

FEATURES

- Patents protected
- No opto feedback
- Optimised bipolar output voltages for IGBT/ SiC & MOSFET gate drives
- Configurable dual outputs for all gate drive applications:
+15V/-5V, +15V/-10V & +20V/-5V outputs
- UL60950 Reinforced isolation to 690Vrms recognised
- EN61800-5-1 recognised
- Characterised CMTI >100kV/μS
- Characterised partial discharge performance
- 14mm creepage and clearance
- Ultra low isolation capacitance 13pF
- Continuous barrier withstand voltage 3kVDC
- 5V, 12V & 24V input voltages
- 105°C operating temperature

PRODUCT OVERVIEW

With 14mm creepage and clearance distances and reinforced insulation rating of 690VAC, the MGJ6-14mm is ideally suited for use in higher efficiency 690VAC industrial electrical distribution systems. Offering configurable dual output voltages of +15V/-10V, +20V/-5V and +15V/-5V, the MGJ6-14mm series of DC-DC converters is ideal for powering 'high side' and 'low side' gate drive circuits for IGBTs, Silicon and Silicon Carbide MOSFETs in bridge circuits. A choice of asymmetric output voltages allows optimum drive levels for best system efficiency and EMI. The MGJ6-14mm series is characterised for high isolation and dv/dt requirements commonly seen in bridge circuits used in motor drives and inverters.

SELECTION GUIDE

Order Code ¹	Input Voltage Range	Typical Application	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
MGJ6D051510WMC	4.5 - 9	IGBT	+15	240	3.6	-10	240	2.4
MGJ6D121510WMC	9 - 18	IGBT	+15	240	3.6	-10	240	2.4
MGJ6D241510WMC	18 - 36	IGBT	+15	240	3.6	-10	240	2.4
MGJ6D052005WMC	4.5 - 9	SiC	+20	240	4.8	-5	240	1.2
MGJ6D122005WMC	9 - 18	SiC	+20	240	4.8	-5	240	1.2
MGJ6D242005WMC	18 - 36	SiC	+20	240	4.8	-5	240	1.2
MGJ6D051505WMC	4.5 - 9	MOSFET	+15	300	4.5	-5	300	1.5
MGJ6D121505WMC	9 - 18	MOSFET	+15	300	4.5	-5	300	1.5
MGJ6D241505WMC	18 - 36	MOSFET	+15	300	4.5	-5	300	1.5

SELECTION GUIDE (Continued)

Order Code ¹	Input Voltage Range	Typical Application	Output 1				Output 2			
			Load Regulation (Typ) ³	Load Regulation (Max) ³	Ripple & Noise (Typ) ²	Ripple & Noise (Max) ²	Load Regulation (Typ)	Load Regulation (Max)	Ripple & Noise (Typ) ²	Ripple & Noise (Max) ²
			%	%	mVp-p	mVp-p	%	%	mVp-p	mVp-p
MGJ6D051510WMC	4.5 - 9	IGBT	5	10	105	160	5	10	80	120
MGJ6D121510WMC	9 - 18	IGBT	5	10	105	160	5	10	80	120
MGJ6D241510WMC	18 - 36	IGBT	5	10	105	160	5	10	80	120
MGJ6D052005WMC	4.5 - 9	SiC	5	10	105	160	5	10	80	120
MGJ6D122005WMC	9 - 18	SiC	5	10	105	160	5	10	80	120
MGJ6D242005WMC	18 - 36	SiC	5	10	105	160	5	10	80	120
MGJ6D051505WMC	4.5 - 9	MOSFET	5	10	105	160	5	10	80	120
MGJ6D121505WMC	9 - 18	MOSFET	5	10	105	160	5	10	80	120
MGJ6D241505WMC	18 - 36	MOSFET	5	10	105	160	5	10	80	120



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



1. Components are supplied in tape and reel packaging, please refer to package specification section. Orderable part numbers are MGJ6DXXXXXWMC-R7 (25 pieces per reel), or MGJ6DXXXXXWMC-R13 (140 pieces per reel).

2. See ripple & noise test method.

3. Between 50% and 100% rated output current.

All specifications typical at T_a=25°C, nominal input voltage and rated output current unless otherwise specified.

SELECTION GUIDE (Continued)

Order Code	Nominal Input Voltage	Input Current at Rated Load	Efficiency (Min)	Efficiency (Typ)	Isolation Capacitance	MTTF ¹	
						MIL 217	Telcordia
						kHrs	
	V	mA	%		pF		
MGJ6D051510WMC	5	1500	74	77.5	13	669	21.388
MGJ6D121510WMC	12	620	76.5	80	13	789	19,546
MGJ6D241510WMC	24	300	78	81.5	13	784	19,570
MGJ6D052005WMC	5	1500	74	77.5	13	669	21.388
MGJ6D122005WMC	12	620	76.5	80	13	789	19,546
MGJ6D242005WMC	24	300	78	81.5	13	784	19,570
MGJ6D051505WMC	5	1500	74	77.5	13	669	21.388
MGJ6D121505WMC	12	620	76.5	80	13	789	19,546
MGJ6D241505WMC	24	300	78	81.5	13	784	19,570

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	
Under voltage lock out	Turn on threshold MGJ6D05		4.1		V
	Turn off threshold MGJ6D05		3.0		
	Turn on threshold MGJ6D12		8.1		
	Turn off threshold MGJ6D12		7.5		
	Turn on threshold MGJ6D24		16.7		
	Turn off threshold MGJ6D24		16.3		
Input ripple current	5V input types		20		mA p-p
	12V input types		50		
	24V input types		38		

OUTPUT CHARACTERISTICS

Parameter	Conditions	Min.	Typ.	Max.	Units
Minimum load	Below 10% load, 5V and 15V outputs are clamped to 6V and 17V respectively	10			%
Voltage set point accuracy	Output 1		±3		%
	Output 2		±5		
Line regulation	Low line to high line			2	%
Total Regulation				15	%
Transient response	Peak deviation (50-100% & 100-50% load swing)		0.5		%V _{out}
	Settling time		0.3		ms

ISOLATION CHARACTERISTICS

Parameter	Conditions	Min.	Typ.	Max.	Units
Isolation test voltage	Flash tested for 1 second	10200			VDC
	Qualification tested for 1 minute	10200			
Resistance	Viso = 1kVDC	100			GΩ
Continuous barrier withstand voltage	Non-safety barrier application			3000	VDC
Safety standard	Reinforced	Creepage and clearance 14mm		690	Vrms
			UL60950-1	690	
	EN61800-5-1				

GENERAL CHARACTERISTICS

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

TEMPERATURE CHARACTERISTICS					
Parameter	Conditions	Min.	Typ.	Max.	Units
Operation	See derating graphs	-40		105	°C
Storage		-55		125	
Product temperature rise above ambient	100% Load, Nom V_{IN} , Still Air		20		

ABSOLUTE MAXIMUM RATINGS	
Short-circuit protection	Continuous
Input voltage, MGJ6-14mm 5V input types	12V
Input voltage, MGJ6-14mm 12V input types	20V
Input voltage, MGJ6-14mm 24V input types	40V

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 MGJ6-14mm series of DC-DC converters are all 100% production tested at 10.2kVDC for 1 second and have been qualification tested at 10.2kVDC for 1 minute.

The MGJ6-14mm series is recognised by Underwriters Laboratory, please see safety approval section for more information. When the insulation in the MGJ6-14mm 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. 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

EN61800-5-1

The MGJ6-14mm series is recognised by EN61800-5-1 based upon a working voltage of 690 Vrms max., between Primary and Secondary.

UL60950

The MGJ6-14mm series is recognised by Underwriters Laboratory (UL) to UL60950 for reinforced insulation to a working voltage of 690Vrms with a maximum measured product operating temperature of 130°C.

File number E151252 applies.
Creepage and clearance 14mm.
Working altitude OVC II 5000m

FUSING

The MGJ6-14mm 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.
Input Voltage, 5V 4A
Input Voltage, 12V 2A
Input Voltage, 24V 1A
All fuses should be UL recognised, 125V rated.

RoHS COMPLIANCE, MSL, PSL AND REFLOW SOLDERING INFORMATION



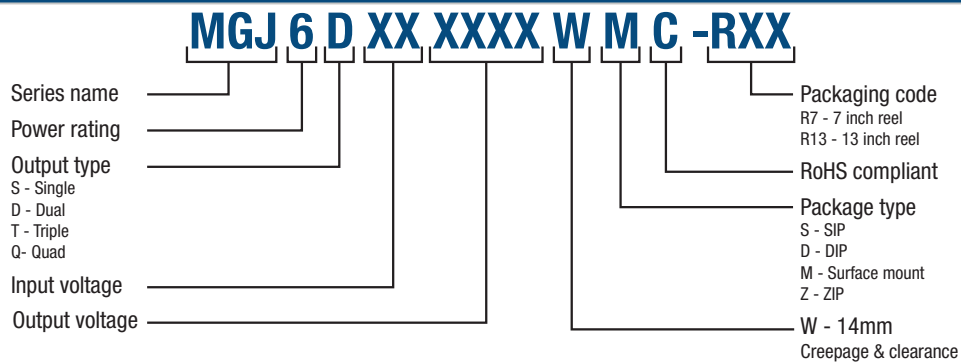
This series is compatible with RoHS soldering systems with a peak reflow solder temperature of 245°C and Time Above Liquidus for 90 seconds, as per J-STD-020. Please refer to [application notes](#) for further information. The pin termination finish on this product series is Gold with Nickel Pre-plate. The series is backward compatible with Sn/Pb soldering systems. The series has a Moisture Sensitivity Level (MSL) 2. Samples of the product series were tested in accordance with the conditioning described for MSL level 2 in IPC/J-STD-020. The product series passed electrical tests, co-planarity 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 between two chambers set to achieve -55°C and +125°C. The dwell time shall not be less than 10min and the load shall reach the specified temperature in 15min.
HAST	JEDEC JESD22-A110	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 ² rms. 5 hours in each axis. Crest factor: 3 Sigma. Device is secured via 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: Vertical, Traverse and Longitudinal: 50m/s ² . Device is secured via surface mount pins.
Moisture sensitivity level (MSL 2)	Based on IPC/JEDEC J-STD-020	Bake samples at 125 +5/-0°C for 24hours minimum before conditioning in the temperature/humidity chamber for 168 hours at 85°C/60%RH and Pb Free JEDEC Max profile conditioning with electrical testing, co-planarity inspection before and after.

PART NUMBER STRUCTURE



CHARACTERISATION TEST METHODS

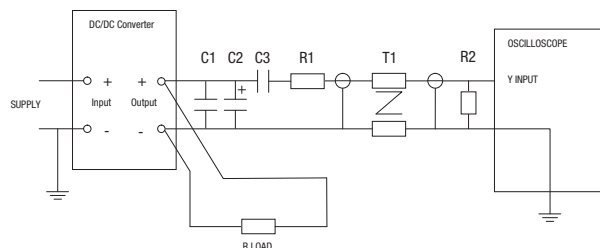
Ripple & Noise Characterisation Method

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 ¹	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 $\overline{\text{Dis}}$ /Synchronization pin has three modes:

1. When a DC logic low voltage is applied to this pin the MGJ6-14mm 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 MGJ6-14mm 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 MGJ6-14mm is disabled, it must be disabled for 7 clock cycles before being re-enabled.

Note: The $\overline{\text{Dis}}$ /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.](#)

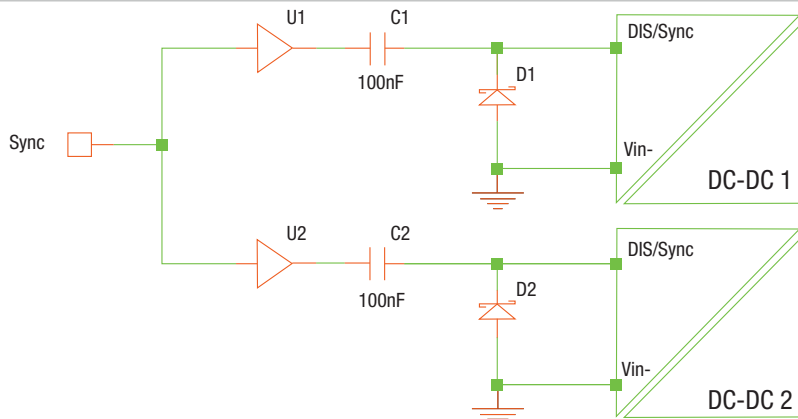
LAYOUT CONSIDERATIONS

Unlike standard isolated DC-DC products the MGJ6-14mm 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 MGJ6-14mm series and can also be used as a guard ring for the gate drive isolator inputs. If the $\overline{\text{Dis}}$ /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 $\overline{\text{Dis}}$ /Sync pin is not used for synchronisation, then a 22nF capacitor can be added between the $\overline{\text{Dis}}$ /Sync pin and $-V_{in}$ pin to improve noise immunity. If the functionality of $\overline{\text{Dis}}$ /Sync is not required, the $\overline{\text{Dis}}$ /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, with no additional output capacitance are:

Output capacitance must not exceed:

Part No.	Start-up times
	ms
MGJ6D051510WMC	15
MGJ6D121510WMC	15
MGJ6D241510WMC	15

Output Voltage	Maximum output capacitance
V	µF
-5	470
-10	220
15	220
20	150

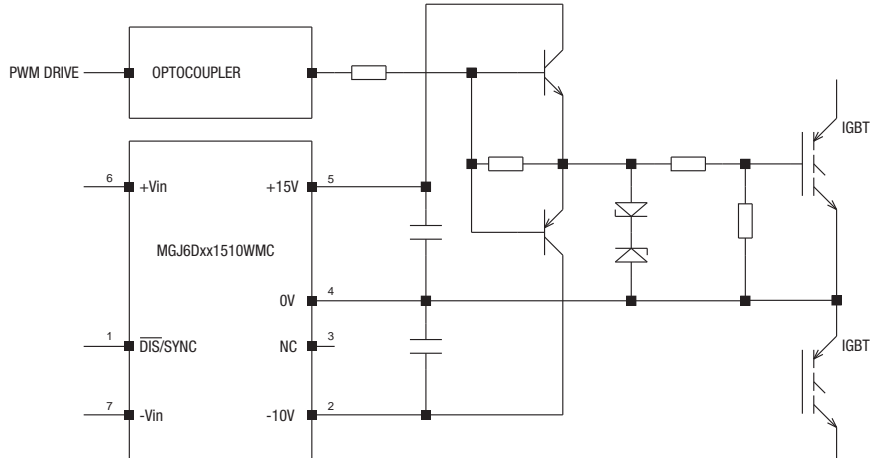
Output configurations for power switches

Terminal	IGBT	SIC	MOSFET
(P5) 15V Output	+15V 0.24A	+20V 0.24A	+15V 0.3A
(P4) 15V Return 5VA Output	0V	No connection	0V
(P3) 5VA Return 5VB Output	No connection	0V	-5V 0.3A
(P2) 5VB Return	-10V 0.24A	-5V 0.24A	No connection

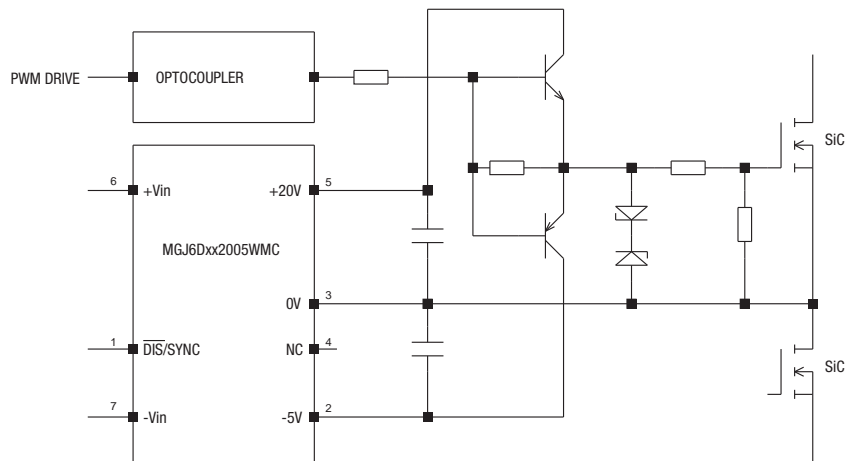
APPLICATION NOTES (Continued)

Schematic for driving IGBT, SiC & MOSFET

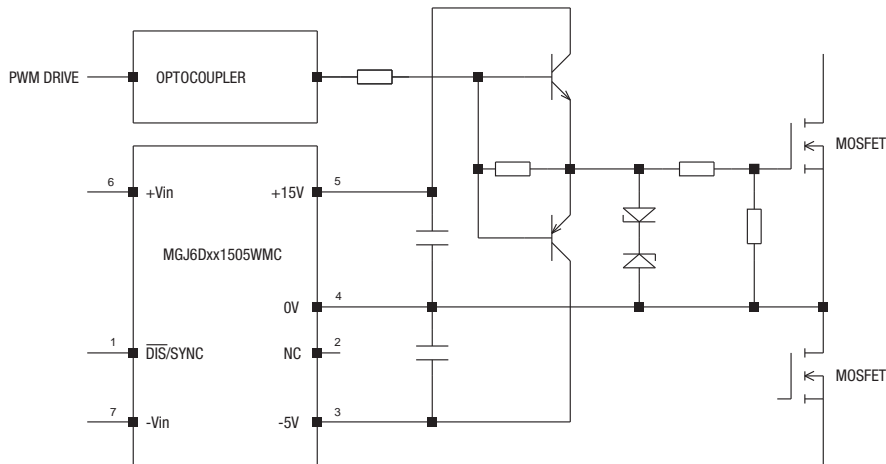
MGJ DC-DC CONNECTIONS FOR DRIVING IGBT DEVICES



MGJ DC-DC CONNECTIONS FOR DRIVING SiC DEVICES

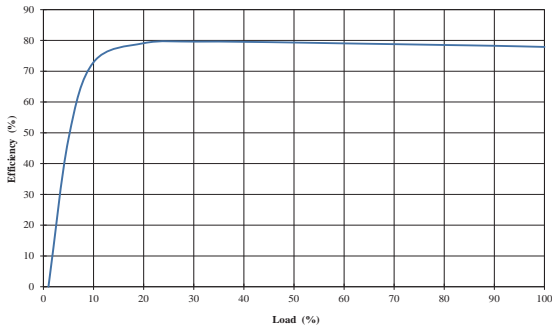


MGJ DC-DC CONNECTIONS FOR DRIVING MOSFET DEVICES

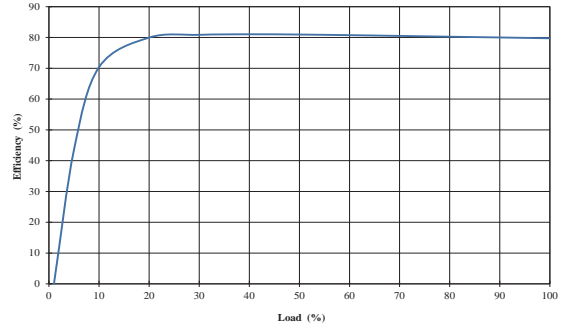


EFFICIENCY VS LOAD

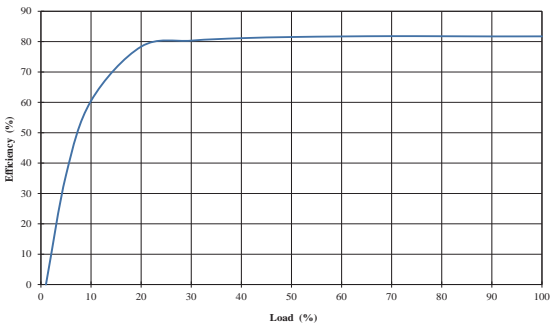
MGJ6D05XXXWMC



MGJ6D12XXXWMC

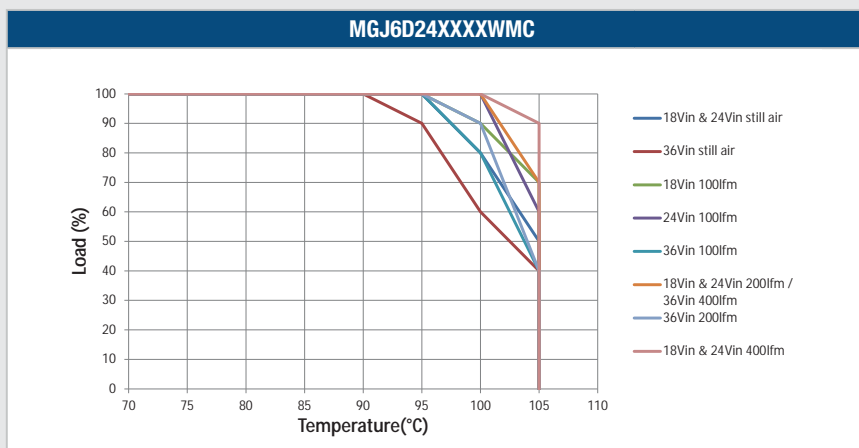
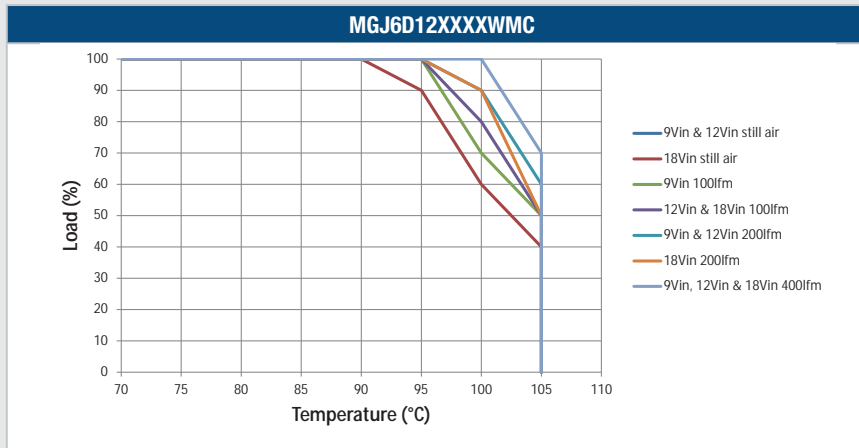
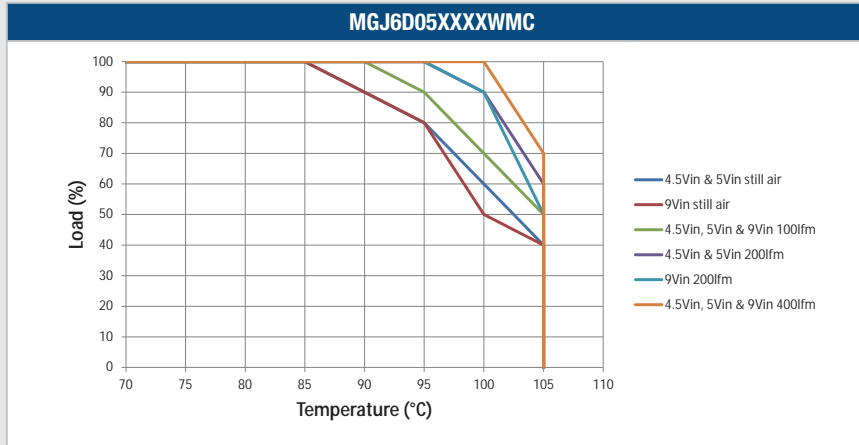


MGJ6D24XXXWMC



TEMPERATURE DERATING

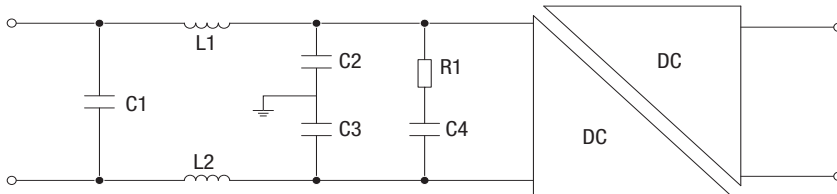
Derating curves are based on IPC-9592. With no derating some components may be operating at the manufacturers maximum temperature ratings.



EMC FILTERING AND SPECTRA

FILTERING

The following filter circuit and filter table shows the input filters typically required to meet conducted emissions limits for EN 55022 curve B using Quasi-Peak (pink line) and average (green line) detectors according to CISPR 22. The following plots show measurements of the positive (L1) and negative (L2) inputs for both Quasi-peak limit B adherence and Average limit B adherence. If a high dv/dt above 80kV/us is expected from output to input it is advised that a common mode filter is used on the input without Y capacitors. This will reduce the common mode current and reduce interference with primary side circuits.



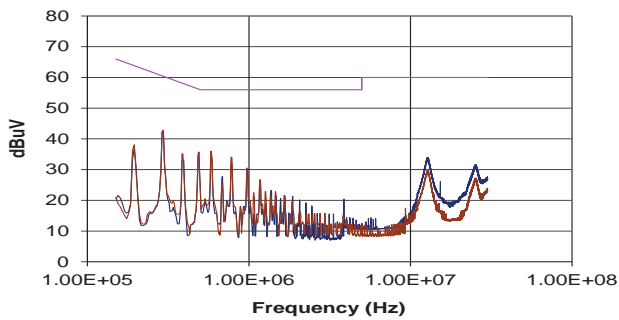
C1, C2 & C3 Polyester or ceramic capacitor

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

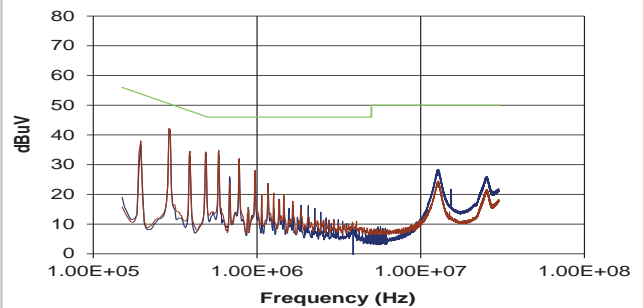
TO MEET CURVE B

Part Number	C1	L1	L2	C2&3	R1	C4
MGJ6D05XXXXWMC	3.3uF	47100SC	10nF	10nF	500mΩ	470uF
MGJ6D12XXXXWMC	3.3uF	47100SC	10nF	10nF	500mΩ	470uF
MGJ6D24XXXXWMC	3.3uF	47100SC	10nF	10nF	500mΩ	470uF

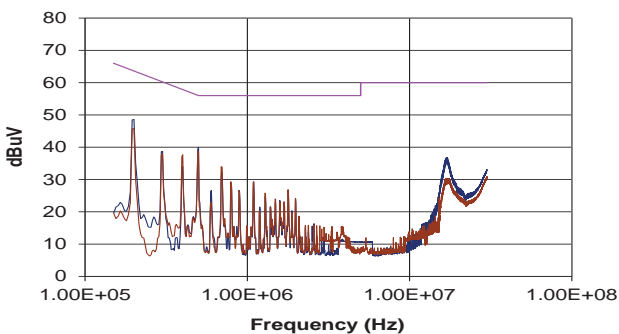
MGJ6D05XXXXWMC (Quasi-Peak)



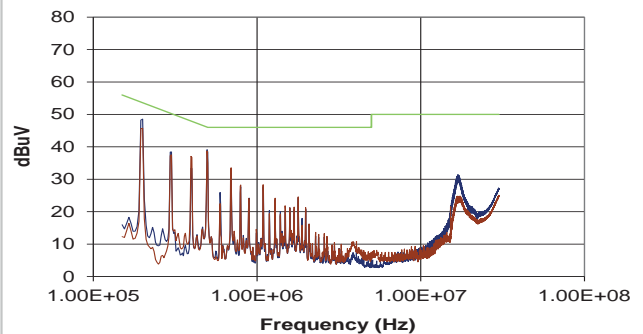
MGJ6D05XXXXWMC (Average)



MGJ6D12XXXXWMC (Quasi-Peak)

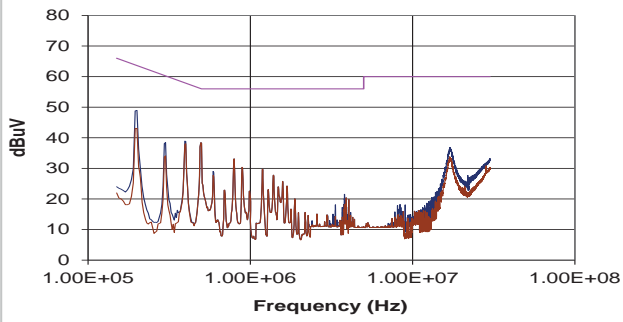


MGJ6D12XXXXWMC (Average)

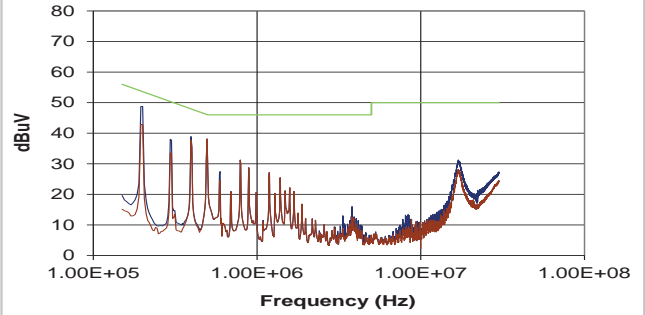


EMC FILTERING AND SPECTRA (Continued)

MGJ6D24XXXXWMC ((Quasi-Peak)

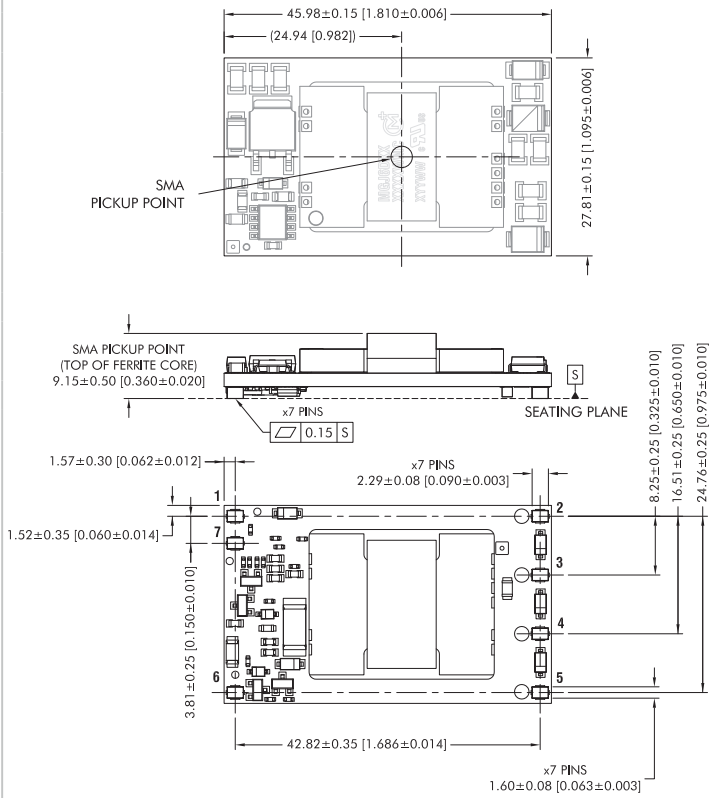


MGJ6D24XXXXWMC (Average)



PACKAGE SPECIFICATIONS

MECHANICAL DIMENSIONS



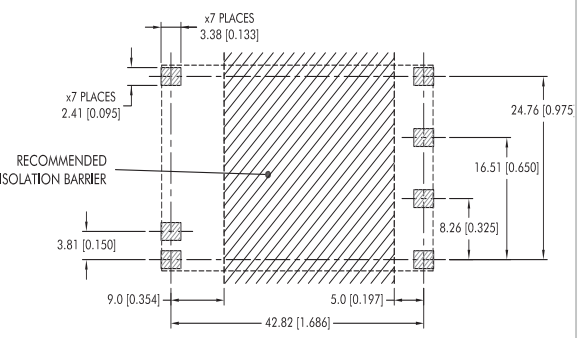
All dimensions in mm (inches), Controlling dimensions is mm.
Components shown for reference only.

Weight: 12.9g

PIN CONNECTIONS

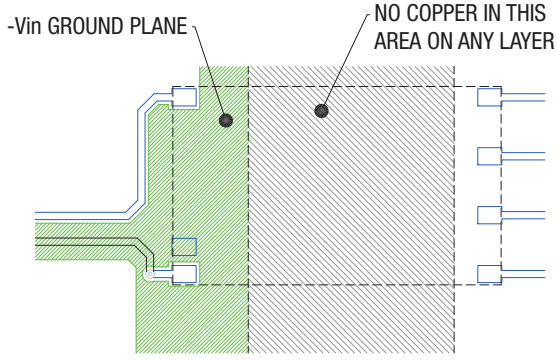
Pin	Function
1	DIS/SYNC
2	5VB RTN
3	5VA RTN
	5VB
4	15V RTN
	5VA
5	15VOUT
6	+Vin
7	-Vin

RECOMMENDED FOOTPRINT DETAILS



All dimensions in mm (inches), Controlling dimensions is mm.

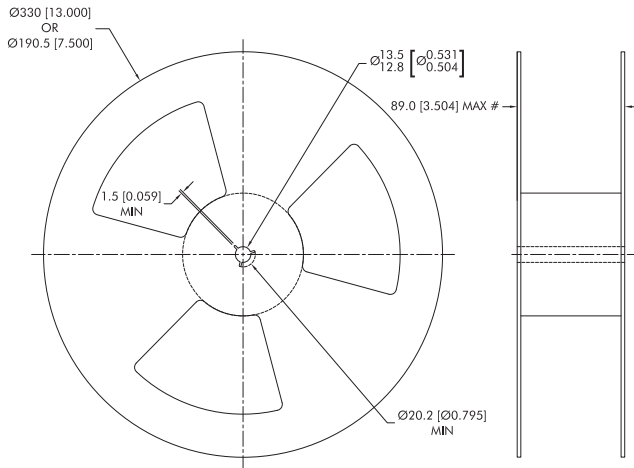
RECOMMENDED LAYOUT



Please refer to "LAYOUT CONSIDERATIONS" for further details.

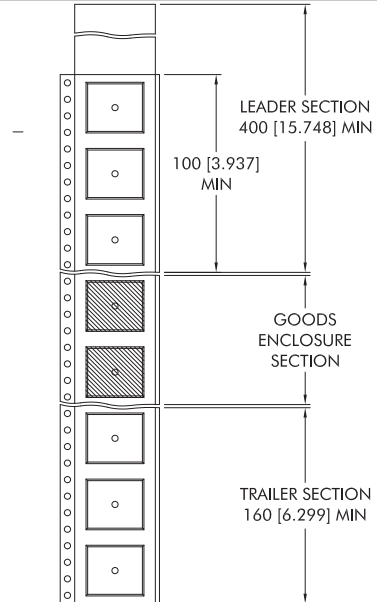
TAPE & REEL SPECIFICATIONS

REEL OUTLINE DIMENSIONS



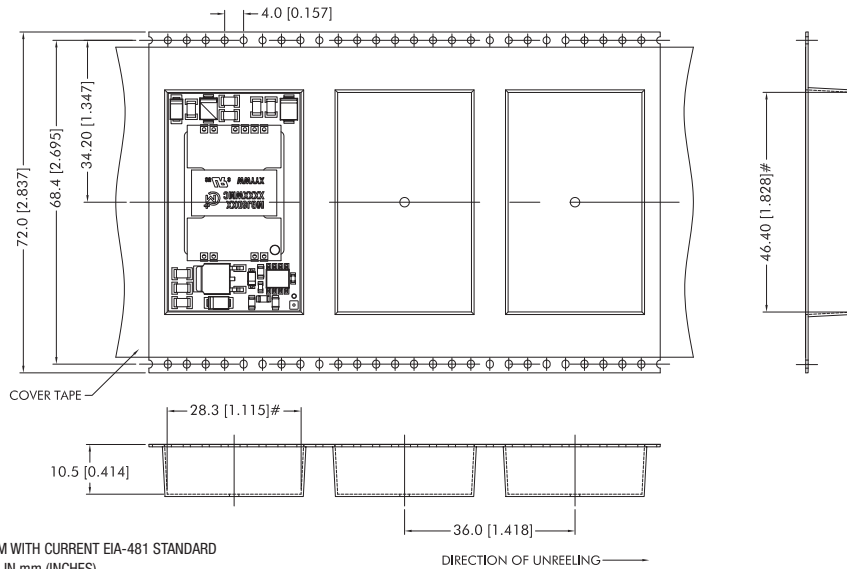
Tape & Reel specifications shall conform with current EIA-481 standard
 Unless otherwise stated all dimensions in mm(inches)
 Controlling dimension is mm
 # Measured at hub

REEL PACKAGING DETAILS



Reel Quantity: 7" - 25 or 13" - 140
 Carrier tape pockets shown are illustrative only - Refer to carrier tape diagram for actual pocket details

TAPE OUTLINE DIMENSIONS



TAPE & REEL SPECIFICATIONS SHALL CONFORM WITH CURRENT EIA-481 STANDARD
 UNLESS OTHERWISE STATED ALL DIMENSIONS IN mm (INCHES)
 CONTROLLING DIMENSION IS mm
 COMPONENTS SHALL BE ORIENTATED WITHIN THE CARRIER TAPE AS INDICATED
 # MEASURED ON A PLANE 0.3mm ABOVE THE BOTTOM OF THE POCKET

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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