

## FEATURES

- RoHS Compliant
- Sub-Miniature SIP & DIP Styles
- 3kVDC Isolation 'Hi Pot Test'
- UL Recognised
- Wide Temperature performance at full 1 Watt load, -40°C to 85°C
- UL 94V-0 Package Material
- Footprint at 0.69cm<sup>2</sup>
- Industry Standard Pinout
- 3.3V, 5V & 12V Input
- 3.3V, 5V, 9V, 12V and 15V Output
- Internal SMD Construction
- Fully Encapsulated with Toroidal Magnetics
- MTTF up to 2.4 Million hours
- Custom Solutions Available
- No Electrolytic or Tantalum Capacitors

## PRODUCT OVERVIEW

The NKE sub-miniature series of DC/DC Converters is particularly suited to isolating and/or converting DC power rails. A smaller package size, improved efficiency, lower output ripple and 3kVDC isolation capability through state of the art packaging and improved technology. 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 1 watt output at 85°C.



## SELECTION GUIDE

Order Code	Nominal Input Voltage	Output Voltage	Output Current	Input Current at Rated Load	Efficiency		Isolation Capacitance	MTTF <sup>1</sup>		Package Style
					%			MIL.	Tel.	
					Min.	Typ.		kHrs		
NKE0303DC	3.3	3.3	303	400	68	72	30	4337	46,969	DIP
NKE0305DC	3.3	5	200	400	72	75	35	4105	46,783	
NKE0309DC	3.3	9	111	403	71	74	30	1904	28,918	
NKE0303SC	3.3	3.3	303	400	68	72	30	4337	46,969	SIP
NKE0305SC	3.3	5	200	400	72	75	35	4105	46,783	
NKE0309SC	3.3	9	111	403	71	74	30	1904	28,918	
NKE0503DC	5	3.3	303	270	70	74	40	3710	36,234	DIP
NKE0505DC	5	5	200	289	66	69	28	4277	34,897	
NKE0505DEC	5	5	200	250	73	77	34	2686	35,919	
NKE0509DC	5	9	111	266	72	75	29	3729	76,553	
NKE0512DC	5	12	83	260	73	78	30	2910	73,523	
NKE0515DC	5	15	66	256	74	78	32	2211	71,725	
NKE0503SC	5	3.3	303	270	70	74	40	3710	36,234	SIP
NKE0505SC	5	5	200	289	66	69	28	4277	34,897	
NKE0505SEC	5	5	200	250	73	77	34	2686	35,919	
NKE0509SC	5	9	111	266	72	75	29	3729	76,553	
NKE0512SC	5	12	83	260	73	78	30	2910	73,523	
NKE0515SC	5	15	66	256	74	78	32	2211	71,725	
NKE1205DC	12	5	200	117	68	72	35	3981	58,202	DIP
NKE1209DC	12	9	111	107	72	78	50	3482	57,895	
NKE1212DC	12	12	83	105	73	79	57	1982	77,806	
NKE1215DC	12	15	66	103	76	81	60	2122	56,404	
NKE1205SC	12	5	200	117	68	72	35	3981	58,202	
NKE1209SC	12	9	111	107	72	78	50	3482	57,895	
NKE1212SC	12	12	83	105	73	79	57	1982	77,806	SIP
NKE1215SC	12	15	66	103	76	81	60	2122	56,404	

NKE0505SEC/NKE0505DEC offers higher efficiency than NKE0505SC/NKE0505DC but over a narrower operating temperature range. See temperature characteristics graph.

## INPUT CHARACTERISTICS

Parameter	Conditions	Min.	Typ.	Max.	Units
Voltage range	Continuous operation, 3.3V input types	2.97	3.3	3.63	V
	Continuous operation, 5V input types	4.5	5.0	5.5	
	Continuous operation, 12V input types	10.8	12.0	13.2	
Reflected ripple current	3.3V input types		40	60	mA p-p

## ABSOLUTE MAXIMUM RATINGS

Lead temperature 1.5mm from case for 10 seconds	260°C
Input voltage $V_{in}$ , NKE03 types	5.5V
Input voltage $V_{in}$ , NKE05 types	7V
Input voltage $V_{in}$ , NKE12 types	15V

1. Calculated using MIL-HDBK-217 FN2 and Telcordia SR-332 calculation model with nominal input voltage at full load.  
All specifications typical at  $T_A=25^\circ\text{C}$ , nominal input voltage and rated output current unless otherwise specified.

OUTPUT CHARACTERISTICS					
Parameter	Conditions	Min.	Typ.	Max.	Units
Rated Power	T <sub>A</sub> =-40°C to 120°C, see derating graphs			1.0	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>1</sup>	10% load to rated load, 3.3V output types & 0309		10	15	%
	10% load to rated load, 5V output types		12	15	
	10% load to rated load, 9V output types		7.5	10	
	10% load to rated load, 12V output types		6.5	9.5	
	10% load to rated load, 15V output types		6.0	8.5	
Ripple and Noise	BW=DC to 20MHz, 3.3V output types & 0305, 0505SEC, 0505DEC		40	80	mV p-p
	BW=DC to 20MHz, other 5V output types		77	100	
	BW=DC to 20MHz, 9V output types		43	90	
	BW=DC to 20MHz, 12V output types		35	65	
	BW=DC to 20MHz, 15V output types		32	55	

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

GENERAL CHARACTERISTICS					
Parameter	Conditions	Min.	Typ.	Max.	Units
Switching frequency	All output types		115		kHz

TEMPERATURE CHARACTERISTICS					
Parameter	Conditions	Min.	Typ.	Max.	Units
Specification	All output types	-40		85	°C
Storage		-50		130	
Case temperature rise above ambient	0505D/S, 1205D/S			41	
	All other output types			32	
Cooling	Free air convection				

### 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 NKE series of dc/dc converters are all 100% production tested at their stated isolation voltage. This is 3000V DC for 1 second.

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

The NKE series has been recognized 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. While manufactured parts can 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.

### SAFETY APPROVAL

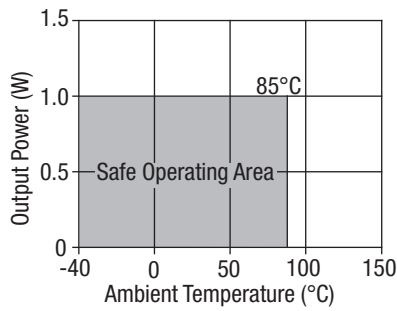
The NKE series has been recognised by Underwriters Laboratory (UL) to UL 60950 for functional insulation in a maximum ambient temperature of 85°C and/or case temperature limit of 130°C. Case temperature measured on the face opposite the pins. File number E151252 applies.

1. 12V input types have typically 3% less load regulation.

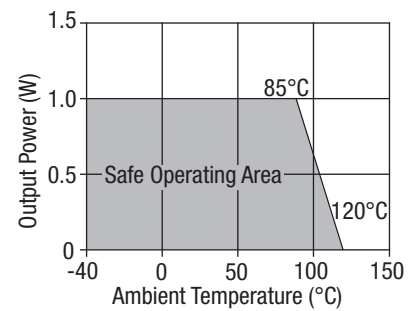
**TEMPERATURE DERATING GRAPHS**

NKE 0303DC/SC, 0305DC/SC, 0309DC/SC, 0503DC/SC, 0505DEC/SEC types only.

UL recognition to a maximum ambient temperature of 85°C and/or case temperature limit of 130°C.

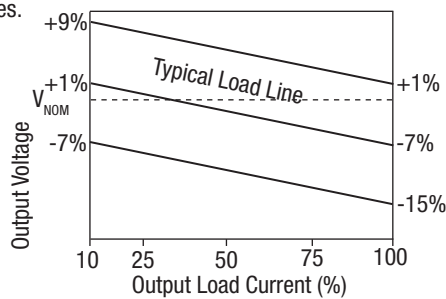


All other types.

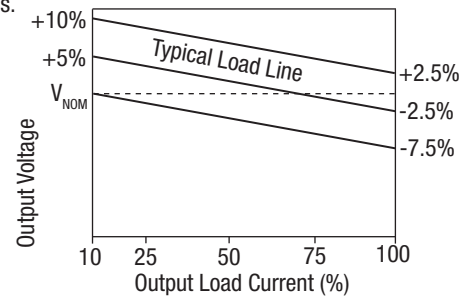


**TOLERANCE ENVELOPES**

3.3V output types.



All other 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.

**APPLICATION NOTES**

**Minimum load**

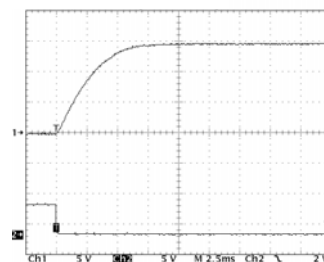
The minimum load to meet datasheet specification is 10% of the full rated load across the specified input voltage range. Lower than 10% minimum loading will result in an increase in output voltage, which may rise to typically double the specified output voltage if the output load falls to less than 5%.

**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		Start-up time µs
NKE0303SC	544	NKE0512SC	5040
NKE0305SC	1306	NKE0515SC	9940
NKE0309SC	5250	NKE1205SC	1671
NKE0503SC	496	NKE1209SC	2835
NKE0505SC	1075	NKE1212SC	5295
NKE0505SEC	894	NKE1215SC	8475
NKE0509SC	3140		

Typical Start-Up Wave Form



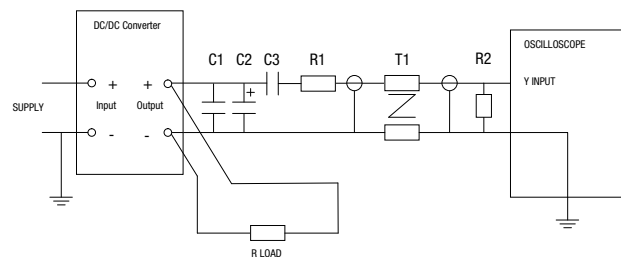
**Ripple & Noise Characterisation Method**

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 (continued)**

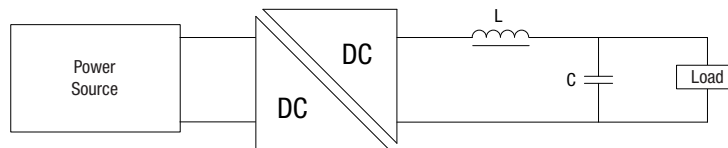
**Output Ripple Reduction**

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.

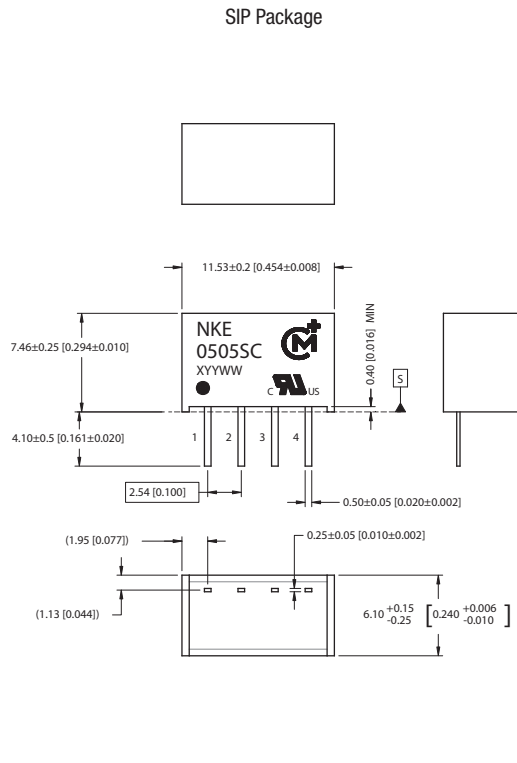
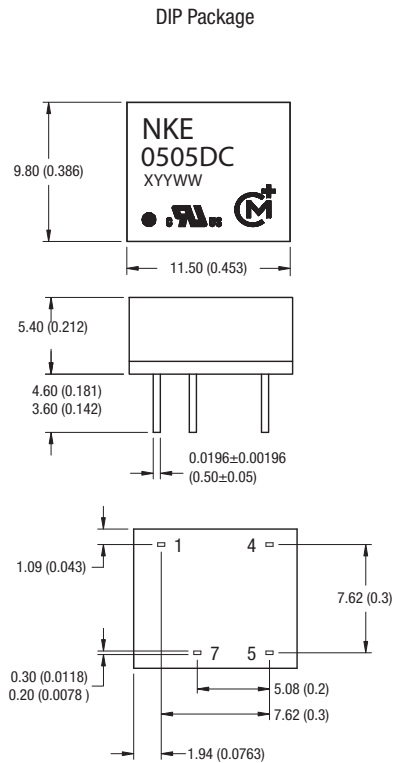
**Inductor:** The rated current of the inductor should not be less than that of the output of the DC/DC converter. At the rated current, the DC resistance of the inductor should be such that the voltage drop across the inductor is <2% of the rated voltage of the DC/DC converter. The SRF (Self Resonant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



	Inductor			Capacitor
	L, $\mu$ H	SMD	Through Hole	C, $\mu$ F
NKE0303xC	10	82103C	11R103C	4.7 $\mu$ F
NKE0305xC	47	82473C	11R473C	4.7 $\mu$ F
NKE0309xC	47	82473C	11R473C	1 $\mu$ F
NKE0503xC	10	82103C	11R103C	4.7 $\mu$ F
NKE0505xC	47	82473C	11R473C	4.7 $\mu$ F
NKE0505xEC	47	82473C	11R473C	4.7 $\mu$ F
NKE0509SC	47	82473C	11R473C	1 $\mu$ F
NKE0512xC	68	82683C	11R683C	0.68 $\mu$ F
NKE0515xC	100	82104C	11R104C	2.2 $\mu$ F
NKE1205xC	47	82473C	11R473C	4.7 $\mu$ F
NKE1209xC	47	82473C	11R473C	1 $\mu$ F
NKE1212xC	68	82683C	11R683C	0.47 $\mu$ F
NKE1215xC	100	82104C	11R104C	2.2 $\mu$ F

**PACKAGE SPECIFICATIONS**

**MECHANICAL DIMENSIONS**



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: 1.09g (SIP) 1.25g (DIP)

**PIN CONNECTIONS - 8 PIN DIP**

Pin	Function
1	-VIN
4	+VIN
5	+VOUT
7	-VOUT

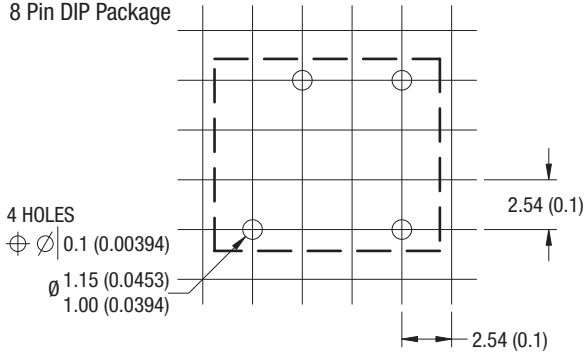
**PIN CONNECTIONS - 4 PIN SIP**

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

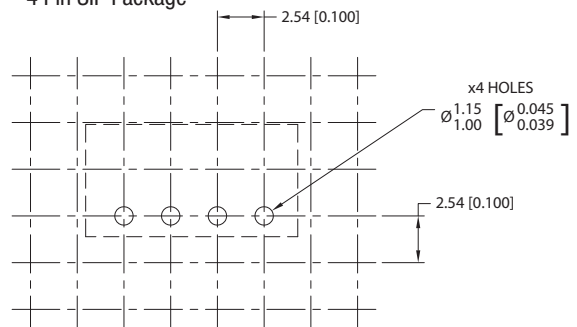
**PACKAGE SPECIFICATIONS (continued)**

**RECOMMENDED FOOTPRINT DETAILS**

8 Pin DIP Package

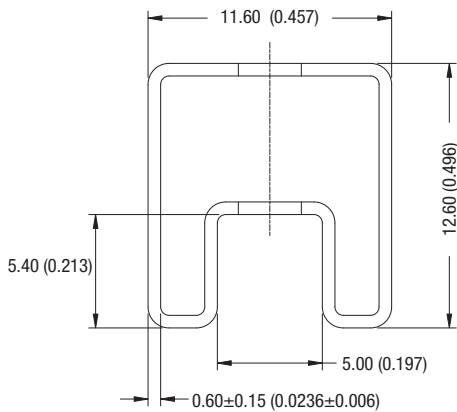


4 Pin SIP Package

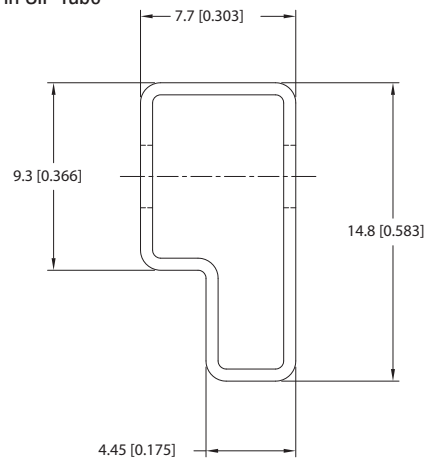


**TUBE OUTLINE DIMENSIONS**

8 Pin DIP Tube



4 Pin SIP Tube



Unless otherwise specified all dimensions in mm [inches]  $\pm 0.55$ mm [0.022].  
 Tube length (8 Pin DIP) : 520mm  $\pm 2$ mm (20.47).  
 Tube length (4 Pin SIP) : 525mm  $\pm 2$ mm (20.67).

Tube Quantity : 40

**RoHS COMPLIANCE INFORMATION**



This series is compatible with RoHS soldering systems with a peak wave solder temperature of 260°C for 10 seconds. 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)

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