



### FEATURES

- RoHS compliant
- 2:1 Wide range voltage input
- Continuous short circuit protection with current foldback
- Operating temperature range  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$
- 0.2% Typical load regulation
- 1kVDC Isolation
- Efficiency from 67%
- 5V, 12V, 24V & 48V Nominal input
- $\pm 5\text{V}$ ,  $\pm 12\text{V}$  &  $\pm 15\text{V}$  Dual outputs
- Power density  $0.94\text{W}/\text{cm}^3$
- Optional remote On/Off
- UL 94V-0 Package materials
- No electrolytic capacitors
- Low noise
- Custom solutions available

### PRODUCT OVERVIEW

The NDX series of DC/DC converters provide up to 7.5W of output power with dual outputs. Unbalanced loading capability with an optional input control pin which will shutdown the NDX from TTL levels. Input voltages of 5V (4.5V to 9V), 12V (9V to 18V), 24V (18V to 36V), and 48V (36V to 75V) with outputs of  $\pm 5\text{V}$ ,  $\pm 12\text{V}$  or  $\pm 15\text{V}$  provided. The device is housed in a 5 sided metal case potted with UL 94V-0 rated material. The pinout is an industry standard 5 pin arrangement with an additional optional control pin.



For full details go to [www.murata-ps.com/rohs](http://www.murata-ps.com/rohs)

### SELECTION GUIDE

Order Code <sup>1</sup>	Input Voltage V (Nom.)	Output Voltage V	Output Current <sup>2</sup>		Input Current			Efficiency (Min.) %	Isolation Capacitance pF
			$\pm 12.5\%$ Load mA	$\pm 50\%$ Load mA	0% Load mA	100% Load A	Shut Down mA		
NDXD0505C	5	$\pm 5$	$\pm 150$	$\pm 600$	19.4	1.83		67	40
NDXD0505EC	5	$\pm 5$	$\pm 150$	$\pm 600$	19.4	1.83	0.075	67	40
NDXD0512C	5	$\pm 12$	$\pm 78.1$	$\pm 312$	33.4	2.15		69	42
NDXD0512EC	5	$\pm 12$	$\pm 78.1$	$\pm 312$	33.4	2.15	0.075	69	42
NDXD0515C	5	$\pm 15$	$\pm 62.5$	$\pm 250$	41.8	2.69		71	43
NDXD0515EC	5	$\pm 15$	$\pm 62.5$	$\pm 250$	41.8	2.69	0.075	71	43
NDXD1205C	12	$\pm 5$	$\pm 187$	$\pm 750$	13.2	0.89		73	36
NDXD1205EC	12	$\pm 5$	$\pm 187$	$\pm 750$	13.2	0.89	0.176	73	36
NDXD1212C	12	$\pm 12$	$\pm 78.1$	$\pm 312$	15	0.86		78	41
NDXD1212EC	12	$\pm 12$	$\pm 78.1$	$\pm 312$	15	0.86	0.159	78	41
NDXD1215C	12	$\pm 15$	$\pm 62.5$	$\pm 250$	17	0.86		79	41
NDXD1215EC	12	$\pm 15$	$\pm 62.5$	$\pm 250$	17	0.86	0.175	79	41
NDXD2405C	24	$\pm 5$	$\pm 187$	$\pm 750$	4.2	0.402		75	58
NDXD2405EC	24	$\pm 5$	$\pm 187$	$\pm 750$	4.2	0.402	0.15	75	58
NDXD2412C	24	$\pm 12$	$\pm 78.1$	$\pm 312$	6.3	0.380		81	56
NDXD2412EC	24	$\pm 12$	$\pm 78.1$	$\pm 312$	6.3	0.380	0.4	81	56
NDXD2415C	24	$\pm 15$	$\pm 62.5$	$\pm 250$	7.0	0.380		82	56
NDXD2415EC	24	$\pm 15$	$\pm 62.5$	$\pm 250$	7.0	0.380	0.4	82	56
NDXD4805C	48	$\pm 5$	$\pm 187$	$\pm 750$	3.6	0.198		77	61
NDXD4805EC	48	$\pm 5$	$\pm 187$	$\pm 750$	3.6	0.198	0.08	77	61
NDXD4812C	48	$\pm 12$	$\pm 78.1$	$\pm 312$	5.9	0.190		82	57
NDXD4812EC	48	$\pm 12$	$\pm 78.1$	$\pm 312$	5.9	0.190	0.5	82	57
NDXD4815C	48	$\pm 15$	$\pm 62.5$	$\pm 250$	5.9	0.190		82	58
NDXD4815EC	48	$\pm 15$	$\pm 62.5$	$\pm 250$	5.9	0.190	0.5	82	58

### INPUT CHARACTERISTICS

Parameter	Conditions	Min.	Typ.	Max.	Units
Voltage range	5V input types	4.5	5	9	V
	12V input types	9	12	18	
	24V input types	18	24	36	
	48V input types	36	48	75	
Reflected ripple current	5V input types with 100 $\mu\text{F}$ at input		70		mA p-p
	12V input types with 100 $\mu\text{F}$ at input		18		
	24V input types with 10 $\mu\text{F}$ at input		90		
	48V input types with 10 $\mu\text{F}$ at input		80		

### ABSOLUTE MAXIMUM RATINGS

Short-circuit protection (Max. case temperature rise $95^{\circ}\text{C}$ above ambient)	12V, 15V outputs	Continuous
	5V output, VIN = nominal, $25^{\circ}\text{C}$	Continuous
Lead temperature 1.0mm from case for 10 seconds (to JEDEC JESD22-B106 ISS C)		$260^{\circ}\text{C}$
Minimum output load for specification <sup>2</sup>		12.5% of rated load on each output
Control pin input voltage		7V
Input voltage, NDXD05 types		10V
Input voltage, NDXD12 types		20V
Input voltage, NDXD24 types		40V
Input voltage, NDXD48 types		80V

1. Suffix 'EC' indicates optional CTRL pin is fitted, as indicated in the mechanical dimensions section.

2. Please refer to minimum load application notes section on page 3.

All specifications typical at  $T_A=25^{\circ}\text{C}$ , with recommended input/output capacitors (refer to application note), nominal input voltage and rated output current unless otherwise specified.

OUTPUT CHARACTERISTICS							
Parameter	Conditions		Min.	Typ.	Max.	Units	
Rated power					7.5	W	
Voltage set point accuracy	With external input/output capacitors	5V & 12V Input		±3	±5	%	
		24V & 48V Input		±2	±5		
Line regulation	Low line to high line, with external input/output capacitors	5V & 12V Input		0.1	0.9	%	
		24V & 48V Input		0.04	0.4		
Load regulation	25% total load to 100% total load With external input/output capacitors	5V & 12V input		0.2	0.9	%	
		24V & 48V input		0.2	0.75		
Ripple <sup>2</sup>	BW=20Hz to 300kHz, with external input/output capacitors			5.0	10	mVrms	
Noise <sup>2</sup>	BW=DC to 20MHz With external input/output capacitors			32	50	mVp-p	
Cross regulation	% voltage change on negative output when positive load varies from 25% to 75% with negative load fixed at 100%	5V & 12V input	5V output		3.8	6	%
			12V, 15V output		1.5	5	
		24V & 48V input	5V output		2.5	7	
			12V, 15V output		2.5	5	

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

GENERAL CHARACTERISTICS <sup>1</sup>						
Parameter	Conditions		Min.	Typ.	Max.	Units
Switching frequency	100% total load to 25% total load	5V & 12V input	5V outputs	100	900	kHz
			12V & 15V outputs			
		24V & 48V input	5V outputs	100	680	
			12V & 15V outputs		620	
Control pin input voltage	Module ON (or pin unconnected)		-0.6		0.8	V
			-0.1		0.2	mA
	Module OFF		3.0		7.0	V
			0.3		3.0	mA

TEMPERATURE CHARACTERISTICS						
Parameter	Conditions		Min.	Typ.	Max.	Units
Operation			-40		85	°C
Storage			-50		130	
Case temperature rise above ambient	100% Load, Nom V <sub>IN</sub> , Still Air	1212, 1215, 2412, 2415, 4812, 4815		35		
		0512, 1205, 2405, 4805		43		
		0505, 0515, 1205		48		

MEAN TIME TO FAILURE (MTTF) <sup>1</sup>			
Part Number	0°C	25°C	Units
NDXD2412C	2590	1528	kHrs
NDXD2415C	2492	1462	
NDXD4812C	2587	1558	
NDXD4815C	2351	1379	

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

2. See Ripple & Noise characterisation method.

All specifications typical at T<sub>A</sub>=25°C, nominal input voltage and rated output current unless otherwise specified.

**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 this product series is a Gold flash (0.05-0.10 micron) over Nickel Preplate. The series is backward compatible with Sn/Pb soldering systems. For further information, please visit [www.murata-ps.com/rohs](http://www.murata-ps.com/rohs)

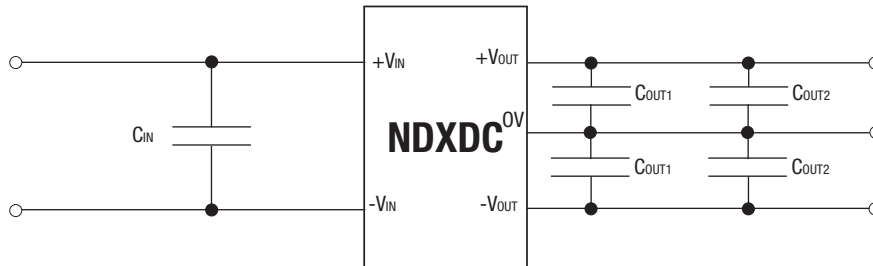
**APPLICATION NOTES**

**External Capacitance**

Although these converters will work without external capacitors, they are necessary in order to guarantee the full parametric performance over the full line and load range. All parts have been tested and characterised using the following values and test circuit.

		Value	
Input Voltage	C <sub>IN</sub>	C <sub>OUT1</sub>	C <sub>OUT2</sub>
5V & 12V input	100µF, 100V	0.1µF, 25V multi-layer ceramic	100µF, 25V (low ESR)
24V & 48V input	10µF, 200V		

**Recommended Input & Output Capacitors**



**Control Pin**

This provides an OFF function, which puts the converter into a low power mode. When the pin is high the converter is OFF. Standard TTL levels can be used but the maximum high level must not exceed 7.0V. The pin can be left open for normal operation or at voltage below 0.8V with respect to the -V<sub>IN</sub> pin.

**Cross Regulation**

Load regulation is at its best when the positive and negative loads are balanced. When the loads are asymmetric, the negative output is not as tightly regulated as the positive output. To meet ripple specification a total minimum load of 25% full load is required, however, the NDX can be used with much lighter loading at the expense of increased ripple. A small load of 150mW is required on the negative output to ensure the maximum negative output voltage is not exceeded. NDX cross regulation is defined on page 2.

**Minimum load**

The minimum load for correct operation is 25% of the full rated load across the specified input voltage range. Lower loads may cause a significant increase in output ripple and may cause the output voltage to exceed its specification transiently during power-down when the input voltage also falls below its rated minimum. A minimum loading of 30% load is required on NDXD4805 to prevent output voltage rise above specification during power-down.

**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 NDX 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 NDX 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 NDX series has an EI ferrite core, 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.

**CHARACTERISATION TEST METHODS**

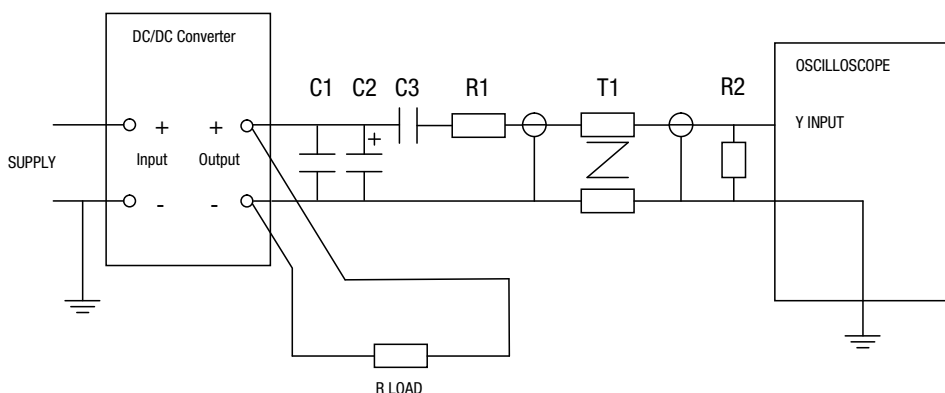
**Ripple & Noise Characterisation Method**

Ripple and noise measurements are performed with the following test configuration with the inclusion of recommended input and output capacitors.

C1	1uF X7R multilayer ceramic capacitor, voltage rating to be a minimum of 3 times the output voltage of the DC/DC converter
C2	10uF 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
R3	50Ω resistor, carbon film, +/-1%

Measured values are multiplied by 10 to obtain the specified values.

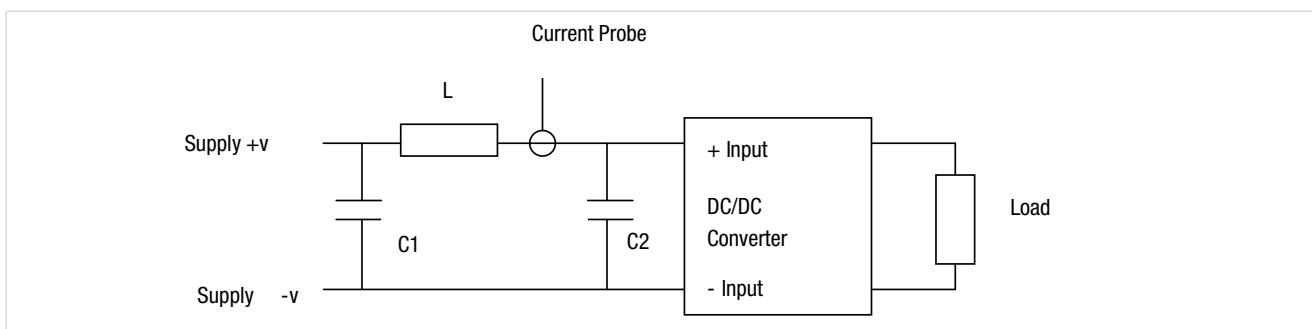
**Differential Mode Noise Test Schematic**



**Input Reflected Ripple Current Test Method**

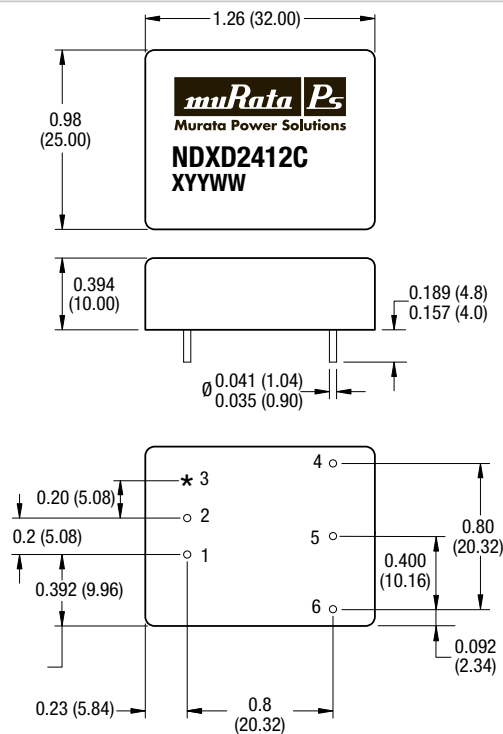
Input reflected ripple current measurements are performed with the following test configuration with the inclusion of recommended input and output capacitors.

C1	220uF with ESR of <0.1Ω at 100kHz, rated at supply voltage
L1	12uH rated at 150% minimum of the DC current taken by the converter.
C2	The recommended input capacitor for the DC/DC converter.



**PACKAGE SPECIFICATIONS**

**MECHANICAL DIMENSIONS**



\* Optional pin  
All dimensions in inches  $\pm 0.010$  (mm 0.25mm).  
All pins on a 0.100 (2.54) pitch and within 0.010 (0.25) of true position.

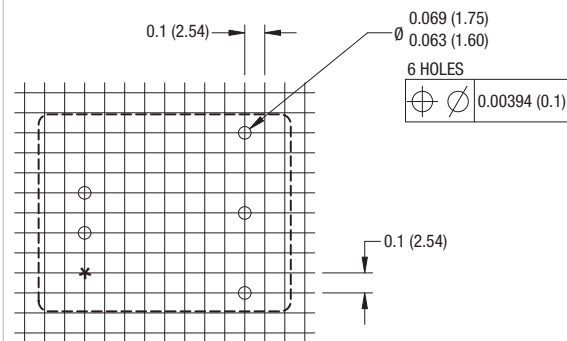
Weight: 20g

**PIN CONNECTIONS**

Pin	Function
1	-VIN
2	+VIN
3*	CTRL
4	+VOUT
5	OV
6	-VOUT

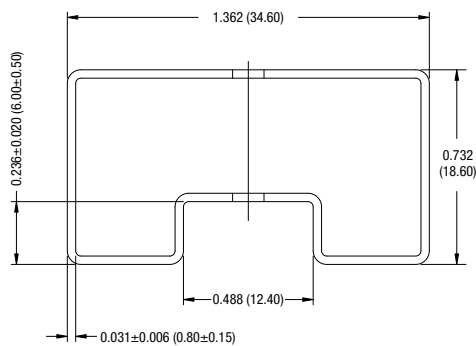
\* Optional pin

**RECOMMENDED FOOTPRINT DETAILS**



All dimensions in inches  $\pm 0.010$  (mm 0.25mm).

**TUBE OUTLINE DIMENSIONS**



All dimensions in inches  $\pm 0.010$  (mm 0.25mm).

Quantity: 15

Murata Power Solutions, Inc.  
11 Cabot Boulevard, Mansfield, MA 02048-1151 U.S.A.  
Tel: (508) 339-3000 (800) 233-2765 Fax: (508) 339-6356  
[www.murata-ps.com](http://www.murata-ps.com) email: [sales@murata-ps.com](mailto:sales@murata-ps.com) ISO 9001 REGISTERED

Murata Power Solutions, Inc. makes no representation that the use of its products in the circuits described herein, or the use of other technical information contained herein, will not infringe upon existing or future patent rights. The descriptions contained herein do not imply the granting of licenses to make, use, or sell equipment constructed in accordance therewith. Specifications are subject to change without notice.  
© 2008 Murata Power Solutions, Inc.

- USA:** Tucson (Az), Tel: (800) 547 2537, email: [sales@murata-ps.com](mailto:sales@murata-ps.com)
- Canada:** Toronto, Tel: (866) 740 1232, email: [toronto@murata-ps.com](mailto:toronto@murata-ps.com)
- UK:** Milton Keynes, Tel: +44 (0)1908 615232, email: [mk@murata-ps.com](mailto:mk@murata-ps.com)
- France:** Montigny Le Bretonneux, Tel: +33 (0)1 34 60 01 01, email: [france@murata-ps.com](mailto:france@murata-ps.com)
- Germany:** München, Tel: +49 (0)89-544334-0, email: [ped.munich@murata-ps.com](mailto:ped.munich@murata-ps.com)
- Japan:** Tokyo, Tel: 3-3779-1031, email: [sales\\_tokyo@murata-ps.com](mailto:sales_tokyo@murata-ps.com)  
Osaka, Tel: 6-6354-2025, email: [sales\\_osaka@murata-ps.com](mailto:sales_osaka@murata-ps.com)  
Website: [www.murata-ps.jp](http://www.murata-ps.jp)
- China:** Shanghai, Tel: +86 215 027 3678, email: [shanghai@murata-ps.com](mailto:shanghai@murata-ps.com)  
Guangzhou, Tel: +86 208 221 8066, email: [guangzhou@murata-ps.com](mailto:guangzhou@murata-ps.com)