400V 140A Trench FS Gen.7 IGBT

General Description

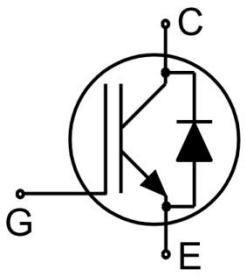
Using NCE's proprietary high density trench gate design and advanced FS (Field Stop) Gen.7 technology, the 400V Trench FS Gen.7 IGBT offers superior conduction and switching performances, and easy parallel operation.

Features

- Trench field stop Gen.7 Technology Offering
- Low saturation voltage: V_{CEsat} = 1.40V(Typ.) @ I_C = 140 A
- High speed switching, low switching losses
- Maximum junction temperature T_{vjmax} = 175°C
- Tighten parameter distribution
- High ruggedness, temperature stable behavior
- Pb-free lead plating; RoHS compliant

Application

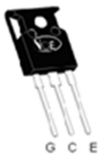
- Inverters
- Motor drives
- Converter



Schematic diagram

Package Marking and Ordering Information

Device	Device Package	Device Marking
NCE140ED40BT	TO-247-3L	NCE140ED40BT



TO-247-3L

Absolute Maximum Ratings (T_C=25°C unless otherwise noted)

Symbol	Parameter	Value	Units
V_{CES}	Collector-Emitter Voltage	400	V
V_{GES}	Gate- Emitter Voltage	±30	V
I_C	Collector Current	280	A
	Collector Current @T_C = 100 °C	140	A
I_{Cpuls}	Pulsed Collector Current，t_p limited by T_{jmax}	420	A
-	Turn off safe operating area，V_{CE}=650V, T_j=175°C	420	A
I_F	Diode Continuous Forward Current @T_C = 100 °C	140	A
I_{FM}	Diode Maximum Forward Current	420	A
P_D	Power Dissipation @ T_C = 25°C	670	W
	Power Dissipation @T_C = 100 °C	335	W
T_{stg}	Storage Temperature	-55 to +150	°C
T_{vj}	Operating junction temperature	-40 to +175	°C
T_L	Maximum Temperature for Soldering	260	°C

Thermal Characteristic

Symbol	Parameter	Value	Units
$R_{\theta JC}$	Thermal Resistance, Junction to case for IGBT	0.22	°C/W
$R_{\theta JC}$	Thermal Resistance, Junction to case for Diode	0.43	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	40	°C/W

Electrical Characteristics (T_C=25°C unless otherwise noted)

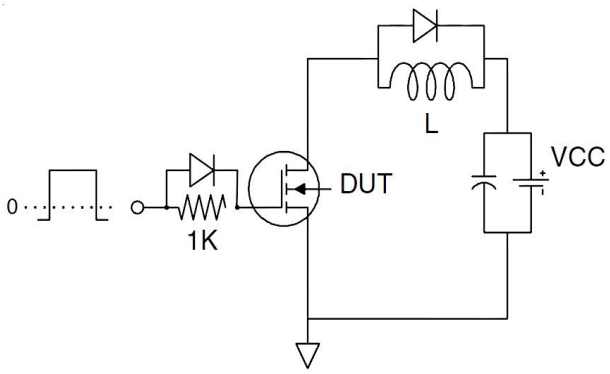
Symbol	Parameter	Conditions		Value			Units
				Min.	Typ.	Max.	
Static Characteristics							
$V_{(BR)CES}$	Collector-Emitter Breakdown Voltage	V_{GE}=0V,I_{CE}=3mA		400	--	--	V
I_{CES}	Collector-Emitter Leakage Current	V_{GE}=0V,V_{CE}=400V		--	--	35	uA
$I_{GES(F)}$	Gate to Emitter Forward Leakage	V_{GE}=+30V,V_{CE}=0V		--	--	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=70A	T_j=25°C	--	1.10	--	V
		V_{GE}=15V	T_j=150°C	--	1.20	--	V
		I_C=140A	T_j=25°C	--	1.40	1.95	V
		V_{GE}=15V	T_j=150°C	--	1.60	--	V
$V_{GE(th)}$	Gate Threshold Voltage	I_C=3mA,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		6560	7700	8880	pF
C_{oes}	Output Capacitance			--	254	--	
C_{res}	Reverse Transfer Capacitance			--	25	--	
Q_g	Total Gate Charge	V_{CE}=320V, I_C=120A, V_{GE}=15V		--	210	--	nC
Q_{ge}	Gate to Emitter Charge			--	53	--	
Q_{gc}	Gate to Collector Charge			--	72	--	
R_g	Internal Gate Resistance	f=1MHz		--	1.5	--	Ω
Switching Characteristics							
$t_{d(on)}$	Turn-on Delay Time	V_{CE}=300V,I_C=140A, V_{GE}=0/15V, R_g=25Ω, Inductive Load, T_j=25°C		--	64	--	ns
t_r	Rise Time			--	65	--	
$t_{d(off)}$	Turn-Off Delay Time			--	266	--	
t_f	Fall Time			--	92	--	
E_{on}	Turn-On Switching Loss			--	5.37	--	mJ
E_{off}	Turn-Off Switching Loss			--	2.44	--	
E_{ts}	Total Switching Loss			--	7.81	--	

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

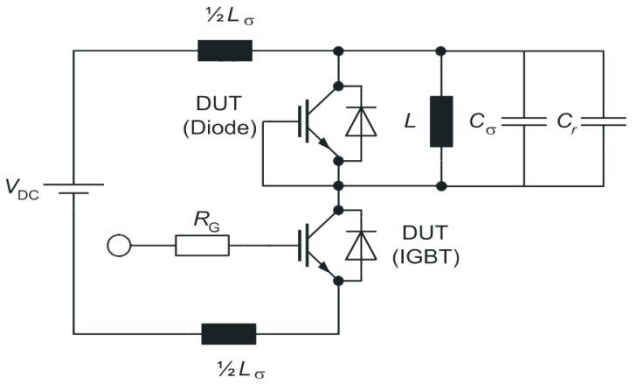
Symbol	Parameter	Conditions		Rating			Units
				Min.	Typ.	Max.	
V_{FM}	Diode Forward Voltage	I_F=140A	T_j=25°C	--	1.4	2.2	V
			T_j=150°C	--	1.3	--	V
T_{rr}	Reverse Recovery Time	V_R=300V,I_F=140A, R_g=25Ω,T_j=150°C		--	171	--	ns
I_{RRM}	Diode Peak Reverse Recovery Current			--	74	--	A
Q_{rr}	Reverse Recovery Charge			--	8.4	--	uC
E_{rec}	Reverse recovery energy			--	0.41	--	mJ

Test Circuit

1) Gate Charge Test Circuit

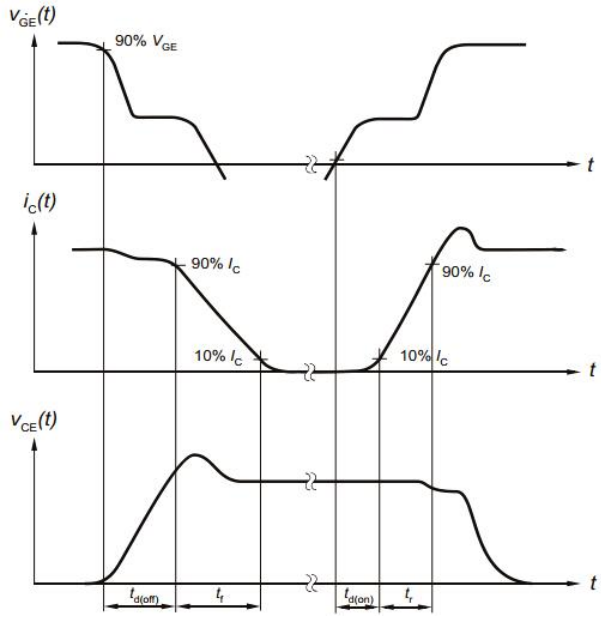


2) Switch Time Test Circuit

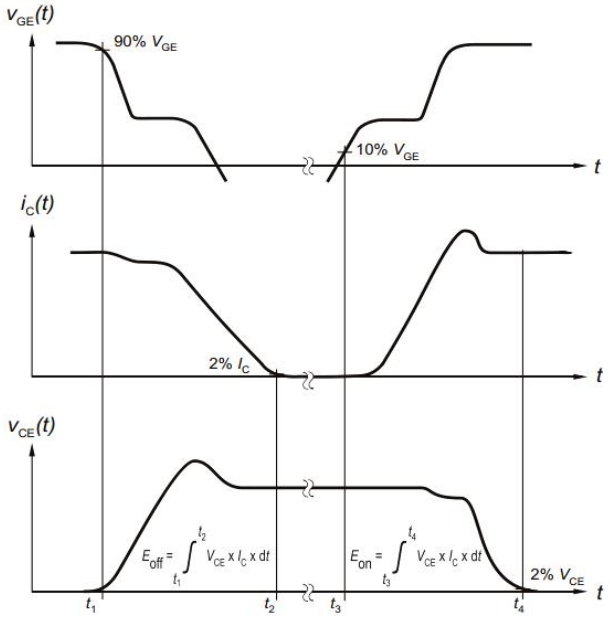


Switching characteristics

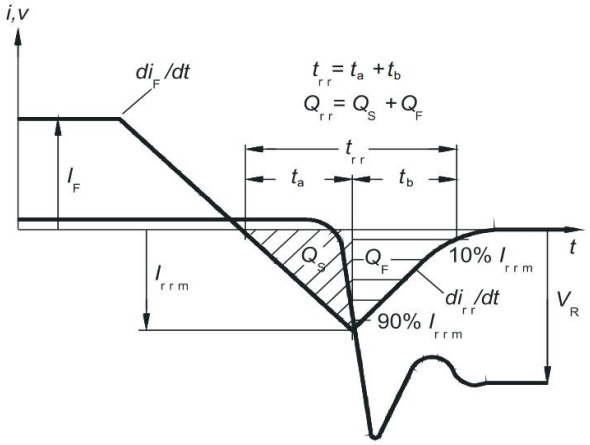
1) Definition of switching times



2) Definition of switching losses



3) Definition of diode switching characteristics



Typical Electrical and Thermal Characteristics

Figure 1 Output Characteristics

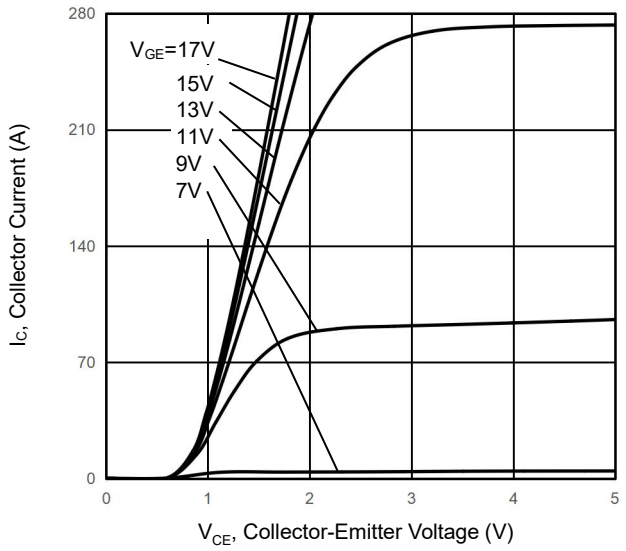


Figure 2 Transfer Characteristics

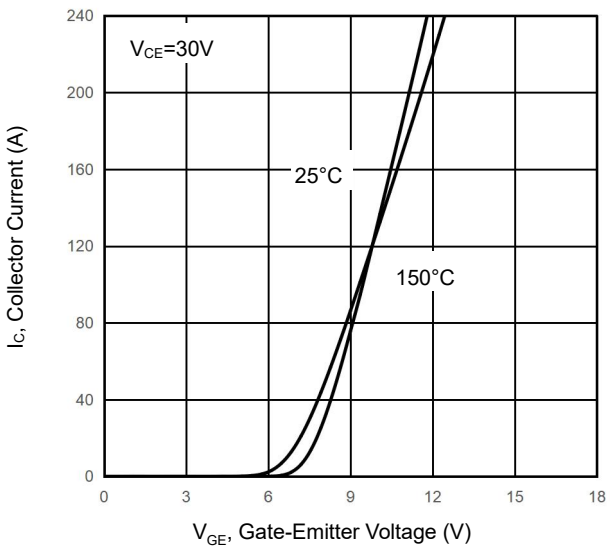


Figure 3 $V_{CE(sat)}$ vs. Temperature

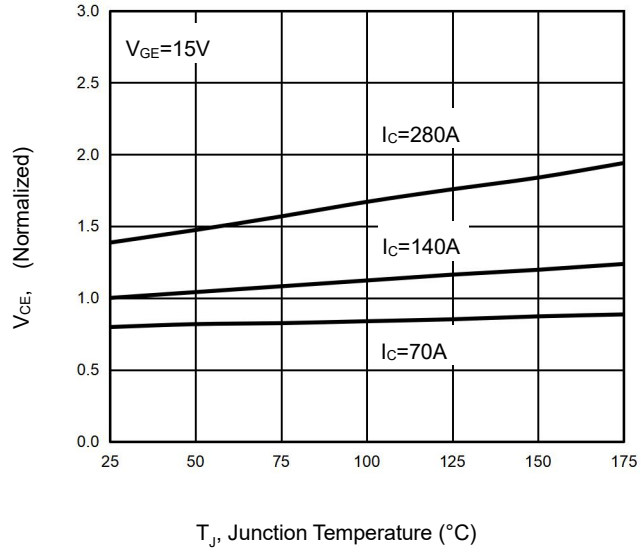


Figure 4 Saturation Voltage vs. V_{GE}

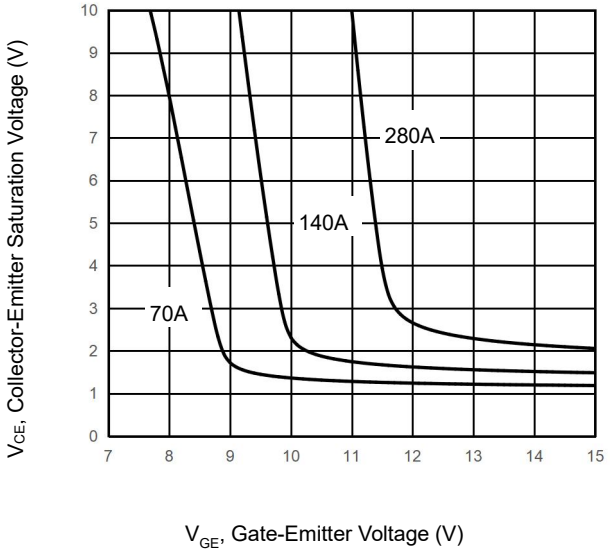


Figure 5 Capacitance Characteristics

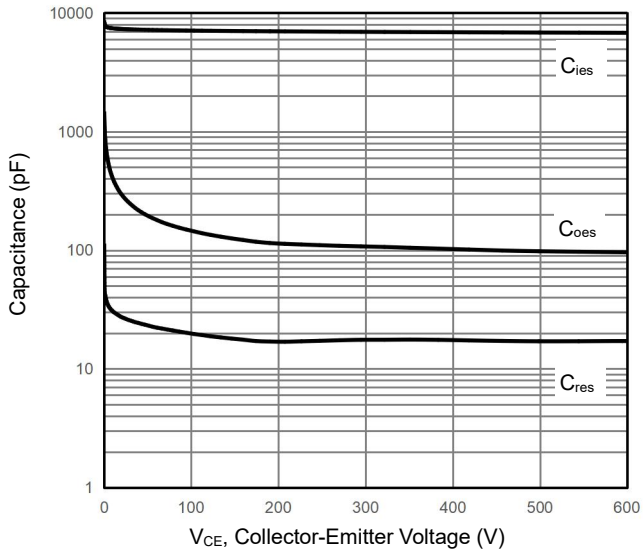
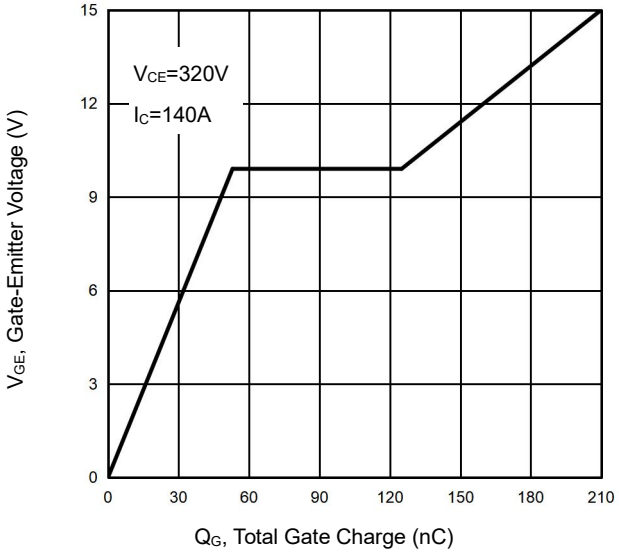


Figure 6 Gate Charge Wave Form



Typical Electrical and Thermal Characteristics

Figure 7 Forward Characteristics

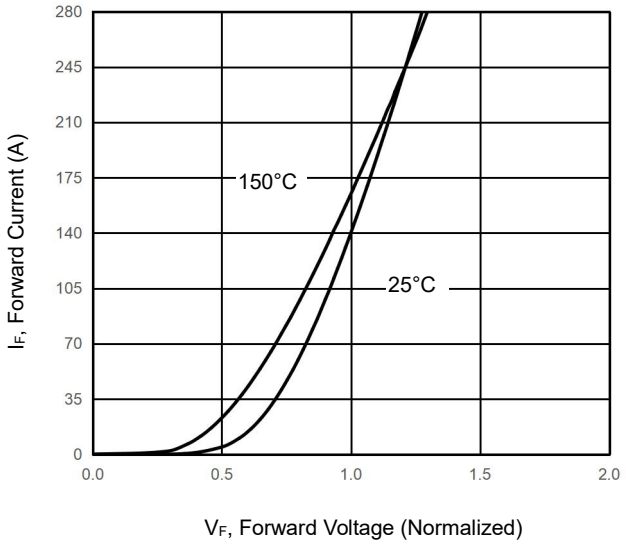


Figure 8 V_F vs. Temperature

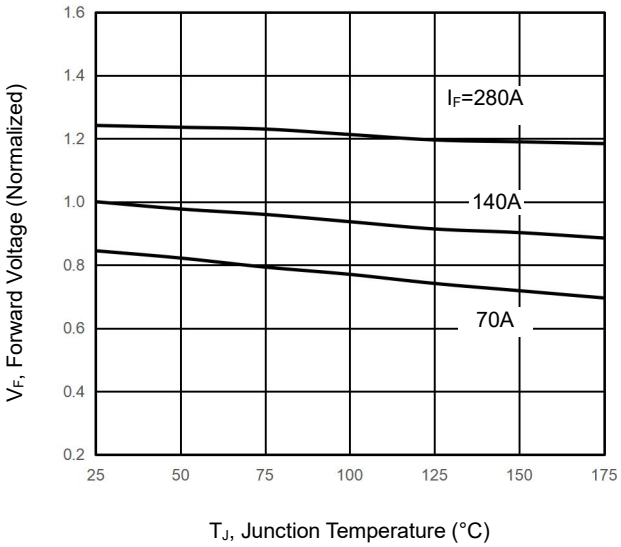


Figure 9 Gate-Emitter Threshold Voltage as a Function of Junction Temperature

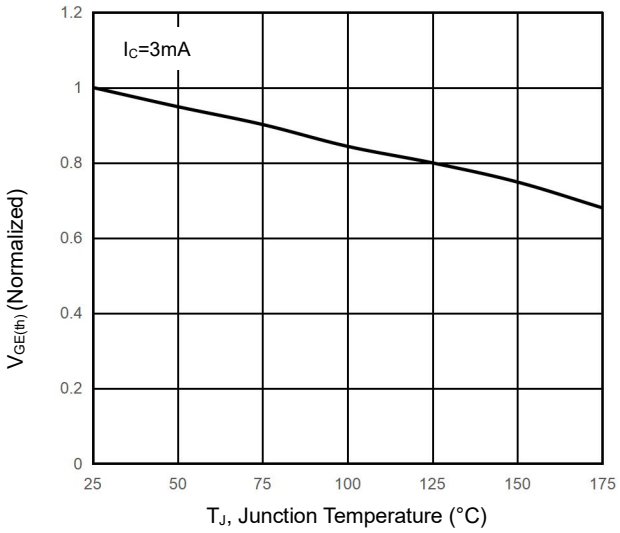


Figure 10 P_{tot} vs. Case Temperature

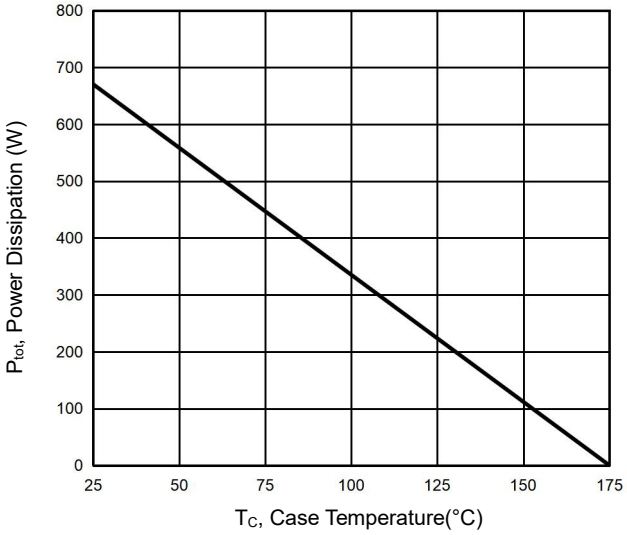


Figure 11 $V_{(BR)CES}$ vs. Temperature

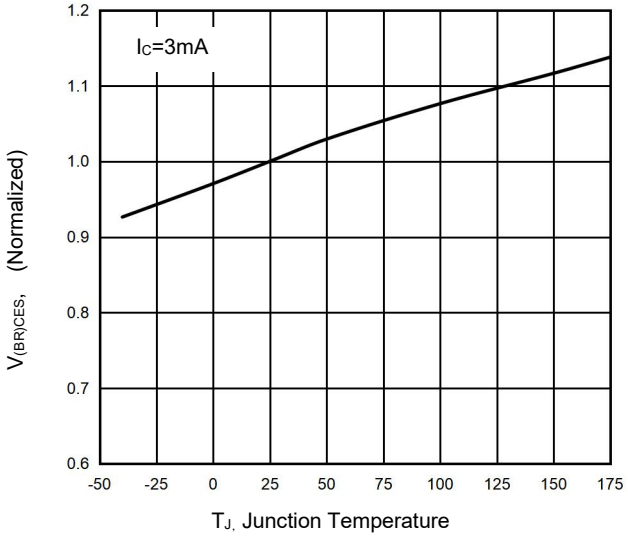
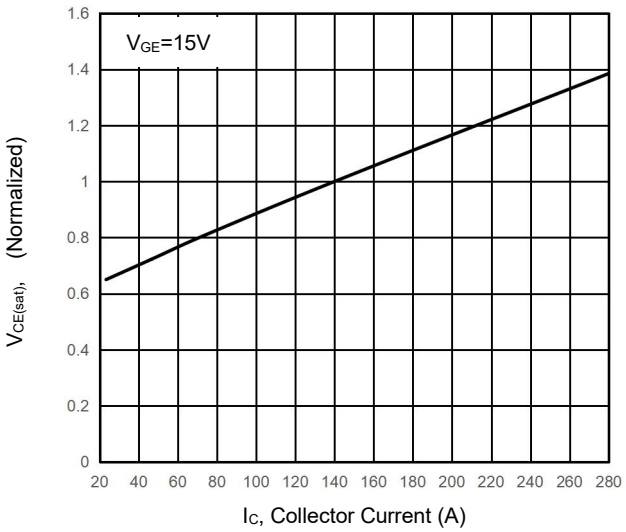
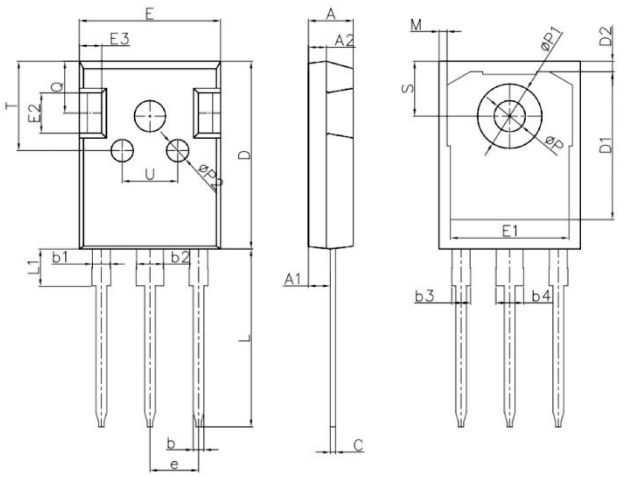


Figure 12 Typical Collector-Emitter Saturation Voltage as a Function of Collector Current

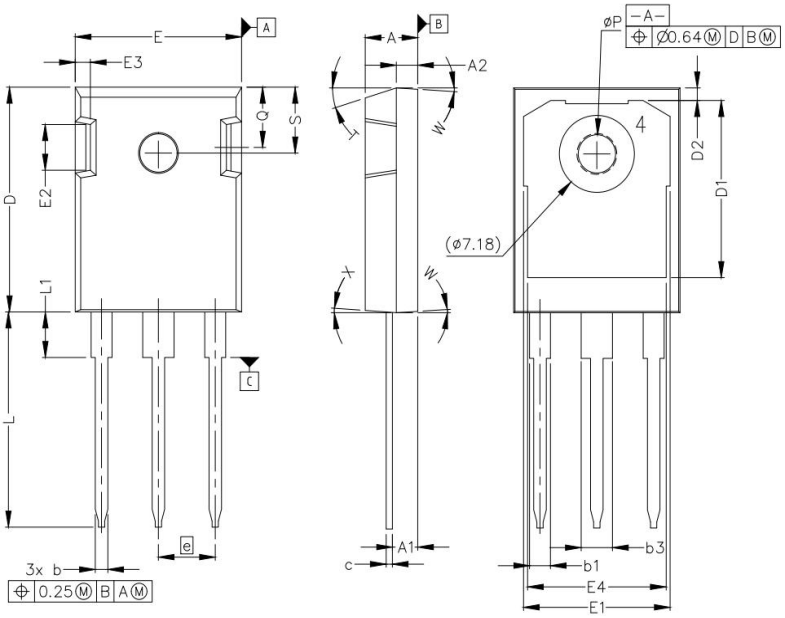


TO-247-3L(E) Package Information



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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