

General Description

The SRE60N065FSUDG is a Field Stop Trench IGBT with anti-parallel diode, which offers ultra-low switching losses, high energy efficiency for switching applications such as PFC, Power Supply, Inverter, etc.

The SRE60N065FSUDG package is TO-247.

Features

- High Breakdown Voltage to 650V
- Advanced Trench Fieldstop technology
 - Ultra low E_{off}
 - High Ruggedness, Temperature Stability
 - Easy Parallel Switching Capability due to Positive Temperature Coefficient in $V_{CE(SAT)}$
- Low $V_{CE(SAT)}$
- Enhanced Avalanche Capability

Application

- Inverter
- Uninterruptible power supplies
- PFC application
- Converter with high switching frequency

Symbol

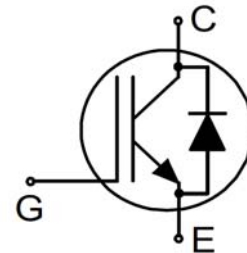


Figure 1 Symbol of SRE60N065FSUDG

Package Type

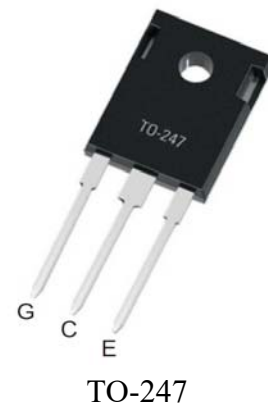
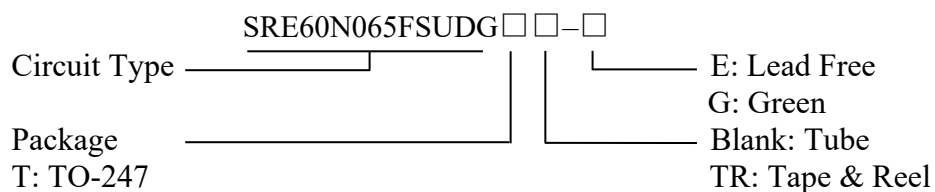


Figure 2 Package Type of SRE60N065FSUDG

Ordering Information



Package	Part Number	Marking ID	Packing Type
	Green	Green	
TO-247	SRE60N065FSUDGT-G	SRE60N065FSUDGTG	Tube

Absolute Maximum Ratings

Parameter		Symbol	Rating	Unit
Collector-emitter Voltage		V_{CES}	650	V
Gate-emitter Voltage		V_{GES}	± 20	V
Transient Gate-emitter Voltage ($t_p \leq 10\mu s$)			± 30	V
Continuous Collector Current	$T_C=25^\circ C$	I_C	100	A
	$T_C=100^\circ C$		60	
Pulsed Collector Current, Limited by T_{Jmax}		I_{CM}	240	A
Diode Continuous Collector Current	$T_C=25^\circ C$	I_F	80 ⁽¹⁾	A
	$T_C=100^\circ C$		60	
Diode Pulsed Current, Limited by T_{Jmax}		I_{FM}	120	A
Power Dissipation	$T_C=25^\circ C$	P_{tot}	306	W
	$T_C=100^\circ C$		153	
Operating Junction Temperature Range		T_J	-40 ~ 175	$^\circ C$
Storage Temperature Range		T_{STG}	-55 ~ 175	$^\circ C$
Lead Temperature (Soldering, 10 sec)		T_{LEAD}	260	$^\circ C$

Note:

1. Current level is limited by T_{j_max} .

Thermal Resistance

Parameter	Symbol	Min.	Typ.	Max.	Unit
IGBT Thermal Resistance, Junction-to-Case	R_{thJC}	-	-	0.49	$^\circ C/W$
Diode Thermal Resistance, Junction-to-Case	R_{thJC}	-	-	1.0	
Thermal Resistance, Junction-to-Ambient	R_{thJA}	-	-	40	

Electrical Characteristics

 T_J = 25°C, unless otherwise specified.

Parameter		Symbol	Test Conditions	Min.	Typ.	Max.	Unit	
Statistic Characteristics								
Collector-emitter Voltage	Breakdown	BV _{CES}	V _{GE} =0V, I _C =250μA	650			V	
Gate Threshold Voltage		V _{GE(th)}	V _{CE} =V _{GE} , I _C =250μA	4.0	4.8	6.0	V	
Collector-emitter saturation voltage		V _{CEsat}	V _{GE} =15V, I _C =60A, T _J =25°C		1.45	2.0	V	
			T _J =125°C		1.64		V	
			T _J =150°C		1.75		V	
Zero Gate Voltage Collector Current		I _{CES}	V _{CE} =650V, V _{GE} =0V T _J =25°C		0.1	40	μA	
			T _J =150°C			1	mA	
Gate-emitter Leakage Current	Forward	I _{GESF}	V _{GE} =20V, V _{CE} =0V			100	nA	
	Reverse	I _{GESR}	V _{GE} =-20V, V _{CE} =0V			-100	nA	
Dynamic Characteristics								
Input Capacitance		C _{IES}	V _{CE} =25V, V _{GE} =0V, f=1 MHz		2350		pF	
Output Capacitance		C _{OES}			220			
Reverse Transfer Capacitance		C _{RES}			25			
Gate Resistance		R _G	f=1 MHz, Open Drain		1.7		Ω	
Turn-on Delay Time		t _{d(on)}	T _J =25°C V _{CC} =400V, I _C =60A R _G =20Ω, V _{GE} =0/15V		35		ns	
Rise Time		t _r			73		ns	
Turn-off Delay Time		t _{d(off)}			223		ns	
Fall Time		t _f			16		ns	
Turn-on energy		E _{on}			3.0		mJ	
Turn-off energy		E _{off}			0.80		mJ	
Total switching energy		E _{ts}			3.80		mJ	
Turn-on Delay Time		t _{d(on)}		T _J =150°C V _{CC} =400V, I _C =60A R _G =20Ω, V _{GE} =0/15V		30		ns
Rise Time		t _r				75		ns
Turn-off Delay Time		t _{d(off)}				272		ns
Fall Time		t _f			32		ns	
Turn-on energy		E _{on}			4.05		mJ	
Turn-off energy		E _{off}			1.05		mJ	
Total switching energy		E _{ts}			5.1		mJ	
Gate to Emitter Charge		Q _{GE}	V _{CC} =400V, I _C =60A V _{GE} =0 to 15V		32		nC	
Gate to Collector Charge		Q _{GC}			39			
Gate Charge Total		Q _G			90			

60A 650V Trench Fieldstop IGBT with anti-parallel diode SRE60N065FSUDG

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Reverse Diode Characteristics						
Drain-Source Diode Forward Voltage	V_F	$V_{GE}=0V, I_F=60A$ $T_J=25^{\circ}C$		1.75	2.1	V
		$V_{GE}=0V, I_F=60A$ $T_J=125^{\circ}C$		1.71		
		$V_{GE}=0V, I_F=60A$ $T_J=150^{\circ}C$		1.62		
Reverse Recovery Time	t_{rr}	$T_J=25^{\circ}C$		110		ns
Reverse Recovery Charge	Q_{rr}	$V_R=400V, I_F=40A$		1000		nC
Peak Reverse Recovery Current	I_{rrm}	$dI_F/dt=700A/\mu s$		25.0		A

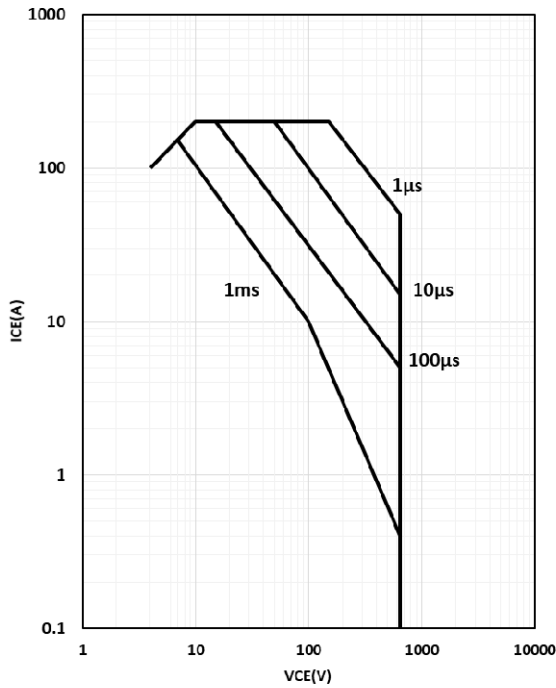
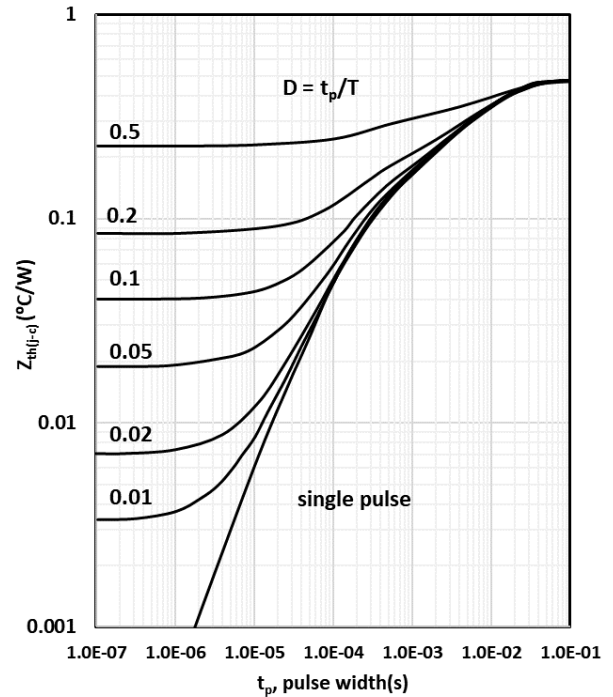
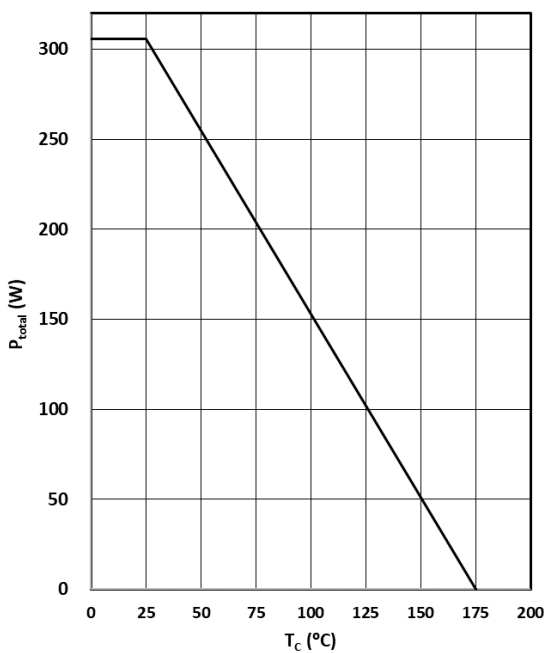
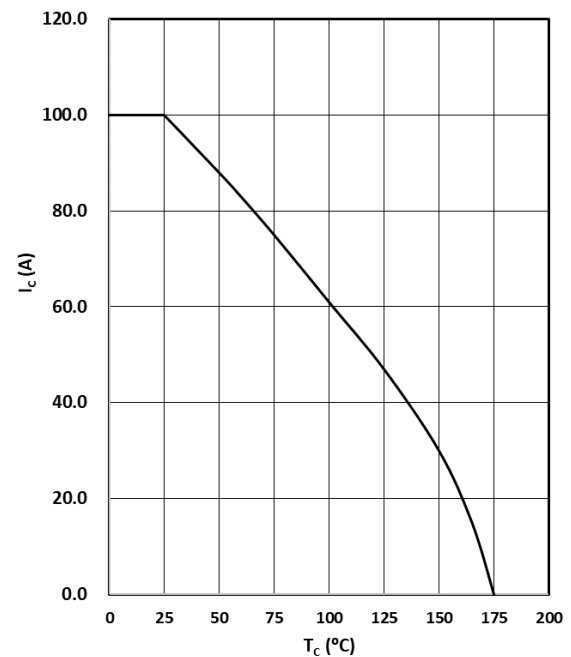
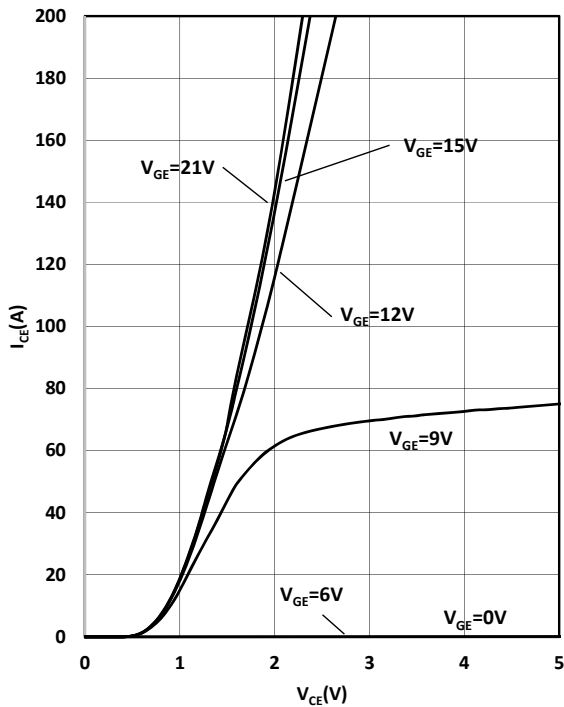
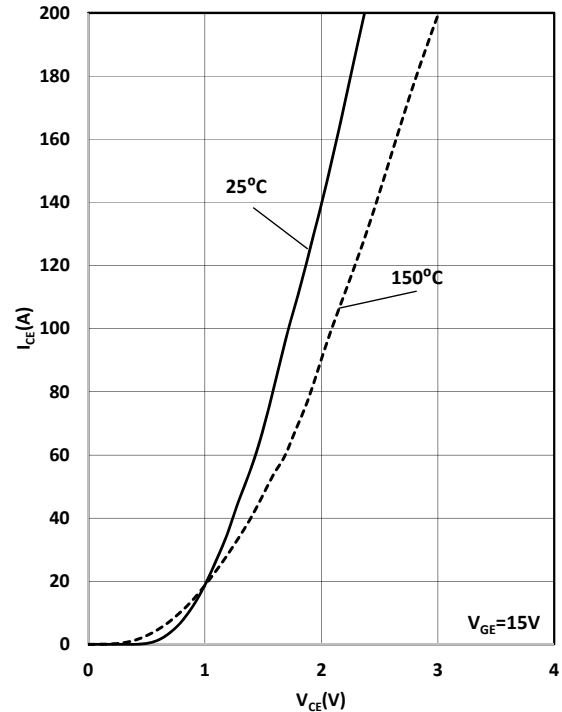
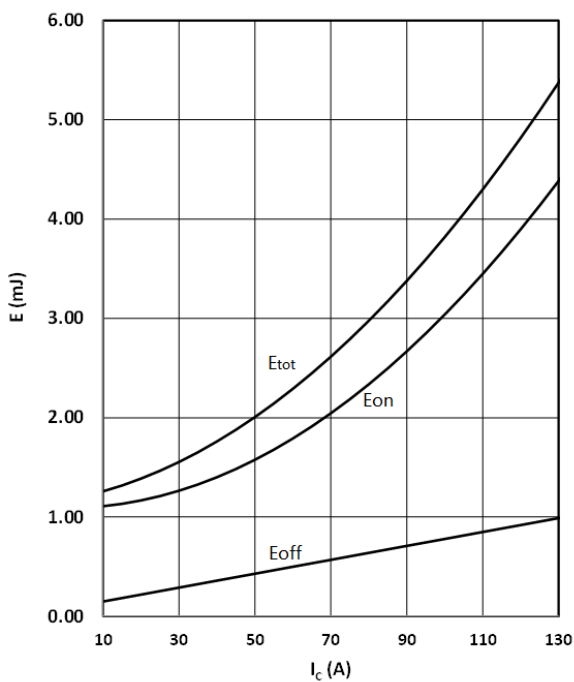
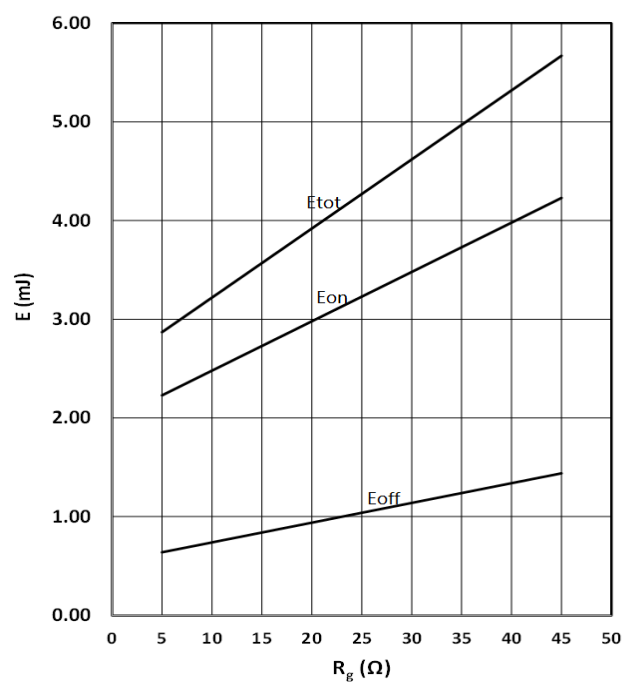
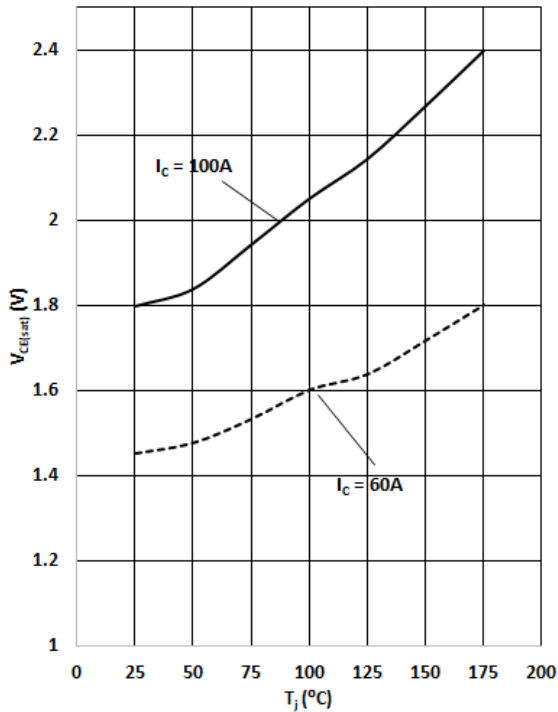
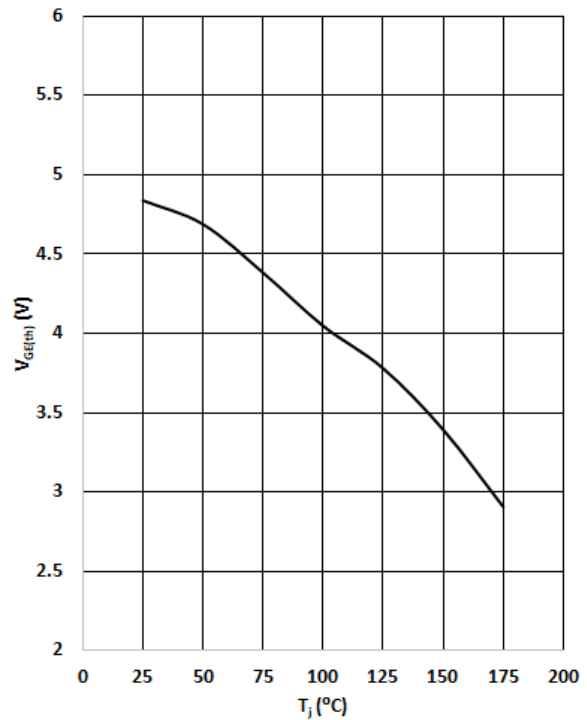
Typical Performance Characteristics
Figure 3: IGBT FBSOA

 $I_C = f(V_{CE}); V_{GE} \geq 15/0V; T_j \leq 175^\circ C$
Figure 4: IGBT transient thermal impedance

 $R_{th(j-c)} = f(t_p); \text{ duty cycle: } D = t_p/T$
Figure 5: Power dissipation

 $P_{tot} = f(T_c);$
Figure 6: Collector current vs. temperature

 $I_c = f(T_j); V_{GE} \geq 15V; T_j \leq 175^\circ C$

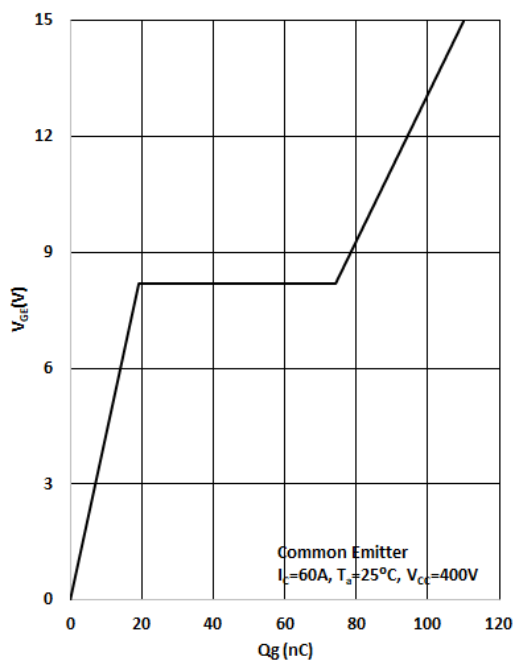
Figure 7: Typ. Output Characteristics

 $I_C = f(V_{CE}); T_j = 25^\circ\text{C}; \text{parameter: } V_{GE}$
Figure 8: Saturation Voltage Characteristics

 $I_C = f(V_{CE}); T_j = 25^\circ\text{C vs } 150^\circ\text{C}$
Figure 9: IGBT switching energy losses

 $E = f(I_c); V_{CE} = 400\text{V}; T_j = 25^\circ\text{C}; R_G = 20\Omega$
Figure 10: IGBT switching energy losses

 $E = f(R_G); V_{CE} = 400\text{V}; T_j = 25^\circ\text{C}; I_c = 60\text{A}$

60A 650V Trench Fieldstop IGBT with anti-parallel diode SRE60N065FSUDG
Figure 11: Typ. Collector Voltage vs. Temperature


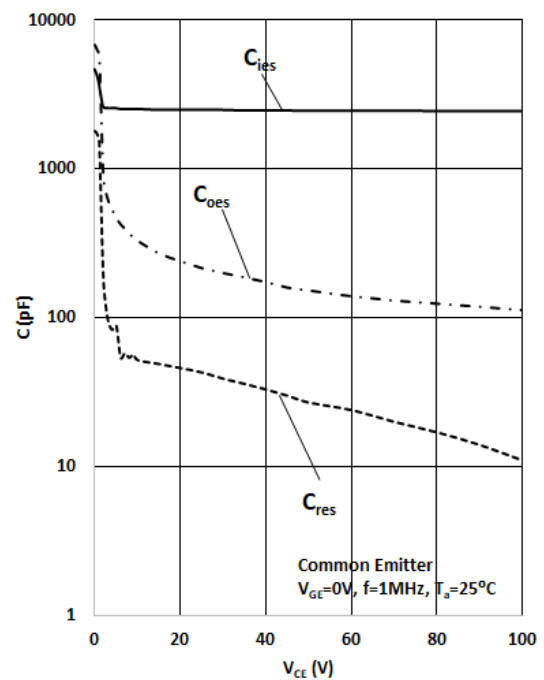
$$V_{CE} = f(T_j); V_{GE} = 15V$$

Figure 12: Typ. emitter threshold voltage as a function of junction temperature


$$V_{GE} = f(T_j); I_{CE} = 250\mu A$$

Figure 13: Typ. Gate Charge


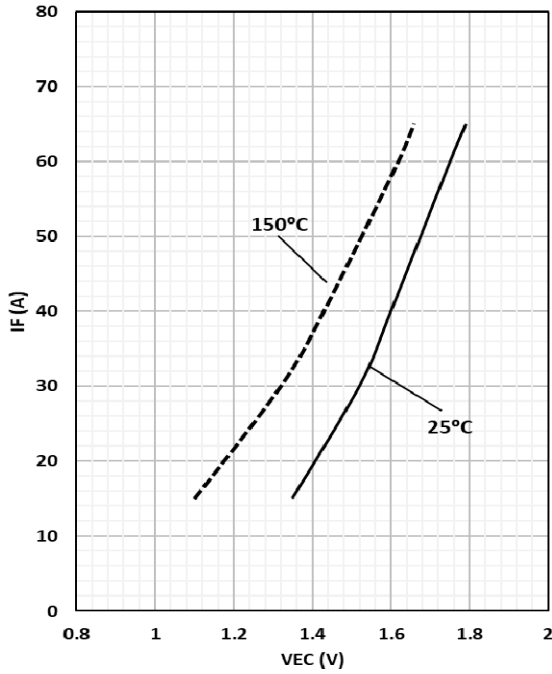
$$V_{GE} = f(Q_{gate}); I_C = 60A$$

Figure 14: Typ. Capacitances


$$C = f(V_{CE}); V_{GE} = 0; f = 1MHz$$

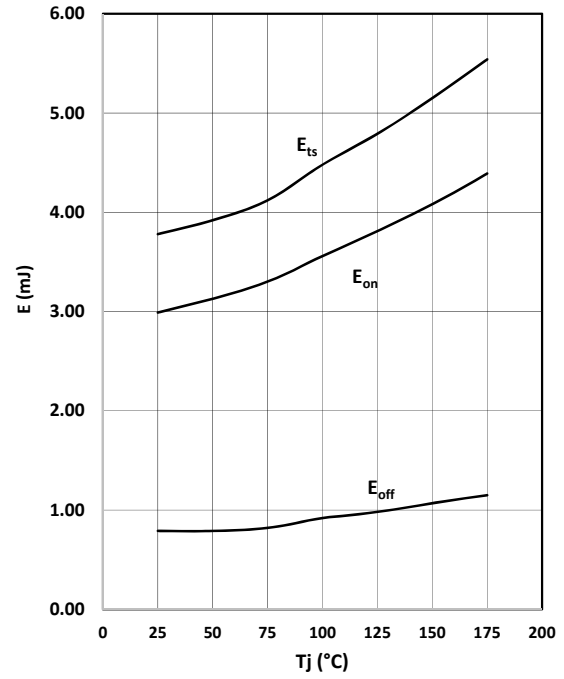
60A 650V Trench Fieldstop IGBT with anti-parallel diode SRE60N065FSUDG

Figure 15: Typ. diode forward current as a function of forward voltage

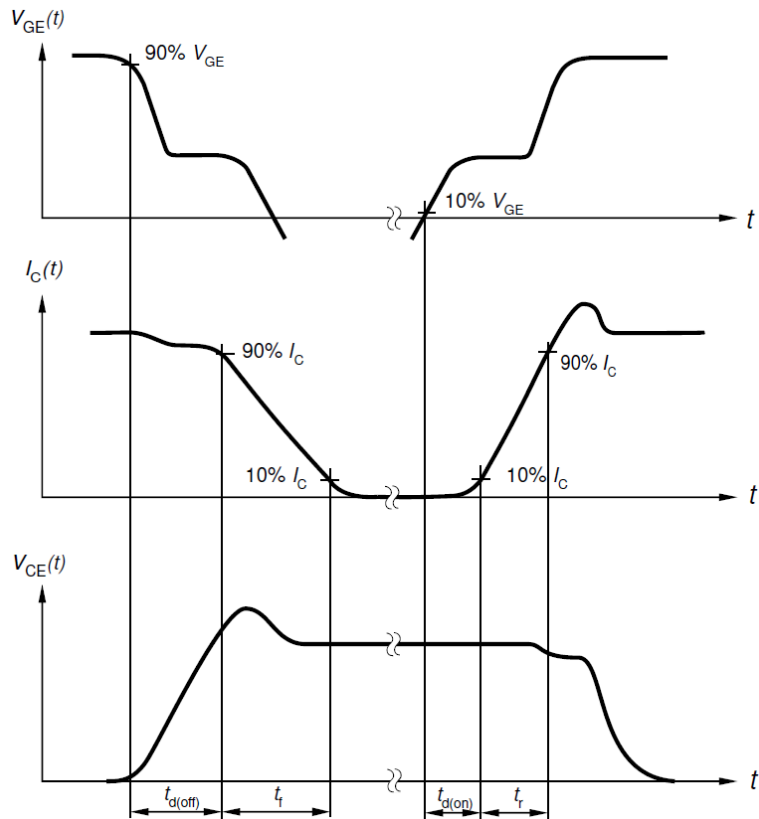
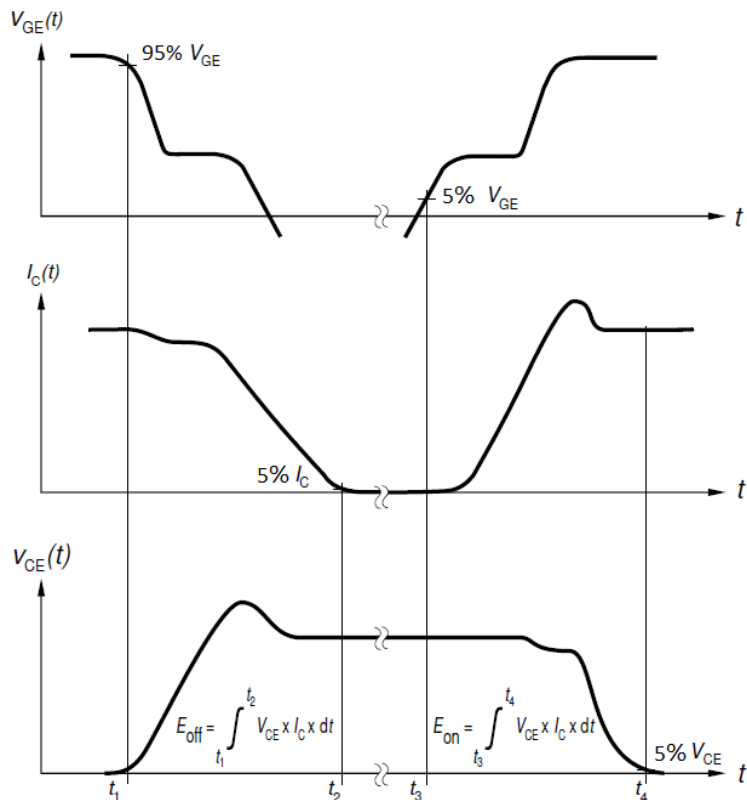


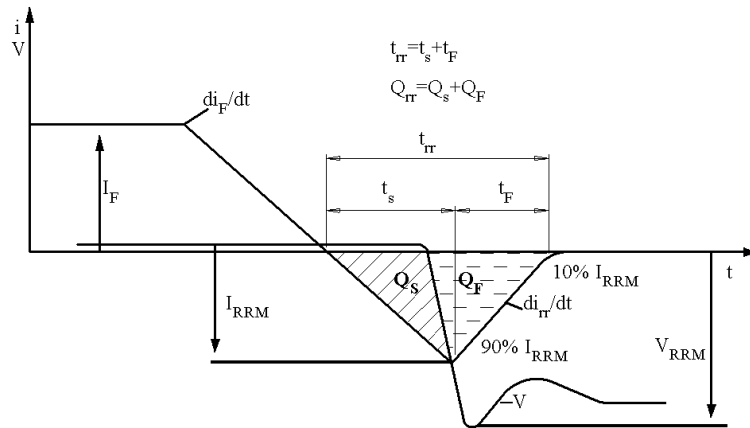
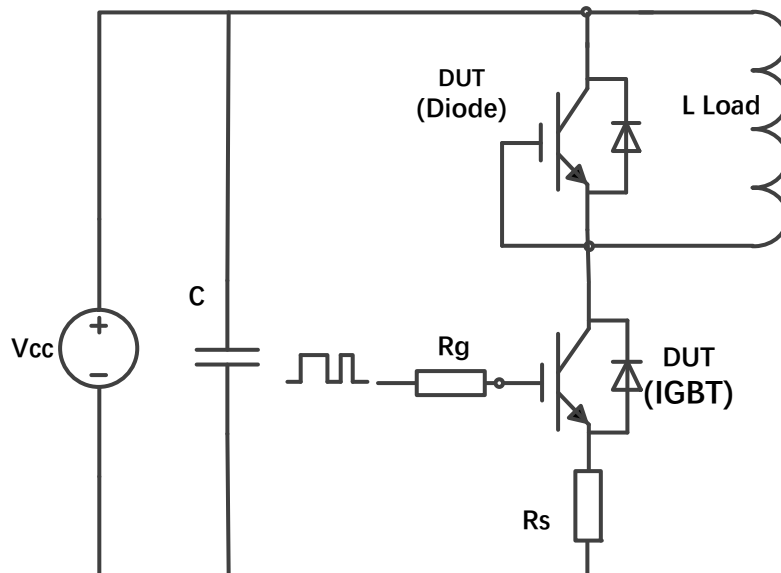
$$I_F = f(V_{EC});$$

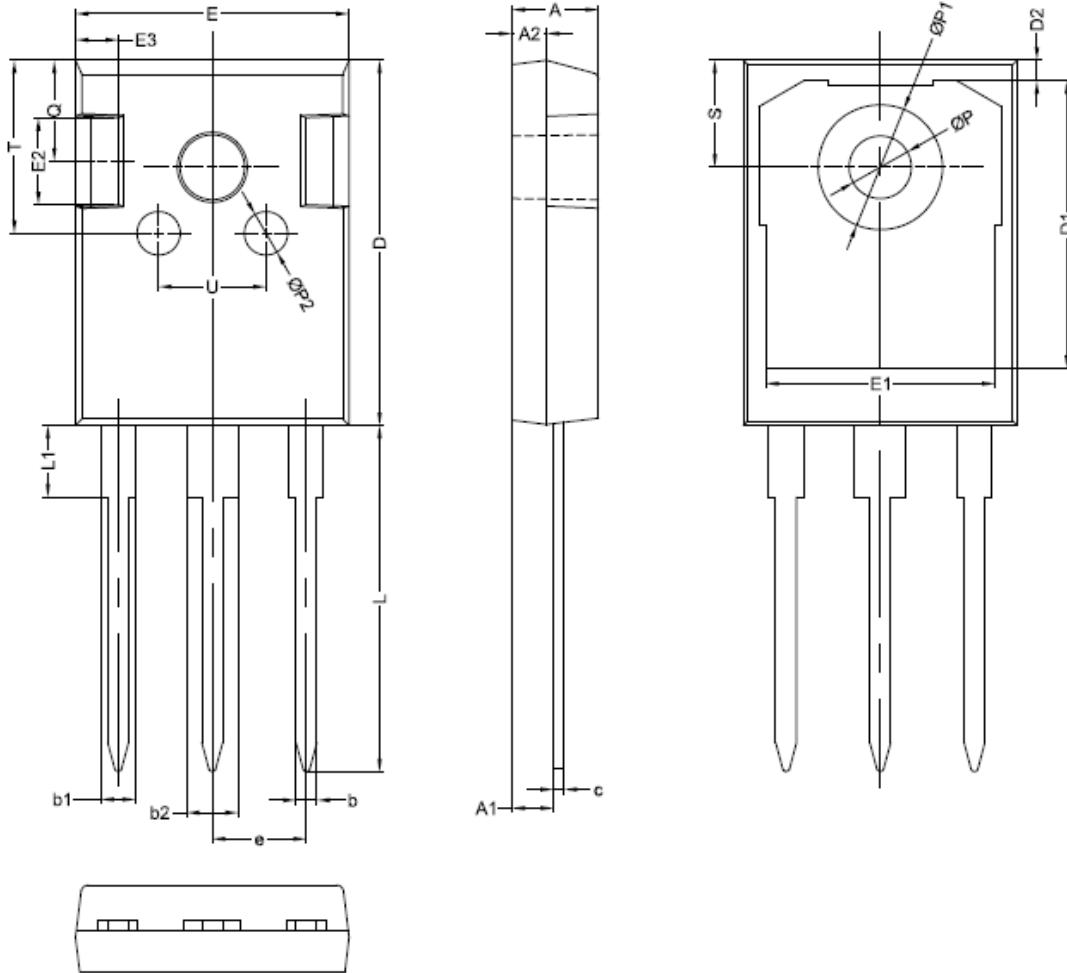
Figure 16: IGBT switching energy losses



$$E = f(T_j); V_{CE} = 400V; I_c = 60A; R_G = 20\Omega$$

Test Circuits
1. Definition Switching times

2. Definition Switching losses


3. Definition Diode Switching Characteristics

4. Dynamic test circuit


Mechanical Dimensions
TO-247
Unit: mm


Symbol	Dimensions(mm)			Symbol	Dimensions(mm)		
	Min.	Typ.	Max.		Min.	Typ.	Max.
A	4.80	5.00	5.20	E2	-	5.00	-
A1	2.21	2.41	2.61	E3	-	2.50	-
A2	1.90	2.00	2.10	e	5.44(BSC)		
b	1.10	1.20	1.35	L	19.42	19.92	20.42
b1	-	2.00	-	L1	-	4.13	-
b2	-	3.00	-	P	3.50	3.60	3.70
c	0.55	0.60	0.75	P1	-	-	7.40
D	20.80	21.00	21.20	P2	-	2.50	-
D1	-	16.55	-	Q	-	5.80	-
D2	-	1.20	-	S	6.05	6.15	6.25
E	15.60	15.80	16.00	T	-	10.00	-
E1	-	13.30	-	U	-	6.20	-



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