Murata Power Solutions

MER1 Series

1kVDC Isolated 1W Single Output DC/DC Converters

FEATURES

- UL 60950 recognized
- RoHS compliant
- Typical efficiency to 89%
- Wide temperature performance at full load, –40°C to 85°C
- UL 94V-0 package material
- No heatsink required
- Industry standard pinout
- 1kVDC isolation 'Hi Pot Test'
- 5V, 12V, 15V, 24V, & 48V inputs
- 5V, 9V, 12V, & 15V output
- Fully encapsulated with toroidal magnetics
- No external components required
- No electrolytic or tantalum capacitors

PRODUCT OVERVIEW

The MER1 series is the new high performance version of our 1W NMR series. The MER1 series is more efficient and offers improved regulation performance for applications where a wide output voltage variation can not be tolerated. They are ideally suited for providing local supplies on control system boards with the added benefit of 1kVDC galvanic isolation to reduce switching noise.

SELECTION GUIDE

Order Code	Nominal Input Voltage	Output Voltage	Output Current	Input Current at Rated Load	Load Regulation (Typ)	Load Regulation (Max)	Ripple & Noise (Typ)[1]	Ripple & Noise (Max)[1]	Efficiency (Min.)	Efficiency (Typ.)	Isolation Capacitance	MTTF[2]
	V	V	mA	mA	%		mVp-p		%	%	pF	kHrs
MER1S0505SC	5	5	200	233	5.5	6.5	15	25	82	84	50	7684
MER1S0509SC	5	9	111	226	4.2	5	11	20	84	87	55	7698
MER1S0512SC	5	12	84	227	4.6	5.2	9	17	85	87	53	7175
MER1S0515SC	5	15	67	225	4.4	5	9	17	86	87.5	54	6496
MER1S1205SC	12	5	200	97	4.5	5	11	20	82	84	49	7569
MER1S1209SC	12	9	111	95	3	3.4	9	17	84	86.5	66	7317
MER1S1212SC	12	12	84	93	3	3.4	9	17	86	88.5	91	6647
MER1S1215SC	12	15	67	94	2.4	2.7	7	17	85	88	78	6279
MER1S1505SC	15	5	200	79	3.8	4.5	10	20	81	83.5	43	7167
MER1S1509SC	15	9	111	77	2.4	2.8	8	17	83	86.5	68	6906
MER1S1512SC	15	12	84	76	2.3	2.7	7	15	84	87.5	75	6523
MER1S1515SC	15	15	67	75	2.4	2.8	7	15	86	89	107	5916
MER1S2405SC	24	5	200	50	3.1	3.7	15	25	81	84	52	7391
MER1S2409SC	24	9	111	48	2.1	2.5	10	20	83	86.5	75	6490
MER1S2412SC	24	12	84	48	1.8	2.4	9	20	84	87.5	91	6772
MER1S2415SC	24	15	67	48	1.7	2.3	9	20	84	87.5	101	5957
MER1S4805SC	48	5	200	26	3.4	3.9	19	30	77	79.5	47	7354
MER1S4809SC	48	9	111	25	2.4	2.8	14	25	80	83	76	7120
MER1S4812SC	48	12	84	25	2.0	2.4	12	25	79	82.5	88	7088
MER1S4815SC	48	15	67	25	1.9	2.4	11	25	80	83	103	7238

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, 15V input types	13.5	15	16.5	
	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		7	15	mA p-p
	12V input types		4	12	
	15V input types		4	12	
	24V input types		8	20	
	48V input types		25	40	

ABSOLUTE MAXIMUM RATINGS

Lead temperature 1mm from case for 10 seconds	260°C
Input voltage V_{IN}, 5Vin types	7V
Input voltage V_{IN}, 12Vin types	15V
Input voltage V_{IN}, 15Vin types	18V
Input voltage V_{IN}, 24Vin types	28V
Input voltage V_{IN}, 48Vin types	54V

1. See Ripple & Noise characterisation method.
2. Calculated using MIL-HDBK-217F FN2 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.

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

OUTPUT CHARACTERISTICS

Parameter	Conditions	Min.	Typ.	Max.	Units
Rated Power	T_A=-40°C to 85°C			1	W
Voltage Set Point Accuracy	See tolerance envelope				
Line regulation	High V_{IN} to low V_{IN}		1.05	1.1	%/%

ISOLATION CHARACTERISTICS

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

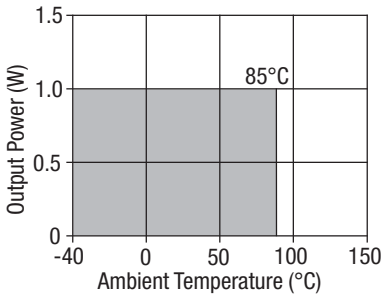
GENERAL CHARACTERISTICS

Parameter	Conditions	Min.	Typ.	Max.	Units
Switching frequency	5V & 48V input types		62		kHz
	12V & 15V input types		75		
	24V input types		82		

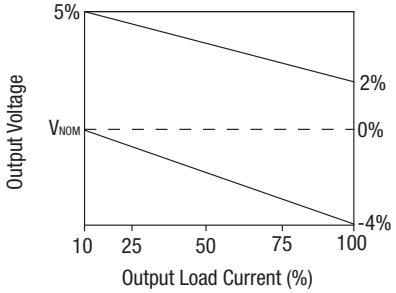
TEMPERATURE CHARACTERISTICS

Parameter	Conditions	Min.	Typ.	Max.	Units
Specification	All output types	-40		85	°C
Storage		-50		125	
Case Temperature rise above ambient	5V, 12V, & 15V input types			15	
	24V & 48V input types			20	
Cooling	Free air convection				

TEMPERATURE DERATING GRAPH



OUTPUT VOLTAGE 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.

RoHS COMPLIANT INFORMATION

RoHS COMPLIANT

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. They 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%.

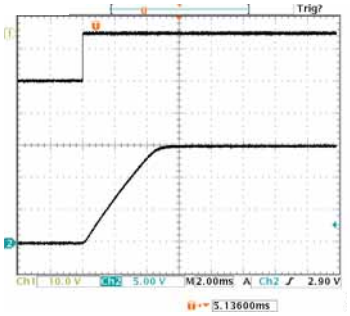
Capacitive loading and start up

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
MER1S0505SC	600
MER1S0509SC	1730
MER1S0512SC	3780
MER1S0515SC	6700
MER1S1205SC	750
MER1S1209SC	2605
MER1S1212SC	3754
MER1S1215SC	5280
MER1S1505SC	704
MER1S1509SC	1859

	Start-up time
	µs
MER1S1512SC	3375
MER1S1515SC	5090
MER1S2405SC	431
MER1S2409SC	245
MER1S2412SC	1634
MER1S2415SC	2682
MER1S4805SC	512
MER1S4809SC	1432
MER1S4812SC	2528
MER1S4815SC	3884

Typical Start-Up Wave Form

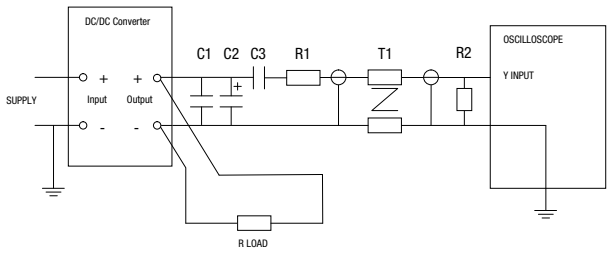


Ripple & Noise Characterisation Method

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



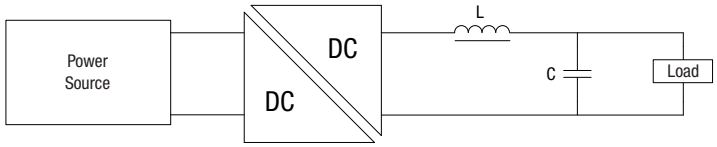
APPLICATION NOTES (continued)

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, µH	SMD	Through Hole	C, µF
MER1S0505SC	10	82103C	11R103C	4.7
MER1S0509SC	22	82223C	11R223C	2.2
MER1S0512SC	47	82473C	11R473C	1
MER1S0515SC	47	82473C	11R473C	1
MER1S1205SC	10	82103C	11R103C	4.7
MER1S1209SC	22	82223C	11R223C	2.2
MER1S1212SC	47	82473C	11R473C	1
MER1S1215SC	47	82473C	11R473C	1
MER1S1505SC	10	82103C	11R103C	4.7
MER1S1509SC	22	82223C	11R223C	2.2
MER1S1512SC	47	82473C	11R473C	1
MER1S1515SC	47	82473C	11R473C	1
MER1S2405SC	10	82103C	11R103C	4.7
MER1S2409SC	22	82223C	11R223C	2.2
MER1S2412SC	47	82473C	11R473C	1
MER1S2415SC	47	82473C	11R473C	1
MER1S4805SC	10	82103C	11R103C	4.7
MER1S4809SC	22	82223C	11R223C	2.2
MER1S4812SC	47	82473C	11R473C	1
MER1S4815SC	47	82473C	11R473C	1

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 MER1 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 MER1 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. The MER1 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.

SAFETY APPROVAL

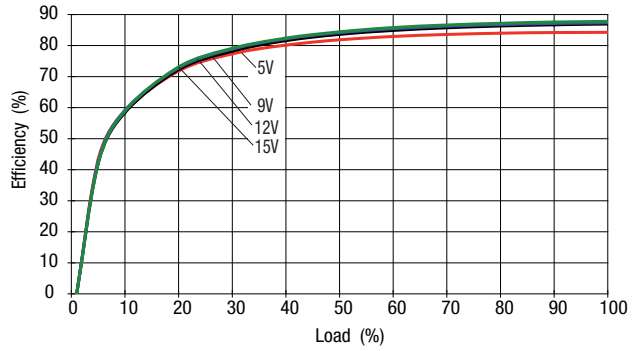
The MER1 series has been recognized by Underwriters Laboratory (UL) to UL 60950 for functional insulation in a maximum ambient temperature of 85°C and/or case temperature limit of 130°C (case temperature measured on the face opposite the pins). File number E151252 applies.

The MER1 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.
MER1S05xxSC: 1A
MER1S12xxSC: 0.375A
MER1S15xxSC: 0.375A
MER1S24xxSC: 0.2A
MER1S48xxSC: 0.1A

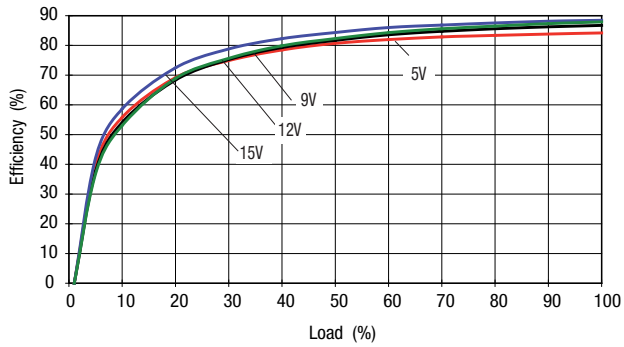
All fuses should be UL approved and rated to at least the maximum allowable DC input voltage.

EFFICIENCY VS LOAD

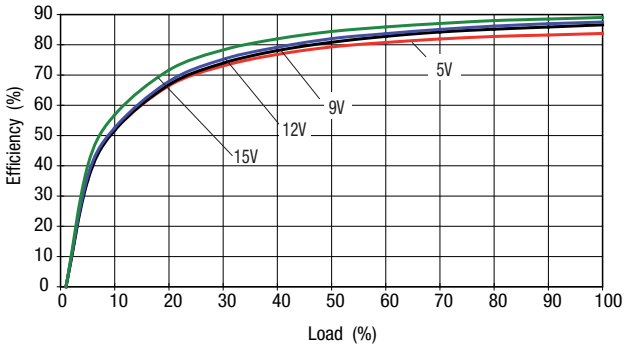
MER1S05XXSC



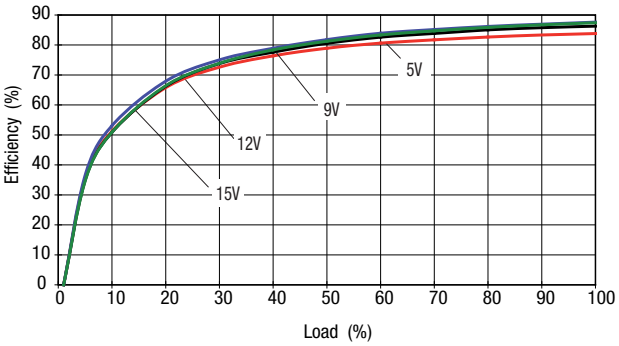
MER1S12XXSC



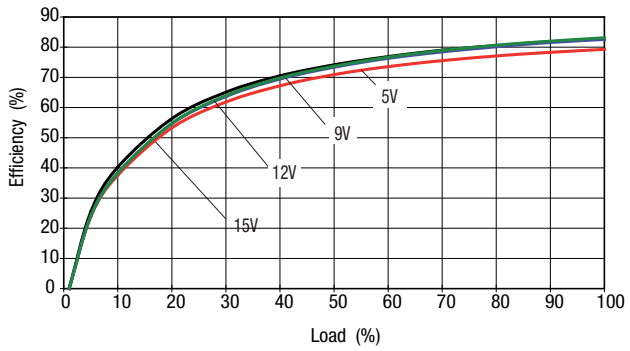
MER1S15XXSC



MER1S24XXSC



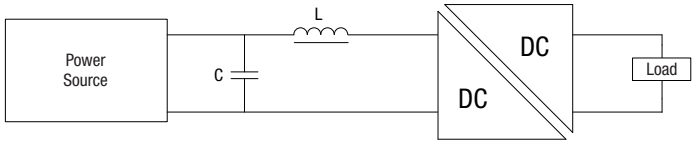
MER1S48XXSC



EMC FILTERING AND SPECTRA

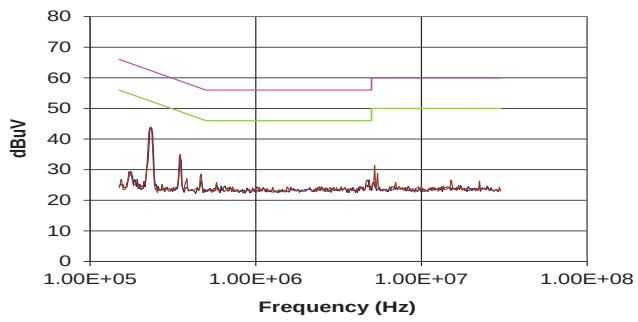
FILTERING

An input capacitor and inductor is 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 (green line) and Quasi Peak Limit B (pink line) adherence limits.

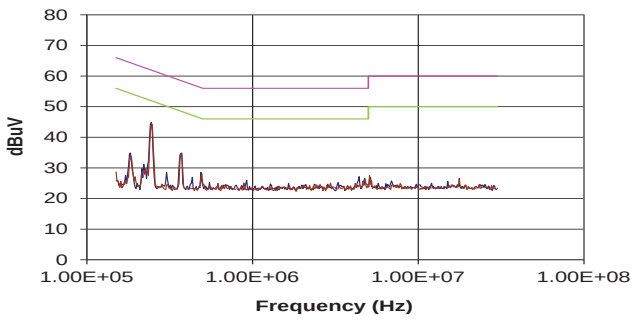


	Inductor			Capacitor
	L, µH	SMD	Through Hole	C, µF
MER1S0505SC	10	82103C	11R103C	2.2
MER1S0509SC	10	82103C	11R103C	2.2
MER1S0512SC	10	82103C	11R103C	1
MER1S0515SC	10	82103C	11R103C	2.2
MER1S1205SC	10	82103C	11R103C	2.2
MER1S1209SC	10	82103C	11R103C	2.2
MER1S1212SC	10	82103C	11R103C	0.68
MER1S1215SC	10	82103C	11R103C	2.2
MER1S1505SC	10	82103C	11R103C	2.2
MER1S1509SC	10	82103C	11R103C	1
MER1S1512SC	10	82103C	11R103C	1
MER1S1515SC	10	82103C	11R103C	1
MER1S2405SC	10	82103C	11R103C	2.2
MER1S2409SC	10	82103C	11R103C	2.2
MER1S2412SC	10	82103C	11R103C	2.2
MER1S2415SC	10	82103C	11R103C	2.2
MER1S4805SC	10	82103C	11R103C	4.7
MER1S4809SC	10	82103C	11R103C	4.7
MER1S4812SC	10	82103C	11R103C	4.7
MER1S4815SC	10	82103C	11R103C	4.7

MER1S0505SC

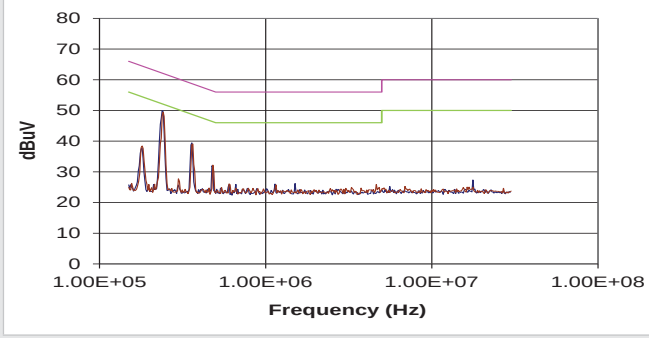


MER1S0509SC

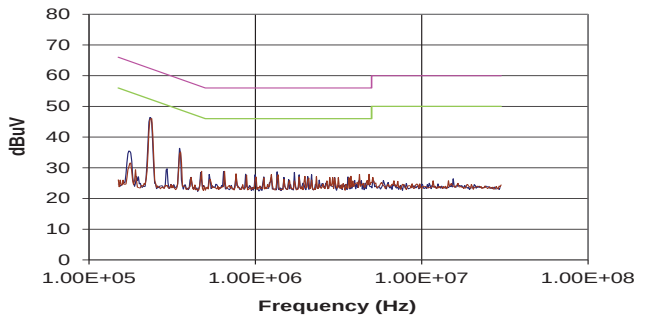


EMC FILTERING AND SPECTRA

MER1S0512SC



MER1S0515SC



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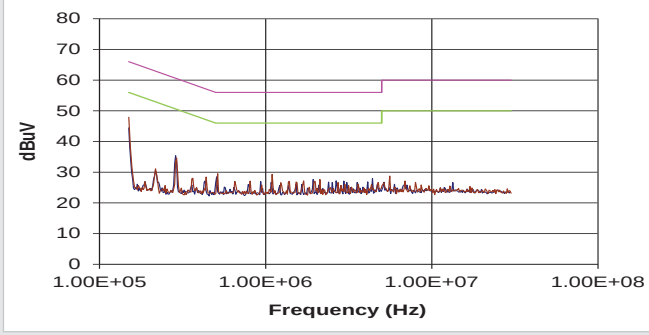

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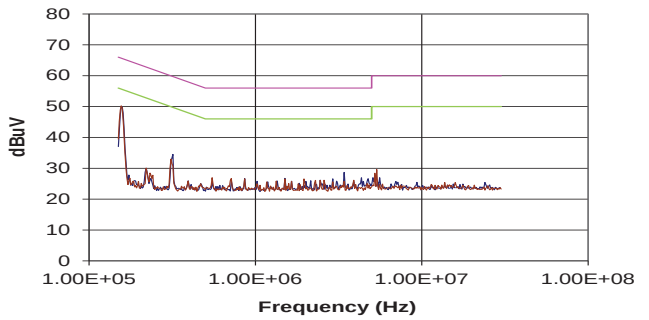

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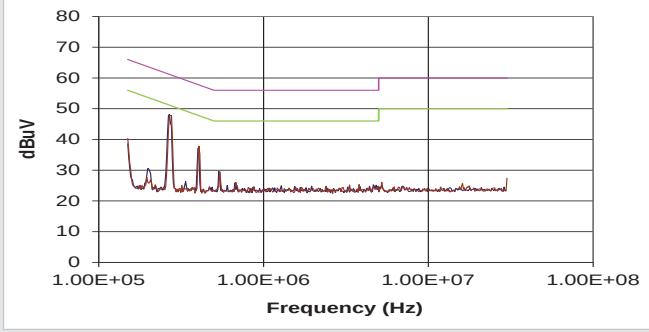
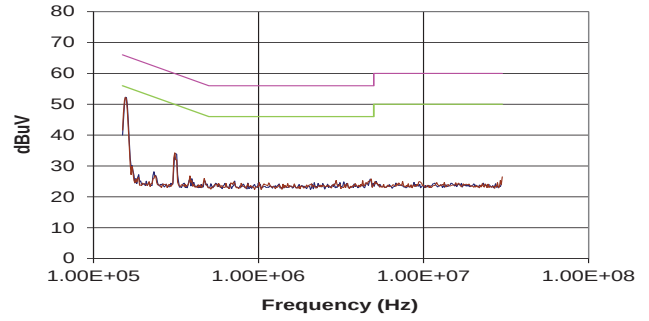
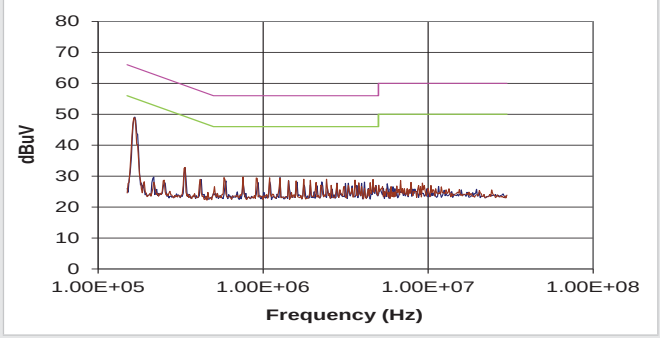


MER1S1215SC



EMC FILTERING AND SPECTRA

MER1S1505SC



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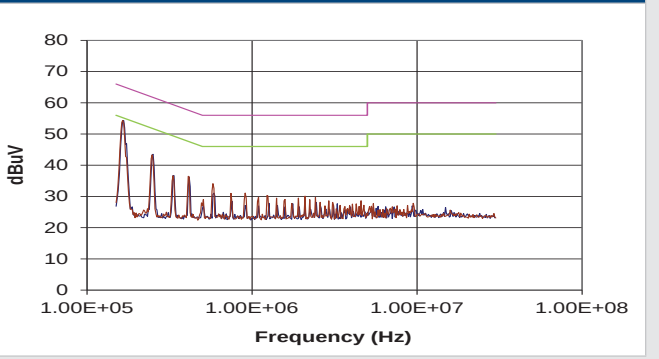
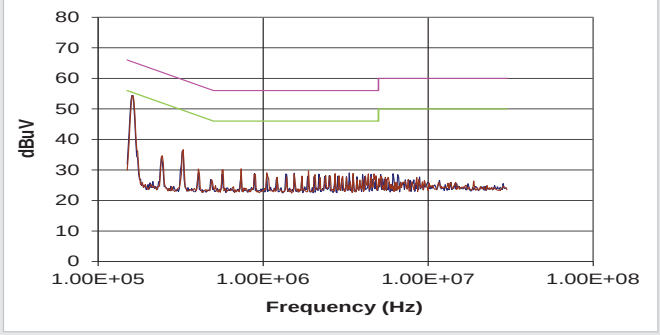
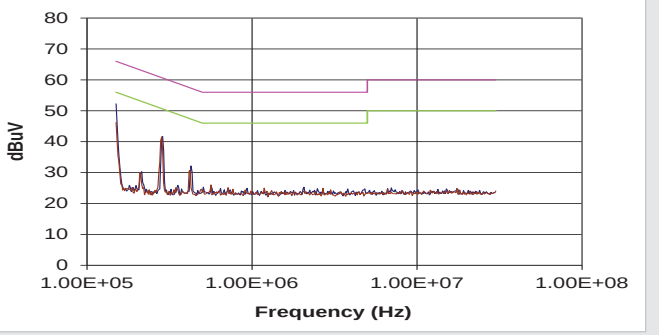


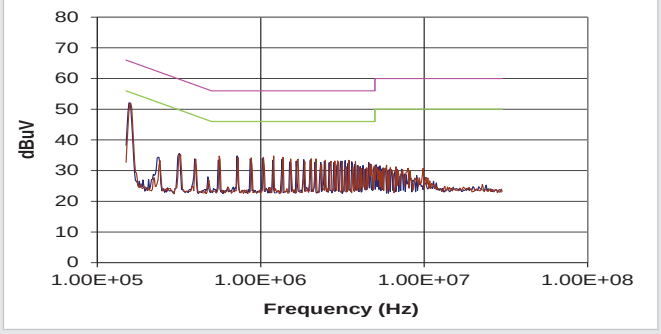
MER1S1512SC



MER1S1515SC



MER1S2405SC



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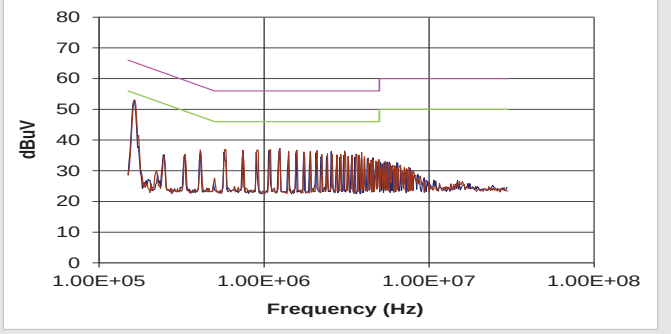
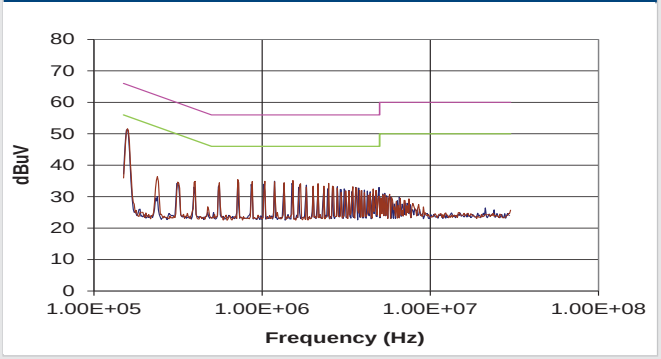
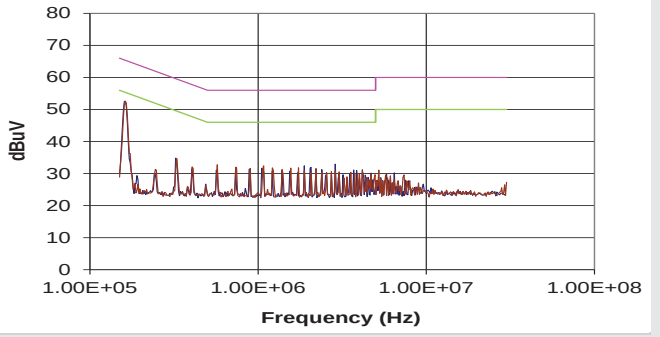


EMC FILTERING AND SPECTRA (continued)

MER1S2412SC



MER1S2415SC



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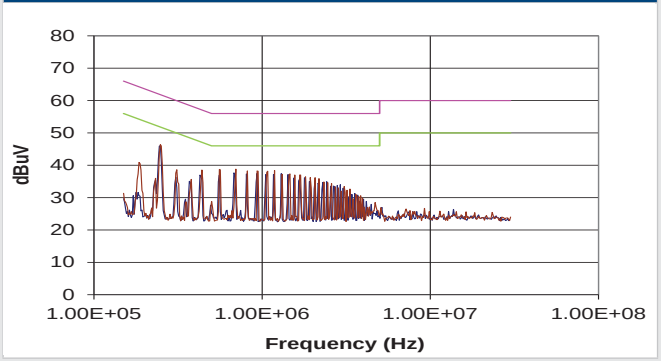

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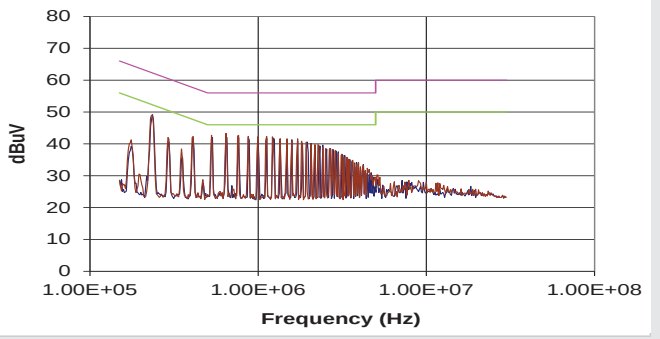

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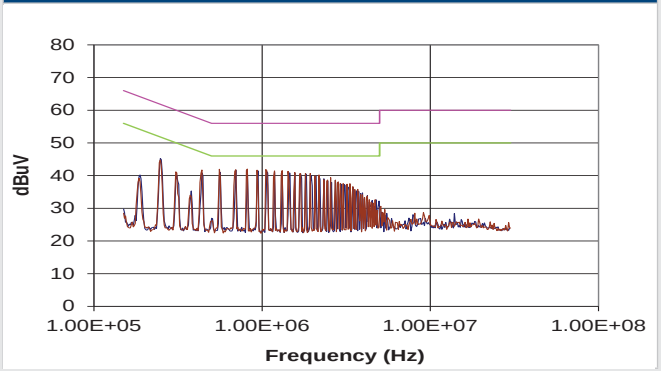

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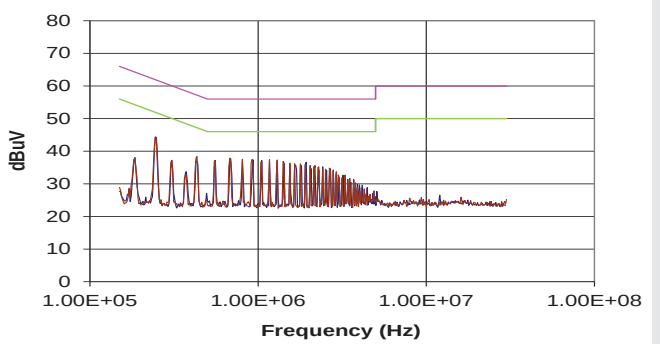
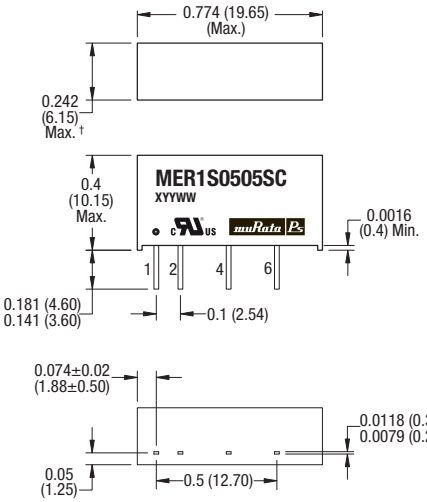


PACKAGE SPECIFICATIONS

MECHANICAL DIMENSIONS



Unless otherwise stated, 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.

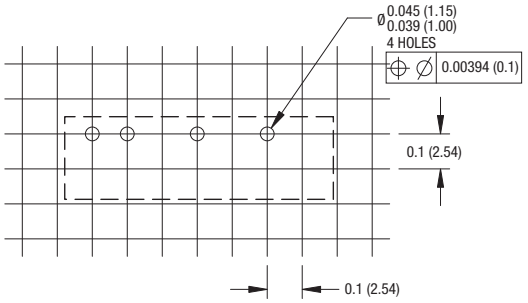
† 48V input variants: 0.301 (7.65).

Weight: 48Vin types: 2.75g (Typ.), all other types: 2.25g (Typ.)

PIN CONNECTIONS

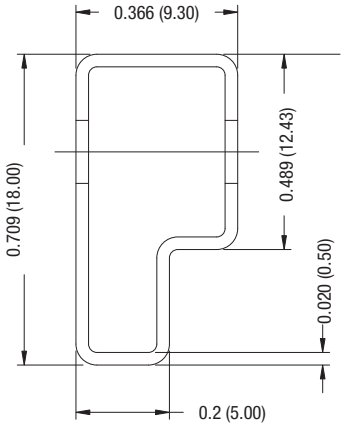
Pin	Function
1	$+V_{IN}$
2	$-V_{IN}$
4	$-V_{OUT}$
6	$+V_{OUT}$

RECOMMENDED FOOTPRINT DETAILS



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

TUBE OUTLINE DIMENSIONS



Tube Quantity : 25

Unless otherwise stated all dimensions in inches (mm) ±0.5mm.
Tube length : 20.47 (520mm ±2mm).

Murata Power Solutions, Inc.
11 Cabot Boulevard, Mansfield, MA 02048-1151 U.S.A.
ISO 9001 and 14001 REGISTERED

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