

# ISL9V5045S3S / ISL9V5045S3

## EcoSPARK™ N-Channel Ignition IGBT

500mJ, 450V

### Features

- SCIS Energy = 500mJ at  $T_J = 25^\circ\text{C}$
- Logic Level Gate Drive

### Applications

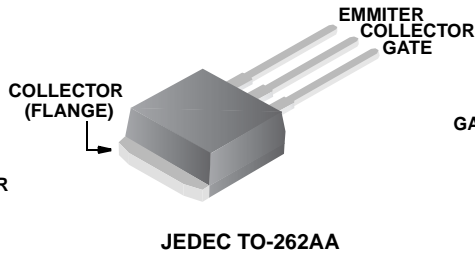
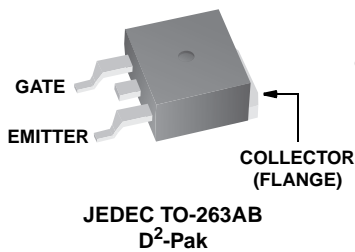
- Automotive Ignition Coil Driver Circuits
- Coil - On Plug Applications

### General Description

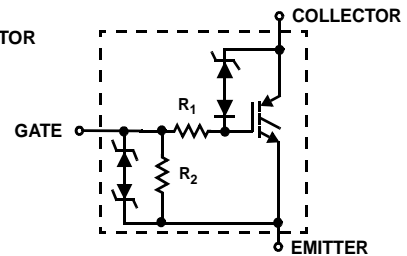
The ISL9V5045S3S and ISL9V5045S3 are next generation ignition IGBTs that offer outstanding SCIS capability in the industry standard D<sup>2</sup>-Pak (TO-263) plastic package. This device is intended for use in automotive ignition circuits, specifically as a coil drivers. Internal diodes provide voltage clamping without the need for external components.

**EcoSPARK™** devices can be custom made to specific clamp voltages. Contact your nearest Fairchild sales office for more information.

### 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 ( $I_C = 1\text{ mA}$ )	480	V
$BV_{ECS}$	Emitter to Collector Voltage - Reverse Battery Condition ( $I_C = 10\text{ mA}$ )	24	V
$E_{SCIS25}$	At Starting $T_J = 25^\circ\text{C}$ , $I_{SCIS} = 39.2\text{ A}$ , $L = 650\ \mu\text{H}$	500	mJ
$E_{SCIS150}$	At Starting $T_J = 150^\circ\text{C}$ , $I_{SCIS} = 31.1\text{ A}$ , $L = 650\ \mu\text{H}$	315	mJ
$I_{C25}$	Collector Current Continuous, At $T_C = 25^\circ\text{C}$ , See Fig 9	51	A
$I_{C110}$	Collector Current Continuous, At $T_C = 110^\circ\text{C}$ , See Fig 9	43	A
$V_{GEM}$	Gate to Emitter Voltage Continuous	$\pm 10$	V
$P_D$	Power Dissipation Total $T_C = 25^\circ\text{C}$	300	W
	Power Dissipation Derating $T_C > 25^\circ\text{C}$	2	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

**Package Marking and Ordering Information**

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
V5045S	ISL9V5045S3ST	TO-263AB	330mm	24mm	800
V5045S	ISL9V5045S3	TO-262AA	Tube	N/A	50
V5045S	ISL9V5045S3S	TO-263AB	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	$I_C = 2\text{ mA}$ , $V_{GE} = 0$ , $R_G = 1\text{ K}\Omega$ , See Fig. 15 $T_J = -40\text{ to }150^\circ\text{C}$	420	450	480	V	
$BV_{CES}$	Collector to Emitter Breakdown Voltage	$I_C = 10\text{ mA}$ , $V_{GE} = 0$ , $R_G = 0$ , See Fig. 15 $T_J = -40\text{ to }150^\circ\text{C}$	445	475	505	V	
$BV_{ECS}$	Emitter to Collector Breakdown Voltage	$I_C = -75\text{ mA}$ , $V_{GE} = 0\text{ V}$ , $T_C = 25^\circ\text{C}$	30	-	-	V	
$BV_{GES}$	Gate to Emitter Breakdown Voltage	$I_{GES} = \pm 2\text{ mA}$	$\pm 12$	$\pm 14$	-	V	
$I_{CER}$	Collector to Emitter Leakage Current	$V_{CER} = 320\text{ V}$ , $R_G = 1\text{ K}\Omega$ , See Fig. 11	$T_C = 25^\circ\text{C}$	-	-	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. 11	$T_C = 25^\circ\text{C}$	-	-	1	mA
			$T_C = 150^\circ\text{C}$	-	-	40	mA
$R_1$	Series Gate Resistance		-	100	-	$\Omega$	
$R_2$	Gate to Emitter Resistance		10K	-	30K	$\Omega$	

**On State Characteristics**

$V_{CE(SAT)}$	Collector to Emitter Saturation Voltage	$I_C = 10\text{ A}$ , $V_{GE} = 4.0\text{ V}$	$T_C = 25^\circ\text{C}$ , See Fig. 4	-	1.25	1.60	V
$V_{CE(SAT)}$	Collector to Emitter Saturation Voltage	$I_C = 15\text{ A}$ , $V_{GE} = 4.5\text{ V}$	$T_C = 150^\circ\text{C}$	-	1.47	1.80	V

### Dynamic Characteristics

$Q_{G(ON)}$	Gate Charge	$I_C = 10A, V_{CE} = 12V,$ $V_{GE} = 5V, \text{ See Fig. 14}$	-	32	-	nC	
$V_{GE(TH)}$	Gate to Emitter Threshold Voltage	$I_C = 1.0mA,$ $V_{CE} = V_{GE},$ $\text{ See Fig. 10}$	$T_C = 25^\circ C$	1.3	-	2.2	V
			$T_C = 150^\circ C$	0.75	-	1.8	V
$V_{GEP}$	Gate to Emitter Plateau Voltage	$I_C = 10A,$ $V_{CE} = 12V$	-	3.0	-	V	

### Switching Characteristics

$t_{d(ON)R}$	Current Turn-On Delay Time-Resistive	$V_{CE} = 14V, R_L = 1\Omega,$ $V_{GE} = 5V, R_G = 1K\Omega$ $T_J = 25^\circ C, \text{ See Fig. 12}$	-	0.7	4	$\mu s$
$t_{rR}$	Current Rise Time-Resistive		-	2.1	7	$\mu s$
$t_{d(OFF)L}$	Current Turn-Off Delay Time-Inductive	$V_{CE} = 300V, L = 2mH,$ $V_{GE} = 5V, R_G = 1K\Omega$ $T_J = 25^\circ C, \text{ See Fig. 12}$	-	10.8	15	$\mu s$
$t_{fL}$	Current Fall Time-Inductive		-	2.8	15	$\mu s$
SCIS	Self Clamped Inductive Switching	$T_J = 25^\circ C, L = 650 \mu H,$ $R_G = 1K\Omega, V_{GE} = 5V, \text{ See Fig. 1 \& 2}$	-	-	500	mJ

### Thermal Characteristics

$R_{\theta JC}$	Thermal Resistance Junction-Case	TO-263, TO-262	-	-	0.5	$^\circ C/W$
-----------------	----------------------------------	----------------	---	---	-----	--------------

### Typical Characteristics

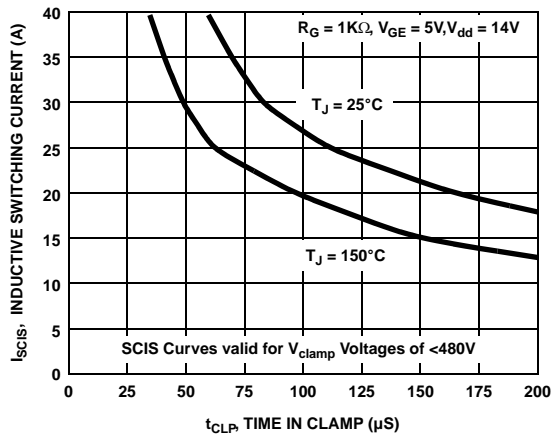


Figure 1. Self Clamped Inductive Switching Current vs Time in Clamp

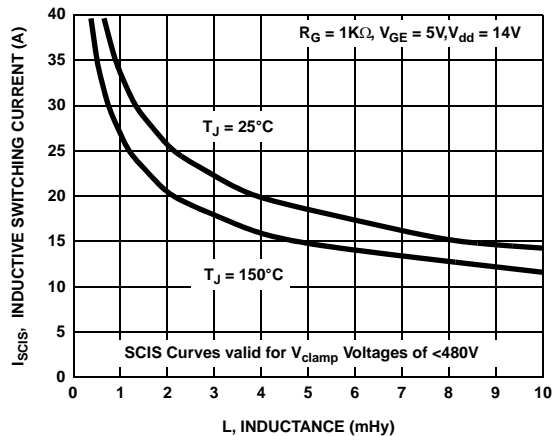


Figure 2. Self Clamped Inductive Switching Current vs Inductance

Typical Characteristics (Continued)

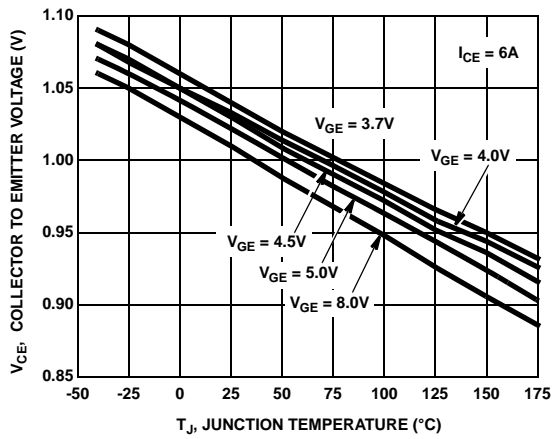


Figure 3. Collector to Emitter On-State Voltage vs Junction Temperature

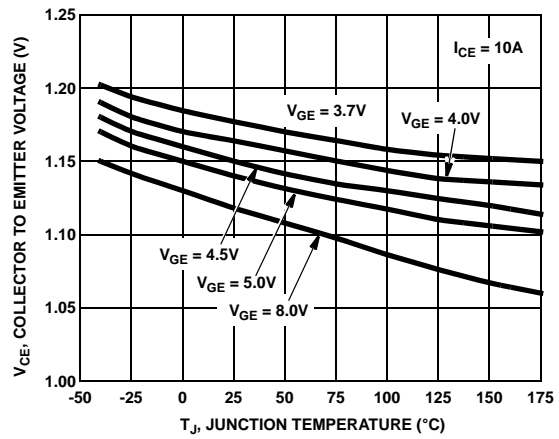


Figure 4. Collector to Emitter On-State Voltage vs Junction Temperature

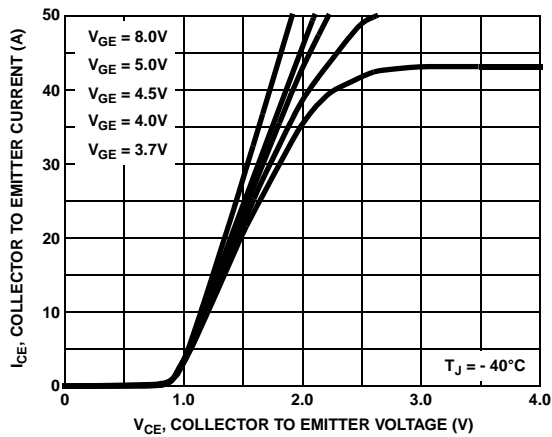


Figure 5. Collector Current vs Collector to Emitter On-State Voltage

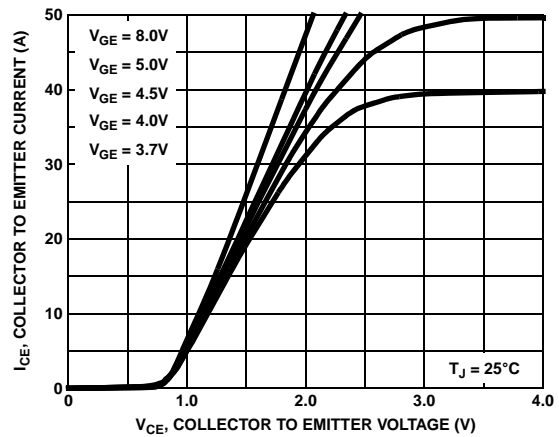


Figure 6. Collector Current vs Collector to Emitter On-State Voltage

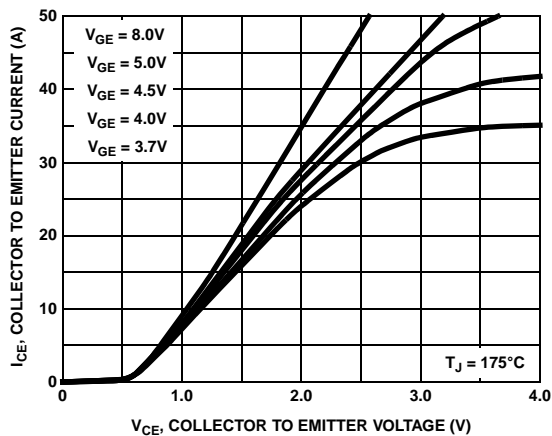


Figure 7. Collector to Emitter On-State Voltage vs Collector Current

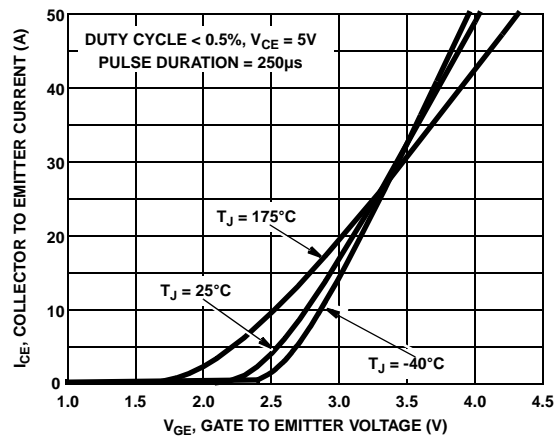


Figure 8. Transfer Characteristics

Typical Characteristics (Continued)

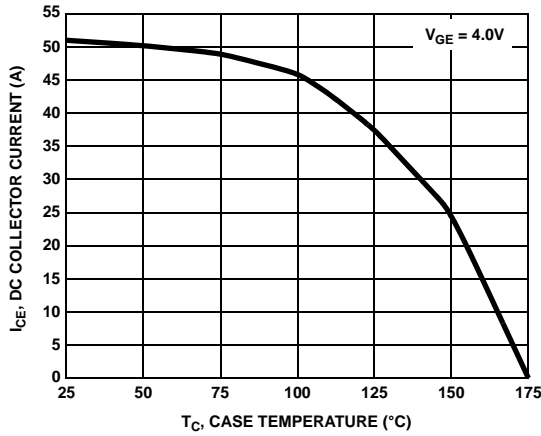


Figure 9. DC Collector Current vs Case Temperature

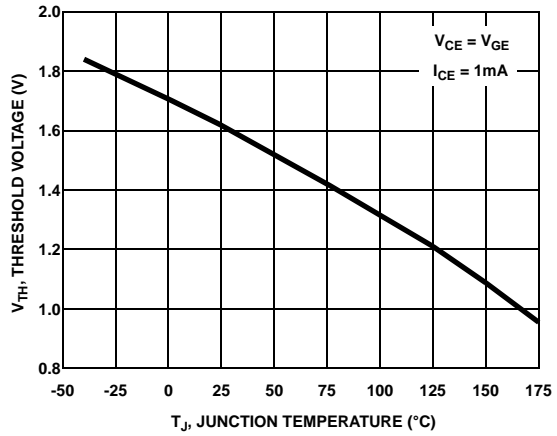


Figure 10. Threshold Voltage vs Junction Temperature

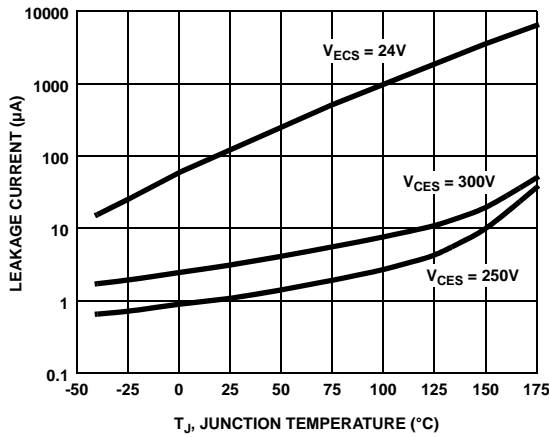


Figure 11. Leakage Current vs Junction Temperature

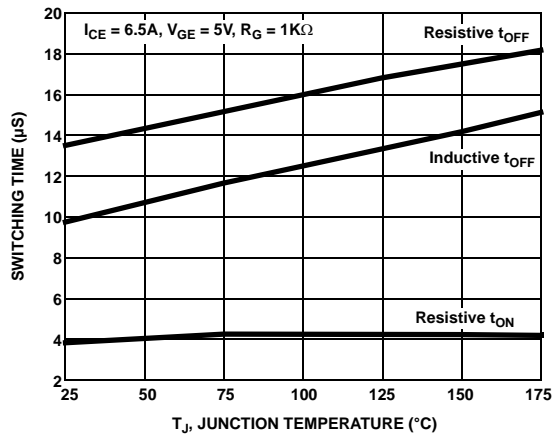


Figure 12. Switching Time vs Junction Temperature

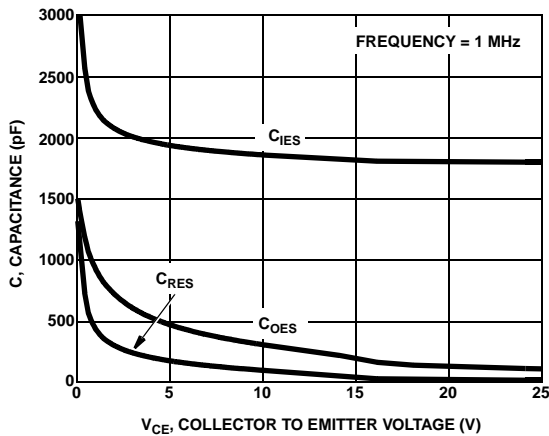


Figure 13. Capacitance vs Collector to Emitter Voltage

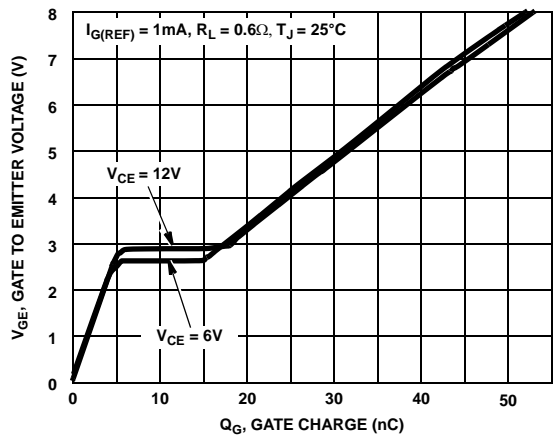
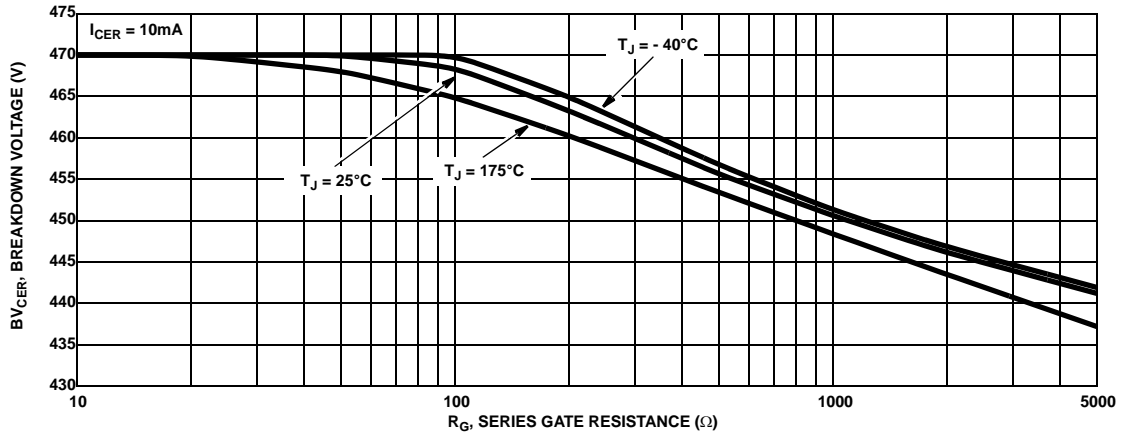
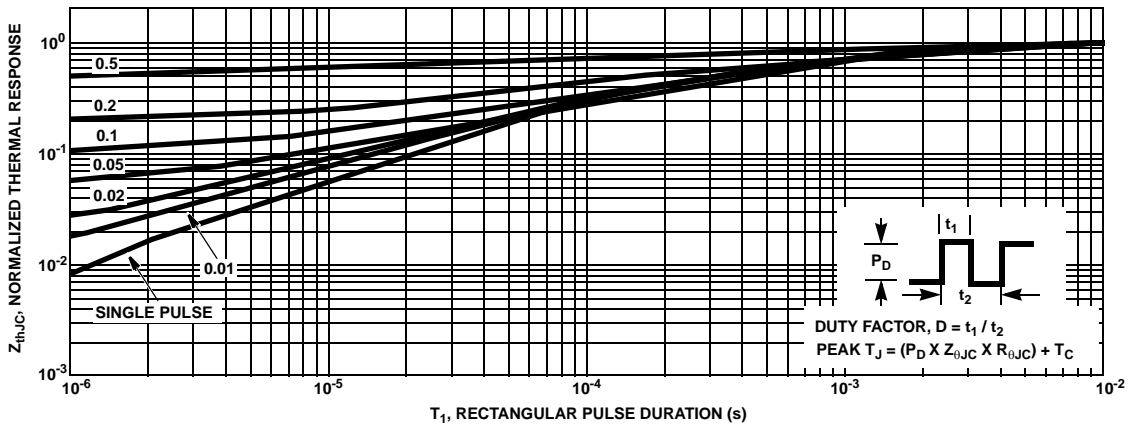


Figure 14. Gate Charge

**Typical Characteristics** (Continued)

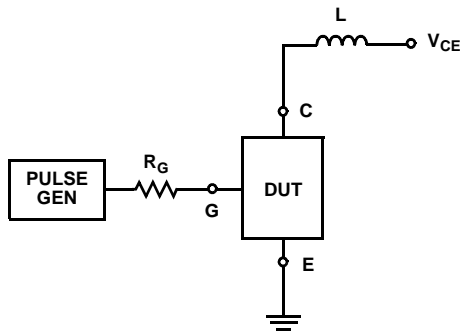


**Figure 15. Breakdown Voltage vs Series Gate Resistance**

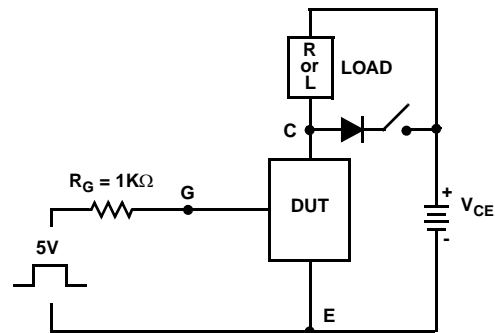


**Figure 16. IGBT Normalized Transient Thermal Impedance, Junction to Case**

**Test Circuits and Waveforms**



**Figure 17. Inductive Switching Test Circuit**



**Figure 18. t<sub>ON</sub> and t<sub>OFF</sub> Switching Test Circuit**

Test Circuits and Waveforms (Continued)

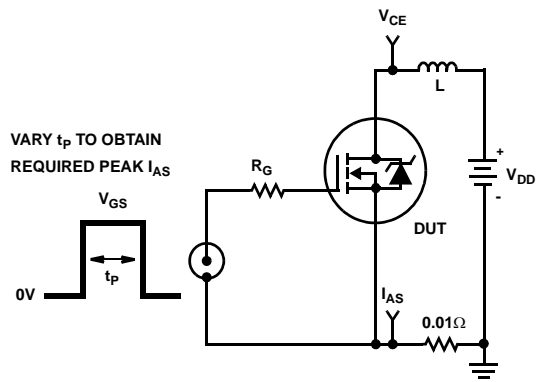


Figure 19. Energy Test Circuit

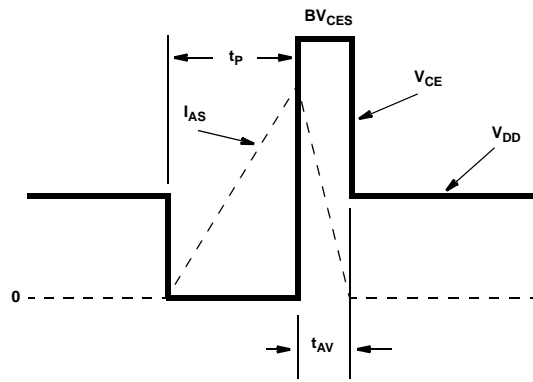


Figure 20. Energy Waveforms

### SPICE Thermal Model

REV 27 May 2005

ISL9V5045S3S / ISL9V5045S3

CTHERM1 th 6 82e-4  
 CTHERM2 6 5 105e-4  
 CTHERM3 5 4 12e-3  
 CTHERM4 4 3 33e-3  
 CTHERM5 3 2 55e-3  
 CTHERM6 2 tl 170e-3

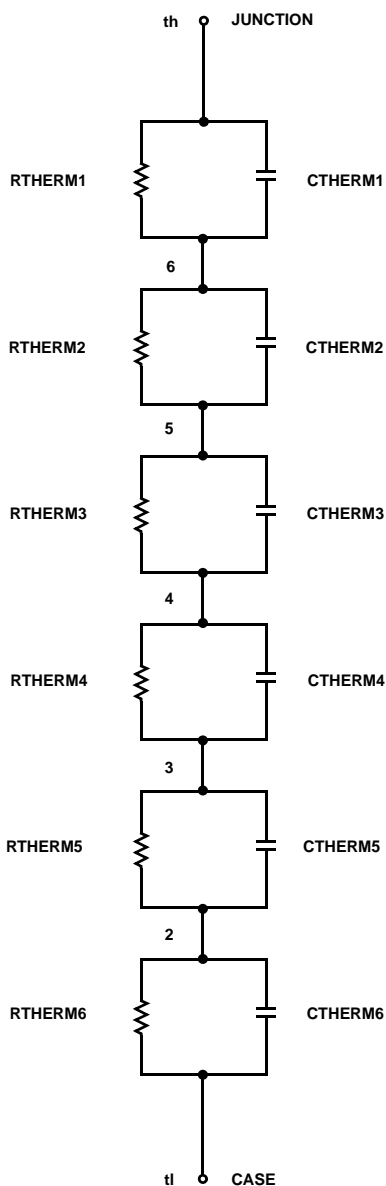
RTHERM1 th 6 3e-3  
 RTHERM2 6 5 20e-3  
 RTHERM3 5 4 50e-3  
 RTHERM4 4 3 60e-3  
 RTHERM5 3 2 100e-3  
 RTHERM6 2 tl 127e-3

### SABER Thermal Model

SABER thermal model  
 ISL9V5045S3S / ISL9V5045S3  
 template thermal\_model th tl  
 thermal\_c th, tl

```
{
    ctherm.ctherm1 th 6 = 82e-4
    ctherm.ctherm2 6 5 = 105e-4
    ctherm.ctherm3 5 4 = 12e-3
    ctherm.ctherm4 4 3 = 33e-3
    ctherm.ctherm5 3 2 = 55e-3
    ctherm.ctherm6 2 tl = 170e-3
```

```
rtherm.rtherm1 th 6 = 3e-3
rtherm.rtherm2 6 5 = 20e-3
rtherm.rtherm3 5 4 = 50e-3
rtherm.rtherm4 4 3 = 60e-3
rtherm.rtherm5 3 2 = 100e-3
rtherm.rtherm6 2 tl = 127e-3
}
```





## TRADEMARKS

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

ACE <sup>x</sup> <sup>TM</sup>	FACT <sup>TM</sup>	<i>i-Lo</i> <sup>TM</sup>	PACMAN <sup>TM</sup>	SPM <sup>TM</sup>
ActiveArray <sup>TM</sup>	FACT Quiet Series <sup>TM</sup>	ImpliedDisconnect <sup>TM</sup>	POP <sup>TM</sup>	Stealth <sup>TM</sup>
Bottomless <sup>TM</sup>	FAST <sup>®</sup>	IntelliMAX <sup>TM</sup>	Power247 <sup>TM</sup>	SuperFET <sup>TM</sup>
Build it Now <sup>TM</sup>	FAST <sup>r</sup> <sup>TM</sup>	ISOPLANAR <sup>TM</sup>	PowerEdge <sup>TM</sup>	SuperSOT <sup>TM</sup> -3
CoolFET <sup>TM</sup>	FPST <sup>TM</sup>	LittleFET <sup>TM</sup>	PowerSaver <sup>TM</sup>	SuperSOT <sup>TM</sup> -6
CROSSVOLT <sup>TM</sup>	FRFET <sup>TM</sup>	MICROCOUPLER <sup>TM</sup>	PowerTrench <sup>®</sup>	SuperSOT <sup>TM</sup> -8
DOME <sup>TM</sup>	GlobalOptoisolator <sup>TM</sup>	MicroFET <sup>TM</sup>	QFET <sup>®</sup>	SyncFET <sup>TM</sup>
EcoSPARK <sup>TM</sup>	GTO <sup>TM</sup>	MicroPak <sup>TM</sup>	QS <sup>TM</sup>	TinyLogic <sup>®</sup>
E <sup>2</sup> C <sup>MOS</sup> <sup>TM</sup>	HiSeC <sup>TM</sup>	MICROWIRE <sup>TM</sup>	QT Optoelectronics <sup>TM</sup>	TINYOPTO <sup>TM</sup>
EnSigna <sup>TM</sup>	I <sup>2</sup> C <sup>TM</sup>	MSX <sup>TM</sup>	Quiet Series <sup>TM</sup>	TruTranslation <sup>TM</sup>
		MSXPro <sup>TM</sup>	RapidConfigure <sup>TM</sup>	UHC <sup>TM</sup>
Across the board. Around the world. <sup>TM</sup>		OCX <sup>TM</sup>	RapidConnect <sup>TM</sup>	UltraFET <sup>®</sup>
The Power Franchise <sup>®</sup>		OCXPro <sup>TM</sup>	µSerDes <sup>TM</sup>	UniFET <sup>TM</sup>
Programmable Active Droop <sup>TM</sup>		OPTOLOGIC <sup>®</sup>	SILENT SWITCHER <sup>®</sup>	VCX <sup>TM</sup>
		OPTOPLANAR <sup>TM</sup>	SMART START <sup>TM</sup>	Wire <sup>TM</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.

## 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:

- 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, or (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 significant injury to the user.
- A critical component is 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, and supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice in order 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 in order 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. 116