

## Introduction

This Tech Brief will show how the HI7188 can be set to operate at gains other than those listed in the data sheet [1]. The HI7188 is a very versatile device and as such can be programmed to easily operate over several standard gains. These are integer gains of 1, 2, 4, and 8. Although these gains are adequate for many uses, it leaves gaps of some useful non-standard gains such as 5 and 10 along with non-integer values.

The standard calibration procedure is to perform offset calibration followed by positive and negative gain calibration with the device programmed with the desired gain [2]. The input conditions are “zero scale”, “positive full scale” and “negative full scale” respectively. For simplicity, we will assume the positive and negative full scale points are the same magnitude and will refer to it as full scale ( $F_S$ ). The  $F_S$  value is defined as  $V_{REF}/Gain$ . For example: Using a standard internal gain of 8 and a reference voltage ( $V_{REF}$ ) of 2.5V, the  $F_S$  calibration voltage would be  $F_S = 2.5V/8 = 0.3125V$ .

To achieve the non-standard gains, the user must utilize the internal gain and manipulate the gain coefficients. The gain coefficients or gain slope factor will be used to “fine tune” or adjust the final system gain to the desired level. It is imperative that the user be very familiar with the device operation [1] and the calibration techniques [2] to understand this procedure.

To achieve a non-standard gain, the user sets the internal gain to the next lowest internal gain than the desired gain and calibrates at the system FS. For example: To achieve a gain of 10, first program the HI7188 to the next lowest gain than the desired gain, eight in this case, then calibrate at the system FS which is  $F_S = V_{REF}/Gain$  or  $2.5V/10 = 0.25V$ . Please refer to Table 1 for additional calibration points.

**TABLE 1. FULL SCALE vs GAIN**

SYSTEM GAIN	FULL SCALE ( $F_S$ ) CALIBRATION POINT	INTERNAL GAIN
1	2.5	1
1.5	1.666667	1
2	1.25	2
2.5	1	2
3	0.833333	2
3.5	0.714286	2
4	0.625	4
4.5	0.555556	4
5	0.5	4
5.5	0.454545	4
6	0.416667	4
6.5	0.384615	4
7	0.357143	4
7.5	0.333333	4
8	0.3125	8
8.5	0.294118	8
9	0.277778	8
9.5	0.263158	8
10	0.25	8

In conclusion, this paper discussed techniques to achieve non-standard gains with acceptable bench results. As with any non-standard solution, it is left up to the user to determine if the operating results are adequate in their system given a certain error budget and temperature requirements.

## References

For Intersil documents available on the web, see <http://www.intersil.com/>

- [1] *HI7188 Data Sheet*, Intersil Corporation, FN4016.
- [2] *TB329 Technical Brief*, Intersil Corporation, “Intersil Sigma-Delta Calibration Technique.”

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