FAIRCHILD SEMICONDUCTOR®

July 2013

# FGD3040G2_F085

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

### Features

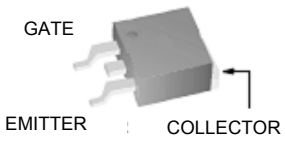
- SCIS Energy = 300mJ at $T_J$ = 25°C
- Logic Level Gate Drive
- Qualified to AEC Q101
- RoHS Compliant

### Applications

- Automotive Ignition Coil Driver Circuits
- Coil On Plug Applications

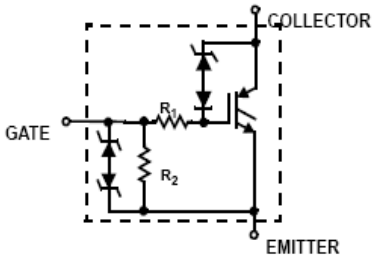
100% RoHS COMPLIANT

### Package




JEDEC TO-252
D-Pak

### Symbol



## Device Maximum Ratings $T_A$ = 25°C unless otherwise noted

| Symbol | Parameter | Ratings | Units |
|---|---|---|---|
| $BV_{CER}$ | Collector to Emitter Breakdown Voltage ($I_C$ = 1mA) | 400 | V |
| $BV_{ECS}$ | Emitter to Collector Voltage - Reverse Battery Condition ($I_C$ = 10mA) | 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 $V_{GE}$ = 5.0V, $T_C$ = 25°C | 41 | A |
| $I_{C110}$ | Collector Current Continuous, at $V_{GE}$ = 5.0V, $T_C$ = 110°C | 25.6 | A |
| $V_{GEM}$ | Gate to Emitter Voltage Continuous | ±10 | V |
| $P_D$ | Power Dissipation Total, at $T_C$ = 25°C | 150 | W |
| | Power Dissipation Derating, for $T_C$ > 25°C | 1 | W/°C |
| $T_J$ | Operating Junction Temperature Range | -55 to +175 | °C |
| $T_{STG}$ | Storage Junction Temperature Range | -55 to +175 | °C |
| $T_L$ | Max. Lead Temp. for Soldering (Leads at 1.6mm from case for 10s) | 300 | °C |
| $T_{PKG}$ | Reflow soldering according to JESD020C | 260 | °C |
| ESD | HBM-Electrostatic Discharge Voltage at100pF, 1500Ω | 4 | kV |
| | CDM-Electrostatic Discharge Voltage at 1Ω | 2 | kV |

## Package Marking and Ordering Information

| Device Marking | Device | Package | Reel Size | Tape Width | Quantity |
|---|---|---|---|---|---|
| FGD3040G2 | FGD3040G2_F085 | TO252 | 330mm | 16mm | 2500 units |

## Electrical Characteristics $T_A$ = 25°C unless otherwise noted

| Symbol | Parameter | Test Conditions | | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| **Off State Characteristics** | | | | | | | |
| $BV_{CER}$ | Collector to Emitter Breakdown Voltage | $I_{CE}$ = 2mA, $V_{GE}$ = 0, $R_{GE}$ = 1KΩ, $T_J$ = -40 to 150°C | | 370 | 400 | 430 | V |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | $I_{CE}$ = 10mA, $V_{GE}$ = 0V, $R_{GE}$ = 0, $T_J$ = -40 to 150°C | | 390 | 420 | 450 | V |
| $BV_{ECS}$ | Emitter to Collector Breakdown Voltage | $I_{CE}$ = -20mA, $V_{GE}$ = 0V, $T_J$ = 25°C | | 28 | - | - | V |
| $BV_{GES}$ | Gate to Emitter Breakdown Voltage | $I_{GES}$ = ±2mA | | ±12 | ±14 | - | V |
| $I_{CER}$ | Collector to Emitter Leakage Current | $V_{CE}$ = 250V, $R_{GE}$ = 1KΩ | $T_J$ = 25°C | - | - | 25 | μA |
| | | | $T_J$ = 150°C | - | - | 1 | mA |
| $I_{ECS}$ | Emitter to Collector Leakage Current | $V_{EC}$ = 24V, | $T_J$ = 25°C | - | - | 1 | mA |
| | | | $T_J$ = 150°C | - | - | 40 | |
| $R_1$ | Series Gate Resistance | | | - | 120 | - | Ω |
| $R_2$ | Gate to Emitter Resistance | | | 10K | - | 30K | Ω |
| **On State Characteristics** | | | | | | | |
| $V_{CE(SAT)}$ | Collector to Emitter Saturation Voltage | $I_{CE}$ = 6A, $V_{GE}$ = 4V, | $T_J$ = 25°C | - | 1.15 | 1.25 | V |
| $V_{CE(SAT)}$ | Collector to Emitter Saturation Voltage | $I_{CE}$ = 10A, $V_{GE}$ = 4.5V, | $T_J$ = 150°C | - | 1.35 | 1.50 | V |
| $V_{CE(SAT)}$ | Collector to Emitter Saturation Voltage | $I_{CE}$ = 15A, $V_{GE}$ = 4.5V, | $T_J$ = 150°C | - | 1.68 | 1.85 | V |
| $E_{SCIS}$ | Self Clamped Inductive Switching | L = 3.0 mHy, $R_G$ = 1KΩ, $V_{GE}$ = 5V, (Note 1) | $T_J$ = 25°C | - | - | 300 | mJ |

## Electrical Characteristics $T_A$ = 25°C unless otherwise noted

| Symbol | Parameter | Test Conditions | | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| **Dynamic Characteristics** | | | | | | | |
| $Q_{G(ON)}$ | Gate Charge | $I_{CE}$ = 10A, $V_{CE}$ = 12V, $V_{GE}$ = 5V | | - | 21 | - | nC |
| $V_{GE(TH)}$ | Gate to Emitter Threshold Voltage | $I_{CE}$ = 1mA, $V_{CE}$ = $V_{GE}$, | $T_J$ = 25°C | 1.3 | 1.7 | 2.2 | V |
| | | | $T_J$ = 150°C | 0.75 | 1.2 | 1.8 | |
| $V_{GEP}$ | Gate to Emitter Plateau Voltage | $V_{CE}$ = 12V, $I_{CE}$ = 10A | | - | 2.8 | - | V |
| **Switching Characteristics** | | | | | | | |
| $t_{d(ON)R}$ | Current Turn-On Delay Time-Resistive | $V_{CE}$ = 14V, $R_L$ = 1Ω | | - | 0.9 | 4 | μs |
| $t_{rR}$ | Current Rise Time-Resistive | $V_{GE}$ = 5V, $R_G$ = 1KΩ $T_J$ = 25°C, | | - | 1.9 | 7 | μs |
| $t_{d(OFF)L}$ | Current Turn-Off Delay Time-Inductive | $V_{CE}$ = 300V, L = 1mH, | | - | 4.8 | 15 | μs |
| $t_{fL}$ | Current Fall Time-Inductive | $V_{GE}$ = 5V, $R_G$ = 1KΩ $I_{CE}$ = 6.5A, $T_J$ = 25°C, | | - | 2.0 | 15 | μs |
| **Thermal Characteristics** | | | | | | | |
| $R_{\theta JC}$ | Thermal Resistance Junction to Case | | | - | - | 1 | °C/W |

**Notes:**

1: Self Clamping Inductive Switching Energy ($E_{SCIS25}$) of 300 mJ is based on the test conditions that starting Tj=25°C; L=3mHy, $I_{SCIS}$=14.2A,$V_{CC}$=100V during inductor charging and $V_{CC}$=0V during the time in clamp.

2: Self Clamping Inductive Switching Energy ($E_{SCIS150}$) of 170 mJ is based on the test conditions that starting Tj=150°C; L=3mHy, $I_{SCIS}$=10.8A,$V_{CC}$=100V during inductor charging and $V_{CC}$=0V during the time in clamp.

## Typical Performance Curves

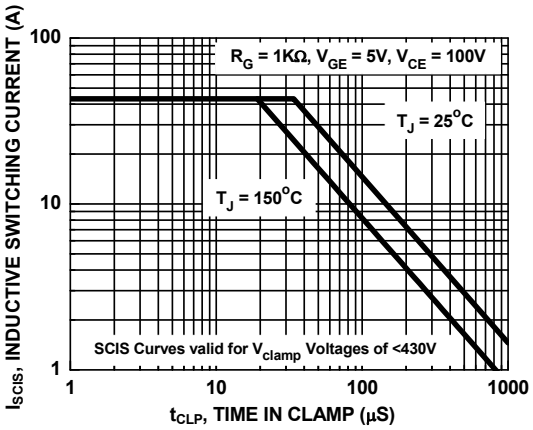



**Figure 1. Self Clamped Inductive Switching Current vs. Time in Clamp**

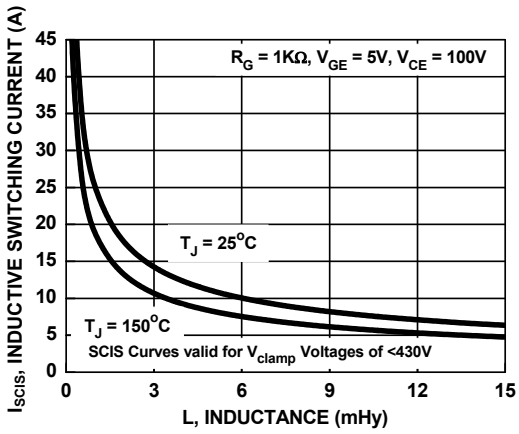



**Figure 2. Self Clamped Inductive Switching Current vs. Inductance**

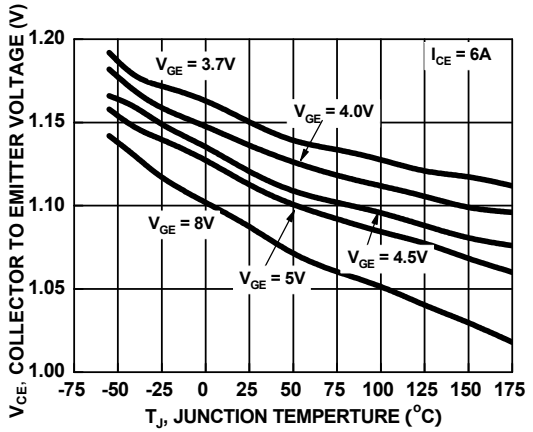



**Figure 3. Collector to Emitter On-State Voltage vs. Junction Temperature**

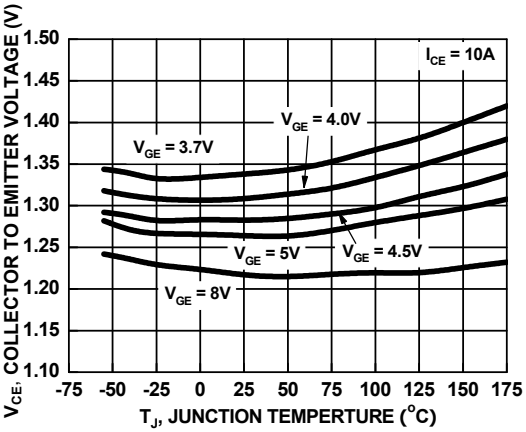



**Figure 4. Collector to Emitter On-State Voltage vs. Junction Temperature**

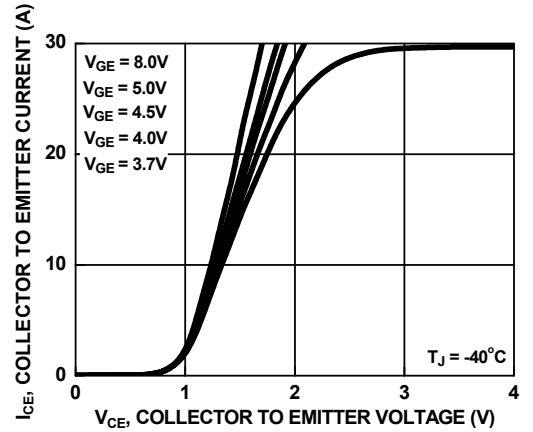



**Figure 5. Collector to Emitter On-State Voltage vs. Collector Current**

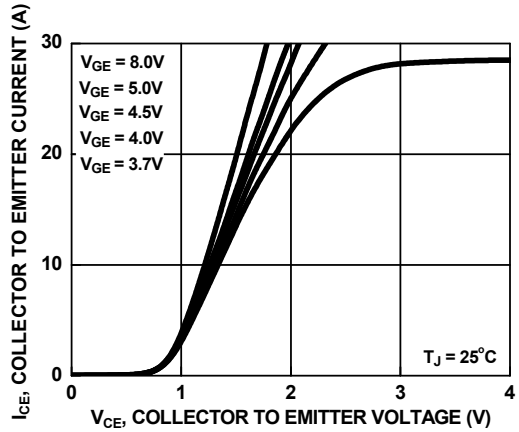



**Figure 6. Collector to Emitter On-State Voltage vs. Collector Current**

## Typical Performance Curves (Continued)

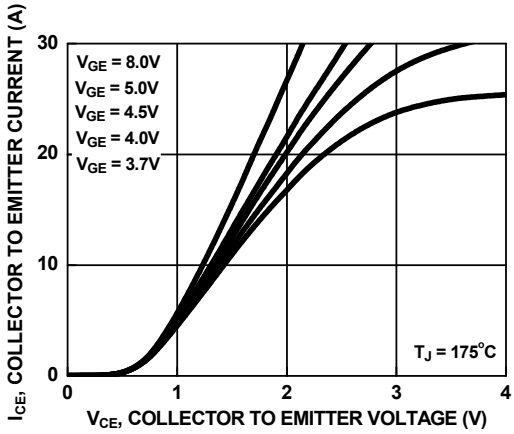



**Figure 7. Collector to Emitter On-State Voltage vs. Collector Current**

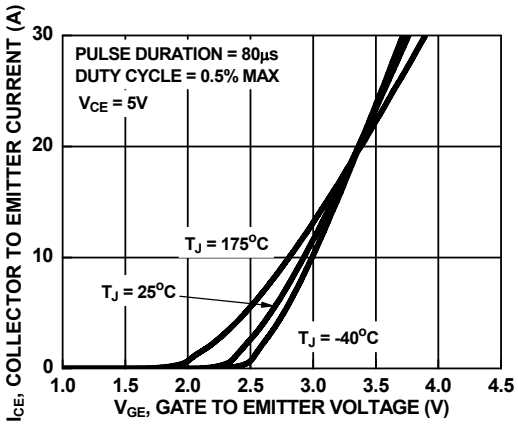



**Figure 8. Transfer Characteristics**

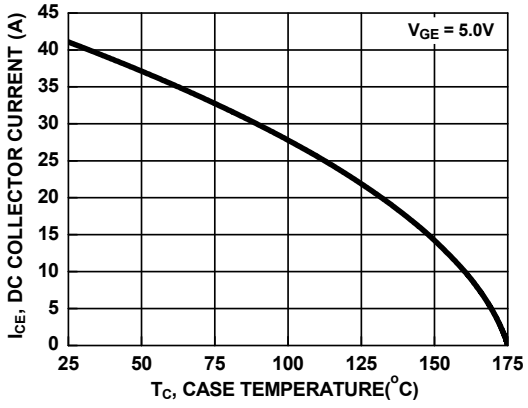



**Figure 9. DC Collector Current vs. Case Temperature**

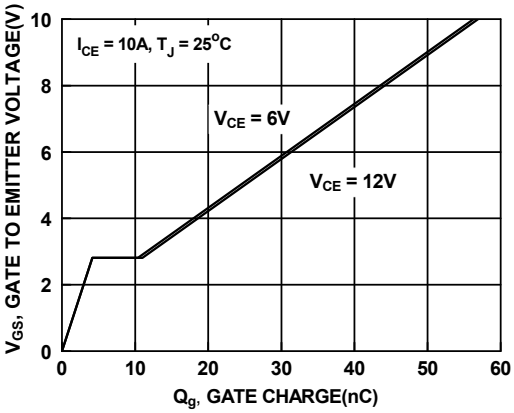



**Figure 10. Gate Charge**

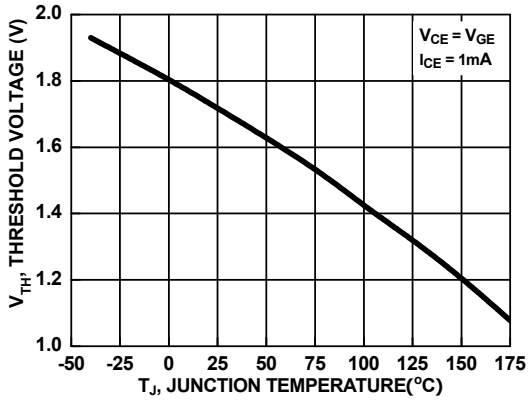



**Figure 11. Threshold Voltage vs. Junction Temperature**

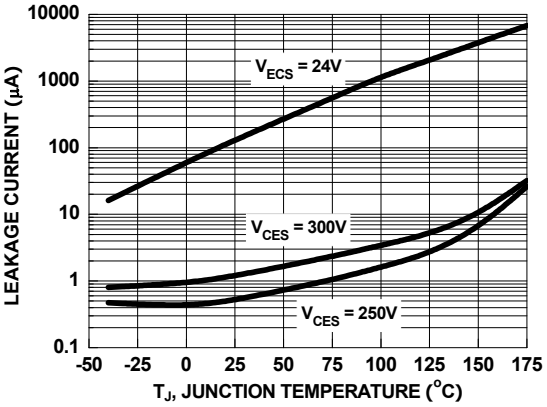



**Figure 12. Leakage Current vs. Junction Temperature**

## Typical Performance Curves (Continued)

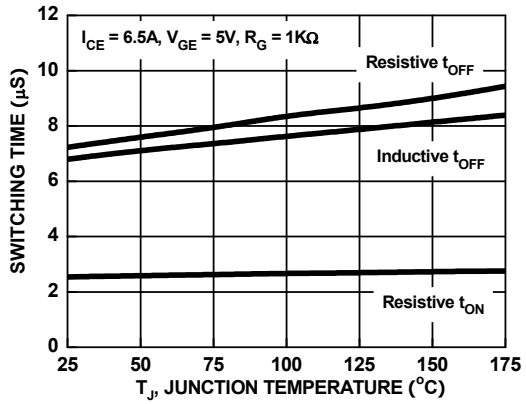



Figure 13. Switching Time vs. Junction Temperature

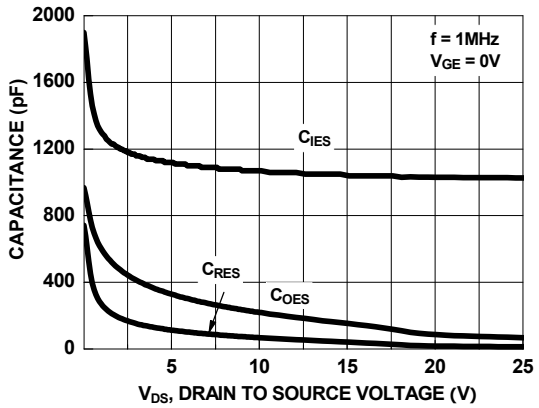



Figure 14. Capacitance vs. Collector to Emitter Voltage

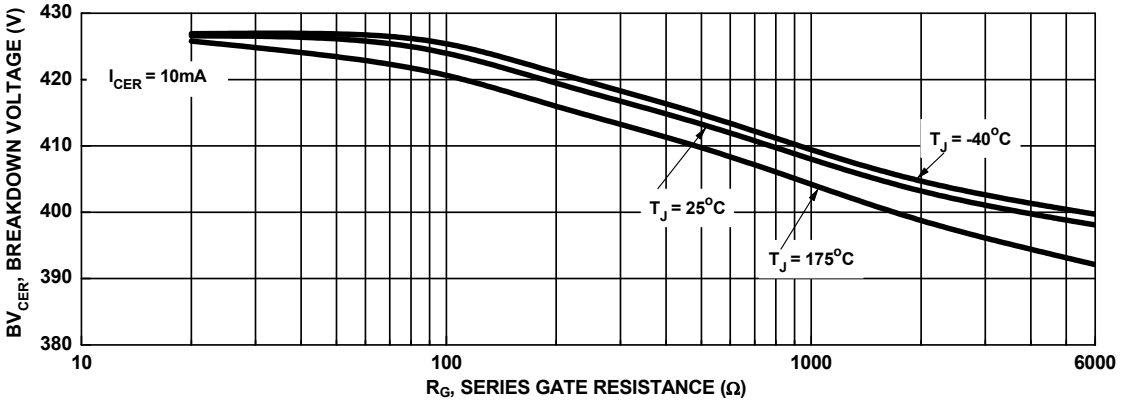



Figure 15. Break down Voltage vs. Series Gate Resistance

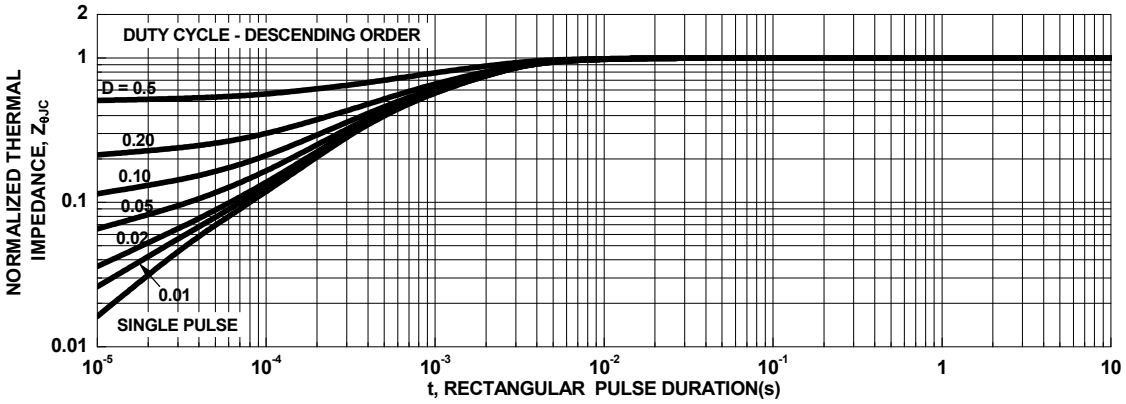



Figure 16. IGBT Normalized Transient Thermal Impedance, Junction to Case

## Typical Performance Curves

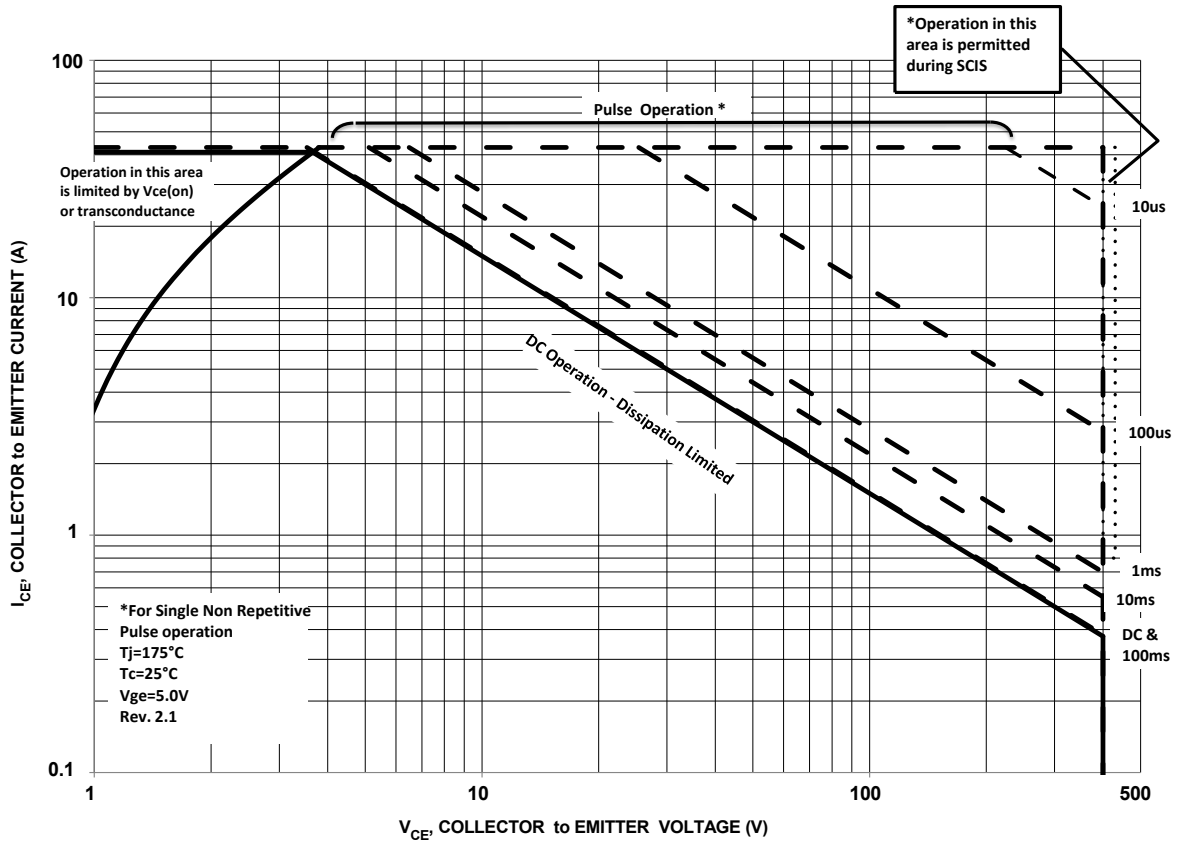



**Figure 17. Forward Safe Operating Area**

## Test Circuit and Waveforms

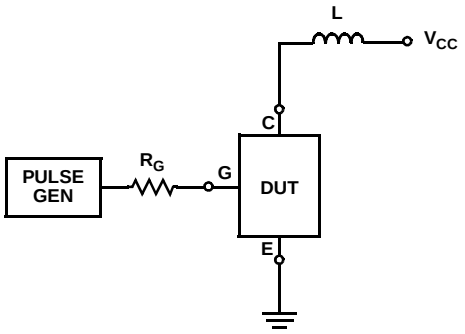



Figure 18. Inductive Switching Test Circuit

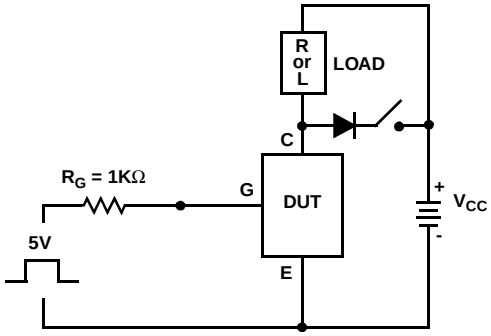



Figure 19. $t_{ON}$ and $t_{OFF}$ Switching Test Circuit

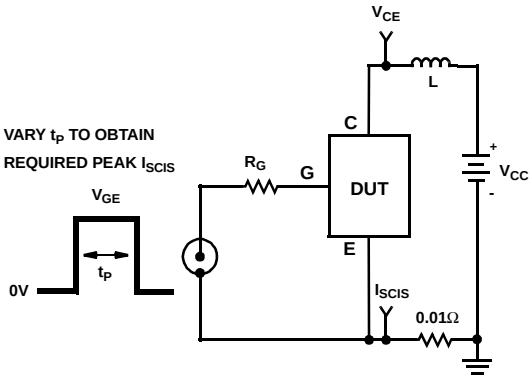



Figure 20. Energy Test Circuit

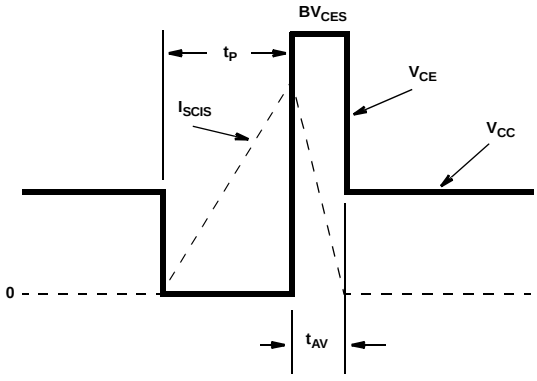
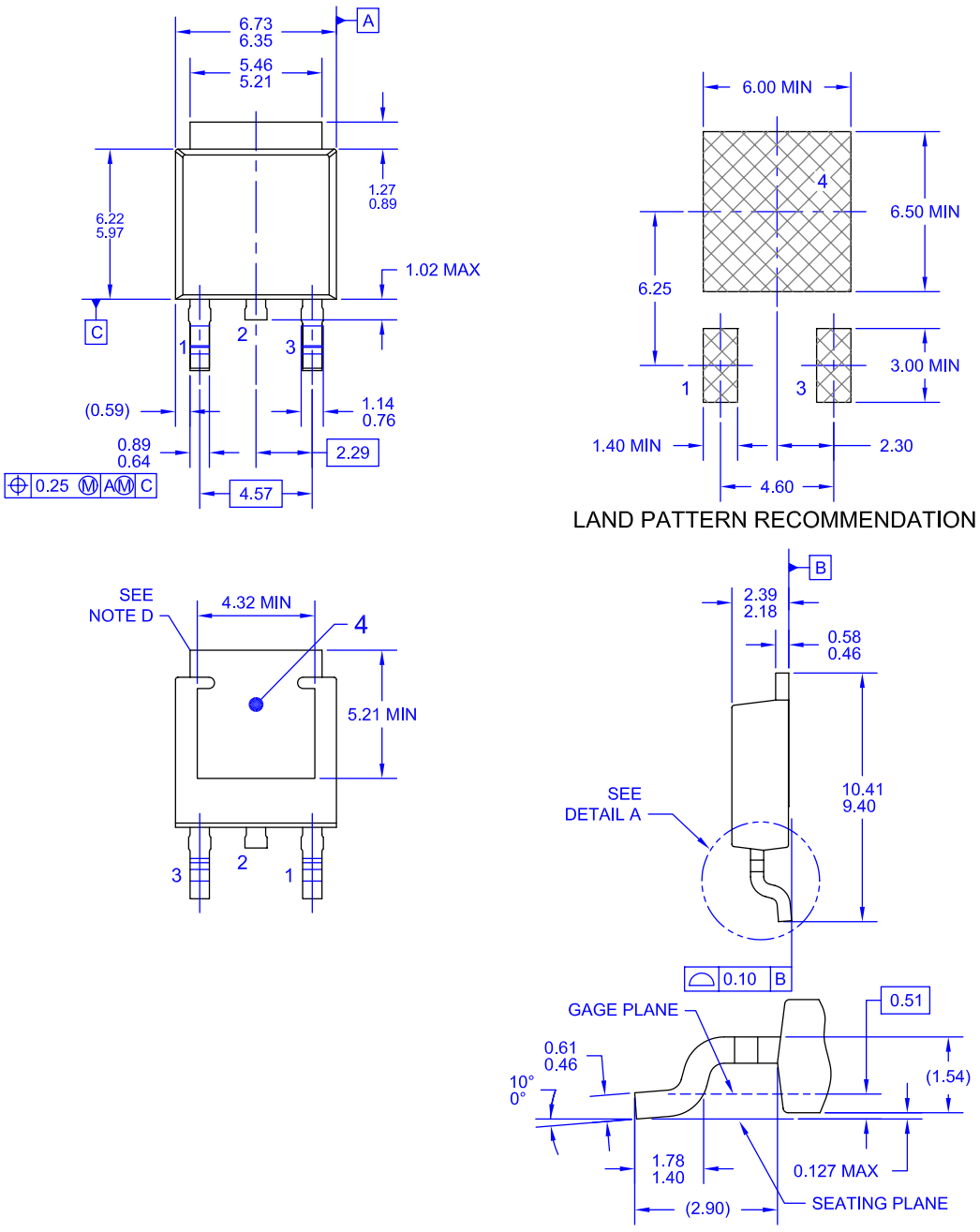



Figure 21. Energy Waveforms

## Mechanical Dimensions

D-PAK




Dimensions in Millimeters

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