

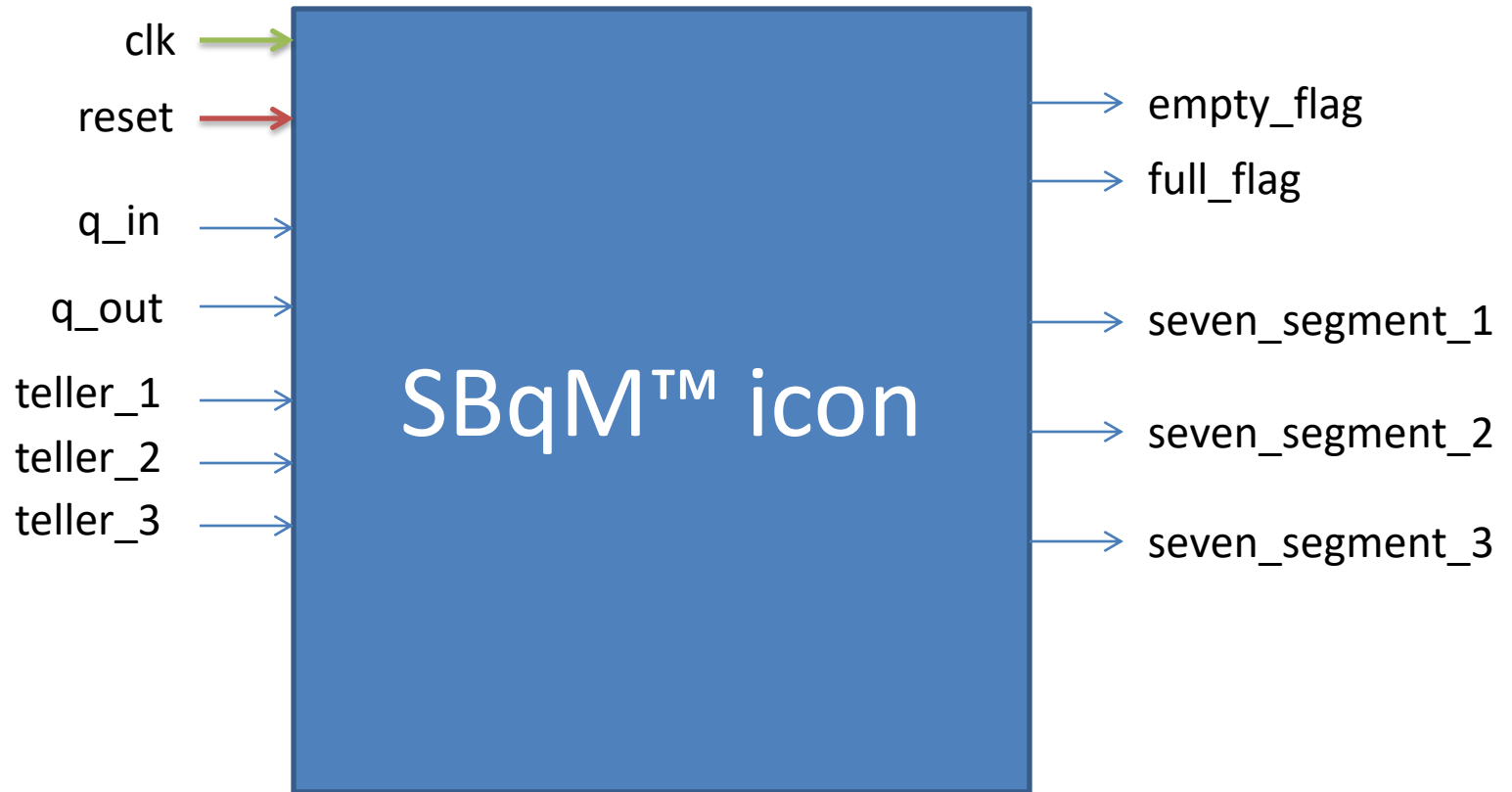
SBQM™

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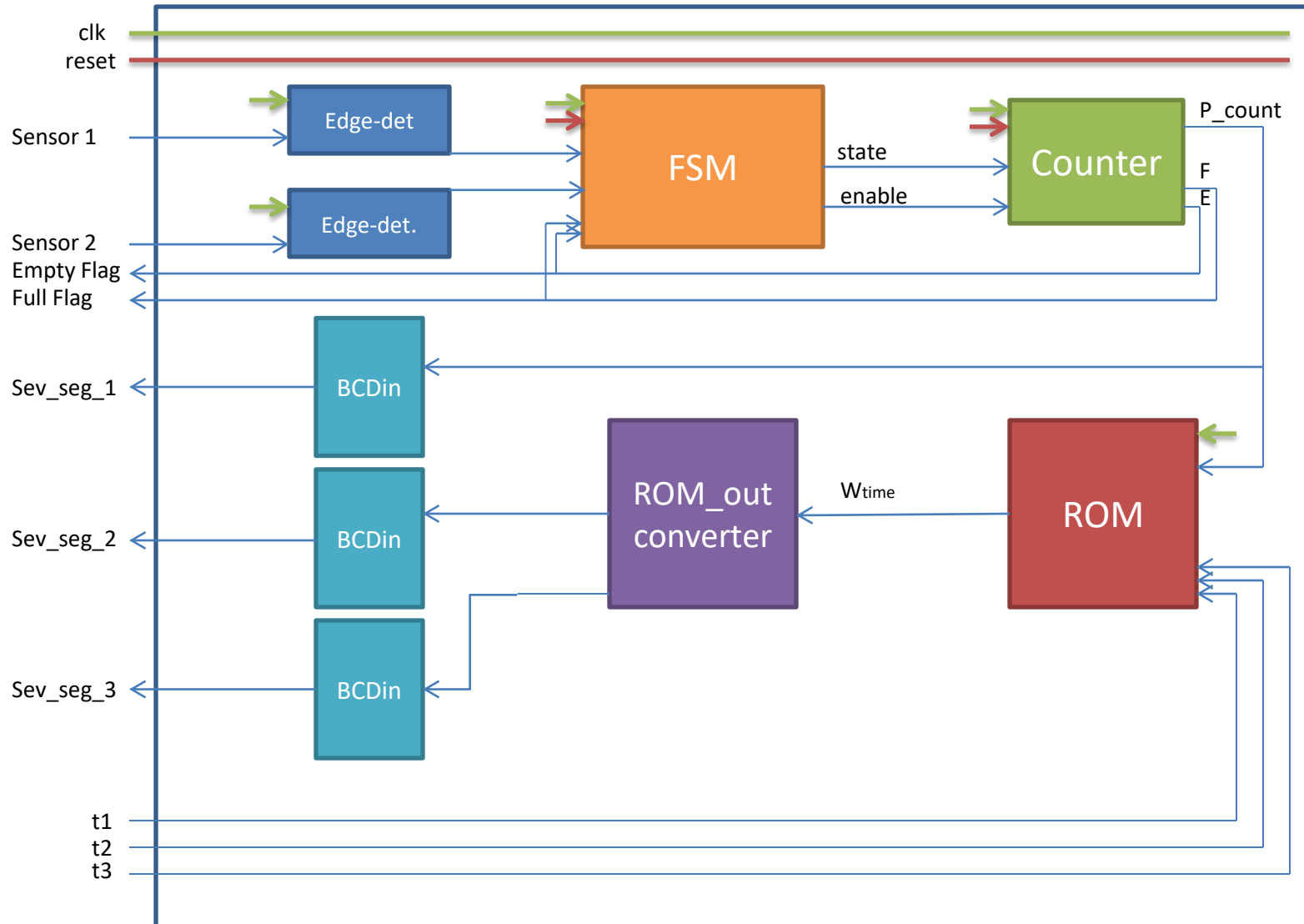
1. I/O Table :

| Name | Type | Size (n of bit(s)) | Description |
|-----------------|------|--------------------|---|
| clk | In | 1 | Clock |
| reset | In | 1 | Reset |
| q_in | In | 1 | Photo Cell 1 |
| q_out | In | 1 | Photo Cell 2 |
| teller_1 | In | 1 | First Teller |
| teller_2 | In | 1 | Second Teller |
| teller_3 | In | 1 | Third Teller |
| empty_fg | Out | 1 | Empty Flag |
| full_fg | Out | 1 | Full Flag |
| seven_segment_1 | Out | 7 | Seven Seg. To display number of customers |
| seven_segment_2 | Out | 7 | Seven Seg. To display the first digit of W(time) |
| seven_segment_3 | Out | 7 | Seven Seg. To display the second digit of W(time) |

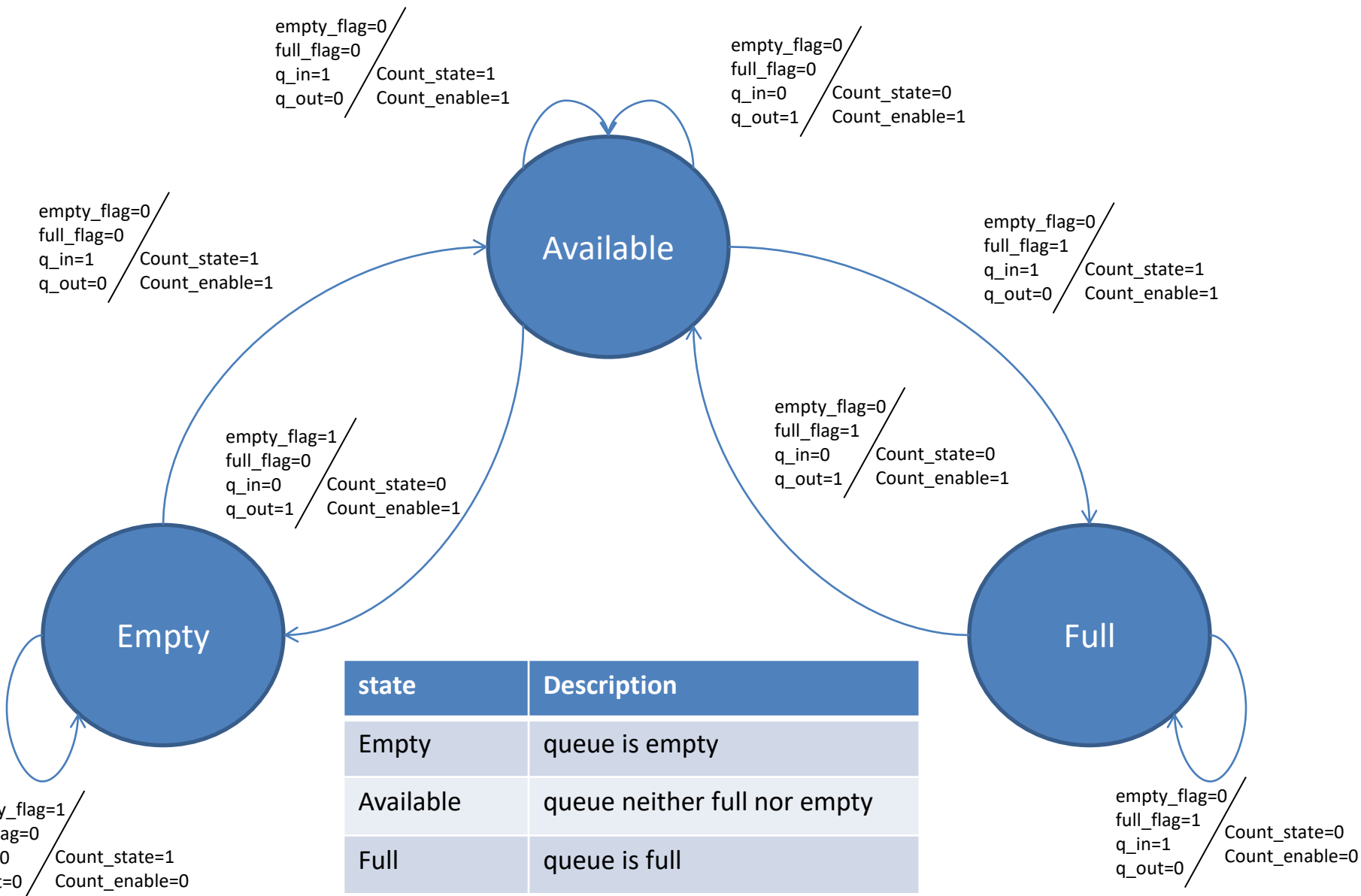
2. SBqM™ icon:



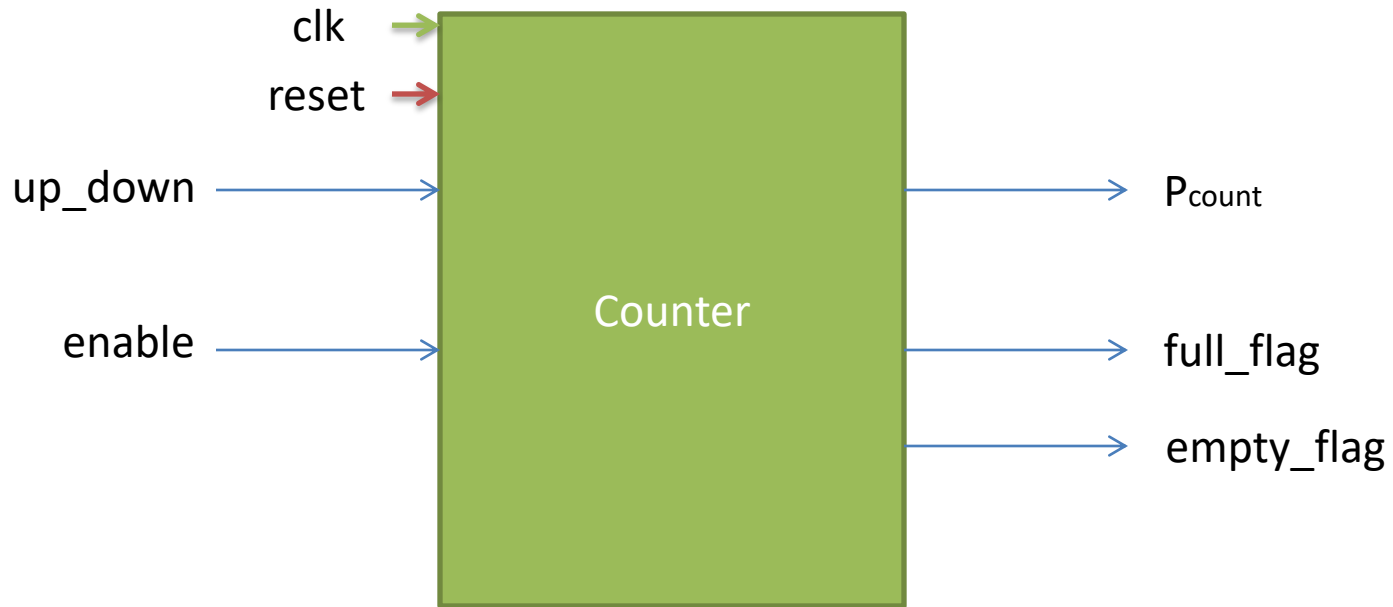
3. Full Architecture :



4. Finite State Machine (FSM) :



5. Counter :

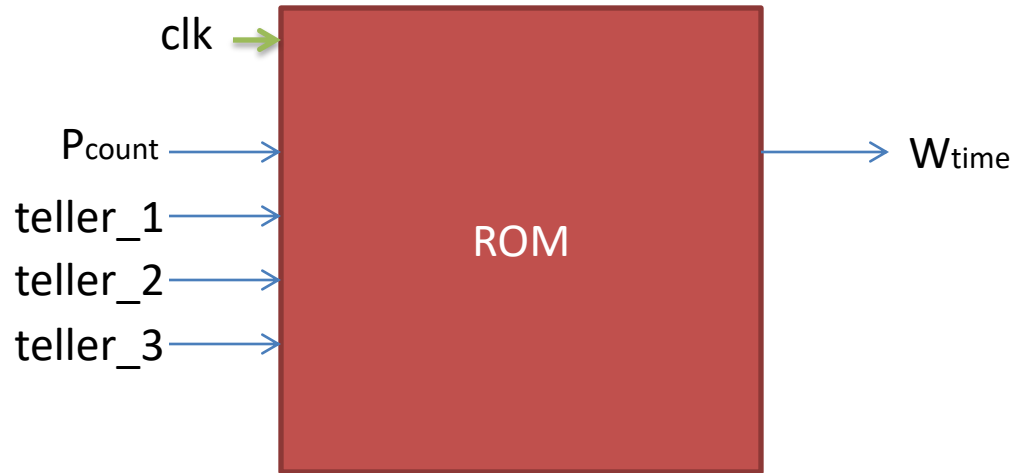


The counter start at 0 and it will increment or decrement based on “up_down” and “enable” signals. Pcount represents the number of customer(s) in the queue. Full_flag represents if the queue is full or not. Empty_flag represents if the queue is empty or not.

Note: - The size of inputs and outputs are 1-bit except Pcount is 3-bits

- The maximum number of customers in the queue is “7” and at this case the full_flag will be equal “1”
- Empty_flag will be equal 1 only when Pcount=000
- Counter’s Range is from “0” (000) to “7” (111)
- reset will set the counter to “0” (000)

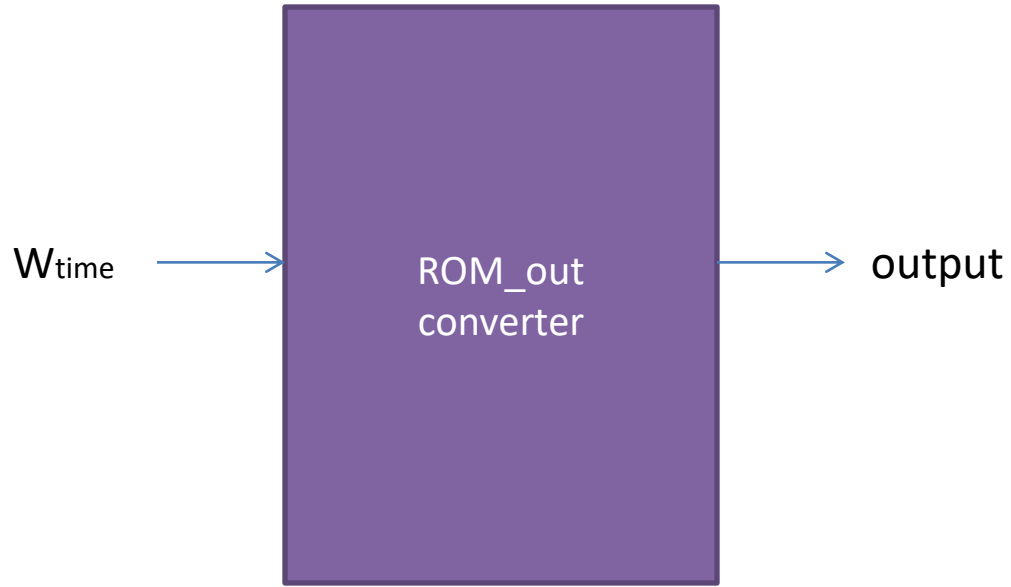
6. ROM :



ROM converts the three signals of teller_1, teller_2 and teller_3 to a representation of 2 bits. Those 2 bits represent the number of tellers in the system. Then it will concatenate between tellers_num (2 bits) and Pcount (3 bits) to get the address of the location in "rom.txt" that has the Wtime.

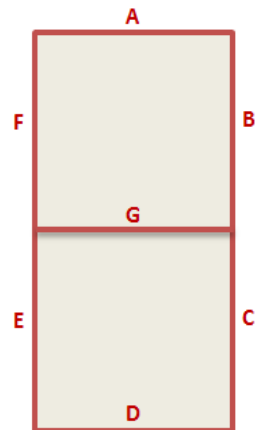
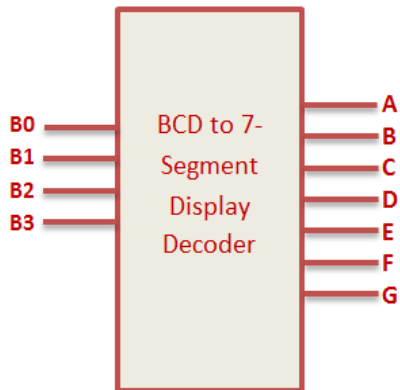
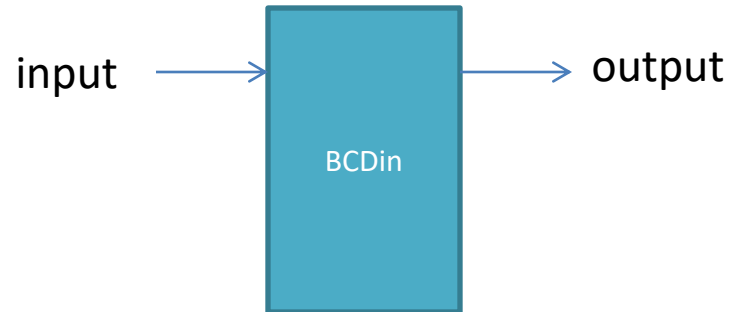
Note: - Wtime represents the waiting time in binary and it a size of 8-bits

7. ROM_out Converter :



- This converter used to convert the W_{time} to a suitable representation that can be valid to be inputs for two BCDin.
- W_{time} has size of 8-bits
- Output has size of 8-bits

8. Seven Segment Decoder :



| B3 B2 B1 B0 | A B C D E F G |
|-------------|---------------|
| 0000 | 0000001 |
| 0001 | 1001111 |
| 0010 | 0010010 |
| 0011 | 0000110 |
| 0100 | 1001100 |
| 0101 | 0100100 |
| 0110 | 0100000 |
| 0111 | 0001111 |
| 1000 | 0000000 |
| 1001 | 0000100 |

9. SBqM™ test_bench:



This architecture has been passed through several test cases which had been set by the design team. The test shows that the two flags correctly reflect the status of the queue. And that the counter does not wrap around. So, it does not display '0' when it gets an increment signal while the queue is full or '7' when it gets a decrement signal while the queue is empty.

THANK YOU