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National Semiconductor

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.

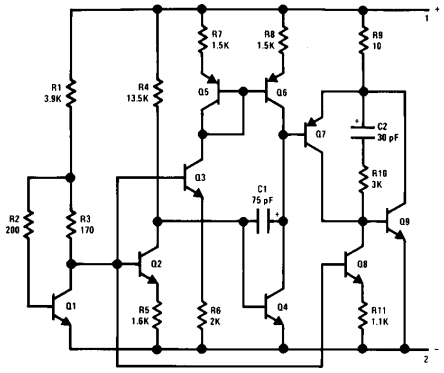
- Dynamic impedance of 0.3Ω from 500 μA to 20 mA
- Temperature stability typically 1% over −55°C to 125°C range (LM113), 0°C to 70°C (LM313)
- Tight tolerance: ±5%, ±2% or ±1%

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.

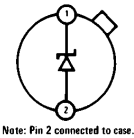
Features

- Low breakdown voltage: 1.220V

Schematic and Connection Diagrams



Metal Can Package



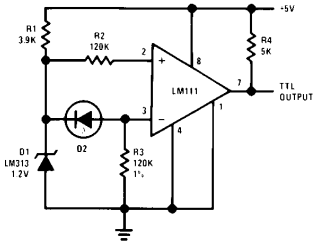
Note: Pin 2 connected to case.
TOP VIEW

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

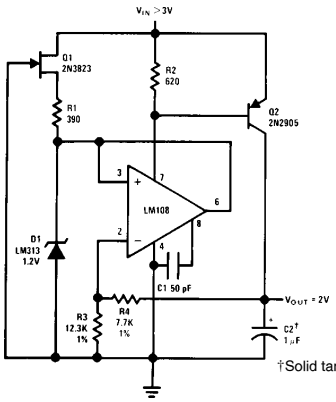
TL/H/5713–1

Typical Applications

Level Detector for Photodiode



Low Voltage Regulator



†Solid tantalum.

TL/H/5713–2

RRD-B30M115/Printed in U. S. A.

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 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 mA ≤ I_R ≤ 20 mA		6.0	15	mV
Reverse Dynamic Impedance	I_R = 1 mA		0.2	1.0	Ω
	I_R = 10 mA		0.25	0.8	Ω
Forward Voltage Drop	I_F = 1.0 mA		0.67	1.0	V
RMS Noise Voltage	10 Hz ≤ f ≤ 10 kHz, I_R = 1 mA		5		μV
Reverse Breakdown Voltage Change with Current	0.5 mA ≤ I_R ≤ 10 mA, T_{MIN} ≤ T_A ≤ T_{MAX}			15	mV
Breakdown Voltage Temperature Coefficient	1.0 mA ≤ I_R ≤ 10 mA, T_{MIN} ≤ T_A ≤ T_{MAX}		0.01		%/°C

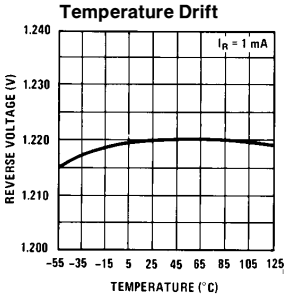
Note 1: For operating at elevated temperatures, the device must be derated based on a 150°C maximum junction and a thermal resistance of 80°C/W junction to case or 440°C/W junction to ambient.

Note 2: These specifications apply for T_A = 25°C, unless stated otherwise. At high currents, breakdown voltage should be measured with lead lengths less than ¼ inch. Kelvin contact sockets are also recommended. The diode should not be operated with shunt capacitances between 200 pF and 0.1 μF, unless isolated by at least a 100Ω resistor, as it may oscillate at some currents.

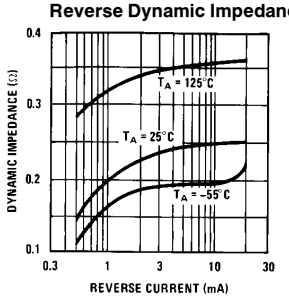
Note 3: Refer to the following RETS drawings for military specifications: RETS113-1X for LM113-1, RETS113-2X for LM113-2 or RETS113X for LM113.

Typical Performance Characteristics

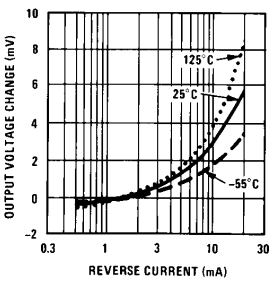
Temperature Drift



Reverse Dynamic Impedance



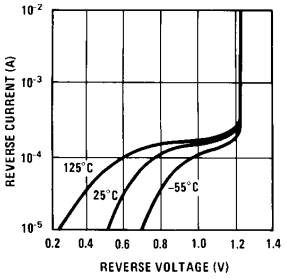
Reverse Characteristics



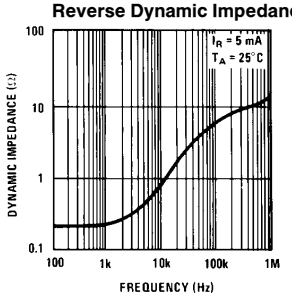
TL/H/5713–3

Typical Performance Characteristics (Continued)

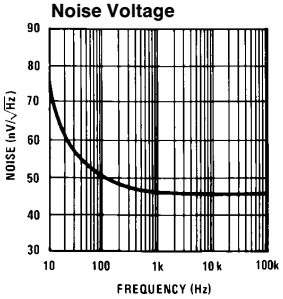
Reverse Characteristics



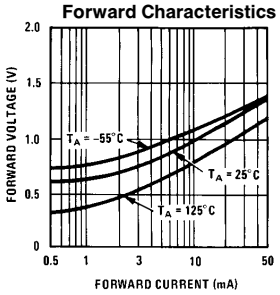
Reverse Dynamic Impedance



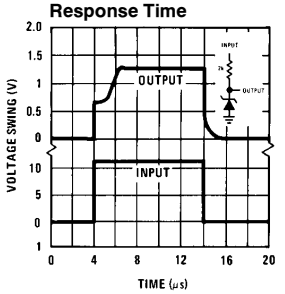
Noise Voltage



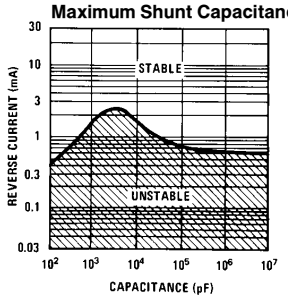
Forward Characteristics



Response Time



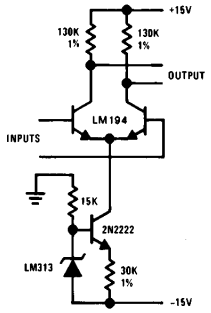
Maximum Shunt Capacitance



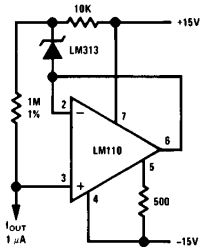
TL/H/5713–4

Typical Applications (Continued)

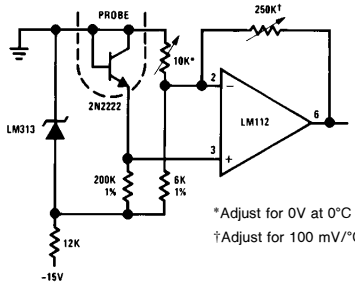
Amplifier Biasing for Constant Gain with Temperature



Constant Current Source



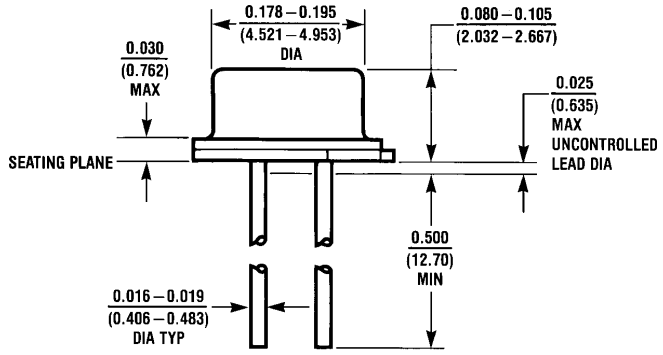
Thermometer

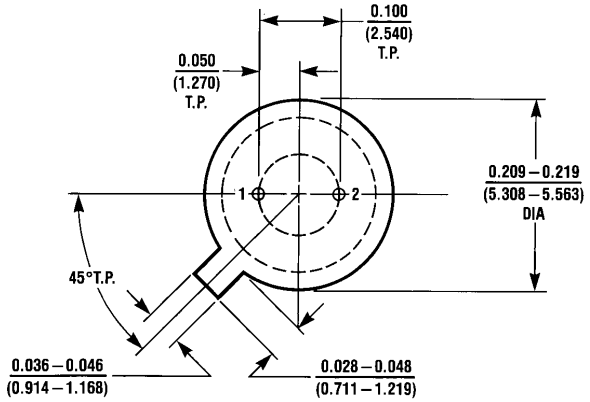


*Adjust for 0V at 0°C
†Adjust for 100 mV/°C

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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