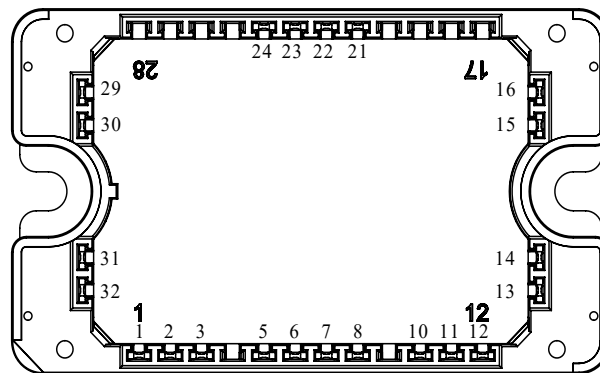
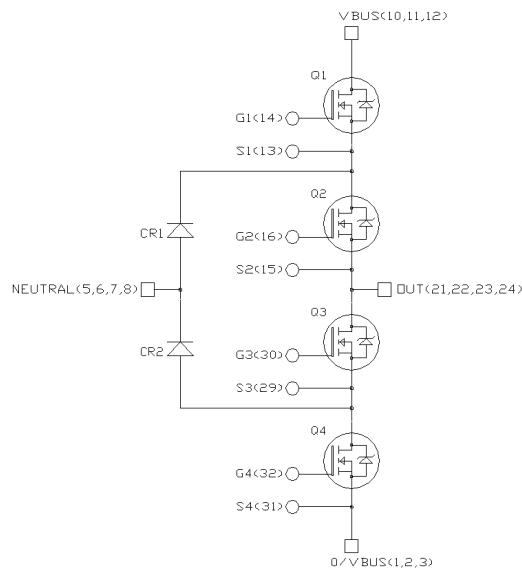


Three Level Inverter SiC MOSFET Power Module

Product Overview

The MSCSM170TLM45C3AG device is a three level inverter 1700V/64A silicon carbide (SiC) MOSFET power module.



Notes:

1. All multiple inputs and outputs must be shorted together. 1/2/3 ; 10/11/12 ; 5/6/7/8 ; 21/22/23/24.
2. All ratings at $T_J = 25\text{ }^\circ\text{C}$, unless otherwise specified.



These devices are sensitive to electrostatic discharge. Proper handling procedures must be followed.

Features

The following are key features of the MSCSM170TLM45C3AG device:

- SiC Power MOSFET
 - Low $R_{DS(on)}$
 - High temperature performance
- SiC Schottky Diode (CR1 and CR2)
 - Zero reverse recovery
 - Zero forward recovery
 - Temperature independent switching behavior
 - Positive temperature coefficient on VF
- Low stray inductance
- Kelvin source for easy drive
- High level of integration
- Aluminum nitride (AlN) substrate for improved thermal performance

Benefits

The following are the benefits of MSCSM170TLM45C3AG device:

- Outstanding performance at high frequency operation
- Direct mounting to heatsink (isolated package)
- Low junction-to-case thermal resistance
- Solderable terminals for power and signal for easy mounting of PCB mounting
- Low profile
- RoHS Compliant

Application

The MSCSM170TLM45C3AG device is designed for the following applications:

- Uninterruptible power supplies

Electrical Specifications

This section provides the electrical specifications of the MSCSM170TLM45C3AG device.

SiC MOSFET Characteristics (Per SiC MOSFET)

The following table lists the absolute maximum ratings per SiC MOSFET of the MSCSM170TLM45C3AG device.

Table 1. Absolute Maximum Ratings

| Symbol | Parameter | Maximum Ratings | Unit |
|--------------|----------------------------|----------------------------------|------------|
| V_{DSS} | Drain-Source voltage | 1700 | V |
| I_D | Continuous drain current | $T_C = 25\text{ }^\circ\text{C}$ | 64 |
| | | $T_C = 80\text{ }^\circ\text{C}$ | 51 |
| I_{DM} | Pulsed drain current | 130 | |
| V_{GS} | Gate-Source voltage | -10/23 | V |
| $R_{DS(on)}$ | Drain-Source ON resistance | 45 | m Ω |
| P_D | Power dissipation | $T_C = 25\text{ }^\circ\text{C}$ | 319 |

The following table lists the electrical characteristics per SiC MOSFET of the MSCSM170TLM45C3AG device.

Table 2. Electrical Characteristics

| Symbol | Characteristic | Test Conditions | Min. | Typ. | Max. | Unit |
|--------------|---------------------------------|---|------|------|------|---------------|
| I_{DSS} | Zero gate voltage drain current | $V_{GS} = 0V$; $V_{DS} = 1700V$ | — | 10 | 100 | μA |
| $R_{DS(on)}$ | Drain-Source on resistance | $V_{GS} = 20V$ | — | 35 | 45 | m Ω |
| | | $I_D = 30A$ | — | 62 | — | |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{GS} = V_{DS}$; $I_D = 2.5\text{ mA}$ | 1.8 | 3.2 | — | V |
| I_{GSS} | Gate-Source leakage current | $V_{GS} = 20V$; $V_{DS} = 0V$ | — | — | 150 | nA |

The following table lists the dynamic characteristics per SiC MOSFET of the MSCSM170TLM45C3AG device.

Table 3. Dynamic Characteristics

| Symbol | Characteristic | Test Conditions | Min. | Typ. | Max. | Unit |
|--------------|-------------------------------------|--|------|------|------|---------------|
| C_{iss} | Input capacitance | $V_{GS} = 0V$ | — | 3300 | — | pF |
| C_{oss} | Output capacitance | $V_{DS} = 1000V$ | — | 150 | — | |
| C_{rss} | Reverse transfer capacitance | $f = 1\text{ MHz}$ | — | 10 | — | |
| Q_g | Total gate charge | $V_{GS} = -5V/20V$ | — | 178 | — | nC |
| Q_{gs} | Gate-source charge | $V_{Bus} = 850V$ | — | 49 | — | |
| Q_{gd} | Gate-drain charge | $I_D = 30A$ | — | 27 | — | |
| $T_{d(on)}$ | Turn-on delay time | $V_{GS} = -5V/20V$ | — | 24 | — | ns |
| T_r | Rise time | $V_{Bus} = 900V$ | | | | |
| $T_{d(off)}$ | Turn-off delay time | $I_D = 50A$ | | | | |
| T_f | Fall time | $R_{G(on)} = 4.7\Omega$ $R_{G(off)} = 2.7\Omega$ | | | | |
| E_{on} | Turn-on energy | $V_{GS} = -5V/20V$ | — | 1.1 | — | mJ |
| E_{off} | Turn-off energy | $V_{Bus} = 900V$ $I_D = 50A$ $R_{G(on)} = 4.7\Omega$ $R_{G(off)} = 2.7\Omega$ | — | 0.16 | — | |
| R_{Gint} | Internal gate resistance | | — | 0.85 | — | Ω |
| R_{thJC} | Junction-to-case thermal resistance | | — | — | 0.47 | $^{\circ}C/W$ |

The following table lists the body diode ratings and characteristics per SiC MOSFET of the MSCSM170TLM45C3AG device.

Table 4. Body Diode Ratings and Characteristics

| Symbol | Characteristic | Test Conditions | Min. | Typ. | Max. | Unit |
|----------|--------------------------|---|------|------|------|------|
| V_{SD} | Diode forward voltage | $V_{GS} = 0V; I_{SD} = 30A$ | — | 3.7 | — | V |
| | | $V_{GS} = -5V; I_{SD} = 30A$ | — | 3.9 | — | |
| t_{rr} | Reverse recovery time | $I_{SD} = 30A; V_{GS} = -5V$ | — | 27 | — | ns |
| Q_{rr} | Reverse recovery charge | $V_R = 900V; di_F/dt = 1000\text{ A}/\mu\text{s}$ | — | 650 | — | nC |
| I_{rr} | Reverse recovery current | | — | 46 | — | A |

CR1 and CR2 SiC Diode Ratings and Characteristics (Per SiC Diode)

The following table lists the CR1 and CR2 SiC diode ratings and characteristics per SiC diode of MSCSM170TLM45C3AG device.

Table 5. SiC Schottky Diode Ratings and Characteristics

| Symbol | Characteristic | Test Conditions | | Min. | Typ. | Max. | Unit |
|------------|-------------------------------------|--------------------------------|-----------------------------------|------|------|------|--------------------|
| V_{RRM} | Peak repetitive reverse voltage | | | — | — | 1700 | V |
| I_{RRM} | Reverse leakage current | $V_R = 1700V$ | $T_J = 25\text{ }^\circ\text{C}$ | — | 10 | 200 | μA |
| | | | $T_J = 175\text{ }^\circ\text{C}$ | — | 150 | — | |
| I_F | DC forward current | — | $T_C = 125\text{ }^\circ\text{C}$ | — | 30 | — | A |
| V_F | Diode forward voltage | $I_F = 30A$ | $T_J = 25\text{ }^\circ\text{C}$ | — | 1.5 | 1.8 | V |
| | | | $T_J = 175\text{ }^\circ\text{C}$ | — | 2.3 | — | |
| Q_C | Total capacitive charge | $V_R = 900V$ | | — | 230 | — | nC |
| C | Total capacitance | $f = 1\text{ MHz}, V_R = 600V$ | | — | 167 | — | pF |
| | | $f = 1\text{ MHz}, V_R = 900V$ | | — | 138 | — | |
| R_{thJC} | Junction-to-case thermal resistance | | | — | — | 0.52 | $^\circ\text{C/W}$ |

Thermal and Package Characteristics

The following table lists the thermal and package characteristics of the MSCSM170TLM45C3AG device.

Table 6. Thermal and Package Characteristics

| Symbol | Characteristics | | Min. | Max. | Unit |
|------------|--|----------------|------|-----------------|------------------|
| V_{ISOL} | RMS isolation voltage, any terminal to case $t = 1\text{ min}$, 50 Hz/60 Hz | | 4000 | — | V |
| T_J | Operating junction temperature range | | –40 | 175 | $^\circ\text{C}$ |
| T_{JOP} | Recommended junction temperature under switching conditions | | –40 | $T_{Jmax} - 25$ | |
| T_{STG} | Storage temperature range | | –40 | 125 | |
| T_C | Operating case temperature | | –40 | 125 | |
| Torque | Mounting torque | To heatsink M4 | 2 | 3 | |
| Wt | Package weight | | — | 110 | g |

Typical SiC MOSFET Performance Curve

This section shows the typical SiC MOSFET performance curves of the MSCSM170TLM45C3AG device.

Figure 1. Maximum Thermal Impedance

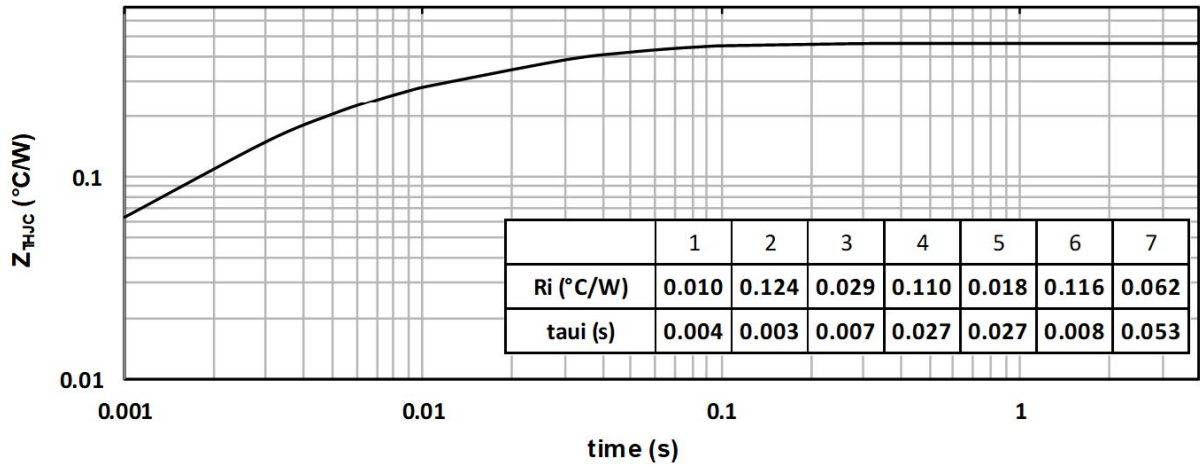


Figure 2. Output Characteristics, $T_J = 25^\circ\text{C}$

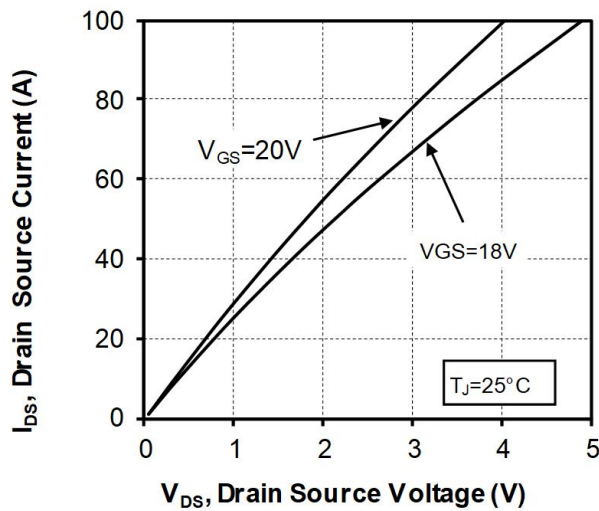


Figure 3. Output Characteristics, $T_J = 175^\circ\text{C}$

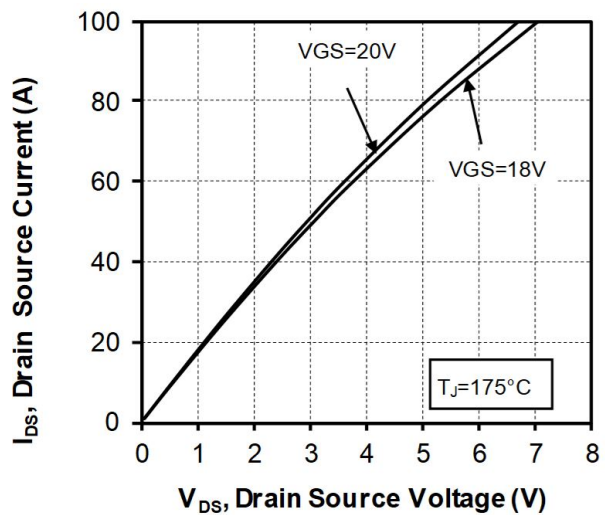


Figure 4. Normalized $R_{DS(on)}$ vs. Temperature

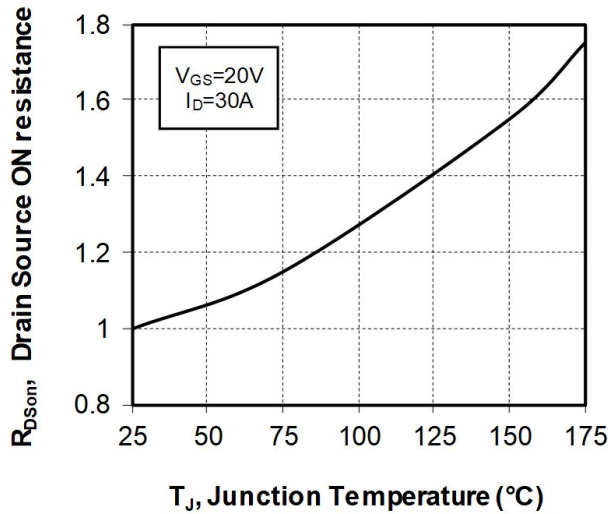


Figure 5. Transfer Characteristics

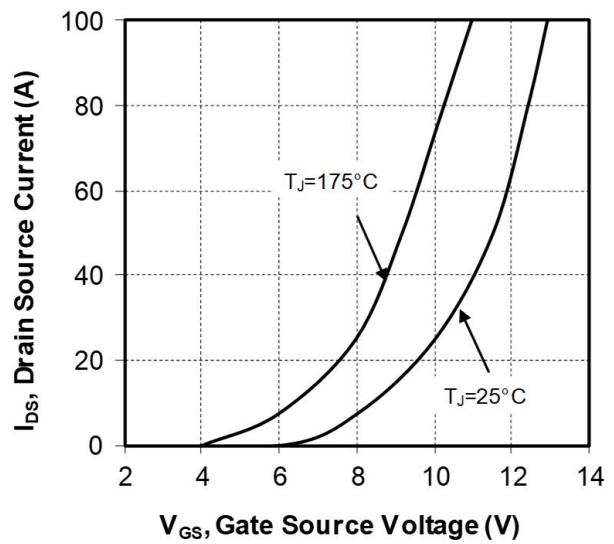


Figure 6. Switching Energy vs. R_g

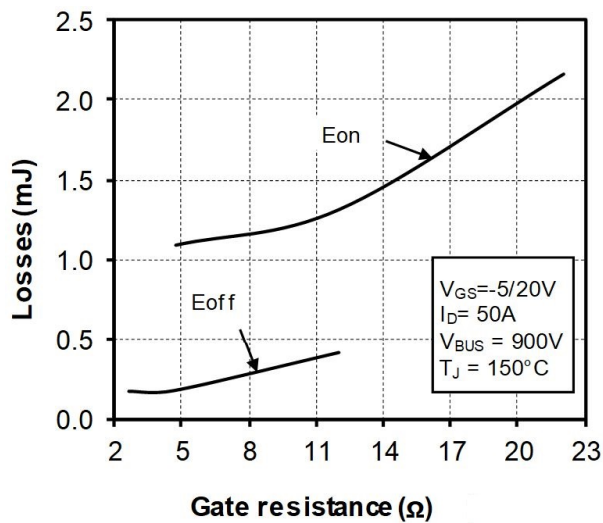


Figure 7. Switching Energy vs. Current

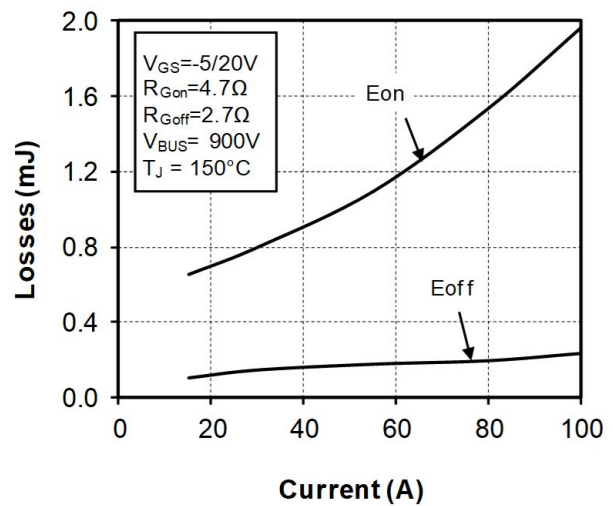


Figure 8. Capacitance vs. Drain Source Voltage

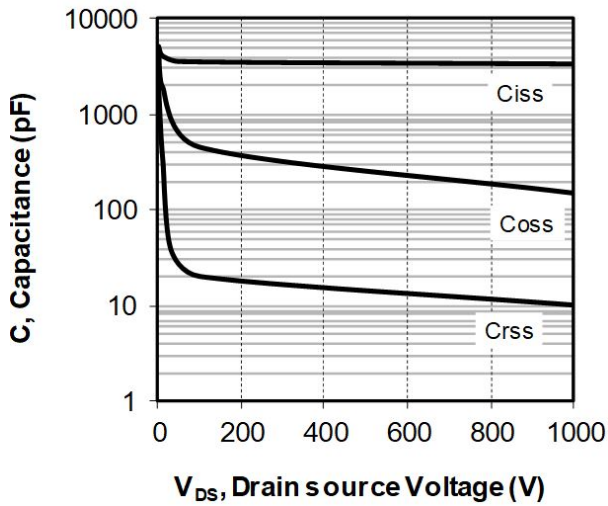


Figure 9. Gate Charge vs. Gate Source Voltage

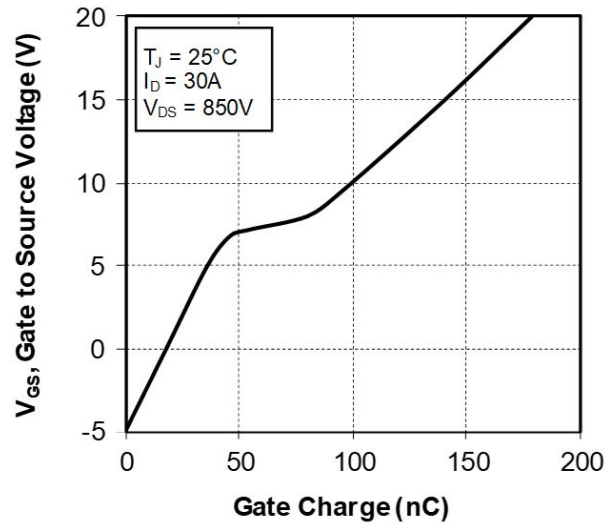


Figure 10. Body Diode Characteristics, $T_J = 25^\circ\text{C}$

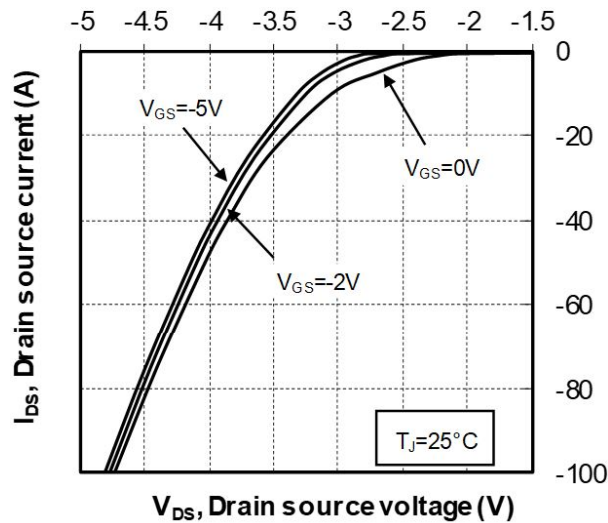


Figure 11. 3rd Quadrant Characteristics, $T_J = 25^\circ\text{C}$

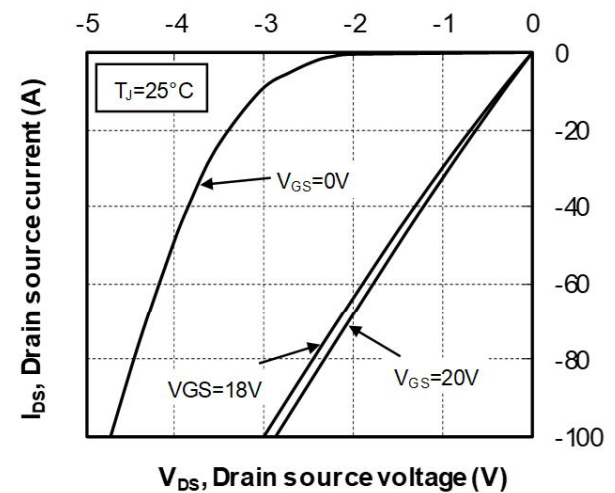


Figure 12. Body Diode Characteristics, $T_J = 175^\circ\text{C}$

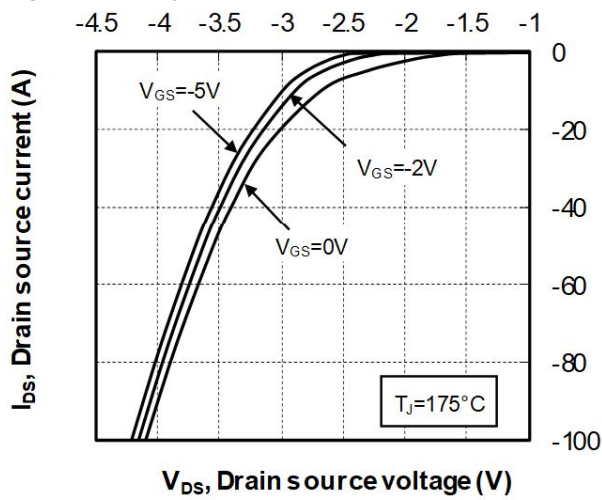


Figure 13. 3rd Quadrant Characteristics, $T_J = 175^\circ\text{C}$

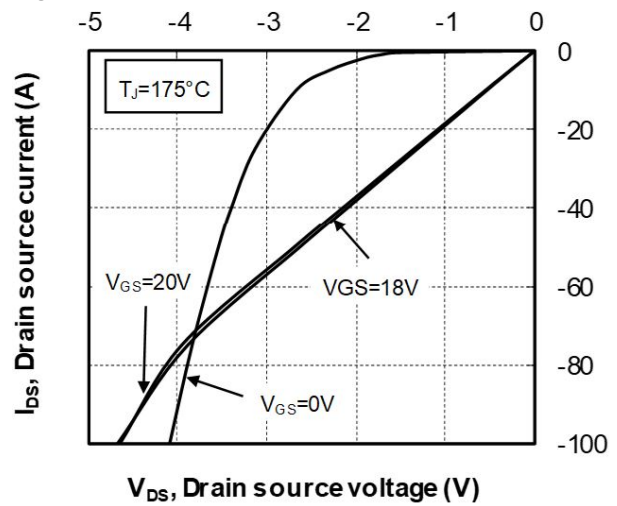
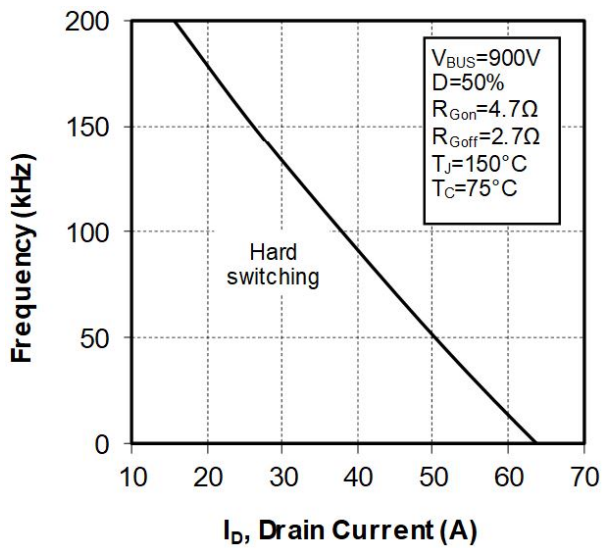


Figure 14. Operating Frequency vs Drain Current



Typical SiC Diode Performance Curves

This section shows the typical SiC diode performance curves of the MSCSM170TLM45C3AG device.

Figure 15. Maximum Thermal Impedance

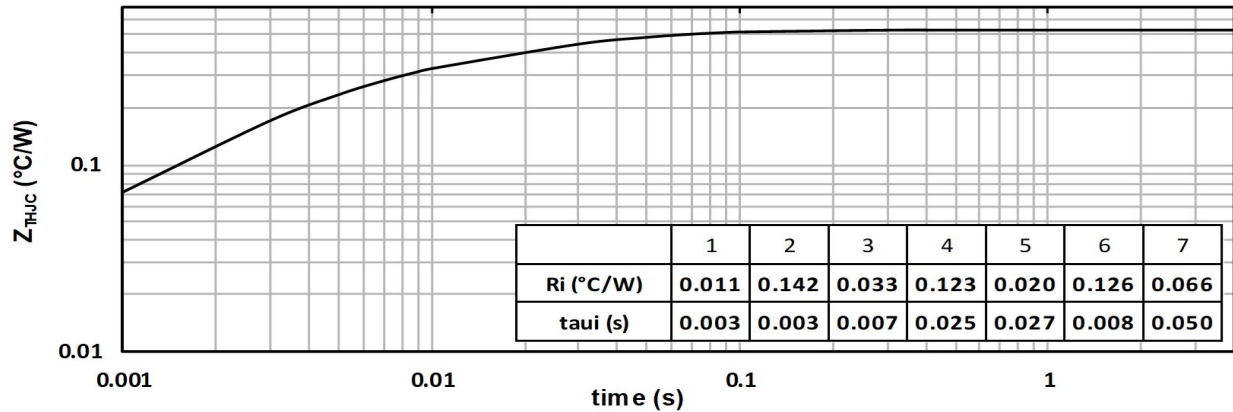


Figure 16. Forward Characteristics

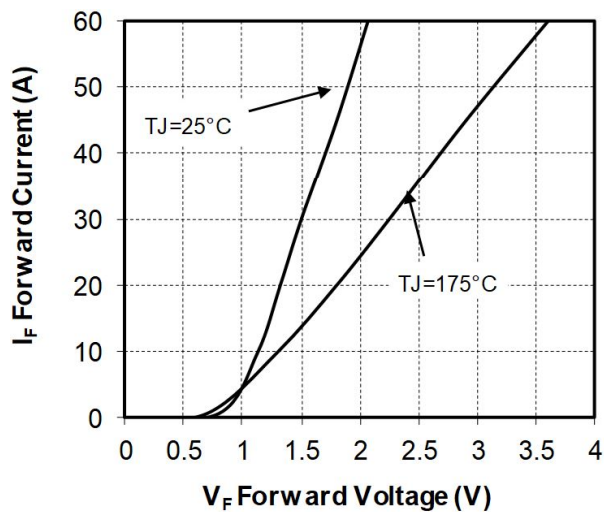
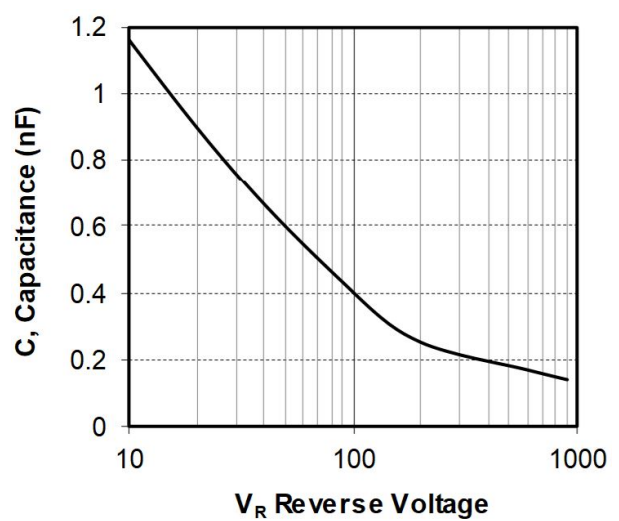


Figure 17. Capacitance vs. Reverse Voltage



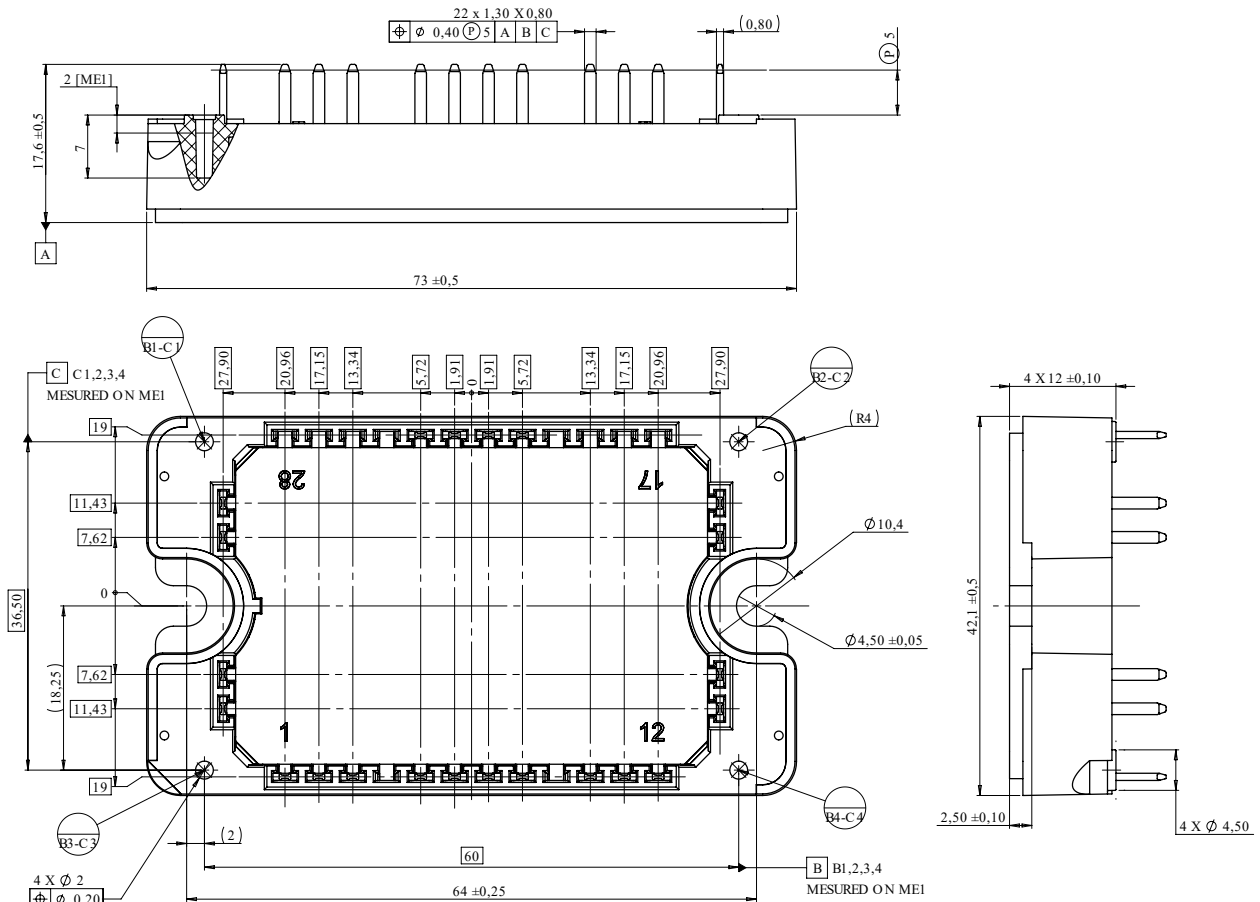
Package Specifications

The following section shows the package specification of the MSCSM170TLM45C3AG device.

Package Outline

The following figure shows the package outline drawing of the MSCSM170TLM45C3AG device. The dimensions in the following figure are in millimeters.

Figure 18. Package Outline Drawing



Note: See [AN3500A—Mounting Instructions for SP1F and SP3F Power Modules](#) for more information..

Revision History

| Revision | Date | Description |
|----------|---------|---|
| A | 12/2021 | This is the first publication of this document. |

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