20A 650V Trench Fieldstop IGBT with FRD SRE20N065FSU2DJ

General Description

The SRE20N065FSU2DJ 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 SRE20N065FSU2DJ is available in TO-220F、TO-220C and TO-263 packages.

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

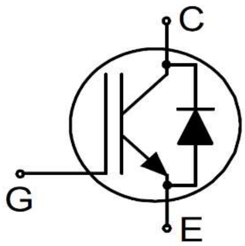
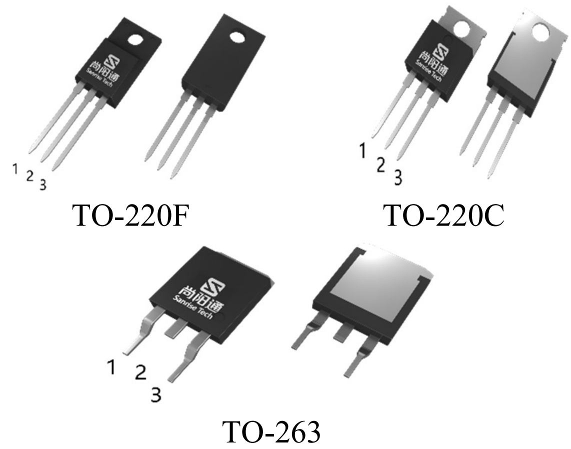


Figure 1 Symbol of SRE20N065FSU2DJ

Package Type



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

Figure 2 Package Type of SRE20N065FSU2DJ

Ordering Information

SRE20N065FSU2DJ□□–□

Circuit Type
Package
S2: TO-263; TF: TO-220F; TC:TO-220C

G: Green
Blank: Tube
TR: Tape & Reel

Package	Part Number	Marking ID	Packing Type
	Green	Green	
TO-220F	SRE20N065FSU2DJTF-GC	SRE20N065FSU2DJTFGC	Tube
TO-220C	SRE20N065FSU2DJTC-GC	SRE20N065FSU2DJTCGC	Tube
TO-263	SRE20N065FSUD2JS2TR-GC	SRE20N065FSU2DJS2GC	Tape & Reel

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	32	A
	T_C=100ºC		20	
Pulsed Collector Current,Limited by T_{Jmax}		I_{CM}	60	A
Diode Continuous Collector Current	T_C=25ºC	I_F	32	A
	T_C=100ºC		20	
Diode Pulsed Current, Limited by T_{Jmax}		I_{FM}	60	A
Short circuit withstand time (V_{GE}=15V,V_{CC}=300V,T_{Jstart}=25℃)		t_{sc}	8	us
Power Dissipation (TO220C&TO-263 Packages)	T_C=25ºC	P_{tot}	50	W
	T_C=100ºC		25	
Power Dissipation (TO-220F Package)	T_C=25ºC	P_{tot}	30	W
	T_C=100ºC		15	
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 (TO220C & TO-263 Packages)	R_{thJC}	-	-	3.0	ºC/W
Diode Thermal Resistance， Junction-to-Case (TO220C & TO-263 Packages)	R_{thJC}	-	-	4.0	
Thermal Resistance， Junction-to-Ambient (TO220C & TO-263 Packages)	R_{thJA}	-	-	40	
IGBT Thermal Resistance， Junction-to-Case (TO-220F Package)	R_{thJC}			5.0	
Diode Thermal Resistance， Junction-to-Case (TO-220F Package)	R_{thJC}			6.5	
Thermal Resistance， Junction-to-Ambient (TO-220F Package)	R_{thJA}			62	

Electrical Characteristics

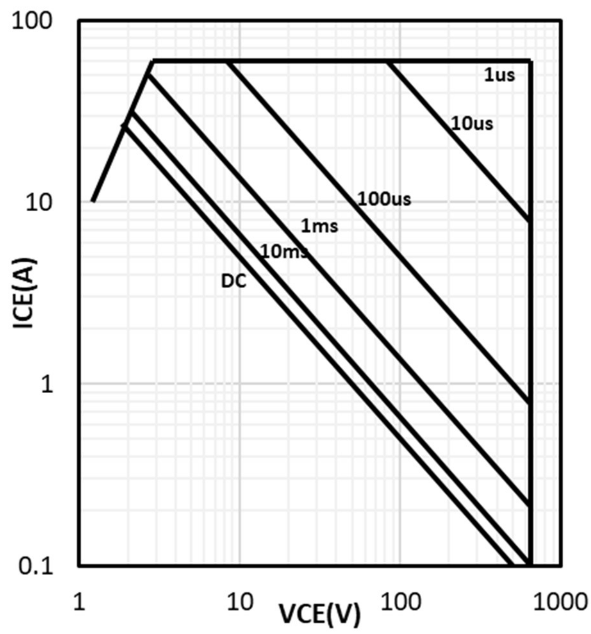
T_J = 25ºC, unless otherwise specified.

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	4.4	5.2	6.0	V
Collector-emitter saturation voltage		V_{CEsat}	V_{GE}=15V, I_C=20A, T_J=25ºC		1.53	1.7	V
			T_J=125ºC		1.74		V
			T_J=175ºC		1.85		V
Zero Gate Voltage Collector Current		I_{CES}	V_{CE}=650V,V_{GE}=0V T_J=25ºC		0.1	40	μA
			T_J=175ºC			1.5	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=100KHz		678		pF
Output Capacitance		C_{OES}			54		
Reverse Transfer Capacitance		C_{RES}			13		
Gate Resistance		R_G	f=1 MHz, Open Drain		1.5		Ω
Turn-on Delay Time		$t_{d(on)}$	T_J=25ºC V_{CC}=400V, I_C=20A R_G=10Ω, V_{GE}=0/15V		12		ns
Rise Time		t_r			11		ns
Turn-off Delay Time		$t_{d(off)}$			38		ns
Fall Time		t_f			66		ns
Turn-on energy		E_{on}			0.36		mJ
Turn-off energy		E_{off}			0.33		mJ
Total switching energy		E_{ts}			0.69		mJ
Turn-on Delay Time		$t_{d(on)}$	T_J=175ºC V_{CC}=400V, I_C=20A R_G=10Ω, V_{GE}=0/15V		12		ns
Rise Time		t_r			11		ns
Turn-off Delay Time		$t_{d(off)}$			45		ns
Fall Time		t_f			99		ns
Turn-on energy		E_{on}			0.43		mJ
Turn-off energy		E_{off}			0.46		mJ
Total switching energy		E_{ts}			0.89		mJ
Gate to Emitter Charge		Q_{GE}	V_{CC}=400V, I_C=20A V_{GE}=0 to 15V		10		nC
Gate to Collector Charge		Q_{GC}			19		
Gate Charge Total		Q_G			43		

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Reverse Diode Characteristics						
Drain-Source Diode Forward Voltage	V_F	V_{GE}=0V, I_F=20A T_J=25ºC		1.89	2.2	V
		V_{GE}=0V, I_F=20A T_J=125ºC		1.61		
		V_{GE}=0V, I_F=20A T_J=175ºC		1.47		
Reverse Recovery Time	t_{rr}	T_J=25ºC V_R=400V, I_F=20A R_G=10Ω dI_F/dt=840A/µs		90		ns
Reverse Recovery Charge	Q_{rr}			0.4		uC
Peak Reverse Recovery Current	I_{rrm}			10		A
Diode peak rate of fall off reverse recovery current	dirr/dt			-135		A/µs
Reverse recovery energy	Erec			0.15		mJ

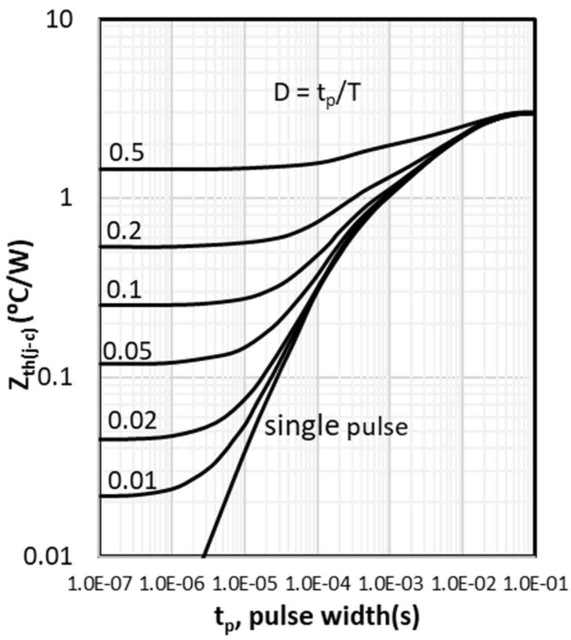
Typical Performance Characteristics

Figure 3: IGBT FBSOA



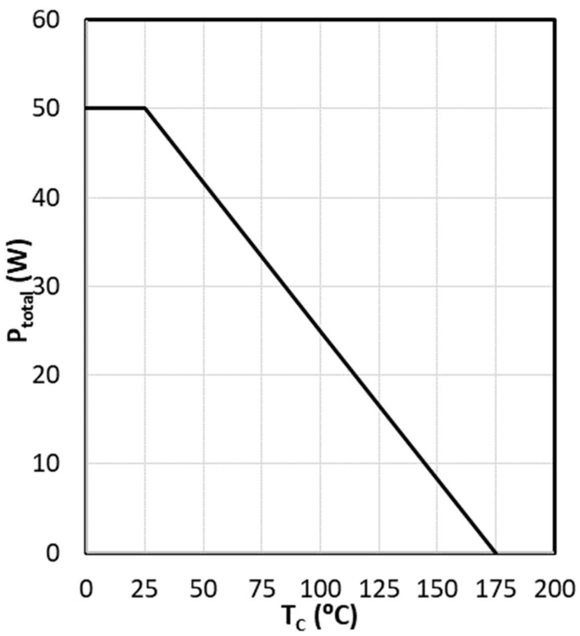
$I_C = f(V_{CE})$; $V_{GE} \geq 15/0V$; $Tj \leq 175$ºC

Figure 4: IGBT transient thermal impedance (TO220C & TO-263 Packages)



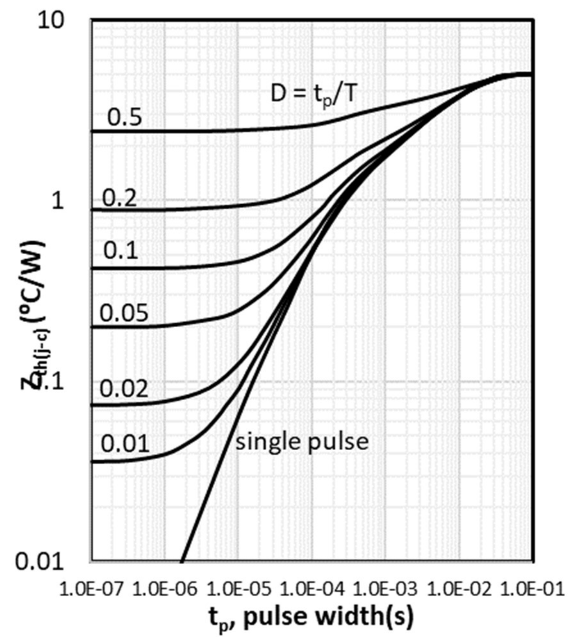
$R_{th(J-C)} = f(t_p)$; duty cycle: $D = t_p/T$

Figure 5: Power dissipation (TO220C & TO-263 Packages)



Ptot= f(Tc);

Figure 6: IGBT transient thermal impedance (TO-220F Package)



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

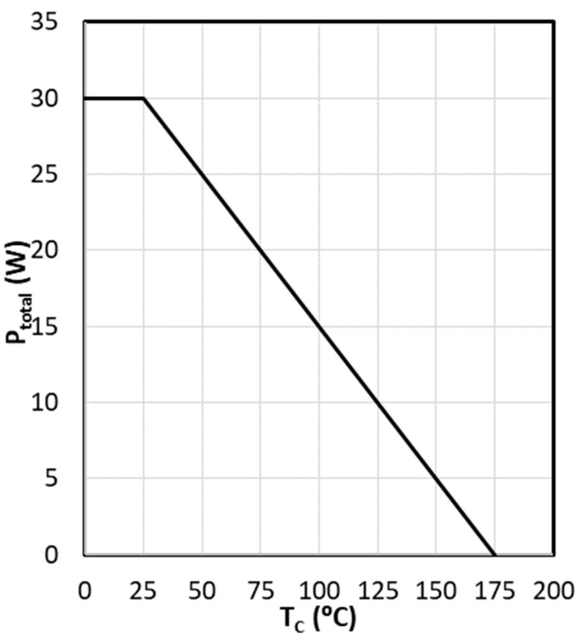
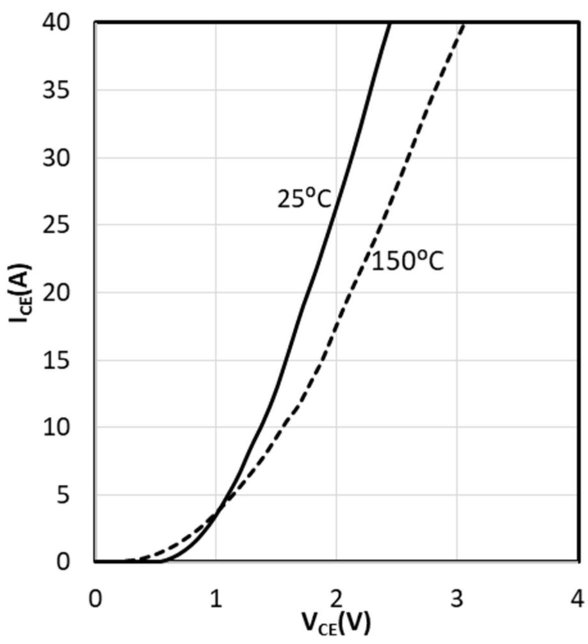
Figure 7: Power dissipation (TO-220F Package)	Figure 8: Saturation Voltage Characteristics
	
Ptot= f(Tc);	I_C = f(V_{CE}); Tj= 25ºC vs 150ºC

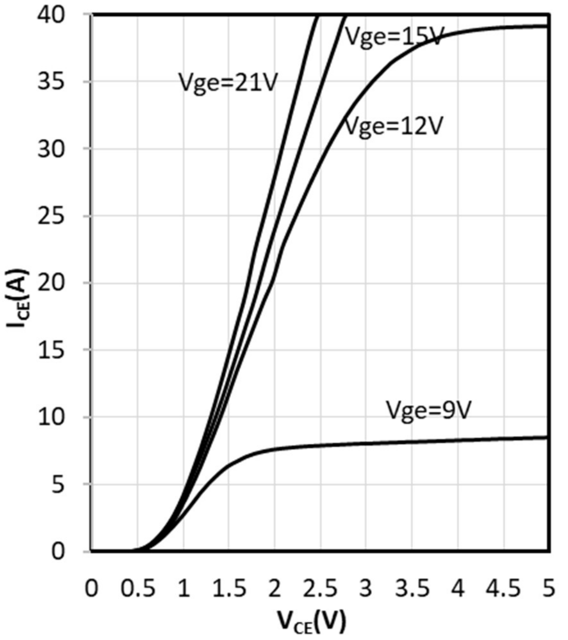
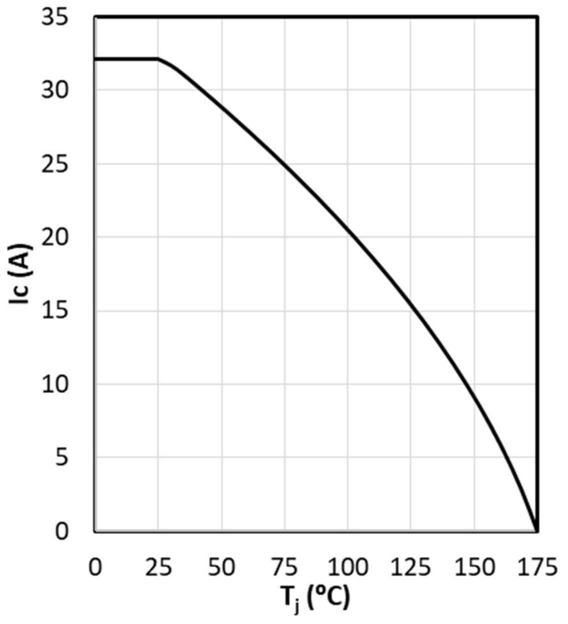
Figure 9: Typ. Output Characteristics	Figure 10: Collector current vs. temperature
	
I_C = f(V_{CE}); Tj= 25ºC; parameter: V_{GE}	Ic= f(Tj); V_{GE}≥15V; Tj≤175ºC

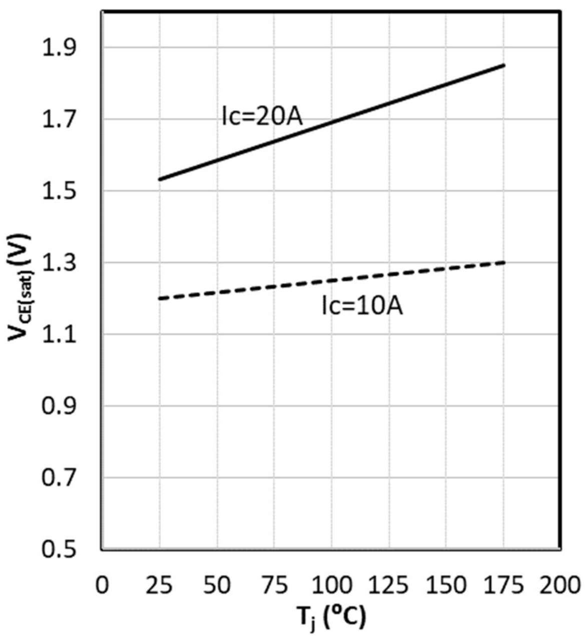
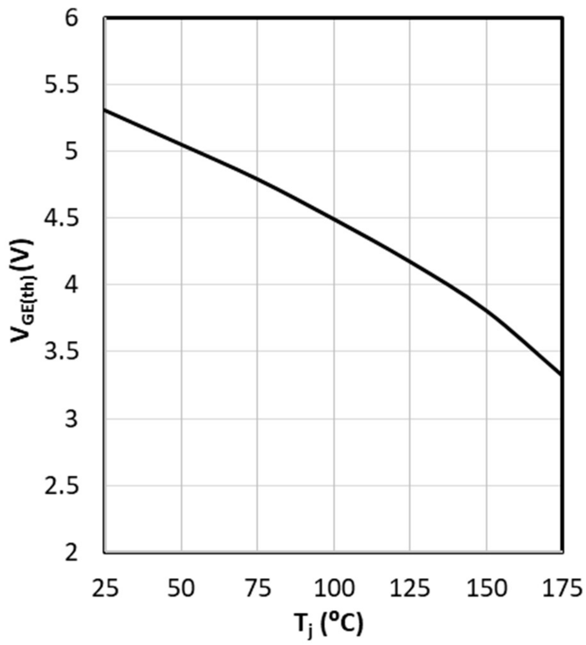
Figure 11: Typ. Collector Voltage vs. Temperature	Figure 12: Typ. emitter threshold voltage as a function of junction temperature
	
V_{CE} =f(T_j); V_{GE}=15V	V_{GE} =f(T_j); I_{CE} = 250µA

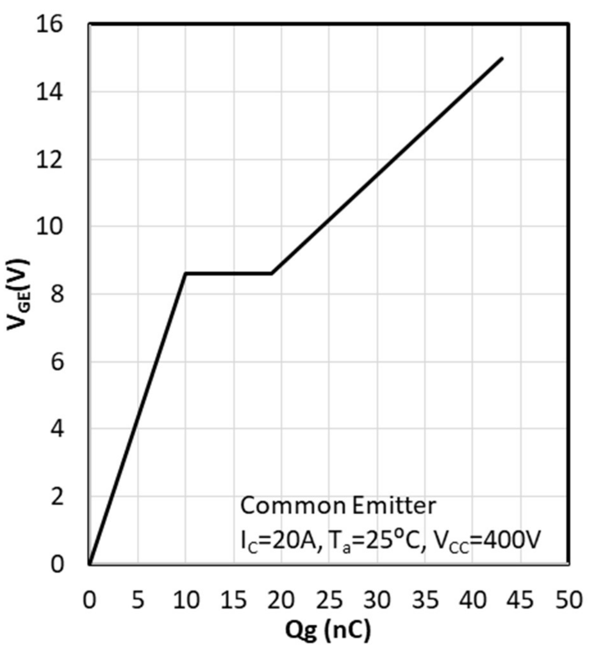
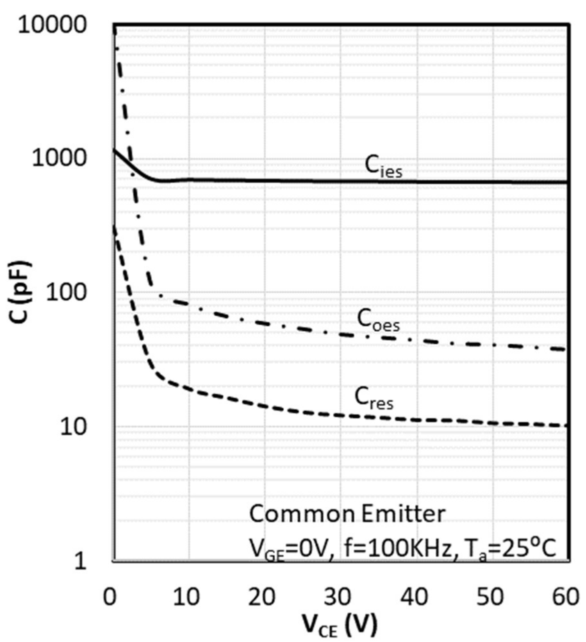
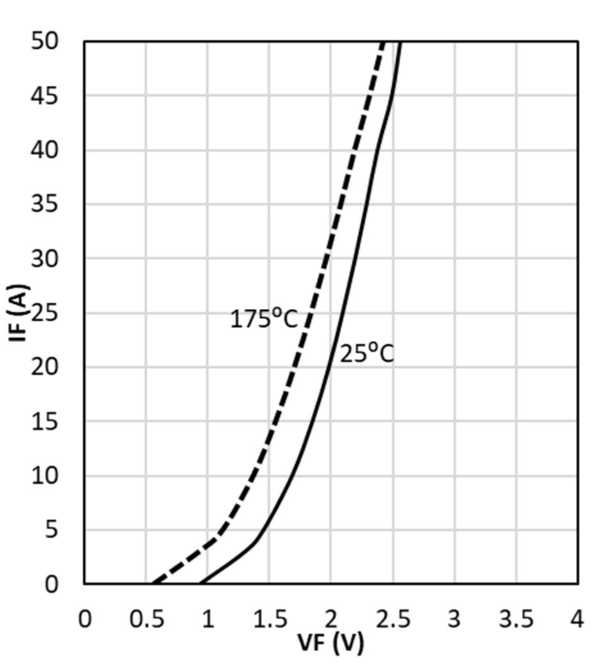
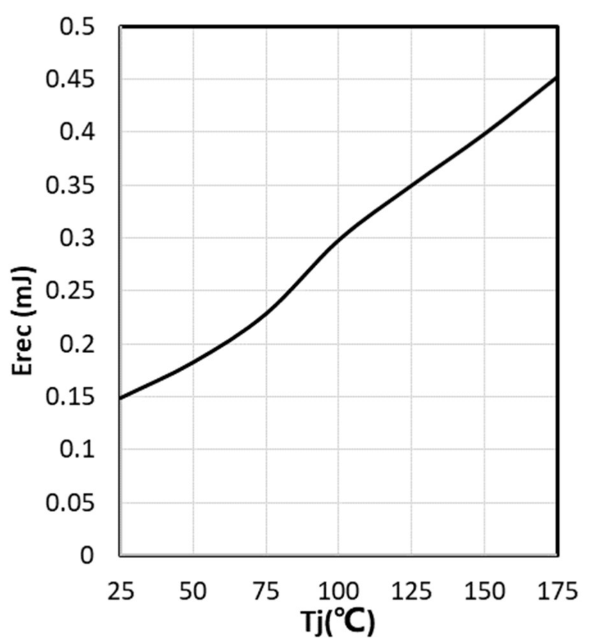
Figure 13: Typ. Gate Charge	Figure 14: Typ. Capacitances
	
V_{GE}= f(Q_{gate}); I_C= 20A	C=f(V_{CE}); V_{GE}=0; f=100KHz

Figure 15: Typ. diode forward current as a function of forward voltage



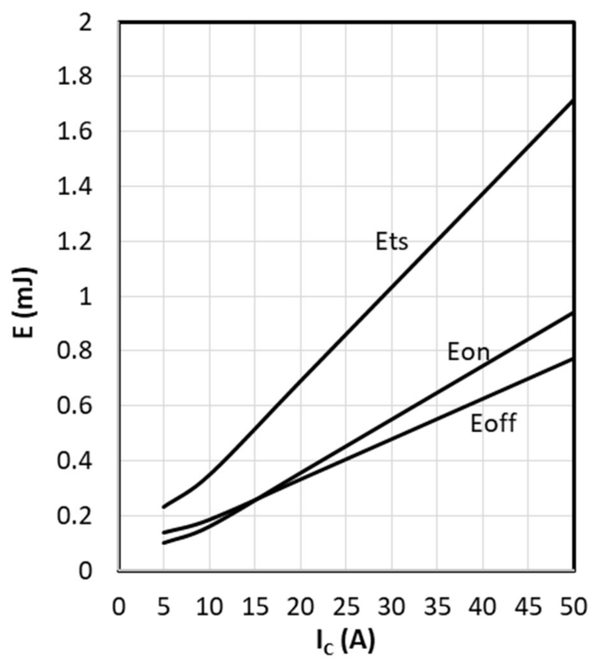
I_F= f(V_F);

Figure 16: Typical reverse energy losses as a function of diode current slope



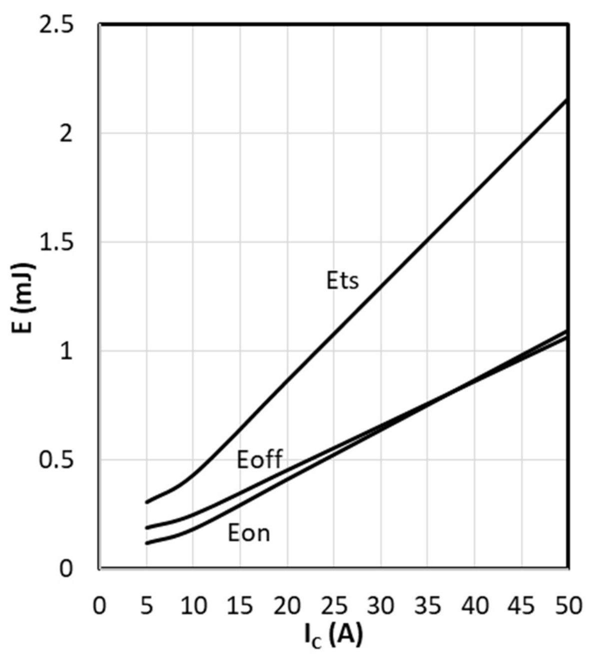
Erec= f(T_j); V_{CE}=400V;I_C=20A;

Figure 17: IGBT switching energy losses

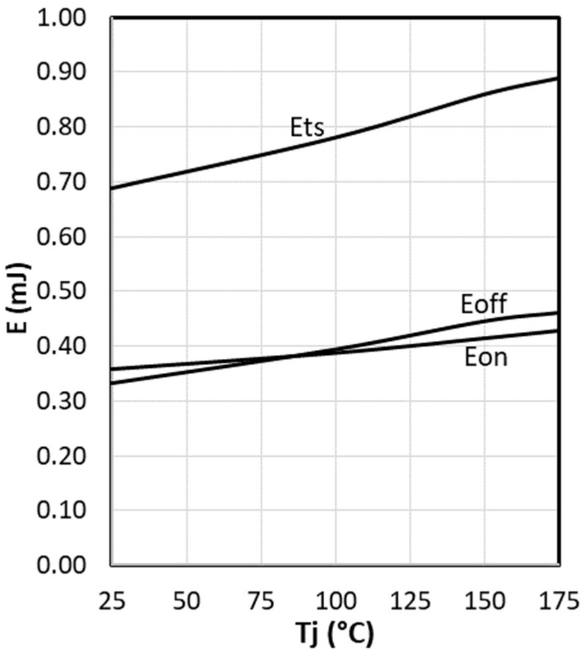
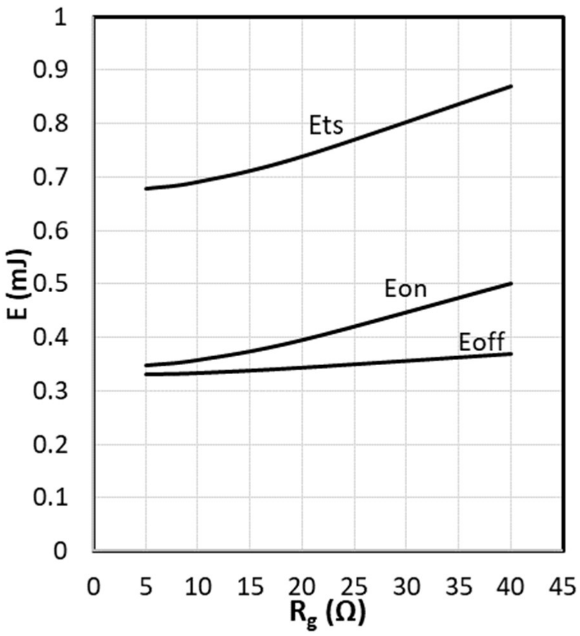


E=f(Ic); V_{CE}=400V; Tj=25ºC; R_G=10Ω

Figure 18: IGBT switching energy losses

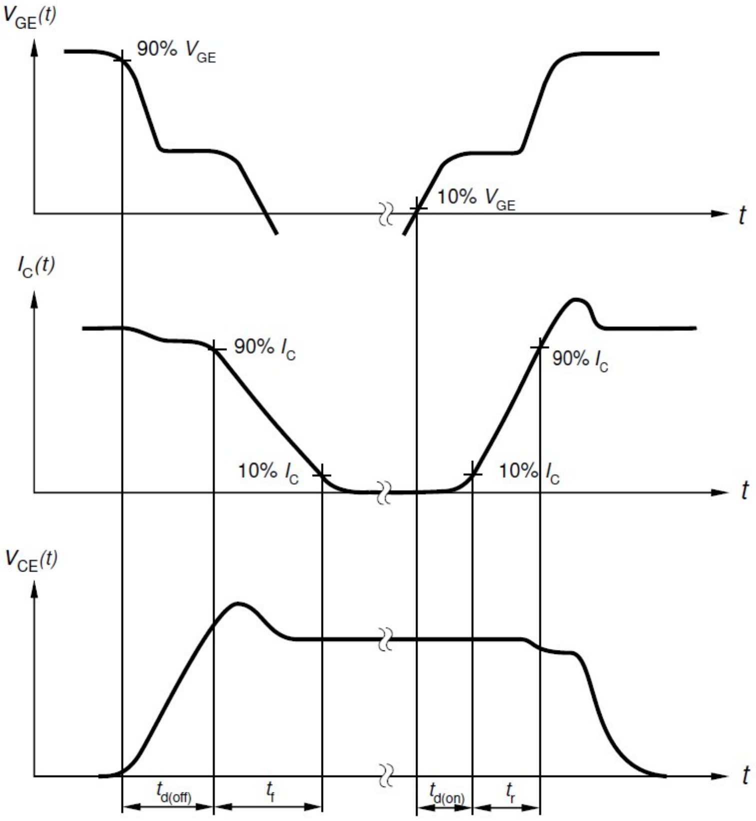


E=f(Ic); V_{CE}=400V; Tj=150ºC; R_G=10Ω

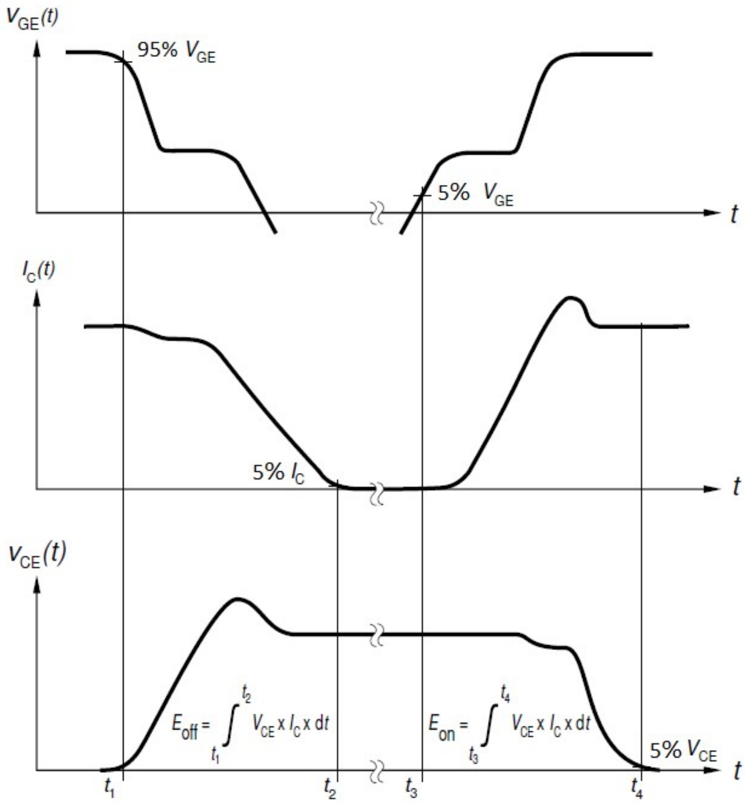
Figure 19: Typical switching energy losses as a function of junction temperature	Figure20: IGBT switching energy losses
	
E=f(Tj); V_{CE}=400V; Ic =20A; R_G=10Ω	E=f(R_G); V_{CE}=400V; Tj=25ºC; Ic=20A

Test Circuits

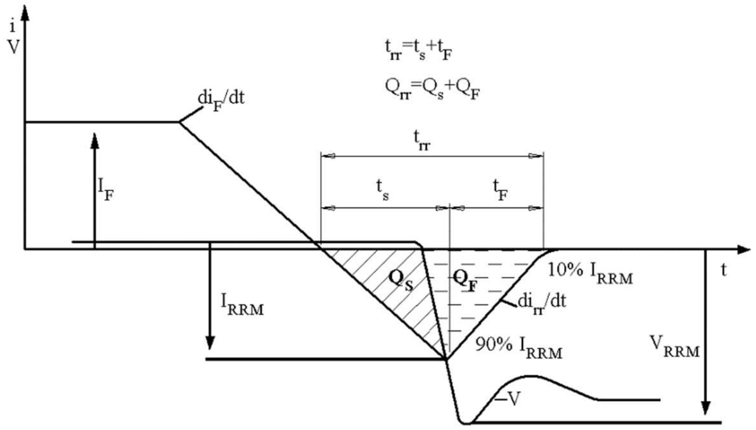
1. Definition Switching times



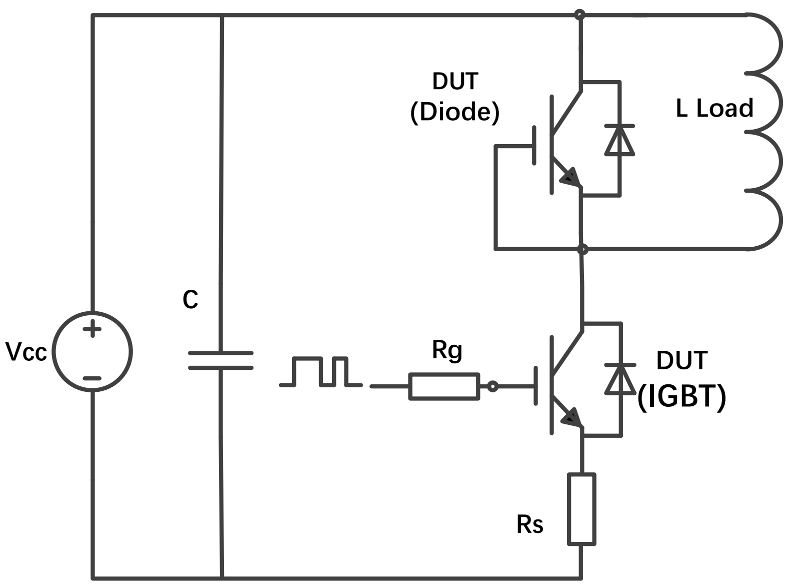
2. Definition Switching losses



3. Definition Diode Switching Characteristics

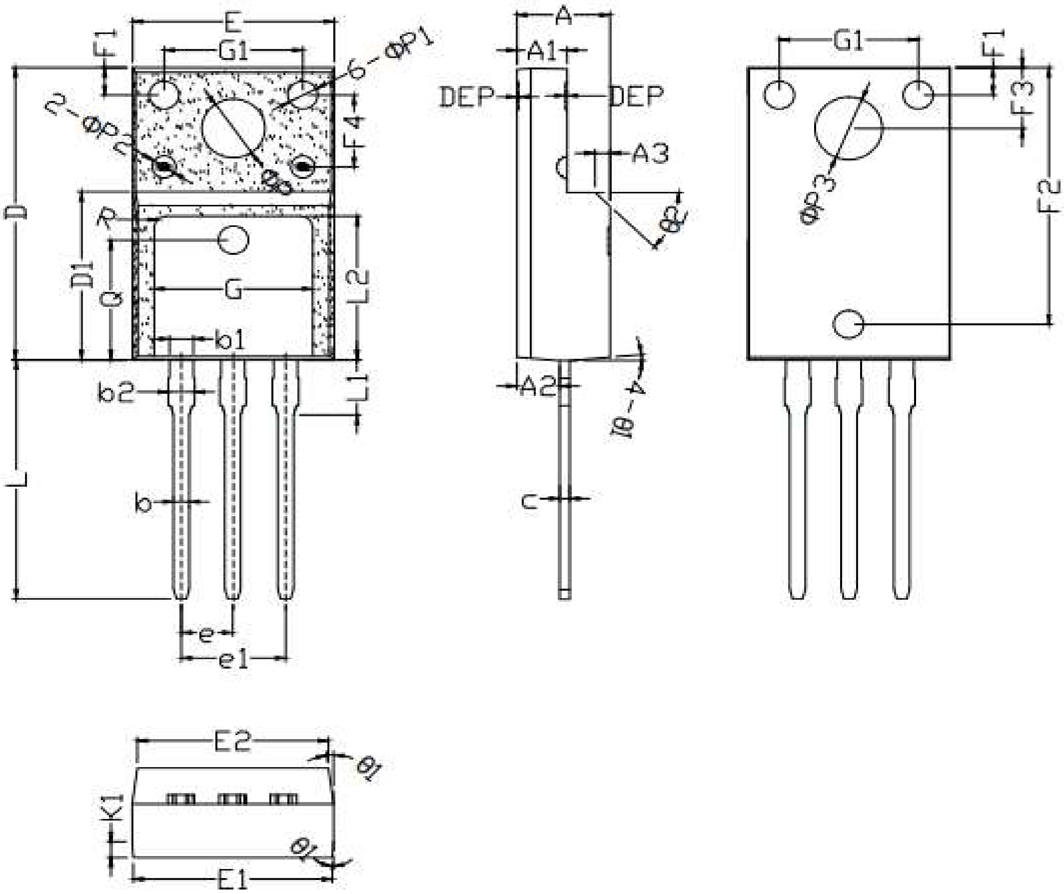


4. Dynamic test circuit



Mechanical Dimensions

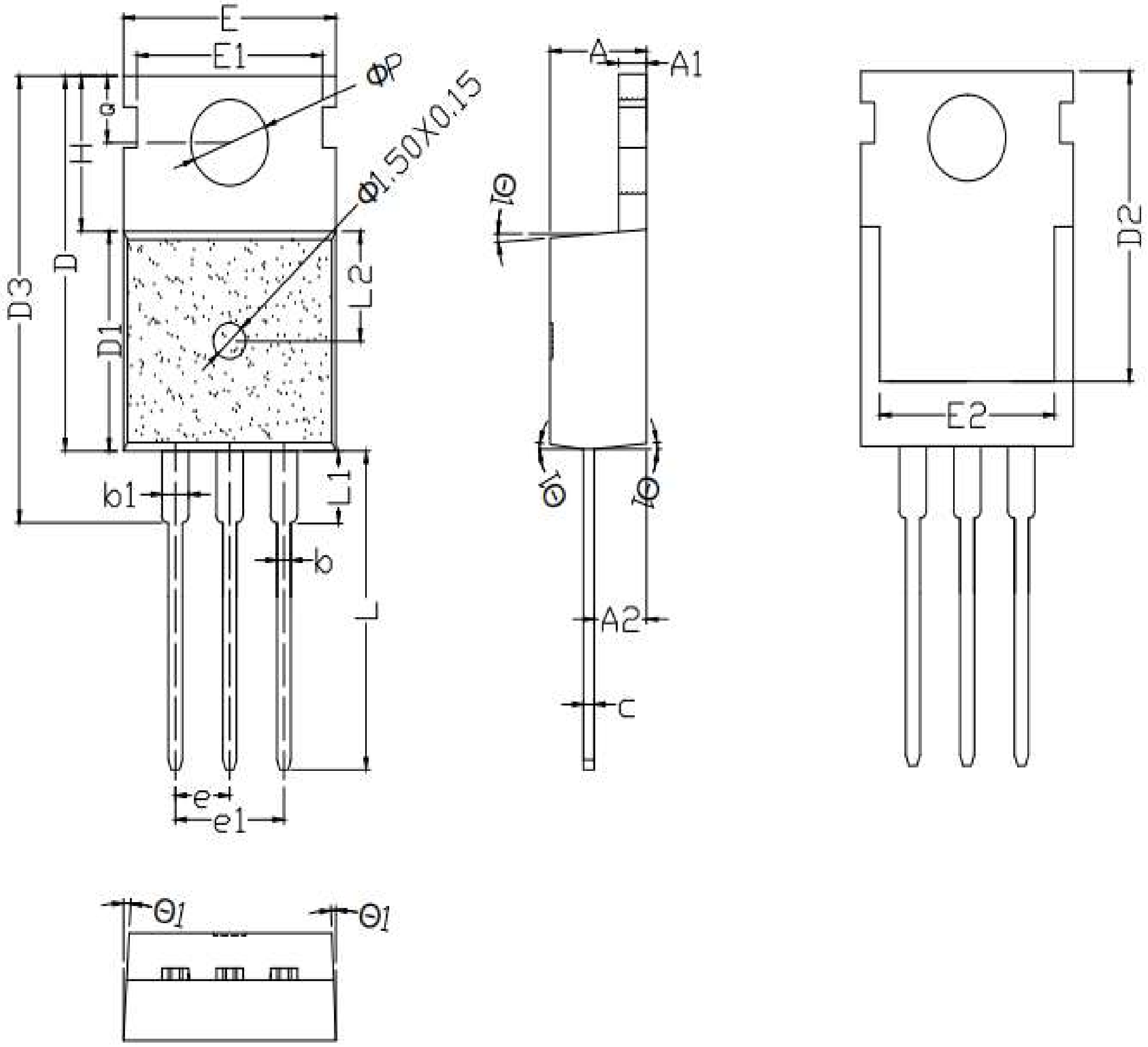
TO-220F **Unit: mm**



Symbol	Dimensions (mm)			Symbol	Dimensions (mm)		
	Min.	Typ.	Max.		Min.	Typ.	Max.
A	4. 50	4. 70	4. 90	F3	3. 20	3. 30	3. 40
A1	2. 34	2. 54	2. 74	F4	3. 70	3. 90	4. 10
A2	2. 60	2. 80	2. 95	G	7. 80	8. 00	8. 20
A3	–	1. 0REF	–	G1	6. 90	7. 00	7. 10
b	0. 75	0. 80	0. 85	K1	0. 65	0. 70	0. 75
b1	1. 18	1. 20	1. 24	L	12. 78	12. 98	13. 18
b2	1. 18	1. 24	1. 30	L1	2. 70	2. 92	3. 20
c	0. 45	0. 50	0. 55	L2	7. 70	7. 80	7. 90
D	15. 67	15. 87	16. 07	Q	–	6. 50REF	–
D1	9. 04	9. 12	9. 20	ΦP	3. 08	3. 18	3. 28
e	2. 50	2. 54	2. 58	ΦP1	1. 45	1. 55	1. 65
e1	–	5. 08REF	–	ΦP2	0. 95	1. 15	1. 35
E	10. 00	10. 16	10. 30	ΦP3	3. 30	3. 40	3. 50
E1	9. 94	10. 06	10. 20	Θ1	3°	5°	7°
E2	9. 40	9. 50	9. 60	Θ2	42°	45°	48°

TO-220C

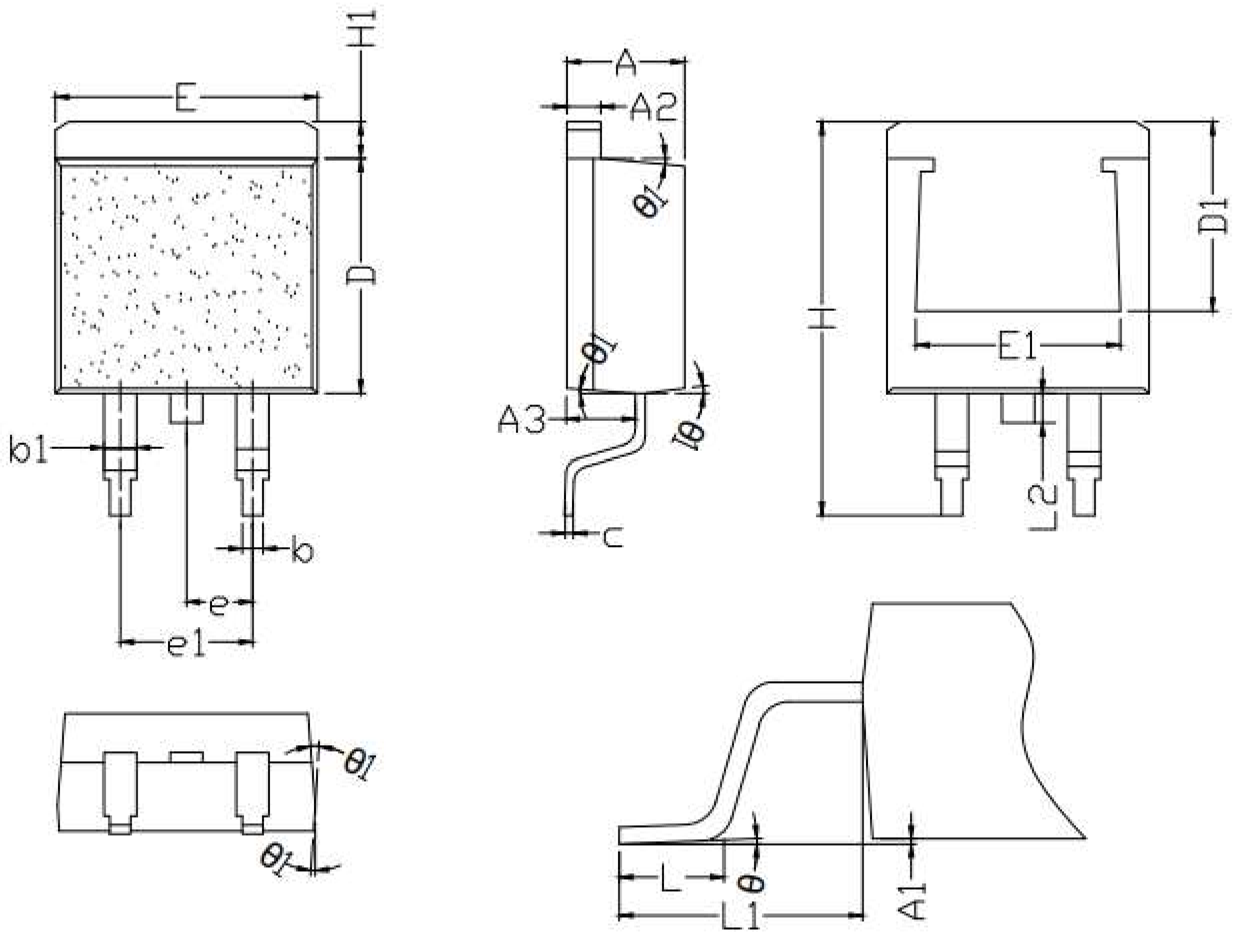
Unit: mm



Symbol	Dimensions (mm)			Symbol	Dimensions (mm)		
	Min.	Typ.	Max.		Min.	Typ.	Max.
A	4. 40	4. 50	4. 60	E2	7. 40	7. 60	7. 80
A1	1. 25	1. 30	1. 35	e	−	2. 54BSC	−
A2	2. 30	2. 40	2. 50	e1	−	5. 08BSC	−
b	0. 70	0. 80	0. 90	H	6. 40	6. 50	6. 60
b1	1. 25	1. 33	1. 42	L	13. 00	13. 28	13. 45
c	0. 45	0. 50	0. 55	L1	−	−	3. 40
D	15. 50	15. 75	16. 00	L2	4. 50	4. 65	4. 80
D1	9. 10	9. 20	9. 30	L3	1. 10	1. 30	1. 50
D2	12. 90	13. 10	13. 30	ΦP	3. 55	3. 65	3. 75
D3	15. 45	15. 80	16. 15	Q	2. 65	2. 75	2. 85
E	9. 80	10. 02	10. 15	θ1	2°	−	7°
E1	8. 55	8. 70	8. 85				

TO-263

Unit: mm



Symbol	Dimensions (mm)			Symbol	Dimensions (mm)		
	Min.	Typ.	Max.		Min.	Typ.	Max.
A	4.42	4.52	4.62	E1	-	7.85REF	-
A1	0.00	0.10	0.20	e	2.50	2.54	2.58
A2	1.24	1.27	1.32	e1	-	5.08REF	-
A3	2.50	2.60	2.70	H	14.80	15.10	15.30
b	0.77	0.81	0.84	H1	1.12	1.28	1.42
b1	1.23	1.28	1.41	L	2.10	2.23	2.36
c	0.33	0.38	0.43	L1	4.55	4.75	4.95
D	8.80	8.95	9.10	L2	1.10	1.30	1.50
D1	-	7.25REF	-	Θ	0°	2°	5°
E	9.92	10.07	10.22	Θ1	3°	-	9°

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