



### FEATURES

- UL62368-1 recognised
- 1kVDC isolation 'Hi Pot Test'
- Operation up to 115°C (with derating)
- Industry standard pinout
- Fully encapsulated with toroidal magnetics
- No electrolytic or tantalum capacitors
- Pin compatible with NMG, NMR & CRR

### PRODUCT OVERVIEW

The NMR1 series of extended industrial temperature range DC-DC converters are the standard building blocks for on-board distributed power systems. They are ideally suited for providing single rail supplies on primarily digital boards with the added benefit of galvanic isolation to reduce switching noise. Surface mount technology and advanced packaging materials produce rugged reliable performance over an extended temperature range from -40°C up to 115°C.

### SELECTION GUIDE

Order Code	Nominal Input Voltage	Output Voltage	Output Current	Input Current at Rated Load	Load Regulation		Ripple & Noise		Efficiency (Min)	Efficiency (Typ)	Isolation Capacitance	MTTF <sup>1</sup>	
	V	V	mA	mA	%		mV p-p		%		pF	MIL.	Tel.
					Typ.	Max.	Typ.	Max.				kHrs	
NMR1S0505SC	5	5	200	275	11	14	15	30	67	72	15	4083	37011

### INPUT CHARACTERISTICS

Parameter	Conditions	Min.	Typ.	Max.	Units
Voltage range	Continuous operation	4.5	5	5.5	V
Input reflected ripple current			5		mA p-p

### GENERAL CHARACTERISTICS

Parameter	Conditions	Min.	Typ.	Max.	Units
Switching frequency			120		kHz

### OUTPUT CHARACTERISTICS

Parameter	Conditions	Min.	Typ.	Max.	Units
Rated Power	T <sub>A</sub> = -40°C to 105°C, see derating graph			1.0	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	%/%

### ISOLATION CHARACTERISTICS

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

### TEMPERATURE CHARACTERISTICS

Parameter	Conditions	Min.	Typ.	Max.	Units
Specification	See safety approval section for UL temperature specification	-40		115	°C
Storage		-50		125	
Case Temperature above ambient				28	
Cooling	Free air convection				

### ABSOLUTE MAXIMUM RATINGS

Input voltage V <sub>IN</sub>	7V
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.



1. Calculated using MIL-HDBK-217 and Telcordia SR-332 calculation model 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.

### 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 NMR1 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 NMR1 series is 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 NMR1 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 NMR1 series is recognised by Underwriters Laboratory (UL) to UL62368-1 for functional insulation with a case temperature limit of 120°C.

Creepage and clearance: 1mm

#### FUSING

The NMR1 series is not internally fused so to meet the requirements of UL62368-1 an anti-surge input line fuse should always be used with ratings as defined below.

NMR1S0505SC: 0.5A

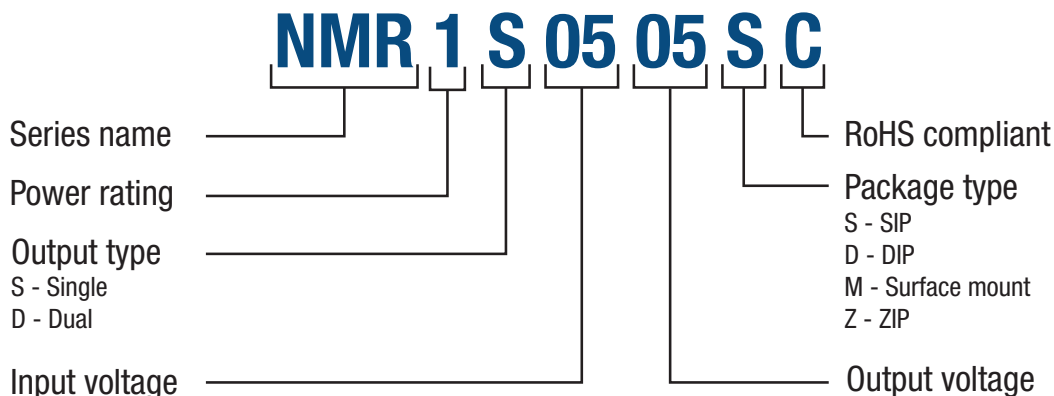
All fuses should be UL recognised and rated to 125V.  
File number E151252 applies.

### 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 Preplate. The series is backward compatible with Sn/Pb soldering systems. For further information, please visit <https://www.murata.com/en-global/products/power/rohs>

### PART NUMBER STRUCTURE



### ENVIRONMENTAL VALIDATION TESTING

The following tests have been conducted on this product series, please contact Murata if further information about the tests is required.

Test	Standard	Condition
Temperature cycling	JEDEC JESD22-A104	200 cycles in a dual zone chamber from -40 (+5/-10)°C to 105 (+10/-5)°C. 15 mins dwell at each (inclusive of ramps). 2 cycles per hour.
Humidity	JEDEC JESD22-A101	Run powered samples at 85±2°C/85±5% RH for 1000 (-24/+168) hours.
Storage life (high temperature)	JEDEC JESD22-A103, Condition A	125°C +10/-0°C for ≥1000 hours.
Solderability	EIA/IPC/JEDEC J-STD-002	SnPb (Test A) For leaded solderability the parts are conditioned in a steam ager for 8 hours ±15 min. at a temperature of 93°C ±3°C. Dipped in solder at 245°C ±5°C for 5 (+0/-0.5) seconds. Pb-free (Test A1) For lead free solderability the parts are conditioned in a steam ager for 8 hours ±15 min. at a temperature of 93°C ±3°C. Dipped in solder at 255°C ±5°C for 5 (+0/-0.5) seconds.
Solder heat	JEDEC JESD22-B106	The test sample is subjected to a molten solder bath at 270°C ±5°C for 7 (+2/-0) seconds (96SC tin/silver/copper).
Hand solder heat	MIL-STD-202 Method 210, Test Condition A	The soldering iron is heated to 350°C ±10°C and applied to the terminations for a duration of 4 to 5 seconds.
Shock	BS EN 61373	Test is 30ms duration, 3 shocks in each sense of 3 mutually perpendicular axes (18 shocks total). Level at each axis: Vertical, Traverse and Longitudinal: 50m/s <sup>2</sup> . Device is secured via the pins.
Vibration	BS EN 61373 with respect to BS EN 60068-2-64	5 – 150Hz. Level at each axis – Vertical, Traverse and Longitudinal: 5.72m/s <sup>2</sup> rms. 5 hours in each axis. Device is secured via the pins.
Solvent resistance	MIL-STD-883, Method 2015	Separate samples subjected to IPA.
Solvent cleaning	Resistance to cleaning agents	Solvent – Novec 71IPA & Topklean EL-20A. Pulsed ultrasonic immersion 45°C - 60°C.
ESD	JEDEC JESD22-A114	HBM at 8.0kV.
Lead integrity: pull	MIL-STD 883 Method 2004 Test Condition A	A pull of 0.227kg applied for 30 seconds. The force is then increased until the pins snap.
Lead integrity: fatigue	MIL-STD 883 Method 2004 Test condition B <sub>2</sub>	The leads are bent to an angle of 15°. Each lead is subjected to 3 cycles.
Lead integrity: adhesion	MIL-STD 883 Method 2025	Leads are bent through 90° until a fracture occurs.

**CHARACTERISATION TEST METHODS**

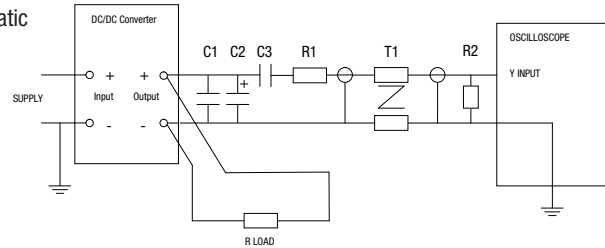
**Ripple & Noise Characterisation Method**

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 100kHz
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**

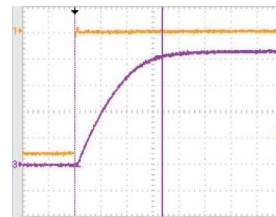
The minimum load to meet datasheet specification is 10% of the full rated load across the specified input voltage range. Lower than 10% minimum loading will result in an increase in output voltage, which may rise to typically double the specified output voltage if the output load falls to less than 5%.

**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
NMR1S0505SC	300

Typical Start-Up Wave Form



**APPLICATION NOTES (Continued)**

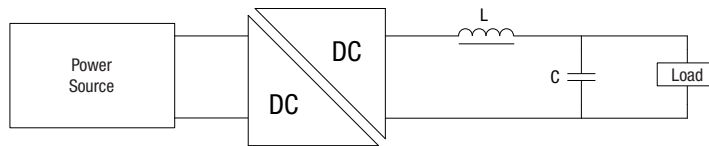
**Output Ripple Reduction**

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 the rated output voltage of the DC-DC converter.

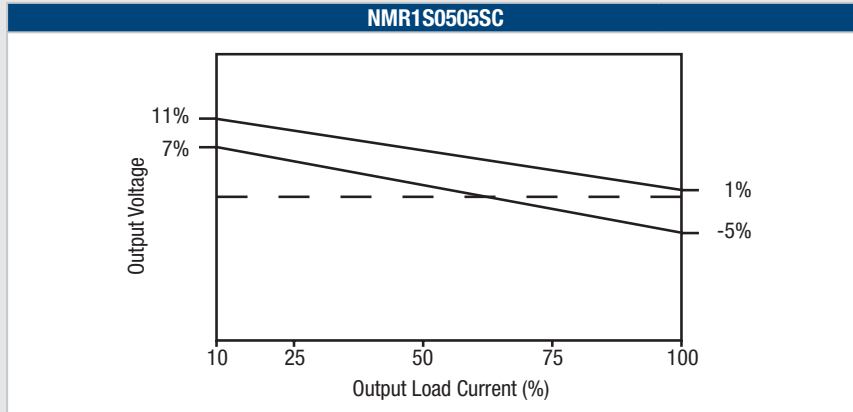
**Inductor:** The rated current of the inductor should not be less than that of the output of the DC-DC converter. At the rated current, the DC resistance of the inductor should be such that the voltage drop across the inductor is <2% of the rated voltage of the DC-DC converter. The SRF (Self Resonant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



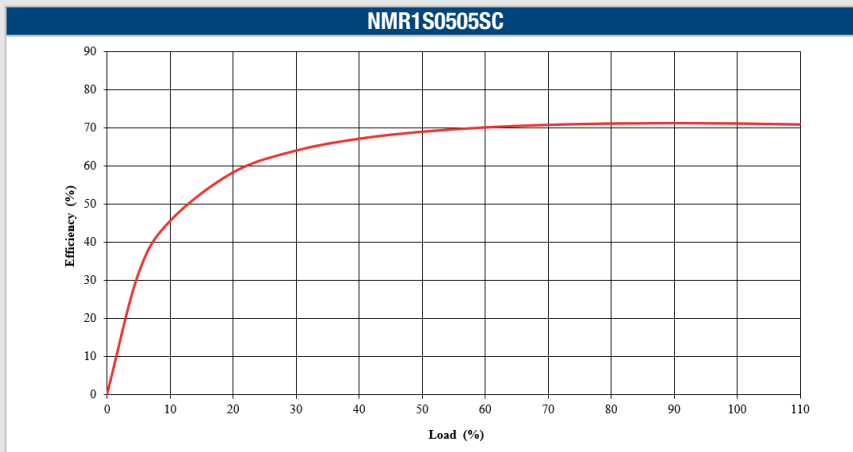
	Inductor		Capacitor	
	L, $\mu$ H	Through Hole	C, $\mu$ F	SMD
NMR1S0505SC	10	11R103C	4.7	GRM21BC71H475KE11L

**TOLERANCE ENVELOPE**

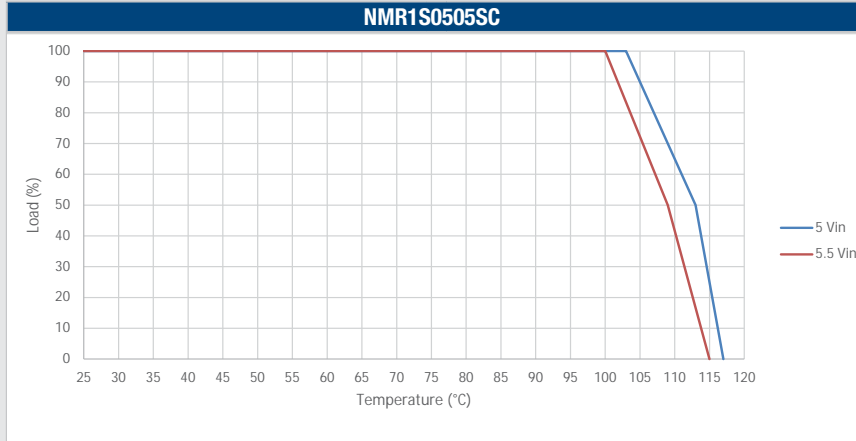
The voltage tolerance envelope shows typical load regulation characteristics for this product series. The tolerance envelope is the maximum output voltage variation due to changes in output loading.



**EFFICIENCY VS LOAD**



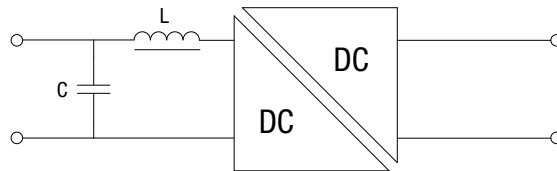
## TEMPERATURE DERATING



**EMC FILTERING AND SPECTRA**

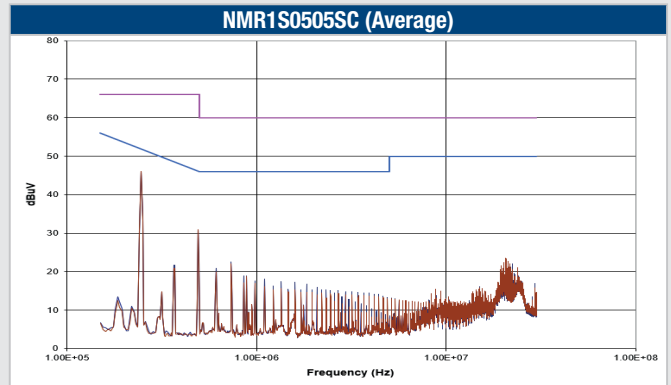
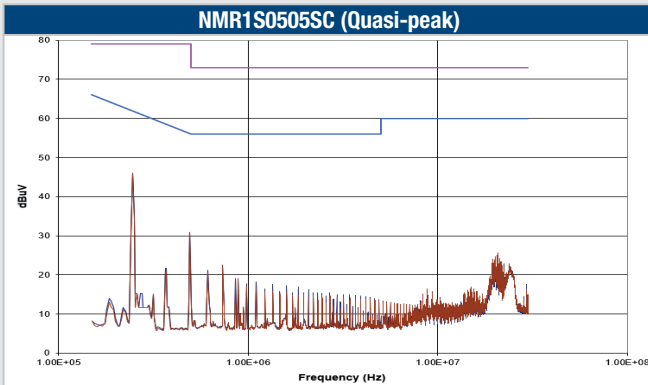
**FILTERING**

The following filter circuit and filter table shows the input filters typically required to meet EN 55022 Curve B, Quasi-Peak EMC limit, as shown in the following plots. The following plots show positive and negative quasi peak and CISPR22 Average Limit B (pink line) and Quasi Peak Limit B (green line) adherence limits.



**C** Ceramic capacitor

Part Number	Inductor		Capacitor	
	L, $\mu$ H	SMD	C, $\mu$ F	SMD
<b>NMR1S0505SC</b>	10	23100C	2.2	GRM188C71E225KE11D

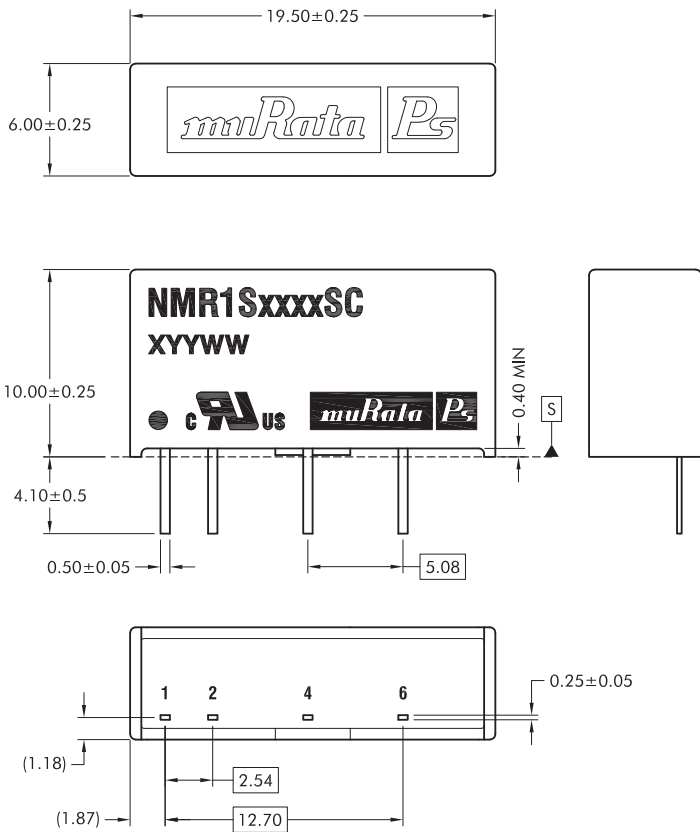




**PACKAGE SPECIFICATIONS**

**MECHANICAL DIMENSIONS**

7 Pin SIP Package



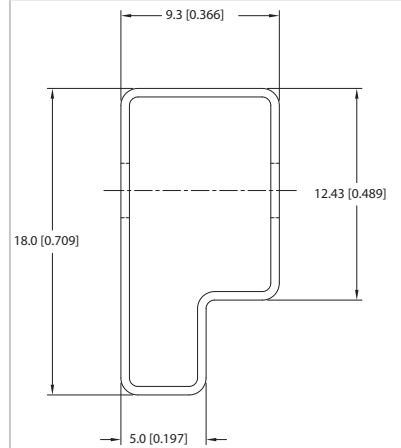
All dimensions in mm. Controlling dimension is mm.  
All pins on a 2.54 pitch and within ±0.1 of true position from pin 1 at seating plane 'S'

Weight: 1.90g

**PIN CONNECTIONS - 7 PIN SIP**

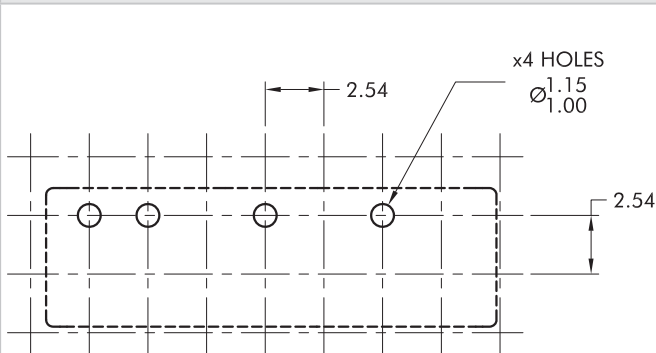
Pin	Function
1	+VIN
2	-VIN
4	-VOUT
6	+VOUT

**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: 25

**RECOMMENDED FOOTPRINT DETAILS**



All dimensions in mm. Controlling dimension is mm.

**DISCLAIMER**

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.

Particularly for safety-critical and/or life-critical applications, i.e. applications that may directly endanger or cause the loss of life, inflict bodily harm and/or loss or severe damage to equipment/property, and severely harm the environment, a prior explicit written approval from Murata is strictly required. Any use of Murata standard products for any safety-critical, life-critical or any related applications without any prior explicit written approval from Murata shall be deemed unauthorised use.

These applications include but are not limited to:

- Aircraft equipment
- Aerospace equipment
- Undersea equipment
- Power plant control equipment
- Medical equipment
- Transportation equipment ( automobiles, trains, ships, etc.)
- Traffic signal equipment
- Disaster prevention / crime prevention equipment
- Data Processing equipment

Murata makes no express or implied warranty, representation, or guarantee of suitability, fitness for any particular use/purpose and/or compatibility with any application or device of the buyer, nor does Murata assume any liability whatsoever arising out of unauthorised use of any Murata product for the application of the buyer. The suitability, fitness for any particular use/purpose and/or compatibility of Murata product with any application or device of the buyer remain to be the responsibility and liability of the buyer.

Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards that anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm, and take appropriate remedial actions. Buyer will fully indemnify and hold Murata, its affiliated companies, and its representatives harmless against any damages arising out of unauthorised use of any Murata products in any safety-critical and/or life-critical applications.

Remark: Murata in this section refers to Murata Manufacturing Company and its affiliated companies worldwide including, but not limited to, Murata Power Solutions.



This product is subject to the following [operating requirements](https://www.murata.com/en-eu/products/power/requirements) and the [Life and Safety Critical Application Sales Policy](https://www.murata.com/en-eu/products/power/requirements):

Refer to: <https://www.murata.com/en-eu/products/power/requirements>

Murata Power Solutions (Milton Keynes) Ltd. 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.

© 2023 Murata Power Solutions (Milton Keynes) Ltd.