Caution: Specifications of this document may be changed without prior notice for improvement.

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http://www.ezTCP.com
## Contents

1 Overview ..................................................................................................................- 2 -

2 Pulse Output ................................................................................................................- 3 -
   2.1 What is the Pulse Output? ......................................................................................- 3 -
   2.2 Implementation of Pulse Output ..............................................................................- 4 -
      2.2.1 Output a Pulse with FC 05 ............................................................................- 4 -
      2.2.2 Output a Pulse with FC 105 ..........................................................................- 5 -

3 Write Pulse ....................................................................................................................- 6 -
   3.1 Frame Structure .....................................................................................................- 6 -
      3.1.1 Request / Response .......................................................................................- 6 -
      3.1.2 Exception .......................................................................................................- 7 -
   3.2 Matters to be attended ..........................................................................................- 8 -
      3.2.1 Control Status Error .....................................................................................- 8 -
      3.2.2 Level State Error .............................................................................................- 9 -

4 Example using ModMap ...............................................................................................- 10 -
   4.1 What is ModMap? ..................................................................................................- 10 -
   4.2 Implementation of Pulse Output ............................................................................- 10 -
      4.2.1 Add I/O Controller .......................................................................................- 10 -
      4.2.2 Set Pulse Output .............................................................................................- 10 -
   4.3 Other Prevention ....................................................................................................- 12 -

5 Revision History ..........................................................................................................- 13 -
1 Overview

As one of the control methods, all of our digital I/O controllers support Modbus/TCP in which it is possible to make user-defined functions for specific operations. Our products support a new function that outputs digital Pulse during certain time.

Directions for using this function are covered in this document.
2 Pulse Output

2.1 What is the Pulse Output?

Pulse output generally means that the level of output signals is toggled every certain time interval (period: $T$). Contrastively, the Pulse output we define here is staying HIGH(ON) or LOW(OFF) for a specific time(duration: $t$) and returns the previous status straightaway.

![Figure 2-1 general pulse output](image1)

![Figure 2-2 HIGH Pulse output function](image2)

![Figure 2-3 LOW Pulse output function](image3)
2.2 Implementation of Pulse Output

Modbus/TCP offers some functions such as Write Multiple Register (FC 16) and Write Coil (FC 05) for controlling output ports. If you are supposed to implement the Pulse output with the two functions, the Master program should calculate the exact time of arrival of Modbus/TCP queries to control the output ports for certain time.

For instance, let us assume that you need a normal open system which should be closed for 3 seconds in specific situations. Then you can realize the system with Write Coil function (FC 05) as follows:

2.2.1 Output a Pulse with FC 05

![Diagram showing the process of output a Pulse with FC 05](image)

Figure 2-4 output a Pulse with FC 05

1. A master S/W forwards [Q#1] to a controller
2. A controller outputs HIGH by [Q#1]
3. 3 seconds later from forwarding [Q#1], the master S/W sends [Q#2]
4. The controller outputs LOW by [Q#2]

As use FC 05, the process might be a little complicated. However, it can be much easier with FC 105 like the chapter below.
2.2.2 Output a Pulse with FC 105

As you can see, it is so convenient because the process is accomplished with just one frame of request with FC 105.
3 Write Pulse

3.1 Frame Structure

3.1.1 Request / Response

Request / Response of Write Pulse

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>3</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function code (0x69)</td>
<td>Reference number</td>
<td>Duration</td>
<td>Data value</td>
</tr>
</tbody>
</table>

Figure 3-1 request / response frame of the Write Pulse

- byte 0: function code
  Function code of write pulse is 0x69(=105).

- byte 1~2: reference number
  This is address of an output port you want to control.

- byte 3~4: duration
  The unit is millisecond. You can set this value from 40 to 10000. (0x0028 ~ 0x2710)
  Some examples are as follows:

<table>
<thead>
<tr>
<th>decimal</th>
<th>hexadecimal (HEX)</th>
<th>note</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 (0.04sec)</td>
<td>0028</td>
<td>minimum value</td>
</tr>
<tr>
<td>500 (0.5sec)</td>
<td>01F4</td>
<td>-</td>
</tr>
<tr>
<td>1000 (1sec)</td>
<td>03E8</td>
<td>-</td>
</tr>
<tr>
<td>3000 (3sec)</td>
<td>0BB8</td>
<td>-</td>
</tr>
<tr>
<td>10000 (10sec)</td>
<td>2710</td>
<td>maximum value</td>
</tr>
</tbody>
</table>

Table 3-1 setting examples

- byte 5: On/Off
  Set the data value to ‘0xFF’ for giving HIGH level output and set it to ‘0x00’ for giving LOW level output.
3.1.2 Exception

Exceptions of Write Pulse

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function code (0xE9)</td>
<td>Exception code</td>
</tr>
</tbody>
</table>

Figure 3-2 exceptions of write pulse

- byte 0: function code
  
  Function code of exception response is 0xE9

- byte 1: exception code
  
  Exception code can be 0x01, 0x02, 0x03 or 0x06.

<table>
<thead>
<tr>
<th>code</th>
<th>name</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x01</td>
<td>Illegal Function</td>
<td>Error in the function code</td>
</tr>
<tr>
<td>0x02</td>
<td>Illegal Data Address</td>
<td>Error in the reference number</td>
</tr>
<tr>
<td>0x03</td>
<td>Illegal Data Value</td>
<td>Error in the data value</td>
</tr>
<tr>
<td>0x06</td>
<td>Slave Device Busy</td>
<td>Another master is already controlling the slave by FC 105.</td>
</tr>
</tbody>
</table>

Table 3-2 exception codes
3.2 Matters to be attended

Before controlling a device by FC 105, a master S/W should check the current status of the slave. Please check if the slave is in one of the two states below.

3.2.1 Control Status Error

The slave’s output port which is on a pulse output control by itself or another device cannot be controlled till the previous control is finished.

At the time point ③, a controller cannot set the output port to HIGH by [Q#2] because the control by [Q#1] has not been finished yet. The exception code of [R#2] is 0x06. (Slave Device Busy)
3.2.2 Level State Error

The slave's output port cannot be controlled by FC 105 if the port is set to the same level as the query of the function code.

<table>
<thead>
<tr>
<th>Control Level</th>
<th>Current State</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH</td>
<td>HIGH</td>
<td>error response</td>
</tr>
<tr>
<td>HIGH</td>
<td>LOW</td>
<td>normal operation</td>
</tr>
<tr>
<td>LOW</td>
<td>HIGH</td>
<td>normal operation</td>
</tr>
<tr>
<td>LOW</td>
<td>LOW</td>
<td>error response</td>
</tr>
</tbody>
</table>

Table 3-3 available conditions for FC 105

At the time point ②, a controller cannot set the output port to HIGH by [Q#1] because the output port is already set to HIGH. In this case, the master S/W should change the level to LOW by FC 05 or etc., before controlling the port with FC 105. The exception code of [R#1] is 0x03. (Illegal Data Value)
4 Example using ModMap

4.1 What is ModMap?

ModMap is a Modbus/TCP master program which offers controlling multiple remote I/O devices on a single window for MS Windows.

You can download ModMap on our web site for free.

4.2 Implementation of Pulse Output

4.2.1 Add I/O Controller

[Group] > [Add I/O Controller]

Run ModMap and add the remote I/O device. You can add it automatically and manually.

Figure 4-1 add I/O controller

4.2.2 Set Pulse Output

[Modify I/O Controller Settings]

Right click the name of I/O controller on a control window or tree region.
Figure 4-2 modify I/O controller
[Set Pulse Control]

1. Choose an output port.
2. Select an output level.
3. Input a duration of pulse.
4. Press the [OK] button.

[Completion of the setting]

4.3 Other Prevention

If a level status error occurs, the message below will be popped up.

The LOW pulse type is valid only if the port status is HIGH.
After choosing the job you want to do, please click the OK button.

- I want to close the window with no additional operation.
- I want to let the ModMap change the port status to HIGH and write LOW pulse type.

Figure 4-5 message by level state error
# 5 Revision History

<table>
<thead>
<tr>
<th>Date</th>
<th>Version</th>
<th>Description</th>
<th>Author</th>
</tr>
</thead>
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<td>1.0</td>
<td>○ created</td>
<td>Roy LEE</td>
</tr>
<tr>
<td>2018.02.09</td>
<td>1.1</td>
<td>○ remove available products</td>
<td>Roy LEE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>○ move positions of table captions: top &gt; bottom</td>
<td></td>
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