October 2004

ISL9V5036S3S / ISL9V5036P3 / ISL9V5036S3

EcoSPARK^{TM} 500mJ, 360V, N-Channel Ignition IGBT

General Description

The ISL9V5036S3S, ISL9V5036P3, and ISL9V5036S3 are the next generation IGBTs that offer outstanding SCIS capability in the D²-Pak (TO-263) and TO-220 plastic package. These devices are intended for use in automotive ignition circuits, specifically as 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 49443

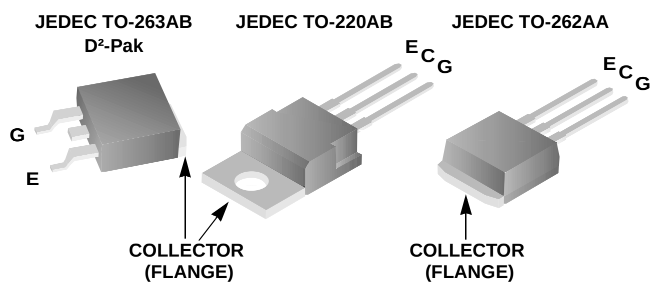
Applications

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

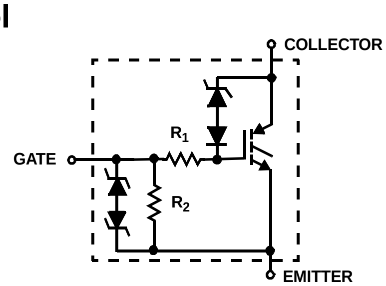
Features

- Industry Standard D^2-Pak package
- SCIS Energy = 500mJ at T_J = 25^{o}C
- 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)	390	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} = 38.5A, L = 670 µHy	500	mJ
$E_{SCIS150}$	At Starting T_J = 150°C, I_{SCIS} = 30A, L = 670 µHy	300	mJ
I_{C25}	Collector Current Continuous, At T_C = 25°C, See Fig 9	46	A
I_{C110}	Collector Current Continuous, At T_C = 110°C, See Fig 9	31	A
V_{GEM}	Gate to Emitter Voltage Continuous	±10	V
P_D	Power Dissipation Total T_C = 25°C	250	W
	Power Dissipation Derating T_C > 25°C	1.67	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

Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
V5036S	ISL9V5036S3ST	TO-263AB	330mm	24mm	800
V5036P	ISL9V5036P3	TO-220AA	Tube	N/A	50
V5036S	ISL9V5036S3	TO-262AA	Tube	N/A	50
V5036S	ISL9V5036S3S	TO-263AB	Tube	N/A	50

Electrical Characteristics T_A = 25°C unless otherwise noted

Off State Characteristics

Symbol	Parameter	Test Conditions		Min	Typ	Max	Units
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		330	360	390	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		360	390	420	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			-	75	-	Ω
R_2	Gate to Emitter Resistance			10K	-	30K	Ω

On State Characteristics

Symbol	Parameter	Test Conditions		Min	Typ	Max	Units
$V_{CE(SAT)}$	Collector to Emitter Saturation Voltage	I_C = 10A, V_{GE} = 4.0V	T_C = 25°C, See Fig. 4	-	1.17	1.60	V
$V_{CE(SAT)}$	Collector to Emitter Saturation Voltage	I_C = 15A, V_{GE} = 4.5V	T_C = 150°C	-	1.50	1.80	V

Dynamic Characteristics

Symbol	Parameter	Test Conditions		Min	Typ	Max	Units
$Q_{G(ON)}$	Gate Charge	I_C = 10A, V_{CE} = 12V, V_{GE} = 5V, See Fig. 14		-	32	-	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	-	3.0	-	V

Switching Characteristics

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
$t_{d(ON)R}$	Current Turn-On Delay Time-Resistive	V_{CE} = 14V, R_L = 1Ω, V_{GE} = 5V, R_G = 1KΩ T_J = 25°C, See Fig. 12	-	0.7	4	µs
t_{rR}	Current Rise Time-Resistive		-	2.1	7	µs
$t_{d(OFF)L}$	Current Turn-Off Delay Time-Inductive	V_{CE} = 300V, L = 2mH, V_{GE} = 5V, R_G = 1KΩ T_J = 25°C, See Fig. 12	-	10.8	15	µs
t_{fL}	Current Fall Time-Inductive		-	2.8	15	µs
SCIS	Self Clamped Inductive Switching	T_J = 25°C, L = 670 µH, R_G = 1KΩ, V_{GE} = 5V, See Fig. 1 & 2	-	-	500	mJ

Thermal Characteristics

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
$R_{\theta JC}$	Thermal Resistance Junction-Case	TO-263, TO-220, TO-262	-	-	0.6	°C/W

Typical Characteristics

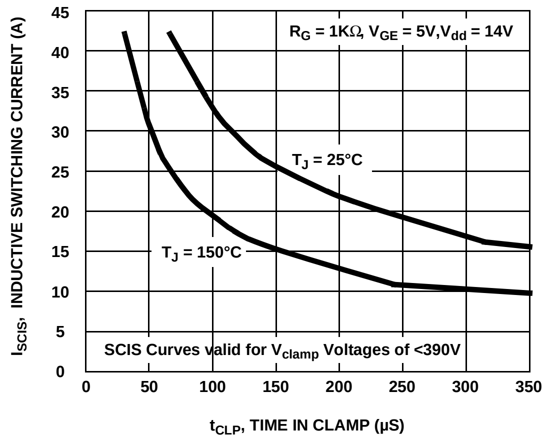


Figure 1. Self Clamped Inductive Switching Current vs Time in Clamp

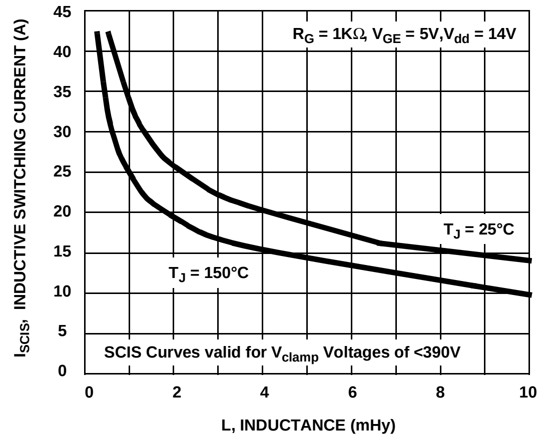


Figure 2. Self Clamped Inductive Switching Current vs Inductance

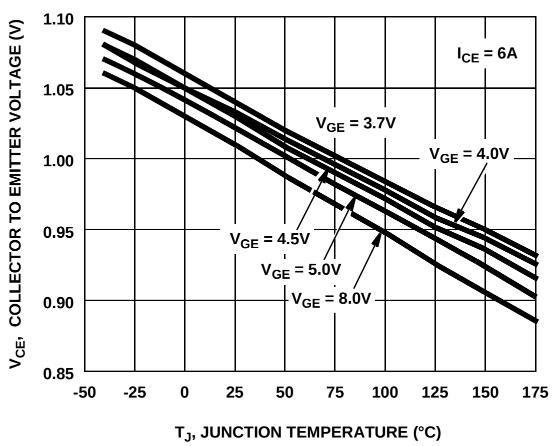


Figure 3. Collector to Emitter On-State Voltage vs Junction Temperature

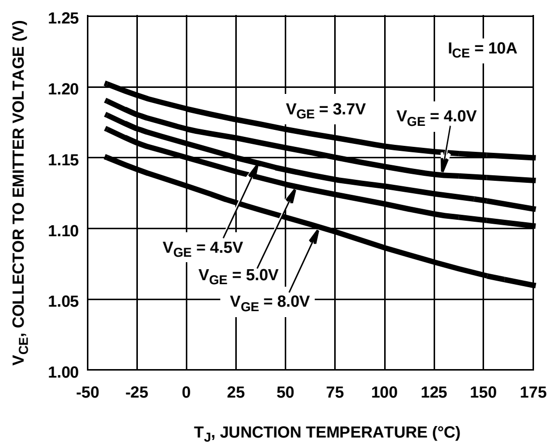


Figure 4. Collector to Emitter On-State Voltage vs Junction Temperature

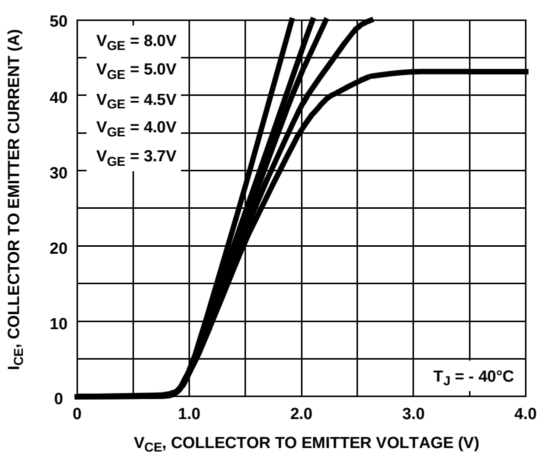


Figure 5. Collector Current vs Collector to Emitter On-State Voltage

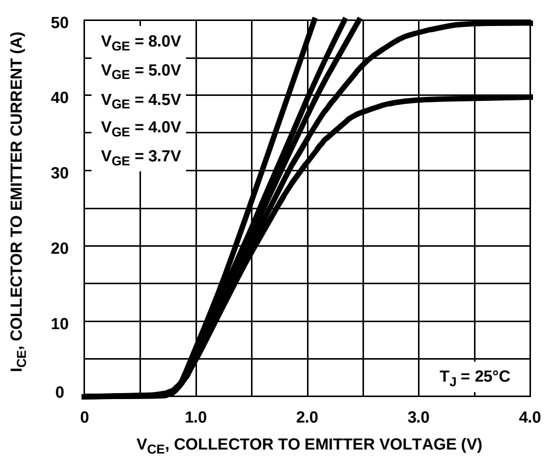


Figure 6. Collector Current vs Collector to Emitter On-State Voltage

Typical Characteristics (Continued)

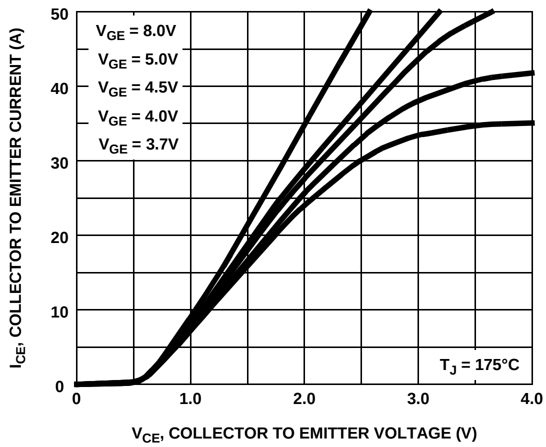


Figure 7. Collector to Emitter On-State Voltage vs Collector Current

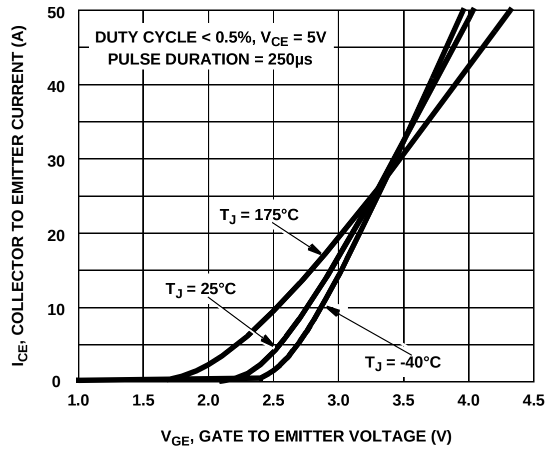


Figure 8. Transfer Characteristics

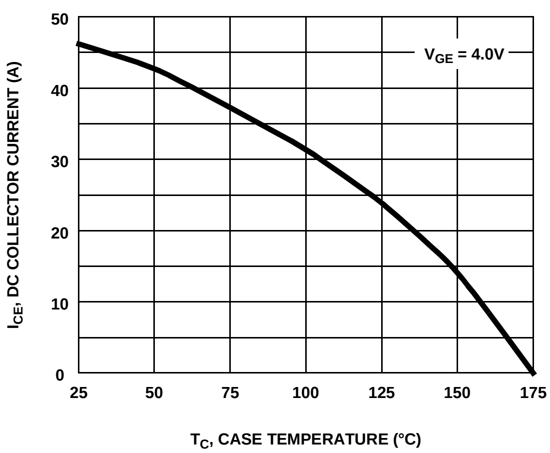


Figure 9. DC Collector Current vs Case Temperature

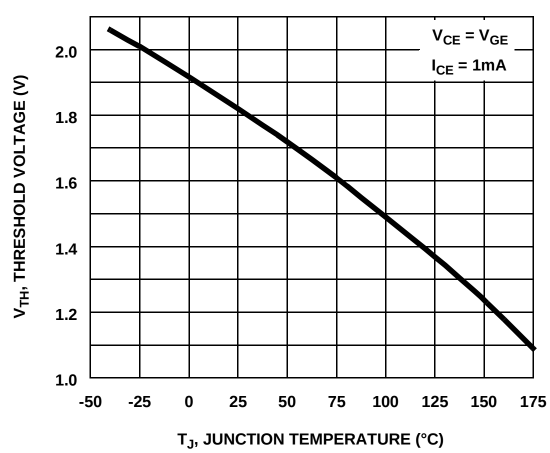


Figure 10. Threshold Voltage vs Junction Temperature

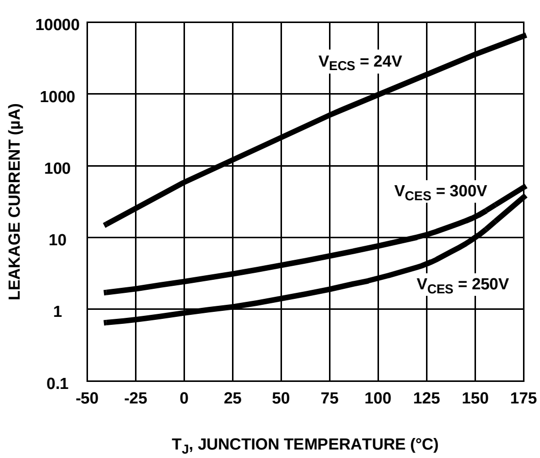


Figure 11. Leakage Current vs Junction Temperature

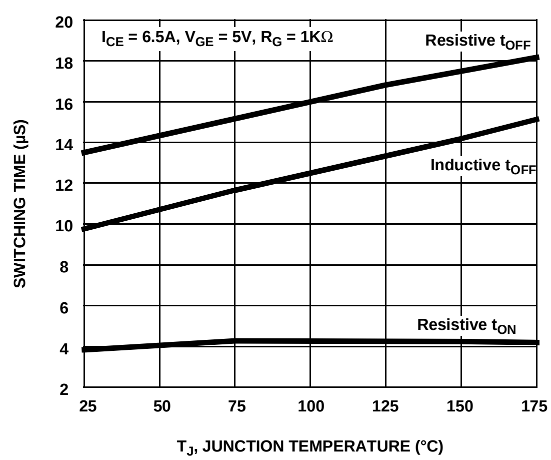


Figure 12. Switching Time vs Junction Temperature

Typical Characteristics (Continued)

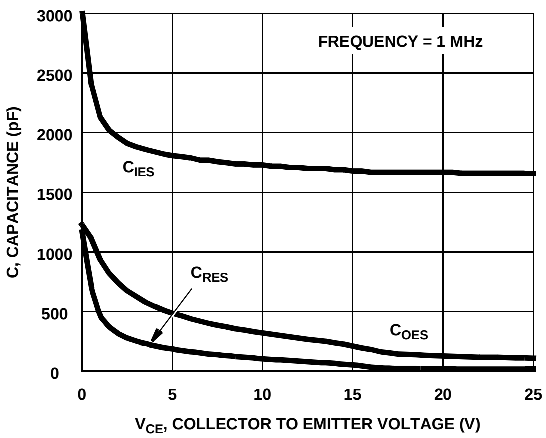


Figure 13. Capacitance vs Collector to Emitter Voltage

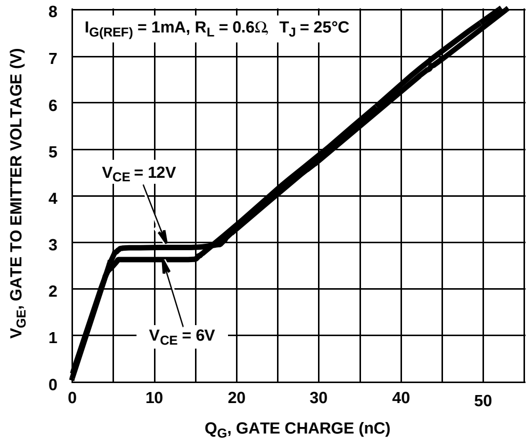


Figure 14. Gate Charge

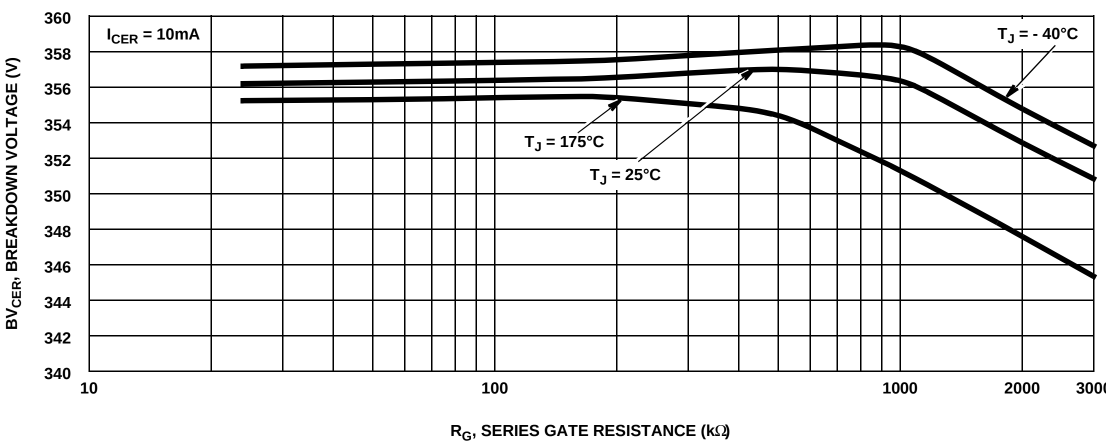


Figure 15. Breakdown Voltage vs Series Gate Resistance

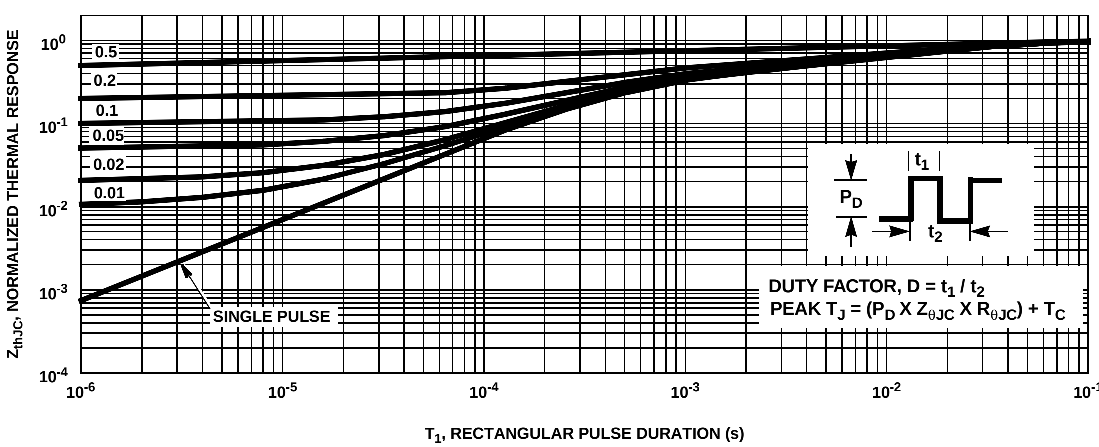


Figure 16. IGBT Normalized Transient Thermal Impedance, Junction to Case

Test Circuits and Waveforms

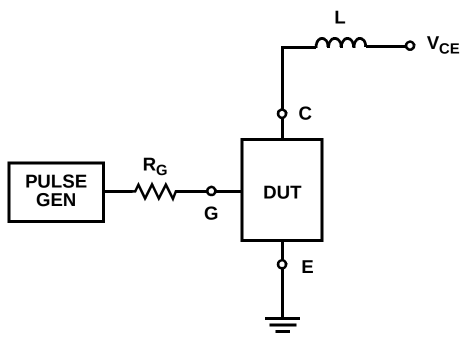


Figure 17. Inductive Switching Test Circuit

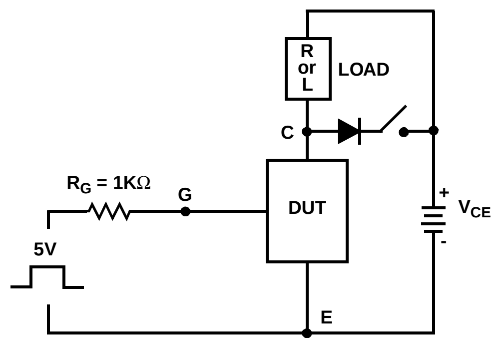


Figure 18. t_{ON} and t_{OFF} Switching Test Circuit

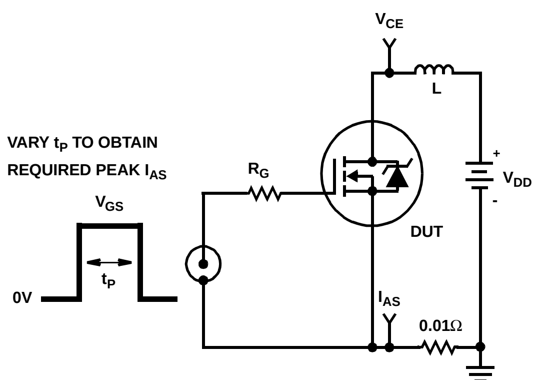


Figure 19. Energy Test Circuit

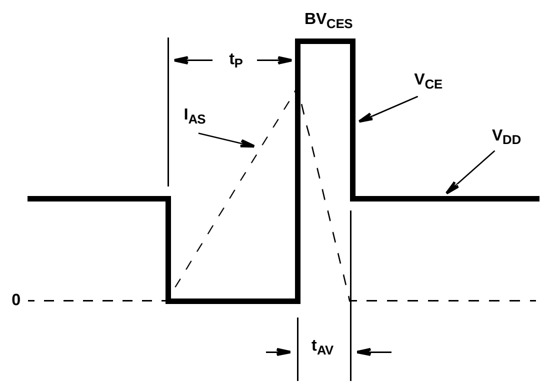


Figure 20. Energy Waveforms

SPICE Thermal Model

REV 1 May 2002

ISL9V5036S3S / ISL9V3536P3 / ISL9V5036S3

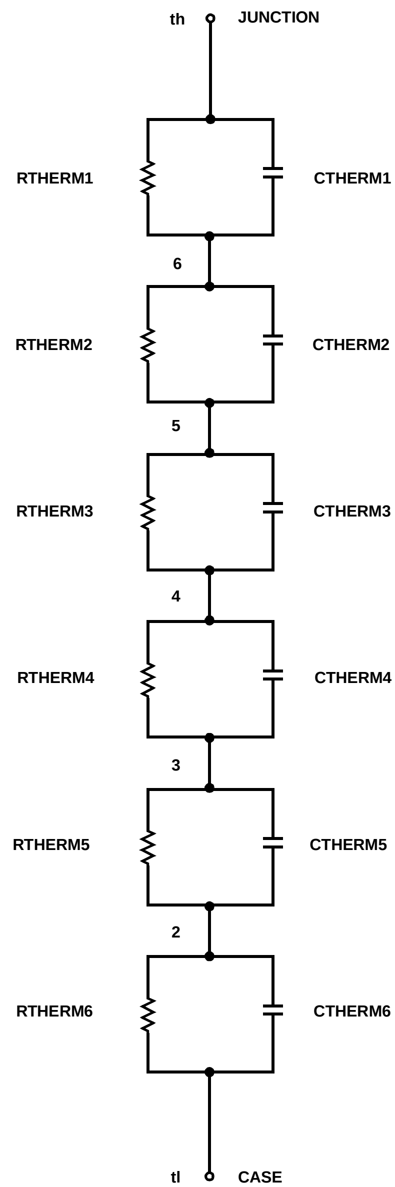
CTHERM1 th 6 4.0e2
CTHERM2 6 5 3.6e-3
CTHERM3 5 4 4.9e-2
CTHERM4 4 3 3.2e-1
CTHERM5 3 2 3.0e-1
CTHERM6 2 tl 1.6e-2

RTHERM1 th 6 1.0e-2
RTHERM2 6 5 1.4e-1
RTHERM3 5 4 1.0e-1
RTHERM4 4 3 9.0e-2
RTHERM5 3 2 9.4e-2
RTHERM6 2 tl 1.9e-2

SABER Thermal Model

SABER thermal model
ISL9V5036S3S / ISL9V5036P3 / ISL9V5036S3
template thermal_model th tl
thermal_c th, tl
{
ctherm.ctherm1 th 6 = 4.0e2
ctherm.ctherm2 6 5 = 3.6e-3
ctherm.ctherm3 5 4 = 4.9e-2
ctherm.ctherm4 4 3 = 3.2e-1
ctherm.ctherm5 3 2 = 3.0e-1
ctherm.ctherm6 2 tl = 1.6e-2

rtherm.rtherm1 th 6 = 1.0e-2
rtherm.rtherm2 6 5 = 1.4e-1
rtherm.rtherm3 5 4 = 1.0e-1
rtherm.rtherm4 4 3 = 9.0e-2
rtherm.rtherm5 3 2 = 9.4e-2
rtherm.rtherm6 2 tl = 1.9e-2
}



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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.

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