

## LM113QML Reference Diode

Check for Samples: [LM113QML](#)

### FEATURES

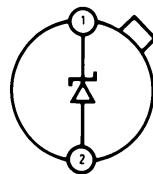
- **Low Breakdown Voltage:** 1.220V
- **Dynamic Impedance of 0.3Ω** from 500  $\mu$ A to 20 mA
- **Temperature Stability Typically 1% over –55°C to 125°C Range**
- **Tight Tolerance:  $\pm 5\%$  or  $\pm 1\%$** 
  - The characteristics of this reference recommend it for use in bias-regulation circuitry, 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.

### DESCRIPTION

The LM113 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.

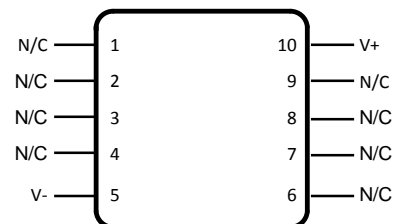
The diodes are synthesized using transistors and resistors in a monolithic integrated circuit. As such, they have the same low noise and long term stability as modern IC op amps. Further, output voltage of the reference depends only on highly-predictable properties of components in the IC; so they can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

### Connection Diagrams



Note: Pin 2 connected to case.  
TOP VIEW

**Figure 1. 2-Pin PFM**  
See NDU0002A Package



**Figure 2. 10-Pin CLGA**  
See NAC0010A Package



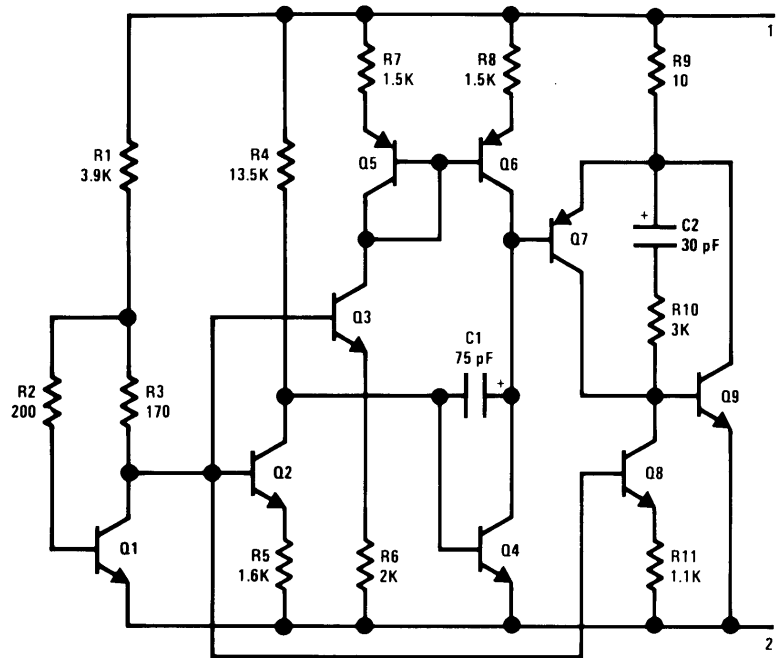
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## Schematic Diagram



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<sup>(1)</sup>

Power Dissipation <sup>(2)</sup>			100 mW
Reverse Current			50 mA
Forward Current			50 mA
Storage Temperature Range			-65°C ≤ T <sub>A</sub> ≤ +150°C
Lead Temperature (Soldering, 10 seconds)			300°C
Maximum Junction Temperature (T <sub>Jmax</sub> )			+150°C
Operating Temperature Range			-55°C ≤ T <sub>A</sub> ≤ +125°C
Thermal Resistance	θ <sub>JA</sub>	PFM (Still Air)	440°C/W
		PFM (500LF / Min Air Flow)	TBD
		CLGA (Still Air)	218°C/W
		CLGA (500LF / Min Air Flow)	140°C/W
	θ <sub>JC</sub>	PFM	80°C/W
		CLGA	27°C/W
Package Weight		PFM	275mg
		CLGA	220mg
ESD Tolerance <sup>(3)</sup>			4000V

- (1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not ensure specific performance limits. For ensured specifications and test conditions, see the Electrical Characteristics. The ensured specifications apply only for the test conditions listed. Some performance characteristics may degrade when the device is not operated under the listed test conditions.
- (2) The maximum power dissipation must be derated at elevated temperatures and is dictated by T<sub>Jmax</sub> (maximum junction temperature), θ<sub>JA</sub> (package junction to ambient thermal resistance), and T<sub>A</sub> (ambient temperature). The maximum allowable power dissipation at any temperature is P<sub>Dmax</sub> = (T<sub>Jmax</sub> - T<sub>A</sub>)/θ<sub>JA</sub> or the number given in the Absolute Maximum Ratings, whichever is lower.
- (3) Human body model, 1.5KΩ in series with 100pF.

**Table 1. QUALITY CONFORMANCE**

Mil-Std-883, Method 5005 - Group A		
Subgroup	Description	Temp (°C)
1	Static tests at	+25
2	Static tests at	+125
3	Static tests at	-55
4	Dynamic tests at	+25
5	Dynamic tests at	+125
6	Dynamic tests at	-55
7	Functional tests at	+25
8A	Functional tests at	+125
8B	Functional tests at	-55
9	Switching tests at	+25
10	Switching tests at	+125
11	Switching tests at	-55
12	Settling time at	+25
13	Settling time at	+125
14	Settling time at	-55

**LM113 ELECTRICAL CHARACTERISTICS DC PARAMETERS**

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
$V_{ZR}$	Zener Voltage	$I_R = 1\text{ mA}$		1.16	1.28	V	1
				1.157	1.283	V	2, 3
$\Delta V_{ZR}$	Delta Zener Voltage	$0.5\text{mA} \leq I_R \leq 20\text{mA}$			15	mV	1
		$0.5\text{mA} \leq I_R \leq 10\text{mA}$			15	mV	2, 3
$V_F$	Forward Voltage Drop	$I_F = 1\text{mA}$			1.0	V	1, 2, 3
$R_R$	Reverse Dynamic Impedance	$I_R = 1\text{mA}$	See <sup>(1)</sup>		1.0	$\Omega$	4
		$I_R = 10\text{mA}$			0.8	$\Omega$	4

(1) Specified parameter, not tested.

**LM113 ELECTRICAL CHARACTERISTICS DC DRIFT PARAMETERS**

Delta Calculations performed on QMLV devices at Group B, Subgroup 5, only.

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
$V_{ZR}$	Zener Voltage	$I_R = 1\text{mA}$		-0.02	0.02	V	1

**LM113-1 ELECTRICAL CHARACTERISTICS DC PARAMETERS**

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
$V_{ZR}$	Zener Voltage	$I_R = 1 \text{ mA}$		1.210	1.232	V	1
				1.206	1.234	V	2, 3
$\Delta V_{ZR}$	Delta Zener Voltage	$0.5\text{mA} \leq I_R \leq 20\text{mA}$			15	mV	1
		$0.5\text{mA} \leq I_R \leq 10\text{mA}$			15	mV	2, 3
$V_F$	Forward Voltage Drop	$I_F = 1\text{mA}$			1.0	V	1, 2, 3
$R_R$	Reverse Dynamic Impedance	$I_R = 1\text{mA}$	See <sup>(1)</sup>		1.0	$\Omega$	4
		$I_R = 10\text{mA}$			0.8	$\Omega$	4

(1) Specified parameter, not tested.

**LM113-1 Electrical Characteristics DC Drift Parameters**

Delta Calculations performed on QMLV devices at Group B, Subgroup 5, only.

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
$V_{ZR}$	Zener Voltage	$I_R = 1\text{mA}$		-0.02	0.02	V	1

## TYPICAL PERFORMANCE CHARACTERISTICS

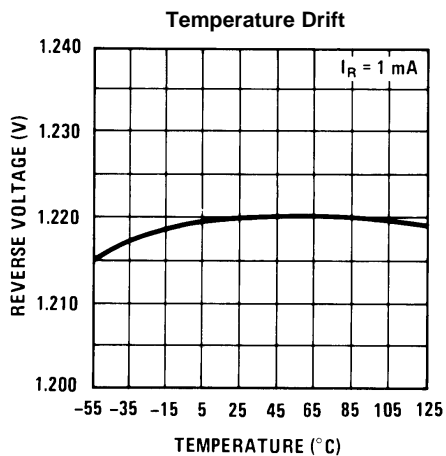


Figure 3.

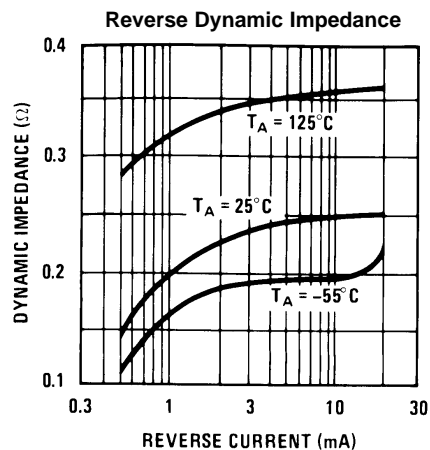


Figure 4.

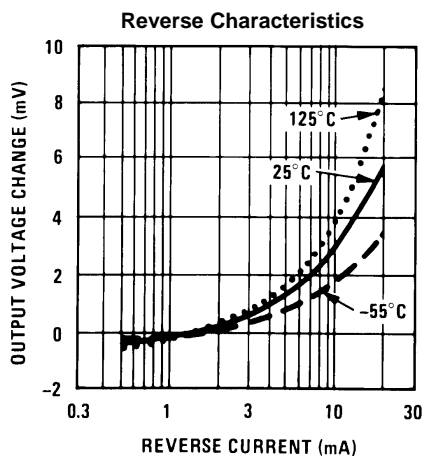


Figure 5.

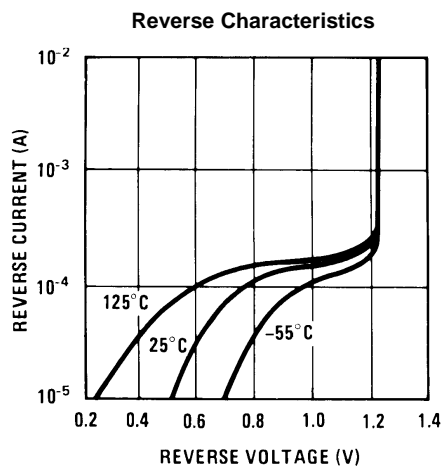


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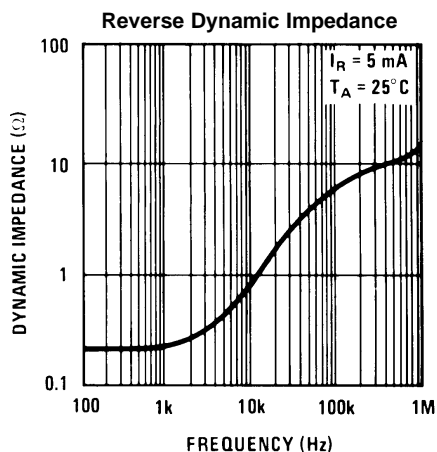


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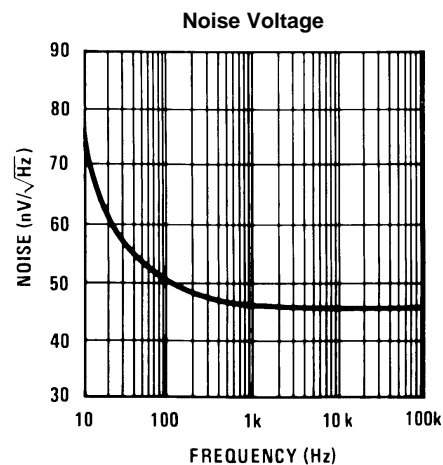


Figure 8.

## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

### Forward Characteristics

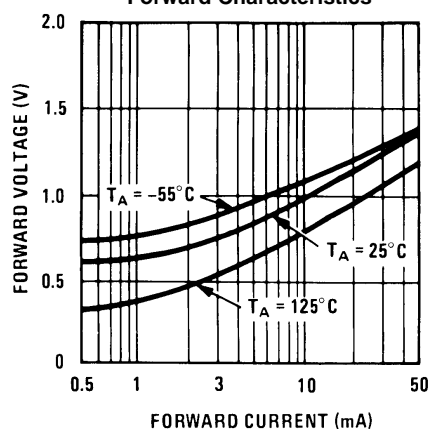


Figure 9.

### Response Time

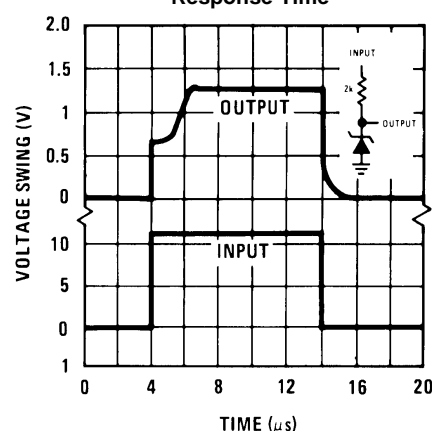


Figure 10.

### Maximum Shunt Capacitance

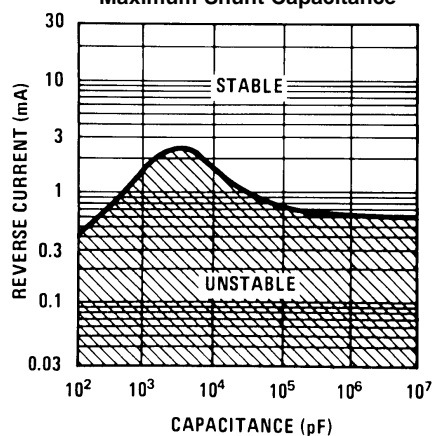


Figure 11.

## TYPICAL APPLICATIONS

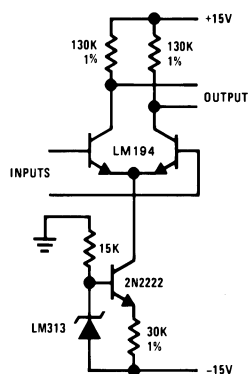


Figure 12. Amplifier Biasing for Constant Gain with Temperature

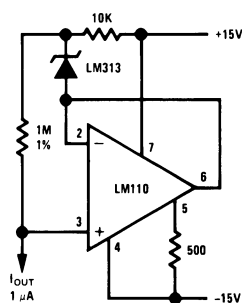
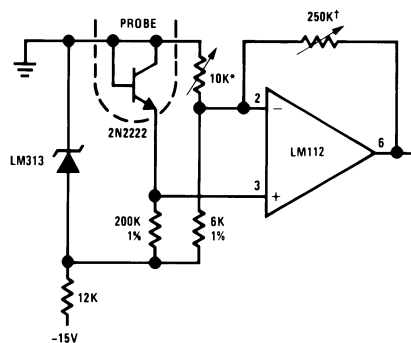


Figure 13. Constant Current Source



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

Figure 14. Thermometer

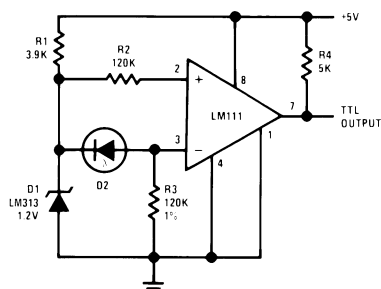
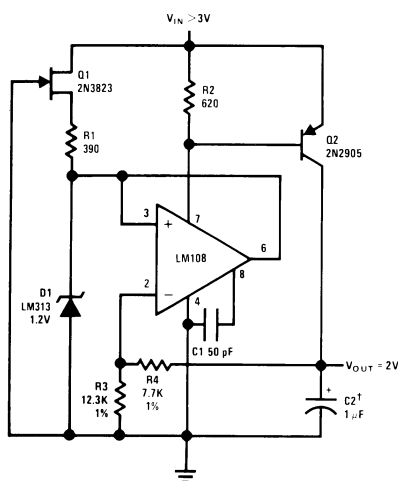


Figure 15. Level Detector for Photodiode



†Solid tantalum.

Figure 16. Low Voltage Regulator



**REVISION HISTORY**

Released	Revision	Section	Changes
12/16/2010	A	New release to corporate format	2 MDS data sheets converted into one Corp. data sheet format. MDSs MNLM113-X Rev 1C1 and MNLM113-1-X Rev. 2A1 will be archived.

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