To our customers,

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April 1st, 2010
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation ([http://www.renesas.com](http://www.renesas.com))

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H8S Family
Measuring the High- and Low-Level Periods of a Pulse

Introduction
Measures the high and low widths of a pulse, and stores the result in the RAM.

Target Device
H8S/2339

Contents

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1. Specifications

(1) Measures the low and high periods of a pulse and stores the results in the on-chip RAM, as shown in figure 1.
(2) In operation at 19.6608 MHz, the measurement of pulses with high and low widths is possible for every 50.86 ns between 0.86 ns and about 3.33 ms.

Figure 1  Timing of the Measurement of Pulse Width
2. Description of Function Usage

(1) The high and low widths of the pulse are measured by using TPU0.
   (a) The following functions are used; a block diagram is given in figure 2.
   - Detection of the rising and falling edges of pulses and setting of the timer value at the time in the internal register (input capture)
   - Clearing of the timer counter on generation of the input capture
   - Starting up interrupt handling on detection of the rising or falling edge of a pulse

![Block Diagram](image)

Figure 2  Blocks Used in Measuring the High and Low Periods of a Pulse
3. Principles of Operation

An outline of task operation is given in figure 3. As the figure shows, a combination of hardware and software processing is used to measure the high and low widths of the pulse.

**Figure 3  Measuring the Pulse Width**
4. **Software Description**

(1) **Function**

<table>
<thead>
<tr>
<th>Function</th>
<th>Label</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main routine</td>
<td>PWHLN</td>
<td>Initializes setting of the TPU and RAM</td>
</tr>
<tr>
<td>Measurement of high/low periods</td>
<td>PWHL1</td>
<td>Initiated by TGI0A; reads the values of TGR0A that indicate the high and low periods of the pulse and places them in RAM</td>
</tr>
</tbody>
</table>

(2) **Arguments**

<table>
<thead>
<tr>
<th>Label</th>
<th>Description</th>
<th>Data Type</th>
<th>Used in</th>
<th>I/O</th>
</tr>
</thead>
<tbody>
<tr>
<td>pwh_hdata</td>
<td>Sets the timer value for the high period of the pulse. The period is obtained by this expression: pulse-high width (ns) = timer value x φ (cycle time, 50.86 ns in operation at 19.66 MHz)</td>
<td>unsigned short</td>
<td>Measurement of high and low periods of the pulse</td>
<td>Output</td>
</tr>
<tr>
<td>pwh_ldata</td>
<td>Sets the timer value for the low period of the pulse. The period is obtained by this expression: pulse-low width (ns) = timer value x φ (cycle time, 50.86 ns in operation at 19.66 MHz)</td>
<td>unsigned short</td>
<td>Measurement of high and low periods of the pulse</td>
<td></td>
</tr>
</tbody>
</table>

(3) **Internal Registers**

<table>
<thead>
<tr>
<th>Register</th>
<th>Description</th>
<th>Used in</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSTR</td>
<td>Starts/stops the timer counter</td>
<td>Main routine</td>
</tr>
<tr>
<td>TCR0</td>
<td>Selects the TCNT counter clock, and sets input-capture A as the source for clearing the counter</td>
<td>Main routine</td>
</tr>
<tr>
<td>TIOR0</td>
<td>Sets the transfer value in TCNT to TGR0A on detection of the rising or falling edge of the pulse</td>
<td>Main routine</td>
</tr>
<tr>
<td>TIER0</td>
<td>Enables generation of TGI0A interrupts</td>
<td>Main routine, measurement of the high and low periods of the pulse</td>
</tr>
<tr>
<td>TGR0A</td>
<td>Sets the values of TCNT on rising and falling edges of the pulse signal for measuring the pulse cycle</td>
<td>Measurement of the high and low periods of the pulse</td>
</tr>
<tr>
<td>TSR0</td>
<td>Indicates the generation of input-capture A</td>
<td>Measurement of the high and low periods of the pulse</td>
</tr>
<tr>
<td>MSTPCR</td>
<td>Takes the TPU out of module-stopped mode</td>
<td>Main routine</td>
</tr>
</tbody>
</table>

(4) **RAM Usage**

In this sample task, no RAM is used other than that for argument storage.
### 5. PAD

#### (1) Main routine

<table>
<thead>
<tr>
<th><strong>Main routine</strong></th>
<th><strong>Take the TPU out of module-stopped mode.</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Main routine</td>
<td><strong>Set TCR0 so that input-capture A is the source for counter clearing.</strong></td>
</tr>
<tr>
<td>(2) Measurement of high and low widths of a pulse</td>
<td><strong>Set TIER0 to enable interrupts by TGFA.</strong></td>
</tr>
<tr>
<td><strong>Set TCR0 so that input-capture A is the source for counter clearing.</strong></td>
<td><strong>Clear the I flag to enable interrupts.</strong></td>
</tr>
<tr>
<td><strong>Starts counting by TPU0.</strong></td>
<td><strong>while (1)</strong></td>
</tr>
</tbody>
</table>

#### (2) Measurement of high and low widths of a pulse

<table>
<thead>
<tr>
<th><strong>Measurement of the high and low periods of the pulse</strong></th>
<th><strong>Clear TGFA0 of TSR0.</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Place the pulse-width measurement in the area for the low width.</strong></td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Set the falling edge for detection.</strong></td>
<td>No</td>
</tr>
<tr>
<td><strong>Place the pulse-width measurement in the area for the high width.</strong></td>
<td><strong>Set the rising edge for detection.</strong></td>
</tr>
</tbody>
</table>

Rising edge detected?
## Revision Record

<table>
<thead>
<tr>
<th>Rev.</th>
<th>Date</th>
<th>Description</th>
<th>Page</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td>Feb.17.05</td>
<td></td>
<td>—</td>
<td>First edition issued</td>
</tr>
</tbody>
</table>
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