Smart Analog IC101

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Smart Analog Easy Starter 101 Tutorial (RL78/L13)

Introduction

This application note is a tutorial that explains the setup routine required for enabling transmission between the Smart Analog Easy Starter 101 (herein referred to as Easy Starter 101), which is the GUI tool for Smart Analog IC101 evaluations, and the CPU board included in the Renesas Starter Kit for RL78/L13, which connects to the Smart Analog IC RSK Option Evaluation Board.

Note: Smart Analog IC101 is referred to as "SAIC101" throughout this document.

Target Board

Smart Analog IC RSK Option Evaluation Board [TSA-OP-IC101], Renesas Starter Kit for RL78/L13 [R0K5010WMS900BE] CPU board

Operation Confirmation Device

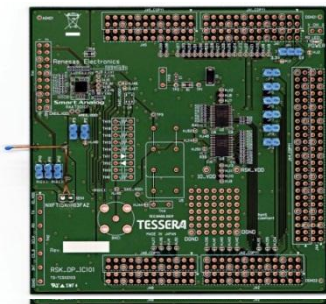Smart Analog IC 101(part name: RAA730101), RL78/L13 (part name: R5F10WMGAFB)

Contents

1. What You Will Need

You will need to prepare the following software and hardware environments to perform the setup described in this application note.

Table 1-1   Requirements

Item	Description
Boards	• Renesas Starter Kit for RL78/L13 [R0K5010WMS900BE] CPU Board (herein referred to as "RSK CPU board") • Smart Analog IC RSK Option Evaluation Board [TSA-OP-IC101] (herein referred to as "TSA-OP-IC101 board")
Pin headers 2.54 mm pitch/straight	2 x 13 pin (26P) ---------- 2 pins → for TSA-OP-IC101 board 2 x 12 pin (24P) ---------- 2 pins → for TSA-OP-IC101 board 2 x 25 pin (50P) ---------- 1 pin → for TSA-OP-IC101 board[Note]
Pin sockets 2.54 mm pitch/straight	2 x 13 pin (26P) ---------- 2 pins → for RSK CPU board 2 x 12 pin (24P) ---------- 2 pins → for RSK CPU board 2 x 25 pin (50P) ---------- 1 pin → for TSA-OP-IC101 board[Note]
Jumper socket 2.54 mm pitch	2 pins ---------- 7 pins → for TSA-OP-IC101 board
Debugger	Renesas Electronics on-chip debugging emulator E1 (R0E000010KCE00)
Flash programming tool	Renesas Electronics Renesas Flash Programmer
Smart Analog evaluation GUI Analog circuit design tool	Smart Analog Easy Starter 101 SA_Easy_Starter_101_Ver2.1.zip
Firmware	Hex file for Easy Starter 101 RL78L13_RSK+TSA-OP-IC101_Hex.zip
Connection cable	RS-232C cable or serial cable for D-SUB 9 pin
AC adapter	Plug diameter: 2.1 mm; Center Plus DC 5V

Note: For connecting LCD extension board (Renesas Starter Kit LCD Application Board V2). As Easy Starter 101 does not use the LCD extension board, confirmation is not necessary unless other operations require it.

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2. Board Soldering

To connect the RSK CPU board and the TSA-OP-IC101 board, the user must attach pin sockets or headers to the extension board interface (herein referred to as "application header"). This section explains the soldering locations on both boards.

- RSK CPU Board

    Solder pin sockets to the RSK CPU board application headers (JA1, JA2, JA5, and JA6). Solder 26 pins (2 x 13) to JA1 and JA2, and 24 pins (2 x 12) to JA5 and JA6, facing upward. Make sure the pin sockets are mounted perpendicular to the board.
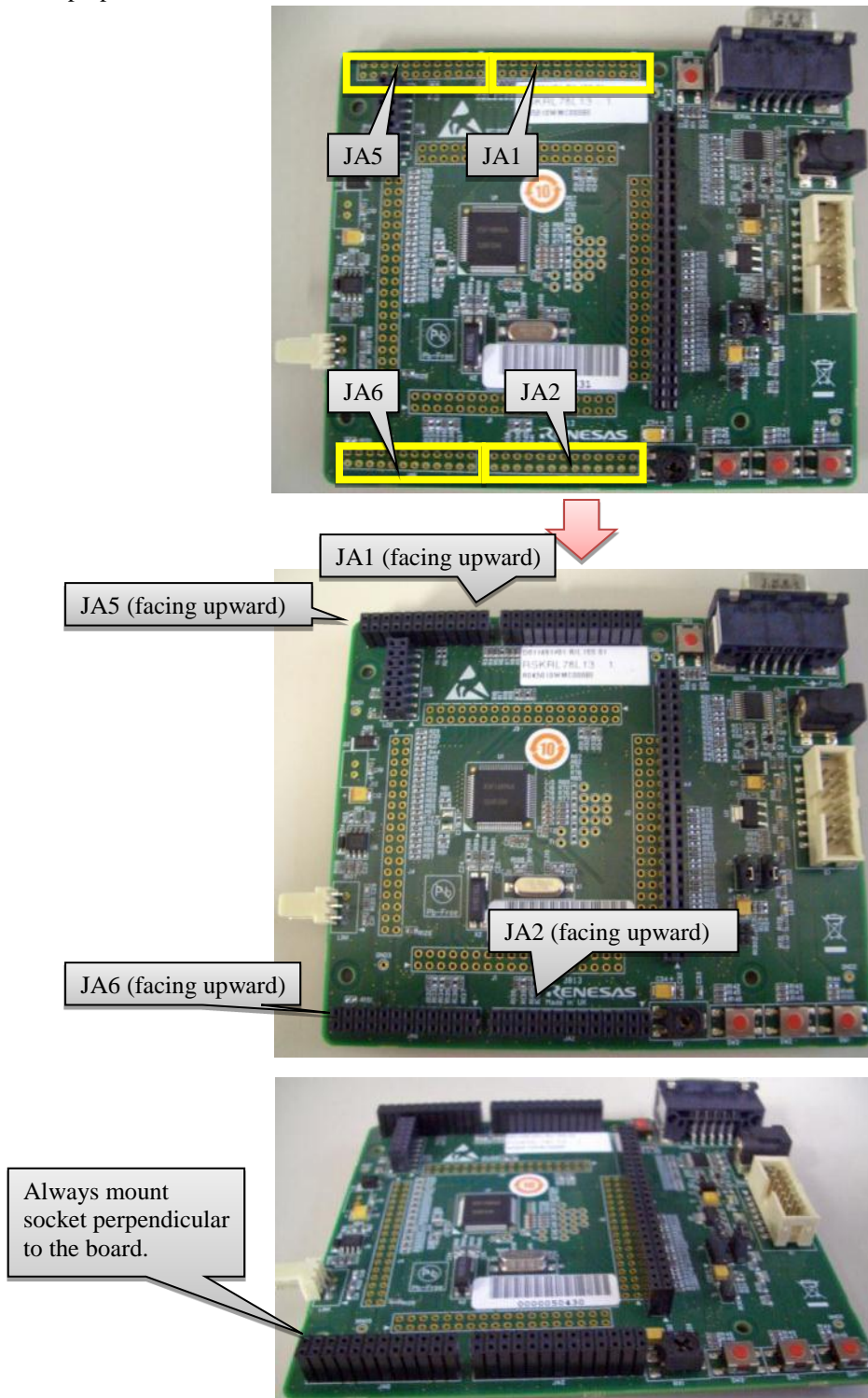
Figure 2-1　Pin Socket Mounting on RSK CPU Board

- TSA-OP-IC101 Board

Solder pin headers to the application headers (JA1, JA2, JA5, and JA6) on the TSA-OP-IC101 board. Solder the pin headers facing downward (facing the board), with 26 pins (2 x 13) to JA1 and JA2, and 24 pins (2 x 12) to JA5 and JA6. Make sure the pin headers are mounted perpendicular to the board.

Although Easy Starter 101 does not use the LCD extension board, if you are using the LCD Extension Board while it is connected to the TSA-OP-IC101 board, make sure you solder 50 pin headers (2 x 25) to the application header (JA4) facing downward (facing the board), and 50 pin sockets (2 x 25) to the application header (JA4_COPY1) facing upward.
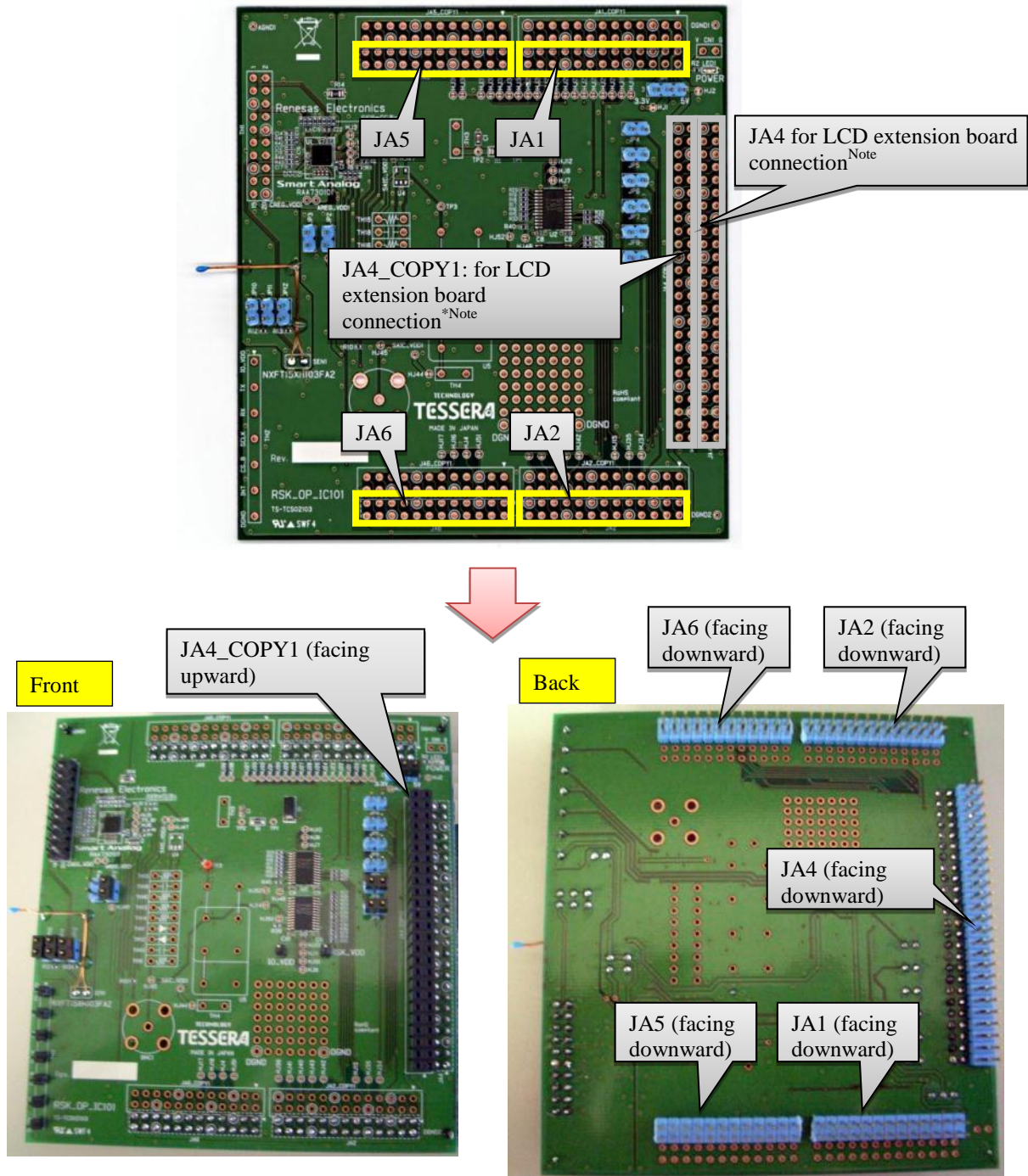
Figure 2-1   TSA-OP-IC101 Board Pin Header/Socket Mounting

Note: Easy Starter 101 does not use the LCD extension board (Renesas Starter Kit LCD Application Board V2).

3.   Jumper Confirmation

Before using Easy Starter 101, you will need to set the jumpers on each board. The following provides instructions on how to set the on-board thermistor (herein referred to as "thermistor") mounted on the TSA-OP-IC101 board as well as the jumpers on each board.

- RSK CPU Board

Use the initial settings to set the RSK CPU board jumpers. For details, refer to the User's Manual (R20UT2125EG) for the Renesas Starter Kit for RL78/L13.
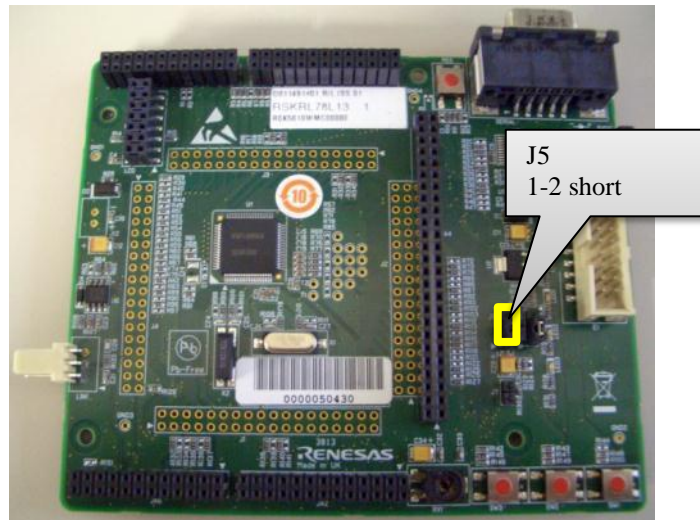

J5
1-2 short

Figure 3-1   RSK CPU Board Jumper Settings

Table 3-1   RSK CPU Board Jumper Settings

Item	Description	Function
J5	1-2 pin short	Supplies 5V power from RSK CPU board to TSA-OP-IC101 board

- TSA-OP-IC101 Board

Set the power supply, serial jumpers, etc., referring to Figure 3-2 and Table 3-2 for details.
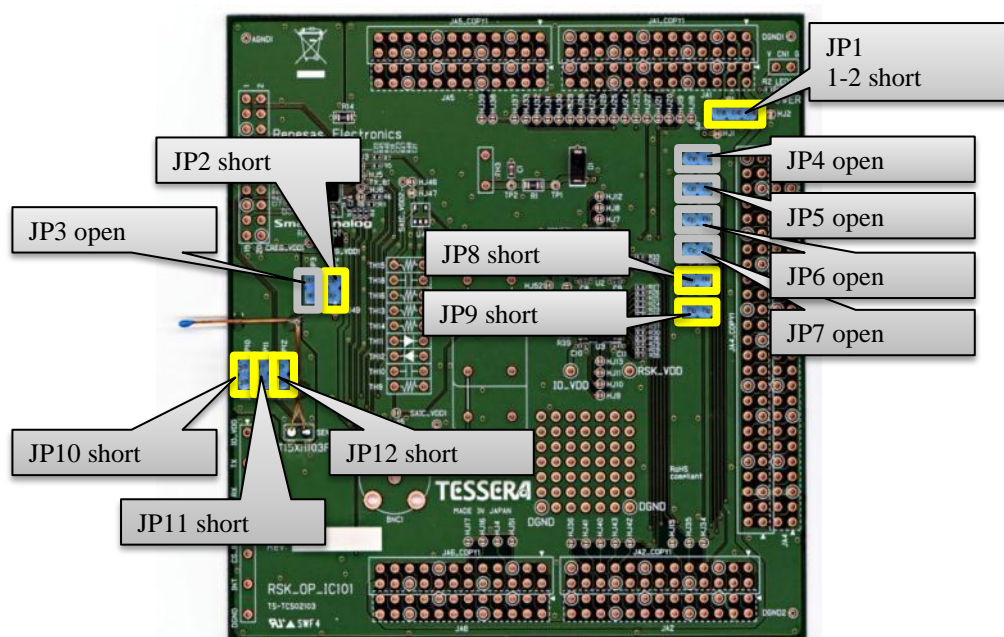
Figure 3-2   TSA-OP-IC101 Board Jumper Settings

Table 3-2   TSA-OP-IC101 Board Jumper Settings

Item	Description	Function
JP1	1-2 pin short	Supplies 5V power from RSK CPU board to TSA-OP-IC101 board
JP2	short	Selects configuration 1 as the SAIC101 power supply configuration
JP3	open	Selects configuration 1 as the SAIC101 power supply configuration
JP4	open	Disables connection between SCIaRX on RSK CPU board and SAIC101's MISO_TX
JP5	open	Disables connection between SCIaTX on RSK CPU board and SAIC101's MOSI_RX
JP6	open	Disables connection between SCIbRX on RSK CPU board and SAIC101's MISO_TX
JP7	open	Disables connection between SCIbTX on RSK CPU board and SAIC101's MOSI_RX
JP8	short	Enables connection between SCIcRX (SO10_RXD1 of RL78/L13) on RSK CPU board and SAIC101's MISO_TX
JP9	short	Enables connection between SCIcTX (SO10_TXD1 of RL78/L13) on RSK CPU board and SAIC101's MOSI_RX
JP10	short	Enables thermistor Supplies SAIC101 SBIAS to sensor
JP11	short	Enables thermistor Connects SAIC101 analog input multiplexer AIN2P to sensor
JP12	short	Enables thermistor Connects SAIC101 analog input multiplexer AIN2N to sensor

4. RSK CPU Board and TSA-OP-IC101 Board Connection

After mounting pin headers and pin sockets and setting jumpers on both boards, connect the corresponding application headers (JA1 → JA1, JA2 → JA2, JA5 → JA5, and JA6 → JA6).
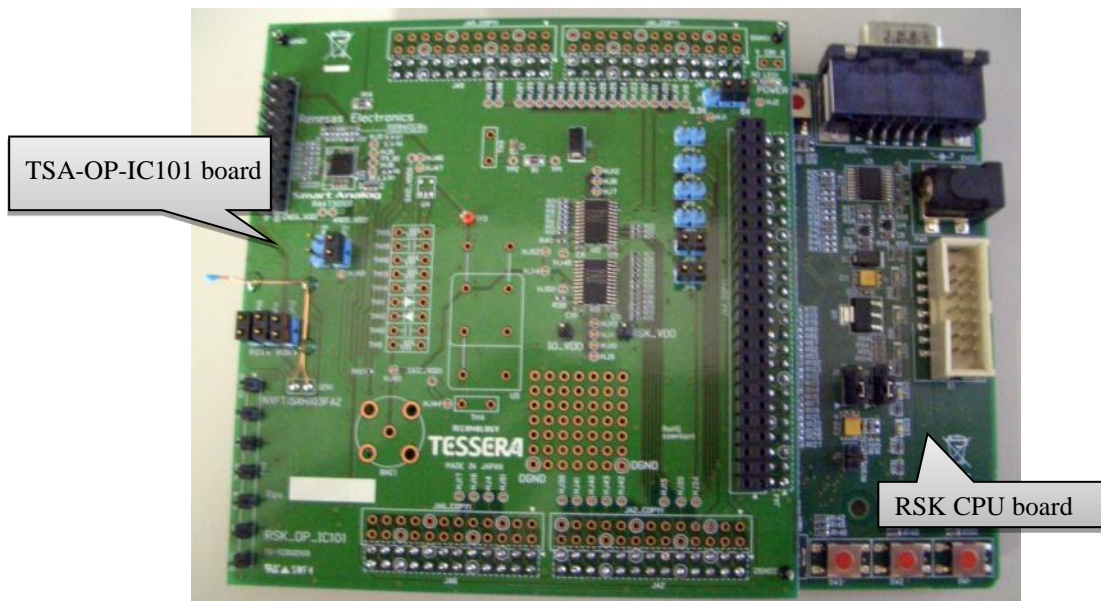
Figure 4-1   Connection Between RSK CPU Board and TSA-OP-IC101 Board (top view)
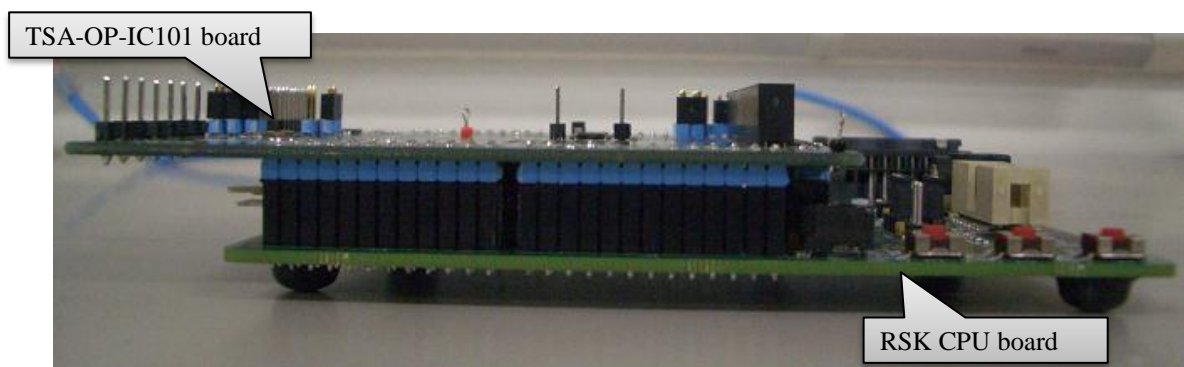
Figure 4-2   Connection Between RSK CPU Board and TSA-OP-IC101 Board (side view)

5. Firmware

5.1 Download

The RSK CPU board must be programmed with dedicated firmware in order to run Easy Starter 101. Download the RL78/L13 HEX file for Easy Starter 101 from the Renesas Electronics website as specified below.

Firmware download URL: http://www.renesas.com/smart_analog/down_load_101

File name: RL78L13_RSK+TSA-OP-IC101_Hex.zip

5.2 Write

Use the Renesas Flash Programmer and On-chip Debugging Emulator E1 to write the firmware to the board.

Refer to the Renesas Flash Programmer User's Manual for details on writing.

Operation Confirmation Device

Smart Analog IC 101 (part name: RAA730101), RL78/L13 (part name: R5F10WMGAFB)
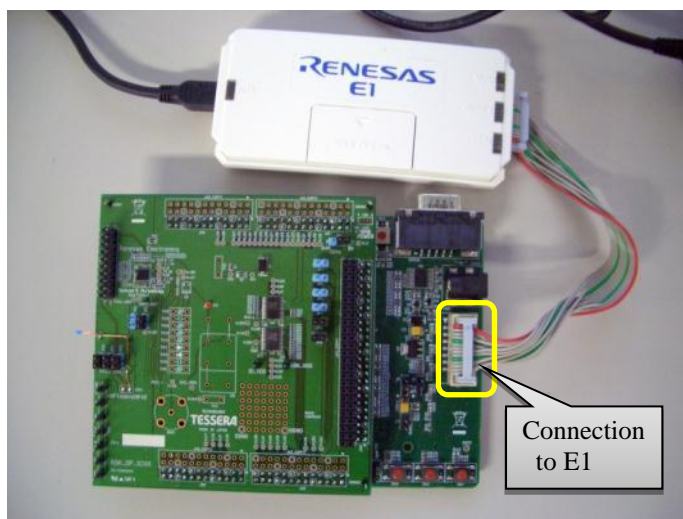
Connection to E1

Figure 5-1   Writing Firmware to Board

6.   Serial Connection

6.1   Power Supply Cable Connection

Power is supplied to the TSA-OP-IC101 board from the RSK CPU board. Connect the AC adapter and the RSK CPU board as shown in Figure 6-1.

Note: The power supply confirmation LED on the corresponding boards will turn on when the cable is correctly connected.
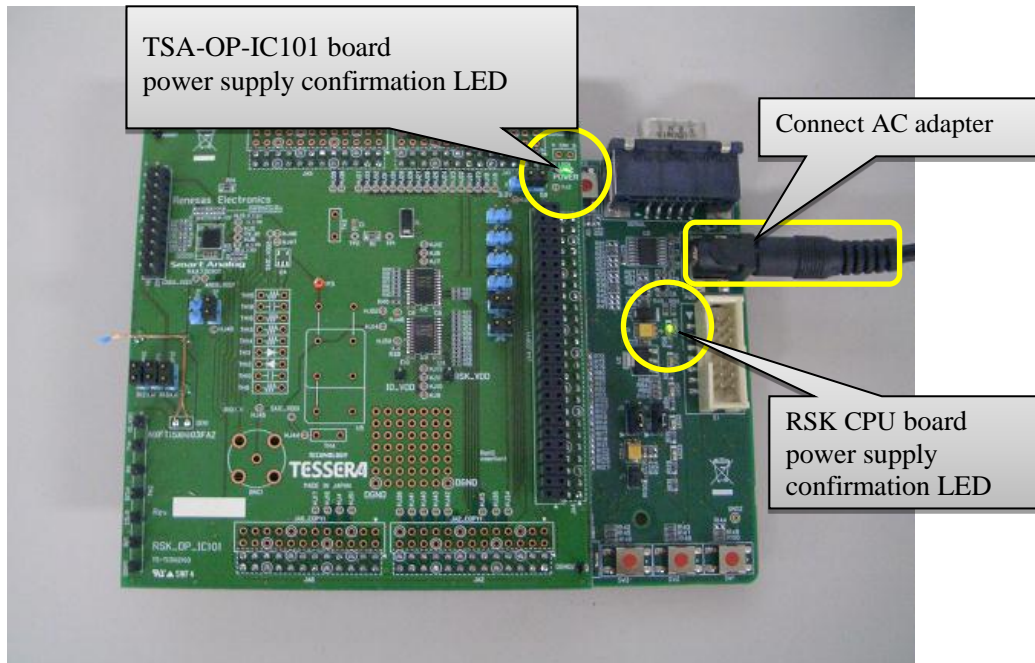
Figure 6-1   Power Supply Cable Connection

6.2   Serial Cable Connection

Connect the PC to the RS233 serial connector on the RSK CPU board with a serial cable. If your PC is equipped with a D-SUB 9 pin connector, you can use the RS-232C cable, as shown in Image 1 of Figure 6-2. If your PC does not have a D-SUB 9 pin connector, use a serial cable that supports D-SUB 9 pin connectors such as the USB serial conversion cable shown in Image 2 of Figure 6-2.

Note: Drive installation is required when connecting with a USB serial conversion cable. See cable instructions for details.

Image 1: RS-232C cable

Image 2: USB serial conversion

Figure 6-2   Applicable Serial Cables

Connect serial cable
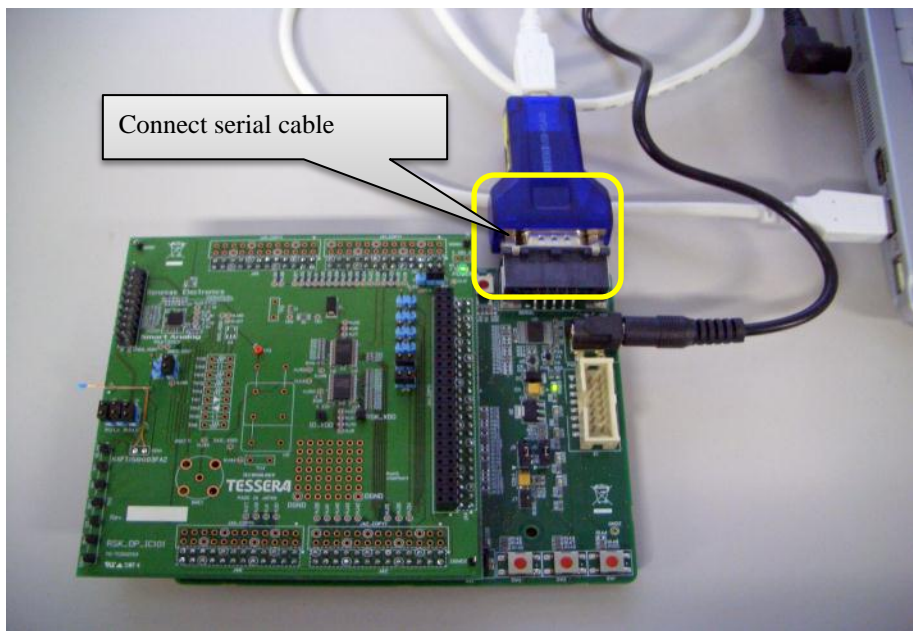
Figure 6-3   Serial Cable Connection

6.3   COM Port Number Confirmation

If you do not know the serial port number (COM port number) connected to the RSK CPU board, confirm the number by referring to the device manager.
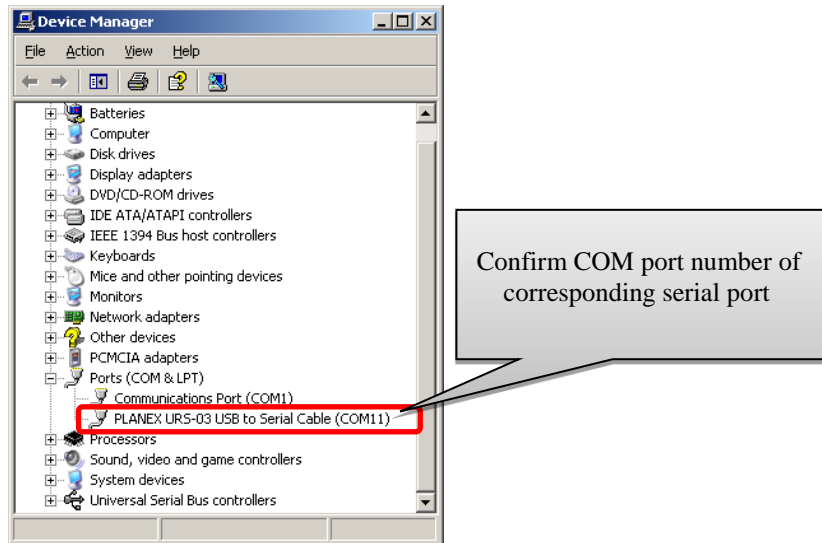
Figure 6-4   COM Port Number Confirmation

7. Smart Analog Easy Starter 101

7.1 Startup

Double click **Start.exe** located in the SA_Easy_Starter_101_Ver2.1.zip file to start Easy Starter 101. Download Easy Starter 101 from the Renesas Electronics website as specified below

Smart Analog Easy Starter 101 download URL: http://www.renesas.com/smart_analog/down_load_101
File name: SA_Easy_Starter_101_Ver2.1.zip

Figure 7-1   How to Start Up Easy Starter 101

7.2 Serial Port Manual Settings

Easy Starter 101 for SAIC101 evaluation requires manual setting of serial ports for connections.

After starting Easy Starter 101, open the Option Dialog from the Start window by selecting **File → Option.** Next, in the Option Dialog, remove the check from the **Serial port auto detection** checkbox in the **Serial Port** tab. Select the COM port number confirmed in section 6.3.
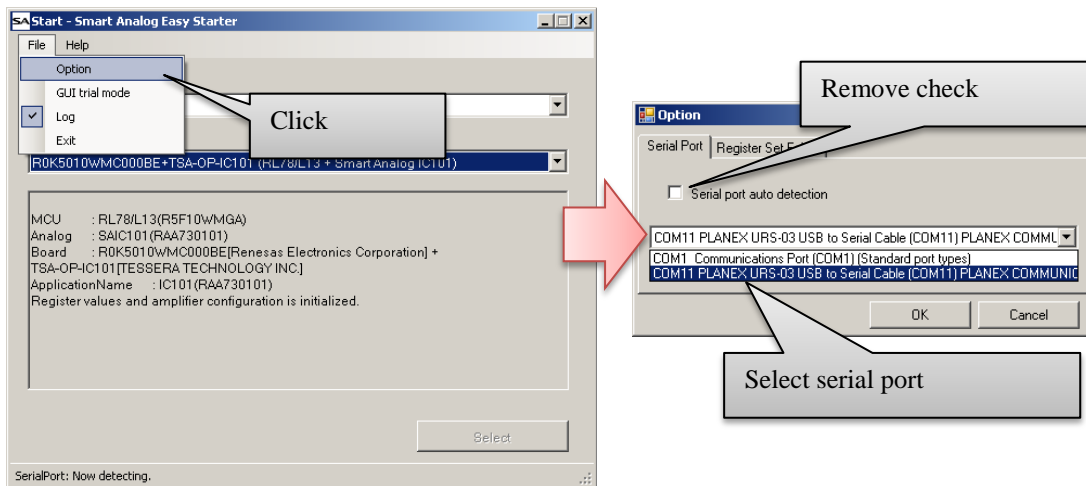
Figure 7-2   Serial Port Manual Settings
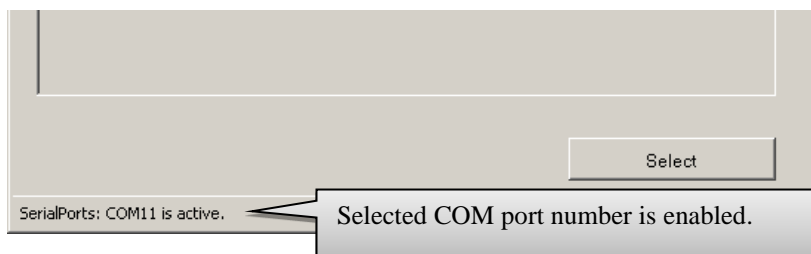
Figure 7-3   Start Window Displayed After Serial Port Confirmation

7.3   Read Setting File

Easy Starter 101 allows the user to reload the stored settings by reading the Setting file[Note] stored in the register set folder. The default register set folder is specified as the **setting** folder located in the SA_Easy_Starter_101_Ver2.1 folder. To change the register set folder, open the Option Dialog in the Start window and change the folder path in the **Register Set Folder Setting** tab.

Note: The Setting file stores information concerning the state of the designed AFE circuit and can be created by the user.
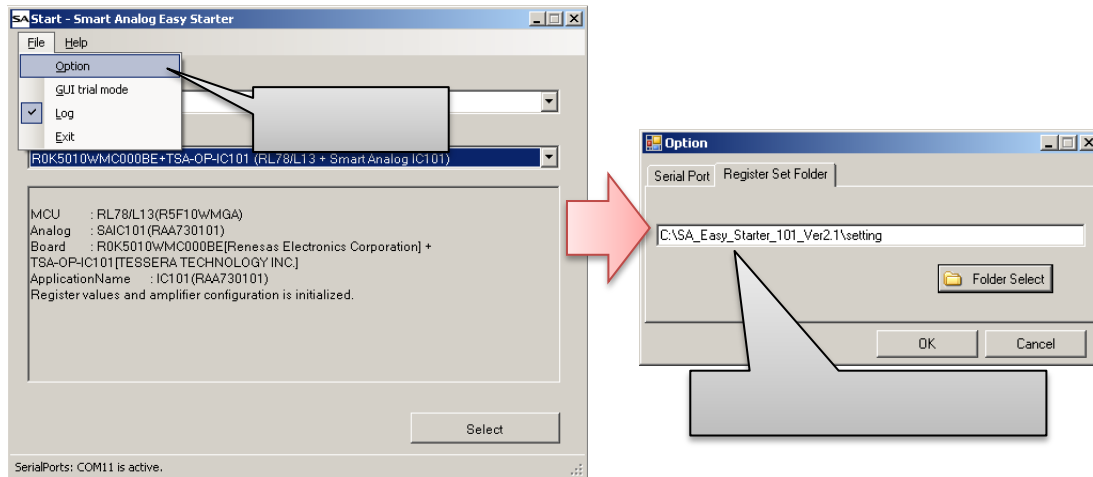
Figure 7-4   Register Set Folder

The TSA-OP-IC101 board is equipped with a thermistor to be used as a sensor to confirm operations. The sensor's Setting file required to run the thermistor can be downloaded from the Renesas Electronics website. Store the downloaded file in the register set folder.

The Setting file will show up in the **Register** combo box when Easy Starter 101 is started up. If you add the Setting file while Easy Starter 101 is already running, restart the program to ensure the file is correctly displayed.

Thermistor Setting file download URL: http://www.renesas.com/smart_analog/down_load_101

File name: Thermistor_RL78L13_RSK_on_TSA-OP-IC101.zip
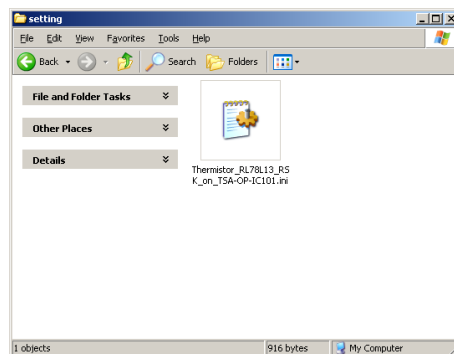
Figure 7-5   Setting File Stored in Register Set Folder

Next, select the Setting file that you added in the **Register** combo box in the Start window. Also select the RSK CPU and TSA-OP-IC101 boards in the Start window's **Target Board** combo box, and click **Select**. When the target boards are successfully connected, the Main window is displayed.

Register: RSK Option Board Thermistor 2014/08/08 18:00:57

Target Board: R0K5010WMC000BE+ TSA-OP-IC101 (RL78/L13 + Smart Analog IC101)
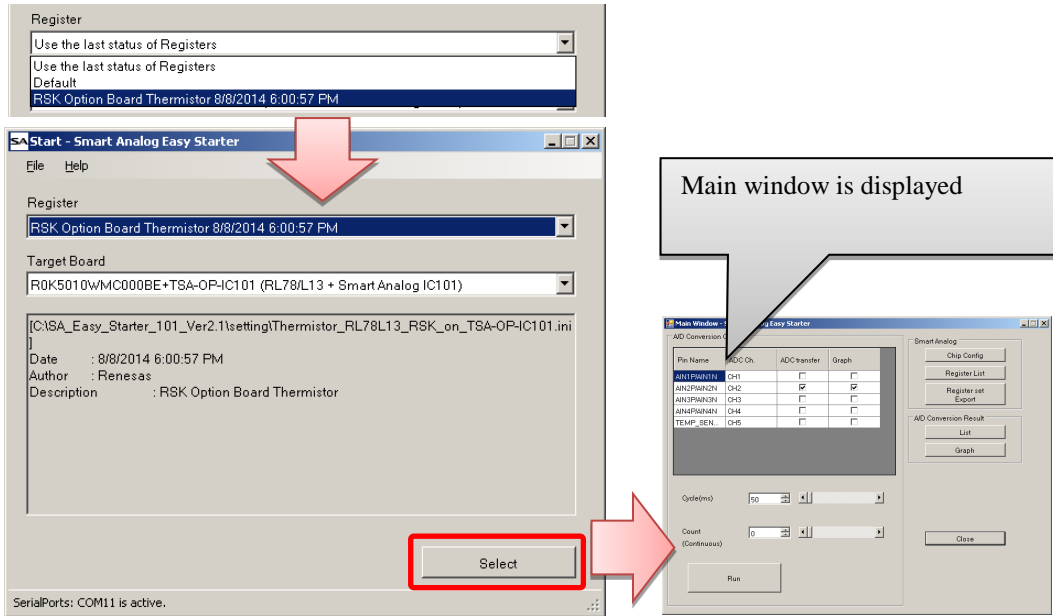
Figure 7-6 Setting File Selection

Refer to the **A/D Conversion Control** items in the Main window frame and the Chip Config window (click **Chip Config** under **Smart Analog**) to confirm that the A/D conversion control settings for the on-board thermistor sampling and the TSA-OP-IC101 board parameters have been restored.

A/D Conversion Control Settings

- Enable only CH2

- Conversion frequency = 50 ms

- Conversion times = Continuous

SAIC101 Parameter Settings
- Set CH2
    Input Mode = Differential Input (differential amp)
    GSET1= 1, GSET2 = 8
    Oversampling Ratio = 256
    AIN2OFT = 2
・SBIAS = 1.2V
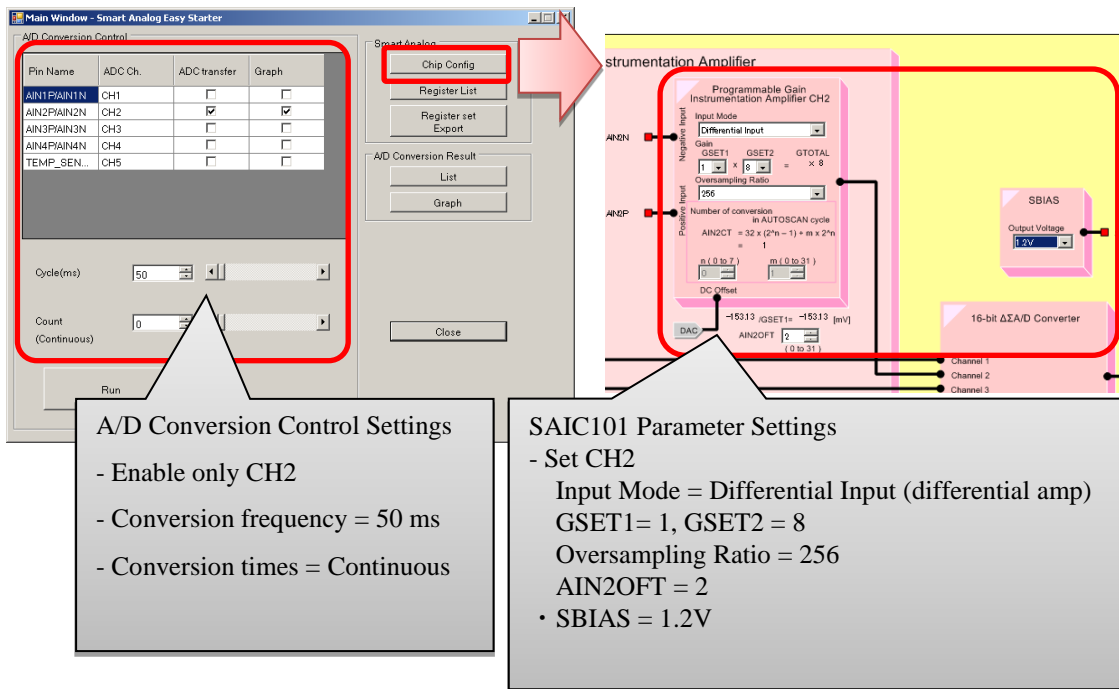
Figure 7-7   Restored Settings Confirmation

7.4   Operation Confirmation

Use the thermistor to confirm that the board and Easy Starter 101 are operating correctly.

First, click **Graph** in the Main window frame to display the ADC Graph window.
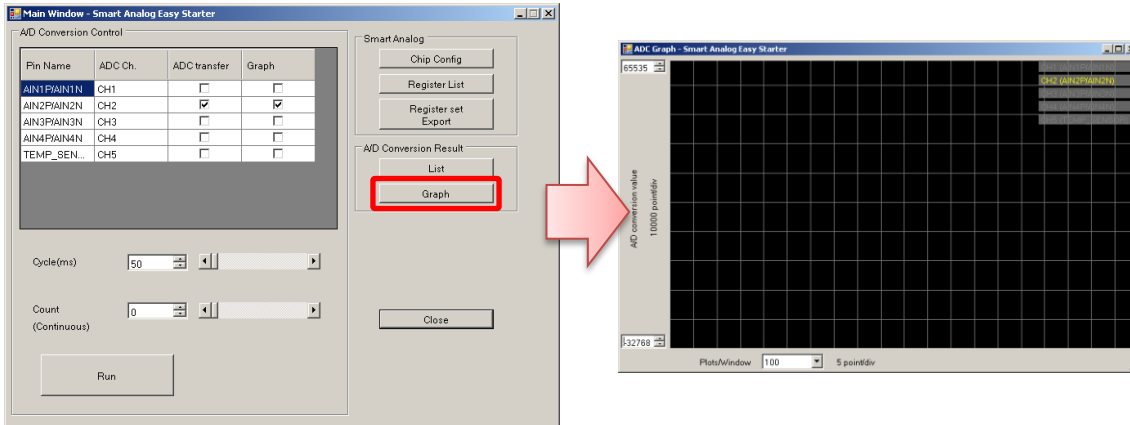
Figure 7-8   ADC Graph Window Display

Next, click **Run** in the Main window frame to display conversion frequency waveforms in the ADC Graph window. At this point, hold the thermistor on the TSA-OP-IC101 board between your fingers, and then let go. This allows you to visually confirm the change in waveform on the CH2 graph in the ADC Graph window.
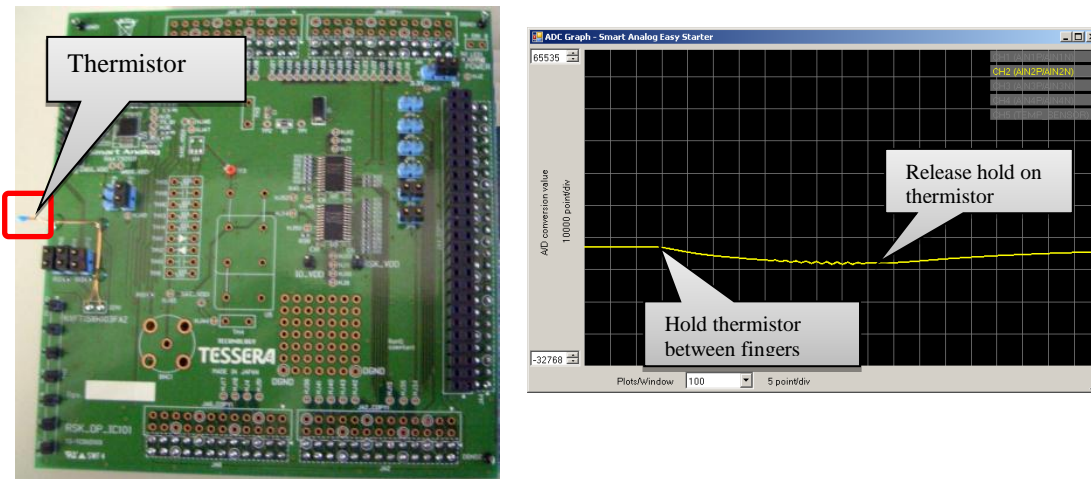
Figure 7-9   Operation Confirmation

After confirming operations as instructed above, confirm the change in waveform by changing the SAIC101 settings. First, change the value of AIN2OFT in the Chip Config window (sect. 7.3) to 1. This value is used to adjust the offset voltage. By changing AIN2OFT from 2 to 1, the offset voltage changes from -153.13 / G_{SET1}[mV](G_{SET1}=1) to -164.06 / G_{SET1}[mV] (G_{SET1}=1).The effect of the changed setting can be confirmed in the ADC Graph window waveform.
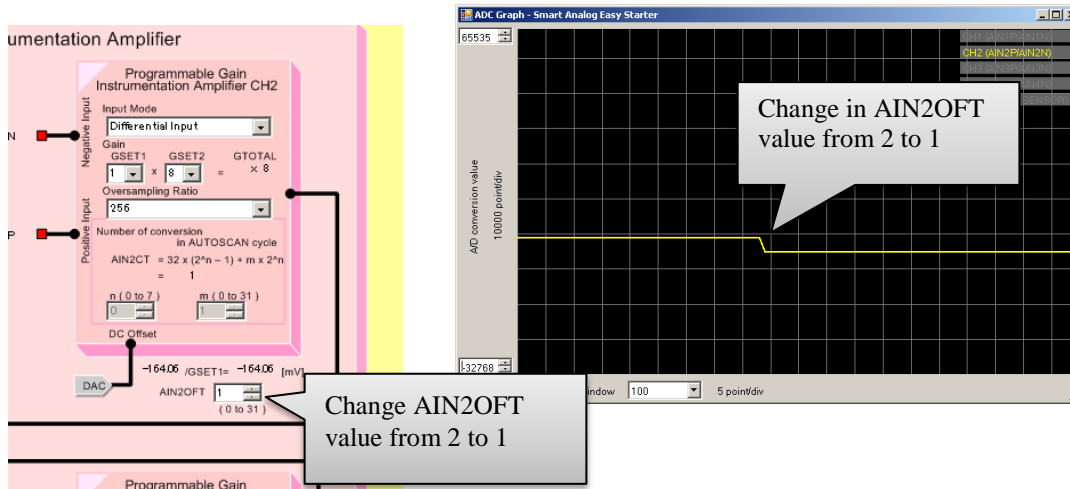
Figure 7-10   Operation Confirmation After Setting Change

7.5   Output AFE Register File

Store the SAIC101 device's changed AFE register file (sect. 7.4) in an external file. This AFE register file can be reloaded from the Start window.

The AFE register file contains the following information: register values set in the Chip Config window, A/D conversion setting values (frequency, number of conversions, channels) set in the Main window frame, and the author, date created, and description input in the Export window.
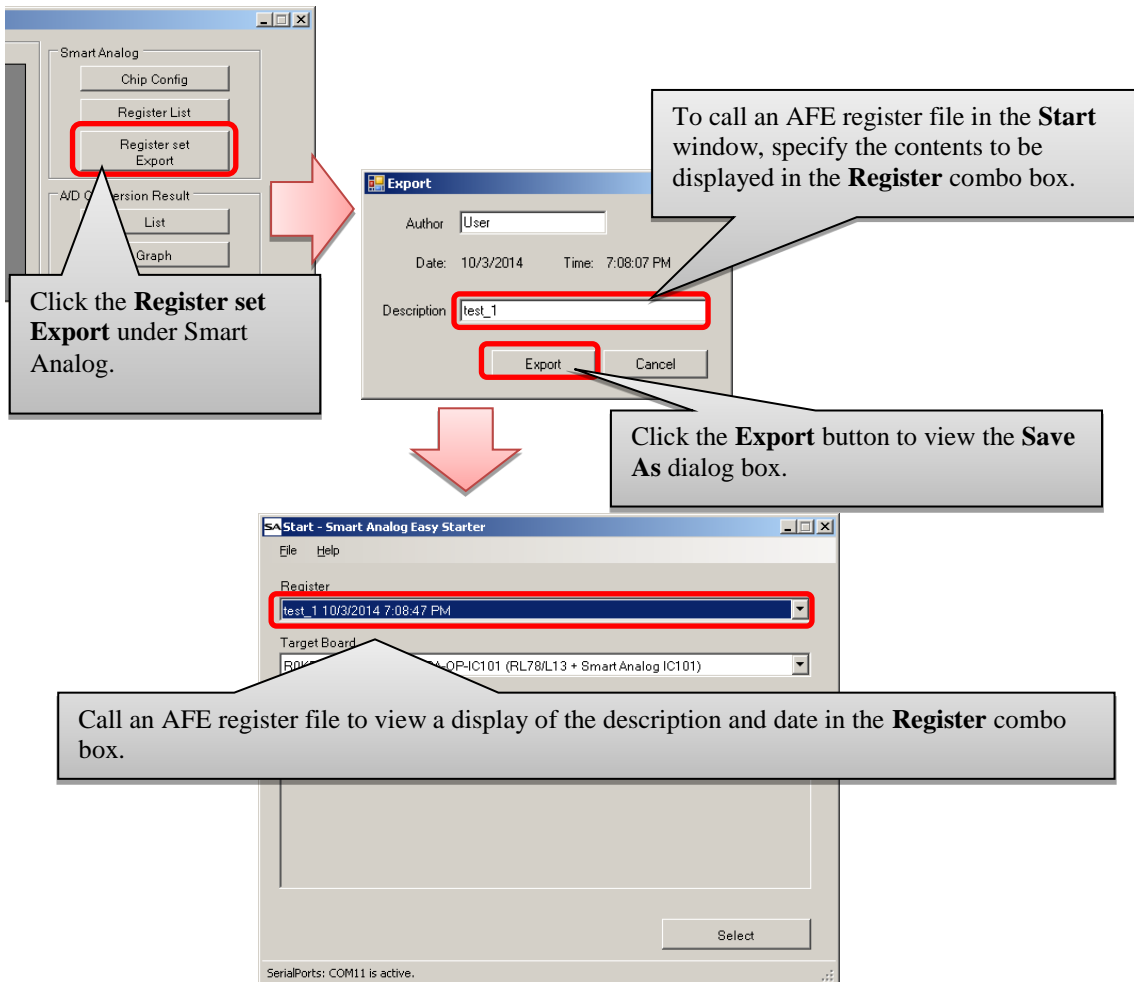
Figure 7-11   AFE Register File Output

Remark: An AFE register file created with Easy Starter 101 can be read by the SA-Designer tool, which can customize circuit data and create C source code. After completing analog circuit design using SA-Designer, proceed with the development according to the Smart Analog development tool chain.

URL Development tool chain URL: http://www.renesas.com/smart_analog_tools

7.6   Conclusion

This completes the Smart Analog Easy Starter 101 Tutorial. For detailed usage instructions, please refer to the Easy Starter 101 help file, which can be accessed by from the Start window; click **Help → Help.**

Website and Support

Renesas Electronics Website
   http://www.renesas.com/

Inquiries
   http://www.renesas.com/contact/

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Revision History

		Description	
Rev.	**Date**	**Page**	**Summary**
Rev.1.00	Nov 01, 2014	---	First edition issued

General Precautions in the Handling of MPU/MCU Products

The following usage notes are applicable to all MPU/MCU 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. 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 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. Unused pins should be handled as described under Handling of Unused Pins in the manual.

2. Processing at Power-on

   The state of the product is undefined at the moment 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 moment 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 moment 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 moment when power is supplied until the power reaches the level at which resetting has been specified.

3. Prohibition of Access to Reserved Addresses

   Access to reserved addresses is prohibited.

   — The reserved addresses are provided for the possible future expansion of functions. Do not access these addresses; the correct operation of LSI is not guaranteed if they are accessed.

4. Clock Signals

   After applying a reset, only release the reset line after the operating clock signal has become stable. When switching the clock signal during program execution, wait until the target clock signal has 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. Moreover, 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.

5. Differences between Products

   Before changing from one product to another, i.e. to a product with a different part number, confirm that the change will not lead to problems.

   — The characteristics of an MPU or MCU in the same group but having a different part number may differ in terms of the 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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