致尊敬的顾客

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2010年4月1日
瑞萨电子公司

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3858 群
定时器 Z1 的操作（脉冲周期测量模式）

1. 要点
本篇资料介绍如何使用定时器 Z1 的脉冲周期测量模式，并举例说明如何应用该功能接收红外遥控信号的引导码。

2. 说明
该应用说明适用于以下条件：
采用的 MCU：3858 群
振荡频率：8MHz
3. 内容

3.1 脉冲周期测量功能说明

3.1.1 通过将定时器 Z1 模式寄存器（地址 0028H）的定时器 Z1 模式运行位（b2、b1、b0）设定为“010”，并将定时器模式/事件计数模式转换位（b7）设为“0”，选择脉冲周期测量模式。

3.1.2 在选择高速和中速模式时，计数源为 f(XIN) 的 1/2、1/4、1/8、1/16、1/32、1/64、1/128、1/256、1/512、1/1024 分频或 f(XCN)；在选择低速模式时，计数源为 f(XCN) 的 1/2、1/4、1/8、1/16、1/32、1/64、1/128、1/256、1/512、1/1024 分频。

3.1.3 测量从 CNTR2 管脚的脉冲周期。当定时器 Z1 模式寄存器（地址 0028H）的 CNTR2 极性转换位（b5）为“0”时，在 CNTR2 管脚输入的下降沿到下一个下降沿的期间进行计数；为“1”时，就在 CNTR2 管脚输入的上升沿到下一个上升沿的期间进行计数。

3.1.4 如果检测到测量结束/测量开始的有效边沿，就将定时器值的 1 的补码（测量值）写到定时器锁存器，并将“FFFF16”设定到定时器。如果定时器发生下溢，就产生定时器 Z1 中断，将“FFFF16”设定到定时器。

3.1.5 如果读定时器 Z1，就读取定时器锁存器（测量值）。测量值被保存到下一次测量结束。

3.2 红外遥控接收信号引导码示意图

- P1_7
- T = 0.277ms

图 1 脉冲周期测量模式的时序图（测量下降沿区间时）

图 2 红外遥控引导码定义示意图
3858 群
定时器 Z1 的操作（脉冲周期测量模式）

- 说明
  (1) 将遥控信号利用红外接收头去掉载波后输入到 CNTR2 管脚，信号波形如上图所示；
  (2) 该引导码定义为两个脉冲周期，第一个脉冲 22T（6.094ms±5%），第二个脉冲 27T（7.479ms±5%）；
  (3) 通过测定两个脉冲的周期长度判断是否为有效的遥控信号，如果有效继续接收处理遥控信号。本例中 MCU 接收到有效的遥控信号后，在 P1_7 输出一个 1 秒的低电平点亮一个 LED 作为指示。

3.3 寄存器设置
3858 群定时器 Z1 脉冲周期测量模式的寄存器设置。

(1) 设置端口P2上拉控制寄存器

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<thead>
<tr>
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<tr>
<td>P22/CNTR2 无内部上拉</td>
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(2) 设置端口P2方向寄存器

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(3) 设置定时器Z1模式寄存器

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<td>TZ1M [地址 0028H]</td>
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<tr>
<td>0 0 0 : 定时器/事件计数器模式</td>
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<tr>
<td>0 0 1 : 脉冲输出模式</td>
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<td>0 1 0 : 脉冲周期测量模式</td>
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<td>0 1 1 : 脉宽测量模式</td>
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<tr>
<td>1 0 0 : 可编程波形发生模式</td>
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</tr>
<tr>
<td>1 1 0 : 禁止选择</td>
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<tr>
<td>1 1 1 : 禁止选择</td>
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<tr>
<td>CNTR2极性转换位，在下降沿和下一个下降沿期间进行测量</td>
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<tr>
<td>定时器Z1计数停止位</td>
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<td>定时器模式/事件计数器模式转换位</td>
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(4) 设置定时器Y、Z1计数源设定选择寄存器

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<tbody>
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<td>TYZ1CSS [地址 002FH]</td>
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<td>定时器A计数源选择位置</td>
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<tr>
<td>0 0 0 0 : f(xin)/2 or f(xcin)/2</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>0 0 0 1 : f(xin)/4 or f(xcin)/4</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 0 1 0 : f(xin)/8 or f(xcin)/8</td>
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</tr>
<tr>
<td>0 0 1 1 : f(xin)/16 or f(xcin)/16</td>
<td></td>
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</tr>
<tr>
<td>0 1 0 0 : f(xin)/32 or f(xcin)/32</td>
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<tr>
<td>0 1 0 1 : f(xin)/64 or f(xcin)/64</td>
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</tr>
<tr>
<td>0 1 1 0 : f(xin)/128 or f(xcin)/128</td>
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<td></td>
</tr>
<tr>
<td>0 1 1 1 : f(xin)/256 or f(xcin)/256</td>
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</tr>
<tr>
<td>1 0 0 0 : f(xin)/512 or f(xcin)/512</td>
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</tr>
<tr>
<td>1 0 0 1 : f(xin)/1024 or f(xcin)/1024</td>
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<tr>
<td>1 0 1 0 : f(xcin)</td>
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</tbody>
</table>
定时器 Z1 的操作 (脉冲周期测量模式)

(5) 设置定时器 Z1

<table>
<thead>
<tr>
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</table>

TZ1L [地址 0029h]
定时器 Z1（低位）

TZ1H [地址 002Ah]
定时器 Z1（高位）

注意: 在写操作时，必须按照定时器 Z1 的低位（TZ1L），定时器 Z1 的高位（TZ1H）的顺序写两个寄存器；在读操作时，必须按照定时器 Z1 的高位（TZ1H），定时器 Z1 的低位（TZ1L）的顺序读两个寄存器。

(6) 设置中断源选择寄存器

<table>
<thead>
<tr>
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<th>b2</th>
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</table>

INTSEL [地址 0036h]
定时器 Z1/CNTR2 中断源选择位
CNTR0/CNTR2 中断源选择位
不使用（总是读出“0”）

(7) 设置中断请求寄存器 1

<table>
<thead>
<tr>
<th>b7</th>
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<th>b4</th>
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<th>b2</th>
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<tbody>
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</table>

IREQ1 [地址 003Ch]
定时器 Z1/CNTR2 中断请求位

(8) 设置中断控制寄存器 1

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<th>b2</th>
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ICON1 [地址 003Eh]
定时器 Z1/CNTR2 中断允许位

(9) 设置中断请求寄存器 2

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<tr>
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<th>b4</th>
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<th>b2</th>
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<th>b0</th>
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</thead>
<tbody>
<tr>
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</table>

IREQ2 [地址 003Dh]
CNTR0/CNTR2 中断请求位
不使用（总是读出“0”）

(10) 设置中断控制寄存器 2

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ICON2 [地址 003Fh]
CNTR0/CNTR2 中断允许位
不使用（总是读出“0”，不能写入“1”）
4. 程序流程图

4.1 主程序

```
Main
  disable_interrupt() ;禁止中断
  cld_instruction() ;二进制运算模式
  CPUM=0x0C
  P1D=0x80
  P1=0xFF
  PULL2=0x00
  P2D=0x00
  P2=0x00
  TZ1M=0x42
  TYZ1CSS=0x40
  TZ1L=0xFF
  TZ1H=0xFF
  TZ2M=0x40
  TZ2CSS=0x06
  TZ2L=0x23
  TZ2H=0xF4
  INTSEL=0x08
  nop_instruction() ;清除中断请求寄存器1
  IE_TZ1C2=1
  IE_C0C2=1
  IREQ1=0x00
  IREQ2=0x00
  IE_C0C2=1
  IREQ1=0x00
  IREQ2=0x00
  TZ1STP=0 ;启动定时器Z1计数
  enable_interrupt() ;允许中断
  Infrared receive ;遥控信号接受处理
  IR_Rcv() ;清除中断请求寄存器2
  ;设定ONTR0/ONTR2中断允许位
  ;启动定时器Z1计数
  ;设定ONTR0/ONTR2中断允许位
  ;清除中断请求寄存器1
  ;清除中断请求寄存器2
  ;清除中断请求寄存器2
  ;清除中断请求寄存器1
  ;启动定时器Z1计数
  ;设定ONTR0/ONTR2中断允许位
  ;清除中断请求寄存器1

A
A
```

4.2 红外遥控信号处理子程序（IR_Rcv）
4.3 CNTR2 中断服务子程序（I_CNTR0_CNTR2）

```plaintext
[Diagram]
```

4.4 定时器 Z1 中断服务子程序（I_TimerZ1_CNTR2）

```plaintext
[Diagram]
```
5. 参考例程

/************************************************************************
* File name : rcc05b0038_0100_source.c
* Contents : Timer Z1 (Pulse Period Measurement Mode)
* Copyright(C) 2007. Renesas Technology Corp., All rights reserved.
* Version : 1.00 (2007-07-02)
************************************************************************/

#include <stdio.h>
#include <intr740.h>
#include "sfr_3858.h"

#define LedLamp P1_7     /* Led lamp */
#define Period1Max 1599     /* 6.094ms*(1+5%) */
#define Period1Min 1447     /* 6.094ms*(1-5%) */
#define Period2Max 1963     /* 7.479ms*(1+5%) */
#define Period2Min 1776     /* 7.479ms*(1-5%) */

typedef union {
    unsigned int Word;
    struct {
        unsigned char LowByte;
        unsigned char HighByte;
    }Byte_Def;
}TwoByteUnion_Def;

zpage TwoByteUnion_Def PeriodValue;   /* Declare an union */

#define PeriodWord   PeriodValue.Word
#define PeriodLowByte  PeriodValue.Byte_Def.LowByte
#define PeriodHighByte  PeriodValue.Byte_Def.HighByte

zpage unsigned char Rcv_Sts;     /* Declare a variable */
zpage unsigned char Rcv_Flag = 0;    /* Declare a variable */

/************************************************************************
* Main
************************************************************************/
void main(void) {
    disable_interrupt();   /* Interrupt disable */
    cld_instruction();    /* Binary mode */
    CPUM = 0x0c;          /* Stack 1page */
    P1D = 0x80;           /* Set Port P1 direction register */
    P1 = 0xff;            /* Set Port P1 register */
    PULL2 = 0x00;         /* Set Port P22 pull-up control bit */
    P2D = 0x00;           /* Set Port P2 direction register */
    P2 = 0x00;            /* Set Port P2 register */
    TZ1M = 0x42;          /* Set Timer Z1 mode register */
    TYZ1CSS = 0x40;       /* Set Timer YZ1 Count register */
    TZ1L = 0xff;          /* Set Timer Z1(low) */
    TZ1H = 0xff;          /* Set Timer Z1(high) */
    TZ2M = 0x40;          /* Set Timer Z2 mode register */
    TZ2CSS = 0x06;        /* Set Timer Z2 Count register */
    TZ2L = 0x23;          /* Set Timer Z2(low) */
    TZ2H = 0xf4;          /* Set Timer Z2(high) */
    INTSEL = 0x08;        /* Set Interrupt source selection register */
    nop_instruction();
    IREQ1 = 0x00;         /* All Interrupt Request Bit are cleared */
    IREQ2 = 0x00;
    IE_TZ1C2 = 1;         /* TimerZ1 Interrupt enable */
    IE_CNTR2 = 1;         /* CNTR2 Interrupt enable */
    IREQ1 = 0x00;         /* All Interrupt Request Bit are cleared */
    IREQ2 = 0x00;
    TZ1STP = 0;           /* Timer Z1 count start */
    enable_interrupt();   /* Interrupt enable */
    while(1) {
        IR_Rcv();
    }
}

*****************************************************************************
/*   Infrared Receive   */
*****************************************************************************

void IR_Rcv(void) {
    if (Rcv_Flag) {
        Rcv_Flag = 0;
        switch(Rcv_Sts) {
            case 1:
                if ((PeriodWord > Period1Min) && (PeriodWord < Period1Max)) {
                    Rcv_Sts = 2;    /* Trun to case2 */
                }
            break;
            case 2:
                if ((PeriodWord > Period2Min) && (PeriodWord < Period2Max)) {
                    Rcv_Sts = 3;    /* Trun to case3 */
                }
            break;
            default:
                Rcv_Sts = 0;    /* Set Error Flag */
                break;
        }
    }
}
定时器 Z1 的操作 (脉冲周期测量模式)

```c
Rcv_Sts = 3;                  /* Trun to case3 */
}
else{
    Rcv_Sts = 1;
    PeriodLowByte = 0;
    PeriodHighByte = 0;
}
break;
case 3:
    IR_TZ2C3 = 0; /* Clear TimerZ2 Interrup Request bit */
    TZ2L = 0x23; /* Set Timer Z2(low) */
    TZ2H = 0xf4; /* Set Timer Z2(high) */
    TZ2STP = 0; /* Timer Z2 count start */
    LedLamp = 0; /* Output "0", light LED lamp */
    while (!IR_TZ2C3){} /* 1 second */
    IR_TZ2C3 = 0; /* Clear TimerZ2 Interrup Request bit */
    LedLamp = 1; /* Output "1", close LED lamp */
    TZ2STP = 1; /* Timer Z2 count stop */
break;
default:
    Rcv_Sts = 1;
    PeriodLowByte = 0;
    PeriodHighByte = 0;
    break;
}
}

/*************************************************************************/
*/                     Interrupt CNTR2                                    */
/*************************************************************************/
void interrupt[6] I_CNTR0_CNTR2(void){
    Rcv_Flag = 1; /* Receive request flag */
    PeriodLowByte = TZ1L; /* Read period measure value */
    PeriodHighByte = TZ1H;
}

/*************************************************************************/
*/                     Interrupt TimerZ1                                 */
/*************************************************************************/
void interrupt[28] I_TimerZ1_CNTR2(void){
    Rcv_Sts = 1; /* Reset receive status */
    Rcv_Flag = 0; /* Clear receive request flag */
    PeriodWord = 0; /* Clear variable value */
}
```
6. 参考文献

硬件手册
3858 群数据手册
（最新版本请从瑞萨科技网页上取得）

技术信息/技术更新
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