

勝特力材料 886-3-5753170
 勝特力电子(上海) 86-21-34970699
 勝特力电子(深圳) 86-755-83298787
 Http://www.100y.com.tw

Data Sheet

September 2002

**16A, 60V, 0.047 Ohm, Logic Level,
N-Channel Power MOSFETs**

These are N-Channel power MOSFETs manufactured using a modern process. This process, which uses feature sizes approaching those of LSI integrated circuits gives optimum utilization of silicon, resulting in outstanding performance. They were designed for use in applications such as switching regulators, switching converters, motor drivers, relay drivers and emitter switches for bipolar transistors. This performance is accomplished through a special gate oxide design which provides full rated conductance at gate bias in the 3V to 5V range, thereby facilitating true on-off power control directly from logic level (5V) integrated circuits.

Formerly developmental type TA49027.

Ordering Information

PART NUMBER	PACKAGE	BRAND
RFD16N06LESM*	TO-252AA	16N06LE

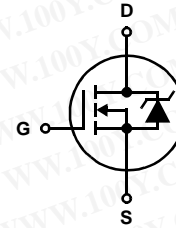
NOTE: When ordering, use the entire part number. Add suffix 9A to obtain the TO-252AA variant in the tape and reel, i.e., RFD16N06LESM9A.

*RFD16N06LESM is only available in tape and reel.

Features

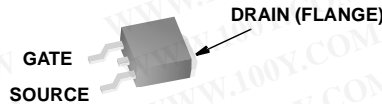
- 16A, 60V
- $r_{DS(ON)} = 0.047\Omega$
- Temperature Compensating PSPICE® Model
- Can be Driven Directly from CMOS, NMOS, TTL Circuits
- Peak Current vs Pulse Width Curve
- UIS Rating Curve
- Related Literature
 - TB334 "Guidelines for Soldering Surface Mount Components to PC Boards"

Symbol



Packaging

JEDEC TO-252AA



RFD16N06LESM

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

	RFD16N06LESM	UNITS
Drain to Source Voltage (Note 1)	V_{DS}	60 V
Drain to Gate Voltage ($R_{GS} = 20\text{k}\Omega$) (Note 1)	V_{DGR}	60 V
Gate to Source Voltage	V_{GS}	+10, -8 V
Continuous Drain Current	I_D	16 A
Pulsed Drain Current (Note 3)	I_{DM}	Refer to Peak Current Curve
Pulsed Avalanche Rating	E_{AS}	Refer to UIS Curve
Power Dissipation	P_D	90 W
Derate Above 25°C		0.606 W/ $^\circ\text{C}$
Operating and Storage Temperature	T_J, T_{STG}	-55 to 175 $^\circ\text{C}$
Maximum Temperature for Soldering		
Leads at 0.063in (1.6mm) from Case for 10s	T_L	300 $^\circ\text{C}$
Package Body for 10s, See Techbrief 334	T_{pkg}	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:

- $T_J = 25^\circ\text{C}$ to 150°C .

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

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Drain to Source Breakdown Voltage	BV_{DS}	$I_D = 250\mu\text{A}, V_{GS} = 0\text{V}$, Figure 11	60	-	-	V
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 250\mu\text{A}$, Figure 10	1	-	3	V
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 55\text{V}, V_{GS} = 0\text{V}$	-	-	1	μA
		$V_{DS} = 50\text{V}, V_{GS} = 0\text{V}, T_C = 150^\circ\text{C}$	-	-	250	μA
Gate to Source Leakage Current	I_{GSS}	$V_{GS} = +10, -8\text{V}$	-	-	10	μA
Drain to Source On Resistance (Note 2)	$r_{DS(ON)}$	$I_D = 16\text{A}, V_{GS} = 5\text{V}$	-	-	0.047	Ω
Turn-On Time	t_{ON}	$V_{DD} = 30\text{V}, I_D = 16\text{A}, R_L = 1.88\Omega,$ $V_{GS} = 5\text{V}, R_{GS} = 5\Omega$ Figures 16, 17	-	-	100	ns
Turn-On Delay Time	$t_{d(ON)}$		-	11	-	ns
Rise Time	t_r		-	60	-	ns
Turn-Off Delay Time	$t_{d(OFF)}$		-	48	-	ns
Fall Time	t_f		-	35	-	ns
Turn-Off Time	t_{OFF}		-	-	115	ns
Total Gate Charge	$Q_g(TOT)$	$V_{GS} = 0\text{V}$ to 10V	-	51	62	nC
Gate Charge at 5V	$Q_g(5)$	$V_{GS} = 0\text{V}$ to 5V				
Threshold Gate Charge	$Q_g(TH)$	$V_{GS} = 0\text{V}$ to 1V				
Input Capacitance	C_{ISS}	$V_{DS} = 25\text{V}, V_{GS} = 0\text{V},$ $f = 1\text{MHz}$ Figure 12	-	1350	-	pF
Output Capacitance	C_{OSS}		-	300	-	pF
Reverse Transfer Capacitance	C_{RSS}		-	90	-	pF
Thermal Resistance Junction to Case	$R_{\theta JC}$		-	-	1.65	$^\circ\text{C/W}$
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	TO-251AA, TO-252AA	-	-	80	$^\circ\text{C/W}$

Source to Drain Diode Specifications

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Source to Drain Diode Voltage (Note 2)	V_{SD}	$I_{SD} = 16\text{A}$	-	-	1.5	V
Diode Reverse Recovery Time	t_{rr}	$I_{SD} = 16\text{A}, dI_{SD}/dt = 100\text{A}/\mu\text{s}$	-	-	125	ns

NOTES:

- Pulse Test: Pulse Width $\leq 300\mu\text{s}$, Duty Cycle $\leq 2\%$.
- Repetitive Rating: Pulse Width limited by max junction temperature.

Typical Performance Curves Unless Otherwise Specified

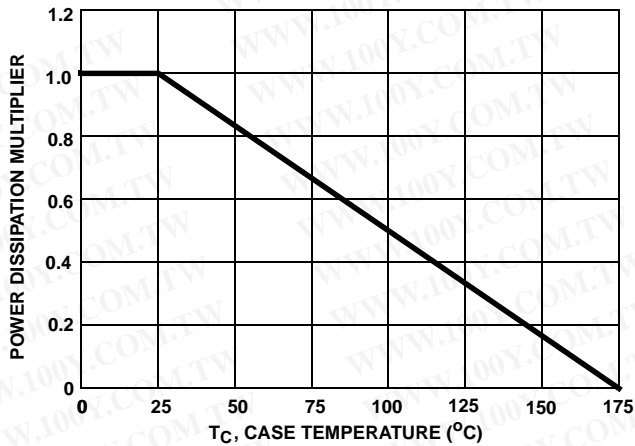


FIGURE 1. NORMALIZED POWER DISSIPATION vs CASE TEMPERATURE

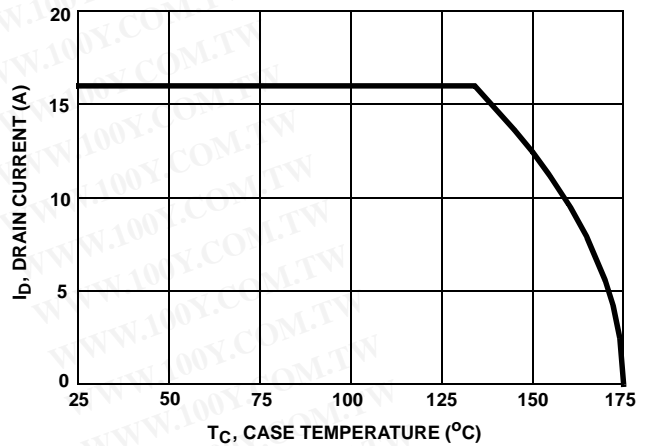


FIGURE 2. MAXIMUM CONTINUOUS DRAIN CURRENT vs CASE TEMPERATURE

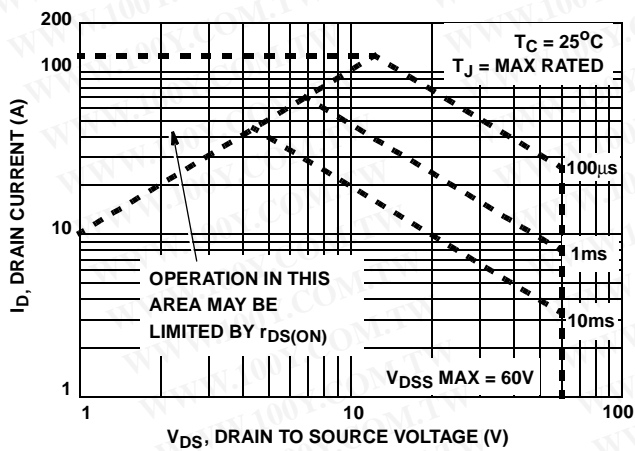


FIGURE 3. FORWARD BIAS SAFE OPERATING AREA

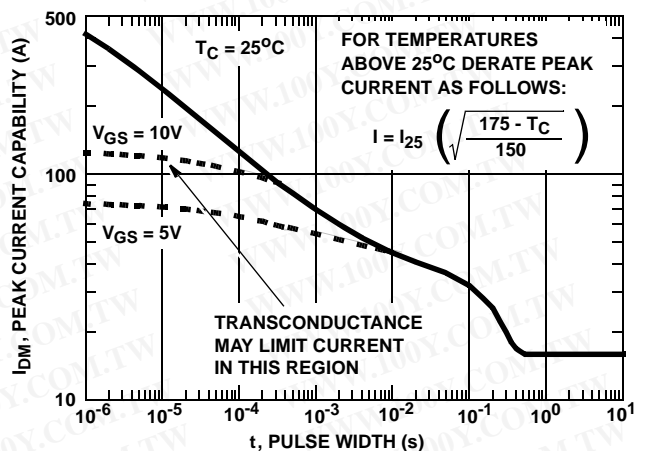


FIGURE 4. PEAK CURRENT CAPABILITY

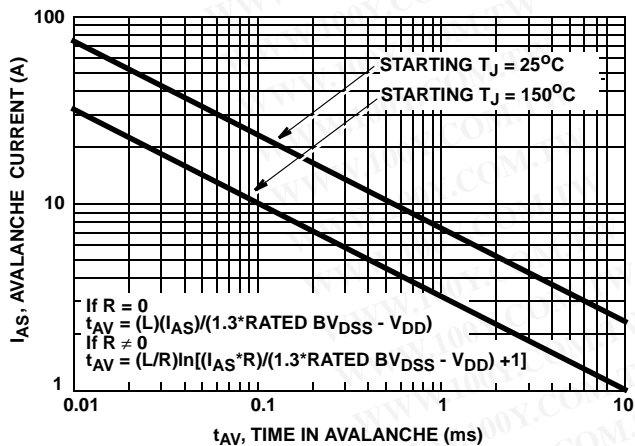


FIGURE 5. UNCLAMPED INDUCTIVE SWITCHING

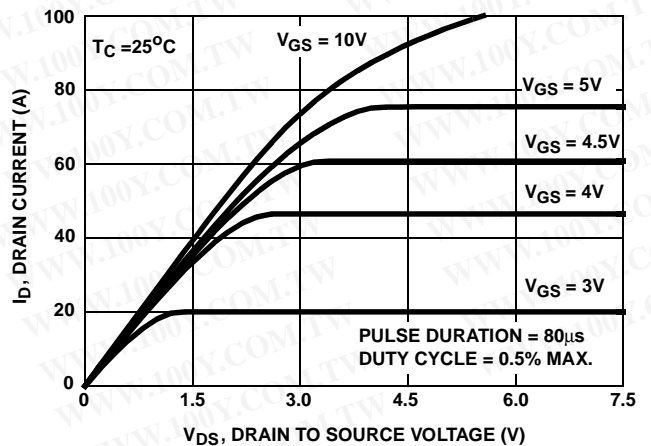


FIGURE 6. SATURATION CHARACTERISTICS

Typical Performance Curves Unless Otherwise Specified (Continued)

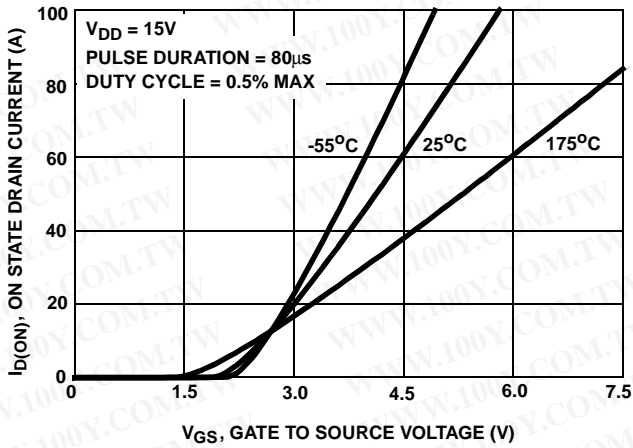


FIGURE 7. TRANSFER CHARACTERISTICS

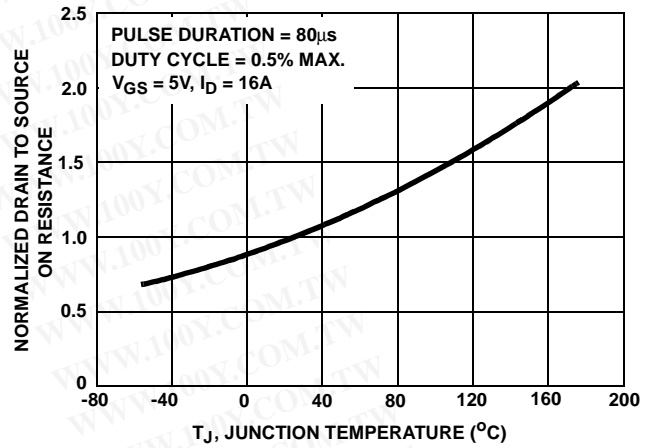


FIGURE 8. NORMALIZED DRAIN TO SOURCE ON RESISTANCE vs JUNCTION TEMPERATURE

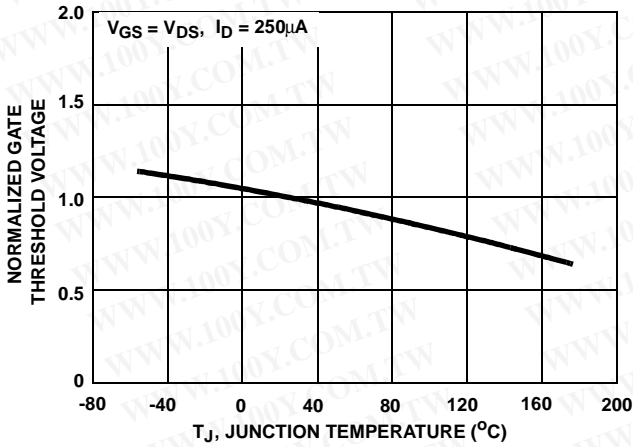


FIGURE 9. NORMALIZED GATE THRESHOLD VOLTAGE vs TEMPERATURE

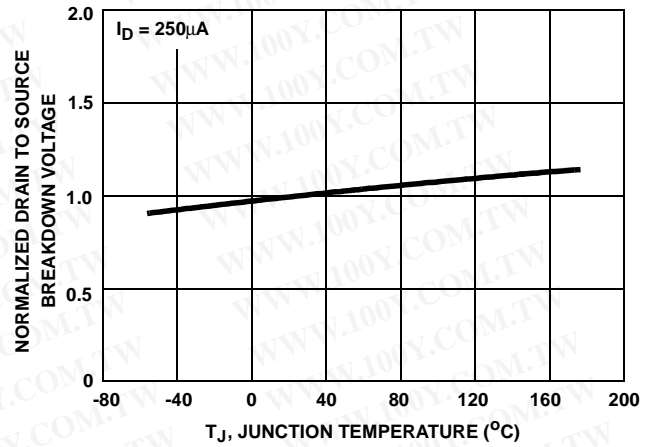


FIGURE 10. NORMALIZED DRAIN TO SOURCE BREAKDOWN VOLTAGE vs JUNCTION TEMPERATURE

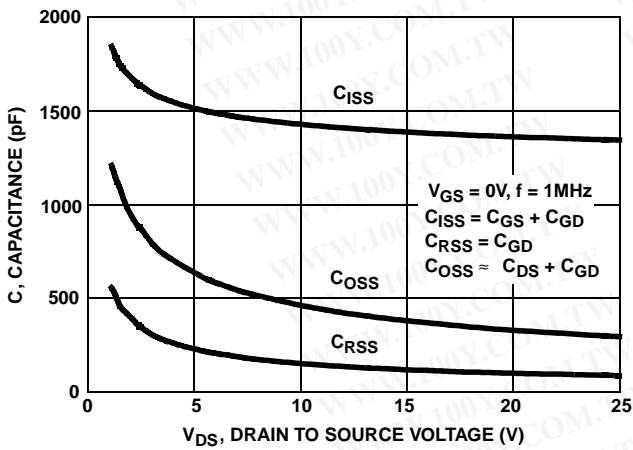
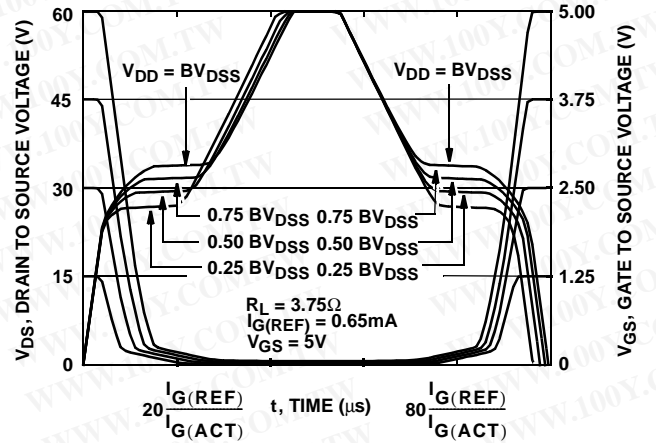


FIGURE 11. CAPACITANCE vs DRAIN TO SOURCE VOLTAGE



NOTE: Refer to Fairchild Application Notes AN7254 and AN7260.

FIGURE 12. NORMALIZED SWITCHING WAVEFORMS FOR CONSTANT GATE CURRENT

Test Circuits and Waveforms

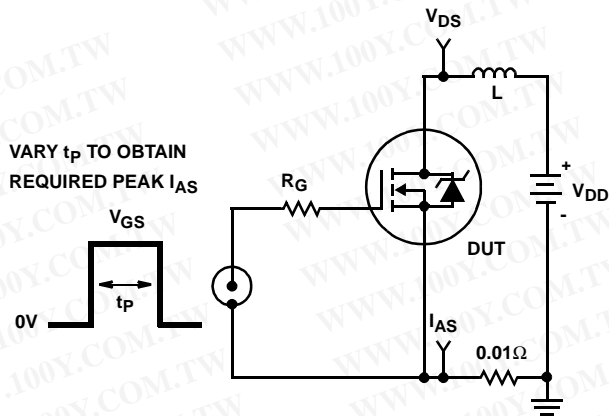


FIGURE 13. UNCLAMPED ENERGY TEST CIRCUIT

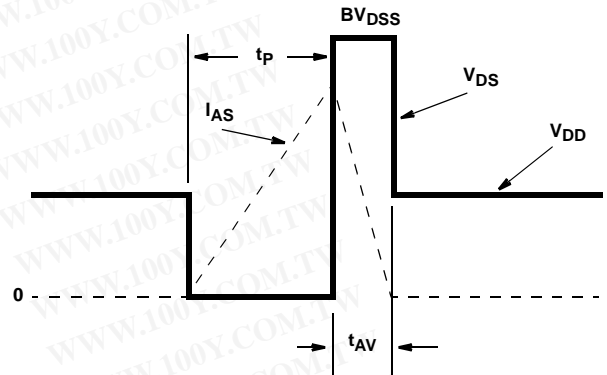


FIGURE 14. UNCLAMPED ENERGY WAVEFORMS

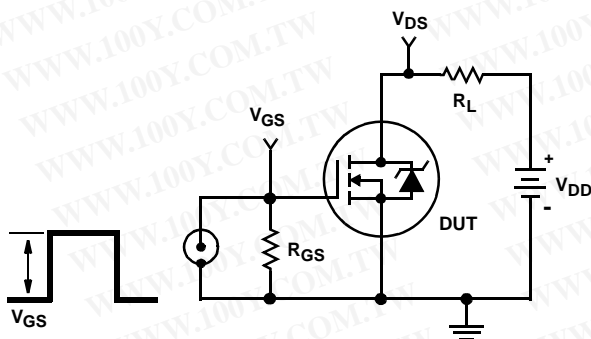


FIGURE 15. SWITCHING TIME TEST CIRCUIT

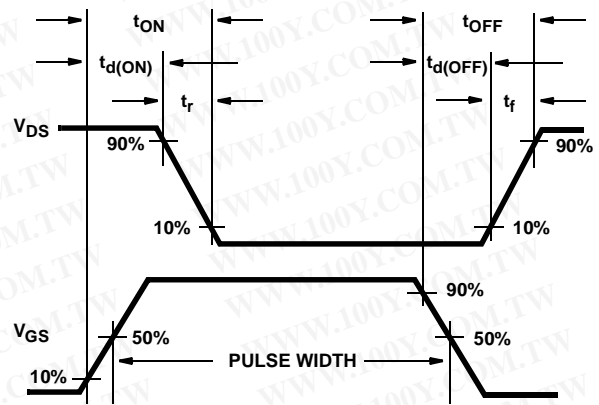


FIGURE 16. RESISTIVE SWITCHING WAVEFORMS

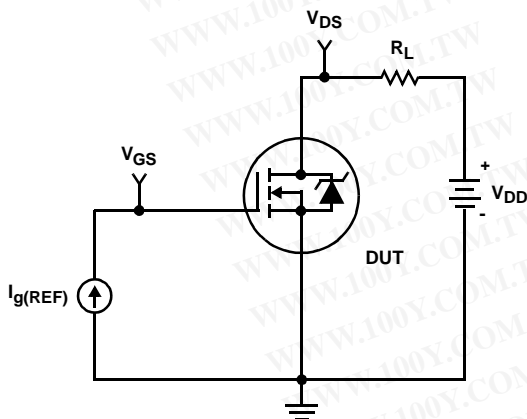


FIGURE 17. GATE CHARGE TEST CIRCUIT

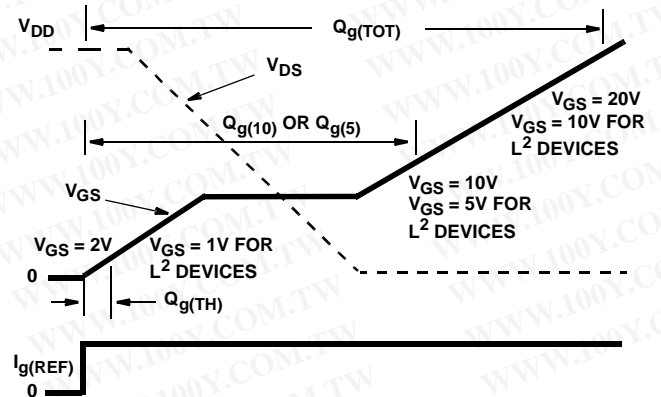


FIGURE 18. GATE CHARGE WAVEFORMS

RFD16N06LESM

PSPICE Electrical Model

SUBCKT RFD16N06LESM 2 1 3 ; rev 8/2/93

CA 12 8 1.46e-9
 CB 15 14 1.46e-9
 CIN 6 8 1.0e-9

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

EBREAK 11 7 17 18 66.0
 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 1e-9
 LGATE 1 9 5.5e-9
 LSOURCE 3 7 4.4e-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 7.0e-3
 RGATE 9 20 3.6
 RLDRAIN 2 5 10
 RLGATE 1 9 55
 RLSOURCE 3 7 44
 RSLC1 5 51 RSLCMOD 1e-6
 RSLC2 5 50 1e3
 RSOURCE 8 7 RSOURCEMOD 1.45e-2
 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

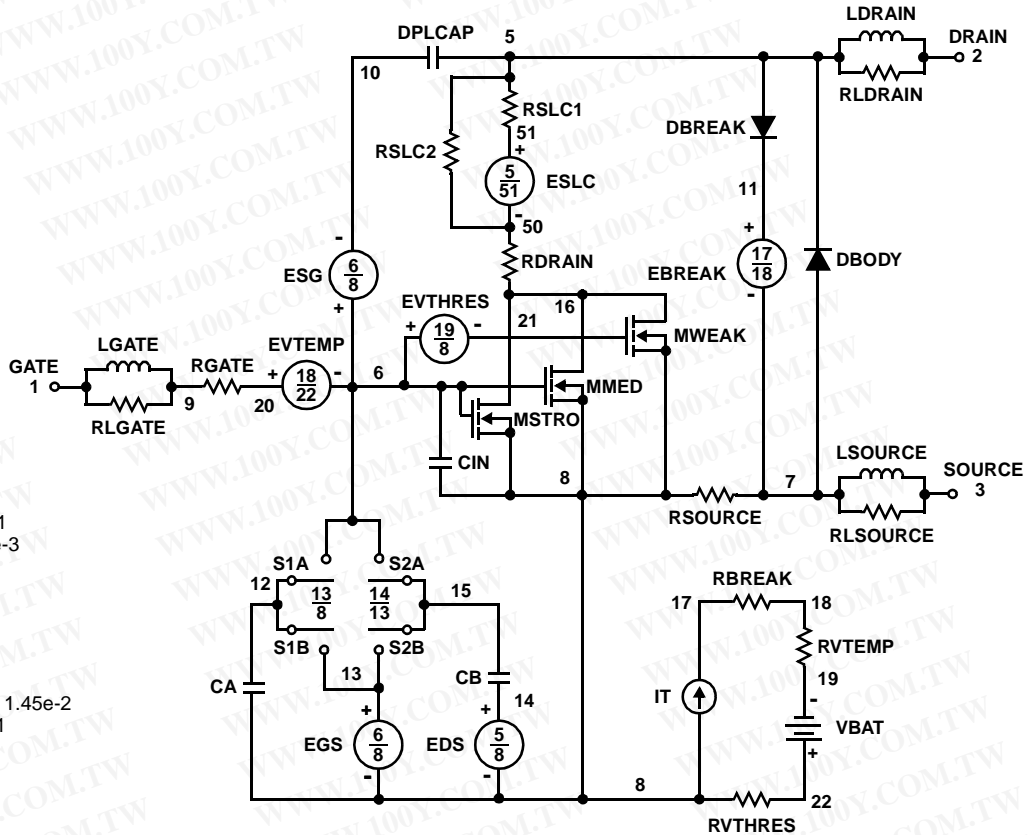
ESLC 51 50 VALUE=((V(5,51)/ABS(V(5,51)))²*(PWR(V(5,51))/(1e-6*100),3.5))

.MODEL DBODYMOD D (IS = 6.3e-13 RS = 6.8e-3 TRS1 = 1e-3 TRS2 = 1e-6 XTI = 4.3 CJO = 1.28e-9 TT = 5.1e-8 M = 0.5)
 .MODEL DBREAKMOD D (RS = 2.9e-1 TRS1 = 1e-4 TRS2 = 0)
 .MODEL DPLCAPMOD D (CJO = 9.5e-10 IS = 1e-30 N = 10 M = 0.82)
 .MODEL MMEDMOD NMOS (VTO = 2.10 KP = 6 IS = 1e-30 N = 10 TOX = 1 L = 1u W = 1u RG = 3.6)
 .MODEL MSTROMOD NMOS (VTO = 2.45 KP = 60.5 IS = 1e-30 N = 10 TOX = 1 L = 1u W = 1u)
 .MODEL MWEAKMOD NMOS (VTO = 1.79 KP = 0.13 IS = 1e-30 N = 10 TOX = 1 L = 1u W = 1u RG = 36 RS = 0.1)
 .MODEL RBREAKMOD RES (TC1 = 1.2e-3 TC2 = -5e-7)
 .MODEL RDRAINMOD RES (TC1 = 1.3e-2 TC2 = 3.1e-5)
 .MODEL RSLCMOD RES (TC1 = 5.5e-3 TC2 = 7e-6)
 .MODEL RSOURCEMOD RES (TC1 = 1e-3 TC2 = 1e-6)
 .MODEL RVTHRESMOD RES (TC1 = -1.8e-3 TC2 = -5.8e-6)
 .MODEL RVTEMPMOD RES (TC1 = -1.7e-3 TC2 = 8e-7)

.MODEL S1AMOD VSWITCH (RON = 1e-5 ROFF = 0.1 VON = -4.8 VOFF = -2.8)
 .MODEL S1BMOD VSWITCH (RON = 1e-5 ROFF = 0.1 VON = -2.8 VOFF = -4.8)
 .MODEL S2AMOD VSWITCH (RON = 1e-5 ROFF = 0.1 VON = -0.6 VOFF = 0.5)
 .MODEL S2BMOD VSWITCH (RON = 1e-5 ROFF = 0.1 VON = 0.5 VOFF = -0.6)

.ENDS

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.



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 ^x ™	FACT™	ImpliedDisconnect™	PACMAN™	SPM™
ActiveArray™	FACT Quiet Series™	ISOPLANAR™	POP™	Stealth™
Bottomless™	FAST®	LittleFET™	Power247™	SuperSOT™-3
CoolFET™	FAST _r ™	MicroFET™	PowerTrench®	SuperSOT™-6
CROSSVOLT™	FRFET™	MicroPak™	QFET™	SuperSOT™-8
DOME™	GlobalOptoisolator™	MICROWIRE™	QS™	SyncFET™
EcoSPARK™	GTO™	MSX™	QT Optoelectronics™	TinyLogic™
E ² C MOS™	HiSeC™	MSXPro™	Quiet Series™	TruTranslation™
EnSigna™	I ² C™	OCX™	RapidConfigure™	UHC™
Across the board. Around the world.™		OCXPro™	RapidConnect™	UltraFET®
The Power Franchise™		OPTOLOGIC®	SILENT SWITCHER®	VCX™
Programmable Active Droop™		OPTOPLANAR™	SMART START™	

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:

- 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.
- 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.