

### FEATURES

- No opto feedback
- Patents protected
- Optimised bipolar output voltages for Rohm & Wolfspeed SiC gate drives
- Reinforced insulation to UL60950 recognition pending
- ANSI/AAMI ES60601-1 recognition pending
- Characterised CMTI >100kV/μS
- Characterised partial discharge performance
- 5.7kVDC isolation test voltage 'Hi Pot Test'
- Ultra low isolation capacitance 13pF
- Continuous barrier withstand voltage 3kVDC
- 12V input voltage
- 105°C operating temperature

### PRODUCT OVERVIEW

Offering dual output voltages of +18V/-2.5V for Rohm devices & +15V/-4V for Wolfspeed devices, the MGJ6D series DC-DC converter is ideal for powering 'high side' and 'low side' gate drive circuits for Silicon Carbide Mosfets in bridge circuits. A choice of asymmetric output voltages allows optimum drive levels for best system efficiency and EMI. The MGJ6D series is characterised for high isolation and dv/dt requirements commonly seen in bridge circuits used in motor drives and inverters. A disable/frequency synchronisation pin simplifies EMC filter design. The MGJ6D series protection features include short circuit protection and overload protection.

### SELECTION GUIDE

Order Code <sup>1</sup>	Input Voltage Range	Output 1			Output 2		
		Rated Output Voltage	Rated Output Current	Output Power	Rated Output Voltage	Rated Output Current	Output Power
		V	mA	W	V	mA	W
MGJ6D1215040MC	9 - 18	+15	316	4.74	-4	316	1.26
MGJ6D1218025MC	9 - 18	+18	293	5.27	-2.5	293	0.73

### SELECTION GUIDE (Continued)

Order Code <sup>1</sup>	Input Voltage Range	Output 1				Output 2			
		Load Regulation (Typ) <sup>4</sup>	Load Regulation (Max) <sup>4</sup>	Ripple & Noise (Typ) <sup>3</sup>	Ripple & Noise (Max) <sup>3</sup>	Load Regulation (Typ) <sup>4</sup>	Load Regulation (Max) <sup>4</sup>	Ripple & Noise (Typ) <sup>3</sup>	Ripple & Noise (Max) <sup>3</sup>
		%	%	mVp-p	mVp-p	%	%	mVp-p	mVp-p
MGJ6D1215040MC	9 - 18	3.7	5	100	200	0.08	0.1	80	100
MGJ6D1218025MC	9 - 18	3.7	5	100	200	0.08	0.1	80	100

### SELECTION GUIDE (Continued)

Order Code	Nominal Input Voltage	Input Current at Rated Load	Efficiency (Min)	Efficiency (Typ)	Isolation Capacitance	MTTF <sup>2</sup>	
						MIL 217	Telecordia
						kHrs	kHrs
MGJ6D1215040MC	12	630	77	80	13	420	1257
MGJ6D1218025MC	12	630	77	80	13	420	1257

### INPUT CHARACTERISTICS

Parameter	Conditions	Min.	Typ.	Max.	Units
Voltage range		9	12	18	V
Under voltage lock out	Turn on threshold		8.1		V
	Turn off threshold		7.5		
Input ripple current			50		mA p-p

1. Components are supplied in tape and reel packaging, please refer to package specification section. Orderable part numbers are MGJ6DXXXXXXMC-R7 (23 pieces per reel), or MGJ6DXXXXXXMC-R13 (92 pieces per reel).  
 2. Calculated using MIL-HDBK-217 FN2 and Telecordia SR-332 calculation model at TA=25°C with nominal input voltage at full load.  
 3. See ripple & noise test method.  
 4. Between 40% and 100% rated output current.  
 All specifications typical at TA=25°C, nominal input voltage and rated output current unless otherwise specified.



For full details go to <https://www.murata.com/en-global/products/power/rohs>



OUTPUT CHARACTERISTICS						
Parameter	Conditions		Min.	Typ.	Max.	Units
Minimum load	Below 10% load -	MGJ6D1215040MC is clamped to 23V from +V <sub>OUT</sub> to -V <sub>OUT</sub>	40			%
		MGJ6D1218025MC is clamped to 24.5V from +V <sub>OUT</sub> to -V <sub>OUT</sub>				
Voltage set point accuracy	Positive output			±4		%
	Negative output			±2		
Line regulation	Low line to high line	Output 1		0.3	1	%
		Output 2		0.03	0.1	
Transient response	Peak deviation (50-100% & 100-50% load swing)			0.4		%V <sub>OUT</sub>
	Settling time			0.1		ms

GENERAL CHARACTERISTICS						
Parameter	Conditions		Min.	Typ.	Max.	Units
Switching frequency				100		kHz

ISOLATION CHARACTERISTICS						
Parameter	Conditions		Min.	Typ.	Max.	Units
Isolation test voltage	Flash tested for 1 second		4000			VAC
	Qualification tested for 1 minute		5700			VDC
Resistance	Viso = 1kVDC		100			GΩ
Continuous barrier withstand voltage	Non-safety barrier application				3000	V
Safety standard	UL60950-1	Reinforced			250	Vrms
	ANSI/AAMI ES60601-1	1 MOPP/2 MOOP	Creepage and clearance 8mm		250	

TEMPERATURE CHARACTERISTICS						
Parameter	Conditions		Min.	Typ.	Max.	Units
Operation	See derating graphs		-40		105	°C
Storage			-50		125	
Product temperature rise above ambient	100% Load, Nom V <sub>IN</sub> , Still Air			30		

ABSOLUTE MAXIMUM RATINGS						
Short-circuit protection			Continuous			
Input voltage			20V			

**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 MGJ6D series DC-DC converter is 100% production tested at 4kVAC for 1 second and qualification tested at 5.7kVDC for 1 minute.

A question commonly asked is, "What is the continuous voltage that can be applied across the part in normal operation?"

When the insulation in the MGJ6D series is not used as a safety barrier, i.e. provides functional isolation only, continuous or switched voltages across the barrier up to 3kV are sustainable. Long term reliability testing at these voltages continues. Peak Inception voltages measured were in excess of 3.5kV when testing for partial discharge in accordance with IEC 60270. Please contact Murata for further information.

The MGJ6D series is pending recognition by Underwriters Laboratory to 250Vrms Reinforced Insulation, please see safety approval section below.

**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**

**ANSI/AAMI ES60601-1**

The MGJ6D series is pending recognition to ANSI/AAMI ES60601-1 and provides 1 MOPP (Means Of Patient Protection) and 2 MOOP (Means Of Operator Protection) based upon a working voltage of 250 Vrms max, between Primary and Secondary.

**UL60950**

The MGJ6D series is pending recognition by Underwriters Laboratory (UL) to UL60950 for reinforced insulation to a working voltage of 250Vrms with a maximum measured product operating temperature of 105°C.

Creepage and clearance 8mm.

**FUSING**

The MGJ6D series is 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.

Input Voltage, 12V 2A

All fuses should be UL recognised, 125V rated.

**RoHS COMPLIANCE, MSL, PSL AND REFLOW SOLDERING INFORMATION**



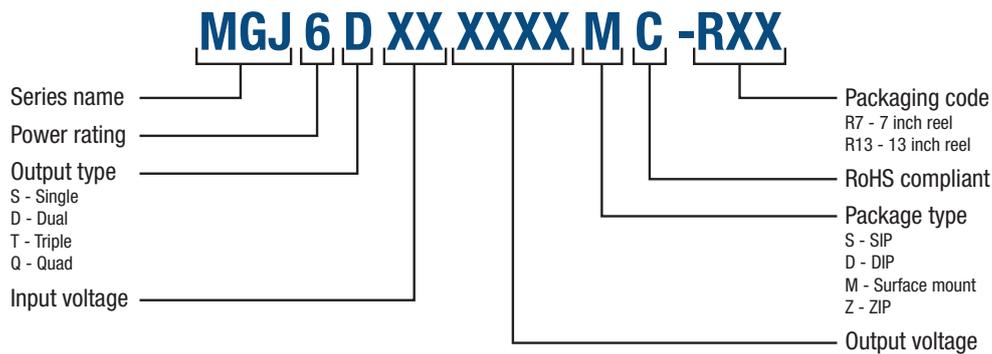
The MGJ6D series is compatible with RoHS soldering systems with a peak reflow solder temperature of 245°C and Time Above Liquidus for 90 seconds, as per J-STD-020. Please refer to [application notes](#) for further information. The pin termination finish on this product series is Gold with Nickel Pre-plate. The MGJ6D series is backward compatible with Sn/Pb soldering systems. The MGJ6D series has a Moisture Sensitivity Level (MSL) 2. Samples of the product were tested in accordance with the conditioning described for MSL level 2 in IPC/J-STD-020. The product passed electrical tests, coplanarity and visual inspection criteria.

**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	MIL-STD-883 Method 1010, Condition B	10 cycles. -55°C to +125°C. The dwell time shall not be less than 10min.
HAST (Unbiased)	JEDEC JESD22-A118	96Hrs +2/-0Hrs at 130°C ± 2°C, 85% ± 5% R.H
High Temperature Storage life	JEDEC JESD22-A103, Condition A	125°C +10/-0°C for ≥1000 hours
Vibration	BS EN 61373 with respect to BS EN 60068-2-64, Test Fh Category 1 Class B	5 – 150Hz. Level at each axis – Vertical, Traverse and Longitudinal: 5.72m/s <sup>2</sup> rms. 5 hours in each axis. Crest factor: 3 Sigma. Device is secured via the surface mount pins.
Shock	BS EN 61373, Category 1 Class B	Test is 30ms duration, 3 shocks in each sense of 3 mutually perpendicular axis (18 shocks total). Level at each axis as follows: Vertical, Traverse and Longitudinal: 50m/s <sup>2</sup> . Device is secured via the surface mount pins.
Solderability	EIA/IPC/JEDEC J-STD-002, Test S and S1	The parts are conditioned in a steam ager for 8 hours ±15 min. at a temperature of 93±3°C. SnPb (Test S): The parts are placed onto a stencil with Sn60Pb40 solder paste on and then placed into the reflow oven at 215 ±5°C for 50–70 seconds. Pb-free (Test S1): The parts are placed onto a stencil with Sn96.5Ag3.0Cu0.5 solder paste on and then placed into the reflow oven at 245 ±5°C for 30–60 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	The parts and the bristle portion of the brush are immersed in Isopropanol for a minimum of 1 minute. The parts are brushed 3 times, after the third time the parts are blown dry and inspected.

**PART NUMBER STRUCTURE**



**CHARACTERISATION TEST METHODS**

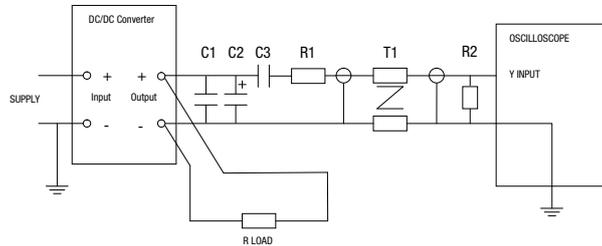
**Ripple & Noise Characterisation Method**

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**

**Disable/Frequency synchronisation**

Please refer to application notes for further information.

		Min	Typ	Max	Units
Disable/Sync <sup>1</sup>	Pull Down Current		0.5		mA
	Input High	2		60	V
	Input Low	-0.6		0.8	V
Synchronisation	Frequency Range	90	100	110	kHz
	Duty Cycle	25		75	%

The  $\overline{\text{Dis}}/\text{Sync}$  pin has three modes:

1. When a DC logic low voltage is applied to this pin the MGJ6D is disabled and enters a low quiescent current sleep mode.
2. When this pin is left floating or a DC logic high (CMOS/TTL compatible) voltage is applied the MGJ6D is enabled and operates at the programmed frequency of 100kHz.
3. When a square wave of between 90kHz and 110kHz is applied to this pin, the switcher operates at the same frequency as the square wave. The falling edge of the square wave corresponds to the start of the switching cycle. If the signal is slower than 25Hz, it will be interpreted as enabling and disabling the part. If the MGJ6D is disabled, it must be disabled for 7 clock cycles before being re-enabled.

Note: The  $\overline{\text{Dis}}/\text{Sync}$  pin is a high impedance TTL input and can be triggered by noise from external circuits if not treated carefully.

Please refer to "LAYOUT CONSIDERATIONS" and "SYNCHRONISATION CIRCUIT" for further details.

[Click here for general guidance for gate drive applications.](#)

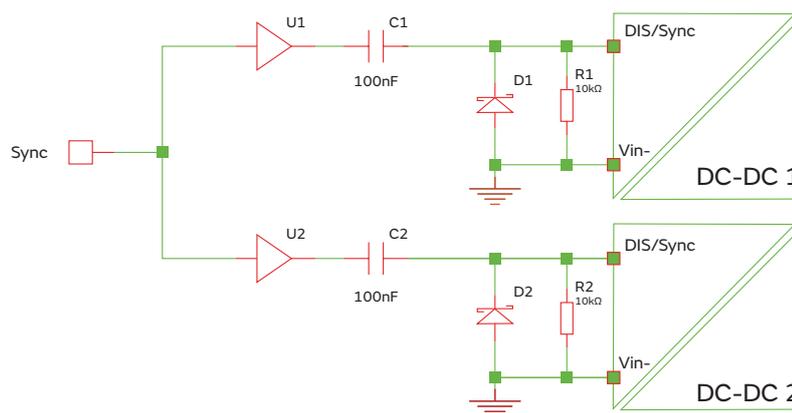
**LAYOUT CONSIDERATIONS**

Unlike standard isolated DC-DC products the MGJ6D series has been designed specifically for high side gate drive applications where the outputs are being driven to a high voltage at a very high dV/dT. This is possible due to minimum transformer isolation capacitance and considered circuit design regarding common mode transient immunity. It is important that these few simple pcb layout guidelines are implemented so as not to compromise the performance of the DC-DC and that of the overall system.

1. The keep clear area shown must not have any copper traces even on internal layers. This is not only to avoid compromising the creepage and clearance distance but also to minimise capacitive isolation between the noisy output circuits and input control circuits. In general it is good practice to maintain the same band of clearance area running directly through both the DC-DC and the gate drive isolators as shown so that input and output are kept separate and do not overlap or mesh together at any point.
2. A top layer ground plane copper area connected to  $-V_{in}$  can be used to create an effective screen to the underside of the MGJ6D series and can also be used as a guard ring for the gate drive isolator inputs. If the  $\overline{\text{Dis}}/\text{Sync}$  pin is being used then it is imperative that it follows a route covered by this screen to avoid differential pick up. It should also be kept as short as possible.

Please refer to "PACKAGE SPECIFICATIONS" for recommended layout.

**SYNCHRONISATION CIRCUIT**



1. A suggested synchronisation circuit is shown. C1 and C2 are 100nF capacitors. D1 and D2 are schottky diodes. The capacitive isolation and close connected diode ensures that a transition from high to low is seen at the input pin even in a noisy environment or when there is a slight ground shift between devices.
2. If the  $\overline{\text{Dis}}/\text{Sync}$  pin is not used for synchronisation, then a 22nF capacitor can be added between the  $\overline{\text{Dis}}/\text{Sync}$  pin and  $-V_{in}$  pin to improve noise immunity. If the functionality of  $\overline{\text{Dis}}/\text{Sync}$  is not required, the  $\overline{\text{Dis}}/\text{Sync}$  pin can be connected directly to the  $+V_{in}$  pin to improve noise immunity.
3. One very effective method to reduce common mode transient interference is to add a common mode filter to the DC input. It may only be necessary to add one before splitting the supply to each DC-DC.

**APPLICATION NOTES (Continued)**

Start-up times

Typical start up times for this series, inclusive of maximum rated caps:

Part No.	Start-up times
	ms
<b>MGJ6D1215040MC</b>	20
<b>MGJ6D1218025MC</b>	20

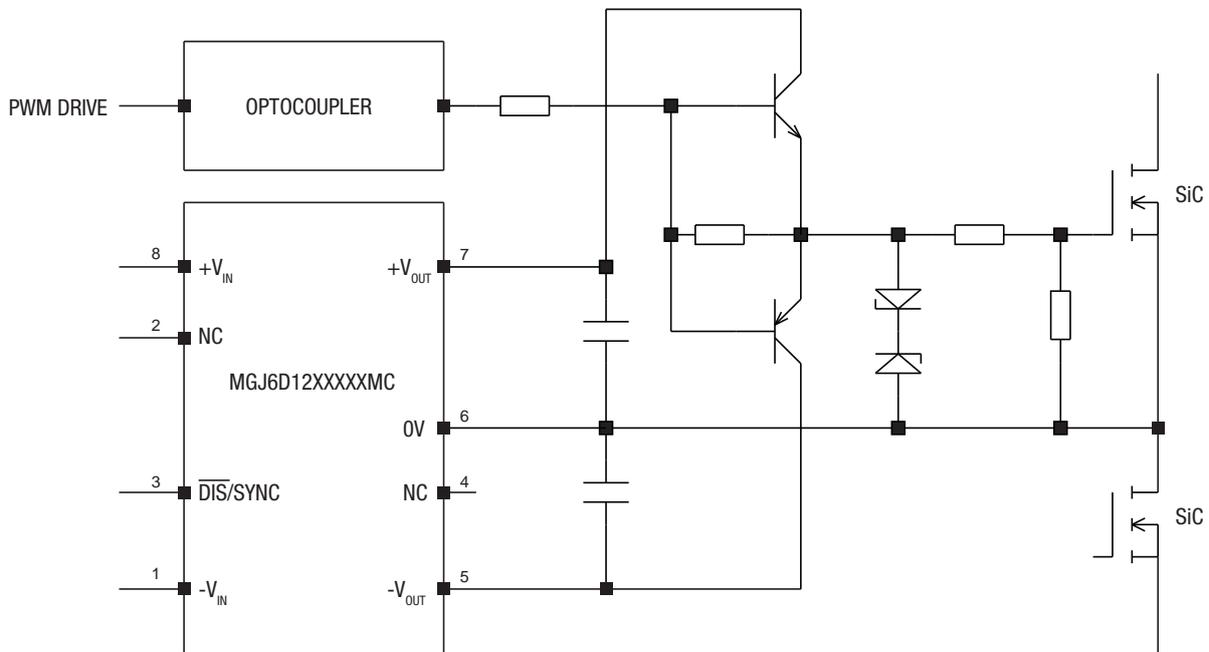
Output capacitance must not exceed:

Output Voltage	Maximum output capacitance
V	μF
+15	220
-4	1000
+18	150
-2.5	1000

**APPLICATION NOTES (Continued)**

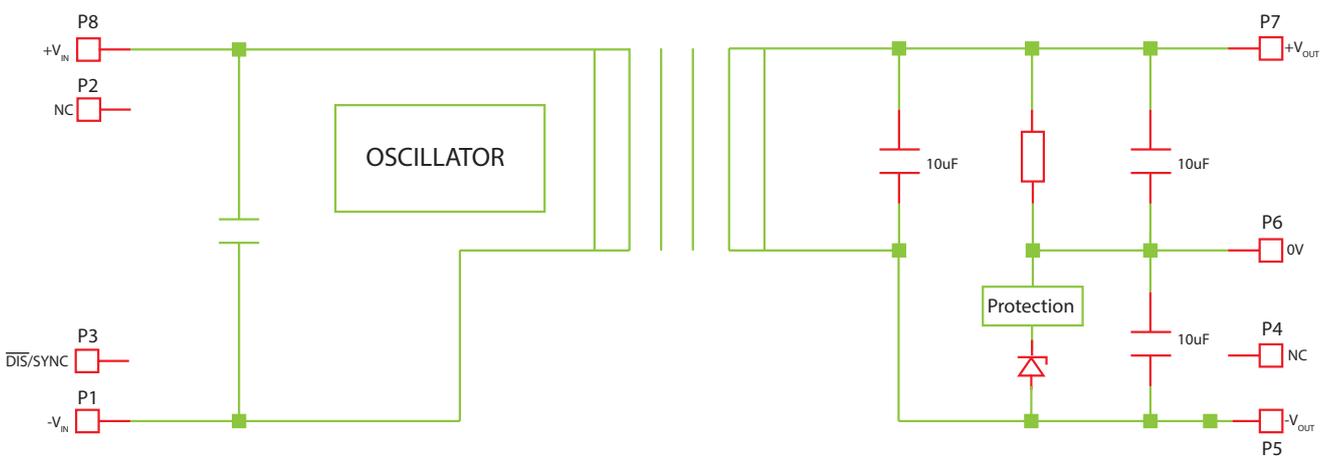
Schematic for driving SiC

MGJ6D12XXXXXMC DC-DC CONNECTIONS FOR DRIVING SiC DEVICES

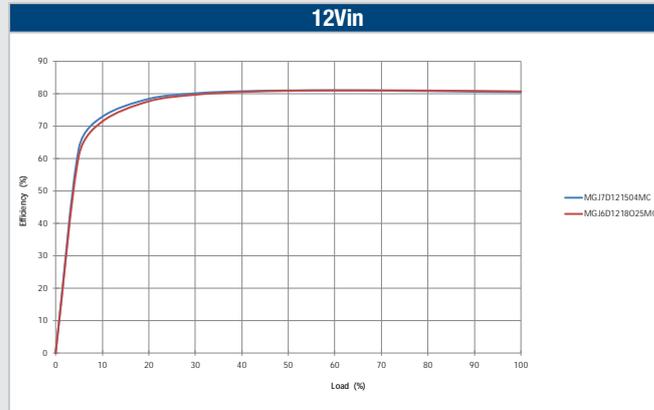


The MGJ6D series is a dual output DC-DC specifically designed for gate drive applications and its output configuration is not suitable for application usage as a general dual output DC-DC converter. However the MGJ6D series can be used as a general purpose single output converter, by loading from  $+V_{OUT}$  to  $-V_{OUT}$ .

The MGJ6D series provides a dual output by using a zener voltage divider network, the negative output is obtained by using a zener diode as a voltage regulator. If a short circuit occurs, the zener diode is protected. A 4V zener diode is used to set the  $-4V_{OUT}$ . A 2.5V zener is used to set the  $-2.5V_{OUT}$ . A tolerance of 2% should be taken into consideration for the zener diodes. The 4V & 2.5V zener diodes are rated at 330mW.

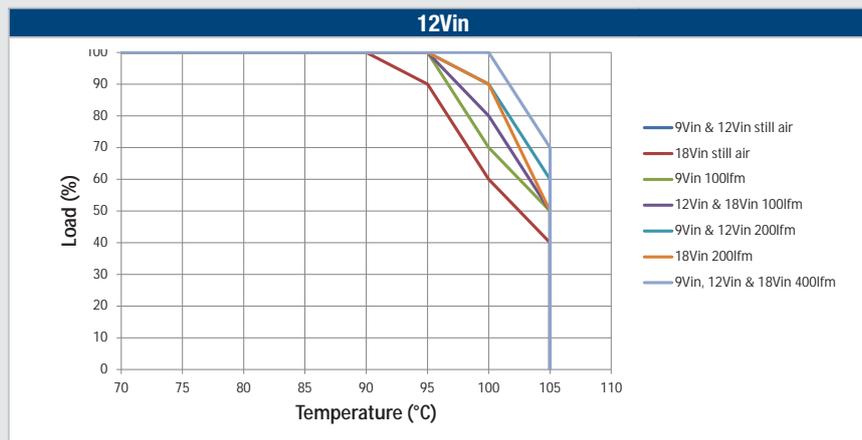


**EFFICIENCY VS LOAD**



**TEMPERATURE DERATING**

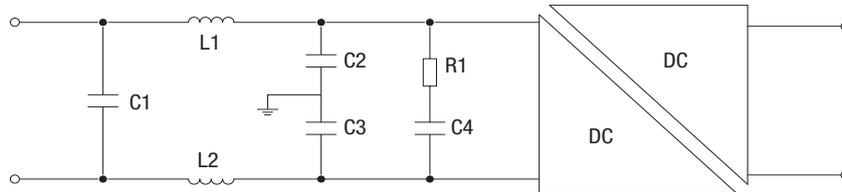
Derating curves are based on IPC-9592. With no derating some components may be operating at the manufacturers maximum temperature ratings.



**EMC FILTERING AND SPECTRA**

**FILTERING**

The following filter circuit and filter table shows the input filters typically required to meet EN55022 Quasi-Peak Curve A or B.

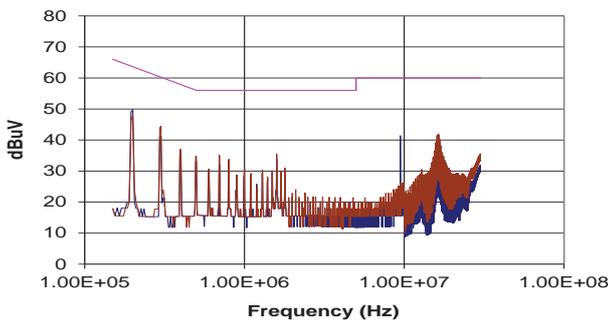


**C1, C2 & C3** Polyester or ceramic capacitor

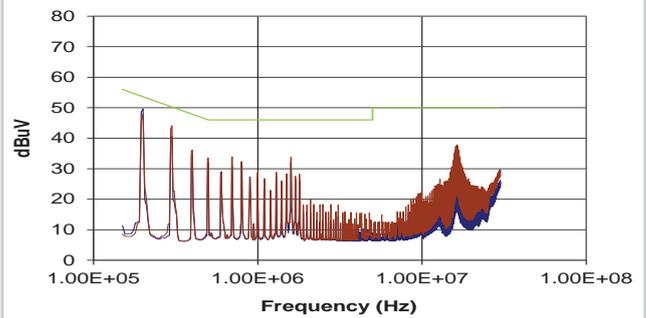
**C4** Electrolytic capacitor (note R1 could be omitted if C4 has ESR  $\geq$  R1)

TO MEET CURVE B							
Part Number	C1	L1	L2	C2	C3	R1	C4
MGJ6D1215040MC	3.3 $\mu$ F	47100SC	10nF	10nF	10nF	500m $\Omega$	470 $\mu$ F
MGJ6D121802SMC	3.3 $\mu$ F	47100SC	10nF	10nF	10nF	500m $\Omega$	470 $\mu$ F

**12Vin (Quasi-Peak)**

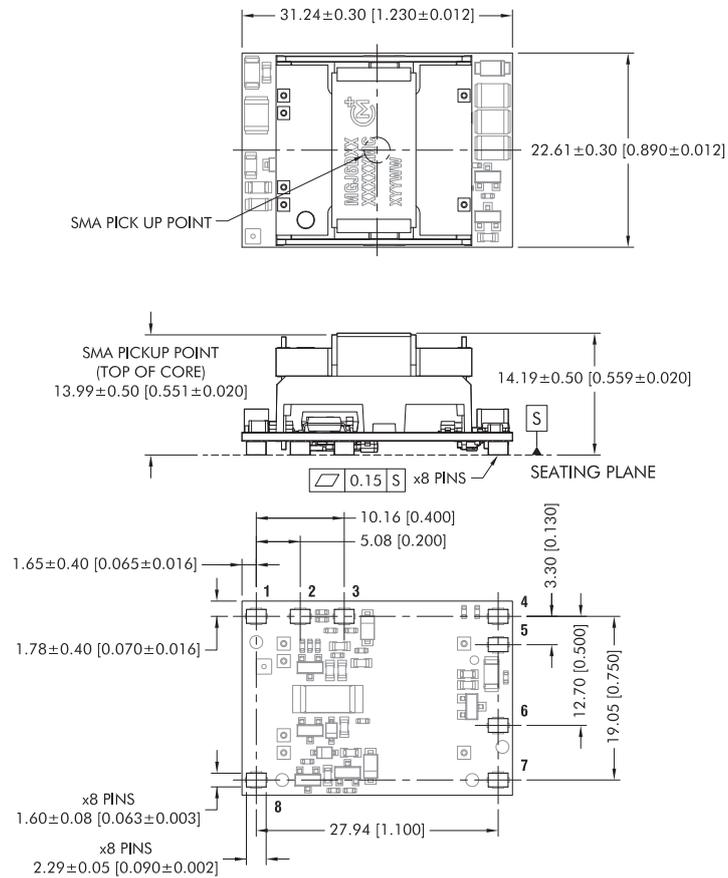


**12Vin (Average)**



**PACKAGE SPECIFICATIONS**

**MECHANICAL DIMENSIONS**



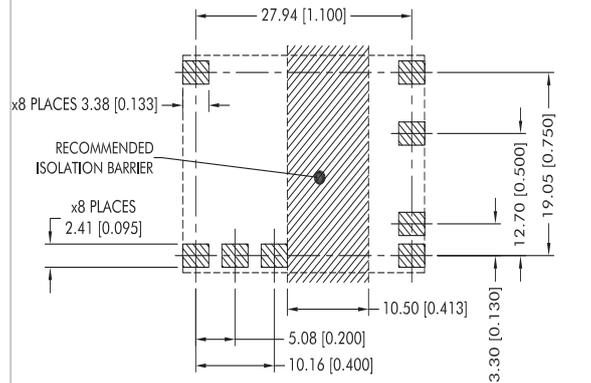
Unless otherwise specified all dimensions are in mm (inches) ±0.15mm (0.006").  
Controlling dimension is mm.  
Components shown for reference only.

Weight: 11.2g

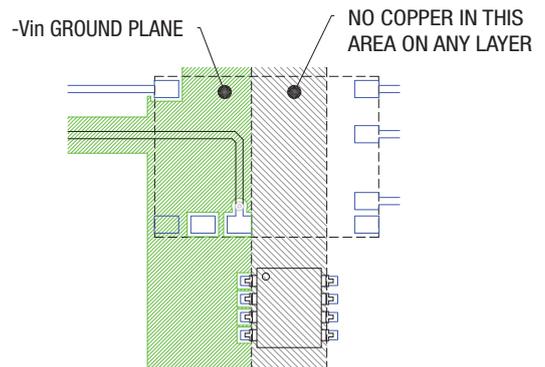
**PIN CONNECTIONS**

Pin	Function
1	-Vin
2	NA
3	Dis/Sync
4	NA
5	-Vout
6	0V
7	+Vout
8	+Vin

**RECOMMENDED FOOTPRINT DETAILS**



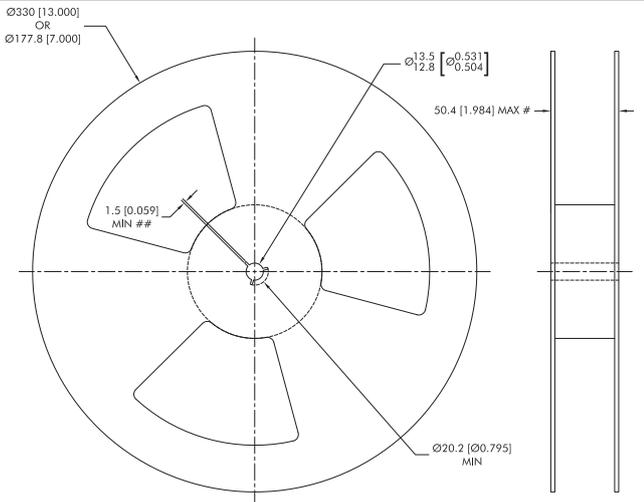
**RECOMMENDED LAYOUT**



Please refer to "[LAYOUT CONSIDERATIONS](#)" for further details.

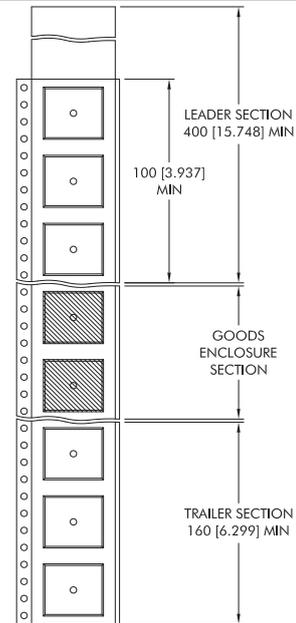
**TAPE & REEL SPECIFICATIONS**

**REEL OUTLINE DIMENSIONS**



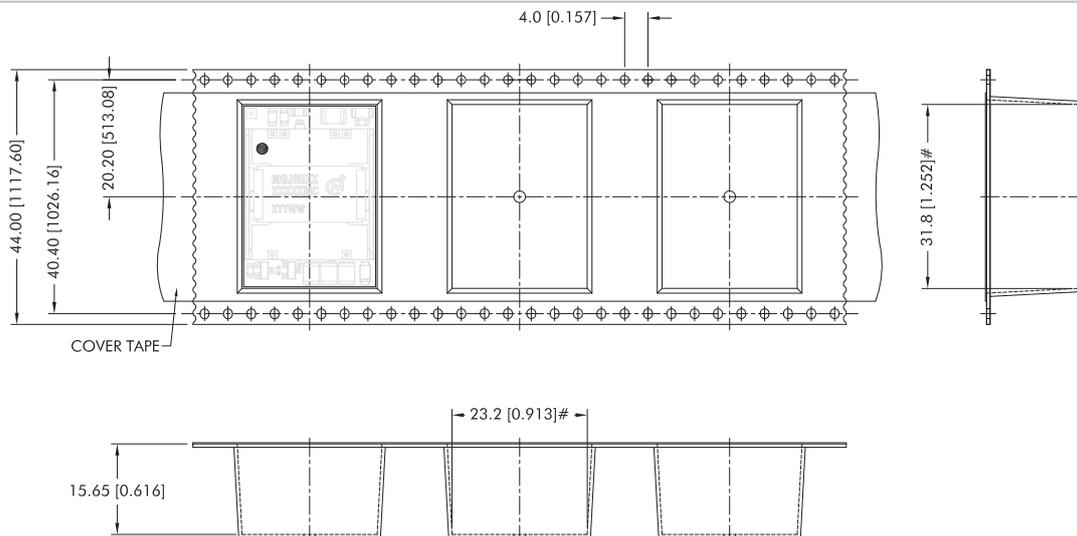
Tape & Reel specifications shall conform with current EIA-481 standard  
 Unless otherwise stated all dimensions in mm(inches)  
 Controlling dimension is mm  
 # Measured at hub  
 ## Six equi-spaced slots on 180mm/7" reel

**REEL PACKAGING DETAILS**



Reel Quantity: 7" - 23 or 13" - 92

**TAPE OUTLINE DIMENSIONS**



Tape & Reel specifications shall conform with current EIA-481 standard  
 Unless otherwise stated all dimensions in mm(inches) ±0.1mm (±0.004 Inches)  
 Controlling dimension is mm  
 Components shall be orientated within the carrier tape as indicated  
 # Measured on a plane 0.3mm above the bottom pocket

DIRECTION OF UNREELING →

**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.

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- 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

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

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