

600V, 10A, 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;

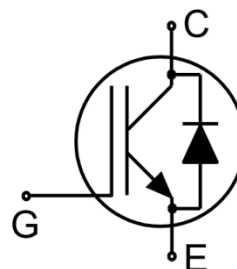
Features

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

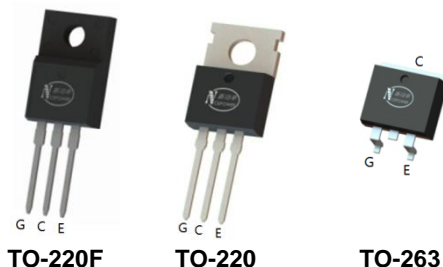
- Air Condition
- Inverters
- Motor drives



Schematic diagram

Package Marking and Ordering Information

Device	Device Package	Device Marking
NCE10TD60BF	TO-220F	NCE10TD60BF
NCE10TD60B	TO-220	NCE10TD60B
NCE10TD60BD	TO-263	NCE10TD60BD



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	20	20*	A
	Collector Current @ $T_c = 100^\circ\text{C}$	10	10*	A
I_{Cplus}	Pulsed Collector Current, t_p limited by T_{jmax}	30	30*	A
-	turn off safe operating area, $V_{CE}=600\text{V}$, $T_j=150^\circ\text{C}$	30	30*	A
I_F	Diode Continuous Forward Current @ $T_c = 100^\circ\text{C}$	10	10*	A
I_{FM}	Diode Maximum Forward Current	30	30*	A
P_D	Power Dissipation @ $T_c = 25^\circ\text{C}$	83	33	W
	Power Dissipation @ $T_c = 100^\circ\text{C}$	33	13.2	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	Value		Units
R _{θJC}	Thermal Resistance, Junction to case for IGBT	1.5	3.78	°C/W
R _{θJC}	Thermal Resistance, Junction to case for Diode	2.35	4.04	°C/W
R _{θJA}	Thermal Resistance, Junction to Ambient	65	78	°C/W

Electrical Characteristics (T_C=25°C unless otherwise noted)

Symbol	Parameter	Test Conditions	Value			Units
			Min.	Typ.	Max.	
STATIC Characteristics						
V _{(BR)CES}	Collector-Emitter Breakdown Voltage	V _{GE} =0V, I _{CE} =1mA	600	--	--	V
I _{CES}	Collector-Emitter Leakage Current	V _{GE} =0V, V _{CE} =600V	--	--	4	uA
I _{GES(F)}	Gate to Emitter Forward Leakage	V _{GE} =+30V, V _{CE} =0V	--	--	100	nA
I _{GES(R)}	Gate to Source Reverse Leakage	V _{GE} =-30V, V _{CE} =0V	--	--	100	nA
V _{CE(sat)}	Collector-Emitter Saturation Voltage	I _C =10A, T _J =25°C	--	1.7	1.9	V
		V _{GE} =15V, T _J =100°C	--	1.9	--	V
V _{GE(th)}	Gate Threshold Voltage	I _C =1mA, V _{CE} =V _{GE}	4.0	5.0	6.0	V
Dynamic Characteristics						
C _{ies}	Input Capacitance	V _{CE} =25V, V _{GE} =0V, f=1MHz	--	1127	--	pF
C _{oes}	Output Capacitance		--	40	--	
C _{res}	Reverse Transfer Capacitance		--	24	--	
Q _g	Total Gate Charge	V _{CC} =480V, I _C =10A V _{GE} =15V	--	44	--	nC
Q _{ge}	Gate to Emitter Charge		--	10	--	
Q _{gc}	Gate to Collector Charge		--	19	--	
I _{C(SC)}	Short circuit collector current Max.1000 short circuits Time between short circuits: ≥1.0s	V _{GE} =15V, V _{CC} ≤400V, t _{sc} ≤3us, T _J ≤150°C	--	60	--	A
Switching Characteristics						
t _{d(ON)}	Turn-on Delay Time	V _{CE} =400V, I _C =10A V _{GE} =0/15V, R _g =5Ω Inductive Load	--	20	--	ns
t _r	Rise Time		--	15	--	
t _{d(OFF)}	Turn-Off Delay Time		--	73	--	
t _f	Fall Time		--	18	--	
E _{on}	Turn-On Switching Loss		--	0.21	--	mJ
E _{off}	Turn-Off Switching Loss		--	0.11	--	
E _{ts}	Total Switching Loss		--	0.32	--	

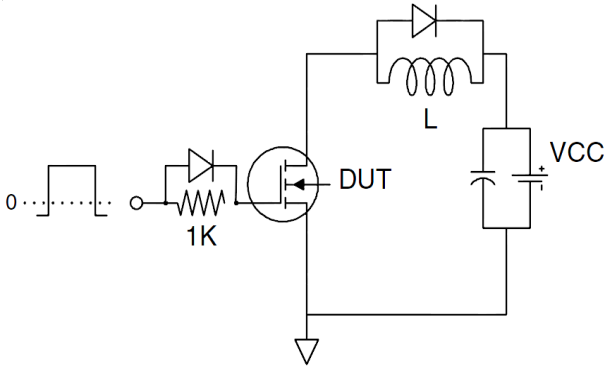
Electrical Characteristics of the Diode(T_C= 25°C unless otherwise specified):

Symbol	Parameter	Test Conditions	Rating			Units
			Min.	Typ.	Max.	
V _{FM}	Diode Forward Voltage	I _F =10A	--	1.5	1.7	V
T _{rr}	Reverse Recovery Time	V _{CC} =400V, I _F =10A, di/dt=200A/uS	--	158	--	ns
I _{RRM}	Diode Peak Reverse Recovery Current		--	5.8	--	A
Q _{rr}	Reverse Recovery Charge		--	0.5	--	uC

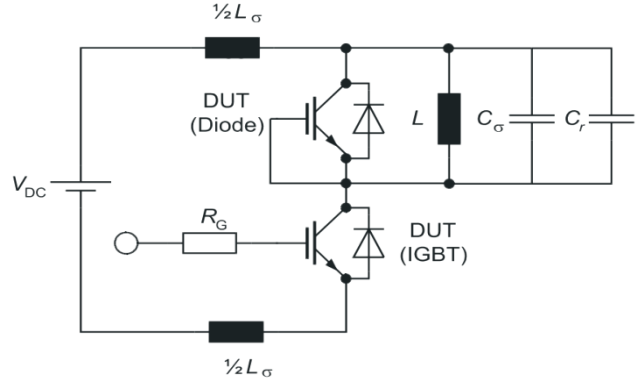
Pulse width t_{tp}≤380μs, δ≤2%

Test Circuit

1) Gate Charge Test Circuit

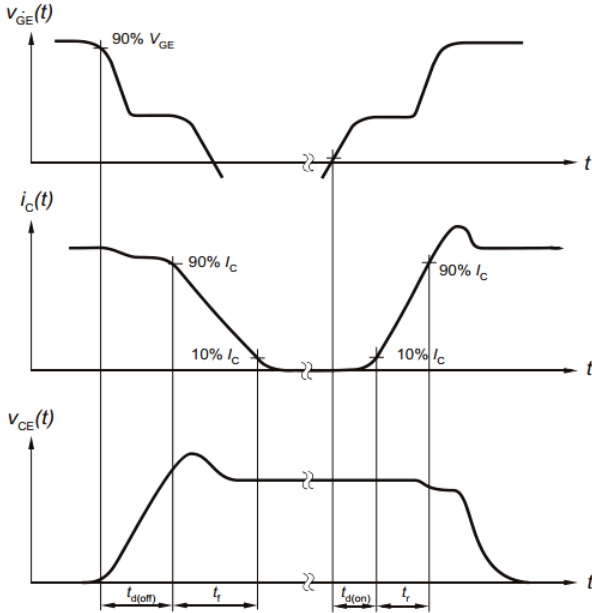


2) Switch Time Test Circuit

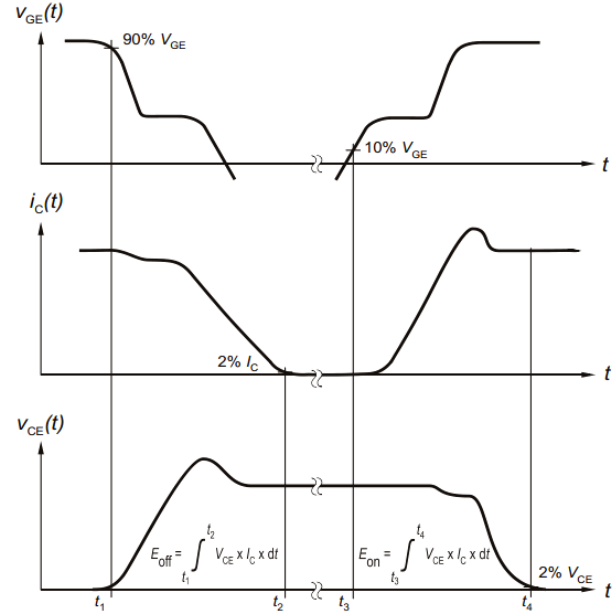


Switching characteristics

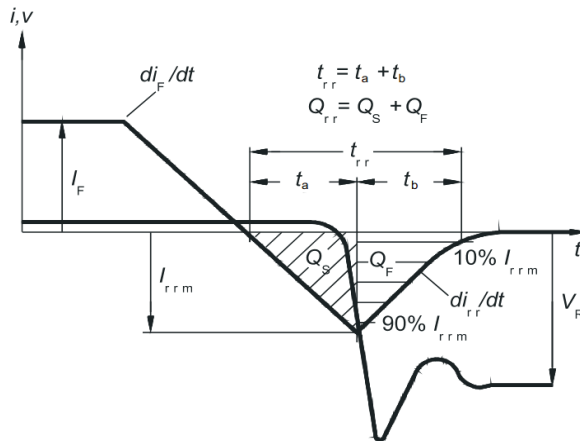
1) definition of switching times



2) definition of switching losses



3) Definition of diode switching characteristics



Typical Electrical and Thermal Characteristics

Figure 1 Output Characteristics

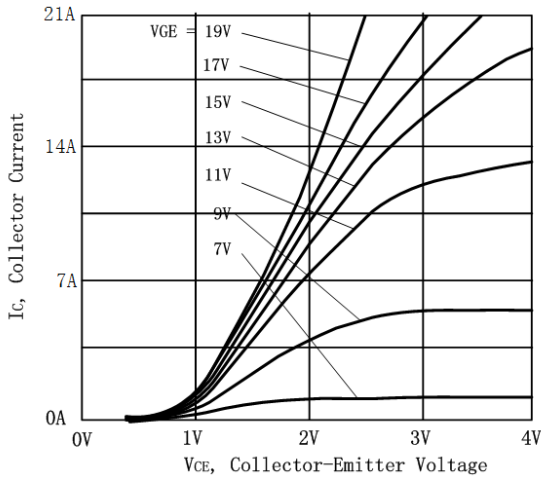


Figure 2. Transfer Characteristics

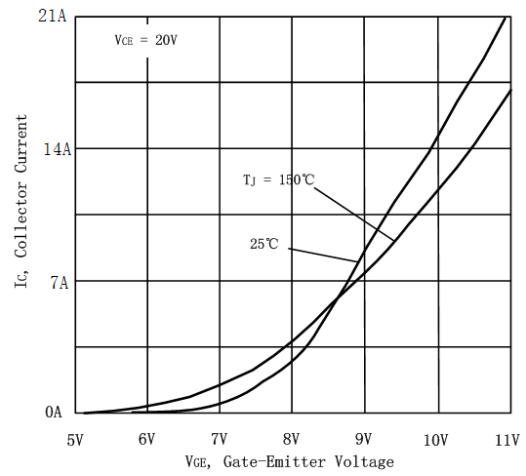


Figure 3 V_{CEsat} vs. Case Temperature

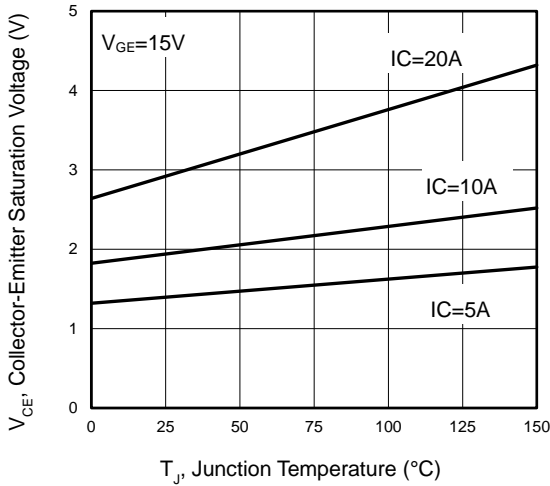


Figure 4 Saturation Voltage vs. VGE

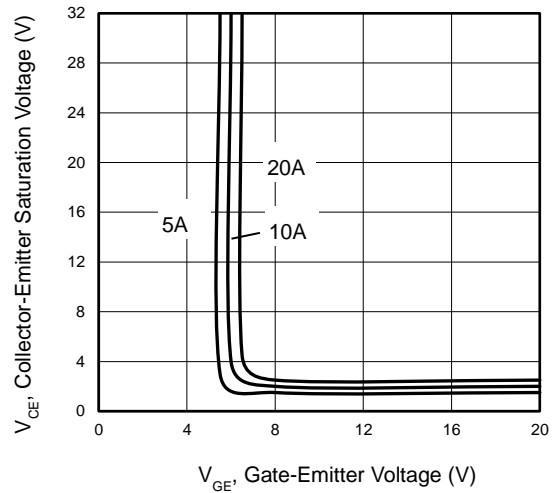


Figure 5 Capacitance Characteristics

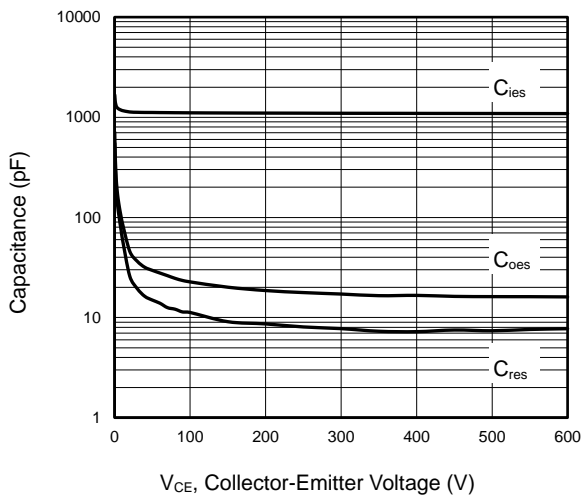
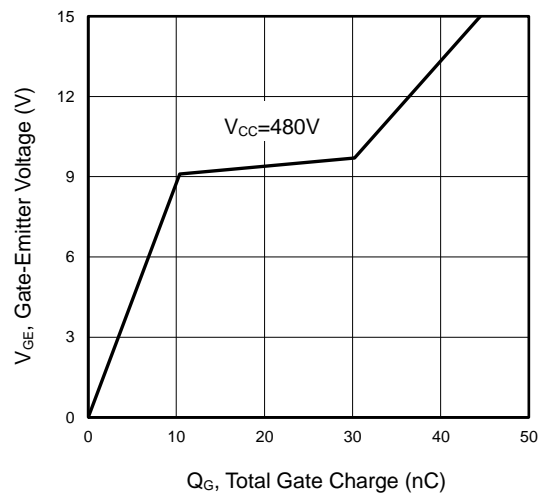


Figure 6 Gate charge waveform



Typical Electrical and Thermal Characteristics

Figure 7 Forward Characteristics

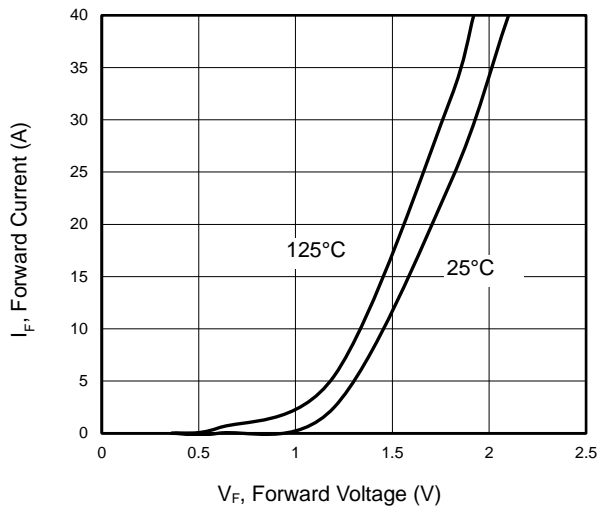


Figure 8 V_F vs. temperature

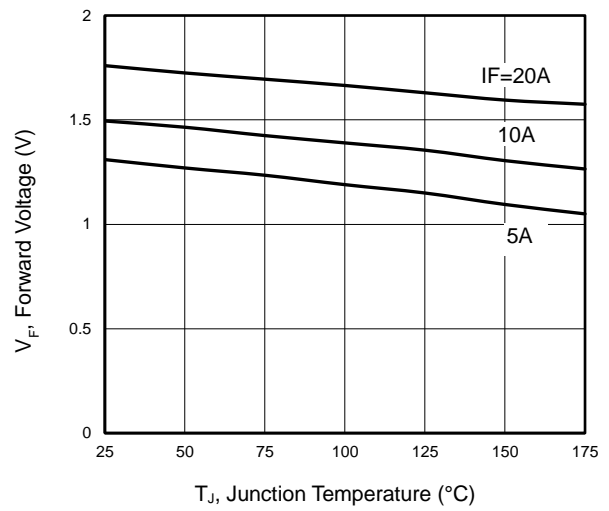


Figure 9 Typical Switching Times as a Function of Gate Resistor

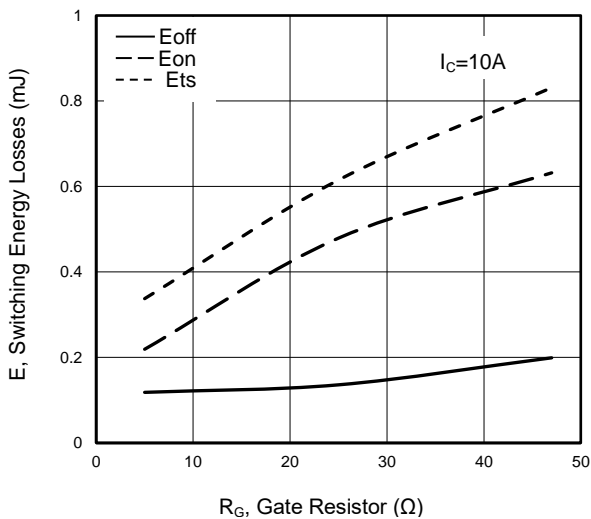


Figure 10 Typical Switching Times as a Function of Junction Temperature

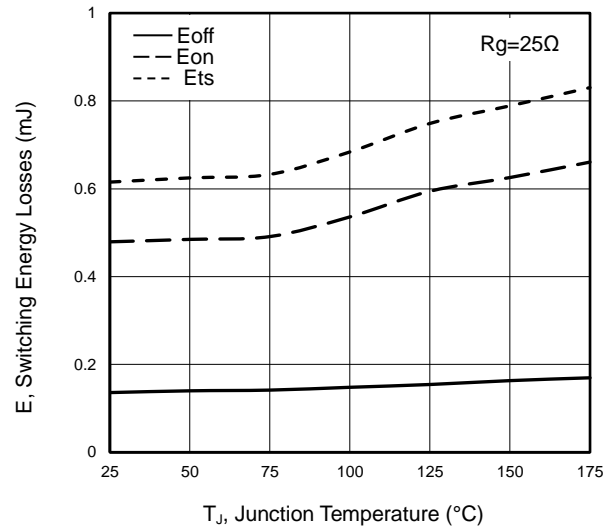


Figure 11 Gate-emitter Threshold Voltage as a Function of Junction Temperature

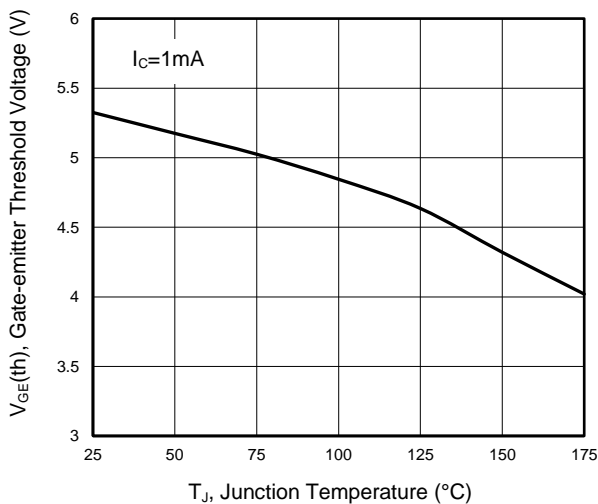
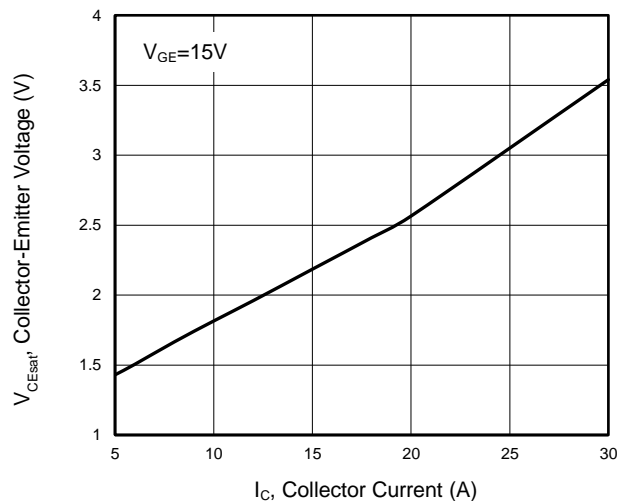
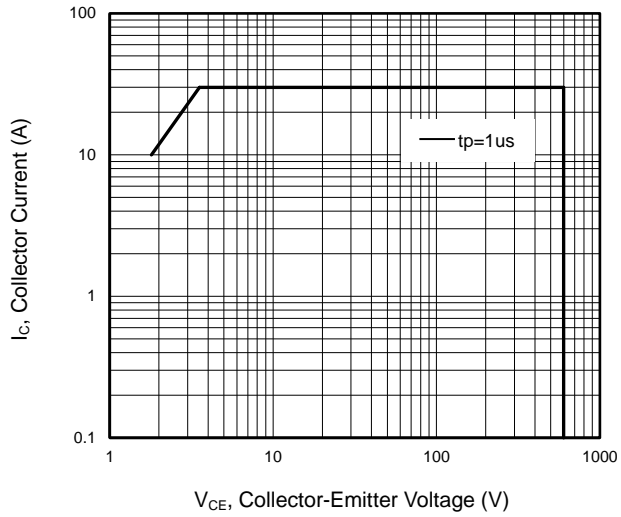


Figure 12 Typical Collector-emitter Saturation Voltage as a function of Collector Current

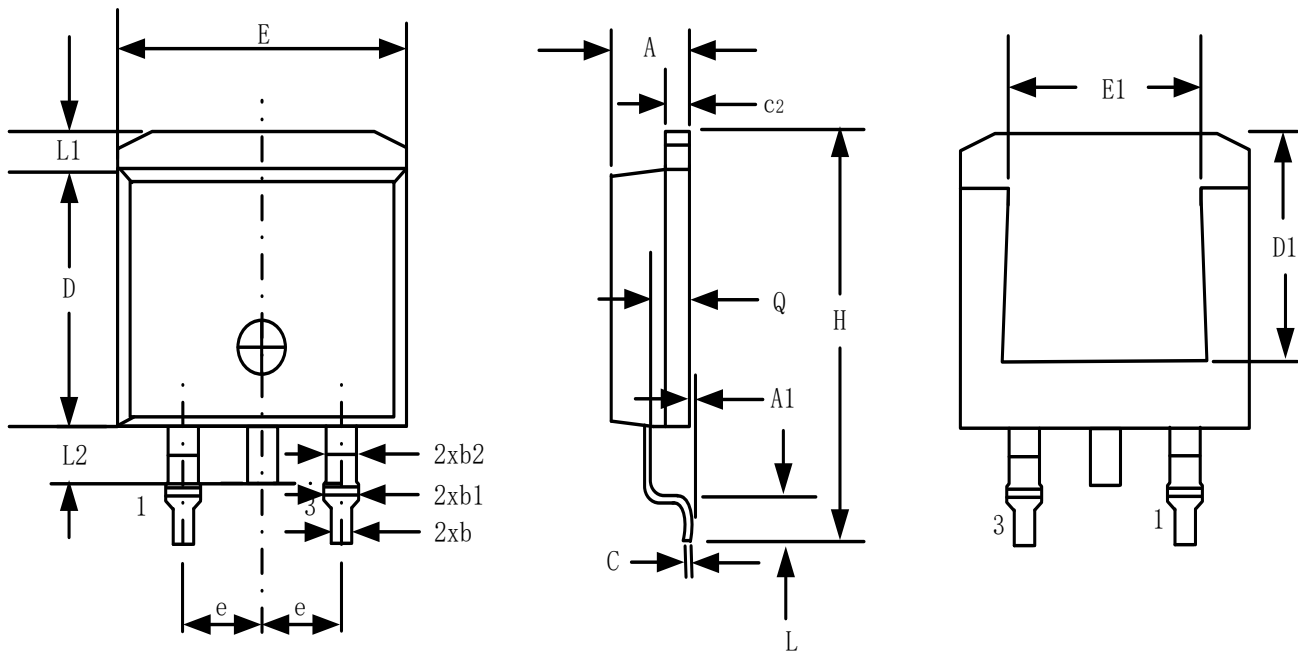


Typical Electrical and Thermal Characteristics

Figure 13 Forward Bias Safe Operating Area

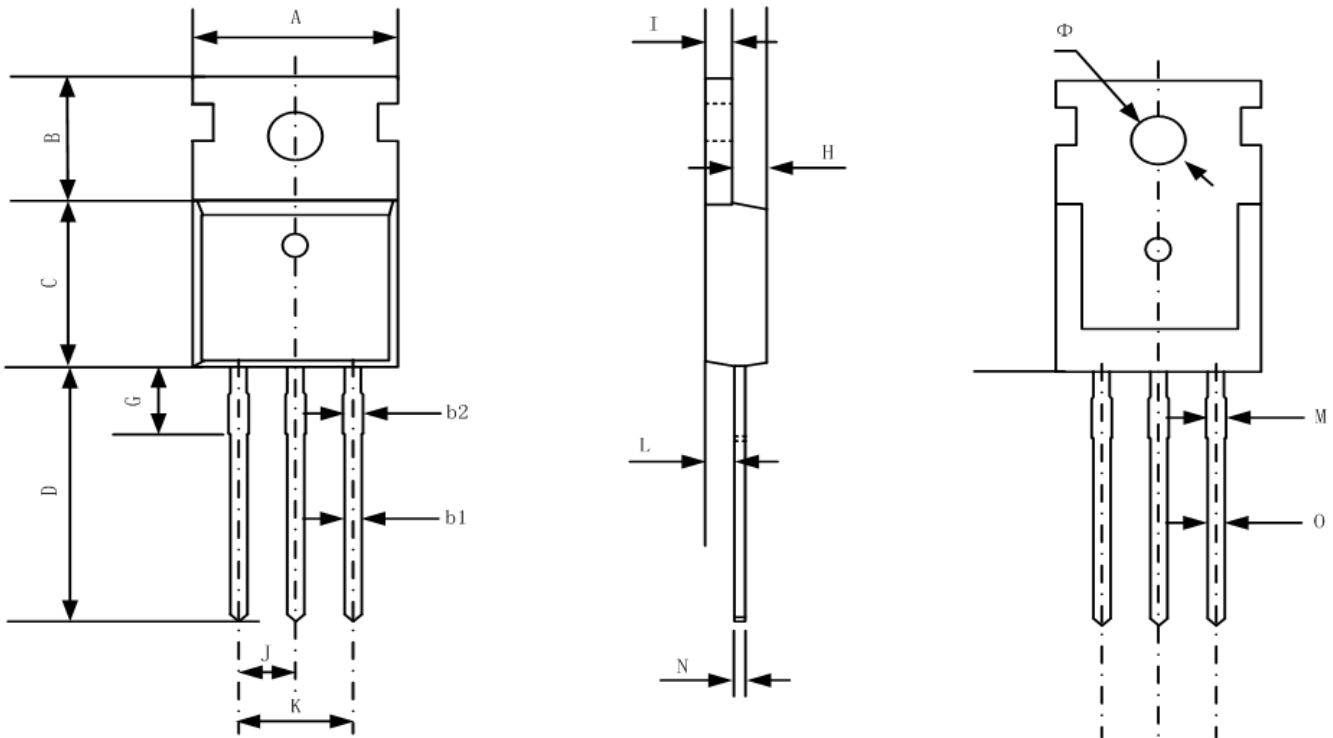


TO-263-3L Package Information



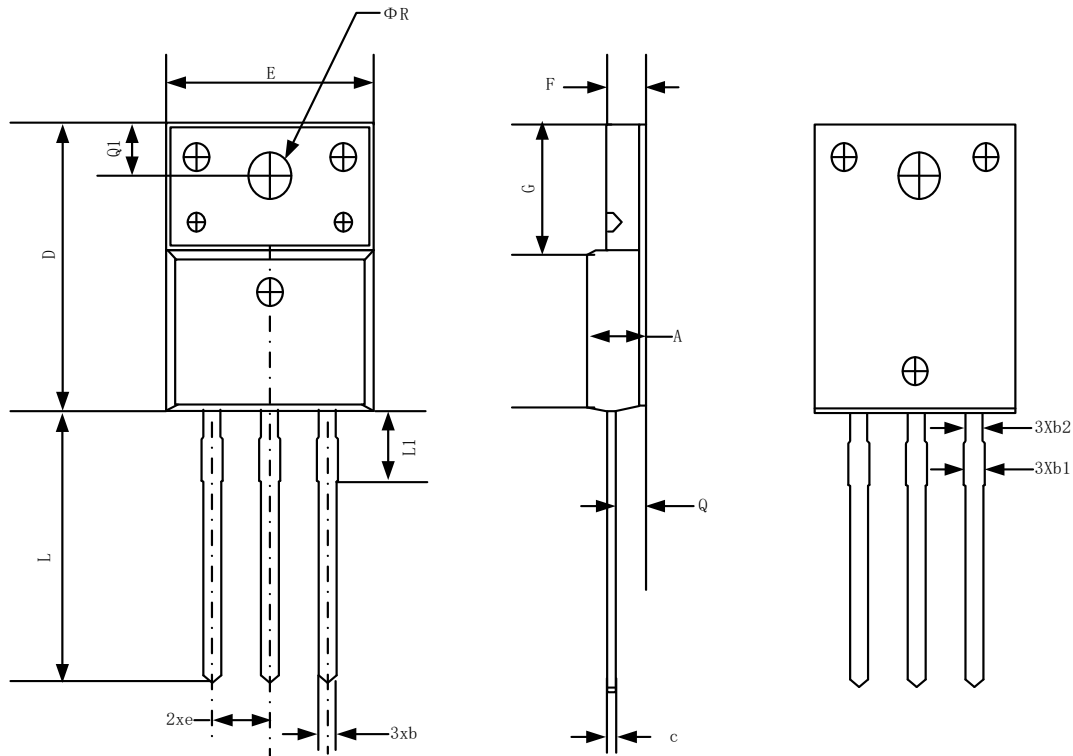
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.24	4.64	0.167	0.183
A1	0.00	0.25	0.000	0.010
b	0.70	0.90	0.028	0.035
b1	1.20	1.75	0.047	0.069
b2	1.20	1.70	0.047	0.067
C	0.40	0.60	0.016	0.024
c2	1.15	1.40	0.045	0.055
D	8.82	9.02	0.347	0.355
D1	6.86	--	0.270	--
E	9.96	10.36	0.392	0.408
E1	6.89	7.89	0.271	0.311
e	2.54 BSC		0.10 BSC	
H	14.61	15.88	0.575	0.625
L	1.78	2.79	0.070	0.110
L1	1.36 REF		0.054 REF	
L2	1.50 REF		0.059 REF	
L3	0.25 REF		0.010 REF	
Q	2.30	2.70	0.091	0.106

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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