Counting and Measuring with the Counter Module "TM Count 2x24V"

S7-1500, ET 200MP, "TM Count 2x24V"

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Table of Contents

1 Task

Introduction

The counter module "TM Count 2x24V" for S7-1500 and ET 200MP is used in particular for capturing fast digital signals.

The counter module can:

- count signals.
- capture frequencies and speeds.
- capture period durations.

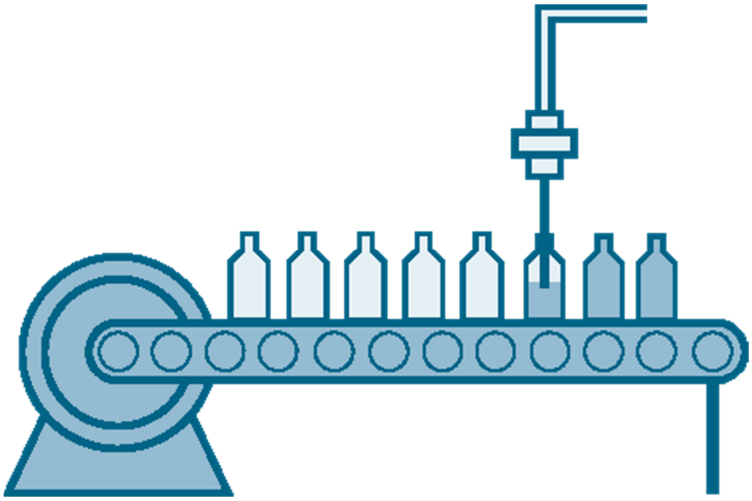
Extensive parameter setting options allow to adapt the module optimally to the respective automation task. The module takes tasks off the control in this way.

Two scenarios are used in the Application Example to demonstrate how the counter module (the technology module) can be parameterized and used.

Overview of the scenario "Fill bottles"

The figure below provides an overview of the first automation task:

Figure 1-1



A solution for filling bottles with "TM Count 2x24V" shall be realized. TM Count counts the liquid volume filled into the bottles and it controls the feed valve.

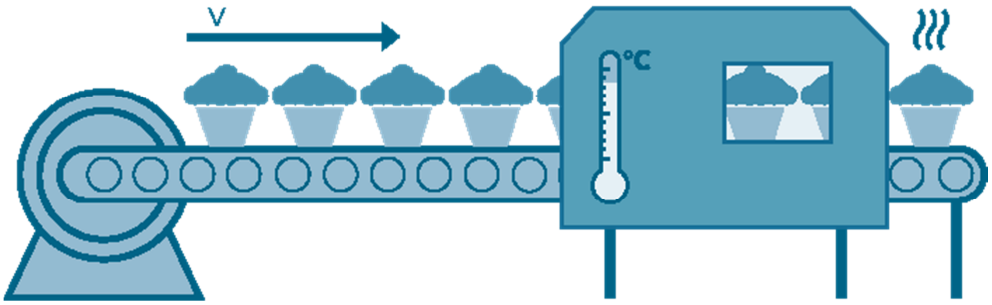
The scenario "Fill bottles" shall meet the following requirements:

- The counter is started by the user program when a bottle is in the proper position (photo sensor).
- TM Count shall reset an output signal for closing the feed valve when the bottle is full.
- The bottles shall be filled with the exact volume despite the reaction time of the feed valve.
- It shall be possible to change the bottle size or its filling quantity during operation.

Overview of the scenario "Bake cupcakes"

The figure below provides an overview of the second automation task.

Figure 1-2



A solution for monitoring the speed of a conveyor belt shall be realized with TM Count. The aim is to ensure that objects pass a continuous oven at an exactly defined speed.

The scenario "Bake cupcakes" shall meet the following requirements:

- The measurement shall be started when an object is detected on the conveyor belt.
- The measurement shall be stopped when the end of a batch is detected.
- A warning signal shall be given by the TM when the conveyor belt speed violated the configured speed limits.
- The speed limits shall allow to be adjusted during operation.

Terminology

- Technology module:

  The technology module (TM) is the technological counter module "TM Count 2x24V".
- Technology object:

  The technology object (TO) is the interface which STEP 7 V12 provides for parameterization and operation of the technology module.
- HWCN (hardware configuration)

  Specifies the device configuration from STEP 7 V10. Corresponds to "HW Config" in STEP 7 <V10.

2 Solution

2.1 Overview

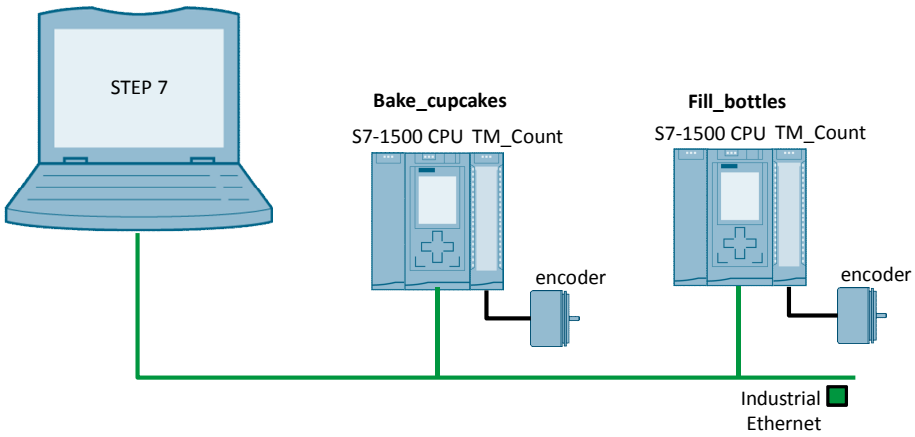
Content

This chapter shows the hardware and software used for the two scenarios and the schematic layout of the individual components.

Schematic layout

The following figure gives a schematic overview of the most important components of the solution:

Figure 2-1



The incremental encoder simulates

- the flow meter in the scenario "Fill bottles".
- the rotating axle of the conveyor belt in the scenario "Bake cupcakes".

Advantages

The application shows the user the optimal use of the technology module by means of the two scenarios:

Table 2-1

Scenario "Fill bottles"	Scenario "Bake cupcakes"
Explanation of parameter setting of TM Count with the technology object "High_Speed_Counter" in STEP 7 V12.	Explanation of parameter setting of TM Count using the HWCN, control and feedback interface and the data record 128.
Illustrative example of programming TM Count using the technology object "High_Speed_Counter"	Illustrative example of programming TM Count using the control and feedback interface and the data record 128.
Lower engineering efforts needed due to use of the technology object.	Reparameterization of the technology module during operation.

Note When the counter module parameters are set via the technology object, only the mode "Count" is adjustable, not the mode "Measure".

Visualization

The individual scenarios can be operated and monitored with prefabricated pictures in the WinCC Runtime Professional.

Figure 2-2 Visualization of the scenario "Fill bottles"

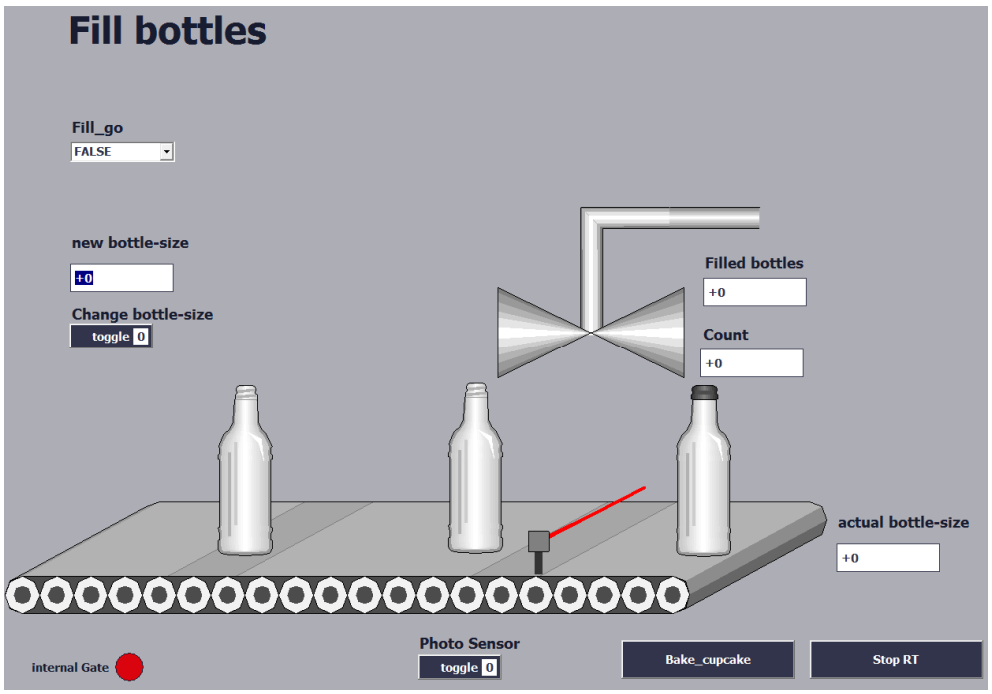
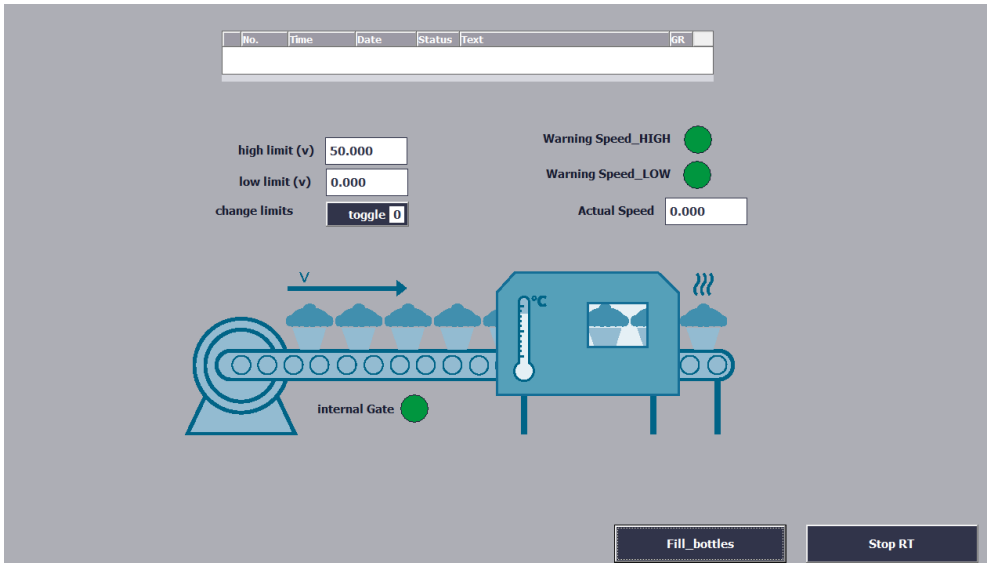


Figure 2-3 Visualization of the scenario "Bake cupcakes"



Delimitation

This application does not include a description of:

- STEP 7 V12 SP1.
- WinCC Runtime Professional V12 SP1.
- the programming language SCL.

Basic knowledge of these topics is assumed.

2.2 Hardware and software components

2.2.1 Validity

This application is valid for

- STEP 7 from V12
- S7-1500 FW 1.1

2.2.2 Components used

This application has been generated with the following components:

Hardware components

Table 2-2

Component	Qty.	Order number	Note
PS 25W 24VDC	1	6ES7 505-0KA00-0AB0	Alternatively, other power supplies can also be used.
CPU 1516-3 PN/DP	2	6ES7516-3AN00-0AB0	
TM Count 2x24V	2	6ES7550-1AA00-0AB0	
Incremental encoder	2	6FX2001-4SB00	
PC station	1	e.g. 6ES7647-6C...-....	Any optional PC station can be used here with the respective software.

Note You need only one CPU, one counter module "TM Count 2x24V" and one incremental encoder each per scenario.

Software components

Table 2-3

Component	Qty.	Order number	Note
STEP 7 V12 SP1 (TIA Portal V12)	1	6ES78221AE02-0YA5	Component for programming the S7-1500.
WinCC V12 SP1 Professional (TIA Portal V12)	1	6AV2103-0DA02-0AA5	Component for configuring the visualization.

Sample files and projects

The following list contains all files and projects that are used in this example.

Table 2-4

Component	Note
76798774_TM_Count_CODE_V1_0.zip	This zipped file contains the scenarios in a STEP 7 project.
76798774_TM_Count_DOKU_v1_0_de.pdf	This document.

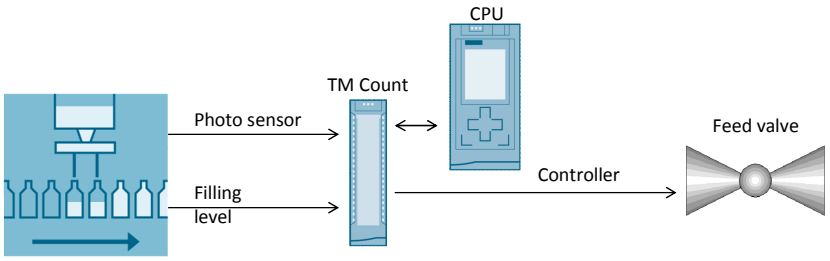
3 Function Principle: Scenario "Fill bottles"

The scenario "Fill bottles" is parameterized and controlled by the technology module "TM Count 2x24V" via the technology object "High_Speed_Counter". The technology object "High_Speed_Counter" provides a simple graphic support for parameterization and a block for programming the TM Count.

3.1 General overview

Task

Figure 3-1



The technology module "TM Count" counts the flow rate into the bottles.

A project is provided which fulfils the following functions:

- A positive edge of the photo sensor starts the counter ("software gate") and opens the feed valve.
- When the maximum filling quantity is reached, the TM outputs a close signal. The counter is not stopped to ensure that the liquid volume which flows out during the traversing time of the valve is also counted.
- The counter of the technology module starts counting at 0 again after the maximum value (maximum filling quantity) has been reached.

Purpose of internal, software and hardware gates

The internal gate of the counter is controlled by the software and hardware gates. When the internal gate is open, the counter is ready for counting. For details refer to the manual \3\ "STEP 7 Professional V12.0 SP1 System Manual", Chapter 11.1.1.1.

The following table shows the state of the internal gate depending on the software and hardware gates:

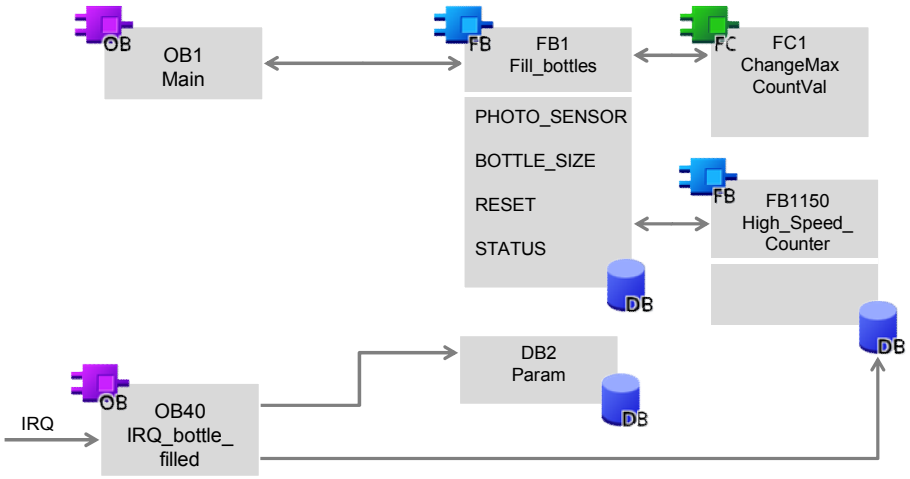
Table 3-1

Hardware gate	Software gate	Internal gate
open/not parameterized	open	open
open/not parameterized	closed	closed
closed	open	closed
closed	closed	closed

Program overview

The following graphic provides an overview of the user program blocks:

Figure 3-2



Blocks and instructions

Table 3-2

Element	Symbolic name	Description
OB1	Main	Includes the main program. Calls the FB Fill_bottles (FB1)
OB40	IRQ_bottle_filled	Interrupt-OB, is called at counter overflow. Counts the number of filled bottles.
FC1	ChangeMaxCountVal	Changes the maximum count value and the comparison value of the technology object ("Change filling quantity").
FB1	Fill_bottles	Operates the technology object "High_Speed_Counter" and calls up FC ChangeMaxCountVal (FC1).
FB1150	High_Speed_Counter	Programming interface of the technology object "High_Speed_Counter". For a brief description of the FB refer to Chapter 5.2 and the online help of the TIA Portal.
DB1	High_Speed_Counter_1	Instance DB of the FB High_Speed_Counter (FB1)
DB2	Param	Data block with parameters
DB3	Fill_bottles_DB	Instance DB of FB Fill_bottles (FB1)

Behavior of the technology module

The following behavior of "TM Count" is set through the parameter setting with the help of the technology object "High_Speed_Counter" (see Chapter 5.1):

- Use as counter with defined upper counting limit and lower counting limit at 0.
- Continue with the count value 0 when the upper counting limit is reached.
- Output of a close signal at a digital output when a bottle is full.

3.2 Functions of the user program

Overview of the functions

The user program realizes the following functions:

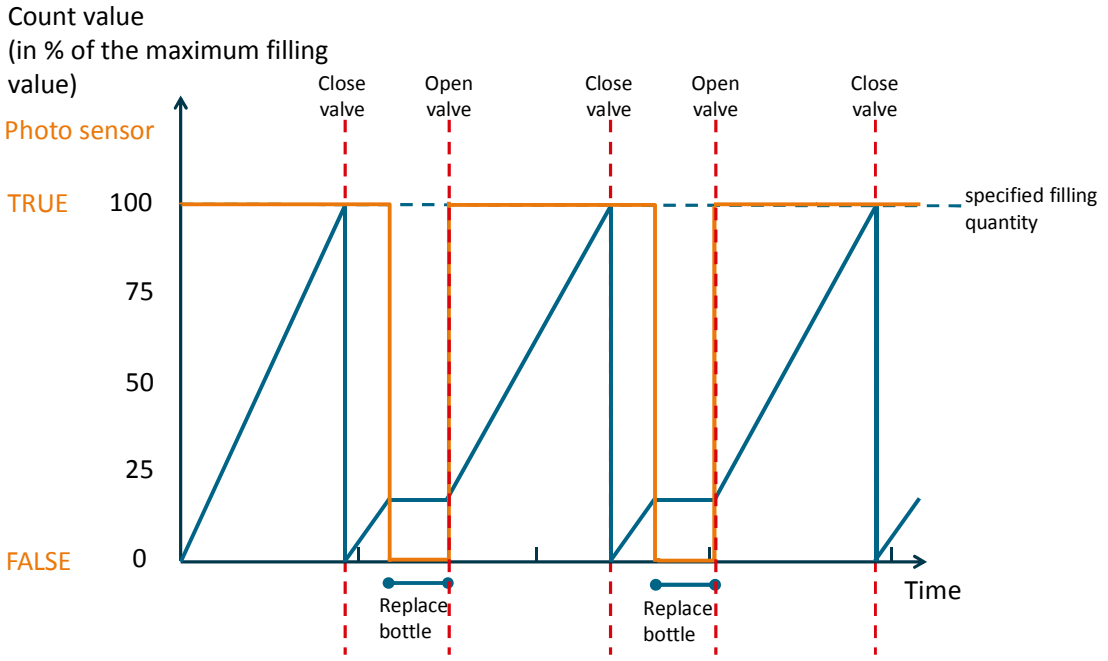
Table 3-3

Function	realized in		
	FB "Fill_bottles"	OB "IRQ_bottle_filled"	Parameter setting
Start of counting upon a trigger.	X	-	-
Provision of digital output signal for control of a valve.	X	-	X
Stop of counting when sensor detects no bottle.	X	-	-
Counting the full bottles.	X	X	-
Changing filling quantity of bottles.	X	-	X
After "overflow" continue with counting from 0.	-	-	X

Schematic diagram

The filling process looks like this schematically:

Figure 3-3



The high levels of the count value (blue curve) occur because liquid still flows out during the traversing time of the valve after the close signal. The counter also counts this "drip rest". Therefore, the filled quantity is exacter from the second bottle and it is not bigger by the "drip rest".

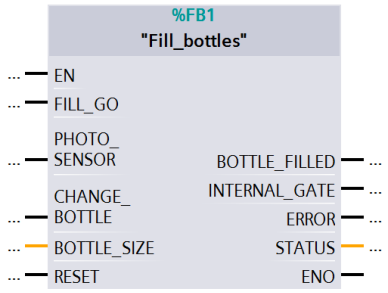
3.3 The function block "Fill_bottles" (FB1)

Call and parameters of the FB "Fill_bottles"

The FB "Fill bottles" internally calls up the FB "High_Speed_Counter" and the FC "ChangeMaxCountVal".

The following figure shows the call interface of FB "Fill_bottles" (FB1).

Figure 3-4



The FB "Fill_bottles" has the following input and output parameters

Table 3-4

Parameter	Type	Remarks
FILL_GO	IN: Bool	The filling process is started with a positive edge: • Reset of error and event acknowledgement. • Opening the software gate.
PHOTO_SENSOR	IN: Bool	Input variable for capture of photo sensor. At PHOTO_SENSOR = FALSE the software gate is closed. The software gate will be opened upon successful initialization and at positive edge.
CHANGE_BOTTLE	IN: Bool	To change the filling quantity, the user enters the new size at BOTTLE_SIZE and adopts it with a positive edge at CHANGE_BOTTLE. A positive edge changes the upper counting limit and the comparison value of the counter to the value "BOTTLE_SIZE": "Change of filling quantity"
BOTTLE_SIZE	IN: DInt	The user enters the desired bottle size here. The upper counting limit and the comparison value are internally set to the value BOTTLE_SIZE at a positive edge of CHANGE_BOTTLE.
RESET	IN: Bool	RESET is controlled with a positive edge when the filling process is to be aborted or errors of the counter module shall be acknowledged. A positive edge causes • setting the error and event acknowledgement bits • resetting the initialization (new edge of FILL_GO will be required). • resetting the software gate • resetting the counted bottles
BOTTLE_FILLED	OUT: Bool	Shows for a cycle that filling of the bottle is complete.
INTERNAL_GATE	OUT: Bool	Indicates whether the counter is active. INTERNAL_GATE=TRUE: Counter is ready for counting.
ERROR	OUT:	Indicates an error at TO "High_Speed_Counter".

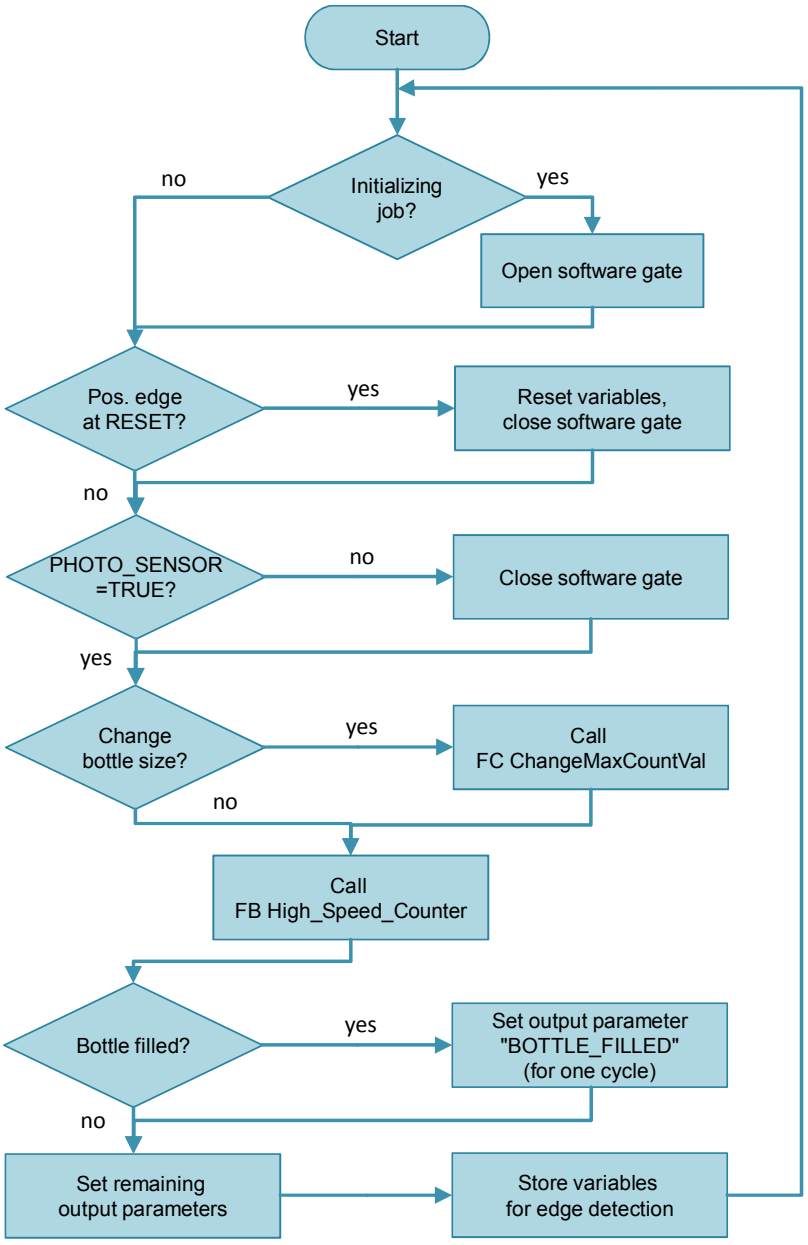
Parameter	Type	Remarks
	Bool	Interconnect this output to read out and evaluate the parameter STATUS in the case of an error.
STATUS	OUT: Word	Outputs the error ID of the TO "High_Speed_Counter" in the case of error. For a description of the error IDs refer to the online help of the TIA Portal.

Program code

The FB "Fill_bottles" (FB1) is not know-how-protected and it is commented for a better understanding.

Program flow chart

Figure 3-5

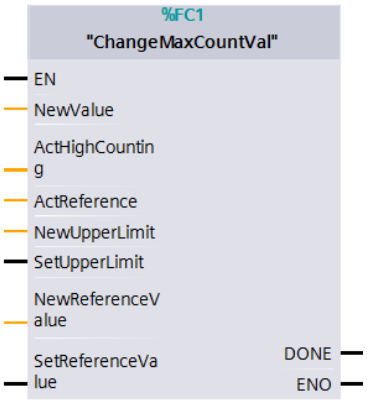


3.4 The function "ChangeMaxCountVal" (FC1)

Call and parameters of the FC "ChangeMaxCountVal"

The following figure shows the call interface of the FC "ChangeMaxCountVal".

Figure 3-6



The function block has the following inputs and outputs:

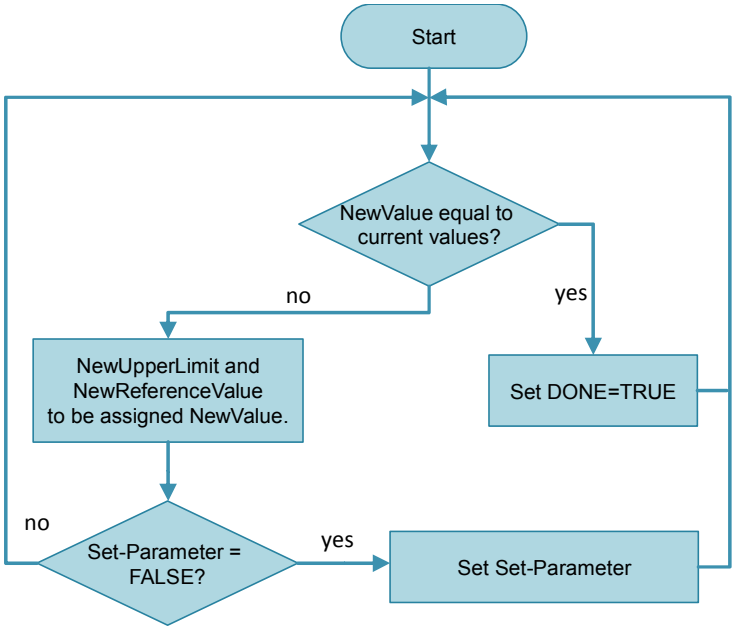
Table 3-5

Parameter	Type	Remarks
NewValue	IN: DInt	Indicates the new value for the upper counting limit and the comparison value ("new filling quantity").
ActHighCounting	IN: DInt	Transfers the current upper counting limit (from instance DB of the FB "High_Speed_Counter")
ActReference	IN: DInt	Transfers the current comparison value (from instance DB of the FB "High_Speed_Counter").
NewUpperLimit	INOUT: DInt	Transfers the variable "NewUpperLimit" from the instance DB of the FB "High_Speed_Counter".
SetUpperLimit	INOUT: Bool	Transfers the variable "SetUpperLimit" from the instance DB of the FB "High_Speed_Counter".
NewReferenceValue	INOUT: DInt	Transfers the variable "NewReferenceValue" from the instance DB of the FB "High_Speed_Counter".
SetReferenceValue	INOUT: Bool	Transfers the variable "SetReferenceValue" from the instance DB of the FB "High_Speed_Counter".
DONE	OUT: Bool	When the current values correspond to the "NewValue", the FC will output DONE=TRUE.

Flow of the FC "ChangeMaxCountValue" (FC1)

The following program flow shows an overview of the behavior of the FC "ChangeMaxCountValue":

Figure 3-7



3.5 The function block "High_Speed_Counter" (FB1150)

Call

The FB "High_Speed_Counter" is called up for monitoring and controlling the technology module of the FB "Fill_bottles".

Call and parameters of the FB "High_Speed_Counter"

The call interface of the FB "High_Speed_Counter" looks like this:

Figure 3-8

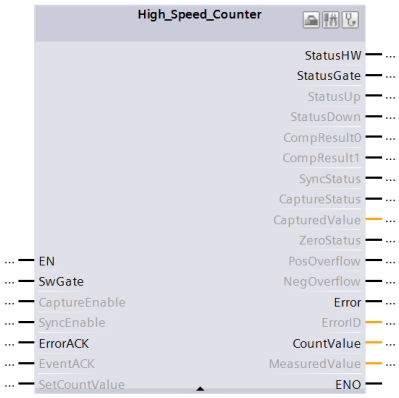


Table 3-6

Parameter	Type	Remarks
SwGate	IN: Bool	The software gate releases the internal gate in connection with the hardware gate. Rising edge: Software gate opens. Falling edge: Software gate closes.
ErrorACK	IN: Bool	A rising edge acknowledges the reported error state.
StatusHW	OUT: Bool	If StatusHW=TRUE, the technology module parameters have been set and the module is ready for operation.
StatusGate	OUT: Bool	If StatusGate=TRUE, the internal gate is released.
Error	OUT: Bool	If Error=TRUE, an error occured at the technology object.
CountValue	OUT: DInt	The current count value.

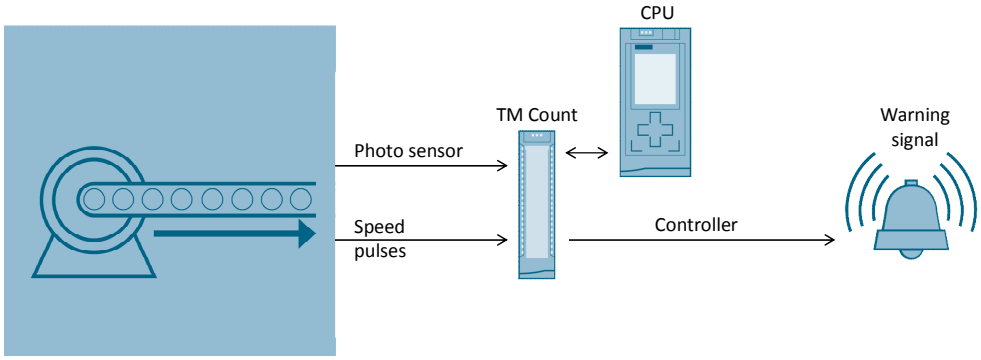
Note For detailed explanations, please, refer to the manual \3\ and Chapter 5.2.

4 Function Principle: Scenario "Bake cupcakes"

The scenario "Bake cupcakes" parameterizes and controls the technology module "TM Count 2x24V" via the HWCN, the data record 128 and the control and feedback interface. In contrast to the use of the technology object, the mode "measuring" can also be set and the counter module TM Count can be parameterized during operation.

4.1 General overview

Figure 4-1



The technology module "TM Count 2x24V" measures the speed of the conveyor belt.

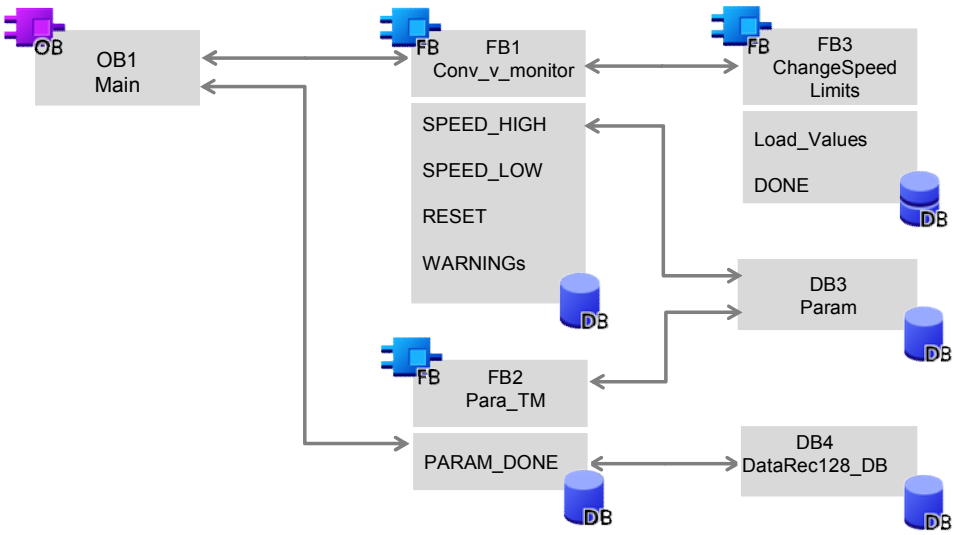
A project is provided which fulfils the following functions:

- Starting the speed measurement: Positive edge at the digital input 0 (photo sensor) of the TM Count: "Starting a batch operation"
- Monitoring of the current speed and output of warning signals at the digital outputs of the counter module TM Count.
- Stopping the speed measurement: Negative edge at the digital input 1 (photo sensor) of the TM Count: "End of a batch operation"
- Changing speed limits via the user program.

Program overview

The following graphic provides an overview of the user program blocks:

Figure 4-2



Blocks and instructions

Table 4-1

Element	Symbolic name	Description
OB1	Main	Includes the main program. Calls the FB conv_v_monitor (FB1)
OB40	IRQ_gate_stop	Interrupt-OB, is called at gate stop. Outputs the number of increments since gate start.
FB1	Conv_v_monitor	• Calls the FB ChangeSpeedLimits (FB3). • Generates a message if the speed limits are violated. • Is connected with the FB Para_TM (FB2) via PARAM_DONE. PARAM_DONE coordinates the calls of the FBs and is already interconnected in the user program.
FB2	Para_TM	Re-parameterizes 4 values of the counter module TM Count during the operation.
FB3	ChangeSpeedLimits	New comparison values are written into the technology module.
-	RDREC	The instruction reads a data record with the number INDEX from the ID-addressed component (here: to the TM Count 2x24V).
-	WRREC	The instruction writes a data record with the number INDEX to the ID-addressed component (here: to the TM Count 2x24V).
DB1	Conv_v_monitor_DB	Instance DB of the FB Conv_v_monitor(FB1)
DB2	Para_TM_DB	Instance DB of the FB Para_TM (FB2)
DB3	Param	Data block with parameters.
DB2	DataRec128_DB	Contains the data record 128 for parameterization of the technology module.

Behavior of the technology module

The parameter setting in the HWCN is used to set the following behavior of the "TM Count":

- Using the TM Count for measuring the speed with the time basis "second".
- Hardware gate start through digital input 0.
- Hardware gate stop through digital input 1.
- Automatic setting of the outputs DQ0 and DQ1 when the configured comparison values are exceeded or fallen below.

Note The parameters in the FB Para_TM (FB2) are transmitted in addition with the data record 128 via the system functions RDREC and WRREC as an example of parameterizing the technology module during the operation (see Chapter 5.3).

4.2 Functions of the user program

Overview of the functions

The user program realizes the following functions:

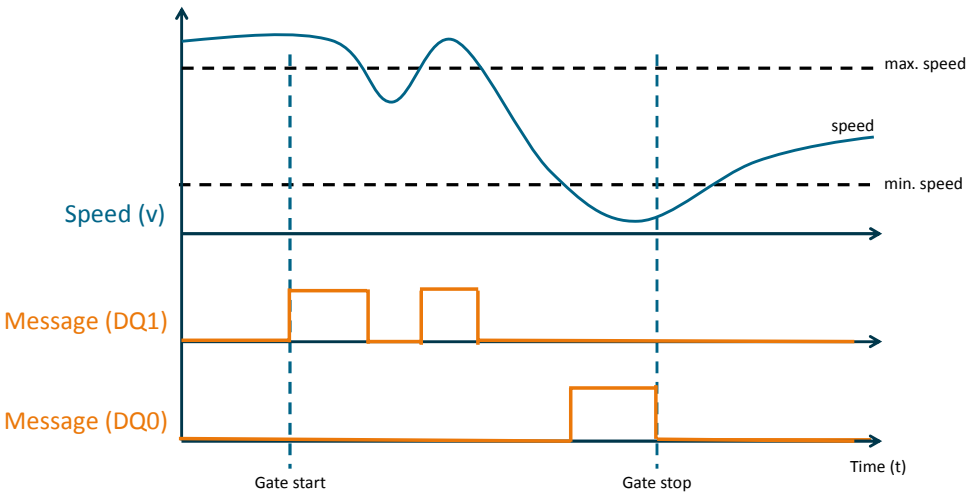
Table 4-2

Function	realized in		
	FB "Conv_v_ monitor"	FB "Para_TM"	Parameter setting
Start of measurement upon an external input signal.	-	X	X
Stop of measurement upon an external input signal.	-	X	X
Output of different warning signals when the set speed limits are exceeded and fallen below.	-	-	X
Generation of messages when the set speed limits are exceeded and fallen below.	X	-	-
Changing the speed limits.	X	-	-

Schematic diagram

The following diagram shows schematically the behavior of the user program depending on the speed of the conveyor belt:

Figure 4-3



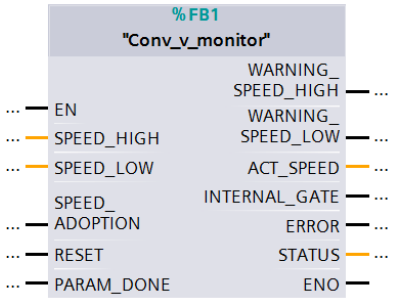
A message is output at the digital outputs when the maximum or minimum speed is exceeded or fallen below and when the measurement has already been started (DQ0=TRUE, for v<min. speed; DQ1=TRUE, for v< max. speed).

4.3 The function block "Conv_v_monitor" (FB1)

Call and parameters of the FB "Conv_v_monitor"

The following figure shows the call interface of the FB "Conv_v_monitor":

Figure 4-4



The function block has the following inputs and outputs:

Table 4-3

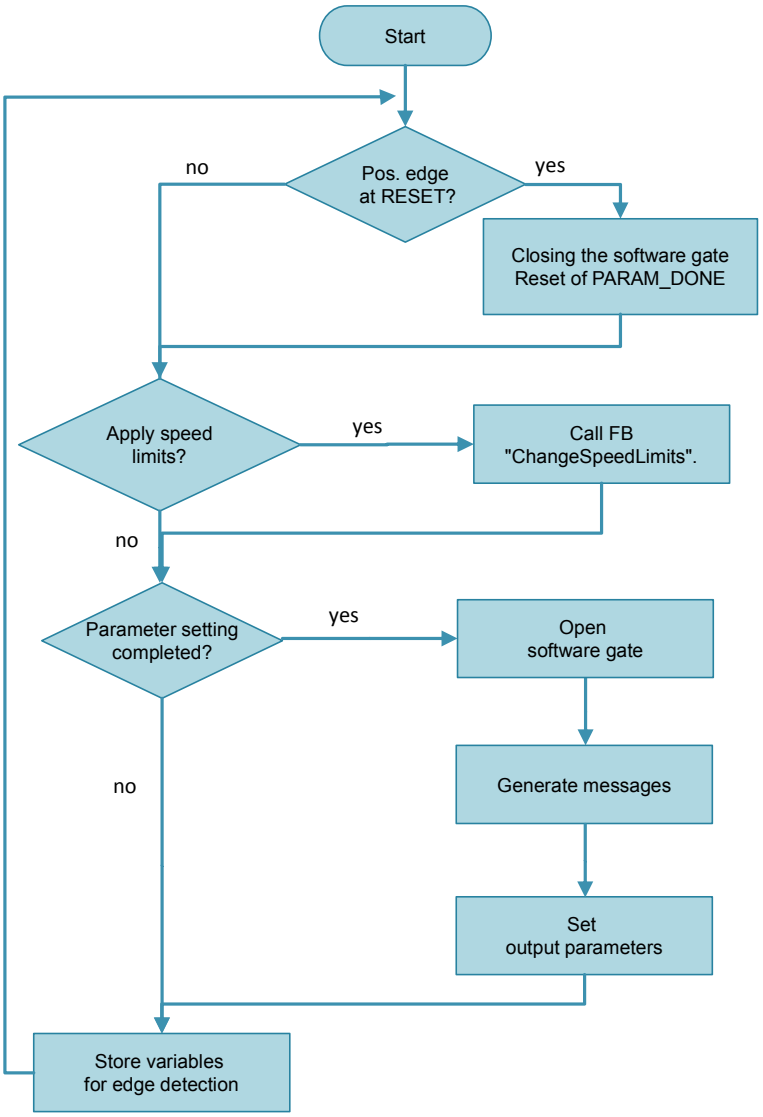
Parameter	Type	Remarks
SPEED_HIGH	IN: Real	The user specifies the upper limit of the speed via SPEED_HIGH.
SPEED_LOW	IN: Real	The user specifies the lower limit of the speed via SPEED_LOW.
SPEED_ADOPTION	IN: Bool	If the input SPEED_ADOPTION is controlled with a positive edge, the current speed limits are adopted.
RESET	IN: Bool	If there is an error at the TM Count, a positive edge at RESET will reset it. A positive edge will reset the block. The FB "Para_TM" is called another time.
PARAM_DONE	INOUT: Bool	This parameter has to be interconnected with the parameter with the same name at the FB "Para_TM" to realize coordination between the two blocks. The parameter causes to open the software gate after the parameter setting has been completed successfully.
WARNING _SPEED_HIGH	OUT: Bool	When the upper limit is exceeded, WARNING_SPEED_HIGH = TRUE will be active as long as the limit value is exceeded.
WARNING SPEED_LOW	OUT: Bool	When the lower limit is fallen below, WARNING_SPEED_LOW = TRUE will be active as long as the limit value is fallen below.
ACT_SPEED	OUT: Real	Outputs the current speed.
INTERNAL_GATE	OUT: Bool	Indicates the status of the internal gate.
ERROR	OUT: Bool	Indicates whether an error is pending. Interconnect this output to read out and evaluate the parameter STATUS in the case of an error.
STATUS	OUT: Word	Outputs • the STATUS of RDREC if an error is pending at RDREC (calls FB ChangeSpeedLimits (FB3)). • the STATUS of WRREC if an error is pending at WRREC (calls FB ChangeSpeedLimits (FB3)).

Parameter	Type	Remarks
		• the STATUS 16#0001_0001 if the specified upper limit is smaller than the lower limit of the speed. For information on the purpose of the STATUS of WRREC and RDREC refer to the online help of the TIA Portal.

Flow of the FB "Conv_v_monitor" (FB1)

The following program flow shows an overview of the behavior of the FB "Conv_v_monitor":

Figure 4-5



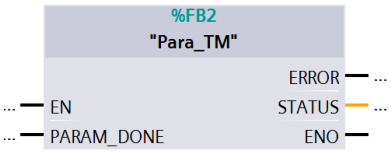
4.4 The function block "Para_TM" (FB2)

Call and parameters of the FB "Para_TM"

The FB "Para_TM" changes some parameters of the counter module TM Count during the operation. For the procedure see also Chapter 5.3.2.

The following figure shows the call interface of the FB "Para_TM".

Figure 4-6



The function block has the following inputs and outputs:

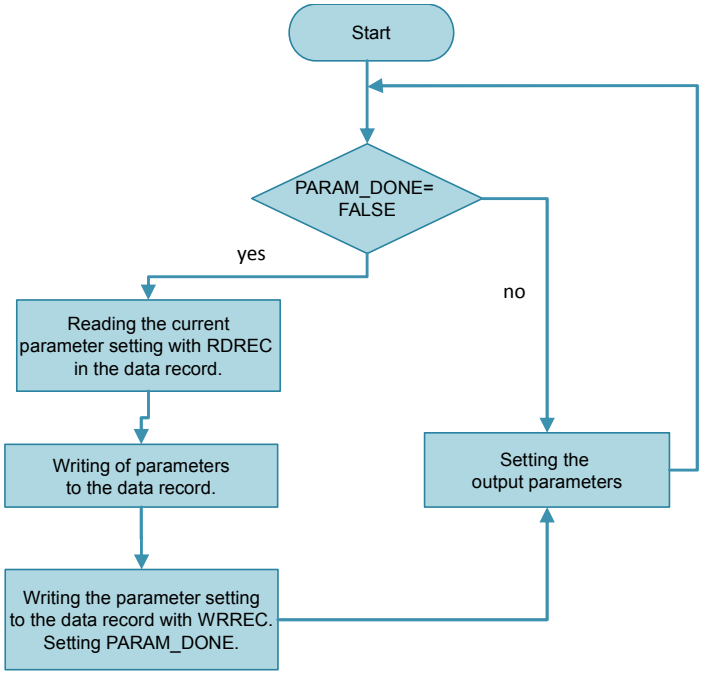
Table 4-4

Parameter	Type	Remarks
PARAM_DONE	INOUT: Bool	This parameter has to be interconnected with the parameter with the same name at the FB "Conv_v_monitor" to realize coordination between the two blocks. The parameter causes that the parameter setting is performed in the FB "Para_TM" if PARAM_DONE = FALSE.
ERROR	OUT: Bool	Indicates if an error occurred during the processing of RDREC or WRREC. If an error occurs, the parameter "STATUS" of the FB has to be evaluated.
STATUS	OUT: DWORD	Outputs the error code of the faulty instruction. More information is provided in the online help of the TIA Portal.

Flow of the FB "Para_TM"

The following program flow shows an overview of the behavior of the FB "Para_TM":

Figure 4-7



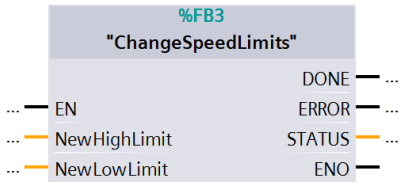
4.5 The function block "ChangeSpeedLimits" (FB3)

Call and parameters of the FB "ChangeSpeedLimits"

The FB "ChangeSpeedLimits" changes the comparison values of the counter module TM Count via the control and feedback interface (see Chapter 5.4).

The following figure shows the call interface of the FB "ChangeSpeedLimits".

Figure 4-8



The function block has the following inputs and outputs:

Table 4-5

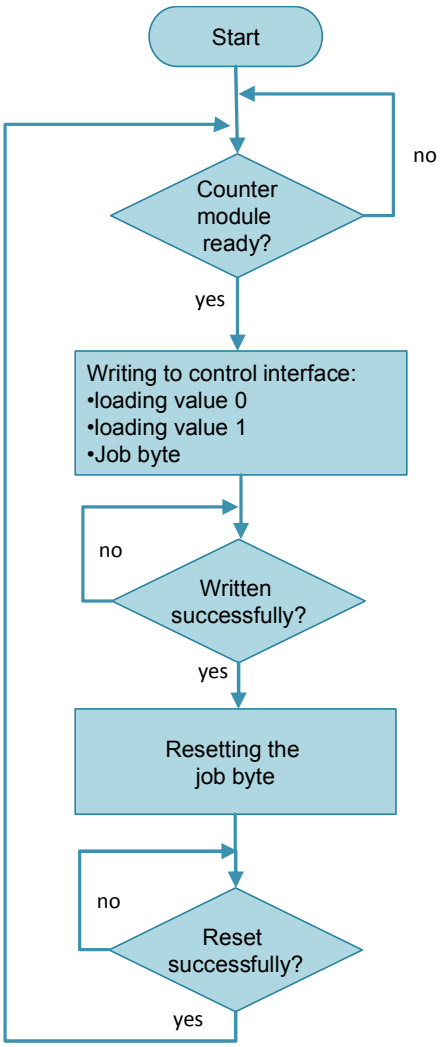
Parameter	Type	Remarks
NewHighLimit	IN: REAL	Indicates the new upper speed limit.
NewLowLimit	IN: REAL	Indicates the new lower speed limit.
DONE	INOUT: Bool	DONE is TRUE for a cycle when the new speed limits were adopted.

Parameter	Type	Remarks
ERROR	OUT: Bool	Indicates if an error occurred in changing the comparison values. If an error occurs, the parameter STATUS of the FB "ChangeSpeedLimits" has to be evaluated.
STATUS	OUT: Word	The following error codes can be output: • 16#0001: Module has not yet started. • 16#0201: Loading of the comparison values has failed.

Flow of the FB "ChangeSpeedLimits"

The following program flow shows an overview of the behavior of the FB "ChangeSpeedLimits".

Figure 4-9



4.6 The instructions "RDREC" and "WRREC"

Typical use

The system functions RDREC and WRREC serve to read out parameters from modules and write them to modules. They can be used to set parameters of the technology module "TM Count" during operation.

Call and parameters of the system function WRREC

The figure below shows the interface of the system function "WRREC": Write data record. The interface "RDREC": Read data record has an analogue configuration and, like the interface of "WRREC", it can be found in the online help of the TIA Portal.

Figure 4-10

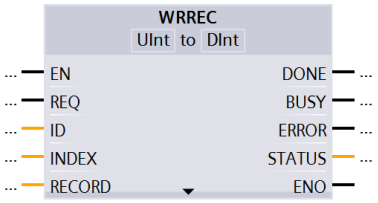


Table 4-6

Parameter	Type	Remarks
REQ	IN: Bool	REQ=1: Perform data record transmission.
ID	IN: HW_IO	Identification number of the hardware component.
INDEX	IN: DINT	Data record number (number 128 for "TM Count")
RECORD	INOUT: VARIANT	Data record
DONE	OUT: Bool	Data record was transmitted.
BUSY	OUT: Bool	BUSY=1: The write process is not yet completed.
ERROR	OUT: Bool	ERROR=1: An error occurred in the write process.
STATUS	OUT: DWord	Block status or error information.

Data record 128

The system functions WRREC and RDREC are used for the processing of the data record 128. For more information about the procedure refer to the Chapter 5.3.2.

5 Configuration and Settings of the Technology Module

Possible parameter setting methods

Various options exist in STEP 7 for using the technology module "TM Count 2x24V".

- Some parameter settings can be made in the hardware configuration (HWCN).
- The technology object "High_Speed_Counter" supports the user in the parameter setting and programming of the counter module TM Count through a graphical user interface and the FB "High_Speed_Counter".
- User who do not want to use the technology object can set parameters of the counter module TM Count with the data record 128 and control the counter module via the control and feedback interface.

Advantages and disadvantages of the technology object

Advantages:

- easier and faster parameter setting via the graphical user interface.
- simpler programming via the function block High_Speed_Counter.

Disadvantages:

- no re-parameterization of the counter module TM Count during operation.
- Only available for the mode "Counting".

Recommendation:

Use the technology object always when you create an application in which you use the mode "counting" and in which you do not want to re-parameterize the counter module during operation.

Realized parameter setting methods

The parameters of the technology module are set in different ways in the two scenarios in this application. This chapter describes the procedure for parameter setting and programming.

- Scenario "Fill bottles":

  Set the parameters and program the TM Count via the technology object "High_Speed_Counter": Chapter 5.1 and Chapter 5.2.

- Scenario "Bake cupcakes"

  Set parameters and program the TM Count via the data record 128 and the control and feedback interface: Chapter 5.3 and Chapter 5.4.

5.1 Setting parameters with the technology object

The technology object "High_Speed_Counter" provides the user

- with a graphical user interface for setting parameters
- with a function block for controlling the technology module for the programming

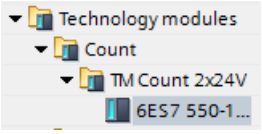
and, thus, it reduces the engineering effort.

5.1.1 Hardware configuration (HWCN)

Adding the technology module and opening the hardware configuration

The prerequisite for the following steps is a STEP 7 V12 project which has already been created and an S7-1500 CPU.

Table 5-1

No.	Description
1.	Open the device configuration of the S7-1500 CPU. Add the module "TM Count 2x24V" (6ES7550-1AA00-0AB0) to the project by double-clicking the icon of the module in the hardware catalog. 
2.	Click on the TM Count module and open the tab "Properties" in the inspector window.

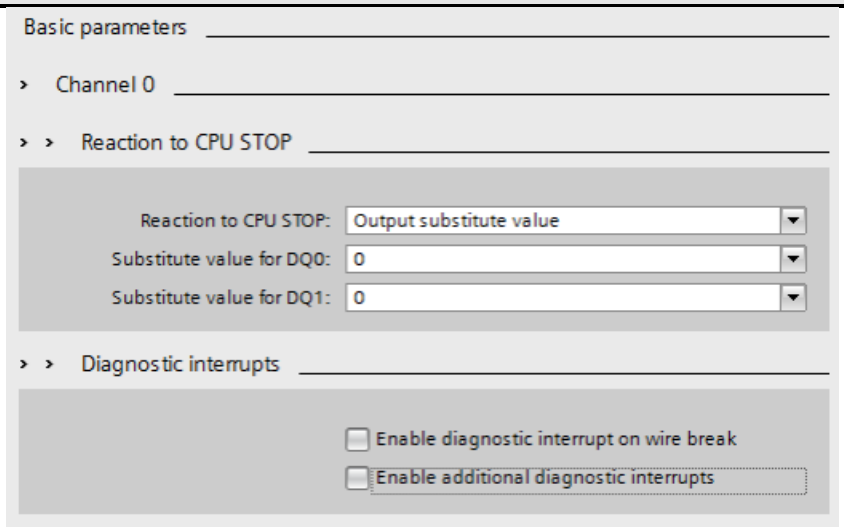
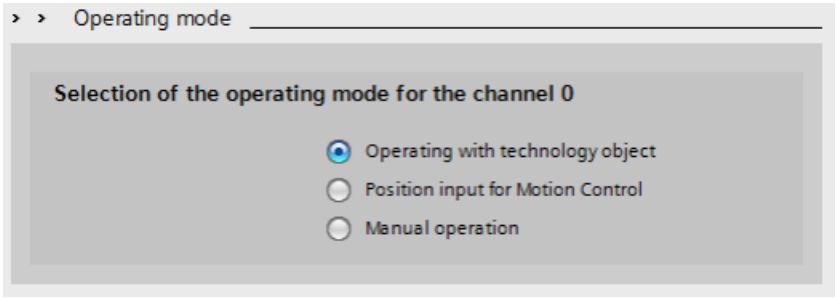
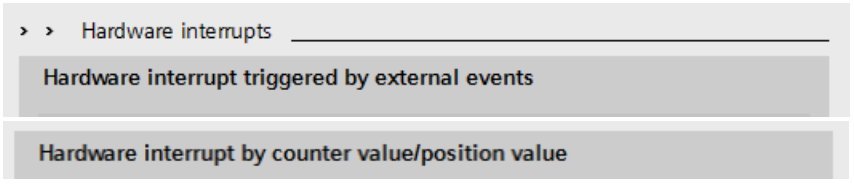
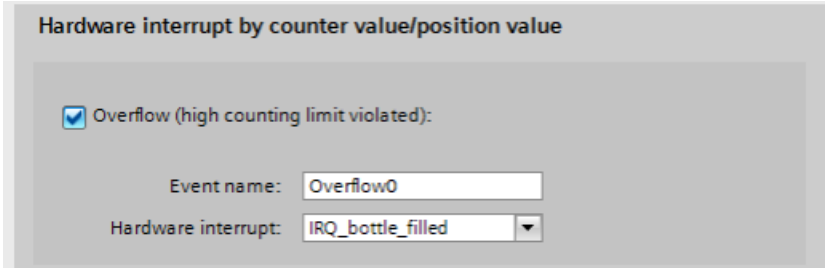
Parameter setting of the technology module

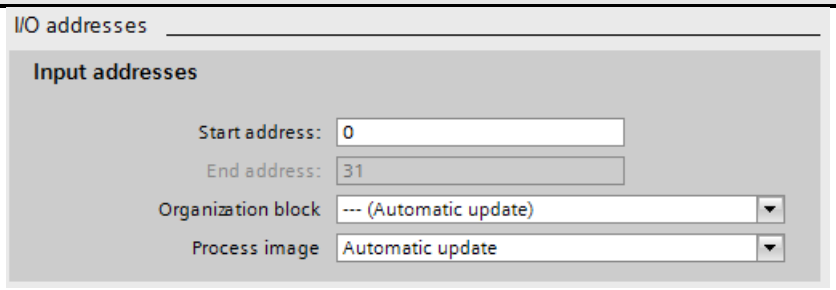
The technology module has two channels and therefore it can realize two counters. The setting options shown in the table below also apply analogously to the second channel of the module.

The settings are made in such a way that the counter module TM Count can be controlled with the technology object "High_Speed_Counter".

Table 5-2

No.	Description
1.	Select the technology module and open "Properties > Count 2x24V > Basic parameters".
2.	You can set the behavior for CPU stop here. You can also set the interrupts for wire break and extended interrupts. For an overview of the extended interrupts refer to the Chapter 5.3.2 in the manual \4\.

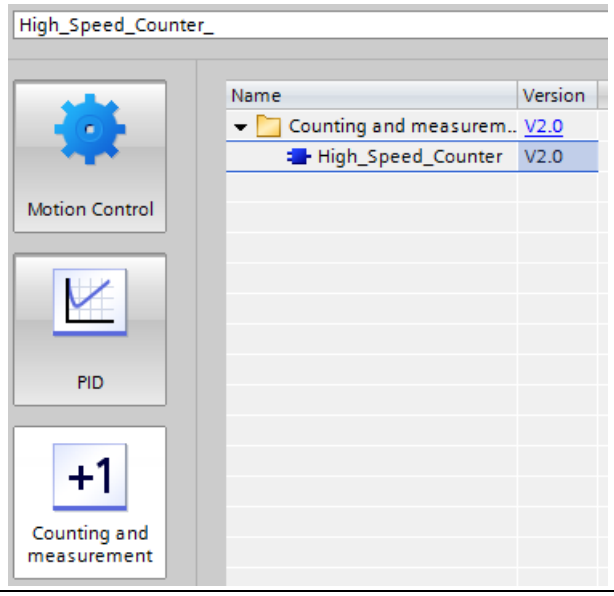
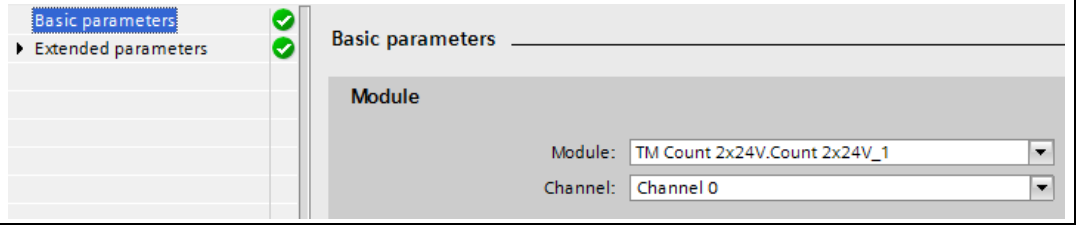
No.	Description
	
3.	Set the counter module TM Count to "Operating with technology object" to control the TM Count via the technology object "High_Speed_Counter".  **Note** These settings can be made for channel 0 and channel 1 separately.
4.	Select the hardware interrupts which you want to use in your user program. You can determine the name and the OB to be called for every hardware interrupt.  The hardware interrupt "Overflow" is activated for the scenario "Fill bottles". The used OB can be selected by the user: 
5.	At "I/O addresses" you can set the offset of the input and output addresses of the technology module within the input and output addresses of the used CPU.

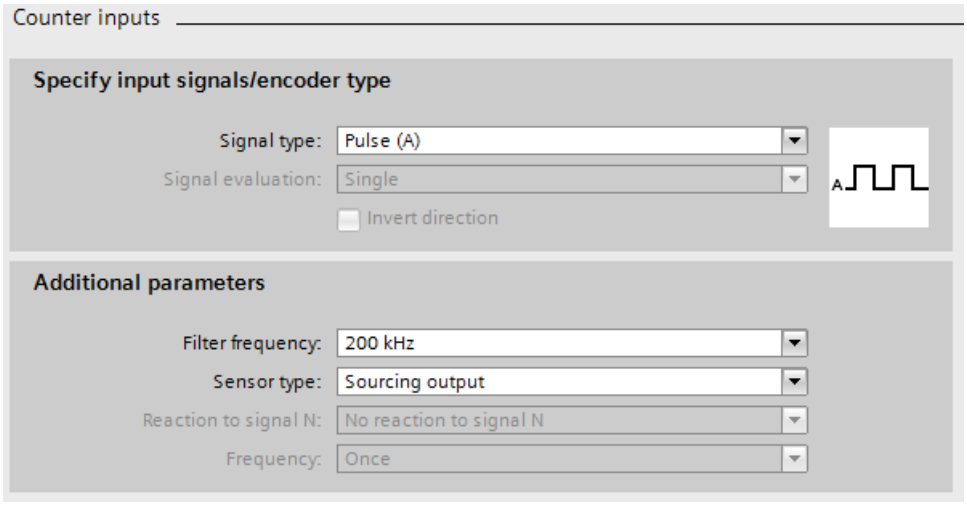
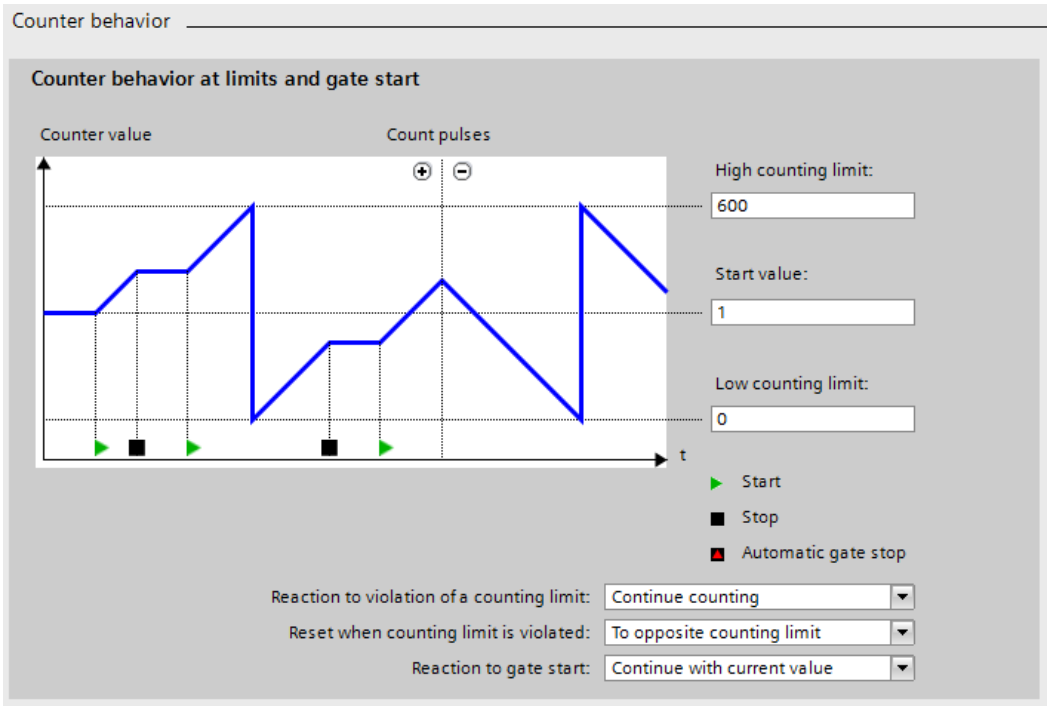
No.	Description
	
6.	The "Hardware identifier" is not required for the programming with the technology object.

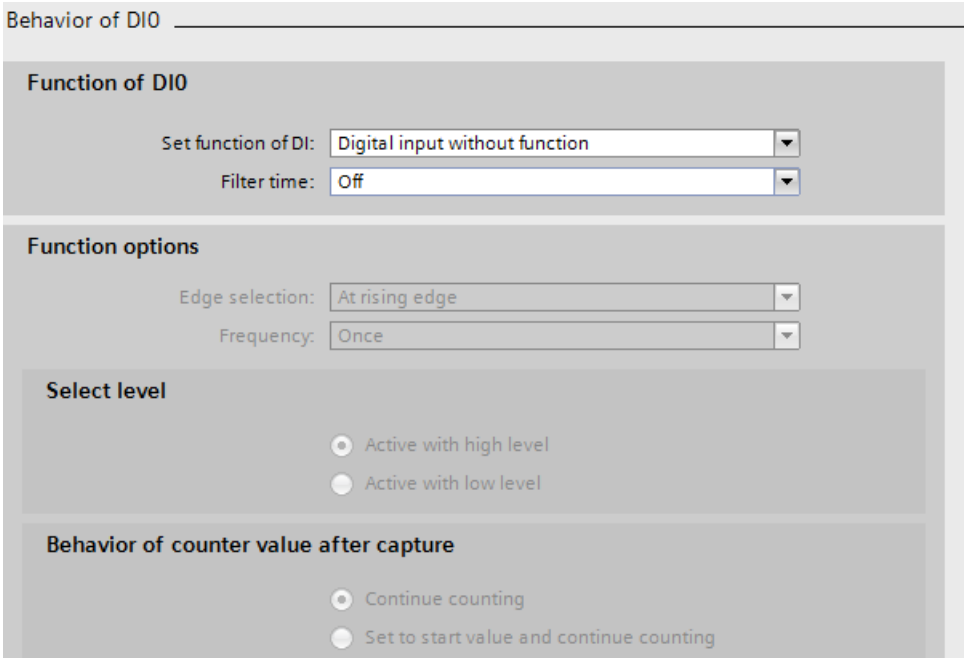
5.1.2 Technology object

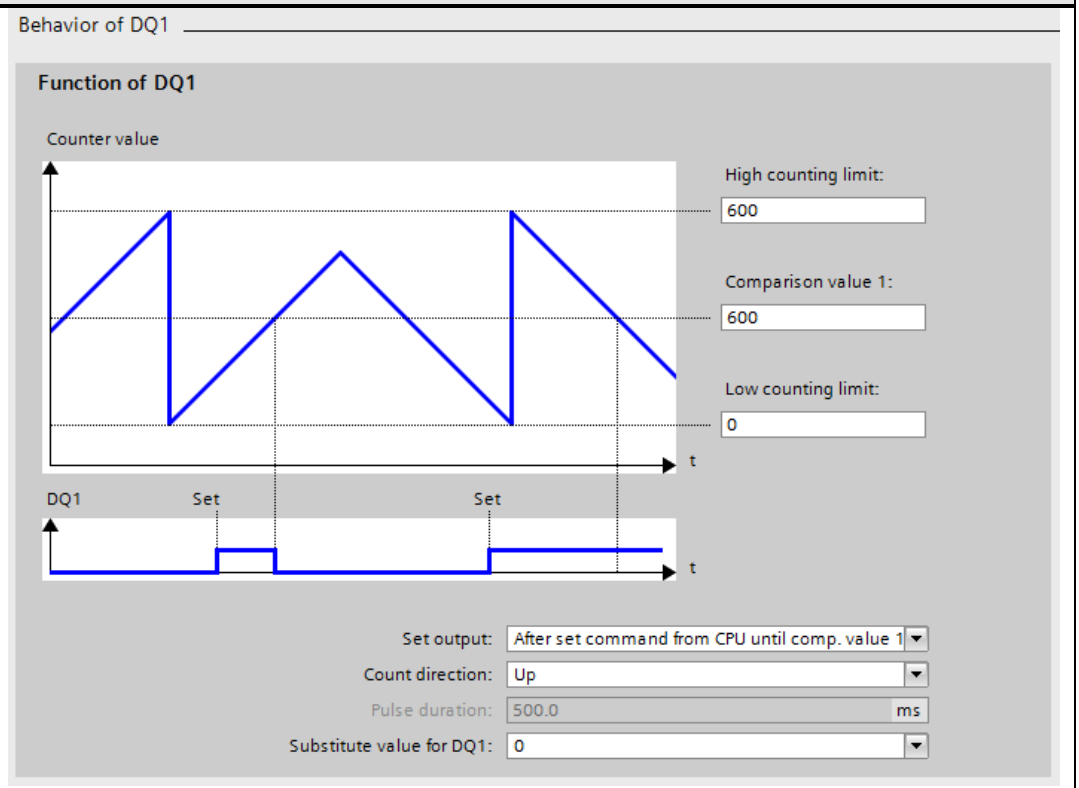
The following table shows the parameters of the technology object "High_Speed_Counter". The screenshots are taken from the scenario "Fill bottles".

Table 5-3

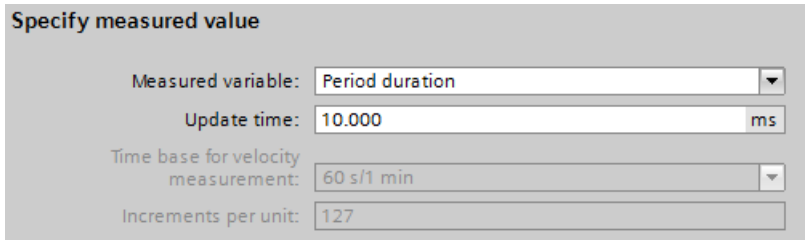
No.	Description
1.	In the project navigation go to "[YOUR_CPU] > Technology objects > Add new object". Select "Counting and Measurement" then and add the object "High_Speed_Counter" with a click on "OK". 
2.	Open the configuration of the object now and click on "Basic parameters". From the hardware configuration select the TM Count which you configured and the channel which you want to use. The counter module TM Count 2x24V has two channels. 

No.	Description
3.	At "Extended parameters" specify the input signals of the module. In addition, set the counter and measurement behavior and the behavior of the digital inputs and outputs. At "Counter inputs" specify the input signals such as the type of encoder and signal evaluation. 
4.	The behavior of the counter at the counting limits and the actual counting limits are set at "Counter behavior". 

No.	Description
5.	The digital inputs have identical parameters. The following settings are available: • Digital input without function. • Gate start / stop (level-controlled). • Gate start (edge-controlled). • Gate stop (edge-controlled). • Synchronization. • Capture. The digital inputs are not used in the scenario "Fill bottles" and are set to "Digital input without function". **Note** Only one digital input can be parameterized, for instance, as a gate start, as a rule. 
6.	The two digital outputs have identical parameters. The status of the output can be determined by the following events: • between comparison value 0 and upper counting limit • between comparison value 0 and lower counting limit • at comparison value 0 for one pulse duration • after the set command from the CPU to the comparison value 0 • use by user program

<table>
<tr><th>No.</th><th>Description</th></tr>
<tr><td></td><td>


</td></tr>
<tr><td>7.</td><td>If the actual encoder value detects a change of direction due to an unsteady or poor encoder signal, this can be compensated by definition of a hysteresis. The value 0 deactivates the hysteresis.


</td></tr>
<tr><td>8.</td><td>You can set the measured value and have the choice between
frequency
period duration
speed
This function is not used in the scenario "Fill bottles" and remains set to the default settings.


</td></tr>
</table>

5.2 Programming: The FB "High_Speed_Counter" (FB1150)

5.2.1 Using the technology object

Technology object "High_Speed_Counter"

The technology object provides the user not only with a graphical user interface for parameter setting but also a block as a simplified interface to the technology module "TM Count". The call interface of the technology object is described in Chapter 3.5.

Typical use

After the parameter setting (Chapter 5.1.2) you can use the FB "High_Speed_Counter" in your user program and also access the individual parameters of the instance DB. This allows you to influence parameters of the technology module during operation.

5.2.2 Further parameters FB "High_Speed_Counter" (FB 1150)

Overview

Not all user-programmable parameters are led outside for the technology object "High_Speed_Counter".

If you want to change further parameters, e.g. the upper counting limit, you have to access the internal static variables of the technology object.

Opening the technology object in the DB editor

To check the further parameters of the FB "High_Speed_Counter" (FB1150) you can open the technology object in the DB editor.

Navigate to the context menu of "[YOUR_PROJECT] > [YOUR_PLC] > Technology objects > [YOUR_COUNTER]". Select "Open DB-Editor" there.

Typical use: State request

The following static variables are available for request in the data block instance of the technology object for the extended state request of the technology module, such as the current counting limits:

Table 5-4

Name	Meaning
CurReferenceValue0	current comparison value (input 0)
CurReferenceValue1	current comparison value (input 1)
CurUpperLimit	current upper counting limit
CurLowerLimit	current lower counting limit
CurStartValue	current start value
UserStatusFlags	
StatusDI0	state of digital input 0 (DI0)
StatusDI1	state of digital input 1 (DI1)
StatusDI2	state of digital input 2 (DI2)
StatusDQ0	state of digital output 0 (DQ0)

Name	Meaning
StatusDQ1	state of digital output 1 (DQ1)

Typical use: Control

Static variables are available for the control of the technology module, such as changing the current counting limits. Proceed as follows to change a current value:

1. Write the desired value into the variable "New[..]".
2. Set the corresponding UserCmdFlag "Set[..]". The variable will be reset to 0 automatically after the value has been transmitted successfully. (Exceptions: SetDQ0 and SetDQ1)

The following parameters can be changed during operation when the technology object is used:

Table 5-5

Name	Remarks
NewCountValue	new counting value
NewReferenceValue0	new comparison value (input 0)
NewReferenceValue1	new comparison value (input 1)
NewUpperLimit	new upper counting limit
NewLowerLimit	new lower counting limit
NewStartValue	new start value
NewDirection	new counting direction
UserCmdFlag	
SetNewDirection	Request: Overwrite the counting direction
SetUpperLimit	Request: Overwrite the upper counting limit
SetLowerLimit	Request: Overwrite the lower counting limit
SetReferenceValue0	Request: Overwrite the comparison value (Input0)
SetReferenceValue1	Request: Overwrite the comparison value (input 1)
SetStartValue	Request: Overwrite
SetDQ0	Positive edge: Set DQ0. Negative edge: Reset DQ0.
SetDQ1	Positive edge: Set DQ1. Negative edge: Reset DQ1.

5.3 Setting parameters using HWCN and the data record 128

If you do not want to set parameters and program the technology module "TM Count 2x24V" using the technology object "High_Speed_Counter" you can proceed instead as follows

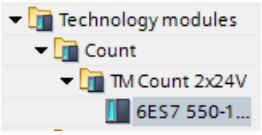
- Set parameters in HWCN or
- change parameters during operation using the data record 128.
- use the control and feedback interface options for handling the module.

5.3.1 Hardware configuration (HWCN)

Adding the technology module and opening the hardware configuration

The prerequisite for the following steps is a STEP 7 V12 project which has already been created and an S7-1500 CPU.

Table 5-6

No.	Description
1.	Open the device configuration of the S7-1500 CPU. Add the module "TM Count 2x24V" (6ES7550-1AA00-0AB0) to the project by double-clicking the icon of the module in the hardware catalog. 
2.	Click on the TM Count module and open the tab "Properties" in the inspector window.

Properties of the technology module

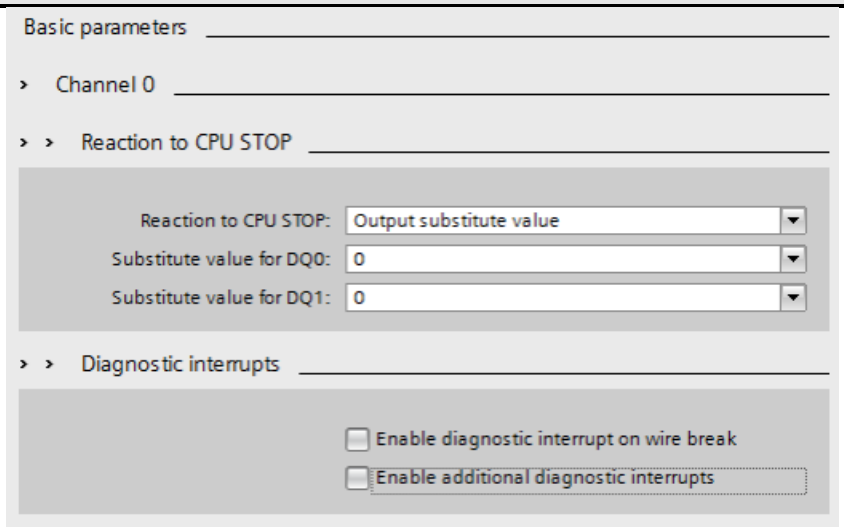
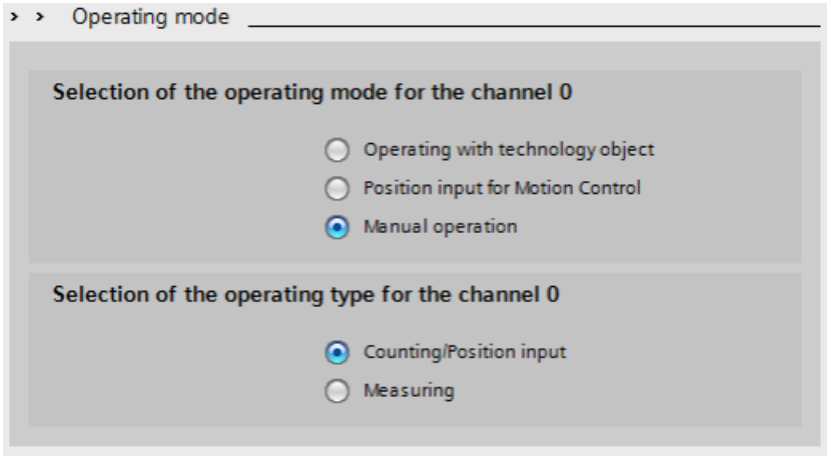
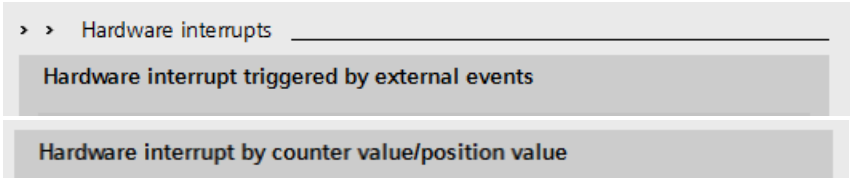
The technology module can realize two counters. The setting options shown in the table below also apply analogously to the second counter of the module.

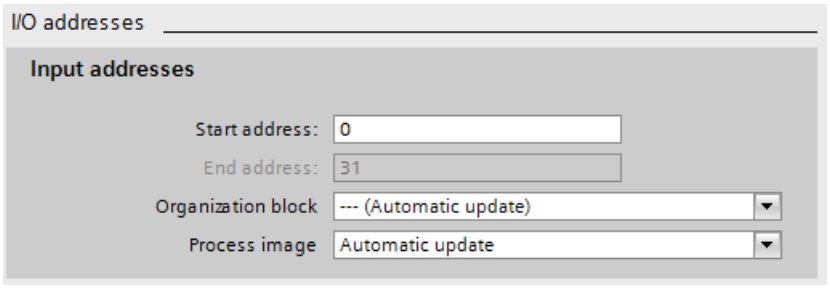
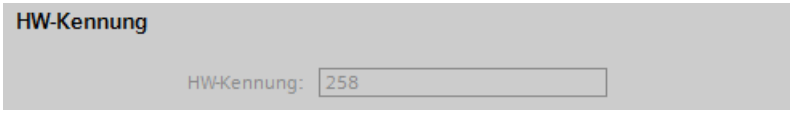
The settings are made so that the counter module TM Count gets its parameters set and is operated with the data record 128 and the control and feedback interface.

The screenshots are taken from the scenario "Bake cupcakes".

Table 5-7

No.	Description
1.	Select the technology module and open "Properties > Count 2x24V > Basic parameters".
2.	You can set the behavior for CPU stop here. You can also set the interrupts for wire break and extended interrupts. For an overview of the extended interrupts refer to the Chapter 5.3.2 in the manual \4\.

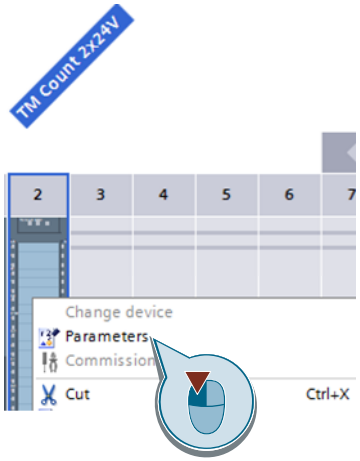
No.	Description
	
3.	Set the counter module TM Count to "Manual operation" to control the TM Count with the data record 128 and the control and feedback interface. Select either counting oder measuring for the mode.  **Note** These settings can be made for channel 0 and channel 1 separately.
4.	Select the hardware interrupts which you want to use in your user program. You can determine the name and the OB to be called for every hardware interrupt.  Hardware interrupt is not used for the scenario "Bake cupcakes".

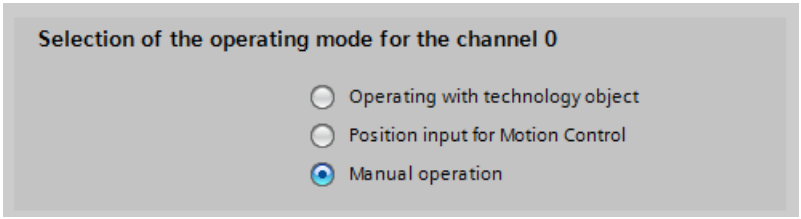
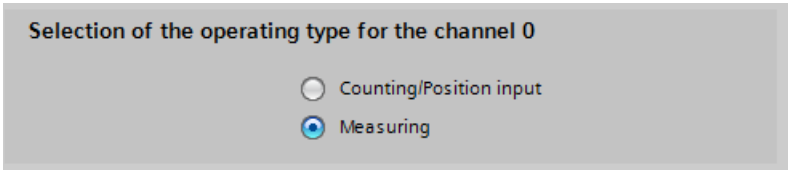
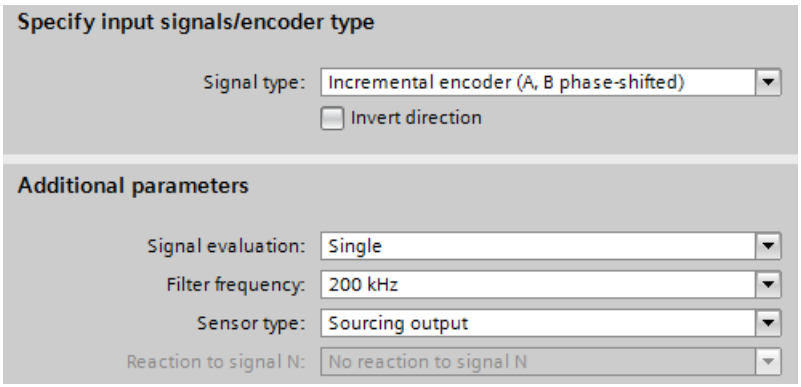
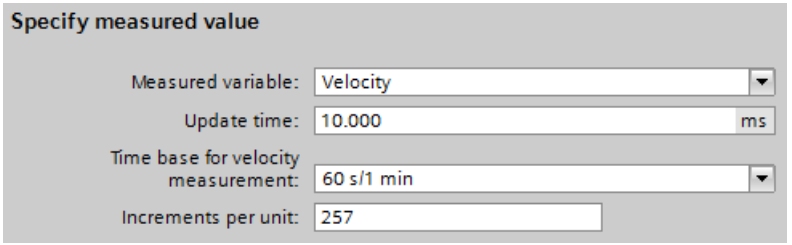
No.	Description
5.	At "I/O addresses" you can set the offset of the input and output addresses of the technology module. 
6.	The "Hardware identifier" is required for setting parameters with the data record 128. 

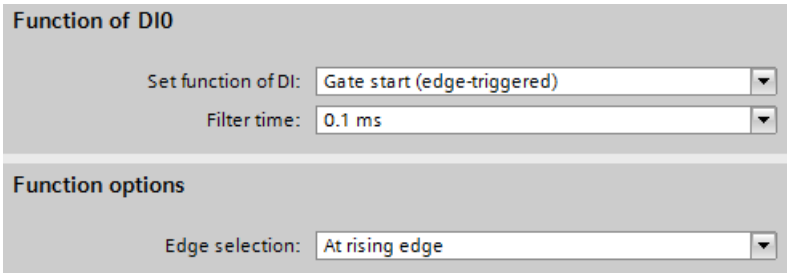
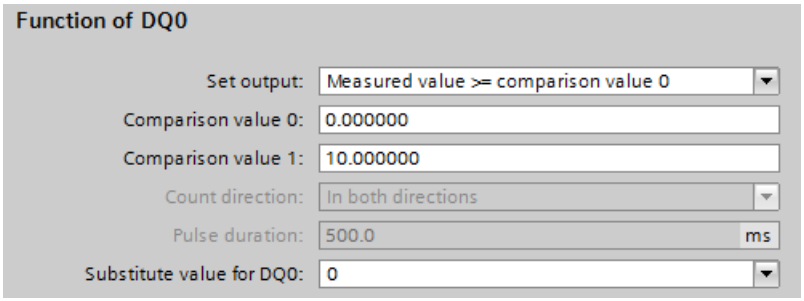
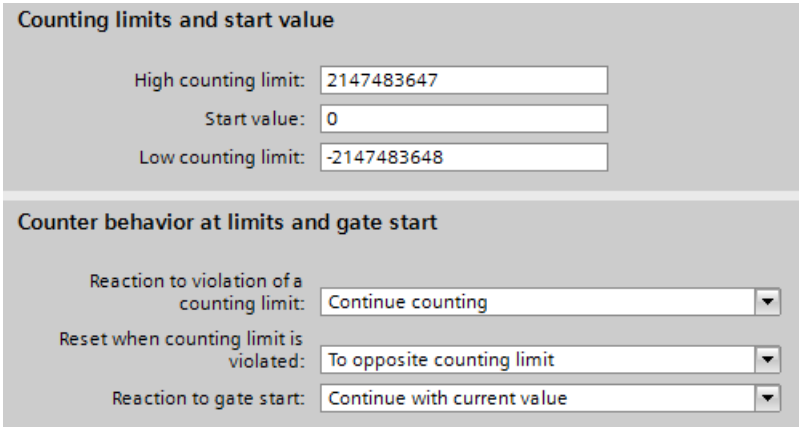
Parameters of the technology module

In addition to setting parameters using the data record 128 during operation the parameters can also be set in the hardware configuration (HWCN). The following table describes the procedure for the extended parameters. The settings apply to the scenario "Bake cupcakes".

Table 5-8

No.	Description
1.	In HWCN right-click on the TM. In the context menu, select “Parameters”. 
2.	As in the properties of the module, the parameters are identical for the channel 0 and the channel 1, respectively.

No.	Description
3.	Like in properties, the operating mode can be set for the channel at "Operating mode".  The operating mode of the channel (counting / positioning or measuring) is set directly below. 
4.	Depending on the parameter setting, the settings for the counter inputs and the digital inputs and outputs adapt.
5.	At "Counter inputs" the type of measured value encoder is specified. 
6.	With "Measured value" you can determine what is to be measured (speed, frequency, period duration) and you can scale the measured value. 

No.	Description
7.	The digital inputs have identical parameters. The following settings are available: • Digital input without function. • Gate start / stop (level-controlled). • Gate start (edge-controlled). • Gate stop (edge-controlled). • Synchronization. • Capture. In the scenario "Bake cupcakes" the digital inputs DI0 and DI1 are used to open and close the hardware gate. **Note** Only one digital input can be parameterized, for instance, as a gate start, as a rule. 
8.	The two digital outputs have identical parameters. The setting of the output can be determined by the following events: • For measured value >= comparison value 0 • For measured value <= comparison value 0 • use by user program 
9.	The counter will continue counting even if the technology module has been set to measuring. You can set the parameters of the counter further accordingly: 

5.3.2 The parameter data record 129

Definition

The parameter data record 128 provides the user with the option to re-parameterize the technology module while the project is executed. The parameters are transmitted with the instruction WRREC and the data record 128 for this purpose.

Documentation

The documentation of the technology module "TM Count 2x24V" \4\ describes the structure of the data record in the Annex B. For a description how to read and write the data record (RDREC and WRREC) refer to the online help of the TIA Portal. A brief instruction is given in the following section.

Typical use

The following steps should be executed to set parameters and change their settings during the operation (Table 5-9):

- Reading and storing the current parameters with RDREC. It is advisable to read out a parameter record at least once in order to have a consistent parameter record available.
- Adapting the parameters you want to change. For an explanation of the parameters refer to Annex B of the documentation \4\.
- Writing the parameters with WRREC to the counter module TM Count 2x24V.

Table 5-9

No.	Description
1.	Create a data block out of the PLC data type "DataRecord128" provided in the CPU "Bake_Cupcake" in the project "TM_Count". **DataRec128_DB** Name / Data type / Offset Static Header — "Header" — 0.0 CounterChannel0 — "CounterChannel" — 4.0 CounterChannel1 — "CounterChannel" — 52.0
2.	Read out the current parameters of the technology module with RDREC to enter valid parameters to the DB. Save the data to the data block which was created at (1). The following input parameters must be assigned: • REQ: As long as REQ=1, RDREC tries to read out the data from the technology module. • ID: ID = hardware identifier (For the parameter refer to the variable table, please, or to the properties of the counter module in the HWCN. Value in the sample project: 16#102). • INDEX: Number of the data record (128). • MLEN: Maximum length of the data record (100). • RECORD: Pointer to the data block created at (1).
3.	Adapt the desired parameters to your requirements. Example: Positive edge at DI0 starts hardware gate `"DataRec128_DB".CounterChannel0.behavDI0 := 16#21;` For an explanation of the parameters refer to Annex B of the documentation \4\.

No.	Description
4.	Write back the processed parameters with WRREC to the technology module. The output "DONE" indicates when the parameter setting has been completed successfully. • REQ: As long as REQ=1, WRREC tries to write the data to the technology module. • ID: ID = hardware identifier (For the parameter refer to the variable table, please, or to the properties of the counter module in the HWCN. Value in the sample project: 16#102). • INDEX: Number of the data record (128). • LEN: Maximum length of the data record; use the value which was indicated at the output RDREC. • RECORD: Pointer to the data block created in (1).

5.4 Programming: The control and feedback interface

Control interface

The control interface is used by the user program to influence the behavior of the technology module.

For a detailed description of the control interface refer to Chapter 4.5 of the manual \5\.

Feedback interface

The feedback interface provides the user program with current values and status information of the technology module.

For a detailed description of the feedback interface refer to Chapter 4.5 of the manual \5\.

6 Installation

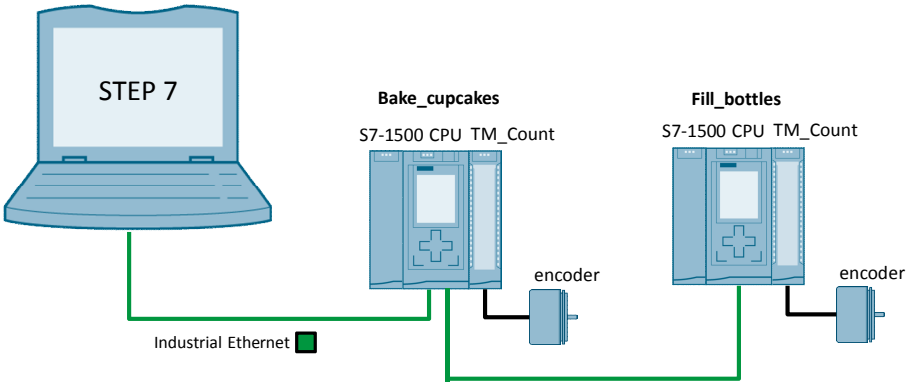
This chapter describes how the enclosed TIA Portal project "76798774_TM_Count" is commissioned.

6.1 Hardware installation

Note In order to be able to toggle between both scenarios in the visualization, you need two CPUs so that the layout with two CPUs is described.

The figure below illustrates the hardware structure of this application.

Figure 6-1



Note Always follow the installation guidelines for SIMATIC S7 systems (see also \9\ and \10\).

The CPUs are named CPU "Bake_cupcakes" and "CPU Fill_bottles".

Table 6-1

No.	Action
1.	Attach the S7 CPU "Fill_bottles" and the CPU "Bake_cupcakes" together with the two "TM Count 2x24V" and a power supply on a DIN rail.
2.	Connect the CPU "Bake_cupcakes" via PROFINET from port X1 P1R with the CPU "Fill_bottles" port X1 P1R. Use another PROFINET cable to connect the port X1 P2R of the CPU "Bake_cupcakes" with the field PG.
3.	Connect the power supplies of the S7 CPUs and the two "TM Count 2x24V" with the power supply.
4.	Connect the power supply to the respective mains.

No.	Action
5.	Set the IP address of the X1 port of the CPUs via the display to the IP addresses used in the example • CPU "Bake_cupcakes": 192.168.0.1 • CPU "Fill_bottles": 192.168.0.2 The IP address can be set under "Settings > Addresses >X1 (IE/PN)" in the display. **Note** For loading to the CPU, the engineering station must be installed in the same subnet.
6.	Connect the incremental encoders with the inputs A, B, N, +24VDC and M of the channel 0 of the "TM Count 2x24V".
7.	At TM Count 2x24 of the CPU "Fill_bottles" connect the inputs 0 and 1 of the channel 0 with the respective hardware (switch, photo sensor, etc.).

Note Using a field PG as engineering station and PC station at the same time is described here.

Alternatively, using a rack PC for visualization is also possible, for instance.

6.2 Software installation

This chapter describes the steps for the installation of the used programs.

Table 6-2 Installation of software components

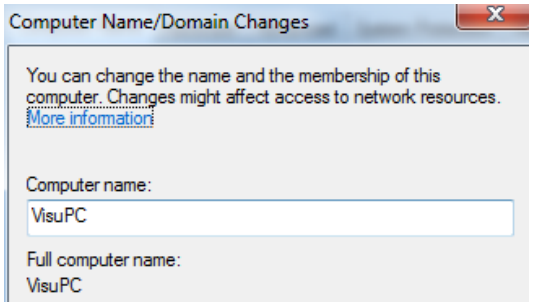
No.	Action	Remarks
1.	Install STEP 7 Professional V12.0 SP1	Note the instructions in the system manual: \3\
2.	Install WinCC Professional V12 SP1	Note the instructions in the system manual: \11\
3.	Load the sample project "76798774_TM_Count_CODE_v1_0.zip" from the Siemens Online Support site.	This entry is accessed via the following link: http://support.automation.siemens.com/WW/view/en/76798774

6.3 Configuring the hardware

Renaming the engineering station

Table 6-3 Renaming the engineering station

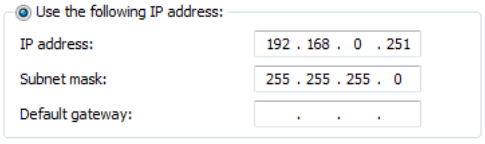
No.	Action	Remarks
1.	To load the WinCC Runtime to your engineering station, the engineering station must have the PC name which is used in the project.	Alternatively, you can adapt the name of the PC station in the project to your engineering station.
2.	Go to the context menu of "Computer" and click on "Properties". In the following window click below "Computer name, domain and workgroup settings" on "Change settings".	

No.	Action	Remarks
3.	In the window "System properties" select "Change" and enter the new computer name "VisuPC" in the respective field then.	
4.	Confirm and restart your engineering station to apply the computer name.	

Setting the IP address of the engineering station

If you use the engineering station also as PC station for visualization, you have to assign the specified IP address in the project to the engineering station:

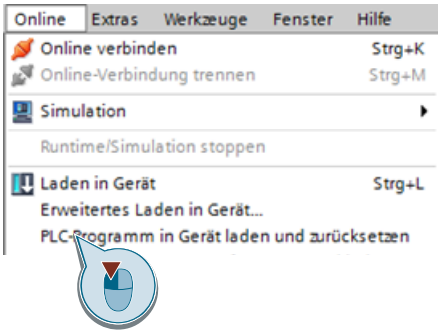
Table 6-4 Assigning the IP address

No.	Action	Remarks
1.	Open the "Network and Sharing Center"	
2.	Click on "Change Adapter Settings" and in the context menu of your Ethernet adapter select "Properties"	
3.	Select "Internet Protocol Version 4" and change the IP address as follows: IP address: 192.168.0.251 Subnet mask: 255.255.255.0	
4.	Confirm the change by clicking on OK. Your engineering station has the same IP address now which has also been assigned in the project "76798774_TM_Count".	
5.	In addition, set your PG/PC interface ("Control Panel>Set PG/PC interface") to TCP/IP and the network adapter which you are using.	

Opening and loading the TIA Portal project

Table 6-5

No.	Action	Remarks
1.	Download the file "76798774_TM_Count_CODE_v1_0.zip" to your engineering station and unzip the folder.	
2.	In the program folder double-click on the icon "76798774_TM_Count.ap12". The project opens in TIA V12 now.	

No.	Action	Remarks
3.	Click on the CPU "Fill_bottles" and download the user program to the CPU via "Online > Download and reset PLC program".	
4.	Repeat step 3 with the CPU "Bake_cupcakes".	
5.	Click on the PC station "VisuPC" and for a graphical representation of the scenarios start the WinCC Runtime with the respective icon.	
6.	You can monitor the individual variables and the state of the scenario now.	For a description of the WinCC surface refer to Chapter 7.2.

7 Operation of the Application

7.1 Overview

For a better overview of the behavior of the implemented scenarios the user has several options:

- Insight into the current state of the scenarios via the HMI system WinCC Runtime Advanced.
- More detailed insight into further optional variables via the configurable watch tables which have already been prepared in the CPU.

7.2 Operation via the WinCC Runtime

A WinCC Runtime system is running in the PC station "VisuPC" whose start screen allows selecting the two scenarios. If you realize the configuration with only one CPU, you have to download the other configuration to the CPU for switching over.

7.2.1 Scenario "Fill bottles"

Overview

Figure 7-1

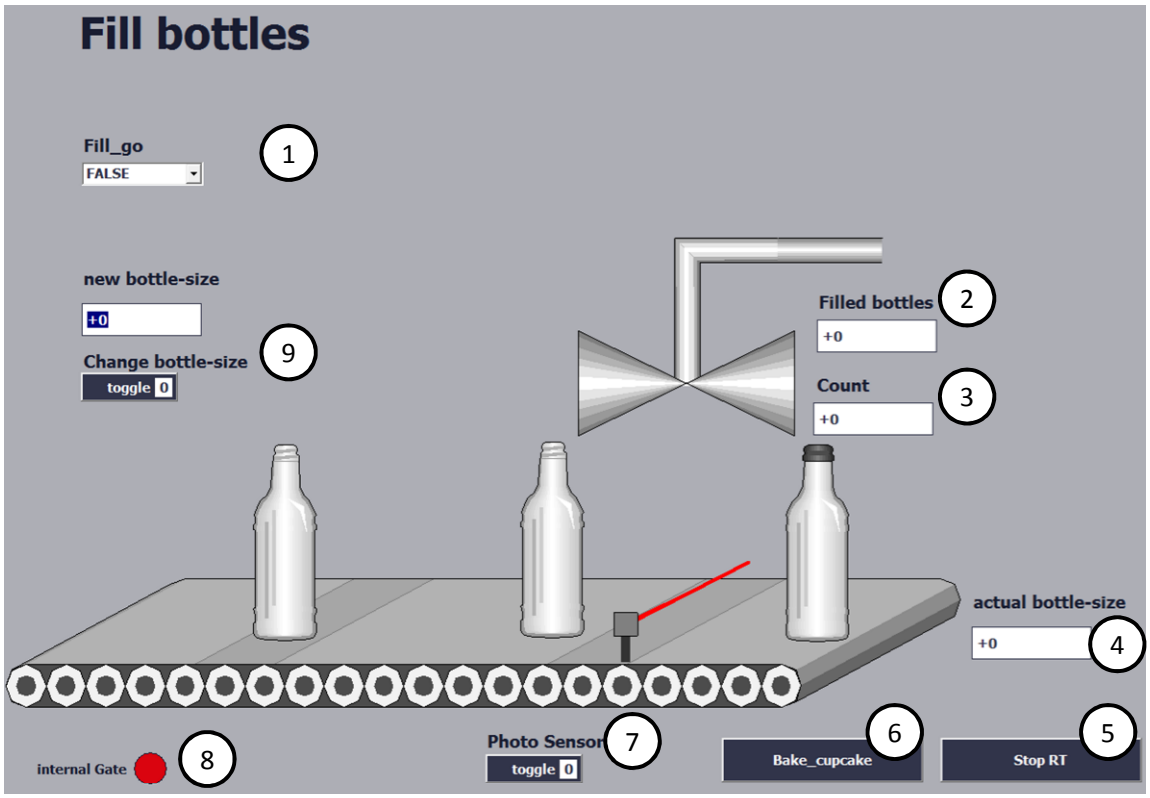


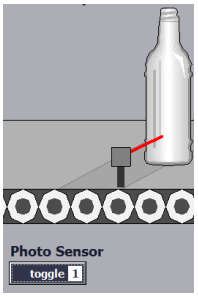
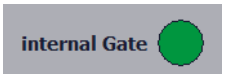
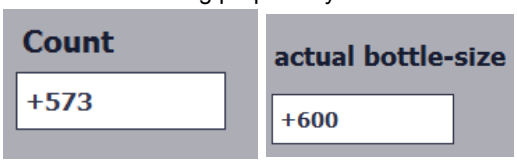
Table 7-1

Position	Remarks
1	The dropdown menu influences the variable Fill_go for triggering the initialization at a positive edge.
2	Indicates how many bottles have been filled since the last initialization.
3	Indicates the count value of the bottle which has to be filled now.
4	Indicates the current filling quantity of a bottle.
5	A click on the button will stop the WinCC Runtime.
6	A click on the button will change over to the screen "Bake_cupcakes".
7	The dropdown menu is used to specify "TRUE" or "FALSE" for the virtual photo sensor.
8	State of the internal gate.
9	The I/O field "new bottle-size" is used to specify a new value for the filling quantity of a bottle. The value of the filling quantity is applied by a positive edge which is created with the dropdown menu.

Process

The following table describes the process of the start of the virtual bottling plant, the filling of the first bottles and a change of filling quantity.

Table 7-2

No.	Remarks
1.	After the installation as described in Chapter 6 start the WinCC Runtime and select the button "Fill_bottles". Now you see the picture shown in Figure 7-1
2.	Create a positive edge at "Fill_go" to start the bottling by setting the dropdown menu to "TRUE". 
3.	Simulate a bottle at the photo sensor by selecting the option "TRUE" in the dropdown menu.  The internal gate is enabled now: 
4.	Through movement at the incremental encoder you see at "Count" now how the "bottle is filled". For checking purposes you see the current filling quantity of a bottle at the right bottom.  Note: When the bottle is full, a close signal is output at the digital output. The counter is not

No.	Remarks
	stopped. It is assumed that the traversing time of the valve will also cause a "surplus" on the next bottle and that therefore all bottles will be filled with exactly the same quantity.
5.	If you want to change the filling quantity of the bottle enter the new quantity in the input field. Confirm with Return.  Create a positive edge at "Change bottle-size" then (you can still check the current filling quantity of a bottle at the right lower field "actual bottle-size"). 
6.	In order to open the internal gate of the TM Count again and to count the signals of the incremental encoder again, the initialization has to be repeated with a positive edge at Fill_go.

7.2.2 Scenario "Bake cupcakes"

Overview

Figure 7-2

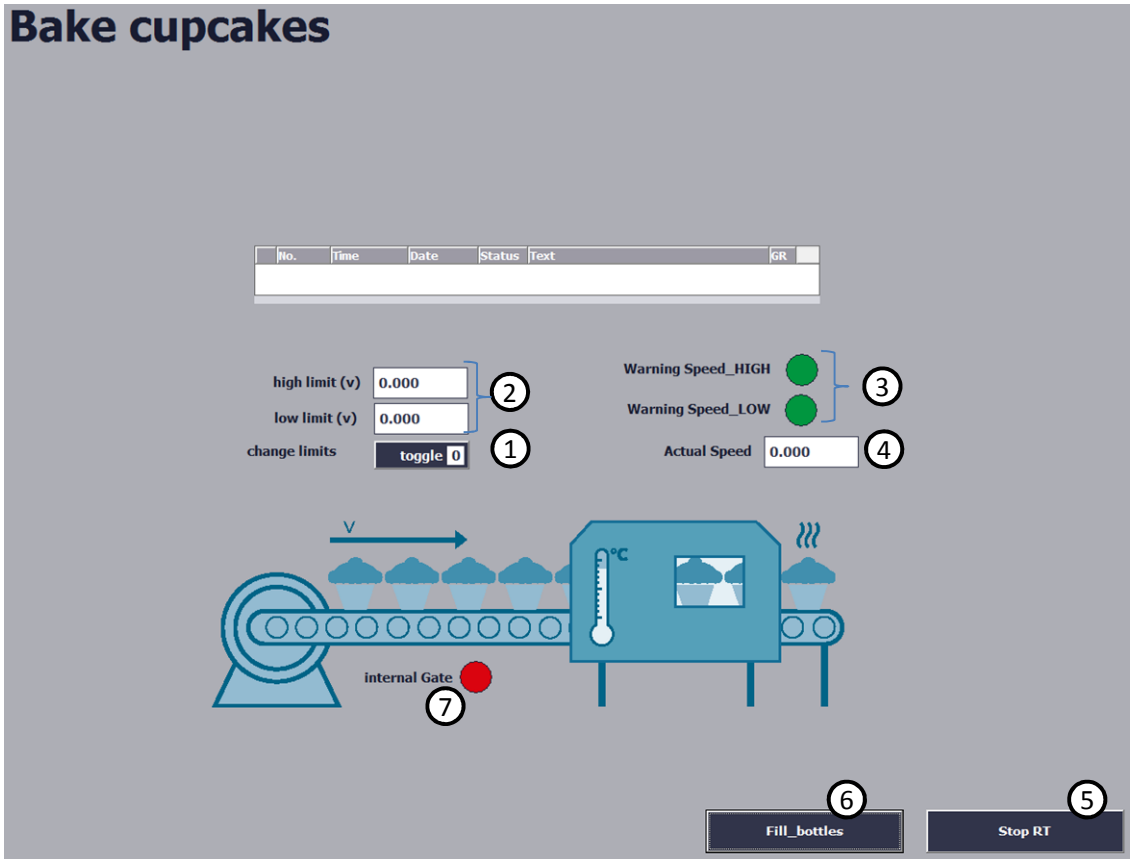


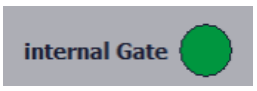
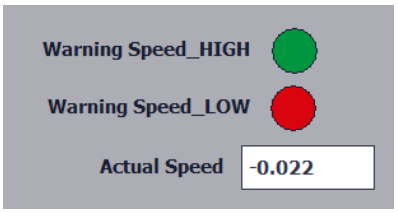
Table 7-3

Position	Remarks
1	A positive edge which has been created with the dropdown menu adopts the new monitored speed limits.
2	New upper and lower limits can be input in the input fields and confirmed with Return. These limits will be adopted by the positive edge at (1).
3	The warning outputs of the function block are displayed with colored signals. "Red" means that the speed was too high or too low.
4	Indicates the current speed of the conveyor belt.
5	A click on the button will stop the WinCC Runtime.
6	A click on the button will change over to the screen "Bake_cupcakes".
7	The state of the internal gate is shown. "Green" indicates that the measurement started.

Process

The following table describes the process for starting the speed monitoring and changing the checked limits.

Table 7-4

No.	Remarks
1.	After the CPU has been commissioned and WinCC Runtime has started, the internal gate of the "TM Count 2x24V" is closed, i.e. no measurement is carried out.  The software gate is kept open in the FB, i.e. only the hardware gate has to be opened. This is done by a positive edge at the digital input 0 (DI0).
2.	With the opening of the internal gate the measurement and, thus, the speed monitoring are started.  When the upper limit is exceeded, the digital output 0 is set and the Boolean variable "WARNING_SPEED_HIGH" is set at the FB.  When the lower limit is exceeded, the digital output 1 is also set and the Boolean variable "WARNING_SPEED_LOW" is set at the FB.  If the speed returns to the monitored range, the warnings will be reset (see Figure 4-3)
3.	If you want to change the warning limits, you have to enter the desired limits at the I/O field "high limit" and "low limit". After that create a positive edge at "change limits" with the dropdown menu. 

7.3 Monitoring and controlling via the watch tables

Overview

You can analyze the S7 program of the CPU via the online access on the CPU and via the monitoring of blocks.

Watch tables

For support every CPU is already provided with a watch table which contains important parameters of the individual blocks of the individual scenarios. You access the watch tables via "76798774_TM_Count > Interface/Tech_Object > Watch and force tables":

- Fill_bottles
- Bake_cupcakes

Function

You can monitor and control any variables during operation with the help of the watch table.

Figure 7-3 Watch table "Fill_bottles"

Name	Adresse	Kommentar
"Param".Fill_bottles.FILL_GO		positive edge starts the program
"Param".Fill_bottles.PHOTO_SENSOR		photo sensor = TRUE: bottle in position
"Param".Fill_bottles.CHANGE_BOTTLE		positive edge at CHANGE_BOTTLE adopts t..
"Param".Fill_bottles.BOTTLE_SIZE		new bottle size
"Param".Fill_bottles.RESET		positive edge resets the programm
"Param".Fill_bottles.NDR		bottle filled
"Param".Fill_bottles.BUSY		busy flag
"Param".Fill_bottles.ERROR		error flag
"Param".Fill_bottles.STATUS		status
"Fill_bottles_DB".control.firststart		flag for activating main programm
"Fill_bottles_DB".control.change_done		flag which shows that the bottle change is.
"Fill_bottles_DB".Number_bottles		counts number of filled bottles after last r...
"COUNTVALUE"	%ID0	feedback interface: count value
"STS_GATE"	%I14.2	feedback interface: state of intern gate

Figure 7-4 Watch table "Bake_cupcakes"

Name	Adresse	Kommentar
"Conv_v_monitor_DB".control.postread	%DB1.DBX22.1	parameter read? (RDREC)
"Conv_v_monitor_DB".control.postini	%DB1.DBX22.0	initialisation ready? (RDREC and WRREC)
"Conv_v_monitor_DB".RESET	%DB1.DBX8.1	new upper limit
"Param".conveyer_speed_monitor.speed_high		new upper limit
"Param".conveyer_speed_monitor.speed_low		new lower limit
"Param".conveyer_speed_monitor.speed_adoption		adoption new limits
"Param".conveyer_speed_monitor.warning_speed_h		ACT_SPEED > actual upper limit
"Param".conveyer_speed_monitor.warning_speed_l		ACT_SPEED < actual lower limit
"Param".conveyer_speed_monitor.act_speed		actual speed
"Param".conveyer_speed_monitor.error		error
"Param".conveyer_speed_monitor.error_ID		status
"COUNTVALUE"	%ID0	feedback interface: count value
"STS_GATE"	%I14.2	feedback interface: state of intern gate
"MEASUREDVALUE"	%ID8	feedback interface: measured value

8 References

Table 8-1

	Subject	Title
\1\	Siemens Industry Online Support	http://support.automation.siemens.com
\2\	Download page of the entry	http://support.automation.siemens.com/WW/view/en/76798774
\3\	STEP 7 Professional V12.0 SP1 System manual	http://support.automation.siemens.com/WW/view/en/77991795
\4\	S7-1500/ET 200MP Technology module TM Count 2x24V Device manual	http://support.automation.siemens.com/WW/view/en/59193105
\5\	SIMATIC S7-1500, ET 200MP, ET 200SP Counting, measurement and position detection	http://support.automation.siemens.com/WW/view/en/59709820
\6\	Technical data TM Count 2x24V	http://support.automation.siemens.com/WW/view/en/66470651/td
\7\	Technical Data Incremental Encoder	http://support.automation.siemens.com/WW/view/en/28260768/td
\8\	Incremental encoders with TTL, HTL, 1 Vpp Description	http://support.automation.siemens.com/WW/view/en/57249405
\9\	SIMATIC Installing the assembly Getting Started	http://www.automation.siemens.com/salesmaterial-as/interactive-manuals/getting-started_simatic-s7-1500/documents/EN/mount_en.pdf
\10\	SIMATIC Wiring Getting Started	http://www.automation.siemens.com/salesmaterial-as/interactive-manuals/getting-started_simatic-s7-1500/documents/EN/wire_en.pdf
\11\	WinCC Professional V12 SP1 System manual	http://support.automation.siemens.com/WW/view/en/78327231

9 History

Table 9-1

Version	Date	Modifications
V1.0	09/13	First version