Ultracompact Precision 10 V/5 V/2.5 V Voltage References

ADR01/ADR02/ADR03

FEATURES

Ultra compact SC70-5/TSOT-5
Low temperature coefficient 3 ppm/°C
Long term stability 50 ppm/1000 hr
Line regulation 30 ppm/V
Load regulation 50 ppm/mA
Low noise 25 µV p-p (0.1 Hz to 10 Hz)
Low hysteresis 70 ppm typical
Wide operating range
ADR01 12 V to 40 V
ADR02 7 V to 40 V
ADR03 4.5 V to 40 V
Quiescent current 1 mA max
High output current 10 mA
Wide temperature range –40°C to +125°C
Industry standard REF01/REF02/REF03 compatible[1]

APPLICATIONS

Precision data acquisition systems
High resolution converters
Industrial process control systems
Precision instruments
PCMCIA cards

PIN CONFIGURATIONS

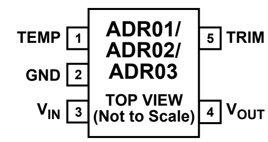

Figure 1. 5-Lead SC-70/TSOT Surface Mount Packages

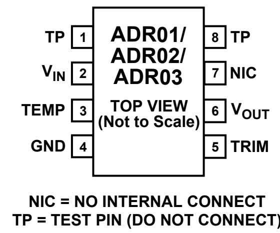

Figure 2. 8-Lead SOIC Surface Mount Package

GENERAL DESCRIPTION

The ADR01, ADR02, and ADR03 are precision 10 V, 5 V, and 2.5 V band gap voltage references featuring high accuracy, high stability, and low power, housed in tiny SC70-5 and TSOT-5 packages. SOIC-8 versions of ADR01, ADR02, and ADR03 are available for industry standard REF01, REF02, and REF03 drop in replacement.[1] The small footprint and wide operating range make them ideal for general-purpose and space constraint applications.

With an external buffer and a simple resistor network, the TEMP terminal can be used for temperature sensing and approximation. A TRIM terminal is provided on the ADR01, ADR02, and ADR03 for fine adjustment of the output voltage.

The ADR01, ADR02, and ADR03 are compact, low drift voltage references that provide an extremely stable output voltage from a wide supply voltage range. They are available in SC70-5, TSOT-5, and SOIC-8 packages with A and B grade selection. All parts are specified over the extended industrial (–40°C to +125°C) temperature range.

[1] ADR01, ADR02, and ADR03 are component-level compatible with REF01, REF02, and REF03, respectively. No guarantees for system-level compatibility are implied. SOIC-8 versions of ADR01/ADR02/ADR03 are pin-to-pin compatible with SOIC-8 versions of REF01/REF02/REF03, respectively, with the additional temperature monitoring function.

Rev. B

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2/03—Data Sheet Changed from REV. A to REV. B.

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Revision A
12/02—Data Sheet Changed from REV. 0 to REV. A.

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SPECIFICATIONS

Table 1. ADR01—Electrical Characteristics (V_{IN} = 12 V to 40 V, T_A = 25°C, unless otherwise noted.)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output Voltage	V_O	A Grade	9.990	10.000	10.010	V
Initial Accuracy	V_{OERR}	A Grade			10	mV
					0.1	%
Output Voltage	V_O	B Grade	9.995	10.000	10.005	V
Initial Accuracy	V_{OERR}	B Grade			5	mV
					0.05	%
Temperature Coefficient	TCV_O	A Grade, SOIC-8, –40°C < T_A < +125°C		3	10	ppm/°C
		A Grade, TSOT-5, –40°C < T_A < +125°C			25	ppm/°C
		A Grade, SC70-5, –40°C < T_A < +125°C			25	ppm/°C
		B Grade, SOIC-8, –40°C < T_A < +125°C		1	3	ppm/°C
		B Grade, TSOT-5, –40°C < T_A < +125°C			9	ppm/°C
		B Grade, SC70-5, –40°C < T_A < +125°C			9	ppm/°C
Supply Voltage Headroom	$V_{IN} – V_O$		2			V
Line Regulation	$\Delta V_O/\Delta V_{IN}$	V_{IN} = 15 V to 40 V, –40° < T_A < +125°C		7	30	ppm/V
Load Regulation	$\Delta V_O/\Delta I_{LOAD}$	I_{LOAD} = 0 mA to 10 mA, –40° < T_A < +125°C		40	70	ppm/mA
Quiescent Current	I_{IN}	No Load, –40° < T_A < +125°C		0.65	1	mA
Voltage Noise	$e_{N\ p-p}$	0.1 Hz to 10 Hz		25		µV p-p
Voltage Noise Density	e_N	1 kHz		510		nV/√Hz
Turn-On Settling Time	t_R			4		µs
Long Term Stability[1]	ΔV_O	1,000 Hours		50		ppm
Output Voltage Hysterisis	ΔV_{O_HYS}			70		ppm
Ripple Rejection Ratio	RRR	f_{IN} = 10 kHz		–75		dB
Short Circuit to GND	I_{SC}			30		mA
Voltage Output at TEMP Pin	V_{TEMP}			550		mV
Temperature Sensitivity	TCV_{TEMP}			1.96		mV/°C

[1] The long term stability specification is noncumulative. The drift in subsequent 1,000 hour periods is significantly lower than in the first 1,000 hour period.

Table 2. ADR02—Electrical Characteristics (V_{IN} = 7 V to 40 V, T_A = 25°C, unless otherwise noted.)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output Voltage	V_O	A Grade	4.995	5.000	5.005	V
Initial Accuracy	V_{OERR}	A Grade			5	mV
					0.1	%
Output Voltage	V_O	B Grade	4.997	5.000	5.003	V
Initial Accuracy	V_{OERR}	B Grade			3	mV
					0.06	%
Temperature Coefficient	TCV_O	A Grade, SOIC-8, –40°C < T_A < +125°C		3	10	ppm/°C
		A Grade, TSOT-5, –40°C < T_A < +125°C			25	ppm/°C
		A Grade, SC70-5, –40°C < T_A < +125°C			25	ppm/°C
		B Grade, SOIC-8, –40°C < T_A < +125°C		1	3	ppm/°C
		B Grade, TSOT-5, –40°C < T_A < +125°C			9	ppm/°C
		B Grade, SC70-5, –40°C < T_A < +125°C			9	ppm/°C
Supply Voltage Headroom	$V_{IN} – V_O$		2			V
Line Regulation	$\Delta V_O/\Delta V_{IN}$	V_{IN} = 10 V to 40 V, –40° < T_A < +125°C		7	30	ppm/V
Load Regulation	$\Delta V_O/\Delta I_{LOAD}$	I_{LOAD} = 0 mA to 10 mA, –40° < T_A < +125°C		40	70	ppm/mA
Quiescent Current	I_{IN}	No Load, –40° < T_A < +125°C		0.65	1	mA
Voltage Noise	$e_{N\ p-p}$	0.1 Hz to 10 Hz		25		µV p-p
Voltage Noise Density	e_N	1 kHz		230		nV/√Hz
Turn-On Settling Time	t_R			4		µs
Long Term Stability[1]	ΔV_O	1,000 Hours		50		ppm
Output Voltage Hysterisis	ΔV_{O_HYS}			70		ppm
Ripple Rejection Ratio	RRR	f_{IN} = 10 kHz		–75		dB
Short Circuit to GND	I_{SC}			30		mA
Voltage Output at TEMP Pin	V_{TEMP}			550		mV
Temperature Sensitivity	TCV_{TEMP}			1.96		mV/°C

[1] The long term stability specification is noncumulative. The drift in subsequent 1,000 hour periods is significantly lower than in the first 1,000 hour period.

Table 3. ADR03—Electrical Characteristics (V_{IN} = 4.5 V to 40 V, T_A = 25°C, unless otherwise noted.)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output Voltage	V_O	A Grade	2.495	2.500	2.505	V
Initial Accuracy	V_{OERR}	A Grade			5	mV
					0.2	%
Output Voltage	V_O	B Grade	2.4975	2.5000	2.5025	V
Initial Accuracy	V_{OERR}	B Grade			2.5	mV
					0.01	%
Temperature Coefficient	TCV_O	A Grade, SOIC-8, −40°C < T_A < +125°C		3	10	ppm/°C
		A Grade, TSOT-5, −40°C < T_A < +125°C			25	ppm/°C
		A Grade, SC70-5, −40°C < T_A < +125°C			25	ppm/°C
		B Grade, SOIC-8, −40°C < T_A < +125°C		1	3	ppm/°C
		B Grade, TSOT-5, −40°C < T_A < +125°C			9	ppm/°C
		B Grade, SC70-5, −40°C < T_A < +125°C			9	ppm/°C
Supply Voltage Headroom	$V_{IN} - V_O$		2			V
Line Regulation	$\Delta V_O/\Delta V_{IN}$	V_{IN} = 5 V to 18 V, −40° < T_A < +125°C		7	30	ppm/V
Load Regulation	$\Delta V_O/\Delta I_{LOAD}$	I_{LOAD} = 0 mA to 10 mA, −40° < T_A < +125°C		25	50	ppm/mA
Quiescent Current	I_{IN}	No Load, −40° < T_A < +125°C		0.65	1	mA
Voltage Noise	$e_{N\ p\text{-}p}$	0.1 Hz to 10 Hz		25		μV p-p
Voltage Noise Density	e_N	1 kHz		105		nV/√Hz
Turn-On Settling Time	t_R			4		μs
Long Term Stability[1]	ΔV_O	1,000 Hours		50		ppm
Output Voltage Hysterisis	ΔV_{O_HYS}			70		ppm
Ripple Rejection Ratio	RRR	f_{IN} = 10 kHz		−75		dB
Short Circuit to GND	I_{SC}			30		mA
Temperature Sensitivity	TCV_{TEMP}			1.96		mV/°C

[1] The long term stability specification is noncumulative. The drift in subsequent 1,000 hour periods is significantly lower than in the first 1,000 hour period.

ABSOLUTE MAXIMUM RATINGS

Table 4. Absolute Maximum Ratings (at 25°C, unless otherwise noted)

Parameter	Rating
Supply Voltage	18 V
Output Short-Circuit Duration to GND	Indefinite
Storage Temperature Range	–65°C to +150°C
Operating Temperature Range	–40°C to +125°C
Junction Temperature Range: KS, UJ, R Packages	–65°C to +150°C
Lead Temperature Range (Soldering, 60 Sec)	300°C

Table 5. Thermal Resistance

Package Type	θ_{JA}[1]	θ_{JC}	Unit
SC70-5 (KS-5)	376	189	°C/W
TSOT-5 (UJ-5)	230	146	°C/W
SOIC-8 (R-8)	130	43	°C/W

[1] θ_{JA} is specified for the worst-case conditions, i.e., θ_{JA} is specified for device soldered in circuit board for surface mount packages.

PARAMETER DEFINITIONS

TEMPERATURE COEFFICIENT

The change of output voltage with respect to operating temperature changes normalized by the output voltage at 25°C. This parameter is expressed in ppm/°C and can be determined by the following equation:

$$TCV_O[\text{ppm/°C}] = \frac{V_O(T_2) - V_O(T_1)}{V_O(25°\text{C}) \times (T_2 - T_1)} \times 10^6$$

where,

$V_O(25°\text{C}) = V_O$ at 25°C

$V_O(T_1) = V_O$ at temperature 1

$V_O(T_2) = V_O$ at temperature 2

LINE REGULATION

The change in output voltage due to a specified change in input voltage. This parameter accounts for the effects of self-heating. Line regulation is expressed in either percent per volt, parts-per-million per volt, or microvolts per volt change in input voltage.

LOAD REGULATION

The change in output voltage due to a specified change in load current. This parameter accounts for the effects of self-heating. Load regulation is expressed in either microvolts per milliampere, parts-per-million per milliampere, or ohms of dc output resistance.

LONG TERM STABILITY

Typical shift of output voltage at 25°C on a sample of parts subjected to a test of 1,000 hours at 25°C:

$$\Delta V_O = V_O(t_0) - V_O(t_1)$$

$$\Delta V_O[\text{ppm}] = \frac{V_O(t_0) - V_O(t_1)}{V_O(t_0)} \times 10^6$$

where,

$V_O(t_0) = V_O$ at 25°C at time 0

$V_O(t_1) = V_O$ at 25°C after 1,000 hours operation at 25°C

THERMAL HYSTERISIS

Defined as the change of output voltage after the device is cycled through temperature from +25°C to −40°C to +125°C and back to +25°C. This is a typical value from a sample of parts put through such a cycle.

$$V_{O\_HYS} = V_O(25°\text{C}) - V_{O\_TC}$$

$$V_{O\_HYS}[\text{ppm}] = \frac{V_O(25°\text{C}) - V_{O\_TC}}{V_O(25°\text{C})} \times 10^6$$

where,

$V_O(25°\text{C}) = V_O$ at 25°C

$V_{O\_TC} = V_O$ at 25°C after temperature cycle at + 25°C to – 40°C to + 125°C and back to + 25°C

NOTES

Input Capacitor

Input capacitors are not required on the ADR01/ADR02/ADR03. There is no limit for the value of the capacitor used on the input, but a 1 μF to 10 μF capacitor on the input will improve transient response in applications where the supply suddenly changes. An additional 0.1 μF in parallel will also help reducing noise from the supply.

Output Capacitor

The ADR01/ADR02/ADR03 do not require output capacitors for stability under any load condition. An output capacitor, typically 0.1 μF, will filter out any low level noise voltage and will not affect the operation of the part. On the other hand, the load transient response can be improved with an additional 1μF to 10 μF output capacitor in parallel. A capacitor here will act as a source of stored energy for sudden increase in load current. The only parameter that will degrade by adding an output capacitor is the turn-on time, and it depends on the size of the capacitor chosen.

TYPICAL PERFORMANCE CHARACTERISTICS

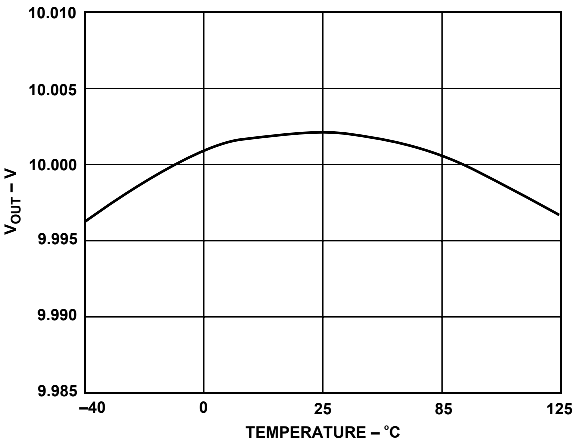

Figure 3. ADR01 Typical Output Voltage vs. Temperature

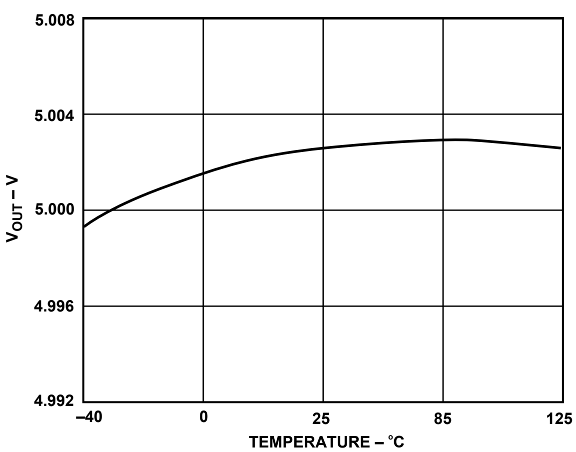

Figure 4. ADR02 Typical Output Voltage vs. Temperature

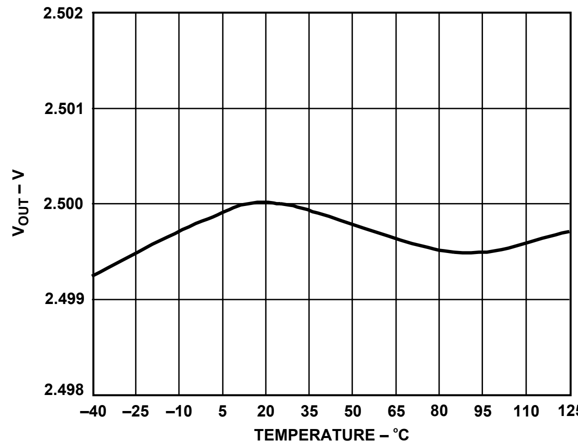

Figure 5. ADR03 Typical Output Voltage vs. Temperature

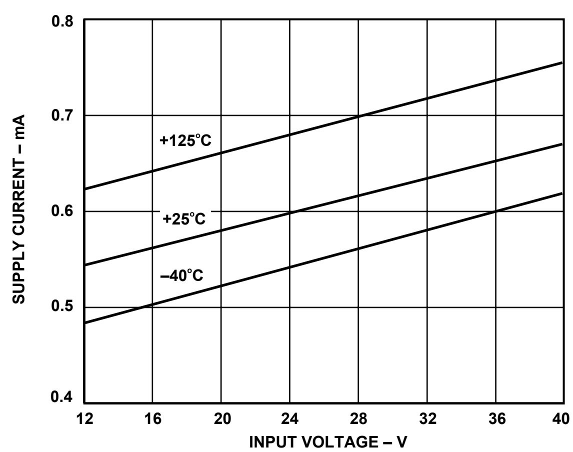

Figure 6. ADR01 Supply Current vs. Input Voltage

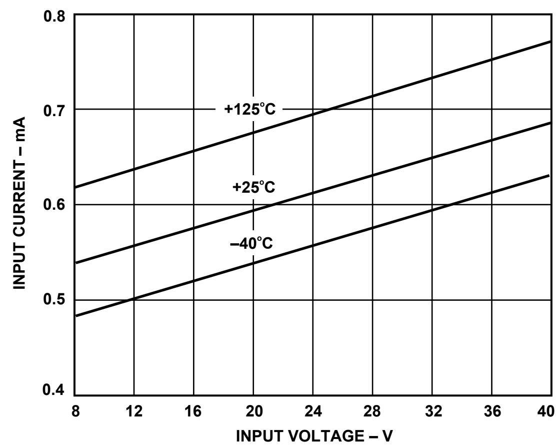

Figure 7. ADR02 Supply Current vs. Input Voltage

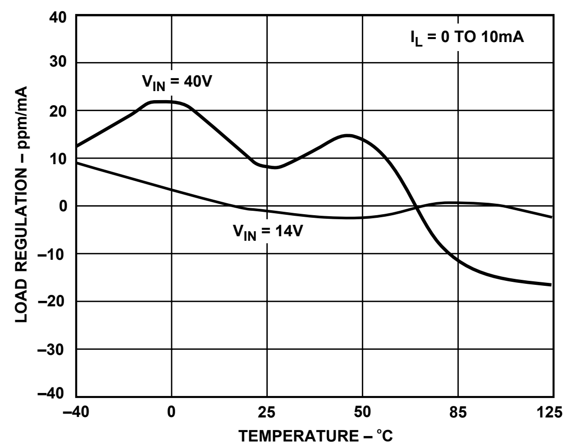

Figure 9. ADR01 Load Regulation vs. Temperature

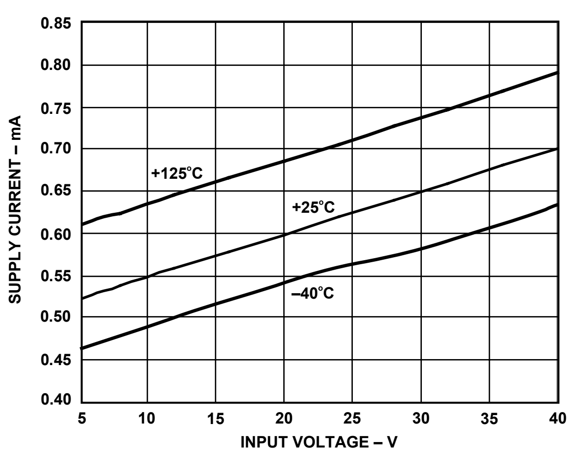

Figure 8. ADR03 Supply Current vs. Input Voltage

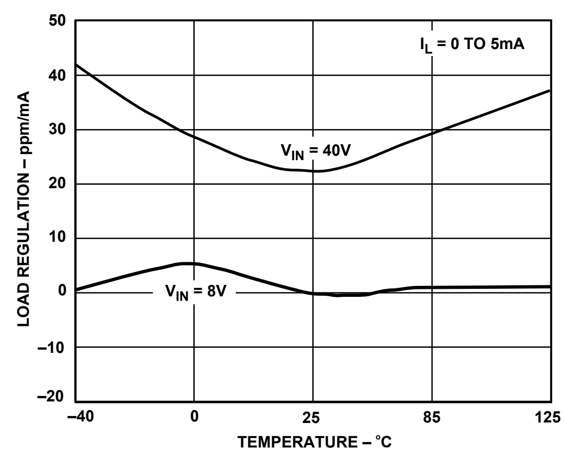

Figure 10. ADR02 Load Regulation vs. Temperature

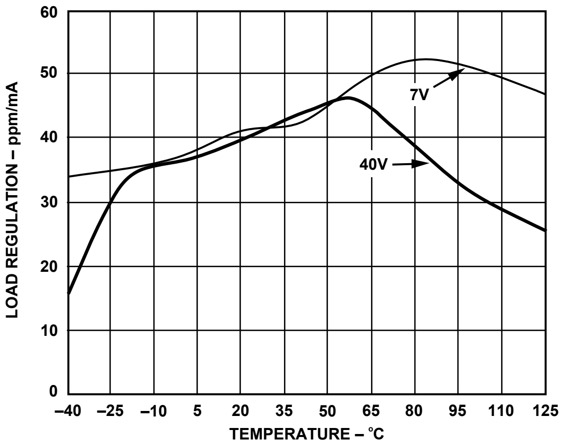

Figure 11. ADR03 Load Regulation vs. Temperature

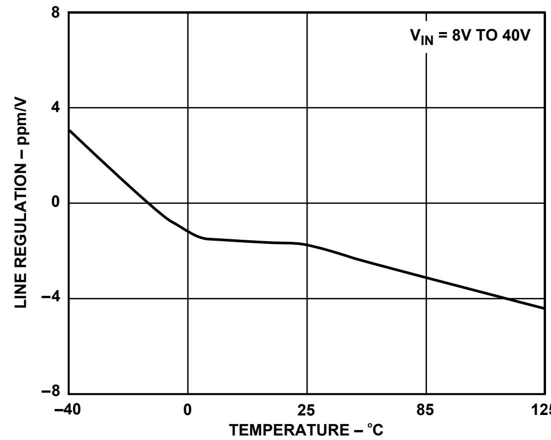

Figure 13. ADR02 Line Regulation vs. Temperature

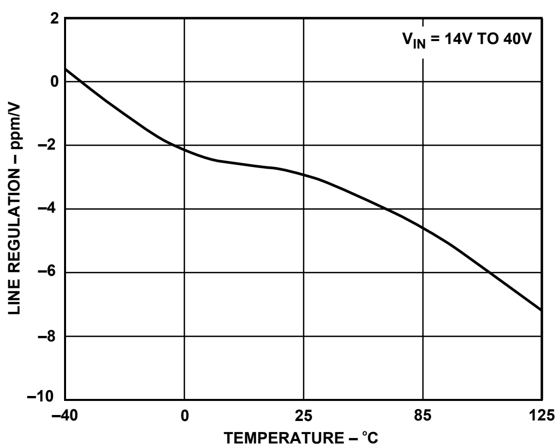

Figure 12. ADR01 Line Regulation vs. Temperature

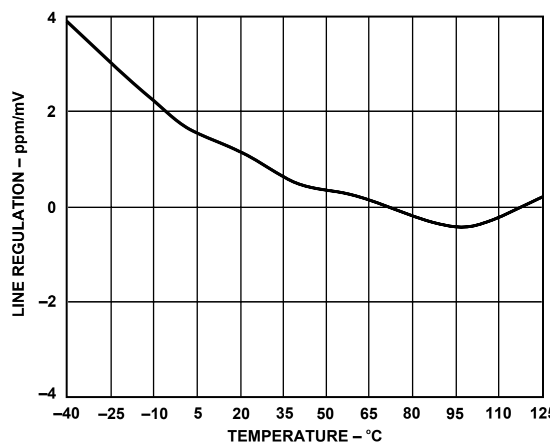

Figure 14. ADR03 Line Regulation vs. Temperature

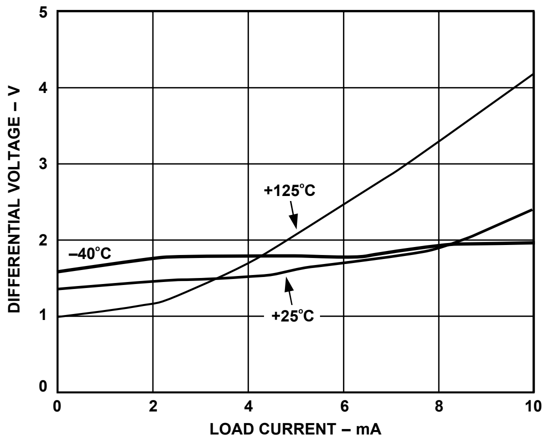

Figure 15. ADR01 Minimum Input-Output Voltage Differential vs. Load Current

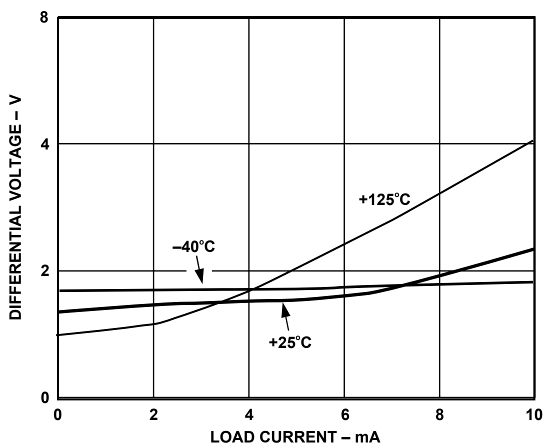

Figure 16. ADR02 Minimum Input-Output Voltage Differential vs. Load Current

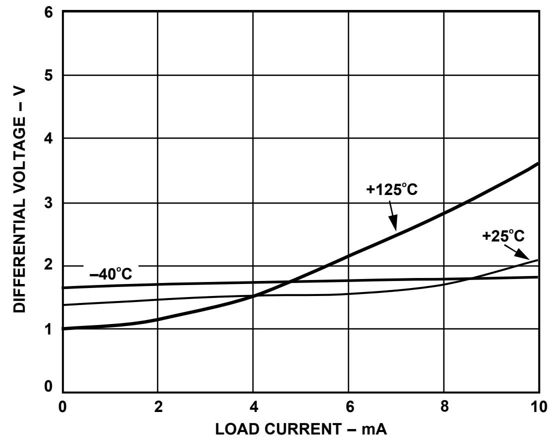

Figure 17. ADR02 Minimum Input-Output Voltage Differential vs. Load Current

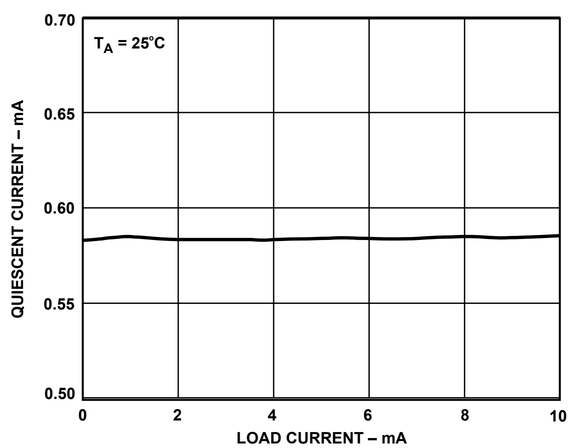

Figure 18. ADR01 Quiescent Current vs. Load Current

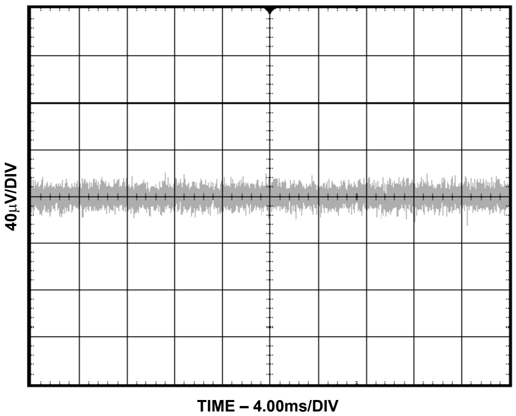

Figure 19. ADR02 Typical Noise Voltage 0.1 Hz to 10 Hz

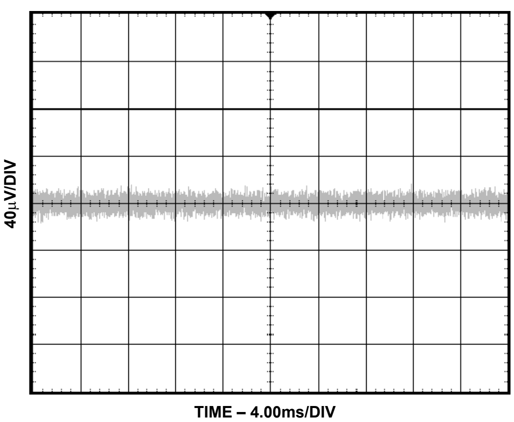

Figure 20. ADR02 Typical Noise Voltage 10 Hz to 10 KHz

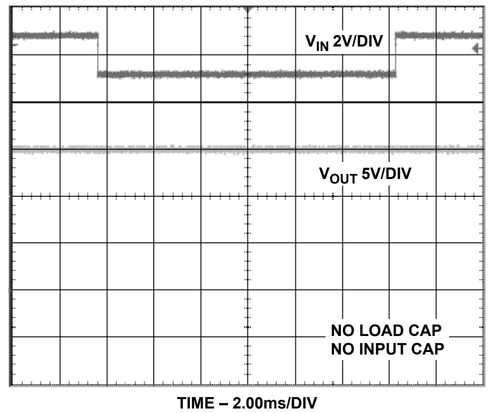

Figure 21. ADR02 Line Transient Response

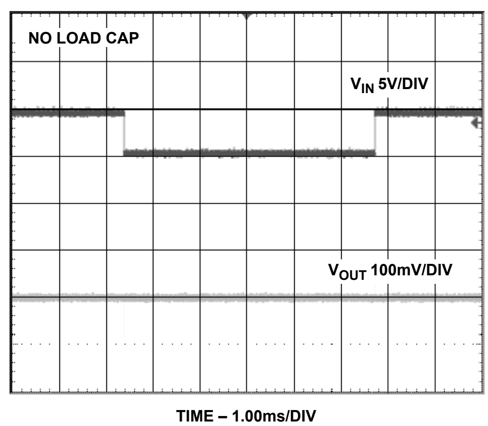

Figure 22. ADR02 Load Transient Response

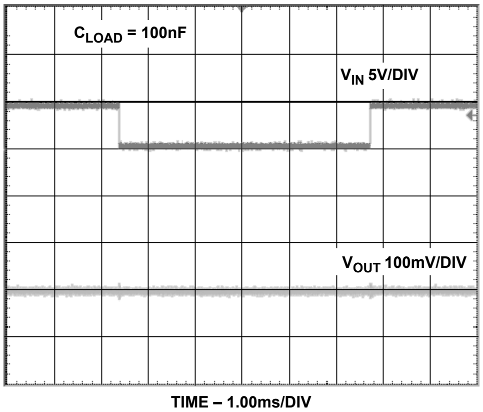

Figure 23. ADR02 Load Transient Response

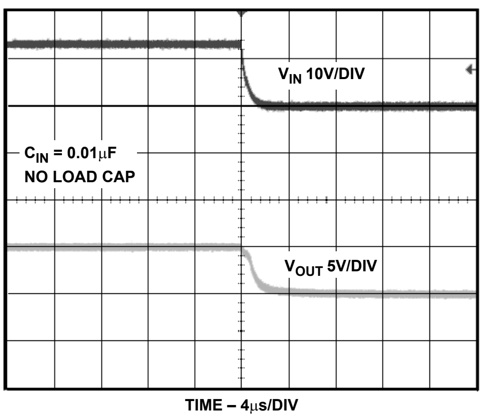

Figure 24. ADR02 Turn-On Response

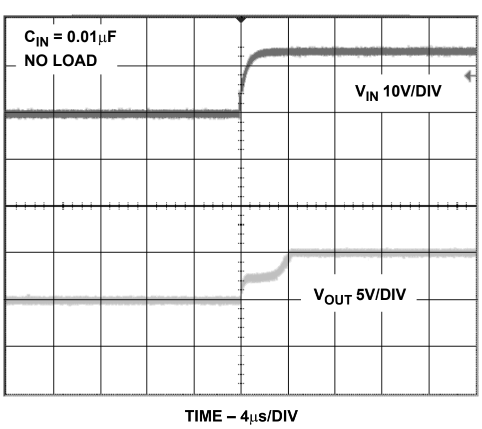

Figure 25. ADR02 Turn-On Response

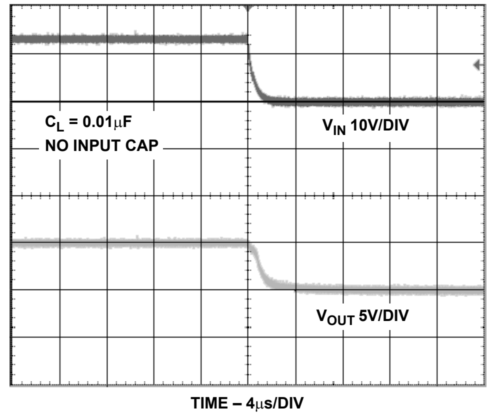

Figure 26. ADR02 Turn-Off Response

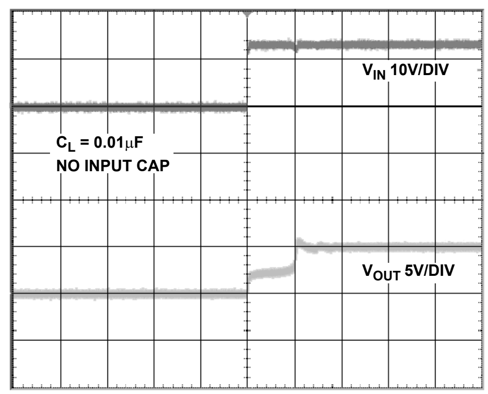

Figure 27. ADR02 Turn-On Response

THEORY OF OPERATION

Introduction

The ADR01/ADR02/ADR03 represent improved versions of the industry standard REF01/REF02/REF03 10 V, 5 V, and 2.5 V voltage references with higher precision, lower drift, and smaller footprint. The SOIC-8 version of the ADR01/ADR02/ADR03 is a drop-in replacement of the REF01/REF02/REF03 sockets with improved cost and performance.

The ADR01/ADR02/ADR03 are standard band gap references. The band gap cell contains two NPN transistors (Q18 and Q19) that differ in emitter area by 2×. The difference in their V_{BE} produces a Proportional to Absolute Temperature (PTAT) current in R14, when combined with the V_{BE} of Q19, produces a band gap voltage V_{BG} that is almost constant in temperature. With an internal op amp and the feedback network of R5 and R6, V_O is set precisely at 10 V, 5 V, and 2.5 V for the ADR01, ADR02, and ADR03, respectively. Precision laser trimming of the resistors and other proprietary circuit techniques are used to further enhance the initial accuracy, temperature curvature, and drift performance of the ADR01/ADR02/ADR03.

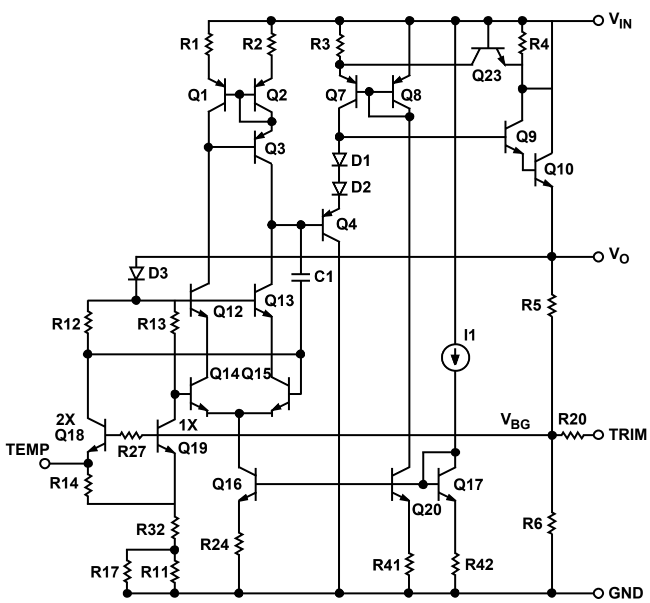

Figure 28. Simplified Schematic Diagram

The PTAT voltage is made available at the TEMP pin of the ADR01/ADR02/ADR03. It has a stable 1.96 mV/°C temperature coefficient, such that users can estimate the temperature change of the device by knowing the voltage change at the TEMP pin.

Applying the ADR01/ADR02/ADR03

The ADR01/ADR02/ADR03 can be used without any external components to achieve the specified performance. Because of the internal op amp amplifying the band gap cell to 10 V/5 V/2.5 V, power supply decoupling will help the transient response of the ADR01/ADR02/ADR03. As a result, a 0.1 μF ceramic type decoupling capacitor should be applied as close as possible to the input and output pins of the device. An optional 1 μF to 10 μF bypass capacitor can also be applied at the V_{IN} node to maintain the input under transient disturbance.

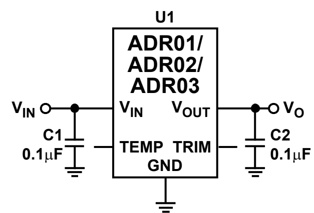

Figure 29. Basic Configuration

OUTPUT ADJUSTMENT

The ADR01/ADR02/ADR03 trim terminal can be used to adjust the output voltage over a nominal voltage. This feature allows a system designer to trim system errors by setting the reference to a voltage other than 10 V/5 V/2.5 V. For finer adjustment, a series resistor of 470 kΩ can be added. With the configuration shown in Figure 30, the ADR01 can be adjusted from 9.70 V to 10.05 V, the ADR02 can be adjusted from 4.95 V to 5.02 V, and the ADR03 can be adjusted from 2.3 V to 2.8 V. Adjustment of the output does not significantly affect the temperature performance of the device, provided the temperature coefficients of the resistors are relatively low.

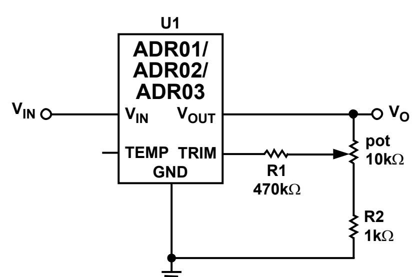

Figure 30. Optional Trim Adjustment

TEMPERATURE MONITORING

As described previously, the ADR01/ADR02/ADR03 provide a TEMP output (Pin 3) that varies linearly with temperature. This output can be used to monitor the temperature change in the system. The voltage at V_{TEMP} is approximately 550 mV at 25°C, and the temperature coefficient is approximately 1.96 mV/°C (see Figure 31).

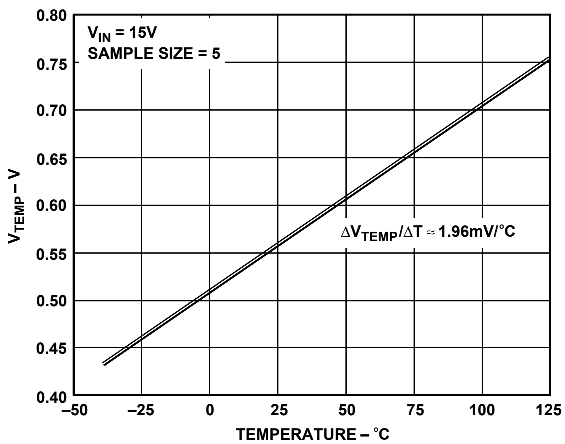

Figure 31. Voltage at TEMP Pin vs. Temperature

A voltage change of 39.2 mV at the TEMP pin corresponds to a 20°C change in temperature.

The TEMP function is provided as a convenience rather than a precise feature. Since the voltage at the TEMP node is acquired from the band gap core, current pulling from this pin will have a significant effect on V_{OUT}. Care must be taken to buffer the TEMP output with a suitable low bias current op amp, such as the AD8601, AD820, or OP1177 (all of which would result in less than a 100 μV change in ΔV_{OUT}) (see Figure 32). Without buffering, even tens of mircoamps drawn from the TEMP pin can cause V_{OUT} to fall out of specification.

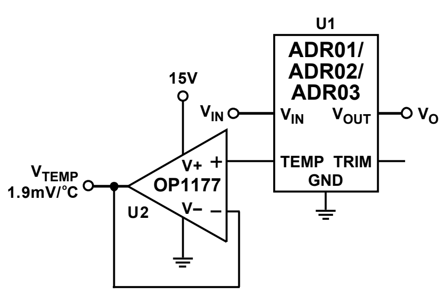

Figure 32. Temperature Monitoring

Applications

NEGATIVE REFERENCE

Without using any matching resistors, a negative reference can be configured as shown in Figure 33. For the ADR01, the voltage difference between V_{OUT} and GND is 10 V. Since V_{OUT} is at virtual ground, U2 will close the loop by forcing the GND pin to be the negative reference node. U2 should be a precision op amp with a low offset voltage characteristic.

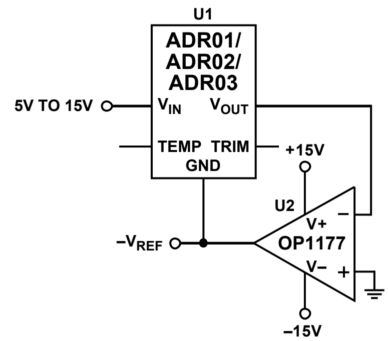

Figure 33. Negative Reference

LOW COST CURRENT SOURCE

Unlike most references, the ADR01/ADR02/ADR03 employ an NPN Darlington in which the quiescent current remains constant with respect to the load current (see Figure 18). As a result, a current source can be configured as shown in Figure 34 where $I_{SET} = (V_{OUT} - V_L)/R_{SET}$. I_L is simply the sum of I_{SET} and I_Q. Although simple, I_Q varies typically from 0.55 mA to 0.65 mA, limiting this circuit to general purpose applications.

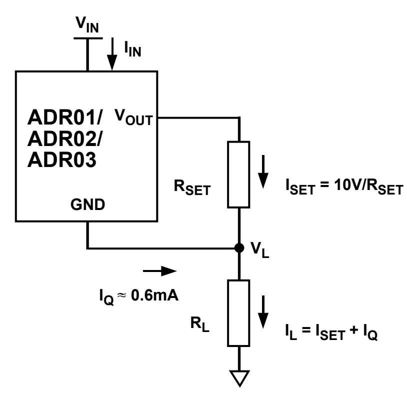

Figure 34. Low Cost Current Source

PRECISION CURRENT SOURCE WITH ADJUSTABLE OUTPUT

A precision current source, on the other hand, can be implemented with the circuit shown in Figure 35. By adding a mechanical or digital potentiometer, this circuit becomes an adjustable current source. If a digital potentiometer is used, the load current is simply the voltage across terminals B-to-W of the digital potentiometer divided by R_{SET},

$$I_L = \frac{V_{REF} \times D}{R_{SET}} \quad (1)$$

where D is the decimal equivalent of the digital potentiometer input code.

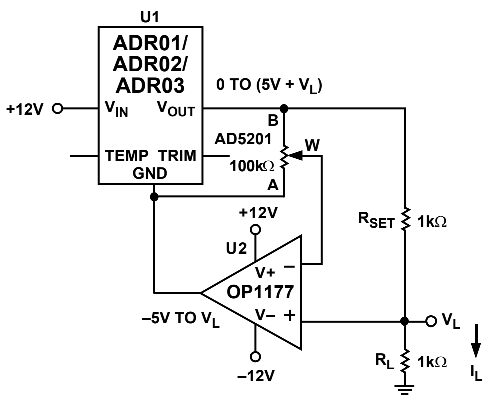

Figure 35. Programmable 0-to-5mA Current Source

To optimize the resolution of this circuit, dual supply op amps should be used, because the ground potential of ADR02 can swing from –5 V at zero scale to V_L at full scale of the potentiometer setting.

PROGRAMMABLE 4–20 mA CURRENT TRANSMITTER

Because of their precision, adequate current handling, and small footprint, the ADR01/ADR02/ADR03 are suitable as the reference sources for many high performance converter circuits. One of these applications is the multichannel 16-bit 4–20 mA current transmitter in the industrial control market (see Figure 36). This circuit employs a Howland Current Pump at the output, which yields better efficiency, less component count, and higher voltage compliance than the conventional design with op amps and MOSFETs. In this circuit, if the resistors are matched such that R1 = R1′, R2 = R2′, R3 = R3′, the load current is:

$$I_L = \frac{(R2 + R3)/R1}{R3'} \times \frac{V_{REF} \times D}{2^N} \quad (2)$$

where D is similarly the decimal equivalent of the DAC input code and N is the number of bits of the DAC.

According to Equation 2, R3′ can be used to set the sensitivity. R3′ can in fact be made as small as necessary to achieve the current needed within U4 output current driving capability. On the other hand, other resistors can be kept high to conserve power.

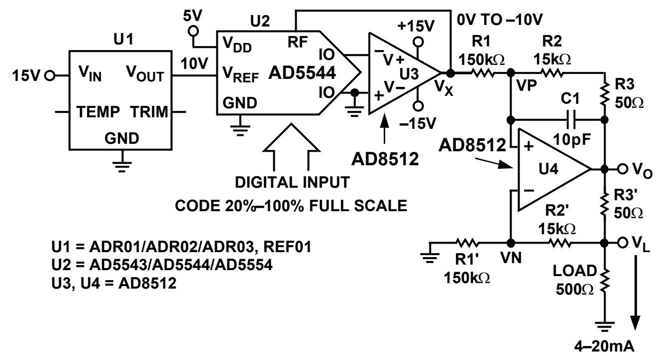

Figure 36. Programmable 4–20 mA Transmitter

In this circuit, the AD8512 is capable of delivering 20 mA of current, and the voltage compliance approaches 15 V.

The Howland Current Pump yields a potentially infinite output impedance, which is highly desirable, but resistance matching is critical in this application. The output impedance can be determined using Equation 3. As can be seen by this equation, if the resistors are perfectly matched, Z_O is infinite. On the other hand, if they are not matched, Z_O will be either positive or negative. If the latter is true, oscillation may occur. For this reason, a capacitor C1, in the range of 1 pF to 10 pF should be connected between VP and the output terminal of U4, to filter any oscillation.

$$Z_O = \frac{V_t}{I_t} = \frac{R1'}{\left(\frac{R1'R2}{R1R2'} - 1\right)} \quad (3)$$

In this circuit, an ADR01 provides the stable 10.000 V reference for the AD5544 quad 16-bit DAC. The resolution of the adjustable current is 0.3 μA/step, and the total worst-case INL error is merely 4 LSB. Such error is equivalent to 1.2 μA or 0.006% system error, which is well below most systems' requirements. The result is shown in Figure 37 with measurement taken at 25°C and 70°C: total system error of 4 LSB at both 25°C and 70°C.

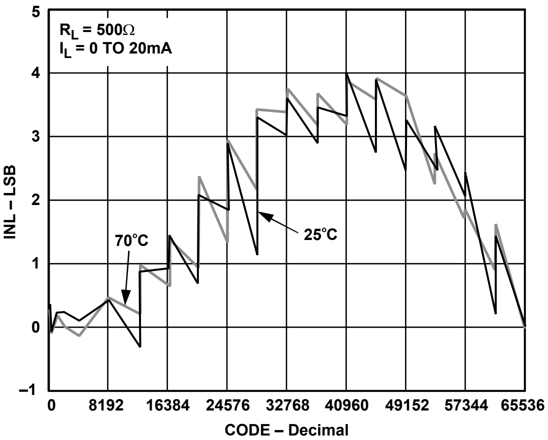

Figure 37. Result of Programmable 4–20 mA Current Transmitter

PRECISION BOOSTED OUTPUT REGULATOR

A precision voltage output with boosted current capability can be realized with the circuit shown in Figure 38. In this circuit, U2 forces V_O to be equal to V_{REF} by regulating the turn-on of N1, thereby making the load current furnished by V_{IN}. In this configuration, a 50 mA load is achievable at V_{IN} of 15 V. Moderate heat will be generated on the MOSFET, and higher current can be achieved with a replacement of a larger device. In addition, for a heavy capacitive load with a fast edging input signal, a buffer should be added at the output to enhance the transient response.

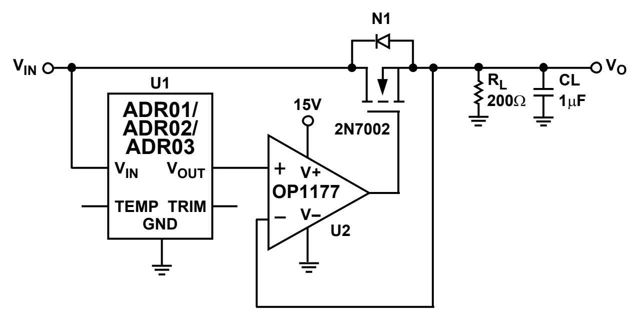

Figure 38. Precision Boosted Output Regulator

OUTLINE DIMENSIONS

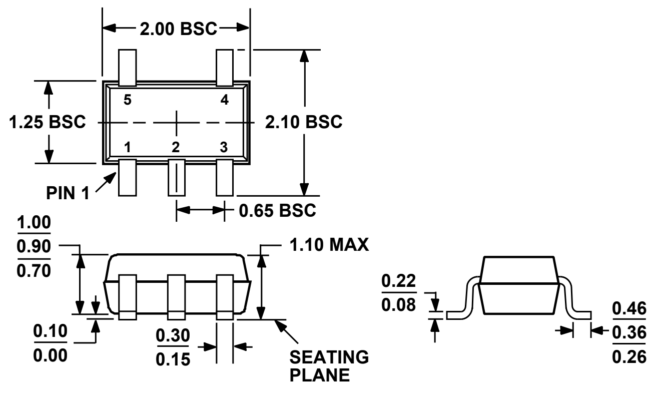

Figure 39. 5-Lead [SC70] Plastic Surface-Mount Package (KS-5) Dimensions Shown in Millimeters

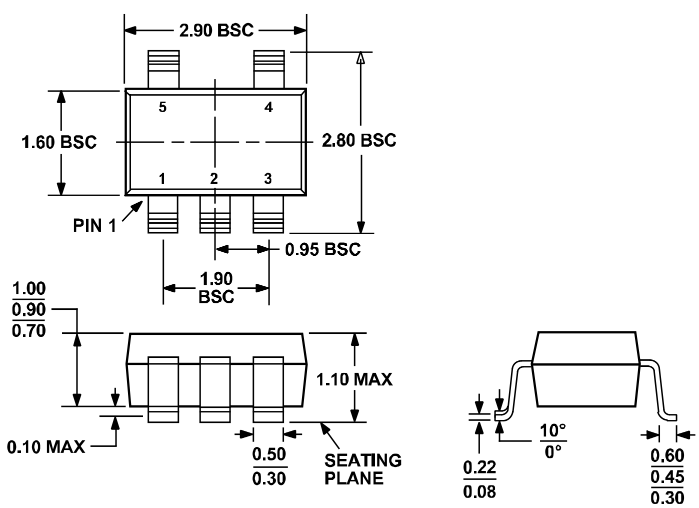

Figure 40. 5-Lead [TSOT-5] Thin Small Outline Transistor Package (UJ-5) Dimensions Shown in Millimeters

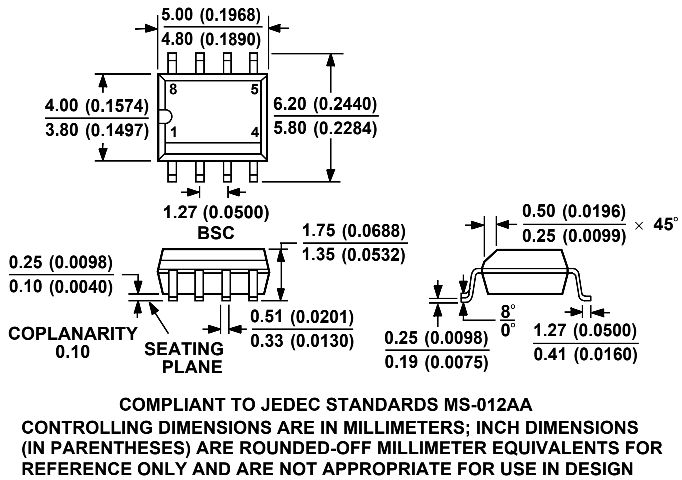

Figure 41. 8-Lead [SOIC] Standard Small Outline Package
(R-8)
Dimensions Shown in Millimeters and (Inches)

ESD CAUTION

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although these products feature proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.

ORDERING GUIDE

Table 6.

ADR01/ADR02/ADR03 Product	Output Voltage	Initial Accuracy		Temperature Coefficient	Package Description	Package Option	Top Mark[1]	No. of Parts per Reel	Temperature Range
	V_O (V)	(mV)	(%)	(ppm/°C)					(°C)
ADR01AR	10	10	0.1	10	SOIC-8	R-8	ADR01	98	–40 to +125
ADR01AR-REEL7	10	10	0.1	10	SOIC-8	R-8	ADR01	1,000	–40 to +125
ADR01BR	10	5	0.05	3	SOIC-8	R-8	ADR01	98	–40 to +125
ADR01BR-REEL7	10	5	0.05	3	SOIC-8	R-8	ADR01	1,000	–40 to +125
ADR01AUJ-REEL7	10	10	0.1	25	TSOT-5	UJ-5	R8A	3,000	–40 to +125
ADR01BUJ-REEL7	10	5	0.05	9	TSOT-5	UJ-5	R8B	3,000	–40 to +125
ADR01AKS-REEL7	10	10	0.1	25	SC70	KS-5	R8A	3,000	–40 to +125
ADR01BKS-REEL7	10	5	0.05	9	SC70	KS-5	R8B	3,000	–40 to +125
ADR02AR	5	5	0.1	10	SOIC-8	R-8	ADR02	98	–40 to +125
ADR02AR-REEL7	5	5	0.1	10	SOIC-8	R-8	ADR02	1,000	–40 to +125
ADR02BR	5	3	0.06	3	SOIC-8	R-8	ADR02	98	–40 to +125
ADR02BR-REEL7	5	3	0.06	3	SOIC-8	R-8	ADR02	1,000	–40 to +125
ADR02AUJ-REEL7	5	5	0.1	25	TSOT-5	UJ-5	R9A	3,000	–40 to +125
ADR02BUJ-REEL7	5	3	0.06	9	TSOT-5	UJ-5	R9B	3,000	–40 to +125
ADR02AKS-REEL7	5	5	0.1	25	SC70	KS-5	R9A	3,000	–40 to +125
ADR02BKS-REEL7	5	3	0.06	9	SC70	KS-5	R9B	3,000	–40 to +125
ADR03AR	2.5	5	0.2	10	SOIC-8	R-8	ADR03	98	–40 to +125
ADR03AR-REEL7	2.5	5	0.2	10	SOIC-8	R-8	ADR03	1,000	–40 to +125
ADR03BR	2.5	2.5	0.1	3	SOIC-8	R-8	ADR03	98	–40 to +125
ADR03BR-REEL7	2.5	2.5	0.1	3	SOIC-8	R-8	ADR03	1,000	–40 to +125
ADR03AUJ-REEL7	2.5	5	0.2	25	TSOT-5	UJ-5	RFA	3,000	–40 to +125
ADR03BUJ-REEL7	2.5	2.5	0.1	9	TSOT-5	UJ-5	RFB	3,000	–40 to +125
ADR03AKS-REEL7	2.5	5	0.1	25	SC70	KS-5	RFA	3,000	–40 to +125
ADR03BKS-REEL7	2.5	2.5	0.1	9	SC70	KS-5	RFB	3,000	–40 to +125

[1] First line shows part number ADR0x. Second line shows A or B for the grade, with the YYMM date code. Third line shows the lot number.

Printed in the U.S.A. C02747-0-2/03(B)