

HGTP14N44G3VL / HGT1S14N44G3VLS

300mJ, 440V, N-Channel Ignition IGBT

General Description

This N-Channel IGBT is a MOS gated, logic level device which is intended to be used as an ignition coil driver in automotive ignition circuits. Unique features include an active voltage clamp between the collector and the gate and ESD protection for the logic level gate. Some specifications are unique to this automotive application and are intended to assure device survival in this harsh environment.

Formerly Developmental Type 49238

Applications

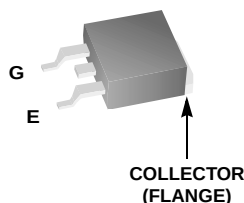
- Automotive Ignition Coil Driver Circuits
- Coil-On Plug Applications

Features

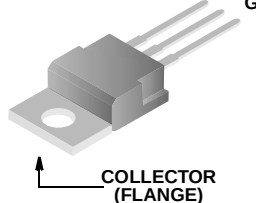
- Logic Level Gate Drive
- Internal Voltage Clamp
- ESD Gate Protection
- Max $T_J = 175^{\circ}\text{C}$
- SCIS Energy = 300mJ at $T_J = 25^{\circ}\text{C}$

Package

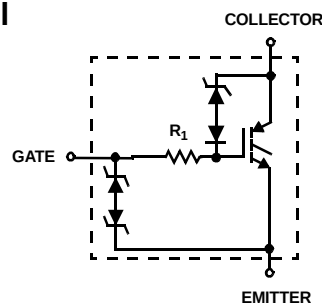
JEDEC TO-263AB
D²-Pak



JEDEC TO-220AB
E C G



Symbol



Device Maximum Ratings $T_A = 25^{\circ}\text{C}$ unless otherwise noted

Symbol	Parameter	Ratings	Units
BV_{CES}	Collector to Emitter Breakdown Voltage ($I_C = 10\text{ mA}$)	490	V
E_{SCIS25}	Drain to Source Avalanche Energy at $L = 2.3\text{mH}$, $T_C = 25^{\circ}\text{C}$	300	mJ
I_{C25}	Collector Current Continuous, at $T_C = 25^{\circ}\text{C}$, $V_{GE} = 4.5\text{V}$	27	A
I_{C90}	Collector Current Continuous, at $T_C = 90^{\circ}\text{C}$, $V_{GE} = 4.5\text{V}$	21	A
V_{GES}	Gate to Emitter Voltage Continuous	± 10	V
V_{GEM}	Gate to Emitter Voltage Pulsed	± 12	V
I_{CO}	$L = 2.3\text{mH}$, $T_C = 25^{\circ}\text{C}$	20	A
I_{CO}	$L = 2.3\text{mH}$, $T_C = 150^{\circ}\text{C}$	15	A
P_D	Power Dissipation Total $T_C = 25^{\circ}\text{C}$	231	W
	Power Dissipation Derating $T_C > 25^{\circ}\text{C}$	1.54	W/ $^{\circ}\text{C}$
T_J, T_{STG}	Operating and 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 Ω	6	KV

Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
14N44GV	HGT1S14N44G3VLT	TO-263AB	24mm	24mm	800 units
14N44GV	HGT1S14N44G3VLS	TO-263AB	Tube	N/A	50 units
14N44GV	HGTP14N44G3VL	TO-220AB	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_{CES}	Collector to Emitter Breakdown Voltage	$I_C = 2\text{mA}$, $V_{GE} = 0$	$T_C = -40^\circ\text{C}$ to 175°C	400	-	480	V
BV_{CER}	Collector to Emitter Breakdown Voltage	$I_C = 10\text{mA}$, $R_G = 1\text{k}\Omega$	$T_C = 150^\circ\text{C}$	390	-	470	V
BV_{ECS}	Emitter to Collector Breakdown Voltage	$I_C = 1\text{mA}$	$T_C = 25^\circ\text{C}$	24	-	-	V
BV_{GES}	Gate to Emitter Breakdown Voltage	$I_{GES} = \pm 1\text{mA}$		± 14	-	-	V
I_{CES}	Collector to Emitter Leakage Current	$V_{CE} = 300\text{V}$,	$T_C = 25^\circ\text{C}$	-	-	10	μA
			$T_C = 150^\circ\text{C}$	-	-	250	μA
I_{GES}	Gate to Emitter Leakage Current	$V_{GE} = \pm 10\text{V}$	$T_C = 25^\circ\text{C}$	-	-	± 5	μA
R_1	Series Gate Resistance			-	1000	-	Ω

On State Characteristics

$V_{CE(\text{SAT})}$	Collector to Emitter Saturation Voltage	$I_C = 8\text{A}$, $V_{GE} = 4.5\text{V}$	$T_C = 25^\circ\text{C}$	-	1.3	1.9	V
			$T_C = 150^\circ\text{C}$	-	1.4	2.2	V
$V_{GE(\text{TH})}$	Gate to Emitter Threshold Voltage	$I_C = 1\text{mA}$, $V_{CE} = V_{GE}$	$T_C = -40^\circ\text{C}$	-	-	2.5	V
			$T_C = 150^\circ\text{C}$	0.6	-	-	V

Switching Characteristics

$t_{d(\text{off})}$	Current Turn-Off Delay Time-Inductive Load	$I_C = 7.5\text{A}$, $R_G = 1\text{k}\Omega$, $L = 1.0\text{mH}$, $V_{CL} = 300\text{V}$, $V_{GE} = 5\text{V}$, $T_C = 25^\circ\text{C}$, See Fig. 12		3	-	18	μs
t_f	Current Turn-Off Fall Time-Inductive Load	$I_C = 7.5\text{A}$, $R_G = 1\text{k}\Omega$, $L = 1.0\text{mH}$, $V_{CL} = 300\text{V}$, $V_{GE} = 5\text{V}$, $T_C = 25^\circ\text{C}$, See Fig. 12		3	-	15	μs
SCIS	Self Clamped Inductive Switching	$L = 2.3\text{mH}$, $V_{GE} = 5\text{V}$, See Fig. 1 & 2	$T_C = 25^\circ\text{C}$	20	-	-	A
			$T_C = 150^\circ\text{C}$	15	-	-	A

Thermal Characteristics

$R_{\theta\text{JC}}$	Thermal Resistance Junction to Case		-	-	0.70	$^\circ\text{C/W}$
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Typical Performance Curves (Continued)

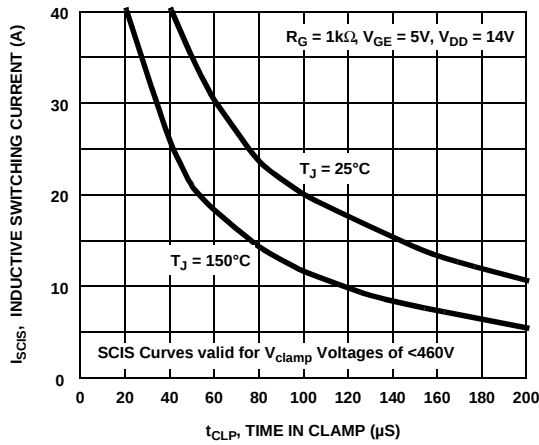


Figure 1. Self Clamped Inductive Switching Current vs Time

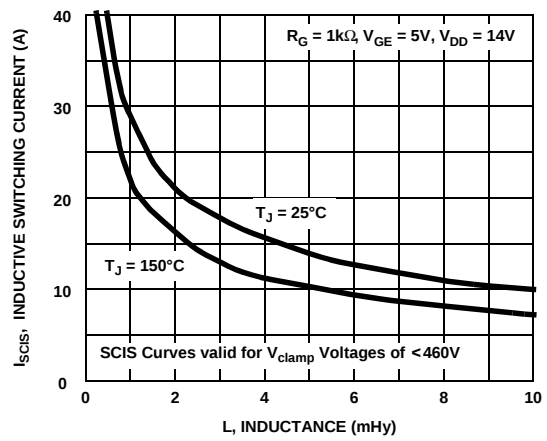


Figure 2. Self Clamped Inductive Switching Current vs Inductance

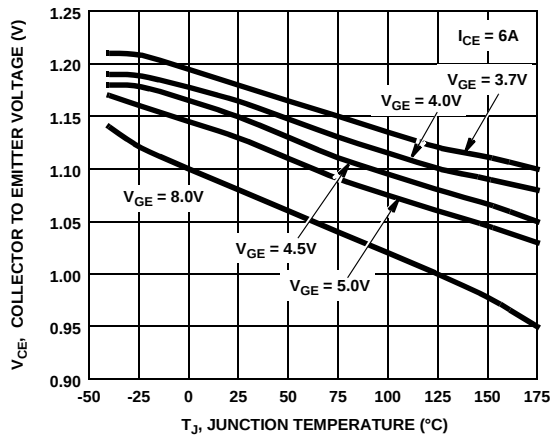


Figure 3. Collector to Emitter On-State Voltage vs Junction Temperature

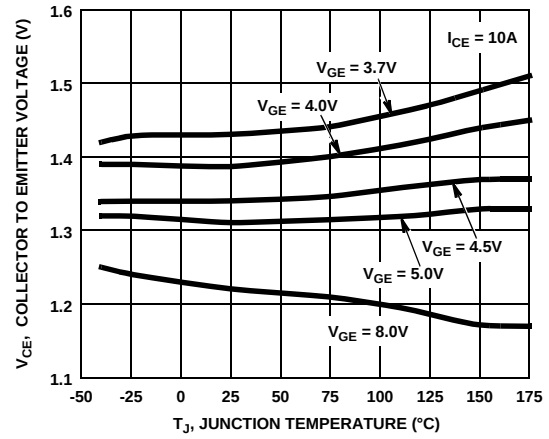


Figure 4. Collector to Emitter On-State Voltage vs Junction Temperature

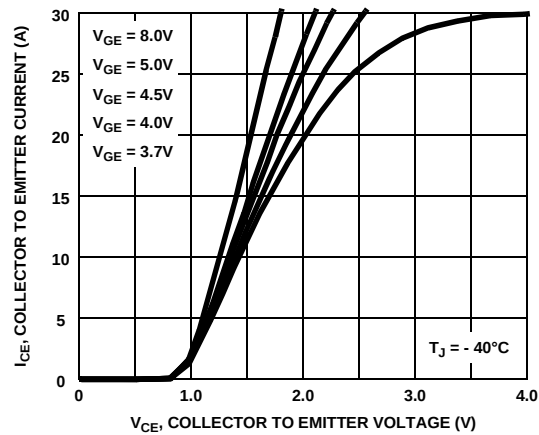


Figure 5. Collector to Emitter Current vs Collector to Emitter On-State Voltage

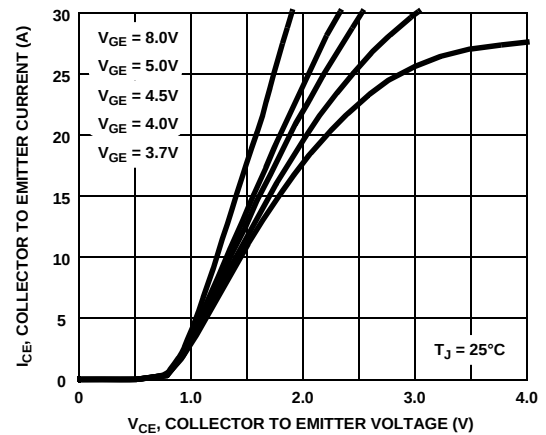


Figure 6. Collector to Emitter Current vs Collector to Emitter On-State Voltage

Typical Performance Curves (Continued)

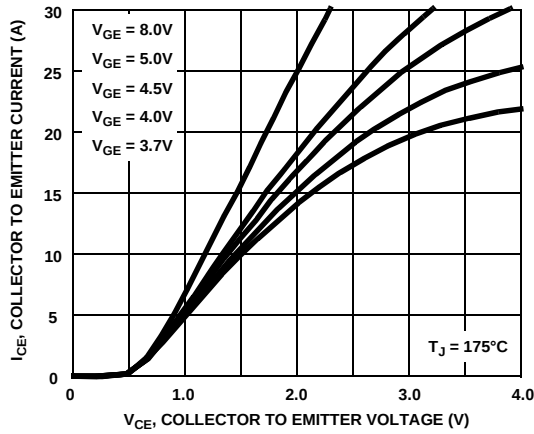


Figure 7. Collector to Emitter Current vs Collector to Emitter On-State Voltage

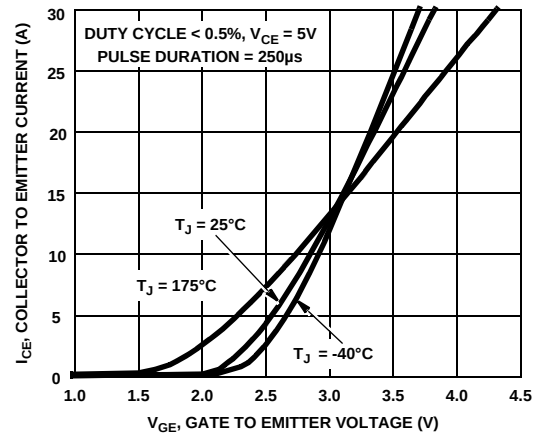


Figure 8. Transfer Characteristics

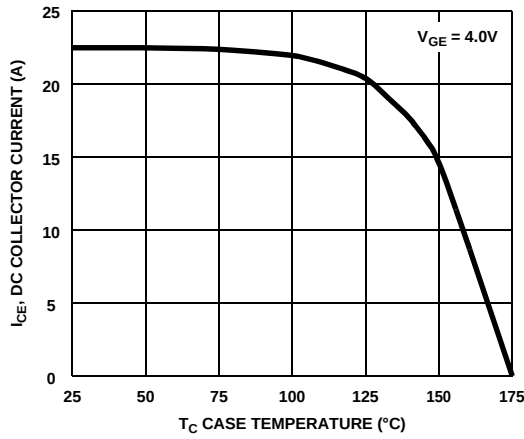


Figure 9. DC Collector Current vs Case Temperature

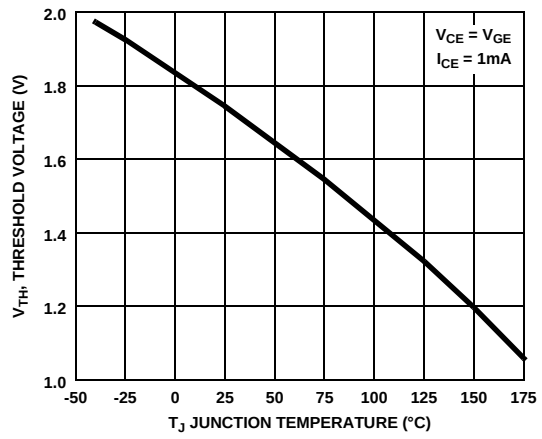


Figure 10. Threshold Voltage vs Junction Temperature

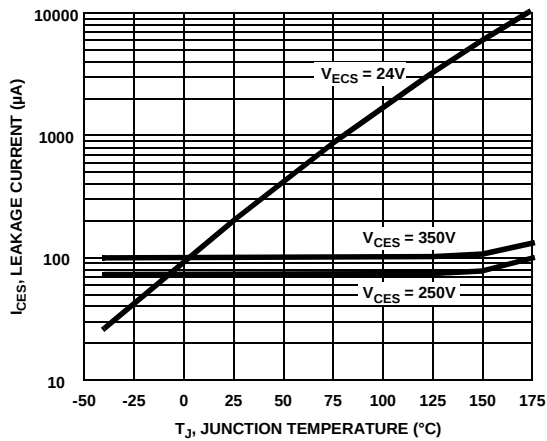


Figure 11. Leakage Current vs Junction Temperature

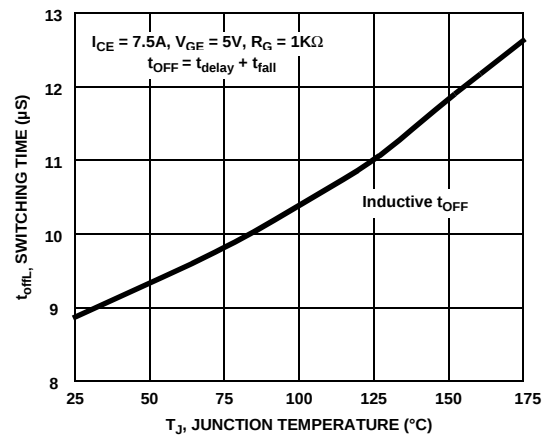


Figure 12. Switching Time vs Junction Temperature

Test Circuit and Waveforms

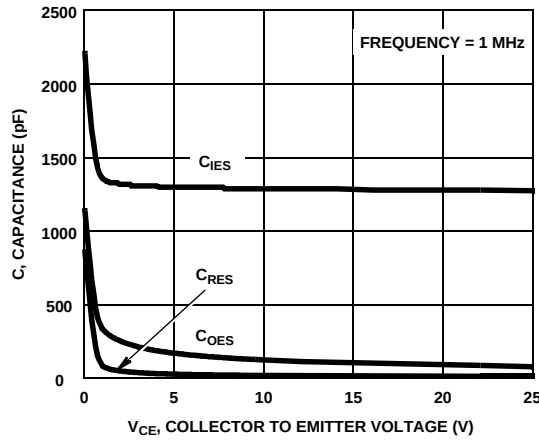


Figure 13. Capacitance vs Collector to Emitter Voltage

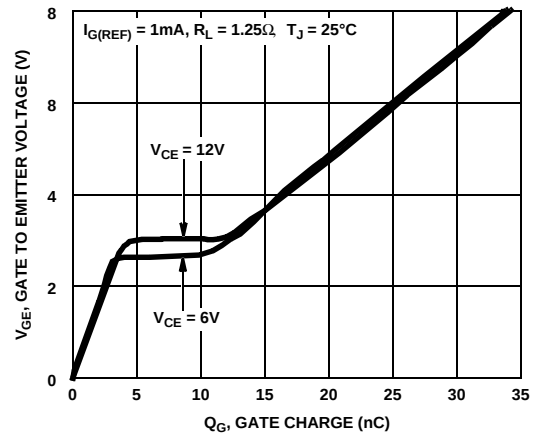


Figure 14. Gate Charge

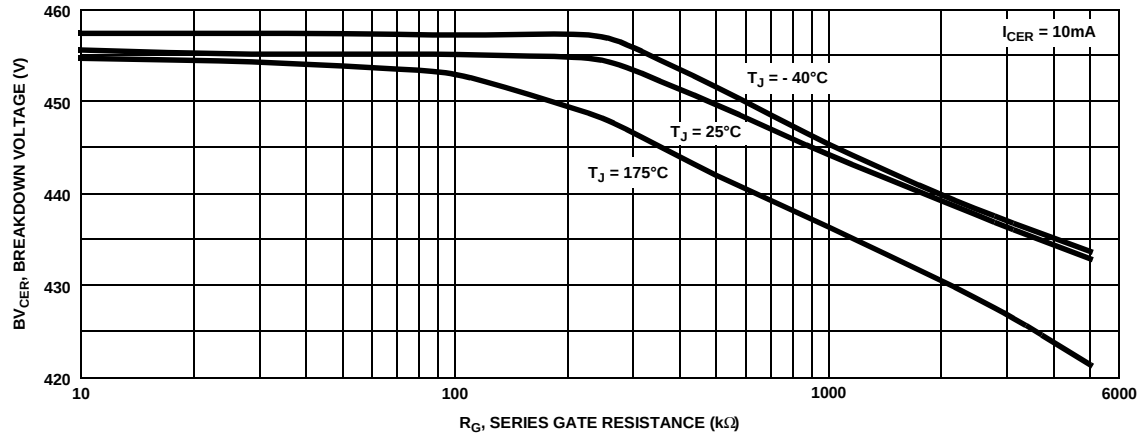


Figure 15. Breakdown Voltage vs Series Gate Resistance

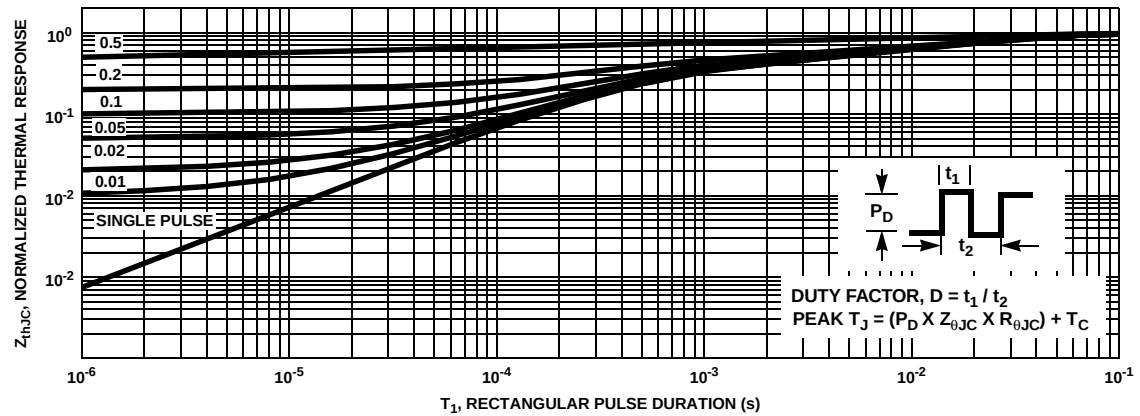


Figure 16. Normalized Transient Thermal Impedance

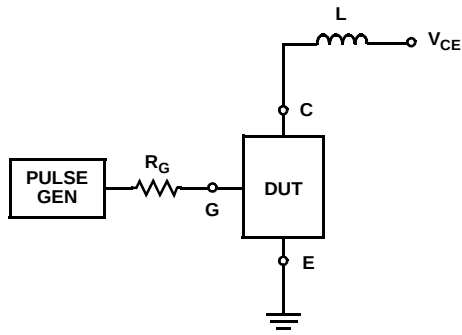


Figure 17. SCIS Test Circuit

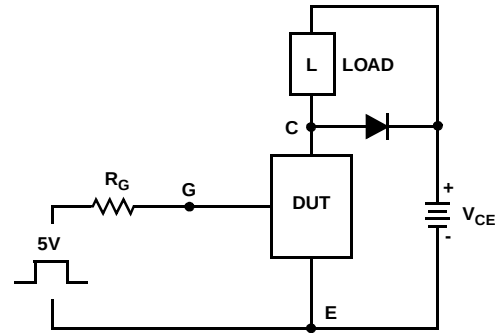


Figure 18. t_{OFF} Switching Test Circuit

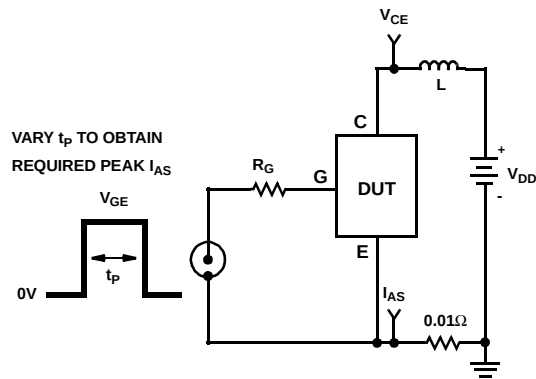


Figure 19. Unclamped Energy Test Circuit

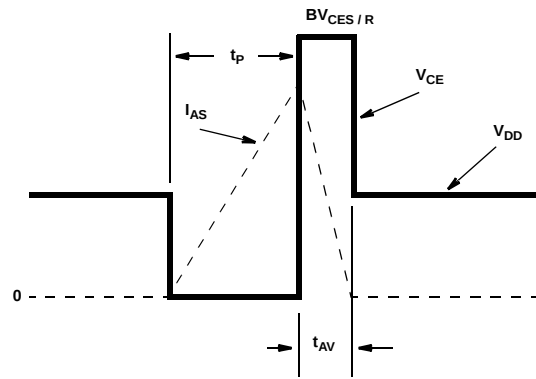


Figure 20. Unclamped Energy Waveforms

SPICE Thermal Model

REV April 2002

HGTP14N44G3VL / HGT1S14N44G3VLS

CTHERM1 th 6 3.2e-3
CTHERM2 6 5 1.7e-2
CTHERM3 5 4 2.6e-2
CTHERM4 4 3 4.8e-1
CTHERM5 3 2 1.8e-1
CTHERM6 2 tl 7.2e-1

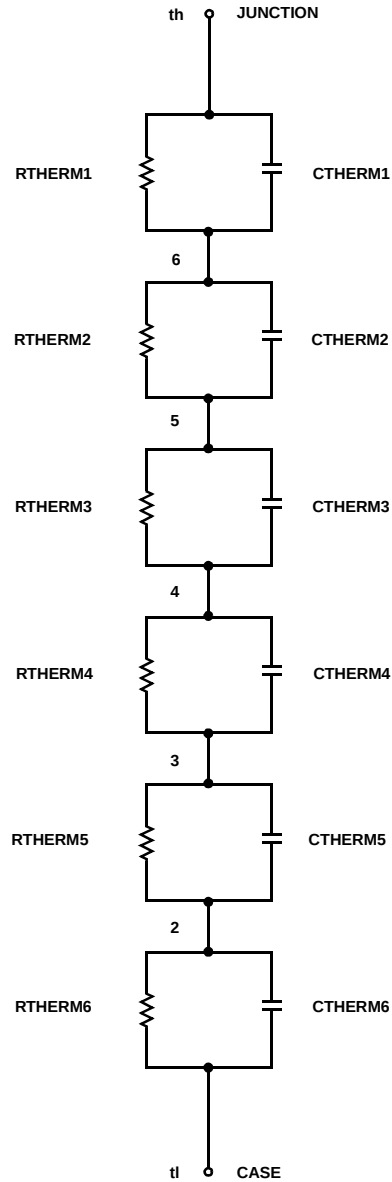
RTHERM1 th 6 6.8e-2
RTHERM2 6 5 1.3e-1
RTHERM3 5 4 1.0e-1
RTHERM4 4 3 6.0e-2
RTHERM5 3 2 1.4e-1
RTHERM6 2 tl 3.6e-2

SABER Thermal Model

SABER thermal model
HGTP14N44G3VL / HGT1S14N44G3VLS
template thermal_model th tl
thermal_c th, tl

```
{
  ctherm.ctherm1 th 6 = 3.2e-3
  ctherm.ctherm2 6 5 = 1.7e-2
  ctherm.ctherm3 5 4 = 2.6e-2
  ctherm.ctherm4 4 3 = 4.8e-1
  ctherm.ctherm5 3 2 = 1.8e-1
  ctherm.ctherm6 2 tl = 7.2e-2
```

```
rtherm.rtherm1 th 6 = 6.8e-2
rtherm.rtherm2 6 5 = 1.3e-1
rtherm.rtherm3 5 4 = 1.0e-1
rtherm.rtherm4 4 3 = 6.0e-2
rtherm.rtherm5 3 2 = 1.4e-1
rtherm.rtherm6 2 tl = 3.6e-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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