APPENDIX

ACCURACIES OF THE AD590

Maximum errors over limited temperature spans, with $V_S = +5V$, are listed by device grade in the following tables. The tables reflect the worst-case departures of the AD590 from linearity; they invariably occur at the extremities of the specified temperature range. The trimming conditions for the data in the tables are shown in Figures A-1 and A-2. The data is subject to the considerations in the Notes, which follow the tables.

All errors listed in the tables are ±°C. For example, if ±1°C maximum error is required over the +25°C to +75°C range (i.e., lowest temperature of +25°C and span of 50°C), then the trimming of a J-grade device, using the single-trim circuit (Figure A-1), will result in output having the required accuracy over the stated range. An M-grade device with no trims will have less than ±0.9° error, and an I-grade device with two trims (Figure A-2) will have less than ±0.2° error. If the requirement is for less than ±1.4°C max error, from −25°C to +75°C (100° span from −25°C), it can be satisfied by an M-grade device with no trims, a K-grade device with one trim, or an I-grade device with two trims.

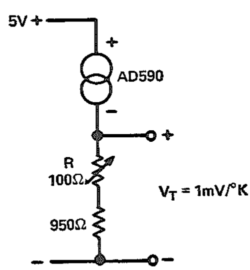
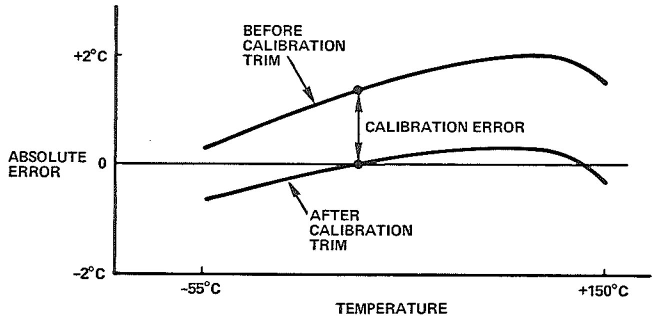
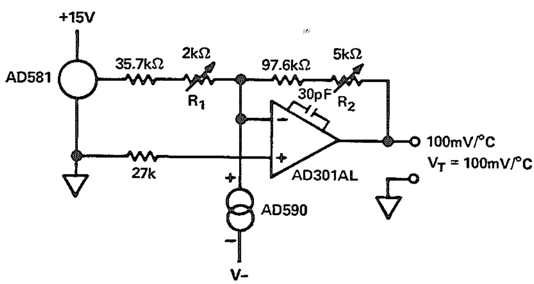


Figure A-1a. Single-trim calibration circuit

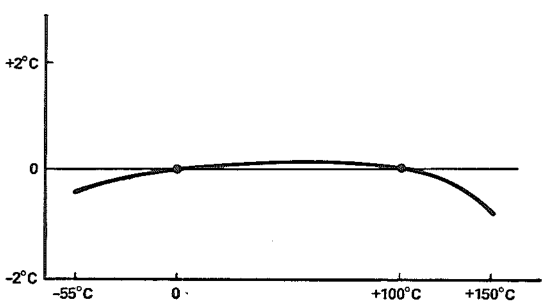


b. Effect of single calibration trim on accuracy

Figure A-1. One-temperature calibration trim



a. Two-temperature trim circuit



b. Typical two-trim accuracy

Figure A-2. Two-temperature offset and gain trim

M GRADE – Maximum Errors, °C

Number Of Trims	Temperature Span – °C	Lowest Temperature In Span – °C							
		-55	-25	0	+25	+50	+75	+100	+125
None	10	0.6	0.5	0.6	0.6	0.7	0.7	0.7	0.9
None	25	0.8	0.8	0.7	0.7	0.8	0.8	1.0	1.1
None	50	1.0	0.9	0.8	0.9	0.9	1.1	1.2	
None	100	1.3	1.4	1.3	1.4	1.5			
None	150	1.5	1.6	1.6					
None	205	1.7							
One	10	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.2
One	25	0.4	0.3	0.2	0.2	0.2	0.2	0.3	0.4
One	50	0.5	0.4	0.3	0.3	0.3	0.4	0.5	
One	100	0.8	0.8	0.7	0.7	0.8			
One	150	0.9	0.9	0.9					
One	205	1.0							
Two	10	0.1	<	<	<	<	<	<	0.1
Two	25	0.1	<	<	<	<	<	<	0.1
Two	50	0.2	<	<	<	<	<	0.2	
Two	100	0.2	0.1	<	0.1	0.2			
Two	150	0.3	0.2	0.3					
Two	205	0.3							

<: Less than ±0.05°C

L GRADE – Maximum Errors, °C

Number Of Trims	Temperature Span – °C	Lowest Temperature In Span – °C							
		-55	-25	0	+25	+50	+75	+100	+125
None	10	1.0	1.0	1.1	1.1	1.2	1.3	1.4	1.6
None	25	1.3	1.3	1.3	1.4	1.5	1.6	1.7	1.9
None	50	1.9	1.8	1.7	1.8	1.9	2.1	2.4	
None	100	2.4	2.4	2.4	2.4	2.7			
None	150	2.7	2.6	2.8					
None	205	3.0							
One	10	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.2
One	25	0.5	0.4	0.3	0.3	0.3	0.3	0.4	0.5
One	50	1.0	0.8	0.6	0.6	0.6	0.8	1.0	
One	100	1.3	1.2	1.1	1.1	1.3			
One	150	1.4	1.3	1.4					
One	205	1.6							
Two	10	0.1	<	<	<	<	<	<	0.1
Two	25	0.1	<	<	<	<	<	<	0.1
Two	50	0.2	<	<	<	<	<	0.2	
Two	100	0.3	0.2	0.1	0.2	0.3			
Two	150	0.3	0.2	0.3					
Two	205	0.4							

<: Less than ±0.05°C

K GRADE – Maximum Errors, °C

Number Of Trims	Temperature Span – °C	Lowest Temperature in Span – °C							
		-55	-25	0	+25	+50	+75	+100	+125
None	10	2.1	2.3	2.5	2.7	2.9	3.1	3.3	3.6
None	25	2.6	2.7	2.8	3.0	3.2	3.5	3.8	4.2
None	50	3.8	3.5	3.4	3.6	3.8	4.3	5.1	
None	100	4.2	4.3	4.4	4.6	5.1			
None	150	4.8	4.8	5.3					
None	205	5.5							
One	10	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.2
One	25	0.6	0.4	0.3	0.3	0.3	0.4	0.5	0.6
One	50	1.2	1.0	0.7	0.7	0.7	1.0	1.2	
One	100	1.5	1.4	1.3	1.3	1.5			
One	150	1.7	1.5	1.7					
One	205	2.0							
Two	10	0.1	<	<	<	<	<	<	0.1
Two	25	0.2	0.1	<	<	<	<	0.1	0.2
Two	50	0.3	0.1	<	<	<	0.1	0.2	
Two	100	0.5	0.3	0.2	0.3	0.7			
Two	150	0.6	0.5	0.7					
Two	205	0.8							

<: Less than ±0.05°C

J GRADE – Maximum Errors, °C

Number Of Trims	Temperature Span – °C	Lowest Temperature In Span – °C							
		-55	-25	0	+25	+50	+75	+100	+125
None	10	4.2	4.6	5.0	5.4	5.8	6.2	6.6	7.2
None	25	5.0	5.2	5.5	5.9	6.0	6.9	7.5	8.0
None	50	6.5	6.5	6.4	6.9	7.3	8.2	9.0	
None	100	7.7	8.0	8.3	8.7	9.4			
None	150	9.2	9.5	9.6					
None	205	10.0							
One	10	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.3
One	25	0.9	0.6	0.5	0.5	0.5	0.6	0.8	0.9
One	50	1.9	1.5	1.0	1.0	1.0	1.5	1.9	
One	100	2.3	2.2	2.0	2.0	2.3			
One	150	2.5	2.4	2.5					
One	205	3.0							
Two	10	0.1	<	<	<	<	<	<	0.1
Two	25	0.2	0.1	<	<	<	<	0.1	0.2
Two	50	0.4	0.2	0.1	<	<	0.1	0.2	<
Two	100	0.7	0.5	0.3	0.7	1.0			
Two	150	1.0	0.7	1.2					
Two	205	1.5							

<: Less than ±0.05°C

I GRADE — Maximum Errors, °C

Number Of Trims	Temperature Span — °C	Lowest Temperature In Span — °C -55	-25	0	+25	+50	+75	+100	+125
None	10	8.4	9.2	10.0	10.8	11.6	12.4	13.2	14.4
None	25	10.0	10.4	11.0	11.8	12.0	13.8	15.0	16.0
None	50	13.0	13.0	12.8	13.8	14.6	16.4	18.0	
None	100	15.2	16.0	16.6	17.4	18.8			
None	150	18.4	19.0	19.2					
None	205	20.0							
One	10	0.6	0.4	0.4	0.4	0.4	0.4	0.4	0.6
One	25	1.8	1.2	1.0	1.0	1.0	1.2	1.6	1.8
One	50	3.8	3.0	2.0	2.0	2.0	3.0	3.8	
One	100	4.8	4.5	4.2	4.2	5.0			
One	150	5.5	4.8	5.5					
One	205	5.8							
Two	10	0.3	0.2	0.1	<	<	0.1	0.2	0.3
Two	25	0.5	0.3	0.2	<	0.1	0.2	0.3	0.5
Two	50	1.2	0.6	0.4	0.2	0.2	0.3	0.7	
Two	100	1.8	1.4	1.0	2.0	2.5			
Two	150	2.6	2.0	2.8					
Two	205	3.0							

<: Less than ±0.05°C

NOTES

1. Accuracy over the 205°C span is tested for all devices by a 4-point measurement, at –55°C, +25°C, +125°C, and +150°C. Maximum errors over other ranges are guaranteed (but not tested), based on the known characteristic behavior of the AD590.

2. For one-trim accuracy specifications, the 205°C span is assumed to be trimmed at +25°C; for all other spans, it is assumed that the device is trimmed at the midpoint.

3. For the 205°C span, it is assumed that the two trim tempertures are in the vicinity of 0°C and +140°C; for all other spans, the specified trims are at the endpoints.

4. In precision applications, the actual errors encountered are usually dependent upon sources of error which are often overlooked in error budgets. These typically include:

   a. Trim error in the calibration technique used
   b. Repeatability error
   c. Long-term drift errors

Trim error is usually the largest error source. This error arises from such causes as poor thermal coupling between the device to be calibrated and the reference sensor; reference sensor errors; lack of adequate time for the device being calibrated to settle to the final temperature; radically different thermal resistances between the case and the surroundings (θ_{CA}) when trimming and when applying the device.

Repeatability errors arise from a strain hysteresis of the package. The magnitude of this error is solely a function of the magnitude of the temperature span over which the device is used. For example, thermal shocks between 0°C and 100°C involve extremely low hysteresis and result in repeatability errors of less than ±0.05°C. When the thermal-shock excursion is widened to –55°C-to-+150°C, the device will typically exhibit a repeatability error of ±0.05°C (±0.10 guaranteed maximum).

Long-term drift errors are related to the average operating temperature and the magnitude of the thermal shocks experienced by the device. Extended use of the AD590 at temperatures above 100°C typically results in long-term drift of ±0.03°C per month; the guaranteed maximum is ±0.10°C/mo. Continuous operation at temperature below 100°C induces no measurable drifts in the device. Besides the effects of operating temperature, the severity of thermal shocks incurred will also affect absolute stability. For thermal-shock excursions less than 100°C, the drift is difficult to measure (<0.03°C). However, for 200°C excursions, the device may drift by as much as ±0.10°C after twenty such shocks. If severe, quick shocks are necessary in the application of the device, realistic simulated life tests are recommended for a thorough evaluation of the error introduced by such shocks.

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DEVICE INDEX

Analog Devices Products mentioned in the the book and their properties are listed in alphabetic, then numerical order, for devices that have alphabetic prefixes (e.g., AD590). Devices with numerical designations or prefixes follow (e.g., 2B31, 261), in numerical order. In general, suffixes designating options are omitted.

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GENERAL INDEX

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