650V, 60A, Trench FS II Fast IGBT

General Description:

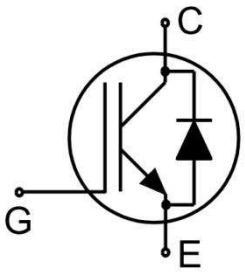
Using NCE's proprietary trench design and advanced FS (Field Stop) second generation technology, the 650V Trench FSII IGBT offers superior conduction and switching performances, and easy parallel operation;

Features

- Trench FSII Technology offering
- Very low $V_{CE(sat)}$
- High speed switching
- Positive temperature coefficient in $V_{CE(sat)}$
- Very tight parameter distribution
- High ruggedness, temperature stable behavior

Application

- Air Condition
- Inverters
- Motor drives



Schematic diagram

Package Marking and Ordering Information

Device	Device Package	Device Marking
NCE60TD65BT	TO-247	NCE60TD65BT

TO-247

Absolute Maximum Ratings (T_C=25°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	120	A
	Collector Current @T_C = 100 °C	60	A
I_{Cpuls}	Pulsed Collector Current，t_p limited by T_{jmax}	240	A
-	turn off safe operating area，V_{CE}=650V, T_j=175°C	240	A
I_F	Diode Continuous Forward Current @T_C = 100 °C	60	A
I_{FM}	Diode Maximum Forward Current	240	A
P_D	Power Dissipation @ T_C = 25°C	319	W
	Power Dissipation @T_C = 100 °C	159	W
T_J,T_{stg}	Operating Junction and Storage Temperature Range	-55 to +175	°C
T_L	Maximum Temperature for Soldering	260	°C
t_{sc}	Short circuit withstand time V_{GE}=15V, V_{CC}≤400V, Allowed number of short circuits<1000Time between short circuits:≥1.0s,T_j≤150°C	5	us

Thermal Characteristic

Symbol	Parameter	Value	Units
$R_{\theta JC}$	Thermal Resistance, Junction to case for IGBT	0.47	°C/W
$R_{\theta JC}$	Thermal Resistance, Junction to case for Diode	0.95	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	40	°C/W

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

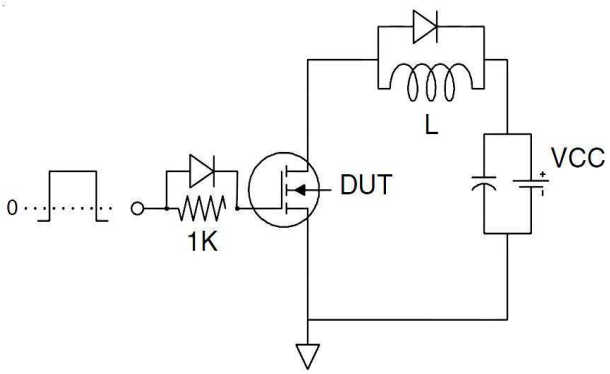
Symbol	Parameter	Conditions		Value			Units
				Min.	Typ.	Max.	
Static Characteristics							
$V_{(BR)CES}$	Collector-Emitter Breakdown Voltage	V_{GE}=0V,I_{CE}=1mA		650	--	--	V
I_{CES}	Collector-Emitter Leakage Current	V_{GE} =0V,V_{CE}=650V		--	--	50	uA
$I_{GES(F)}$	Gate to Emitter Forward Leakage	V_{GE}=+30V,V_{CE}=0V		--	--	200	nA
$I_{GES(R)}$	Gate to Emitter Reverse Leakage	V_{GE}=-30V,V_{CE} =0V		--	--	200	nA
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	I_C=50A	Tj=25°C	--	1.6	1.8	V
		V_{GE}=15V	Tj=175°C	--	1.8	--	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	I_C=60A	Tj=25°C	--	1.7	1.9	V
		V_{GE}=15V	Tj=175°C	--	1.9	--	V
$V_{GE(th)}$	Gate Threshold Voltage	I_C=1mA,V_{CE}=V_{GE}		4.0	5.0	6.0	V
Dynamic Characteristics							
C_{ies}	Input Capacitance	V_{CE}=25V,V_{GE}=0V, f=1MHz		--	7018	--	pF
C_{oes}	Output Capacitance			--	199	--	
C_{res}	Reverse Transfer Capacitance			--	138	--	
Q_g	Total Gate Charge	V_{CC}=480V, I_C=60A, V_{GE}=15V		--	262	--	nC
Q_{ge}	Gate to Emitter Charge			--	60	--	
Q_{gc}	Gate to Collector Charge			--	113	--	
$I_{C(SC)}$	Short circuit collector current Max.1000 short circuits Time between short circuits: ≥1.0s	V_{GE}=15V,V_{CC}≤400V, t_{SC}≤5us,Tj≤150°C		--	320	--	A
Switching Characteristics							
$t_{d(ON)}$	Turn-on Delay Time	V_{CC}=400V,I_C=60A, V_{GE}=0/15V, R_g=5Ω, Inductive Load		--	19	--	ns
t_r	Rise Time			--	17	--	
$t_{d(OFF)}$	Turn-Off Delay Time			--	170	--	
t_f	Fall Time			--	18	--	
E_{on}	Turn-On Switching Loss			--	1.1	--	mJ
E_{off}	Turn-Off Switching Loss			--	0.9	--	
E_{ts}	Total Switching Loss			--	2.0	--	
E_{on}	Turn-On Switching Loss	V_{CC}=400V,I_C=60A, V_{GE}=0/15V,R_g=5Ω, Tj=175°C		--	1.4	--	mJ
E_{off}	Turn-Off Switching Loss			--	1.3	--	
E_{ts}	Total Switching Loss			--	2.7	--	

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

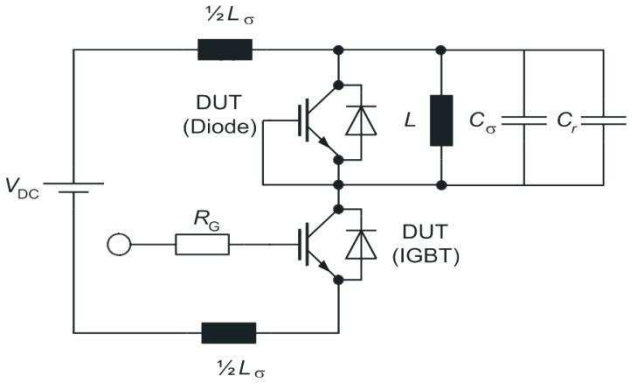
Symbol	Parameter	Conditions		Rating			Units
				Min.	Typ.	Max.	
V_{FM}	Diode Forward Voltage	I_F=50A	Tj=25°C	--	1.65	2.2	V
			Tj=175°C	--	1.3	--	V
V_{FM}	Diode Forward Voltage	I_F=60A	Tj=25°C	--	1.75	2.4	V
			Tj=175°C	--	1.4	--	V
T_{rr}	Reverse Recovery Time	I_F=60A, di/dt=200A/us		--	186	--	ns
I_{RRM}	Diode Peak Reverse Recovery Current			--	3.8	--	A
Q_{rr}	Reverse Recovery Charge			--	0.3	--	uC
T_{rr}	Reverse Recovery Time	I_F=60A, di/dt=200A/us, Tj=175°C		--	458	--	ns
I_{RRM}	Diode Peak Reverse Recovery Current			--	5.3	--	A
Q_{rr}	Reverse Recovery Charge			--	1.3	--	uC

Test Circuit

1) Gate Charge Test Circuit

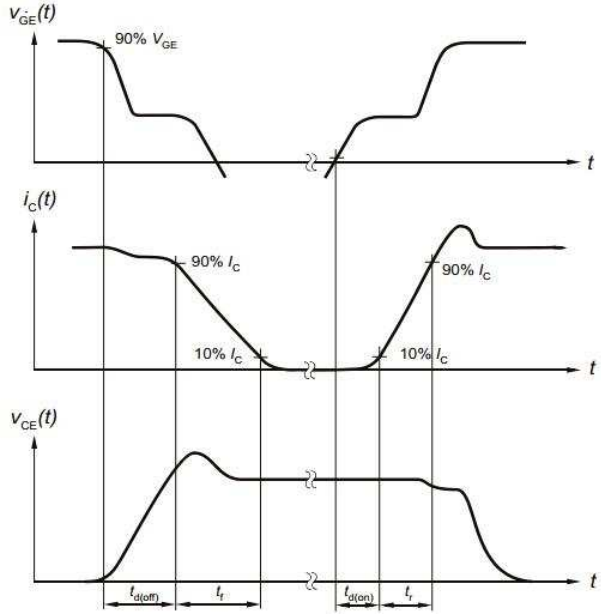


2) Switch Time Test Circuit

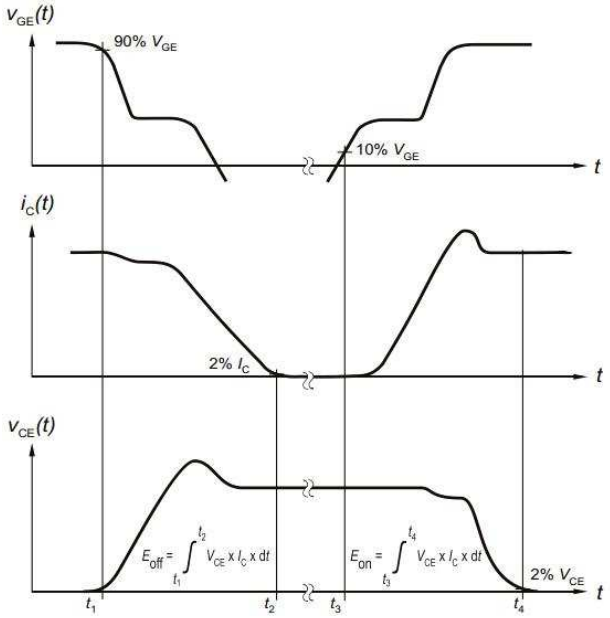


Switching characteristics

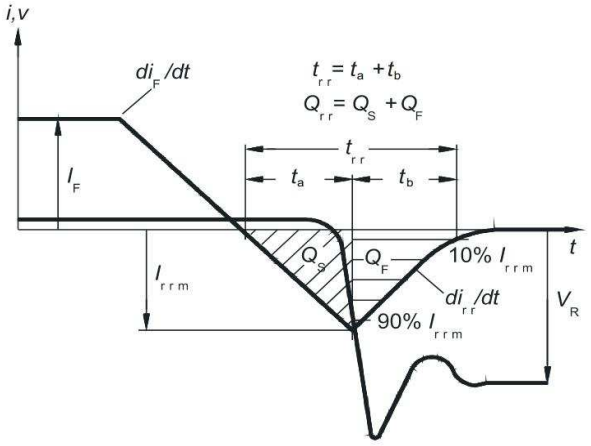
1) Definition of switching times



2) Definition of switching losses



3) Definition of diode switching characteristics



Typical Electrical and Thermal Characteristics

Figure 1 Output Characteristics

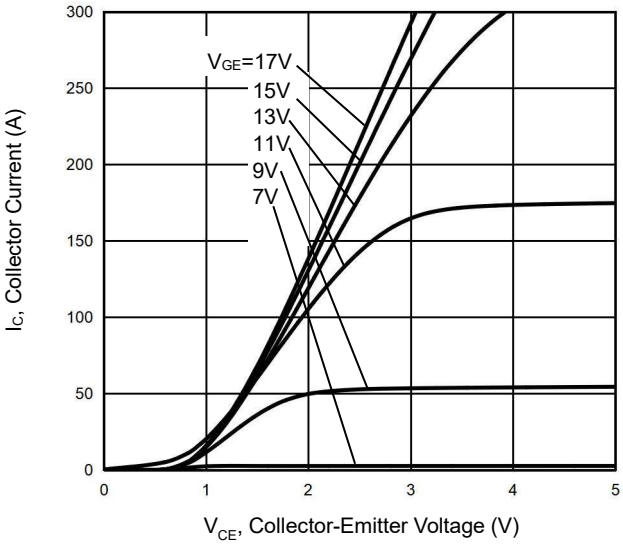


Figure 2 Transfer Characteristics

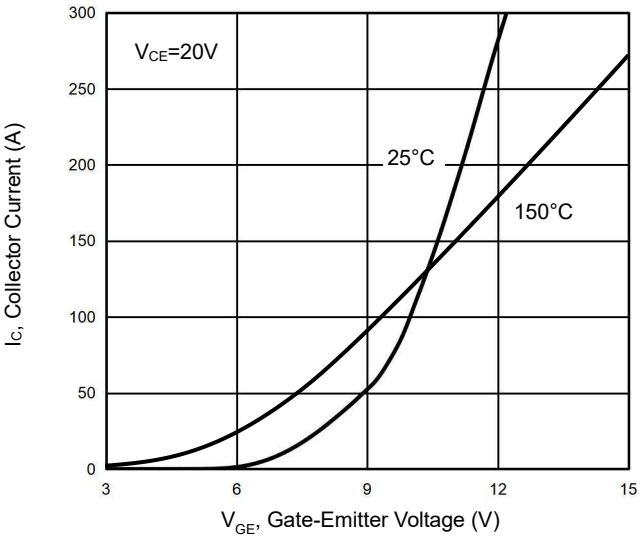


Figure 3 V_{CEsat} vs. Case Temperature

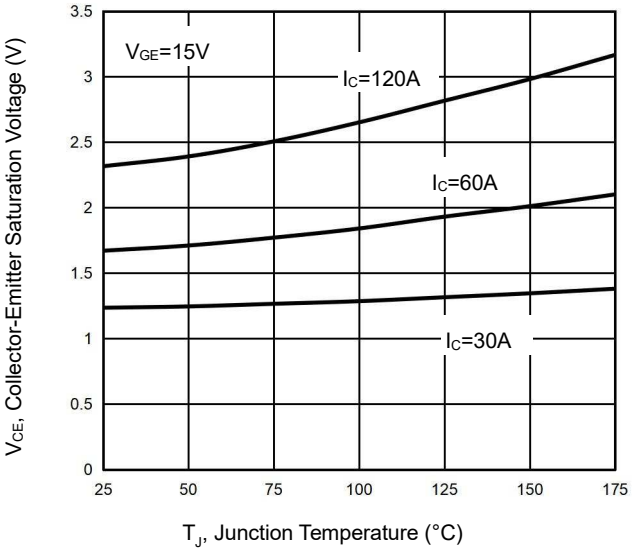


Figure 4 Saturation Voltage vs. V_{GE}

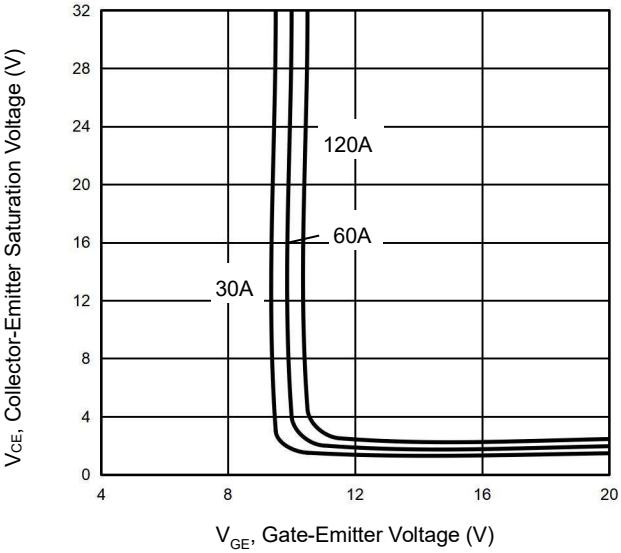


Figure 5 Capacitance Characteristics

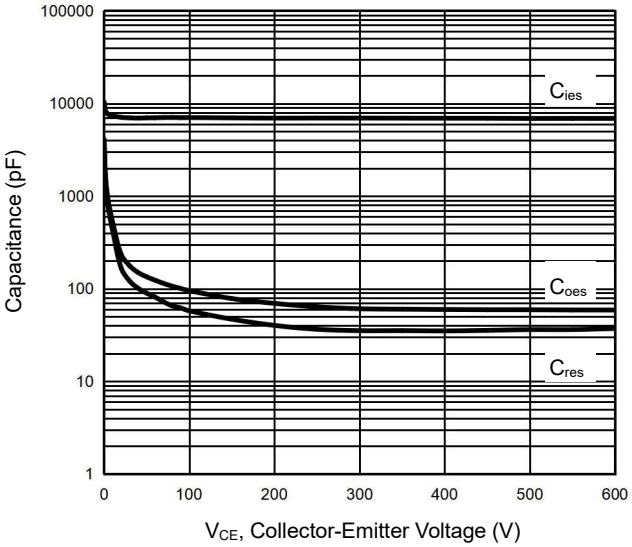
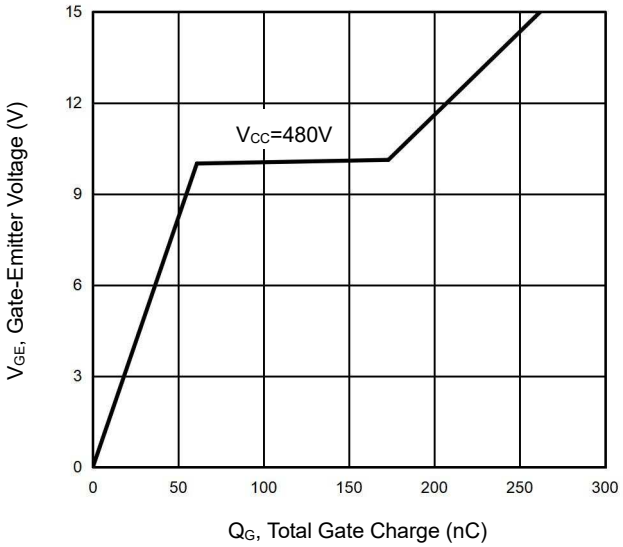


Figure 6 Gate Charge Wave Form



Typical Electrical and Thermal Characteristics

Figure 7 Forward Characteristics

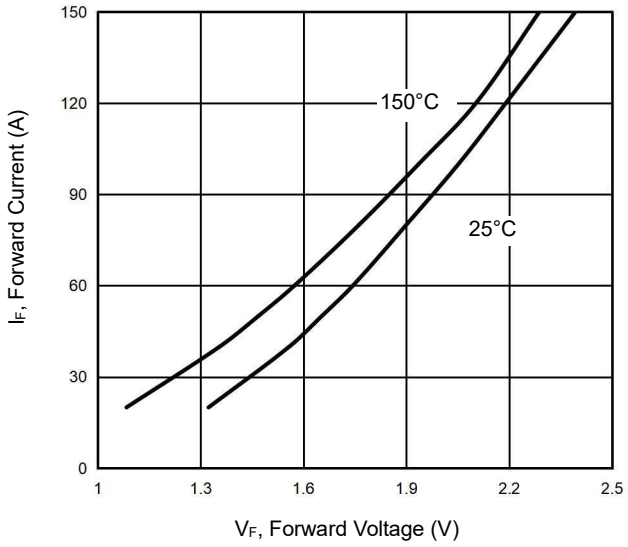


Figure 8 V_F vs. Temperature

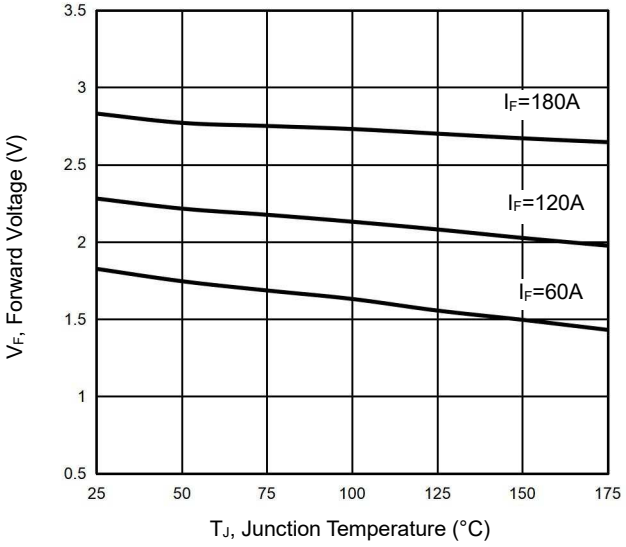


Figure 9 Switching Loss vs. R_G

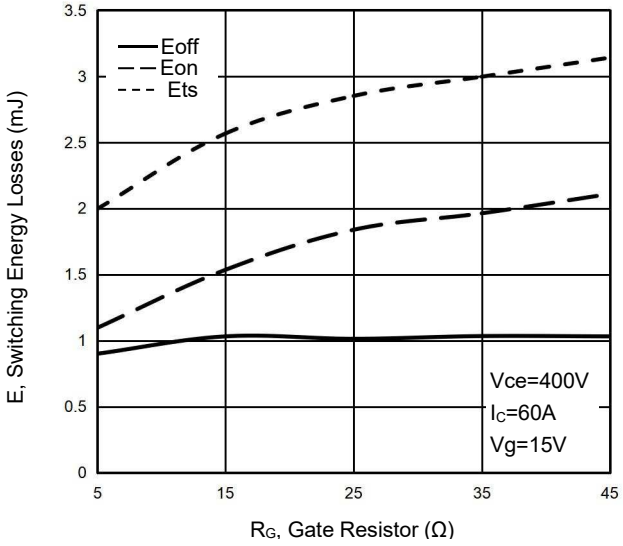


Figure 10 Switching Energy vs. Temperature

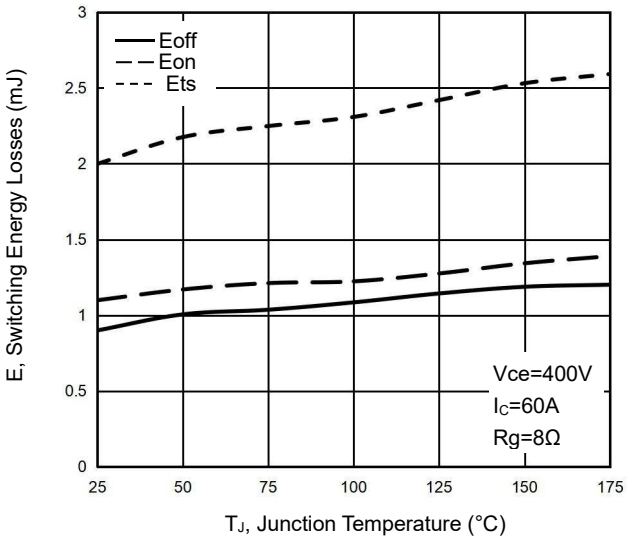


Figure 11 Switching Loss vs. Collector Current

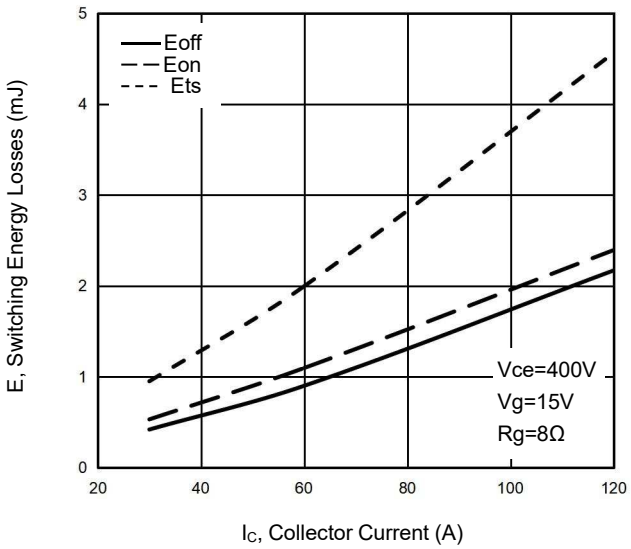
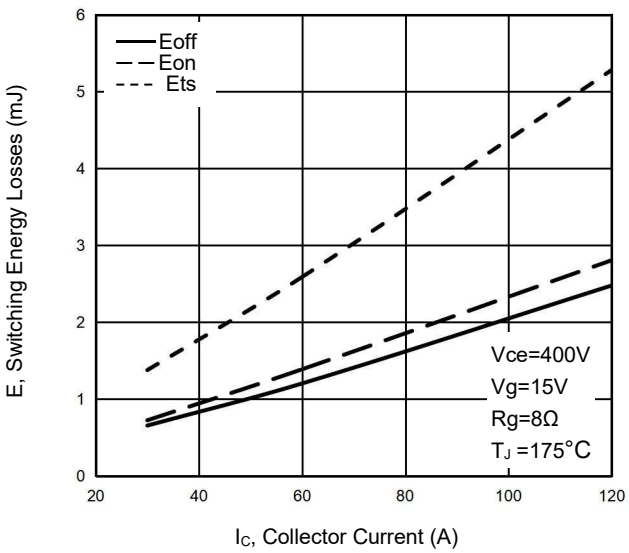


Figure 12 Switching Loss vs. Collector Current



Typical Electrical and Thermal Characteristics

Figure 13 $V_{GE(th)}$ vs. Junction Temperature

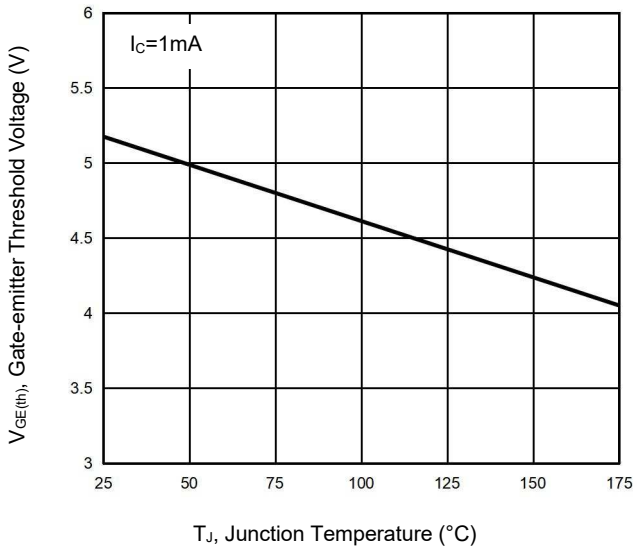


Figure 14 $V_{CE(SAT)}$ vs. Collector Current

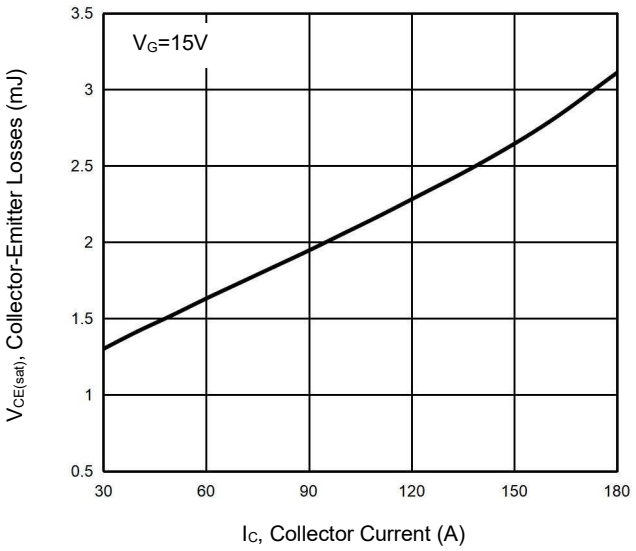


Figure 15 Forward Bias Safe Operating Area

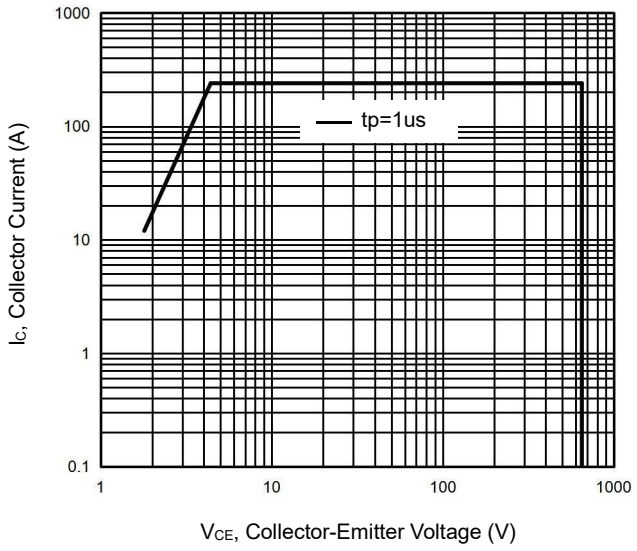


Figure 16 P_{tot} vs. Case Temperature

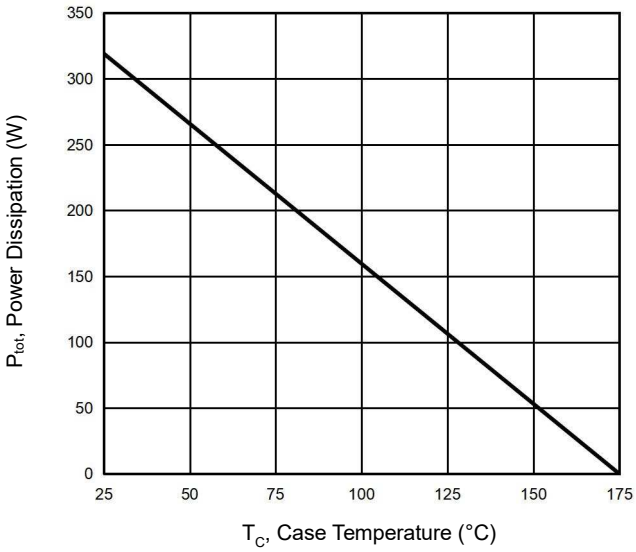


Figure 17 V_{CES} vs. Temperature

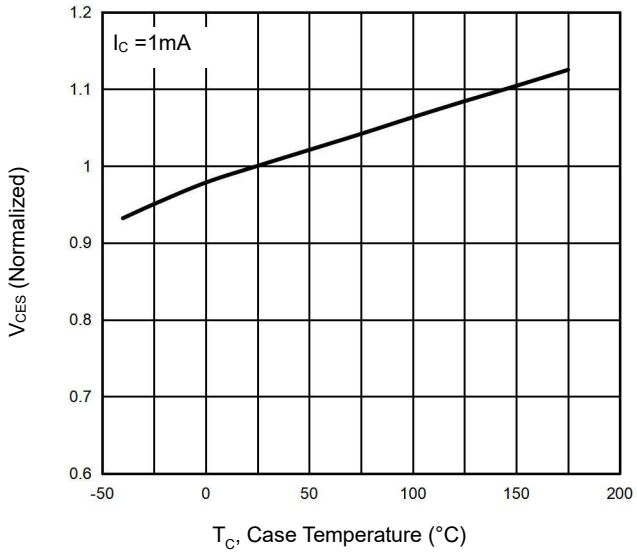
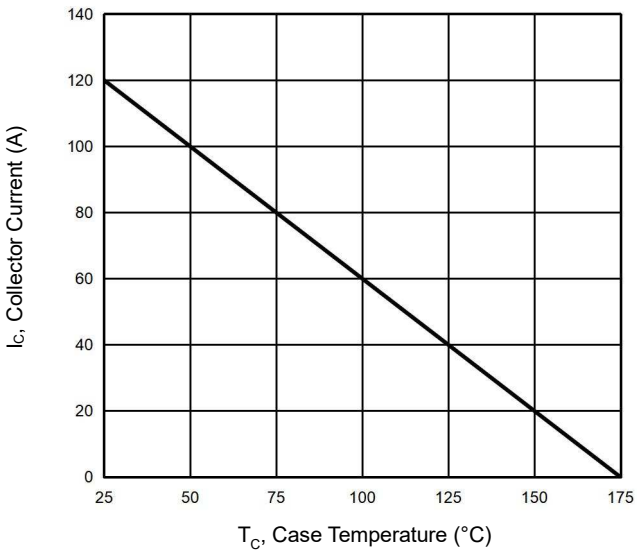


Figure 18 I_C vs. Temperature



Typical Electrical and Thermal Characteristics

Figure 19 $V_{CE(sat)}$ vs. Collector Current

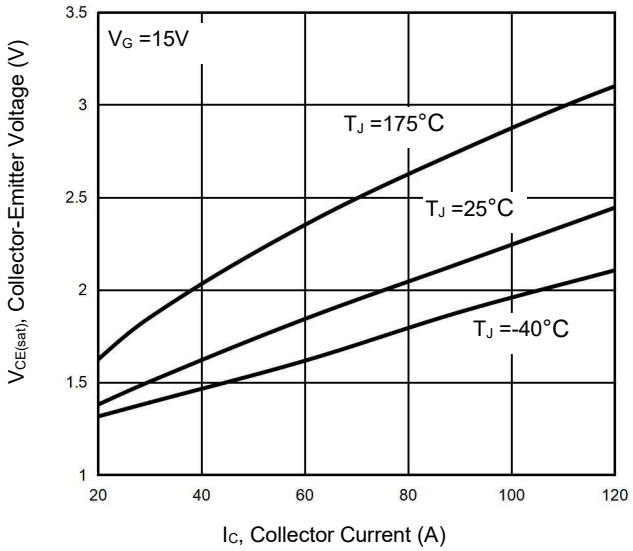
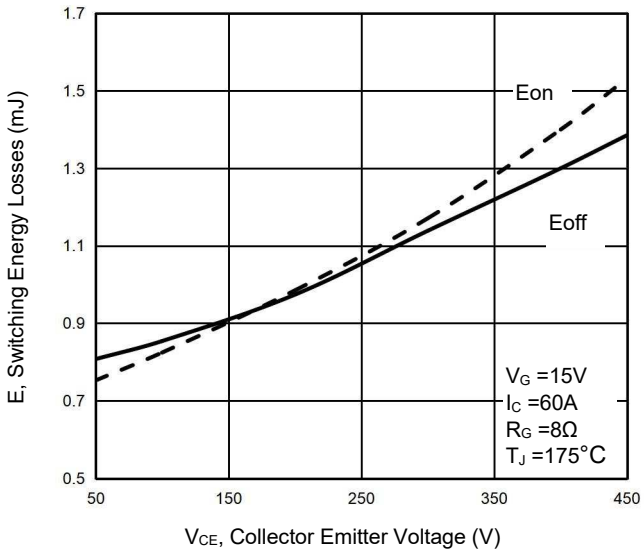
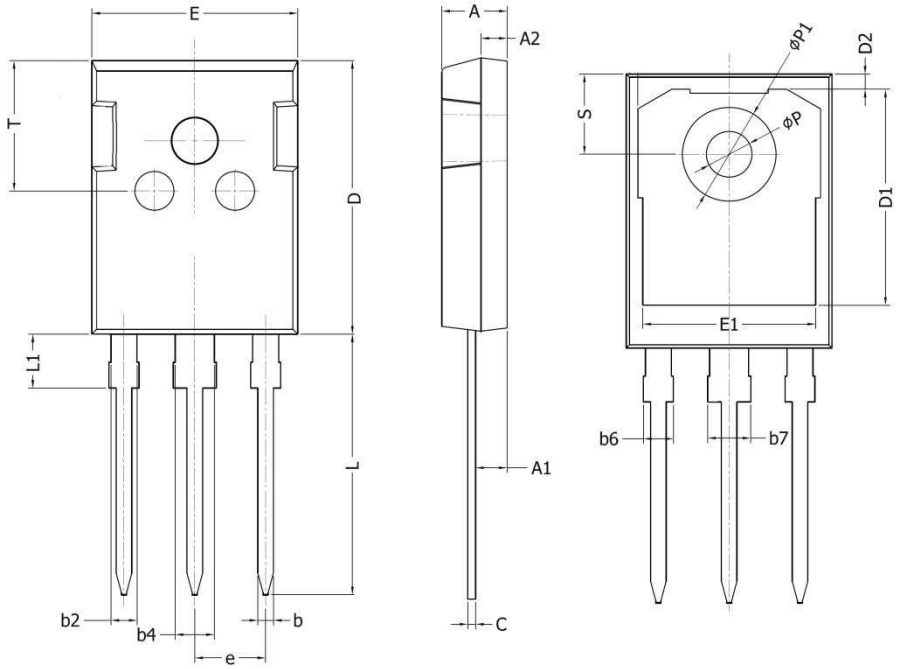


Figure 20 Switching Loss vs. V_{CE}

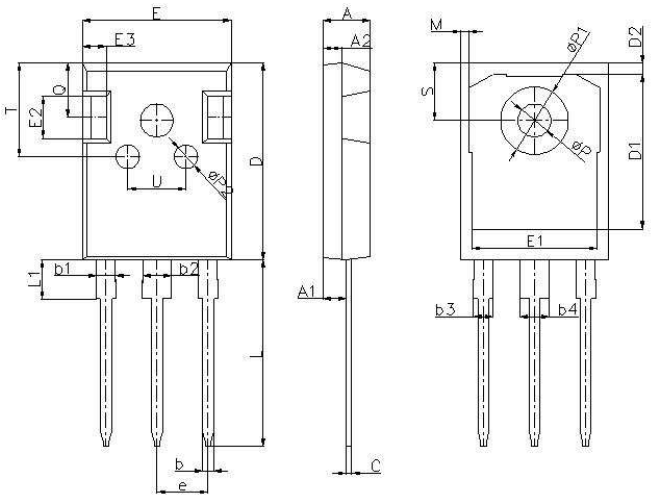


TO-247-P Package Information



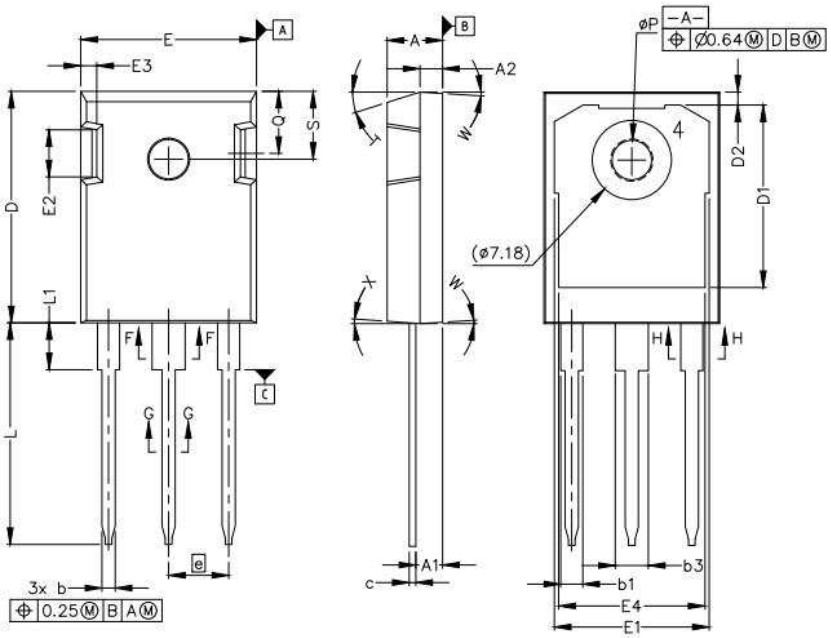
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.90	5.10	0.193	0.201
A1	2.31	2.51	0.091	0.099
A2	1.90	2.10	0.075	0.083
b	1.16	1.26	0.046	0.050
b2	1.96	2.06	0.077	0.081
b4	2.96	3.06	0.117	0.120
b6	-	2.25	-	0.089
b7	-	3.25	-	0.128
C	0.59	0.66	0.023	0.026
D	20.90	21.10	0.823	0.831
D1	16.25	16.85	0.640	0.663
D2	1.05	1.35	0.041	0.053
E	15.70	15.90	0.618	0.626
E1	13.10	13.50	0.516	0.531
e	5.436 BSC		0.214 BSC	
L	19.80	20.10	0.780	0.791
L1	-	4.30	-	0.169
P	3.40	3.60	0.134	0.142
P1	7.00	7.40	0.276	0.291
S	6.05	6.25	0.238	0.246
T	9.80	10.20	0.386	0.402
U	6.00	6.40		

TO-247-E Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.90	5.10	0.193	0.201
A1	2.31	2.51	0.091	0.099
A2	1.90	2.10	0.075	0.083
b	1.16	1.26	0.046	0.050
b1	1.96	2.06	0.077	0.081
b2	2.96	3.06	0.117	0.120
b3	-	2.25	-	0.089
b4	-	3.25	-	0.128
C	0.59	0.66	0.023	0.026
D	20.90	21.10	0.823	0.831
D1	16.25	16.85	0.640	0.663
D2	1.05	1.35	0.041	0.053
E	15.70	15.90	0.618	0.626
E1	13.10	13.50	0.516	0.531
E2	4.40	4.60	0.173	0.181
E3	2.40	2.60	0.094	0.102
e	5.436BSC		0.214BSC	
L	19.80	20.10	0.780	0.791
L1	-	4.30	-	0.169
M	0.35	0.95	0.014	0.037
P	3.40	3.60	0.134	0.142
P1	7.00	7.40	0.276	0.291
P2	2.40	2.60	0.094	0.102
Q	5.60	6.00	0.220	0.236
S	6.05	6.25	0.238	0.246
T	9.80	10.20	0.386	0.402
U	6.00	6.40	0.236	0.252

TO-247-B Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.83	5.21	0.190	0.205
A1	2.29	2.54	0.090	0.100
A2	1.91	2.16	0.075	0.085
b'	1.07	1.28	0.042	0.050
b	1.07	1.33	0.042	0.052
b1	1.91	2.41	0.075	0.095
b2	1.91	2.16	0.075	0.085
b3	2.87	3.38	0.113	0.133
b4	2.87	3.13	0.113	0.123
c'	0.55	0.65	0.022	0.026
c	0.55	0.68	0.022	0.027
D	20.80	21.10	0.819	0.831
D1	16.25	17.65	0.640	0.695
D2	0.95	1.25	0.037	0.049
E	15.75	16.13	0.620	0.635
E1	13.10	14.15	0.516	0.557
E2	3.68	5.10	0.145	0.201
E3	1.00	1.90	0.039	0.075
E4	12.38	13.43	0.487	0.529
e	5.44 BSC		0.214BSC	
N	3		0.118	
L	19.81	20.32	0.780	0.800
L1	4.10	4.40	0.161	0.173

ØP	3.51	3.65	0.138	0.144
Q	5.49	6.00	0.216	0.236
S	6.04	6.30	0.238	0.248
T	17.5° REF.			
W	3.5° REF.			
X	4° REF.			

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