600V, 15A, Trench FS II IGBT

General Description:

Using H&M SEMI's proprietary trench design and advanced FS (field stop) second generation technology, the 600V Trench FS II IGBT offers superior conduction and switching performances, and easy parallel operation;

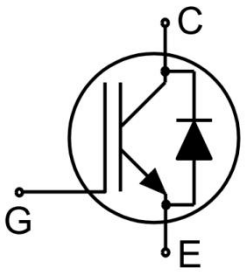
Features

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
HMG15N60D	TO-263	HMG15N60D
HMG15N60	TO-220	HMG15N60
HMG15N60F	TO-220F	HMG15N60F



TO-263



TO-220



TO-220F

Absolute Maximum Ratings (TC=25℃unless otherwise noted)

Symbol	Parameter	HMG15N60D HMG15N60	HMG15N60F	Units
V_{CES}	Collector-Emitter Voltage	600		V
V_{GES}	Gate- Emitter Voltage	±30		V
I_C	Collector Current	30	30*	A
	Collector Current @T_C = 100 °C	15	15*	A
I_{Cplus}	Pulsed Collector Current，t_p limited by T_{jmax}	45	45	A
-	turn off safe operating area，VCE=600V，Tj=150℃	45	45	A
I_F	Diode Continuous Forward Current @T_C = 100 °C	15	15*	A
I_{FM}	Diode Maximum Forward Current	45	45	A
P_D	Power Dissipation @ T_C = 25°C	105	35	W
	Power Dissipation @T_C = 100 °C	42	12.8	W
T_J,T_{stg}	Operating Junction and Storage Temperature Range	-55 to +150		℃
T_L	Maximum Temperature for Soldering	260		℃
t_{sc}	Short circuit withstand time V_{GE}=15.0V, V_{CC} ≤ 400V, Allowed number of short circuits<1000Time between short circuits:≥1.0s,T_j≤150℃	10		us

Thermal Characteristic

Symbol	Parameter	HMG15N60D HMG15N60	HMG15N60F	Units
$R_{\theta JC}$	Thermal Resistance, Junction to case for IGBT	1.19	3.6	℃/W
$R_{\theta JC}$	Thermal Resistance, Junction to case for Diode	1.92	3.9	℃/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	62	78	℃/W

Electrical Characteristics (T_C=25℃unless otherwise noted)

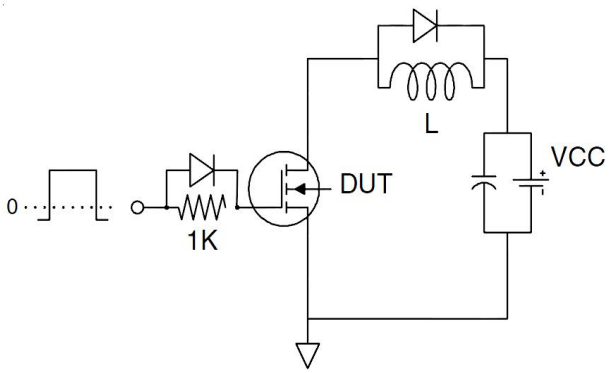
Symbol	Parameter	Test Conditions	Rating			Units
			Min.	Typ.	Max.	
OFF Characteristics						
$V_{(BR)CES}$	Collector-Emitter Breakdown Voltage	V_{GE}=0V,I_{CE}=1mA	600	--	--	V
I_{CES}	Collector-Emitter Leakage Current	V_{GE} =0V,V_{CE}=600V	--	--	4	uA
$I_{GES(F)}$	Gate to Emitter Forward Leakage	V_{GE}=+30V,V_{CE}=0V	--	--	100	nA
$I_{GES(R)}$	Gate to Source Reverse Leakage	V_{GE}=-30V,V_{CE} =0V	--	--	100	nA
ON Characteristics						
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	I_C=15A,V_{GE}=15V	--	1.8	2.0	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	--	649	--	pF
C_{oes}	Output Capacitance		--	61	--	
C_{res}	Reverse Transfer Capacitance		--	27	--	
Q_{Gate}	Gate charge	V_{CC}=480V, I_C=15A V_{GE}=15V	--	75	--	nC
$I_{C(SC)}$	Short circuit collector current Max.1000 short circuits Time between short circuits: ≥1.0s	V_{GE}=15V,V_{CC}≤400V, t_{SC}≤10us,Tj≤150℃	--	70	--	A
Switching Characteristics						
$t_{d(ON)}$	Turn-on Delay Time	V_{CE}=400V,I_C=15A V_{GE}=0/15V, R_g=15Ω Inductive Load	--	17	--	ns
t_r	Rise Time		--	18	--	
$t_{d(OFF)}$	Turn-Off Delay Time		--	114	--	
t_f	Fall Time		--	41	--	
E_{on}	Turn-On Switching Loss		--	0.60	--	mJ
E_{off}	Turn-Off Switching Loss		--	0.38	--	
E_{ts}	Total Switching Loss		--	0.98	--	

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

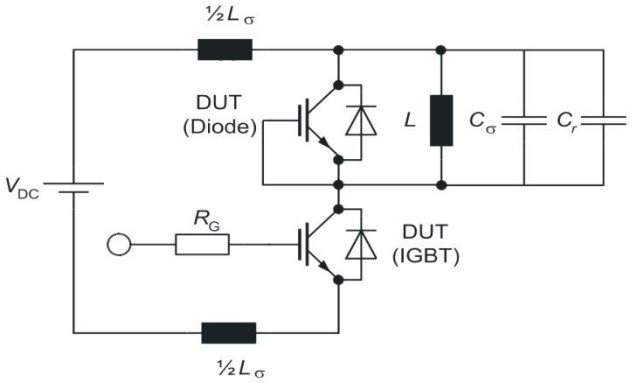
Symbol	Parameter	Test Conditions	Rating			Units
			Min.	Typ.	Max.	
V_{FM}	Diode Forward Voltage	I_F=15A	--	1.45	1.7	V
T_{rr}	Reverse Recovery Time	Vcc=400V, I_F=15A, di/dt=800A/uS	--	122	--	ns
I_{RRM}	Diode Peak Reverse Recovery Current		--	13	--	A
Q_{rr}	Reverse Recovery Charge		--	1.04	--	uC
Pulse width t_{tp}≤380μs,δ≤2%						

Test Circuit

1) Gate Charge Test Circuit

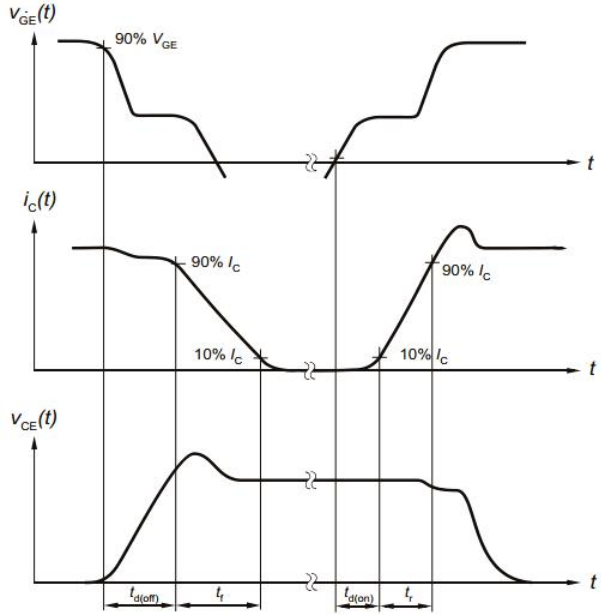


2) Switch Time Test Circuit

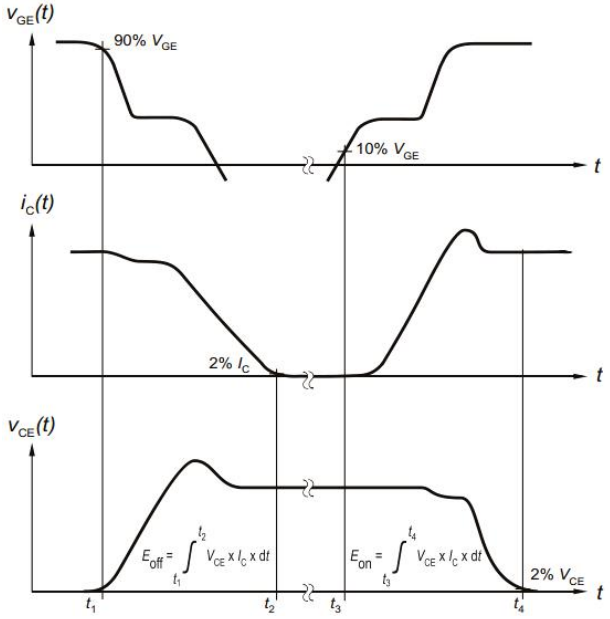


Switching characteristics

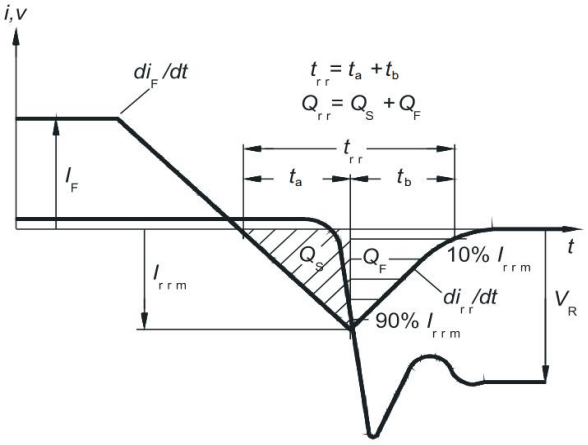
1) definition of switching times



2) definition of switching losses



3) Definition of diode switching characteristics



Typical Electrical and Thermal Characteristics

Figure 1 Output Characteristics

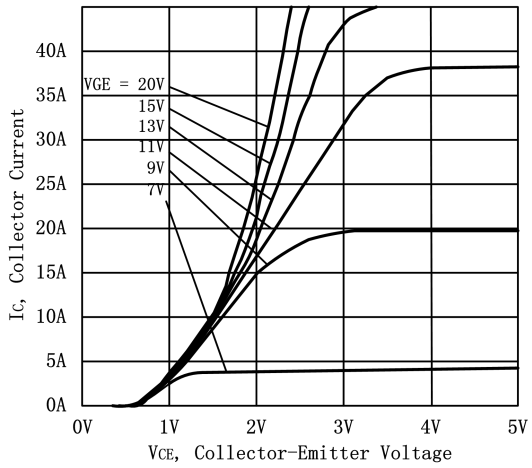


Figure 2. Transfer Characteristics

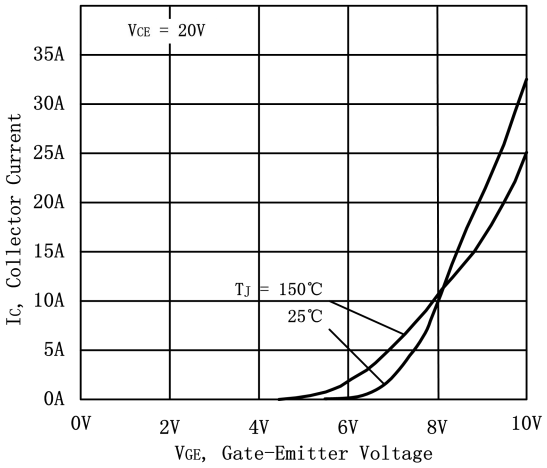


Figure 3 V_{CEsat} vs. Case Temperature

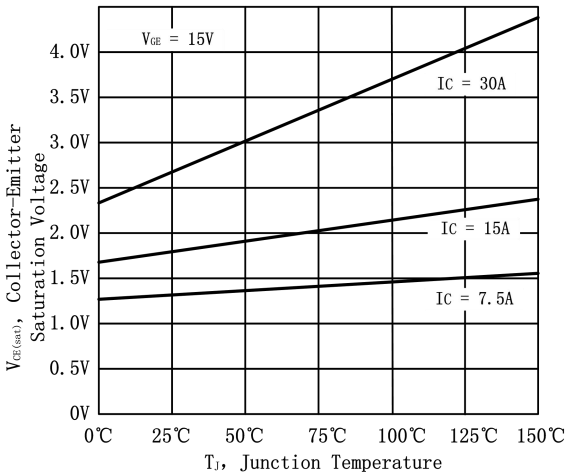


Figure 4 Saturation Voltage vs. VGE

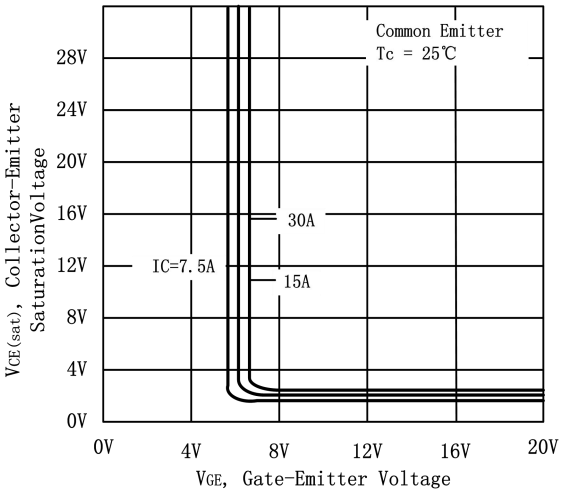


Figure 5 Capacitance Characteristics

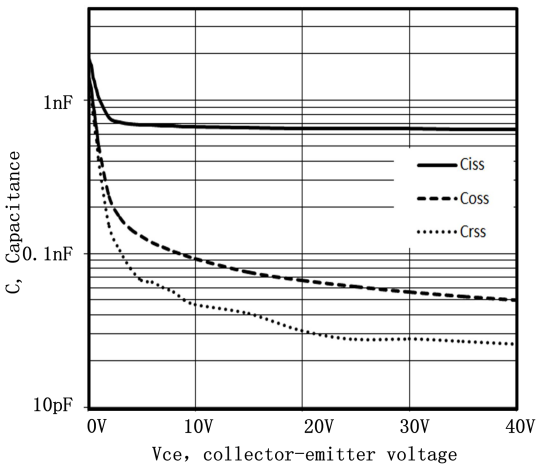
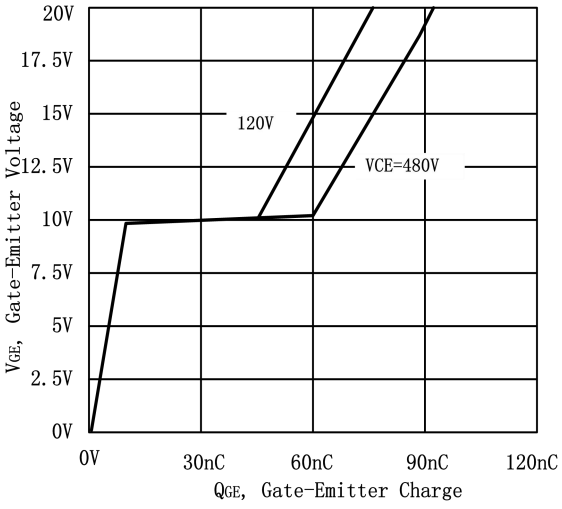


Figure 6 Gate charge waveform



Typical Electrical and Thermal Characteristics（continued）

Figure 7. Forward Characteristics

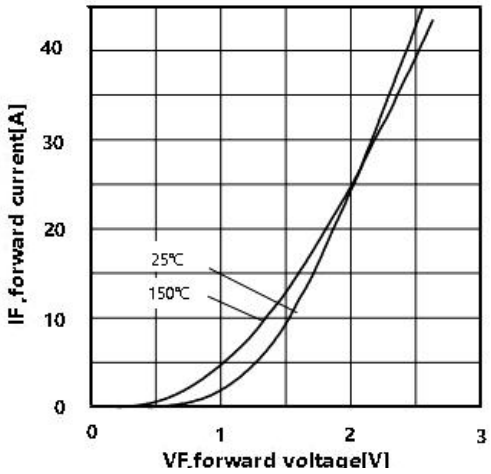


Figure 8 V_F vs. temperature

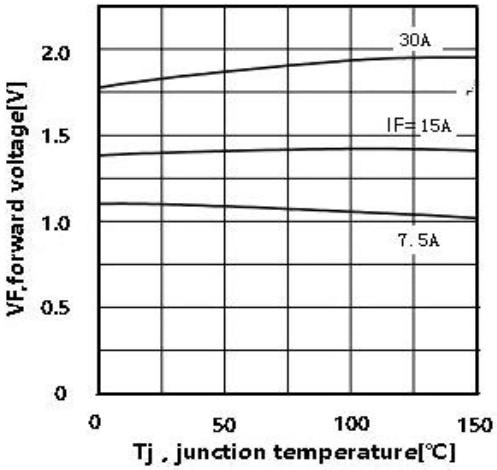


Figure 9. Transient Thermal Impedance of IGBT for TO-220F

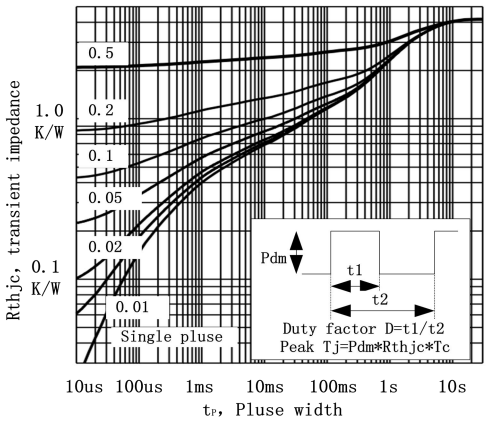
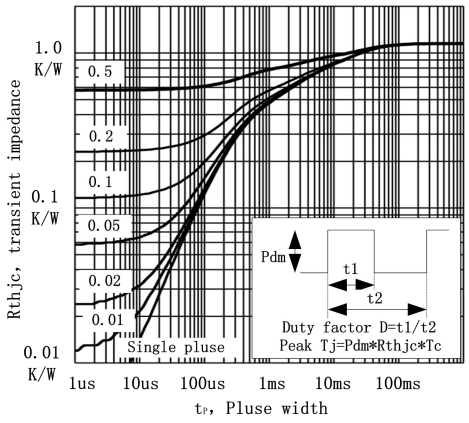
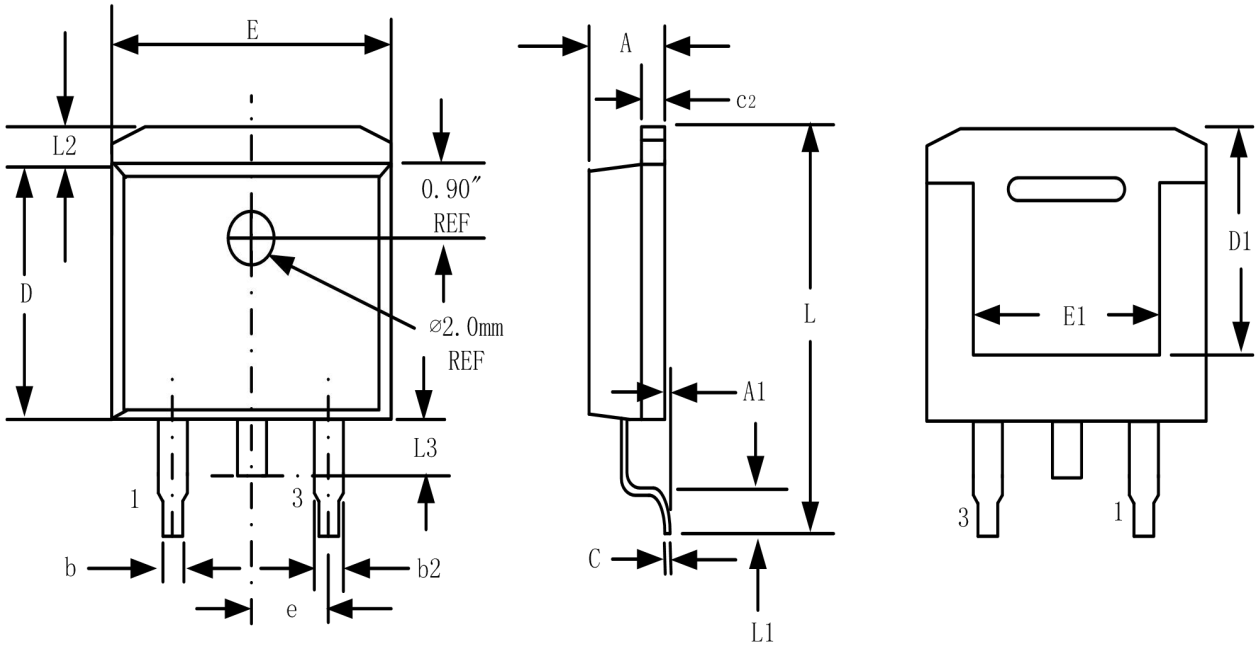


Figure 10. Transient Thermal Impedance of IGBT for TO-220,TO-263

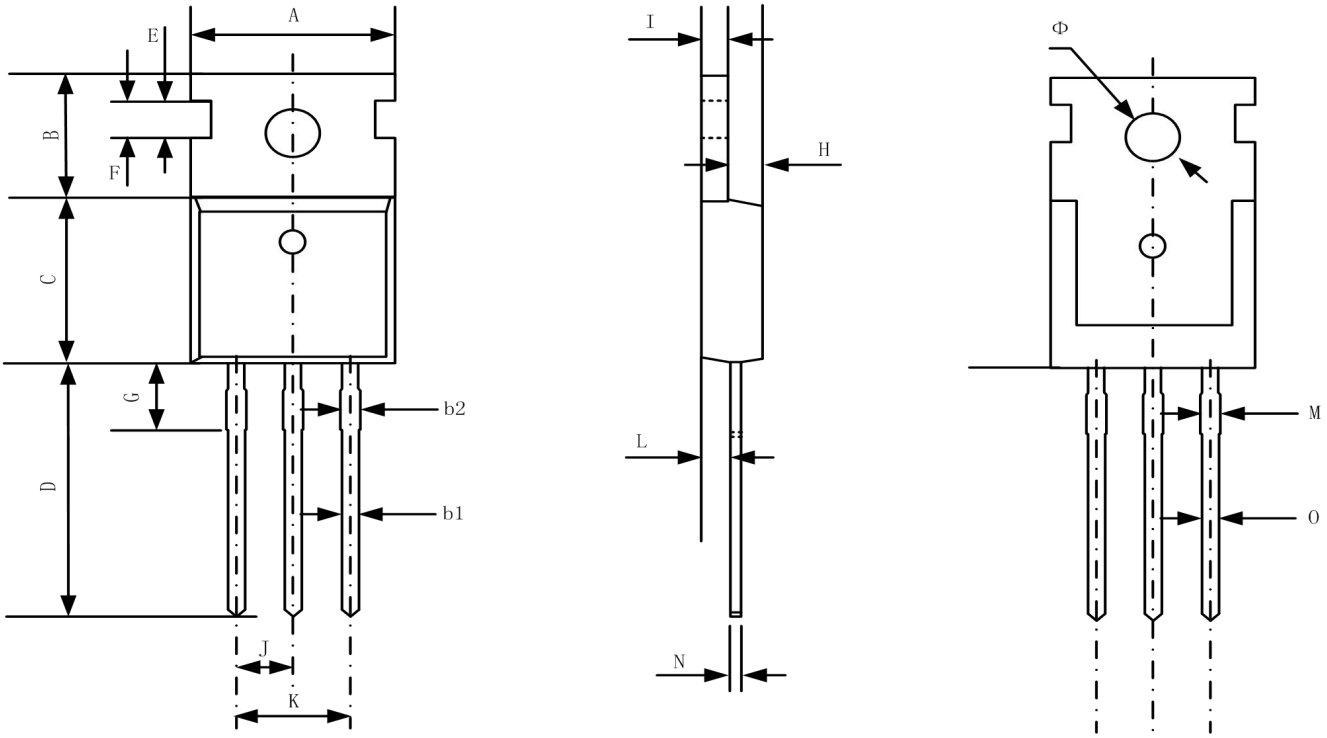


TO-263-3L Package Information



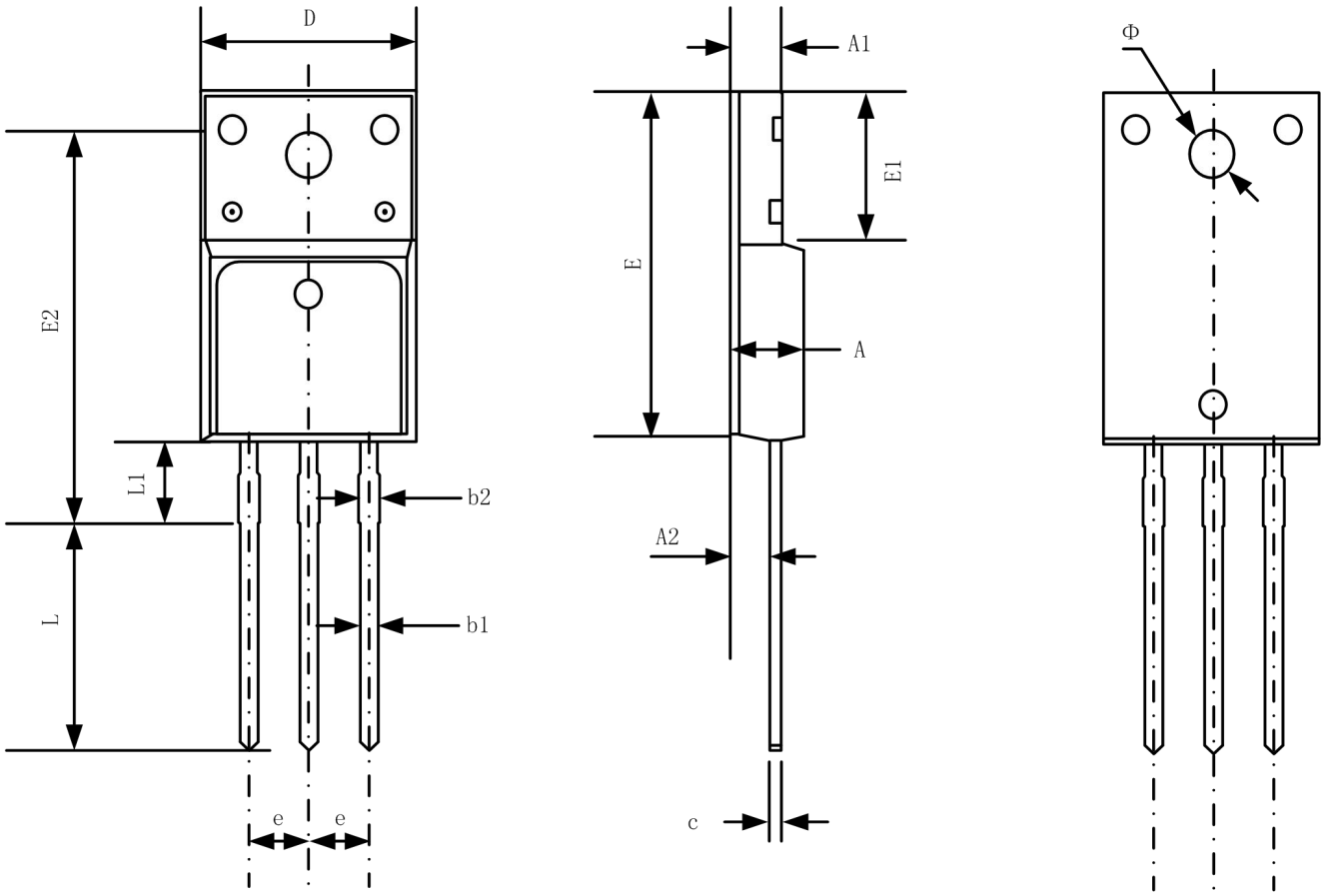
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.32	4.57	0.170	0.180
A1	-	0.25		0.010
b	0.71	0.94	0.028	0.037
b2	1.15	1.40	0.045	0.055
c	0.46	0.61	0.018	0.024
c2	1.22	1.40	0.048	0.055
D	8.89	9.40	0.350	0.370
D1	8.01	8.23	0.315	0.324
E	10.04	10.28	0.395	0.405
E1	7.88	8.08	0.310	0.318
e	2.54 BSC		0.100 BSC	
L	14.73	15.75	0.580	0.620
L1	2.29	2.79	0.090	0.110
L2	1.15	1.39	0.045	0.055
L3	1.27	1.77	0.050	0.070

TO-220-3L-C Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	9.70	10.10	0.38	0.40
B	6.30	6.70	0.25	0.26
C	9.00	9.47	0.35	0.37
D	12.80	13.30	0.50	0.52
E	1.20	1.40	0.05	0.06
F	1.70 REF		0.067 REF	
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	4.500	4.900	0.177	0.193
A1	2.340	2.740	0.092	0.108
A2	2.560	2.960	0.101	0.117
b1	0.700	0.900	0.028	0.035
b2	1.180	1.580	0.046	0.062
c	0.400	0.600	0.016	0.024
D	9.960	10.360	0.392	0.408
E	15.670	15.970	0.617	0.629
E1	6.500	6.900	0.256	0.272
E2	15.500	16.100	0.610	0.634
e	2.540 TYP		0.100 TYP	
Φ	3.080	3.280	0.121	0.129
L	12.640	13.240	0.498	0.521
L1	3.030	3.430	0.119	0.135