ON Semiconductor®

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

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

### Features

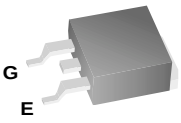
- SCIS Energy = 300mJ at $T_J$ = 25°C
- Logic Level Gate Drive
- Qualified to AEC Q101
- RoHS Compliant

### Applications

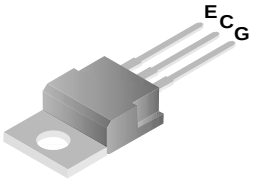
- Automotive Ignition Coil Driver Circuits
- Coil On Plug Applications

### Package

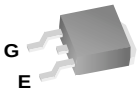
JEDEC TO-263AB
D²-Pak




JEDEC TO-220AB

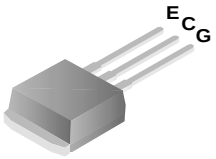



JEDEC TO-252AA
D-Pak

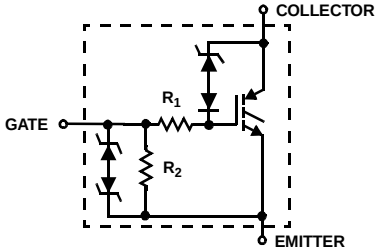



COLLECTOR
(FLANGE)

JEDEC TO-262AA




### 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 |


August-2017, Rev. 3

Publication Order Number:
FGB3040G2-F085/D

## 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°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 |
| **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.

## 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 |

## Typical Performance Curves

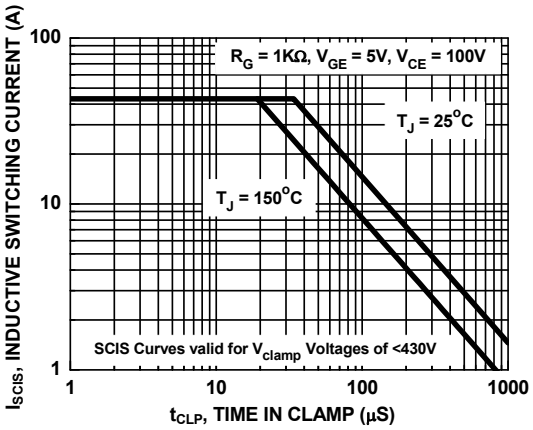



**Figure 1. Self Clamped Inductive Switching Current vs. Time in Clamp**

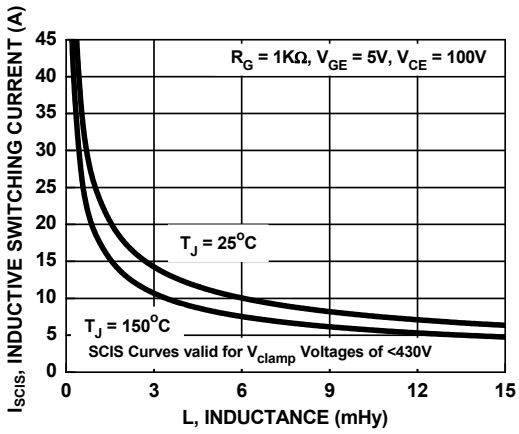



**Figure 2. Self Clamped Inductive Switching Current vs. Inductance**

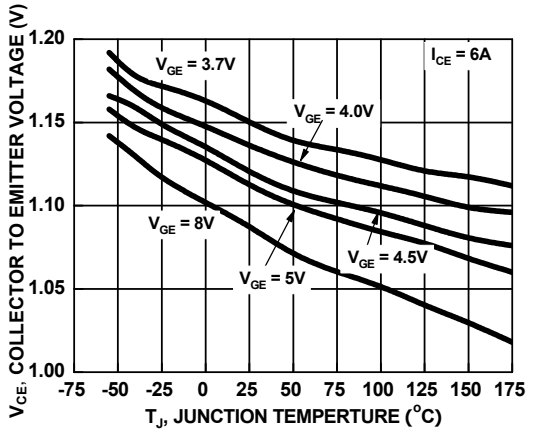



**Figure 3. Collector to Emitter On-State Voltage vs. Junction Temperature**

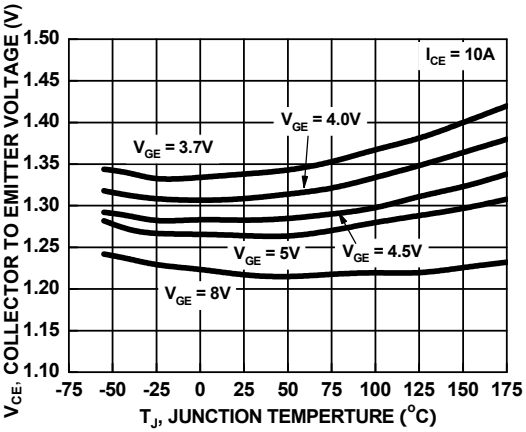



**Figure 4. Collector to Emitter On-State Voltage vs. Junction Temperature**

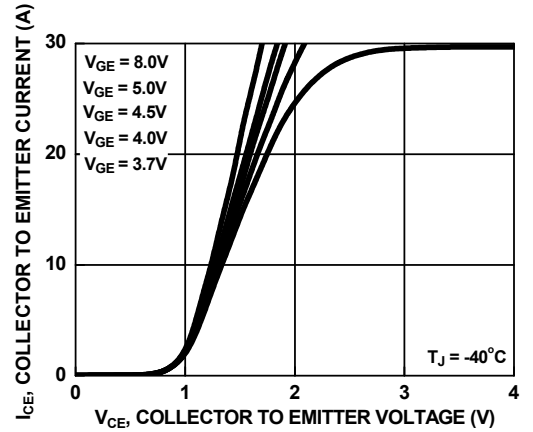



**Figure 5. Collector to Emitter On-State Voltage vs. Collector Current**

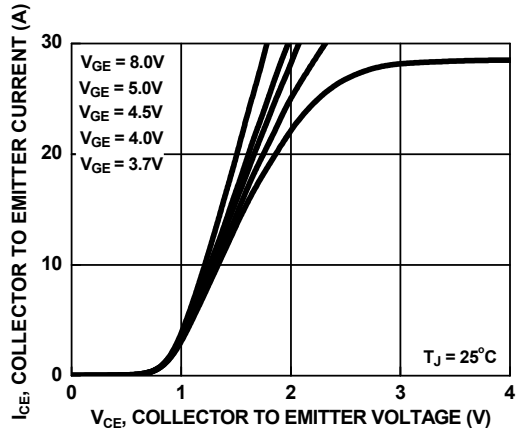



**Figure 6. Collector to Emitter On-State Voltage vs. Collector Current**

## Typical Performance Curves (Continued)

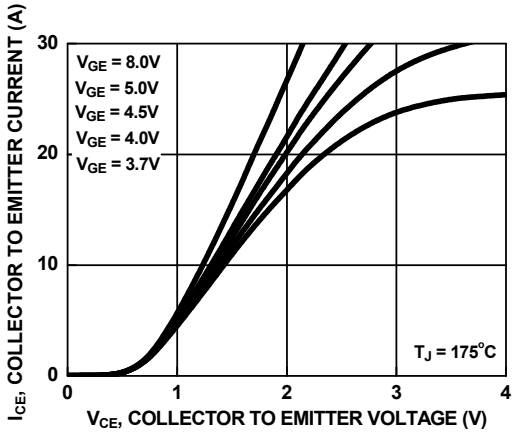



**Figure 7. Collector to Emitter On-State Voltage vs. Collector Current**

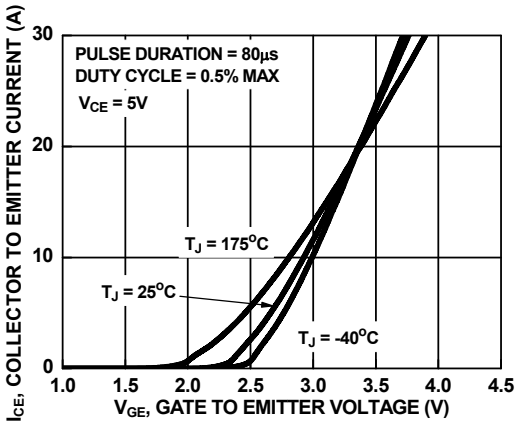



**Figure 8. Transfer Characteristics**

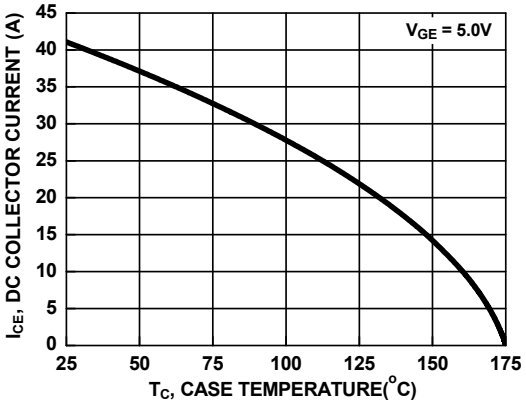



**Figure 9. DC Collector Current vs. Case Temperature**

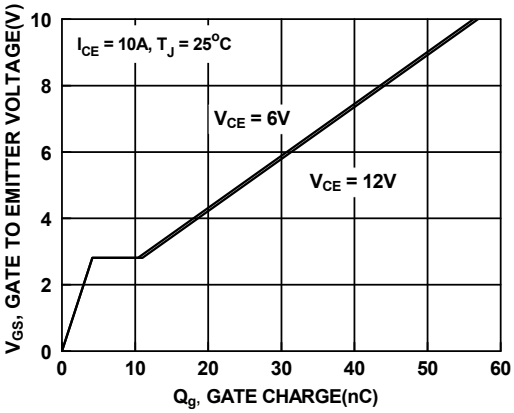



**Figure 10. Gate Charge**

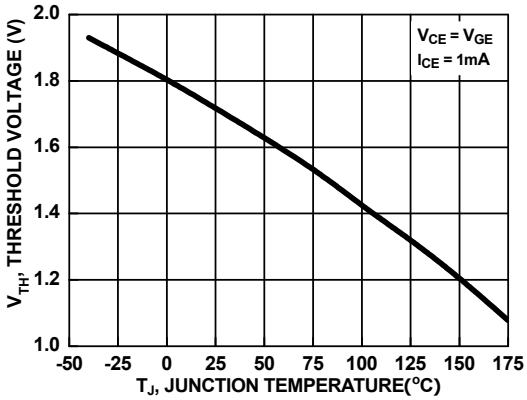



**Figure 11. Threshold Voltage vs. Junction Temperature**

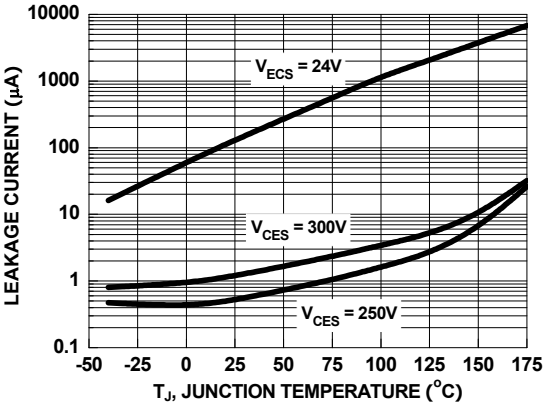



**Figure 12. Leakage Current vs. Junction Temperature**

## Typical Performance Curves (Continued)

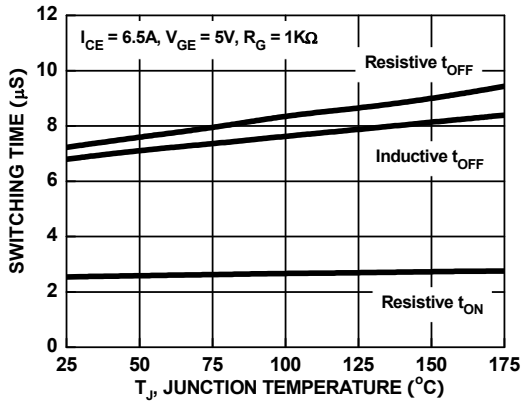



**Figure 13. Switching Time vs. Junction Temperature**

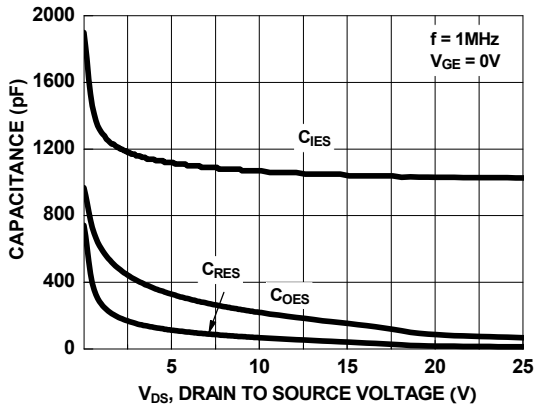



**Figure 14. Capacitance vs. Collector to Emitter Voltage**

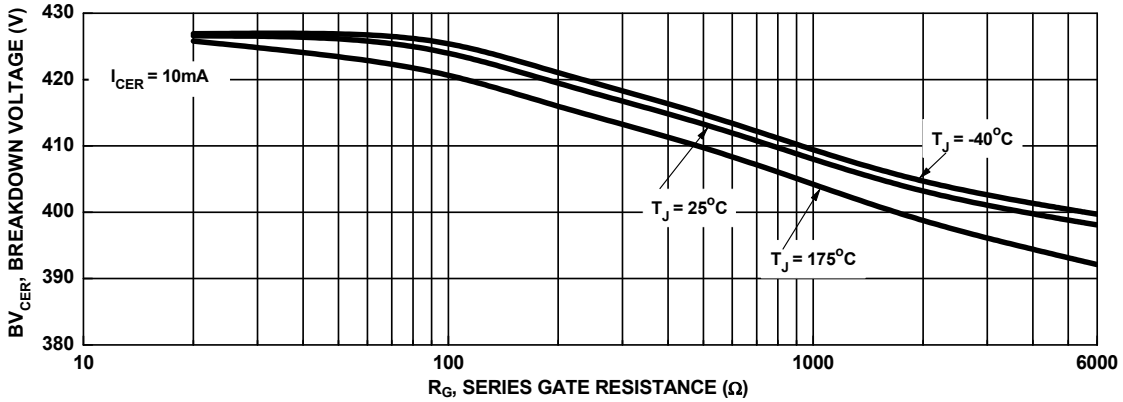



**Figure 15. Break down Voltage vs. Series Gate Resistance**

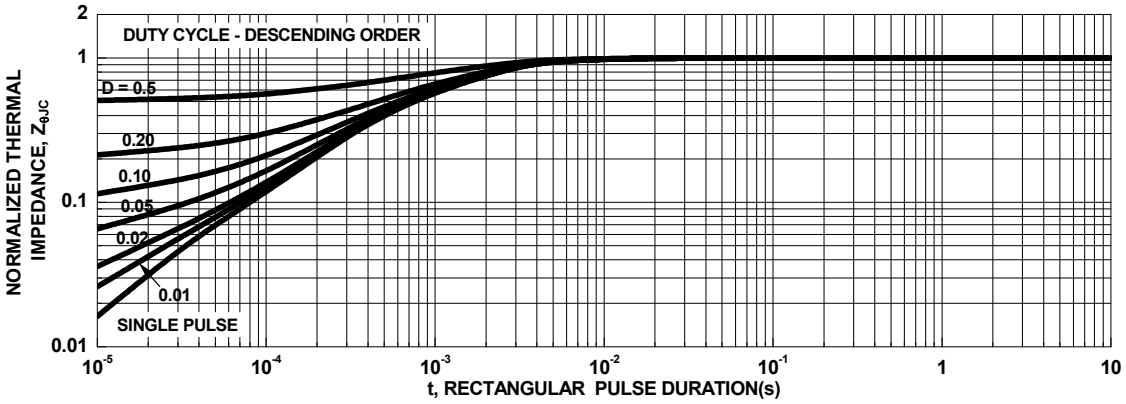



**Figure 16. IGBT Normalized Transient Thermal Impedance, Junction to Case**

## Typical Performance Curves

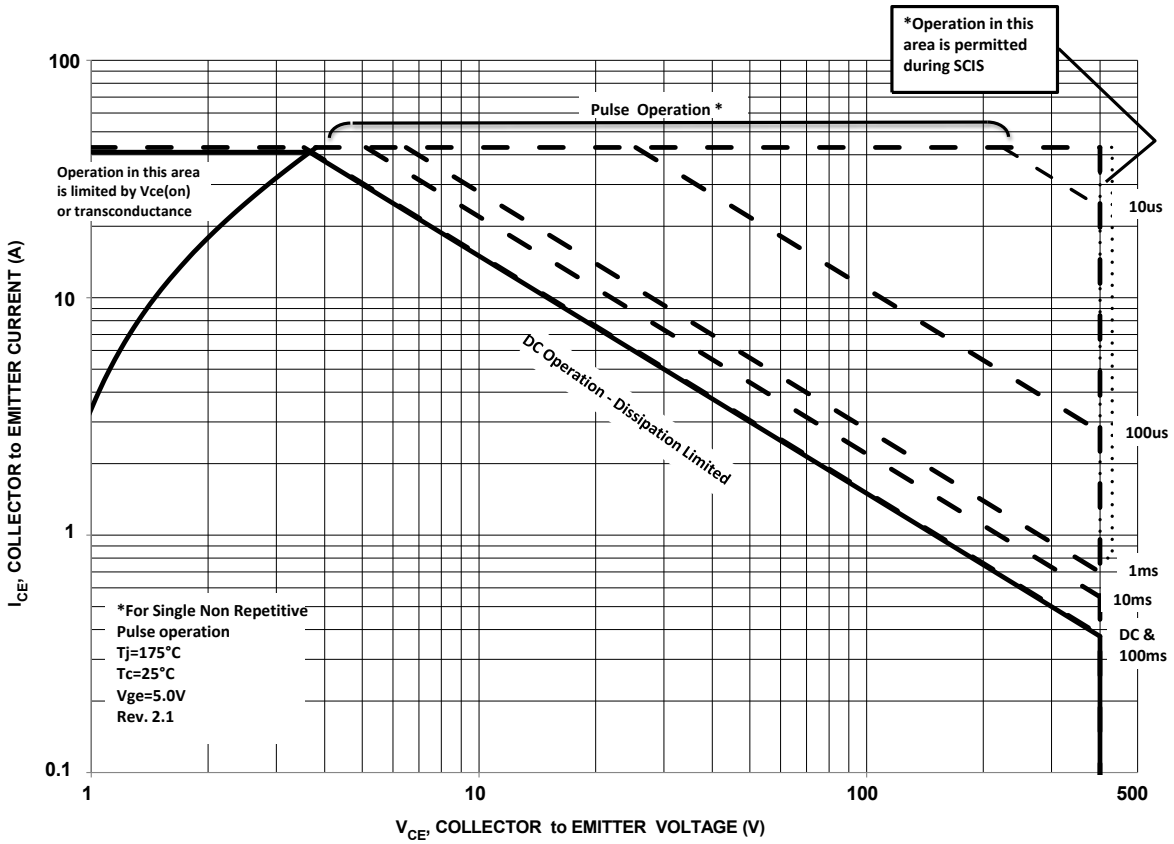



**Figure 17. Forward Safe Operating Area**

## Test Circuit and Waveforms

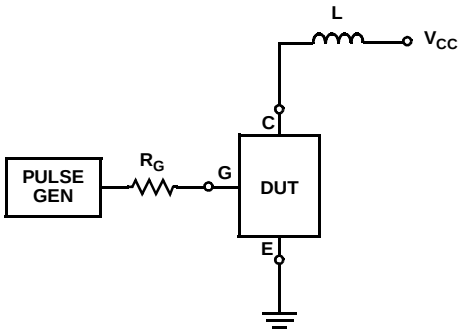



Figure 18. Inductive Switching Test Circuit

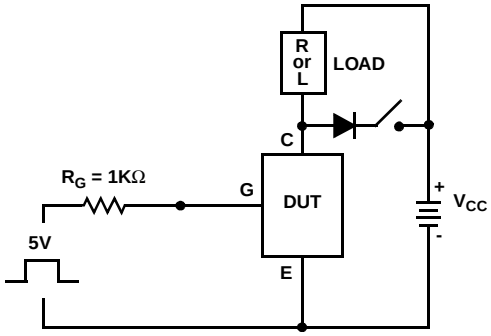



Figure 19. $t_{ON}$ and $t_{OFF}$ Switching Test Circuit

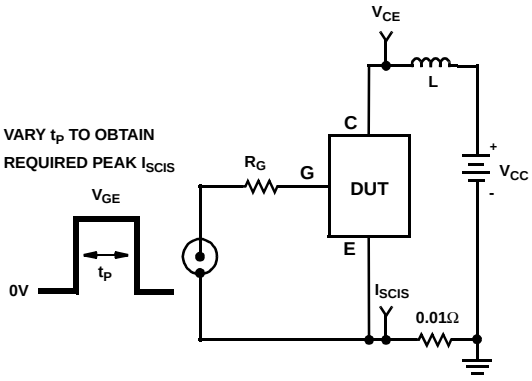



Figure 20. Energy Test Circuit

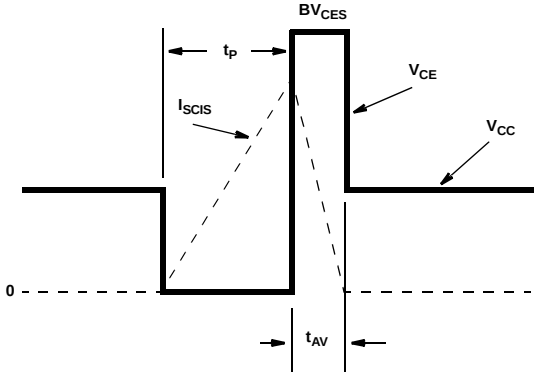



Figure 21. Energy Waveforms

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