

## 60V, 3.5A, 3-Transistor Common Source ESD Protected Power MOSFET Array

June 1997

### Features

- Three 3.5A Power MOS N-Channel Transistors
- Output Voltage to 60V
- $r_{DS(ON)}$  . . . . . 0.225 $\Omega$  Max Per Transistor at  $V_{GS} = 10V$
- Pulsed Current . . . . . 10A Each Transistor
- Avalanche Energy . . . . . 100mJ Each Transistor
- Grounded Tab Eliminates Heat Sink Isolation

### Applications

- Automotive
- Appliance
- Industrial Control
- Robotics
- Relay, Solenoid, Lamp Drivers

### Ordering Information

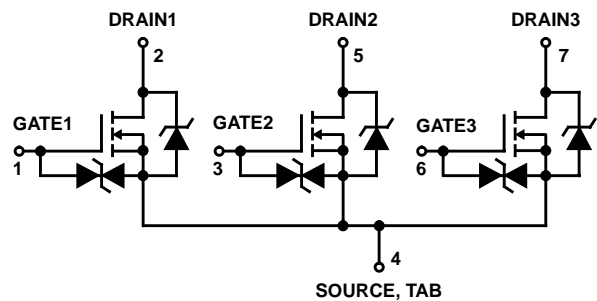
PART NUMBER	TEMP. RANGE (°C)	PACKAGE	PKG. NO.
HIP0061AS1	-40 to 125	7 Ld Staggered Vertical SIP	Z7.05C
HIP0061AS2	-40 to 125	7 Ld Gullwing SIP	Z7.05B

### Description

The HIP0061 is a power MOSFET array that consists of three matched N-Channel enhancement mode MOS transistors connected in a common source configuration. The advanced Harris PASIC2 process technology used in this product utilizes efficient geometries that provides outstanding device performance and ruggedness.

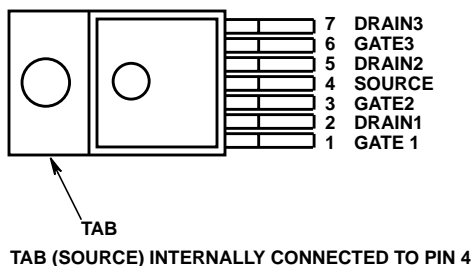
The HIP0061 is designed to integrate three power devices in one chip thus providing board layout area and heat sink savings for applications such as Motor Controls, Lamps, Solenoids and Resistive Loads.

### Symbol

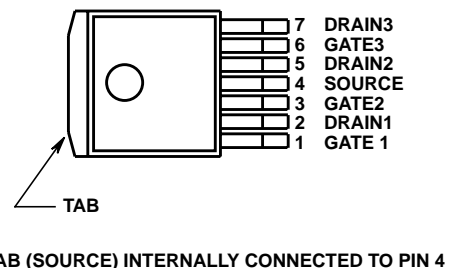


### Pinouts

HIP0061AS1  
(SIP - VERTICAL)  
TOP VIEW



HIP0061AS2  
(SIP - GULLWING)  
TOP VIEW



# HIP0061

## Absolute Maximum Ratings $T_A = 25^\circ\text{C}$

Drain to Source Voltage, $V_{DS}$ (Over Operating Junction and Case Temperature Range) . . . . .	60V
Drain to Gate Voltage, $V_{DGR}$ . . . . .	60V
Gate to Source Voltage, $V_{GS}$ . . . . .	-15, +20V
Pulsed Drain Current, $I_{DM}$ , Each Output, All Outputs on at $V_{GS} = 10\text{V}$ (Notes 1, 2) . . . . .	10A
Continuous Source to Drain Diode Current, $I_{SD}$ at $V_{GS} = 10\text{V}$ (Note 2) . . . . .	3.5A
Continuous Drain Current, $I_{DS}$ , Each Output, All Outputs on at $V_{GS} = 10\text{V}$ (Note 2) . . . . .	3.5A
Single Pulse Avalanche Energy, $E_{AS}$ (Note 3) . . . . .	100mJ

## Thermal Information

Thermal Resistance (Typical, Note 4)	$\theta_{JA}$ ( $^\circ\text{C}/\text{W}$ )	$\theta_{JC}$ ( $^\circ\text{C}/\text{W}$ )
SIP-Vertical Package . . . . .	55	3
SIP-Gullwing Package . . . . .	55	3
Maximum Junction Temperature, $T_J$ . . . . .	150 $^\circ\text{C}$	
Maximum Storage Temperature Range, $T_{STG}$ . . . . .	-55 $^\circ\text{C}$ to 150 $^\circ\text{C}$	
Maximum Lead Temperature (Soldering 10s) . . . . .	300 $^\circ\text{C}$	

## Die Characteristics

Back Side Potential . . . . . V- (Source, Tab)

## Operating Conditions

Temperature Range . . . . .	-40 $^\circ\text{C}$ to 125 $^\circ\text{C}$
Drain to Source On-State Voltage Range . . . . .	5V to 10V

*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.*

### NOTES:

1. Pulse width limited by maximum junction temperature.
2. Drain current limited by package construction.
3.  $V_{DD} = 25\text{V}$ , Start  $T_J = 25^\circ\text{C}$ ,  $L = 15\text{mH}$ ,  $R_{GS} = 50\Omega$ ,  $I_{PEAK} = 3.5\text{A}$ . See Figures 1, 2, 12, and 13.
4.  $\theta_{JA}$  is measured with the component mounted on an evaluation PC board in free air.

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

PARAMETERS	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS	
Drain to Source Breakdown Voltage	$BV_{DSS}$	$I_D = 100\mu\text{A}$ , $V_{GS} = 0\text{V}$	$T_C = -40^\circ\text{C}$ to 125 $^\circ\text{C}$	60	-	-	V
			$T_C = 25^\circ\text{C}$	-	70	-	V
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}$ , $I_D = 250\mu\text{A}$	1.8	2.3	2.7	V	
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 60\text{V}$ $V_{GS} = 0\text{V}$	$T_C = 25^\circ\text{C}$	-	-	1	$\mu\text{A}$
			$T_C = 125^\circ\text{C}$	-	-	10	$\mu\text{A}$
Forward Gate Current, Drain Short Circuited to Source	$I_{GSSF}$	$V_{DS} = 0\text{V}$ , $V_{GS} = 20\text{V}$	-	-	100	nA	
Reverse Gate Current, Drain Short Circuited to Source	$I_{GSSR}$	$V_{DS} = 0\text{V}$ , $V_{GS} = -15\text{V}$	-	-	-100	nA	
Drain to Source On Resistance (Note 5)	$r_{DS(ON)}$	$V_{GS} = 10\text{V}$ , $I_D = 3.5\text{A}$	$T_C = 25^\circ\text{C}$	-	0.215	0.265	$\Omega$
		$V_{GS} = 10\text{V}$ , $I_D = 3.5\text{A}$	$T_C = 125^\circ\text{C}$	-	0.365	0.425	$\Omega$
		$V_{GS} = 5\text{V}$ , $I_D = 2\text{A}$	$T_C = 25^\circ\text{C}$	-	0.275	0.320	$\Omega$
		$V_{GS} = 5\text{V}$ , $I_D = 2\text{A}$	$T_C = 125^\circ\text{C}$	-	0.465	0.5	$\Omega$
Drain to Source On Resistance Matching	$r_{DS(ON)}$	$V_{GS} = 10\text{V}$ , $I_D = 3.5\text{A}$	$T_C = 25^\circ\text{C}$	-	95	-	%
Forward Transconductance (Note 5)	$g_{fs}$	$V_{DS} = 10\text{V}$ , $I_D = 1\text{A}$	-	2.5	-	S	

# HIP0061

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

PARAMETERS	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Turn-On Delay Time (Note 6)	$t_{d(\text{ON})}$	$V_{\text{DD}} = 30\text{V}$ , $R_L = 15\Omega$ , $V_{\text{GS}} = +10\text{V}$ , $I_D = 2\text{A}$ , $R_G = 50\Omega$ See Figure 14	-	10	-	ns
Rise Time (Note 6)	$t_r$		-	25	-	ns
Turn-Off Delay Time (Note 6)	$t_{d(\text{OFF})}$		-	18	-	ns
Fall Time (Note 6)	$t_f$		-	12	-	ns
Total Gate Charge (Note 6)	$Q_{g(\text{TOT})}$	$V_{\text{DS}} = 50\text{V}$ , $V_{\text{GS}} = 10\text{V}$ , $I_D = 2\text{A}$ See Figures 16, 17	-	8.0	9.5	nC
Gate-Source Charge (Note 6)	$Q_{gs}$		-	0.7	1.0	nC
Gate-Drain Charge (Note 6)	$Q_{gd}$		-	3.5	4.0	nC
Short-Circuit Input Capacitance, Common Source	$C_{\text{ISS}}$	$V_{\text{DS}} = 25\text{V}$ , $V_{\text{GS}} = 0\text{V}$ $f = 1\text{MHz}$	-	142	-	pF
Short-Circuit Output Capacitance, Common Source	$C_{\text{OSS}}$		-	107	-	pF
Short-Circuit Reverse Transfer Capacitance, Common Source	$C_{\text{RSS}}$		-	24	-	pF

## Source-Drain Diode Ratings and Specifications

PARAMETERS	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Diode Forward Voltage (Note 5)	$V_{\text{SD}}$	$I_{\text{SD}} = 2\text{A}$ , $V_{\text{GS}} = 0\text{V}$	-	0.9	1.1	V
Reverse Recovery Time	$t_{\text{rr}}$	$I_{\text{SD}} = 2\text{A}$ , $dI_{\text{SD}}/dt = 100\text{A}/\mu\text{s}$	-	50	-	ns

### NOTES:

5. Pulse test: Pulse width  $\leq 300\mu\text{s}$ , duty cycle  $\leq 2\%$ .
6. Independent of operating temperature.

Typical Performance Curves

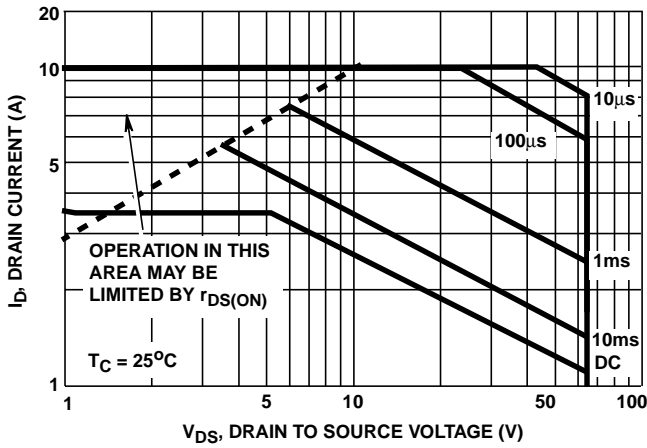


FIGURE 1. SAFE-OPERATING AREA CURVE

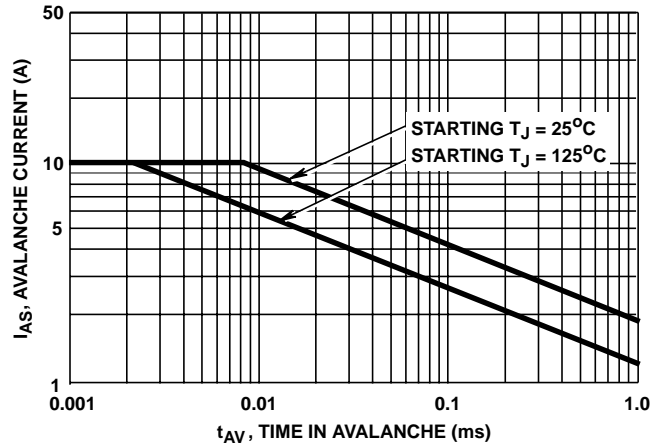


FIGURE 2. UNCLAMPED INDUCTIVE-SWITCHING

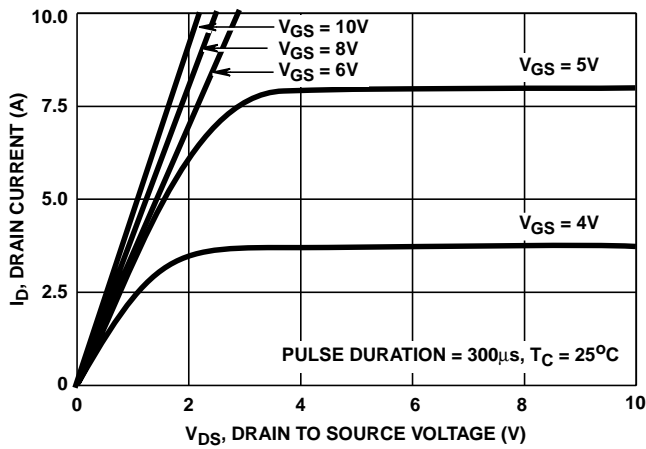


FIGURE 3. TYPICAL SATURATION CHARACTERISTICS

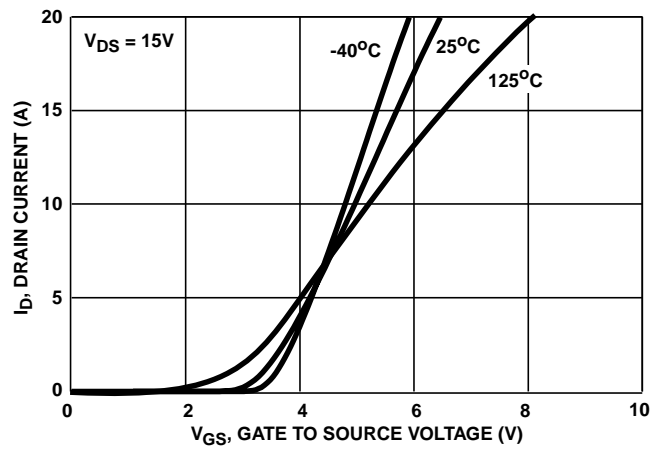


FIGURE 4. TYPICAL TRANSFER CHARACTERISTICS

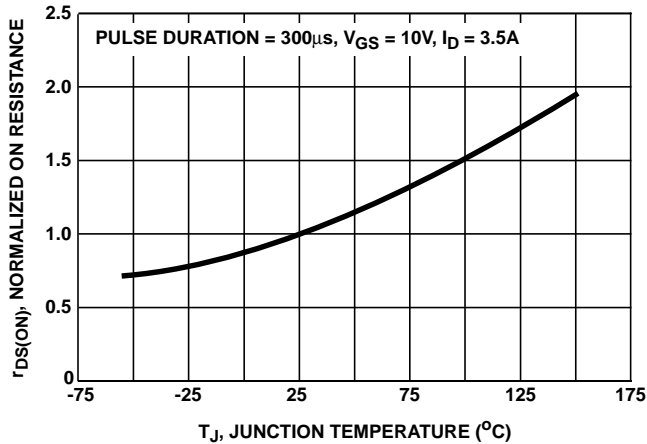


FIGURE 5. NORMALIZED  $r_{DS(ON)}$  vs JUNCTION TEMPERATURE

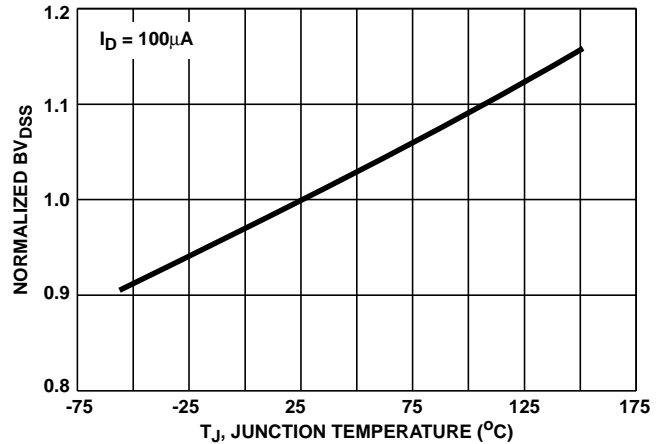


FIGURE 6. NORMALIZED  $BV_{DS(sat)}$  vs JUNCTION TEMPERATURE

Typical Performance Curves (Continued)

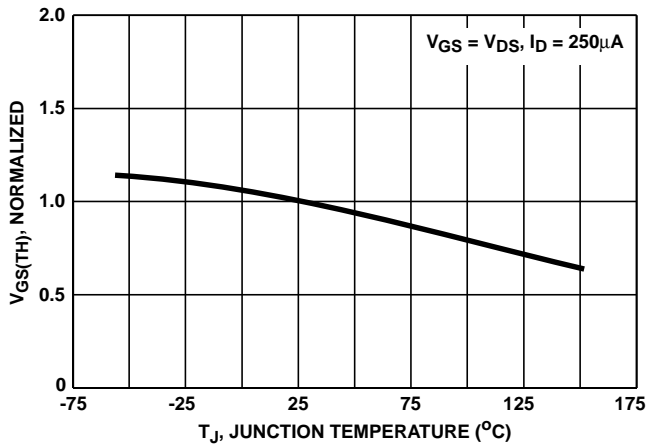


FIGURE 7. NORMALIZED  $V_{GS(TH)}$  vs JUNCTION TEMPERATURE

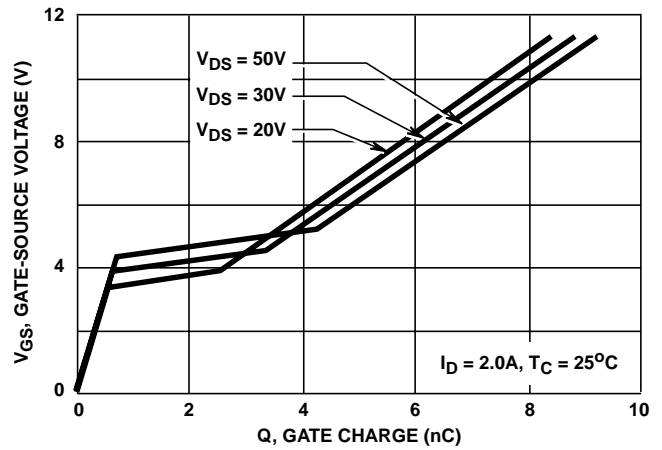


FIGURE 8. GATE-SOURCE VOLTAGE vs GATE CHARGE

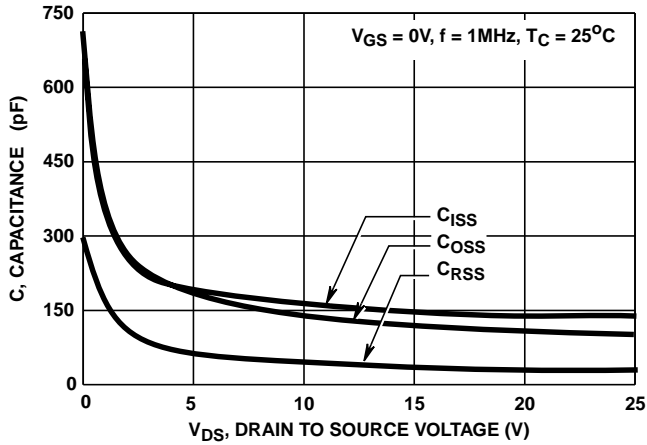


FIGURE 9. TYPICAL CAPACITANCE vs VOLTAGE

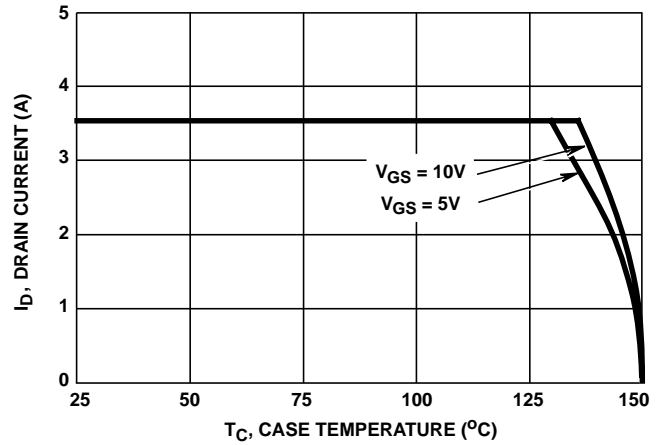


FIGURE 10. MAXIMUM CONTINUOUS DRAIN CURRENT vs CASE TEMPERATURE

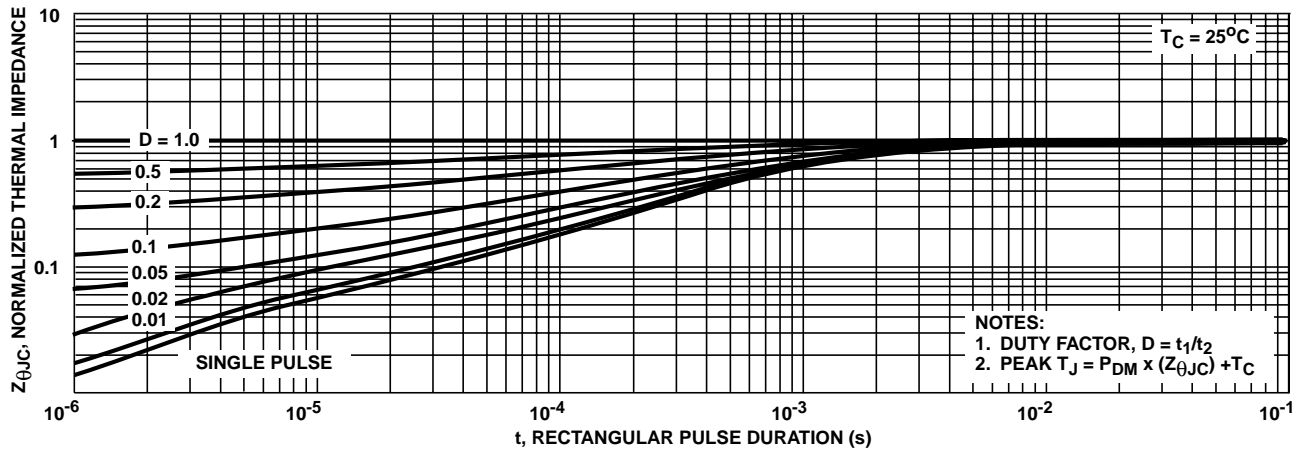


FIGURE 11. NORMALIZED MAXIMUM TRANSIENT THERMAL IMPEDANCE

Test Circuits and Waveforms

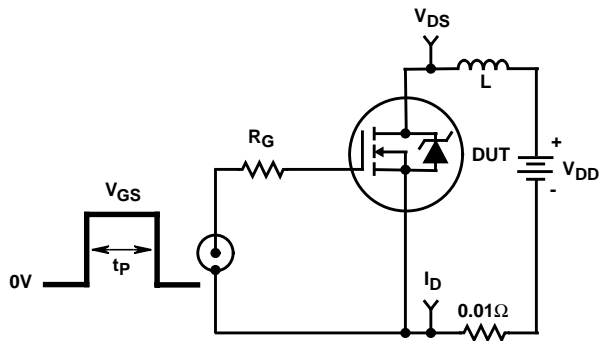


FIGURE 12. UNCLAMPED ENERGY TEST CIRCUIT

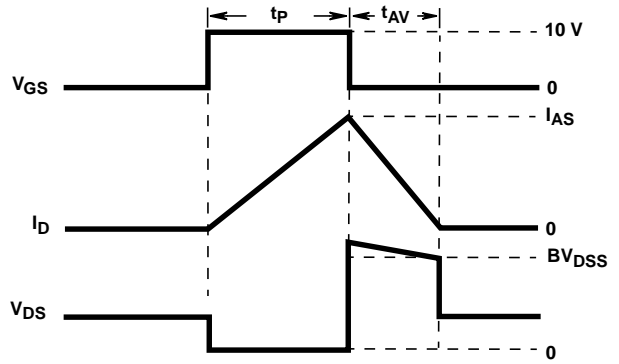


FIGURE 13. UNCLAMPED ENERGY WAVEFORMS

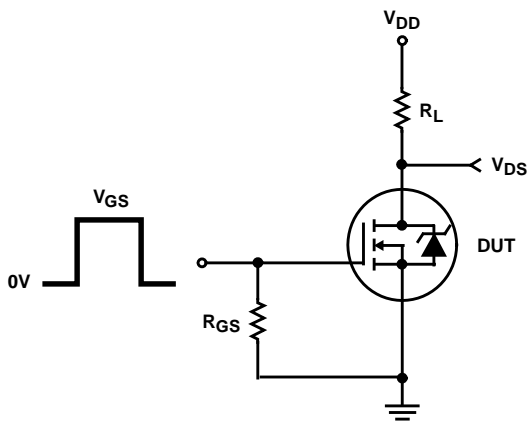


FIGURE 14. RESISTIVE SWITCHING TEST CIRCUIT

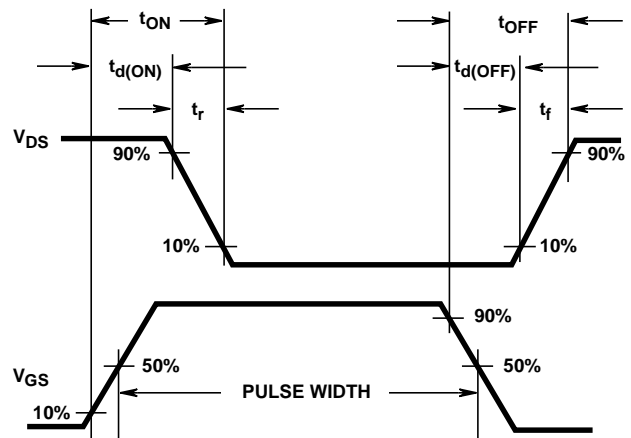


FIGURE 15. RESISTIVE SWITCHING WAVEFORMS

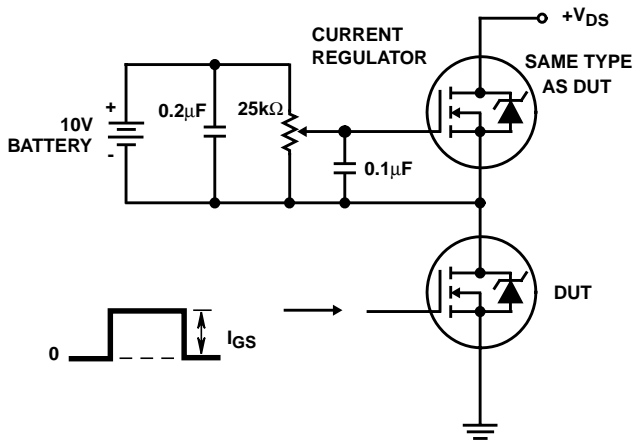


FIGURE 16. GATE CHARGE TEST CIRCUIT

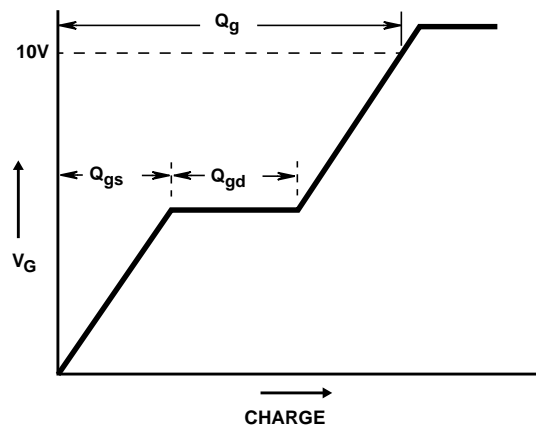


FIGURE 17. BASIC GATE CHARGE WAVEFORM

## HIP0061

### **PSPICE Model Listing**

### **Device Model Netlist for the HIP0061 Power MOSFET Array**

\*Rev: 6/12/95

```
.SUBCKT HIP0061 1 2 3 4 5 6 7
```

```
X1 8 1 11 4 HIP0061_1
```

```
LS1 2 8 7.5n
```

```
X2 9 3 11 4 HIP0061_1
```

```
LS2 5 9 7.5n
```

```
X3 10 6 11 4 HIP0061_1
```

```
LS3 7 10 7.5n
```

```
LS4 4 11 7.5n
```

```
.ENDS
```

```
.SUBCKT HIP0061_1 3 2 11 9
```

```
MOS1 4 2 1 1 NMOS1
```

```
JFET 13 1 4 J1
```

```
D1 5 6 D1
```

```
DBODY 1 13 D2
```

```
DBREAK 3 7 D3
```

```
DSUB 9 13 D4
```

```
DESD1 2 12 D5
```

```
DESD2 15 12 D5
```

```
VBREAK 7 1 DC 90
```

```
C21 2 1 750P
```

```
C23 2 13 45P
```

```
C24 2 4 1100P
```

```
RDRAIN 13 14 9.0e-02
```

```
LDRAIN 14 3 7.5n
```

```
RSOURCE 1 15 17.5e-03
```

```
LSOURCE 15 11 7.5n
```

```
FDSCHRG 4 2 VMEAS 1.0
```

```
E41 5 15 4 1 1.0
```

```
VPINCH 6 8 DC 10.0
```

```
VMEAS 8 15 DC 0.0
```

```
.MODEL NMOS1 NMOS LEVEL=3 (VTO=2.75 TOX=5e-08
```

```
KP=3.150e-03 PHI=0.65 GAMMA=2.55
```

```
+ VMAX=6.42e+07 NSUB=4.33e+16 THETA=0.60973
```

```
ETA=0.0015 KAPPA=1.275
```

```
+ L=1u W=3050u)
```

```
.MODEL J1 NJF (VTO=-15.0 BETA=10.736
```

```
LAMBDA=1.15e-02 PB=0.5848 IS=+1.0e-13
```

```
+ RD=3.53e-02 ALPHA=0.2)
```

```
.MODEL D1 D (IS=1.0e-15 N=0.03 RS=1.0)
```

```
.MODEL D2 D (IS=3.0e-13 RS=2.5e-03 TT=20N
```

```
CJO=350e-12)
```

```
.MODEL D3 D (IS=1.0e-13 N=1.0 RS=2.0)
```

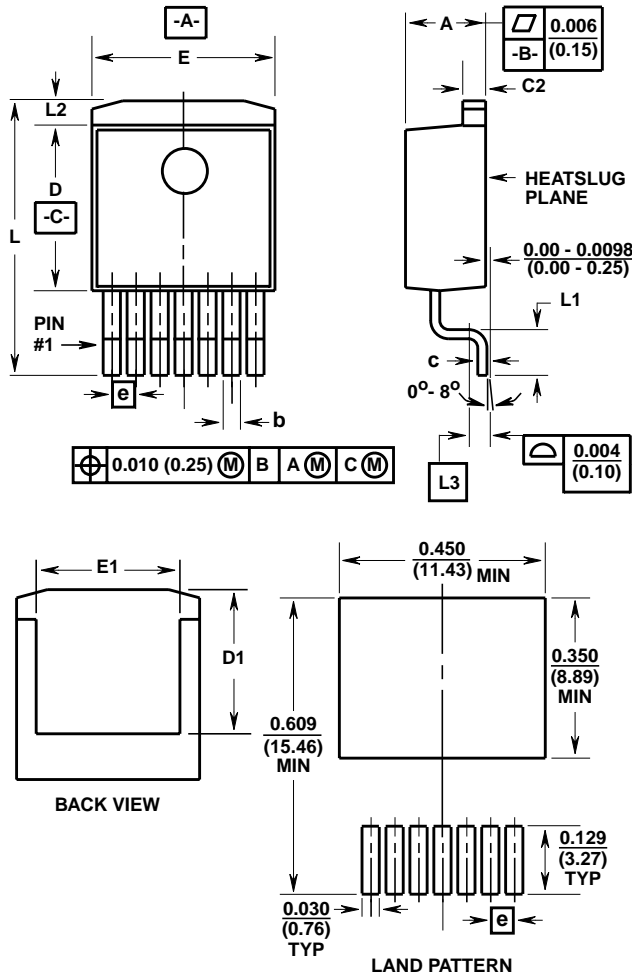
```
.MODEL D4 D (IS=1.0e-13 RS=2.0e-03 CJO=80e-12)
```

```
.MODEL D5 D (IS=1.0e-15 RS=1.0e-03 CJO=2.5e-12)
```

```
.ENDS
```

NOTE: For further discussion of the PSPICE PowerFET macromodel consult **Spicing-Up SPICE II Software for Power MOSFET Modeling**, Harris Application Note AN8610.

Single-In-Line Plastic Packages (SIP)



Z7.05B

7 LEAD PLASTIC SINGLE-IN-LINE PACKAGE SURFACE MOUNT "GULLWING" LEAD FORM

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.170	0.180	4.32	4.57	-
C2	0.048	0.055	1.22	1.39	5
D	0.350	0.370	8.89	9.39	-
E	0.395	0.405	10.04	10.28	-
D1	0.310	-	7.88	-	-
E1	0.310	-	7.88	-	-
L	0.549	0.569	13.95	14.45	-
L1	0.068	0.088	1.72	2.24	-
L2	0.045	0.055	1.15	1.40	-
L3	0.030 BSC		0.76 BSC		4
b	0.028	0.034	0.71	0.86	5, 6, 7
c	0.018	0.024	0.46	0.60	5
e	0.050 BSC		1.27 BSC		-

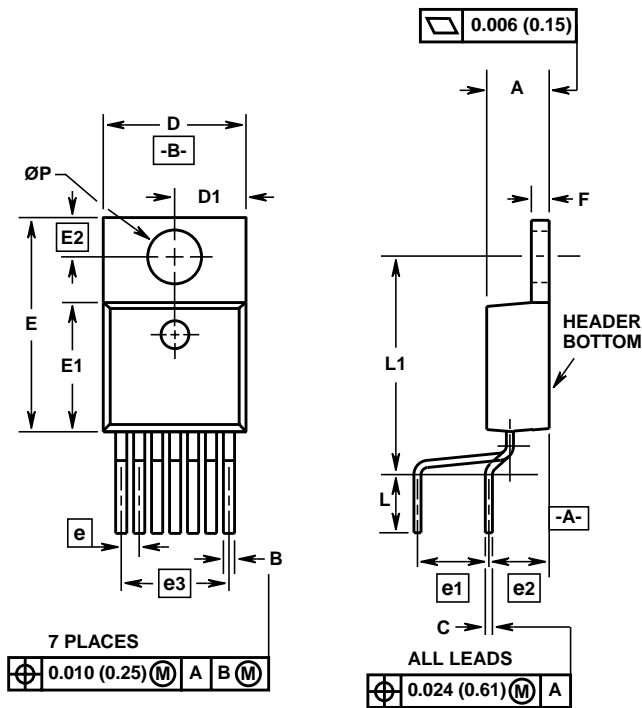
Rev. 2 12/95

NOTES:

1. These package dimensions are within allowable dimensions of JEDEC MO-169AC, Issue A.
2. Controlling dimension: Inch.
3. Dimensioning and tolerance per ANSI Y14.5M-1982.
4. Gauge plane L3 is parallel to heatslug plane.
5. Dimensions include lead finish.
6. Leads are not allowed above the datum **-B-**.
7. Dimension "b" does not include dambar protrusion. Allowable dambar protrusion shall not cause the lead width to exceed the maximum "b" by more than 0.003" (0.08mm).



Single-In-Line Plastic Packages (SIP)



**Z7.05C**  
**7 LEAD PLASTIC SINGLE-IN-LINE PACKAGE**  
**STAGGERED VERTICAL LEAD FORM**

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.170	0.180	4.32	4.57	-
B	0.028	0.034	0.71	0.86	3, 4
C	0.018	0.024	0.46	0.60	3
D	0.395	0.405	10.04	10.28	-
D1	0.198	0.202	5.03	5.13	-
E	0.595	0.605	15.11	15.37	-
E1	0.350	0.370	8.89	9.39	-
E2	0.110 BSC		2.79 BSC		
e	0.050 BSC		1.27 BSC		-
e1	0.200 BSC		5.08 BSC		-
e2	0.169 BSC		4.29 BSC		-
e3	0.300 BSC		7.62 BSC		-
F	0.048	0.055	1.22	1.39	3
L	0.150	0.176	3.81	4.47	-
L1	0.600	0.620	15.24	15.74	-
ØP	0.147	0.152	3.73	3.86	3

Rev. 0 6/95

NOTES:

1. Controlling dimension: INCH.
2. Dimensioning and tolerancing per ANSI Y14.5M-1982.
3. Dimensions include lead finish.
4. Dimension "B" does not include dambar protrusion. Allowable dambar protrusion shall not cause lead width to exceed maximum "B" by more than 0.003 inches (0.08mm).

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