Timers are used to operate an output for a certain time or wait a certain time before operating an output.

Siemens S7-300 PLC can be programmed with five types of timers: S_PULSE, S_PEXT, S_ODT, S_ODTS and S_OFFDT timer. These times differ in function but all of them have the block shown in Figure 7.1 in common.

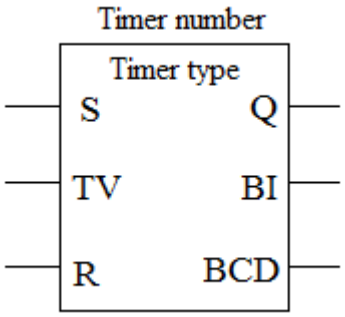

Figure 7.1: Timer block.

where,

- S: is the Set (Trigger) signal of the timer.
- TV: is the time value stored in the timer which must be in the form (S5T#tv). The maximum time value for *tv* that you can enter is 9,990 seconds, or 2H_46M_30S.
- R: is the Reset signal of the timer.
- Q: is the output of the timer.
- BI: is the current time* in binary code.
- BCD: is the current time* in binary coded decimal code.
- Timer number: this can be in the form (T#), where # can be any number in the range (0-255), since Siemens S7-300 PLC allows the use of 256 timers at max.
- Timer type: is one of the 5 timer types mentioned above.

* The current time value is the initial TV value minus the time elapsed since the timer was started.

The following are examples on how to write the time tv in its correct form:
S5TIME#4S = 4 seconds

The following five sections will discuss each timer type individually.

7.1 S_PULSE Timer

S_PULSE (Pulse S5 Timer) starts the specified timer if there is a positive edge at the start (S) input. A

The timer is reset when the timer reset (R) input changes from "0" to "1" while the timer is running. The current time and the time base are also set to zero. Logic "1" at the timer's R input has no effect if the timer is not running.

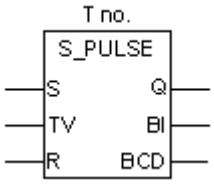

Figure 7.2: S_PULSE timer block.

7.2 S_PEXT Timer

S_PEXT (Extended Pulse S5 Timer) starts the specified timer if there is a positive edge at the start (S) input. A signal change is always necessary in order to enable a timer. The timer runs for the preset time interval specified at input TV even if the signal state at the S input changes to "0" before the time interval has elapsed. The signal state at output Q is "1" as long as the timer is running. The timer will be restarted ("re-triggered") with the preset time value if the signal state at input S changes from "0" to "1" while the timer is running.

The timer is reset if the reset (R) input changes from "0" to "1" while the timer is running. The current time and the time base are set to zero.

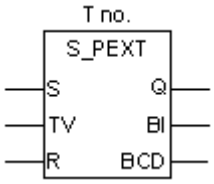

Figure 7.3: S_PEXT timer block.

7.3 S_ODT Timer

S_ODT (On-Delay S5 Timer) starts the specified timer if there is a positive edge at the start (S) input. A signal change is always necessary in order to enable a timer. The timer runs for the time interval specified at input TV as long as the signal state at input S is positive. The signal state at output Q is "1" when the timer has elapsed without error and the signal state at the S input is still "1". When the signal state at input S changes from "1" to "0" while the timer is running, the timer is stopped. In this case the signal state of output Q is "0".

The timer is reset if the reset (R) input changes from "0" to "1" while the timer is running. The current time and the time base are set to zero. The signal state at output Q is then "0". The timer is also reset if there is a logic "1" at the R input while the timer is not running and the RLO at input S is "1".

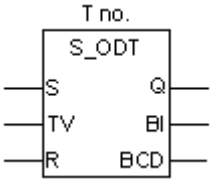

Figure 7.4: S_ODT timer block.

7.4 S_ODTS Timer

S_ODTS (Retentive On-Delay S5 Timer) starts the specified timer if there is a positive edge at the start (S) input. A signal change is always necessary in order to enable a timer. The timer runs for the time interval specified at input TV even if the signal state at input S changes to "0" before the time interval has elapsed. The signal state at output Q is "1" when the timer has elapsed without regard to the signal state at

input S. The timer will be restarted (re-triggered) with the specified time if the signal state at input S changes from "0" to "1" while the timer is running.

The timer is reset if the reset (R) input changes from "0" to "1" without regard to the RLO at the S input. The signal state at output Q is then "0".

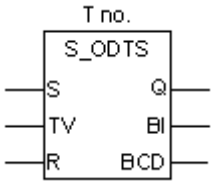

Figure 7.5: S_ODTS timer block.

7.5 S_OFFDT Timer

S_OFFDT (Off-Delay S5 Timer) starts the specified timer if there is a negative edge at the start (S) input. A signal change is always necessary in order to enable a timer. The signal state at output Q is "1" if the signal state at the S input is "1" or while the timer is running. The timer is reset when the signal state at input S goes from "0" to "1" while the timer is running. The timer is not restarted until the signal state at input S changes again from "1" to "0".

The timer is reset when the reset (R) input changes from "0" to "1" while the timer is running.

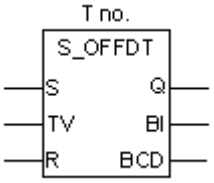

Figure 7.6: S_OFFDT timer block.

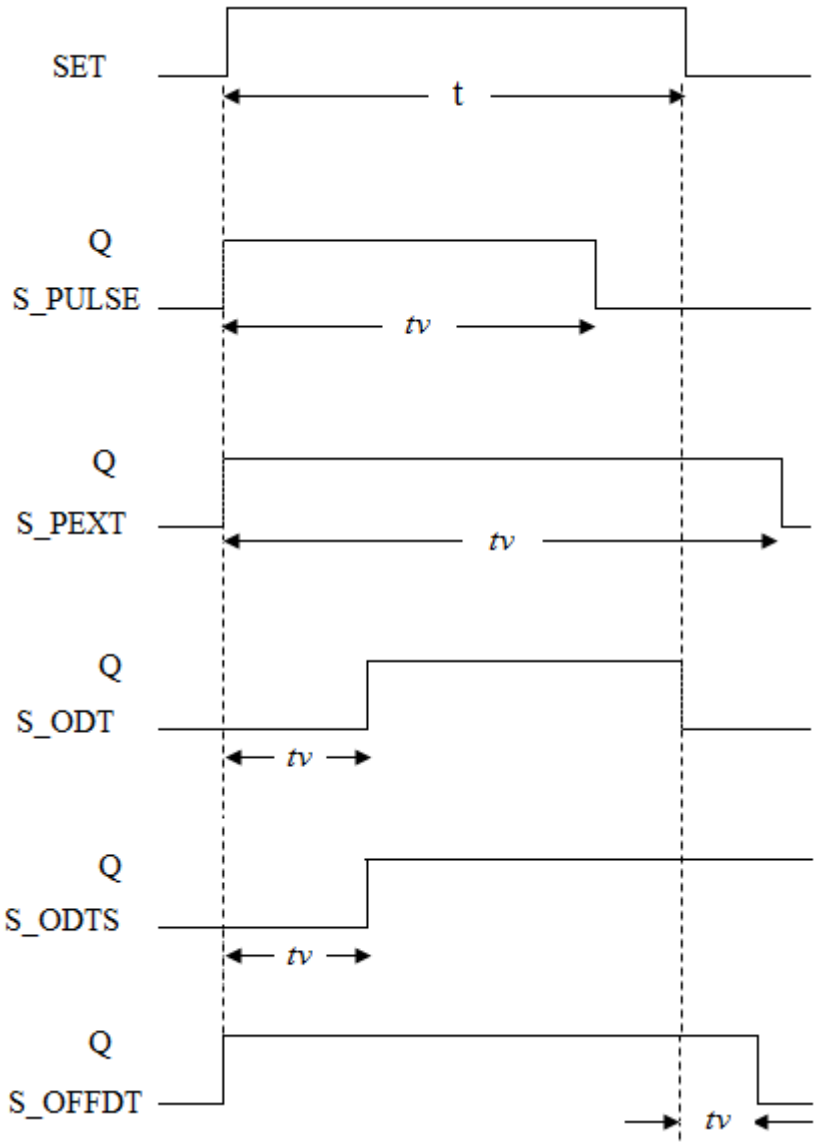

Figure 7.7: Timing diagram.

7.6 Examples

Example 7.1:

If "Start" push button is pressed, the conveyor belt will be activated for 4 sec or till "Stop" push button is pressed.

It is obvious from the question that the conveyor belt will start immediately once "Start" is pressed, which mean that there is no delay. Then the proper timer for this type of question is S_PULSE or S_PEXT timers.

Using S_PULSE timer:

According to the timing diagram shown in Figure 7.7, S_PULSE timer needs the set signal to be maintained for at least t=tv if the time tv is to elapse completely, hence the need for the latch. Once "Stop" is pressed or the 4 sec are over the timer will turn off so will the conveyor belt.

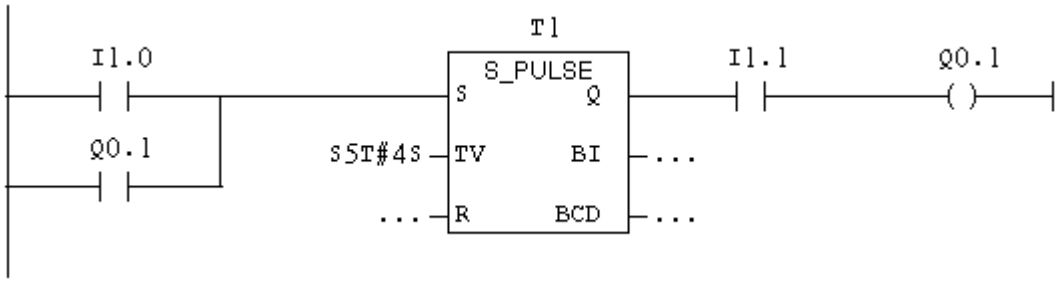

Figure 7.8: Example 7.1 ladder diagram using S_PULSE timer.

Using S_PEXT timer:

This type does not require a latch, then even if "Stop" is placed in series with "Start", it will has no effect. The solution then is to use "stop" as a reset signal but since "Stop" is a normally closed push button a normally close contact is used from it to ensure that no current exist at the reset terminal until "Stop" is pressed.

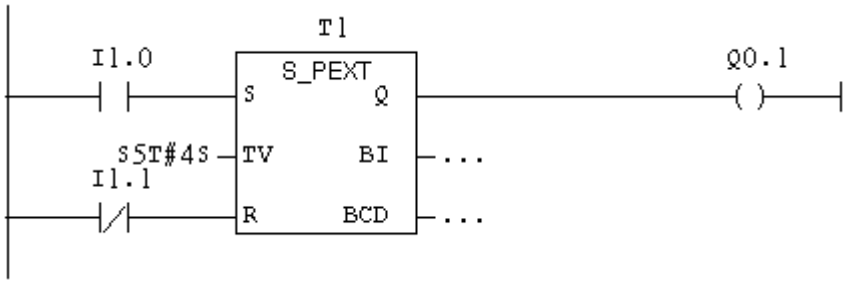

Figure 7.9: Example 7.1 ladder diagram using S_PEXT timer.

<u>Example 7.2:</u>

If "Start" push button is pressed, the conveyor belt will wait 4sec then get activated till "Stop" push button is pressed.

The obvious from the question is that there is a delay time between the press of "Start" and the operation of the conveyor belt. So obviously, an ON delay timer is needed. But there are two types of ON delay timers: S_ODT and S_ODTS.

Using S_ODT timer:

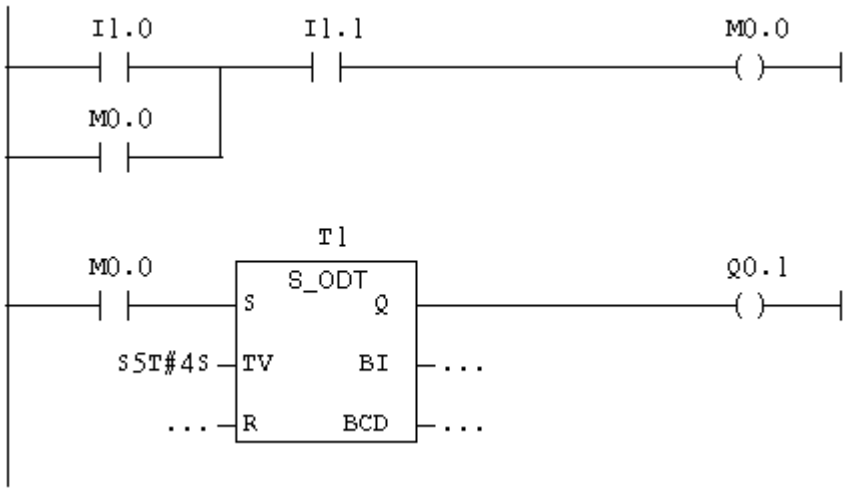

Figure 7.10: Example 7.2 ladder diagram using S_ODT timer.

Using S_ODTS timer:

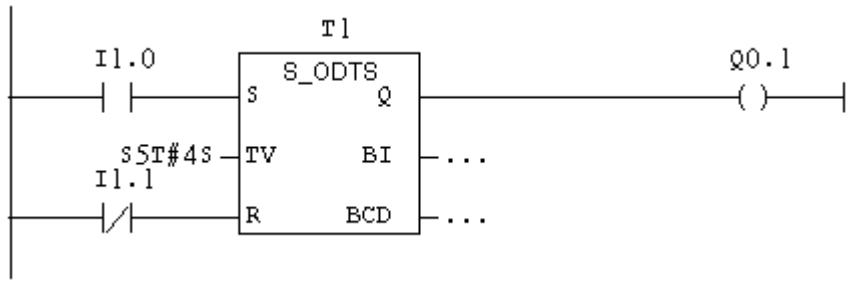

Figure 7.11: Example 7.2 ladder diagram using S_ODTS timer.

The above two methods are obvious solution for this type of question. But we can manipulate the S_PULSE and S_PEXT timers to obtain the same result as follows:

Using S_PULSE timer:

The ladder diagram to solve this example using S_PULSE timer is shown in Figure 7.12. As shown in the diagram, once "Start" is pressed and since "Stop" is a normally closed push button, the internal coil "M0.0" will get activated. Consequently, the timer T1 will start timing. Once the 4 sec are over, the normally closed contact in the last rung will get back to its normally closed state and since the contact "M0.0" is closed now, current will flow through "Q0.0" activating the conveyor belt.

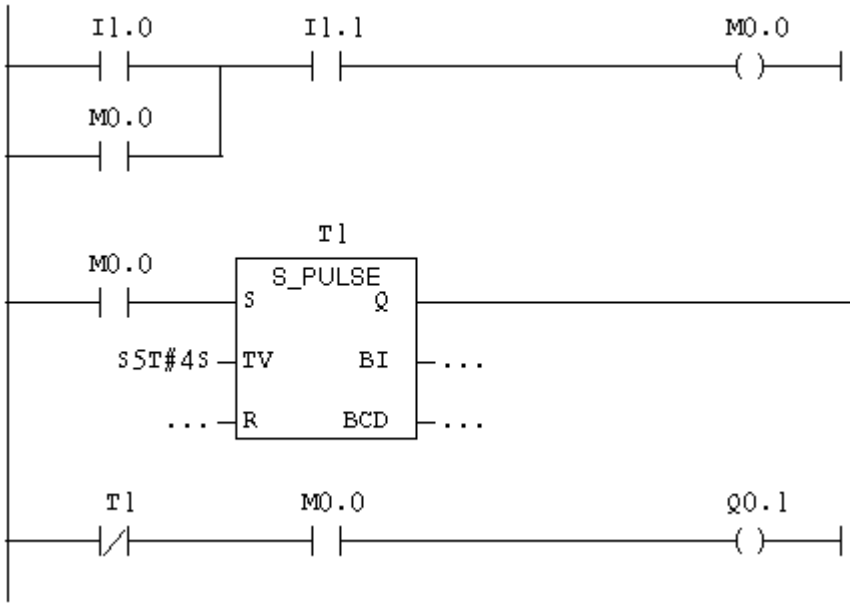

Figure 7.12: Example 7.2 ladder diagram using S_PULSE timer.

Using S_PEXT timer:

The ladder diagram to solve this example using S_PEXT timer is shown in Figure 7.13. Here we "Start" directly at the set signal of the timer, since S_PEXT timer does not need latch. But even the use of "M0.0" here will be valid.

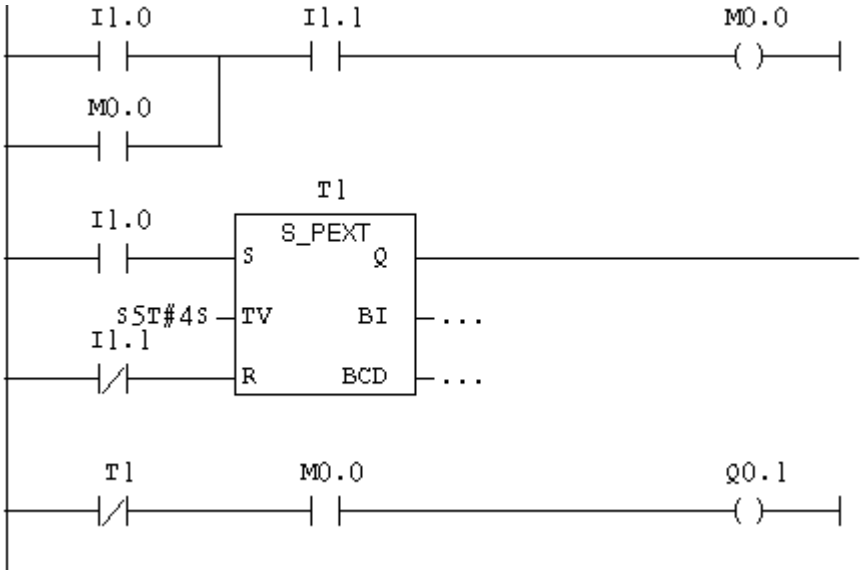

Figure 7.13: Example 7.2 ladder diagram using S_PEXT timer.

Example 7.3:

If "Start" push button is pressed, the conveyor belt will be activated. If "Stop" push button is pressed, the conveyor belt will wait 4 seconds then stop.

In this question the conveyor belt will start immediately when "Start" push button is pressed but will start timing once "Stop" is pressed. This leads to an off delay timer or S_OFFDT.

The ladder diagram required to solve this question is shown in Figure 7.14.

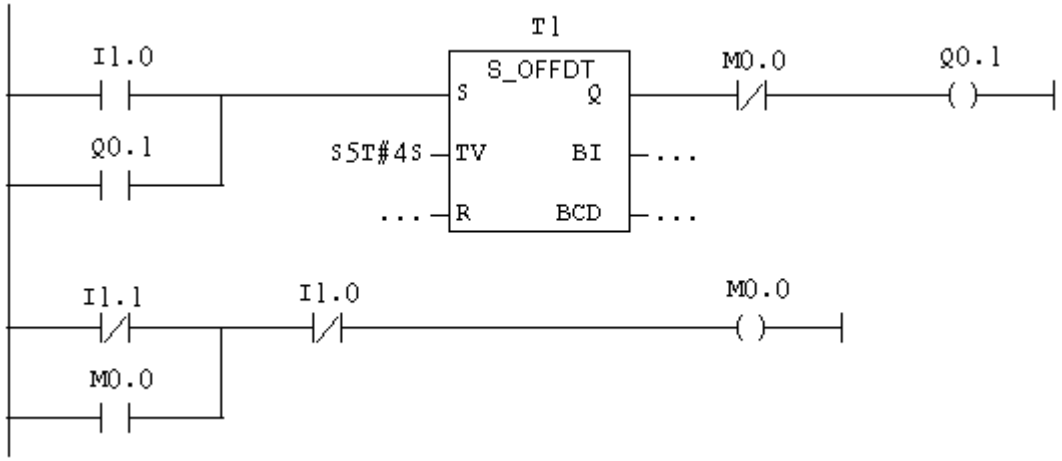

Figure 7.14: Example 7.3 ladder diagram using S_OFFDT timer.