MGJ2 Series

5.2kVDC Isolated 2W Gate Drive DC-DC Converters

FEATURES

- Optimised bipolar output voltages for IGBT/ Mosfet gate drives
- Reinforced insulation to UL60950 recognised
- ANSI/AAMI ES60601-1, 1 MOPP/2 MOOP's recognised[3]
- 5.2kVDC isolation test voltage 'Hi Pot Test'
- Ultra low coupling capacitance
- SIP package style
- 5V, 12V, 15V & 24V inputs
- +15V/-3V, +15V/-5V, +15V/-8.7V, +15V/-15V, +17V/-9V, +18V/-2.5V, +20V/-3.5V & +20V/-5V outputs
- Operation to 100°C
- Characterised CMTI >200kV/µS
- Continuous barrier withstand voltage 2.4kVDC
- Characterised partial discharge performance

PRODUCT OVERVIEW

The MGJ2 series of DC-DC converters is ideal for powering 'high side' and 'low side' gate drive circuits for IGBTs and Mosfets in bridge circuits. A choice of asymmetric output voltages allows optimum drive levels for best system efficiency and EMI. The MGJ2 series is characterised for high isolation and dv/dt requirements commonly seen in bridge circuits used in motor drives and inverters, while the MGJ2 industrial grade temperature rating and construction gives long service life and reliability.

SELECTION GUIDE

Order Code	Nominal Input Voltage	Output Voltage 1	Output Voltage 2	Output Current 1	Output Current 2	Input Current at Rated Load	Load Regulation (Typ)	Load Regulation (Max)	Ripple & Noise (Typ)[2]	Ripple & Noise (Max)[2]	Efficiency (Min)	Efficiency (Typ)	Isolation Capacitance	MTTF[1]	
														MIL.	Tel.
	V	V	V	mA			%		mVp-p		%		pF	kHrs	
MGJ2D051505SC	5	15	-5	80	40	360	5.7	7	30	50	71	76	3	2095	
MGJ2D051509SC	5	15	-8.7	80	40	390	6	7	30	50	73	77.5	3	1902	
MGJ2D051515SC	5	15	-15	67	67	492	7	8.5	20	35	74	78	3	2629	
MGJ2D051802SC	5	18	-2.5	80	80	410	9	12	20	50	70	75	3	1376	31920
MGJ2D052003SC	5	20	-3.5	80	80	470	8	11	20	50	72	77	3	1253	32603
MGJ2D052005SC	5	20	-5	80	40	440	6.2	8	30	50	74	78.5	3	1655	
MGJ2D121503SC	12	15	-3	95	95	170	8	10	25	50	76	80	3	2014	80644
MGJ2D121505SC	12	15	-5	80	40	150	4.7	6	30	50	76	80	3	2339	
MGJ2D121509SC	12	15	-8.7	80	40	155	5.3	7.5	30	50	76	80	3	2296	
MGJ2D121515SC	12	15	-15	67	67	203	6.0	7	24	40	78	82	3	2707	
MGJ2D121802SC	12	18	-2.5	80	80	170	8	11	20	50	74	80	3	1553	36519
MGJ2D122003SC	12	20	-3.5	80	80	190	7	10	20	50	77	82	3	1371	36431
MGJ2D122005SC	12	20	-5	80	40	195	5.5	8	30	45	78	82	3	1799	
MGJ2D151505SC	15	15	-5	80	40	120	5	7	30	50	75	80	3	2374	
MGJ2D151509SC	15	15	-8.7	80	40	130	5	7	30	50	76	80	3	2736	
MGJ2D151515SC	15	15	-15	67	67	167	5.5	7	23	35	75	79	3	2100	
MGJ2D151802SC	15	18	-2.5	80	80	130	8	11	20	50	73	79	3	1392	32908
MGJ2D152003SC	15	20	-3.5	80	80	150	7	10	20	50	76	81	3	2000	80000
MGJ2D152005SC	15	20	-5	80	40	145	6	8	30	50	78	81	3	1864	
MGJ2D241503SC	24	15	-3	95	95	90	8	10	25	50	76	80	4	2535	70910
MGJ2D241505SC	24	15	-5	80	40	75	4.6	7	30	50	75	80.5	4	2194	
MGJ2D241509SC	24	15	-8.7	80	40	80	4.8	7	30	50	77	82	4	2275	
MGJ2D241709SC	24	17	-9	80	80	105	6	8	30	50	78	83	4	1050	47000
MGJ2D241802SC	24	18	-2.5	80	80	90	8	11	20	50	74	80	4	1461	32315
MGJ2D242003SC	24	20	-3.5	80	80	90	7	10	20	50	76	82	4	1333	32482
MGJ2D242005SC	24	20	-5	80	40	90	6	8	30	50	78	82	4	1725	

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	
Input reflected ripple	051505, 051509, 051515, 052003 & 052005 types		40		mA
	121503, 121505, 121509, 121515, 122003, 122005, 151505, 151509, 151515 & 152005 types		20		
	051802, 241505, 241509, 241709, 241802 & 242005 types		15		
	122003, 121802, 151802, 152003, 241503, 241802 & 242003 types		10		

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

1. Calculated using MIL-HDBK-217 FN2 and Telecordia SR-332 calculation model with nominal input voltage at full load.
2. See ripple & noise test method.
3. ANSI/AAMI ES60601-1 recognition is currently pending for the MGJ2D241709SC, MGJ2Dxx1515SC, MGJ2Dxx1802SC, MGJ2Dxx1503SC and MGJ2Dxx2003SC variants.

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	T_A=-40ºC to 100ºC			2	W
Voltage Set Point Accuracy	See tolerance envelopes				
Line regulation	High V_{IN} to low V_{IN}		1.0	1.2	%/%

ISOLATION CHARACTERISTICS

Parameter		Conditions		Min.	Typ.	Max.	Units
Isolation test voltage		Production tested for 1 second		5200			VDC
		Qualification tested for 1 minute		5200			
Resistance		Viso= 500VDC			1		GΩ
Continuous barrier withstand voltage		Non-safety barrier application				2400	VDC
Safety standard	UL60950-1	MGJ2Dxx1515SC types	Basic/supplementary			200	Vrms
		All others	Reinforced			150	
			Basic/supplementary			300	
	ANSI/AAMI ES60601-1	MGJ2Dxx1515SC types	1 MOOP			200	
		All others[1]	1 MOOP			300	
			2 MOOP/1 MOPP			200	

GENERAL CHARACTERISTICS

Parameter	Conditions	Min.	Typ.	Max.	Units
Switching frequency	All other types		45		kHz
	MGJ2Dxx1802SC & MGJ2D241503SC types		50		

TEMPERATURE CHARACTERISTICS

Parameter	Conditions	Min.	Typ.	Max.	Units
Specification	All output types (see safety approval section for limitations)	-40		100	°C
Storage		-55		125	
Case Temperature above ambient	5V input types		24		
	All other input types		20		
Cooling	Free air convection				

ABSOLUTE MAXIMUM RATINGS

Short-circuit protection	Continuous
Lead temperature 1mm from case for 10 seconds	260°C
Input voltage V_{IN}, MGJ2D05xxxxSC	5.5V
Input voltage V_{IN}, MGJ2D12xxxxSC	13.2V
Input voltage V_{IN}, MGJ2D15xxxxSC	16.5V
Input voltage V_{IN}, MGJ2D24xxxxSC	26.4V
Wave Solder	Wave Solder profile not to exceed the profile recommended in IEC 61760-1 Section 6.1.3. Please refer to application notes for further information.

1. ANSI/AAMI ES60601-1 recognition is currently pending for the MGJ2D241709SC, MGJ2Dxx1515SC, MGJ2Dxx1802SC, MGJ2Dxx1503SC and MGJ2Dxx2003SC variants.

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 MGJ2 series of DC-DC converters are all 100% production tested at 5.2kVDC for 1 second and have been qualification tested at 5.2kVDC for 1 minute.

The MGJ2 series is recognised by Underwriters Laboratory, please see safety approval section for more information. When the insulation in the MGJ2 series is not used as a safety barrier, i.e. provides functional isolation only, continuous or switched voltages across the barrier up to 2.4kV are sustainable. This is established by measuring the partial discharge Inception voltage in accordance with IEC 60270. Please contact Murata for further information.

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. 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

MGJ2Dxx1515SC

ANSI/AAMI ES60601-1

The MGJ2Dxx1515SC variants are pending recognition by Underwriters Laboratory (UL) to ANSI/AAMI ES60601-1 and provides 1 MOOP (Means Of Operator Protection) based upon a working voltage of 200 Vrms max and 280 Vpk max., between Primary and Secondary and between Primary and its Enclosure, 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 E202895 applies.

UL60950

The MGJ2Dxx1515SC variants have been recognised by Underwriters Laboratory (UL) to UL60950 for basic/supplementary insulation to a working voltage of 200Vrms 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.
Creepage and clearance 2mm
Working altitude 4000m

Fusing

The MGJ2 Series of converters are not internally fused so to meet the requirements of UL an anti-surge input line fuse should always be used with ratings as defined below.
MGJ2D051515SC: 2A
MGJ2D121515SC: 750mA
MGJ2D151515SC: 750mA
All fuses should be UL recognised and rated to 125V.

All other variants

ANSI/AAMI ES60601-1

The MGJ2 series has been recognised by Underwriters Laboratory (UL) to ANSI/AAMI ES60601-1 and provides 1 MOOP (Means Of Operator Protection) based on a working voltage of 300Vrms or 2 MOOP based upon a working voltage of 200 Vrms, and 1 MOPP (Mean Of Patient Protection) based on a working voltage of 200Vrms., between Primary and Secondary. The MGJ2D241709SC, MGJ2Dxx1802SC, MGJ2Dxx1503SC and MGJ2Dxx2003SC variants are currently pending recognition.

File number E202895 applies.

UL60950

The MGJ2 series is recognised by Underwriters Laboratory (UL) to UL60950 for reinforced insulation to a working voltage of 150Vrms and for basic/supplementary insulation to a working voltage of 300Vrms.

File number E151252 applies.

Over voltage category	OVC I	OVC II
Working voltage	150Vrms	300Vrms
Working altitude	2000m	2000m
Creepage & clearance	2mm	2mm

Fusing

The MGJ2 Series of converters are not internally fused so to meet the requirements of UL an anti-surge input line fuse should always be used with ratings as defined below.
MGJ2D05xxxxSC: 1.25A
MGJ2D12xxxxSC: 750mA
MGJ2D15xxxxSC: 750mA
MGJ2D24xxxxSC: 750mA
All fuses should be UL recognised and rated to 125V.

RoHS COMPLIANCE INFORMATION

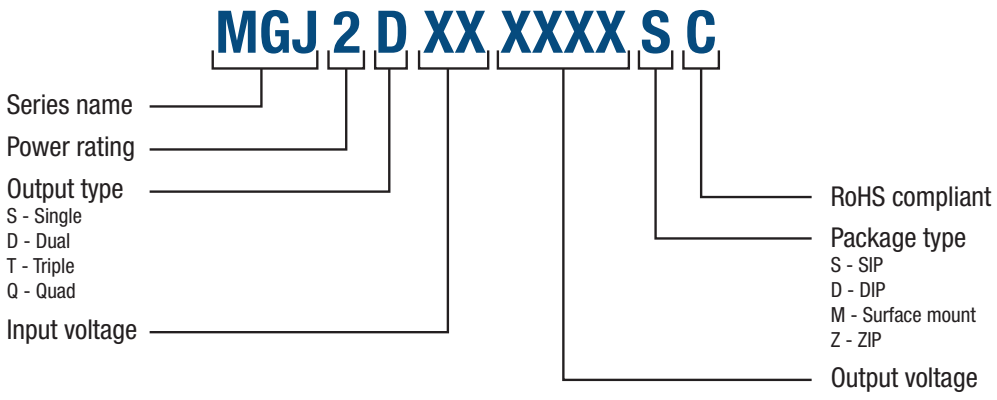
This series is compatible with RoHS soldering systems with a peak wave solder temperature of 260ºC for 10 seconds. Please refer to application notes for further information. The pin termination finish on this product series is Tin Plate, Hot Dipped over Matte Tin with Nickel Preplate. The series is backward compatible with Sn/Pb soldering systems. For further information, please visit www.murata-ps.com/rohs

ENVIRONMENTAL VALIDATION TESTING

The following tests have been conducted on this product series, as part of our design verification process. The datasheet characteristics specify user operating conditions for this series, please contact Murata if further information about the tests is required.

Test	Standard	Condition
Temperature cycling	MIL-STD-883 Method 1010, Condition B	10 cycles between two chambers set to achieve -55°C and +125°C.The dwell time shall not be less than 10min.
Humidity bias	JEDEC JESD22-A101	85°C ± 2°C, 85% ± 5% R.H. for >1000 hours.
High temperature storage life	JEDEC JESD22-A103, Condition A	125°C +10/-0°C for ≥1000 hours.
Vibration	MIL-STD-883 Method 2007, Condition A	1.5mm pk-pk / 20g pk min, 20-2000Hz, 4 sweeps in each of 3 mutually perpendicular axes at 3 oct/min.
Shock	MIL-STD-883 Method 2002, Condition A	500g 1.0ms half sine, 5 shocks in each direction of 3 mutually perpendicular axis.
ESD	JEDEC JESD22-A114	HBM Testing Standard at 3 stress levels; 2.0kV, 4.0kV and 8.0kV.
Bump	IEC Class 4M5 of ETS 300 019-2-4	Shock Spectrum Type II, 6mS duration, 250m/s² 500 bumps in 6 directions.
Solderability	IPC/ECA J-STD-002, Test A and A1	SnPb (Test A): For lead free solderability the parts are conditioned in a steam ager for 8 hours ±15 min. at a temperature of 93±3°C. Dipped in solder at 255°C ±5°C for 5 +0/-0.5 seconds. Pb-free (Test A1): For leaded solderability the parts are conditioned in a steam ager for 8 hours ±15 min. at a temperature of 93±3°C. Dipped in solder at 245°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 260 ±5°C for 10 seconds (96SC tin/ silver/copper).
Solder heat (hand)	MIL-STD-202 Method 210, 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.
Solvent cleaning	Resistance to cleaning agents.	Solvent – Novec 71IPA & Topklean EL-20A. Pulsed ultrasonic immersion 45°C- 65°C
Solvent Resistance	MIL-STD-883 Method 2015	Separate samples subjected to solvent A, solvent B and solvent D
Lead Integrity (Adhesion)	MIL-STD-883 Method 2025	Leads are bent through 90º until a fracture occurs.
Lead Integrity (Fatigue)	MIL-STD-883 Method 2004, condition B_2	The leads are bent to an angle of 15º. Each lead is subjected to 3 cycles.
Lead Integrity (Tension/Pull)	MIL-STD-883 Method 2004, Condition A_1	Pull of 0.227kg applied for 30 seconds. The force is then increased until the pins snap.

PART NUMBER STRUCTURE



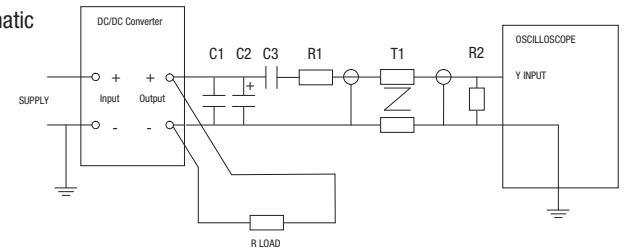
CHARACTERISATION TEST METHODS

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 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

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 1.25 times the specified output voltage if the output load falls to less than 5%.

Gate Drive Applications Advisory Note

For general guidance for product usage in gate drive applications please refer to "gate drive application notes".

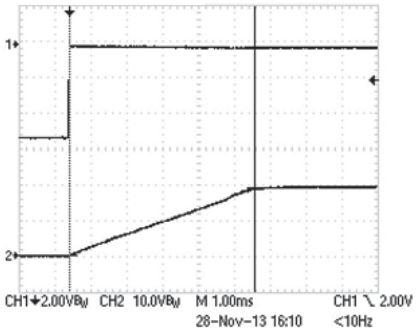
Capacitive loading and start up

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 capacitance ranging from 47µF up to 220µF with increased start times.

	Start-up time ms
MGJ2D051505SC	3
MGJ2D051509SC	4.5
MGJ2D051515SC	21
MGJ2D051802SC	4
MGJ2D052003SC	5
MGJ2D052005SC	5
MGJ2D121503SC	3
MGJ2D121505SC	3
MGJ2D121509SC	4
MGJ2D121515SC	14.5
MGJ2D121802SC	5
MGJ2D122003SC	5
MGJ2D122005SC	5.5

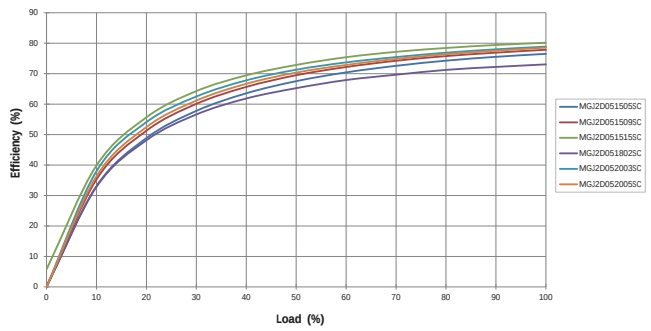
	Start-up time ms
MGJ2D151505SC	2.5
MGJ2D151509SC	3
MGJ2D151515SC	10.5
MGJ2D151802SC	3
MGJ2D152003SC	5
MGJ2D152005SC	4.5
MGJ2D241503SC	3
MGJ2D241505SC	3
MGJ2D241509SC	3
MGJ2D241709SC	4
MGJ2D241802SC	3
MGJ2D242003SC	4
MGJ2D242005SC	4

Typical Start-Up Wave Form

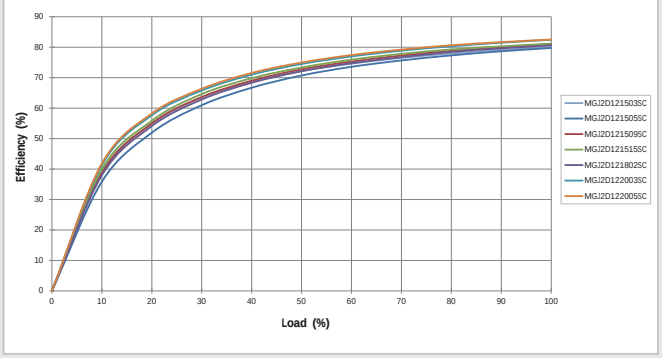


EFFICIENCY VS LOAD

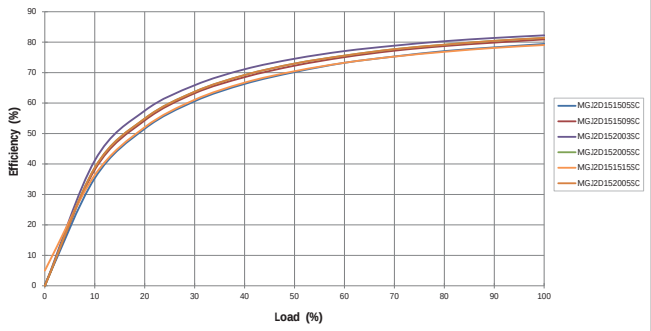
5V INPUT



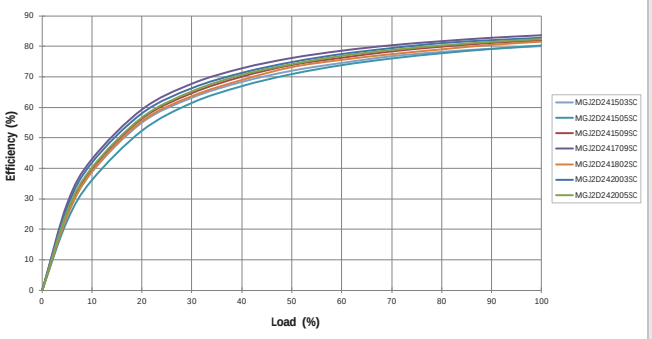
12V INPUT



15V INPUT

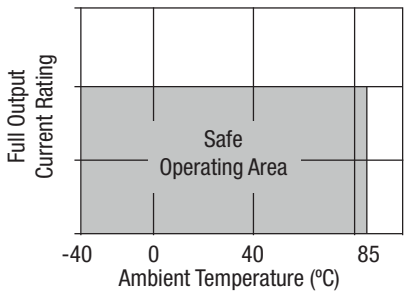


24V INPUT

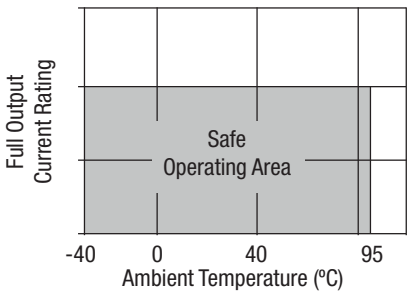


TEMPERATURE DERATING GRAPHS

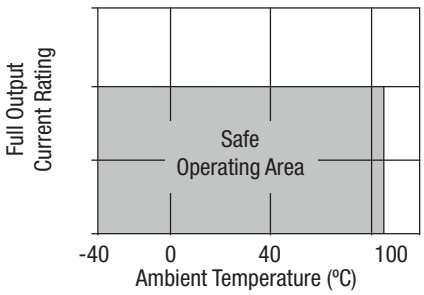
051515, 051802, 052003, 121503, 121515 & 151515



051505, 052005, 121802, 122003, 151802, 152003, 241802 & 242003



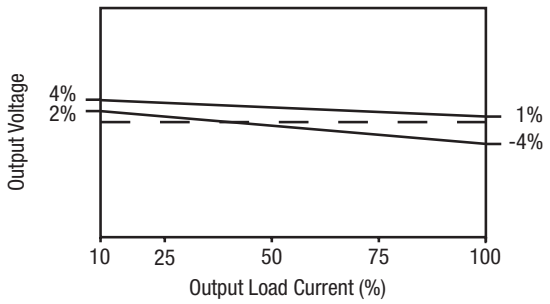
All other variants



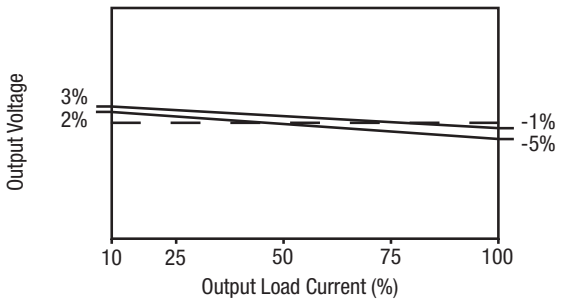
POSITIVE OUTPUT VOLTAGE TOLERANCE ENVELOPES

The voltage tolerance envelopes show typical load regulation characteristics for this product series. The tolerance envelope is the maximum output voltage variation due to changes in output loading and set point accuracy.

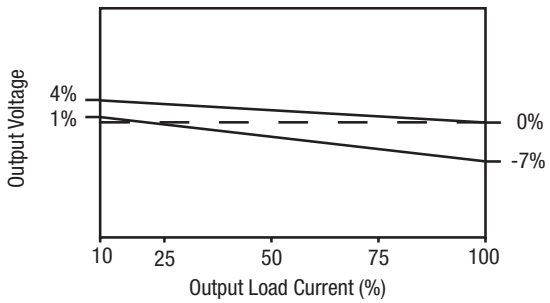
051505, 051509, 151505 & 151509



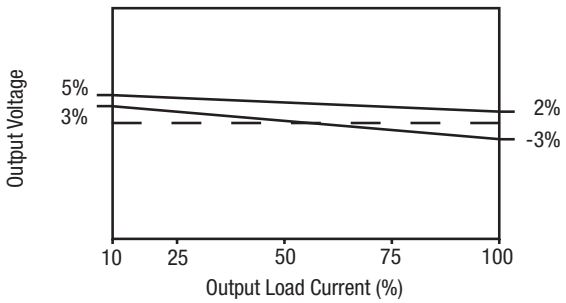
122005, 152005& 242005



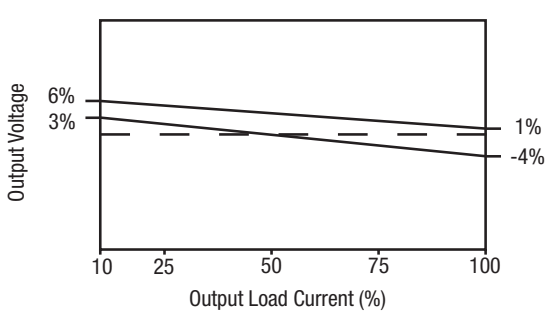
121509, 241509 & 052005



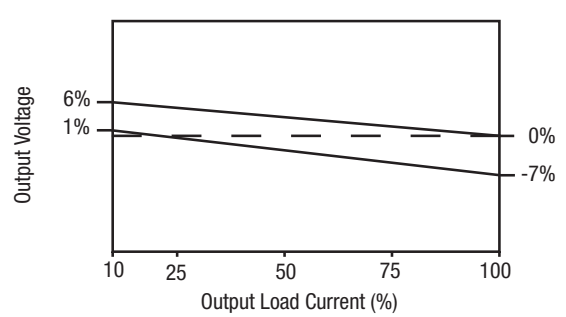
121505 & 241505



121515 & 151515

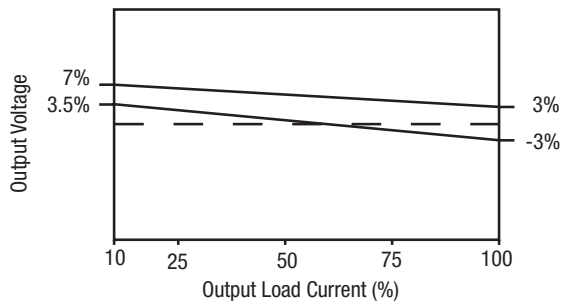


051515

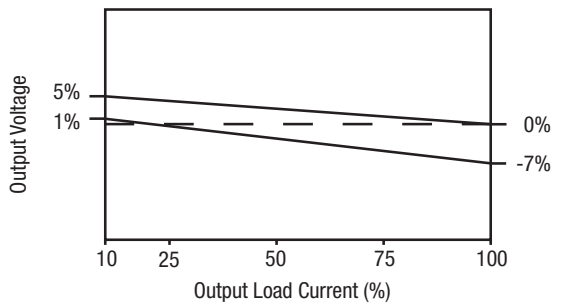


POSITIVE OUTPUT VOLTAGE TOLERANCE ENVELOPES (Continued)

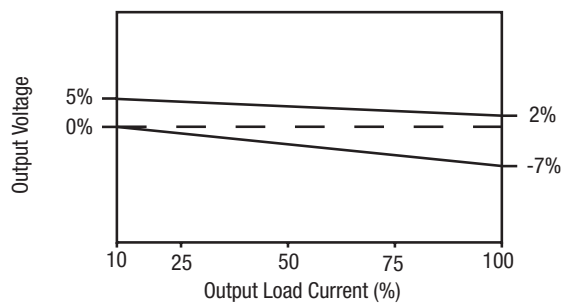
241709



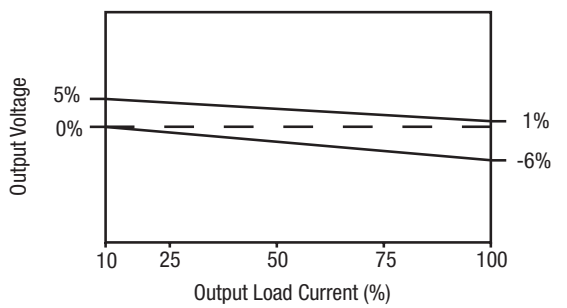
052003



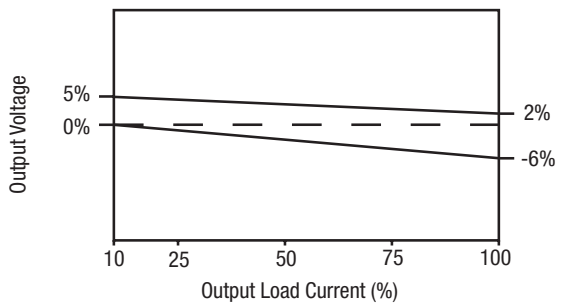
122003, 152003 & 242003



051802



121802, 151802 & 241802



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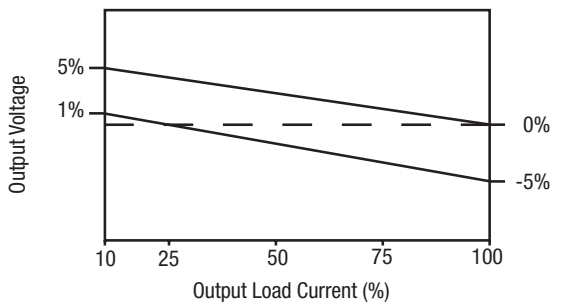

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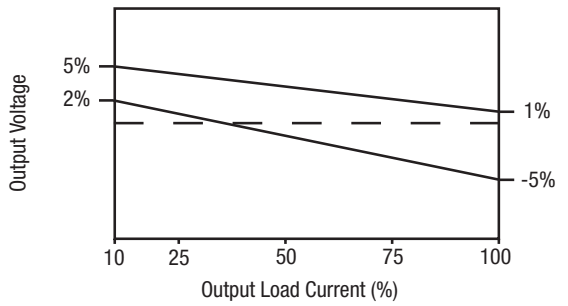
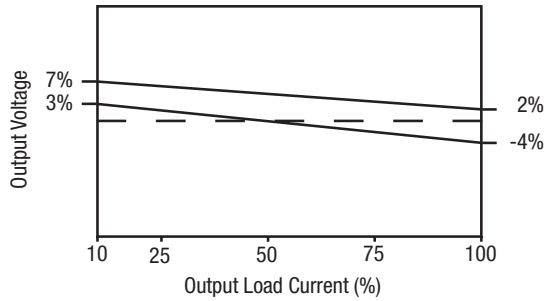


NEGATIVE OUTPUT VOLTAGE TOLERANCE ENVELOPES

051509, 052005, 121505, 122005, 152005 & 242005



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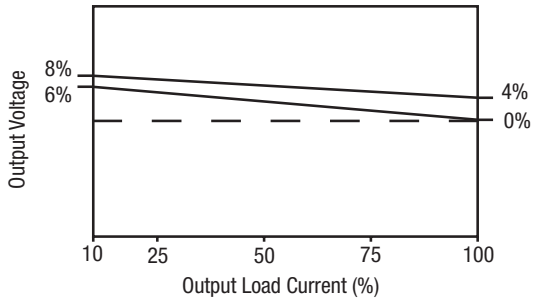
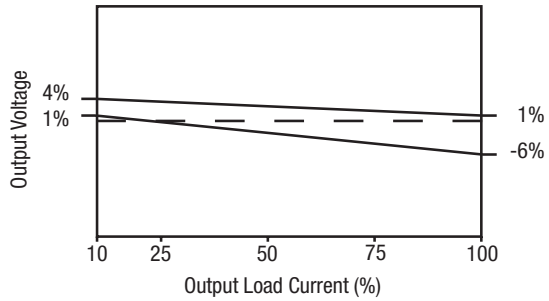


121509 & 241509



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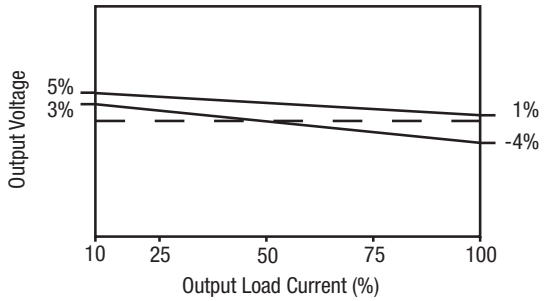
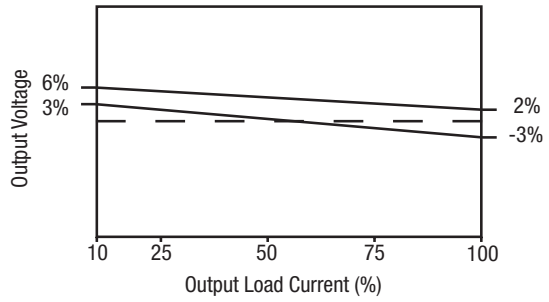
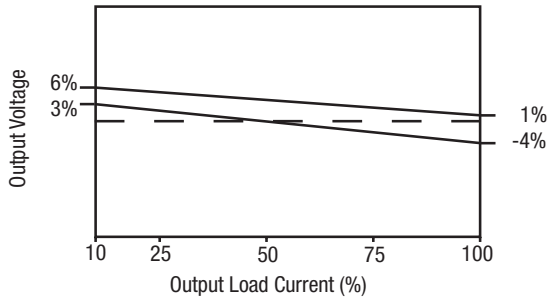


151509 & 241505

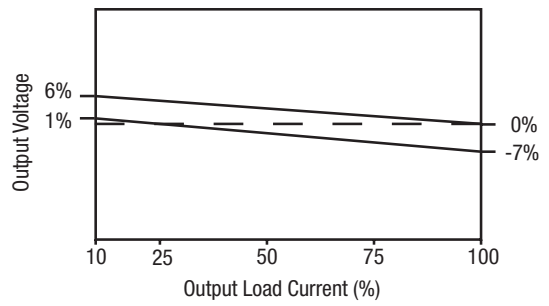


121515 & 151515



NEGATIVE OUTPUT VOLTAGE TOLERANCE ENVELOPES (Continued)

051515



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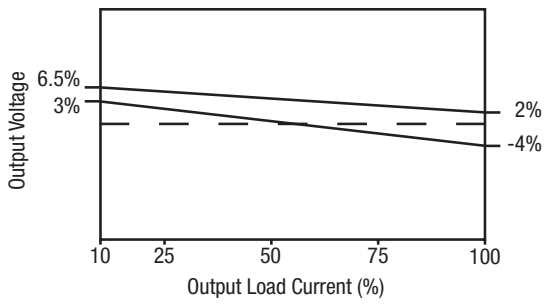

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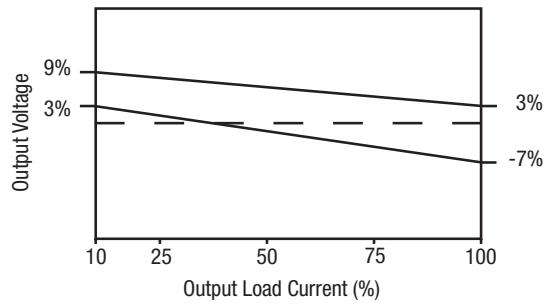
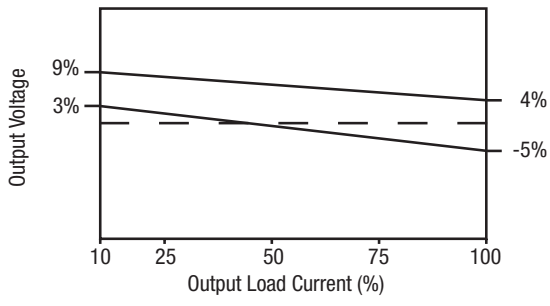


122003, 152003 & 242003



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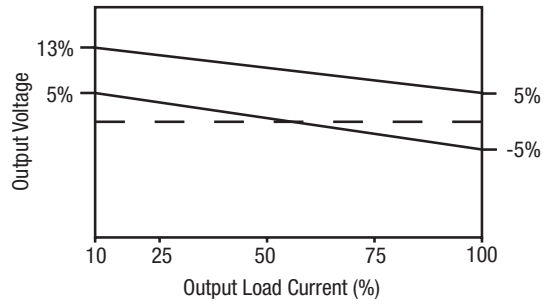
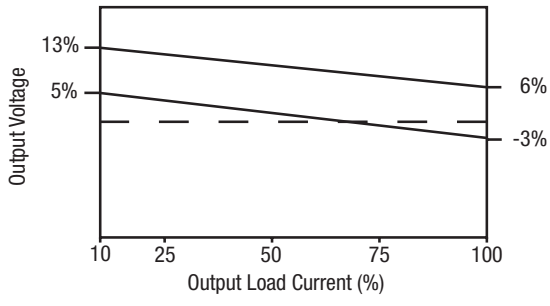


121802, 151802 & 241802



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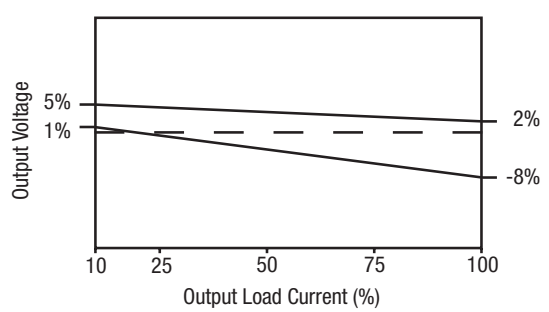

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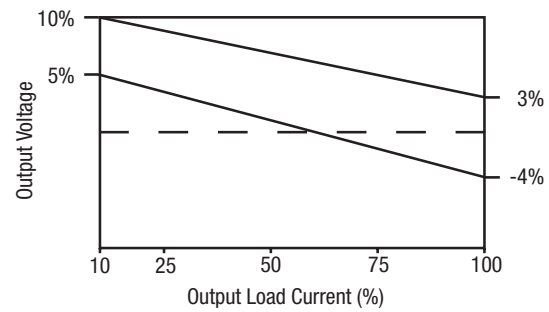
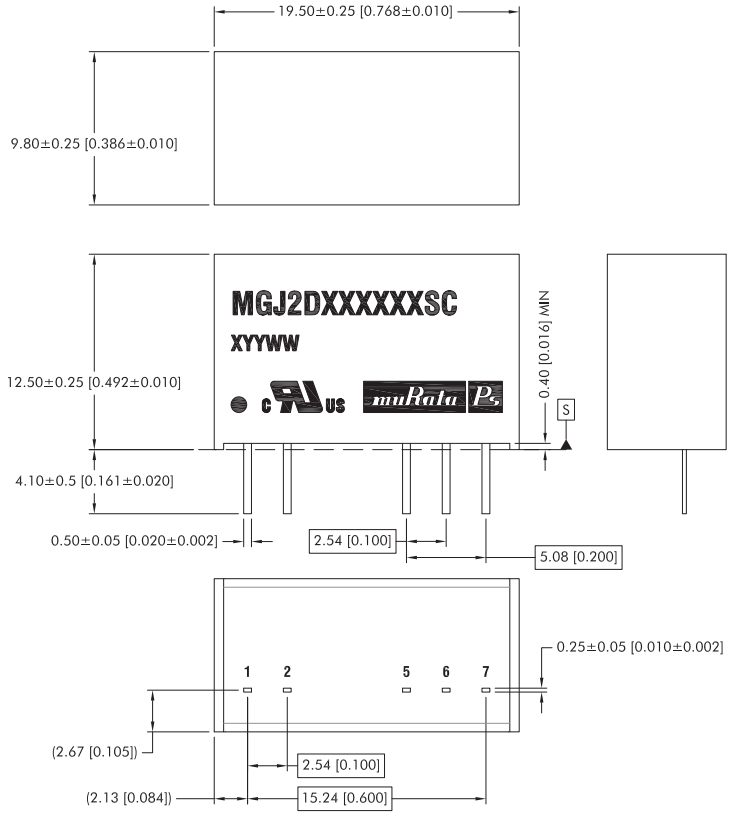


PACKAGE SPECIFICATIONS

MECHANICAL DIMENSIONS



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

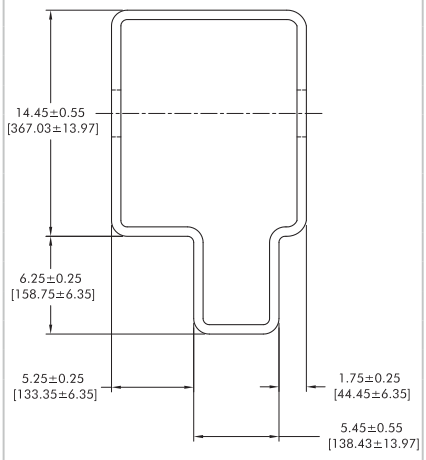
Weight: 4.3g

PIN CONNECTIONS

Pin Output

Pin	Function
1	$+V_{IN}$
2	$-V_{IN}$
5	$-V_{OUT}$
6	0V
7	$+V_{OUT}$

Tube outline dimensions

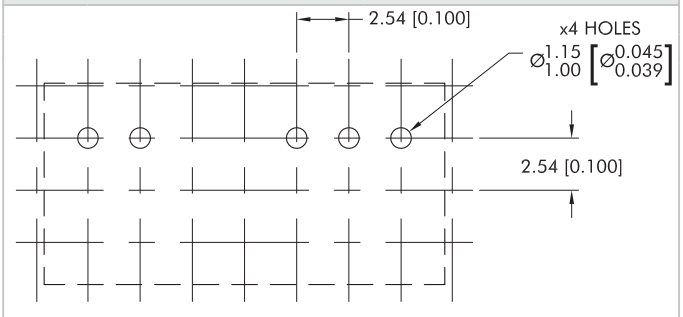


Unless otherwise stated all dimensions in mm (inches).

Tube length : 525mm [20.669] ±2.0 [0.079]

Tube Quantity : 25

RECOMMENDED FOOTPRINT DETAILS



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