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Renesas Electronics Corporation

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M16C/26

Using the A-D Converter In Repeat Mode

1.0 Abstract

The following article outlines the steps necessary to set up, perform and read multiple conversions on a single channel using the on-chip analog to digital converter (ADC) of the M16C/26. The ADC is useful in measuring output voltages of sensors such as accelerometers or other analog instrumentation and converting them to digital values.

2.0 Introduction

The Renesas M30262 is a 16-bit MCU based on the M16C/60 series CPU core. The MCU features include up to 64K bytes of Flash ROM, 2K bytes of RAM, and 4K bytes of Virtual EEPROM. The peripheral set includes UARTS, Timers, DMA, and GPIO. The M16C/26 features an on-chip analog to digital converter (ADC). The ADC consists of one 10-bit successive approximation circuit with a capacitive coupled amplifier. There are eight analog input pins, selectable conversion clock speeds, sample and hold function, and several conversion modes. Figure 1 shows the internal circuitry of the ADC block and Table 1 shows the performance of the ADC.

Table 1 ADC Performance

Item	Performance
Method of A-D Conversion	Successive approximation (capacitive coupling amplifier)
Analog input voltage	0V to AVcc (Vcc)
Operating clock f_{AD}	f_{AD} , f_{AD2} , f_{AD3} , f_{AD4} , f_{AD6} , or f_{AD12} where $f_{AD}=f(Xin)$
Resolution	8-bit or 10-bit (selectable)
Operating modes	One-shot mode, repeat, single sweep mode, repeat mode, repeat sweep mode 0 and repeat sweep mode 1.
Analog input pins	8 pins AN ₀ to AN ₇
A-D conversion start condition	Software trigger: A-D conversion starts when the A-D conversion start flag changes to "1" External trigger (can be retriggered): A-D conversion starts when the A-D conversion start flag is "1" and the AD _{TRG} /P15 input (shared with INT3) changes from "H" to "L"
Conversion speed per pin	Without sample and hold function 8-bit resolution: 49 f_{AD} cycles, 10-bit resolution: 59 f_{AD} cycles. With sample and hold function 8-bit resolution: 28 f_{AD} cycles, 10-bit resolution: 33 f_{AD} cycles.

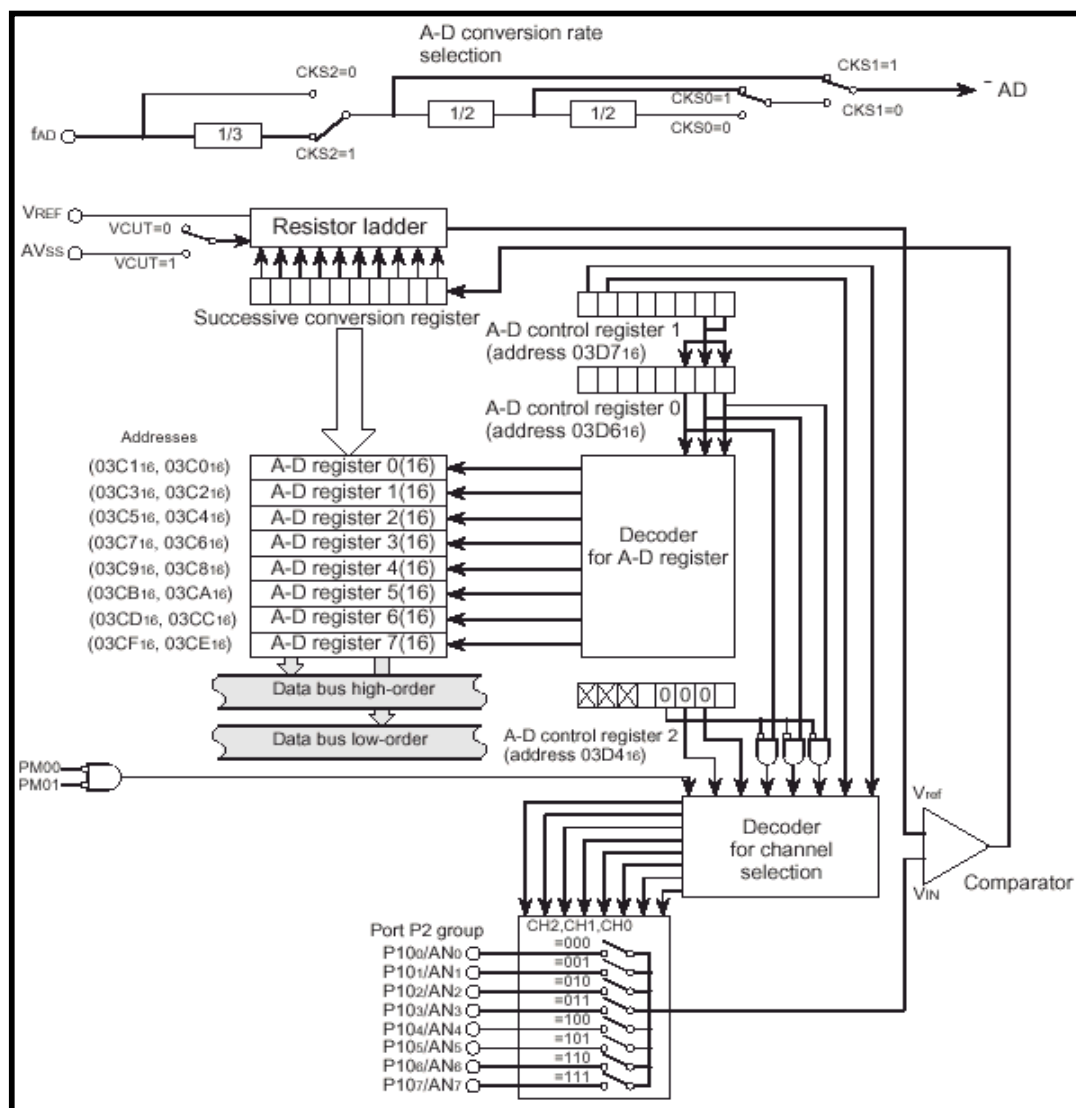


Figure 1 ADC Block Diagram

3.0 Repeat Mode Description

In repeat mode, one pin of the ADC is selected as the input source. Once triggered, a conversion takes place on the selected pin and the result is stored in the ADC result register corresponding to the selected channel. This is repeated until the ADC conversion start flag is disabled. No interrupt is generated on the completed conversion, but rather the ADC output register can be read anytime to determine the converted value. Below is an overview of the registers that will be used in this example. These registers are detailed in the included sample code. For specific details, consult the MCU datasheet. Figure 2 and Figure 3 show the control registers for the ADC setup in the Repeat Mode.

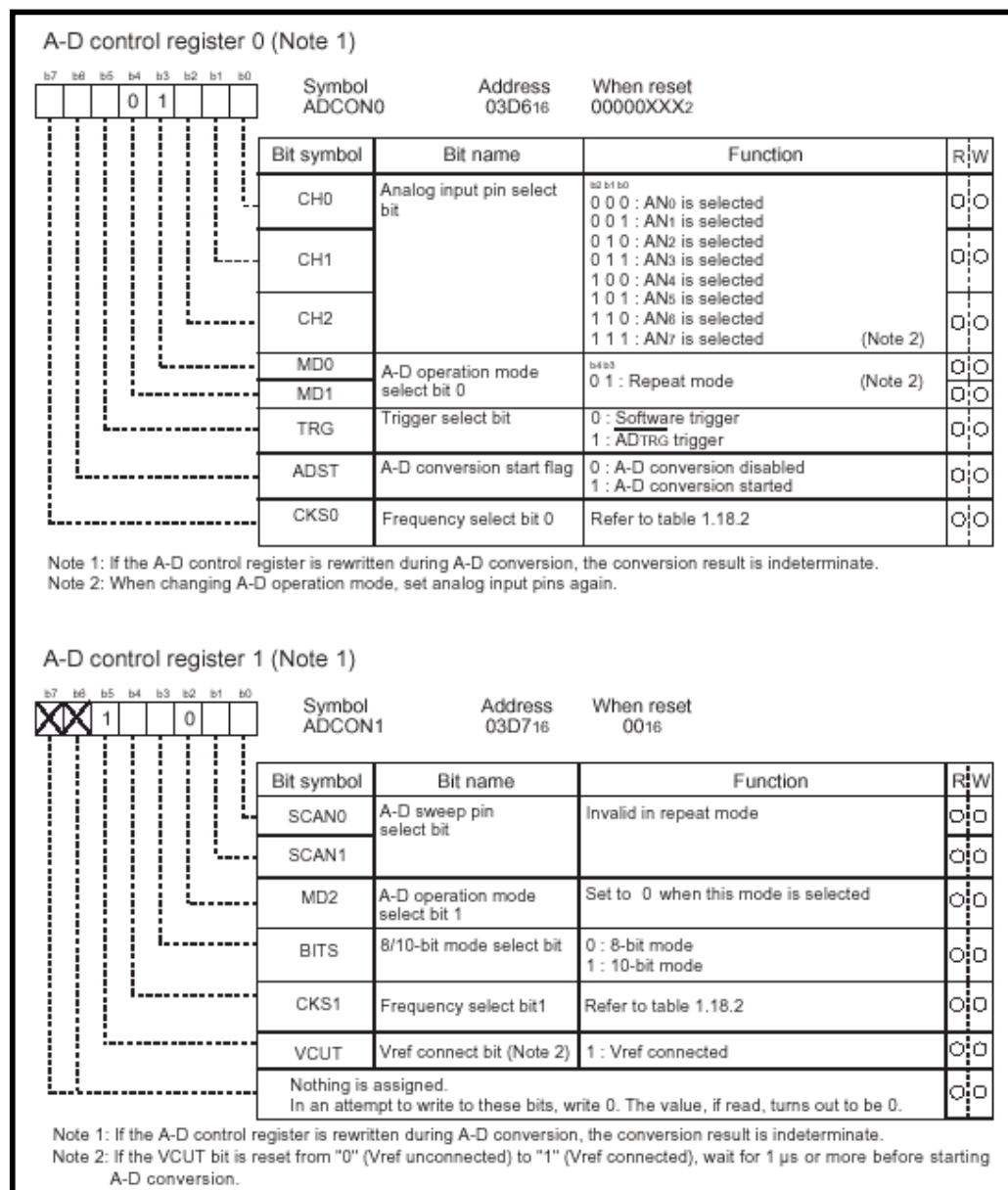


Figure 2 ADC Control Registers In Repeat Mode

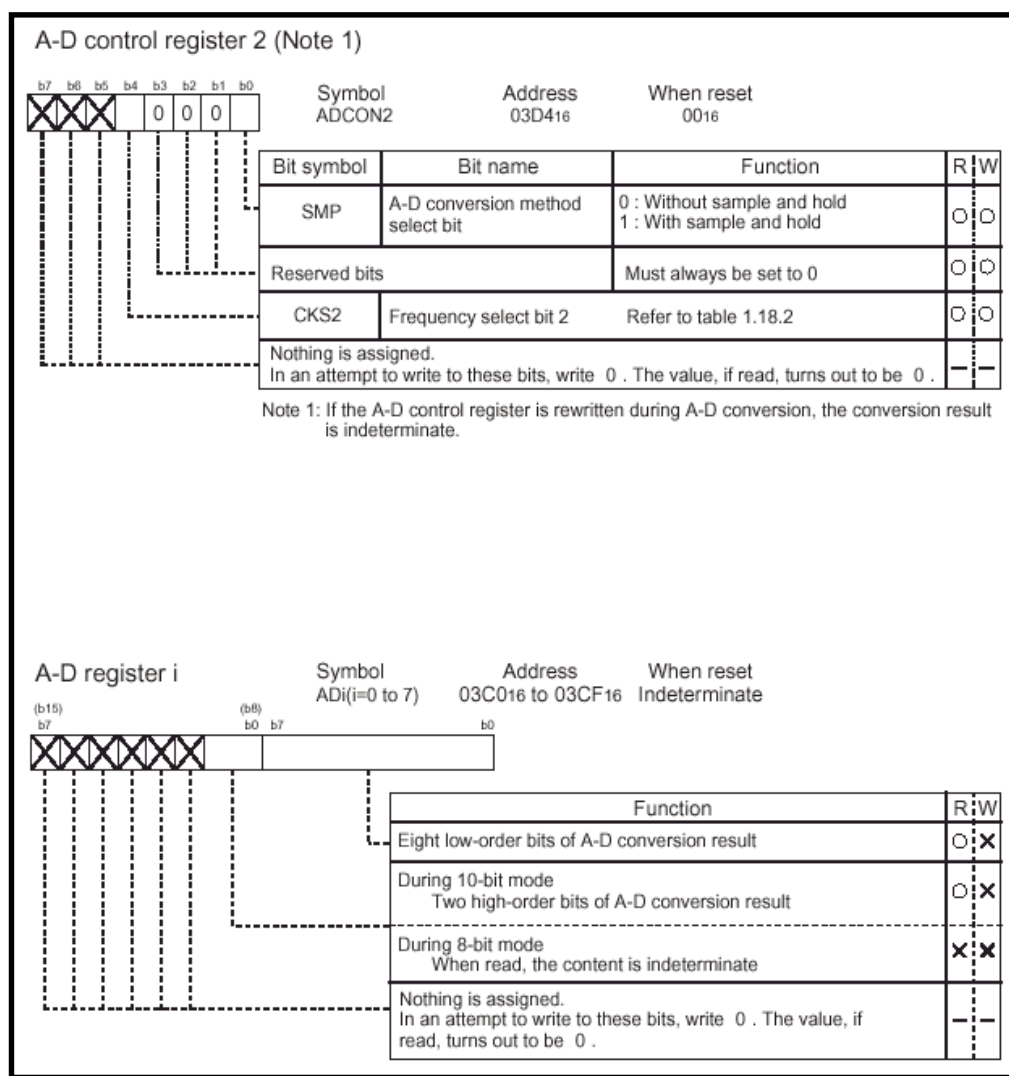


Figure 3 ADC Control Register

4.0 Example Program

The following example program demonstrates how to perform a conversion using the ADC with the following environment:

- Repeat mode conversion
- 10-bit mode
- Analog input 0 used
- Sample and hold enabled
- Vref connected
- Conversion clock used will be $f_{AD}/4$ (When $f(Xin)$ is greater than 10 MHz, f_{AD} must be divided)
- Software conversion start

5.0 Reference

Renesas Technology Corporation Semiconductor Home Page

<http://www.renesas.com>

E-mail Support

support_apl@renesas.com

Data Sheets

- M16C/26 datasheets, M30262eds.pdf

User's Manual

- M16C/20/60 C Language Programming Manual, 6020c.pdf
- M16C/20/60 Software Manual, 6020software.pdf
- MSV30262-SKP or MSV-Mini26-SKP Quick start guide
- MSV30262-SKP or MSV-Mini26-SKP Users Manual
- MDECE30262 or MSV-Mini26-SKP Schematic

6.0 Software Code

The sample software provided was compiled using the KNC30 compiler. The program starts the conversion process on reset. This code was written to run on the MSV30262 Starter Kit and can be modified for a user application.

```
/* *****  
*   DESCRIPTION: repeat_mode.c                                     *  
*   *****  
*   PURPOSE: Outlines how to use the M16C/26 ADC in repeat      *  
*             mode. On reset, program repeatedly stores the result *  
*             of the conversion in a variable that can be examined *  
*             using KD30 and the MSV30262-Starter Kit or similar tool. *  
*   *****  
***** */  
  
#include "sfr26.h"  
  
unsigned int TempStore = 0x0000;          // Location where ADC result is stored  
  
/*  
** main  
*  
*   PARAMETERS: None  
*  
** */
```



```
adst = 1;                                // Start a conversion here

while (1){

    TempStore = ad0 & 0x03ff;           // Mask off the upper 6 bits of the
                                        // variable leaving only the result
                                        // in the variable itself
}
}
```

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