RX Family

Renesas ZMOD4410, ZMOD4450 and ZMOD4510 Sensor Control Module Firmware Integration Technology

Introduction

This application note explains the sensor control modules for ZMOD4410&ZMOD4450&ZMOD4510 (Digital Gas Sensors) using Firmware Integration Technology (FIT).

This control module acquires the sensor data using the I2C bus control FIT module (IIC FIT Module). And calculate environmental gas value for ZMOD4410, ZMOD4450 and ZMOD4510.

The detail descriptions include “Overview”, “API Information” and “ZMOD4XXX API Functions” of this FIT module are described in application note “Renesas Sensor Control Modules Firmware Integration Technology (R01AN5892)”.

Please refer to “Renesas Sensor Control Modules Firmware Integration Technology (R01AN5892)” for using this FIT module.

Note: Do not include both NO2O3 Lib and IAQ2nd Lib at a project at the same time.
Please refer to “Renesas Sensor Control Modules Firmware Integration Technology (R01AN5892)” for descriptions of this FIT module and other Gas Sensor FIT modules.

Target Device

- **Sensors:**
  - Renesas Electronics Digital Gas Senser ZMOD4410 (ZMOD4410 Indoor Air Quality Platform), ZMOD4450 (ZMOD4450 Refrigeration Air Quality Sensor Platform) and ZMOD4510 (ZMOD4510 Outdoor Air Quality Platform)

- **RX Family MCUs:**
  MCUs supported the following IIC FIT module
  - I2C Bus Interface (RIIC) Module (RIIC FIT Module)
  - Simple I2C Module (SCI_IIC FIT Module) using Serial Communication Interface (SCI)

- **Operation Confirmed MCU:**
  - RX65N (RIIC FIT Module, SCI_IIC FIT Module)

When using this application note with other Renesas MCUs, careful evaluation is recommended after making modifications to comply with the alternate MCU.

Target Compiler

- Renesas Electronics CC-RX: V3.06.00 or higher
- GCC for Renesas RX：8.3.0.202405 or higher
- IAR Embedded Workbench for Renesas RX: V5.10 or higher

Reference Documents

- Renesas Electronics ZMOD4410 Datasheet (March 10, 2023)
- Renesas Electronics ZMOD4510 Datasheet (May 30, 2024)
- Renesas Electronics ZMOD4450 Datasheet (June 30, 2021)
- RX Family I2C Bus Interface (RIIC) Module Using Firmware Integration Technology (R01AN1692)
- RX Family Simple I2C Module Using Firmware Integration Technology (R01AN1691)
- RX65N User's Manual: The latest version can be downloaded from the Renesas Electronics website.
- Technical Update/Technical News
  The latest information can be downloaded from the Renesas Electronics website.
- RX Family Compiler CC-RX User's Manual (R20UT3248)
  The latest versions can be downloaded from the Renesas Electronics website.

Operating Test Environment

The following describes for details of the operating test environments of this FIT module.

Table 1 Operation Test Environment using e2 studio and CC-RX

Item	Contents
Integrated Development Environment	Renesas Electronics e2 studio 2024-07
C Compiler	Renesas Electronics CC−RX V.3.06.00 Compiler options: The integrated development environment default settings are used, with the following option added. -lang = c99 The compiler option default values. optimization level: 2 optimization type: for size
Endian Order	Little-endian
Module Version	r_riic_rx Ver.2.49 r_sci_iic_rx Ver.2.49 r_irq_rx Ver.4.40 r_gpio_rx Ver.5.00

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	September 30, 2021	-	First Release
1.10	December 9, 2021	-	Application note “Renesas Sensor Control Modules Firmware Integration Technology (R01AN5892)” is updated.
1.20	February 15, 2022	-	Application note “Renesas Sensor Control Modules Firmware Integration Technology (R01AN5892)” is updated. ZMOD4410 Datasheet (December 17, 2021) is updated.
1.30	August 31, 2022	-	Application note “Renesas Sensor Control Modules Firmware Integration Technology (R01AN5892)” is updated. ZMOD4450 is added.
1.31	June 28, 2023	-	Application note “Renesas Sensor Control Modules Firmware Integration Technology (R01AN5892)” is updated.
1.40	Oct.23.24	-	Application note “Renesas Sensor Control Modules Firmware Integration Technology (R01AN5892)” is updated.

General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

1. Precaution against Electrostatic Discharge (ESD)

   A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.
2. Processing at power-on

   The state of the product is undefined at the time when power is supplied. The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the time when power is supplied. In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the time when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the time when power is supplied until the power reaches the level at which resetting is specified.
3. Input of signal during power-off state

   Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.
4. Handling of unused pins

   Handle unused pins in accordance with the directions given under handling of unused pins in the manual. The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of the LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible.
5. Clock signals

   After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is stabilized. When the clock signal is generated with an external resonator or from an external oscillator during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Additionally, when switching to a clock signal produced with an external resonator or by an external oscillator while program execution is in progress, wait until the target clock signal is stable.
6. Voltage application waveform at input pin

   Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between V_{IL} (Max.) and V_{IH} (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between V_{IL} (Max.) and V_{IH} (Min.).
7. Prohibition of access to reserved addresses

   Access to reserved addresses is prohibited. The reserved addresses are provided for possible future expansion of functions. Do not access these addresses as the correct operation of the LSI is not guaranteed.
8. Differences between products

   Before changing from one product to another, for example to a product with a different part number, confirm that the change will not lead to problems. The characteristics of a microprocessing unit or microcontroller unit products in the same group but having a different part number might differ in terms of internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

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Corporate Headquarters

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

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