50A 1200V Trench Fieldstop IGBT with anti-parallel diode SRE50N120FSUD9

General Description

The SRE50N120FSUD9 is a Field Stop Trench IGBT with anti-parallel diode, which offers low switching losses, high energy efficiency and high avalanche ruggedness for soft switching applications such as UPS, solar inverters, industrial power supplies, etc.

The SRE50N120FSUD9 package is TO-247.

Features

- High Breakdown Voltage to 1200V
- Advanced Trench Fieldstop technology
  - Low $V_{CE(sat)}$
  - High Ruggedness, Temperature Stability
  - Easy Parallel Switching Capability due to Positive Temperature Coefficient in $V_{CE(SAT)}$
- Soft Current Turn-off Waveforms
- Enhanced Avalanche Capability
- Non-Automotive Qualified

Application

- Solar Inverters
- Uninterrupted Power Supply
- Industrial Power Supplies
- Grid Inverter

Symbol

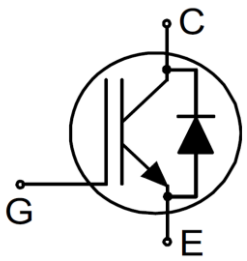
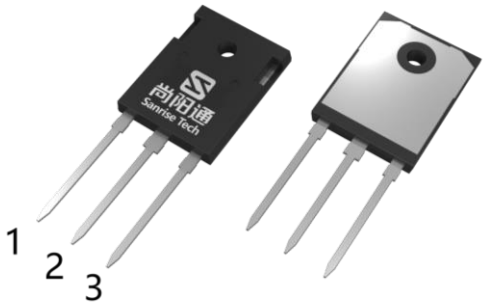


Figure 1 Symbol of SRE50N120FSUD9

Package Type



TO-247

Pin 1- Gate； Pin 2&backside- Collector； Pin 3-Emitter

Figure 2 Package Type of SRE50N120FSUD9

Ordering Information

SRE50N120FSUD9□□–□

Circuit Type
Package
T: TO-247

G: Green
Blank: Tube
TR: Tape & Reel

Package	Part Number	Marking ID	Packing Type
TO-247	SRE50N120FSUD9T-G	SRE50N120FSUD9TG	Tube

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Absolute Maximum Ratings

Parameter		Symbol	Rating	Unit
Collector-emitter voltage		V_{CES}	1200	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		50	
Pulsed Collector Current, Limited by T_{Jmax}		I_{CM}	200	A
Diode Continuous Collector Current (T_C=100ºC)		I_F	50	A
Diode Pulsed Current, Limited by T_{Jmax}		I_{FM}	150	A
Power dissipation	T_C=25ºC	P_{tot}	500	W
	T_C=100ºC		250	W
Maximum Operating Junction Temperature		T_{Jmax}	175(1)	ºC
Storage Temperature		T_{STG}	-55 ~ 150	ºC
Lead Temperature (Soldering, 10 sec)		T_{LEAD}	260	ºC

Note:
1. Reliability testing conducted at Tj=175℃.

Thermal Resistance

Parameter	Package	Symbol	Min	Typ	Max	Unit
IGBT thermal Resistance，Junction-to-Case	TO-247	R_{thJC}	-	-	0.3	ºC/W
Diode thermal Resistance，Junction-to-Case	TO-247	R_{thJC}	-	-	0.9	
Thermal Resistance，Junction-to-Ambient	TO-247	R_{thJA}	-	-	40	

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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=500uA	1200			V
Gate Threshold Voltage		$V_{GE(th)}$	V_{CE}=V_{GE}, I_C=1.6mA	4.6	5.4	6.2	V
Collector-emitter saturation voltage		$V_{CE(sat)}$	V_{GE}=15V, I_C=50A, T_J=25ºC		1.6	2.0	V
			T_J=125ºC		2.0		V
			T_J=150ºC		2.43		V
Zero Gate Voltage Collector Current		I_{CES}	V_{CE}=1200V,V_{GE}=0V T_J=25ºC			100	uA
			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=1MHz		4450		pF
Output Capacitance		C_{OES}			215		
Reverse Transfer Capacitance		C_{RES}			26		
Gate Resistance		R_G	f=1MHz, Open Drain		1.2		Ω
Turn-on Delay Time		$t_{d(on)}$	Tj=25℃ V_{CC}=600V, I_C=50A R_G=10Ω, V_{GE}=0/15V Energy losses include "tail" and diode reverse recovery		44		ns
Rise Time		t_r			55		ns
Turn-off Delay Time		$t_{d(off)}$			164		ns
Fall Time		t_f			127		ns
Turn-on energy		E_{on}			3.4		mJ
Turn-off energy		E_{off}			1.6		mJ
Total switching energy		E_{ts}			5.0		mJ
Turn-on Delay Time		$t_{d(on)}$	Tj=150℃ V_{CC}=600V, I_C=50A R_G=10Ω,V_{GE}=0/15V Energy losses include "tail" and diode reverse recovery		60.4		ns
Rise Time		t_r			46.4		ns
Turn-off Delay Time		$t_{d(off)}$			302		ns
Fall Time		t_f			196		ns
Turn-on energy		E_{on}			4.3		mJ
Turn-off energy		E_{off}			2.1		mJ
Total switching energy		E_{ts}			6.4		mJ
Gate to Emitter Charge		Q_{GE}	V_{CC}=600V, I_C=50A V_{GE}=0 to 15V		62		nC
Gate to Collector Charge		Q_{GC}			170		
Gate Charge Total		Q_G			410		

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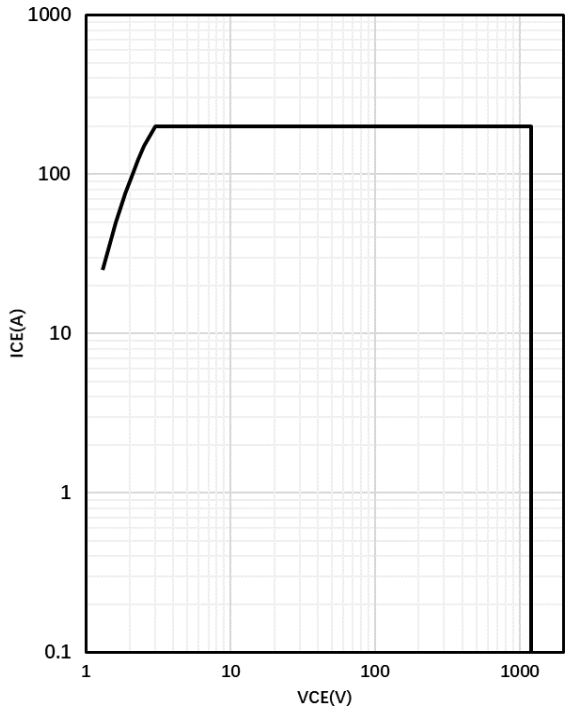
Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Reverse Diode Characteristics						
Diode Forward Voltage	V_F	I_F=25A T_J=25ºC		1.99	2.6	V
		I_F=25A T_J=125ºC		1.78		
		I_F=25A T_J=175ºC		1.69		
		I_F=50A T_J=25ºC		2.2	2.8	
		I_F=50A T_J=125ºC		2.0		
		I_F=50A T_J=175ºC		1.9		
Reverse Recovery Time	t_{rr}	V_R=600V, I_F=50A dI_F/dt=660A/us		75		ns
Reverse Recovery Charge	Q_{rr}			803		nC
Peak Reverse Recovery Current	I_{rrm}			17		A

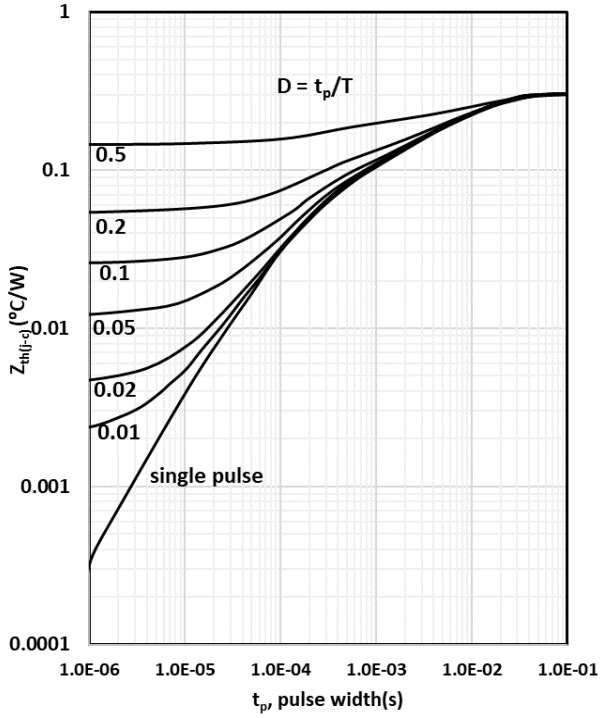
Typical Performance Characteristics

Figure 3: IGBT FBSOA



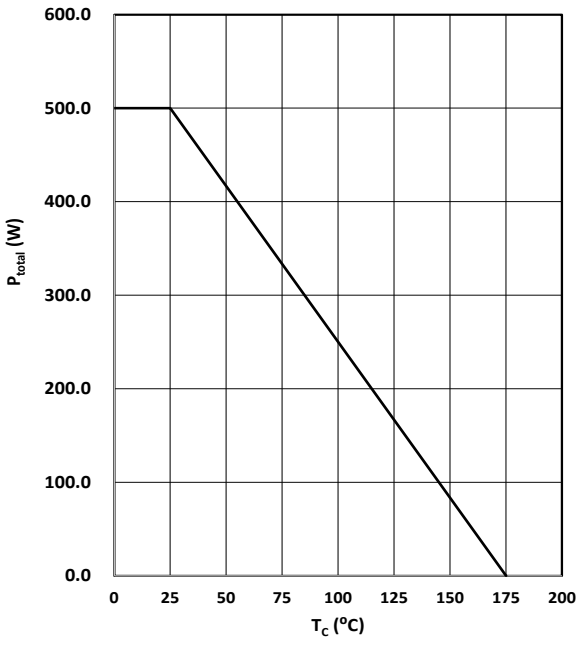
I_C=f(V_{CE});V_{GE}>=15/0V;Tj≤ 175 ºC

Figure 4: IGBT Transient Thermal Impedance



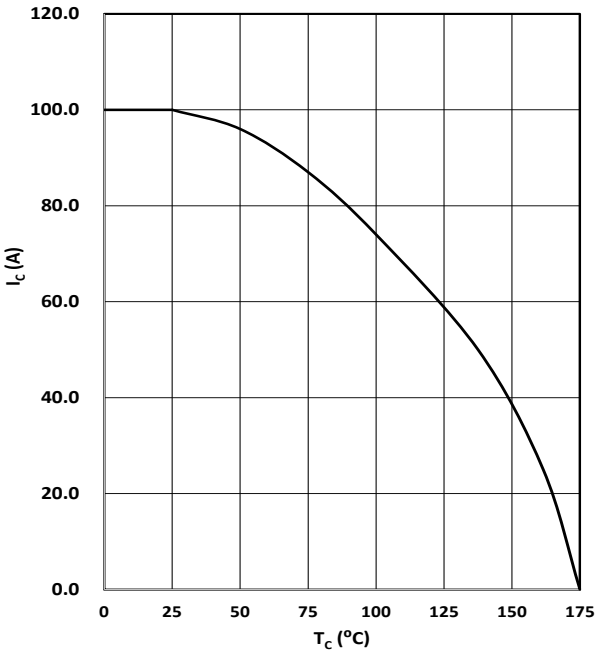
R(thJC) = f(tp); parameter: D = tp/T

Figure 5: Power Dissipation



Ptot=f(T_C)

Figure 6: Collector Current vs. Temperature



I_C = f(Tj); V_{GE}>=15V;Tj≤ 175 ºC

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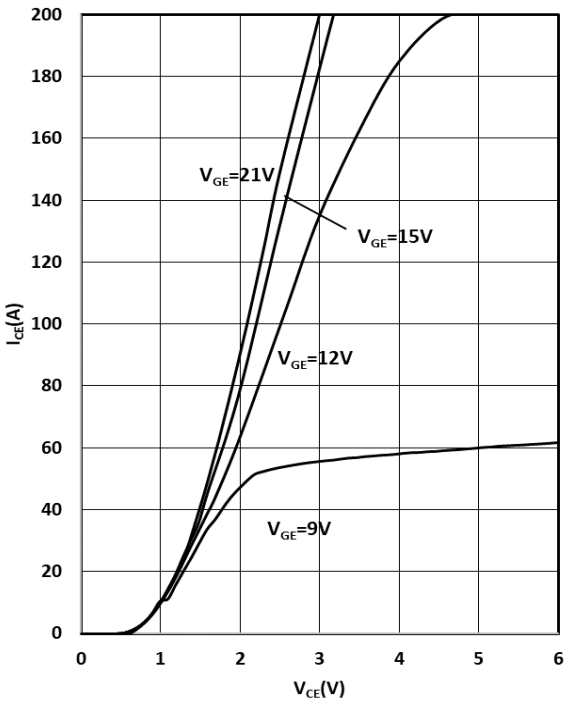
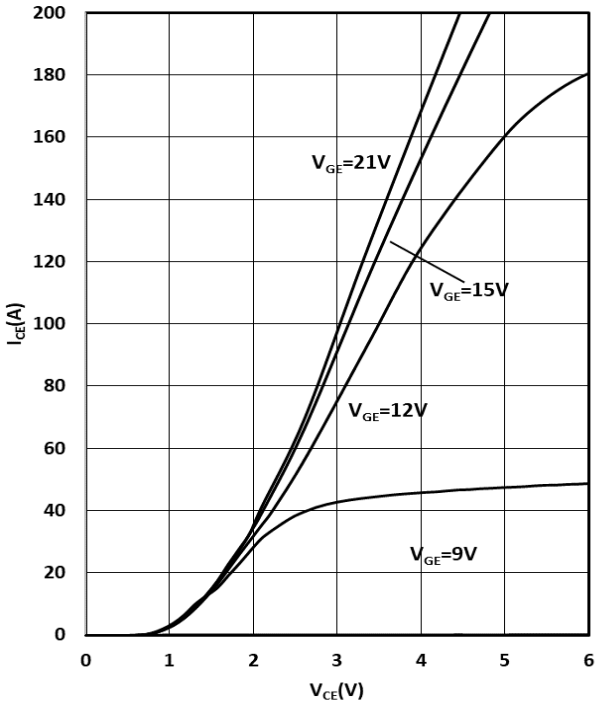
Figure 7: Typical Output Characteristics



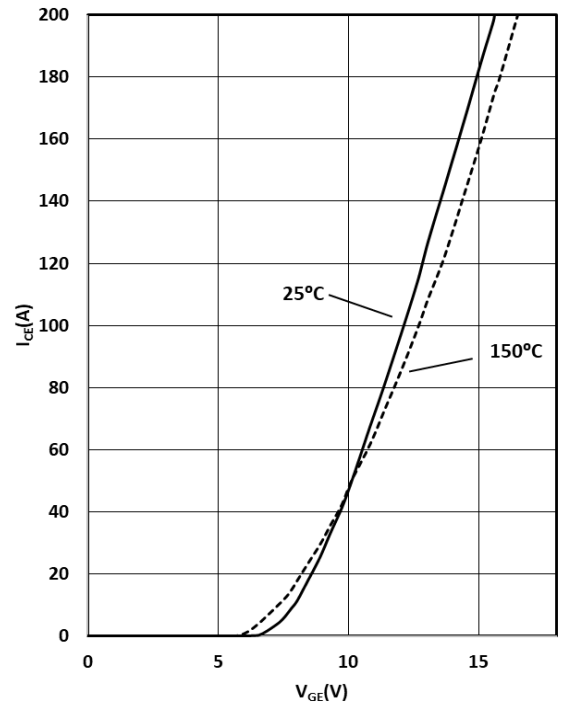
$I_C = f(V_{CE})$; Tj= 25ºC; parameter: V_{GE}

Figure 8: Typical Output Characteristics



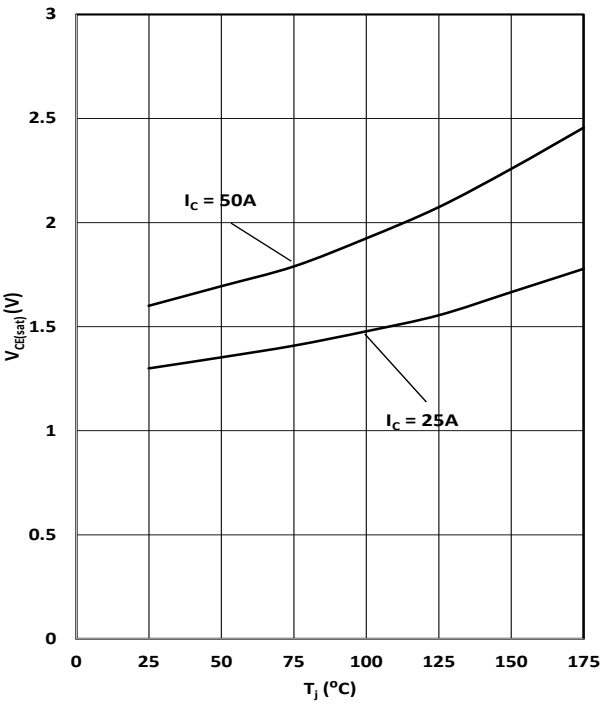
$I_C = f(V_{CE})$; Tj= 175ºC; parameter: V_{GE}

Figure 9: Typical transfer characteristic



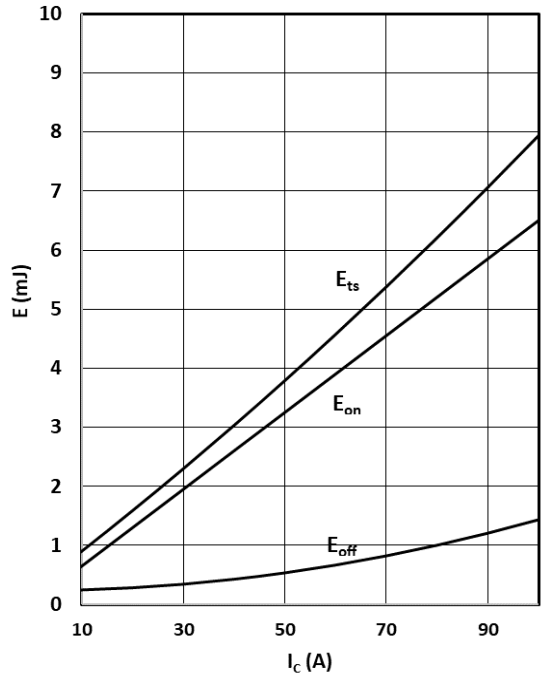
$I_C = f(V_{GE})$; V_{CE}=20V

Figure 10: Typical collector-emitter saturation voltage as a function of junction temperature



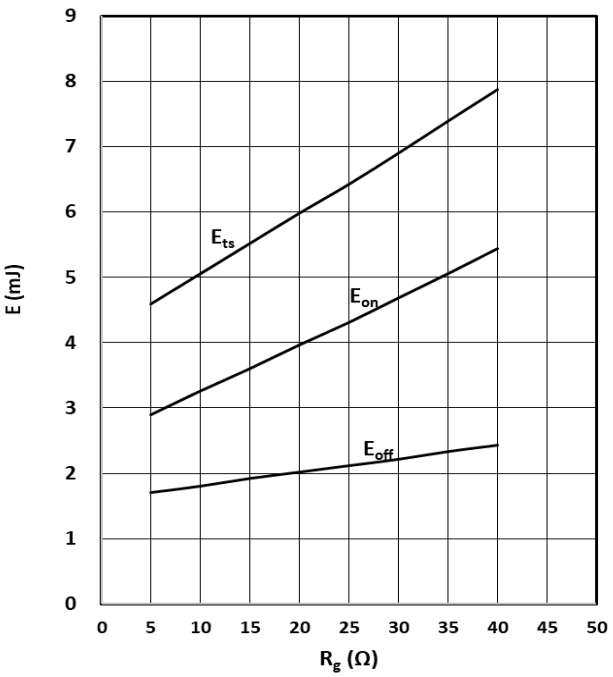
$V_{CE} = f(Tj)$; V_{GE}=15V

Figure 11: Typical switching energy losses as a function of collector current



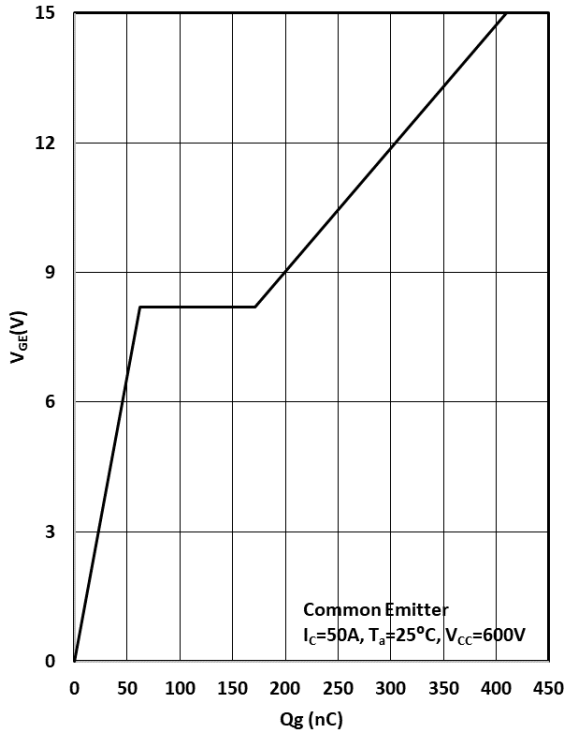
$E=f(I_C)$; V_{CE}=600V;Tj=25°C; R_G=10Ω

Figure 12: Typical switching energy losses as a function of gate resistor



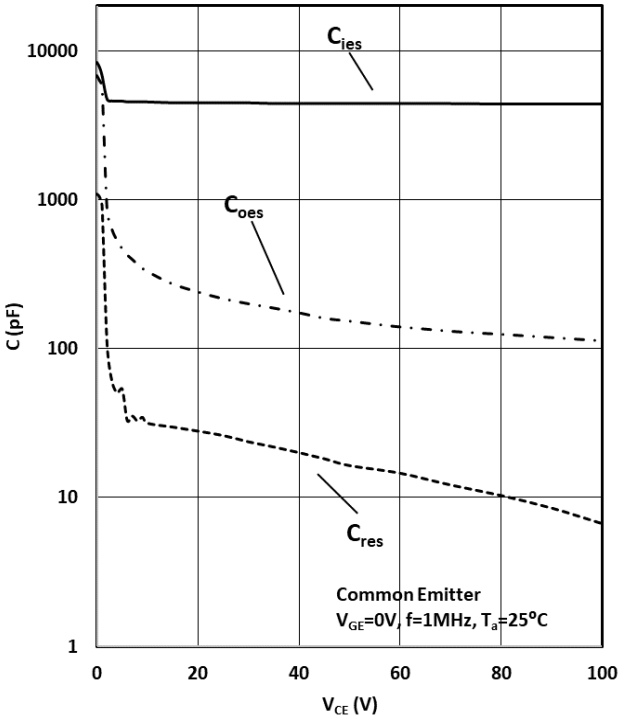
$E=f(R_G)$; V_{CE}=600V;Tj=25°C; I_C=50A

Figure 13: Typical Gate Charge



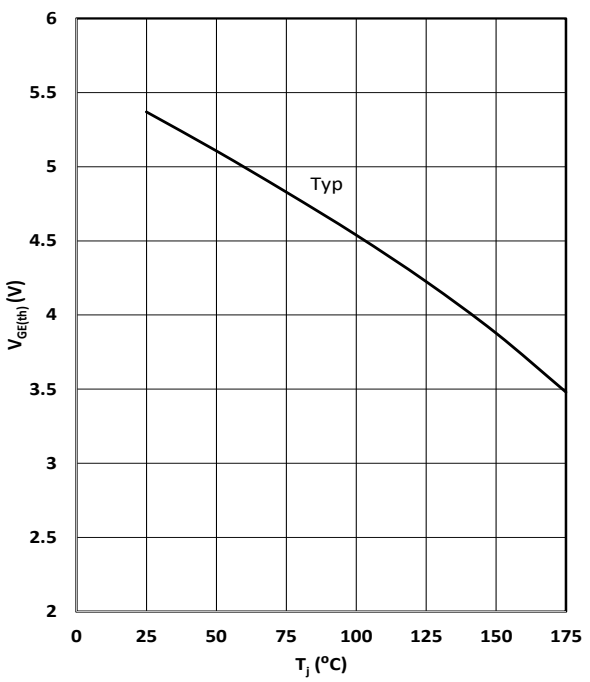
V_{GE}= f(Qg), I_C= 50A

Figure 14: Typical Capacitances



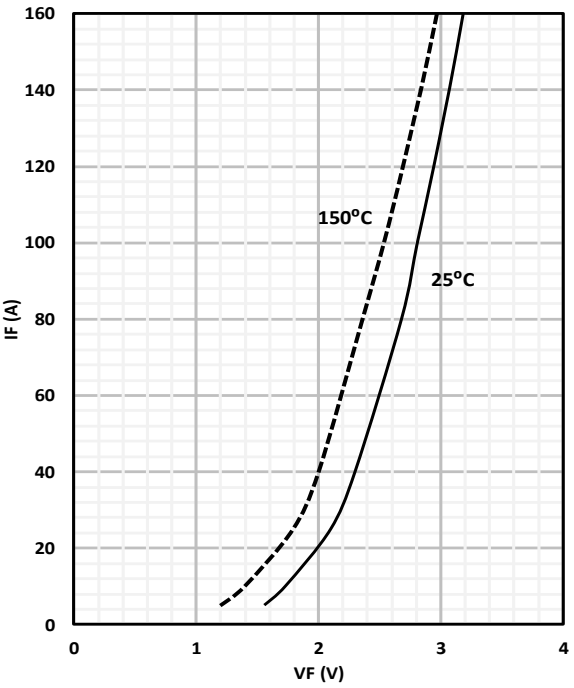
C=f(V_{CE}); V_{GE}=0; f=1MHz

Figure 15: Gate-emitter threshold voltage as a function of junction temperature



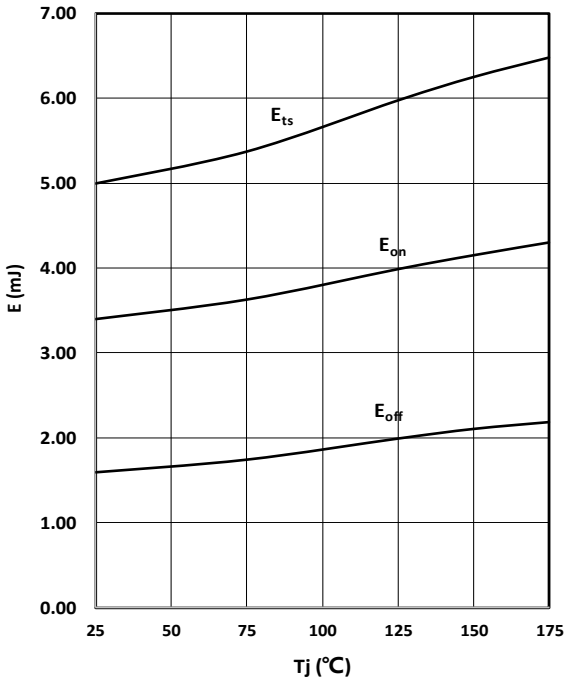
I_C = 1.6mA; V_{GE}= f(Tj)

Figure 16: Typical diode forward current as a function of forward voltage



VF= f(IF);

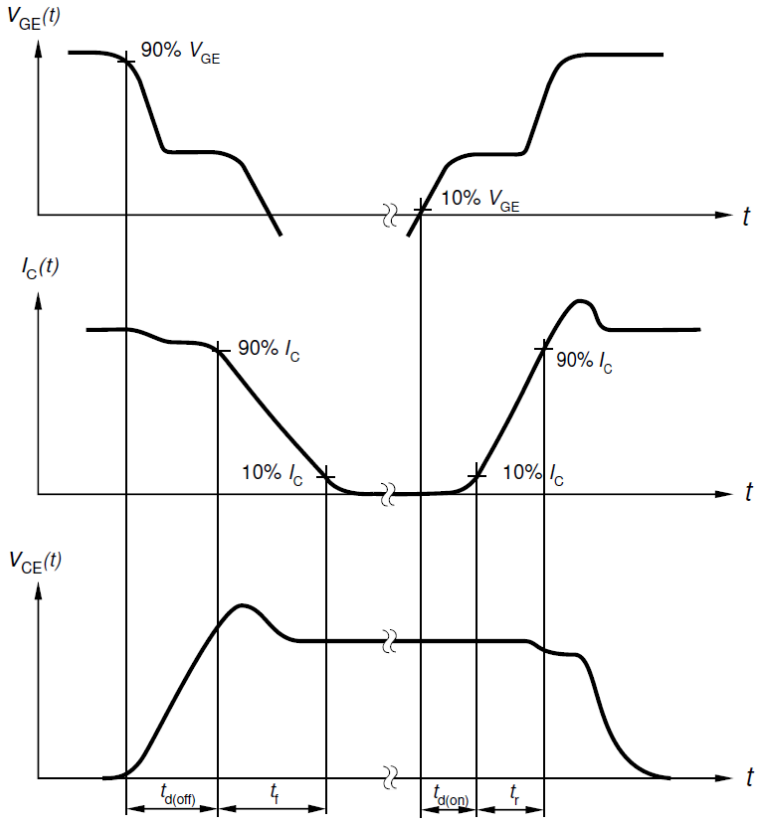
Figure 17: Typical switching energy losses as a function of junction temperature



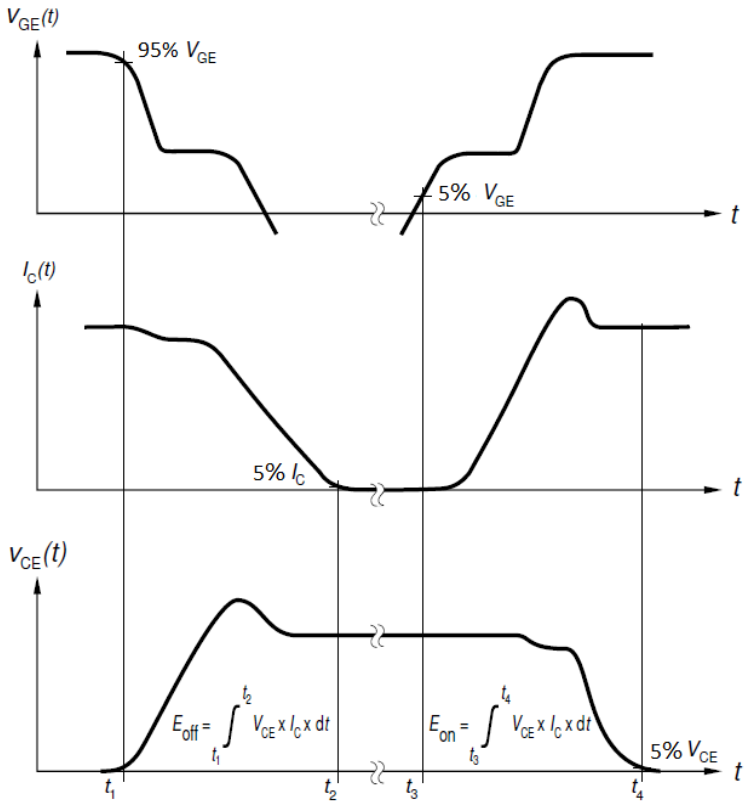
E= f(Tj); V_{CE}=600V;I_C= 50A;R_G=10Ω

Test Circuits

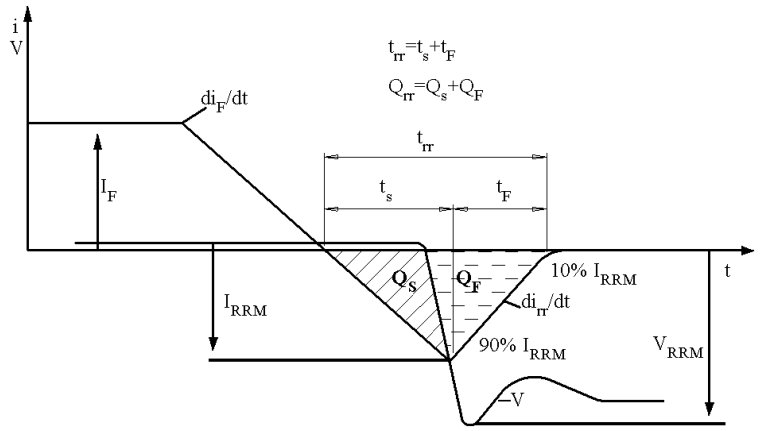
1. Definition Switching times



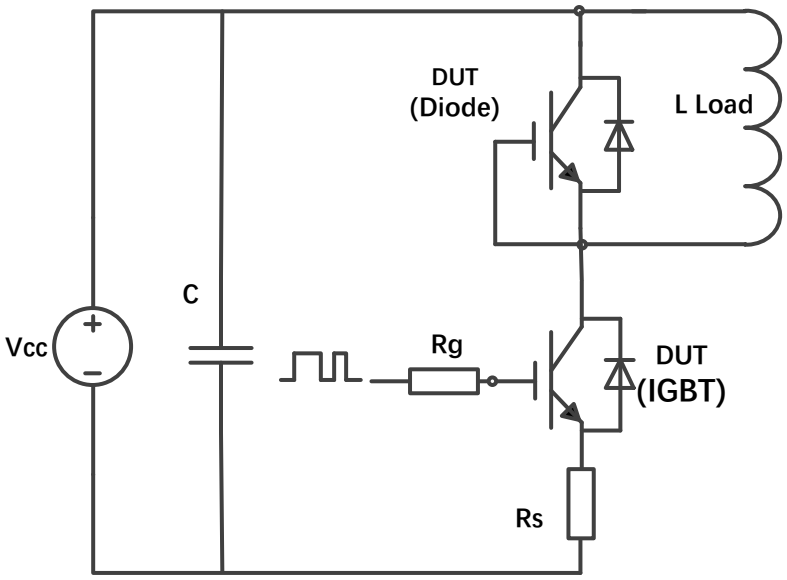
2. Definition Switching losses



3. Definition Diode Switching Characteristics



4. Dynamic test circuit



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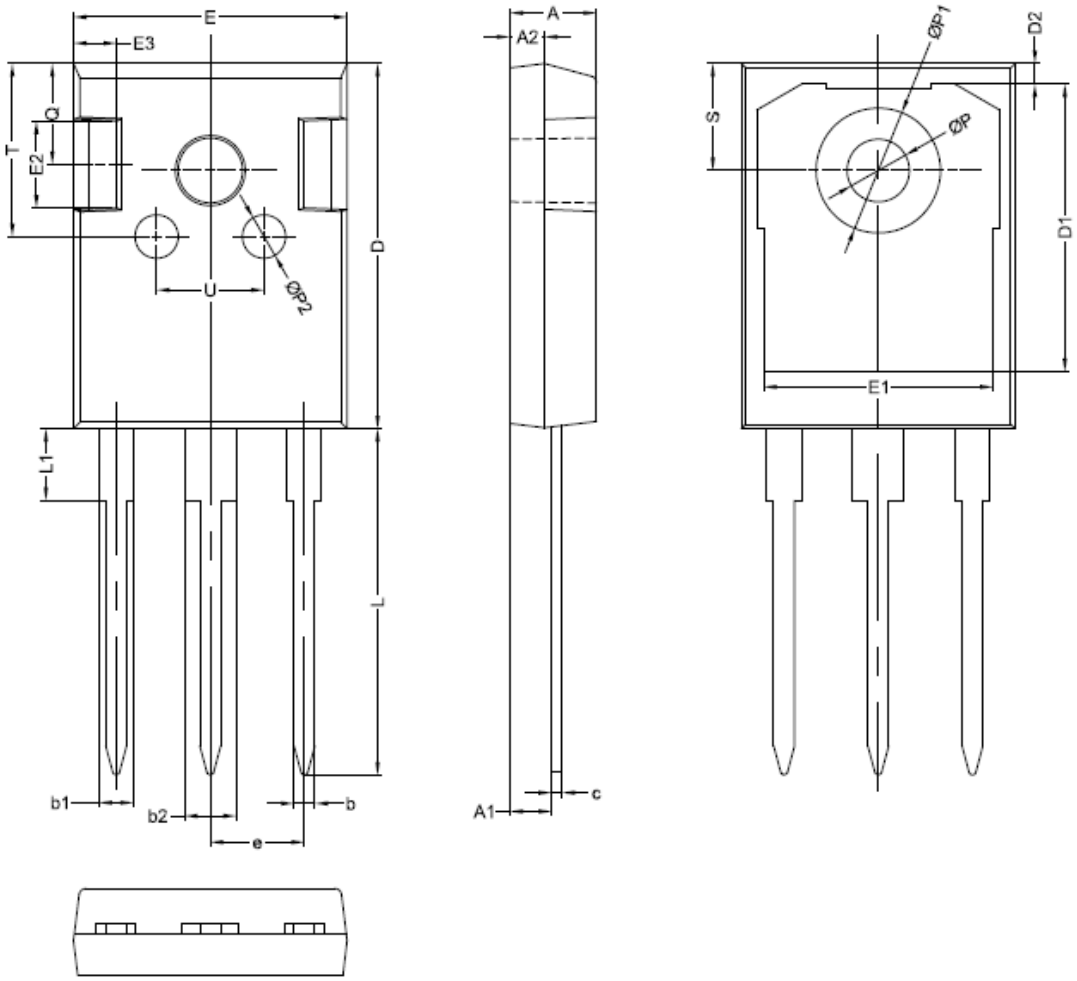
Mechanical Dimensions

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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