



## 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.



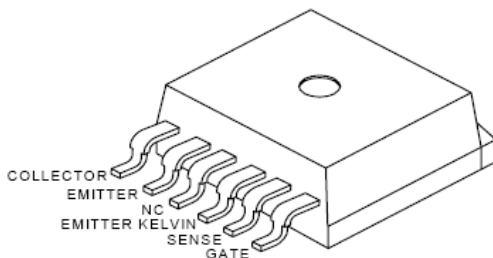
#### Applications

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

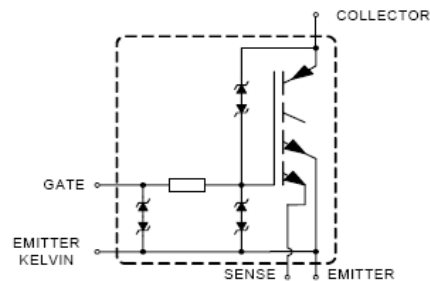
#### Features

- SCIS Energy = 300mJ at  $T_J = 25^\circ\text{C}$
- Logic Level Gate Drive

#### 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
--------	-----------	-----------------	-----	-----	-----	-------

### 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	$^\circ\text{C/W}$
-----------------	-------------------------------------	--------------	---	---	-----	--------------------

## Typical Performance Curves

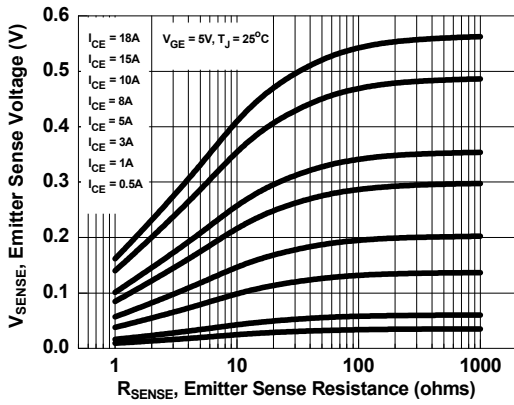


Figure 1. Emitter Sense Voltage vs. Emitter Sense Resistance

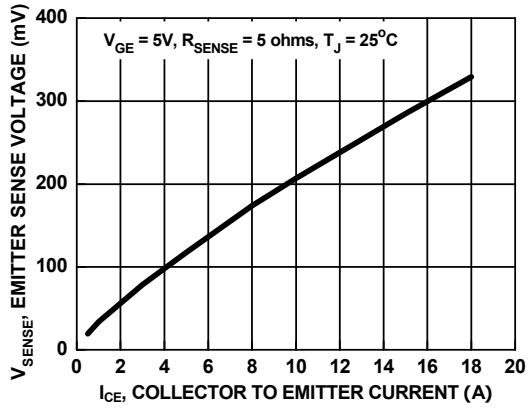


Figure 2. Emitter Sense Voltage vs. Collector to Emitter Current

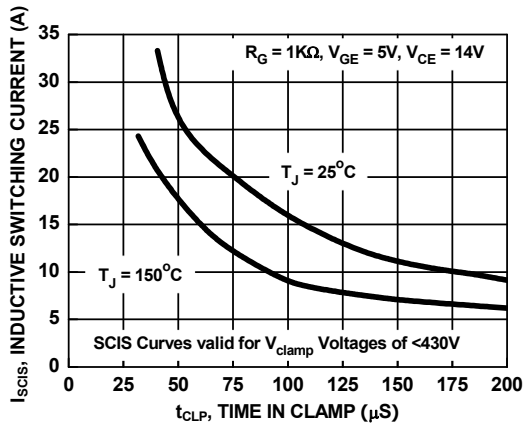


Figure 3. Self Clamped Inductive Switching Current vs. Time in Clamp

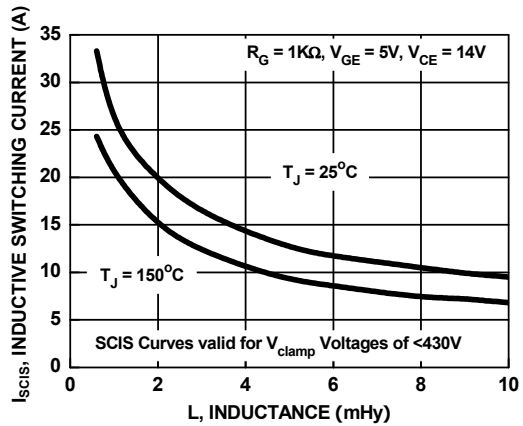


Figure 4. Self Clamped Inductive Switching Current vs. Inductance

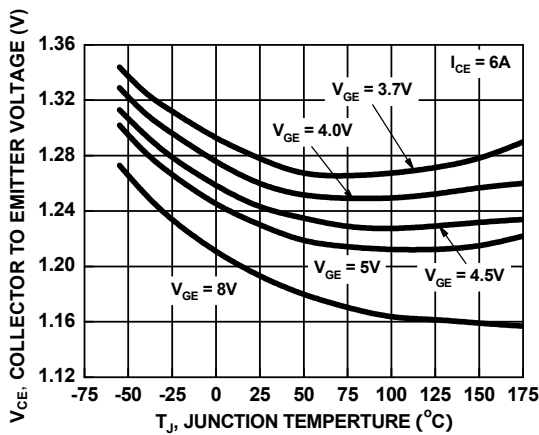


Figure 5. Collector to Emitter On-State Voltage vs. Junction Temperature

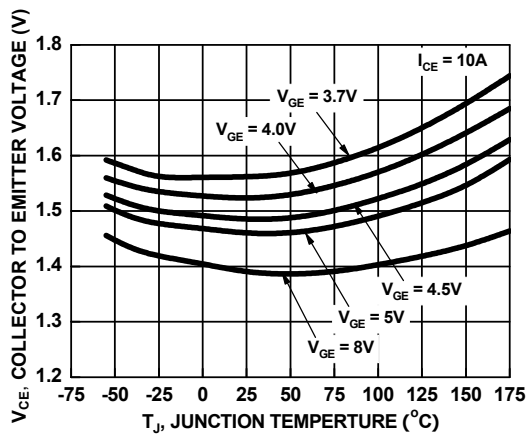
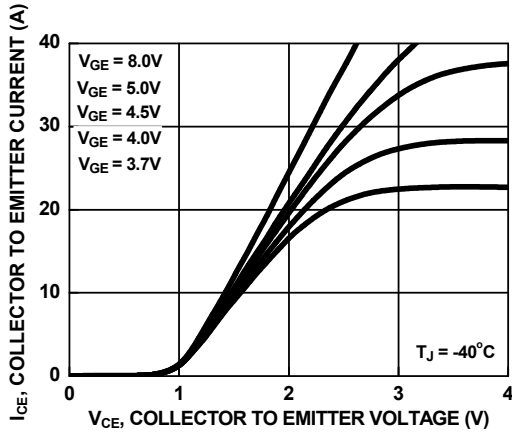
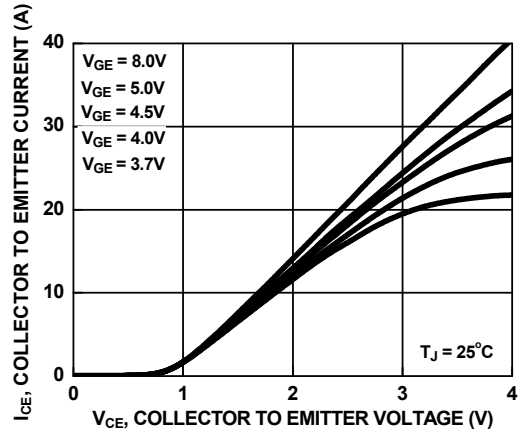


Figure 6. Collector to Emitter On-State Voltage vs. Junction Temperature

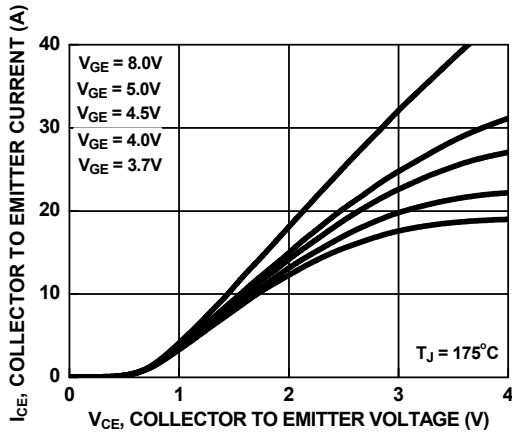
**Typical Performance Curves** (Continued)



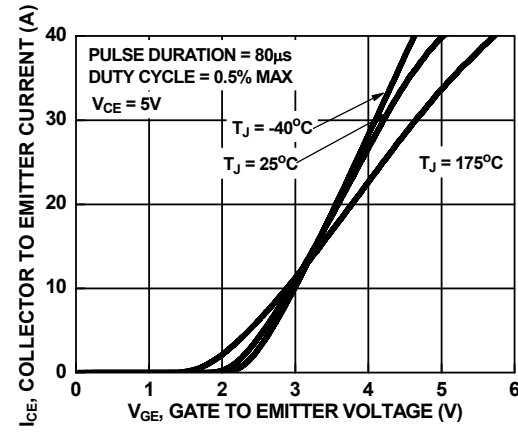
**Figure 7. Collector to Emitter On-State Voltage vs. Collector Current**



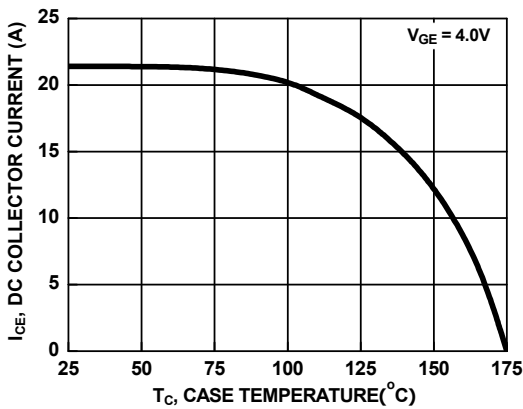
**Figure 8. Collector to Emitter On-State Voltage vs. Collector Current**



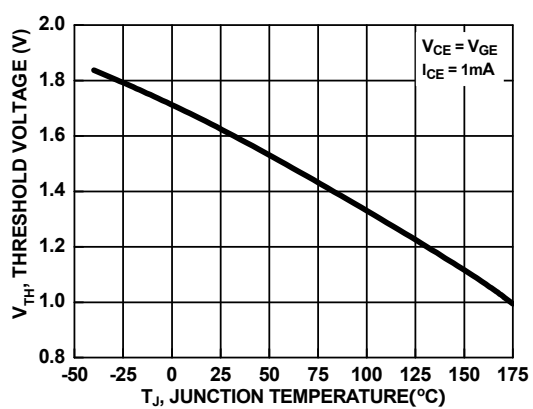
**Figure 9. Collector to Emitter On-State Voltage vs. Collector Current**



**Figure 10. Transfer Characteristics**

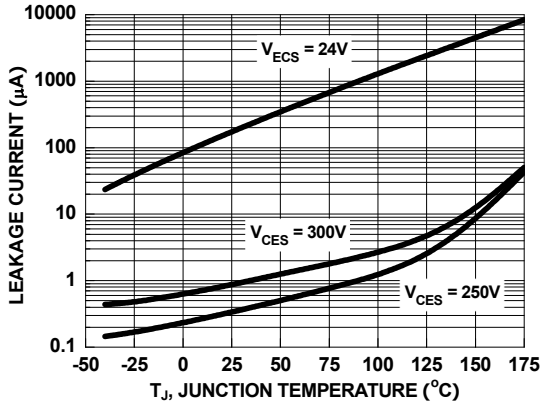


**Figure 11. DC Collector Current vs. Case Temperature**

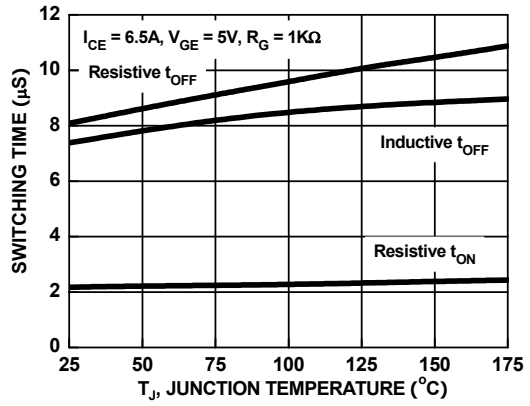


**Figure 12. Threshold Voltage vs. Junction Temperature**

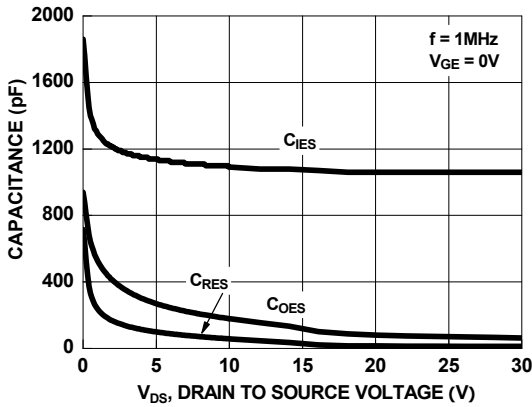
**Typical Performance Curves** (Continued)



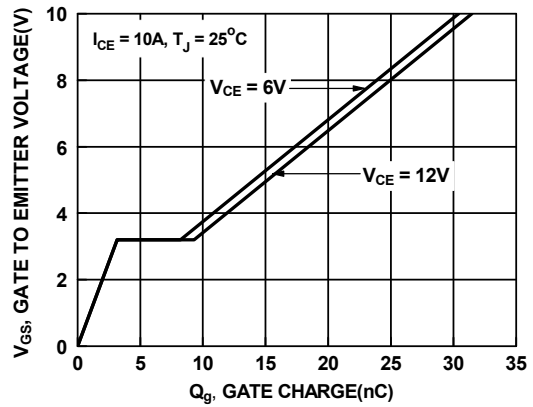
**Figure 13. Leakage Current vs. Junction Temperature**



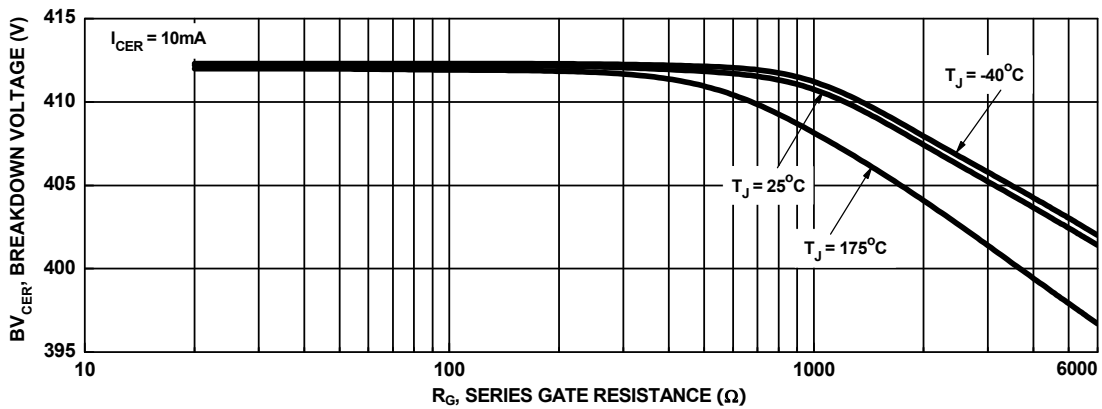
**Figure 14. Switching Time vs. Junction Temperature**



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



**Figure 16. Gate Charge**



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

Typical Performance Curves

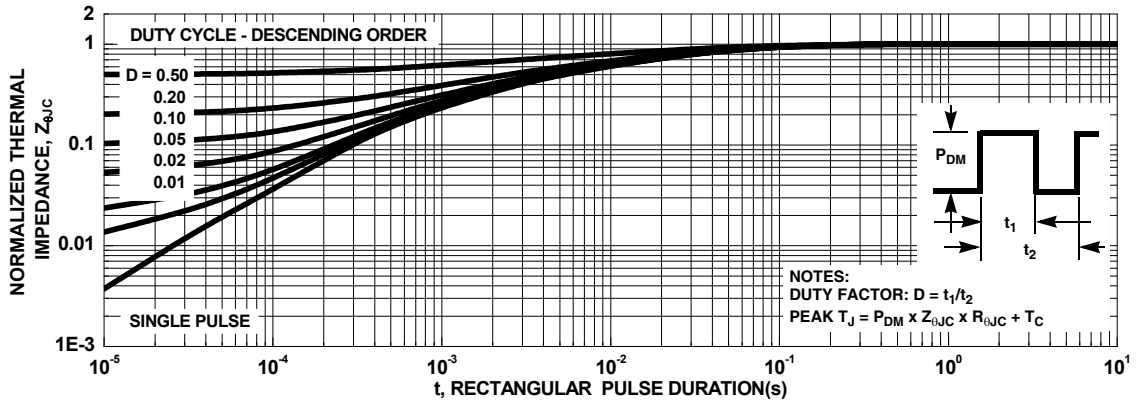
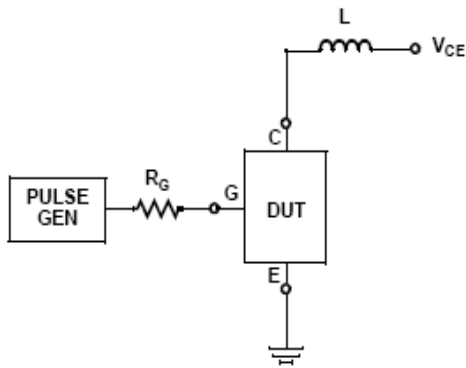
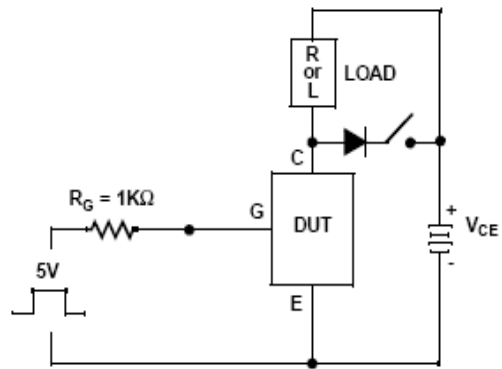


Figure 18. IGBT Normalized Transient Thermal Impedance, Junction to Case

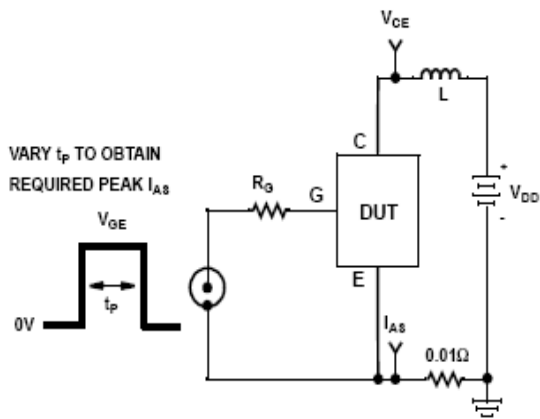
**Test Circuit and Waveforms**



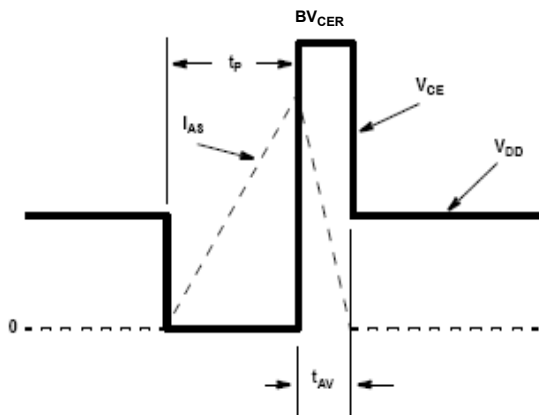
**Figure 19. Inductive Switching Test Circuit**



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

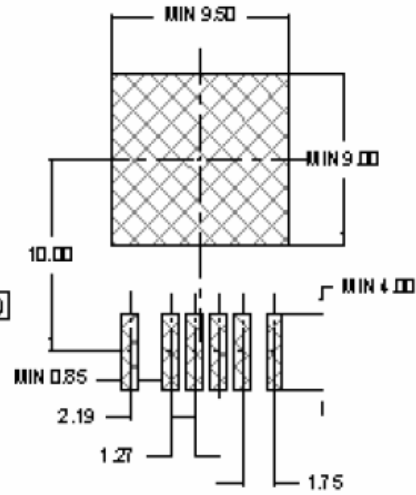
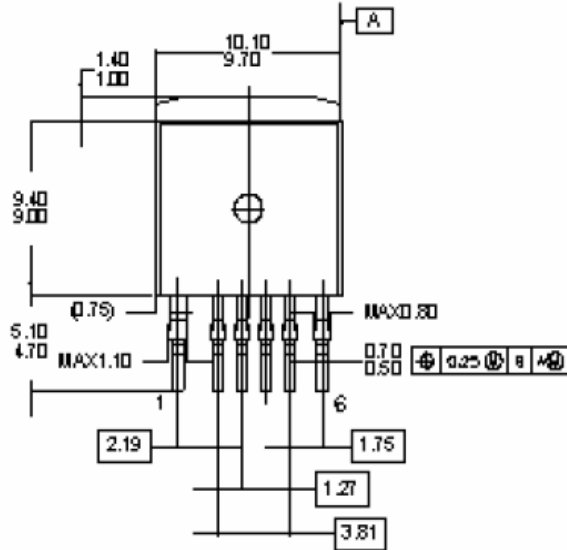


**Figure 21. Energy Test Circuit**

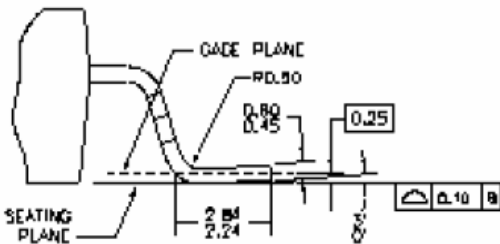
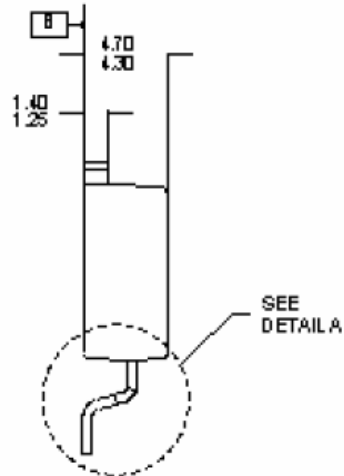
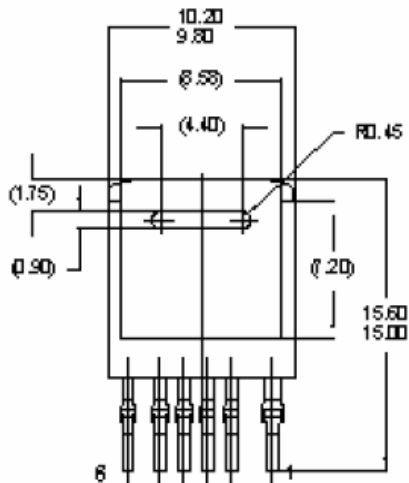


**Figure 22. Energy Waveforms**

1. DIMENSIONS IN PARENTHESES ARE FOR REFERENCE ONLY.  
 2. DIMENSIONS IN SQUARES ARE MANDATORY TO LISTEN. OTHERWISE, LISTEN TO THE DIMENSIONS IN PARENTHESES.  
 3. DIMENSIONS IN PARENTHESES ARE FOR REFERENCE ONLY.  
 4. DIMENSIONS IN PARENTHESES ARE FOR REFERENCE ONLY.  
 5. DIMENSIONS IN PARENTHESES ARE FOR REFERENCE ONLY.  
 6. DIMENSIONS IN PARENTHESES ARE FOR REFERENCE ONLY.



LAND PATTERN RECOMMENDATION



DETAIL A, ROTATED 90°  
SCALE: 2X

- NOTES: UNLESS OTHERWISE SPECIFIED  
 A) THIS PACKAGE DOES NOT COMPLY TO ANY CURRENT PACKAGING STANDARD.  
 B) ALL DIMENSIONS ARE IN MILLIMETERS.  
 C) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.  
 D) DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994


MKT-T 0263A06 revA





## TRADEMARKS

The following are registered and unregistered trademarks and service marks Fairchild Semiconductor owns or is authorized to use and is not intended to be an exhaustive list of all such trademarks.

ACE <sup>®</sup>	Green FPS <sup>™</sup> e-Series <sup>™</sup>	POWEREDGE <sup>®</sup>	SuperSOT <sup>™</sup> -8
Build it Now <sup>™</sup>	GTO <sup>™</sup>	Power-SPM <sup>™</sup>	SyncFET <sup>™</sup>
CorePLUS <sup>™</sup>	<i>i-Lo</i> <sup>™</sup>	PowerTrench <sup>®</sup>	The Power Franchise <sup>®</sup>
CROSSVOLT <sup>™</sup>	IntelliMAX <sup>™</sup>	Programmable Active Droop <sup>™</sup>	 ™
CTL <sup>™</sup>	ISOPLANAR <sup>™</sup>	QFET <sup>®</sup>	TinyBoost <sup>™</sup>
Current Transfer Logic <sup>™</sup>	MegaBuck <sup>™</sup>	QS <sup>™</sup>	TinyBuck <sup>™</sup>
EcoSPARK <sup>®</sup>	MICROCOUPLER <sup>™</sup>	QT Optoelectronics <sup>™</sup>	TinyLogic <sup>®</sup>
FACT Quiet Series <sup>™</sup>	MicroFET <sup>™</sup>	Quiet Series <sup>™</sup>	TINYOPTO <sup>™</sup>
FACT <sup>®</sup>	MicroPak <sup>™</sup>	RapidConfigure <sup>™</sup>	TinyPower <sup>™</sup>
FAST <sup>®</sup>	Motion-SPM <sup>™</sup>	SMART START <sup>™</sup>	TinyPWM <sup>™</sup>
FastvCore <sup>™</sup>	OPTOLOGIC <sup>®</sup>	SPM <sup>®</sup>	TinyWire <sup>™</sup>
FPS <sup>™</sup>	OPTOPLANAR <sup>®</sup>	STEALTH <sup>™</sup>	μSerDes <sup>™</sup>
FRFET <sup>®</sup>	PDP-SPM <sup>™</sup>	SuperFET <sup>™</sup>	UHC <sup>®</sup>
Global Power Resource <sup>SM</sup>	Power220 <sup>®</sup>	SuperSOT <sup>™</sup> -3	UniFET <sup>™</sup>
Green FPS <sup>™</sup>	Power247 <sup>®</sup>	SuperSOT <sup>™</sup> -6	VCX <sup>™</sup>

## DISCLAIMER

FAIRCHILD SEMICONDUCTOR RESERVES THE RIGHT TO MAKE CHANGES WITHOUT FURTHER NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION, OR DESIGN. FAIRCHILD DOES NOT ASSUME ANY LIABILITY ARISING OUT OF THE APPLICATION OR USE OF ANY PRODUCT OR CIRCUIT DESCRIBED HEREIN; NEITHER DOES IT CONVEY ANY LICENSE UNDER ITS PATENT RIGHTS, NOR THE RIGHTS OF OTHERS. THESE SPECIFICATIONS DO NOT EXPAND THE TERMS OF FAIRCHILD'S WORLDWIDE TERMS AND CONDITIONS, SPECIFICALLY THE WARRANTY THEREIN, WHICH COVERS THESE PRODUCTS.

## LIFE SUPPORT POLICY

FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF FAIRCHILD SEMICONDUCTOR CORPORATION.

As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury of the user.
2. A critical component in any component of a life support device, or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

## PRODUCT STATUS DEFINITIONS

### Definition of Terms

Datasheet Identification	Product Status	Definition
Advance Information	Formative or In Design	This datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	This datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
No Identification Needed	Full Production	This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
Obsolete	Not In Production	This datasheet contains specifications on a product that has been discontinued by Fairchild Semiconductor. The datasheet is printed for reference information only.

Rev. I29