

100A 650V Trench Fieldstop IGBT with anti-parallel diode SRE100N065FSUD8
General Description

The SRE100N065FSUD8 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 SRE100N065FSUD8 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 $V_{CE(SAT)}$
- LOW $V_{CE(SAT)}$
- Enhanced Avalanche Capability
- Non-Automotive Qualified

Application

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

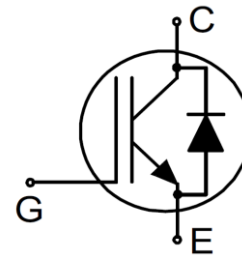
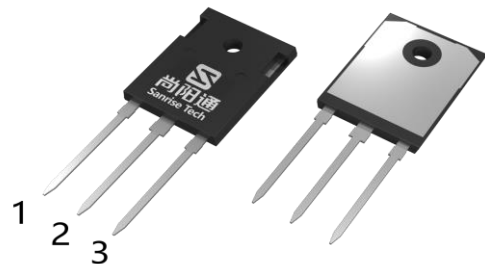
Symbol


Figure 1 Symbol of SRE100N065FSUD8

Package Type


TO-247

Pin 1- Gate

Pin 2&backside- Collector

Pin 3-Emitter

Figure 2 Package Type of SRE100N065FSUD8

Ordering Information

SRE100N065FSUD8□□-□

Circuit Type			
Package			G: Green
T: TO-247			Blank: Tube
			TR: Tape & Reel

Package	Part Number	Marking ID	Packing Type
TO-247	SRE100N065FSUD8T-G	SRE100N065FSUD8TG	Tube

100A 650V Trench Fieldstop IGBT with anti-parallel diode SRE100N065FSUD8
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	$T_C=25^\circ\text{C}$	I_C	125	A
	$T_C=100^\circ\text{C}$		100	
Pulsed Collector Current, Limited by T_{Jmax}		I_{CM}	400	A
Diode Continuous Collector Current	$T_C=25^\circ\text{C}$	I_F	100	A
	$T_C=100^\circ\text{C}$		80	
Diode Pulsed Current, Limited by T_{Jmax}		I_{FM}	320	A
Power Dissipation	$T_C=25^\circ\text{C}$	P_{tot}	395	W
	$T_C=100^\circ\text{C}$		197	
Operating Junction Temperature Range		T_J	$-40 \sim 175^{(1)}$	$^\circ\text{C}$
Storage Temperature Range		T_{STG}	$-55 \sim 150$	$^\circ\text{C}$
Lead Temperature (Soldering, 10 sec)		T_{LEAD}	260	$^\circ\text{C}$

Note:

 1. Reliability testing conducted at $T_j=175^\circ\text{C}$.

Thermal Resistance

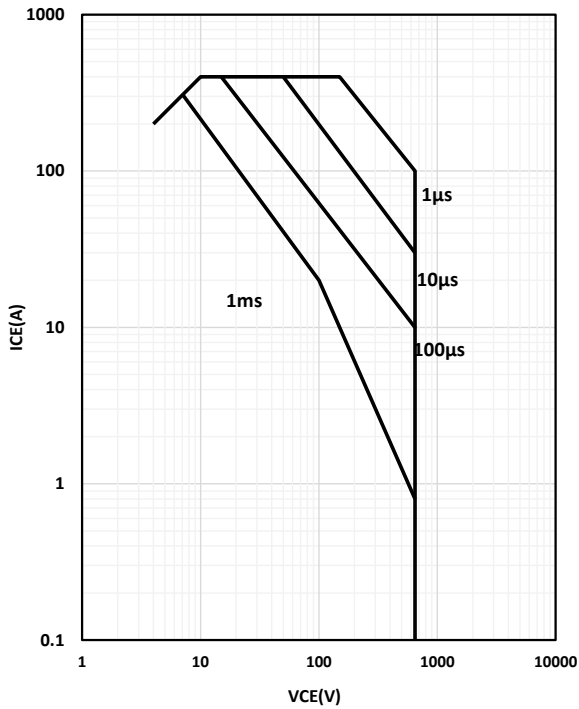
Parameter	Symbol	Min.	Typ.	Max.	Unit
IGBT Thermal Resistance, Junction-to-Case	R_{thJC}	-	-	0.38	$^\circ\text{C/W}$
Diode Thermal Resistance, Junction-to-Case	R_{thJC}	-	-	0.45	
Thermal Resistance, Junction-to-Ambient	R_{thJA}	-	-	40	

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Electrical Characteristics
 $T_J = 25^\circ\text{C}$, unless otherwise specified.

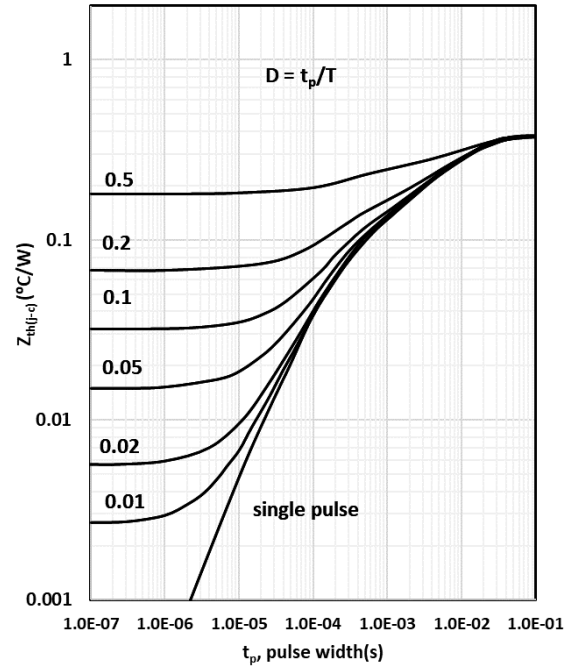
Parameter		Symbol	Test Conditions	Min.	Typ.	Max.	Unit	
Statistic Characteristics								
Collector-emitter Voltage	Breakdown	BV_{CES}	$V_{GE}=0V, I_C=250\mu A$	650			V	
Gate Threshold Voltage		$V_{GE(th)}$	$V_{CE}=V_{GE}, I_C=250\mu A$	4.0	4.8	5.6	V	
Collector-emitter saturation voltage		V_{CEsat}	$V_{GE}=15V, I_C=100A,$ $T_J=25^\circ\text{C}$		1.46	2.0	V	
			$T_J=125^\circ\text{C}$		1.68		V	
			$T_J=175^\circ\text{C}$		1.83		V	
Zero Gate Voltage Collector Current		I_{CES}	$V_{CE}=650V, V_{GE}=0V$ $T_J=25^\circ\text{C}$		0.1	40	μA	
			$T_J=175^\circ\text{C}$			1	mA	
Gate-emitter Current	Leakage 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}	$V_{CE}=25V, V_{GE}=0V,$ $f=1\text{ MHz}$		3750		pF	
Output Capacitance		C_{OES}			350			
Reverse Transfer Capacitance		C_{RES}			40			
Gate Resistance		R_G	$f=1\text{ MHz, Open Drain}$		1.7		Ω	
Turn-on Delay Time		$t_{d(on)}$	$T_J=25^\circ\text{C}$ $V_{CC}=400V, I_C=100A$ $R_G=15\Omega, V_{GE}=0/15V$ Energy losses include "tail" and diode reverse recovery		50		ns	
Rise Time		t_r			110		ns	
Turn-off Delay Time		$t_{d(off)}$			300		ns	
Fall Time		t_f			68		ns	
Turn-on energy		E_{on}			5.85		mJ	
Turn-off energy		E_{off}			1.55		mJ	
Total switching energy		E_{ts}			7.4		mJ	
Turn-on Delay Time		$t_{d(on)}$		$T_J=150^\circ\text{C}$ $V_{CC}=400V, I_C=100A$ $R_G=15\Omega, V_{GE}=0/15V$ Energy losses include "tail" and diode reverse recovery		45		ns
Rise Time		t_r				120		ns
Turn-off Delay Time		$t_{d(off)}$				395		ns
Fall Time		t_f			83		ns	
Turn-on energy		E_{on}			7.85		mJ	
Turn-off energy		E_{off}			2.55		mJ	
Total switching energy		E_{ts}			10.4		mJ	
Gate to Emitter Charge		Q_{GE}	$V_{CC}=400V, I_C=100A$ $V_{GE}=0\text{ to }15V$			65		nC
Gate to Collector Charge		Q_{GC}			89			
Gate Charge Total		Q_G			215			

100A 650V Trench Fieldstop IGBT with anti-parallel diode SRE100N065FSUD8

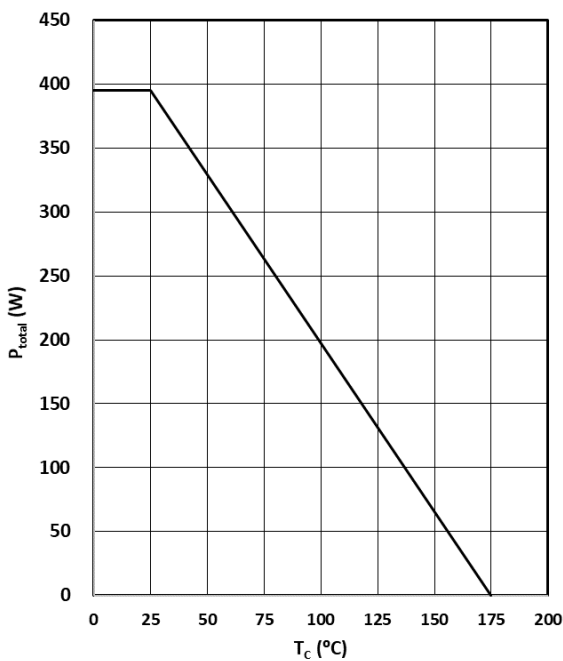
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Reverse Diode Characteristics						
Diode Forward Voltage	V_F	$I_F=50A$ $T_J=25^{\circ}C$		1.36	1.7	V
		$I_F=50A$ $T_J=125^{\circ}C$		1.11		
		$I_F=50A$ $T_J=175^{\circ}C$		1.01		
		$I_F=100A$ $T_J=25^{\circ}C$		1.58	1.9	
		$I_F=100A$ $T_J=125^{\circ}C$		1.46		
		$I_F=100A$ $T_J=175^{\circ}C$		1.38		
Reverse Recovery Time	t_{rr}	$T_J=25^{\circ}C$		125		ns
Reverse Recovery Charge	Q_{rr}	$V_R=400V, I_F=100A$		1084		nC
Peak Reverse Recovery Current	I_{rrm}	$dI_F/dt=700A/\mu s$		18.5		A

100A 650V Trench Fieldstop IGBT with anti-parallel diode SRE100N065FSUD8
Typical Performance Characteristics
Figure 3: IGBT FBSOA


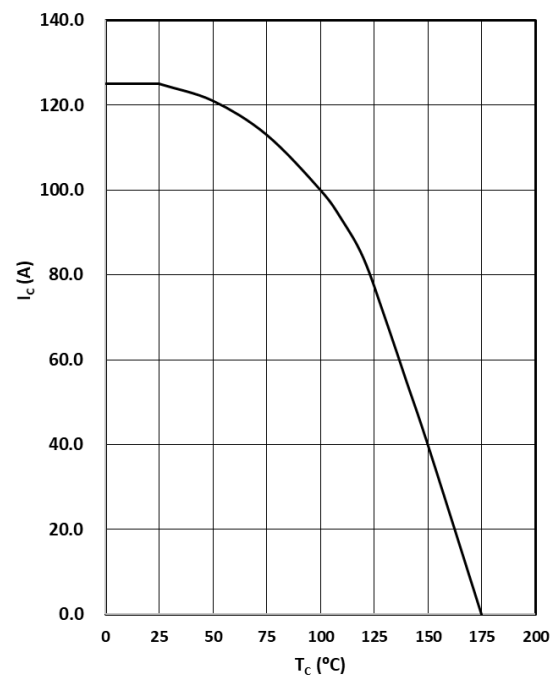
$$I_C = f(V_{CE}); V_{GE} \geq 15/0V; T_j \leq 175^\circ C$$

Figure 4: IGBT transient thermal impedance


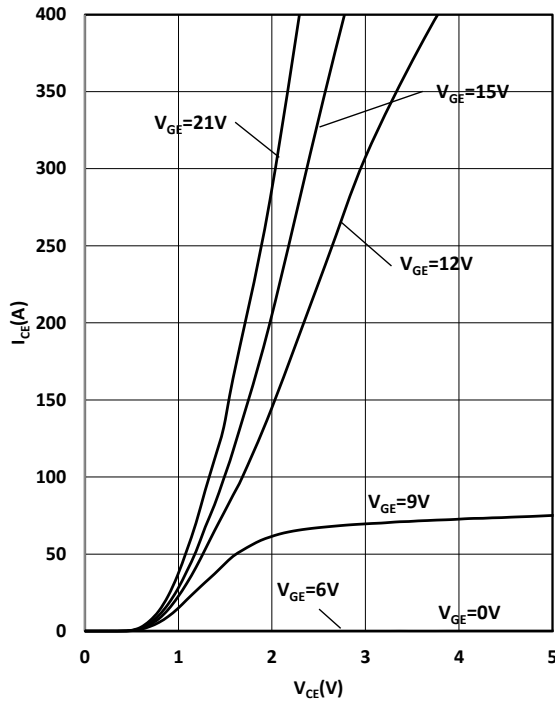
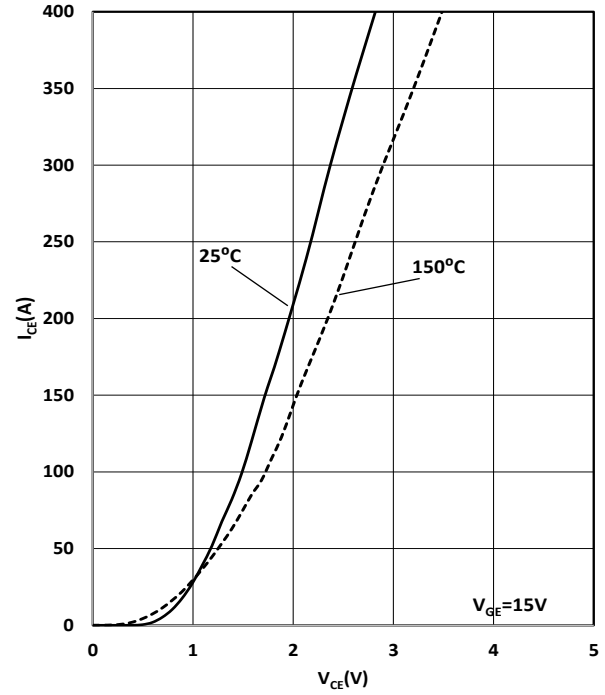
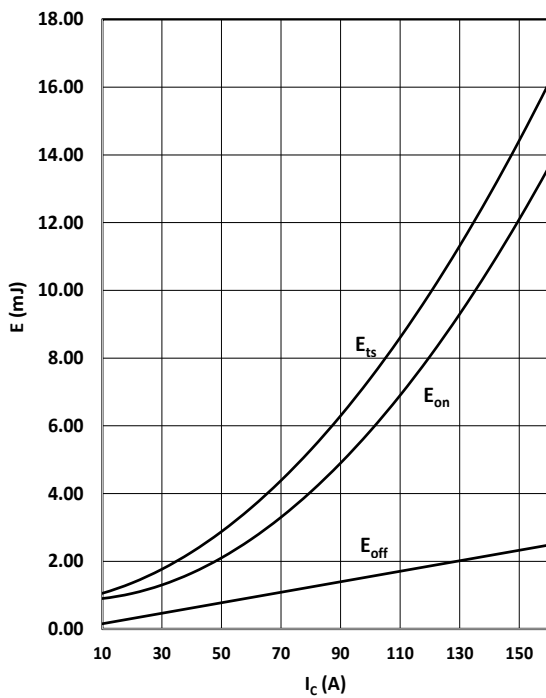
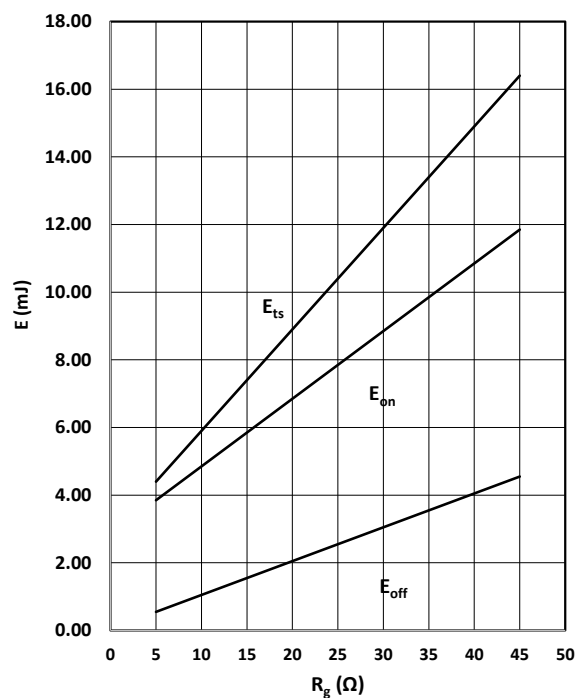
$$R_{th(j-c)} = f(t_p); \text{ duty cycle: } D = t_p/T$$

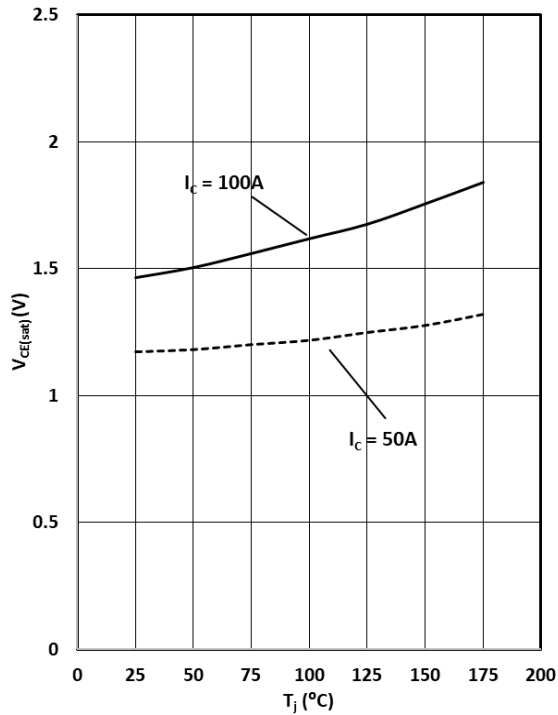
Figure 5: Power dissipation


$$P_{tot} = f(T_c);$$

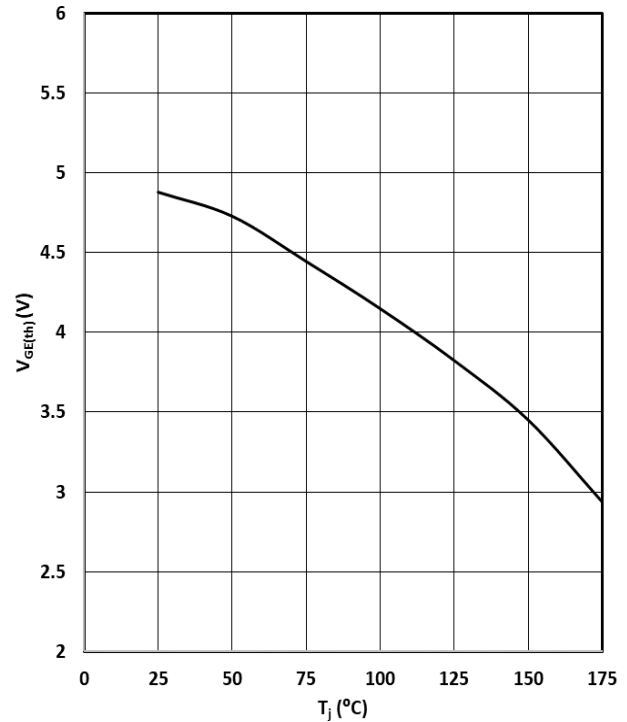
Figure 6: Collector current vs. temperature


$$I_C = f(T_c); V_{GE} \geq 15V; T_j \leq 175^\circ C$$

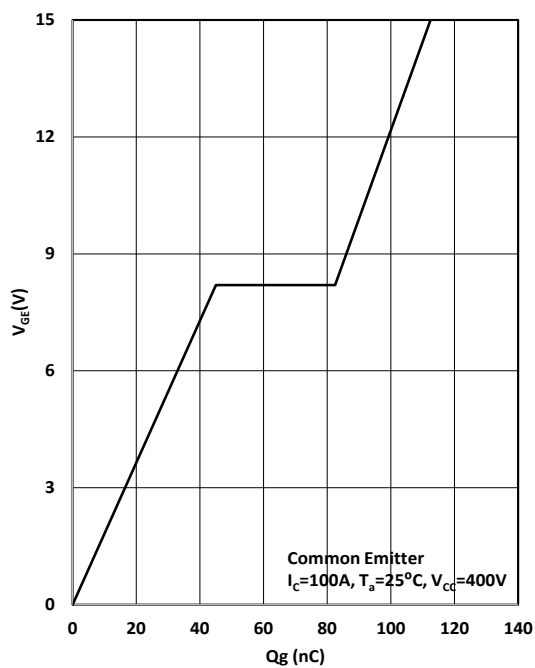
100A 650V Trench Fieldstop IGBT with anti-parallel diode SRE100N065FSUD8
Figure 7: Typical Output Characteristics

 $I_C = f(V_{CE}); T_j = 25^\circ\text{C}; \text{parameter: } V_{GE}$
Figure 8: Typical transfer characteristic

 $I_C = f(V_{CE}); T_j = 25^\circ\text{C vs } 150^\circ\text{C}$
Figure 9: Typical switching energy losses as a function of collector current

 $E = f(I_C); V_{CE} = 400V; T_j = 25^\circ\text{C}; R_G = 15\Omega$
Figure 10: Typical switching energy losses as a function of gate resistor

 $E = f(R_G); V_{CE} = 400V; T_j = 25^\circ\text{C}; I_C = 100A$

100A 650V Trench Fieldstop IGBT with anti-parallel diode SRE100N065FSUD8
Figure 11: Typical collector-emitter saturation voltage as a function of junction temperature


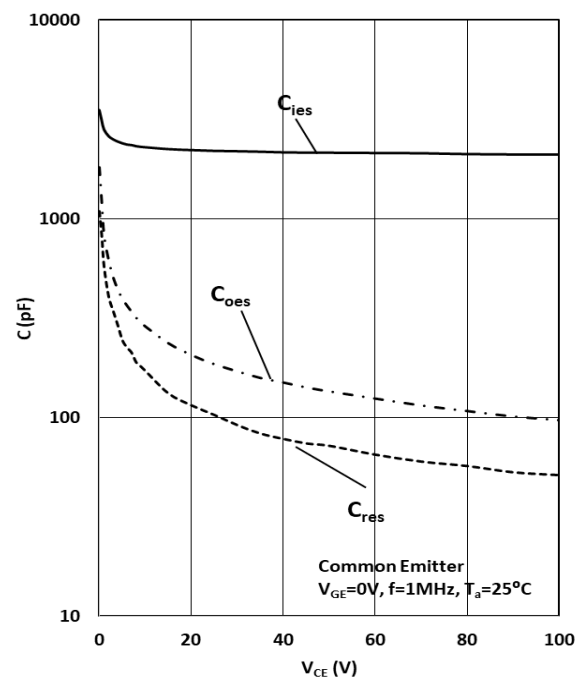
$$V_{CE} = f(T_j); V_{GE} = 15V$$

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


$$V_{GE} = f(T_j); I_{CE} = 250\mu A$$

Figure 13: Typical Gate Charge


$$V_{GE} = f(Q_{gate}); I_C = 100A$$

Figure 14: Typical Capacitances


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

100A 650V Trench Fieldstop IGBT with anti-parallel diode SRE100N065FSUD8

Figure 15: Collector-emitter Breakdown Voltage vs. temperature

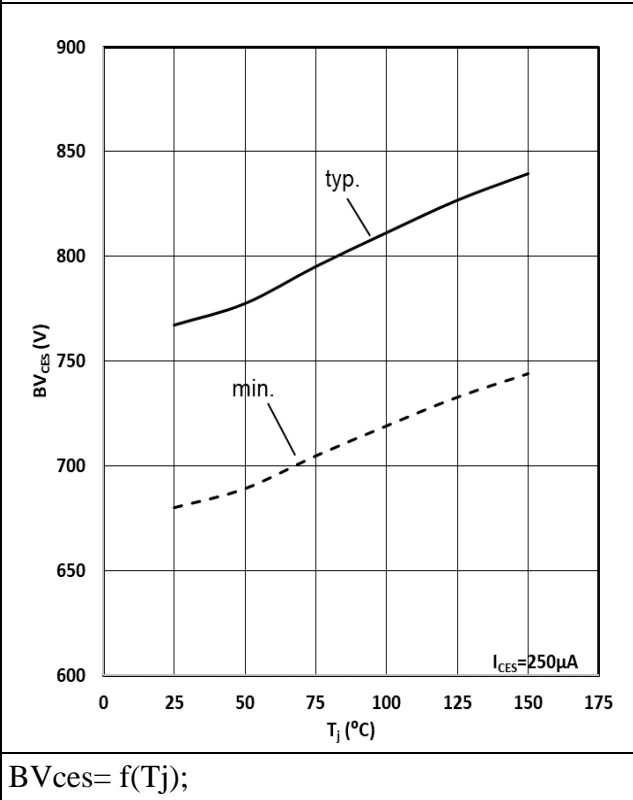


Figure 16: Typical diode forward current as a function of forward voltage

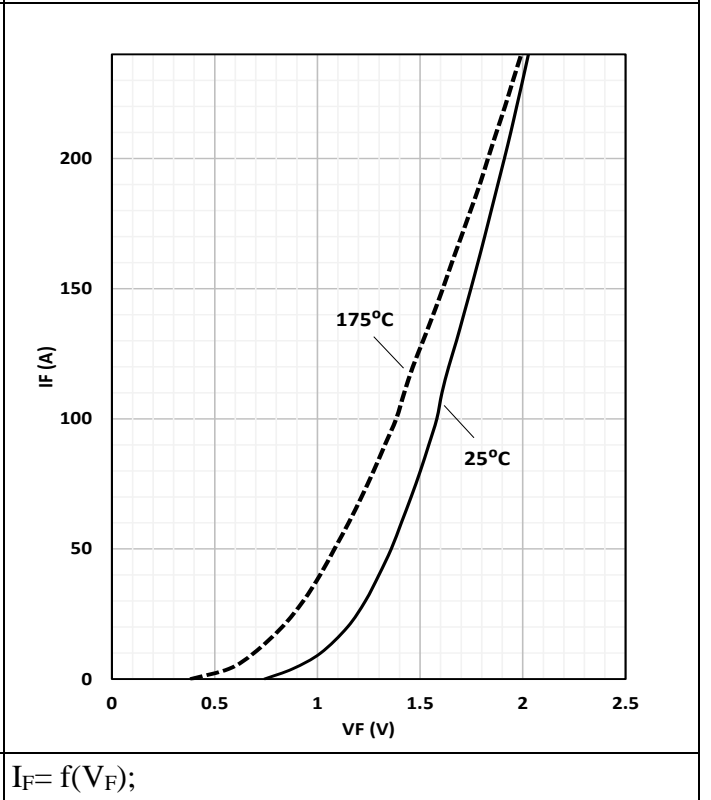


Figure 17: Typical switching energy losses as a function of junction temperature

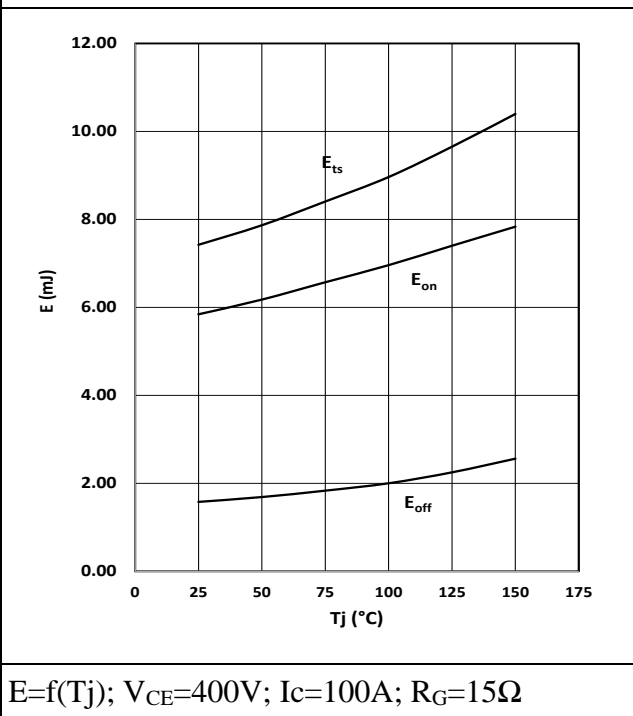
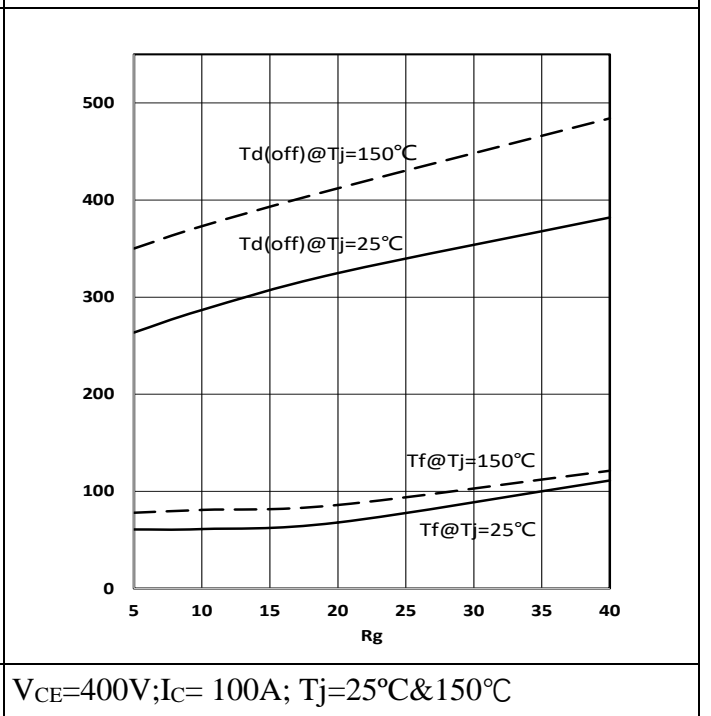
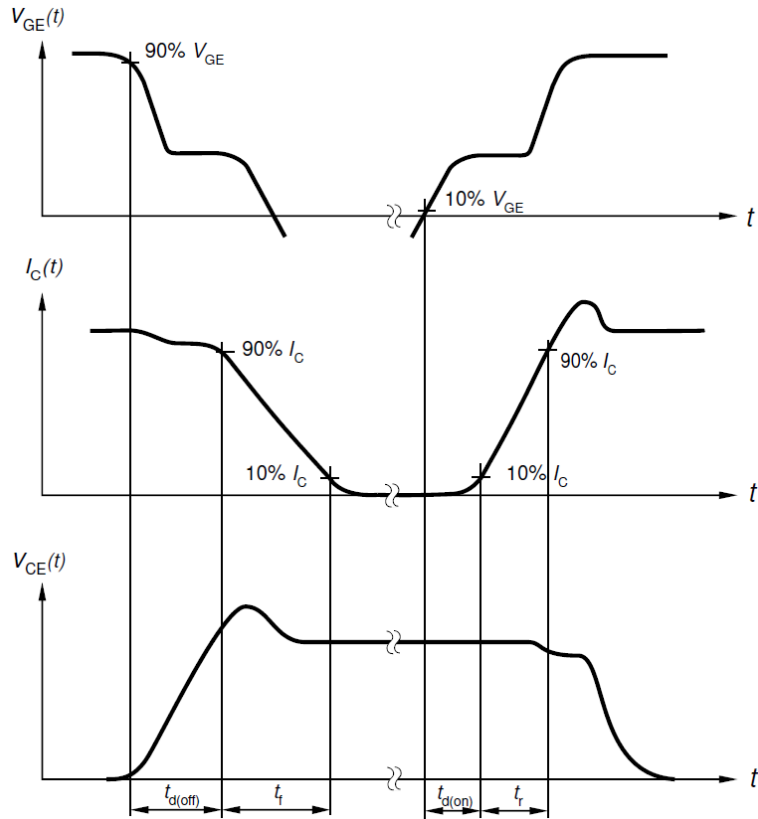
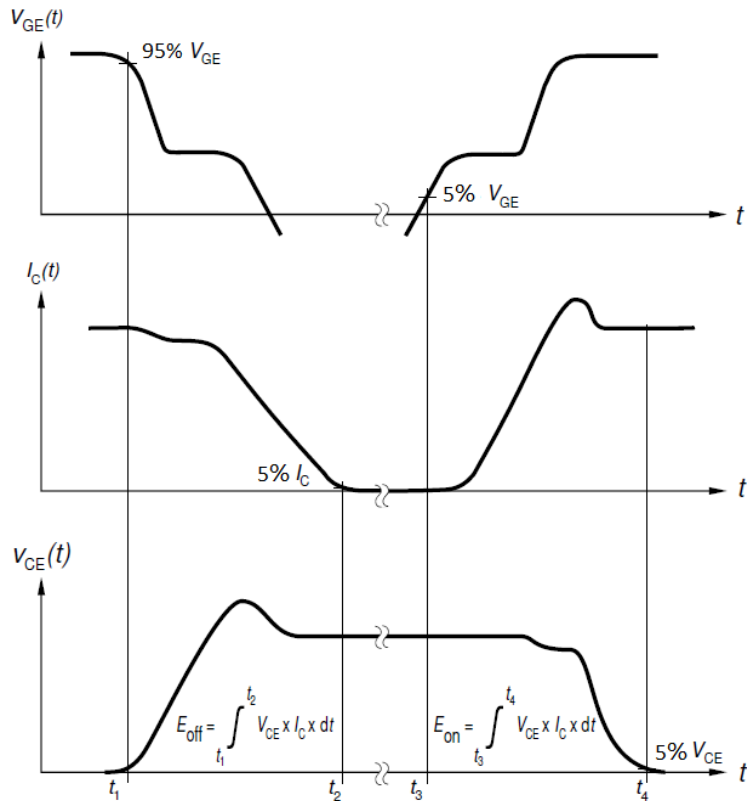


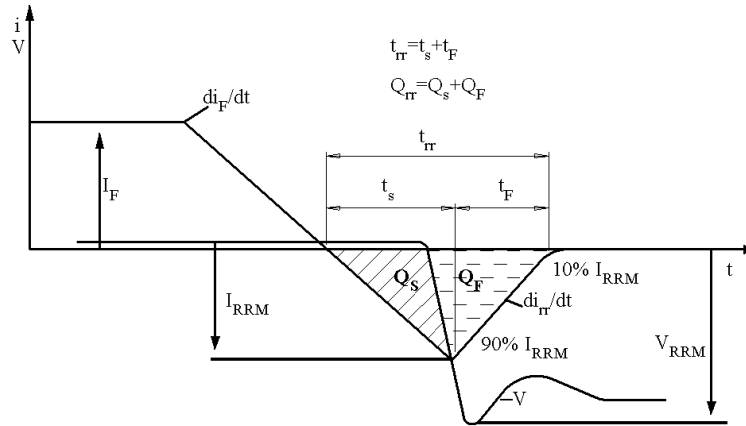
Figure 18: Typical Switching time as a function of gate resistor



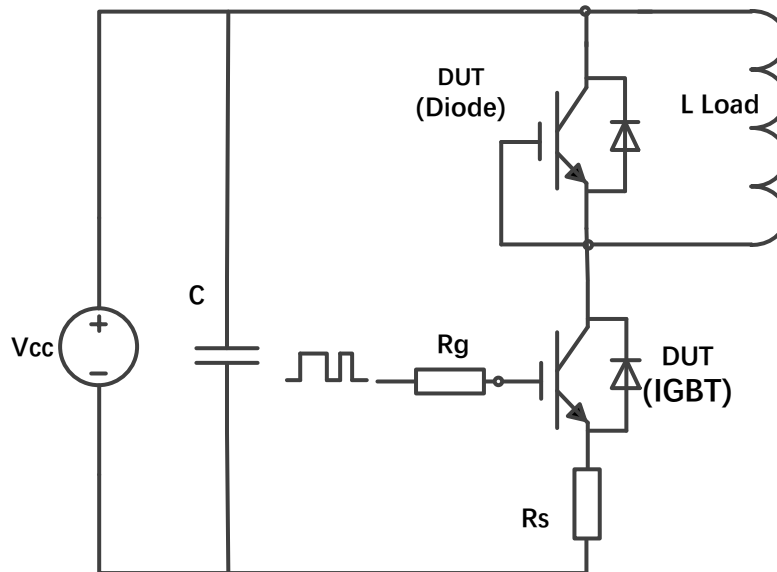
Test Circuits
1. Definition Switching times

2. Definition Switching losses


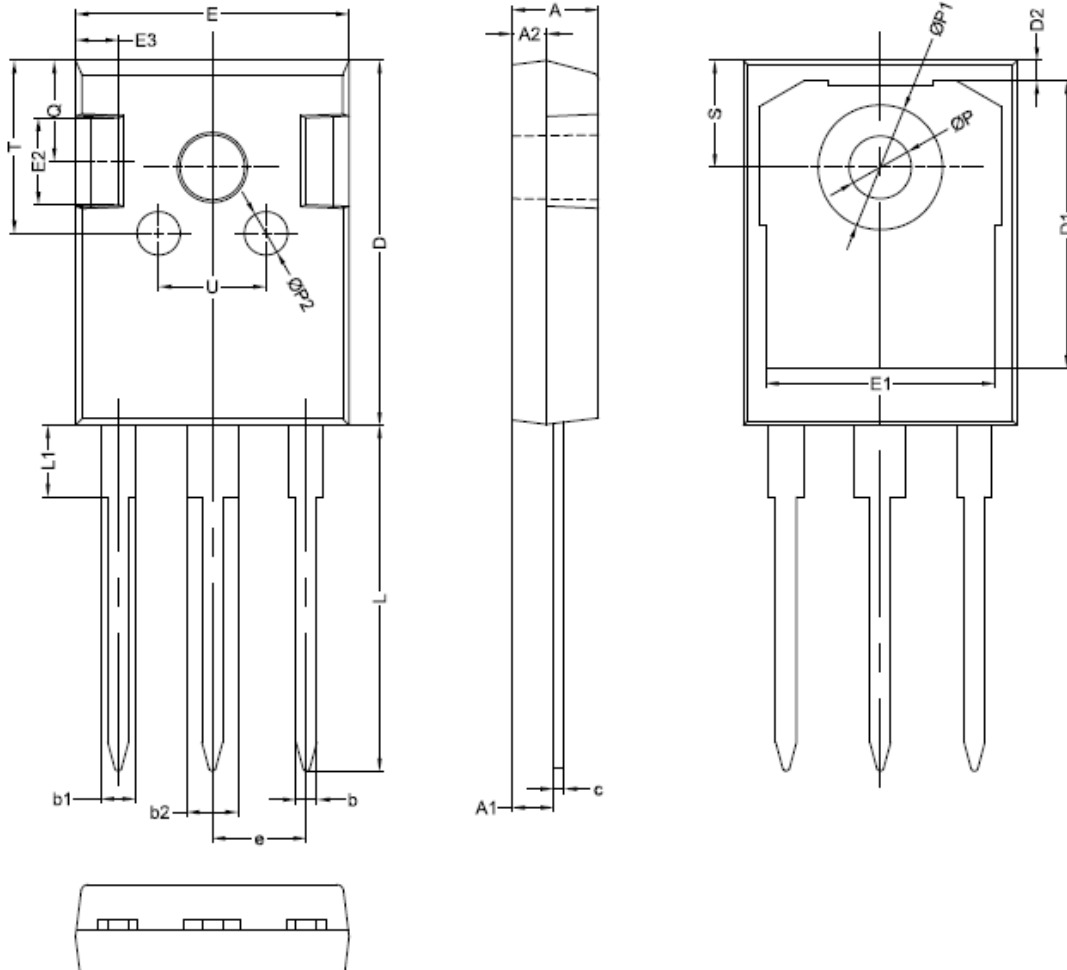
100A 650V Trench Fieldstop IGBT with anti-parallel diode SRE100N065FSUD8

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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