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Renesas Electronics Corporation

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SH7046 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 $P\phi = 20.0$ MHz, the pulse high width and low width can be measured in a range of 50.0 ns to 3.27 ms in 50.0 ns units.

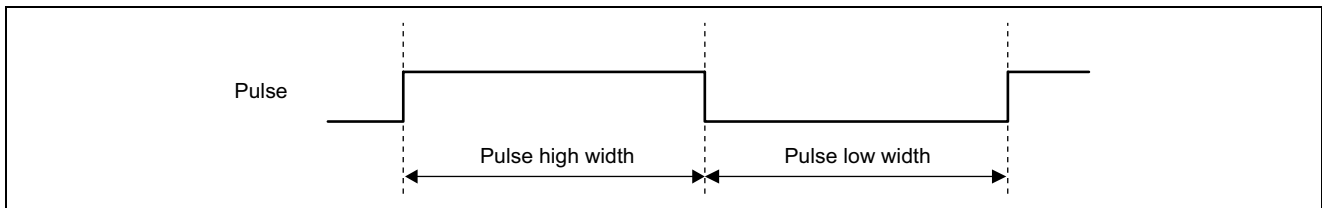


Figure 1 Pulse Width Measurement Timing

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

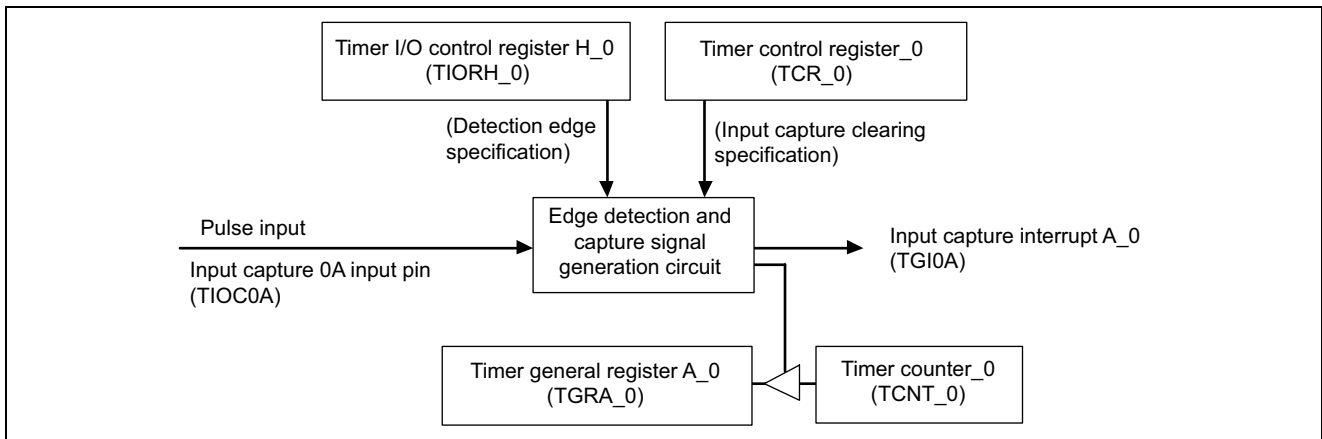


Figure 2 Block Diagram of MTU/ch0

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

3. Operation

Figure 3 illustrates the principles of operation of this sample task. Pulse high width and low width measurement is performed by SH7046 hardware and software processing as shown in the figure.

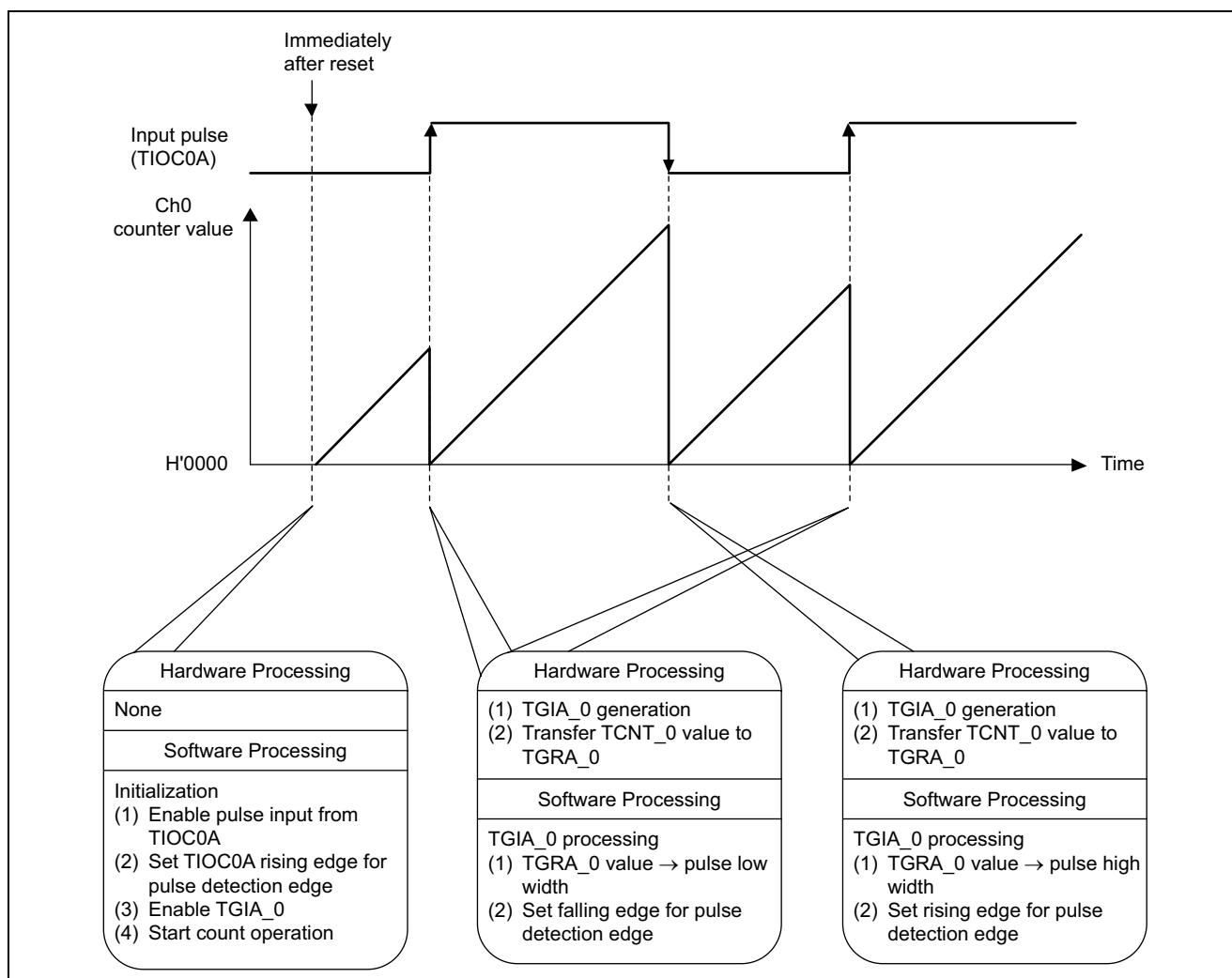


Figure 3 Principles of Operation of Pulse Width Measurement

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 (50.0 ns at 20.0 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 (50.0 ns at 20.0 MHz operation)	1 word		

(3) Internal Registers Used

Register Name	Function	Address	Set Value
P_PORTE.PECRL2	Enables pulse input from TIOC0A input pin	H'FFFF83BA	H'0001
P_MTU0.TCR_0	TCNT counter clock selection, and setting of input capture A as counter clearing source	H'FFFF8260	H'20
P_MTU0.TIORH_0	Sets transfer from TCNT_0 to TGRA_0 on detection of pulse rise or fall	H'FFFF8262	H'08
P_MTU0.TIER_0	Enables interrupt 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'd2fd

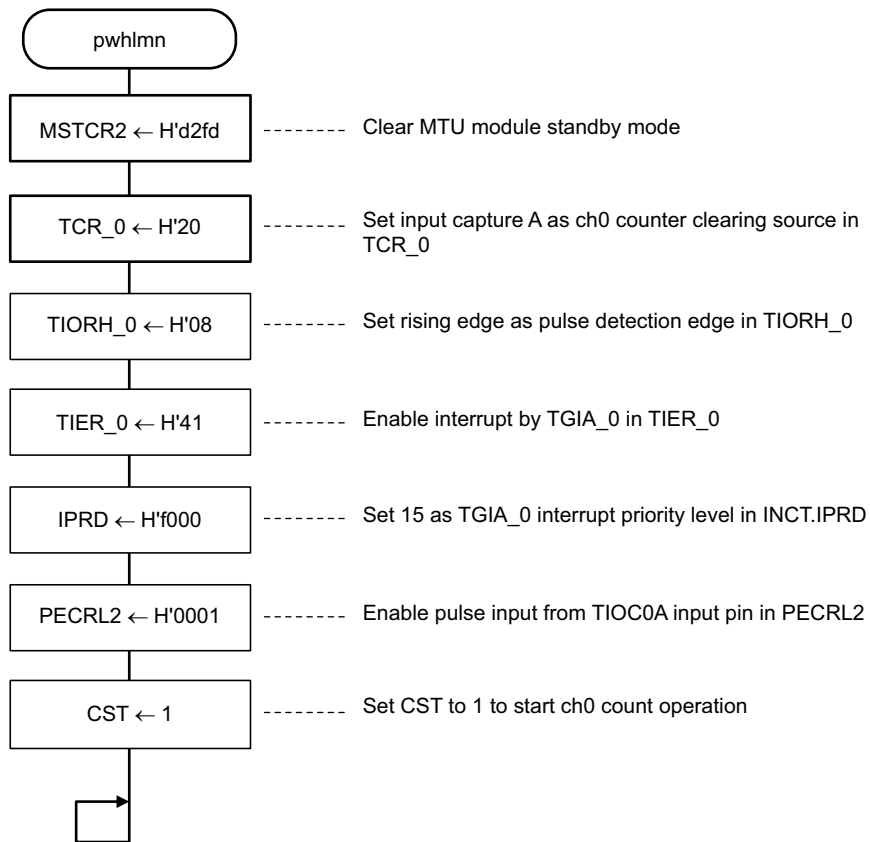
(4) RAM Used

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

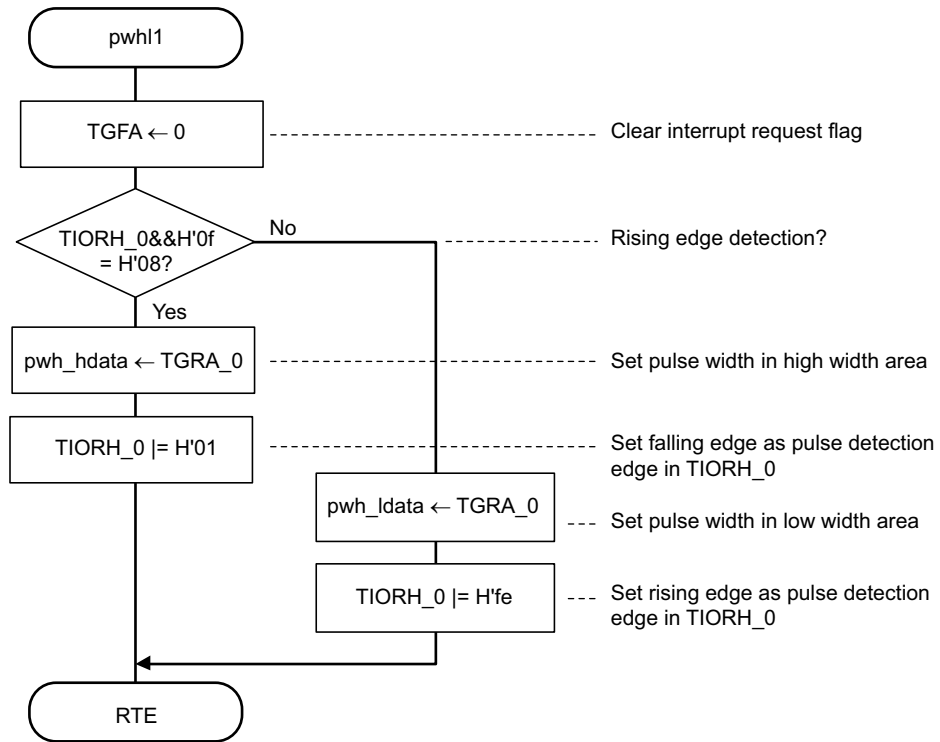
Note: SH7046 header file names are used for register label names.

5. Flowcharts

(1) Main routine



(2) Pulse high and low width measurement



6. Program Listing

```

/*****
/*
INCLUDE FILE
*/
*****/
#include <machine.h>
#include "iodefine_7046.h"
/*****
/*
PROTOTYPE
*/
*****/
void pwhlmn(void);
#pragma interrupt(pwhll)
/*****
/*
RAM ALLOCATION
*/
*****/
#define pwh_hdata (*(unsigned short *)0xffffd000)
#define pwh_ldata (*(unsigned short *)0xffffd002)
/*****
/*
MAIN PROGRAM
*/
*****/
void pwhlmn(void)
{
    set_imask(0xf);
    P_STBY.MSTCR2.WORD = 0xd2fd;
    P_MTU0.TCR_0.BYTE = 0x20; /* timer clear input capture with TGRA_0 */
    /* counter clock = φ/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 pwhll()
{
    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;
        P_MTU0.TIORH_0 |= 0x01;
    }
    else
    {
        pwh_ldata = P_MTU0.TGRA_0.BYTE;
        P_MTU0.TIORH_0 |= 0xfe;
    }
}

```


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