

# Learn-/Training Document

Siemens Automation Cooperates with Education (SCE) | From Version V14 SP1

**TIA Portal Module 031-300** IEC Timers and IEC Counters Multi-instances for SIMATIC S7-1200

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- SIMATIC S7-1200 DC/DC/DC (set of 6) "TIA Portal" Order no.: 6ES7214-1AE30-4AB3
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# Table of contents

1	Goa	al	4
2	Pre	erequisite	4
3	Red	quired hardware and software	5
4	The	eory	6
	4.1	Instances and multi-instances in SIMATIC S7-1200	6
	4.1	.1 Instance data blocks / Single instances	7
	4.1	.2 Multi-instances	8
5	Tas	sk	
6	Pla	nning	
	6.1	Automatic mode - Conveyor motor with time function	10
	6.2	Technology diagram	11
	6.3	Reference list	12
7	Stru	uctured step-by-step instructions	13
	7.1	Retrieve an existing project	13
	7.2	Addition of an IEC timer TP to function block FB1 "MOTOR_AUTO"	15
	7.3	Update the block call in the organization block	
	7.4	Save and compile the program	23
	7.5	Download the program	24
	7.6	Monitor program blocks	25
	7.7	Archive the project	27
	7.8	Checklist	
8	Exe	ercise	29
	8.1	Task – Exercise	29
	8.2	Technology diagram	29
	8.3	Reference list	
	8.4	Planning	
	8.5	Checklist – Exercise	
9	Ado	ditional information	

# IEC Timers and IEC Counters Multiinstances for SIMATIC S7-1200

# 1 Goal

In this chapter, you will become acquainted with the use of single instances and multi-instances for programming of SIMATIC S7-1200 with the TIA Portal programming tool.

The module explains the various types of instance data blocks and shows step-by-step how to add IEC timers and IEC counters to a program block.

The SIMATIC S7 controllers listed in Chapter 3 can be used.

# 2 Prerequisite

This chapter builds on the FB programming for SIMATIC S7 CPU1214C. For this chapter, you can use the following project, for example:

031-200\_FB-Programming\_S7-1200....zap14

# 3 Required hardware and software

- 1 Engineering station: requirements include hardware and operating system (for additional information, see Readme on the TIA Portal Installation DVDs)
- 2 SIMATIC STEP 7 Basic software in TIA Portal as of V14 SP1
- 3 SIMATIC S7-1200 controller, e.g. CPU 1214C DC/DC/DC with ANALOG OUTPUT SB1232 signal board, 1 AO Firmware as of V4.2.1

Note: The digital inputs should be fed out to a control panel.

4 Ethernet connection between engineering station and controller



# 4 Theory

### 4.1 Instances and multi-instances in SIMATIC S7-1200

The call of a function block is referred to as an **instance**. An **instance** is assigned to every call of a function block and serves as a data memory. It stores the actual parameters and the static data of the function block.

The tags declared in the function block determine the structure of the instance data block.

#### Use of single instances and multi-instances

You can assign instances as follows:

#### Call as a single instance:

- A separate instance data block for each instance of a function block

#### Call as a multi-instance:

- One instance data block for several instances of one or more function blocks

#### 4.1.1 Instance data blocks / Single instances

The call of a function block that is assigned its own instance data block is called a **single instance**.

If the function block was created according to the rules for library-compatible standard blocks, it can also be called multiple times.

However, you must assign another instance data block for each call as a single instance.

#### Example of single instances:

The following figure shows the control of two motors using one function block FB10 and two different data blocks:

The different data for the individual motors, such as speed, acceleration time and total operating time, are saved in the instance data blocks DB10 and DB11.



**Note:** Some commands, such as timers and counters, behave like function blocks. When these are called, they also require an assigned memory area, e.g., in the form of an instance data block.

#### 4.1.2 Multi-instances

You may want to limit the number of data blocks used for instances or this may be necessary due to lack of memory in the utilized CPU.

If other function blocks, timers, counters, etc. that already exist are to be called in a function block in your user program, you can call these other function blocks without separate (i.e. additional) instance DBs.

Simply select 'Multi-instance' for the call options:

Call options	×
Single instance	Multiple instance Name in the interface EC_Timer_overrun  The called function block saves its data in the instance data block of the calling function block and not in its own instance data block. This allows you to concentrate the instance data in a single block and to get by with fewer instance data blocks in your program.
	OK Cancel

**Notes:** Multi-instances enable a called function block to store its data in the instance data block of the calling function block.

In this case, the calling block must always be a function block.

This allows you to concentrate the instance data in one instance data block and thus make better use of the number of DBs available.

Incidentally, this is always required when the calling block is to remain available for reuse as a standard block.

#### Example of multi-instances:

The following figure shows two calls of an IEC timer of type TP (pulse) within a function block.

The different data for the two counters is stored as different **multi-instances** in the instance data block DB1 of the calling function block FB1.



# 5 Task

In this chapter, an IEC timer will be added to the function block from chapter "SCE\_EN\_031-200 FB Programming S7-1200".

# 6 Planning

The IEC timer is programmed as an addition to the MOTOR\_AUTO [FB1] function block from the "031-200\_FB-Programming\_S7-1200.zap13" project. This project must be retrieved in order to now add the IEC timer TP (latching pulse). A multi-instance will be created as a memory for the timer.

### 6.1 Automatic mode - Conveyor motor with time function

The Memory\_automatic\_start\_stop is latched with Start but only if the reset conditions are not present.

The Memory\_automatic\_start\_stop is reset if Stop is present or safety shutoff is active or automatic mode is not activated (manual mode).

The Conveyor\_motor\_automatic\_mode output is activated when Memory\_automatic\_start\_stop is set, the enable conditions are met and Memory\_conveyor\_start\_stop is set.

To save energy, the conveyor should only run when a part is present.

For this reason, the Memory\_conveyor\_start\_stop is set when Sensor\_chute\_occupied signals a part and reset when Sensor\_end\_of\_conveyor produces a negative edge or safety shutoff is active or automatic mode is not activated (manual mode).

#### Addition of time function:

Because the Sensor\_end\_of\_conveyor is not able to be mounted directly at the end of the conveyor, the Sensor\_end\_of\_conveyor signal must be stretched.

To achieve this, a latching pulse will be inserted between Sensor\_end\_of\_conveyor and the negative edge detection.

### 6.2 Technology diagram

Here, you see the technology diagram for the task.



Figure 1: Technology diagram

Schalter der Sortieranlage Switches of sorting station	Automatikbetrieb Automatic mode	Handbetrieb / Manual mode -S3 Tippbetrieb -M1 vorwärts/ Manual -M1 forwards
-Q0 Hauptschalter/Main switch -P4 aktiviert/active -P4 aktiviert/active	-S1 Start/start	-S4 Tippbetrieb -M1 rückwärts/ Manual -M1 backwards -S6 Zylinder -M4 ausfahren/ cylinder -M4 extend -S5 Zylinder -M4 einfahren/ cylinder -M4 retract

Figure 2: Control panel

### 6.3 Reference list

DI	Туре	Identifier	Function	NC/NO
1 0.0	BOOL	-A1	Return signal emergency stop ok	NC
I 0.1	BOOL	-K0	Main switch "ON"	NO
I 0.2	BOOL	-S0	Mode selector manual (0)/ automatic (1)	Manual = 0 Auto = 1
1 0.3	BOOL	-S1	Pushbutton automatic start	NO
I 0.4	BOOL	-S2	Pushbutton automatic stop	NC
I 0.5	BOOL	-B1	Sensor cylinder M4 retracted	NO
l 1.0	BOOL	-B4	Sensor at chute occupied	NO
l 1.3	BOOL	-B7	Sensor part at end of conveyor	NO

The following signals are needed as global operands for this task.

DO	Туре	Identifier	Function	
Q 0.0	BOOL	-Q1	Conveyor motor M1 forwards fixed speed	

#### Legend for reference list

DI	Digital Input	DO	Digital Output
AI	Analog Input	AO	Analog Output

Q

Output

- l Input
- NC Normally Closed
- NO Normally Open

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# 7 Structured step-by-step instructions

You can find instructions on how to carry out planning below. If you already have a good understanding of everything, it will be sufficient to focus on the numbered steps. Otherwise, simply follow the detailed steps in the instructions.

### 7.1 Retrieve an existing project

Before we can expand the "MOTOR\_AUTO [FB1]" function block, we must retrieve the "031-200\_FB-Programming\_S7-1200.zap14" project from chapter "SCE\_EN\_031-200 FB Programming S7-1200". To retrieve an existing project that has been archived, you must select the relevant archive with 
Project 
Retrieve in the project view. Confirm your selection with Open (
Project 
Retrieve 
Select a .zap archive 
031-200\_FB-Programming\_S7-1200.zap14 
Open).



® The next step is to select the target directory where the retrieved project will be stored. Confirm your selection with "OK". Save the opened project under the name 031-300\_IEC\_Timers\_Counters
 (
 Project 
 ß Save as ... 
 ß 031-300\_IEC\_Timers\_Counters 
 ß Save)



### 7.2 Addition of an IEC timer TP to function block FB1 "MOTOR\_AUTO"

® First, open the "MOTOR\_AUTO [FB1]" function block with a double-click.



Insert another network at the beginning of the "MOTOR\_AUTO [FB1]" function block by selecting the 
 "block title" and clicking the 
 icon for "Insert network".



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® Add helpful information to the block comment and the network title of "Network 1:".



- ® On the right side of your programming window, you will see the timer functions in the list of instructions. Under ® Basic instructions ® Timer operations, find function **TP** (Generate pulse) and use a drag & drop operation to move it to Network 1 (green line appears, mouse pointer with + symbol).
  - (
     R Instructions 
     R Basic instructions 
     R Timer operations 
     R 
     <sup>■</sup>
     TP )

_						_					
										Options	
Å R	K 🖻 🖹 🐛 🖿 🚍 🚍	🖻 📲 ± 📲 ± 📲 ±	😑 😰 🍋 🕻	, 🖑 🖓 🤣	<b>¢</b> ≡ <sup>1</sup> ≡ <sup>3</sup> ≡	6 6	e 🚏 🔒	i 🗄		· lini	
M	DTOR_AUTO									> Favorites	
	Name	Data type	Default value	Retain	Accessible f	Writa	Visible in	Setp		✓ Basic instructions	
-00	▼ Input								^	Name	Dercr
-00	Automatic_mode_act	Bool	false	Non-ret						Ceneral	Desci
-0	Start	Bool	false	Non-retain					=	Bit logic operations	
-0	Stop	Bool	false	Non-retain						Imer operations	
-0	Enable_OK	Bool	false	Non-retain							Gener
-00	Safety_shutoff_active	Bool	false	Non-retain						TON	Gener
-00	Sensor_slide	Bool	false	Non-retain							Gener
-00	Sensor_end_of_conve	Bool	false	Non-retain							Time
-0	<ul> <li>Output</li> </ul>										Start
0 🕣	Conveyor_motor_aut	Bool	false	Non-retain					~	I -ITONI-	Start
<			111					>		I -ITOFI-	Start
_									-	I -[TONR]-	Time
8	>=1 📅 🚽 –ol 🛏	-[=]								III -[RT]-	Reset
Pla	ak titlet. Motor control in sute	matic mode							~	IPTI-	Load
Con	ever motor in automatic mode								-	the second	
com	eyor motor in automatic mode.								_	Comparator operations	
	Network 1: Overrun time en	d of conveyor pulse 2 s	econds						=	Thath functions	
									-	Move operations	
(	omment									Conversion operations	
-							-			Program control operati	
										Word logic operations	
										Shift and rotate	

® The timer function requires a memory. This memory is provided in this case within the instance data block of the function block without creating a new instance data block. Select the ® "Multi-instance" option for this. Enter a name for the multi-instance and confirm with ® "OK". (® Multi-instance ® IEC\_Timer\_overrun ® OK)

an options	Multiple instance		
Single instance	Name in the interface If you call the function bloc data in the instance data not in its own instance da concentrate the instance with fewer instance data b	EC_Timer_overrun k as a multi-instance, it save block of the calling function b ta block. This allows you to data in a single block and to locks in your program.	es its block and get by
Parameter instance	more	ок	ancel

 R As a result, a tag structure of "Static" type suitable for TP Timer will be created in the interface description.

								lan b-lana
NOTOR_AUTO	Detectors	Defectorelise	Details	Assessible 6	101-10-	A COLORED TO	Constant	
Name	Data type	Default value	Retain	Accessible f	writa	visible in	Setpoint	Comment
Memory automatic start sto	n Bool	false	Non-retain					Memory used for start/ stop automatic
Memory conveyor start stor	Bool	false	Non-retain				Ä	Memory used for start/stop of convey
Memory edge detection	Bool	false	Non-retain					Memory used for edge detection
IEC Timer overrun	TP TIME		Non-retain					
• PT	Time	T#Oms	Non-retain					
• ET	Time	T#Oms	Non-retain		Ä			
🔟 = IN	Bool	false	Non-retain					
0 • Q	Bool	false	Non-retain	Image: A start and a start				
🔟 🔻 Temp								
<							1	
T []								
>=1 [??] → -0  → -[=]								
>=1 (??)ol(=)	mode							
>=1 [??] → -ol → -[=] lock title: Motor control in automati	: mode							
>=1 1 127 → -ol → -[=] lock title: Motor control in automati nveyor motor in automatic mode:	: mode							
>=1 (22)	: mode onveyor pulse 2	seconds						
>=1 1 → + -01 → +=] lock title: Motor control in automati nveyor motor in automatic mode: Network 1: Overrun time end of co Comment	: mode onveyor pulse 2	2 seconds						

**Note:** A multi-instance can only be used for programming within a function block because static tags are only available there.

N 2 2 4 - E E E 2 2 3	z - 24 z - 28 z		43 (m 45		1 <b>e</b> 1 <b>i</b>	i ≡ '≡	NI 41 CH	un 🕞 Wa
MOTOR_AUTO	1							
Name	Data type	Default value	Retain	Accessible f	Writa	Visible in	. Setpoint	Comment
Input								
Automatic_mode_active	Bool	false	Non-retain					Automatic mode activated
Start	Bool	false	Non-retain					Pushbutton automatic start
Stop	Bool	talse	Non-retain					Pushbutton automatic stop
Enable_OK	Bool	talse	Non-retain					All enable conditions OK
Safety_shutoff_active	Bool	false	Non-retain		-			Safety shutoff active e.g. emergency s
Sensor_slide	Bool	false	Non-retain					Sensor part at slide
Sensor_end_of_conveyor	Bool	false	Non-ret					Sensor part at end of conveyor
□ ▼ Output								
Conveyor_motor_automatic	Bool	false	Non-retain					Control of the conveyor motor in auto
<								
			•					
>=1 1 → -01 → -1=] lock title: Motor control in automatic n nveyor motor in automatic mode: Network 1: Overrun time end of cor Comment	mode nveyor pulse 2	seconds						

® Enter the required pulse duration of 2 seconds in front of parameter "PT" (® 2s ).



 The entry of 2s is converted automatically to the IEC-Time format suitable for the IEC timer and is shown as constant "T#2s".



® Now move output "Q" from tag structure "IEC\_Timer\_overrun" onto input "CLK" of negative edge "N\_TRIG" in Network 2. This will replace the #Sensor\_end\_of\_conveyor input tag previously entered there and the conveyor will be stopped by a negative edge of the IEC\_Timer\_overrun pulse.

(
 Network 2 
 IEC\_Timer\_overrun
 Q 
 #Sensor\_end\_of\_conveyor)



Bo not forget to click Save project regularly. The finished function block "MOTOR\_AUTO"
 [FB1] with the timer is shown in FBD below.



® Under "General" in the properties of the block, you can change the "Language" to LAD (Ladder Logic) (® Properties ® General ® Language: LAD)

	S P	roperties	L Info	<ol> <li>Diagnostics</li> </ol>	
definitions					
General					
	Name: Type:	MOTOR_AUTO			
	Language: Number:	FBD LAD FBD Manual			-
	definitions General	definitions General Name: Type: Language: Number:	General General Name: MOTOR_AUTO Type: FB Language: FBD Number: FAD Manual Automatic	General Name: MOTOR_AUTO Type: FB Language: FBD Number: LAD FBD Manual Automatic	General       Mame:     MOTOR_AUTO       Type:     FB       Language:     FBD       Number:     LAD       Monul     Automatic

® This is what networks 1 and 2 look like in LAD.

031-300_IEC_Ti	mers_Counters   CPU_1214C [CPU	1214C DC/DC/DC] > Progra	am blocks 🔸 MOT	OR_AUTO [FB1]	_ # = ×
<mark>⊮⊈ 121</mark> 121	•, ⊨ Ξ ≡ 🗩 뮏 ± ≌ ± (	= 😥 🥙 💊 🖑 🗣 😵	<b>⊊</b> <sup>1</sup> ≡ <sup>3</sup> ≡ <b>€ €</b>	0 00 Ba	3
		Block inte	rface		
	#IEC_Timer_				^
#Sensor en	d TP				
of_conveyo	or Time		5410		
	T#2s - PT ET		-		
1					
<ul> <li>Network 2:</li> </ul>	Memory automatic_start_stop and conti	rol of the conveyor motor in autor	natic mode		
Comment					
		>=1	#Me	mory_	_
	#Safety shut	top —	auto	matic_ t_stop	=
	act	tive —		SR	
	#Automa mode act	tic_ tive —o 😵 —————	#Start — S	a&	
				*	
	N_TRIG				
wern					
	#Memory_edge_ detection				
		#M conve	emory_ yor_start_		#Conveyor_ motor
	#Safety_shutoff_		stop		automatic_
	#Automatic	#Sensor_slide — s	SR #	Enable_OK —	=
	mode_active 0 🗱	R1	Q	*	
<		III		> 100%	

### 7.3 Update the block call in the organization block

® Open the "Main [OB1]" organization block with a double-click.



In Network 1 of the "Main [OB1" organization block, instance data block "MOTOR\_AUTO\_DB1" for the "MOTOR\_AUTO [FB1]" function block appears incorrect, because the additional memory for the TP Timer has not yet been added there. Click the Image of the



### 7.4 Save and compile the program

Poject Edit Vew Insit Online Options Took Window Help       Constructions Program Backs Mini (DB)       Insite Mini Program Backs Mini (D	Ma Siemens - C:\Users\mde\Documents\Automa	ion\031-300_IEC_Timers_Counters\031-300_IEC_Timers_Counters		- 9
Compared a la l	Project Edit View Insert Online Options	Tools Window Help		Totally Integrated Automation
Project tree       Image: Counters > CPU_1214C [CPU 1214C [	📑 📴 🔒 Save project 🚇 🐰 🏥 📺 🗙 🍤	(객 ± 🐻 🔃 🌆 🖳 🌽 Go online 🖉 Go offline 🎄 🖪 📑 💉 🖃 🛄	Search in project>	PORTAL
Devices         Options           Image: I	Project tree	)0_IEC_Timers_Counters + CPU_1214C [CPU 1214C DC/DC/DC] + Progra	m blocks 🕨 Main [OB1] 🛛 🗖 🖬 🗙	Instructions 📑 🔳 🕨
Image: Second	Devices			Options
Image: Second				ML MT
Bola 300_JEC_Timers_Counters     Add new device     Add new d		Block interface		> Equaritar
Made new device       Maske instructions         Device a networks       Device a networks         Device a networks       Device networks         Device a networks       Device networks         Device proxy data       Device proxy data	▼ □ 031-300 IEC Timers Counters			7 ravontes
Comment  Co	Add new device	<ul> <li>Block title: "Main Program Sweep (Cycle)"</li> </ul>	<u>^</u>	✓ Basic instructions
<ul> <li></li></ul>	Devices & networks	Comment		Name Description
Comment Commen	▼ CPU 1214C [CPU 1214C DC/DC/DC]	Network 1: Control conveyor motor forwards in automatic mode		General
Comment       Solar         Comment       Solar         Solar       Solar <t< td=""><td>Device configuration</td><td>Command</td><td></td><td>Bit logic operations</td></t<>	Device configuration	Command		Bit logic operations
Program blocks <td>V. Online &amp; diagnostics</td> <td>Comment</td> <td></td> <td>Timer operations</td>	V. Online & diagnostics	Comment		Timer operations
Water       Solat         Water       Main [081]         Water       Water         Water       Water </td <td>Program blocks</td> <td></td> <td></td> <td>Counter operations</td>	Program blocks			Counter operations
*MoTOR_AUTO_[RB1] WoTOR_AUTO_[RB1] WoTOR_AUTO_[RB1] WoTOR_AUTO_[RB1] WoTOR_AUTO_REDB1] WoTOR_AUTO_REDB1] WoTOR_AUTO_REDB1] WoTOR_AUTO_REDB1] WoTOR_AUTO_REDB1] WoTOR_AUTO_REDB1] WoTOR_AUTO_REDB1] WoTOR_AUTO_CREDB1] Wetwork 2:	Add new block	%DB1		Comparator operations
MOTOR_AUTO [F81]     MOTOR_AUTO_D6 [D81]     MOTOR_AUTO_D6 [D81]     MOTOR_AUTO_D6 [D81]     MOTOR_AUTO_D6 [D81]     MOTOR_AUTO_D6 [D81]     MOTOR_AUTO_D6 [D81]     MOTOR_AUTO_B6 [D81]     MOTOR_AUTO_B6 [D81]     MOTOR_AUTO^*     MOTOR_AUTO*     MOTO*     MOTO*     MOTO*     MOTO*	Main [OB1]	"MOTOR_AU	/TO_	Math functions
MOTOR_AUTO_D8 [D81]         MOTOR_AUTO_D8 [D81]         MOTOR_AUTO_D8 [D81]         MOTOR_AUTO_D8 [D81]         MOTOR_AUTO_BALTO*         MOTOR_AUTO*         MOTO*         MOTOR	MOTOR AUTO [FB1]	9601		Move operations
<ul> <li>Technology objects</li> <li>Technology</li> <li>Technology</li> <li>Technology</li> <li>Technology</li> </ul>	MOTOR AUTO DB [DB1]	MOTOR AL	ITO"	Conversion operations
Image: State and source files       Image: State and source files         Image: State and source files       Image: State and source files         Image: State and source tables       Image: State and source files         Image: State and source tables       Image: State and source files         Image: State and source tables       Image: State and source files         Image: State and source tables       Image: State and source files         Image: State and source tables       Image: State and source files         Image: State and source tables       Image: State and source files         Image: State and source tables       Image: State and source files         Image: State and source tables       Image: State and source files         Image: State and source tables       Image: State and source files         Image: State and source tables       Image: State and source files         Image: State and source tables       Image: State and source files         Image: State and source files       Image: State and source files         Image: State and source files       Image: State and source files         Image: State and source files       Image: State and source files         Image: State and source files       Image: State and source files         Image: State and source files       Image: State and source files         Image: State and source files	Technology objects	in the second		Program control operati
* PLC tags       **0.2       **unantic_         * S0.2       **unantic_       **unantic_         * CL Cats types       **unantic_       **unantic_         * Outrine backups       **s1* - start       **unantic_         * So Taccs       **unantic_       *unantic_         * So Taccs       **unantic_       *unantic_         * So Taccs       **unantic_       *unantic_         * So Taccs       *unantic_       *unantic_         * So Taccs       *unantic_       *unantic_         * So Call modules       *unantic_       *unantic_         * So Contentation settings       *unantic_       *unantic_         * So Contractions       *unantic_       *unantic_       *unantic_         * So Card Readen/USB memory       * Network 2:	External source files	— EN		Word logic operations
Sub	PLC tags	40.2 Automatic_	=	Shift and rotate
* Watch and force tables     * 00.3       * Gonine backups     * 51' - Start       * Gonine backups     * 40' - 100'       * Gonine backups     * 51' - Start       * Wold     * 52' - 9 Stop       * Bit Coal modules     * 00.3       * Bit Coal modules     * 00.5       * Bit Coal modules     * 100's       * Bit Coal Reader/USB memory     * Network 2:       Comment     * 100's       * Communication     * 100's	PLC data types	-so — mode_active		
> Image: Control of the backups     > 31 - Start       > Image: Control of the backups     > 31	Watch and force tables	& %0.3		
* Traces     * 30.4	Online backups	%0.1		
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® The "Info", "Compile" area shows which blocks were successfully compiled.

General 🚺 Cre	oss-references	Compile	Energy Suite	Syntax					
🕄 🛕 🚺 Show all	messages	-							
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<b>O</b>		Compiling finishe	d (errors: 0; warnings	: 0)					4:48:37 PM

## 7.5 Download the program

 After successful compilation, the complete controller with the created program including the hardware configuration, as previously described in the modules, can be downloaded (
 ID).

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### 7.6 Monitor program blocks

® The desired block must be open for monitoring the downloaded program. Monitoring can now

be activated/deactivated by clicking the 🔛 icon (® Main [OB1] ® 🖭).



**Note:** The monitoring here is signal-related and controller-dependent. The signal states at the terminals are indicated with TRUE or FALSE.

- ® The "MOTOR\_AUTO" [FB1] function block called in the "Main [OB1]" organization block can be selected directly for "Open and monitor" after right-clicking, thereby allowing the program code in the function block with the TP Timer to be monitored
  - (® "MOTOR\_AUTO" [FB1] ® Open and monitor).



**Note:** The monitoring here is function-related and controller-independent. The actuation of sensors and the station status are shown here with TRUE or FALSE.

### 7.7 Archive the project

As the final step, we want to archive the complete project. Select the 
 "Archive ..." command in the 
 "Project" menu. Select a folder where you want to archive your project and save it with the file type "TIA Portal project archive". (
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# 7.8 Checklist

No.	Description	Completed
1	Compiling successful and without error message	
2	Download successful and without error message	
3	Switch on station (-K0 = 1) Cylinder retracted / Feedback activated (-B1 = 1) EMERGENCY OFF (-A1 = 1) not activated AUTOMATIC mode (-S0 = 1) Pushbutton automatic stop not actuated (-S2 = 1) Briefly press the automatic start pushbutton (-S1 = 1) Sensor at chute activated (-B4 = 1) Conveyor motor forwards fixed speed then switches on (-Q1 = 1) and stays on.	
4	Sensor at end of conveyor activated (-B7 = 1) $\circledast$ -Q1 = 0 (after 2 seconds)	
5	Briefly press the automatic stop pushbutton $(-S2 = 0)$ ® $-Q1 = 0$	
6	Activate EMERGENCY OFF (-A1 = 0) ® -Q1 = 0	
7	Manual mode (-S0 = 0) ® -Q1 = 0	
8	Switch off station (-K0 = 0) $\circledast$ -Q1 = 0	
9	Cylinder not retracted (-B1 = 0) $\textcircled{B}$ -Q1 = 0	
10	Project successfully archived	

# 8 Exercise

### 8.1 Task – Exercise

In this exercise, an IEC counter is to be added to the MOTOR\_AUTO [FB1] function block. The expanded function block will be planned, programmed and tested:

The magazine for plastic holds only 5 parts. The parts are therefore be counted at the end of the conveyor.

When 5 parts are stored in the magazine, automatic mode is to be stopped.

Once the magazine has been emptied, automatic mode will be restarted with Start\_command is started again and the counter is reset.

### 8.2 Technology diagram

Here, you see the technology diagram for the task.



Figure 3: Technology diagram



Figure 4: Control panel

# 8.3 Reference list

DI	Туре	Identifier	Function	NC/NO
1 0.0	BOOL	-A1	Return signal emergency stop ok	NC
I 0.1	BOOL	-K0	Main switch "ON"	NO
I 0.2	BOOL	-S0	Mode selector manual (0)/ automatic (1)	Manual = 0 Auto = 1
1 0.3	BOOL	-S1	Pushbutton automatic start	NO
I 0.4	BOOL	-S2	Pushbutton automatic stop	NC
I 0.5	BOOL	-B1	Sensor cylinder M4 retracted	NO
I 1.0	BOOL	-B4	Sensor at chute occupied	NO
l 1.3	BOOL	-B7	Sensor part at end of conveyor	NO

The following signals are needed as global operands for this task.

DO	Туре	Identifier	Function	
Q 0.0	BOOL	-Q1	Conveyor motor M1 forwards fixed speed	

#### Legend for reference list

DI	Digital Input	DO	Digital Output
AI	Analog Input	AO	Analog Output
I	Input	Q	Output
NC	Normally Closed		

NO Normally Open

## 8.4 Planning

Plan the implementation of the task on your own.

Note: Learn about the use of IEC counters in SIMATIC S7-1200 in the online help.

## 8.5 Checklist – Exercise

No.	Description	Completed
1	Compiling successful and without error message	
2	Download successful and without error message	
3	Switch on station (-K0 = 1) Cylinder retracted / Feedback activated (-B1 = 1) EMERGENCY OFF (-A1 = 1) not activated AUTOMATIC mode (-S0 = 1) Pushbutton automatic stop not actuated (-S2 = 1) Briefly press the automatic start pushbutton (-S1 = 1) Sensor at chute activated (-B4 = 1) Conveyor motor forwards fixed speed then switches on (-Q1 = 1) and stays on.	
4	Sensor at end of conveyor activated (-B7 = 1) $\circledast$ -Q1 = 0 (after 2 seconds)	
5	Briefly press the automatic stop pushbutton $(-S2 = 0)$ ® $-Q1 = 0$	
6	Activate EMERGENCY OFF (-A1 = 0) ® -Q1 = 0	
7	Manual mode (-S0 = 0) ® -Q1 = 0	
8	Switch off station $(-K0 = 0)$ ® $-Q1 = 0$	
9	Cylinder not retracted (-B1 = 0) $\circledast$ -Q1 = 0	
10	5th part in magazine $\circledast$ -Q1 = 0	
11	Project successfully archived	

# 9 Additional information

More information for further practice and consolidation is available as orientation, for example: Getting Started, videos, tutorials, apps, manuals, programming guidelines and trial software / firmware, under the following link:

#### www.siemens.com/sce/s7-1200

#### Preview "Additional information"

- Getting Started, Videos, Tutorials, Apps, Manuals, Trial-SW/Firmware
  - ↗ TIA Portal Videos
  - ↗ TIA Portal Tutorial Center
  - > Getting Started
  - ↗ Programming Guideline
  - ↗ Easy Entry in SIMATIC S7-1200
  - > Download Trial Software/Firmware
  - Technical Documentation SIMATIC Controller
  - ↗ Industry Online Support App
  - TIA Portal, SIMATIC S7-1200/1500 Overview
  - ↗ TIA Portal Website
  - ↗ SIMATIC S7-1200 Website
  - ↗ SIMATIC S7-1500 Website

### **Further Information**

Siemens Automation Cooperates with Education siemens.com/sce

SCE Learn-/Training Documents siemens.com/sce/documents

SCE Trainer Packages siemens.com/sce/tp

SCE Contact Partners siemens.com/sce/contact

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Industrie 4.0 siemens.com/future-of-manufacturing

Totally Integrated Automation (TIA) siemens.com/tia

TIA Portal siemens.com/tia-portal

SIMATIC Controller siemens.com/controller

SIMATIC Technical Documentation siemens.com/simatic-docu

Industry Online Support support.industry.siemens.com

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