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## FDG6318PZ

### Dual P-Channel, Digital FET

#### General Description

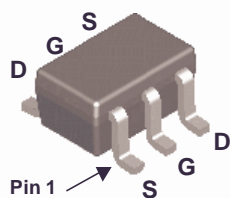
These dual P-Channel logic level enhancement mode MOSFET are produced using Fairchild Semiconductor's especially tailored to minimize on-state resistance. This device has been designed especially for bipolar digital transistors and small signal MOSFETS

#### Applications

- Battery management

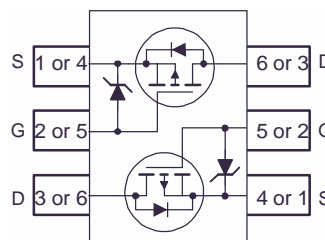
#### Features

- 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	$\pm 12$	V
$I_D$	Drain Current		
	Continuous ( $T_C = 25^\circ\text{C}$ , $V_{GS} = -4.5\text{V}$ )	-0.5	A
	Continuous ( $T_C = 100^\circ\text{C}$ , $V_{GS} = -2.5\text{V}$ )	-0.3	A
	Pulsed	Figure 4	
$P_D$	Power dissipation	0.3	W
	Derate above $25^\circ\text{C}$	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 $\Omega$ )	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	$V_{DS} = -16\text{V}$ , $V_{GS} = 0\text{V}$	-	-	-3	$\mu\text{A}$
$I_{GSS}$	Gate to Source Leakage Current	$V_{GS} = \pm 12\text{V}$ , $V_{DS} = 0\text{V}$	-	-	$\pm 10$	$\mu\text{A}$

**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	$V_{DS} = -10\text{V}$ , $V_{GS} = 0\text{V}$ , $f = 1\text{MHz}$	-	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	$V_{GS} = 0\text{V}$ to -4.5V	$V_{DD} = -10\text{V}$ $I_D = -0.5\text{A}$ $I_g = 1.0\text{mA}$	-	1.08	1.62	nC
$Q_{g(-2.5)}$	Total Gate Charge at -2.5V	$V_{GS} = 0\text{V}$ 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

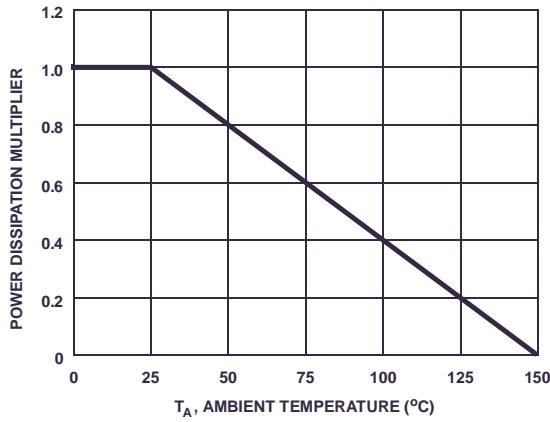
**Drain-Source Diode Characteristics**

$V_{SD}$	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

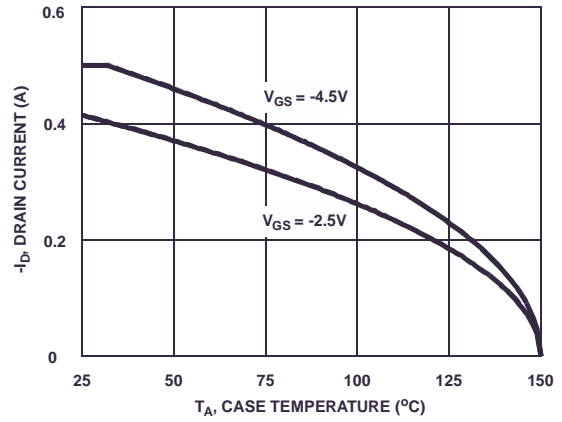
**Notes:**

- $R_{\theta JA}$  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.  $R_{\theta JA} = 415^\circ\text{C}/\text{W}$  when mounted on a 1inch<sup>2</sup> copper pad.

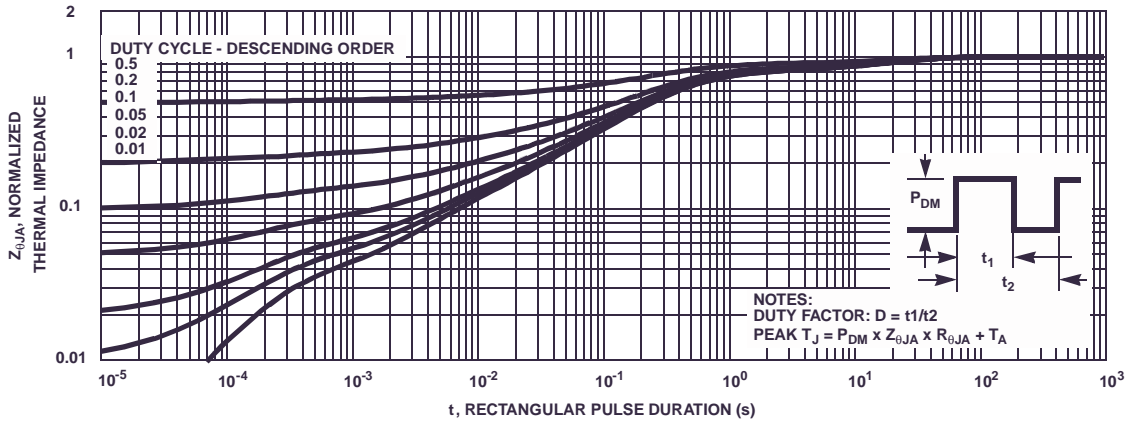
**Typical Characteristic**  $T_A = 25^\circ\text{C}$  unless otherwise noted



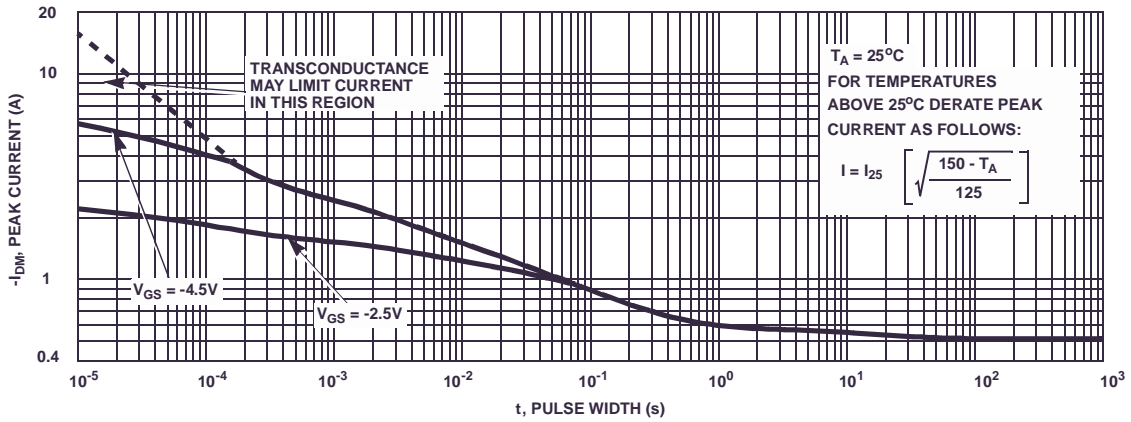
**Figure 1. Normalized Power Dissipation vs Ambient Temperature**



**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

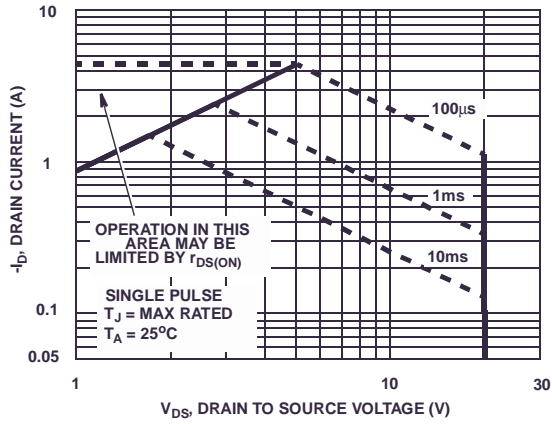


Figure 5. Forward Bias Safe Operating Area

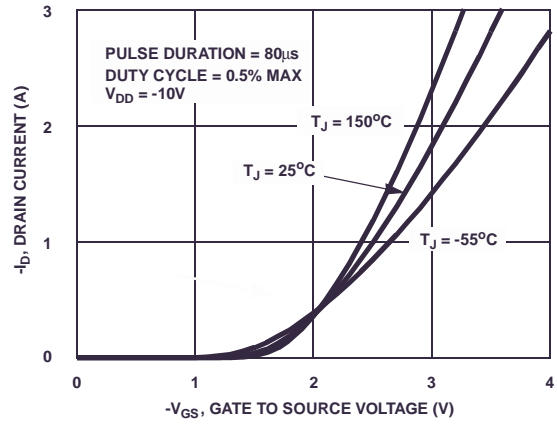


Figure 6. Transfer Characteristics

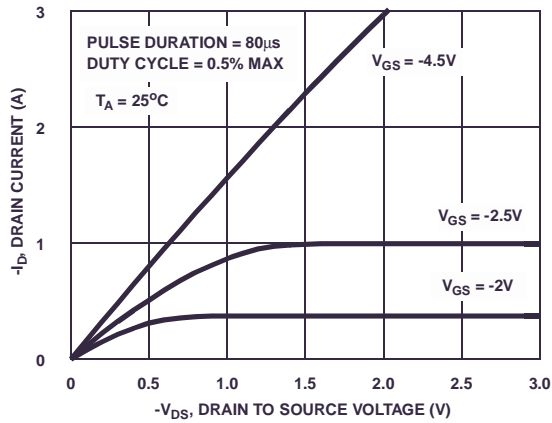


Figure 7. Saturation Characteristics

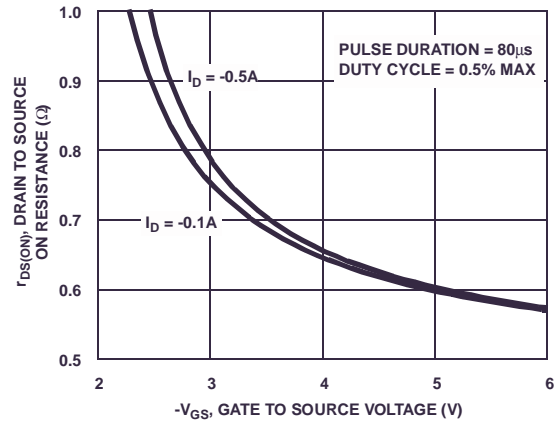


Figure 8. Drain to Source On Resistance vs Gate Voltage and Drain Current

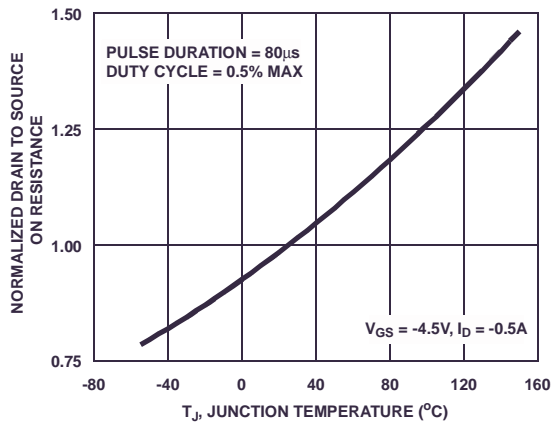


Figure 9. Normalized Drain to Source On Resistance vs Junction Temperature

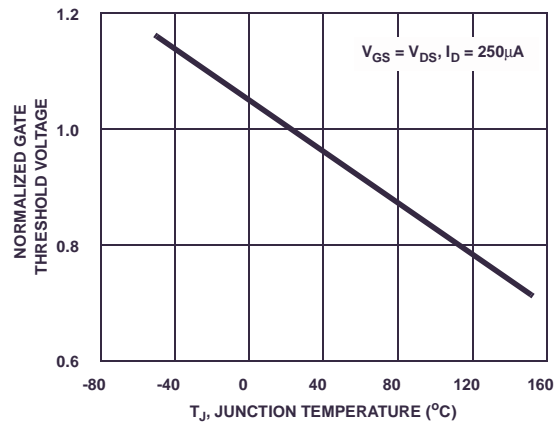
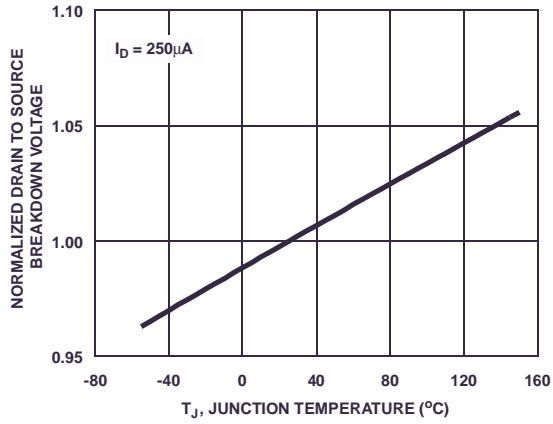
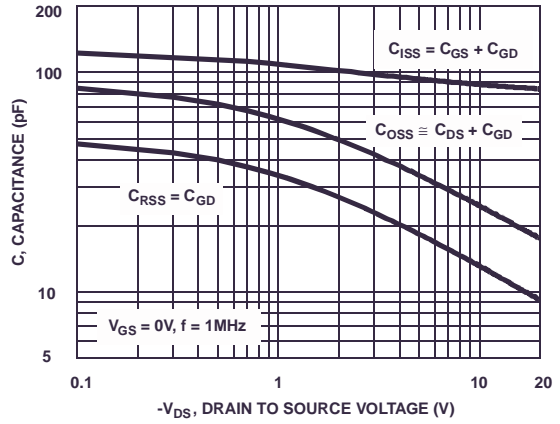


Figure 10. Normalized Gate Threshold Voltage vs Junction Temperature

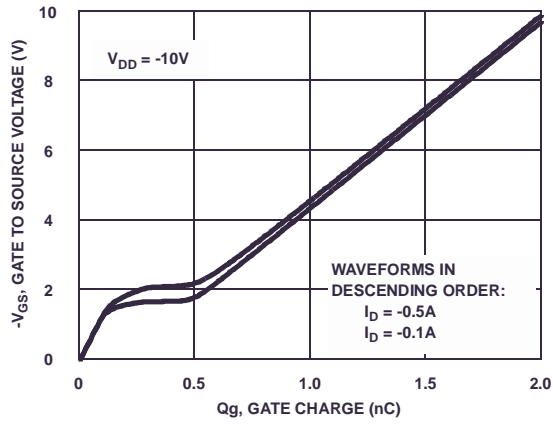
**Typical Characteristic** (Continued)  $T_A = 25^\circ\text{C}$  unless otherwise noted



**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)

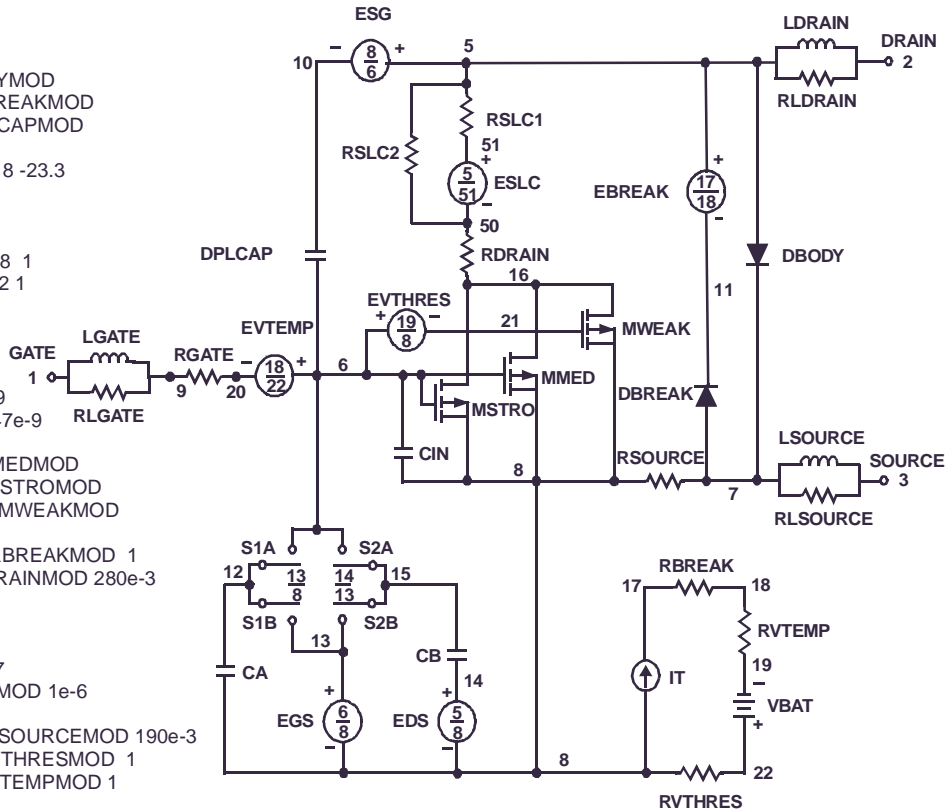
.MODEL S1BMOD VSWITCH (RON = 1e-5 ROFF = 0.1 VON = 0.2 VOFF= 0.5)

.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  
 CHERM2 c2 c3 2.7e-4  
 CHERM3 c3 c4 5.5e-4  
 CHERM4 c4 c5 1.4e-3  
 CHERM5 c5 c6 2.2e-3  
 CHERM6 c6 c7 2.6e-3  
 CHERM7 c7 c8 6.6e-3  
 CHERM8 c8 Ambient 0.29

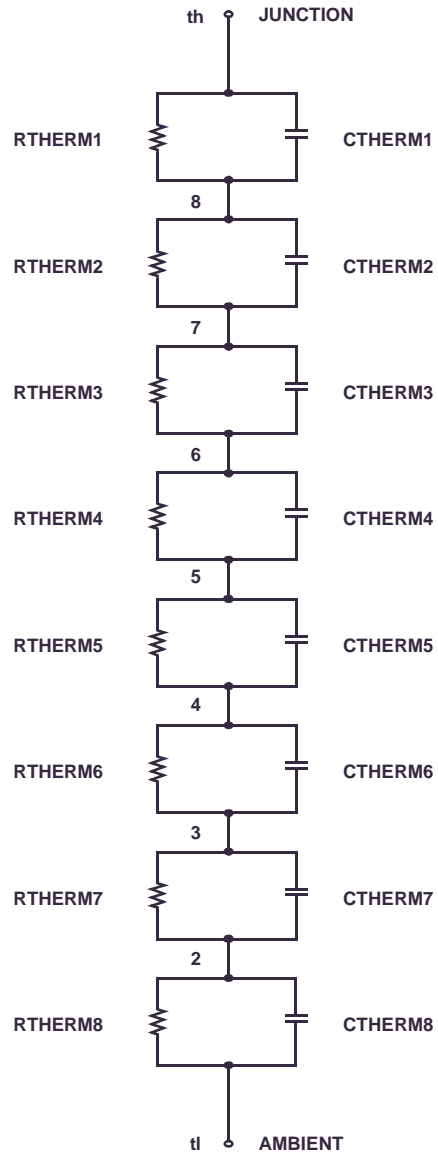
R THERM1 Junction c2 11.2  
 R THERM2 c2 c3 11.5  
 R THERM3 c3 c4 12.5  
 R THERM4 c4 c5 27  
 R THERM5 c5 c6 81  
 R THERM6 c6 c7 88  
 R THERM7 c7 c8 92  
 R THERM8 c8 Ambient 93

### 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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CoolFET™	FASTr™	MicroFET™	PowerTrench®	SuperSOT™-6
CROSSVOLT™	FRFET™	MicroPak™	QFET™	SuperSOT™-8
DOME™	GlobalOptoisolator™	MICROWIRE™	QS™	SyncFET™
EcoSPARK™	GTO™	MSX™	QT Optoelectronics™	TinyLogic®
E <sup>2</sup> C MOS™	HiSeC™	MSXPro™	Quiet Series™	TruTranslation™
EnSigna™	I <sup>2</sup> C™	OCX™	RapidConfigure™	UHC™
Across the board. Around the world.™		OCXPro™	RapidConnect™	UltraFET®
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Programmable Active Droop™		OPTOPLANAR™	SMART START™	

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