

FDT461N

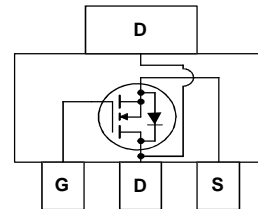
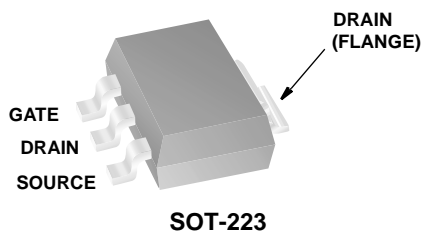
N-Channel Logic Level PowerTrench® MOSFET 100V, 0.4A, 2.5Ω

Features

- $r_{DS(ON)} = 1.45\Omega$ (Typ.), $V_{GS} = 4.5V$, $I_D = 0.4A$
- $Q_g(tot) = 2.36nC$ (Typ.), $V_{GS} = 10V$
- Low Miller Charge
- Low Q_{RR} Body Diode

Applications

- Servo Motor Load Control
- DC-DC converters



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

| Symbol | Parameter | Ratings | Units |
|----------------|---------------------------------------------------------------------------------------|------------|----------------|
| V_{DSS} | Drain to Source Voltage | 100 | V |
| V_{GS} | Gate to Source Voltage | ± 20 | V |
| I_D | Drain Current | | |
| | Continuous ($T_A = 25^\circ C$, $V_{GS} = 10V$, $R_{\theta JA} = 110^\circ C/W$) | 0.54 | A |
| | Continuous ($T_A = 25^\circ C$, $V_{GS} = 4.5V$, $R_{\theta JA} = 110^\circ C/W$) | 0.4 | A |
| | Pulsed | Figure 4 | A |
| E_{AS} | Single Pulse Avalanche Energy (Note 1) | 6.3 | mJ |
| P_D | Power dissipation | 1.13 | W |
| | Derate above $25^\circ C$ | 9 | mW/ $^\circ C$ |
| T_J, T_{STG} | Operating and Storage Temperature | -55 to 150 | $^\circ C$ |

Thermal Characteristics

| | | | |
|-----------------|----------------------------------------------------------------------------------|-----|--------------|
| $R_{\theta JA}$ | Thermal Resistance Junction to Ambient SOT-223, Pad area = 0.171 in ² | 110 | $^\circ C/W$ |
| $R_{\theta JA}$ | Thermal Resistance Junction to Ambient SOT-223, Pad area = 0.068 in ² | 128 | $^\circ C/W$ |
| $R_{\theta JA}$ | Thermal Resistance Junction to Ambient SOT-223, Pad area = 0.026 in ² | 147 | $^\circ C/W$ |

Package Marking and Ordering Information

| Device Marking | Device | Package | Reel Size | Tape Width | Quantity |
|----------------|---------|---------|-----------|------------|------------|
| 461 | FDT461N | SOT-223 | 13" | 12mm | 2500 units |

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

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|--------|-----------|-----------------|-----|-----|-----|-------|
|--------|-----------|-----------------|-----|-----|-----|-------|

Off Characteristics

| | | | | | | |
|------------|-----------------------------------|------------------------------------------------|-----|---|-----------|---------------|
| B_{VDSS} | Drain to Source Breakdown Voltage | $I_D = 250\mu\text{A}, V_{GS} = 0\text{V}$ | 100 | - | - | V |
| I_{DSS} | Zero Gate Voltage Drain Current | $V_{DS} = 80\text{V}$ | - | - | 1 | μA |
| | | $V_{GS} = 0\text{V}$ $T_C = 125^\circ\text{C}$ | - | - | 250 | |
| I_{GSS} | Gate to Source Leakage Current | $V_{GS} = \pm 20\text{V}$ | - | - | ± 100 | nA |

On Characteristics

| | | | | | | |
|--------------|----------------------------------|--------------------------------------------------------------------|-----|------|-----|----------|
| $V_{GS(TH)}$ | Gate to Source Threshold Voltage | $V_{GS} = V_{DS}, I_D = 250\mu\text{A}$ | 0.8 | - | 2 | V |
| $r_{DS(ON)}$ | Drain to Source On Resistance | $I_D = 0.54\text{A}, V_{GS} = 10\text{V}$ | - | 1.40 | 2.0 | Ω |
| | | $I_D = 0.4\text{A}, V_{GS} = 4.5\text{V}$ | - | 1.45 | 2.5 | |
| | | $I_D = 0.54\text{A}, V_{GS} = 10\text{V}, T_J = 150^\circ\text{C}$ | - | 2.80 | 4.0 | |

Dynamic Characteristics

| | | | | | | | |
|--------------|----------------------------------|------------------------------------------------------------|-----------------------------------------------------------------------|------|------|-----|----|
| C_{ISS} | Input Capacitance | $V_{DS} = 25\text{V}, V_{GS} = 0\text{V}, f = 1\text{MHz}$ | - | 74 | - | pF | |
| C_{OSS} | Output Capacitance | | - | 11 | - | pF | |
| C_{RSS} | Reverse Transfer Capacitance | | - | 2.5 | - | pF | |
| $Q_{g(TOT)}$ | Total Gate Charge at 10V | $V_{GS} = 0\text{V to } 10\text{V}$ | $V_{DD} = 50\text{V}$ $I_D = 0.54\text{A}$ $I_g = 1.0\text{mA}$ | 2.36 | 4.0 | nC | |
| $Q_{g(4.5)}$ | Total Gate Charge at 4.5V | $V_{GS} = 0\text{V to } 4.5\text{V}$ | | - | 1.27 | 2.0 | nC |
| $Q_{g(TH)}$ | Threshold Gate Charge | $V_{GS} = 0\text{V to } 1\text{V}$ | | 0.1 | 0.15 | nC | |
| Q_{gs} | Gate to Source Gate Charge | | | - | 0.37 | - | nC |
| Q_{gs2} | Gate Charge Threshold to Plateau | | | - | 0.27 | - | nC |
| Q_{gd} | Gate to Drain "Miller" Charge | | | - | 0.25 | - | nC |

Switching Characteristics ($V_{GS} = 10\text{V}$)

| | | | | | | |
|--------------|---------------------|----------------------------------------------------------------------------------------|---|-----|-----|----|
| t_{ON} | Turn-On Time | $V_{DD} = 50\text{V}, I_D = 0.54\text{A}$ $V_{GS} = 10\text{V}, R_{GS} = 120\Omega$ | - | - | 6.5 | ns |
| $t_{d(ON)}$ | Turn-On Delay Time | | - | 3 | - | ns |
| t_r | Rise Time | | - | 1.3 | - | ns |
| $t_{d(OFF)}$ | Turn-Off Delay Time | | - | 63 | - | ns |
| t_f | Fall Time | | - | 12 | - | ns |
| t_{OFF} | Turn-Off Time | | - | - | 113 | ns |

Drain-Source Diode Characteristics

| | | | | | | |
|----------|-------------------------------|---------------------------------------------------------------|---|---|------|----|
| V_{SD} | Source to Drain Diode Voltage | $I_{SD} = 0.54\text{A}$ | - | - | 1.25 | V |
| | | $I_{SD} = 0.3\text{A}$ | - | - | 1.0 | V |
| t_{rr} | Reverse Recovery Time | $I_{SD} = 0.54\text{A}, dI_{SD}/dt = 100\text{A}/\mu\text{s}$ | - | - | 22 | ns |
| Q_{RR} | Reverse Recovered Charge | $I_{SD} = 0.54\text{A}, dI_{SD}/dt = 100\text{A}/\mu\text{s}$ | - | - | 18 | nC |

Notes:

1: Starting $T_J = 25^\circ\text{C}$, $L = 67\text{mH}$, $I_{AS} = 0.43\text{A}$.

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

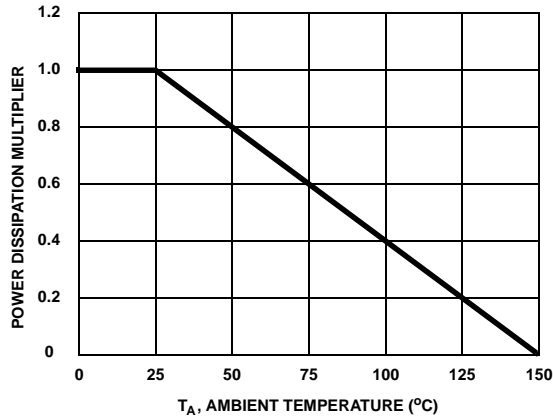


Figure 1. Normalized Power Dissipation vs Ambient Temperature

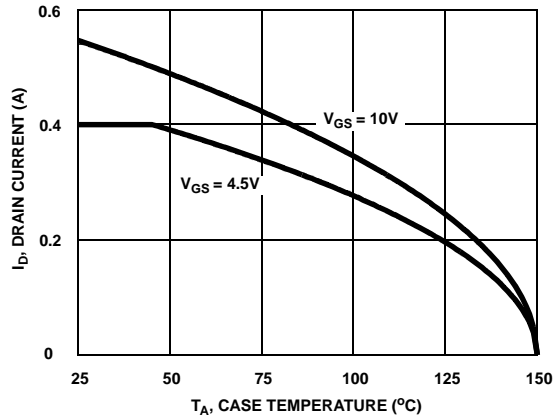


Figure 2. Maximum Continuous Drain Current vs Case Temperature

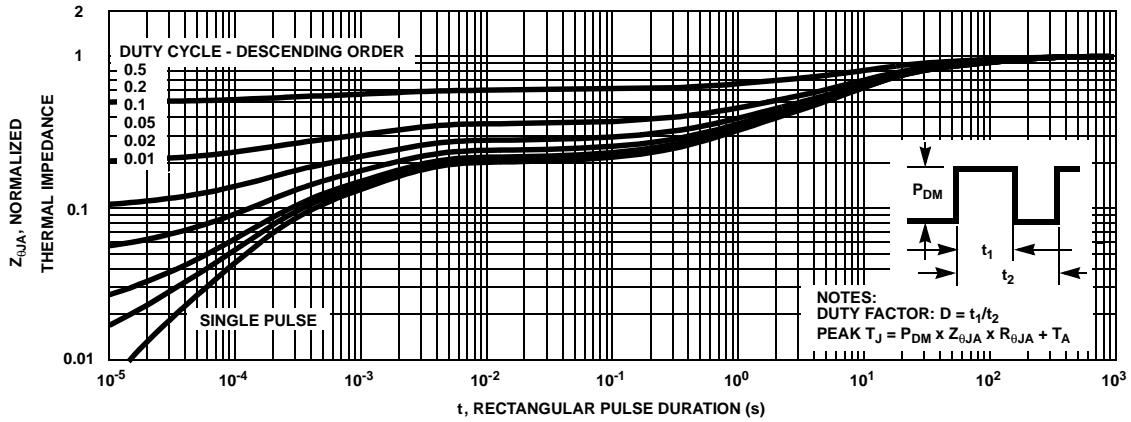


Figure 3. Normalized Maximum Transient Thermal Impedance

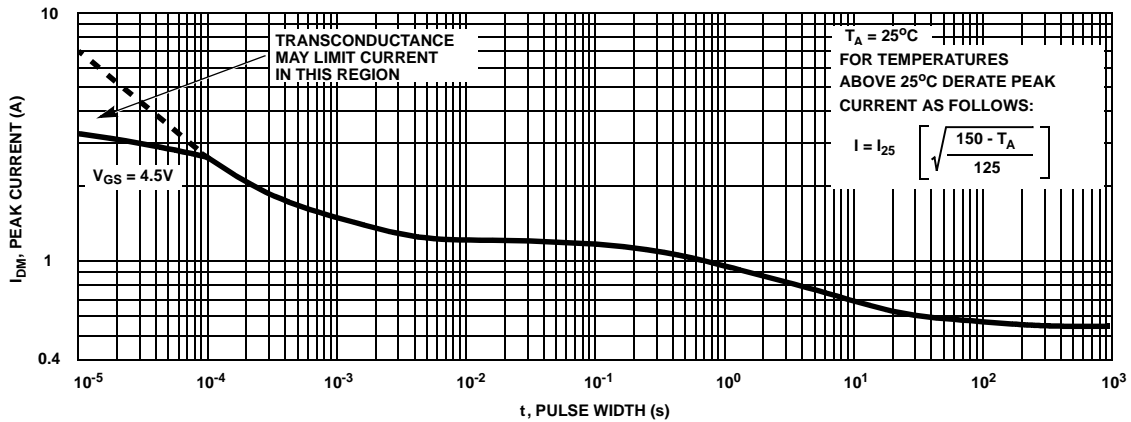


Figure 4. Peak Current Capability

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

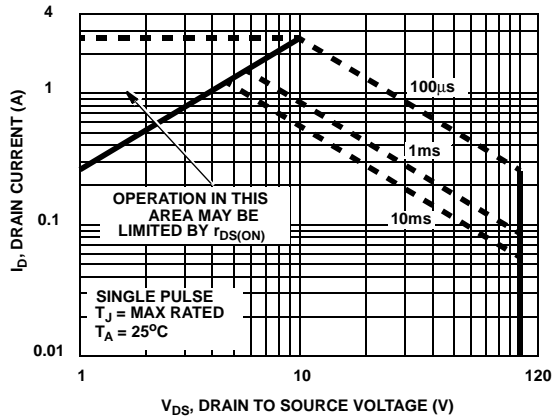


Figure 5. Forward Bias Safe Operating Area

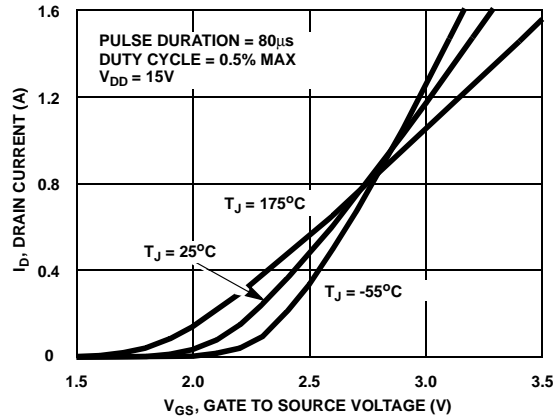


Figure 6. Transfer Characteristics

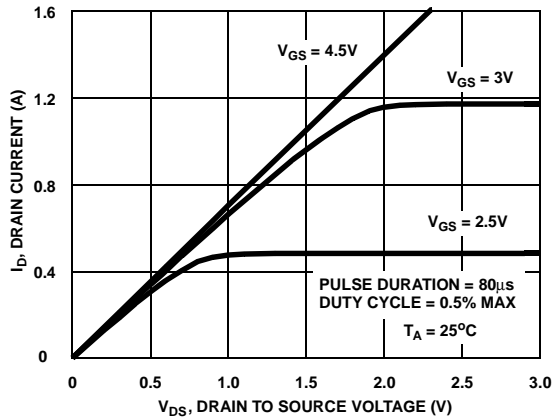


Figure 7. Saturation Characteristics

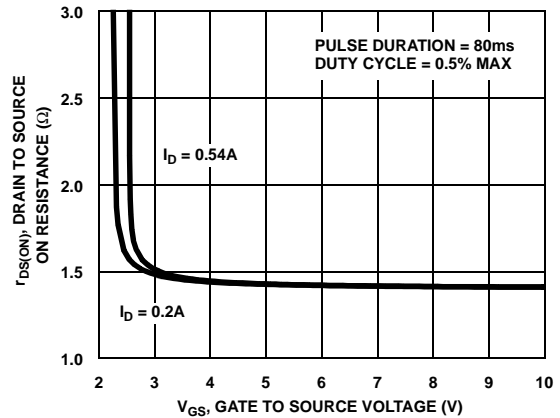


Figure 8. Drain to Source On Resistance vs Gate Voltage and Drain Current

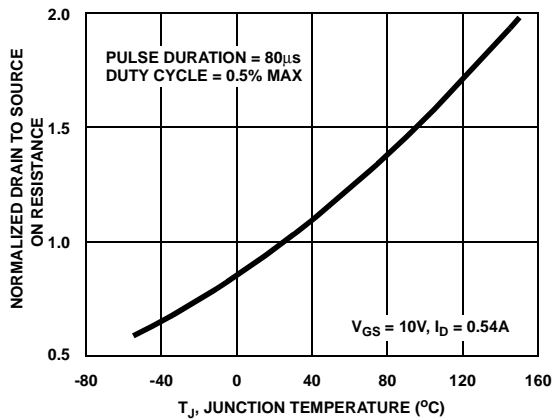


Figure 9. Normalized Drain to Source On Resistance vs Junction Temperature

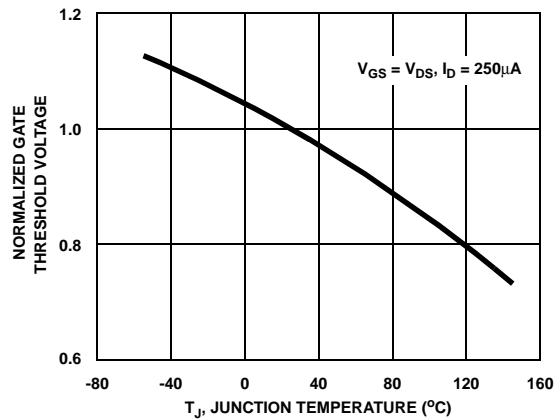


Figure 10. Normalized Gate Threshold Voltage vs Junction Temperature

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

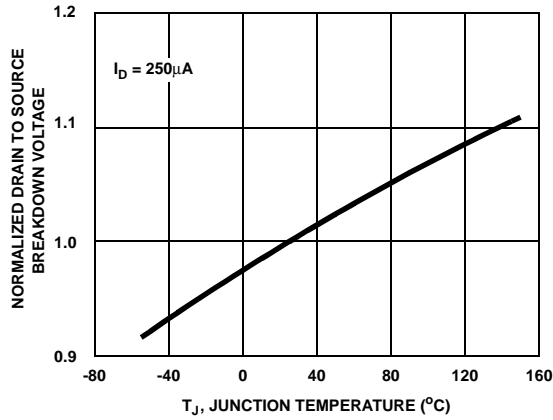


Figure 11. Normalized Drain to Source Breakdown Voltage vs Junction Temperature

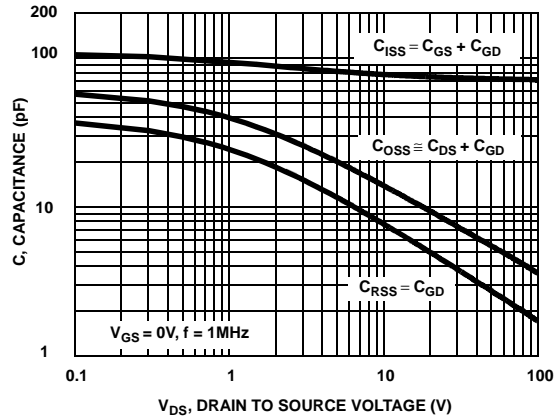


Figure 12. Capacitance vs Drain to Source Voltage

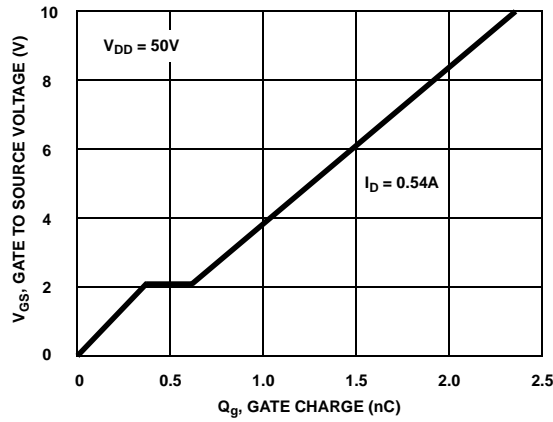


Figure 13. Gate Charge Waveforms for Constant Gate Current

Test Circuits and Waveforms

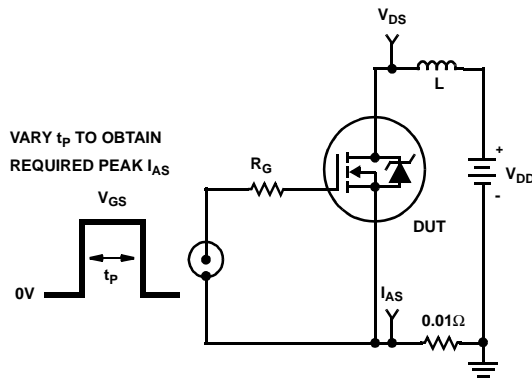


Figure 14. Unclamped Energy Test Circuit

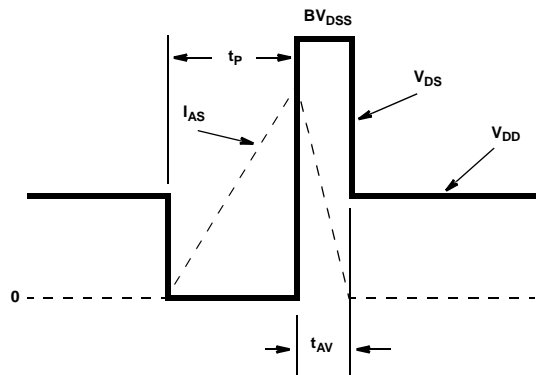


Figure 15. Unclamped Energy Waveforms

Test Circuits and Waveforms (Continued)

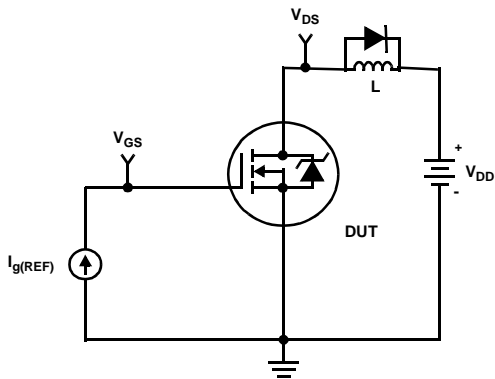


Figure 16. Gate Charge Test Circuit

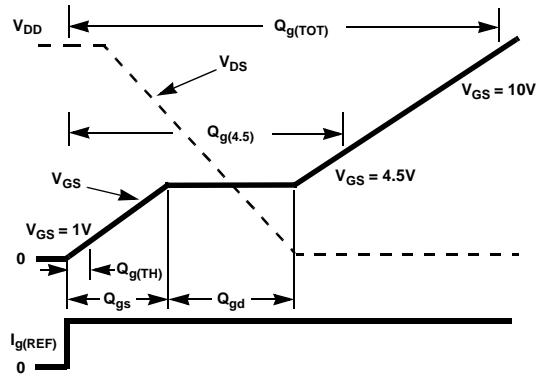


Figure 17. Gate Charge Waveforms

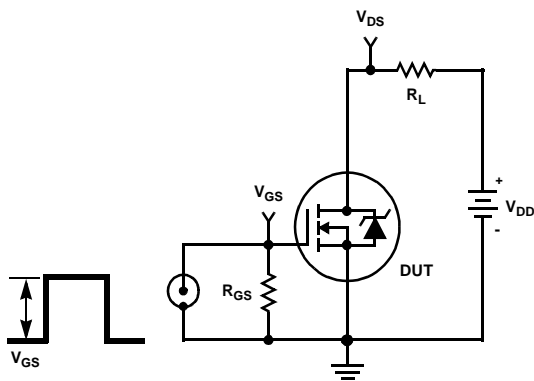


Figure 18. Switching Time Test Circuit

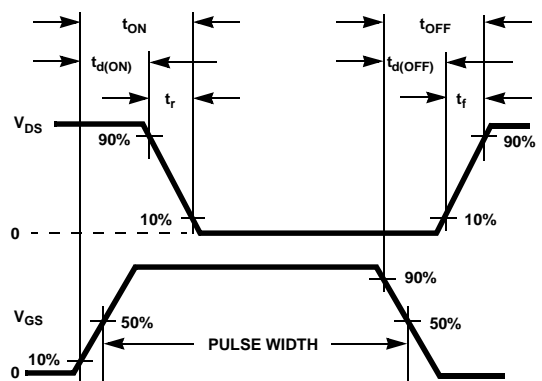


Figure 19. Switching Time Waveforms

PSPICE Electrical Model

.SUBCKT FDT461N 2 1 3 ; rev January 2004
 Ca 12 8 1.5e-10
 Cb 15 14 1.1e-10
 Cin 6 8 7.0e-11

Dbody 7 5 DbodyMOD
 Dbreak 5 11 DbreakMOD
 Dplcap 10 5 DplcapMOD

Ebreak 11 7 17 18 109.7
 Eds 14 8 5 8 1
 Egs 13 8 6 8 1
 Esg 6 10 6 8 1
 Evthres 6 21 19 8 1
 Evtemp 20 6 18 22 1

It 8 17 1

Lgate 1 9 5.29e-9
 Ldrain 2 5 1.0e-9
 Lsource 3 7 5.71e-9

RLgate 1 9 52.9
 RLdrain 2 5 10
 RLsource 3 7 57.1

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 0.9
 Rgate 9 20 3.94
 RSLC1 5 51 RSLCMOD 1e-6
 RSLC2 5 50 1e3
 Rsource 8 7 RsourceMOD 0.5
 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*15),2.5))}}

.MODEL DbodyMOD D (IS=6.4E-11 RS=8.0e-3 IKF=0.9 TRS1=2.5e-3 TRS2=9.5e-6
 + CJO=2.2e-11 M=0.52 TT=2.9e-8 XTI=0.1)

.MODEL DbreakMOD D (RS=0.6 TRS1=1.4e-3 TRS2=-5.0e-5)

.MODEL DplcapMOD D (CJO=3.9e-11 IS=1e-30 N=10 M=0.67)

.MODEL MmedMOD NMOS (VTO=1.75 KP=1.2 IS=1e-30 N=10 TOX=1 L=1u W=1u RG=3.94 T_ABS=25)

.MODEL MstroMOD NMOS (VTO=2.03 KP=12 IS=1e-30 N=10 TOX=1 L=1u W=1u T_ABS=25)

.MODEL MweakMOD NMOS (VTO=1.46 KP=0.02 IS=1e-30 N=10 TOX=1 L=1u W=1u RG=39.4 RS=0.1 T_ABS=25)

.MODEL RbreakMOD RES (TC1=1.0e-3 TC2=-8.8e-7)

.MODEL RdrainMOD RES (TC1=7.0e-3 TC2=2.0e-5)

.MODEL RSLCMOD RES (TC1=1.0e-3 TC2=9.0e-6)

.MODEL RsourceMOD RES (TC1=4.8e-3 TC2=1.0e-6)

.MODEL RvthresMOD RES (TC1=-9.0e-4 TC2=-7.0e-6)

.MODEL RvtempMOD RES (TC1=-2.1e-3 TC2=1.8e-6)

.MODEL S1AMOD VSWITCH (RON=1e-5 ROFF=0.1 VON=-5.0 VOFF=-2.0)

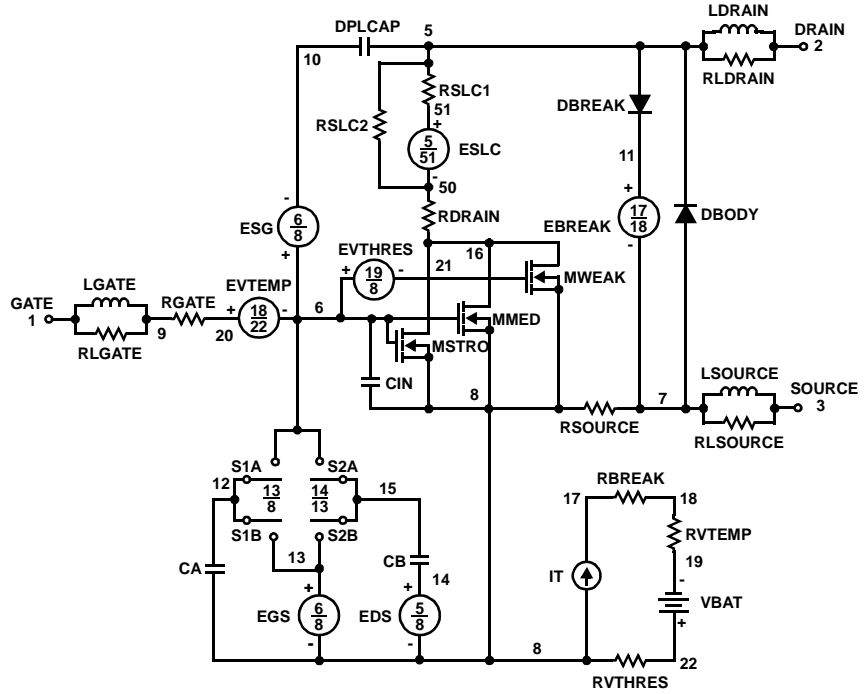
.MODEL S1BMOD VSWITCH (RON=1e-5 ROFF=0.1 VON=-2.0 VOFF=-5.0)

.MODEL S2AMOD VSWITCH (RON=1e-5 ROFF=0.1 VON=-0.4 VOFF=0.3)

.MODEL S2BMOD VSWITCH (RON=1e-5 ROFF=0.1 VON=0.3 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.



PSPICE Thermal Model

REV January 2004
 FDT461N_JA Junction Ambient
 Copper Area= 1sq.in

CTHERM1 Junction c2 3.0e-5
 CTHERM2 c2 c3 3.2e-5
 CTHERM3 c3 c4 2.0e-4
 CTHERM4 c4 c5 9.6e-2
 CTHERM5 c5 c6 8.9e-1
 CTHERM6 c6 c7 9.1e-1
 CTHERM7 c7 c8 9.3e-1
 CTHERM8 c8 Ambient 7

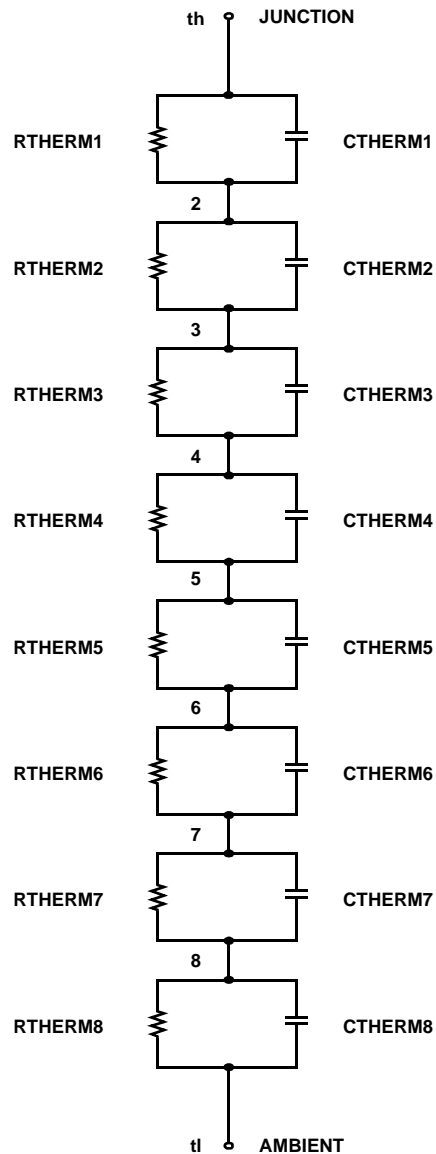
RTHERM1 Junction c2 0.5
 RTHERM2 c2 c3 6
 RTHERM3 c3 c4 9
 RTHERM4 c4 c5 10
 RTHERM5 c5 c6 11
 RTHERM6 c6 c7 12
 RTHERM7 c7 c8 13
 RTHERM8 c8 Ambient 16

SABER Thermal Model

SABER thermal model FDT461N
 Copper Area= 1sq.in
 template thermal_model th tl
 thermal_c th, tl

```
{
ctherm.ctherm1 th c2 = 3.0e-5
ctherm.ctherm2 c2 c3 = 3.2e-5
ctherm.ctherm3 c3 c4 = 2.0e-4
ctherm.ctherm4 c4 c5 = 9.6e-2
ctherm.ctherm5 c5 c6 = 8.9e-1
ctherm.ctherm6 c6 c7 = 9.1e-1
ctherm.ctherm7 c7 c8 = 9.3e-1
ctherm.ctherm8 c8 tl = 7
}
```

```
rtherm.rtherm1 th c2 = 0.5
rtherm.rtherm2 c2 c3 = 6
rtherm.rtherm3 c3 c4 = 9
rtherm.rtherm4 c4 c5 = 10
rtherm.rtherm5 c5 c6 = 11
rtherm.rtherm6 c6 c7 = 12
rtherm.rtherm7 c7 c8 = 13
rtherm.rtherm8 c8 tl = 16
}
```



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| ActiveArray™ | FAST® | ISOPLANAR™ | POP™ | Stealth™ |
| Bottomless™ | FASTr™ | LittleFET™ | Power247™ | SuperFET™ |
| CoolFET™ | FPST™ | MICROCOUPLER™ | PowerSaver™ | SuperSOT™-3 |
| CROSSVOLT™ | FRFET™ | MicroFET™ | PowerTrench® | SuperSOT™-6 |
| DOMET™ | GlobalOptoisolator™ | MicroPak™ | QFET® | SuperSOT™-8 |
| EcoSPARK™ | GTO™ | MICROWIRE™ | QS™ | SyncFET™ |
| E ² C MOS™ | HiSeC™ | MSX™ | QT Optoelectronics™ | TinyLogic® |
| EnSigna™ | µC™ | MSXPro™ | Quiet Series™ | TINYOPTO™ |
| FACT™ | i-Lo™ | OCX™ | RapidConfigure™ | TruTranslation™ |
| Across the board. Around the world.™ | OCXPro™ | OCXPro™ | RapidConnect™ | UHC™ |
| The Power Franchise® | OPTOLOGIC® | OPTOLOGIC® | SILENT SWITCHER® | UltraFET® |
| Programmable Active Droop™ | OPTOPLANAR™ | OPTOPLANAR™ | SMART START™ | VCX™ |

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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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