50A 650V Trench Fieldstop IGBT with anti-parallel diode SRE50N065FSUD6

General Description

The SRE50N065FSUD6 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 SRE50N065FSUD6 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

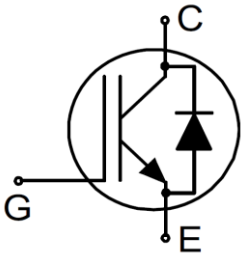
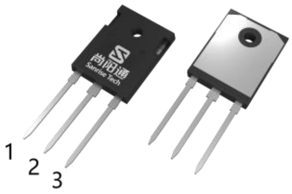


Figure 1 Symbol of SRE50N065FSUD6

Package Type



TO-247

Figure 2 Package Type of SRE50N065FSUD6

Ordering Information

SRE50N065FSUD6□□–□

Circuit Type
Package
T: TO-247

G: Green
Blank: Tube
TR: Tape & Reel

Package	Part Number	Marking ID	Packing Type
TO-247	SRE50N065FSUD6T-G	SRE50N065FSUD6TG	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			±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}	288	W
	T_C=100ºC		144	
Operating Junction Temperature Range		T_J	-40 ~ 175(1)	ºC
Storage Temperature Range		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	Symbol	Min.	Typ.	Max.	Unit
IGBT Thermal Resistance，Junction-to-Case	R_{thJC}	-	-	0.52	ºC/W
Diode Thermal Resistance，Junction-to-Case	R_{thJC}	-	-	0.65	
Thermal Resistance，Junction-to-Ambient	R_{thJA}	-	-	40	

Electrical Characteristics

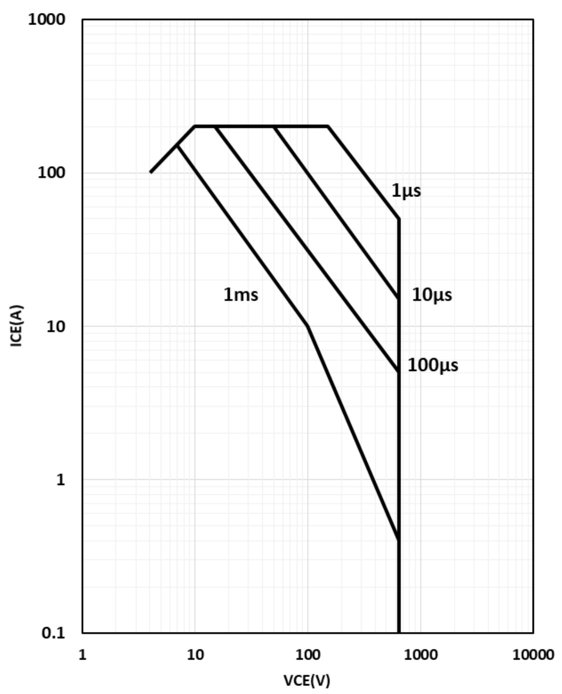
T_J = 25ºC, unless otherwise specified.

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	4.2	5.0	5.8	V
Collector-emitter saturation voltage		V_{CEsat}	V_{GE}=15V, I_C=50A, T_J=25ºC		1.50	2.0	V
			T_J=125ºC		2.2		V
			T_J=175ºC		2.6		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=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=25ºC V_{CC}=400V, I_C=50A R_G=10Ω, V_{GE}=0/15V Energy losses include “tail” and diode reverse recovery		17		ns
Rise Time		t_r			55		ns
Turn-off Delay Time		$t_{d(off)}$			133		ns
Fall Time		t_f			15		ns
Turn-on energy		E_{on}			1.70		mJ
Turn-off energy		E_{off}			0.30		mJ
Total switching energy		E_{ts}			2.00		mJ
Turn-on Delay Time		$t_{d(on)}$	T_J=150ºC V_{CC}=400V, I_C=50A R_G=10Ω,V_{GE}=0/15V Energy losses include “tail” and diode reverse recovery		14.5		ns
Rise Time		t_r			52		ns
Turn-off Delay Time		$t_{d(off)}$			173		ns
Fall Time		t_f			24		ns
Turn-on energy		E_{on}			2.23		mJ
Turn-off energy		E_{off}			0.44		mJ
Total switching energy		E_{ts}			2.67		mJ
Gate to Emitter Charge		Q_{GE}	V_{CC}=400V, I_C=50A V_{GE}=0 to 15V		19		nC
Gate to Collector Charge		Q_{GC}			55		
Gate Charge Total		Q_G			110		

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Reverse Diode Characteristics						
Diode Forward Voltage	V_F	I_F=25A T_J=25°C		1.22	1.5	V
		I_F=25A T_J=125°C		1.07		
		I_F=25A T_J=175°C		0.98		
		I_F=50A T_J=25°C		1.3	1.7	
		I_F=50A T_J=125°C		1.2		
		I_F=50A T_J=175°C		1.12		
Reverse Recovery Time	t_{rr}	T_J=25°C V_R=400V, I_F=50A dI_F/dt=700A/µs		70		ns
Reverse Recovery Charge	Q_{rr}			860		nC
Peak Reverse Recovery Current	I_{rrm}			20.0		A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt			-590		A/µs
Reverse Recovery Time	t_{rr}	T_J=150°C V_R=400V, I_F=50A dI_F/dt=700A/µs		250		ns
Reverse Recovery Charge	Q_{rr}			5.3		µC
Peak Reverse Recovery Current	I_{rrm}			46.0		A
Diode peak rate of fall of reverse recovery current during t_b	di_{rr}/dt			-330		A/µs

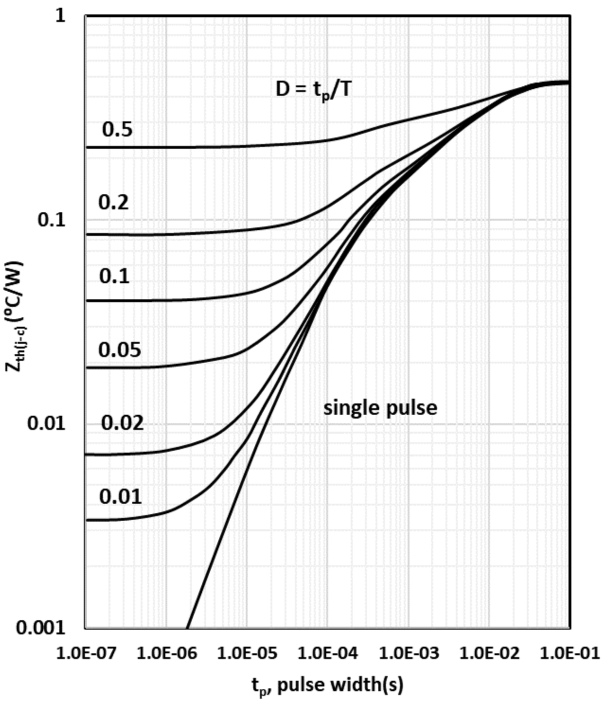
Typical Performance Characteristics

Figure 3: IGBT FBSOA



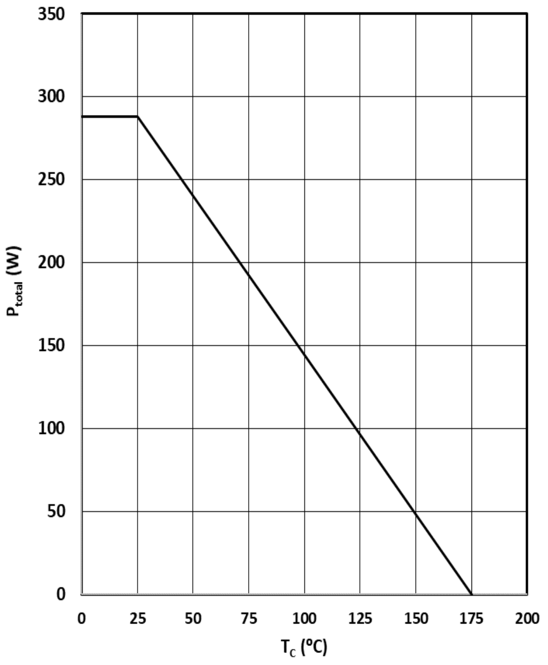
$I_C = f(V_{CE})$; $V_{GE} \geq 15/0V$; $Tj \leq 175°C$

Figure 4: IGBT transient thermal impedance



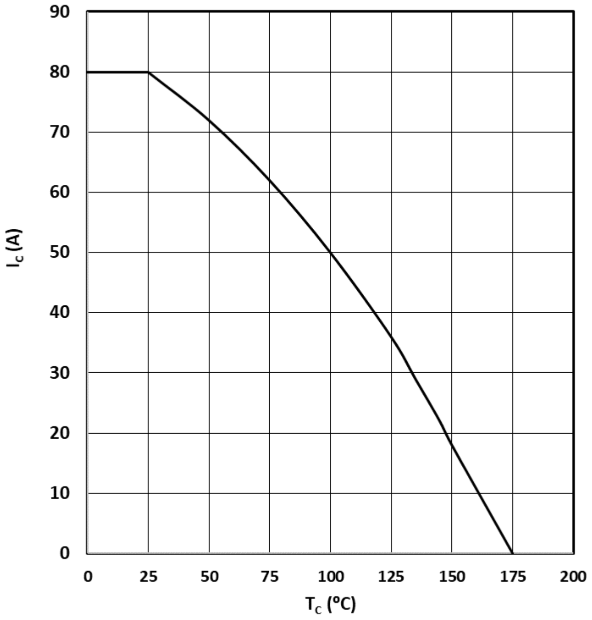
$R_{th(J-C)} = f(t_p)$; duty cycle: $D = t_p/T$

Figure 5: Power dissipation



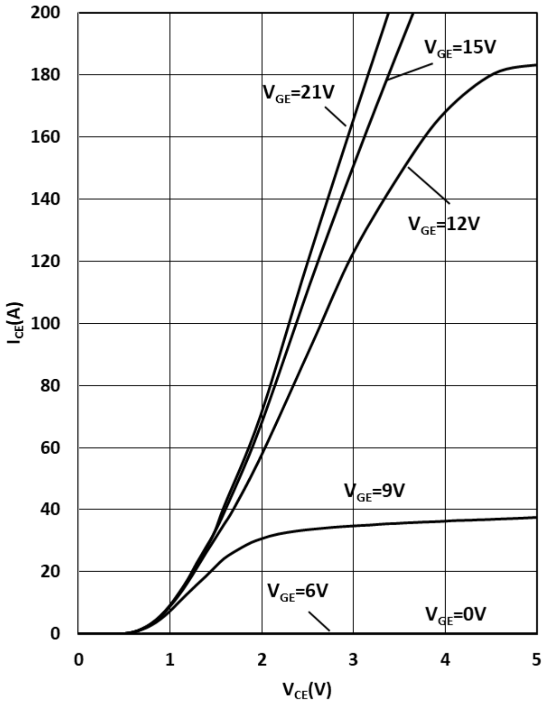
Ptot= f(Tc);

Figure 6: Collector current vs. temperature



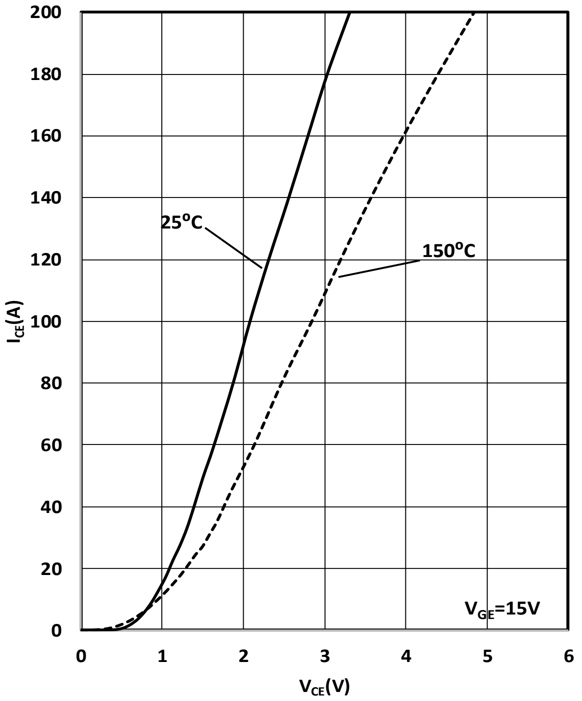
$Ic = f(Tj)$; $V_{GE} \geq 15V$; $Tj \leq 175°C$

Figure 7: Typical Output Characteristics



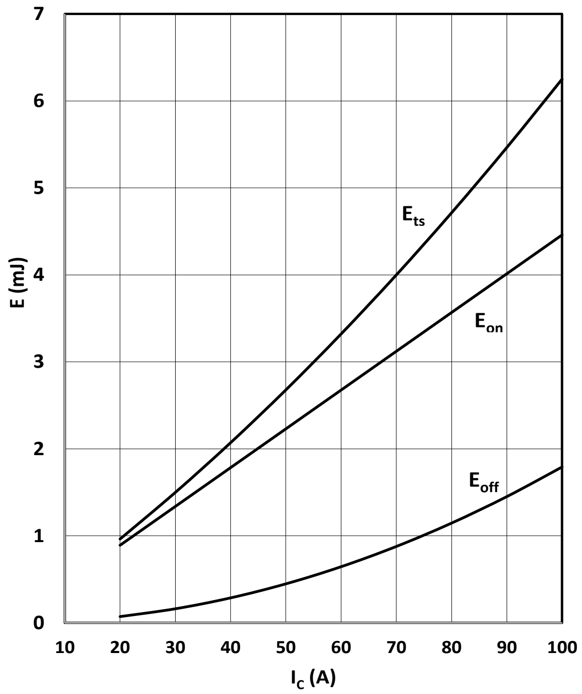
$I_C = f(V_{CE})$; Tj= 25ºC; parameter: V_{GE}

Figure 8: Typical transfer characteristic



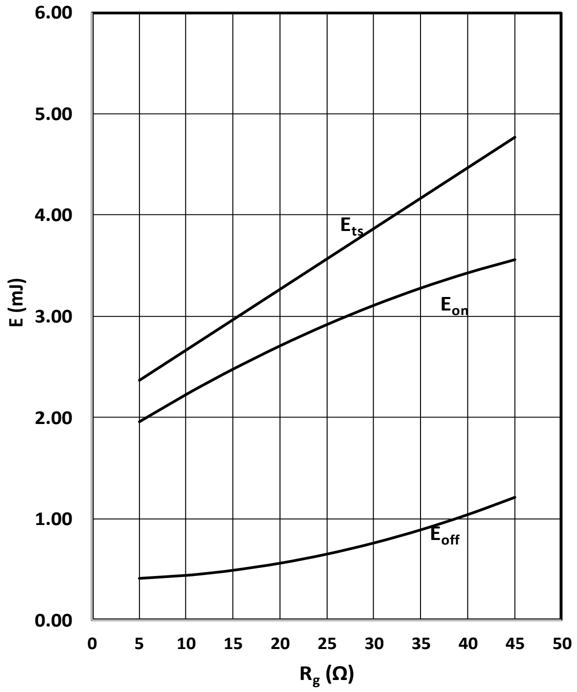
$I_C = f(V_{CE})$; Tj= 25ºC vs 150ºC

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



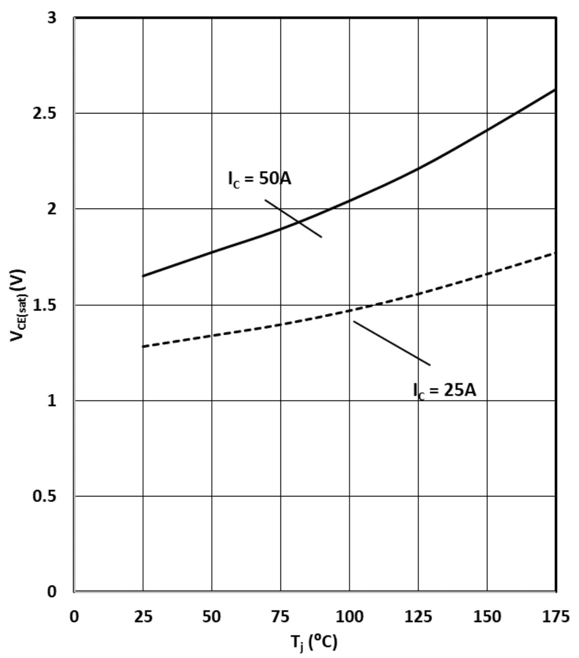
E=f(Ic); V_{CE}=400V; Tj=150ºC; R_G=10Ω

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



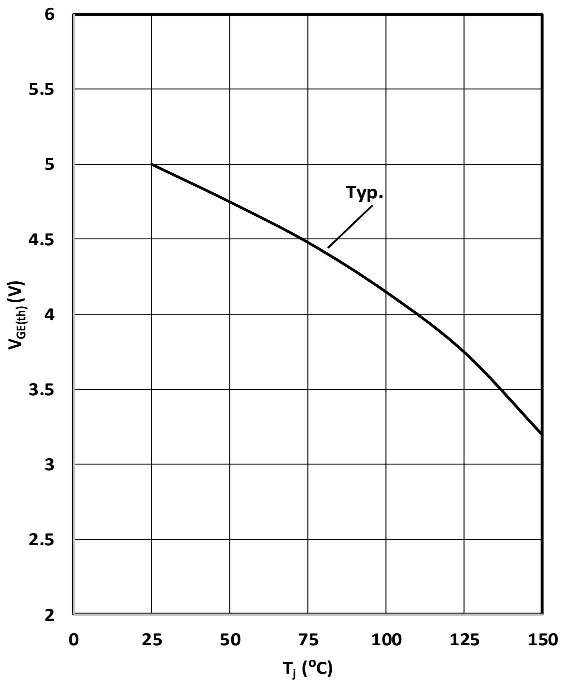
E=f(R_G); V_{CE}=400V; Tj=150ºC; Ic=50A

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



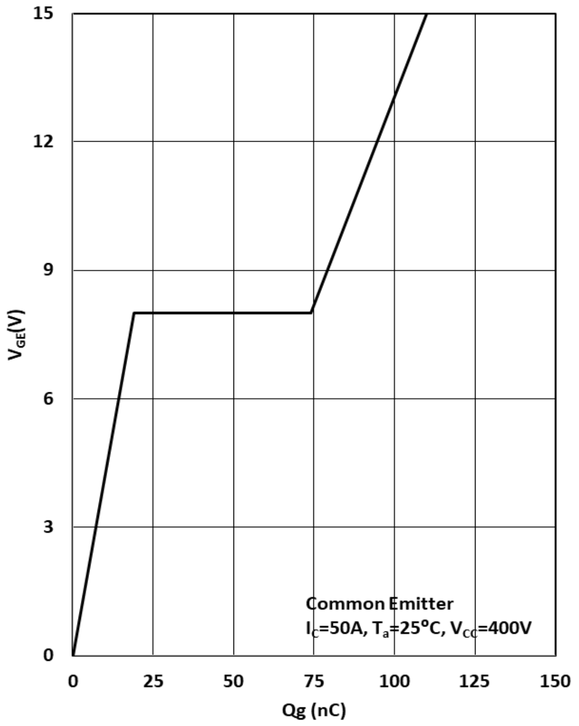
V_{CE} =f(T_j); V_{GE}=15V

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



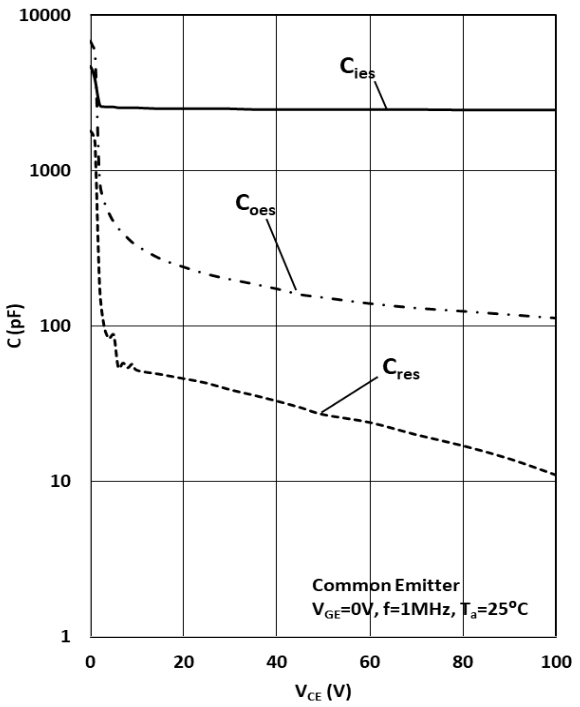
V_{GE} =f(T_j); I_{CE} = 250µA

Figure 13: Typical Gate Charge



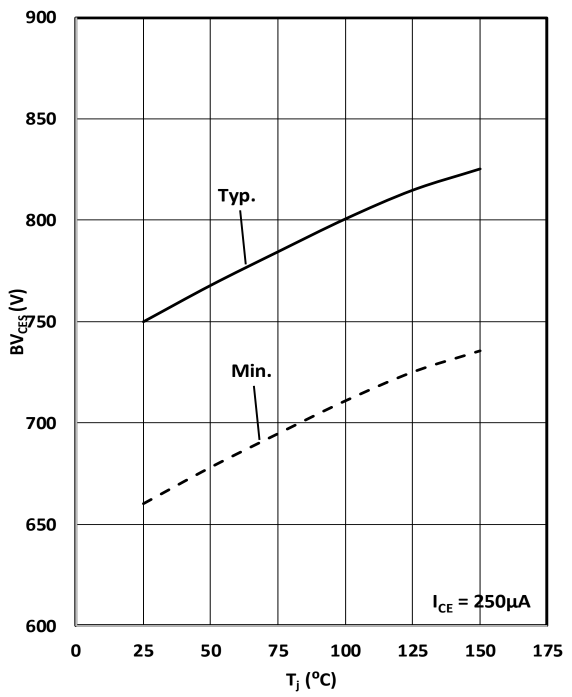
V_{GE}= f(Q_{gate}); I_C= 50A

Figure 14: Typical Capacitances



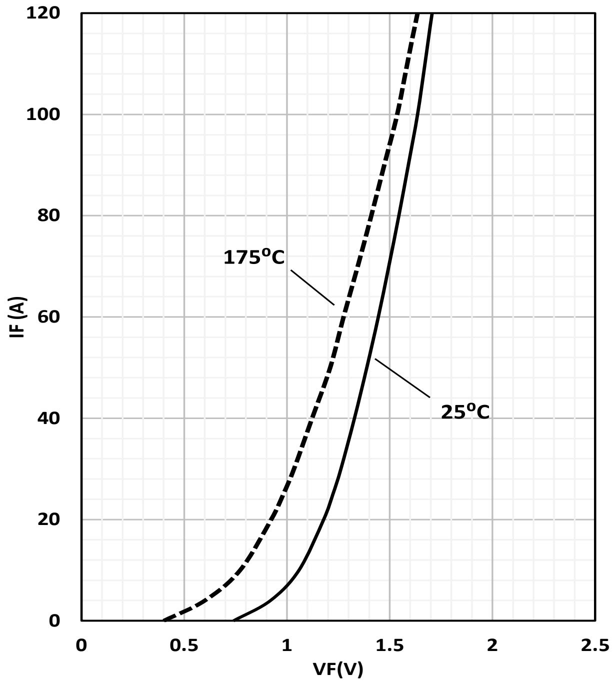
C=f(V_{CE}); V_{GE}=0; f=1MHz

Figure 15: Collector-emitter Breakdown Voltage vs. temperature



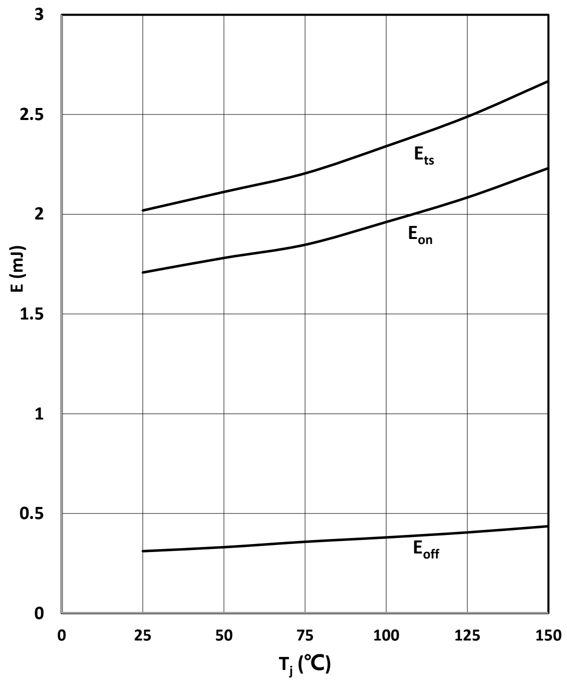
BVces= f(Tj);

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



I_F= f(V_F);

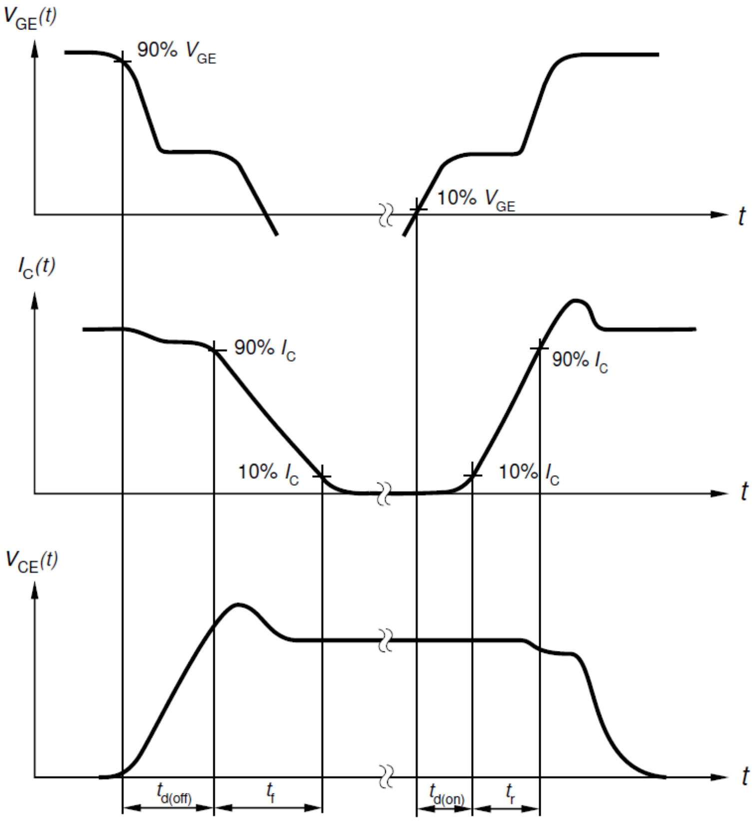
Figure 17: Typical switching energy losses as a function of junction temperature



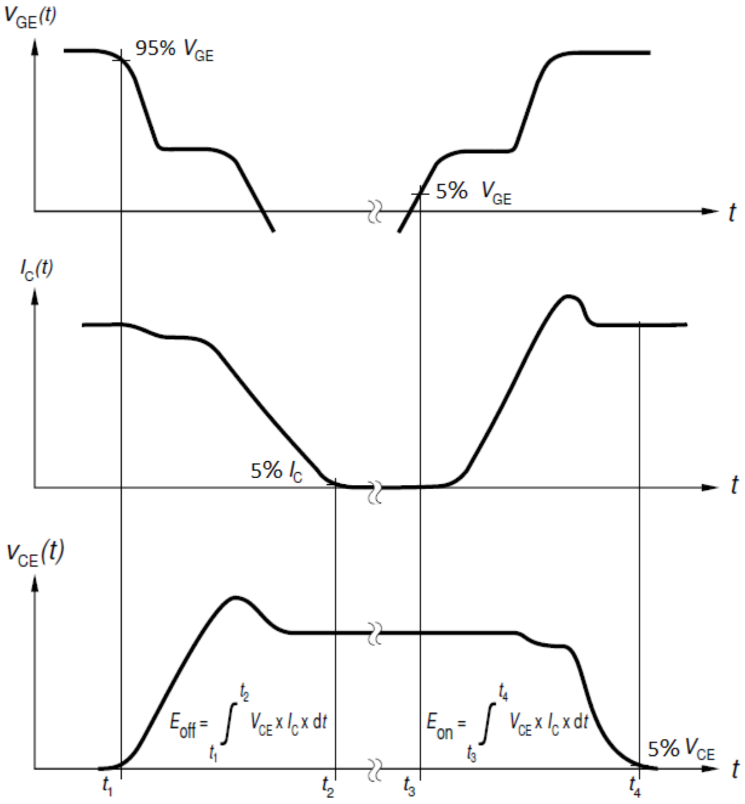
E=f(Tj); V_{CE}=400V; Ic =50A; R_G=10Ω

Test Circuits

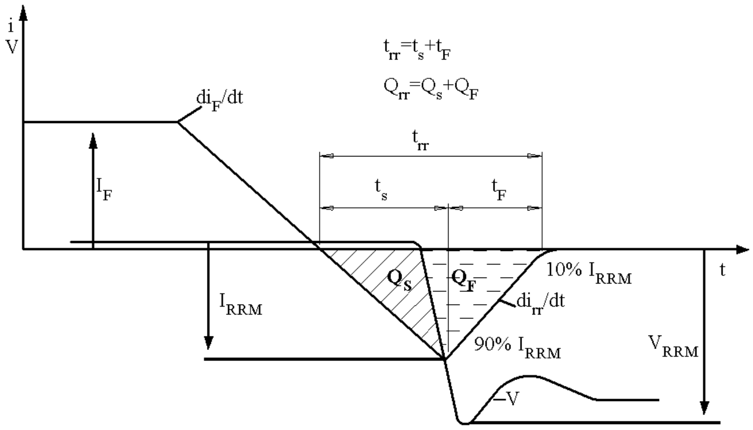
1. Definition Switching times



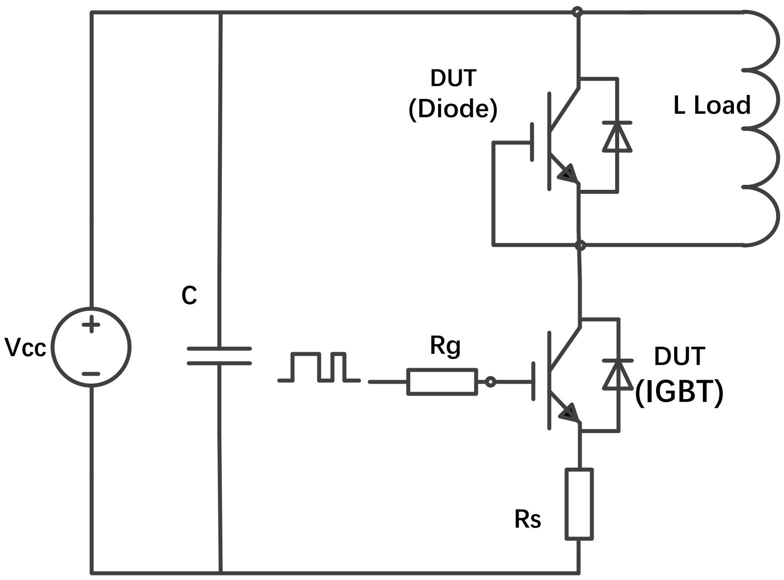
2. Definition Switching losses



3. Definition Diode Switching Characteristics

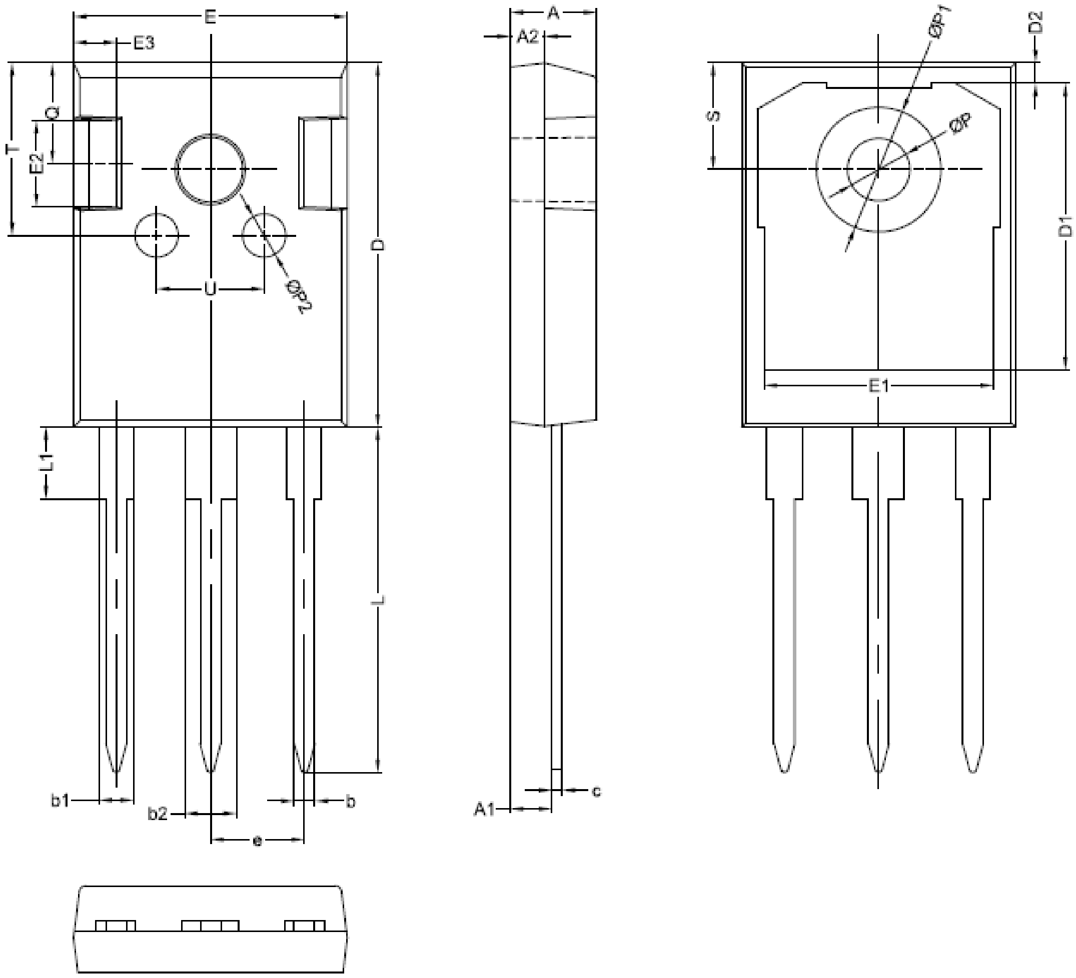


3. Dynamic test circuit



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	-

TM
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