

Contents

1	Introduction.....	2
2	Digital Interface using the ZSC31014	2
3	Analog Interface	3
4	Related Documents.....	4
5	Glossary	4
6	Document Revision History.....	4

List of Figures

Figure 2.1	Gas Sensor Connected to ZSC31014 with Digital Interface	2
Figure 3.1	Gas Sensor Connected to the ZSC31010 with Analog Out	3

1 Introduction

This application note discusses methods for using IDT's ZSC31010 or ZSC31014 Sensor Signal Conditioner ICs (SSCs) to interface with typical gas sensors for the purpose of compensating the sensor signal and outputting the measurement results. Refer to the data sheets for each product for operation details and specifications for the SSCs.

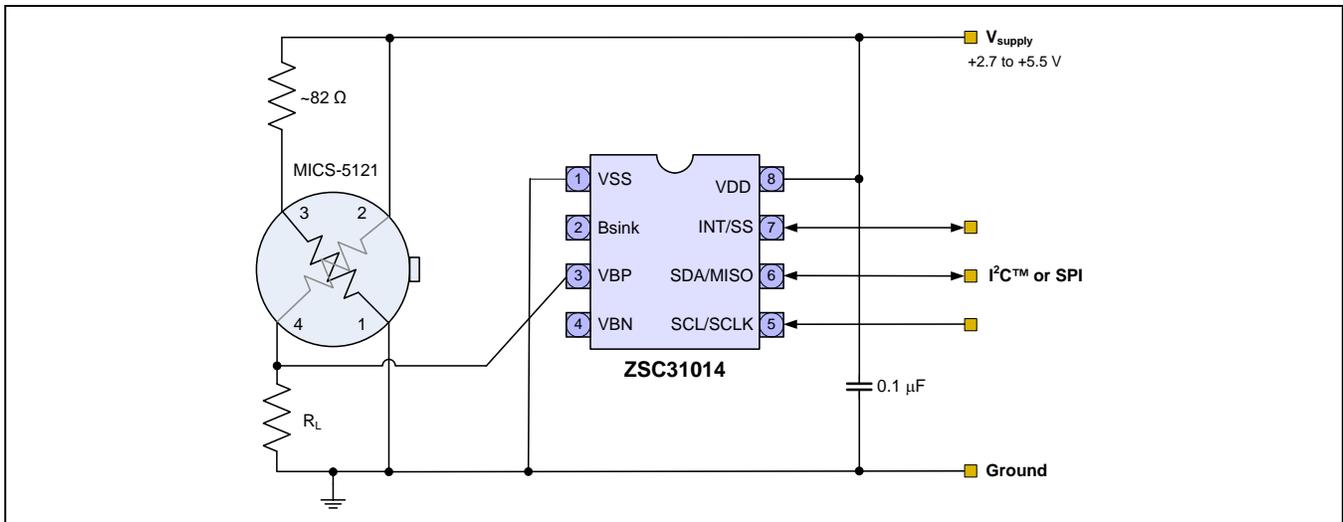
The ZSC31014 is a sensor signal conditioner for highly accurate amplification and analog-to-digital conversion of differential full-bridge and half-bridge input signals. Its operating range is -40°C to 125°C . Measured and corrected bridge values are provided at the ZSC31014's digital output pins, which can be configured as I²C™* or SPI. Section 2 describes an application using the ZSC31014 to compensate the sensor signal from a typical gas sensor via a digital interface.

The ZSC31010 is a sensor signal conditioner for highly accurate amplification and analog-to-digital conversion of differential input signals from a full bridge. It features a wider operating range: -50°C to 150°C . Its output options include rail-to-rail analog output voltage, absolute analog voltage, and digital ZACwire™* one-wire interface (OWI). Section 3 describes an application using the ZSC31010 to compensate the sensor signal from a typical gas sensor via an analog interface.

2 Digital Interface using the ZSC31014

In this application example, the ZSC31014 is used to interface to an SGX SensorTECH®* gas sensor. The gas sensor consists of a heater and a gas sensor element. The heater current is set through an external 82Ω resistor, which roughly matches the resistance of the heater resistor. The gas sensor requires a load resistor to ground (R_L). R_L is selected to set the output range of the sensor element. The sensor element changes resistance when exposed to gas and, in combination with R_L , forms a half bridge.

Figure 2.1 Gas Sensor Connected to ZSC31014 with Digital Interface



* I²C™ is a trademark of NXP. SensorTECH® is a trademark of SGX Sensortech, Ltd. ZACwire™, RBic_{Lite}™, RBic_{Lite}™ and Sig™ are trademarks of IDT.

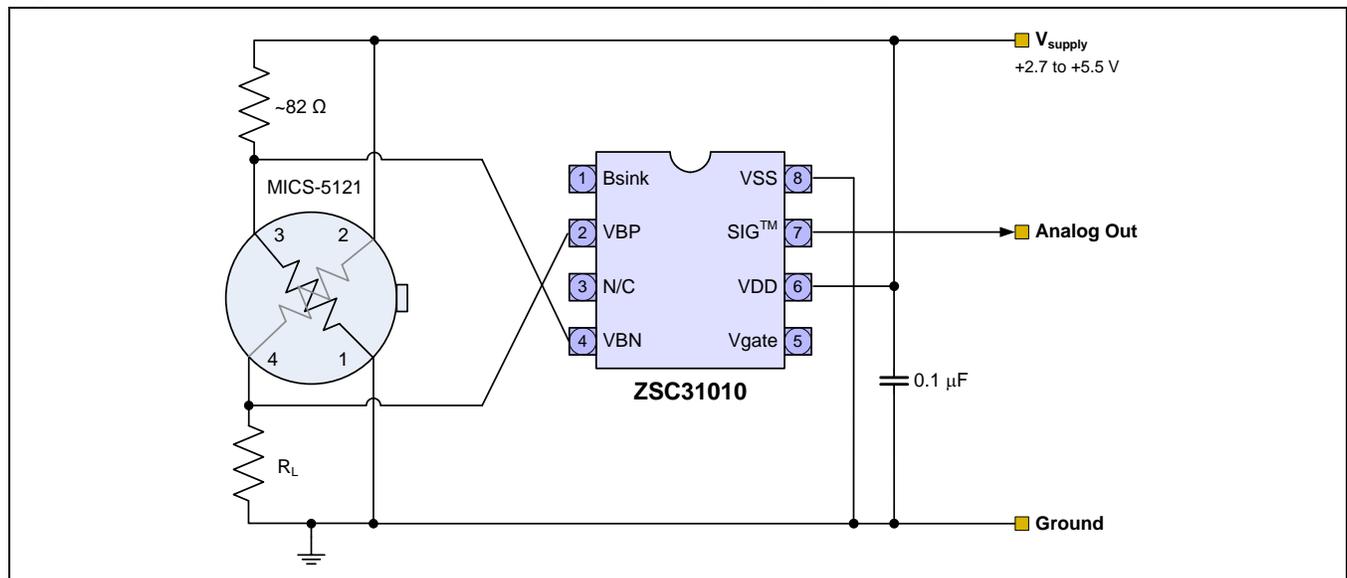
The ZSC31014 has a differential signal path to support full-bridge measurements into the VBP and VBN pins. There is an option that sets VBN to an internal VDD/2 reference and thus supports a half-bridge measurement through VBP. Figure 2.1 shows how the gas sensor interfaces to the VBP pin.

The ZSC31014 has an analog front-end that allows gain adjustment from 1.5 up to 192. A 14-bit ADC converts the signal to the digital domain, and an integrated math engine performs linearization, calibration, and offset correction operations. An onboard temperature sensor can be used to temperature compensate the sensor signal. The digital serial output format is I²C™ or SPI.

3 Analog Interface

An alternative is to use the ZSC31010 to provide an analog output. This device does not have the option to supply an internal VDD/2 reference; however, the gas sensor already has a ½ supply divider in the heater section. Any variation in the divider voltage over temperature can be compensated via calibration using the on-chip temperature sensor available on the ZSC31010. Figure 3.1 shows the circuit configuration.

Figure 3.1 Gas Sensor Connected to the ZSC31010 with Analog Output



If the gas sensor does not have ½ supply divider available, then a two-resistor divider is required. Typical resistor values would be 10KΩ.

The ZSC31010 has an analog front-end that allows gain adjustment from 6 up to 48. A 14-bit ADC converts the signal to the digital domain. An on-board temperature sensor can be used to temperature compensate the sensor signal. The on-chip DSP applies temperature compensation and then the signal is converted back to analog through a DAC converter. A buffer amplifier drives the Sig™* pin. The Sig™ pin also supports a one-wire interface that allows for digital bidirectional communications with the part during calibration.

4 Related Documents

Document
ZSC31010 RBiC _{Lite} TM Data Sheet
ZSC31014 RBiC _{Lite} TM Data Sheet

Visit the following ZSC31010 and ZSC31014 product pages on IDT's website www.IDT.com or contact your nearest sales office for the latest version of these documents.

www.IDT.com/ZSC31010

www.IDT.com/ZSC31014

5 Glossary

Term	Description
ADC	Analog-to-Digital Converter
DAC	Digital-to-Analog Converter
DSP	Digital Signal Processor

6 Document Revision History

Revision	Date	Description
1.00	July 9, 2014	First release.
	April 26, 2016	Changed to IDT branding.

Notice

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation or any other use of the circuits, software, and information in the design of your product or system. Renesas Electronics disclaims any and all liability for any losses and damages incurred by you or third parties arising from the use of these circuits, software, or information.
2. Renesas Electronics hereby expressly disclaims any warranties against and liability for infringement or any other claims involving patents, copyrights, or other intellectual property rights of third parties, by or arising from the use of Renesas Electronics products or technical information described in this document, including but not limited to, the product data, drawings, charts, programs, algorithms, and application examples.
3. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
4. You shall be responsible for determining what licenses are required from any third parties, and obtaining such licenses for the lawful import, export, manufacture, sales, utilization, distribution or other disposal of any products incorporating Renesas Electronics products, if required.
5. You shall not alter, modify, copy, or reverse engineer any Renesas Electronics product, whether in whole or in part. Renesas Electronics disclaims any and all liability for any losses or damages incurred by you or third parties arising from such alteration, modification, copying or reverse engineering.
6. Renesas Electronics products are classified according to the following two quality grades: "Standard" and "High Quality". The intended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below.

"Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; industrial robots; etc.

"High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control (traffic lights); large-scale communication equipment; key financial terminal systems; safety control equipment; etc.

Unless expressly designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not intended or authorized for use in products or systems that may pose a direct threat to human life or bodily injury (artificial life support devices or systems; surgical implantations; etc.), or may cause serious property damage (space system; undersea repeaters; nuclear power control systems; aircraft control systems; key plant systems; military equipment; etc.). Renesas Electronics disclaims any and all liability for any damages or losses incurred by you or any third parties arising from the use of any Renesas Electronics product that is inconsistent with any Renesas Electronics data sheet, user's manual or other Renesas Electronics document.
7. No semiconductor product is absolutely secure. Notwithstanding any security measures or features that may be implemented in Renesas Electronics hardware or software products, Renesas Electronics shall have absolutely no liability arising out of any vulnerability or security breach, including but not limited to any unauthorized access to or use of a Renesas Electronics product or a system that uses a Renesas Electronics product. RENESAS ELECTRONICS DOES NOT WARRANT OR GUARANTEE THAT RENESAS ELECTRONICS PRODUCTS, OR ANY SYSTEMS CREATED USING RENESAS ELECTRONICS PRODUCTS WILL BE INVULNERABLE OR FREE FROM CORRUPTION, ATTACK, VIRUSES, INTERFERENCE, HACKING, DATA LOSS OR THEFT, OR OTHER SECURITY INTRUSION ("Vulnerability Issues"). RENESAS ELECTRONICS DISCLAIMS ANY AND ALL RESPONSIBILITY OR LIABILITY ARISING FROM OR RELATED TO ANY VULNERABILITY ISSUES. FURTHERMORE, TO THE EXTENT PERMITTED BY APPLICABLE LAW, RENESAS ELECTRONICS DISCLAIMS ANY AND ALL WARRANTIES, EXPRESS OR IMPLIED, WITH RESPECT TO THIS DOCUMENT AND ANY RELATED OR ACCOMPANYING SOFTWARE OR HARDWARE, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY, OR FITNESS FOR A PARTICULAR PURPOSE.
8. When using Renesas Electronics products, refer to the latest product information (data sheets, user's manuals, application notes, "General Notes for Handling and Using Semiconductor Devices" in the reliability handbook, etc.), and ensure that usage conditions are within the ranges specified by Renesas Electronics with respect to maximum ratings, operating power supply voltage range, heat dissipation characteristics, installation, etc. Renesas Electronics disclaims any and all liability for any malfunctions, failure or accident arising out of the use of Renesas Electronics products outside of such specified ranges.
9. Although Renesas Electronics endeavors to improve the quality and reliability of Renesas Electronics products, semiconductor products have specific characteristics, such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Unless designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not subject to radiation resistance design. You are responsible for implementing safety measures to guard against the possibility of bodily injury, injury or damage caused by fire, and/or danger to the public in the event of a failure or malfunction of Renesas Electronics products, such as safety design for hardware and software, including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult and impractical, you are responsible for evaluating the safety of the final products or systems manufactured by you.
10. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. You are responsible for carefully and sufficiently investigating applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive, and using Renesas Electronics products in compliance with all these applicable laws and regulations. Renesas Electronics disclaims any and all liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
11. Renesas Electronics products and technologies shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations. You shall comply with any applicable export control laws and regulations promulgated and administered by the governments of any countries asserting jurisdiction over the parties or transactions.
12. It is the responsibility of the buyer or distributor of Renesas Electronics products, or any other party who distributes, disposes of, or otherwise sells or transfers the product to a third party, to notify such third party in advance of the contents and conditions set forth in this document.
13. This document shall not be reprinted, reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.
14. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products.

(Note1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its directly or indirectly controlled subsidiaries.

(Note2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

(Disclaimer Rev.5.0-1 October 2020)

Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan
www.renesas.com

Trademarks

Renesas and the Renesas logo are trademarks of Renesas Electronics Corporation. All trademarks and registered trademarks are the property of their respective owners.

Contact Information

For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit:
www.renesas.com/contact/