

# NGTB20N120LWG

## 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 Fieldstop 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 @ $T_c = 25^\circ\text{C}$ @ $T_c = 100^\circ\text{C}$	$I_C$	40 20	A
Pulsed collector current, $T_{pulse}$ limited by $T_{Jmax}$	$I_{CM}$	200	A
Diode forward current @ $T_c = 25^\circ\text{C}$ @ $T_c = 100^\circ\text{C}$	$I_F$	40 20	A
Diode pulsed current, $T_{pulse}$ limited by $T_{Jmax}$	$I_{FM}$	200	A
Gate-emitter voltage	$V_{GE}$	$\pm 20$	V
Power Dissipation @ $T_c = 25^\circ\text{C}$ @ $T_c = 100^\circ\text{C}$	$P_D$	192 77	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	$^\circ\text{C}$

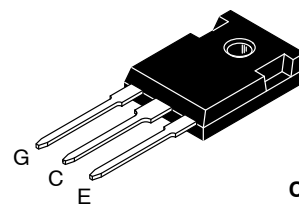
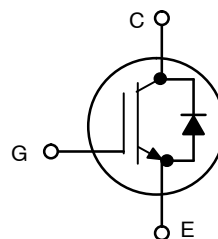
Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.



ON Semiconductor®

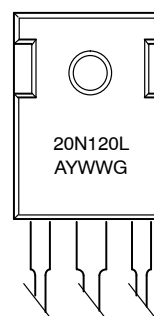
<http://onsemi.com>

20 A, 1200 V  
 $V_{CEsat} = 1.80\text{ V}$   
 $E_{off} = 0.7\text{ mJ}$



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
NGTB20N120LWG	TO-247 (Pb-Free)	30 Units / Rail

# NGTB20N120LWG

## THERMAL CHARACTERISTICS

Rating	Symbol	Value	Unit
Thermal resistance junction-to-case, for IGBT	$R_{\theta JC}$	0.65	°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
-----------	-----------------	--------	-----	-----	-----	------

### 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	$V_{GE} = 15\text{ V}, I_C = 20\text{ A}$ $V_{GE} = 15\text{ V}, I_C = 20\text{ A}, T_J = 150^\circ\text{C}$	$V_{CEsat}$	-	1.80 2.0	2.2 -	V
Gate-emitter threshold voltage	$V_{GE} = V_{CE}, I_C = 250\ \mu\text{A}$	$V_{GE(th)}$	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	$V_{GE} = 20\text{ V}, V_{CE} = 0\text{ V}$	$I_{GES}$	-	-	100	nA

### DYNAMIC CHARACTERISTIC

Input capacitance	$V_{CE} = 20\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$	$C_{ies}$	-	4700	-	pF
Output capacitance		$C_{oes}$	-	155	-	
Reverse transfer capacitance		$C_{res}$	-	100	-	
Gate charge total	$V_{CE} = 600\text{ V}, I_C = 20\text{ A}, V_{GE} = 15\text{ V}$	$Q_g$		200		nC
Gate to emitter charge		$Q_{ge}$		36		
Gate to collector charge		$Q_{gc}$		98		

### SWITCHING CHARACTERISTIC, INDUCTIVE LOAD

Turn-on delay time	$T_J = 25^\circ\text{C}$ $V_{CC} = 600\text{ V}, I_C = 20\text{ A}$ $R_g = 10\ \Omega$ $V_{GE} = 0\text{ V}/15\text{ V}$	$t_{d(on)}$		86		ns	
Rise time		$t_r$		26			
Turn-off delay time		$t_{d(off)}$		235			
Fall time			$t_f$		180		mJ
Turn-on switching loss			$E_{on}$		3.1		
Turn-off switching loss			$E_{off}$		0.7		
Turn-on delay time	$T_J = 125^\circ\text{C}$ $V_{CC} = 600\text{ V}, I_C = 20\text{ A}$ $R_g = 10\ \Omega$ $V_{GE} = 0\text{ V}/15\text{ V}$	$t_{d(on)}$		84		ns	
Rise time		$t_r$		26			
Turn-off delay time		$t_{d(off)}$		235			
Fall time			$t_f$		250		mJ
Turn-on switching loss			$E_{on}$		3.9		
Turn-off switching loss			$E_{off}$		1.3		

### DIODE CHARACTERISTIC

Forward voltage	$V_{GE} = 0\text{ V}, I_F = 20\text{ A}$ $V_{GE} = 0\text{ V}, I_F = 20\text{ A}, T_J = 150^\circ\text{C}$	$V_F$		1.55 1.65	1.75	V
-----------------	---	-------	--	--------------	------	---

# NGTB20N120LWG

## TYPICAL CHARACTERISTICS

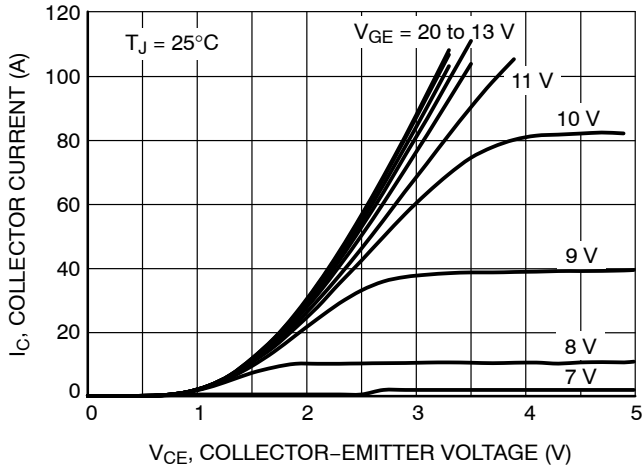


Figure 1. Output Characteristics

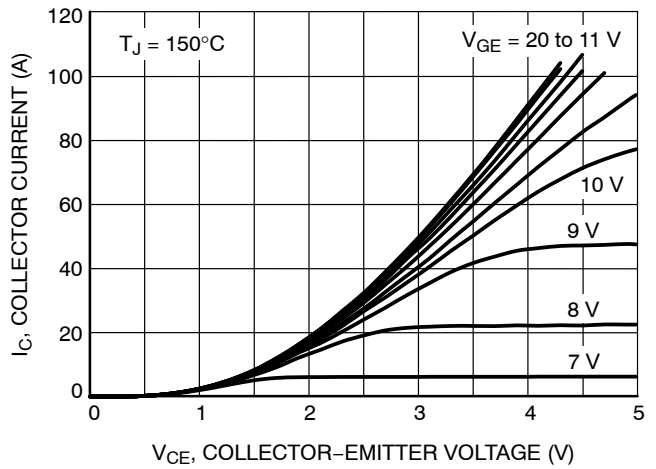


Figure 2. Output Characteristics

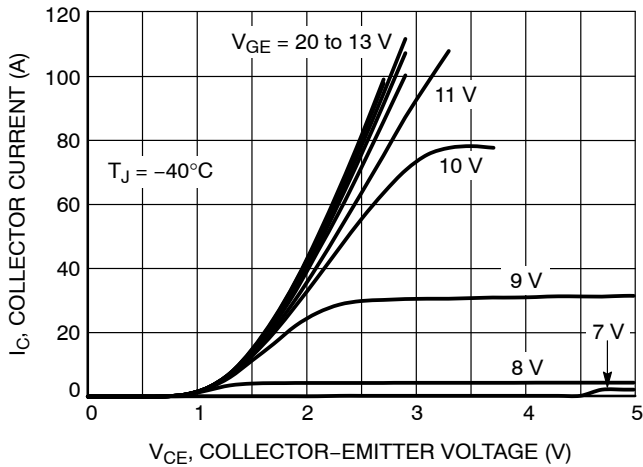


Figure 3. Output Characteristics

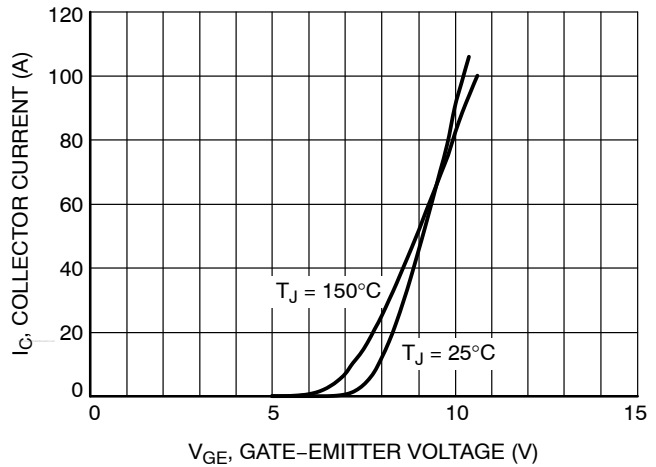


Figure 4. Typical Transfer Characteristics

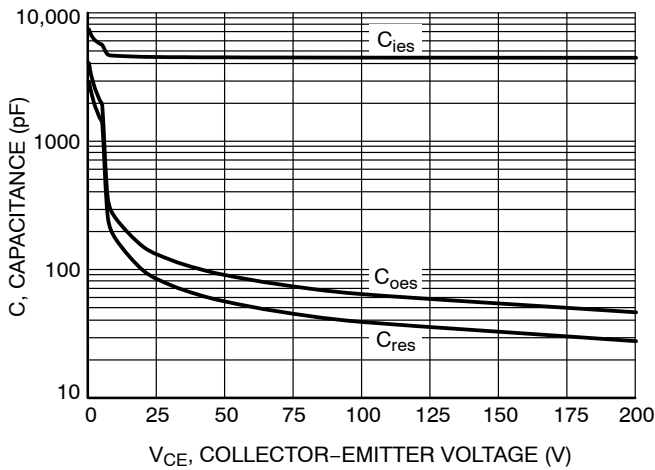


Figure 5. Typical Capacitance

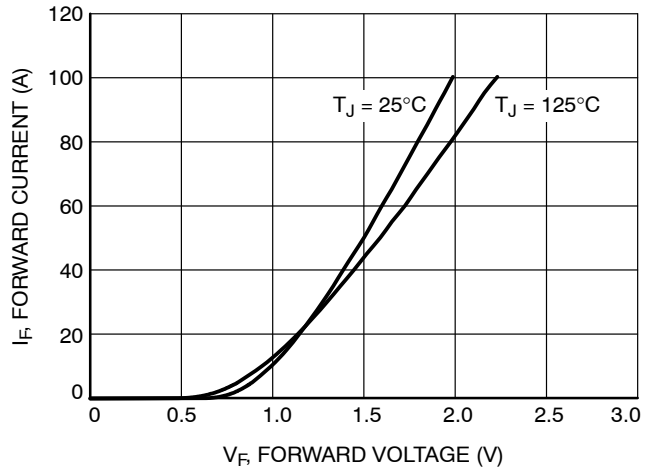


Figure 6. Diode Forward Characteristics

# NGTB20N120LWG

## TYPICAL CHARACTERISTICS

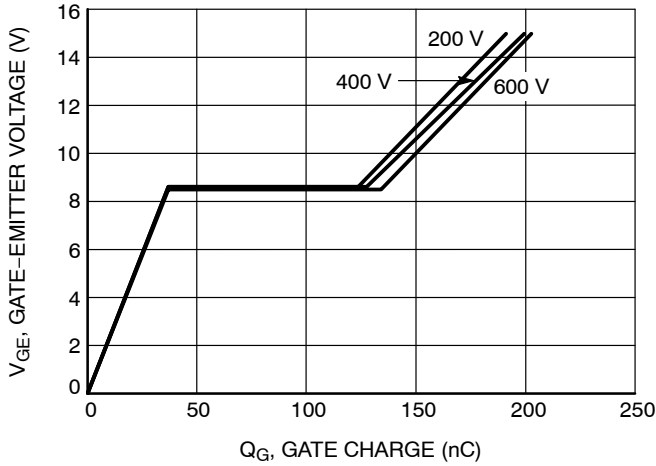


Figure 7. Typical Gate Charge

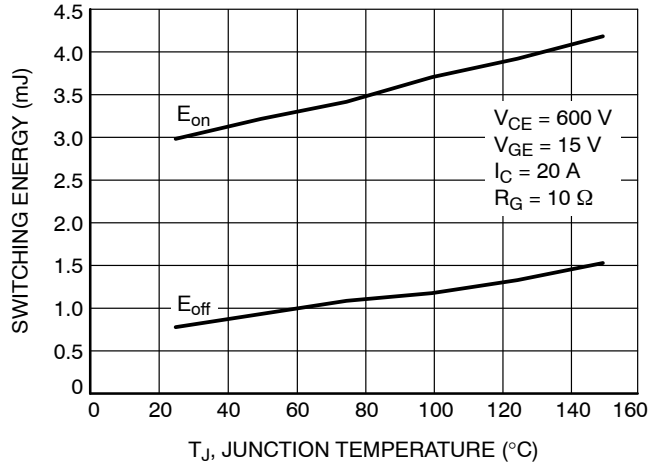


Figure 8. Energy Loss vs. Temperature

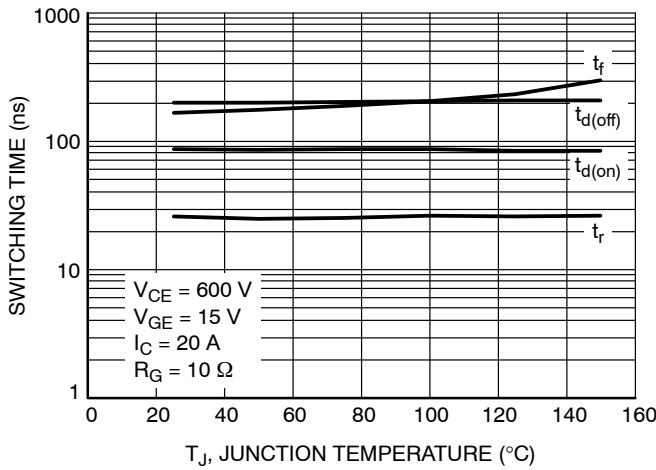


Figure 9. Switching Time vs. Temperature

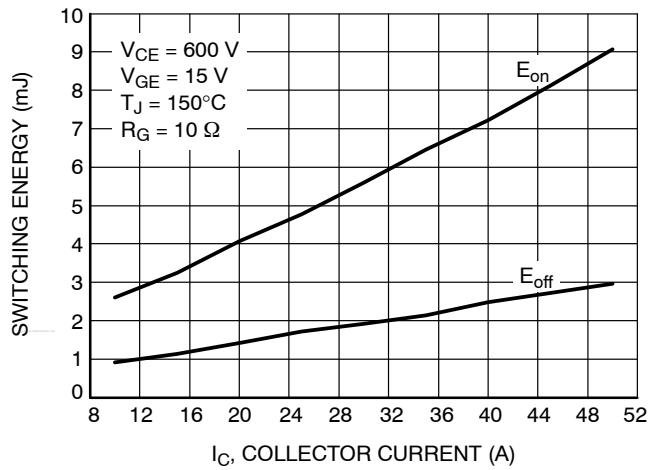


Figure 10. Energy Loss vs.  $I_C$

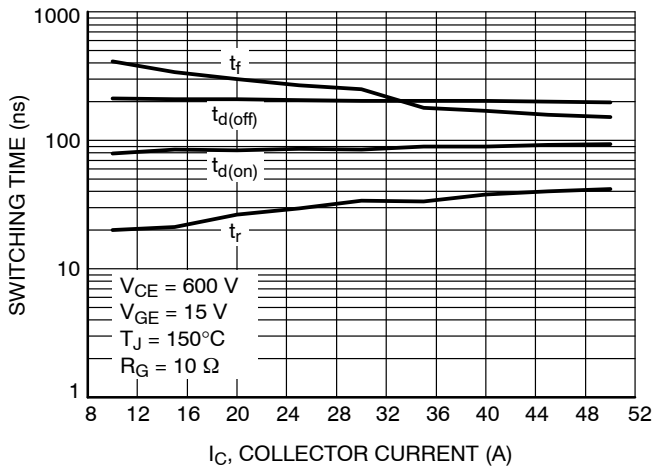


Figure 11. Switching Time vs.  $I_C$

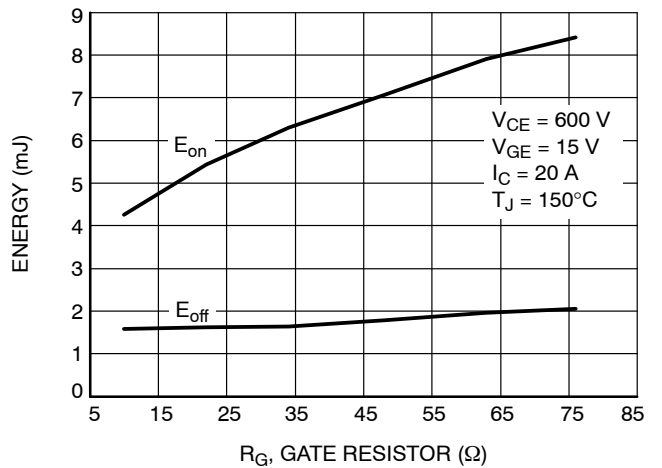


Figure 12. Energy Loss vs.  $R_G$

# NGTB20N120LWG

## TYPICAL CHARACTERISTICS

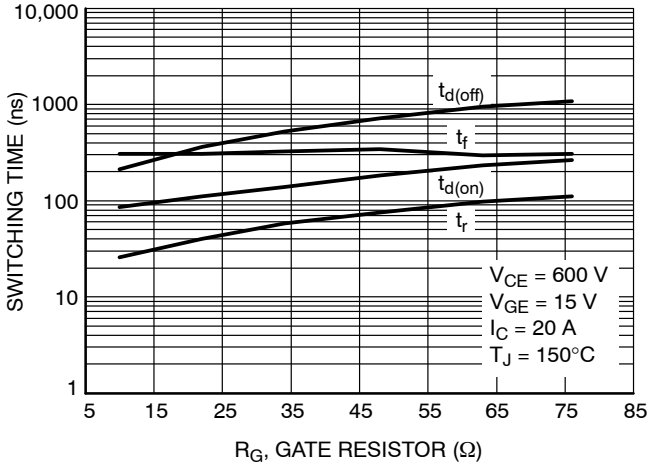


Figure 13. Switching Time vs.  $R_G$

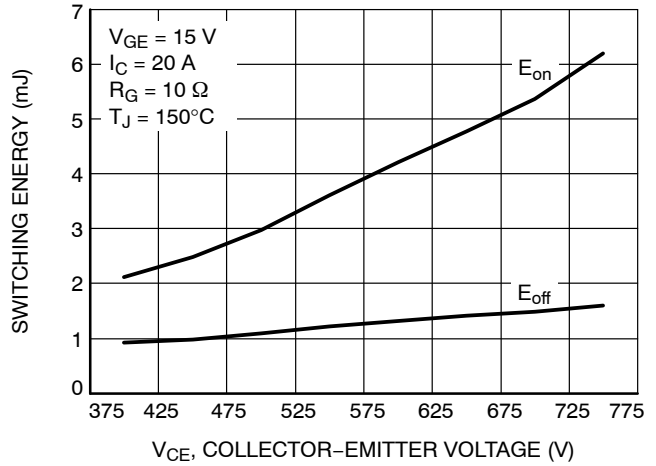


Figure 14. Energy Loss vs.  $V_{CE}$

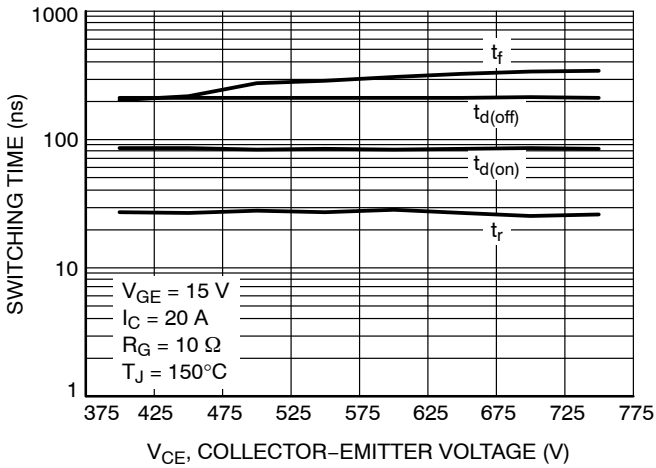


Figure 15. Switching Time vs.  $V_{CE}$

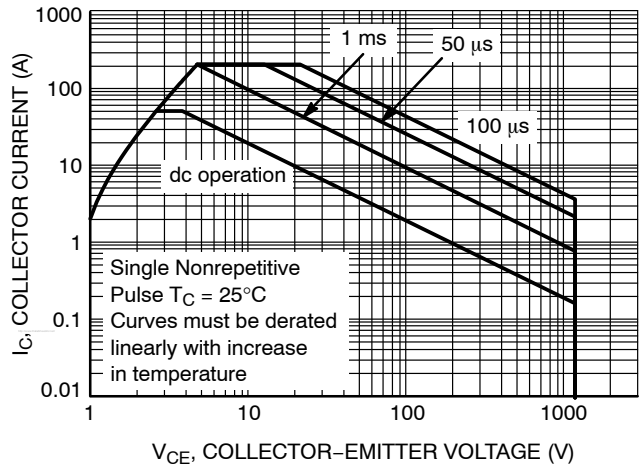


Figure 16. Safe Operating Area

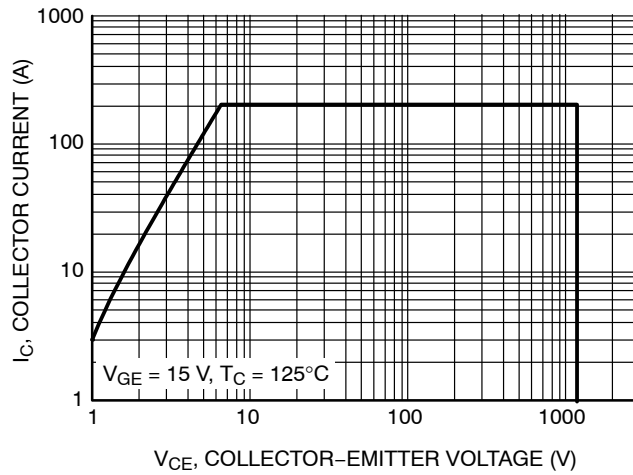


Figure 17. Reverse Bias Safe Operating Area

# NGTB20N120LWG

## TYPICAL CHARACTERISTICS

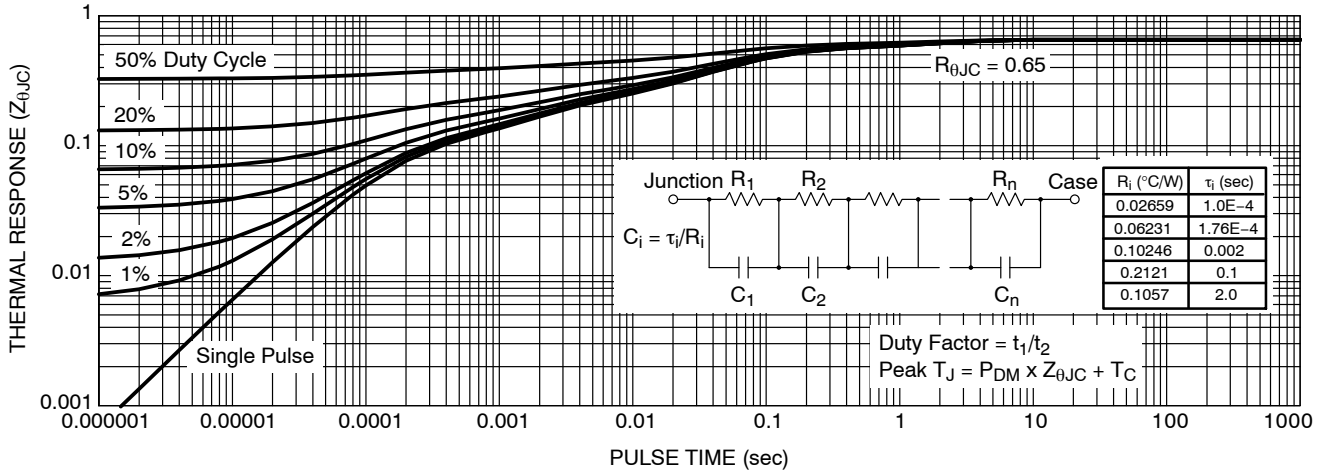


Figure 18. IGBT Transient Thermal Impedance

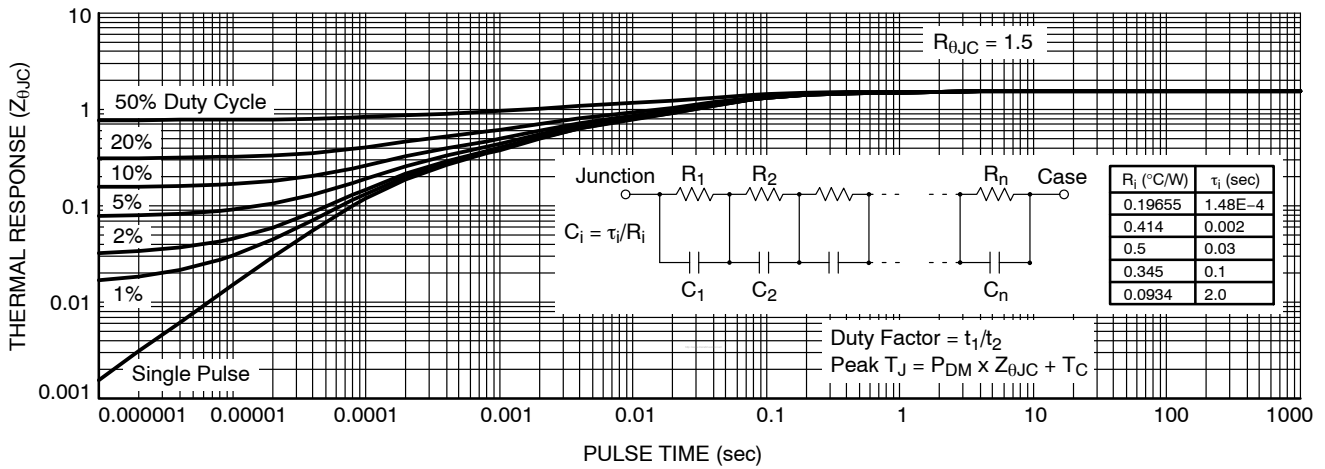


Figure 19. Diode Transient Thermal Impedance

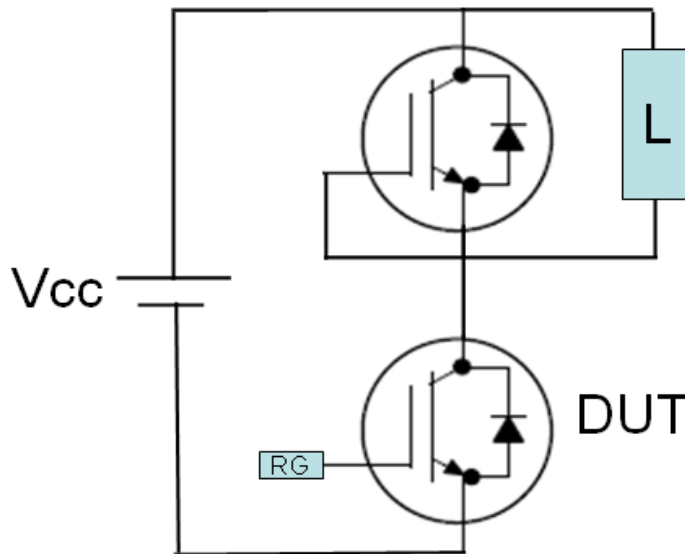


Figure 20. Test Circuit for Switching Characteristics

# NGTB20N120LWG

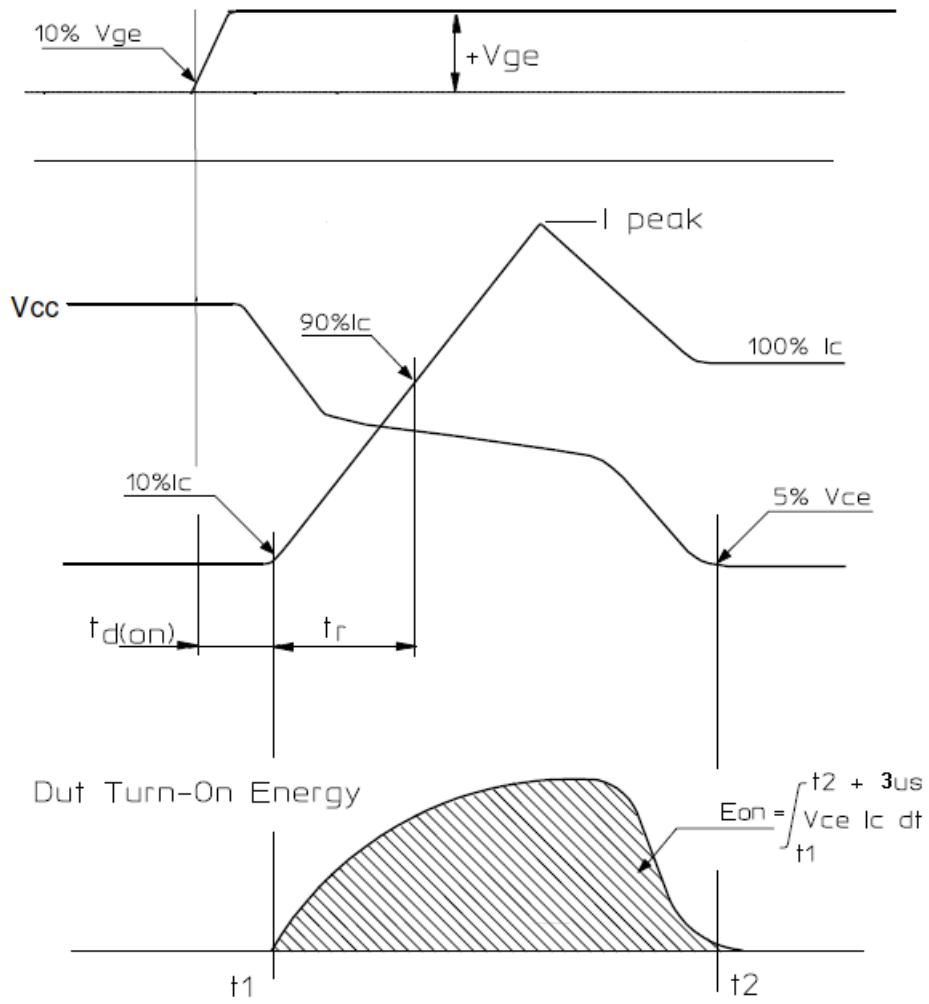


Figure 21. Definition of Turn On Waveform

# NGTB20N120LWG

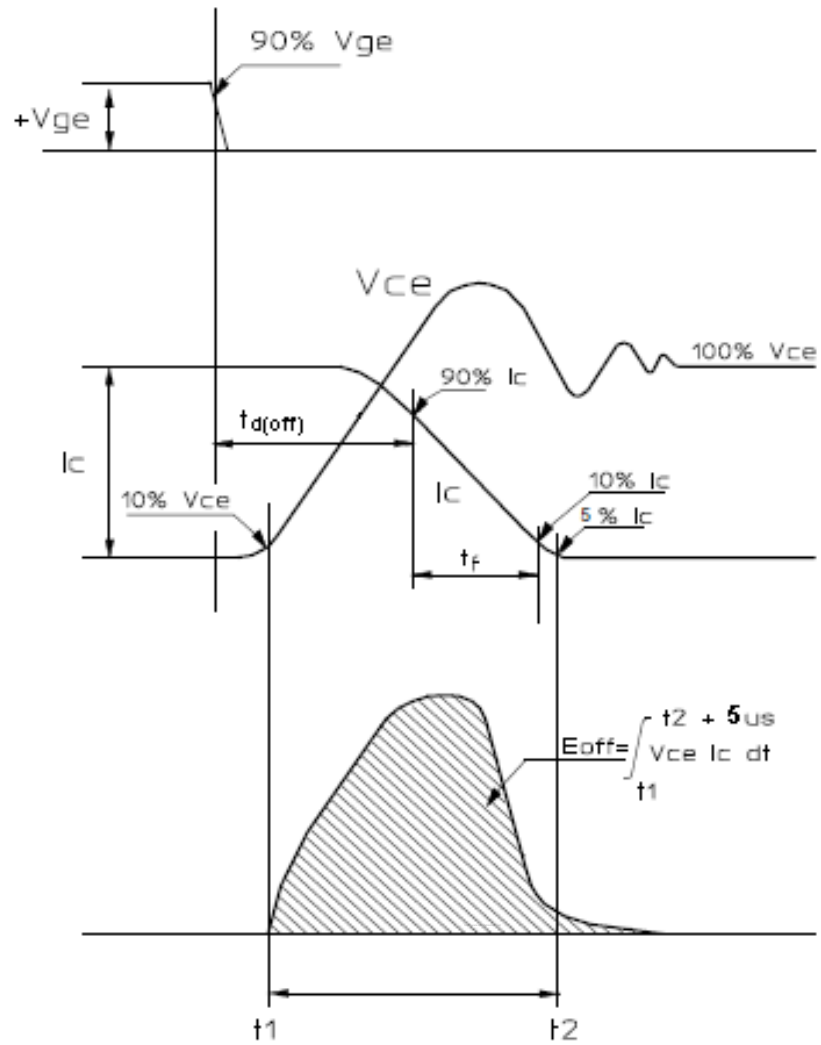


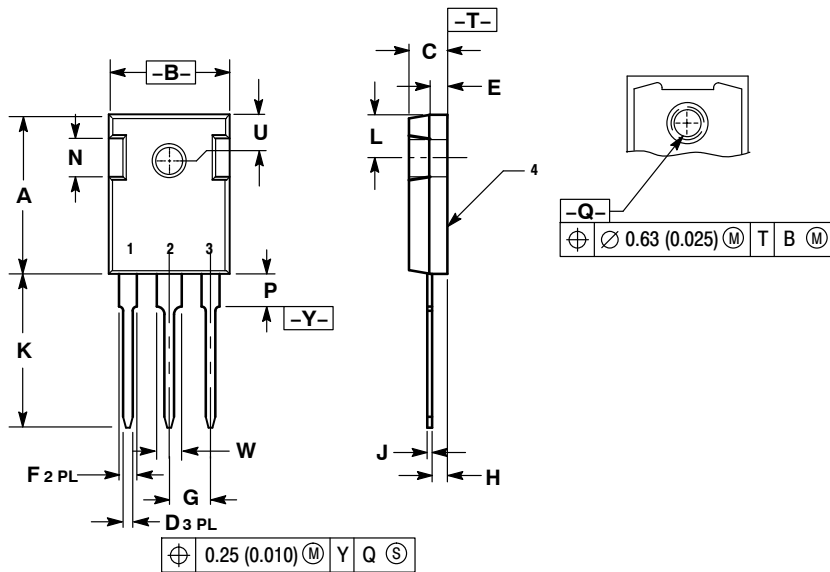
Figure 22. Definition of Turn Off Waveform



# NGTB20N120LWG

## PACKAGE DIMENSIONS

TO-247  
CASE 340L-02  
ISSUE E



- 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

ON Semiconductor and are registered trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of SCILLC's product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

### PUBLICATION ORDERING INFORMATION

**LITERATURE FULFILLMENT:**  
Literature Distribution Center for ON Semiconductor  
P.O. Box 5163, Denver, Colorado 80217 USA  
**Phone:** 303-675-2175 or 800-344-3860 Toll Free USA/Canada  
**Fax:** 303-675-2176 or 800-344-3867 Toll Free USA/Canada  
**Email:** [orderlit@onsemi.com](mailto:orderlit@onsemi.com)

**N. American Technical Support:** 800-282-9855 Toll Free  
USA/Canada  
**Europe, Middle East and Africa Technical Support:**  
Phone: 421 33 790 2910  
**Japan Customer Focus Center**  
Phone: 81-3-5817-1050

**ON Semiconductor Website:** [www.onsemi.com](http://www.onsemi.com)  
**Order Literature:** <http://www.onsemi.com/orderlit>  
For additional information, please contact your local Sales Representative