

# CAS325M12HM2

## 1.2 kV, 3.7 mΩ All-Silicon Carbide High-Performance, Half-Bridge Module C2M MOSFET and Z-Rec™ Diode

|                                |        |
|--------------------------------|--------|
| $V_{DS}$                       | 1.2 kV |
| $E_{sw, Total}$ @ 600 V, 300 A | 9.3 mJ |
| $R_{DS(on)}$                   | 3.7 mΩ |

### Features

- Ultra-Low Loss, Low (5 nH) Inductance
- Ultra-Fast Switching Operation
- Zero Reverse Recovery Current from Diode
- Zero Turn-Off Tail Current from MOSFET
- Normally-Off, Fail-Safe Device Operation
- AlSiC Baseplate and  $\text{Si}_3\text{N}_4$  AMB Substrate
- Ease of Paralleling
- High-Temperature Packaging,  $T_{J(max)} = 175^\circ\text{C}$
- AS9100 / ISO9001 Certified Manufacturing

### Package



### System Benefits

- Enables Compact and Lightweight Systems
- High-Efficiency Operation
- Reduced Thermal Requirements

### Applications

- High-Efficiency Converters / Inverters
- Motor & Traction Drives
- Smart-Grid / Grid-Tied Distributed Generation

| Part Number  | Package            | Marking      |
|--------------|--------------------|--------------|
| CAS325M12HM2 | Half-Bridge Module | CAS325M12HM2 |

### Maximum Ratings ( $T_c = 25^\circ\text{C}$ unless otherwise specified)

| Symbol         | Parameter   | Value       | Unit | Test Conditions  | Notes   |
|----------------|---|-------------|------|--|---------|
| $V_{DSmax}$    | Drain - Source Voltage                                | 1.2         | kV   |  |         |
| $V_{GSmax}$    | Gate - Source Voltage, Maximum Values                 | -10/+25     | V    | $T_J = -55$ to $150^\circ\text{C}$                             | Fig. 21 |
|                |   | -10/+23     |      | $T_J = -55$ to $175^\circ\text{C}$                             |         |
| $V_{GSop}$     | Gate - Source Voltage, Recommended Operational Values | -5/+20      | V    | $T_J = -55$ to $150^\circ\text{C}$                             |         |
|                |   | -5/+18      |      | $T_J = -55$ to $175^\circ\text{C}$                             |         |
| $I_D$          | Continuous Drain Current                              | 444         | A    | $T_c = 25^\circ\text{C}, T_J = 175^\circ\text{C}$              |         |
|                |   | 256         |      | $T_c = 125^\circ\text{C}, T_J = 175^\circ\text{C}$             |         |
| $T_{Jmax}$     | Maximum Junction Temperature                          | 175         | °C   |  |         |
| $T_c, T_{STG}$ | Case and Storage Temperature Range                    | -55 to +175 | °C   |  |         |
| $V_{Isol}$     | Case Isolation Voltage                                | 1.2         | kV   | AC, 50 Hz, 1 min   |         |
| $L_{Stray}$    | Stray Inductance                                      | 5           | nH   | Measured between terminals 1 and 3                             |         |
| $P_D$          | Power Dissipation                                     | 1500        | W    | $T_c = 25^\circ\text{C}, T_J = 175^\circ\text{C}$ (per switch) | Fig. 20 |

## Electrical Characteristics ( $T_c = 25^\circ\text{C}$ unless otherwise specified)

| Symbol              | Parameter                       | Min. | Typ. | Max. | Unit             | Test Conditions  | Note            |
|---------------------|---------------------------------|------|------|------|------------------|--|-----------------|
| $V_{DSS}$           | Drain - Source Blocking Voltage | 1.2  |      |      | kV               | $V_{GS} = -5 \text{ V}, I_D = 3.7 \text{ mA}$  |                 |
| $V_{GS(\text{th})}$ | Gate Threshold Voltage          | 2.0  | 2.6  | 4    | V                | $V_{DS} = V_{GS}, I_D = 105 \text{ mA}$  |                 |
|                     |                                 |      | 2.0  |      |                  | $V_{DS} = V_{GS}, I_D = 105 \text{ mA}, T_J = 175^\circ\text{C}$   |                 |
| $I_{DSS}$           | Zero Gate Voltage Drain Current |      | 614  | 3700 | $\mu\text{A}$    | $V_{DS} = 1.2 \text{ kV}, V_{GS} = 0 \text{ V}$  |                 |
| $I_{GSS}$           | Gate-Source Leakage Current     |      |      | 4.2  |                  | $V_{GS} = 20 \text{ V}, V_{DS} = 0 \text{ V}$  |                 |
| $R_{DS(\text{on})}$ | On-State Resistance             |      | 3.7  | 5.0  | $\text{m}\Omega$ | $V_{GS} = 20 \text{ V}, I_{DS} = 350 \text{ A}$  | Fig. 5,<br>6, 7 |
|                     |                                 |      | 7.5  |      |                  | $V_{GS} = 18 \text{ V}, I_{DS} = 350 \text{ A}, T_J = 175^\circ\text{C}$   |                 |
| $C_{ISS}$           | Input Capacitance               |      | 19.5 |      | nF               | $V_{GS} = 0 \text{ V}, V_{DS} = 1000 \text{ V}, f = 1 \text{ MHz}, V_{AC} = 25 \text{ mV}$   | Fig. 14,<br>15  |
| $C_{OSS}$           | Output Capacitance              |      | 1.54 |      |                  |  |                 |
| $C_{RSS}$           | Reverse Transfer Capacitance    |      | 0.10 |      |                  |  |                 |
| $E_{On}$            | Turn-On Switching Energy        |      | 5.6  |      | mJ               | $V_{DD} = 600 \text{ V}, V_{GS} = -5 \text{ V}/+20 \text{ V}$<br>$I_D = 300 \text{ A}, R_{G(\text{ext})} = 2 \Omega$<br>Note: IEC 60747-8-4 Definitions                                  | Fig. 16         |
| $E_{Off}$           | Turn-Off Switching Energy       |      | 3.7  |      |                  |  |                 |
| $E_{\text{Diode}}$  | Diode Switching Energy          |      | 2.8  |      |                  |  |                 |
| $Q_{GS}$            | Gate-Source Charge              |      | 322  |      |                  |  |                 |
| $Q_{GD}$            | Gate-Drain Charge               |      | 350  |      | nC               | $V_{DD} = 800 \text{ V}, V_{GS} = -5 \text{ V}/+20 \text{ V},$<br>$I_D = 350 \text{ A}$ , Per JEDEC24 pg 27  | Fig. 13         |
| $Q_G$               | Total Gate Charge               |      | 1127 |      |                  |  |                 |
| $t_{D(on)}$         | Turn-On Delay Time              |      | 47.6 |      |                  |  |                 |
| $t_R$               | Rise Time                       |      | 35.2 |      | ns               | $V_{DD} = 600 \text{ V}, V_{GS} = -5 \text{ V}/+20 \text{ V}$<br>$I_D = 300 \text{ A}, R_{G(\text{ext})} = 2 \Omega, L = 33 \mu\text{H}$<br>Note: IEC 60747-8-4, pg 83<br>Inductive Load |                 |
| $t_{D(off)}$        | Turn-Off Delay Time             |      | 114  |      |                  |  |                 |
| $t_F$               | Fall Time                       |      | 29.2 |      |                  |  |                 |
| $V_{SD}$            | Diode Forward Voltage           |      | 1.6  | 1.8  | V                | $I_F = 300 \text{ A}, V_{GS} = -5 \text{ V}$   | Fig. 8          |
|                     |                                 |      | 2.3  |      |                  | $I_F = 300 \text{ A}, T_J = 175^\circ\text{C}, V_{GS} = -5 \text{ V}$  |                 |
| $Q_C$               | Total Capacitive Charge         |      | 4.3  |      | $\mu\text{C}$    | Includes Schottky & Body diodes  |                 |

Note: The Diode Switching Energy is purely capacitive.

## Thermal Characteristics

| Symbol      | Parameter                                     | Min.  | Typ.  | Max.  | Unit | Test Conditions | Note           |
|-------------|---|-------|-------|-------|------|-----------------|----------------|
| $R_{thJCM}$ | Thermal Resistance Juction-to-Case for MOSFET | 0.085 | 0.100 | 0.115 | °C/W |                 | Fig. 22,<br>23 |
| $R_{thJCD}$ | Thermal Resistance Junction-to-Case for Diode | 0.094 | 0.110 | 0.127 |      |                 |                |

## Additional Module Data

| Symbol | Parameter                  | Min. | Typ. | Max. | Unit | Test Condition               |
|--------|----------------------------|------|------|------|------|------------------------------|
| W      | Weight                     |      | 140  |      | g    |                              |
| M      | Mounting Torque            | 0.9  | 1.1  | 1.3  | Nm   | Power Terminals, M4 Bolts    |
|        |                            | 3    | 4.5  | 5    |      | Baseplate, M6 Bolts          |
| CTI    | Comparative Tracking Index |      | 600  |      |      |                              |
|        | Clearance Distance         |      | 13.3 |      | mm   | Terminal to Terminal         |
|        |                            |      | 5.6  |      |      | Terminal to Baseplate        |
|        |                            |      | 8    |      |      | Gate-Source Pin to Baseplate |
|        | Creepage Distance          |      | 16.9 |      |      | Terminal to Terminal         |
|        |                            |      | 13.5 |      |      | Terminal to Baseplate        |
|        |                            |      | 12.3 |      |      | Gate-Source Pin to Baseplate |

## Typical Performance

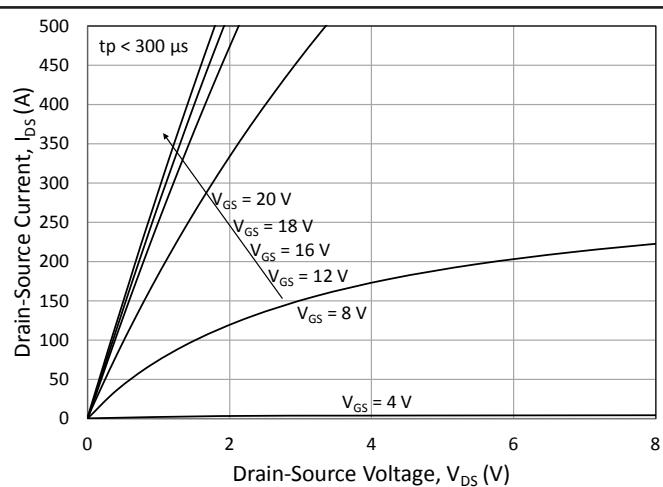


Figure 1. Typical Output Characteristics  $T_J = 25^\circ\text{C}$

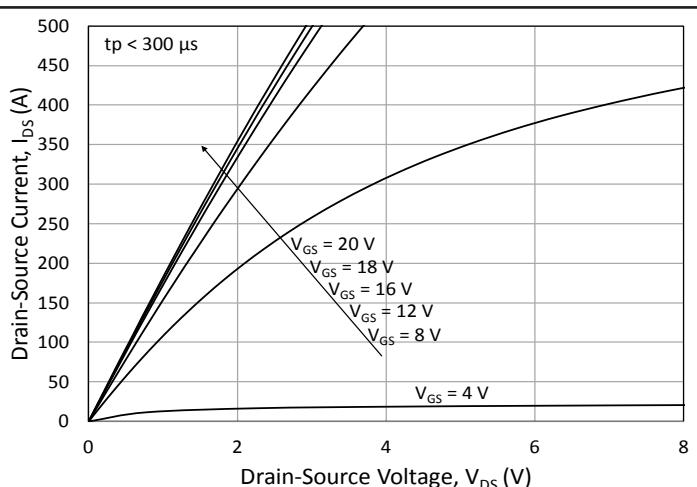


Figure 2. Typical Output Characteristics  $T_J = 125^\circ\text{C}$

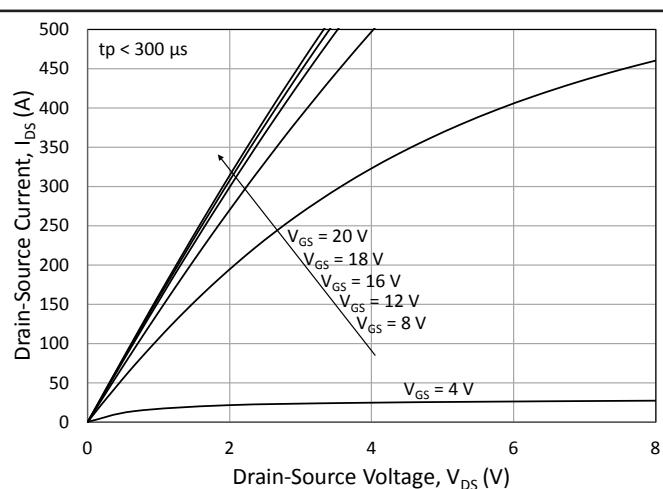


Figure 3. Typical Output Characteristics  $T_J = 150^\circ\text{C}$

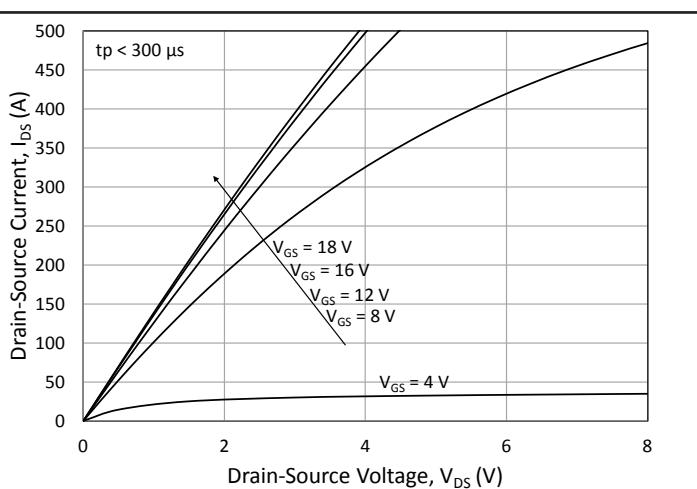


Figure 4. Typical Output Characteristics  $T_J = 175^\circ\text{C}$

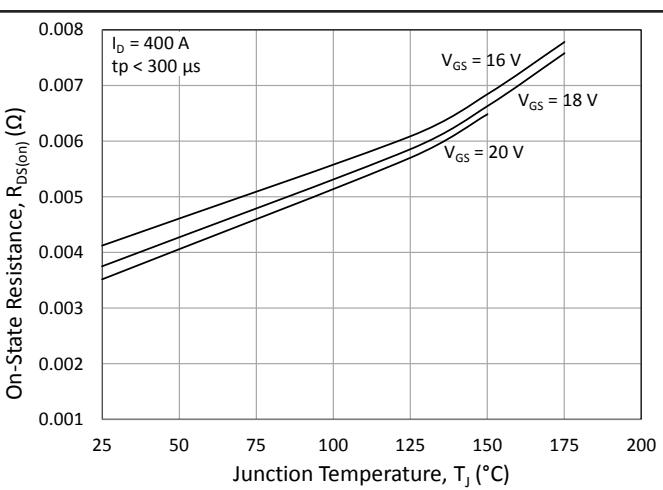


Figure 5. On-State Resistance vs. Temperature for Various Gate-Source Voltages

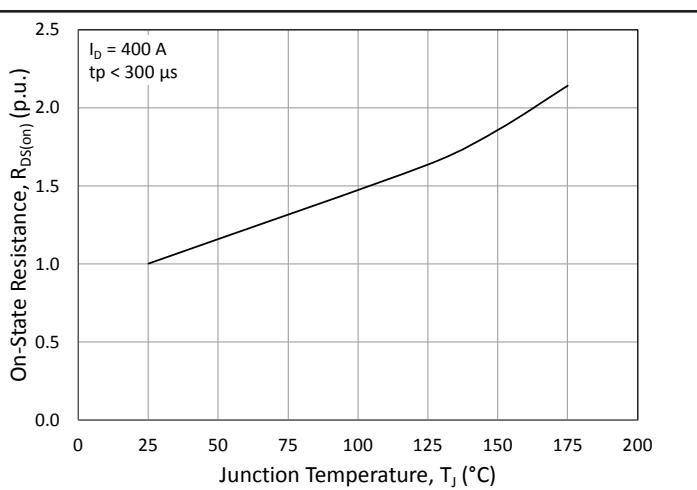


Figure 6. Normalized On-State Resistance vs. Temperature

## Typical Performance

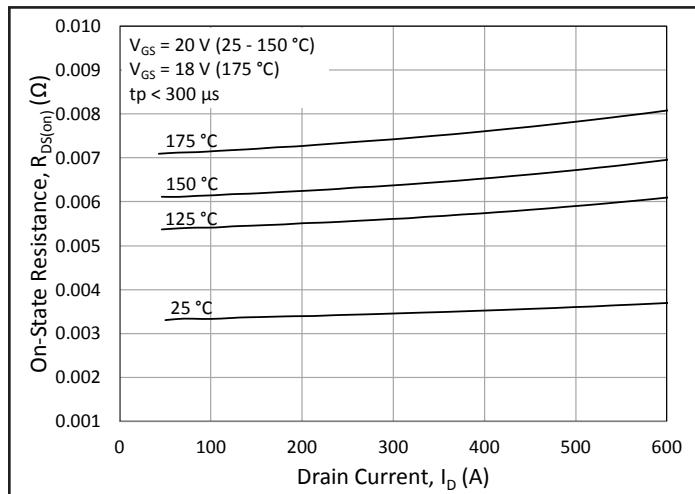


Figure 7. On-State Resistance vs. Drain Current for Various Temperatures

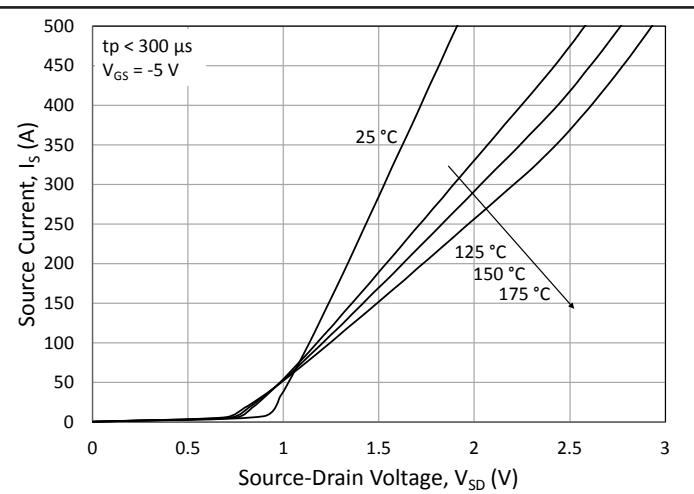


Figure 8. Antiparallel Diode Characteristic for Various Temperatures,  $V_{GS} = -5 \text{ V}$

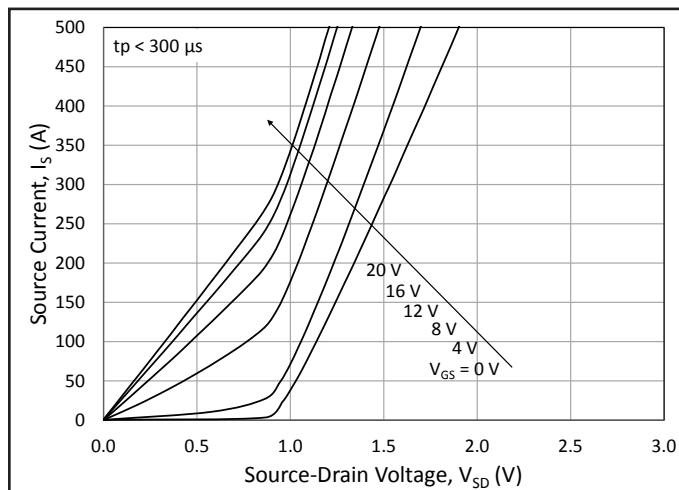


Figure 9. 3<sup>rd</sup> Quadrant Characteristic at 25 °C

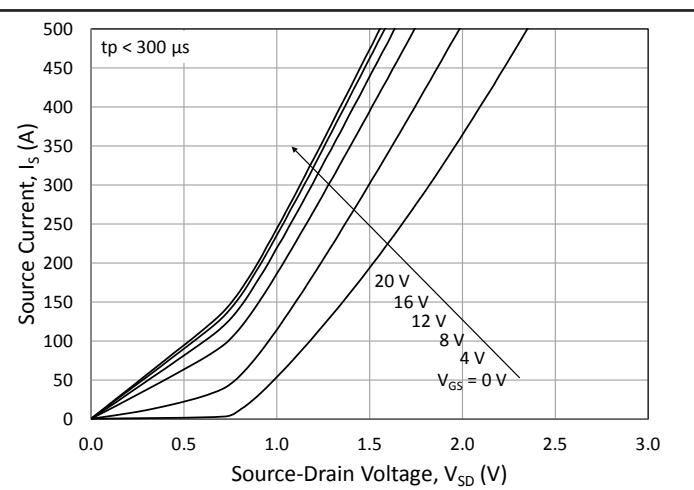


Figure 10. 3<sup>rd</sup> Quadrant Characteristic at 125 °C

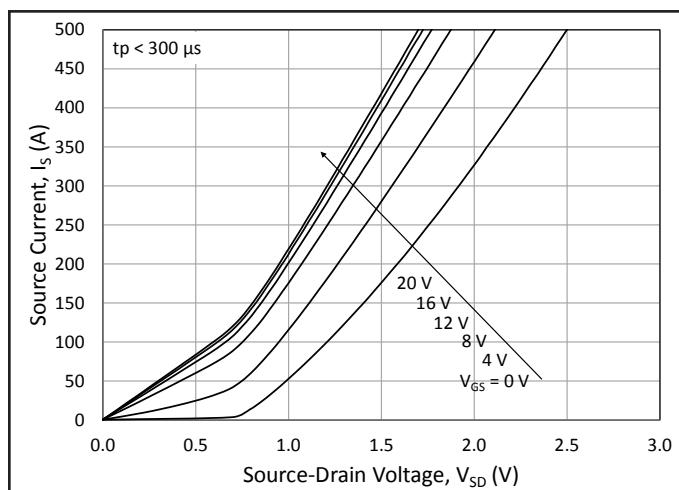


Figure 11. 3<sup>rd</sup> Quadrant Characteristic at 150 °C

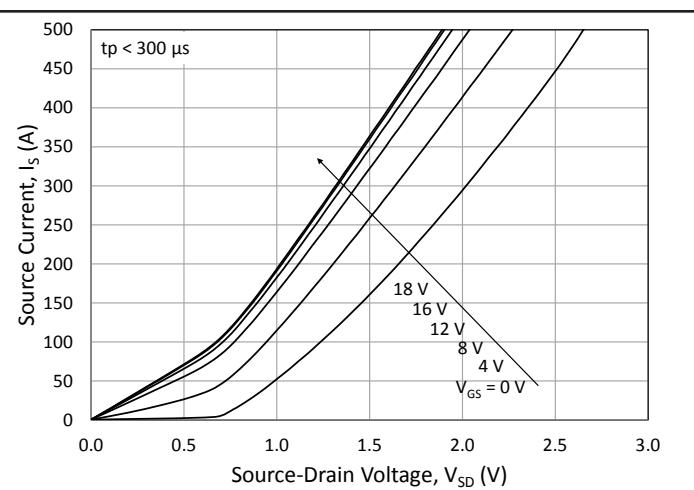


Figure 12. 3<sup>rd</sup> Quadrant Characteristic at 175 °C

## Typical Performance

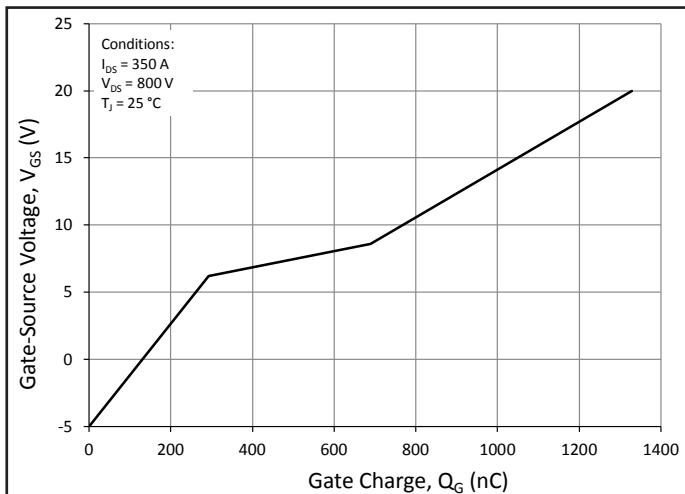


Figure 13. Scaled Gate Charge Characteristic

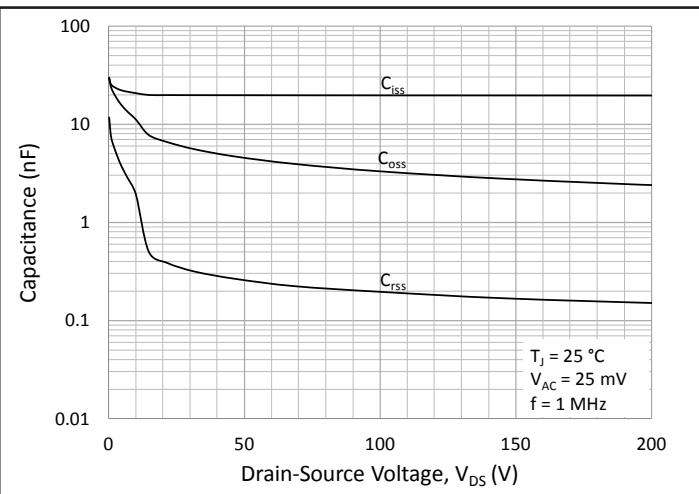


Figure 14. Typical Capacitances vs. Drain-Source Voltage (0 - 200 V)

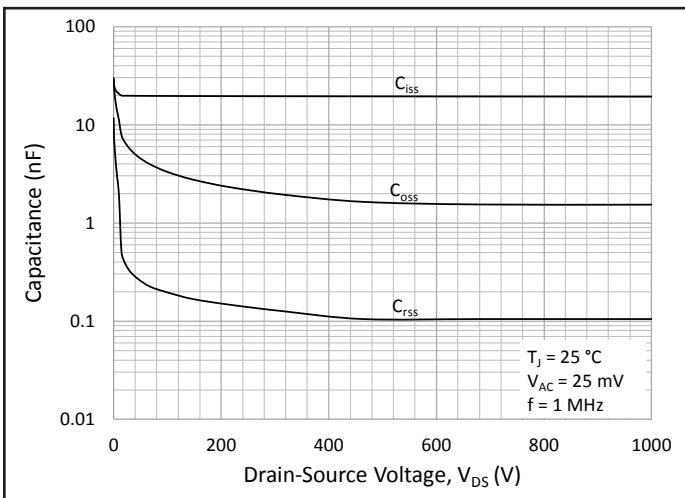


Figure 15. Typical Capacitances vs. Drain-Source Voltage (0 - 1 kV)

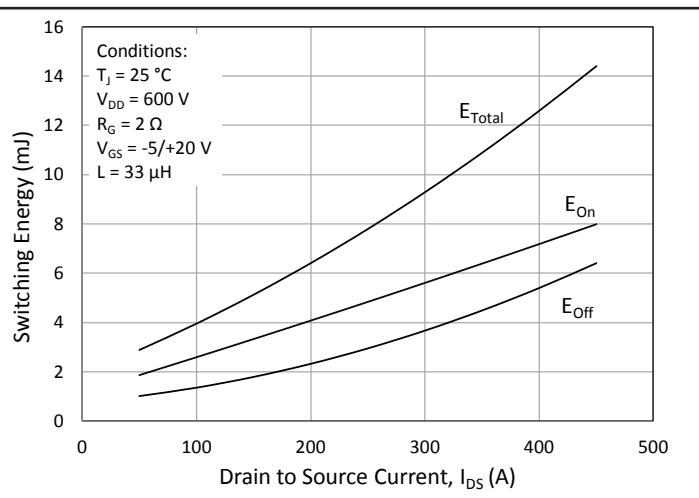


Figure 16. Inductive Switching Energy vs. Drain Current For  $V_{DD} = 600 \text{ V}$ ,  $R_G = 2 \Omega$

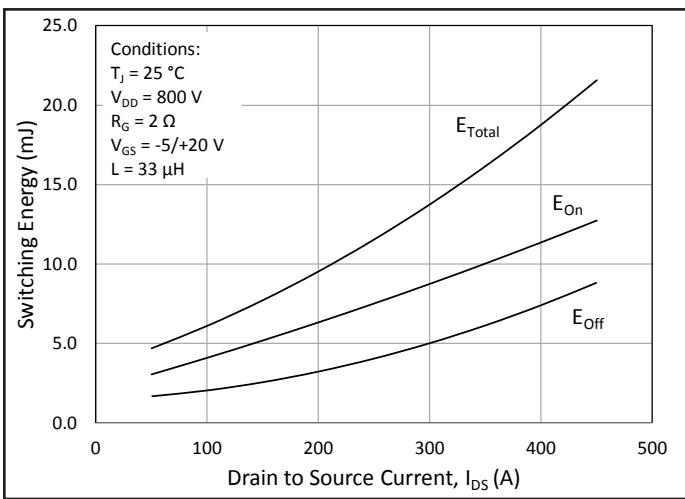


Figure 17. Inductive Switching Energy vs. Drain Current For  $V_{DD} = 800 \text{ V}$ ,  $R_G = 2 \Omega$

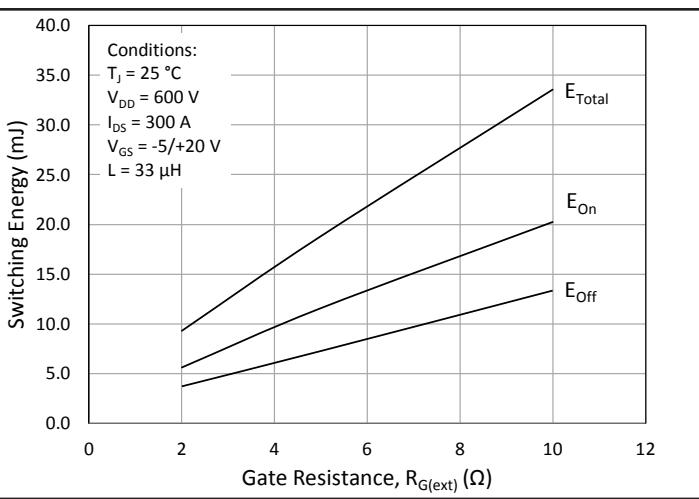


Figure 18. Inductive Switching Energy vs. External Gate Resistance,  $I_{DS} = 300 \text{ A}$

## Typical Performance

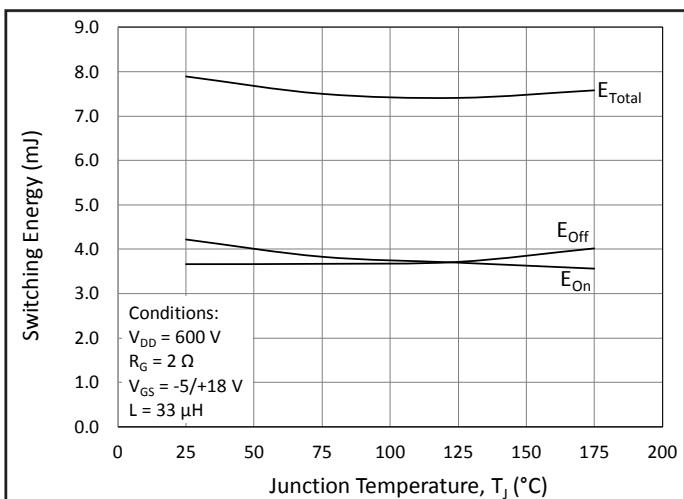


Figure 19. Inductive Switching Energy vs. Temperature

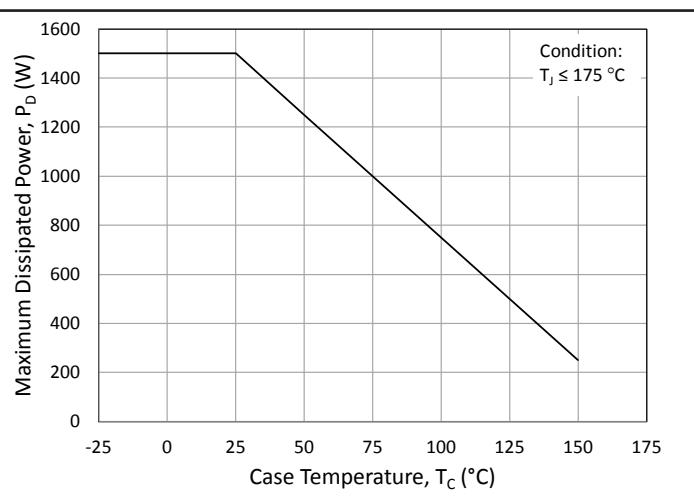


Figure 20. Maximum Power Dissipation (MOSFET) Derating Per Switch Position vs. Case Temperature

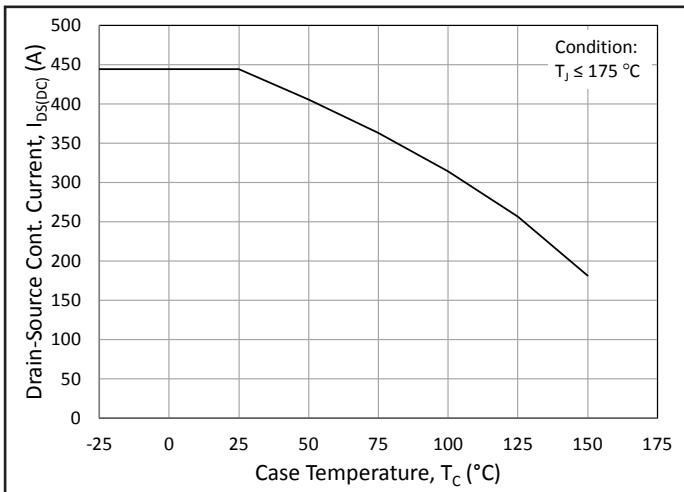


Figure 21. Continuous Drain Current Derating vs. Case Temperature

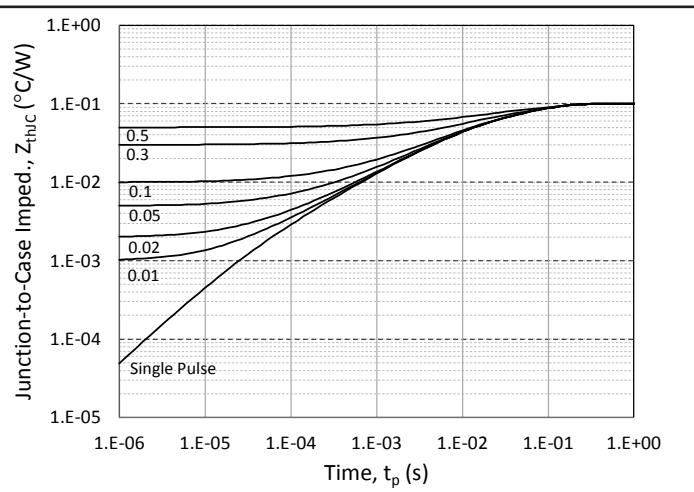


Figure 22. MOSFET Junction-to-Case Thermal Impedance

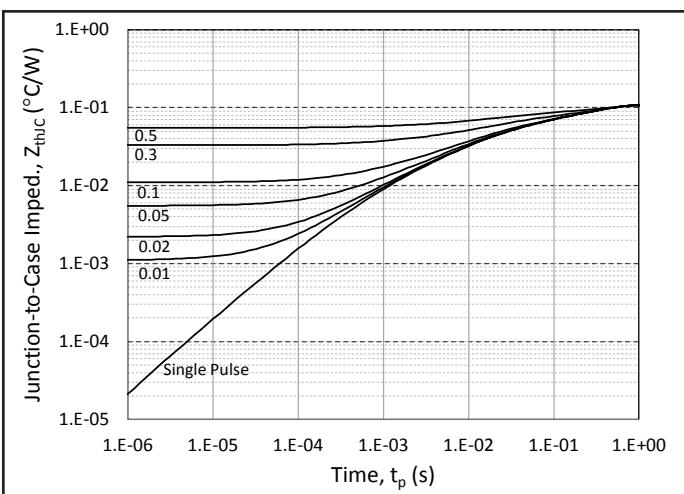


Figure 23. Schottky Diode Junction-to-Case Thermal Impedance

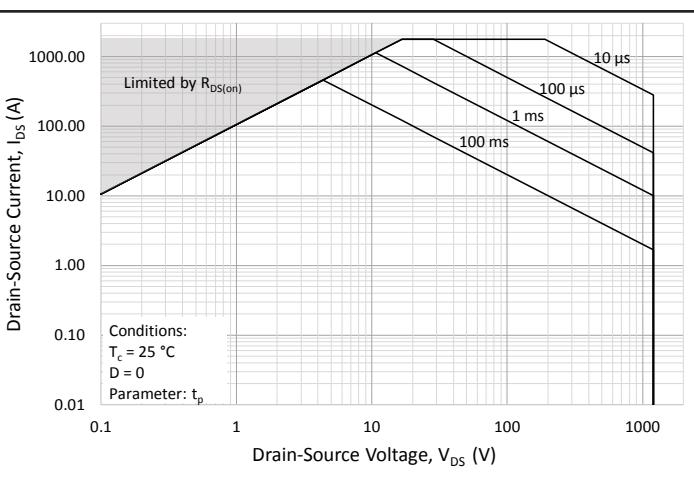
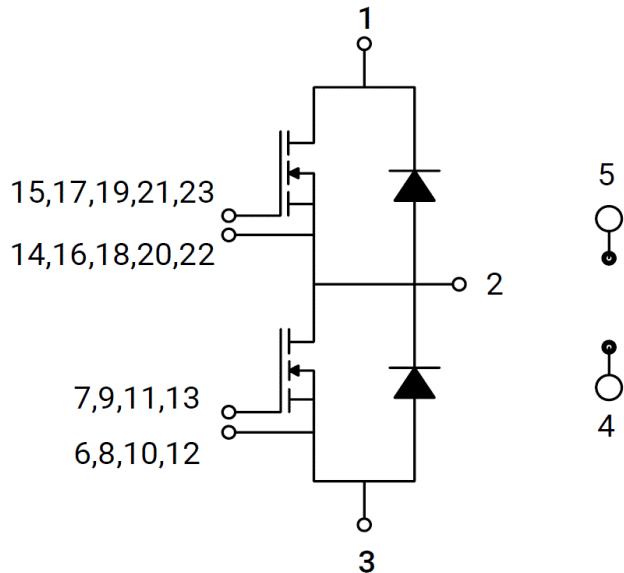
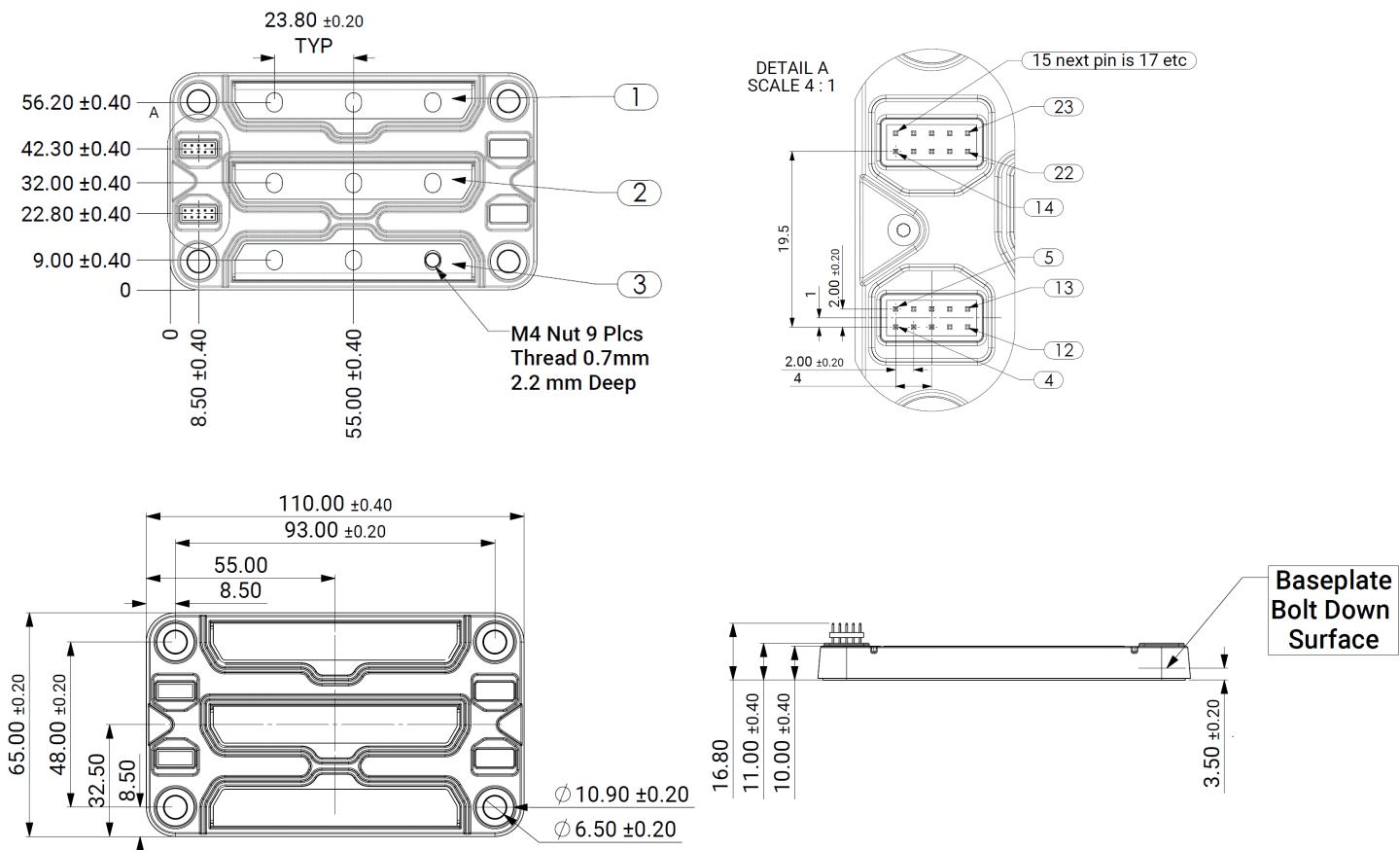


Figure 24. Safe Operating Area

## Schematic



## Package Dimensions (mm)



IF NO TOLERANCE IS SPECIFIED,  
DIMENSION IS FOR REFERENCE ONLY.

(SURFACE MODEL AVAILABLE UPON  
REQUEST)

## Important Notes

- The SiC MOSFET module switches at speeds beyond what is customarily associated with IGBT-based modules. Therefore, special precautions are required to realize the best performance. The interconnection between the gate driver and module housing needs to be as short as possible. This will afford the best switching time and avoid the potential for device oscillation. Also, great care is required to ensure minimum inductance between the module and DC link capacitors to avoid excessive VDS overshoot.
- The module utilizes the ESQT-105-02-G-D-XXX family of elevated socket connectors from Samtec, which are available in varying heights according to the customer's preference.
- Companion Parts: CGD15HB62LP + CRD200DA12E High-Performance, Three-Phase Evaluation Unit.
- Some values were obtained from the CPM2-1200-0025B and CPW5-1200-Z050B device datasheets.
- This product has not been designed or tested for use in, and is not intended for use in, applications implanted into the human body nor in applications in which failure of the product could lead to death, personal injury or property damage, including but not limited to equipment used in the operation of nuclear facilities, life-support machines, cardiac defibrillators or similar emergency medical equipment, aircraft navigation or communication or control systems, air traffic control systems.
- The product described is not eligible for Distributor Stock Rotation or Inventory Price Protection.



# OCEAN CHIPS

## Океан Электроники

### Поставка электронных компонентов

Компания «Океан Электроники» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибутором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения «JONHON», а так же официальным дистрибутором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов «FORSTAR».



## JONHON

«JONHON» (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

«FORSTAR» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели, кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).



Телефон: 8 (812) 309-75-97 (многоканальный)

Факс: 8 (812) 320-03-32

Электронная почта: ocean@oceanchips.ru

Web: <http://oceanchips.ru/>

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А