

**IGBT/SiC Diode Co-pack**

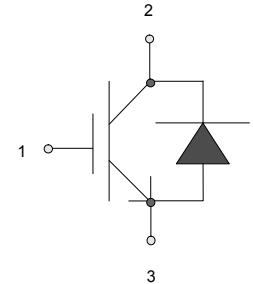
$V_{CES}$	=	<b>1200 V</b>
$I_{CM}$	=	<b>100 A</b>
$V_{CE(SAT)}$	=	<b>1.9 V</b>

**Features**

- Optimal Punch Through (OPT) technology
- SiC freewheeling diode
- Positive temperature coefficient for easy paralleling
- Extremely fast switching speeds
- Temperature independent switching behavior of SiC rectifier
- Best RBSOA/SCSOA capability in the industry
- High junction temperature
- Industry standard packaging

**Package**

- RoHS Compliant


**SOT – 227**
**Advantages**

- Industry's highest switching speeds
- High temperature operation
- Improved circuit efficiency
- Low switching losses

**Applications**

- Solar Inverters
- Aerospace Actuators
- Server Power Supplies
- Resonant Inverters > 100 kHz
- Inductive Heating
- Electronic Welders

**Maximum Ratings at  $T_j = 175\text{ }^\circ\text{C}$ , unless otherwise specified**

Parameter	Symbol	Conditions	Values	Unit
<b>IGBT</b>				
Collector-Emitter Voltage	$V_{CES}$		1200	V
DC-Collector Current	$I_C$	$T_C \leq 130\text{ }^\circ\text{C}$	100	A
Peak Collector Current	$I_{CM}$	Limited by $T_{vjmax}$	200	A
Gate Emitter Peak Voltage	$V_{GES}$		$\pm 20$	V
IGBT Short Circuit SOA	$t_{psc}$	$V_{CC} = 900\text{ V}$ , $V_{CEM} \leq 1200\text{ V}$ $V_{GE} \leq 15\text{ V}$ , $T_{vj} \leq 125\text{ }^\circ\text{C}$	10	$\mu\text{s}$
Operating Temperature	$T_{vj}$		-40 to +175	$^\circ\text{C}$
Storage Temperature	$T_{stg}$		-40 to +175	$^\circ\text{C}$
Isolation Voltage	$V_{ISOL}$	$I_{SOL} < 1\text{ mA}$ , 50/60 Hz, $t = 1\text{ s}$	3000	V

**Free-wheeling Silicon Carbide diode**

DC-Forward Current	$I_F$	$T_C \leq 130\text{ }^\circ\text{C}$	100	A
Non Repetitive Peak Forward Current	$I_{FM}$	$T_C = 25\text{ }^\circ\text{C}$ , $t_p = 10\text{ }\mu\text{s}$	tbd	A
Surge Non Repetitive Forward Current	$I_{F,SM}$	$t_p = 10\text{ ms}$ , half sine, $T_C = 25\text{ }^\circ\text{C}$	tbd	A

**Thermal Characteristics**

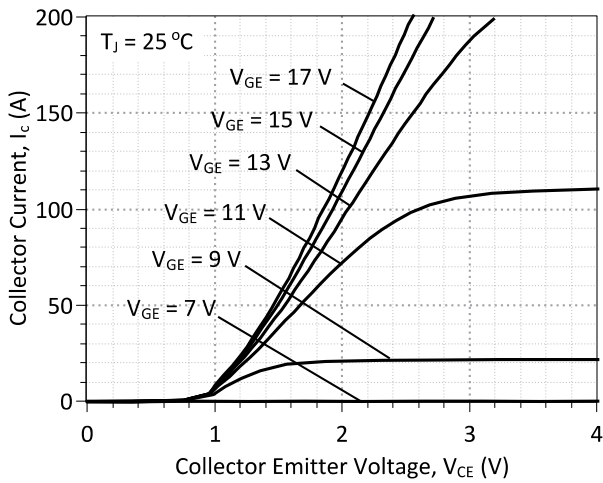
Thermal resistance, junction - case	$R_{thJC}$	IGBT	0.08	$^\circ\text{C/W}$
Thermal resistance, junction - case	$R_{thJC}$	SiC Diode	0.53	$^\circ\text{C/W}$

**Mechanical Properties**

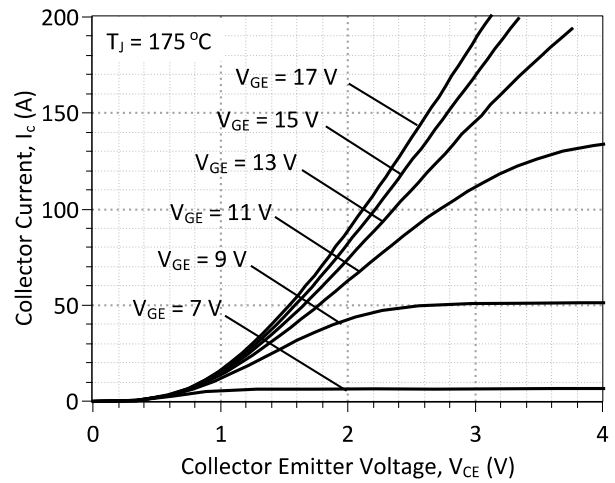
	Symbol	Values		
		min.	typ.	max.
Mounting Torque	$M_d$		1.5	Nm
Terminal Connection Torque		1.3		Nm
Weight			29	g
Case Color		Black		
Dimensions		38 x 25.4 x 12 mm		

**Electrical Characteristics at  $T_j = 175\text{ }^\circ\text{C}$ , unless otherwise specified**

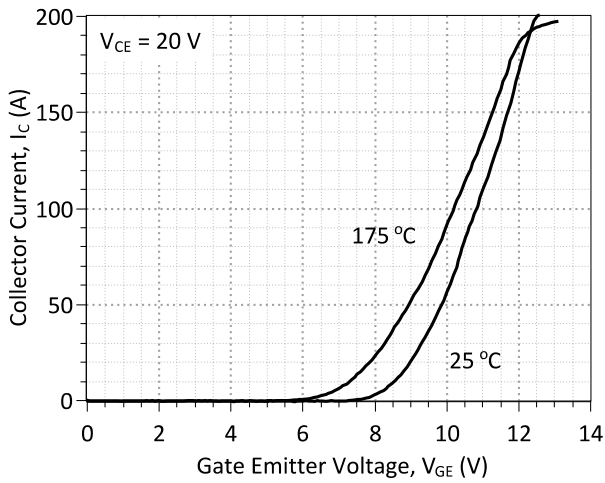
Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
<b>IGBT</b>						
Gate Threshold Voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 4\text{ mA}, T_j = 25\text{ }^\circ\text{C}$	5	6.2	7	V
Collector-Emitter Leakage Current	$I_{CES,25}$	$V_{GE} = 0\text{ V}, V_{CE} = V_{CES}, T_j = 25\text{ }^\circ\text{C}$		0.10	1	mA
	$I_{CES,175}$	$V_{GE} = 0\text{ V}, V_{CE} = V_{CES}, T_j = 175\text{ }^\circ\text{C}$		3.15		mA
Gate-Leakage Current	$I_{GES}$	$V_{CE} = 0\text{ V}, V_{GE} = 20\text{ V}, T_j = 175\text{ }^\circ\text{C}$	-400		400	nA
Collector-Emitter Threshold Voltage	$V_{GE(TO)}$	$T_j = 25\text{ }^\circ\text{C}$		1.1		V
Collector-Emitter Slope Resistance	$R_{CE,25}$	$V_{GE} = 15\text{ V}, T_j = 25\text{ }^\circ\text{C}$		7.9		m $\Omega$
	$R_{CE,175}$	$V_{GE} = 15\text{ V}, T_j = 175\text{ }^\circ\text{C}$		11.4		m $\Omega$
Collector-Emitter Saturation Voltage	$V_{CE(SAT)}$	$I_C = 100\text{ A}, V_{GE} = 15\text{ V}, T_j = 25\text{ }^\circ\text{C} (175\text{ }^\circ\text{C})$		1.9 (2.2)		V
Input Capacitance	$C_{ies}$	$V_{GE} = 0\text{ V}, V_{CE} = 25\text{ V}, f = 1\text{ MHz}, T_j = 150\text{ }^\circ\text{C}$		8.55		nF
Output Capacitance	$C_{oes}$			1.39		nF
Reverse Transfer Capacitance	$C_{res}$			0.25		nF
Internal Gate Resistance	$R_{Gint}$			2		$\Omega$
Gate Charge	$Q_G$	$V_{CC} = 750\text{ V}, I_C = 100\text{ A}, V_{GE} = -8..15\text{ V}, T_j = 25\text{ }^\circ\text{C} (125\text{ }^\circ\text{C})$		900 (900)		nC
Module Lead Resistance	$R_{mod}$	$T_c = 25\text{ }^\circ\text{C} (175\text{ }^\circ\text{C})$		tbid		m $\Omega$
Reverse Bias Safe Operating Area	RBSOA	$T_j = 175\text{ }^\circ\text{C}, R_{\theta} = 56\text{ }^\circ\text{C/W}, V_{CC} = 1200\text{ V}, V_{GE} = 15\text{ V}$		150		A
Short Circuit Current	$I_{sc}$	$T_j = 175\text{ }^\circ\text{C}, R_{\theta} = 56\text{ }^\circ\text{C/W}, V_{CC} = 900\text{ V}, V_{GE} = \pm 15\text{ V}$		470		A
Short Circuit Duration	$t_{sc}$				10	
Rise Time	$t_r$	$V_{CC} = 800\text{ V}, I_C = 100\text{ A}, R_{gon} = R_{goff} = 10\text{ }^\circ\Omega, V_{GE(on)} = 15\text{ V}, V_{GE(off)} = -8\text{ V}, L_S = 0.8\text{ }^\mu\text{H}, T_j = 25\text{ }^\circ\text{C}$		254		ns
Fall Time	$t_f$			153		ns
Turn On Delay Time	$t_{d(on)}$			244		ns
Turn Off Delay Time	$t_{d(off)}$			488		ns
Turn-On Energy Loss Per Pulse	$E_{on}$			14.2		mJ
Turn-Off Energy Loss Per Pulse	$E_{off}$			15.7		mJ
Rise Time	$t_r$	$V_{CC} = 800\text{ V}, I_C = 100\text{ A}, R_{gon} = R_{goff} = 10\text{ }^\circ\Omega, V_{GE(on)} = 15\text{ V}, V_{GE(off)} = -8\text{ V}, L_S = 0.8\text{ }^\mu\text{H}, T_j = 175\text{ }^\circ\text{C}$		211		ns
Fall Time	$t_f$			172		ns
Turn On Delay Time	$t_{d(on)}$			240		ns
Turn Off Delay Time	$t_{d(off)}$			636		ns
Turn-On Energy Loss Per Pulse	$E_{on}$			11.1		mJ
Turn-Off Energy Loss Per Pulse	$E_{off}$			21.8		mJ
<b>Free-wheeling Silicon Carbide Diode</b>						
Forward Voltage	$V_F$	$I_F = 100\text{ A}, V_{GE} = 0\text{ V}, T_j = 25\text{ }^\circ\text{C} (175\text{ }^\circ\text{C})$		2.08 (3.5)		V
Threshold Voltage at Diode	$V_{D(TO)}$	$T_j = 25\text{ }^\circ\text{C}$		0.8		V
Peak Reverse Recovery Current	$I_{rrm}$	$I_F = 100\text{ A}, V_{GE} = 0\text{ V}, V_R = 800\text{ V}, -di_F/dt = 625\text{ A}/\mu\text{s}, T_j = 175\text{ }^\circ\text{C}$		10		A
Reverse Recovery Time	$t_{rr}$			100		ns
Rise Time	$t_r$	$V_{CC} = 800\text{ V}, I_C = 100\text{ A}, R_{gon} = R_{goff} = 10\text{ }^\circ\Omega, V_{GE(on)} = 15\text{ V}, V_{GE(off)} = -8\text{ V}, L_S = 0.8\text{ }^\mu\text{H}, T_j = 25\text{ }^\circ\text{C}$		148		ns
Fall Time	$t_f$			336		ns
Turn-On Energy Loss Per Pulse	$E_{on}$			218		$\mu\text{J}$
Turn-Off Energy Loss Per Pulse	$E_{off}$			113		$\mu\text{J}$
Reverse Recovery Charge	$Q_{rr}$			730		nC
Rise Time	$t_r$			178		ns
Fall Time	$t_f$	$V_{CC} = 800\text{ V}, I_C = 100\text{ A}, R_{gon} = R_{goff} = 10\text{ }^\circ\Omega, V_{GE(on)} = 15\text{ V}, V_{GE(off)} = -8\text{ V}, L_S = 0.8\text{ }^\mu\text{H}, T_j = 175\text{ }^\circ\text{C}$		268		ns
Turn-On Energy Loss Per Pulse	$E_{on}$			23		$\mu\text{J}$
Turn-Off Energy Loss Per Pulse	$E_{off}$			334		$\mu\text{J}$
Reverse Recovery Charge	$Q_{rr}$			480		nC



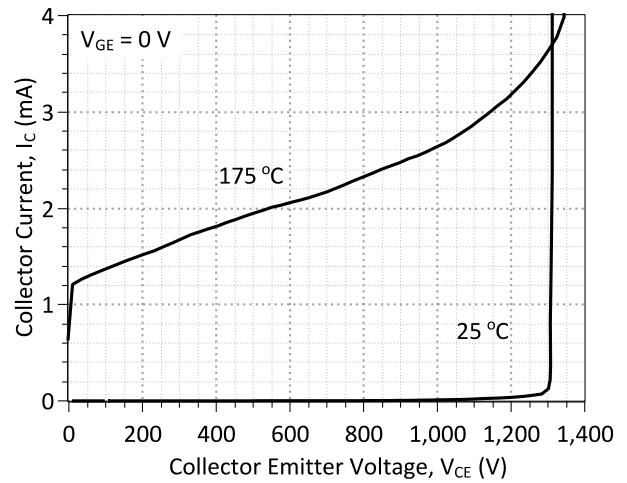
**Figure 1: Typical Output Characteristics at 25 °C**



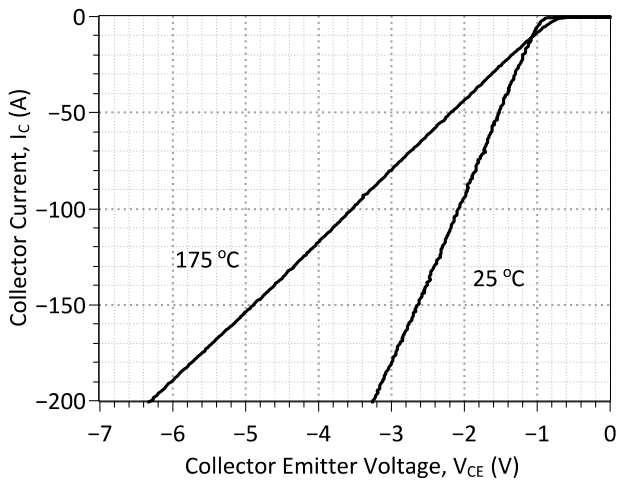
**Figure 2: Typical Output Characteristics at 175 °C**



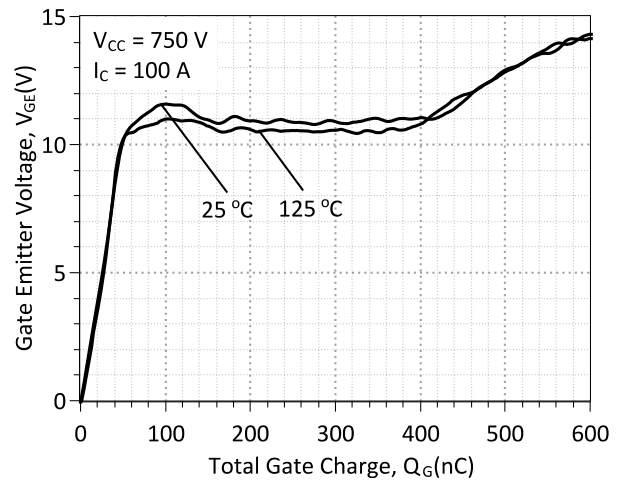
**Figure 3: Typical Transfer Characteristics**



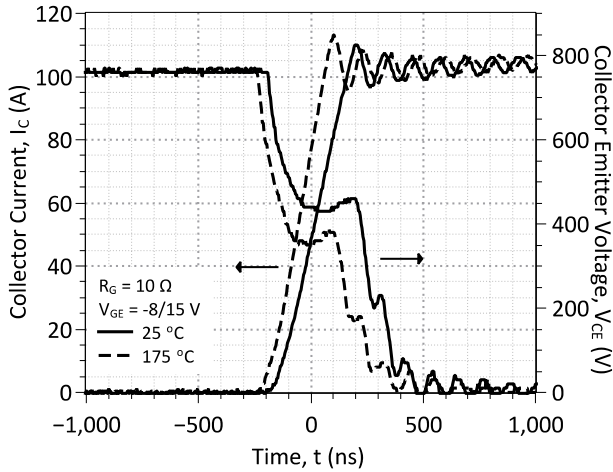
**Figure 4: Typical Blocking Characteristics**



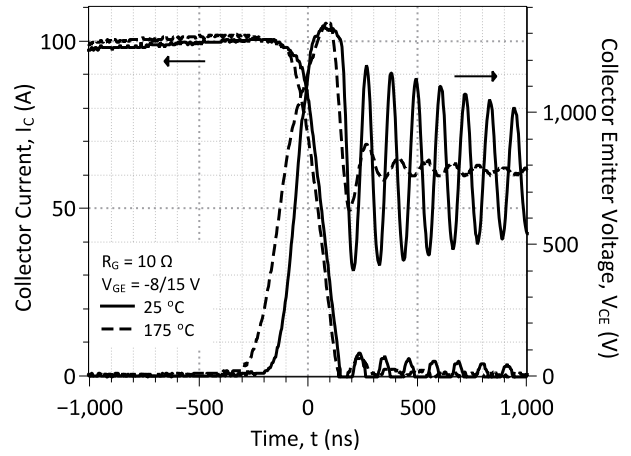
**Figure 5: Typical FWD Forward Characteristics**



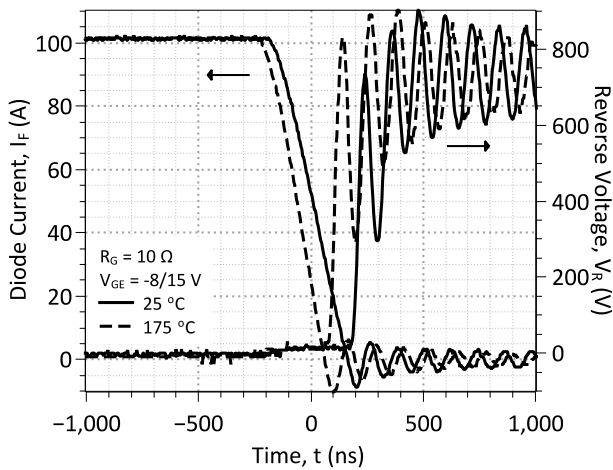
**Figure 6: Typical Turn On Gate Charge**



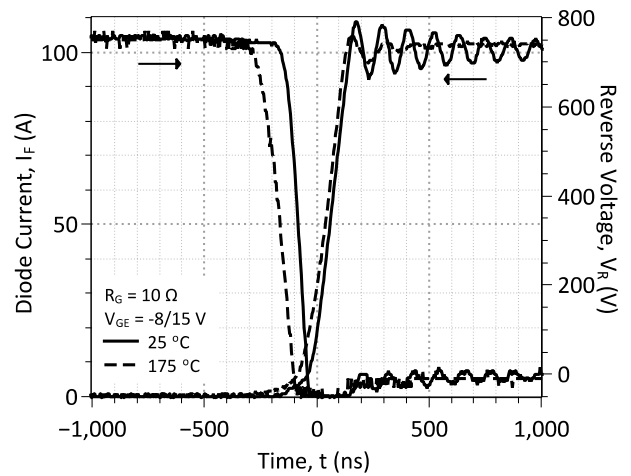
**Figure 7: Typical Hard-Switched IGBT Turn On Waveforms**



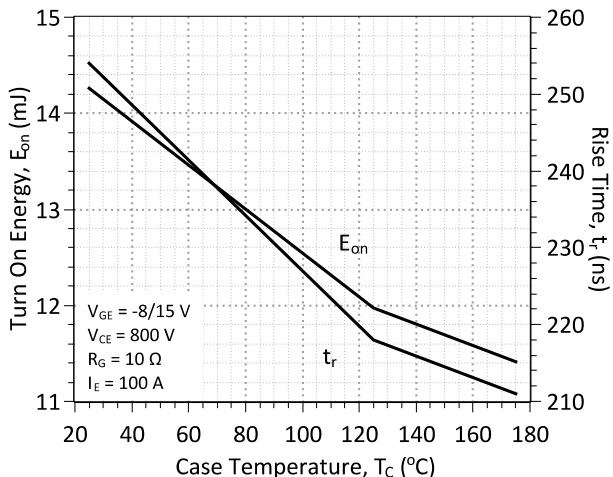
**Figure 8: Typical Hard-Switched IGBT Turn Off Waveforms**



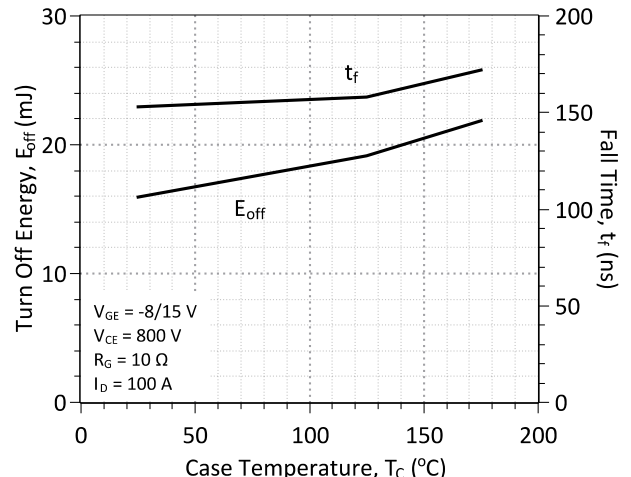
**Figure 9: Typical Hard-Switched Free-wheeling SiC Diode Turn Off Waveforms**



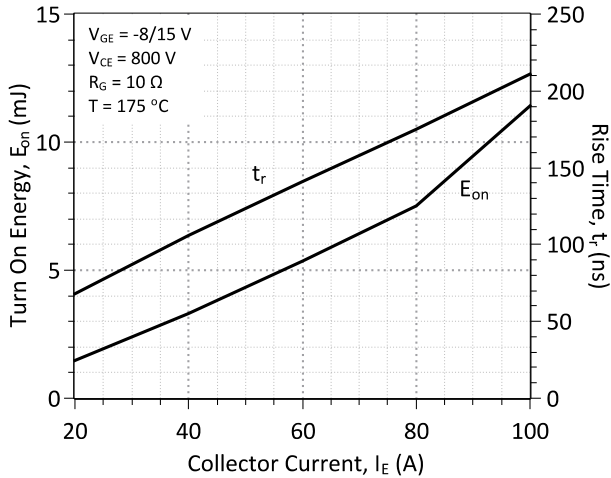
**Figure 10: Typical Hard-Switched Free-wheeling SiC Diode Turn On Waveforms**



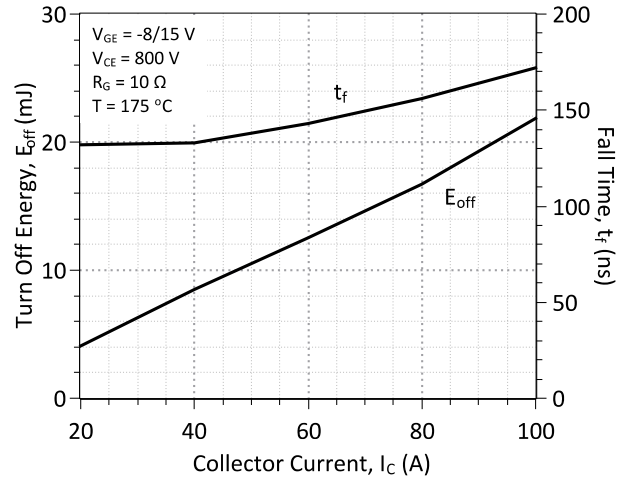
**Figure 11: Typical Module Energy Losses and Switching Times at IGBT Turn On vs. Temperature**



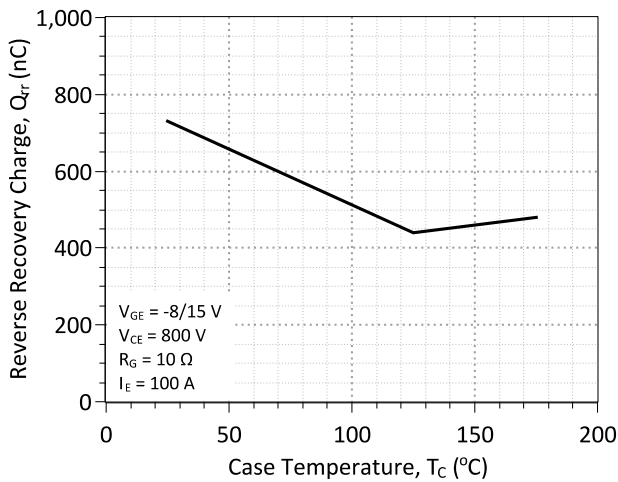
**Figure 12: Typical Module Energy Losses and Switching Times at IGBT Turn Off vs. Temperature**



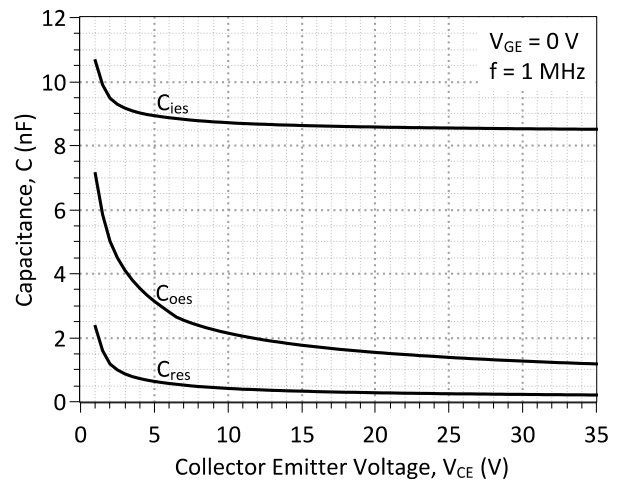
**Figure 13: Typical Module Energy Losses and Switching Times at IGBT Turn On vs. Current**



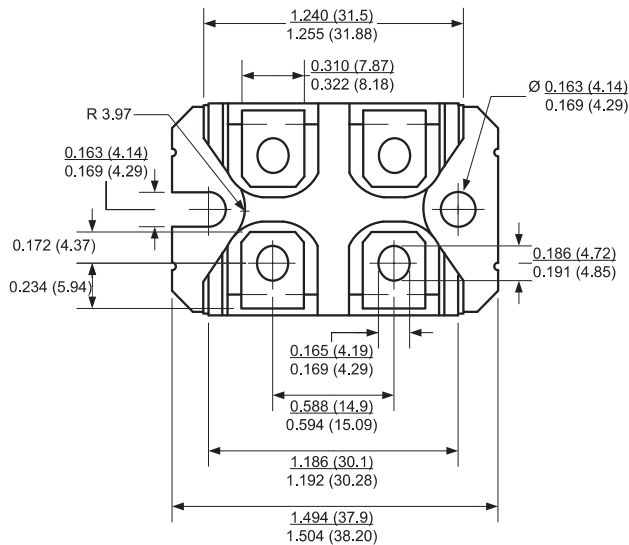
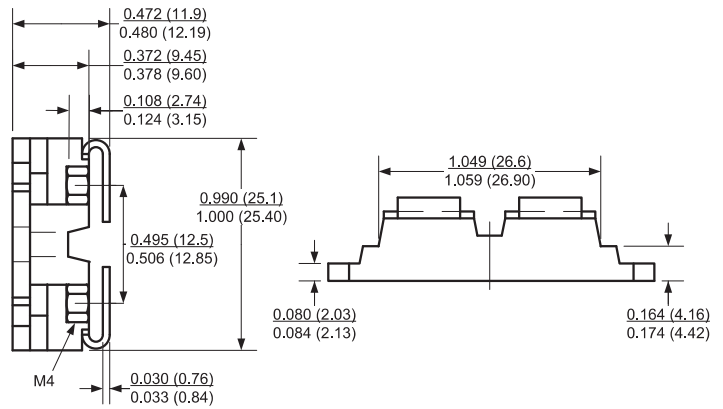
**Figure 14: Typical Module Energy Losses and Switching Times at IGBT Turn Off vs. Current**



**Figure 15: Typical Hard-Switched Reverse Recovery Charge vs. Temperature**



**Figure 16: Typical C-V Characteristics**

**Package Dimensions:**
**SOT-227**

**PACKAGE OUTLINE**

**NOTE**

1. CONTROLLED DIMENSION IS INCH. DIMENSION IN BRACKET IS MILLIMETER.
2. DIMENSIONS DO NOT INCLUDE END FLASH, MOLD FLASH, MATERIAL PROTRUSIONS

Revision History			
Date	Revision	Comments	Supersedes
2013/02/08	2	Updated Electrical Characteristics	
2012/07/30	1	Second generation release	GA100XCP12-227
2011/01/06	0	Initial release	

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 43670 Trade Center Place Suite 155  
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### Наши контакты:

**Телефон:** +7 812 627 14 35

**Электронная почта:** [sales@st-electron.ru](mailto:sales@st-electron.ru)

**Адрес:** 198099, Санкт-Петербург,  
Промышленная ул, дом № 19, литера Н,  
помещение 100-Н Офис 331