

**56A, 115V, 0.025 Ohm, N-Channel
UltraFET Power MOSFET**

This N-Channel power MOSFETs is manufactured using the innovative UltraFET® process. This advanced process technology achieves the lowest possible on-resistance per silicon area, resulting in outstanding performance. This device is capable of withstanding high energy in the avalanche mode and the diode exhibits very low reverse recovery time and stored charge. It was designed for use in applications where power efficiency is important, such as switching regulators, switching converters, motor drivers, relay drivers, low-voltage bus switches, and power management in portable and battery-operated products.

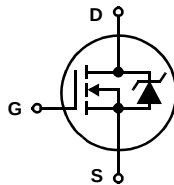
Formerly developmental type TA75639.'

Ordering Information

PART NUMBER	PACKAGE	BRAND
HUF75639S3R4851	TO-262AA	R4851

NOTE: When ordering, use the entire part number.

Symbol

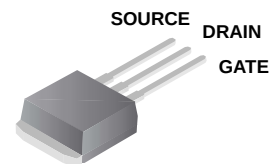


Features

- 56A, 115V
- Simulation Models
 - Temperature Compensated PSPICE® and SABER™ Electrical Models
 - Spice and Saber Thermal Impedance Models
 - www.fairchildsemi.com
- Peak Current vs Pulse Width Curve
- UIS Rating Curve
- Related Literature
 - TB334, "Guidelines for Soldering Surface Mount Components to PC Boards"

Packaging

JEDEC TO-262AA



Absolute Maximum Ratings $T_C = 25^\circ\text{C}$, Unless Otherwise Specified

	HUF75639S3R4851	UNITS
Drain to Source Voltage (Note 1)	115	V
Drain to Gate Voltage ($R_{GS} = 20\text{k}\Omega$) (Note 1)	115	V
Gate to Source Voltage	± 20	V
Drain Current		
Continuous (Figure 2)	56	A
Pulsed Drain Current	Figure 4	
Pulsed Avalanche Rating	Figures 6, 14, 15	
Power Dissipation	200	W
Derate Above 25°C	1.35	W/ $^\circ\text{C}$
Operating and Storage Temperature	-55 to 175	$^\circ\text{C}$
Maximum Temperature for Soldering		
Leads at 0.063in (1.6mm) from Case for 10s.	300	$^\circ\text{C}$
Package Body for 10s, See Techbrief 334	260	$^\circ\text{C}$

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

NOTE:

1. $T_J = 25^\circ\text{C}$ to 150°C .

Product reliability information can be found at <http://www.fairchildsemi.com/products/discrete/reliability/index.html>

For severe environments, see our Automotive HUFA series.

All Fairchild semiconductor products are manufactured, assembled and tested under ISO9000 and QS9000 quality systems certification.

HUF75639S3R4851

Electrical Specifications $T_C = 25^{\circ}\text{C}$, Unless Otherwise Specified

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS	
OFF STATE SPECIFICATIONS							
Drain to Source Breakdown Voltage	BV _{DSS}	I _D = 250μA, V _{GS} = 0V (Figure 11)	115	-	-	V	
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} = 95V, V _{GS} = 0V	-	-	1	μA	
		V _{DS} = 90V, V _{GS} = 0V, T _C = 150°C	-	-	250	μA	
Gate to Source Leakage Current	I _{GSS}	V _{GS} = ±20V	-	-	±100	nA	
ON STATE SPECIFICATIONS							
Gate to Source Threshold Voltage	V _{GS(TH)}	V _{GS} = V _{DS} , I _D = 250μA (Figure 10)	2	-	4	V	
Drain to Source On Resistance	r _{DS(ON)}	I _D = 56A, V _{GS} = 10V (Figure 9)	-	0.021	0.025	Ω	
THERMAL SPECIFICATIONS							
Thermal Resistance Junction to Case	R _{θJC}	(Figure 3)	-	-	0.74	°C/W	
Thermal Resistance Junction to Ambient	R _{θJA}	TO-262	-	-	62	°C/W	
SWITCHING SPECIFICATIONS (V _{GS} = 10V)							
Turn-On Time	t _{ON}	V _{DD} = 50V, I _D ≅ 56A, R _L = 0.89Ω, V _{GS} = 10V, R _{GS} = 5.1Ω	-	-	110	ns	
Turn-On Delay Time	t _{d(ON)}		-	15	-	ns	
Rise Time	t _r		-	60	-	ns	
Turn-Off Delay Time	t _{d(OFF)}		-	20	-	ns	
Fall Time	t _f		-	25	-	ns	
Turn-Off Time	t _{OFF}		-	-	70	ns	
GATE CHARGE SPECIFICATIONS							
Total Gate Charge	Q _{g(TOT)}	V _{GS} = 0V to 20V	V _{DD} = 50V, I _D ≅ 56A, R _L = 0.89Ω I _{g(REF)} = 1.0mA (Figure 13)	-	110	130	nC
Gate Charge at 10V	Q _{g(10)}	V _{GS} = 0V to 10V		-	57	75	nC
Threshold Gate Charge	Q _{g(TH)}	V _{GS} = 0V to 2V		-	3.7	4.5	nC
Gate to Source Gate Charge	Q _{gs}			-	9.8	-	nC
Reverse Transfer Capacitance	Q _{gd}			-	24	-	nC
CAPACITANCE SPECIFICATIONS							
Input Capacitance	C _{ISS}	V _{DS} = 25V, V _{GS} = 0V, f = 1MHz (Figure 12)	-	2000	-	pF	
Output Capacitance	C _{OSS}		-	500	-	pF	
Reverse Transfer Capacitance	C _{RSS}		-	65	-	pF	

Source to Drain Diode Specifications

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Source to Drain Diode Voltage	V_{SD}	$I_{SD} = 56\text{A}$	-	-	1.25	V
Reverse Recovery Time	t_{rr}	$I_{SD} = 56\text{A}$, $dI_{SD}/dt = 100\text{A}/\mu\text{s}$	-	-	110	ns
Reverse Recovered Charge	Q_{RR}	$I_{SD} = 56\text{A}$, $dI_{SD}/dt = 100\text{A}/\mu\text{s}$	-	-	320	nC

Typical Performance Curves

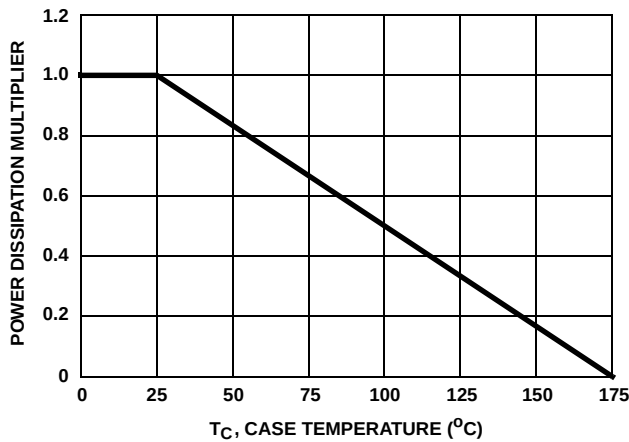


FIGURE 1. NORMALIZED POWER DISSIPATION vs CASE TEMPERATURE

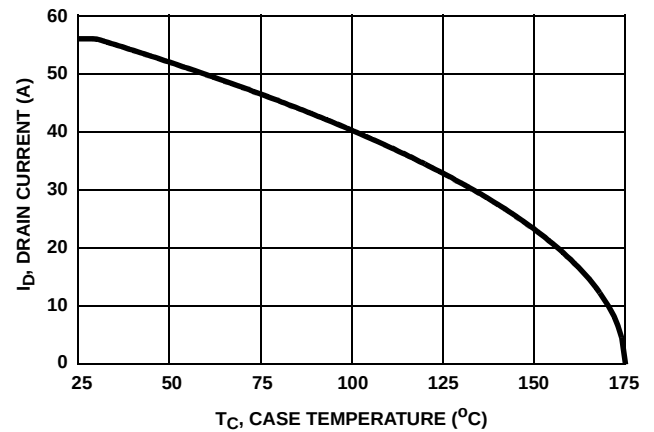


FIGURE 2. MAXIMUM CONTINUOUS DRAIN CURRENT vs CASE TEMPERATURE

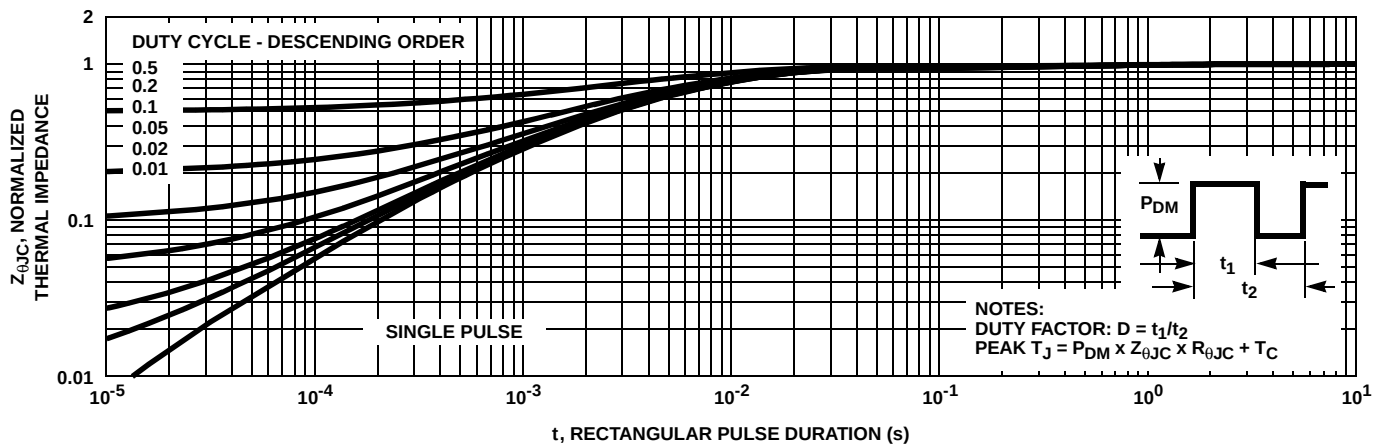


FIGURE 3. NORMALIZED MAXIMUM TRANSIENT THERMAL IMPEDANCE

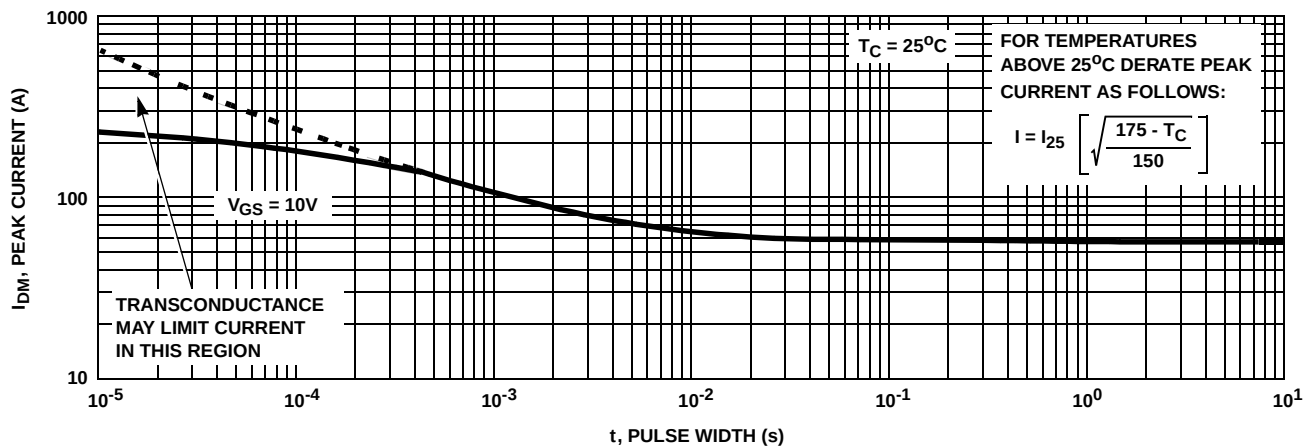


FIGURE 4. PEAK CURRENT CAPABILITY

Typical Performance Curves (Continued)

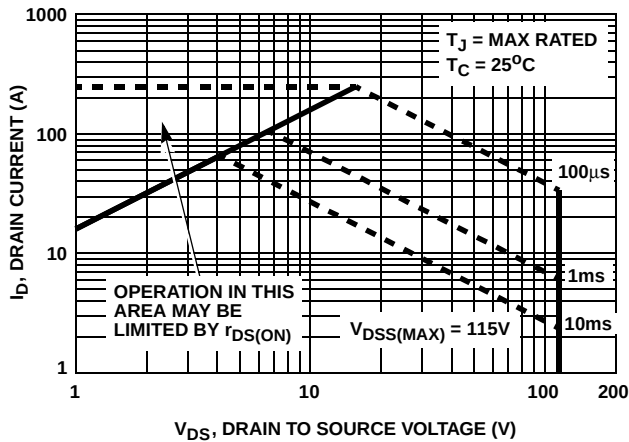
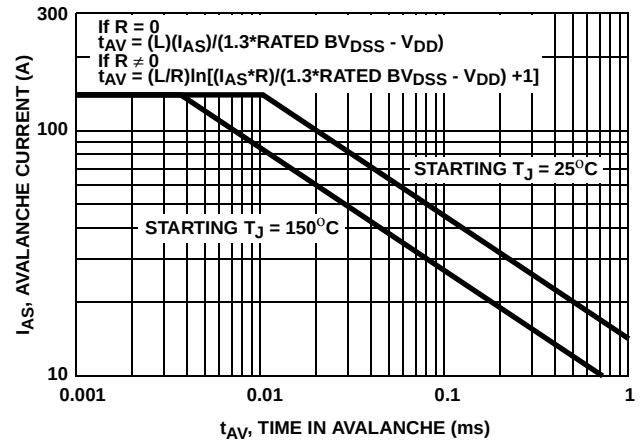


FIGURE 5. FORWARD BIAS SAFE OPERATING AREA



NOTE: Refer to Fairchild Application Notes AN9321 and AN9322.

FIGURE 6. UNCLAMPED INDUCTIVE SWITCHING CAPABILITY

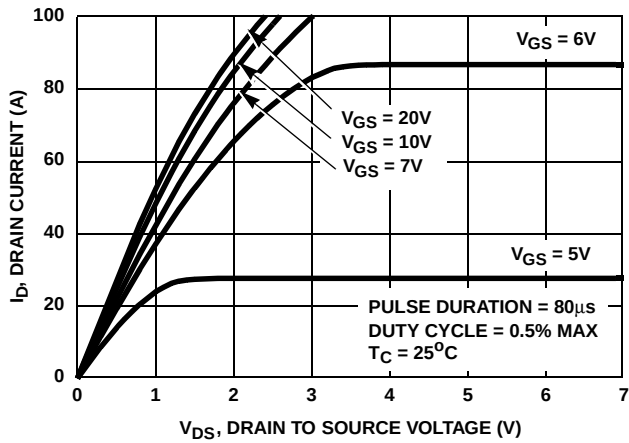


FIGURE 7. SATURATION CHARACTERISTICS

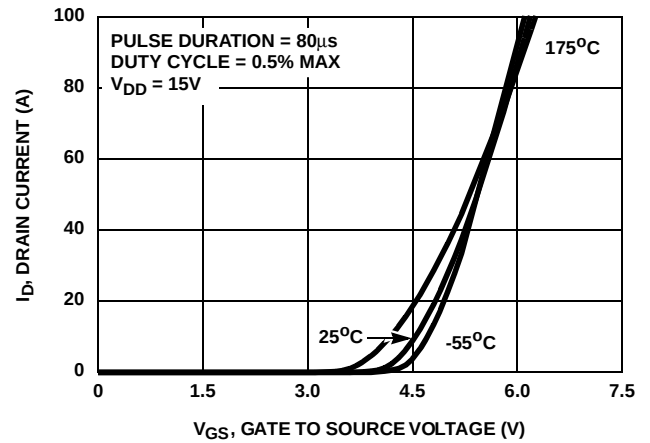


FIGURE 8. TRANSFER CHARACTERISTICS

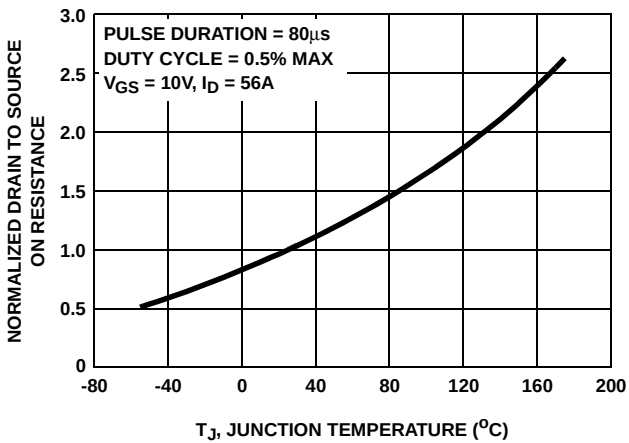


FIGURE 9. NORMALIZED DRAIN TO SOURCE ON RESISTANCE vs JUNCTION TEMPERATURE

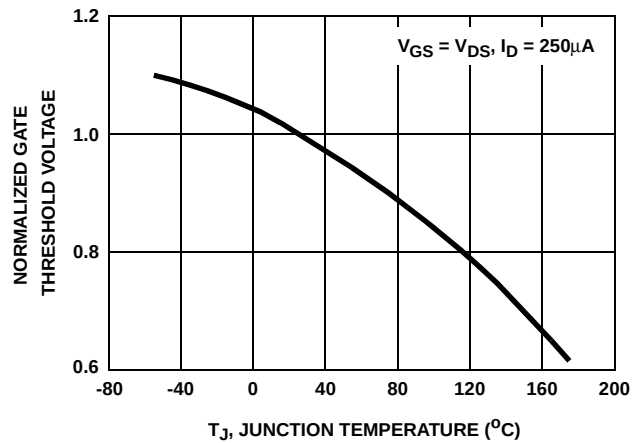


FIGURE 10. NORMALIZED GATE THRESHOLD VOLTAGE vs JUNCTION TEMPERATURE

Typical Performance Curves (Continued)

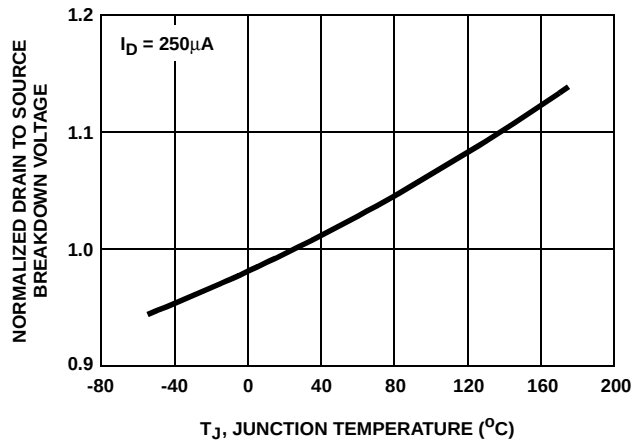


FIGURE 11. NORMALIZED DRAIN TO SOURCE BREAKDOWN VOLTAGE vs JUNCTION TEMPERATURE

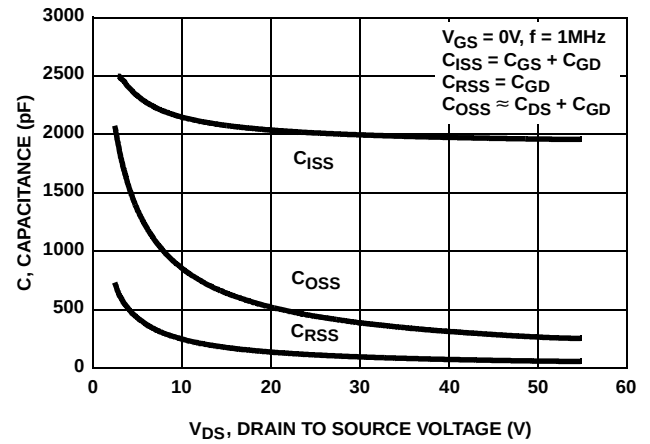
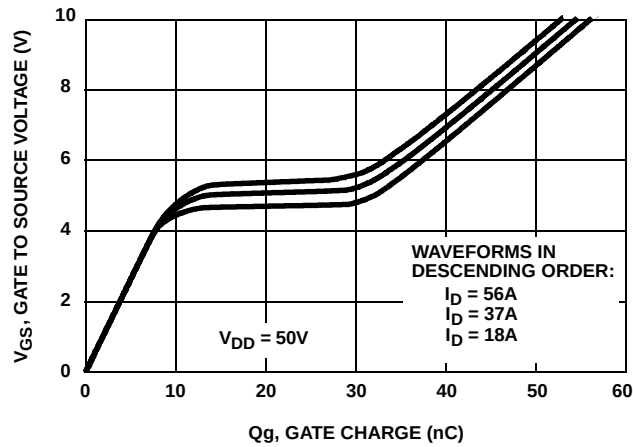


FIGURE 12. CAPACITANCE vs DRAIN TO SOURCE VOLTAGE



NOTE: Refer to Fairchild Application Notes AN7254 and AN7260.
FIGURE 13. GATE CHARGE WAVEFORMS FOR CONSTANT GATE CURRENT

Test Circuits and Waveforms

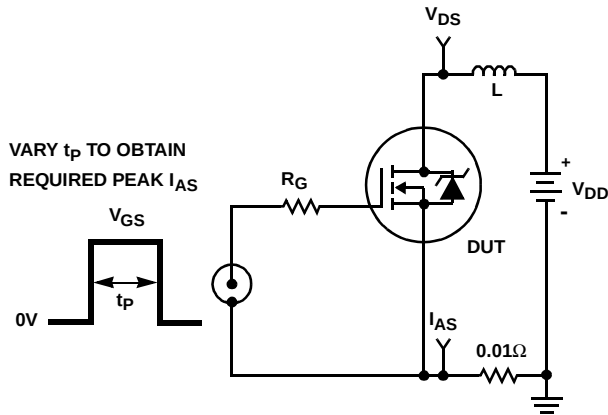


FIGURE 14. UNCLAMPED ENERGY TEST CIRCUIT

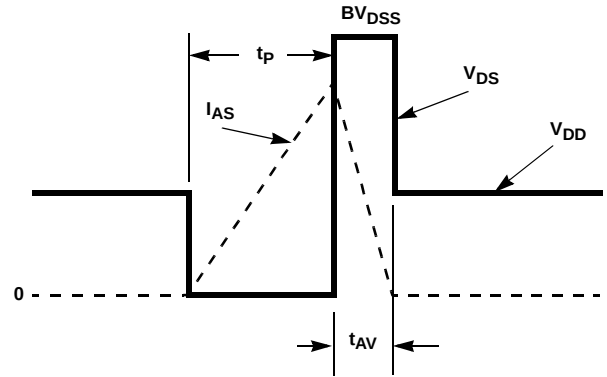


FIGURE 15. UNCLAMPED ENERGY WAVEFORMS

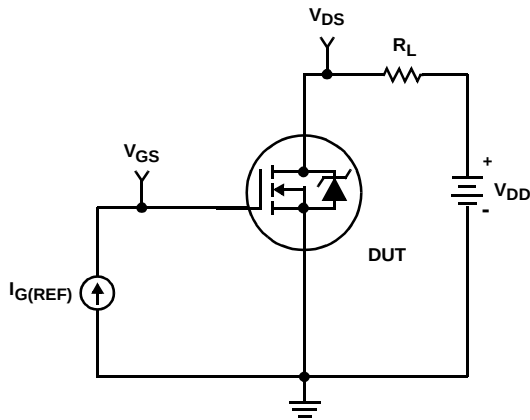


FIGURE 16. GATE CHARGE TEST CIRCUIT

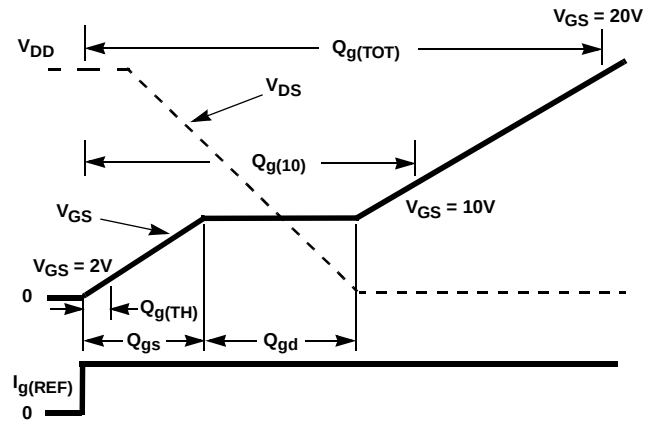


FIGURE 17. GATE CHARGE WAVEFORM

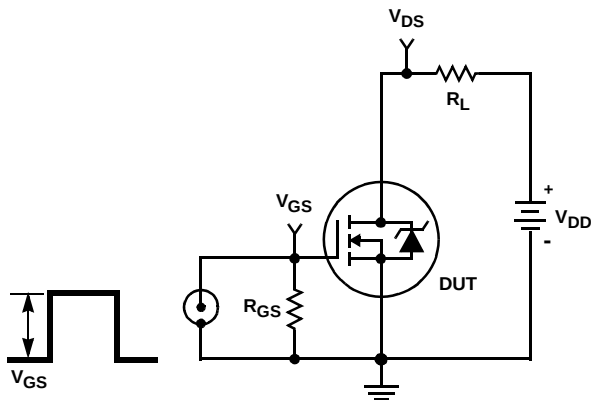


FIGURE 18. SWITCHING TIME TEST CIRCUIT

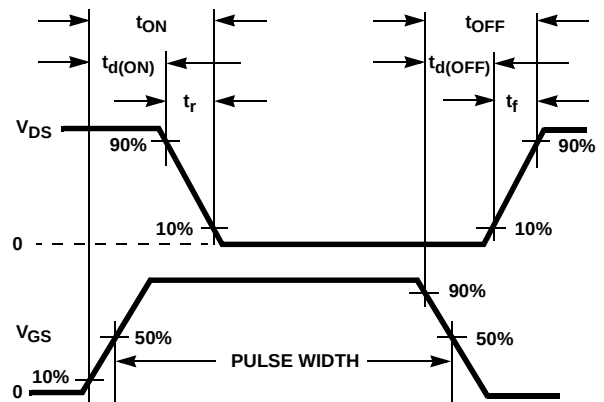


FIGURE 19. RESISTIVE SWITCHING WAVEFORMS

PSPICE Electrical Model

SUBCKT R4851 2 1 3 ; rev 19 Oct. 99

CA 12 8 2.8e-9

CB 15 14 2.65e-9

CIN 6 8 1.9e-9

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

EBREAK 11 7 17 18 126
 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

LDRAIN 2 5 2e-9

LGATE 1 9 1e-9

LSOURCE 3 7 0.47e-9

RLGATE 1 9 10

RLDRAIN 2 5 20

RLSOURCE 3 7 4.69

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 1.3e-2
 RGATE 9 20 0.7
 RSLC1 5 51 RSLCMOD 1e-6
 RSLC2 5 50 1e3
 RSOURCE 8 7 RSOURCEMOD 4.5e-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

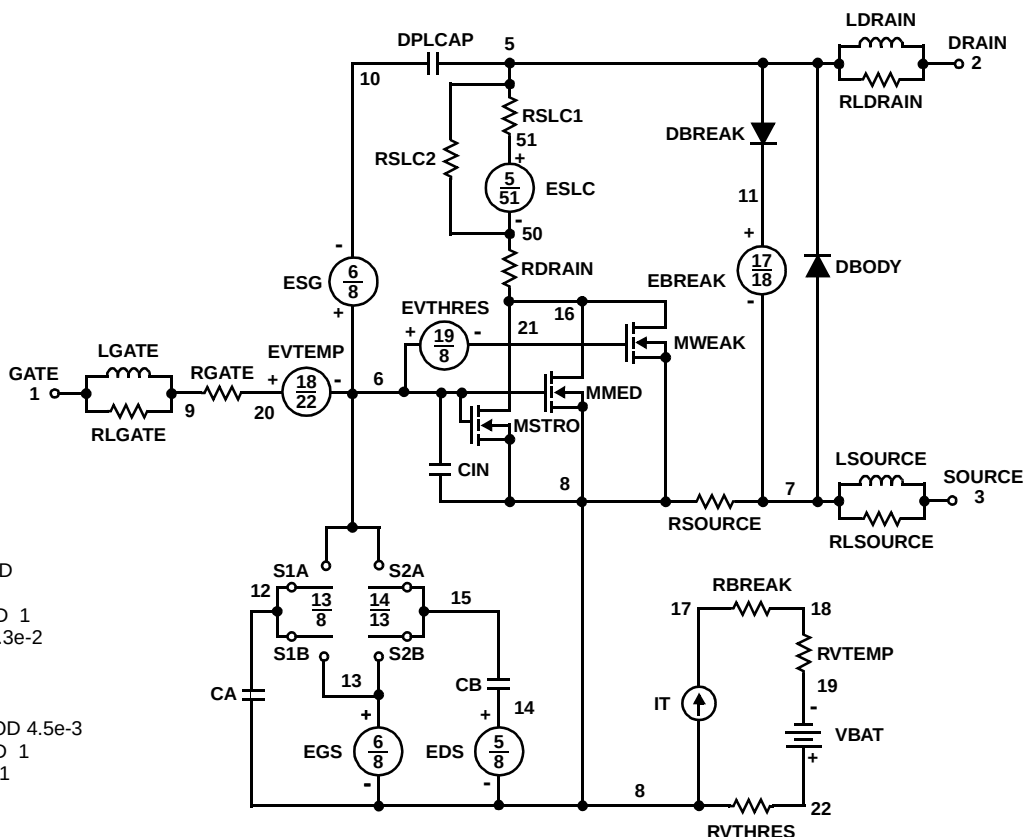
ESLC 51 50 VALUE = {(V(5,51)/ABS(V(5,51)))*(PWR(V(5,51)/(1e-6*115),4))}

.MODEL DBODYMOD D (IS = 1.4e-12 RS = 3.3e-3 XTI = 4.7 TRS1 = 2e-3 TRS2 = 0.1e-5 CJO = 3.3e-9 TT = 6.1e-8 M = 0.7)
 .MODEL DBREAKMOD D (RS = 3.5e-1 TRS1 = 1e-3 TRS2 = 1e-6)
 .MODEL DPLCAPMOD D (CJO = 2.2e-9 IS = 1e-3 ON = 10 M = 0.95 vj = 1.0)
 .MODEL MMEDMOD NMOS (VTO = 3.5 KP = 4.8 IS = 1e-30 N = 10 TOX = 1 L = 1u W = 1u Rg = 0.7)
 .MODEL MSTROMOD NMOS (VTO = 3.97 KP = 56.5 IS = 1e-30 N = 10 TOX = 1 L = 1u W = 1u)
 .MODEL MWEAKMOD NMOS (VTO = 3.11 KP = 0.085 IS = 1e-30 N = 10 TOX = 1 L = 1u W = 1u RG = 7 RS = 0.1)
 .MODEL RBREAKMOD RES (TC1 = 0.8e-3 TC2 = 1e-6)
 .MODEL RDRAINMOD RES (TC1 = 1e-2 TC2 = 1.75e-5)
 .MODEL RSLCMOD RES (TC1 = 2.8e-3 TC2 = 14e-6)
 .MODEL RSOURCEMOD RES (TC1 = 0 TC2 = 0)
 .MODEL RVTHRESMOD RES (TC = -2.0e-3 TC2 = -1.75e-5)
 .MODEL RVTEMPMOD RES (TC1 = -2.75e-3 TC2 = 0.05e-9)

.MODEL S1AMOD VSWITCH (RON = 1e-5 ROFF = 0.1 VON = -6.0 VOFF = -3.5)
 .MODEL S1BMOD VSWITCH (RON = 1e-5 ROFF = 0.1 VON = -3.5 VOFF = -6.0)
 .MODEL S2AMOD VSWITCH (RON = 1e-5 ROFF = 0.1 VON = -2.5 VOFF = 4.95)
 .MODEL S2BMOD VSWITCH (RON = 1e-5 ROFF = 0.1 VON = 4.95 VOFF = -2.5)

.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. Frank Wheatley.



Spice Thermal Model

REV 19 Oct 1999

R4851

CTHERM1 TH 6 5.0e-3
 CHERM2 6 5 1.9e-2
 CHERM3 5 4 7.95e-3
 CHERM4 4 3 9.0e-3
 CHERM5 3 2 2.95e-2
 CHERM6 2 TL 12.55

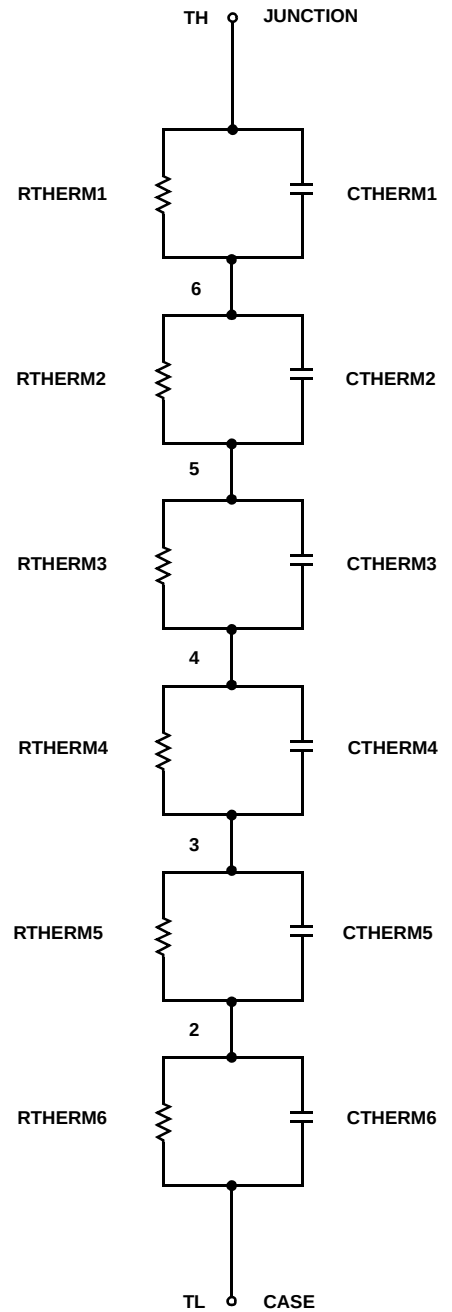
RHERM1 TH 6 5.04e-3
 RHERM2 6 5 1.25e-2
 RHERM3 5 4 3.54e-2
 RHERM4 4 3 1.98e-1
 RHERM5 3 2 2.99e-1
 RHERM6 2 TL 3.97e-2

Saber Thermal Model

Saber thermal model R4851

```
template thermal_model th tl
thermal_c th, tl
{
  ctherm.ctherm1 th 6 = 5.0e-3
  ctherm.ctherm2 6 5 = 1.9e-2
  ctherm.ctherm3 5 4 = 7.95e-3
  ctherm.ctherm4 4 3 = 9.0e-3
  ctherm.ctherm5 3 2 = 2.95e-2
  ctherm.ctherm6 2 tl = 12.55
```

```
rtherm.rtherm1 th 6 = 5.04e-3
rtherm.rtherm2 6 5 = 1.25e-2
rtherm.rtherm3 5 4 = 3.54e-2
rtherm.rtherm4 4 3 = 1.98e-1
rtherm.rtherm5 3 2 = 2.99e-1
rtherm.rtherm6 2 tl = 3.97e-2
}
```



TRADEMARKS

The following are registered and unregistered trademarks Fairchild Semiconductor owns or is authorized to use and is not intended to be an exhaustive list of all such trademarks.

ACE ^{Ex} TM	FAST [®]	OPTOLOGIC TM	SMART START TM	VCX TM
Bottomless TM	FAST ^r TM	OPTOPLANAR TM	STAR*POWER TM	
CoolFET TM	FRFET TM	PACMAN TM	Stealth TM	
CROSSVOLT TM	GlobalOptoisolator TM	POP TM	SuperSOT TM -3	
DenseTrench TM	GTO TM	Power247 TM	SuperSOT TM -6	
DOME TM	HiSeC TM	PowerTrench [®]	SuperSOT TM -8	
EcoSPARK TM	ISOPLANAR TM	QFET TM	SyncFET TM	
E ² CMOS TM	LittleFET TM	QS TM	TinyLogic TM	
EnSigna TM	MicroFET TM	QT Optoelectronics TM	TruTranslation TM	
FACT TM	MicroPak TM	Quiet Series TM	UHC TM	
FACT Quiet Series TM	MICROWIRE TM	SILENT SWITCHER [®]	UltraFET [®]	

STAR*POWER is used under license

DISCLAIMER

FAIRCHILD SEMICONDUCTOR RESERVES THE RIGHT TO MAKE CHANGES WITHOUT FURTHER NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION OR DESIGN. FAIRCHILD DOES NOT ASSUME ANY LIABILITY ARISING OUT OF THE APPLICATION OR USE OF ANY PRODUCT OR CIRCUIT DESCRIBED HEREIN; NEITHER DOES IT CONVEY ANY LICENSE UNDER ITS PATENT RIGHTS, NOR THE RIGHTS OF OTHERS.

LIFE SUPPORT POLICY

FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF FAIRCHILD SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, or (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in significant injury to the user.
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.

PRODUCT STATUS DEFINITIONS

Definition of Terms

Datasheet Identification	Product Status	Definition
Advance Information	Formative or In Design	This datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	This datasheet contains preliminary data, and supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design.
No Identification Needed	Full Production	This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design.
Obsolete	Not In Production	This datasheet contains specifications on a product that has been discontinued by Fairchild semiconductor. The datasheet is printed for reference information only.