

## 650V 75A Trench FS Gen.7 IGBT

### General Description

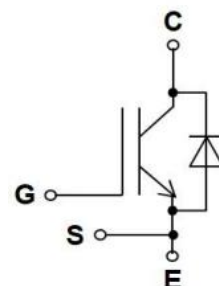
Using NCE's proprietary high density trench gate design and advanced FS (Field Stop) Gen.7 technology, the 650V Trench FS Gen.7 IGBT offers superior conduction and switching performances, and easy parallel operation.

### Features

- Trench field stop Gen.7 Technology Offering
- Low saturation voltage:  $V_{CEsat} = 1.45V(Typ.) @ I_C = 75 A$
- High speed switching, low switching losses
- Maximum junction temperature  $T_{vjmax} = 175^{\circ}C$
- Tighten parameter distribution
- High ruggedness, temperature stable behavior
- Pb-free lead plating; RoHS compliant

### Application

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



Schematic diagram

### Package Marking and Ordering Information

Device	Device Package	Device Marking
NCE75ED65VT4	TO-247-4L	NCE75ED65VT4



TO-247-4L

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

Symbol	Parameter	Value	Units
$V_{CES}$	Collector-Emitter Voltage	650	V
$V_{GES}$	Gate- Emitter Voltage	$\pm 30$	V
$I_C$	Collector Current	150	A
	Collector Current @ $T_C = 100^{\circ}C$	75	A
$I_{Cpuls}$	Pulsed Collector Current, $t_p$ limited by $T_{jmax}$	262	A
-	Turn off safe operating area, $V_{CE}=650V, T_j=175^{\circ}C$	262	A
$I_F$	Diode Continuous Forward Current @ $T_C = 100^{\circ}C$	75	A
$I_{FM}$	Diode Maximum Forward Current	262	A
$P_D$	Power Dissipation @ $T_C = 25^{\circ}C$	402	W
	Power Dissipation @ $T_C = 100^{\circ}C$	201	W
$T_{stg}$	Storage Temperature	-55 to +150	$^{\circ}C$
$T_{vj}$	Operating junction temperature	-40 to +175	$^{\circ}C$
$T_L$	Maximum Temperature for Soldering	260	$^{\circ}C$

## Thermal Characteristic

Symbol	Parameter	Value	Units
$R_{\theta JC}$	Thermal Resistance, Junction to case for IGBT	0.38	$^{\circ}\text{C}/\text{W}$
$R_{\theta JC}$	Thermal Resistance, Junction to case for Diode	0.43	$^{\circ}\text{C}/\text{W}$
$R_{\theta JA}$	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	$V_{GE}=0\text{V}, I_{CE}=1\text{mA}$	650	--	--	V	
$I_{CES}$	Collector-Emitter Leakage Current	$V_{GE}=0\text{V}, V_{CE}=650\text{V}$	--	--	15	$\mu\text{A}$	
$I_{GES(F)}$	Gate to Emitter Forward Leakage	$V_{GE}=+30\text{V}, V_{CE}=0\text{V}$	--	--	100	nA	
$I_{GES(R)}$	Gate to Emitter Reverse Leakage	$V_{GE}=-30\text{V}, V_{CE}=0\text{V}$	--	--	100	nA	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$I_C=40\text{A}$ $V_{GE}=15\text{V}$	$T_J=25^{\circ}\text{C}$	--	1.15	--	V
			$T_J=175^{\circ}\text{C}$	--	1.25	--	V
		$I_C=75\text{A}$ $V_{GE}=15\text{V}$	$T_J=25^{\circ}\text{C}$	--	1.45	1.90	V
			$T_J=175^{\circ}\text{C}$	--	1.75	--	V
$V_{GE(th)}$	Gate Threshold Voltage	$I_C=1\text{mA}, V_{CE}=V_{GE}$	4.0	4.75	5.5	V	
<b>Dynamic Characteristics</b>							
$C_{ies}$	Input Capacitance	$V_{CE}=25\text{V}, V_{GE}=0\text{V},$ $f=1\text{MHz}$	4020	4730	5440	pF	
$C_{oes}$	Output Capacitance		--	157	--		
$C_{res}$	Reverse Transfer Capacitance		--	29	--		
$Q_g$	Total Gate Charge	$V_{CC}=480\text{V}, I_C=75\text{A},$ $V_{GE}=15\text{V}$	--	155	--	nC	
$Q_{ge}$	Gate to Emitter Charge		--	40	--		
$Q_{gc}$	Gate to Collector Charge		--	37	--		
$R_g$	Internal Gate Resistance	$f=1\text{MHz}$	--	0.5	--	$\Omega$	
<b>Switching Characteristics</b>							
$t_{d(ON)}$	Turn-on Delay Time	$V_{CC}=400\text{V}, I_C=75\text{A},$ $V_{GE}=0/15\text{V}, R_g=6.2\Omega,$ Inductive Load	--	50	--	ns	
$t_r$	Rise Time		--	20	--		
$t_{d(OFF)}$	Turn-Off Delay Time		--	200	--		
$t_f$	Fall Time		--	31	--		
$E_{on}$	Turn-On Switching Loss		Inductive Load	--	2.0	--	mJ
$E_{off}$	Turn-Off Switching Loss			--	0.9	--	
$E_{ts}$	Total Switching Loss			--	2.9	--	
$E_{on}$	Turn-On Switching Loss			$V_{CC}=400\text{V}, I_C=75\text{A},$ $V_{GE}=0/15\text{V}, R_g=6.2\Omega,$ Inductive Load, $T_J=175^{\circ}\text{C}$	--	2.7	
$E_{off}$	Turn-Off Switching Loss	--	1.4		--		
$E_{ts}$	Total Switching Loss	--	4.1		--		

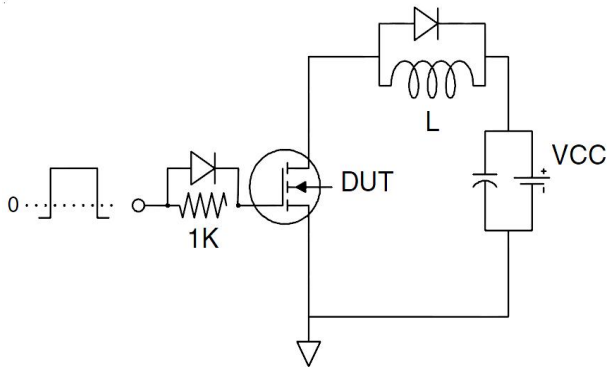
**Electrical Characteristics of the Diode (T<sub>c</sub>= 25°C unless otherwise specified)**

Symbol	Parameter	Conditions		Rating			Units
				Min.	Typ.	Max.	
V <sub>FM</sub>	Diode Forward Voltage	I <sub>F</sub> =75A	T <sub>J</sub> =25°C	--	1.7	2.4	V
			T <sub>J</sub> =175°C	--	1.5	--	V
T <sub>rr</sub>	Reverse Recovery Time	I <sub>F</sub> =75A, R <sub>g</sub> =6.2Ω		--	120	--	ns
I <sub>RRM</sub>	Diode Peak Reverse Recovery Current			--	33	--	A
Q <sub>rr</sub>	Reverse Recovery Charge			--	2.11	--	uC
E <sub>rec</sub>	Reverse recovery energy			--	0.24	--	mJ
T <sub>rr</sub>	Reverse Recovery Time	I <sub>F</sub> =75A,R <sub>g</sub> =6.2Ω, T <sub>J</sub> =175°C		--	180	--	ns
I <sub>RRM</sub>	Diode Peak Reverse Recovery Current			--	49	--	A
Q <sub>rr</sub>	Reverse Recovery Charge			--	4.49	--	uC
E <sub>rec</sub>	Reverse recovery energy			--	0.36	--	mJ

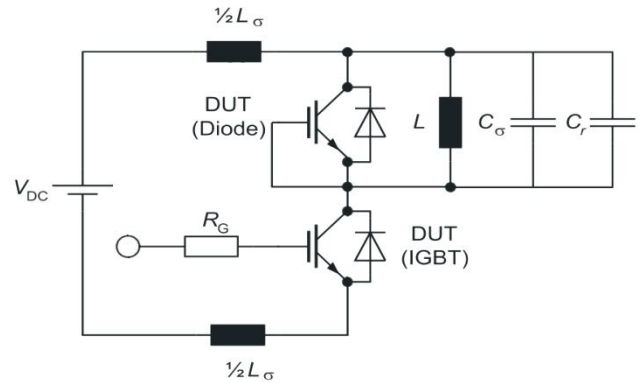
Note: For optimum lifetime and reliability, NCE recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.

## Test Circuit

### 1) Gate Charge Test Circuit

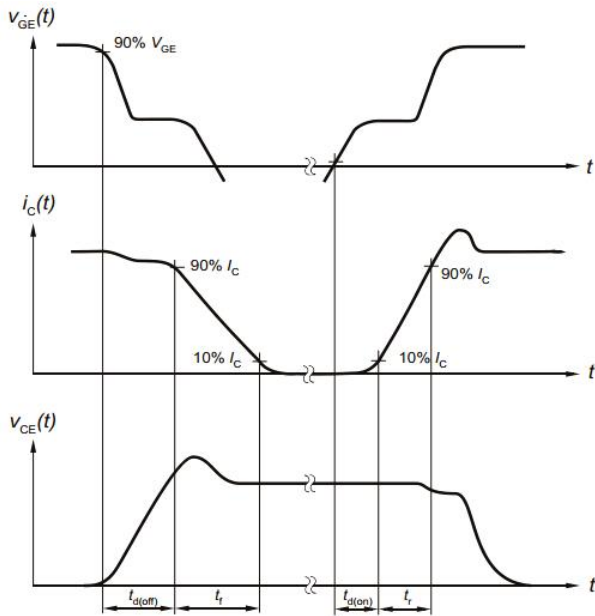


### 2) Switch Time Test Circuit

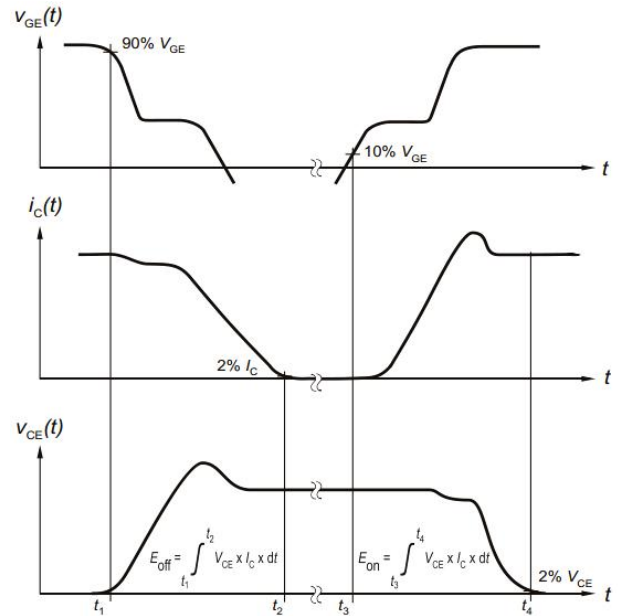


## Switching characteristics

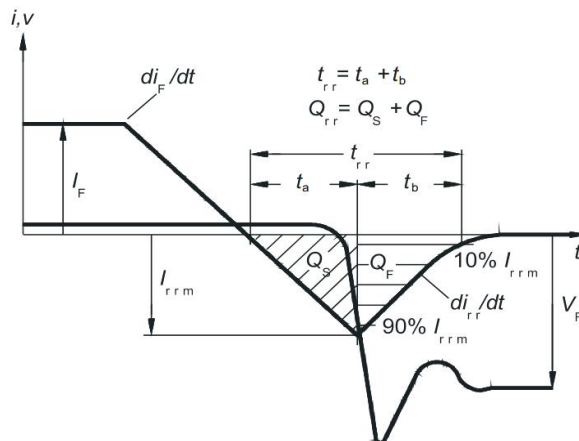
### 1) Definition of switching times



### 2) Definition of switching losses



### 3) Definition of diode switching characteristics



Typical Electrical and Thermal Characteristics

Figure 1 Output Characteristics

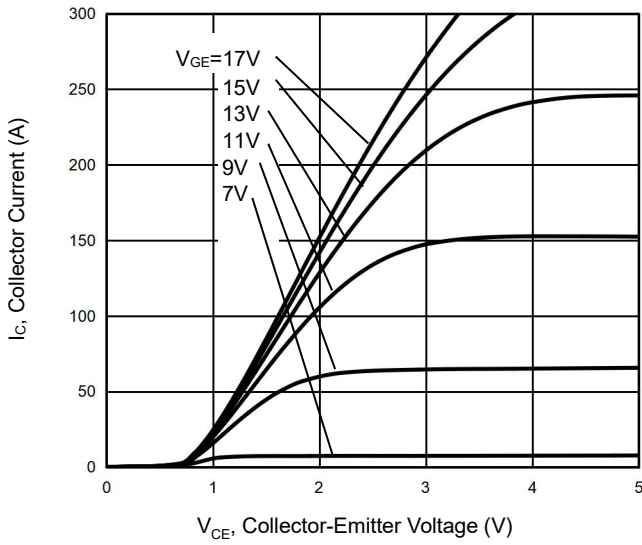


Figure 2 Transfer Characteristics

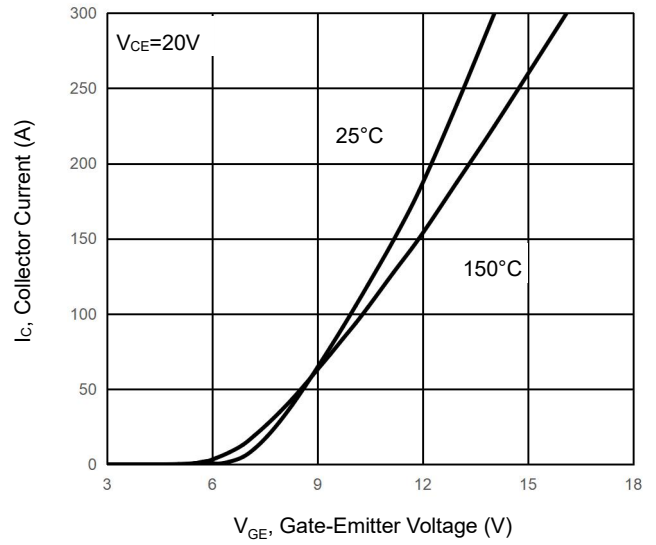


Figure 3  $V_{CE(sat)}$  vs. Temperature

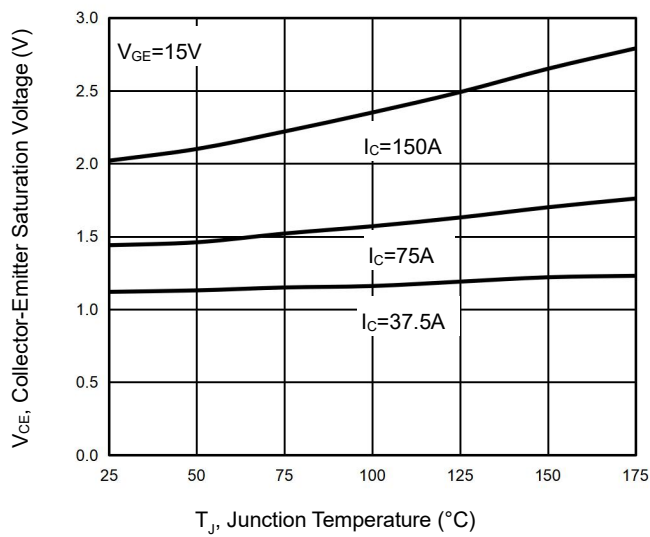


Figure 4 Saturation Voltage vs.  $V_{GE}$

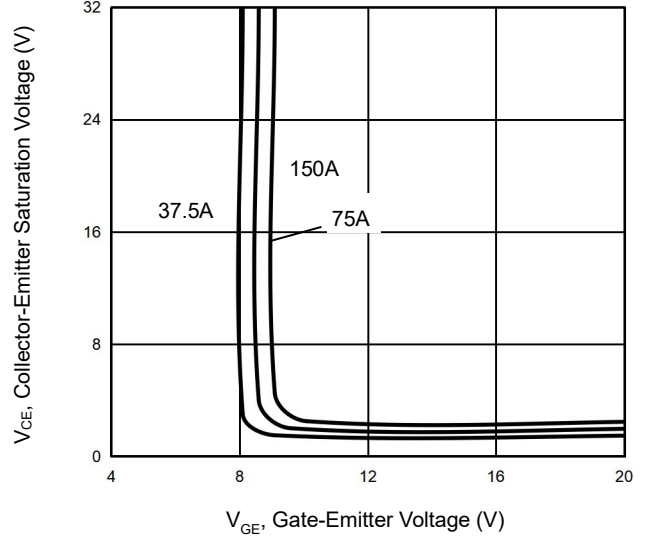


Figure 5 Capacitance Characteristics

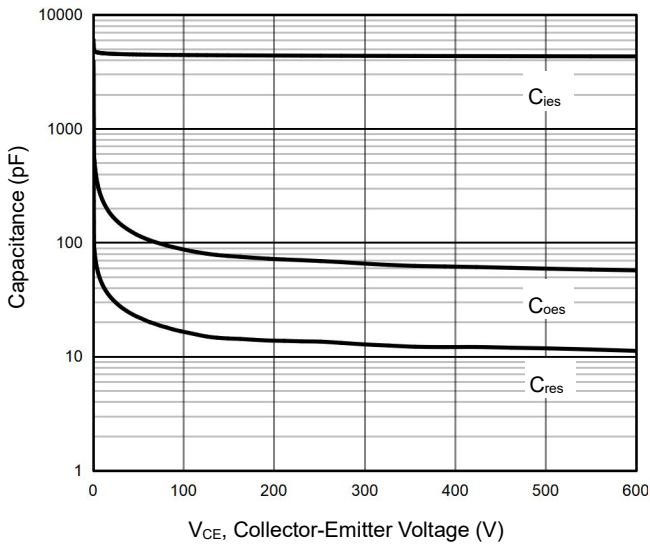
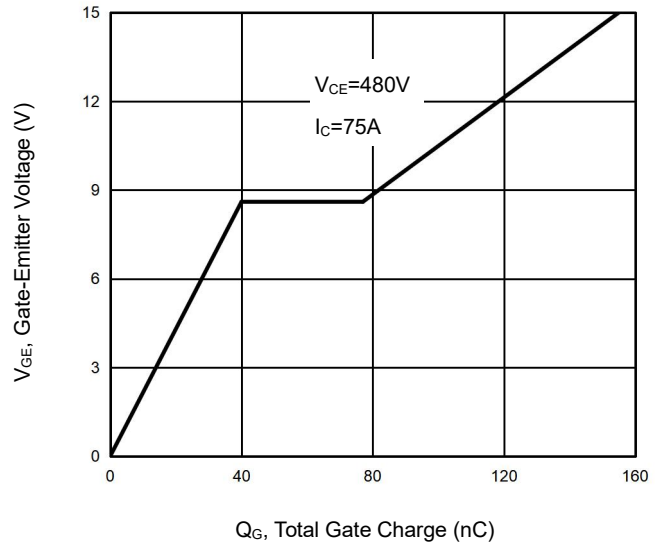
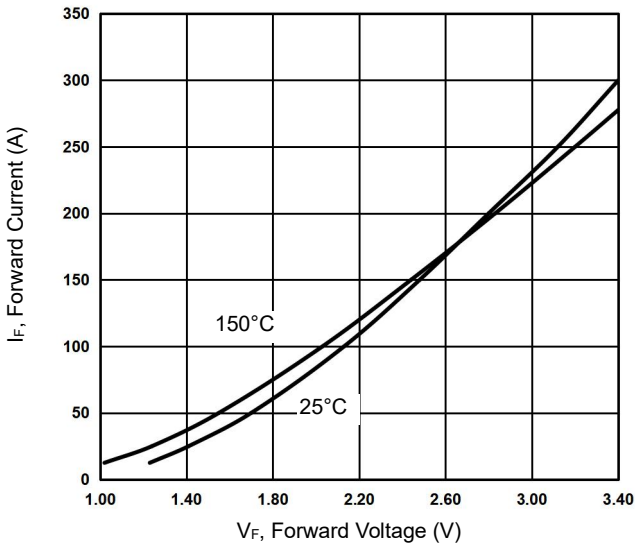


Figure 6 Gate Charge Wave Form

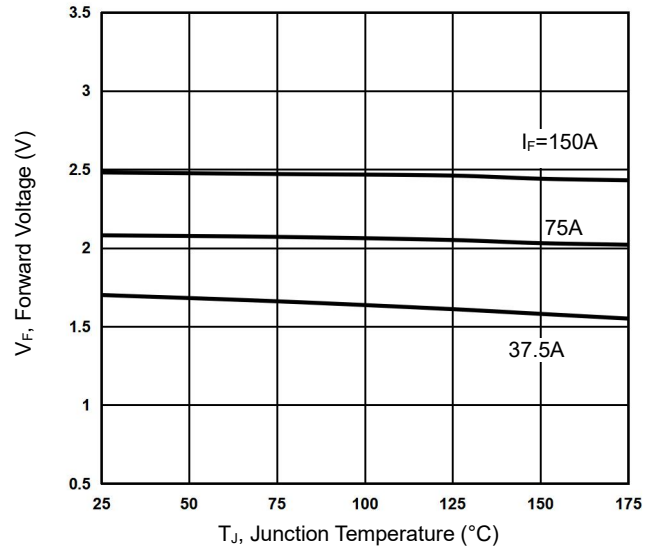


## Typical Electrical and Thermal Characteristics

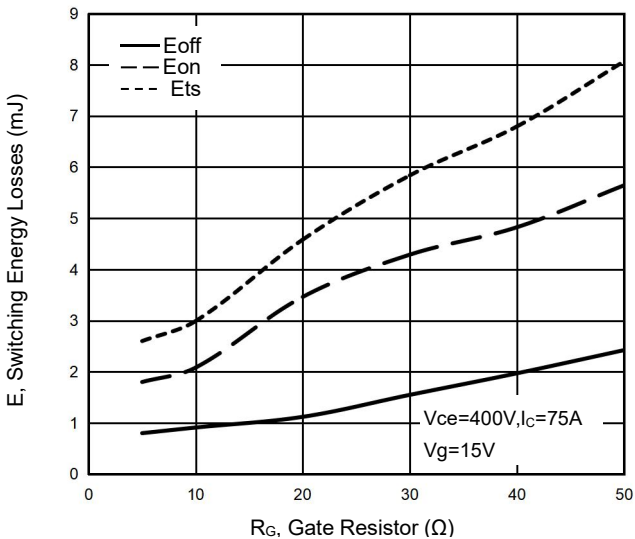
**Figure 7 Forward Characteristics**



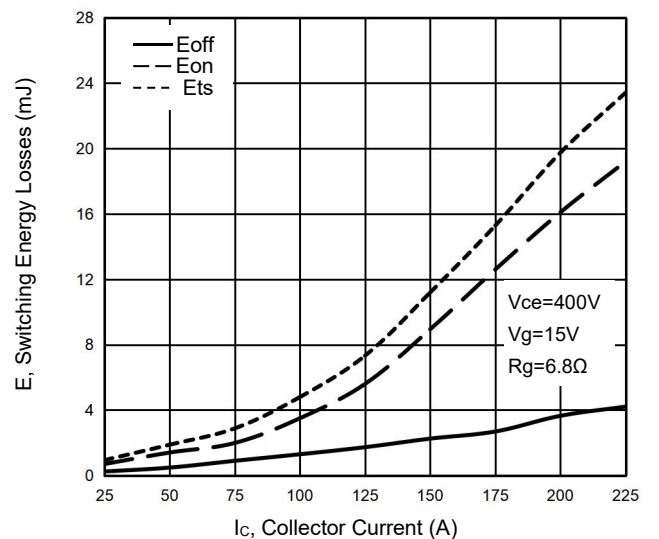
**Figure 8  $V_F$  vs. Temperature**



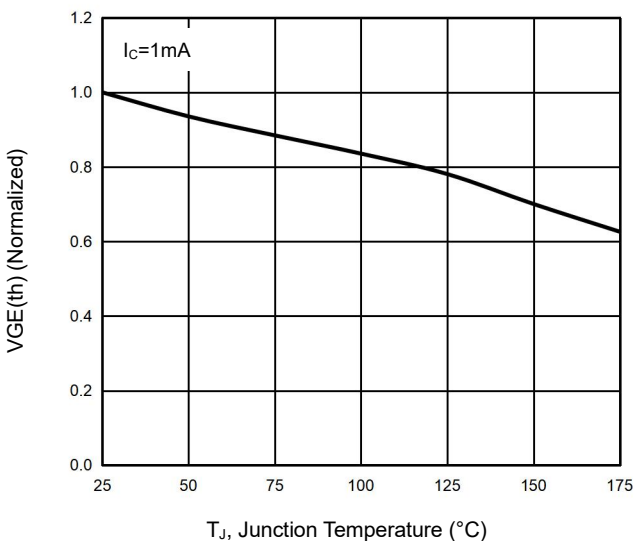
**Figure 9 Switching Loss vs.  $R_G$**



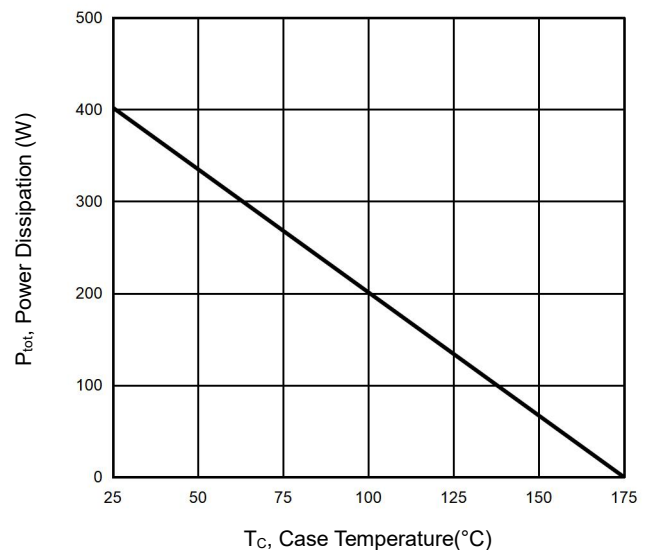
**Figure 10 Switching Loss vs. Collector Current**



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



**Figure 12  $P_{tot}$  vs. Case Temperature**



Typical Electrical and Thermal Characteristics

Figure 13 Switching Loss vs. Temperature

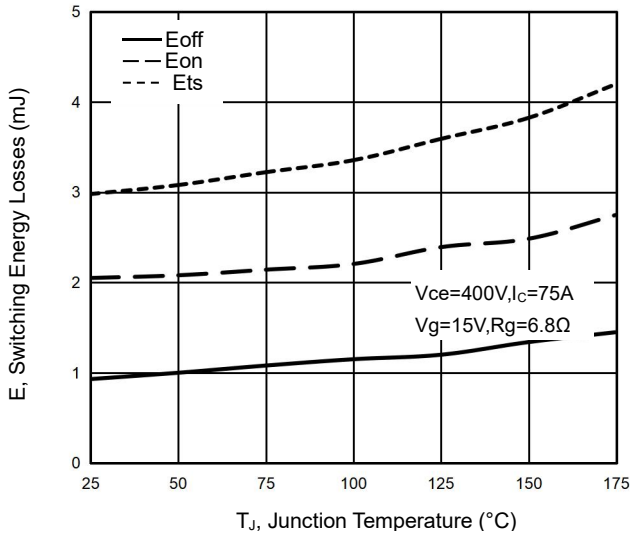


Figure 14 Switching Loss vs. V<sub>CE</sub>

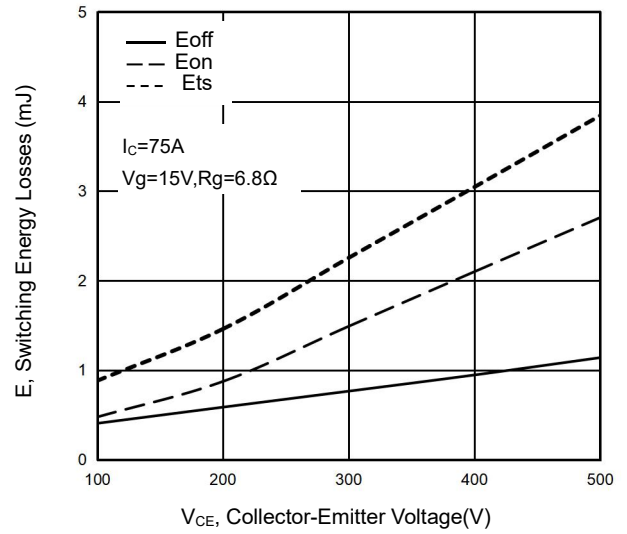


Figure 15 Gate-Emitter Threshold Voltage as a Function of Junction Temperature(Normalized)

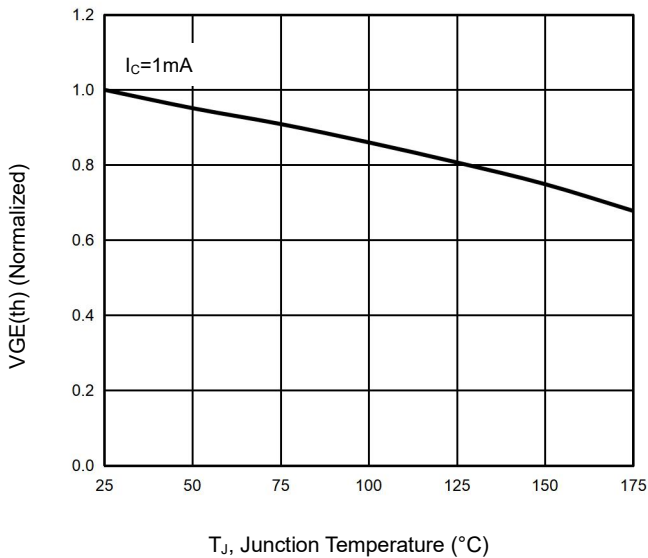


Figure 16 Typical Collector-Emitter Saturation Voltage as a Function of Collector Current(Normalized)

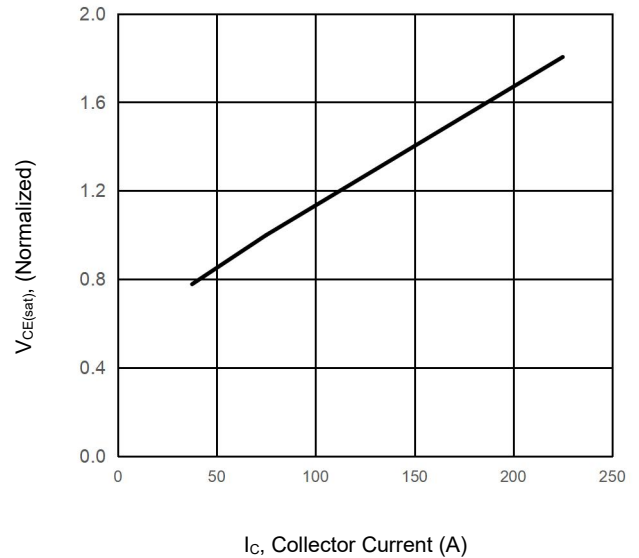


Figure 17 V<sub>(BR)CES</sub> vs. Temperature

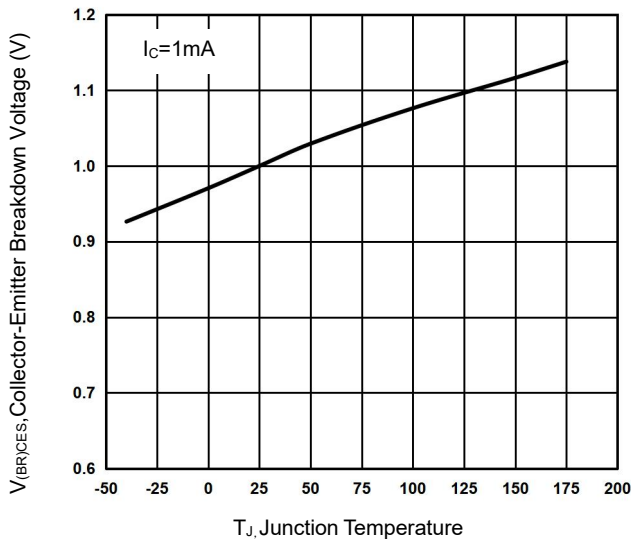
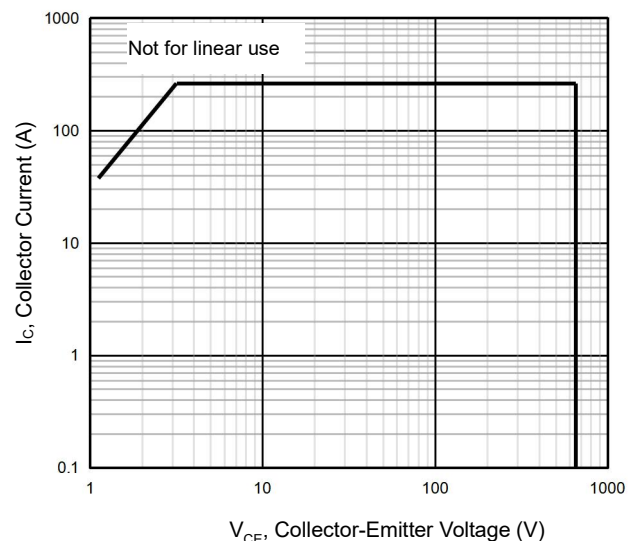
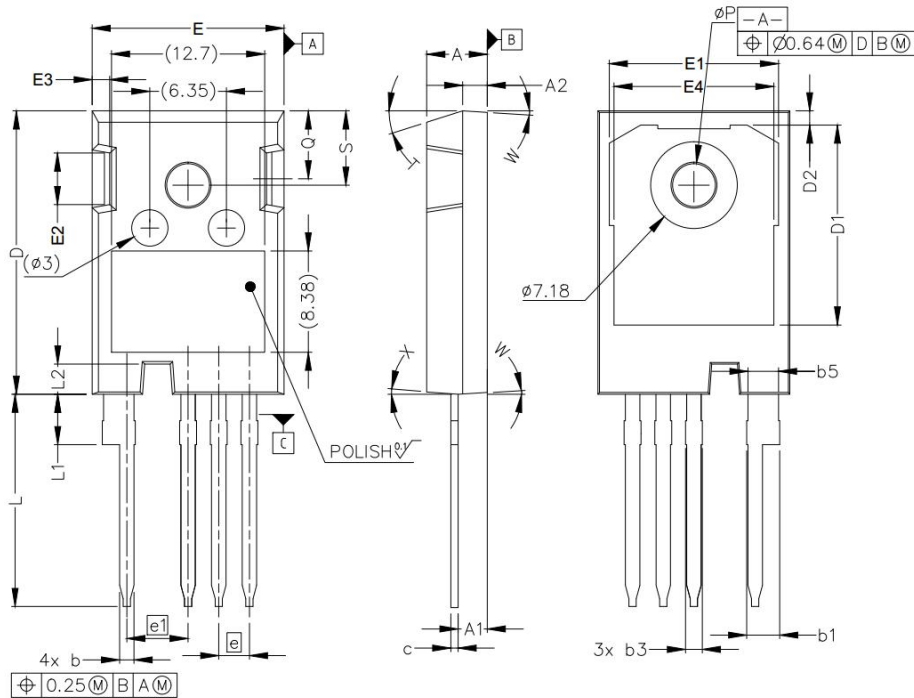


Figure 18 Forward Bias Safe Operating Area



# TO-247-4L(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	2.39	2.94	0.09	0.12
b3	1.07	1.60	0.04	0.06
b5	2.39	2.69	0.09	0.11
c	0.55	0.68	0.02	0.03
D	23.30	23.60	0.92	0.93
D1	16.25	17.65	0.64	0.69
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	0.14	0.20
E3	1.00	1.90	0.04	0.07
E4	12.38	13.43	0.49	0.53
e	2.54 BSC		0.1 BSC	
e1	5.08 BSC		0.2 BSC	
L	17.31	17.82	0.68	0.70
L1	3.97	4.37	0.16	0.17
L2	2.35	2.65	0.09	0.10
$\phi P$	3.51	3.65	0.14	0.14
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	4.0° REF.			



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