

## 600V, 7A, 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;

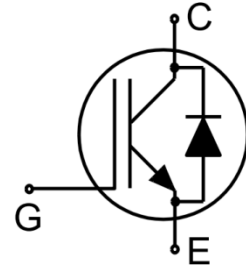
### Features

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
NCE07TD60BI	TO-251	NCE07TD60BI
NCE07TD60BK	TO-252	NCE07TD60BK



TO-251



TO-252

### 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	$\pm 30$	V
$I_C$	Collector Current	14	A
	Collector Current @ $T_C = 100^\circ\text{C}$	7	A
$I_{Cplus}$	Pulsed Collector Current, $t_p$ limited by $T_{jmax}$	21	A
-	turn off safe operating area, $V_{CE}=600\text{V}$ , $T_J=150^\circ\text{C}$	21	A
$I_F$	Diode Continuous Forward Current @ $T_C = 100^\circ\text{C}$	7	A
$I_{FM}$	Diode Maximum Forward Current	21	A
$P_D$	Power Dissipation @ $T_C = 25^\circ\text{C}$	73	W
	Power Dissipation @ $T_C = 100^\circ\text{C}$	29	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 $V_{GE}=15\text{V}$ , $V_{CC}\leq 400\text{V}$ , Allowed number of short circuits<1000Time between short circuits: $\geq 1.0\text{s}$ , $T_J\leq 150^\circ\text{C}$	3	us

**Thermal Characteristic**

Symbol	Parameter	Value	Units
R <sub>θJC</sub>	Thermal Resistance, Junction to case for IGBT	1.71	°C/W
R <sub>θJC</sub>	Thermal Resistance, Junction to case for Diode	2.50	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction to Ambient	62	°C/W

**Electrical Characteristics (T<sub>c</sub>=25°C unless otherwise noted)**

Symbol	Parameter	Test Conditions	Value			Units
			Min.	Typ.	Max.	
<b>Static Characteristics</b>						
V <sub>(BR)CES</sub>	Collector-Emitter Breakdown Voltage	V <sub>GE</sub> =0V, I <sub>CE</sub> =1mA	600	--	--	V
I <sub>CES</sub>	Collector-Emitter Leakage Current	V <sub>GE</sub> =0V, V <sub>CE</sub> =600V	--	--	4	μA
I <sub>GES(F)</sub>	Gate to Emitter Forward Leakage	V <sub>GE</sub> =+30V, V <sub>CE</sub> =0V	--	--	100	nA
I <sub>GES(R)</sub>	Gate to Source Reverse Leakage	V <sub>GE</sub> =-30V, V <sub>CE</sub> =0V	--	--	100	nA
V <sub>CE(sat)</sub>	Collector-Emitter Saturation Voltage	I <sub>C</sub> =5A, T <sub>J</sub> =25°C	--	1.7	1.9	V
		V <sub>GE</sub> =15V, T <sub>J</sub> =100°C	--	1.9	--	V
V <sub>GE(th)</sub>	Gate Threshold Voltage	I <sub>C</sub> =1mA, V <sub>CE</sub> =V <sub>GE</sub>	4.0	5.0	6.0	V
<b>Dynamic Characteristics</b>						
C <sub>ies</sub>	Input Capacitance	V <sub>CE</sub> =25V, V <sub>GE</sub> =0V, f=1MHz	--	675	--	pF
C <sub>oes</sub>	Output Capacitance		--	22	--	
C <sub>res</sub>	Reverse Transfer Capacitance		--	13	--	
Q <sub>g</sub>	Total Gate Charge	V <sub>CC</sub> =480V, I <sub>C</sub> =7A, V <sub>GE</sub> =15V	--	28	--	nC
Q <sub>ge</sub>	Gate to Emitter Charge		--	8	--	
Q <sub>gc</sub>	Gate to Collector Charge		--	13	--	
I <sub>C(SC)</sub>	Short circuit collector current Max.1000 short circuits Time between short circuits: ≥1.0s	V <sub>GE</sub> =15V, V <sub>CC</sub> ≤400V, t <sub>sc</sub> ≤3us, T <sub>J</sub> ≤150°C	--	34	--	A
<b>Switching Characteristics</b>						
t <sub>d(ON)</sub>	Turn-on Delay Time	V <sub>CC</sub> =400V, I <sub>C</sub> =7A, V <sub>GE</sub> =0/15V, R <sub>g</sub> =5Ω Inductive Load	--	20	--	ns
t <sub>r</sub>	Rise Time		--	15	--	
t <sub>d(OFF)</sub>	Turn-Off Delay Time		--	73	--	
t <sub>f</sub>	Fall Time		--	18	--	
E <sub>on</sub>	Turn-On Switching Loss		--	0.21	--	mJ
E <sub>off</sub>	Turn-Off Switching Loss		--	0.10	--	
E <sub>ts</sub>	Total Switching Loss		--	0.31	--	

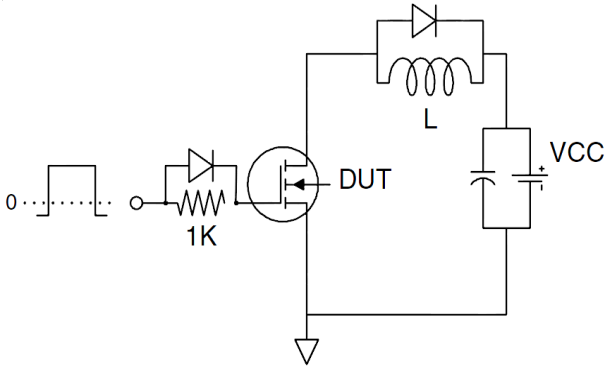
**Electrical Characteristics of the Diode(T<sub>c</sub>= 25°C unless otherwise specified):**

Symbol	Parameter	Test Conditions	Rating			Units
			Min.	Typ.	Max.	
V <sub>FM</sub>	Diode Forward Voltage	I <sub>F</sub> =7A	--	1.5	1.7	V
T <sub>rr</sub>	Reverse Recovery Time	I <sub>F</sub> =7A, di/dt=200A/us	--	230	--	ns
I <sub>RRM</sub>	Diode Peak Reverse Recovery Current		--	3.5	--	A
Q <sub>rr</sub>	Reverse Recovery Charge		--	0.44	--	μC

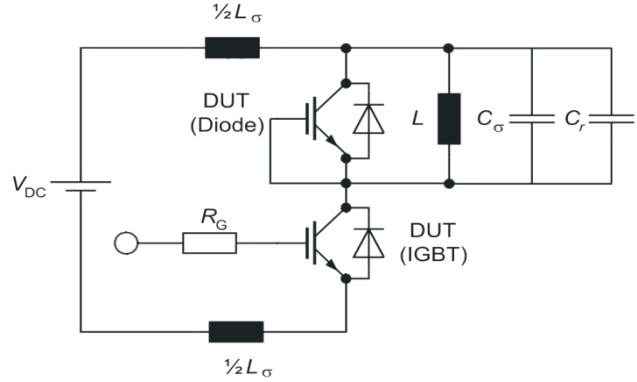
Pulse width t<sub>tp</sub>≤380μs, δ≤2%

Test Circuit

1) Gate Charge Test Circuit

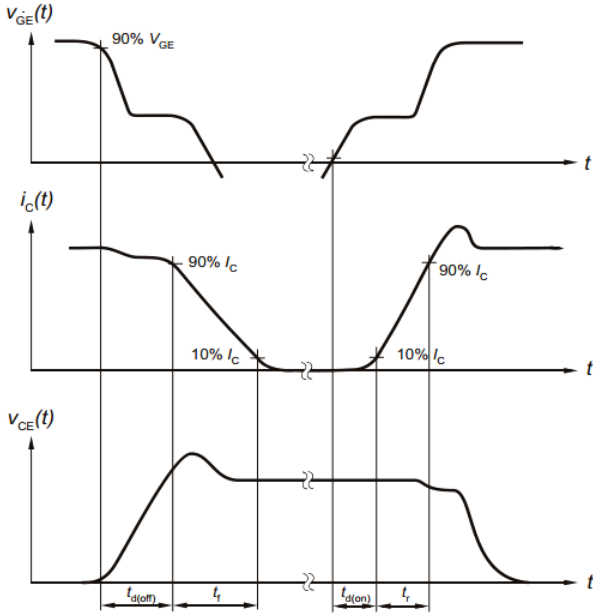


2) Switch Time Test Circuit

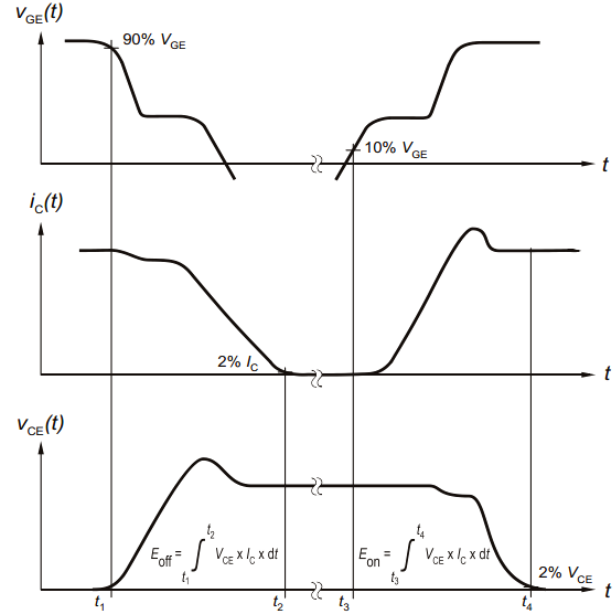


Switching characteristics

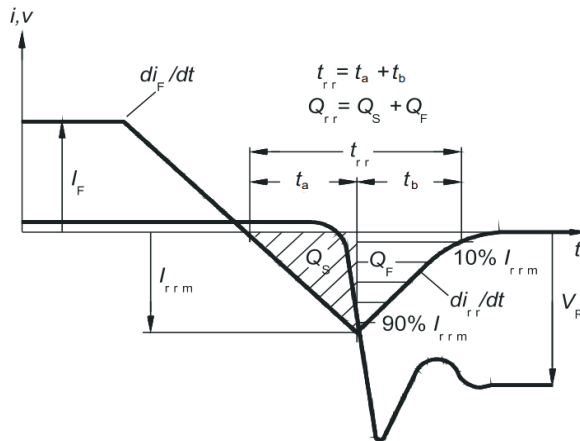
1) definition of switching times



2) definition of switching losses



3) Definition of diode switching characteristics



Typical Electrical and Thermal Characteristics

Figure 1 Output Characteristics

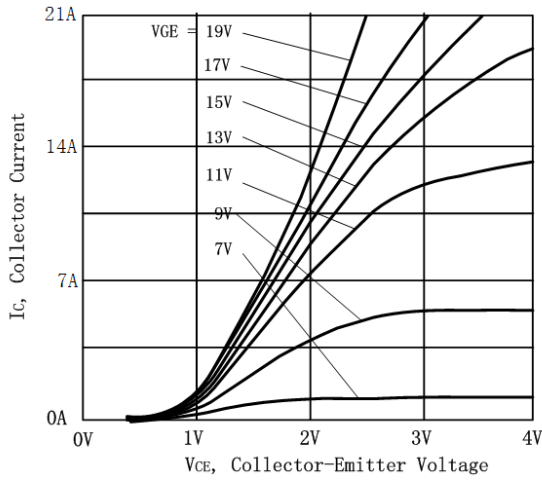


Figure 2 Transfer Characteristics

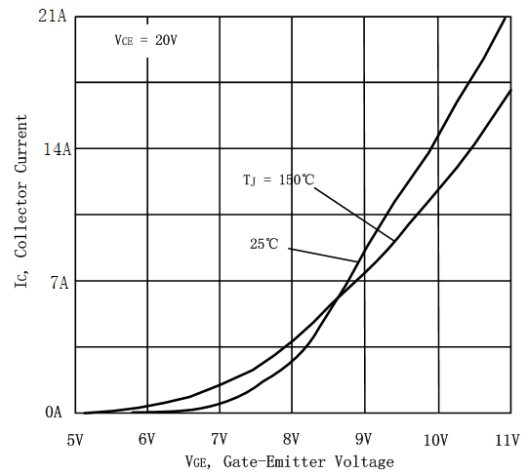


Figure 3  $V_{CEsat}$  vs. Case Temperature

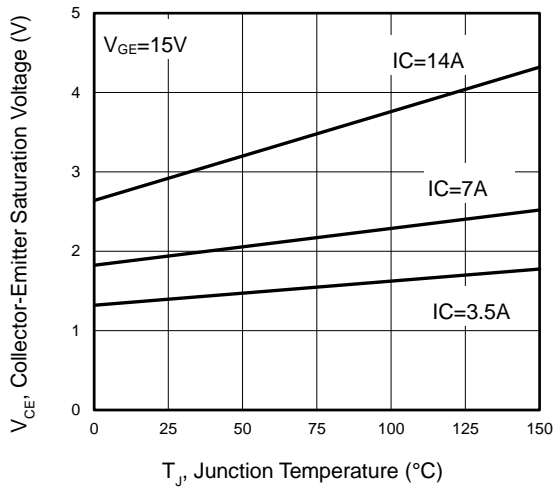


Figure 4 Saturation Voltage vs.  $V_{GE}$

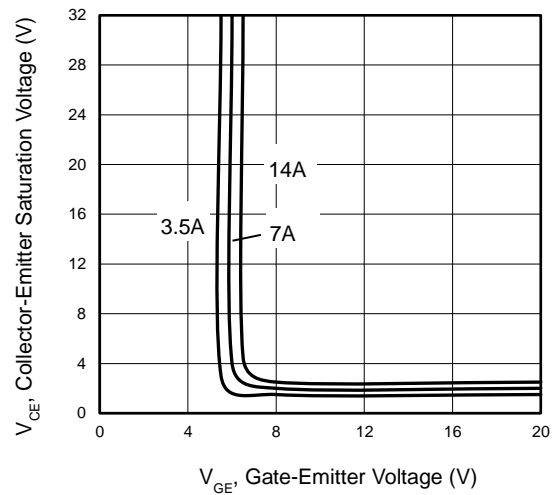


Figure 5 Capacitance Characteristics

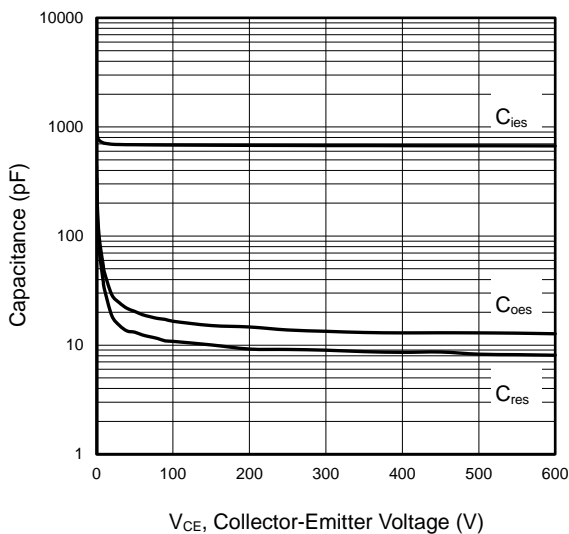
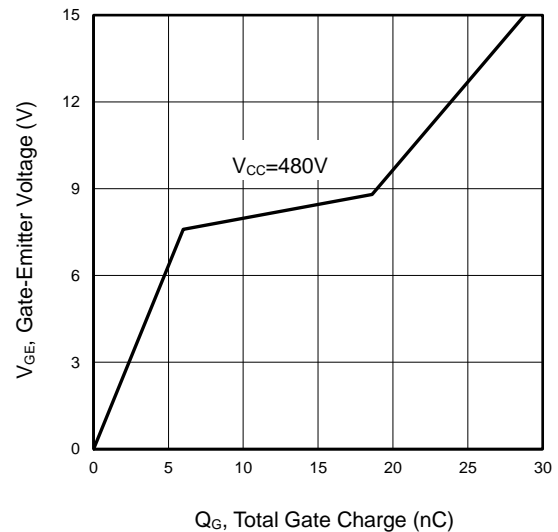
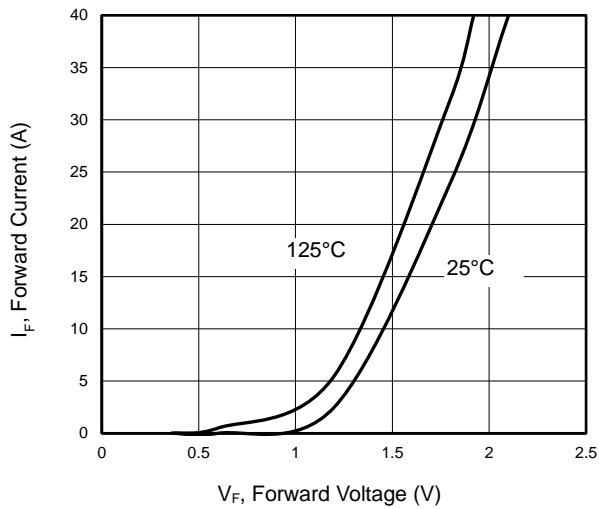


Figure 6 Gate charge waveform

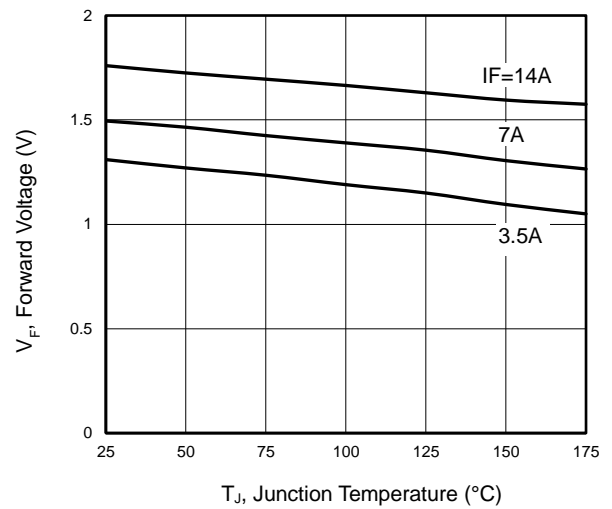


## Typical Electrical and Thermal Characteristics

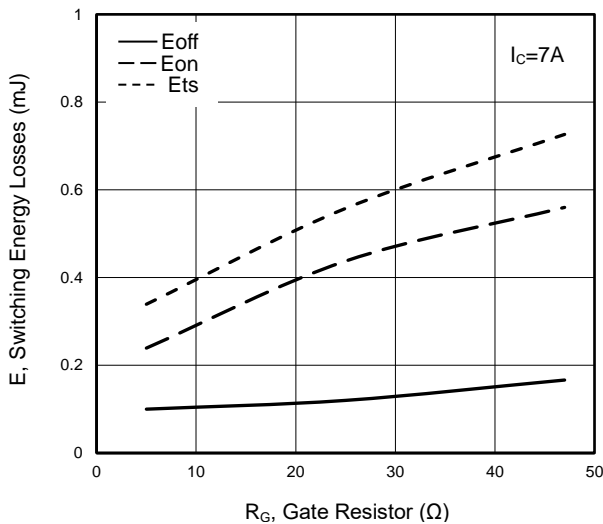
**Figure 7 Forward Characteristics**



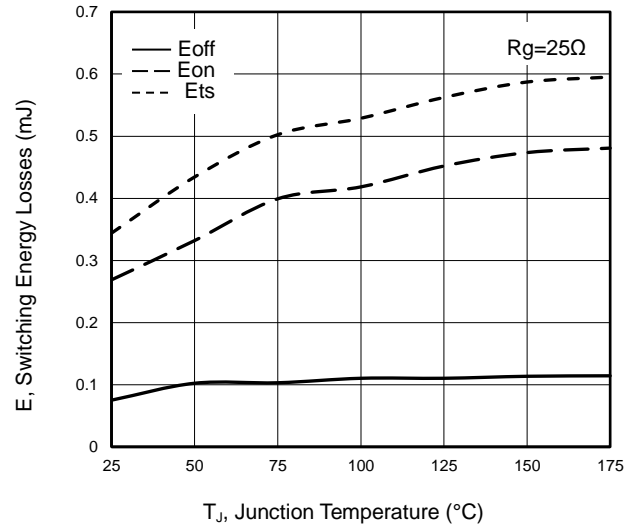
**Figure 8  $V_F$  vs. Temperature**



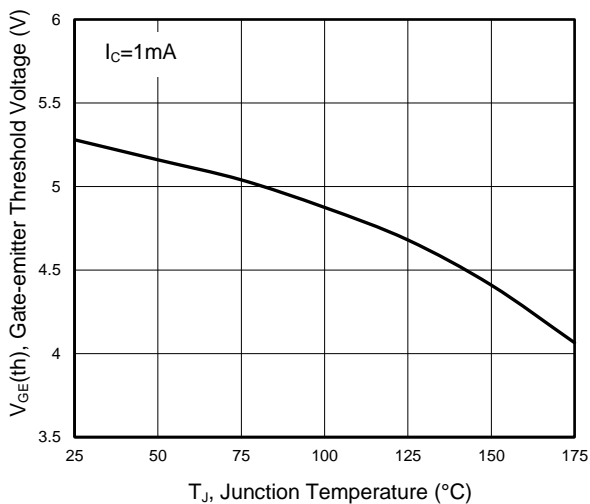
**Figure 9 Typical Switching Times as a Function of Gate Resistor**



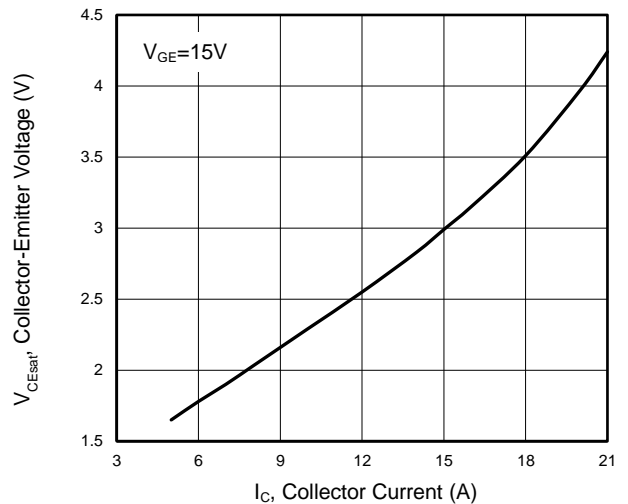
**Figure 10 Typical Switching Times as a Function of Junction Temperature**



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

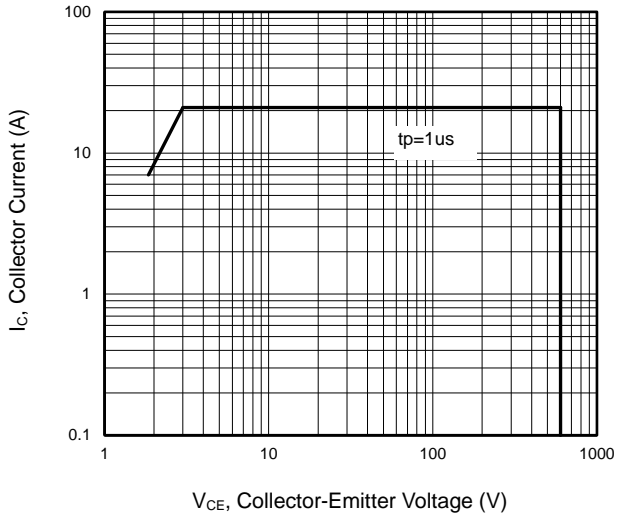


**Figure 12 Typical Collector-emitter Saturation Voltage as a function of Collector Current**

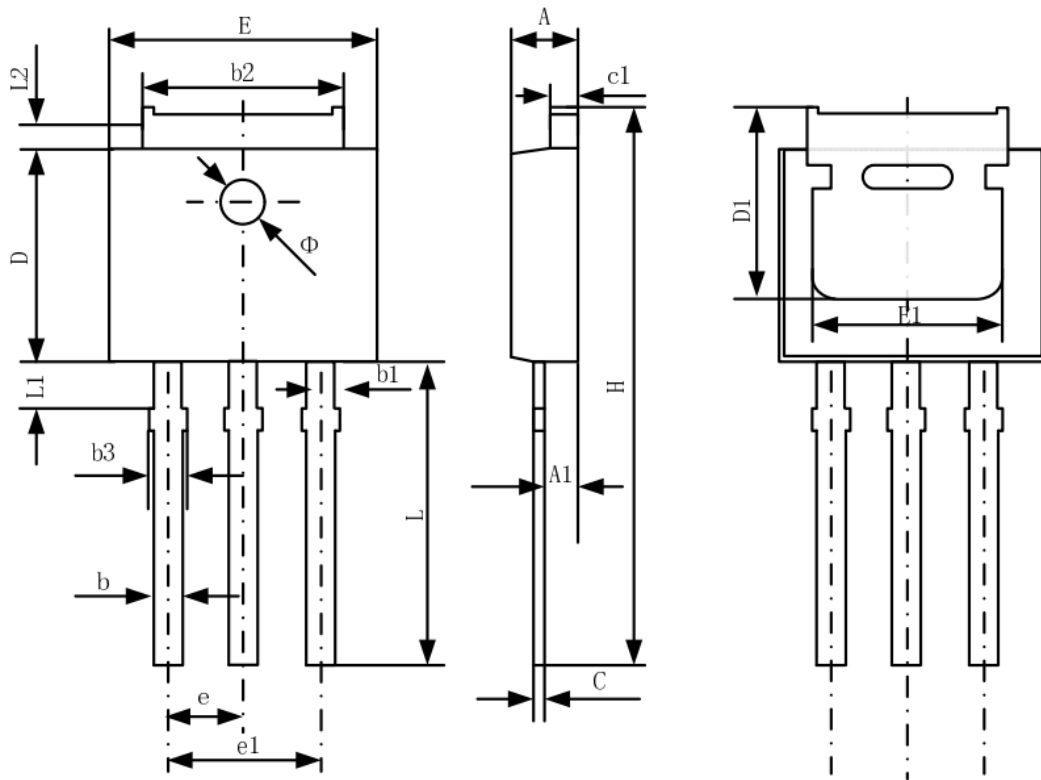


### Typical Electrical and Thermal Characteristics

Figure 13 Forward Bias Safe Operating Area

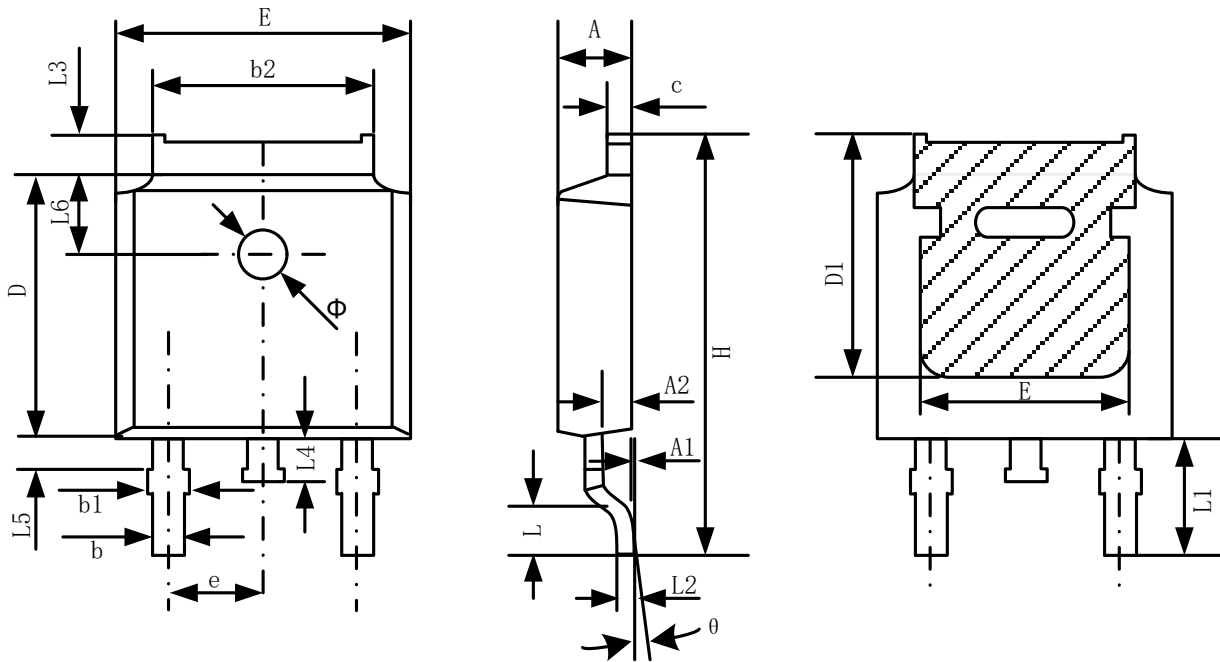


## TO-251 Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	2.20	2.35	0.087	0.093
A1	0.90	1.10	0.035	0.043
b	0.56	0.69	0.022	0.027
b1	0.77	0.90	0.030	0.035
b2	5.23	5.43	0.206	0.214
b3		1.05		0.041
C	0.46	0.59	0.018	0.023
c1	0.46	0.59	0.018	0.023
D	6.00	6.20	0.236	0.244
D1	5.20		0.205	
E	6.50	6.70	0.256	0.264
E1	4.60	5.00	0.181	0.197
e	2.24	2.34	0.088	0.092
e1	4.47	4.67	0.176	0.184
H	16.18	16.78	0.637	0.661
L	9.00	9.60	0.354	0.378
L1	0.95	1.35	0.037	0.053
L2	0.90	1.25	0.035	0.049

## TO-252-2 Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	2.20	2.38	0.087	0.094
A1	0.00	0.10	0.000	0.004
A2	0.90	1.10	0.035	0.043
b	0.72	0.85	0.028	0.033
b1	0.72	0.90	0.028	0.035
b2	5.13	5.46	0.202	0.215
c	0.47	0.60	0.019	0.024
D	6.00	6.20	0.236	0.244
D1	5.25	--	0.207	--
E	6.50	6.70	0.256	0.264
E1	4.70	--	0.185	--
e	2.19	2.39	0.086	0.094
H	9.80	10.40	0.386	0.409
L	1.40	1.70	0.055	0.067
L1	2.90 REF		0.114 REF	
L2	0.508 BSC		0.020 BSC	
L3	0.90	1.25	0.035	0.049
L4	0.60	1.00	0.024	0.039
L5	0.15	0.75	0.006	0.030
L6	1.80 REF		0.071 REF	
Φ	1.20	1.40	0.047	0.055
θ	0°	8°	0°	8°



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