

# NGD8209N

## Ignition IGBT 12 A, 410 V N-Channel DPAK

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 motorbike ignition, Direct Fuel Injection, or wherever high voltage and high current switching is required.

### Features

- Ideal for Coil-on-Plug Applications
- DPAK Package Offers Smaller Footprint and Increased Board Space
- Gate-Emitter ESD Protection
- Temperature Compensated Gate-Collector Voltage Clamp Limits Stress Applied to Load
- Low Saturation Voltage
- High Pulsed Current Capability
- These are Pb-Free Devices

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

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	$V_{CES}$	445	$V_{DC}$
Collector-Gate Voltage	$V_{CER}$	445	$V_{DC}$
Gate-Emitter Voltage	$V_{GE}$	15	$V_{DC}$
Collector Current-Continuous @ $T_C = 25^\circ\text{C}$ - Pulsed	$I_C$	12 30	$A_{DC}$ $A_{AC}$
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	800	V
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	94 0.63	Watts $W/^\circ\text{C}$
Operating and Storage Temperature Range	$T_J, T_{stg}$	-55 to +175	$^\circ\text{C}$

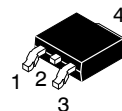
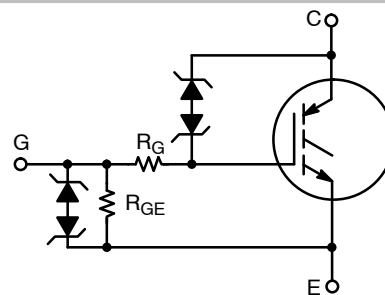
Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.



**ON Semiconductor®**

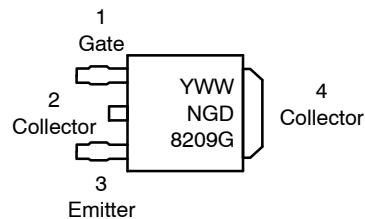
<http://onsemi.com>

**12 AMPS**  
**410 VOLTS**  
 $V_{CE(on)} \leq 2.0 \text{ V @}$   
 $I_C = 6.0 \text{ A}, V_{GE} \geq 4.0 \text{ V}$



**DPAK  
CASE 369C  
STYLE 7**

### MARKING DIAGRAM



Y = Year  
WW = Work Week  
G = Pb-Free Device

### ORDERING INFORMATION

Device	Package	Shipping†
NGD8209NT4G	DPAK (Pb-Free)	2500 / Tape & Reel

†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.

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## UNCLAMPED COLLECTOR-TO-EMITTER AVALANCHE CHARACTERISTICS

Characteristic	Symbol	Value	Unit
Single Pulse Collector-to-Emitter Avalanche Energy $V_{CC} = 50\text{ V}$ , $V_{GE} = 5.0\text{ V}$ , $\text{Pk } I_L = 7.4\text{ A}$ , $L = 10\text{ mH}$ , Starting $T_J = 25^\circ\text{C}$	$E_{AS}$	274	mJ

## THERMAL CHARACTERISTICS

Characteristic	Symbol	Value	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.6	$^\circ\text{C/W}$
Thermal Resistance, Junction to Ambient (Note 1)	$R_{\theta JA}$	105	
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

Characteristic	Symbol	Test Conditions	Temperature	Min	Typ	Max	Unit
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## OFF CHARACTERISTICS

Collector-Emitter Clamp Voltage	$BV_{CES}$	$I_C = 2.0\text{ mA}$	$T_J = -40^\circ\text{C}$ to $150^\circ\text{C}$	380	410	435	$V_{DC}$
		$I_C = 10\text{ mA}$	$T_J = -40^\circ\text{C}$ to $150^\circ\text{C}$	390	420	445	
Zero Gate Voltage Collector Current	$I_{CES}$	$V_{CE} = 350\text{ V}$ , $V_{GE} = 0\text{ V}$	$T_J = 25^\circ\text{C}$	-	1.0	25	$\mu\text{A}_{DC}$
			$T_J = 150^\circ\text{C}$	-	9.0	50	
			$T_J = -40^\circ\text{C}$	-	0.5	15	
Reverse Collector-Emitter Leakage Current	$I_{ECS}$	$V_{CE} = -24\text{ V}$	$T_J = 25^\circ\text{C}$	-	0.5	1.0	mA
			$T_J = 150^\circ\text{C}$	-	10	30	
			$T_J = -40^\circ\text{C}$	-	0.05	0.5	
Reverse Collector-Emitter Clamp Voltage	$BV_{CES(R)}$	$I_C = -75\text{ mA}$	$T_J = 25^\circ\text{C}$	26	33	38	$V_{DC}$
			$T_J = 150^\circ\text{C}$	29	36	41	
			$T_J = -40^\circ\text{C}$	24	32	36	
Gate-Emitter Clamp Voltage	$BV_{GES}$	$I_G = 5.0\text{ mA}$	$T_J = -40^\circ\text{C}$ to $150^\circ\text{C}$	10	13	16	$V_{DC}$
Gate-Emitter Leakage Current	$I_{GES}$	$V_{GE} = 10\text{ V}$	$T_J = -40^\circ\text{C}$ to $150^\circ\text{C}$	380	635	1000	$\mu\text{A}_{DC}$
Gate Resistor	$R_G$	-	$T_J = -40^\circ\text{C}$ to $150^\circ\text{C}$	-	70	-	$\Omega$
Gate Emitter Resistor	$R_{GE}$	-	$T_J = -40^\circ\text{C}$ to $150^\circ\text{C}$	10	16	26	k $\Omega$

## ON CHARACTERISTICS (Note 2)

Gate Threshold Voltage	$V_{GE(th)}$	$I_C = 1.0\text{ mA}$ , $V_{GE} = V_{CE}$	$T_J = 25^\circ\text{C}$	1.0	1.42	2.0	$V_{DC}$
			$T_J = 150^\circ\text{C}$	0.7	0.95	1.5	
			$T_J = -40^\circ\text{C}$	1.1	1.62	2.2	
Threshold Temperature Coefficient (Negative)	-	-	-	-	3.5	-	mV/ $^\circ\text{C}$

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

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## ELECTRICAL CHARACTERISTICS (continued)

Characteristic	Symbol	Test Conditions	Temperature	Min	Typ	Max	Unit
<b>ON CHARACTERISTICS (continued)</b> (Note 3)							
Collector-to-Emitter On-Voltage	$V_{CE(on)}$	$I_C = 6.0 \text{ A}$ , $V_{GE} = 4.0 \text{ V}$	$T_J = 25^\circ\text{C}$	0.8	1.45	2.0	$V_{DC}$
			$T_J = 150^\circ\text{C}$	0.85	1.44	1.85	
			$T_J = -40^\circ\text{C}$	1.0	1.5	1.95	
		$I_C = 10 \text{ A}$ , $V_{GE} = 4.5 \text{ V}$	$T_J = 25^\circ\text{C}$	1.1	1.79	2.3	
			$T_J = 150^\circ\text{C}$	1.2	1.9	2.2	
			$T_J = -40^\circ\text{C}$	1.3	1.77	2.2	
Forward Transconductance	gfs	$V_{CE} = 5.0 \text{ V}$ , $I_C = 6.0 \text{ A}$	$T_J = -40^\circ\text{C}$ to $150^\circ\text{C}$	5.0	14	30	Mhos

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

## TYPICAL CHARACTERISTICS

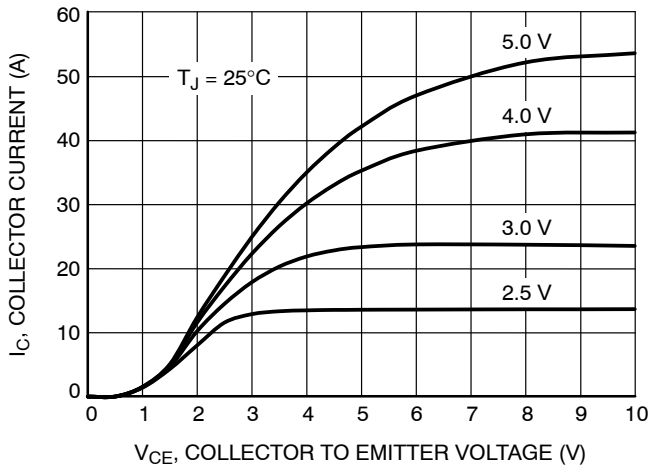


Figure 1. Output Characteristics

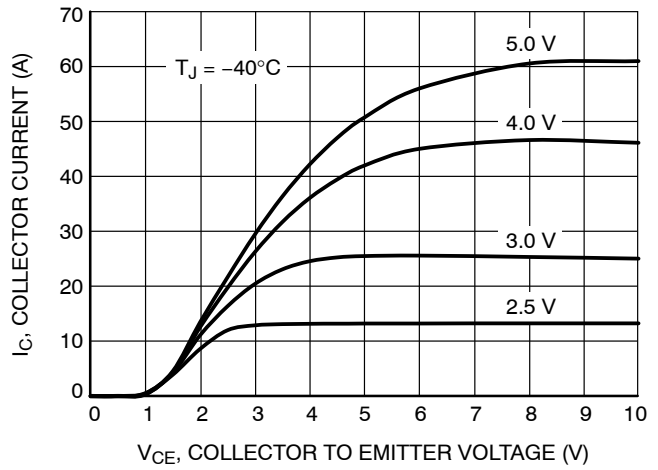


Figure 2. Output Characteristics

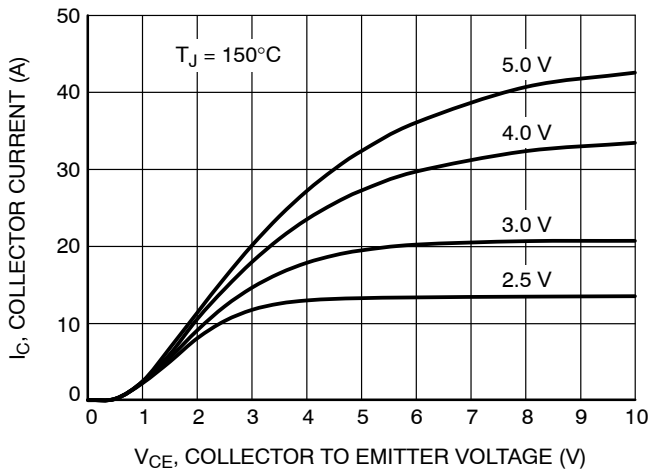


Figure 3. Output Characteristics

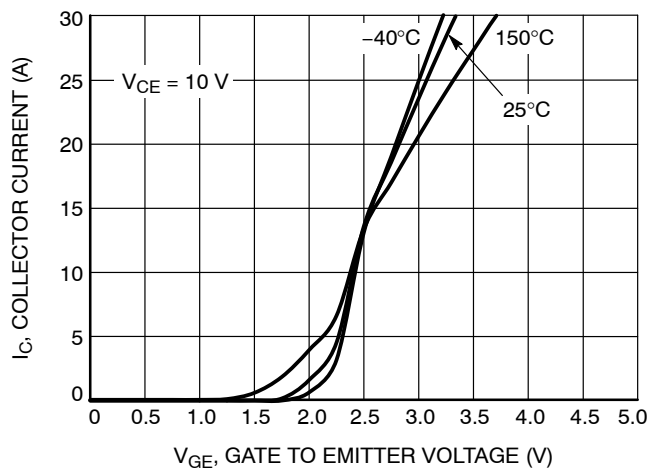
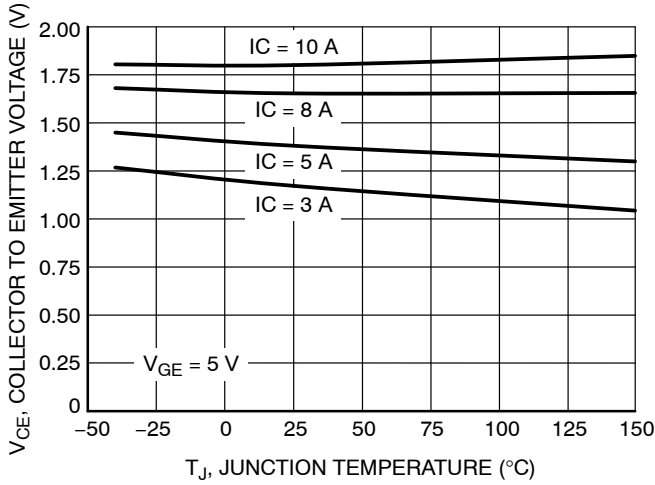


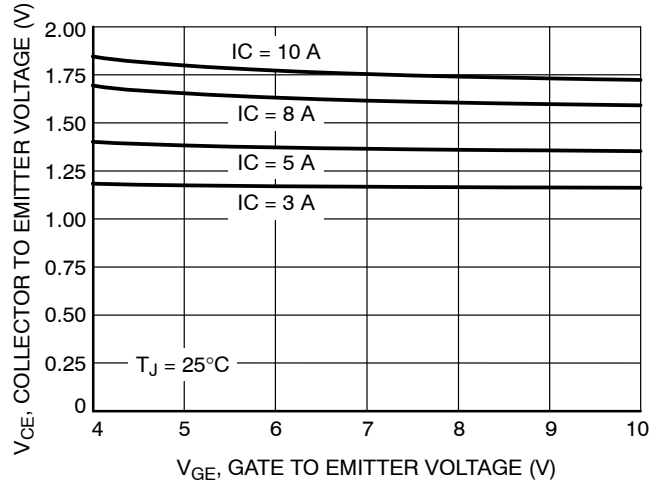
Figure 4. Transfer Characteristics

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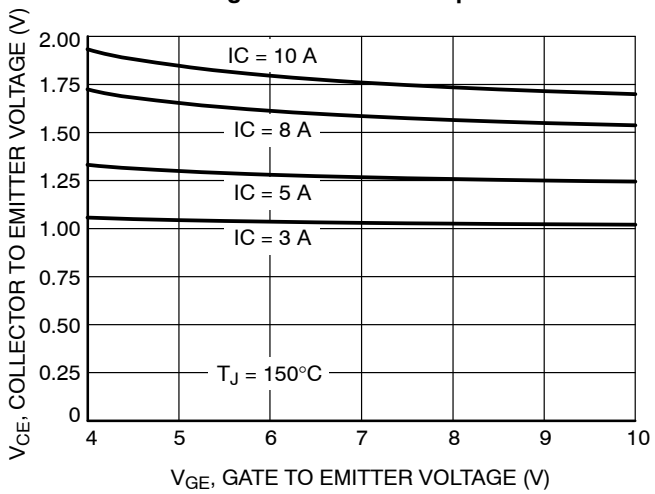
## TYPICAL CHARACTERISTICS



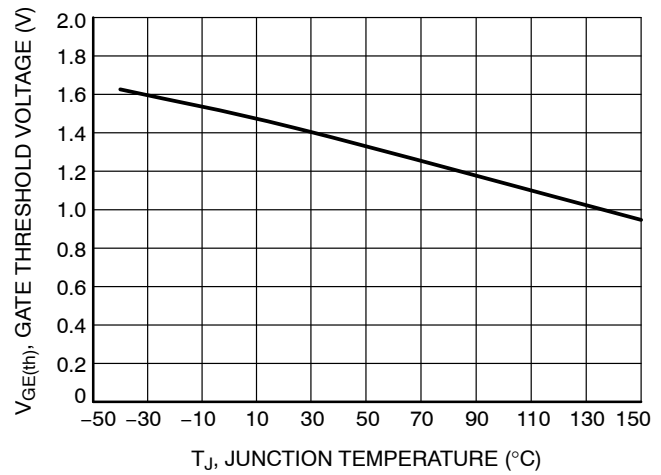
**Figure 5. Collector-to-Emitter Saturation Voltage vs. Junction Temperature**



**Figure 6. Collector-to-Emitter Voltage vs. Gate-to-Emitter Voltage**



**Figure 7. Collector-to-Emitter Voltage vs. Gate-to-Emitter Voltage**

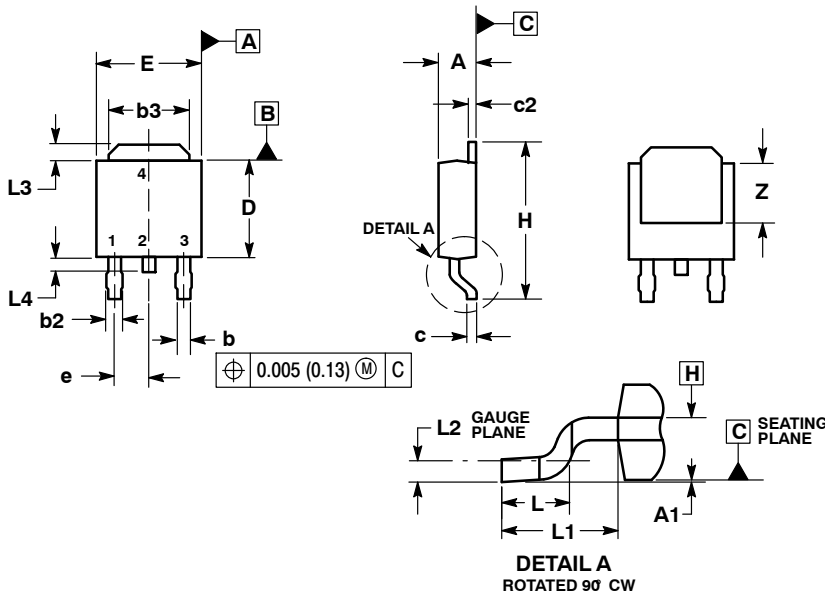


**Figure 8. Gate Threshold Voltage vs. Junction Temperature**

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## PACKAGE DIMENSIONS

### DKPAK (SINGLE GAUGE) CASE 369C ISSUE D

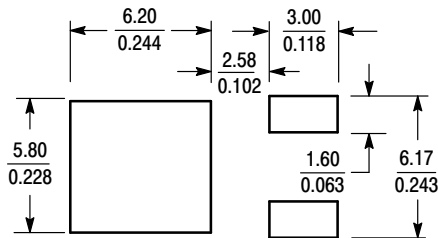


**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCHES.
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.

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	0.030	0.045	0.76	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	0.108	REF	2.74	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	---

### SOLDERING FOOTPRINT\*



SCALE 3:1  $\left(\frac{\text{mm}}{\text{inches}}\right)$

**STYLE 7:**

- PIN 1. GATE
- COLLECTOR
- EMITTER
- 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.

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