

# NGTB40N120LWG

## 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 resonant or soft switching applications. Incorporated into the device is a rugged co-packaged free wheeling diode with a low forward voltage.

### Features

- Low Saturation Voltage using Trench with Field Stop Technology
- Low Switching Loss Reduces System Power Dissipation
- Low Gate Charge
- 5  $\mu$ s Short-Circuit Capability
- These are Pb-Free Devices

### Typical Applications

- Inverter Welding Machines
- Microwave Ovens
- Industrial Switching
- Motor Control Inverter

### ABSOLUTE MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-emitter voltage	$V_{CES}$	1200	V
Collector current @ $T_c = 25^\circ\text{C}$ @ $T_c = 100^\circ\text{C}$	$I_C$	80 40	A
Pulsed collector current, $T_{pulse}$ limited by $T_{Jmax}$	$I_{CM}$	320	A
Diode forward current @ $T_c = 25^\circ\text{C}$ @ $T_c = 100^\circ\text{C}$	$I_F$	80 40	A
Diode pulsed current, $T_{pulse}$ limited by $T_{Jmax}$	$I_{FM}$	320	A
Gate-emitter voltage	$V_{GE}$	$\pm 20$	V
Power Dissipation @ $T_c = 25^\circ\text{C}$ @ $T_c = 100^\circ\text{C}$	$P_D$	260 104	W
Short-Circuit Withstand Time $V_{GE} = 15\text{ V}$ , $V_{CE} = 600\text{ V}$ , $T_J \leq 150^\circ\text{C}$	$T_{sc}$	5	$\mu\text{s}$
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	$^\circ\text{C}$

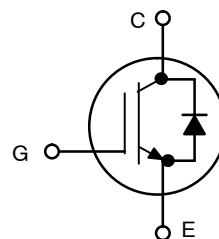
Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.



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**40 A, 1200 V**  
 **$V_{CEsat} = 1.90\text{ V}$**   
 **$E_{off} = 1.40\text{ mJ}$**



**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
NGTB40N120LWG	TO-247 (Pb-Free)	30 Units / Rail

# NGTB40N120LWG

## THERMAL CHARACTERISTICS

Rating	Symbol	Value	Unit
Thermal resistance junction-to-case, for IGBT	$R_{\theta JC}$	0.48	°C/W
Thermal resistance junction-to-case, for Diode	$R_{\theta JC}$	1.5	°C/W
Thermal resistance junction-to-ambient	$R_{\theta JA}$	40	°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	$V_{GE} = 0\text{ V}, I_C = 500\ \mu\text{A}$	$V_{(BR)CES}$	1200	-	-	V
Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}, I_C = 40\text{ A}$ $V_{GE} = 15\text{ V}, I_C = 25\text{ A}, T_J = 150^\circ\text{C}$	$V_{CEsat}$	1.45 -	1.90 2.1	2.35 -	V
Gate-emitter threshold voltage	$V_{GE} = V_{CE}, I_C = 400\ \mu\text{A}$	$V_{GE(th)}$	4.5	5.5	6.5	V
Collector-emitter cut-off current, gate-emitter short-circuited	$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}$ $V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_J = 150^\circ\text{C}$	$I_{CES}$	-	-	0.5 2.0	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	$V_{CE} = 20\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$	$C_{ies}$	-	10,400	-	pF
Output capacitance		$C_{oes}$	-	245	-	
Reverse transfer capacitance		$C_{res}$	-	185	-	
Gate charge total	$V_{CE} = 600\text{ V}, I_C = 40\text{ A}, V_{GE} = 15\text{ V}$	$Q_g$	-	420	-	nC
Gate to emitter charge		$Q_{ge}$	-	95	-	
Gate to collector charge		$Q_{gc}$	-	178	-	

### SWITCHING CHARACTERISTIC, INDUCTIVE LOAD

Turn-on delay time	$T_J = 25^\circ\text{C}$ $V_{CC} = 600\text{ V}, I_C = 40\text{ A}$ $R_g = 10\ \Omega$ $V_{GE} = 0\text{ V}/15\text{ V}$	$t_{d(on)}$	-	140	-	ns
Rise time		$t_r$	-	40	-	
Turn-off delay time		$t_{d(off)}$	-	360	-	
Fall time		$t_f$	-	132	-	mJ
Turn-on switching loss		$E_{on}$	-	5.5	-	
Turn-off switching loss	$E_{off}$	-	1.40	-		
Turn-on delay time	$T_J = 125^\circ\text{C}$ $V_{CC} = 600\text{ V}, I_C = 40\text{ A}$ $R_g = 10\ \Omega$ $V_{GE} = 0\text{ V}/15\text{ V}$	$t_{d(on)}$	-	134	-	ns
Rise time		$t_r$	-	44	-	
Turn-off delay time		$t_{d(off)}$	-	380	-	
Fall time		$t_f$	-	185	-	mJ
Turn-on switching loss		$E_{on}$	-	6.8	-	
Turn-off switching loss	$E_{off}$	-	2.6	-		

### DIODE CHARACTERISTIC

Forward voltage	$V_{GE} = 0\text{ V}, I_F = 40\text{ A}$ $V_{GE} = 0\text{ V}, I_F = 40\text{ A}, T_J = 150^\circ\text{C}$	$V_F$	-	1.6 1.8	1.8 -	V
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# NGTB40N120LWG

## TYPICAL CHARACTERISTICS

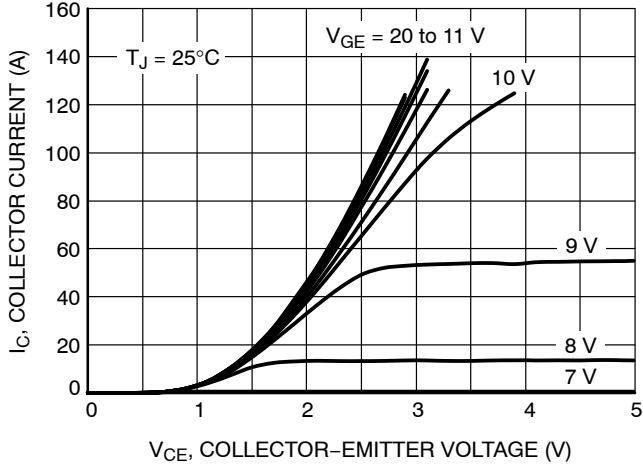


Figure 1. Output Characteristics

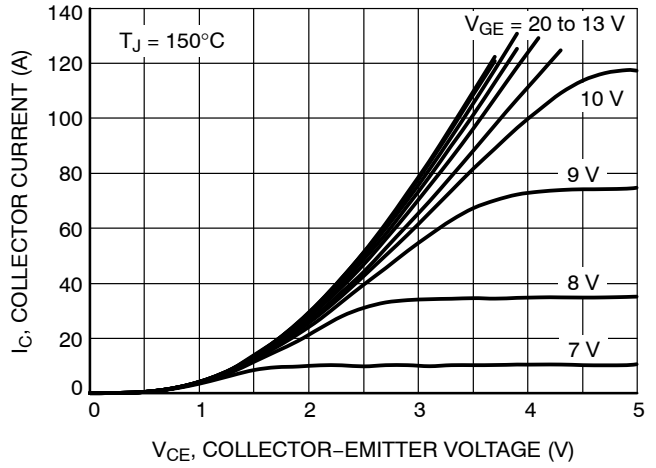


Figure 2. Output Characteristics

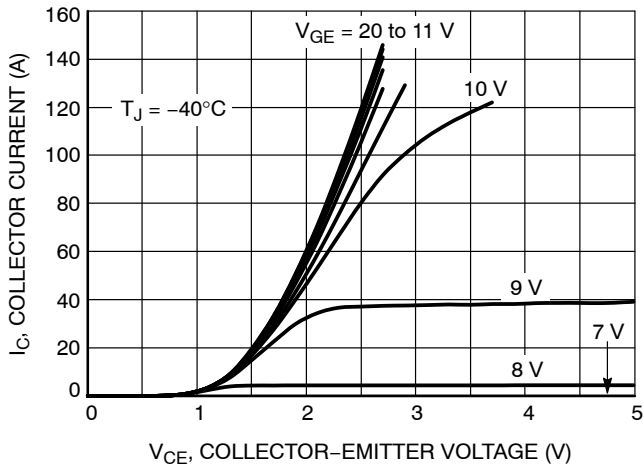


Figure 3. Output Characteristics

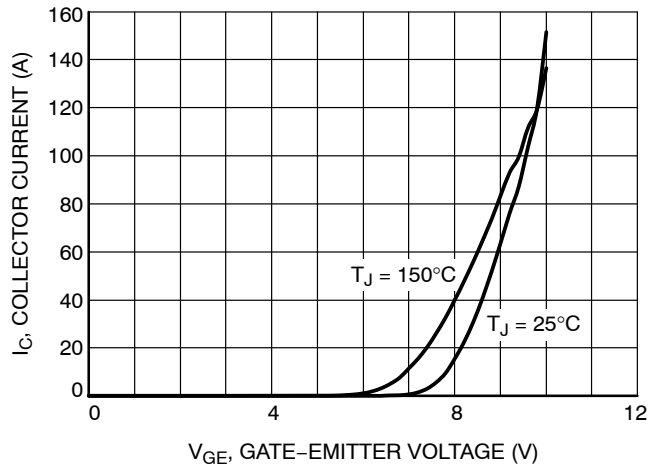


Figure 4. Typical Transfer Characteristics

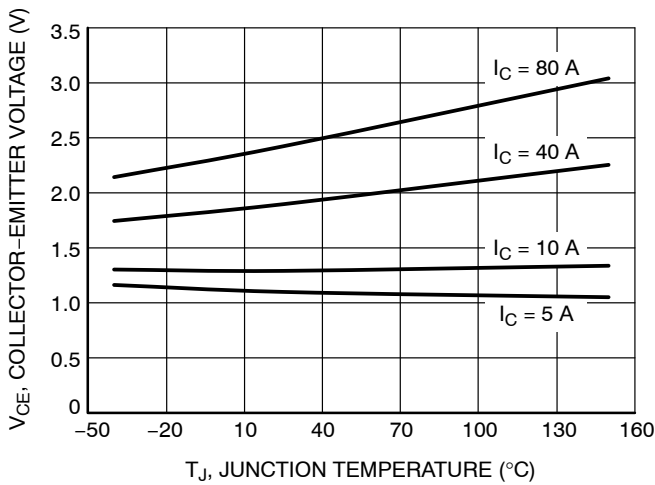


Figure 5.  $V_{CE(sat)}$  vs.  $T_J$

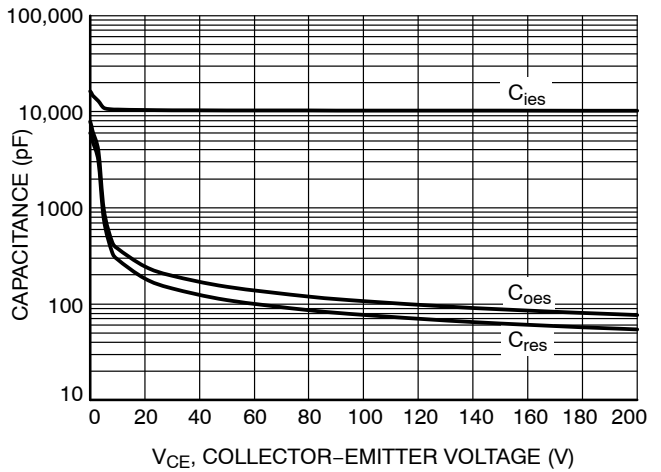


Figure 6. Typical Capacitance

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## TYPICAL CHARACTERISTICS

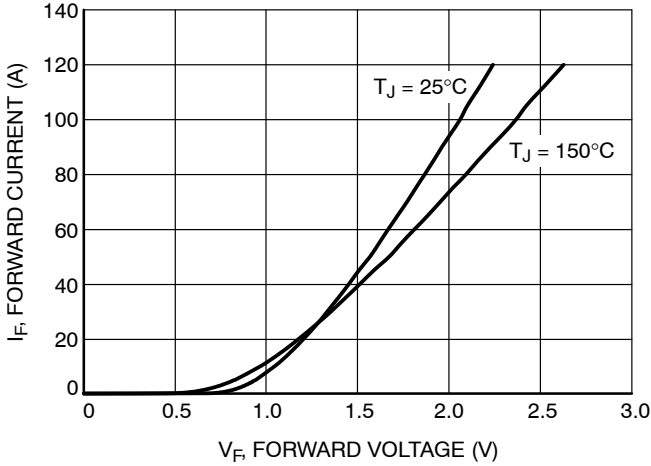


Figure 7. Diode Forward Characteristics

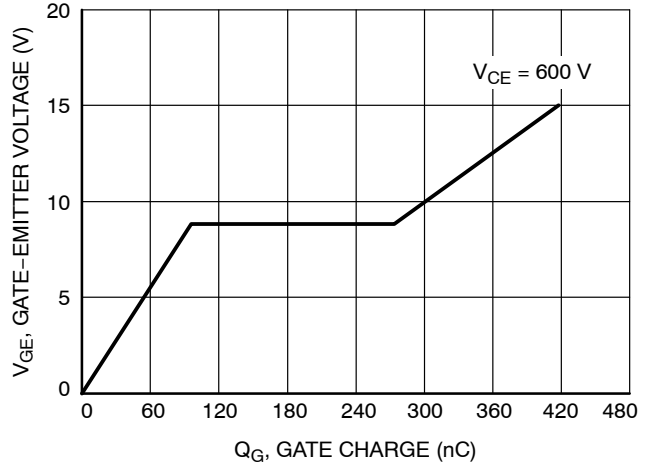


Figure 8. Typical Gate Charge

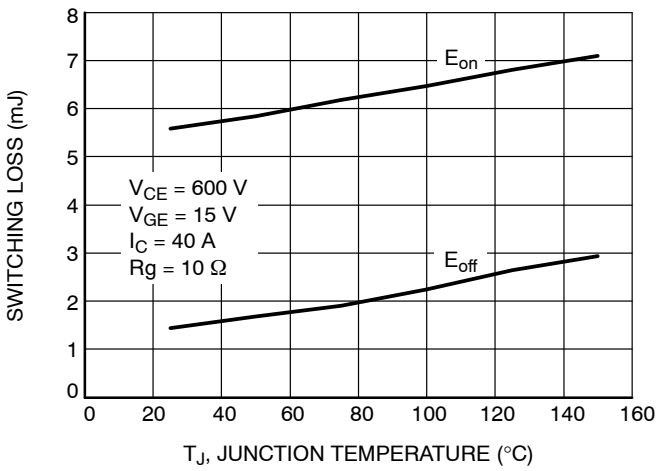


Figure 9. Switching Loss vs. Temperature

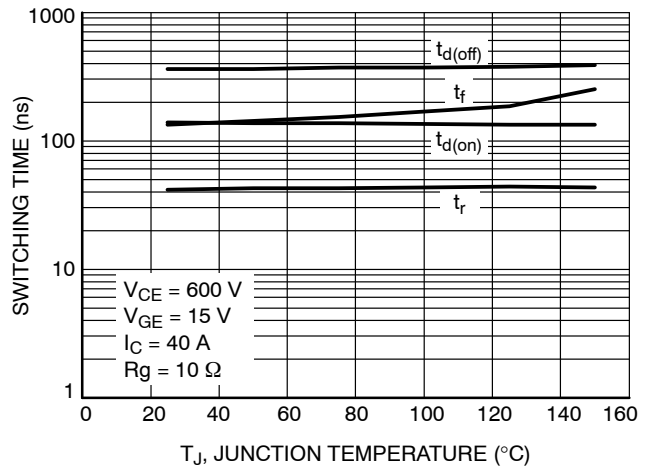


Figure 10. Switching Time vs. Temperature

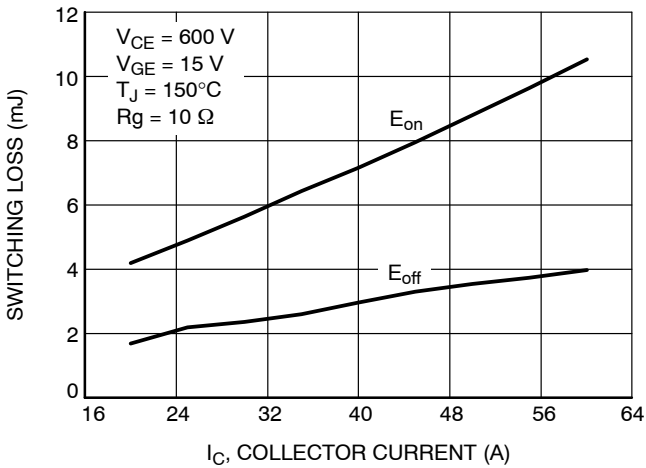


Figure 11. Switching Loss vs.  $I_C$

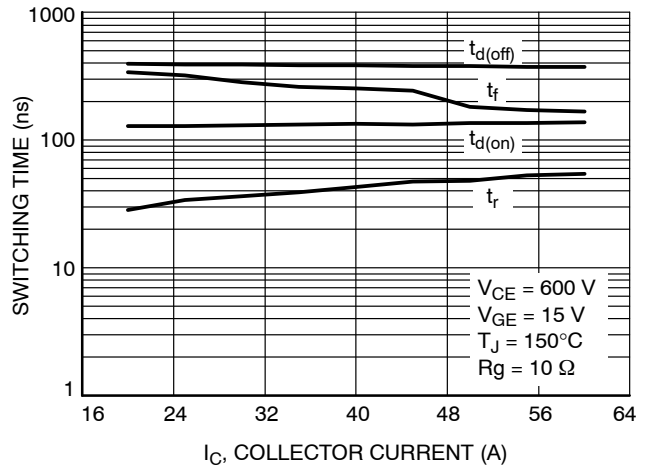


Figure 12. Switching Time vs.  $I_C$

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## TYPICAL CHARACTERISTICS

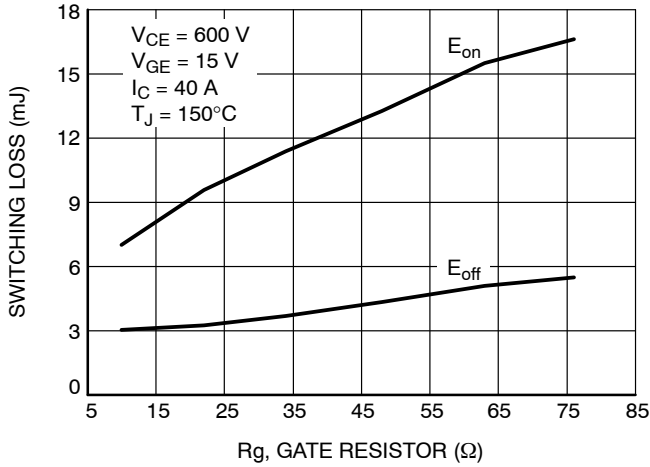


Figure 13. Switching Loss vs. Rg

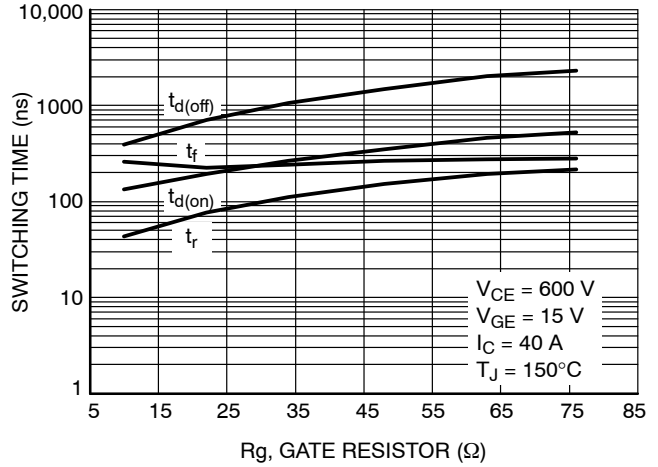


Figure 14. Switching Time vs. Rg

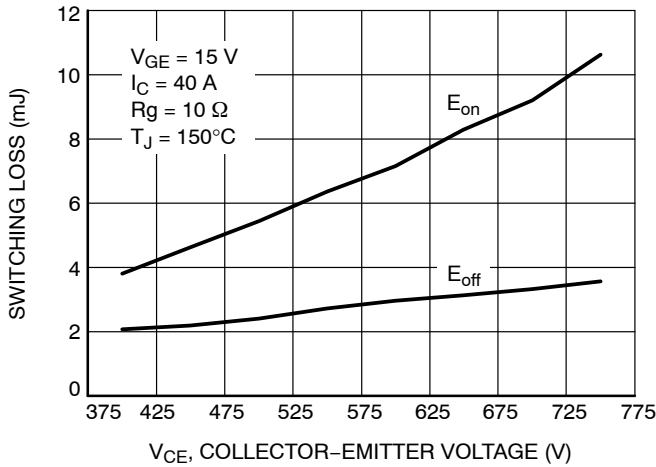


Figure 15. Switching Loss vs.  $V_{CE}$

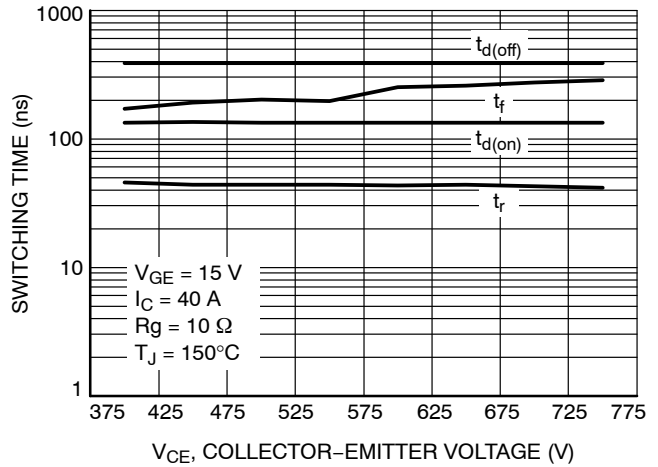


Figure 16. Switching Time vs.  $V_{CE}$

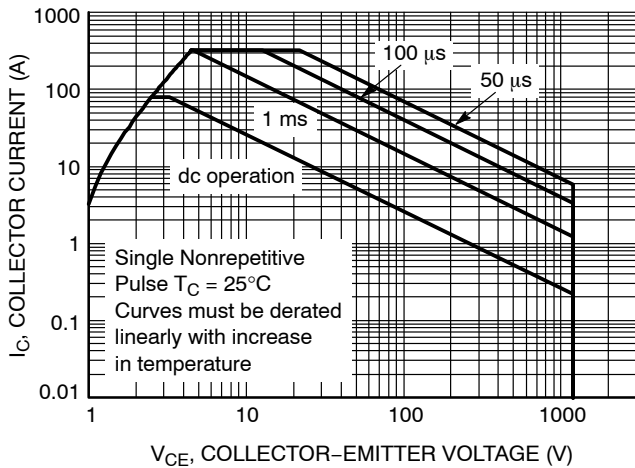


Figure 17. Safe Operating Area

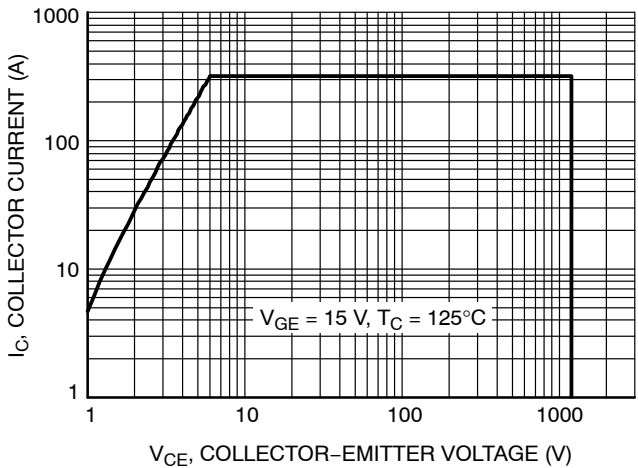


Figure 18. Reverse Bias Safe Operating Area

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## TYPICAL CHARACTERISTICS

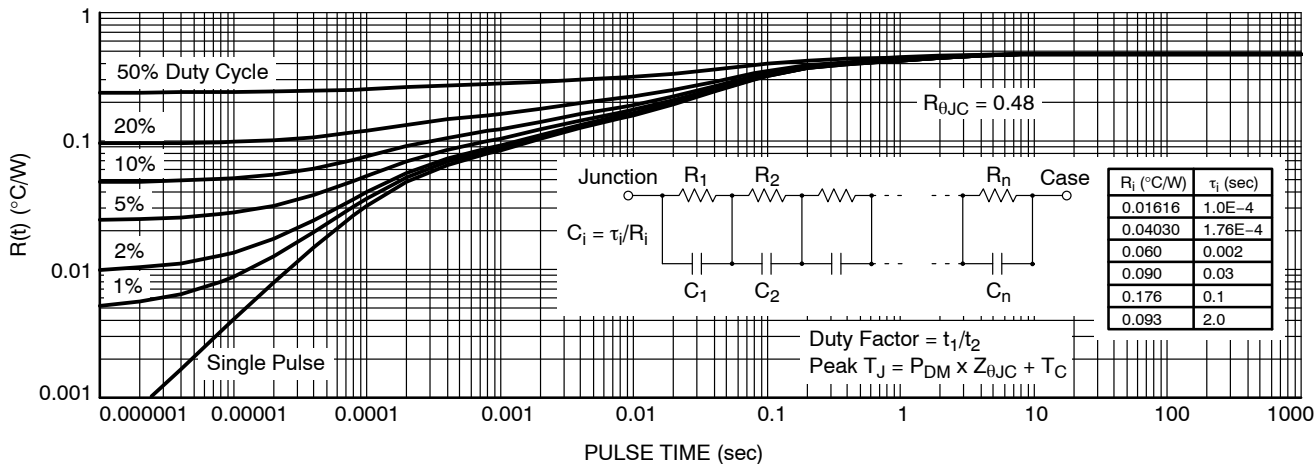


Figure 19. IGBT Transient Thermal Impedance

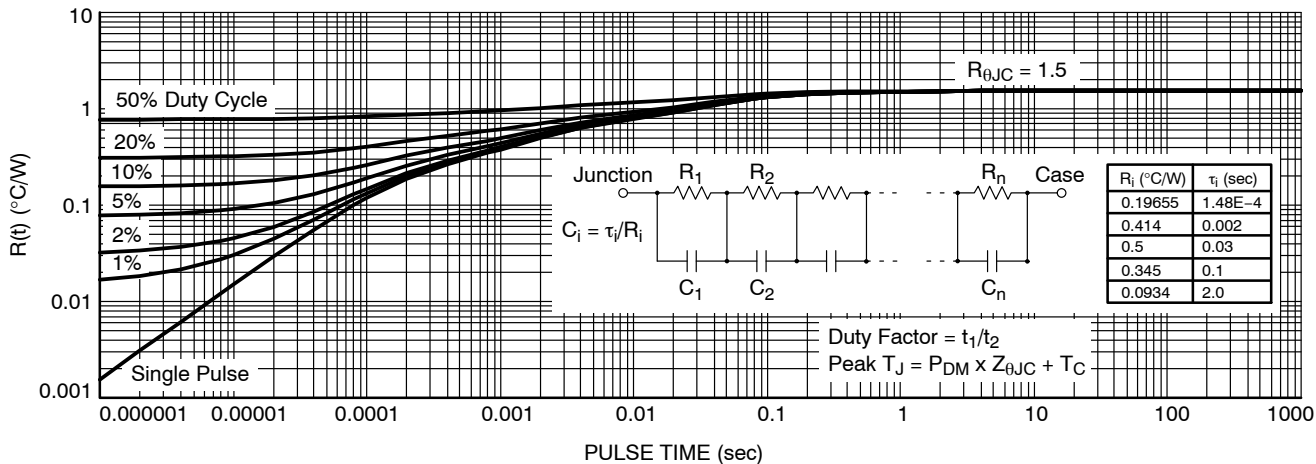


Figure 20. Diode Transient Thermal Impedance

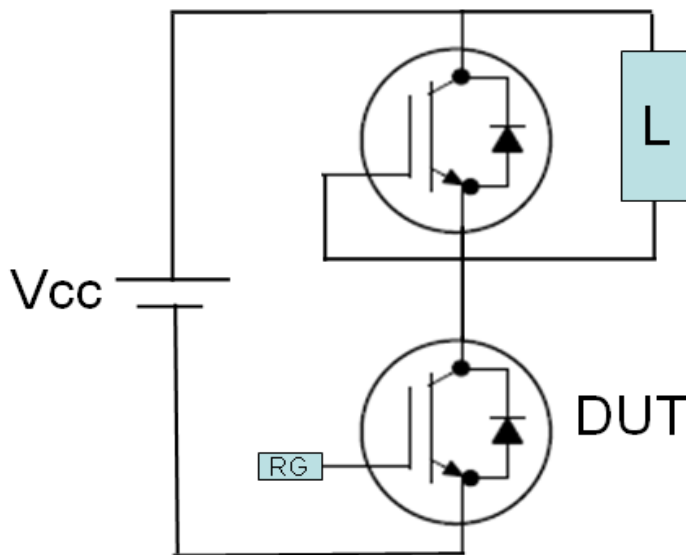


Figure 21. Test Circuit for Switching Characteristics

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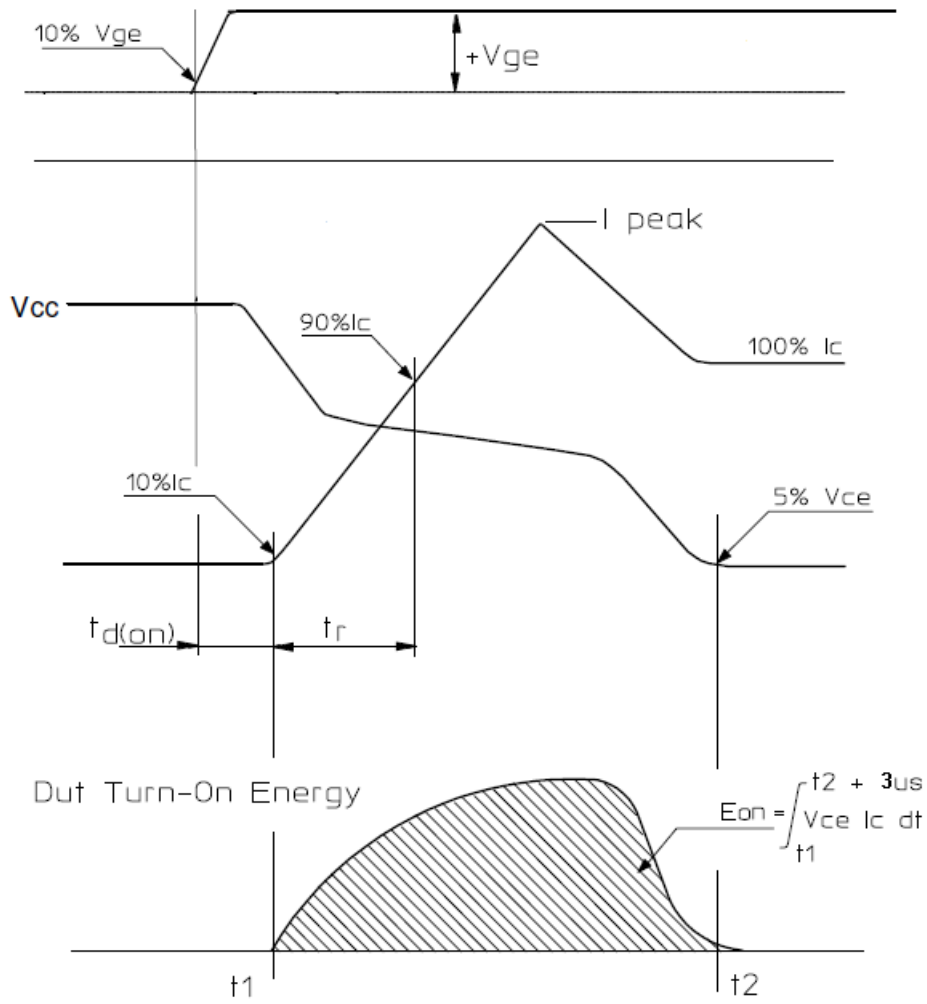


Figure 22. Definition of Turn On Waveform



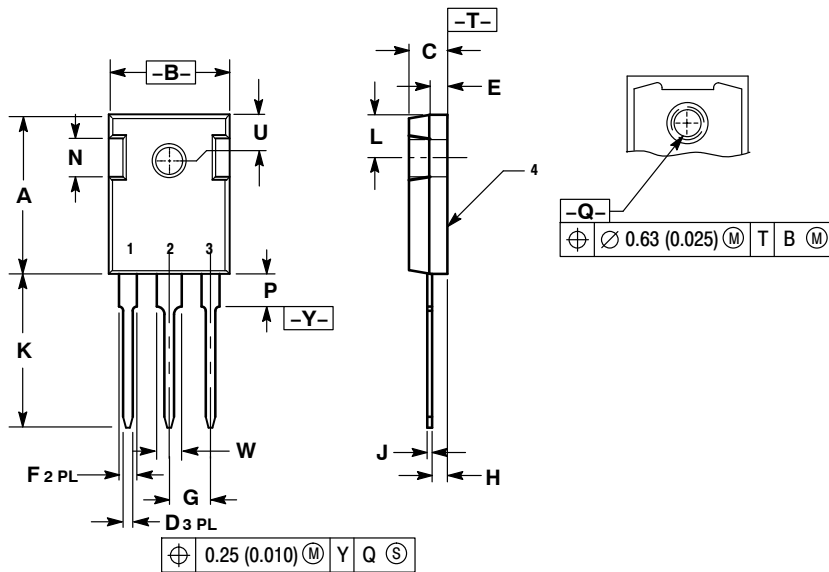
Figure 23. Definition of Turn Off Waveform



# NGTB40N120LWG

## 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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