

# MOSFET – Power, N-Channel

50 V, 14 A, 100 mΩ

## RFD14N05SM9A

### Description

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.

### Features

- 14 A, 50 V
- $R_{DS(ON)} = 0.100 \Omega$
- 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”
- This is a Pb-Free Device

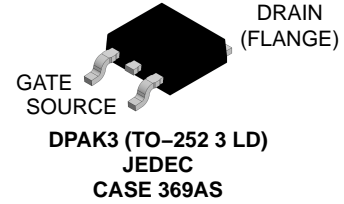
### ABSOLUTE MAXIMUM RATINGS (T<sub>C</sub> = 25°C, unless otherwise noted)

| Parameter  | Symbol                            | Ratings                     | Unit |
|--|-----------------------------------|-----------------------------|------|
| Drain to Source Voltage (Note 1)                         | V <sub>DSS</sub>                  | 50                          | V    |
| Drain to Gate Voltage (R <sub>GS</sub> = 20 kΩ) (Note 1) | V <sub>DGR</sub>                  | 50                          | V    |
| Gate to Source Voltage                                   | V <sub>GS</sub>                   | ±20                         | V    |
| Continuous Drain Current                                 | I <sub>D</sub>                    | 14                          | A    |
| Pulsed Drain Current (Note 3)                            | I <sub>DM</sub>                   | Refer to Peak Current Curve |      |
| Pulsed Avalanche Rating                                  | E <sub>AS</sub>                   | Refer to UIS Curve          |      |
| Power Dissipation  | P <sub>D</sub>                    | 48                          | W    |
| Derate above 25°C  |                                   | 0.32                        | W/°C |
| Operating and Storage Temperature                        | T <sub>J</sub> , T <sub>STG</sub> | -55 to 175                  | °C   |
| Maximum Temperature for Soldering                        |                                   |                             |      |
| Leads at 0.063 in (1.6 mm) from Case for 10 s            | T <sub>L</sub>                    | 300                         | °C   |
| Package Body for 10 s, See Techbrief 334                 | T <sub>pkg</sub>                  | 260                         | °C   |

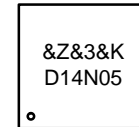
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. T<sub>J</sub> = 25°C to 150°C.

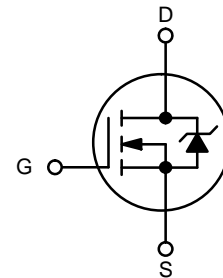
| V <sub>DSS</sub> | R <sub>DS(ON)</sub> MAX | I <sub>D</sub> MAX |
|------------------|-------------------------|--------------------|
| 50 V             | 100 mΩ @ 10 V           | 14 A               |



### MARKING DIAGRAM



&Z = Assembly Plant Code  
 &3 = 3-Digit Date Code  
 &K = 2-Digits Lot Run Code  
 D14N05 = Specific Device Code



N-Channel MOSFET

### ORDERING INFORMATION

| Device       | Package                       | Shipping†          |
|--------------|-------------------------------|--------------------|
| RFD14N05SM9A | DPAK3 (TO-252 3 LD) (Pb-Free) | 2500 / Tape & Reel |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

# RFD14N05SM9A

## ELECTRICAL SPECIFICATIONS (T<sub>C</sub> = 25°C, unless otherwise noted)

| Parameter                              | Symbol              | Test Conditions   | Min  | Typ | Max   | Unit |    |
|--|---------------------|---|--|-----|-------|------|----|
| Drain to Source Breakdown Voltage      | BV <sub>DSS</sub>   | I <sub>D</sub> = 250 μA, V <sub>GS</sub> = 0 V (Figure 9)   | 50   | –   | –     | V    |    |
| Gate Threshold Voltage                 | V <sub>GS(TH)</sub> | V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 250 μA   | 2  | –   | 4     | V    |    |
| Zero Gate Voltage Drain Current        | I <sub>DSS</sub>    | V <sub>DS</sub> = Rated BV <sub>DSS</sub> , V <sub>GS</sub> = 0 V   | –  | –   | 25    | μA   |    |
|  |                     | V <sub>DS</sub> = 0.8 × Rated BV <sub>DSS</sub> , V <sub>GS</sub> = 0 V, T <sub>C</sub> = 150°C                                   | –  | –   | 250   | μA   |    |
| Gate to Source Leakage Current         | I <sub>GSS</sub>    | V <sub>GS</sub> = ±20 V   | –  | –   | ±100  | nA   |    |
| Drain to Source On Resistance (Note 2) | R <sub>DS(ON)</sub> | I <sub>D</sub> = 14 A, V <sub>GS</sub> = 10 V, (Figure 11)  | –  | –   | 0.100 | Ω    |    |
| Turn-On Time                           | t <sub>ON</sub>     | V <sub>DD</sub> = 25 V, I <sub>D</sub> ≈ 14 A, V <sub>GS</sub> = 10 V, R <sub>GS</sub> = 25 Ω, R <sub>L</sub> = 1.7 Ω (Figure 13) | –  | –   | 60    | ns   |    |
| Turn-On Delay Time                     | t <sub>d(ON)</sub>  |   | –  | 14  | –     | ns   |    |
| Rise Time                              | t <sub>r</sub>      |   | –  | 26  | –     | ns   |    |
| Turn-Off Delay Time                    | t <sub>d(OFF)</sub> |   | –  | 45  | –     | ns   |    |
| Fall Time                              | t <sub>f</sub>      |   | –  | 17  | –     | ns   |    |
| Turn-Off Time                          | t <sub>OFF</sub>    |   | –  | –   | 100   | ns   |    |
| Total Gate Charge                      | Q <sub>g(TOT)</sub> | V <sub>GS</sub> = 0 V to 20 V   | V <sub>DD</sub> = 40 V, I <sub>D</sub> = 14 A, R <sub>L</sub> = 2.86 Ω<br>I <sub>g(REF)</sub> = 0.4 mA (Figure 13) | –   | –     | 40   | nC |
| Gate Charge at 5 V                     | Q <sub>g(10)</sub>  | V <sub>GS</sub> = 0 V to 10 V   |  | –   | –     | 25   | nC |
| Threshold Gate Charge                  | Q <sub>g(TH)</sub>  | V <sub>GS</sub> = 0 V to 2 V  |  | –   | –     | 1.5  | nC |
| Input Capacitance                      | C <sub>ISS</sub>    | V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V, f = 1MHz (Figure 12)   | –  | 570 | –     | pF   |    |
| Output Capacitance                     | C <sub>OSS</sub>    |   | –  | 185 | –     | pF   |    |
| Reverse Transfer Capacitance           | C <sub>RSS</sub>    |   | –  | 50  | –     | pF   |    |
| Thermal Resistance Junction to Case    | R <sub>θJC</sub>    |   | –  | –   | 3.125 | °C/W |    |
| Thermal Resistance Junction to Ambient | R <sub>θJA</sub>    |   | –  | –   | 100   | °C/W |    |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

## SOURCE TO DRAIN DIODE SPECIFICATIONS

| Parameter                              | Symbol          | Test Conditions   | Min | Typ | Max | Unit |
|--|-----------------|---|-----|-----|-----|------|
| Source to Drain Diode Voltage (Note 2) | V <sub>SD</sub> | I <sub>SD</sub> = 14 A                                  | –   | –   | 1.5 | V    |
| Diode Reverse Recovery Time            | t <sub>rr</sub> | I <sub>SD</sub> = 14 A, dI <sub>SD</sub> /dt = 100 A/μs | –   | –   | 125 | ns   |

2. Pulse Test: Pulse Width ≤300 ms, 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).

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## TYPICAL PERFORMANCE CURVES

(UNLESS OTHERWISE NOTED)

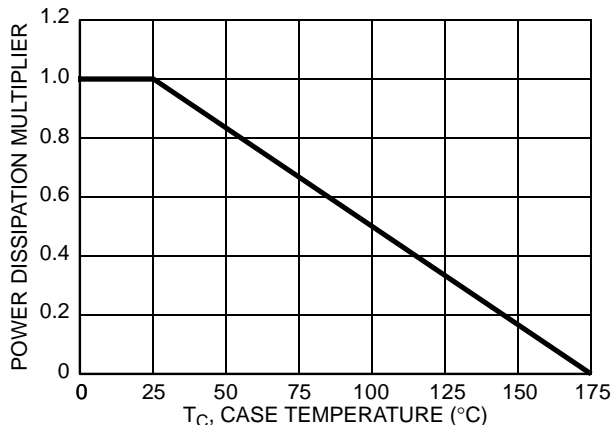


Figure 1. Normalized Power Dissipation vs. Case Temperature

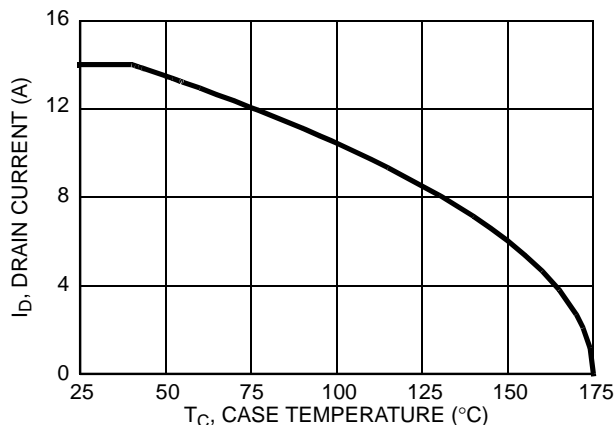


Figure 2. Maximum Continuous Drain Current vs. Case Temperature

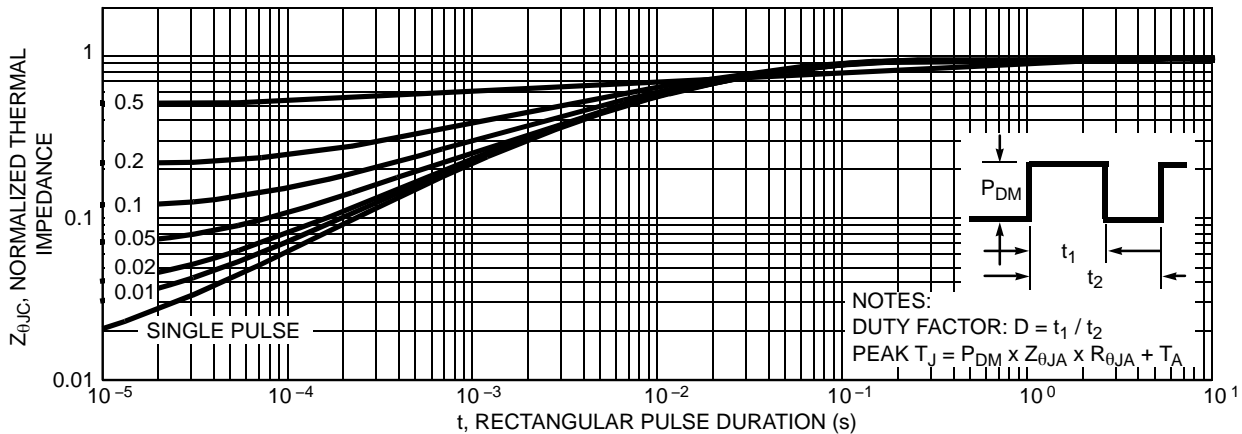


Figure 3. Normalized Maximum Transient Thermal Impedance

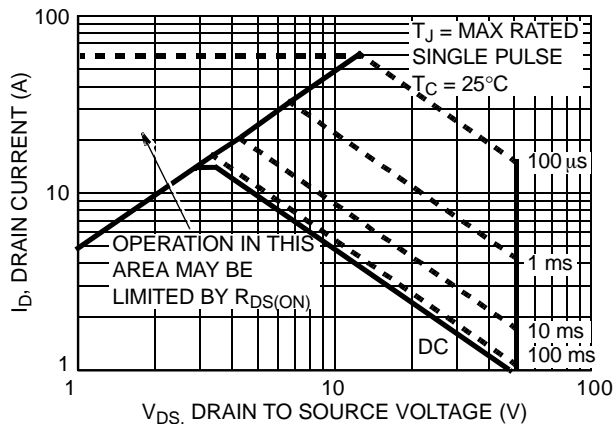


Figure 4. Forward Bias Safe Operating Area

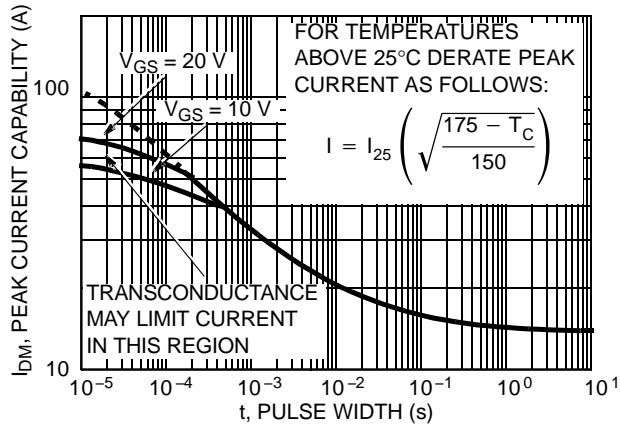
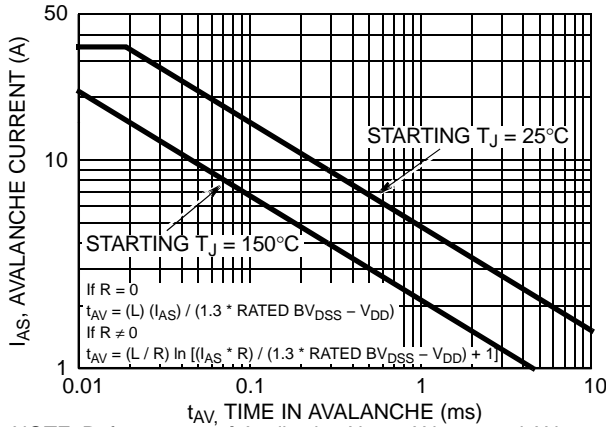


Figure 5. Peak Current Capability

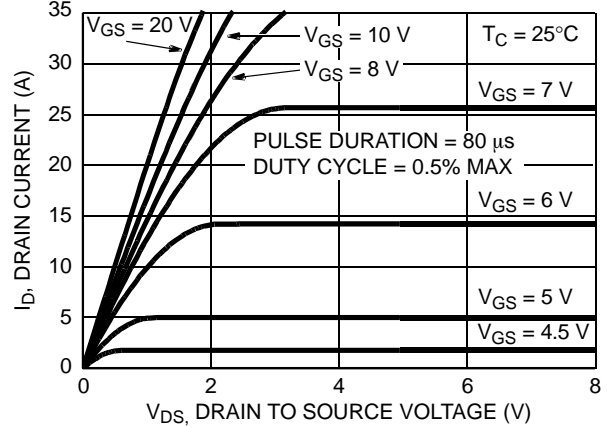
# RFD14N05SM9A

## TYPICAL PERFORMANCE CURVES

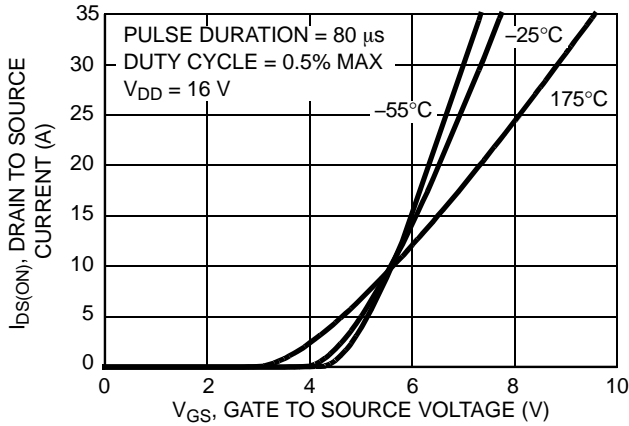
(UNLESS OTHERWISE NOTED) (CONTINUED)



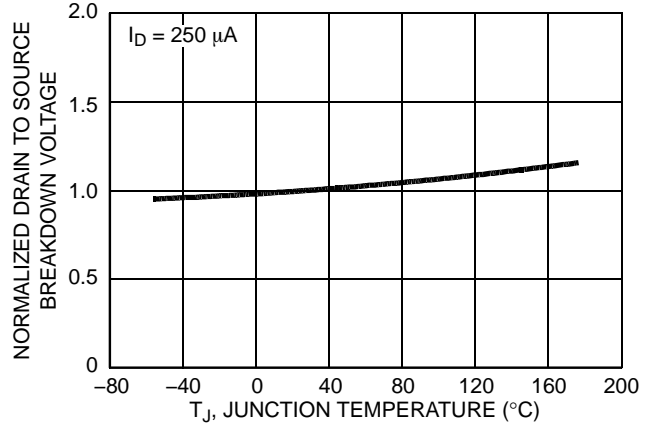
NOTE: Refer to onsemi Application Notes AN9321 and AN9322.  
**Figure 6. Unclamped Inductive Switching**



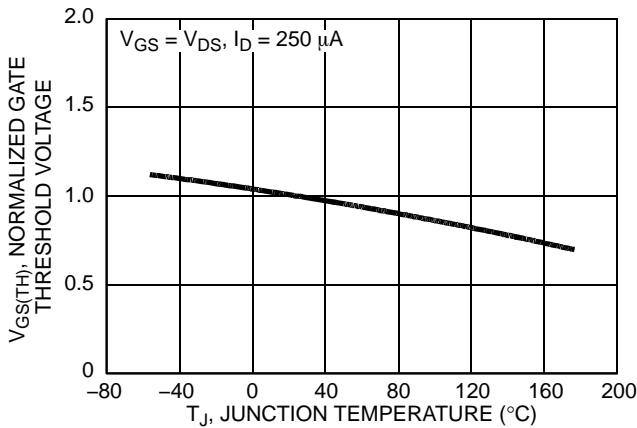
**Figure 7. Saturation Characteristics**



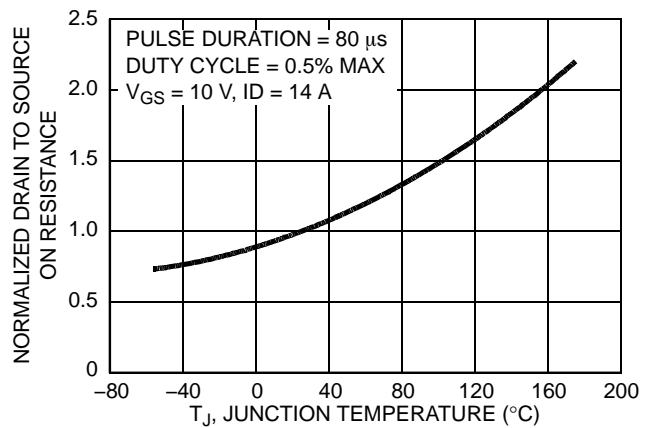
**Figure 8. Transfer Characteristics**



**Figure 9. Normalized Drain to Source Breakdown Voltage vs. Junction Temperature**



**Figure 10. Normalized Gate Threshold Voltage vs. Junction Temperature**



**Figure 11. Normalized Gate to Source On Resistance vs. Junction Temperature**

**TYPICAL PERFORMANCE CURVES**  
(UNLESS OTHERWISE NOTED) (CONTINUED)

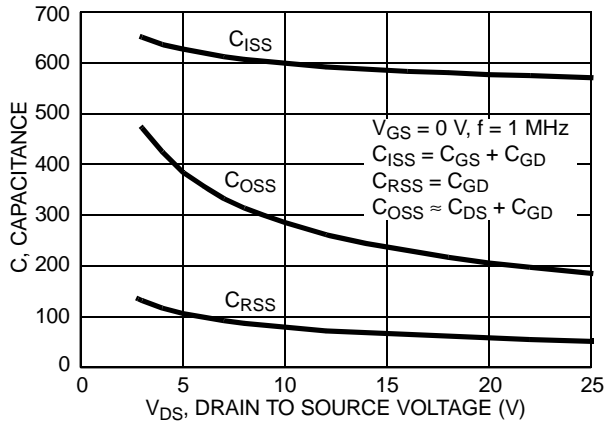
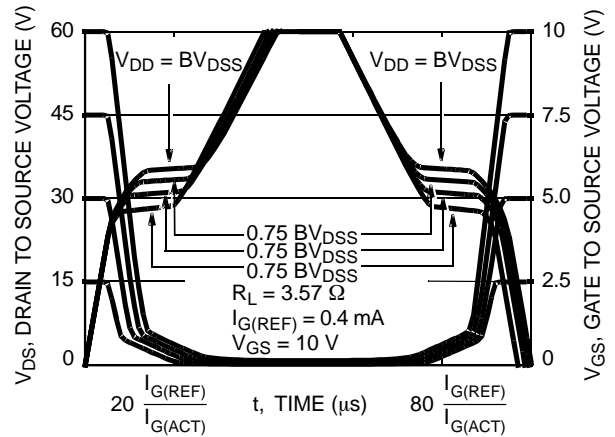


Figure 12. Capacitance vs. Drain to Source Voltage



NOTE: Refer to **onsemi** Application Notes AN7254 and AN7260.  
Figure 13. Normalized Switching Waveforms for Constant Current Gate Drive

**TEST CIRCUITS AND WAVEFORMS**

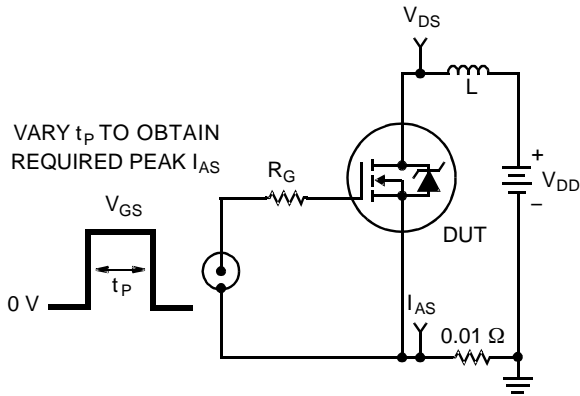


Figure 14. Unclamped Energy Test Circuit

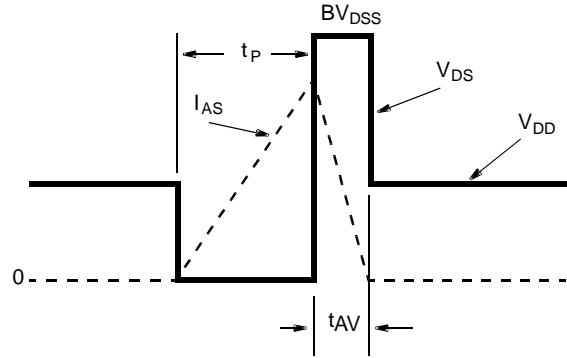


Figure 15. Unclamped Energy Waveforms

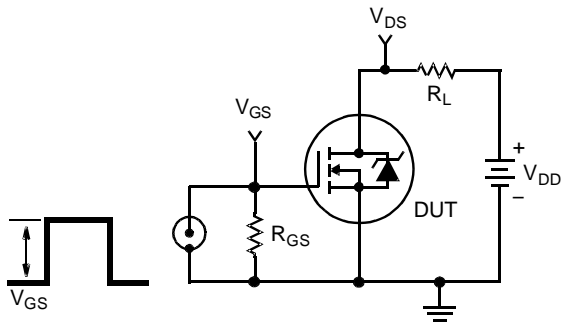


Figure 16. Switching Time Test Circuit

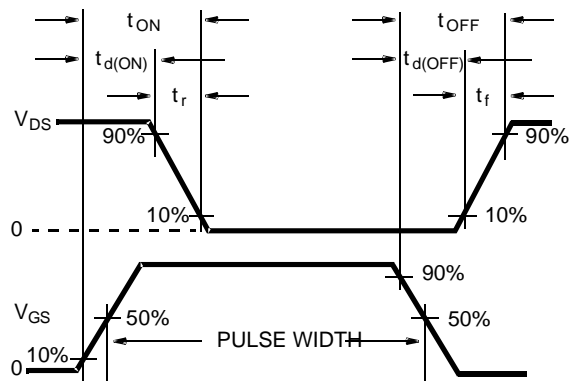


Figure 17. Resistive Switching Waveforms

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## TEST CIRCUITS AND WAVEFORMS

(CONTINUED)

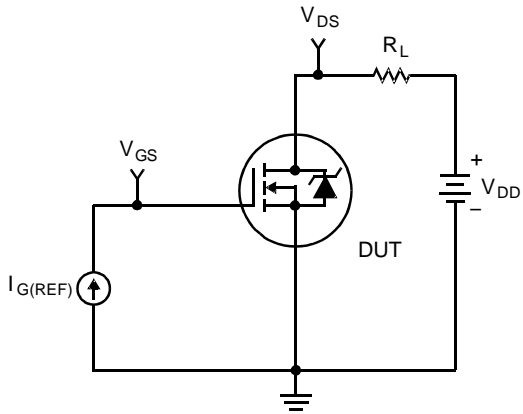


Figure 18. Gate Charge Test Circuit

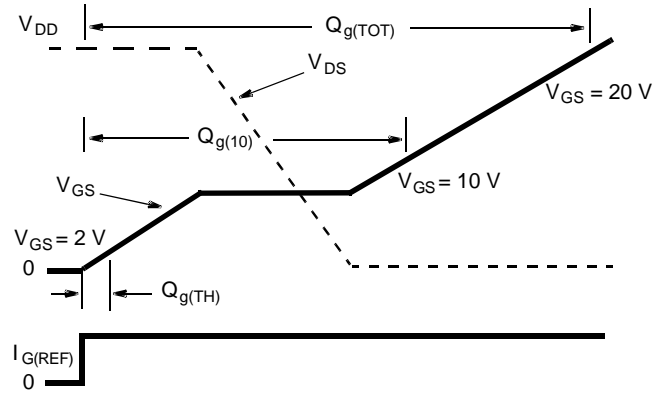


Figure 19. Gate Charge Waveforms

# RFD14N05SM9A

## 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)
```

# RFD14N05SM9A

.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.

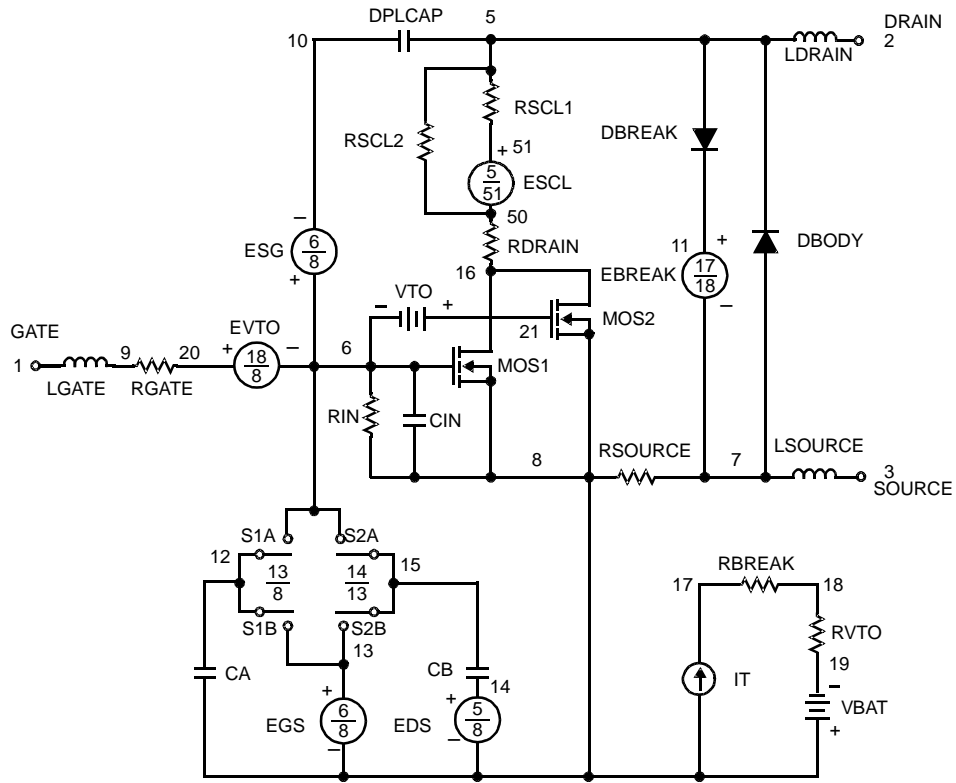
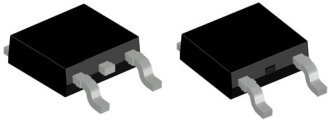


Figure 20. PSPICE Electrical Model

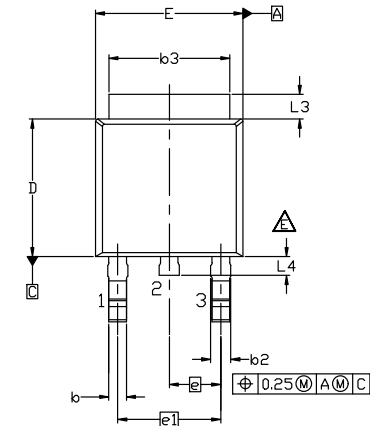


# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

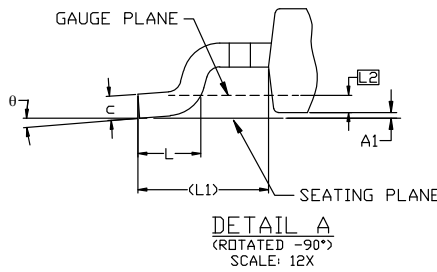
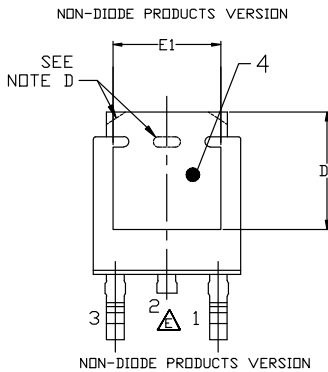


**DPAK3 6.10x6.54x2.29, 4.57P**  
**CASE 369AS**  
**ISSUE B**

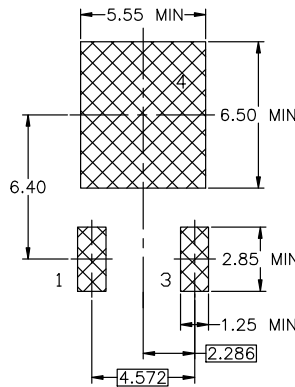
DATE 20 DEC 2023



- NOTES: UNLESS OTHERWISE SPECIFIED  
 A) THIS PACKAGE CONFORMS TO JEDEC, TO-252, ISSUE F, VARIATION AA.  
 B) ALL DIMENSIONS ARE IN MILLIMETERS.  
 C) DIMENSIONING AND TOLERANCING PER ASME Y14.5M-2018.  
 D) SUPPLIER DEPENDENT MOLD LOCKING HOLES OR CHAMFERED CORNERS OR EDGE PROTRUSION.  
 E) FOR DIODE PRODUCTS, L4 IS 0.25 MM MAX PLASTIC BODY STUB WITHOUT CENTER LEAD.  
 F) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR EXTRUSIONS.  
 G) LAND PATTERN RECOMMENDATION IS BASED ON IPC7351A STD TD228P991X239-3N.



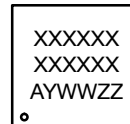
| DIM | MILLIMETERS |      |       |
|-----|-------------|------|-------|
|     | MIN.        | NOM. | MAX.  |
| A   | 2.18        | 2.29 | 2.39  |
| A1  | 0.00        | -    | 0.127 |
| b   | 0.64        | 0.77 | 0.89  |
| b2  | 0.76        | 0.95 | 1.14  |
| b3  | 5.21        | 5.34 | 5.46  |
| c   | 0.45        | 0.53 | 0.61  |
| c2  | 0.45        | 0.52 | 0.58  |
| D   | 5.97        | 6.10 | 6.22  |
| D1  | 5.21        | ---  | ---   |
| E   | 6.35        | 6.54 | 6.73  |
| E1  | 4.32        | ---  | ---   |
| e   | 2.286 BSC   |      |       |
| e1  | 4.572 BSC   |      |       |
| H   | 9.40        | 9.91 | 10.41 |
| L   | 1.40        | 1.59 | 1.78  |
| L1  | 2.90 REF    |      |       |
| L2  | 0.51 BSC    |      |       |
| L3  | 0.89        | 1.08 | 1.27  |
| L4  | ---         | ---  | 1.02  |
| θ   | 0°          | ---  | 10°   |



### LAND PATTERN RECOMMENDATION

\*FOR ADDITIONAL INFORMATION ON OUR PB-FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE ON SEMICONDUCTOR SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERM/D.

### GENERIC MARKING DIAGRAM\*



\*This information is generic. Please refer to device data sheet for actual part marking. Pb-free indicator, "G" or microdot "•", may or may not be present. Some products may not follow the Generic Marking.

XXXX = Specific Device Code  
 A = Assembly Location  
 Y = Year  
 WW = Work Week  
 ZZ = Assembly Lot Code

|                         |                                    |  |
|-------------------------|------------------------------------|--|
| <b>DOCUMENT NUMBER:</b> | <b>98AON13810G</b>                 | Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red. |
| <b>DESCRIPTION:</b>     | <b>DPAK3 6.10x6.54x2.29, 4.57P</b> | <b>PAGE 1 OF 1</b>   |

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