

### FEATURES

- UL 60950 recognised
- Single isolated output
- 1kVDC isolation 'Hi Pot Test'
- Efficiency up to 85%
- Wide temperature performance at full 2 watt load, -40°C to 85°C
- Industry standard pinout
- 5V & 12V inputs
- 5V, 9V, 12V & 15V outputs
- Internal SMD construction
- No external components required
- MTF up to 2.3 million hours
- Custom solutions available
- Pin compatible with CME, CRE1, CRL2, LME, MEE1, NKE & NME series
- No electrolytic or tantalum capacitors

### DESCRIPTION

The NML series of DC-DC Converters is particularly suited to isolating and/or converting DC power rails. The galvanic isolation allows the device to be configured to provide an isolated negative rail in systems where only positive rails exist. The wide temperature range guarantees startup from -40°C and full 2 watt output at 85°C.

### SELECTION GUIDE

Order Code	Nominal Input Voltage	Output Voltage	Output Current	Input Current at Rated	Efficiency	Isolation	MTTF <sup>1</sup>	Recommended Alternative
	V	V	mA	mA	%	pF	kHrs	
<span style="border: 1px solid green; padding: 2px;">Recommended</span> <span style="border: 1px solid blue; padding: 2px; margin-left: 20px;">In Production</span>								
NML0505SC	5	5	400	513	78	19	2327	
NML0509SC	5	9	222	492	81	27	1393	
NML0512SC	5	12	167	479	84	32	832	
NML0515SC	5	15	133	481	83	27	481	
NML1205SC	12	5	400	207	81	28	716	
NML1212SC	12	12	167	197	85	46	461	
<span style="border: 1px solid black; padding: 2px; background-color: #333; color: white;">Discontinued</span>								
NML1209SC	12	9	222	198	84	42	593	Contact Murata
NML1215SC	12	15	133	197	85	54	328	Contact Murata

### INPUT CHARACTERISTICS

Parameter	Conditions	Min.	Typ.	Max.	Units
Voltage range	Continuous operation, 5V input types	4.5	5.0	5.5	V
	Continuous operation, 12V input types	10.8	12.0	13.2	
Reflected ripple current	5V input types		33		mA p-p
	12V input types		38		

### GENERAL CHARACTERISTICS

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

### OUTPUT CHARACTERISTICS

Parameter	Conditions	Min.	Typ.	Max.	Units	
Rated Power	T <sub>A</sub> = -40°C to 85°C			2.0	W	
Voltage Set Point Accuracy	See tolerance envelope					
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		7.0	8.5	%	
	10% load to rated load, 9V output types		4.5	5.2		
	10% load to rated load, 12V output types		4.5	5.5		
	10% load to rated load, 15V output types		3.7	8.5		
Ripple and Noise	NML0505SC, BW=DC to 20MHz		96		200	mV p-p
	NML0509SC, BW=DC to 20MHz		67			
	NML0512SC, BW=DC to 20MHz		59			
	NML0515SC, BW=DC to 20MHz		53			
	NML1205SC, BW=DC to 20MHz		76			
	NML1209SC, BW=DC to 20MHz		63			
	NML1212SC, BW=DC to 20MHz		53			
	NML1215SC, BW=DC to 20MHz		45			

### ISOLATION CHARACTERISTICS

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

1. Calculated using MIL-HDBK-217F with nominal input voltage at full load.  
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  
<https://www.murata.com/en-global/products/power/rohs>



TEMPERATURE CHARACTERISTICS					
Parameter	Conditions	Min.	Typ.	Max.	Units
Specification	All output types	-40		85	°C
Storage		-50		130	
Case Temperature above ambient	5V output types			45	
	All other output types			36	
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 $V_{IN}$ , NML05 types	7V
Input voltage $V_{IN}$ , NML12 types	15V

**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 NML 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?"

The NML 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 NML 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 NML series has been recognised by Underwriters Laboratory (UL) to UL 60950 for functional insulation in a maximum ambient temperature of 85°C and/or case temperature limit of 100°C as measured at any point on the case of the unit (hotspot).

The NML 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.

NML05xxSC: 0.8A

NML12xxSC: 0.315A

All fuses should be UL recognised and rated to 125V. File number E151252 applies.

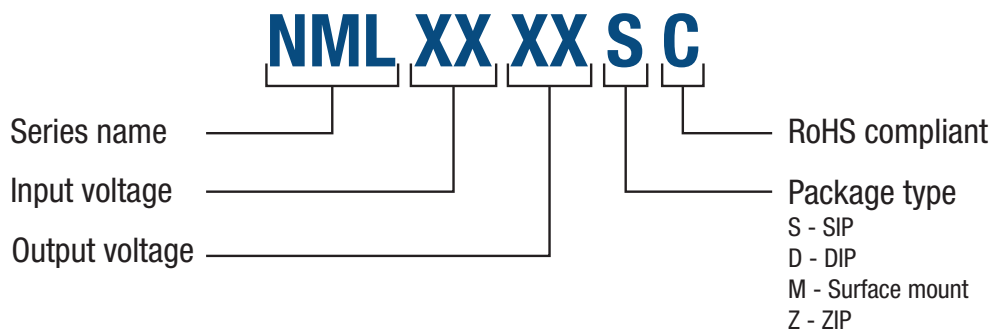
**RoHS COMPLIANCE INFORMATION**



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 this product series is Tin Plate, Hot Dipped over Matte Tin with Nickel replating. The series is 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**

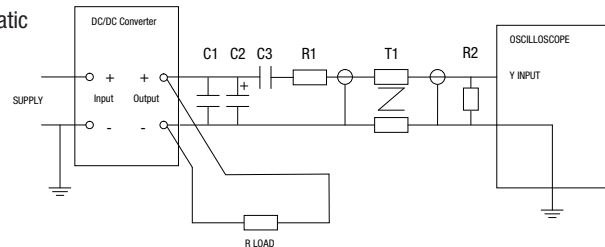
**Ripple & Noise Characterisation Method**

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

C1	1µF X7R multilayer ceramic capacitor, voltage rating to be a minimum of 3 times the output voltage of the DC-DC converter
C2	10µF 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 100mΩ at 100 kHz
C3	100nF multilayer ceramic capacitor, general purpose
R1	450Ω resistor, carbon film, ±1% tolerance
R2	50Ω 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**

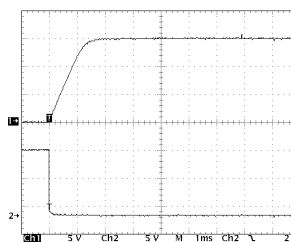
The minimum load to meet datasheet specification is 10% of the full rated load across the specified input voltage range. Lower than 10% minimum loading will result in an increase in output voltage, which may rise to typically double the specified output voltage if the output load falls to less than 5%.

**Capacitive loading and start up**

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

	Start-up time	
	µs	
NML0505SC	790	
NML0509SC	1154	
NML0512SC	2265	
NML0515SC	2998	
NML1205SC	396	
NML1209SC	880	
NML1212SC	1156	
NML1215SC	2394	

**Typical Start-Up Wave Form**



**APPLICATION NOTES (Continued)**

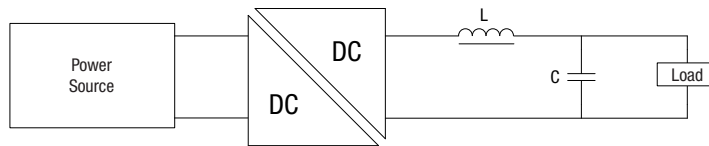
**Output Ripple Reduction**

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.

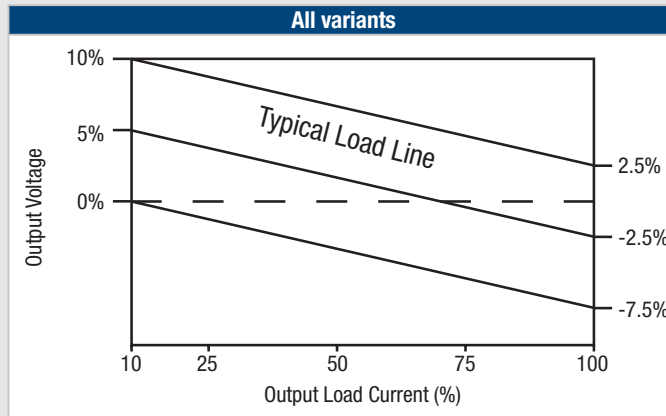
**Inductor:** The rated current of the inductor should not be less than that of the output of the DC-DC converter. At the rated current, the DC resistance of the inductor should be such that the voltage drop across the inductor is <2% of the rated voltage of the DC-DC converter. The SRF (Self Resonant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



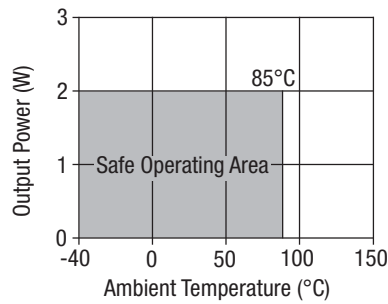
	Inductor			Capacitor
	L, $\mu$ H	SMD	Through Hole	C, $\mu$ F
NML0505SC	22	82223	11R223C	2.2 $\mu$ F
NML0509SC	47	82473	11R473C	1 $\mu$ F
NML0512SC	47	82473	11R473C	2.2 $\mu$ F
NML0515SC	68	82683	11R683C	3.3 $\mu$ F
NML1205SC	22	82223	11R223C	2.2 $\mu$ F
NML1209SC	47	82473	11R473C	1 $\mu$ F
NML1212SC	47	82473	11R473C	2.2 $\mu$ F
NML1215SC	68	82683	11R683C	3.3 $\mu$ F

**TOLERANCE ENVELOPE**

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.



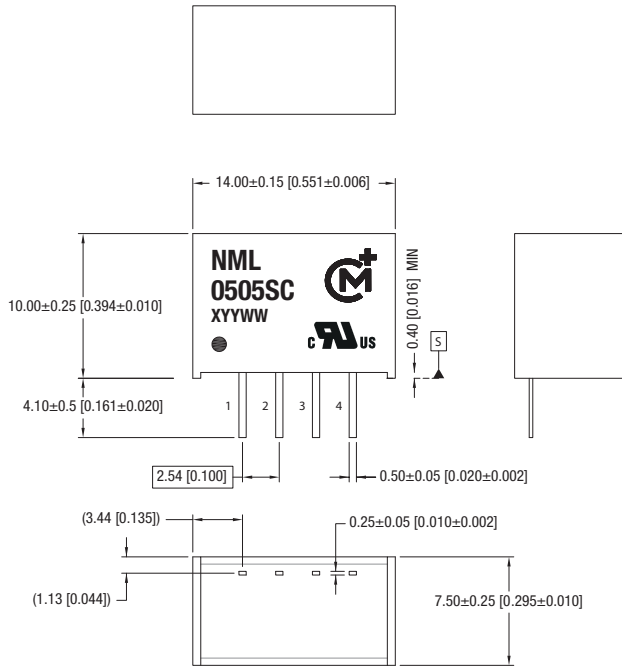
**TEMPERATURE DERATING GRAPH**



**PACKAGE SPECIFICATIONS**

**MECHANICAL DIMENSIONS**

SIP Package

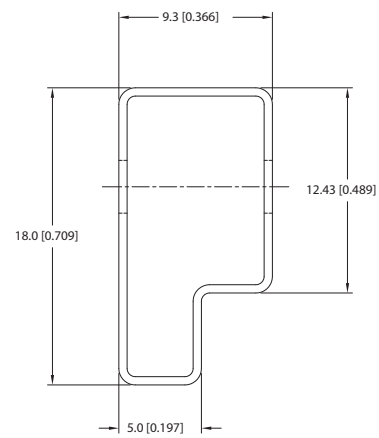


All dimensions in mm (inches). Controlling dimension is mm. Weight: 2.0g  
 All pins on a 2.54 (0.100) pitch and within ±0.1 (0.004) of true position from pin 1 at seating plane 'S'

**PIN CONNECTIONS - 4 PIN SIP**

Pin	Function
1	-VIN
2	+VIN
3	-VOUT
4	+VOUT

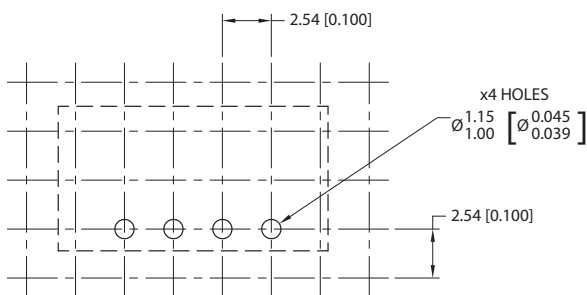
**TUBE OUTLINE DIMENSIONS**



Unless otherwise specified all dimensions in mm [inches] ±0.55mm [0.022].  
 Tube Length : 520mm [20.472] ±2.0 [0.079].

Tube Quantity : 35

**RECOMMENDED FOOTPRINT DETAILS**



Unless otherwise stated all dimensions in mm (inches) ±0.5mm.

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

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