FEATURES

- Low Drift—20ppm/°C Max Slope*
- Trimmed Output Voltage*
- Operates in Series or Shunt Mode
- Output Sinks and Sources in Series Mode
- Very Low Noise <1ppm p-p (0.1Hz to 10Hz)
- >100dB Ripple Rejection
- Minimum Input-Output Differential of 1V
- 100% Noise Tested

APPLICATIONS

- A to D and D to A Converters
- Precision Regulators
- Digital Voltmeters
- Inertial Navigation Systems
- Precision Scales
- Portable Reference Standard

*Units specified at 10ppm/°C maximum drift and 0.1% output voltage tolerance are available on request.

DESCRIPTION

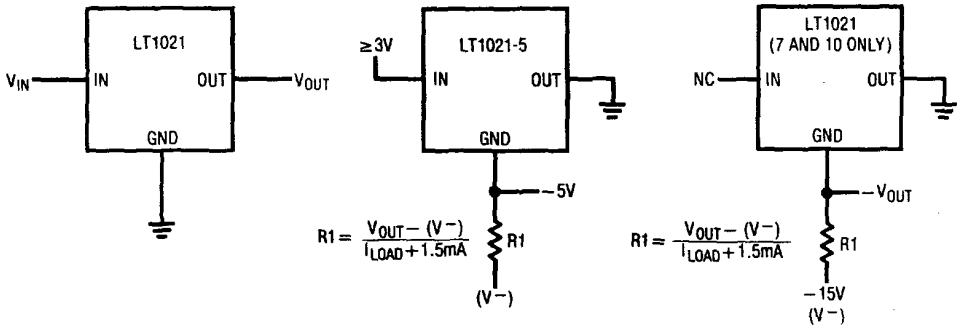
The LT1021 is a precision reference with ultra low drift and noise, extremely good long term stability, and almost total immunity to input voltage variations. The reference output will both source and sink up to 10mA. Three voltages are available; 5V, 7V and 10V. The 7V and 10V units can be used as shunt regulators (two terminal zeners) with the same precision characteristics as the three terminal connection. Special care has been taken to minimize thermal regulation effects and temperature induced hysteresis.

The LT1021 references are based on a buried zener diode structure which eliminates noise and stability problems associated with surface breakdown devices. Further, a subsurface zener exhibits better temperature drift and time stability than even the best band-gap references.

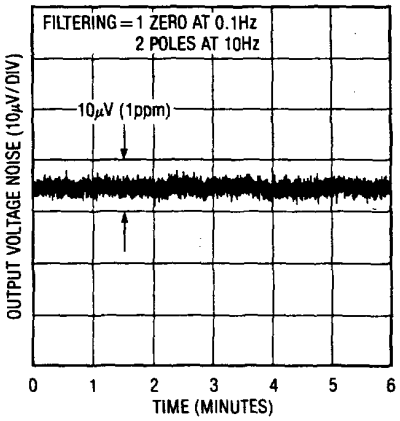
Unique circuit design makes the LT1021 the first IC reference to offer ultra low drift without the use of high power on-chip heaters.

The LT1021-7 uses no resistive divider to set output voltage, and therefore exhibits the best long term stability and temperature hysteresis. The LT1021-5 and LT1021-10 are intended for systems requiring a precise 5V or 10V reference, with an initial tolerance as low as 0.05%.*

Basic Positive and Negative Connections



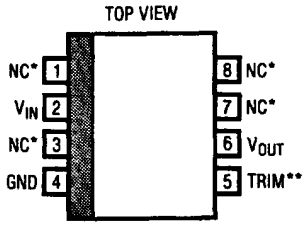
Output Noise 0.1Hz to 10Hz—LT1021-10



ABSOLUTE MAXIMUM RATINGS

Input Voltage 40V
Input-Output Voltage Differential 35V
Output to Ground Voltage (Shunt Mode Current Limit)
  LT1021-5 ..... 10V
  LT1021-7 ..... 10V
  LT1021-10 ..... 16V
Trim Pin to Ground Voltage
  Positive ..... Equal to V_{OUT}
  Negative ..... –20V
Output Short Circuit Duration
  V_{IN} = 35V ..... 10 sec
  $V_{IN} \leq 20V$ ..... Indefinite
Operating Temperature Range ..... 0°C to 70°C
Storage Temperature Range
  All Devices ..... –65°C to 150°C
Lead Temperature (Soldering, 10 sec.) ..... 300°C

PACKAGE/ORDER INFORMATION



S8 PACKAGE
PLASTIC SO

*CONNECTED INTERNALLY. DO NOT CONNECT EXTERNAL CIRCUITRY TO THESE PINS.
**NO TRIM PIN ON LT1021-7. DO NOT CONNECT EXTERNAL CIRCUITRY TO PIN 5 ON LT1021-7.

ORDER PART NUMBER
LT1021DCS8-5 LT1021DCS8-7 LT1021DCS8-10
PART MARKING
2105 (5V VERSION) 2107 (7V VERSION) 2110 (10V VERSION)

ELECTRICAL CHARACTERISTICS LT1021-5 V_{IN} = 10V, I_{OUT} = 0, T_A = 25°C, unless otherwise noted

PARAMETER	CONDITIONS		LT1021D-5 MIN	LT1021D-5 TYP	LT1021D-5 MAX	UNITS
Output Voltage (Note 1)			4.95	5.00	5.05	V
Output Voltage Temperature Coefficient (Note 2)	0°C ≤ T_J ≤ 70°C			5	20	ppm/°C
Line Regulation (Note 3)	7.2V ≤ V_{IN} ≤ 10V			4	12	ppm/V
		•			20	ppm/V
	10V ≤ V_{IN} ≤ 40V			2	6	ppm/V
		•			10	ppm/V
Load Regulation (Sourcing Current)	0 ≤ I_{OUT} ≤ 10mA (Note 3)			10	20	ppm/mA
		•			35	ppm/mA
Load Regulation (Sinking Current)	0 ≤ I_{OUT} ≤ 10mA (Note 3)			60	100	ppm/mA
		•			150	ppm/mA
Supply Current				0.8	1.2	mA
		•			1.5	mA
Output Voltage Noise (Note 5)	0.1Hz ≤ f ≤ 10Hz			3		μVp-p
	10Hz ≤ f ≤ 1kHz			2.2	3.5	μVrms
Long Term Stability of Output Voltage				15		ppm/√khrs
Temperature Hysteresis of Output	ΔT = ±25°C			10		ppm

ELECTRICAL CHARACTERISTICS LT1021-7 V_{IN} = 12V, I_{OUT} = 0, T_A = 25°C, unless otherwise noted

PARAMETER	CONDITIONS	LT1021D-7 MIN	LT1021D-7 TYP	LT1021D-7 MAX	UNITS
Output Voltage (Note 1)		6.95	7.00	7.05	V
Output Voltage Temperature Coefficient (Note 2)	$T_{MIN} \leq T_J \leq T_{MAX}$		5	20	ppm/°C

ELECTRICAL CHARACTERISTICS LT1021-7 V_{IN} = 12V, I_{OUT} = 0, T_A = 25°C, unless otherwise noted

PARAMETER	CONDITIONS		LT1021D-7 MIN	LT1021D-7 TYP	LT1021D-7 MAX	UNITS
Line Regulation (Note 3)	8.5V ≤ V_{IN} ≤ 12V			1	4	ppm/V
		●		2	8	ppm/V
	12V ≤ V_{IN} ≤ 40V			0.5	2	ppm/V
		●		1	4	ppm/V
Load Regulation (Sourcing Current)	0 ≤ I_{OUT} ≤ 10mA (Note 3)			12	25	ppm/mA
		●			40	ppm/mA
Load Regulation (Shunt Mode)	1.2mA ≤ I_{SHUNT} ≤ 10mA (Notes 3, 4)			50	100	ppm/mA
		●			150	ppm/mA
Supply Current (Series Mode)				0.75	1.2	mA
		●			1.5	mA
Minimum Current (Shunt Mode)	V_{IN} is Open			0.7	1.0	mA
		●			1.2	mA
Output Voltage Noise (Note 5)	0.1Hz ≤ f ≤ 10Hz			4		μVp-p
	10Hz ≤ f ≤ 1kHz			2.5	4	μVrms
Long Term Stability of Output Voltage				7		ppm/√khrs
Temperature Hysteresis of Output	ΔT = ±25°C			3		ppm

ELECTRICAL CHARACTERISTICS LT1021-10 V_{IN} = 15V, I_{OUT} = 0, T_A = 25°C, unless otherwise noted

PARAMETER	CONDITIONS		LT1021D-10 MIN	LT1021D-10 TYP	LT1021D-10 MAX	UNITS
Output Voltage (Note 1)			9.95	10.00	10.05	V
Output Voltage Temperature Coefficient (Note 2)	T_{MIN} ≤ T_J ≤ T_{MAX}			5	20	ppm/°C
Line Regulation (Note 3)	11.5V ≤ V_{IN} ≤ 14V.5			1	4	ppm/V
		●			6	ppm/V
	14.5V ≤ V_{IN} ≤ 40V			0.5	2	ppm/V
		●			4	ppm/V
Load Regulation (Sourcing Current)	0 ≤ I_{OUT} ≤ 10mA (Note 3)			12	25	ppm/mA
		●			40	ppm/mA
Load Regulation (Shunt Mode)	1.7mA ≤ I_{SHUNT} ≤ 10mA (Notes 3, 4)			50	100	ppm/mA
		●			150	ppm/mA
Series Mode Supply Current				1.2	1.7	mA
		●			2.0	mA
Shunt Mode Minimum Current	V_{IN} is Open			1.1	1.5	mA
		●			1.7	mA
Output Voltage Noise (Note 5)	0.1Hz ≤ f ≤ 10Hz			6		μVp-p
	0.1Hz ≤ f ≤ 1kHz			3.5	6	μVrms
Long Term Stability of Output Voltage	Δt = 1000 Hrs Non-Cumulative			15		ppm/√khrs
Temperature Hysteresis of Output	ΔT = ±25°C			5		ppm

The ● denotes the specifications which apply over the full operating temperature range.

Note 1: Output voltage is measured immediately after turn-on. Changes due to chip warm-up are typically less than 0.005%.

Note 2: Temperature coefficient is guaranteed as a slope from room temperature (25°C) to 0°C and 70°C, also known as a "butterfly" specification.

Note 3: Line and load regulation are measured on a pulse basis. Output changes due to die temperature change must be taken into account separately. Package thermal resistance is 110°C/W.

Note 4: Shunt mode regulation is measured with the input open. With the input connected, shunt mode current can be reduced to 0mA. Load regulation will remain the same.

Note 5: RMS noise is measured with a single high pass filter at 10Hz and a 2-pole low pass filter at 1 kHz. The resulting output is full wave rectified and then integrated for a fixed period, making the final reading an average as opposed to RMS. A correction factor of 1.1 is used to convert from average to RMS, and a second correction of 0.88 is used to correct for the non-ideal bandpass of the filters.

Peak-to-peak noise is measured with a single high pass filter at 0.1Hz and a 2-pole low pass filter at 10Hz. The unit is enclosed in a still-air environment to eliminate thermocouple effects on the leads. Test time is 10 seconds.