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**R32C/100 Series****A/D Converter Operation in One-shot Mode Using DMAC**

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**1. Abstract**

This document describes a method for transferring an A/D converted result in one-shot mode to an internal RAM area using DMA.

**2. Introduction**

The application example described in this document applies to the following microcomputer (MCU):

MCUs: R32C/111 Group

This program can be used with other R32C/100 Series MCUs which have the same special function registers (SFRs) as the above group. Check the manuals for any modifications to functions. Careful evaluation is recommended before using the program described in this application note.

### 3. Application Example

In one-shot mode, the analog voltage applied to the AN\_0 pin is converted into a digital code only once.

The converted result is transferred to an internal RAM area using DMA.

Table 3.1 and Table 3.2 list the A/D Converter Operating Conditions and DMAC Operating Conditions, respectively.

**Table 3.1 A/D Converter Operating Conditions**

Item	Contents
Operating clock	fAD divided by 2
Resolution	10-bit mode
A/D conversion start condition	Software trigger
A/D conversion method	With sample and hold function
Analog input pin	AN_0 (P10_0)
External op-amp	Not used
DMAC operating mode	Enabled (2, 3)

Notes:

1. The  $\phi$ AD frequency should be as follows:  
When VCC = 4.2 to 5.5 V, 16 MHz or below.  
When VCC = 3.0 to 4.2 V, 10 MHz or below.  
Without the sample and hold function, 250 kHz or above.  
With the sample and hold function, 1 MHz or above.
2. When DMAC operating mode is enabled, all A/D converted results are stored in the AD00 register.
3. If this register is read by a program while the DMAC operating mode is enabled, the value is undefined.

**Table 3.2 DMAC Operating Conditions**

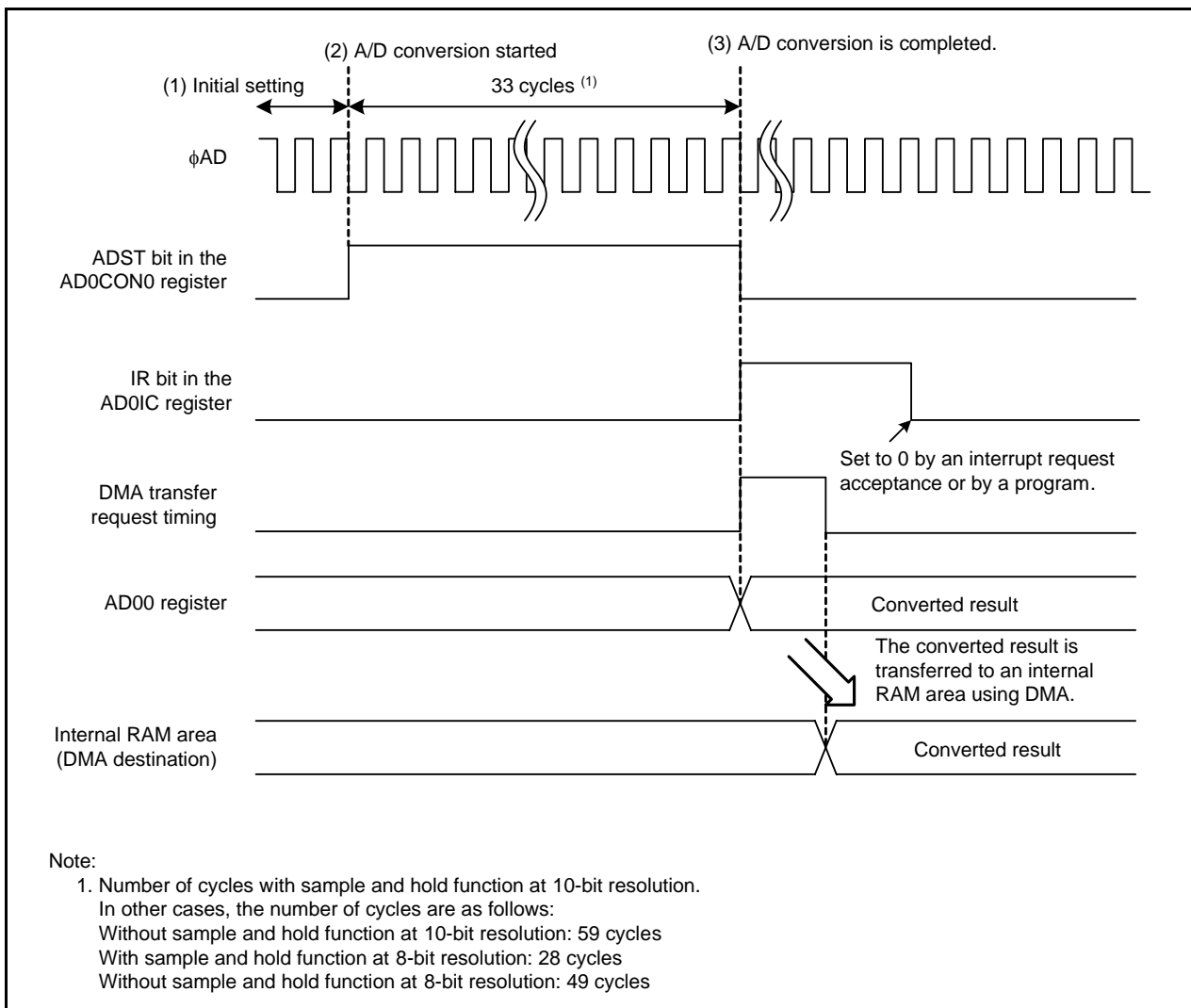
Item	Contents
DMA trigger	A/D0 interrupt request
Transfer mode	Single transfer
Transfer size	16 bits
Addressing	Fixed address (AD00 register) to fixed address (internal RAM area)

### 3.1 Explanation

The following steps are for operation by the sample program:

- (1) Initial setting  
Initialize the DMAC and A/D converter.
- (2) A/D conversion started  
When setting the ADST bit in the AD0CON0 register to 1 (A/D conversion started), A/D conversion starts.
- (3) A/D conversion completed  
After A/D conversion is completed, the converted result is transferred to the AD00 register. Then, the ADST bit becomes 0 (A/D conversion stopped) and the IR bit in the AD0IC register becomes 1. At the same time, the result transferred to the AD00 register is transferred to an internal RAM area using DMA.

Figure 3.1 shows an Operation Example in One-shot Mode Using DMAC.



**Figure 3.1 Operation Example in One-shot Mode Using DMAC**

### 3.2 Settings

The section shows the setting procedure and setting values to execute 3.1 “Explanation”. Refer to hardware user’s manuals for details of each register.

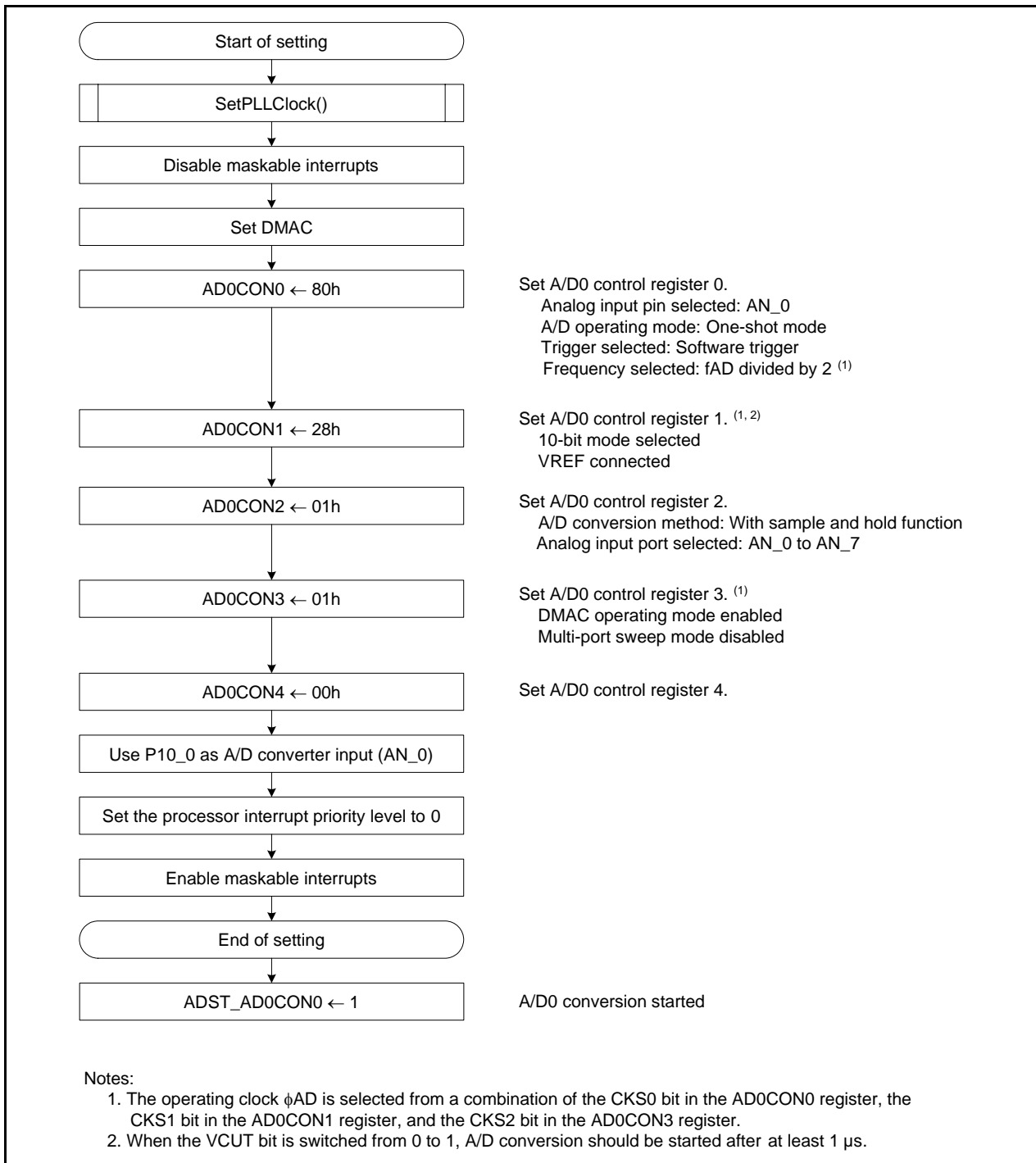


Figure 3.2 Setting Procedure of A/D Converter Operation in One-shot Mode Using DMAC (1/2)

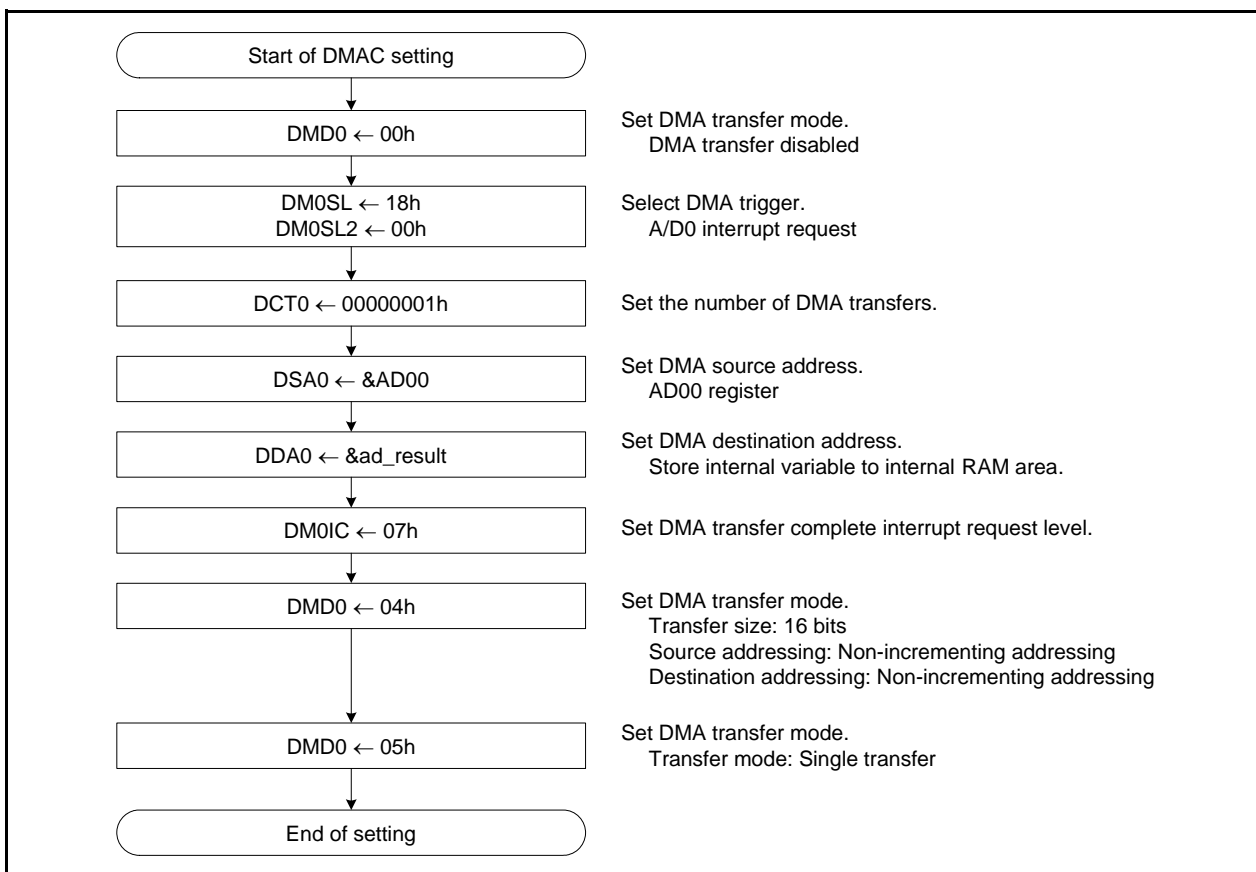


Figure 3.3 Setting Procedure of A/D Converter Operation in One-shot Mode Using DMAC (2/2)

## 4. Sample Program

A sample program can be downloaded from the Renesas Electronics website.

## 5. Reference Documents

### User's Manuals

R32C/111 Group User's Manual: Hardware Rev.1.10

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.

### C Compiler Manual

R32C/100 Series C Compiler Package V.1.02 C Compiler User's Manual Rev.2.00

The latest version can be downloaded from the Renesas Electronics website.

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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 part number, confirm that the change will not lead to problems.

- The characteristics of MPU/MCU in the same group but having different part numbers may differ because of the differences in internal memory capacity and layout pattern. When changing to products of different part numbers, implement a system-evaluation test for each of the products.



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