

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.

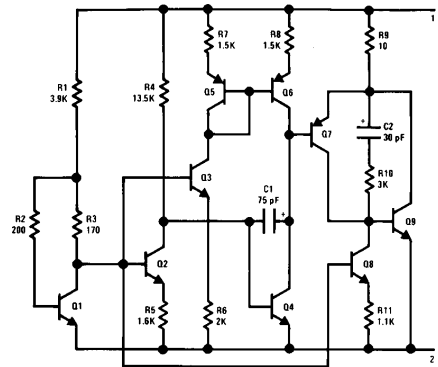
- Dynamic impedance of 0.3Ω from $500\ \mu\text{A}$ to $20\ \text{mA}$
- Temperature stability typically 1% over -55°C to 125°C range (LM113), 0°C to 70°C (LM313)
- Tight tolerance: $\pm 5\%$, $\pm 2\%$ or $\pm 1\%$

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.

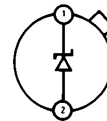
Features

- Low breakdown voltage: 1.220V

Schematic and Connection Diagrams



Metal Can Package



Note: Pin 2 connected to case.
TOP VIEW

Order Number

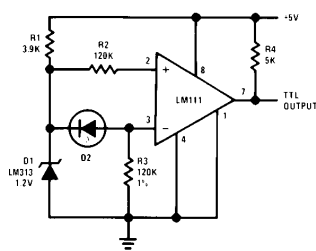
LM113H, LM113H/883,
LM113-1H, LM113-1H/883,
LM113-2H, LM113-2H/883,
or LM313H

See NS Package Number H02A

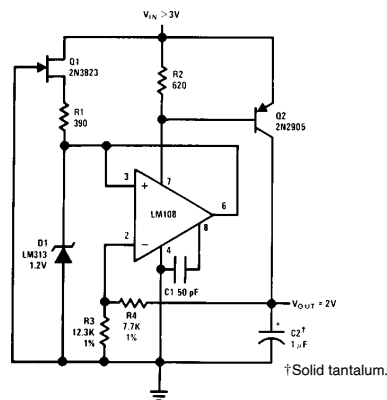
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Typical Applications

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)

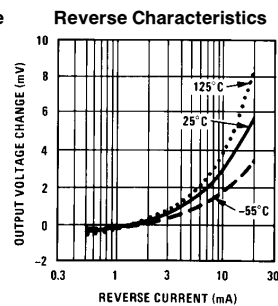
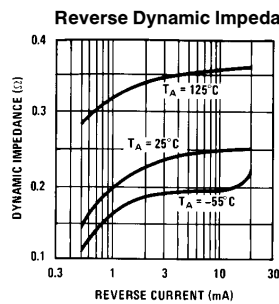
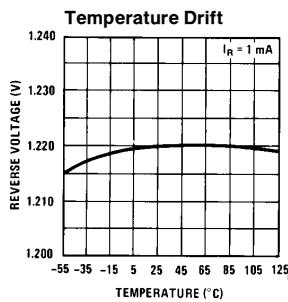
| Parameter | Conditions | Min | Typ | Max | Units |
|--|---|-------|-------|-------|---------------|
| Reverse Breakdown Voltage LM113/LM313 LM113-1 LM113-2 | $I_R = 1 \text{ mA}$ | 1.160 | 1.220 | 1.280 | V |
| | | 1.210 | 1.22 | 1.232 | V |
| | | 1.195 | 1.22 | 1.245 | V |
| Reverse Breakdown Voltage 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 | Ω |
| | | | 0.25 | 0.8 | Ω |
| 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 | | μV |
| 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 μF , unless isolated by at least a 100 Ω resistor, as it may oscillate at some currents.

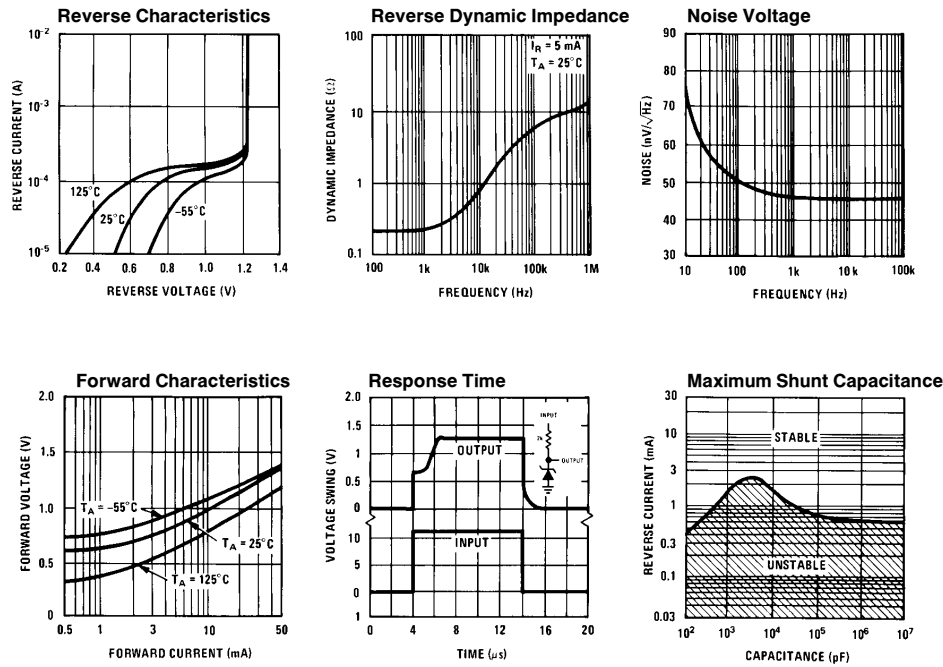
Note 3: Refer to the following RETS drawings for military specifications: RETS113-1X for LM113-1, RETS113-2X for LM113-2 or RETS113X for LM113.

Typical Performance Characteristics



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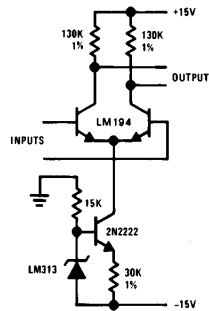
Typical Performance Characteristics (Continued)



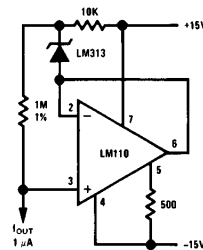
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Typical Applications (Continued)

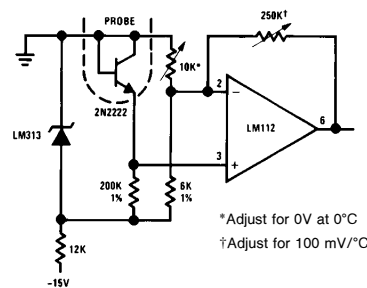
Amplifier Biasing for Constant Gain with Temperature



Constant Current Source

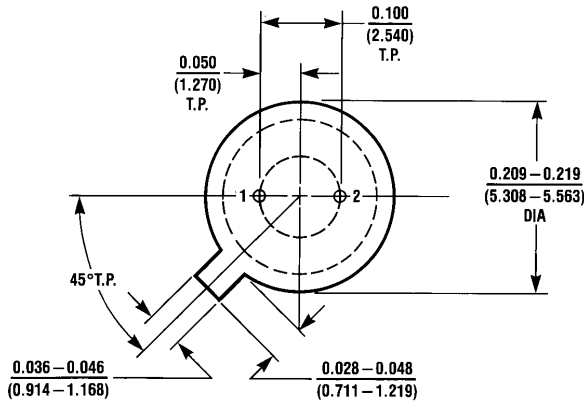
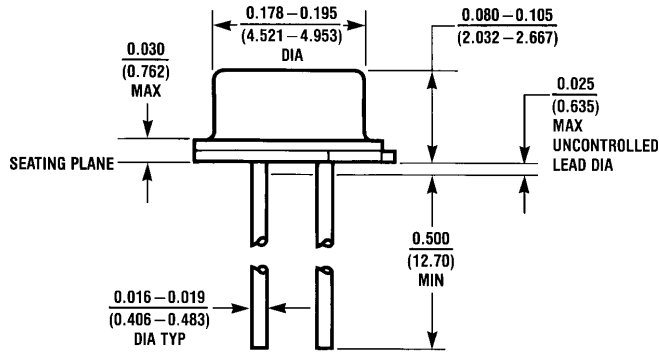


Thermometer



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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