FEATURES

- Trimmed Output ±0.3%
- Low Drift—5ppm/°C Typical
- Low Noise—3ppm (p-p)
- High Line Rejection
- Temperature Output—REF-02
- Low Supply Current 1.4mA Max.

APPLICATIONS

- A to D and D to A Converters
- Precision Regulators
- Constant Current Sources
- V to F Converters
- Bridge Excitation

DESCRIPTION

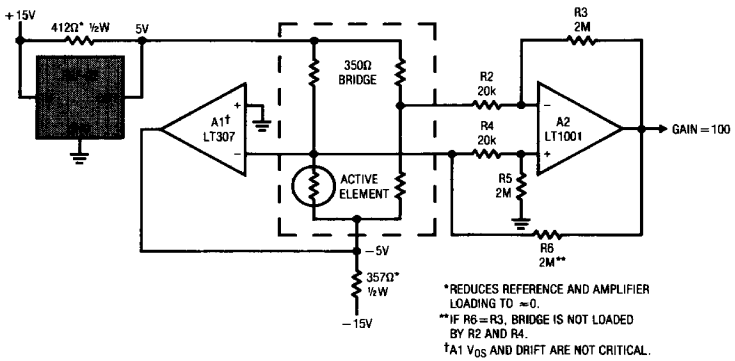
The REF-01/REF-02 are precision 10V and 5V bandgap references which provide stable output voltages over a wide range of operating conditions. Output voltage is accurate to ±0.3% with a low 5ppm/°C typical temperature coefficient. The REF-01 and REF-02 are excellent choices for applications where low drift, moderate accuracy, low power consumption and low cost are considerations.

The REF-02 includes a temperature output pin which provides a linear voltage proportional to absolute temperature.

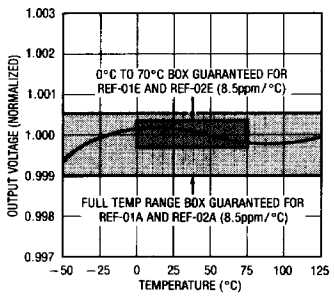
For lower drift and higher accuracy references, please see the LT1019 and LT1021 data sheets.

3

Ultra Linear Strain Gauge Amplifier



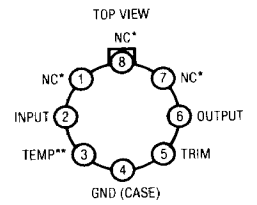
Output Voltage Temperature Drift



ABSOLUTE MAXIMUM RATINGS

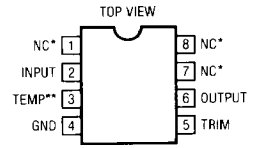
REF-01/02, A, E, H 40V
REF-01C/02C 30V
Power Dissipation 500mW
Output Short Circuit Duration
To Ground ..... Indefinite
To $V_{IN} \leq 16V$ ..... Indefinite
To $V_{IN} > 16V$ ..... Not Allowed
Storage Temperature ..... −65°C to 150°C
Operating Temperature
REF-01/02, REF-01A/02A ..... −55°C to 125°C
REF-01E/02E, REF-01H/02H,
REF-01C/02C, REF-01D/02D ..... 0°C to 70°C

PACKAGE/ORDER INFORMATION



METAL CAN H PACKAGE
*INTERNALLY CONNECTED. DO NOT CONNECT EXTERNALLY.
**DO NOT CONNECT ON REF-01.

ORDER PART NUMBER	
REF-01AH	REF-02AH
REF-01H	REF-02H
REF-01EH	REF-02EH
REF-01HH	REF-02HH
REF-01CH	REF-02CH
	REF-02DH



PLASTIC DIP N8 PACKAGE
8 PIN HERMETIC DIP
*INTERNALLY CONNECTED. DO NOT CONNECT EXTERNALLY.
**DO NOT CONNECT ON REF-01

REF-01EJ8	REF-02EJ8
REF-01HJ8	REF-02HJ8
REF-01CJ8	REF-02CJ8
REF-01EN8	REF-02DJ8
REF-01HN8	REF-02EN8
REF-01CN8	REF-02HN8
	REF-02CN8
	REF-02DN8

ELECTRICAL CHARACTERISTICS

$V_{IN} = +15V$, $T_A = 25°C$ unless otherwise noted

SYMBOL	PARAMETER	CONDITIONS		REF-01A/E REF-02A/E MIN	TYP	MAX	REF-01/H REF-02/H MIN	TYP	MAX	UNITS
V_O	Output Voltage	$I_L = 0$	REF-01	9.97	10.00	10.03	9.95	10.00	10.05	V
			REF-02	4.985	5.000	5.015	4.975	5.000	5.025	V
	Output Adjustment Range	$R_p = 10k\Omega$	REF-01	±3.0	+5, −27	—	±3.0	+5, −27	—	%
			REF-02	±3.0	+5, −13	—	±3.0	+5, −13	—	%
e_{np-p}	Output Voltage Noise	0.1Hz to 10Hz (Note 6)	REF-01	—	20	—	—	20	—	μVp-p
			REF-02	—	10	—	—	10	—	μVp-p
V_{IN}	Input Voltage Range		REF-01	12	—	40	12	—	40	V
			REF-02	7	—	40	7	—	40	V
$\frac{\Delta V_{OUT}}{\Delta V_{IN}}$	Line Regulation (Note 1)	$(V_{OUT} + 3V) \leq V_{IN} \leq 33V$		—	0.0001	0.010	—	0.0001	0.010	%/V
$\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$	Load Regulation (Note 1)	$I_L = 0mA$ to $10mA$	REF-01	—	0.0005	0.008	—	0.0005	0.010	%/mA
			REF-02	—	0.0010	0.010	—	0.001	0.010	%/mA
I_Q	Quiescent Supply Current	No Load		—	0.65	1.4	—	0.65	1.4	mA
I_{OUT}	Load Current			10	20	—	10	20	—	mA
	Sink Current			−0.3	−20	—	−0.3	−20	—	mA
I_{SC}	Short Circuit Current	$V_O = 0$		—	25	—	—	25	—	mA
V_T	Temperature Voltage Output	(Note 2)	REF-02 Only	—	620	—	—	620	—	mV

ELECTRICAL CHARACTERISTICS

$V_{IN} = +15V$, $T_A = 25°C$ unless otherwise noted

SYMBOL	PARAMETER	CONDITIONS		REF-01C REF-02C MIN	REF-01C REF-02C TYP	REF-01C REF-02C MAX	REF-02D MIN	REF-02D TYP	REF-02D MAX	UNITS
V_O	Output Voltage	$I_L = 0mA$	REF-01	9.90	10.00	10.10				V
			REF-02	4.950	5.000	5.050	4.900	5.000	5.100	V
	Output Adjustment Range	$R_P = 10k\Omega$	REF-01		+5, −27	—	—	—	—	%
			REF-02	±2.7	+5, −13	—	±2.0	+5, −13	—	%
e_{np-p}	Output Voltage Noise	0.1Hz to 10Hz (Note 6)	REF-01		30	—				μVp-p
			REF-02	—	12	—	—	12	—	μVp-p
$\frac{\Delta V_{OUT}}{\Delta V_{IN}}$	Line Regulation (Note 1)	$(V_{OUT} + 3V) \leq V_{IN} \leq 33V$		—	0.0001	0.015	—	0.0001	0.04	%/V
$\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$	Load Regulation (Note 1)	$I_L = 0mA$ to 8mA		—	0.0005	0.015	—	—	—	%/mA
		$I_L = 0mA$ to 4mA		—	—	—	—	0.001	0.04	%/mA
I_Q	Quiescent Supply Current	No Load		—	0.65	1.6	—	0.65	2.0	mA
I_{OUT}	Load Current			8	20	—	8	20	—	mA
	Sink Current			−0.2	20	—	−0.2	20	—	mA
I_{SC}	Short Circuit Current	$V_O = 0$		—	25	—	—	25	—	mA
V_T	Temperature Voltage Output	(Note 2)	REF-02 Only	—	620	—	—	620	—	mV

ELECTRICAL CHARACTERISTICS

$V_{IN} = +15V$, $-55°C \leq T_A \leq \pm 125°C$ for REF-01A/02A and REF-01/REF-02, $0°C \leq T_A \leq +70°C$ for REF-01E/02E and REF-01H/02H, $I_L = 0mA$ unless otherwise noted

SYMBOL	PARAMETER	CONDITIONS		REF-01A/E REF-02A/E MIN	REF-01A/E REF-02A/E TYP	REF-01A/E REF-02A/E MAX	REF-01/H REF-02/H MIN	REF-01/H REF-02/H TYP	REF-01/H REF-02/H MAX	UNITS
$\frac{\Delta V}{\Delta T}$	Output Voltage Change with Temperature (Notes 3 and 4)	$0°C \leq T_A \leq +70°C$	●	—	0.02	0.06	—	0.035	0.17	%
		$-55°C \leq T_A \leq +125°C$	●	—	0.09	0.15	—	0.144	0.45	%
TC	Output Voltage Temperature Coefficient	(Note 5)	●	—	5	8.5	—	8	25	ppm/°C
	Change in V_O Temperature Coefficient with Output Adjustment	$R_P = 10k\Omega$	●	—	0.5	—	—	0.5	—	ppm/%
$\frac{\Delta V_{OUT}}{\Delta V_{IN}}$	Line Regulation ($V_{IN} = 8V$ to 33V) (Note 1)	$0°C \leq T_A \leq +70°C$	●	—	0.0001	0.012	—	0.0001	0.012	%/V
		$-55°C \leq T_A \leq +125°C$	●	—	0.0001	0.015	—	0.0001	0.015	%/V
$\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$	Load Regulation ($I_L = 0mA$ to 8mA) (Note 1)	$0°C \leq T_A \leq +70°C$	●	—	0.002	0.010	—	0.002	0.012	%/mA
		$-55°C \leq T_A \leq +125°C$	●	—	0.002	0.012	—	0.002	0.015	%/mA
	Temperature Voltage Output Temperature Coefficient	(Note 2) REF-02	●	—	2.1	—	—	2.1	—	mV/°C

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

ELECTRICAL CHARACTERISTICS

$V_{IN} = +15V$, $0°C \leq T_A \leq +70°C$ and $I_L = 0mA$ unless otherwise noted

SYMBOL	PARAMETER	CONDITIONS		REF-01C REF-02C MIN	REF-01C REF-02C TYP	REF-01C REF-02C MAX	REF-02D MIN	REF-02D TYP	REF-02D MAX	UNITS
$\frac{\Delta V}{\Delta T}$	Output Voltage Change with Temperature	(Notes 3 and 4)	●	—		0.45	—		1.7	%
TC	Output Voltage Temperature Coefficient	(Note 5)	●	—	8	65	—	8	250	ppm/°C
	Change in V_O Temperature Coefficient with Output Adjustment	$R_p = 10k\Omega$	●	—	0.5	—	—	0.5	—	ppm/%
$\frac{\Delta V_{OUT}}{\Delta V_{IN}}$	Line Regulation (Note 1)	$V_{IN} = 8V$ to 30V	●	—	0.0001	0.018	—	0.0001	0.05	%/V
$\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$	Load Regulation (Note 1)	$I_L = 0mA$ to 5mA	●	—	0.002	0.018	—	0.002	0.05	%/mA
	Temperature Voltage Output Temperature Coefficient	(Note 2) REF-02	●	—	2.1	—	—	2.1	—	mV/°C

Note 1: Line and load regulation specifications include the effect of self heating.

Note 2: Limit current in or out of pin 3 to 50nA and capacitance on pin 3 to 30pF.

Note 3: ΔV is defined as the absolute difference between the maximum output voltage and the minimum output voltage over the specified temperature range expressed as a percentage of nominal output.

$$\Delta V = \left| \frac{V_{MAX} - V_{MIN}}{V_{OUT}} \right| \times 100$$

Note 4: ΔV specification applies trimmed or untrimmed.

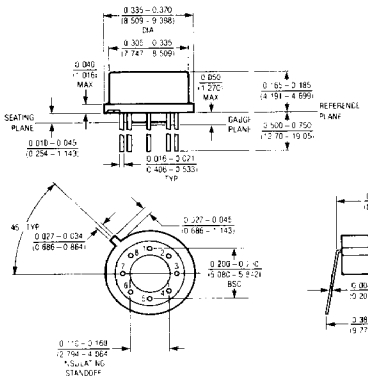
Note 5: TC is defined as ΔV divided by the temperature range, i.e.,

$$TC = \frac{\Delta V}{T_{MAX} - T_{MIN}}$$

Note 6: 0.1Hz to 10Hz noise cannot be 100% tested on modern high speed test equipment, so Linear Technology does not put a guaranteed maximum specification on this parameter for standard units. 100% bench testing of 0.1Hz to 10Hz noise is available on special request. To ensure low output noise, Linear Technology *does* 100% test 10Hz to 1kHz noise. Consult factory for details.

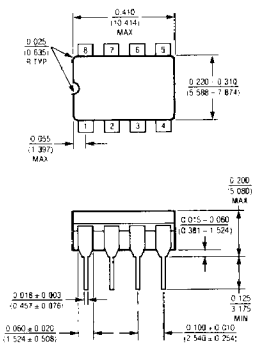
PACKAGE DESCRIPTION Dimensions in inches (millimeters) unless otherwise noted.

H Package
Metal Can



T_{jmax}	θ_{ja}	θ_{jc}
150°C	150°C/W	45°C/W

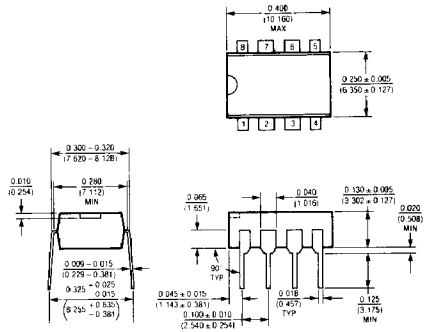
J8 Package
8 Lead Hermetic DIP



*LEADS WITHIN 0.007 OF TRUE POSITION (TP) AT GAUGE PLANE

T_{jmax}	θ_{ja}
150°C	100°C/W

N8 Package
8 Lead Plastic



*LEADS WITHIN 0.007 OF TRUE POSITION (TP) AT GAUGE PLANE

T_{jmax}	θ_{ja}
100°C	130°C/W