

14A, 60V, Avalanche Rated N-Channel Enhancement-Mode Power MOSFETs (MegaFETs)

June 1995

Features

- 14A, 60V
- $r_{DS(ON)} = 0.100\Omega$
- *Temperature Compensating* PSPICE Model
- Peak Current vs Pulse Width Curve
- UIS Rating Curve
- +175°C Operating Temperature

Description

The RFD14N06, RFD14N06SM, and RFP14N06 N-channel power MOSFETs are 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.

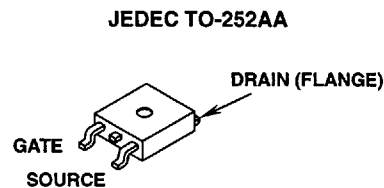
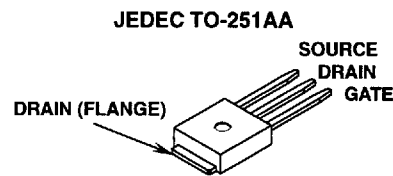
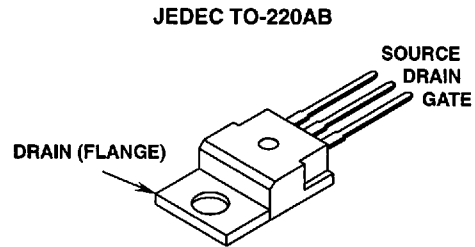
PACKAGING AVAILABILITY

PART NUMBER	PACKAGE	BRAND
RFD14N06	TO-251AA	F14N06
RFD14N06SM	TO-252AA	F14N06
RFP14N06	TO-220AB	RFP14N06

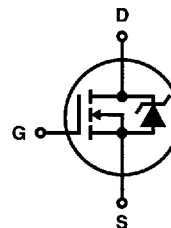
NOTE: When ordering, use the entire part number. Add the suffix 9A to obtain the TO-252AA variant in the tape and reel, i.e., RFD14N06SM9A.

Formerly developmental type TA09770.

Packaging



Symbol



Absolute Maximum Ratings $T_C = +25^\circ\text{C}$

	RFD14N06, RFD14N06SM, RFP14N06	UNITS
Drain-Source Voltage	60	V
Drain-Gate Voltage	60	V
Gate-Source Voltage	± 20	V
Drain Current		
RMS Continuous	14	A
Pulsed Drain Current	Refer to Peak Current Curve	
Pulsed Avalanche Rating	Refer to UIS Curve	
Power Dissipation		
$T_C = +25^\circ\text{C}$	48	W
Derate above $+25^\circ\text{C}$	0.32	W/°C
Operating and Storage Temperature	-55 to +175	°C
Soldering Temperature of Leads for 10s	260	°C

Specifications RFD14N06, RFD14N06SM, RFP14N06

Electrical Specifications

$T_C = +25^{\circ}\text{C}$, Unless Otherwise Specified

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS	
Drain-Source Breakdown Voltage	BV_{DSS}	$I_D = 0.25\text{mA}$, $V_{GS} = 0\text{V}$	60	-	-	V	
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}$, $I_D = 0.25\text{mA}$	2	-	4	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	μA
			$T_C = +150^{\circ}\text{C}$	-	-	50	μA
Gate-Source Leakage Current	I_{GSS}	$V_{GS} = \pm 20\text{V}$	-	-	100	nA	
On Resistance	$r_{DS(ON)}$	$I_D = 14\text{A}$, $V_{GS} = 10\text{V}$	-	-	0.100	Ω	
Turn-On Time	t_{ON}	$V_{DD} = 30\text{V}$, $I_D = 7\text{A}$, $R_L = 4.3\Omega$, $V_{GS} = 10\text{V}$, $R_{GS} = 25\Omega$	-	-	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	$Q_{G(TOT)}$		$V_{GS} = 0\text{V to } 20\text{V}$	$V_{DD} = 48\text{V}$, $I_D = 14\text{A}$, $R_L = 3.42\Omega$	-	-	40
Gate Charge at 10V	$Q_{G(10)}$	$V_{GS} = 0\text{V to } 10\text{V}$	-		-	25	nC
Threshold Gate Charge	$Q_{G(TH)}$	$V_{GS} = 0\text{V to } 2\text{V}$	-		-	1.5	nC
Plateau Voltage	$V_{PLATEAU}$	$I_D = 14\text{A}$, $V_{DS} = 15\text{V}$	-	-	7.5	V	
Input Capacitance	C_{ISS}	$V_{DS} = 25\text{V}$, $V_{GS} = 0\text{V}$, $f = 1\text{MHz}$	-	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	$^{\circ}\text{C/W}$	
Thermal Resistance Junction-to-Ambient	$R_{\theta JA}$	TO-251 and TO-252	-	-	100	$^{\circ}\text{C/W}$	
		TO-220	-	-	80	$^{\circ}\text{C/W}$	

Source-Drain Diode Specifications

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Forward Voltage	V_{SD}	$I_{SD} = 14\text{A}$	-	-	1.5	V
Reverse Recovery Time	t_{RR}	$I_{SD} = 14\text{A}$, $dI_{SD}/dt = 100\text{A}/\mu\text{s}$	-	-	125	ns

Typical Performance Curves

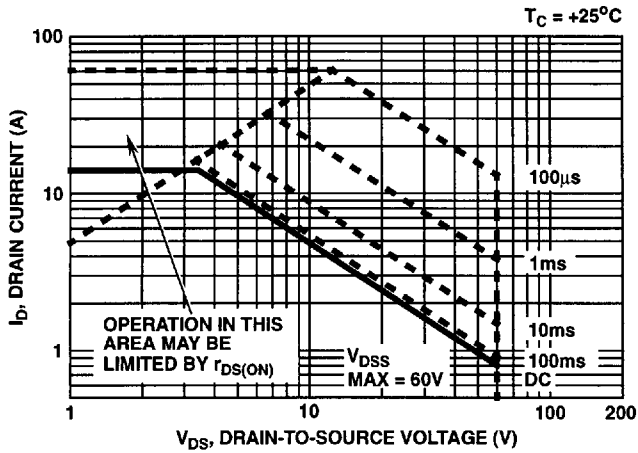


FIGURE 1. SAFE OPERATING AREA CURVE

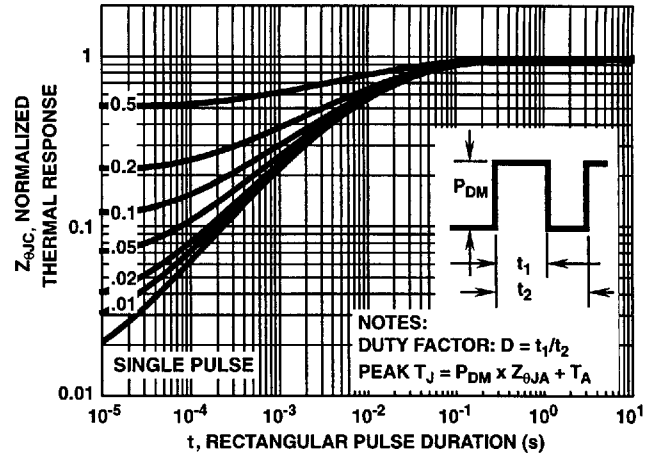


FIGURE 2. NORMALIZED MAXIMUM TRANSIENT THERMAL IMPEDANCE

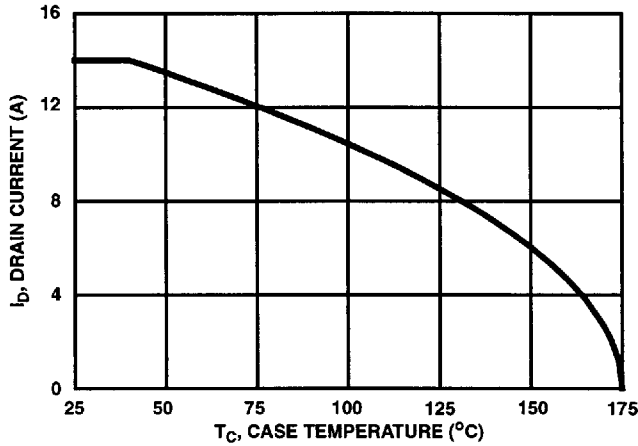


FIGURE 3. MAXIMUM CONTINUOUS DRAIN CURRENT vs TEMPERATURE

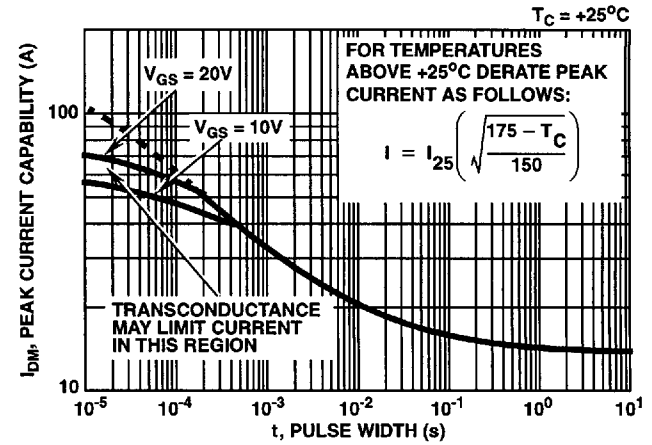


FIGURE 4. PEAK CURRENT CAPABILITY

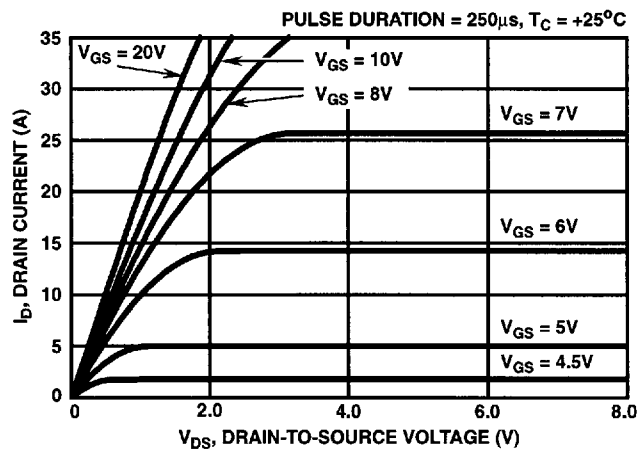


FIGURE 5. TYPICAL SATURATION CHARACTERISTICS

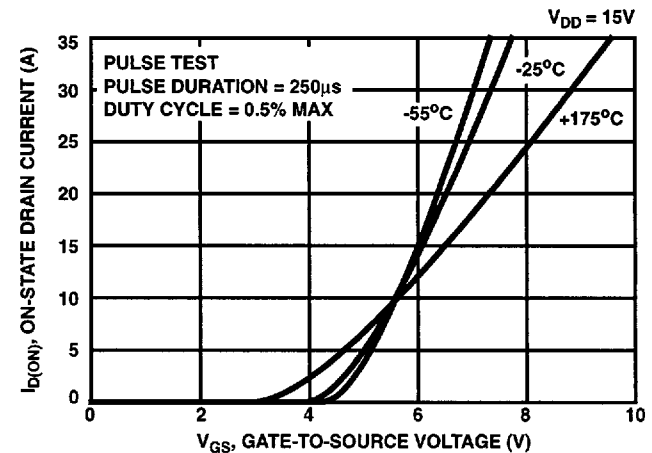


FIGURE 6. TYPICAL TRANSFER CHARACTERISTICS

Typical Performance Curves (Continued)

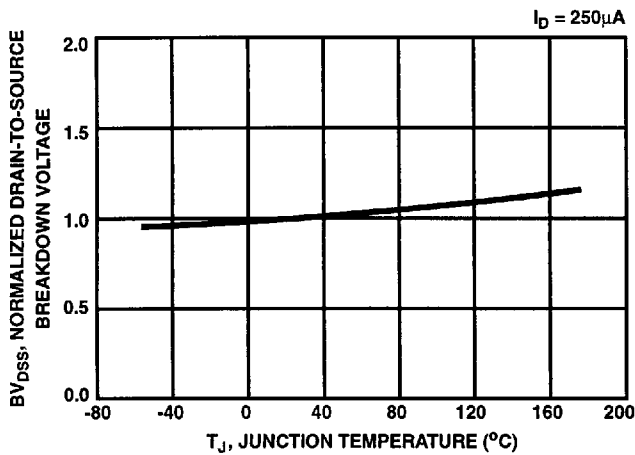


FIGURE 7. NORMALIZED DRAIN-SOURCE BREAKDOWN VOLTAGE vs JUNCTION TEMPERATURE

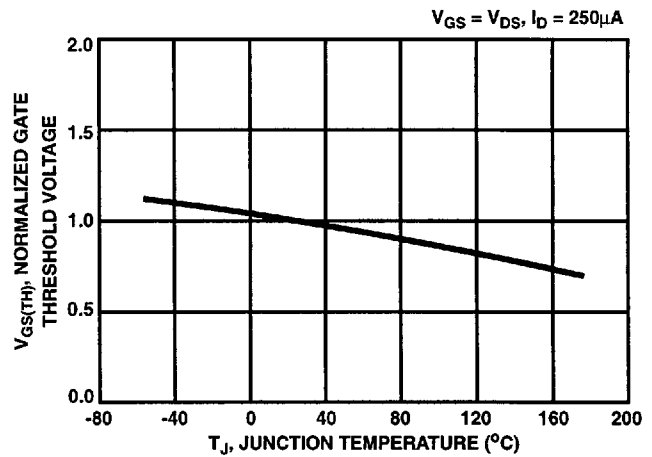


FIGURE 8. NORMALIZED GATE THRESHOLD VOLTAGE vs JUNCTION TEMPERATURE

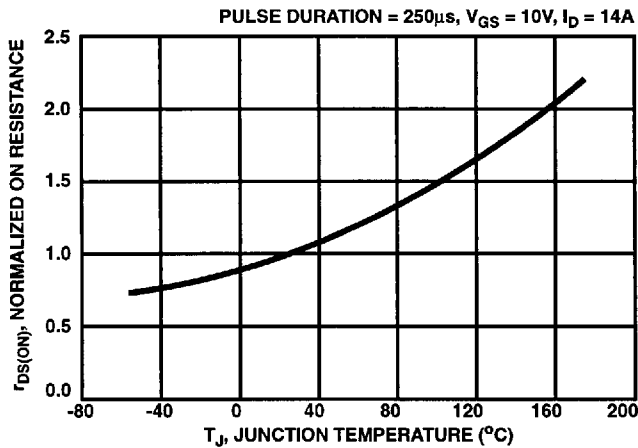


FIGURE 9. NORMALIZED $r_{DS(ON)}$ vs JUNCTION TEMPERATURE

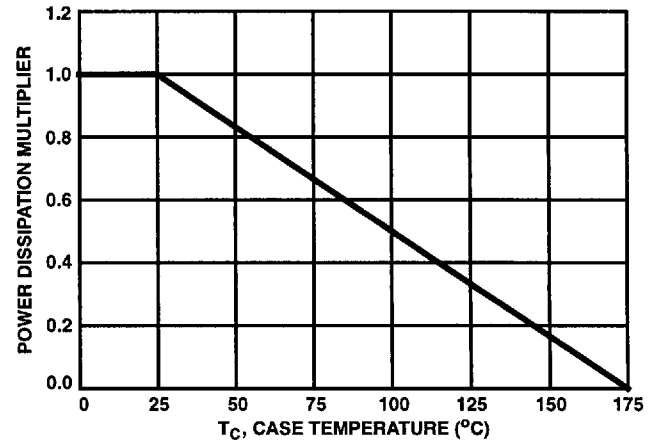


FIGURE 10. NORMALIZED POWER DISSIPATION vs TEMPERATURE DERATING CURVE

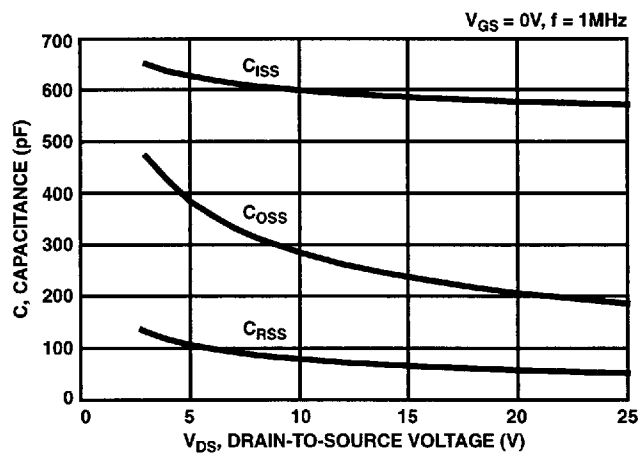


FIGURE 11. TYPICAL CAPACITANCE vs VOLTAGE

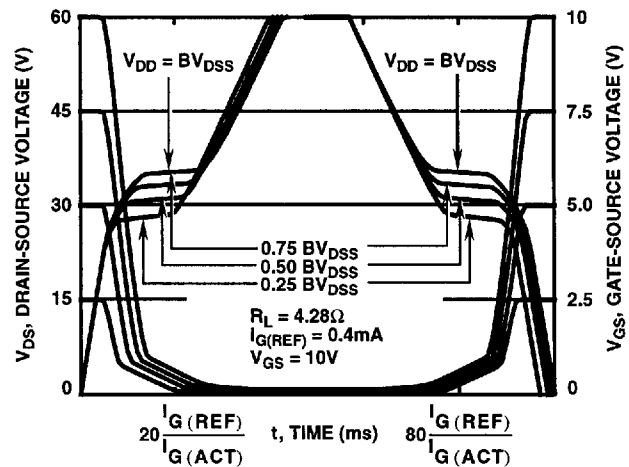


FIGURE 12. NORMALIZED SWITCHING WAVEFORMS FOR CONSTANT GATE CURRENT. REFER TO HARRIS APPLICATION NOTES AN7254 AND AN7260

Typical Performance Curves (Continued)

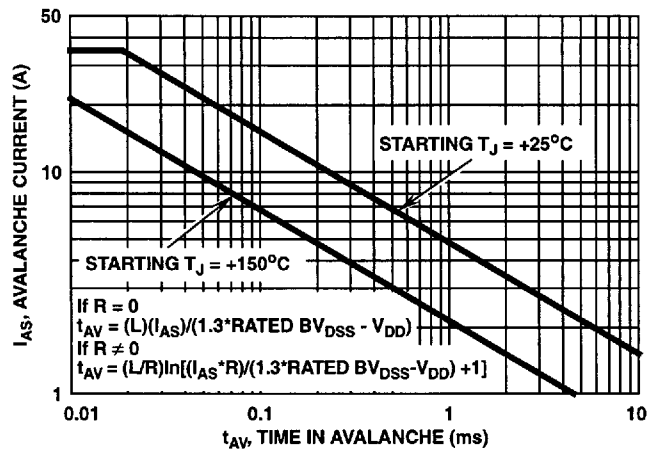


FIGURE 13. UNCLAMPED INDUCTIVE SWITCHING. REFER TO HARRIS APPLICATION NOTES AN9321 AND AN9322

Test Circuits and Waveforms

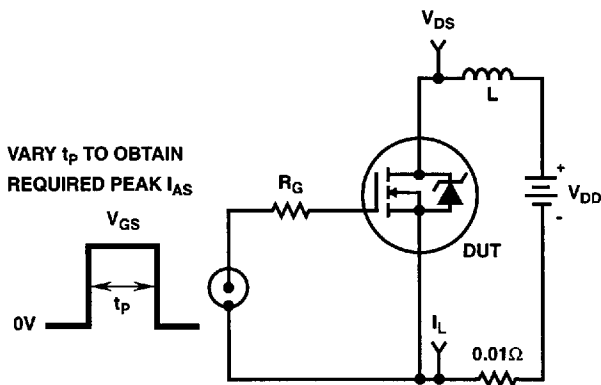


FIGURE 14. UNCLAMPED ENERGY TEST CIRCUIT

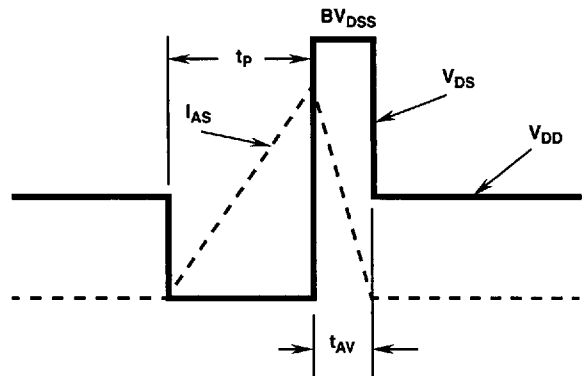


FIGURE 15. UNCLAMPED ENERGY WAVEFORMS

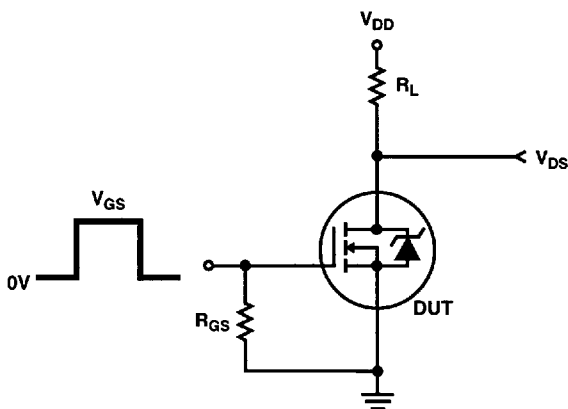


FIGURE 16. RESISTIVE SWITCHING TEST CIRCUIT

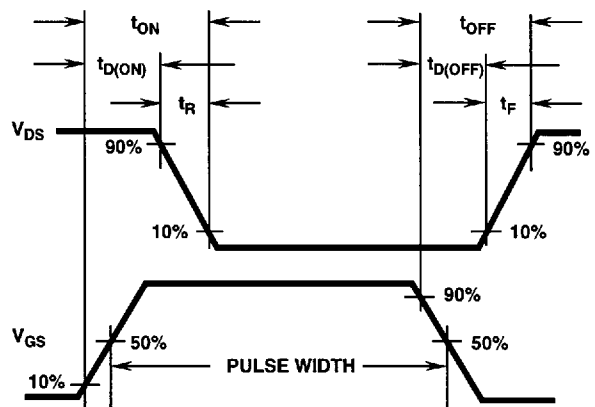
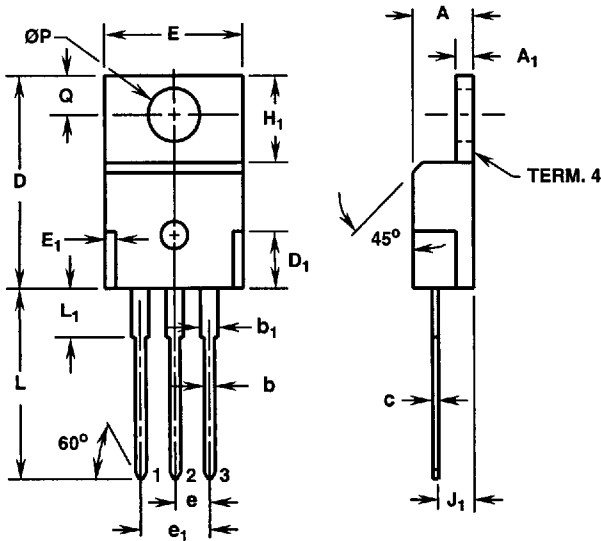


FIGURE 17. RESISTIVE SWITCHING WAVEFORMS

RFD14N06, RFD14N06SM, RFP14N06

Packaging



LEAD NO. 1 - GATE
 LEAD NO. 2 - DRAIN
 LEAD NO. 3 - SOURCE
 TERM. 4 MOUNTING FLANGE - DRAIN

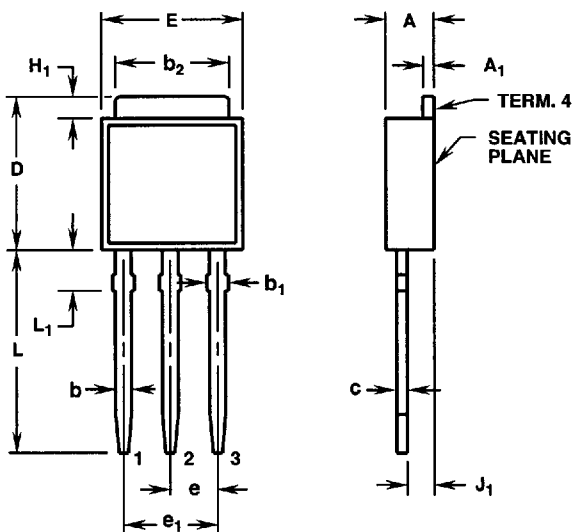
TO-220AB
 3 LEAD JEDEC TO-220AB PLASTIC PACKAGE

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:

- These dimensions are within allowable dimensions of Rev. J of JEDEC TO-220AB outline dated 3-24-87.
- Lead dimension and finish uncontrolled in L₁.
- Lead dimension (without solder).
- Add typically 0.002 inches (0.05mm) for solder coating.

- Position of lead to be measured 0.250 inches (6.35mm) from bottom of dimension D.
- Position of lead to be measured 0.100 inches (2.54mm) from bottom of dimension D.
- Controlling dimension: Inch.
- Revision 1 dated 1-93.



LEAD NO. 1 - GATE
 LEAD NO. 2 - DRAIN
 LEAD NO. 3 - SOURCE
 TERM. 4 MOUNTING FLANGE - DRAIN

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

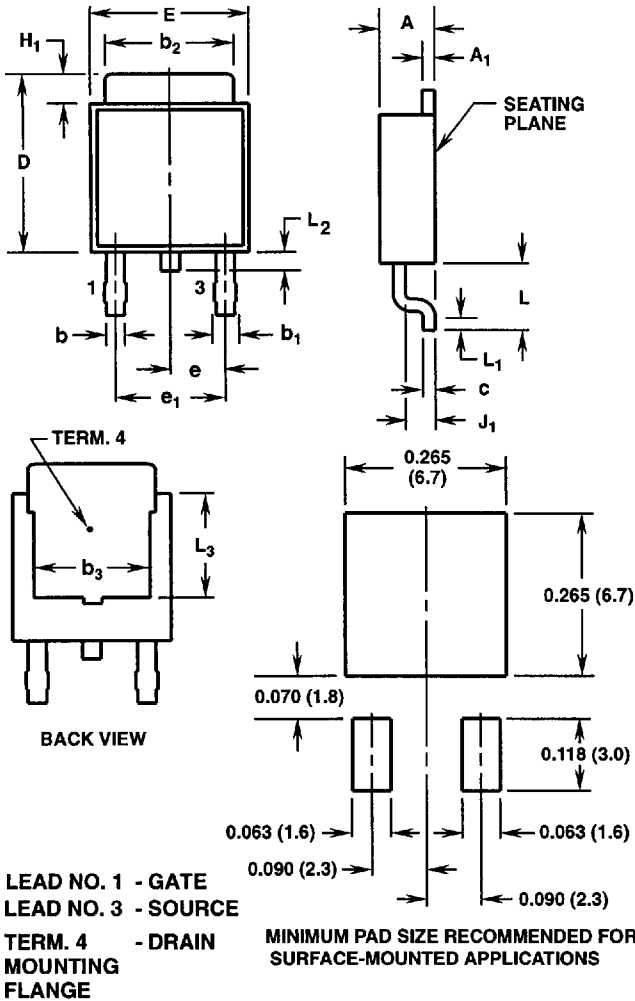
NOTES:

- These dimensions are within allowable dimensions of Rev. C of JEDEC TO-251AA outline dated 9-88.
- Solder finish uncontrolled.
- Dimension (without solder).
- Add typically 0.0006 inches (0.015mm) for solder coating.

- Position of lead to be measured 0.250 inches (6.35mm) from bottom of dimension D.
- Position of lead to be measured 0.100 inches (2.54mm) from bottom of dimension D.
- Controlling dimension: Inch.
- Revision 1 dated 1-93.

RFD14N06, RFD14N06SM, RFP14N06

Packaging (Continued)



TO-252AA
2 LEAD JEDEC TO-252AA 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	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	-
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. L₃ and b₃ dimensions establish a minimum mounting surface for terminal 4.
3. Solder finish uncontrolled.
4. Dimension (without solder).
5. Add typically 0.0006 inches (0.015mm) for solder coating.
6. L₁ 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 3 dated 3-94.

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Melbourne, FL 32902
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EUROPE

Harris Semiconductor
Mercure Center
100, Rue de la Fusee
1130 Brussels, Belgium
TEL: (32) 2.724.2111
FAX: (32) 2.724.22.05

ASIA

Harris Semiconductor PTE Ltd.
No. 1 Tannery Road
Cencon 1, #09-01
Singapore 1334
TEL: (65) 748-4200
FAX: (65) 748-0400

