

# NGTB40N60FLWG

## IGBT

This Insulated Gate Bipolar Transistor (IGBT) features a robust and cost effective Trench construction, and provides superior performance in demanding switching applications, offering both low on state voltage and minimal switching loss.

### Features

- Low Saturation Voltage using Trench with Field Stop Technology
- Low Switching Loss Reduces System Power Dissipation
- Soft Fast Reverse Recovery Diode
- Optimized for High Speed Switching
- 5  $\mu$ s Short-Circuit Capability
- These are Pb-Free Devices

### Typical Applications

- Solar Inverters
- Uninterruptable Power Supply (UPS)

### ABSOLUTE MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-emitter voltage	$V_{CES}$	600	V
Collector current @ $T_C = 25^\circ\text{C}$ @ $T_C = 100^\circ\text{C}$	$I_C$	80 40	A
Pulsed collector current, $T_{\text{pulse}}$ limited by $T_{J\text{max}}$	$I_{CM}$	160	A
Diode Forward Current @ $T_C = 25^\circ\text{C}$ @ $T_C = 100^\circ\text{C}$	$I_F$	80 40	A
Diode Pulsed Current $T_{\text{pulse}}$ Limited by $T_{J\text{max}}$	$I_{FM}$	160	A
Short-circuit withstand time $V_{GE} = 15\text{ V}$ , $V_{CE} = 300\text{ V}$ , $T_J \leq +150^\circ\text{C}$	$t_{SC}$	5	$\mu\text{s}$
Gate-emitter voltage Transient Gate Emitter Voltage ( $t_p = 5\text{ }\mu\text{s}$ , $D < 0.010$ )	$V_{GE}$	$\pm 20$ $\pm 30$	V
Power Dissipation @ $T_C = 25^\circ\text{C}$ @ $T_C = 100^\circ\text{C}$	$P_D$	257 102	W
Operating junction temperature range	$T_J$	$-55$ to $+150$	$^\circ\text{C}$
Storage temperature range	$T_{stg}$	$-55$ to $+150$	$^\circ\text{C}$
Lead temperature for soldering, 1/8" from case for 5 seconds	$T_{SLD}$	260	$^\circ\text{C}$

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

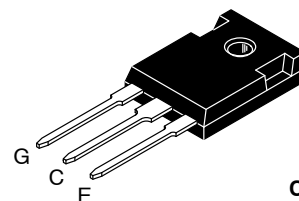
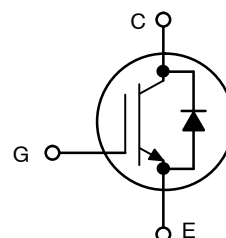


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**40 A, 600 V**

**$V_{CEsat} = 1.85\text{ V}$**



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
NGTB40N60FLWG	TO-247 (Pb-Free)	30 Units / Rail

# NGTB40N60FLWG

## THERMAL CHARACTERISTICS

Rating	Symbol	Value	Unit
Thermal resistance junction-to-case, for IGBT	$R_{\theta JC}$	0.470	$^{\circ}\text{C/W}$
Thermal resistance junction-to-case, for Diode	$R_{\theta JC}$	1.06	$^{\circ}\text{C/W}$
Thermal resistance junction-to-ambient	$R_{\theta JA}$	40	$^{\circ}\text{C/W}$

## 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	$V_{GE} = 0\text{ V}, I_C = 500\text{ }\mu\text{A}$	$V_{(BR)CES}$	600	–	–	V
Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}, I_C = 40\text{ A}$ $V_{GE} = 15\text{ V}, I_C = 40\text{ A}, T_J = 150^{\circ}\text{C}$	$V_{CEsat}$	1.6 –	1.85 2.3	2.1 –	V
Gate-emitter threshold voltage	$V_{GE} = V_{CE}, I_C = 200\text{ }\mu\text{A}$	$V_{GE(th)}$	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	$V_{GE} = 20\text{ V}, V_{CE} = 0\text{ V}$	$I_{GES}$	–	–	100	nA

### DYNAMIC CHARACTERISTIC

Input capacitance	$V_{CE} = 20\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$	$C_{ies}$	–	4200	–	pF
Output capacitance		$C_{oes}$	–	170	–	
Reverse transfer capacitance		$C_{res}$	–	110	–	
Gate charge total	$V_{CE} = 480\text{ V}, I_C = 40\text{ A}, V_{GE} = 15\text{ V}$	$Q_g$	–	171	–	nC
Gate to emitter charge		$Q_{ge}$	–	36	–	
Gate to collector charge		$Q_{gc}$	–	83	–	

### SWITCHING CHARACTERISTIC, INDUCTIVE LOAD

Turn-on delay time	$T_J = 25^{\circ}\text{C}$ $V_{CC} = 400\text{ V}, I_C = 40\text{ A}$ $R_g = 10\text{ }\Omega$ $V_{GE} = 0\text{ V}/15\text{ V}$	$t_{d(on)}$	–	85	–	ns
Rise time		$t_r$	–	37	–	
Turn-off delay time		$t_{d(off)}$	–	174	–	
Fall time		$t_f$	–	73	–	
Turn-on switching loss		$E_{on}$	–	0.89	–	mJ
Turn-off switching loss		$E_{off}$	–	0.44	–	
Total switching loss		$E_{ts}$	–	1.33	–	
Turn-on delay time	$T_J = 150^{\circ}\text{C}$ $V_{CC} = 400\text{ V}, I_C = 40\text{ A}$ $R_g = 10\text{ }\Omega$ $V_{GE} = 0\text{ V}/15\text{ V}$	$t_{d(on)}$	–	82	–	ns
Rise time		$t_r$	–	38	–	
Turn-off delay time		$t_{d(off)}$	–	179	–	
Fall time		$t_f$	–	95	–	
Turn-on switching loss		$E_{on}$	–	1.10	–	mJ
Turn-off switching loss		$E_{off}$	–	0.84	–	
Total switching loss		$E_{ts}$	–	1.94	–	

# NGTB40N60FLWG

## ELECTRICAL CHARACTERISTICS (T<sub>J</sub> = 25°C unless otherwise specified)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
<b>DIODE CHARACTERISTIC</b>						
Forward voltage	V <sub>GE</sub> = 0 V, I <sub>F</sub> = 40 A V <sub>GE</sub> = 0 V, I <sub>F</sub> = 40 A, T <sub>J</sub> = 150°C	V <sub>F</sub>	1.55 –	2.2 2.3	2.60 –	V
Reverse recovery time	T <sub>J</sub> = 25°C I <sub>F</sub> = 40 A, V <sub>R</sub> = 200 V di <sub>F</sub> /dt = 200 A/μs	t <sub>rr</sub>	–	77	–	ns
Reverse recovery charge		Q <sub>rr</sub>	–	0.35	–	μC
Reverse recovery current		I <sub>rrm</sub>	–	7	–	A

TYPICAL CHARACTERISTICS

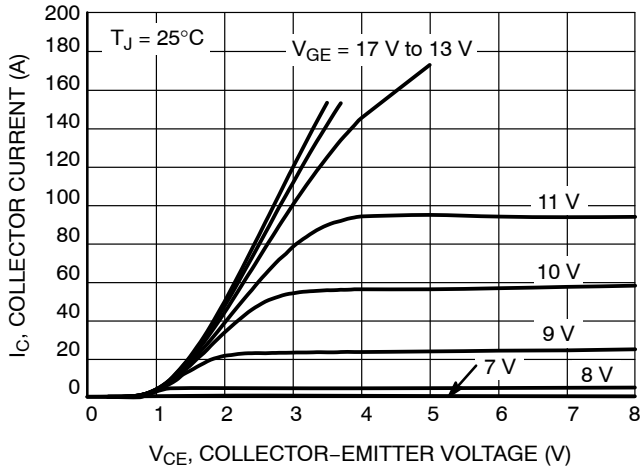


Figure 1. Output Characteristics

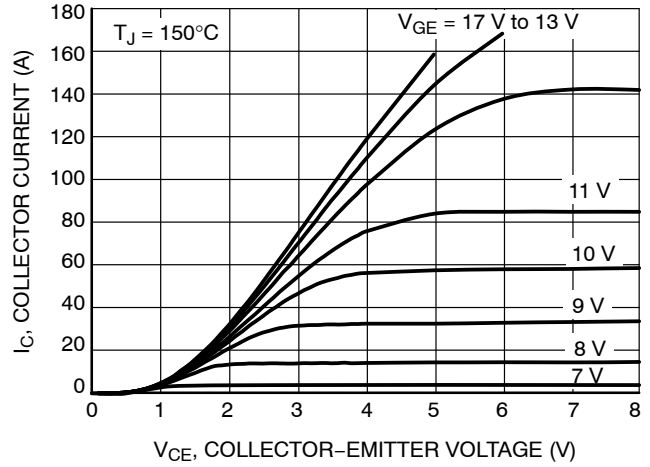


Figure 2. Output Characteristics

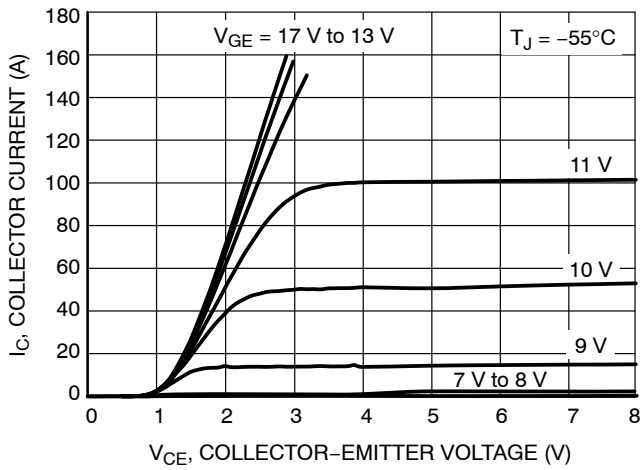


Figure 3. Output Characteristics

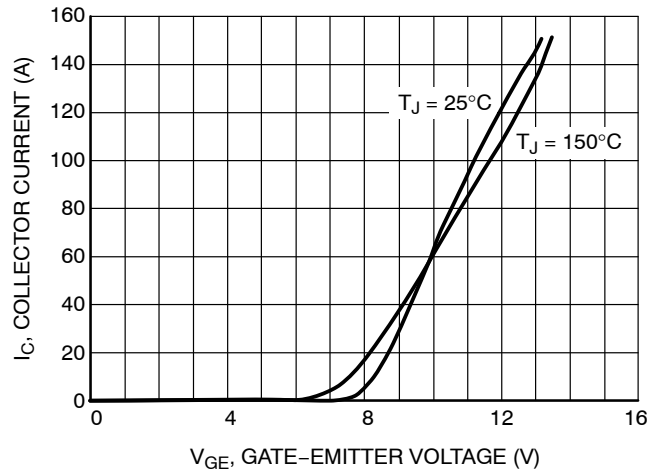


Figure 4. Typical Transfer Characteristics

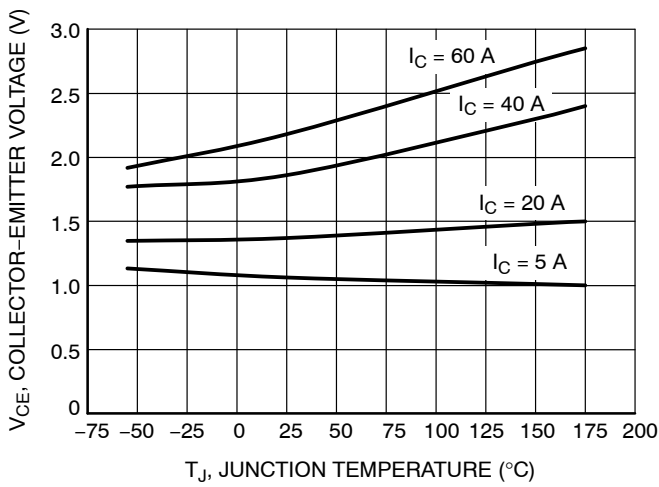


Figure 5.  $V_{CE(sat)}$  vs.  $T_J$

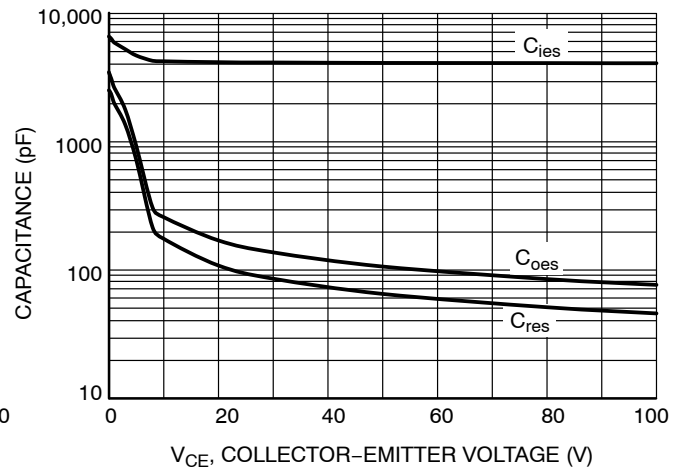


Figure 6. Typical Capacitance

# NGTB40N60FLWG

## TYPICAL CHARACTERISTICS

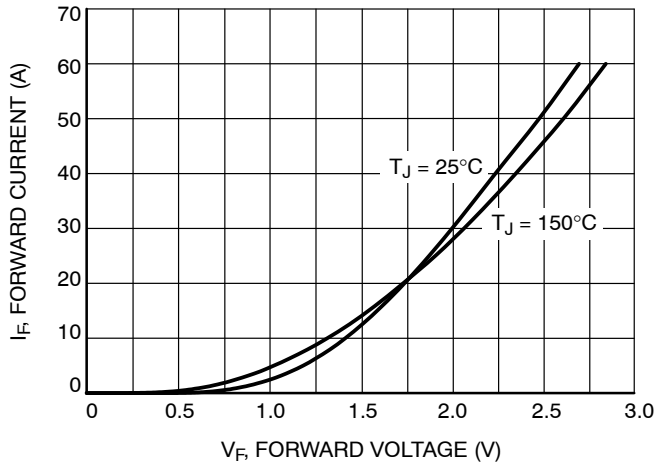


Figure 7. Diode Forward Characteristics

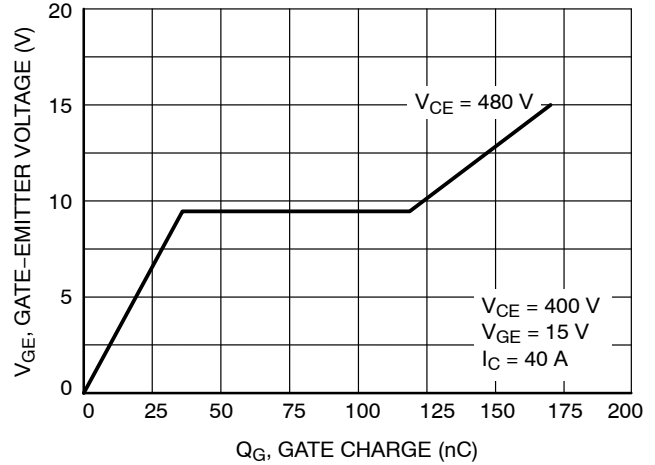


Figure 8. Typical Gate Charge

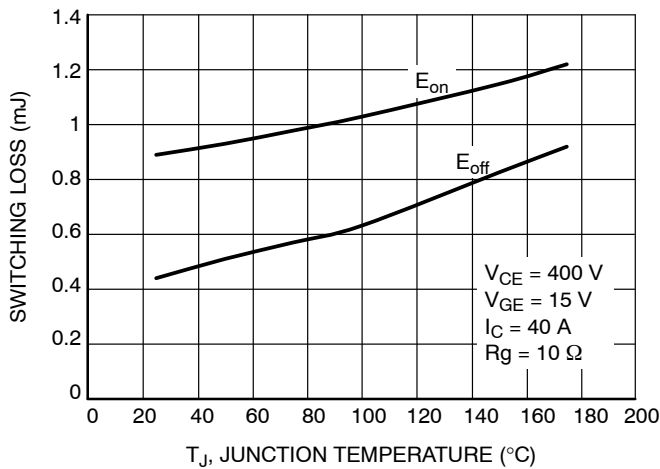


Figure 9. Switching Loss vs. Temperature

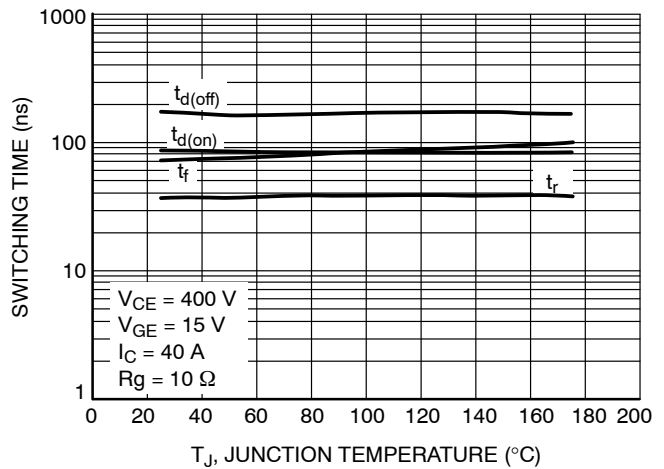


Figure 10. Switching Time vs. Temperature

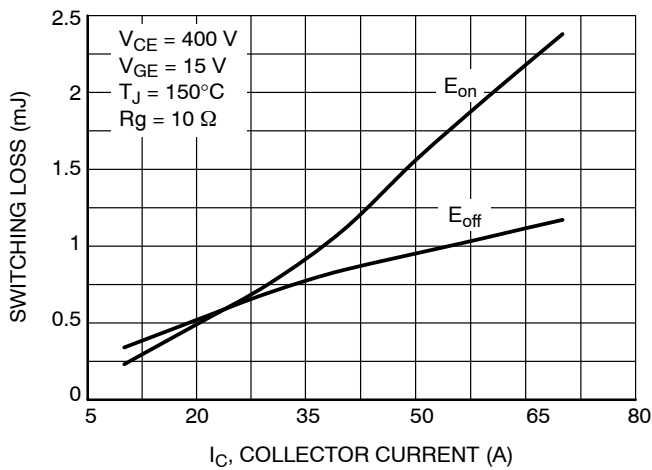


Figure 11. Switching Loss vs.  $I_C$

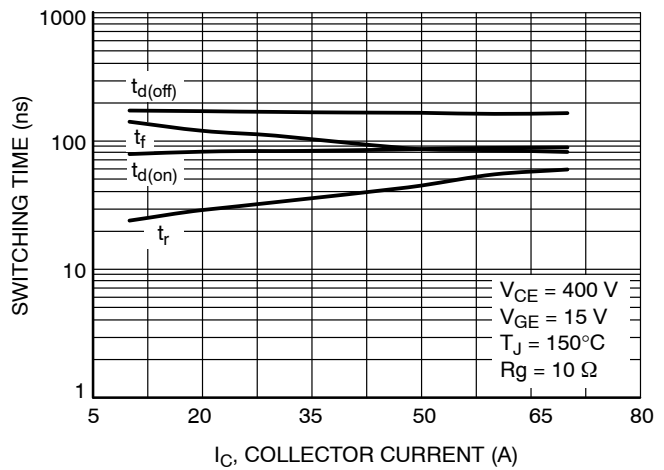


Figure 12. Switching Time vs.  $I_C$

TYPICAL CHARACTERISTICS

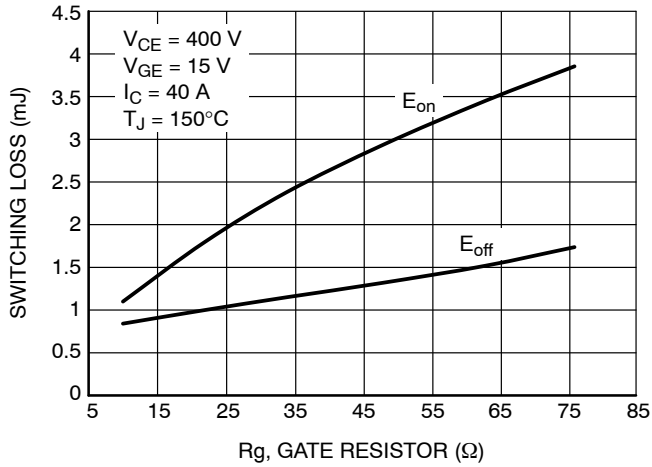


Figure 13. Switching Loss vs.  $R_g$

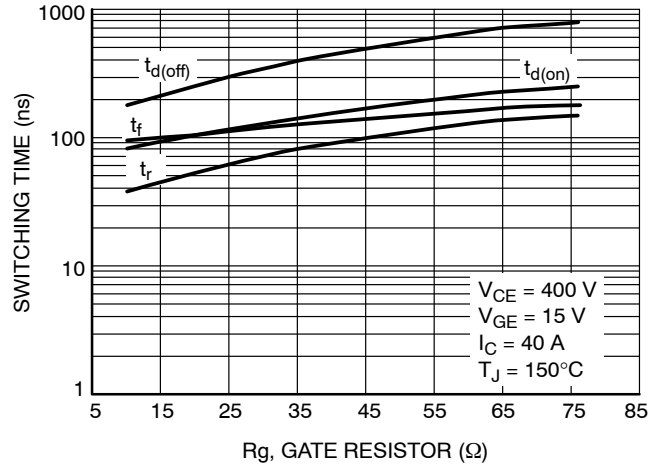


Figure 14. Switching Time vs.  $R_g$

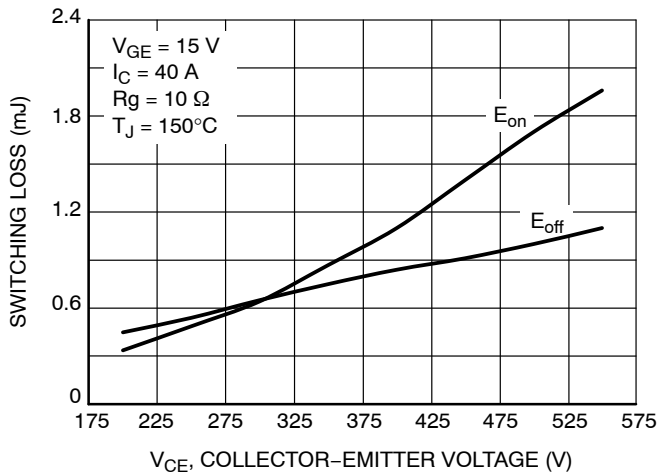


Figure 15. Switching Loss vs.  $V_{CE}$

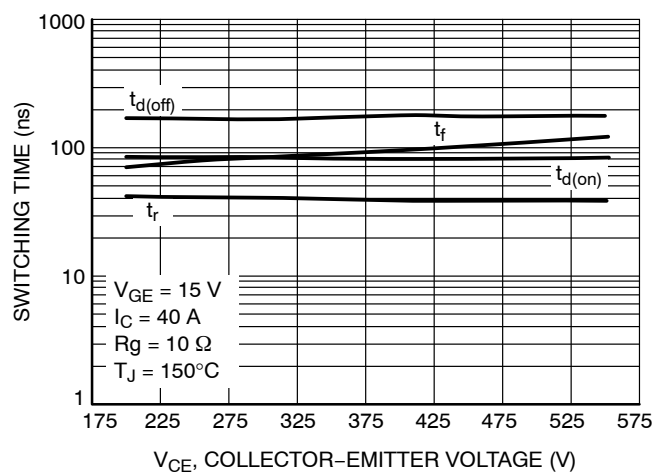


Figure 16. Switching Time vs.  $V_{CE}$

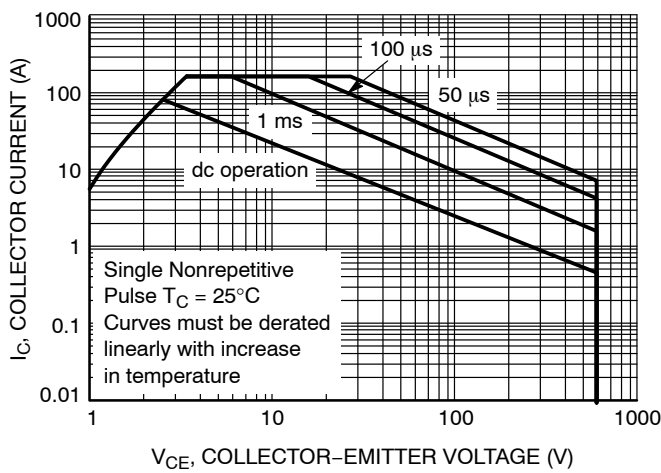


Figure 17. Safe Operating Area

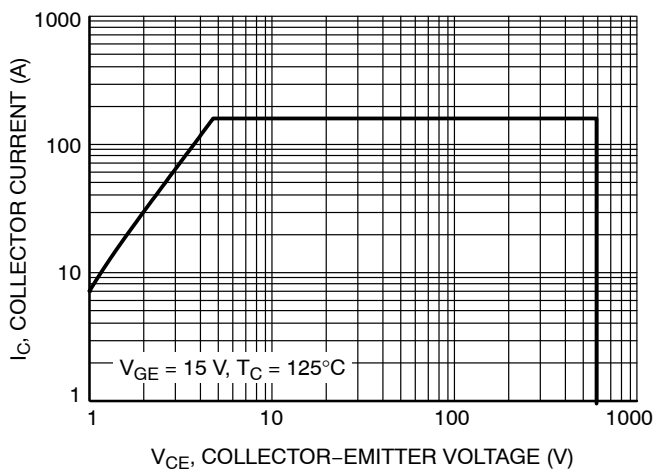


Figure 18. Reverse Bias Safe Operating Area

# NGTB40N60FLWG

## TYPICAL CHARACTERISTICS

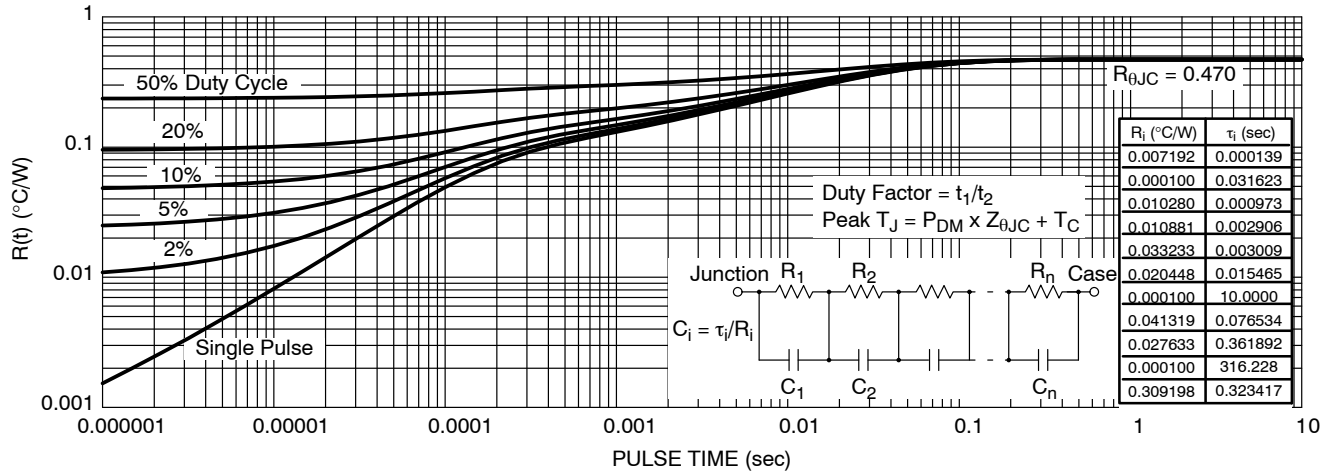


Figure 19. IGBT Transient Thermal Impedance

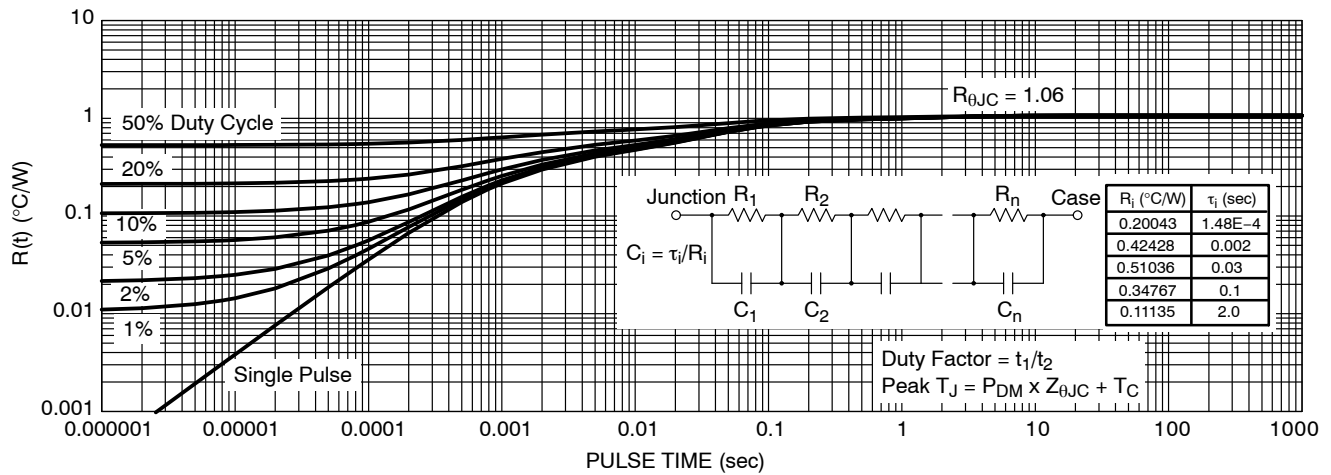


Figure 20. Diode Transient Thermal Impedance

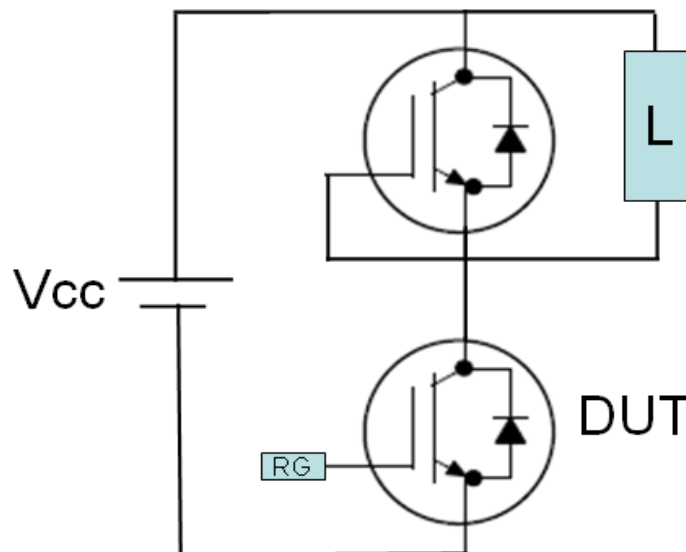
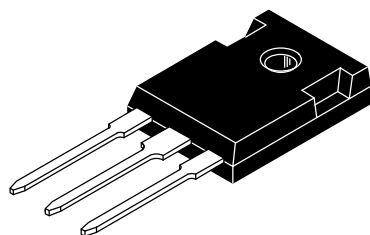


Figure 21. Test Circuit for Switching Characteristics

# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

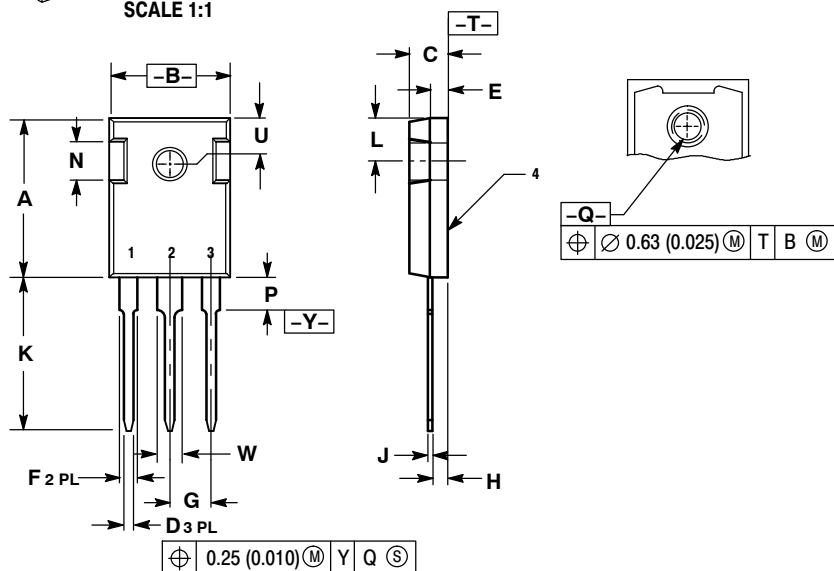
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SCALE 1:1

TO-247  
CASE 340L-02  
ISSUE F

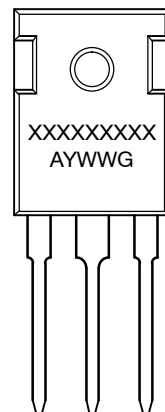
DATE 26 OCT 2011



- 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

## GENERIC MARKING DIAGRAM\*



XXXXXX = Specific Device Code  
A = Assembly Location  
Y = Year  
WW = Work Week  
G = Pb-Free Package

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present.

- STYLE 1:  
PIN 1. GATE  
2. DRAIN  
3. SOURCE  
4. DRAIN
- STYLE 2:  
PIN 1. ANODE  
2. CATHODE (S)  
3. ANODE 2  
4. CATHODES (S)
- STYLE 3:  
PIN 1. BASE  
2. COLLECTOR  
3. EMITTER  
4. COLLECTOR
- STYLE 4:  
PIN 1. GATE  
2. COLLECTOR  
3. EMITTER  
4. COLLECTOR
- STYLE 5:  
PIN 1. CATHODE  
2. ANODE  
3. GATE  
4. ANODE
- STYLE 6:  
PIN 1. MAIN TERMINAL 1  
2. MAIN TERMINAL 2  
3. GATE  
4. MAIN TERMINAL 2

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STATUS:	ON SEMICONDUCTOR STANDARD	
NEW STANDARD:		
DESCRIPTION:	TO-247	
		PAGE 1 OF 2



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