

TP10TD60BF, TP10TD60BD, TP10TD60B

600V, 10A, Trench FS II Fast IGBT

General Description:

Using Topdiode'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

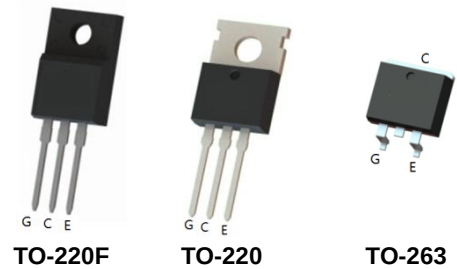
Very low $V_{CE(sat)}$

High speed switching

Positive temperature coefficient in $V_{CE(sat)}$

Very tight parameter distribution

High ruggedness, temperature stable behavior

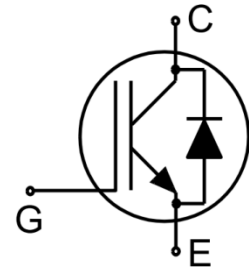


Application

Air Condition

Inverters

Motor drives



Schematic diagram

Package Marking and Ordering Information

Device	Device Package	Device Marking
TP10TD60BF	TO-220F	10TD60BF
TP10TD60B	TO-220	10TD60B
TP10TD60BD	TO-263	10TD60BD

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		μs

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)

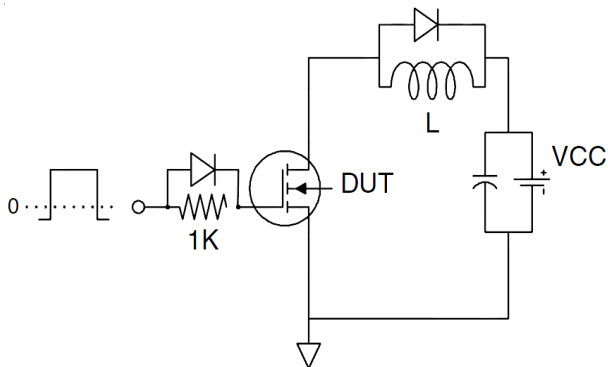
Symbol	Parameter	Test Conditions		Value			Units
				Min.	Typ.	Max.	
STATIC Characteristics							
$V_{(BR)CES}$	Collector-EmitterBreakdown Voltage	$V_{GE}=0V, I_{CE}=1mA$		600	--	--	V
I_{CES}	Collector-Emitter Leakage Current	$V_{GE}=0V, V_{CE}=600V$		--	--	4	uA
$I_{GES(F)}$	Gate to Emitter Forward Leakage	$V_{GE}=+30V, V_{CE}=0V$		--	--	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	$I_C=10A$	$T_J=25^{\circ}C$	--	1.7	1.9	V
		$V_{GE}=15V$	$T_J=100^{\circ}C$	--	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: $\geq 1.0s$	$V_{GE}=15V, V_{CC}\leq 400V,$ $t_{SC}\leq 3\mu s, T_J\leq 150^{\circ}C$		--	60	--	A
Switching Characteristics							
$t_{d(ON)}$	Turn-on Delay Time	$V_{CE}=400V, I_C=10A$ $V_{GE}=0/15V, R_g=5\Omega$ 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($T_C = 25^{\circ}\text{C}$ unless otherwise specified):

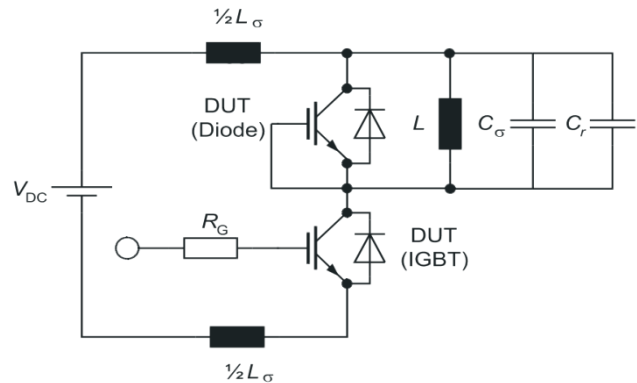
Symbol	Parameter	Test Conditions	Rating			Units
			Min.	Typ.	Max.	
V _{FM}	Diode Forward Voltage	I _F =10A	--	1.5	1.7	V
T _{rr}	Reverse Recovery Time	V _{CC} =400V, I _F =10A, di/dt=200A/uS	--	158	--	ns
I _{RRM}	Diode Peak Reverse Recovery Current		--	5.8	--	A
Q _{rr}	Reverse Recovery Charge		--	0.5	--	uC
Pulse width t _{tp} ≤380μs,δ≤2%						

Test Circuit

1) Gate Charge Test Circuit

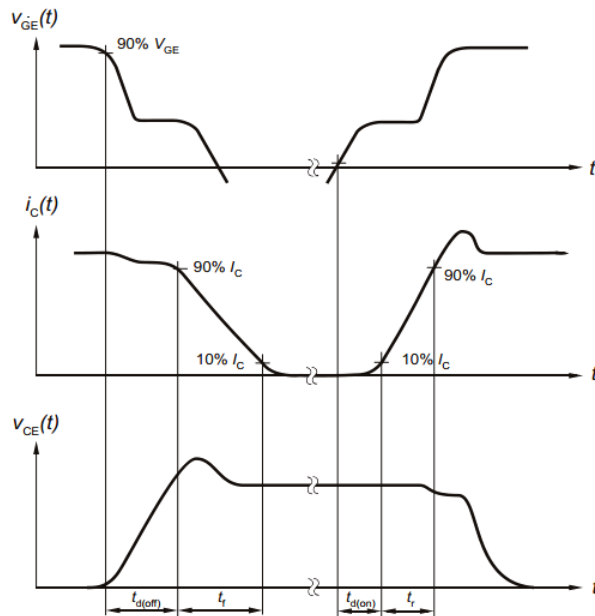


2) Switch Time Test Circuit

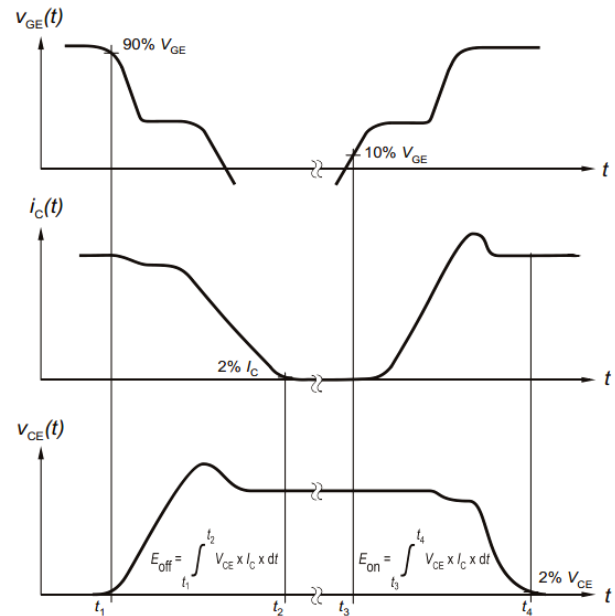


Switching characteristics

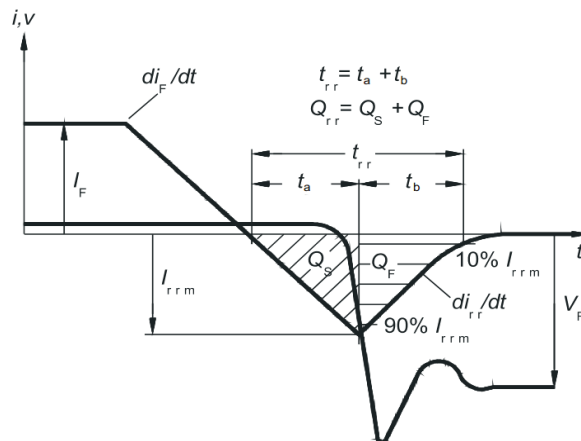
1) definition of switching times



2) definition of switching losses



3) Definition of diode switching characteristics



Typical Electrical and Thermal Characteristics

Figure 1 Output Characteristics

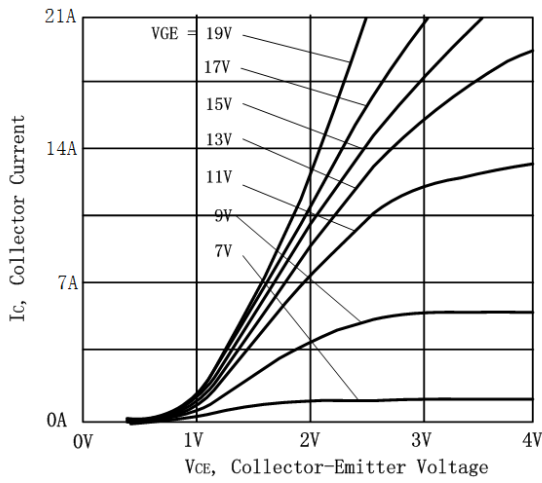


Figure 2. Transfer Characteristics

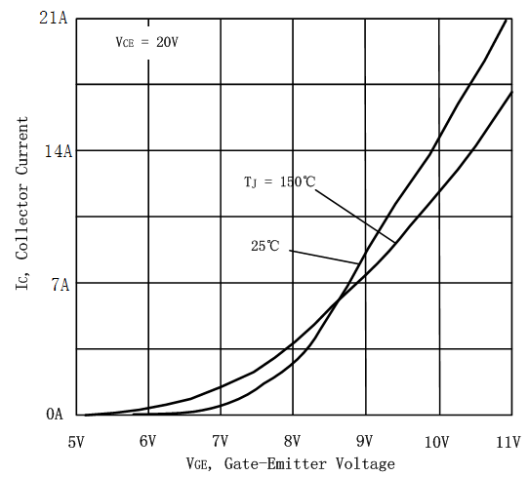


Figure 3 V_{CEsat} vs. Case Temperature

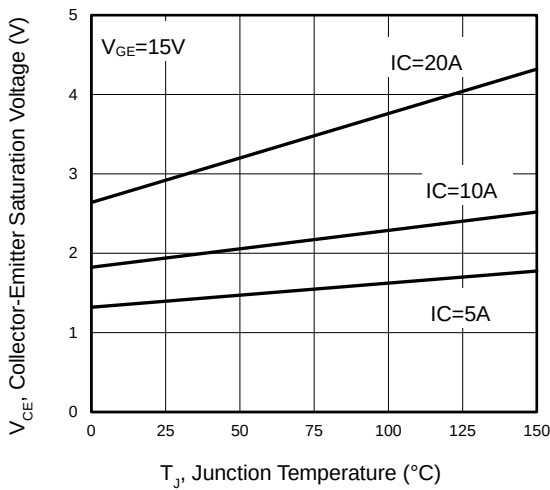


Figure 4 Saturation Voltage vs. V_{GE}

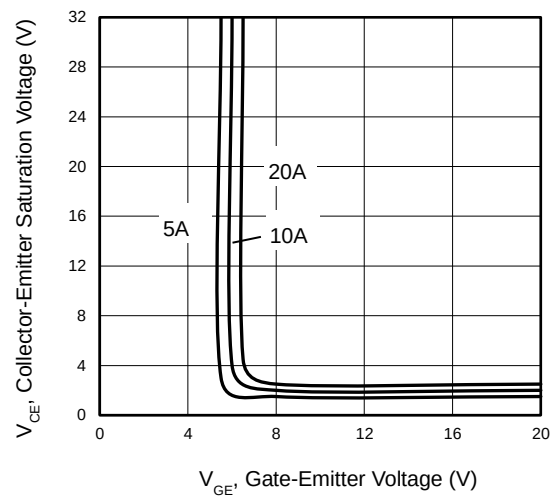


Figure 5 Capacitance Characteristics

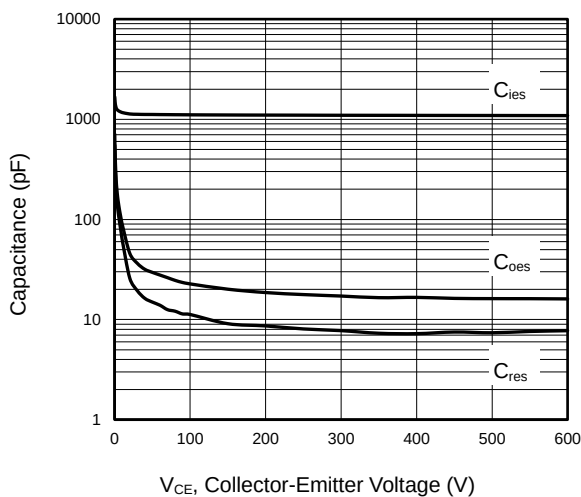
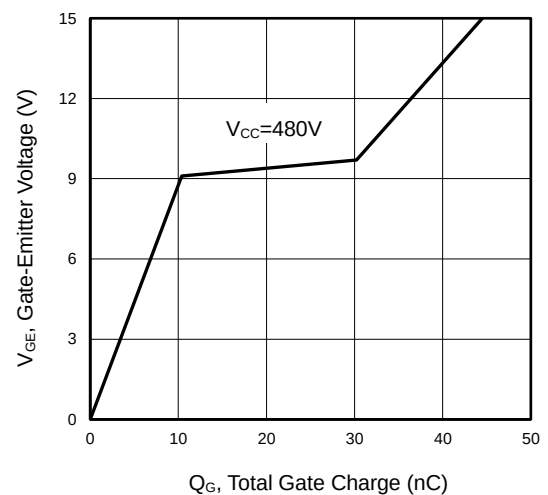


Figure 6 Gate charge waveform



Typical Electrical and Thermal Characteristics

Figure 7 Forward Characteristics

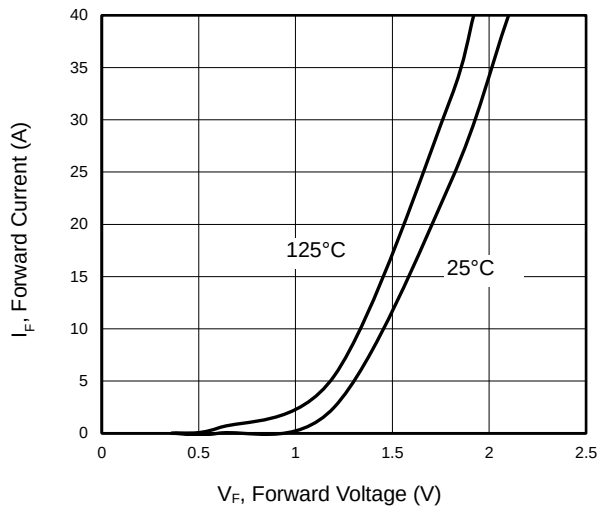


Figure 8 V_F vs. temperature

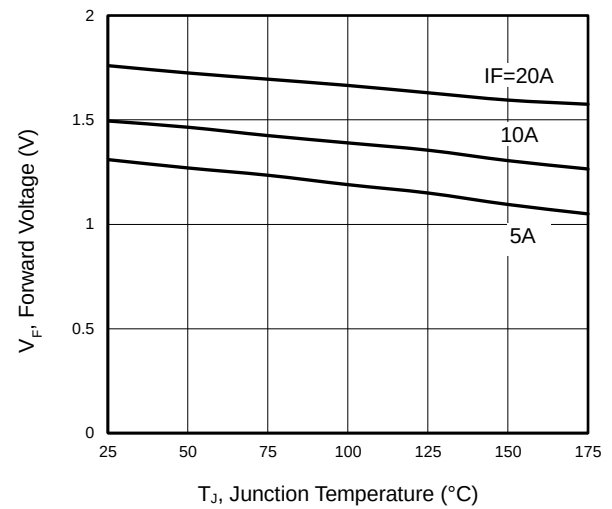


Figure 9 Typical Switching Times as a Function of Gate Resistor

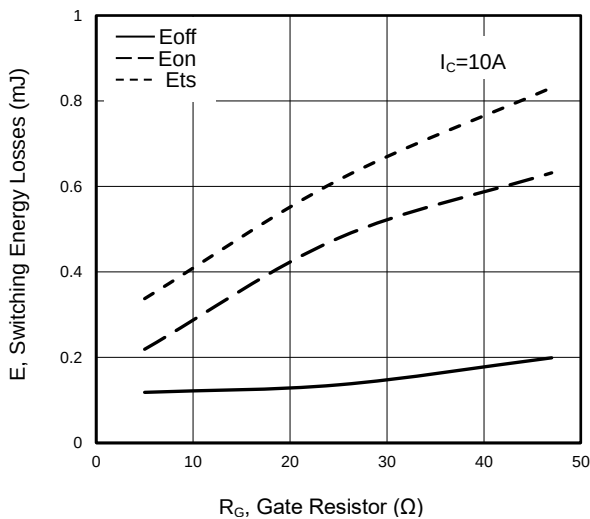


Figure 10 Typical Switching Times as a Function of Junction Temperature

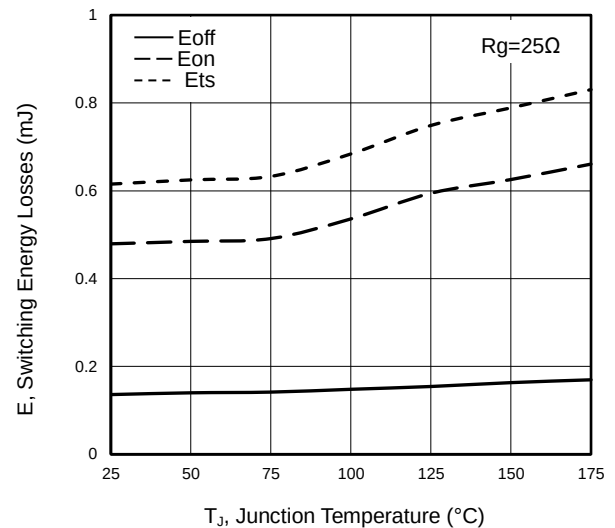


Figure 11 Gate-emitter Threshold Voltage as a Function of Junction Temperature

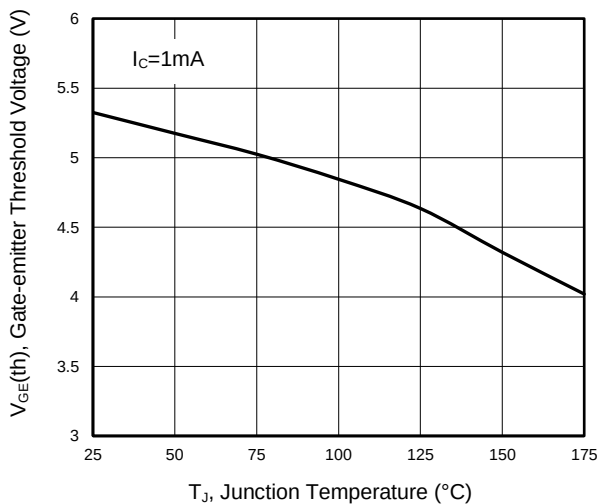
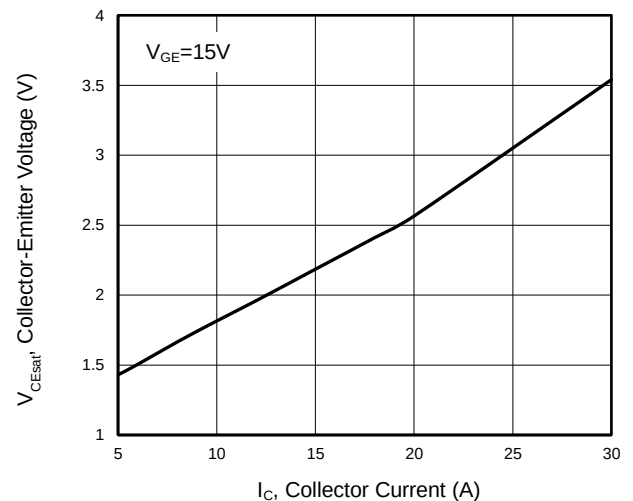
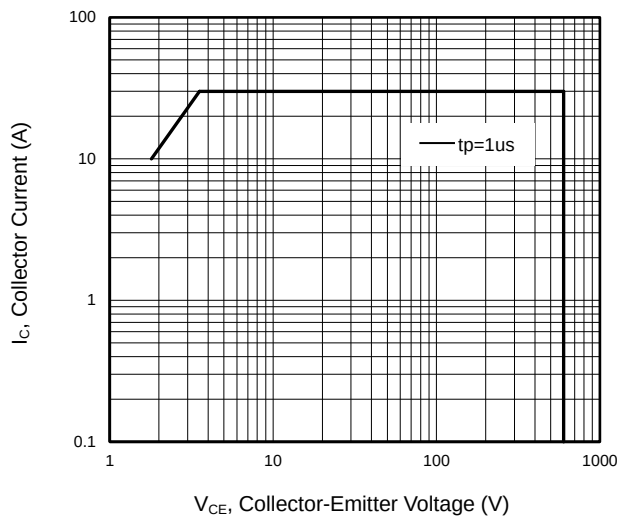


Figure 12 Typical Collector-emitter Saturation Voltage as a function of Collector Current

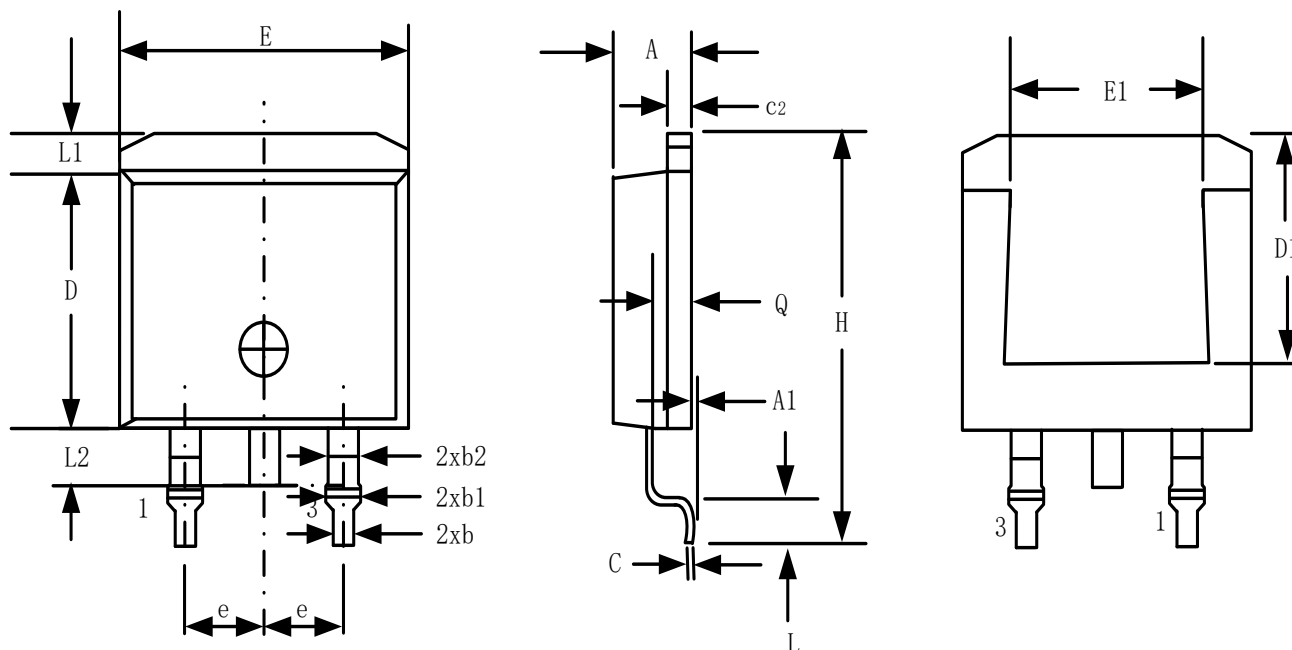


Typical Electrical and Thermal Characteristics

Figure 13 Forward Bias Safe Operating Area

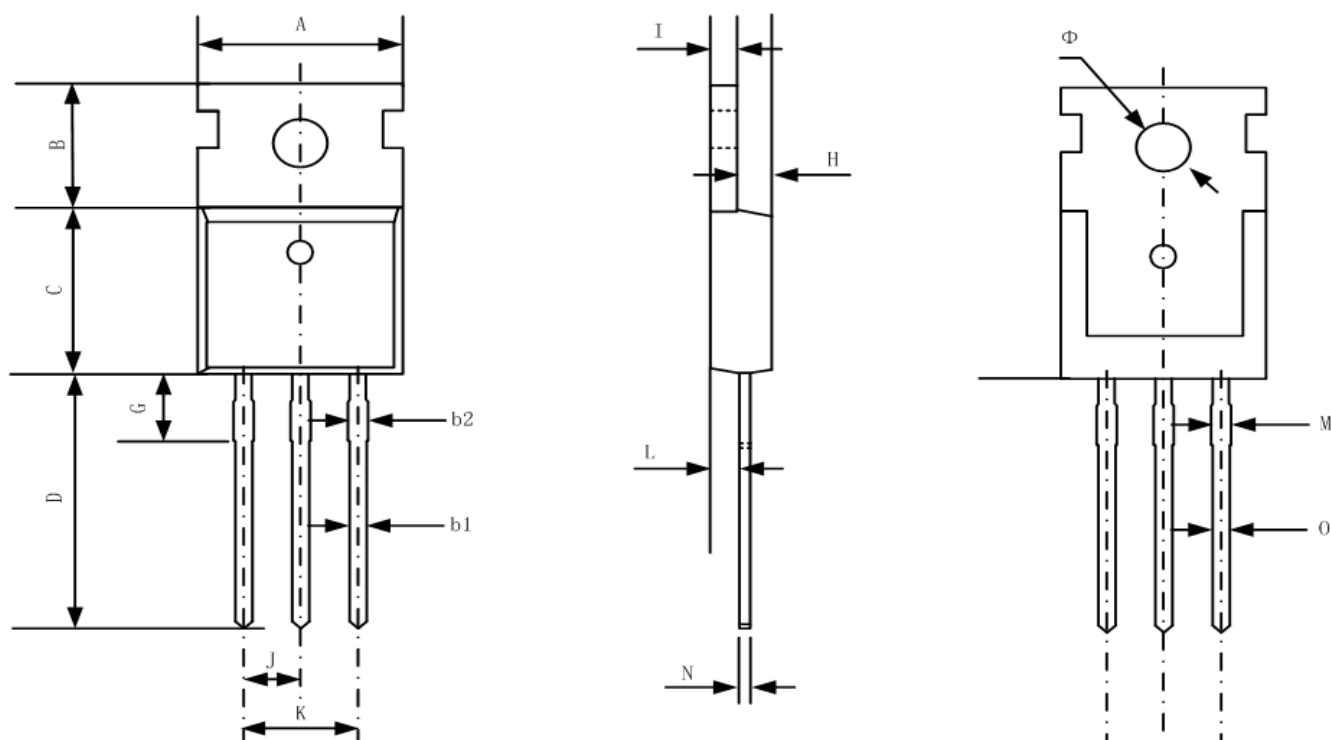


TO-263-3L Package Information



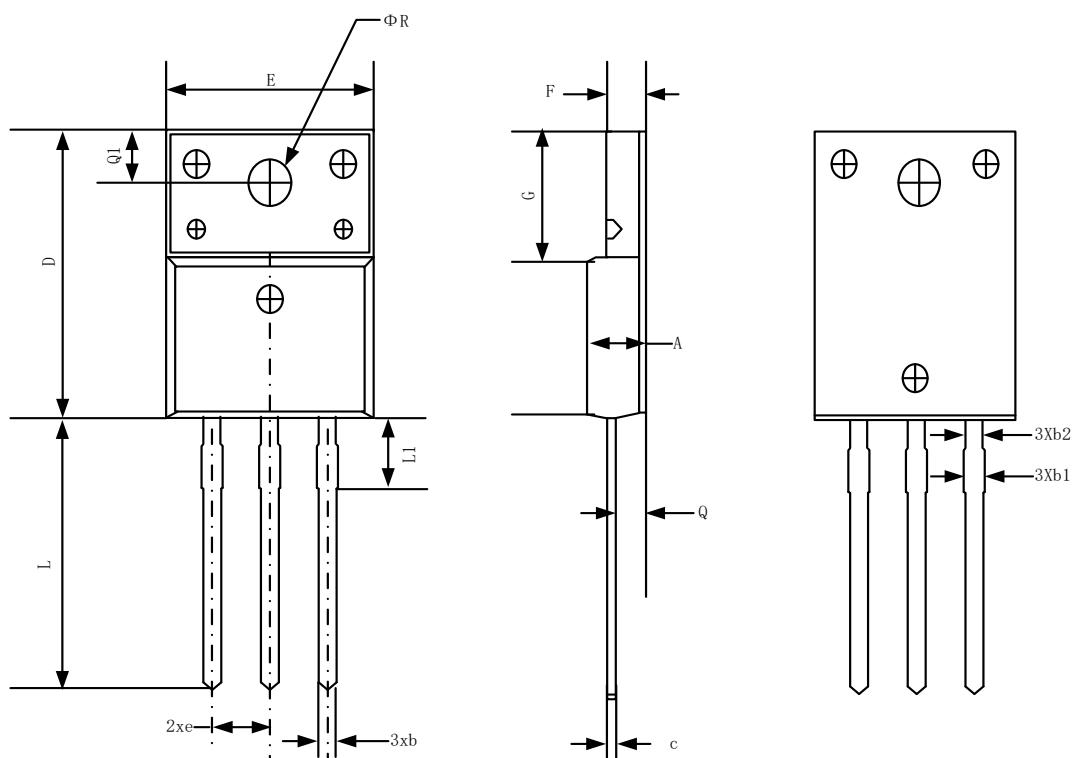
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.24	4.64	0.167	0.183
A1	0.00	0.25	0.000	0.010
b	0.70	0.90	0.028	0.035
b1	1.20	1.75	0.047	0.069
b2	1.20	1.70	0.047	0.067
C	0.40	0.60	0.016	0.024
c2	1.15	1.40	0.045	0.055
D	8.82	9.02	0.347	0.355
D1	6.86	--	0.270	--
E	9.96	10.36	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