60A 650V Trench Fieldstop IGBT with anti-parallel diode SRE60N065FSU2DH

General Description

The SRE60N065FSU2DH 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 SRE60N065FSU2DH package is TO-247.

Features

- High Breakdown Voltage to 715V@ T_j=25ºC
- 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
- Non-Automotive Qualified

Application

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

Symbol

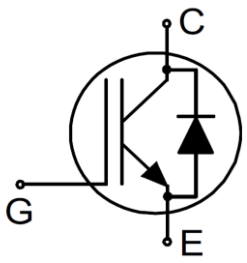
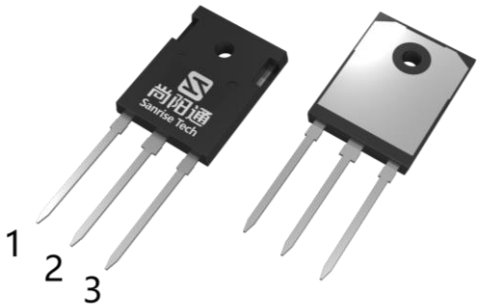


Figure 1 Symbol of SRE60N065FSU2DH

Package Type



TO-247

Pin 1- gate
Pin 2&backside-collector
Pin 3-emitter

Figure 2 Package Type of SRE60N065FSU2DH

Ordering Information

SRE60N065FSU2DH□□–□

Circuit Type
Package
T: TO-247

G: Green
Blank: Tube
TR: Tape & Reel

Package	Part Number	Marking ID	Packing Type
TO-247	SRE60N065FSU2DHT-G1	SRE60N065FSU2DHTG1	Tube

60A 650V Trench Fieldstop IGBT with anti-parallel diode SRE60N065FSU2DH

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			±30	V
Continuous Collector Current	T_C=25ºC	I_C	100	A
	T_C=100ºC		60	
Pulsed Collector Current,Limited by T_{Jmax}		I_{CM}	240	A
Diode Continuous Collector Current	T_C=25ºC	I_F	80	A
	T_C=100ºC		60	
Diode Pulsed Current, Limited by T_{Jmax}		I_{FM}	200	A
Power Dissipation	T_C=25ºC	P_{tot}	306	W
	T_C=100ºC		153	
Operating Junction Temperature Range		T_J	-40 ~ 175	ºC
Storage Temperature Range		T_{STG}	-55 ~ 150	ºC
Lead Temperature (Soldering, 10 sec)		T_{LEAD}	260	ºC

Thermal Resistance

Parameter	Symbol	Min.	Typ.	Max.	Unit
IGBT Thermal Resistance，Junction-to-Case	R_{thJC}	-	-	0.49	ºC/W
Diode Thermal Resistance，Junction-to-Case	R_{thJC}	-	-	0.62	
Thermal Resistance，Junction-to-Ambient	R_{thJA}	-	-	40	

60A 650V Trench Fieldstop IGBT with anti-parallel diode SRE60N065FSU2DH

Electrical Characteristics

T_J = 25ºC, unless otherwise specified.

Parameter		Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Statistic Characteristics							
Collector-emitter Breakdown Voltage		BV_{CES}	V_{GE}=0V, I_C=1mA	715			V
Gate Threshold Voltage		$V_{GE(th)}$	V_{CE}=V_{GE}, I_C=250μA	4.0	4.8	5.6	V
Collector-emitter saturation voltage		V_{CEsat}	V_{GE}=15V, I_C=60A, T_J=25ºC		1.51	1.80	V
			T_J=125ºC		1.81		V
			T_J=175ºC		2.05		V
Zero Gate Voltage Collector Current		I_{CES}	V_{CE}=650V,V_{GE}=0V T_J=25ºC		0.1	40	μA
			T_J=175ºC			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=100KHz		2460		pF
Output Capacitance		C_{OES}			247		
Reverse Transfer Capacitance		C_{RES}			48		
Gate Resistance		R_G	f=1 MHz, Open Drain		1.53		Ω
Turn-on Delay Time		$t_{d(on)}$	T_J=25ºC V_{CC}=400V, I_C=60A R_G=10Ω, V_{GE}=0/15V Energy losses include "tail" and diode reverse recovery		21		ns
Rise Time		t_r			38		ns
Turn-off Delay Time		$t_{d(off)}$			122		ns
Fall Time		t_f			70		ns
Turn-on energy		E_{on}			1.34		mJ
Turn-off energy		E_{off}			0.63		mJ
Total switching energy		E_{ts}			1.97		mJ
Turn-on Delay Time		$t_{d(on)}$	T_J=150ºC V_{CC}=400V, I_C=60A R_G=10Ω,V_{GE}=0/15V Energy losses include "tail" and diode reverse recovery		18		ns
Rise Time		t_r			39		ns
Turn-off Delay Time		$t_{d(off)}$			149		ns
Fall Time		t_f			118		ns
Turn-on energy		E_{on}			2.43		mJ
Turn-off energy		E_{off}			0.92		mJ
Total switching energy		E_{ts}			3.35		mJ
Gate to Emitter Charge		Q_{GE}	V_{CC}=400V, I_C=60A V_{GE}=0 to 15V		28		nC
Gate to Collector Charge		Q_{GC}			91		
Gate Charge Total		Q_G			190		

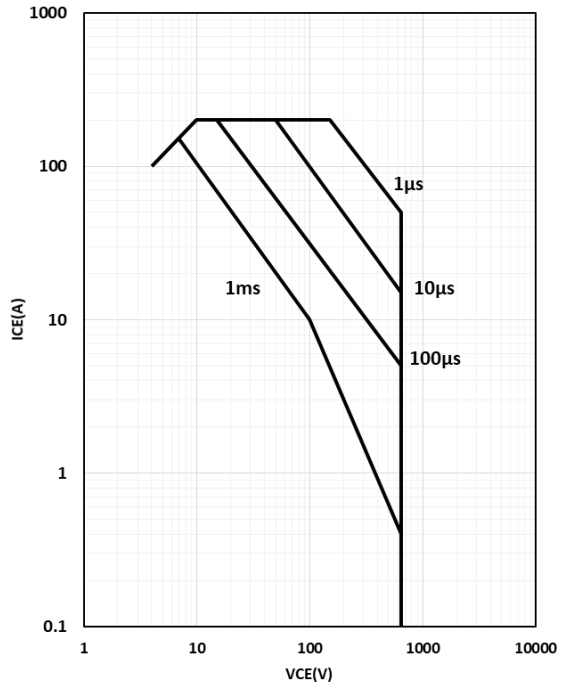
60A 650V Trench Fieldstop IGBT with anti-parallel diode SRE60N065FSU2DH

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Reverse Diode Characteristics						
Diode Forward Voltage	V_F	I_F=30A T_J=25ºC		1.41	1.95	V
		I_F=30A T_J=125ºC		1.23		
		I_F=30A T_J=175ºC		1.12		
		I_F=60A T_J=25ºC		1.62	2.15	
		I_F=60A T_J=125ºC		1.52		
		I_F=60A T_J=175ºC		1.36		
Reverse Recovery Time	t_{rr}	T_J=25ºC V_R=400V, I_F=30A dI_F/dt=1000A/μs		90		ns
Reverse Recovery Charge	Q_{rr}			0.88		uC
Peak Reverse Recovery Current	I_{rrm}			21		A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt			-530		A/μs
Reverse Recovery Time	t_{rr}	T_J=25ºC V_R=400V, I_F=60A dI_F/dt=1000A/μs		100		ns
Reverse Recovery Charge	Q_{rr}			1.1		uC
Peak Reverse Recovery Current	I_{rrm}			20.4		A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt			-470		A/μs

60A 650V Trench Fieldstop IGBT with anti-parallel diode SRE60N065FSU2DH

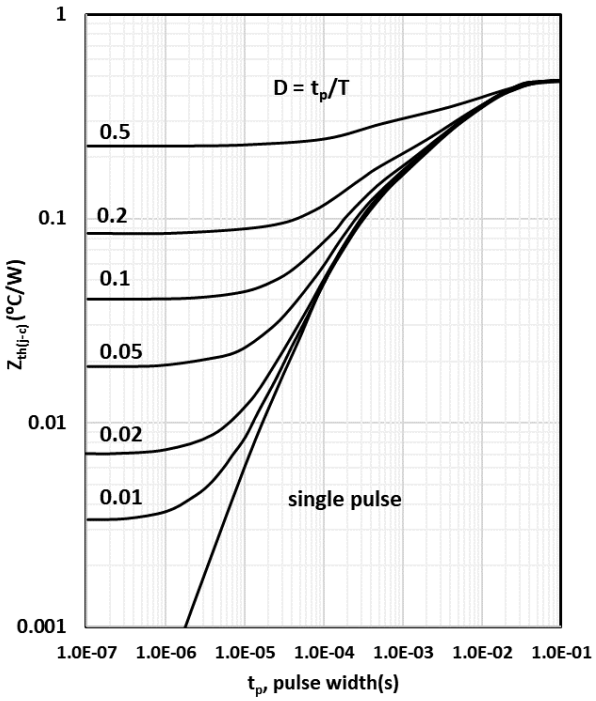
Typical Performance Characteristics

Figure 3: IGBT FBSOA



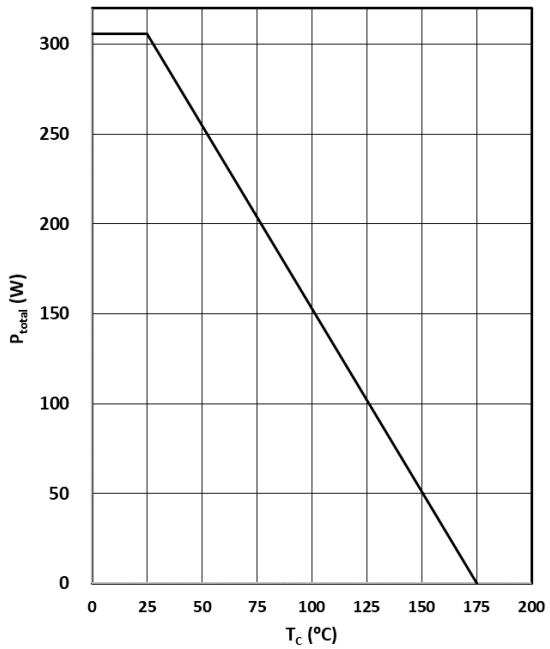
$I_C = f(V_{CE})$; $V_{GE} \geq 15/0V$; $Tj \leq 175^oC$

Figure 4: IGBT transient thermal impedance



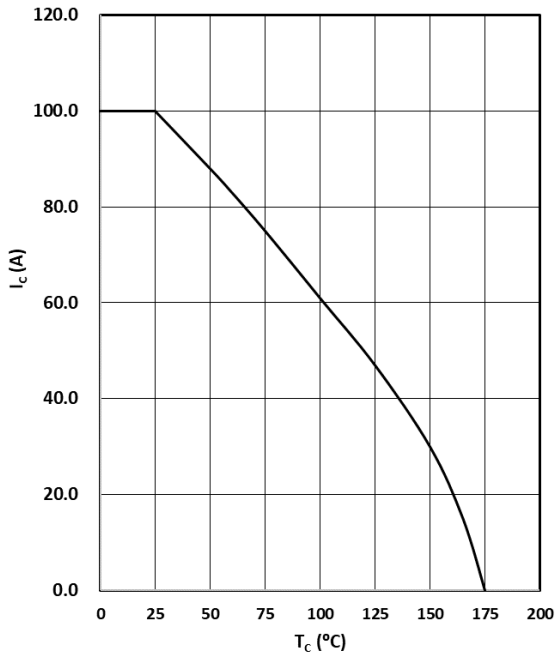
$R_{th(J-C)} = f(t_p)$; duty cycle: $D = t_p/T$

Figure 5: Power dissipation



Ptot= f(Tc);

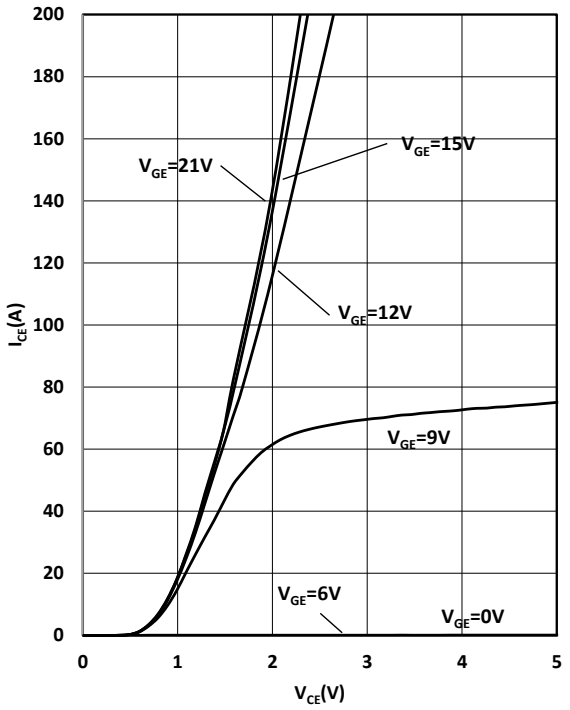
Figure 6: Collector current vs. temperature



$Ic = f(Tj)$; $V_{GE} \geq 15V$; $Tj \leq 175^oC$

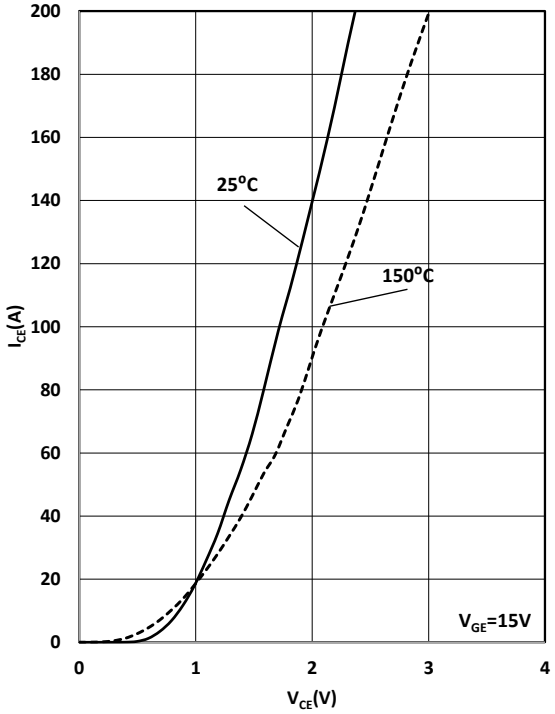
60A 650V Trench Fieldstop IGBT with anti-parallel diode SRE60N065FSU2DH

Figure 7: Typical Output Characteristics



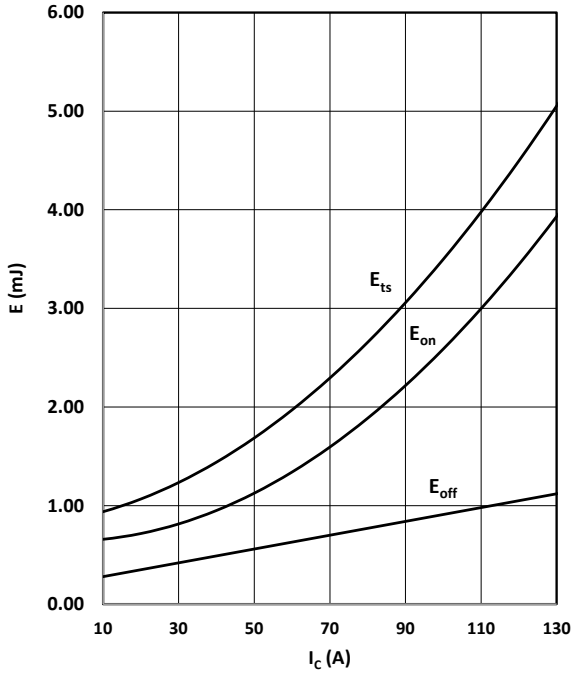
$I_C = f(V_{CE})$; Tj= 25ºC; parameter: V_{GE}

Figure 8: Typical transfer characteristic



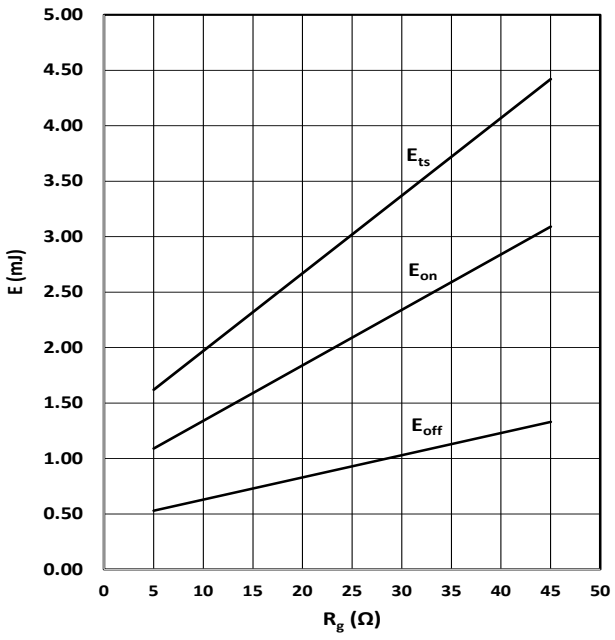
$I_C = f(V_{CE})$; Tj= 25ºC vs 150ºC

Figure 9: Typical switching energy losses as a function of collector current



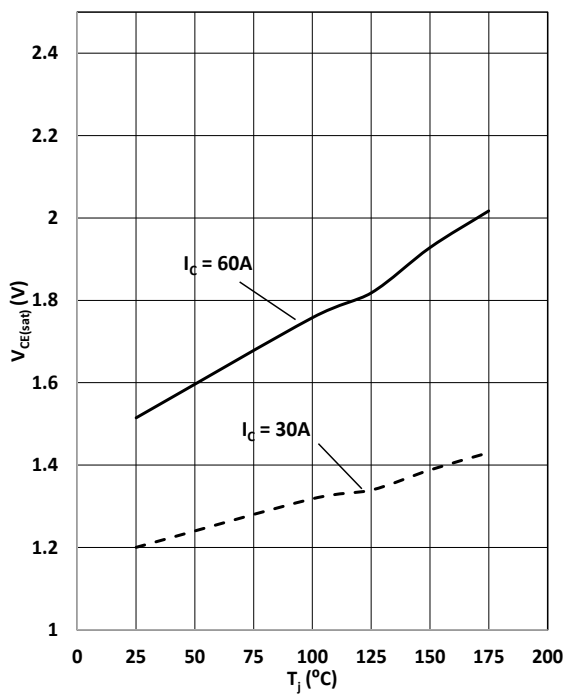
E=f(Ic); V_{CE}=400V; Tj=25ºC; R_G=10Ω

Figure10: Typical switching energy losses as a function of gate resistor



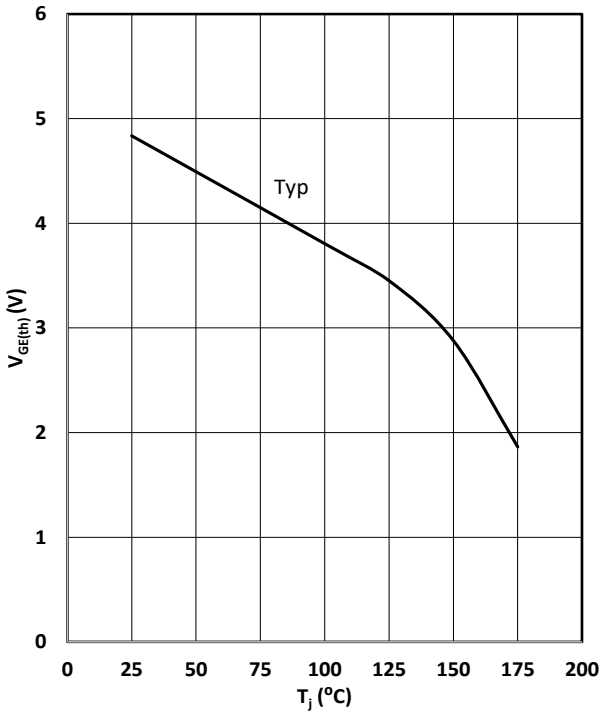
E=f(R_G); V_{CE}=400V; Tj=25ºC; Ic=60A

Figure 11: Typical collector-emitter saturation voltage as a function of junction temperature



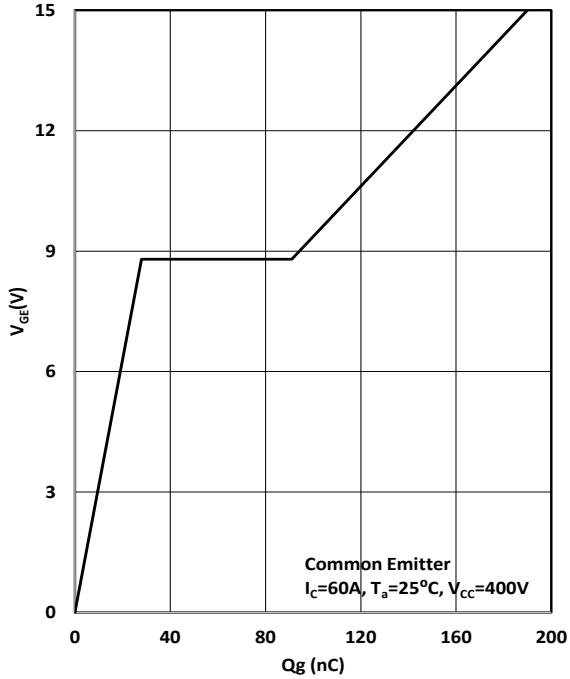
V_{CE} =f(T_j); V_{GE}=15V

Figure 12: Gate-emitter threshold voltage as a function of junction temperature



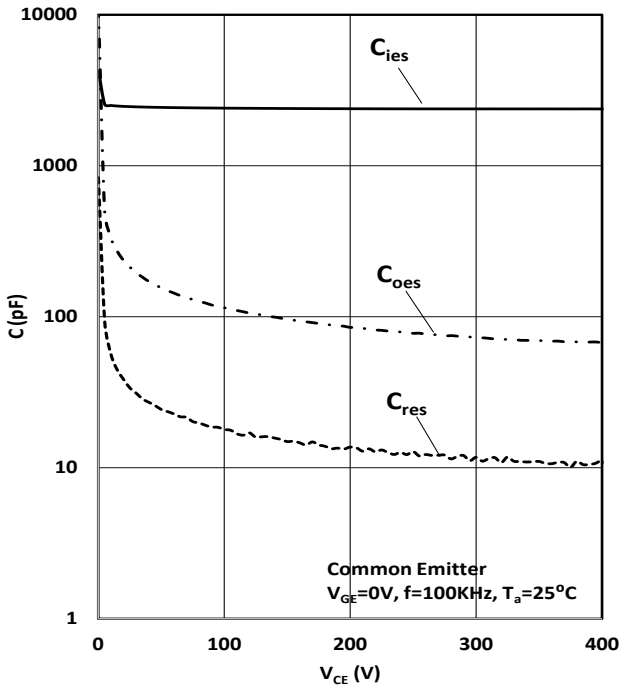
V_{GE} =f(T_j); I_{CE} = 250μA

Figure 13: Typical Gate Charge



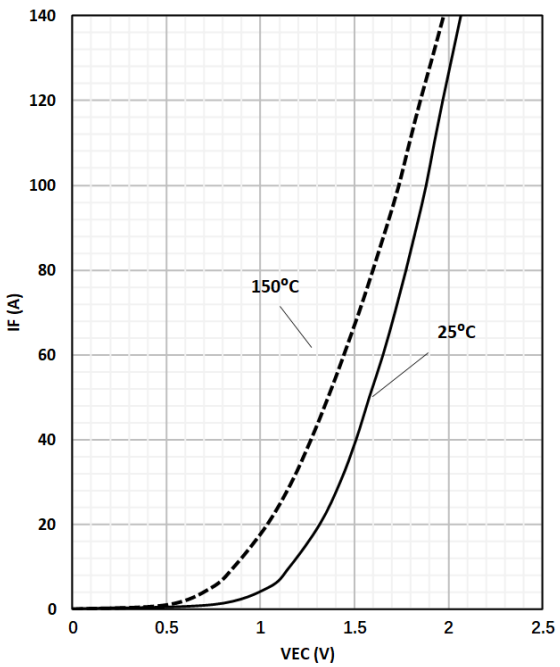
V_{GE}= f(Q_{gate}); I_C= 60A

Figure 14: Typical Capacitances



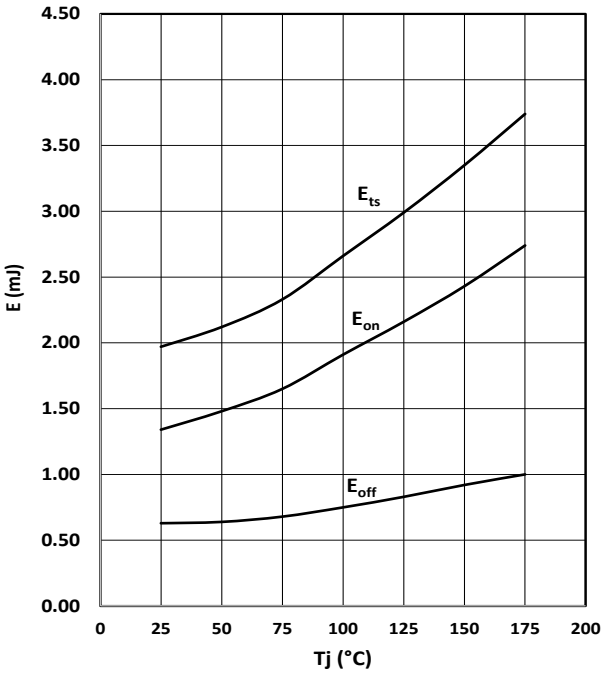
C=f(V_{CE}); V_{GE}=0; f=100KHz

Figure 15: Typical diode forward current as a function of forward voltage



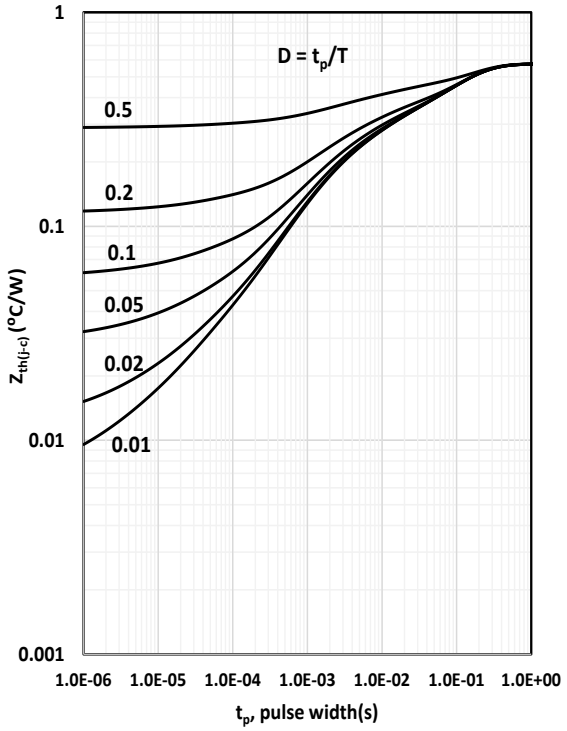
I_F= f(V_{EC});

Figure 16: Typical switching energy losses as a function of junction temperature



E=f(Tj); V_{CE}=400V; Ic=60A; R_G=10Ω

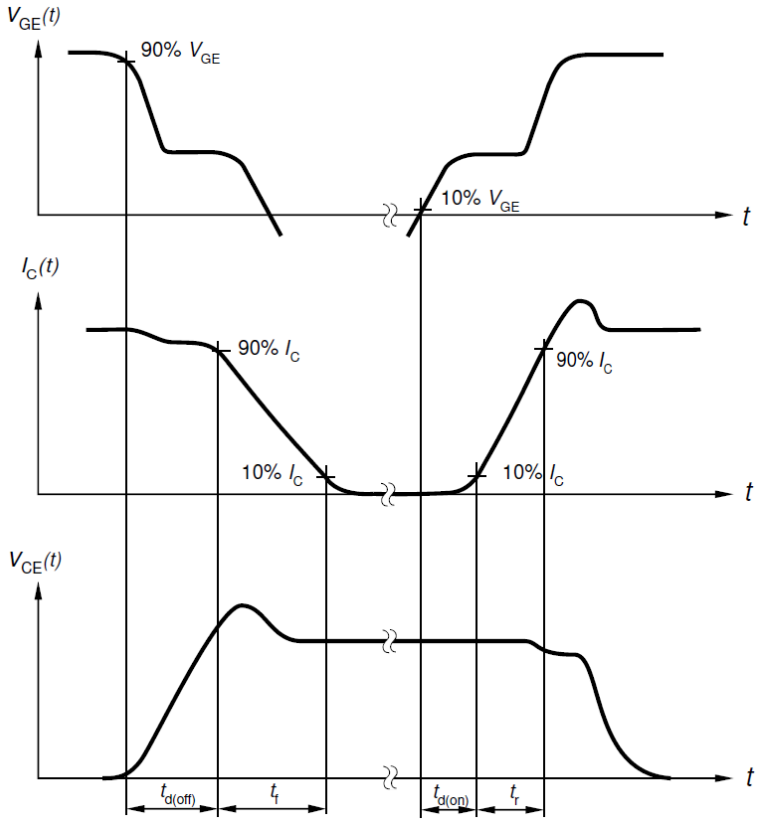
Figure 17: FRD transient thermal impedance



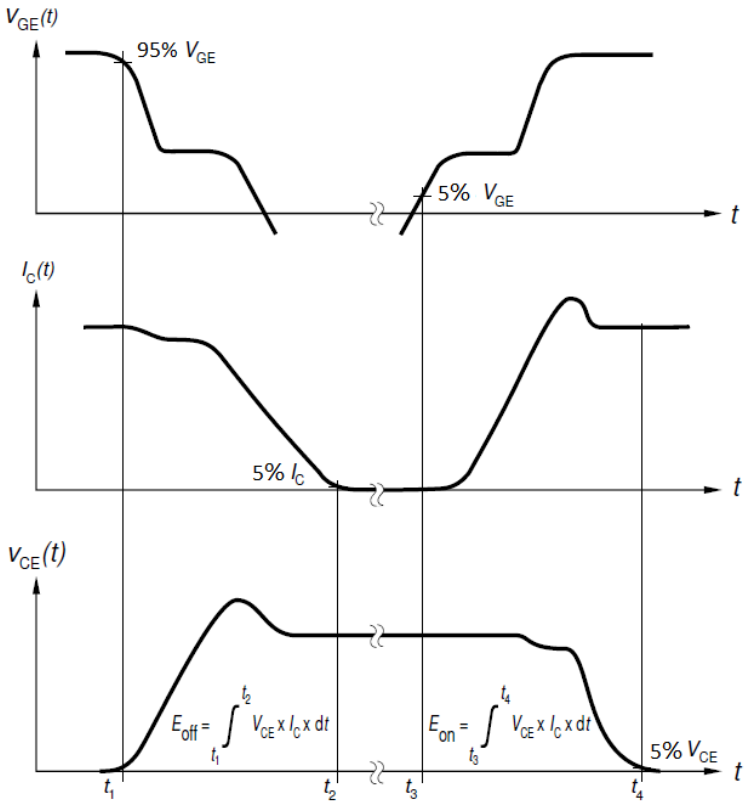
$R_{th(J-C)}$= f(t_p); duty cycle: D= t_p/T

Test Circuits

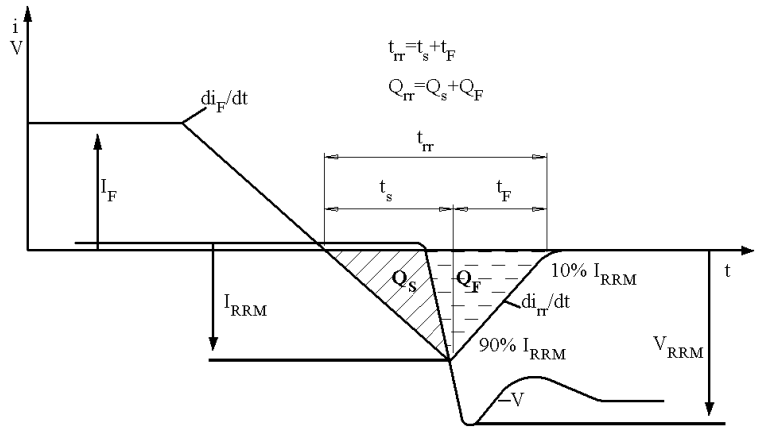
1. Definition Switching times



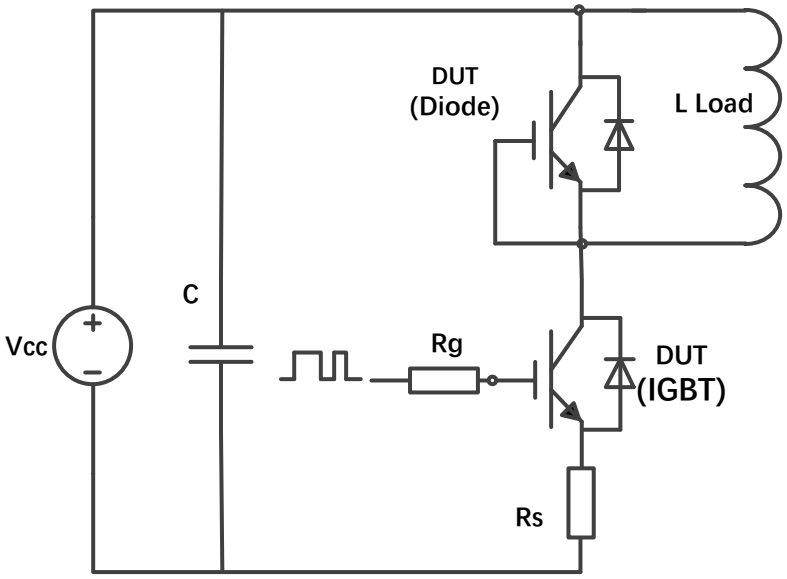
2. Definition Switching losses



3. Definition Diode Switching Characteristics



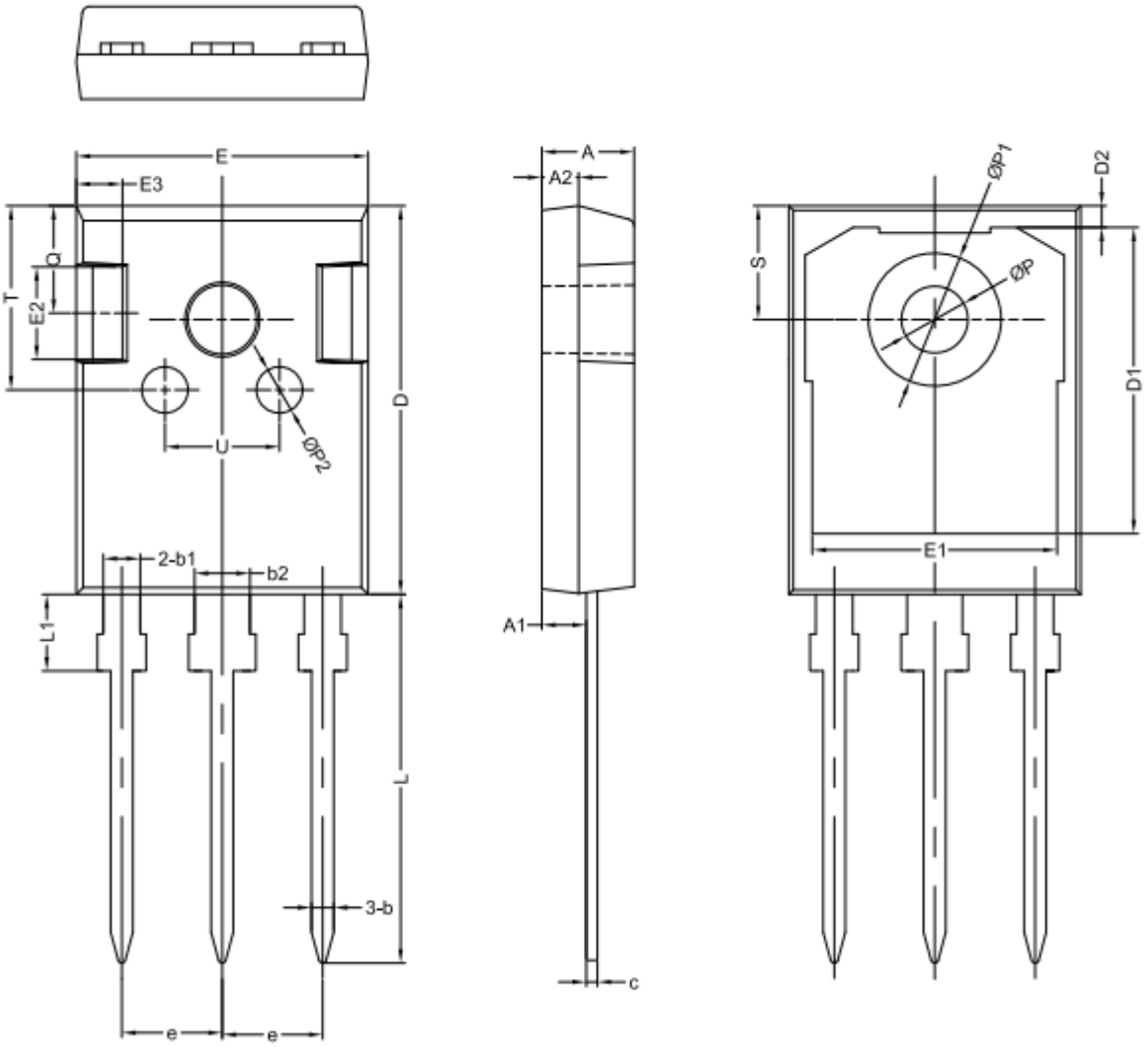
4. Dynamic test circuit



60A 650V Trench Fieldstop IGBT with anti-parallel diode SRE60N065FSU2DH

Mechanical Dimensions

TO-247 **Unit: mm**



60A 650V Trench Fieldstop IGBT with anti-parallel diode SRE60N065FSU2DH

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	–
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	–	7.19	–
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	–

60A 650V Trench Fieldstop IGBT with anti-parallel diode SRE60N065FSU2DH

TM

Sanrise Tech

尚阳通

Sanrise Technology Co., LTD

http://www.sanrise-tech.com

IMPORTANT NOTICE

Shenzhen Sanrise Technology Co., LTD. reserves the right to make changes without further notice to any products or specifications herein. Shenzhen Sanrise Technology Co., LTD. does not assume any responsibility for use of any its products for any particular purpose, nor does Shenzhen Sanrise Technology Co., LTD. assume any liability arising out of the application or use of any its products or circuits. Shenzhen Sanrise Technology Co., LTD. does not convey any license under its patent rights or other rights nor the rights of others.

Main Site:

- Headquarter

Shenzhen Sanrise Technology Co., LTD.

A1206, Skyworth building, No. 008, gaoxinnan 1st Road, Gaoxin District, Yuehai street, Nanshan District, ShenZhen, P.R. China

Tel: +86-755-22953335

Fax: +86-755-22916878

- Shanghai Office

Shenzhen Sanrise Technology Co., LTD.

Rm.401, Building B, No. 666, Zhangheng Road, Zhangjiang Hi-Tech Park, Shanghai, P.R.China

Tel: +86-21-68825918