

650V 40A Trench FS Gen.7 IGBT

General Description

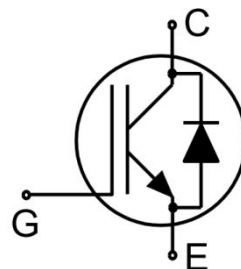
Using NCE's proprietary high density trench gate design and advanced FS (Field Stop) Gen.7 technology, the 650V Trench FS Gen.7 IGBT offers superior conduction and switching performances, and easy parallel operation.

Features

- Trench field stop Gen.7 Technology Offering
- Low saturation voltage: $V_{CESat} = 1.50V(Typ.) @ I_C = 40 A$
- 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
- AEC-Q101 qualified

Application

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



Schematic diagram

Package Marking and Ordering Information

Device	Device Package	Device Marking
NCEA40ED65BT	TO-247-3L	A40ED65BT



TO-247-3L

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	± 30	V
I_C	Collector Current	80	A
	Collector Current @ $T_C = 100^{\circ}C$	40	A
I_{Cpuls}	Pulsed Collector Current, t_p limited by T_{jmax}	120	A
-	Turn off safe operating area, $V_{CE}=650V$, $T_J=175^{\circ}C$	120	A
I_F	Diode Continuous Forward Current @ $T_C = 100^{\circ}C$	40	A
I_{FM}	Diode Maximum Forward Current	120	A
P_D	Power Dissipation @ $T_C = 25^{\circ}C$	245	W
	Power Dissipation @ $T_C = 100^{\circ}C$	123	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	$^{\circ}C$
t_{sc}	Short circuit withstand time $V_{GE}=15V$, $V_{CC} \leq 400V$, Allowed number of short circuits < 1000 Time between short circuits: $\geq 1.0s$, $T_J \leq 150^{\circ}C$	5	us

Thermal Characteristic

Symbol	Parameter	Value	Units
$R_{\theta JC}$	Thermal Resistance, Junction to case for IGBT	0.61	$^{\circ}\text{C/W}$
$R_{\theta JC}$	Thermal Resistance, Junction to case for Diode	0.71	$^{\circ}\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	40	$^{\circ}\text{C/W}$

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

Symbol	Parameter	Conditions		Value			Units
				Min.	Typ.	Max.	
Static Characteristics							
V _{(BR)CES}	Collector-Emitter Breakdown Voltage	V _{GE} =0V, I _{CE} =1mA		650	--	--	V
I _{CES}	Collector-Emitter Leakage Current	V _{GE} =0V, V _{CE} =650V		--	--	5	uA
I _{GES(F)}	Gate to Emitter Forward Leakage	V _{GE} =+30V, V _{CE} =0V		--	--	100	nA
I _{GES(R)}	Gate to Emitter Reverse Leakage	V _{GE} =-30V, V _{CE} =0V		--	--	100	nA
V _{CE(sat)}	Collector-Emitter Saturation Voltage	I _C =20A	T _J =25°C	--	1.20	--	V
		V _{GE} =15V	T _J =175°C	--	1.30	--	V
		I _C =40A	T _J =25°C	--	1.50	2.00	V
		V _{GE} =15V	T _J =175°C	--	1.80	--	V
V _{GE(th)}	Gate Threshold Voltage	I _C =1mA, V _{CE} =V _{GE}		4.5	5.25	6.0	V
Dynamic Characteristics							
C _{ies}	Input Capacitance	V _{CE} =25V, V _{GE} =0V, f=1MHz		1870	2200	2530	pF
C _{oes}	Output Capacitance			--	71	--	
C _{res}	Reverse Transfer Capacitance			--	17	--	
Q _g	Total Gate Charge	V _{CC} =480V, I _C =40A, V _{GE} =15V		--	82	--	nC
Q _{ge}	Gate to Emitter Charge			--	27	--	
Q _{gc}	Gate to Collector Charge			--	25	--	
R _g	Internal Gate Resistance	f=1MHz		--	0.5	--	Ω
I _{C(SC)}	Short circuit collector current Max.1000 short circuits Time between short circuits: ≥1.0s	V _{GE} =15V, V _{CC} ≤400V, t _{SC} ≤5us, T _J ≤150° C		--	200	--	A
Switching Characteristics							
t _{d(ON)}	Turn-on Delay Time	V _{CC} =400V, I _C =40A, V _{GE} =0/15V, R _g =5.4Ω, Inductive Load		--	45	--	ns
t _r	Rise Time			--	16	--	
t _{d(OFF)}	Turn-Off Delay Time			--	133	--	
t _f	Fall Time			--	15	--	
E _{on}	Turn-On Switching Loss			--	1.0	--	mJ
E _{off}	Turn-Off Switching Loss			--	0.4	--	
E _{ts}	Total Switching Loss			--	1.4	--	
E _{on}	Turn-On Switching Loss	V _{CC} =400V, I _C =40A, V _{GE} =0/15V, R _g =5.4Ω, Inductive Load, T _J =175°C		--	1.6	--	mJ
E _{off}	Turn-Off Switching Loss	--	0.8	--			
E _{ts}	Total Switching Loss	--	2.4	--			

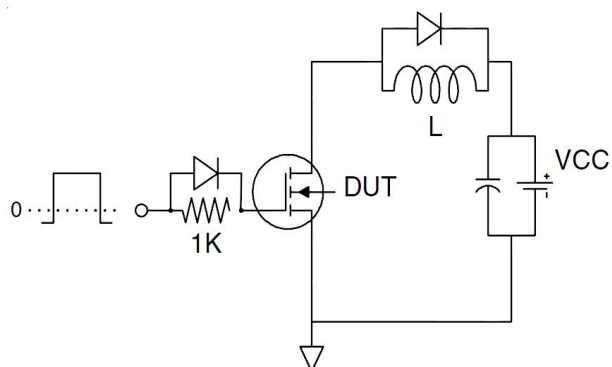
Electrical Characteristics of the Diode (T_c= 25°C unless otherwise specified)

Symbol	Parameter	Conditions		Rating			Units
				Min.	Typ.	Max.	
V _{FM}	Diode Forward Voltage	I _F =40A	T _j =25°C	--	1.6	2.3	V
			T _j =175°C	--	1.4	--	V
T _{rr}	Reverse Recovery Time	I _F =40A, R _g =5.4Ω		--	100	--	ns
I _{RRM}	Diode Peak Reverse Recovery Current			--	25	--	A
Q _{rr}	Reverse Recovery Charge			--	0.98	--	uC
E _{rec}	Reverse recovery energy			--	0.18	--	mJ
T _{rr}	Reverse Recovery Time	I _F =40A, R _g =5.4Ω T _j =175°C		--	150	--	ns
I _{RRM}	Diode Peak Reverse Recovery Current			--	40	--	A
Q _{rr}	Reverse Recovery Charge			--	2.45	--	uC
E _{rec}	Reverse recovery energy			--	0.27	--	mJ

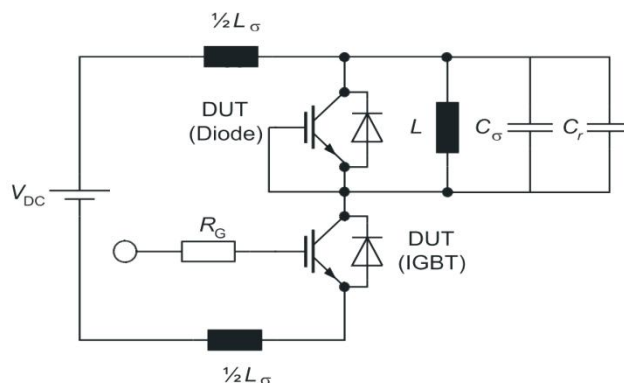
Note: For optimum lifetime and reliability, NCE recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.

Test Circuit

1) Gate Charge Test Circuit

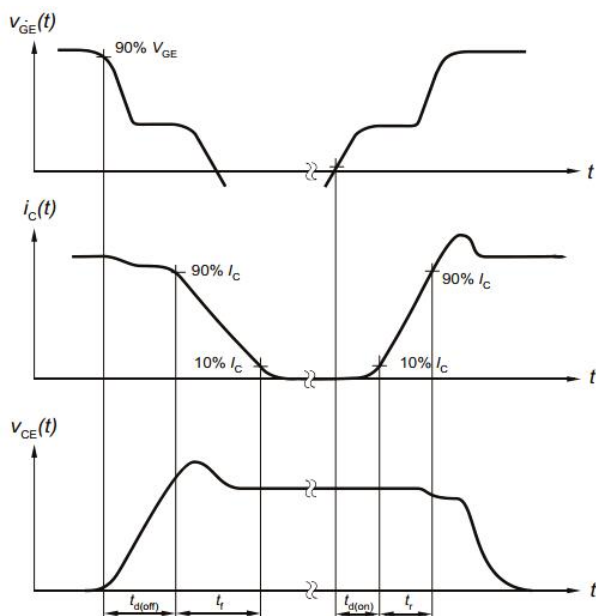


2) Switch Time Test Circuit

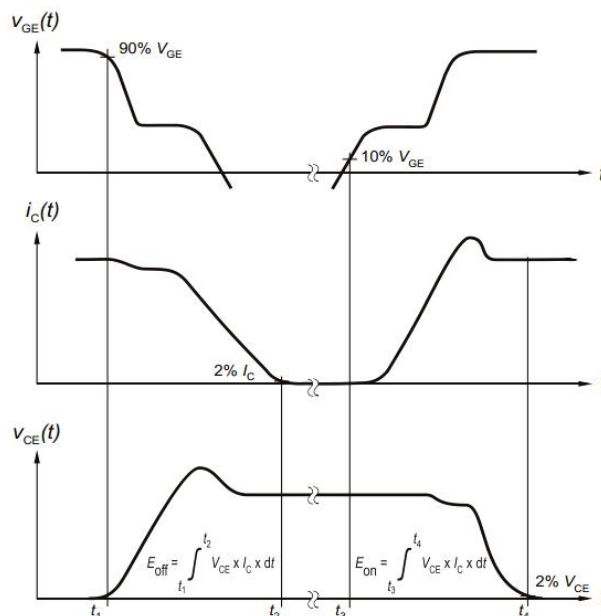


Switching characteristics

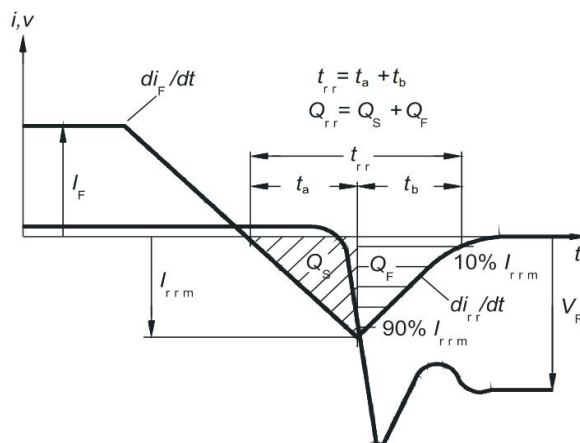
1) Definition of switching times



2) Definition of switching losses



3) Definition of diode switching characteristics



Typical Electrical and Thermal Characteristics

Figure 1 Output Characteristics

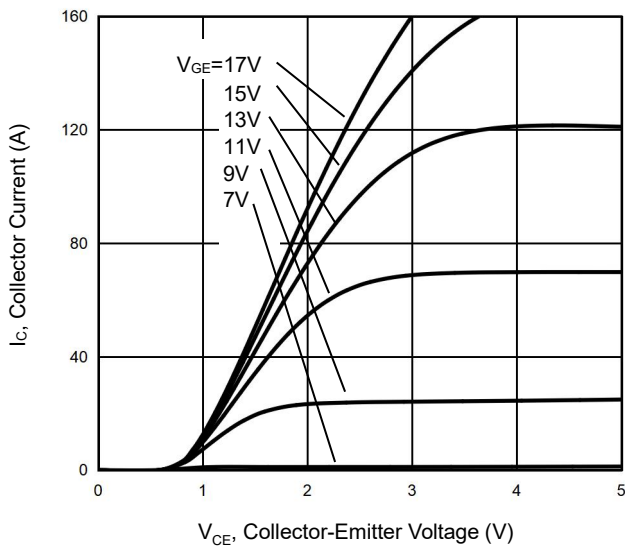


Figure 2 Transfer Characteristics

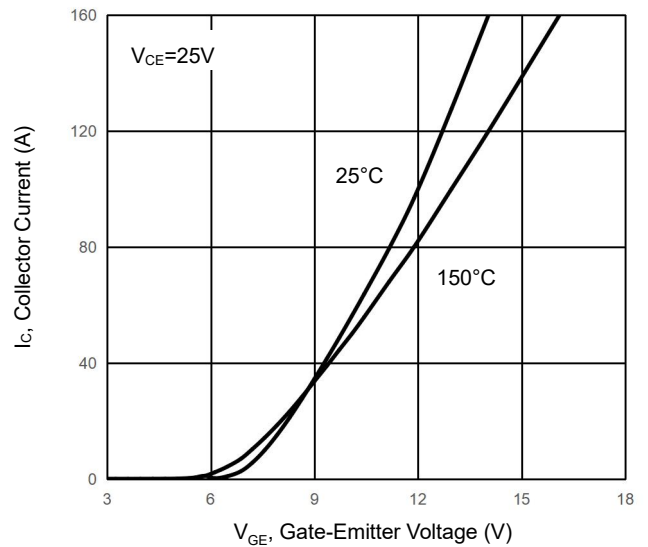


Figure 3 $V_{CE(sat)}$ vs. Temperature

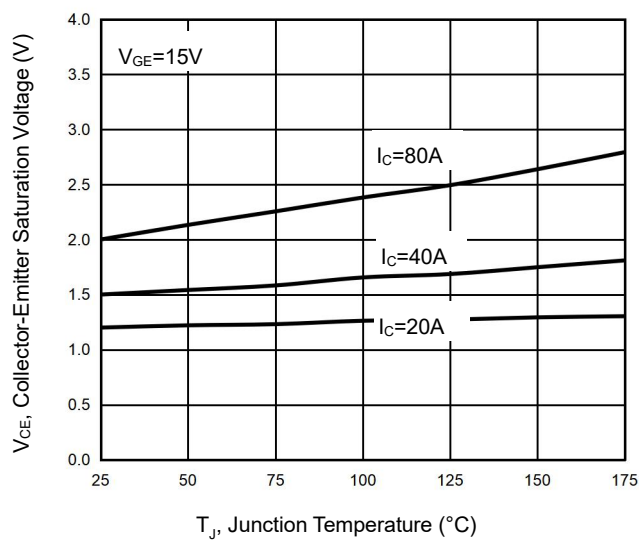


Figure 4 Saturation Voltage vs. V_{GE}

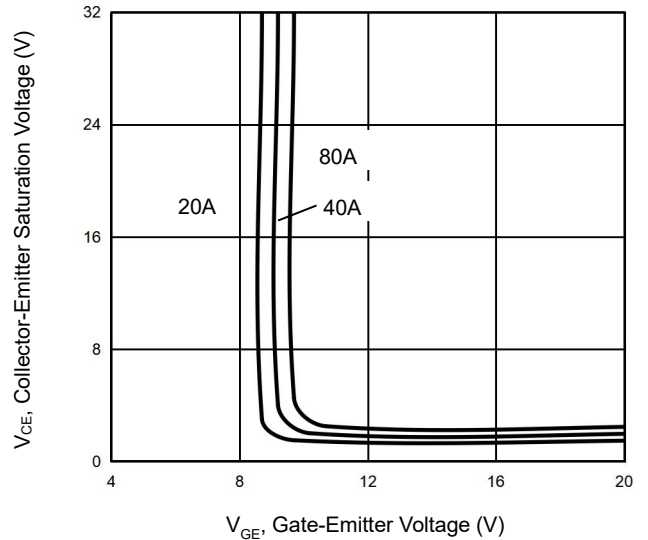


Figure 5 Capacitance Characteristics

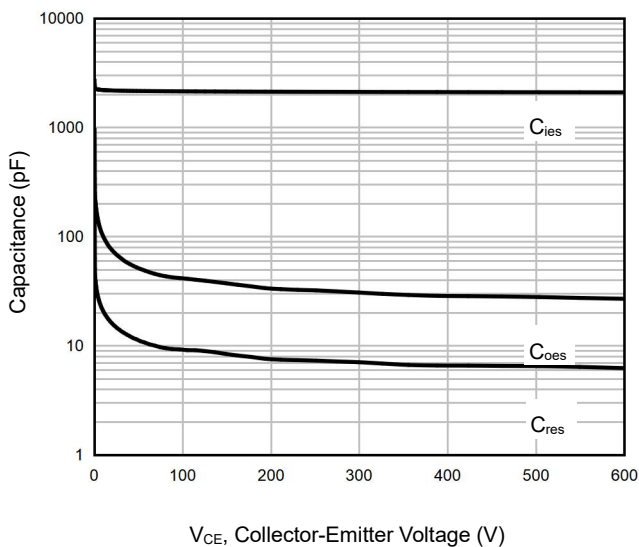
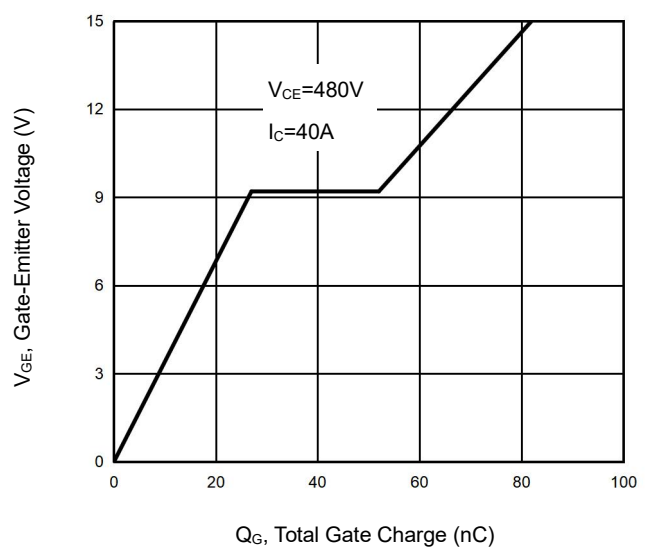


Figure 6 Gate Charge Wave Form



Typical Electrical and Thermal Characteristics

Figure 7 Forward Characteristics

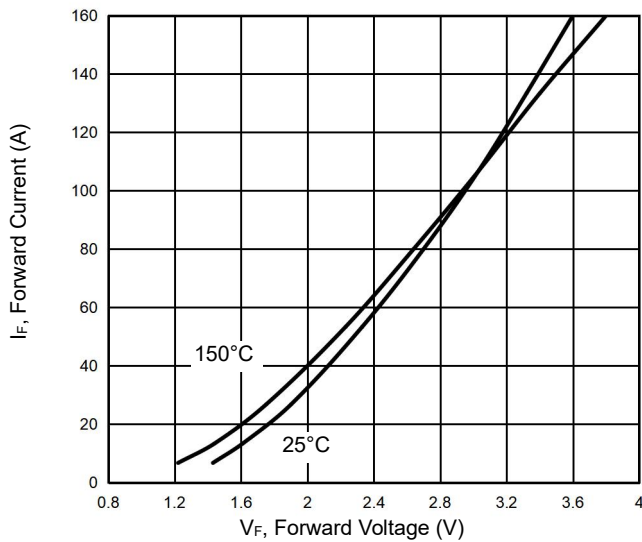


Figure 8 V_F vs. Temperature

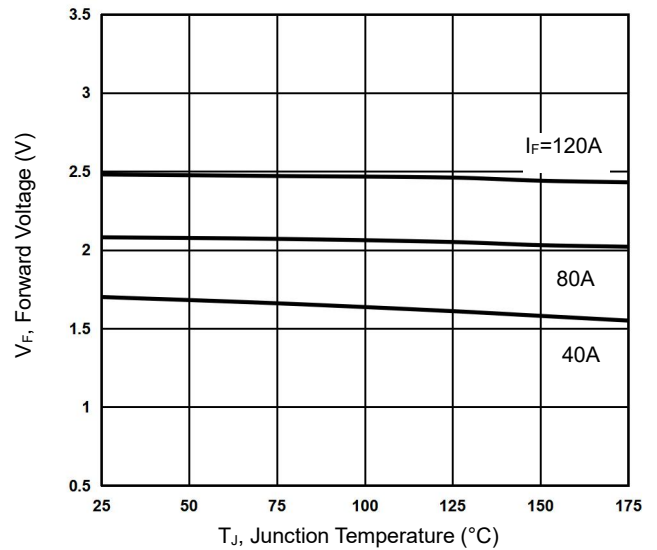


Figure 9 Switching Loss vs. R_G

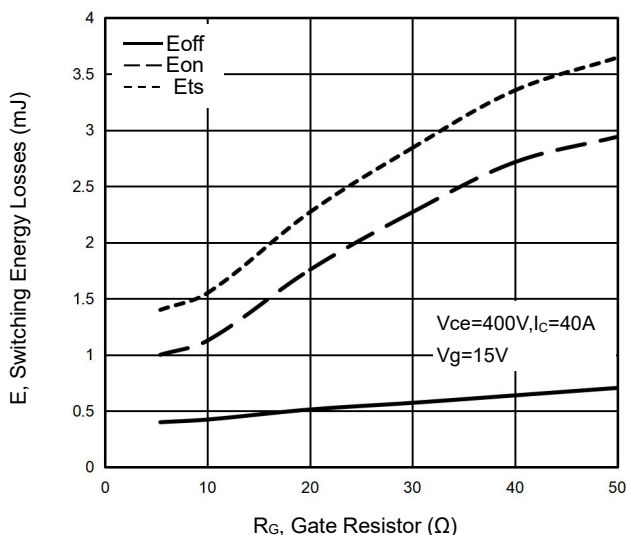


Figure 10 Switching Loss vs. Collector Current

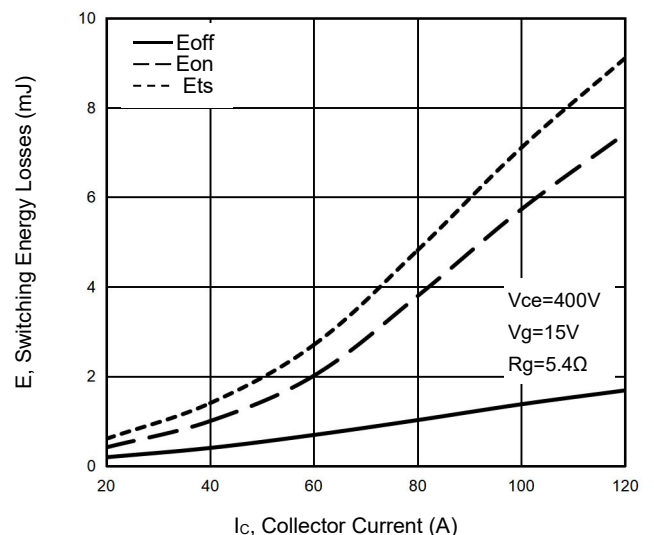


Figure 11 Gate-Emitter Threshold Voltage as a Function of Junction Temperature(Normalized)

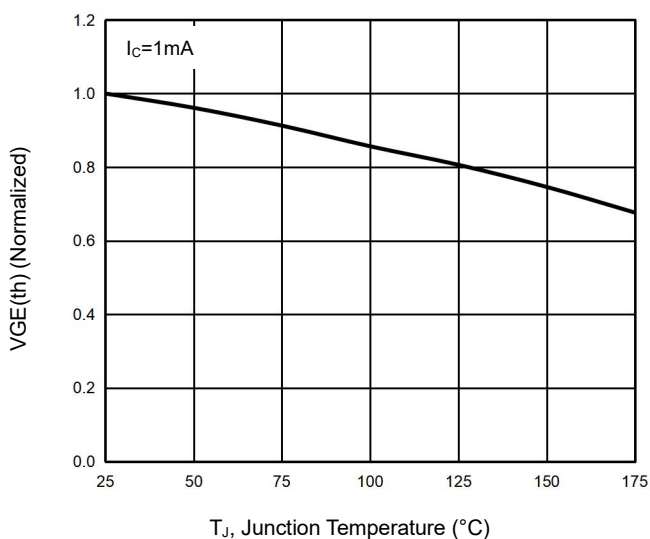
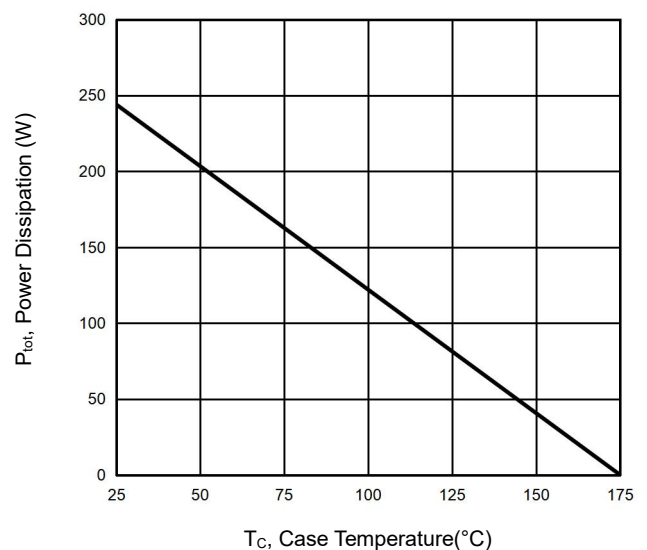


Figure 12 P_{tot} vs. Case Temperature



Typical Electrical and Thermal Characteristics

Figure 13 Switching Loss vs. Temperature

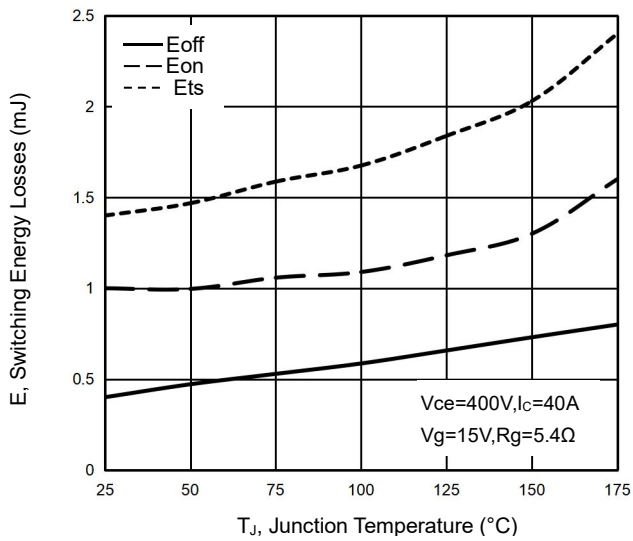


Figure 14 Switching Loss vs. V_{CE}

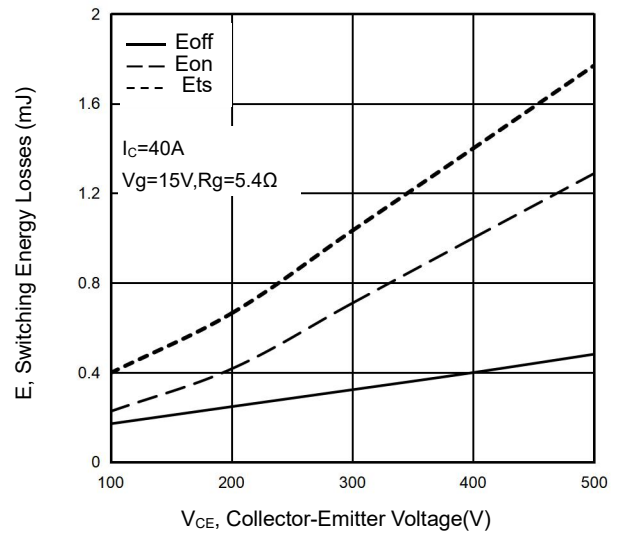


Figure 15 Gate-Emitter Threshold Voltage as a Function of Junction Temperature(Normalized)

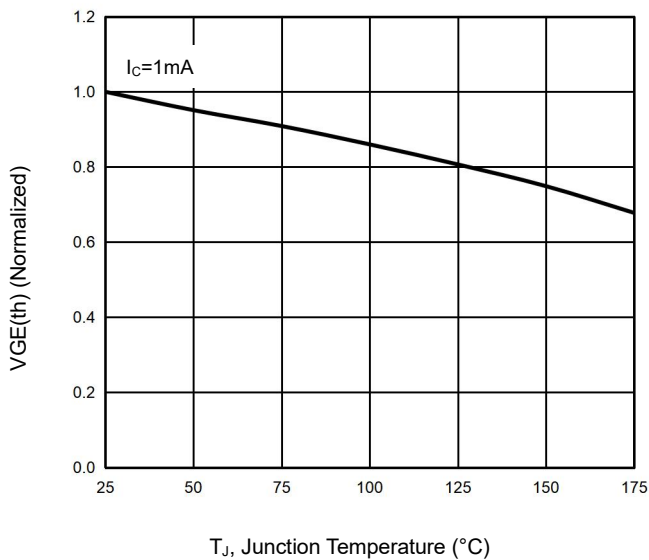


Figure 16 Typical Collector-Emitter Saturation Voltage as a Function of Collector Current(Normalized)

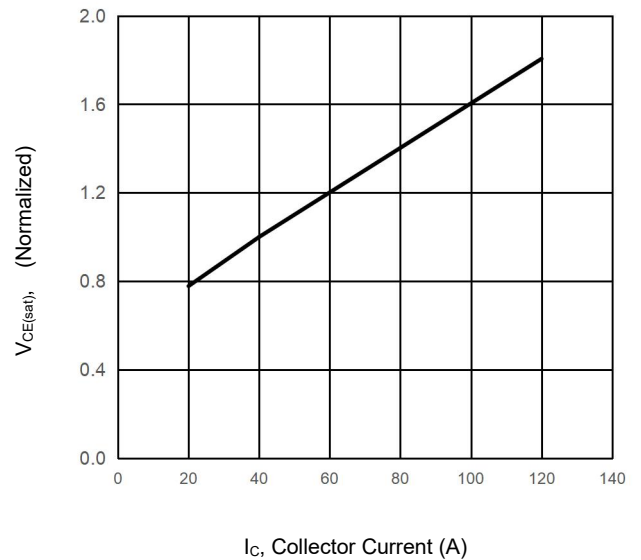


Figure 17 $V_{\text{(BR)CES}}$ vs. Temperature

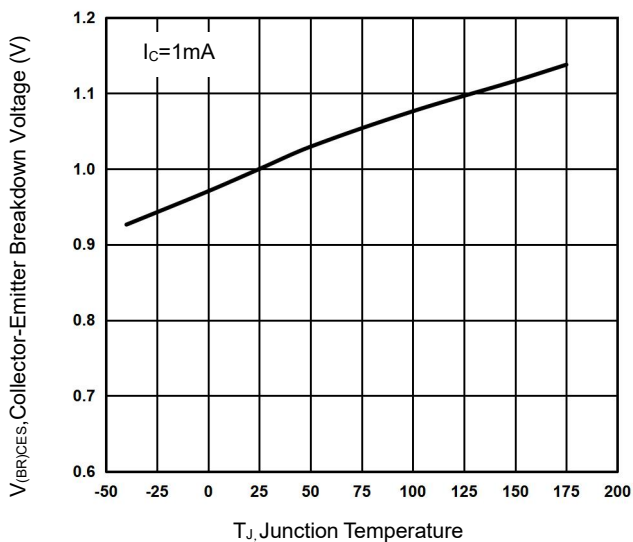
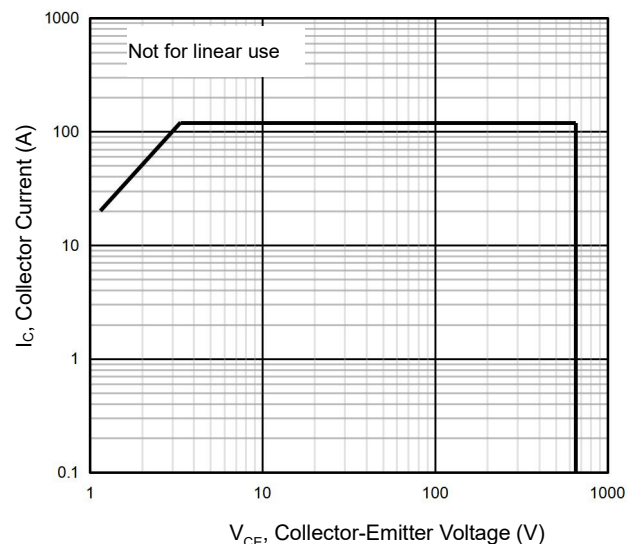
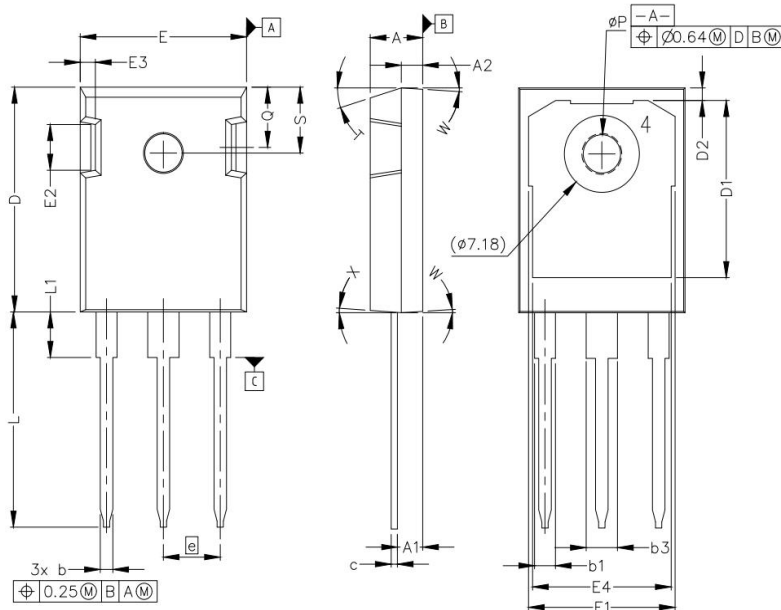


Figure 18 Forward Bias Safe Operating Area



TO-247-3L(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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