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April 1st, 2010
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R8C/2D Group

D/A Converter

1. Abstract

This document shows a program for the D/A converter.

2. Introduction

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

- MCU : R8C/2D Group
- VCC, AVCC/VREF : 5 V

This program can be used with other R8C/Tiny Series MCUs which have the same special function registers (SFRs) as the R8C/2D Group. Check the manual for any additions and modifications to functions. Careful evaluation is recommended before using this application note.

3. Application Description

This section shows how to use the D/A converter to output a 3 V analog voltage to the DA0 pin and a 5 V analog voltage to the DA1 pin.

The D/A converters are 8-bit R-2R type units. There are two independent D/A converters.
D/A conversion is performed by writing to the DAi register (i = 0 or 1). To output the conversion result, set the DAiE bit in the DACON register to 1 (output enabled). Before using D/A conversion, the corresponding port direction bit must be set to 0 (input mode). Setting the DAiE bit to 1 removes the pull-up from the corresponding port.
The output analog voltage (V) is determined by the setting value n (n: decimal) of the DAi register.

$$V = Vref \times n / 256 \quad (n = 0 \text{ to } 255)$$

Vref: Reference voltage

Table 3.1 lists the D/A Converter Specifications. Figure 3.1 shows the Block Diagram of D/A Converter. Figure 3.2 shows the D/A Converter Equivalent Circuit.

Table 3.1 D/A Converter Specifications

Item	Performance
D/A conversion method	R-2R method
Resolution	8 bits
Analog output pins	2 (DA0 and DA1)

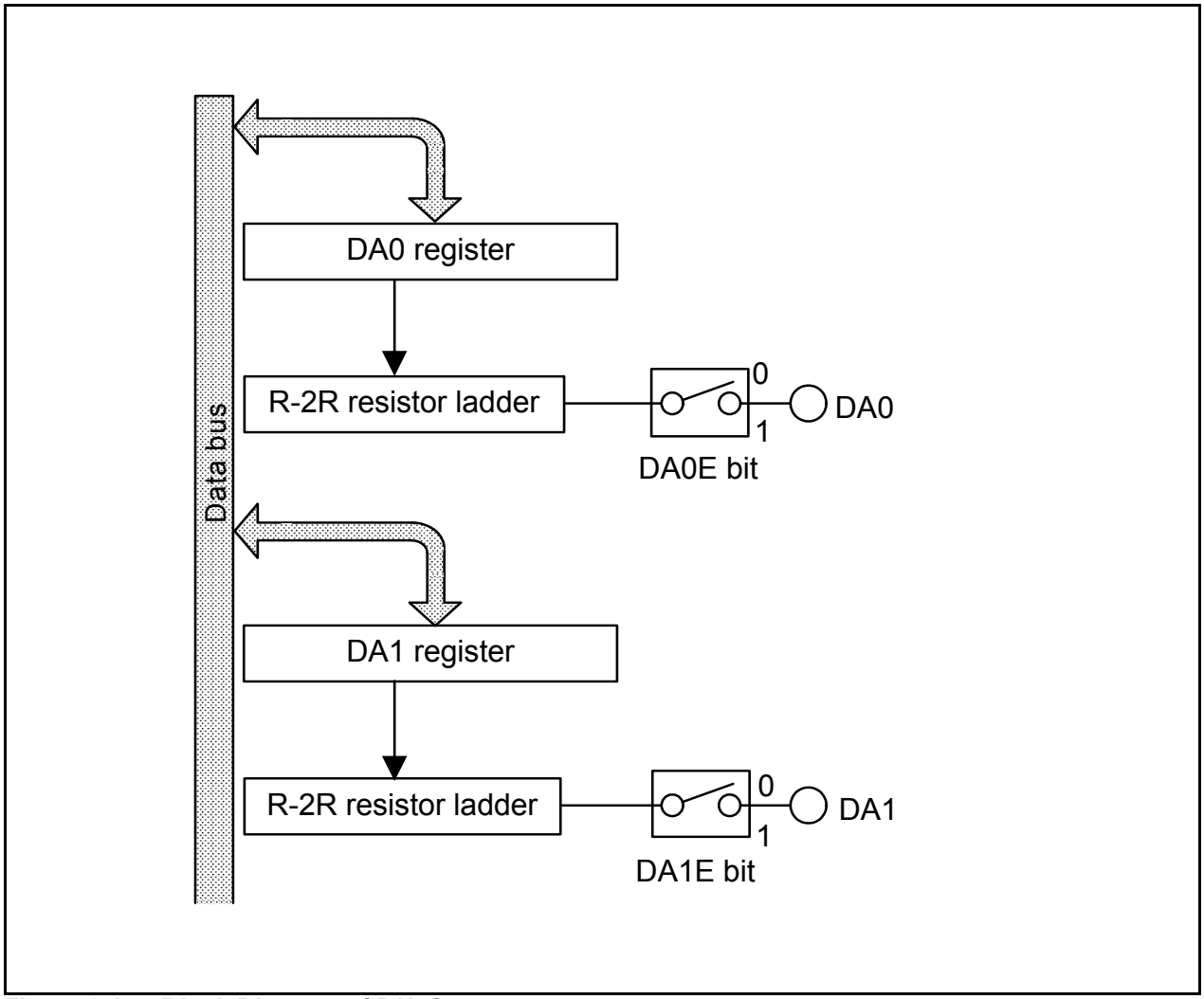


Figure 3.1 Block Diagram of D/A Converter

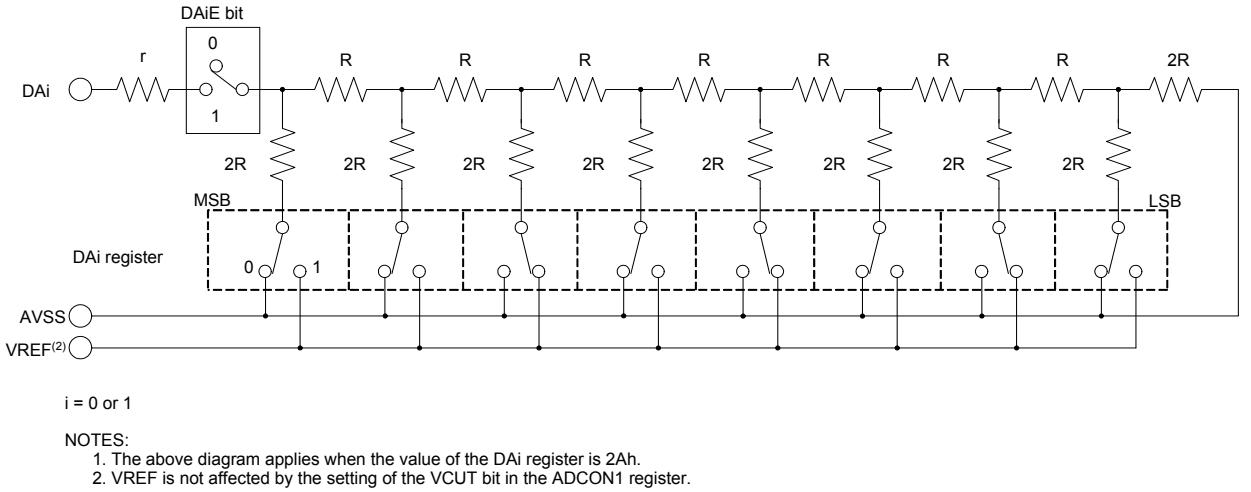


Figure 3.2 D/A Converter Equivalent Circuit

This sample program may include operations of unused bit functions for the convenience of the SER bit layout. Set the values according to the operating conditions of the user system.

3.1 Used Pins

Table 3.2 Used Pins and Functions

Pin Name	I/O	Function
P0_6/AN1/DA0	Output	Analog output DA0
P0_7/AN0/DA1	Output	Analog output DA1

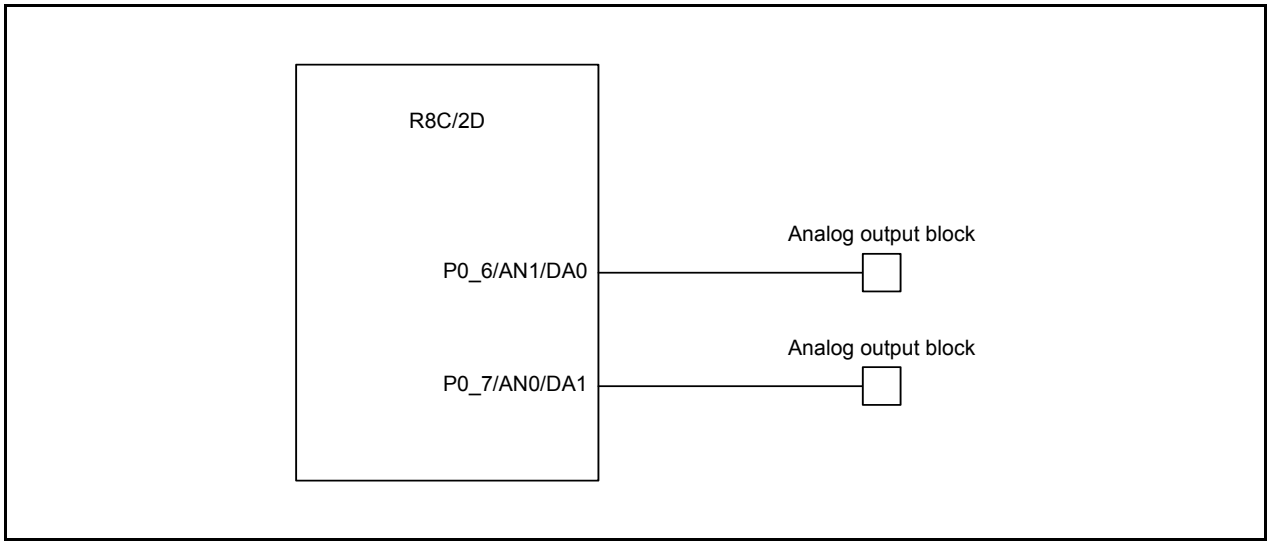


Figure 3.3 Analog Output

3.2 Memory Usage

Table 3.4 Memory Usage

Memory Usage	Size	Remark
ROM	31 bytes	In the main.c module
RAM	0 bytes	In the main.c module
Maximum user stack usage	3 bytes	main function: 3 bytes
Maximum interrupt stack usage	0 bytes	Unused

The size of memory usage depends on the C compiler version or compile option. The above applies to the following conditions:

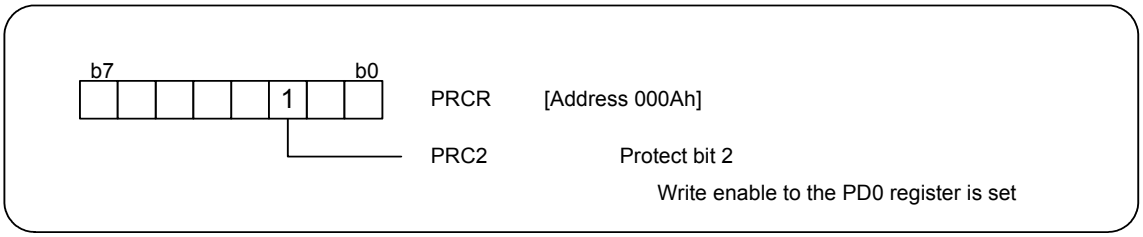
- C compiler: M16C/60, 30, 20, 10, Tiny, R8C/Tiny Series Compiler V.5.40 Release 00
- Compile option: -c -finfo NOTE: -dir “$(CONFIGDIR)” -R8C

NOTE: Unusable in the R8C/Tiny dedicated free version.

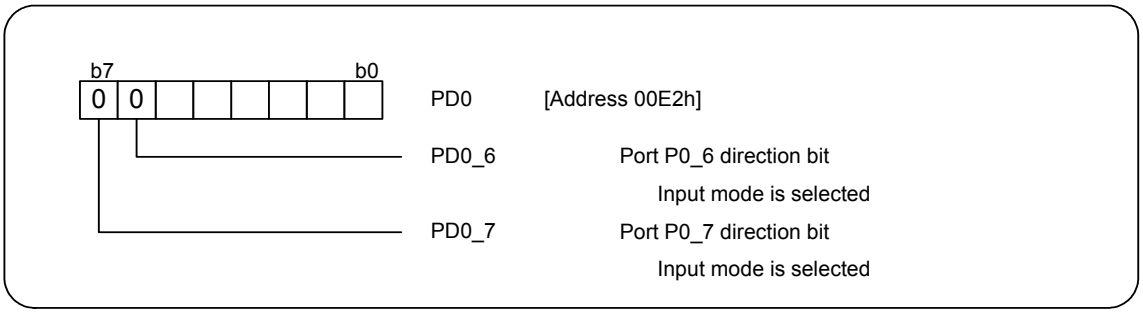
4. Setup

This section shows initial setup procedures and setting values to perform the example in **3. Application Description**. Refer to the **R8C/2D Group Hardware Manual** for details of individual registers.

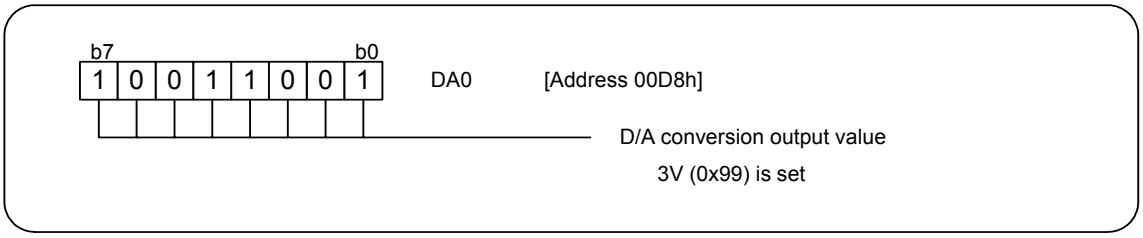
(1) Setting the protect register



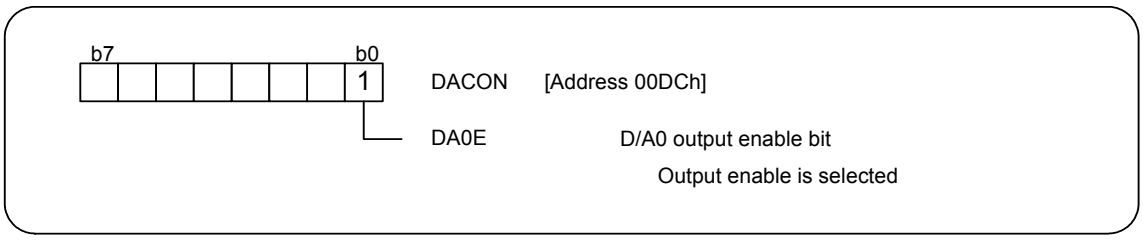
(2) Setting the port P0 direction register



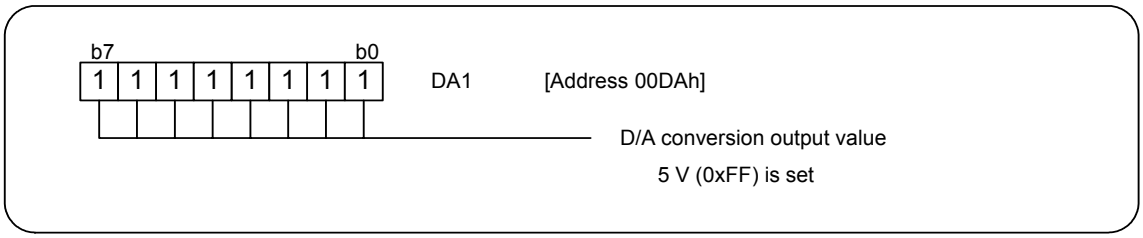
(3) Setting the D/A0 register



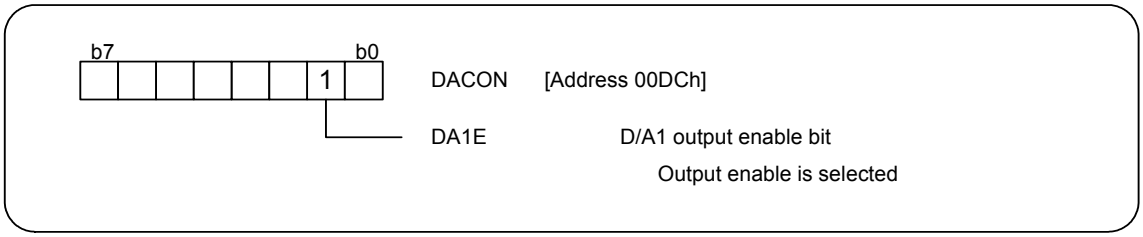
(4) Setting the D/A0 output enable bit



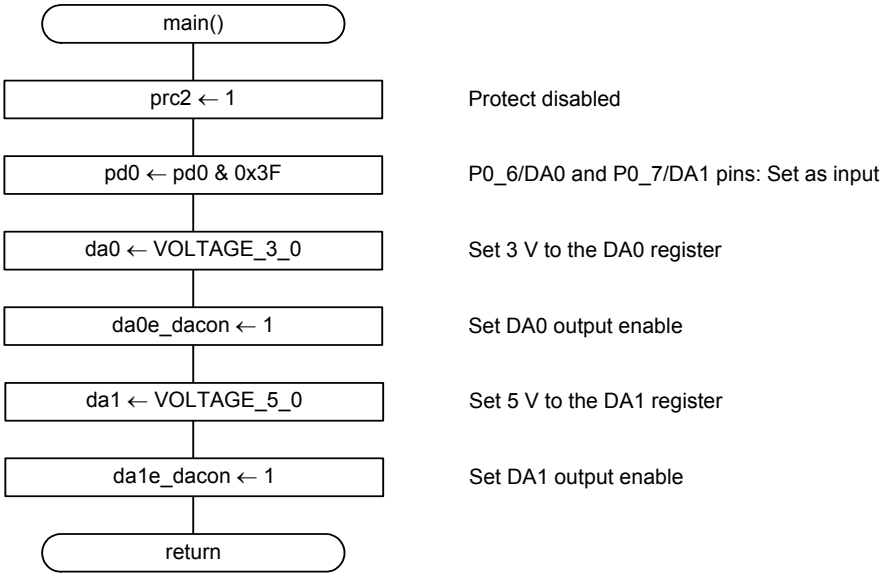
(5) Setting the D/A1 register



(6) Setting the D/A1 output enable bit



5. Flowchart


main()
prc2 ← 1
Protect disabled
pd0 ← pd0 & 0x3F
P0_6/DA0 and P0_7/DA1 pins: Set as input
da0 ← VOLTAGE_3_0
Set 3 V to the DA0 register
da0e_dacon ← 1
Set DA0 output enable
da1 ← VOLTAGE_5_0
Set 5 V to the DA1 register
da1e_dacon ← 1
Set DA1 output enable
return

6. 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 R8C/Tiny Series page.

7. Reference Documents

Hardware Manual
R8C/2D Group Hardware Manual
The latest version can be downloaded from the Renesas Technology website.

Technical Update/Technical News
The latest information can be downloaded from the Renesas Technology website.

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Rev.	Date	Description	
		Page	Summary
1.00	Jan 31, 2007	–	First Edition issued

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