R8C/33T group

Sharing operations of Touch detection & A/D Conversion

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Summary

Touch panel microcomputer R8C/33T group builds hardware (SCU: sensor control unit) that perceives the contact of the human body by measuring the stray capacity generated between the touch electrode and the human body into.

This application note explains a method to perform sharing operation of the Touch detection and the A/D Conversion in the R8C/33T group that A/D converter shares some circuits with SCU.

Target device

R8C/33T,R8C/3JT and R8C/3NT group

Contents

1. Summary

Because the A/D converter shares a part of the circuit with SCU, SCU and A/D Conversion cannot be used at the same time. This application note explains a method to use the touch detection and A/D Conversion by sharing operation.

1.1 Operation Conditions

An operation condition of the firmware that is introduced in this application note is as follows.

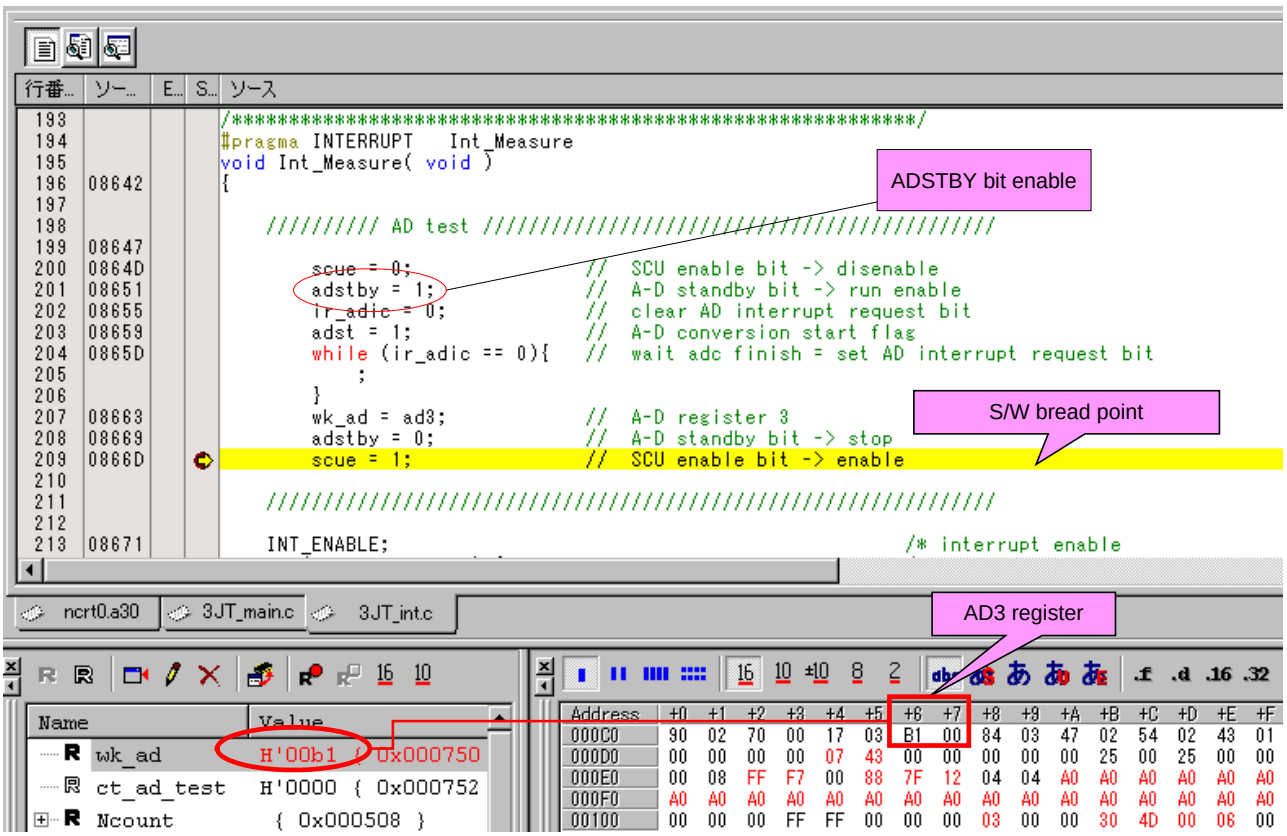
- When a measurement by SCU stops, the A/D conversion is executed. By the following timings, A/D conversion is executed in SCU interrupt.
- AN11 is used as an analog input pin.
- Operation mode is “One-shot mode” and Resolution is 8 bits.
- Operating clock φAD is “fAD divided by 1 (no division)”.
- CPU Clock is used High-Speed On-Chip Oscillator (40 MHz divided by 2).

2. Sharing operation of SCU and A/D Conversion

2.1 A/D Conversion result

The following contents displayed by Hew(High-performance Embedded Workshop) are shown in ”Figure 2-1”.

- Editor window which displays a source code of A/D Conversion
- C Watch window which displays a variable to store A/D Conversion result
- Memory window which displays the contents of the AD3 register.



- At Resolution is 8 bts and Analog input voltage is 3.5V, A/D Conversion result shows “0x00b1”.
- The A/D Conversion result of AD11 is set to AD3 register by the choice of the P1 group.

Figure 2-1 Hew (Source code/Watch/Memory window)

2.2 Process flowchart

A flowchart of the setting of the A/D Conversion for Low power consumption and SCU process is shown in “Figure 2-2”. The A/D Conversion is executed in SCU interrupt executed every end of the measurement of the touch sensor. According to the flowchart, when a measurement of SCU stops, the A/D Conversion can work.

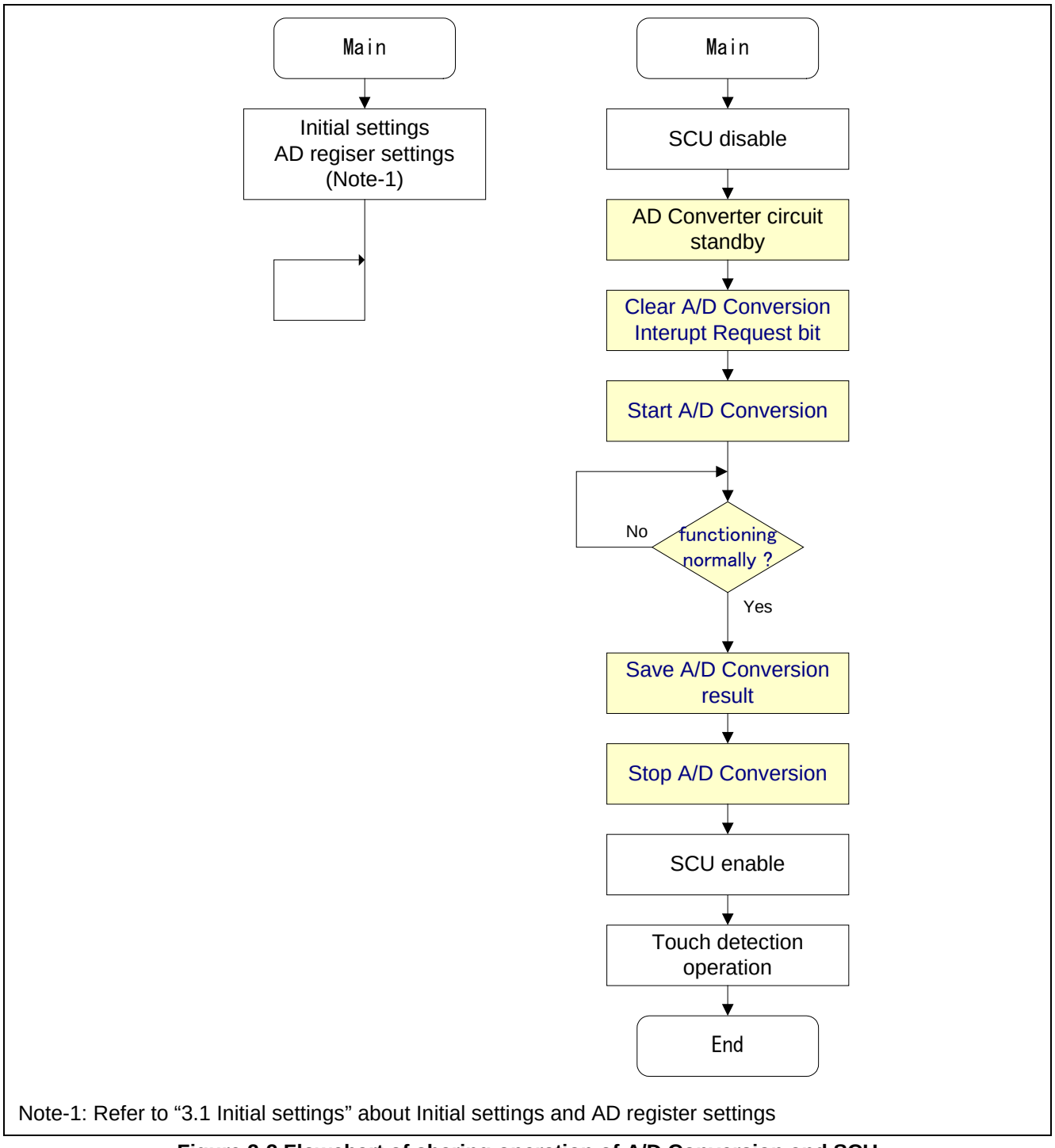


Figure 2-2 Flowchart of sharing operation of A/D Conversion and SCU

3. Source code(Extracts)

The extract of the source code of initial setting for A/D Conversion and the A/D Conversion process is shown below.

When A/D Conversion works, SCU must be stop.

3.1 Initial settings

A setting of the register for A/D Conversion is shown in “Figure 3-1 “.

The contents of the setting are as follows.

- Operating clock φAD is set to High-Speed On-Chip Oscillator.
- Operation mode is set to One-shot mode.
- Resolution is 8 bits. AD standby bit is set just before A/D Conversion.
- AN11(P1_3) is set as Input.

```
/* ===== AD initialization  ===== */
admod = 0x07;         // A-D mode register
                      //    division select bit -> fAD 1div.
                      //    clock select bit -> fOCO-F sel.
                      //    A-D mode select bit -> single
                      //    A-D Conversion trigger select bi -> s/w trigger
adinsel = 0x43;       // A-D input select register
                      //    Analog input pin select bit -> AN3/AN11 sel.
                      //    A-D input group select bit -> P1 group
// adcon1 = 0x20;     // A-D control register1
//                    //    8/10-bit mode select bit -> 8bit
//                    //    A-D standby bit -> run enable
adcon1 = 0x00;        // A-D control register1
                      //    8/10-bit mode select bit -> 8bit
                      //    A-D standby bit -> stop
pd1_3 = 0;            // AD11 input
```

Figure 3-1 Initial settings for A/D Conversion

3.2 A/D Conversion

A content of the A/D conversion process is shown in “Figure 3-2”.

The contents of the process are as follows.

- SCU operation is disabled.
- A/D Conversion operation is enabled.
- A/D Conversion interrupt request bit is cleared.
  A/D conversion interrupt is prohibited because the end of A/D Conversion is confirmed by the interrupt request bit.
- A/D Conversion is started.
- Waiting for the end of A/D Conversion
- A/D Conversion result is saved.
- A/D Conversion is disabled.
- SCU operation is enabled.

```
/* ===== AD convert  ======== */
scue = 0;                   // SCU enable bit -> disenable
adstby = 1;                 // A-D standby bit -> run enable
ir_adic = 0;                // clear AD interrupt request bit
adst = 1;                   // A-D conversion start flag
while (ir_adic == 0){       // wait adc finish = set AD interrupt request bit
      ;
}
wk_ad = ad3;                // A-D register 3
adstby = 0;                 // A-D standby bit -> stop
scue = 1;                   // SCU enable bit -> enable
```

Figure 3-2 A/D Conversion result

4. Notes

- When SCU is stopped during a SCU measurement, the measurement result of SCU is undefined. A SCU measurement result must be canceled, and a SCU measurement must be executed again.
- When A/D Conversion is stopped during execution of the A/D Conversion, the A/D Conversion result is undefined. The A/D Conversion result is canceled, and A/D Conversion must be executed again.
- Refer to “R8C/33T Group Hardware Manual” for the Notes about SCU and A/D Conversion which are not listed in this application note.

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Revision Record

Rev.	Date	Description	
		Page	Summary
1.00	May 21, 2013	—	Numbering change (Contents is as same as REJ05B1404-0100)

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 manual, refer to the relevant sections of the manual. If the descriptions under General Precautions in the Handling of MPU/MCU Products and in the body of the manual differ from each other, the description in the body of the manual takes precedence.

1. Handling of Unused Pins
   Handle unused pins in accord 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 one with a different type number, confirm that the change will not lead to problems.
   The characteristics of MPU/MCU in the same group but having different type numbers may differ because of the differences in internal memory capacity and layout pattern. When changing to products of different type numbers, implement a system-evaluation test for each of the products.

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