

1. Abstract

The D/A converter is a device that converts a digital code to an analog voltage when a value is written to the DAi register, and the D/A conversion result is output (i = 0, 1). Analog voltage to be output (V) is calculated based on the value (n) set in the DAi register (n = 0 to 255).

$$\text{Analog voltage to be output (V)} = \frac{\text{reference voltage (VREF)} \times (\text{setting value in the DAi register})}{256}$$

2. Introduction

The application example described in this document applies to the following microcomputers (MCUs):

MCUs: R32C/116 Group, R32C/117 Group, and R32C/118 Group

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

3. Application Example

This application example describes how to output analog voltage from the DA0 pin (P9_3). This document explains how to rewrite the DA0 register using timer A0 to generate an interrupt with a 1 ms interval. The initial output value is 0.0 V. The output value rises approximately 1.0 V every 1 ms (e.g. 1.0 V → 2.0 V). After reaching an output value of approximately 5.0 V, the output value loops back to 0.0 V (e.g. 0.0 V → 1.0 V → 2.0 V → 3.0 V → 4.0 V → 5.0 V → 0.0 V).

The other condition is that the reference voltage (VREF) is 5.0 V.

3.1 Description of Application Example

The following numbers in parenthesis correspond to the number in parenthesis in the figure below.

- (1) In the DA0 register, set the value that outputs 0.0 V.
- (2) When the DA0E bit in the DACON register is set to 1, the conversion result is output from the DA0 pin.
- (3) Timer A0 starts counting.
- (4) When timer A0 underflows, an interrupt request is generated. Change the output value of the DA0 register in the interrupt handler for that interrupt.

Additional description:

- To disable the D/A conversion result output, the DA0E bit should be set to 0. At that time, the DA0 pin becomes high-impedance.
- To use the DA0 pin, the P9_3S register should be set to 80h and the PD9_3 bit in the PD9 register should be set to input.
- To use the DA1 pin, the P9_4S register should be set to 80h and the PD9_4 bit in the PD9 register should be set to input.

3.2 Timing

Figure 3.1 shows D/A Converter Operation.

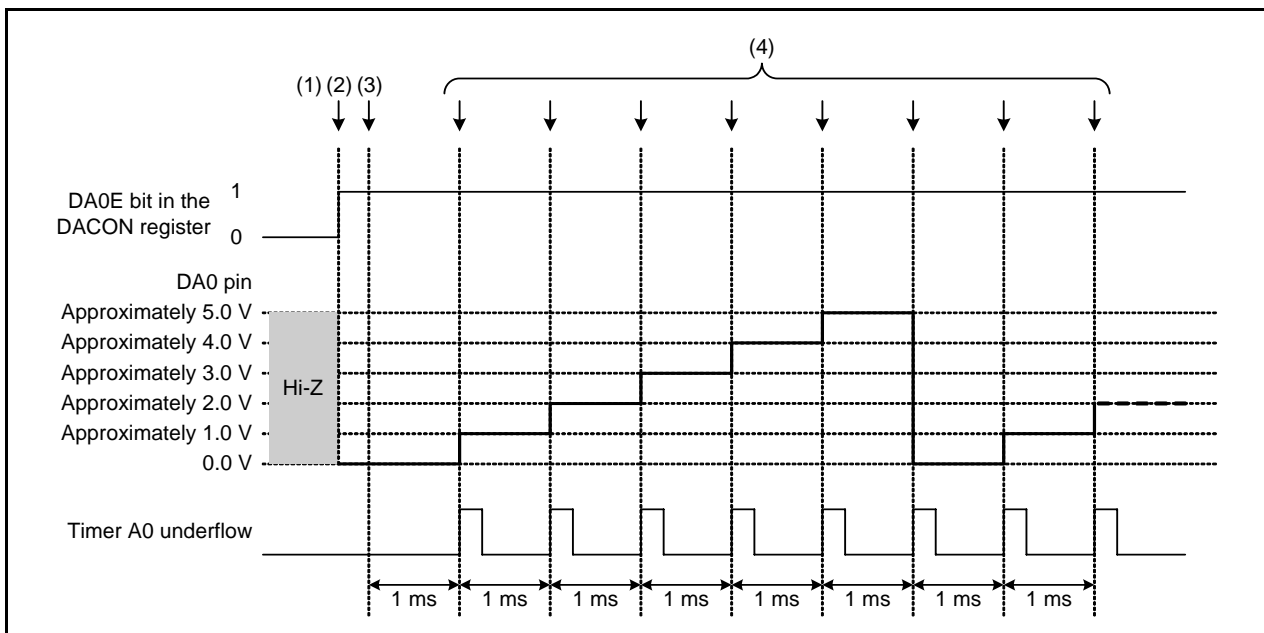


Figure 3.1 D/A Converter Operation

3.3 Flowcharts

Figure 3.2 and Figure 3.3 show the Main Function and Timer A0 Interrupt Function, respectively.

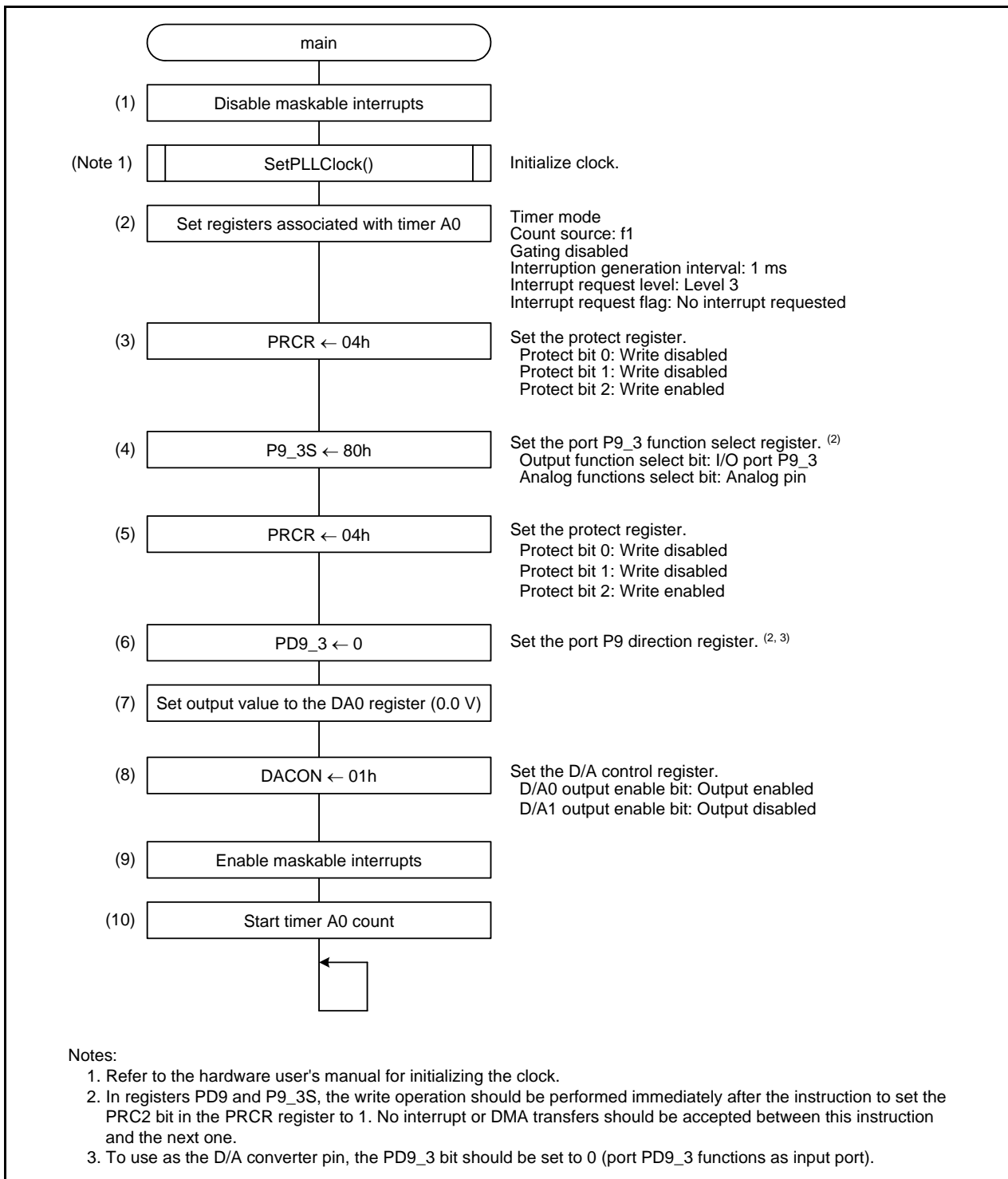


Figure 3.2 Main Function

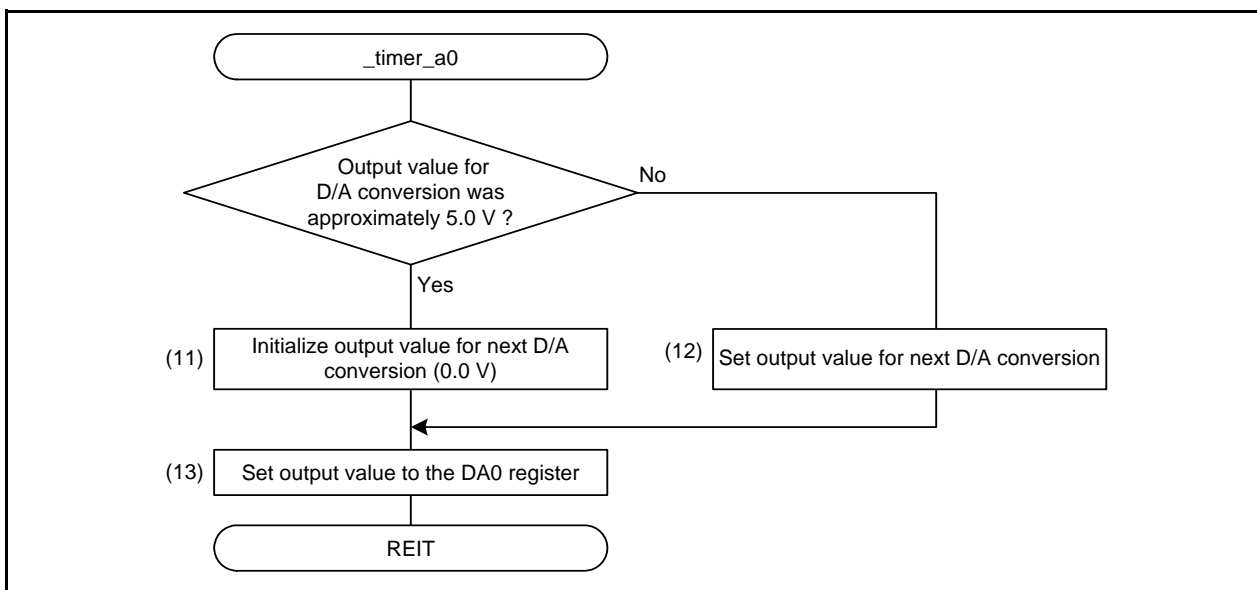


Figure 3.3 Timer A0 Interrupt Function

4. Sample Program

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

5. Reference Documents

User's Manuals

R32C/116 Group User's Manual: Hardware Rev.1.00

R32C/117 Group User's Manual: Hardware Rev.1.00

R32C/118 Group User's Manual: Hardware Rev.1.00

The latest versions 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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REVISION HISTORY	R32C/100 Series D/A Converter Operation
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		Page	Summary
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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 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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