

650V 50A Trench FS Gen.7 IGBT

General Description

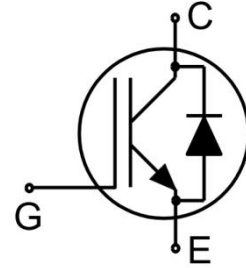
Using NCE's proprietary high density trench gate design and advanced FS (Field Stop) Gen.7 technology, the 650V Trench FS Gen.7 IGBT offers superior conduction and switching performances, and easy parallel operation;

Features

- Trench Field Stop Gen.7 Technology Offering
- Low saturation voltage: $V_{CESat} = 1.50V(Typ.) @ I_C = 50 A$
- 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

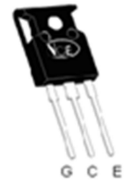
- Inverters
- Motor drives
- Converter
- Automotive application



Schematic diagram

Package Marking and Ordering Information

Device	Device Package	Device Marking
NCEA50ED65BT	TO-247-3L	A50ED65BT



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	100	A
	Collector Current @ $T_C = 100^{\circ}C$	50	A
I_{Cpuls}	Pulsed Collector Current, t_p limited by T_{jmax}	150	A
-	Turn off safe operating area, $V_{CE}=650V, T_J=175^{\circ}C$	150	A
I_F	Diode Continuous Forward Current @ $T_C = 100^{\circ}C$	50	A
I_{FM}	Diode Maximum Forward Current	150	A
P_D	Power Dissipation @ $T_C = 25^{\circ}C$	294	W
	Power Dissipation @ $T_C = 100^{\circ}C$	147	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 $V_{GE}=15.0V, V_{CC} \leq 400V$, 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 _{θJC}	Thermal Resistance, Junction to case for IGBT	0.50	°C/W
R _{θJC}	Thermal Resistance, Junction to case for Diode	0.63	°C/W
R _{θJA}	Thermal Resistance, Junction to Ambient	40	°C/W

Electrical Characteristics (T_C=25°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	--	--	10	μA	
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 =25A, V _{GE} =15V,	--	1.20	--	V	
		I _C =50A, T _J =25°C	--	1.50	2.00	V	
		I _C =25A, V _{GE} =15V,	--	1.30	--	V	
		I _C =50A, 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	2400	3050	3700	pF	
C _{oes}	Output Capacitance		--	105	--		
C _{res}	Reverse Transfer Capacitance		--	23	--		
Q _g	Total Gate Charge	V _{CC} =480V, I _C =50A, V _{GE} =15V	--	106	--	nC	
Q _{ge}	Gate to Emitter Charge		--	35	--		
Q _{gc}	Gate to Collector Charge		--	33	--		
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} ≤5μs, T _J ≤150°C	--	230	--	A	
Switching Characteristics							
t _{d(ON)}	Turn-on Delay Time	V _{CC} =400V, I _C =50A, V _{GE} =0/15V, R _g =5.7Ω, Inductive Load	--	51	--	ns	
t _r	Rise Time		--	19	--		
t _{d(OFF)}	Turn-Off Delay Time		--	149	--		
t _f	Fall Time		--	23	--		
E _{on}	Turn-On Switching Loss		V _{CC} =400V, I _C =50A, V _{GE} =0/15V, R _g =5.7Ω, Inductive Load, T _J =175°C	--	1.29	--	mJ
E _{off}	Turn-Off Switching Loss			--	0.42	--	
E _{ts}	Total Switching Loss			--	1.71	--	
E _{on}	Turn-On Switching Loss		V _{CC} =400V, I _C =50A, V _{GE} =0/15V, R _g =5.7Ω, Inductive Load, T _J =175°C	--	2.21	--	mJ
E _{off}	Turn-Off Switching Loss			--	1.07	--	
E _{ts}	Total Switching Loss	--		3.28	--		

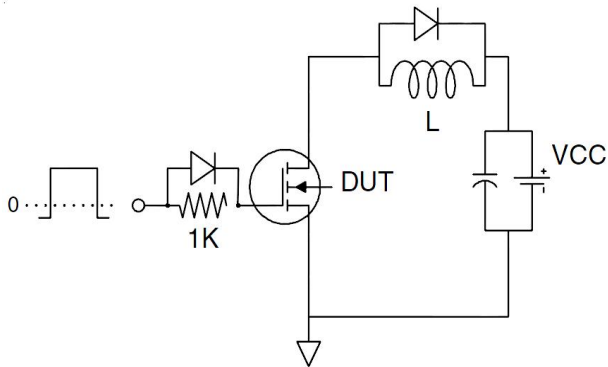
Electrical Characteristics of the Diode ($T_c=25^{\circ}\text{C}$ unless otherwise specified)

Symbol	Parameter	Conditions	Rating			Units	
			Min.	Typ.	Max.		
V_{FM}	Diode Forward Voltage	$I_F=50\text{A}$	$T_j=25^{\circ}\text{C}$	--	1.6	2.3	V
			$T_j=175^{\circ}\text{C}$	--	1.4	--	V
T_{rr}	Reverse Recovery Time	$I_F=50\text{A}, R_g=5.7\Omega,$ $T_j=25^{\circ}\text{C}$	--	116	--	ns	
I_{RRM}	Diode Peak Reverse Recovery Current		--	30	--	A	
Q_{rr}	Reverse Recovery Charge		--	1.41	--	μC	
E_{rec}	Reverse recovery energy		--	0.22	--	mJ	
T_{rr}	Reverse Recovery Time	$I_F=50\text{A}, R_g=5.7\Omega,$ $T_j=175^{\circ}\text{C}$	--	175	--	ns	
I_{RRM}	Diode Peak Reverse Recovery Current		--	48	--	A	
Q_{rr}	Reverse Recovery Charge		--	3.45	--	μC	
E_{rec}	Reverse recovery energy		--	0.32	--	mJ	

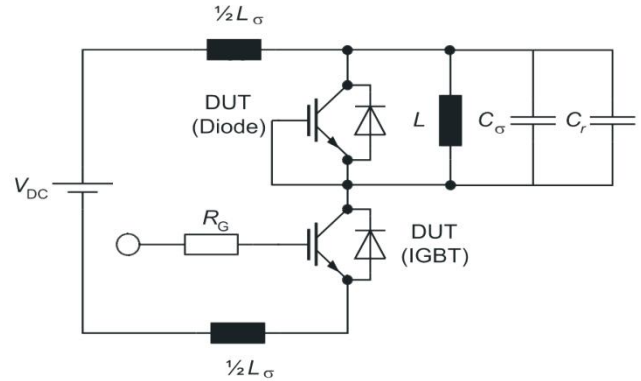
Note: For optimum lifetime and reliability, NCE recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.

Test Circuit

1) Gate Charge Test Circuit

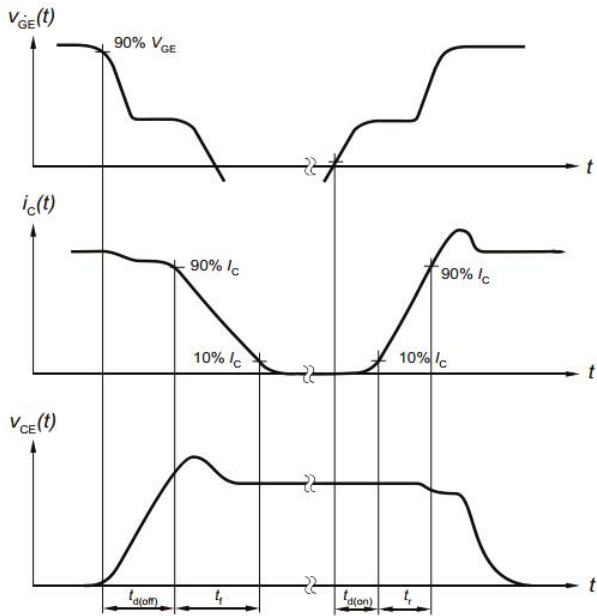


2) Switch Time Test Circuit

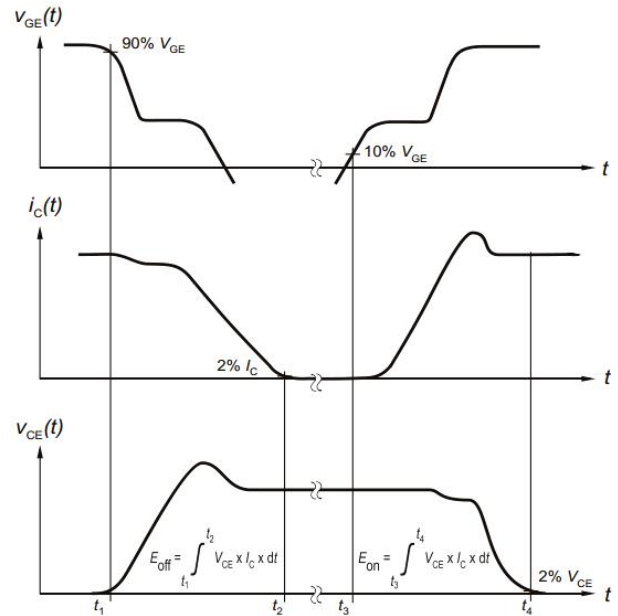


Switching characteristics

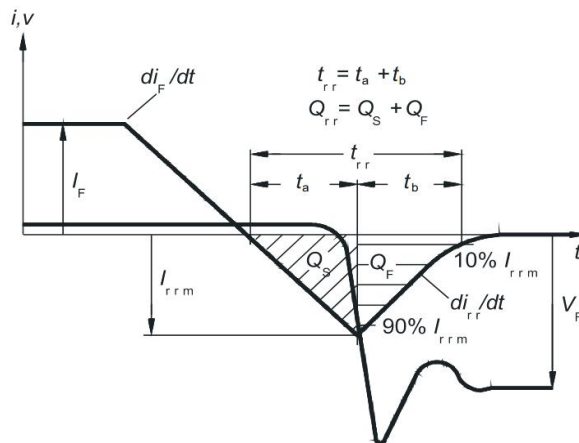
1) Definition of switching times



2) Definition of switching losses



3) Definition of diode switching characteristics



Typical Electrical and Thermal Characteristics

Figure 1 Output Characteristics

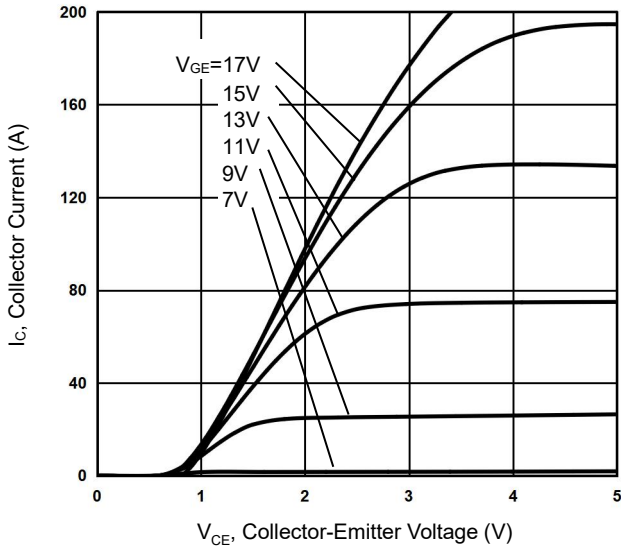


Figure 2 Transfer Characteristics

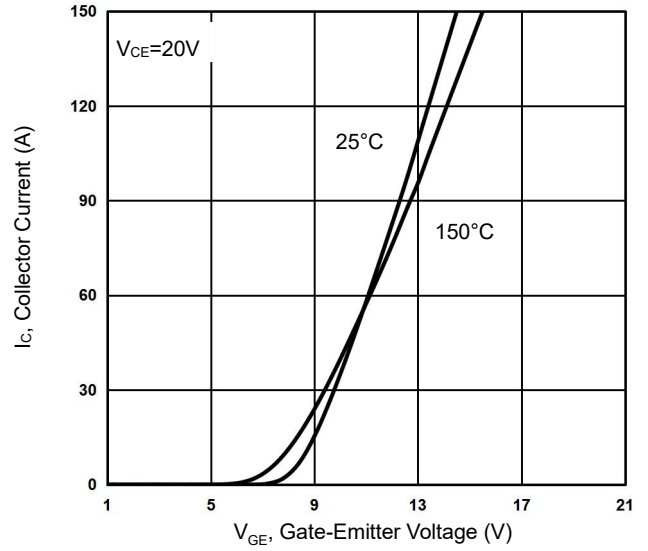


Figure 3 $V_{CE(sat)}$ vs. Temperature

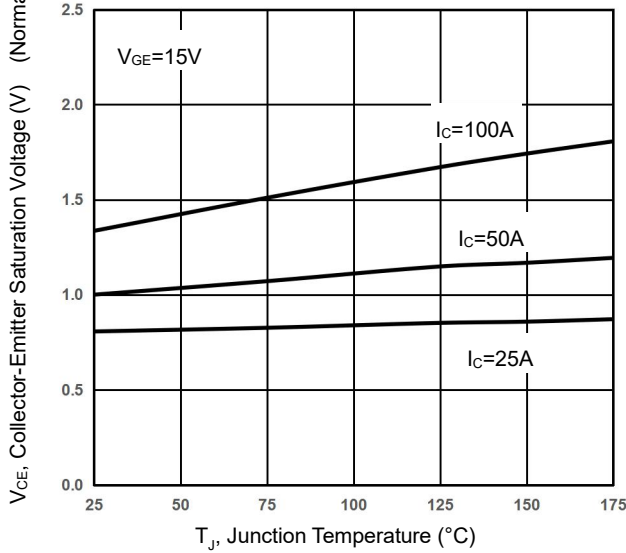


Figure 4 Saturation Voltage vs. V_{GE}

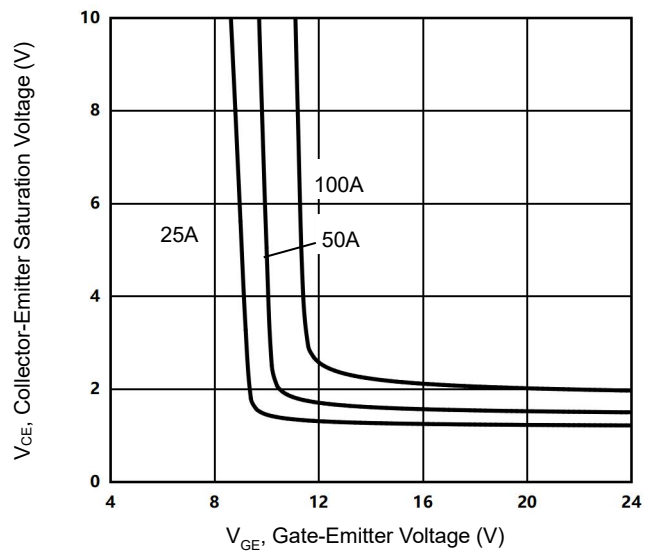


Figure 5 Capacitance Characteristics

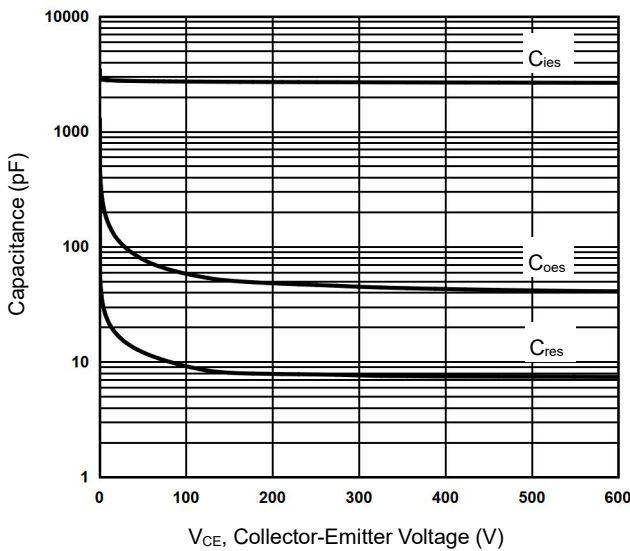
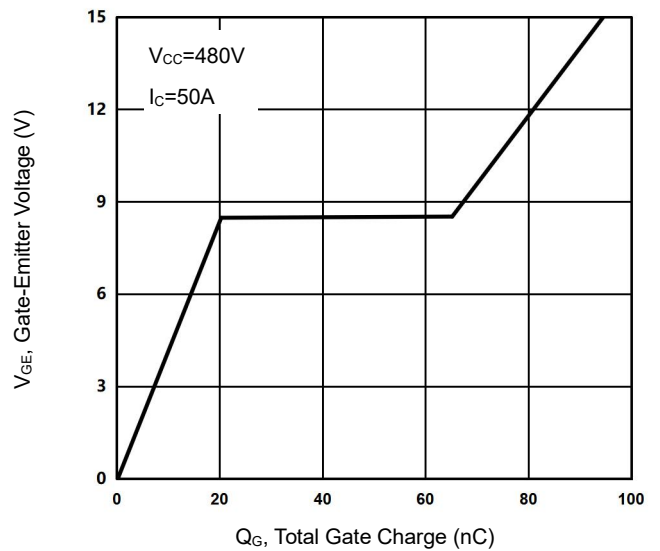


Figure 6 Gate Charge Wave Form



Typical Electrical and Thermal Characteristics

Figure 7 Forward Characteristics

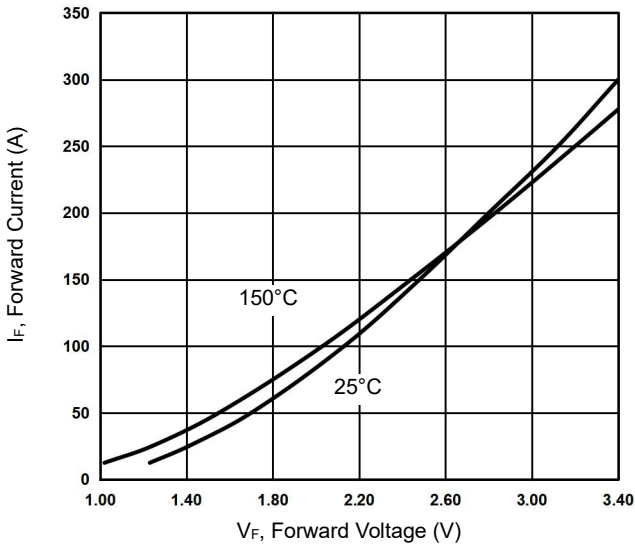


Figure 8 V_F vs. Temperature

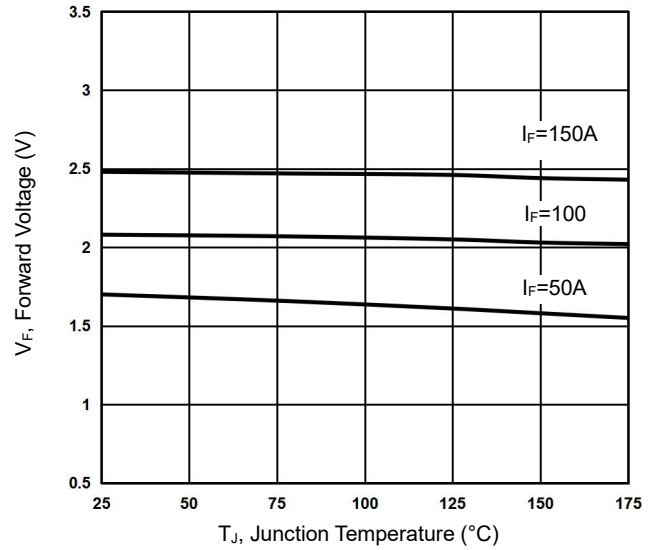


Figure 9 $V_{(BR)CES}$ vs. Temperature

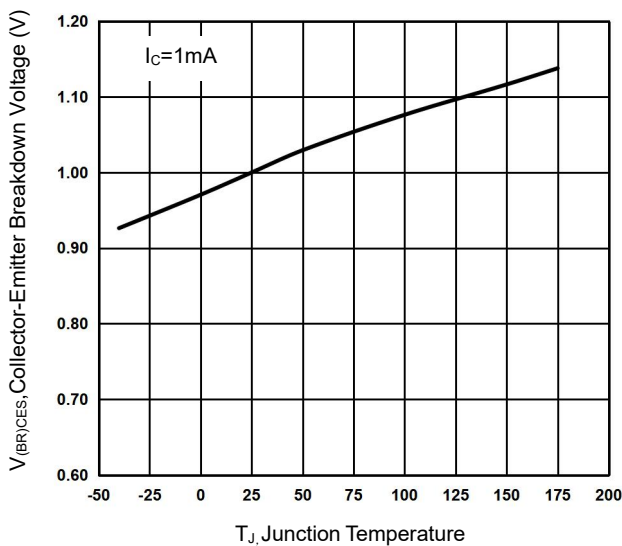


Figure 10 Forward Bias Safe Operating Area

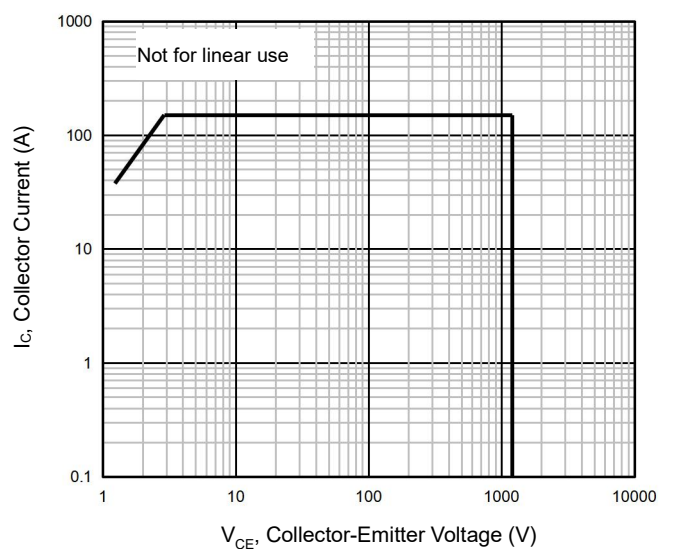


Figure 11 $V_{GE(th)}$ vs. Junction Temperature

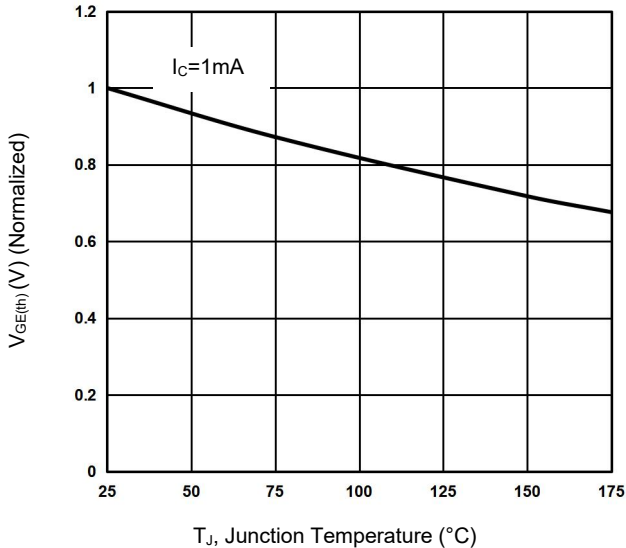
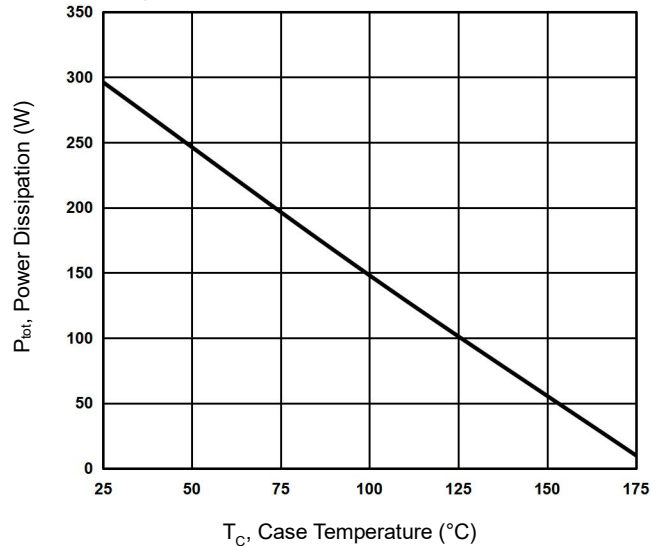


Figure 12 P_{tot} vs. Case Temperature



Typical Electrical and Thermal Characteristics

Figure 13 Switching Loss vs. Collector Current

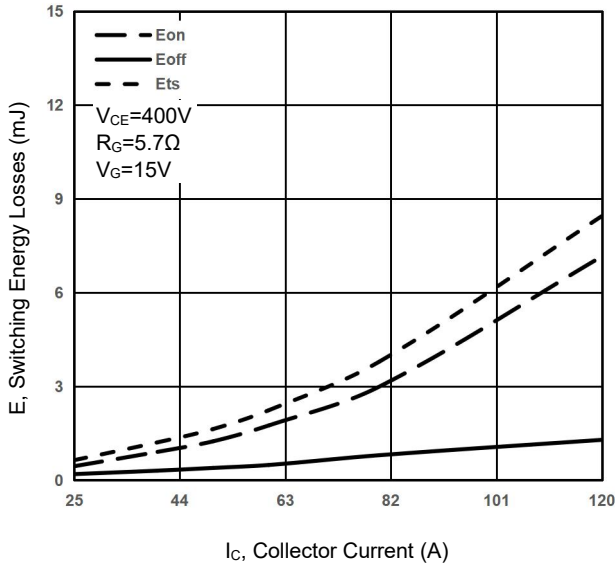


Figure 14 Switching Loss vs. Collector Current

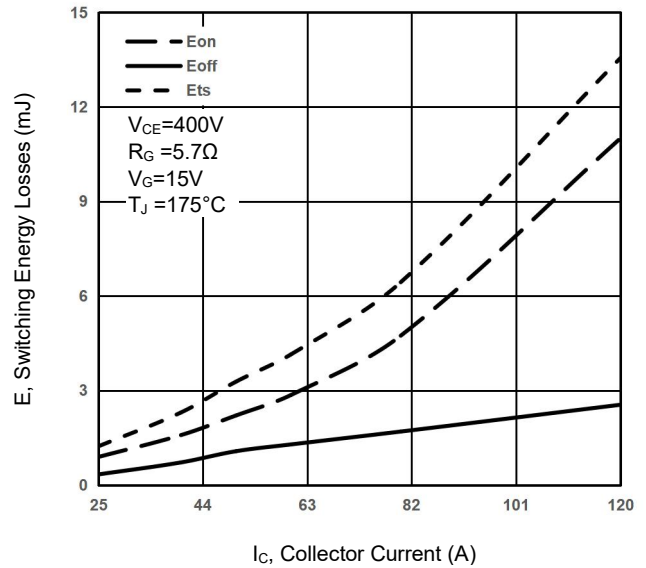


Figure 15 Switching Loss vs. R_G

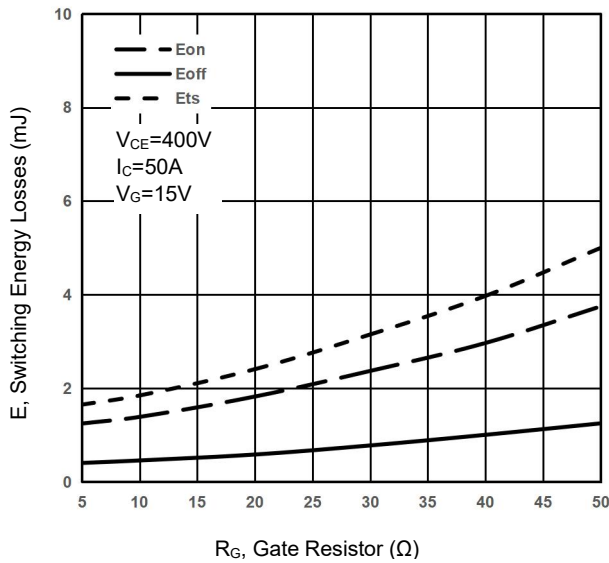


Figure 16 Switching Loss vs. R_G

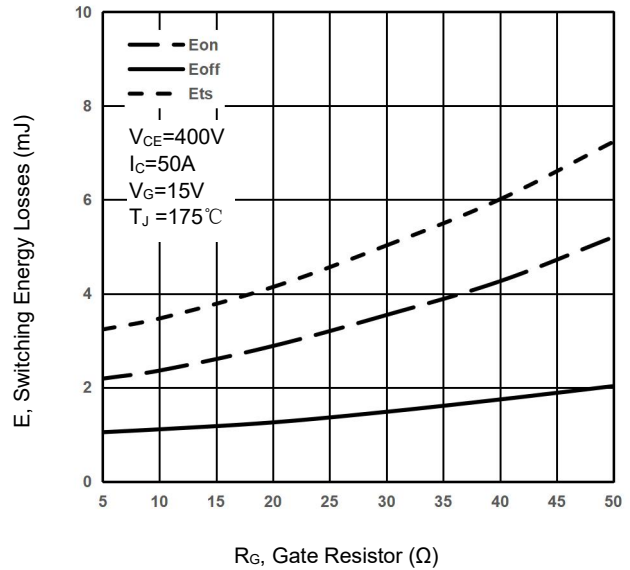
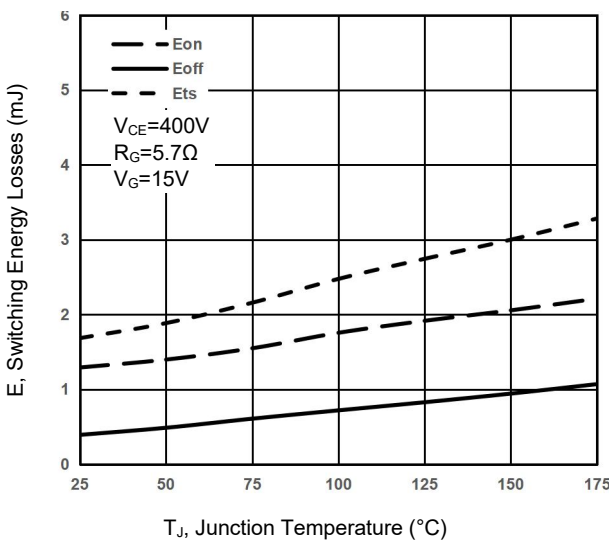
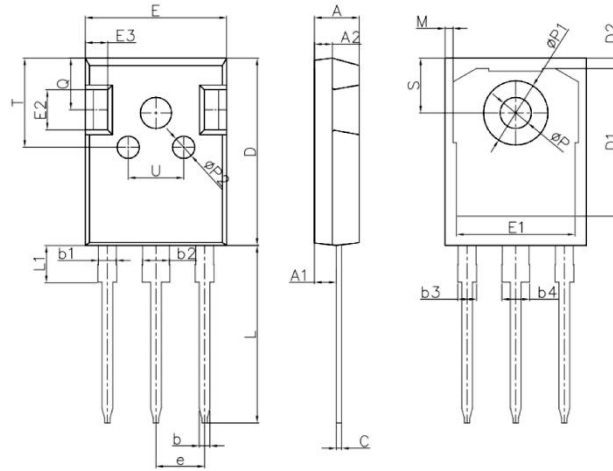


Figure 17 Switching Loss vs. Temperature

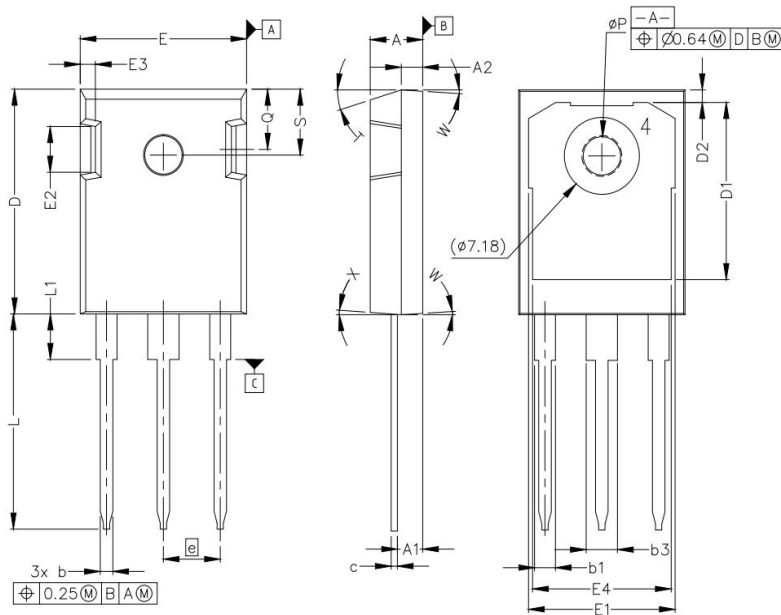


TO-247-3L(E) Package Information



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-247-3L(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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