

# NGB8206N, NGB8206AN

## Ignition IGBT

### 20 A, 350 V, N-Channel D<sup>2</sup>PAK

This Logic Level Insulated Gate Bipolar Transistor (IGBT) features monolithic circuitry integrating ESD and Overvoltage clamped protection for use in inductive coil drivers applications. Primary uses include Ignition, Direct Fuel Injection, or wherever high voltage and high current switching is required.

#### Features

- Ideal for Coil-on-Plug and Driver-on-Coil Applications
- Gate-Emitter ESD Protection
- Temperature Compensated Gate-Collector Voltage Clamp Limits Stress Applied to Load
- Integrated ESD Diode Protection
- Low Threshold Voltage for Interfacing Power Loads to Logic or Microprocessor Devices
- Low Saturation Voltage
- High Pulsed Current Capability
- These are Pb-Free Devices

#### Applications

- Ignition Systems

#### MAXIMUM RATINGS (T<sub>J</sub> = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V <sub>CES</sub>	390	V
Collector-Gate Voltage	V <sub>CER</sub>	390	V
Gate-Emitter Voltage	V <sub>GE</sub>	±15	V
Collector Current-Continuous @ T <sub>C</sub> = 25°C - Pulsed	I <sub>C</sub>	20 50	A <sub>DC</sub> A <sub>AC</sub>
Continuous Gate Current	I <sub>G</sub>	1.0	mA
Transient Gate Current (t ≤ 2 ms, f ≤ 100 Hz)	I <sub>G</sub>	20	mA
ESD (Charged-Device Model)	ESD	2.0	kV
ESD (Human Body Model) R = 1500 Ω, C = 100 pF	ESD	8.0	kV
ESD (Machine Model) R = 0 Ω, C = 200 pF	ESD	500	V
Total Power Dissipation @ T <sub>C</sub> = 25°C Derate above 25°C	P <sub>D</sub>	150 1.0	W W/°C
Operating & Storage Temperature Range	T <sub>J</sub> , T <sub>stg</sub>	-55 to +175	°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.

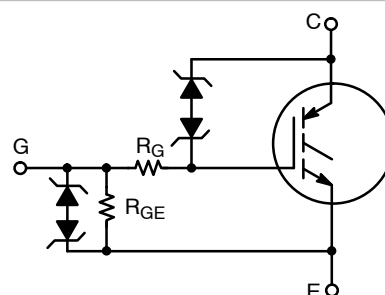


**ON Semiconductor®**

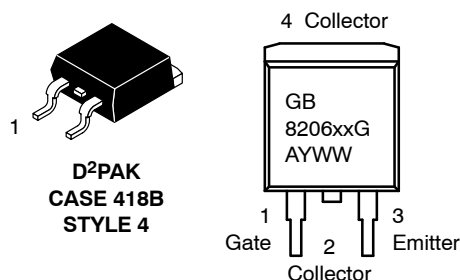
<http://onsemi.com>

**20 AMPS, 350 VOLTS**

**V<sub>CE(on)</sub> = 1.3 V @  
I<sub>C</sub> = 10 A, V<sub>GE</sub> ≥ 4.5 V**



#### MARKING DIAGRAM



GB8206xx = Device Code  
 xx = N or AN  
 A = Assembly Location  
 Y = Year  
 WW = Work Week  
 G = Pb-Free Package

#### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 7 of this data sheet.

# NGB8206N, NGB8206AN

## UNCLAMPED COLLECTOR-TO-EMITTER AVALANCHE CHARACTERISTICS ( $-55^{\circ} \leq T_J \leq 175^{\circ}C$ )

Characteristic	Symbol	Value	Unit
Single Pulse Collector-to-Emitter Avalanche Energy $V_{CC} = 50\text{ V}$ , $V_{GE} = 5.0\text{ V}$ , Pk $I_L = 16.7\text{ A}$ , $L = 1.8\text{ mH}$ , $R_g = 1\text{ k}\Omega$ Starting $T_J = 25^{\circ}C$ $V_{CC} = 50\text{ V}$ , $V_{GE} = 5.0\text{ V}$ , Pk $I_L = 14.9\text{ A}$ , $L = 1.8\text{ mH}$ , $R_g = 1\text{ k}\Omega$ Starting $T_J = 150^{\circ}C$ $V_{CC} = 50\text{ V}$ , $V_{GE} = 5.0\text{ V}$ , Pk $I_L = 14.1\text{ A}$ , $L = 1.8\text{ mH}$ , $R_g = 1\text{ k}\Omega$ Starting $T_J = 175^{\circ}C$	$E_{AS}$	250 200 180	mJ
Reverse Avalanche Energy $V_{CC} = 100\text{ V}$ , $V_{GE} = 20\text{ V}$ , Pk $I_L = 25.8\text{ A}$ , $L = 6.0\text{ mH}$ , Starting $T_J = 25^{\circ}C$	$E_{AS(R)}$	2000	mJ

## THERMAL CHARACTERISTICS

Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	1.0	$^{\circ}C/W$
Thermal Resistance, Junction-to-Ambient (Note 1)	$R_{\theta JA}$	62.5	$^{\circ}C/W$
Maximum Temperature for Soldering Purposes, 0.125 in from case for 5 seconds (Note 2)	$T_L$	275	$^{\circ}C$

- When surface mounted to an FR4 board using the minimum recommended pad size.
- For further details, see Soldering and Mounting Techniques Reference Manual: SOLDERRM/D.

## ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Test Conditions	Temperature	Min	Typ	Max	Unit
----------------	--------	-----------------	-------------	-----	-----	-----	------

### OFF CHARACTERISTICS

Collector-Emitter Clamp Voltage	$BV_{CES}$	$I_C = 2.0\text{ mA}$	$T_J = -40^{\circ}C$ to $175^{\circ}C$	325	350	375	V
		$I_C = 10\text{ mA}$	$T_J = -40^{\circ}C$ to $175^{\circ}C$	340	365	390	
Zero Gate Voltage Collector Current	$I_{CES}$	$V_{CE} = 15\text{ V}$ , $V_{GE} = 0\text{ V}$	$T_J = 25^{\circ}C$		0.1	1.0	$\mu A$
			$T_J = 25^{\circ}C$	0.5	1.5	10	
			$T_J = 175^{\circ}C$	1.0	25	100*	
		$V_{CE} = 175\text{ V}$ , $V_{GE} = 0\text{ V}$	$T_J = -40^{\circ}C$	0.4	0.8	5.0	
			$T_J = 25^{\circ}C$	30	35	39	V
			$T_J = 175^{\circ}C$	35	39	45*	
Reverse Collector-Emitter Clamp Voltage	$BV_{CES(R)}$	$I_C = -75\text{ mA}$ – NGB8206	$T_J = -40^{\circ}C$	30	33	37	
			$T_J = 25^{\circ}C$	30	35	39	
			$T_J = 175^{\circ}C$	32	37	42	
		$I_C = -75\text{ mA}$ – NGB8206A	$T_J = -40^{\circ}C$	29	32	37	
			$T_J = 25^{\circ}C$	0.05	0.25	0.5	mA
			$T_J = 175^{\circ}C$	1.0	12.5	25	
Reverse Collector-Emitter Leakage Current	$I_{CES(R)}$	$V_{CE} = -24\text{ V}$ – NGB8206	$T_J = -40^{\circ}C$	0.005	0.03	0.25	
			$T_J = 25^{\circ}C$	0.05	0.25	1.0	
			$T_J = 175^{\circ}C$	1.0	12.5	25	
		$V_{CE} = -24\text{ V}$ – NGB8206A	$T_J = -40^{\circ}C$	0.005	0.03	0.25	
			$T_J = 25^{\circ}C$	12	12.5	14	V
			$T_J = 175^{\circ}C$	200	300	350*	
Gate-Emitter Clamp Voltage	$BV_{GES}$	$I_G = \pm 5.0\text{ mA}$	$T_J = -40^{\circ}C$ to $175^{\circ}C$	12	12.5	14	
Gate-Emitter Leakage Current	$I_{GES}$	$V_{GE} = \pm 5.0\text{ V}$	$T_J = -40^{\circ}C$ to $175^{\circ}C$	200	300	350*	$\mu A$
Gate Resistor	$R_G$		$T_J = -40^{\circ}C$ to $175^{\circ}C$		70		$\Omega$
Gate-Emitter Resistor	$R_{GE}$		$T_J = -40^{\circ}C$ to $175^{\circ}C$	14.25	16	25	k $\Omega$

### ON CHARACTERISTICS (Note 3)

Gate Threshold Voltage	$V_{GE(th)}$	$I_C = 1.0\text{ mA}$ , $V_{GE} = V_{CE}$	$T_J = 25^{\circ}C$	1.5	1.8	2.1	V
			$T_J = 175^{\circ}C$	0.7	1.0	1.3	
			$T_J = -40^{\circ}C$	1.7	2.0	2.3*	

\*Maximum Value of Characteristic across Temperature Range.

- Pulse Test: Pulse Width  $\leq 300\text{ }\mu S$ , Duty Cycle  $\leq 2\%$ .

# NGB8206N, NGB8206AN

## ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Test Conditions	Temperature	Min	Typ	Max	Unit
----------------	--------	-----------------	-------------	-----	-----	-----	------

### ON CHARACTERISTICS (Note 3)

Threshold Temperature Coefficient (Negative)				3.8	4.6	6.0	mV/°C
Collector-to-Emitter On-Voltage	$V_{CE(on)}$	$I_C = 6.5 \text{ A}, V_{GE} = 3.7 \text{ V}$	$T_J = 25^\circ\text{C}$	0.95	1.15	1.35	V
			$T_J = 175^\circ\text{C}$	0.70	0.95	1.15	
			$T_J = -40^\circ\text{C}$	1.0	1.30	1.40	
		$I_C = 9.0 \text{ A}, V_{GE} = 3.9 \text{ V}$	$T_J = 25^\circ\text{C}$	0.95	1.25	1.45	
			$T_J = 175^\circ\text{C}$	0.8	1.05	1.25	
			$T_J = -40^\circ\text{C}$	1.1	1.4	1.50	
		$I_C = 7.5 \text{ A}, V_{GE} = 4.5 \text{ V}$	$T_J = 25^\circ\text{C}$	0.85	1.15	1.4	
			$T_J = 175^\circ\text{C}$	0.7	0.95	1.2	
			$T_J = -40^\circ\text{C}$	1.0	1.3	1.6*	
		$I_C = 10 \text{ A}, V_{GE} = 4.5 \text{ V}$ NGB8206	$T_J = 25^\circ\text{C}$	1.0	1.3	1.6	
			$T_J = 175^\circ\text{C}$	0.8	1.05	1.4	
			$T_J = -40^\circ\text{C}$	1.1	1.4	1.7*	
		$I_C = 10 \text{ A}, V_{GE} = 4.5 \text{ V}$ NGB8206A	$T_J = 25^\circ\text{C}$	0.9	1.2	1.6	
			$T_J = 175^\circ\text{C}$	0.8	1.05	1.4	
			$T_J = -40^\circ\text{C}$	1.0	1.2	1.7*	
		$I_C = 15 \text{ A}, V_{GE} = 4.5 \text{ V}$ NGB8206	$T_J = 25^\circ\text{C}$	1.15	1.45	1.7	
			$T_J = 175^\circ\text{C}$	1.0	1.3	1.55	
			$T_J = -40^\circ\text{C}$	1.25	1.55	1.8*	
		$I_C = 15 \text{ A}, V_{GE} = 4.5 \text{ V}$ NGB8206A	$T_J = 25^\circ\text{C}$	1.0	1.3	1.7	
			$T_J = 175^\circ\text{C}$	1.0	1.3	1.55	
			$T_J = -40^\circ\text{C}$	1.1	1.35	1.8*	
		$I_C = 20 \text{ A}, V_{GE} = 4.5 \text{ V}$	$T_J = 25^\circ\text{C}$	1.3	1.6	1.9	
			$T_J = 175^\circ\text{C}$	1.2	1.5	1.8	
			$T_J = -40^\circ\text{C}$	1.4	1.75	2.0*	
Forward Transconductance	gfs	$I_C = 6.0 \text{ A}, V_{CE} = 5.0 \text{ V}$	$T_J = 25^\circ\text{C}$	10	18	25	Mhos

### DYNAMIC CHARACTERISTICS

Input Capacitance	$C_{ISS}$	f = 10 kHz, $V_{CE} = 25 \text{ V}$	$T_J = 25^\circ\text{C}$	1100	1300	1500	pF
Output Capacitance	$C_{OSS}$			70	80	90	
Transfer Capacitance	$C_{RSS}$			18	20	22	

\*Maximum Value of Characteristic across Temperature Range.

3. Pulse Test: Pulse Width  $\leq 300 \mu\text{s}$ , Duty Cycle  $\leq 2\%$ .

# NGB8206N, NGB8206AN

## ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Test Conditions	Temperature	Min	Typ	Max	Unit
----------------	--------	-----------------	-------------	-----	-----	-----	------

### SWITCHING CHARACTERISTICS

Turn-Off Delay Time (Resistive)	$t_{d(off)}$	$V_{CC} = 300\text{ V}, I_C = 9.0\text{ A}$ $R_G = 1.0\text{ k}\Omega, R_L = 33\text{ }\Omega$ $V_{GE} = 5\text{ V}$	$T_J = 25^\circ\text{C}$	6.0	8.0	10	$\mu\text{Sec}$
			$T_J = 175^\circ\text{C}$	6.0	8.0	10	
Fall Time (Resistive)	$t_f$	$V_{CC} = 300\text{ V}, I_C = 9.0\text{ A}$ $R_G = 1.0\text{ k}\Omega, R_L = 33\text{ }\Omega$ $V_{GE} = 5\text{ V}$	$T_J = 25^\circ\text{C}$	4.0	6.0	8.0	
			$T_J = 175^\circ\text{C}$	8.0	10.5	14	
Turn-Off Delay Time (Inductive)	$t_{d(off)}$	$V_{CC} = 300\text{ V}, I_C = 9.0\text{ A}$ $R_G = 1.0\text{ k}\Omega, L = 300\text{ }\mu\text{H}$ $V_{GE} = 5\text{ V}$	$T_J = 25^\circ\text{C}$	3.0	5.0	7.0	
			$T_J = 175^\circ\text{C}$	5.0	7.0	9.0	
Fall Time (Inductive)	$t_f$	$V_{CC} = 300\text{ V}, I_C = 9.0\text{ A}$ $R_G = 1.0\text{ k}\Omega, L = 300\text{ }\mu\text{H}$ $V_{GE} = 5\text{ V}$	$T_J = 25^\circ\text{C}$	1.5	3.0	4.5	
			$T_J = 175^\circ\text{C}$	5.0	7.0	10	
Turn-On Delay Time	$t_{d(on)}$	$V_{CC} = 14\text{ V}, I_C = 9.0\text{ A}$ $R_G = 1.0\text{ k}\Omega, R_L = 1.5\text{ }\Omega$ $V_{GE} = 5\text{ V}$	$T_J = 25^\circ\text{C}$	1.0	1.5	2.0	
			$T_J = 175^\circ\text{C}$	1.0	1.5	2.0	
Rise Time	$t_r$	$V_{CC} = 14\text{ V}, I_C = 9.0\text{ A}$ $R_G = 1.0\text{ k}\Omega, R_L = 1.5\text{ }\Omega$ $V_{GE} = 5\text{ V}$	$T_J = 25^\circ\text{C}$	4.0	6.0	8.0	
			$T_J = 175^\circ\text{C}$	3.0	5.0	7.0	

\*Maximum Value of Characteristic across Temperature Range.

3. Pulse Test: Pulse Width  $\leq 300\text{ }\mu\text{s}$ , Duty Cycle  $\leq 2\%$ .

# NGB8206N, NGB8206AN

## TYPICAL ELECTRICAL CHARACTERISTICS

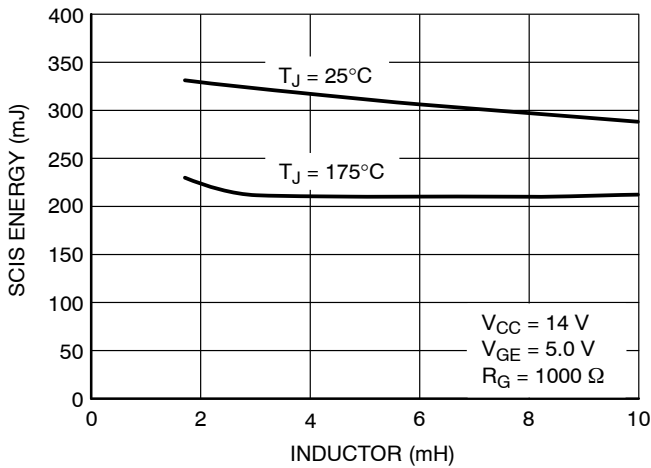


Figure 1. Self Clamped Inductive Switching

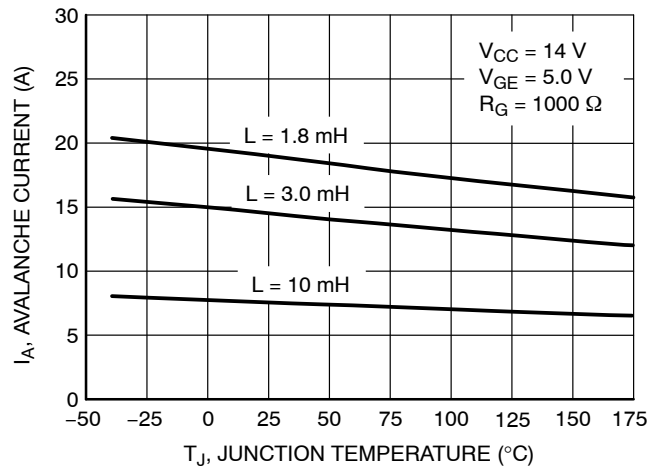


Figure 2. Open Secondary Avalanche Current vs. Temperature

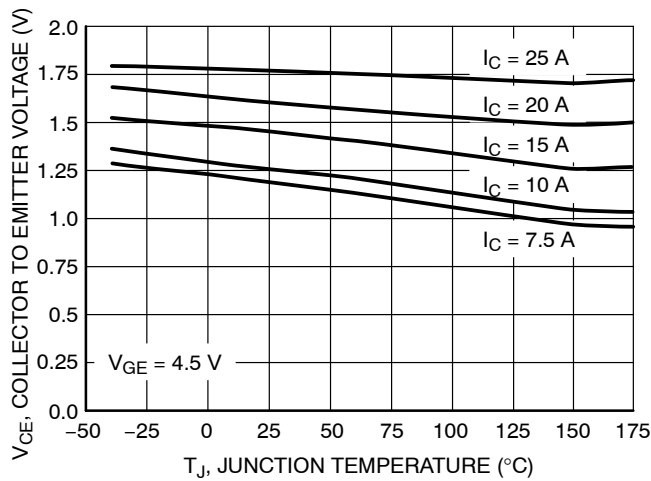


Figure 3. Collector-to-Emitter Voltage vs. Junction Temperature

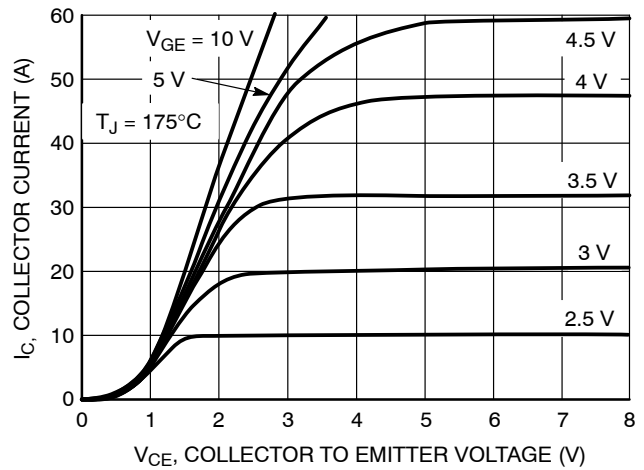


Figure 4. Collector Current vs. Collector-to-Emitter Voltage

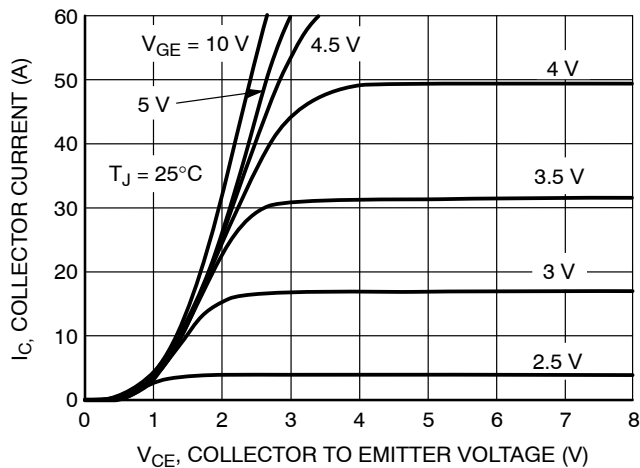


Figure 5. Collector Current vs. Collector-to-Emitter Voltage

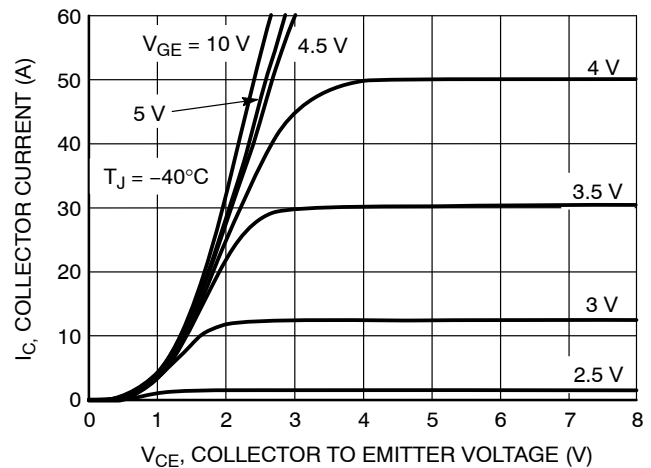


Figure 6. Collector Current vs. Collector-to-Emitter Voltage

TYPICAL ELECTRICAL CHARACTERISTICS

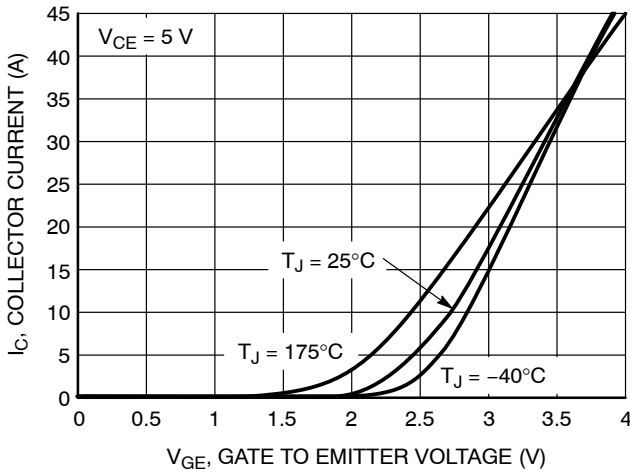


Figure 7. Transfer Characteristics

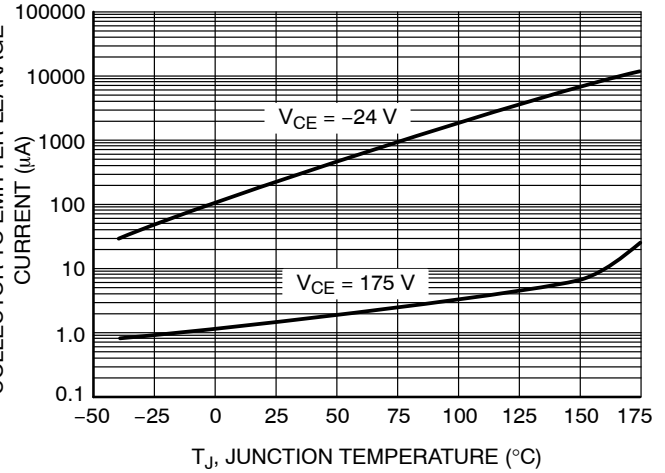


Figure 8. Collector-to-Emitter Leakage Current vs. Temperature

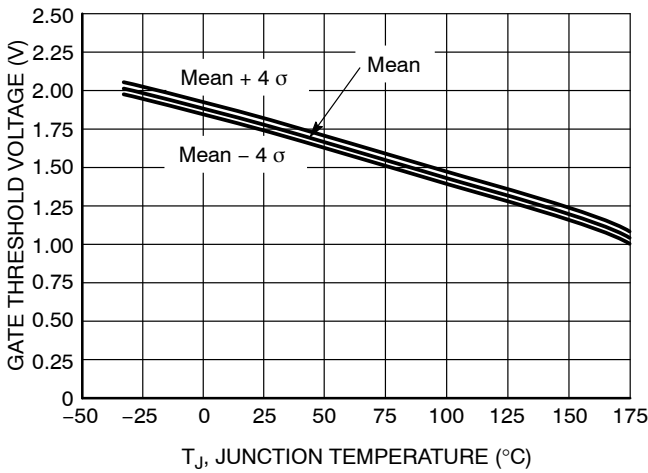


Figure 9. Gate Threshold Voltage vs. Temperature

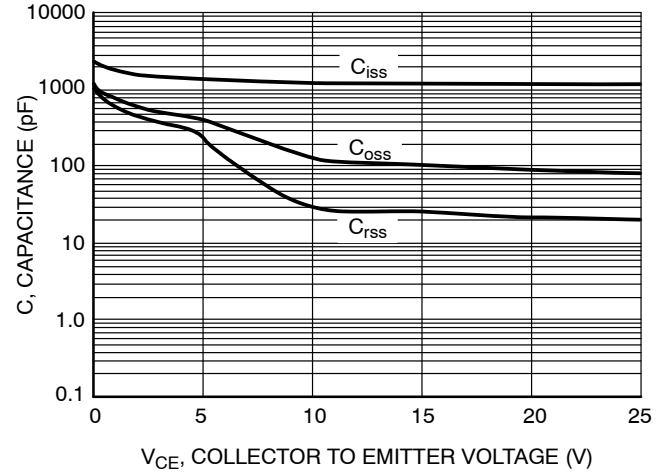


Figure 10. Capacitance vs. Collector-to-Emitter Voltage

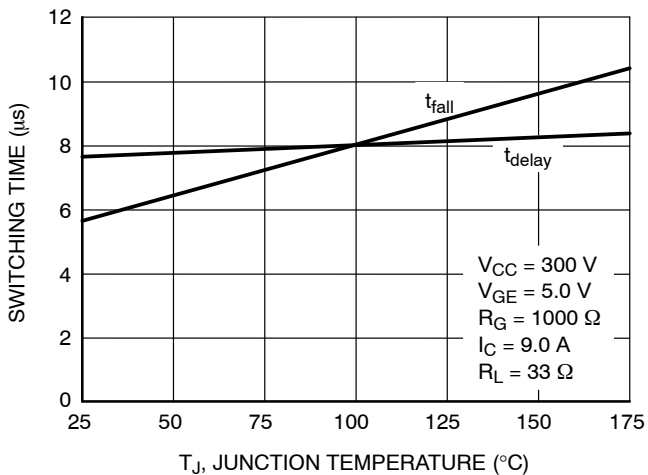


Figure 11. Resistive Switching Fall Time vs. Temperature

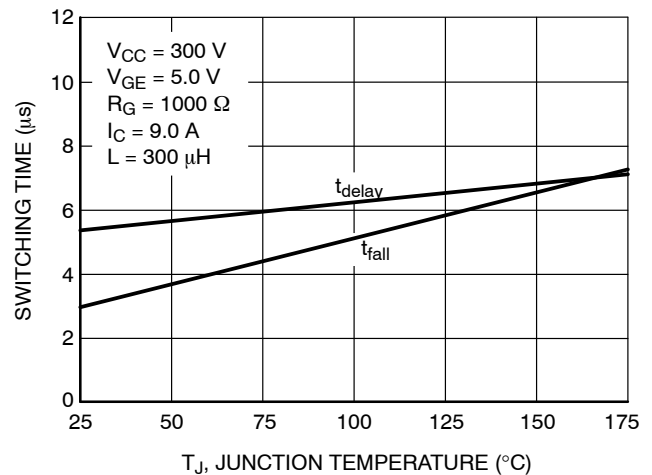
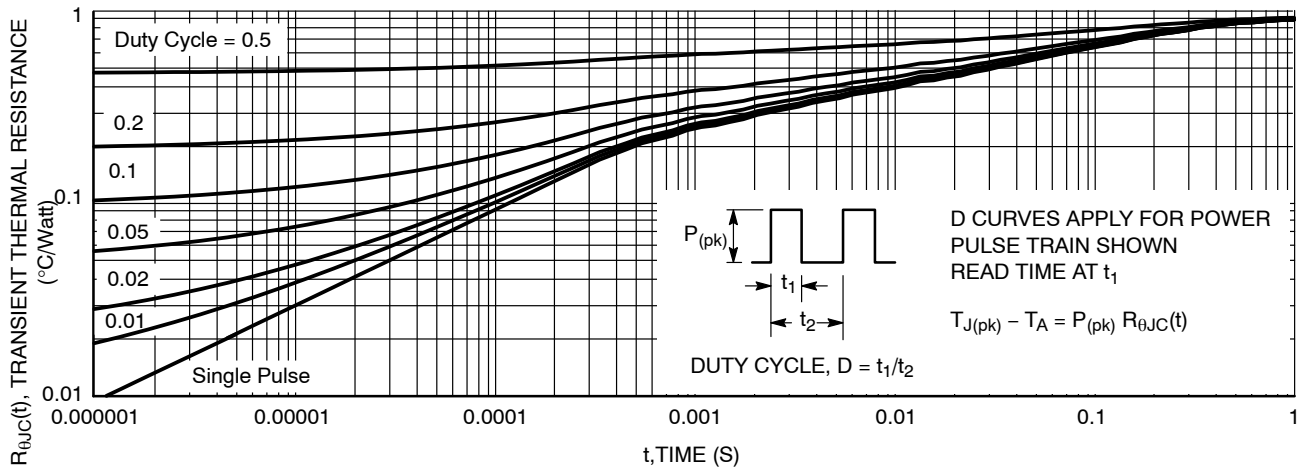


Figure 12. Inductive Switching Fall Time vs. Temperature

# NGB8206N, NGB8206AN



**Figure 13. Best Case Transient Thermal Resistance  
(Non-normalized Junction-to-Case Mounted on Cold Plate)**

## ORDERING INFORMATION

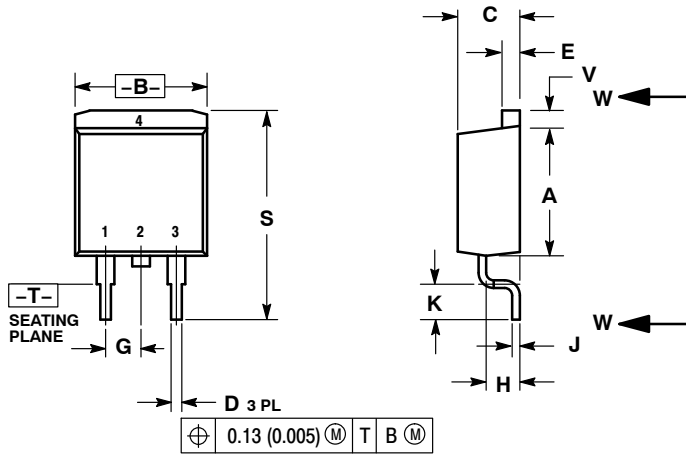
Device	Package	Shipping†
NGB8206NG	D <sup>2</sup> PAK (Pb-Free)	50 Units / Rail
NGB8206NT4G	D <sup>2</sup> PAK (Pb-Free)	800 / Tape & Reel
NGB8206ANT4G	D <sup>2</sup> PAK (Pb-Free)	800 / Tape & Reel
NGB8206ANTF4G	D <sup>2</sup> PAK (Pb-Free)	700 / Tape & Reel
NGB8206ANSL3G	D <sup>2</sup> PAK (Pb-Free)	50 Units / Rail

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

# NGB8206N, NGB8206AN

## PACKAGE DIMENSIONS

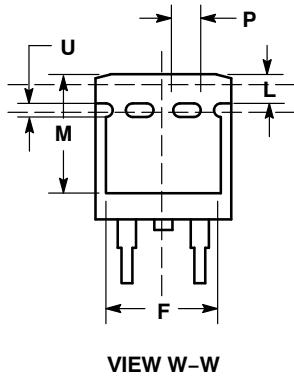
D<sup>2</sup>PAK 3  
CASE 418B-04  
ISSUE K



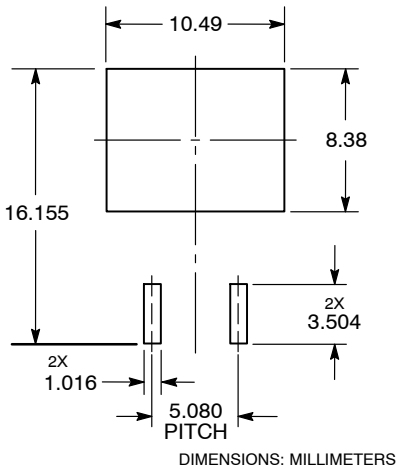
**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. 418B-01 THRU 418B-03 OBSOLETE, NEW STANDARD 418B-04.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.340	0.380	8.65	9.65
B	0.380	0.405	9.65	10.29
C	0.160	0.190	4.06	4.83
D	0.020	0.035	0.51	0.89
E	0.045	0.055	1.14	1.40
F	0.310	0.350	7.87	8.89
G	0.100 BSC		2.54 BSC	
H	0.080	0.110	2.03	2.79
J	0.018	0.025	0.46	0.64
K	0.090	0.110	2.29	2.79
L	0.052	0.072	1.32	1.83
M	0.280	0.320	7.11	8.13
N	0.197 REF		5.00 REF	
P	0.079 REF		2.00 REF	
R	0.039 REF		0.99 REF	
S	0.575	0.625	14.60	15.88
V	0.045	0.055	1.14	1.40



### SOLDERING FOOTPRINT\*



**STYLE 4:**

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

\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

ON Semiconductor and are registered trademarks of Semiconductor Components Industries, LLC (SCILLC). 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

**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