

## FEATURES

- No opto feedback
- Patent protected
- Two isolated output voltages for IGBT/SiC & Mosfet gate drives in half bridge configuration
- Reinforced insulation to UL60950 with 8mm creepage & clearance recognised
- ANSI/AAMI ES60601-1, 2 MOPP recognised
- Characterised CMTI >100kV/μS
- Characterised partial discharge performance
- 5.7kVDC isolation test voltage 'Hi Pot Test'
- Ultra low isolation capacitance typically 15pF
- Continuous barrier withstand voltage 3kVDC
- 5V, 12V & 24V input voltages
- 105°C operating temperature

## PRODUCT OVERVIEW

Offering two configurable isolated output voltages of 24V, the MGJ6-HB series of DC-DC converters is ideal for simultaneously powering 'high side' and 'low side' gate drive circuits for IGBTs, Silicon and Silicon Carbide Mosfets in half bridge circuits. The MGJ6-HB series is characterised for high isolation and dv/dt requirements commonly seen in bridge circuits used in motor drives and inverters.



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



# MGJ6 Half Bridge Series

5.7kVDC Isolated 6W Dual Output Gate Drive SM DC-DC Converters

## SELECTION GUIDE

| Order Code <sup>1</sup> | Input Voltage Range | Output 1 VH          |                      |              | Output 2 VL          |                      |              |
|-------------------------|---------------------|----------------------|----------------------|--------------|----------------------|----------------------|--------------|
|                         |                     | Rated Output Voltage | Rated Output Current | Output Power | Rated Output Voltage | Rated Output Current | Output Power |
|                         | V                   | V                    | mA                   | W            | V                    | mA                   | W            |
| MGJ6D05H24MC            | 4.5 - 9             | 24                   | 125                  | 3            | 24                   | 125                  | 3            |
| MGJ6D12H24MC            | 9 - 18              | 24                   | 125                  | 3            | 24                   | 125                  | 3            |
| MGJ6D24H24MC            | 18 - 36             | 24                   | 125                  | 3            | 24                   | 125                  | 3            |

## SELECTION GUIDE (Continued)

| Order Code <sup>1</sup> | Input Voltage Range | Output 1 VH                        |                                    |                                   |                                   | Output 2 VL           |                       |                                   |                                   |
|-------------------------|---------------------|------------------------------------|------------------------------------|-----------------------------------|-----------------------------------|-----------------------|-----------------------|-----------------------------------|-----------------------------------|
|                         |                     | Load Regulation (Typ) <sup>4</sup> | Load Regulation (Max) <sup>4</sup> | Ripple & Noise (Typ) <sup>2</sup> | Ripple & Noise (Max) <sup>2</sup> | Load Regulation (Typ) | Load Regulation (Max) | Ripple & Noise (Typ) <sup>2</sup> | Ripple & Noise (Max) <sup>2</sup> |
|                         | V                   | %                                  | %                                  | mVp-p                             | mVp-p                             | %                     | %                     | mVp-p                             | mVp-p                             |
| MGJ6D05H24MC            | 4.5 - 9             | 2                                  | 3                                  | 100                               | 150                               | 2                     | 3                     | 100                               | 150                               |
| MGJ6D12H24MC            | 9 - 18              | 2                                  | 3                                  | 100                               | 150                               | 2                     | 3                     | 100                               | 150                               |
| MGJ6D24H24MC            | 18 - 36             | 2                                  | 3                                  | 100                               | 150                               | 2                     | 3                     | 100                               | 150                               |

## SELECTION GUIDE (Continued)

| Order Code <sup>1</sup> | Nominal Input Voltage | Input Current at Rated Load | Efficiency (Min) | Efficiency (Typ) | MTTF <sup>3</sup> |            |
|-------------------------|-----------------------|-----------------------------|------------------|------------------|-------------------|------------|
|                         |                       |                             |                  |                  | MIL 217           | Telecordia |
|                         | V                     | mA                          | %                | %                | kHrs              |            |
| MGJ6D05H24MC            | 5                     | 1500                        | 76               | 79.5             | 715               | 2377       |
| MGJ6D12H24MC            | 12                    | 600                         | 81               | 84               | 716               | 1756       |
| MGJ6D24H24MC            | 24                    | 300                         | 82               | 85               | 712               | 1768       |

- Components are supplied in tape and reel packaging, please refer to tape and reel specification section. Orderable part numbers are MGJ6DXXH24MC-R7 ( 23 pieces per reel), or MGJ6DXXH24MC-R13 ( 92 pieces per reel).
- See ripple & noise test method.
- Calculated using MIL-HDBK-217 FN2 and Telecordia SR-332 calculation model at T<sub>A</sub>=25°C with nominal input voltage at full load.
- Between 50% and 100% rated output current.

All specifications typical at T<sub>A</sub>=25°C, nominal input voltage and rated output current unless otherwise specified.

**Murata Power Solutions**

# MGJ6 Half Bridge Series

5.7kVDC Isolated 6W Dual Output Gate Drive SM DC-DC Converters

## 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  |      | 3.8  |      | V         |
|                        | Turn off threshold MGJ6D05 |      | 3.2  |      |           |
|                        | 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             |      | 30   |      | mA<br>p-p |
|                        | 12V input types            |      | 40   |      |           |
|                        | 24V input types            |      | 25   |      |           |

## OUTPUT CHARACTERISTICS

| Parameter                  | Conditions                                             | Min. | Typ.   | Max. | Units |
|----------------------------|--------------------------------------------------------|------|--------|------|-------|
| Minimum load               | Below 10% load, output may rise to 30V maximum voltage | 10   |        |      | %     |
| Voltage set point accuracy | All output types                                       |      | +3 /-2 |      | %     |
| Total regulation           |                                                        |      |        | 10   | %     |
| Line regulation            | Low line to high line                                  |      | 0.5    | 1    | %     |

## GENERAL CHARACTERISTICS

| Parameter           | Conditions             | Min. | Typ. | Max. | Units |
|---------------------|------------------------|------|------|------|-------|
| Power Consumption   | Disable pin pulled low |      | 45   |      | mW    |
| Switching frequency |                        |      | 100  |      | kHz   |

## ISOLATION CHARACTERISTICS

| Parameter                            | Conditions                                           | Min.       | Typ. | Max. | Units |
|--------------------------------------|------------------------------------------------------|------------|------|------|-------|
| Isolation test voltage               | Flash tested for 1 second (input to output)          | 4000       |      |      | VAC   |
|                                      | Flash tested for 1 second (output to output)         | 2500       |      |      |       |
|                                      | Qualification tested for 1 minute (input to output)  | 5700       |      |      | VDC   |
|                                      | Qualification tested for 1 minute (output to output) | 3000       |      |      |       |
| Resistance                           | Viso = 1kVDC                                         | 100        |      |      | GΩ    |
| Continuous barrier withstand voltage | Non-safety barrier application                       |            |      | 3000 | VDC   |
| Safety standard                      | UL60950-1                                            | Reinforced |      | 250  | Vrms  |
|                                      | ANSI/AAMI ES60601-1                                  | 2 MOPP     |      | 250  |       |
| Creepage & clearance                 | Input to output                                      |            |      | 8    | mm    |
|                                      | Output to output                                     |            |      | 8    |       |
| Isolation capacitance                | Primary to Output 1 VH                               |            | 15   |      | pF    |
|                                      | Primary to Output 2 VL                               |            | 15   |      |       |

## 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 <sub>IN</sub> , Still Air | 5V input types        | 30   |      |       |
|                                        |                                            | All other input types | 20   |      |       |

## ABSOLUTE MAXIMUM RATINGS

|                                     |            |
|-------------------------------------|------------|
| Short-circuit protection            | Continuous |
| Input voltage, MGJ6 5V input types  | 12V        |
| Input voltage, MGJ6 12V input types | 20V        |
| Input voltage, MGJ6 24V input types | 40V        |

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## 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-HB series of DC-DC converters are all 100% production tested at 4kVACrms for 1 second from input to output and 2.5kVACrms for 1 second from output to output. Also they are all qualification tested at 5.7kVDC for 1 minute from input to output and 3kVDC for 1 minute from output to output.

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

### ANSI/AAMI ES60601-1

The MGJ6-HB series is recognised by Underwriters Laboratory (UL) to ANSI/AAMI ES60601-1 and provides 2 MOPP (Means Of Patient Protection) based on a working voltage of 250Vrms.

### UL 60950

The MGJ6-HB series recognised by Underwriters Laboratory (UL) to UL60950 for reinforced insulation to a working voltage of 250Vrms with a maximum measured product operating temperature of 130°C.

Creepage and clearance 8mm, input to output & across outputs.

Working altitude 5000m

Over voltage category (OVC) II

### FUSING

The MGJ6-HB 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, 250Vac rated.

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



This series is compatible with Pb-Free soldering systems and is also backward compatible with Sn/Pb soldering systems.

The MGJ6 half bridge series has a process, moisture, and reflow sensitivity classification of MSL2 PSL R7F as defined in J-STD-020 and J-STD-075. Please refer to [application notes](#) for further information. This translates to: MSL2 = 1 year floor life, PSL R7F = Peak reflow temperature 245°C with a limitation on the time above liquidus (217°C) which for this series is 90sec max. The pin termination finish on this product series is Gold with Nickel Pre-plate.



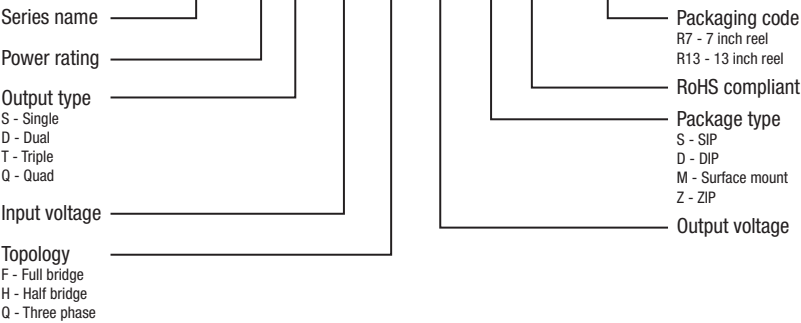
## ENVIRONMENTAL VALIDATION TESTING

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.                                                                                                                                                                                                                                               |
| Humidity bias                      | JEDEC JESD22-A101                                                        | 85±2°C, 85±5% R.H. for 1000 (+168/-24) hours.                                                                                                                                                                                                                                                                                                                                                                          |
| 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 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.<br>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.<br>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.                                                                                                                                                                                                                       |
| 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

**MGJ 6 D XX H XX M C -RXX**



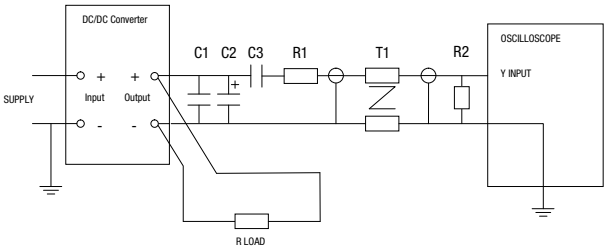
## CHARACTERISATION TEST METHODS

### Ripple & Noise Characterisation Method

Ripple and noise measurements are performed with the following test configuration.

|                                                                      |                                                                                                                                                                        |
|----------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| C1                                                                   | 1 $\mu$ F X7R multilayer ceramic capacitor, voltage rating to be a minimum of 3 times the output voltage of the DC-DC converter                                        |
| C2                                                                   | 10 $\mu$ F 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 100m $\Omega$ at 100 kHz |
| C3                                                                   | 100nF multilayer ceramic capacitor, general purpose                                                                                                                    |
| R1                                                                   | 450 $\Omega$ resistor, carbon film, $\pm$ 1% tolerance                                                                                                                 |
| R2                                                                   | 50 $\Omega$ 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 Disable/Synchronisation pin has three modes:

1. When a DC logic low voltage is applied to this pin the MGJ6-HB 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-HB 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-HB 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.](#)

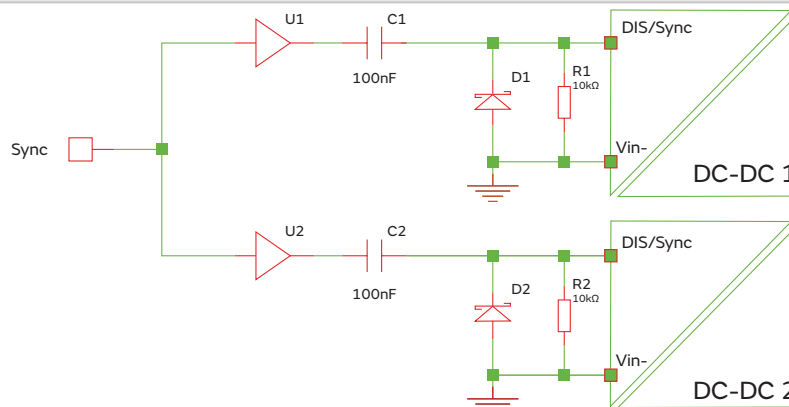
#### LAYOUT CONSIDERATIONS

Unlike standard isolated DC-DC products the MGJ6-HB 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  $-\text{Vin}$  can be used to create an effective screen to the underside of the MGJ6-HB 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  $-\text{Vin}$  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  $+\text{Vin}$  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 recommended maximum additional output capacitance are:

| Part No.     | Start-up times |
|--------------|----------------|
|              | ms             |
| MGJ6D05H24MC | 30             |
| MGJ6D12H24MC | 30             |
| MGJ6D24H24MC | 30             |

Output capacitance must not exceed:

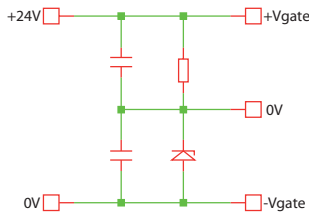
| Output Voltage | Maximum output capacitance |
|----------------|----------------------------|
| V              | μF                         |
| 24 VH          | 56                         |
| 24 VL          | 56                         |

Output configurations for power switches

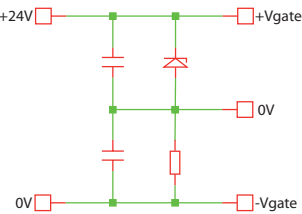
There are several zener based divider circuits that can be used to configure a bipolar output for gate drives as shown below. The table below shows suggested component values for various power switches using circuit A.

| Component                | IGBT | SIC | MOSFET |
|--------------------------|------|-----|--------|
| Zener diode <sup>1</sup> | 9V1  | 5V1 | 9V1    |
| Resistor                 | 15K  | 18K | 15K    |

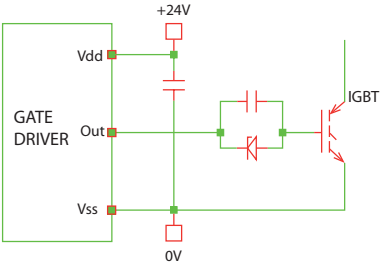
1. Suggested zener diode is BZX84C.



A



B

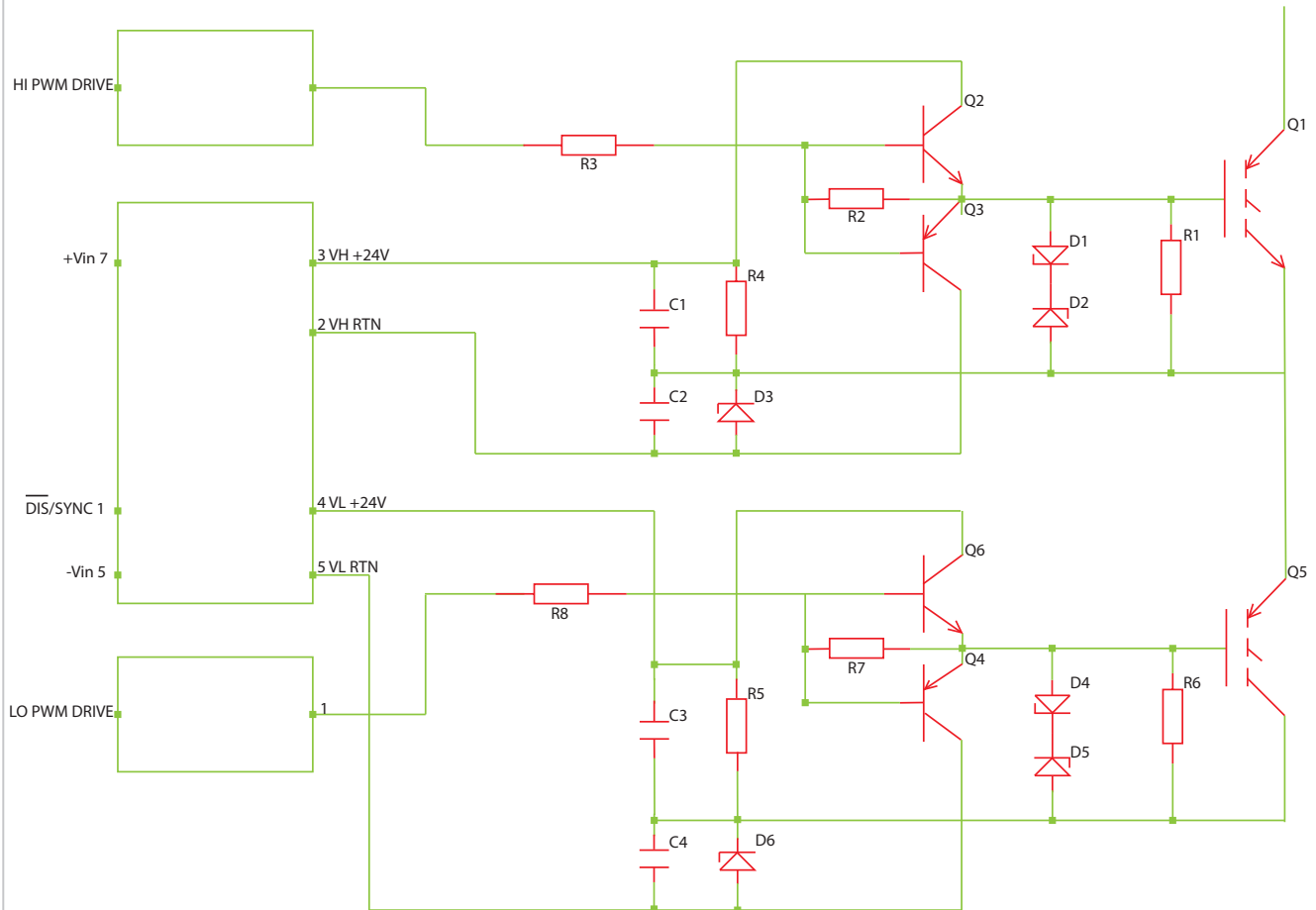


C

## APPLICATION NOTES (Continued)

### Schematic for driving IGBT

The following circuit shows an example of a complete half bridge and how the DC-DC would be connected using the zener divider in circuit A (page 4).





## APPLICATION NOTES (Continued)

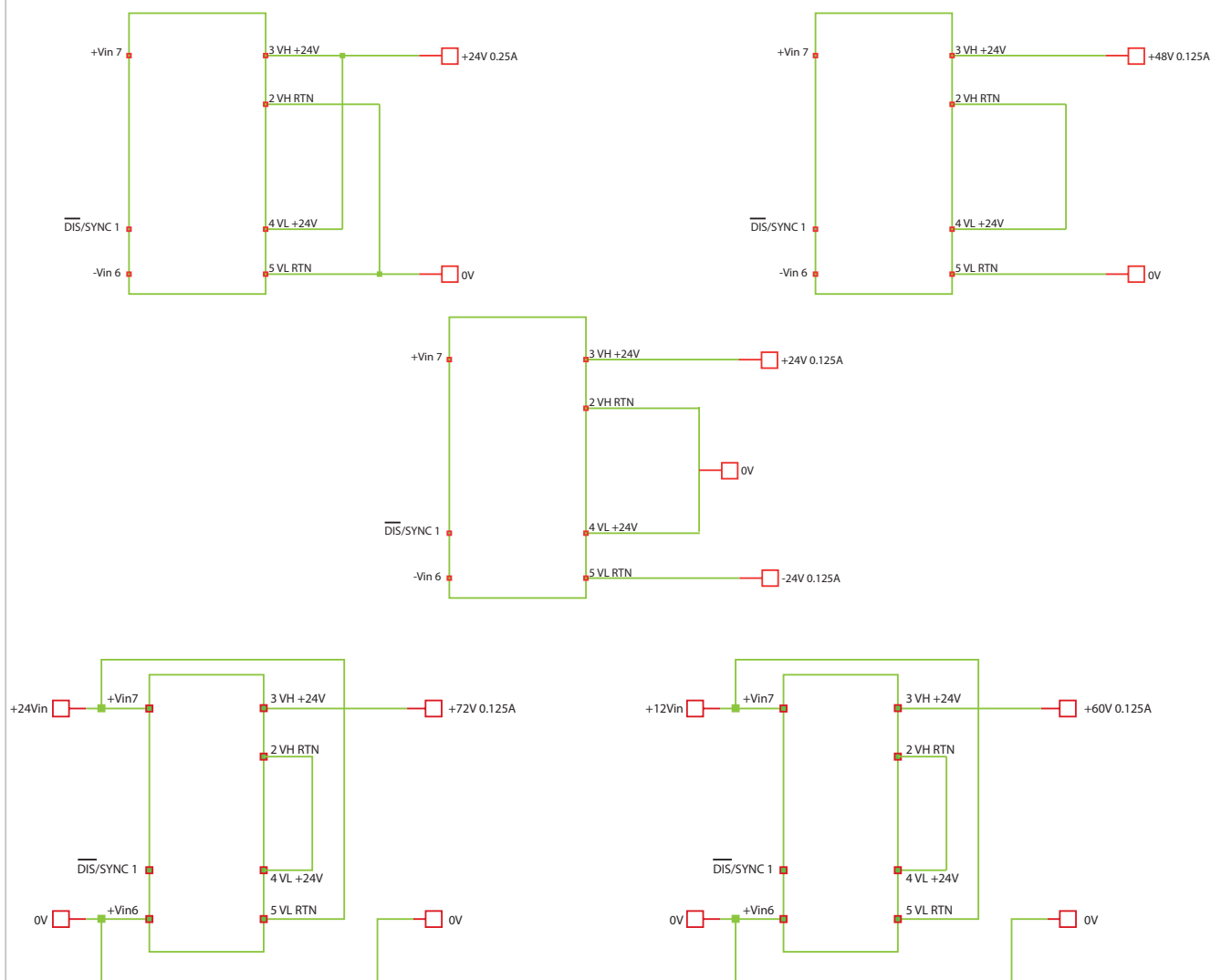
### Alternative configuration options

For convenience the two isolated 24V outputs have been labelled VH (Voltage for high side) and VL (Voltage for low side) however both outputs are identical and they can be swapped if this helps to improve system layout.

Both outputs can be connected in parallel to produce a single 24V @ 0.25A output

Both outputs can also be connected in series to produce a single 48V @ 0.125A output or dual +/-24V @ 0.125A

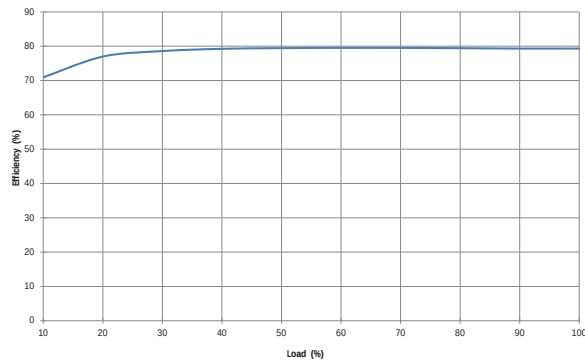
Other configurations include a non-isolated +24V to +72V or +12V to +60V boost converter @ 0.125A as shown below:



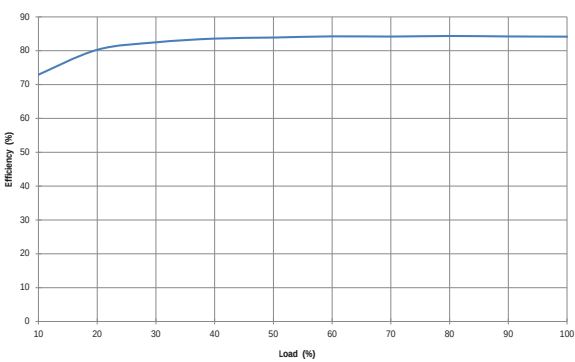


EFFICIENCY VS LOAD

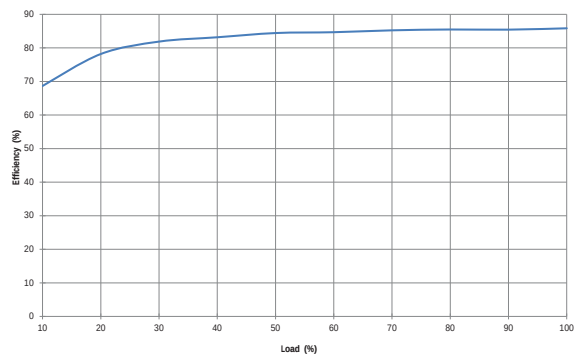
MGJ6D05H24MC



MGJ6D12H24MC

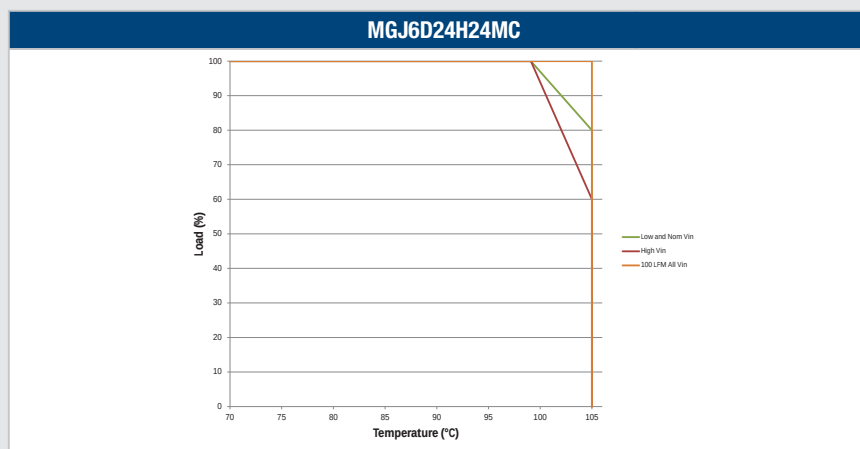
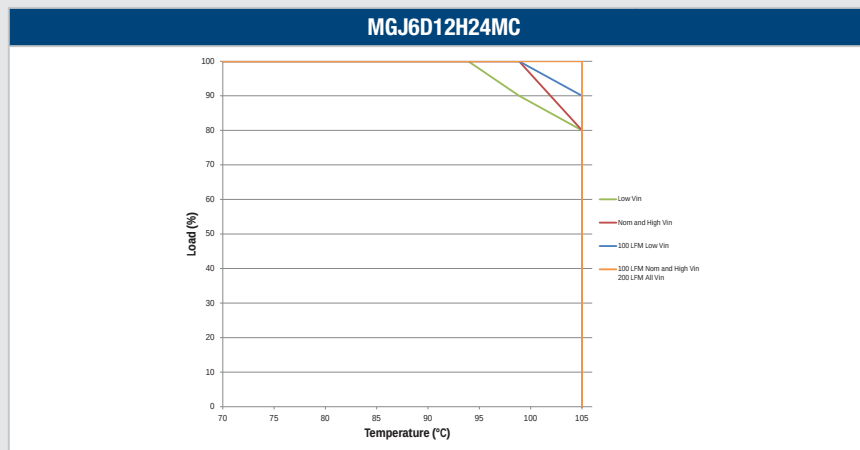
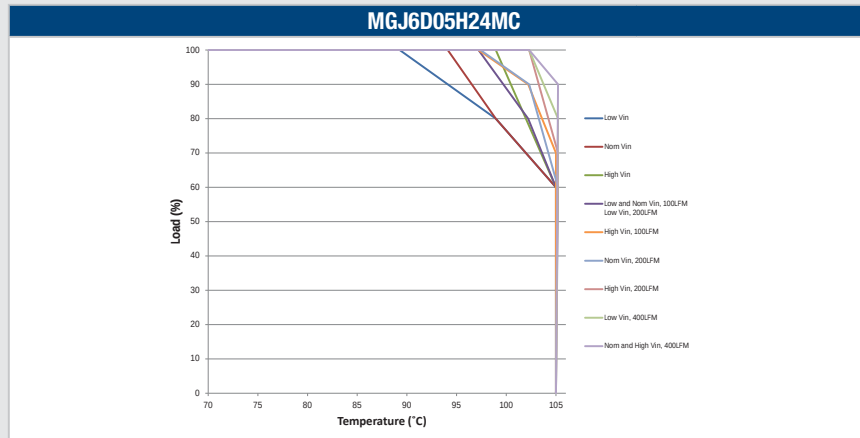


MGJ6D24H24MC



## TEMPERATURE DERATING

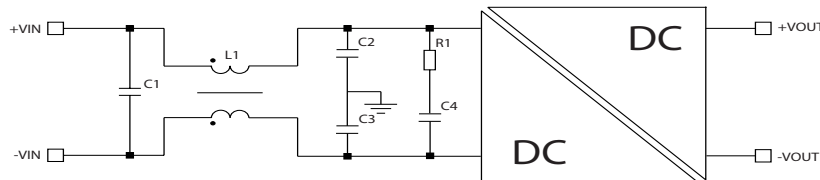
Derating curves are based on IPC-9592. With no derating some components may be operating at the manufacturers maximum temperature ratings.



## 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 CISPR22. 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 each output as this will reduce the common mode current circulating between outputs and input and causing interference.



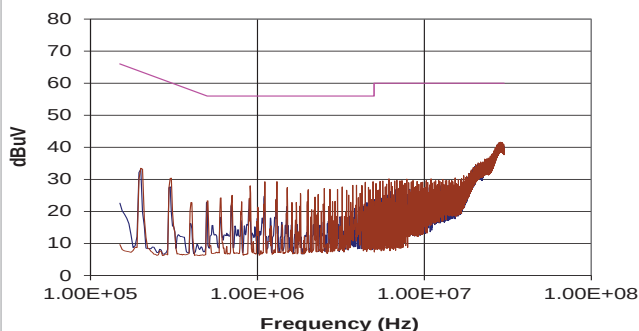
**C1, C2 & C3** Polyester or ceramic capacitor

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

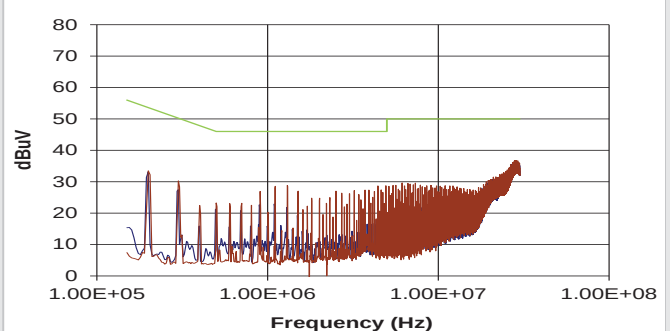
#### TO MEET CURVE B

| Part Number  | C1         | L1  | Part Number | C2  | C3  | R1         | C4          |
|--------------|------------|-----|-------------|-----|-----|------------|-------------|
| MGJ6D05H24MC | 10 $\mu$ F | 1mH | 51105C      | 1nF | 1nF | 1 $\Omega$ | 470 $\mu$ F |
| MGJ6D12H24MC | 10 $\mu$ F | 1mH | 51105C      | 1nF | 1nF | 1 $\Omega$ | 470 $\mu$ F |
| MGJ6D24H24MC | 10 $\mu$ F | 1mH | 51105C      | 1nF | 1nF | 1 $\Omega$ | 470 $\mu$ F |

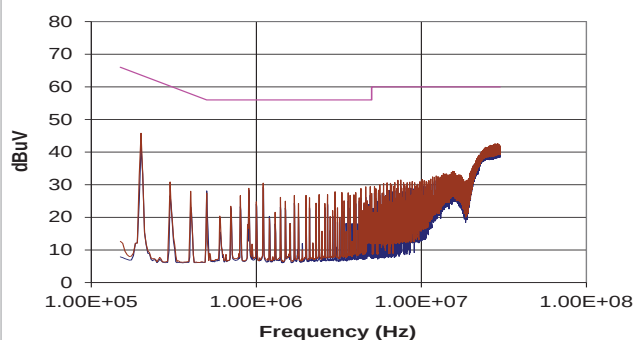
MGJ6D05H24MC (Quasi Peak)



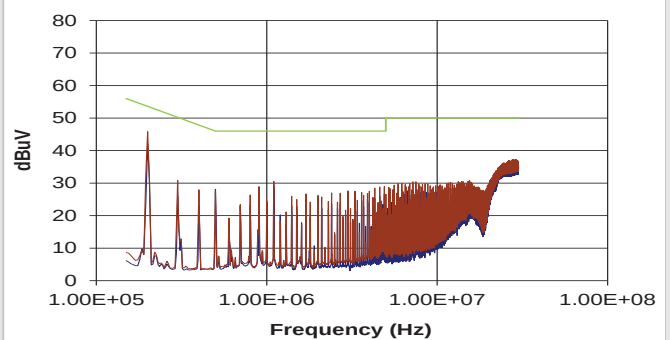
MGJ6D05H24MC (Average)



MGJ6D12H24MC (Quasi Peak)

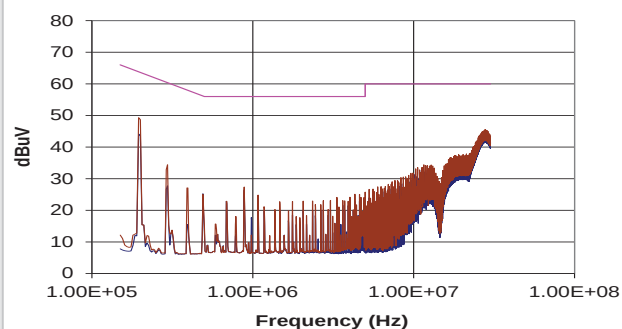


MGJ6D12H24MC (Average)

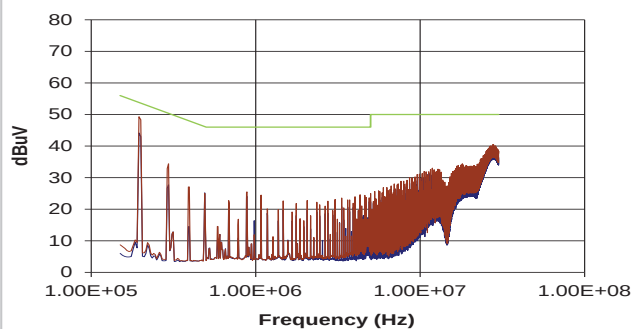


## EMC FILTERING AND SPECTRA (Continued)

MGJ6D24H24MC (Quasi Peak)

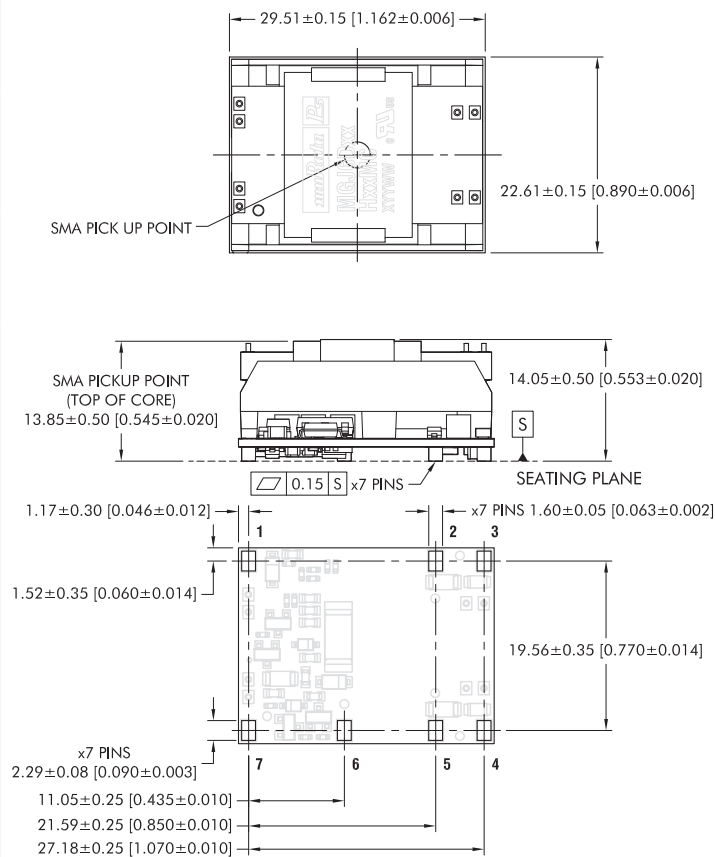


MGJ6D24H24MC (Average)



## PACKAGE SPECIFICATIONS

### MECHANICAL DIMENSIONS



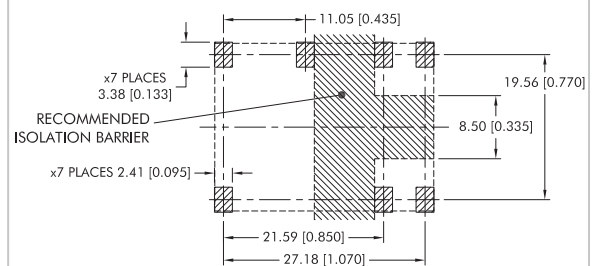
All dimensions in mm (inches). Controlling dimensions in mm.  
Tolerance (unless otherwise stated)  $\pm 0.25$  (0.010).  
Component layout is shown for reference only.

Weight: 14.4g

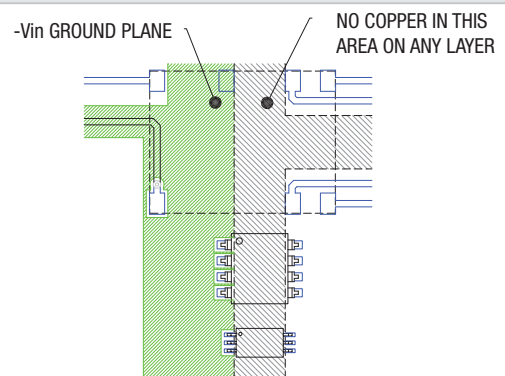
### PIN CONNECTIONS

| Pin | Function |
|-----|----------|
| 1   | Dis/Sync |
| 2   | VH RTN   |
| 3   | VH +24V  |
| 4   | VL +24V  |
| 5   | VL RTN   |
| 6   | -Vin     |
| 7   | +Vin     |

### RECOMMENDED FOOTPRINT DETAILS



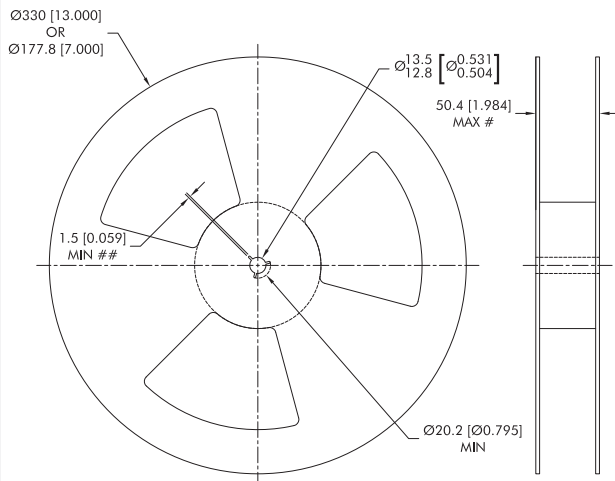
### RECOMMENDED LAYOUT



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

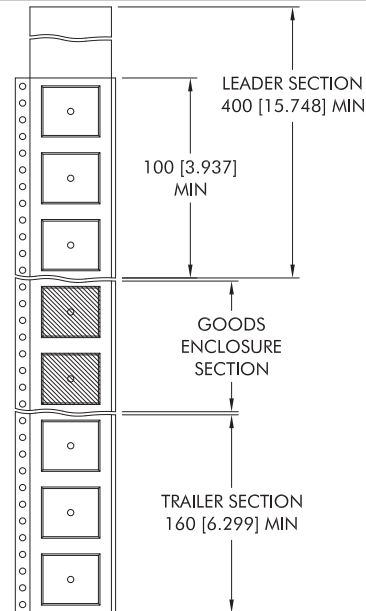
## TAPE & REEL SPECIFICATIONS

### REEL OUTLINE DIMENSIONS



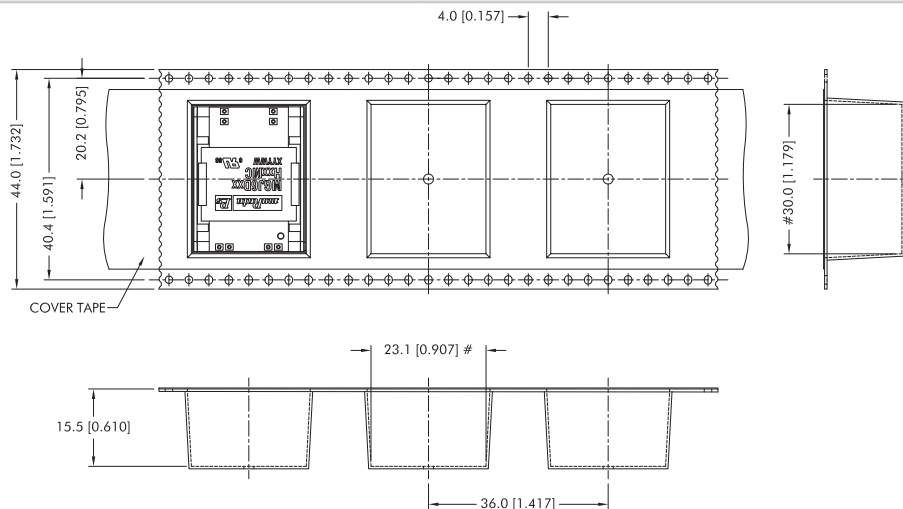
Tape & Reel specifications shall conform with current EIA-481 standard  
Unless otherwise stated all dimensions in mm (inches)  
Controlling dimension is mm  
# Measured at hub  
## Six equi-spaced slots on 180mm/7" reel

### REEL PACKAGING DETAILS



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

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