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Please note: As part of the Fairchild Semiconductor integration, some of the Fairchild orderable part numbers will need to change in order to meet ON Semiconductor's system requirements. Since the ON Semiconductor product management systems do not have the ability to manage part nomenclature that utilizes an underscore (_), the underscore (_) in the Fairchild part numbers will be changed to a dash (-). This document may contain device numbers with an underscore (_). Please check the ON Semiconductor website to verify the updated device numbers. The most current and up-to-date ordering information can be found at www.onsemi.com. Please email any questions regarding the system integration to Fairchild_questions@onsemi.com.

FAIRCHILD SEMICONDUCTOR®

October 2013

FDH038AN08A1

N-Channel PowerTrench® MOSFET

75 V, 80 A, 3.8 mΩ

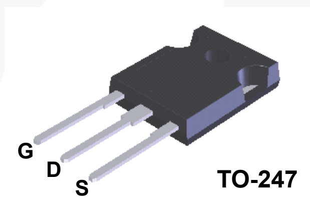
Features

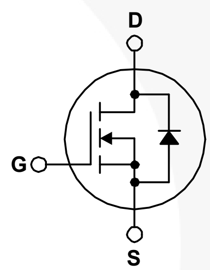
- $R_{DS(ON)}$ = 3.5 mΩ (Typ.), V_{GS} = 10 V, I_D = 80 A
- Q_g(tot) = 125 nC (Typ.), V_{GS} = 10 V
- Low Miller Charge
- Low Q_{rr} Body Diode
- UIS Capability (Single Pulse and Repetitive Pulse)

Formerly developmental type 82690

Applications

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





MOSFET Maximum Ratings T_C = 25°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°C, V_{GS} = 10V)	80	A
	Continuous (T_A = 25°C, V_{GS} = 10V, with $R_{\theta JA}$ = 30°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/°C
T_J, T_{STG}	Operating and Storage Temperature	-55 to 175	°C

Thermal Characteristics

$R_{\theta JC}$	Thermal Resistance Junction to Case, Max. TO-247	0.33	°C/W
$R_{\theta JA}$	Thermal Resistance Junction to Ambient, Max. TO-247	30	°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°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
Off Characteristics						
B_{VDSS}	Drain to Source Breakdown Voltage	I_D = 250µA, V_{GS} = 0V	75	-	-	V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 60V	-	-	1	µA
		V_{GS} = 0V, T_C = 150°C	-	-	250	
I_{GSS}	Gate to Source Leakage Current	V_{GS} = ±20V	-	-	±100	nA
On Characteristics						
$V_{GS(TH)}$	Gate to Source Threshold Voltage	V_{GS} = V_{DS}, I_D = 250µA	2	-	4	V
$r_{DS(ON)}$	Drain to Source On Resistance	I_D = 80A, V_{GS} = 10V	-	0.0035	0.0038	Ω
		I_D = 40A, V_{GS} = 6V	-	0.0047	0.0071	
		I_D = 80A, V_{GS} = 10V, T_J = 175°C	-	0.0074	0.008	
Dynamic Characteristics						
C_{ISS}	Input Capacitance	V_{DS} = 25V, V_{GS} = 0V, f = 1MHz	-	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} = 0V to 10V; V_{DD} = 40V, I_D = 80A, I_g = 1.0mA		125	160	nC
$Q_{g(TH)}$	Threshold Gate Charge	V_{GS} = 0V to 2V	-	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} = 10V)						
t_{ON}	Turn-On Time	V_{DD} = 40V, I_D = 80A, V_{GS} = 10V, R_{GS} = 2.4Ω	-	-	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} = 80A	-	-	1.25	V
		I_{SD} = 40A	-	-	1.0	V
t_{rr}	Reverse Recovery Time	I_{SD} = 75A, dI_{SD}/dt = 100A/µs	-	-	50	ns
Q_{RR}	Reverse Recovered Charge	I_{SD} = 75A, dI_{SD}/dt = 100A/µs	-	-	65	nC

Notes:
1: Starting T_J = 25°C, L = 0.65mH, I_{AS} = 60A.

Typical Characteristics T_C = 25°C unless otherwise noted

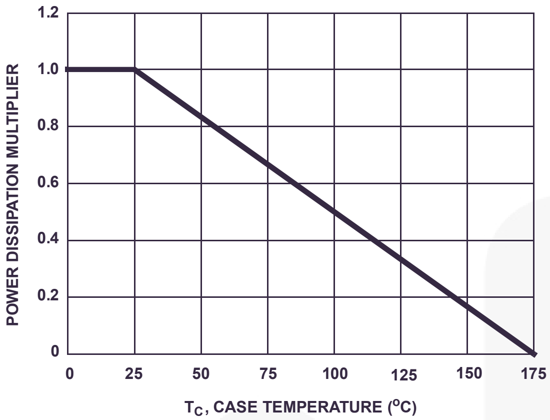


Figure 1. Normalized Power Dissipation vs Ambient Temperature

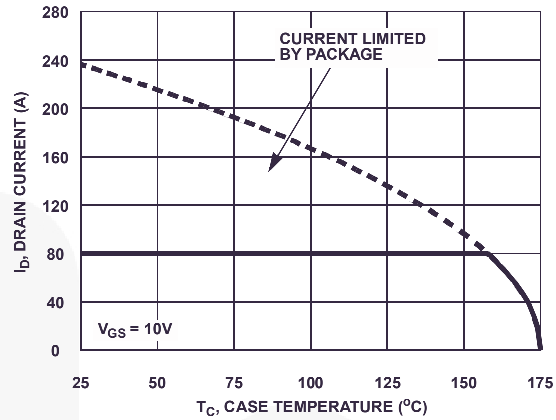


Figure 2. Maximum Continuous Drain Current vs Case Temperature

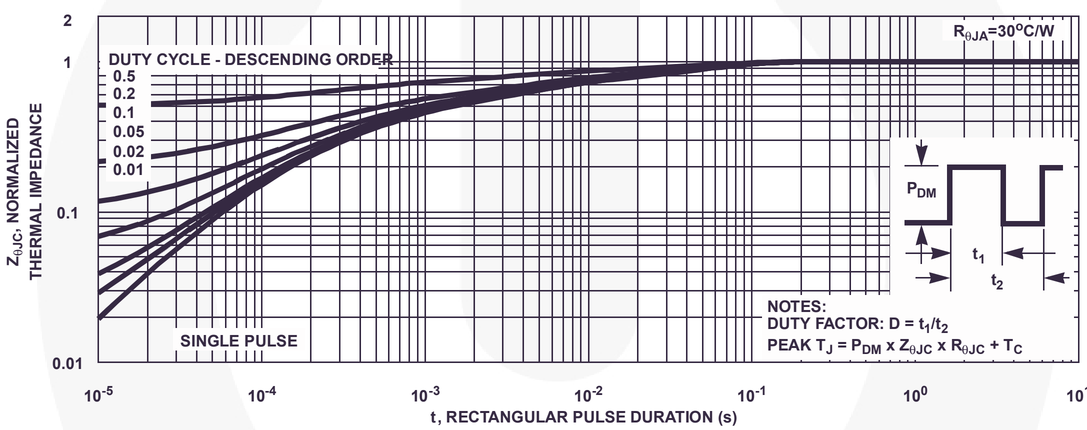


Figure 3. Normalized Maximum Transient Thermal Impedance

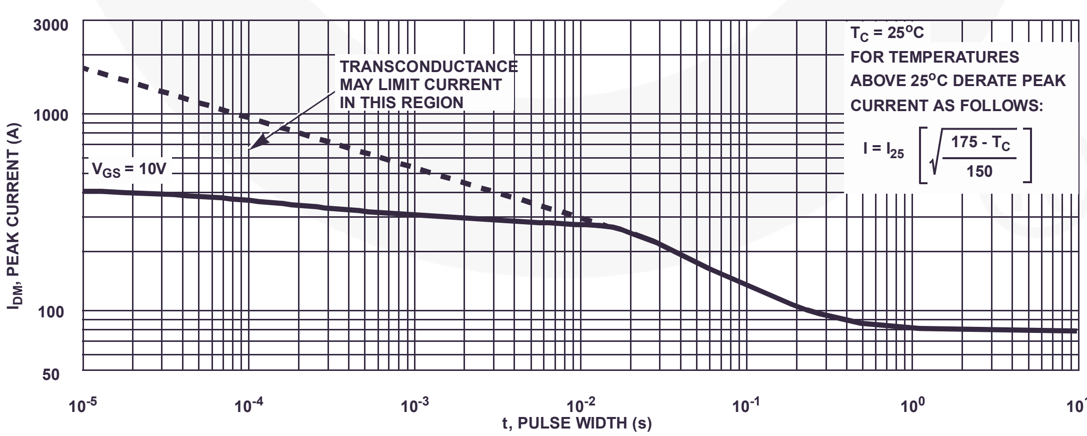


Figure 4. Peak Current Capability

Typical Characteristics T_C = 25°C unless otherwise noted

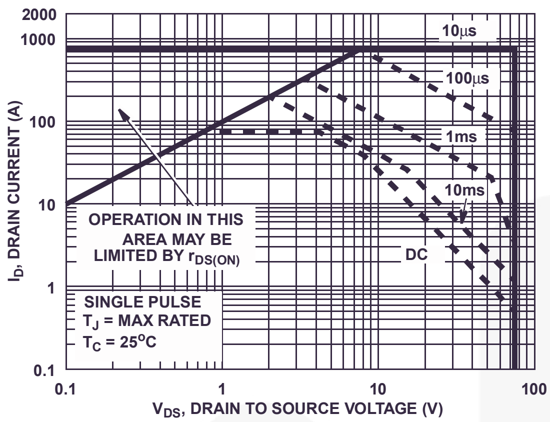
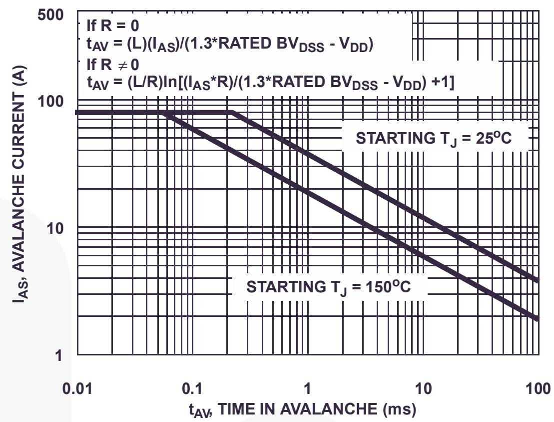


Figure 5. Forward Bias Safe Operating Area



NOTE: Refer to Fairchild Application Notes AN7514 and AN7515

Figure 6. Unclamped Inductive Switching Capability

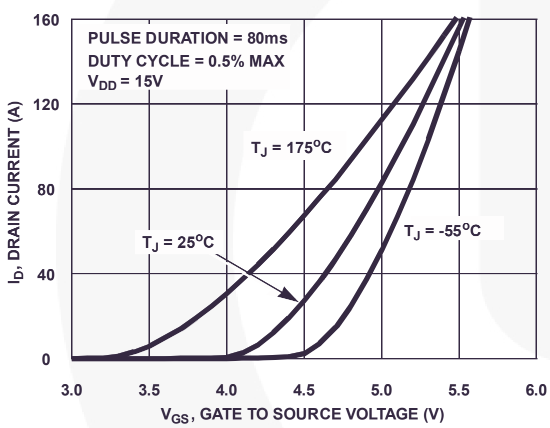


Figure 7. Transfer Characteristics

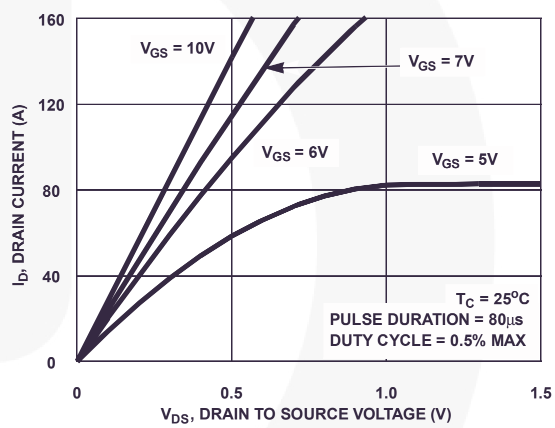


Figure 8. Saturation Characteristics

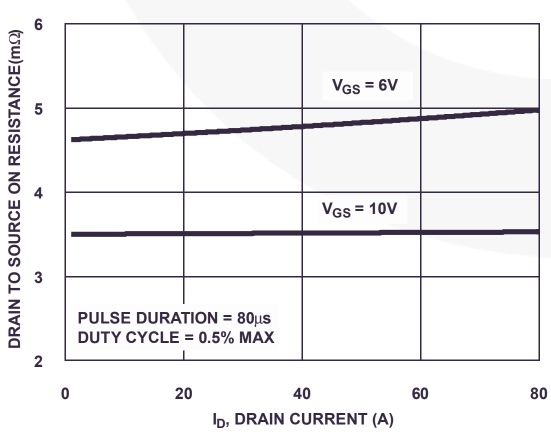


Figure 9. Drain to Source On Resistance vs Drain Current

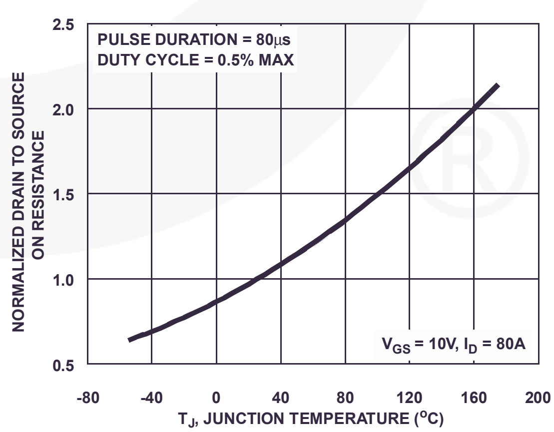


Figure 10. Normalized Drain to Source On Resistance vs Junction Temperature

Typical Characteristics T_C = 25°C unless otherwise noted

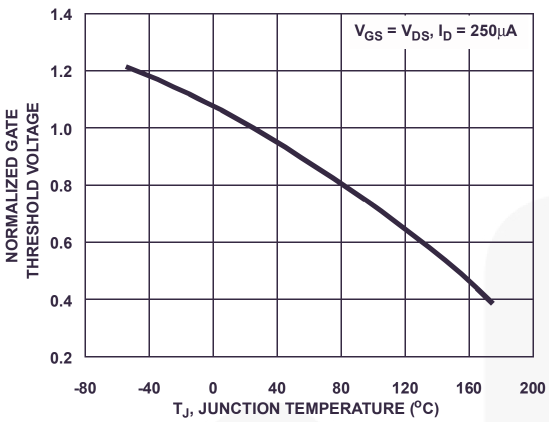


Figure 11. Normalized Gate Threshold Voltage vs Junction Temperature

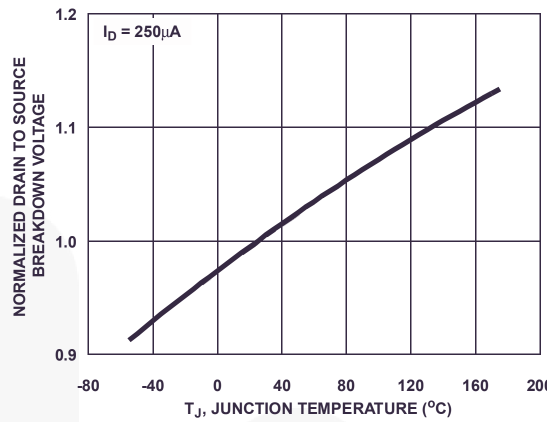


Figure 12. Normalized Drain to Source Breakdown Voltage vs Junction Temperature

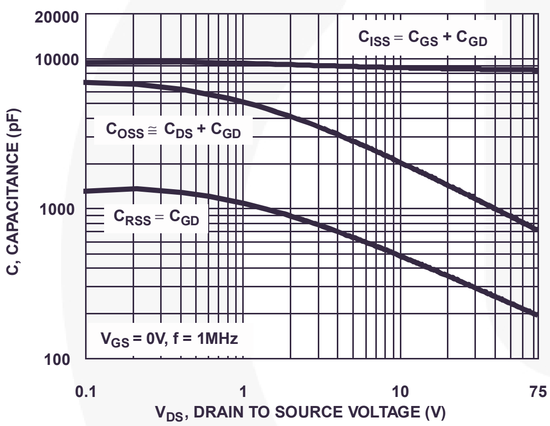


Figure 13. Capacitance vs Drain to Source Voltage

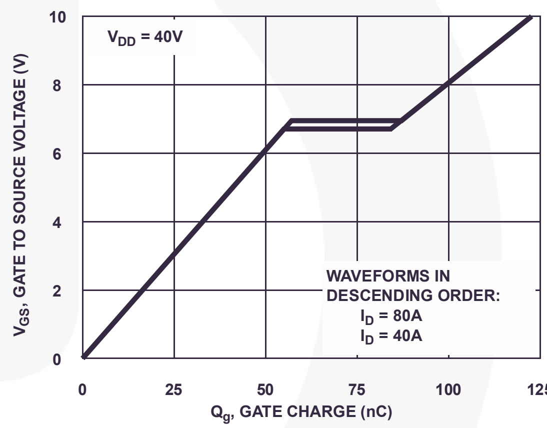


Figure 14. Gate Charge Waveforms for Constant Gate Currents

Test Circuits and Waveforms

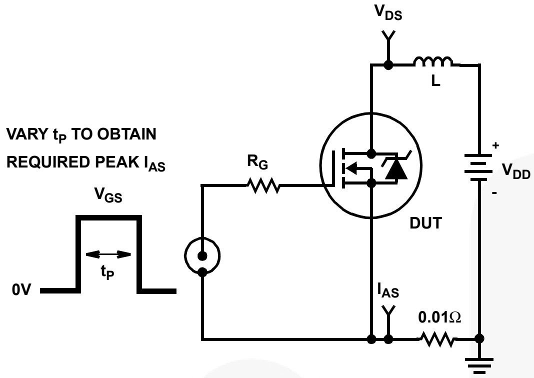


Figure 15. Unclamped Energy Test Circuit

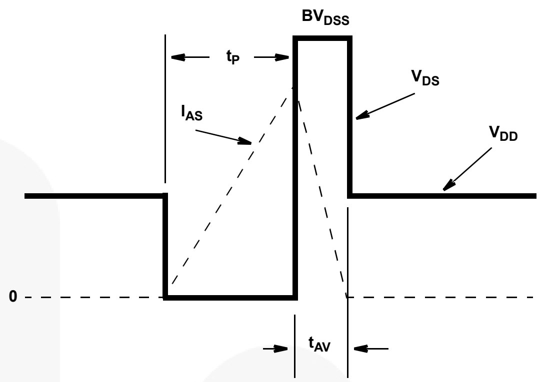


Figure 16. Unclamped Energy Waveforms

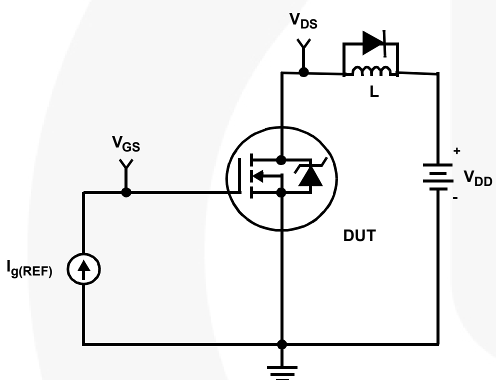


Figure 17. Gate Charge Test Circuit

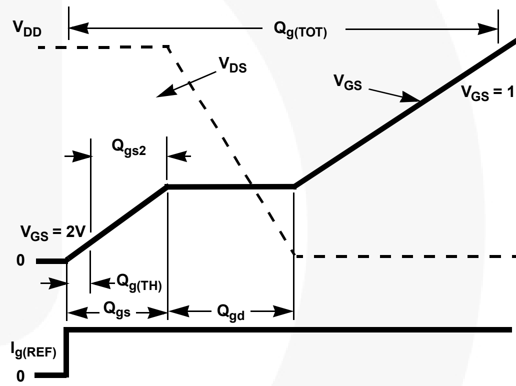


Figure 18. Gate Charge Waveforms

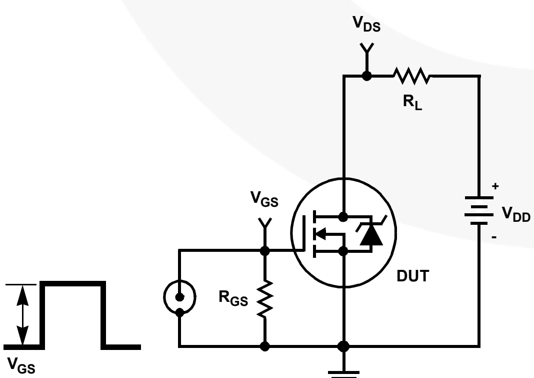


Figure 19. Switching Time Test Circuit

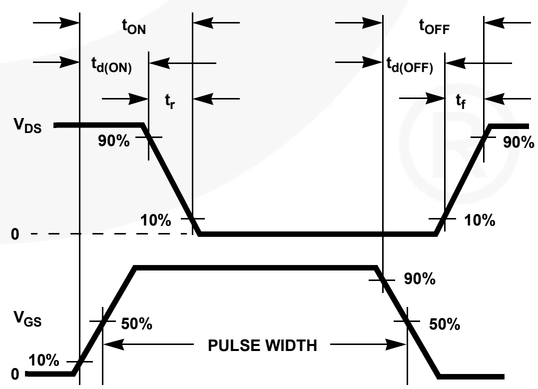
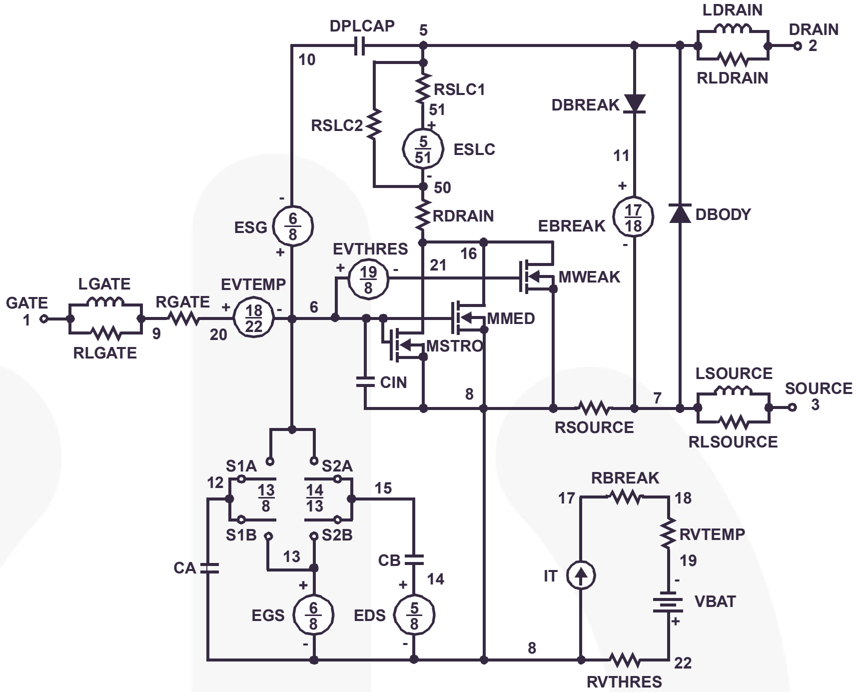


Figure 20. Switching Time Waveforms

PSPICE Electrical Model

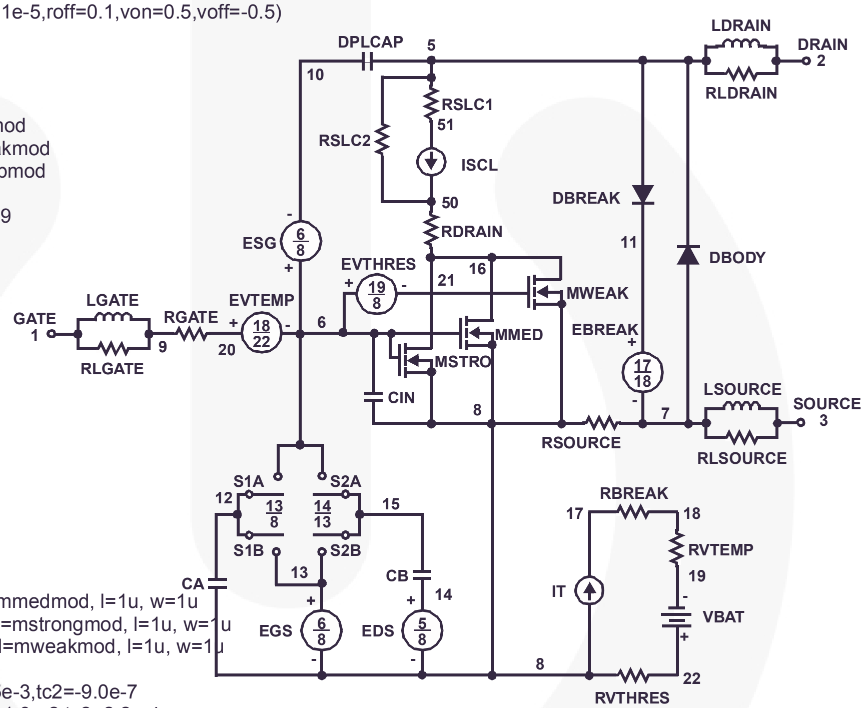



```
.SUBCKT FDH038AN08A1 2 1 3 ;      rev January 2003
CA  12  8 1.0e-9
Cb 15 14 3.1e-9
Cin 6 8 8.22e-9

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

Ebreak 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,is=1.0e-30, tox=1)
m..model mweakmod = (type=_n,vto=2.73,kp=0.02,is=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 n50 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))
}
}
```



SPICE Thermal Model

REV 23 January 2003

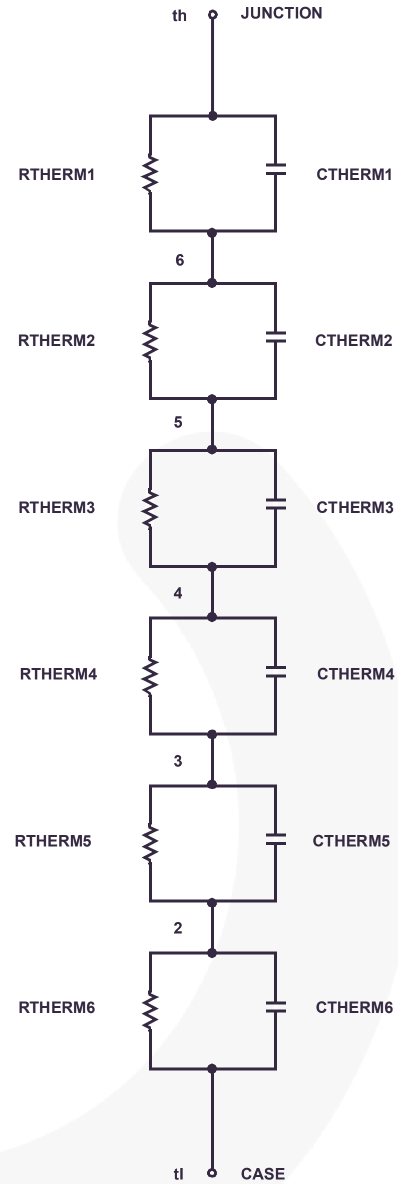
FDH038AN08A1T

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

RTHERM1 TH 6 9.0e-3
RTHERM2 6 5 2.08e-2
RTHERM3 5 4 2.28e-2
RTHERM4 4 3 7.0e-2
RTHERM5 3 2 7.5e-2
RTHERM6 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

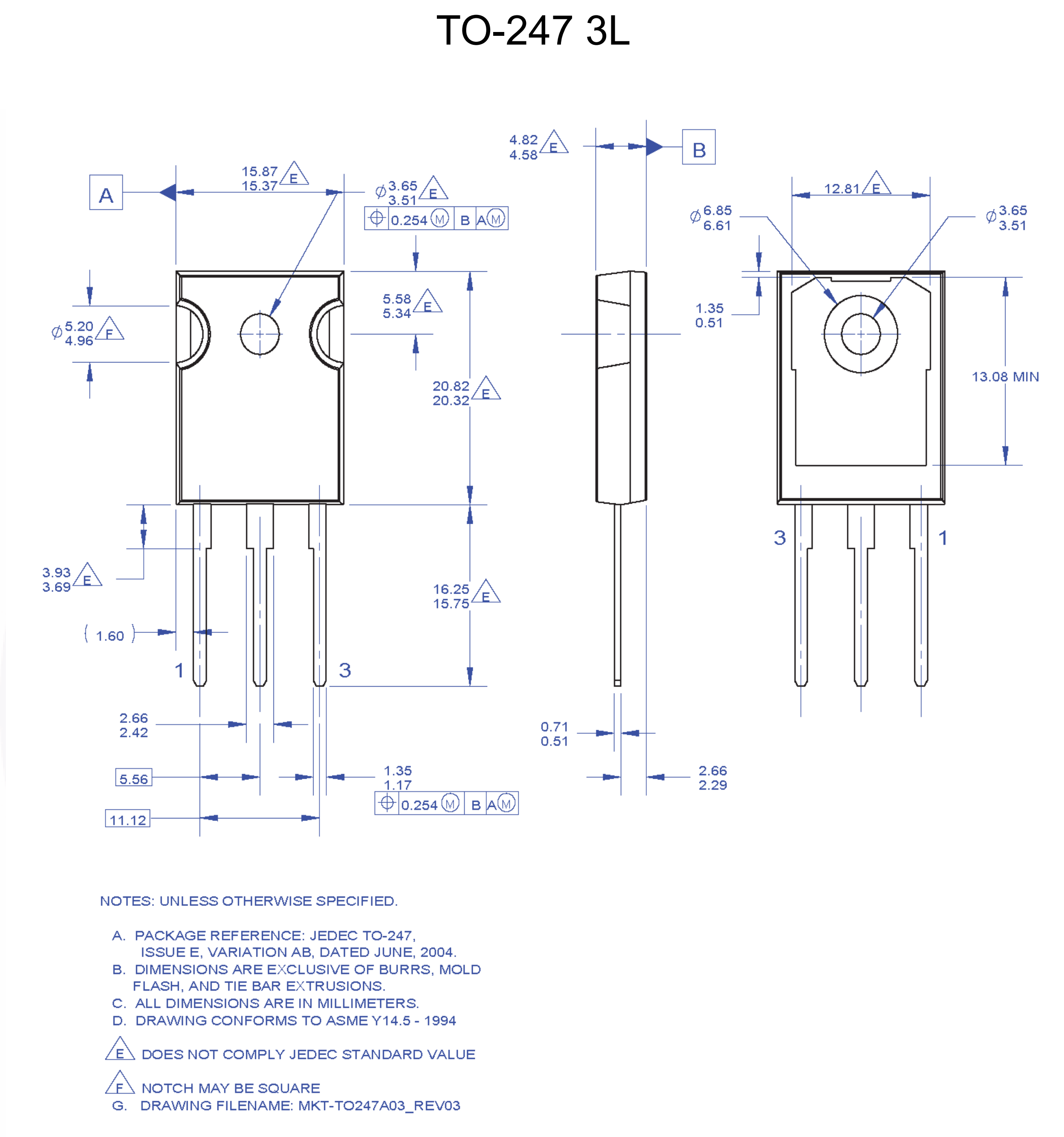


Figure 21. TO-247, Molded, 3 Lead, Jedec Variation AB

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®*
BitSiC™
Build it Now™
CorePLUS™
CorePOWER™
CROSSVOLT™
CTL™
Current Transfer Logic™
DEUXPEED®
Dual Cool™
EcoSPARK®
EfficentMax™
ESBC™
F®
Fairchild®
Fairchild Semiconductor®
FACT Quiet Series™
FACT®
FAST®
FastvCore™
FETBench™
FPS™
F-PFS™
FRFET®
Global Power Resource℠
GreenBridge™
Green FPS™
Green FPS™ e-Series™
Gmax™
GTO™
IntelliMAX™
ISOPLANAR™
Marking Small Speakers Sound Louder and Better™
MegaBuck™
MICROCOUPLER™
MicroFET™
MicroPak™
MicroPak2™
MillerDrive™
MotionMax™
mWSaver®
OptoHiT™
OPTOLOGIC®
OPTOPLANAR®
®
PowerTrench®
PowerXS™
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