

1200V 40A Trench FS Gen.7 IGBT

General Description

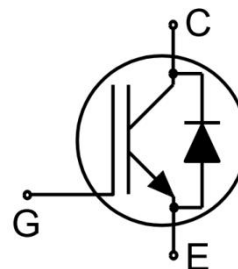
Using NCE's proprietary high density trench gate design and advanced FS (Field Stop) Gen.7 technology, the 1200V Trench FS Gen.7 IGBT offers superior conduction and switching performances, and easy parallel operation;

Features

- Trench Field Stop Gen.7 Technology Offering
- Low saturation voltage: $V_{CEsat} = 1.65V(Typ.) @ I_C = 40A$
- 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
NCE40ED120VT	TO-247-3L	NCE40ED120VT



TO-247-3L

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

Symbol	Parameter	Value	Units
V_{CES}	Collector-Emitter Voltage	1200	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}	140	A
-	Turn off safe operating area, $V_{CE}=1200V, T_J=175^{\circ}C$	140	A
I_F	Diode Continuous Forward Current @ $T_C = 100^{\circ}C$	40	A
I_{FM}	Diode Maximum Forward Current	140	A
P_D	Power Dissipation @ $T_C = 25^{\circ}C$	364	W
	Power Dissipation @ $T_C = 100^{\circ}C$	182	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	0.42	$^{\circ}\text{C}/\text{W}$
$R_{\theta JC}$	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.		
Static Characteristics							
$V_{(BR)CES}$	Collector-Emitter Breakdown Voltage	$V_{GE}=0\text{V}, I_{CE}=1\text{mA}$	1200	--	--	V	
I_{CES}	Collector-Emitter Leakage Current	$V_{GE}=0\text{V}, V_{CE}=1200\text{V}$	--	--	10	μA	
$I_{GES(F)}$	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	$I_C=20\text{A}, V_{GE}=15\text{V}, T_J=25^{\circ}\text{C}$	--	1.30	--	V	
		$I_C=40\text{A}, V_{GE}=15\text{V}, T_J=25^{\circ}\text{C}$	--	1.65	2.10	V	
		$I_C=20\text{A}, V_{GE}=15\text{V}, T_J=175^{\circ}\text{C}$	--	1.50	--	V	
		$I_C=40\text{A}, V_{GE}=15\text{V}, T_J=175^{\circ}\text{C}$	--	1.95	--	V	
$V_{GE(th)}$	Gate Threshold Voltage	$I_C=1\text{mA}, V_{CE}=V_{GE}$	4.5	5.25	6.0	V	
Dynamic Characteristics							
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}, V_{GE}=0\text{V}, f=1\text{MHz}$	3400	4103	4800	pF	
C_{oes}	Output Capacitance		--	104	--		
C_{res}	Reverse Transfer Capacitance		--	23	--		
Q_g	Total Gate Charge	$V_{CE}=960\text{V}, I_C=40\text{A}, V_{GE}=15\text{V}$	--	144	--	nC	
Q_{ge}	Gate to Emitter Charge		--	45	--		
Q_{gc}	Gate to Collector Charge		--	51	--		
R_g	Internal Gate Resistance	$f=1\text{MHz}$	--	0.6	--	Ω	
Switching Characteristics							
$t_{d(ON)}$	Turn-on Delay Time	$V_{CE}=600\text{V}, I_C=40\text{A}, V_{GE}=0/15\text{V}, R_g=4.7\Omega,$ Inductive Load	--	48	--	ns	
t_r	Rise Time		--	37	--		
$t_{d(OFF)}$	Turn-Off Delay Time		--	182	--		
t_f	Fall Time		--	86	--		
E_{on}	Turn-On Switching Loss		Inductive Load, $T_J=175^{\circ}\text{C}$	--	1.53	--	mJ
E_{off}	Turn-Off Switching Loss			--	0.88	--	
E_{ts}	Total Switching Loss			--	2.41	--	
E_{on}	Turn-On Switching Loss			$V_{CE}=600\text{V}, I_C=40\text{A}, V_{GE}=0/15\text{V}, R_g=4.7\Omega,$	--	2.13	--
E_{off}	Turn-Off Switching Loss	Inductive Load, $T_J=175^{\circ}\text{C}$	--	1.19	--		
E_{ts}	Total Switching Loss	Inductive Load, $T_J=175^{\circ}\text{C}$	--	3.32	--		

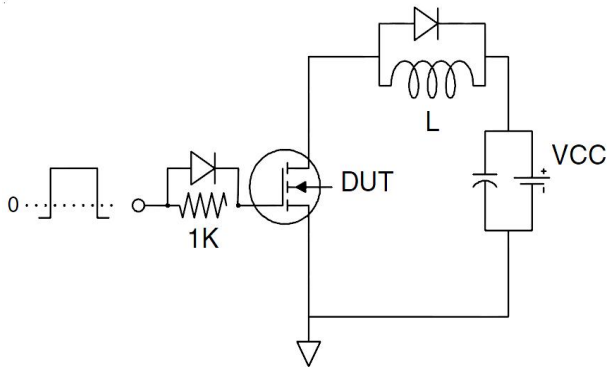
Electrical Characteristics of the Diode ($T_c = 25^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter	Conditions	Rating			Units	
			Min.	Typ.	Max.		
V_{FM}	Diode Forward Voltage	$I_F = 40\text{A}$	$T_j = 25^\circ\text{C}$	--	2.9	3.5	V
			$T_j = 175^\circ\text{C}$	--	2.6	--	V
T_{rr}	Reverse Recovery Time	$I_F = 40\text{A}, R_g = 4.7\Omega,$ $T_j = 25^\circ\text{C}$	--	90	--	ns	
I_{RRM}	Diode Peak Reverse Recovery Current		--	15	--	A	
Q_{rr}	Reverse Recovery Charge		--	0.68	--	μC	
E_{rec}	Reverse recovery energy		--	0.24	--	mJ	
T_{rr}	Reverse Recovery Time	$I_F = 40\text{A}, R_g = 4.7\Omega,$ $T_j = 175^\circ\text{C}$	--	141	--	ns	
I_{RRM}	Diode Peak Reverse Recovery Current		--	25	--	A	
Q_{rr}	Reverse Recovery Charge		--	1.70	--	μC	
E_{rec}	Reverse recovery energy		--	0.87	--	mJ	

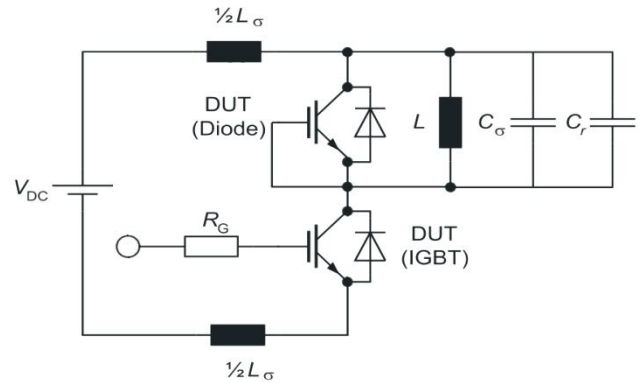
Note: For optimum lifetime and reliability, NCE recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.

Test Circuit

1) Gate Charge Test Circuit

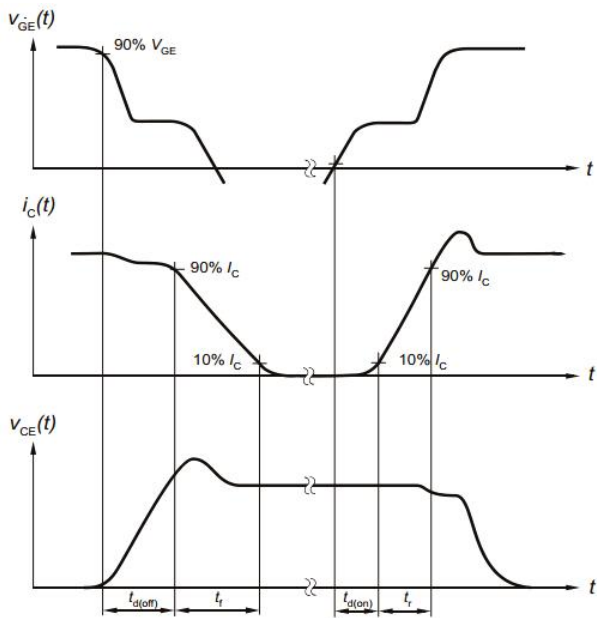


2) Switch Time Test Circuit

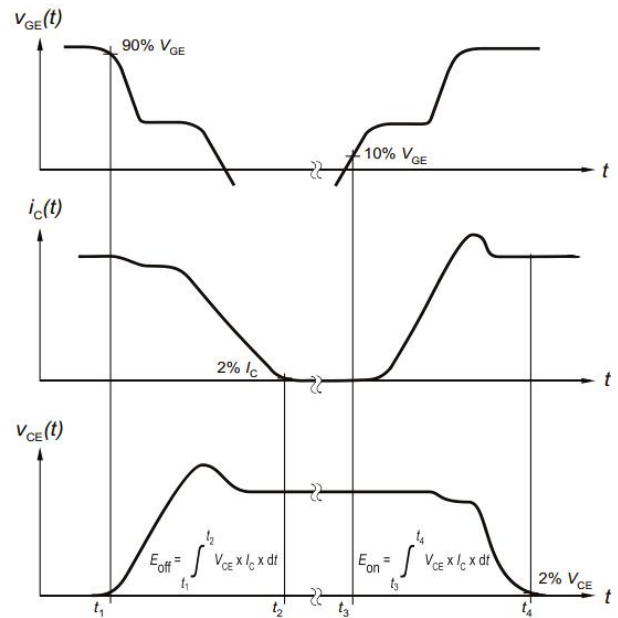


Switching characteristics

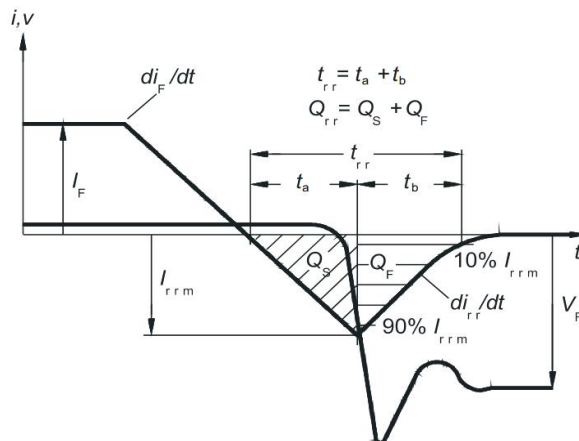
1) Definition of switching times



2) Definition of switching losses



3) Definition of diode switching characteristics



Typical Electrical and Thermal Characteristics

Figure 1 Output Characteristics

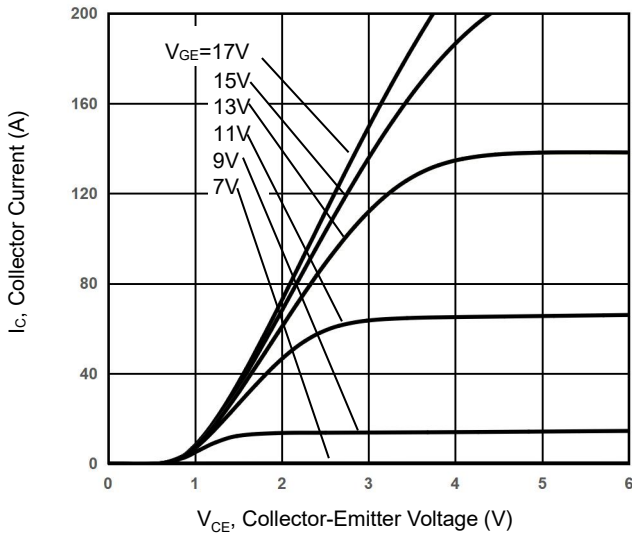


Figure 2 Transfer Characteristics

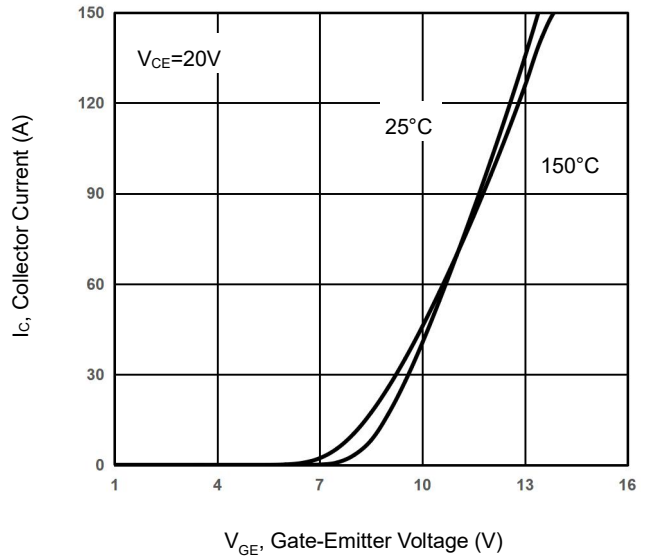


Figure 3 $V_{CE(sat)}$ vs. Temperature

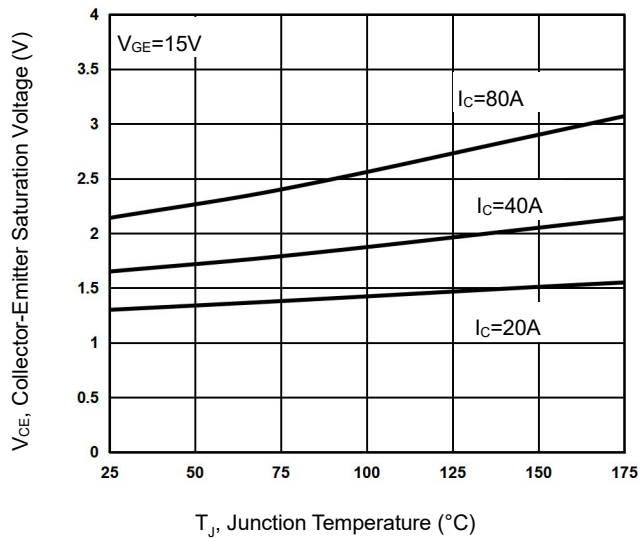


Figure 4 Saturation Voltage vs. V_{GE}

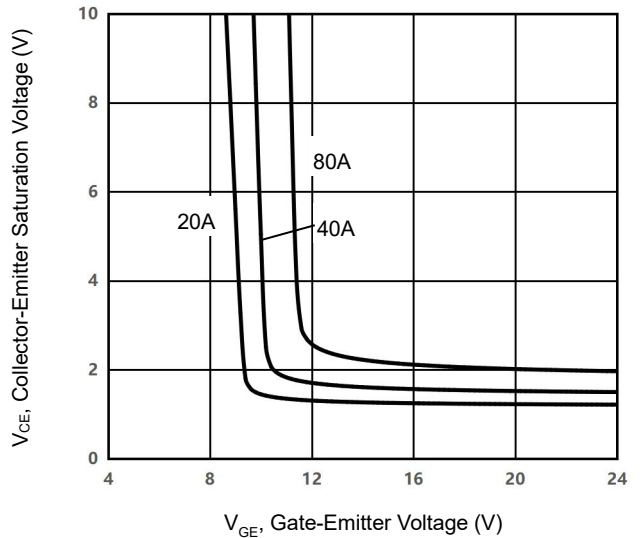


Figure 5 Capacitance Characteristics

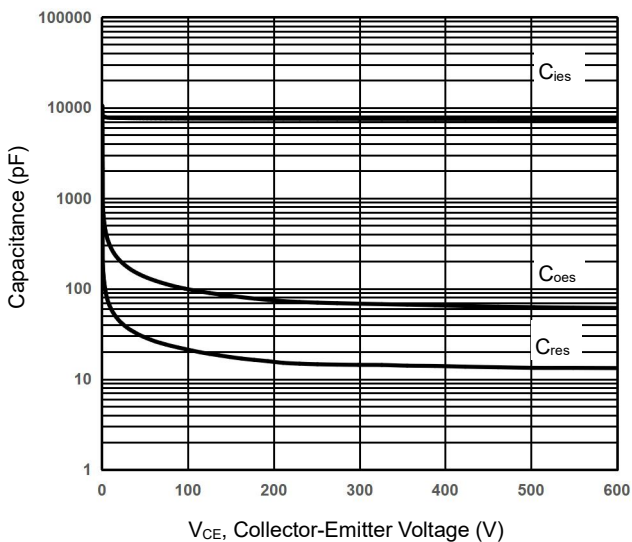
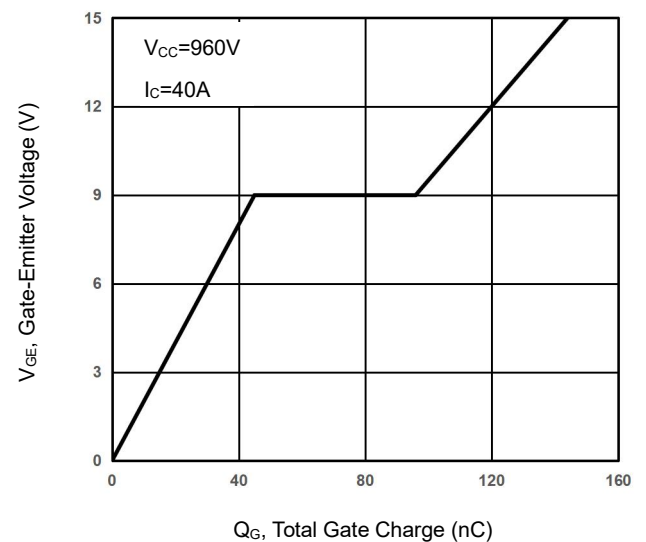


Figure 6 Gate Charge Wave Form



Typical Electrical and Thermal Characteristics

Figure 7 Forward Characteristics

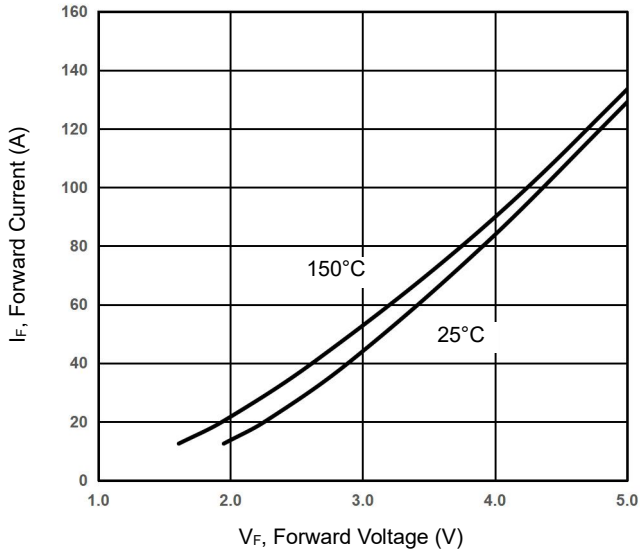


Figure 8 V_F vs. Temperature

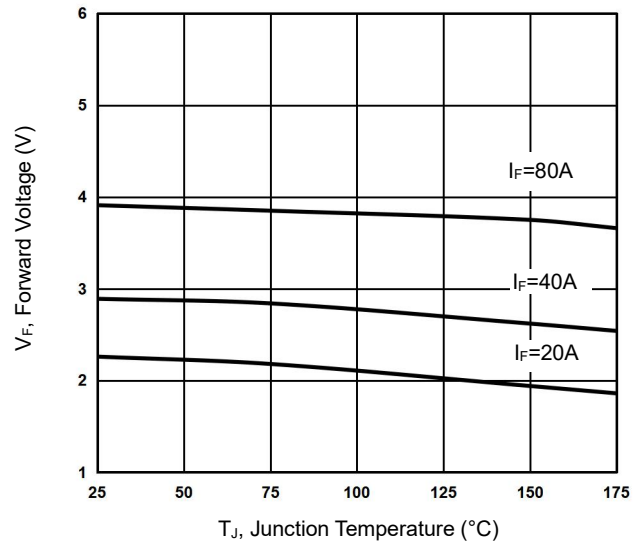


Figure 9 $V_{(BR)CES}$ vs. Temperature

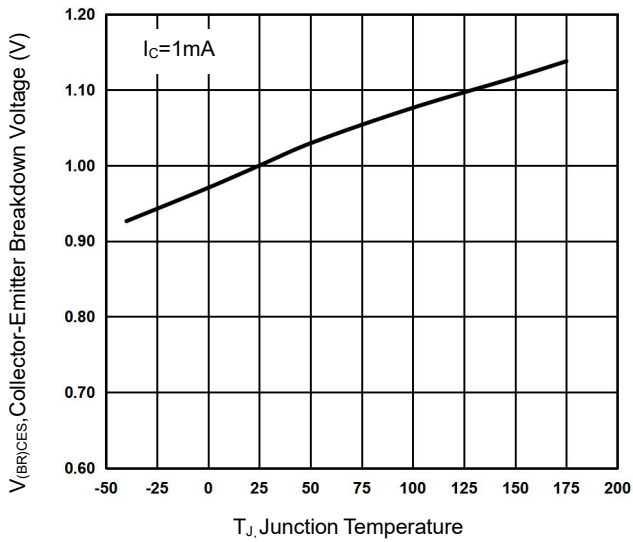


Figure 10 Forward Bias Safe Operating Area

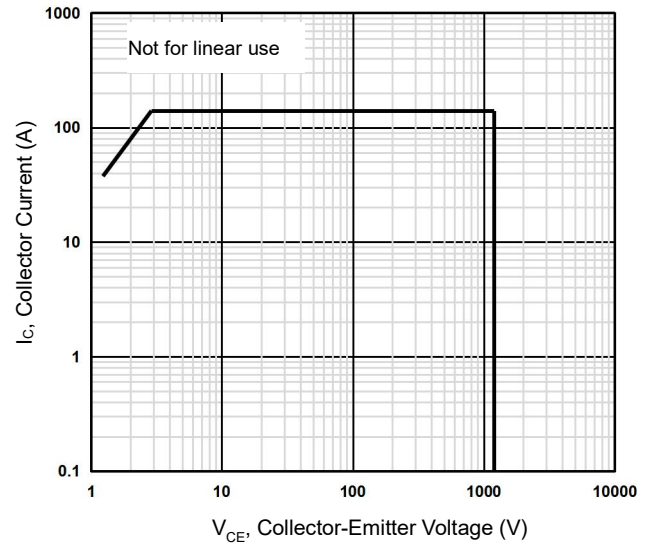


Figure 11 $V_{GE(th)}$ vs. Junction Temperature

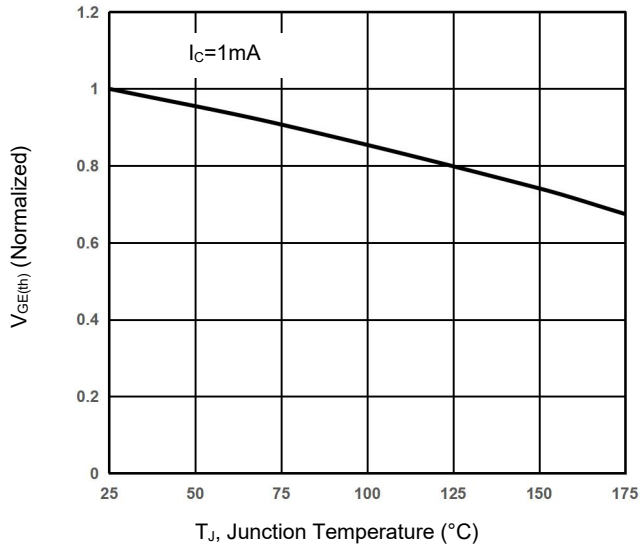
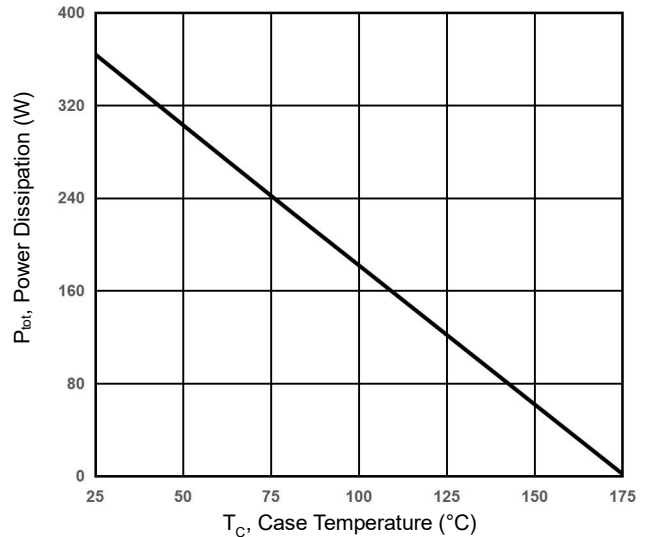


Figure 12 P_{tot} vs. Case Temperature



Typical Electrical and Thermal Characteristics

Figure 13 Switching Loss vs. Collector Current

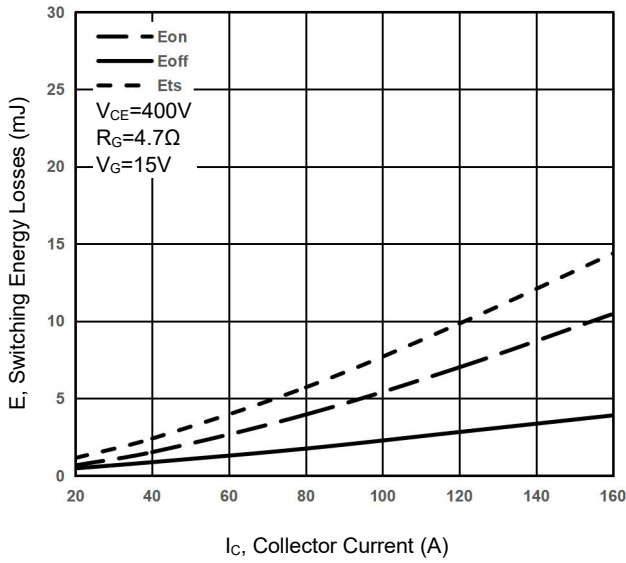


Figure 14 Switching Loss vs. Collector Current

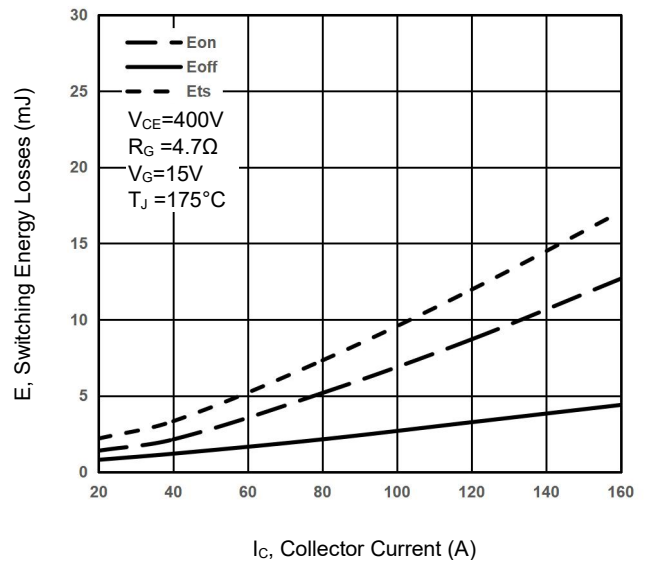


Figure 15 Switching Loss vs. R_G

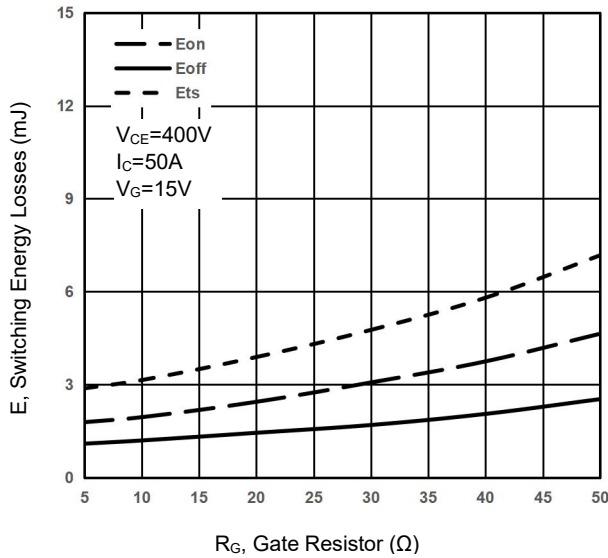


Figure 16 Switching Loss vs. R_G

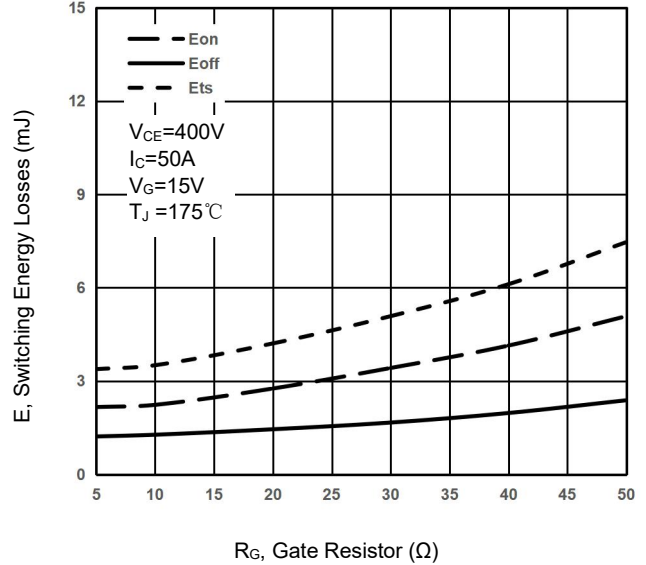
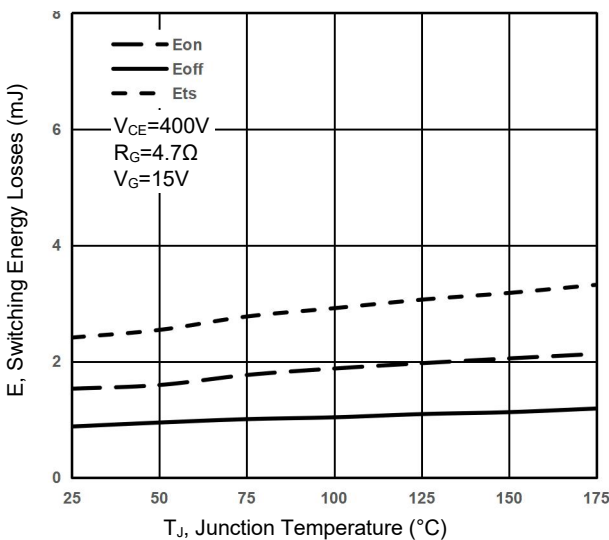
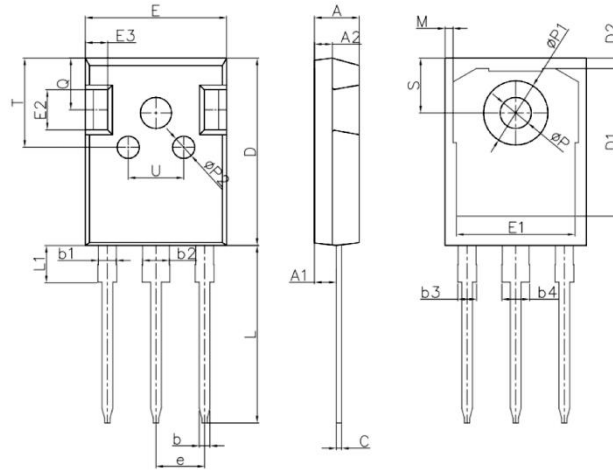


Figure 17 Switching Loss vs. Temperature

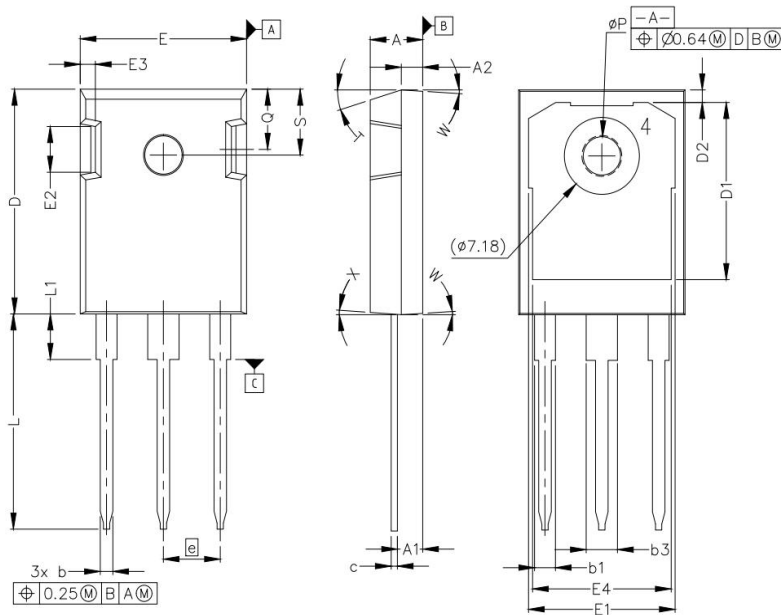


TO-247-3L(E) Package Information



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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