Datasheet

60A 1200V Trench Fieldstop IGBT with anti-parallel diode SRE60N120FSSDA

General Description

TheSRE60N120FSSDA 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, etc. The SRE60N120FSSDA is available in TO-247 packages.

Symbol

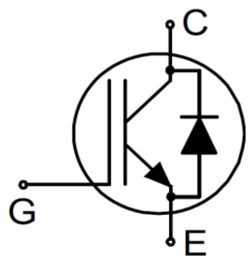
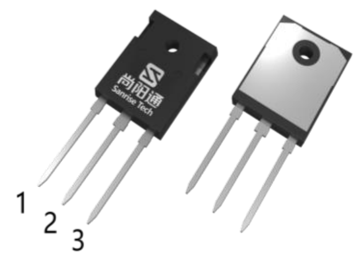


Figure 1 Symbol of SRE60N120FSSDA

Features

- High Breakdown Voltage to 1200V
- Advanced Trench Fieldstop technology
  - Low $V_{CE(sat)}$
  - Short circuit withstand time 6 us
  - Easy Parallel Switching Capability due to Positive Temperature Coefficient in $V_{CE(SAT)}$
- Soft Current Turn-off Waveforms
- Enhanced Avalanche Capability
- Non-Automotive Qualified

Package Type



TO-247

Pin 1- gate

Pin 2&backside-collector

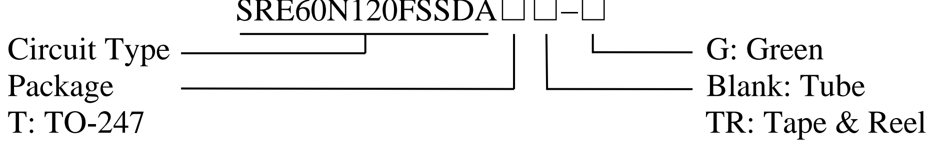
Pin 3-emitter

Figure 2 Package Type of SRE60N120FSSDA

Application

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

Ordering Information



Package	Part Number	Marking ID	Packing Type
TO-247	SRE60N120FSSDAT-G	SRE60N120FSSDATG	Tube

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=25℃	I_C	100	A
	T_C=100℃		60	
Pulsed Collector Current, Limited by T_{Jmax}		I_{CM}	240	A
Diode Continuous Collector Current (T_C=100℃)		I_F	60	A
Diode Pulsed Current, Limited by T_{Jmax}		I_{FM}	240	A
Power dissipation (TO-247)	T_C=25℃	P_{tot}	500	W
	T_C=100℃		250	W
Power dissipation (TO-247Plus)	T_C=25℃	P_{tot}	650	W
	T_C=100℃		325	W
Short Circuit withstand time: V_{GE}≤15V,Vcc≤600V,Tj_start=25℃; Allow number of short circuits<1000; Time between short circuits:1.0s;		tsc	6	us
Operating Junction Temperature		T_J	-40 ~ 175[1]	℃
Storage Temperature		T_{STG}	-55 ~ 150	℃
Lead Temperature (Soldering, 10 sec)		T_{LEAD}	260	℃

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	℃/W
Diode thermal Resistance， Junction-to-Case	TO-247	R_{thJC}	-	-	0.6	
Thermal Resistance， Junction-to-Ambient	TO-247	R_{thJA}	-	-	40	

Electrical Characteristics

T_J = 25℃, 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		$V_{GE(th)}$	VCE=VGE, IC=1.0mA	4.5	5.3	6.1	V
Collector-emitter saturation voltage		V_{CEsat}	V_{GE}=15V, I_C=60A, T_J=25℃		1.5	2.0	V
			T_J=125℃		1.8		V
			T_J=175℃		2.03		V
Zero Gate Voltage Collector Current		I_{CES}	V_{CE}=1200V, V_{GE}=0V T_J=25℃			10	uA
			T_J=175℃			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		4433		pF
Output Capacitance		C_{OES}			257		
Reverse Transfer Capacitance		C_{RES}			44		
Gate Resistance		R_G	f=1MHz, Open Drain		1.53		Ω
Turn-on Delay Time		$t_{d(on)}$	Tj=25℃ V_{CC}=600V, I_C=60A R_G=10Ω, V_{GE}=0/15V Energy losses include “tail” and diode reverse recovery		51		ns
Rise Time		t_r			61		ns
Turn-off Delay Time		$t_{d(off)}$			236		ns
Fall Time		t_f			176		ns
Turn-on energy		E_{on}			4.1		mJ
Turn-off energy		E_{off}			2.7		mJ
Total switching energy		E_{ts}			6.8		mJ
Turn-on Delay Time		$t_{d(on)}$	Tj=150℃ V_{CC}=600V, I_C=60A R_G=10Ω,V_{GE}=0/15V Energy losses include “tail” and diode reverse recovery		46		ns
Rise Time		t_r			58		ns
Turn-off Delay Time		$t_{d(off)}$			284		ns
Fall Time		t_f			231		ns
Turn-on energy		E_{on}			4.8		mJ
Turn-off energy		E_{off}			3.8		mJ
Total switching energy		E_{ts}			8.6		mJ
Gate to Emitter Charge		Q_{GE}	V_{CC}=600V, I_C=60A V_{GE}=0 to 15V		44		nC
Gate to Collector Charge		Q_{GC}			80		
Gate Charge Total		Q_G			131		

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Reverse Diode Characteristics						
Diode Forward Voltage	V_F	I_F=30A T_J=25℃		1.82	2.2	V
		I_F=30A T_J=125℃		1.67		
		I_F=30A T_J=175℃		1.5		
		I_F=60A T_J=25℃		2.18	2.5	
		I_F=60A T_J=125℃		1.91		
		I_F=60A T_J=175℃		1.82		
Reverse Recovery Time	t_{rr}	Tj=25℃ V_R=600V, I_F=60A dI_F/dt=960A/us		447		ns
Reverse Recovery Charge	Q_{rr}			3.3		uC
Peak Reverse Recovery Current	I_{rrm}			30		A
Diode peak rate of fall of reverse Recovery current during tb	dirr/dt			-800		A/us
Reverse Recovery Time	t_{rr}	Tj=150℃ V_R=600V, I_F=60A dI_F/dt=960A/us		718		ns
Reverse Recovery Charge	Q_{rr}			7.9		uC
Peak Reverse Recovery Current	I_{rrm}			53		A
Diode peak rate of fall of reverse Recovery current during tb	dirr/dt			-125		A/us

Typical Performance Characteristics

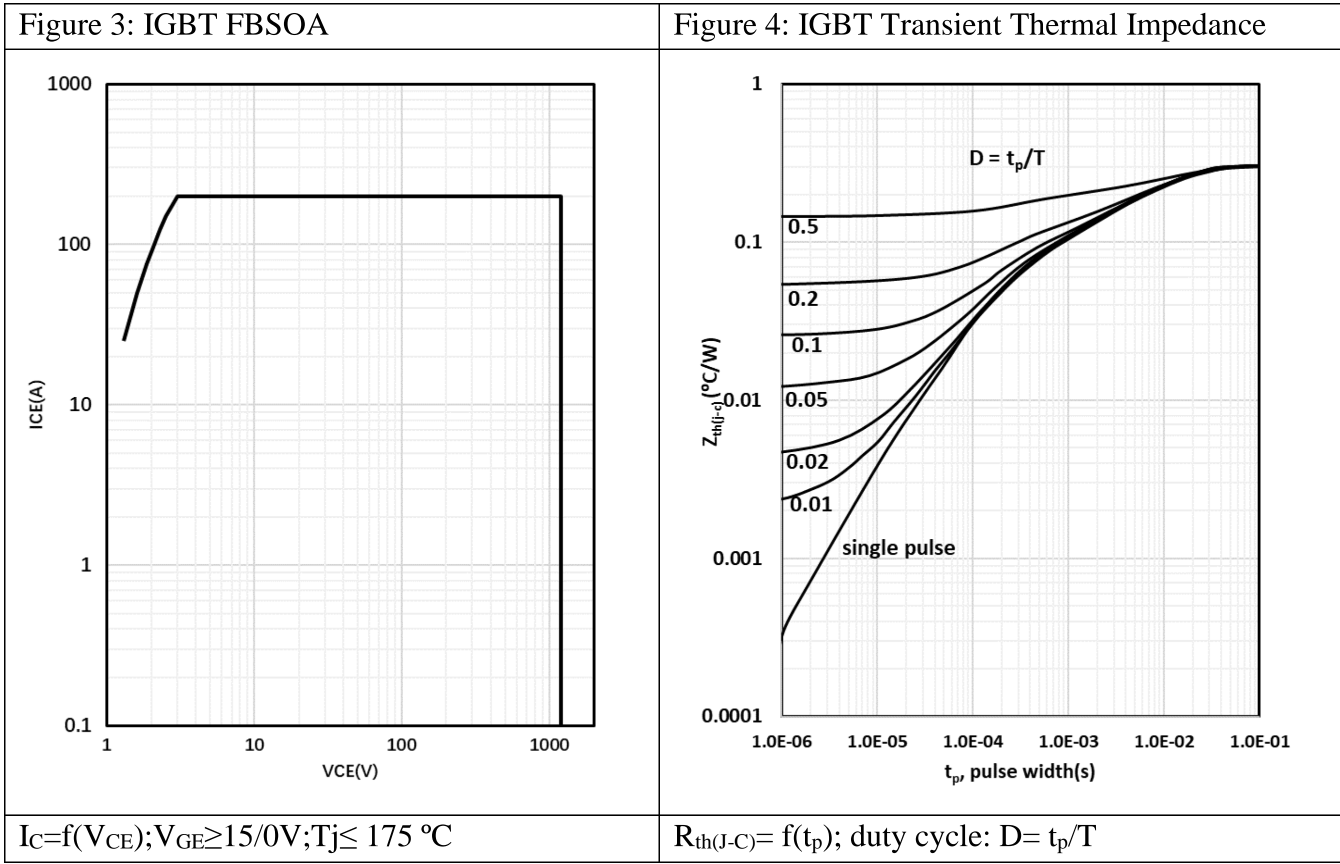


Figure 3: IGBT FBSOA

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

Figure 4: IGBT Transient Thermal Impedance

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

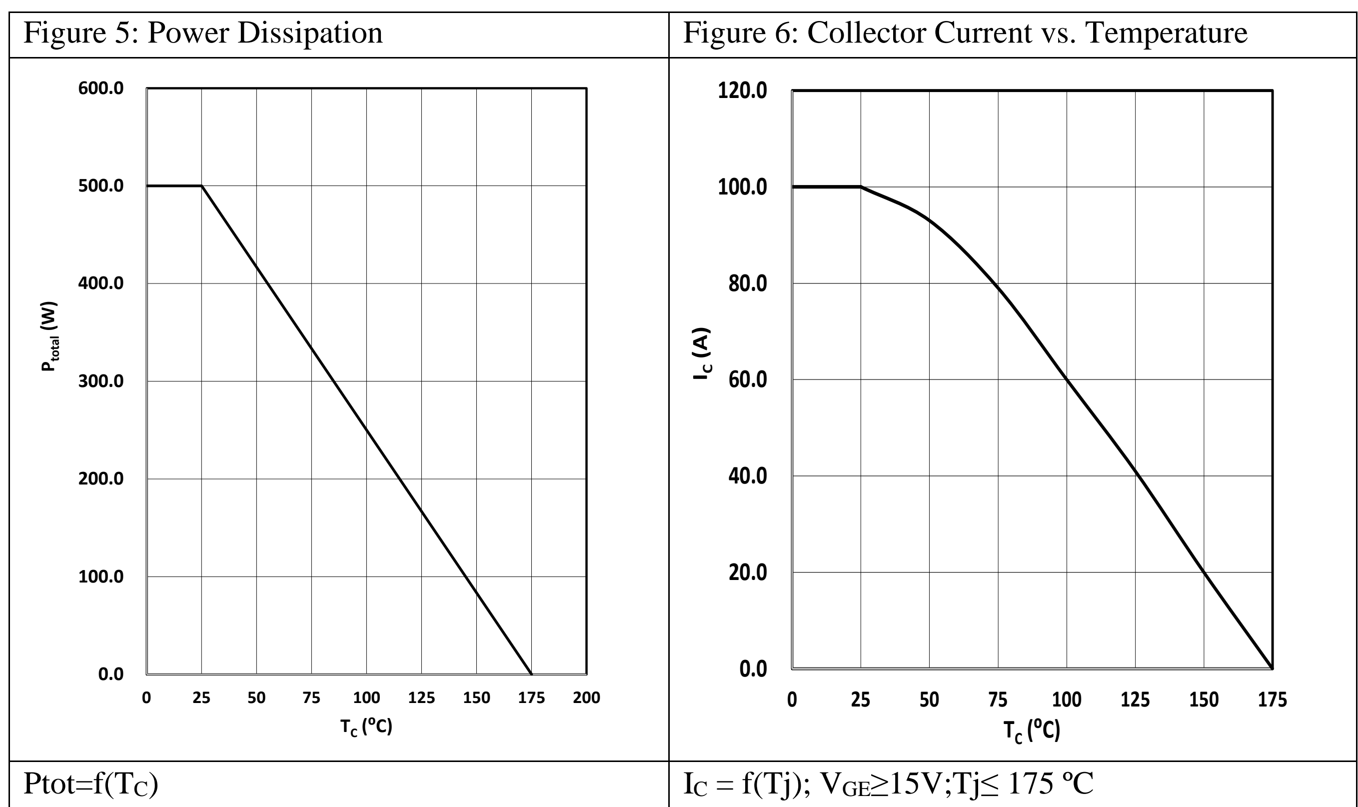


Figure 5: Power Dissipation

$Ptot=f(T_C)$

Figure 6: Collector Current vs. Temperature

$I_C = f(Tj); V_{GE}\geq 15V; Tj\leq 175$ ℃

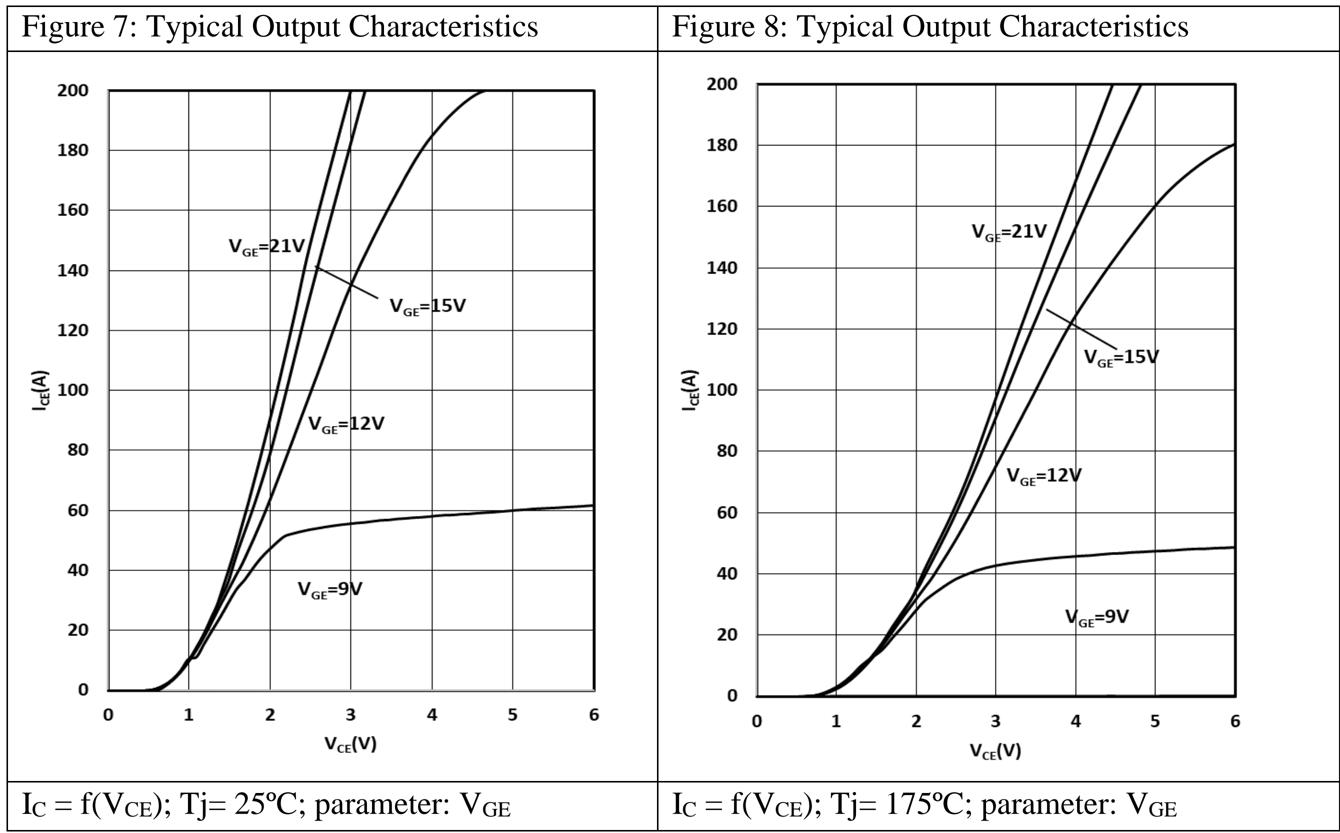


Figure 7: Typical Output Characteristics	Figure 8: Typical Output Characteristics
$I_C = f(V_{CE})$; Tj= 25℃; parameter: V_{GE}	$I_C = f(V_{CE})$; Tj= 175℃; parameter: V_{GE}

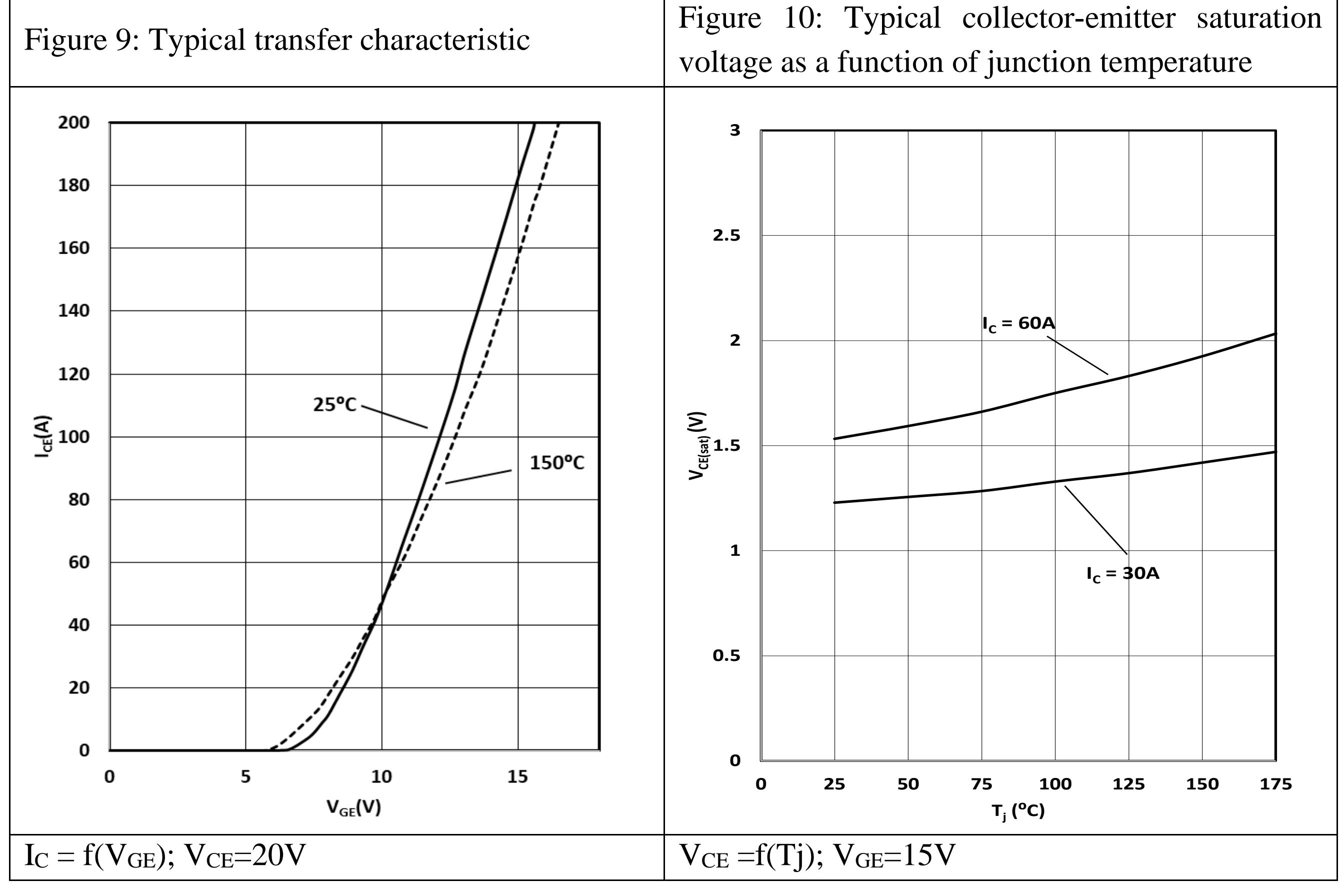


Figure 9: Typical transfer characteristic	Figure 10: Typical collector-emitter saturation voltage as a function of junction temperature
$I_C = f(V_{GE})$; V_{CE}=20V	$V_{CE} = f(Tj)$; V_{GE}=15V

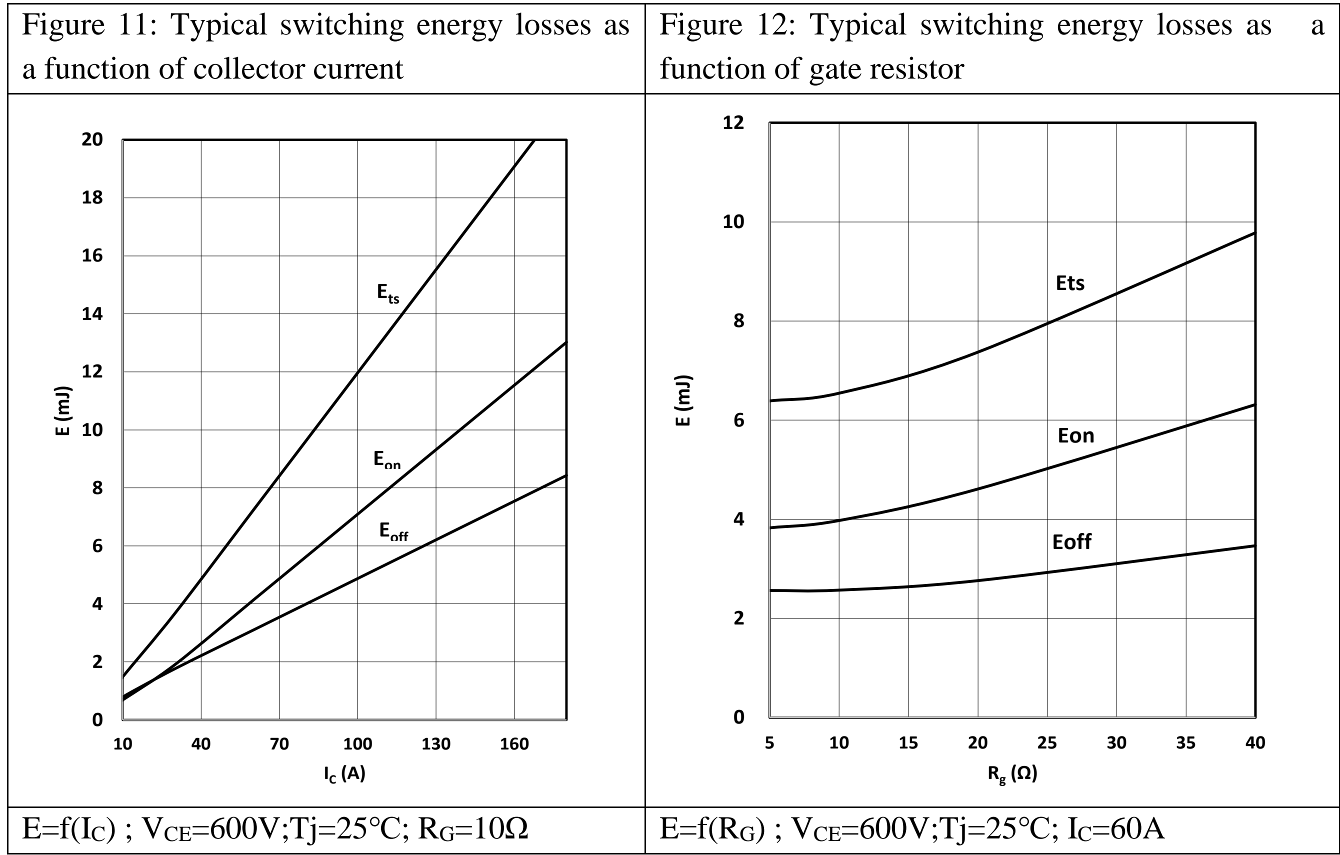


Figure 11: Typical switching energy losses as a function of collector current

$E=f(I_C)$; 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=60A

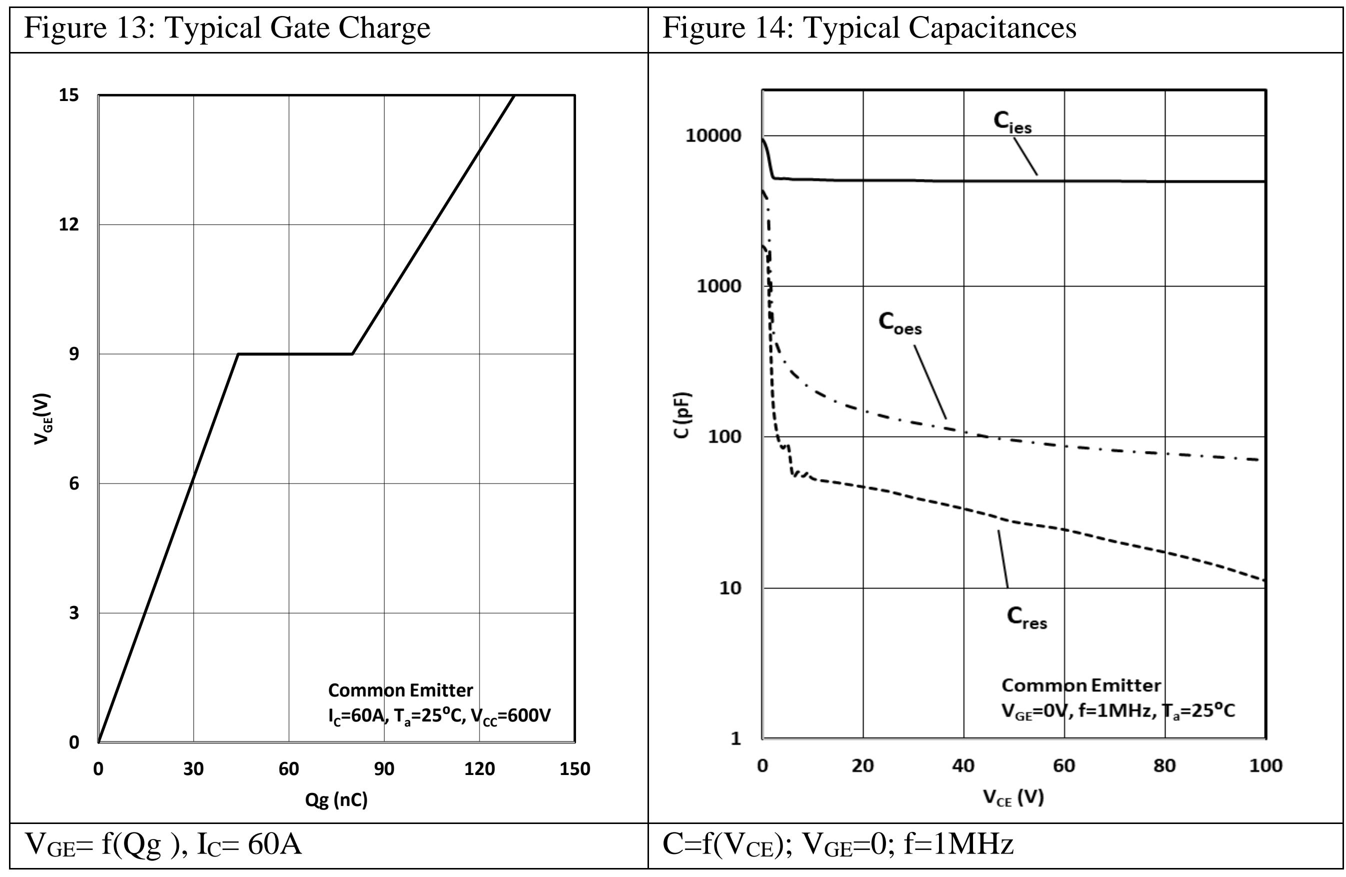


Figure 13: Typical Gate Charge

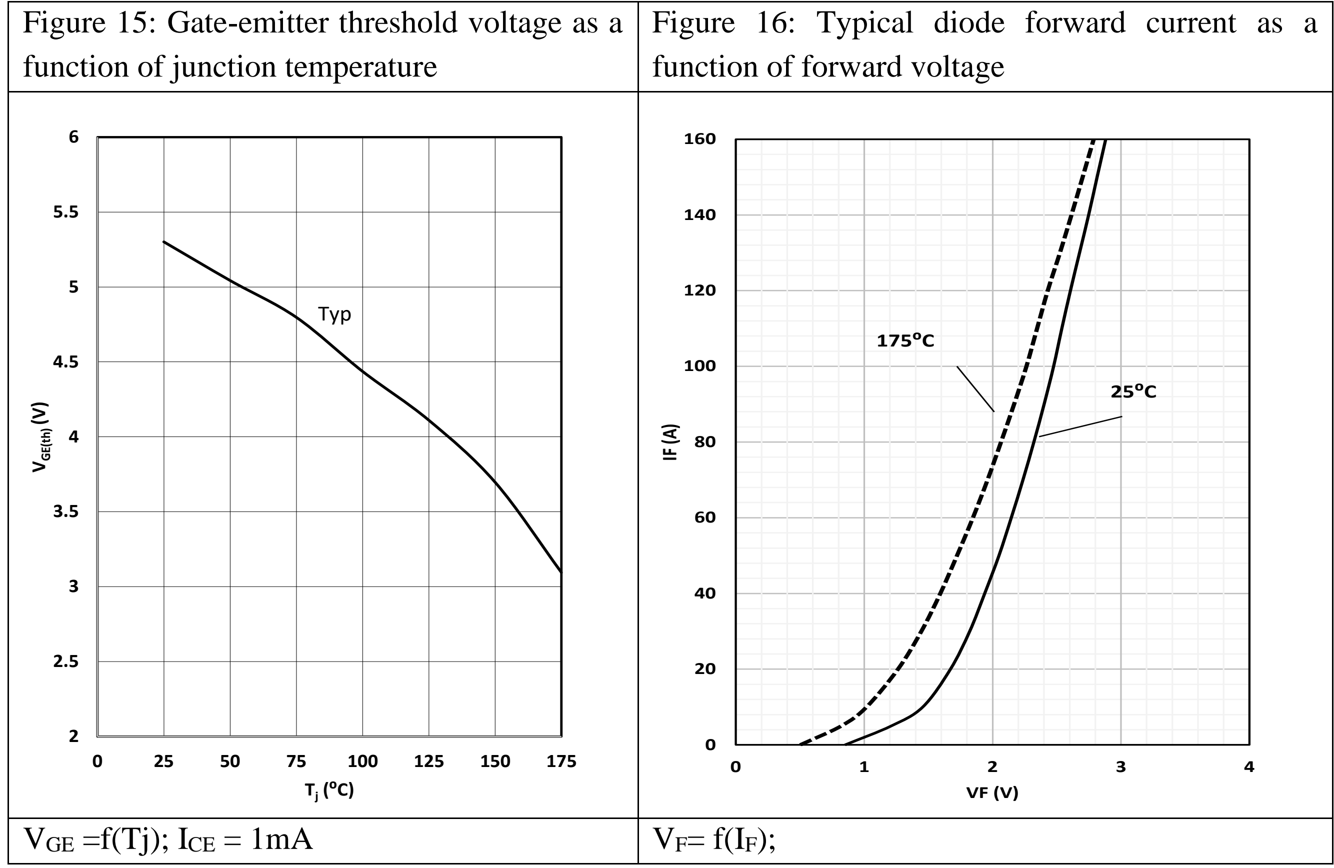
V_{GE}= f(Qg), I_C= 60A

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

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

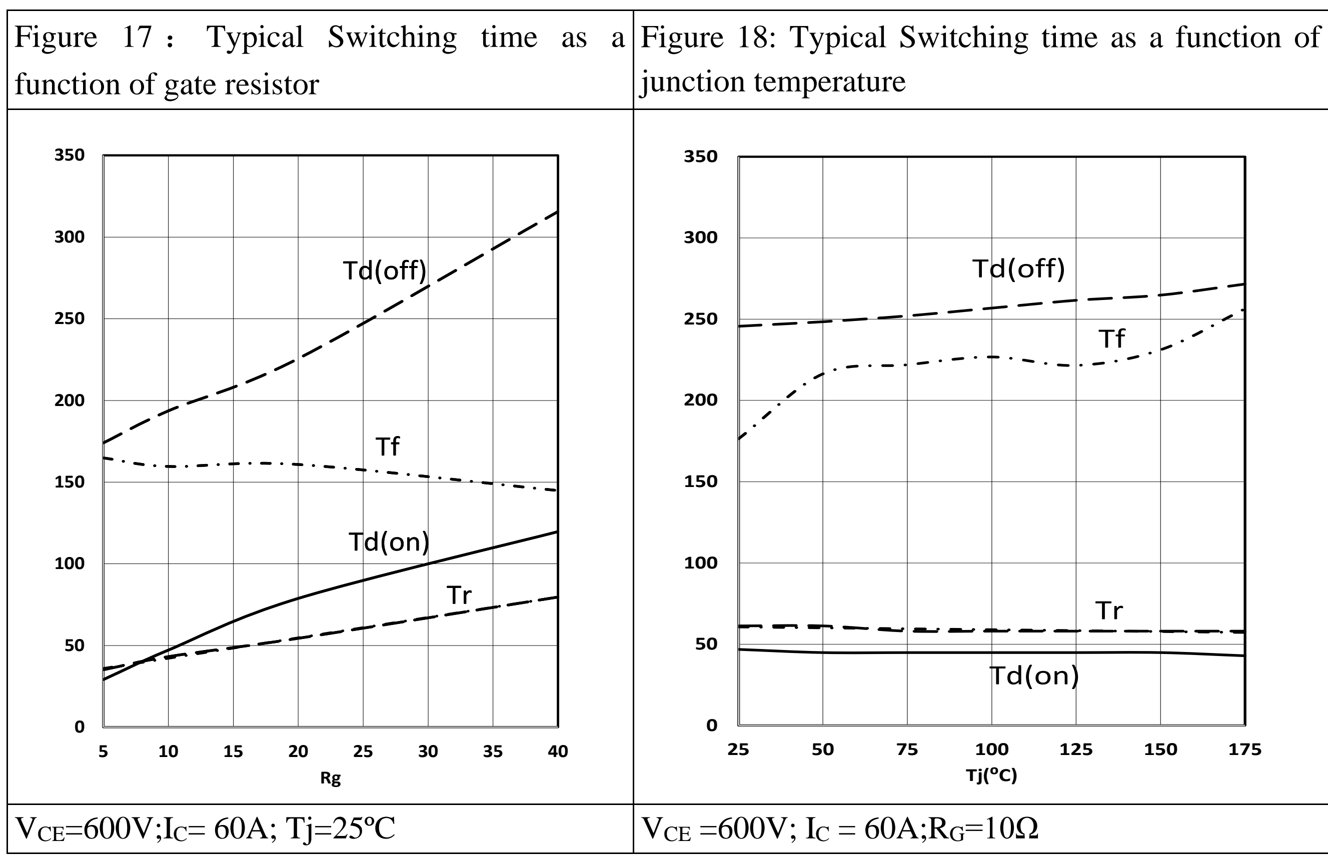


$V_{GE} = f(Tj)$; $I_{CE} = 1mA$

$V_F = f(I_F)$;

Figure 17 : Typical Switching time as a function of gate resistor

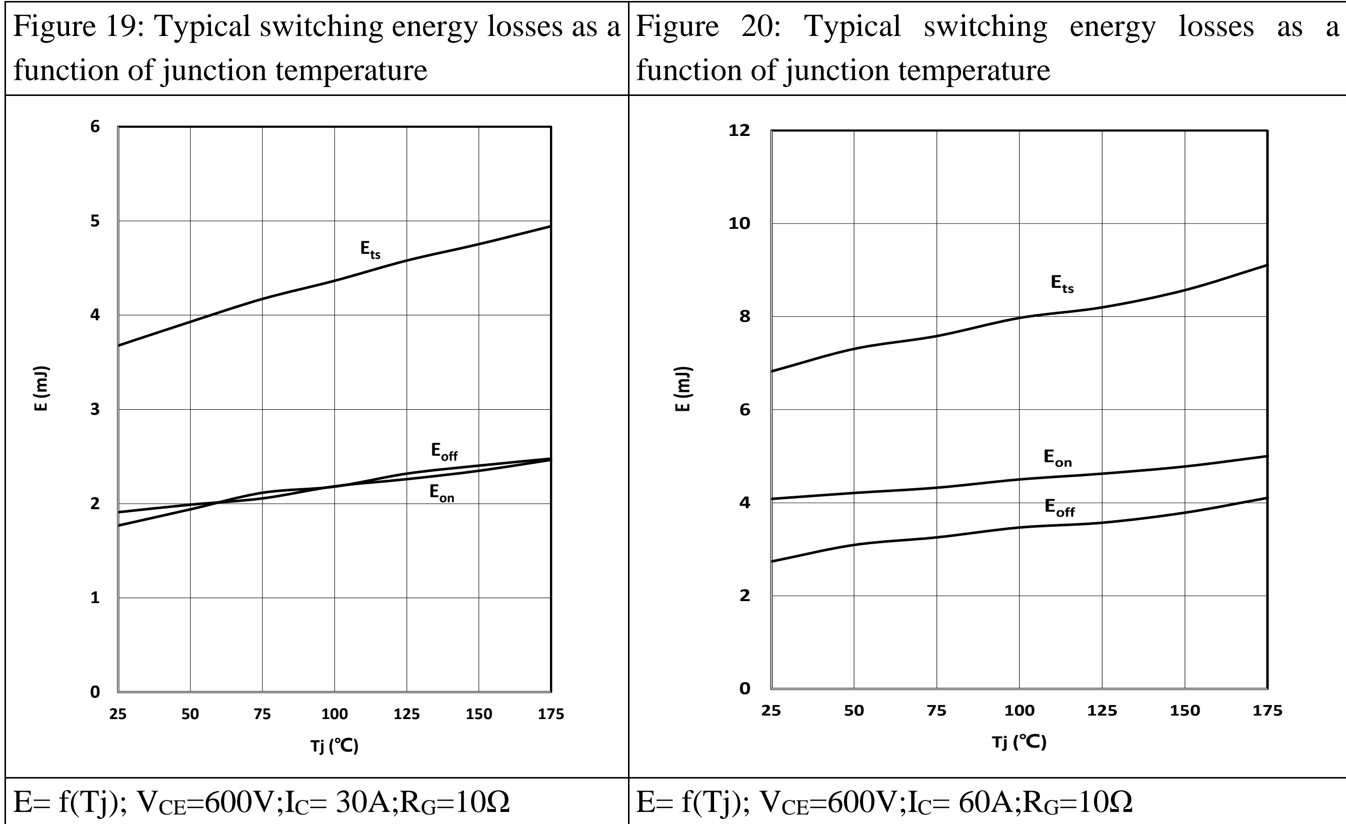
Figure 18: Typical Switching time as a function of junction temperature



V_{CE}=600V;I_C= 60A; Tj=25°C

V_{CE} =600V; I_C = 60A;R_G=10Ω

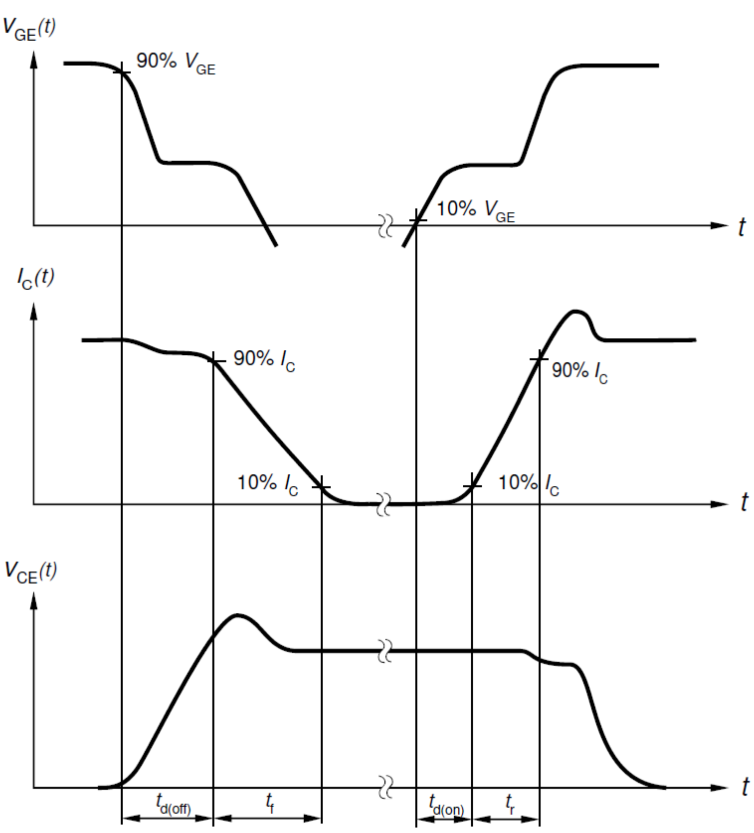
Figure 19: Typical switching energy losses as a function of junction temperature	Figure 20: Typical switching energy losses as a function of junction temperature



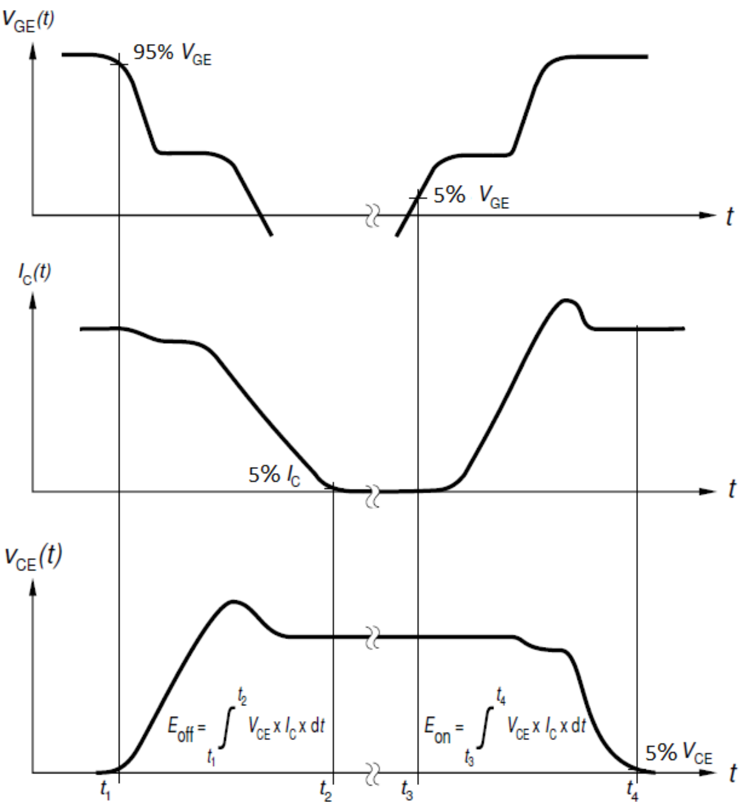
E= f(Tj); V_{CE}=600V;I_C= 30A;R_G=10Ω	E= f(Tj); V_{CE}=600V;I_C= 60A;R_G=10Ω

Test Circuits

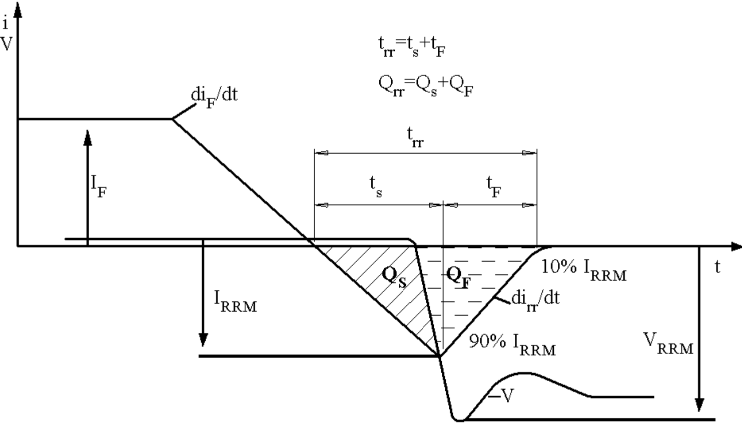
1. Definition Switching times



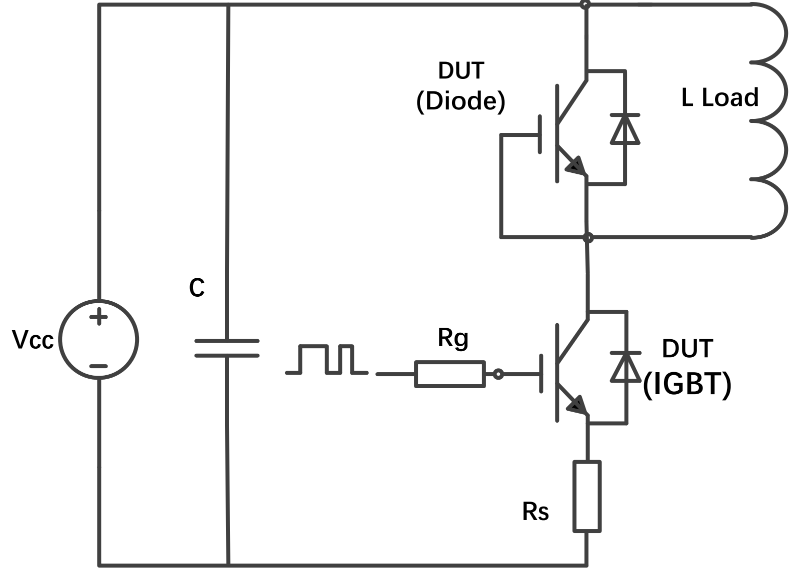
2. Definition Switching losses



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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