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Accuracies of the AD590

INTRODUCTION

Table 1 to Table 5 contain maximum errors by grade for applications involving limited temperature spans. Table 1 to Table 5 reflect the worst-case nonlinearities of the AD590, which invariably occur at the ends of the specified temperature range. The trims in each table refer to the error correction circuits shown in Figure 1 and Figure 2. All accuracies shown in Table 1 to Table 5 are in ±°C. For example, if ±1°C accuracy is required over the +25°C to +75°C temperature range, trimming a J grade device using the corresponding circuit as shown in Figure 1 results in a sensor of the required accuracy and range.

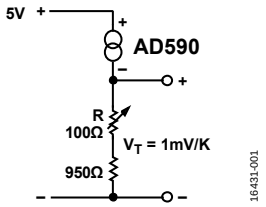

Figure 1. One Temperature Trim Circuit

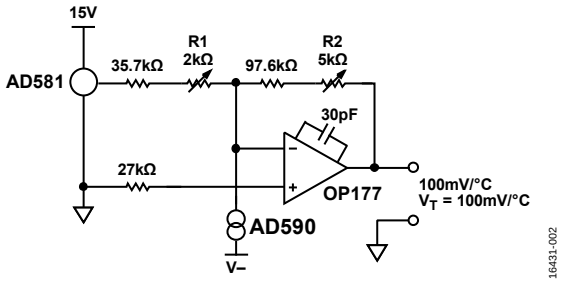

Figure 2. Two Temperature Trim Circuit

Table 1. Worst-Case Nonlinearities of the AD590, M Grade

		Lowest Temperature in Span (°C)							
Number of Trims	**Temperature Span (°C)**	**−55**	**−25[1]**	**0[1]**	**+25[1]**	**+50[1]**	**+75[1]**	**+100[1]**	**+125[1]**
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	≤0.05	≤0.05	≤0.05	≤0.05	≤0.05	≤0.05	0.1
Two	25	0.1	≤0.05	≤0.05	≤0.05	≤0.05	≤0.05	≤0.05	0.1
Two	50	0.2	≤0.05	≤0.05	≤0.05	≤0.05	≤0.05	0.2	
Two	100	0.2	0.1	≤0.05	0.1	0.2			
Two	150	0.3	0.2	0.3					
Two	205	0.3							

[1] Empty cells indicate that the value for the particular cell does not represent the lowest temperature in the span.

Table 2. Worst-Case Nonlinearities of the AD590, L Grade

		Lowest Temperature in Span (°C)							
Number of Trims	**Temperature Span (°C)**	**−55**	**−25[1]**	**0[1]**	**+25[1]**	**+50[1]**	**+75[1]**	**+100[1]**	**+125[1]**
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	0.9	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	≤0.05	≤0.05	≤0.05	≤0.05	≤0.05	≤0.05	0.1
Two	25	0.1	≤0.05	≤0.05	≤0.05	≤0.05	≤0.05	≤0.05	0.1
Two	50	0.2	≤0.05	≤0.05	≤0.05	≤0.05	≤0.05	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							

[1] Empty cells indicate that the value for the particular cell does not represent the lowest temperature in the span.

Table 3. Worst-Case Nonlinearities of the AD590, K Grade

		Lowest Temperature in Span (°C)							
Number of Trims	**Temperature Span (°C)**	**−55**	**−25[1]**	**0[1]**	**+25[1]**	**+50[1]**	**+75[1]**	**+100[1]**	**+125[1]**
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	≤0.05	≤0.05	≤0.05	≤0.05	≤0.05	≤0.05	0.1
Two	25	0.2	0.1	≤0.05	≤0.05	≤0.05	≤0.05	0.1	0.2
Two	50	0.3	0.1	≤0.05	≤0.05	≤0.05	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							

[1] Empty cells indicate that the value for the particular cell does not represent the lowest temperature in the span.

Table 4. Worst-Case Nonlinearities of the AD590, J Grade

		Lowest Temperature in Span (°C)							
Number of Trims	**Temperature Span (°C)**	**−55**	**−25[1]**	**0[1]**	**+25[1]**	**+50[1]**	**+75[1]**	**+100[1]**	**+125[1]**
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	69	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	≤0.05	≤0.05	≤0.05	≤0.05	≤0.05	≤0.05	0.1
Two	25	0.2	0.1	≤0.05	≤0.05	≤0.05	≤0.05	0.1	0.2
Two	50	0.4	0.2	0.1	≤0.05	≤0.05	0.1	0.2	≤0.05
Two	100	0.7	0.5	0.3	0.7	1.0			
Two	150	1.0	0.7	1.2					
Two	205	1.5							

[1] Empty cells indicate that the value for the particular cell does not represent the lowest temperature in the span.

Table 5. Worst-Case Nonlinearities of the AD590, I Grade

		Lowest Temperature in Span (°C)							
Number of Trims	**Temperature Span (°C)**	**−55**	**−25[1]**	**0[1]**	**25[1]**	**50[1]**	**75[1]**	**100[1]**	**125[1]**
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	≤0.05	≤0.05	0.1	0.2	0.3
Two	25	0.5	0.3	0.2	≤0.05	01	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							

[1] Empty cells indicate that the value for the particular cell does not represent the lowest temperature in the span.

NOTES

All accuracies excluding the +205°C span are guaranteed, not tested; the +205°C span accuracies are tested for by testing each device at −55°C, +25°C, +125°C, and +150°C.

All one trim accuracies, excluding the 205°C span, assume that the trim is made at the midpoint in the span; the 205°C span assumes a trim at 25°C.

All two trim accuracies, excluding the 205°C span, assume that the trims are made at the endpoints of the span; the 205°C span assumes that trims are made at approximately 0°C and 140°C.

All accuracies exclude the following:

- Trim error in calibration technique used
- Repeatability error
- Long-term drift errors

In precision applications, the actual errors encountered are usually dependent upon sources of error that are often overlooked in error budgets.

Trim error is usually the largest error source. This error arises from the following sources:

- Poor thermal coupling between the device to be calibrated and the reference sensor
- Reference sensor errors
- Device to be calibrated not permitted to thermally settle
- The thermal resistance between the case and the surroundings, which is determined by the characteristics of the thermal connection (θ_{CA}), is radically different for the trim and the application

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 result in an extremely low hysteresis, for a repeatability error of less than ±0.05°C. When the thermal shocks are widened to −55°C and +150°C, the device typically exhibits a repeatability of ±0.05°C, with ±0.10°C maximum being guaranteed.

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 device at temperatures above +100°C typically results in a long term drift of ±0.03°C; the guaranteed maximum is ±0.10°C. Operating temperatures below 100°C induce no measurable drifts in the device. In addition to operating temperature, the severity of the thermal shocks incurred determines the absolute stability of the device. For thermal shock spans of less than 100°C, the drift is difficult to measure (<0.03°C). However, for +200°C spans, the device can drift by as much as ±0.10°C after 20 such shocks. If this drift is severe, quick shocks are necessary in the application of the device, it is recommended to run simulated life tests for a thorough evaluation of the error introduced by such shocks.

REVISION HISTORY

2/2018—Rev. 0 to Rev. A

4/1998—Revision 0: Initial Version

AN16431-0-2/18(A)