

# ISL9V2540S3S EcoSPARK™ N-Channel Ignition IGBT

250mJ, 400V

## Features

- SCIS Energy = 250mJ at  $T_J = 25^\circ\text{C}$
- Logic Level Gate Drive

## Applications

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

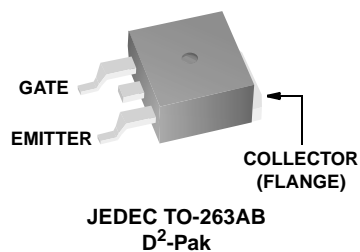
## General Description

The ISL9V2540S3S is a next generation ignition IGBT that offers 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 driver. Internal diodes provide voltage clamping without the need for external components.

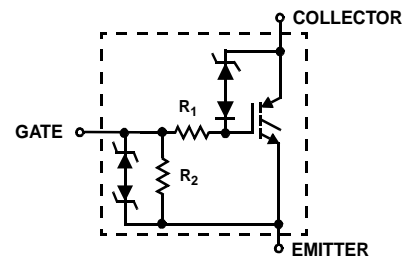
**EcoSPARK™** devices can be custom made to specific clamp voltages. Contact your nearest Fairchild sales office for more information.

ISL9V2540S3S N-Channel Ignition IGBT

## 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 ( $I_C = 1\text{ mA}$ )	430	V
$BV_{ECS}$	Emitter to Collector Voltage - Reverse Battery Condition ( $I_C = 10\text{ mA}$ )	24	V
$E_{SCIS25}$	At Starting $T_J = 25^\circ\text{C}$ , $I_{SCIS} = 12.9\text{A}$ , $L = 3.0\text{mH}$	250	mJ
$E_{SCIS150}$	At Starting $T_J = 150^\circ\text{C}$ , $I_{SCIS} = 10\text{A}$ , $L = 3.0\text{mH}$	150	mJ
$I_{C25}$	Collector Current Continuous, At $T_C = 25^\circ\text{C}$ , See Fig 9	15.5	A
$I_{C110}$	Collector Current Continuous, At $T_C = 110^\circ\text{C}$ , See Fig 9	15.3	A
$V_{GEM}$	Gate to Emitter Voltage Continuous	$\pm 10$	V
$P_D$	Power Dissipation Total $T_C = 25^\circ\text{C}$	166.7	W
	Power Dissipation Derating $T_C > 25^\circ\text{C}$	1.11	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 $\Omega$ (HBM)	4	kV

**Package Marking and Ordering Information**

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
V2540S	ISL9V2540S3ST	TO-263AB	330mm	24mm	800 units
V2540S	ISL9V2540S3S	TO-263AB	Tube	N/A	50 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	$I_C = 2\text{mA}$ , $V_{GE} = 0$ , $R_G = 1\text{K}\Omega$ , See Fig. 15 $T_J = -40$ to $150^\circ\text{C}$	370	400	430	V	
$BV_{CES}$	Collector to Emitter Breakdown Voltage	$I_C = 10\text{mA}$ , $V_{GE} = 0$ , $R_G = 0$ , See Fig. 15 $T_J = -40$ to $150^\circ\text{C}$	390	420	450	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	$V_{CER} = 250\text{V}$ , $R_G = 1\text{K}\Omega$ , 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		-	70	-	$\Omega$	
$R_2$	Gate to Emitter Resistance		10K	-	26K	$\Omega$	

**On State Characteristics**

$V_{CE(SAT)}$	Collector to Emitter Saturation Voltage	$I_C = 6\text{A}$ , $V_{GE} = 4\text{V}$	$T_C = 25^\circ\text{C}$ , See Fig. 3	-	1.37	1.8	V
$V_{CE(SAT)}$	Collector to Emitter Saturation Voltage	$I_C = 10\text{A}$ , $V_{GE} = 4.5\text{V}$	$T_C = 150^\circ\text{C}$ See Fig. 4	-	1.77	2.2	V

**Dynamic Characteristics**

$Q_{G(ON)}$	Gate Charge	$I_C = 10A, V_{CE} = 12V,$ $V_{GE} = 5V, \text{ See Fig. 14}$	-	15.1	-	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	$I_C = 10A,$ $V_{CE} = 12V$	-	3.1	-	V	

**Switching Characteristics**

$t_{d(ON)R}$	Current Turn-On Delay Time-Resistive	$V_{CE} = 14V, R_L = 1\Omega,$ $V_{GE} = 5V, R_G = 1K\Omega,$ $T_J = 25^\circ C$	-	0.61	-	$\mu s$
$t_{riseR}$	Current Rise Time-Resistive		-	2.17	-	$\mu s$
$t_{d(OFF)L}$	Current Turn-Off Delay Time-Inductive	$V_{CE} = 300V, L = 500\mu H,$ $V_{GE} = 5V, R_G = 1K\Omega,$ $T_J = 25^\circ C, \text{ See Fig. 12}$	-	3.64	-	$\mu s$
$t_{fL}$	Current Fall Time-Inductive		-	2.36	-	$\mu s$
SCIS	Self Clamped Inductive Switching	$T_J = 25^\circ C, L = 3.0mH,$ $R_G = 1K\Omega, V_{GE} = 5V, \text{ See}$ $\text{ Fig. 1 \& 2}$	-	-	250	mJ

**Thermal Characteristics**

$R_{\theta JC}$	Thermal Resistance Junction-Case	TO-263	-	-	0.9	$^\circ C/W$
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Typical Performance Curves

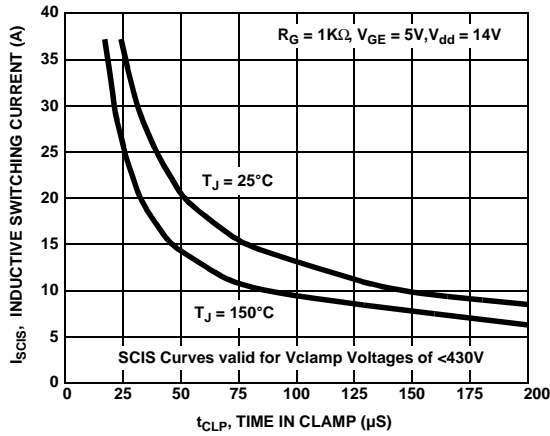


Figure 1. Self Clamped Inductive Switching Current vs Time in Clamp

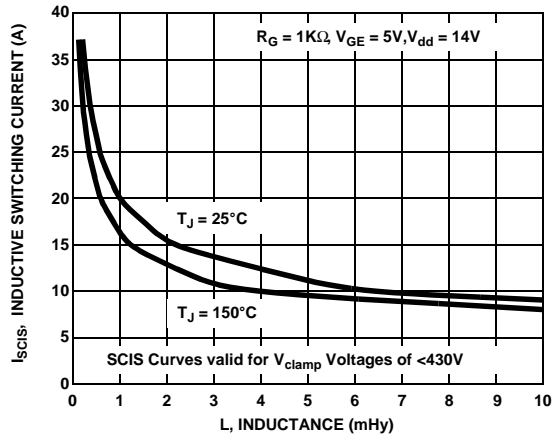


Figure 2. Self Clamped Inductive Switching Current vs Inductance

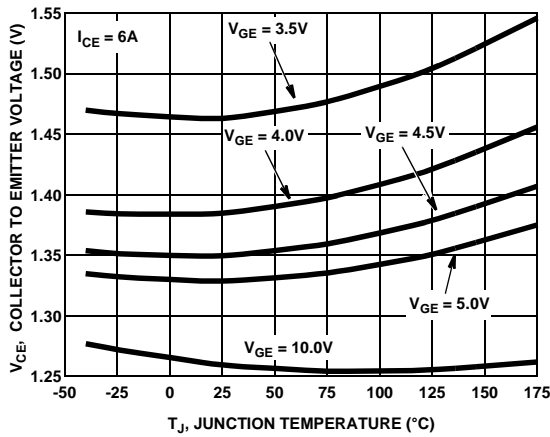


Figure 3. Collector to Emitter On-State Voltage vs Junction Temperature

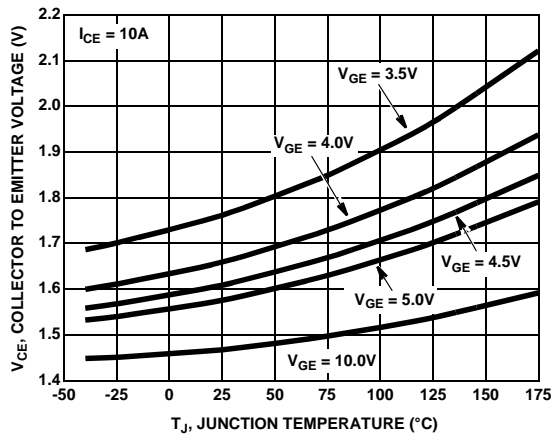


Figure 4. Collector to Emitter On-State Voltage vs Junction Temperature

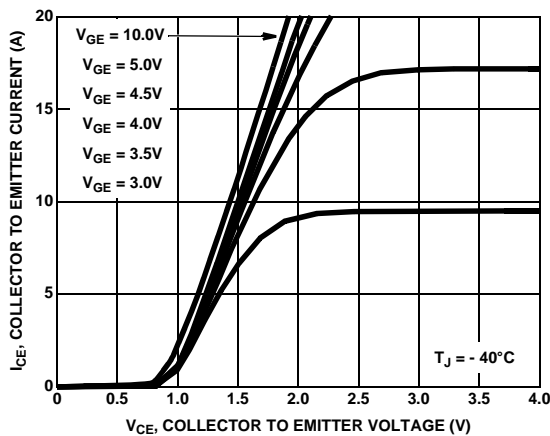


Figure 5. Collector to Emitter On-State Voltage vs Collector Current

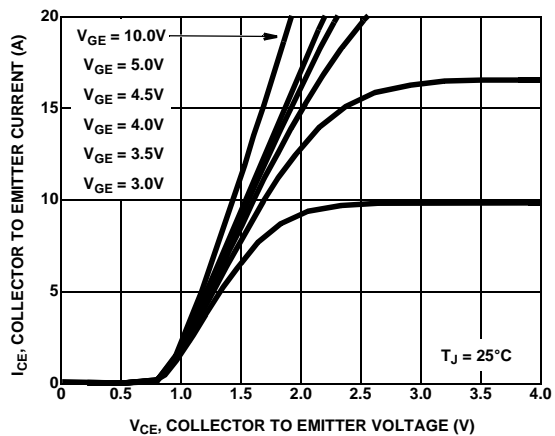
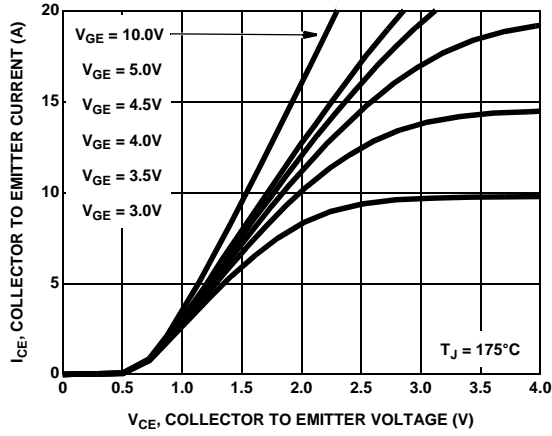
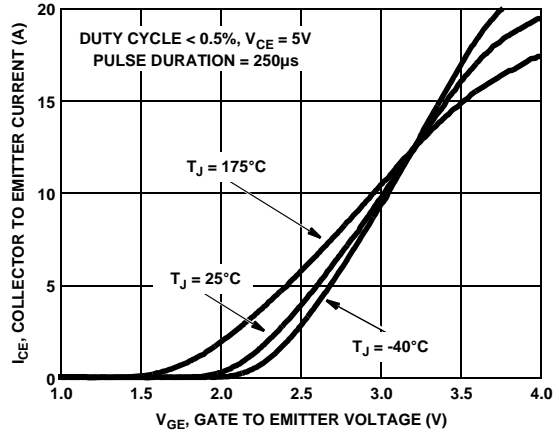


Figure 6. Collector to Emitter On-State Voltage vs Collector Current

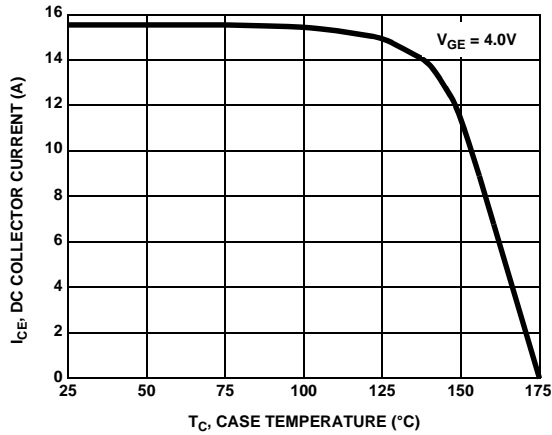
**Typical Performance Curves** (Continued)



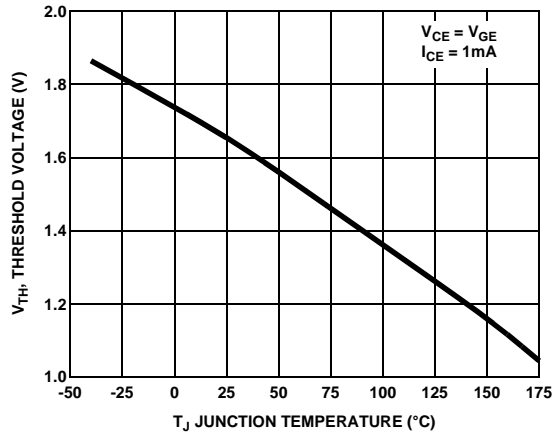
**Figure 7. Collector to Emitter On-State Voltage vs Collector Current**



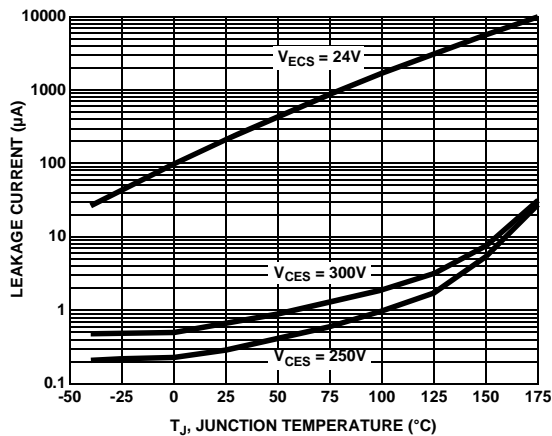
**Figure 8. Transfer Characteristics**



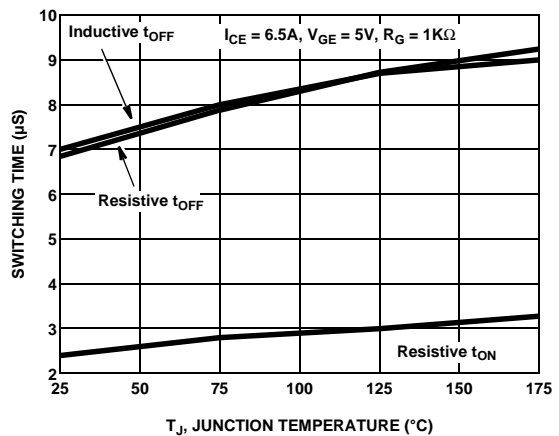
**Figure 9. DC Collector Current vs Case Temperature**



**Figure 10. Threshold Voltage vs Junction Temperature**

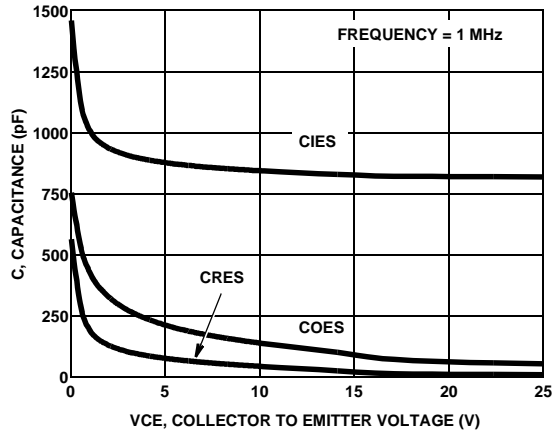


**Figure 11. Leakage Current vs Junction Temperature**

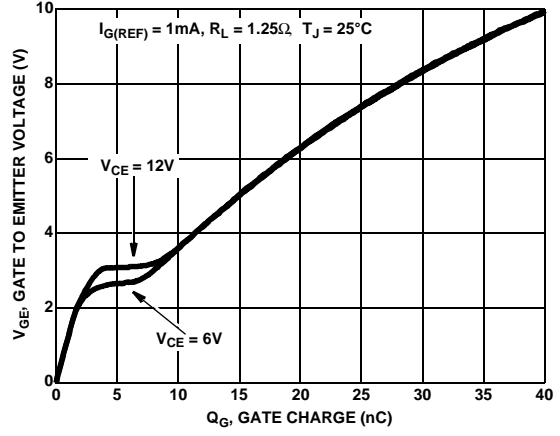


**Figure 12. Switching Time vs Junction Temperature**

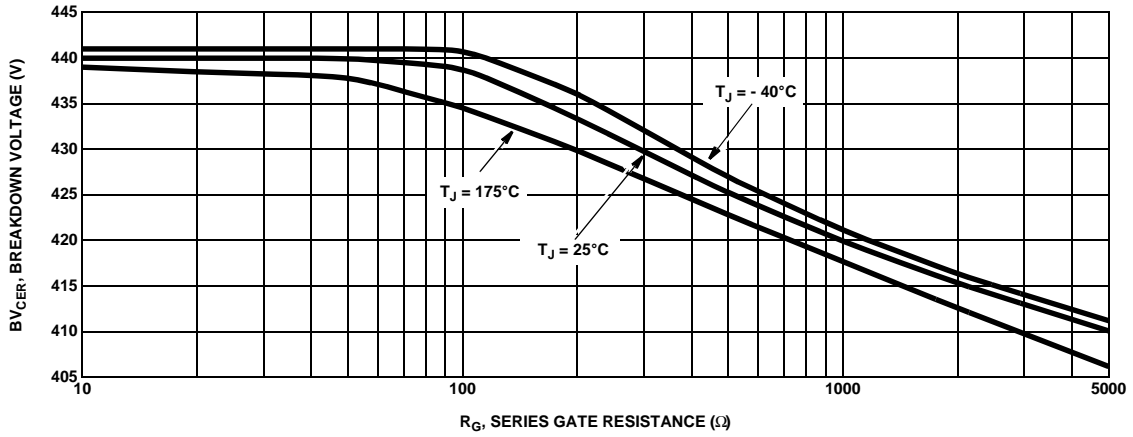
**Typical Performance Curves (Continued)**



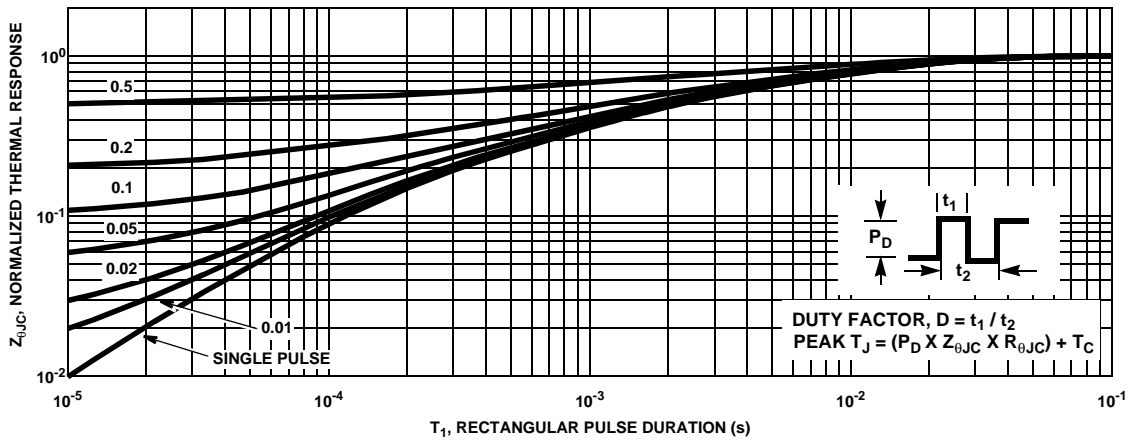
**Figure 13. Capacitance vs Collector to Emitter Voltage**



**Figure 14. Gate Charge**

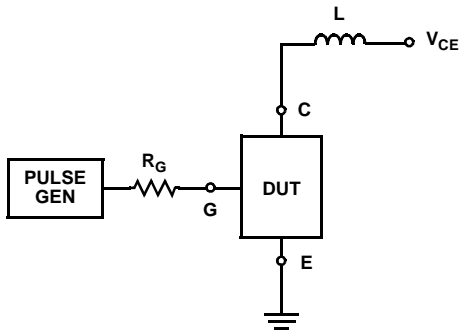


**Figure 15. Breakdown Voltage vs Series Gate Resistance**

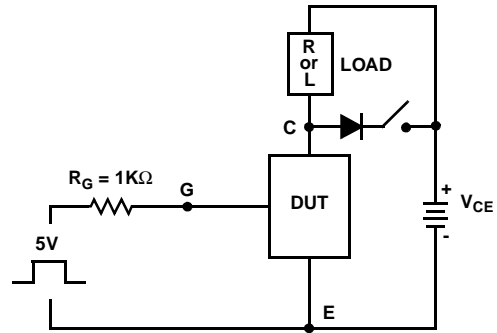


**Figure 16. IGBT Normalized Transient Thermal Impedance, Junction to Case**

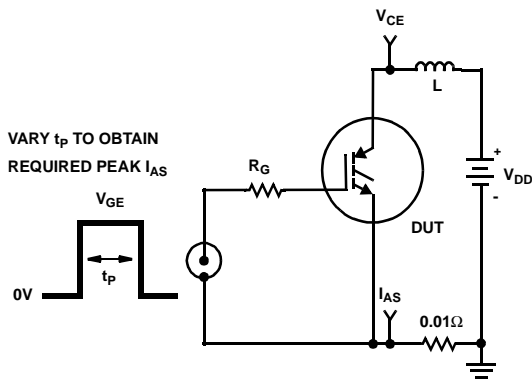
**Test Circuit and Waveforms**



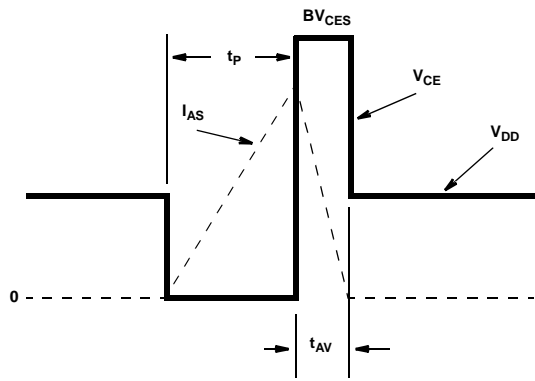
**Figure 17. Inductive Switching Test Circuit**



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



**Figure 19. Unclamped Energy Test Circuit**



**Figure 20. Unclamped Energy Waveforms**

**SPICE Thermal Model**

```

REV 16 May 2005
ISL9V2540S3S
CTHERM1 th 6 19e -4
CTHERM2 6 5 12e -3
CTHERM3 5 4 15e -3
CTHERM4 4 3 25e -3
CTHERM5 3 2 69e -3
CTHERM6 2 tl 100e -3

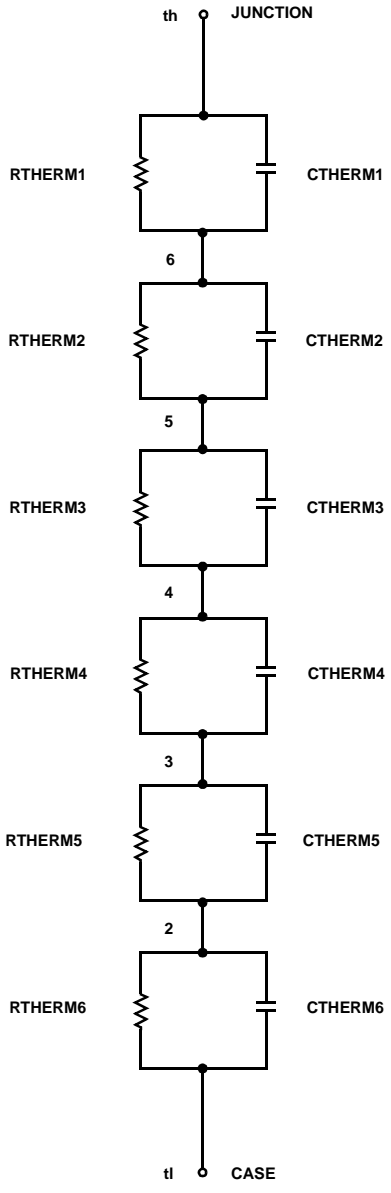
R THERM1 th 6 80e -3
R THERM2 6 5 81e -3
R THERM3 5 4 82e -3
R THERM4 4 3 100e -3
R THERM5 3 2 150e -3
R THERM6 2 tl 1645e -4
    
```

**SABER Thermal Model**

```

ISL9V2540S3S
template thermal_model th tl
thermal_c th, tl
{
    ctherm.ctherm1 th 6 = 19e -4
    ctherm.ctherm2 6 5 = 12e -3
    ctherm.ctherm3 5 4 = 15e -3
    ctherm.ctherm4 4 3 = 25e -3
    ctherm.ctherm5 3 2 = 69e -3
    ctherm.ctherm6 2 tl = 100e -3

    rtherm.rtherm1 th 6 = 80e -3
    rtherm.rtherm2 6 5 = 81e -3
    rtherm.rtherm3 5 4 = 82e -3
    rtherm.rtherm4 4 3 = 100e -3
    rtherm.rtherm5 3 2 = 150e -3
    rtherm.rtherm6 2 tl = 1645e -4
}
    
```





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

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2. 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
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