LM113/LM313 Reference Diode

Check for Samples: LM113, LM313

FEATURES

- **Low Breakdown Voltage: 1.220V**
- **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.

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.

Schematic and Connection Diagram

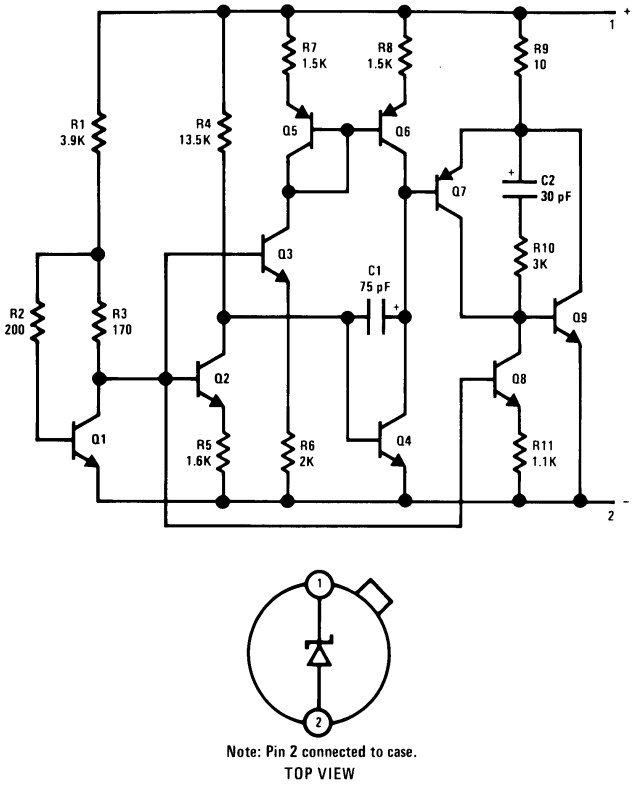

Figure 1. Metal Can Package
See Package Number NDU

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Typical Applications

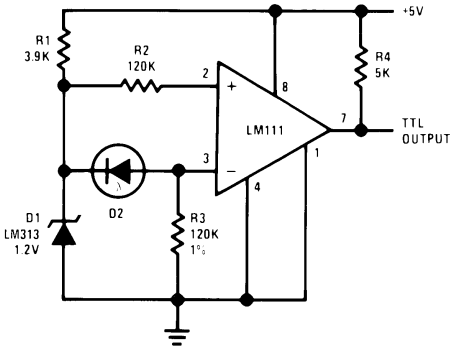
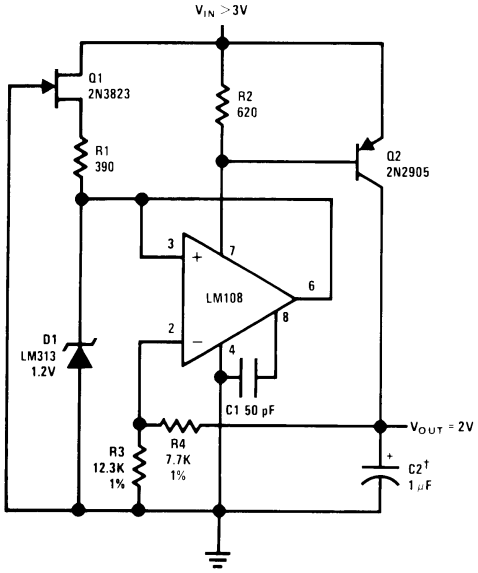


Figure 2. Level Detector for Photodiode



†Solid tantalum.

Figure 3. Low Voltage Regulator

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These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

Absolute Maximum Ratings (1)(2)

Power Dissipation (3)		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

(1) Refer to the following RETS drawings for military specifications: RETS113-1X for LM113-1, RETS113-2X for LM113-2 or RETS113X for LM113.
(2) If Military/Aerospace specified devices are required, please contact the Texas Instruments Sales Office/Distributors for availability and specifications.
(3) 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.

Electrical Characteristics (1)

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

(1) 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.

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Typical Performance Characteristics

Temperature Drift

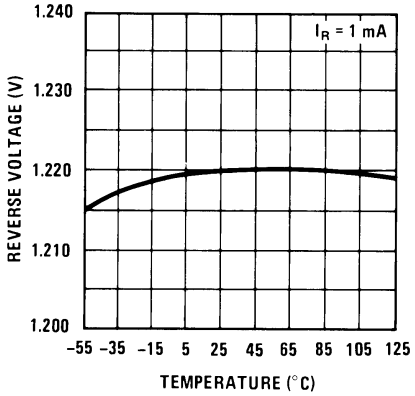

Figure 4.

Reverse Dynamic Impedance

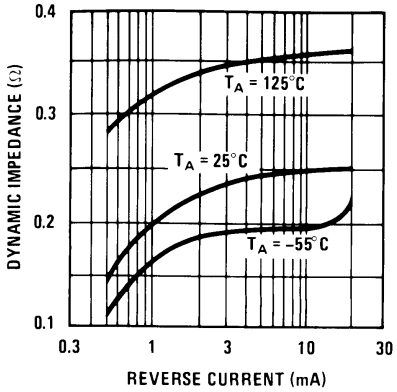

Figure 5.

Reverse Characteristics

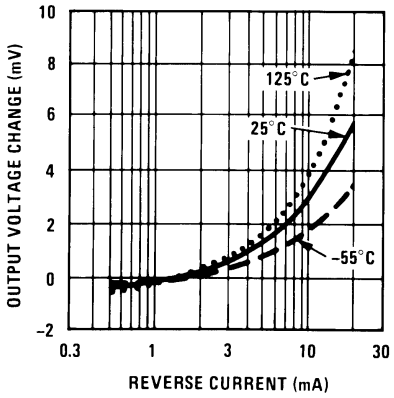

Figure 6.

Reverse Characteristics

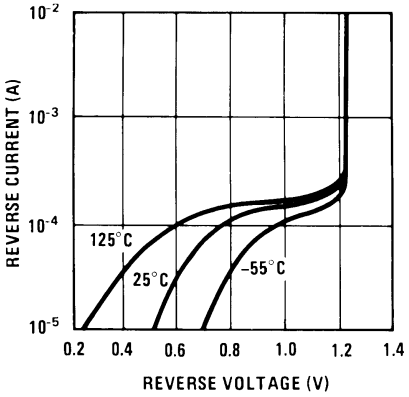

Figure 7.

Reverse Dynamic Impedance

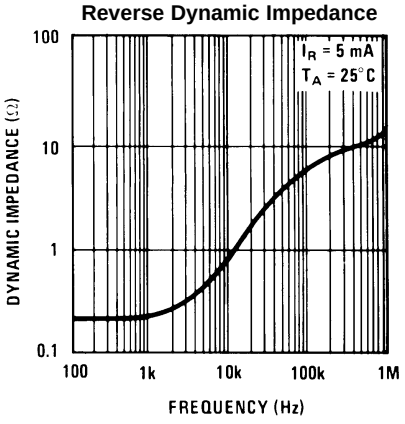

Figure 8.

Noise Voltage

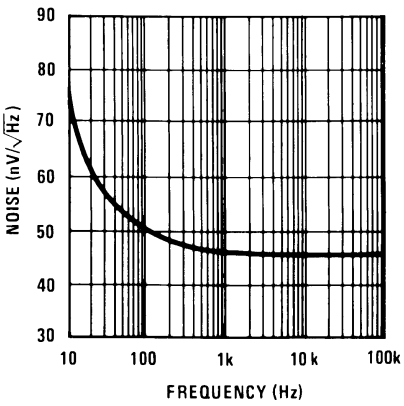

Figure 9.

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Typical Performance Characteristics (continued)

Forward Characteristics

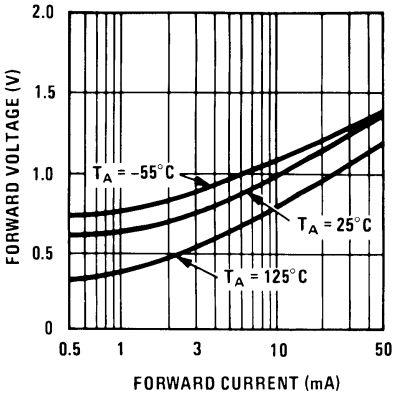


Figure 10.

Response Time

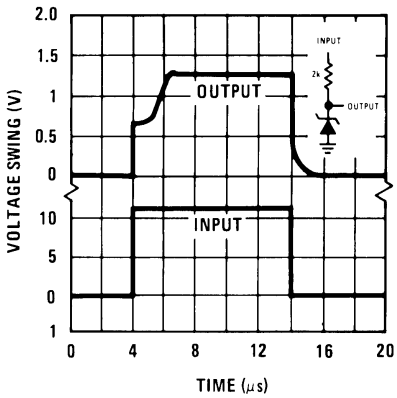


Figure 11.

Maximum Shunt Capacitance

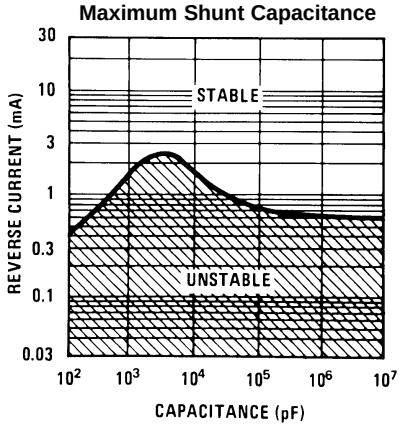


Figure 12.

TYPICAL APPLICATIONS

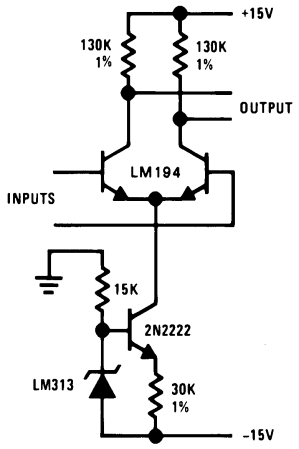


Figure 13. Amplifier Biasing for Constant Gain with Temperature

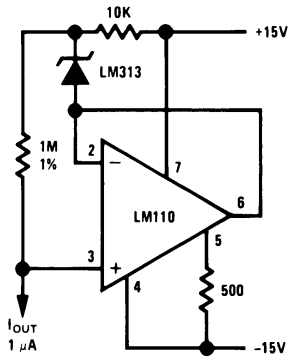
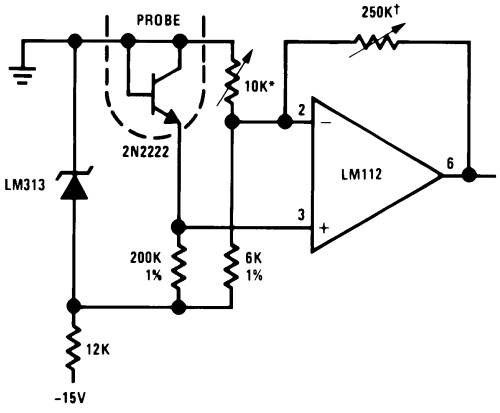


Figure 14. Constant Current Source



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

Figure 15. Thermometer

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REVISION HISTORY

Changes from Original (May 2013) to Revision A	Page
• Changed layout of National Data Sheet to TI format	6

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PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
LM113H	OBSOLETE	TO	NDU	2		TBD	Call TI	Call TI	-55 to 125	LM113H	
LM113H/NOPB	OBSOLETE	TO	NDU	2		TBD	Call TI	Call TI	-55 to 125	LM113H	

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

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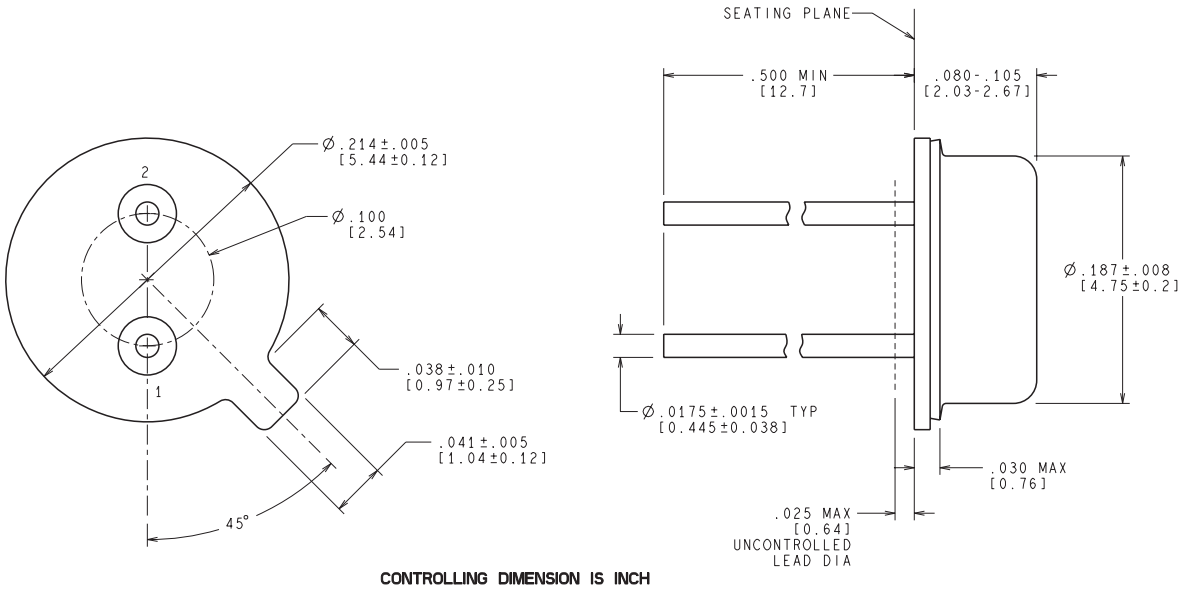

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