



ON Semiconductor®

FGB3040G2-F085 / FGD3040G2-F085 FGP3040G2-F085 / FGI3040G2-F085

EcoSPARK[®] 2 300mJ, 400V, N-Channel Ignition IGBT

Features

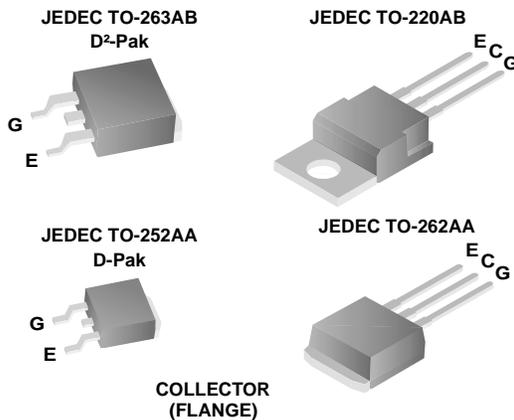
- SCIS Energy = 300mJ at $T_J = 25^\circ\text{C}$
- Logic Level Gate Drive
- Qualified to AEC Q101
- RoHS Compliant



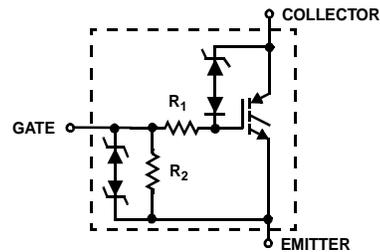
Applications

- Automotive Ignition Coil Driver Circuits
- Coil On Plug Applications

Package



Symbol



Device Maximum Ratings $T_A = 25^\circ\text{C}$ unless otherwise noted

| Symbol | Parameter | Ratings | Units |
|---------------|---|-------------|---------------------|
| BV_{CER} | Collector to Emitter Breakdown Voltage ($I_C = 1\text{mA}$) | 400 | V |
| BV_{ECS} | Emitter to Collector Voltage - Reverse Battery Condition ($I_C = 10\text{mA}$) | 28 | V |
| E_{SCIS25} | Self Clamping Inductive Switching Energy (Note 1) | 300 | mJ |
| $E_{SCIS150}$ | Self Clamping Inductive Switching Energy (Note 2) | 170 | mJ |
| I_{C25} | Collector Current Continuous, at $V_{GE} = 5.0\text{V}$, $T_C = 25^\circ\text{C}$ | 41 | A |
| I_{C110} | Collector Current Continuous, at $V_{GE} = 5.0\text{V}$, $T_C = 110^\circ\text{C}$ | 25.6 | A |
| V_{GEM} | Gate to Emitter Voltage Continuous | ± 10 | V |
| P_D | Power Dissipation Total, at $T_C = 25^\circ\text{C}$ | 150 | W |
| | Power Dissipation Derating, for $T_C > 25^\circ\text{C}$ | 1 | W/ $^\circ\text{C}$ |
| T_J | Operating Junction Temperature Range | -55 to +175 | $^\circ\text{C}$ |
| T_{STG} | Storage Junction Temperature Range | -55 to +175 | $^\circ\text{C}$ |
| T_L | Max. Lead Temp. for Soldering (Leads at 1.6mm from case for 10s) | 300 | $^\circ\text{C}$ |
| T_{PKG} | Reflow soldering according to JESD020C | 260 | $^\circ\text{C}$ |
| ESD | HBM-Electrostatic Discharge Voltage at 100pF, 1500 Ω | 4 | kV |
| | CDM-Electrostatic Discharge Voltage at 1 Ω | 2 | kV |

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Package Marking and Ordering Information

| Device Marking | Device | Package | Reel Size | Tape Width | Quantity |
|----------------|----------------|----------|-----------|------------|----------|
| FGB3040G2 | FGB3040G2-F085 | TO-263AB | 330mm | 24mm | 800 |
| FGD3040G2 | FGD3040G2-F085 | TO-252AA | 330mm | 16mm | 2500 |
| FGP3040G2 | FGP3040G2-F085 | TO-220AB | Tube | N/A | 50 |
| FGI3040G2 | FGI3040G2-F085 | TO-262AA | Tube | N/A | 50 |

Electrical Characteristics $T_A = 25^\circ\text{C}$ unless otherwise noted

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|--------|-----------|-----------------|-----|-----|-----|-------|
|--------|-----------|-----------------|-----|-----|-----|-------|

Off State Characteristics

| | | | | | | | |
|-------------------|--|---|---------------------------|----------|-----|----------|---------------|
| BV_{CER} | Collector to Emitter Breakdown Voltage | $I_{\text{CE}} = 2\text{mA}$, $V_{\text{GE}} = 0$, $R_{\text{GE}} = 1\text{K}\Omega$, $T_J = -40$ to 150°C | 370 | 400 | 430 | V | |
| BV_{CES} | Collector to Emitter Breakdown Voltage | $I_{\text{CE}} = 10\text{mA}$, $V_{\text{GE}} = 0\text{V}$, $R_{\text{GE}} = 0$, $T_J = -40$ to 150°C | 390 | 420 | 450 | V | |
| BV_{ECS} | Emitter to Collector Breakdown Voltage | $I_{\text{CE}} = -20\text{mA}$, $V_{\text{GE}} = 0\text{V}$, $T_J = 25^\circ\text{C}$ | 28 | - | - | V | |
| BV_{GES} | Gate to Emitter Breakdown Voltage | $I_{\text{GES}} = \pm 2\text{mA}$ | ± 12 | ± 14 | - | V | |
| I_{CER} | Collector to Emitter Leakage Current | $V_{\text{CE}} = 250\text{V}$, $R_{\text{GE}} = 1\text{K}\Omega$ | $T_J = 25^\circ\text{C}$ | - | - | 25 | μA |
| | | | $T_J = 150^\circ\text{C}$ | - | - | 1 | mA |
| I_{ECS} | Emitter to Collector Leakage Current | $V_{\text{EC}} = 24\text{V}$ | $T_J = 25^\circ\text{C}$ | - | - | 1 | mA |
| | | | $T_J = 150^\circ\text{C}$ | - | - | 40 | mA |
| R_1 | Series Gate Resistance | | - | 120 | - | Ω | |
| R_2 | Gate to Emitter Resistance | | 10K | - | 30K | Ω | |

On State Characteristics

| | | | | | | | |
|----------------------|---|---|---------------------------|---|------|------|----|
| $V_{\text{CE(SAT)}}$ | Collector to Emitter Saturation Voltage | $I_{\text{CE}} = 6\text{A}$, $V_{\text{GE}} = 4\text{V}$, | $T_J = 25^\circ\text{C}$ | - | 1.15 | 1.25 | V |
| $V_{\text{CE(SAT)}}$ | Collector to Emitter Saturation Voltage | $I_{\text{CE}} = 10\text{A}$, $V_{\text{GE}} = 4.5\text{V}$, | $T_J = 150^\circ\text{C}$ | - | 1.35 | 1.50 | V |
| $V_{\text{CE(SAT)}}$ | Collector to Emitter Saturation Voltage | $I_{\text{CE}} = 15\text{A}$, $V_{\text{GE}} = 4.5\text{V}$, | $T_J = 150^\circ\text{C}$ | - | 1.68 | 1.85 | V |
| E_{SCIS} | Self Clamped Inductive Switching | $L = 3.0\text{mHy}$, $R_G = 1\text{K}\Omega$, $V_{\text{GE}} = 5\text{V}$, (Note 1) | $T_J = 25^\circ\text{C}$ | - | - | 300 | mJ |

Thermal Characteristics

| | | | | | | |
|-----------------------|-------------------------------------|--|---|---|---|--------------------|
| $R_{\theta\text{JC}}$ | Thermal Resistance Junction to Case | | - | - | 1 | $^\circ\text{C/W}$ |
|-----------------------|-------------------------------------|--|---|---|---|--------------------|

Notes:

1: Self Clamping Inductive Switching Energy ($E_{\text{SCIS}25}$) of 300 mJ is based on the test conditions that starting $T_J = 25^\circ\text{C}$; $L = 3\text{mHy}$, $I_{\text{SCIS}} = 14.2\text{A}$, $V_{\text{CC}} = 100\text{V}$ during inductor charging and $V_{\text{CC}} = 0\text{V}$ during the time in clamp.

2: Self Clamping Inductive Switching Energy ($E_{\text{SCIS}150}$) of 170 mJ is based on the test conditions that starting $T_J = 150^\circ\text{C}$; $L = 3\text{mHy}$, $I_{\text{SCIS}} = 10.8\text{A}$, $V_{\text{CC}} = 100\text{V}$ during inductor charging and $V_{\text{CC}} = 0\text{V}$ during the time in clamp.

Electrical Characteristics $T_A = 25^\circ\text{C}$ unless otherwise noted

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|--------|-----------|-----------------|-----|-----|-----|-------|
|--------|-----------|-----------------|-----|-----|-----|-------|

Dynamic Characteristics

| | | | | | | |
|--------------|-----------------------------------|--|------|-----|-----|----|
| $Q_{G(ON)}$ | Gate Charge | $I_{CE} = 10\text{A}, V_{CE} = 12\text{V}, V_{GE} = 5\text{V}$ | - | 21 | - | nC |
| $V_{GE(TH)}$ | Gate to Emitter Threshold Voltage | $I_{CE} = 1\text{mA}, V_{CE} = V_{GE}, T_J = 25^\circ\text{C}$ | 1.3 | 1.7 | 2.2 | V |
| | | $T_J = 150^\circ\text{C}$ | 0.75 | 1.2 | 1.8 | |
| V_{GEP} | Gate to Emitter Plateau Voltage | $V_{CE} = 12\text{V}, I_{CE} = 10\text{A}$ | - | 2.8 | - | V |

Switching Characteristics

| | | | | | | |
|---------------|---------------------------------------|---|---|-----|----|---------------|
| $t_{d(ON)R}$ | Current Turn-On Delay Time-Resistive | $V_{CE} = 14\text{V}, R_L = 1\Omega$ | - | 0.9 | 4 | μs |
| t_{rR} | Current Rise Time-Resistive | $V_{GE} = 5\text{V}, R_G = 1\text{K}\Omega, T_J = 25^\circ\text{C}$ | - | 1.9 | 7 | |
| $t_{d(OFF)L}$ | Current Turn-Off Delay Time-Inductive | $V_{CE} = 300\text{V}, L = 1\text{mH}, V_{GE} = 5\text{V}, R_G = 1\text{K}\Omega$ | - | 4.8 | 15 | μs |
| t_{fL} | Current Fall Time-Inductive | $I_{CE} = 6.5\text{A}, T_J = 25^\circ\text{C}$ | - | 2.0 | 15 | |

Typical Performance Curves

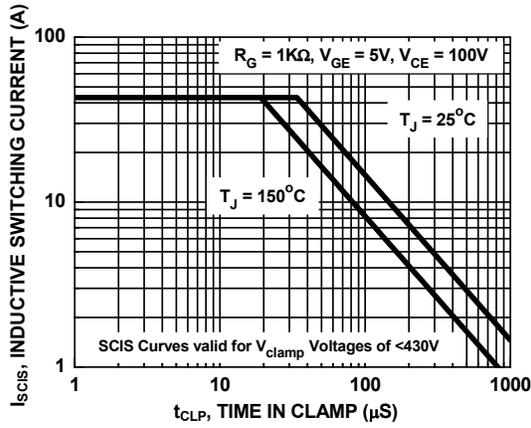


Figure 1. Self Clamped Inductive Switching Current vs. Time in Clamp

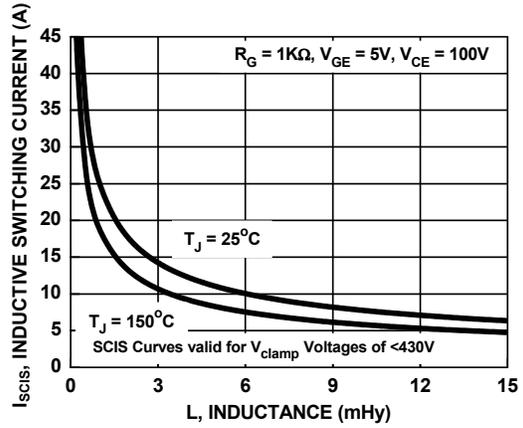


Figure 2. Self Clamped Inductive Switching Current vs. Inductance

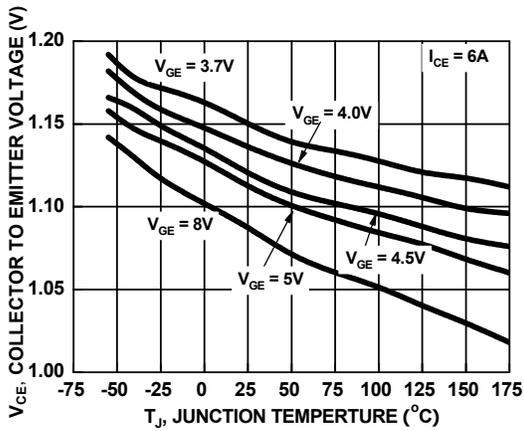


Figure 3. Collector to Emitter On-State Voltage vs. Junction Temperature

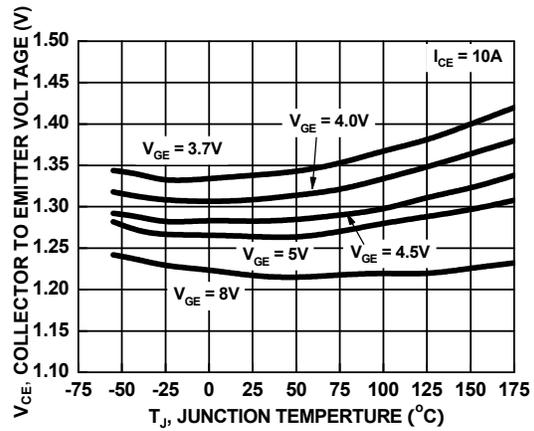


Figure 4. Collector to Emitter On-State Voltage vs. Junction Temperature

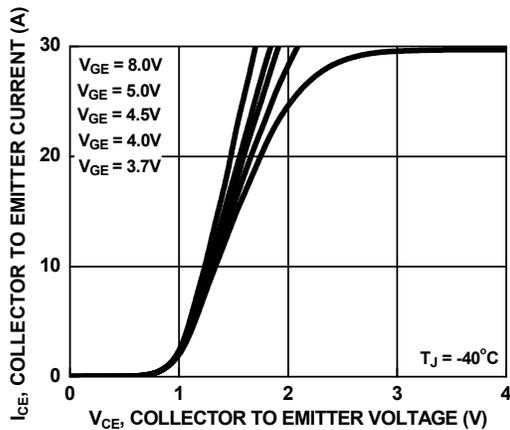


Figure 5. Collector to Emitter On-State Voltage vs. Collector Current

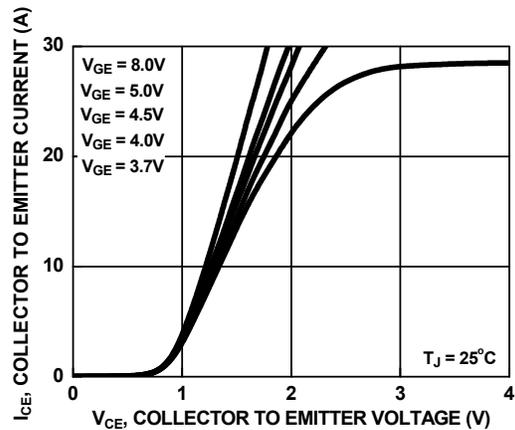


Figure 6. Collector to Emitter On-State Voltage vs. Collector Current

Typical Performance Curves (Continued)

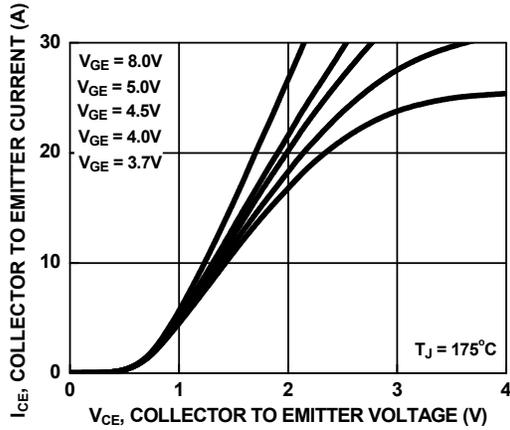


Figure 7. Collector to Emitter On-State Voltage vs. Collector Current

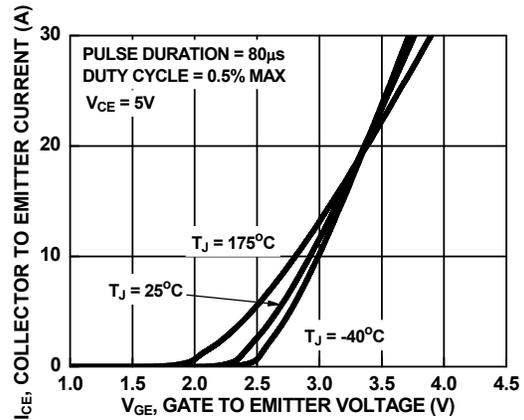


Figure 8. Transfer Characteristics

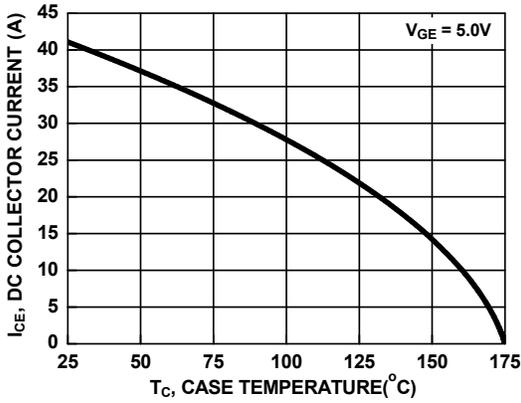


Figure 9. DC Collector Current vs. Case Temperature

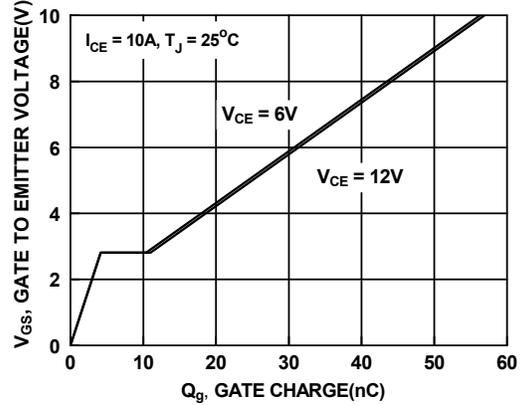


Figure 10. Gate Charge

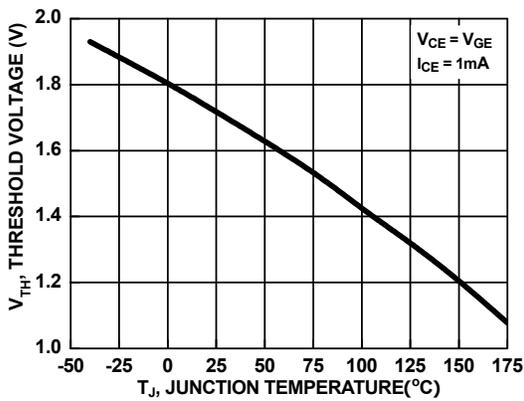


Figure 11. Threshold Voltage vs. Junction Temperature

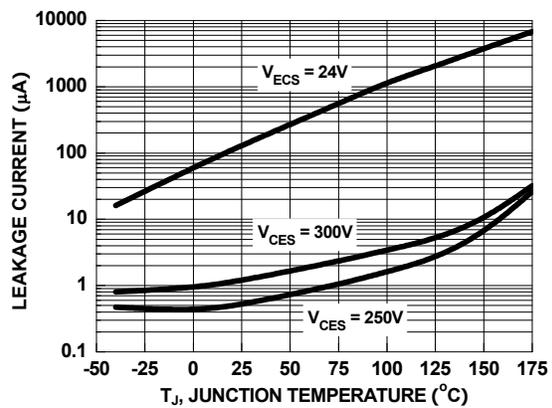


Figure 12. Leakage Current vs. Junction Temperature

Typical Performance Curves (Continued)

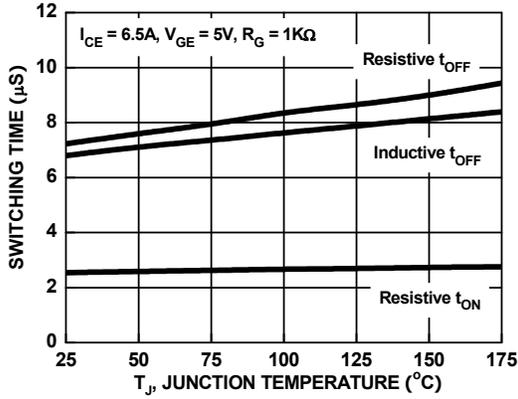


Figure 13. Switching Time vs. Junction Temperature

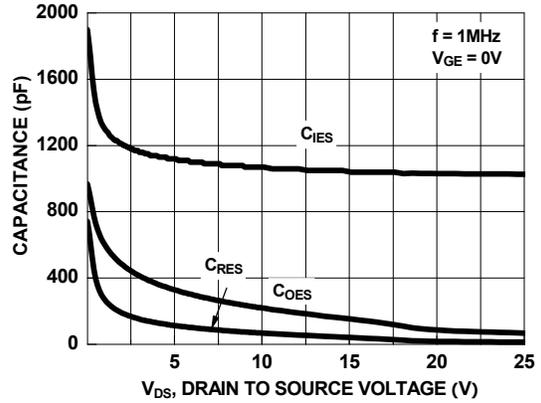


Figure 14. Capacitance vs. Collector to Emitter Voltage

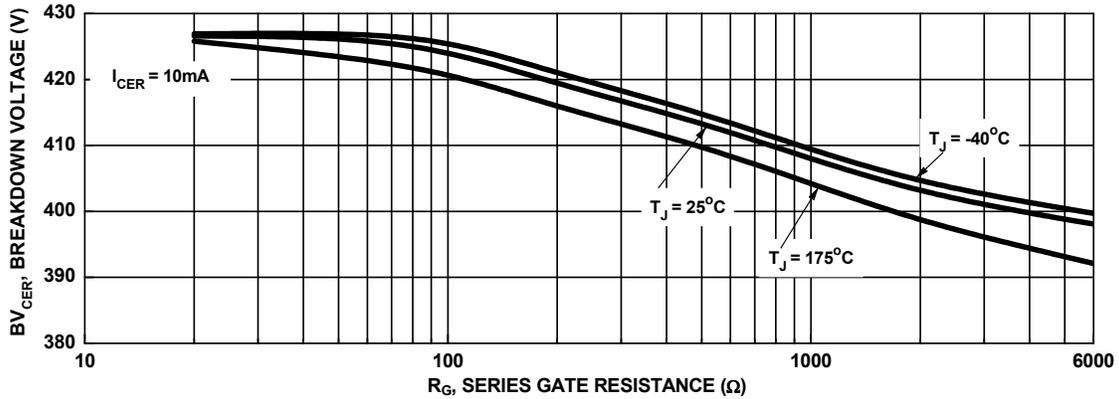


Figure 15. Break down Voltage vs. Series Gate Resistance

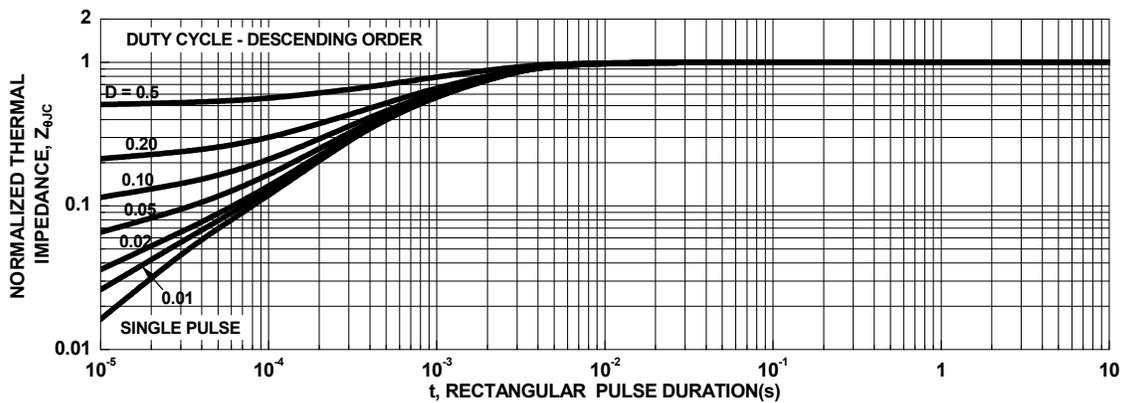


Figure 16. IGBT Normalized Transient Thermal Impedance, Junction to Case

Typical Performance Curves

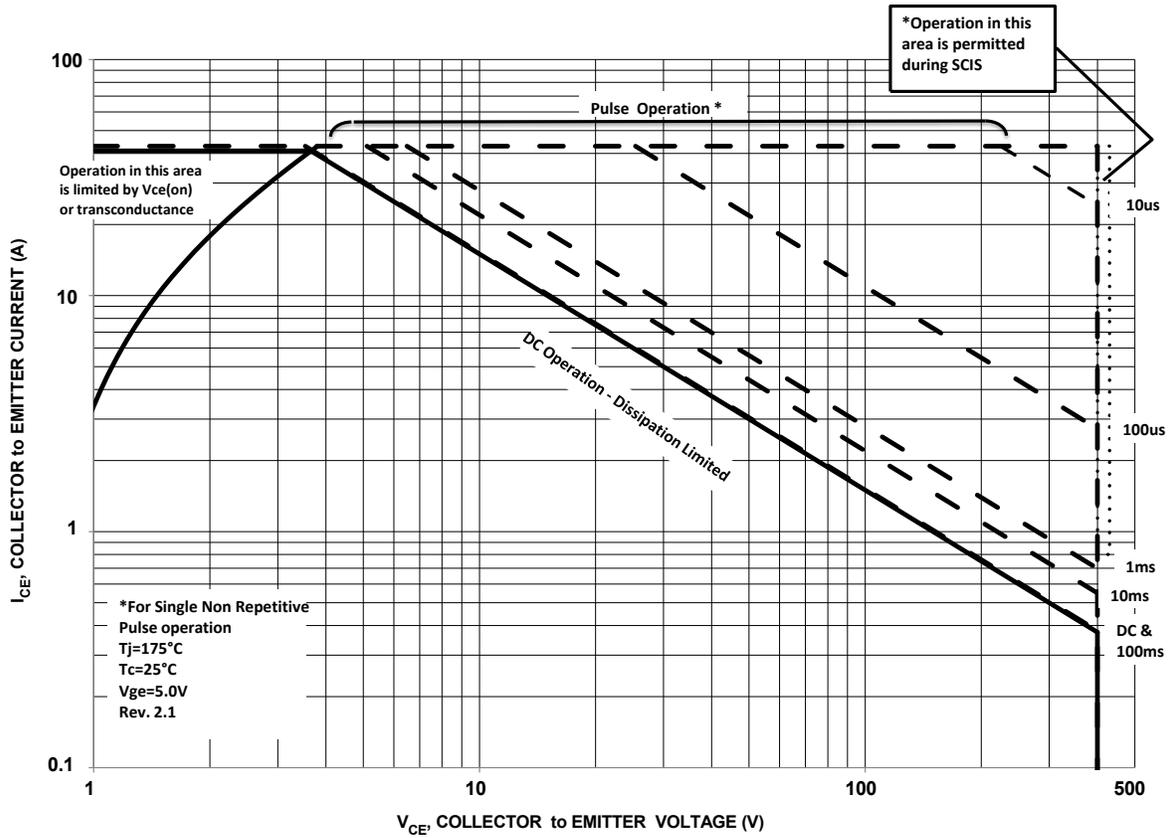


Figure 17. Forward Safe Operating Area

Test Circuit and Waveforms

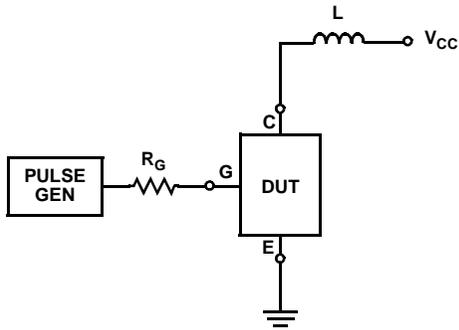


Figure 18. Inductive Switching Test Circuit

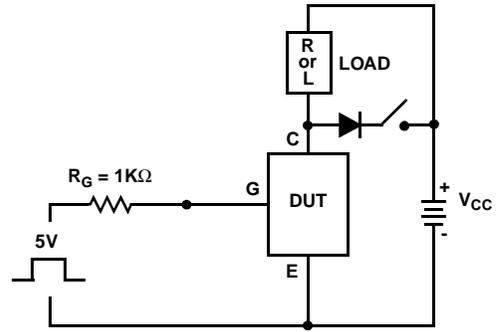


Figure 19. t_{ON} and t_{OFF} Switching Test Circuit

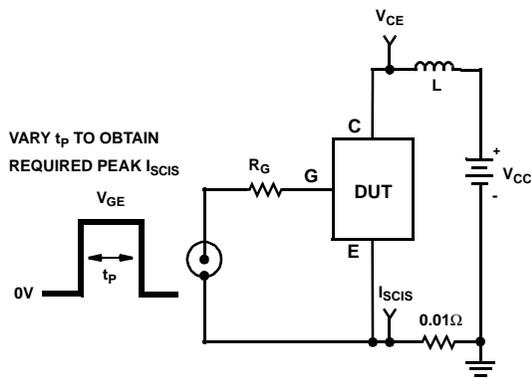


Figure 20. Energy Test Circuit

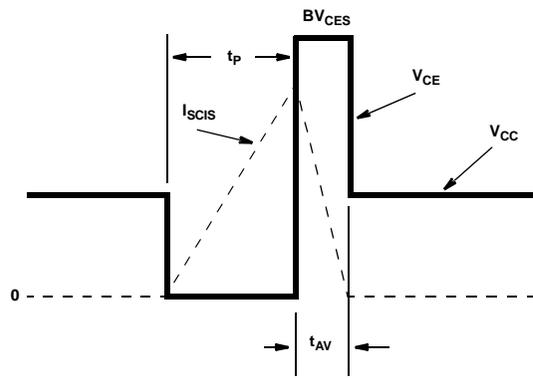


Figure 21. Energy Waveforms

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