

600V, 20A, Trench FS II Fast IGBT

General Description:

Using NCE's proprietary trench design and advanced FS (Field Stop) second generation technology, the 600V Trench FSII IGBT offers superior conduction and switching performances, and easy parallel operation;

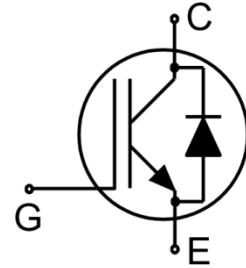
Features

Trench FSII Technology offering

- Very low $V_{CE(sat)}$
- High speed switching
- Positive temperature coefficient in $V_{CE(sat)}$
- Very tight parameter distribution
- High ruggedness, temperature stable behavior

Application

- Air Condition
- Inverters
- Motor drives



Schematic diagram

Package Marking and Ordering Information

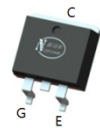
Device	Device Package	Device Marking
NCE20TD60BD	TO-263	NCE20TD60BD
NCE20TD60B	TO-220	NCE20TD60B
NCE20TD60BF	TO-220F	NCE20TD60BF



TO-220F



TO-220



TO-263

Absolute Maximum Ratings ($T_c=25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	TO-220/TO-263	TO-220F	Units
V_{CES}	Collector-Emitter Voltage	600		V
V_{GES}	Gate- Emitter Voltage	± 30		V
I_C	Collector Current	40	40*	A
	Collector Current @ $T_c = 100^\circ\text{C}$	20	20*	A
I_{Cplus}	Pulsed Collector Current, t_p limited by T_{jmax}	60	60*	A
-	turn off safe operating area, $V_{CE}=600\text{V}$, $T_j=150^\circ\text{C}$	60	60*	A
I_F	Diode Continuous Forward Current @ $T_c = 100^\circ\text{C}$	20	20*	A
I_{FM}	Diode Maximum Forward Current	60	60*	A
P_D	Power Dissipation @ $T_c = 25^\circ\text{C}$	135	34.5	W
	Power Dissipation @ $T_c = 100^\circ\text{C}$	54	13.8	W
T_J, T_{stg}	Operating Junction and Storage Temperature Range	-55 to +150		$^\circ\text{C}$
T_L	Maximum Temperature for Soldering	260		$^\circ\text{C}$
t_{sc}	Short circuit withstand time $V_{GE}=15.0\text{V}$, $V_{CC} \leq 400\text{V}$, Allowed number of short circuits < 1000 Time between short circuits: $\geq 1.0\text{s}$, $T_j \leq 150^\circ\text{C}$	3		us

Thermal Characteristic

Symbol	Parameter	TO-220/TO-263	TO-220F	Units
$R_{\theta JC}$	Thermal Resistance, Junction to case for IGBT	0.93	3.63	$^{\circ}\text{C}/\text{W}$
$R_{\theta JC}$	Thermal Resistance, Junction to case for Diode	1.92	3.9	$^{\circ}\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	62	78	$^{\circ}\text{C}/\text{W}$

Electrical Characteristics ($T_C=25^{\circ}\text{C}$ unless otherwise noted)

Symbol	Parameter	Test Conditions	Rating			Units	
			Min.	Typ.	Max.		
STATIC Characteristics							
$V_{(BR)CES}$	Collector-Emitter Breakdown Voltage	$V_{GE}=0\text{V}, I_{CE}=1\text{mA}$	600	--	--	V	
I_{CES}	Collector-Emitter Leakage Current	$V_{GE}=0\text{V}, V_{CE}=600\text{V}$	--	--	4	μA	
$I_{GES(F)}$	Gate to Emitter Forward Leakage	$V_{GE}=+30\text{V}, V_{CE}=0\text{V}$	--	--	100	nA	
$I_{GES(R)}$	Gate to Source Reverse Leakage	$V_{GE}=-30\text{V}, V_{CE}=0\text{V}$	--	--	100	nA	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$I_C=20\text{A}$	--	$T_j=25^{\circ}\text{C}$	1.7	1.9	V
		$V_{GE}=15\text{V}$		$T_j=100^{\circ}\text{C}$	1.9	--	V
$V_{GE(th)}$	Gate Threshold Voltage	$I_C=1\text{mA}, V_{CE}=V_{GE}$	4.0	--	6.0	V	
Dynamic Characteristics							
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}, V_{GE}=0\text{V},$ $f=1\text{MHz}$	--	2580	--	pF	
C_{oes}	Output Capacitance		--	48	--		
C_{res}	Reverse Transfer Capacitance		--	26	--		
Q_g	Total Gate Charge	$V_{CC}=480\text{V}, I_C=20\text{A}$ $V_{GE}=15\text{V}$	--	97	--	nC	
Q_{ge}	Gate to Emitter Charge		--	17	--	nC	
Q_{gc}	Gate to Collector Charge		--	37	--	nC	
$I_{C(SC)}$	Short circuit collector current Max.1000 short circuits Time between short circuits: $\geq 1.0\text{s}$	$V_{GE}=15\text{V}, V_{CC}\leq 400\text{V},$ $t_{sc}\leq 3\mu\text{s}, T_j\leq 150^{\circ}\text{C}$	--	130	--	A	
Switching Characteristics							
$t_{d(ON)}$	Turn-on Delay Time	$V_{CE}=400\text{V}, I_C=10\text{A}$ $V_{GE}=0/15\text{V}, R_g=25\Omega$ Inductive Load	--	18	--	ns	
t_r	Rise Time		--	16	--		
$t_{d(OFF)}$	Turn-Off Delay Time		--	164	--		
t_f	Fall Time		--	15	--		
E_{on}	Turn-On Switching Loss		--	0.43	--	mJ	
E_{off}	Turn-Off Switching Loss		--	0.17	--		
E_{ts}	Total Switching Loss		--	0.60	--		

Electrical Characteristics of the Diode ($T_C=25^{\circ}\text{C}$ unless otherwise specified):

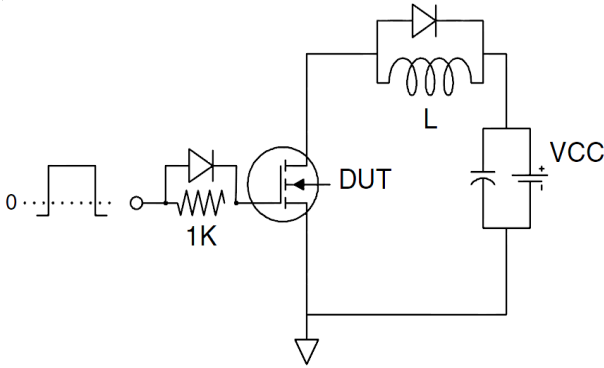
Symbol	Parameter	Test Conditions	Rating			Units
			Min.	Typ.	Max.	
V_{FM}	Diode Forward Voltage	$I_F=20\text{A}$	--	1.45	1.7	V
T_{rr}	Reverse Recovery Time	$V_{CC}=400\text{V}, I_F=20\text{A},$ $di/dt=200\text{A}/\mu\text{s}$	--	182	--	ns
I_{RRM}	Diode Peak Reverse Recovery Current		--	5.3	--	A
Q_{rr}	Reverse Recovery Charge		--	0.5	--	μC

Pulse width $t_p\leq 380\mu\text{s}, \delta\leq 2\%$

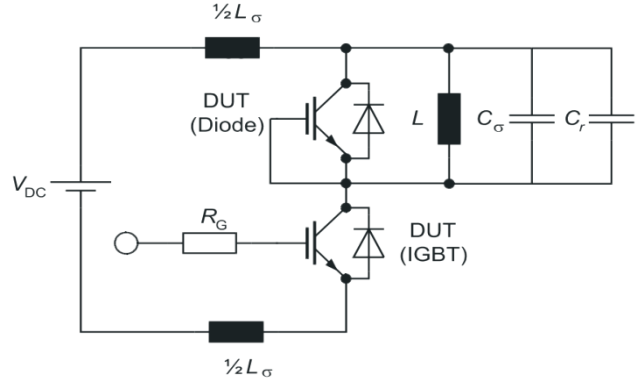
* TO-220F Ic Follow TO-220/TO-263.

Test Circuit

1) Gate Charge Test Circuit

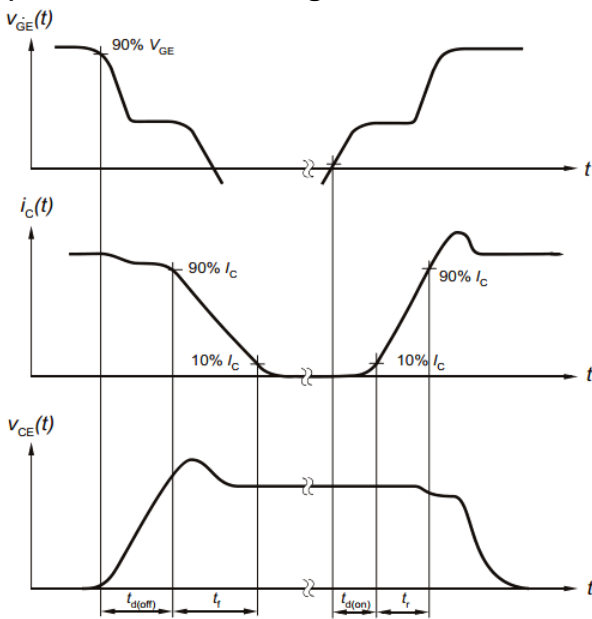


2) Switch Time Test Circuit

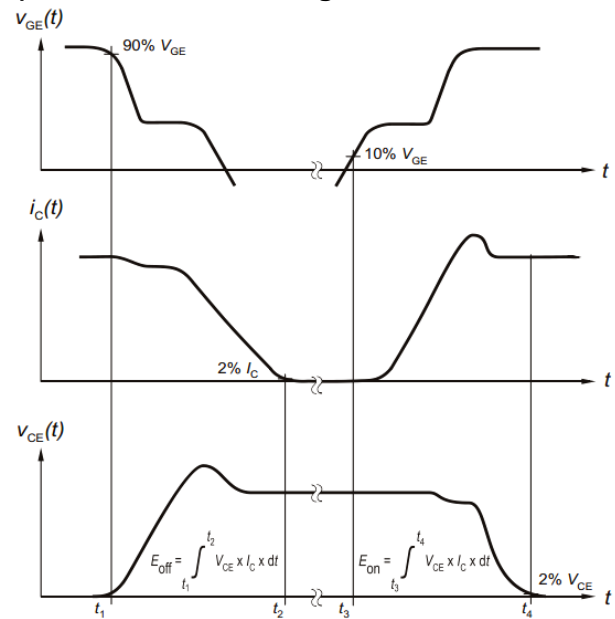


Switching characteristics

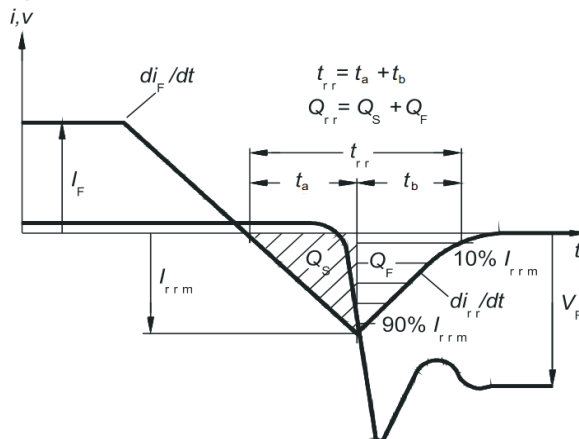
1) definition of switching times



2) definition of switching losses



3) Definition of diode switching characteristics



Typical Electrical and Thermal Characteristics

Figure 1 Output Characteristics

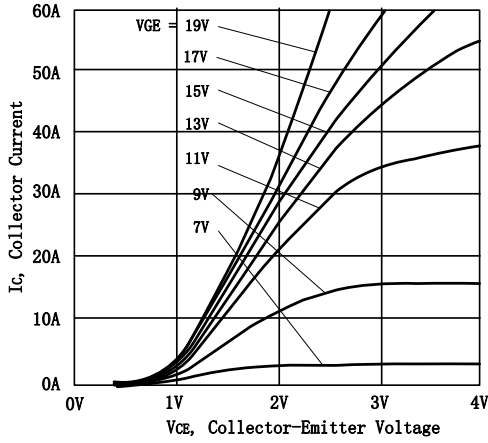


Figure 2 Transfer Characteristics

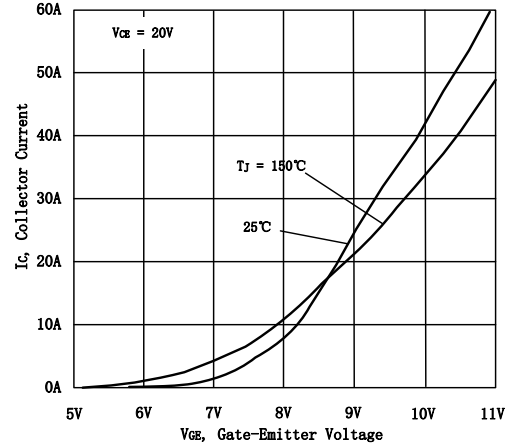


Figure 3 V_{CEsat} vs. Case Temperature

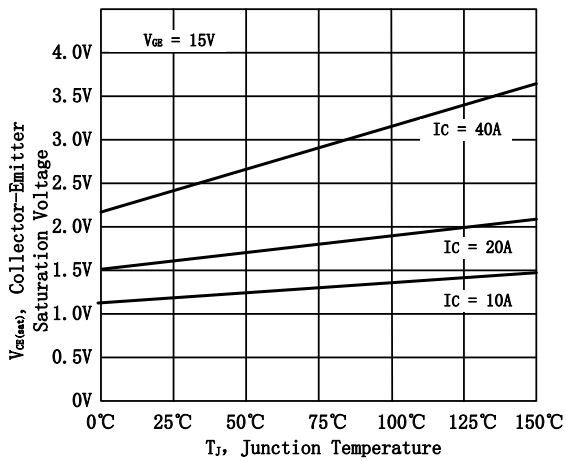


Figure 4 Saturation Voltage vs. VGE

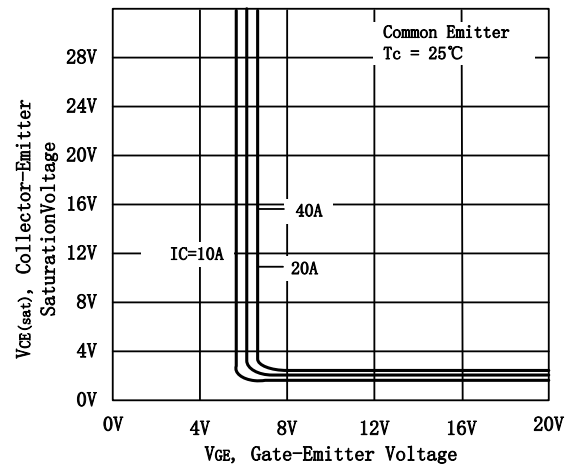


Figure 5 Capacitance Characteristics

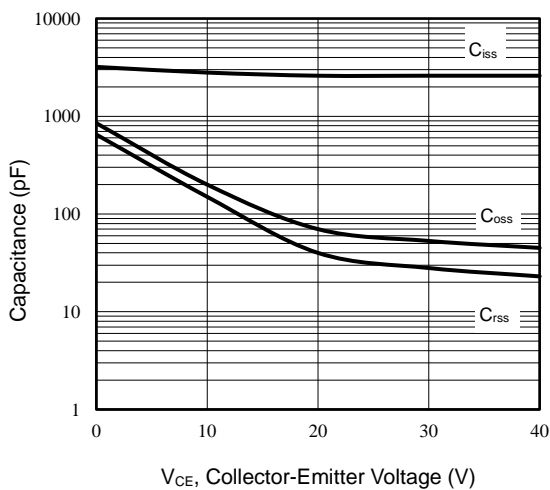
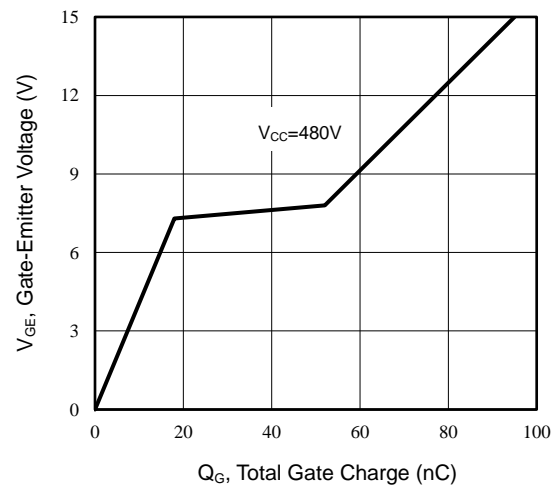


Figure 6 Gate charge waveform



Typical Electrical and Thermal Characteristics(continued)

Figure 7 Forward Characteristics

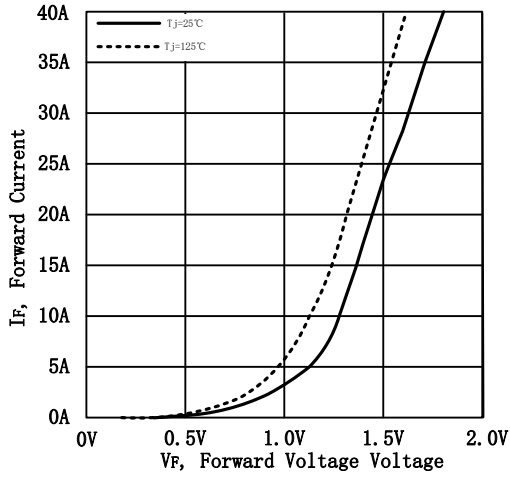


Figure 8 V_F vs. temperature

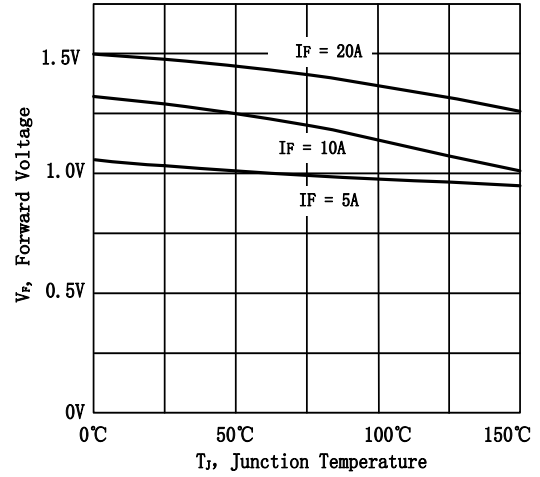


Figure 9 Forward Bias Safe Operating

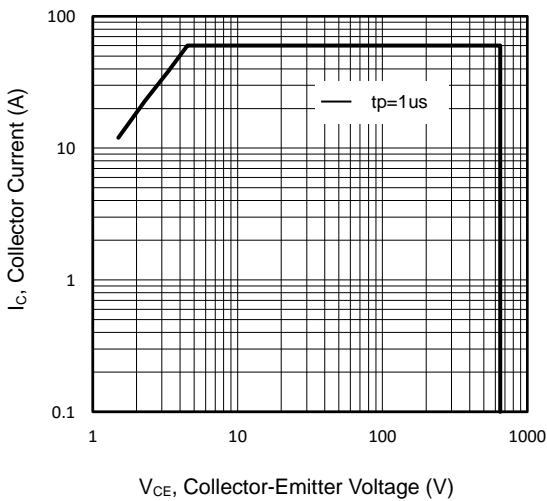


Figure 10 Gate-emitter Threshold Voltage as a Function of Junction Temperature

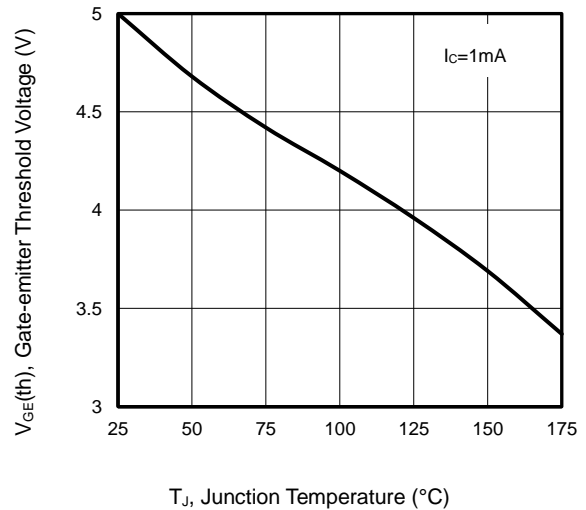


Figure 11 Typical Switching Times as a Function of Gate Resistor

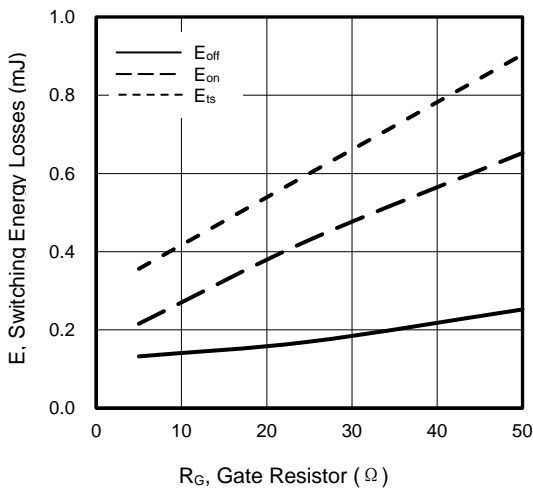
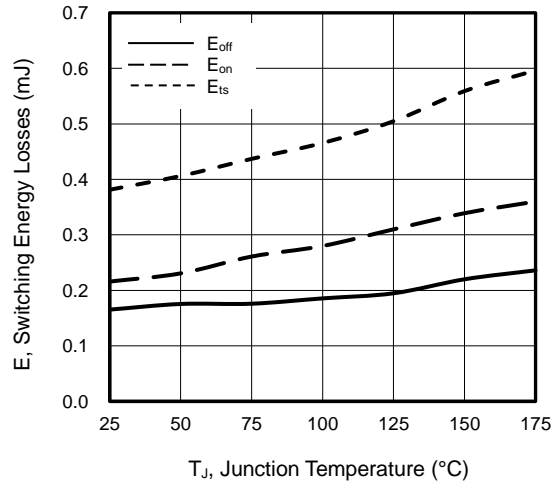


Figure 12 Typical Switching Times as a Function of Junction Temperature



Typical Electrical and Thermal Characteristics(continued)

Figure 13 Current Derating

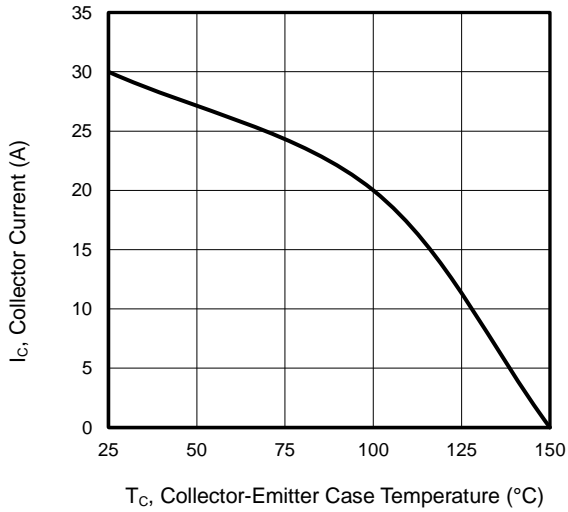


Figure 14 Typical Collector-emitter Saturation Voltage as a function of Collector Current

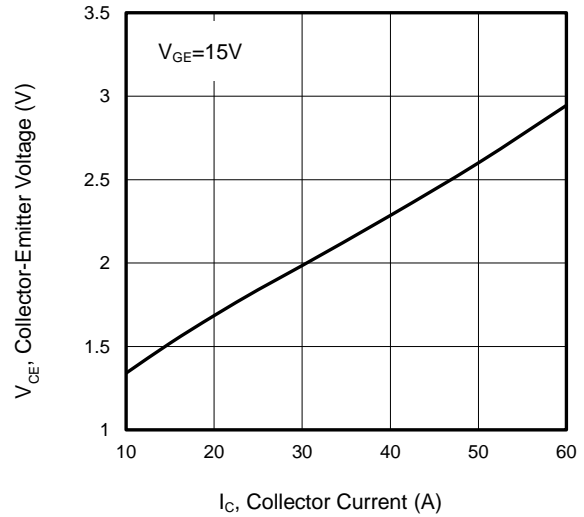


Figure 15 Transient Thermal Impedance of IGBT for TO-220F

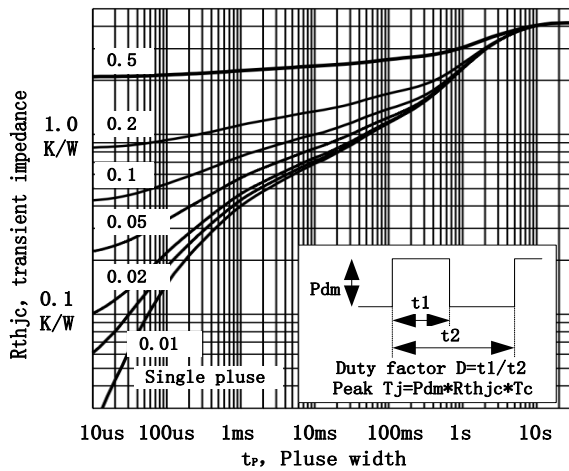
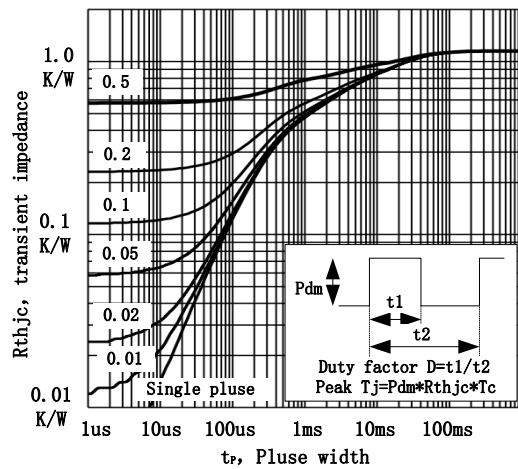
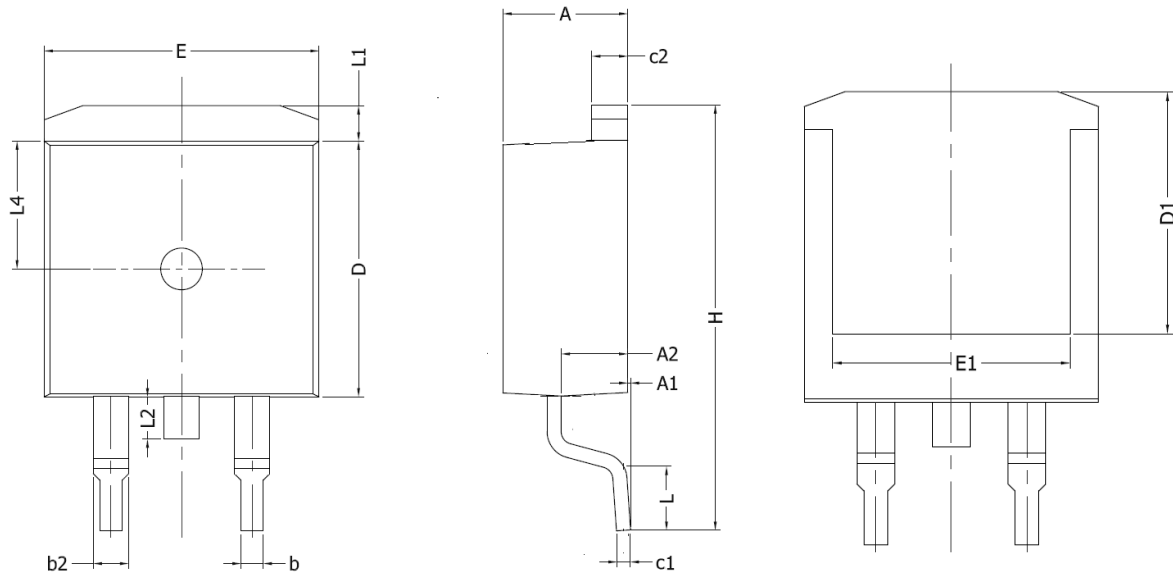


Figure 16 Transient Thermal Impedance of IGBT for TO-220, TO-263

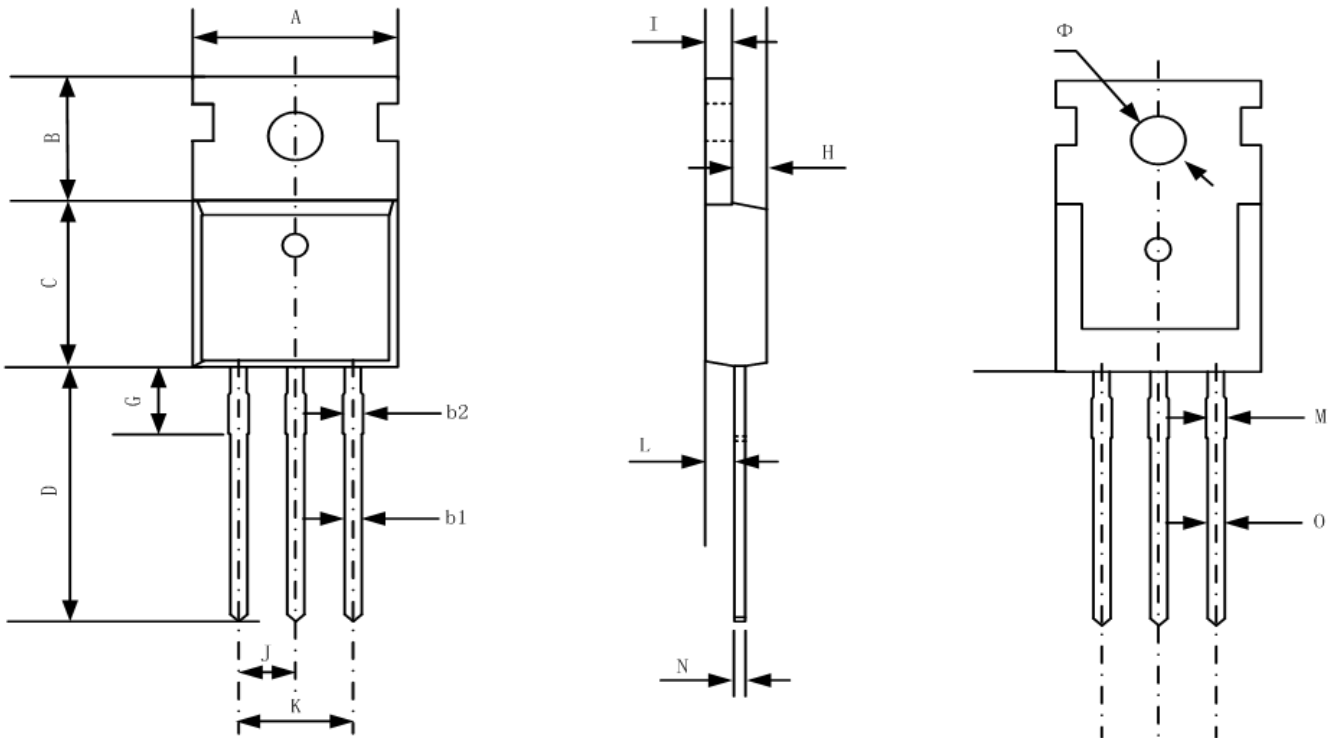


TO-263-3L Package Information



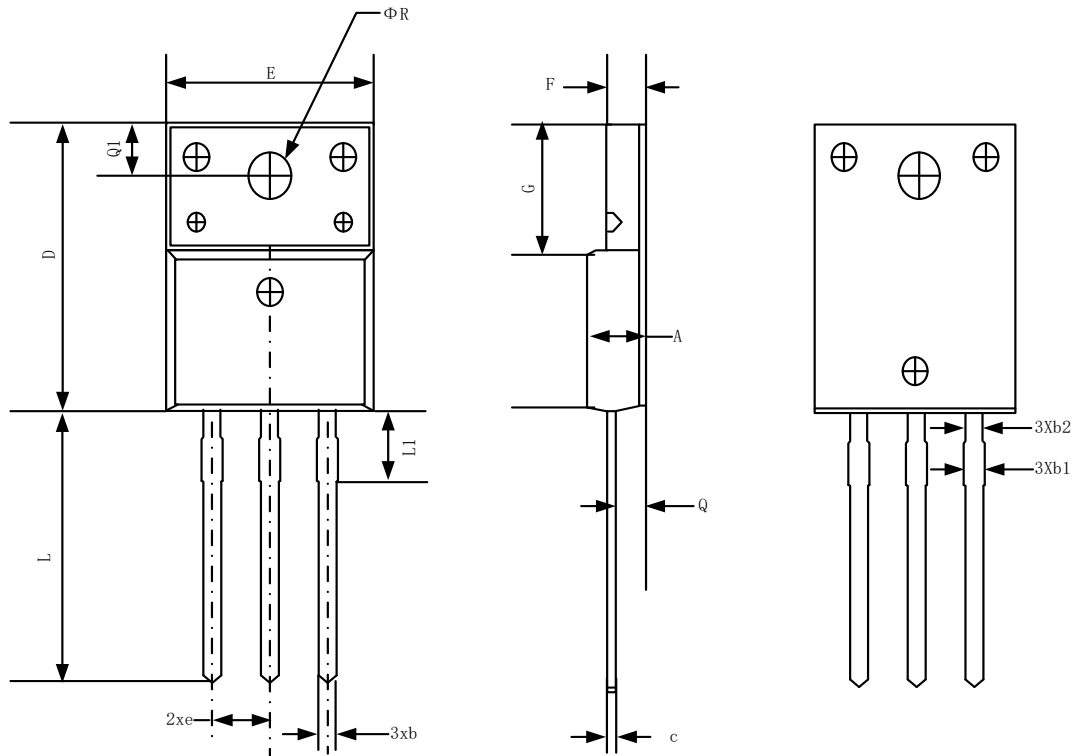
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.40	4.60	0.17	0.18
A1	0.00	0.25	0.00	0.01
A2	2.20	2.60	0.09	0.10
b	0.76	0.89	0.03	0.04
b2	1.23	1.37	0.05	0.05
C	0.47	0.60	0.02	0.02
c1	0.46	0.56	0.02	0.02
c2	1.25	1.35	0.05	0.05
D	0.91	0.93	0.04	0.04
D1	8.00	-	0.31	-
E	9.80	10.00	0.39	0.39
E1	7.80	-	0.31	-
e	2.54BSC		0.10BSC	
H	14.90	15.70	0.59	0.62
L	2.00	2.60	0.08	0.10
L1	1.17	1.40	0.05	0.06
L2	-	1.75	-	0.07
L4	4.60REF		0.18REF	

TO-220-3L-C Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	9.70	10.20	0.38	0.40
B	6.30	6.70	0.25	0.26
C	9.00	9.47	0.35	0.37
D	12.78	13.38	0.50	0.53
G	2.65 REF		0.104 REF	
H	3.00	3.40	0.12	0.13
I	1.25	1.40	0.05	0.06
J	2.40	2.70	0.09	0.11
K	5.00	5.15	0.20	0.20
L	2.20	2.60	0.09	0.10
M	1.25	1.45	0.05	0.06
N	0.45	0.60	0.02	0.02
O	0.70	0.90	0.03	0.04
Φ	3.6 REF		0.142 REF	

TO-220F Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.50	4.83	0.18	0.19
b	0.70	0.91	0.03	0.04
b1	1.20	1.47	0.05	0.06
b2	1.10	1.38	0.04	0.05
c	0.45	0.63	0.02	0.02
D	15.67	16.07	0.62	0.63
e	2.54 BSC		0.10 BSC	
E	9.96	10.36	0.39	0.41
F	2.34	2.74	0.09	0.11
G	6.48	6.90	0.26	0.27
L	12.68	13.30	0.50	0.52
L1	3.13	3.50	0.12	0.14
Q	2.56	2.93	0.10	0.12
Q1	3.20	3.40	0.13	0.13
ΦR	3.08	3.28	0.12	0.13

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