xxxxC: 0.2A

All fuses should be UL recognised and rated to at least the maximum allowable DC input voltage.

File number E151252 applies.

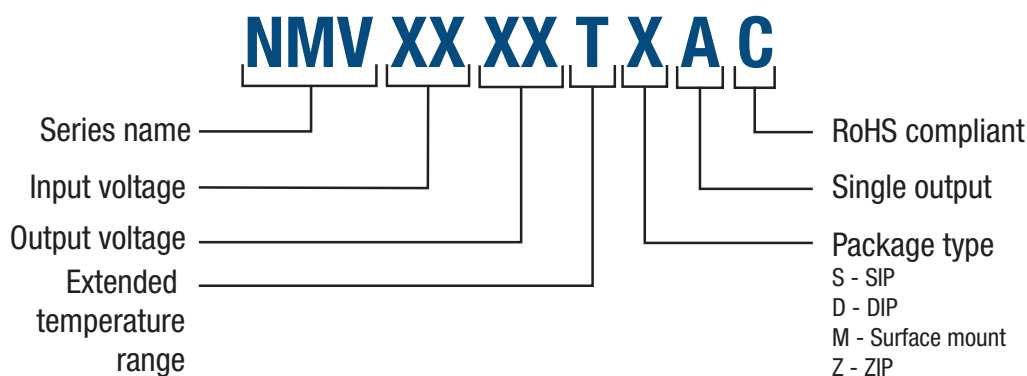
## RoHS COMPLIANCE INFORMATION



This series is compatible with RoHS soldering systems with a peak wave solder temperature of 260°C for 10 seconds. Please refer to [application notes](#) for further information. The pin termination finish on the SIP package type is Tin Plate, Hot Dipped over Matte Tin with Nickel Preplate. The DIP types are Matte Tin over Nickel Preplate. Both types in this series are backward compatible with Sn/Pb soldering systems.

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

## PART NUMBER STRUCTURE



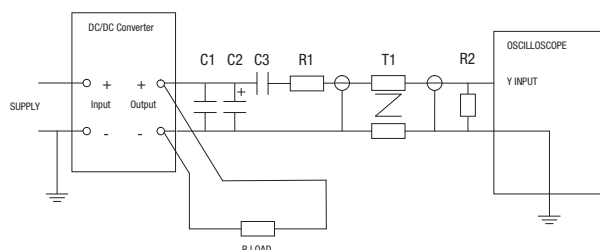
## CHARACTERISATION TEST METHODS

### 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

### Minimum load

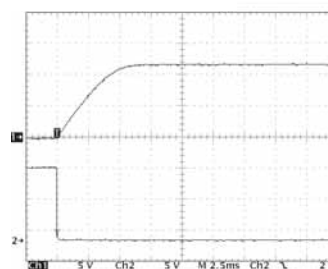
The minimum load to meet datasheet specification is 10% of the full rated load across the specified input voltage range. Lower than 10% minimum loading will result in an increase in output voltage, which may rise to typically double the specified output voltage if the output load falls to less than 5%.

### 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.

Typical Start-Up Wave Form

| Start-up time |         | Start-up time |         |
|---------------|---------|---------------|---------|
|               | $\mu$ s |               | $\mu$ s |
| NMV0505TSAC   | 215     | NMV1209xC     | 4140    |
| NMV0505xC     | 1966    | NMV1212xC     | 8650    |
| NMV0509xC     | 5360    | NMV1215xC     | 11171   |
| NMV0512xC     | 11180   | NMV1505xC     | 803     |
| NMV0515xC     | 16270   | NMV1512xC     | 3510    |
| NMV0512TSC    | 2300    | NMV1515xC     | 8361    |
| NMV1205xC     | 1290    |               |         |



## APPLICATION NOTES (Continued)

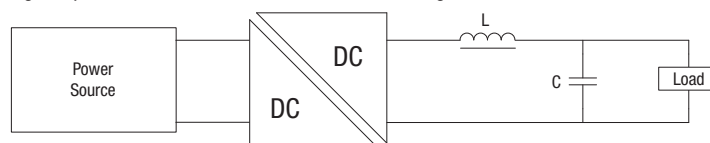
### Output Ripple Reduction

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.

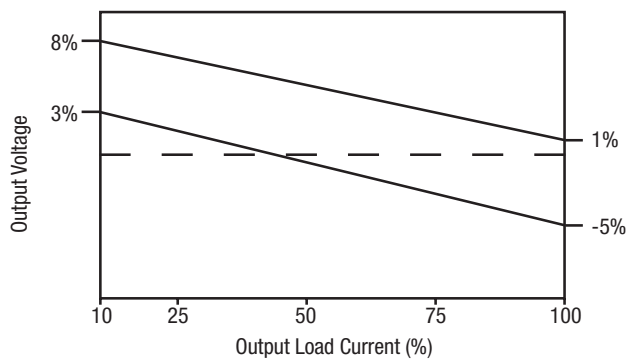


|             | Inductor   |        |              | Capacitor  |
|-------------|------------|--------|--------------|------------|
|             | L, $\mu$ H | SMD    | Through Hole | C, $\mu$ F |
| NMV0505TSAC | 22         | 84223C | 11R223C      | 22         |
| NMV0505xC   | 22         | 82223C | 11R223C      | 1          |
| NMV0509xC   | 100        | 82104C | 11R104C      | 0.47       |
| NMV0512TSC  | 10         | 82103C | 11R103C      | 22         |
| NMV0512xC   | 150        | 82154C | 11R154C      | 0.33       |
| NMV0515xC   | 220        | 82224C | 11R224C      | 0.22       |
| NMV1205xC   | 22         | 82223C | 11R223C      | 2.2        |
| NMV1209xC   | 100        | 82104C | 11R104C      | 1          |
| NMV1212xC   | 150        | 82154C | 11R154C      | 0.33       |
| NMV1215xC   | 220        | 82224C | 11R224C      | 0.22       |
| NMV1505xC   | 22         | 82223C | 11R223C      | 1          |
| NMV1512xC   | 150        | 82154C | 11R154C      | 0.33       |
| NMV1515xC   | 220        | 82224C | 11R224C      | 0.22       |

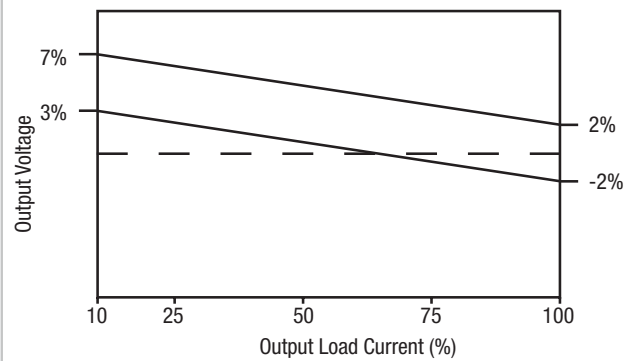
## TOLERANCE ENVELOPES

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.

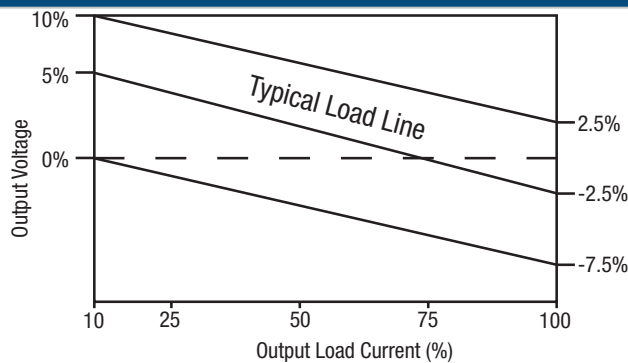
**NMV0505TSAC**



**NMV0512TSC**

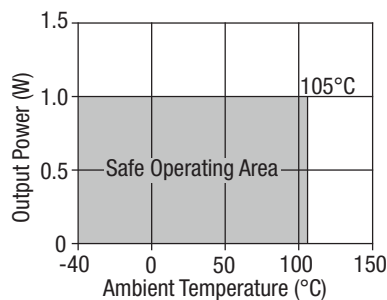


**All other variants**

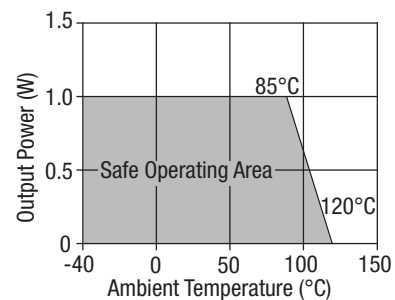


## TEMPERATURE DERATING GRAPH

**NMV0505TSAC & NMV0512TSC:**

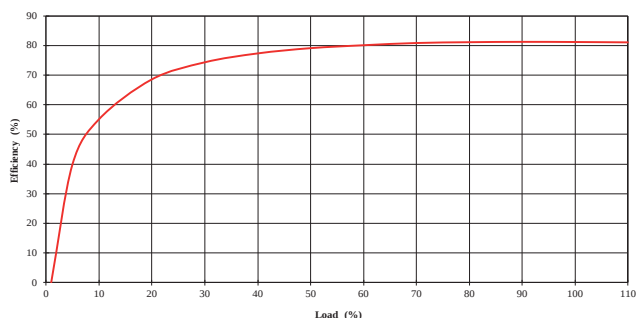


**All other variants:**

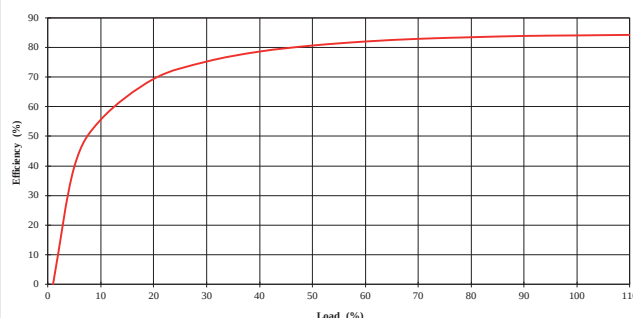


## EFFICIENCY VS LOAD

**NMV0505TSAC**



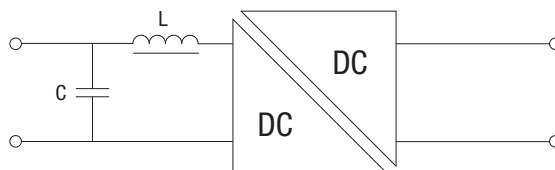
**NMV0512TSC**



## EMC FILTERING AND SPECTRA

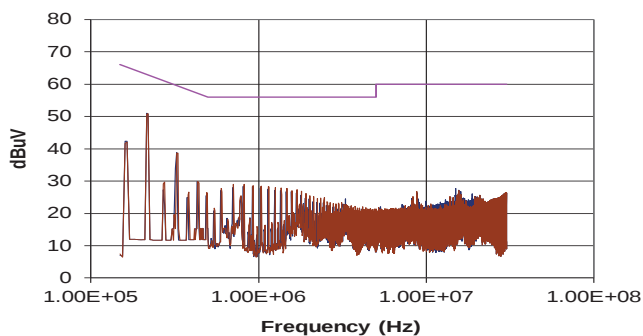
### FILTERING

The following filter circuit and filter table shows the input filters typically required to meet conducted emissions limits for EN 55022 curve B using Quasi-Peak and average detectors according to CISPR 22.

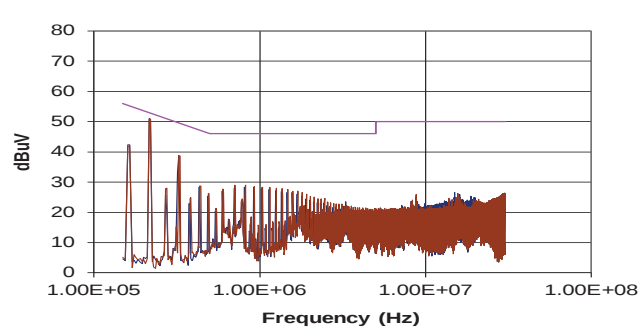


| Part Number        | Inductor   |        | Capacitor   |                    |
|--------------------|------------|--------|-------------|--------------------|
|                    | L, $\mu$ H | SMD    | C, $\mu$ F  | SMD                |
| <b>NMV0505TSAC</b> | 10 $\mu$ H | 23100C | 2.2 $\mu$ F | GRM188C71E225KE11D |
| <b>NMV0512TSC</b>  | 10 $\mu$ H | 23100C | 2.2 $\mu$ F | GRM188C71E225KE11D |

**NMV0505TSAC (Quasi-Peak)**

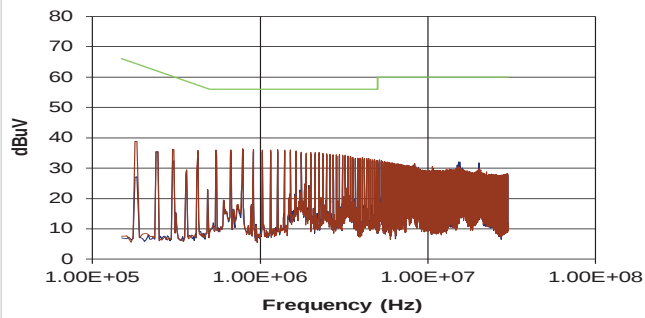


**NMV0505TSAC (Average)**

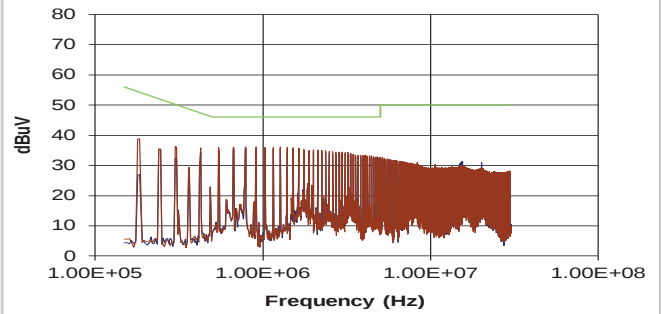


## EMC FILTERING AND SPECTRA (Continued)

**NMV0512TSC (Quasi-Peak)**



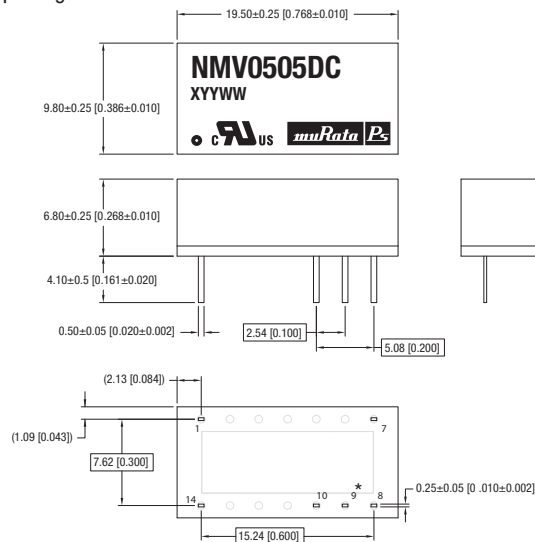
**NMV0512TSC (Average)**



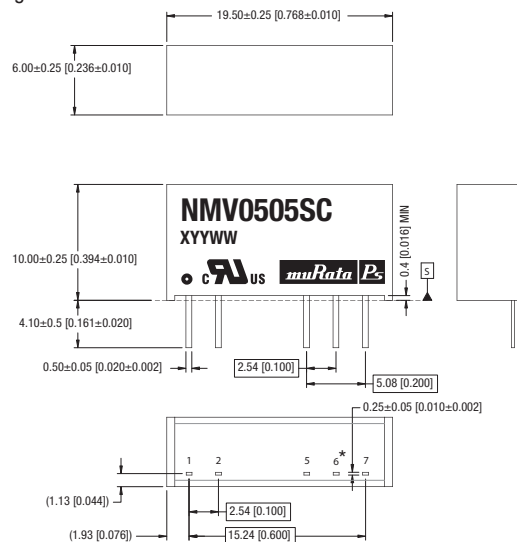
## PACKAGE SPECIFICATIONS

### MECHANICAL DIMENSIONS

#### DIP package



#### SIP package



\* Pin not fitted on single output variants.

All dimensions in mm (inches) Controlling dimension is mm.

All pins on a 2.54 (0.100) pitch and within ±0.1 (0.004) of true position from pin 1 at seating plane 'S'

Weight: 2.4g (DIP) 2.1g (SIP)

### PIN CONNECTIONS

#### Single output variants

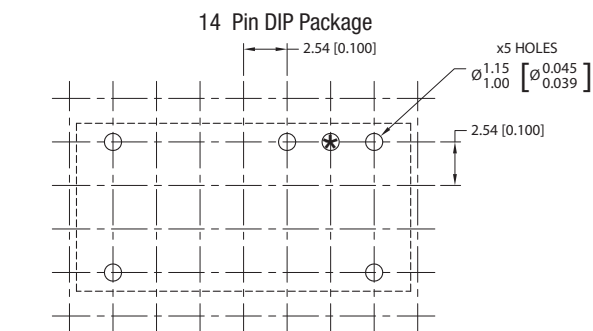
| 14 Pin DIP |                   | 7 Pin SIP |                   |
|------------|-------------------|-----------|-------------------|
| Pin        | Function          | Pin       | Function          |
| 1          | -V <sub>IN</sub>  | 1         | +V <sub>IN</sub>  |
| 7          | NC                | 2         | -V <sub>IN</sub>  |
| 8          | +V <sub>OUT</sub> | 5         | -V <sub>OUT</sub> |
| 10         | -V <sub>OUT</sub> | 7         | +V <sub>OUT</sub> |
| 14         | +V <sub>IN</sub>  |           |                   |

#### Dual output variants

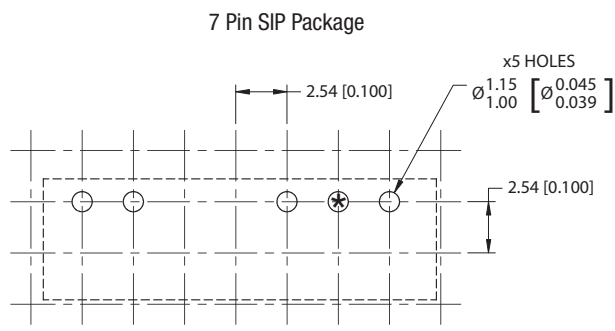
| 14 Pin DIP |                   | 7 Pin SIP |                   |
|------------|-------------------|-----------|-------------------|
| Pin        | Function          | Pin       | Function          |
| 1          | -V <sub>IN</sub>  | 1         | +V <sub>IN</sub>  |
| 7          | NC                | 2         | -V <sub>IN</sub>  |
| 8          | +V <sub>OUT</sub> | 5         | -V <sub>OUT</sub> |
| 9          | OV                | 6         | OV                |
| 10         | -V <sub>OUT</sub> | 7         | +V <sub>OUT</sub> |
| 14         | +V <sub>IN</sub>  |           |                   |

## PACKAGE SPECIFICATIONS (Continued)

### RECOMMENDED FOOTPRINT DETAILS

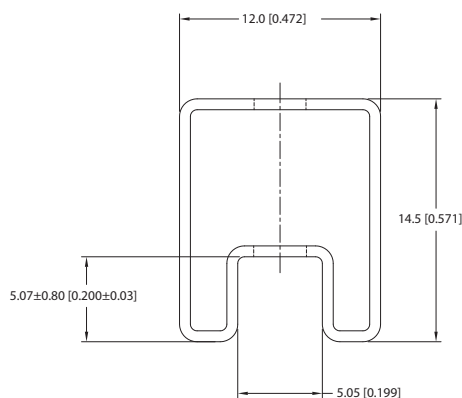


\*Hole not required for single output variants.

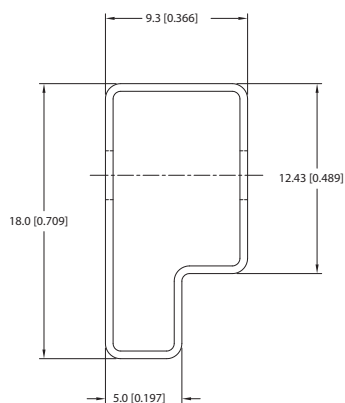


### TUBE OUTLINE DIMENSIONS

#### 14 Pin DIP Tube



#### 7 Pin SIP Tube



Unless otherwise specified all dimensions in mm [inches] ±0.55mm [0.022]. Tube length  
(14 Pin DIP) : 520mm [20.472] ±2.0 [0.079].  
Tube length (7 Pin SIP) : 520mm [20.472] ±2.0 [0.079].

Tube Quantity : 25