



## FEATURES

- UL62368-1 recognised
- RoHS compliant
- Efficiency from 77%
- Power density 1.31W/cm<sup>3</sup>
- Wide temperature performance at full 2 Watt load, -40°C up to 105°C
- UL 94V-0 package material
- No heatsink required
- Industry standard pinout
- 3kVDC isolation (1 minute) 'Hi Pot Test'
- 5V, 12V, 15V & 24V inputs
- 5V, 9V, 12V & 15V outputs
- Fully encapsulated with toroidal magnetics
- No electrolytic or tantalum capacitors
- Pin compatible with MEV1, MEV3 & NMV series

## PRODUCT OVERVIEW

The NMK series of industrial temperature range DC-DC converters, available in industry standard SIP packaging offers a power upgrade path from the 1W NMV series. The un-regulated NMK series has superior output voltage set point accuracy in conjunction with excellent load regulation for this converter type.

Unbalanced loading capabilities on dual output variants, all of the rated output power may be drawn from a single output <sup>3</sup>.

## NMK Series

## 3kVDC Isolated 2W Single & Dual Output DC-DC Converters

## SELECTION GUIDE

Order Code <sup>3</sup>	Nominal Input Voltage		Output Voltage	Output Current	Input Current at Rated Load		Load Regulation (Typ)		Load Regulation (Max)		Ripple & Noise (Typ) <sup>1</sup>		Ripple & Noise (Max) <sup>1</sup>		Efficiency (Min.)	Efficiency (Typ.)	Isolation Capacitance	MTTF <sup>2</sup>		Recommended Alternative
	V	V	V	mA	mA	%	%	mVp-p	%	%	pF	MIL. kHrs	Tel.							
<div>RecommendedIn Production</div>																				
NMK0505SAC	5	5	400	470	5.7	7.3	24	40	80	83	28	3998								
NMK0505TSAC	5	5	400	470	5.8	8	25	50	77	83	30	2995	74887							
NMK0512SAC	5	12	167	450	3.8	5.1	18	20	83	87	36	3328								
NMK0515SAC	5	15	133	450	3.4	4.5	17	20	84	87	34	2855								
NMK1205SAC	12	5	400	200	4.2	4.9	25	30	80	83	33	3532								
NMK1212SAC	12	12	167	190	2.4	2.9	17	23	85	88	62	2246								
NMK1215SAC	12	15	133	185	2.0	2.4	14	25	84	89	56	2020								
NMK1505SAC	15	5	400	158	4.3	5.5	34	55	81	84	37	2202	9857							
NMK1515SAC	15	15	133	149	2.4	3.5	20	40	85	88	72	2220	13067							
NMK2405SAC	24	5	400	99	4.2	5.5	42	70	80	84	41	1618	9838							
NMK2409SAC	24	9	222	95	2.7	3.5	30	55	83	87	59	2032	12177							
NMK2415SAC	24	15	133	93	2.2	3	34	70	85	88	85	1558	11155							
NMK0505SC	5	±5	±200	470	5	6.2	24	40	81	83	28	2324								
NMK0509SC	5	±9	±111	455	3.9	5.3	18	30	83	86	33	2158								
NMK0512SC	5	±12	±83	450	3.7	4.8	14	20	84	87	35	1931								
NMK1212SC	12	±12	±83	190	2.2	2.7	13	20	84	87	53	1821								
NMK1215SC	12	±15	±67	190	1.9	2.4	13	20	83	87	57	1574								
NMK1515SC	15	±15	±67	150	2.0	3	14	35	85	88	74	1404	11747							
NMK2415SC	24	±15	±67	93	1.7	3	17	35	85	89	86	1581	12750							
Discontinued																				
NMK0509SAC	5	9	222	455	4.2	5.9	20	25	83	86	36	3718							MEJ2S0509SC	
NMK0515SC	5	±15	±67	450	3.5	5.2	12	20	84	87	31	1655							MEJ2D0515SC	
NMK1205SC	12	±5	±200	200	3.4	3.9	21	30	80	84	35	1952							MEJ2D1205SC	
NMK1209SAC	12	9	222	190	2.6	3.1	19	20	83	87	53	2417							MEJ2S1209SC	
NMK1209SC	12	±9	±111	190	2.4	2.8	16	20	83	87	50	2021							MEJ2D1209SC	
NMK1505SC	15	±5	±200	156	3.7	5	27	50	81	84	43	1466	8190						MEJ2D1505SC	
NMK1509SAC	15	9	222	153	3	4	21	40	83	86	51	2478	11668						MEJ2S1509SC	
NMK1509SC	15	±9	±111	153	2.4	3.5	19	35	82	86	47	1957	11117						MEJ2D1509SC	
NMK1512SAC	15	12	167	150	2.5	3.5	20	40	84	87	63	1825	10324						MEJ2S1512SC	
NMK1512SC	15	±12	±83	151	2.2	3	18	35	84	88	65	1515	10279						MEJ2D1515SC	
NMK2405SC	24	±5	±200	96	3.4	5	30	50	81	84	43	2268	12558						NMH2405SC	
NMK2409SC	24	±9	±111	94	2.3	3.5	26	45	84	87	65	2571	12903						Contact Murata	
NMK2412SC	24	±12	±83	93	1.9	3	24	45	85	89	82	2134	12888						Contact Murata	



For full details go to  
<https://www.murata.com/en-global/products/power/rohs>



1. See Ripple & Noise characterisation method.
2. Calculated using MIL-HDBK-217 FN2 and Telcordia SR-332 calculation model with nominal input voltage at full load.
3. See application notes on page 4.

All specifications typical at  $T_A=25^{\circ}\text{C}$ , nominal input voltage and rated output current unless otherwise specified.

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	
	Continuous operation, 24V input types	21.6	24	26.4	
Reflected ripple current	NMK0505TSAC		5		mA p-p
	NMK2405SAC, NMK2409SAC, NMK2405SC, NMK2409SC		14	25	
	All other variants		7.5	15	

GENERAL CHARACTERISTICS					
Parameter	Conditions	Min.	Typ.	Max.	Units
Switching frequency	NMK0505TSAC		50		kHz
	All other variants		60		

OUTPUT CHARACTERISTICS					
Parameter	Conditions	Min.	Typ.	Max.	Units
Rated Power	T <sub>A</sub> =-40°C to 105°C			2	W
Voltage Set Point Accuracy	See tolerance envelope				
Line regulation	High V <sub>IN</sub> to low V <sub>IN</sub>		1.1	1.2	%/%
			1.05	1.2	

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

TEMPERATURE CHARACTERISTICS					
Parameter	Conditions	Min.	Typ.	Max.	Units
Specification	NMK0505TSAC	-40		105	°C
	All other output types, see safety approval section for UL temperature specification	-40		85	
Storage		-50		125	
Case Temperature above ambient	NMK0505TSAC		22		
	5V output types & NMK1509SAC (Except NMK1505S(A)C & NMK2405S(A))			28	
	NMK1505S(A)C & NMK2405S(A)C			32	
	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> , NMK05 types	7V
Input voltage V <sub>IN</sub> , NMK12 types	15V
Input voltage V <sub>IN</sub> , NMK15 types	18V
Input voltage V <sub>IN</sub> , NMK24 types	28V

## 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 NMK 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 NMK series 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 NMK 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

## UL62368-1

The NMK series has been recognised by Underwriters Laboratory (UL) to UL62368-1 for functional insulation in a maximum ambient temperature of 85°C and/or case temperature limit of 130°C. Case temperature measured on the face opposite the pins. File number E151252 applies.

## FUSING

The NMK Series of converters are not internally fused so to meet the requirements of UL63368-1 an anti-surge input line fuse should always be used as below:

NMK05xxSC/SAC: 2A

NMK12xxSC/SAC: 0.75A

NMK15xxSC/SAC: 0.75A

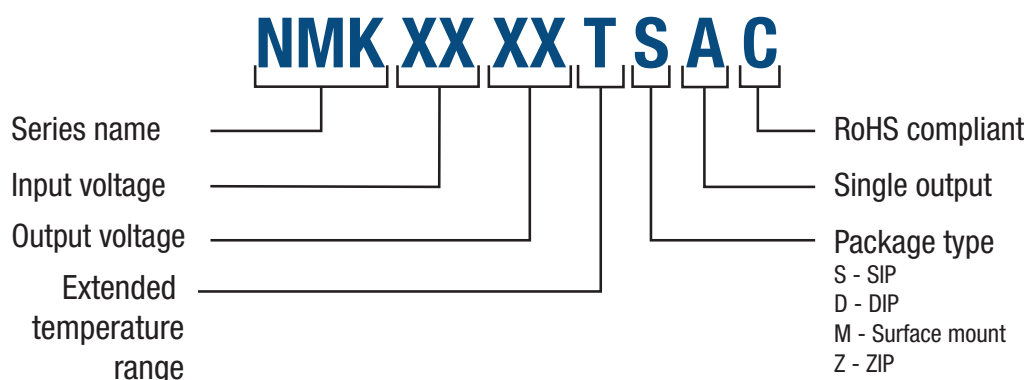
NMK24xxSC/SAC: 0.375A

## RoHS COMPLIANT 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.com/en-global/products/power/rohs](http://www.murata.com/en-global/products/power/rohs)

## PART NUMBER STRUCTURE



## CHARACTERISATION TEST METHODS

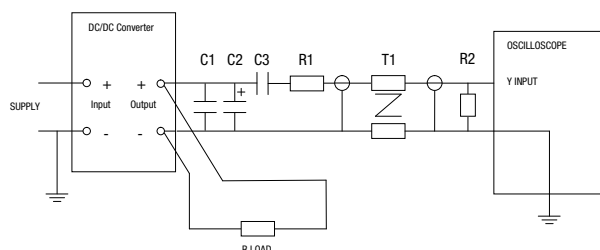
### Ripple & Noise Characterisation Method

All measurement to be taken with the following components connected to the UUT as detailed below. 50 Ohm coax cable, solder connections one end, BNC plug at the other end.

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 rated at minimum 1.5 x the output voltage of the UUT with ESR of less than 100 milliohms at 100 kHz e.g. AVX TPS series.
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%.

### Unbalanced Load

The NMK series offers unbalanced loading capabilities with up to the full 2W available from a single output. However, when operated in this mode there may be a slight performance decrease in efficiency and load regulation.

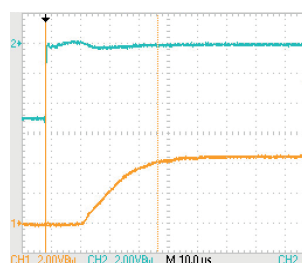
### Capacitive loading and start up

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 $\mu$ s
NMK0505TSAC	110
NMK05XXSAC	
NMK12XXSAC	
NMK15XXSAC	
NMK24XXSAC	
NMK05XXSC	
NMK12XXSC	

	Start-up time $\mu$ s
NMK15XXSC	
NMK24XXSC	

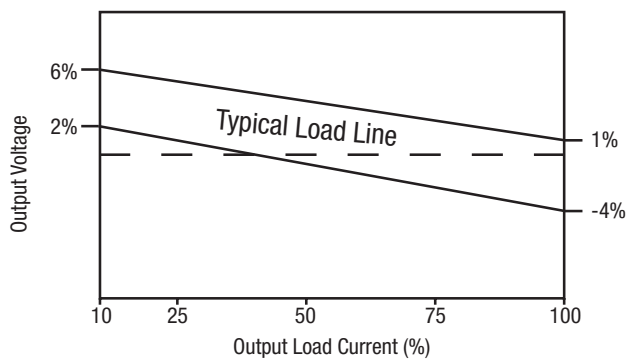
Typical Start-Up Wave Form



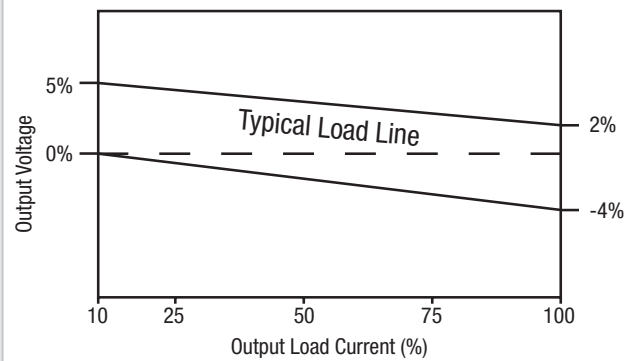
## TOLERANCE ENVELOPES

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.

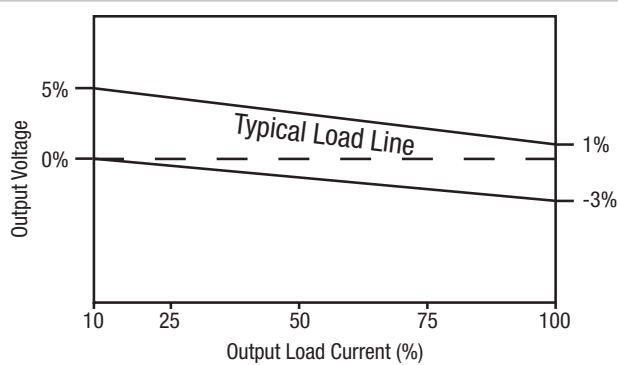
**NMK0505TSAC**



**NMKXXXXSAC**

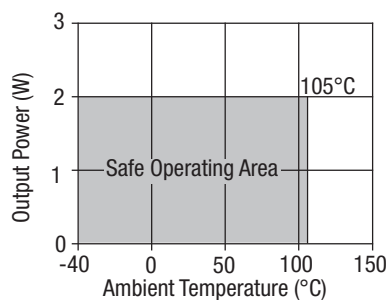


**NMKXXXXSC**

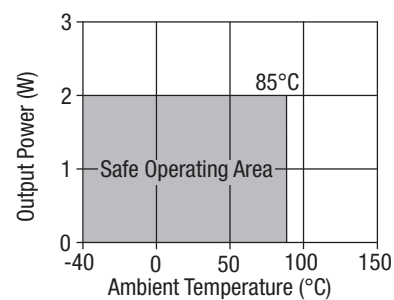


## TEMPERATURE DERATING GRAPH

**NMK0505TSAC:**

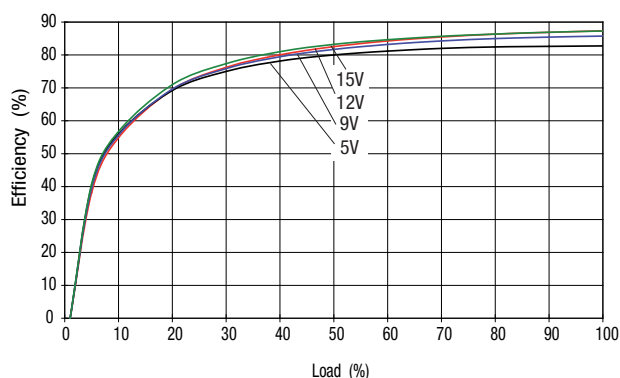


**All other variants:**

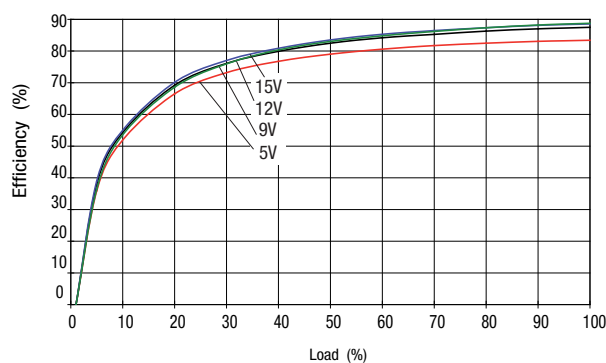


## EFFICIENCY VS LOAD

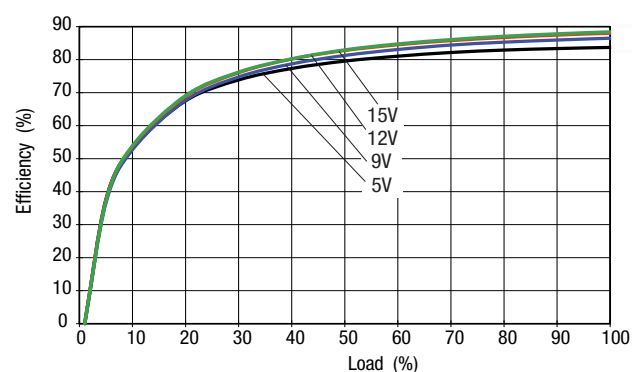
**NMK05XXSAC**



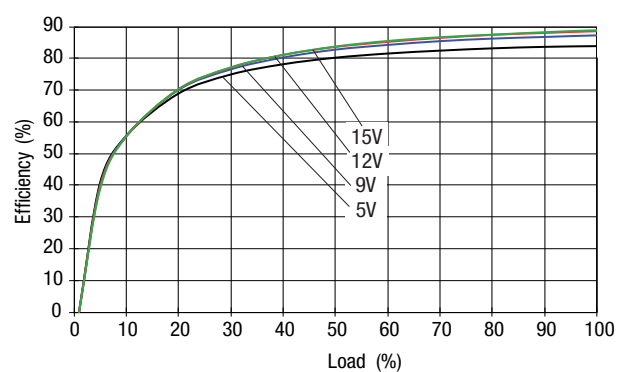
**NMK12XXSAC**



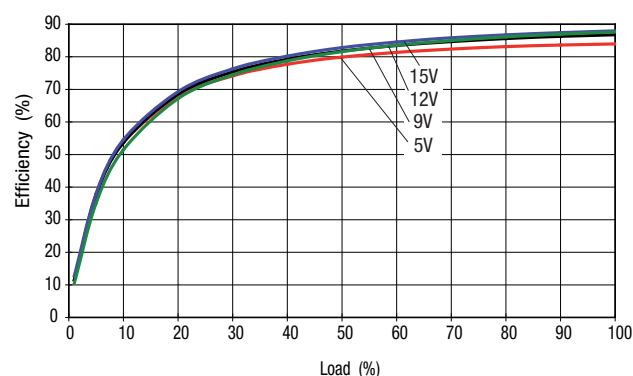
**NMK15XXSAC**



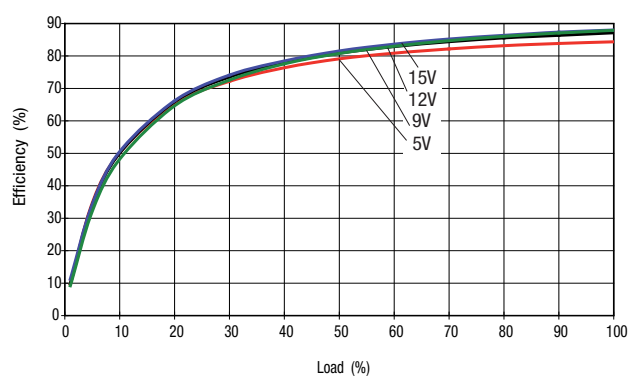
**NMK24XXSAC**



**NMK05XXSC**

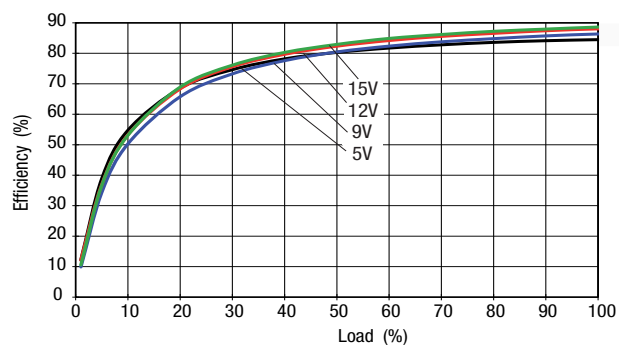


**NMK12XXSC**

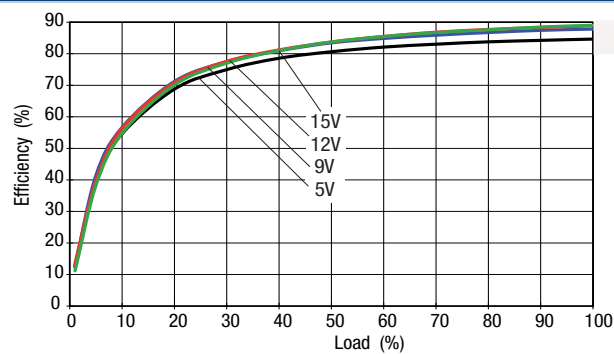


## EFFICIENCY VS LOAD (Continued)

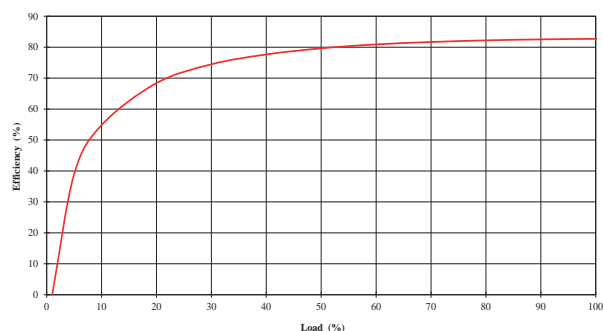
**NMK15XXSC**



**NMK24XXSC**



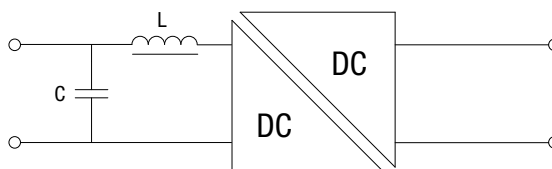
**NMK0505TSAC**



## EMC FILTERING AND SPECTRA

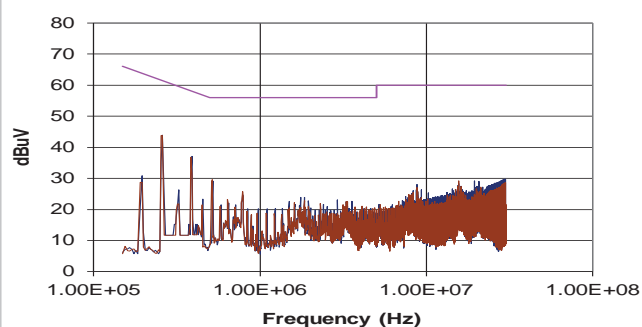
### FILTERING

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.

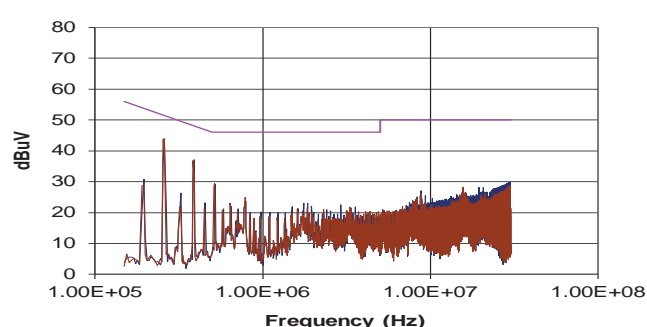


Part Number	Inductor		Capacitor	
	L, $\mu$ H	SMD	C, $\mu$ F	SMD
<b>NMK0505TSAC</b>	10 $\mu$ H	23100C	2.2 $\mu$ F	GRM188C71E225KE11D

**NMK0505TSAC (Quasi-Peak)**



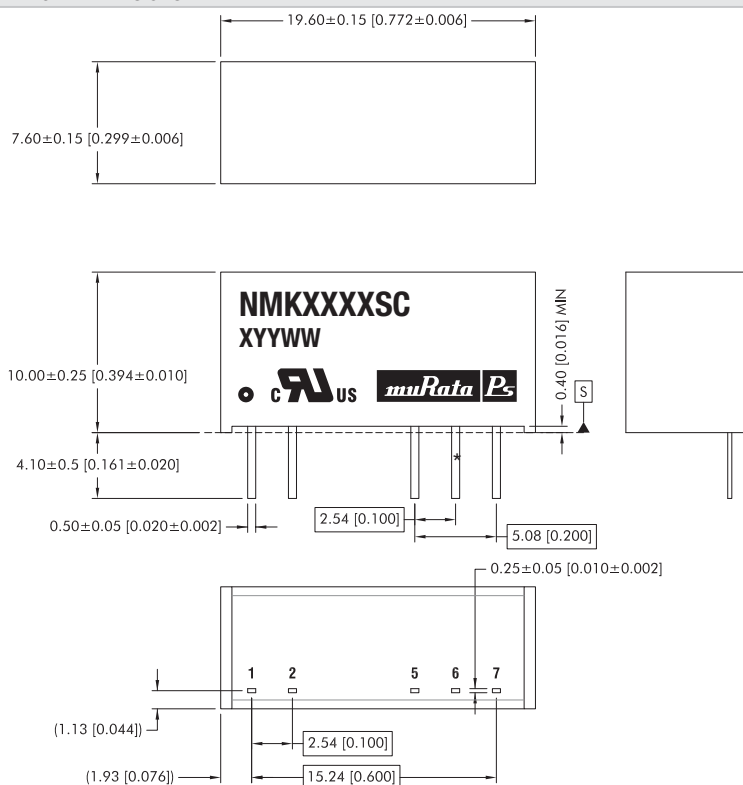
**NMK0505TSAC (Average)**





## PACKAGE SPECIFICATIONS

### MECHANICAL DIMENSIONS



\* 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'

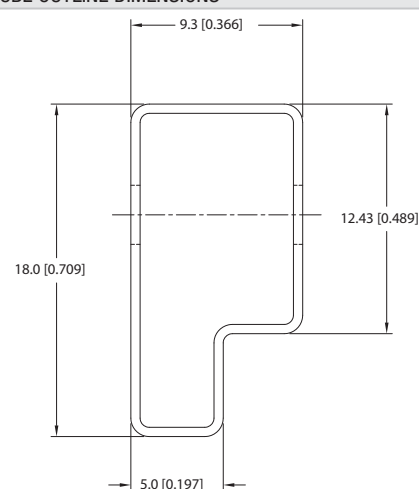
Weight: 2.8g

### PIN CONNECTIONS

Single output variants	
Pin	Function
1	+VIN
2	-VIN
5	-VOUT
7	+VOUT

Dual output variants	
Pin	Function
1	+VIN
2	-VIN
5	-VOUT
6	0V
7	+VOUT

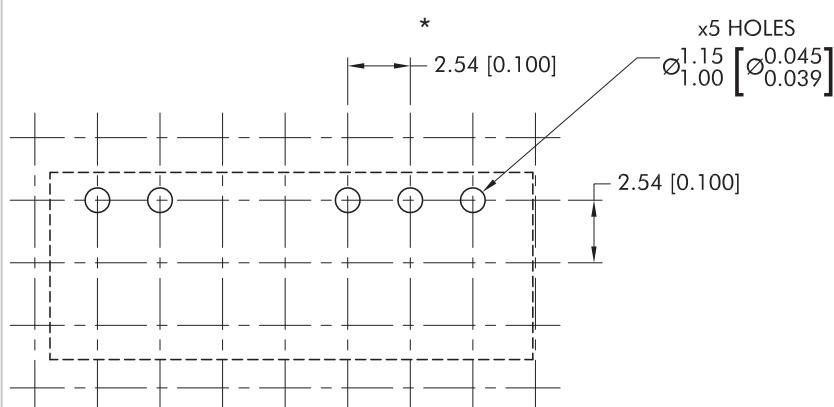
### TUBE OUTLINE DIMENSIONS



Unless otherwise stated all dimensions in mm (inches) ±0.5mm.  
Tube length : 520mm ±2mm (20.47).

Tube Quantity : 25

### RECOMMENDED FOOTPRINT DETAILS



\* Hole not required for single output variants.

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Unless otherwise stated in the datasheet, all products are designed for standard commercial and industrial applications and NOT for safety-critical and/or life-critical applications.

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- Traffic signal equipment
- Disaster prevention / crime prevention equipment
- Data Processing equipment

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