

Precision Voltage References

FEATURES

- Trimmed Output $\pm 0.3\%$
- Low Drift— $5\text{ppm}/^{\circ}\text{C}$ Typ
- Low Noise— $3\text{ppm}_{(\text{P-P})}$
- High Line Rejection
- Temperature Output—REF-02
- Low Supply Current 1.4mA Max

APPLICATIONS

- A/D and D/A Converters
- Precision Regulators
- Constant Current Sources
- V/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 $\pm 0.3\%$ with a low 5ppm/ $^{\circ}\text{C}$ 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.

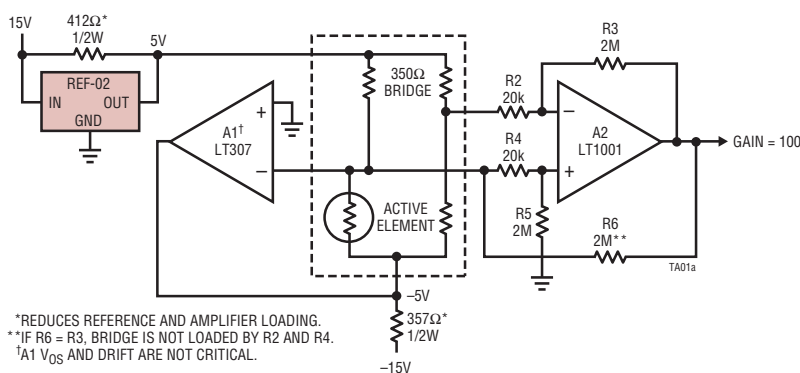
The REF-02 includes a temperature output pin which provides a linear voltage proportional to absolute temperature.

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

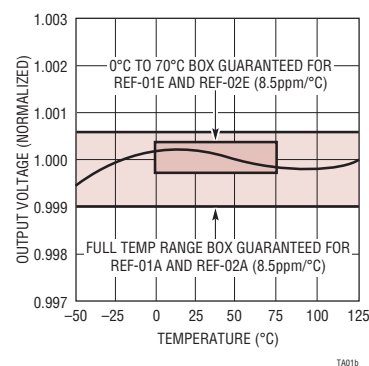
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TYPICAL APPLICATION

Ultra Linear Strain Gauge Amplifier



Output Voltage Temperature Drift

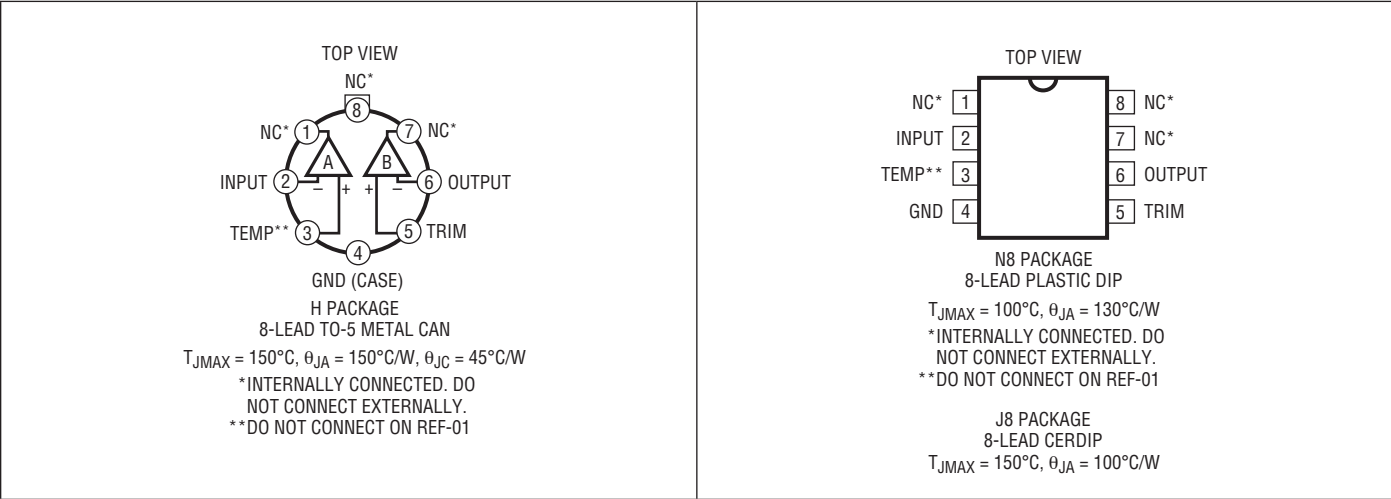


REF-01/REF-02

ABSOLUTE MAXIMUM RATINGS

REF-01/REF-02 A, E, H	40V	Storage Temperature Range	–65°C to 150°C
REF-01C/REF-02C	30V	Operating Temperature	
Power Dissipation	500mW	REF-01/REF-02, REF-01A/REF-02A...	–55°C to 125°C
Output Short-Circuit Duration		REF-01E/REF-02E, REF-01H/REF-02H,	
To Ground	Indefinite	REF-01C/REF-02C, REF-01D/REF-02D	0°C to 70°C
To $V_{IN} \leq 16V$	Indefinite	Lead Temperature (Soldering, 10 sec)	300°C
To $V_{IN} > 16V$	Not Allowed		

PIN CONFIGURATION



ORDER INFORMATION

LEAD FREE FINISH	PART MARKING	PACKAGE DESCRIPTION	TEMPERATURE RANGE
REF01EN8#PBF	REF01EN8	8-Lead Plastic Dip	0°C to 70°C
REF01HN8#PBF	REF01HN8	8-Lead Plastic Dip	0°C to 70°C
REF01CN8#PBF	REF01CN8	8-Lead Plastic Dip	0°C to 70°C
REF02EN8#PBF	REF02EN8	8-Lead Plastic Dip	0°C to 70°C
REF02HN8#PBF	REF02HN8	8-Lead Plastic Dip	0°C to 70°C
REF02CN8#PBF	REF02CN8	8-Lead Plastic Dip	0°C to 70°C
REF02DN8#PBF	REF02DN8	8-Lead Plastic Dip	0°C to 70°C
REF01AH#PBF		8-Lead TO-5 Metal Can	–55°C to 125°C
REF01H#PBF		8-Lead TO-5 Metal Can	–55°C to 125°C
REF01EH#PBF		8-Lead TO-5 Metal Can	0°C to 70°C
REF01HH#PBF		8-Lead TO-5 Metal Can	0°C to 70°C
REF01CH#PBF		8-Lead TO-5 Metal Can	0°C to 70°C
REF02H#PBF		8-Lead TO-5 Metal Can	–55°C to 125°C
REF02EH#PBF		8-Lead TO-5 Metal Can	0°C to 70°C
REF02HH#PBF		8-Lead TO-5 Metal Can	0°C to 70°C
REF02CH#PBF		8-Lead TO-5 Metal Can	0°C to 70°C

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ORDER INFORMATION

LEAD FREE FINISH	PART MARKING	PACKAGE DESCRIPTION	TEMPERATURE RANGE
REF02DH#PBF		8-Lead TO-5 Metal Can	0°C to 70°C
REF01EJ8#PBF		8-Lead Cerdip	0°C to 70°C
REF01HJ8#PBF		8-Lead Cerdip	0°C to 70°C
REF01CJ8#PBF		8-Lead Cerdip	0°C to 70°C
REF02EJ8#PBF		8-Lead Cerdip	0°C to 70°C
REF02HJ8#PBF		8-Lead Cerdip	0°C to 70°C
REF02CJ8#PBF		8-Lead Cerdip	0°C to 70°C
REF02DJ8#PBF		8-Lead Cerdip	0°C to 70°C
OBSOLETE Consider the N Package for Alternate Source			
LEAD BASED FINISH	PART MARKING	PACKAGE DESCRIPTION	TEMPERATURE RANGE
REF02AH	REF02AH	8-Lead TO-5 Metal Can	-55°C to 125°C
REF02AJ8	REF02AJ8	8-Lead Cerdip	-55°C to 125°C

Consult LTC Marketing for parts specified with wider operating temperature ranges.

For more information on lead free part marking, go to: <http://www.linear.com/leadfree/>

For more information on tape and reel specifications, go to: <http://www.linear.com/tapeandreel/>

ELECTRICAL CHARACTERISTICS $V_{IN} = 15V$, $T_A = 25^\circ C$ unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		REF-01A/E, REF-02A/E MIN	TYP	MAX	REF-01H, REF-02H MIN	TYP	MAX	UNITS
V_O	Output Voltage	$I_L = 0mA$	REF-01 REF-02	9.97 4.985	10 5	10.03 5.015	9.95 4.975	10 5	10.05 5.025	V V
	Output Adjustment Range	$R_P = 10k\Omega$	REF-01 REF-02	± 3 ± 3	5, -27 5, -13		± 3 ± 3	5, -27 5, -13		% %
e_{nP-P}	Output Voltage Noise	0.1Hz to 10Hz (Note 7)	REF-01 REF-02		20 10			20 10		μV_{P-P} μV_{P-P}
V_{IN}	Input Voltage Range		REF-01 REF-02	12 7		40 40	12 7		40 40	V V
$\frac{\Delta V_{OUT}}{\Delta V_{IN}}$	Line Regulation (Note 2)	$(V_{OUT} + 3V) \leq V_{IN} \leq 33V$			0.0001	0.01		0.0001	0.01	%/V
$\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$	Load Regulation (Note 2)	$I_L = 0mA$ to 10mA	REF-01 REF-02		0.0005 0.001	0.008 0.01		0.0005 0.001	0.01 0.01	%/mA %/mA
I_Q	Quiescent Supply Current	No Load			0.65	1.4		0.65	1.4	mA
I_{OUT}	Load Current Sink Current			10 -0.3	20 -20		10 -0.3	20 -20		mA mA
I_{SC}	Short-Circuit Current	$V_O = 0V$			25			25		mA
V_T	Temperature Voltage Output	(Note 3)	REF-02 Only		620			620		mV

$V_{IN} = 15V$, $T_A = 25^\circ C$ unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		REF-01C, REF-02C MIN	TYP	MAX	REF-02D MIN	TYP	MAX	UNITS
V_O	Output Voltage	$I_L = 0mA$	REF-01 REF-02	9.9 4.95	10 5	10.1 5.05	4.9	5	5.1	V V
	Output Adjustment Range	$R_P = 10k\Omega$	REF-01 REF-02	± 2.7	5, -27 5, -13		± 2	5, -13		% %
e_{nP-P}	Output Voltage Noise	0.1Hz to 10Hz (Note 7)	REF-01 REF-02		30 12			12		μV_{P-P} μV_{P-P}

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REF-01/REF-02

ELECTRICAL CHARACTERISTICS $V_{IN} = 15V$, $T_A = 25^\circ C$ unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	REF-01C, REF-02C			REF-02D			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
$\frac{\Delta V_{OUT}}{\Delta V_{IN}}$	Line Regulation (Note 2)	$(V_{OUT} + 3V) \leq V_{IN} \leq 33V$		0.0001	0.015		0.0001	0.04	%/V
$\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$	Load Regulation (Note 2)	$I_L = 0mA$ to 8mA $I_L = 0mA$ to 4mA		0.0005	0.015		0.001	0.04	%/mA %/mA
I_Q	Quiescent Supply Current	No Load		0.65	1.6		0.65	2	mA
I_{OUT}	Load Current Sink Current		8 -0.2	20 20		8 -0.2	20 20		mA mA
I_{SC}	Short-Circuit Current	$V_O = 0V$		25			25		mA
V_T	Temperature Voltage Output	(Note 3) REF-02 Only		620			620		mV

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at $T_A = 25^\circ C$.
 $V_{IN} = 15V$, $-55^\circ C \leq T_A \leq \pm 125^\circ C$ for REF-01A/REF-02A and REF-01/REF-02, $0^\circ C \leq T_A \leq 70^\circ C$ for REF-01E/REF-02E and
REF-01H/REF-02H, $I_L = 0mA$ unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		REF-01A/E, REF-02A/E			REF-01H/ REF-02H			UNITS
				MIN	TYP	MAX	MIN	TYP	MAX	
$\frac{\Delta V}{\Delta T}$	Output Voltage Change With Temperature (Notes 4, 5)	$0^\circ C \leq T_A \leq 70^\circ C$ $-55^\circ C \leq T_A \leq 125^\circ C$	● ●		0.02 0.09	0.06 0.15		0.035 0.144	0.17 0.45	% %
TC	Output Voltage Temperature Coefficient	(Note 6)	●		5	8.5		8	25	ppm/ $^\circ C$
	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 $(V_{OUT} + 3V) \leq V_{IN} \leq 33V$ (Note 2)	$0^\circ C \leq T_A \leq 70^\circ C$ $-55^\circ C \leq T_A \leq 125^\circ C$	● ●		0.0001 0.0001	0.012 0.015		0.0001 0.0001	0.012 0.015	%/V %/V
$\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$	Load Regulation ($I_L = 0mA$ to 8mA) (Note 2)	$0^\circ C \leq T_A \leq 70^\circ C$ $-55^\circ C \leq T_A \leq 125^\circ C$	● ●		0.002 0.002	0.01 0.012		0.002 0.002	0.012 0.015	%/mA %/mA
	Temperature Voltage Output Temperature Coefficient	(Note 3) REF-02	●		2.1			2.1		mV/ $^\circ C$

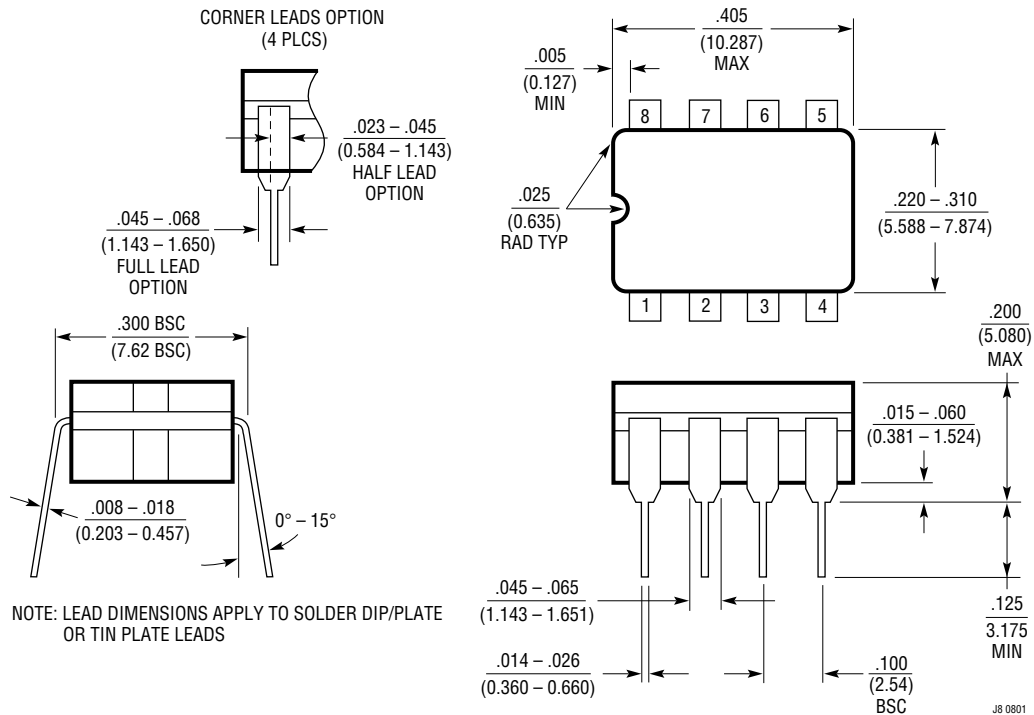
The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at $T_A = 25^\circ C$.
 $V_{IN} = 15V$, $0^\circ C \leq T_A \leq 70^\circ C$ and $I_L = 0mA$ unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		REF-01C, REF-02C			REF-02D			UNITS
				MIN	TYP	MAX	MIN	TYP	MAX	
$\frac{\Delta V}{\Delta T}$	Output Voltage Change With Temperature	(Notes 4, 5)	●			0.45			1.7	%
TC	Output Voltage Temperature Coefficient	(Note 6)	●		8	65		8	250	ppm/ $^\circ C$
	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 2)	$V_{IN} = 8V$ to 30V	●		0.0001	0.018		0.0001	0.05	%/V
$\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$	Load Regulation (Note 2)	$I_L = 0mA$ to 5mA	●		0.002	0.018		0.002	0.05	%/mA
	Temperature Voltage Output Temperature Coefficient	(Note 3) REF-02	●		2.1			2.1		mV/ $^\circ C$

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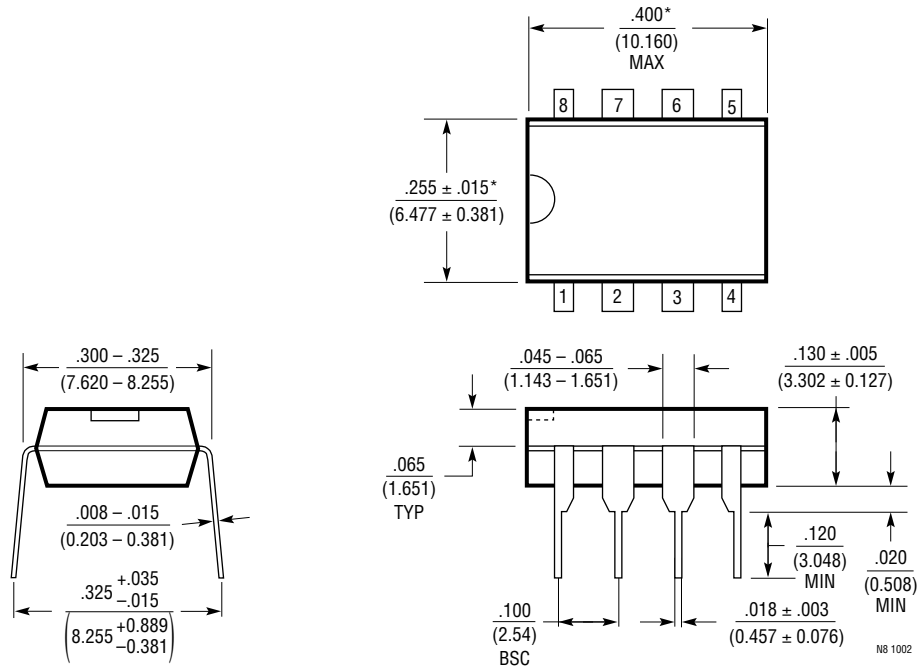
PACKAGE DESCRIPTION

J8 Package 8-Lead Cerdip (Narrow .300 Inch, Hermetic) (Reference LTC DWG # 05-08-1110)



PACKAGE DESCRIPTION

N8 Package 8-Lead PDIP (Narrow .300 Inch) (Reference LTC DWG # 05-08-1510)



NOTE:

1. DIMENSIONS ARE $\frac{\text{INCHES}}{\text{MILLIMETERS}}$

*THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED .010 INCH (0.254mm)

REF-01/REF-02

RELATED PARTS

PART NUMBER	DESCRIPTION	COMMENTS
LT1019	0.05%, 5ppm/°C Precision Reference	Pin Compatible With the REF-01, REF-02, Improved Specs