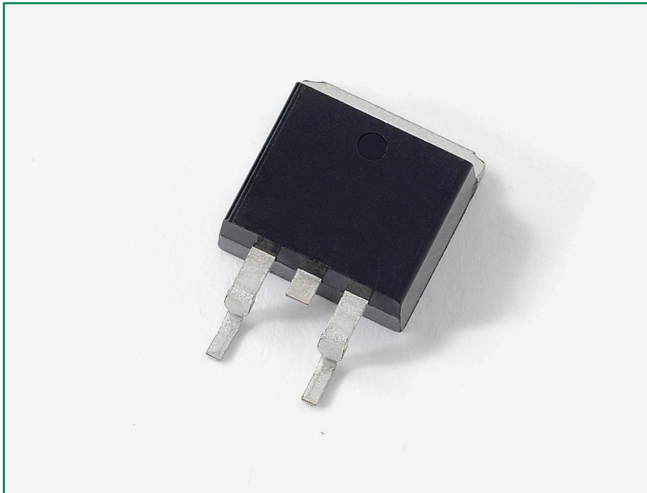


# NGB8206AN - 20 A, 350 V, N-Channel Ignition IGBT, D<sup>2</sup>PAK



**20 Amps, 350 Volts**  
 $V_{CE(on)} \leq 1.3 \text{ V @}$   
 $I_C = 10A, V_{GE} \geq 4.5 \text{ V}$

### Maximum Ratings ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

Rating	Symbol	Value	Unit
Collector–Emitter Voltage	$V_{CES}$	390	V
Collector–Gate Voltage	$V_{CER}$	390	V
Gate–Emitter Voltage	$V_{GE}$	$\pm 15$	V
Collector Current–Continuous @ $T_C = 25^\circ\text{C}$ – Pulsed	$I_C$	20 50	$A_{DC}$ $A_{AC}$
Continuous Gate Current	$I_G$	1.0	mA
Transient Gate Current ( $t \leq 2 \text{ ms}, f \leq 100 \text{ Hz}$ )	$I_G$	20	mA
ESD (Charged–Device Model)	ESD	2.0	kV
ESD (Human Body Model) $R = 1500 \Omega, C = 100 \text{ pF}$	ESD	8.0	kV
ESD (Machine Model) $R = 0 \Omega, C = 200 \text{ pF}$	ESD	500	V
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	150 1.0	Watts $\text{W}/^\circ\text{C}$
Operating and Storage Temperature Range	$T_J, T_{stg}$	$-55$ to $+175$	$^\circ\text{C}$

### Description

This Logic Level Insulated Gate Bipolar Transistor (IGBT) features monolithic circuitry integrating ESD and Over–Voltage 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.

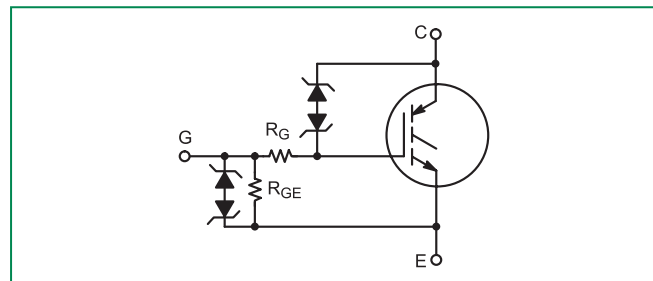
### Features

- 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

### Functional Diagram



### Additional Information



Datasheet



Resources



Samples

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.

**Unclamped Collector–To–Emitter Avalanche Characteristics ( $-55^{\circ} \leq T_J \leq 175^{\circ}\text{C}$ )**

	Symbol	Value	Unit
Single Pulse Collector–to–Emitter Avalanche Energy			
$V_{CC} = 50\text{ V}, V_{GE} = 5.0\text{ V}, P_k I_L = 16.7\text{ A}, R_G = 1000\ \Omega, L = 1.8\text{ mH}, \text{Starting } T_J = 25^{\circ}\text{C}$	$E_{AS}$	250	mJ
$V_{CC} = 50\text{ V}, V_{GE} = 5.0\text{ V}, P_k I_L = 14.9\text{ A}, R_G = 1000\ \Omega, L = 1.8\text{ mH}, \text{Starting } T_J = 150^{\circ}\text{C}$		200	
$V_{CC} = 50\text{ V}, V_{GE} = 5.0\text{ V}, P_k I_L = 14.1\text{ A}, R_G = 1000\ \Omega, L = 1.8\text{ mH}, \text{Starting } T_J = 175^{\circ}\text{C}$		180	
Reverse Avalanche Energy			
$V_{CC} = 100\text{ V}, V_{GE} = 20\text{ V}, P_k I_L = 25.8\text{ A}, L = 6.0\text{ mH}, \text{Starting } T_J = 25^{\circ}\text{C}$	$E_{AS(R)}$	2000	mJ

1. When surface mounted to an FR4 board using the minimum recommended pad size.

**Thermal Characteristics**

Rating	Symbol	Value	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.0	$^{\circ}\text{C}/\text{W}$
Thermal Resistance, Junction to Ambient (Note 1)	$R_{\theta JA}$	62.5	$^{\circ}\text{C}/\text{W}$
Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 5 seconds	$T_L$	275	$^{\circ}\text{C}$

**Electrical Characteristics - OFF**

Characteristic	Symbol	Test Conditions	Temperature	Min	Typ	Max	Unit
Collector–Emitter Clamp Voltage	$BV_{CES}$	$I_C = 2.0 \text{ mA}$	$T_J = -40^\circ\text{C}$ to $150^\circ\text{C}$	325	350	375	V
		$I_C = 10 \text{ mA}$	$T_J = -40^\circ\text{C}$ to $150^\circ\text{C}$	340	365	390	
Zero Gate Voltage Collector Current	$I_{CES}$	$V_{CE} = 15 \text{ V},$ $V_{GE} = 0 \text{ V},$	$T_J = 25^\circ\text{C}$	–	0.1	1.0	$\mu\text{A}$
			$T_J = 25^\circ\text{C}$	0.5	1.5	10	
		$V_{CE} = 175 \text{ V}$ $V_{GE} = 0 \text{ V}$	$T_J = 175^\circ\text{C}$	1.0	25	100*	
Reverse Collector–Emitter Clamp Voltage	$BV_{CES(R)}$	$I_C = -75 \text{ mA}$	$T_J = 25^\circ\text{C}$	30	35	39	V
			$T_J = 175^\circ\text{C}$	32	37	42	
			$T_J = -40^\circ\text{C}$	29	32	37	
Reverse Collector–Emitter Leakage Current	$I_{CES(R)}$	$V_{CE} = -24 \text{ V}$	$T_J = 25^\circ\text{C}$	0.05	0.25	1.0	mA
			$T_J = 175^\circ\text{C}$	1.0	12.5	25	
			$T_J = -40^\circ\text{C}$	0.005	0.03	0.25	
Gate–Emitter Clamp Voltage	$BV_{GES}$	$I_G = \pm 5.0 \text{ mA}$	$T_J = -40^\circ\text{C}$ to $175^\circ\text{C}$	12	12.5	14	V
Gate–Emitter Leakage Current	$I_{GES}$	$V_{GE} = \pm 5.0 \text{ V}$	$T_J = -40^\circ\text{C}$ to $175^\circ\text{C}$	200	300	350*	$\mu\text{A}$
Gate Resistor	$R_G$	–	$T_J = -40^\circ\text{C}$ to $175^\circ\text{C}$	–	–	–	$\Omega$
Gate Emitter Resistor	$R_{GE}$	–	$T_J = -40^\circ\text{C}$ to $175^\circ\text{C}$	14.25	16	25	k $\Omega$

**Electrical Characteristics - ON (Note 3)**

Characteristic	Symbol	Test Conditions	Temperature	Min	Typ	Max	Unit
Gate Threshold Voltage	$V_{GE(th)}$	$I_C = 1.0 \text{ mA},$ $V_{GE} = V_{CE}$	$T_J = 25^\circ\text{C}$	1.5	1.8	2.1	V
			$T_J = 175^\circ\text{C}$	0.7	1.0	1.3	
			$T_J = -40^\circ\text{C}$	1.7	2.0	2.3*	
Threshold Temperature Coefficient (Negative)	–	–	–	3.8	4.6	6.0	mV/ $^\circ\text{C}$

\*Maximum Value of Characteristic across Temperature Range.

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

**Electrical Characteristics - ON (Note 4)**

Characteristic	Symbol	Test Conditions	Temperature	Min	Typ	Max	Unit
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*	
		$I_C = 10\text{ A}$ , $V_{GE} = 4.5\text{ V}$	$T_J = 25^\circ\text{C}$	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*	
		$I_C = 15\text{ A}$ , $V_{GE} = 4.5\text{ V}$	$T_J = 25^\circ\text{C}$	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	$V_{CE} = 5.0\text{ V}$ , $I_C = 6.0\text{ A}$	$T_J = 25^\circ\text{C}$	10	18	25	Mhos

\*Maximum Value of Characteristic across Temperature Range.

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

**Dynamic Characteristics**

Characteristic	Symbol	Test Conditions	Temperature	Min	Typ	Max	Unit
Input Capacitance	$C_{ISS}$	$V_{CE} = 25\text{ V}$ $f = 10\text{ kHz}$	$T_J = 25^\circ\text{C}$	1100	1300	1500	pF
Output Capacitance	$C_{OSS}$			70	80	90	
Transfer Capacitance	$C_{RSS}$			18	20	22	

**Switching Characteristics**

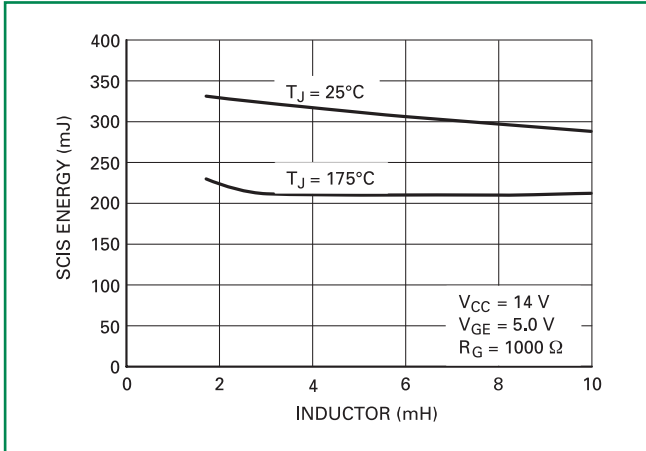
Characteristic	Symbol	Test Conditions	Temperature	Min	Typ	Max	Unit	
Turn-Off Delay Time (Resistive)	$t_{d(off)}$	$V_{CC} = 300\text{ V}$ , $I_C = 9\text{ A}$ , $R_G = 1.0\text{ k}\Omega$ , $R_L = 33\ \Omega$ , $V_{GE} = 5.0\text{ V}$	$T_J = 25^\circ\text{C}$	6.0	8.0	10	μSec	
			$T_J = 175^\circ\text{C}$	6.0	8.0	10		
Fall Time (Resistive)	$t_f$		$T_J = 25^\circ\text{C}$	4.0	6.0	8.0		
			$T_J = 175^\circ\text{C}$	8.0	10.5	14		
Turn-Off Delay Time (Inductive)	$t_{d(off)}$		$V_{CC} = 300\text{ V}$ , $I_C = 9\text{ A}$ , $R_G = 1.0\text{ k}\Omega$ , $L = 300\ \mu\text{H}$ , $V_{GE} = 5.0\text{ V}$	$T_J = 25^\circ\text{C}$	3.0	5.0		7.0
				$T_J = 175^\circ\text{C}$	5.0	7.0		9.0
Fall Time (Inductive)	$t_f$	$T_J = 25^\circ\text{C}$		1.5	3.0	4.5		
		$T_J = 175^\circ\text{C}$		5.0	7.0	10		
Turn-On Delay Time	$t_{d(on)}$	$V_{CC} = 14\text{ V}$ , $I_C = 9.0\text{ A}$ , $R_G = 1.0\text{ k}\Omega$ , $R_L = 1.5\ \Omega$ , $V_{GE} = 5.0\text{ V}$		$T_J = 25^\circ\text{C}$	1.0	1.5	2.0	
				$T_J = 175^\circ\text{C}$	1.0	1.5	2.0	
Rise Time	$t_r$		$T_J = 25^\circ\text{C}$	4.0	6.0	8.0		
			$T_J = 175^\circ\text{C}$	3.0	5.0	7.0		

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

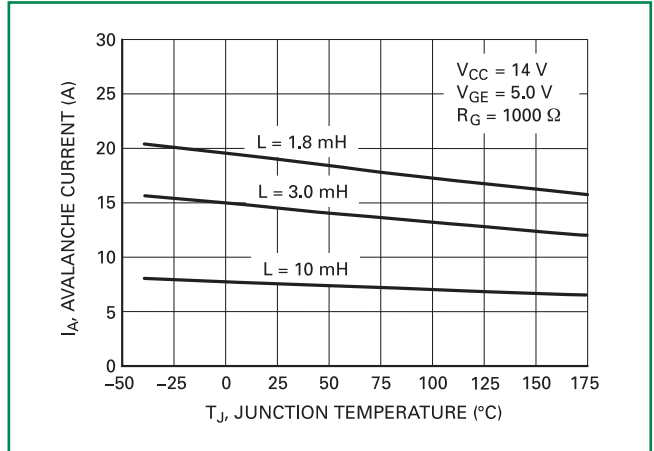
\*Maximum Value of Characteristic across Temperature Range.

**Ratings and Characteristic Curves**

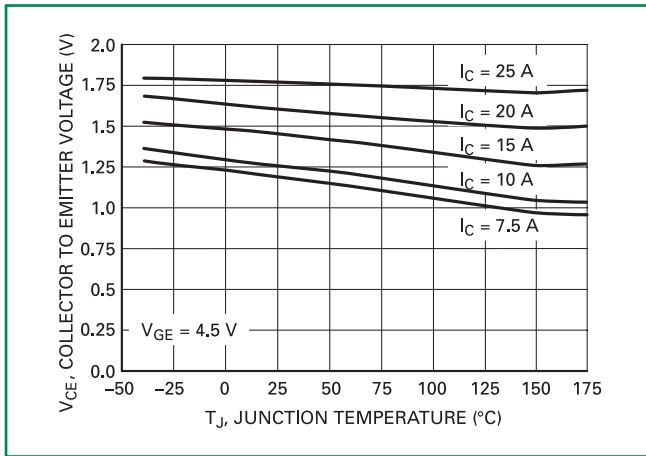
**Figure 1. Self Clamped Inductive Switching**



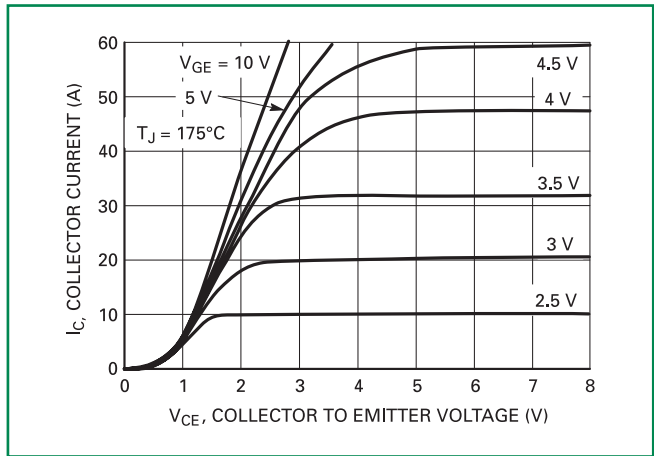
**Figure 2. Open Secondary Avalanche Current vs. Temperature**



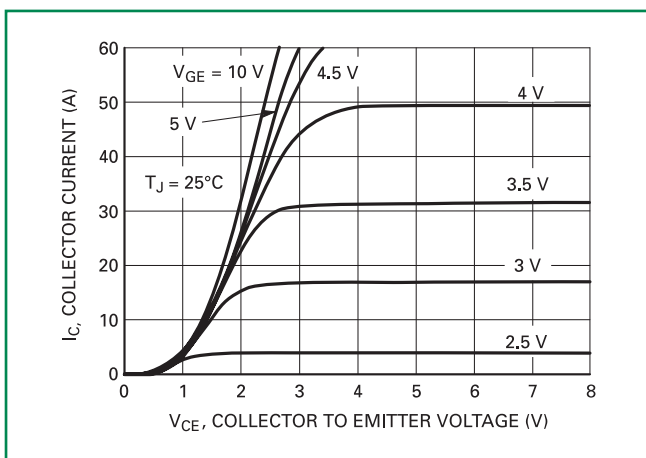
**Figure 3. Collector-to-Emitter Voltage vs. Junction Temperature**



**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**

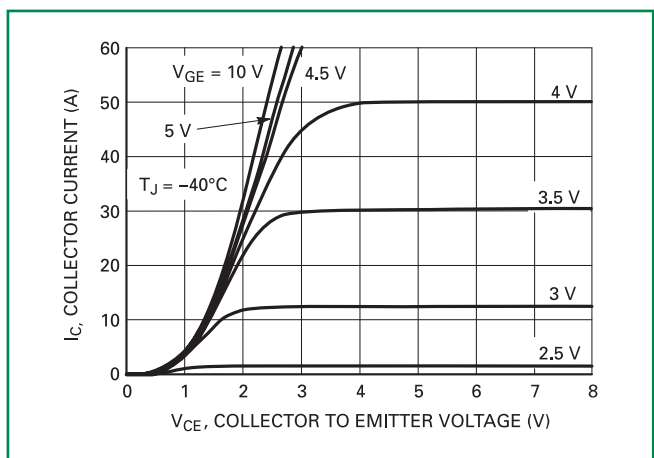


Figure 7. Transfer Characteristics

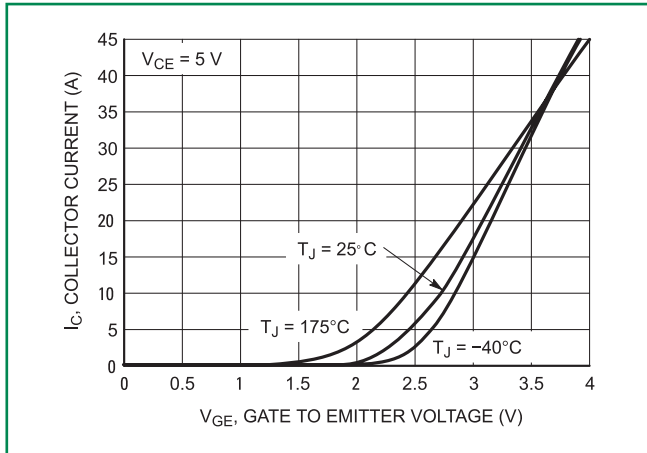


Figure 8. Collector-to-Emitter Leakage Current vs. Temperature

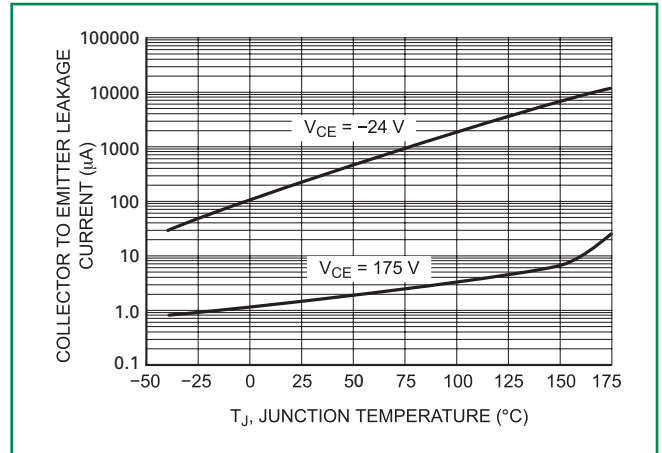


Figure 9. Gate Threshold Voltage vs. Temperature

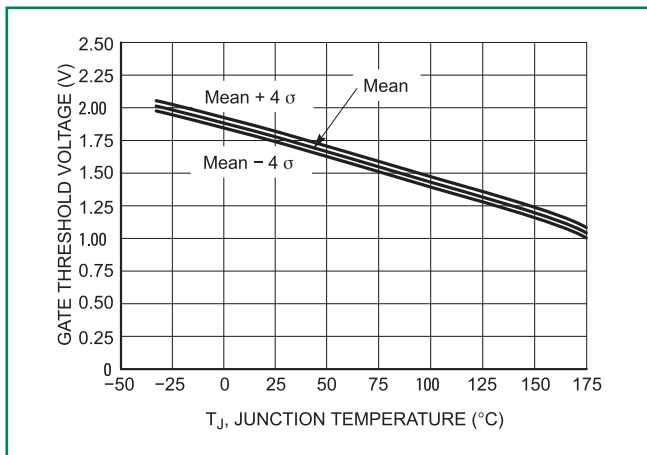


Figure 10. Capacitance vs. Collector-to-Emitter Voltage

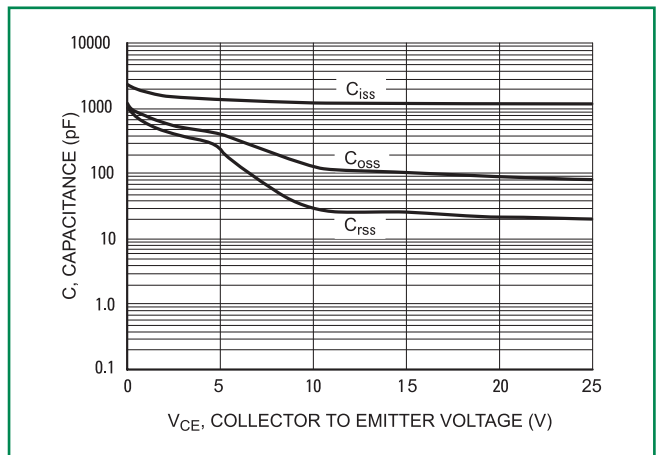


Figure 11. Resistive Switching Fall Time vs. Temperature

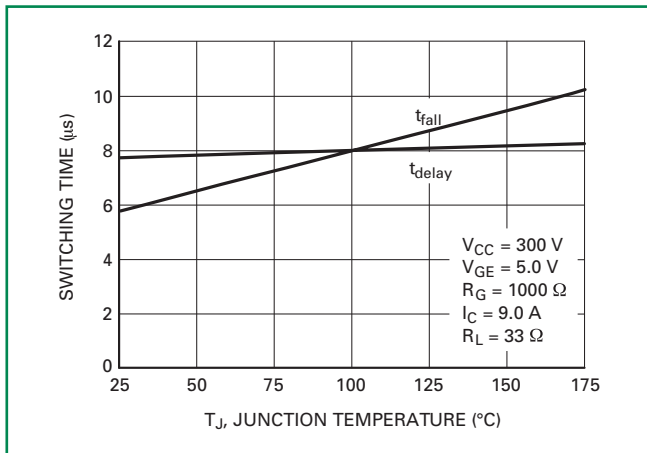
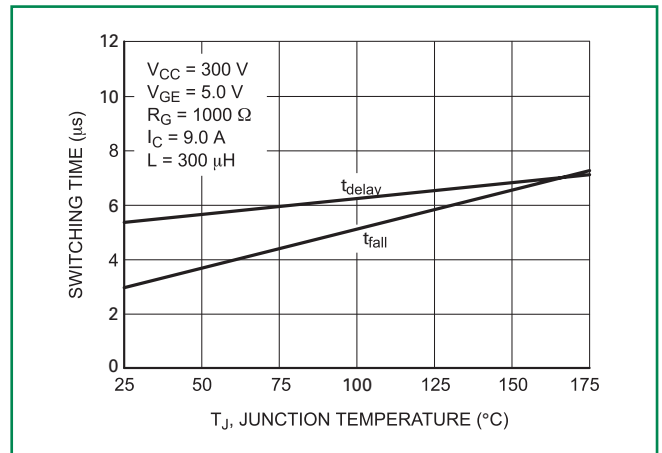
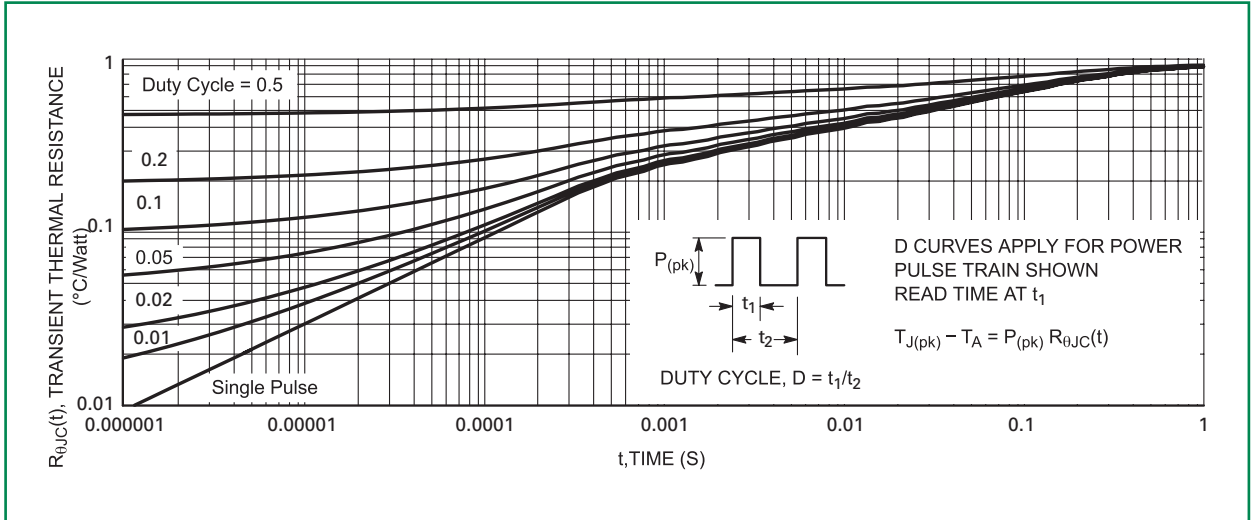


Figure 12. Inductive Switching Fall Time vs. Temperature

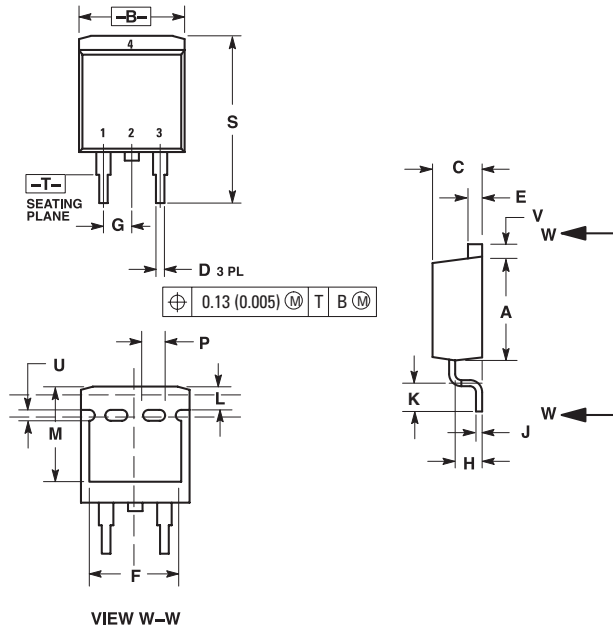


**Figure 13. Minimum Pad Transient Thermal Resistance (Non-normalized Junction-to-Ambient)**





**Dimensions**

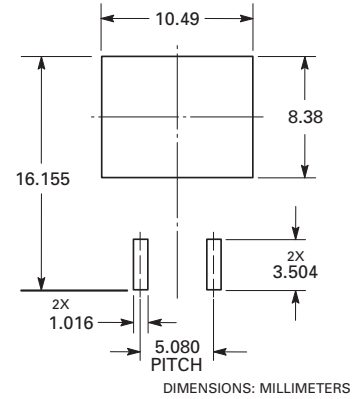


Dim	Inches		Millimeters	
	Min	Max	Min	Max
A	0.340	0.380	8.64	9.65
B	0.380	0.405	9.65	10.29
C	0.160	0.190	4.06	4.83
D	0.020	0.035	0.51	0.89
E	0.045	0.055	1.14	1.40
F	0.310	0.350	7.87	8.89
G	0.100 BSC		2.54 BSC	
H	0.080	0.110	2.03	2.79
J	0.018	0.025	0.46	0.64
K	0.090	0.110	2.29	2.79
L	0.052	0.072	1.32	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

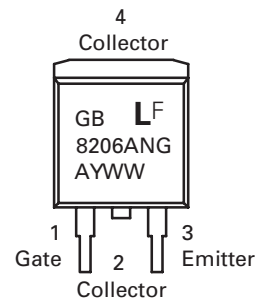
**NOTES:**

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

**Soldering Footprint**



**Part Marking System**



GB8206AN = Device Code

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

**ORDERING INFORMATION**

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

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