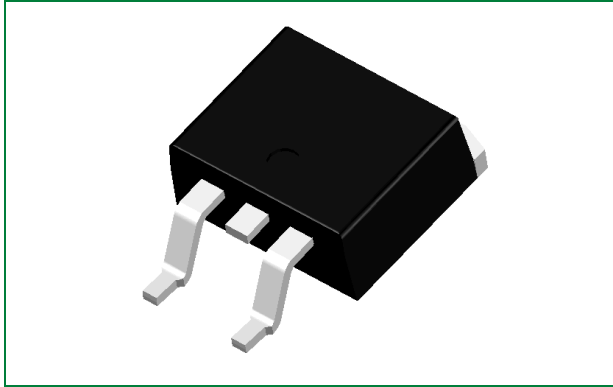


# LGB8204ATH

## 400 V, 18 A N-Channel Ignition IGBT



### Product Summary

Characteristic	Value	Unit
$V_{CES}$	400	V
$I_c$	18	A

### Description

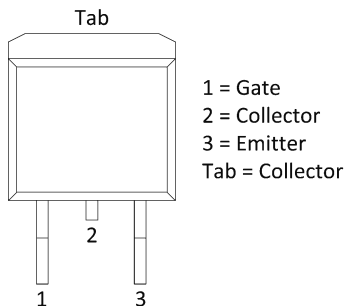
This Logic Level Insulated Gate Bipolar Transistor (IGBT) features monolithic circuitry integrating ESD and Over-Voltage clamped protection for use in inductive coil drivers applications. Primary uses include Ignition, Direct Fuel Injection, or wherever high voltage and high current switching is required.

### Agency Approvals

Environmental Approvals



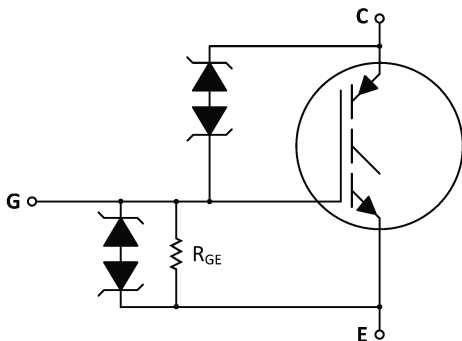
### Pinout Diagram



### Features

- Ideal for Coil-on-Plug Applications
- 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
- Integrated Gate-Emitter Resistor ( $R_{GE}$ )
- AEC-Q101 Qualified
- These are Pb-Free Devices
- Emitter Ballasting for Short-Circuit Capability

### Functional Diagram



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## 1. Maximum Ratings (T<sub>J</sub> = 25 °C unless otherwise specified)

Characteristic	Conditions	Symbol	Value	Unit
Collector-Emitter Voltage	-	V <sub>CEs</sub>	430	V <sub>DC</sub>
Collector-Gate Voltage	-	V <sub>CER</sub>	430	V <sub>DC</sub>
Gate-Emitter Voltage	-	V <sub>GE</sub>	18	V <sub>DC</sub>
Collector Current – Continuous	T <sub>C</sub> = 25 °C	I <sub>C</sub>	18	A <sub>DC</sub>
Collector Current – Pulsed			50	A <sub>AC</sub>
ESD – Human Body Model	R = 1500 Ω, C = 100 pF	ESD	8.0	kV
ESD – Machine Model	R = 0 Ω, C = 200 pF		800	V
Total Power Dissipation	T <sub>C</sub> = 25 °C	P <sub>D</sub>	115	W
	Derating for > 25 °C		0.77	W/°C
Operating and Storage Temperature Range	-	T <sub>J</sub> , T <sub>stg</sub>	-55 to +175	°C

## 2. Unclamped Collector-to-Emitter Avalanche Characteristics

Characteristic	Symbol	Value	Unit
Single Pulse Collector-to-Emitter Avalanche Energy			
V <sub>CC</sub> = 50 V, V <sub>GE</sub> = 5.0 V, P <sub>kL</sub> = 21.1 A, L = 1.8 mH, Starting T <sub>J</sub> = 25 °C	E <sub>AS</sub>	400	mJ
V <sub>CC</sub> = 50 V, V <sub>GE</sub> = 5.0 V, P <sub>kL</sub> = 18.3 A, L = 1.8 mH, Starting T <sub>J</sub> = 125 °C		300	
Reverse Avalanche Energy			
V <sub>CC</sub> = 100 V, V <sub>GE</sub> = 20 V, P <sub>kL</sub> = 25.8 A, L = 6.0 mH, Starting T <sub>J</sub> = 25 °C	E <sub>AS(R)</sub>	2000	mJ

Note: -55 °C ≤ T<sub>J</sub> ≤ 150 °C

## 3. Maximum Short-Circuit Times

Characteristic	Symbol	Value	Unit
Short Circuit Withstand Time 1 <sup>1</sup>	t <sub>sc,1</sub>	750	μs
Short Circuit Withstand Time 2 <sup>2</sup>	t <sub>sc,2</sub>	5.0	ms

Note: -55 °C ≤ T<sub>J</sub> ≤ 150 °C

Footnote 1: See Figure 17, 3 pulses with 10 ms period

Footnote 2: See Figure 18, 3 pulses with 10 ms period

## 4. Thermal Characteristics

Characteristic	Symbol	Value	Unit
Thermal Resistance, Junction to Case	R <sub>θJC</sub>	1.3	°C/W
Thermal Resistance, Junction to Ambient (D2PAK) <sup>3</sup>	R <sub>θJA</sub>	50	°C/W
Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 5 seconds	T <sub>L</sub>	275	°C

Footnote 3: When surface mounted to an FR4 board using the minimum recommended pad size

## 5. Electrical Characteristics – Off

Characteristic	Symbol	Conditions	Temperature	Value			Unit
				Min	Typ	Max	
Collector-Emitter Clamp Voltage	BV <sub>CES</sub>	I <sub>C</sub> = 2.0 mA	T <sub>J</sub> = -40 °C to 150 °C	380	395	420	V <sub>DC</sub>
		I <sub>C</sub> = 10 mA		390	405	430	
Zero Gate Voltage Collector Current	I <sub>CES</sub>	V <sub>CE</sub> = 200 V, V <sub>GE</sub> = 0 V	T <sub>J</sub> = 25 °C	-	2.0	10	μA <sub>DC</sub>
			T <sub>J</sub> = 150 °C	-	10	40 <sup>4</sup>	
			T <sub>J</sub> = -40 °C	-	1.0	10	
Reverse Collector-Emitter Leakage Current	I <sub>ECs</sub>	V <sub>CE</sub> = -24 V	T <sub>J</sub> = 25 °C	-	0.7	1.0	mA
			T <sub>J</sub> = 150 °C	-	12	25 <sup>4</sup>	
			T <sub>J</sub> = -40 °C	-	0.1	1.0	
Reverse Collector-Emitter Clamp Voltage	BV <sub>CES(R)</sub>	I <sub>C</sub> = -75 mA	T <sub>J</sub> = 25 °C	27	33	37	V <sub>DC</sub>
			T <sub>J</sub> = 150 °C	30	36	40	
			T <sub>J</sub> = -40 °C	25	32	35	
Gate-Emitter Clamp Voltage	BV <sub>GES</sub>	I <sub>G</sub> = 5.0 mA	T <sub>J</sub> = -40 °C to 150 °C	11	13	15	V <sub>DC</sub>
Gate-Emitter Leakage Current	I <sub>GES</sub>	V <sub>GE</sub> = 10 V	T <sub>J</sub> = -40 °C to 150 °C	384	640	700	μA <sub>DC</sub>
Gate-Emitter Resistor	R <sub>GE</sub>	-	T <sub>J</sub> = -40 °C to 150 °C	10	16	26	kΩ

Footnote 4: Maximum value of characteristic across temperature range

## 6. Electrical Characteristics – On

Characteristic	Symbol	Conditions	Temperature	Value			Unit
				Min	Typ	Max	
Gate Threshold Voltage	V <sub>GE(th)</sub>	I <sub>C</sub> = 1.0 mA, V <sub>GE</sub> = V <sub>CE</sub>	T <sub>J</sub> = 25 °C	1.1	1.4	1.9	V <sub>DC</sub>
			T <sub>J</sub> = 150 °C	0.75	1.0	1.4	
			T <sub>J</sub> = -40 °C	1.2	1.6	2.1 <sup>4</sup>	
Threshold Temperature Coefficient (Negative)	-	-	-	-	3.4	-	mV/°C
Collector-Emitter On-Voltage <sup>5</sup>	V <sub>CE(on)</sub>	I <sub>C</sub> = 6.0 A, V <sub>GE</sub> = 4.0 V	T <sub>J</sub> = 25 °C	1.0	1.4	1.6	V <sub>DC</sub>
			T <sub>J</sub> = 150 °C	0.9	1.3	1.6	
			T <sub>J</sub> = -40 °C	1.1	1.45	1.7 <sup>4</sup>	
		I <sub>C</sub> = 8.0 A, V <sub>GE</sub> = 4.0 V	T <sub>J</sub> = 25 °C	1.3	1.6	1.9 <sup>4</sup>	
			T <sub>J</sub> = 150 °C	1.2	1.55	1.8	
			T <sub>J</sub> = -40 °C	1.4	1.6	1.9 <sup>4</sup>	
		I <sub>C</sub> = 10 A, V <sub>GE</sub> = 4.0 V	T <sub>J</sub> = 25 °C	1.4	1.8	2.0	
			T <sub>J</sub> = 150 °C	1.5	1.8	2.0	
			T <sub>J</sub> = -40 °C	1.4	1.8	2.1 <sup>4</sup>	
		I <sub>C</sub> = 15 A, V <sub>GE</sub> = 4.0 V	T <sub>J</sub> = 25 °C	1.8	2.2	2.5	
			T <sub>J</sub> = 150 °C	2.0	2.4	2.6	
			T <sub>J</sub> = -40 °C	1.7	2.1	2.5	
I <sub>C</sub> = 10 A, V <sub>GE</sub> = 4.5 V	T <sub>J</sub> = 25 °C	1.3	1.8	2.0 <sup>4</sup>			
	T <sub>J</sub> = 150 °C	1.3	1.75	2.0 <sup>4</sup>			
	T <sub>J</sub> = -40 °C	1.4	1.8	2.0 <sup>4</sup>			
Forward Transconductance <sup>5</sup>	gfs	V <sub>CS</sub> = 5.0 V, I <sub>C</sub> = 6.0 A	T <sub>J</sub> = -40 °C to 150 °C	8.0	14	25	Mhos

Footnote 4: Maximum value of characteristic across temperature range

Footnote 5: Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%

## 7. Dynamic Characteristics

Characteristic	Symbol	Conditions	Temperature	Value			Unit
				Min	Typ	Max	
Input Capacitance	$C_{ISS}$	$V_{CC} = 25\text{ V}, V_{GE} = 0\text{ V},$ $f = 1.0\text{ MHz}$	$T_J = -40\text{ }^\circ\text{C to } 150\text{ }^\circ\text{C}$	400	800	1000	pF
Output Capacitance	$C_{OSS}$			50	75	100	
Transfer Capacitance	$C_{RSS}$			4.0	7.0	10	

## 8. Switching Characteristics

Characteristic	Symbol	Conditions	Temperature	Value			Unit
				Min	Typ	Max	
Turn-off Delay Time (Resistive)	$t_{d(off)}$	$V_{CC} = 300\text{ V}, I_C = 6.5\text{ A},$ $R_G = 1.0\text{ k}\Omega, R_L = 46\text{ }\Omega$	$T_J = 25\text{ }^\circ\text{C}$	-	4.0	10	$\mu\text{s}$
Fall Time (Resistive)	$t_f$			-	9.0	15	
Turn-on Delay Time	$t_{d(on)}$	$V_{CC} = 10\text{ V}, I_C = 6.5\text{ A},$ $R_G = 1.0\text{ k}\Omega, R_L = 1.5\text{ }\Omega$	$T_J = 25\text{ }^\circ\text{C}$	-	0.7	4.0	$\mu\text{s}$
Rise Time	$t_r$			-	4.5	7.0	

## 9. Figure Data

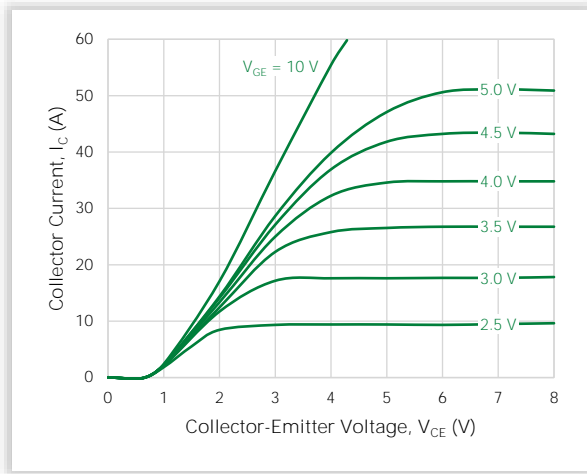
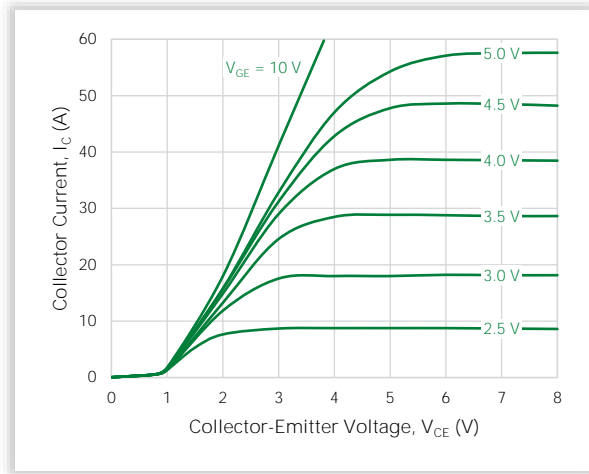
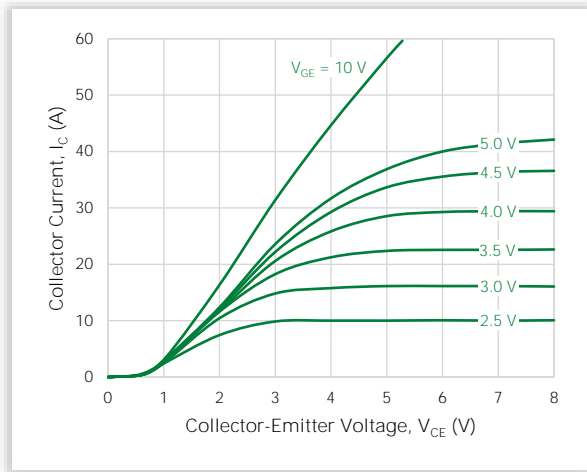
 Figure 1. Output Characteristics ( $T_J = 25\text{ }^\circ\text{C}$ )

 Figure 2. Output Characteristics ( $T_J = -40\text{ }^\circ\text{C}$ )

 Figure 3. Output Characteristics ( $T_J = 150\text{ }^\circ\text{C}$ )


Figure 4. Transfer Characteristics

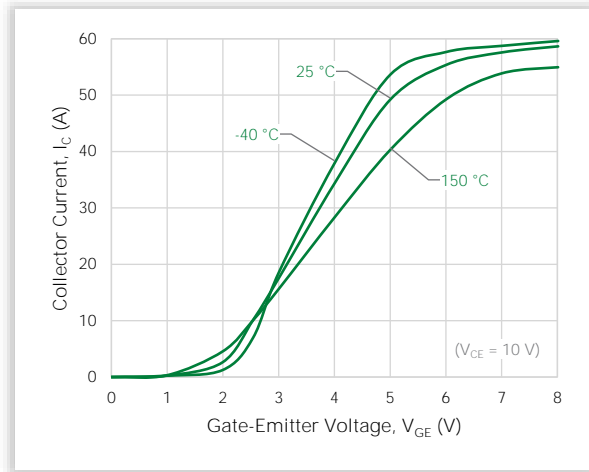


Figure 5. Collector-Emitter Saturation Voltage vs. Junction Temperature

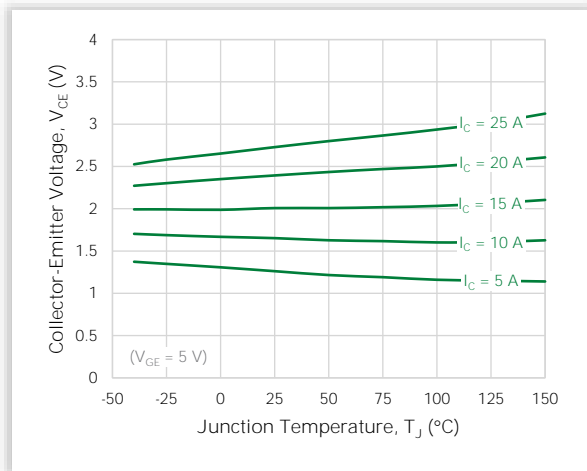
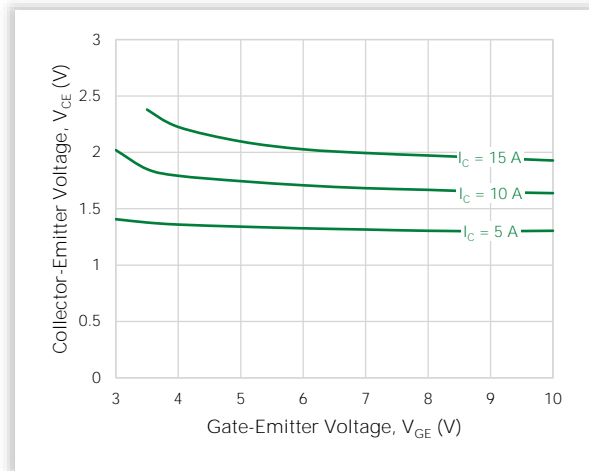

 Figure 6. Collector-Emitter Voltage vs. Gate-Emitter Voltage ( $T_J = 25\text{ }^\circ\text{C}$ )


Figure 7. Collector-Emitter Voltage vs. Gate-Emitter Voltage ( $T_J = 150\text{ }^\circ\text{C}$ )

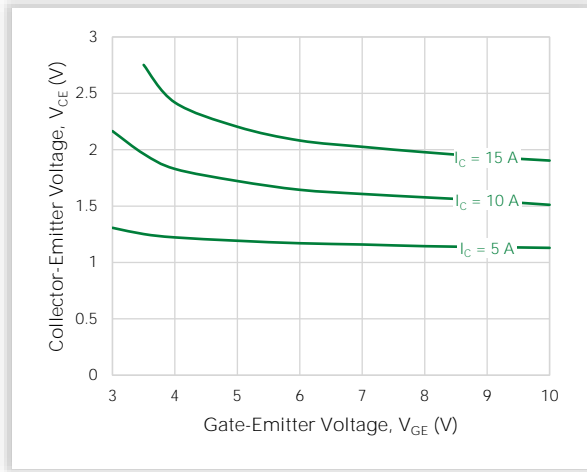


Figure 8. Capacitance Variation

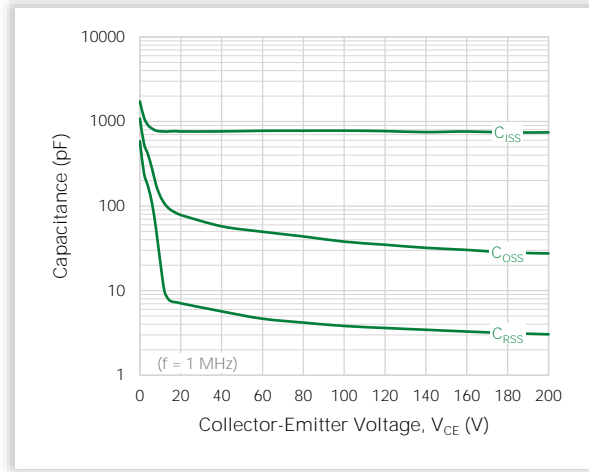


Figure 9. Gate Threshold Voltage vs. Temperature

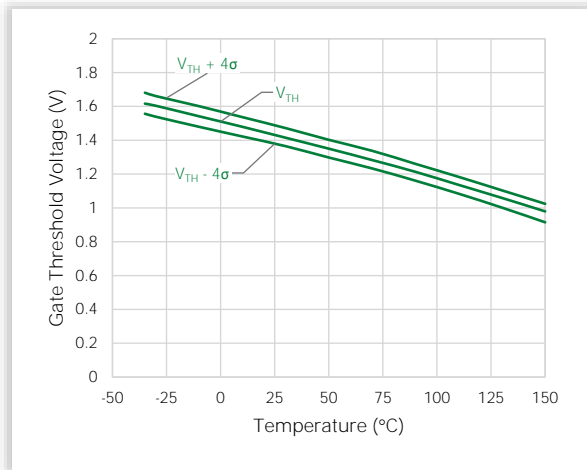


Figure 10. Minimum Open Secondary Latch Current vs. Temperature

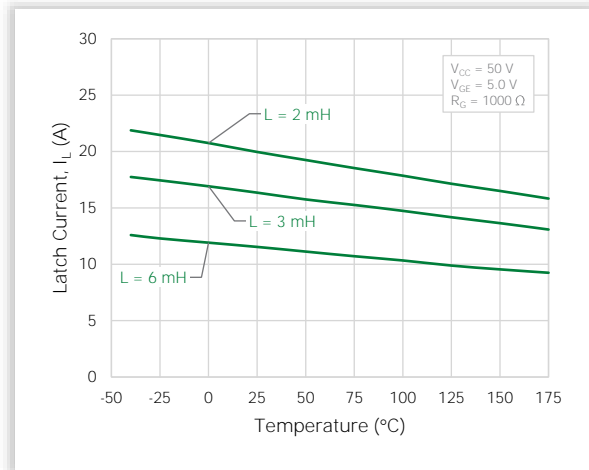


Figure 11. Typical Open Secondary Latch Current vs. Temperature

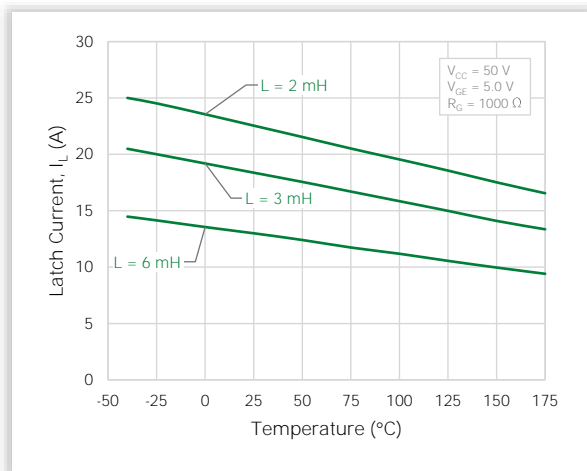


Figure 12. Inductive Switching Fall Time vs. Temperature

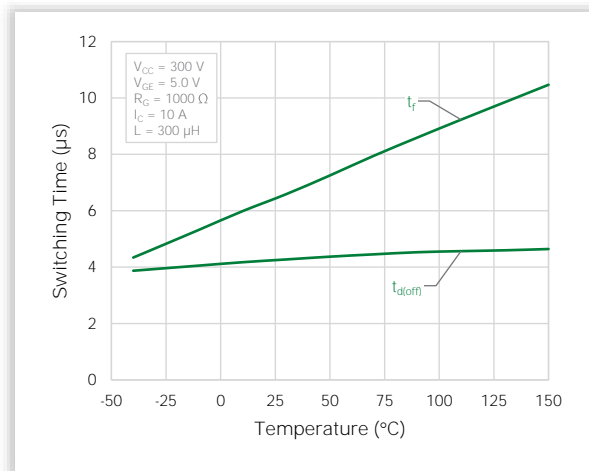


Figure 13. Single Pulse Safe Operating Area  
(Mounted on an Infinite Heatsink at  $T_A = 25^\circ\text{C}$ )

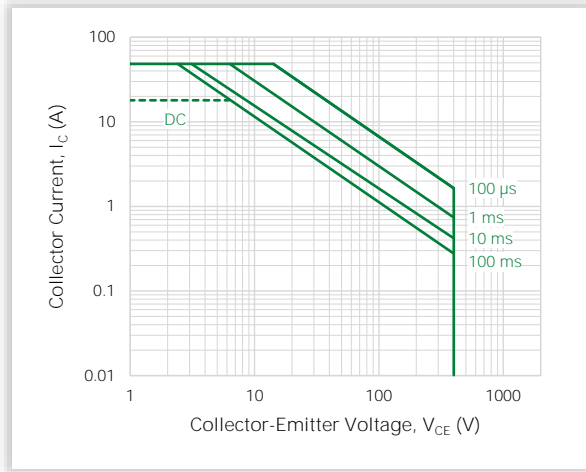


Figure 14. Single Pulse Safe Operating Area  
(Mounted on an Infinite Heatsink at  $T_A = 125^\circ\text{C}$ )

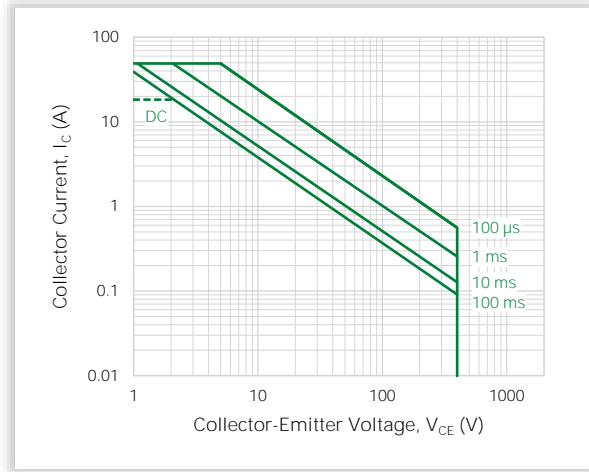


Figure 15. Pulse Train Safe Operating Area  
(Mounted on an Infinite Heatsink at  $T_A = 25^\circ\text{C}$ )

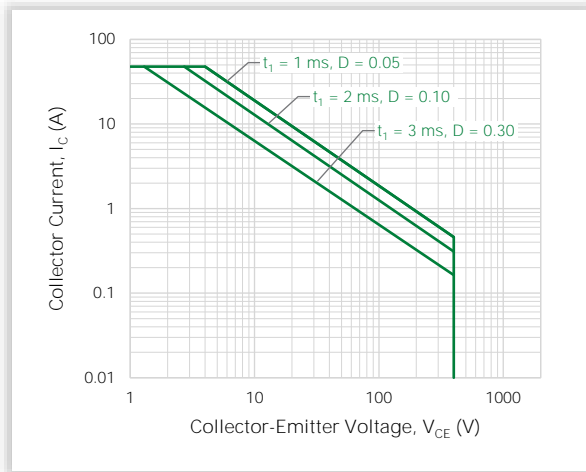


Figure 16. Pulse Train Safe Operating Area  
(Mounted on an Infinite Heatsink at  $T_A = 125^\circ\text{C}$ )

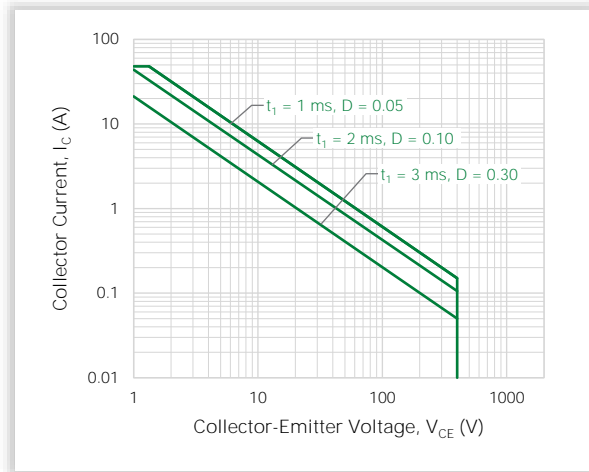


Figure 17. Circuit Configuration for Short Circuit Test 1

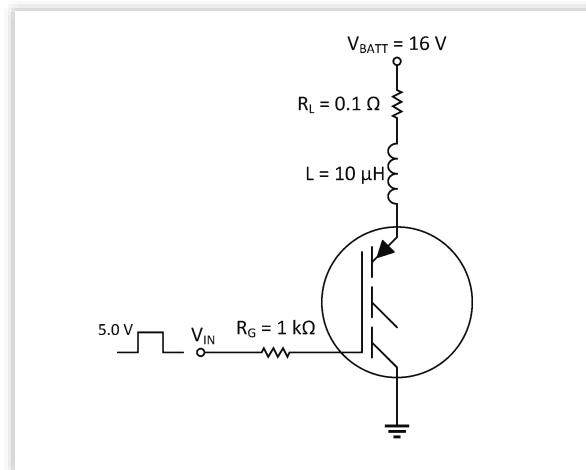


Figure 18. Circuit Configuration for Short Circuit Test 2

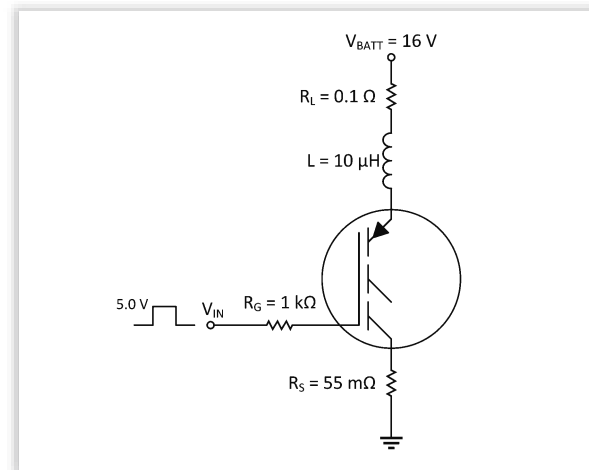
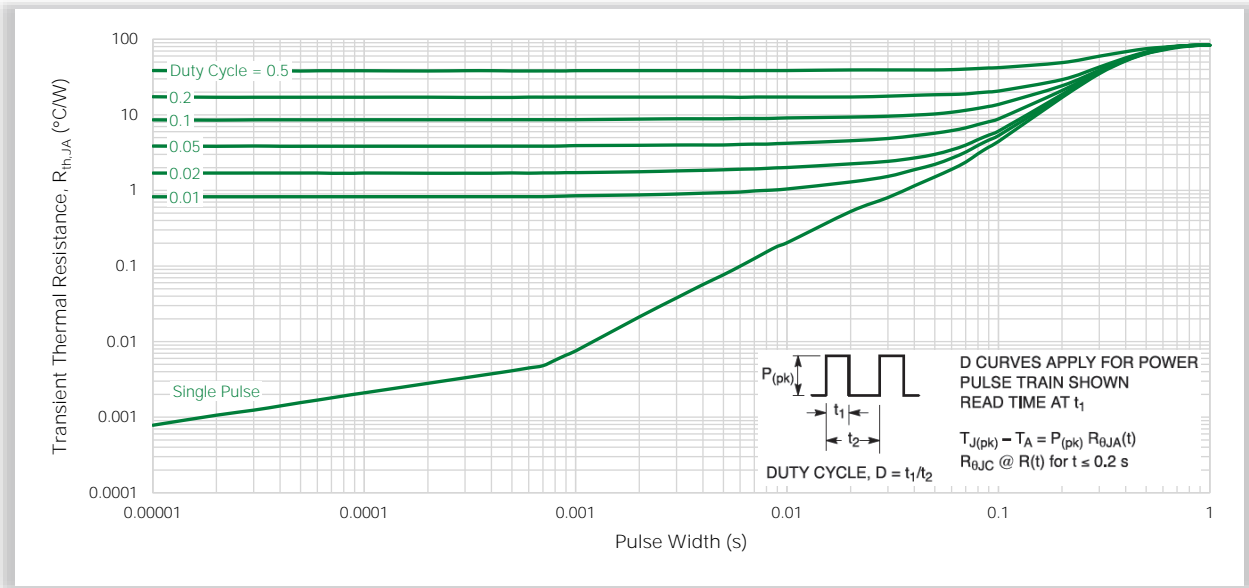


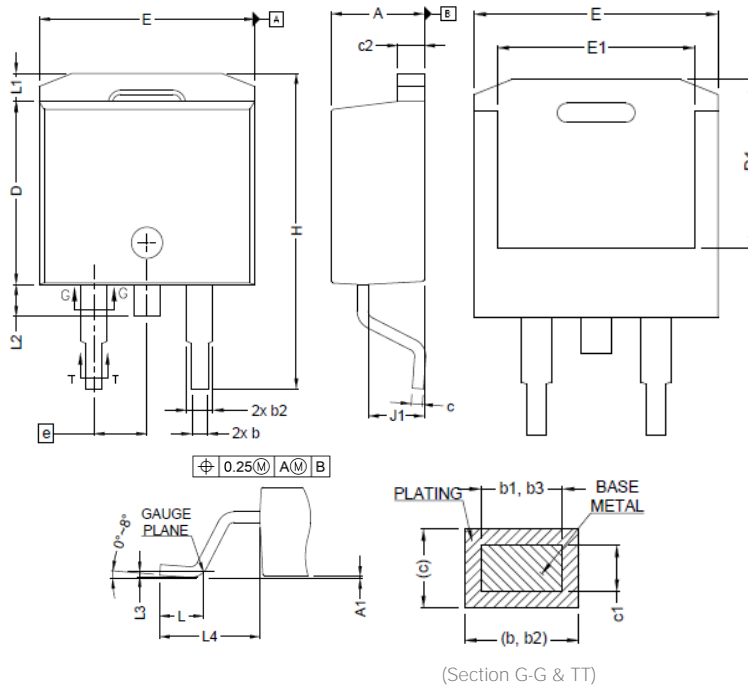


Figure 19. Transient Thermal Resistance

(Non-normalized Junction-Ambient mounted on minimum pad area)

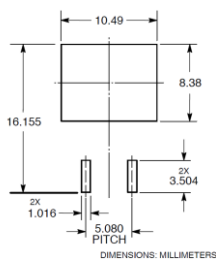


## 10. Package Dimensions



Symbol	Millimeters		
	Min	Nom	Max
A	4.360	-	4.560
A1	0.000	-	0.250
b	0.700	-	0.900
b1	0.510	-	0.890
b2	1.200	-	1.460
b3	1.170	-	1.370
c	0.380	-	0.694
c1	0.380	-	0.534
c2	1.190	-	1.340
D	8.600	-	9.000
D1	6.900	-	7.500
E	10.150	-	10.550
E1	8.100	-	8.700
e	2.540 BSC		
H	15.000	-	15.600
L	1.900	-	2.500
L1	-	-	1.650
L2	-	-	1.780
L3	0.250		
L4	4.780	-	5.280
J1	2.560	-	2.960

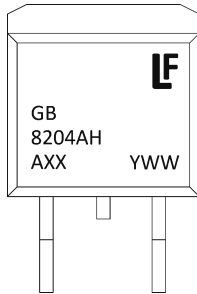
Recommended Solder Pad Layout:



Notes:

1. Dimensioning & tolerancing conform to ASME Y14.5M-1994.
2. All dimensions are in millimeters. Angles are in degrees.
3. Heatsink side flash is max 0.8 mm.
4. Radius on terminal is optional

## 11. Part Numbering and Marking



GB8204x = Device Code  
 A = Assembly Location  
 XX = Lot Number  
 Y = Year  
 WW = Work Week  
 H = Ballast Structure Design

## 12. Packing Options

Part Number	Package	Packing Mode	M.O.Q.
LGB8204ATH	D2PAK (Pb-Free)	Tape & Reel	800

For additional information please visit [www.Littelfuse.com/powersemi](http://www.Littelfuse.com/powersemi)

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