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FAIRCHILD SEMICONDUCTOR®

October 2013

ISL9V2040D3S / ISL9V2040S3S / ISL9V2040P3

EcoSPARK® 200mJ, 400V, N-Channel Ignition IGBT

General Description

The ISL9V2040D3S, ISL9V2040S3S, and ISL9V2040P3 are the next generation ignition IGBTs that offer outstanding SCIS capability in the space saving D-Pak (TO-252), as well as the industry standard D²-Pak (TO-263) and TO-220 plastic packages. 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.

Formerly Developmental Type 49444

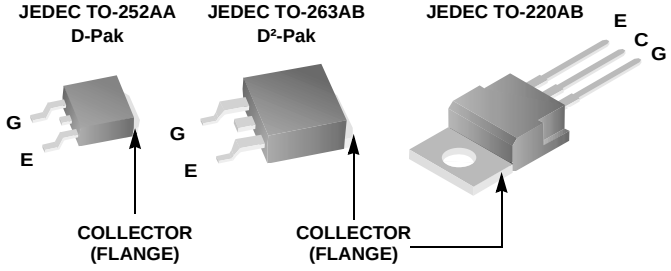
Applications

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

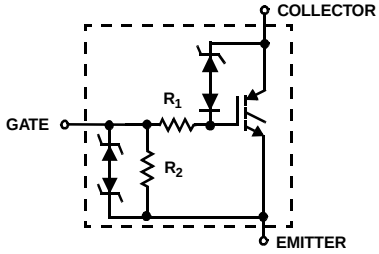
Features

- Space saving D - Pak package available
- SCIS Energy = 200mJ at $T_J = 25^oC$
- Logic Level Gate Drive

Package



Symbol



Device Maximum Ratings $T_A = 25°C$ unless otherwise noted

Symbol	Parameter	Ratings	Units
BV_{CER}	Collector to Emitter Breakdown Voltage (I_C = 1 mA)	430	V
BV_{ECS}	Emitter to Collector Voltage - Reverse Battery Condition (I_C = 10 mA)	24	V
E_{SCIS25}	At Starting $T_J = 25°C$, I_{SCIS} = 11.5A, L = 3.0mHy	200	mJ
$E_{SCIS150}$	At Starting $T_J = 150°C$, I_{SCIS} = 8.9A, L = 3.0mHy	120	mJ
I_{C25}	Collector Current Continuous, At $T_C = 25°C$, See Fig 9	10	A
I_{C110}	Collector Current Continuous, At $T_C = 110°C$, See Fig 9	10	A
V_{GEM}	Gate to Emitter Voltage Continuous	±10	V
P_D	Power Dissipation Total $T_C = 25°C$	130	W
	Power Dissipation Derating $T_C > 25°C$	0.87	W/°C
T_J	Operating Junction Temperature Range	-40 to 175	°C
T_{STG}	Storage Junction Temperature Range	-40 to 175	°C
T_L	Max Lead Temp for Soldering (Leads at 1.6mm from Case for 10s)	300	°C
T_{pkg}	Max Lead Temp for Soldering (Package Body for 10s)	260	°C
ESD	Electrostatic Discharge Voltage at 100pF, 1500Ω	4	kV

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Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
V2040D	ISL9V2040D3ST	TO-252AA	330mm	16mm	2500
V2040S	ISL9V2040S3ST	TO-263AB	330mm	24mm	800
V2040P	ISL9V2040P3	TO-220AB	Tube	N/A	50
V2040D	ISL9V2040D3S	TO-252AA	Tube	N/A	75
V2040S	ISL9V2040S3S	TO-263AB	Tube	N/A	50

Electrical Characteristics T_A = 25°C unless otherwise noted

Symbol	Parameter	Test Conditions		Min	Typ	Max	Units
Off State Characteristics							
BV_{CER}	Collector to Emitter Breakdown Voltage	I_C = 2mA, V_{GE} = 0, R_G = 1KΩ, See Fig. 15 T_J = -40 to 150°C		370	400	430	V
BV_{CES}	Collector to Emitter Breakdown Voltage	I_C = 10mA, V_{GE} = 0, R_G = 0, See Fig. 15 T_J = -40 to 150°C		390	420	450	V
BV_{ECS}	Emitter to Collector Breakdown Voltage	I_C = -75mA, V_{GE} = 0V, T_C = 25°C		30	-	-	V
BV_{GES}	Gate to Emitter Breakdown Voltage	I_{GES} = ± 2mA		±12	±14	-	V
I_{CER}	Collector to Emitter Leakage Current	V_{CER} = 250V, R_G = 1KΩ, See Fig. 11	T_C = 25°C	-	-	25	µA
			T_C = 150°C	-	-	1	mA
I_{ECS}	Emitter to Collector Leakage Current	V_{EC} = 24V, See Fig. 11	T_C = 25°C	-	-	1	mA
			T_C = 150°C	-	-	40	mA
R_1	Series Gate Resistance			-	70	-	Ω
R_2	Gate to Emitter Resistance			10K	-	26K	Ω
On State Characteristics							
$V_{CE(SAT)}$	Collector to Emitter Saturation Voltage	I_C = 6A, V_{GE} = 4V	T_C = 25°C, See Fig. 3	-	1.45	1.9	V
$V_{CE(SAT)}$	Collector to Emitter Saturation Voltage	I_C = 10A, V_{GE} = 4.5V	T_C = 150°C See Fig. 4	-	1.95	2.3	V
Dynamic Characteristics							
$Q_{G(ON)}$	Gate Charge	I_C = 10A, V_{CE} = 12V, V_{GE} = 5V, See Fig. 14		-	12	-	nC
$V_{GE(TH)}$	Gate to Emitter Threshold Voltage	I_C = 1.0mA, V_{CE} = V_{GE}, See Fig. 10	T_C = 25°C	1.3	-	2.2	V
			T_C = 150°C	0.75	-	1.8	V
V_{GEP}	Gate to Emitter Plateau Voltage	I_C = 10A, V_{CE} = 12V		-	3.4	-	V
Switching Characteristics							
$t_{d(ON)R}$	Current Turn-On Delay Time-Resistive	V_{CE} = 14V, R_L = 1Ω, V_{GE} = 5V, R_G = 1KΩ T_J = 25°C		-	0.61	-	µs
t_{riseR}	Current Rise Time-Resistive			-	2.17	-	µs
$t_{d(OFF)L}$	Current Turn-Off Delay Time-Inductive	V_{CE} = 300V, L = 500µHy, V_{GE} = 5V, R_G = 1KΩ T_J = 25°C, See Fig. 12		-	3.64	-	µs
t_{fL}	Current Fall Time-Inductive			-	2.36	-	µs
SCIS	Self Clamped Inductive Switching	T_J = 25°C, L = 3.0mHy, R_G = 1KΩ, V_{GE} = 5V, See Fig. 1 & 2		-	-	200	mJ
Thermal Characteristics							
$R_{\theta JC}$	Thermal Resistance Junction-Case	TO-252, TO-263, TO-220		-	-	1.15	°C/W

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Typical Performance Curves

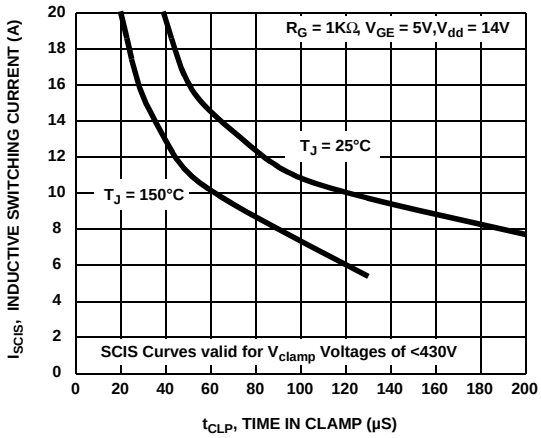


Figure 1. Self Clamped Inductive Switching Current vs Time in Clamp

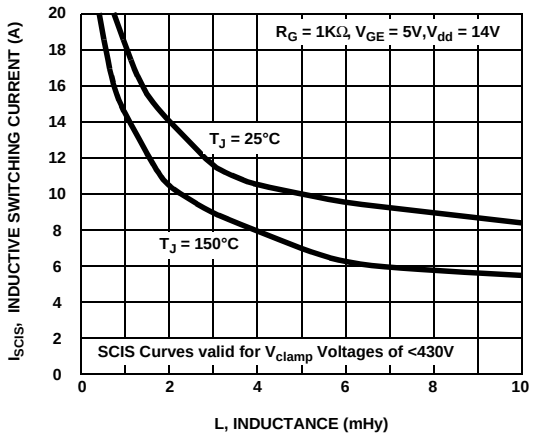


Figure 2. Self Clamped Inductive Switching Current vs Inductance

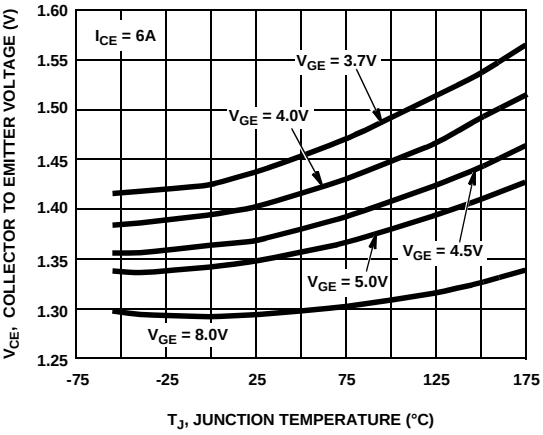


Figure 3. Collector to Emitter On-State Voltage vs Junction Temperature

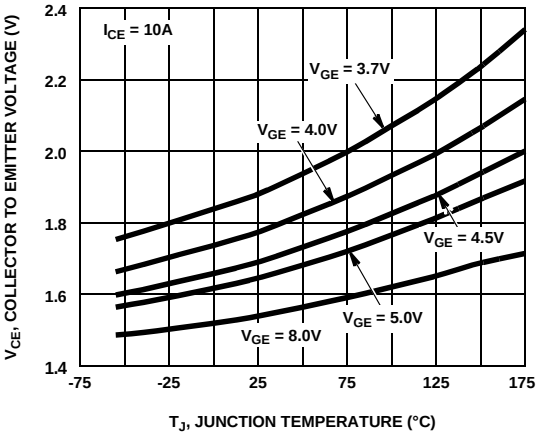


Figure 4. Collector to Emitter On-State Voltage vs Junction Temperature

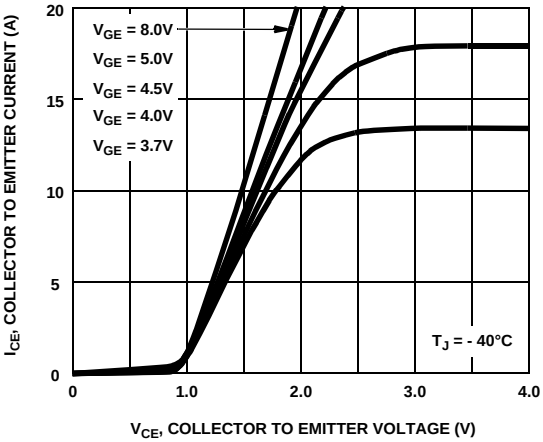


Figure 5. Collector to Emitter On-State Voltage vs Collector Current

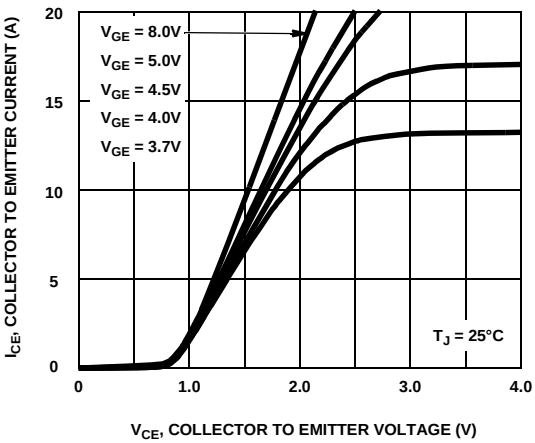


Figure 6. Collector to Emitter On-State Voltage vs Collector Current

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Typical Performance Curves (Continued)

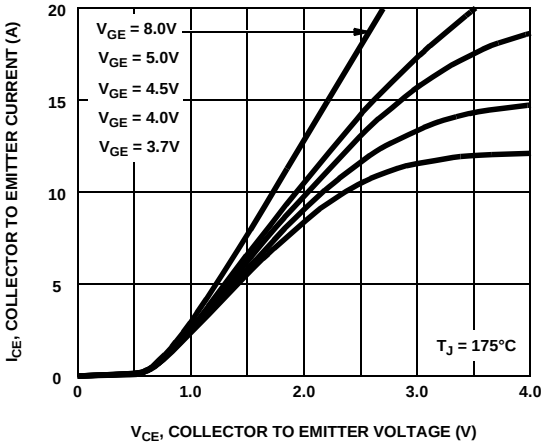


Figure 7. Collector to Emitter On-State Voltage vs Collector Current

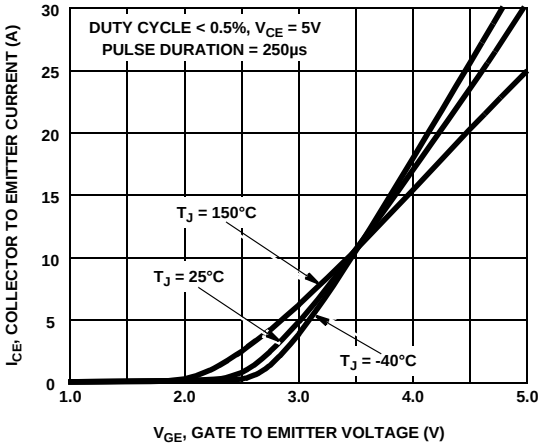


Figure 8. Transfer Characteristics

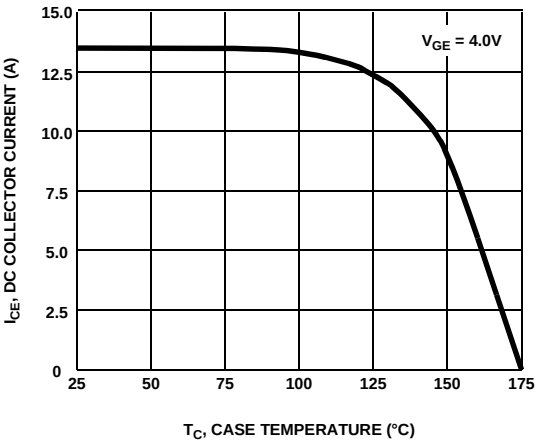


Figure 9. DC Collector Current vs Case Temperature

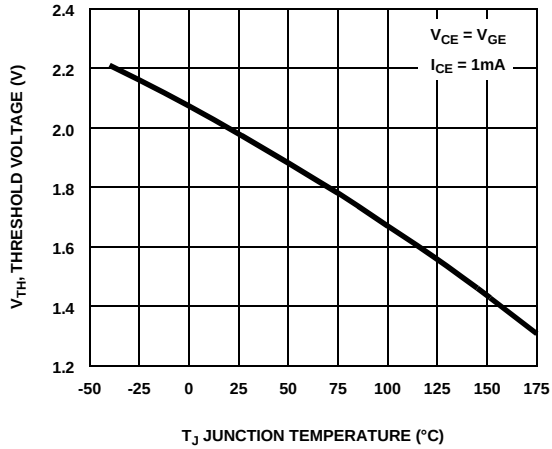


Figure 10. Threshold Voltage vs Junction Temperature

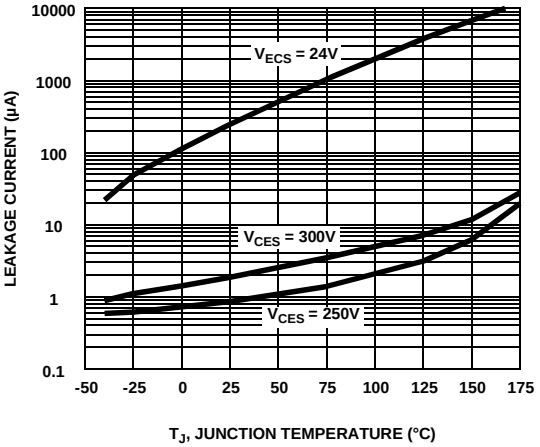


Figure 11. Leakage Current vs Junction Temperature

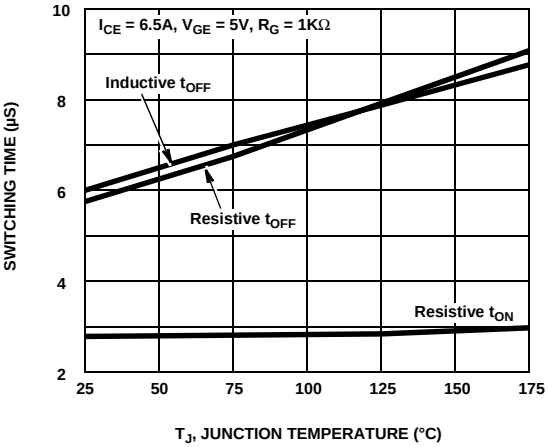


Figure 12. Switching Time vs Junction Temperature

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Typical Performance Curves (Continued)

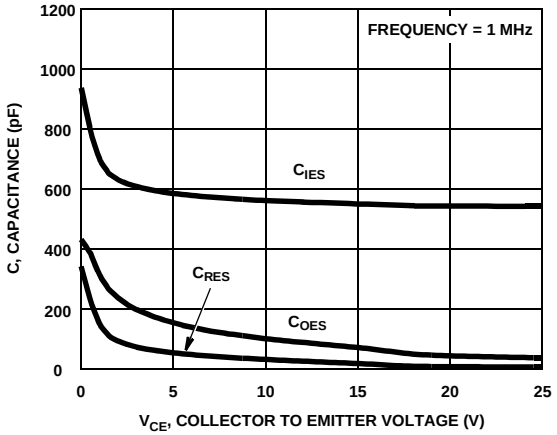


Figure 13. Capacitance vs. Collector to Emitter Voltage

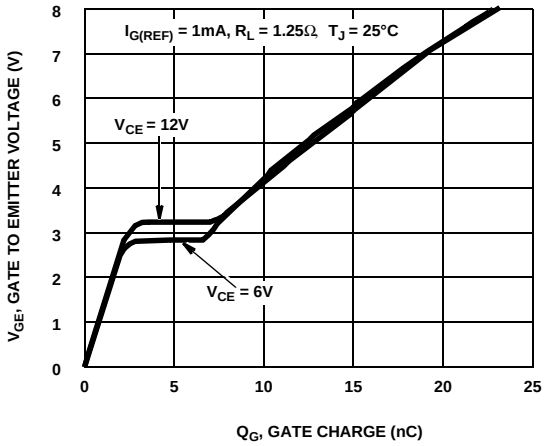


Figure 14. Gate Charge

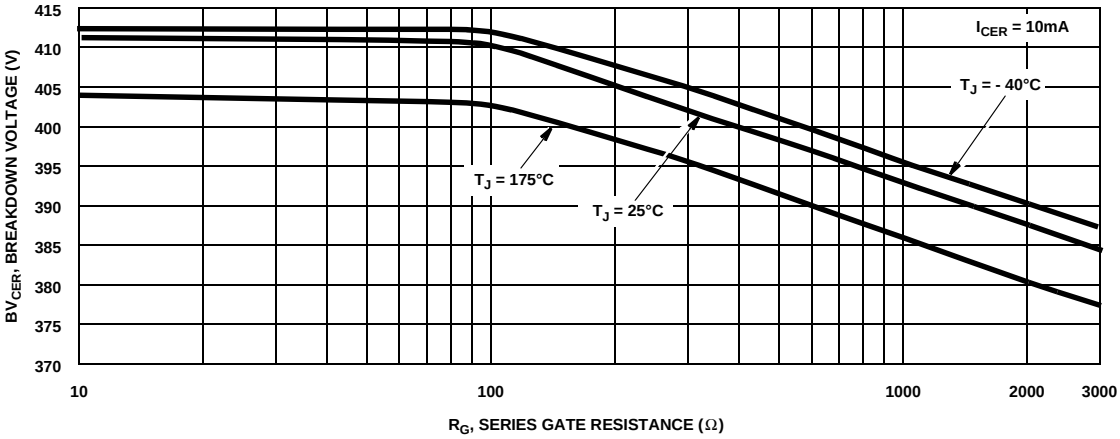


Figure 15. Breakdown Voltage vs. Series Gate Resistance

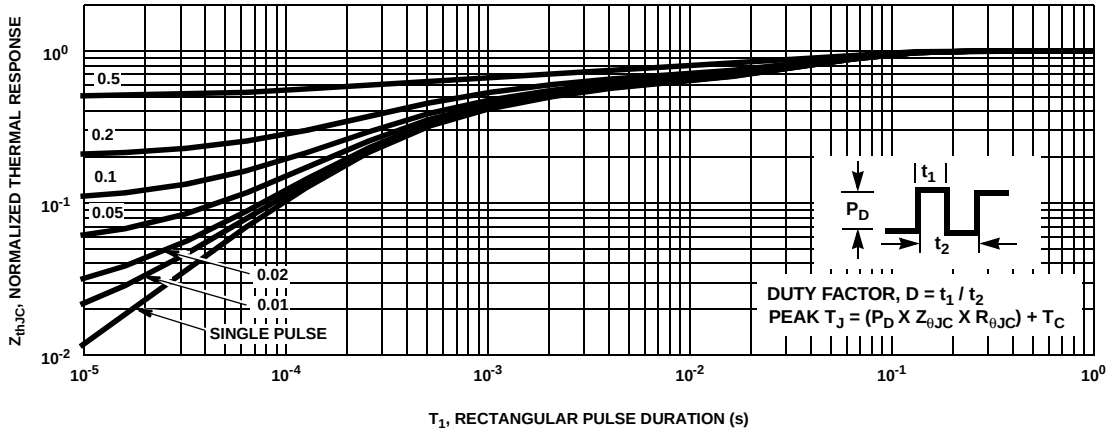


Figure 16. IGBT Normalized Transient Thermal Impedance, Junction to Case

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Test Circuit and Waveforms

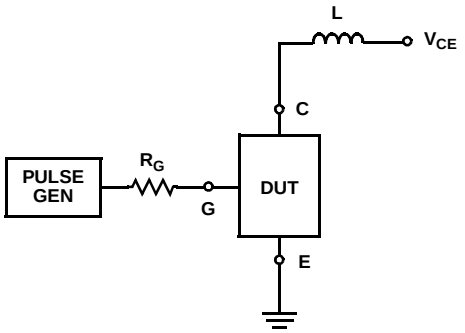


Figure 17. Inductive Switching Test Circuit

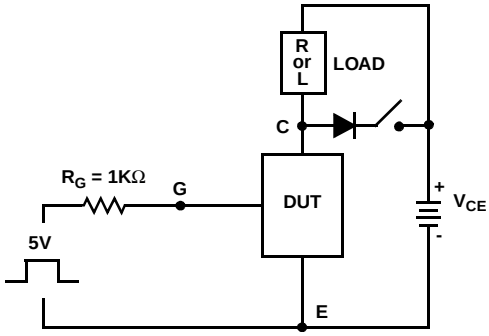


Figure 18. t_{ON} and t_{OFF} Switching Test Circuit

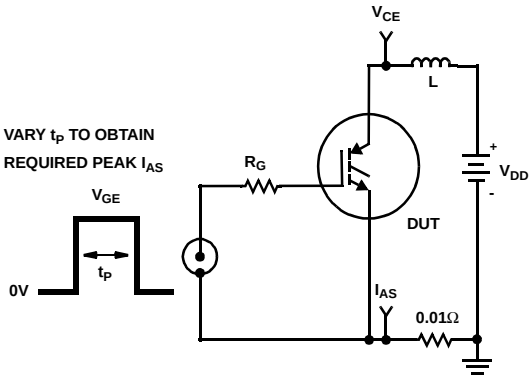


Figure 19. Unclamped Energy Test Circuit

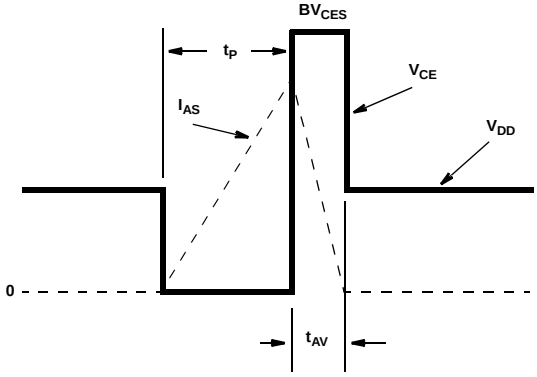


Figure 20. Unclamped Energy Waveforms

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SPICE Thermal Model

REV 25 April 2002

ISL9V2040D3S, ISL9V2040S3S, ISL9V2040P3

CTHERM1 th 6 1.3e -2
CTHERM2 6 5 8.8e -4
CTHERM3 5 4 8.8e -3
CTHERM4 4 3 3.9e -1
CTHERM5 3 2 3.6e -1
CTHERM6 2 tl 1.9e -1

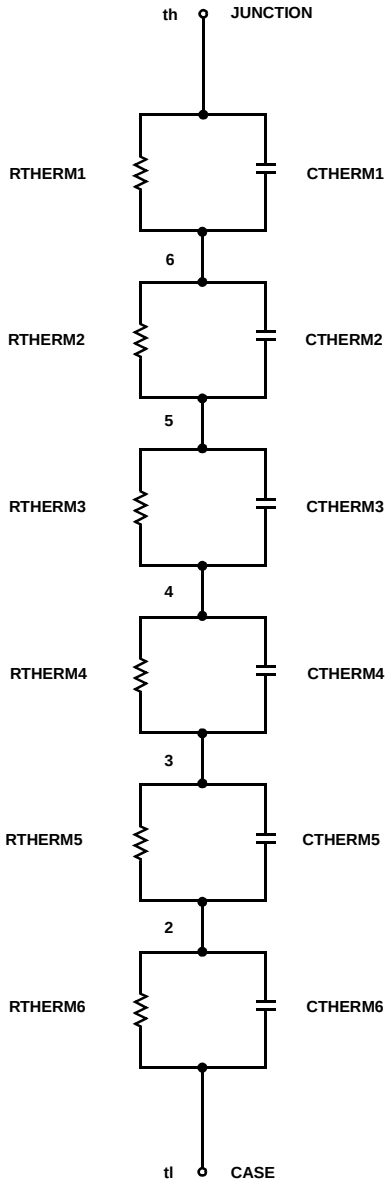
RTHERM1 th 6 1.2e -1
RTHERM2 6 5 3.2e -1
RTHERM3 5 4 1.7e -1
RTHERM4 4 3 1.2e -1
RTHERM5 3 2 1.3e -1
RTHERM6 2 tl 2.5e -1

SABER Thermal Model

SABER thermal model
ISL9V2040D3S, ISL9V2040S3S, ISL9V2040P3

```
template thermal_model th tl
thermal_c th, tl
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ctherm.ctherm1 th 6 = 1.3e -3
ctherm.ctherm2 6 5 = 8.8e -4
ctherm.ctherm3 5 4 = 8.8e -3
ctherm.ctherm4 4 3 = 3.9e -1
ctherm.ctherm5 3 2 = 3.6e -1
ctherm.ctherm6 2 tl = 1.9e -1

rtherm.rtherm1 th 6 = 1.2e -1
rtherm.rtherm2 6 5 = 3.2e -1
rtherm.rtherm3 5 4 = 1.7e -1
rtherm.rtherm4 4 3 = 1.2e -1
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rtherm.rtherm6 2 tl = 2.5e -1
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Datasheet Identification	Product Status	Definition
Advance Information	Formative / In Design	Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	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	Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.
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