

**2A, 60V, 0.130 Ohm, Dual N-Channel, LittleFET™ Power MOSFET**

This Dual N-Channel power MOSFET is manufactured using the latest manufacturing process technology. This process, which uses feature sizes approaching those of LSI integrated circuits, gives optimum utilization of silicon, resulting in outstanding performance. It is designed for use in applications such as switching regulators, switching converters, motor drivers, relay drivers, and low voltage bus switches. These devices can be operated directly from integrated circuits.

Formerly developmental type TA49154.

**Ordering Information**

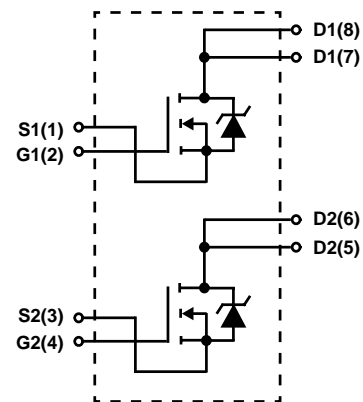
PART NUMBER	PACKAGE	BRAND
RF1K49154	MS-012AA	RF1K49154

NOTE: When ordering, use the entire part number. For ordering in tape and reel, add the suffix 96 to the part number, i.e., RF1K4915496.

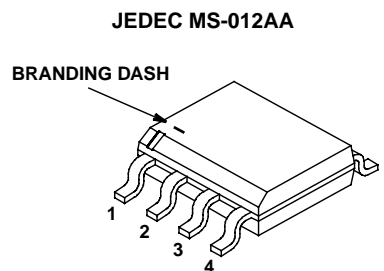
**Features**

- 2A, 60V
- $r_{DS(ON)} = 0.130\Omega$
- 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**



**Packaging**



# RF1K49154

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

	RF1K49154	UNITS
Drain to Source Voltage (Note 1) . . . . .	60	V
Drain to Gate Voltage ( $R_{GS} = 20\text{k}\Omega$ , Note 1) . . . . .	60	V
Gate to Source Voltage . . . . .	$\pm 20$	V
Drain Current Continuous (Pulse width = 5s) . . . . .	2	A
Pulsed (Figure 5) . . . . .	Refer to Peak Current Curve	
Pulsed Avalanche Rating (Figure 6) . . . . .	Refer to UIS Curve	
Power Dissipation . . . . .	2	W
Derate Above $25^\circ\text{C}$ . . . . .	0.016	$\text{W}/^\circ\text{C}$
Operating and Storage Temperature . . . . .	-55 to 150	$^\circ\text{C}$
Maximum Temperature for Soldering		
Leads at 0.063in (1.6mm) from Case for 10s . . . . .	300	$^\circ\text{C}$
Package Body for 10s, See Techbrief 334 . . . . .	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:**

1.  $T_J = 25^\circ\text{C}$  to  $125^\circ\text{C}$ .

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

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Drain to Source Breakdown Voltage	$BV_{DSS}$	$I_D = 250\mu\text{A}$ , $V_{GS} = 0\text{V}$ , (Figure 12)	60	-	-	V
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}$ , $I_D = 250\mu\text{A}$ , (Figure 11)	2	-	4	V
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 55\text{V}$ , $V_{GS} = 0\text{V}$	-	-	1	$\mu\text{A}$
		$V_{DS} = 50\text{V}$ , $V_{GS} = 0\text{V}$ , $T_C = 150^\circ\text{C}$	-	-	250	$\mu\text{A}$
Gate to Source Leakage Current	$I_{GSS}$	$V_{GS} = \pm 20\text{V}$	-	-	$\pm 10$	$\mu\text{A}$
Drain to Source On Resistance	$r_{DS(ON)}$	$I_D = 2\text{A}$ , $V_{GS} = 10\text{V}$ , (Figures 9, 10)	-	-	0.130	$\Omega$
Turn-On Time	$t_{ON}$	$V_{DD} = 30\text{V}$ , $I_D \approx 2\text{A}$ , $R_L = 15\Omega$ , $V_{GS} = 10\text{V}$ , $R_{GS} = 25\Omega$ (Figure 14)	-	-	50	ns
Turn-On Delay Time	$t_{d(ON)}$		-	10	-	ns
Rise Time	$t_r$		-	25	-	ns
Turn-Off Delay Time	$t_{d(OFF)}$		-	70	-	ns
Fall Time	$t_f$		-	35	-	ns
Turn-Off Time	$t_{OFF}$		-	-	155	ns
Total Gate Charge	$Q_{g(TOT)}$	$V_{GS} = 0\text{V}$ to $20\text{V}$	-	26	32	nC
Gate Charge at 10V	$Q_{g(10)}$	$V_{GS} = 0\text{V}$ to $10\text{V}$				
Threshold Gate Charge	$Q_{g(TH)}$	$V_{GS} = 0\text{V}$ to $2\text{V}$				
Input Capacitance	$C_{ISS}$	$V_{DS} = 25\text{V}$ , $V_{GS} = 0\text{V}$ , $f = 1\text{MHz}$ (Figure 13)	-	340	-	pF
Output Capacitance	$C_{OSS}$		-	140	-	pF
Reverse Transfer Capacitance	$C_{RSS}$		-	40	-	pF
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	Pulse Width = 1s Device Mounted on FR-4 Material	-	-	62.5	$^\circ\text{C}/\text{W}$

## Source to Drain Diode Specifications

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Source to Drain Diode Voltage	$V_{SD}$	$I_{SD} = 2\text{A}$	-	-	1.5	V
Reverse Recovery Time	$t_{rr}$	$I_{SD} = 2\text{A}$ , $dI_{SD}/dt = 100\text{A}/\mu\text{s}$	-	-	62	ns

Typical Performance Curves  $T_A = 25^\circ\text{C}$ , Unless Otherwise Specified

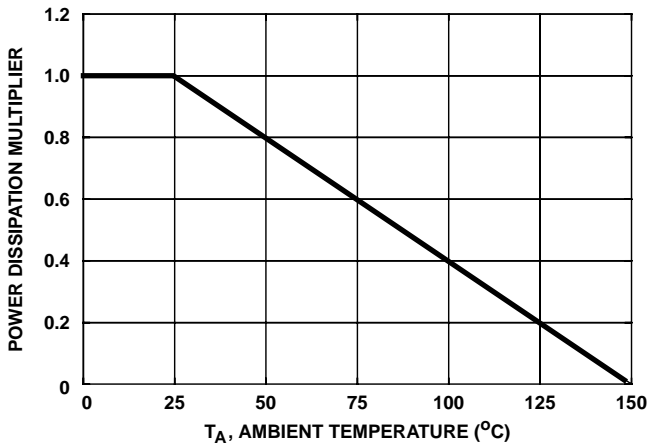


FIGURE 1. NORMALIZED POWER DISSIPATION vs AMBIENT TEMPERATURE

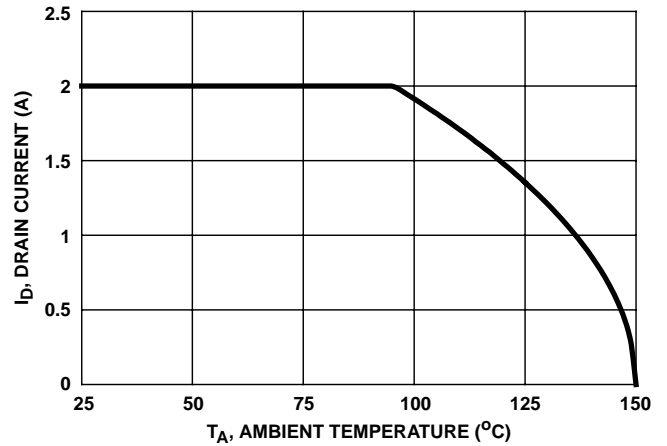


FIGURE 2. MAXIMUM CONTINUOUS DRAIN CURRENT vs AMBIENT TEMPERATURE

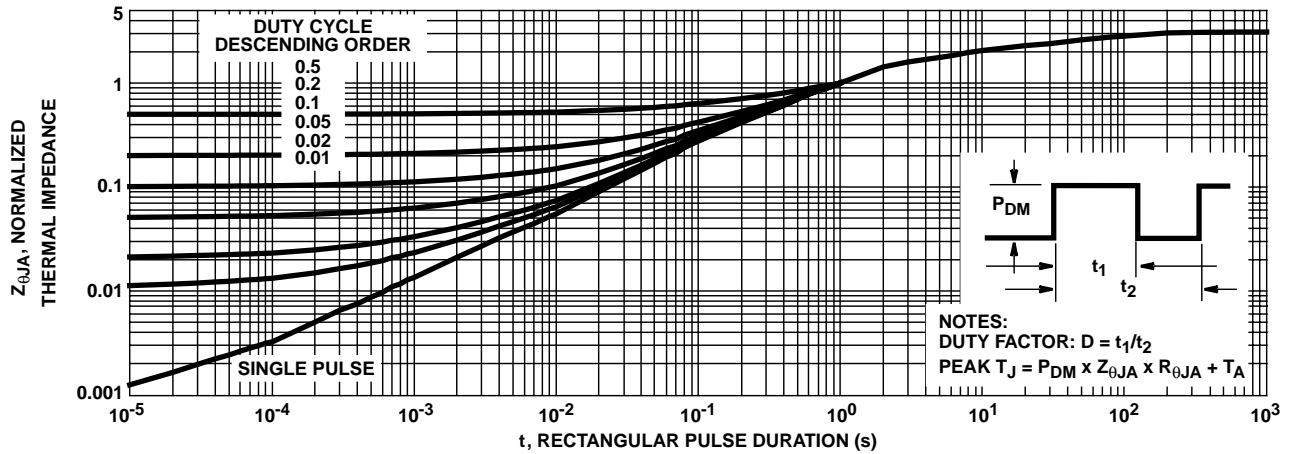


FIGURE 3. NORMALIZED MAXIMUM TRANSIENT THERMAL IMPEDANCE

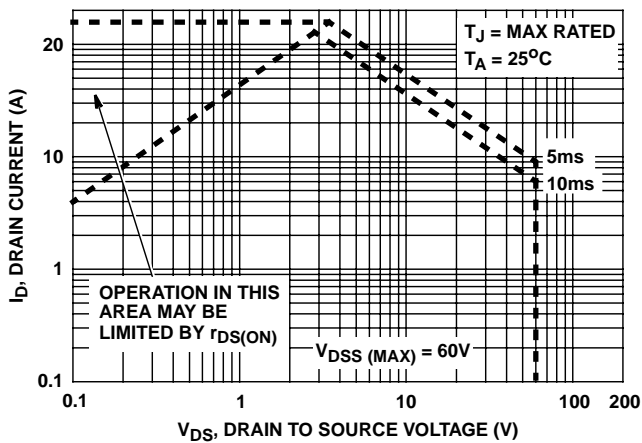


FIGURE 4. FORWARD BIAS SAFE OPERATING AREA

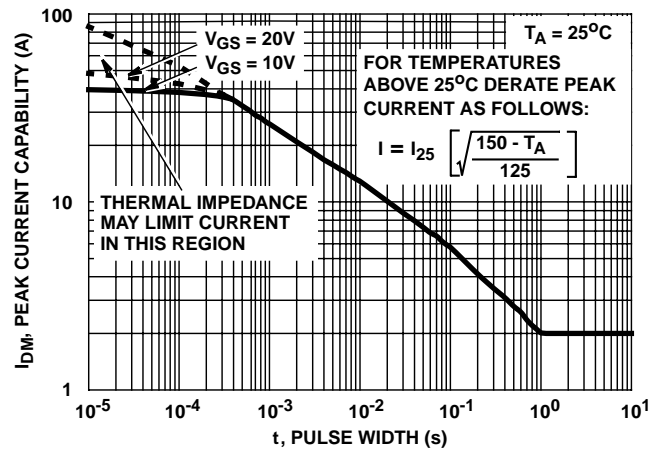
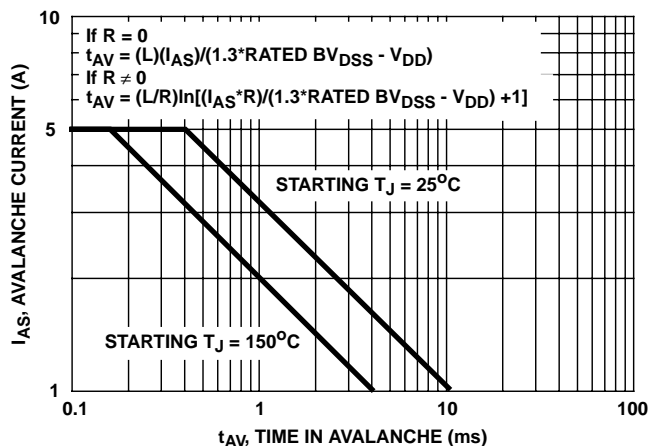


FIGURE 5. PEAK CURRENT CAPABILITY

Typical Performance Curves  $T_A = 25^\circ\text{C}$ , Unless Otherwise Specified (Continued)



NOTE: Refer to Intersil Application Notes AN9321 and AN9322.

FIGURE 6. UNCLAMPED INDUCTIVE SWITCHING CAPABILITY

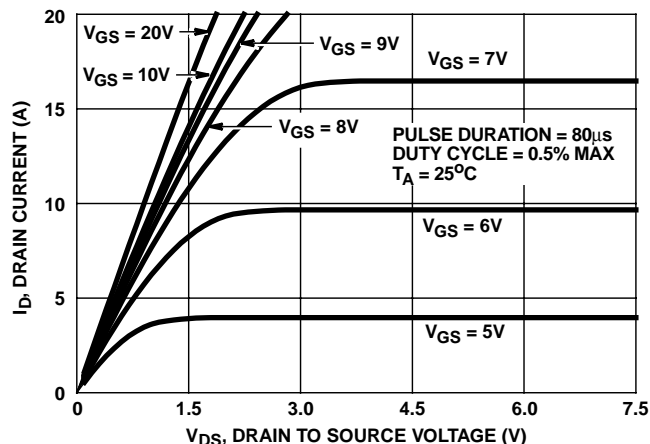


FIGURE 7. SATURATION CHARACTERISTICS

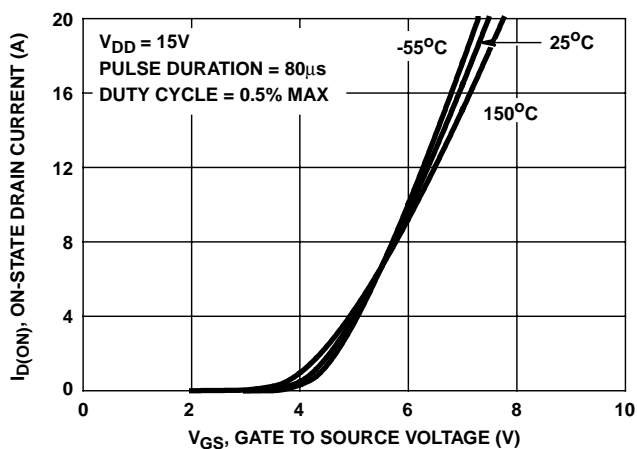


FIGURE 8. TRANSFER CHARACTERISTICS

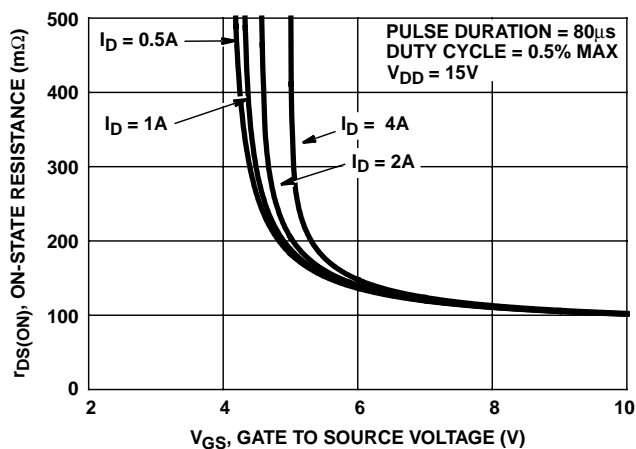


FIGURE 9. DRAIN TO SOURCE ON RESISTANCE vs GATE VOLTAGE AND DRAIN CURRENT

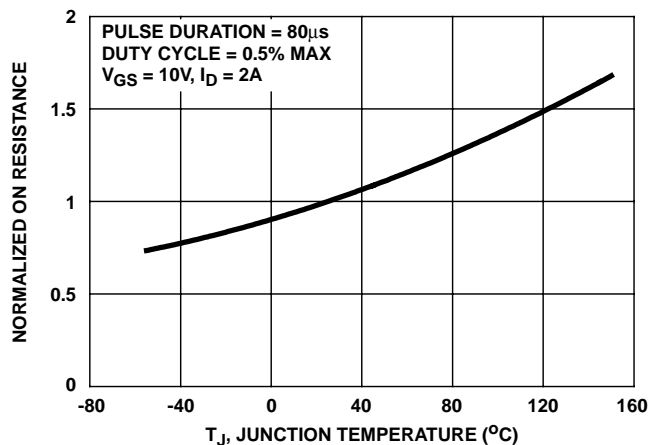


FIGURE 10. NORMALIZED DRAIN TO SOURCE ON RESISTANCE vs JUNCTION TEMPERATURE

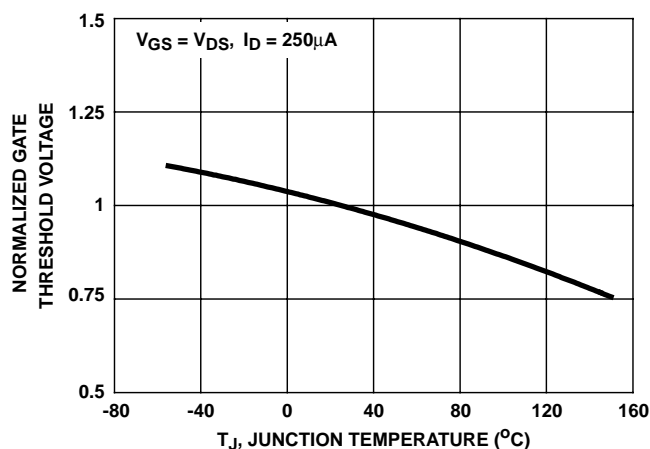


FIGURE 11. NORMALIZED GATE THRESHOLD VOLTAGE vs JUNCTION TEMPERATURE

**Typical Performance Curves**  $T_A = 25^\circ\text{C}$ , Unless Otherwise Specified (Continued)

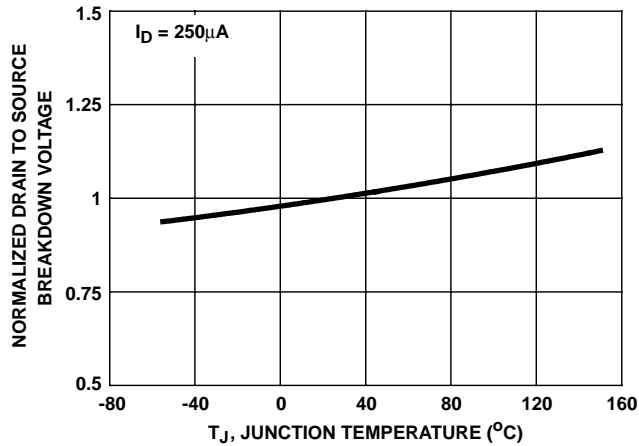


FIGURE 12. NORMALIZED DRAIN TO SOURCE BREAKDOWN VOLTAGE vs JUNCTION TEMPERATURE

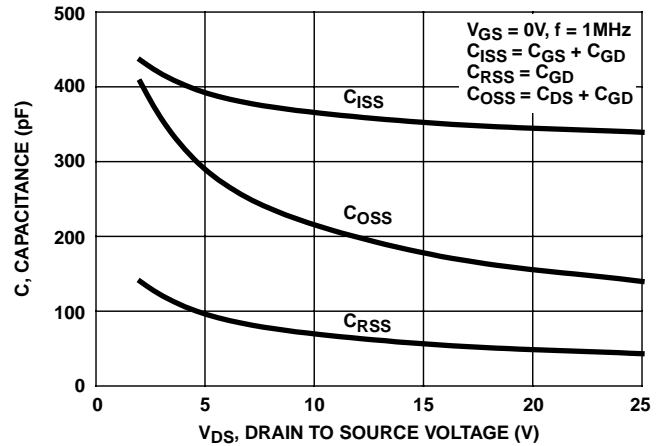
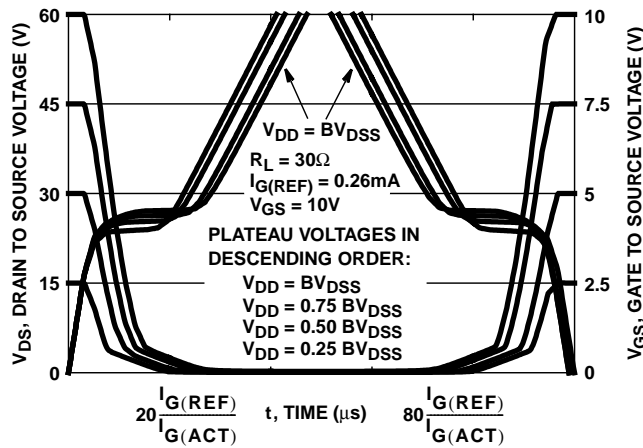


FIGURE 13. CAPACITANCE vs DRAIN TO SOURCE VOLTAGE



NOTE: Refer to Intersil Application Notes AN7254 and AN7260.

FIGURE 14. NORMALIZED SWITCHING WAVEFORMS FOR CONSTANT GATE CURRENT

**Test Circuits and Waveforms**

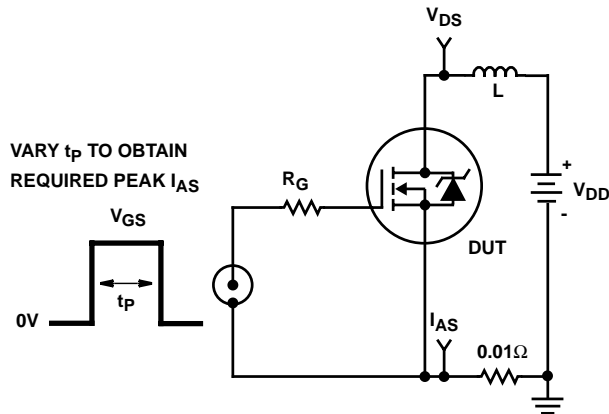


FIGURE 15. UNCLAMPED ENERGY TEST CIRCUIT

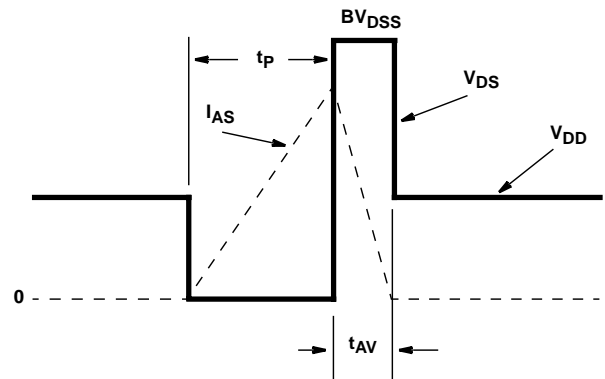


FIGURE 16. UNCLAMPED ENERGY WAVEFORMS

Test Circuits and Waveforms (Continued)

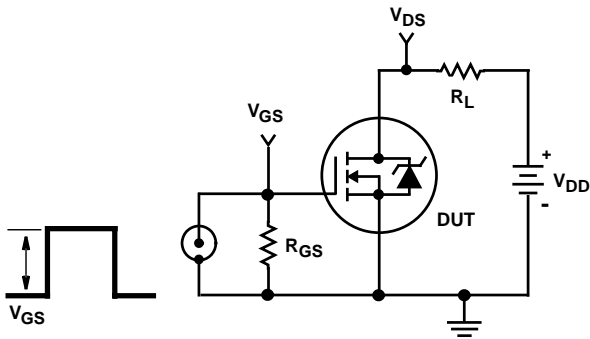


FIGURE 17. SWITCHING TIME TEST CIRCUIT

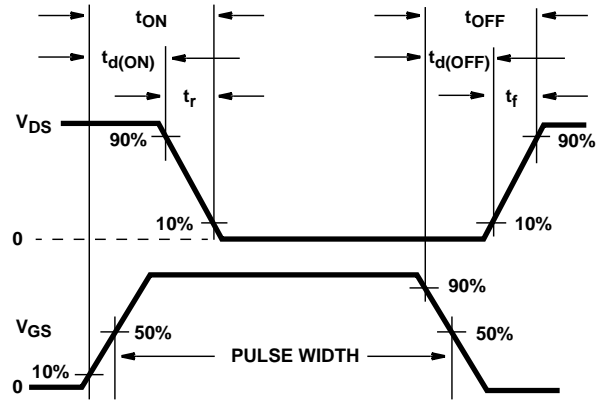


FIGURE 18. RESISTIVE SWITCHING WAVEFORMS

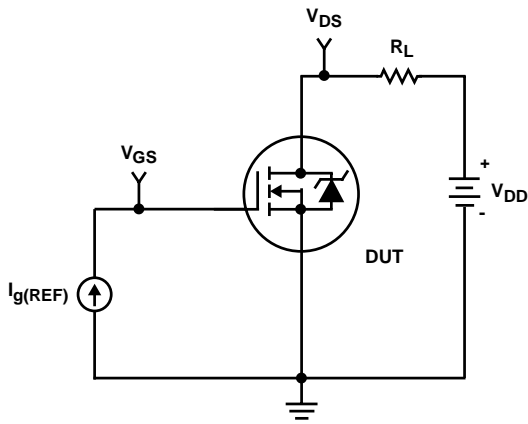


FIGURE 19. GATE CHARGE TEST CIRCUIT

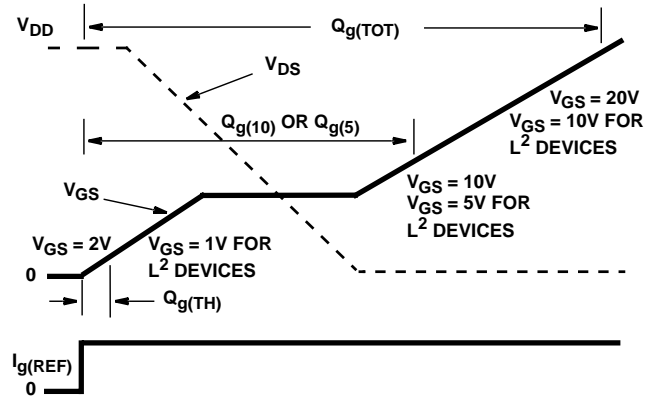


FIGURE 20. GATE CHARGE WAVEFORMS

**PSPICE Electrical Model**

SUBCKT RF1K49154 2 1 3 ; rev 2/2/96

CA 12 8 3.5e-10  
 CB 15 14 3.7e-10  
 CIN 6 8 2.26e-10

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

EBREAK 11 7 17 18 63  
 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 1.4e-9  
 LSOURCE 3 7 3.1e-10  
 K1 LGATE LSOURCE 0.131

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 1.9  
 RLDRAIN 2 5 10  
 RLGATE 1 9 14  
 RLSOURCE 3 7 3  
 RSLC1 5 51 RSLCMOD 1e-6  
 RSLC2 5 50 1e3  
 RSOURCE 8 7 RSOURCEMOD 5.6e-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\*50),3))}

.MODEL DBODYMOD D (IS = 2.6e-13 RS = 2.34e-2 IKF = 5.5 N = 0.995 TRS1 = 2.8e-3 TRS2 = 1.1e-5 CJO = 3.7e-10 TT = 3.5e-8 M = 0.46 + XTI = 5.5)

.MODEL DBREAKMOD D (RS = 0.5 IKF = 0.1 N = 1 TRS1 = 3e-3 TRS2 = -5e-5)

.MODEL DPLCAPMOD D (CJO = 5.6e-10 IS = 1e-30 N = 10 M = 0.92)

.MODEL MMEDMOD NMOS (VTO = 3.25 KP = 1.8 IS = 1e-30 N = 10 TOX = 1 L = 1u W = 1u RG = 1.9)

.MODEL MSTROMOD NMOS (VTO = 3.68 KP = 13.5 IS = 1e-30 N = 10 TOX = 1 L = 1u W = 1u)

.MODEL MWEAKMOD NMOS (VTO = 2.83 KP = 0.03 IS = 1e-30 N = 10 TOX = 1 L = 1u W = 1u RG = 19 RS = 0.1)

.MODEL RBREAKMOD RES (TC1 = 1.08e-3 TC2 = 5e-7)

.MODEL RDRAINMOD RES (TC1 = 1.7e-2 TC2 = 1e-4)

.MODEL RSLCMOD RES (TC1 = 1e-9 TC2 = 1e-4)

.MODEL RSOURCEMOD RES (TC1 = 3.3e-3 TC2 = 1e-9)

.MODEL RVTHRESMOD RES (TC1 = -1.9e-3 TC2 = -4e-6)

.MODEL RVTEMPMOD RES (TC1 = -2.9e-3 TC2 = 2.2e-6)

.MODEL S1AMOD VSWITCH (RON = 1e-5 ROFF = 0.1 VON = -7.1 VOFF = -4)

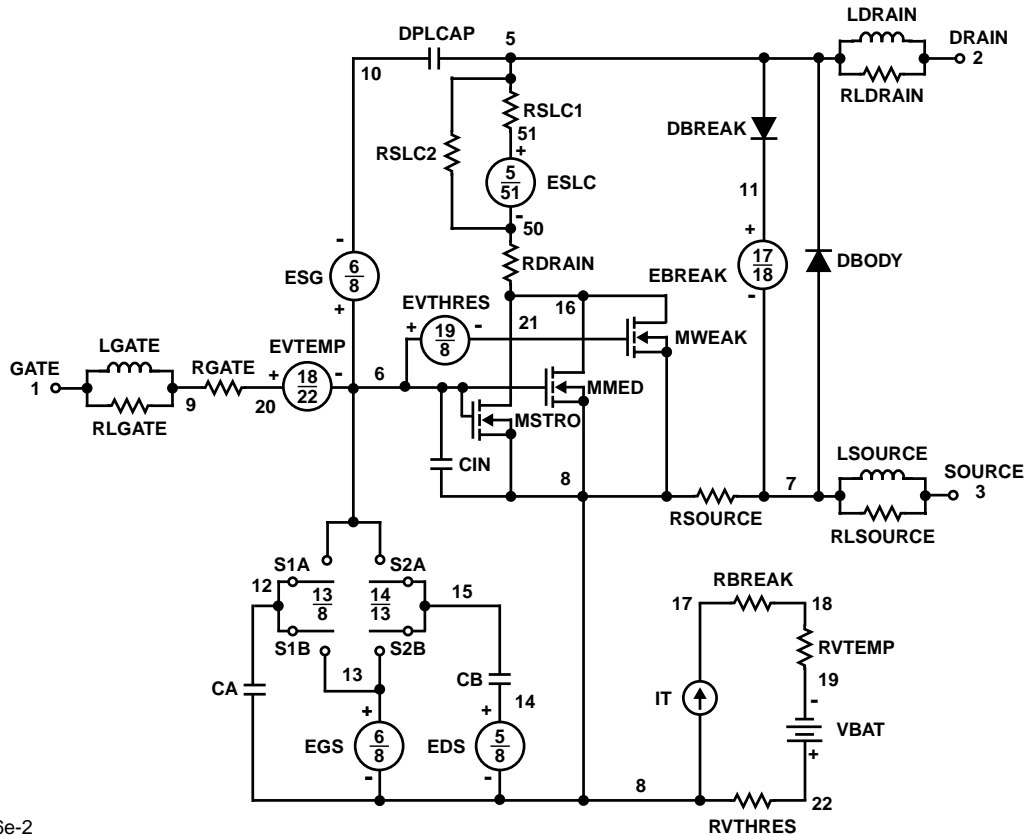
.MODEL S1BMOD VSWITCH (RON = 1e-5 ROFF = 0.1 VON = -4 VOFF = -7.1)

.MODEL S2AMOD VSWITCH (RON = 1e-5 ROFF = 0.1 VON = 0.01 VOFF = 1.9)

.MODEL S2BMOD VSWITCH (RON = 1e-5 ROFF = 0.1 VON = 1.9 VOFF = 0.01)

.ENDS

NOTE: 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.



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