



ON Semiconductor®

## FGD3245G2-F085 / FGB3245G2-F085

### EcoSPARK® 2 320mJ, 450V, N-Channel Ignition IGBT

#### Features

- SCIS Energy = 320mJ at  $T_J = 25^\circ\text{C}$
- Logic Level Gate Drive
- Low Saturation Voltage
- Qualified to AEC Q101
- RoHS Compliant

#### Applications

- Automotive Ignition Coil Driver Circuits
- Coil On Plug Applications

#### General Description

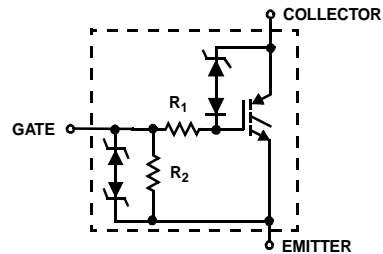
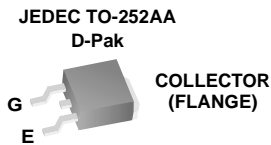
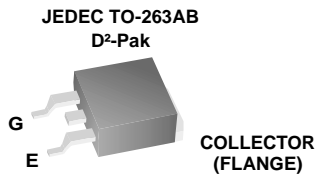
The FGB3245G2-F085 and FGD3245G2 are N-channel IGBTs designed in ON Semiconductor's EcoSPARK-2 technology which helps in eliminating external protection circuitry. The technology is optimized for driving the coil in the harsh environment of automotive ignition systems and offers out-standing  $V_{sat}$  and SCIS Energy capability also at elevated operating temperatures. The logic level gate input is ESD protected and features an integrated gate resistor. An integrated zener-circuitry clamps the IGBT's collector-to-emitter voltage at 450V which enables systems requiring a higher spark voltage



FGD3245G2-F085 / FGB3245G2-F085

#### Package

#### Symbol



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

Symbol	Parameter	Rating	Units
$BV_{CER}$	Collector to Emitter Breakdown Voltage ( $I_C = 1\text{mA}$ )	450	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)	320	mJ
$E_{SCIS150}$	Self Clamping Inductive Switching Energy (Note 2)	180	mJ
$I_{C25}$	Collector Current Continuous, at $V_{GE} = 4.0\text{V}$ , $T_C = 25^\circ\text{C}$	23	A
$I_{C110}$	Collector Current Continuous, at $V_{GE} = 4.0\text{V}$ , $T_C = 110^\circ\text{C}$	23	A
$V_{GEM}$	Gate to Emitter Voltage Continuous	$\pm 10$	V
$P_D$	Power Dissipation Total, at $T_C = 25^\circ\text{C}$	150	W
	Power Dissipation Derating, for $T_C > 25^\circ\text{C}$	1.1	W/ $^\circ\text{C}$
$T_J$	Operating Junction Temperature Range	-40 to +175	$^\circ\text{C}$
$T_{STG}$	Storage Junction Temperature Range	-40 to +175	$^\circ\text{C}$
$T_L$	Max. Lead Temp. for Soldering (Leads at 1.6mm from case for 10s)	300	$^\circ\text{C}$
$T_{PKG}$	Max. Lead Temp. for Soldering (Package Body for 10s)	260	$^\circ\text{C}$
ESD	Electrostatic Discharge Voltage at 100pF, 1500 $\Omega$	4	kV
	CDM-Electrostatic Discharge Voltage at 1 $\Omega$	2	kV

**Package Marking and Ordering Information**

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FGD3245G2	FGD3245G2-F085	TO252AA	330mm	16mm	2500 units
FGB3245G2	FGB3245G2-F085	TO263AB	330mm	24mm	800 units

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
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**Off State Characteristics**

$BV_{CER}$	Collector to Emitter Breakdown Voltage	$I_{CE} = 2\text{mA}$ , $V_{GE} = 0$ , $R_{GE} = 1\text{K}\Omega$ , $T_J = -40$ to $150^\circ\text{C}$	420	-	480	V	
$BV_{CES}$	Collector to Emitter Breakdown Voltage	$I_{CE} = 10\text{mA}$ , $V_{GE} = 0\text{V}$ , $R_{GE} = 0$ , $T_J = -40$ to $150^\circ\text{C}$	440	-	500	V	
$BV_{ECS}$	Emitter to Collector Breakdown Voltage	$I_{CE} = -75\text{mA}$ , $V_{GE} = 0\text{V}$ , $T_J = 25^\circ\text{C}$	28	-	-	V	
$BV_{GES}$	Gate to Emitter Breakdown Voltage	$I_{GES} = \pm 2\text{mA}$	$\pm 12$	$\pm 14$	-	V	
$I_{CER}$	Collector to Emitter Leakage Current	$V_{CE} = 250\text{V}$ , $R_{GE} = 1\text{K}\Omega$	$T_J = 25^\circ\text{C}$	-	-	25	$\mu\text{A}$
			$T_J = 150^\circ\text{C}$	-	-	1	mA
$I_{ECS}$	Emitter to Collector Leakage Current	$V_{EC} = 24\text{V}$	$T_J = 25^\circ\text{C}$	-	-	1	mA
			$T_J = 150^\circ\text{C}$	-	-	40	
$R_1$	Series Gate Resistance		-	120	-	$\Omega$	
$R_2$	Gate to Emitter Resistance		10K	-	30K	$\Omega$	

**On State Characteristics**

$V_{CE(SAT)}$	Collector to Emitter Saturation Voltage	$I_{CE} = 6\text{A}$ , $V_{GE} = 4\text{V}$ ,	$T_J = 25^\circ\text{C}$	-	1.13	1.25	V
$V_{CE(SAT)}$	Collector to Emitter Saturation Voltage	$I_{CE} = 10\text{A}$ , $V_{GE} = 4.5\text{V}$ ,	$T_J = 150^\circ\text{C}$	-	1.32	1.50	V
$V_{CE(SAT)}$	Collector to Emitter Saturation Voltage	$I_{CE} = 15\text{A}$ , $V_{GE} = 4.5\text{V}$ ,	$T_J = 150^\circ\text{C}$	-	1.64	1.85	V

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
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**Dynamic Characteristics**

$Q_{G(ON)}$	Gate Charge	$I_{CE} = 10\text{A}, V_{CE} = 12\text{V}, V_{GE} = 5\text{V}$	-	23	-	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	1.6	2.2	V
		$T_J = 150^\circ\text{C}$	0.75	1.1	1.8	
$V_{GEP}$	Gate to Emitter Plateau Voltage	$V_{CE} = 12\text{V}, I_{CE} = 10\text{A}$	-	2.7	-	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	$\mu\text{s}$
$t_{rR}$	Current Rise Time-Resistive	$V_{GE} = 5\text{V}, R_G = 1\text{K}\Omega, T_J = 25^\circ\text{C}$	-	2.6	7	$\mu\text{s}$
$t_{d(OFF)L}$	Current Turn-Off Delay Time-Inductive	$V_{CE} = 300\text{V}, L = 1\text{mH}$	-	5.4	15	$\mu\text{s}$
$t_{fL}$	Current Fall Time-Inductive	$V_{GE} = 5\text{V}, R_G = 1\text{K}\Omega, I_{CE} = 6.5\text{A}, T_J = 25^\circ\text{C}$	-	2.7	15	$\mu\text{s}$
$E_{SCIS}$	Self Clamped Inductive Switching	$L = 3.0\text{mHy}, R_G = 1\text{K}\Omega, V_{GE} = 5\text{V}, (Note 1), T_J = 25^\circ\text{C}$	-	-	320	mJ

**Thermal Characteristics**

$R_{\theta JC}$	Thermal Resistance Junction to Case	All packages	-	-	0.9	$^\circ\text{C/W}$
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**Notes:**

1: Self Clamping Inductive Switching Energy ( $E_{SCIS25}$ ) of 320 mJ is based on the test conditions that starting  $T_J = 25^\circ\text{C}$ ;  $L = 3\text{mHy}$ ,  $I_{SCIS} = 14.6\text{A}$ ,  $V_{CC} = 100\text{V}$  during inductor charging and  $V_{CC} = 0\text{V}$  during the time in clamp.

2: Self Clamping Inductive Switching Energy ( $E_{SCIS150}$ ) of 180 mJ is based on the test conditions that starting  $T_J = 150^\circ\text{C}$ ;  $L = 3\text{mHy}$ ,  $I_{SCIS} = 10.9\text{A}$ ,  $V_{CC} = 100\text{V}$  during inductor charging and  $V_{CC} = 0\text{V}$  during the time in clamp.

## Typical Performance Curves

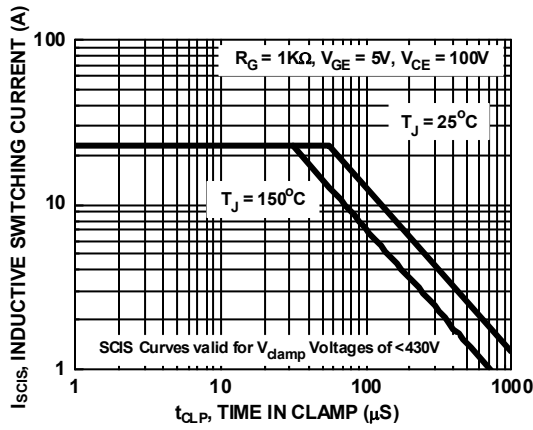


Figure 1. Self Clamped Inductive Switching Current vs. Time in Clamp

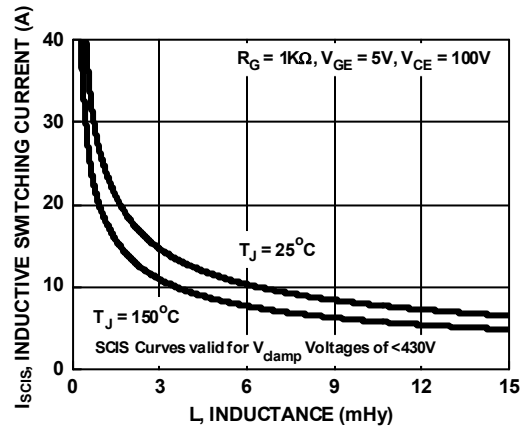


Figure 2. Self Clamped Inductive Switching Current vs. Inductance

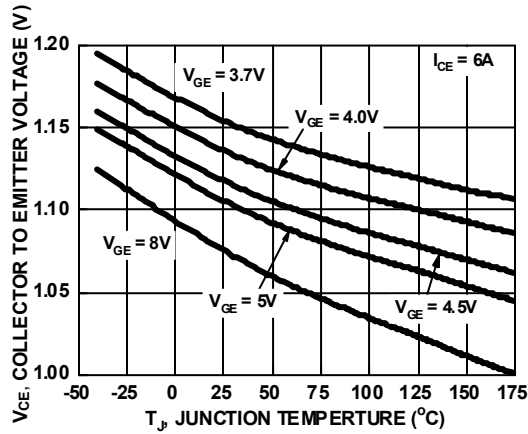


Figure 3. Collector to Emitter On-State Voltage vs. Junction Temperature

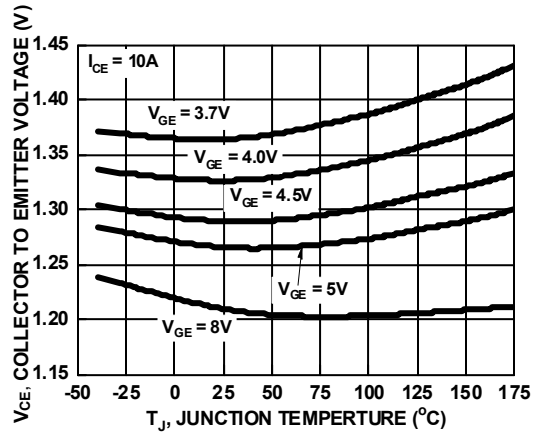


Figure 4. Collector to Emitter On-State Voltage vs. Junction Temperature

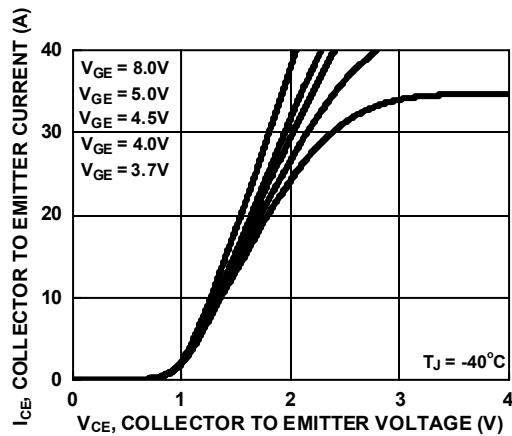


Figure 5. Collector to Emitter On-State Voltage vs. Collector Current

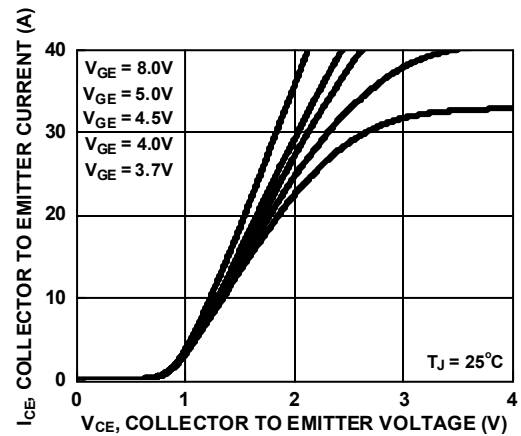


Figure 6. Collector to Emitter On-State Voltage vs. Collector Current

Typical Performance Curves (Continued)

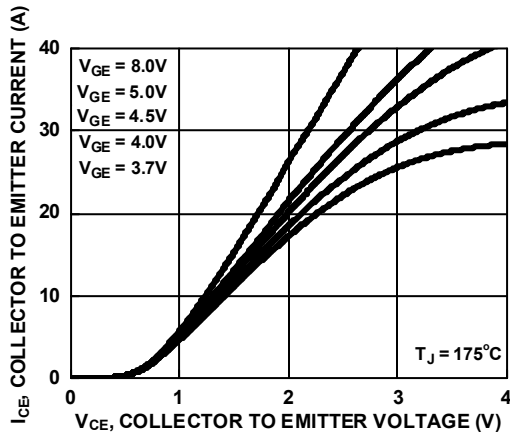


Figure 7. Collector to Emitter On-State Voltage vs. Collector Current

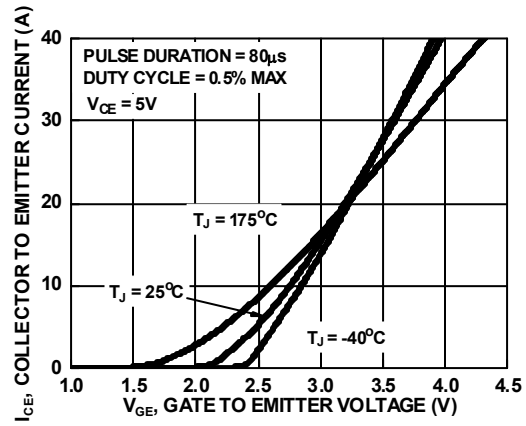


Figure 8. Transfer Characteristics

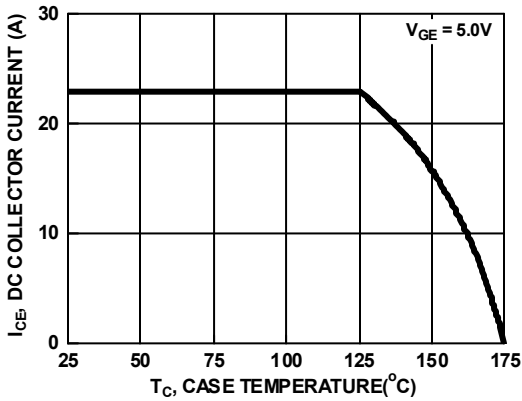


Figure 9. DC Collector Current vs. Case Temperature

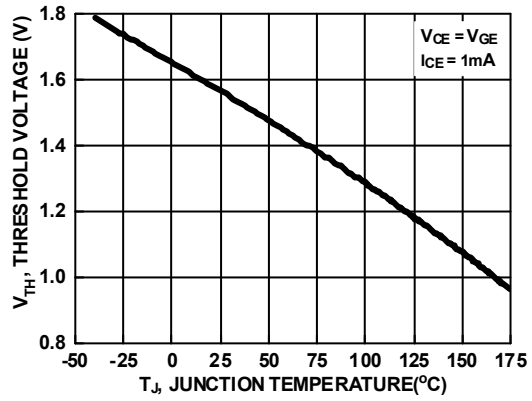


Figure 10. Threshold Voltage vs. Junction Temperature

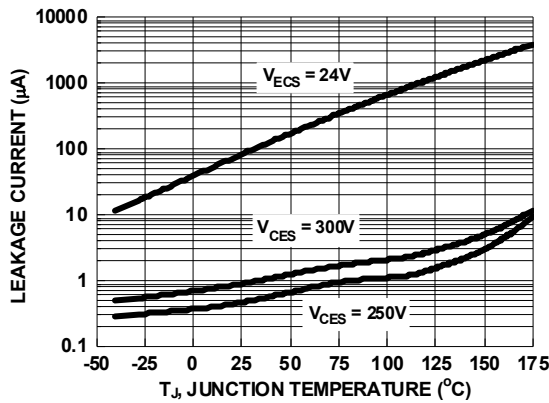


Figure 11. Leakage Current vs. Junction Temperature

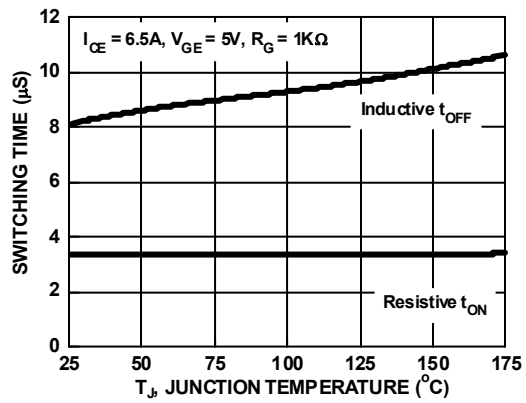
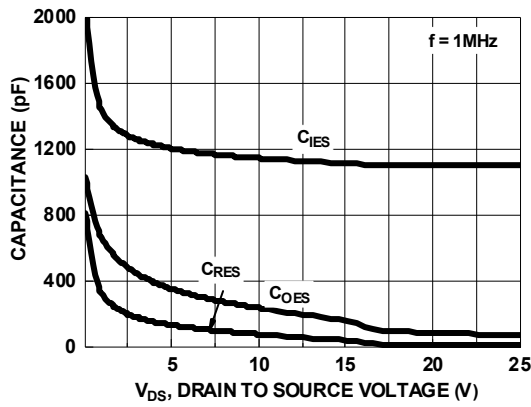
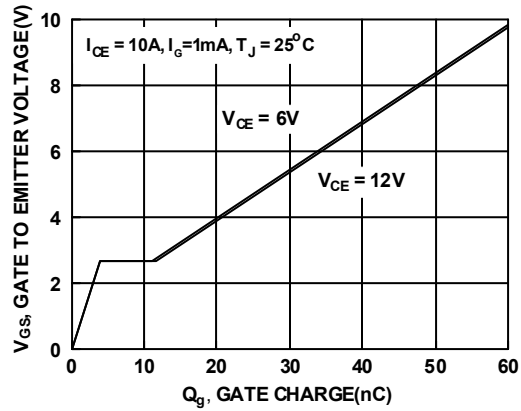


Figure 12. Switching Time vs. Junction Temperature

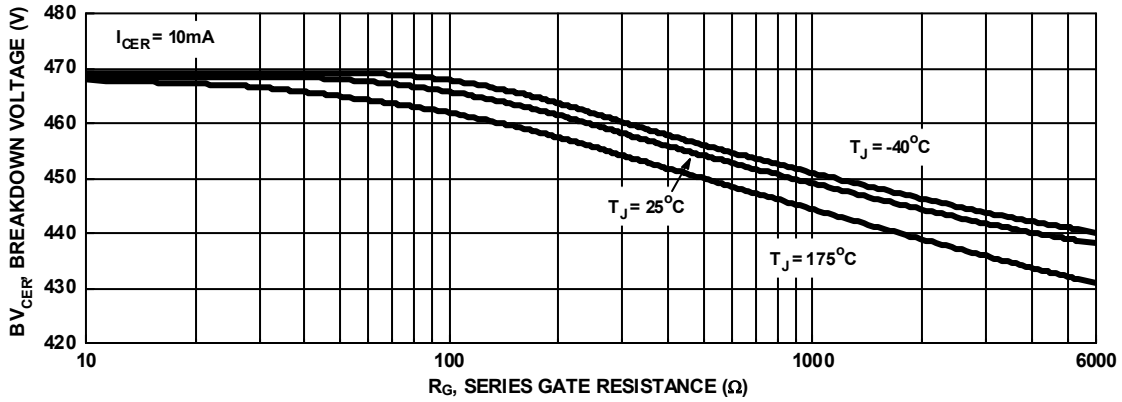
**Typical Performance Curves** (Continued)



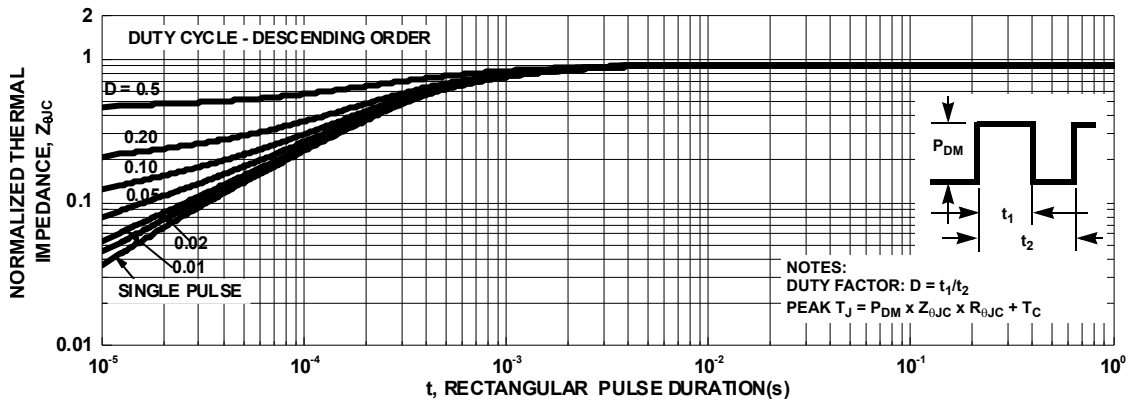
**Figure 13. Capacitance vs. Collector to Emitter Voltage**



**Figure 14. Gate Charge**



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



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

## Test Circuit and Waveforms

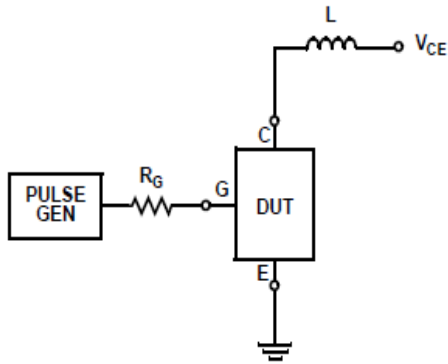


Figure 17. Inductive Switching Test Circuit

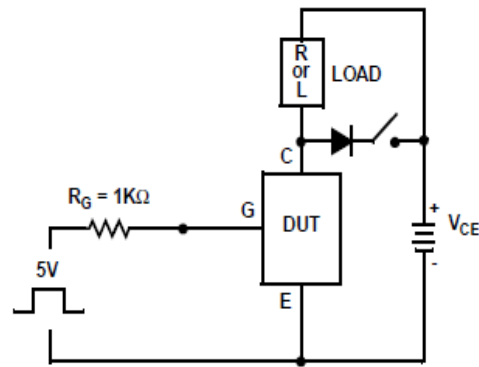


Figure 18.  $t_{ON}$  and  $t_{OFF}$  Switching Test Circuit

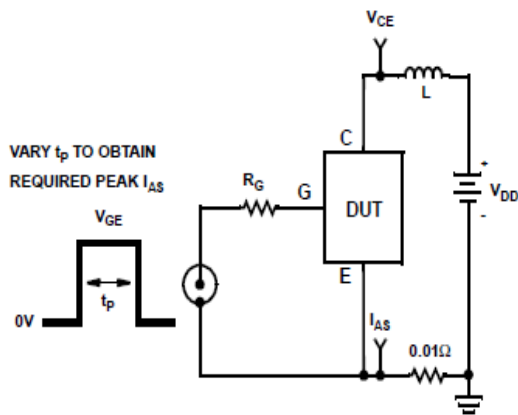


Figure 19. Energy Test Circuit

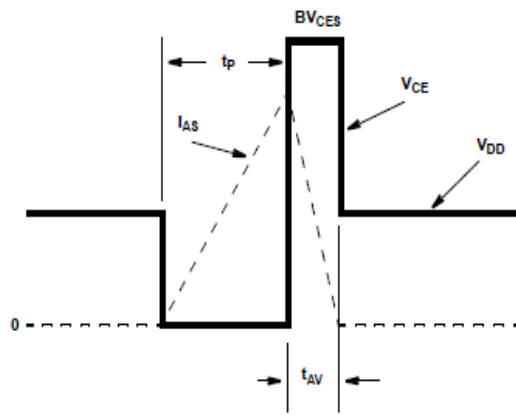



Figure 20. Energy Waveforms

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