

## 1200V, 75A, Trench FS II Fast IGBT

### General Description

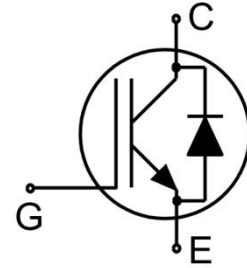
Using NCE's proprietary trench design and advanced FS (Field Stop) second generation technology, the 1200V Trench FSII IGBT offers superior conduction and switching performances, and easy parallel operation;

### 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

- Inverters
- Motor drives
- Converter



Schematic diagram

### Package Marking and Ordering Information

Device	Device Package	Device Marking
NCE75TD120BT	TO-247	NCE75TD120BT



TO-247

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

Symbol	Parameter	Value	Units
$V_{CES}$	Collector-Emitter Voltage	1200	V
$V_{GES}$	Gate- Emitter Voltage	$\pm 30$	V
$I_C$	Collector Current	150	A
	Collector Current @ $T_C = 100^\circ\text{C}$	75	A
$I_{Cpuls}$	Pulsed Collector Current, $t_p$ limited by $T_{jmax}$	225	A
-	Turn off safe operating area, $V_{CE}=1200\text{V}$ , $T_J=175^\circ\text{C}$	225	A
$I_F$	Diode Continuous Forward Current @ $T_C = 100^\circ\text{C}$	75	A
$I_{FM}$	Diode Maximum Forward Current	225	A
$P_D$	Power Dissipation @ $T_C = 25^\circ\text{C}$	833	W
	Power Dissipation @ $T_C = 100^\circ\text{C}$	417	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 $V_{GE}=15.0\text{V}$ , $V_{CC} \leq 600\text{V}$ , Allowed number of short circuits<1000Time between short circuits: $\geq 1.0\text{s}$ , $T_J \leq 150^\circ\text{C}$	10	$\mu\text{s}$

**Thermal Characteristic**

Symbol	Parameter	Value	Units
R <sub>θJC</sub>	Thermal Resistance, Junction to case for IGBT	0.18	°C/W
R <sub>θJC</sub>	Thermal Resistance, Junction to case for Diode	0.44	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction to Ambient	40	°C/W

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

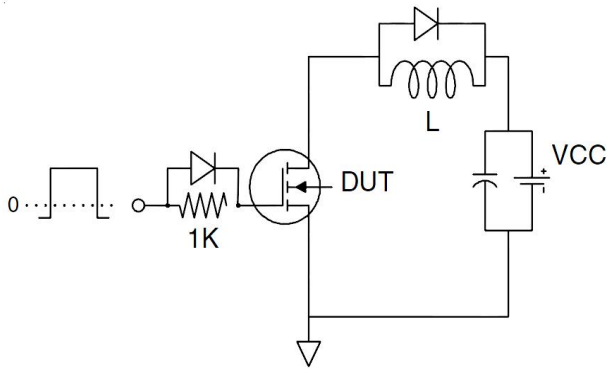
Symbol	Parameter	Conditions	Value			Units	
			Min.	Typ.	Max.		
<b>Static Characteristics</b>							
V <sub>(BR)CES</sub>	Collector-Emitter Breakdown Voltage	V <sub>GE</sub> =0V, I <sub>CE</sub> =3mA	1200	--	--	V	
I <sub>CES</sub>	Collector-Emitter Leakage Current	V <sub>GE</sub> =0V, V <sub>CE</sub> =1200V	--	--	400	uA	
I <sub>GES(F)</sub>	Gate to Emitter Forward Leakage	V <sub>GE</sub> =+30V, V <sub>CE</sub> =0V	--	--	200	nA	
I <sub>GES(R)</sub>	Gate to Emitter Reverse Leakage	V <sub>GE</sub> =-30V, V <sub>CE</sub> =0V	--	--	200	nA	
V <sub>CE(sat)</sub>	Collector-Emitter Saturation Voltage	I <sub>C</sub> =75A, T <sub>J</sub> =25°C	--	1.55	1.80	V	
		V <sub>GE</sub> =15V, T <sub>J</sub> =175°C	--	1.80	--	V	
V <sub>GE(th)</sub>	Gate Threshold Voltage	I <sub>C</sub> =3mA, V <sub>CE</sub> =V <sub>GE</sub>	5.0	--	6.5	V	
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> ≤600V, t <sub>SC</sub> ≤10us, T <sub>J</sub> ≤150°C	--	450	--	A	
<b>Dynamic Characteristics</b>							
C <sub>ies</sub>	Input Capacitance	V <sub>CE</sub> =30V, V <sub>GE</sub> =0V, f=1MHz	--	9747	--	pF	
C <sub>oes</sub>	Output Capacitance		--	327	--		
C <sub>res</sub>	Reverse Transfer Capacitance		--	271	--		
Q <sub>g</sub>	Total Gate Charge	V <sub>CC</sub> =960V, I <sub>C</sub> =75A, V <sub>GE</sub> =15V	--	572	--	nC	
Q <sub>ge</sub>	Gate to Emitter Charge		--	69	--		
Q <sub>gc</sub>	Gate to Collector Charge		--	368	--		
<b>Switching Characteristics</b>							
t <sub>d(ON)</sub>	Turn-on Delay Time	V <sub>CE</sub> =600V, I <sub>C</sub> =75A, V <sub>GE</sub> =0/15V, R <sub>g</sub> =8Ω Inductive Load	--	19	--	ns	
t <sub>r</sub>	Rise Time		--	17	--		
t <sub>d(OFF)</sub>	Turn-Off Delay Time		--	170	--		
t <sub>f</sub>	Fall Time		--	18	--		
E <sub>on</sub>	Turn-On Switching Loss		V <sub>CE</sub> =600V, I <sub>C</sub> =75A, V <sub>GE</sub> =0/15V, R <sub>g</sub> =8Ω T <sub>J</sub> =175°C	--	6.7	--	mJ
E <sub>off</sub>	Turn-Off Switching Loss			--	3.7	--	
E <sub>ts</sub>	Total Switching Loss	--		10.4	--		
E <sub>on</sub>	Turn-On Switching Loss	V <sub>CE</sub> =600V, I <sub>C</sub> =75A, V <sub>GE</sub> =0/15V, R <sub>g</sub> =8Ω T <sub>J</sub> =175°C	--	8.3	--	mJ	
E <sub>off</sub>	Turn-Off Switching Loss		--	5.3	--		
E <sub>ts</sub>	Total Switching Loss		--	13.6	--		

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

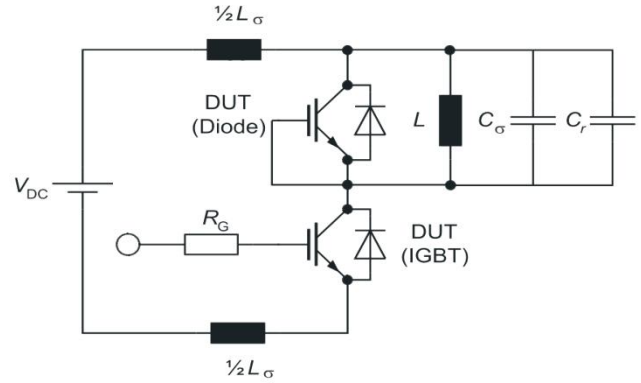
Symbol	Parameter	Test Conditions	Rating			Units
			Min.	Typ.	Max.	
V <sub>FM</sub>	Diode Forward Voltage	I <sub>F</sub> =75A	--	2.2	2.8	V
T <sub>rr</sub>	Reverse Recovery Time	I <sub>F</sub> =37.5A, di/dt=800A/us	--	180	--	ns
I <sub>RRM</sub>	Diode Peak Reverse Recovery Current		--	29	--	A
Q <sub>rr</sub>	Reverse Recovery Charge		--	2.6	--	uC

## Test Circuit

### 1) Gate Charge Test Circuit

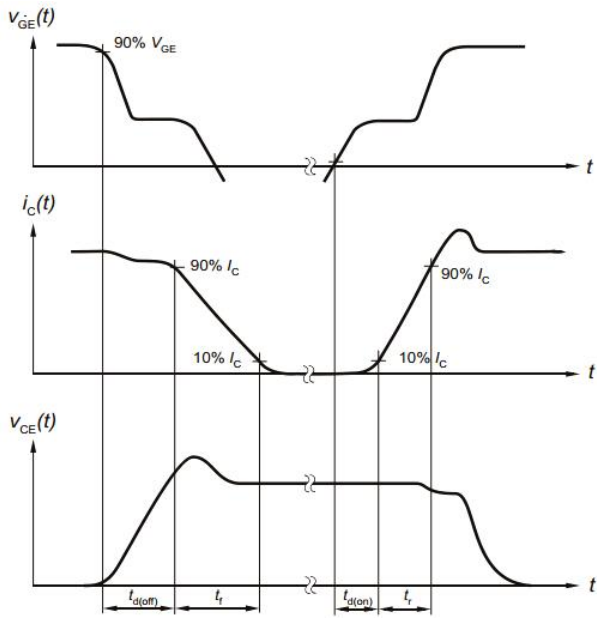


### 2) Switch Time Test Circuit

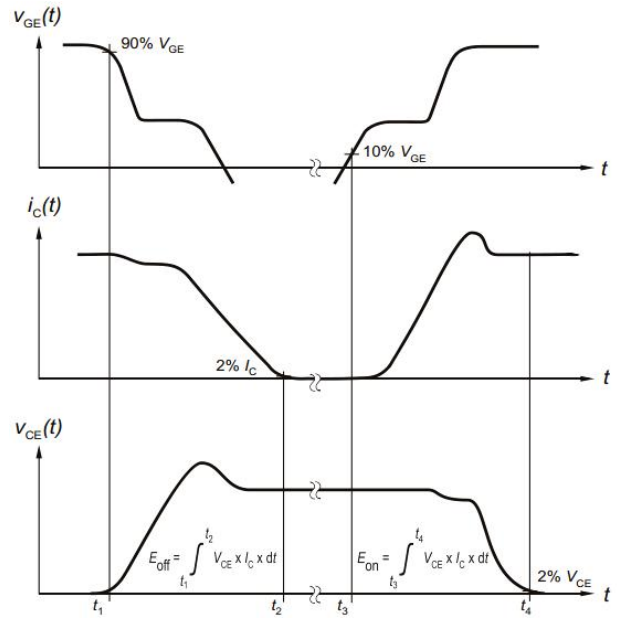


## Switching characteristics

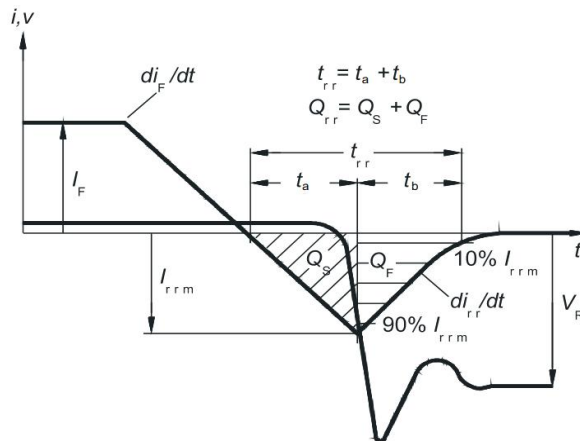
### 1) Definition of switching times



### 2) Definition of switching losses



### 3) Definition of diode switching characteristics



Typical Electrical and Thermal Characteristics

Figure 1 Output Characteristics

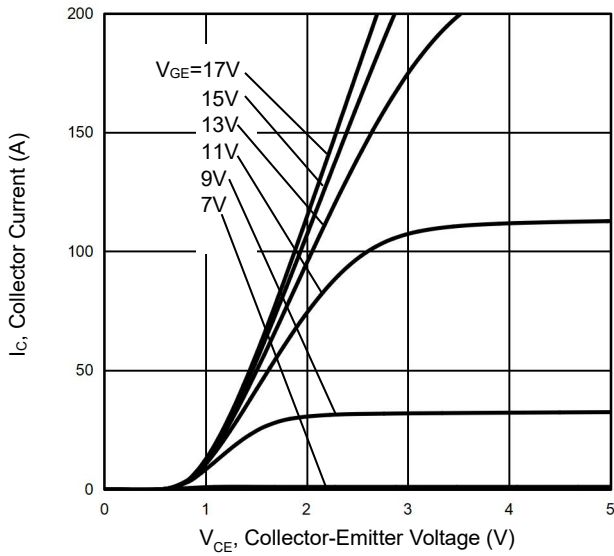


Figure 2 Transfer Characteristics

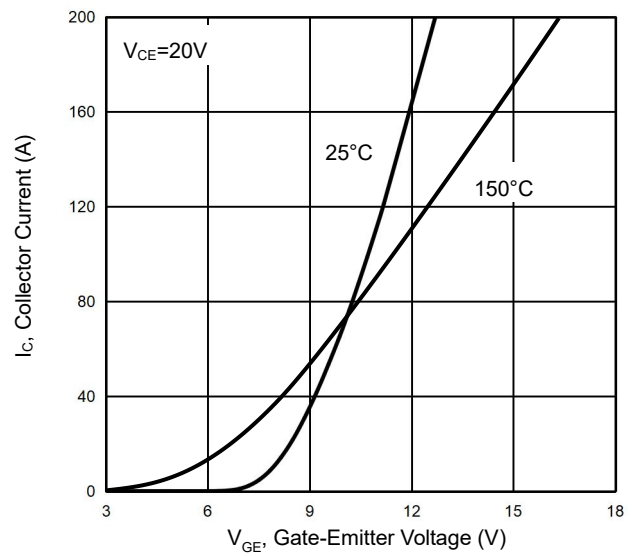


Figure 3  $V_{CE(sat)}$  vs. Case Temperature

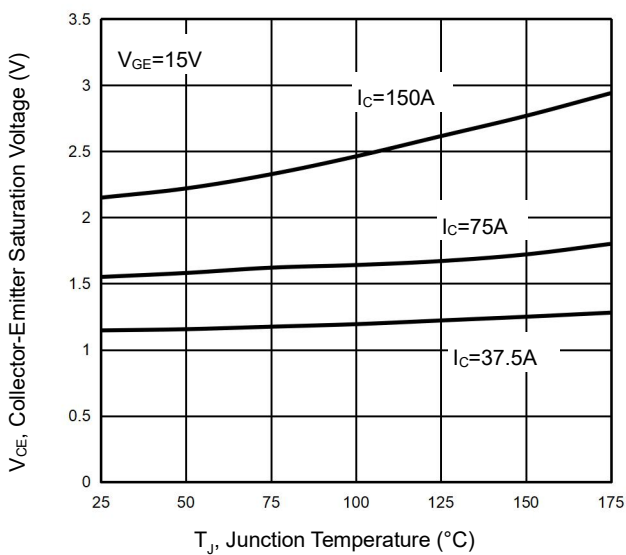


Figure 4 Saturation Voltage vs.  $V_{GE}$

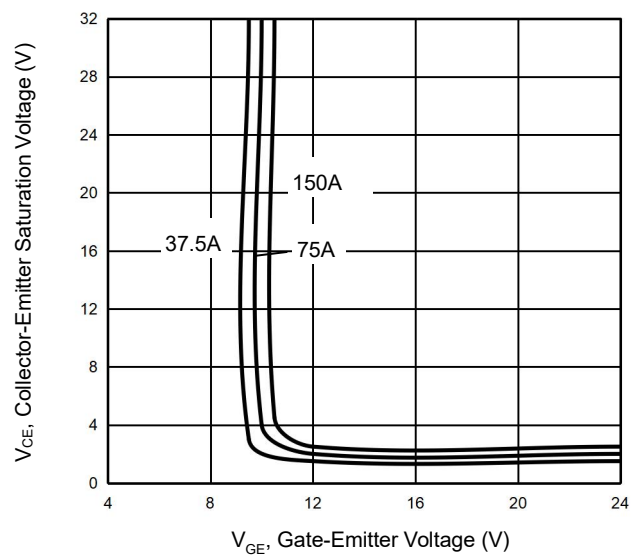


Figure 5 Capacitance Characteristics

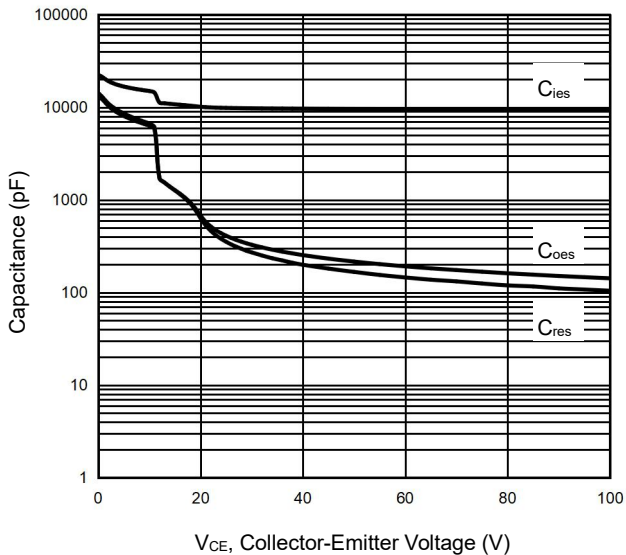
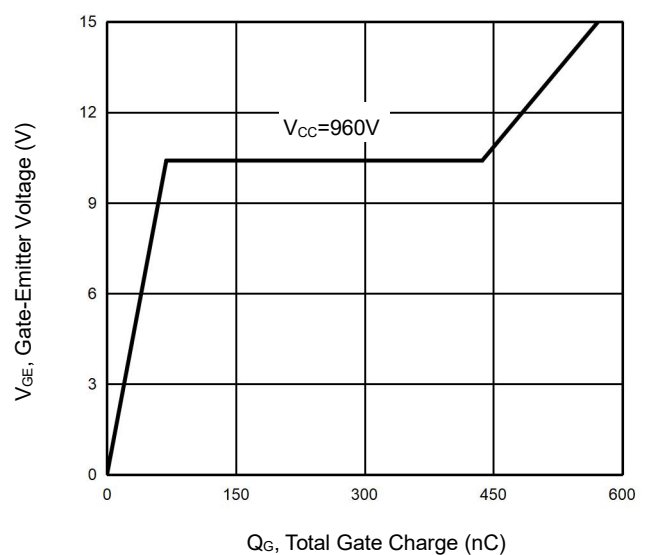


Figure 6 Gate Charge Wave Form



Typical Electrical and Thermal Characteristics

Figure 7 Forward Characteristics

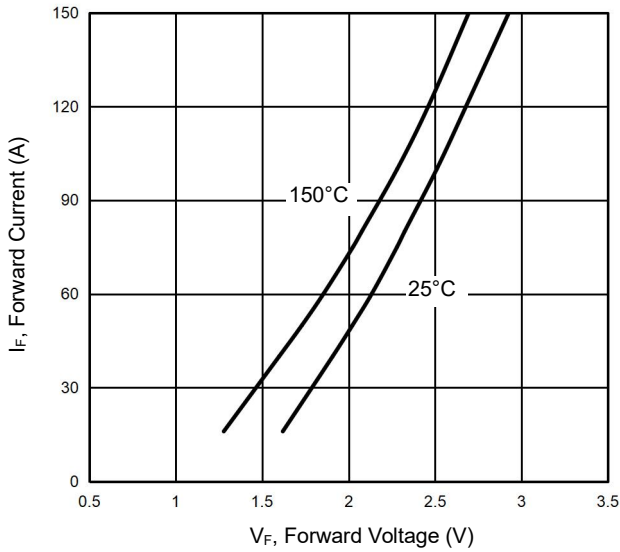


Figure 8  $V_F$  vs. Temperature

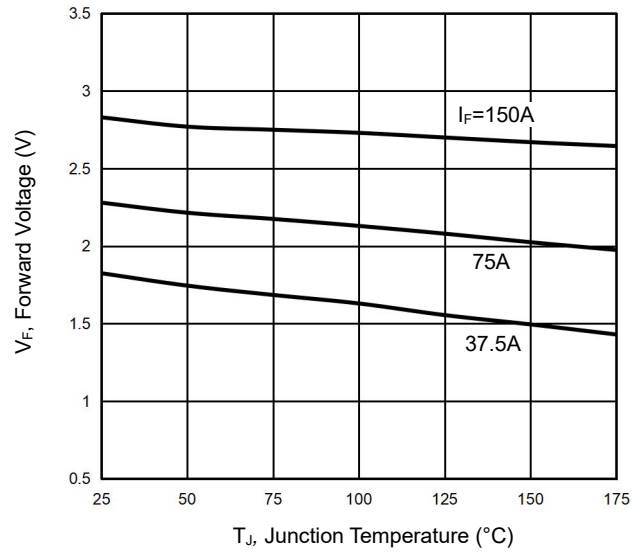


Figure 9 Switching Energy vs. Temperature

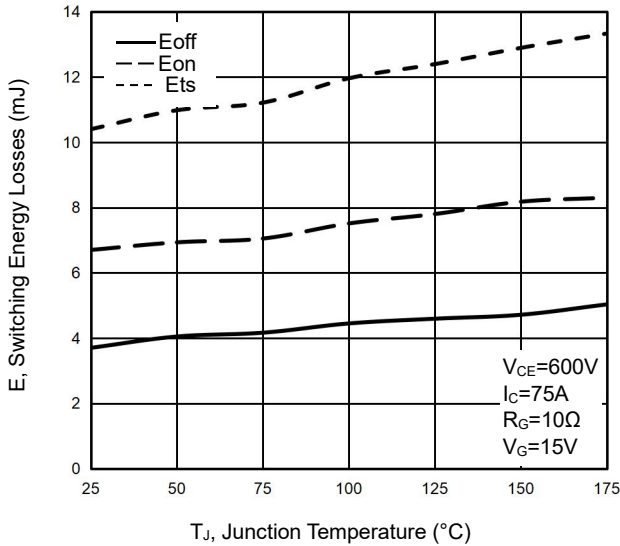


Figure 10 Forward Bias Safe Operating Area

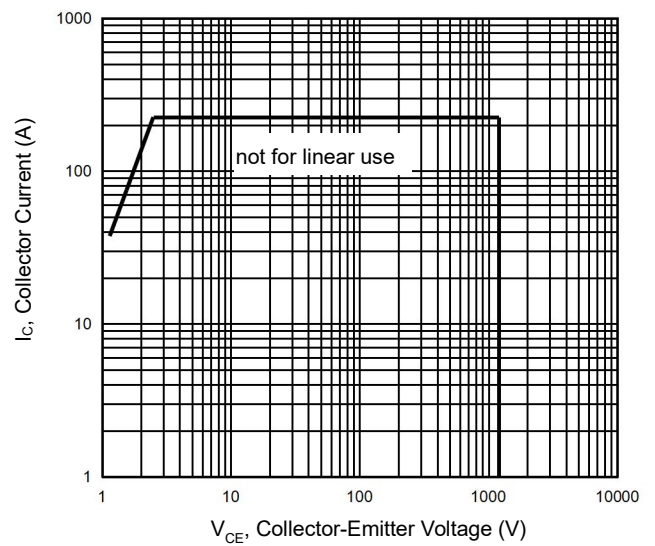


Figure 11 Gate-Emitter Threshold Voltage as a Function of Junction Temperature

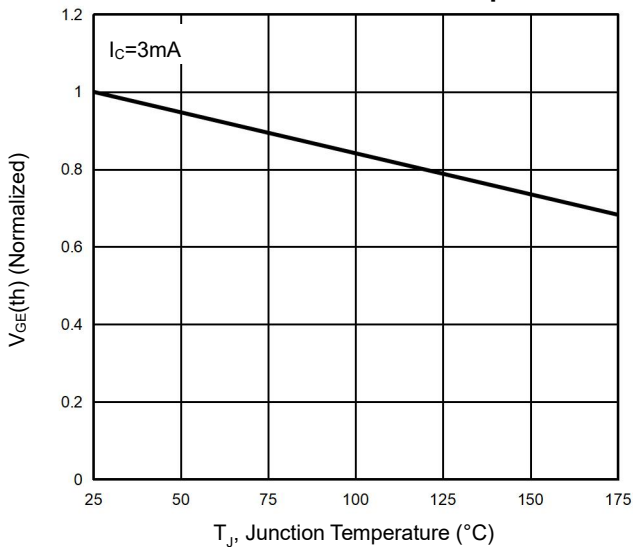
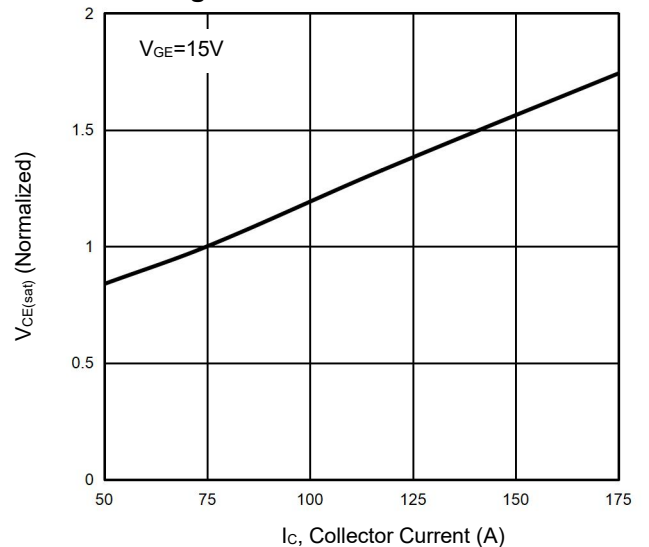


Figure 12 Typical Collector-Emitter Saturation Voltage as a function of Collector Current



Typical Electrical and Thermal Characteristics

Figure 13 Switching Loss vs.  $R_G$

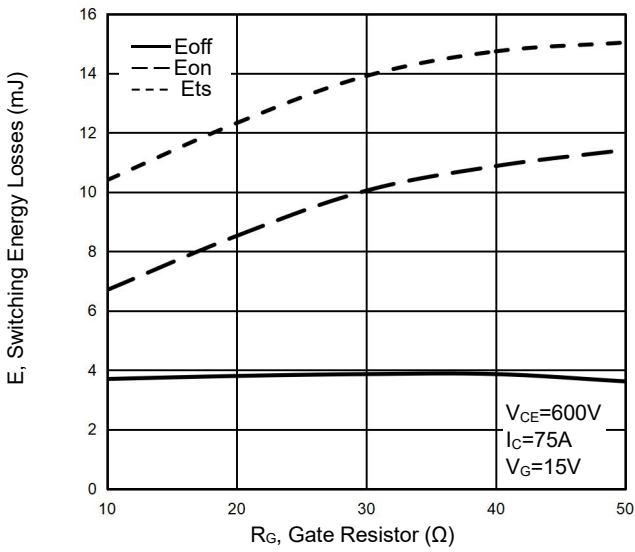


Figure 14 Switching Loss vs. Collector Current

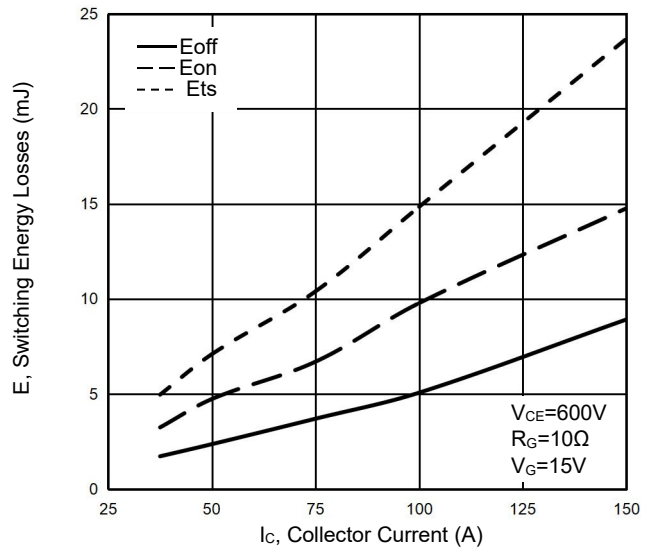


Figure 15 Switching Loss vs. Collector Current



Figure 16  $P_{tot}$  vs. Case Temperature

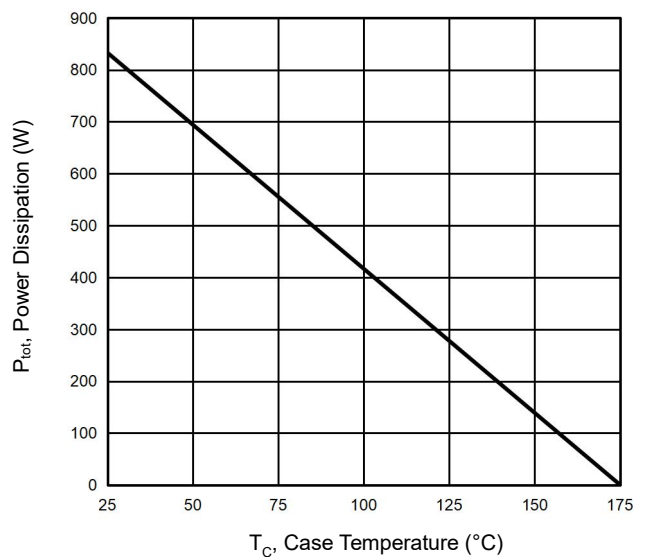


Figure 17  $V_{CES}$  vs. Case Temperature

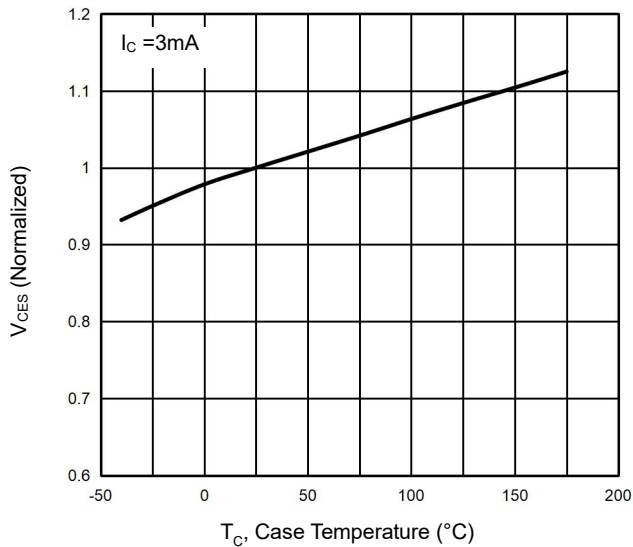
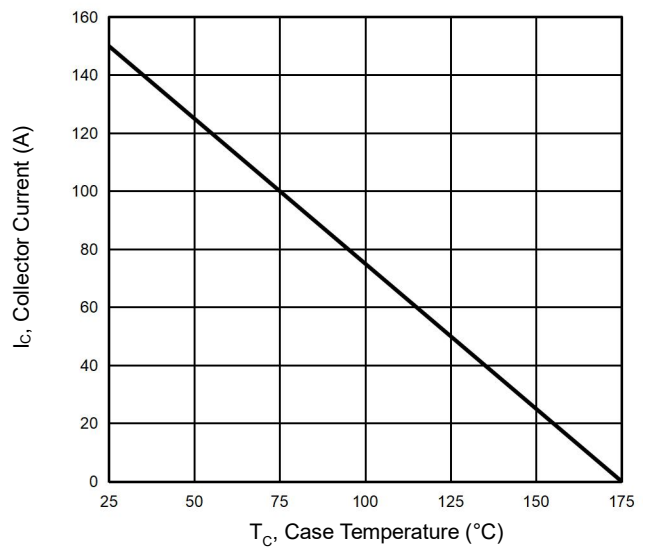
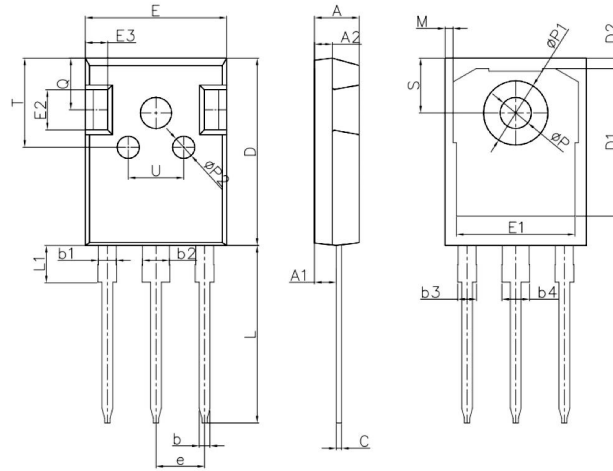


Figure 18  $I_C$  vs. Temperature

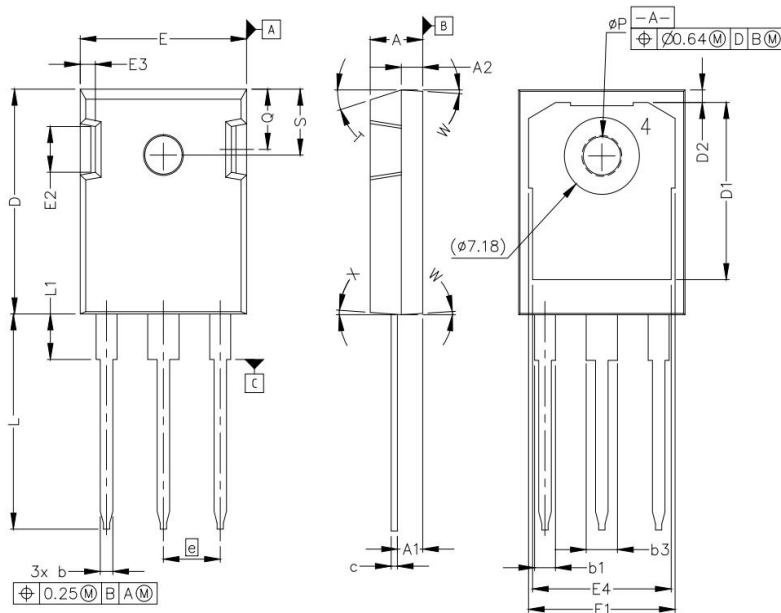


## TO-247-E Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.90	5.10	0.19	0.20
A1	2.31	2.51	0.09	0.10
A2	1.90	2.10	0.07	0.08
b	1.16	1.26	0.05	0.06
b1	1.96	2.06	0.08	0.09
b2	2.96	3.06	0.12	0.13
b3	--	2.25	--	0.09
b4	--	3.25	--	0.13
c	0.59	0.66	0.02	0.03
D	20.90	21.10	0.82	0.83
D1	16.25	16.85	0.64	0.66
D2	1.05	1.35	0.04	0.05
E	15.70	15.90	0.62	0.63
E1	13.10	13.50	0.52	0.53
E2	4.40	4.60	0.17	0.18
E3	2.40	2.60	0.09	0.10
e	5.436 BSC		0.214 BSC	
L	19.80	20.10	0.78	0.79
L1	--	4.30	--	0.17
M	0.35	0.95	0.01	0.04
P	3.40	3.60	0.13	0.14
P1	7.00	7.40	0.28	0.29
P2	2.40	2.60	0.09	0.10
Q	5.60	6.00	0.22	0.24
S	6.05	6.25	0.24	0.25
T	9.80	10.20	0.39	0.40
U	6.00	6.40	0.24	0.25

## TO-247-B Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.83	5.21	0.19	0.21
A1	2.29	2.54	0.09	0.10
A2	1.91	2.16	0.08	0.09
b	1.07	1.33	0.04	0.05
b1	1.91	2.41	0.08	0.10
b3	2.87	3.38	0.11	0.13
c	0.55	0.68	0.02	0.03
D	20.80	21.10	0.82	0.83
D1	16.25	17.65	0.64	0.70
D2	0.95	1.25	0.04	0.05
E	15.75	16.13	0.62	0.64
E1	13.10	14.15	0.52	0.56
E2	3.68	5.10	0.15	0.20
E3	1.00	1.90	0.04	0.08
E4	12.38	13.43	0.49	0.53
e	5.44 BSC		0.21 BSC	
L	19.81	20.32	0.78	0.80
L1	4.10	4.40	0.16	0.17
ØP	3.51	3.65	0.14	0.15
Q	5.49	6.00	0.22	0.24
S	6.04	6.30	0.24	0.25
T	17.5° REF			
W	3.5° REF			
X	4° REF			

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