HUF75307P3, HUF75307D3, HUF75307D3S

HARRIS SEMICONDUCTOR

13A, 55V, 0.090 Ohm, N-Channel, UltraFET Power MOSFETs

January 1998

Features

- **13A, 55V**
- ***Ultra Low On-Resistance***, **$r_{DS(ON)}$ = 0.090Ω**
- **Diode Exhibits Both High Speed and Soft Recovery**
- ***Temperature Compensating* PSPICE Model**
- ***Thermal Impedance* SPICE Model**
- **Peak Current vs Pulse Width Curve**
- **UIS Rating Curve**
- **Related Literature**
  - **TB334, "Guidelines for Soldering Surface Mount Components to PC Boards"**

Ordering Information

PART NUMBER	PACKAGE	BRAND
HUF75307P3	TO-220AB	75307P
HUF75307D3	TO-251AA	75307D
HUF75307D3S	TO-252AB	75307D

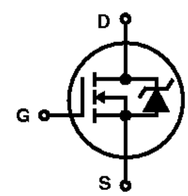
NOTE: When ordering, use the entire part number. Add the suffix T, to obtain the TO-252AA variant in tape and reel, e.g., HUF76133S3ST.

Description

This N-Channel power MOSFET is manufactured using the innovative UltraFET™ process. This advanced process technology achieves the lowest possible on-resistance per silicon area, resulting in outstanding performance. This device is capable of withstanding high energy in the avalanche mode and the diode exhibits very low reverse recovery time and stored charge. It was designed for use in applications where power efficiency is important, such as switching regulators, switching converters, motor drivers, relay drivers, low-voltage bus switches, and power management in portable and battery-operated products.

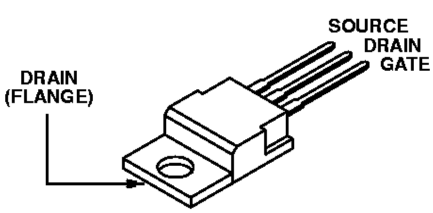
Formerly developmental type TA75307.

Symbol

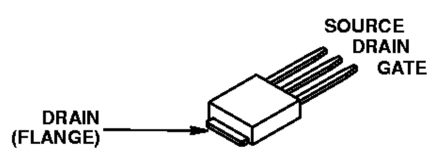


Packaging

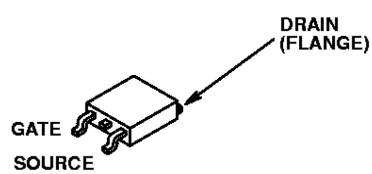
JEDEC TO-220AB



JEDEC TO-251AA



JEDEC TO-252AA



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

Drain to Source Voltage (Note 1)	V_{DSS}	55	V
Drain to Gate Voltage ($R_{GS} = 20k\Omega$) (Note 1)	V_{DGR}	55	V
Gate to Source Voltage	V_{GS}	±20	V
Drain Current			
Continuous (Figure 2)	I_D	13	A
Pulsed Drain Current	I_{DM}	Figure 5	
Pulsed Avalanche Rating	E_{AS}	Figures 6, 14, 15	
Power Dissipation	P_D	35	W
Derate Above 25^oC		0.24	$W/^oC$
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 11)		55	-	-	V
Gate to Source Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}$, $I_D = 250\mu A$ (Figure 10)		2	-	4	V
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 50V$, $V_{GS} = 0V$		-	-	1	μA
		$V_{DS} = 45V$, $V_{GS} = 0V$, $T_C = 150^oC$		-	-	250	μA
Gate to Source Leakage Current	I_{GSS}	$V_{GS} = \pm20V$		-	-	±100	nA
Drain to Source On Resistance	$r_{DS(ON)}$	$I_D = 13A$, $V_{GS} = 10V$ (Figure 9)		-	-	0.090	Ω
Turn-On Time	t_{ON}	$V_{DD} = 30V$, $I_D \cong 13A$, $R_L = 2.3\Omega$, $V_{GS} = 10V$, $R_{GS} = 100\Omega$ (Figures 18, 19)		-	-	60	ns
Turn-On Delay Time	$t_{d(ON)}$			-	7	-	ns
Rise Time	t_r			-	40	-	ns
Turn-Off Delay Time	$t_{d(OFF)}$			-	35	-	ns
Fall Time	t_f			-	45	-	ns
Turn-Off Time	t_{OFF}			-	-	100	ns
Total Gate Charge	$Q_{g(TOT)}$	$V_{GS} = 0V$ to $20V$	$V_{DD} = 30V$, $I_D \cong 13A$, $R_L = 2.3\Omega$, $I_{g(REF)} = 1.0mA$ (Figures 13,16,17)	-	16	20	nC
Gate Charge at 10V	$Q_{g(10)}$	$V_{GS} = 0V$ to $10V$		-	9	11	nC
Threshold Gate Charge	$Q_{g(TH)}$	$V_{GS} = 0V$ to $2V$		-	0.6	0.8	nC
Input Capacitance	C_{ISS}	$V_{DS} = 25V$, $V_{GS} = 0V$, f = 1MHz (Figure 12)		-	250	-	pF
Output Capacitance	C_{OSS}			-	100	-	pF
Reverse Transfer Capacitance	C_{RSS}			-	25	-	pF
Thermal Resistance Junction to Case	$R_{\theta JC}$	(Figure 3)		-	-	4.2	$^oC/W$
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	TO-220		-	-	62	$^oC/W$
		TO-251, TO-252		-	-	100	$^oC/W$

Source to Drain Diode Specifications

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Source to Drain Diode Voltage	V_{SD}	$I_{SD} = 13A$	-	-	1.25	V
Reverse Recovery Time	t_{rr}	$I_{SD} = 13A$, $dI_{SD}/dt = 100A/\mu s$	-	-	45	ns
Reverse Recovered Charge	Q_{RR}	$I_{SD} = 13A$, $dI_{SD}/dt = 100A/\mu s$	-	-	55	nC

Typical Performance Curves

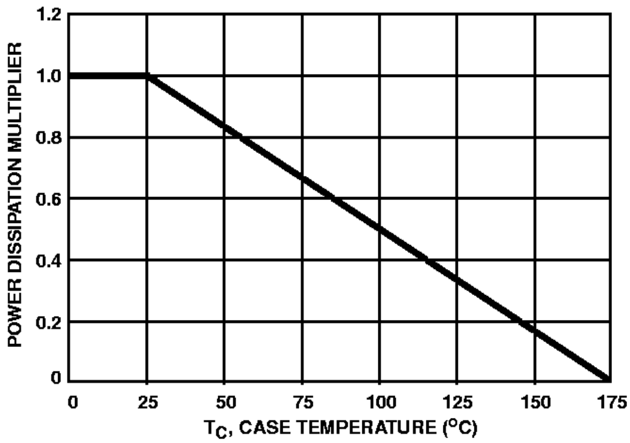


FIGURE 1. NORMALIZED POWER DISSIPATION vs CASE TEMPERATURE

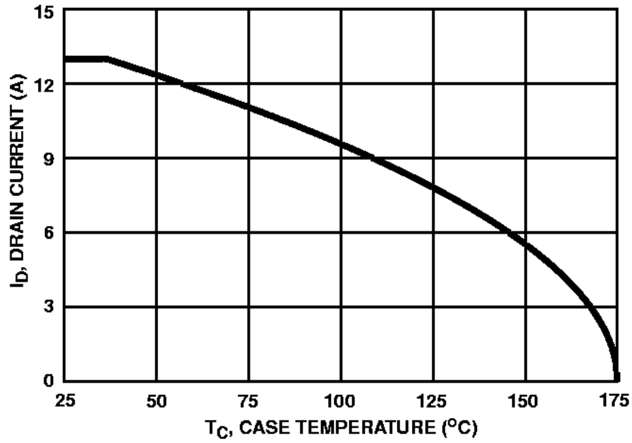


FIGURE 2. MAXIMUM CONTINUOUS DRAIN CURRENT vs CASE TEMPERATURE

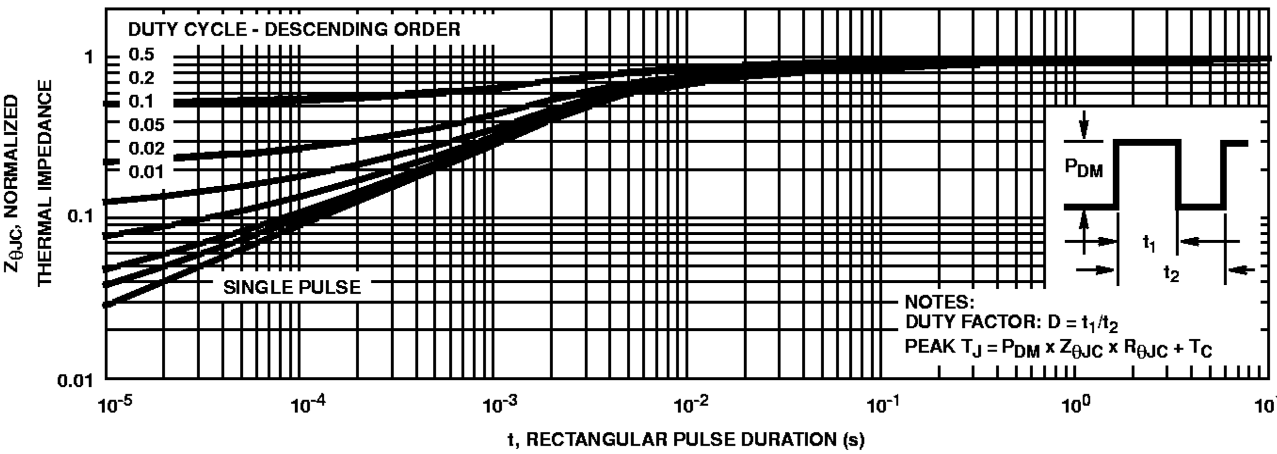


FIGURE 3. NORMALIZED MAXIMUM TRANSIENT THERMAL IMPEDANCE

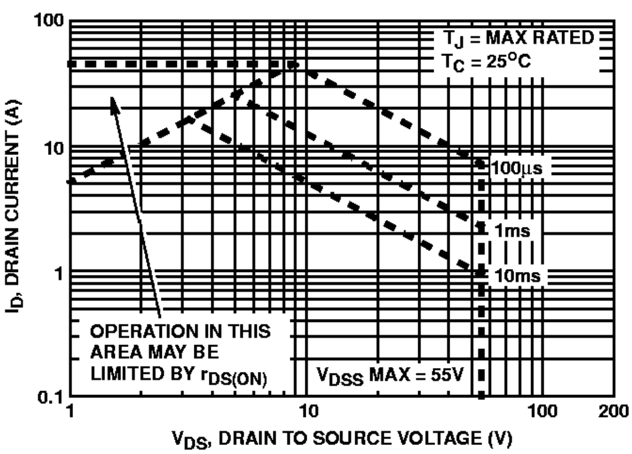


FIGURE 4. FORWARD BIAS SAFE OPERATING AREA

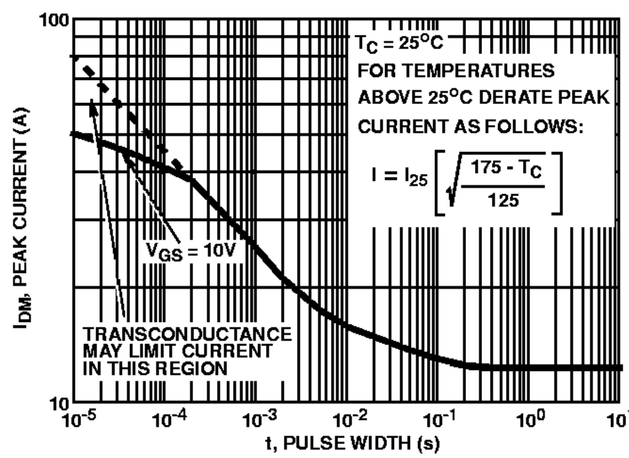
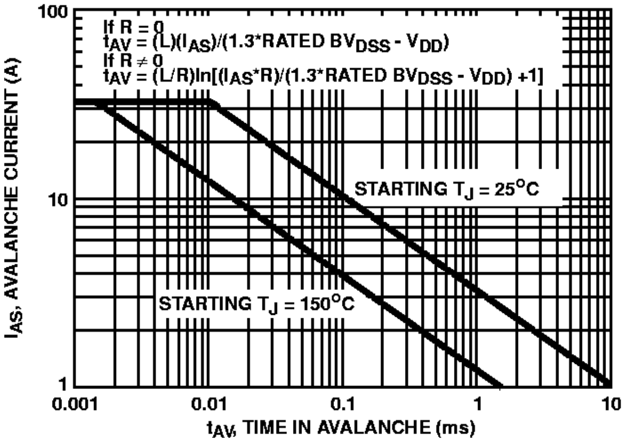


FIGURE 5. PEAK CURRENT CAPABILITY

Typical Performance Curves (Continued)



NOTE: Refer to Harris Application Notes AN9321 and AN9322.

FIGURE 6. UNCLAMPED INDUCTIVE SWITCHING CAPABIITY

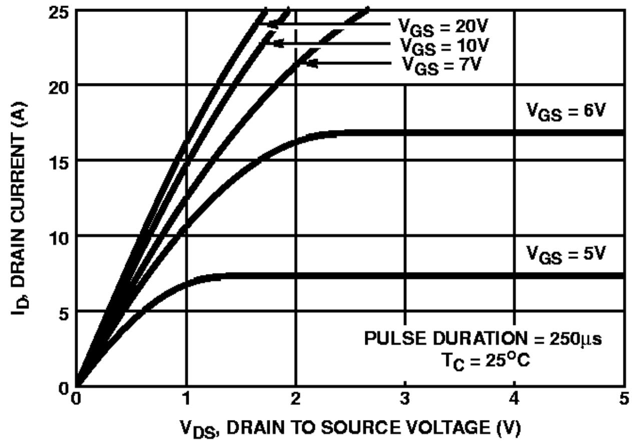


FIGURE 7. SATURATION CHARACTERISTICS

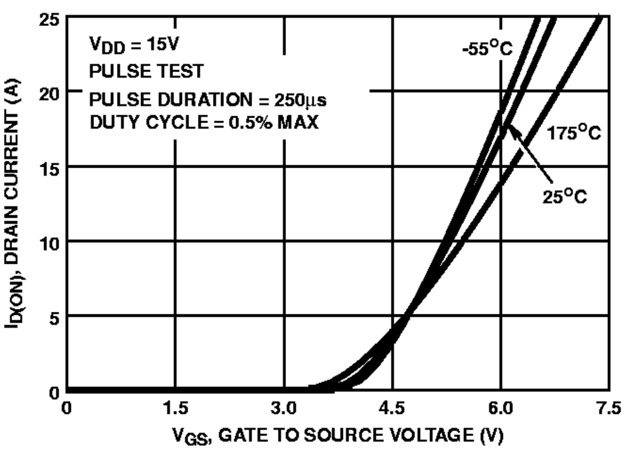


FIGURE 8. TRANSFER CHARACTERISTICS

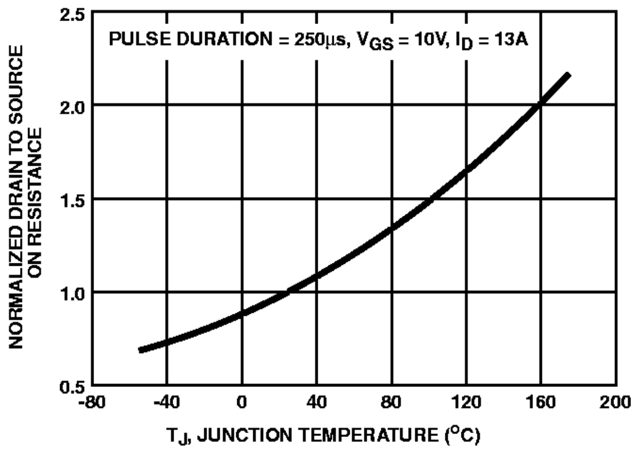


FIGURE 9. NORMALIZED DRAIN TO SOURCE ON RESISTANCE vs JUNCTION TEMPERATURE

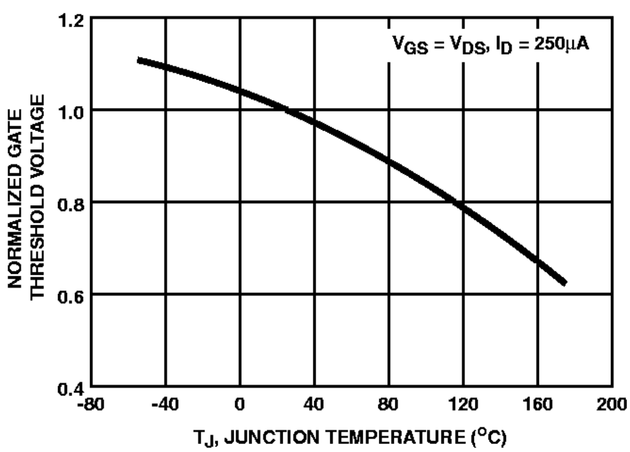


FIGURE 10. NORMALIZED GATE THRESHOLD VOLTAGE vs JUNCTION TEMPERATURE

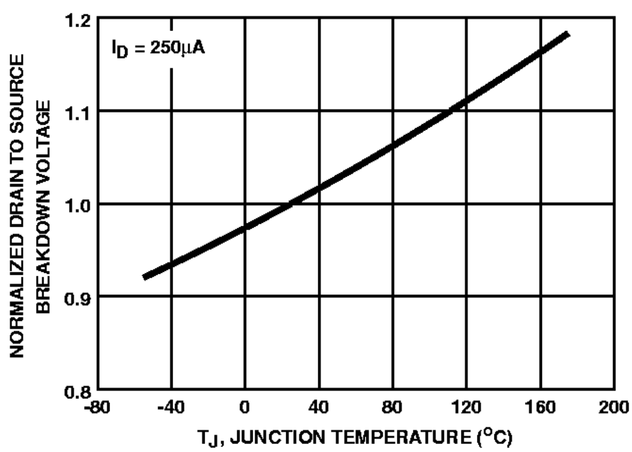


FIGURE 11. NORMALIZED DRAIN TO SOURCE BREAKDOWN VOLTAGE vs JUNCTION TEMPERATURE

Typical Performance Curves (Continued)

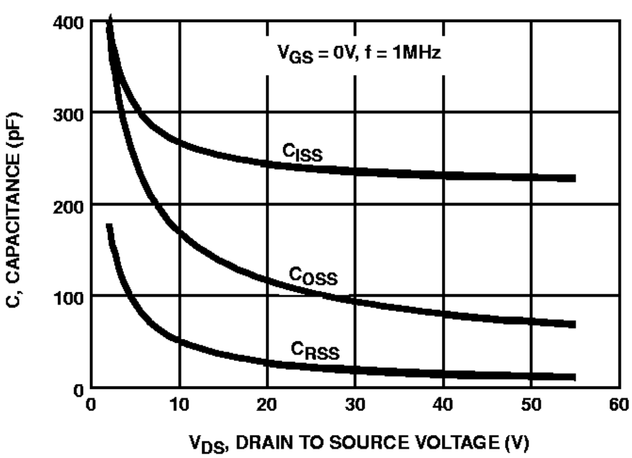
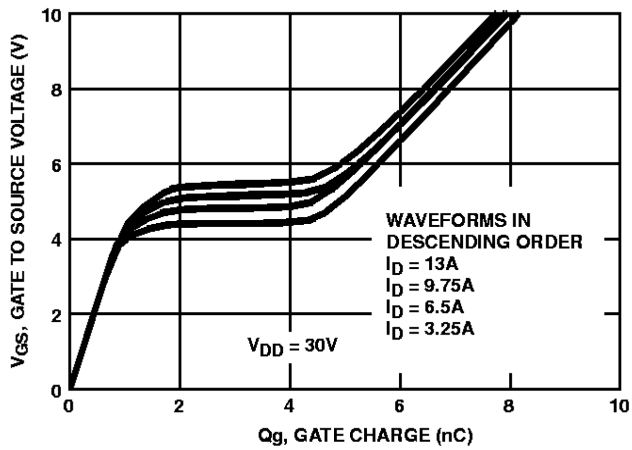


FIGURE 12. CAPACITANCE vs DRAIN TO SOURCE VOLTAGE



NOTE: Refer to Harris Application Notes AN7254 and AN7260.

FIGURE 13. GATE CHARGE WAVEFORMS FOR CONSTANT GATE CURRENT

Test Circuits and Waveforms

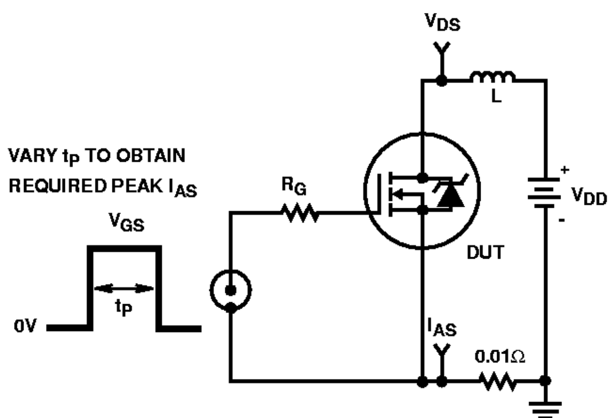


FIGURE 14. UNCLAMPED ENERGY TEST CIRCUIT

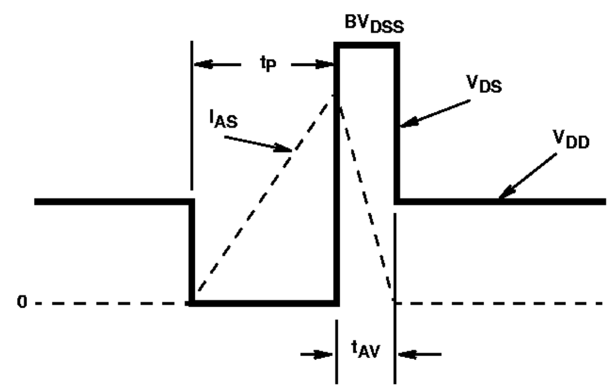


FIGURE 15. UNCLAMPED ENERGY WAVEFORMS

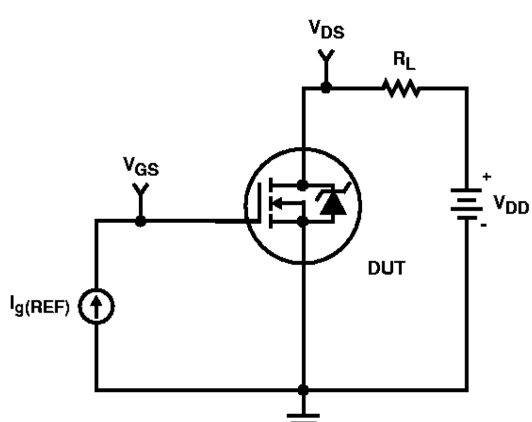


FIGURE 16. GATE CHARGE TEST CIRCUIT

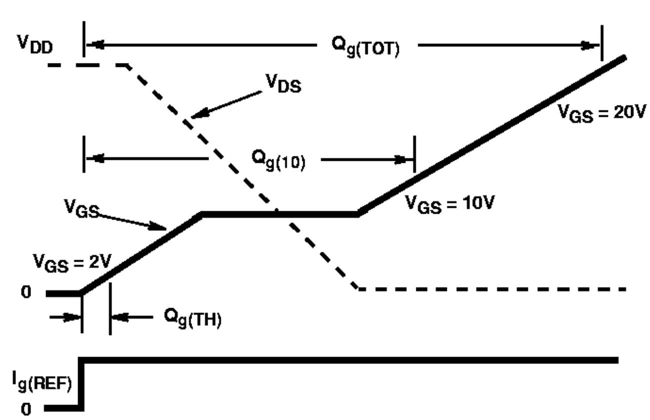


FIGURE 17. GATE CHARGE WAVEFORM

Test Circuits and Waveforms (Continued)

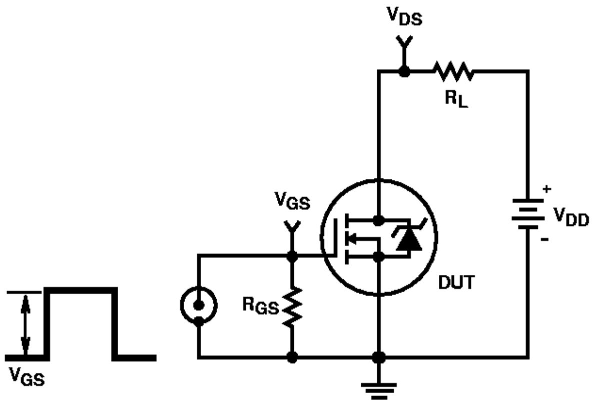


FIGURE 18. SWITCHING TIME TEST CIRCUIT

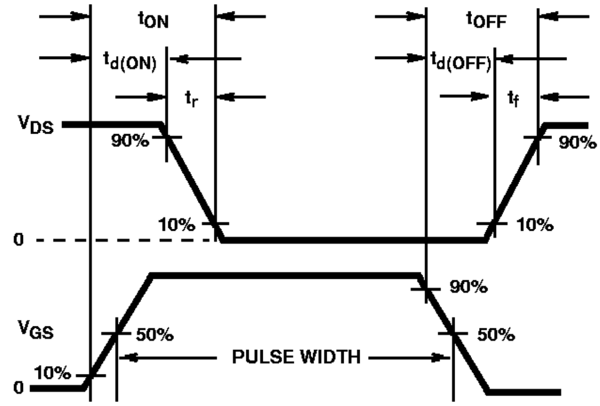
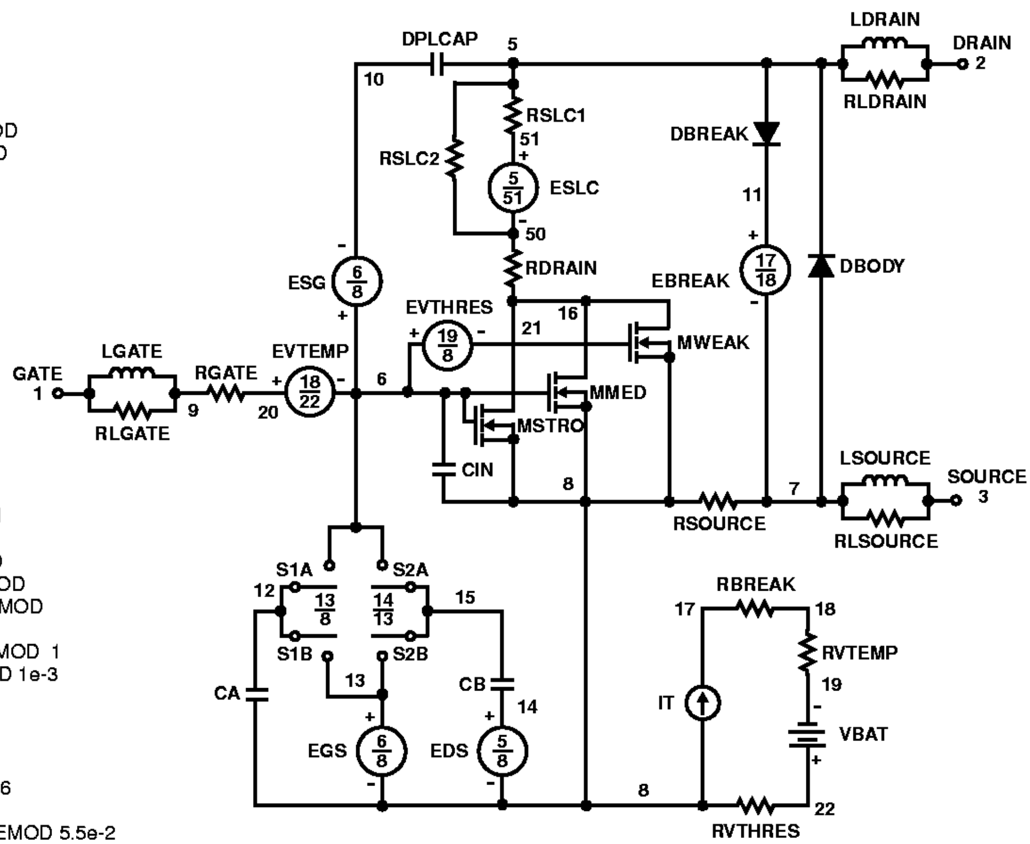


FIGURE 19. RESISTIVE SWITCHING WAVEFORMS

PSPICE Electrical Model

```
SUBCKT HUF75307 2 1 3 ;     rev 6/1/97

CA 12 8 4.5e-10
CB 15 14 4.1e-10
CIN 6 8 2.154e-10

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

EBREAK 11 7 17 18 56
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 5.97e-10
LSOURCE 3 7 2.39e-9
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 1e-3
RGATE 9 20 1.9
RLDRAIN 2 5 10
RLGATE 1 9 60
RLSOURCE 3 7 24
RSLC1 5 51 RSLCMOD 1e-6
RSLC2 5 50 1e3
RSOURCE 8 7 RSOURCEMOD 5.5e-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*35),4))}

.MODEL DBODYMOD D (IS=1.6e-13 RS=12.75e-3 IKF=5.5 N=0.985 TRS1=2.9e-3 TRS2=-4e-6 CJO=3.5e-10 TT=3.1e-8 M=.45 XTI=6)
.MODEL DBREAKMOD D (RS=2.5e-1 IKF=.1 TRS1=-4e-3 TRS2=3e-5)
.MODEL DPLCAPMOD D (CJO=5e-10 IS=1e-30 N=10 M=0.95)
.MODEL MMEDMOD NMOS (VTO=3.25 KP=2.2 LAMBDA=.001 IS=1e-30 N=10 TOX=1 L=1u W=1u RG=1)
.MODEL MSTROMOD NMOS (VTO=3.75 KP=14.75 LAMBDA=.001 IS=1e-30 N=10 TOX=1 L=1u W=1u)
.MODEL MWEAKMOD NMOS (VTO=2.88 KP=.03 LAMBDA=.001 IS=1e-30 N=10 TOX=1 L=1u W=1u RG=10 RS=0.1)
.MODEL RBREAKMOD RES (TC1=1.12e-3 TC2=1e-6)
.MODEL RDRAINMOD RES (TC1=2.3e-1 TC2=6e-4)
.MODEL RSLCMOD RES (TC1=4e-3 TC2=1e-6)
.MODEL RSOURCEMOD RES (TC1=1e-3 TC2=6e-6)
.MODEL RVTHRESMOD RES (TC=-3.31e-3 TC2=-1.49e-5)
.MODEL RVTEMPMOD RES (TC1=-1.4e-3 TC2=1e-9)

.MODEL S1AMOD VSWITCH (RON=1e-5 ROFF=0.1 VON=-8.1 VOFF=-4)
.MODEL S1BMOD VSWITCH (RON=1e-5 ROFF=0.1 VON=-4 VOFF=-8.1)
.MODEL S2AMOD VSWITCH (RON=1e-5 ROFF=0.1 VON=0 VOFF=2)
.MODEL S2AMOD VSWITCH (RON=1e-5 ROFF=0.1 VON=2 VOFF=0)

.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, written by William J. Hepp and C. Frank Wheatley.

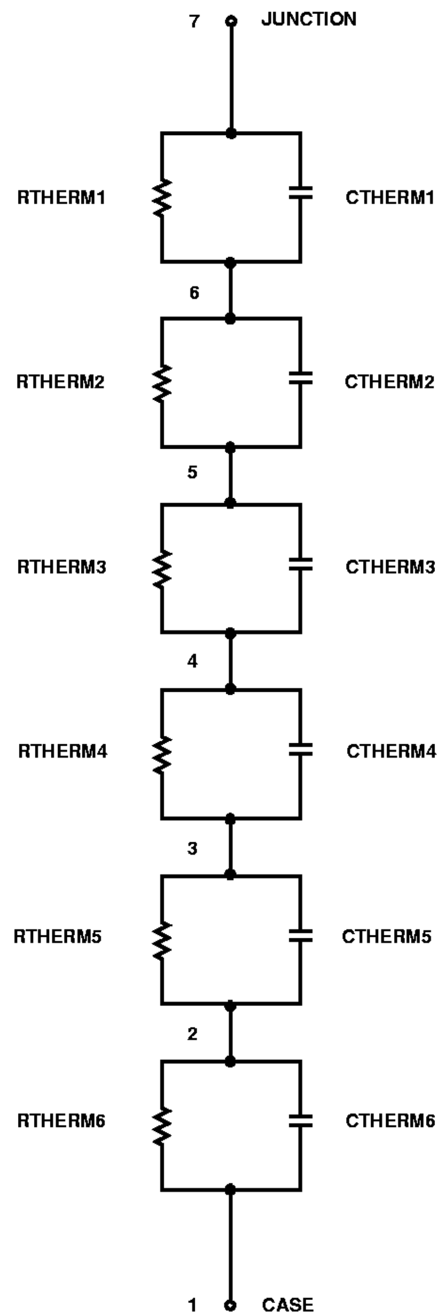
SPICE Thermal Model

REV 1 June 97

HUF75307

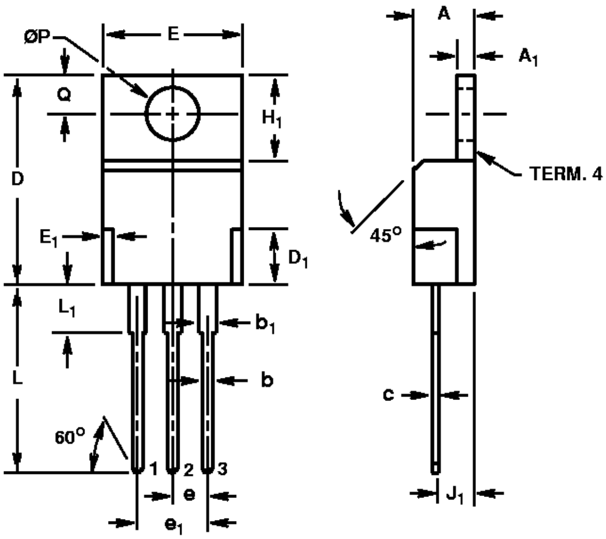
CTHERM1 7 6 1.50e-7
CTHERM2 6 5 2.20e-4
CTHERM3 5 4 8.00e-4
CTHERM4 4 3 3.40e-2
CTHERM5 3 2 5.00e-3
CTHERM6 2 1 2.00e-1

RTHERM1 7 6 5.50e-2
RTHERM2 6 5 2.00e-1
RTHERM3 5 4 1.10
RTHERM4 4 3 2.10e-1
RTHERM5 3 2 1.50
RTHERM6 2 1 4.50e-1



TO-220AB

3 LEAD JEDEC TO-220AB PLASTIC PACKAGE



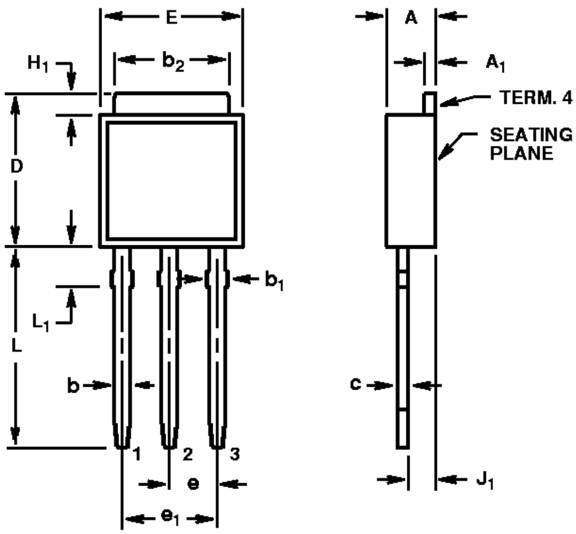
SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.170	0.180	4.32	4.57	-
A_1	0.048	0.052	1.22	1.32	-
b	0.030	0.034	0.77	0.86	3, 4
b_1	0.045	0.055	1.15	1.39	2, 3
c	0.014	0.019	0.36	0.48	2, 3, 4
D	0.590	0.610	14.99	15.49	-
D_1	-	0.160	-	4.06	-
E	0.395	0.410	10.04	10.41	-
E_1	-	0.030	-	0.76	-
e	0.100 TYP		2.54 TYP		5
e_1	0.200 BSC		5.08 BSC		5
H_1	0.235	0.255	5.97	6.47	-
J_1	0.100	0.110	2.54	2.79	6
L	0.530	0.550	13.47	13.97	-
L_1	0.130	0.150	3.31	3.81	2
ØP	0.149	0.153	3.79	3.88	-
Q	0.102	0.112	2.60	2.84	-

NOTES:

1. These dimensions are within allowable dimensions of Rev. J of JEDEC TO-220AB outline dated 3-24-87.
2. Lead dimension and finish uncontrolled in L_1.
3. Lead dimension (without solder).
4. Add typically 0.002 inches (0.05mm) for solder coating.
5. Position of lead to be measured 0.250 inches (6.35mm) from bottom of dimension D.
6. Position of lead to be measured 0.100 inches (2.54mm) from bottom of dimension D.
7. Controlling dimension: Inch.
8. Revision 2 dated 7-97.

TO-251AA

3 LEAD JEDEC TO-251AA PLASTIC PACKAGE



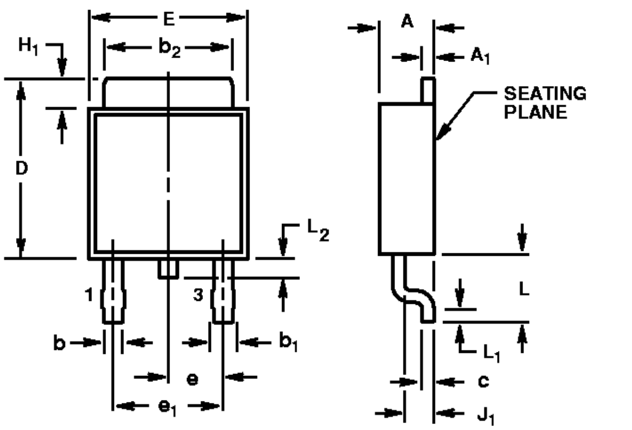
SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.086	0.094	2.19	2.38	-
A_1	0.018	0.022	0.46	0.55	3, 4
b	0.028	0.032	0.72	0.81	3, 4
b_1	0.033	0.040	0.84	1.01	3
b_2	0.205	0.215	5.21	5.46	3, 4
c	0.018	0.022	0.46	0.55	3, 4
D	0.270	0.290	6.86	7.36	-
E	0.250	0.265	6.35	6.73	-
e	0.090 TYP		2.28 TYP		5
e_1	0.180 BSC		4.57 BSC		5
H_1	0.035	0.045	0.89	1.14	-
J_1	0.040	0.045	1.02	1.14	6
L	0.355	0.375	9.02	9.52	-
L_1	0.075	0.090	1.91	2.28	2

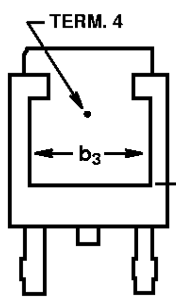
NOTES:

1. These dimensions are within allowable dimensions of Rev. C of JEDEC TO-251AA outline dated 9-88.
2. Solder finish uncontrolled in this area.
3. Dimension (without solder).
4. Add typically 0.002 inches (0.05mm) for solder plating.
5. Position of lead to be measured 0.250 inches (6.35mm) from bottom of dimension D.
6. Position of lead to be measured 0.100 inches (2.54mm) from bottom of dimension D.
7. Controlling dimension: Inch.
8. Revision 2 dated 10-95.

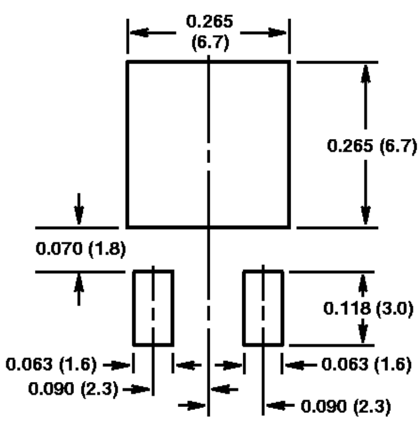
TO-252AA

SURFACE MOUNT JEDEC TO-252AA PLASTIC PACKAGE





BACK VIEW



MINIMUM PAD SIZE RECOMMENDED FOR SURFACE-MOUNTED APPLICATIONS

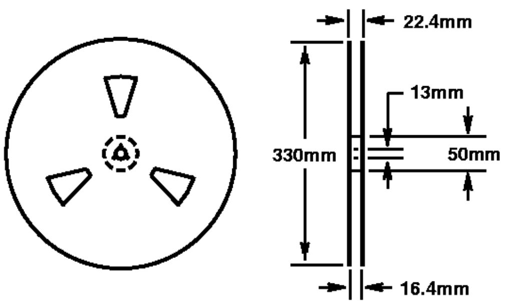
SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.086	0.094	2.19	2.38	-
A_1	0.018	0.022	0.46	0.55	4, 5
b	0.028	0.032	0.72	0.81	4, 5
b_1	0.033	0.040	0.84	1.01	4
b_2	0.205	0.215	5.21	5.46	4, 5
b_3	0.190	-	4.83	-	2
c	0.018	0.022	0.46	0.55	4, 5
D	0.270	0.290	6.86	7.36	-
E	0.250	0.265	6.35	6.73	-
e	0.090 TYP		2.28 TYP		7
e_1	0.180 BSC		4.57 BSC		7
H_1	0.035	0.045	0.89	1.14	-
J_1	0.040	0.045	1.02	1.14	-
L	0.100	0.115	2.54	2.92	-
L_1	0.020	-	0.51	-	4, 6
L_2	0.025	0.040	0.64	1.01	3
L_3	0.170	-	4.32	-	2

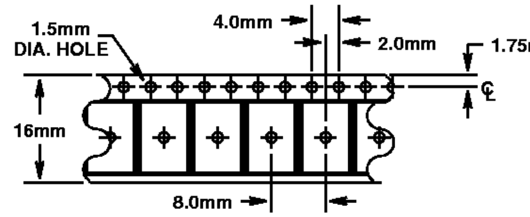
NOTES:

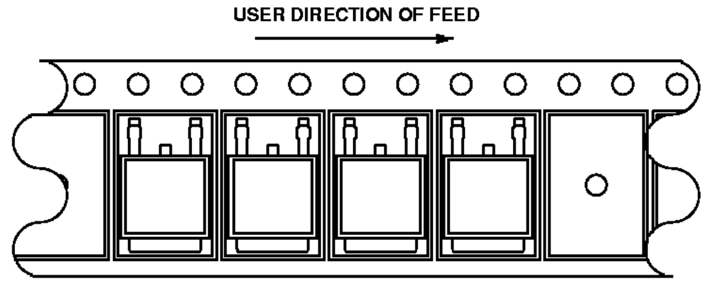
1. These dimensions are within allowable dimensions of Rev. B of JEDEC TO-252AA outline dated 9-88.
2. L_3 and b_3 dimensions establish a minimum mounting surface for terminal 4.
3. Solder finish uncontrolled in this area.
4. Dimension (without solder).
5. Add typically 0.002 inches (0.05mm) for solder plating.
6. L_1 is the terminal length for soldering.
7. Position of lead to be measured 0.090 inches (2.28mm) from bottom of dimension D.
8. Controlling dimension: Inch.
9. Revision 7 dated 7-97.

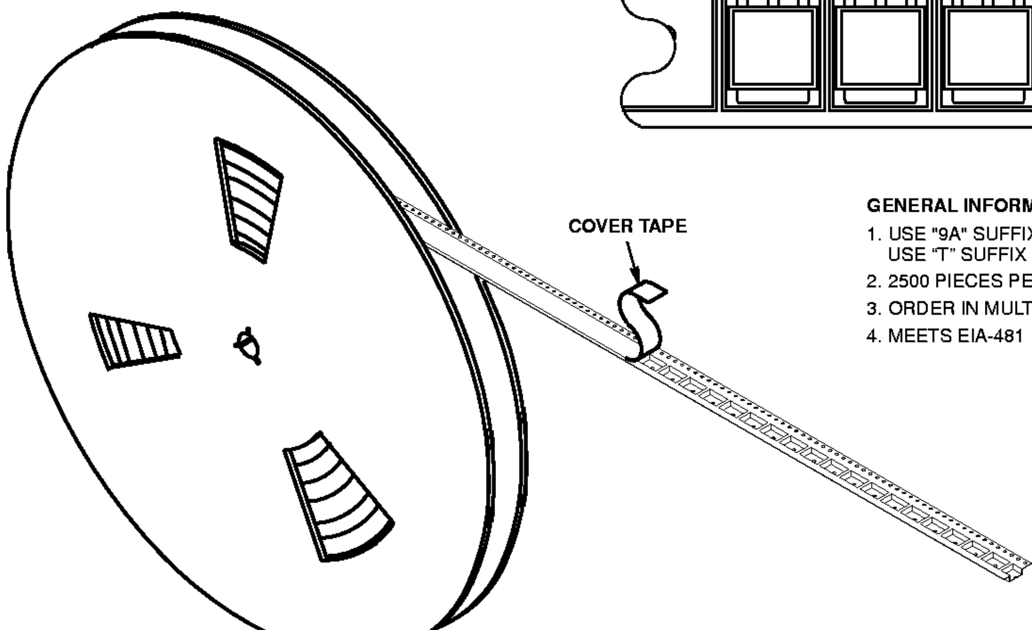
TO-252AA

16mm TAPE AND REEL









GENERAL INFORMATION

1. USE "9A" SUFFIX ON PART NUMBER. USE “T” SUFFIX ON PART FOR “HUF” SERIES.
2. 2500 PIECES PER REEL.
3. ORDER IN MULTIPLES OF FULL REELS ONLY.
4. MEETS EIA-481 REVISION "A" SPECIFICATIONS.

Revision 7 dated 7-97

All Harris Semiconductor products are manufactured, assembled and tested under **ISO9000** quality systems certification.

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