

## 1200V, 50A, 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

- PV power
- Three-level Solar String Inverter
- UPS



Schematic diagram

### Package Marking and Ordering Information

Device	Device Package	Device Marking
NCE50TD120VT	TO-247	NCE50TD120VT



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	100	A
	Collector Current @ $T_C = 100^\circ\text{C}$	50	A
$I_{Cpuls}$	Pulsed Collector Current, $t_p$ limited by $T_{jmax}$	200	A
-	Turn off safe operating area, $V_{CE}=1200\text{V}$ , $T_j=175^\circ\text{C}$	200	A
$I_F$	Diode Continuous Forward Current @ $T_C = 100^\circ\text{C}$	50	A
$I_{FM}$	Diode Maximum Forward Current	200	A
$P_D$	Power Dissipation @ $T_C = 25^\circ\text{C}$	535	W
	Power Dissipation @ $T_C = 100^\circ\text{C}$	268	W
$T_J, T_{stg}$	Operating Junction and Storage Temperature Range	-55 to +175	$^\circ\text{C}$
$T_L$	Maximum Temperature for Soldering	260	$^\circ\text{C}$

**Thermal Characteristic**

Symbol	Parameter	Value	Units
R <sub>θJC</sub>	Thermal Resistance, Junction to case for IGBT	0.28	°C/W
R <sub>θJC</sub>	Thermal Resistance, Junction to case for Diode	0.50	°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)**

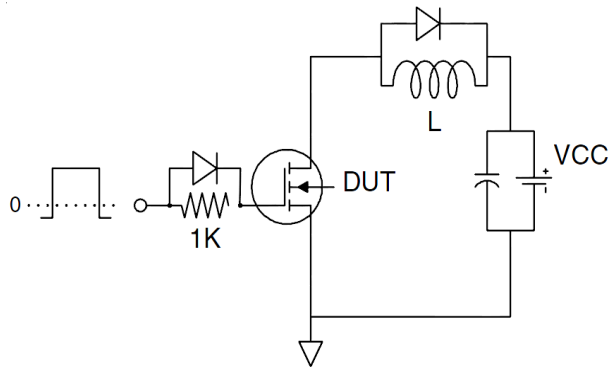
Symbol	Parameter	Conditions	Value			Units	
			Min.	Typ.	Max.		
<b>Static Characteristics</b>							
V <sub>(BR)CES</sub>	Collector-Emitter Breakdown Voltage	V <sub>GE</sub> =0V, I <sub>CE</sub> =1mA	1200	--	--	V	
I <sub>CES</sub>	Collector-Emitter Leakage Current	V <sub>GE</sub> =0V, V <sub>CE</sub> =1200V	--	--	200	μA	
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> =50A, T <sub>J</sub> =25°C	--	1.70	1.95	V	
		V <sub>GE</sub> =15V, T <sub>J</sub> =175°C	--	1.95	--	V	
V <sub>GE(th)</sub>	Gate Threshold Voltage	I <sub>C</sub> =1mA, V <sub>CE</sub> =V <sub>GE</sub>	4.5	--	6.0	V	
<b>Dynamic Characteristics</b>							
C <sub>ies</sub>	Input Capacitance	V <sub>CE</sub> =30V, V <sub>GE</sub> =0V, f=1MHz	--	6980	--	pF	
C <sub>oes</sub>	Output Capacitance		--	220	--		
C <sub>res</sub>	Reverse Transfer Capacitance		--	167	--		
Q <sub>g</sub>	Total Gate Charge	V <sub>CC</sub> =960V, I <sub>C</sub> =50A, V <sub>GE</sub> =15V	--	370	--	nC	
Q <sub>ge</sub>	Gate to Emitter Charge		--	65	--		
Q <sub>gc</sub>	Gate to Collector Charge		--	211	--		
<b>Switching Characteristics</b>							
t <sub>d(ON)</sub>	Turn-on Delay Time	V <sub>CE</sub> =600V, I <sub>C</sub> =50A, 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> =50A, V <sub>GE</sub> =0/15V, R <sub>g</sub> =8Ω, T <sub>J</sub> =175°C	--	2.6	--	mJ
E <sub>off</sub>	Turn-Off Switching Loss			--	1.7	--	
E <sub>ts</sub>	Total Switching Loss			--	4.3	--	
E <sub>on</sub>	Turn-On Switching Loss		V <sub>CE</sub> =600V, I <sub>C</sub> =50A, V <sub>GE</sub> =0/15V, R <sub>g</sub> =8Ω, T <sub>J</sub> =175°C	--	3.3	--	mJ
E <sub>off</sub>	Turn-Off Switching Loss			--	2.1	--	
E <sub>ts</sub>	Total Switching Loss	--		5.4	--		

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

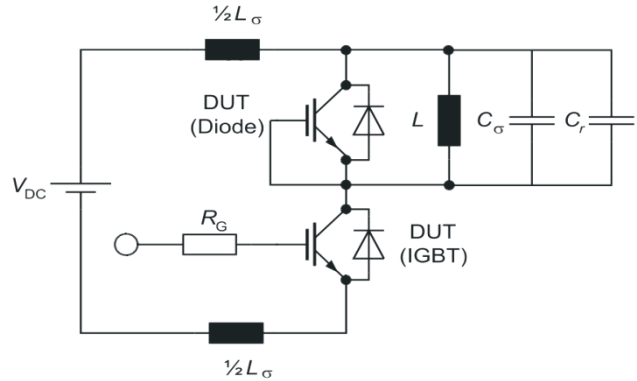
Symbol	Parameter	Conditions	Rating			Units
			Min.	Typ.	Max.	
V <sub>FM</sub>	Diode Forward Voltage	I <sub>F</sub> =50A	--	2.2	3.0	V
T <sub>rr</sub>	Reverse Recovery Time	I <sub>F</sub> =25A, di/dt=700A/us	--	150	--	ns
I <sub>RRM</sub>	Diode Peak Reverse Recovery Current		--	10	--	A
Q <sub>rr</sub>	Reverse Recovery Charge		--	2.2	--	μC

### Test Circuit

#### 1) Gate Charge Test Circuit

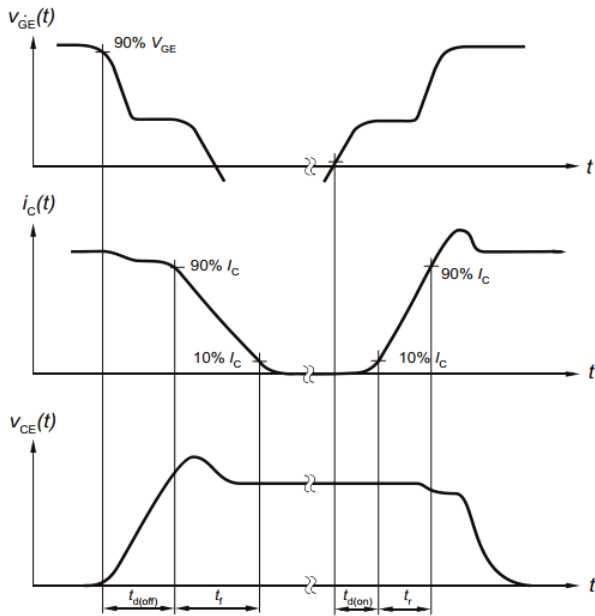


#### 2) Switch Time Test Circuit

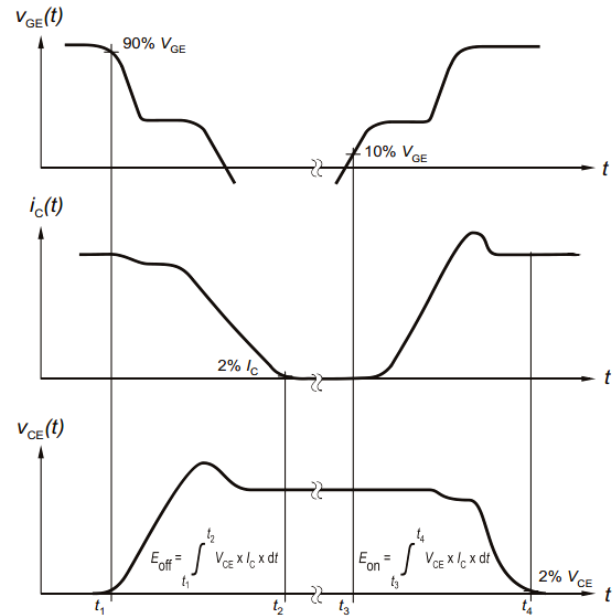


### Switching characteristics

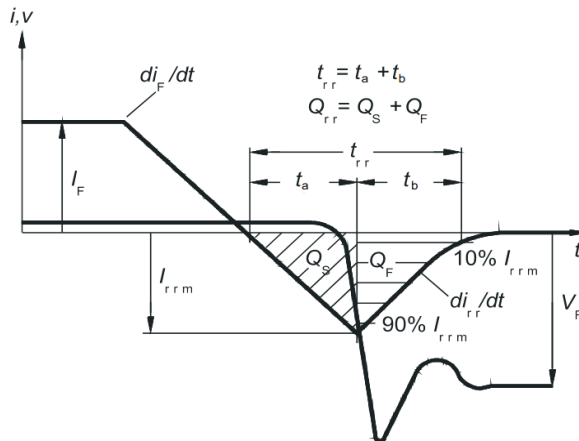
#### 1) Definition of switching times



#### 2) Definition of switching losses



#### 3) Definition of diode switching characteristics



Typical Electrical and Thermal Characteristics

Figure 1 Output Characteristics

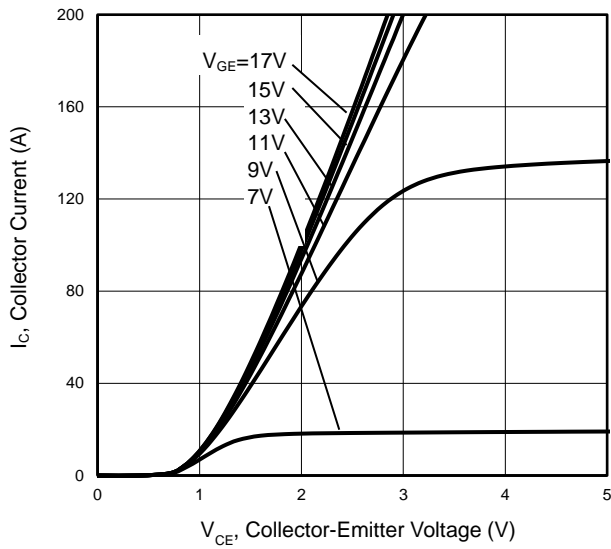


Figure 2 Transfer Characteristics

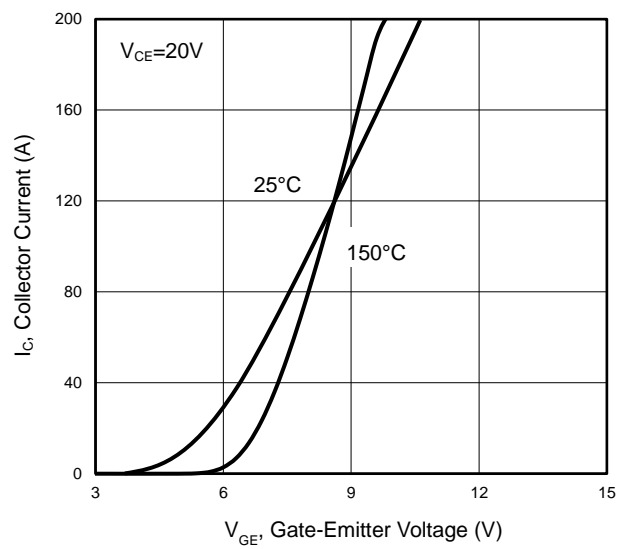


Figure 3  $V_{CE(sat)}$  vs. Case Temperature

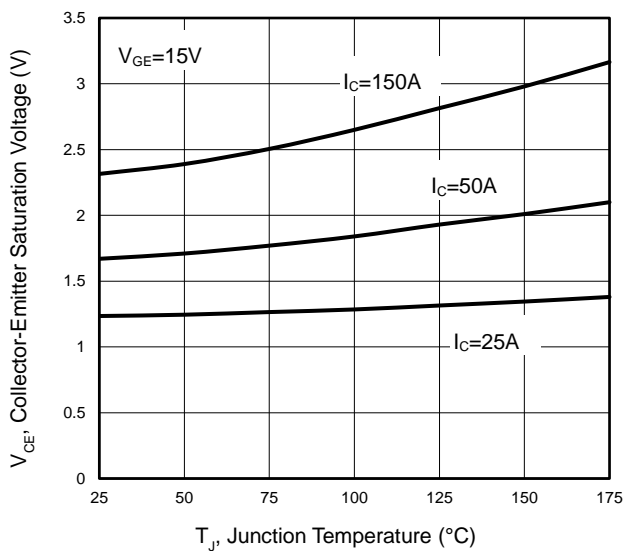


Figure 4 Saturation Voltage vs.  $V_{GE}$

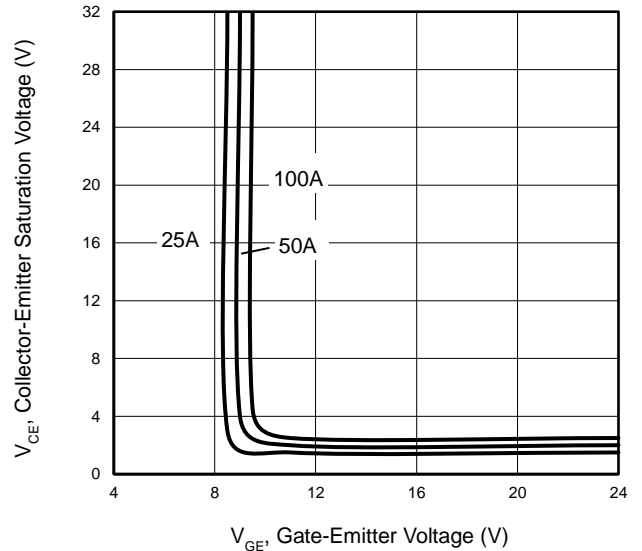


Figure 5 Capacitance Characteristics

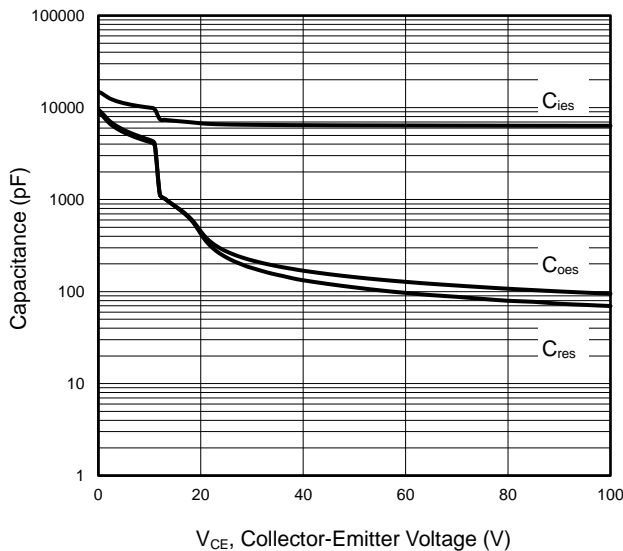
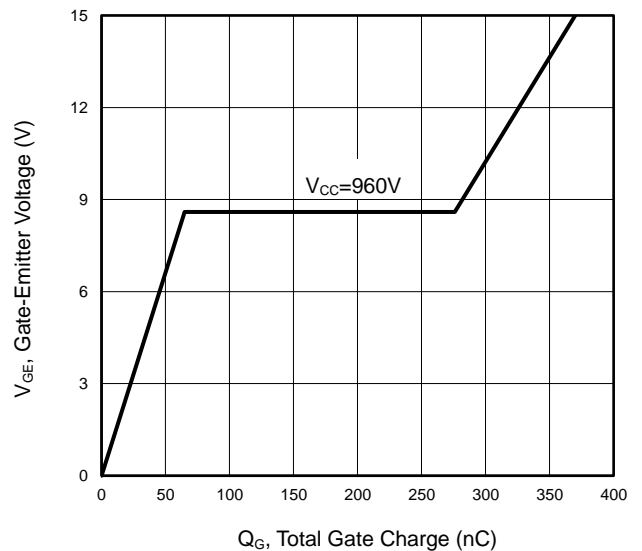


Figure 6 Gate Charge Wave Form



Typical Electrical and Thermal Characteristic

Figure 7 Forward Characteristics

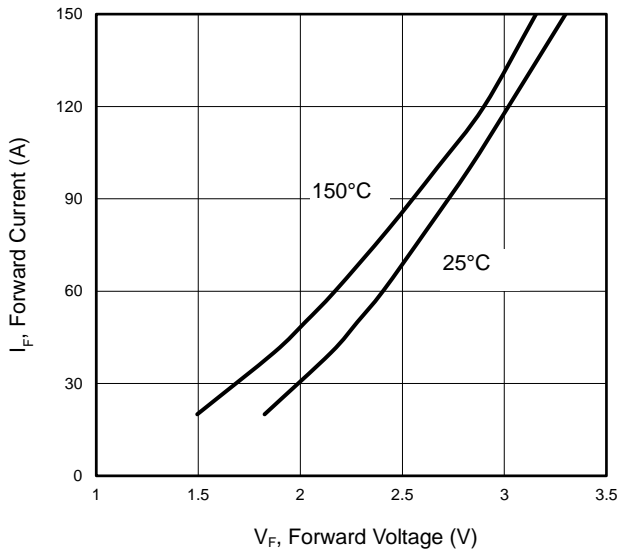


Figure 8  $V_F$  vs. Temperature

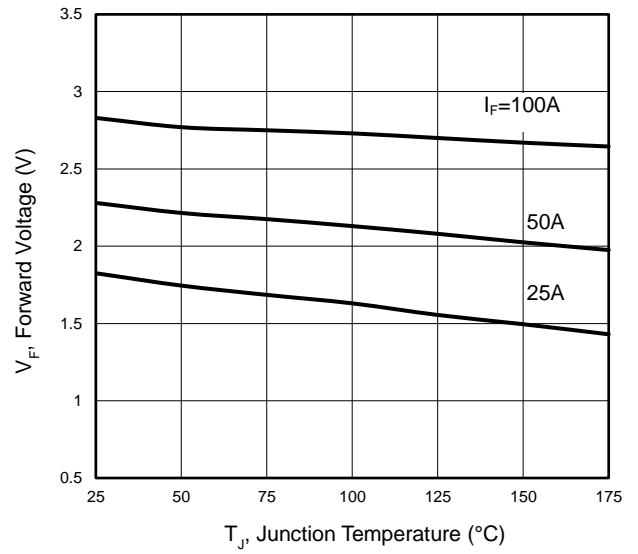


Figure 9 Switching Energy vs. Temperature

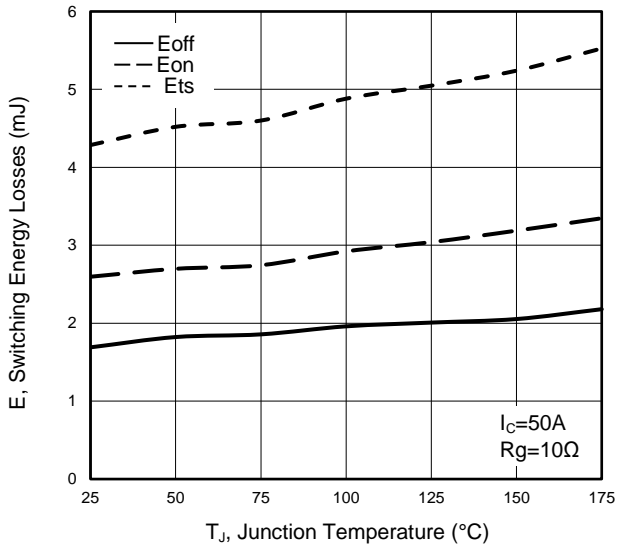


Figure 10 Forward Bias Safe Operating Area

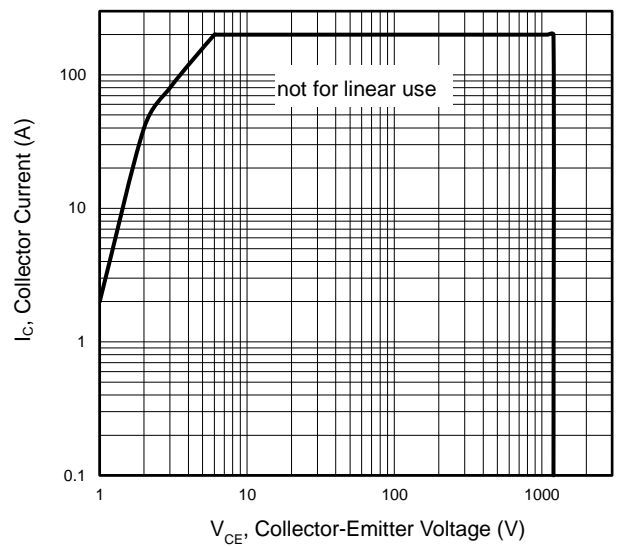


Figure 11 Gate-Emitter Threshold Voltage as a Function of Junction Temperature

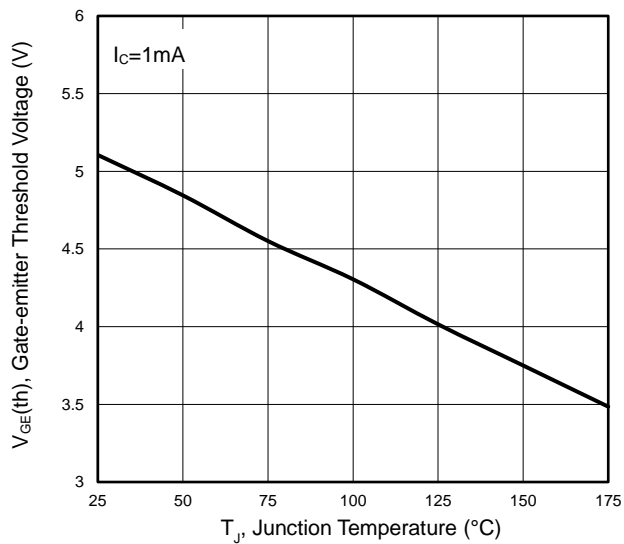
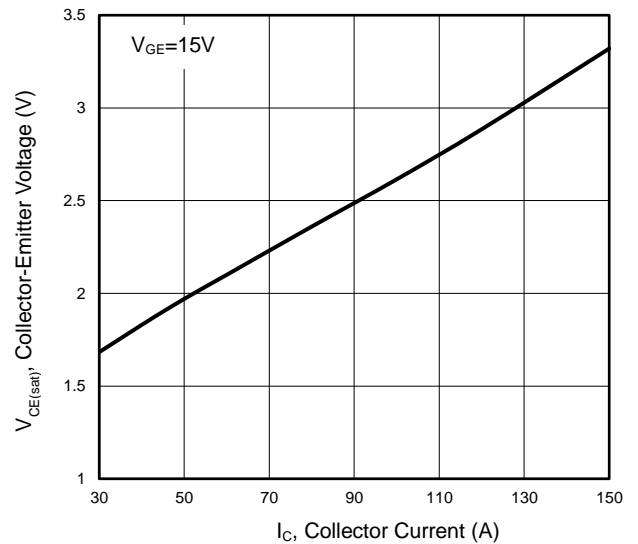


Figure 12 Typical Collector-Emitter Saturation Voltage as a function of Collector Current



Typical Electrical and Thermal Characteristics

Figure 13 Switching Loss vs.  $R_G$

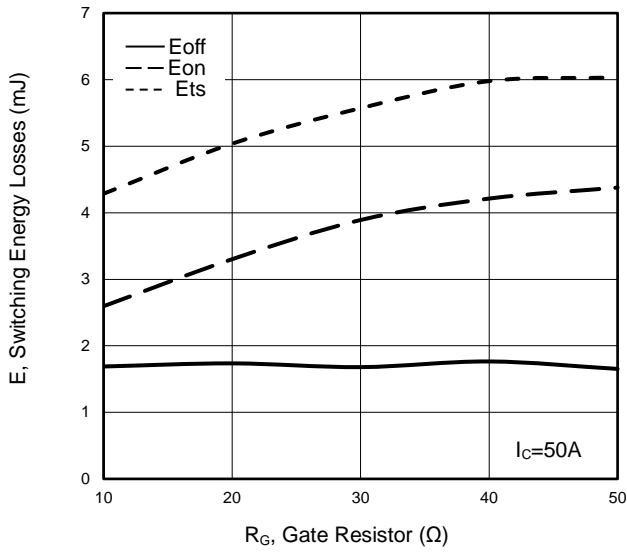


Figure 14 Switching Loss vs. Collector Current

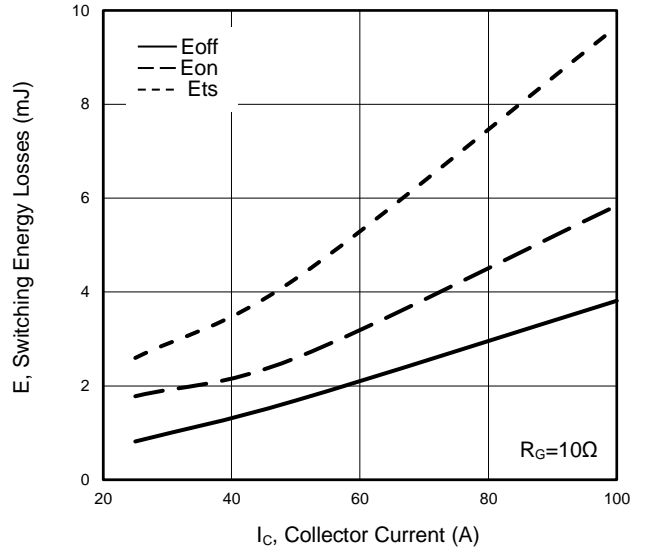


Figure 15 Switching Loss vs. Collector Current

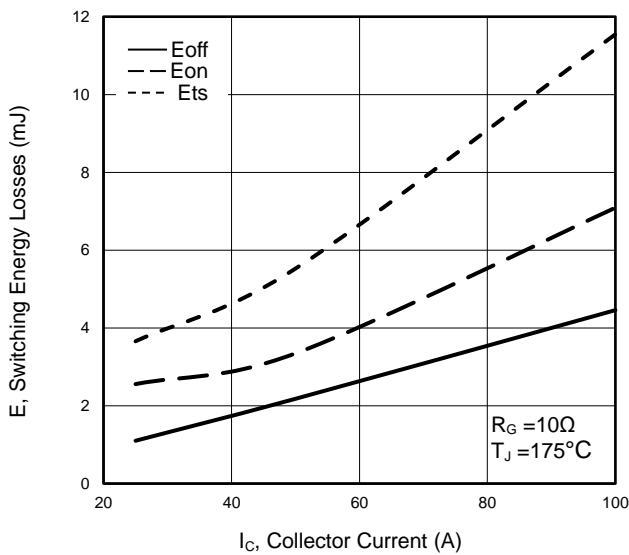


Figure 16  $P_{tot}$  vs. Case Temperature

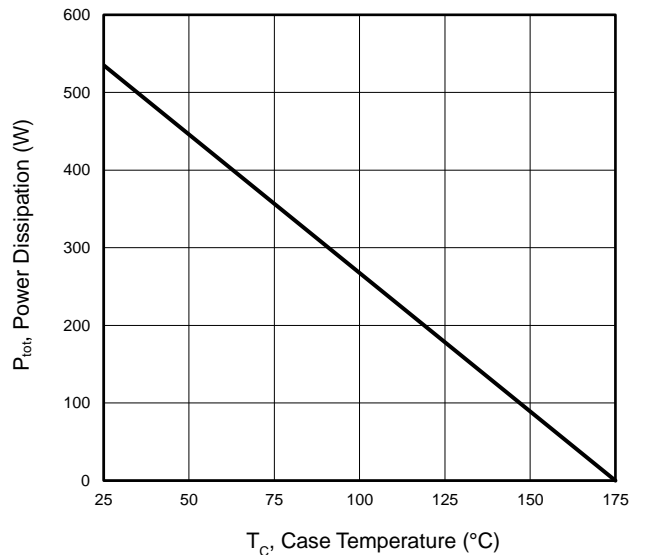


Figure 17  $V_{CES}$  vs. Temperature

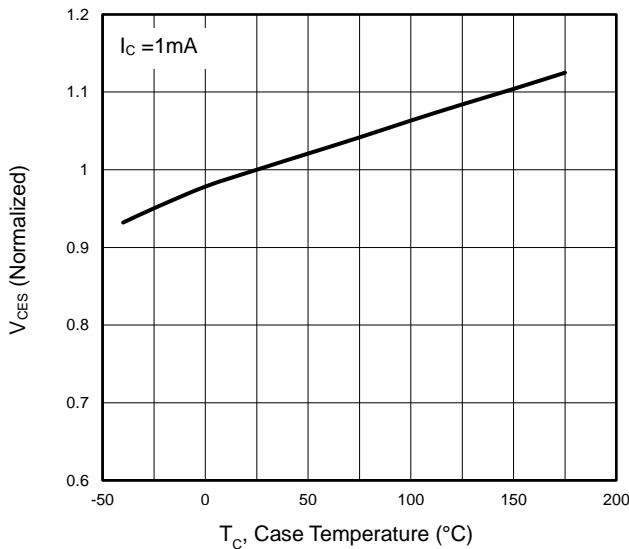
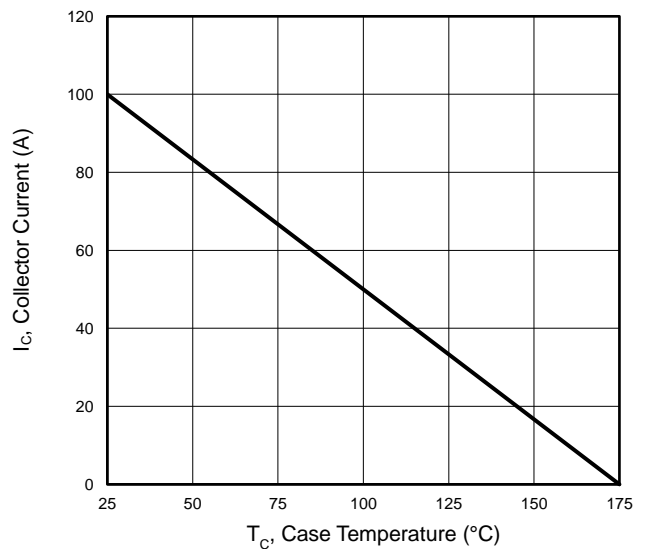
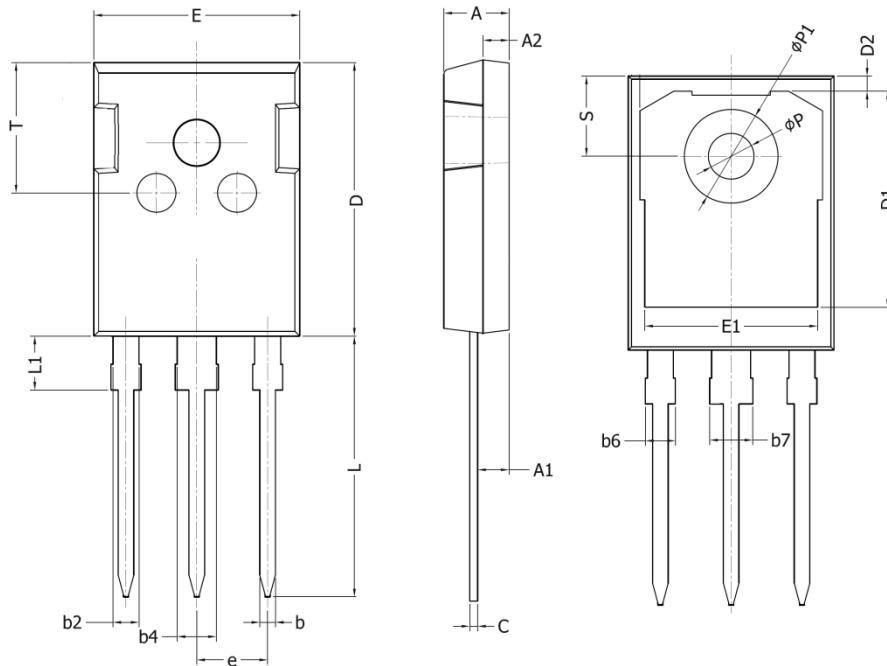


Figure 18  $I_C$  vs. Temperature

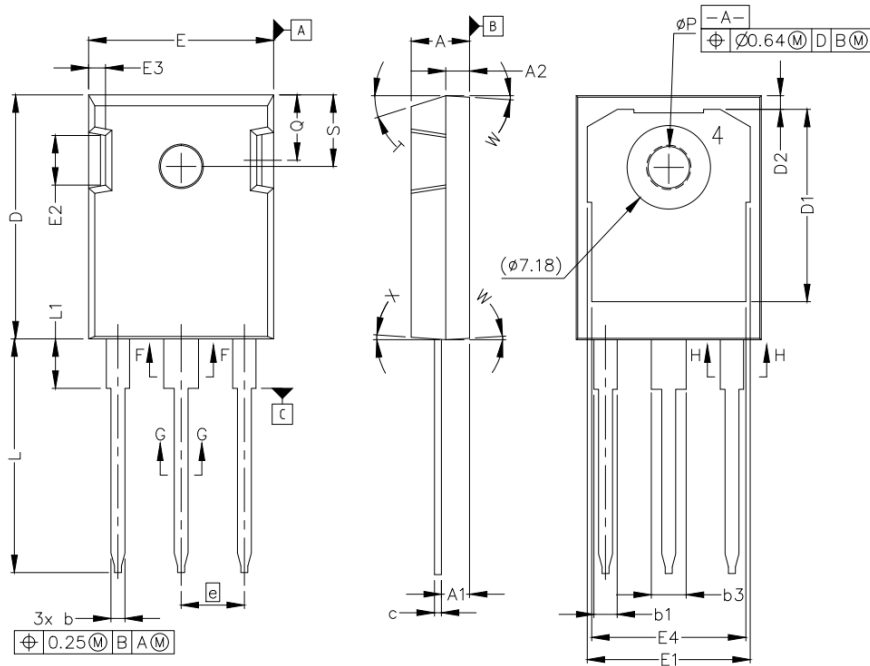


## TO-247-P Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.90	5.10	0.193	0.201
A1	2.31	2.51	0.091	0.099
A2	1.90	2.10	0.075	0.083
b	1.16	1.26	0.046	0.050
b2	1.96	2.06	0.077	0.081
b4	2.96	3.06	0.117	0.120
b6	-	2.25	-	0.089
b7	-	3.25	-	0.128
C	0.59	0.66	0.023	0.026
D	20.90	21.10	0.823	0.831
D1	16.25	16.85	0.640	0.663
D2	1.05	1.35	0.041	0.053
E	15.70	15.90	0.618	0.626
E1	13.10	13.50	0.516	0.531
e	5.436 BSC		0.214 BSC	
L	19.80	20.10	0.780	0.791
L1	-	4.30	-	0.169
P	3.40	3.60	0.134	0.142
P1	7.00	7.40	0.276	0.291
S	6.05	6.25	0.238	0.246
T	9.80	10.20	0.386	0.402

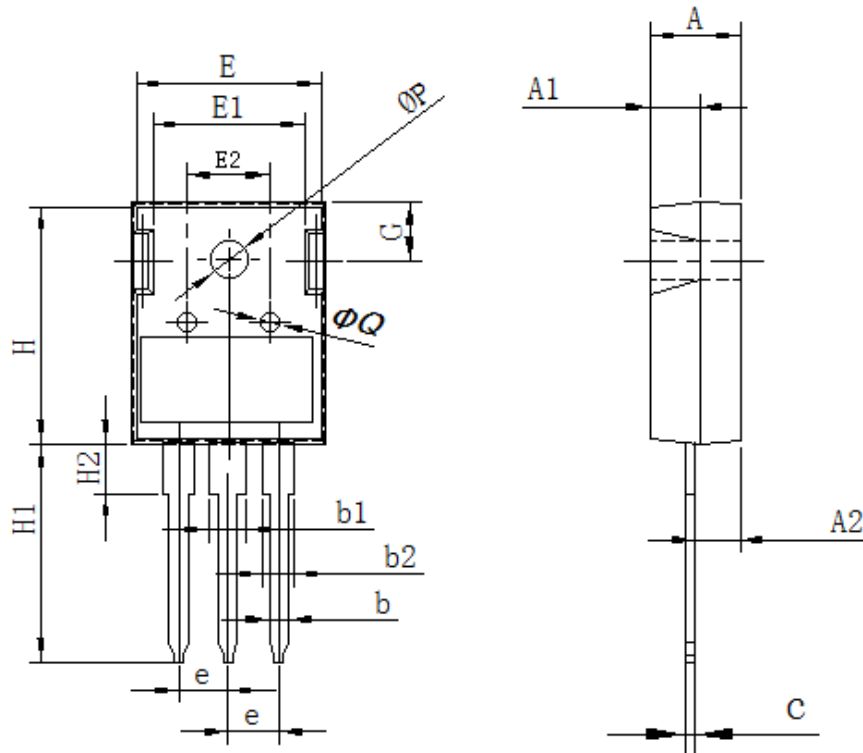
# TO-247-B Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.83	5.21	0.190	0.205
A1	2.29	2.54	0.090	0.100
A2	1.91	2.16	0.075	0.085
b	1.07	1.33	0.042	0.052
b1	1.91	2.41	0.075	0.095
b3	2.87	3.38	0.113	0.133
c	0.55	0.68	0.022	0.027
D	20.80	21.10	0.819	0.831
D1	16.25	17.65	0.640	0.695
D2	0.95	1.25	0.037	0.049
E	15.75	16.13	0.620	0.635
E1	13.10	14.15	0.516	0.557
E2	3.68	5.10	0.145	0.201
E3	1.00	1.90	0.039	0.075
E4	12.38	13.43	0.487	0.529
e	5.44 BSC		0.214 BSC	
N	3.00		0.118	
L	19.81	20.32	0.780	0.800
L1	4.10	4.40	0.161	0.173
P	3.51	3.65	0.138	0.144
Q	5.49	6.00	0.216	0.236
S	6.04	6.30	0.238	0.248



# TO-247-d Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.80	5.20	0.189	0.205
A1	2.80	3.20	0.110	0.126
A2	2.20	2.60	0.087	0.102
b	1.05	1.35	0.041	0.053
b1	2.80	3.20	0.110	0.126
b2	1.80	2.20	0.071	0.087
c	0.50	0.70	0.020	0.028
e	5.25	5.65	0.207	0.222
E	15.60	16.00	0.614	0.630
E1	12.30	12.70	0.484	0.500
E2	6.00	6.40	0.236	0.252
H	20.50	21.50	0.807	0.846
H1	19.00	21.00	0.748	0.827
H2	3.00	5.00	0.118	0.197
G	5.70	6.10	0.224	0.240
ΦP	3.30	3.50	0.130	0.138
ΦQ	2.30	2.70	0.091	0.106

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