50A 650V Trench Fieldstop IGBT with anti-parallel diode SRE50N065FSGDH

General Description

The SRE50N065FSGDH 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 SRE50N065FSGDH 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 $V_{CE(SAT)}$
- Non-automotive Qualified
- Enhanced Avalanche Capability

Application

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

Symbol

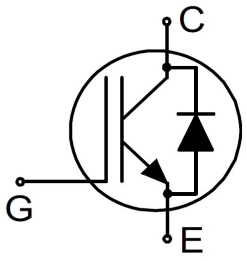
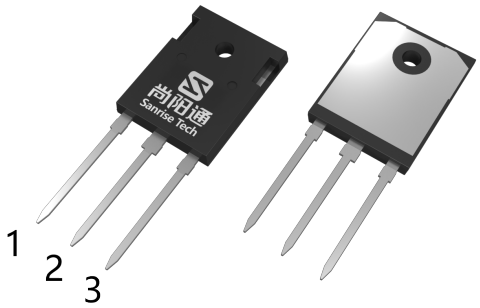


Figure 1 Symbol of SRE50N065FSGDH

Package Type



TO-247

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

Figure 2 Package Type of SRE50N065FSGDH

Ordering Information

SRE50N065FSGDH□□–□

Circuit Type
Package
T: TO-247

G: Green
Blank: Tube
TR: Tape & Reel

Package	Part Number	Marking ID	Packing Type
TO-247	SRE50N065FSGDHT-G2	SRE50N065FSGDHTG2	Tube

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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	80	A
	T_C=100ºC		50	
Pulsed Collector Current,Limited by T_{Jmax}		I_{CM}	200	A
Diode Continuous Collector Current	T_C=25ºC	I_F	80	A
	T_C=100ºC		50	
Diode Pulsed Current, Limited by T_{Jmax}		I_{FM}	200	A
Power Dissipation	T_C=25ºC	P_{tot}	300	W
	T_C=100ºC		150	
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}	-	-	0.50	ºC/W
Diode Thermal Resistance，Junction-to-Case	R_{thJC}	-	-	0.62	
Thermal Resistance，Junction-to-Ambient	R_{thJA}	-	-	40	

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=250μA	650			V
Gate Threshold Voltage		$V_{GE(th)}$	V_{CE}=V_{GE}, I_C=250μA	3.8	4.5	5.3	V
Collector-emitter saturation voltage		V_{CEsat}	V_{GE}=15V, I_C=50A, T_J=25ºC		1.58	2.00	V
			T_J=125ºC		2.05		V
			T_J=175ºC		2.23		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=100 KHz		2480		pF
Output Capacitance		C_{OES}			148		
Reverse Transfer Capacitance		C_{RES}			21		
Gate Resistance		R_G	f=1 MHz, Open Drain		1.7		Ω
Turn-on Delay Time		$t_{d(on)}$	T_J=25ºC V_{CC}=400V, I_C=25A R_G=10Ω, V_{GE}=0/15V Energy losses include "tail" and diode reverse recovery		29		ns
Rise Time		t_r			20		ns
Turn-off Delay Time		$t_{d(off)}$			133		ns
Fall Time		t_f			16		ns
Turn-on energy		E_{on}			0.63		mJ
Turn-off energy		E_{off}			0.18		mJ
Total switching energy		E_{ts}			0.81		mJ
Turn-on Delay Time		$t_{d(on)}$	T_J=25ºC V_{CC}=400V, I_C=50A R_G=10Ω,V_{GE}=0/15V Energy losses include "tail" and diode reverse recovery		32		ns
Rise Time		t_r			41		ns
Turn-off Delay Time		$t_{d(off)}$			122		ns
Fall Time		t_f			32		ns
Turn-on energy		E_{on}			1.67		mJ
Turn-off energy		E_{off}			0.48		mJ
Total switching energy		E_{ts}			2.15		mJ
Gate to Emitter Charge		Q_{GE}	V_{CC}=400V, I_C=50A V_{GE}=0 to 15V		21		nC
Gate to Collector Charge		Q_{GC}			47		
Gate Charge Total		Q_G			115		

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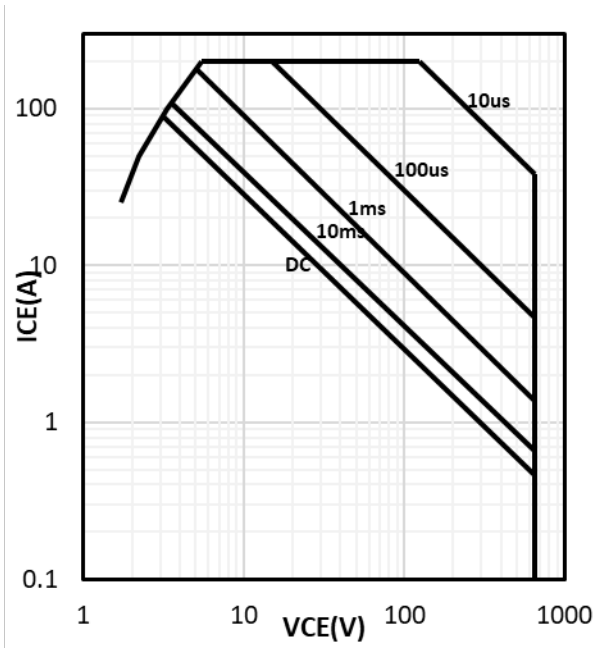
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Reverse Diode Characteristics						
Diode Forward Voltage	V_F	I_F=25A T_J=25ºC		1.38	1.8	V
		I_F=25A T_J=125ºC		1.63		
		I_F=25A T_J=175ºC		1.05		
		I_F=50A T_J=25ºC		1.51	2.0	
		I_F=50A T_J=125ºC		1.34		
		I_F=50A T_J=175ºC		1.22		
Reverse Recovery Time	t_{rr}	T_J=25ºC V_R=400V, I_F=25A dI_F/dt=1200A/μs		80		ns
Reverse Recovery Charge	Q_{rr}			0.9		uC
Peak Reverse Recovery Current	I_{rrm}			27		A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt			-870		A/μs
Reverse Recovery Time	t_{rr}	T_J=25ºC V_R=400V, I_F=50A dI_F/dt=1200A/μs		120		ns
Reverse Recovery Charge	Q_{rr}			1.4		uC
Peak Reverse Recovery Current	I_{rrm}			21		A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt			-548		A/μs

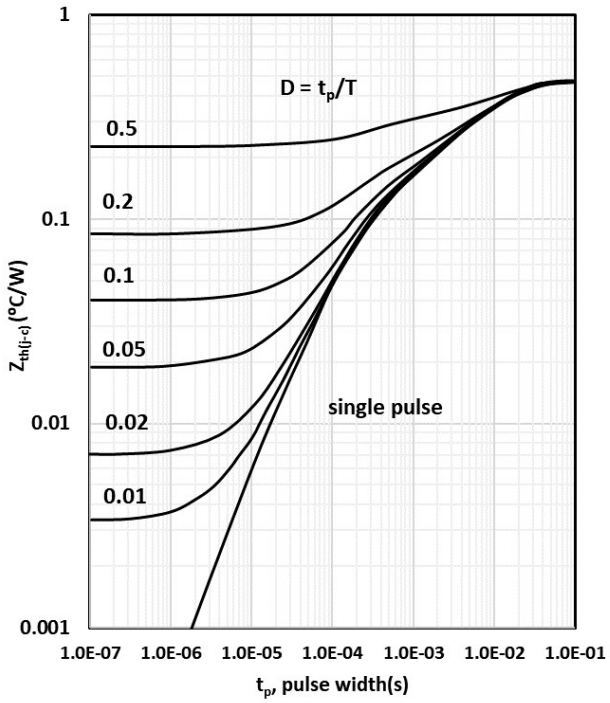
Typical Performance Characteristics

Figure 3: IGBT FBSOA



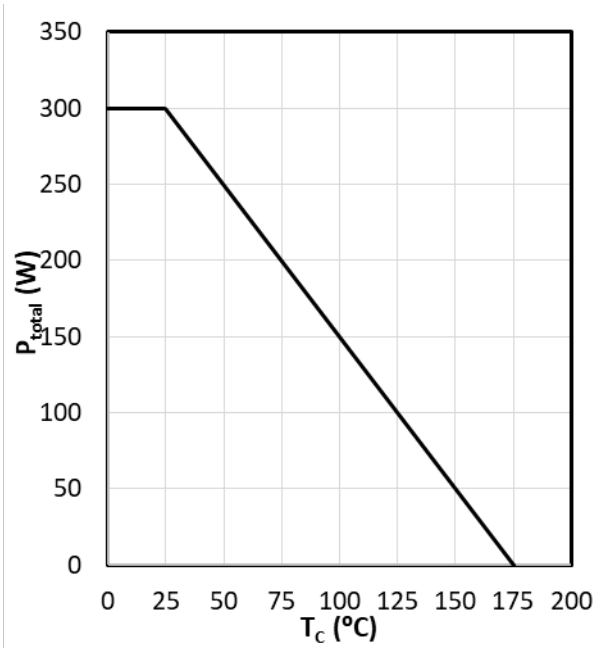
$I_C = f(V_{CE})$; $V_{GE} \geq 15/0V$; $Tj \leq 175°C$

Figure 4: IGBT transient thermal impedance



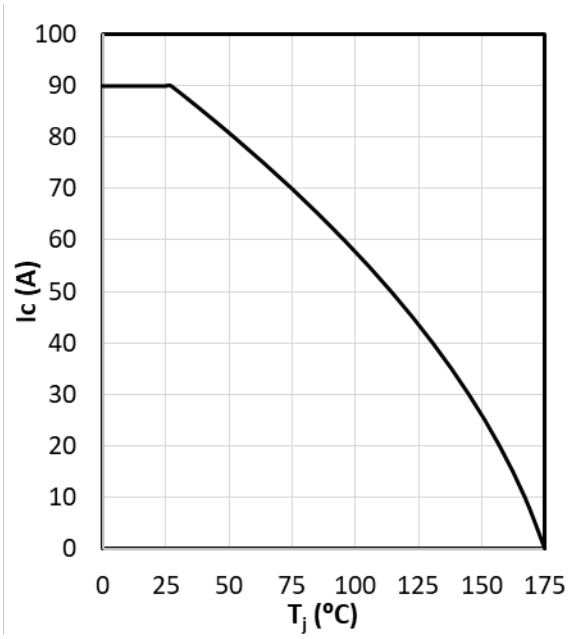
$R_{th(J-C)} = f(t_p)$; duty cycle: $D = t_p/T$

Figure 5: Power dissipation



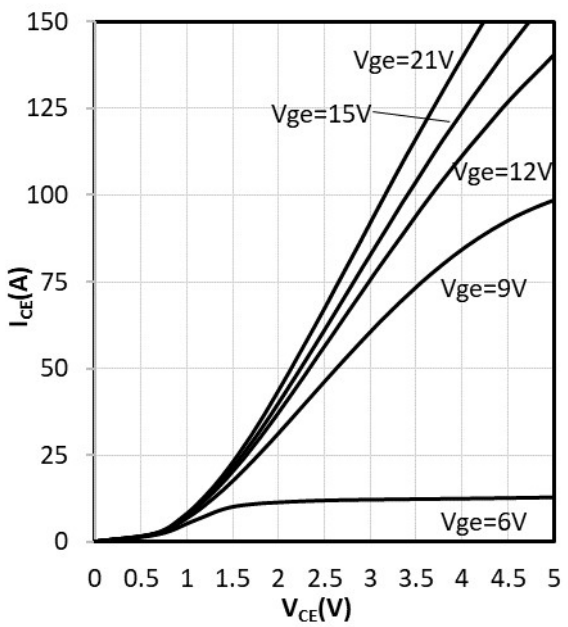
Ptot= f(Tc);

Figure 6: Collector current vs. temperature



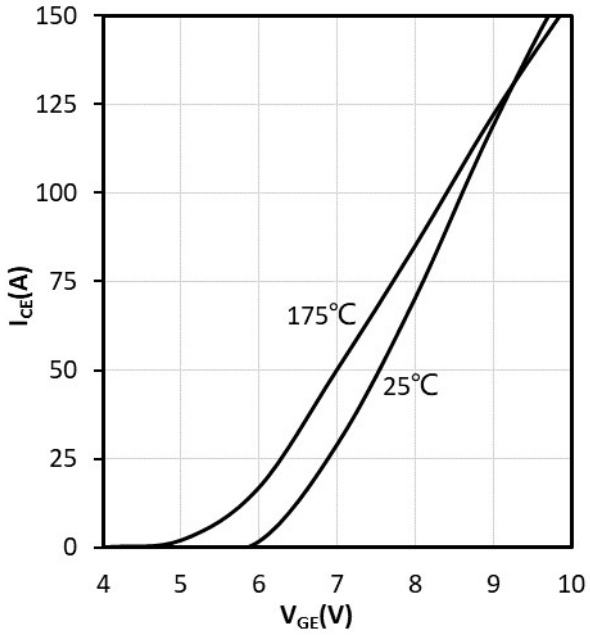
Ic= f(Tj); $V_{GE} \geq 15V$; $Tj \leq 175°C$

Figure 7: Typical Output Characteristics



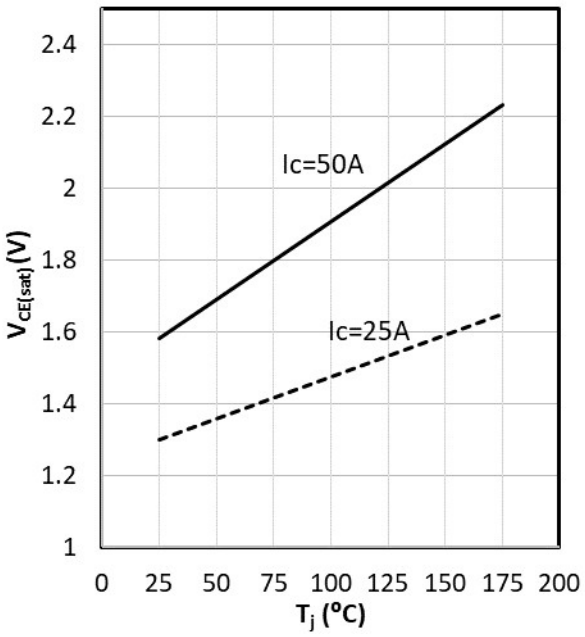
$I_C = f(V_{CE})$; Tj= 175ºC; parameter: V_{GE}

Figure 8: Typical transfer characteristic



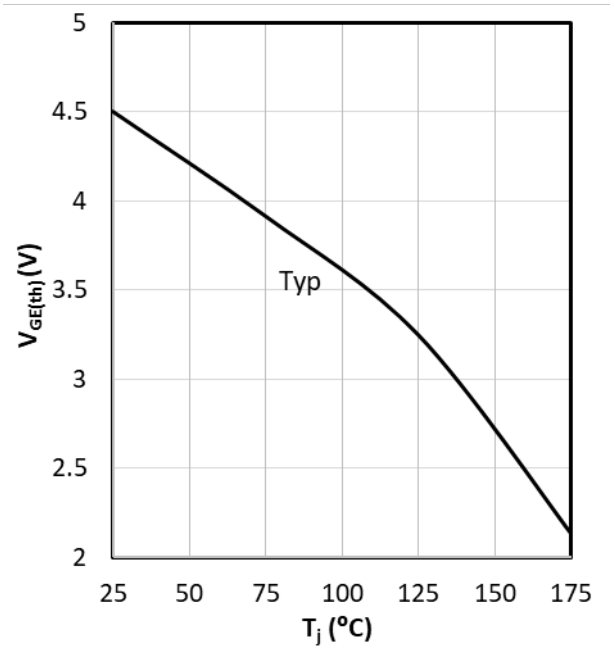
$I_C = f(V_{CE})$; Tj= 25ºC vs 150ºC

Figure 9: Typical collector-emitter saturation voltage as a function of junction temperature



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

Figure 10: Gate-emitter threshold voltage as a function of junction temperature



V_{GE} =f(Tj); I_{CE} = 250μA

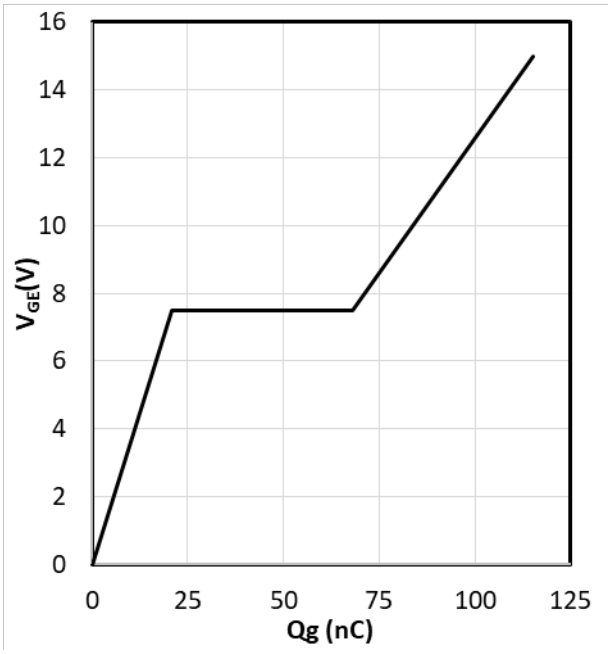
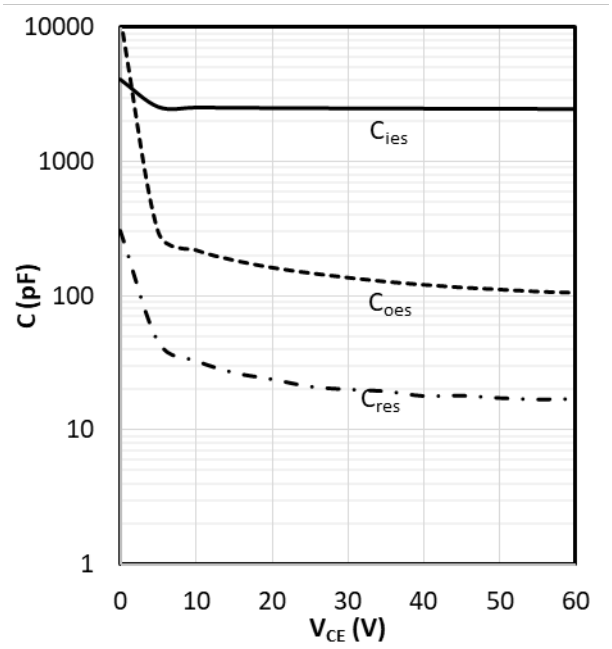
Figure 11: Typical Gate Charge	Figure 12: Typical Capacitances
	
V_{GE}= f(Qgate); I_C= 50A	C=f(V_{CE}); V_{GE}=0; f=100 KHz

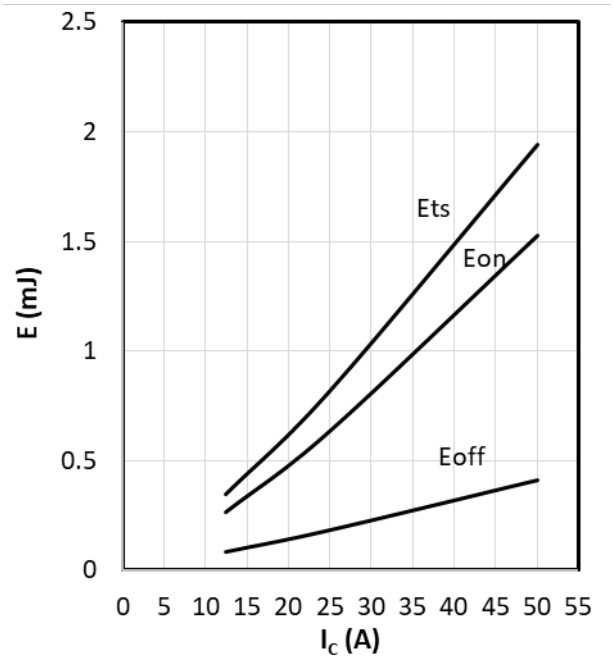
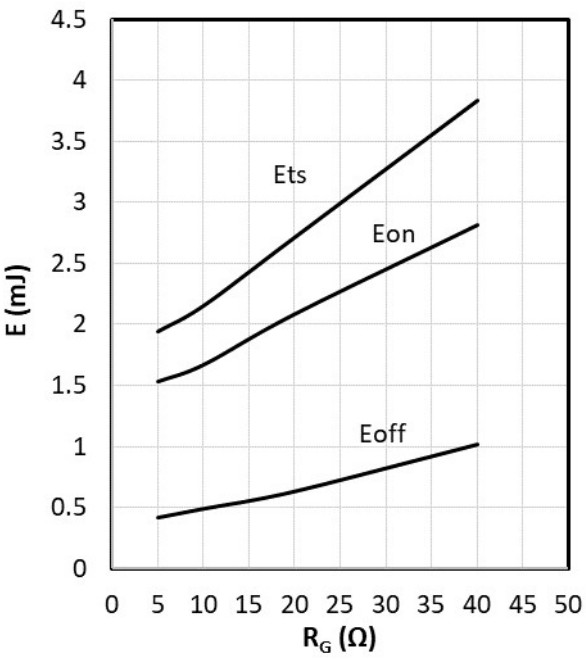
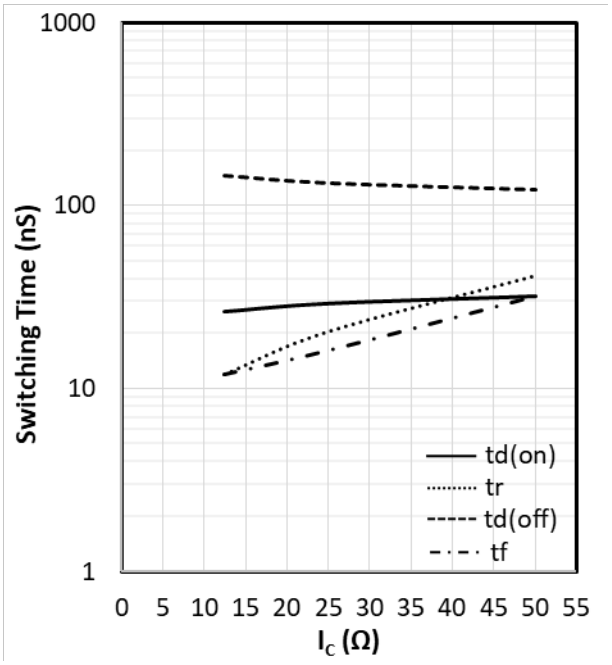
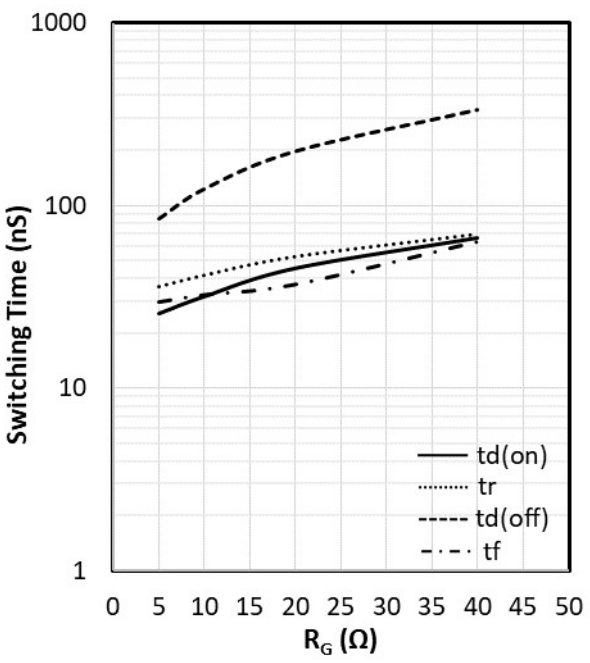
Figure 13: Typical switching energy losses as a function of collector current	Figure14: Typical switching energy losses as a function of gate resistor
	
E=f(Ic); V_{CE}=400V; Tj=25ºC; R_G=10Ω	E=f(R_G); V_{CE}=400V; Tj=25ºC; Ic=50A

Figure 15: Typical Switching time as a function of collector current



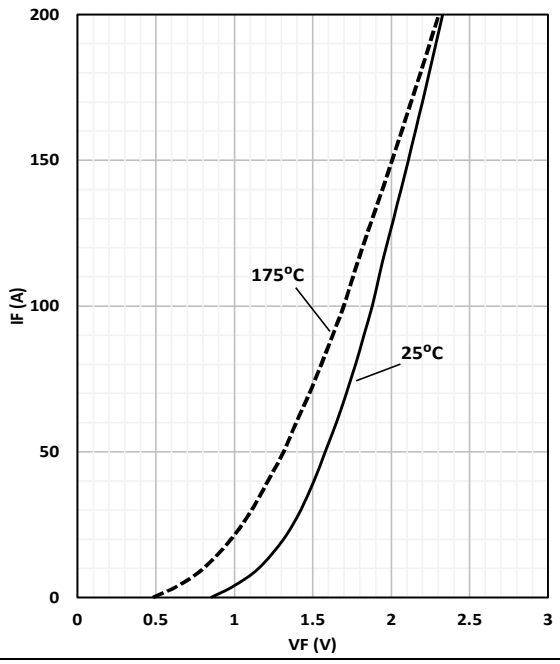
t=f(Ic); V_{CE}=400V; Tj=25ºC; R_G=10Ω

Figure 16: Typical Switching time as a function of gate resistor



t=f(R_G); V_{CE}=400V; Tj=25ºC; Ic=50A

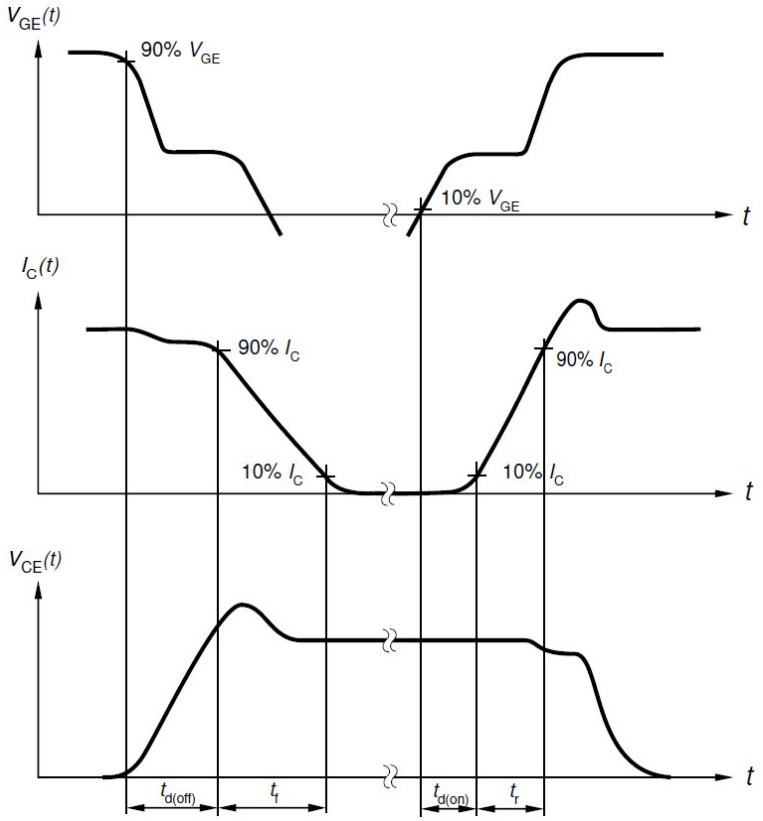
Figure 17: Typical diode forward current as a function of forward voltage



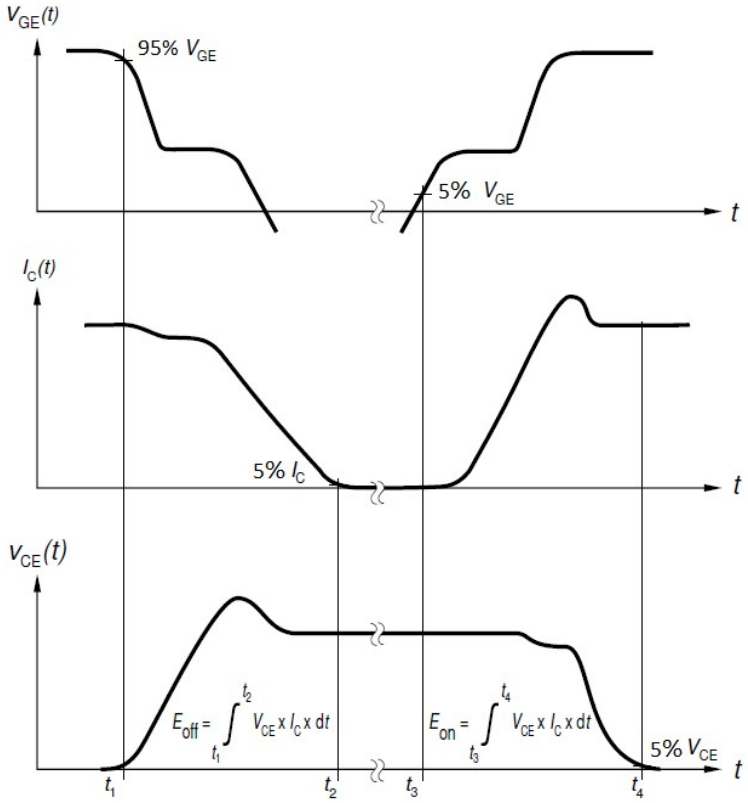
I_F= f(V_F);

Test Circuits

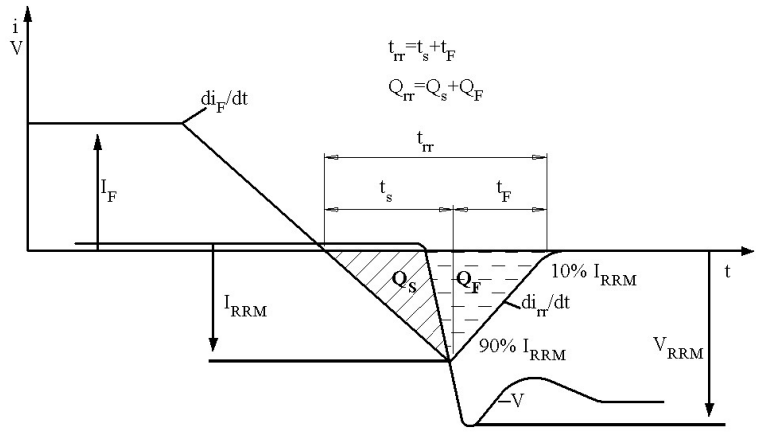
1. Definition Switching times



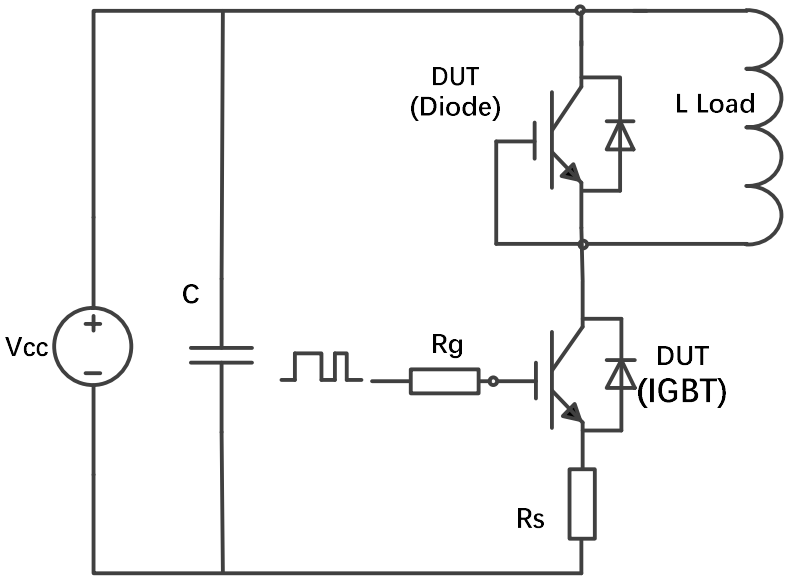
2. Definition Switching losses



3. Definition Diode Switching Characteristics



3. Dynamic test circuit



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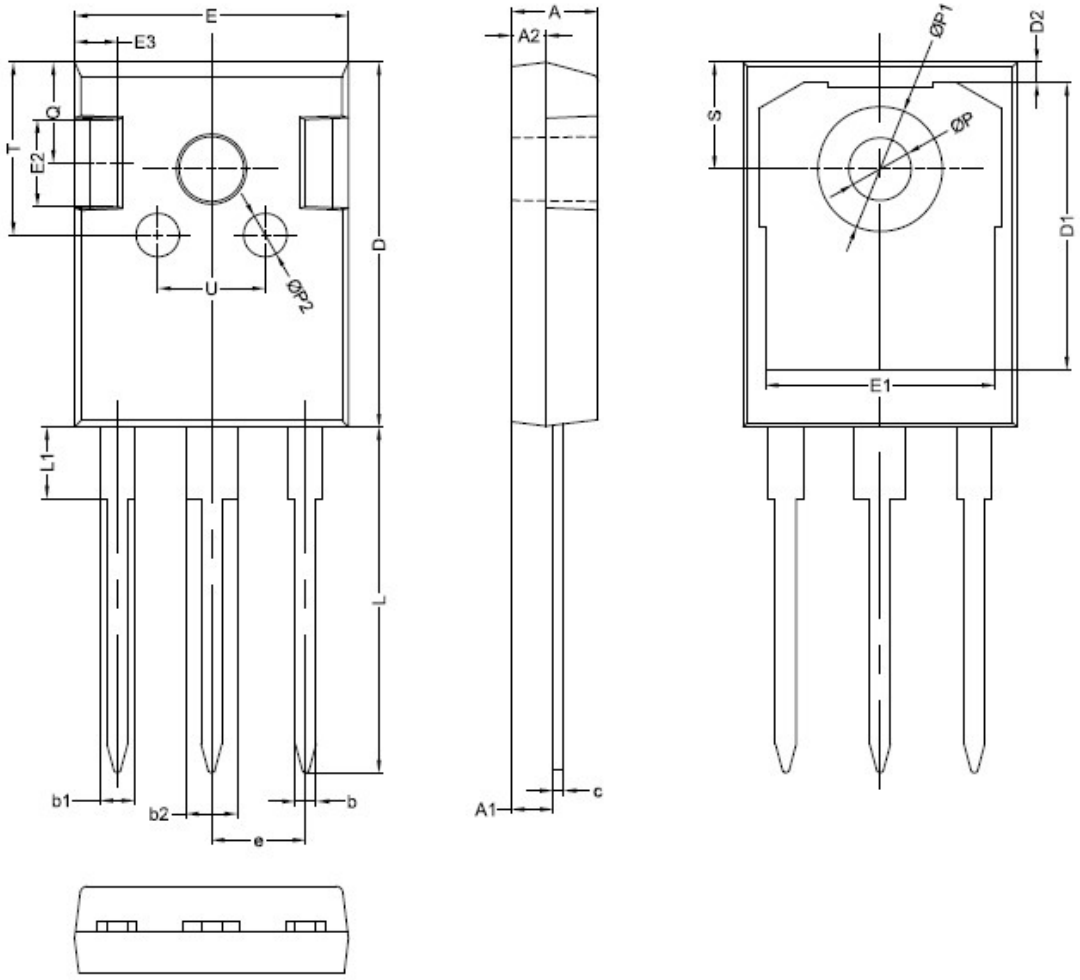
Mechanical Dimensions

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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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

Sanrise Technology Limited Company

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

Tel: +86-21-68825918