

NGD8201N

Ignition IGBT

20 A, 400 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 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})

Applications

- Ignition Systems

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

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CES}	440	V
Collector-Gate Voltage	V_{CER}	440	V
Gate-Emitter Voltage	V_{GE}	± 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°C	P_D	125 0.83	Watts W/ $^\circ\text{C}$
Operating & Storage Temperature Range	T_J, T_{stg}	-55 to +175	$^\circ\text{C}$



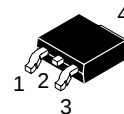
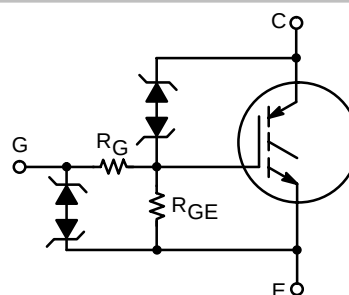
ON Semiconductor®

<http://onsemi.com>

20 AMPS

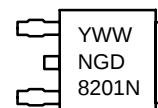
400 VOLTS

$V_{CE(on)} = 1.3 \text{ V @}$
 $I_C = 10 \text{ A, } V_{GE} \geq 4.5 \text{ V}$



DPAK
CASE 369C
STYLE 7

MARKING DIAGRAM



NGD8201N = Device Code
Y = Year
WW = Work Week

ORDERING INFORMATION

Device	Package	Shipping†
NGD8201NT4	DPAK	2500 / Tape & Reel

†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.

NGD8201N

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

Characteristic	Symbol	Value	Unit
Single Pulse Collector-to-Emitter Avalanche Energy $V_{CC} = 50\text{ V}$, $V_{GE} = 5.0\text{ V}$, $Pk\ I_L = 16.7\text{ A}$, $R_G = 1000\ \Omega$, $L = 1.8\text{ mH}$, Starting $T_J = 25^{\circ}\text{C}$ $V_{CC} = 50\text{ V}$, $V_{GE} = 5.0\text{ V}$, $Pk\ I_L = 14.9\text{ A}$, $R_G = 1000\ \Omega$, $L = 1.8\text{ mH}$, Starting $T_J = 150^{\circ}\text{C}$ $V_{CC} = 50\text{ V}$, $V_{GE} = 5.0\text{ V}$, $Pk\ I_L = 14.1\text{ A}$, $R_G = 1000\ \Omega$, $L = 1.8\text{ mH}$, Starting $T_J = 175^{\circ}\text{C}$	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 $T_J = 25^{\circ}\text{C}$	$E_{AS(R)}$	2000	mJ

THERMAL CHARACTERISTICS

Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.2	$^{\circ}\text{C/W}$
Thermal Resistance, Junction to Ambient (Note 1)	$R_{\theta JA}$	95	$^{\circ}\text{C/W}$
Maximum Temperature for Soldering Purposes, 1/8" from case for 5 seconds (Note 2)	T_L	275	$^{\circ}\text{C}$

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

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Test Conditions	Temperature	Min	Typ	Max	Unit
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OFF CHARACTERISTICS

Collector-Emitter Clamp Voltage	BV_{CES}	$I_C = 2.0\text{ mA}$	$T_J = -40^{\circ}\text{C to } 175^{\circ}\text{C}$	370	395	420	V
		$I_C = 10\text{ mA}$	$T_J = -40^{\circ}\text{C to } 175^{\circ}\text{C}$	390	415	440	
Zero Gate Voltage Collector Current	I_{CES}	$V_{GE} = 0\text{ V}$, $V_{CE} = 15\text{ V}$	$T_J = 25^{\circ}\text{C}$		0.1	1.0	μA
			$T_J = 175^{\circ}\text{C}$	0.5	1.5	10	
		$V_{CE} = 200\text{ V}$, $V_{GE} = 0\text{ V}$	$T_J = 175^{\circ}\text{C}$	1.0	25	100*	μA
			$T_J = -40^{\circ}\text{C}$	0.4	0.8	5.0	
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	0.1	0.5	mA
			$T_J = 175^{\circ}\text{C}$	1.0	5.0	10*	
			$T_J = -40^{\circ}\text{C}$	0.005	0.01	0.1	
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*	μA
Gate Resistor (Optional)	R_G		$T_J = -40^{\circ}\text{C to } 175^{\circ}\text{C}$		70		Ω
Gate Emitter Resistor	R_{GE}		$T_J = -40^{\circ}\text{C to } 175^{\circ}\text{C}$	14.25	16	25	k Ω

ON CHARACTERISTICS (Note 4)

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)				4.0	4.6	5.2	mV/ $^{\circ}\text{C}$

- Pulse Test: Pulse Width $\leq 300\ \mu\text{s}$, Duty Cycle $\leq 2\%$.
- *Maximum Value of Characteristic across Temperature Range.

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Test Conditions	Temperature	Min	Typ	Max	Unit
ON CHARACTERISTICS (Note 4)							
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

DYNAMIC CHARACTERISTICS

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

SWITCHING CHARACTERISTICS

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

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

*Maximum Value of Characteristic across Temperature Range.

TYPICAL ELECTRICAL CHARACTERISTICS

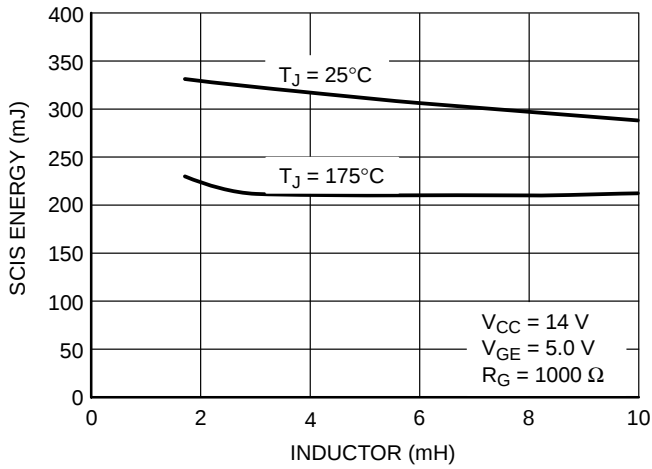


Figure 1. Self Clamped Inductive Switching

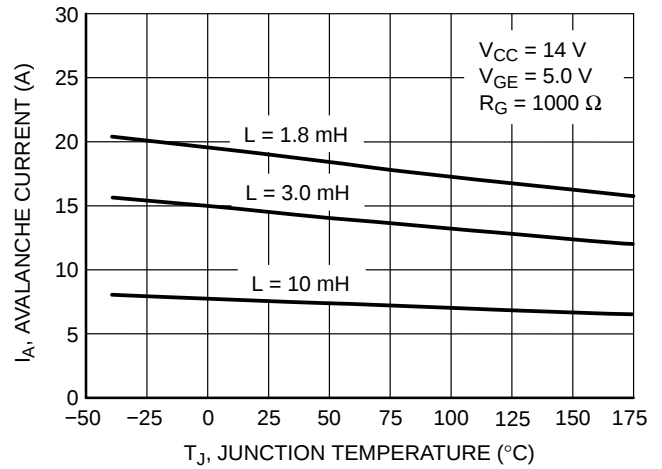


Figure 2. Open Secondary Avalanche Current vs. Temperature

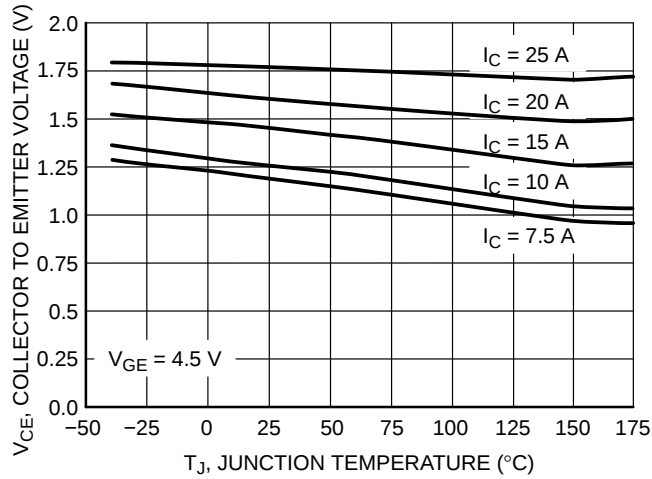


Figure 3. Collector-to-Emitter Voltage vs. Junction Temperature

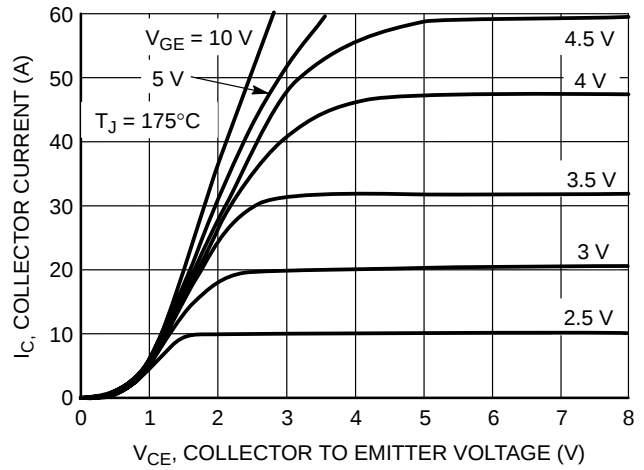


Figure 4. Collector Current vs. Collector-to-Emitter Voltage

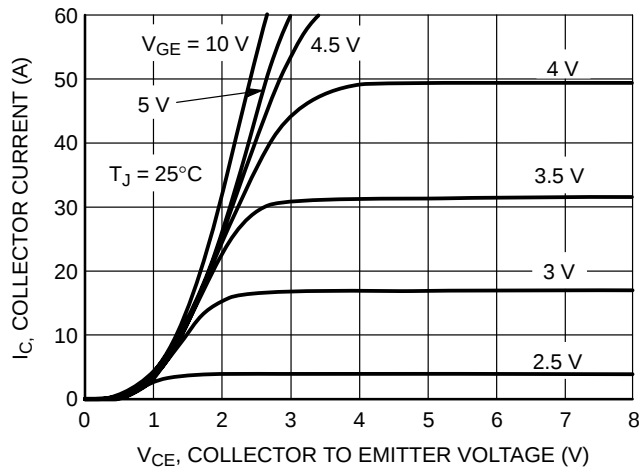


Figure 5. Collector Current vs. Collector-to-Emitter Voltage

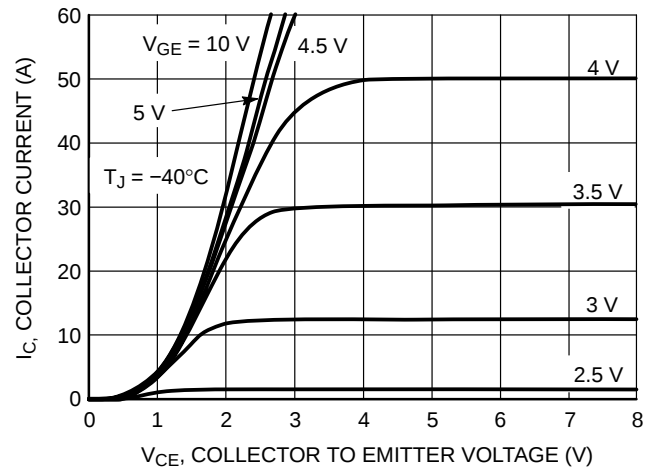


Figure 6. Collector Current vs. Collector-to-Emitter Voltage

TYPICAL ELECTRICAL CHARACTERISTICS

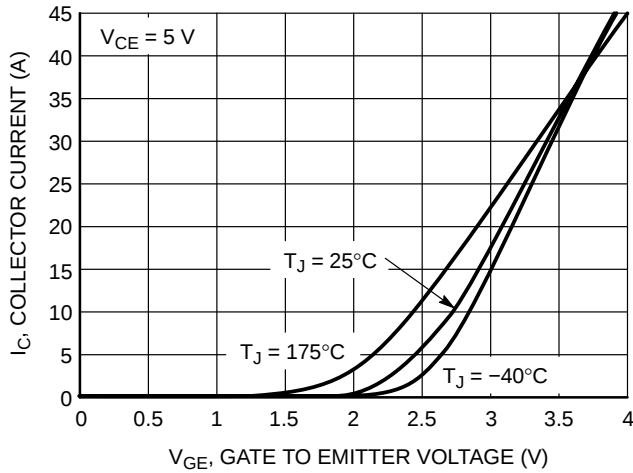


Figure 7. Transfer Characteristics

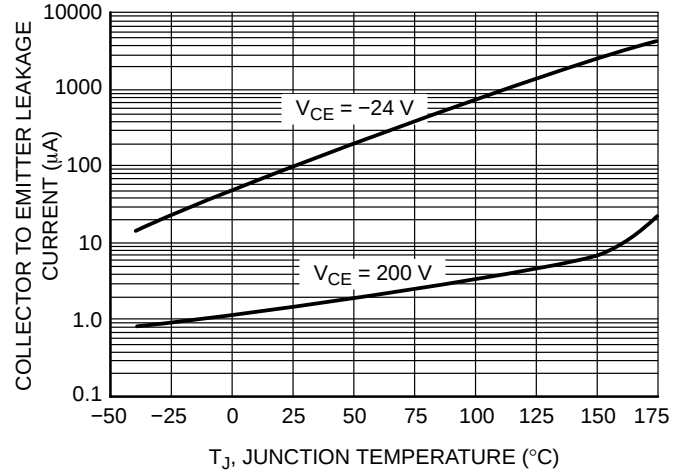


Figure 8. Collector-to-Emitter Leakage Current vs. Temperature

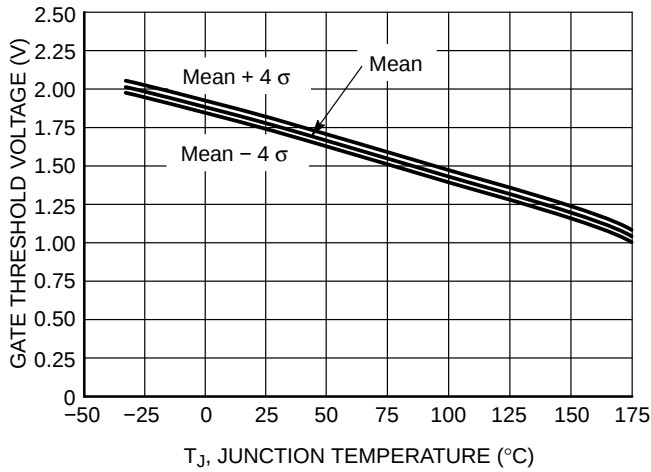


Figure 9. Gate Threshold Voltage vs. Temperature

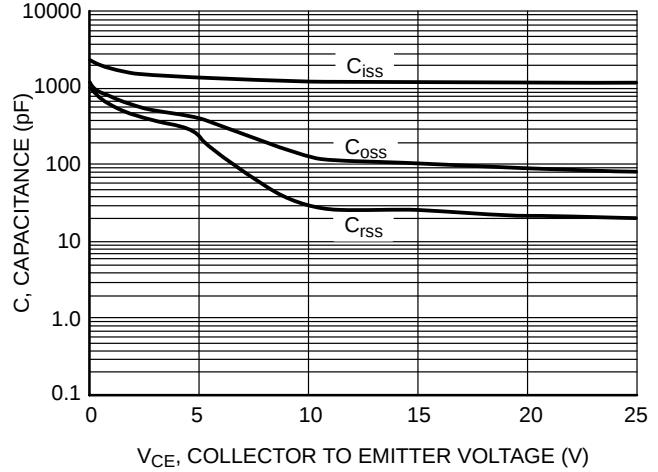


Figure 10. Capacitance vs. Collector-to-Emitter Voltage

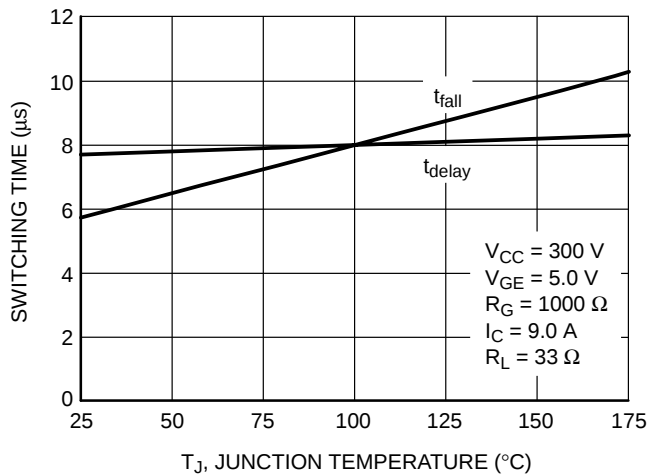


Figure 11. Resistive Switching Fall Time vs. Temperature

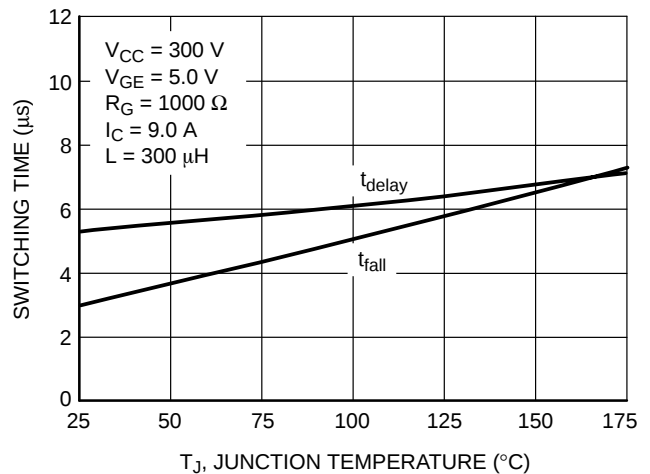
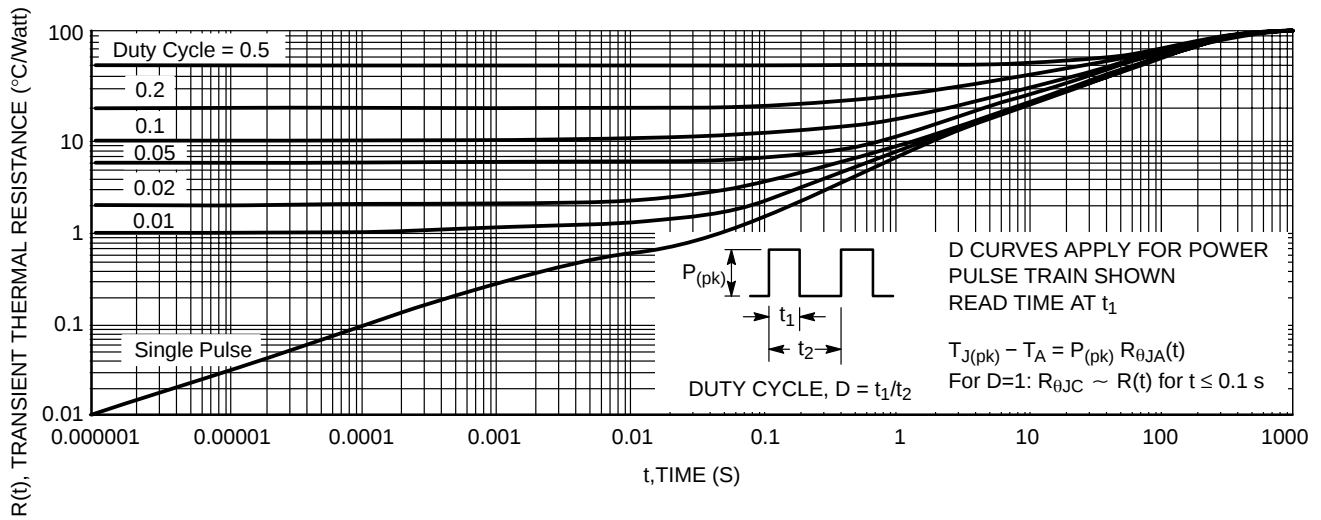
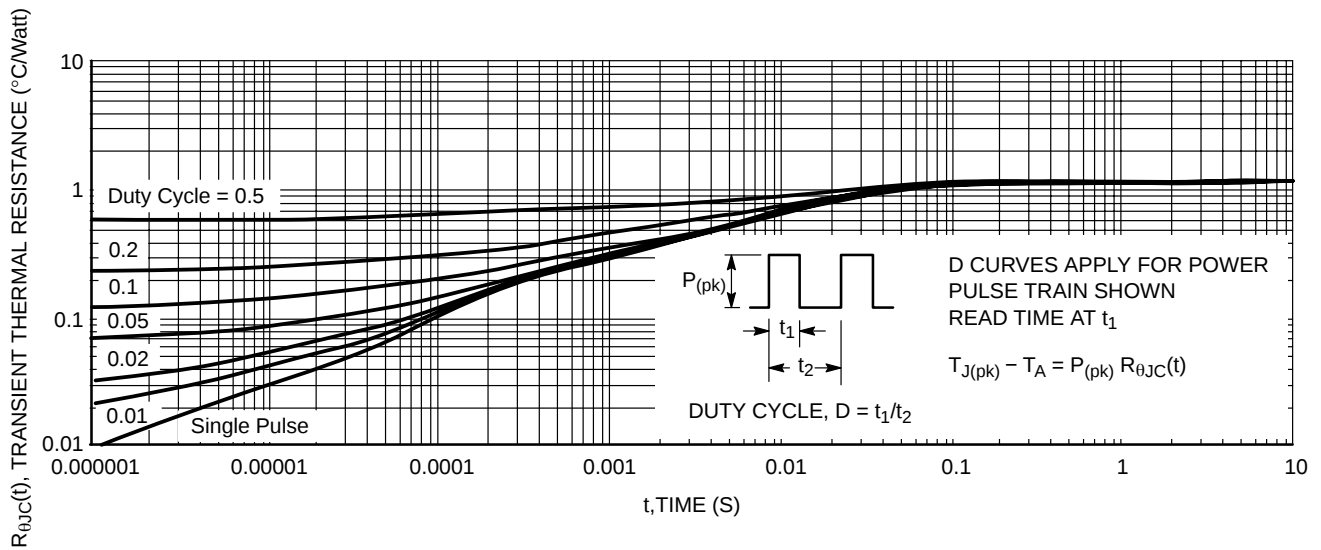


Figure 12. Inductive Switching Fall Time vs. Temperature



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

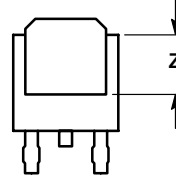
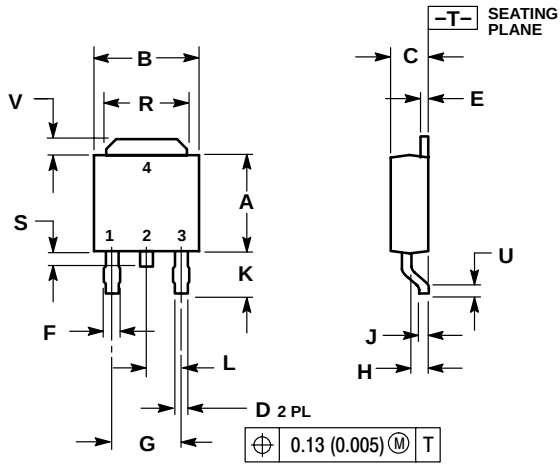


**Figure 14. Best Case Transient Thermal Resistance
(Non-normalized Junction-to-Case Mounted on Cold Plate)**

NGD8201N

PACKAGE DIMENSIONS

DPAK
CASE 369C-01
ISSUE O



STYLE 7:
PIN 1. GATE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: INCH.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.235	0.245	5.97	6.22
B	0.250	0.265	6.35	6.73
C	0.086	0.094	2.19	2.38
D	0.027	0.035	0.69	0.88
E	0.018	0.023	0.46	0.58
F	0.037	0.045	0.94	1.14
G	0.180	BSC	4.58	BSC
H	0.034	0.040	0.87	1.01
J	0.018	0.023	0.46	0.58
K	0.102	0.114	2.60	2.89
L	0.090	BSC	2.29	BSC
R	0.180	0.215	4.57	5.45
S	0.025	0.040	0.63	1.01
U	0.020	---	0.51	---
V	0.035	0.050	0.89	1.27
Z	0.155	---	3.93	---

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