

# NGD18N40CLBT4

## Ignition IGBT 18 Amps, 400 Volts

### 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.

- Ideal for Coil-on-Plug 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
- New Design Increases Unclamped Inductive Switching (UIS) Energy Per Area
- Low Threshold Voltage Interfaces Power Loads to Logic or Microprocessor Devices
- Low Saturation Voltage
- High Pulsed Current Capability
- Optional Gate Resistor ( $R_G$ ) and Gate-Emitter Resistor ( $R_{GE}$ )
- Emitter Ballasting for Short-Circuit Capability

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

| Rating                                                                                | Symbol         | Value          | Unit                               |
|---------------------------------------------------------------------------------------|----------------|----------------|------------------------------------|
| Collector-Emitter Voltage                                                             | $V_{CES}$      | 430            | $V_{DC}$                           |
| Collector-Gate Voltage                                                                | $V_{CER}$      | 430            | $V_{DC}$                           |
| Gate-Emitter Voltage                                                                  | $V_{GE}$       | 18             | $V_{DC}$                           |
| Collector Current-Continuous<br>@ $T_C = 25^\circ\text{C}$ - Pulsed                   | $I_C$          | 15<br>50       | $A_{DC}$<br>$A_{AC}$               |
| ESD (Human Body Model)<br>$R = 1500\ \Omega$ , $C = 100\ \text{pF}$                   | ESD            | 8.0            | kV                                 |
| ESD (Machine Model) $R = 0\ \Omega$ , $C = 200\ \text{pF}$                            | ESD            | 800            | V                                  |
| Total Power Dissipation @ $T_C = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$          | 115<br>0.77    | Watts<br>$\text{W}/^\circ\text{C}$ |
| Operating and Storage Temperature Range                                               | $T_J, T_{stg}$ | -55 to<br>+175 | $^\circ\text{C}$                   |



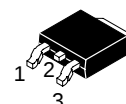
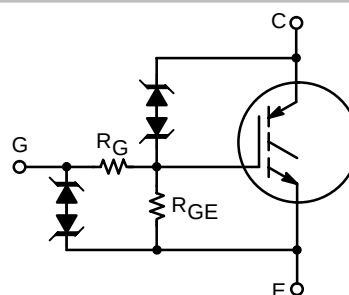
ON Semiconductor®

<http://onsemi.com>

**18 AMPS**

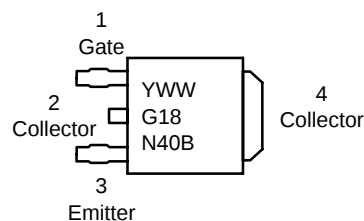
**400 VOLTS**

$$V_{CE(on)} \leq 2.0\ \text{V} @ \\ I_C = 10\ \text{A}, V_{GE} \geq 4.5\ \text{V}$$



DPAK  
CASE 369C  
STYLE 7

#### MARKING DIAGRAM



G18N40B = NGD18N40CLB  
Y = Year  
WW = Work Week

#### ORDERING INFORMATION

| Device        | Package | Shipping†        |
|---------------|---------|------------------|
| NGD18N40CLB   | DPAK    | 75 Units/Rail    |
| NGD18N40CLBT4 | 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.

# NGD18N40CLBT4

## 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<br>$V_{CC} = 50\text{ V}$ , $V_{GE} = 5.0\text{ V}$ , Pk $I_L = 21.1\text{ A}$ , $L = 1.8\text{ mH}$ , Starting $T_J = 25^{\circ}C$<br>$V_{CC} = 50\text{ V}$ , $V_{GE} = 5.0\text{ V}$ , Pk $I_L = 16.2\text{ A}$ , $L = 3.0\text{ mH}$ , Starting $T_J = 25^{\circ}C$<br>$V_{CC} = 50\text{ V}$ , $V_{GE} = 5.0\text{ V}$ , Pk $I_L = 18.3\text{ A}$ , $L = 1.8\text{ mH}$ , Starting $T_J = 125^{\circ}C$ | $E_{AS}$    | 400<br>400<br>300 | mJ   |
| Reverse Avalanche Energy<br>$V_{CC} = 100\text{ V}$ , $V_{GE} = 20\text{ V}$ , Pk $I_L = 25.8\text{ A}$ , $L = 6.0\text{ mH}$ , Starting $T_J = 25^{\circ}C$                                                                                                                                                                                                                                                                                                    | $E_{AS(R)}$ | 2000              | mJ   |

## MAXIMUM SHORT-CIRCUIT TIMES ( $-55^{\circ}C \leq T_J \leq 150^{\circ}C$ )

|                                                                            |           |     |         |
|----------------------------------------------------------------------------|-----------|-----|---------|
| Short Circuit Withstand Time 1 (See Figure 17, 3 Pulses with 10 ms Period) | $t_{sc1}$ | 750 | $\mu s$ |
| Short Circuit Withstand Time 2 (See Figure 18, 3 Pulses with 10 ms Period) | $t_{sc2}$ | 5.0 | ms      |

## THERMAL CHARACTERISTICS

|                                                                               |                 |     |               |
|-------------------------------------------------------------------------------|-----------------|-----|---------------|
| Thermal Resistance, Junction to Case                                          | $R_{\theta JC}$ | 1.3 | $^{\circ}C/W$ |
| Thermal Resistance, Junction to Ambient DPAK (Note 1)                         | $R_{\theta JA}$ | 95  | $^{\circ}C/W$ |
| Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 5 seconds | $T_L$           | 275 | $^{\circ}C$   |

## ELECTRICAL CHARACTERISTICS

| Characteristic | Symbol | Test Conditions | Temperature | Min | Typ | Max | Unit |
|----------------|--------|-----------------|-------------|-----|-----|-----|------|
|----------------|--------|-----------------|-------------|-----|-----|-----|------|

## OFF CHARACTERISTICS

|                                           |               |                                                    |                                        |     |     |     |              |
|-------------------------------------------|---------------|----------------------------------------------------|----------------------------------------|-----|-----|-----|--------------|
| Collector-Emitter Clamp Voltage           | $BV_{CES}$    | $I_C = 2.0\text{ mA}$                              | $T_J = -40^{\circ}C$ to $150^{\circ}C$ | 380 | 395 | 420 | $V_{DC}$     |
|                                           |               | $I_C = 10\text{ mA}$                               | $T_J = -40^{\circ}C$ to $150^{\circ}C$ | 390 | 405 | 430 |              |
| Zero Gate Voltage Collector Current       | $I_{CES}$     | $V_{CE} = 350\text{ V}$ ,<br>$V_{GE} = 0\text{ V}$ | $T_J = 25^{\circ}C$                    | –   | 2.0 | 20  | $\mu A_{DC}$ |
|                                           |               |                                                    | $T_J = 150^{\circ}C$                   | –   | 10  | 40* |              |
|                                           |               |                                                    | $T_J = -40^{\circ}C$                   | –   | 1.0 | 10  |              |
|                                           |               | $V_{CE} = 15\text{ V}$ ,<br>$V_{GE} = 0\text{ V}$  | $T_J = 25^{\circ}C$                    | –   | –   | 2.0 |              |
| Reverse Collector-Emitter Leakage Current | $I_{ECS}$     | $V_{CE} = -24\text{ V}$                            | $T_J = 25^{\circ}C$                    | –   | 0.7 | 1.0 | mA           |
|                                           |               |                                                    | $T_J = 150^{\circ}C$                   | –   | 12  | 25* |              |
|                                           |               |                                                    | $T_J = -40^{\circ}C$                   | –   | 0.1 | 1.0 |              |
| Reverse Collector-Emitter Clamp Voltage   | $BV_{CES(R)}$ | $I_C = -75\text{ mA}$                              | $T_J = 25^{\circ}C$                    | 27  | 33  | 37  | $V_{DC}$     |
|                                           |               |                                                    | $T_J = 150^{\circ}C$                   | 30  | 36  | 40  |              |
|                                           |               |                                                    | $T_J = -40^{\circ}C$                   | 25  | 32  | 35  |              |
| Gate-Emitter Clamp Voltage                | $BV_{GES}$    | $I_G = 5.0\text{ mA}$                              | $T_J = -40^{\circ}C$ to $150^{\circ}C$ | 11  | 13  | 15  | $V_{DC}$     |
| Gate-Emitter Leakage Current              | $I_{GES}$     | $V_{GE} = 10\text{ V}$                             | $T_J = -40^{\circ}C$ to $150^{\circ}C$ | 384 | 640 | 700 | $\mu A_{DC}$ |
| Gate Resistor (Optional)                  | $R_G$         | –                                                  | $T_J = -40^{\circ}C$ to $150^{\circ}C$ | –   | 70  | –   | $\Omega$     |
| Gate Emitter Resistor                     | $R_{GE}$      | –                                                  | $T_J = -40^{\circ}C$ to $150^{\circ}C$ | 10  | 16  | 26  | k $\Omega$   |

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

\*Maximum Value of Characteristic across Temperature Range.

# NGD18N40CLBT4

## ELECTRICAL CHARACTERISTICS (continued)

| Characteristic | Symbol | Test Conditions | Temperature | Min | Typ | Max | Unit |
|----------------|--------|-----------------|-------------|-----|-----|-----|------|
|----------------|--------|-----------------|-------------|-----|-----|-----|------|

### ON CHARACTERISTICS (Note 2)

|                                              |              |                                                     |                                                  |      |      |      |                            |
|----------------------------------------------|--------------|-----------------------------------------------------|--------------------------------------------------|------|------|------|----------------------------|
| Gate Threshold Voltage                       | $V_{GE(th)}$ | $I_C = 1.0 \text{ mA}$ ,<br>$V_{GE} = V_{CE}$       | $T_J = 25^\circ\text{C}$                         | 1.1  | 1.4  | 1.9  | $V_{DC}$                   |
|                                              |              |                                                     | $T_J = 150^\circ\text{C}$                        | 0.75 | 1.0  | 1.4  |                            |
|                                              |              |                                                     | $T_J = -40^\circ\text{C}$                        | 1.2  | 1.6  | 2.1* |                            |
| Threshold Temperature Coefficient (Negative) | –            | –                                                   | –                                                | –    | 3.4  | –    | $\text{mV}/^\circ\text{C}$ |
| Collector-to-Emitter On-Voltage              | $V_{CE(on)}$ | $I_C = 6.0 \text{ A}$ ,<br>$V_{GE} = 4.0 \text{ V}$ | $T_J = 25^\circ\text{C}$                         | 1.0  | 1.4  | 1.6  | $V_{DC}$                   |
|                                              |              |                                                     | $T_J = 150^\circ\text{C}$                        | 0.9  | 1.3  | 1.6  |                            |
|                                              |              |                                                     | $T_J = -40^\circ\text{C}$                        | 1.1  | 1.45 | 1.7* |                            |
|                                              |              | $I_C = 8.0 \text{ A}$ ,<br>$V_{GE} = 4.0 \text{ V}$ | $T_J = 25^\circ\text{C}$                         | 1.3  | 1.6  | 1.9* |                            |
|                                              |              |                                                     | $T_J = 150^\circ\text{C}$                        | 1.2  | 1.55 | 1.8  |                            |
|                                              |              |                                                     | $T_J = -40^\circ\text{C}$                        | 1.4  | 1.6  | 1.9* |                            |
|                                              |              | $I_C = 10 \text{ A}$ ,<br>$V_{GE} = 4.0 \text{ V}$  | $T_J = 25^\circ\text{C}$                         | 1.4  | 1.8  | 2.05 |                            |
|                                              |              |                                                     | $T_J = 150^\circ\text{C}$                        | 1.4  | 1.8  | 2.0  |                            |
|                                              |              |                                                     | $T_J = -40^\circ\text{C}$                        | 1.4  | 1.8  | 2.1* |                            |
|                                              |              | $I_C = 15 \text{ A}$ ,<br>$V_{GE} = 4.0 \text{ V}$  | $T_J = 25^\circ\text{C}$                         | 1.8  | 2.2  | 2.5  |                            |
|                                              |              |                                                     | $T_J = 150^\circ\text{C}$                        | 2.0  | 2.4  | 2.6* |                            |
|                                              |              |                                                     | $T_J = -40^\circ\text{C}$                        | 1.7  | 2.1  | 2.5  |                            |
|                                              |              | $I_C = 10 \text{ A}$ ,<br>$V_{GE} = 4.5 \text{ V}$  | $T_J = 25^\circ\text{C}$                         | 1.3  | 1.8  | 2.0* |                            |
|                                              |              |                                                     | $T_J = 150^\circ\text{C}$                        | 1.3  | 1.75 | 2.0* |                            |
|                                              |              |                                                     | $T_J = -40^\circ\text{C}$                        | 1.4  | 1.8  | 2.0* |                            |
|                                              |              | $I_C = 6.5 \text{ A}$ ,<br>$V_{GE} = 3.7 \text{ V}$ | $T_J = 25^\circ\text{C}$                         | –    | –    | 1.65 |                            |
| Forward Transconductance                     | $g_{fs}$     | $V_{CE} = 5.0 \text{ V}$ , $I_C = 6.0 \text{ A}$    | $T_J = -40^\circ\text{C}$ to $150^\circ\text{C}$ | 8.0  | 14   | 25   | Mhos                       |

### DYNAMIC CHARACTERISTICS

|                      |           |                                                                           |                                                  |     |     |      |    |
|----------------------|-----------|---------------------------------------------------------------------------|--------------------------------------------------|-----|-----|------|----|
| Input Capacitance    | $C_{ISS}$ | $V_{CC} = 25 \text{ V}$ , $V_{GE} = 0 \text{ V}$<br>$f = 1.0 \text{ MHz}$ | $T_J = -40^\circ\text{C}$ to $150^\circ\text{C}$ | 400 | 800 | 1000 | pF |
| Output Capacitance   | $C_{OSS}$ |                                                                           |                                                  | 50  | 75  | 100  |    |
| Transfer Capacitance | $C_{RSS}$ |                                                                           |                                                  | 4.0 | 7.0 | 10   |    |

### SWITCHING CHARACTERISTICS

|                                 |              |                                                                                                             |                          |   |     |     |                 |
|---------------------------------|--------------|-------------------------------------------------------------------------------------------------------------|--------------------------|---|-----|-----|-----------------|
| Turn-Off Delay Time (Resistive) | $t_{d(off)}$ | $V_{CC} = 300 \text{ V}$ , $I_C = 6.5 \text{ A}$<br>$R_G = 1.0 \text{ k}\Omega$ , $R_L = 46 \text{ }\Omega$ | $T_J = 25^\circ\text{C}$ | – | 4.0 | 10  | $\mu\text{Sec}$ |
| Fall Time (Resistive)           | $t_f$        | $V_{CC} = 300 \text{ V}$ , $I_C = 6.5 \text{ A}$<br>$R_G = 1.0 \text{ k}\Omega$ , $R_L = 46 \text{ }\Omega$ | $T_J = 25^\circ\text{C}$ | – | 9.0 | 15  |                 |
| Turn-On Delay Time              | $t_{d(on)}$  | $V_{CC} = 10 \text{ V}$ , $I_C = 6.5 \text{ A}$<br>$R_G = 1.0 \text{ k}\Omega$ , $R_L = 1.5 \text{ }\Omega$ | $T_J = 25^\circ\text{C}$ | – | 0.7 | 4.0 | $\mu\text{Sec}$ |
| Rise Time                       | $t_r$        | $V_{CC} = 10 \text{ V}$ , $I_C = 6.5 \text{ A}$<br>$R_G = 1.0 \text{ k}\Omega$ , $R_L = 1.5 \text{ }\Omega$ | $T_J = 25^\circ\text{C}$ | – | 4.5 | 7.0 |                 |

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

\*Maximum Value of Characteristic across Temperature Range.

# NGD18N40CLBT4

## TYPICAL ELECTRICAL CHARACTERISTICS (unless otherwise noted)

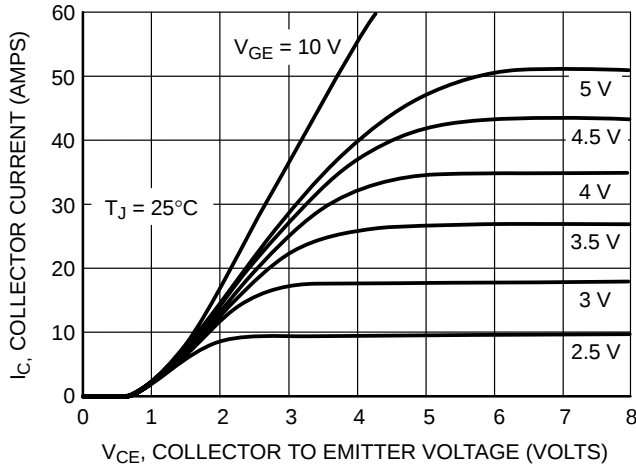


Figure 1. Output Characteristics

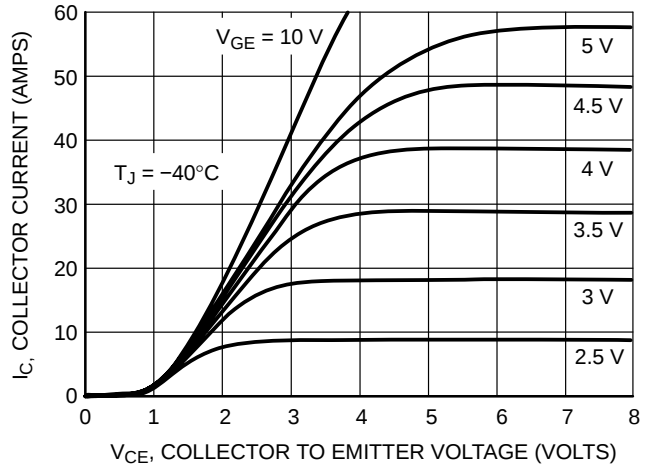


Figure 2. Output Characteristics

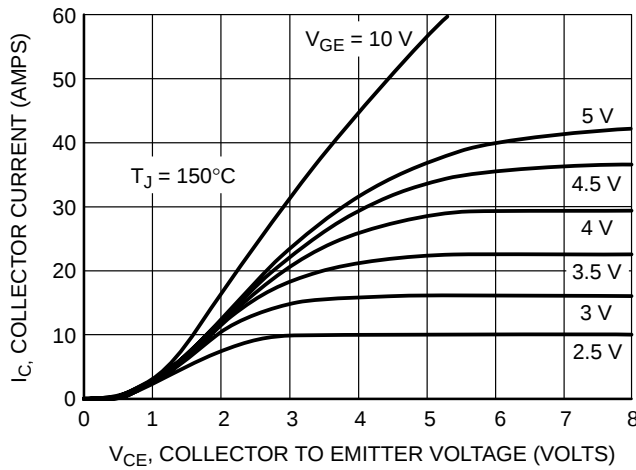


Figure 3. Output Characteristics

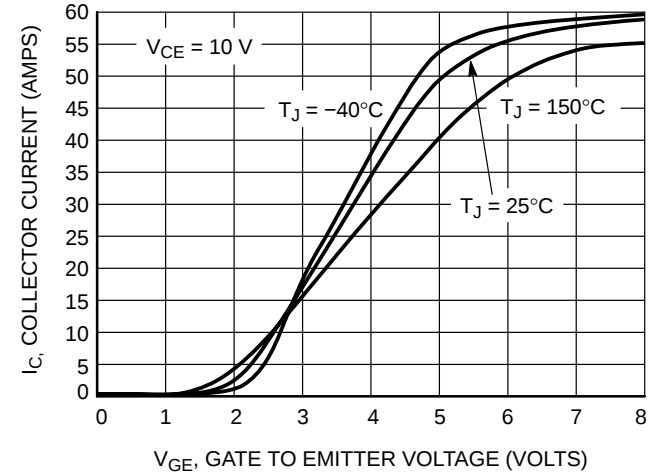


Figure 4. Transfer Characteristics

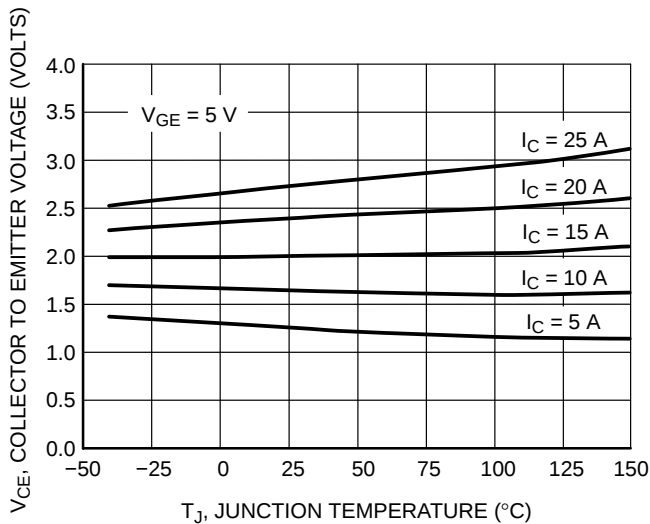


Figure 5. Collector-to-Emitter Saturation Voltage versus Junction Temperature

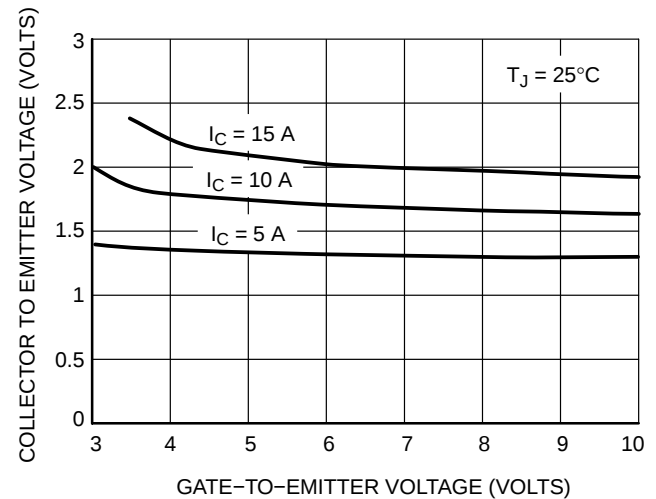
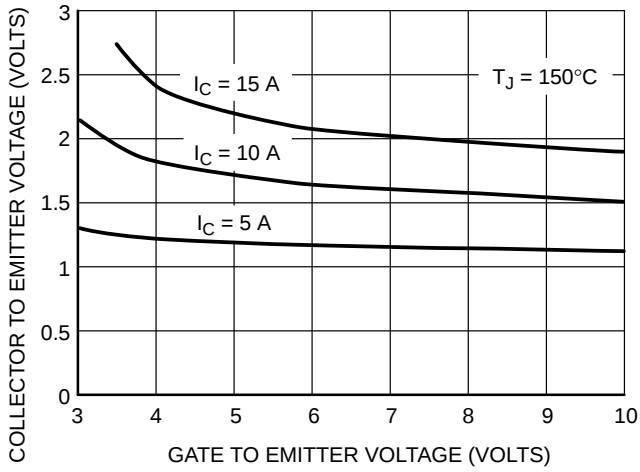
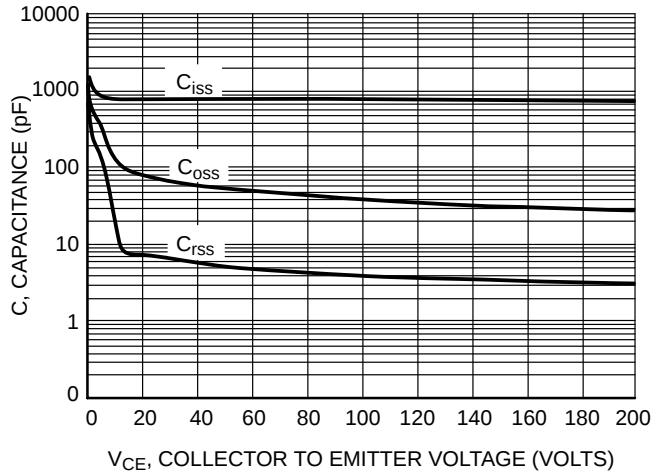


Figure 6. Collector-to-Emitter Voltage versus Gate-to-Emitter Voltage

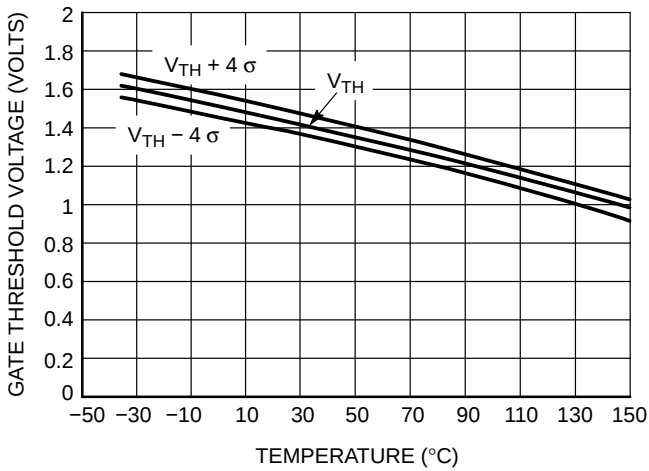
# NGD18N40CLBT4



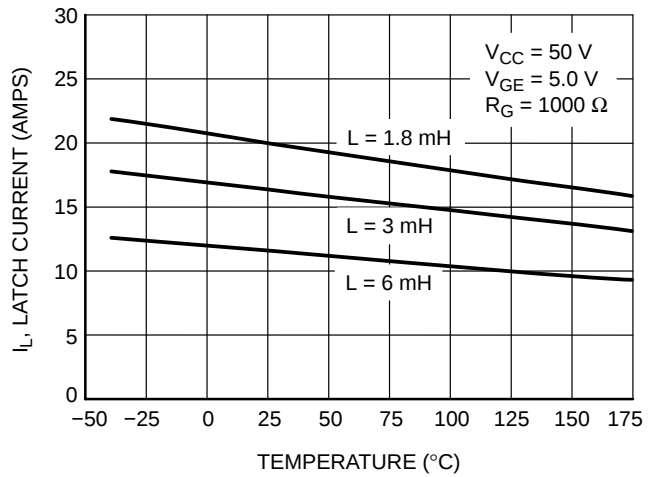
**Figure 7. Collector-to-Emitter Voltage versus Gate-to-Emitter Voltage**



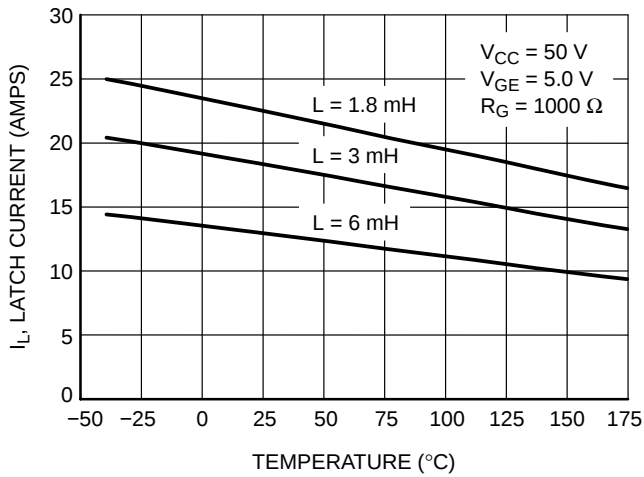
**Figure 8. Capacitance Variation**



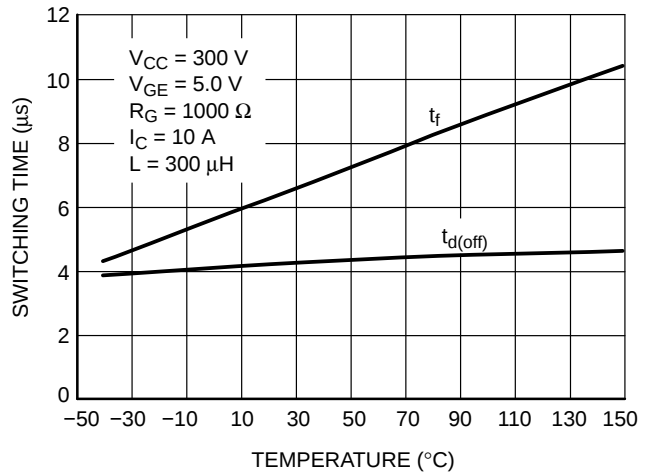
**Figure 9. Gate Threshold Voltage versus Temperature**



**Figure 10. Minimum Open Secondary Latch Current versus Temperature**

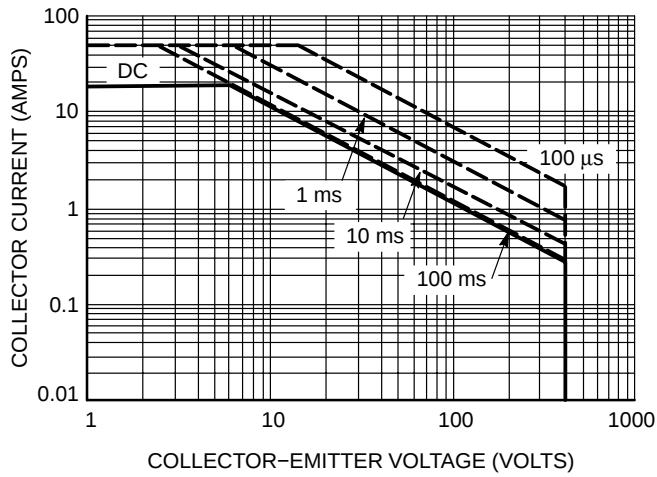


**Figure 11. Typical Open Secondary Latch Current versus Temperature**

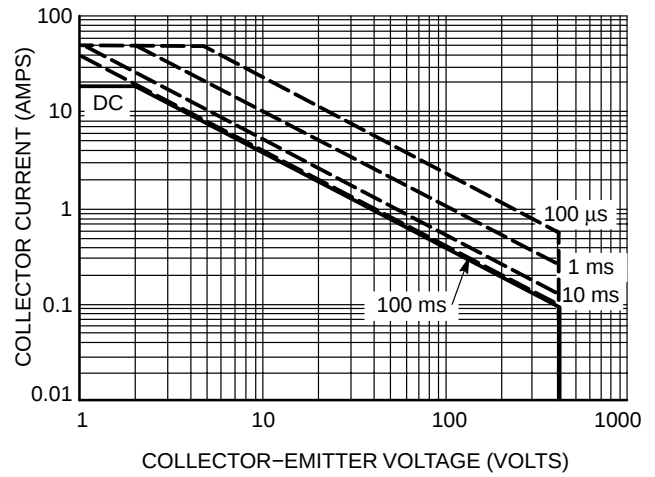


**Figure 12. Inductive Switching Fall Time versus Temperature**

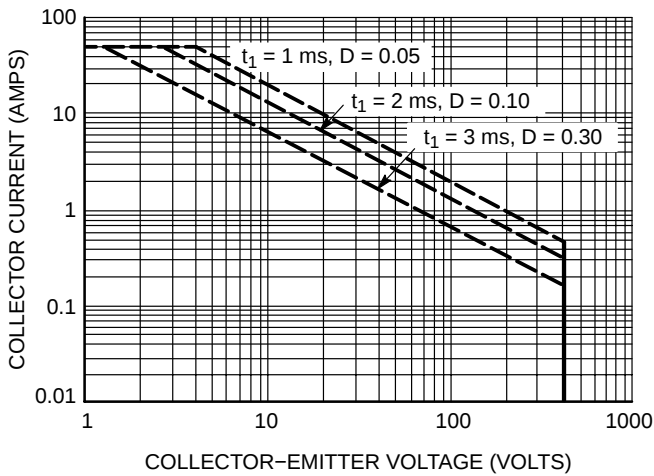
# NGD18N40CLBT4



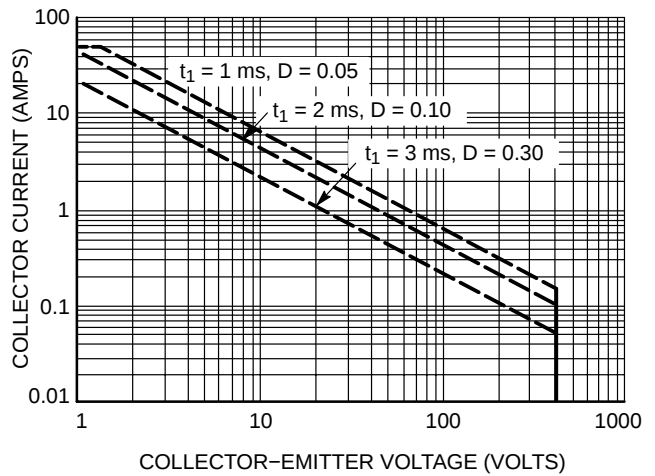
**Figure 13. Single Pulse Safe Operating Area**  
(Mounted on an Infinite Heatsink at  $T_A = 25^\circ\text{C}$ )



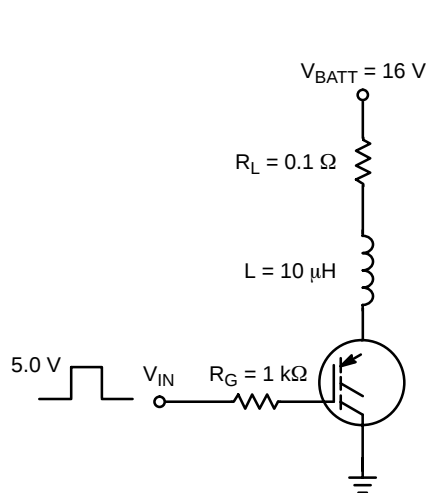
**Figure 14. Single Pulse Safe Operating Area**  
(Mounted on an Infinite Heatsink at  $T_A = 125^\circ\text{C}$ )



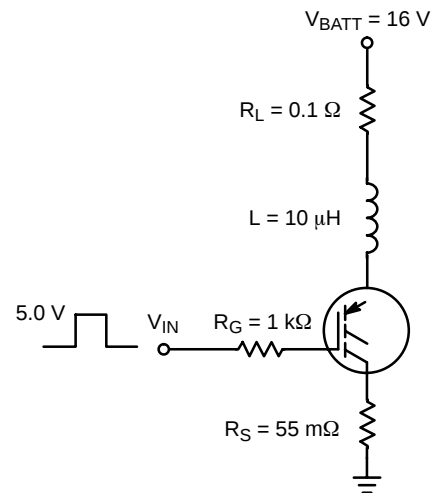
**Figure 15. Pulse Train Safe Operating Area**  
(Mounted on an Infinite Heatsink at  $T_C = 25^\circ\text{C}$ )



**Figure 16. Pulse Train Safe Operating Area**  
(Mounted on an Infinite Heatsink at  $T_C = 125^\circ\text{C}$ )

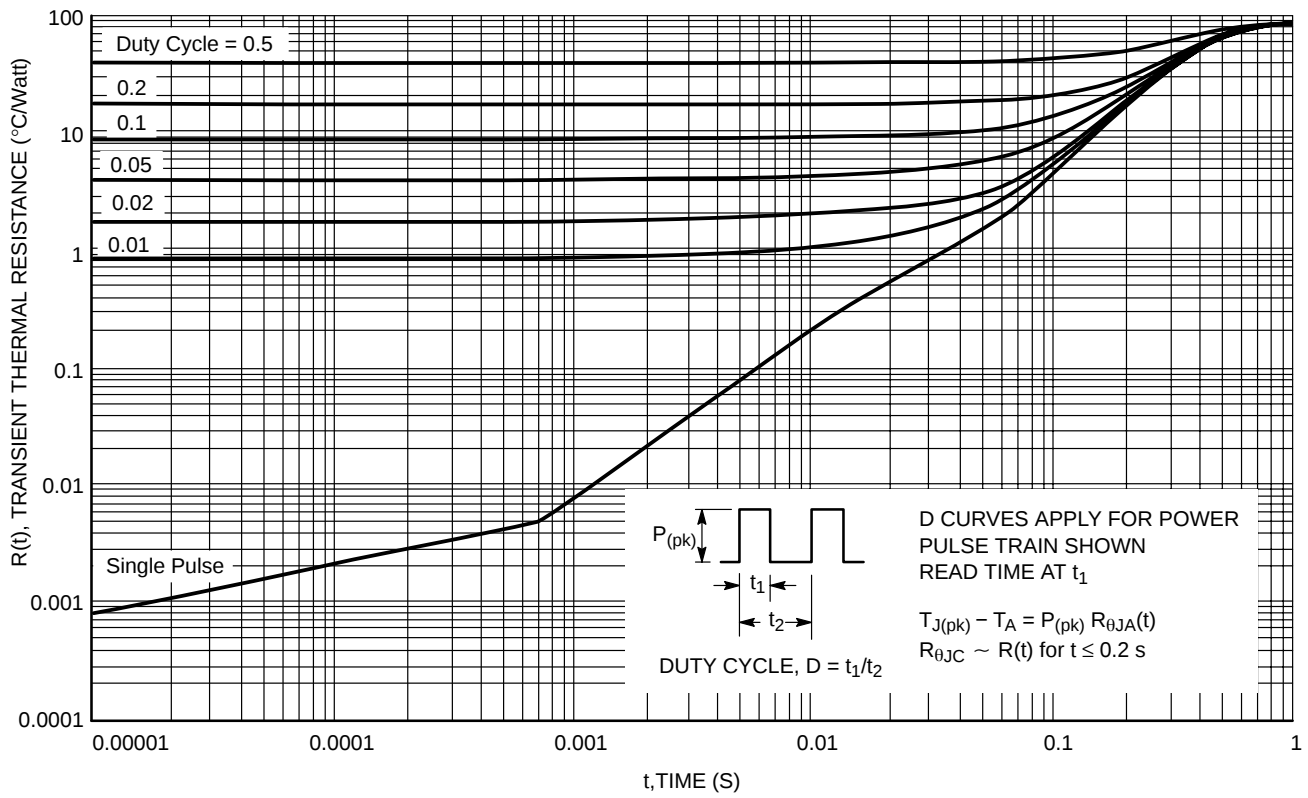


**Figure 17. Circuit Configuration for**  
**Short Circuit Test #1**



**Figure 18. Circuit Configuration for**  
**Short Circuit Test #2**

# NGD18N40CLBT4

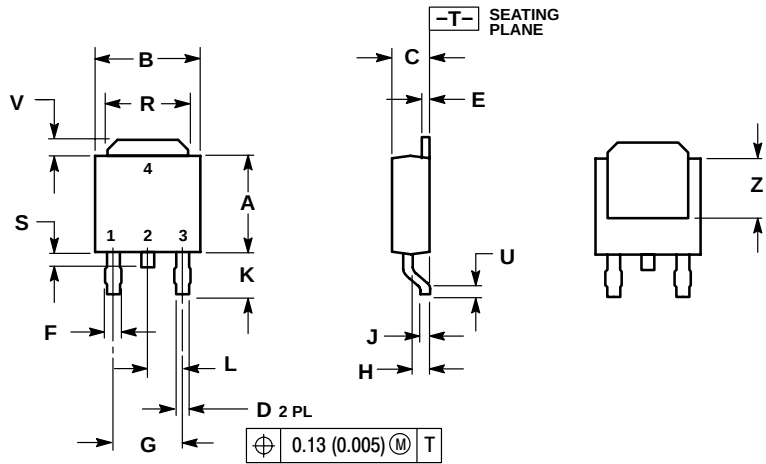


**Figure 19. Transient Thermal Resistance**  
(Non-normalized Junction-to-Ambient mounted on minimum pad area)

# NGD18N40CLBT4

## PACKAGE DIMENSIONS

DPAK  
CASE 369C-01  
ISSUE O



- 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        | ---  |

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

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