

49A, 55V, 0.022 Ohm, N-Channel UltraFET Power MOSFET



This N-Channel power MOSFET 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 TA75329.

Ordering Information

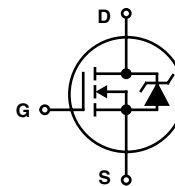
PART NUMBER	PACKAGE	BRAND
HRFZ44N	TO-220AB	HRFZ44N

NOTE: When ordering, use the entire part number.

Features

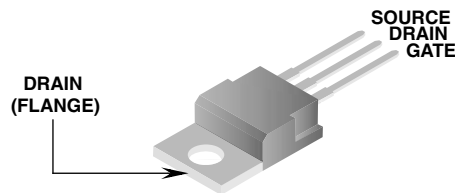
- 49A, 55V
- Simulation Models
 - Temperature Compensated PSPICE® and SABER® Electrical Models
 - Spice and Saber Thermal Impedance Models
 - www.Fairchild.com
- Peak Current vs Pulse Width Curve
- UIS Rating Curve
- Related Literature
 - TB334, "Guidelines for Soldering Surface Mount Components to PC Boards"

Symbol



Packaging

JEDEC TO-220AB



HRFZ44N

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

			UNITS
Drain to Source Voltage (Note 1)	V_{DSS}	55	V
Drain to Gate Voltage ($R_{GS} = 20k\Omega$) (Note 1)	V_{DGR}	55	V
Gate to Source Voltage	V_{GS}	± 20	V
Drain Current			
Continuous (Figure 2)	I_D	49	A
Pulsed Drain Current (Note 2)	I_{DM}	160	A
Pulsed Avalanche Rating	UIS	0.227	A^2s
Power Dissipation	P_D	120	W
Derate Above 25°C		0.8	$\text{W}/^\circ\text{C}$
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 .
- Repetitive rating: pulse width limited by maximum junction temperature.

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}	$I_D = 250\mu\text{A}, V_{GS} = 0\text{V}$ (Figure 11)	55	-	-	V	
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 50\text{V}, V_{GS} = 0\text{V}$	-	-	1	μA	
		$V_{DS} = 45\text{V}, V_{GS} = 0\text{V}, T_C = 150^\circ\text{C}$	-	-	250	μA	
Gate to Source Leakage Current	I_{GSS}	$V_{GS} = \pm 20\text{V}$	-	-	± 100	nA	
ON STATE SPECIFICATIONS							
Gate to Source Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 250\mu\text{A}$ (Figure 10)	2	-	4	V	
Drain to Source On Resistance	$r_{DS(ON)}$	$I_D = 25\text{A}, V_{GS} = 10\text{V}$ (Figure 9)	-	0.019	0.022	Ω	
THERMAL SPECIFICATIONS							
Thermal Resistance Junction to Case	$R_{\theta JC}$	(Figure 3)	-	-	1.25	$^\circ\text{C}/\text{W}$	
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	TO-220	-	-	62	$^\circ\text{C}/\text{W}$	
SWITCHING SPECIFICATIONS ($V_{GS} = 10\text{V}$)							
Turn-On Time	t_{ON}	$V_{DD} = 30\text{V}, I_D \cong 25\text{A},$ $R_L = 1.2\Omega, V_{GS} = 10\text{V},$ $R_{GS} = 9.1\Omega$	-	-	105	ns	
Turn-On Delay Time	$t_{d(ON)}$		-	12	-	ns	
Rise Time	t_r		-	58	-	ns	
Turn-Off Delay Time	$t_{d(OFF)}$		-	33	-	ns	
Fall Time	t_f		-	33	-	ns	
Turn-Off Time	t_{OFF}		-	-	100	ns	
GATE CHARGE SPECIFICATIONS							
Total Gate Charge	$Q_{g(TOT)}$	$V_{GS} = 0\text{V}$ to 20V	$V_{DD} = 30\text{V},$ $I_D \cong 25\text{A},$ $R_L = 1.2\Omega$ $I_{g(REF)} = 1.0\text{mA}$ (Figure 13)	-	60	75	nC
Gate Charge at 10V	$Q_{g(10)}$	$V_{GS} = 0\text{V}$ to 10V		-	35	43	nC
Threshold Gate Charge	$Q_{g(TH)}$	$V_{GS} = 0\text{V}$ to 2V		-	2.0	2.5	nC
Gate to Source Gate Charge	Q_{gs}			-	4	-	nC
Gate to Drain "Miller" Charge	Q_{gd}			-	14	-	nC

HRFZ44N

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

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
CAPACITANCE SPECIFICATIONS						
Input Capacitance	C_{ISS}	$V_{DS} = 25\text{V}$, $V_{GS} = 0\text{V}$, $f = 1\text{MHz}$ (Figure 12)	-	1060	-	pF
Output Capacitance	C_{OSS}		-	405	-	pF
Reverse Transfer Capacitance	C_{RSS}		-	95	-	pF

Source to Drain Diode Specifications

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Source to Drain Diode Voltage	V_{SD}	$I_{SD} = 25\text{A}$	-	-	1.25	V
Reverse Recovery Time	t_{rr}	$I_{SD} = 25\text{A}$, $dI_{SD}/dt = 100\text{A}/\mu\text{s}$	-	-	72	ns
Reverse Recovered Charge	Q_{RR}	$I_{SD} = 25\text{A}$, $dI_{SD}/dt = 100\text{A}/\mu\text{s}$	-	-	120	nC

Typical Performance Curves

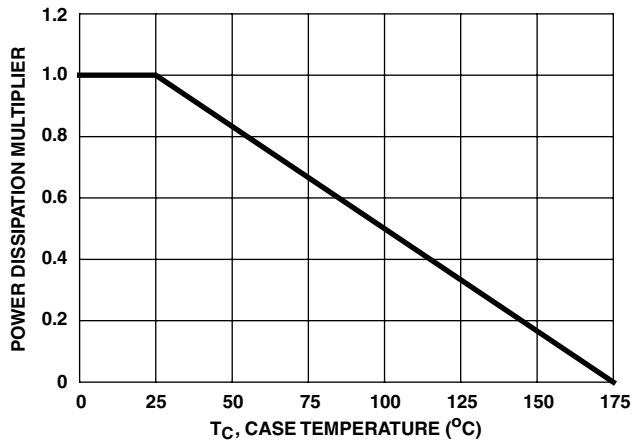


FIGURE 1. NORMALIZED POWER DISSIPATION vs CASE TEMPERATURE

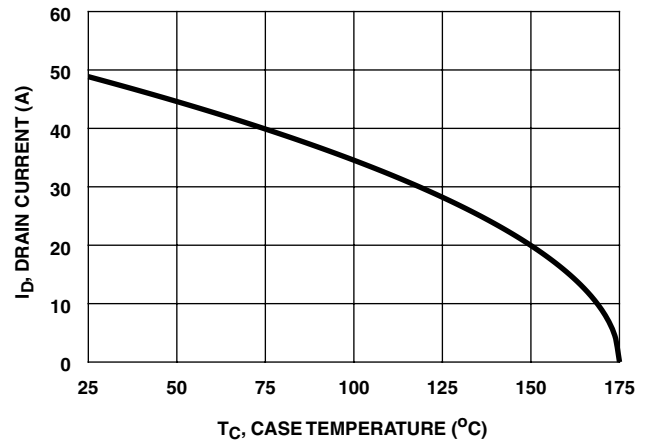


FIGURE 2. MAXIMUM CONTINUOUS DRAIN CURRENT vs CASE TEMPERATURE

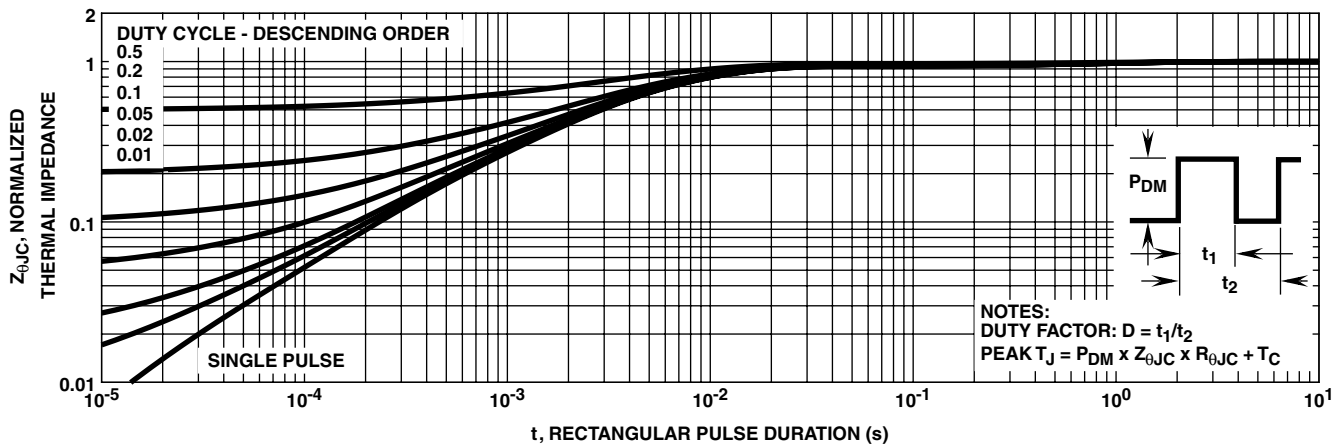


FIGURE 3. NORMALIZED MAXIMUM TRANSIENT THERMAL IMPEDANCE

Typical Performance Curves (Continued)

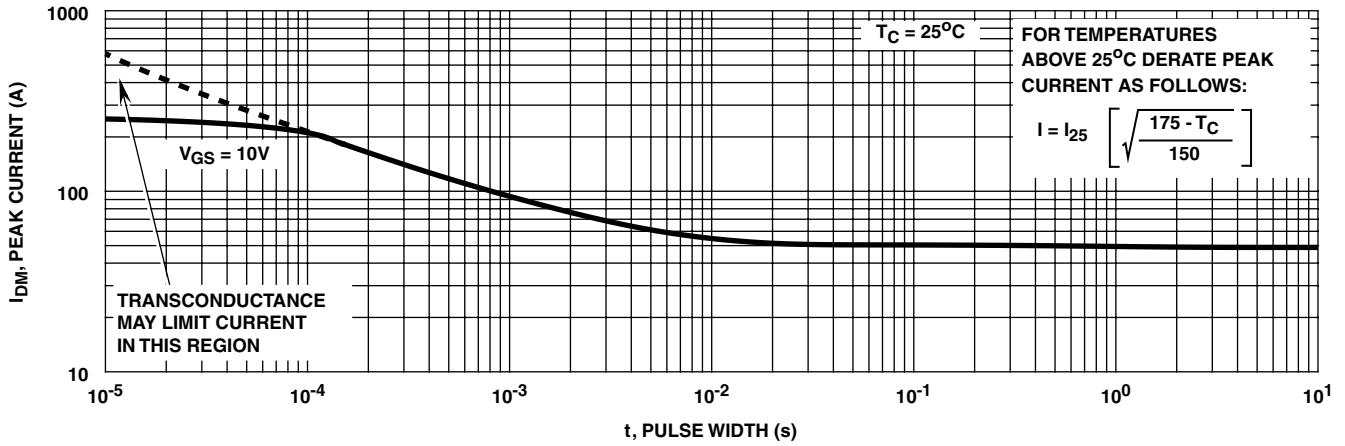


FIGURE 4. PEAK CURRENT CAPABILITY

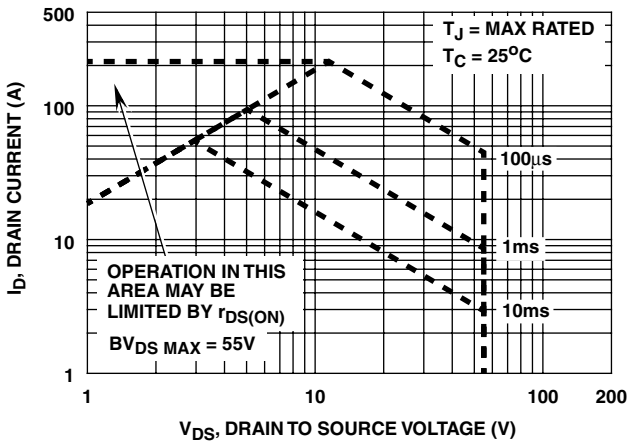
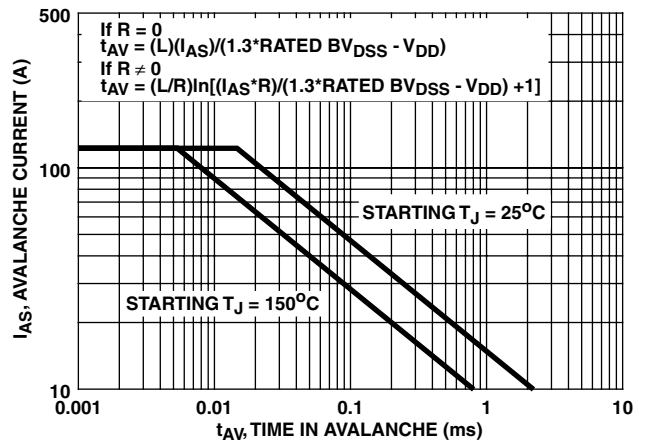


FIGURE 5. FORWARD BIAS SAFE OPERATING AREA



NOTE: Refer to Fairchild Application Notes AN9321 and AN9322.
FIGURE 6. UNCLAMPED INDUCTIVE SWITCHING CAPABILITY

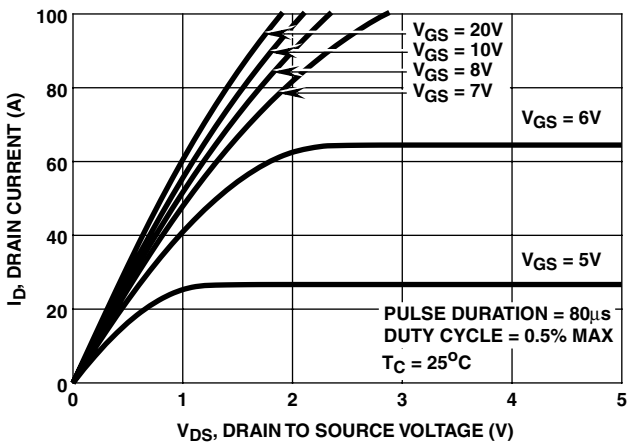


FIGURE 7. SATURATION CHARACTERISTICS

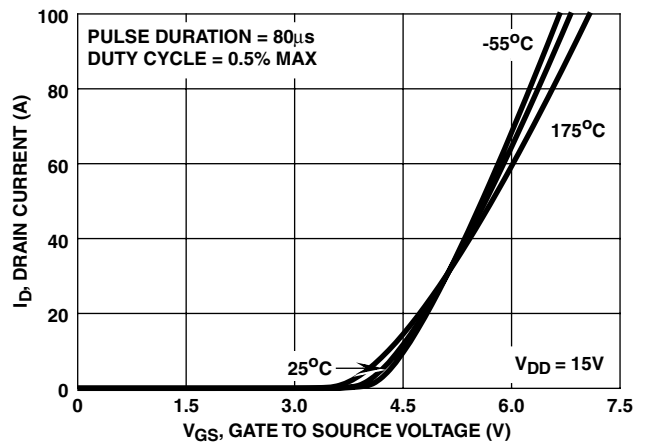


FIGURE 8. TRANSFER CHARACTERISTICS

Typical Performance Curves (Continued)

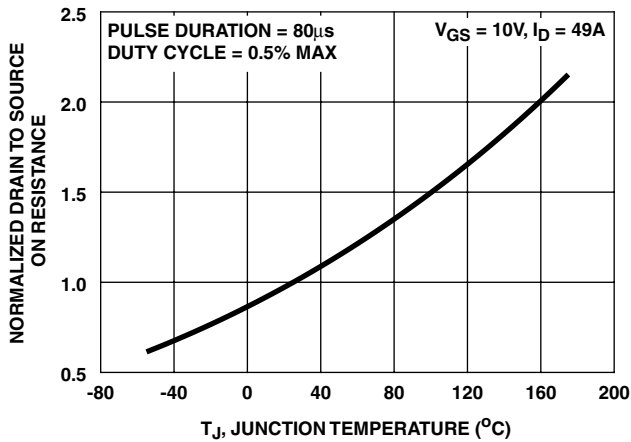


FIGURE 9. NORMALIZED DRAIN TO SOURCE ON RESISTANCE vs JUNCTION TEMPERATURE

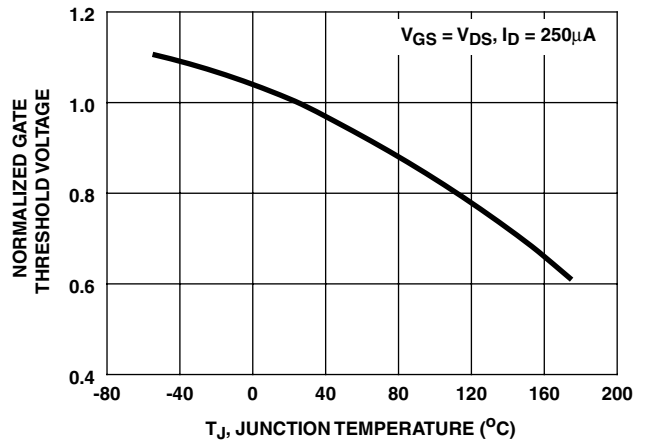


FIGURE 10. NORMALIZED GATE THRESHOLD VOLTAGE vs JUNCTION TEMPERATURE

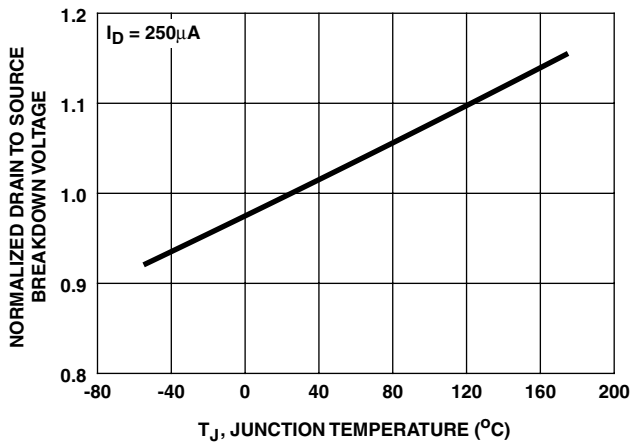


FIGURE 11. NORMALIZED DRAIN TO SOURCE BREAKDOWN VOLTAGE vs JUNCTION TEMPERATURE

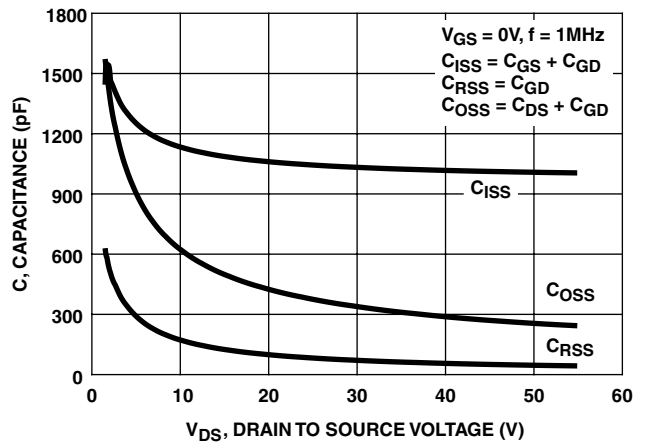
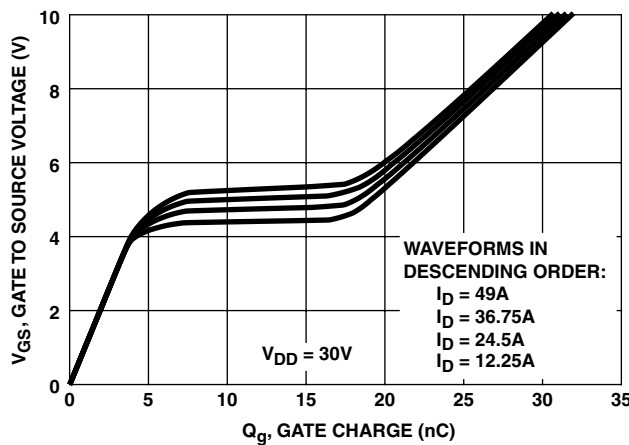


FIGURE 12. CAPACITANCE vs DRAIN TO SOURCE VOLTAGE



NOTE: Refer to Fairchild Application Notes AN7254 and AN7260.

FIGURE 13. GATE CHARGE WAVEFORMS FOR CONSTANT GATE CURRENT

Test Circuits and Waveforms

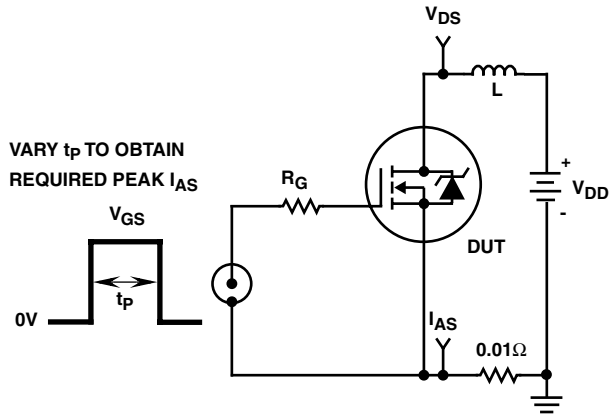


FIGURE 14. UNCLAMPED ENERGY TEST CIRCUIT

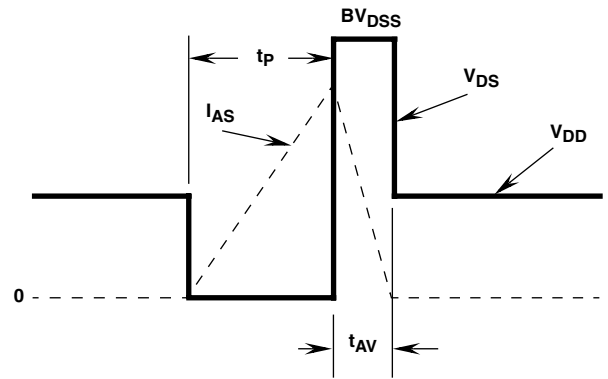


FIGURE 15. UNCLAMPED ENERGY WAVEFORMS

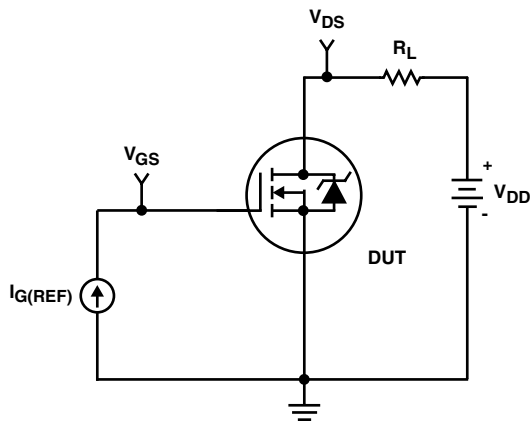


FIGURE 16. GATE CHARGE TEST CIRCUIT

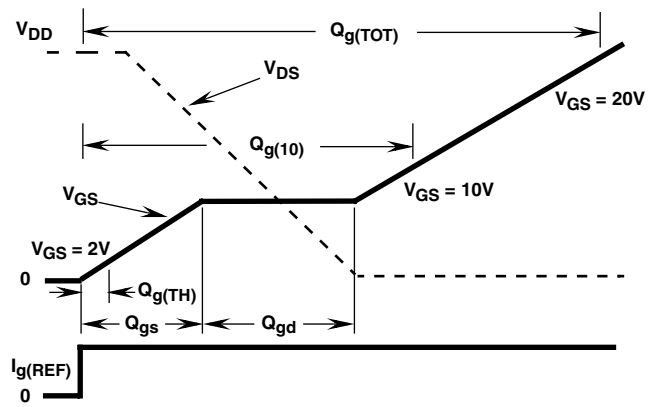


FIGURE 17. GATE CHARGE WAVEFORM

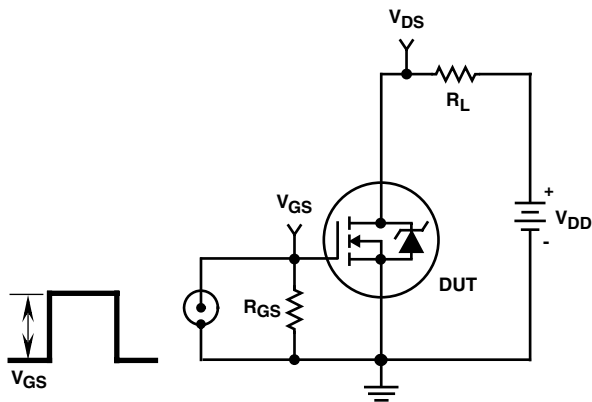


FIGURE 18. SWITCHING TIME TEST CIRCUIT

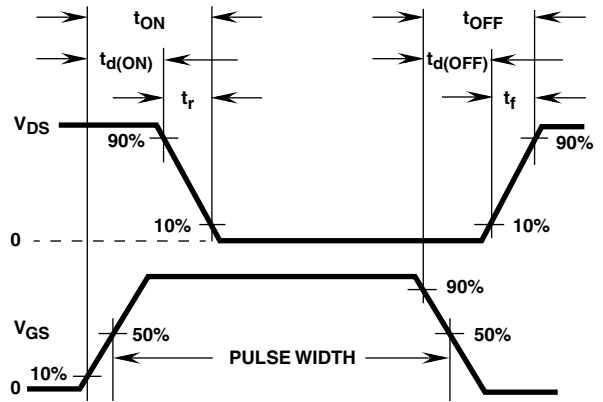


FIGURE 19. RESISTIVE SWITCHING WAVEFORMS

SABER Electrical Model

REV June 1997

template hrfz44n n2, n1, n3
electrical n2, n1, n3

```
{
var i iscl
d..model dbodymod = (is = 7.50e-13, cjo = 1.51e-9, tt = 4.05e-8, m = 0.5)
d..model dbreakmod = ()
d..model dplcapmod = (cjo = 13.5e-10, is = 1e-30, n = 10, m = 0.85)
m..model mmedmod = (type=_n, vto = 3.25, kp = 2.50, is = 1e-30, tox = 1)
m..model mstrongmod = (type=_n, vto = 3.80, kp = 70, is = 1e-30, tox = 1)
m..model mweakmod = (type=_n, vto = 2.91, kp = 0.06, is = 1e-30, tox = 1)
sw_vcsp..model s1amod = (ron = 1e-5, roff = 0.1, von = -7.90, voff = -4.90)
sw_vcsp..model s1bmod = (ron = 1e-5, roff = 0.1, von = -4.90, voff = -7.90)
sw_vcsp..model s2amod = (ron = 1e-5, roff = 0.1, von = -0.50, voff = 2.50)
sw_vcsp..model s2bmod = (ron = 1e-5, roff = 0.1, von = 2.50, voff = -0.50)
```

```
c.ca n12 n8 = 1.72e-9
c.cb n15 n14 = 1.52e-9
c.cin n6 n8 = 9.61e-10
```

```
d.dbody n7 n71 = model=dbodymod
d.dbreak n72 n11 = model=dbreakmod
d.dplcap n10 n5 = model=dplcapmod
```

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

```
l.ldrain n2 n5 = 1e-9
l.lgate n1 n9 = 2.86e-9
l.lsource n3 n7 = 2.69e-9
```

```
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
```

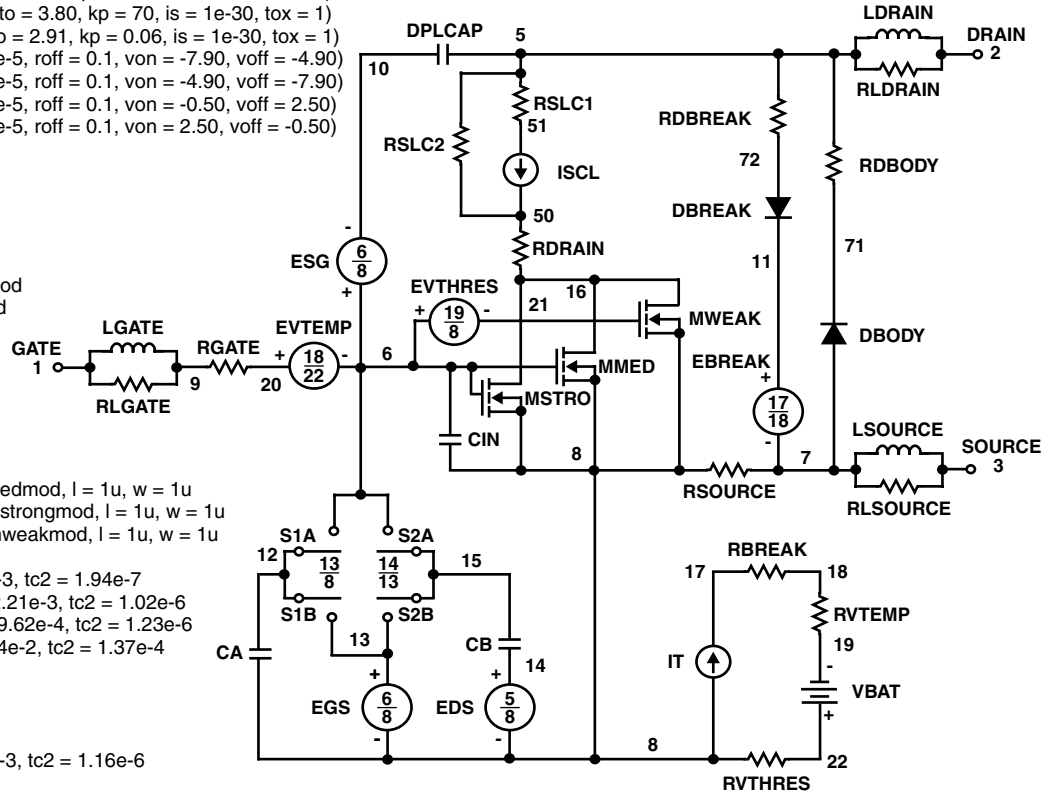
```
res.rbreak n17 n18 = 1, tc1 = 1.05e-3, tc2 = 1.94e-7
res.rbody n71 n5 = 5.05e-3, tc1 = 2.21e-3, tc2 = 1.02e-6
res.rdbreak n72 n5 = 2.14e-1, tc1 = 9.62e-4, tc2 = 1.23e-6
res.rdrain n50 n16 = 1e-3, tc1 = 8.04e-2, tc2 = 1.37e-4
res.rgate n9 n20 = 1.52
res.rldrain n2 n5 = 10
res.rlgate n1 n9 = 26.9
res.rlsource n3 n7 = 28.6
res.rslc1 n5 n51 = 1e-6, tc1 = 4.83e-3, tc2 = 1.16e-6
res.rslc2 n5 n50 = 1e3
res.rsource n8 n7 = 13.85e-3, tc1 = 0, tc2 = 0
res.rvtemp n18 n19 = 1, tc1 = -1.35e-3, tc2 = 1.16e-6
res.rvthres n22 n8 = 1, tc1 = -3.43e-3, tc2 = -1.63e-5
```

```
spe.ebreak n11 n7 n17 n18 = 58.13
spe.eds n14 n8 n5 n8 = 1
spe.egs n13 n8 n6 n8 = 1
spe.esg n6 n10 n6 n8 = 1
spe.evtemp n20 n6 n18 n22 = 1
spe.evthres n6 n21 n19 n8 = 1
```

```
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))*1e6/135))** 3.5))
}
}
```



SPICE Thermal Model

REV 23 February 1999

HRFZ44N

CTHERM1 th 6 2.80e-3
 CTHERM2 6 5 1.00e-2
 CTHERM3 5 4 6.80e-3
 CTHERM4 4 3 7.00e-3
 CTHERM5 3 2 1.60e-2
 CTHERM6 2 tl 15.55

RTHERM1 th 6 7.94e-3
 RTHERM2 6 5 1.98e-2
 RTHERM3 5 4 5.57e-2
 RTHERM4 4 3 3.13e-1
 RTHERM5 3 2 4.71e-1
 RTHERM6 2 tl 6.26e-2

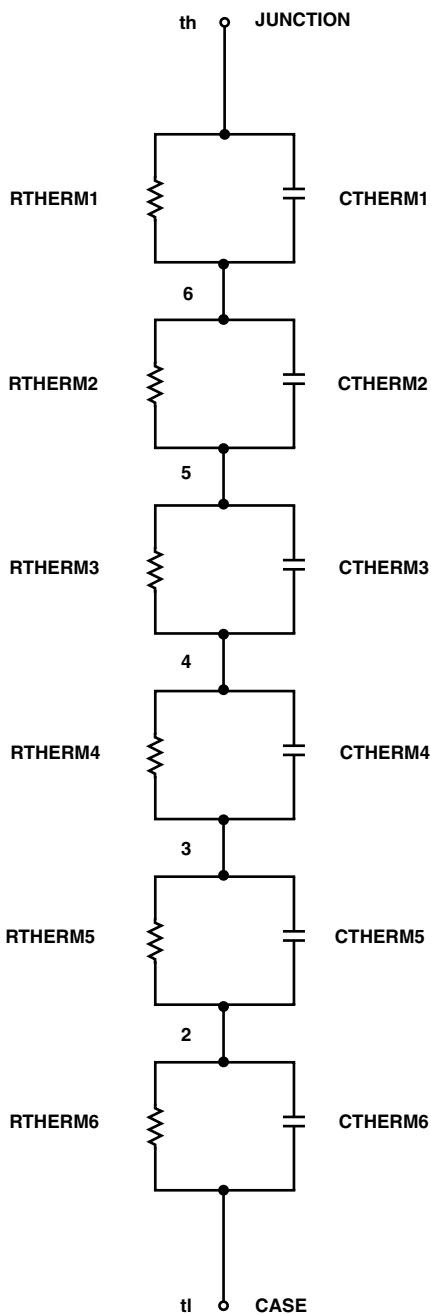
SABER Thermal Model

SABER thermal model HRFZ44N

template thermal_model th tl
 thermal_c th, tl

```
{
ctherm.ctherm1 th 6 = 2.80e-3
ctherm.ctherm2 6 5 = 1.00e-2
ctherm.ctherm3 5 4 = 6.80e-3
ctherm.ctherm4 4 3 = 7.00e-3
ctherm.ctherm5 3 2 = 1.60e-2
ctherm.ctherm6 2 tl = 15.55
```

```
rtherm.rtherm1 th 6 = 7.94e-3
rtherm.rtherm2 6 5 = 1.98e-2
rtherm.rtherm3 5 4 = 5.57e-2
rtherm.rtherm4 4 3 = 3.13e-1
rtherm.rtherm5 3 2 = 4.71e-1
rtherm.rtherm6 2 tl = 6.26e-2
}
```



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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	
DOMET TM	HiSeC TM	PowerTrench [®]	SuperSOT TM -8	
EcoSPARK TM	ISOPLANAR TM	QFET TM	SyncFET TM	
E ² CMOS TM	LittleFET TM	QST TM	TinyLogic TM	
EnSigna TM	MicroFET TM	QT Optoelectronics TM	TruTranslation TM	
FACT TM	MicroPak TM	Quiet Series TM	UHC TM	
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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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Advance Information	Formative or In Design	This datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
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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.
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