

# Ignition IGBT

## 20 A, 365 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
- Minimum Avalanche Energy – 500 mJ
- Gate Resistor ( $R_G$ ) = 70  $\Omega$
- This is a Pb-Free Device

### Applications

- Ignition Systems

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

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	$V_{CES}$	365	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 ( $t \leq 2$ ms, $f \leq 100$ Hz)	$I_G$	20	mA
ESD (Charged-Device Model)	ESD	2.0	kV
ESD (Human Body Model) $R = 1500 \Omega$ , $C = 100$ pF	ESD	8.0	kV
ESD (Machine Model) $R = 0 \Omega$ , $C = 200$ pF	ESD	500	V
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$ (Note 1)	$P_D$	165 1.1	W W/ $^\circ\text{C}$
Operating & Storage Temperature Range	$T_J, T_{stg}$	-55 to +175	$^\circ\text{C}$

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.

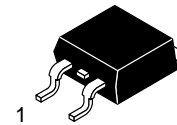
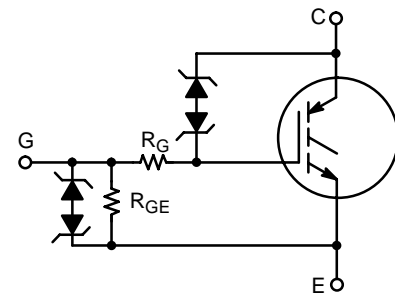
1. Assuming infinite heatsink Case-to-Ambient



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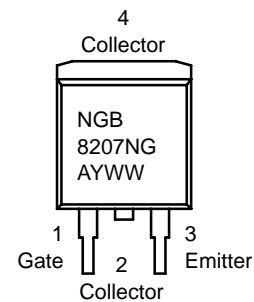
<http://onsemi.com>

**20 AMPS**  
**365 VOLTS**  
 $V_{CE(on)} = 1.5$  V Typ @  
 $I_C = 10$  A,  $V_{GE} \geq 4.5$  V



**D<sup>2</sup>PAK**  
**CASE 418B**  
**STYLE 4**

### MARKING DIAGRAM



NGB8207N = Device Code  
A = Assembly Location  
Y = Year  
WW = Work Week  
G = Pb-Free Package

### ORDERING INFORMATION

Device	Package	Shipping <sup>†</sup>
NGB8207NT4G	D <sup>2</sup> PAK (Pb-Free)	800 / Tape & Reel

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

# NGB8207N

## 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 $V_{CC} = 50\text{ V}$ , $V_{GE} = 10\text{ V}$ , Pk $I_L = 16.5\text{ A}$ , $L = 3.7\text{ mH}$ , $R_g = 1\text{ k}\Omega$ Starting $T_J = 25^{\circ}C$ $V_{CC} = 50\text{ V}$ , $V_{GE} = 10\text{ V}$ , Pk $I_L = 10\text{ A}$ , $L = 6.1\text{ mH}$ , $R_g = 1\text{ k}\Omega$ Starting $T_J = 125^{\circ}C$	$E_{AS}$	500 306	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	$R_{\theta JC}$	0.9	$^{\circ}C/W$
Thermal Resistance, Junction-to-Ambient (Note 2)	$R_{\theta JA}$	50	$^{\circ}C/W$
Maximum Temperature for Soldering Purposes, 0.125 in from case for 5 seconds (Note 3)	$T_L$	275	$^{\circ}C$

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

### ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Test Conditions	Temperature	Min	Typ	Max	Unit
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#### 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	$I_{CES}$	$V_{CE} = 24\text{ V}$ $V_{GE} = 0\text{ V}$	$T_J = 25^{\circ}C$		0.1	2.0	$\mu A$
			$T_J = 175^{\circ}C$	-	1.0	5	
		$T_J = -40^{\circ}C$	-	0.25	2.5		
Reverse Collector-Emitter Clamp Voltage	$BV_{CES(R)}$	$I_C = -75\text{ mA}$	$T_J = 25^{\circ}C$	30	33	39	V
			$T_J = 175^{\circ}C$	30	36	42	
			$T_J = -40^{\circ}C$	29	32	35	
Reverse Collector-Emitter Leakage Current	$I_{CES(R)}$	$V_{CE} = -24\text{ V}$	$T_J = 25^{\circ}C$	0.10	0.25	0.85	mA
			$T_J = 175^{\circ}C$	20	25	40	
			$T_J = -40^{\circ}C$	-	0.03	0.3	
Gate-Emitter Clamp Voltage	$BV_{GES}$	$I_G = \pm 5.0\text{ mA}$	$T_J = -40^{\circ}C$ to $175^{\circ}C$	12	13	14.5	V
Gate-Emitter Leakage Current	$I_{GES}$	$V_{GE} = \pm 10\text{ V}$	$T_J = -40^{\circ}C$ to $175^{\circ}C$	500	700	1000	$\mu A$
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 4)

Gate Threshold Voltage	$V_{GE(th)}$	$I_C = 1.0\text{ mA}$ $V_{GE} = V_{CE}$	$T_J = 25^{\circ}C$	1.2	1.5	2.0	V
			$T_J = 175^{\circ}C$	0.6	0.8	1.2	
			$T_J = -40^{\circ}C$	1.4	1.7	2.0	
Threshold Temperature Coefficient (Negative)				12	12	12	mV/ $^{\circ}C$
Collector-to-Emitter On-Voltage	$V_{CE(on)}$	$I_C = 6.0\text{ A}$ $V_{GE} = 4.0\text{ V}$	$T_J = 25^{\circ}C$	1.0	1.3	1.6	V
			$T_J = 175^{\circ}C$	0.8	1.1	1.4	
			$T_J = -40^{\circ}C$	1.15	1.4	1.75	
		$I_C = 10\text{ mA}$ $V_{GE} = 4.5\text{ V}$	$T_J = 25^{\circ}C$	-	0.62	1.0	

\*Maximum Value of Characteristic across Temperature Range.

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

# NGB8207N

## ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Test Conditions	Temperature	Min	Typ	Max	Unit
<b>ON CHARACTERISTICS</b> (Note 4)							
Collector-to-Emitter On-Voltage	$V_{CE(on)}$	$I_C = 8.0\text{ A}$ $V_{GE} = 4.0\text{ V}$	$T_J = 25^\circ\text{C}$	1.1	1.5	1.7	V
			$T_J = 175^\circ\text{C}$	1.0	1.3	1.6	
			$T_J = -40^\circ\text{C}$	1.2	1.5	1.85	
		$I_C = 10\text{ A}$ $V_{GE} = 3.7\text{ V}$	$T_J = 25^\circ\text{C}$	1.2	1.6	1.9	
			$T_J = 175^\circ\text{C}$	1.1	1.45	1.8	
			$T_J = -40^\circ\text{C}$	1.3	1.7	2.0	
		$I_C = 10\text{ A}$ $V_{GE} = 4.0\text{ V}$	$T_J = 25^\circ\text{C}$	1.1	1.5	1.85	
			$T_J = 175^\circ\text{C}$	1.1	1.4	1.75	
			$T_J = -40^\circ\text{C}$	1.35	1.7	2.1	
		$I_C = 10\text{ A}$ $V_{GE} = 4.5\text{ V}$	$T_J = 25^\circ\text{C}$	1.2	1.5	1.8	
			$T_J = 175^\circ\text{C}$	1.1	1.4	1.7	
			$T_J = -40^\circ\text{C}$	1.2	1.6	2.0	
		$I_C = 15\text{ A}$ $V_{GE} = 4.0\text{ V}$	$T_J = 25^\circ\text{C}$	1.45	1.85	2.15	
			$T_J = 175^\circ\text{C}$	1.6	1.9	2.4	
			$T_J = -40^\circ\text{C}$	1.5	1.9	2.25	
		$I_C = 20\text{ A}$ $V_{GE} = 4.0\text{ V}$	$T_J = 25^\circ\text{C}$	1.6	2.1	2.6	
			$T_J = 175^\circ\text{C}$	2.0	2.4	3.1	
			$T_J = -40^\circ\text{C}$	1.6	2.1	2.5	
Forward Transconductance	gfs	$I_C = 6.0\text{ A}$ $V_{CE} = 5.0\text{ V}$	$T_J = 25^\circ\text{C}$	-	15.8	-	Mhos

## DYNAMIC CHARACTERISTICS

Input Capacitance	$C_{ISS}$	$f = 10\text{ kHz}$ $V_{CE} = 25\text{ V}$	$T_J = 25^\circ\text{C}$	750	810	900	pF
Output Capacitance	$C_{OSS}$			75	90	105	
Transfer Capacitance	$C_{RSS}$			4	7	12	

## SWITCHING CHARACTERISTICS

Turn-On Delay Time (Resistive) Low Voltage	$t_{d(on)}$	$V_{CE} = 14\text{ V}$ $R_L = 1.0\ \Omega$ $V_{GE} = 5.0\text{ V}$ $R_G = 1000\ \Omega$	$T_J = 25^\circ\text{C}$	0.5	0.55	0.7	$\mu\text{Sec}$
Rise Time (Resistive) Low Voltage	$t_r$		$T_J = 25^\circ\text{C}$	2.0	2.32	2.7	
Turn-Off Delay Time (Resistive) Low Voltage	$t_{d(off)}$	$V_{CE} = 14\text{ V}$ $R_L = 1.0\ \Omega$ $V_{GE} = 5.0\text{ V}$ $R_G = 1000\ \Omega$	$T_J = 25^\circ\text{C}$	2.0	2.5	3.0	
Fall Time (Resistive) Low Voltage	$t_f$		$T_J = 25^\circ\text{C}$	8.0	10	13	
Turn-On Delay Time (Resistive) High Voltage	$t_{d(on)}$	$V_{CE} = 300\text{ V}$ $R_L = 46\ \Omega$ $V_{GE} = 5.0\text{ V}$ $R_G = 1000\ \Omega$	$T_J = 25^\circ\text{C}$	0.5	0.65	0.75	
Rise Time (Resistive) High Voltage	$t_r$		$T_J = 25^\circ\text{C}$	0.7	1.8	2.0	
Turn-Off Delay Time (Resistive) High Voltage	$t_{d(off)}$	$V_{CE} = 300\text{ V}$ $R_L = 46\ \Omega$ $V_{GE} = 5.0\text{ V}$ $R_G = 1000\ \Omega$	$T_J = 25^\circ\text{C}$	4.0	4.7	6.0	
Fall Time (Resistive) High Voltage	$t_f$		$T_J = 25^\circ\text{C}$	6.0	10	15	

\*Maximum Value of Characteristic across Temperature Range.

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

TYPICAL ELECTRICAL CHARACTERISTICS

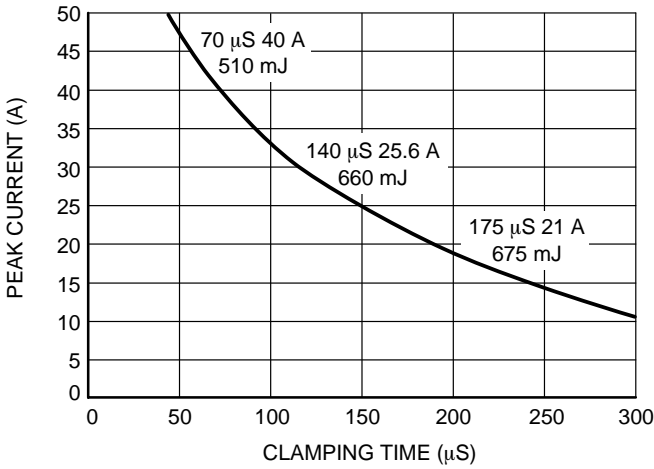


Figure 1. Typical Self Clamped Inductive Switching Performance (SCIS) @ 25°C

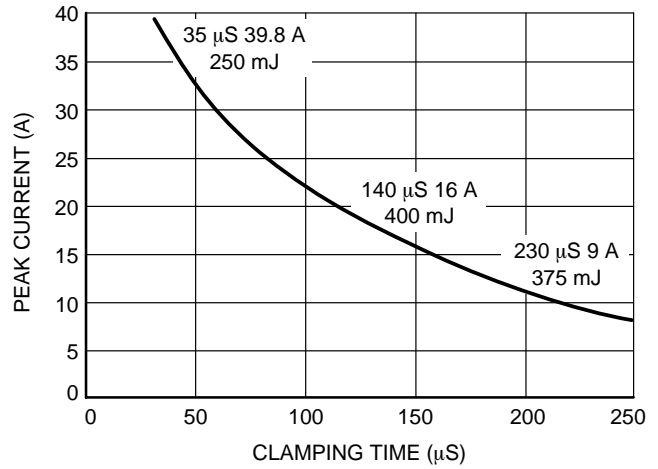


Figure 2. Typical Self Clamped Inductive Switching Performance (SCIS) @ 150°C

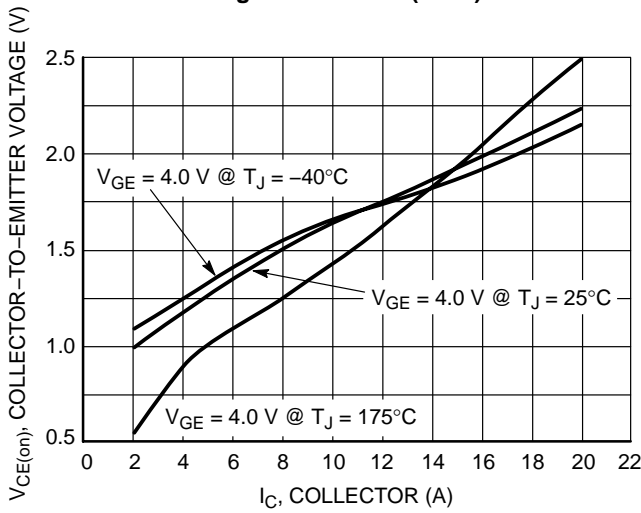


Figure 3. Collector-to-Emitter Voltage vs. Collector Current

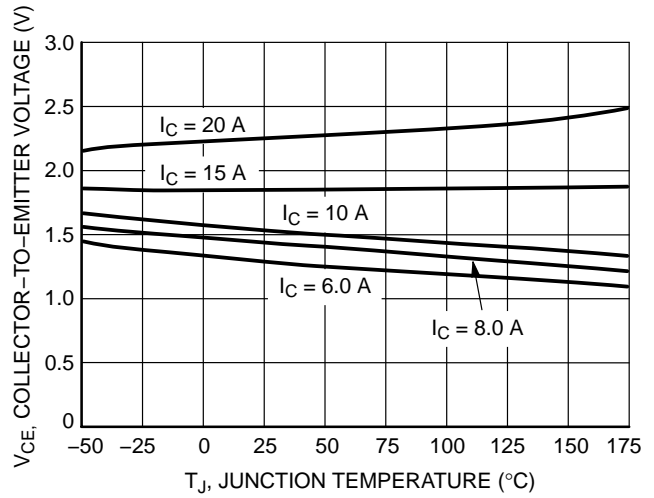


Figure 4. Collector-to-Emitter Voltage vs. Junction Temperature

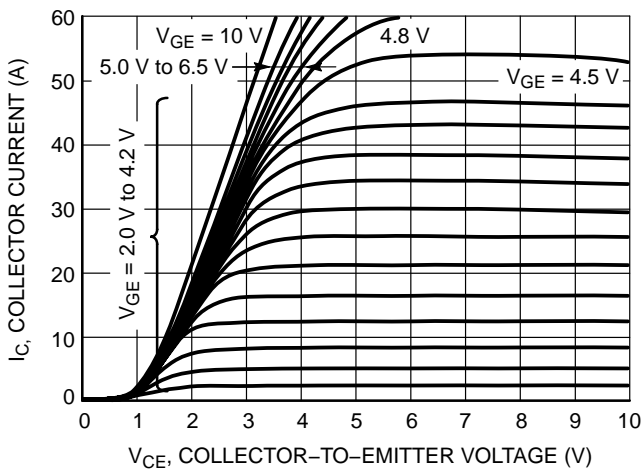


Figure 5. On-Region Characteristics @  $T_J = 25^\circ\text{C}$

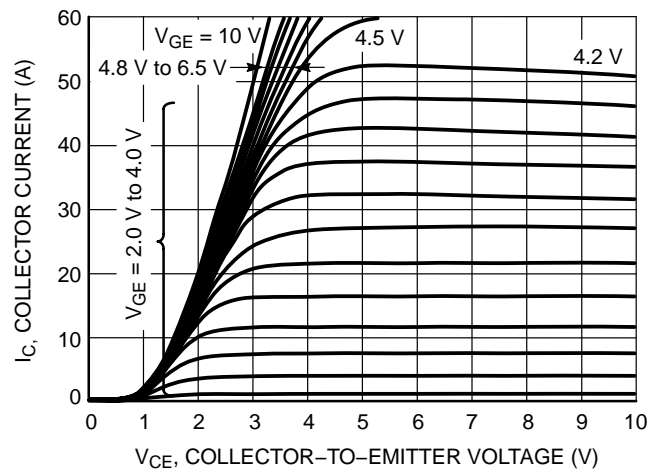


Figure 6. On-Region Characteristics @  $T_J = -40^\circ\text{C}$

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TYPICAL ELECTRICAL CHARACTERISTICS

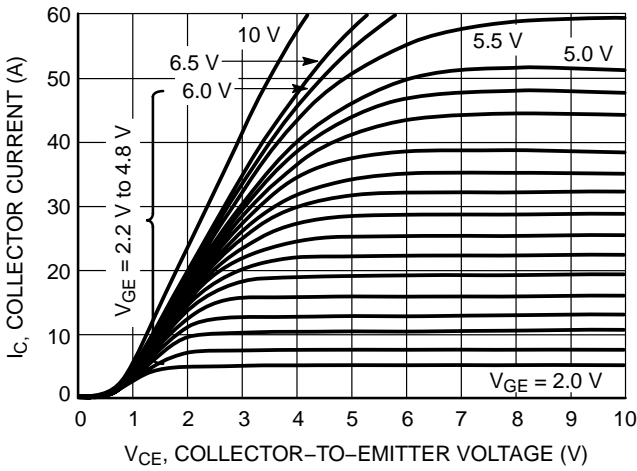


Figure 7. On-Region Characteristics  
@  $T_J = 175^\circ\text{C}$

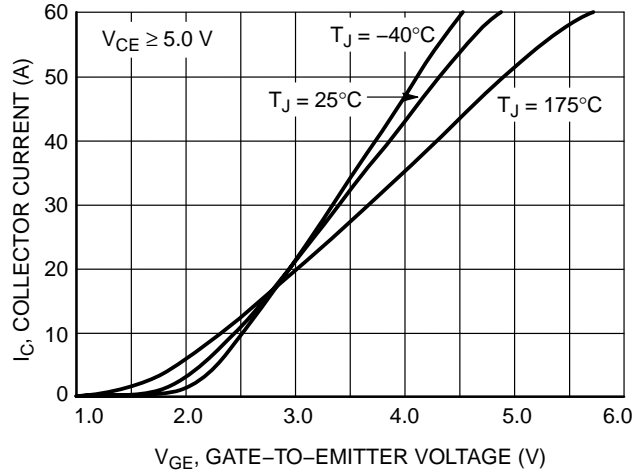


Figure 8. Transfer Characteristics

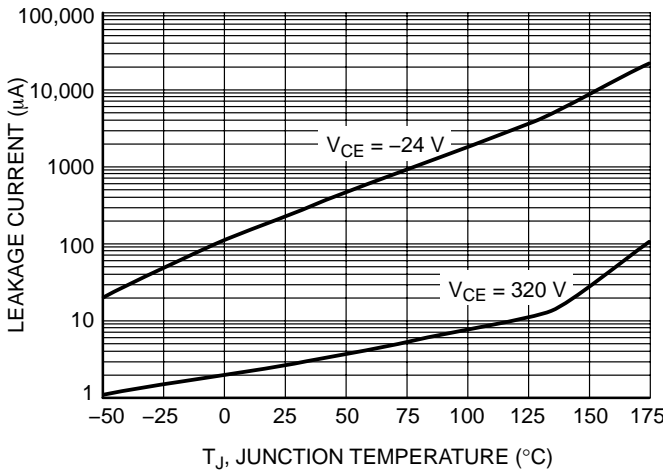


Figure 9. Collector-to-Emitter Leakage Current vs. Temperature

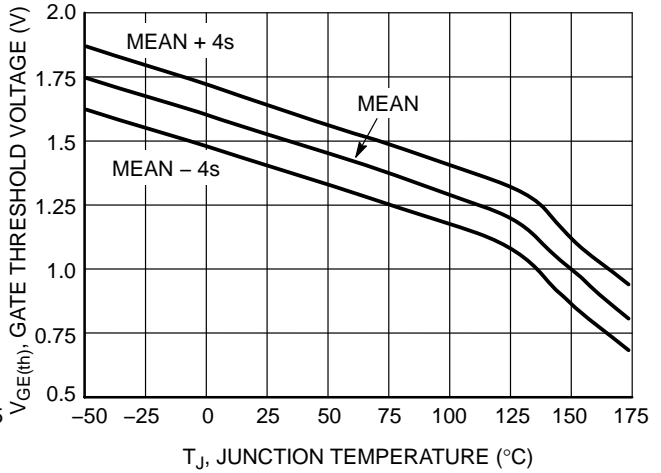


Figure 10. Gate Threshold Voltage vs. Temperature

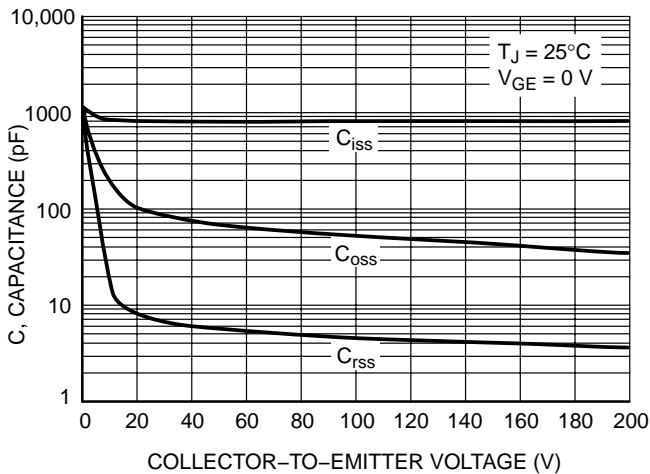


Figure 11. Capacitance Variation

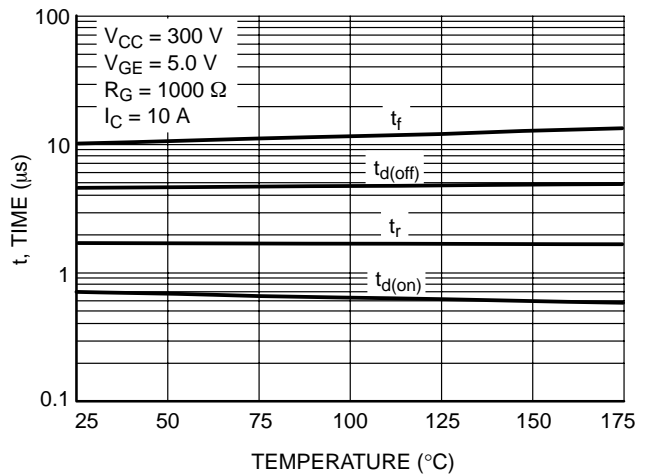


Figure 12. Resistive Switching Time Variation vs. Temperature

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TYPICAL ELECTRICAL CHARACTERISTICS

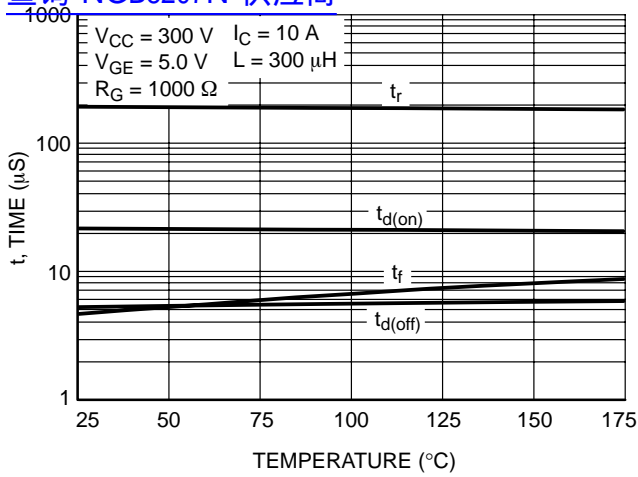


Figure 13. Inductive Switching Time Variation vs. Temperature

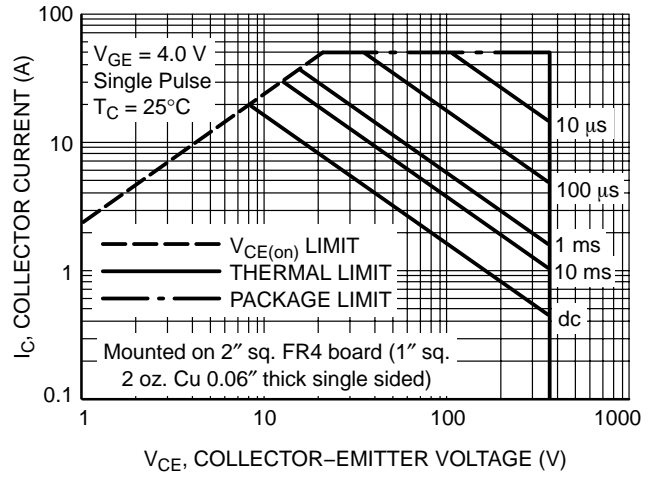


Figure 14. Forward Biased Safe Operating Area

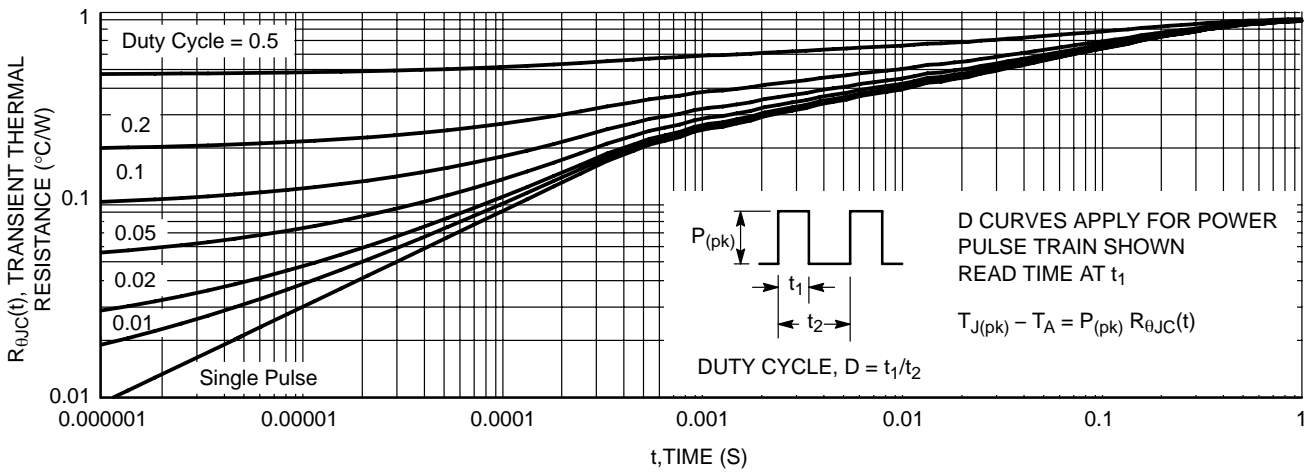


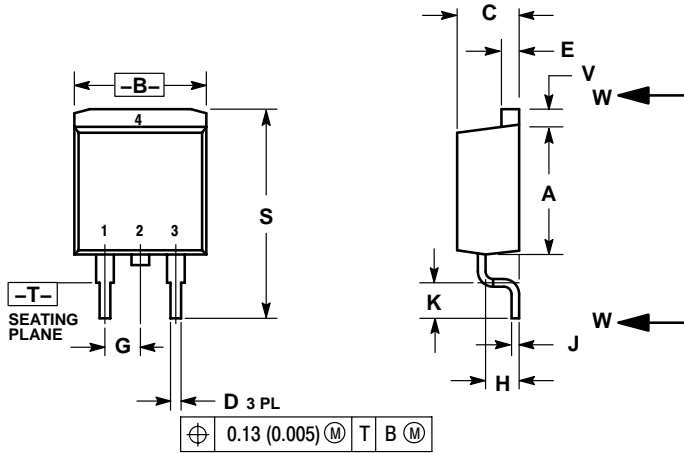
Figure 15. Best Case Transient Thermal Resistance (Non-normalized Junction-to-Case Mounted on Cold Plate)

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## PACKAGE DIMENSIONS

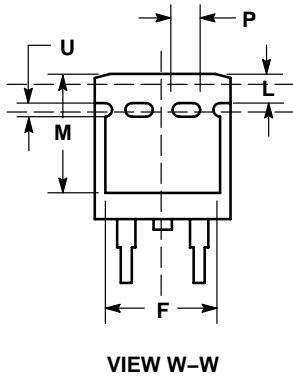
D<sup>2</sup>PAK 3  
CASE 418B-04  
ISSUE J



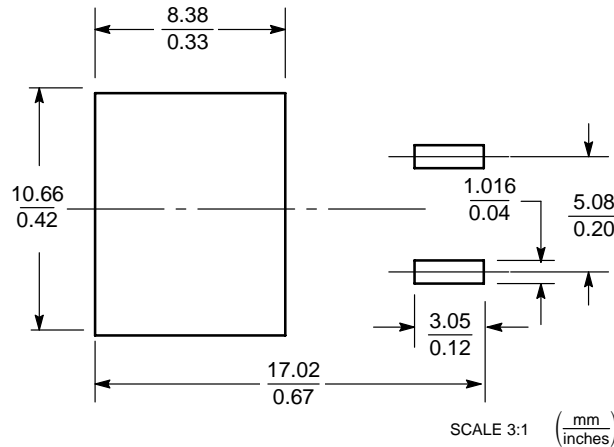
- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. 418B-01 THRU 418B-03 OBSOLETE, NEW STANDARD 418B-04.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.340	0.380	8.64	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

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



### SOLDERING FOOTPRINT\*



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

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