

December 1994

## 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.

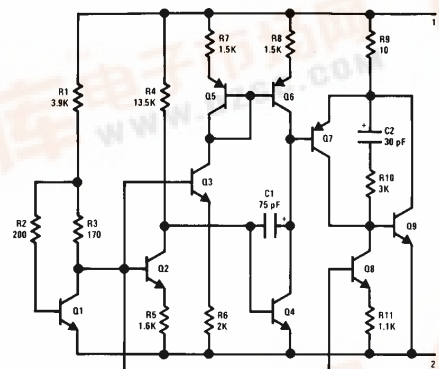
- Dynamic impedance of  $0.3\Omega$  from  $500\mu\text{A}$  to  $20\text{mA}$
- Temperature stability typically 1% over  $-55^\circ\text{C}$  to  $125^\circ\text{C}$  range (LM113),  $0^\circ\text{C}$  to  $70^\circ\text{C}$  (LM313)
- Tight tolerance:  $\pm 5\%$ ,  $\pm 2\%$  or  $\pm 1\%$

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.

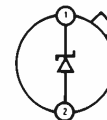
### Features

- Low breakdown voltage: 1.220V

### Schematic and Connection Diagrams



Metal Can Package



Note: Pin 2 connected to case.  
TOP VIEW

#### Order Number

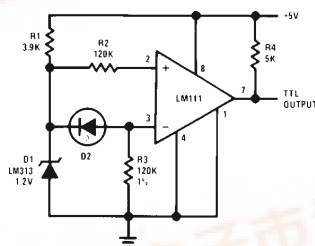
LM113H, LM113H/883,  
LM113-1H, LM113-1H/883,  
LM113-2H, LM113-2H/883,  
or LM313H

See NS Package Number H02A

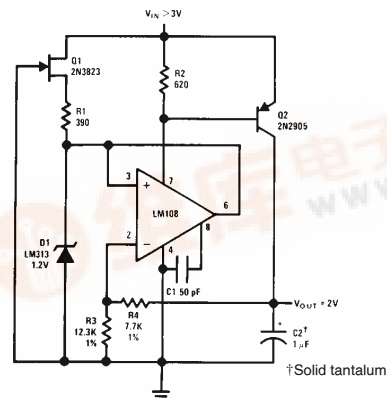
TL/H/5713-1

### 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)

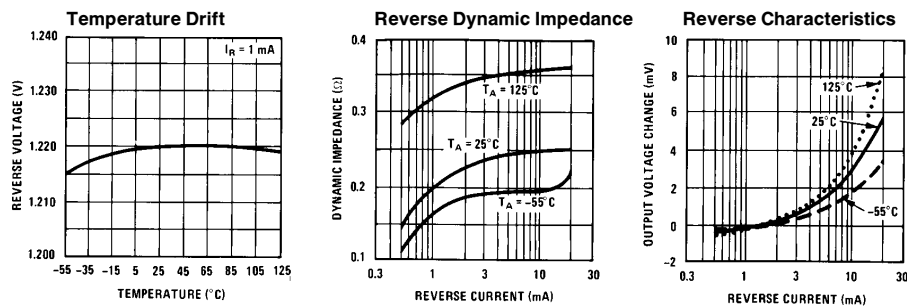
Parameter	Conditions	Min	Typ	Max	Units
Reverse Breakdown Voltage LM113/LM313	$I_R = 1 \text{ mA}$	1.160	1.220	1.280	V
LM113-1		1.210	1.22	1.232	V
LM113-2		1.195	1.22	1.245	V
Reverse Breakdown Voltage Change	$0.5 \text{ mA} \leq I_R \leq 20 \text{ mA}$		6.0	15	mV
Reverse Dynamic Impedance	$I_R = 1 \text{ mA}$		0.2	1.0	$\Omega$
	$I_R = 10 \text{ mA}$		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.

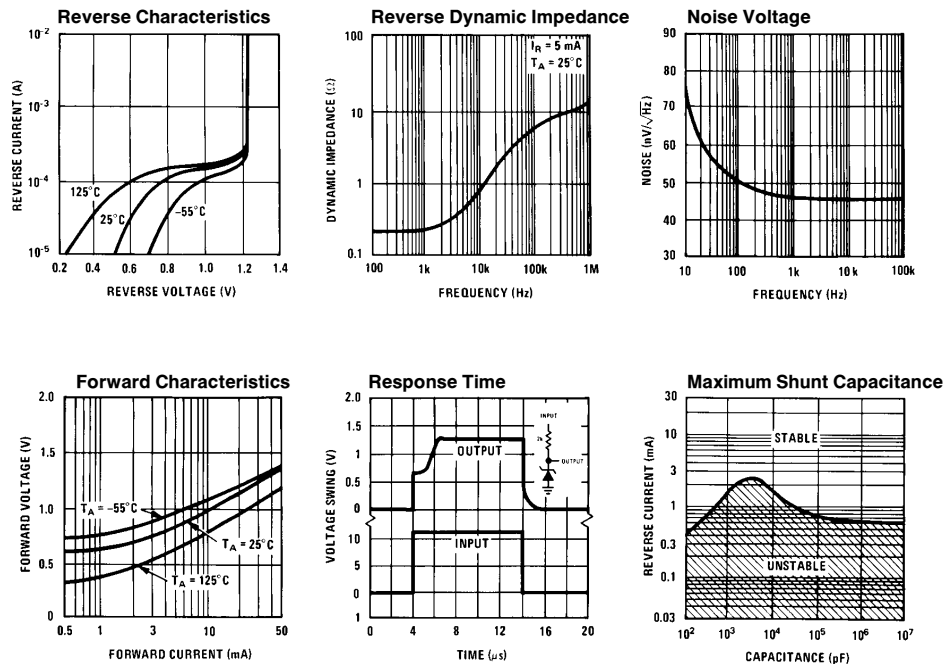
**Note 3:** Refer to the following RETS drawings for military specifications: RETS113-1X for LM113-1, RETS113-2X for LM113-2 or RETS113X for LM113.

## Typical Performance Characteristics



TL/H/5713-3

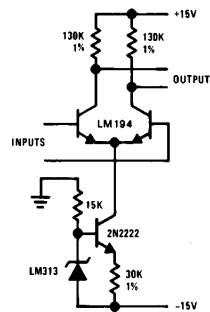
## Typical Performance Characteristics (Continued)



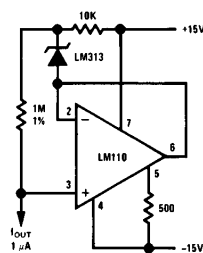
TL/H/5713-4

## Typical Applications (Continued)

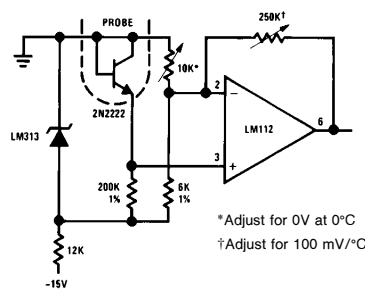
### Amplifier Biasing for Constant Gain with Temperature



### Constant Current Source

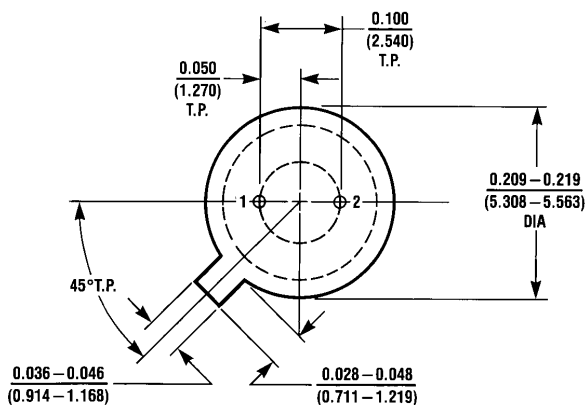
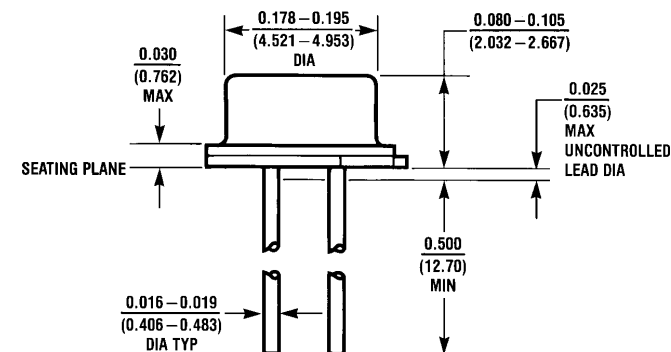


### Thermometer



\*Adjust for 0V at  $0^\circ\text{C}$   
†Adjust for 100 mV/ $^\circ\text{C}$

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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