



ON Semiconductor®

## ISL9V3036D3S / ISL9V3036S3S / ISL9V3036P3

### EcoSPARK® 300mJ, 360V, N-Channel Ignition IGBT

#### General Description

The ISL9V3036D3S, ISL9V3036S3S, and ISL9V3036P3 are the next generation IGBTs that offer outstanding SCIS capability in the space saving D-Pak (TO-252), as well as the industry standard D<sup>2</sup>-Pak (TO-263) and TO-220 plastic packages. These devices are 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.

Formerly Developmental Type 49442

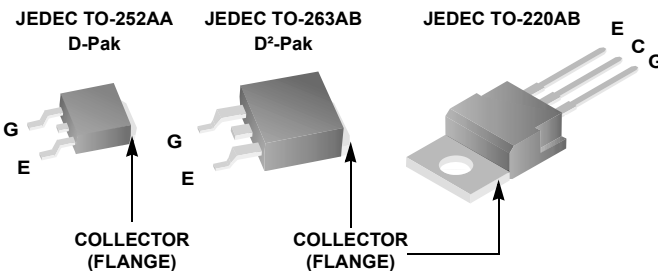
#### Applications

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

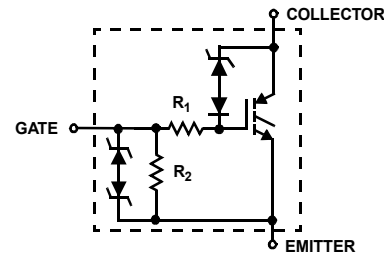
#### Features

- Industry Standard D<sup>2</sup>-Pak package
- SCIS Energy = 300mJ at T<sub>J</sub> = 25°C
- Logic Level Gate Drive

#### Package



#### Symbol



#### Device Maximum Ratings T<sub>J</sub> = 25°C unless otherwise noted

Symbol	Parameter	Ratings	Units
BV <sub>CER</sub>	Collector to Emitter Breakdown Voltage (I <sub>C</sub> = 1 mA)	360	V
BV <sub>ECS</sub>	Emitter to Collector Voltage - Reverse Battery Condition (I <sub>C</sub> = 10 mA)	24	V
E <sub>SCIS25</sub>	T <sub>J</sub> = 25°C, I <sub>SCIS</sub> = 14.2A, L = 3.0 mHy	300	mJ
E <sub>SCIS150</sub>	T <sub>J</sub> = 150°C, I <sub>SCIS</sub> = 10.6A, L = 3.0 mHy	170	mJ
I <sub>C25</sub>	Collector Current Continuous, At T <sub>C</sub> = 25°C, See Fig 9	21	A
I <sub>C110</sub>	Collector Current Continuous, At T <sub>C</sub> = 110°C, See Fig 9	17	A
V <sub>GEM</sub>	Gate to Emitter Voltage Continuous	±10	V
P <sub>D</sub>	Power Dissipation Total T <sub>C</sub> = 25°C	150	W
	Power Dissipation Derating T <sub>C</sub> > 25°C	1.0	W/°C
T <sub>J</sub>	Operating Junction Temperature Range	-40 to 175	°C
T <sub>STG</sub>	Storage Junction Temperature Range	-40 to 175	°C
T <sub>L</sub>	Max Lead Temp for Soldering (Leads at 1.6mm from Case for 10s)	300	°C
T <sub>pkg</sub>	Max Lead Temp for Soldering (Package Body for 10s)	260	°C
ESD	Electrostatic Discharge Voltage at 100pF, 1500Ω	4	kV

ISL9V3036D3S / ISL9V3036S3S / ISL9V3036P3

## Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
V3036D	ISL9V3036D3ST	TO-252AA	330mm	16mm	2500
V3036S	ISL9V3036S3ST	TO-263AB	330mm	24mm	800
V3036P	ISL9V3036P3	TO-220AA	Tube	N/A	50
V3036D	ISL9V3036D3S	TO-252AA	Tube	N/A	75
V3036S	ISL9V3036S3S	TO-263AB	Tube	N/A	50

## Electrical Characteristics $T_J = 25^\circ\text{C}$ 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 $T_J = -40$ to $150^\circ\text{C}$	330	360	390	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 $150^\circ\text{C}$	350	380	410	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	$\text{mA}$
$I_{ECS}$	Emitter to Collector Leakage Current	$V_{EC} = 24\text{V}$ , See Fig. 11	$T_C = 25^\circ\text{C}$	-	-	1	$\text{mA}$
			$T_C = 150^\circ\text{C}$	-	-	40	$\text{mA}$
$R_1$	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	-	1.25	1.60	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	-	1.58	1.80	V
$V_{CE(SAT)}$	Collector to Emitter Saturation Voltage	$I_C = 15\text{A}$ , $V_{GE} = 4.5\text{V}$	$T_C = 150^\circ\text{C}$	-	1.90	2.20	V

### Dynamic Characteristics

$Q_{G(ON)}$	Gate Charge	$I_C = 10\text{A}$ , $V_{CE} = 12\text{V}$ , $V_{GE} = 5\text{V}$ , See Fig. 14	-	17	-	$\text{nC}$	
$V_{GE(TH)}$	Gate to Emitter Threshold Voltage	$I_C = 1.0\text{mA}$ , $V_{CE} = V_{GE}$ , See Fig. 10	$T_C = 25^\circ\text{C}$	1.3	-	2.2	V
			$T_C = 150^\circ\text{C}$	0.75	-	1.8	V
$V_{GEP}$	Gate to Emitter Plateau Voltage	$I_C = 10\text{A}$ , $V_{CE} = 12\text{V}$	-	3.0	-	V	

### 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. 12	-	0.7	4	$\mu\text{s}$
$t_{rR}$	Current Rise Time-Resistive		-	2.1	7	$\mu\text{s}$
$t_{d(OFF)L}$	Current Turn-Off Delay Time-Inductive	$V_{CE} = 300\text{V}$ , $R_L = 500\mu\text{H}$ , $V_{GE} = 5\text{V}$ , $R_G = 1\text{k}\Omega$ $T_J = 25^\circ\text{C}$ , See Fig. 12	-	4.8	15	$\mu\text{s}$
$t_{fL}$	Current Fall Time-Inductive		-	2.8	15	$\mu\text{s}$
SCIS	Self Clamped Inductive Switching	$T_J = 25^\circ\text{C}$ , $L = 3.0\text{mH}$ , $R_G = 1\text{k}\Omega$ , $V_{GE} = 5\text{V}$	-	-	300	$\text{mJ}$

### Thermal Characteristics

$R_{\theta JC}$	Thermal Resistance Junction-Case	TO-252, TO-263, TO-220	-	-	1.0	$^\circ\text{C/W}$
-----------------	----------------------------------	------------------------	---	---	-----	--------------------

Typical Performance Curves

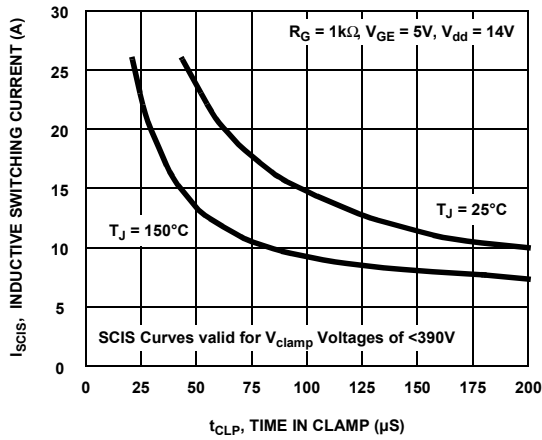


Figure 1. Self Clamped Inductive Switching Current vs Time in Clamp

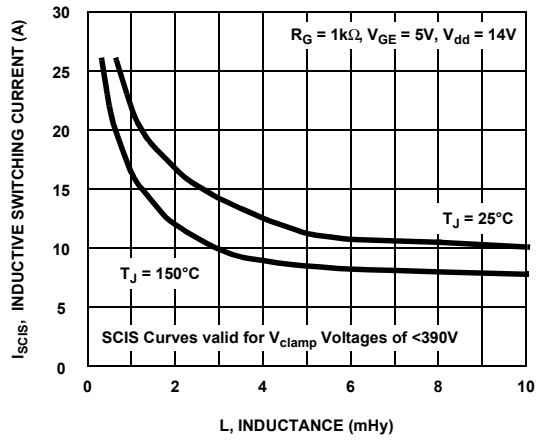


Figure 2. Self Clamped Inductive Switching Current vs Inductance

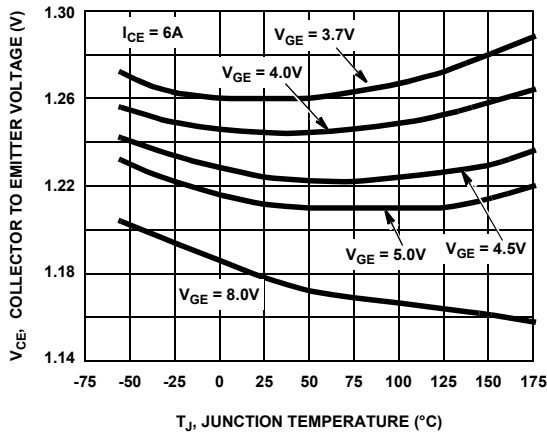


Figure 3. Collector to Emitter On-State Voltage vs Junction Temperature

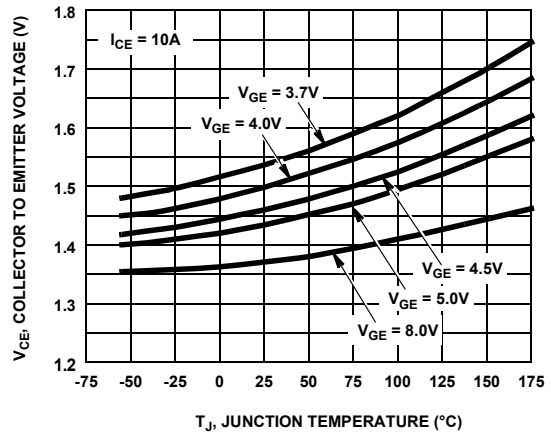


Figure 4. Collector to Emitter On-State Voltage vs Junction Temperature

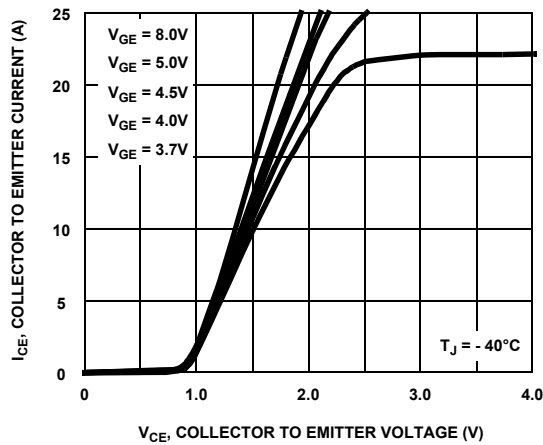


Figure 5. Collector to Emitter On-State Voltage vs Collector Current

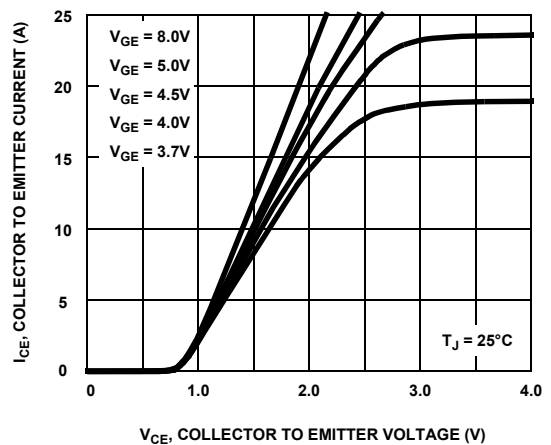


Figure 6. Collector to Emitter On-State Voltage vs Collector Current

Typical Performance Curves (Continued)

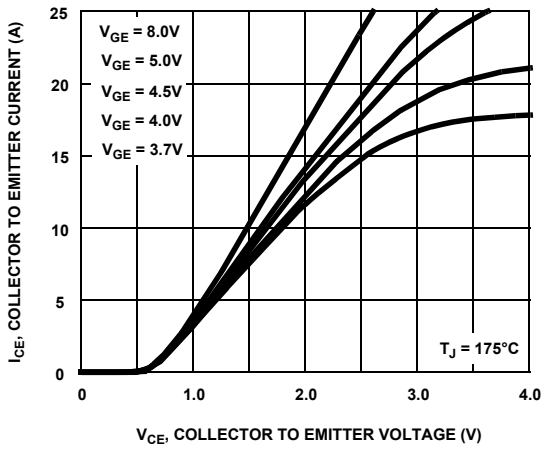


Figure 7. Collector to Emitter On-State Voltage vs Collector Current

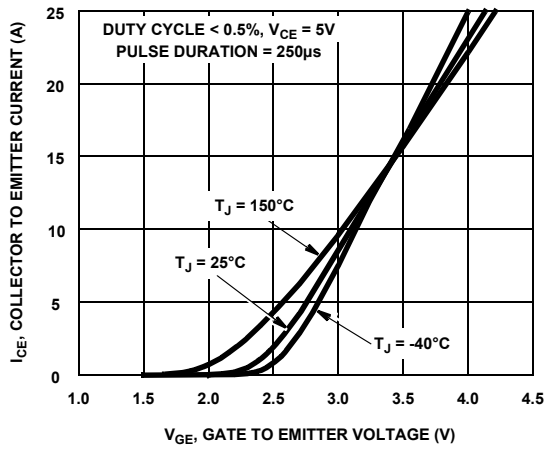


Figure 8. Transfer Characteristics

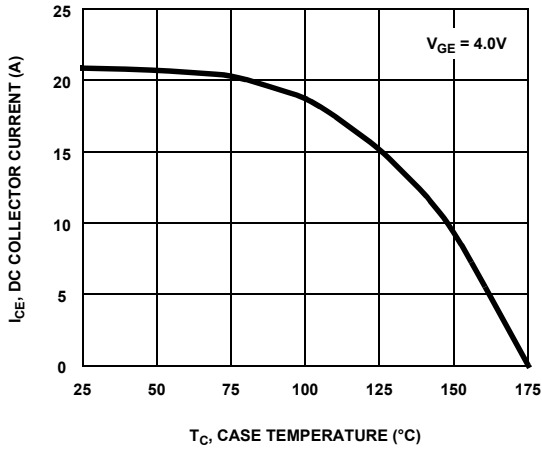


Figure 9. DC Collector Current vs Case Temperature

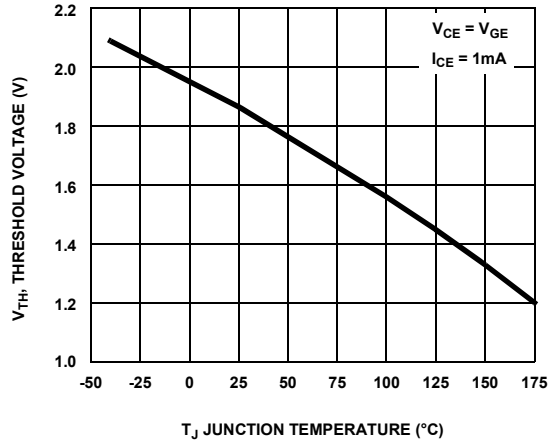


Figure 10. Threshold Voltage vs Junction Temperature

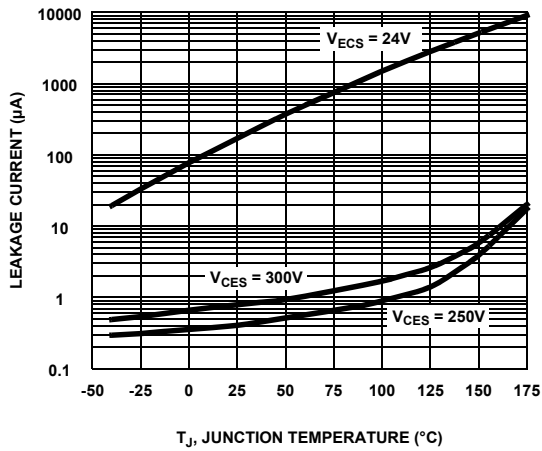


Figure 11. Leakage Current vs Junction Temperature

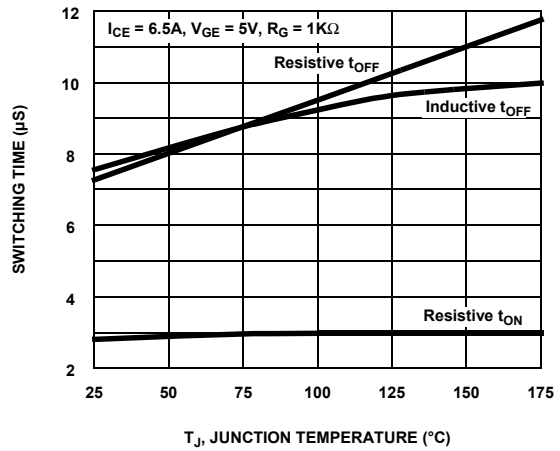


Figure 12. Switching Time vs Junction Temperature

Typical Performance Curves (Continued)

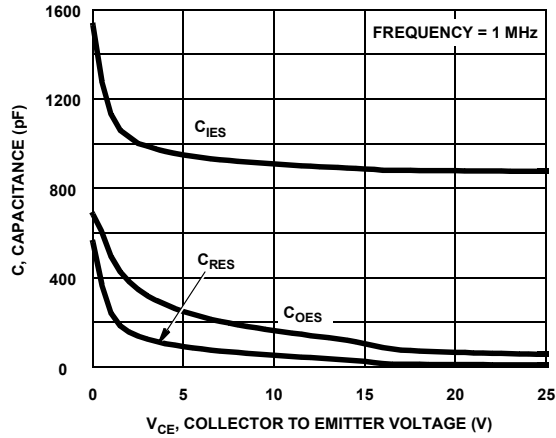


Figure 13. Capacitance vs Collector to Emitter Voltage

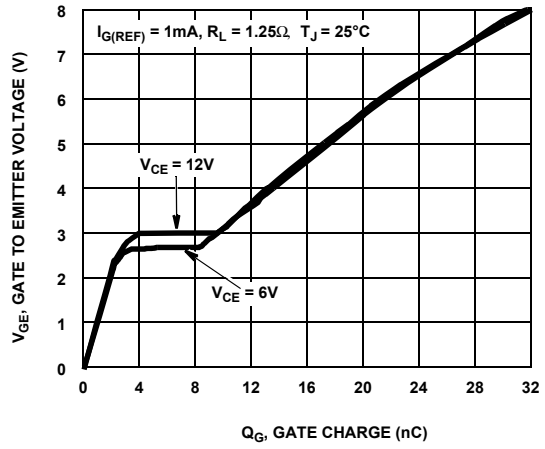


Figure 14. Gate Charge

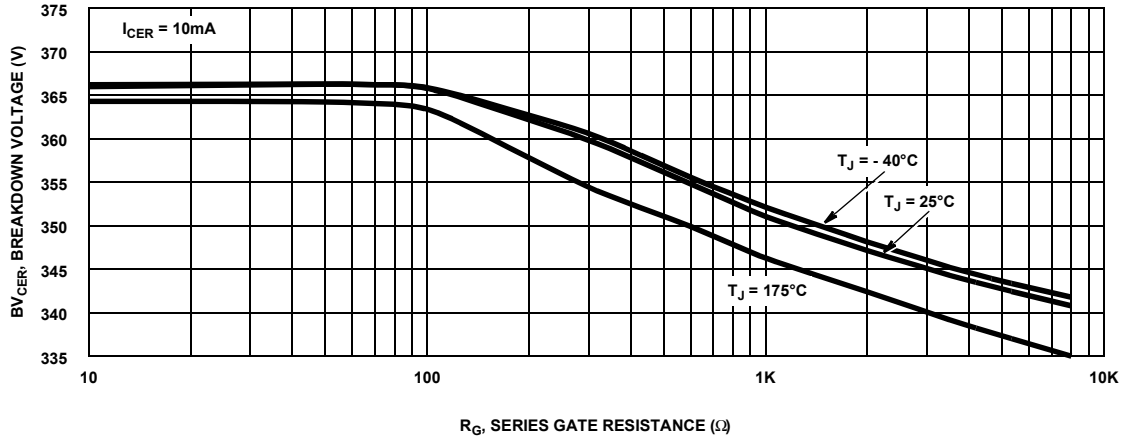


Figure 15. Breakdown Voltage vs Series Gate Resistance

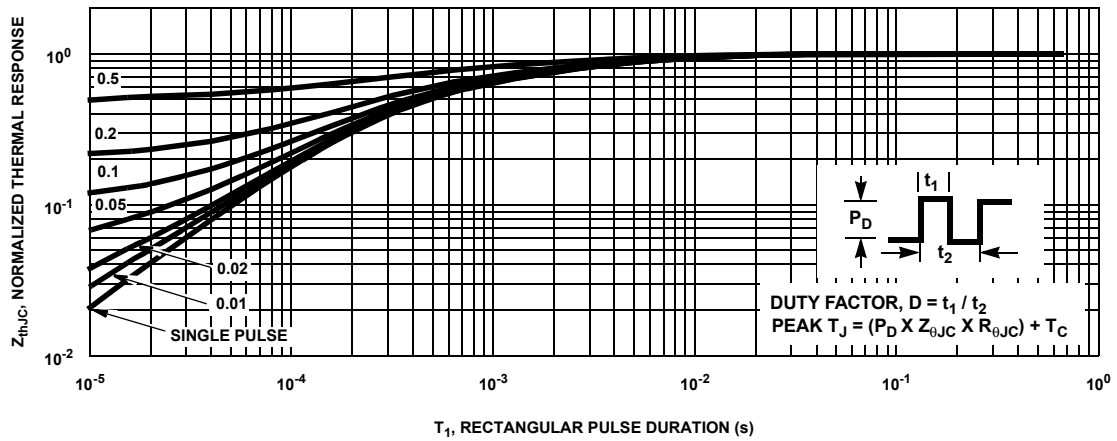


Figure 16. IGBT Normalized Transient Thermal Impedance, Junction to Case

Test Circuit and Waveforms

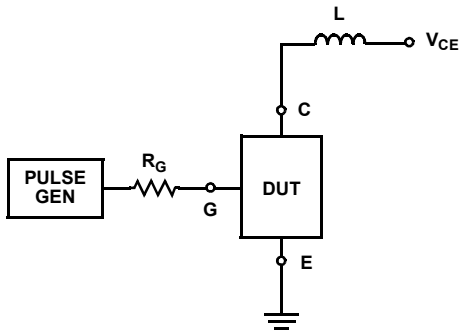


Figure 17. Inductive Switching Test Circuit

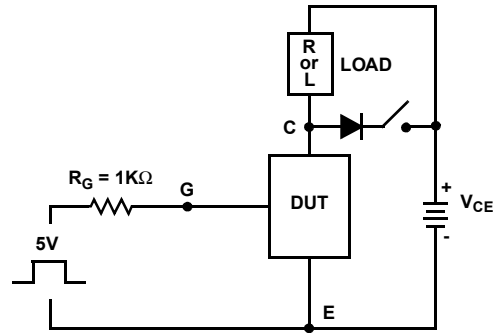


Figure 18.  $t_{ON}$  and  $t_{OFF}$  Switching Test Circuit

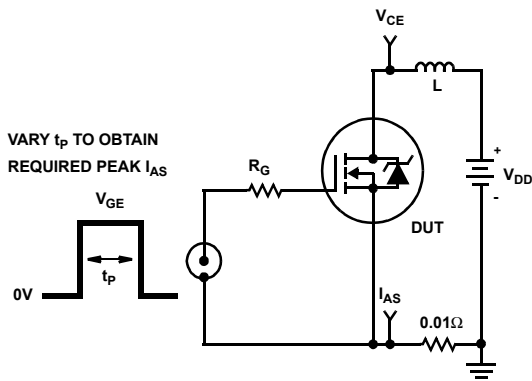


Figure 19. Unclamped Energy Test Circuit

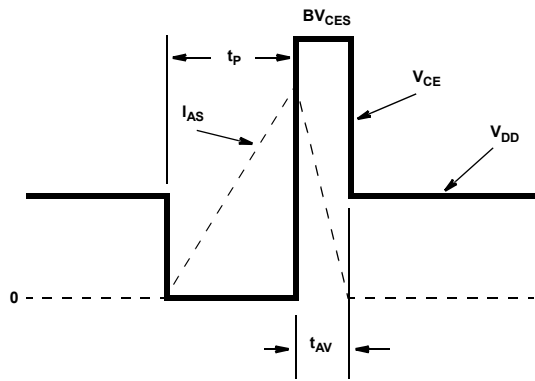


Figure 20. Unclamped Energy Waveforms

### SPICE Thermal Model

REV 24 April 2002

ISL9V3036D3S/ ISL9V3036S3S / ISL9V3036P3

```

CTHERM1 th 6 2.1e -3
CTHERM2 6 5 1.4e -1
CTHERM3 5 4 7.3e -3
CTHERM4 4 3 2.1e -1
CTHERM5 3 2 1.1e -1
CTHERM6 2 tl 6.2e +6
    
```

```

R THERM1 th 6 1.2e -1
R THERM2 6 5 1.9e -1
R THERM3 5 4 2.2e -1
R THERM4 4 3 6.0e -2
R THERM5 3 2 5.8e -2
R THERM6 2 tl 1.6e -3
    
```

### SABER Thermal Model

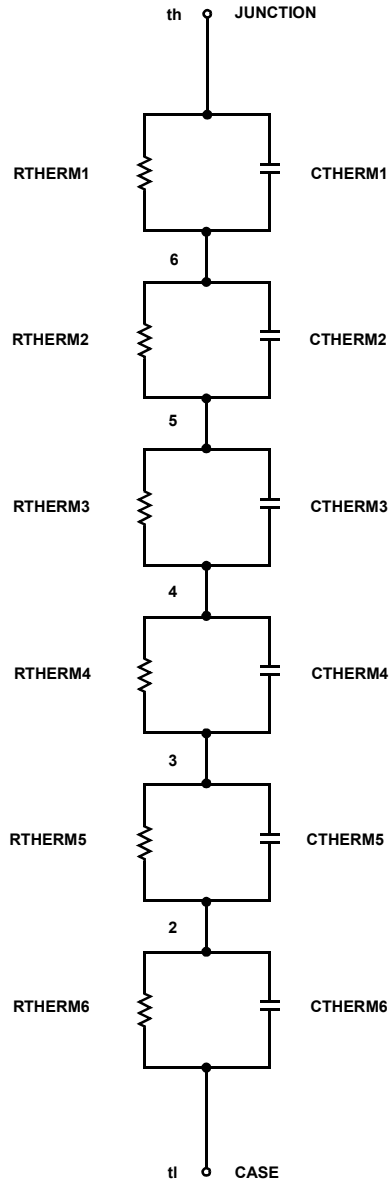
SABER thermal model  
 ISL9V3036D3S / ISL9V3036S3S / ISL9V3036P3  
 template thermal\_model th tl  
 thermal\_c th, tl

```

{
ctherm.ctherm1 th 6 = 2.1e -3
ctherm.ctherm2 6 5 = 1.4e -1
ctherm.ctherm3 5 4 = 7.3e -3
ctherm.ctherm4 4 3 = 2.2e -1
ctherm.ctherm5 3 2 = 1.1e -1
ctherm.ctherm6 2 tl = 6.2e +6
    
```

```

rtherm.rtherm1 th 6 = 1.2e -1
rtherm.rtherm2 6 5 = 1.9e -1
rtherm.rtherm3 5 4 = 2.2e -1
rtherm.rtherm4 4 3 = 6.0e -2
rtherm.rtherm5 3 2 = 5.8e -2
rtherm.rtherm6 2 tl = 1.6e -3
}
    
```



ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

## PUBLICATION ORDERING INFORMATION

### LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor  
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA  
**Phone:** 303-675-2175 or 800-344-3860 Toll Free USA/Canada  
**Fax:** 303-675-2176 or 800-344-3867 Toll Free USA/Canada  
**Email:** [orderlit@onsemi.com](mailto:orderlit@onsemi.com)

**N. American Technical Support:** 800-282-9855 Toll Free  
USA/Canada  
**Europe, Middle East and Africa Technical Support:**  
Phone: 421 33 790 2910  
**Japan Customer Focus Center**  
Phone: 81-3-5817-1050

**ON Semiconductor Website:** [www.onsemi.com](http://www.onsemi.com)  
**Order Literature:** <http://www.onsemi.com/orderlit>  
For additional information, please contact your local  
Sales Representative