**FAIRCHILD**
SEMICONDUCTOR®

## N-Channel Power MOSFET
### 50V, 14A, 100 mΩ

These are N-channel power MOSFETs manufactured using the MegaFET 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 and relay drivers. These transistors can be operated directly from integrated circuits.

Formerly developmental type TA09770.

## Ordering Information

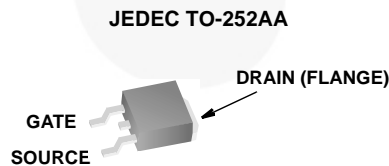| PART NUMBER | PACKAGE | BRAND |
|---|---|---|
| RFD14N05SM9A | TO-252AA | F14N05 |

## Features

- 14A, 50V

- $r_{DS(ON)} = 0.100\Omega$

- Temperature Compensating PSPICE® Model

- Peak Current vs Pulse Width Curve

- UIS Rating Curve

- 175°C Operating Temperature

- Related Literature
  - TB334 "Guidelines for Soldering Surface Mount Components to PC Boards"

## Symbol



## Packaging

**JEDEC TO-252AA**
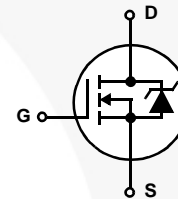


GATE
SOURCE
DRAIN (FLANGE)

## Absolute Maximum Ratings    $T_C = 25^oC$, Unless Otherwise Specified

|  |  | RFD14N05SM9A | UNITS |
|---|---|---|---|
| Drain to Source Voltage (Note 1) . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . $V_{DSS}$ | | 50 | V |
| Drain to Gate Voltage ($R_{GS} = 20k\Omega$) (Note 1) . . . . . . . . . . . . . . . . . . . . . . . . . . . . . $V_{DGR}$ | | 50 | V |
| Gate to Source Voltage . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . $V_{GS}$ | | ±20 | V |
| Continuous Drain Current . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . $I_D$ | | 14 | A |
| Pulsed Drain Current (Note 3) . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . $I_{DM}$ | | Refer to Peak Current Curve | |
| Pulsed Avalanche Rating. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . $E_{AS}$ | | Refer to UIS Curve | |
| Power Dissipation . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . $P_D$ | | 48 | W |
| Derate above $25^oC$ . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . | | 0.32 | $W/^oC$ |
| Operating and Storage Temperature . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . $T_J, T_{STG}$ | | -55 to 175 | $^oC$ |
| Maximum Temperature for Soldering | | | |
| Leads at 0.063in (1.6mm) from Case for 10s. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . $T_L$ | | 300 | $^oC$ |
| Package Body for 10s, See Techbrief 334 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . $T_{pkg}$ | | 260 | $^oC$ |

*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 | $BV_{DSS}$ | $I_D = 250\mu A$, $V_{GS} = 0V$ (Figure 9) | | 50 | - | - | V |
| Gate Threshold Voltage | $V_{GS(TH)}$ | $V_{GS} = V_{DS}$, $I_D = 250\mu A$ | | 2 | - | 4 | V |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$ = Rated $BV_{DSS}$, $V_{GS} = 0V$ | | - | - | 25 | $\mu A$ |
|  |  | $V_{DS} = 0.8$ x Rated $BV_{DSS}$, $V_{GS} = 0V$, $T_C = 150^oC$ | | - | - | 250 | $\mu A$ |
| Gate to Source Leakage Current | $I_{GSS}$ | $V_{GS} = ±20V$ | | - | - | ±100 | nA |
| Drain to Source On Resistance (Note 2) | $r_{DS(ON)}$ | $I_D = 14A$, $V_{GS} = 10V$, (Figure 11) | | - | - | 0.100 | $\Omega$ |
| Turn-On Time | $t_{ON}$ | $V_{DD} = 25V$, $I_D \approx 14A$, $V_{GS} = 10V$, $R_{GS} = 25\Omega$, $R_L = 1.7\Omega$ (Figure 13) | | - | - | 60 | ns |
| Turn-On Delay Time | $t_{d(ON)}$ | | | - | 14 | - | ns |
| Rise Time | $t_r$ | | | - | 26 | - | ns |
| Turn-Off Delay Time | $t_{d(OFF)}$ | | | - | 45 | - | ns |
| Fall Time | $t_f$ | | | - | 17 | - | ns |
| Turn-Off Time | $t_{OFF}$ | | | - | - | 100 | ns |
| Total Gate Charge | $Q_{g(TOT)}$ | $V_{GS} = 0V$ to $20V$ | $V_{DD} = 40V$, $I_D = 14A$, $R_L = 2.86\Omega$ $I_{g(REF)} = 0.4mA$ (Figure 13) | - | - | 40 | nC |
| Gate Charge at 5V | $Q_{g(10)}$ | $V_{GS} = 0V$ to $10V$ | | - | - | 25 | nC |
| Threshold Gate Charge | $Q_{g(TH)}$ | $V_{GS} = 0V$ to $2V$ | | - | - | 1.5 | nC |
| Input Capacitance | $C_{ISS}$ | $V_{DS} = 25V$, $V_{GS} = 0V$, $f = 1MHz$ (Figure 12) | | - | 570 | - | pF |
| Output Capacitance | $C_{OSS}$ | | | - | 185 | - | pF |
| Reverse Transfer Capacitance | $C_{RSS}$ | | | - | 50 | - | pF |
| Thermal Resistance Junction to Case | $R_{\theta JC}$ | | | - | - | 3.125 | $^oC/W$ |
| Thermal Resistance Junction to Ambient | $R_{\theta JA}$ | | | - | - | 100 | $^oC/W$ |

### Source to Drain Diode Specifications

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| Source to Drain Diode Voltage (Note 2) | $V_{SD}$ | $I_{SD} = 14A$ | - | - | 1.5 | V |
| Diode Reverse Recovery Time | $t_{rr}$ | $I_{SD} = 14A$, $dI_{SD}/dt = 100A/\mu s$ | - | - | 125 | 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).

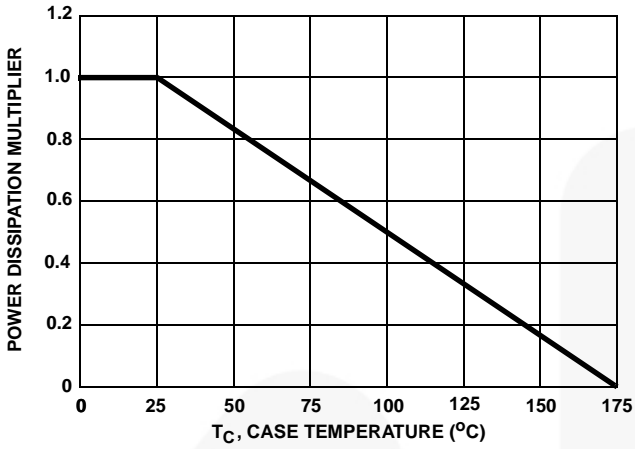## Typical Performance Curves  Unless Otherwise Specified



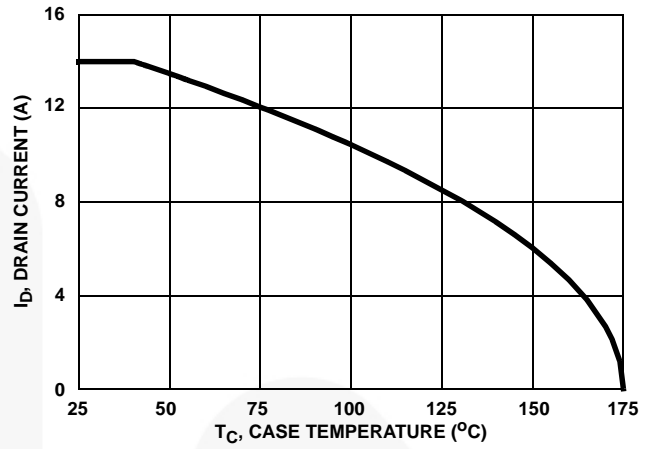FIGURE 1. NORMALIZED POWER DISSIPATION vs CASE TEMPERATURE



FIGURE 2. MAXIMUM CONTINUOUS DRAIN CURRENT vs CASE TEMPERATURE



NOTES:
DUTY FACTOR: $D = t_1/t_2$
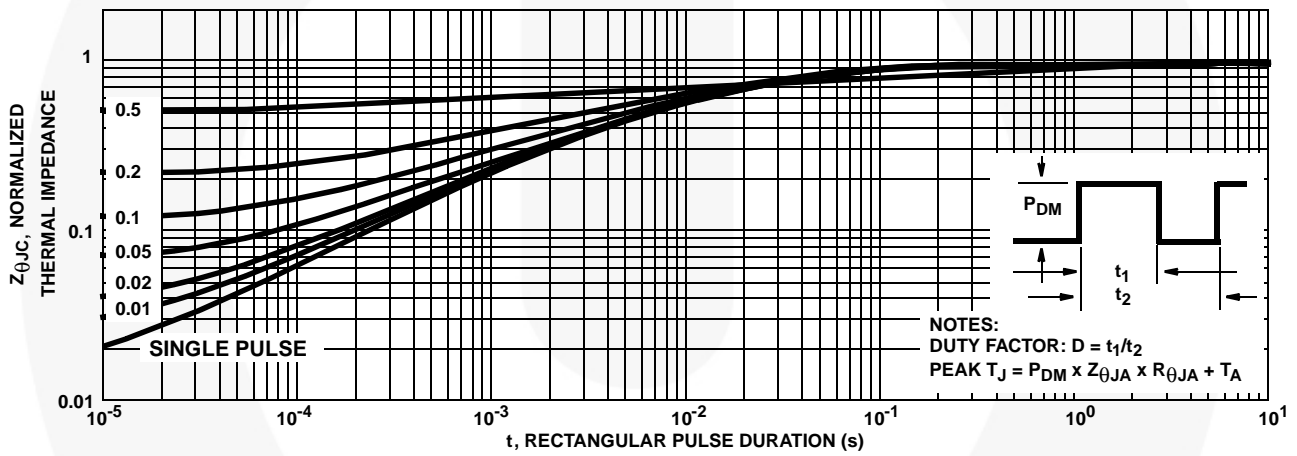PEAK $T_J = P_{DM} \times Z_{\theta JA} \times R_{\theta JA} + T_A$

FIGURE 3.  NORMALIZED MAXIMUM TRANSIENT THERMAL IMPEDANCE
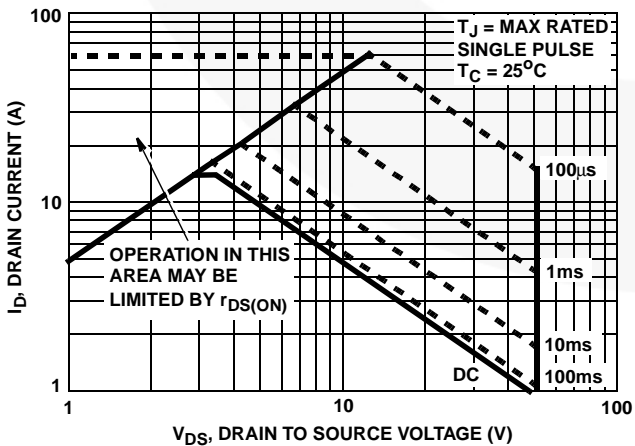


FIGURE 4.  FORWARD BIAS SAFE OPERATING AREA



FOR TEMPERATURES ABOVE 25°C DERATE PEAK CURRENT AS FOLLOWS:

$$I = I_{25}\left(\sqrt{\frac{175 - T_C}{150}}\right)$$
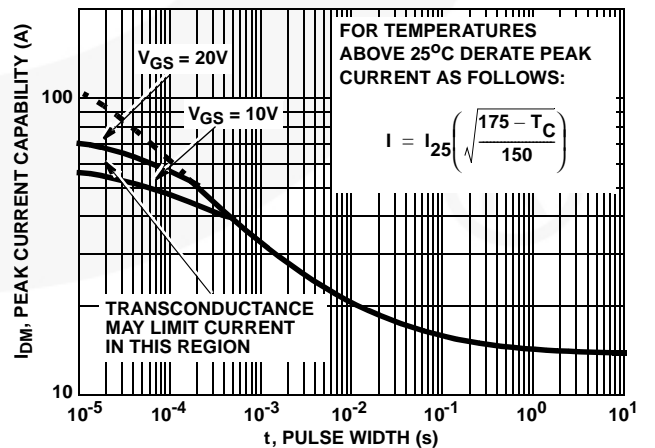
FIGURE 5.  PEAK CURRENT CAPABILITY

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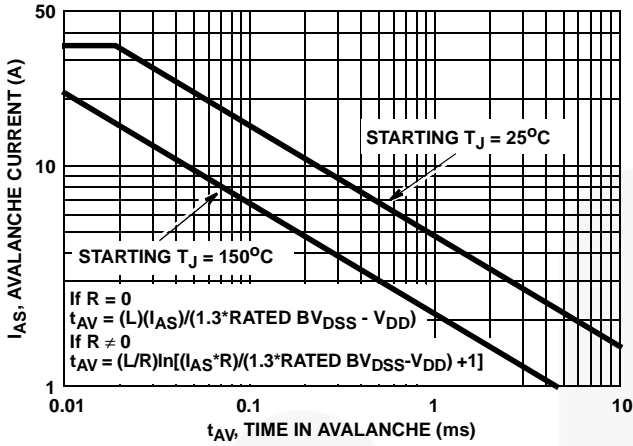


NOTE: Refer to Fairchild Application Notes AN9321 and AN9322.

**FIGURE 6. UNCLAMPED INDUCTIVE SWITCHING**
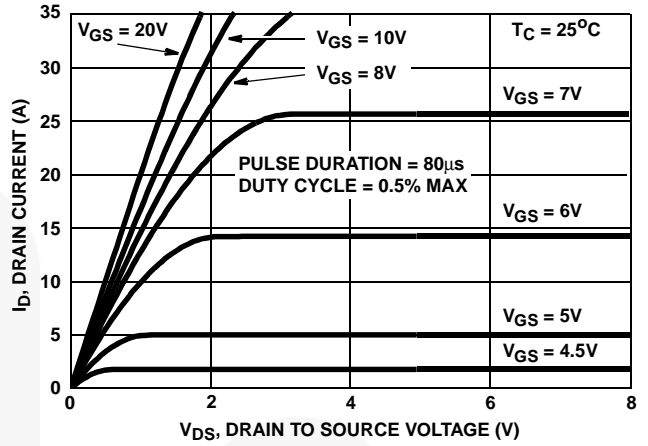


**FIGURE 7. SATURATION CHARACTERISTICS**
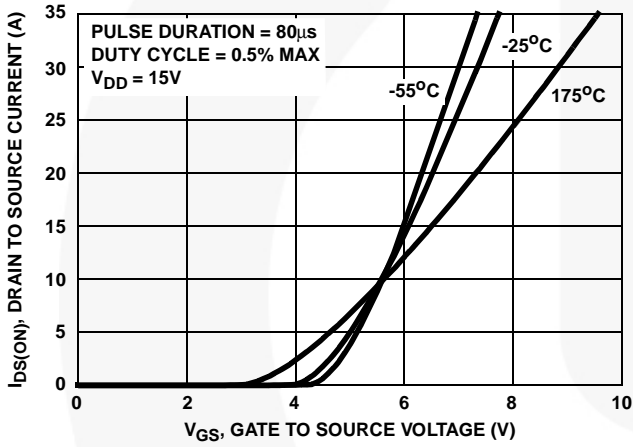


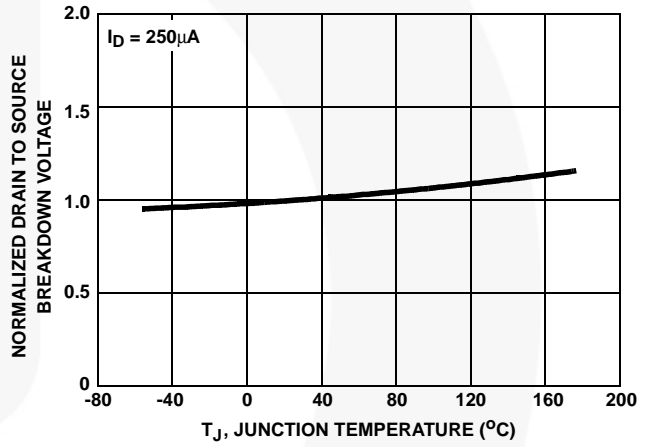**FIGURE 8. TRANSFER CHARACTERISTICS**



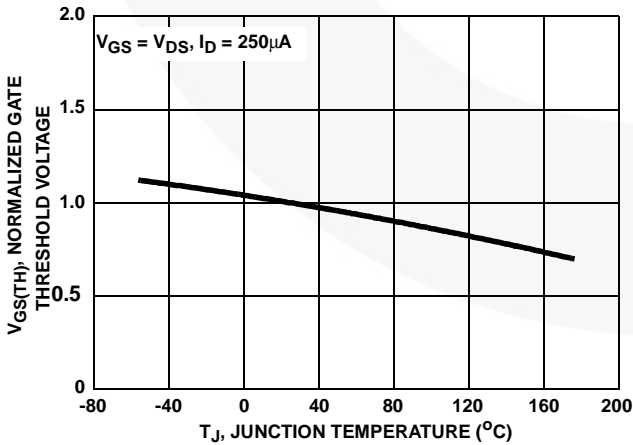**FIGURE 9. NORMALIZED DRAIN TO SOURCE BREAKDOWN VOLTAGE vs JUNCTION TEMPERATURE**



**FIGURE 10. NORMALIZED GATE THRESHOLD VOLTAGE vs JUNCTION TEMPERATURE**
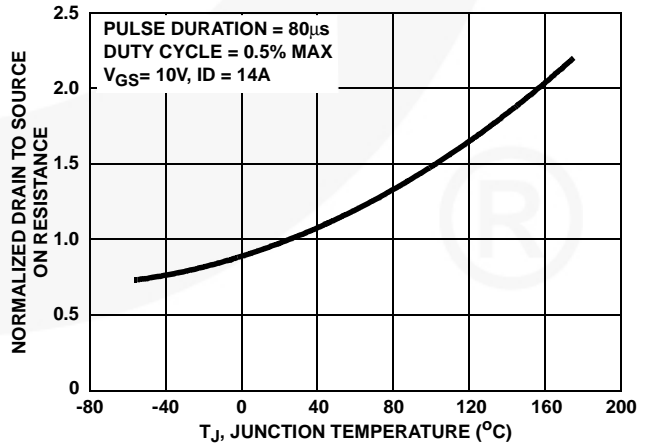


**FIGURE 11. NORMALIZED DRAIN TO SOURCE ON RESISTANCE vs JUNCTION TEMPERATURE**

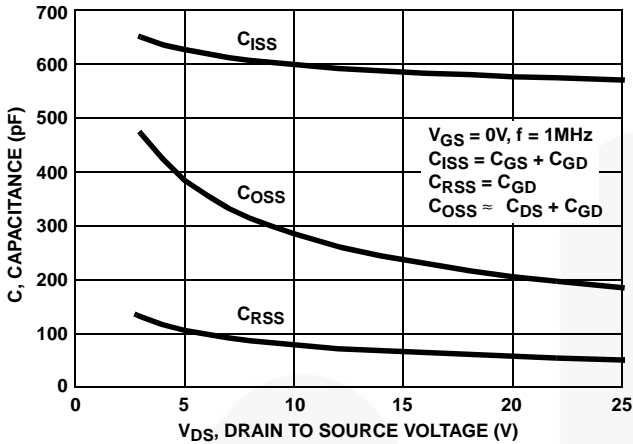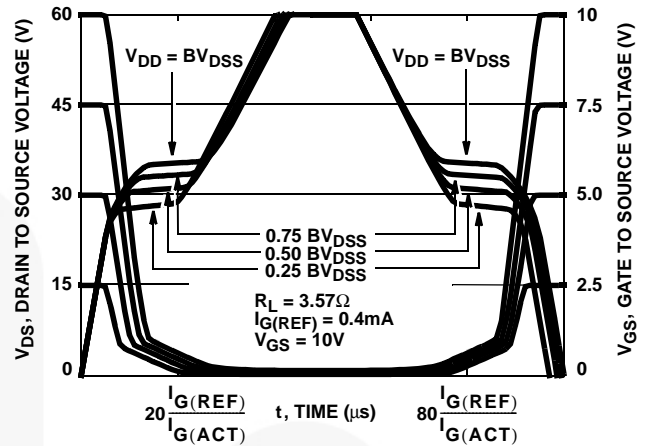## *Typical Performance Curves* Unless Otherwise Specified **(Continued)**



FIGURE 12. CAPACITANCE vs DRAIN TO SOURCE VOLTAGE

$V_{GS} = 0V, f = 1MHz$
$C_{ISS} = C_{GS} + C_{GD}$
$C_{RSS} = C_{GD}$
$C_{OSS} \approx C_{DS} + C_{GD}$



$V_{DD} = BV_{DSS}$     $V_{DD} = BV_{DSS}$

0.75 $BV_{DSS}$
0.50 $BV_{DSS}$
0.25 $BV_{DSS}$

$R_L = 3.57\Omega$
$I_{G(REF)} = 0.4mA$
$V_{GS} = 10V$

NOTE: Refer to Fairchild Application Notes AN7254 and AN7260,

FIGURE 13. NORMALIZED SWITCHING WAVEFORMS FOR CONSTANT CURRENT GATE DRIVE

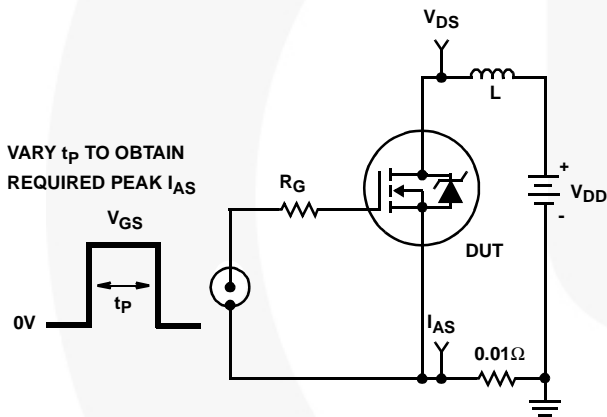## *Test Circuits and Waveforms*
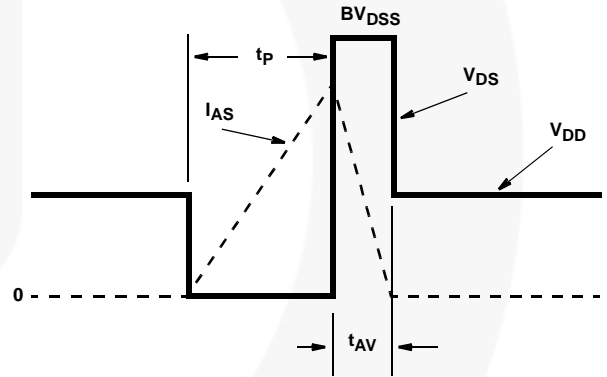


FIGURE 14. UNCLAMPED ENERGY TEST CIRCUIT
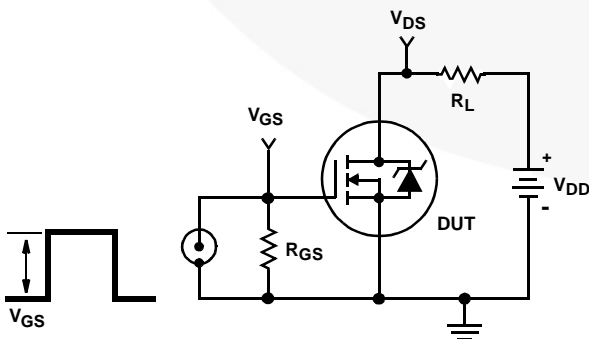


FIGURE 15. UNCLAMPED ENERGY WAVEFORMS



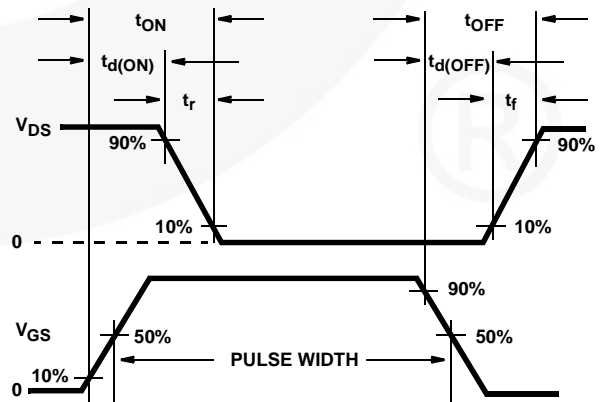FIGURE 16. SWITCHING TIME TEST CIRCUIT



FIGURE 17. RESISTIVE SWITCHING WAVEFORMS

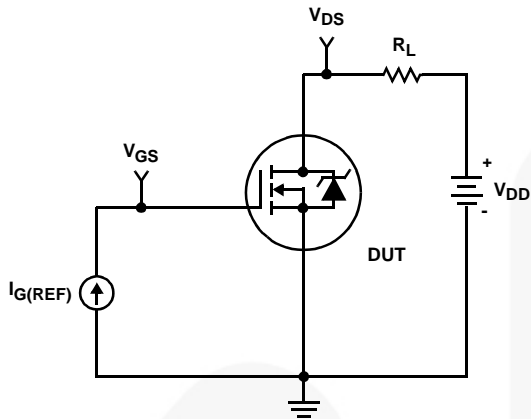## *Test Circuits and Waveforms* (Continued)
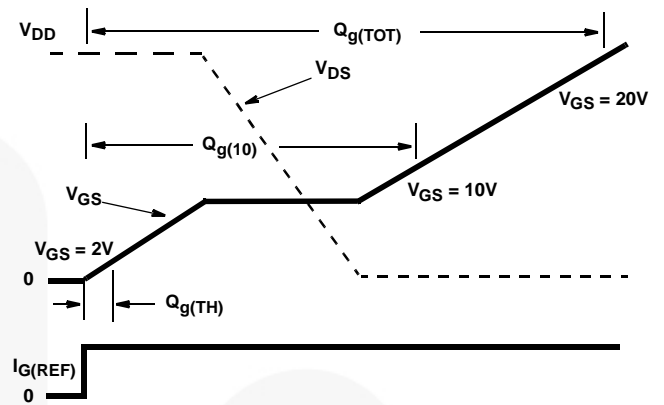


**FIGURE 18. GATE CHARGE TEST CIRCUIT**



**FIGURE 19. GATE CHARGE WAVEFORMS**

## *PSPICE Electrical Model*

.SUBCKT  RFD14N05  2 1 3 ;     rev 9/12/94

CA  12  8  8.84e-10
CB  15  14  9.34e-10
CIN  6  8  5.2e-10

DBODY  7  5  DBDMOD
DBREAK  5 11  DBKMOD
DPLCAP  10  5  DPLCAPMOD

EBREAK  11  7  17  18  62.87
EDS  14  8  5  8  1
EGS  13  8  6  8  1
ESG  6  10  6  8  1
EVTO  20  6  18  8  1

IT  8  17  1

LDRAIN  2  5  1e-9
LGATE  1  9  4.34e-9
LSOURCE  3  7  3.79e-9

MOS1  16  6  8  8  MOSMOD  M = 0.99
MOS2  16  21  8  8  MOSMOD  M = 0.01

RBREAK  17  18  RBKMOD  1
RDRAIN  50  16  RDSMOD  2.2e-3
RGATE  9  20  5.64
RIN  6  8  1e9
RSCL1  5  51  RSCLMOD  1e-6
RSCL2  5  50  1e3
RSOURCE  8  7  RDSMOD  42.3e-3
RVTO  18  19  RVTOMOD  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  8  19  DC  1
VTO  21  6  0.82

ESCL  51  50  VALUE = {(V(5,51)/ABS(V(5,51)))*(PWR(V(5,51)*1e6/50,6))}

.MODEL DBDMOD D (IS = 1.5e-13  RS = 10.9e-3  TRS1 = 2.3e-3  TRS2 = -1.75e-5  CJO = 6.84e-10  TT = 4.2e-8)
.MODEL DBKMOD D (RS = 4.15e-1  TRS1 = 3.73e-3  TRS2 = -3.21e-5)
.MODEL DPLCAPMOD D (CJO = 26.2e-11  IS = 1e-30  N = 10)
.MODEL MOSMOD NMOS (VTO = 3.91  KP = 12.68  IS = 1e-30  N = 10  TOX = 1  L = 1u  W = 1u)
.MODEL RBKMOD RES (TC1 = 7.73e-4  TC2 = 2.12e-6)
.MODEL RDSMOD RES (TC1 = 5.0e-3  TC2 = 2.53e-5)
.MODEL RSCLMOD RES (TC1 = 2.05e-3  TC2 = 1.35e-5)
.MODEL RVTOMOD RES (TC1 = -4.44e-3  TC2 = -6.45e-6)
.MODEL S1AMOD VSWITCH (RON = 1e-5  ROFF = 0.1  VON = -5.29  VOFF= -3.29)
.MODEL S1BMOD VSWITCH (RON = 1e-5  ROFF = 0.1  VON = -3.29  VOFF= -5.29)
.MODEL S2AMOD VSWITCH (RON = 1e-5  ROFF = 0.1  VON = -2.25  VOFF= 2.75)
.MODEL S2BMOD VSWITCH (RON = 1e-5  ROFF = 0.1  VON = 2.75  VOFF= -2.25)

.ENDS
NOTE: For further discussion of the PSPICE model, consult **A New PSPICE Sub-circuit for the Power MOSFET Featuring Global Temperature Options**; written  by William J. Hepp and C. Frank Wheatley.

**FAIRCHILD**
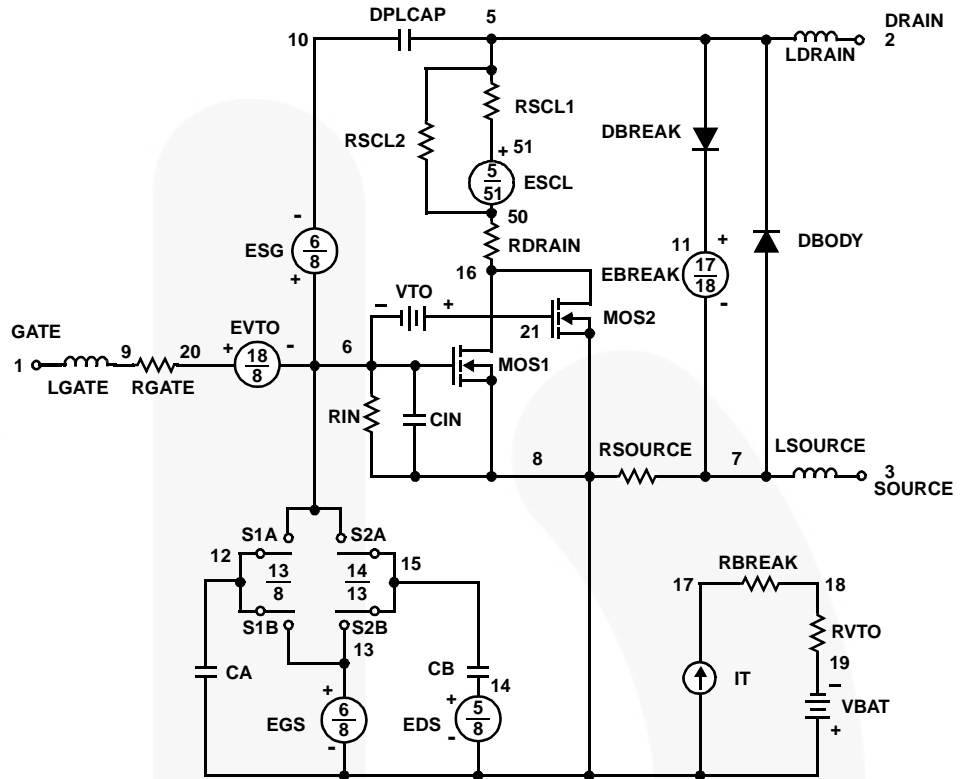
SEMICONDUCTOR®

## TRADEMARKS

The following includes registered and unregistered trademarks and service marks, owned by Fairchild Semiconductor and/or its global subsidiaries, and is not intended to be an exhaustive list of all such trademarks.

| | | | |
|---|---|---|---|
| AccuPower™ | F-PFS™ | ® | Sync-Lock™ |
| AX-CAP®* | FRFET® | | SYSTEM ®* |
| BitSiC™ | Global Power Resource℠ | PowerTrench® | GENERAL |
| Build it Now™ | GreenBridge™ | PowerXS™ | TinyBoost® |
| CorePLUS™ | Green FPS™ | Programmable Active Droop™ | TinyBuck® |
| CorePOWER™ | Green FPS™ e-Series™ | QFET® | TinyCalc™ |
| CROSSVOLT™ | Gmax™ | QS™ | TinyLogic® |
| CTL™ | GTO™ | Quiet Series™ | TINYOPTO™ |
| Current Transfer Logic™ | IntelliMAX™ | RapidConfigure™ | TinyPower™ |
| DEUXPEED® | ISOPLANAR™ | ™ | TinyPWM™ |
| Dual Cool™ | Marking Small Speakers Sound Louder | | TinyWire™ |
| EcoSPARK® | and Better™ | Saving our world, 1mW/W/kW at a time™ | TranSiC™ |
| EfficentMax™ | MegaBuck™ | SignalWise™ | TriFault Detect™ |
| ESBC™ | MICROCOUPLER™ | SmartMax™ | TRUECURRENT®* |
| | MicroFET™ | SMART START™ | µSerDes™ |
| F® | MicroPak™ | Solutions for Your Success™ | |
| Fairchild® | MicroPak2™ | SPM® | |
| Fairchild Semiconductor® | MillerDrive™ | STEALTH™ | UHC® |
| FACT Quiet Series™ | MotionMax™ | SuperFET® | Ultra FRFET™ |
| FACT® | mWSaver® | SuperSOT™-3 | UniFET™ |
| FAST® | OptoHiT™ | SuperSOT™-6 | VCX™ |
| FastvCore™ | OPTOLOGIC® | SuperSOT™-8 | VisualMax™ |
| FETBench™ | OPTOPLANAR® | SupreMOS® | VoltagePlus™ |
| FPS™ | | SyncFET™ | XS™ |

*Trademarks of System General Corporation, used under license by Fairchild Semiconductor.

## 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. THESE SPECIFICATIONS DO NOT EXPAND THE TERMS OF FAIRCHILD'S WORLDWIDE TERMS AND CONDITIONS, SPECIFICALLY THE WARRANTY THEREIN, WHICH COVERS THESE PRODUCTS.

## 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 here in:

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, and (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 a significant injury of the user.

2. A critical component in 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.

## ANTI-COUNTERFEITING POLICY

Fairchild Semiconductor Corporation's Anti-Counterfeiting Policy. Fairchild's Anti-Counterfeiting Policy is also stated on our external website, www.Fairchildsemi.com, under Sales Support.

Counterfeiting of semiconductor parts is a growing problem in the industry. All manufactures of semiconductor products are experiencing counterfeiting of their parts. Customers who inadvertently purchase counterfeit parts experience many problems such as loss of brand reputation, substandard performance, failed application, and increased cost of production and manufacturing delays. Fairchild is taking strong measures to protect ourselves and our customers from the proliferation of counterfeit parts. Fairchild strongly encourages customers to purchase Fairchild parts either directly from Fairchild or from Authorized Fairchild Distributors who are listed by country on our web page cited above. Products customers buy either from Fairchild directly or from Authorized Fairchild Distributors are genuine parts, have full traceability, meet Fairchild's quality standards for handing and storage and provide access to Fairchild's full range of up-to-date technical and product information. Fairchild and our Authorized Distributors will stand behind all warranties and will appropriately address and warranty issues that may arise. Fairchild will not provide any warranty coverage or other assistance for parts bought from Unauthorized Sources. Fairchild is committed to combat this global problem and encourage our customers to do their part in stopping this practice by buying direct or from authorized distributors.

## PRODUCT STATUS DEFINITIONS
### Definition of Terms

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

Rev. I66

# Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[onsemi](#):
  [RFD14N05_Q](#)  [RFD14N05](#)