

## 1200V, 40A, Trench FS II Fast IGBT

### General Description

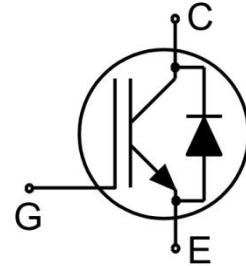
Using NCE's proprietary trench design and advanced FS (Field Stop) second generation technology, the 1200V Trench FSII IGBT offers superior conduction and switching performances, and easy parallel operation;

### 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

- Welding



Schematic diagram

### Package Marking and Ordering Information

Device	Device Package	Device Marking
NCE40TD120WT	TO-247	NCE40TD120WT



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	80	A
	Collector Current @ $T_C = 100^\circ\text{C}$	40	A
$I_{Cpuls}$	Pulsed Collector Current, $t_p$ limited by $T_{jmax}$	160	A
-	turn off safe operating area, $V_{CE}=1200\text{V}$ , $T_j=175^\circ\text{C}$	160	A
$I_F$	Diode Continuous Forward Current @ $T_C = 100^\circ\text{C}$	40	A
$I_{FM}$	Diode Maximum Forward Current	160	A
$P_D$	Power Dissipation @ $T_C = 25^\circ\text{C}$	468	W
	Power Dissipation @ $T_C = 100^\circ\text{C}$	234	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
$R_{\theta JC}$	Thermal Resistance, Junction to case for IGBT	0.32	$^{\circ}\text{C}/\text{W}$
$R_{\theta JC}$	Thermal Resistance, Junction to case for Diode	0.75	$^{\circ}\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	40	$^{\circ}\text{C}/\text{W}$

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

Symbol	Parameter	Conditions	Value			Units
			Min.	Typ.	Max.	
<b>Static Characteristics</b>						
$V_{(BR)CES}$	Collector-Emitter Breakdown Voltage	$V_{GE}=0\text{V}, I_{CE}=1\text{mA}$	1200	--	--	V
$I_{CES}$	Collector-Emitter Leakage Current	$V_{GE}=0\text{V}, V_{CE}=1200\text{V}$	--	--	200	$\mu\text{A}$
$I_{GES(F)}$	Gate to Emitter Forward Leakage	$V_{GE}=+30\text{V}, V_{CE}=0\text{V}$	--	--	200	nA
$I_{GES(R)}$	Gate to Emitter Reverse Leakage	$V_{GE}=-30\text{V}, V_{CE}=0\text{V}$	--	--	200	nA
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$I_C=40\text{A}$	--	1.9	2.4	V
		$V_{GE}=15\text{V}$	--	2.2	--	V
$V_{GE(th)}$	Gate Threshold Voltage	$I_C=1\text{mA}, V_{CE}=V_{GE}$	4.5	--	6.5	V
<b>Dynamic Characteristics</b>						
$C_{ies}$	Input Capacitance	$V_{CE}=30\text{V}, V_{GE}=0\text{V}, f=1\text{MHz}$	--	6190	--	pF
$C_{oes}$	Output Capacitance		--	185	--	
$C_{res}$	Reverse Transfer Capacitance		--	133	--	
$Q_g$	Total Gate Charge	$V_{CC}=960\text{V}, I_C=40\text{A}, V_{GE}=15\text{V}$	--	242	--	nC
$Q_{ge}$	Gate to Emitter Charge		--	51	--	
$Q_{gc}$	Gate to Collector Charge		--	115	--	
<b>Switching Characteristics</b>						
$t_{d(ON)}$	Turn-on Delay Time	$V_{CE}=600\text{V}, I_C=40\text{A}, V_{GE}=0/15\text{V}, R_g=8\Omega$ Inductive Load	--	19	--	ns
$t_r$	Rise Time		--	17	--	
$t_{d(OFF)}$	Turn-Off Delay Time		--	170	--	
$t_f$	Fall Time		--	18	--	
$E_{on}$	Turn-On Switching Loss		--	2.1	--	mJ
$E_{off}$	Turn-Off Switching Loss		--	1.2	--	
$E_{ts}$	Total Switching Loss	--	3.3	--		

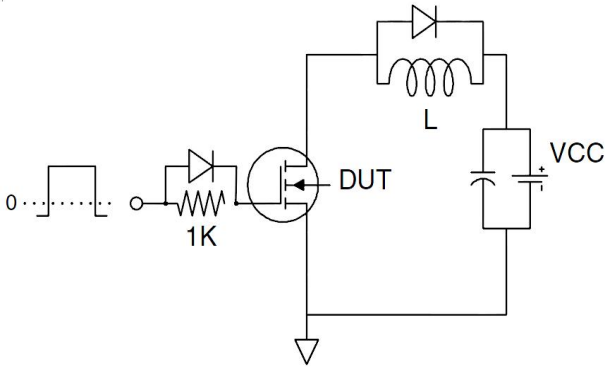
**Electrical Characteristics of the Diode ( $T_c=25^{\circ}\text{C}$  unless otherwise specified)**

Symbol	Parameter	Conditions	Rating			Units
			Min.	Typ.	Max.	
$V_{FM}$	Diode Forward Voltage	$I_F=20\text{A}$	--	2.1	2.8	V
$T_{rr}$	Reverse Recovery Time	$I_F=20\text{A}, di/dt=500\text{A}/\mu\text{s}$	--	203	--	ns
$I_{RRM}$	Diode Peak Reverse Recovery Current		--	10	--	A
$Q_{rr}$	Reverse Recovery Charge		--	1.1	--	$\mu\text{C}$

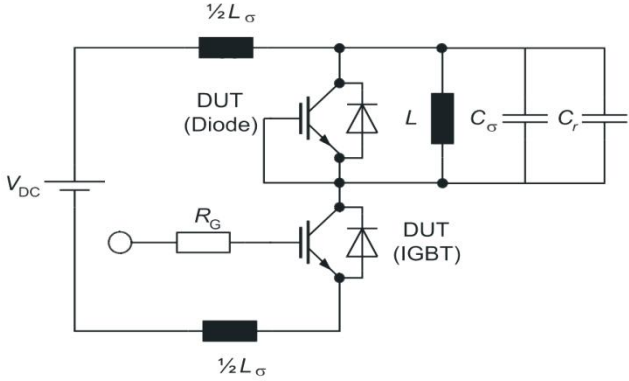
Pulse width  $t_p \leq 380\mu\text{s}, \delta \leq 2\%$

Test Circuit

1) Gate Charge Test Circuit

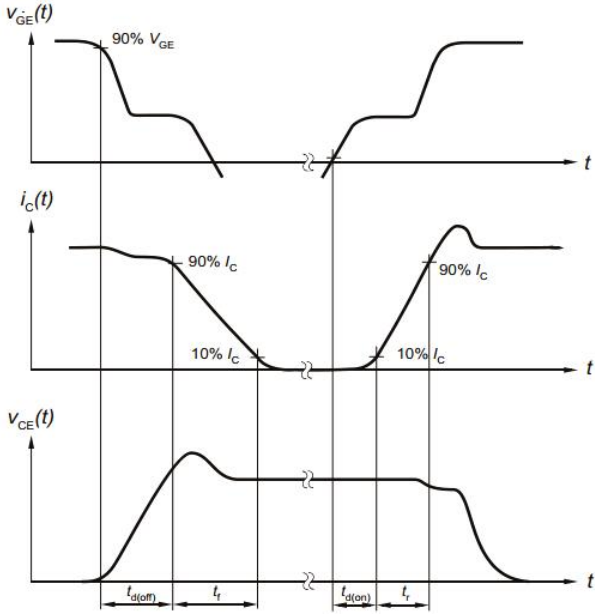


2) Switch Time Test Circuit

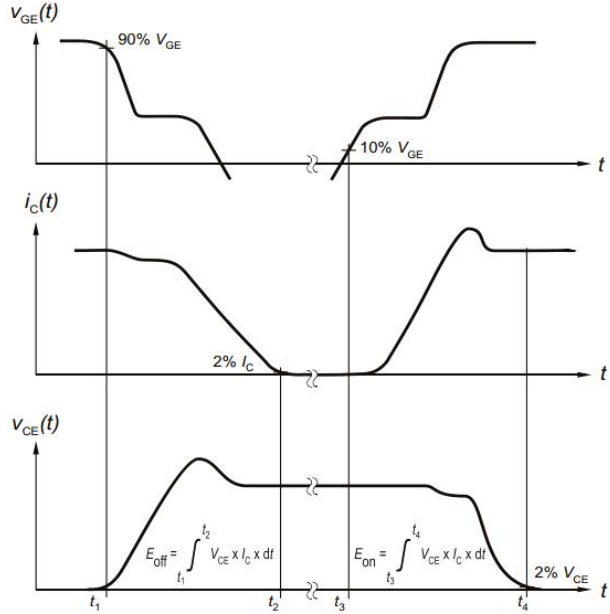


Switching characteristics

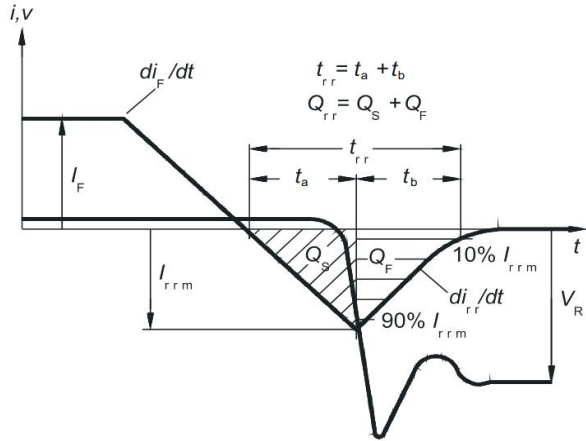
1) Definition of switching times



2) Definition of switching losses



3) Definition of diode switching characteristics



Typical Electrical and Thermal Characteristics

Figure 1 Output Characteristics

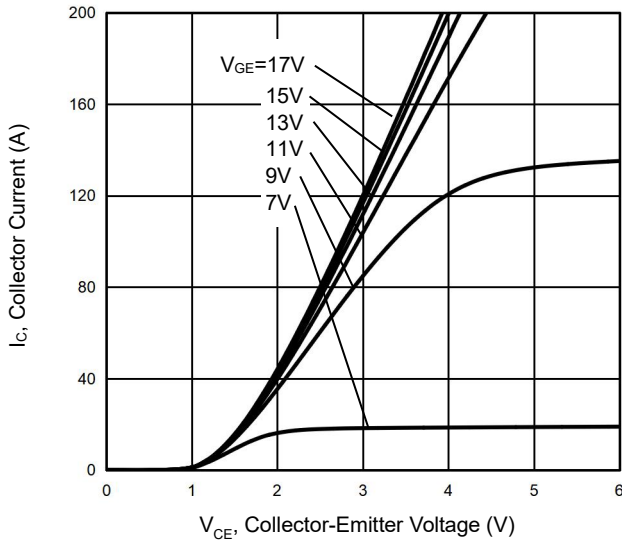


Figure 2 Transfer Characteristics

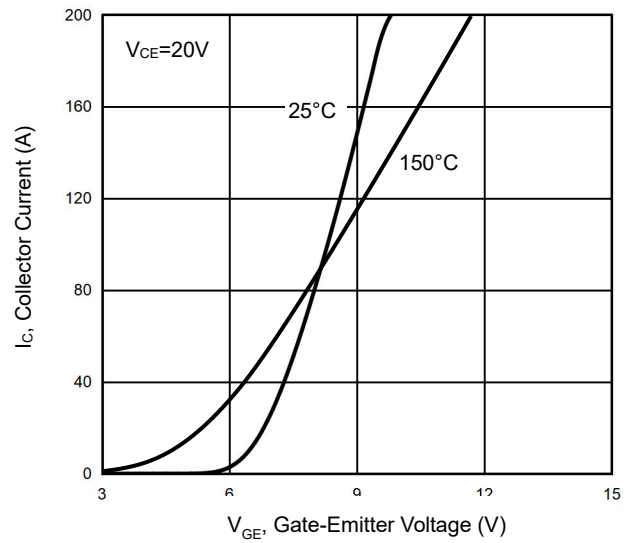


Figure 3  $V_{CE(sat)}$  vs. Case Temperature

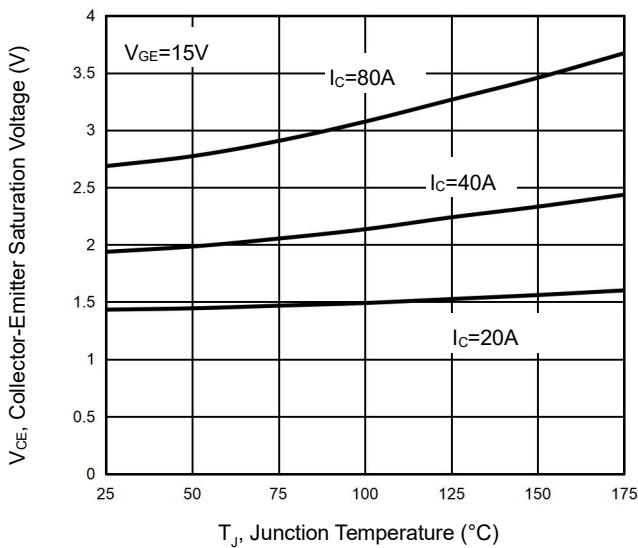


Figure 4 Saturation Voltage vs.  $V_{GE}$

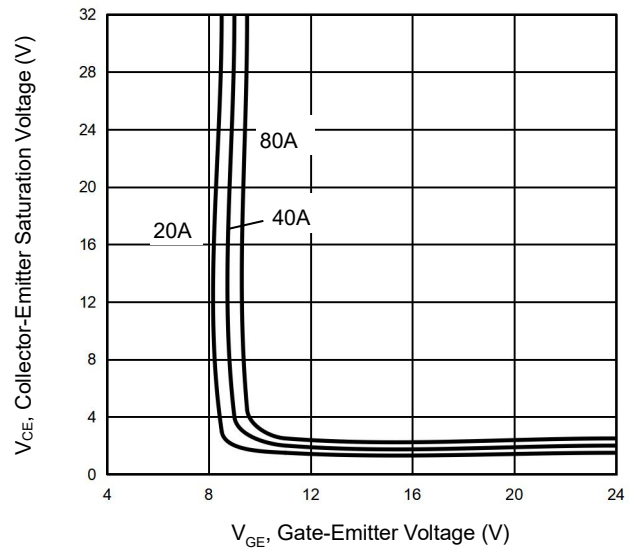


Figure 5 Capacitance Characteristics

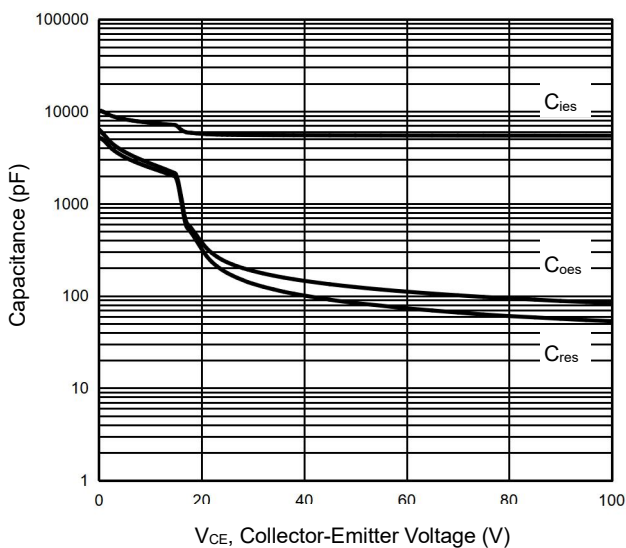
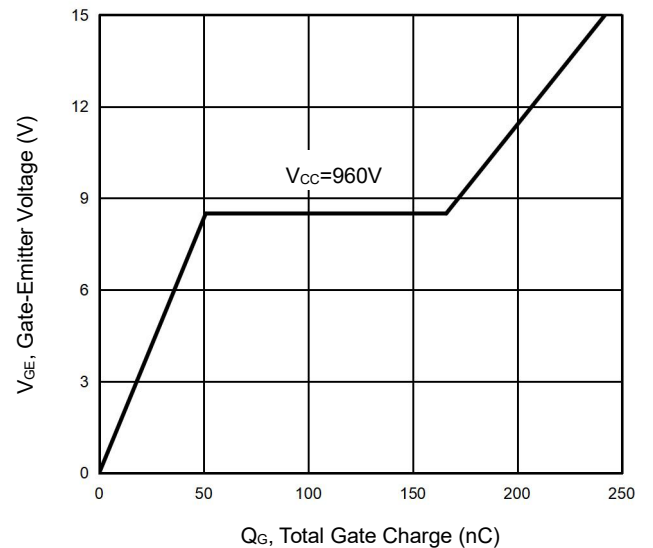
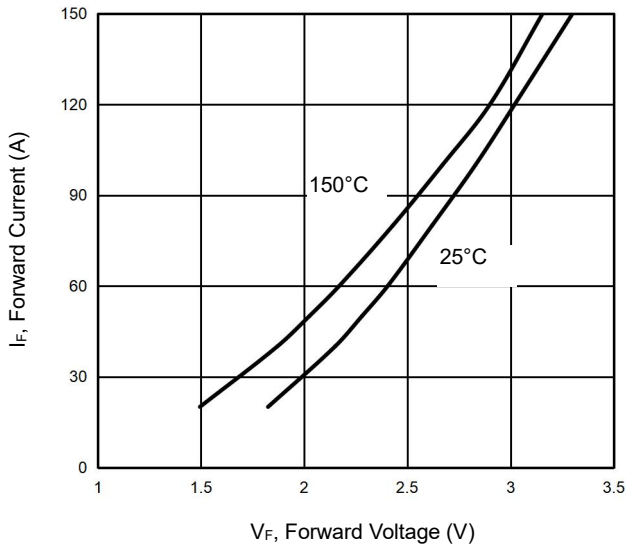


Figure 6 Gate Charge Wave Form

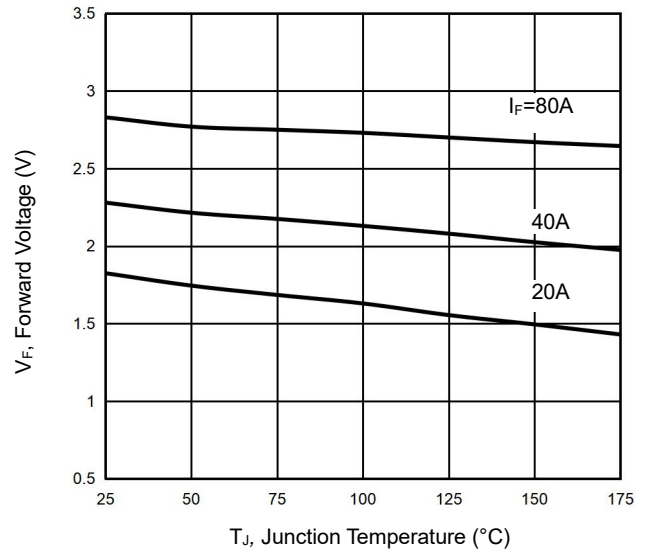


## Typical Electrical and Thermal Characteristics

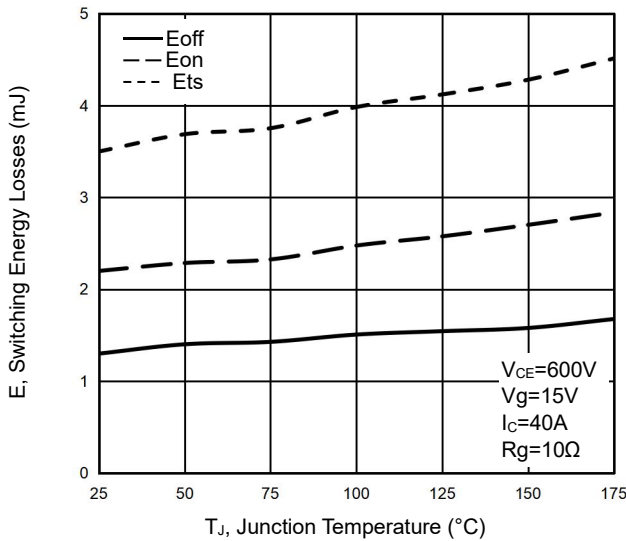
**Figure 7 Forward Characteristics**



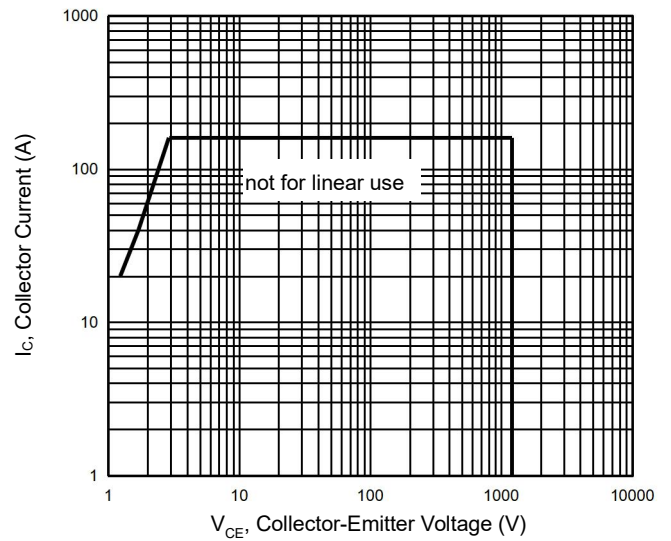
**Figure 8  $V_F$  vs. Temperature**



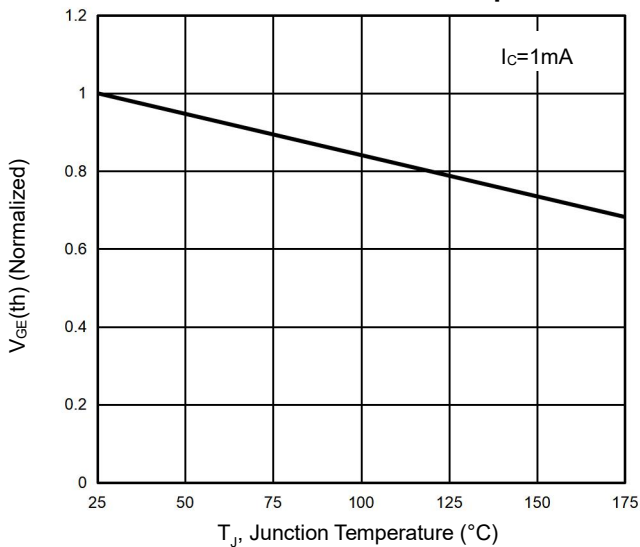
**Figure 9 Switching Energy vs. Temperature**



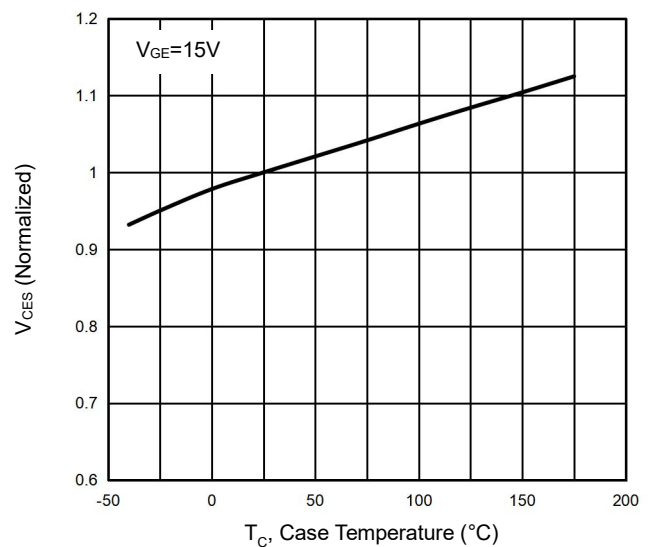
**Figure 10 Forward Bias Safe Operating Area**



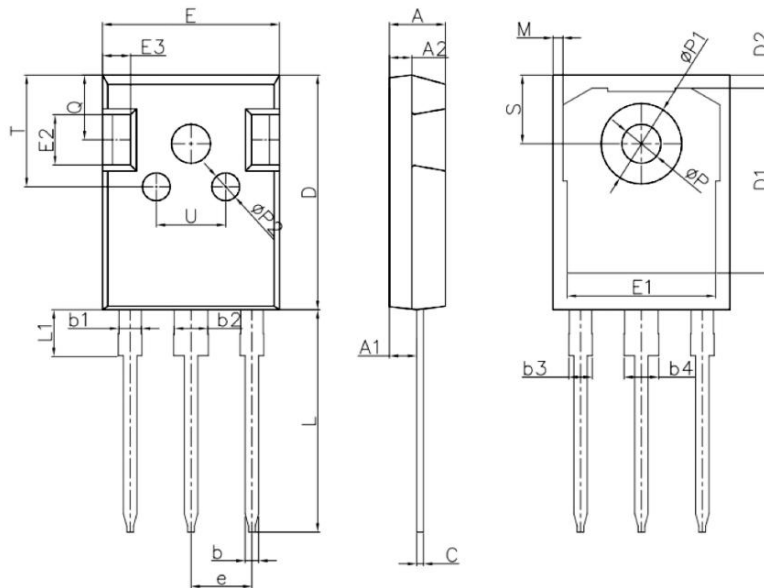
**Figure 11 Gate-Emitter Threshold Voltage as a Function of Junction Temperature**



**Figure 12  $V_{CES}$  vs. Temperature**

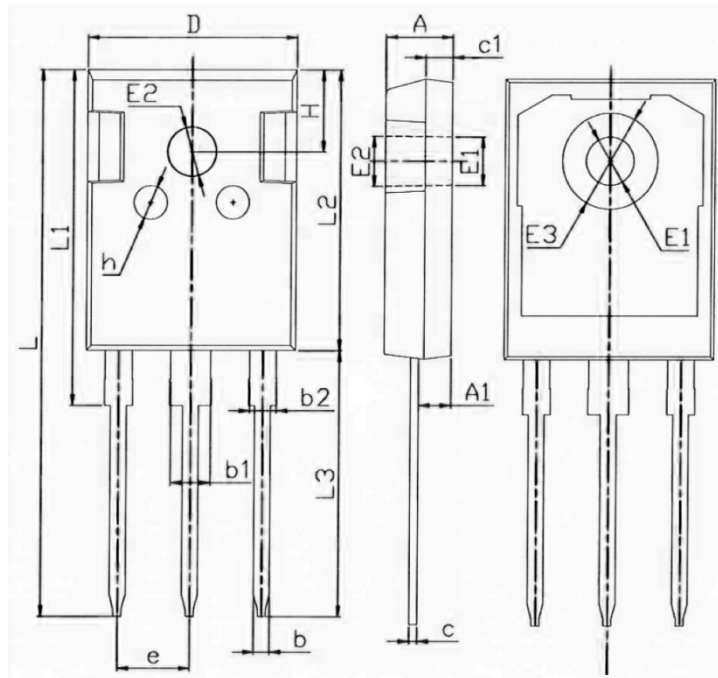


## TO-247-E Package Information



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	5.436BSC		0.214BSC	
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-L Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.80	5.20	0.19	0.20
A1	2.26	2.56	0.09	0.10
b	1.10	1.30	0.04	0.05
b1	2.85	3.15	0.11	0.12
b2	1.85	2.15	0.07	0.08
c	0.50	0.70	0.02	0.03
c1	1.85	2.15	0.07	0.08
D	15.60	16.00	0.61	0.63
E1	3.45	3.75	0.14	0.15
E2	3.55	3.85	0.14	0.15
E3	7.04	7.34	0.28	0.29
L	40.67	41.17	1.60	1.62
L1	24.80	25.10	0.98	0.99
L2	20.80	21.20	0.82	0.83
L3	19.72	20.12	0.78	0.79
e	5.29	5.59	0.21	0.22
H	6.00	6.30	0.24	0.25
h	2.35	2.65	0.09	0.10

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