



SPX1004

## 1.2V / 2.5V Micropower Voltage Reference

### FEATURES

- Initial Voltage Tolerance:  
SPX1004-1.2 =  $\pm 4\text{mV}$   
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  
10 $\mu\text{A}$  to 20mA
- Direct Replacement for LT1004,  
LM1004 and AS1004



Now Available in Lead Free Packaging

### 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  $\pm 4\text{mV}$  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, SOIC-8 and TO-92 packages over the operating temperature range of 0 $^{\circ}\text{C}$  to 70 $^{\circ}\text{C}$ .

### BLOCK DIAGRAMS

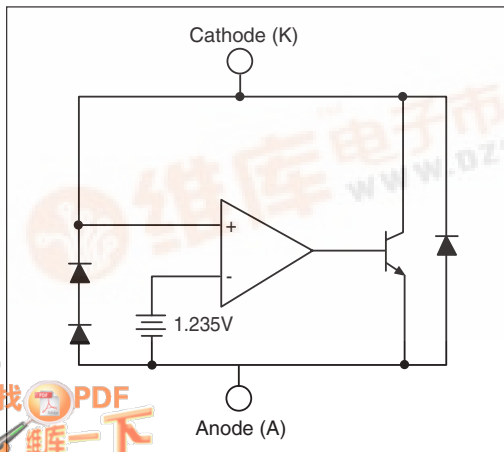


Figure 1a. SPX1004-1.2 Block Diagram

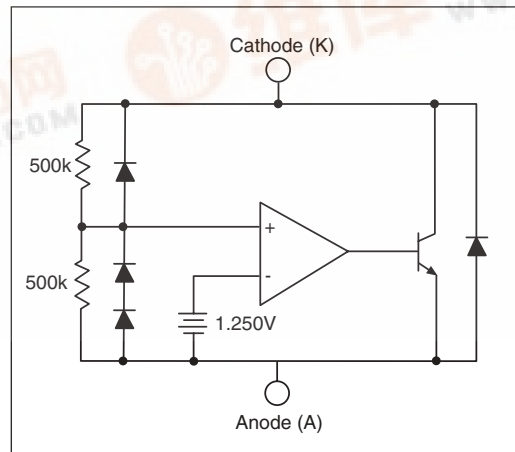


Figure 1b. SPX1004-2.5 Block Diagram



## 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
SOIC-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
SOIC-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	$I_Z=100\mu A$ , $T_J=25^\circ C$ $0^\circ C \leq T_A \leq 70^\circ C$	1.231	1.235	1.239	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
		0.5	1.5		0.5	1.5		
		6.5	10		6.5	10		
		6.5	20		6.5	20		
Reverse Dynamic Impedance	$I_Z=100\mu A$ , $f=25Hz$ over temperature	0.2	0.6		0.8	0.9		$\Omega$
		1	1.5		1.5			
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

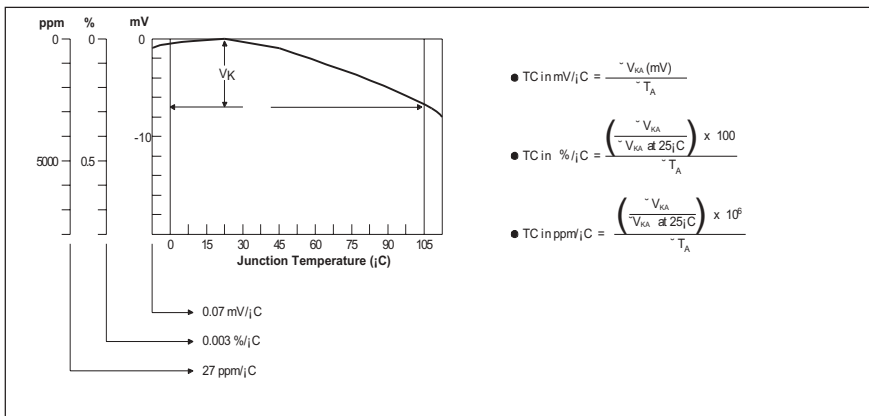


Figure 2.  $V_{REF}$  vs Temperature for 2.5V Version

## TYPICAL PERFORMANCE CHARACTERISTICS

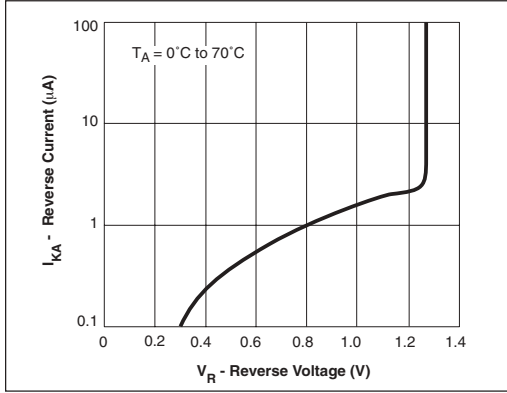


Figure 3. SPX1004-1.2V Reverse Operating Characteristic

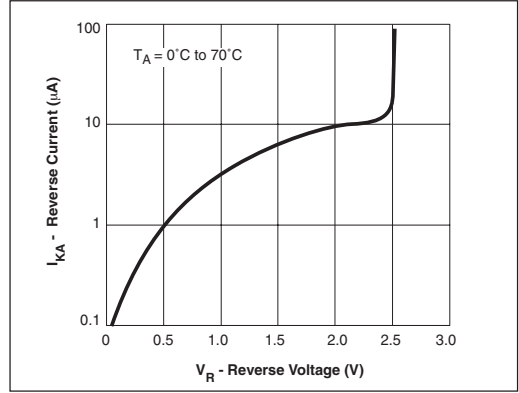


Figure 4. SPX1004-2.5V Reverse Operating Characteristic

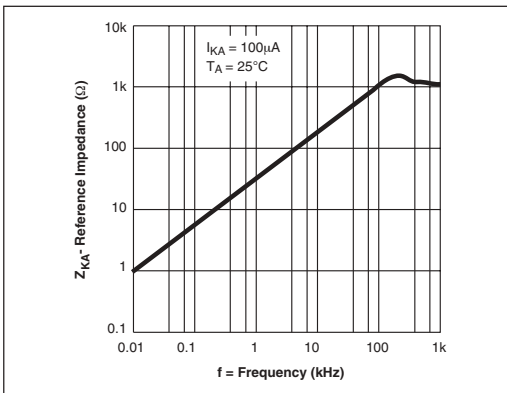


Figure 5. SPX1004-1.2V Reverse Dynamic Impedance

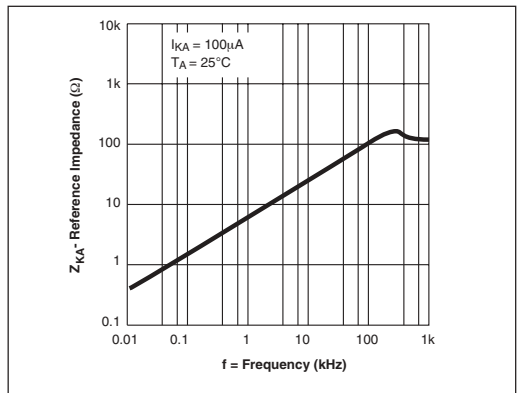


Figure 6. SPX1004-2.5V Reverse Dynamic Impedance

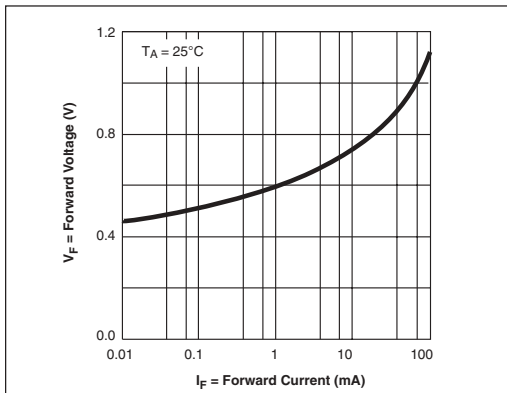


Figure 7. Forward Characteristics for SPX1004-1.2 and SPX1004-2.5

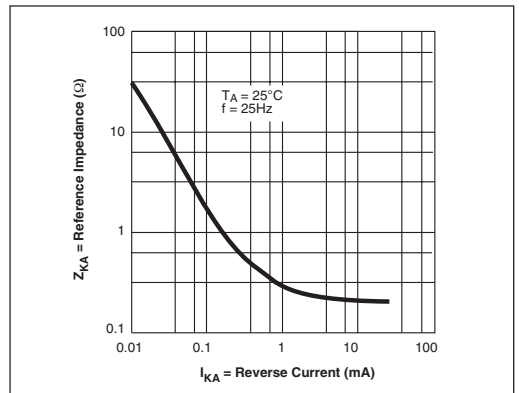


Figure 8. Low Frequency Reverse Dynamic Impedance for SPX1004-1.2

## APPLICATION CIRCUITS

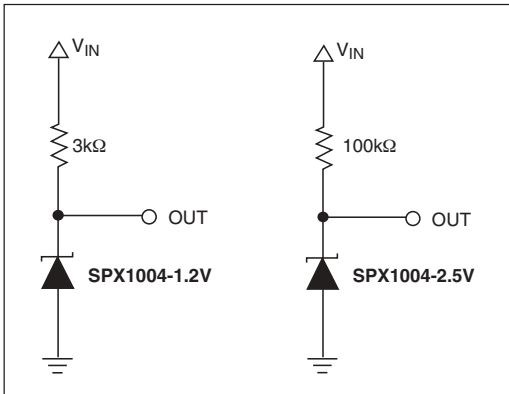


Figure 9a. 1.2V Reference, Figure 9b. 2.5V Reference

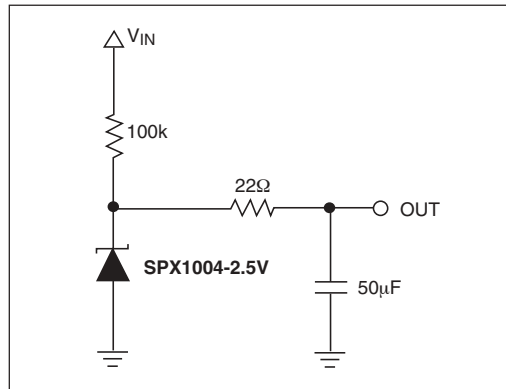


Figure 10. Low Noise Reference

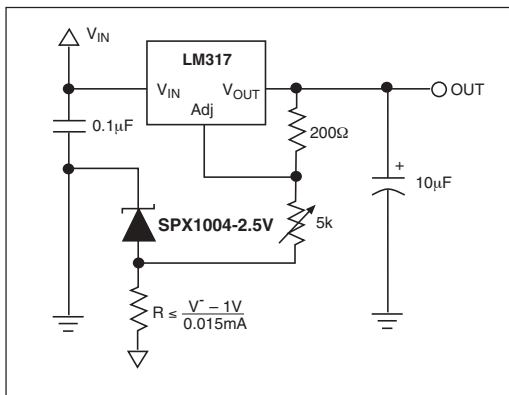


Figure 11. Variable Output Regulator

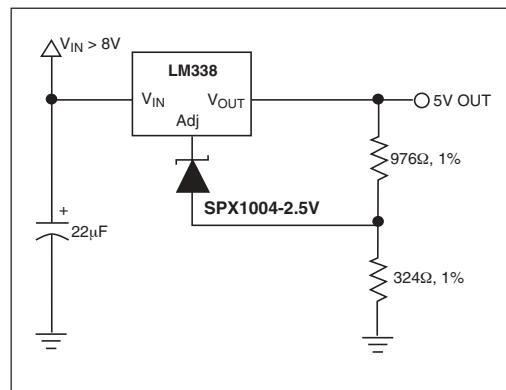


Figure 12. High Stability 5V Regulator

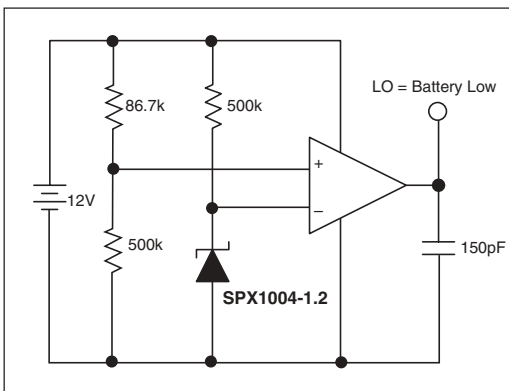


Figure 13. Low Battery Detector

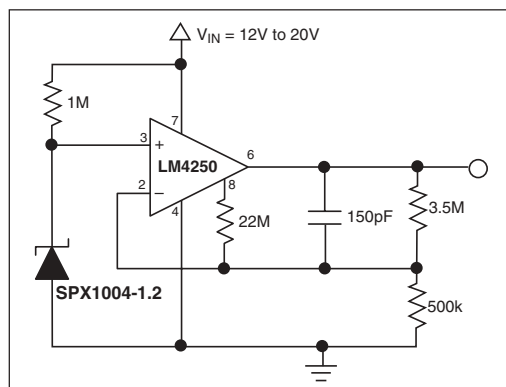
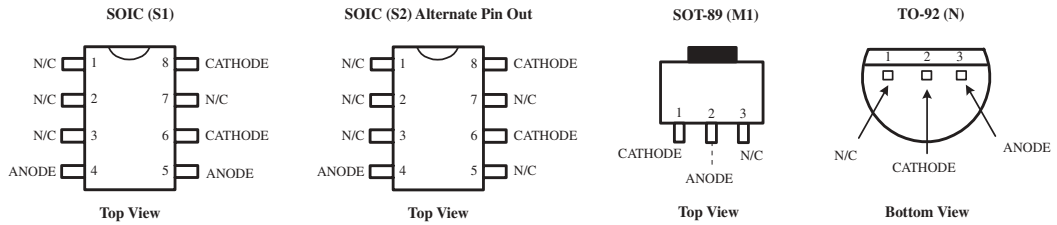


Figure 14. Micropower 10V Reference

## PACKAGE: PINOUTS



## ORDERING INFORMATION

Ordering No.	Accuracy	Output Voltage	Packages
SPX1004M1-1.2	0.3%	1.235V	3-Pin SOT-89
SPX1004M1-1.2/TR	0.3%	1.235V	3-Pin SOT-89
SPX1004S1-1.2	0.3%	1.235V	8-Pin SOIC
SPX1004S1-1.2/TR	0.3%	1.235V	8-Pin SOIC
SPX1004S2-1.2	0.3%	1.235V	8-Pin SOIC, alternate pinout
SPX1004S2-1.2/TR	0.3%	1.235V	8-Pin SOIC, alternate pinout
SPX1004N-1.2	0.3%	1.235V	3-Pin TO-92
SPX1004N-1.2/TR	0.3%	1.235V	3-Pin TO-92
SPX1004M1-2.5	0.8%	2.500V	3-Pin SOT-89
SPX1004M1-2.5/TR	0.8%	2.500V	3-Pin SOT-89
SPX1004S1-2.5	0.8%	2.500V	8-Pin SOIC
SPX1004S1-2.5/TR	0.8%	2.500V	8-Pin SOIC
SPX1004S2-2.5	0.8%	2.500V	8-Pin SOIC, alternate pinout
SPX1004S2-2.5/TR	0.8%	2.500V	8-Pin SOIC, alternate pinout
SPX1004N-2.5	0.8%	2.500V	3-Pin TO-92
SPX1004N-2.5/TR	0.8%	2.500V	3-Pin TO-92

Available in lead free packaging. To order add "-L" suffix to part number.

Example: SPX1004N-1.2/TR = standard; SPX1004N-1.2-L/TR = lead free

/TR = Tape and Reel

Pack quantity is 2,000 for TO-92,  
2500 for NSOIC and SOT-89.

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