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April 1st, 2010
Renesas Electronics Corporation

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SH7144/45 Group

Pulse High and Low Width Measurement

1. Specifications

Pulse high width and low width times are measured and the results are stored in RAM as shown in figure 1.

When operating with on-chip peripheral clock Pϕ = 40.0 MHz, the pulse high width and low width can be measured in a range of 25.0 ns to 1.63 ms in 25.0 ns units.

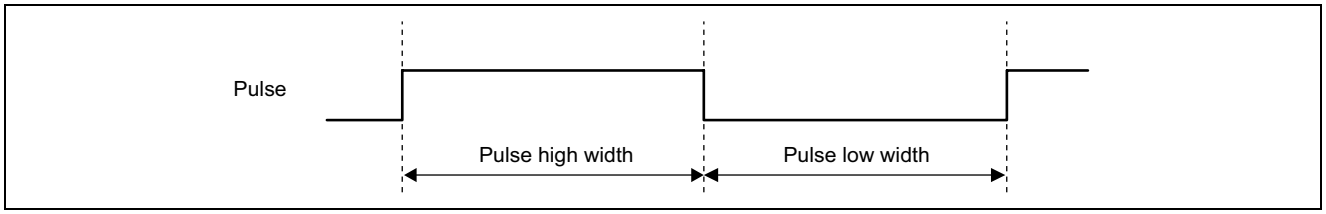


Figure 1 Pulse Width Measurement Timing

2. Functions Used

In this sample task, the high width and low width of a pulse are measured using channel 0 (ch0).

Figure 2 shows a block diagram of ch0. This task uses the following functions.

- A function that performs pulse rising edge and falling edge detection, and sets the timer value at that time in an internal register (input capture)
- A function that clears the timer counter when input capture occurs (counter clearing)
- A function that initiates interrupt handling when a pulse rising edge or falling edge is detected

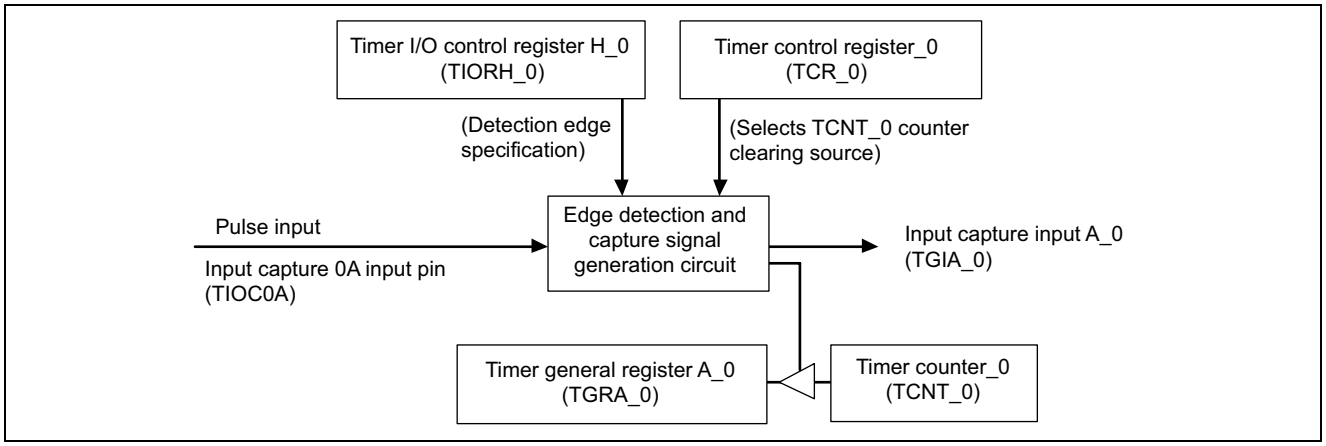


Figure 2 Block Diagram of MTU/ch0

Table 1 shows the function assignments used in this sample task. The high width and low width of a pulse are measured by assigning MTU functions as shown in the table.

Table 1 Function Assignments

Pin or Register Name	Function Assignment
TCR_0	Counter clearing source selection
TIORH_0	Selects input edge of input capture signal
TIOC0A	Inputs pulse to be measured
TGRA_0	Detection of counter value at pulse rising edge or falling edge
TGIA_0	Initiates pulse high and low width measurement at pulse rising edge or falling edge

3. Principles of Operation

Figure 3 illustrates the principles of operation of this sample task. Pulse high width and low width measurement is performed by SH7145 hardware and software processing as shown in the figure.

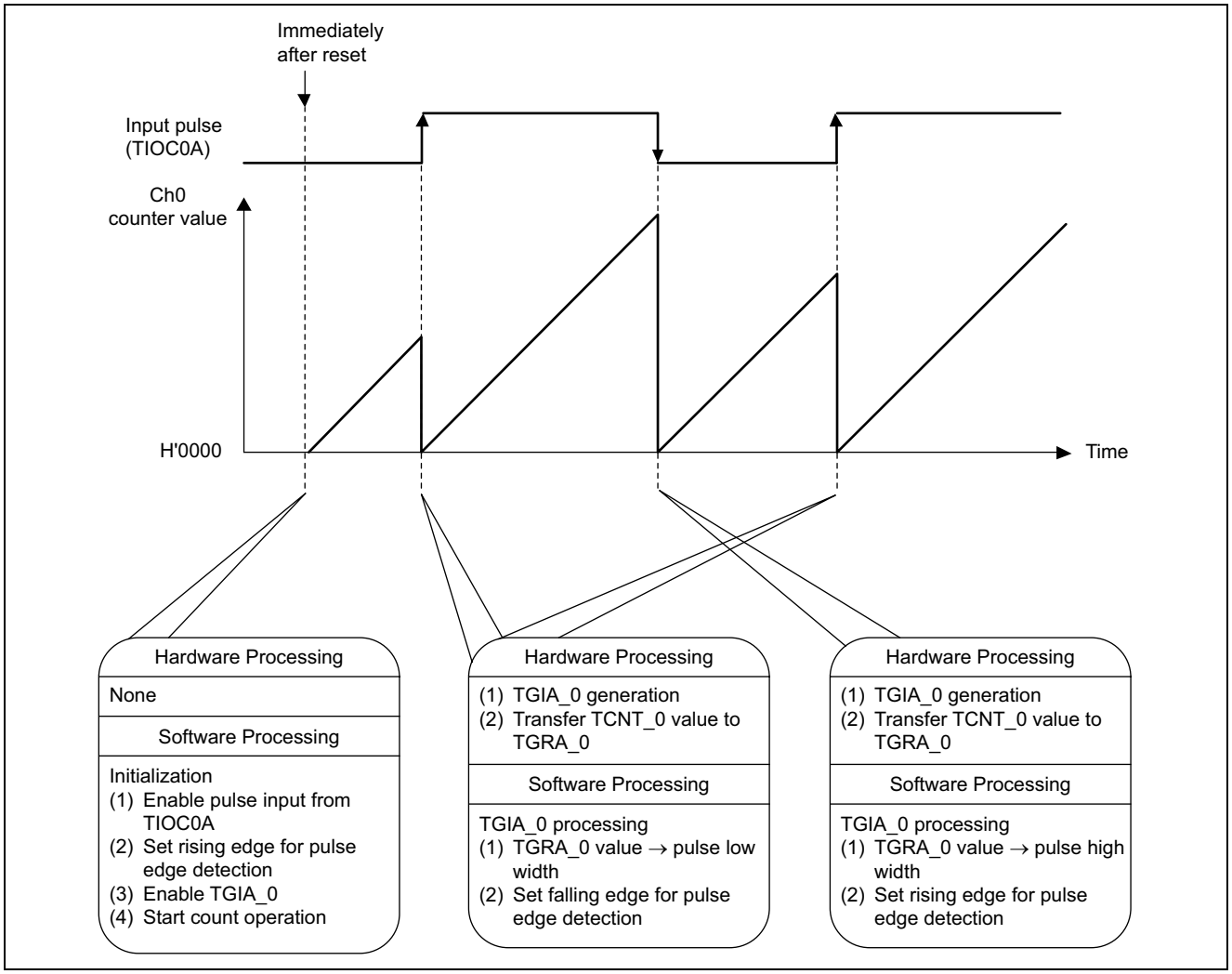


Figure 3 Principles of Operation of Pulse Width Measurement

4. Software

(1) Modules

Module Name	Label	Function Assignment
Main routine	pwhlmn	MTU initialization
Pulse high width and low width measurement	pwhl1	Initiated by TGIA_0. Measures pulse high width and low width based on TGRA_0 value, and stores results in RAM

(2) Arguments

Label or Register Name	Function Assignment	Data Length	Module	Input/Output
pwh_hdata	Used to set timer value for pulse high width Pulse high width is calculated using following equation: Pulse high width (ns) = timer value × ϕ period (25.0 ns at 40.0 MHz operation)	1 word	Pulse high width and low width measurement	Output
pwh_ldata	Used to set timer value for pulse low width Pulse low width is calculated using following equation: Pulse low width (ns) = timer value × ϕ period (25.0 ns at 40.0 MHz operation)	1 word		

(3) Internal Registers Used

Register Name	Function	Address	Set Value
P_PORTE.PECRL2	Sets PE0 as TIOC0A input pin	H'FFFF83BA	H'0001
P_MTU0.TCR_0	TCNT_0 counter clock selection, and setting of TCNT_0 clearing by TGRA_0 input capture as counter clearing source	H'FFFF8260	H'20
P_MTU0.TIORH_0	Sets transfer of TCNT_0 value to TGRA_0 on detection of pulse rising edge or falling edge	H'FFFF8262	H'08
P_MTU0.TIER_0	Enables interrupt request by TGIA_0	H'FFFF8264	H'41
P_MTU0.TGRA_0	TCNT_0 values at time of pulse rising edge and falling edge are stored, and pulse period is calculated from these values	H'FFFF8268	pwh_ldata pwh_hdata
P_INTC.IPRD	Sets 15 as TGIA_0 interrupt priority level	H'FFFF834E	H'f000
P_STBY.MSTCR2	MTU module standby mode clearing	H'FFFF861E	H'd0fd

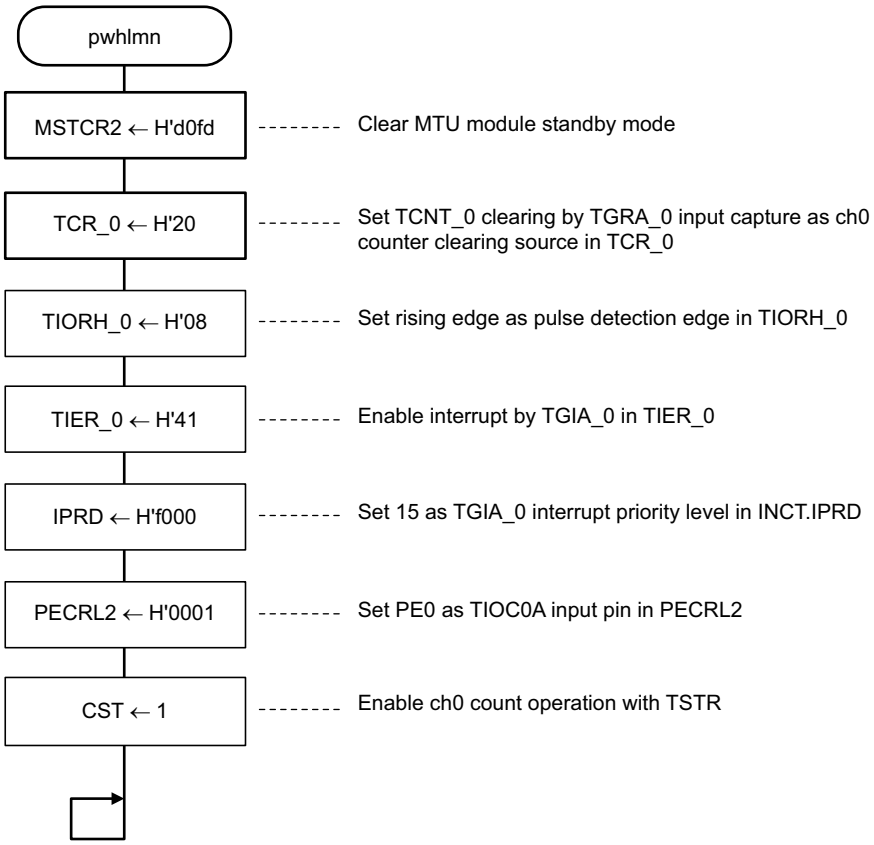
(4) RAM Used

This sample task does not use any RAM apart from the arguments.

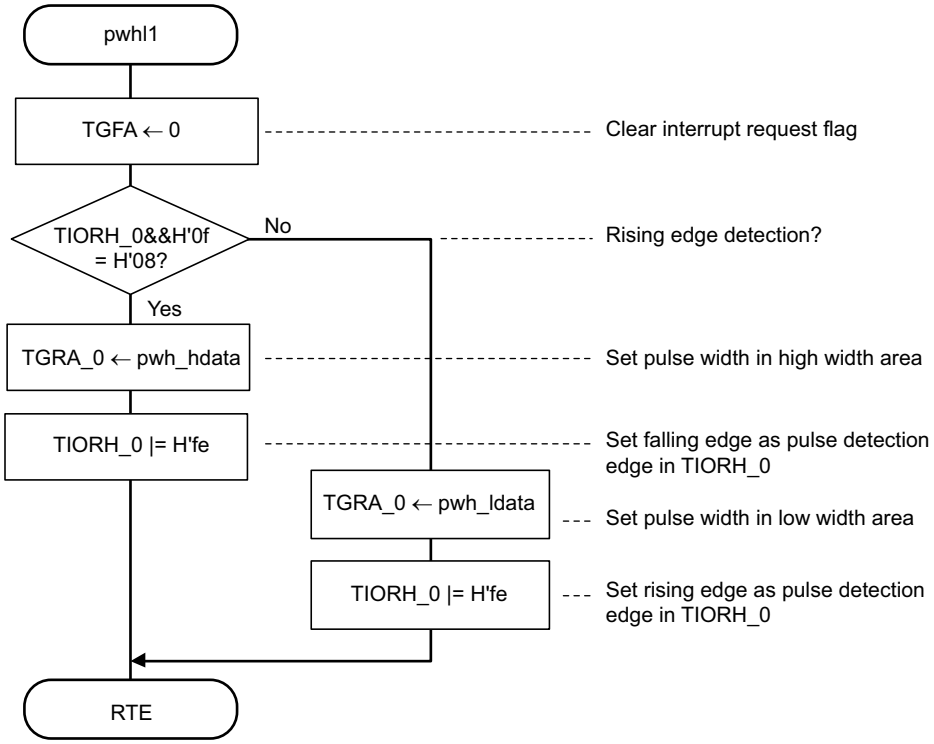
Note: SH7145 header file names are used for register label names.

5. Flowcharts

(1) Main routine



(2) Pulse high and low width measurement



6. Program Listing

```
/************************************************************************/
/*                                INCLUDE FILE                          */
/************************************************************************/
#include <machine.h>
#include "iodefine_7145F.h"
/************************************************************************/
/*                                PROTOTYPE                             */
/************************************************************************/
void  pwhlmn(void);
#pragma interrupt(pwhl1)
/************************************************************************/
/*                              RAM ALLOCATION                          */
/************************************************************************/
#define pwh_hdata   (*(unsigned short  *)0xffffe000)
#define pwh_ldata   (*(unsigned short  *)0xffffe002)
/************************************************************************/
/*                              MAIN PROGRAM                            */
/************************************************************************/
void pwhlmn(void)
 {
      set_imask(0xf);
      P_STBY.MSTCR2.WORD = 0xd0fd;
      P_MTU0.TCR_0.BYTE = 0x20;          /* timer clear input capture with TGRA_0 */
                                         /* counter clock = Pϕ/1 */
      P_MTU0.TIORH_0.BYTE = 0x08;        /* input capture by TIOC0A rising edge */
      P_MTU0.TIER_0.BYTE = 0x41;         /* enable TGIA interrupt */
      P_INTC.IPRD.WORD = 0xf000;         /* set initialize level = 15 */
      P_PORTE.PECRL2.WORD = 0x0001;
      P_MTU34.TSTR.BIT.CST = 1;          /* start TCNT_0 */
      set_imask(0x0);
      while(1);
  }

void pwhl1()
 {
     P_MTU0.TSR_0.BIT.TGFA = 0;          /* clear interrupt flag */
     if((P_MTU0.TIORH_0.BYTE & 0x0f) == 0x08)
      {
         pwh_hdata = P_MTU0.TGRA_0.BYTE; /* set pwh */
         P_MTU0.TIORH_0 |= 0x01;         /* input capture falling edge TIOC0A */
      }
     else
      {
        pwh_ldata = P_MTU0.TGRA_0.BYTE;  /* set pwl */
        P_MTU0.TIORH_0 |= 0xfe;          /* input capture rising edge TIOC0A */
     }
  }
```

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