LamaPLC: Simatic S7 SCL commands: Timer / counter functions

Counter operations

IEC Counters

Counters - similar to IEC times - can be called in two ways, embedded or with a separate DB. I don't feel like describing this separately, please take a look at the times: IEC Timers.

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CTU: Count up

The function that only counts upwards.

The CTU counts the positive edges of the “CU:” parameter. As soon as it reaches the value of “PV” with the calculation, the output “Q” changes to “TRUE”. The function continues to count. The function can be restarted with the “R” input.

CTU types:

- CTU_SINT / CTU_USINT: the calculation goes with the variable types SINT, USINT
- CTU_INT / CTU_UINT: the calculation goes with the variable types INT, UINT
- CTU_DINT / CTU_UDINT: the calculation goes with the variable types DINT, UDINT
- CTU_LINT / CTU_ULINT: the calculation goes with the variable types LINT, ULINT (only on S7-1500 PLC)

_FB_ **CTU (**			
	CU: BOOL **,**	input	**Counter signal:** The function monitors the positive edge of this binary signal. The counter counted, if signal change from “FALSE” to “TRUE”.
	R: BOOL **,**	input	**Reset:** Reset CV value.
	PV: INT **,**	input	**Set value to Q:** Value at which the Q output is set

	Q: BOOL **,**	output	**Result:** When the counter reaches “PV”.
	CV: INT / CHAR / WCHAR / DATE	output	**Current counter value**
);			

Example

```
1  // timer set "secTimerQ" in every second
2 #secTimer(IN:=NOT(#secTimerQ),
3           PT:=t#1s,
4           ET=>#secTimerET);
5
6  #secTimerQ := #secTimer.Q;
7
8  // secTact change state every second
9 IF #secTimerQ THEN
10     #secTact := NOT (#secTact);
11 END_IF;
12
13 // testCounter count every 2 second (its works with positive edge
14 // Q will "true" after 48 second
15 #testCounter(CU:=#secTact,
16              PV:=24,
17              Q=>#testCounterQ,
18              CV=>#testCounterInt);
19
20 // actual state from testCounter
21 #tempInt := #testCounterInt;
```

#secTimerQ	FALSE
#secTimerET	T#739MS
#secTimerQ	FALSE
Result	FALSE
#secTact	FALSE
#secTact	FALSE
#testCounterQ	TRUE
#testCounterInt	141
#tempInt	141

The example program below can be downloaded here:

ctu_example.scl

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Here is a description of how to import the downloaded program to the TIA Portal: Import source code to the TIA portal.

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CTD: Count down

The function that only counts downwards.

The CTD counts the positive edges of the “CD” parameter, the current counter value of the CV parameter is decremented by one. The function can be restarted with “LD” input, in this case, the countdown starts again from the “PV” value. If the current counter value is less than or equal to zero, the “Q” parameter is set to signal state “TRUE”.

CTD types:

- CTD_SINT / CTD_USINT: the calculation goes with the variable types SINT, USINT
- CTD_INT / CTD_UINT: the calculation goes with the variable types INT, UINT
- CTD_DINT / CTD_UDINT: the calculation goes with the variable types DINT, UDINT
- CTD_LINT / CTD_ULINT: the calculation goes with the variable types LINT, ULINT (only on S7-1500 PLC)

FB **CTD (**			
	CD: BOOL **,**	input	**Counter signal:** The function monitors the positive edge of this binary signal. The counter downcounted, if signal change from “FALSE” to “TRUE”.
	LD: BOOL **,**	input	**Reset:** Load PV value to CV. (Counter newstart)
	PV: INT **,**	input	**Downcounter start value:** The value from which the counter counts down. It can be reloaded with the LD parameter.
	Q: BOOL **,**	output	**Result:** If the current counter value is less than or equal to zero, the parameter is set to signal state “TRUE”.
	CV: INT / CHAR / WCHAR / DATE	output	**Current counter value**
);			

Example

```
#secTimer(IN:=NOT(#secTimerQ),
          PT:=t#1s,
          ET=>#secTimerET);

#secTimerQ := #secTimer.Q;

// secTact change state every second
IF #secTimerQ THEN
    #secTact := NOT (#secTact);
END_IF;

// testCounter count down every 2 second (its works with positive edge
// Q will "true" at 0
// CV cannot be less than 0 because it is an unsigned SINT counter (CTD_USINT)
#testCounter(CD:=#secTact,
             LD:=NOT(#init),
             PV:=100,
             Q=>#testCounterQ,
             CV=>#testCounterInt);

#init := TRUE;

// actual state from testCounter
#tempInt := #testCounterInt;
```

#secTimerQ	FALSE
#secTimerET	T#952MS
#secTimerQ	FALSE
Result	FALSE
#secTact	TRUE
#secTact	TRUE
#init	TRUE
#testCounterQ	TRUE
#testCounterInt	0
#init	TRUE
#tempInt	0

The example program below can be downloaded here:

ctd_example.scl

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Here is a description of how to import the downloaded program to the TIA Portal: Import source code to the TIA portal.

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CTUD: Count up

The function that counts up- and downwards.

The CTUD counts up the positive edges of the “CU” input, and counts down with “CD” input. As soon as it reaches the value of “PV” with the calculation, the output “QU” changes to “TRUE”. The function continues to count. The function can be restarted with the “R” input. The downcounts function can be restarted with “LD” input, in this case, the countdown starts again from the “PV” value. If the current counter value is less than or equal to zero, the “QD” parameter is set to signal state “TRUE”.

CTUD types:

- CTUD_SINT / CTUD_USINT: the calculation goes with the variable types SINT, USINT
- CTUD_INT / CTUD_UINT: the calculation goes with the variable types INT, UINT
- CTUD_DINT / CTUD_UDINT: the calculation goes with the variable types DINT, UDINT
- CTUD_LINT / CTUD_ULINT: the calculation goes with the variable types LINT, ULINT (only on S7-1500 PLC)

FB **CTUD (**			
	CU: BOOL **,**	input	**Counter up signal:** The function monitors the positive edge of this binary signal. The counter counted up, if signal change from “FALSE” to “TRUE”.
	CD: BOOL **,**	input	**Counter down signal:** The function monitors the positive edge of this binary signal. The counter downcounted, if signal change from “FALSE” to “TRUE”.
	R: BOOL **,**	input	**Reset upcounter:** Reset upcounter CV value.
	LD: BOOL **,**	input	**Reset downcounter:** Load PV value to CV. (Downcounter newstart)
	PV: INT **,**	input	**Set value to Q / startpoint for downcounter** Value at which the Q output is set / The value from which the counter counts down. It can be reloaded with the LD parameter.
	QU: BOOL **,**	output	**Result:** When the counter reaches “PV”.
	QD: BOOL **,**	output	**Result:** If the current counter value is less than or equal to zero, the parameter is set to signal state “TRUE”.

	CV: INT / CHAR / WCHAR / DATE	output	**Current counter value**
);			

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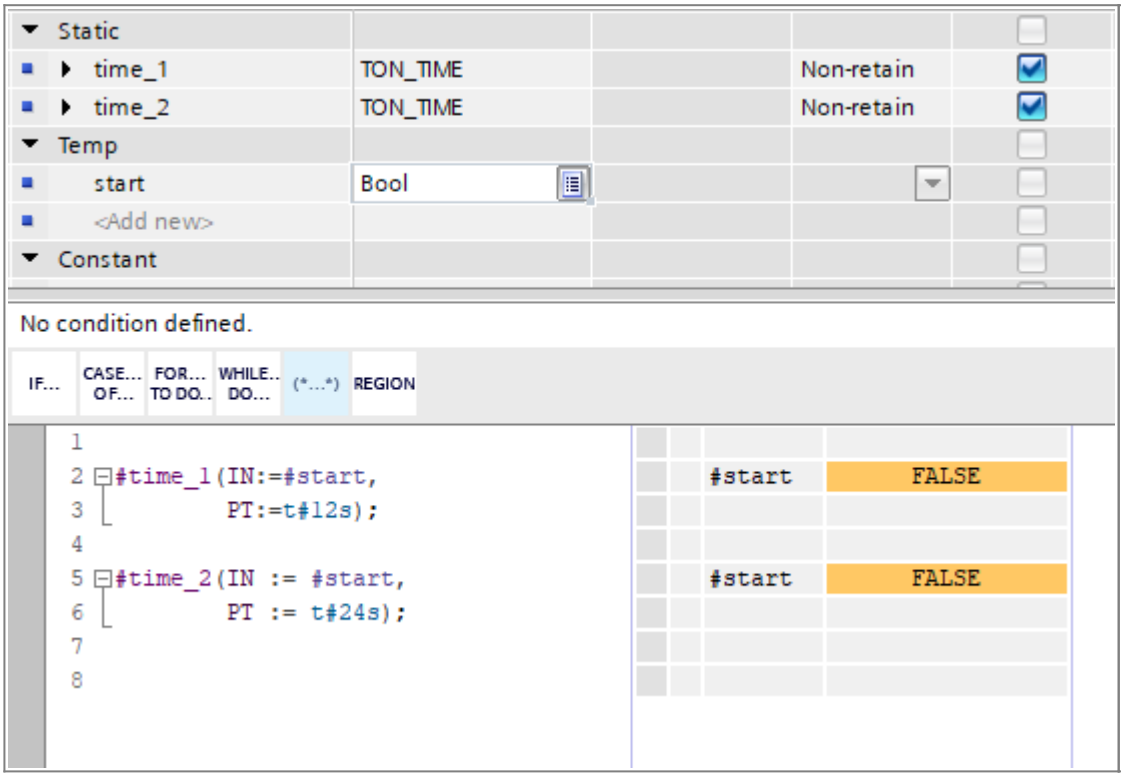
Timer operations

IEC timers

IEC timers (TP, TON, TOF) should definitely be called embedded from the FBs, the description of which can be found here: Call FBs
In the case of embedding, the functions must be called from the “static” block of the calling FB (just type “TON” for the “data type”):



In the case of embedding, the functions must be called from the “static” block of the calling FB (just type “TON” for the “data type”. FBs must be called in the program in much the same way, of course the DB call must be omitted.

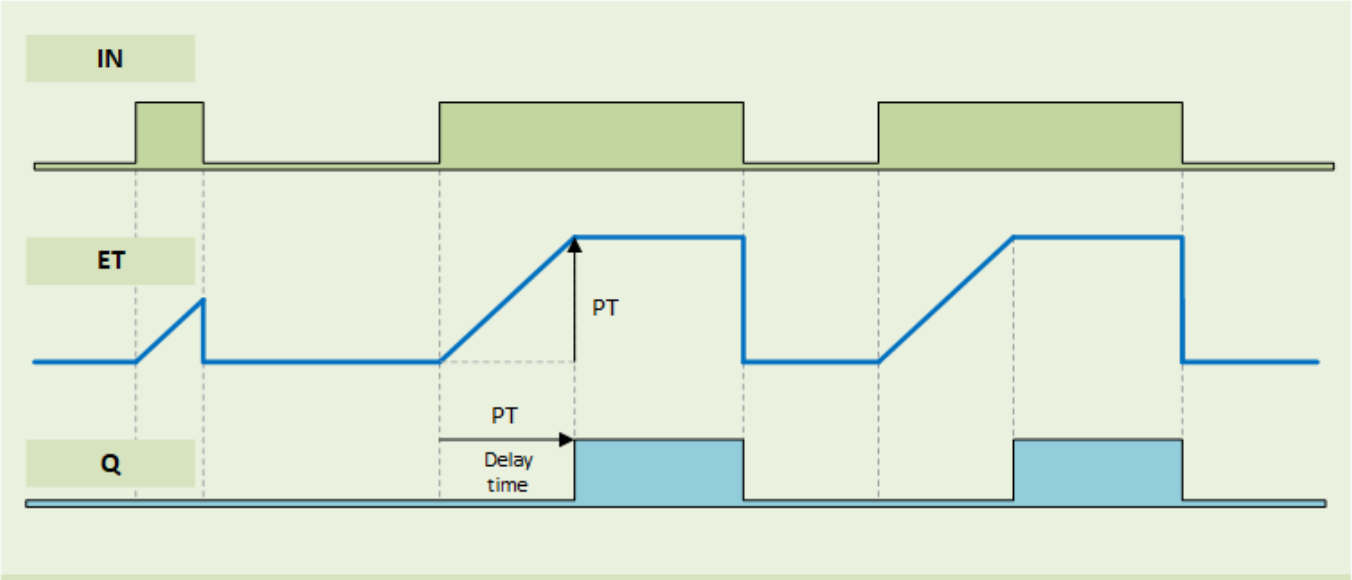
test_3_DB

Name	Data type	Start value	Monitor value	Re
Input				
Output				
InOut				
Static				
time_1	TON_TIME			
PT	Time	T#0ms	T#0MS	
ET	Time	T#0ms	T#0MS	
IN	Bool	false	FALSE	
Q	Bool	false	FALSE	
time_2	TON_TIME			
PT	Time	T#0ms	T#0MS	
ET	Time	T#0ms	T#0MS	
IN	Bool	false	FALSE	
Q	Bool	false	FALSE	

The image shows the data of the embedded FBs in the IDB of the calling FB. The great advantage of this method is that the program is easy to import / export / copy, as you only need one FB definition.

TON: Generate on-delay

The TON “switch-on delay” function. It monitors the positive edge of the binary signal at the “IN” input. If the signal persists for a specified “PT” time, it outputs “Q”. The timer is most commonly used to delay signals, for example: - in the case of a field signal, we want to make sure that not only one interference signal is received - in case of level signals we want to get a certain signal (many level signals “wobble”)



„TON“ Generate on - delay IEC timer / Simatic TIA Portal

lamaplc.com

FB **TON (**			
	IN: BOOL **,**	input	**Start signal:** The function monitors the positive edge of this binary signal. The timer start, if signal is “TRUE”.
	PT: TIME **,**	input	**Delay time:** The delay time, example: t#12s
	Q: BOOL **,**	output	**Result:** When the time is up, the result will be “TRUE”.

	ET: TIME	output	**Elapsed time**
);			

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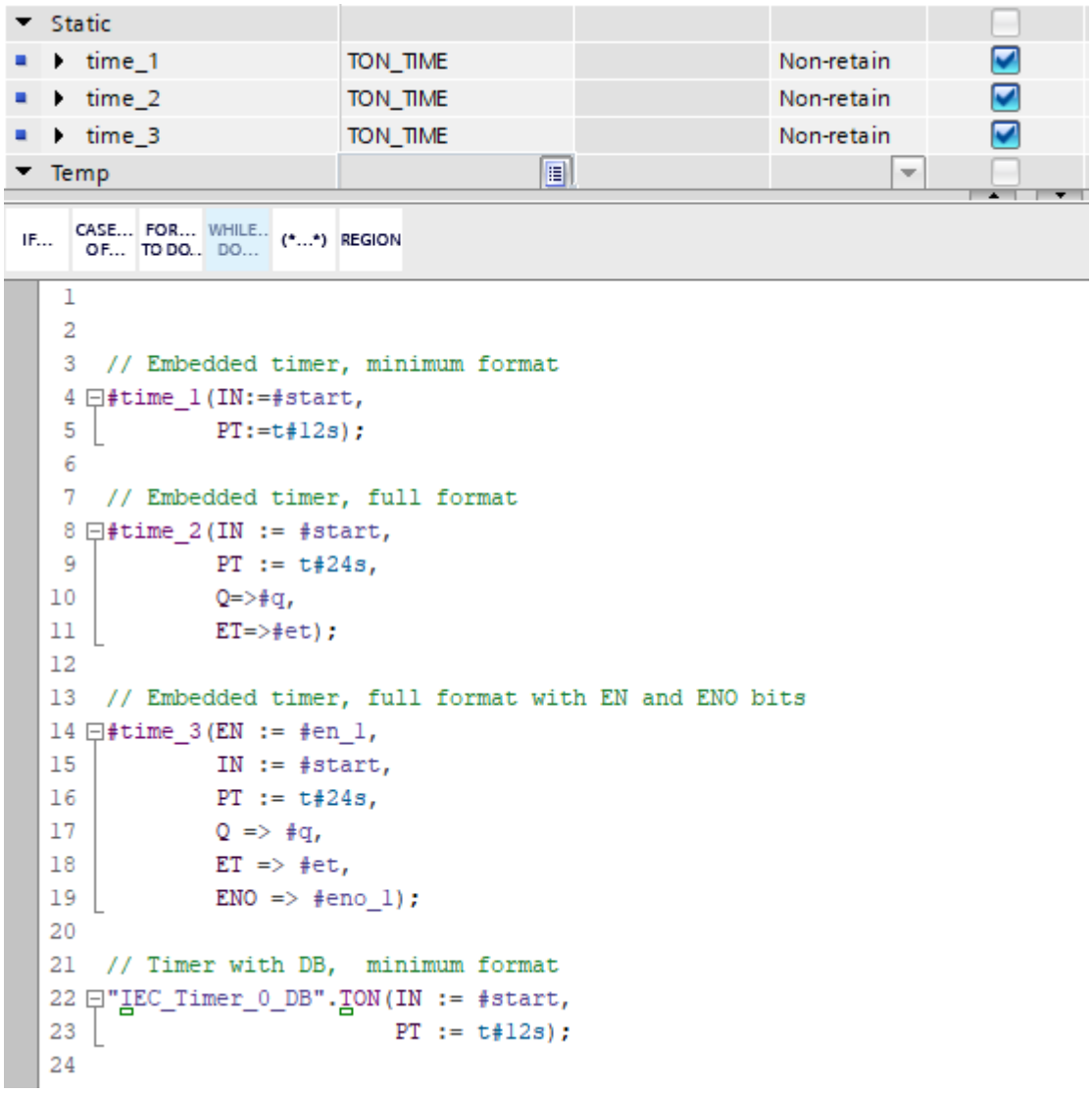
TON Examples

CALL TON



TON second impuls

The example program below can be downloaded here:

test_ton.scl

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Here is a description of how to import the downloaded program to the TIA Portal:

Import source code to the TIA portal.

```
// author OB121 / Sandor Vamos
// ob121.com; 2022.04.13.
// TON example: sec impuls
//
// More information:
// https://www.ob121.com/doku.php?id=de:s7:scl_reference_timers
//
// FB "static" variables:
// secTakt: TON_TIME
// q, secChange: BOOL
// secCount: INT
// FB "temp" variables:
// tempInt: INT
// tempBool: BOOL

// TON, as sec impuls generator
#secTakt(IN:=NOT(#q),
         PT:=t#1s);

// For example, the "Q" parameter can be called
// directly when calling "secTakt",
// OR it can be referred to as:
#q := #secTakt.Q;

// when the time has elapsed, the block will be called:
// - secChange changes its status every second
// - secCount increases every second, in the range 0..9
IF #q THEN
    #secChange := NOT (#secChange);
    #secCount := #secCount + 1;
    IF #secCount > 9 THEN
        #secCount := 0;
    END_IF;
END_IF;

// monitor
#tempInt := #secCount;
#tempBool := #secChange;
```

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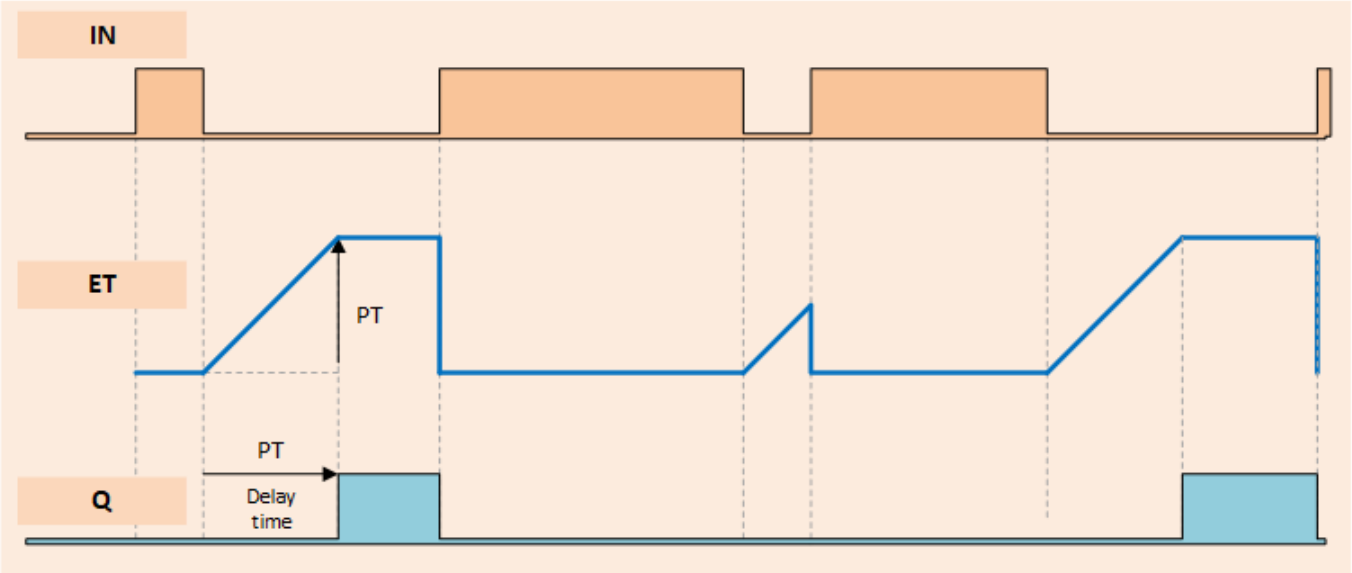
TOF: Generate off-delay

The TOF “switch-off delay” function. It monitors the positive edge of the binary signal at the “IN”

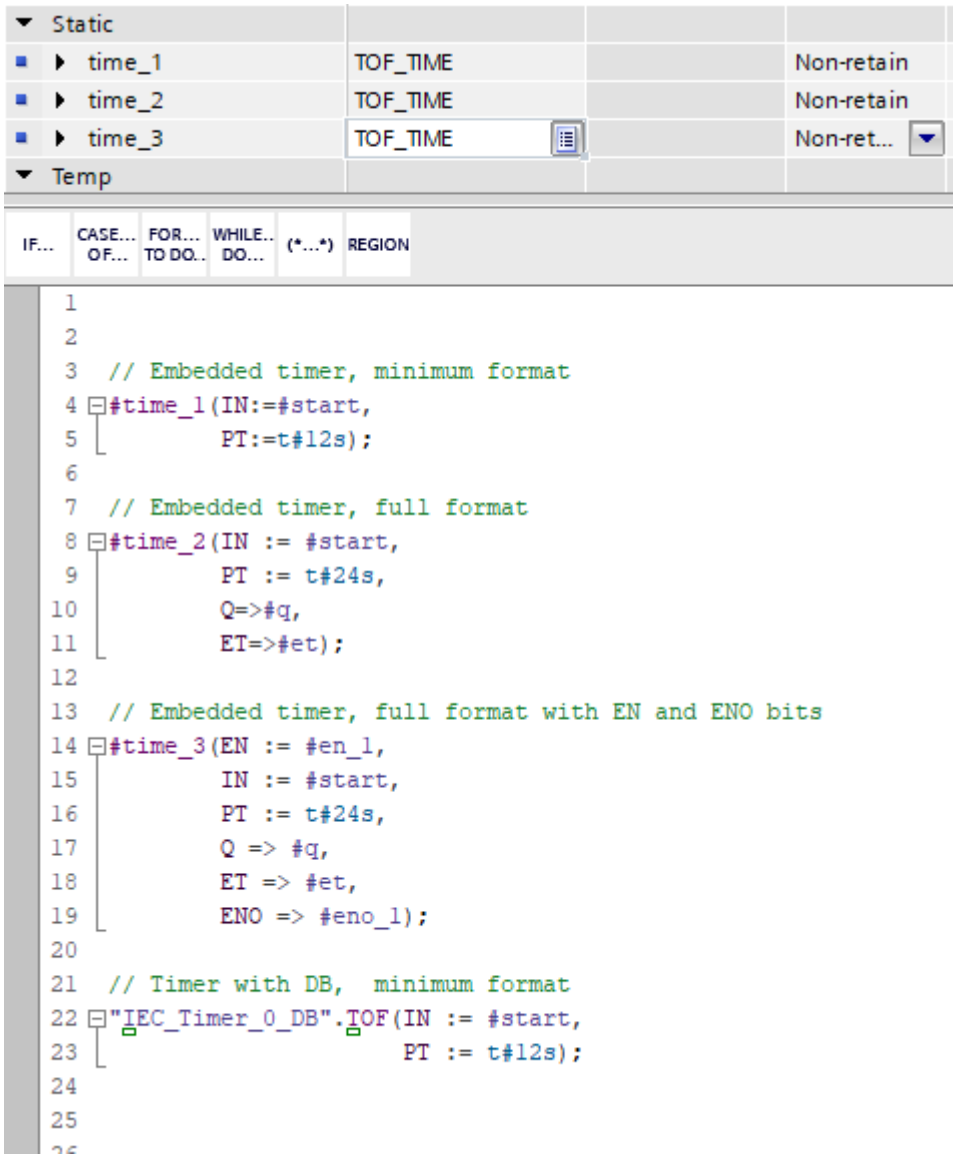
input. If the signal persists for a specified “PT” time, it outputs “Q”. The timer is most commonly used to delay signals, for example: - in the case of a field signal, we want to make sure that not only one interference signal is received - in case of level signals we want to get a certain signal (many level signals “wobble”)



„TOF“ Generate off - delay IEC timer / Simatic TIA Portal

FB **TOF (**			
	IN: BOOL **,**	input	**Start signal:** The function monitors the positive edge of this binary signal. The timer start, if signal is “TRUE”.
	PT: TIME **,**	input	**Delay time:** The delay time, example: t#12s
	Q: BOOL **,**	output	**Result:** When the time is up, the result will be “TRUE”.
	ET: TIME	output	**Elapsed time**
);			

TOF Examples



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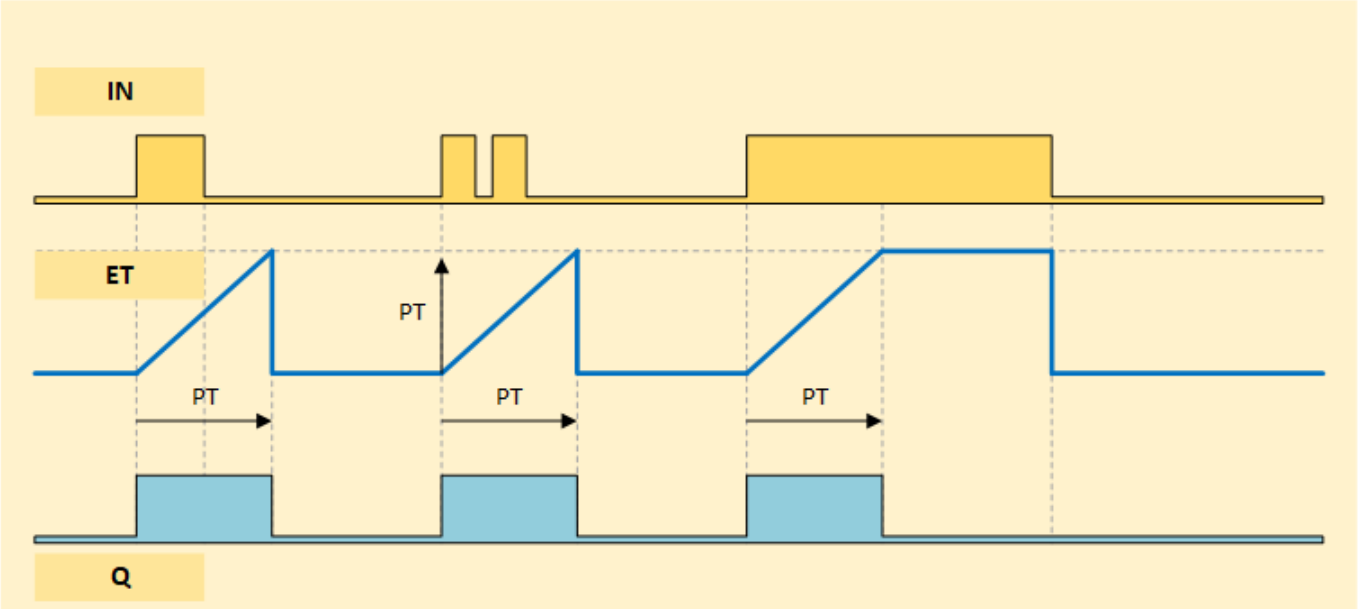
TP: Generate pulse

The TP “pulse generator” function. It monitors the positive edge of the binary signal at the “IN” input, and generates pulses in effect equal “PT” length from this. It is commonly used to extend very short-lived signals because, for example, the cycle time of a WinCC HMI is typically 1 sec. If the signals are “extended” for 2 seconds, the HMI can also process them.



„TP“ Generate pulse IEC timer / Simatic TIA Portal

FB TP (			
	IN: BOOL ,	input	**Start signal:** The function monitors the positive edge of this binary signal. The timer start, if signal is first time “TRUE”.
	PT: TIME ,	input	**Extending time:** example: t#12s
	Q: BOOL ,	output	**Result:** “Q” will be TRUE for the duration of the signal extension.
	ET: TIME	output	**Elapsed time**
);			

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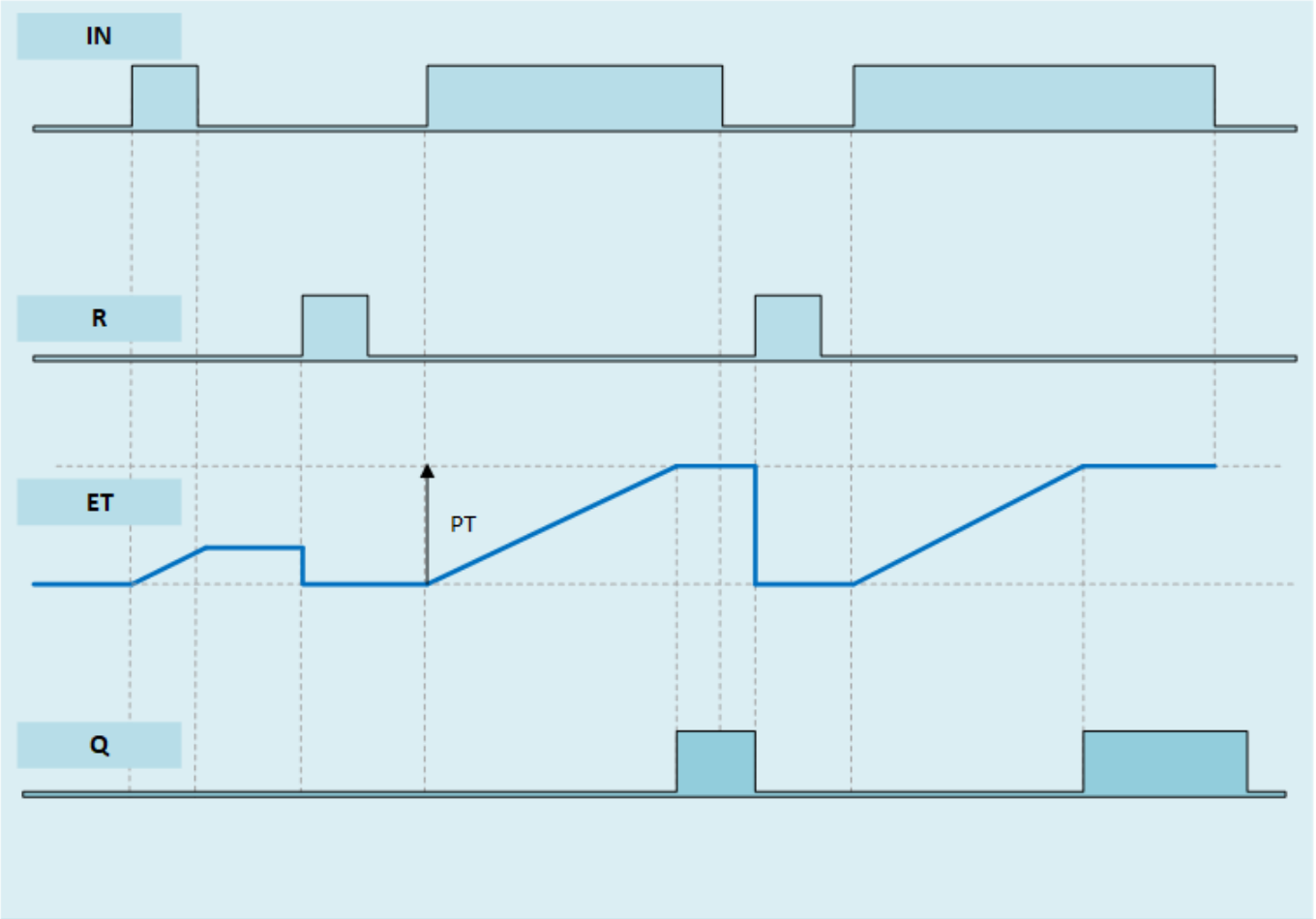
TONR: Time accumulator

The TONR “time accumulator” function. It practically collects the times, and if the input signal “IN” has already existed for the right amount of time, it indicates a result “Q”. The timer function can be reset with the reset input “R” to set null the amount of time collected.



„TONR“ Time accumulator IEC timer / Simatic TIA Portal

FB **TONR (**			
	IN: BOOL **,**	input	**Start signal:** The function monitors the positive edge of this binary signal. The timer running, if signal is “TRUE”.
	R: BOOL **,**	input	**Reset signal:** The timer function can be reset with the reset input “R” to set null the amount of time collected.
	PT: TIME **,**	input	**Extending time:** example: t#12s
	Q: BOOL **,**	output	**Result:** After collecting the “PT” amount of time, the “Q” output will be “TRUE”. The function can then be restarted with the “R” input.
	ET: TIME	output	**Elapsed / collected time**
);			

Simatic, SCL, TIA, Math, CTU, CTD, CTUD, IEC timers, TP, TON, TOF, counter, timer