

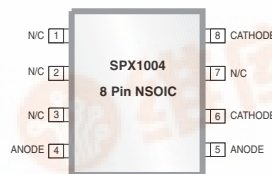


## SPX1004

### 1.2V / 2.5V Micropower Voltage Reference

#### FEATURES

- Initial Voltage Tolerance:  
 SPX1004-1.2 =  $\pm 10\text{mV}$   
 SPX1004-2.5 =  $\pm 20\text{mV}$
- Low Dynamic Impedance  
 0.6  $\Omega$  Max.
- Low Operating Current:  
 SPX1004-1.2 =  $\pm 10\mu\text{A}$   
 SPX1004-2.5  $\pm 20\mu\text{A}$
- Wide Operating Current Range  
 0.6  $\Omega$  Max.
- Direct Replacement for LT1004,  
 LM1004 and AS1004
- Lead Free, RoHS Compliant  
 Packages



#### APPLICATIONS

- A/D and D/A Reference
- Reference for 5V Systems
- Digital Voltmeter
- Power Supply Monitor

#### DESCRIPTION

The SPX1004 is a 2-terminal bandgap precision voltage reference that provides a stable fixed output voltage of 1.2V and 2.5V with a tolerance of  $\pm 10\text{mV}$  for SPX1004-1.2 and  $\pm 20\text{mV}$  for SPX1004-2.5. Design, process and precision on chip trimming yield a very low temperature coefficient of 25 ppm/ $^{\circ}\text{C}$ .

The SPX1004 can be used as a pin-to-pin replacement for the LT1004, LM1004 or AS1004. The SPX1004 is available in SOT-89, NSOIC-8 and TO-92 packages over the operating temperature range of  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

#### BLOCK DIAGRAMS

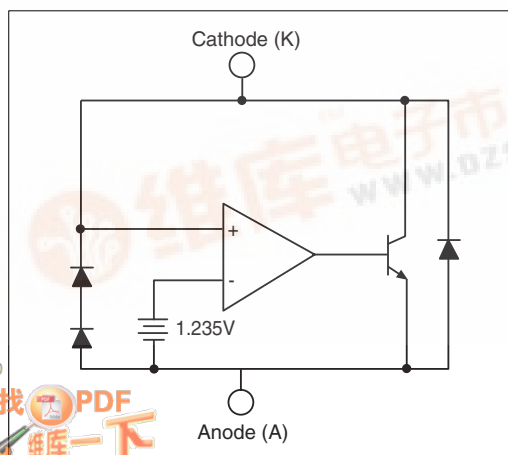


Figure 1a. SPX1004-1.2 Block Diagram

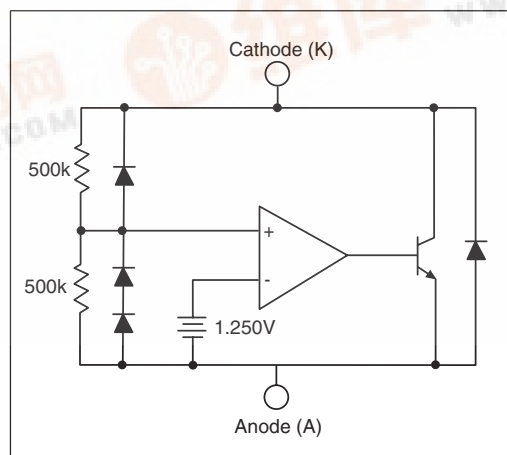


Figure 1b. SPX1004-2.5 Block Diagram



### ABSOLUTE MAXIMUM RATINGS

Stresses greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

Forward Current ( $I_{AK}$ ).....10mA  
 Reverse Current ( $I_{KA}$ ).....30mA  
 Lead Temperature (soldering, 10 seconds).....300°C  
 Storage Temperature Range.....-65°C to +150°C  
 Junction Temperature.....150°C

Continuous Power Dissipation ( $P_D$ )

TO-92.....775mW  
 NSOIC-8.....750mW  
 SOT-89.....1000mW

### TYPICAL THERMAL RESISTANCES

PACKAGE	$\theta_{JA}$	$\theta_{JA}$	TYPICAL DERATING
TO-92	160°C/W	80°C/W	6.3 mW/°C
NSOIC-8	175°C/W	45°C/W	5.7mW/°C
SOT-89	110°C/W	8°C/W	9.1mW/°C

### ELECTRICAL CHARACTERISTICS

Electrical characteristics are guaranteed over full junction temperature range (0°C to 70°C). Ambient temperature must be derated based on power dissipation and package thermal characteristics.

PARAMETER	CONDITIONS	SPX1004-1.2V			SPX1004-2.5V			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	
Reverse breakdown	$I_Z=100\mu A, T_J=25^\circ C$ $0^\circ C \leq T_A \leq 70^\circ C$	1.225	1.235	1.245	2.480	2.500	2.520	V
Ave Temp. Coeff.	$I_{min} \leq I_Z \leq 20mA$	20			60			ppm/ °C
Min Operating Current		4	10		12	20	$\mu A$	
Reverse Breakdown Voltage Change with Current	$I_{min} \leq I_Z \leq 1mA$ over temperature $1mA \leq I_Z \leq 20mA$ over temperature	0.5	1		0.5	1	mV	
Reverse Dynamic Impedance	$I_Z=100\mu A, f=25Hz$ over temperature	0.2	0.6		0.8	0.9	$\Omega$	
Wide Band Noise	$I_Z=100\mu A, 10Hz \leq f \leq 10kHz$	60			120			$\mu V$
Long Term Stability	$I_Z=100\mu A, T_A=25^\circ C \pm 0.1^\circ C$	20			60			ppm/ kHr
Operating Temp Range		0	70		0	70	°C	

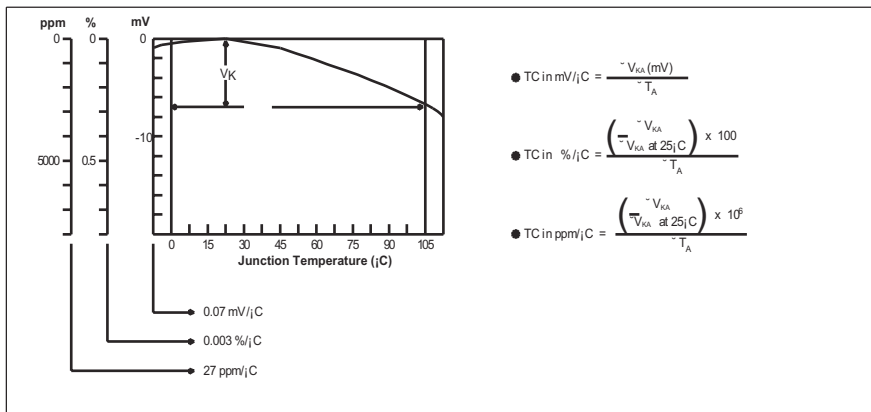


Figure 2.  $V_{REF}$  vs Temperature for 2.5V Version

**TYPICAL PERFORMANCE CHARACTERISTICS**

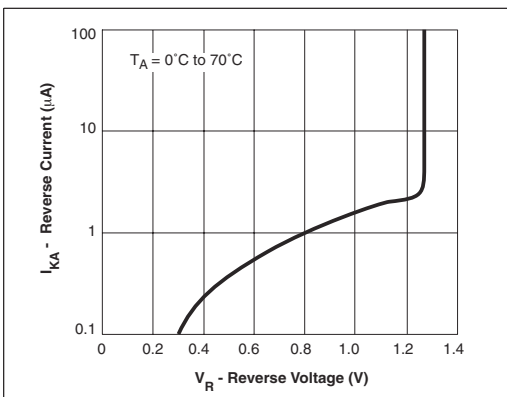


Figure 3. SPX1004-1.2V Reverse Operating Characteristic

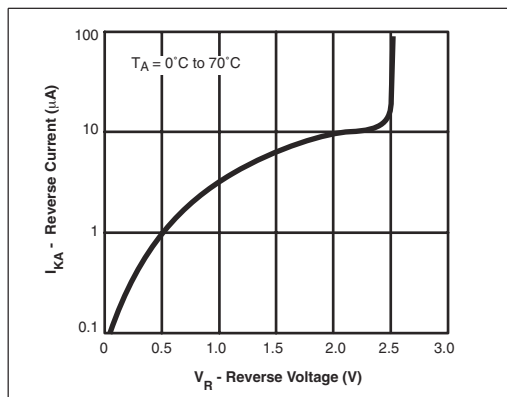


Figure 4. SPX1004-2.5V Reverse Operating Characteristic

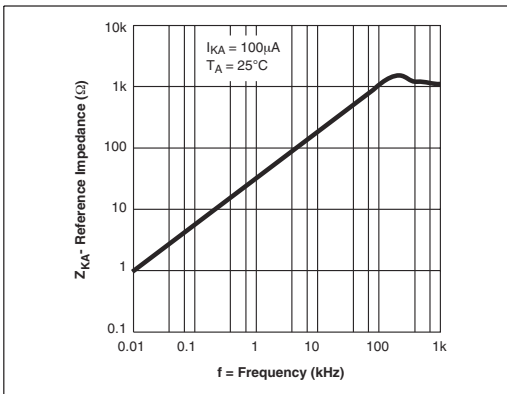


Figure 5. SPX1004-1.2V Reverse Dynamic Impedance

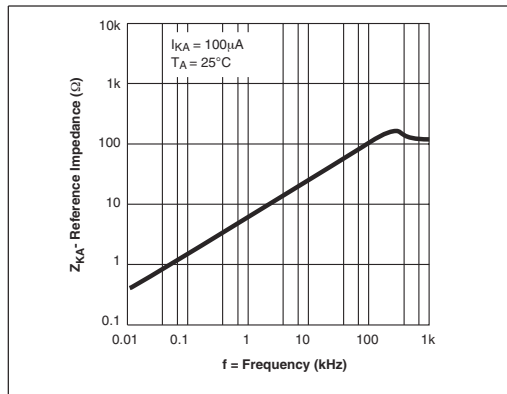


Figure 6. SPX1004-2.5V Reverse Dynamic Impedance

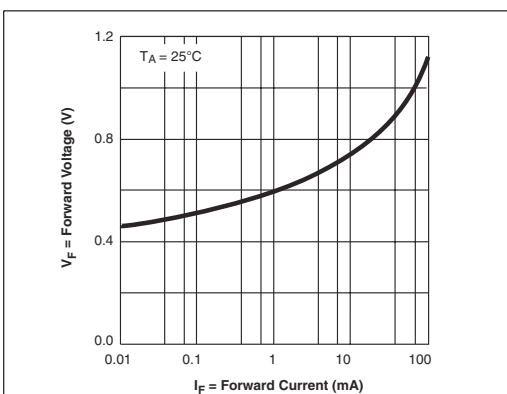


Figure 7. Forward Characteristics for SPX1004-1.2 and SPX1004-2.5

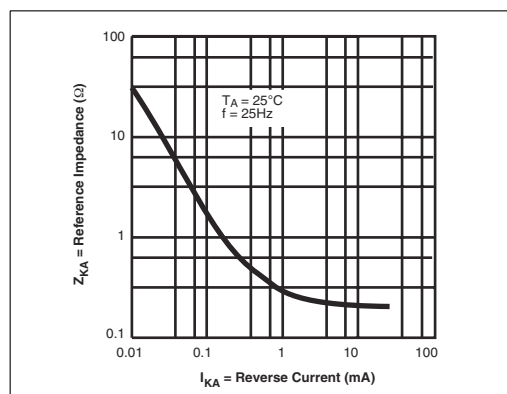


Figure 8. Low Frequency Reverse Dynamic Impedance for SPX1004-1.2

## APPLICATION CIRCUITS

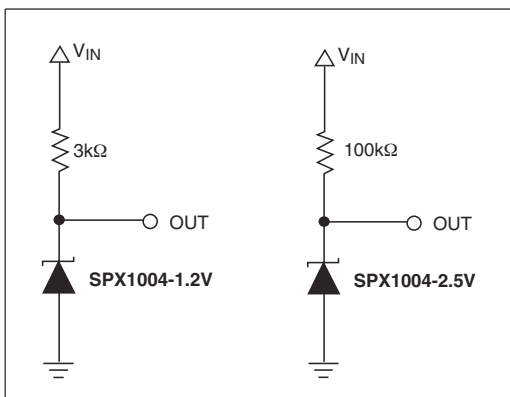


Figure 9a. 1.2V Reference, Figure 9b. 2.5V Reference

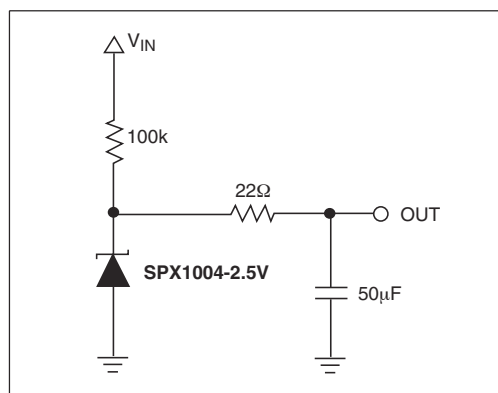


Figure 10. Low Noise Reference

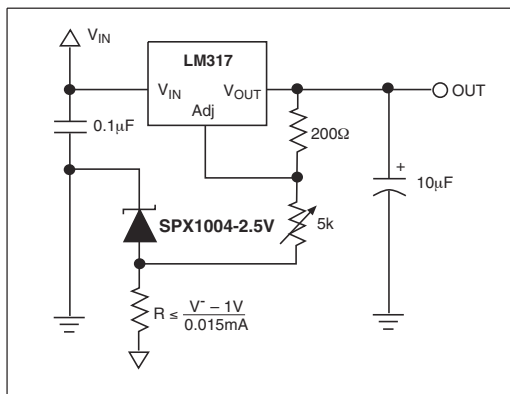


Figure 11. Variable Output Regulator

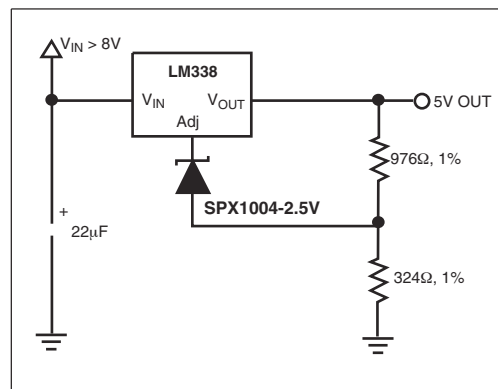


Figure 12. High Stability 5V Regulator

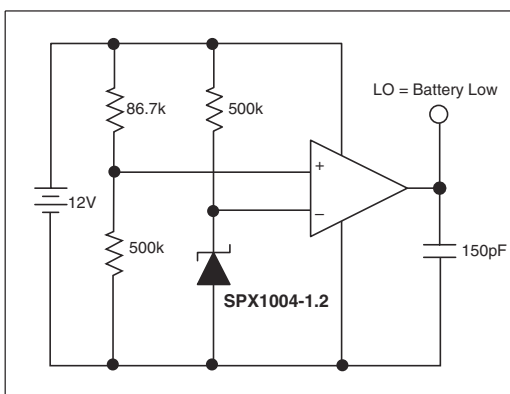


Figure 13. Low Battery Detector

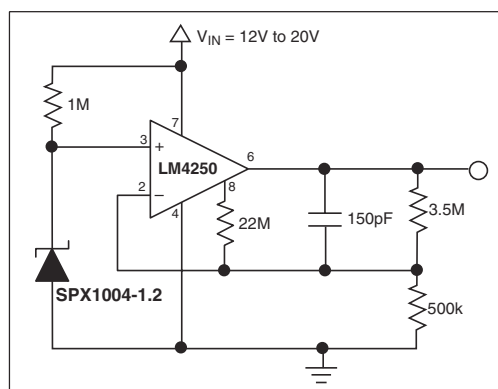
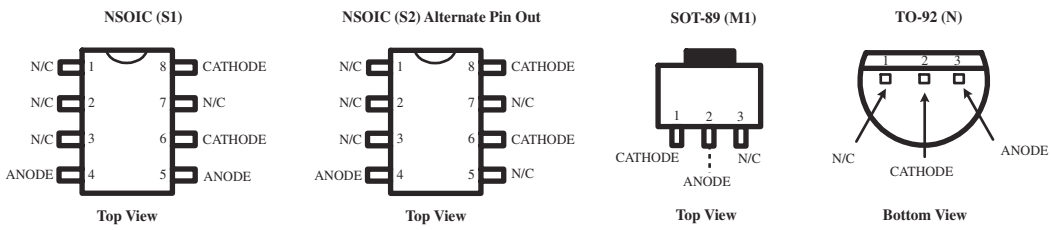
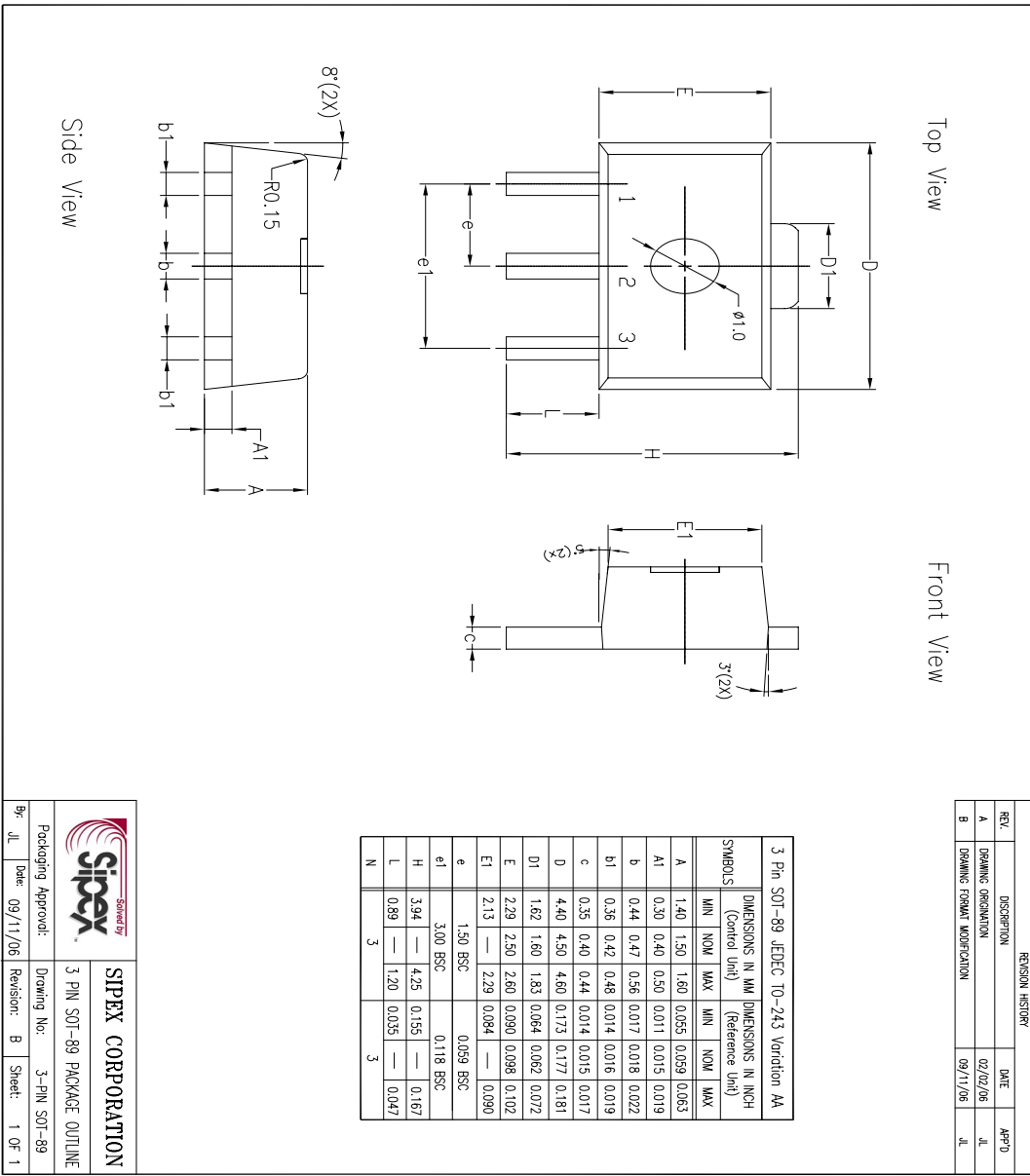


Figure 14. Micropower 10V Reference

**PACKAGE: PINOUTS**



**PACKAGE: 3 PIN SOT-89**



REVISION HISTORY			
REV.	DISPOSITION	DATE	APP'D
A	DRAWING ORIGINATOR	02/02/06	JL
B	DRAWING FORMAT MODIFICATION	09/11/06	JL

**SIPLEX CORPORATION**

3 PIN SOT-89 PACKAGE OUTLINE

Drawing No.: 3-PIN SOT-89

Revision: B Sheet: 1 OF 1

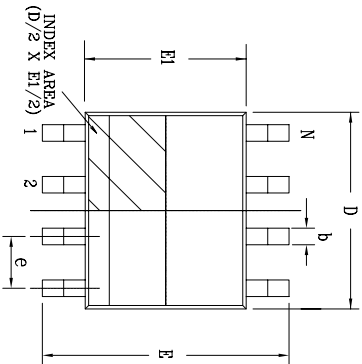
By: JL Date: 09/11/06

Packaging Approval:

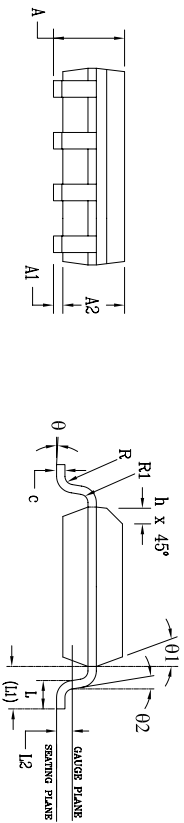
PACKAGE: 8 PIN NSOIC

REVISION HISTORY			
REV.	DESCRIPTION	DATE	APP'D.
A	DRAWING ORIGINATOR	08/16/05	JL
B	DRAWING FORMAT MODIFICATION	07/19/06	JL

8 Pin SOICN		JEDEC MS-012		Variation AA		
SYMBOLS	DIMENSIONS IN MM (Control Unit)			DIMENSIONS IN INCH (Reference Unit)		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.35	—	1.75	0.053	—	0.069
A1	0.10	—	0.25	0.004	—	0.010
A2	1.25	—	1.65	0.049	—	0.065
b	0.31	—	0.51	0.012	—	0.020
c	0.17	—	0.25	0.007	—	0.010
E	6.00 BSC			0.236 BSC		
E1	3.90 BSC			0.154 BSC		
e	1.27 BSC			0.050 BSC		
h	0.25	—	0.50	0.010	—	0.020
L	0.40	—	1.27	0.016	—	0.050
L1	1.04 REF			0.041 REF		
L2	0.25 BSC			0.010 BSC		
R	0.07	—	—	0.003	—	—
R1	0.07	—	—	0.003	—	—
θ	0°	—	8°	0°	—	8°
θ1	5°	—	15°	5°	—	15°
θ2	0°	—	—	0°	—	—
D	4.90 BSC			0.193 BSC		
N	8			8		



Top View



Side View

Front View



SIPLEX CORPORATION

8 PIN SOICN PACKAGE OUTLINE

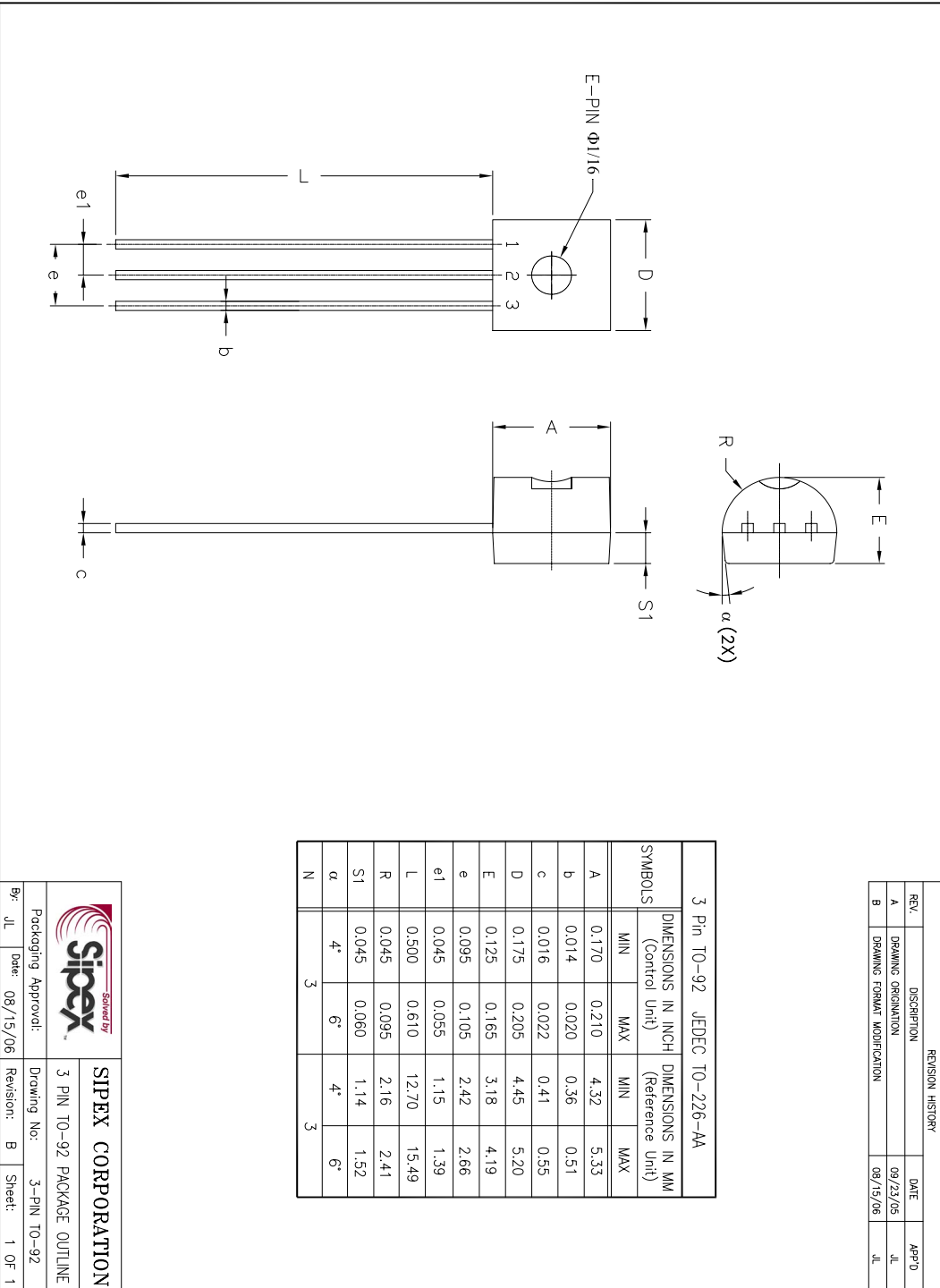
Packaging Approval:

Drawing No: 8-PIN SOICN

By: JL Date: 07/19/06


Revision: B Sheet: 1 OF 1

PACKAGE: 3 PIN TO-92



3 Pin TO-92 JEDEC TO-226-AA					
SYMBOLS	DIMENSIONS IN INCH (Control Unit)		DIMENSIONS IN MM (Reference Unit)		
	MIN	MAX	MIN	MAX	MAX
A	0.170	0.210	4.32	5.33	
b	0.014	0.020	0.36	0.51	
c	0.016	0.022	0.41	0.55	
D	0.175	0.205	4.45	5.20	
E	0.125	0.165	3.18	4.19	
e	0.095	0.105	2.42	2.66	
e1	0.045	0.055	1.15	1.39	
L	0.500	0.610	12.70	15.49	
R	0.045	0.095	2.16	2.41	
S1	0.045	0.060	1.14	1.52	
alpha	4°	6°	4°	6°	
N	3		3		

REVISION HISTORY				
REV.	DESCRIPTION	DATE	APP'D	
A	DRAWING ORIGINATOR	09/23/05	JL	
B	DRAWING FORMAT MODIFICATION	08/15/06	JL	

		<b>SIPEX CORPORATION</b>	
Packaging Approval:		Drawing No: 3 PIN TO-92 PACKAGE OUTLINE	
By: JL	Date: 08/15/06	Revision: B	Sheet: 1 OF 1

## ORDERING INFORMATION

Part Number	Accuracy	Output Voltage	MSL Level	RoHS	Package	Pack Type	Quantity
SPX1004AS1-L-1-2	0.8%	1.235V	L1 @ 260°C	Yes	NSOIC8	TUBE	98
SPX1004AS1-L-1-2/TR	0.8%	1.235V	L1 @ 260°C	Yes	NSOIC8	Tape & Reel	2500
SPX1004AS2-L-1-2	0.8%	1.235V	L1 @ 260°C	Yes	NSOIC8 Alt. Pinout	TUBE	98
SPX1004AS2-L-1-2/TR	0.8%	1.235V	L1 @ 260°C	Yes	NSOIC8	Tape & Reel	2500
SPX1004S1-L-1-2	0.8%	1.235V	L1 @ 260°C	Yes	NSOIC8	TUBE	98
SPX1004S1-L-1-2/TR	0.8%	1.235V	L1 @ 260°C	Yes	NSOIC8	Tape & Reel	2500
SPX1004S2-L-1-2	0.8%	1.235V	L1 @ 260°C	Yes	NSOIC8 Alt. Pinout	TUBE	98
SPX1004S2-L-1-2/TR	0.8%	1.235V	L1 @ 260°C	Yes	NSOIC8 Alt. Pinout	Tape & Reel	2500
SPX1004AM1-L-1-2	0.8%	1.235V	L2 @ 260°C	Yes	SOT-89-3	Canister	Any
SPX1004AM1-L-1-2/TR	0.8%	1.235V	L2 @ 260°C	Yes	SOT-89-3	Tape & Reel	2500
SPX1004M-L-1-2	0.8%	1.235V	L2 @ 260°C	Yes	SOT-89-3	Canister	Any
SPX1004M-L-1-2/TR	0.8%	1.235V	L2 @ 260°C	Yes	SOT-89-3	Tape & Reel	2500
SPX1004AN-L-1-2	0.8%	1.235V	No MSL for thru hole package.	Yes	TO-92-3	BOX	Any
SPX1004AN-L-1-2/TR	0.8%	1.235V	No MSL for thru hole package.	Yes	TO-92-3	Tape & Reel	2000
SPX1004N-L-1-2	0.8%	1.235V	No MSL for thru hole package.	Yes	TO-92-3	BOX	Any
SPX1004N-L-1-2/TR	0.8%	1.235V	No MSL for thru hole package.	Yes	TO-92-3	Tape & Reel	2000
SPX1004AS1-1-2	0.8%	1.235V	L1 @ 240°C	No	NSOIC8	TUBE	98
SPX1004AS1-1-2/TR	0.8%	1.235V	L1 @ 240°C	No	NSOIC8	Tape & Reel	2500
SPX1004AS2-1-2	0.8%	1.235V	L1 @ 240°C	No	NSOIC8 Alt. Pinout	TUBE	98
SPX1004AS2-1-2/TR	0.8%	1.235V	L1 @ 240°C	No	NSOIC8 Alt. Pinout	Tape & Reel	2500
SPX1004S1-1-2	0.8%	1.235V	L1 @ 240°C	No	NSOIC8	TUBE	98
SPX1004S1-1-2/TR	0.8%	1.235V	L1 @ 240°C	No	NSOIC8	Tape & Reel	2500
SPX1004S2-1-2	0.8%	1.235V	L1 @ 240°C	No	NSOIC8 Alt. Pinout	TUBE	98
SPX1004S2-1-2/TR	0.8%	1.235V	L1 @ 240°C	No	NSOIC8 Alt. Pinout	Tape & Reel	2500
SPX1004AM1-1-2	0.8%	1.235V	L1 @ 240°C	No	SOT-89-3	Canister	Any
SPX1004AM1-1-2/TR	0.8%	1.235V	L1 @ 240°C	No	SOT-89-3	Tape & Reel	2500
SPX1004M1-1-2	0.8%	1.235V	L1 @ 240°C	No	SOT-89-3	Canister	Any
SPX1004M1-1-2/TR	0.8%	1.235V	L1 @ 240°C	No	SOT-89-3	Tape & Reel	2500
SPX1004M-1-2	0.8%	1.235V	L1 @ 240°C	No	SOT-89-3	Canister	Any
SPX1004M-1-2/TR	0.8%	1.235V	L1 @ 240°C	No	SOT-89-3	Tape & Reel	2500
SPX1004AN-1-2	0.8%	1.235V	No MSL for thru hole package.	No	TO-92-3	BOX	Any
SPX1004AN-1-2/TR	0.8%	1.235V	No MSL for thru hole package.	No	TO-92-3	Tape & Reel	2000
SPX1004N-1-2	0.8%	1.235V	No MSL for thru hole package.	No	TO-92-3	BOX	Any
SPX1004N-1-2/TR	0.8%	1.235V	No MSL for thru hole package.	No	TO-92-3	Tape & Reel	2000



## ORDERING INFORMATION (continued)

Part Number	Accuracy	Output Voltage	MSL Level	RoHS	Package	Pack Type	Quantity
SPX1004S1-L-2-5	0.8%	2.500V	L1 @ 260°C	Yes	NSOIC8	TUBE	98
SPX1004S1-L-2-5/TR	0.8%	2.500V	L1 @ 260°C	Yes	NSOIC8	Tape & Reel	2500
SPX1004S2-L-2-5	0.8%	2.500V	L1 @ 260°C	Yes	NSOIC8 Alt. Pinout	TUBE	98
SPX1004S2-L-2-5/TR	0.8%	2.500V	L1 @ 260°C	Yes	NSOIC8 Alt. Pinout	Tape & Reel	2500
SPX1004M1-L-2-5	0.8%	2.500V	L2 @ 260°C	Yes	SOT-89-3	Canister	Any
SPX1004M1-L-2-5/TR	0.8%	2.500V	L2 @ 260°C	Yes	SOT-89-3	Tape & Reel	2500
SPX1004M-L-2-5	0.8%	2.500V	L2 @ 260°C	Yes	SOT-89-3	Canister	Any
SPX1004M-L-2-5/TR	0.8%	2.500V	L2 @ 260°C	Yes	SOT-89-3	Tape & Reel	2500
SPX1004N-L-2-5	0.8%	2.500V	No MSL for thru hole package.	Yes	TO-92-3	BOX	Any
SPX1004N-L-2-5/TR	0.8%	2.500V	No MSL for thru hole package.	Yes	TO-92-3	Tape & Reel	2000
SPX1004S1-2-5	0.8%	2.500V	L1 @ 240°C	No	NSOIC8	TUBE	98
SPX1004S1-2-5/TR	0.8%	2.500V	L1 @ 240°C	No	NSOIC8	Tape & Reel	2500
SPX1004S2-2-5	0.8%	2.500V	L1 @ 240°C	No	NSOIC8 Alt. Pinout	TUBE	98
SPX1004S2-2-5/TR	0.8%	2.500V	L1 @ 240°C	No	NSOIC8 Alt. Pinout	Tape & Reel	2500
SPX1004M1-2-5	0.8%	2.500V	L1 @ 240°C	No	SOT-89-3	Canister	Any
SPX1004M1-2-5/TR	0.8%	2.500V	L1 @ 240°C	No	SOT-89-3	Tape & Reel	2500
SPX1004M-2-5	0.8%	2.500V	L1 @ 240°C	No	SOT-89-3	Canister	Any
SPX1004M-2-5/TR	0.8%	2.500V	L1 @ 240°C	No	SOT-89-3	Tape & Reel	2500
SPX1004N-2-5	0.8%	2.500V	No MSL for thru hole package.	No	TO-92-3	BOX	Any
SPX1004N-2-5/TR	0.8%	2.500V	No MSL for thru hole package.	No	TO-92-3	Tape & Reel	2000

For latest information on ordering status, go to the Sipex Web Landing Page for this product  
<http://www.sipex.com/searchResults.aspx?keywordsval=spx1004>

For further assistance:

Email: [Sipexsupport@sipex.com](mailto:Sipexsupport@sipex.com)  
 WWW Support page: <http://www.sipex.com/content.aspx?p=support>  
 Sipex Application Notes: <http://www.sipex.com/applicationNotes.aspx>



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