

600V, 15A, Trench FS II Fast IGBT

General Description

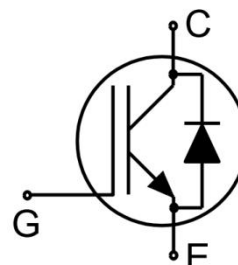
Using NCE's proprietary trench design and advanced FS (Field Stop) second generation technology, the 600V Trench FSII IGBT offers superior conduction and switching performances, and easy parallel operation;

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
NCE15TD60BF	TO-220F-3L	NCE15TD60BF



TO-220F-3L

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

Symbol	Parameter	Value	Units
V_{CES}	Collector-Emitter Voltage	600	V
V_{GES}	Gate- Emitter Voltage	± 30	V
I_C	Collector Current	30	A
	Collector Current @ $T_C = 100^{\circ}\text{C}$	15	A
I_{Cpuls}	Pulsed Collector Current, t_p limited by T_{jmax}	45	A
-	turn off safe operating area, $V_{CE}=600\text{V}$, $T_J=175^{\circ}\text{C}$	45	A
I_F	Diode Continuous Forward Current @ $T_C = 100^{\circ}\text{C}$	15	A
I_{FM}	Diode Maximum Forward Current	45	A
P_D	Power Dissipation @ $T_C = 25^{\circ}\text{C}$	40	W
	Power Dissipation @ $T_C = 100^{\circ}\text{C}$	20	W
T_J, T_{stg}	Operating Junction and Storage Temperature Range	-55 to +175	$^{\circ}\text{C}$
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<1000Time between short circuits: $\geq 1.0\text{s}$, $T_J\leq 150^{\circ}\text{C}$	5	us

Thermal Characteristic

Symbol	Parameter	Value	Units
$R_{\theta JC}$	Thermal Resistance, Junction to case for IGBT	3.75	$^{\circ}\text{C/W}$
$R_{\theta JC}$	Thermal Resistance, Junction to case for Diode	3.37	$^{\circ}\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	78	$^{\circ}\text{C/W}$

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

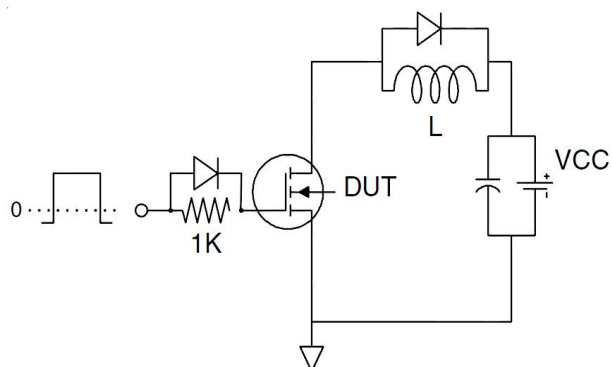
Symbol	Parameter	Conditions		Rating			Units
				Min.	Typ.	Max.	
Static Characteristics							
V _{(BR)CES}	Collector-Emitter Breakdown Voltage	V _{GE} =0V, I _{CE} =1mA		600	--	--	V
I _{CES}	Collector-Emitter Leakage Current	V _{GE} =0V, V _{CE} =600V		--	--	5	uA
I _{GES(F)}	Gate to Emitter Forward Leakage	V _{GE} =+30V, V _{CE} =0V		--	--	200	nA
I _{GES(R)}	Gate to Emitter Reverse Leakage	V _{GE} =-30V, V _{CE} =0V		--	--	200	nA
V _{CE(sat)}	Collector-Emitter Saturation Voltage	I _C =15A,	T _J =25°C	--	1.7	1.9	V
		V _{GE} =15V	T _J =175°C	--	1.9	--	V
V _{GE(th)}	Gate Threshold Voltage	I _C =1mA, V _{CE} =V _{GE}		4.0	--	6.0	V
Dynamic Characteristics							
C _{ies}	Input Capacitance	V _{CE} =25V, V _{GE} =0V, f=1MHz		--	1635	--	pF
C _{oes}	Output Capacitance			--	50	--	
C _{res}	Reverse Transfer Capacitance			--	30	--	
Q _g	Total Gate Charge	V _{CC} =480V, I _C =15A, V _{GE} =15V		--	63	--	nC
Q _{ge}	Gate to Emitter Charge			--	15	--	
Q _{gc}	Gate to Collector Charge			--	26	--	
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} ≤5us, T _J ≤150°C		--	82	--	A
Switching Characteristics							
t _{d(ON)}	Turn-on Delay Time	V _{CC} =400V, I _C =15A V _{GE} =0/15V, R _g =5Ω Inductive Load		--	16	--	ns
t _r	Rise Time			--	12	--	
t _{d(OFF)}	Turn-Off Delay Time			--	124	--	
t _f	Fall Time			--	12	--	
E _{on}	Turn-On Switching Loss			--	0.25	--	mJ
E _{off}	Turn-Off Switching Loss			--	0.12	--	
E _{ts}	Total Switching Loss			--	0.37	--	

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

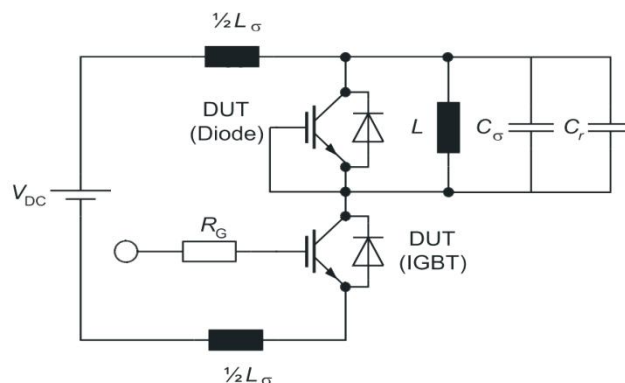
Symbol	Parameter	Conditions	Rating			Units
			Min.	Typ.	Max.	
V _{FM}	Diode Forward Voltage	I _F =15A	--	1.75	2.40	V
T _{rr}	Reverse Recovery Time	I _F =15A, di/dt=200A/us	--	170	--	ns
I _{RRM}	Diode Peak Reverse Recovery Current		--	6.5	--	A
Q _{rr}	Reverse Recovery Charge		--	0.6	--	uC
Pulse width t _p ≤380μs,δ≤2%						

Test Circuit

1) Gate Charge Test Circuit

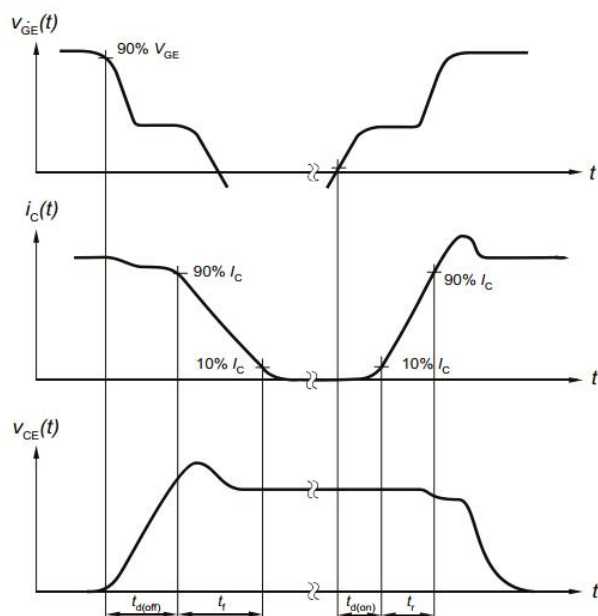


2) Switch Time Test Circuit

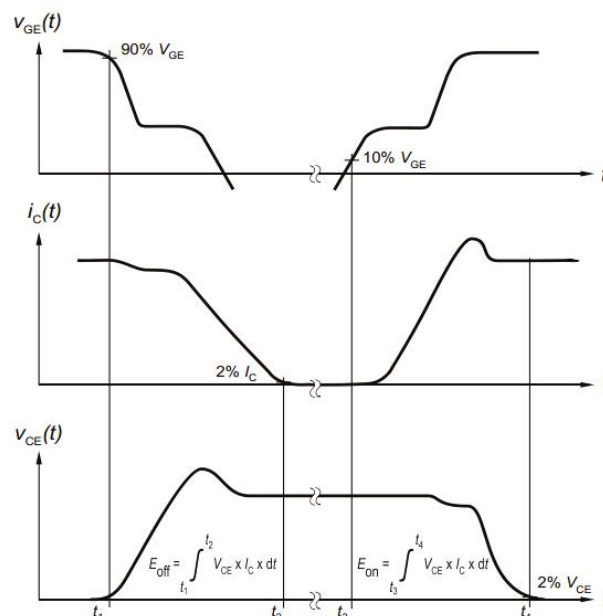


Switching characteristics

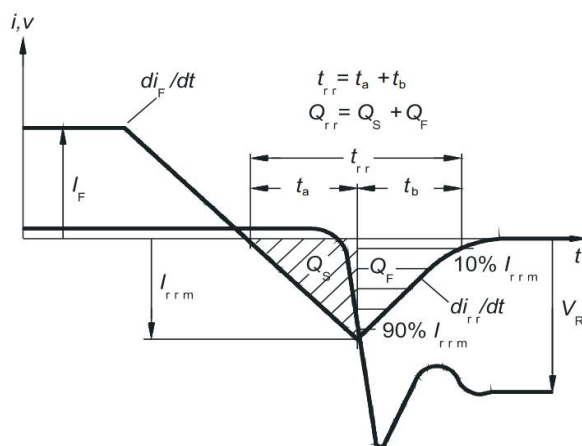
1) Definition of switching times



2) Definition of switching losses



3) Definition of diode switching characteristics



Typical Electrical and Thermal Characteristics

Figure 1 Output Characteristics

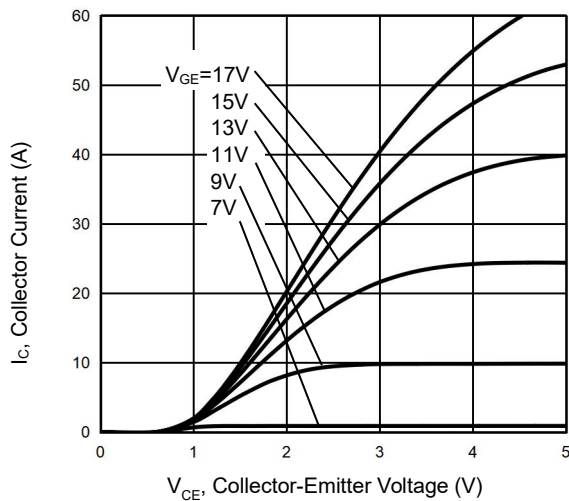


Figure 2 Transfer Characteristics

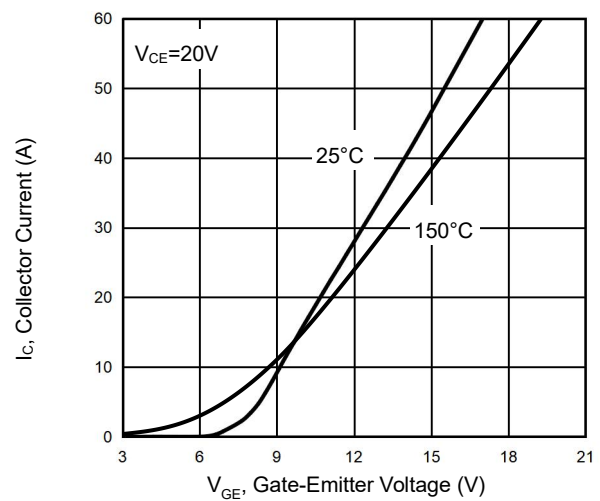


Figure 3 V_{CEsat} vs. Case Temperature

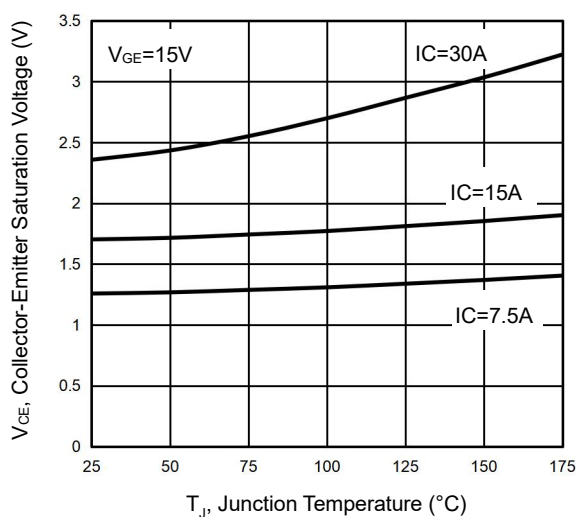


Figure 4 Saturation Voltage vs. V_{GE}

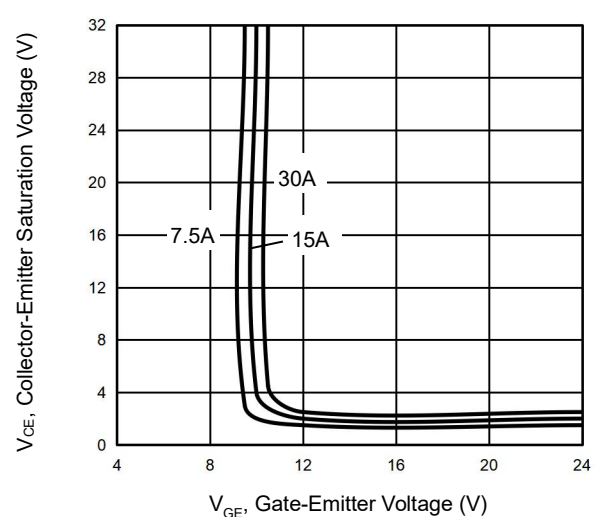


Figure 5 Capacitance Characteristics

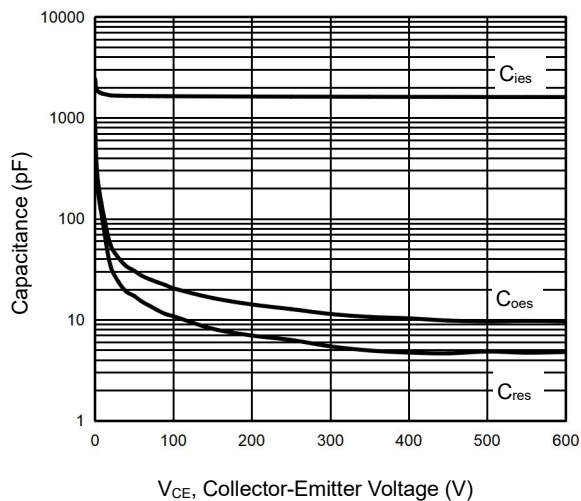
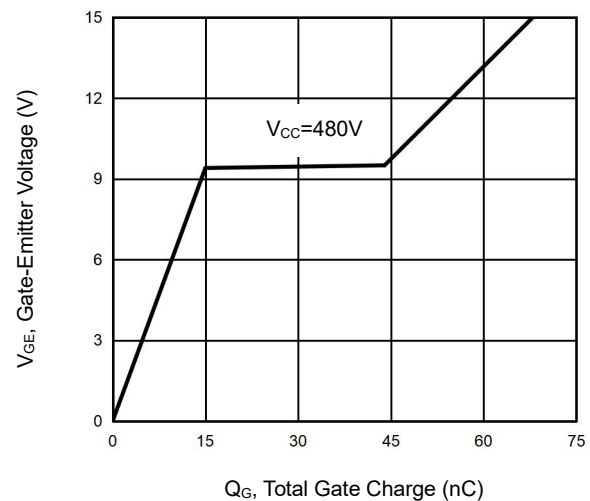


Figure 6 Gate charge waveform



Typical Electrical and Thermal Characteristics

Figure 7 Gate-emitter Threshold Voltage as a Function of Junction Temperature

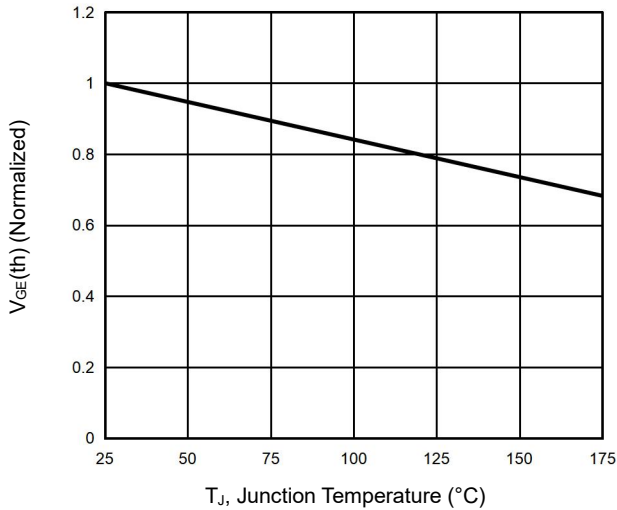


Figure 8 Typical Switching Times as a Function of Gate Resistor

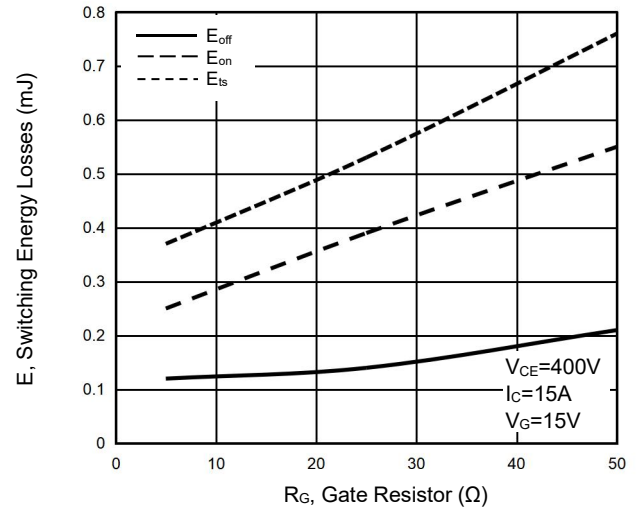


Figure 9 Typical Switching Times as a Function of Junction Temperature

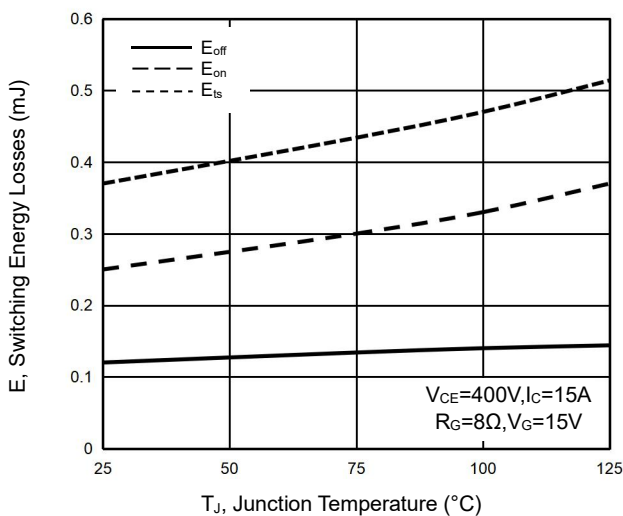


Figure 10 Power Dissipation as a Function of Case Temperature

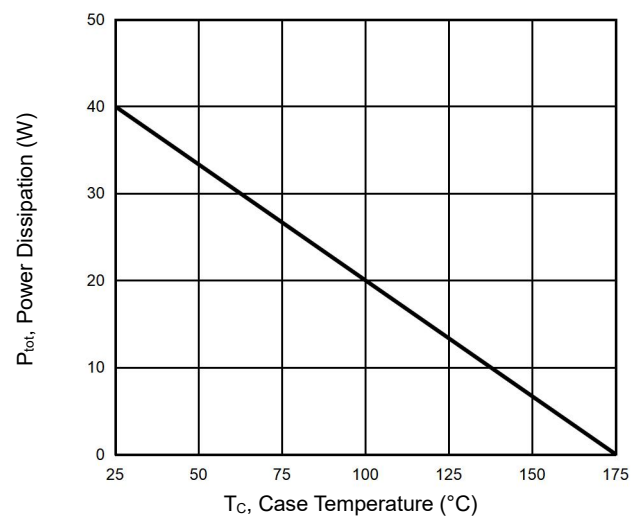


Figure 11 Forward Bias Safe Operating

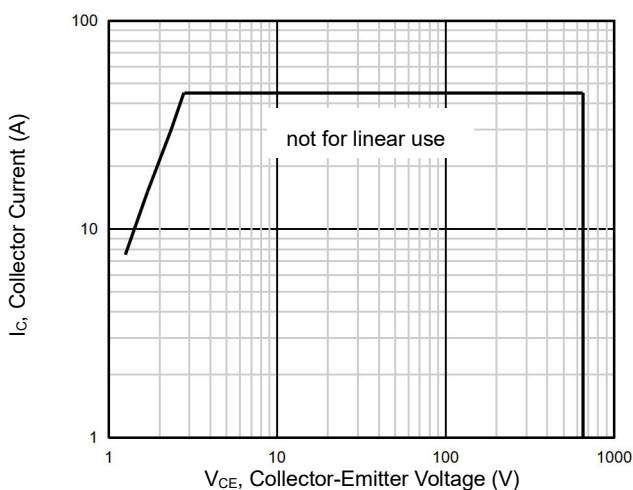
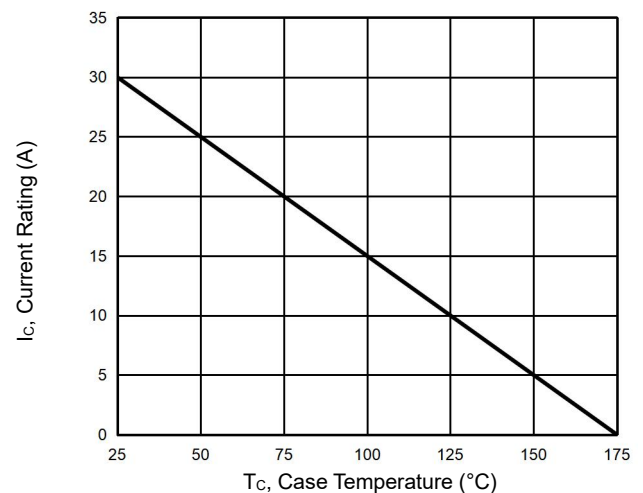


Figure 12 I_C vs. Temperature



Typical Electrical and Thermal Characteristics

Figure 13 Forward Characteristics

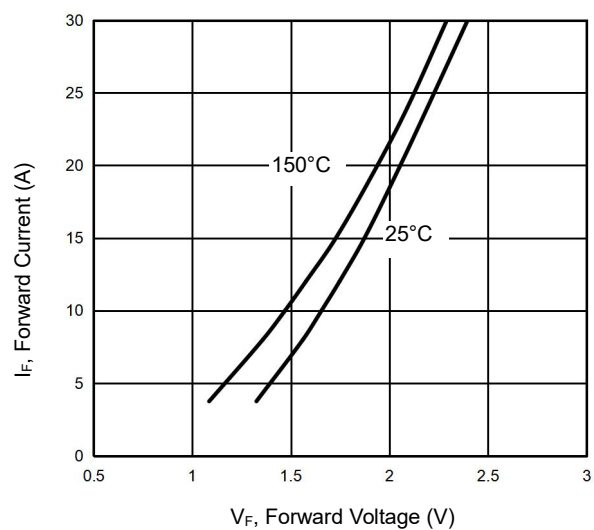
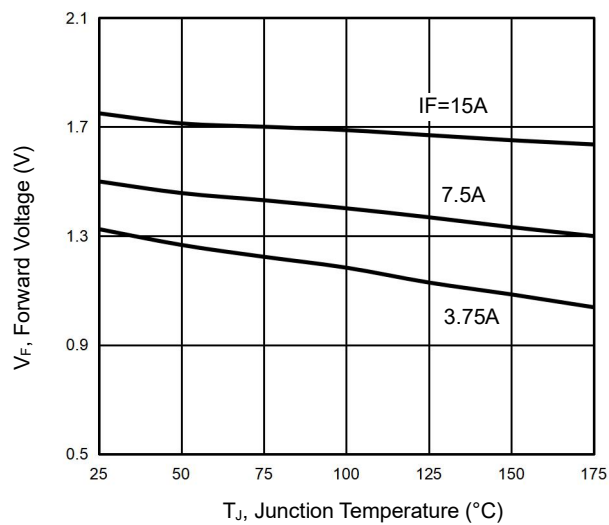
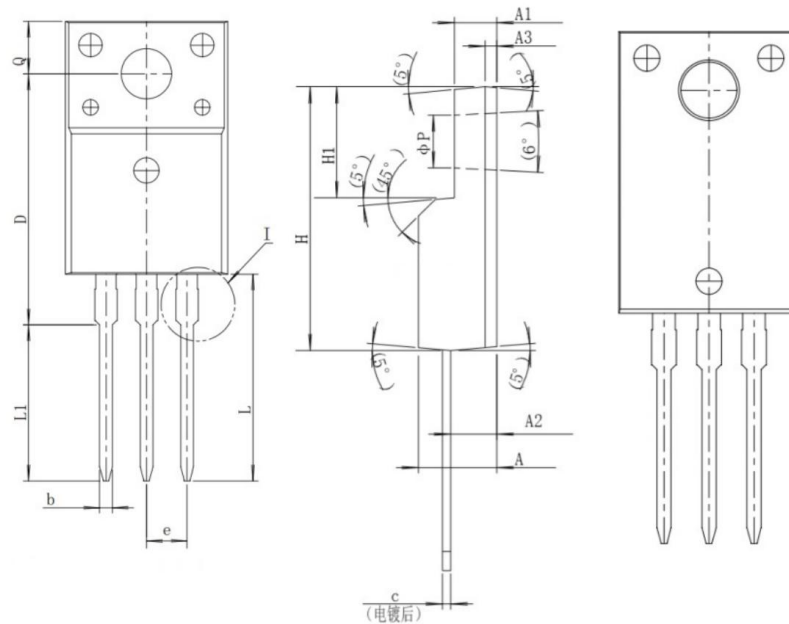


Figure 14 V_F vs. temperature

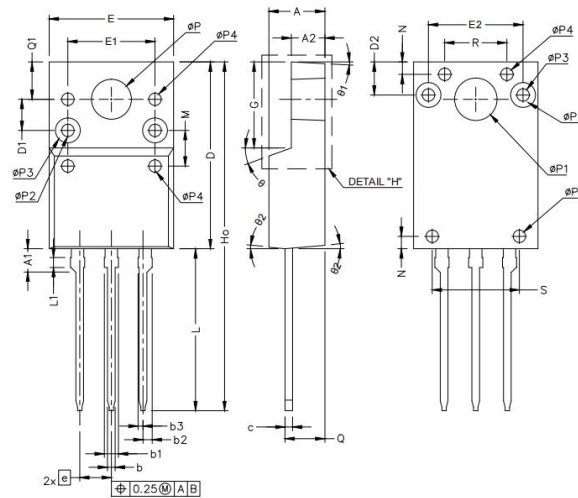


TO-220F-3L-M Package Information



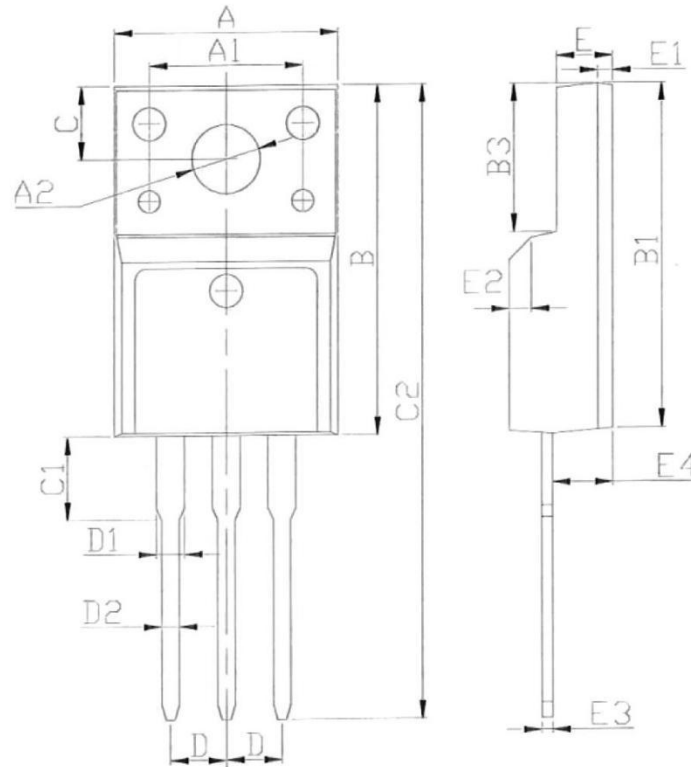
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.60	4.80	0.18	0.19
A1	2.44	2.64	0.10	0.11
A2	2.65	2.85	0.10	0.11
A3	0.70 REF		0.02 REF	
b	0.70	0.90	0.03	0.04
c	0.45	0.60	0.02	0.03
D	15.64	15.85	0.62	0.63
e	2.54 BSC		0.10 BSC	
H	15.77	15.97	0.62	0.63
H1	6.58	6.78	0.26	0.27
L	12.68	13.28	0.50	0.52
L1	9.60	10.00	0.38	0.39
Q	3.20	3.40	0.13	0.14
∅ P	3.08	3.28	0.12	0.13

TO-220F-3L-B Package Information



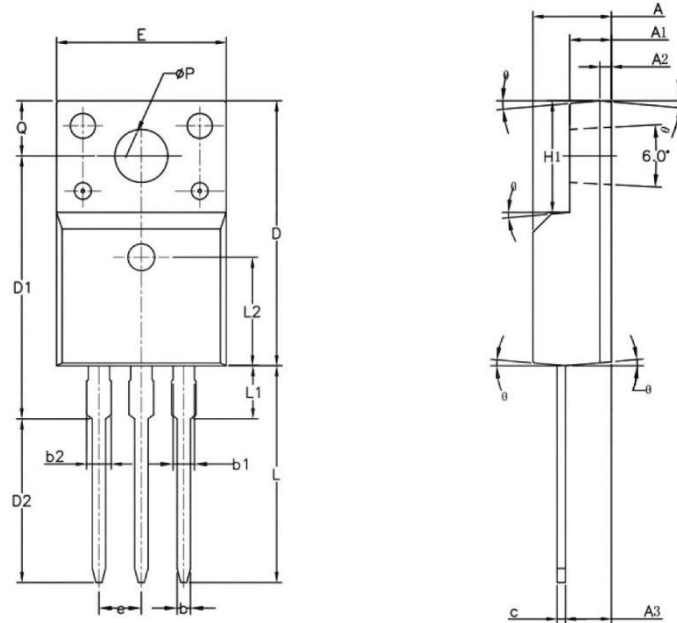
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.30	4.70	0.17	0.19
A1	1.80	2.10	0.07	0.08
A2	2.50	2.90	0.10	0.11
b	0.54	0.84	0.02	0.03
b1	0.99	1.29	0.04	0.05
b2	0.56	0.93	0.02	0.04
b3	0.24	0.55	0.01	0.02
c	0.49	0.79	0.02	0.03
D	14.70	15.30	0.58	0.60
D1	2.50 BSC		0.10 BSC	
D2	2.66 BSC		0.10 BSC	
e	2.29	2.79	0.09	0.11
E	9.70	10.30	0.38	0.41
E1	7.00 BSC		0.28 BSC	
E2	7.60 BSC		0.30 BSC	
G	6.70	7.10	0.26	0.28
Ho	28.00	BSC	1.10 BSC	
L	12.50	13.50	0.49	0.53
L1	0.70	0.90	0.03	0.04
M	2.86 BSC		0.11 BSC	
N	1.00 BSC		0.04 BSC	
∅ P	3.05	3.40	0.12	0.13
∅ P1	3.40 BSC		0.13 BSC	
∅ P2	1.00 BSC		0.04 BSC	
∅ P3	2.00 BSC		0.08 BSC	
∅ P4	1.00 BSC		0.04 BSC	
Q	3.10	3.30	0.12	0.13
Q1	2.70	3.30	0.11	0.13
R	5.00 BSC		0.20 BSC	
S	7.00 BSC		0.28 BSC	
θ	20° BSC		20° BSC	
θ1	3° BSC		3° BSC	
θ2	5° BSC		5° BSC	

TO-220F-3L-L Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	9.86	10.46	0.38	0.41
A1	6.80	7.20	0.26	0.28
A2	2.92	3.32	0.11	0.13
A3	9.40	10.00	0.37	0.39
B	15.40	16.40	0.60	0.64
B1	15.10	16.10	0.59	0.63
B2	4.40	5.00	0.17	0.19
B3	6.40	7.00	0.25	0.27
C	3.05	3.55	0.12	0.13
C1	2.95	3.55	0.11	0.13
C2	28.20	29.20	1.11	1.14
D	2.54	--	0.10	--
D1	--	1.47	--	0.05
D2	0.60	1.00	0.02	0.03
E	2.30	2.80	0.09	0.11
E1	0.45	0.95	0.01	0.03
E2	1.0×45°			
E3	0.30	0.70	0.01	0.02
E4	2.45	3.05	0.09	0.12

TO-220F-3L-P Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.50	4.83	0.17	0.19
A1	2.34	2.74	0.09	0.10
A2	0.70REF		0.02REF	
A3	2.56	2.93	0.10	0.11
b	0.70	0.9	0.02	0.03
b1	1.18	1.38	0.04	0.05
b2	--	1.47	--	0.05
c	0.45	0.60	0.01	0.02
D	15.67	16.07	0.61	0.63
D1	15.55	15.95	0.61	0.62
D2	9.60	10.00	0.37	0.39
E	9.96	10.36	0.39	0.40
e	2.54BSC		0.10BSC	
H1	6.48	6.88	0.25	0.27
L	12.68	13.28	0.49	0.52
L1	--	3.50	--	0.13
L2	6.50REF		0.25REF	
ØP	3.08	3.28	0.12	0.13
Q	3.20	3.40	0.12	0.13
θ1	1°	5°	1°	5°

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