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FDG6318PZ

Dual P-Channel, Digital FET

General Description

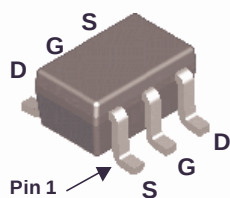
These dual P-Channel logic level enhancement mode MOSFET are produced using Fairchild Semiconductor's especially tailored to minimize on-state resistance. This device has been designed especially for bipolar digital transistors and small signal MOSFETS

Applications

- Battery management

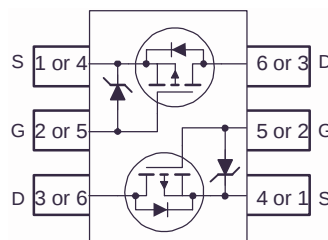
Features

- 0.5A, -20V. $r_{DS(ON)} = 780m\Omega$ (Max) @ $V_{GS} = -4.5V$
 $r_{DS(ON)} = 1200m\Omega$ (Max) @ $V_{GS} = -2.5V$
- Very low level gate drive requirements allowing direct operation in 3V circuits ($V_{GS(TH)} < 1.5V$).
- Gate-Source Zener for ESD ruggedness (>1.4kV Human Body Model).
- Compact industry standard SC-70-6 surface mount package.



SC70-6

The pinouts are symmetrical; pin1 and pin 4 are interchangeable.



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

Symbol	Parameter	Ratings	Units
V_{DSS}	Drain to Source Voltage	-20	V
V_{GS}	Gate to Source Voltage	± 12	V
I_D	Drain Current		
	Continuous ($T_C = 25^\circ\text{C}$, $V_{GS} = -4.5V$)	-0.5	A
	Continuous ($T_C = 100^\circ\text{C}$, $V_{GS} = -2.5V$)	-0.3	A
	Pulsed	Figure 4	
P_D	Power dissipation	0.3	W
	Derate above 25°C	2.4	mW/ $^\circ\text{C}$
T_J, T_{STG}	Operating and Storage Temperature	-55 to 150	$^\circ\text{C}$
ESD	Electrostatic Discharge Rating MIL-STD-883D Human Body Model (100pF / 1500 Ω)	1.4	kV

Thermal Characteristics

$R_{\theta JA}$	Thermal Resistance Junction to Ambient (Note 1)	415	$^\circ\text{C/W}$
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Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
.68	FDG6318PZ	SC70-6	7"	8 mm	3000

Electrical Characteristics $T_A = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
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Off Characteristics

B_{VDSS}	Drain to Source Breakdown Voltage	$I_D = -250\mu\text{A}$, $V_{GS} = 0\text{V}$	-20	-	-	V
I_{DSS}	Zero Gate Voltage Drain Current	$V_{GS} = -16\text{V}$, $V_{GS} = 0\text{V}$	-	-	-3	μA
I_{GSS}	Gate to Source Leakage Current	$V_{GS} = \pm 12\text{V}$, $V_{GS} = 0\text{V}$	-	-	± 10	μA

On Characteristics

$V_{GS(TH)}$	Gate to Source Threshold Voltage	$V_{GS} = V_{DS}$, $I_D = -250\mu\text{A}$	-0.65	-0.9	-1.5	V
$r_{DS(ON)}$	Drain to Source On Resistance	$I_D = -0.5\text{A}$, $V_{GS} = -4.5\text{V}$	-	580	780	$\text{m}\Omega$
		$I_D = -0.4\text{A}$, $V_{GS} = -2.5\text{V}$	-	910	1200	

Dynamic Characteristics

C _{ISS}	Input Capacitance	V _{DS} = -10V, V _{GS} = 0V, f = 1MHz		-	85.4	-	pF
C _{OSS}	Output Capacitance			-	24.9	-	pF
C _{RSS}	Reverse Transfer Capacitance			-	8.83	-	pF
Q _{g(TOT)}	Total Gate Charge at -4.5V	V _{GS} = 0V to -4.5V	V _{DD} = -10V I _D = -0.5A I _g = 1.0mA	-	1.08	1.62	nC
Q _{g(-2.5)}	Total Gate Charge at -2.5V	V _{GS} = 0V to -2.5V		-	0.67	1.0	nC
Q _{gs}	Gate to Source Gate Charge			-	0.21	-	nC
Q _{gd}	Gate to Drain “Miller” Charge			-	0.33	-	nC

Switching Characteristics ($V_{GS} = -4.5\text{V}$)

t_{ON}	Turn-On Time	$V_{DD} = -10\text{V}$, $I_D = -0.5\text{A}$ $V_{GS} = -4.5\text{V}$, $R_{GS} = 120\Omega$	-	-	35	ns
$t_{d(ON)}$	Turn-On Delay Time		-	10	-	ns
t_r	Rise Time		-	13	-	ns
$t_{d(OFF)}$	Turn-Off Delay Time		-	40	-	ns
t_f	Fall Time		-	24	-	ns
t_{OFF}	Turn-Off Time		-	-	96	ns

Drain-Source Diode Characteristics

V_{SD}	Source to Drain Diode Voltage	$I_{SD} = -0.5\text{A}$	-	-0.9	-1.2	V
t_{rr}	Reverse Recovery Time	$I_{SD} = -0.5\text{A}$, $dI_{SD}/dt = 100\text{A}/\mu\text{s}$	-	-	22	ns
Q_{RR}	Reverse Recovered Charge	$I_{SD} = -0.5\text{A}$, $dI_{SD}/dt = 100\text{A}/\mu\text{s}$	-	-	16	nC

Notes:

- $R_{\theta JA}$ is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the center drain pad. $R_{\theta JC}$ is guaranteed by design while $R_{\theta CA}$ is determined by user's board design. $R_{\theta JA} = 415^\circ\text{C/W}$ when mounted on a 1inch^2 copper pad.

Typical Characteristic $T_A = 25^\circ\text{C}$ unless otherwise noted

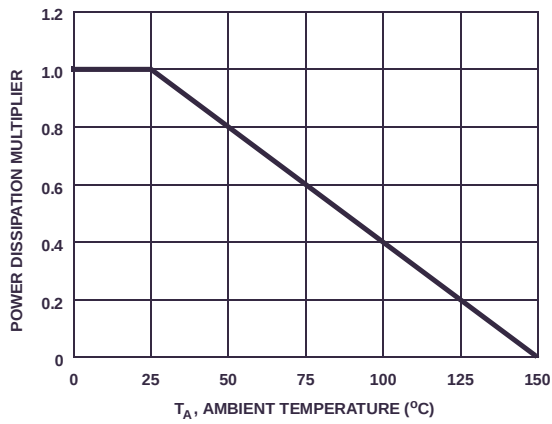


Figure 1. Normalized Power Dissipation vs Ambient Temperature

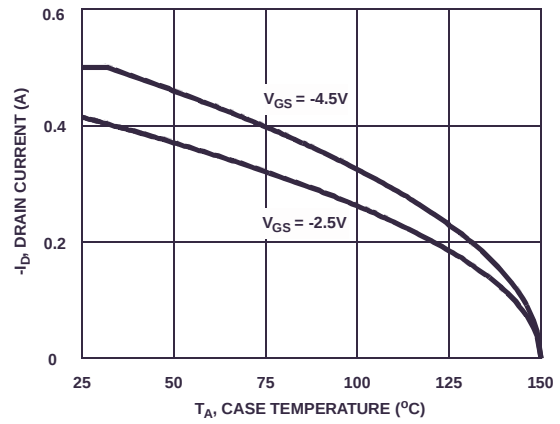


Figure 2. Maximum Continuous Drain Current vs Case Temperature

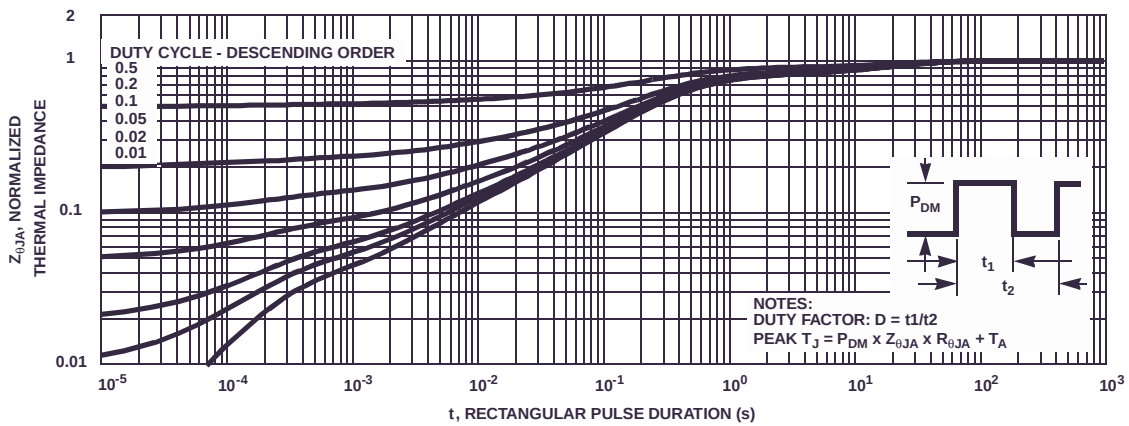


Figure 3. Normalized Maximum Transient Thermal Impedance

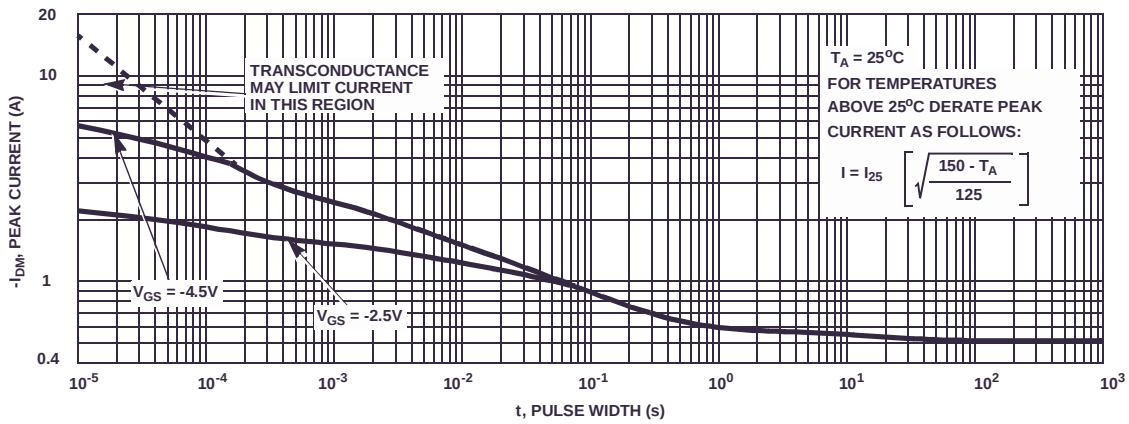


Figure 4. Peak Current Capability

Typical Characteristic (Continued) $T_A = 25^\circ\text{C}$ unless otherwise noted

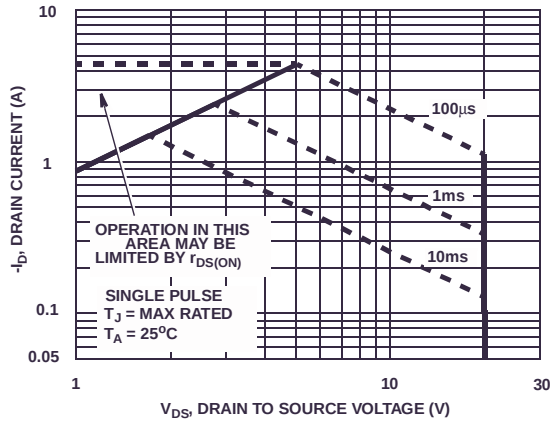


Figure 5. Forward Bias Safe Operating Area

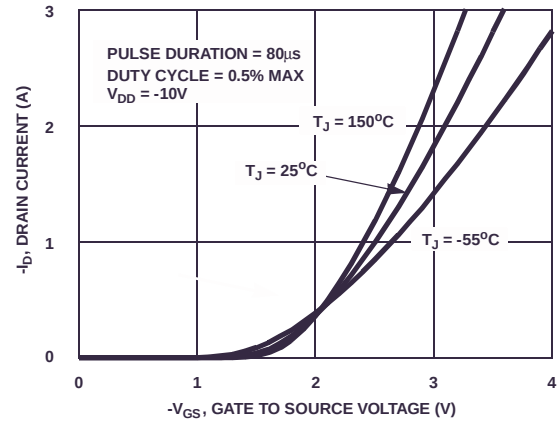


Figure 6. Transfer Characteristics

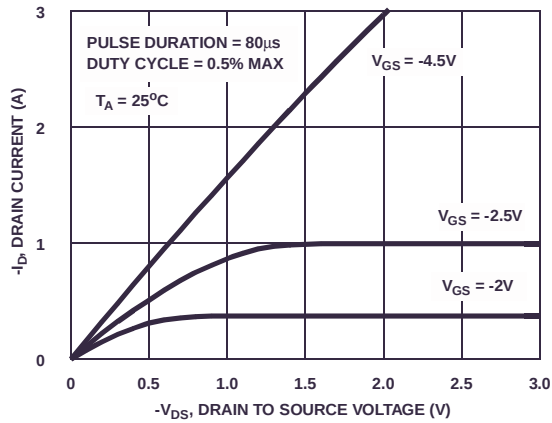


Figure 7. Saturation Characteristics

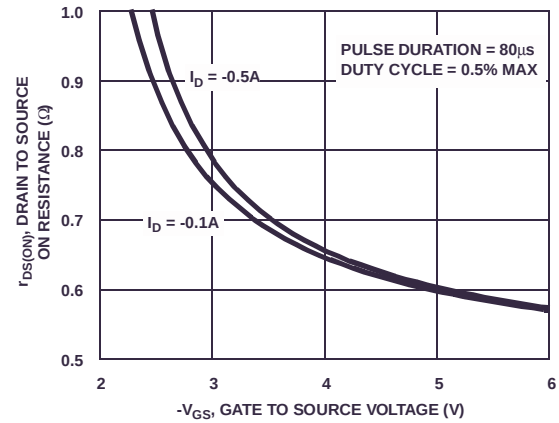


Figure 8. Drain to Source On Resistance vs Gate Voltage and Drain Current

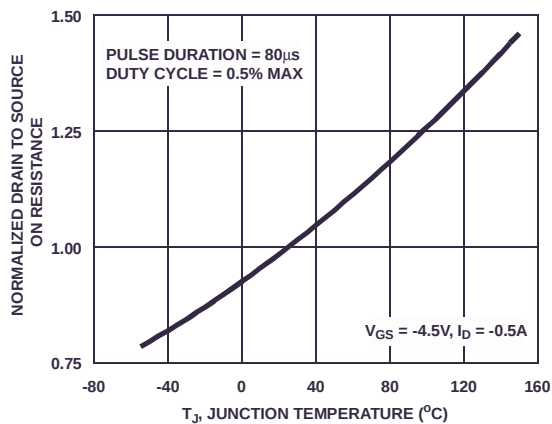


Figure 9. Normalized Drain to Source On Resistance vs Junction Temperature

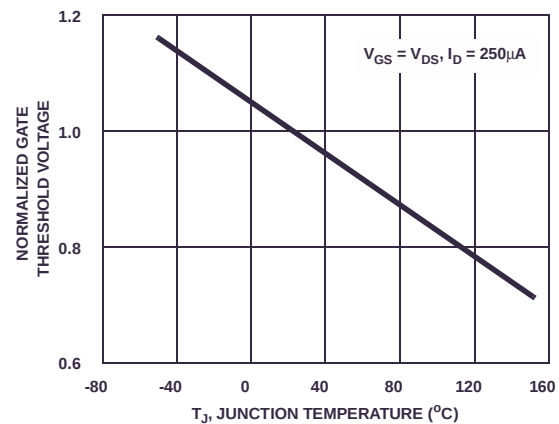


Figure 10. Normalized Gate Threshold Voltage vs Junction Temperature

Typical Characteristic (Continued) $T_A = 25^\circ\text{C}$ unless otherwise noted

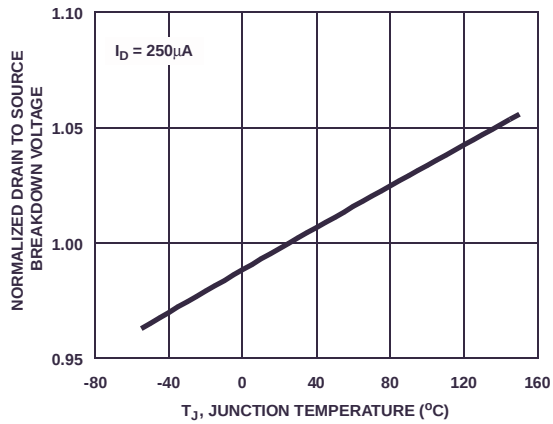


Figure 11. Normalized Drain to Source Breakdown Voltage vs Junction Temperature

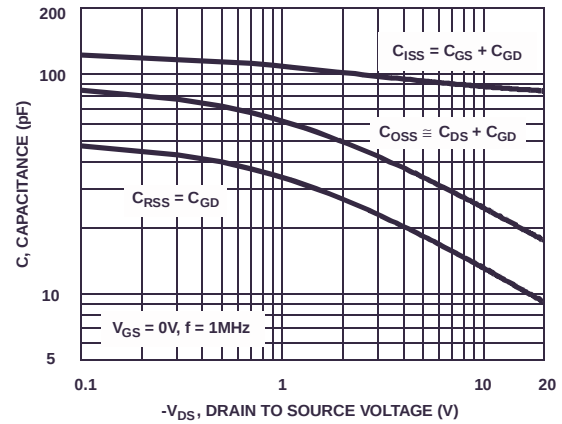


Figure 12. Capacitance vs Drain to Source Voltage

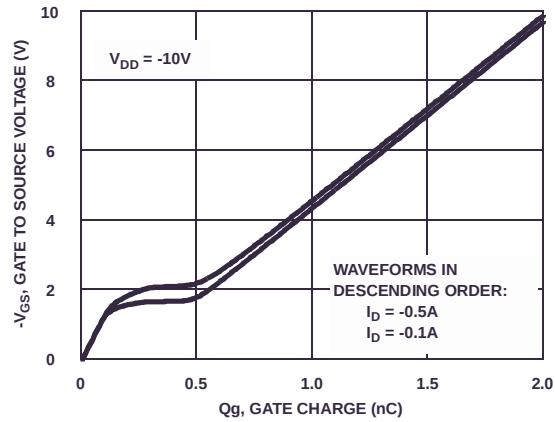


Figure 13. Gate Charge Waveforms for Constant Gate Currents

PSPICE Electrical Model

.SUBCKT FDG6318PZ 2 1 3 ; rev January 2003

CA 12 8 0.6e-10

CB 15 14 1.1e-10

CIN 6 8 0.75e-10

DBODY 5 7 DBODYMOD
DBREAK 7 11 DBREAKMOD
DPLCAP 10 6 DPLCAPMOD

EBREAK 5 11 17 18 -23.3

EDS 14 8 5 8 1

EGS 13 8 6 8 1

ESG 5 10 8 6 1

EVTHRES 6 21 19 8 1

EVTEMP 6 20 18 22 1

IT 8 17 1

LDRAIN 2 5 1e-9

LGATE 1 9 0.47e-9

LSOURCE 3 7 0.47e-9

MMED 16 6 8 8 MMEDMOD
MSTRO 16 6 8 8 MSTROMOD
MWEAK 16 21 8 8 MWEAKMOD

RBREAK 17 18 RBREAKMOD 1

RDRAIN 50 16 RDRAINMOD 280e-3

RGATE 9 20 12.4

RLDRAIN 2 5 10

RLGATE 1 9 4.7

RLSOURCE 3 7 4.7

RSLC1 5 51 RSLCMOD 1e-6

RSLC2 5 50 1e3

RSOURCE 8 7 RSOURCEMOD 190e-3

RVTHRES 22 8 RVTHRESMOD 1

RVTEMP 18 19 RVTEMPMOD 1

S1A 6 12 13 8 S1AMOD

S1B 13 12 13 8 S1BMOD

S2A 6 15 14 13 S2AMOD

S2B 13 15 14 13 S2BMOD

VBAT 22 19 DC 1

ESLC 51 50 VALUE={ (V(5,51)/ABS(V(5,51))) * (PWR(V(5,51)/(1e-6*20), 2.5)) }

.MODEL DBODYMOD D (IS = 7.7e-11 N=1.277 RS = 1e-3 TRS1 = 2.8e-1 TRS2 = 3e-4 XTI=0 IKF=0.5 CJO = 3.9e-11 TT=33e-9 M = 0.50)

.MODEL DBREAKMOD D (RS = 5.3e-1 TRS1 = 5.5e-3 TRS2 = -9e-5)

.MODEL DPLCAPMOD D (CJO = 0.5e-10 IS = 1e-30 N = 10 M = 0.55)

.MODEL MMEDMOD PMOS (VTO = -1.17 KP = 0.6 IS=1e-30 N = 10 TOX = 1 L = 1u W = 1u RG = 12.4)

.MODEL MSTROMOD PMOS (VTO = -1.45 KP = 1.5 IS = 1e-30 N = 10 TOX = 1 L = 1u W = 1u)

.MODEL MWEAKMOD PMOS (VTO = -0.99 KP = 0.05 IS = 1e-30 N = 10 TOX = 1 L = 1u W = 1u RG = 124 RS = 0.1)

.MODEL RBREAKMOD RES (TC1 = 5.5e-4 TC2 = -1e-7)

.MODEL RDRAINMOD RES (TC1 = 2.8e-3 TC2 = 4.9e-6)

.MODEL RSLCMOD RES (TC1 = 3.7e-3 TC2 = 7.8e-6)

.MODEL RSOURCEMOD RES (TC1 = 3e-3 TC2 = 5.2e-6)

.MODEL RVTHRESMOD RES (TC1 = 9e-4 TC2 = 3e-7)

.MODEL RVTEMPMOD RES (TC1 = -5.5e-4 TC2 = -1e-9)

.MODEL S1AMOD VSWITCH (RON = 1e-5 ROFF = 0.1 VON = 0.5 VOFF= 0.2)

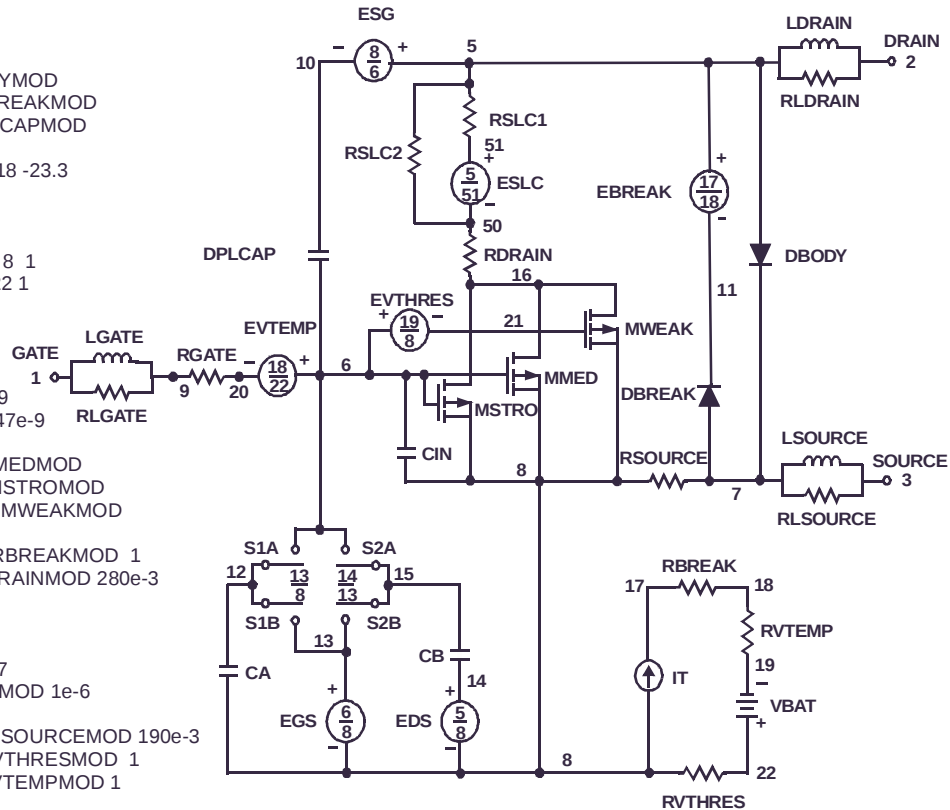
.MODEL S1BMOD VSWITCH (RON = 1e-5 ROFF = 0.1 VON = 0.2 VOFF= 0.5)

.MODEL S2AMOD VSWITCH (RON = 1e-5 ROFF = 0.1 VON = 0.4 VOFF= -0.1)

.MODEL S2BMOD VSWITCH (RON = 1e-5 ROFF = 0.1 VON = -0.1 VOFF= 0.4)

.ENDS

Note: For further discussion of the PSPICE model, consult **A New PSPICE Sub-Circuit for the Power MOSFET Featuring Global Temperature Options**; IEEE Power Electronics Specialist Conference Records, 1991, written by William J. Hepp and C. Frank Wheatley.



SPICE Thermal Model

REV January 2003
 FDG6318PZ_JA Junction Ambient
 Copper Area= 1sq.in

CTHERM1 Junction c2 0.17e-4
 CTHERM2 c2 c3 2.7e-4
 CTHERM3 c3 c4 5.5e-4
 CTHERM4 c4 c5 1.4e-3
 CTHERM5 c5 c6 2.2e-3
 CTHERM6 c6 c7 2.6e-3
 CTHERM7 c7 c8 6.6e-3
 CTHERM8 c8 Ambient 0.29

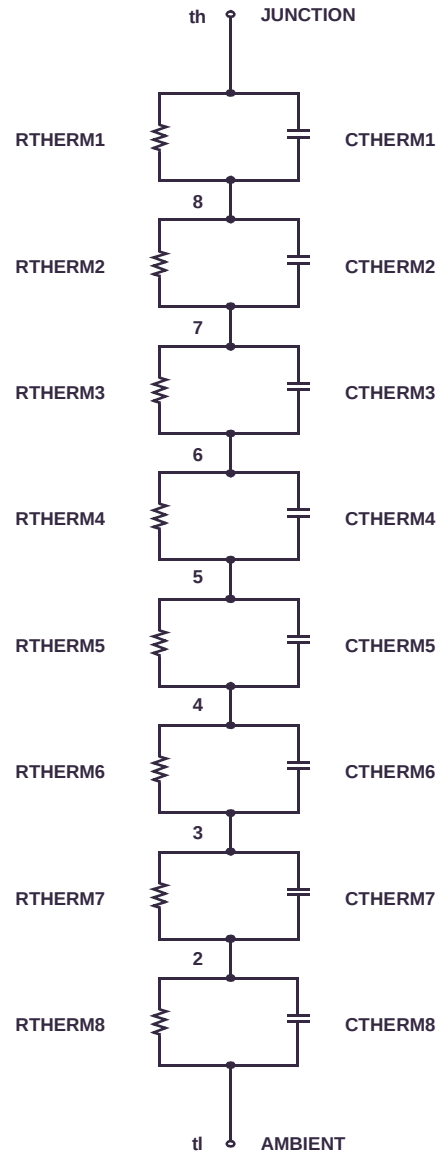
RTHERM1 Junction c2 11.2
 RTHERM2 c2 c3 11.5
 RTHERM3 c3 c4 12.5
 RTHERM4 c4 c5 27
 RTHERM5 c5 c6 81
 RTHERM6 c6 c7 88
 RTHERM7 c7 c8 92
 RTHERM8 c8 Ambient 93

SABER Thermal Model

SABER thermal model FDG6318PZ
 Copper Area= 1sq.in
 template thermal_model th tl
 thermal_c th, tl

```
{
  ctherm.ctherm1 th c2 = 0.17e-4
  ctherm.ctherm2 c2 c3 = 2.7e-4
  ctherm.ctherm3 c3 c4 = 5.5e-4
  ctherm.ctherm4 c4 c5 = 1.4e-3
  ctherm.ctherm5 c5 c6 = 2.2e-3
  ctherm.ctherm6 c6 c7 = 2.6e-3
  ctherm.ctherm7 c7 c8 = 6.6e-3
  ctherm.ctherm8 c8 tl = 0.29
```

```
rtherm.rtherm1 th c2 = 11.2
rtherm.rtherm2 c2 c3 = 11.5
rtherm.rtherm3 c3 c4 = 12.5
rtherm.rtherm4 c4 c5 = 27
rtherm.rtherm5 c5 c6 = 81
rtherm.rtherm6 c6 c7 = 88
rtherm.rtherm7 c7 c8 = 92
rtherm.rtherm8 c8 tl = 93
}
```



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