

## NGTB40N120S3WG-VB Datasheet

### 1200V Trench and Fieldstop IGBT

PRODUCT SUMMARY		
V <sub>CE</sub> (V)	1200	
I <sub>C</sub> (A)	80 (TC=25 °C)	40 (TC=100 °C)
V <sub>CE (sat)</sub> (V)	1.8	
I <sub>CM</sub> (A)	120	

#### FEATURES

- Very Low V<sub>CEsat</sub>
- Low turn-off losses
- High speed switching
- Maximum junction temperature 175°C
- Ultra low gate charge (Q<sub>g</sub>)
- Avalanche energy rated (UIS)



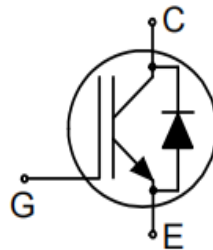
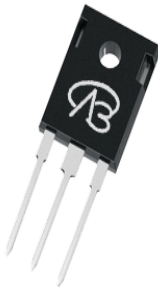
#### APPLICATIONS

- Telecommunications
  - Server and telecom power supplies
- Lighting
  - High-intensity discharge (HID)
  - Fluorescent ballast lighting
- Consumer and computing
  - ATX power supplies
- Industrial
  - Welding
  - Battery chargers
- Renewable energy
  - Solar (PV inverters)
- Switch mode power supplies (SMPS)

#### Package pin definition

- Pin1 G - Gate
- Pin2 C & backside - Collector
- Pin3 E - Emitter

TO-247



Top View

ABSOLUTE MAXIMUM RATINGS (T <sub>C</sub> = 25 °C, unless otherwise noted)				
PARAMETER		SYMBOL	LIMIT	UNIT
Collector-Emitter Voltage		V <sub>CE</sub>	1200	V
Gate-Emitter Voltage		V <sub>GE</sub>	±30	
Continuous Collector Current (T <sub>J</sub> = 150 °C)	V <sub>GE</sub> at 15 V	I <sub>C</sub>	T <sub>C</sub> = 25 °C	80
			T <sub>C</sub> = 100 °C	40
Pulsed Collector Current <sup>a</sup>		I <sub>CM</sub>	120	A
Diode Forward Current <sup>b</sup>		I <sub>F</sub>	40	A
Maximum Power Dissipation		P <sub>D</sub>	T <sub>C</sub> = 25 °C	350
			T <sub>C</sub> = 100 °C	180
Operating Junction and Storage Temperature Range		T <sub>J</sub> , T <sub>stg</sub>	-55 to +175	°C
Short Circuit Withstand Time <sup>TC=150</sup>	V <sub>GE</sub> = 15V, V <sub>CE</sub> 400V	tsc	3	µs
Short Circuit Withstand Time <sup>TC=100</sup>	V <sub>GE</sub> = 15V, V <sub>CE</sub> 330V		5	
Soldering Recommendations (Peak Temperature) <sup>c</sup>	for 10 s		260	°C

#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature.
- Current limited by maximum junction temperature.
- 1.6 mm from case.

THERMAL RESISTANCE RATINGS				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	$R_{thJA}$	-	40	°C/W
Maximum Junction-to-Case	$R_{thJC}$	-	0.5	

SPECIFICATIONS ( $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Static</b>						
Collector-Emitter Breakdown Voltage	$BV_{CE}$	$V_{GE} = 0\text{ V}, I_C = 250\text{ }\mu\text{A}$ $V_{GE} = 0\text{ V}, I_C = 1\text{ mA}$	1200 1200	- -	- -	V
Gate-Source Threshold Voltage (N)	$V_{GE(th)}$	$V_{CE} = V_{GE}, I_D = 250\text{ }\mu\text{A}$	4	5	6	V
Zero Gate Voltage Collector Current	$I_{CES}$	$V_{CE} = 1200\text{ V}, V_{GE} = 0\text{ V}, T_J = 25\text{ }^\circ\text{C}$	-	1	20	$\mu\text{A}$
		$V_{CE} = 1200\text{ V}, V_{GE} = 0\text{ V}, T_J = 150\text{ }^\circ\text{C}$	-	1000	-	$\mu\text{A}$
Gate-Emitter Leakage Current	$I_{GES}$	$V_{CE} = 0\text{ V}, V_{GS} = \pm 2.0\text{ V}$	-	-	100	nA
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$V_{GE} = 15\text{ V}$   $I_C = 40\text{ A}$	-	1.7	2.1	V
Forward Transconductance	$g_{fs}$	$V_{CE} = 20\text{ V}, I_C = 40\text{ A}$	-	40	-	S
<b>Dynamic</b>						
Input Capacitance	$C_{ies}$	$V_{GE} = 0\text{ V}, V_{CE} = 25\text{ V},$ $f = 500\text{ KHz}$	-	4300	-	pF
Output Capacitance	$C_{oes}$		-	230	-	
Reverse Transfer Capacitance	$C_{res}$		-	68	-	
Turn-on Energy	$E_{on}$	$V_{CE} = 400\text{ V}, V_{GE} = 0/15\text{V},$ $I_C = 40\text{ A}, R_g = 10\Omega$	-	0.4	-	nJ
Turn-off Energy	$E_{off}$		-	0.5	-	
Total Gate Charge	$Q_g$	$V_{GE} = 15\text{ V}$   $I_C = 40\text{ A}, V_{CE} = 400\text{ V}$	-	178	-	nC
Gate-Emitter Charge	$Q_{ge}$		-	16	-	
Gate to Collector Charge	$Q_{gc}$		-	42	-	
Turn-On Delay Time	$t_{d(on)}$	$V_{CE} = 400\text{ V}, V_{GE} = 0/15\text{V},$ $I_C = 40\text{ A}, R_g = 10\Omega$	-	68	-	ns
Rise Time	$t_r$		-	52	-	
Turn-Off Delay Time	$t_{d(off)}$		-	178	-	
Fall Time	$t_f$		-	32	-	
Internal emitter inductance measured 5 mm	$L_E$		-	13	-	
<b>Diode Characteristics</b>						
Diode Forward Current	$I_F$	IGBT symbol showing the integral reverse junction diode	-	-	40	A
Pulsed Diode Forward Current	$I_{FM}$		-	-	120	
Diode Forward Voltage	$V_F$	$I_F = 40\text{ A}$	-	1.73	2.0	V
Reverse Recovery Time	$t_{rr}$	$T_J = 25\text{ }^\circ\text{C}, I_F = 40\text{ A},$ $di/dt = 200\text{ A}/\mu\text{s}, V_R = 400\text{ V}$	-	82	-	ns
Reverse Recovery Charge	$Q_{rr}$		-	0.24	-	$\mu\text{C}$
Reverse Recovery Current	$I_{RRM}$		-	14	-	A



Figure 1. Forward bias safe operating area

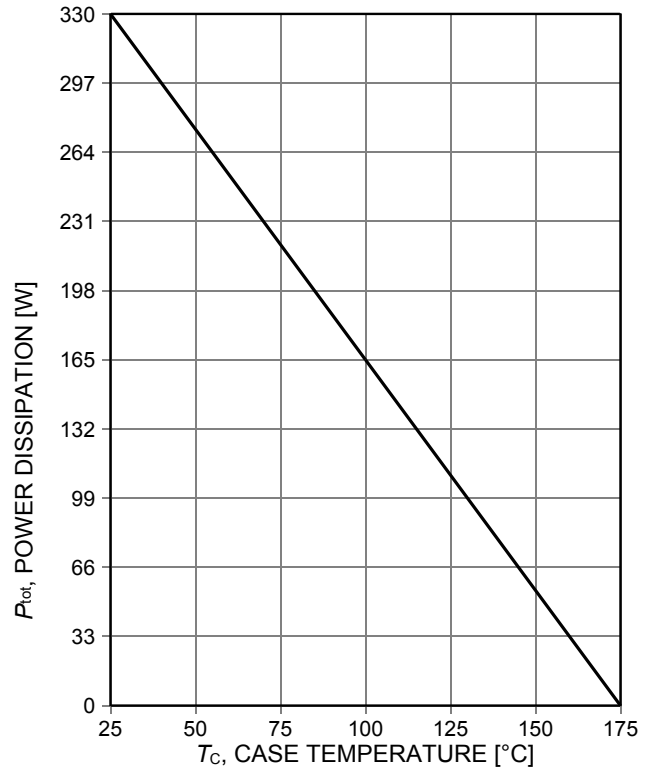


Figure 2. Power dissipation as a function of case temperature

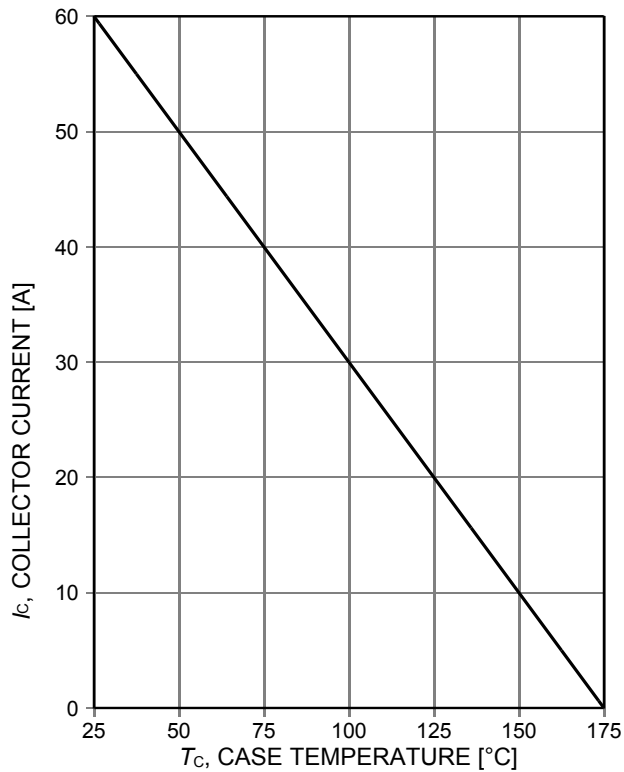


Figure 3. Collector current as a function of case temperature

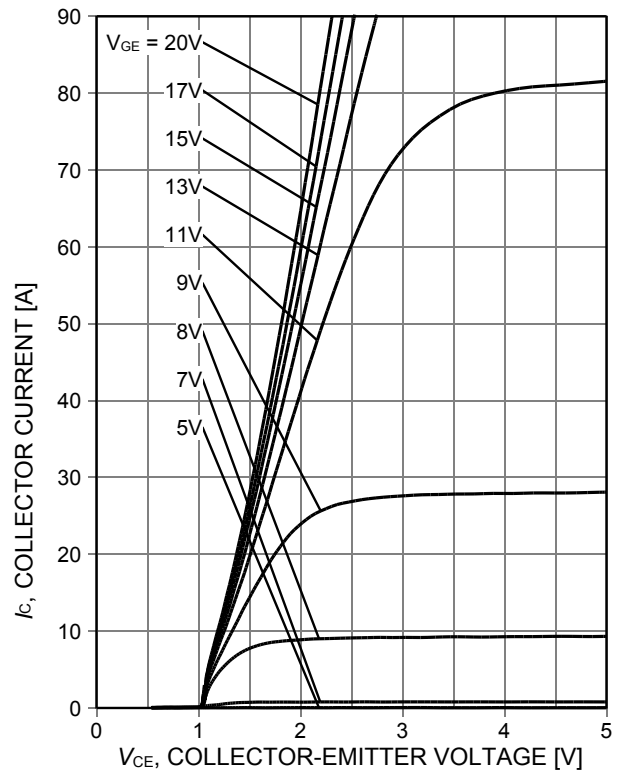


Figure 4. Typical output characteristic

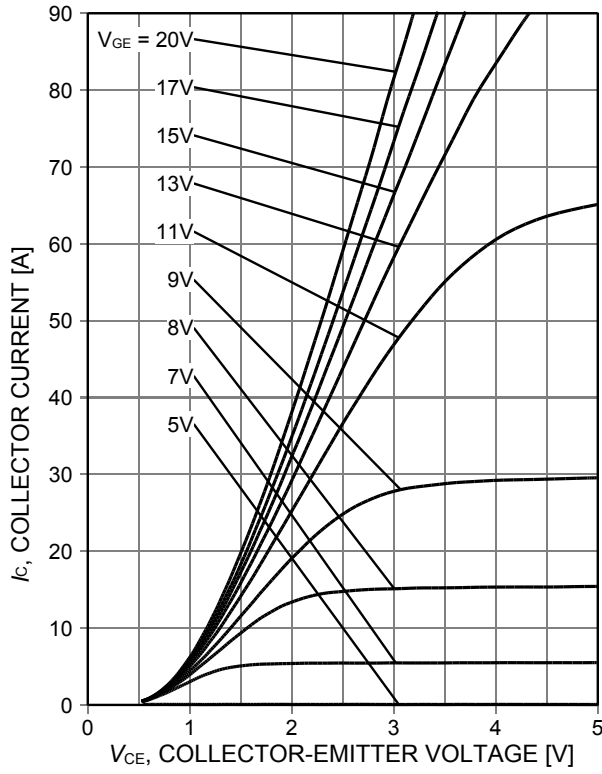


Figure 5. Typical output characteristic

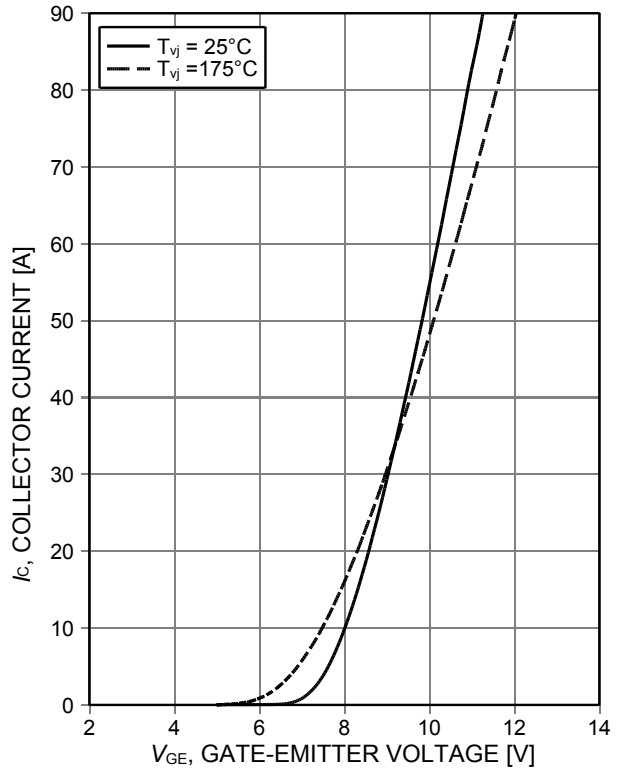


Figure 6. Typical transfer characteristic

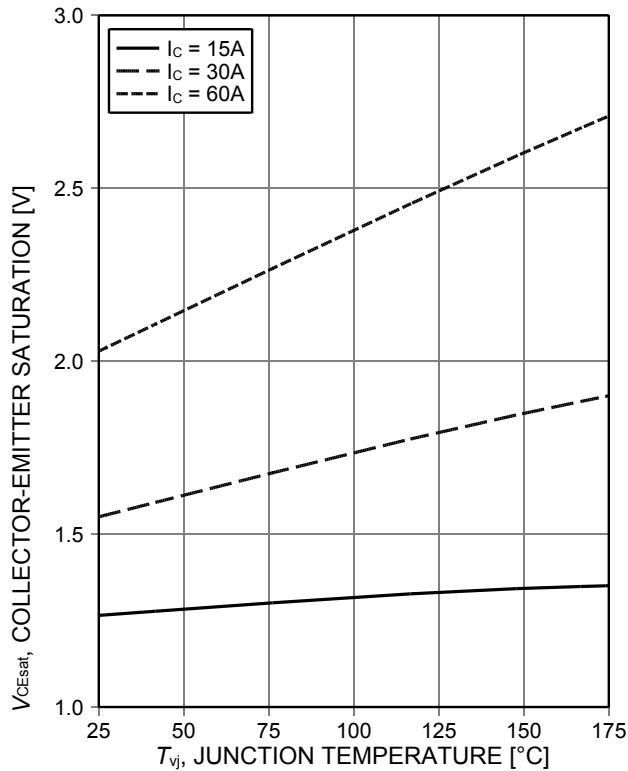


Figure 7. Typical collector-emitter saturation voltage as a function of junction temperature

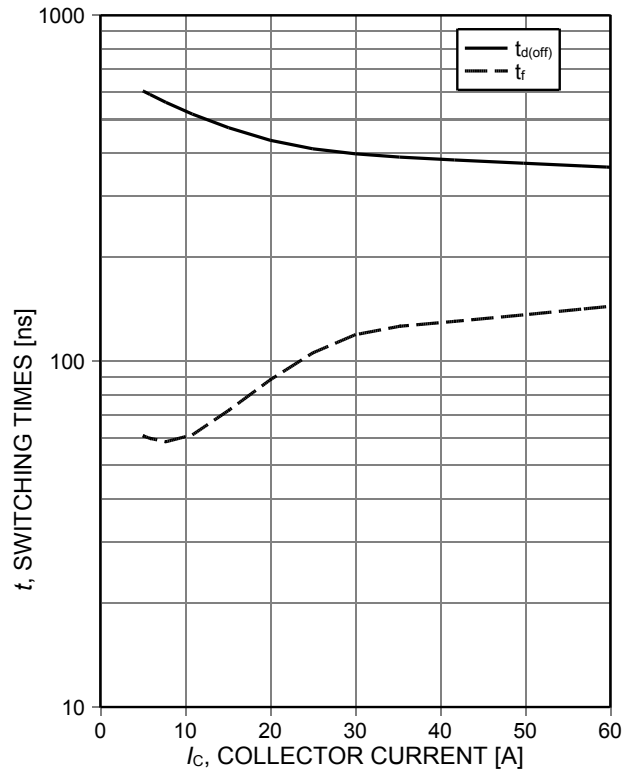


Figure 8. Typical switching times as a function of collector current

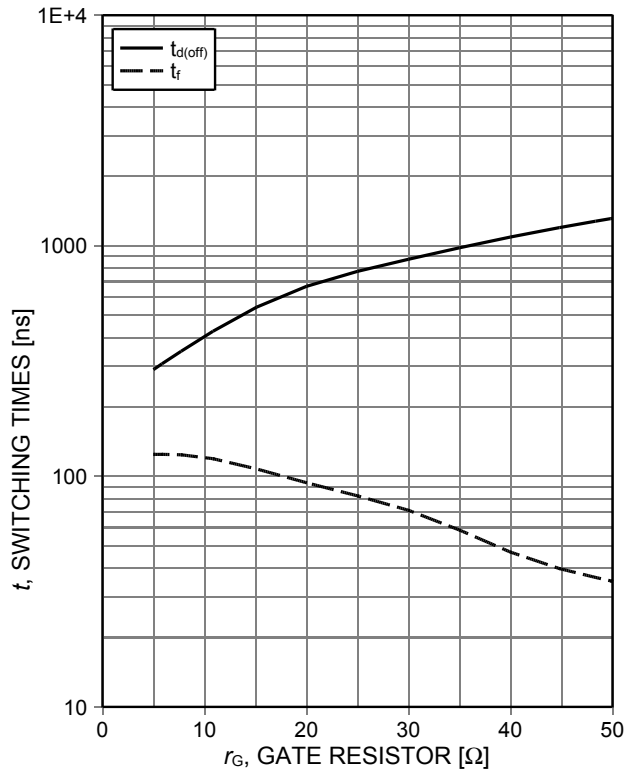


Figure 9. Typical switching times as a function of gate resistor

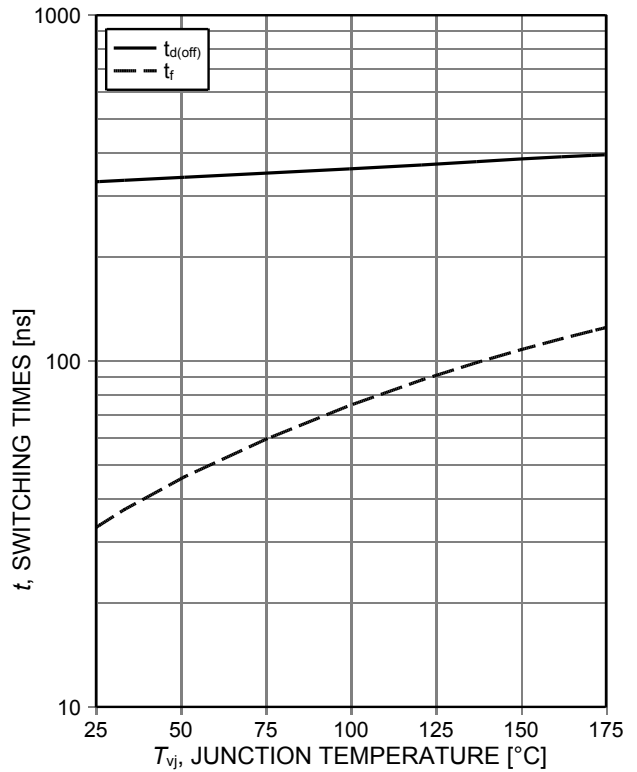


Figure 10. Typical switching times as a function of junction temperature

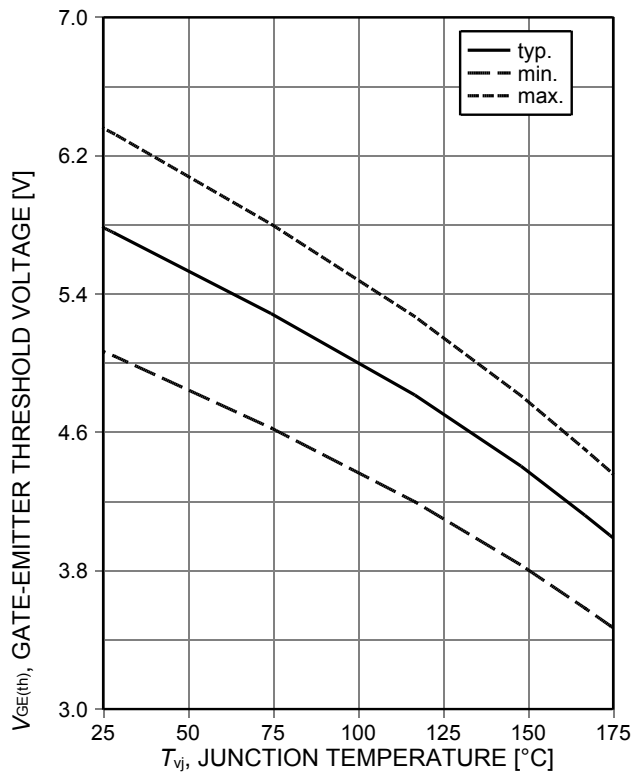


Figure 11. Gate-emitter threshold voltage as a function of junction temperature

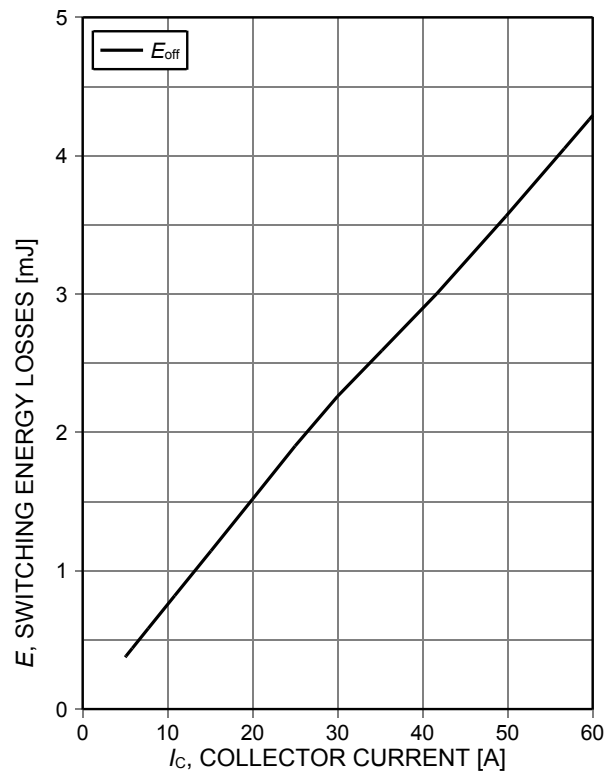


Figure 12. Typical switching energy losses as a function of collector current

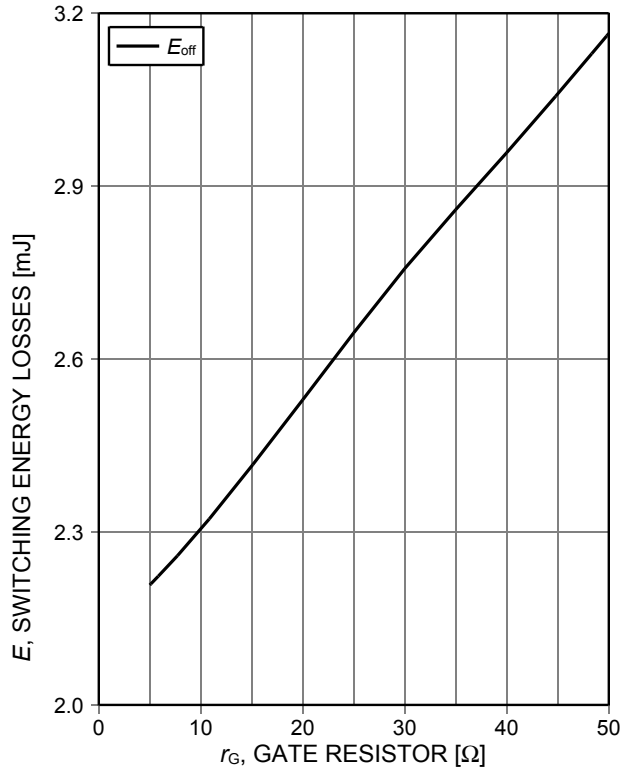


Figure 13. Typical switching energy losses as a function of gate resistor



Figure 14. Typical switching energy losses as a function of junction temperature

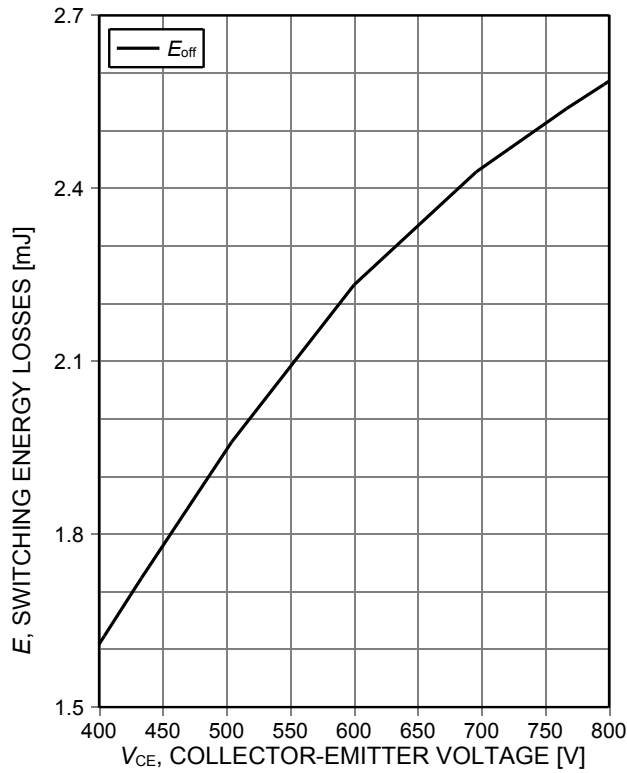


Figure 15. Typical switching energy losses as a function of collector emitter voltage



Figure 16. Typical turn off switching energy loss for soft switching

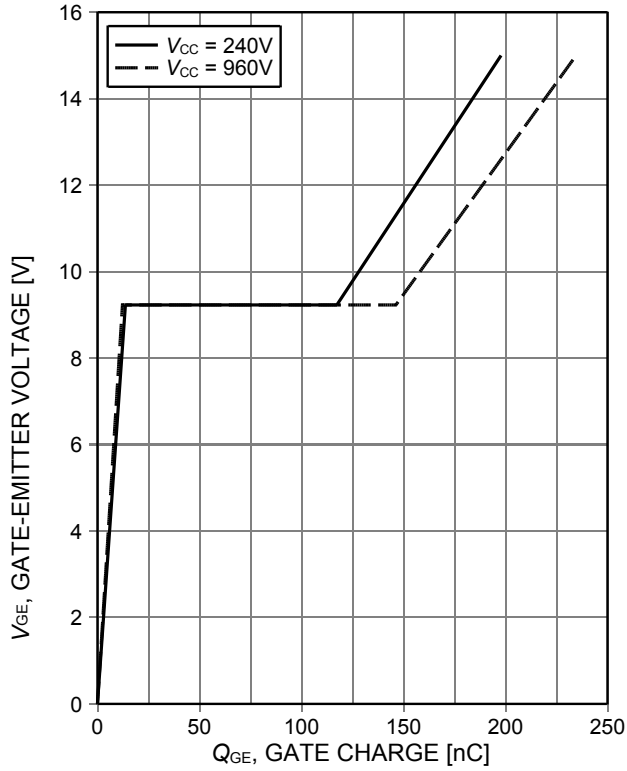


Figure 17. Typical gate charge

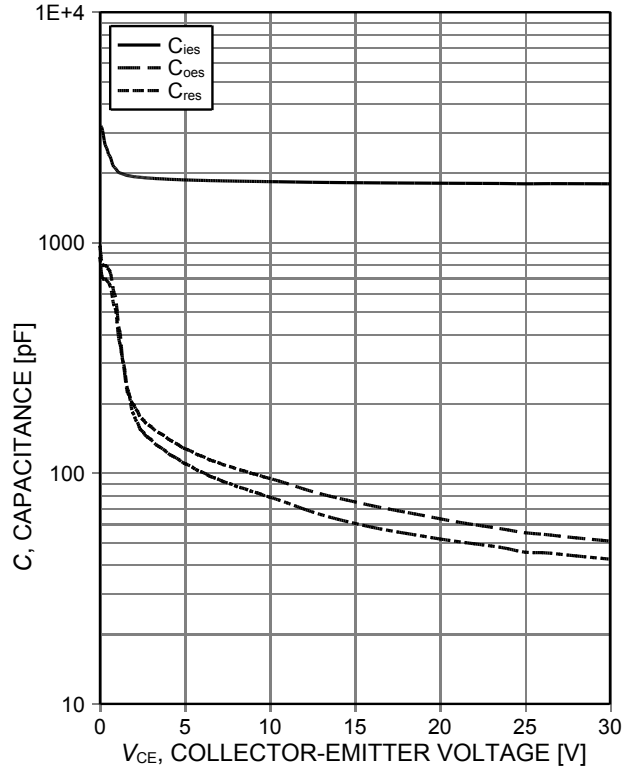


Figure 18. Typical capacitance as a function of collector-emitter voltage

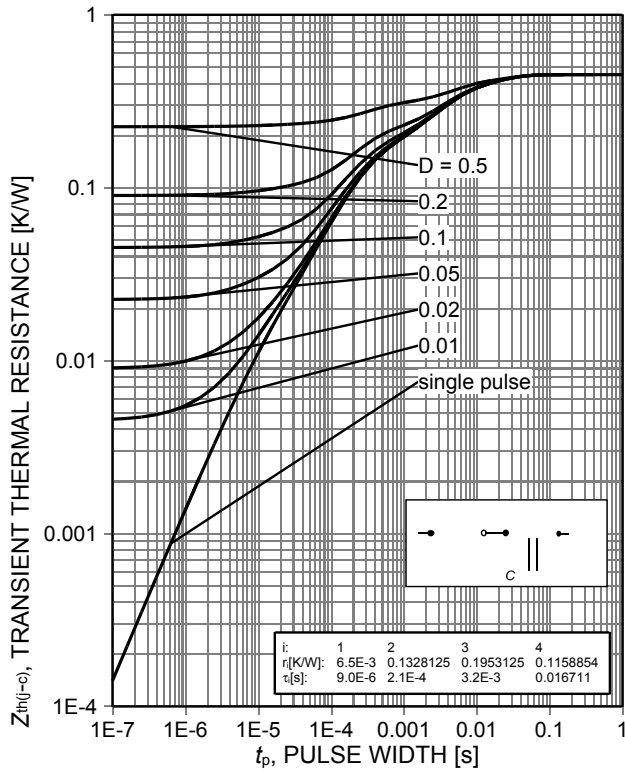


Figure 19. IGBT transient thermal resistance

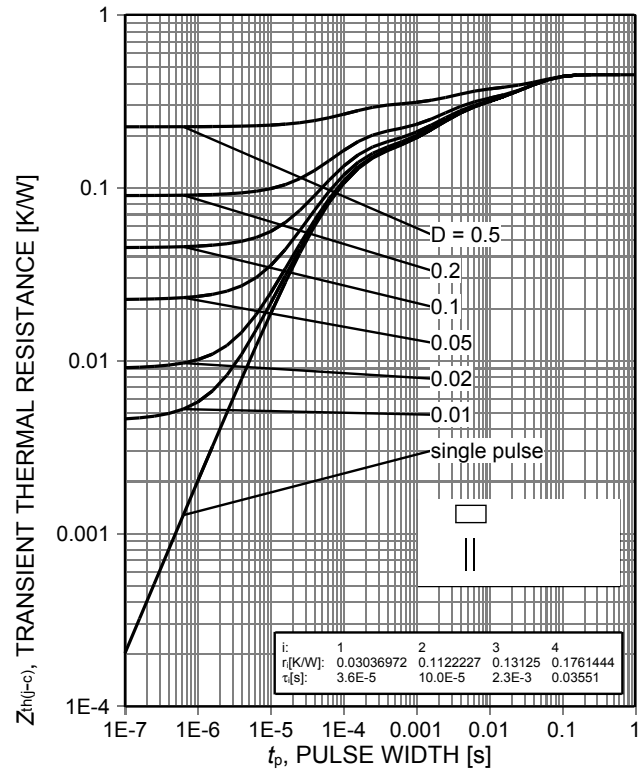


Figure 20. Diode transient thermal impedance as a function of pulse width



Figure 21. Typical diode forward current as a function of forward voltage

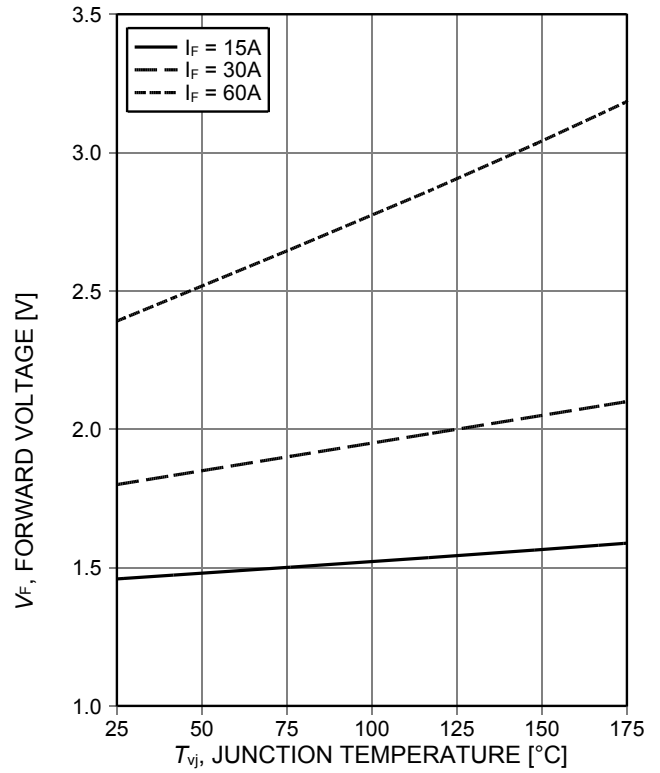


Figure 22. Typical diode forward voltage as a function of junction temperature

Package: TO-247



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	4.850	5.150	0.191	0.200
A1	2.200	2.600	0.087	0.102
b	1.000	1.400	0.039	0.055
b1	2.800	3.200	0.110	0.126
b2	1.800	2.200	0.071	0.087
c	0.500	0.700	0.020	0.028
c1	1.900	2.100	0.075	0.083
D	15.450	15.750	0.608	0.620
E1	3.500 REF		0.138 REF	
E2	3.600 REF		0.142 REF	
L	40.900	41.300	1.610	1.626
L1	24.800	25.100	0.976	0.988
L2	20.300	20.600	0.799	0.811
$\phi$	7.100	7.300	0.280	0.287
e	5.450 TYP		0.215 TYP	
H	5.980 REF		0.235 REF	
h	0.000	0.300	0.000	0.012

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