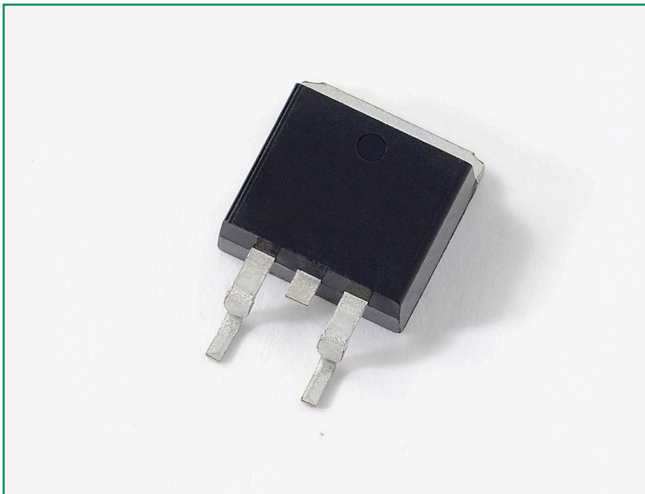


# NGD8205AN - 20 A, 350 V, N-Channel Ignition IGBT, DPAK



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

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

Rating	Symbol	Value	Unit
Collector–Emitter Voltage	$V_{CES}$	390	$V_{DC}$
Gate–Gate Voltage	$V_{CER}$	390	$V_{DC}$
Gate–Emitter Voltage	$V_{GE}$	$\pm 15$	$V_{DC}$
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
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	400	V
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	125 0.83	W $W/^\circ\text{C}$
Operating and 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.

### 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.

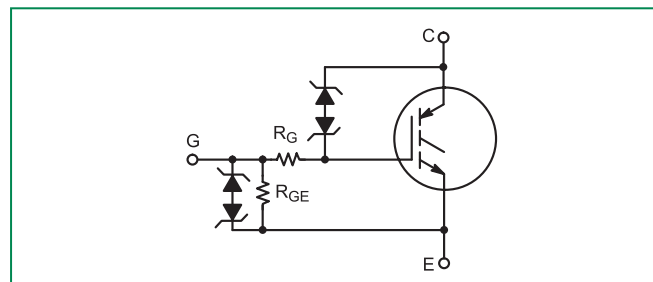
### Features

- Ideal for Coil–on–Plug and Driver–on–Coil Applications
- DPAK Package Offers Smaller Footprint for Increased Board Space
- 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
- Optional Gate Resistor ( $R_G$ ) and Gate–Emitter Resistor ( $R_{GE}$ )
- These are Pb–Free Devices

### Applications

- Ignition Systems

### Functional Diagram



### Additional Information



Datasheet



Resources



Samples

**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

**Thermal Characteristics**

	Symbol	Value	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.2	$^{\circ}\text{C}/\text{W}$
Thermal Resistance, Junction to Ambient DPAK (Note 1)	$R_{\theta JA}$	95	
Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 5 seconds	$T_L$	275	$^{\circ}\text{C}$

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

**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 $175^\circ\text{C}$	325	350	375	V
		$I_C = 10 \text{ mA}$	$T_J = -40^\circ\text{C}$ to $175^\circ\text{C}$	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
			$T_J = 175^\circ\text{C}$	35	39	45*	
			$T_J = -40^\circ\text{C}$	30	33	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	
			$T_J = -40^\circ\text{C}$	–	0.03	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 $175^\circ\text{C}$	–	70	–	$\Omega$
Gate–Emitter Resistor	$R_{GE}$	–	$T_J = -40^\circ\text{C}$ to $150^\circ\text{C}$	14.25	16	25	k $\Omega$

\*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			
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/°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			
			$T_J = 175^\circ\text{C}$	0.7	0.95	1.15				
			$T_J = -40^\circ\text{C}$	1.0	1.3	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	1.5				
		$I_C = 7.5\text{ A}$ , $V_{GE} = 4.5\text{ V}$	$T_J = 25^\circ\text{C}$	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*				
		$I_C = 10\text{ A}$ , $V_{GE} = 4.5\text{ V}$	$T_J = 25^\circ\text{C}$	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*				
		$I_C = 15\text{ A}$ , $V_{GE} = 4.5\text{ V}$	$T_J = 25^\circ\text{C}$	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*				
		$I_C = 20\text{ A}$ , $V_{GE} = 4.5\text{ V}$	$T_J = 25^\circ\text{C}$	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

\*Maximum Value of Characteristic across Temperature Range.

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

**Dynamic Characteristics**

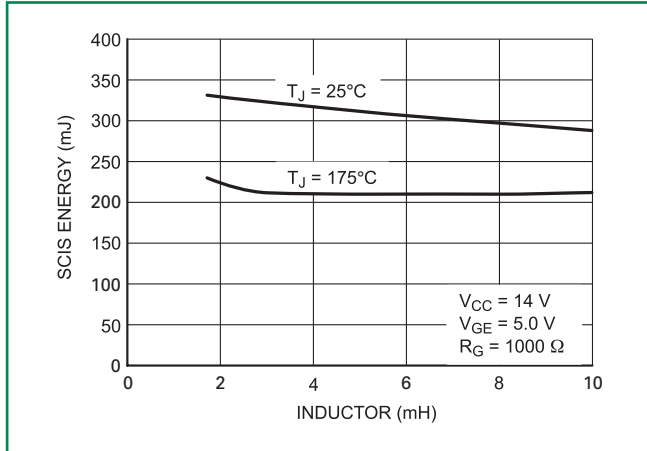
Characteristic	Symbol	Test Conditions	Temperature	Min	Typ	Max	Unit
Input Capacitance	$C_{ISS}$	$V_{CE} = 25\text{ V}$ $f = 10\text{ kHz}$	$T_J = 25^\circ\text{C}$	1100	1300	1500	pF
Output Capacitance	$C_{OSS}$			70	80	90	
Transfer Capacitance	$C_{RSS}$			18	20	22	

**Switching Characteristics**

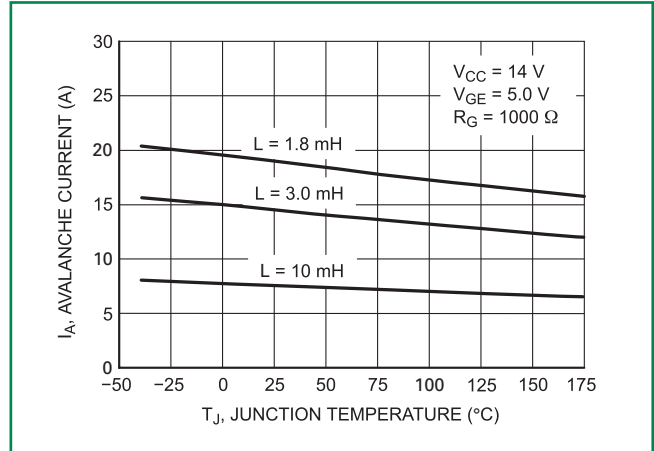
Characteristic	Symbol	Test Conditions	Temperature	Min	Typ	Max	Unit	
Turn-Off Delay Time (Resistive)	$t_{d(off)}$	$V_{CC} = 300\text{ V}$ $I_C = 9.0\text{ A}$ $R_G = 1.0\text{ k}\Omega$ $R_L = 33\ \Omega$ $V_{GE} = 5.0\text{ V}$	$T_J = 25^\circ\text{C}$	6.0	8.0	10	μSec	
			$T_J = 175^\circ\text{C}$	6.0	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)	$t_{d(off)}$		$V_{CC} = 300\text{ V}$ $I_C = 9.0\text{ A}$ $R_G = 1.0\text{ k}\Omega$ $L = 300\ \mu\text{H}$ $V_{GE} = 5.0\text{ V}$	$T_J = 25^\circ\text{C}$	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		

**Typical Electrical Characteristics**

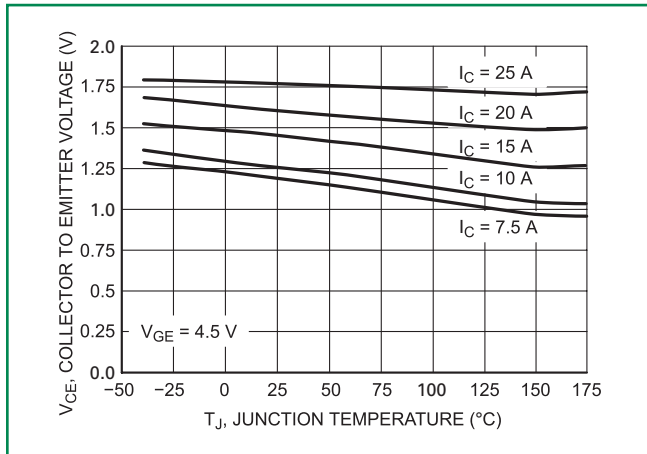
**Figure 1. Self Clamped Inductive Switching**



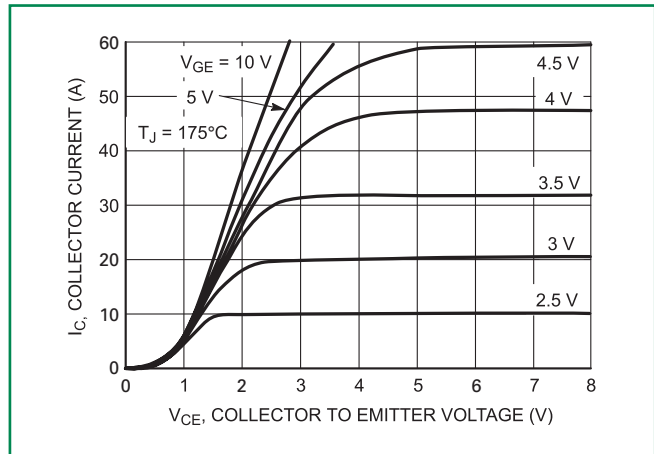
**Figure 2. Open Secondary Avalanche Current vs. Temperature**



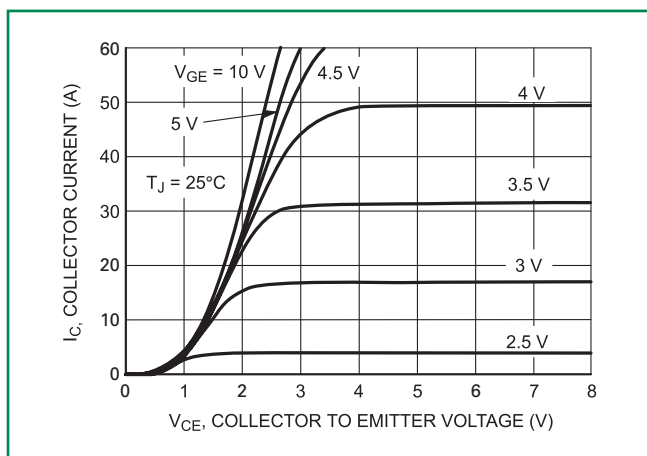
**Figure 3. Collector-to-Emitter Voltage vs. Junction Temperature**



**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**

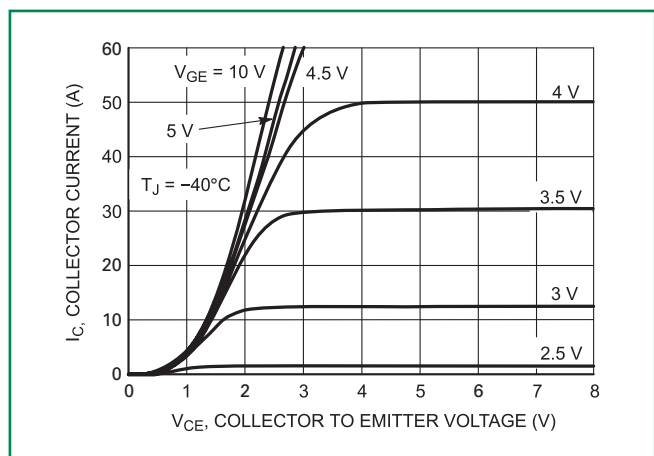


Figure 7. Transfer Characteristics

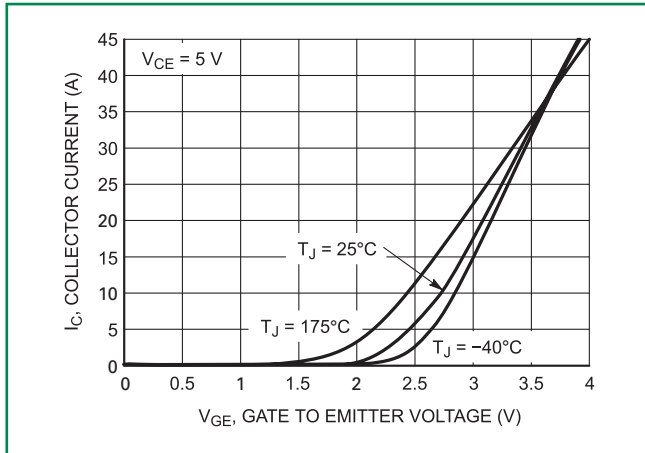


Figure 8. Collector-to-Emitter Leakage Current vs. Temperature

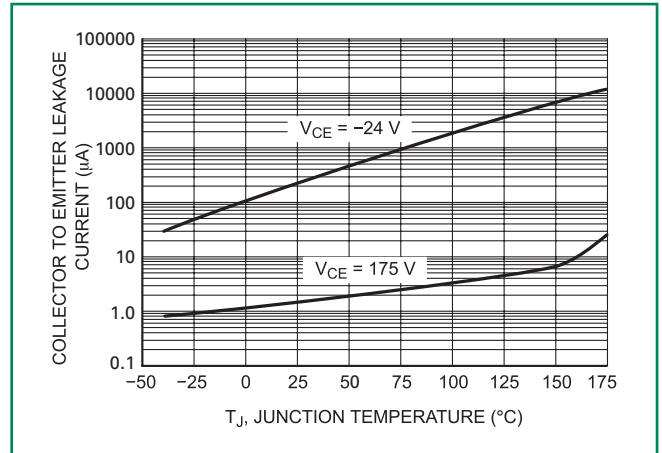


Figure 9. Gate Threshold Voltage vs. Temperature

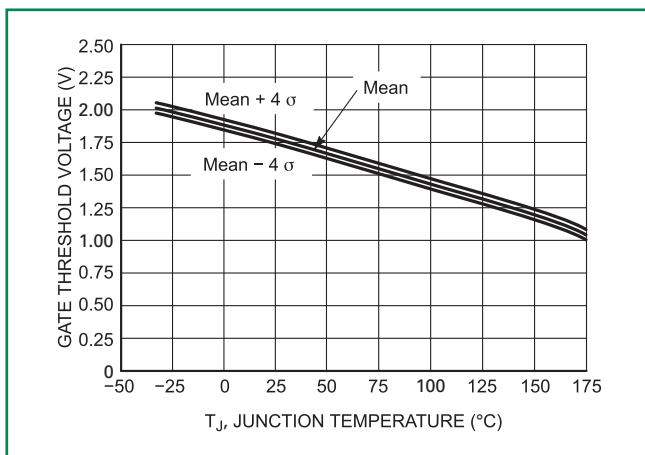


Figure 10. Capacitance vs. Collector-to-Emitter Voltage

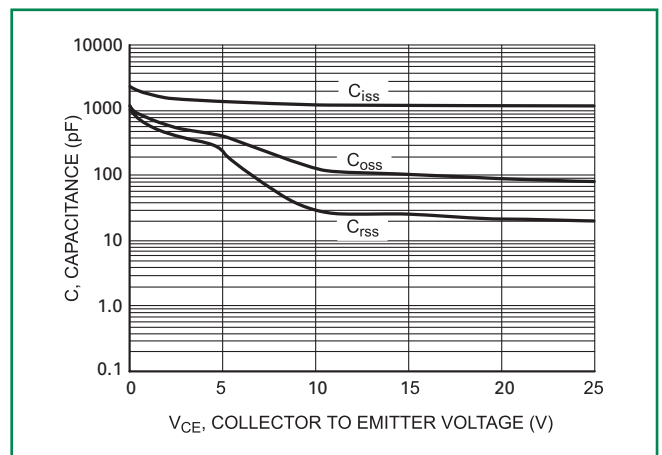


Figure 11. Typical Open Secondary Latch Current vs Temperature

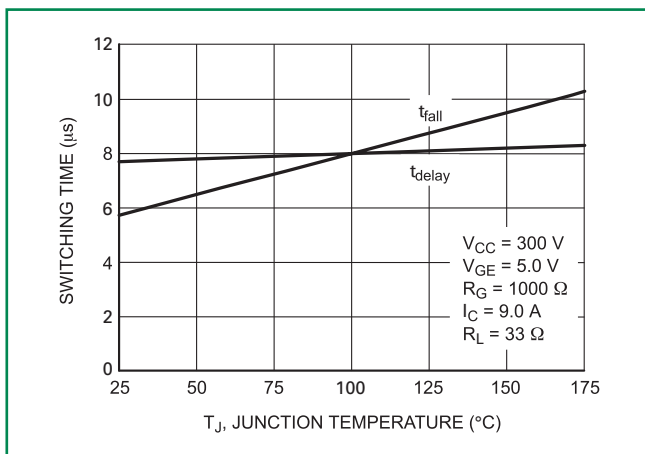
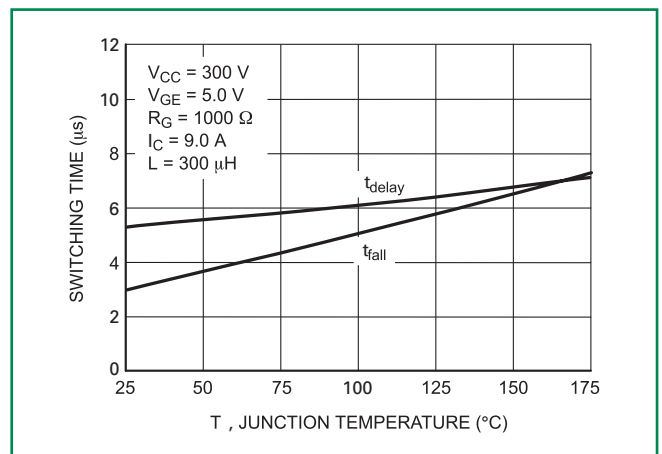
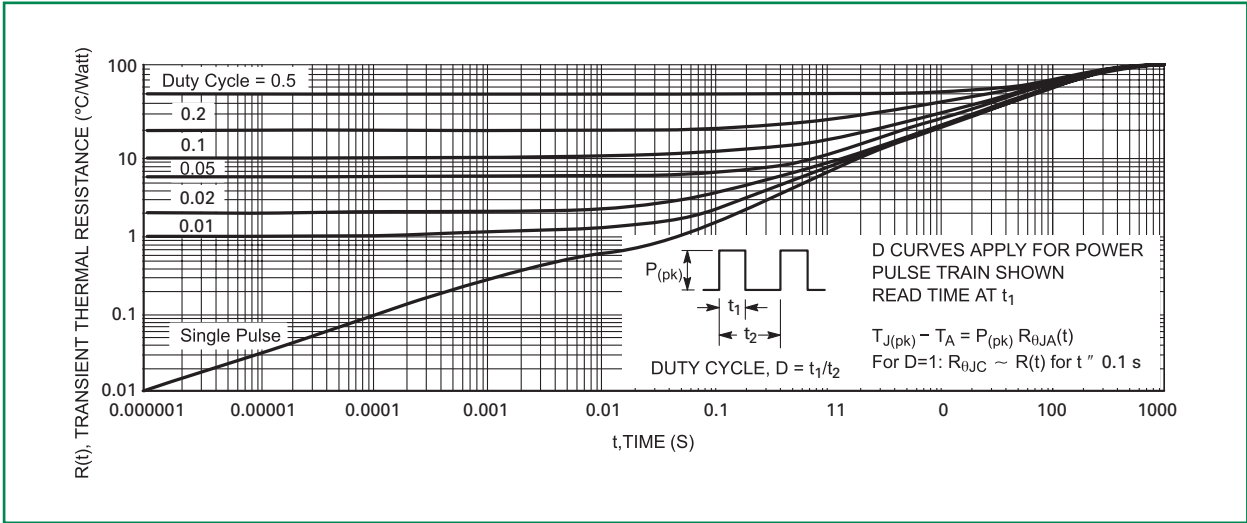


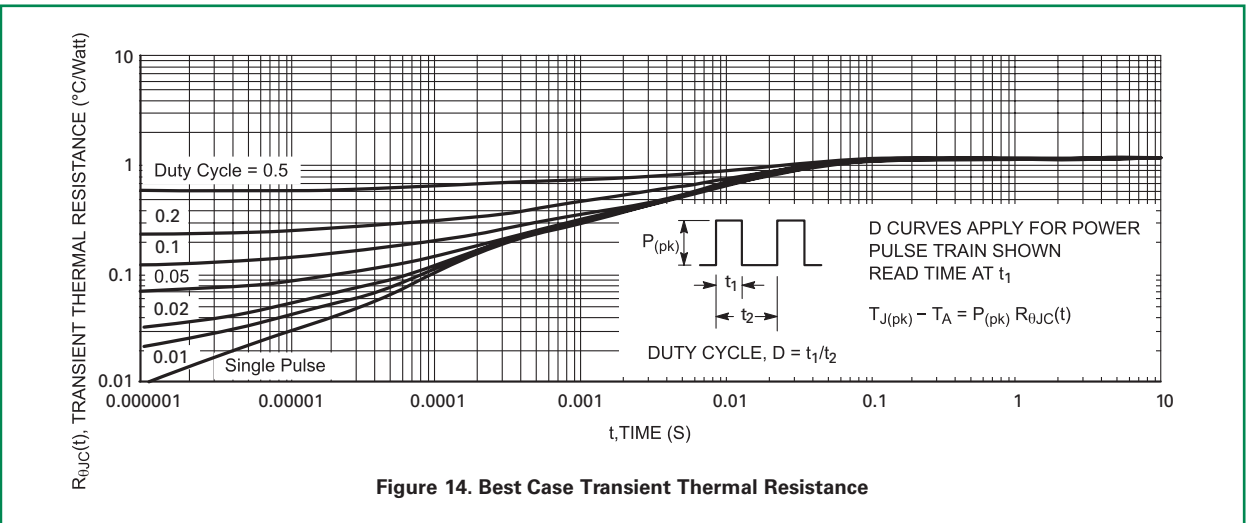
Figure 12. Inductive Switching Fall Time vs. Temperature



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



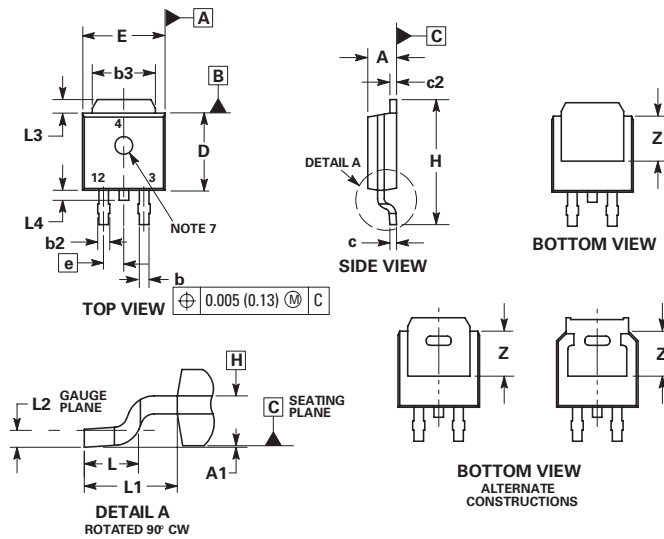
**Figure 14. Best Case Transient Thermal Resistance (Non-normalized Junction-to-Case Mounted on Cold Plate)**



**Figure 14. Best Case Transient Thermal Resistance**



**Dimensions**

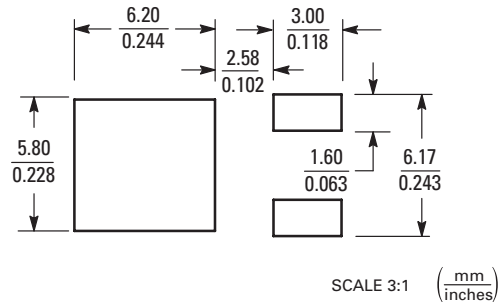


Dim	Inches		Millimeters	
	Min	Max	Min	Max
A	0.086	0.094	2.18	2.38
A1	0.000	0.005	0.00	0.13
b	0.025	0.035	0.63	0.89
b2	0.028	0.045	0.72	1.14
b3	0.180	0.215	4.57	5.46
c	0.018	0.024	0.46	0.61
c2	0.018	0.024	0.46	0.61
D	0.235	0.245	5.97	6.22
E	0.250	0.265	6.35	6.73
e	0.090 BSC		2.29 BSC	
H	0.370	0.410	9.40	10.41
L	0.055	0.070	1.40	1.78
L1	0.114 REF		2.90 REF	
L2	0.020 BSC		0.51 BSC	
L3	0.035	0.050	0.89	1.27
L4	---	0.040	---	1.01
Z	0.155	---	3.93	---

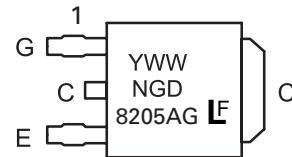
NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCH.
3. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS b3, L3 and Z.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.006 INCHES PER SIDE.
5. DIMENSIONS D AND E ARE DETERMINED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
6. DATUMS A AND B ARE DETERMINED AT DATUM PLANE H.

**Soldering Footprint**



**Part Marking System**



- Y = Year
- WW = Work Week
- NGD8205x = Device Code
- G = Pb-Free Package

**ORDERING INFORMATION**

Device	Package	Shipping†
NGD8205ANT4G	DPAK (Pb-Free)	2,500 / Tape & Reel

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