

FDH038AN08A1

N-Channel PowerTrench® MOSFET

75 V, 80 A, 3.8 mΩ

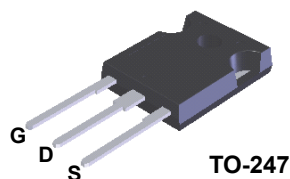
Features

- $R_{DS(ON)} = 3.5 \text{ m}\Omega$ (Typ.), $V_{GS} = 10 \text{ V}$, $I_D = 80 \text{ A}$
- $Q_g(\text{tot}) = 125 \text{ nC}$ (Typ.), $V_{GS} = 10 \text{ V}$
- Low Miller Charge
- Low Q_{rr} Body Diode
- UIS Capability (Single Pulse and Repetitive Pulse)

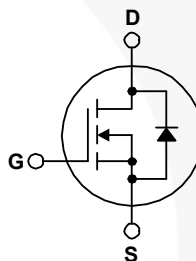
Applications

- Synchronous Rectification for ATX / Server / Telecom PSU
- Battery Protection Circuit
- Motor Drives and Uninterruptible Power Supplies

Formerly developmental type 82690



TO-247



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

Symbol	Parameter	FDH038AN08A1	Unit
V_{DSS}	Drain to Source Voltage	75	V
V_{GS}	Gate to Source Voltage	± 20	V
I_D	Drain Current		
	Continuous ($T_C < 158^\circ\text{C}$, $V_{GS} = 10\text{V}$)	80	A
	Continuous ($T_A = 25^\circ\text{C}$, $V_{GS} = 10\text{V}$, with $R_{\theta JA} = 30^\circ\text{C/W}$)	22	A
	Pulsed	Figure 4	A
E_{AS}	Single Pulse Avalanche Energy (Note 1)	1.17	J
P_D	Power dissipation	450	W
	Derate above 25°C	3.0	W/ $^\circ\text{C}$
T_J, T_{STG}	Operating and Storage Temperature	-55 to 175	$^\circ\text{C}$

Thermal Characteristics

$R_{\theta JC}$	Thermal Resistance Junction to Case, Max. TO-247	0.33	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance Junction to Ambient, Max. TO-247	30	$^\circ\text{C/W}$

Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FDH038AN08A1	FDH038AN08A1	TO-247	Tube	N/A	30 units

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
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Off Characteristics

B_{VDSS}	Drain to Source Breakdown Voltage	$I_D = 250\mu\text{A}$, $V_{GS} = 0\text{V}$	75	-	-	V
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 60\text{V}$ $V_{GS} = 0\text{V}$	-	-	1	μA
		$T_C = 150^\circ\text{C}$	-	-	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	$V_{GS} = V_{DS}$, $I_D = 250\mu\text{A}$	2	-	4	V
$r_{DS(ON)}$	Drain to Source On Resistance	$I_D = 80\text{A}$, $V_{GS} = 10\text{V}$	-	0.0035	0.0038	Ω
		$I_D = 40\text{A}$, $V_{GS} = 6\text{V}$	-	0.0047	0.0071	
		$I_D = 80\text{A}$, $V_{GS} = 10\text{V}$, $T_J = 175^\circ\text{C}$	-	0.0074	0.008	

Dynamic Characteristics

C_{ISS}	Input Capacitance	$V_{DS} = 25\text{V}$, $V_{GS} = 0\text{V}$, $f = 1\text{MHz}$	-	8665	-	pF	
C_{OSS}	Output Capacitance		-	1320	-	pF	
C_{RSS}	Reverse Transfer Capacitance		-	340	-	pF	
$Q_g(TOT)$	Total Gate Charge at 10V	$V_{GS} = 0\text{V to } 10\text{V}$	$V_{DD} = 40\text{V}$ $I_D = 80\text{A}$ $I_g = 1.0\text{mA}$	125	160	nC	
$Q_g(TH)$	Threshold Gate Charge	$V_{GS} = 0\text{V to } 2\text{V}$		-	17	22	nC
Q_{gs}	Gate to Source Gate Charge			-	57	-	nC
Q_{gs2}	Gate Charge Threshold to Plateau			-	42	-	nC
Q_{gd}	Gate to Drain "Miller" Charge			-	30	-	nC

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

t_{ON}	Turn-On Time	$V_{DD} = 40\text{V}$, $I_D = 80\text{A}$ $V_{GS} = 10\text{V}$, $R_{GS} = 2.4\Omega$	-	-	345	ns
$t_{d(ON)}$	Turn-On Delay Time		-	88	-	ns
t_r	Rise Time		-	141	-	ns
$t_{d(OFF)}$	Turn-Off Delay Time		-	232	-	ns
t_f	Fall Time		-	126	-	ns
t_{OFF}	Turn-Off Time		-	-	530	ns

Drain-Source Diode Characteristics

V_{SD}	Source to Drain Diode Voltage	$I_{SD} = 80\text{A}$	-	-	1.25	V
		$I_{SD} = 40\text{A}$	-	-	1.0	V
t_{rr}	Reverse Recovery Time	$I_{SD} = 75\text{A}$, $dI_{SD}/dt = 100\text{A}/\mu\text{s}$	-	-	50	ns
Q_{RR}	Reverse Recovered Charge	$I_{SD} = 75\text{A}$, $dI_{SD}/dt = 100\text{A}/\mu\text{s}$	-	-	65	nC

Notes:

1: Starting $T_J = 25^\circ\text{C}$, $L = 0.65\text{mH}$, $I_{AS} = 60\text{A}$.

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

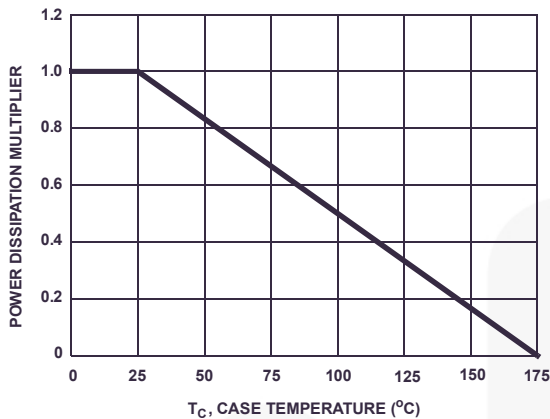


Figure 1. Normalized Power Dissipation vs Ambient Temperature

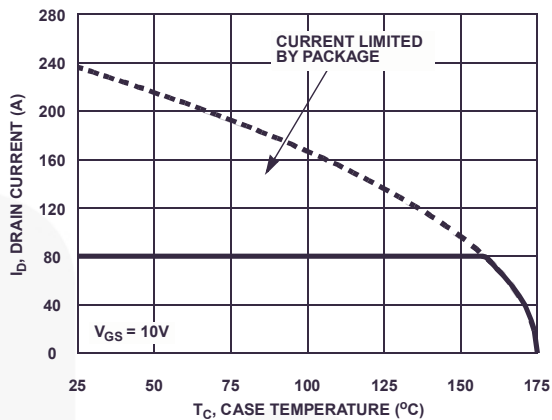


Figure 2. Maximum Continuous Drain Current vs Case Temperature

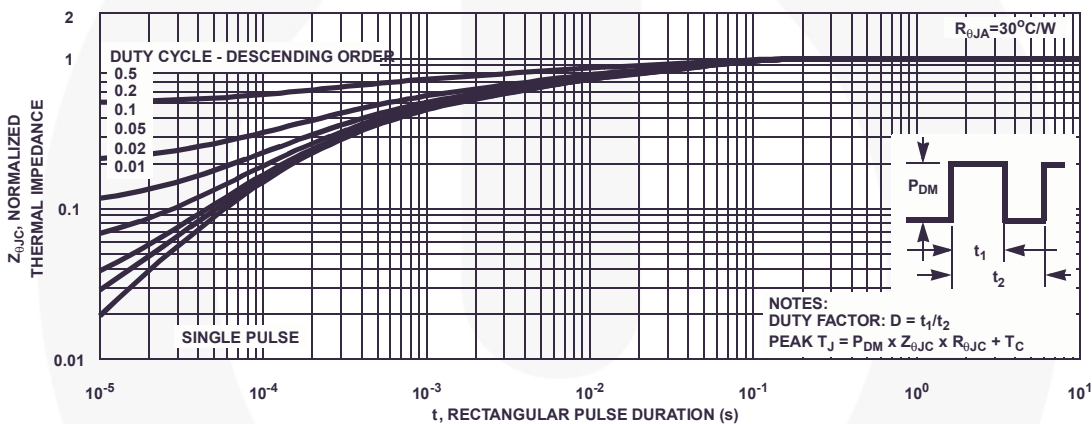


Figure 3. Normalized Maximum Transient Thermal Impedance

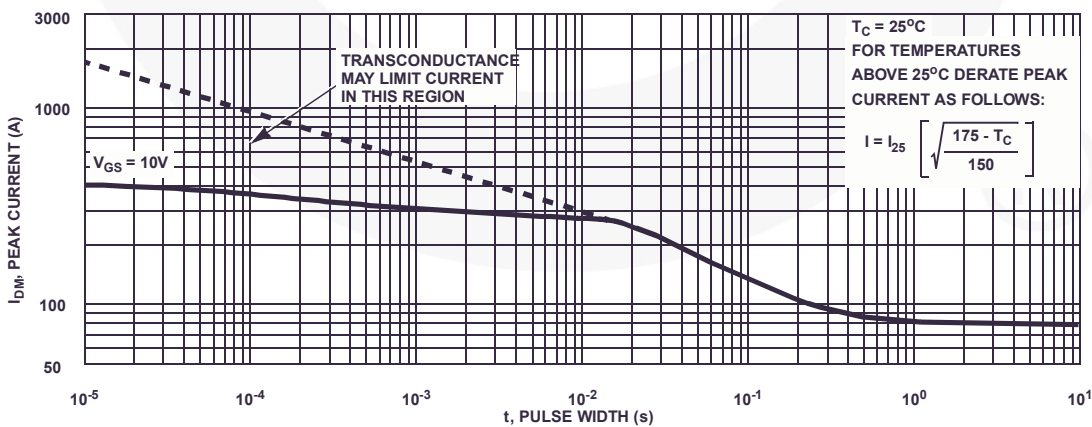


Figure 4. Peak Current Capability

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

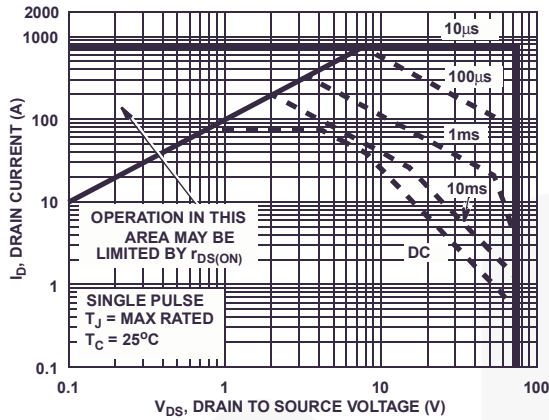
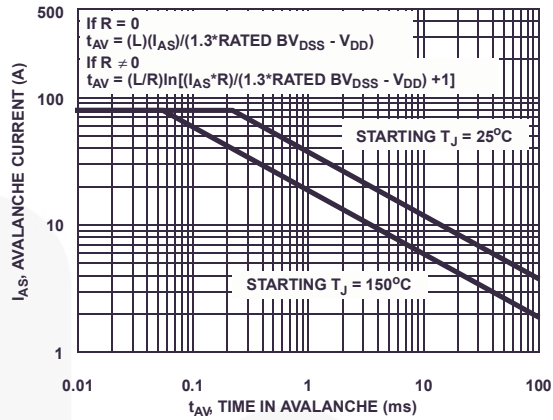


Figure 5. Forward Bias Safe Operating Area



NOTE: Refer to Fairchild Application Notes AN7514 and AN7515
Figure 6. Unclamped Inductive Switching Capability

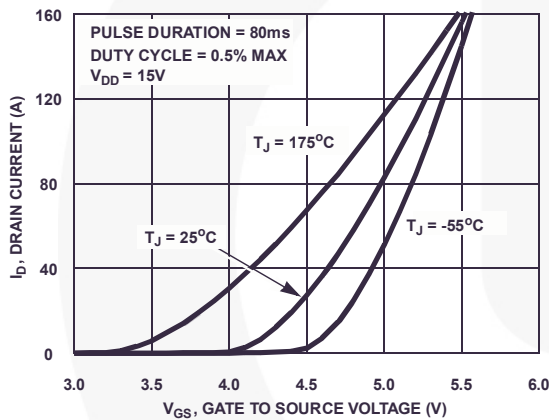


Figure 7. Transfer Characteristics

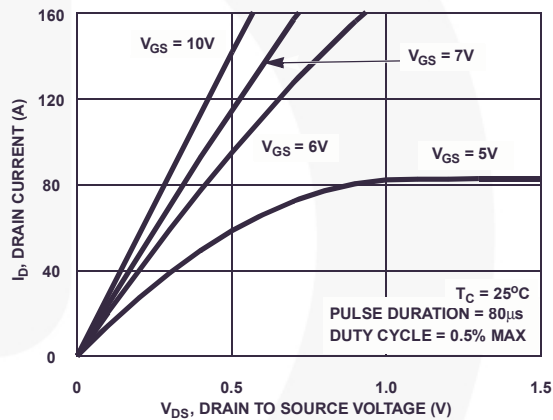


Figure 8. Saturation Characteristics

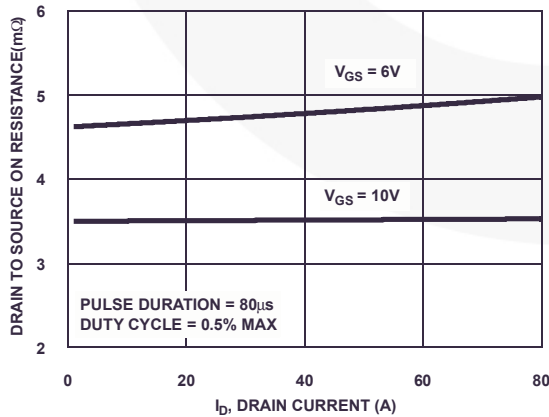


Figure 9. Drain to Source On Resistance vs Drain Current

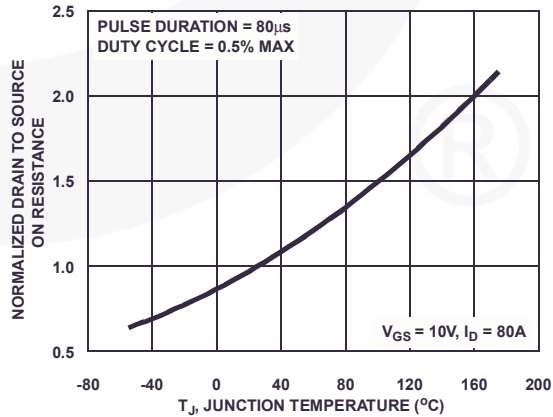


Figure 10. Normalized Drain to Source On Resistance vs Junction Temperature

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

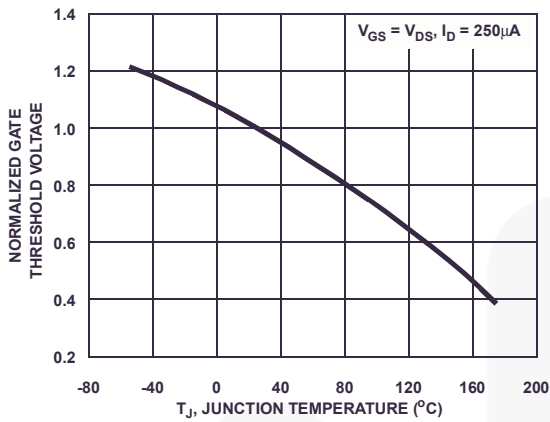


Figure 11. Normalized Gate Threshold Voltage vs Junction Temperature

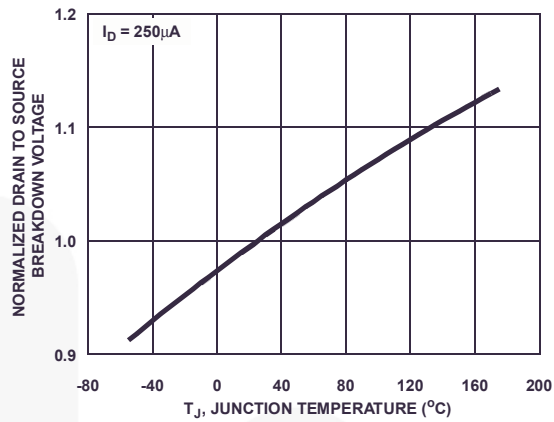


Figure 12. Normalized Drain to Source Breakdown Voltage vs Junction Temperature

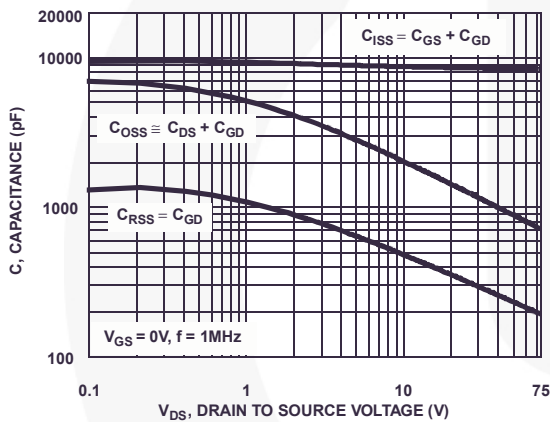


Figure 13. Capacitance vs Drain to Source Voltage

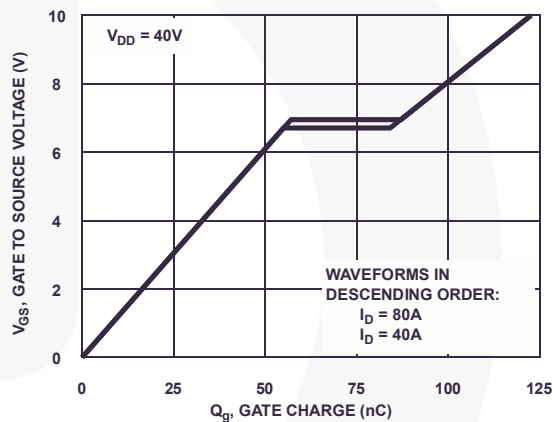
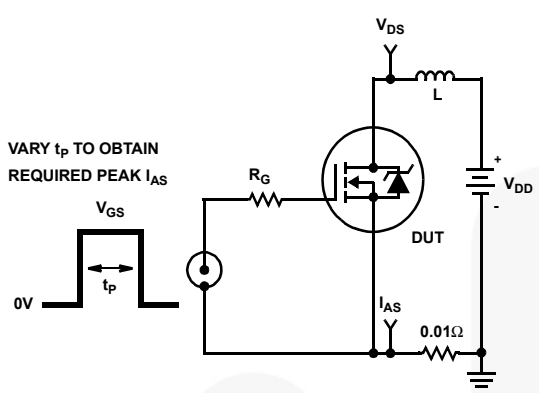


Figure 14. Gate Charge Waveforms for Constant Gate Currents

Test Circuits and Waveforms



VARY t_p TO OBTAIN
REQUIRED PEAK I_{AS}

Figure 15. Unclamped Energy Test Circuit

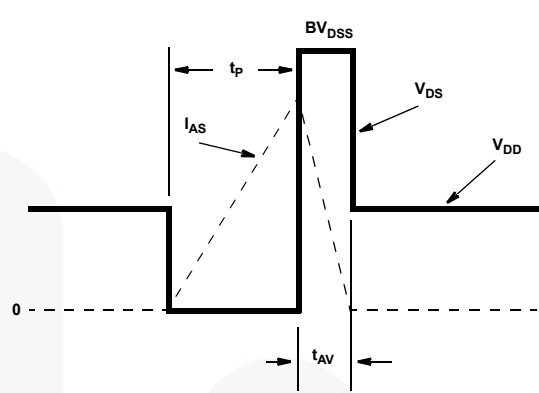


Figure 16. Unclamped Energy Waveforms

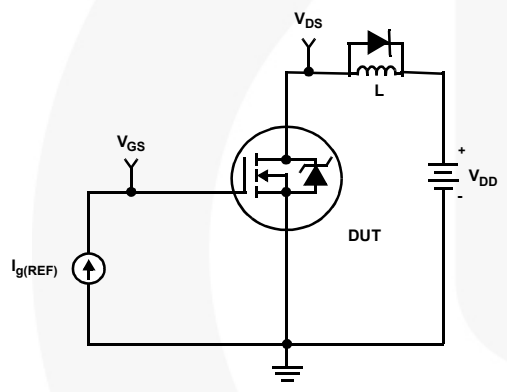


Figure 17. Gate Charge Test Circuit

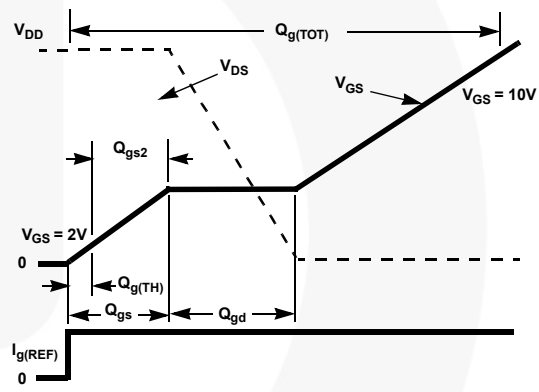


Figure 18. Gate Charge Waveforms

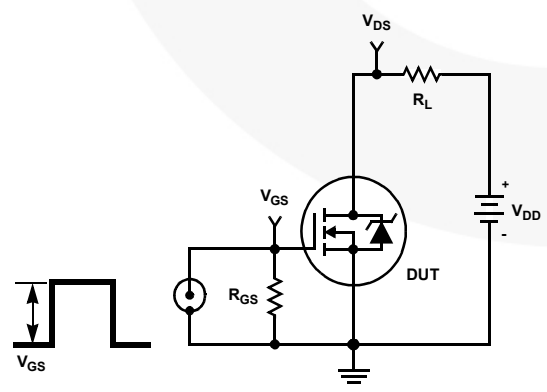


Figure 19. Switching Time Test Circuit

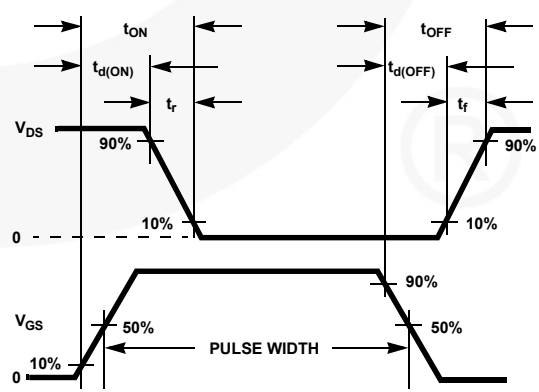


Figure 20. Switching Time Waveforms

PSPICE Electrical Model

.SUBCKT FDH038AN08A1 2 1 3; rev January 2003
 CA 12 8 1.0e-9
 Cb 15 14 3.1e-9
 Cin 6 8 8.22e-9

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

Ebbreak 11 7 17 18 84.9
 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 4.81e-9
 Ldrain 2 5 1.0e-9
 Lsource 3 7 4.63e-9

RLgate 1 9 48.1
 RLdrain 2 5 10
 RLsource 3 7 46.3

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 2.0e-4
 Rgate 9 20 20
 RSLC1 5 51 RSLCMOD 1.0e-6
 RSLC2 5 50 1e3
 Rsource 8 7 RsourceMOD 2.6e-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*300),10))}}

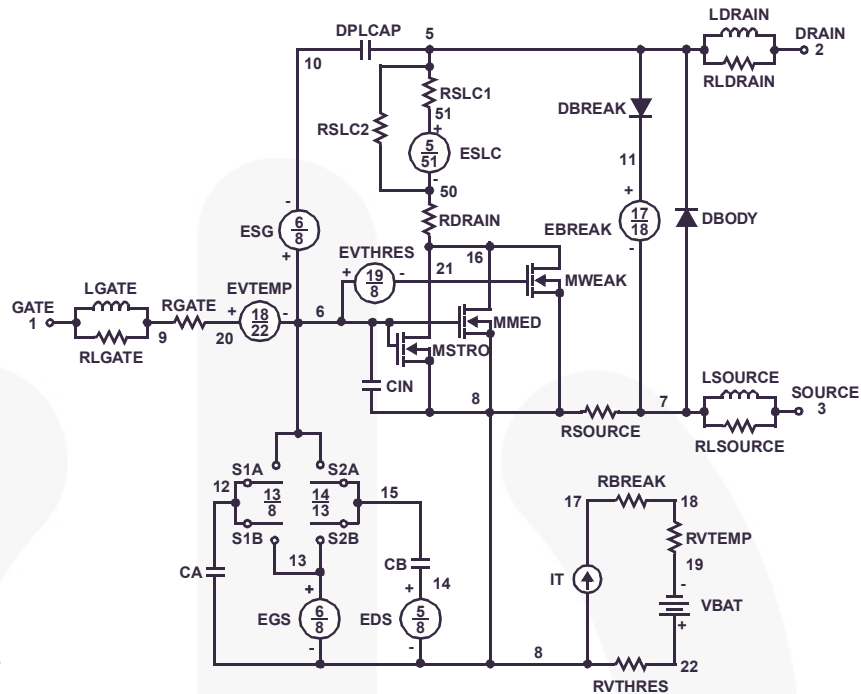
.MODEL DbodyMOD D (IS=2.4E-11 N=1.02 RS=1.65e-3 TRS1=3.2e-3 TRS2=2.0e-7
 + CJO=6.0e-9 M=5.6e-1 TT=2.38e-8 XTI=3.9)
 .MODEL DbreakMOD D (RS=1.5e-1 TRS1=1.0e-3 TRS2=-8.9e-6)
 .MODEL DplcapMOD D (CJO=1.5e-9 IS=1.0e-30 N=10 M=0.47)
 .MODEL MmedMOD NMOS (VTO=3.2 KP=1.5 IS=1.0e-30 N=10 TOX=1 L=1u W=1u RG=20)
 .MODEL MstroMOD NMOS (VTO=3.95 KP=235 IS=1.0e-30 N=10 TOX=1 L=1u W=1u)
 .MODEL MweakMOD NMOS (VTO=2.73 KP=0.02 IS=1e-30 N=10 TOX=1 L=1u W=1u RG=200 RS=.01)

.MODEL RbreakMOD RES (TC1=1.05e-3 TC2=-9.0e-7)
 .MODEL RdrainMOD RES (TC1=1.8e-2 TC2=2.2e-4)
 .MODEL RSLCMOD RES (TC1=2.0e-3 TC2=1.0e-5)
 .MODEL RsourceMOD RES (TC1=5.0e-3 TC2=1.0e-6)
 .MODEL RvthresMOD RES (TC1=-4.2e-3 TC2=-1.8e-5)
 .MODEL RvtempMOD RES (TC1=-4.5e-3 TC2=2.0e-6)

.MODEL S1AMOD VSWITCH (RON=1e-5 ROFF=0.1 VON=-4 VOFF=-1.5)
 .MODEL S1BMOD VSWITCH (RON=1e-5 ROFF=0.1 VON=-1.5 VOFF=-4)
 .MODEL S2AMOD VSWITCH (RON=1e-5 ROFF=0.1 VON=-0.5 VOFF=0.5)
 .MODEL S2BMOD VSWITCH (RON=1e-5 ROFF=0.1 VON=0.5 VOFF=-0.5)

.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. FrankWheatley.



SABER Electrical Model

REV January 2003
 template FDH038AN08A1 n2,n1,n3
 electrical n2,n1,n3

```
{
var i iscl
dp..model dbodymod = (isl=2.4e-11,nl=1.02,rs=1.65e-3,trs1=3.2e-3,trs2=2.0e-7,cjo=6.0e-9,m=5.6e-1,tt=2.38e-8,xti=3.9)
dp..model dbreakmod = (rs=1.5e-1,trs1=1.0e-3,trs2=-8.9e-6)
dp..model dplcapmod = (cjo=1.5e-9,isl=10e-30,nl=10,m=0.47)
m..model mmedmod = (type=_n,vto=3.2,kp=1.5,is=1e-30,tox=1)
m..model mstrongmod = (type=_n,vto=3.95,kp=235,isl=1.0e-30,tox=1)
m..model mweakmod = (type=_n,vto=2.73,kp=0.02,isl=1.0e-30,tox=1,rs=0.1)
sw_vcsp..model s1amod = (ron=1e-5,roff=0.1,von=-4,voff=-1.5)
sw_vcsp..model s1bmod = (ron=1e-5,roff=0.1,von=-1.5,voff=-4)
sw_vcsp..model s2amod = (ron=1e-5,roff=0.1,von=-0.5,voff=0.5)
sw_vcsp..model s2bmod = (ron=1e-5,roff=0.1,von=0.5,voff=-0.5)
c.ca n12 n8 = 1.0e-9
c.cb n15 n14 = 3.1e-9
c.cin n6 n8 = 8.22e-9
```

```
dp.dbody n7 n5 = model=dbodymod
dp.dbreak n5 n11 = model=dbreakmod
dp.dplcap n10 n5 = model=dplcapmod
```

```
spe.ebreak n11 n7 n17 n18 = 84.9
spe.eds n14 n8 n5 n8 = 1
spe.egs n13 n8 n6 n8 = 1
spe.esg n6 n10 n6 n8 = 1
spe.evthres n6 n21 n19 n8 = 1
spe.evtemp n20 n6 n18 n22 = 1
```

```
i.it n8 n17 = 1
```

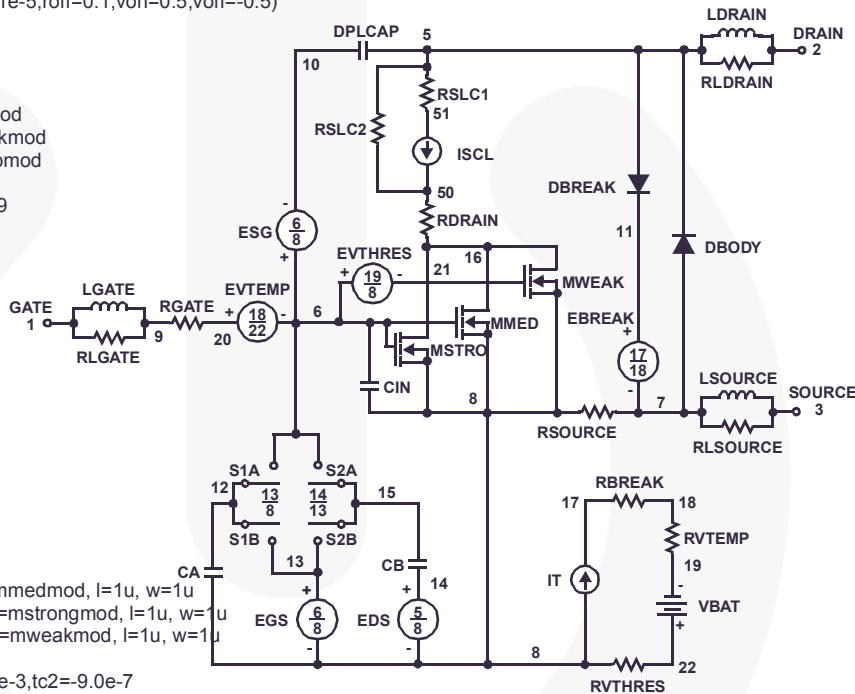
```
l.lgate n1 n9 = 4.81e-9
l.ldrain n2 n5 = 1.0e-9
l.lsource n3 n7 = 4.63e-9
```

```
res.rlgate n1 n9 = 48.1
res.rldrain n2 n5 = 10
res.rlsource n3 n7 = 46.3
```

```
m.mmed n16 n6 n8 n8 = model=mmedmod, l=1u, w=1u
m.mstrong n16 n6 n8 n8 = model=mstrongmod, l=1u, w=1u
m.mweak n16 n21 n8 n8 = model=mweakmod, l=1u, w=1u
```

```
res.rbreak n17 n18 = 1, tc1=1.05e-3,tc2=-9.0e-7
res.rdrain n5 n16 = 2.0e-4, tc1=1.8e-2,tc2=2.2e-4
res.rgate n9 n20 = 20
res.rslc1 n5 n51 = 1e-6, tc1=2.0e-3,tc2=1.0e-5
res.rslc2 n5 n50 = 1.0e3
res.rsource n8 n7 = 2.6e-3, tc1=5.0e-3,tc2=1.0e-6
res.rvthres n22 n8 = 1, tc1=-4.2e-3,tc2=-1.8e-5
res.rvtemp n18 n19 = 1, tc1=-4.5e-3,tc2=2.0e-6
sw_vcsp.s1a n6 n12 n13 n8 = model=s1amod
sw_vcsp.s1b n13 n12 n13 n8 = model=s1bmod
sw_vcsp.s2a n6 n15 n14 n13 = model=s2amod
sw_vcsp.s2b n13 n15 n14 n13 = model=s2bmod
```

```
v.vbat n22 n19 = dc=1
equations {
i (n51->n50) +=iscl
iscl: v(n51,n50) = (((v(n5,n51))/(1e-9+abs(v(n5,n51))))*((abs(v(n5,n51))*1e6/300)** 10))
}
}
```



FDH038AN08A1 — N-Channel PowerTrench® MOSFET

SPICE Thermal Model

REV 23 January 2003

FDH038AN08A1T

```

CTHERM1 TH 6 5.5e-3
CTHERM2 6 5 6.0e-3
CTHERM3 5 4 7.4e-3
CTHERM4 4 3 7.65e-3
CTHERM5 3 2 5.85e-2
CTHERM6 2 TL 6.0e-1
    
```

```

R THERM1 TH 6 9.0e-3
R THERM2 6 5 2.08e-2
R THERM3 5 4 2.28e-2
R THERM4 4 3 7.0e-2
R THERM5 3 2 7.5e-2
R THERM6 2 TL 8.5e-2
    
```

SABER Thermal Model

SABER thermal model FDH038AN08A1T

```

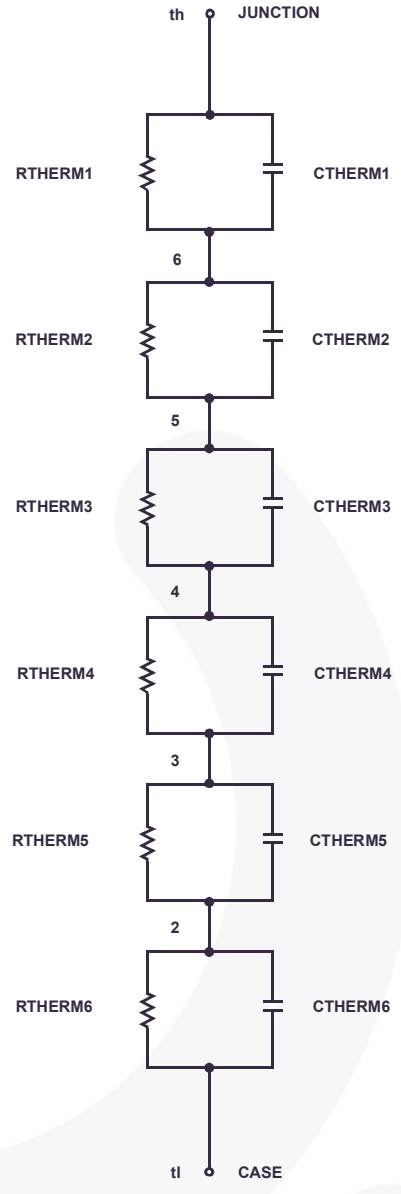
template thermal_model th tl
thermal_c th, tl
    
```

```

{
ctherm.ctherm1 th 6 =5.5e-3
ctherm.ctherm2 6 5 =6.0e-3
ctherm.ctherm3 5 4 =7.4e-3
ctherm.ctherm4 4 3 =7.65e-3
ctherm.ctherm5 3 2 =5.85e-2
ctherm.ctherm6 2 tl =6.0e-1
    
```

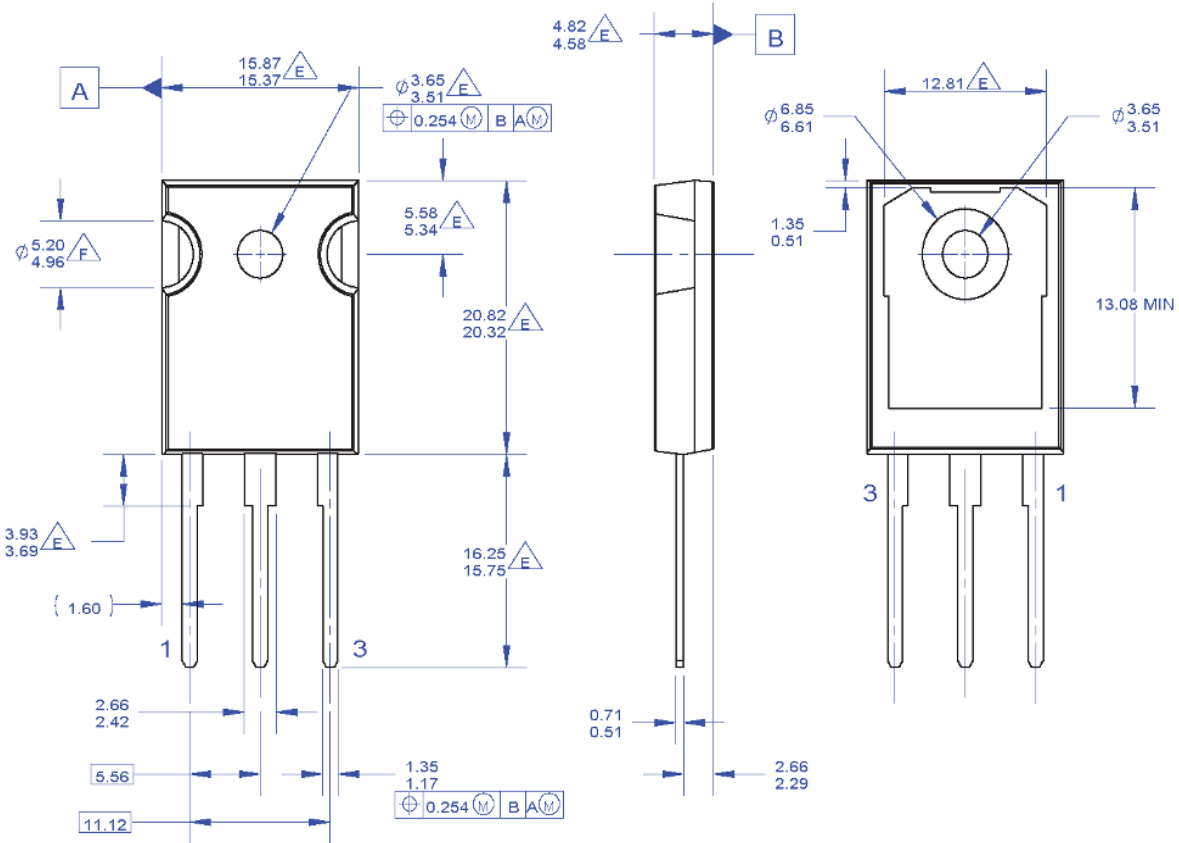
```

rtherm.rtherm1 th 6 =9.0e-3
rtherm.rtherm2 6 5 =2.08e-2
rtherm.rtherm3 5 4 =2.28e-2
rtherm.rtherm4 4 3 =7.0e-2
rtherm.rtherm5 3 2 =7.5e-2
rtherm.rtherm6 2 tl =8.5e-2
}
    
```



Mechanical Dimensions

TO-247 3L



NOTES: UNLESS OTHERWISE SPECIFIED.

- A. PACKAGE REFERENCE: JEDEC TO-247, ISSUE E, VARIATION AB, DATED JUNE, 2004.
- B. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
- C. ALL DIMENSIONS ARE IN MILLIMETERS.
- D. DRAWING CONFORMS TO ASME Y14.5 - 1994

- DOES NOT COMPLY JEDEC STANDARD VALUE
- NOTCH MAY BE SQUARE
- G. DRAWING FILENAME: MKT-TO247A03_REV03

Figure 21. TO-247, Molded, 3 Lead, Jedec Variation AB

Package drawings are provided as a service to customers considering Fairchild components. Drawings may change in any manner without notice. Please note the revision and/or date on the drawing and contact a Fairchild Semiconductor representative to verify or obtain the most recent revision. Package specifications do not expand the terms of Fairchild's worldwide terms and conditions, specifically the warranty therein, which covers Fairchild products.

Always visit Fairchild Semiconductor's online packaging area for the most recent package drawings:

http://www.fairchildsemi.com/package/packageDetails.html?id=PN_TO247-003

Dimension in Millimeters



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| AX-CAP®* | FRFET® | PowerXS™ | SYSTEM GENERAL®* |
| BitSiC™ | Global Power ResourceSM | Programmable Active Droop™ | TinyBoost® |
| Build it Now™ | GreenBridge™ | QFET® | TinyBuck® |
| CorePLUS™ | Green FPS™ | QS™ | TinyCalc™ |
| CorePOWER™ | Green FPS™ e-Series™ | Quiet Series™ | TinyLogic® |
| CROSSVOLT™ | Gmax™ | RapidConfigure™ | TINYOPTO™ |
| CTL™ | GTO™ | ISOPLANAR™ | TinyPower™ |
| Current Transfer Logic™ | IntelliMAX™ | Marking Small Speakers Sound Louder and Better™ | TinyPWM™ |
| DEUXPEED® | ISOPLANAR™ | MegaBuck™ | TinyWire™ |
| Dual Cool™ | MICROCOUPLER™ | MicroFET™ | TranSiC™ |
| EcoSPARK® | MicroPak™ | MillerDrive™ | TriFault Detect™ |
| EfficientMax™ | MicroPak2™ | MotionMax™ | TRUECURRENT®* |
| ESBC™ | FAST™ | mWSaver® | µSerDes™ |
| F ® | FastvCore™ | OPTOLOGIC® | SerDes ™ |
| Fairchild® | FETBench™ | OPTOPLANAR® | UHC® |
| Fairchild Semiconductor® | FPS™ | PowerTrench® | Ultra FRFET™ |
| FACT Quiet Series™ | | PowerXS™ | UniFET™ |
| FACT® | | Programmable Active Droop™ | VCX™ |
| FAST® | | QFET® | VisualMax™ |
| FastvCore™ | | QS™ | VoltagePlus™ |
| FETBench™ | | Quiet Series™ | XS™ |
| FPS™ | | RapidConfigure™ | |
| | | Saving our world, 1mW/W/kW at a time™ | |
| | | SignalWise™ | |
| | | SmartMax™ | |
| | | SMART START™ | |
| | | Solutions for Your Success™ | |
| | | SPM® | |
| | | STEALTH™ | |
| | | SuperFET® | |
| | | SuperSOT™-3 | |
| | | SuperSOT™-6 | |
| | | SuperSOT™-8 | |
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Definition of Terms

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