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April 1st, 2010
Renesas Electronics Corporation

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M32C/84, 85, 86, 87, 88 Group

A/D Converter Operation in One-Shot Mode (External Trigger)

1. Abstract

In one-shot mode, the input voltage of one pin selected from pins AN0 to AN7, AN15_0 to AN15_7, AN0_0 to AN0_7, AN2_0 to AN2_7, ANEX0, and ANEX1 is A/D converted once.

An external trigger (a falling edge of the $\overline{\text{ADTRG}}$ input signal) can be selected as the start trigger of A/D conversion.

2. Introduction

The application example described in this document is applied to the following MCUs and parameter(s):

MCUs: M32C/84 Group
 M32C/85 Group
 M32C/86 Group
 M32C/87 Group
 M32C/88 Group

This program can be used with other M16C Family MCUs which have the same special function registers (SFRs) as the above MCUs. Check the manual for any additions and modifications to functions. Careful evaluation is recommended before using this application note.

3. Application Example

This section describes how to A/D convert the input voltage of the ANi (i = 0 to 7) pin in one-shot mode when a falling edge is input to the ADTRG pin.

Other configurations are as follows:

- Operating clock (ϕ_{AD}) : fAD divided by 2
- Resolution : 10 bits
- Sample & hold function : Enabled
- DMAC operation mode : Disabled

3.1 Example Description

- (1) When the ADST bit in the AD0CON0 register is set to 1 (A/D conversion started), if an input signal to the ADTRG pin changes from “H” to “L”, the A/D converter starts operating.
- (2) After the A/D conversion is completed on the ANi pin, the content of the successive approximation register (conversion result) is transferred to the AD0i register (i = 0 to 7).
Also the A/D converter stops operating.
- (3) If an input signal to the ADTRG pin changes from “H” to “L”, the A/D converter restarts operating.
Also, if an input signal to the ADTRG pin changes from “H” to “L” during an A/D conversion operation, the A/D converter stops the A/D conversion in progress and starts a new A/D conversion.

Figure 1 shows the One-Shot Mode Operation.

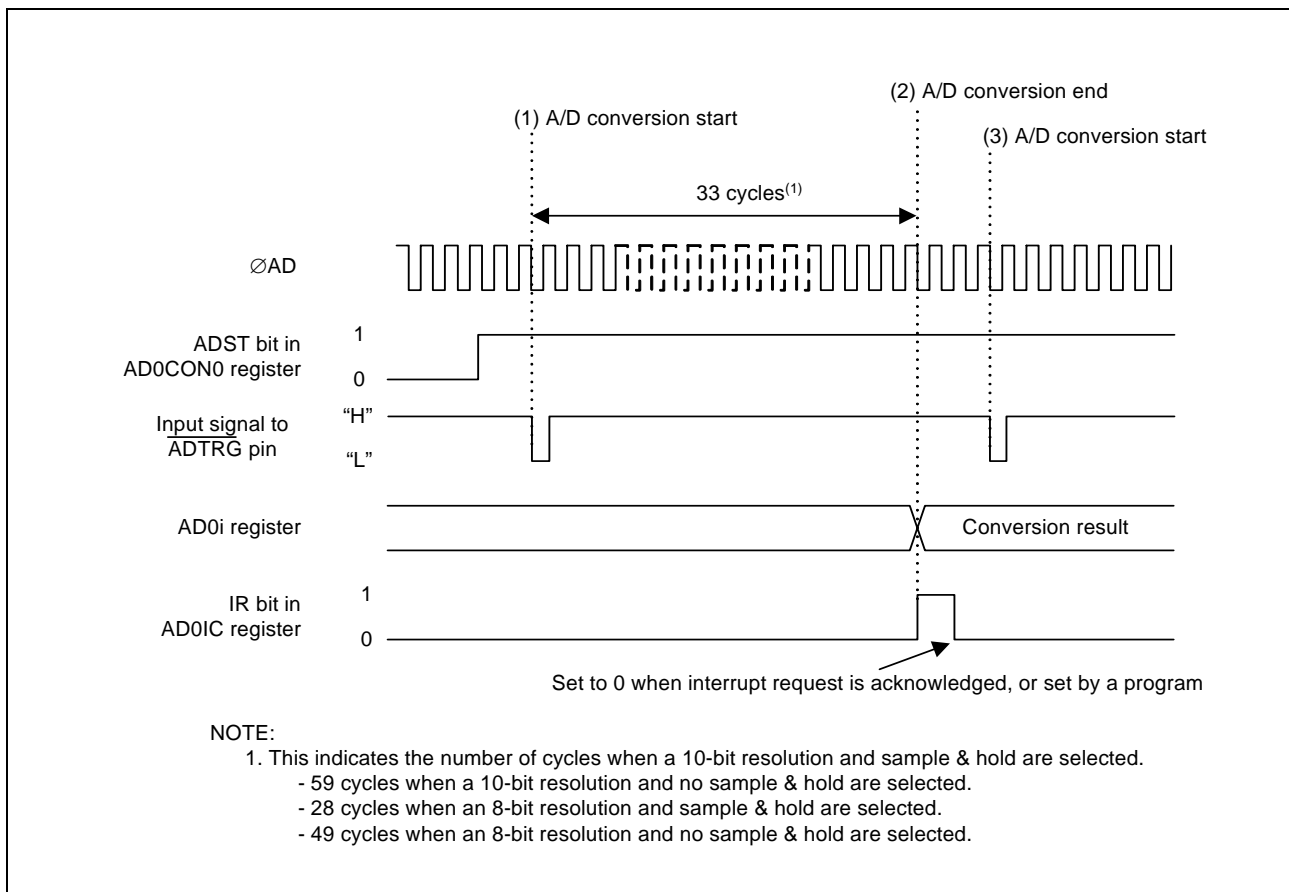


Figure 1 One-Shot Mode Operation

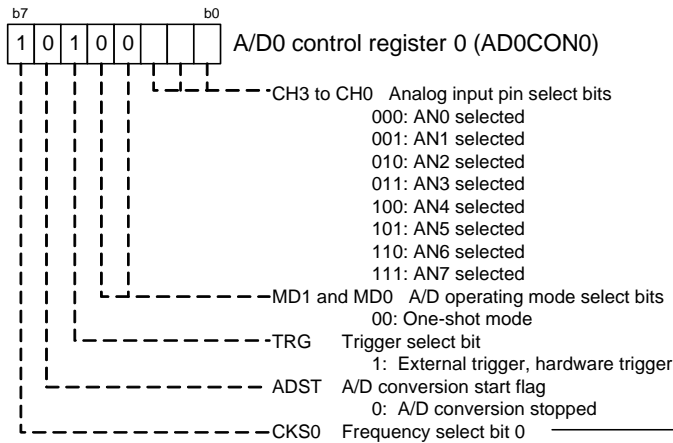
3.2 Setup

This section shows the setup sequence and values to perform the application example described in

3.1 Example Description.

Refer to the MCUs Hardware Manual for details of individual registers.

(1) Set A/D0 control register 0

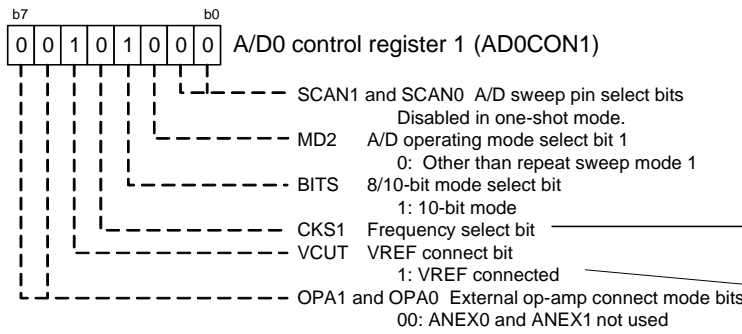


The A/D converter operating clock (ϕ_{AD}) can be selected by: the CKS0 bit in the AD0CON0 register, the CKS1 bit in the AD0CON1 register, or the CKS2 bit in the AD0CON3 register.

CKS2	CKS1	CKS0	
0	0	0	: fAD divided by 4
0	0	1	: fAD divided by 2
0	1	0	: fAD divided by 3
0	1	1	: fAD
1	0	0	: fAD divided by 8
1	1	0	: fAD divided by 6

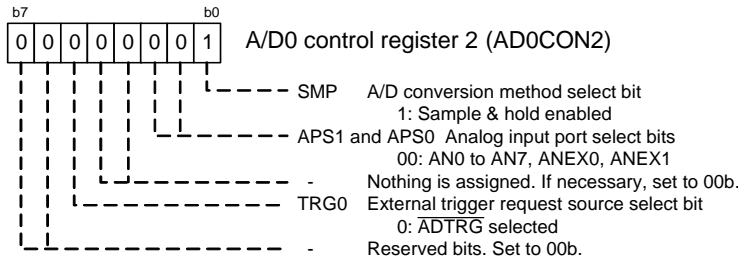
Make sure the settings are set as shown above.
When VCC1 = 4.2 V to 5.5 V, set ϕ_{AD} frequency to 16 MHz or below.
When VCC1 = 3.0 V to 5.5 V, set ϕ_{AD} frequency to 10 MHz or below.

(2) Set A/D0 control register 1

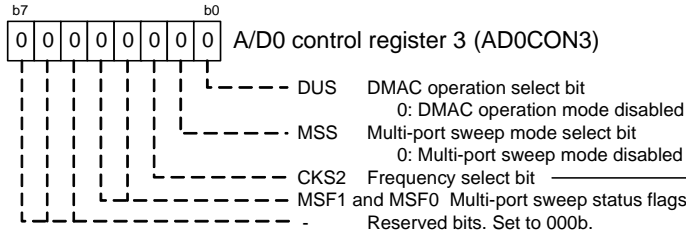


When changing the VCUT bit from 0 to 1, wait for 1 μ s or more before starting A/D conversion.

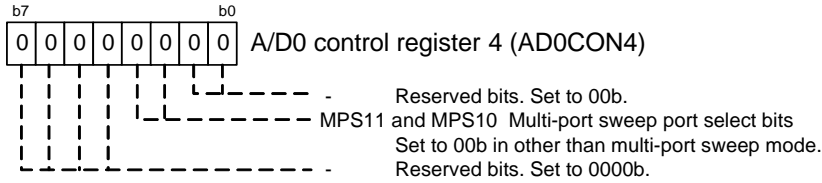
(3) Set A/D0 control register 2



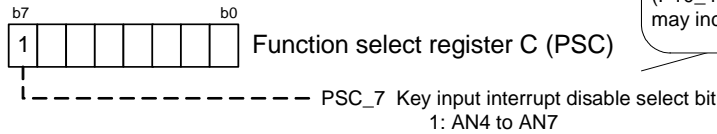
(4) Set A/D0 control register 3



(5) Set A/D0 control register 4

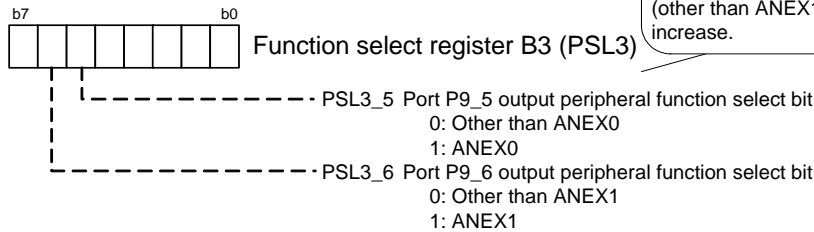


(6) Set the function select registers
(When pins P10_4 to P10_7 are used as analog input pins)



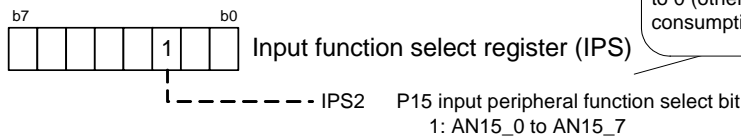
AN4 to AN7 can be used when the PSC_7 bit is set to 0 (P10_4 to P10_7, or K10 to K13), but power consumption may increase.

(When pins P9_5 and P9_6 are used as analog input pins)



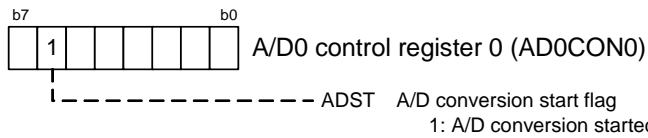
ANEX0 and ANEX1 can be used when the PSL3_5 bit is set to 0 (other than ANEX0) and the PSL3_6 bit is set to 0 (other than ANEX1), but power consumption may increase.

(7) Set the input function select register
(When pins P15_0 to P15_7 are used as analog input pins.)



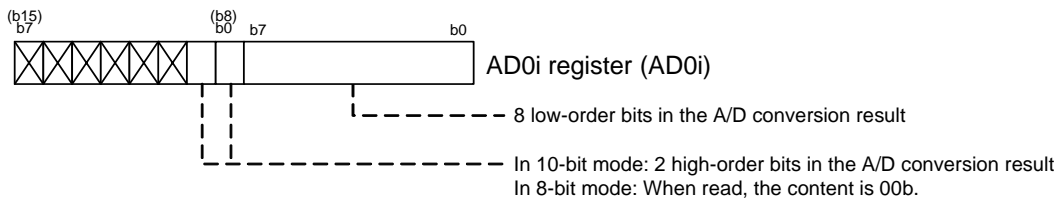
AN15_0 to AN15_7 can be used when the IPS2 bit is set to 0 (other than AN15_0 to AN15_7), but power consumption may increase.

(8) Start A/D Conversion (Set A/D0 control register 0)



(9) Start A/D conversion when an input signal to the \overline{ADTRG} pin changes from "H" to "L".
Wait until A/D conversion is completed.

(10) Read the A/D conversion result (read the AD0i register)



4. Sample Programming Code

A sample program can be downloaded from the Renesas Technology website.
For download, click “Application Notes” in the left-hand side menu of the M16C Family page.

5. Reference Documents

Hardware Manuals

M32C/84 Group Hardware Manual

M32C/85 Group Hardware Manual

M32C/86 Group Hardware Manual

M32C/87 Group Hardware Manual

M32C/88 Group Hardware Manual

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REVISION HISTORY	M32C/84, 85, 86, 87, 88 Group A/D Converter Operation in One-Shot Mode (External Trigger)
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