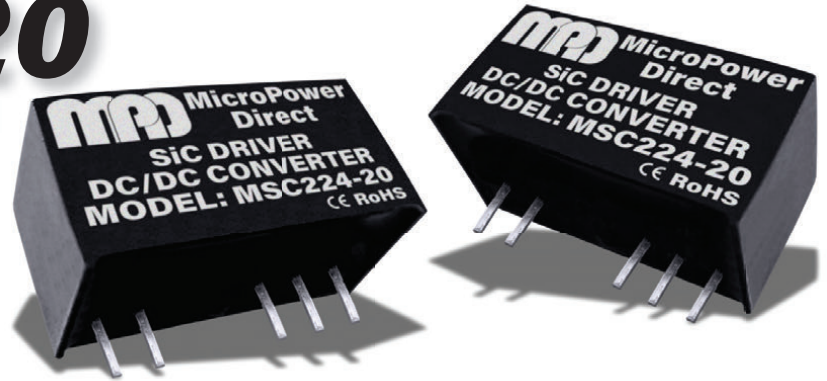


# MSC224-20

## Compact, 3.5 kV ISO SiC MOSFET Driver DC/DC Converter



### Key Features:

- +24 VDC Input
- +20/-4 VDC Outputs
- 80% Efficiency
- -40°C to 105°C Operation
- 3,500 VAC Isolation
- Low Isolation Capacitance
- Miniature SIP Case
- >3.5 MHour MTBF
- Short Circuit Protection
- Industry Standard Pin-Out

RoHS



### MicroPower Direct

292 Page Street  
Suite D  
Stoughton, MA 02072  
USA

T: (781) 344-8226  
F: (781) 344-8481  
E: sales@micropowerdirect.com  
W: www.micropowerdirect.com



### Electrical Specifications

Specifications typical @ +25°C, nominal input voltage & rated output current, unless otherwise noted. Specifications subject to change without notice.

#### Input

Parameter	Conditions	Min.	Typ.	Max.	Units
Supply Voltage Range		21.60		26.40	VDC
Input Filter	Internal Capacitor				

#### Output

Parameter	Conditions	Min.	Typ.	Max.	Units
Output Voltage Accuracy	See Tolerance Graphs On Page 2				
Line Regulation, See Note 1			±1.1	±1.3	%
Load Regulation, See Note 2	20 V <sub>OUT</sub>		5.0	8.0	%
	-4 V <sub>OUT</sub>		10.0	13.0	%
Output Ripple (20 MHz)	See Note 3		60		mV P - P
Output Noise (20 MHz)	See Note 3		75		
Capacitive Load				220	µF
Efficiency		75	80		%
Temperature Coefficient				±0.03	%/°C
Output Short Circuit	Continuous (Autorecovery)				

#### General

Parameter	Conditions	Min.	Typ.	Max.	Units
Isolation Voltage	60 Seconds	3,500			VAC
Isolation Resistance	500 VDC	1,000			MΩ
Isolation Capacitance	100 kHz/0.1V		3.5		pF
Switching Frequency			100		kHz

#### EMI Characteristics

Parameter	Standard	Criteria	Level
Radiated Emissions, See Note 4	EN 55032		Class B
Conducted Emissions, See Note 4	EN 55032		Class B
ESD	EN 61000-4-2	B	±6 kV Contact

#### Environmental

Parameter	Conditions	Min.	Typ.	Max.	Units
Operating Temperature Range	Ambient	-40	+25	+105	°C
Storage Temperature Range		-55		+125	°C
Cooling	Free Air Convection				
Humidity	RH, Non-condensing			95	%

#### Physical

Case Size and Weight	See Mechanical Diagram (Page 4)				
Case Material	Non-Conductive Black Plastic (UL94-V0)				

#### Reliability Specifications

Parameter	Conditions	Min.	Typ.	Max.	Units
MTBF	MIL HDBK 217F, 25°C, Gnd Benign	3.5			MHours

#### Absolute Maximum Ratings

Parameter	Conditions	Min.	Typ.	Max.	Units
Max Supply Voltage (1 Sec)				30.0	VDC
Lead Temperature	1.5 mm From Case For 10 Sec			300	°C

Caution: Exceeding Absolute Maximum Ratings may damage the module. These are not continuous operating ratings.

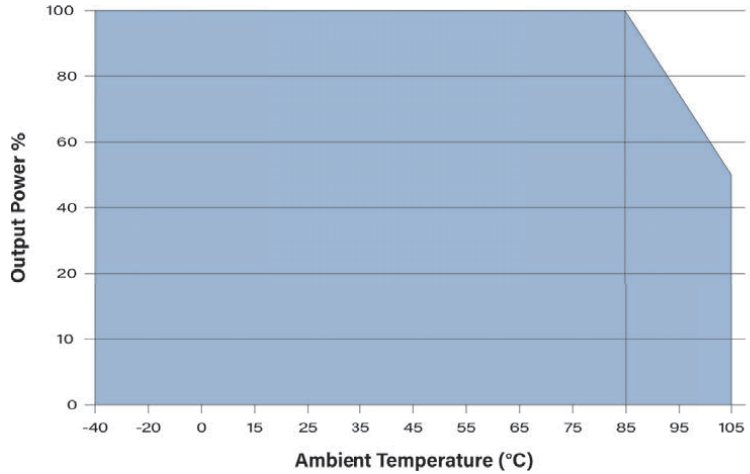
[www.micropowerdirect.com](http://www.micropowerdirect.com)

Model Number	Input (Supply)				Output 1			Output 2			Fuse Rating Slow-Blow (mA)
	Voltage (VDC)		Current (mA)		Voltage	Current (mA)		Voltage	Current (mA)		
	Nom.	Range	Full Load	No Load	Nom. (VDC)	Max	Min	Nom. (VDC)	Max	Min	
MSC224-20	24.0	21.60 - 26.40	125	13	20.0	100.0	10.0	-4.0	-100.0	-10.0	250

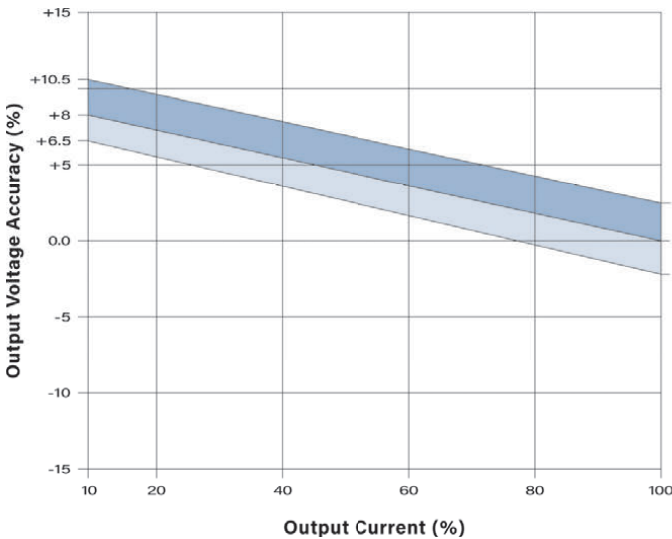
**Notes:**

1. Line regulation is measured for an input voltage change of  $\pm 10\%$ .
2. Load regulation is measured from 10% load to full load.
3. When measuring output ripple & noise, it is recommended that an external capacitor ( $1 \mu\text{F}$  to  $10 \mu\text{F}$ ) be placed from each output to common.
4. The unit will meet the radiated and conducted EMI specifications with the addition of external components as shown in the connection diagram on page 3. These components are shown inside the dotted line box at the bottom of the illustration
5. Operation at no-load will not damage these units. However, they may not meet all specifications.
6. It is recommended that a fuse be used on the input of a power supply for protection. See the Model Selection table above for the correct rating.

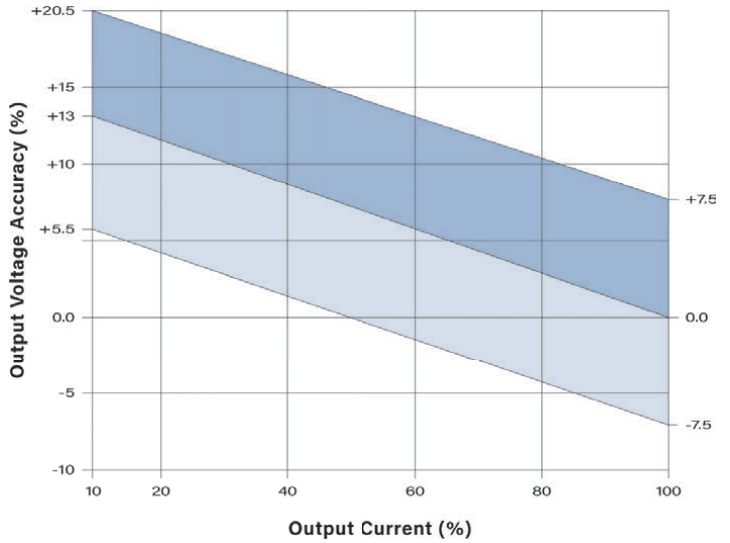
**Derating Curve**



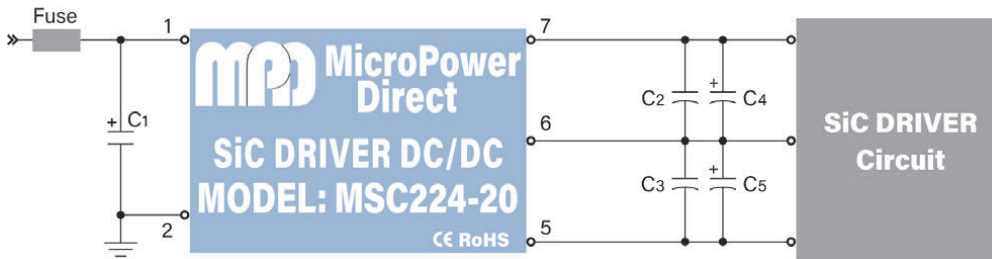
**Output Voltage Tolerance: +20V Output**



**Output Voltage Tolerance: -4V Output**



**Simple Connection**



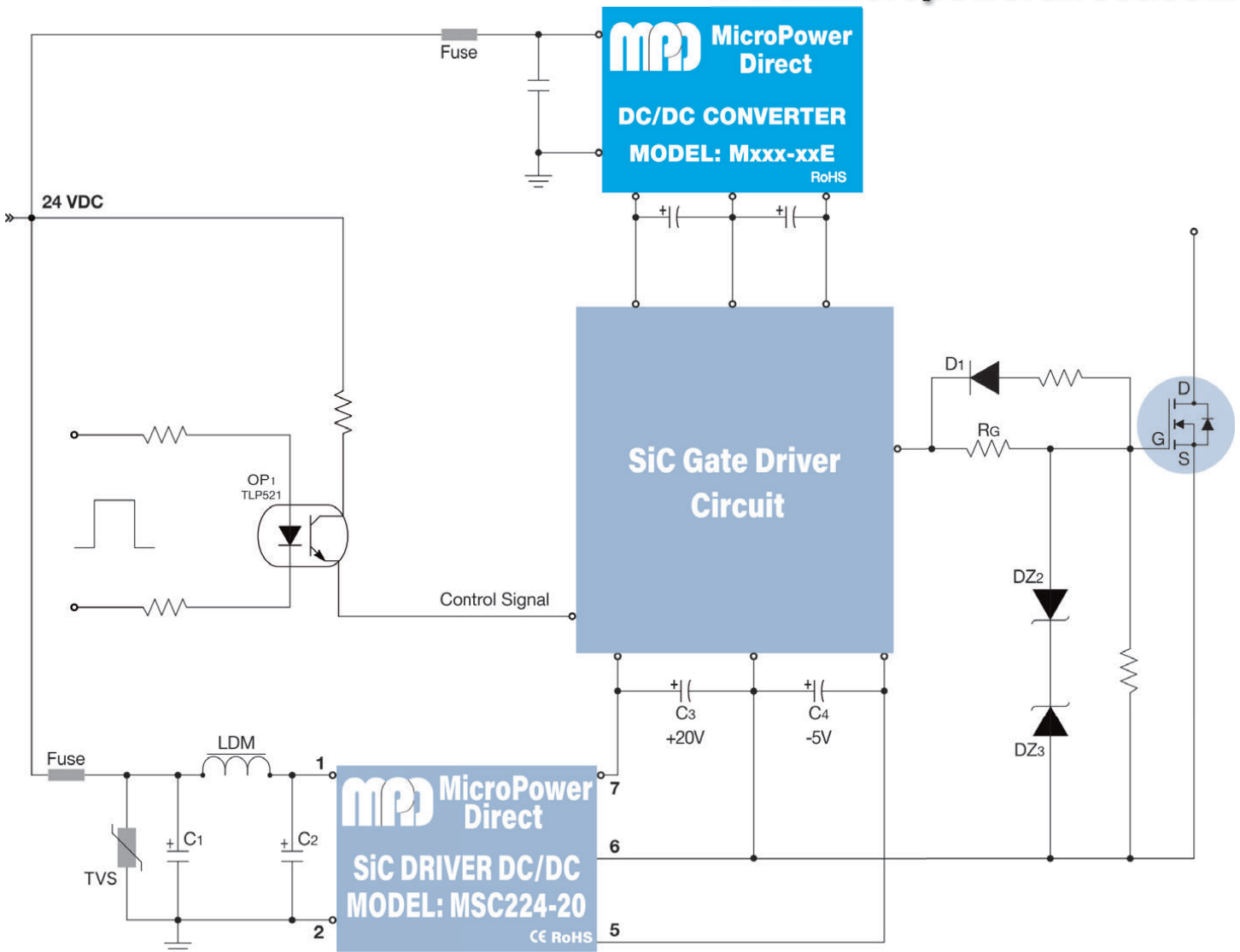
Recommended component values:

Component	Input Voltage
	24 VDC
C1	100 $\mu\text{F}$ /35V
C2, C3	1.0 $\mu\text{F}$ to 10 $\mu\text{F}$
C4, C5	100 $\mu\text{F}$ /35V

The MSC224-20 is designed to be used in the driver circuits for silicon carbide (SiC) MOSFETs. The asymmetrical outputs of the MSC224-20 provide the positive/negative gate bias needed to efficiently switch the MOSFET.

The circuit above shows a simple connection to a driver circuit. Low ESR electrolytic capacitors should be used. The recommended values for all capacitors is given in the chart at the right of the diagram.

A more complete driver power circuit is illustrated on page 3.



The **MSC224-20** is specifically designed for use in gate driver circuits. With asymmetrical outputs of +20 VDC & -4 VDC, an isolation barrier specified at 3.5 kVAC, very low isolation capacitance and a wide operating temperature range; they are an ideal choice for Silicon Carbide (SiC) MOSFET drive & control circuits.

SiC MOSFETs are often used in high voltage, very high frequency applications. The figure above illustrates a typical connection to a driver circuit. Again, **MPD** offers a number of power products that can be used in gate driver circuits (IGBT and SiC).

The circuit above uses two **MPD** parts. At the top, a DC/DC converter is used convert the 24 VDC system bus into voltage levels required by the driver components (if required). This converter also isolates the driver circuit from the power bus. **MPD** offers hundreds of standard DC/DC converters at a variety of power levels that can be used for this purpose.

The **MSC224-20** converts the input 24 VDC into asymmetrical +20 VDC & -4.0 VDC outputs. These outputs are used to set up the positive/minus gate bias required for high and low side switching.

The **MSC224-20** also provides power isolation for the gate drive. It is specified for an I/O isolation

level of 3.5 kVAC. The optocoupler provides isolation for the control signal.

Some notes on the **MSC224-20** connection (starting with the input) are:

1. The **MSC224-20** DC/DC should be mounted as close to the SiC driver circuit as possible, to minimize the length of connecting board traces or wires.
2. The **MSC224-20** does not include overload protection (typical of most low power DC/DC's). It is recommended that an external fuse be used. The recommended fuse is shown in the model chart on page two.
3. The **MSC224-20** series does not include internal protection against voltage transients that might occur on the power line (again, this is typical of most low power DC/DC's). It is recommended that an external suppressor be used. We have included a TVS placed in front of the input filtering components. The recommended value is shown in the table at right.
4. The addition of the input filter components (C1, C2 and LDM) will typically bring the **MSC224-20** circuit to within the limits of EN 55032 Class B. The recommended values for these components are shown in the table at right.

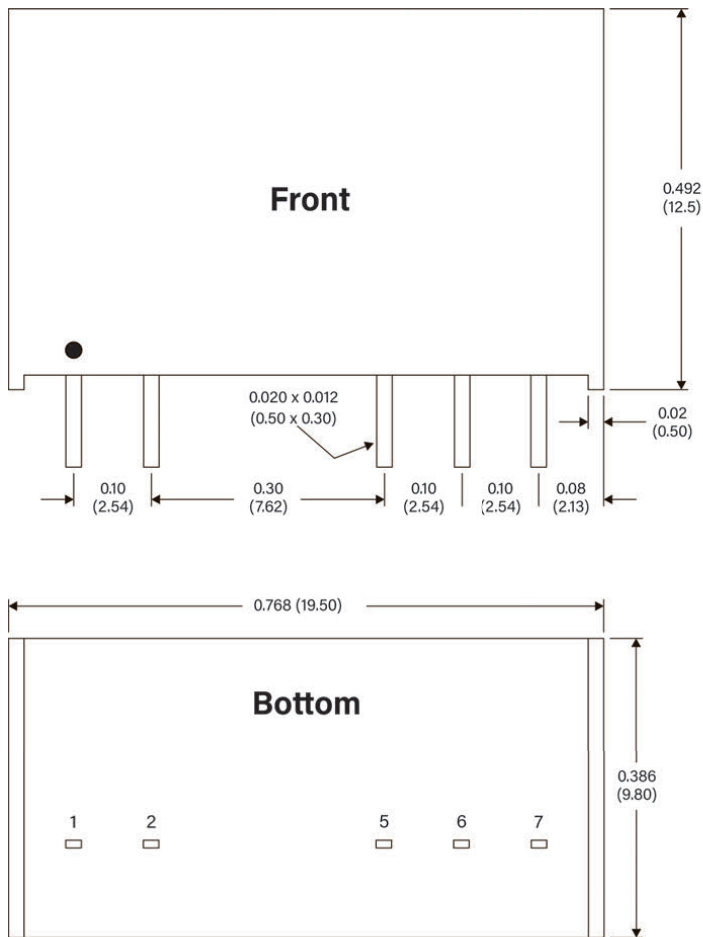
If meeting EN 55032 class A or B is not a concern, the inductor (LDM) and one capacitor (C2) can be eliminated.

5. The recommended values for the decoupling capacitors C3 and C4 are shown in the table below. These low ESR capacitors should be mounted as close to the driver circuit as possible. If needed, 1  $\mu$ F to 5  $\mu$ F ceramic capacitors may be added in parallel with C3 and C4.
6. If used, input filtering components (C1, C2 and LDM) should be mounted as close to the **MSC224-20** as possible. The PC board trace (or wire) between the DC/DC and the driver circuit should be as short as possible.
7. The use of tantalum capacitors in this circuit should be avoided.
8. The recommended values for components are:

Component	Value
TVS	SMBJ30
C1, C2	4.7 $\mu$ F/50V
LDM	6.8 $\mu$ H
C3, C4	100 $\mu$ F/35V

## Mechanical Dimensions

www.micropowerdirect.com



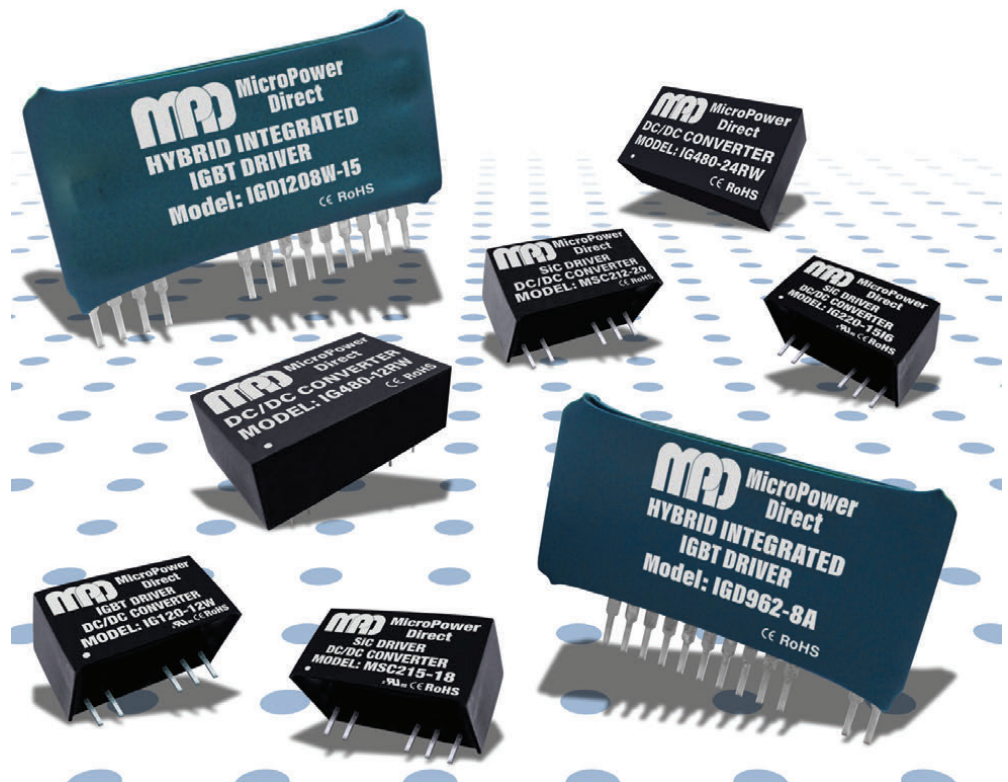
## Pin Connections

Pin	Function
1	+VIN
2	Gnd
5	-VOUT
6	Common
7	+VOUT

### Notes:

- All dimensions are typical in inches (mm)
- Pin 1 is marked by a "dot" or indentation on the unit
- General Tolerance =  $\pm 0.01$  ( $\pm 0.25$ )
- Pin Tolerance =  $\pm 0.004$  ( $\pm 0.10$ )
- Recommended pin hole size (on the application PC Board) is  $\varnothing 0.039$  ( $\varnothing 1.00$ )
- Weight (Typ) = 0.148 Oz (4.2g)

MPD offers a very wide range of products specifically designed for use in high power, high speed gate drive circuits. Products include miniature DC/DC converters with asymmetrical outputs that fit the specific requirements of IGBT and SiC semiconductors. Also available are IGBT driver circuits that include much of the control circuit in a small SIP package. For full information, go to our website or contact the factory.



# MicroPower Direct

**We Power Your Success - For Less!**

292 Page Street Ste D Stoughton, MA 02072 • TEL: (781) 344-8226 • FAX: (781) 344-8481 • E-Mail: sales@micropowerdirect.com