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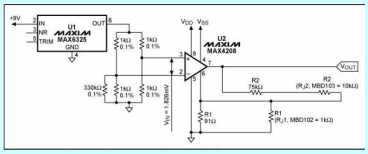

Precision Instrumentation Amplifiers with Rejustors Solve High-Gain Applications

Abstract: This article shows how to use a zero-drift, precision, instrumentation amplifier with a pair of rejustors and gain-setting resistors to ensure high accuracy. The MAX4208 precision instrumentation amplifier serves as the example device. Experiments are described and test results presented.

Introduction

Instrumentation amplifiers are used in a wide variety of applications, some of which interface with sensors that produce small differential signals. In those applications, the instrumentation amplifier needs to provide high and very precise gain, and it must maintain a very low offset voltage. In some conditions the differential signal coming from the sensor is in the order of very few mV, while the amplifier gain can be as high as 1,000.

Some integrated instrumentation amplifiers include gain-setting resistors and are available with a few fixed-gain options. However, when flexibility is needed and the amplified sensor signal must fit within the ADC's full-scale range, then the designer may prefer instrumentation amplifiers whose gain can be adjusted by the ratio of two external resistors. Nonetheless, one should also remember that the performance of even the best precision instrumentation amplifier can be compromised by the accuracy of the external gain-setting resistors.

The best external resistors that offer very high precision over temperature are only available with discrete values. As a result, the combined value of those two resistors may not provide the exact nominal gain value needed for an application. Furthermore, even if resistors were available to provide the exact nominal gain value, still other circuit nonidealities or mismatches might cause the gain to deviate from its ideal nominal value. Ultimately, the real solution for high gain precision lies in adjusting the resistor values.

The ultra-low gain error of the MAX4208 (±0.05% typical and ±0.25% maximum at +25°C) can be compromised by the tolerance of the external resistors. Consequently, to match the performance of the instrumentation amplifier, resistors with tolerance of 0.25% or lower should be used. Resistors with that specification can, however, be even more expensive than the amplifier itself.

The problems of nonadjustable resistors with (often limiting) discrete values and the requirements for low-tolerance values can all be overcome by using rejustors (electronically "readjustable" resistors).

In this application the achieved gain error is better than 0.1%

Conclusion:

In some applications instrumentation amplifiers need to amplify very small signals, therefore precision (ultra-low voltage offset and gain error) and high gain are very critical. Often, the gain is provided by external resistive components. Rejustors which are electrically adjustable continuous-valued passive resistors, provide some key benefits such as adjustability to the exact nominal gain value and precision with lower cost than low-tolerance resistors. Rejustors can either be used alone such to provide a wide range of adjustability or in combination with fixed value resistors. The last case offers the best performance over temperature and stability.

To view the entire application note:
http://www.mbridgetech.com/pdfs/PrecisionAmpsMaxMicro1.pdf

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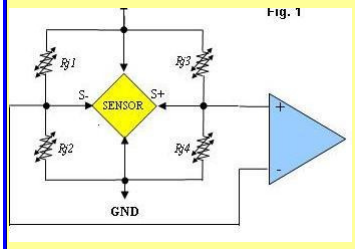
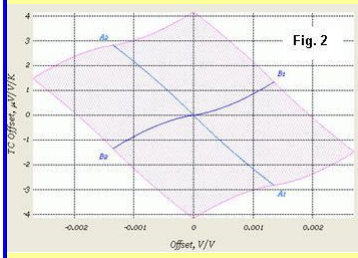
Passive Offset and TC-Offset Compensation for Bridge Sensors

Example: Strain-Gages

Typical strain gage load cells consist of four sensing elements in a bridge configuration, excited by a few volts Vexc, with the differential output voltage (S+ - S-) fed to amplification circuitry. The bridge resistance can be a few hundred ohms (e.g. 300-400ohms). In the manufactured cells, Offsets and TC-Offsets are typically small. (e.g. ±1mV/V, ±3uV/V/C), but not small enough, so it's usually advantageous to reduce them by a compensation/adjustment scheme.



Microbridge's passive eTC Rejustor bridges, such as the MBW-303 Offset Conditioning Network, are designed to allow automated high-precision adjustment of bridge Offset and TC-Offset after assembly of the sensor, during final test. The MBW-303 connects a 30kohm eTC Rejustor in parallel with each sensor-bridge resistor (see Rj1 - Rj4 in Fig. 1), and offers a useful adjustment range. In Fig. 2 below, the shaded region describes the adjustment range, in the space of TC-Offset vs. Offset, for the case of a 300-ohm sensor bridge.



The Offset adjustment precision is typically better than ±20uV/V, and the TC-Offset adjustment precision is usually limited by the ability to measure the TC-Offset in your oven-based test system. Typical improvements in TC-Offset are an order of magnitude or more (e.g. final TC-Offset well below ±0.1uV/V/C). The calibration at zero-stimulus is done in a few seconds, using Microbridge's production calibration tools, MBK-408 or MBK-600. In addition to the MBW-303, Microbridge makes eTC Rejustor bridges over a wide range of resistances, (~50kohm to <5kohm), to accommodate higher-resistance bridges, and/or the needs of wider adjustment ranges. These Rejustors are pure-passive components, do not need any external memory devices, and do not need any power to retain their adjusted values or behave as resistors. Contact Microbridge for eTC-Rejustors to suit the compensation needs of your load cell, or any bridge-sensor.

Interested in seeing a demo of our new Micro Flow Differential Pressure Sensor?

We're still looking for one or two more early adopters who are willing to put our device though its paces.

Microbridge's Rejustor technology allows single-chip integration of a micro-flow sensor, with CMOS signal conditioning circuitry and analog adjustability, in 1.7mm x 2.5mm die-size. This thermo-anemometer-type micro-flow sensor, with very high flow-impedance (e.g. tens of kPa/(ml/s)), allows sensing low differential pressures, (e.g. tens of Pascals FSO to thousands of Pascals FSO), with 0.1Pa resolution. The flow-impedance is pre-defined at the die level and dramatically reduces demands on subsequent packaging.

The sensor's full-scale signal is +/-2V. This full-scale signal corresponds to +/-50Pa of differential pressure. Each mV of sensor signal corresponds to 0.025Pa of differential pressure. (1Pa [Pascal] =0.004 inch H2O)

The micro-flow-based differential pressure sensor can resolve pressures well below 1Pa.

- The micro-flow sensor can easily sense local pressure differences due to elevation changes of a few cm in normal indoor room air. (~1-2 Pa).
- The micro-flow sensor's flow-impedance is very high ➔ in the range ~50kPa/(ml/s).
- Applications include Medical, HVAC, Automotive, Industrial and more.
- If you would like to see a demonstration Microbridge's micro-flow differential pressure sensor, stop by our booth, #511, at the Sensors Expo & Conference Show in Chicago, June 8-10, 2009...

....Or drop us a request at marketing@mbridgetech.com and be sure to include all your contact information.

Investors see bright future in Microbridge and rally behind company's Micro-Flow pressure sensor productization plans

Leveraging on the success of its Rejustor Technology, Microbridge secures funding to build out product line and expand into new markets

Montreal, Québec, - February 3, 2009 - Microbridge Technologies, Inc., the inventor of passive, analog precision calibration products known as Rejustors, announced today it has successfully closed an internal round of funding. Despite the challenges in the current economic climate, Zon Capital Partners, L.P. of New Jersey; BDR Capital Inc. (a spin-out of the Fonds de Solidarité des Travailleurs du Québec); Lothian Partners 27 (Sarl) SICAR of Luxembourg (advised by Multiple Capital, Inc.); and Schneider Electric Ventures of France see Microbridge's future as extremely positive.

"Building upon its portfolio of Rejustor-based precision resistor dividers, Microbridge is at the forefront of a profound shift in accuracy in the manner in which small gas-pressure differentials are measured," said Bill Bridgers, General Partner at Zon Capital Partners. "By continuing to support Microbridge's recent enhancements of its Rejustor technology, we see the company positioning itself to become a leader in sensor chips for many applications, including medical diagnostics, environmental controls such as HVAC and in improving combustion efficiency in automotive engine management systems."

"The company will launch a line of Micro-Flow Pressure Sensors that achieve new levels of performance for a wide range of differential pressures," said Dr. Adam Chowaniec, Chairman of Microbridge Technologies. "With on-chip signal conditioning and amplification, this family of gas pressure sensor chips can address full-scale pressures from tens of Pascal to thousands of Pascal, all with a 0.1 Pascal resolution."

The achievement is founded on in Microbridge's success in combining Rejustor and MEMS technology with on-chip CMOS. Microbridge has achieved pre defined, die level, high pneumatic impedances up to tens of kilo-Pascals, substantially reducing demands on subsequent packaging operations. Pneumatic impedances of this magnitude offer tremendous application advantages. First, it is easier to use gas filters (whose flow impedance is prone to change with contaminant buildup) and not have them affect the performance of the sensor since the sensor element will always remain the high resistance path. Second, long tubing connections do not distort the calibration of the device. Third, the flow-through of the sensor element in shunt configurations becomes significantly easier to protect from contaminants.

"BDR Capital is very impressed with Microbridge's strong record of achievement, and the potential of the Rejustor technology," said Stephane Caron, Partner at BDR Capital, Inc. "We believe Microbridge's chips are going to change the rules of the game in the precision sensing and analog markets by eliminating temperature dependencies, delivering a smaller footprint and decreasing the cost of bringing products to market."

The new pressure sensors from Microbridge will be introduced mid year and are the latest members of the company's Rejustor-based family of products. Rejustors and eTC Rejustors were first announced in 2007 and enable automated, independent adjustment of both resistance and the Temperature Coefficient of Resistance (TCR), providing one to two orders of magnitude performance improvement for many analog designs.

For more information on Rejustors, please click on http://mbridgetech.com/whitepaper.php

About Microbridge Technologies

Microbridge Technologies, Inc. is the leading manufacturer and licensor of next step electronic calibration products and solutions in consumer, automotive, medical and other industries that need to improve manufacturing yields and productivity and enter new markets. Microbridge's resistor calibration products (Rejustor) and enabling technology are the first integrated calibration and temperature compensation systems for analog circuit designs and production. Microbridge's technology enables product designers to achieve one-step calibration and passive adjustment. Rejustors are adaptive and adjustable in circuit, and allow calibration in the analog domain to improve the design of current and future products. Microbridge is a privately held company with headquarters in Montreal, Canada and offices in San Jose, Calif. For more information please visit www.mbridgetech.com

ABOUT MICROBRIDGE

Microbridge is the leading manufacturer and licensor of next step electronic calibration products and solutions in the consumer, automotive, medical and other industries that need to improve manufacturing yields and productivity, and enter new markets. Microbridge's resistor calibration products (Rejustor) and enabling technology are the first integrated calibration and temperature compensation systems for analog electronics design and production. The firm enables manufacturers to: cut scrap up to 50%; reduce in-line manufacturing process steps; eliminate binning, work-arounds, laser trimming, hand-sorting and trim-pots; decrease calibration costs by a factor of 10 without sacrificing performance; and return millions of dollars in production savings.

Microbridge's technology enables product designers to achieve one-step calibration and passive adjustment, is adaptive and adjustable in circuit, and it allows calibration in the analog domain to improve the design of current and future products.

For more information, visit www.mbridgetech.com. Companies with product inquiries can contact Microbridge at sales@mbridgetech.com and licensing inquiries can be answered at license@mbridgetech.com

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