

## LM113/LM313 Reference Diode

### General Description

The LM113/LM313 are temperature compensated, low voltage reference diodes. They feature extremely-tight regulation over a wide range of operating currents in addition to an unusually-low breakdown voltage and good temperature stability.

The diodes are synthesized using transistors and resistors in a monolithic integrated circuit. As such, they have the same low noise and long term stability as modern IC op amps. Further, output voltage of the reference depends only on highly-predictable properties of components in the IC; so they can be manufactured and supplied to tight tolerances.

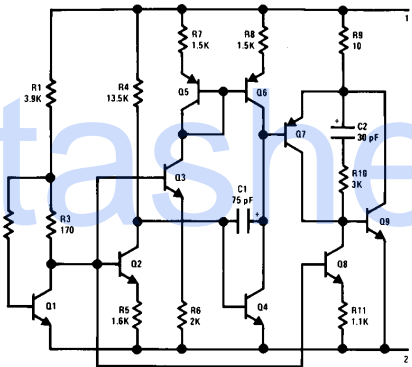
- Dynamic impedance of  $0.3\Omega$  from  $500\ \mu\text{A}$  to  $20\ \text{mA}$
- Temperature stability typically 1% over  $-55^\circ\text{C}$  to  $125^\circ\text{C}$  range (LM113),  $0^\circ\text{C}$  to  $70^\circ\text{C}$  (LM313)
- Tight tolerance:  $\pm 5\%$ ,  $\pm 2\%$  or  $\pm 1\%$

The characteristics of this reference recommend it for use in bias-regulation circuitry, in low-voltage power supplies or in battery powered equipment. The fact that the breakdown voltage is equal to a physical property of silicon—the energy-band gap voltage—makes it useful for many temperature-compensation and temperature-measurement functions.

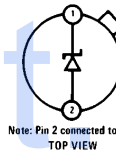
### Features

- Low breakdown voltage: 1.220V

### Schematic and Connection Diagrams



Metal Can Package

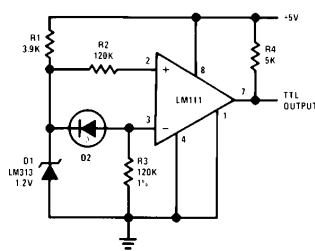


Note: Pin 2 connected to case.  
TOP VIEW  
**Order Number**  
LM113H, LM113H/883,  
LM113-1H, LM113-1H/883,  
LM113-2H, LM113-2H/883,  
or LM313H  
See NS Package Number H02A

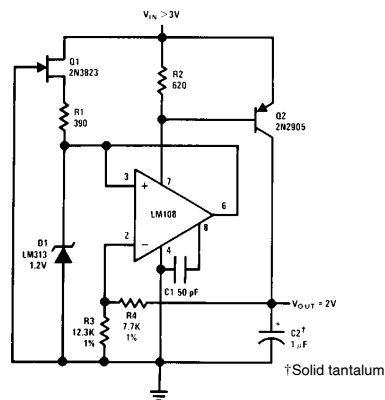
TL/H/5713-1

### Typical Applications

Level Detector for Photodiode



Low Voltage Regulator



TL/H/5713-2

## Absolute Maximum Ratings

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications. (Note 3)

Power Dissipation (Note 1)	100 mW
Reverse Current	50 mA
Forward Current	50 mA

Storage Temperature Range	-65°C to +150°C
Lead Temperature (Soldering, 10 seconds)	300°C
Operating Temperature Range LM113	-55°C to +125°C
LM313	0°C to +70°C

## Electrical Characteristics (Note 2)

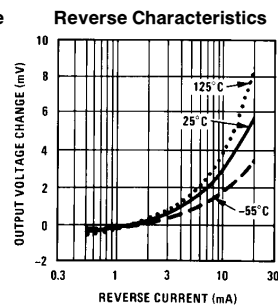
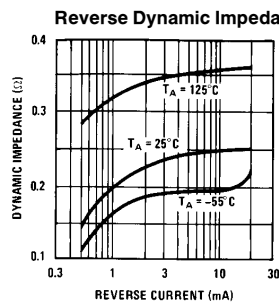
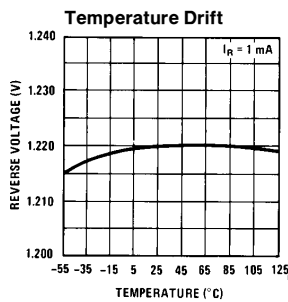
Parameter	Conditions	Min	Typ	Max	Units
Reverse Breakdown Voltage LM113/LM313 LM113-1 LM113-2	$I_R = 1 \text{ mA}$	1.160	1.220	1.280	V
		1.210	1.22	1.232	V
		1.195	1.22	1.245	V
Reverse Breakdown Voltage Change	$0.5 \text{ mA} \leq I_R \leq 20 \text{ mA}$		6.0	15	mV
Reverse Dynamic Impedance	$I_R = 1 \text{ mA}$ $I_R = 10 \text{ mA}$		0.2	1.0	$\Omega$
			0.25	0.8	$\Omega$
Forward Voltage Drop	$I_F = 1.0 \text{ mA}$		0.67	1.0	V
RMS Noise Voltage	$10 \text{ Hz} \leq f \leq 10 \text{ kHz}$ $I_R = 1 \text{ mA}$		5		$\mu\text{V}$
Reverse Breakdown Voltage Change with Current	$0.5 \text{ mA} \leq I_R \leq 10 \text{ mA}$ $T_{\text{MIN}} \leq T_A \leq T_{\text{MAX}}$			15	mV
Breakdown Voltage Temperature Coefficient	$1.0 \text{ mA} \leq I_R \leq 10 \text{ mA}$ $T_{\text{MIN}} \leq T_A \leq T_{\text{MAX}}$		0.01		%/°C

**Note 1:** For operating at elevated temperatures, the device must be derated based on a 150°C maximum junction and a thermal resistance of 80°C/W junction to case or 440°C/W junction to ambient.

**Note 2:** These specifications apply for  $T_A = 25^\circ\text{C}$ , unless stated otherwise. At high currents, breakdown voltage should be measured with lead lengths less than 1/4 inch. Kelvin contact sockets are also recommended. The diode should not be operated with shunt capacitances between 200 pF and 0.1  $\mu\text{F}$ , unless isolated by at least a 100 $\Omega$  resistor, as it may oscillate at some currents.

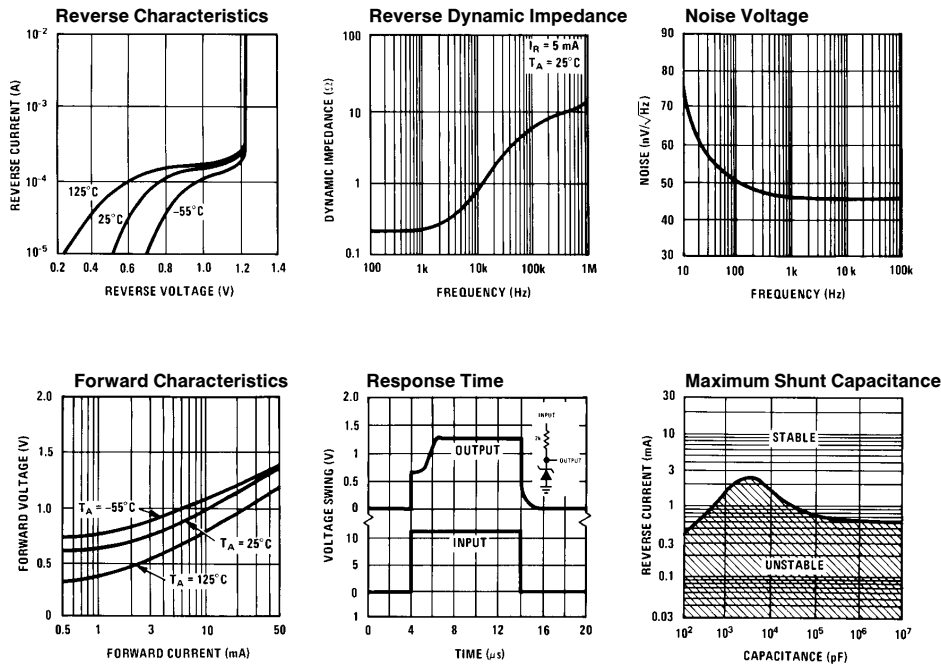
**Note 3:** Refer to the following RETS drawings for military specifications: RETS113-1X for LM113-1, RETS113-2X for LM113-2 or RETS113X for LM113.

## Typical Performance Characteristics



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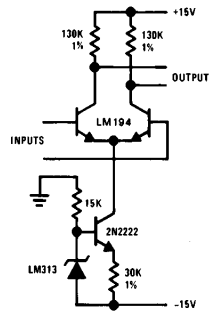
## Typical Performance Characteristics (Continued)



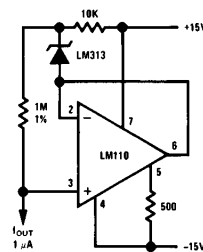
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## Typical Applications (Continued)

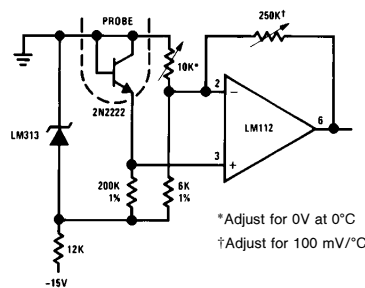
### Amplifier Biasing for Constant Gain with Temperature



### Constant Current Source

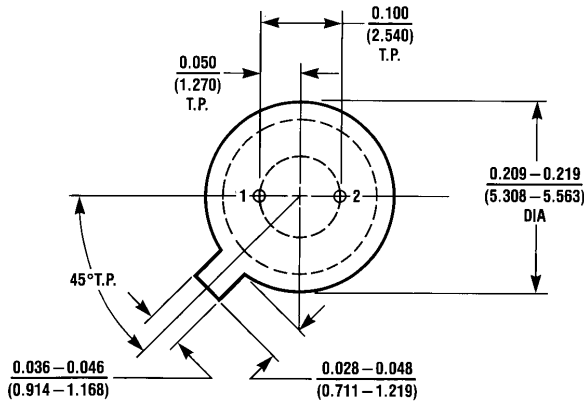
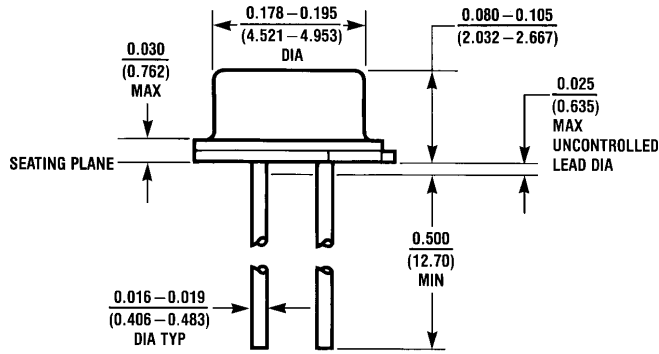


### Thermometer



TL/H/5713-5

**Physical Dimensions** inches (millimeters)



H02A (REV C)

**Order Number LM113H, LM113H/883, LM113-1H, LM113-1H/883,  
LM113-2H, LM113-2H/883 or LM313H  
NS Package Number H02A**

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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.



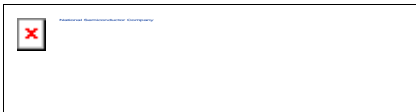
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Arlington, TX 76017  
Tel: 1(800) 272-9959  
Fax: 1(800) 737-7018

**National Semiconductor Europe**  
Fax: (+49) 0-180-530 85 86  
Email: cnjwge@tevm2.nsc.com  
Deutsch Tel: (+49) 0-180-530 85 85  
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**National Semiconductor Hong Kong Ltd.**  
13th Floor, Straight Block,  
Ocean Centre, 5 Canton Rd.  
Tsimshatsui, Kowloon  
Hong Kong  
Tel: (852) 2737-1600  
Fax: (852) 2736-9960

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## LM113 Precision Reference

Generic P/N 113

### Contents

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- [Application Notes](#)

Parametric Table	
Output Current, max (Amp)	.02
Reference Voltage	1.22 V
Initial Accuracy (+/-), max(%) (%)	5
Operating Current, (mA) (mA)	.50

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
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## Datasheet

Title	Size (in Kbytes)	Date	 View Online	 Download	 Receive via Email
LM113/LM313 Reference Diode	126 Kbytes	7-Jan-96	<a href="#">View Online</a>	<a href="#">Download</a>	<a href="#">Receive via Email</a>
LM113 Mil-Aero Datasheet MNLM113-1-X	11 Kbytes		<a href="#">View Online</a>	<a href="#">Download</a>	<a href="#">Receive via Email</a>
LM113 Mil-Aero Datasheet MNLM113-2-X	11 Kbytes		<a href="#">View Online</a>	<a href="#">Download</a>	<a href="#">Receive via Email</a>
LM113 Mil-Aero Datasheet MNLM113-X	186 Kbytes		<a href="#">View Online</a>	<a href="#">Download</a>	<a href="#">Receive via Email</a>




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## Package Availability, Models, Samples & Pricing

Part Number	Package		Status	Models		Samples & Electronic Orders	Budgetary Pricing		Std Pack Size	Package Marking
	Type	# pins		SPICE	IBIS		Quantity	\$US each		
LM113H	TO-46	2	Full production	N/A	N/A		1K+	\$6.8000	bag of 100	[logo]¢2¢T LM113H
5962-8671102XA	TO-46	2	Full production	N/A	N/A		50+	\$23.5000	tray of 20	[logo]¢Z¢S¢4¢A 8671102XA Q\$E

5962-8671101XA	TO-46	2	Full production	N/A	N/A	.	50+	\$8.0500	tray of 20	[logo]çZçSç4çA 8671101XA Q\$E
LM113WG-MPR	Ceramic SOIC	10	Full production	N/A	N/A	.			tray of N/A	çZçSç4çA LM113WG-MPRPROTO [logo] \$E
5962-9684302VXA	TO-46	2	Full production	N/A	N/A	.	50+	\$245.0000	tray of 20	[logo]çZçSç4çA 9684302VXA \$E
5962-9684301VXA	TO-46	2	Full production	N/A	N/A	.	50+	\$235.0000	tray of 20	[logo]çZçSç4çA 9684301VXA\$E
LM113WG-QML	Ceramic SOIC	10	Full production	N/A	N/A	.			tray of N/A	çZçSç4çA LM113WG-QML 9684301QZA [logo] \$E
5962-9684301VZA	Ceramic SOIC	10	Full production	N/A	N/A	.	50+	\$266.0000	tray of 54	[logo] \$E çZçSç4çA 9684301VZA
LM113 MDS	die		Full production	N/A	N/A	.			N/A	-
LM113G MW8	wafer		Full production	N/A	N/A	.			N/A	-

## Application Notes

Title	Size (in Kbytes)	Date	 View Online	 Download	 Receive via Email
<b>AN-56:</b> 1.2 Volt Reference	116 Kbytes	4-Nov-95	<a href="#">View Online</a>	<a href="#">Download</a>	<a href="#">Receive via Email</a>
<b>AN-154:</b> 1.3 Volt IC Flasher, Oscillator, Trigger or Alarm	279 Kbytes	4-Nov-95	<a href="#">View Online</a>	<a href="#">Download</a>	<a href="#">Receive via Email</a>

<b>LB-24:</b> Versatile IC PreAmplifier Makes Thermocouple Amplifier with Cold Junction Compensation	66 Kbytes	28-Jun-96	<a href="#">View Online</a>	<a href="#">Download</a>	<a href="#">Receive via Email</a>
<b>AN-110:</b> Application Note 110 Fast IC Power Transistor with Thermal Protection	333 Kbytes	1-May-98	<a href="#">View Online</a>	<a href="#">Download</a>	<a href="#">Receive via Email</a>
<b>LB-21:</b> Instrumentational Amplifiers	61 Kbytes	28-Jun-96	<a href="#">View Online</a>	<a href="#">Download</a>	<a href="#">Receive via Email</a>
<b>AN-178:</b> Applications for an Adjustable IC Power Regulator	95 Kbytes	4-Nov-95	<a href="#">View Online</a>	<a href="#">Download</a>	<a href="#">Receive via Email</a>
<b>AN-222:</b> Application Note 222 Super Matched Bipolar Transistor Pair Sets New Standards for Drift and Noise	399 Kbytes	24-Feb-99	<a href="#">View Online</a>	<a href="#">Download</a>	<a href="#">Receive via Email</a>
<b>LB-28:</b> Linear Brief 28 General Purpose Power Supply	69 Kbytes	1-May-98	<a href="#">View Online</a>	<a href="#">Download</a>	<a href="#">Receive via Email</a>
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