

# 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 Si<sub>3</sub>N<sub>4</sub> AMB Substrate
- Ease of Paralleling
- High-Temperature Packaging,  $T_{J(max)} = 175\text{ °C}$
- AS9100 / ISO9001 Certified Manufacturing

### 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

**Package** 65 mm x 110 mm x 10 mm



Part Number	Package	Marking
CAS325M12HM2	Half-Bridge Module	CAS325M12HM2

### Maximum Ratings ( $T_c = 25\text{ °C}$ 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	$T_J = -55\text{ to }150\text{ °C}$	
		-10/+23		$T_J = -55\text{ to }175\text{ °C}$	
$V_{GSop}$	Gate - Source Voltage, Recommended Operational Values	-5/+20	V	$T_J = -55\text{ to }150\text{ °C}$	
		-5/+18		$T_J = -55\text{ to }175\text{ °C}$	
$I_D$	Continuous Drain Current	444	A	$T_c = 25\text{ °C}, T_J = 175\text{ °C}$	Fig. 21
		256		$T_c = 125\text{ °C}, T_J = 175\text{ °C}$	
$T_{Jmax}$	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	$T_c = 25\text{ °C}, T_J = 175\text{ °C}$ (per switch)	Fig. 20

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

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
$V_{DSS}$	Drain - Source Blocking Voltage	1.2			kV	$V_{GS} = -5\text{ V}, I_D = 3.7\text{ mA}$	
$V_{GS(th)}$	Gate Threshold Voltage	2.0	2.6	4	V	$V_{DS} = V_{GS}, I_D = 105\text{ mA}$	
			2.0			$V_{DS} = V_{GS}, I_D = 105\text{ mA}, T_J = 175\text{ }^\circ\text{C}$	
$I_{DSS}$	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		$V_{GS} = 20\text{ V}, V_{DS} = 0\text{ V}$	
$R_{DS(on)}$	On-State Resistance		3.7	5.0	m $\Omega$	$V_{GS} = 20\text{ V}, I_{DS} = 350\text{ A}$	Fig. 5, 6, 7
			7.5			$V_{GS} = 18\text{ V}, I_{DS} = 350\text{ A}, T_J = 175\text{ }^\circ\text{C}$	
$C_{ISS}$	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, 15
$C_{OSS}$	Output Capacitance		1.54				
$C_{RSS}$	Reverse Transfer Capacitance		0.10				
$E_{on}$	Turn-On Switching Energy		5.6		mJ	$V_{DD} = 600\text{ V}, V_{GS} = -5\text{ V}/+20\text{ V}$ $I_D = 300\text{ A}, R_{G(ext)} = 2\text{ }\Omega$ Note: IEC 60747-8-4 Definitions	Fig. 16
$E_{off}$	Turn-Off Switching Energy		3.7				
$E_{Diode}$	Diode Switching Energy		2.8				
$Q_{GS}$	Gate-Source Charge		322		nC	$V_{DD} = 800\text{ V}, V_{GS} = -5\text{ V}/+20\text{ V},$ $I_D = 350\text{ A},$ Per JEDEC24 pg 27	Fig. 13
$Q_{GD}$	Gate-Drain Charge		350				
$Q_G$	Total Gate Charge		1127				
$t_{D(on)}$	Turn-On Delay Time		47.6		ns	$V_{DD} = 600\text{ V}, V_{GS} = -5\text{ V}/+20\text{ V}$ $I_D = 300\text{ A}, R_{G(ext)} = 2\text{ }\Omega, L = 33\text{ }\mu\text{H}$ Note: IEC 60747-8-4, pg 83 Inductive Load	
$t_R$	Rise Time		35.2				
$t_{D(off)}$	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			$I_F = 300\text{ A}, T_J = 175\text{ }^\circ\text{C}, V_{GS} = -5\text{ V}$	
$Q_C$	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 Junction-to-Case for MOSFET	0.085	0.100	0.115	$^\circ\text{C}/\text{W}$		Fig. 22, 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

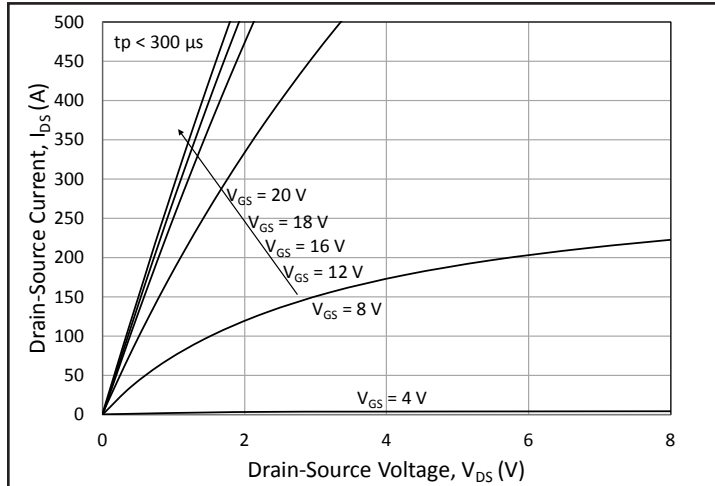


Figure 1. Typical Output Characteristics  $T_J = 25\text{ }^\circ\text{C}$

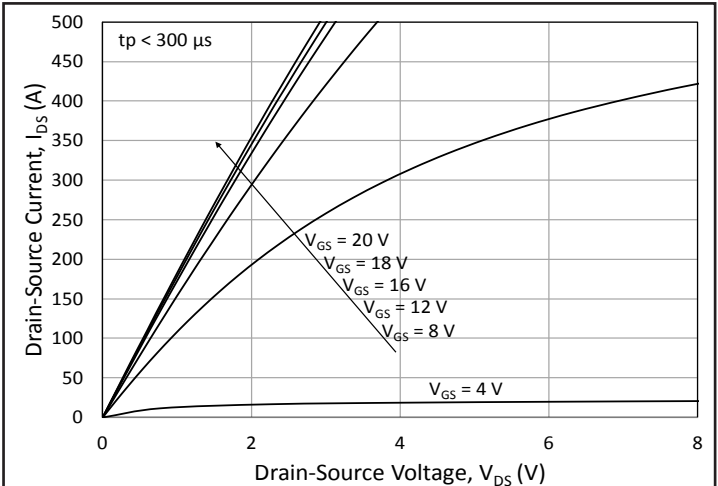


Figure 2. Typical Output Characteristics  $T_J = 125\text{ }^\circ\text{C}$

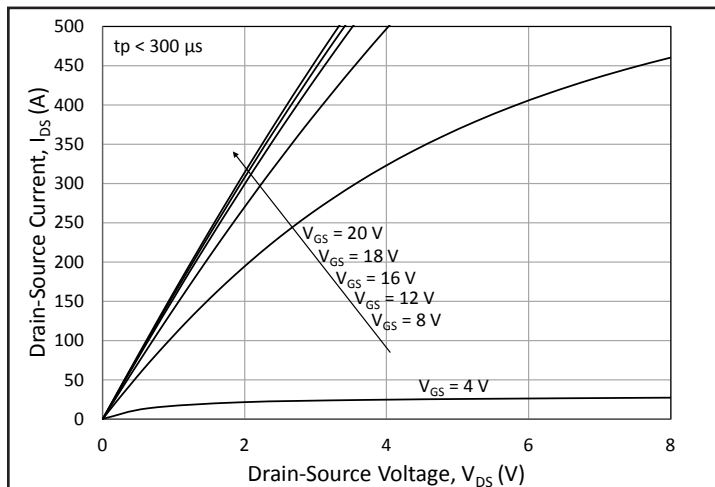


Figure 3. Typical Output Characteristics  $T_J = 150\text{ }^\circ\text{C}$

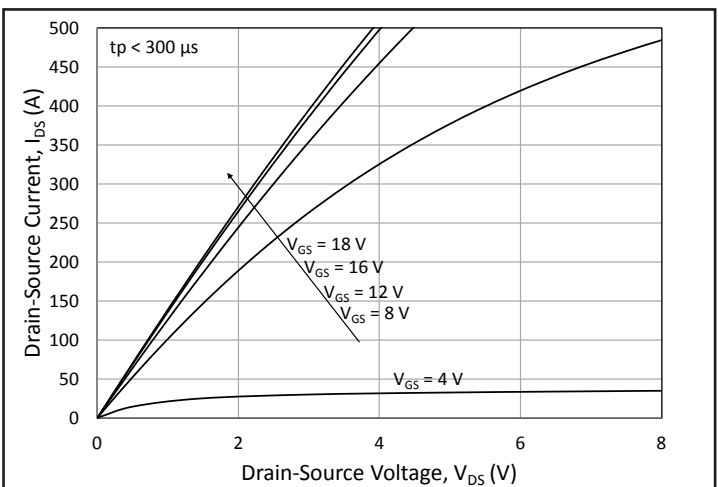


Figure 4. Typical Output Characteristics  $T_J = 175\text{ }^\circ\text{C}$

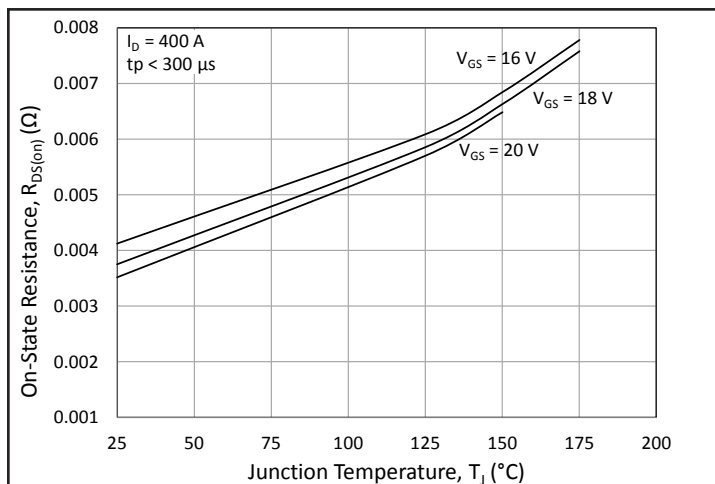


Figure 5. On-State Resistance vs. Temperature for Various Gate-Source Voltages

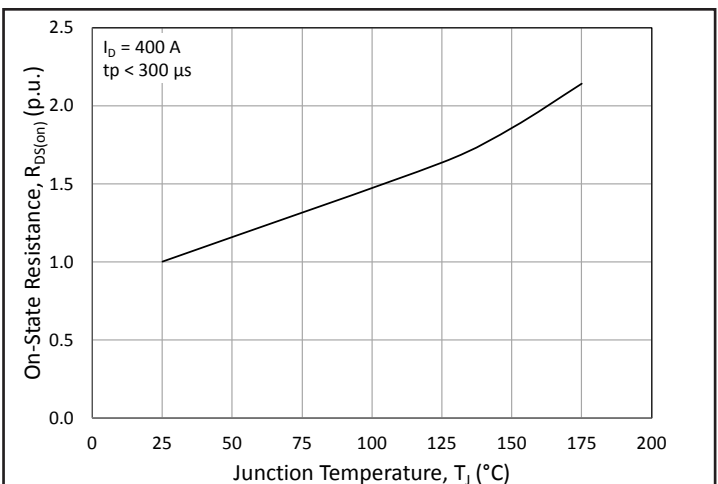


Figure 6. Normalized On-State Resistance vs. Temperature

## Typical Performance

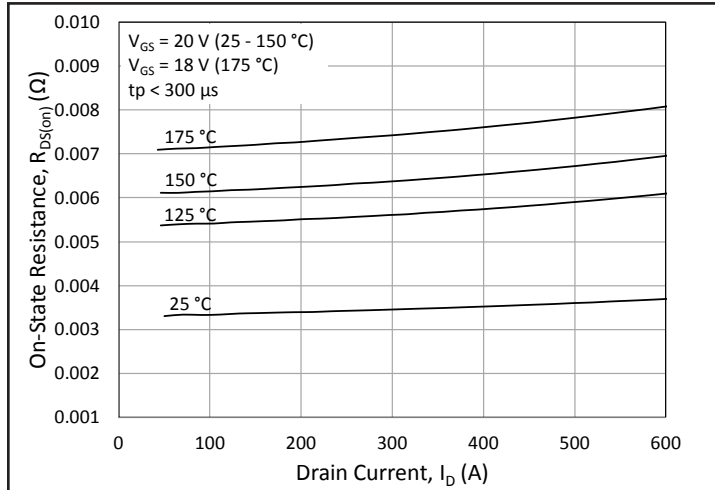


Figure 7. On-State Resistance vs. Drain Current for Various Temperatures

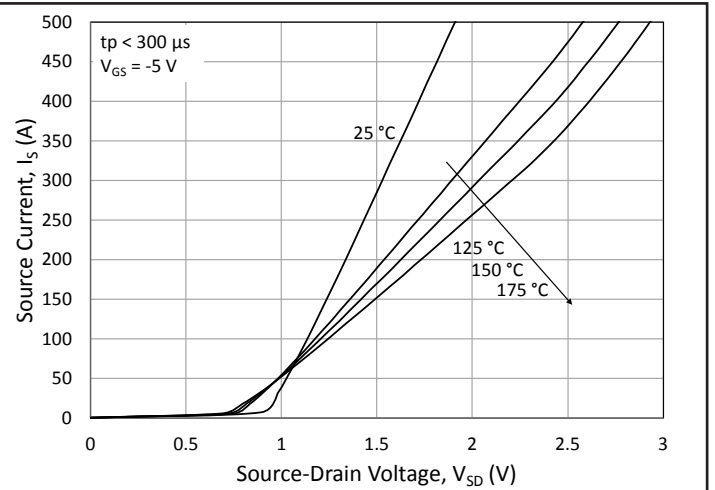


Figure 8. Antiparallel Diode Characteristic for Various Temperatures,  $V_{GS} = -5 V$

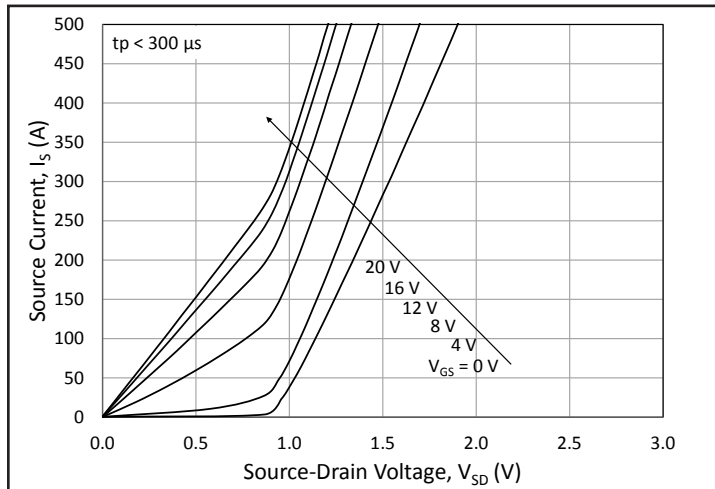


Figure 9. 3<sup>rd</sup> Quadrant Characteristic at 25 °C

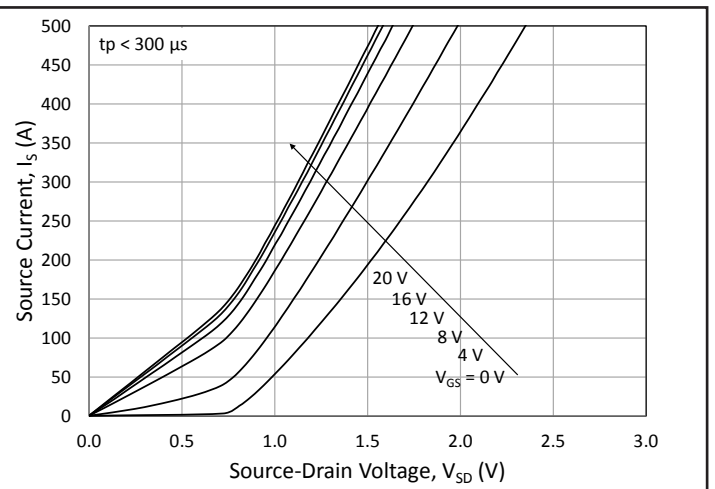


Figure 10. 3<sup>rd</sup> Quadrant Characteristic at 125 °C

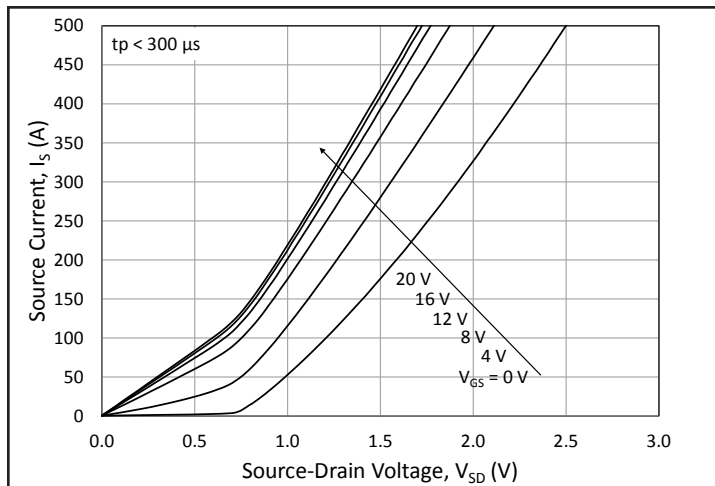


Figure 11. 3<sup>rd</sup> Quadrant Characteristic at 150 °C

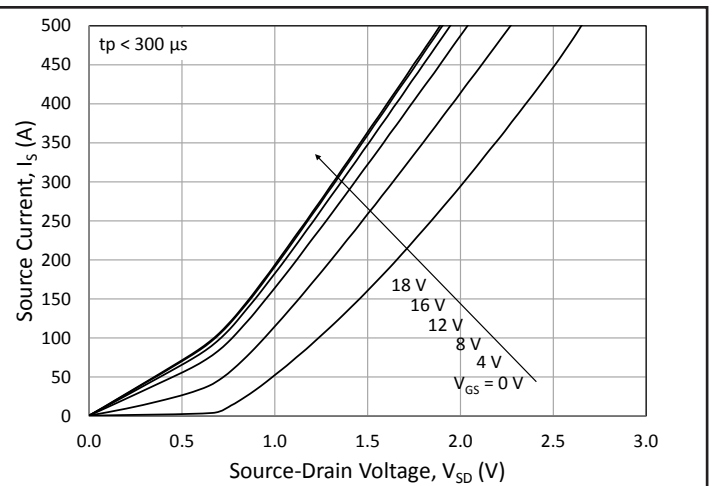


Figure 12. 3<sup>rd</sup> Quadrant Characteristic at 175 °C

## Typical Performance

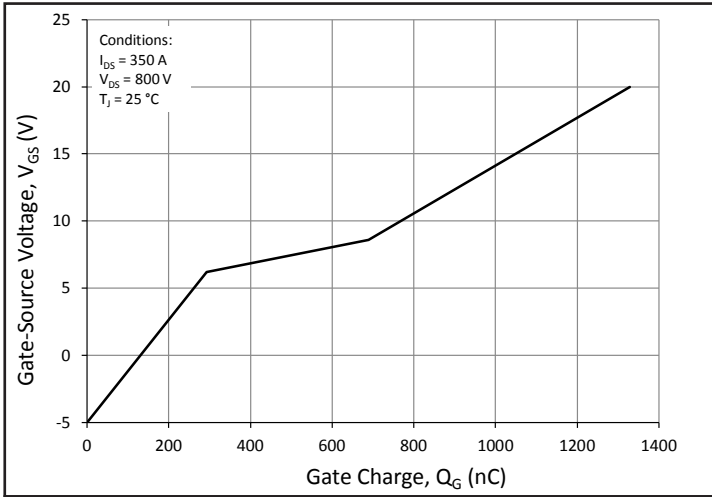


Figure 13. Scaled Gate Charge Characteristic

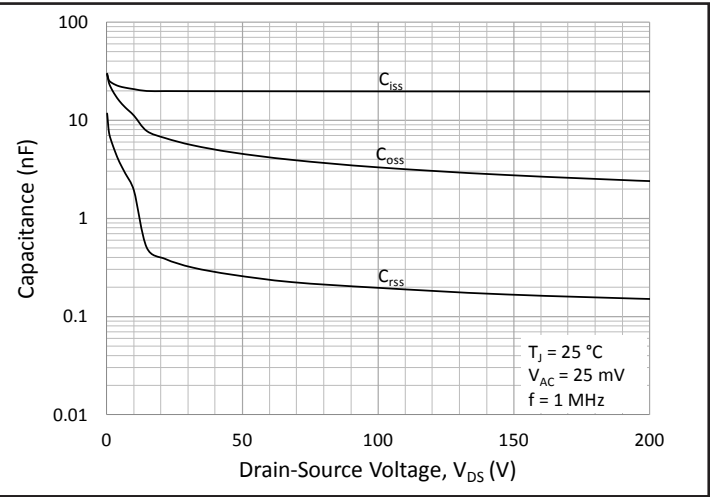


Figure 14. Typical Capacitances vs. Drain-Source Voltage (0 - 200 V)

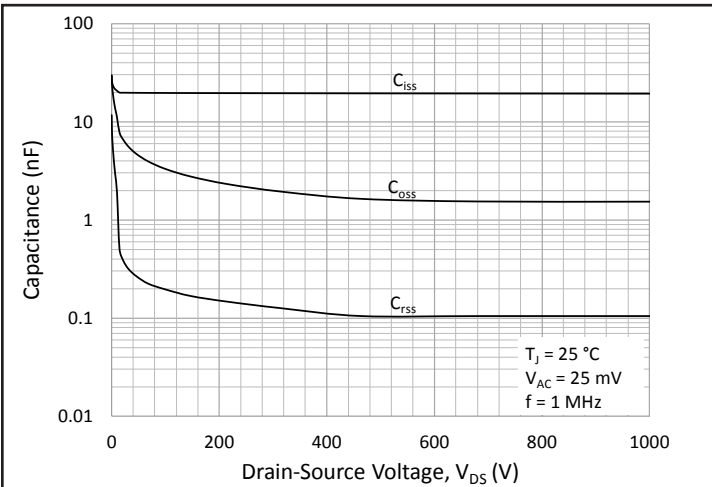


Figure 15. Typical Capacitances vs. Drain-Source Voltage (0 - 1 kV)

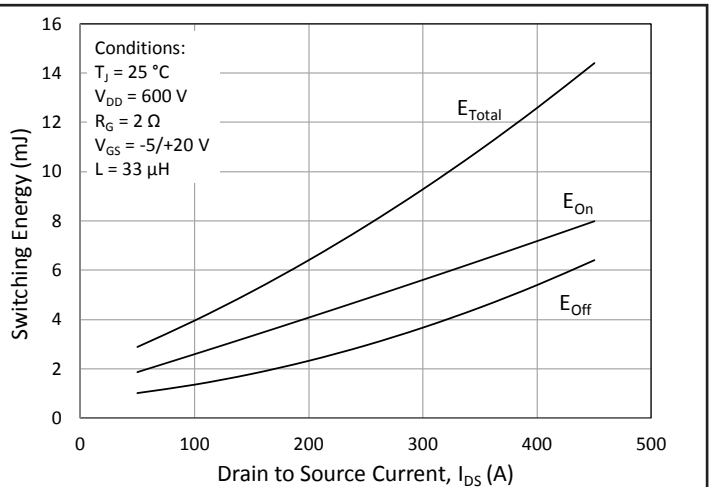


Figure 16. Inductive Switching Energy vs. Drain Current For  $V_{DD} = 600 \text{ V}$ ,  $R_G = 2 \text{ } \Omega$

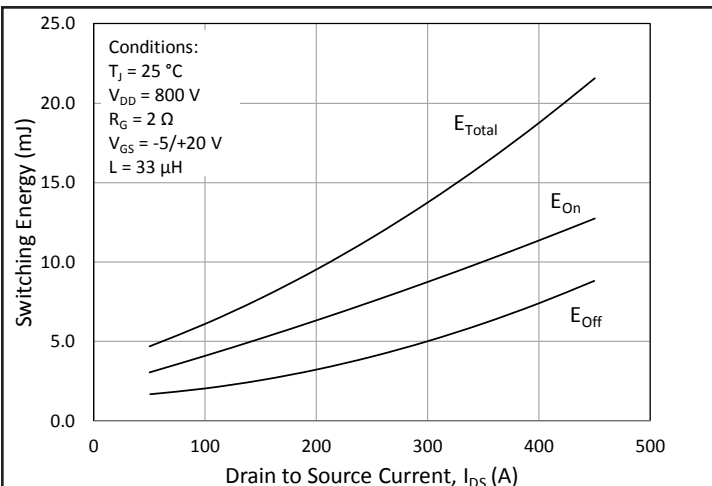


Figure 17. Inductive Switching Energy vs. Drain Current For  $V_{DD} = 800 \text{ V}$ ,  $R_G = 2 \text{ } \Omega$

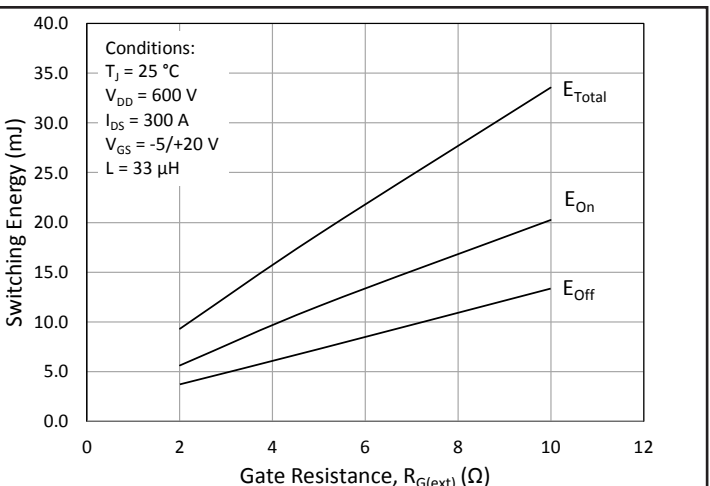


Figure 18. Inductive Switching Energy vs. External Gate Resistance,  $I_{DS} = 300 \text{ A}$

## Typical Performance

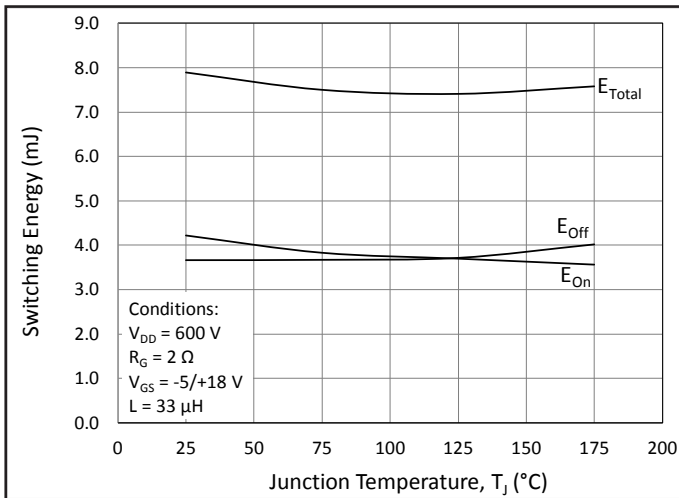


Figure 19. Inductive Switching Energy vs. Temperature

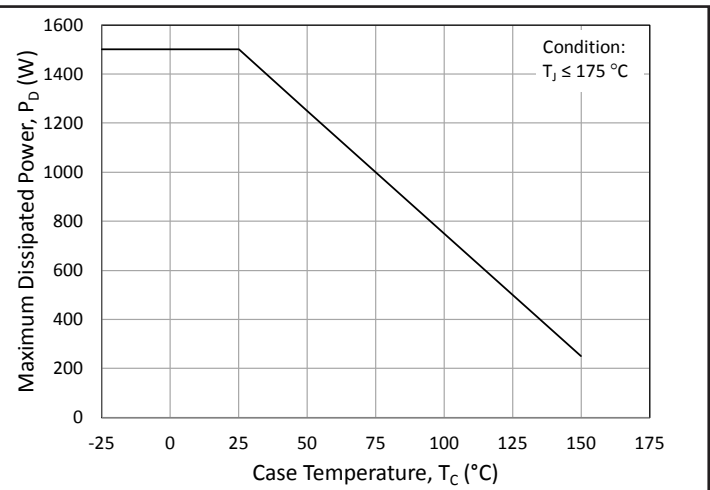


Figure 20. Maximum Power Dissipation (MOSFET) Derating Per Switch Position vs. Case Temperature

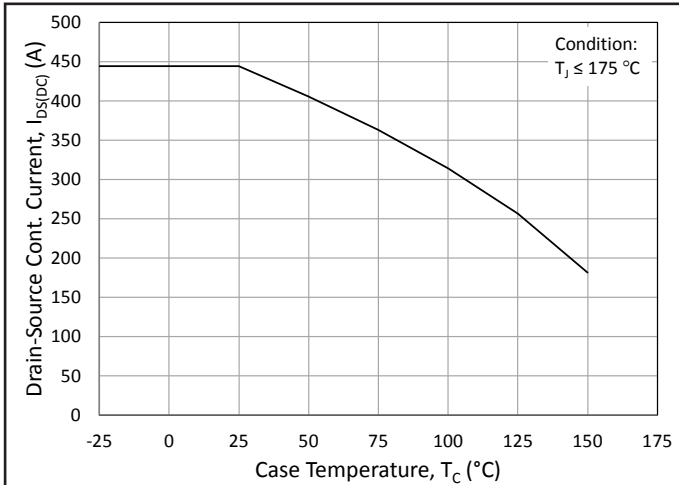


Figure 21. Continuous Drain Current Derating vs. Case Temperature

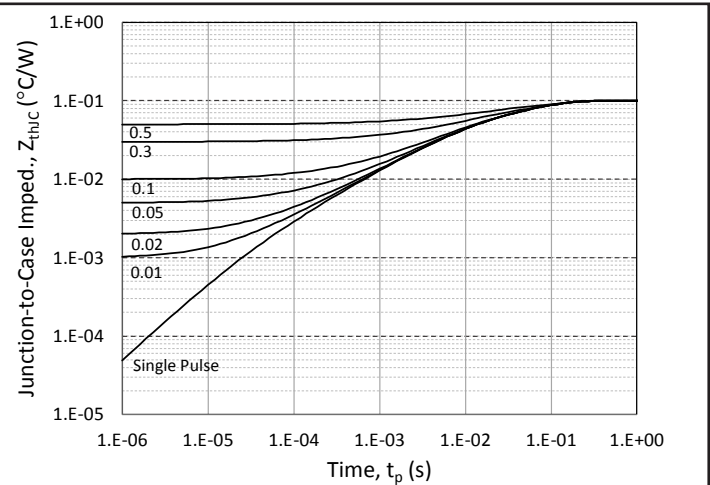


Figure 22. MOSFET Junction-to-Case Thermal Impedance

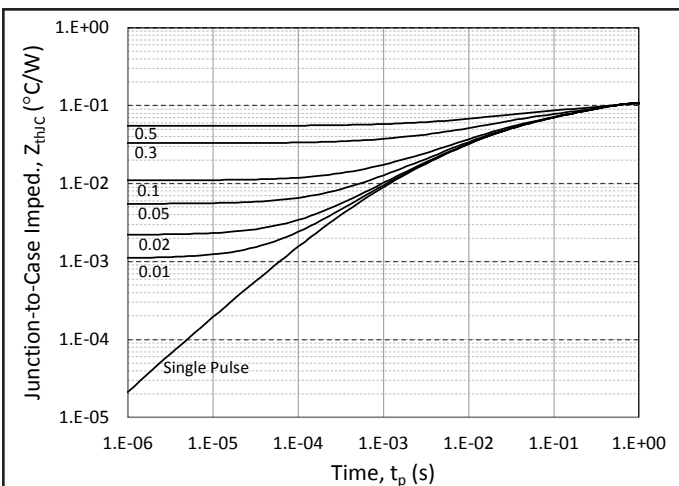


Figure 23. Schottky Diode Junction-to-Case Thermal Impedance

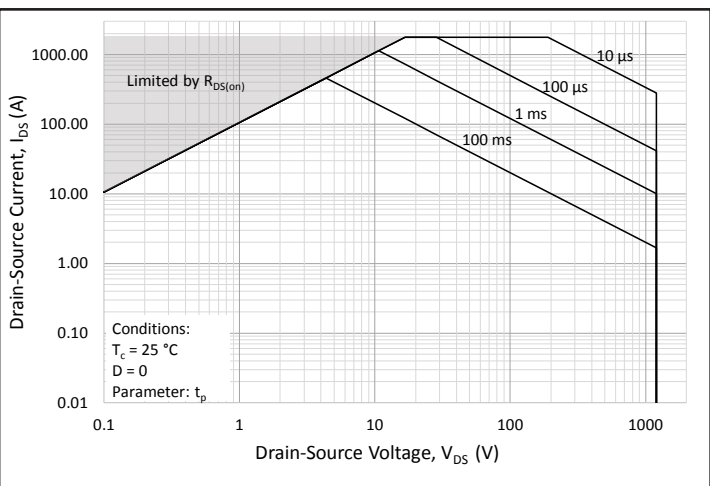
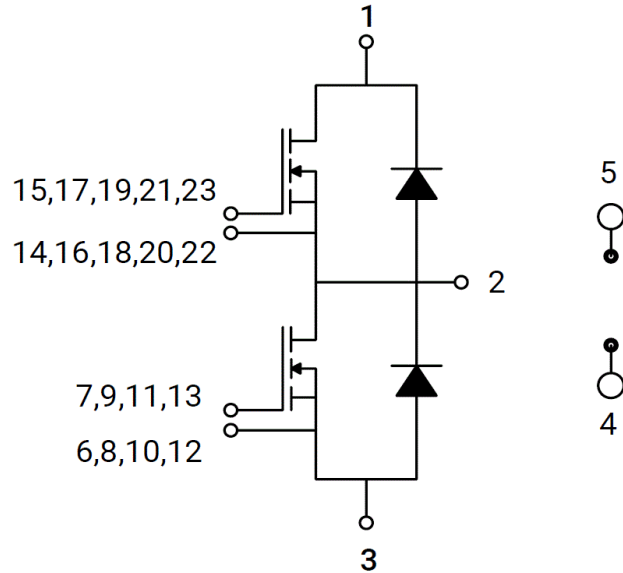
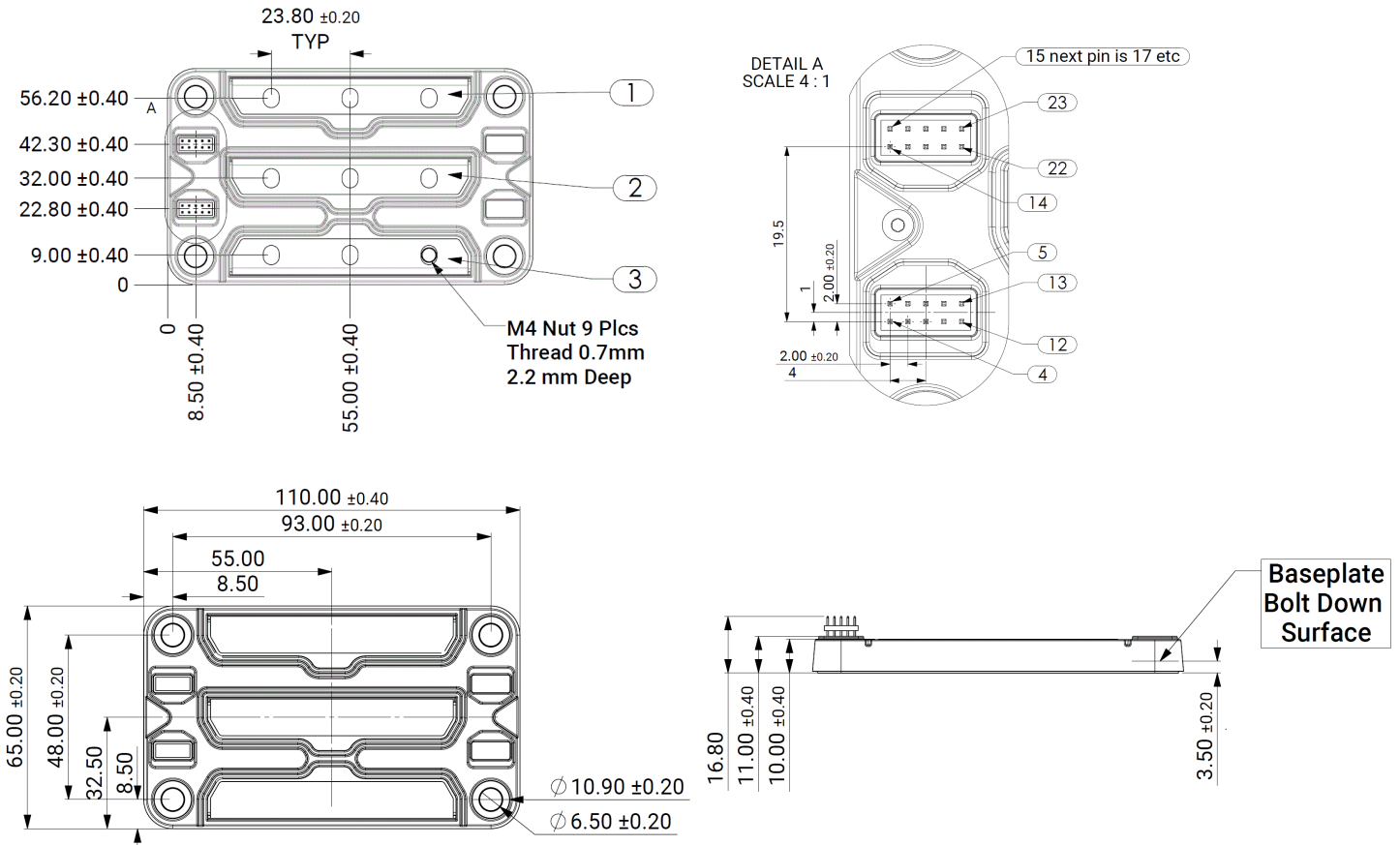


Figure 24. Safe Operating Area

## Schematic



## Package Dimensions (mm)



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

(SURFACE MODEL AVAILABLE UPON  
REQUEST)



## Important Notes

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- 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.





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- Поставка более 17-ти миллионов наименований электронных компонентов;
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- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

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- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



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