

# NGTB60N60SWG

## IGBT

This Insulated Gate Bipolar Transistor (IGBT) features a robust and cost effective Field Stop (FS) Trench construction, and provides superior performance in demanding switching applications, offering both low on state voltage and minimal switching loss. The IGBT is well suited for half bridge resonant applications. Incorporated into the device is a soft and fast co-packaged free wheeling diode with a low forward voltage.

### Features

- Low Saturation Voltage using Trench with Fieldstop Technology
- Low Switching Loss Reduces System Power Dissipation
- Low Gate Charge
- Soft, Fast Free Wheeling Diode
- These are Pb-Free Devices

### Typical Applications

- Inverter Welding

### ABSOLUTE MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-emitter voltage	$V_{CES}$	600	V
Collector current @ $T_C = 25^\circ\text{C}$ @ $T_C = 100^\circ\text{C}$	$I_C$	120 60	A
Diode forward current @ $T_C = 25^\circ\text{C}$ @ $T_C = 100^\circ\text{C}$	$I_F$	120 60	A
Pulsed collector current, $T_{\text{pulse}}$ limited by $T_{J\text{max}}$	$I_{CM}$	240	A
Diode pulsed current, $T_{\text{pulse}}$ limited by $T_{J\text{max}}$	$I_{FM}$	240	A
Gate-emitter voltage	$V_{GE}$	$\pm 20$	V
Power Dissipation @ $T_C = 25^\circ\text{C}$ @ $T_C = 100^\circ\text{C}$	$P_D$	298 119	W
Operating junction temperature range	$T_J$	-55 to +150	$^\circ\text{C}$
Storage temperature range	$T_{\text{stg}}$	-55 to +150	$^\circ\text{C}$
Lead temperature for soldering, 1/8" from case for 5 seconds	$T_{\text{SLD}}$	260	$^\circ\text{C}$

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.



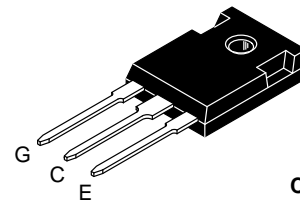
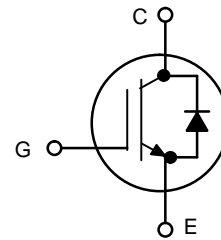
**ON Semiconductor®**

<http://onsemi.com>

**60 A, 600 V**

**$V_{CEsat} = 2.0 \text{ V}$**

**$E_{off} = 0.60 \text{ mJ}$**



**TO-247  
CASE 340L  
STYLE 4**

### MARKING DIAGRAM



- A = Assembly Location
- Y = Year
- WW = Work Week
- G = Pb-Free Package

### ORDERING INFORMATION

Device	Package	Shipping
NGTB60N60SWG	TO-247 (Pb-Free)	30 Units / Rail

# NGTB60N60SWG

## THERMAL CHARACTERISTICS

Rating	Symbol	Value	Unit
Thermal resistance junction-to-case, for IGBT	$R_{\theta JC}$	0.42	$^{\circ}\text{C}/\text{W}$
Thermal resistance junction-to-case, for Diode	$R_{\theta JC}$	1.00	$^{\circ}\text{C}/\text{W}$
Thermal resistance junction-to-ambient	$R_{\theta JA}$	40	$^{\circ}\text{C}/\text{W}$

## ELECTRICAL CHARACTERISTICS ( $T_J = 25^{\circ}\text{C}$ unless otherwise specified)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
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### STATIC CHARACTERISTIC

Collector-emitter breakdown voltage, gate-emitter short-circuited	$V_{GE} = 0\text{ V}, I_C = 500\ \mu\text{A}$	$V_{(BR)CES}$	600	-	-	V
Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}, I_C = 60\text{ A}$ $V_{GE} = 15\text{ V}, I_C = 60\text{ A}, T_J = 150^{\circ}\text{C}$	$V_{CEsat}$	-	2.0 2.6	2.5 -	V
Gate-emitter threshold voltage	$V_{GE} = V_{CE}, I_C = 150\ \mu\text{A}$	$V_{GE(th)}$	4.5	5.5	6.5	V
Collector-emitter cut-off current, gate-emitter short-circuited	$V_{GE} = 0\text{ V}, V_{CE} = 600\text{ V}$ $V_{GE} = 0\text{ V}, V_{CE} = 600\text{ V}, T_J = 150^{\circ}\text{C}$	$I_{CES}$	-	-	0.2 2	mA
Gate leakage current, collector-emitter short-circuited	$V_{GE} = 20\text{ V}, V_{CE} = 0\text{ V}$	$I_{GES}$	-	-	200	nA

### DYNAMIC CHARACTERISTIC

Input capacitance	$V_{CE} = 20\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$	$C_{ies}$	-	4112	-	pF
Output capacitance		$C_{oes}$	-	169	-	
Reverse transfer capacitance		$C_{res}$	-	107	-	
Gate charge total	$V_{CE} = 480\text{ V}, I_C = 60\text{ A}, V_{GE} = 15\text{ V}$	$Q_g$		173		nC
Gate to emitter charge		$Q_{ge}$		38		
Gate to collector charge		$Q_{gc}$		87		

### SWITCHING CHARACTERISTIC, INDUCTIVE LOAD

Turn-on delay time	$T_J = 25^{\circ}\text{C}$ $V_{CC} = 400\text{ V}, I_C = 60\text{ A}$ $R_g = 10\ \Omega$ $V_{GE} = 0\text{ V}/15\text{ V}$	$t_{d(on)}$		87		ns	
Rise time		$t_r$		48			
Turn-off delay time		$t_{d(off)}$		180			
Fall time			$t_f$		70		mJ
Turn-off switching loss		$E_{off}$		0.60			
Turn-on switching loss		$E_{on}$		1.41			
Turn-on delay time		$T_J = 150^{\circ}\text{C}$ $V_{CC} = 400\text{ V}, I_C = 60\text{ A}$ $R_g = 10\ \Omega$ $V_{GE} = 0\text{ V}/15\text{ V}$	$t_{d(on)}$		85		ns
Rise time	$t_r$			50			
Turn-off delay time	$t_{d(off)}$			186			
Fall time			$t_f$		91		mJ
Turn-off switching loss	$E_{off}$			1.11			
Turn-on switching loss	$E_{on}$			1.77			

### DIODE CHARACTERISTIC

Forward voltage	$V_{GE} = 0\text{ V}, I_F = 30\text{ A}$ $V_{GE} = 0\text{ V}, I_F = 30\text{ A}, T_J = 150^{\circ}\text{C}$	$V_F$		1.98 2.10	2.30	V
Reverse recovery time	$T_J = 25^{\circ}\text{C}$ $I_F = 30\text{ A}, V_R = 200\text{ V}$ $di_F/dt = 200\text{ A}/\mu\text{s}$	$t_{rr}$		76		ns
Reverse recovery charge		$Q_{rr}$		291		nc
Reverse recovery current		$I_{rrm}$		7		A

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

# NGTB60N60SWG

## TYPICAL CHARACTERISTICS

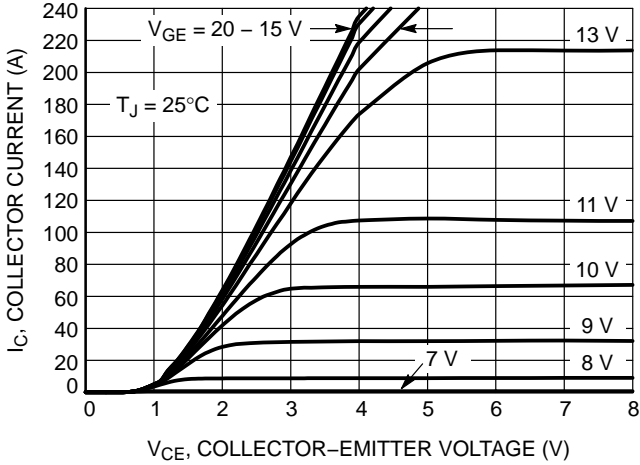


Figure 1. Output Characteristics

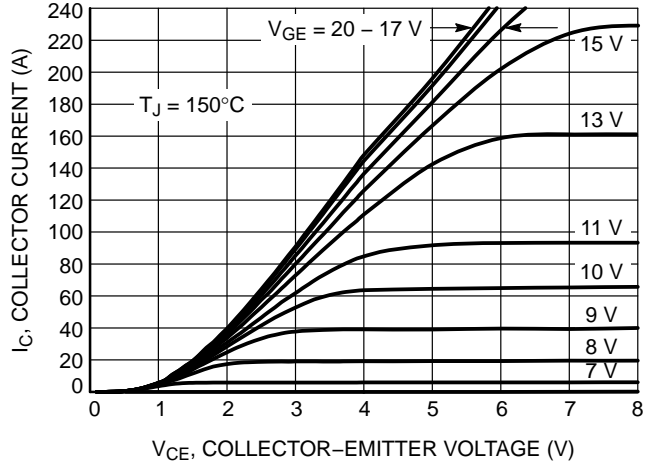


Figure 2. Output Characteristics

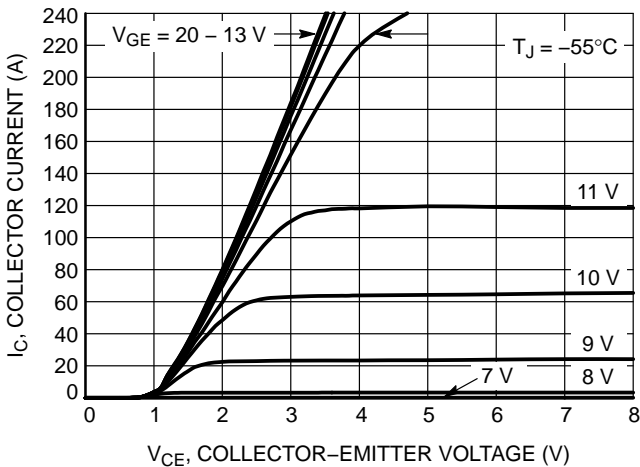


Figure 3. Output Characteristics

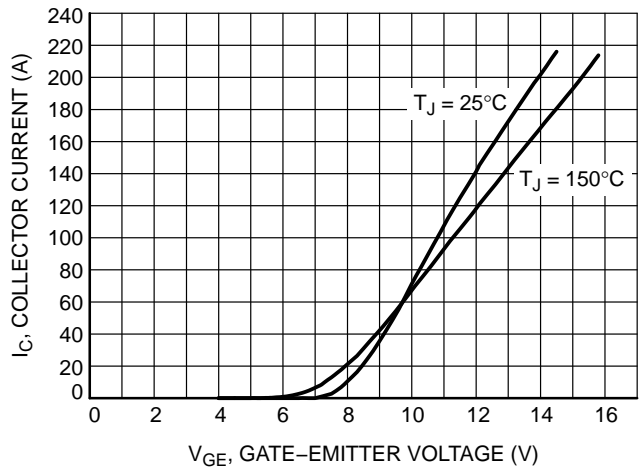


Figure 4. Typical Transfer Characteristics

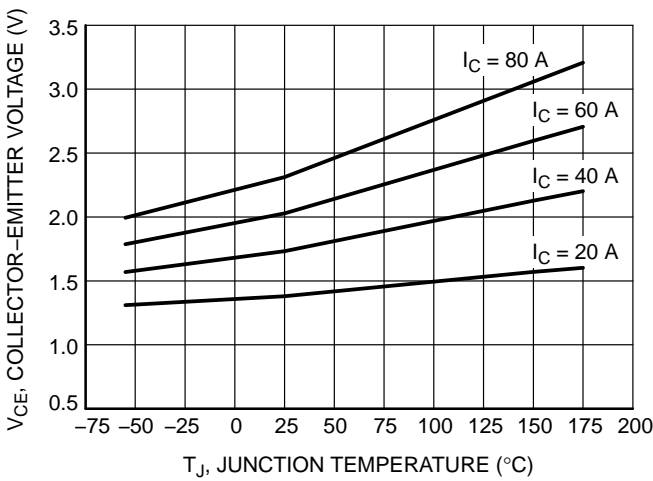


Figure 5.  $V_{CE(sat)}$  vs.  $T_J$

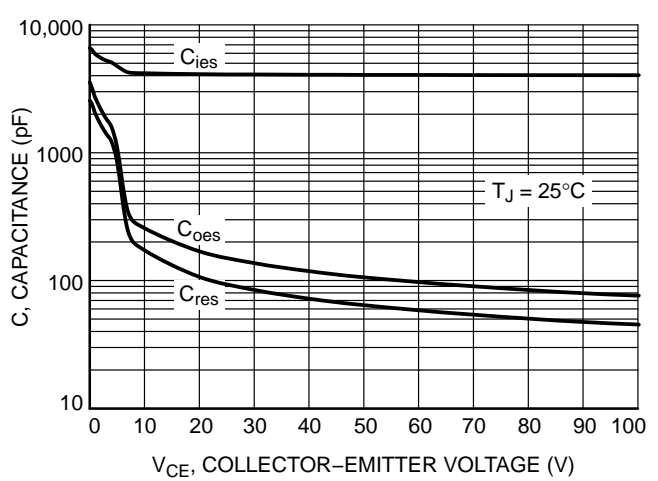


Figure 6. Typical Capacitance

# NGTB60N60SWG

## TYPICAL CHARACTERISTICS

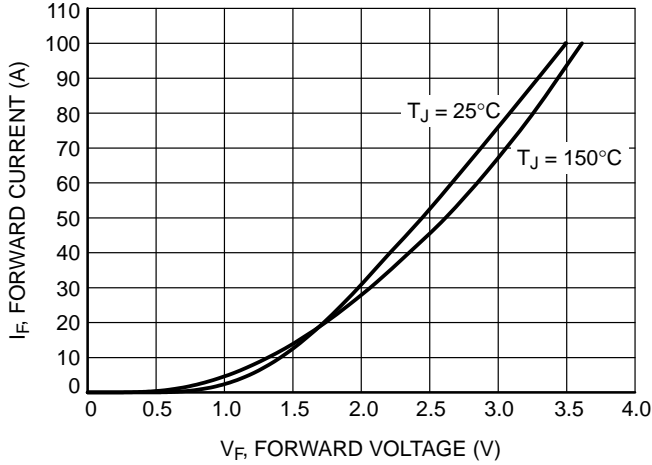


Figure 7. Diode Forward Characteristics

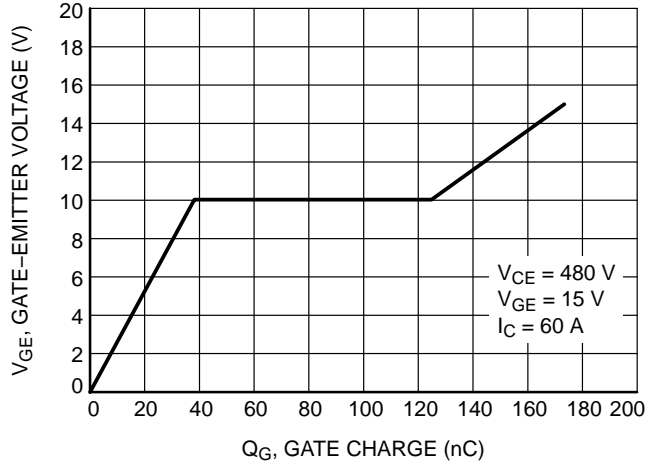


Figure 8. Typical Gate Charge

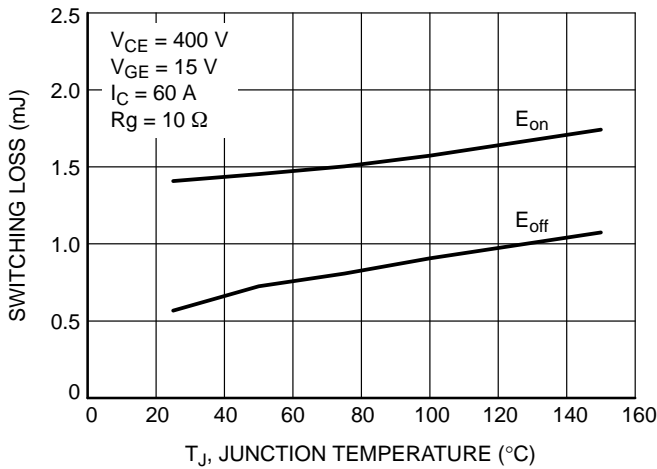


Figure 9. Switching Loss vs. Temperature

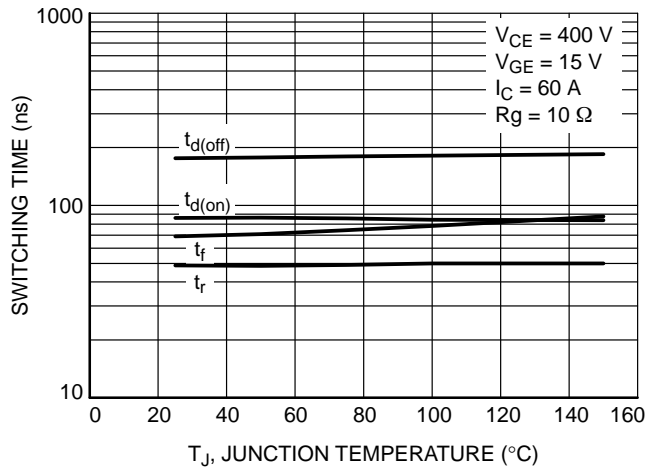


Figure 10. Switching Time vs. Temperature

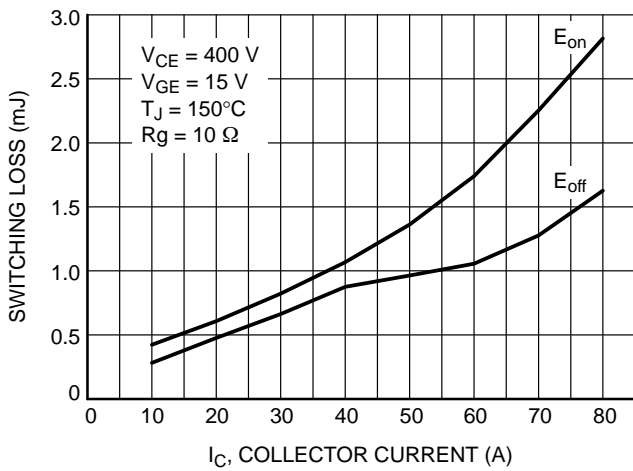


Figure 11. Switching Loss vs.  $I_C$

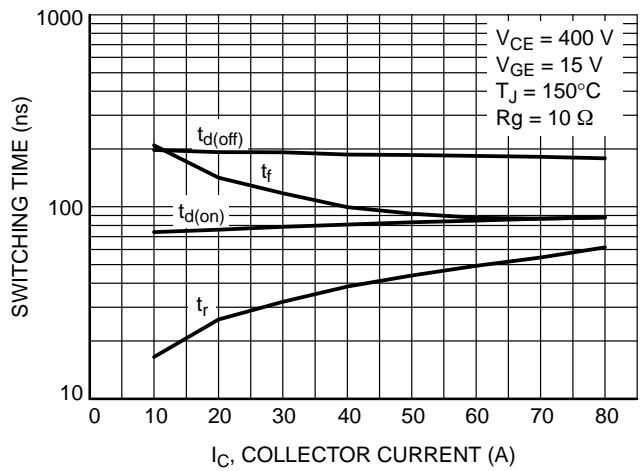


Figure 12. Switching Time vs.  $I_C$

# NGTB60N60SWG

## TYPICAL CHARACTERISTICS

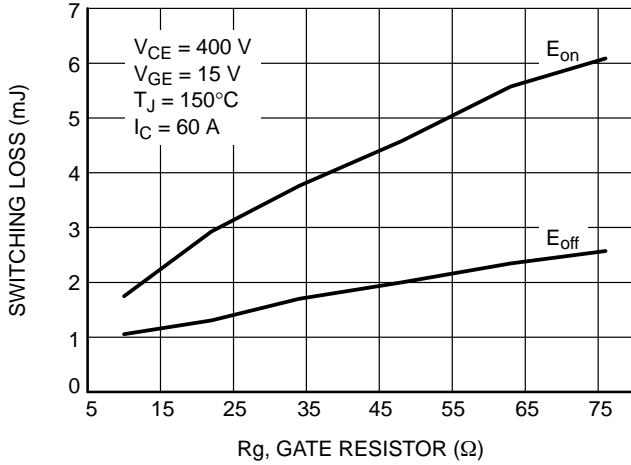


Figure 13. Switching Loss vs. Rg

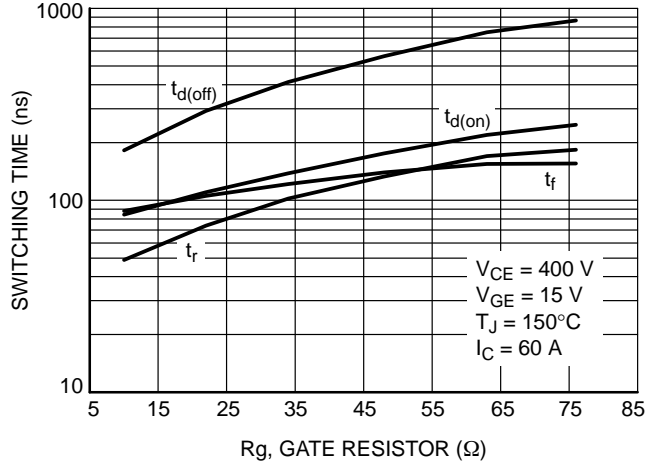


Figure 14. Switching Time vs. Rg

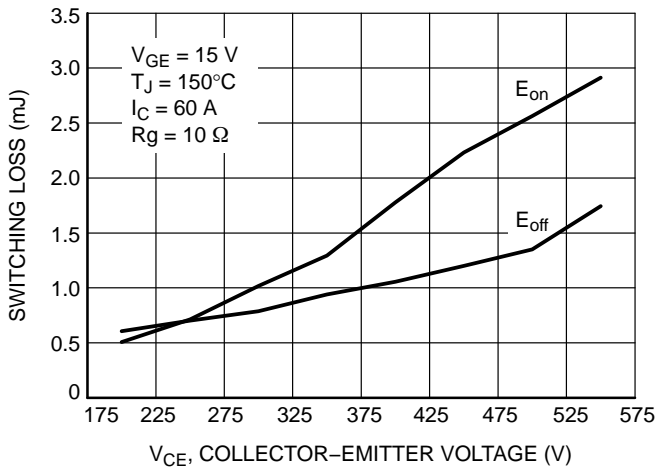


Figure 15. Switching Loss vs.  $V_{CE}$

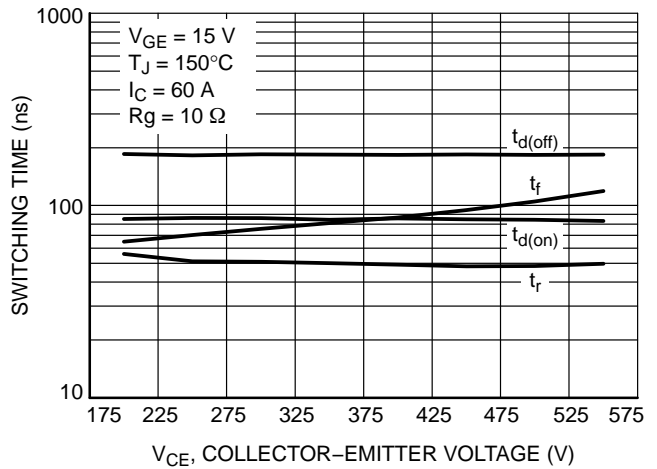


Figure 16. Switching Time vs.  $V_{CE}$

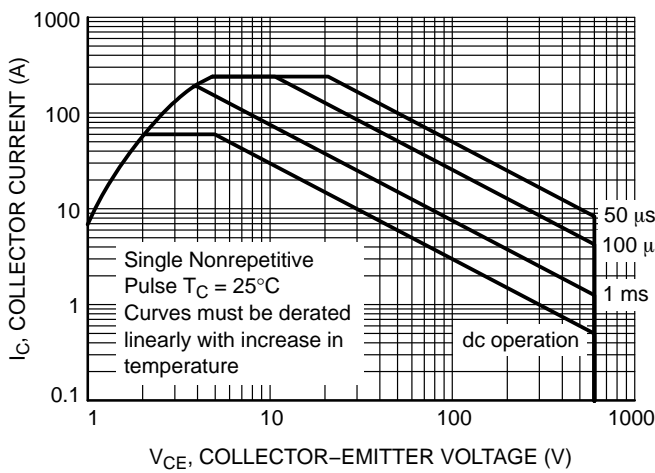


Figure 17.  $I_C$  vs.  $V_{CE}$

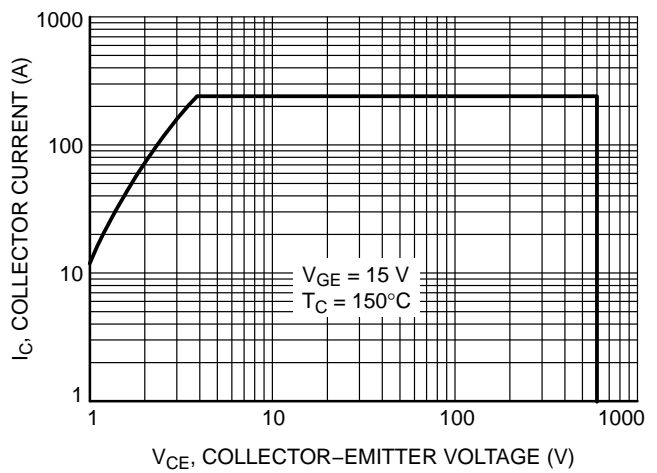


Figure 18.  $I_C$  vs.  $V_{CE}$

# NGTB60N60SWG

## TYPICAL CHARACTERISTICS

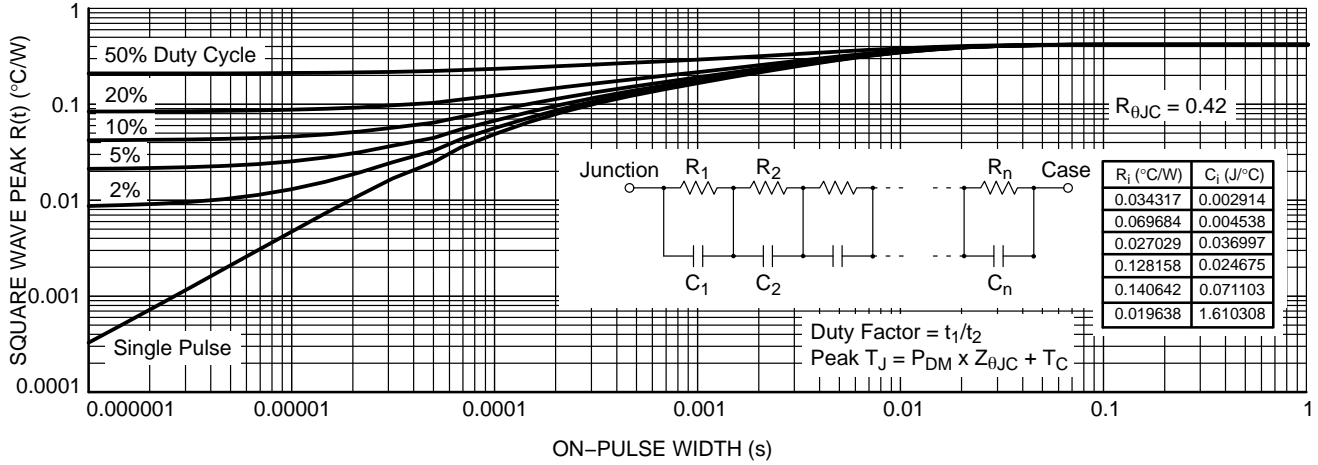


Figure 19. IGBT Transient Thermal Impedance

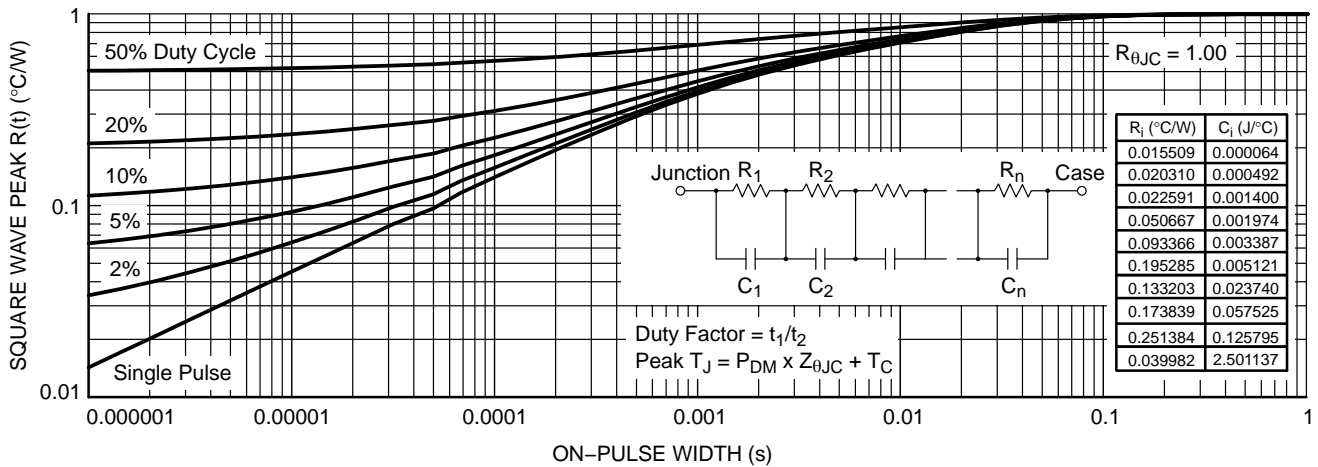
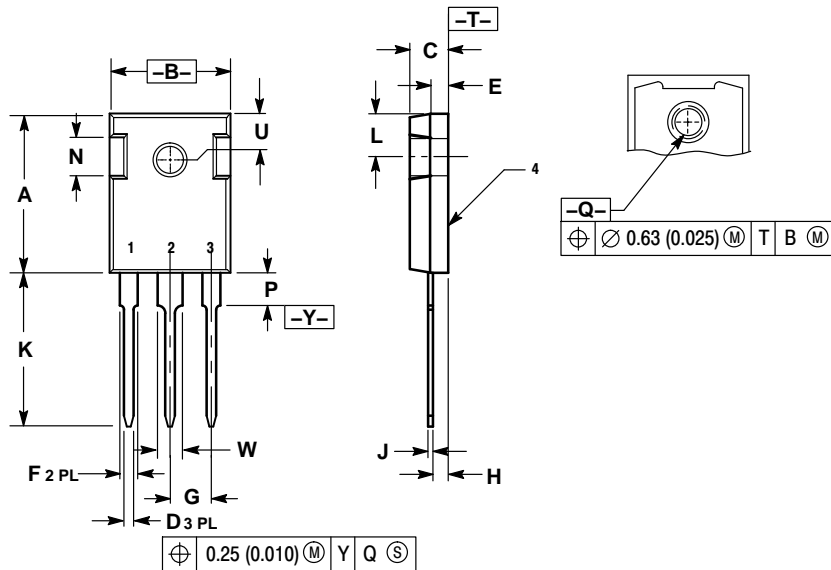


Figure 20. Diode Transient Thermal Impedance

# NGTB60N60SWG

## PACKAGE DIMENSIONS

TO-247  
CASE 340L-02  
ISSUE F



- NOTES:  
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
2. CONTROLLING DIMENSION: MILLIMETER.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	20.32	21.08	0.800	0.830
B	15.75	16.26	0.620	0.640
C	4.70	5.30	0.185	0.209
D	1.00	1.40	0.040	0.055
E	1.90	2.60	0.075	0.102
F	1.65	2.13	0.065	0.084
G	5.45 BSC		0.215 BSC	
H	1.50	2.49	0.059	0.098
J	0.40	0.80	0.016	0.031
K	19.81	20.83	0.780	0.820
L	5.40	6.20	0.212	0.244
N	4.32	5.49	0.170	0.216
P	---	4.50	---	0.177
Q	3.55	3.65	0.140	0.144
U	6.15 BSC		0.242 BSC	
W	2.87	3.12	0.113	0.123

- STYLE 4:  
PIN 1. GATE  
2. COLLECTOR  
3. EMITTER  
4. COLLECTOR

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