FAIRCHILD
SEMICONDUCTOR®

RFD3055LE, RFD3055LESM, RFP3055LE

11A, 60V, 0.107 Ohm, Logic Level, N-Channel Power MOSFETs

These N-Channel enhancement-mode power MOSFETs are manufactured using the latest manufacturing process technology. This process, which uses feature sizes approaching those of LSI 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 and relay drivers. These transistors can be operated directly from integrated circuits.

Formerly developmental type TA49158.

Features

- 11A, 60V
- $r_{DS(ON)} = 0.107\Omega$
- Temperature Compensating PSPICE® Model
- Peak Current vs Pulse Width Curve
- UIS Rating Curve
- Related Literature
  - TB334 "Guidelines for Soldering Surface Mount Components to PC Boards"

Symbol

Ordering Information

PART NUMBER	PACKAGE	BRAND
RFD3055LE	TO-251AA	F3055L
RFD3055LESM	TO-252AA	F3055L
RFP3055LE	TO-220AB	FP3055LE

NOTE: When ordering, use the entire part number. Add the suffix, 9A, to obtain the TO-252 variant in tape and reel, e.g. RFD3055LESM9A.
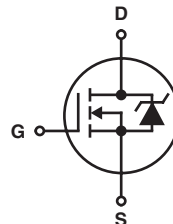
Packaging

JEDEC TO-220AB
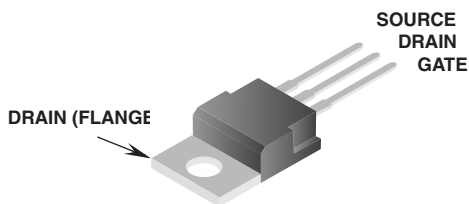
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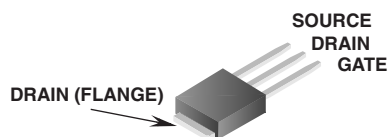
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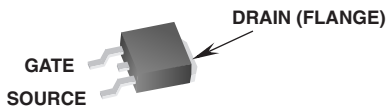
Absolute Maximum Ratings $T_C = 25^oC$, Unless Otherwise Specified

		RFD3055LE, RFD3055LESM, RFP3055LE	UNITS
Drain to Source Voltage (Note 1) . . . . V_{DSS}		60	V
Drain to Gate Voltage ($R_{GS} = 20k\Omega$) (Note 1) . . . . V_{DGR}		60	V
Gate to Source Voltage . . . .V_{GS}		±16	V
Continuous Drain Current . . . . I_D		11	A
Pulsed Drain Current (Note 3) . . . . I_{DM}		Refer to Peak Current Curve	
Single Pulse Avalanche Rating . . . .E_{AS}		Refer to UIS Curve	
Power Dissipation . . . .P_D		38	W
Derate Above 25°C		0.25	W/^{o}C
Operating and Storage Temperature . . . .T_J, T_{STG}		-55 to 175	^{o}C
Maximum Temperature for Soldering			
Leads at 0.063in (1.6mm) from Case for 10s. . . . . T_L		300	^{o}C
Package Body for 10s, See Techbrief 334 . . . . T_{pkg}		260	^{o}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. $T_J = 25^oC$ to 150^oC.

Electrical Specifications $T_C = 25^oC$, Unless Otherwise Specified

PARAMETER	SYMBOL	TEST CONDITIONS		MIN	TYP	MAX	UNITS
Drain to Source Breakdown Voltage	BV$_{DSS}$	$I_D = 250\mu A$, $V_{GS} = 0V$		60	-	-	V
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}$, $I_D = 250\mu A$		1	-	3	V
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 55V$, $V_{GS} = 0V$		-	-	1	μA
		$V_{DS} = 50V$, $V_{GS} = 0V$, $T_C = 150^oC$		-	-	250	μA
Gate to Source Leakage Current	I_{GSS}	$V_{GS} = ±16V$		-	-	±100	nA
Drain to Source On Resistance (Note 2)	$r_{DS(ON)}$	$I_D = 8A$, $V_{GS} = 5V$ (Figure 11)		-	-	0.107	Ω
Turn-On Time	t$_{ON}$	$V_{DD} \approx 30V$, $I_D = 8A$, $V_{GS} = 4.5V$, $R_{GS} = 32\Omega$ (Figures 10, 18, 19)		-	-	170	ns
Turn-On Delay Time	t$_{d(ON)}$			-	8	-	ns
Rise Time	t$_r$			-	105	-	ns
Turn-Off Delay Time	t$_{d(OFF)}$			-	22	-	ns
Fall Time	t$_f$			-	39	-	ns
Turn-Off Time	t$_{OFF}$			-	-	92	ns
Total Gate Charge	Q$_{g(TOT)}$	$V_{GS} = 0V$ to $10V$	$V_{DD} = 30V$, $I_D = 8A$, $I_{g(REF)} = 1.0mA$ (Figures 20, 21)	-	9.4	11.3	nC
Gate Charge at 5V	Q$_{g(5)}$	$V_{GS} = 0V$ to $5V$		-	5.2	6.2	nC
Threshold Gate Charge	Q$_{g(TH)}$	$V_{GS} = 0V$ to $1V$		-	0.36	0.43	nC
Input Capacitance	C$_{ISS}$	$V_{DS} = 25V$, $V_{GS} = 0V$, $f = 1MHz$ (Figure 14)		-	350	-	pF
Output Capacitance	C$_{OSS}$			-	105	-	pF
Reverse Transfer Capacitance	C$_{RSS}$			-	23	-	pF
Thermal Resistance Junction to Case	R$_{\theta JC}$			-	-	3.94	^{o}C/W
Thermal Resistance Junction to Ambient	R$_{\theta JA}$	TO-220AB		-	-	62	^{o}C/W
		TO-251AA, TO-252AA		-	-	100	^{o}C/W

Source to Drain Diode Specifications

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Source to Drain Diode Voltage	V$_{SD}$	$I_{SD} = 8A$		-	1.25	V
Diode Reverse Recovery Time	t$_{rr}$	$I_{SD} = 8A$, $dI_{SD}/dt = 100A/\mu s$		-	66	ns

NOTES:

2. Pulse Test: Pulse Width ≤ 300ms, Duty Cycle ≤ 2%.

3. Repetitive Rating: Pulse Width limited by max junction temperature. See Transient Thermal Impedance Curve (Figure 3) and Peak Current Capability Curve (Figure 5).

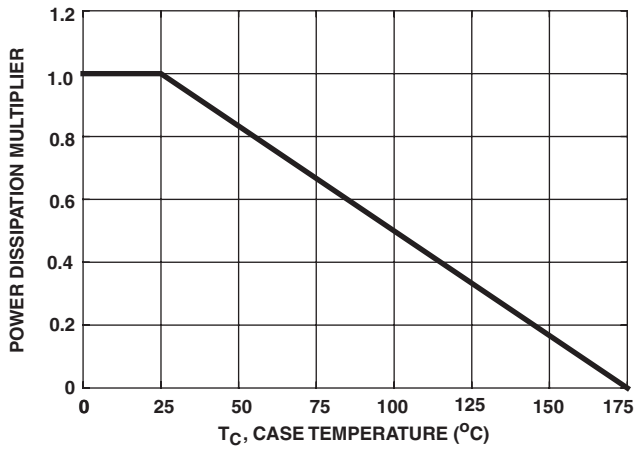## *Typical Performance Curves* Unless Otherwise Specified

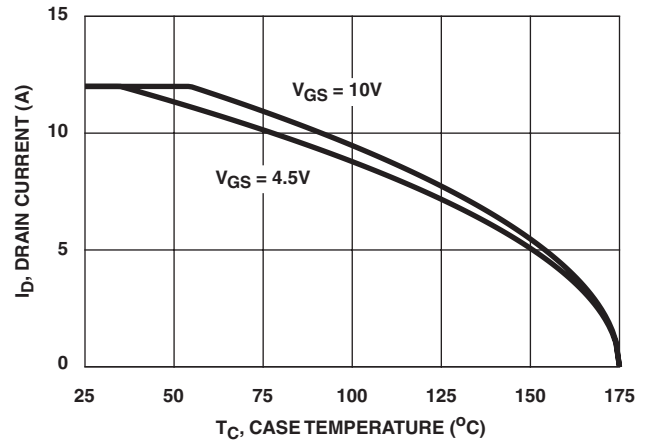**FIGURE 1. NORMALIZED POWER DISSIPATION vs CASE TEMPERATURE**

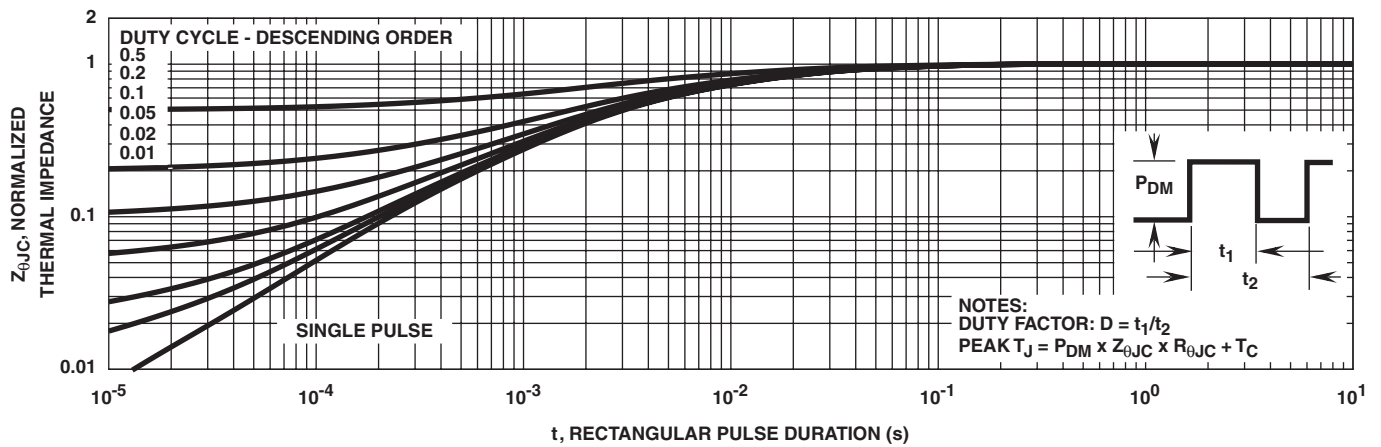**FIGURE 2. MAXIMUM CONTINUOUS DRAIN CURRENT vs CASE TEMPERATURE**

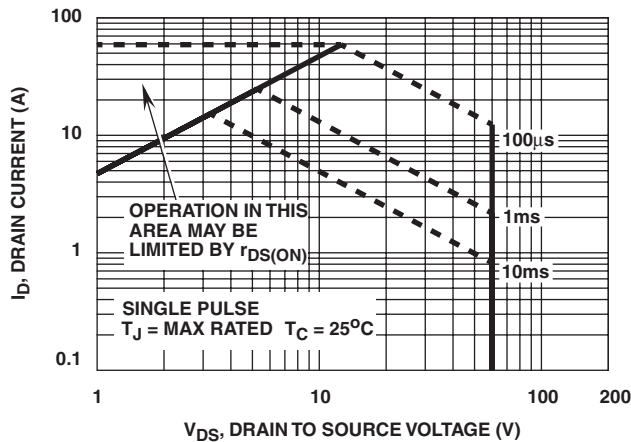**FIGURE 3. NORMALIZED TRANSIENT THERMAL IMPEDANCE**

NOTES:
DUTY FACTOR: $D = t_1/t_2$
PEAK $T_J = P_{DM}$ x $Z_{\theta JC}$ x $R_{\theta JC}$ + T_C

FIGURE 4. FORWARD BIAS SAFE OPERATING AREA
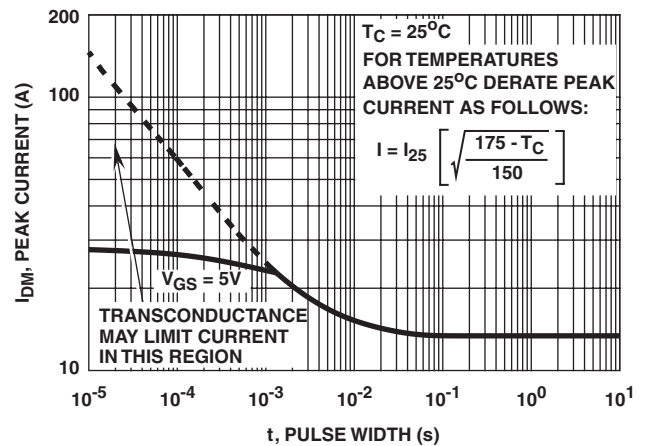
FIGURE 5. PEAK CURRENT CAPABILITY

$$I = I_{25} \left[\sqrt{\frac{175 - T_C}{150}} \right]$$

Typical Performance Curves Unless Otherwise Specified **(Continued)**

If R = 0
$t_{AV} = (L)(I_{AS})/(1.3*RATED BV_{DSS} - V_{DD})$
If R ≠ 0
$t_{AV} = (L/R)ln[(I_{AS}*R)/(1.3*RATED BV_{DSS} - V_{DD}) +1]$

STARTING $T_J = 25^oC$

STARTING $T_J = 150^oC$
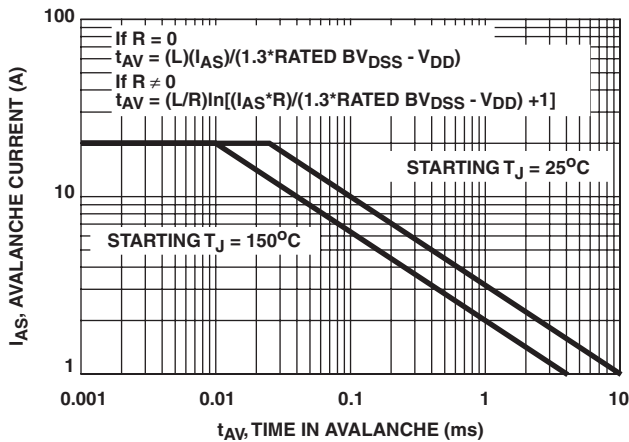
NOTE: Refer to Fairchild Application Notes AN9321 and AN9322

FIGURE 6. UNCLAMPED INDUCTIVE SWITCHING

$V_{GS} = 10V$
$V_{GS} = 5V$
$V_{GS} = 4V$
$V_{GS} = 3.5V$

PULSE DURATION = 80μs
DUTY CYCLE = 0.5% MAX

$T_C = 25^oC$

$V_{GS} = 3V$
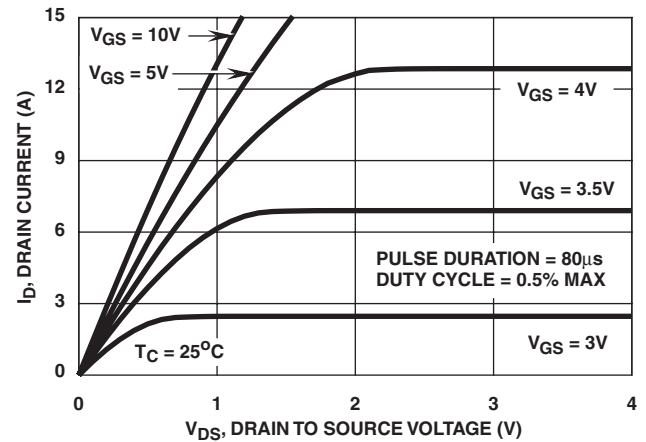
FIGURE 7. SATURATION CHARACTERISTICS

PULSE DURATION = 80μs
DUTY CYCLE = 0.5% MAX
$V_{DD} = 15V$

$T_J = 25^oC$

$T_J = 175^oC$

$T_J = -55^oC$
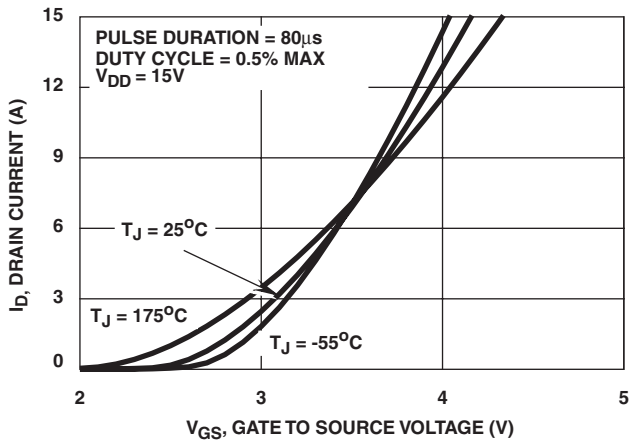
FIGURE 8. TRANSFER CHARACTERISTICS

$I_D = 3A$ $I_D = 11A$

$I_D = 5A$

PULSE DURATION = 80μs
DUTY CYCLE = 0.5% MAX
$T_C = 25^oC$
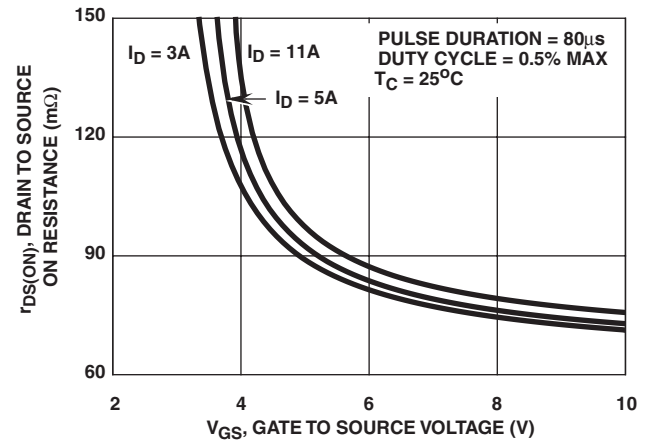
FIGURE 9. DRAIN TO SOURCE ON RESISTANCE vs GATE VOLTAGE AND DRAIN CURRENT

$V_{GS} = 4.5V, V_{DD} = 30V, I_D = 8A$

t_r

t_f

$t_{d(OFF)}$

$t_{d(ON)}$
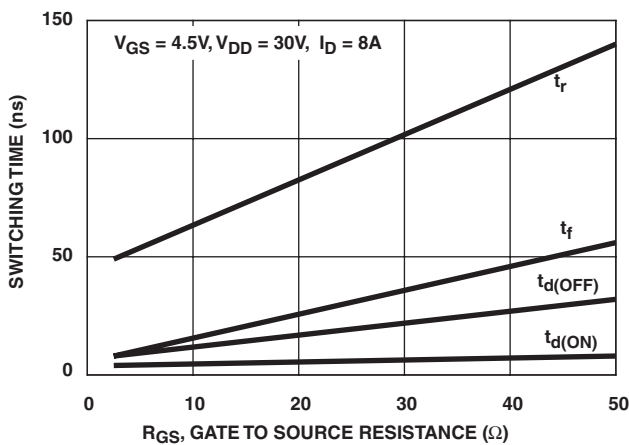
FIGURE 10. SWITCHING TIME vs GATE RESISTANCE

PULSE DURATION = 80μs
DUTY CYCLE = 0.5% MAX

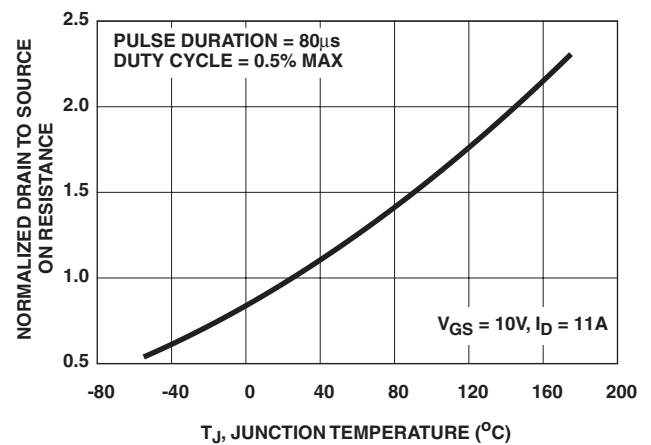$V_{GS} = 10V, I_D = 11A$

FIGURE 11. NORMALIZED DRAIN TO SOURCE ON RESISTANCE vs JUNCTION TEMPERATURE

Typical Performance Curves Unless Otherwise Specified **(Continued)**
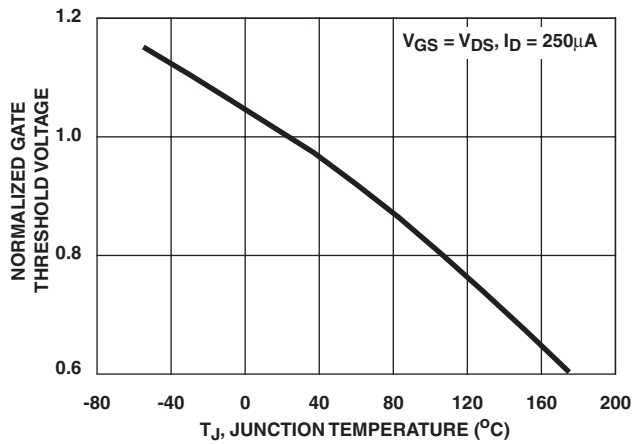
FIGURE 12. **NORMALIZED GATE THRESHOLD VOLTAGE vs JUNCTION TEMPERATURE**
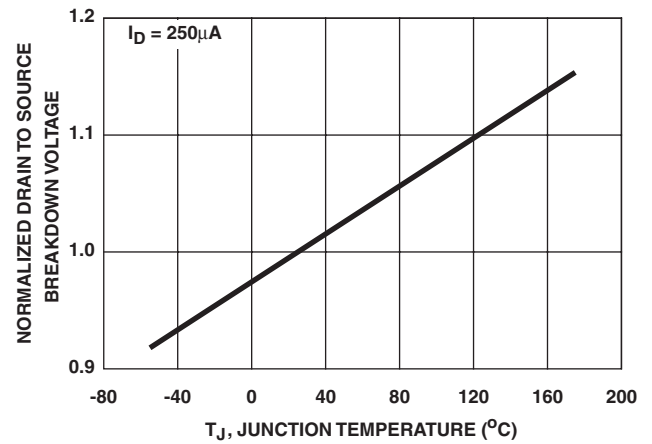
FIGURE 13. **NORMALIZED DRAIN TO SOURCE BREAKDOWN VOLTAGE vs JUNCTION TEMPERATURE**
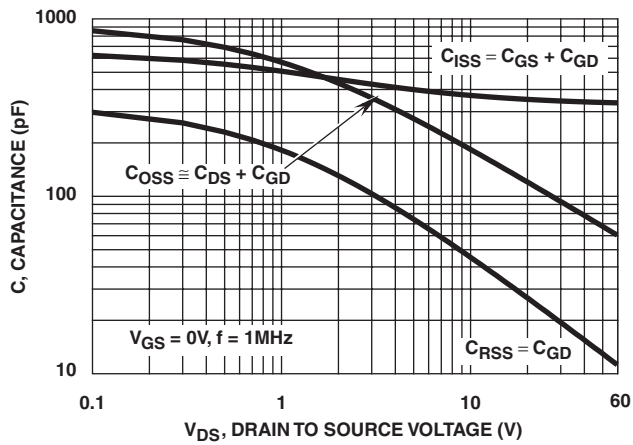
FIGURE 14. **CAPACITANCE vs DRAIN TO SOURCE VOLTAGE**
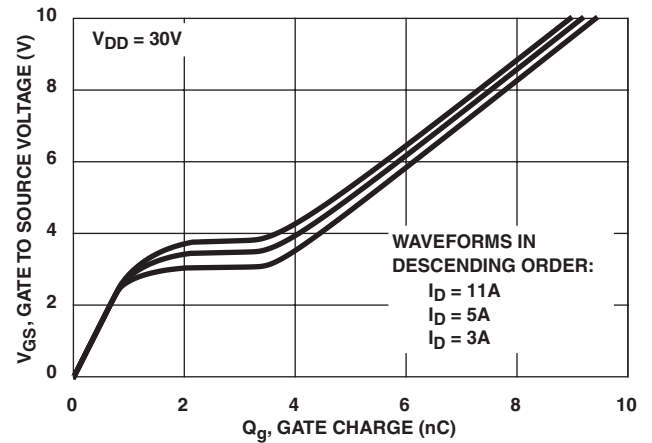
NOTE: Refer to Fairchild Application Notes AN7254 and AN7260.

FIGURE 15. **NORMALIZED SWITCHING WAVEFORMS FOR CONSTANT GATE CURRENT**

Test Circuits and Waveforms
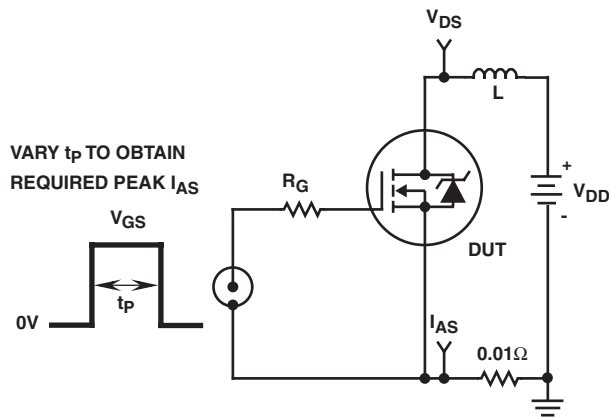
FIGURE 16. **UNCLAMPED ENERGY TEST CIRCUIT**

FIGURE 17. **UNCLAMPED ENERGY WAVEFORMS**

Test Circuits and Waveforms (Continued)

FIGURE 18. SWITCHING TEST CIRCUIT

FIGURE 19. RESISTIVE SWITCHING WAVEFORMS

FIGURE 20. GATE CHARGE TEST CIRCUIT

FIGURE 21. GATE CHARGE WAVEFORMS

PSPICE Electrical Model

.SUBCKT RFD3055LE 2 1 3 ;   rev 1/30/95

CA 12 8 3.9e-9
CB 15 14 4.9e-9
CIN 6 8 3.25e-10

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

EBREAK 11 7 17 18 67.8
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 1.0e-9
LGATE 1 9 5.42e-9
LSOURCE 3 7 2.57e-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 3.7e-2
RGATE 9 20 3.37
RLDRAIN 2 5 10
RLGATE 1 9 54.2
RLSOURCE 3 7 25.7
RSLC1 5 51 RSLCMOD 1e-6
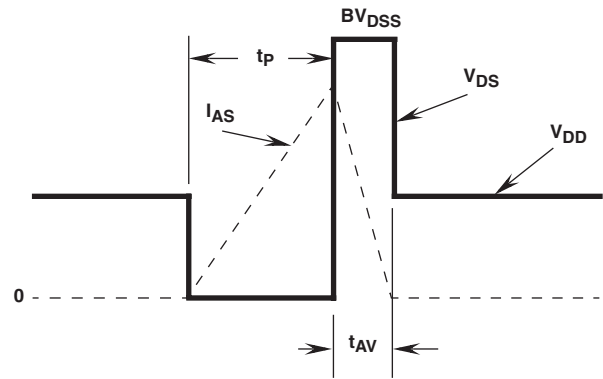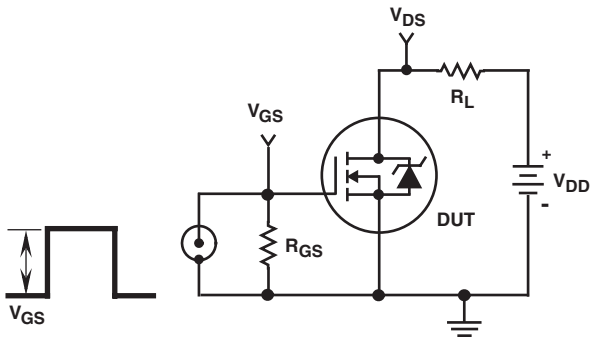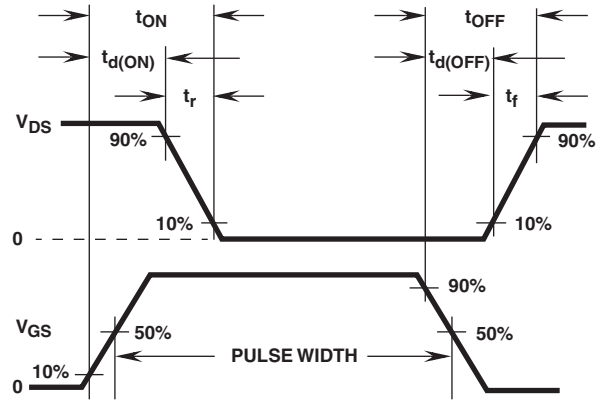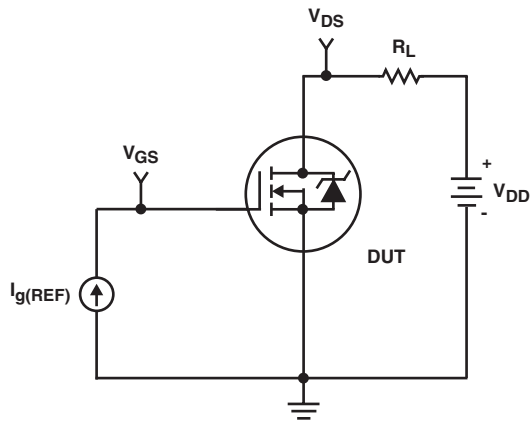RSLC2 5 50 1e3
RSOURCE 8 7 RSOURCEMOD 2.50e-2
RVTHRES 22 8 RVTHRESMOD 1
RVTEMP 18 19 RVTEMPMOD 1

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)))*(PWR(V(5,51)/(1e-6*30),3))}

.MODEL DBODYMOD D (IS = 1.75e-13 RS = 1.75e-2 TRS1 = 1e-4 TRS2 = 5e-6 CJO = 5.9e-10 TT = 5.45e-8 N = 1.03 M = 0.6)
.MODEL DBREAKMOD D (RS = 6.50e-1 TRS1 = 1.25e-4 TRS2 = 1.34e-6)
.MODEL DPLCAPMOD D (CJO = 3.21e-10 IS = 1e-30 N = 10 M = 0.81)
.MODEL MMEDMOD NMOS (VTO = 2.02 KP = .83 IS = 1e-30 N = 10 TOX = 1 L = 1u W = 1u RG = 3.37)
.MODEL MSTROMOD NMOS (VTO = 2.39 KP = 14 IS = 1e-30 N = 10 TOX = 1 L = 1u W = 1u)
.MODEL MWEAKMOD NMOS (VTO = 1.78 KP = 0.02 IS = 1e-30 N = 10 TOX = 1 L = 1u W = 1u RG = 33.7 RS = 0.1)
.MODEL RBREAKMOD RES (TC1 = 1.06e-3 TC2 = 0)
.MODEL RDRAINMOD RES (TC1 = 1.23e-2 TC2 = 2.58e-5)
.MODEL RSLCMOD RES (TC1 = 0 TC2 = 0)
.MODEL RSOURCEMOD RES (TC1 = 1e-3 TC2 = 0)
.MODEL RVTHRESMOD RES (TC1 = -2.19e-3 TC2 = -4.97e-6)
.MODEL RVTEMPMOD RES (TC1 = -1.6e-3 TC2 = 1e-7)

.MODEL S1AMOD VSWITCH (RON = 1e-5 ROFF = 0.1 VON = -4 VOFF= -2.5)
.MODEL S1BMOD VSWITCH (RON = 1e-5 ROFF = 0.1 VON = -2.5 VOFF= -4)
.MODEL S2AMOD VSWITCH (RON = 1e-5 ROFF = 0.1 VON = -0.5 VOFF= 0)
.MODEL S2BMOD VSWITCH (RON = 1e-5 ROFF = 0.1 VON = 0 VOFF= -0.5)

.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.
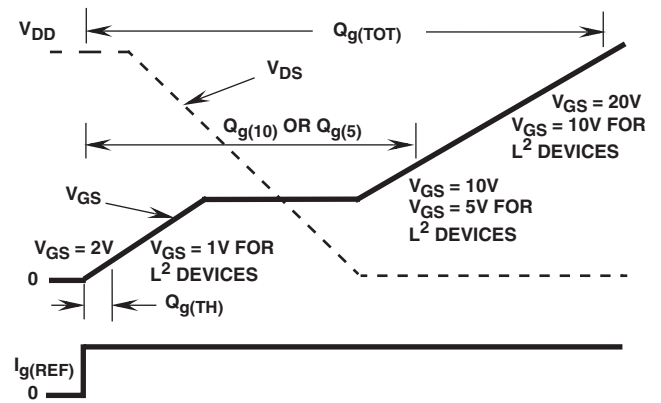
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EnSigna™	MicroFET™	QT Optoelectronics™	TruTranslation™
FACT™	MicroPak™	Quiet Series™	UHC™
FACT Quiet Series™	MICROWIRE™	SILENT SWITCHER ®	UltraFET ®

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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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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.

Rev. H4

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