

1200V 40A Trench FS Gen.7 IGBT

General Description

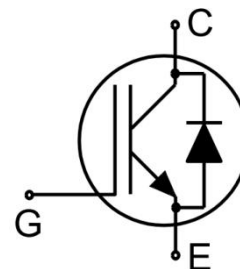
Using NCE's proprietary high density trench gate design and advanced FS (Field Stop) Gen.7 technology, the 1200V Trench FS Gen.7 IGBT offers superior conduction and switching performances, and easy parallel operation;

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
- AEC-Q101 qualified

Application

- Inverters
- Motor drives
- Converter
- Automotive application



Schematic diagram

Package Marking and Ordering Information

Device	Device Package	Device Marking
NCEA40ED120BT	TO-247-3L	A40ED120BT



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

Symbol	Parameter	Value	TO-247-3L 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}	120	A
-	Turn off safe operating area, $V_{CE}=1200V, T_J=175^{\circ}C$	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 @ $T_C = 25^{\circ}C$	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	$^{\circ}C$
t_{sc}	Short circuit with stand time $V_{GE}=15V, V_{CC} \leq 600V$, Allowed number of short circuits < 1000 Time between Short circuits: $\geq 1.0s, T_J \leq 150^{\circ}C$	10	us

Thermal Characteristic

Symbol	Parameter	Value	Units
$R_{\theta JC}$	Thermal Resistance, Junction to case for IGBT	0.42	°C/W
$R_{\theta JC}$	Thermal Resistance, Junction to case for Diode	0.75	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	40	°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	$V_{GE}=0V, I_{CE}=1mA$	1200	--	--	V	
I_{CES}	Collector-Emitter Leakage Current	$V_{GE}=0V, V_{CE}=1200V$	--	--	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	$I_C=20A, V_{GE}=15V,$	--	1.30	--	V	
		$I_C=40A, T_J=25^\circ\text{C}$	--	1.65	2.10	V	
		$I_C=20A, V_{GE}=15V,$	--	1.50	--	V	
		$I_C=40A, T_J=175^\circ\text{C}$	--	1.95	--	V	
$V_{GE(th)}$	Gate Threshold Voltage	$I_C=1mA, V_{CE}=V_{GE}$	5.0	5.75	6.5	V	
Dynamic Characteristics							
C_{ies}	Input Capacitance	$V_{CE}=25V, V_{GE}=0V,$ $f=1MHz$	3500	4203	4900	pF	
C_{oes}	Output Capacitance		--	107	--		
C_{res}	Reverse Transfer Capacitance		--	24	--		
Q_g	Total Gate Charge	$V_{CE}=960V, I_C=40A,$ $V_{GE}=15V$	--	147	--	nC	
Q_{ge}	Gate to Emitter Charge		--	47	--		
Q_{gc}	Gate to Collector Charge		--	53	--		
R_g	Internal Gate Resistance	$f=1MHz$	--	0.6	--	Ω	
$I_{C(sc)}$	Short circuit collector current Max.1000 Short circuits Time between short circuits: $\geq 1.0s$	$V_{GE}=15V, V_{CC}\leq 600V,$ $t_{sc}\leq 10\mu s, T_J\leq 150^\circ\text{C}$	--	200	--	A	
Switching Characteristics							
$t_{d(ON)}$	Turn-on Delay Time	$V_{CE}=600V, I_C=40A,$ $V_{GE}=0/15V, R_g=4.7\Omega,$ Inductive Load	--	55	--	ns	
t_r	Rise Time		--	41	--		
$t_{d(OFF)}$	Turn-Off Delay Time		--	201	--		
t_f	Fall Time		--	51	--		
E_{on}	Turn-On Switching Loss		Inductive Load	--	1.80	--	mJ
E_{off}	Turn-Off Switching Loss			--	1.11	--	
E_{ts}	Total Switching Loss			--	2.91	--	
E_{on}	Turn-On Switching Loss		$V_{CE}=600V, I_C=40A,$ $V_{GE}=0/15V, R_g=4.7\Omega,$ Inductive Load, $T_J=175^\circ\text{C}$	--	2.80	--	mJ
E_{off}	Turn-Off Switching Loss	--		1.54	--		
E_{ts}	Total Switching Loss	--		4.34	--		

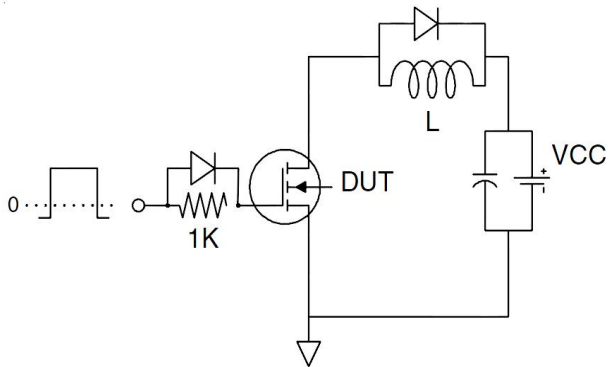
Electrical Characteristics of the Diode ($T_c=25^{\circ}\text{C}$ unless otherwise specified)

Symbol	Parameter	Conditions	Rating			Units	
			Min.	Typ.	Max.		
V_{FM}	Diode Forward Voltage	$I_F=40\text{A}$	$T_j=25^{\circ}\text{C}$	--	2.8	3.4	V
			$T_j=175^{\circ}\text{C}$	--	2.5	--	V
T_{rr}	Reverse Recovery Time	$I_F=40\text{A}, R_g=4.7\Omega,$ $T_j=25^{\circ}\text{C}$	--	100	--	ns	
I_{RRM}	Diode Peak Reverse Recovery Current		--	19	--	A	
Q_{rr}	Reverse Recovery Charge		--	0.78	--	μC	
E_{rec}	Reverse recovery energy		--	0.33	--	mJ	
T_{rr}	Reverse Recovery Time	$I_F=40\text{A}, R_g=4.7\Omega,$ $T_j=175^{\circ}\text{C}$	--	156	--	ns	
I_{RRM}	Diode Peak Reverse Recovery Current		--	29	--	A	
Q_{rr}	Reverse Recovery Charge		--	1.8	--	μC	
E_{rec}	Reverse recovery energy		--	1.06	--	mJ	

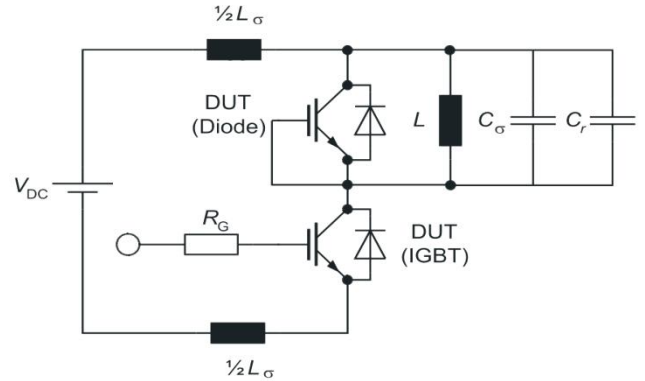
Note: For optimum lifetime and reliability, NCE recommends operating conditions that do not exceed 80% of the maximum ratings stated in this datasheet.

Test Circuit

1) Gate Charge Test Circuit

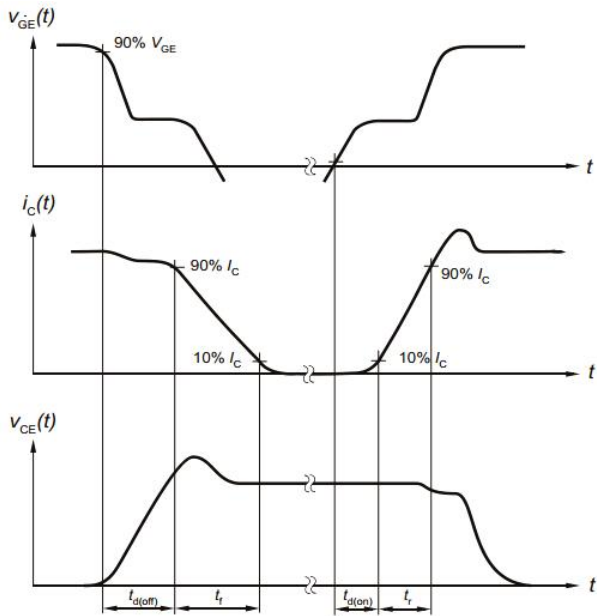


2) Switch Time Test Circuit

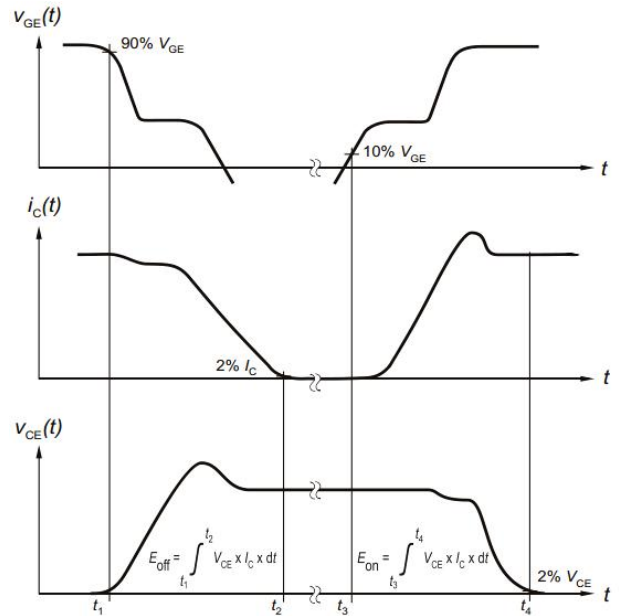


Switching characteristics

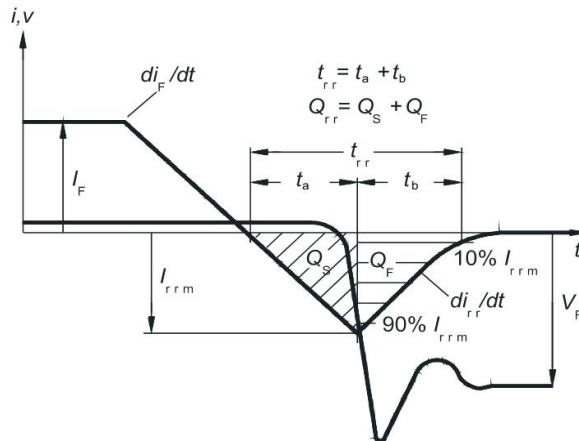
1) Definition of switching times



2) Definition of switching losses



3) Definition of diode switching characteristics



Typical Electrical and Thermal Characteristics

Figure 1 Output Characteristics

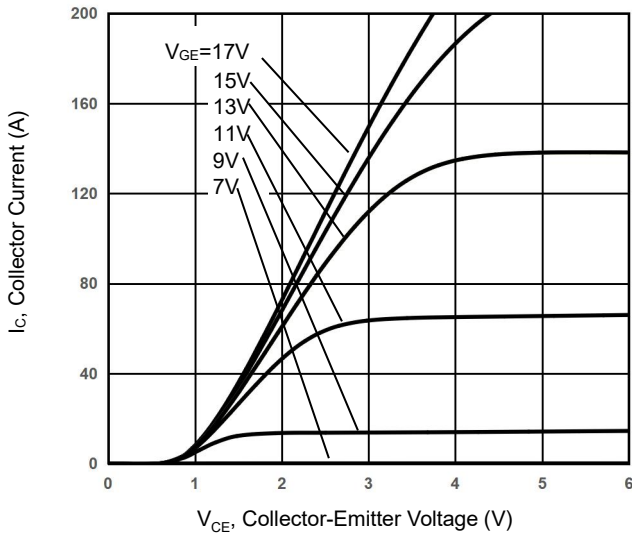


Figure 2 Transfer Characteristics

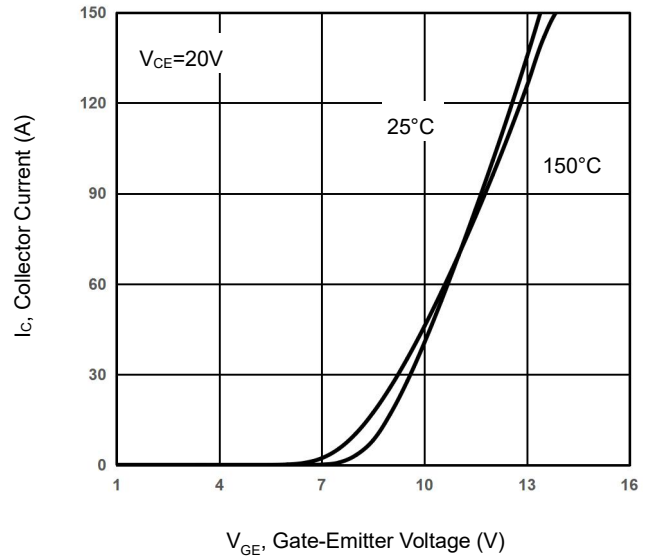


Figure 3 $V_{CE(sat)}$ vs. Temperature

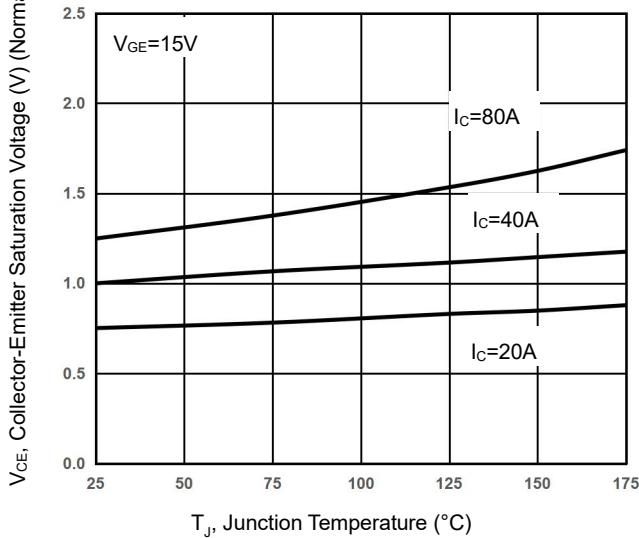


Figure 4 Saturation Voltage vs. V_{GE}

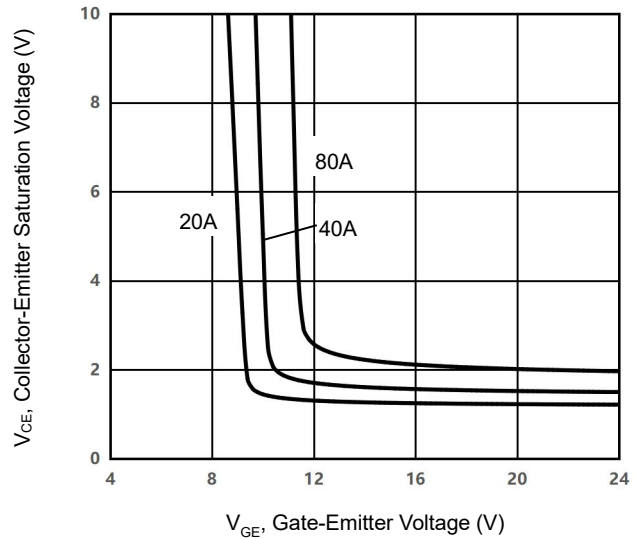


Figure 5 Capacitance Characteristics

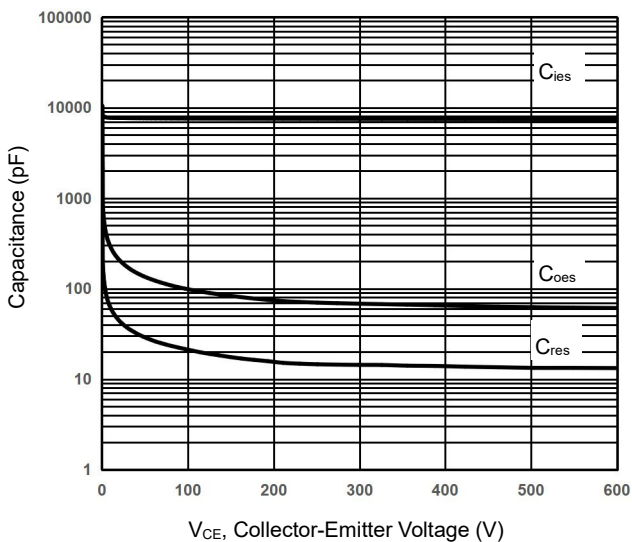
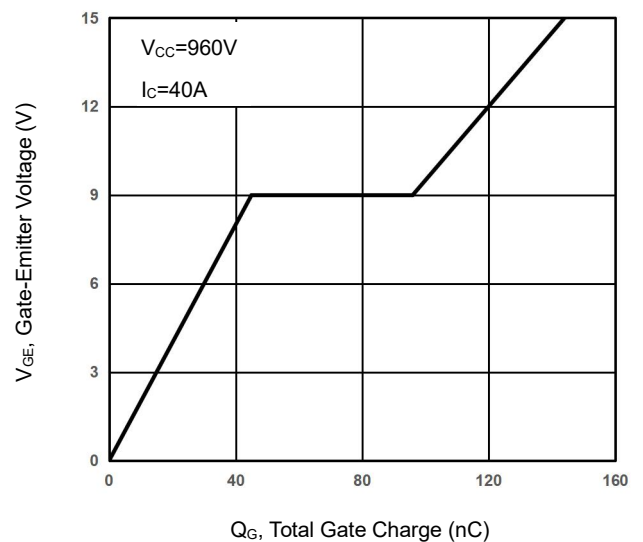


Figure 6 Gate Charge Wave Form



Typical Electrical and Thermal Characteristics

Figure 7 Forward Characteristics

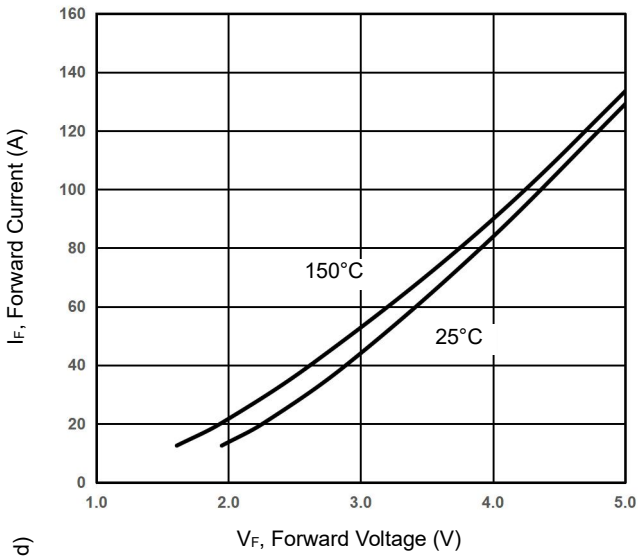


Figure 8 V_F vs. Temperature

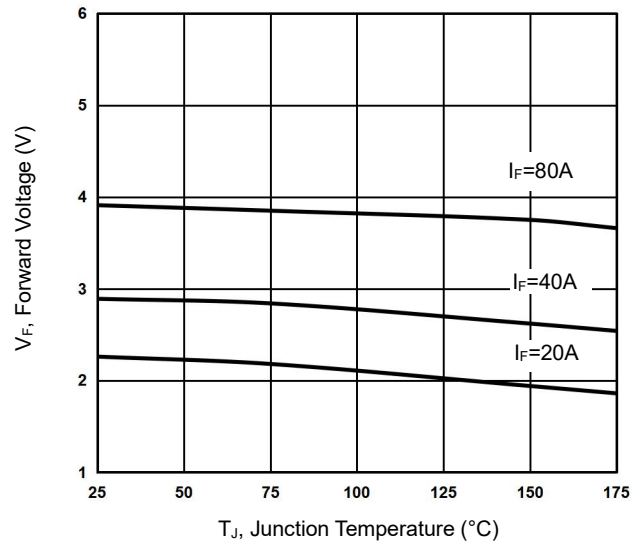


Figure 9 $V_{(BR)CES}$ vs. Temperature

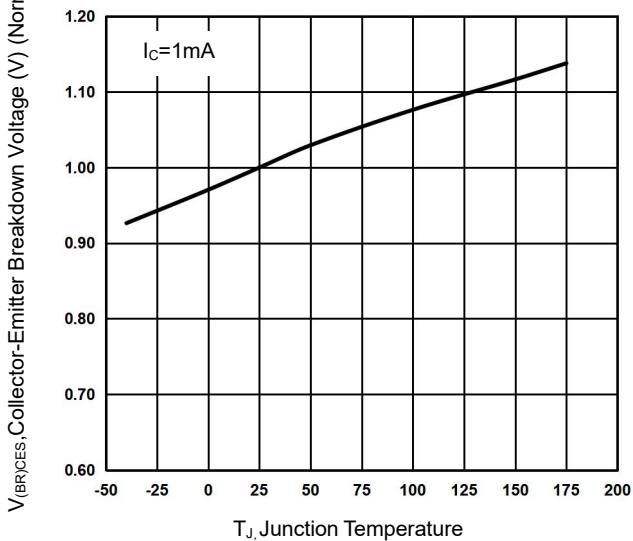


Figure 10 Forward Bias Safe Operating Area

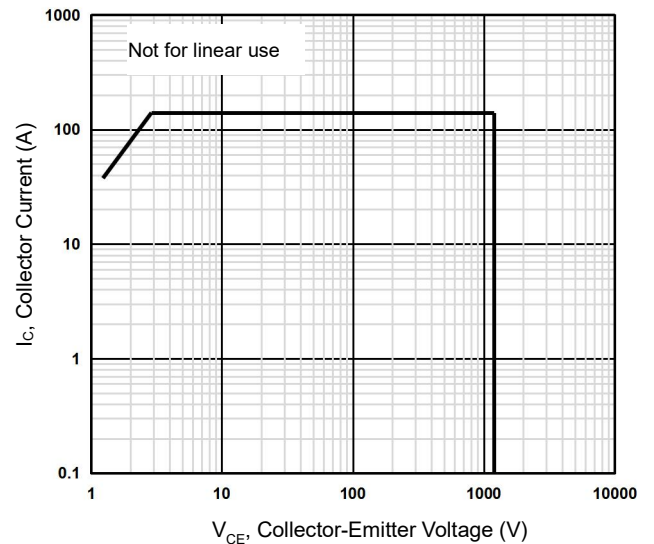


Figure 11 $V_{GE(th)}$ vs. Junction Temperature

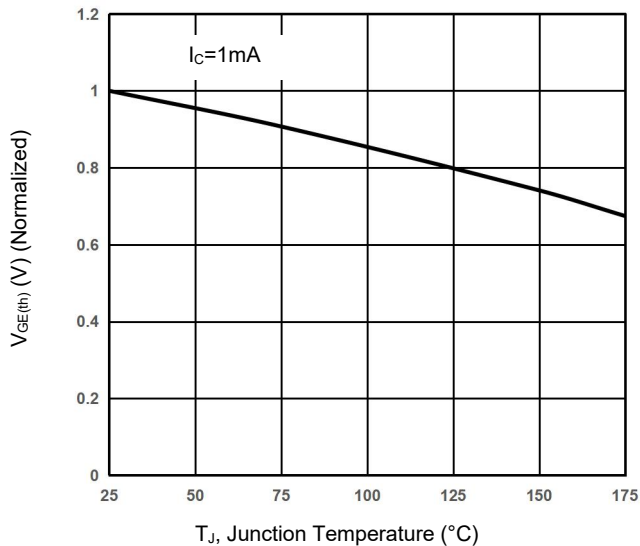
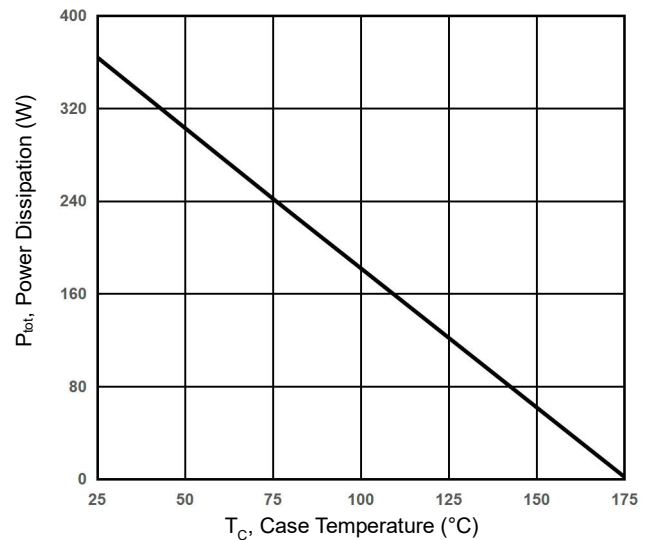


Figure 12 P_{tot} vs. Case Temperature



Typical Electrical and Thermal Characteristics

Figure 13 Switching Loss vs. Collector Current

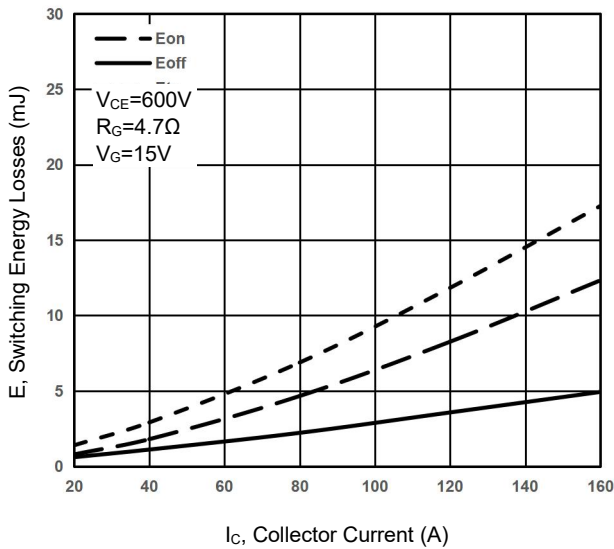


Figure 14 Switching Loss vs. Collector Current

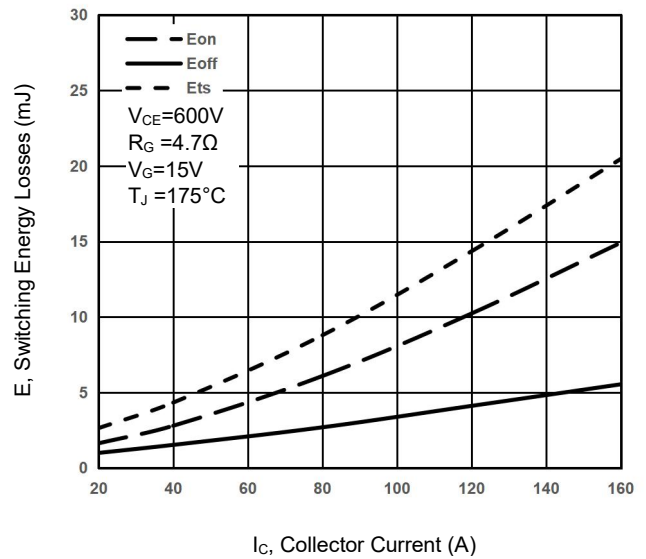


Figure 15 Switching Loss vs. R_G

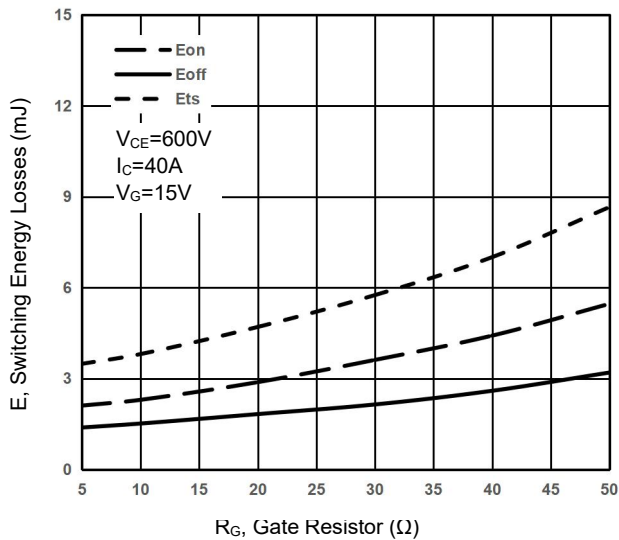


Figure 16 Switching Loss vs. R_G

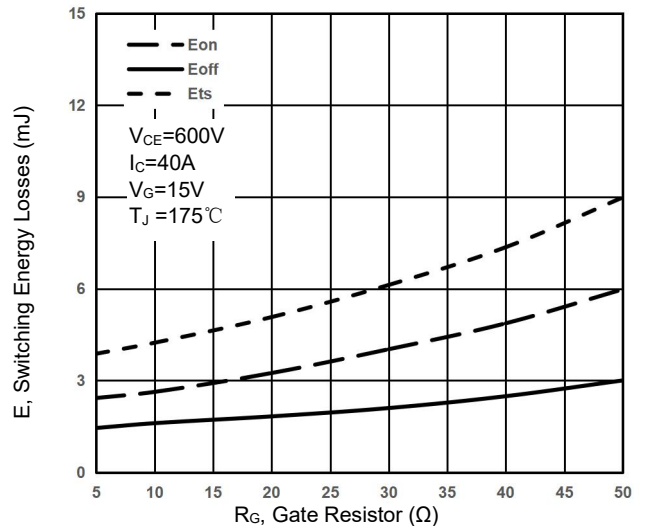


Figure 17 Switching Loss vs. Temperature

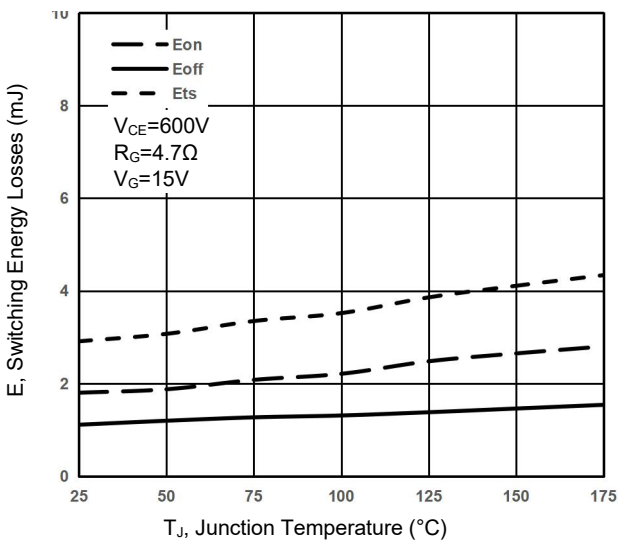
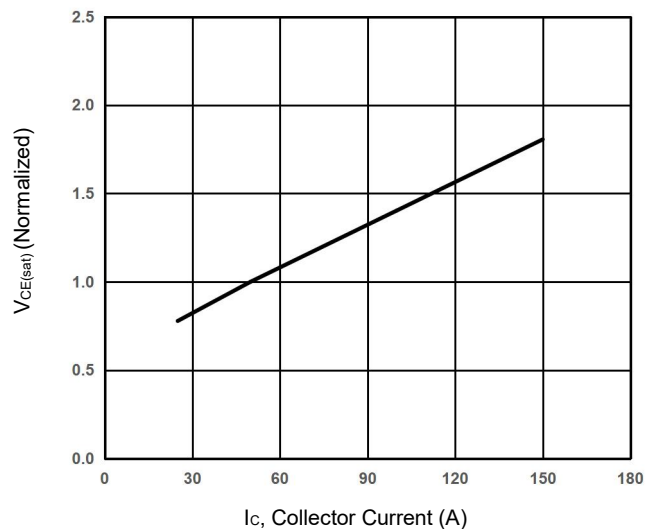
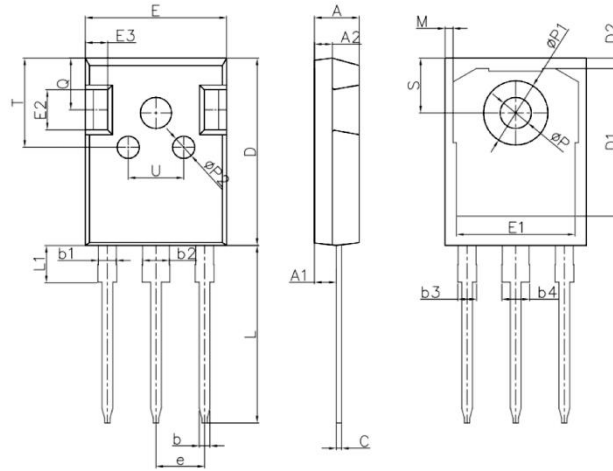


Figure 18 Typical Collector-Emitter Saturation Voltage as a Function of Collector Current

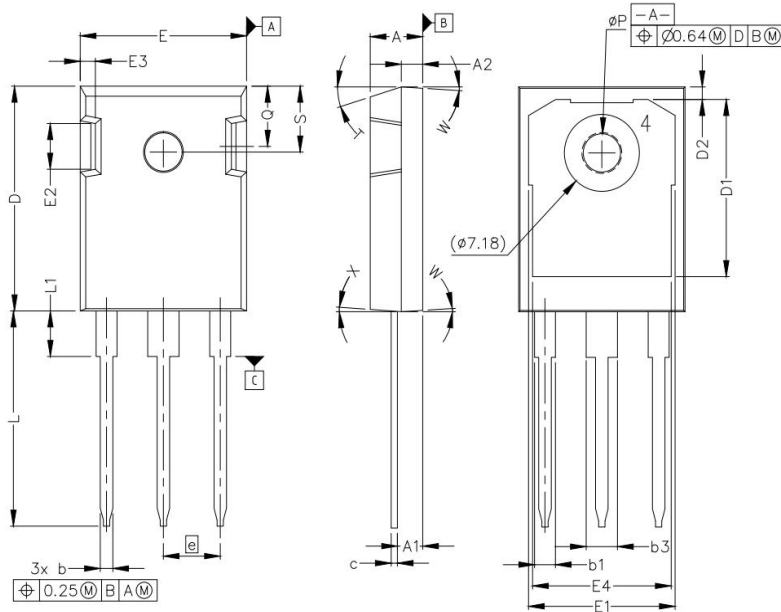


TO-247-3L(E) Package Information



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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