

## FGB3040CS

### EcoSPARK÷ 300mJ, 400V, N-Channel Current Sensing Ignition IGBT

#### General Description

The FGB3040CS is an Ignition IGBT that offers outstanding SCIS capability along with a ratiometric emitter current sensing capability. This sensing is based on a emitter active area ratio of 200:1. The output is provided through a fourth (sense) lead. This signal provides a current level that is proportional to the main collector to emitter current. The effective ratio as measured on the sense lead is a function of the sense output, the collector current and the gate to emitter drive voltage.



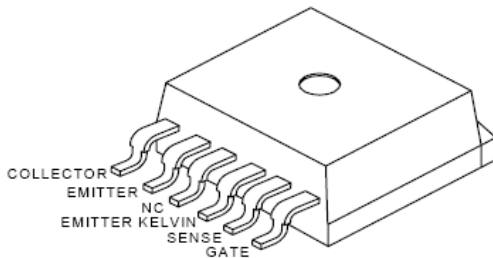
#### Applications

- Smart Automotive Ignition Coil Driver Circuits
- ECU Based Systems
- Distributorless Based Systems
- Coil on Plug Based Systems

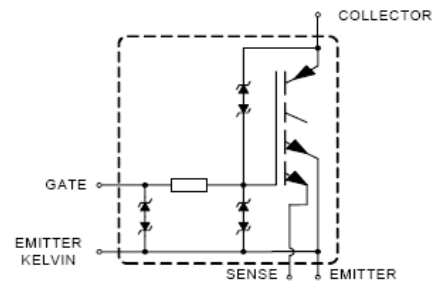
#### Features

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

#### 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 ( $I_C = 2\text{mA}$ )	430	V
$BV_{ECS}$	Emitter to Collector Breakdown Voltage ( $I_C = 1\text{mA}$ ) (Reverse Battery Condition)	24	V
$E_{SCIS25}$	Self Clamping Inductive Switching Energy (at starting $T_J = 25^\circ\text{C}$ )	300	mJ
$E_{SCIS150}$	Self Clamping Inductive Switching Energy (at starting $T_J = 150^\circ\text{C}$ )	170	mJ
$I_{C25}$	Continuous Collector Current, at $V_{GE} = 4.0\text{V}$ , $T_C = 25^\circ\text{C}$	21	A
$I_{C110}$	Continuous Collector Current, at $V_{GE} = 4.0\text{V}$ , $T_C = 110^\circ\text{C}$	19	A
$V_{GEM}$	Maximum Continuous Gate to Emitter Voltage	$\pm 10$	V
$P_D$	Power Dissipation, 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	-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 (at 1.6mm from case for 10sec)	300	$^\circ\text{C}$
$T_{PKG}$	Max. Package Temp. for Soldering (Package Body for 10 sec)	260	$^\circ\text{C}$
ESD	Electrostatic Discharge Voltage, HBM model (100pfd, 1500 ohms)	4	kV

## Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
3040CS	FGB3040CS	TO-263 6 Lead	300mm	24mm	800
3040CS	FGB3040CS	TO-263 6 Lead	Tube	N/A	50

## 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	$I_{CE} = 2\text{mA}, V_{GE} = 0,$ $R_{GE} = 1\text{k}\Omega$ , See Fig. 17 $T_J = -40$ to $150^\circ\text{C}$	370	410	430	V	
$BV_{CES}$	Collector to Emitter Breakdown Voltage	$I_{CE} = 10\text{mA}, V_{GE} = 0\text{V}$ $R_{GE} = 0$ , See Fig. 17 $T_J = -40$ to $150^\circ\text{C}$	390	430	450	V	
$BV_{ECS}$	Emitter to Collector Breakdown Voltage	$I_{CE} = -75\text{mA}, V_{GE} = 0\text{V},$ $T_C = 25^\circ\text{C}$	30	-	-	V	
$BV_{GES}$	Gate to Emitter Breakdown Voltage	$I_{GES} = \pm 2\text{mA}$	$\pm 12$	$\pm 14$	-	V	
$I_{GEO}$	Gate to Emitter Leakage Current	$V_{GE} = \pm 10\text{V}$	-	-	$\pm 9$	$\mu\text{A}$	
$I_{CES}$	Collector to Emitter Leakage Current	$V_{CES} = 250\text{V},$ See Fig. 13	$T_C = 25^\circ\text{C}$	-	-	25	$\mu\text{A}$
			$T_C = 150^\circ\text{C}$	-	-	1	mA
$I_{ECS}$	Emitter to Collector Leakage Current	$V_{EC} = 24\text{V},$ See Fig. 13	$T_C = 25^\circ\text{C}$	-	-	1	mA
			$T_C = 150^\circ\text{C}$	-	-	40	mA
$R_1$	Series Gate Resistance		-	100	-	$\Omega$	

### On State Characteristics

$V_{CE(SAT)}$	Collector to Emitter Saturation Voltage	$I_{CE} = 6\text{A}, V_{GE} = 4\text{V}$	$T_C = 25^\circ\text{C}$ See Fig. 5	-	1.3	1.6	V
$V_{CE(SAT)}$	Collector to Emitter Saturation Voltage	$I_{CE} = 10\text{A}, V_{GE} = 4.5\text{V}$	$T_C = 150^\circ\text{C}$ See Fig. 6	-	1.6	1.85	V
$V_{CE(SAT)}$	Collector to Emitter Saturation Voltage	$I_{CE} = 15\text{A}, V_{GE} = 4.5\text{V}$	$T_C = 150^\circ\text{C}$	-	1.8	2.35	V
$I_{CE(ON)}$	Collector to Emitter On State Current	$V_{CE} = 5\text{V}, V_{GE} = 5\text{V}$		-	37	-	A

### Dynamic Characteristics

$Q_{G(ON)}$	Gate Charge	$I_{CE} = 10\text{A}, V_{CE} = 12\text{V},$ $V_{GE} = 5\text{V}$ , See Fig. 16	-	15	-	nC	
$V_{GE(TH)}$	Gate to Emitter Threshold Voltage	$I_{CE} = 1\text{mA}, V_{CE} = V_{GE}$ See Fig. 12	$T_C = 25^\circ\text{C}$	1.3	1.6	2.2	V
			$T_C = 150^\circ\text{C}$	0.75	1.1	1.8	V
$V_{GEP}$	Gate to Emitter Plateau Voltage	$I_{CE} = 10\text{A}, V_{CE} = 12\text{V}$	-	3.0	-	V	
$\beta_{AREA}$	Emitter Sense Area Ratio	Sense Area/Total Area	-	1/200	-	-	
$\beta_{5\Omega}$	Emitter Current Sense Ratio	$I_{CE} = 8.0\text{A}, V_{GE} = 5\text{V}, R_{SENSE} = 5\Omega$	-	230	-	-	
$\beta_{20\Omega}$	Emitter Current Sense Ratio	$I_{CE} = 9.0\text{A}, V_{GE} = 5\text{V}, R_{SENSE} = 20\Omega$	550	640	765	-	

### Switching Characteristics

$t_{d(ON)R}$	Current Turn-On Delay Time-Resistive	$V_{CE} = 14\text{V}, R_L = 1\Omega$ $V_{GE} = 5\text{V}, R_G = 1\text{k}\Omega$ $T_J = 25^\circ\text{C}$ , See Fig. 14	-	0.6	4	$\mu\text{s}$
$t_{rR}$	Current Rise Time-Resistive		-	1.5	7	$\mu\text{s}$
$t_{d(OFF)L}$	Current Turn-Off Delay Time-Inductive	$V_{CE} = 300\text{V}, L = 500\mu\text{H},$ $V_{GE} = 5\text{V}, R_G = 1\text{k}\Omega$ $T_J = 25^\circ\text{C}$ , See Fig. 14	-	4.7	15	$\mu\text{s}$
$t_{fL}$	Current Fall Time-Inductive		-	2.6	15	$\mu\text{s}$
SCIS	Self Clamped inductive Switching	$T_J = 25^\circ\text{C}, L = 3.0\text{mH}, I_{CE} = 14.2\text{A},$ $R_G = 1\text{k}\Omega, V_{GE} = 5\text{V}$ , See Fig. 3&4	-	-	300	mJ

### Thermal Characteristics

$R_{\theta JC}$	Thermal Resistance Junction to Case	All Packages	-	-	1.0	$^\circ\text{C/W}$
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## Typical Performance Curves

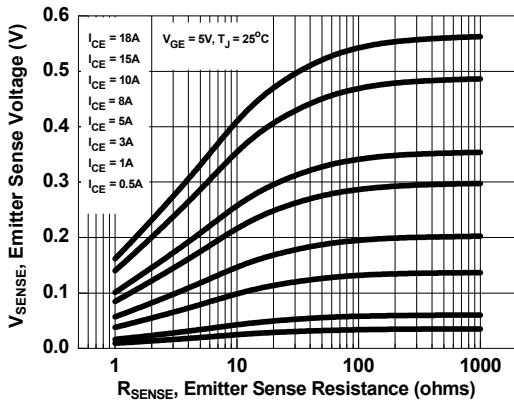


Figure 1. Emitter Sense Voltage vs. Emitter Sense Resistance

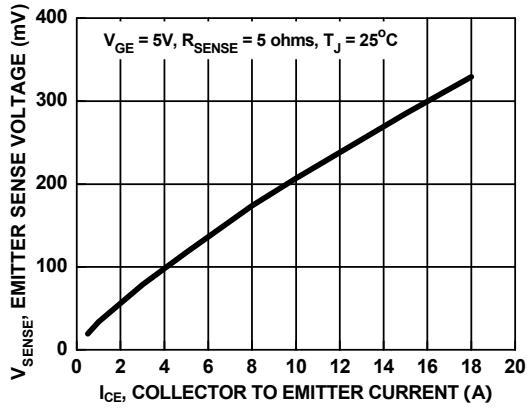


Figure 2. Emitter Sense Voltage vs. Collector to Emitter Current

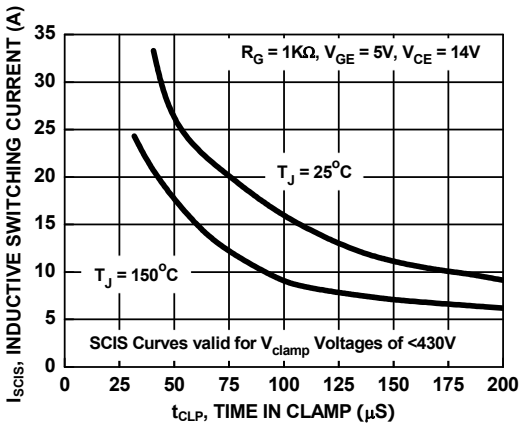


Figure 3. Self Clamped Inductive Switching Current vs. Time in Clamp

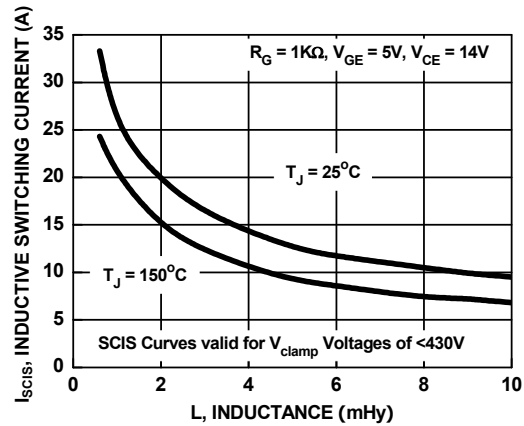


Figure 4. Self Clamped Inductive Switching Current vs. Inductance

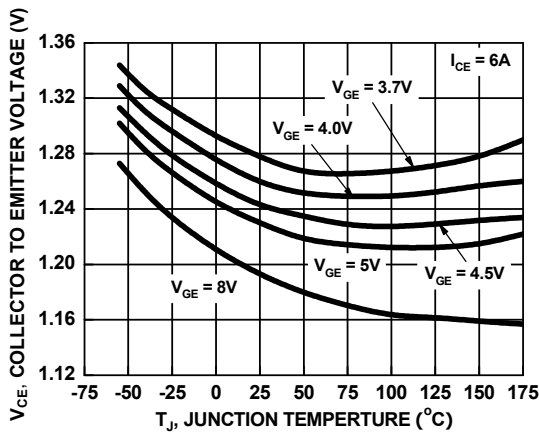


Figure 5. Collector to Emitter On-State Voltage vs. Junction Temperature

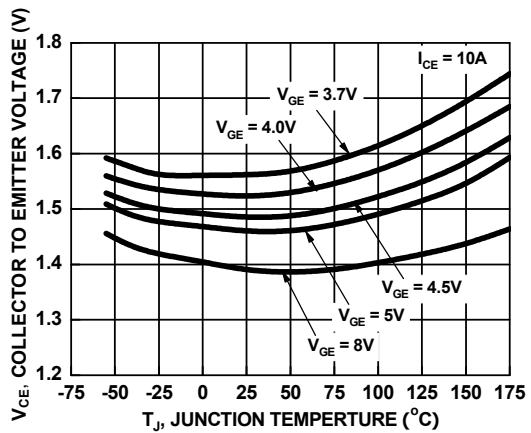
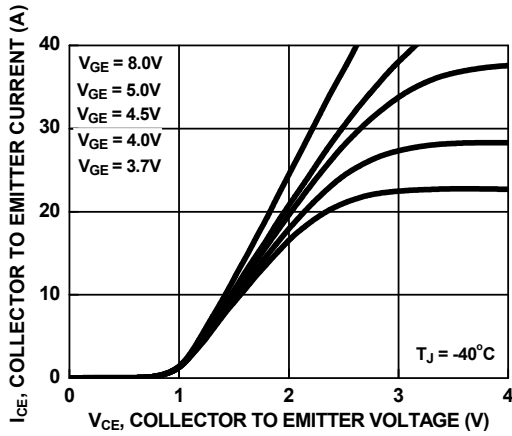
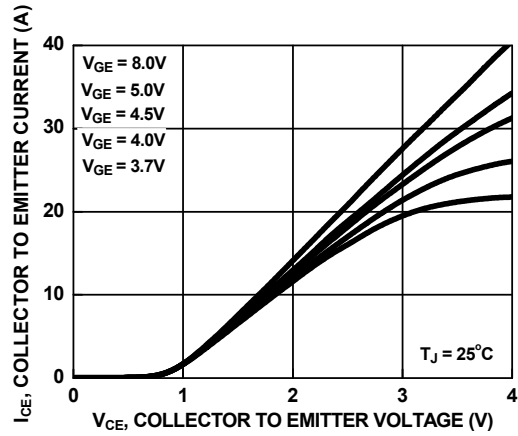


Figure 6. Collector to Emitter On-State Voltage vs. Junction Temperature

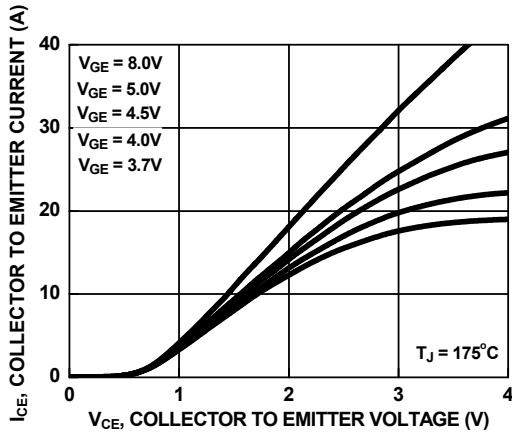
**Typical Performance Curves** (Continued)



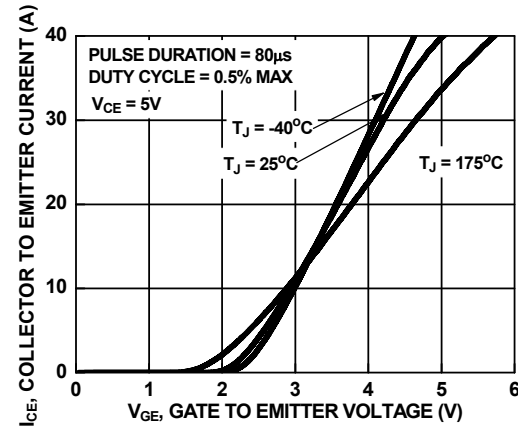
**Figure 7. Collector to Emitter On-State Voltage vs. Collector Current**



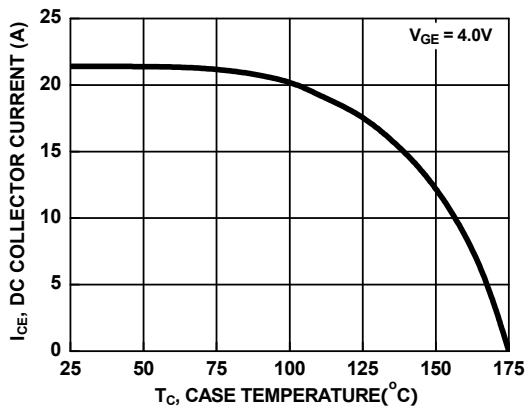
**Figure 8. Collector to Emitter On-State Voltage vs. Collector Current**



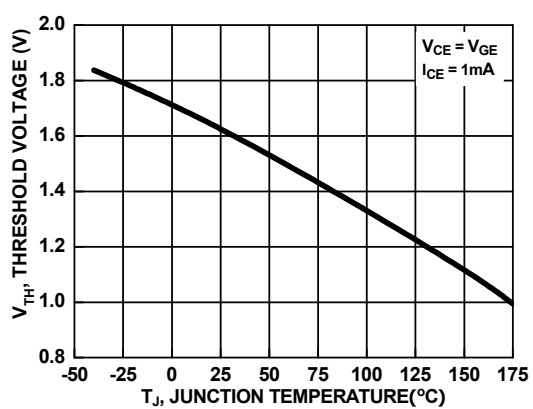
**Figure 9. Collector to Emitter On-State Voltage vs. Collector Current**



**Figure 10. Transfer Characteristics**

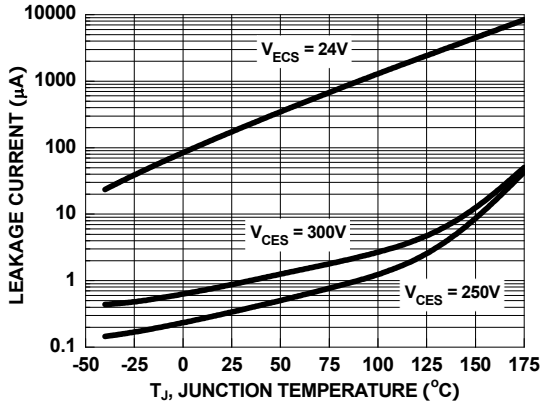


**Figure 11. DC Collector Current vs. Case Temperature**

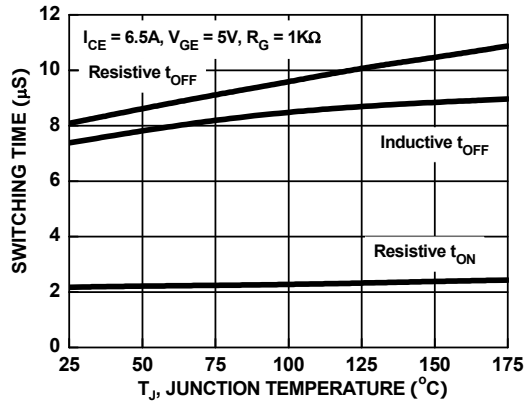


**Figure 12. Threshold Voltage vs. Junction Temperature**

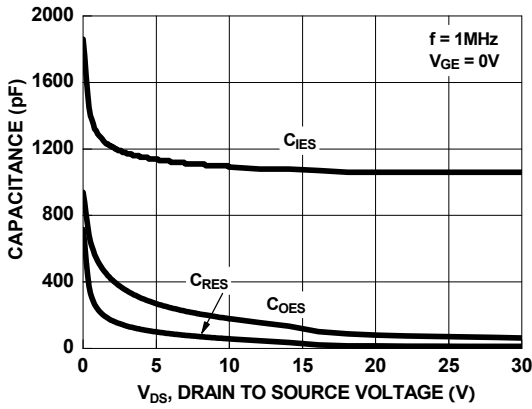
**Typical Performance Curves** (Continued)



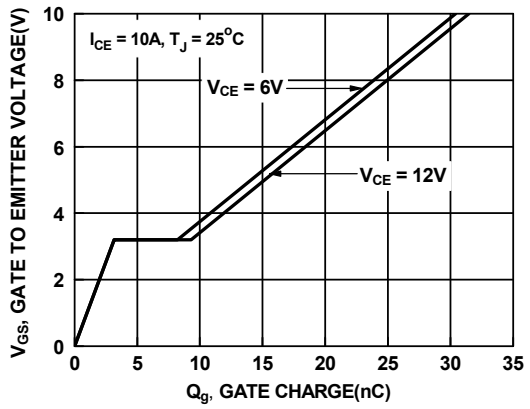
**Figure 13. Leakage Current vs. Junction Temperature**



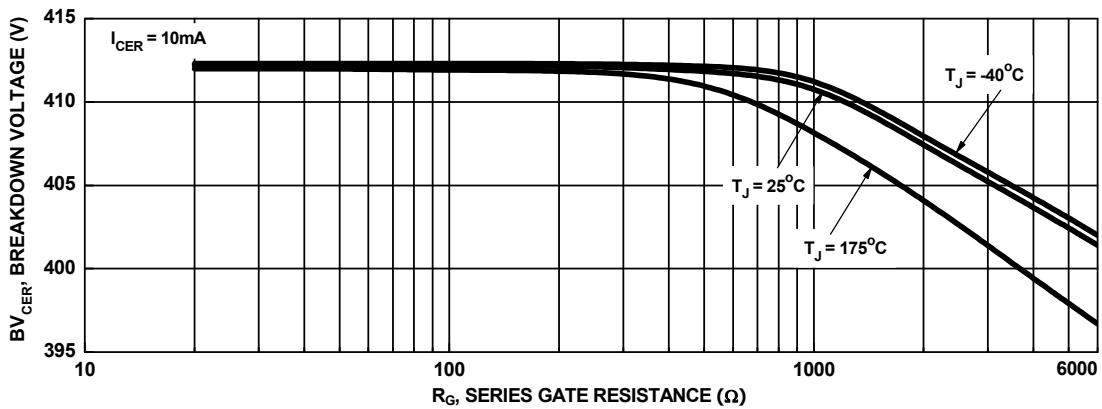
**Figure 14. Switching Time vs. Junction Temperature**



**Figure 15. Capacitance vs. Collector to Emitter Voltage**



**Figure 16. Gate Charge**



**Figure 17. Break Down Voltage vs. Series Gate Resistance**

### Typical Performance Curves

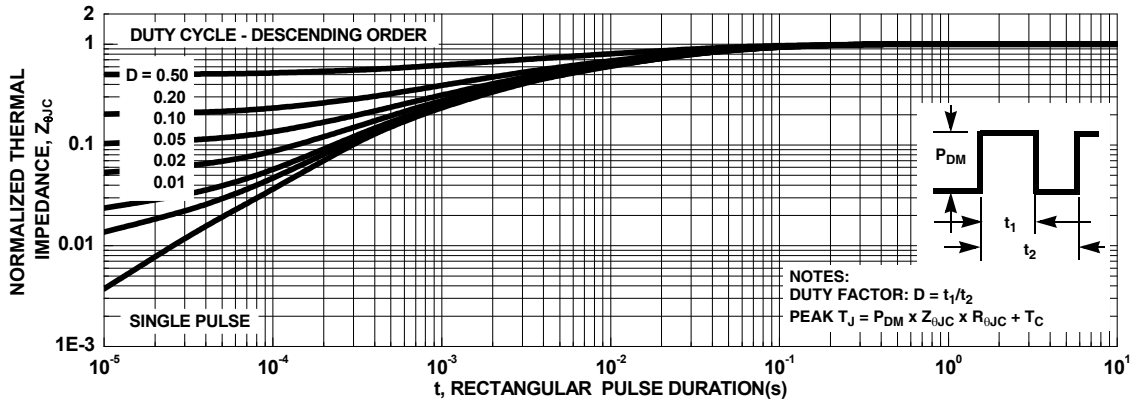
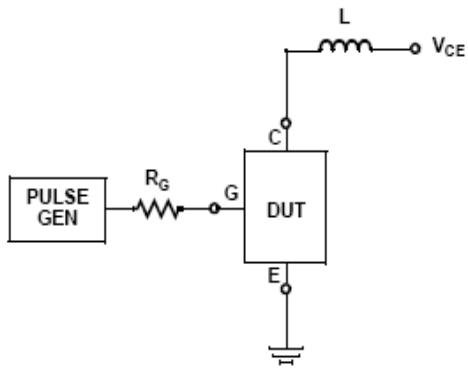
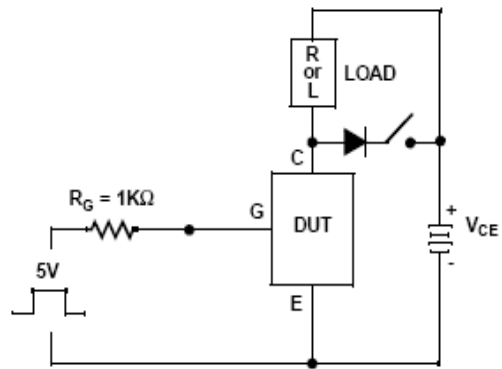


Figure 18. IGBT Normalized Transient Thermal Impedance, Junction to Case

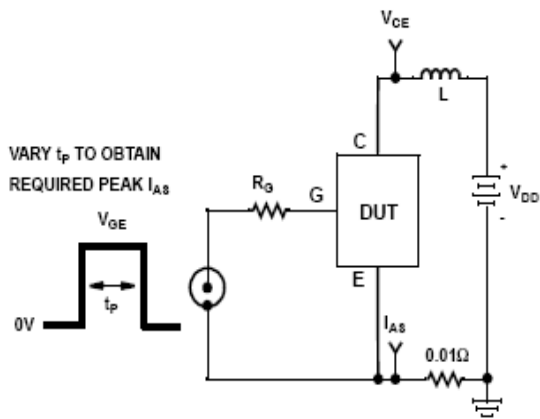
**Test Circuit and Waveforms**



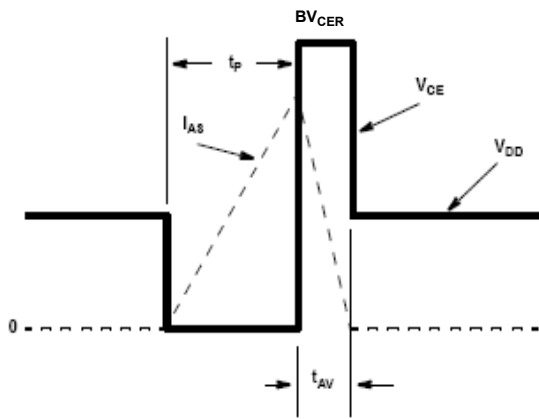
**Figure 19. Inductive Switching Test Circuit**



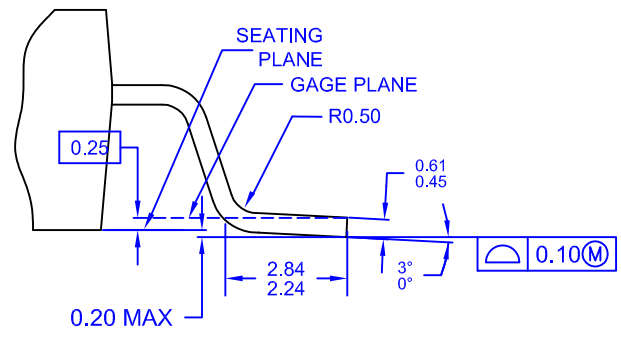
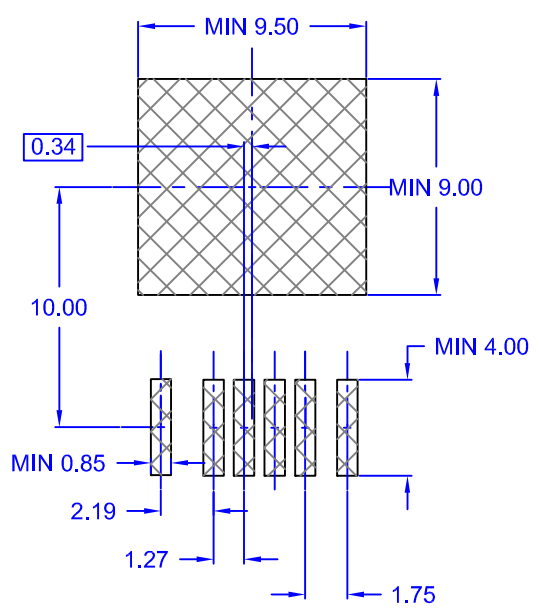
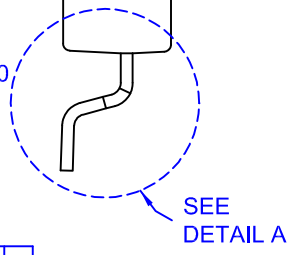
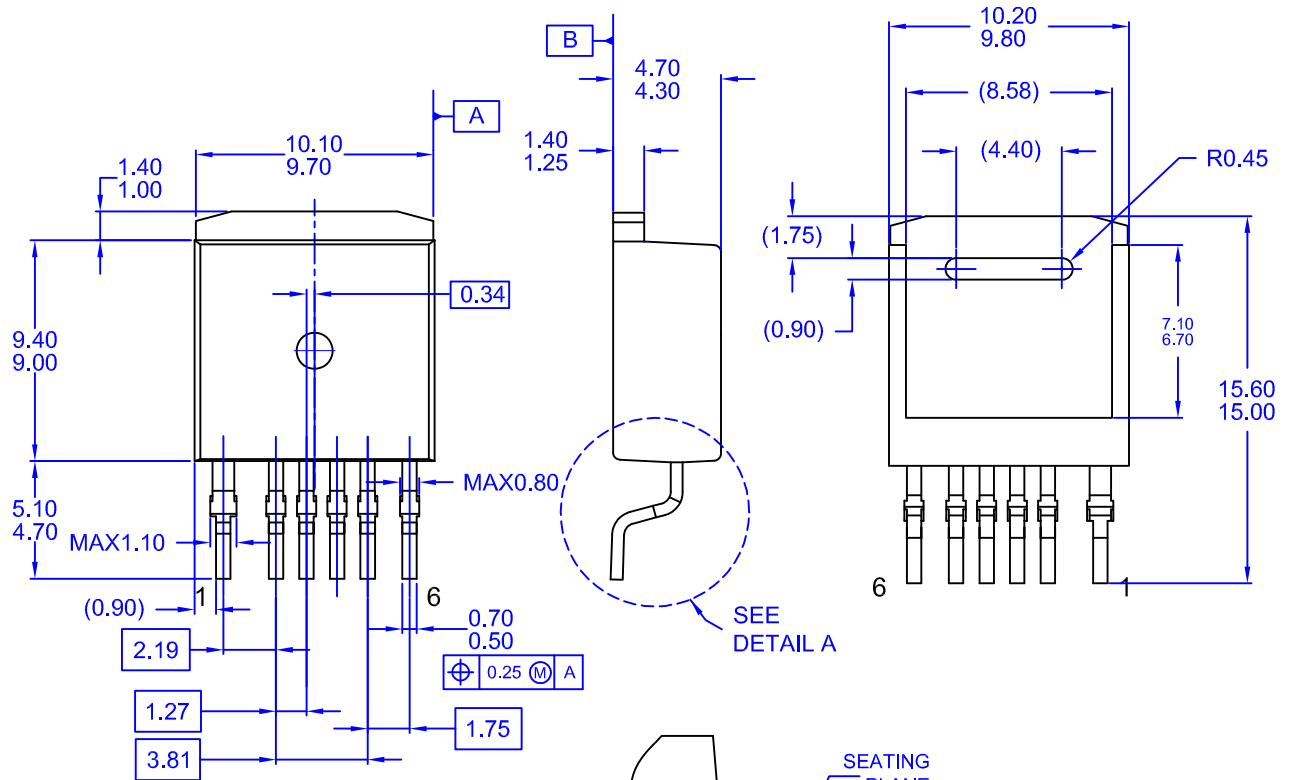
**Figure 20.  $t_{ON}$  and  $t_{OFF}$  Switching Test Circuit**



**Figure 21. Energy Test Circuit**



**Figure 22. Energy Waveforms**








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 D) DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994  
 E) DRAWING FILENAME AND REVISION: MKT-TO263A06REV6





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