

M16C/26

Using the A-D Converter In Repeat Sweep Mode 0

1.0 Abstract

The following document outlines the steps necessary to setup and perform analog to digital conversions of the M16C/26 using repeat sweep mode 0. 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 10-bit A/D, UARTS, Timers, DMA, and GPIO. The M16C/26 features an onboard analog to digital converter (ADC). The ADC consists of one 10-bit successive approximation circuit, eight analog input pins, selectable conversion clock speeds, sample and hold function, and several conversion modes. Table 1 shows the performance of the ADC and Figure 1 shows a diagram of the ADC block.

Table 1 ADC Performance

Item	Performance
Method of A-D Conversion	Successive approximation (capacitive coupling amplifier)
Analog input voltage	0V to AV _{CC} (V _{CC})
Operating clock f _{AD}	f _{AD} , f _{AD2} , f _{AD3} , f _{AD4} , f _{AD6} , or 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.

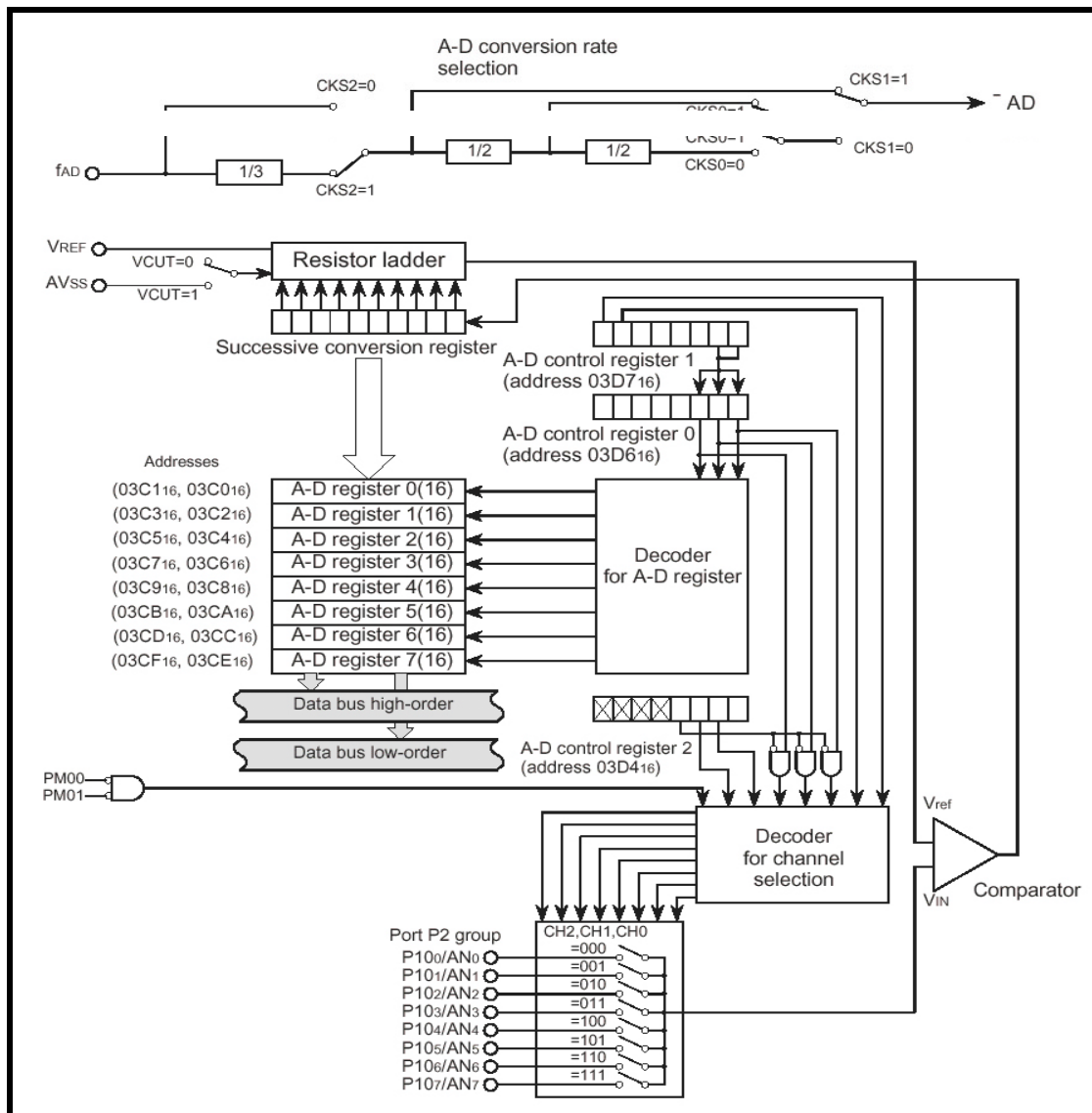


Figure 1 ADC Block Diagram

3.0 Repeat Sweep Mode 0 Description

In repeat sweep mode 0, several pins of the ADC can be selected as input sources. Once triggered, a conversion takes place on the selected pins and the result is stored in the ADC result registers corresponding to the selected channels. This is repeated until the ADC conversion start flag is disabled. No interrupt is generated on the completed conversions, but rather the ADC output registers are read anytime to determine the converted values. 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 ADC setup in Repeat Sweep Mode 0.

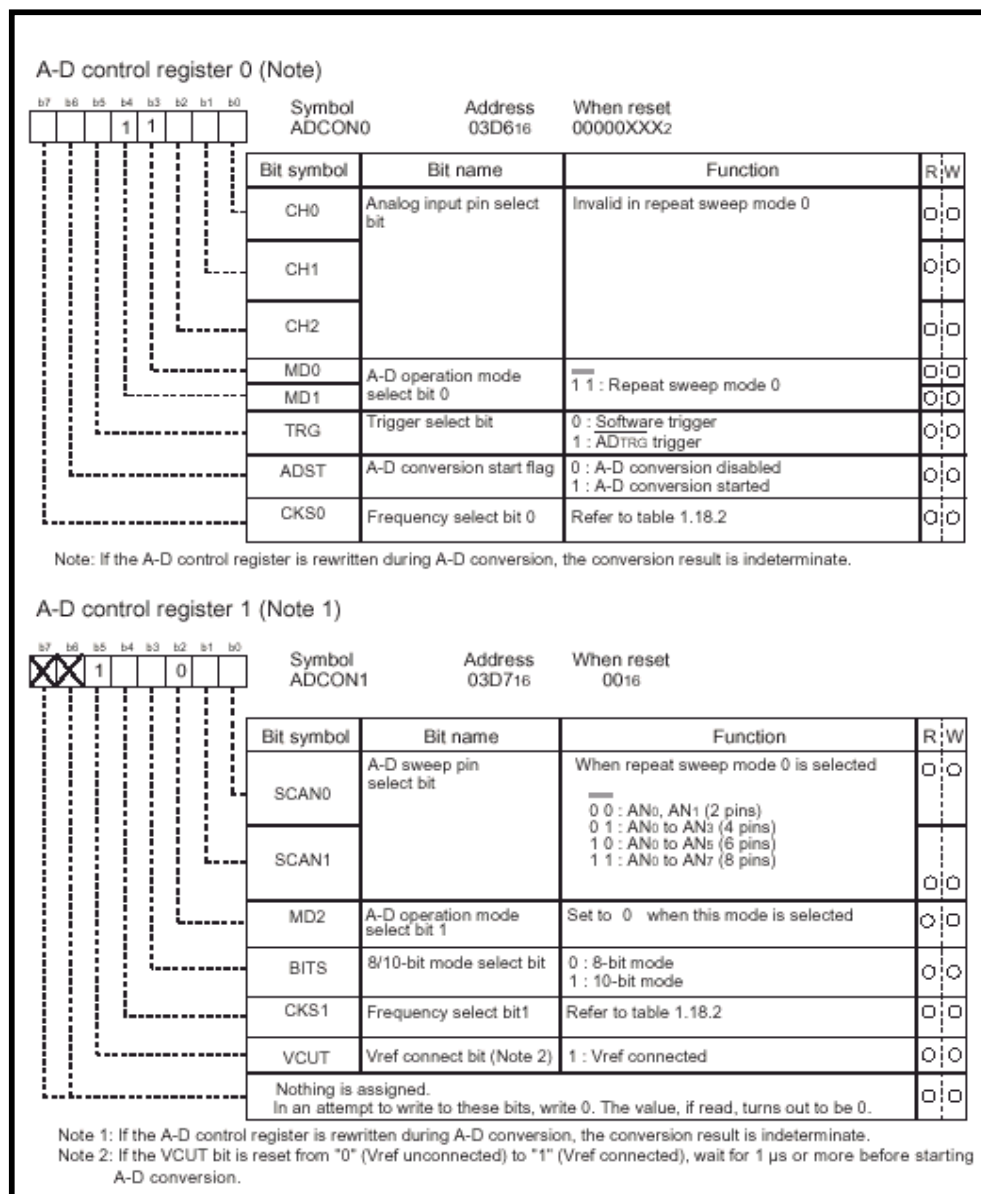


Figure 2 ADC control registers in Repeat Sweep Mode 0

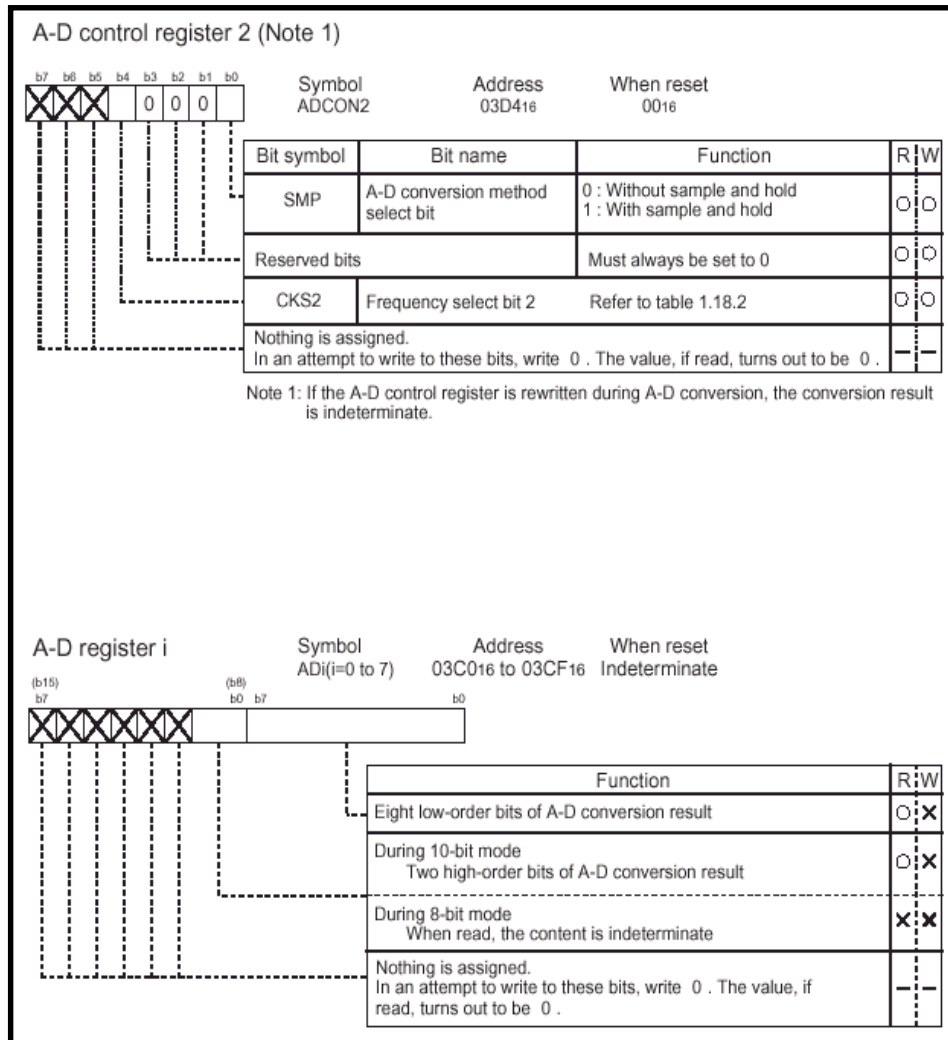


Figure 3 ADC Control Registers

4.0 Example Program

The following example program demonstrates how to perform a conversion using the ADC with the following configuration.

- Repeat sweep mode 0 conversions
- 10 bit mode
- Analog inputs 0-3 used
- Sample and hold enabled
- Internal Vref
- Conversion clock used will be $f_{AD}/4$ (When $f(X_{in})$ 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 sets up the ADC to continuously perform conversions on channels 0 to 3. The code then repeatedly reads the results of those conversions. The example program was written to run on the MSV30262 Starter Kit but could be modified for a user application.

```
/*
*****
*      DESCRIPTION: repeat_sweep_mode_0.c
*
*      PURPOSE: Outlines how to use the M16C/26 ADC in repeat sweep
*      mode0. On reset, program repeatedly stores the result
*      of the conversion in a variable that can be examined
*      using KD30 or similar tool.
*****
#include "sfr26.h"
int TempStore0 = 0x0000;          // Location where ADC result is stored
int TempStore1 = 0x0000;          // Location where ADC result is stored

int TempStore2 = 0x0000;          // Location where ADC result is stored
int TempStore3 = 0x0000;          // Location where ADC result is stored

*/
```



```
_asm (" fset i" ) ;           // globally enable interrupts

adst = 1;                     // Start a conversion here

while (1){
    TempStore0= ad0 & 0x03ff;    // Mask off the upper 6 bits of the
                                // variable leaving only the result
                                // in the variable itself

    TempStore1= ad1 & 0x03ff;    // Mask off the upper 6 bits of the
                                // variable leaving only the result
                                // in the variable itself

    TempStore2= ad2 & 0x03ff;    // Mask off the upper 6 bits of the
                                // variable leaving only the result
                                // in the variable itself

    TempStore3= ad3 & 0x03ff;    // Mask off the upper 6 bits of the
                                // variable leaving only the result
                                // in the variable itself
}
}
```

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