REF-01 +10V Precision Voltage References

Features

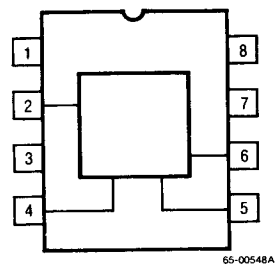
- +10V output — ±0.3%
- Adjustable — ±3%
- Excellent temperature stability — 3 ppm/°C
- Low noise — 20 μV_{p-p}
- Wide input voltage range — +12V to +40V
- No external components
- Short circuit proof
- Low power consumption — 15 mW

Description

The REF-01 Precision Voltage Reference contains a bandgap reference using thin film resistors, a step-up amplifier, short circuit protection, and a zener trim network. The REF-01's +10V output shows excellent stability for large changes of temperature, load current, and input voltage. An adjust pin is provided that can change the output voltage by at least 3% with little effect on temperature coefficient.

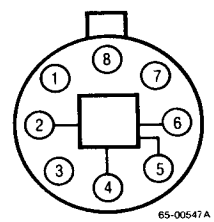
Connection Information

8-Lead Dual In-Line Package (Top View)



Pin	Function
1	NC
2	$+V_S$
3	NC
4	Ground
5	Adjust
6	Output
7	NC
8	NC

8-Lead TO-99 Metal Can (Top View)

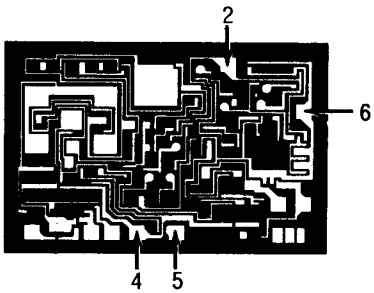


Ordering Information

Part Number	Package	Operating Temperature Range
REF-01CD	D	0°C to +70°C
REF-01DD	D	0°C to +70°C
REF-01ED	D	0°C to +70°C
REF-01HD	D	0°C to +70°C
REF-01CN	N	0°C to +70°C
REF-01DN	N	0°C to +70°C
REF-01EN	N	0°C to +70°C
REF-01HN	N	0°C to +70°C
REF-01CT	T	0°C to +70°C
REF-01DT	T	0°C to +70°C
REF-01ET	T	0°C to +70°C
REF-01HT	T	0°C to +70°C
REF-01AD	D	-55°C to +125°C
REF-01AD/883B	D	-55°C to +125°C
REF-01D	D	-55°C to +125°C
REF-01D/883B	D	-55°C to +125°C
REF-01AT	T	-55°C to +125°C
REF-01AT/883B	T	-55°C to +125°C
REF-01T	T	-55°C to +125°C
REF-01T/883B	T	-55°C to +125°C

Notes:
/883B suffix denotes Mil-Std-883, Level B processing
N = 8-lead plastic DIP
D = 8-lead ceramic DIP
T = 8-lead metal can (TO-99)
Contact a Raytheon sales office or representative for ordering information on special package/temperature range combinations.

Mask Pattern



Die Size: 55 x 79 mils
Min. Pad Dimensions: 4 x 4 mils

Absolute Maximum Ratings

Supply Voltage
- REF-01A, E, H Grades ..... +40V
- REF-01C, D Grades ..... +30V

Internal Power Dissipation ..... 500 mW
Output Short Circuit Duration ..... Indefinite
Storage Temperature
- Range ..... -65°C to +150°C

Operating Temperature Range
- REF-01A, -01 ..... -55°C to +125°C
- REF-01E,H,C,D ..... 0°C to +70°C

Lead Soldering Temperature
- (60 Sec) ..... +300°C

Thermal Characteristics

	8-Lead Ceramic DIP	8-Lead TO-99 Metal Can	8-Lead Plastic DIP
Max. Junction Temp.	+175°C	+175°C	+125°C
Max. P_D T_A <50°C	833 mW	658 mW	468 mW
Therm. Res θ_{JC}	45°C/W	50°C/W	—
Therm. Res. θ_{JA}	150°C/W	190°C/W	160°C/W
For T_A >50°C Derate at	8.33 mW/°C	5.26 mW/°C	6.25 mW/°C

Electrical Characteristics (V_S = +15V and T_A = +25°C unless otherwise noted)

Parameters	Test Conditions	REF-01A/E			REF-01/H			Units
		Min	Typ	Max	Min	Typ	Max	
Output Voltage	I_L = 0mA	9.97	10.00	10.03	9.95	10.00	10.05	V
Output Adjustment Range	R_P = 10kΩ	±3.0	±3.3		±3.0	±3.3		%
Output Voltage Noise[1]	0.1Hz to 10Hz		20	30		20	30	μV_{p-p}
Supply Voltage		12		40	12		40	V
Line Regulation[2]	V_S = +13V to +33V		0.006	0.010		0.006	0.010	%/V
Load Regulation[2]	I_L = 0mA to 10mA		0.005	0.008		0.006	0.010	%/mA
Turn-on Settling Time	To ±0.1% of Final Value		5.0			5.0		μS
Supply Current	No Load		1.0	1.4		1.0	1.4	mA
Load Current		10	21		10	21		mA
Sink Current		-0.3	-0.5		-0.3	-0.5		mA
Short Circuit Current	V_O = 0		30			30		mA

Electrical Characteristics (V_S = +15V and -55°C ≤ T_A ≤ +125°C unless otherwise noted)

Parameters	Test Conditions	REF-01A			REF-01			Units
		Min	Typ	Max	Min	Typ	Max	
Output Voltage Change With Temperature[3] [4]	Over Temp. Range		0.06	0.15		0.18	0.45	%
Output Voltage Temperature Coefficient[5]	Over Temp. Range		3.0	8.5		10	25	ppm/°C
Change in V_{OUT} Temperature Coefficient With Output Adjustment	R_P = 10kΩ		0.7			0.7		ppm/%
Line Regulation[2]	V_S = +13V to +33V		0.009	0.015		0.009	0.015	%/V
Load Regulation[2]	I_O = 0mA to 8mA		0.007	0.012		0.007	0.012	%/mA

Notes: 1. Guaranteed by design.
2. Line and load regulation specifications include the effects of self heating.
3. Output voltage change with temperature = $\frac{V_{MAX} - V_{MIN}}{10V} \times 100\%$
4. Output voltage change with temperature specification applies untrimmed, or trimmed to +10V.
5. Output voltage temperature coefficient = $\frac{\text{Output voltage change with temperature}}{180°C}$

Electrical Characteristics (V_S = +15V and T_A = +25°C unless otherwise noted)

Parameters	Test Conditions	REF-01C			REF-01D			Units
		Min	Typ	Max	Min	Typ	Max	
Output Voltage	I_L = 0mA	9.90	10.00	10.10	9.850	10.00	10.150	V
Output Adjustment Range	R_P = 10kΩ	±2.7	±3.3		±2.0	±3.3		%
Output Voltage Noise[1]	0.1Hz to 10Hz		25	35		25		μV_{p-p}
Supply Voltage		12		30	12		30	V
Line Regulation[2]	V_S = +13V to +33V		0.009	0.015		0.012	0.04	%/V
Load Regulation[2]	I_L = 0mA to 8mA		0.006	0.015				%/mA
	I_L = 0mA to 4mA		0.006	0.015		0.009	0.04	
Turn-on Settling Time	To ±0.1% of Final Value		5.0			5.0		μS
Supply Current	No Load		1.0	1.6		1.0	2.0	mA
Load Current		8.0	21		8.0	21		mA
Sink Current		-0.2	-0.5		-0.2	-0.5		mA
Short Circuit Current	V_O = 0		30			30		mA

Electrical Characteristics (V_S = +15V, 0°C ≤ T_A ≤ +70°C, and I_O = 0 unless otherwise noted)

Parameters	Test Conditions	REF-01E			REF-01H			Units
		Min	Typ	Max	Min	Typ	Max	
Output Voltage Change With Temperature[3] [4]	Over Temp. Range		0.02	0.06		0.07	0.17	%
Output Voltage Temperature Coefficient[5]	Over Temp. Range		3.0	8.5		10	25	ppm/°C
Change in V_{OUT} Temperature Coefficient With Output Adjustment	R_P = 10kΩ		0.7			0.7		ppm/%
Line Regulation[2]	V_S = +13V to +33V		0.007	0.012		0.007	0.012	%/V
Load Regulation[2]	I_L = 0mA to 8mA		0.006	0.010		0.007	0.012	%/mA

Notes: 1. Guaranteed by design.
2. Line and load regulation specifications include the effects of self heating.
3. Output voltage change with temperature = $\frac{V_{MAX} - V_{MIN}}{10V} \times 100\%$
4. Output voltage change with temperature specification applies untrimmed, or trimmed to +10V.
5. Output voltage temperature coefficient = $\frac{\text{Output voltage change with temperature}}{70°C}$

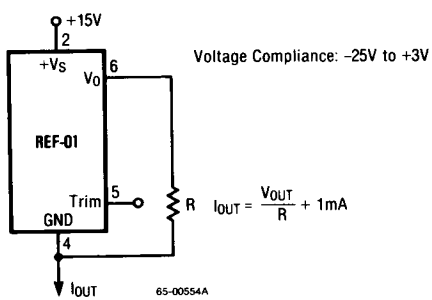
Electrical Characteristics (V_S = +15V, 0°C ≤ T_A ≤ +70°C, and I_O = 0 unless otherwise noted)

Parameters	Test Conditions	REF-01C			REF-01D			Units
		Min	Typ	Max	Min	Typ	Max	
Output Voltage Change With Temperature[3] [4]	Over Temp. Range		0.14	0.45		0.49	1.7	%
Output Voltage Temperature Coefficient[5]	Over Temp. Range		20	65		70	250	ppm/°C
Change in V_{OUT} Temperature Coefficient With Output Adjustment	R_P = 10kΩ		0.7			0.7		ppm/%
Line Regulation[2]	V_S = +13V to +30V		0.011	0.018		0.020	0.025	%/V
Load Regulation[2]	I_O = 0mA to 5mA		0.008	0.018		0.020	0.025	%/mA

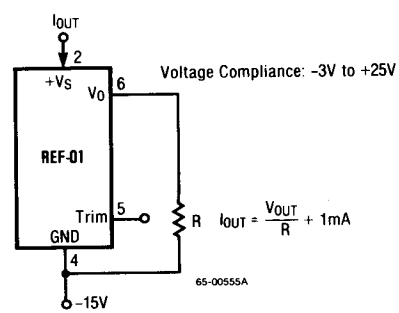
Notes: 1. Guaranteed by design.
2. Line and load regulation specifications include the effects of self heating.
3. Output voltage change with temperature = $\frac{V_{MAX} - V_{MIN}}{10V} \times 100\%$
4. Output voltage change with temperature specification applies untrimmed, or trimmed to +10V.
5. Output voltage temperature coefficient = $\frac{\text{Output voltage change with temperature}}{70°C}$

Typical Applications

Current Source

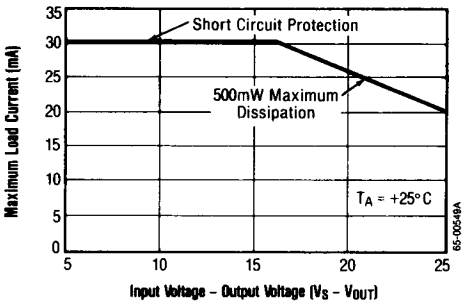


Current Sink

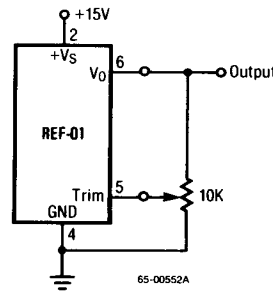


Typical Performance Characteristics

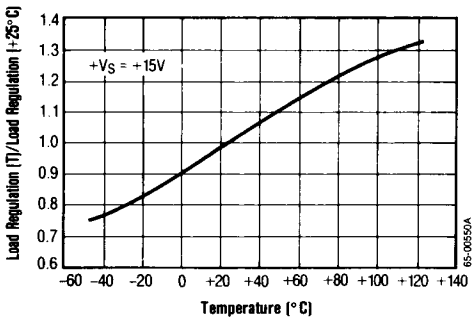
Maximum Load Current vs. Differential Input Voltage



Output Adjustment

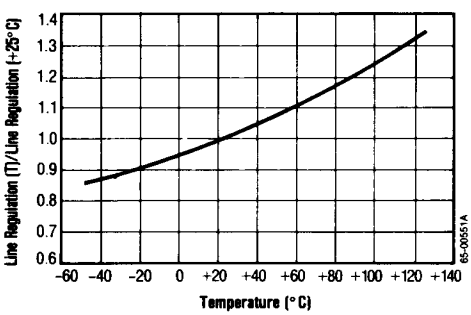


Normalized Load Regulation (ΔIL = 10mA) vs. Temperature

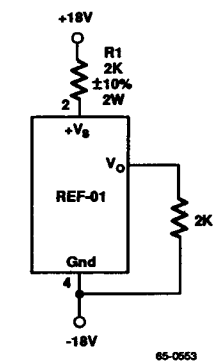


The REF-01 trim terminal can be used to adjust the output voltage over a 10V ±300mV range. This feature allows the system designer to trim system errors by setting the reference to a voltage other than 10V. Of course, the output can also be set to exactly 10.000V or to 10.240V for binary operation. Adjustment of the output does not significantly affect the temperature performance of the device. Typically the temperature coefficient change is 0.7ppm/°C for 100mV of output adjustment.

Normalized Line Regulation vs. Temperature



Burn-In Circuit



Simplified Schematic Diagram