

# GSM20MT12EP3

## SiC MOSFET Half-Bridge Module

### Features:

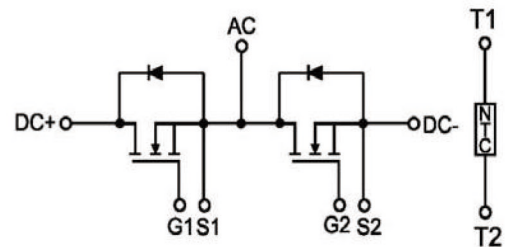
- High Frequency Switching
- Low Capacitances and Low Gate Charge
- Fast and Reliable Body Diode
- Compatible with Commercial Gate Drivers
- Low Conduction Losses at High Temperatures
- Reduced Ringing
- Fast and More Efficient Switching
- Lesser Switching Spikes and Lower Losses
- Better Power Density and System Efficiency
- Ease of Paralleling without Thermal Runaway
- Higher System Reliability
- Simple to Drive
- NTC Temperature Sensor Inside
- Press Fit Terminal

$V_{DS}$	1200V
$R_{DS(ON)}$ (Typ.)	20m $\Omega$
$I_{DS}$	80A



### Applications:

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



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

Symbol	Description	Values	Units
$V_{DSS}$	Drain-Source Blocking Voltage	1200	V
$V_{GSmax}$	Gate-Source Voltage	Absolute Maximum Values	-10/+20
$V_{GSop}$		Recommended Operational Values	-5/+15
$I_D$	Continuous Drain Current	$V_{GS}=-5/+15\text{V}, T_c=25^\circ\text{C}$	113
		$V_{GS}=-5/+15\text{V}, T_c=100^\circ\text{C}$	80
		$V_{GS}=-5/+15\text{V}, T_c=135^\circ\text{C}$	58
$I_{D(pluse)}$	Pulsed Drain Current	$t_p \leq 3\mu\text{s}, D \leq 1\%, V_{GS}=15\text{V}$	300
$E_{AS}$	Non-Repetitive Avalanche Energy	$L=1.7\text{mH}, I_{AS}=30\text{A}$	750
$P_D$	Power Dissipation	$T_c=25^\circ\text{C}, T_J=175^\circ\text{C}$	246

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

Symbol	Description	Conditions	Min.	Typ.	Max.	Units
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	$V_{GS}=0\text{V}, I_D=100\mu\text{A}$	1200			V
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}, I_D=35\text{mA}, T_J=25^\circ\text{C}$		2.50		V
		$V_{DS}=V_{GS}, I_D=35\text{mA}, T_J=125^\circ\text{C}$		1.95		V
		$V_{DS}=V_{GS}, I_D=35\text{mA}, T_J=150^\circ\text{C}$		1.90		V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS}=1200\text{V}, V_{GS}=0\text{V}$			1	mA
$I_{GSS}$	Gate-Source Leakage Current	$V_{GS}=20\text{V}, V_{DS}=0\text{V}$			100	nA
		$V_{GS}=-10\text{V}, V_{DS}=0\text{V}$			-100	nA
$R_{DS(on)}$	On State Resistance	$V_{GS}=15\text{V}, I_{DS}=80\text{A}, T_J=25^\circ\text{C}$		21.4		m $\Omega$
		$V_{GS}=15\text{V}, I_{DS}=80\text{A}, T_J=125^\circ\text{C}$		24.0		
		$V_{GS}=15\text{V}, I_{DS}=80\text{A}, T_J=150^\circ\text{C}$		25.5		
$g_{fs}$	Transconductance	$V_{DS}=10\text{V}, I_D=60\text{A}, T_J=25^\circ\text{C}$		29.2		S
		$V_{DS}=10\text{V}, I_D=60\text{A}, T_J=175^\circ\text{C}$		32.9		
$C_{iss}$	Input Capacitance	$V_{DS}=800\text{V}, f=1\text{MHz}, V_{GS}=0\text{V}, V_{AC}=25\text{mV}$		5814		pF
$C_{oss}$	Output Capacitance			176		pF

$C_{rss}$	Reverse Transfer Capacitance	$V_{DS}=800V, f=1MHz,$ $V_{GS}=0V, V_{AC}=25mV$		14.2		pF
$E_{oss}$	$C_{oss}$ Stored Energy	$V_{DS}=800V, f=1MHz,$ $V_{GS}=0V, V_{AC}=25mV$		68		$\mu J$
$Q_{oss}$	$C_{oss}$ Stored Charge			256		nC
$Q_G$	Total Gate Charge	$V_{DS}=800V, V_{GS}=-5V \text{ to } +15V,$ $I_D=60A$		180		nC
$Q_{GS}$	Gate-Source Charge			50		
$Q_{GD}$	Gate-Drain Charge			70		
$t_{d(on)}$	Turn-on Delay Time	$V_{DD}=600V,$ $V_{GS}=-5V \text{ to } +15V,$ $I_D=60A, R_G(ext)=6.8\Omega$	$T_J=25^\circ C$	55		ns
			$T_J=125^\circ C$	54		
			$T_J=150^\circ C$	58		
$t_r$	Rise Time		$T_J=25^\circ C$	48		ns
			$T_J=125^\circ C$	49		
			$T_J=150^\circ C$	46		
$t_{d(off)}$	Turn-off Delay Time		$T_J=25^\circ C$	113		ns
			$T_J=125^\circ C$	124		
			$T_J=150^\circ C$	126		
$t_f$	Fall Time	$T_J=25^\circ C$	59		ns	
		$T_J=125^\circ C$	67			
		$T_J=150^\circ C$	70			
$E_{on}$	Turn-on Switching Energy	$T_J=25^\circ C$	1.1		mJ	
		$T_J=125^\circ C$	1.1			
		$T_J=150^\circ C$	1.0			
$E_{off}$	Turn-off Switching Energy	$T_J=25^\circ C$	0.37		mJ	
		$T_J=125^\circ C$	0.42			
		$T_J=150^\circ C$	0.44			
$R_{G(int)-C}$	Internal Gate Resistance(chip)			1.3		$\Omega$
$R_{\theta JC}$	Thermal Resistance Junction-to-Case for SiC MOSFET(per leg)			0.609		$^\circ C/W$

### Built-in SiC Body Diode

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

Symbol	Description	Conditions	Min.	Typ.	Max.	Units
$I_S$	Inverse Diode Continuous, Forward Current	$V_{GS}=-5V, T_C=100^\circ\text{C}$	47			A
$I_{S(pluse)}$	Inverse Diode Direct Current, Pulsed	$V_{GS}=-5V$		188		A
$V_{SD}$	Diode Forward Voltage	$I_{SD}=60A, V_{GS}=-5V, T_J=25^\circ\text{C}$		5.05		V
		$I_{SD}=60A, V_{GS}=-5V, T_J=125^\circ\text{C}$		4.75		V
		$I_{SD}=60A, V_{GS}=-5V, T_J=150^\circ\text{C}$		4.65		V
$t_{rr}$	Reverse Recovery Time		$T_J=25^\circ\text{C}$	41		ns
			$T_J=125^\circ\text{C}$	56		
			$T_J=150^\circ\text{C}$	54		
$Q_{rr}$	Reverse Recovery Charge	$I_{SD}=60A, V_{GS}=-5V \text{ to } +15V, V_R=600V, -di/dt=1538A/\mu s (T_J=150^\circ\text{C})$	$T_J=25^\circ\text{C}$	0.64		uC
			$T_J=125^\circ\text{C}$	1.25		
			$T_J=150^\circ\text{C}$	1.45		
$I_{rr}$	Peak Reverse Recovery Current		$T_J=25^\circ\text{C}$	33.8		A
			$T_J=125^\circ\text{C}$	34.7		
			$T_J=150^\circ\text{C}$	38.4		

### Internal NTC-Thermistor Characteristics

$R_{25}$	$T_C=25^\circ\text{C}$	5		k $\Omega$
$\Delta R/R$	$T_C=100^\circ\text{C}, R_{100}=481\Omega$		$\pm 5$	%
$P_{25}$	$T_C=25^\circ\text{C}$	50		mW
$B_{25/50}$	$R_2=R_{25} \exp[B_{25/50}(1/T_2-1/(298.15K))]$	3380		K
$B_{25/80}$	$R_2=R_{25} \exp[B_{25/80}(1/T_2-1/(298.15K))]$	3440		K

**Module**

Symbol	Description	Min.	Typ.	Max.	Units
V <sub>ISO</sub>	Isolation Voltage (All Terminals Shorted)		3000		V
	f=50Hz, 1minute				
Internal Isolation		AL2O3 Ceramic			
	Clearance Distance: Terminal to Terminal		5.0		mm
	Clearance Distance: Terminal to Heatsink		10.0		
	Creepage Distance: Terminal to Terminal		6.3		
	Creepage Distance: Terminal to Heatsink		11.5		
L <sub>SCE</sub>	Stray Inductance Module	Between Terminals DC+ and DC-	11.4		nH
T <sub>J</sub>	Maximum Junction Temperature			175	°C
T <sub>JOP</sub>	Maximum Operating Junction Temperature Range	-40		+150	°C
T <sub>stg</sub>	Storage Temperature	-40		+125	°C
CTI	Comparative Tracking Index	200			
R <sub>θCS</sub>	Case-to-Sink Thermally (Conductive Grease Applied)			0.08	°C/W
M	Mounting Screw:M4	1.0		1.5	N·m
G	Weight		21		g

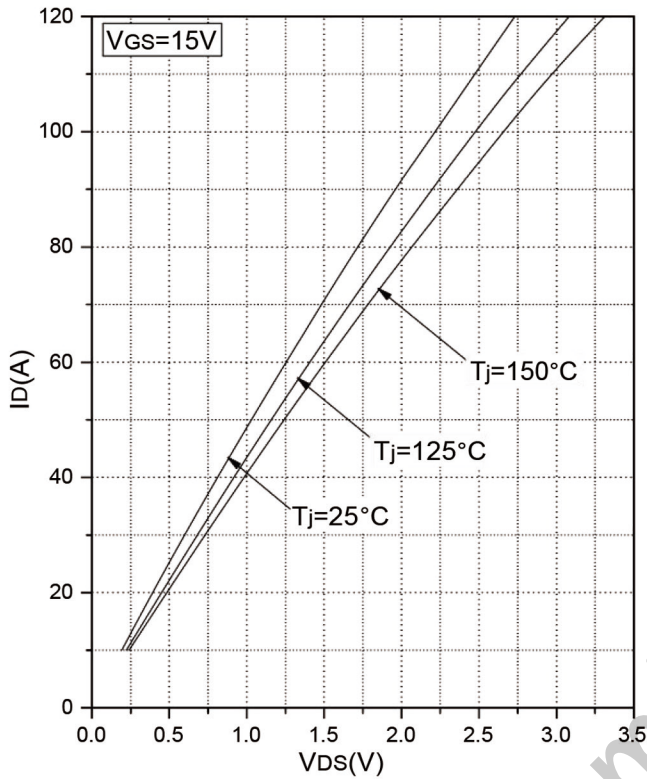


Fig.1 Transfer Characteristics

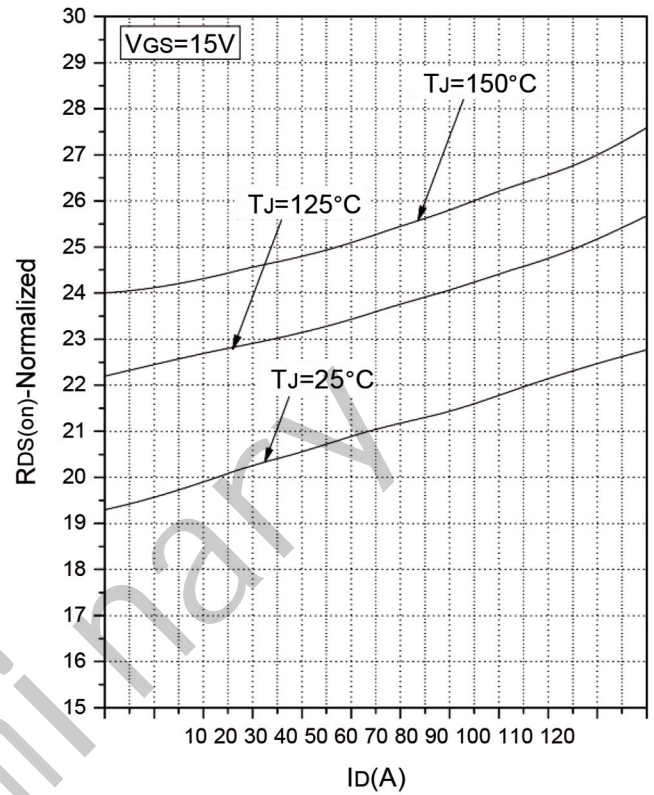


Fig.2 Normalized On-Resistance vs. Drain Current

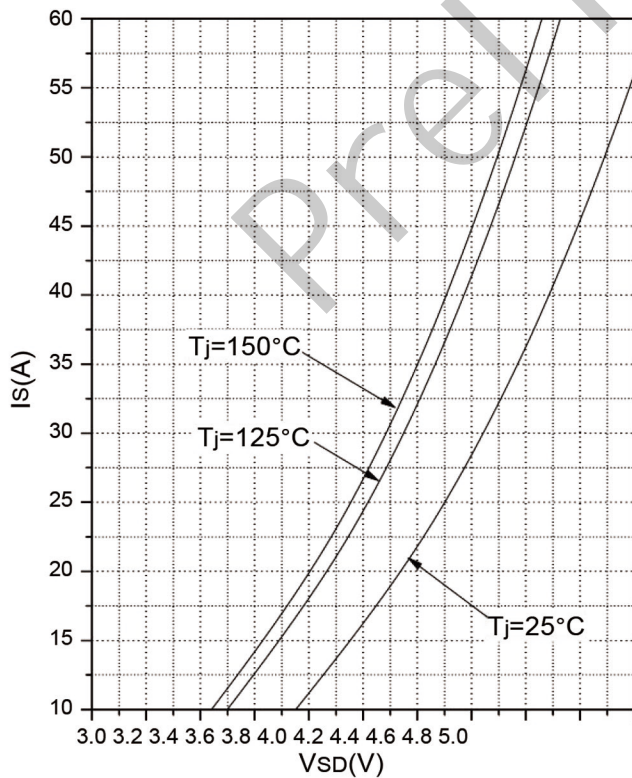


Fig.3 Forward Characteristics

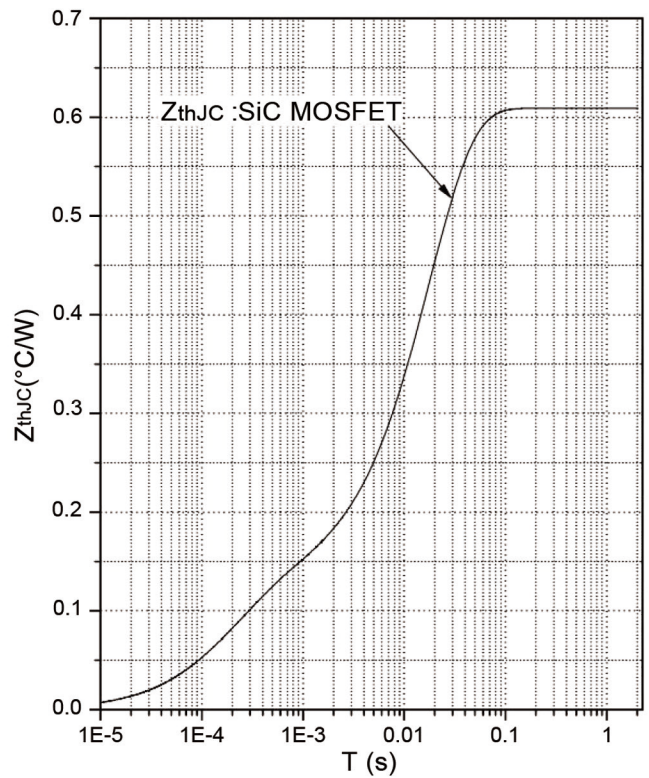


Fig.4 Transient Thermal Impedance

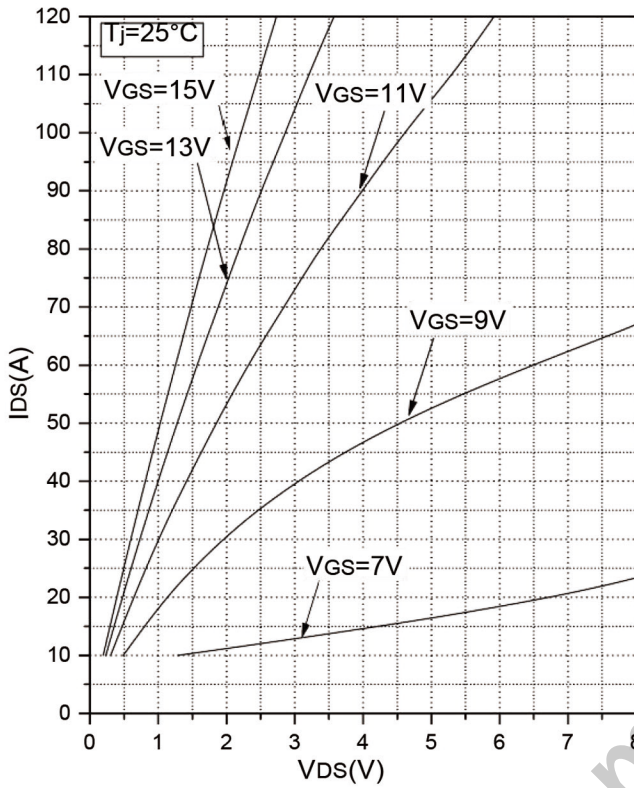


Fig.5 Typical Output Characteristics

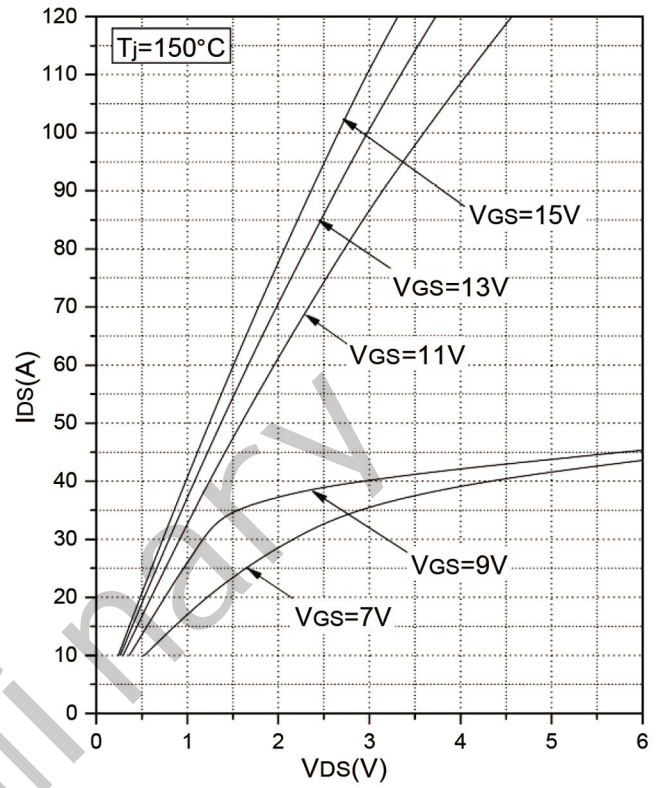


Fig.6 Typical Output Characteristics

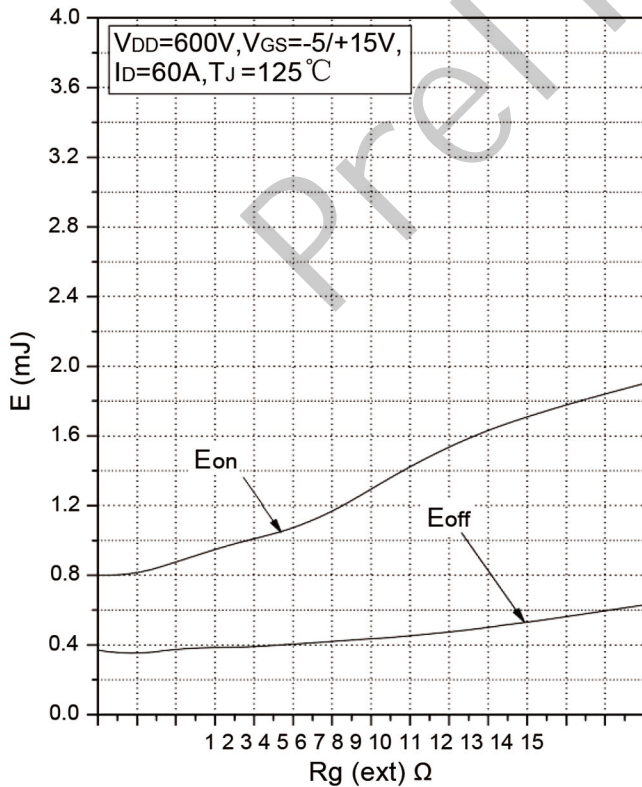


Fig.7 Inductive Switching Energy vs.  $R_G(\text{ext})$

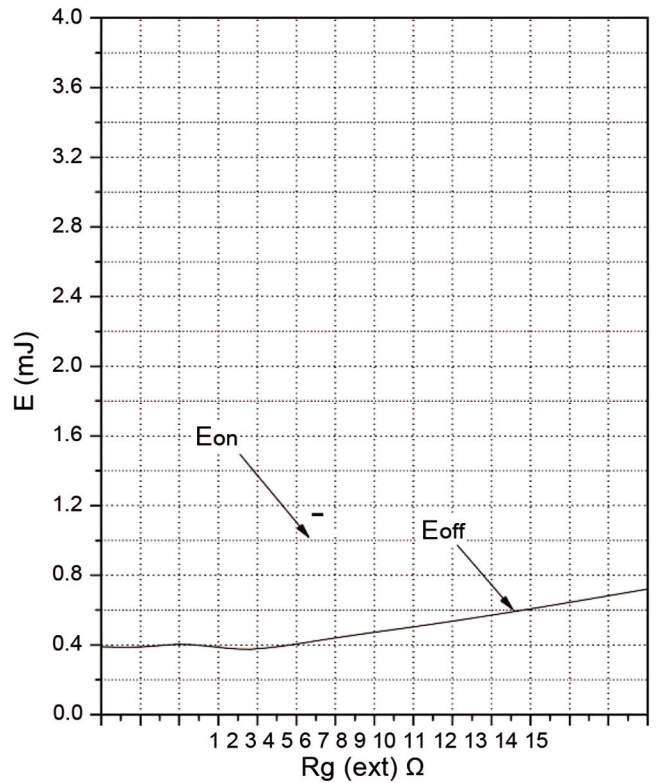
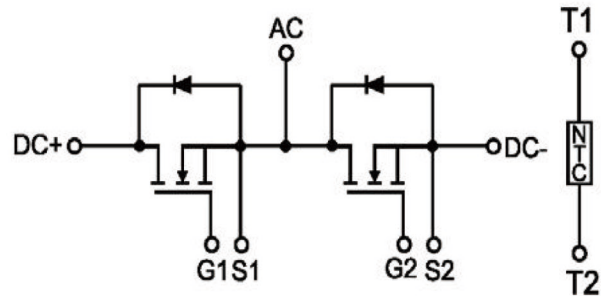
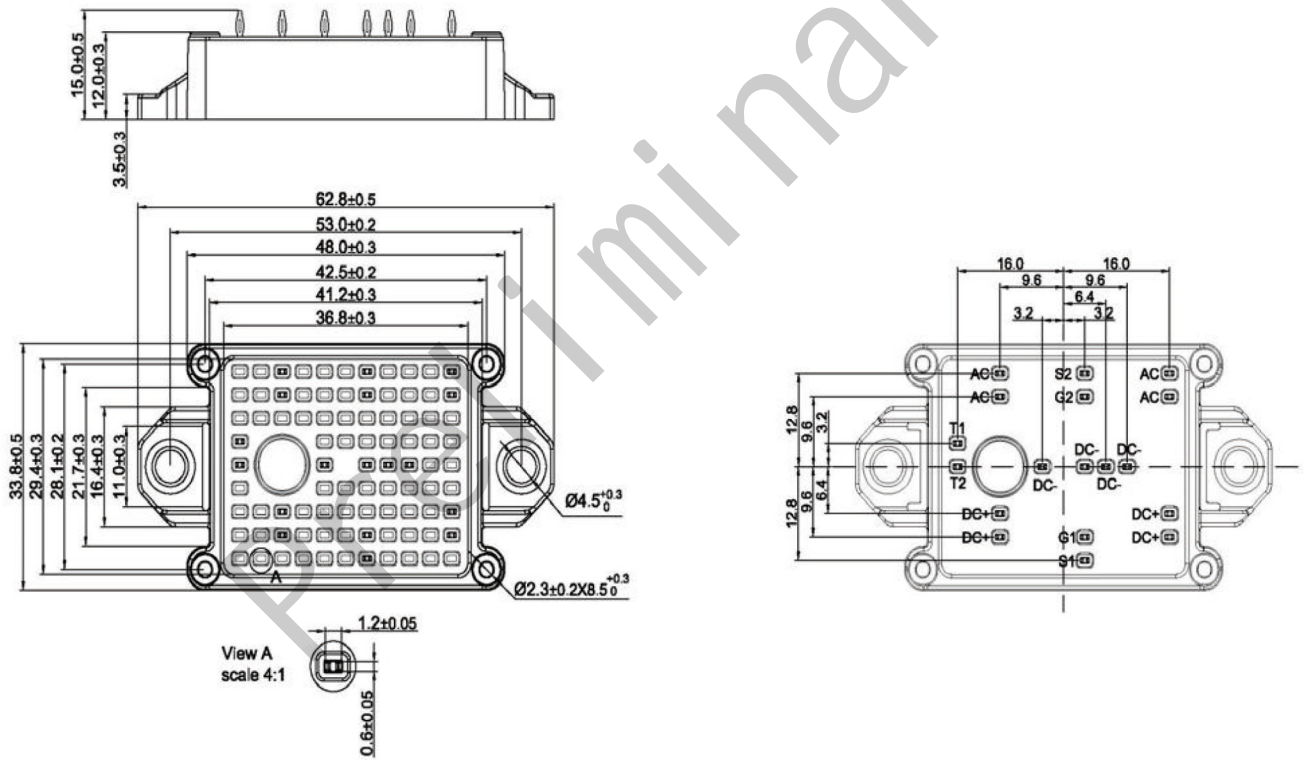


Fig.8 Inductive Switching Energy vs.  $R_G(\text{ext})$

**Internal Circuit**



**Package Outline (Unit: mm):**



Date	Revision	Notes
01/12/2023	01	Initial Release

## Announcement

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The released datasheet would be issued with “REV.” + “alphabet characters”.



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