Murata Power Solutions

NMH Series

Isolated 2W Dual Output DC/DC Converters

FEATURES

- RoHS compliant
- Efficiency up to 86%
- Power density up to 1.44W/cm³
- Wide temperature performance at full 2 watt load, –40°C to 85°C
- Dual output from a single input rail
- UL 94V-0 package material
- No heatsink required
- Footprint from 1.46cm²
- Industry standard pinout
- Power sharing on output
- 1kVDC isolation
- 5V, 12V, 24V & 48V input
- 5V, 9V, 12V and 15V output
- Internal SMD construction
- Fully encapsulated with toroidal magnetics
- No external components required
- MTTF up to 1.5 million hours
- No electrolytic or tantalum capacitors

DESCRIPTION

The NMH series of industrial temperature range DC/DC converters are the standard buliding blocks for on-board point-of-use power systems. They are ideally suited for providing dual rail supplies on single rail boards with the added benefit of galvanic isolation to reduce circuit noise. All of the rated power may be drawn from a single pin provided the total load does not exceed 2 watts.

Pin compatibility with the NMA 1 watt series ensures minimal effort in upgrading distributed power systems.

RoHS COMPLIANT 2002/95/EC

For full details go to
www.murata-ps.com/rohs

SELECTION GUIDE

Order Code	Nominal Input Voltage	Output Voltage	Output Current	Input Current at Rated Load	Efficiency	Isolation Capacitance	MTTF[1]	Package Style
	V	V	mA	mA	%	pF	kHrs	
NMH0505DC	5	±5	±200	500	80	24	1574	DIP
NMH0509DC	5	±9	±111	494	81	28	663	
NMH0512DC	5	±12	±83	488	82	30	338	
NMH0515DC	5	±15	±67	476	84	33	187	
NMH0505SC	5	±5	±200	500	80	24	1574	SIP
NMH0509SC	5	±9	±111	494	81	28	663	
NMH0512SC	5	±12	±83	488	82	30	338	
NMH0515SC	5	±15	±67	476	84	33	187	
NMH1205DC	12	±5	±200	208	80	35	490	DIP
NMH1209DC	12	±9	±111	201	83	55	343	
NMH1212DC	12	±12	±83	198	84	63	229	
NMH1215DC	12	±15	±67	198	84	66	148	
NMH1205SC	12	±5	±200	208	80	35	490	SIP
NMH1209SC	12	±9	±111	201	83	55	343	
NMH1212SC	12	±12	±83	198	84	63	229	
NMH1215SC	12	±15	±67	198	84	66	148	
NMH2405DC	24	±5	±200	103	81	41	318	DIP
NMH2409DC	24	±9	±111	98	85	75	249	
NMH2412DC	24	±12	±83	97	86	95	183	
NMH2415DC	24	±15	±67	97	86	104	127	
NMH2405SC	24	±5	±200	103	81	41	318	SIP
NMH2409SC	24	±9	±111	98	85	75	249	
NMH2412SC	24	±12	±83	97	86	95	183	
NMH2415SC	24	±15	±67	97	86	104	127	
NMH4805DC	48	±5	±200	51	82	45	235	DIP
NMH4809DC	48	±9	±111	51	82	74	195	
NMH4812DC	48	±12	±83	49	85	90	152	
NMH4815DC	48	±15	±67	49	85	112	112	
NMH4805SC	48	±5	±200	51	82	45	235	SIP
NMH4809SC	48	±9	±111	51	82	74	195	
NMH4812SC	48	±12	±83	49	85	90	152	
NMH4815SC	48	±15	±67	49	85	112	112	

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, 24V input types	21.6	24	26.4	
	Continuous operation, 48V input types	43.2	48	52.8	
Reflected ripple current	5V input types		50		mA p-p
	12V input types		70		
	24V input types		130		
	48V input types		200		

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

All specifications typical at T_A=25°C, nominal input voltage and rated output current unless otherwise specified.

OUTPUT CHARACTERISTICS

Parameter	Conditions	Min.	Typ.	Max.	Units
Rated Power[1]	T_A=-40°C to 85°C			2	W
Voltage Set Point Accuracy	NMH0505DC/SC	-5		7.5	%
	All other types	-5		5	
Line regulation	High V_{IN} to low V_{IN}		1.0	1.2	%/%
Load Regulation	10% load to rated load, 5V output types		5	10	%
	10% load to rated load, 9V output types		3	10	
	10% load to rated load, 12V output types				
	10% load to rated load, 15V output types				
Ripple and 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	

ABSOLUTE MAXIMUM RATINGS

Lead temperature 1.5mm from case for 10 seconds	300°C
Internal power dissipation	300mW
Input voltage V_{IN}, NMH05 types	7V
Input voltage V_{IN}, NMH12 types	15V
Input voltage V_{IN}, NMH24 types	28V
Input voltage V_{IN}, NMH48 types	54V

ISOLATION CHARACTERISTICS

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

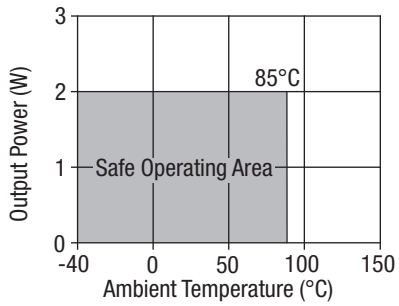
GENERAL CHARACTERISTICS

Parameter	Conditions	Min.	Typ.	Max.	Units
Switching frequency	5V input types		95		kHz
	12V input types		90		
	24V & 48V input types		80		

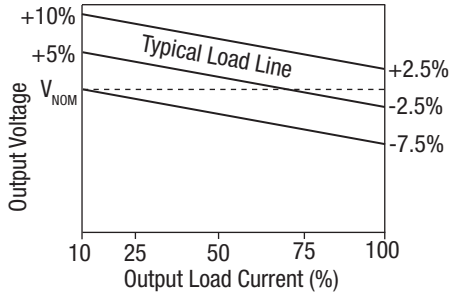
TEMPERATURE CHARACTERISTICS

Parameter	Conditions	Min.	Typ.	Max.	Units
Specification	All output types	-40		85	°C
Storage		-50		130	
Case Temperature above ambient	5V output types		30		
	12V output types		25		
Cooling	Free air convection				

TEMPERATURE DERATING GRAPH



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.

1. See 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 NMH 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 NMH 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 NMH 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.

RoHS COMPLIANCE INFORMATION

RoHS COMPLIANT 2002/95/EC

This series is compatible with RoHS soldering systems with a peak wave solder temperature of 300°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

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%.

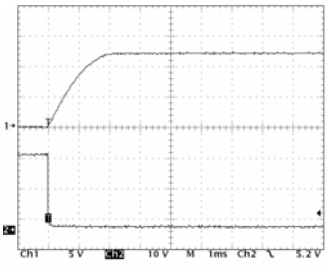
Capacitive loading and start up

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
NMH0505SC	1072
NMH0509SC	2481
NMH0512SC	3546
NMH0515SC	5380
NMH1205SC	672
NMH1209SC	1152
NMH1212SC	1580
NMH1215SC	3150

	Start-up time µs
NMH2405SC	1064
NMH2409SC	1544
NMH2412SC	4398
NMH2415SC	4230
NMH4805SC	966
NMH4809SC	1220
NMH4812SC	2822
NMH4815SC	4275

Typical Start-Up Wave Form



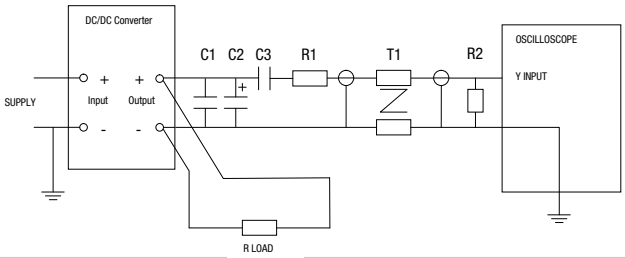
APPLICATION NOTES (continued)

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



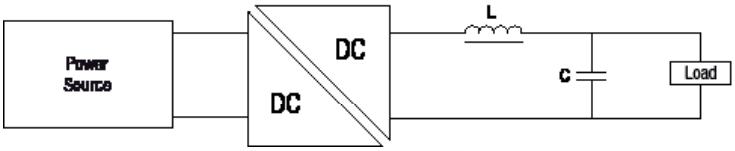
OUTPUT RIPPLE REDUCTION

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: Ceramic chip capacitors are recommended. It is required that the ESR (Equivalent Series Resistance) should be as low as possible, X7R 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.



Order Code	L (µH)	Inductor Order Codes		C (µF)
		SMD	Through Hole	
NMH0505XC	47	82473C	11R473C	4.7
NMH0509XC	47	82473C	11R473C	2.2
NMH0512XC	150	82154C	11R154C	3.3
NMH0515XC	100	82104C	11R104C	3.3
NMH1205XC	47	82473C	11R473C	4.7
NMH1209XC	47	82473C	11R473C	2.2
NMH1212XC	150	82154C	11R154C	3.3
NMH1215XC	100	82104C	11R104C	3.3
NMH2405XC	47	82473C	11R473C	4.7
NMH2409XC	47	82473C	11R473C	2.2
NMH2412XC	150	82154C	11R154C	3.3
NMH2415XC	100	82104C	11R104C	3.3
NMH4805XC	47	82473C	11R473C	4.7
NMH4809XC	47	82473C	11R473C	2.2
NMH4812XC	150	82154C	11R154C	3.3
NMH4815XC	100	82104C	11R104C	3.3

Product specification for MPS inductors can be found at:

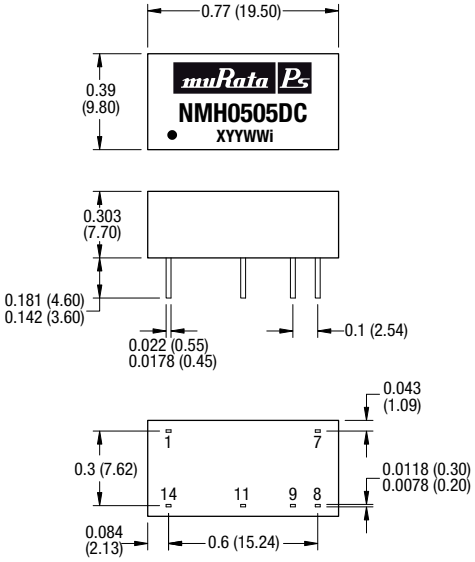
2200R Series (Through Hole)
http://www.murata-ps.com/data/magnetics/kmp_2200r.pdf

8200 Series (SMD)
http://www.murata-ps.com/data/magnetics/kmp_8200c.pdf

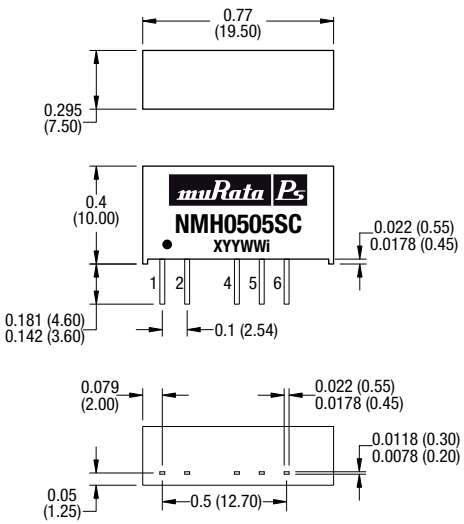
PACKAGE SPECIFICATIONS

MECHANICAL DIMENSIONS

DIP package



SIP package



All dimensions in inches ±0.01 (mm ±0.25mm). All pins on a 0.1 (2.54) pitch and within ±0.01 (0.25) of true position.

Weight: 2.85g (DIP) 2.76g (SIP)

PIN CONNECTIONS - 14 PIN DIP

Pin	Function
1	$-V_{IN}$
7	NC
8	OV
9	$+V_{OUT}$
11	$-V_{OUT}$
14	$+V_{IN}$

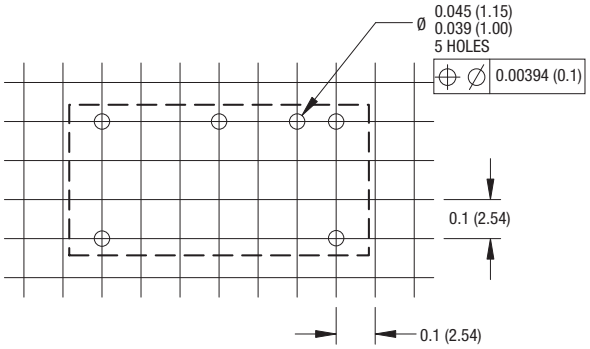
PIN CONNECTIONS - 7 PIN SIP

Pin	Function
1	$+V_{IN}$
2	$-V_{IN}$
4	$-V_{OUT}$
5	OV
6	$+V_{OUT}$

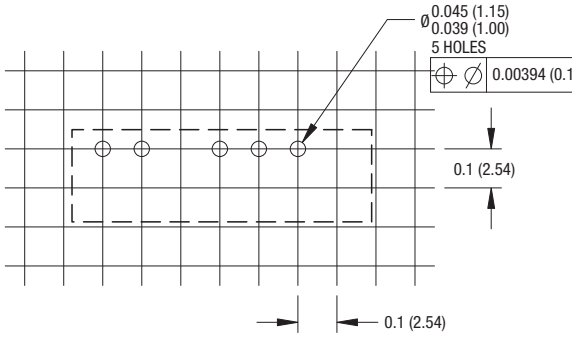
PACKAGE SPECIFICATIONS (continued)

RECOMMENDED FOOTPRINT DETAILS

14 Pin DIP Package

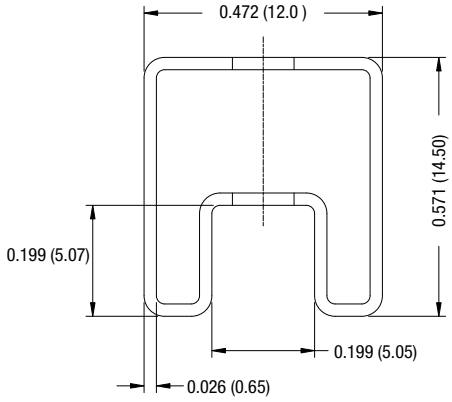


7 Pin SIP Package

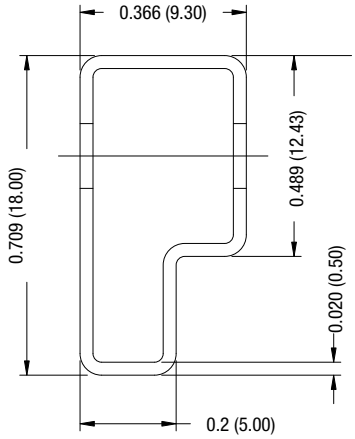


TUBE OUTLINE DIMENSIONS

14 Pin DIP Tube



7 Pin SIP Tube



Unless otherwise stated all dimensions in inches (mm) ±0.5mm.
Tube length (14 Pin DIP) : 20.47 (520mm ±2mm).
Tube length (7 Pin SIP) : 20.47 (520mm ±2mm).

Tube Quantity : 25