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2010年4月1日
瑞萨电子公司

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H8/300L SLP 系列

通过 4 个通道的 A/D 转换进行电压测量

要点

使用内部 A/D 转换器，进行输入电压（4 个通道）的电压测量，结果保存到 RAM。

动作确认器件

H8/38024

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1. 说明

（1） 使用 A/D 转换器，进行 4 个通道的 A/D 转换的电压测量。
（2） 如图 1 所示，将 4 个通道的电压输入到 H8/38024，并且将 A/D 转换结果保存到 RAM。

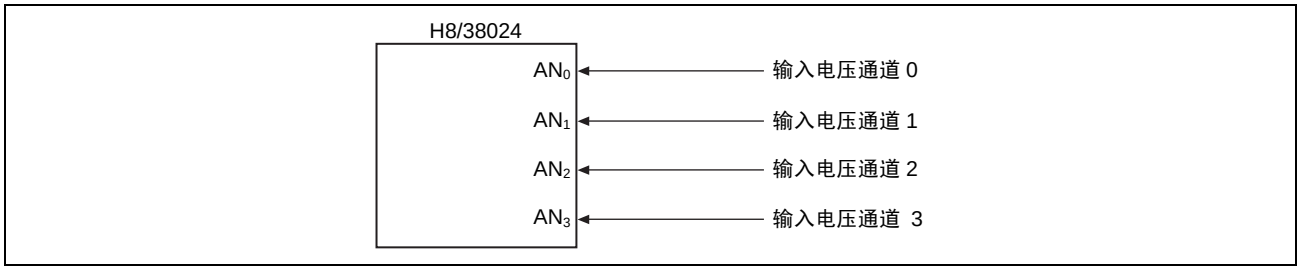


图 1　通过 4 个通道的 A/D 转换进行电压测量

2. 使用功能的说明

（1） 本例子使用 A/D 转换器进行 4 个通道 A/D 转换的电压测量。
（a） A/D 转换器的框图如图 2 所示，以下说明 A/D 转换器的框图：

- A/D 结果寄存器（ADRRH、ADRRL）是 16 位只读寄存器，保存 A/D 转换的结果。将 10 位转换数据的高 8 位保存到 ADRRH、低 2 位保存到 ADRRL 的位 7 和位 6。
- A/D 模式寄存器（AMR）是 8 位可读写寄存器，设定 A/D 转换速度以及指定模拟输入管脚。本例子将 A/D 转换速度设定为 12.4μs。
- A/D 开始寄存器（ADSR）是 8 位可读写寄存器，指定 A/D 转换的开始或者停止。
- 模拟输入管脚 0～7（AN_0～AN_7）是输入电压通道 0～7 的输入管脚。
- 本例子使用模拟输入管脚 0～3（AN_0～AN_3），进行 4 个通道 A/D 转换的电压测量。
- 模拟电源（AV_{CC}）是模拟部的电源和基准电压管脚。
- 模拟接地（AV_{SS}）是模拟部的接地和基准电压管脚。

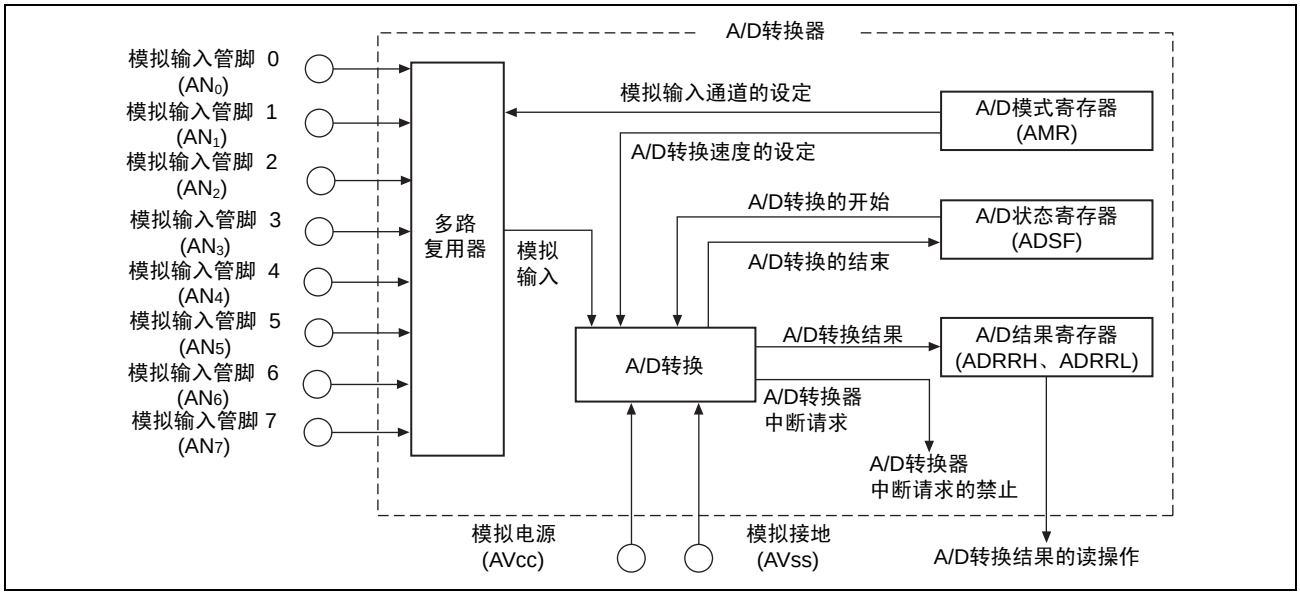


图 2　A/D 转换器的框图

（2）本例子的功能分配如**表 1** 所示。进行如**表 1** 所示的功能分配并且进行 4 个通道 A/D 转换的电压测量。

表 1　功能分配

功能	功能分配
AMR	设定 A/D 转换速度，指定模拟输入管脚
ADSF	指定 A/D 转换的开始或者停止
ADRRH、ADRRL	保存 A/D 转换的结果
AN_0～AN_7	输入电压通道 0～7 的输入管脚（但是，本例子使用 AN_0～AN_3）
AVcc	模拟部的电源和基准电压管脚
AVss	模拟部的接地和基准电压管脚

3.　运行说明

（1）运行说明如**图 3** 所示。通过如**图 3** 所示的硬件处理和软件处理，进行 4 个通道 A/D 转换的电压测量。

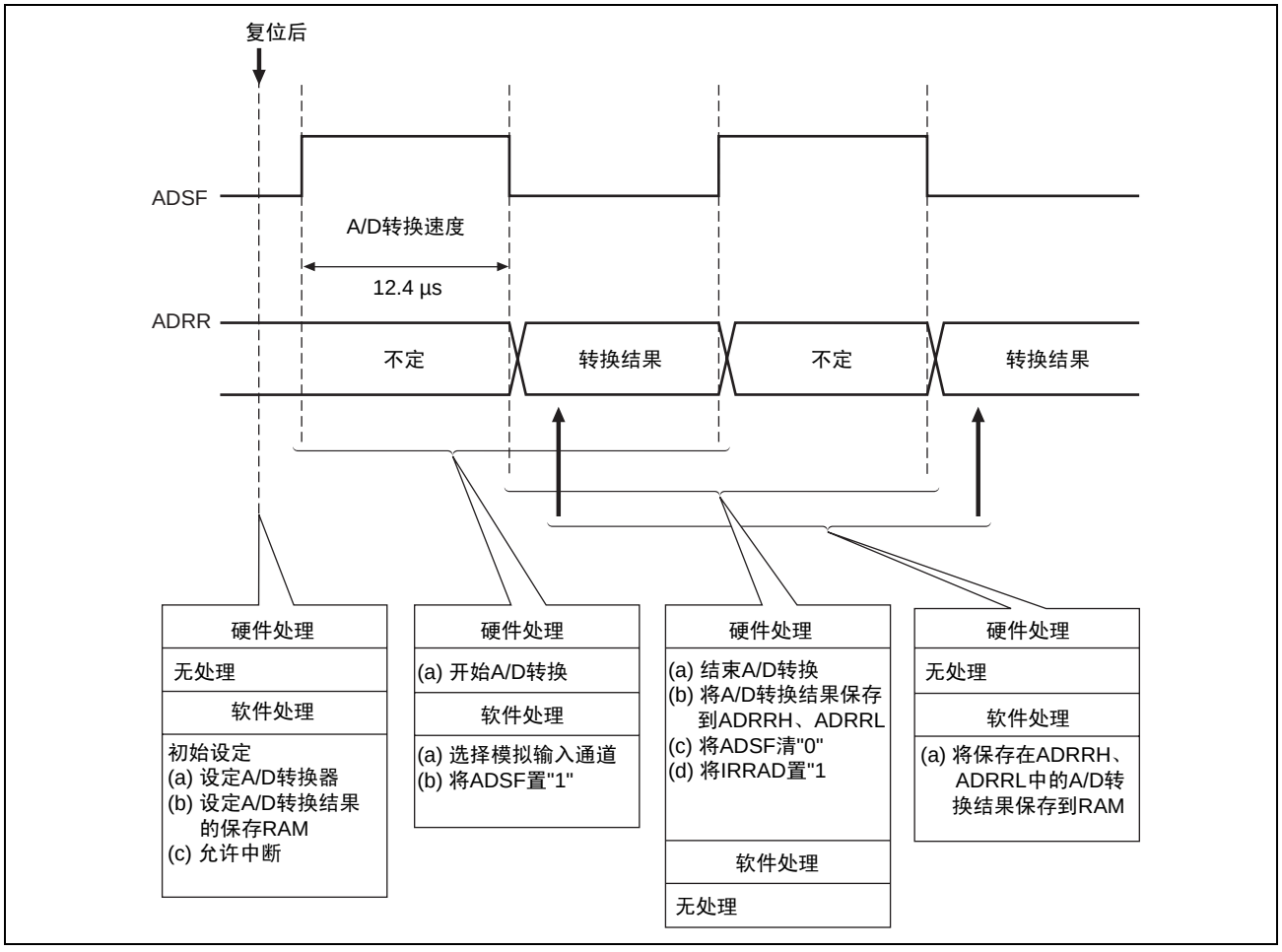


图 3　进行 4 个通道 A/D 转换的电压测量的运行说明

4. 软件说明

（1） 模块说明

本例子的模块如表 2 所示。

表 2 模块说明

模块名	标号名	功能
主程序	main	设定 A/D 转换器，允许中断，选择模拟通道，开始 A/D 转换，并且在 A/D 转换结束后将保存在 ADRRL、ADRRH 中的 A/D 转换结果保存到 RAM，进行模拟通道 0～3 的 A/D 转换后结束。

（2） 参数的说明

本例子的参数如表 3 所示。

表 3 参数的说明

参数名	功能	使用的模块名	数据长度	输入/输出
addata[0]	保存模拟输入通道 0 的 A/D 转换结果	主程序	2 个字节	输出
addata[1]	保存模拟输入通道 1 的 A/D 转换结果	主程序	2 个字节	输出
addata[2]	保存模拟输入通道 2 的 A/D 转换结果	主程序	2 个字节	输出
addata[3]	保存模拟输入通道 3 的 A/D 转换结果	主程序	2 个字节	输出

（3） 使用内部寄存器的说明

本例子使用的内部寄存器如表 4 所示。

表 4 使用内部寄存器的说明

寄存器名		功能	地址	设定值
AMR	CKS	A/D 模式寄存器（时钟选择） ：当 CKS=0 时，将 A/D 转换速度设定为 12.4 μs	H'FFC6 位 7	0
	CH3 CH2 CH1 CH0	A/D 模式寄存器（通道选择 3～0） ：当 CH3=”0”、CH2=”1”、CH1=”0”、CH0=”0”时，选择 AN_0 ：当 CH3=”0”、CH2=”1”、CH1=”0”、CH0=”1”时，选择 AN_1 ：当 CH3=”0”、CH2=”1”、CH1=”1”、CH0=”0”时，选择 AN_2 ：当 CH3=”0”、CH2=”1”、CH1=”1”、CH0=”1”时，选择 AN_3	H'FFC6 位 3 位 2 位 1 位 0	CH3=0 CH2=1 CH1=0 CH0=0
ADSR	ADSF	A/D 开始寄存器（A/D 开始标志） ：当 ADSF=”0”时，结束 A/D 转换 ：当 ADSF=”1”时，开始 A/D 转换	H'FFC7 位 7	0
ADRRH		A/D 结果寄存器 H ：保存 A/D 转换结果的高 8 位数据	H'FFC4	不定
ADRRL		A/D 结果寄存器 L ：保存 A/D 转换结果的低 2 位数据	H'FFC5	不定
PMRB	IRQ1	端口模式寄存器 B （转换 PB3/AN3/$\overline{IRQ1}$ 管脚） ：当 IRQ1=”0”时，用作 PB3/AN3 输入管脚 ：当 IRQ1=”1”时，用作 $\overline{IRQ1}$/TMIC 输入管脚	H'FFEE 位 3	0

（4） 使用 RAM 的说明

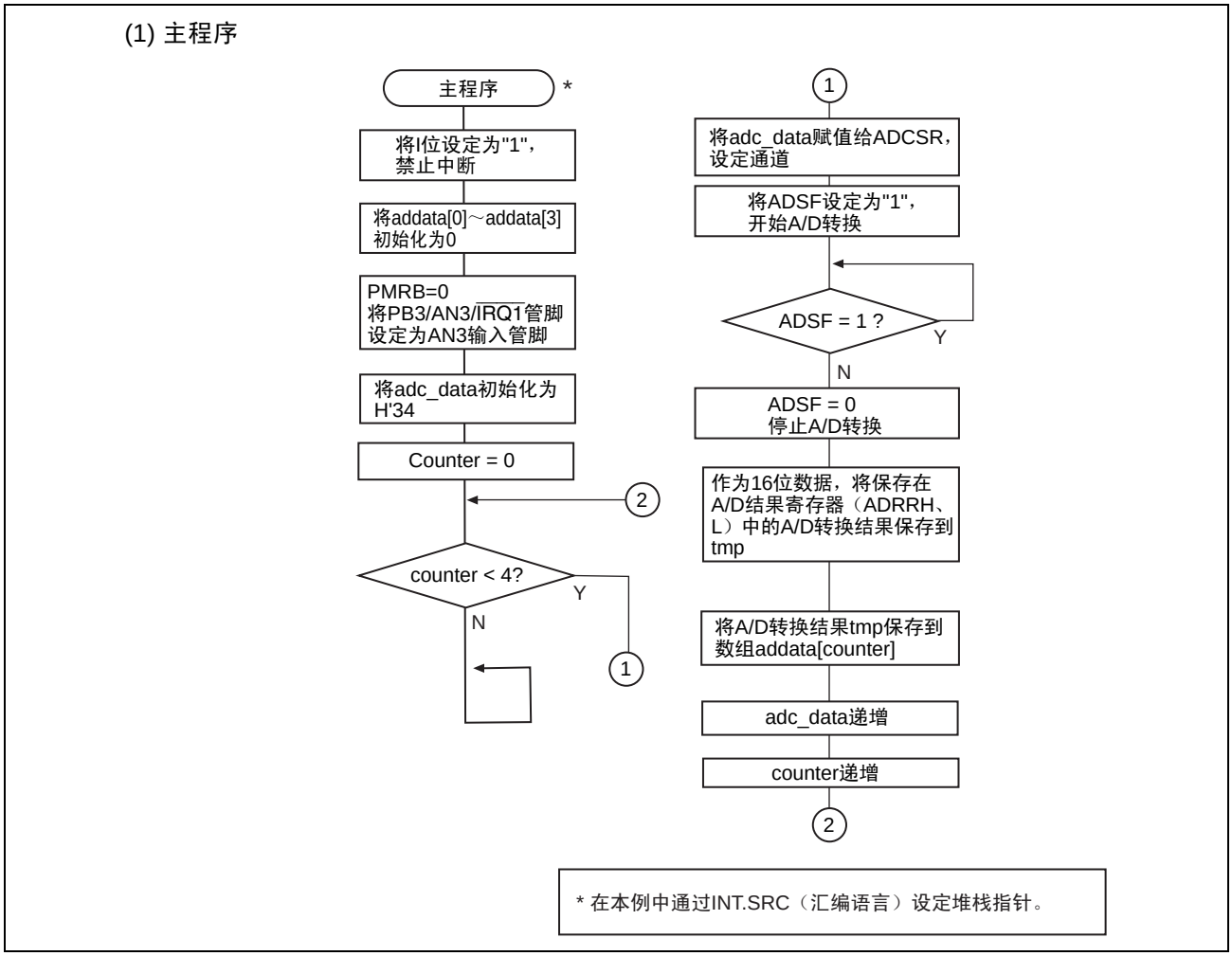
本例子使用的 RAM 如**表 5** 所示。

表 5　使用 RAM 的说明

标号名	功能	地址	使用的模块名
addata[0]	用于 RAM 保存的数据变量	H'FB80	主程序
addata[1]	用于 RAM 保存的数据变量	H'FB82	主程序
addata[2]	用于 RAM 保存的数据变量	H'FB84	主程序
addata[3]	用于 RAM 保存的数据变量	H'FB86	主程序
Counter	对 4 个通道的 A/D 转换次数进行计数	H'FB88	主程序

5. 流程图

(1) 主程序



6. 程序清单

6.1 INIT.SRC（程序清单）

```
      .EXPORT   _INIT
      .IMPORT   _main
  ;
      .SECTION  P,CODE
  _INIT:
      MOV.W     #H'FF80,R7
      LDC.B     #B'10000000,CCR
      JMP       @_main
  ;
      .END
```

```
/************************************************************/
/*                                                          */
/*  H8/300L Super Low Power Series                          */
/*     -H8/38024 Series-                                    */
/*  Application Note                                        */
/*                                                          */
/*  'Voltage Measurement by 4-Channel A/D                   */
/*   Converter'                                             */
/*                                                          */
/*  Function                                                */
/*  : A/D Converter                                         */
/*                                                          */
/*  External Clock : 16MHz                                  */
/*  Internal Clock : 5MHz                                   */
/*  Sub Clock      : 32.768kHz                              */
/*                                                          */
/************************************************************/

#include   <machine.h>

/************************************************************/
/*  Symbol Definition                                       */
/************************************************************/
struct BIT {
   unsigned char   b7:1;      /* bit7 */
   unsigned char   b6:1;      /* bit6 */
   unsigned char   b5:1;      /* bit5 */
   unsigned char   b4:1;      /* bit4 */
   unsigned char   b3:1;      /* bit3 */
   unsigned char   b2:1;      /* bit2 */
   unsigned char   b1:1;      /* bit1 */
   unsigned char   b0:1;      /* bit0 */
};

#define    ADRRH      *(volatile unsigned char *)0xFFC4   /* Timer Mode Register A        */
#define    ADRRL      *(volatile unsigned char *)0xFFC5   /* Timer Counter A             */
#define    AMR        *(volatile unsigned char *)0xFFC6   /* A/D Control/Status Register   */
#define    AMR_BIT    (*(struct BIT *)0xFFC6)           /* A/D Control/Status Register   */
#define    CKS        ADCSR_BIT.b7                    /* A/D Clock Select            */
#define    CH3        ADCSR_BIT.b3                    /* Channel Select 2            */
#define    CH2        ADCSR_BIT.b2                    /* Channel Select 2            */
#define    CH1        ADCSR_BIT.b1                    /* Channel Select 1            */
```

```
#define    CH0       ADCSR_BIT.b0                    /* Channel Select 0            */
#define    ADSR      *(volatile unsigned int *)0xFFC7   /* A/D Data Register A          */
#define    ADSR_BIT   (*(struct BIT *)0xFFC7)          /* A/D Data Register A          */
#define    ADSF      ADSR_BIT.b7                     /* A/D Clock Select            */
#define    PMRB      *(volatile unsigned char *)0xFFEE  /* Port Mode Register B         */

/************************************************************/
/*  Function define                                         */
/************************************************************/
extern void INIT ( void );                          /* SP Set                      */
void       main ( void );

/************************************************************/
/*  RAM define                                              */
/************************************************************/
unsigned int   addata[4];
unsigned char  counter;

/************************************************************/
/*  Vector Address                                          */
/************************************************************/
#pragma section    V1                                /* VECTOR SECTOIN SET          */
void (*const VEC_TBL1[])(void) = {
/* 0x00 - 0x0f */
   INIT                                          /* 00 Reset                  */
};

#pragma section                                      /* P                           */
/************************************************************/
/*  Main Program                                            */
/************************************************************/
void   main ( void )
{
   unsigned char  adc_data;
   unsigned int   tmp;

   set_imask_ccr(1);                                 /* Interrupt Disable           */

   addata[0] = 0;                                    /* Clear adddata[0]            */
   addata[1] = 0;                                    /* Clear adddata[1]            */
   addata[2] = 0;                                    /* Clear adddata[2]            */
   addata[3] = 0;                                    /* Clear adddata[3]            */

   PMRB = 0;                                        /* PB3/AN3 input select        */

   adc_data = 0x34;                                  /* Clear adc_data              */

   for(counter = 0; counter < 4; counter++){            /* A/D Convert END ?           */
      AMR = adc_data;                  /* Select A/D Convert Time & Analog Input Channel*/

      ADSF = 1;                                      /* Start A/D Convert           */
      while(ADSF == 1){                               /* A/D Convert End ?           */
         ;
      }

      ADSF = 0;                                      /* Stop A/D Convert            */
```

```
        tmp  = (ADRRH << 2) | (ADRRL >> 6);

        addata[counter] = tmp;                          /* Store A/D Result Data        */

        adc_data++;                                    /* Increment AMR Set Data       */
    }

    while(1){
        ;
    }
}
```

连接地址的指定

段名	地址
CV1	H'0000
P	H'0100
B	H'FB80

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