SIMATIC Drive Controller - Use of integrated I/Os

SIMATIC Drive Controller / TIA V16

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1 I/Os of the SIMATIC Drive Controller

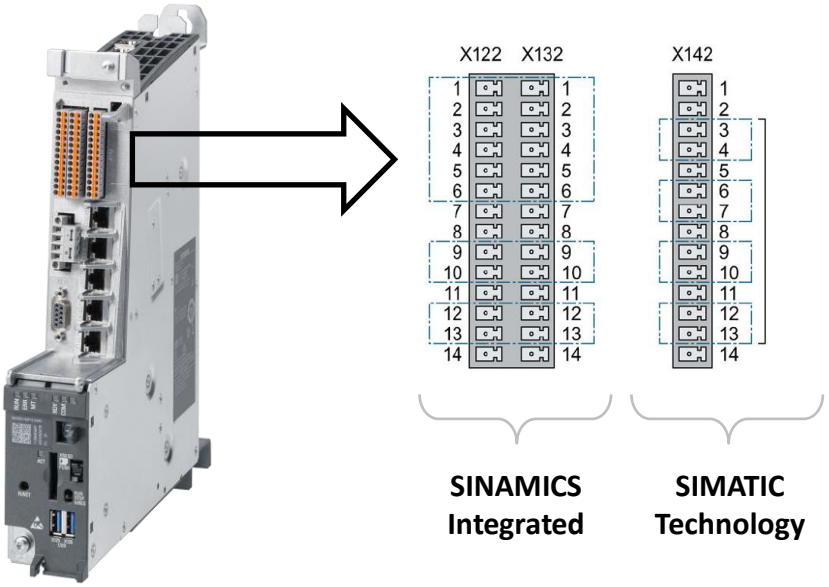
1.1 Overview

The SIMATIC Drive Controller is a drive-based SIMATIC S7-1500 and combines a fail-safe SIMATIC controller and a SINAMICS S120 drive control in one SINAMICS S120 Booksize Compact housing.

The SIMATIC Drive Controller has integrated inputs and outputs (I/Os) that are assigned as follows.

- I/Os of the SIMATIC S7-1500 TF CPU (X142)
- I/Os of the integrated SINAMICS S120 drive control (X122 and X132)

Figure 1-1 Assignment of the I/O interfaces of the SIMATIC Drive Controller



This documentation shows you how you can use the existing inputs and outputs in the user program.

1.2 Drive I/Os and technology I/Os

1.2.1 X122 and X132 interfaces – Drive I/Os

SINAMICS Integrated has 12 digital inputs and 8 digital inputs/outputs (interfaces X122 and X132). The 8 digital inputs/outputs can also be used as measuring inputs.

The drive I/Os are assigned to SINAMICS Integrated. The I/Os can also be used in the SIMATIC CPU in the Drive Controller via the 39x telegrams of the integrated Control Units. This enables direct use of the drive I/Os in the user program.

Table 1-1 Pin assignment of the X122 interface (source: \4\, section 3.4)

Pin	Designation	Signal type	Note	Technology
1	DI 0	Input	Digital input	DI
2	DI 1	Input	Digital input	
3	DI 2	Input	Digital input	
4	DI 3	Input	Digital input	
5	DI 16	Input	Digital input	
6	DI 17	Input	Digital input	
7	M1	Reference potential	Mass for pins 1 to 6	
8	M	Reference potential	Mass (electronics mass)	
9	DI/DQ 8	Bidirectional	Digital input/output	DI/DQ, Measuring input
10	DI/DQ 9	Bidirectional	Digital input/output	
11	M	Reference potential	Mass (electronics mass)	
12	DI/DQ 10	Bidirectional	Digital input/output	DI/DQ, Measuring input
13	DI/DQ 11	Bidirectional	Digital input/output	
14	M	Reference potential	Mass (electronics mass)	

Table 1-2 Pin assignment of the X132 interface (source: \4\, section 3.4)

Pin	Designation	Signal type	Note	Technology
1	DI 4	Input	Digital input	DI
2	DI 5	Input	Digital input	
3	DI 6	Input	Digital input	
4	DI 7	Input	Digital input	
5	DI 20	Input	Digital input	
6	DI 21	Input	Digital input	
7	M2	Reference potential	Mass for pins 1 to 6	
8	M	Reference potential	Mass (electronics mass)	
9	DI/DQ 12	Bidirectional	Digital input/output	DI/DQ, Measuring input
10	DI/DQ 13	Bidirectional	Digital input/output	
11	M	Reference potential	Mass (electronics mass)	
12	DI/DQ 14	Bidirectional	Digital input/output	DI/DQ, Measuring input
13	DI/DQ 15	Bidirectional	Digital input/output	
14	M	Reference potential	Mass (electronics mass)	

Note

A DQ is always only available exclusively to the SINAMICS Integrated or the SIMATIC CPU.

A DI can be used in SINAMICS Integrated and in the SIMATIC CPU at the same time.

1.2.2 X142 interface – Technology I/Os

The 8 digital inputs/outputs present (interface X142) provide configurable technology I/Os. They can be used both for technological functions, such as output cams and measuring input, and as I/Os in the user program of the SIMATIC CPU.

Table 1-3 Pin assignment of the X142 interface (source: \4\, section 3.4)

Pin	Designation	Signal type	Note	Technology
1	-	-	Reserved	
2	-	-	Reserved	
3	DI/DQ 0	Bidirectional	Digital input/output	DI/DQ, Timer DI/DQ Oversampling DI/DQ, Event/period duration measurement Pulse width modulation PWM
4	DI/DQ 1	Bidirectional	Digital input/output	
5	M	Reference potential	Mass	
6	DI/DQ 2	Bidirectional	Digital input/output	
7	DI/DQ 3	Bidirectional	Digital input/output	
8	M	Reference potential	Mass	
9	DI/DQ 4	Bidirectional	Digital input/output	
10	DI/DQ 5	Bidirectional	Digital input/output	
11	M	Reference potential	Mass	
12	DI/DQ 6	Bidirectional	Digital input/output	
13	DI/DQ 7	Bidirectional	Digital input/output	
14	M	Reference potential	Mass	

Note The desired functionality of the I/Os is set via the parameter assignment of the I/Os in the TIA Portal.

1.3 Address space

1.3.1 X122/X132 interfaces (SINAMICS Integrated)

The digital inputs and digital inputs/outputs are assigned to the drive by default (CU DO1). Via CU telegrams, these digital inputs and digital inputs/outputs can also be used by the SIMATIC CPU. For this purpose, Telegram 39x must be configured for the Control Unit (CU) of the SINAMICS Integrated.

Figure 1-2 CU telegrams of the SINAMICS S120 (source: \8\, figure 3-41)

Telegram	390		391		392		393		394	
Application class	-		-		-		-		-	
PZD1	CU_STW1	CU_ZSW1	CU_STW1	CU_ZSW1	CU_STW1	CU_ZSW1	CU_STW1	CU_ZSW1	CU_STW1	CU_ZSW1
PZD2	A_DIGITAL	E_DIGITAL	A_DIGITAL	E_DIGITAL	A_DIGITAL	E_DIGITAL	A_DIGITAL	E_DIGITAL	A_DIGITAL	E_DIGITAL
PZD3			MT_STW	MT_ZSW	MT_STW	MT_ZSW	A_DIGITAL_1	E_DIGITAL_1	A_DIGITAL_1	E_DIGITAL_1
PZD4				MT1_ZS_F		MT1_ZS_F	MT_STW	MT_ZSW		
PZD5				MT1_ZS_S		MT1_ZS_S		MT1_ZS_F		
PZD6				MT2_ZS_F		MT2_ZS_F		MT1_ZS_S		
PZD7				MT2_ZS_S		MT2_ZS_S		MT2_ZS_F		
PZD8						MT3_ZS_F		MT2_ZS_S		
PZD9						MT3_ZS_S		MT3_ZS_F		
PZD10						MT4_ZS_F		MT3_ZS_S		
PZD11						MT4_ZS_S		MT4_ZS_F		
PZD12						MT5_ZS_F		MT4_ZS_S		
PZD13						MT5_ZS_S		MT5_ZS_F		
PZD14						MT6_ZS_F		MT5_ZS_S		
PZD15						MT6_ZS_S		MT6_ZS_F		
PZD16								MT6_ZS_S		
PZD17								MT7_ZS_F		
PZD18								MT7_ZS_S		
PZD19								MT8_ZS_F		
PZD20								MT8_ZS_S		
PZD21								E_ANALOG		

Table 1-4 Digital inputs and digital inputs/outputs X122/X132

Telegram	Inputs	Outputs	Function
Telegram 390	4 bytes	4 bytes	No measuring input; DI0 to DI7; DI/DQ8 to DI/DQ15
Telegram 391	14 bytes	6 bytes	2 measuring inputs; DI0 to DI7; DI/DQ8 to DI/DQ15
Telegram 392	30 bytes	6 bytes	6 measuring inputs; DI0 to DI7; DI/DQ8 to DI/DQ15
Telegram 393	42 bytes	8 bytes	8 measuring inputs; DI0 to DI7; DI16, DI17, DI20, DI21, DI/DQ8 to DI/DQ15
Telegram 394	6 bytes	6 bytes	No measuring input; DI0 to DI7; DI16, DI17, DI20, DI21, DI/DQ8 to DI/DQ15

Note

Due to the hardware structure of the SIMATIC Drive Controller, only telegrams 390 to 394 can be used on the SINAMICS Integrated.

Telegram 393 is set automatically during configuration of the SINAMICS Integrated.

You can find a description of the control and feedback interface of the telegrams in the SINAMICS S120/S150 List Manual (\8\), function diagrams 2422 and 2495 to 2500. There you will also find a description of other telegrams that are not the focus with the SIMATIC Drive Controller.

You can also find more information in the FAQ "SINAMICS G/S: Configuration of standard telegrams in TIA Portal" (\9\).

Address assignment

The TIA Portal assigns the addresses of the telegrams automatically. However, you can change the addresses in the hardware configuration of the TIA Portal, i.e. freely assign the start address. The addresses of the channels are then correspondingly derived from the start address.

You can find the assigned addresses, for example:

- In the device view of the SINAMICS Integrated, in the Inspector window, on the General tab under Telegram configuration
- In the network view when you select the network. The addresses are then displayed under Address overview in the Inspector window

1.3.2 X142 interface (SIMATIC CPU)

The digital input/outputs of interface X142 are permanently assigned to the SIMATIC CPU.

Table 1-5 Size of input/output data on X142

Type		Address space
Digital inputs	DI	76 bytes
Digital outputs	DQ	42 bytes

Address assignment

The TIA Portal assigns the addresses automatically. You can change the addresses in the hardware configuration of the TIA Portals, i.e. freely assign the start address. The addresses of the channels are derived from the start address.

You can find the assigned addresses, for example:

- In the device view of the CPU under Device overview
- In the Inspector window under I/O addresses, on the General tab.

Note

The reason that the address space of the digital inputs/outputs of the X142 interface is so large is because the digital inputs/outputs have a control and feedback interface for use with the technology functions, and not only the bit information of the inputs and outputs is transmitted.

Knowledge of the interface structure is not required for use in conjunction with the technology objects, e.g. for output cams or measuring inputs.
Refer to \5\ in sections 7.9.9 and 7.9.10 for the exact structure of the interface. However, the structure is only required when using the oversampling, event/period duration measurement and pulse width modulation (PWM) functionality.

1.4 Isochronous mode

The SIMATIC Drive Controller consists of a SIMATIC CPU and the integrated SINAMICS Control Unit (CU). In isochronous mode, the SIMATIC CPU can be operated as master or as slave of another clock master. The integrated SINAMICS Control Unit can only be operated asynchronously as slave. The integrated SIMATIC CPU can be used as clock master here.

1.4.1 Independent isochronous mode

If you want to operate the clock systems separately in isochronous mode, configure a cycle time for each clock system and assign the clock systems to different process images, for example:

- SINAMICS Integrated:
  ⇨ Assignment to "OB Servo PIP" [OB 91]
- PROFIBUS DP interface X126
  ⇨ Assignment to "PIP 1" of the isochronous interrupt OB [OB 6x]

The clock systems are not isochronous to each other in this case.

Note You cannot operate the X142 technology I/Os in isochronous mode separately from SINAMICS Integrated.
If you want to operate X142 technology I/Os and SINAMICS Integrated in isochronous mode simultaneously, always set coupled isochronous mode.

1.4.2 Coupled isochronous mode

In coupled isochronous mode, the relevant clock systems use a shared system clock.

The leading clock system provides the system clock to the other involved clock systems. You configure coupled isochronous mode in the TIA Portal.

The following table shows the possible combinations for coupled isochronous mode on the SIMATIC Drive Controller. The leading clock system for each combination is indicated.

Table 1-6 Possible combinations for coupled isochronous mode

PROFINET IO X150	Technology I/Os X142	SINAMICS Integrated	PROFIBUS DP X126
Leading (M ⇨)	Following (⇨S)	Following (⇨S)	-
Leading (M ⇨)		Following (⇨S)	-
Leading (M ⇨)	Following (⇨S)	Not configured	-
-	Leading (M ⇨)	Following (⇨S)	-

Legend: M = Master, S = Slave

Note Isochronous coupling of PROFIBUS interface X126 with other clock systems is not possible.

If you want to expand the drive configuration limits with distributed drive systems, connect those distributed drive systems over the PROFINET IO interface X150. Only PROFINET IO interface X150 can be connected isochronously alongside the "MC-Servo" OB to the clock system of SINAMICS Integrated and the X142 technology I/Os.

1.4.3 Automatic setting of isochronous mode

Isochronous mode is mandatory for certain operating modes of the X142 technology I/O channels.

As soon as you set one of the following operating modes for a technology I/O channel, the TIA Portal automatically enables the "Isochronous mode" option.

- Timer DI
- Timer DQ
- Oversampling DI
- Oversampling DQ
- Event/period duration measurement

If you assign a technology object output cam, cam track or measuring input to an X142 I/O, TIA Portal automatically sets the process image "OB Servo PIP".

In all other cases, you set the process image manually. If isochronous mode is mandatory for at least one technology I/O, you must set the process image of the "MC-Servo" OB (OB91) or an isochronous interrupt OB (OB6x).

1.4.4 Synchronizing MC-Servo with clock system

The "MC-Servo" OB is synchronized in the properties of the OB with the clock system in which the "Synchronous to the bus" option is selected.

The following sources can hereby be set for the send clock of the OB:

Table 1-7 Settings for isochronous mode of the "MC-Servo" OB

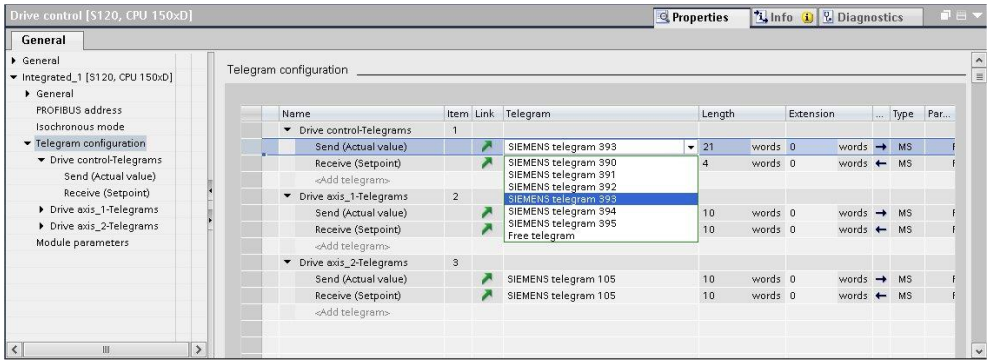
Source of the send clock	Note
PROFIdrive system (1)	With this setting, you synchronize the "MC-Servo" OB with the clock system of SINAMICS Integrated.
PROFINET IO system (100)	With this setting, you synchronize the "MC Servo" OB with PROFINET interface X150.
PLC_1 (0)	With this setting, you synchronize the "MC-Servo" OB with the clock system of technology I/Os X142.
DP master system (2)	With this setting, you synchronize the "MC-Servo" OB with PROFIBUS interface X126.

2 Using drive I/OSs in the SIMATIC

2.1 SINAMICS hardware configuration

In the SINAMICS Integrated hardware configuration, set up Telegram 39x for the Control Unit, if this has not been done yet. Telegram 393, which is the most powerful telegram for the SIMATIC Drive Controller and is automatically set when configuring SINAMICS Integrated, is used in this documentation by way of example.

Figure 2-1 Setting up a telegram on the Control Unit



Note

Due to the hardware structure of the SIMATIC Drive Controller, only telegrams 390 to 394 can be used on the SINAMICS Integrated.

Telegram 393 is set automatically during configuration of the SINAMICS Integrated.

The destination addresses of the telegrams in send and receive direction can be taken from the detail information of the individual telegram parts.

Figure 2-2 Destination address of the telegram in send direction

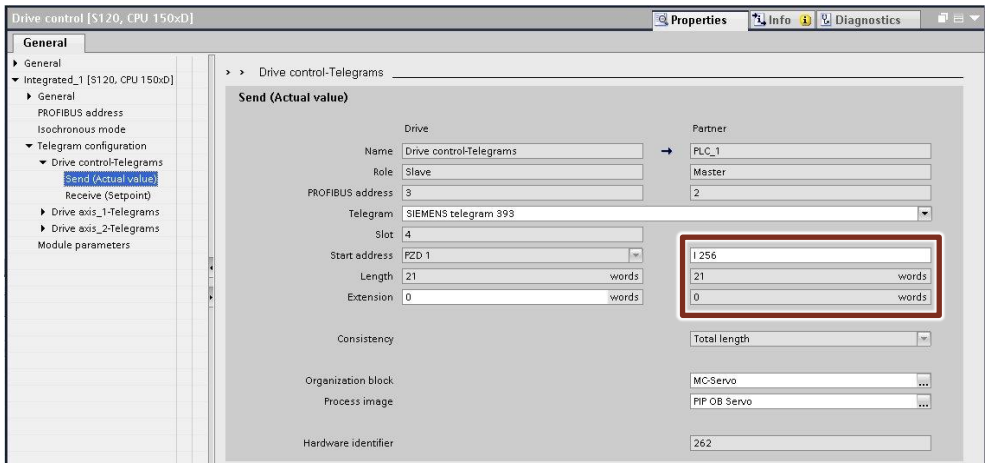
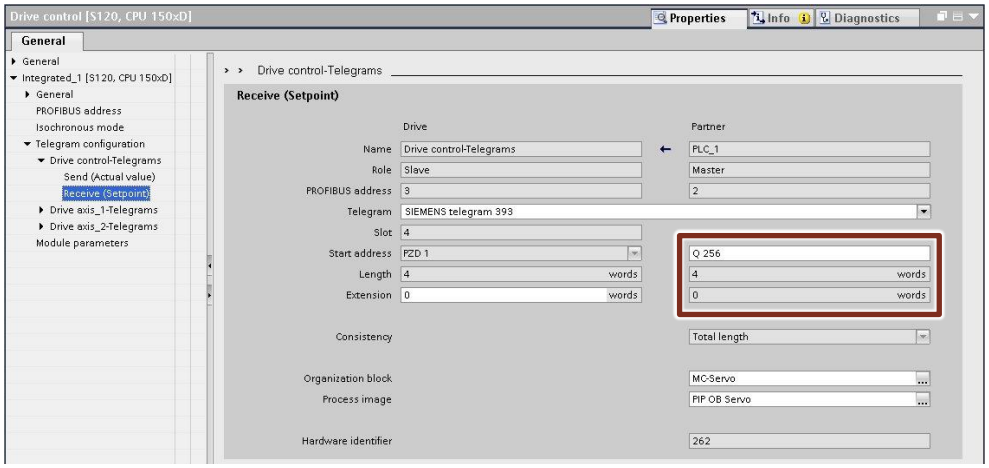


Figure 2-3 Destination address of the telegram in receive direction



Note

From the perspective of the SINAMICS Integrated, the "Send direction" and "Receive direction" names mean the following:

- Send direction:
  The data is transferred from the SINAMICS Integrated to the PLC.
- Receive direction:
  The data is transferred from the PLC to the SINAMICS Integrated.

2.2 Transfer between SINAMICS Integrated and PLC

The states of the drive I/Os are now transferred from and to the PLC via the set-up telegram 39x to the Control Unit (CU) of the SINAMICS Integrated.

The interface of the data in the PLC forms a PLC variable for the send and receive direction which needs to be set up in the PLC. For access to the data of the telegrams or in the PLC variables to be as simple as possible, the "LPD" library (\10\) is used. This library contains PLC data types for simplified access which are usable for many telegrams.

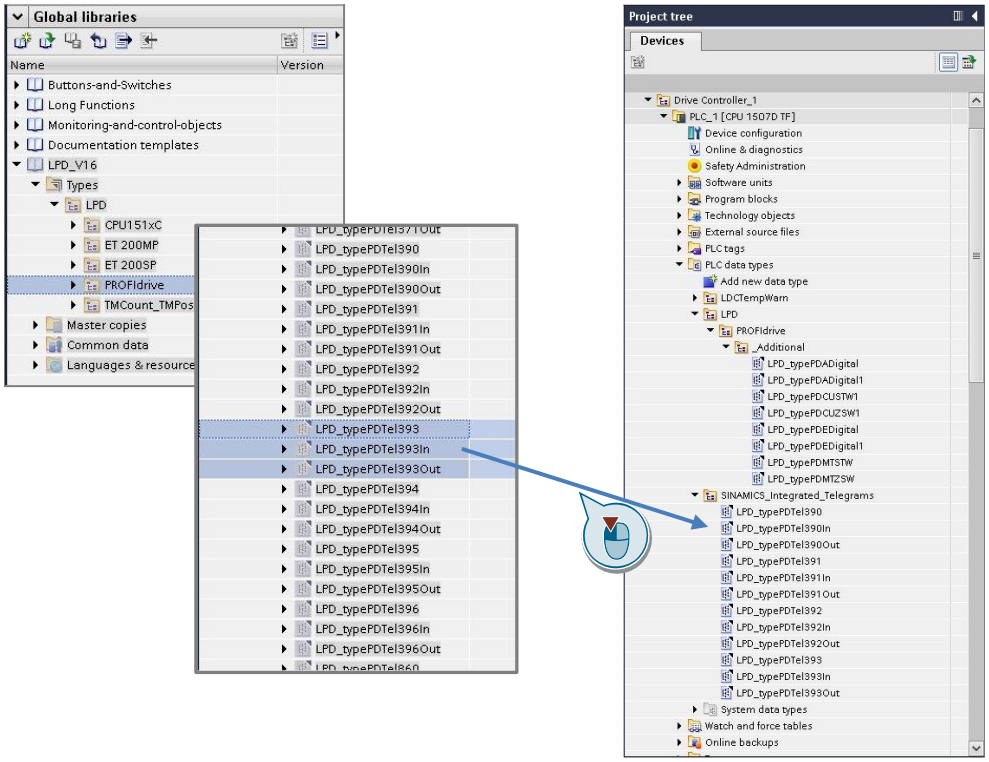
2.2.1 Using the "LPD" library

Download the "LPD library" from the Siemens Industry Online Support, extract the library to your PG/PC and open the library in the TIA Portal.

The procedure for integrating the PLC data types for the telegrams you use is now as follows:

- Under "Types", select the "LPD" entry and then the entry for "PROFIdrive" drive telegrams.
- In the list that is now displayed, search for the telegram you are using, select the three entries of the corresponding telegram, and drag-and-drop the PLC data types to the "PLC data types" folder.
  If necessary, set up a subfolder for structuring the PLC data types beforehand. This is "SINAMICS_Integrated_Telegrams" in the example.

Figure 2-4 Integrating the PLC data types from the "LPD" library



Note When PLC data types are transferred, any additional data types needed by the library are added in the "LPD" folder.

2.2.2 Creating PLC variables

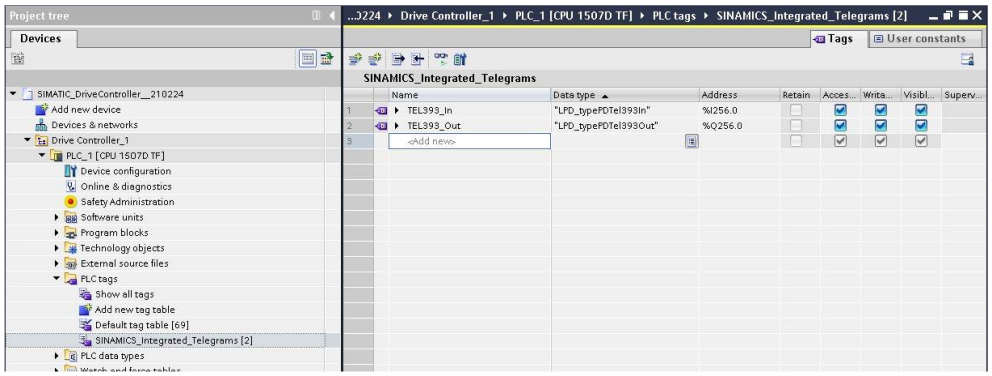
Now create one PLC variable for the send direction and one for the receive direction. Assign the corresponding data type from the "LPD" library to the created PLC variables in each case:

- Data from the SINAMICS Integrated (send direction)
  For example, use the PLC data type "LPD_typePDTel393In" ("In" label at end of data type) at the PLC variable "TEL393_In" for the telegram 393
- Data on the SINAMICS Integrated (receive direction)
  For example, use the PLC data type "LPD_typePDTel393Out" ("Out" label at end of data type) at the PLC variable "TEL393_Out" for the telegram 393

Note When creating PLC variables and assigning the PLC data types, pay attention to the perspective of the data transfer direction. The perspective of SINAMICS is usually used.

- Send direction ⇨ PLC data type "LPD_typePDTel393In"
  ⇨ I address of the variable in the PLC.
- Receive direction ⇨ PLC data type "LPD_typePDTel393Out"
  ⇨ Q address of the variable in the PLC.

Figure 2-5 Creating PLC variables



2.3 Use in the user program

Through the use of the PLC data types from the "LPD" library, very convenient access to the signals of the created PLC variables, and therefore to the evaluation or control of the drive I/Os, is now possible.

Figure 2-6 Use of the drive I/Os in the user program

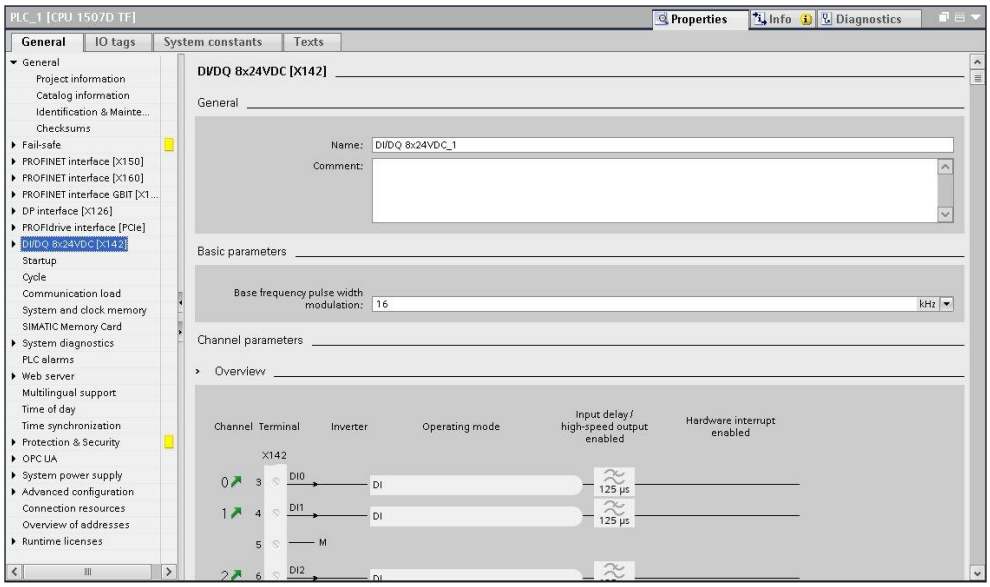
	Name	Data type	Address	Retain	Acces...	Writa...	Visibl...
1	TEL393_In	"LPD_typePDTel393In"	%I256.0		☑	☑	☑
2	CU_ZSW1	LPD_typePDCUZSW1	%I256.0		☑	☑	☑
3	E_DIGITAL	LPD_typePDEDigital	%I258.0		☑	☑	☑
4	digitalInput0	Bool	%I258.0		☑	☑	☑
5	digitalInput1	Bool	%I258.1		☑	☑	☑
6	digitalInput2	Bool	%I258.2		☑	☑	☑
7	digitalInput3	Bool	%I258.3		☑	☑	☑
8	digitalInput4	Bool	%I258.4		☑	☑	☑
9	digitalInput5	Bool	%I258.5		☑	☑	☑
10	digitalInput6	Bool	%I258.6		☑	☑	☑
11	digitalInput7	Bool	%I258.7		☑	☑	☑
12	digitalInput8	Bool	%I259.0		☑	☑	☑
13	digitalInput9	Bool	%I259.1		☑	☑	☑
14	digitalInput10	Bool	%I259.2		☑	☑	☑
15	digitalInput11	Bool	%I259.3		☑	☑	☑
16	digitalInput12	Bool	%I259.4		☑	☑	☑
17	digitalInput13	Bool	%I259.5		☑	☑	☑
18	digitalInput14	Bool	%I259.6		☑	☑	☑
19	digitalInput15	Bool	%I259.7		☑	☑	☑
20	E_DIGITAL_1	LPD_typePDEDigital1	%I260.0		☑	☑	☑
21	digitalInput16	Bool	%I260.0		☑	☑	☑
22	digitalInput17	Bool	%I260.1		☑	☑	☑
23	digitalInput18	Bool	%I260.2		☑	☑	☑
24	digitalInput19	Bool	%I260.3		☑	☑	☑
25	digitalInput20	Bool	%I260.4		☑	☑	☑
26	digitalInput21	Bool	%I260.5		☑	☑	☑
27	digitalInput22	Bool	%I260.6		☑	☑	☑
28	reserved_Bit15	Bool	%I260.7		☑	☑	☑
29	reserved_Bit00	Bool	%I261.0		☑	☑	☑
30	reserved_Bit01	Bool	%I261.1		☑	☑	☑
31	reserved_Bit02	Bool	%I261.2		☑	☑	☑
32	reserved_Bit03	Bool	%I261.3		☑	☑	☑
33	reserved_Bit04	Bool	%I261.4		☑	☑	☑
34	reserved_Bit05	Bool	%I261.5		☑	☑	☑
35	reserved_Bit06	Bool	%I261.6		☑	☑	☑
36	reserved_Bit07	Bool	%I261.7		☑	☑	☑
37	MT_ZSW	LPD_typePDMTZSW	%I262.0		☑	☑	☑

3 Using technology I/Os as DI/DQ

3.1 Hardware configuration

The operating modes and the additionally necessary settings for using the technology I/Os of the X142 interface are selected in the properties of the SIMATIC Drive Controller.

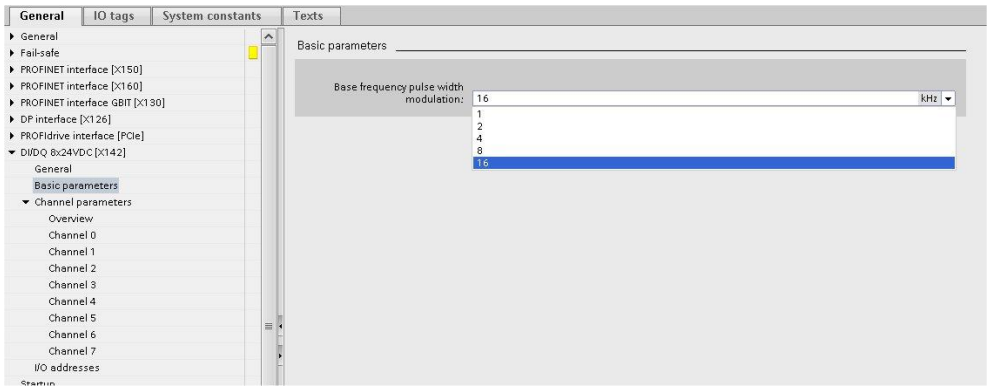
Figure 3-1 Hardware configuration of the interface X142



3.1.1 Basic parameters

If technology I/Os are to be used in pulse width modulation (PWM) mode, the base frequency for outputting the pulses must be set here. The base frequency set here then applies to all channels of interface X142.

Figure 3-2 Basic parameters - Frequency setting



To create pulse patterns, the base frequency set here can be divided over the 32 bits of the data word (WORD) to define the PWM sequence. The shortest pulse that can be output therefore corresponds to $^1/_{32}$ of the base frequency.

If the channel of interface X142 is operated in pulse width modulation (PWM) mode and very short pulses are to be output, set the check mark for the "High-speed output" option.

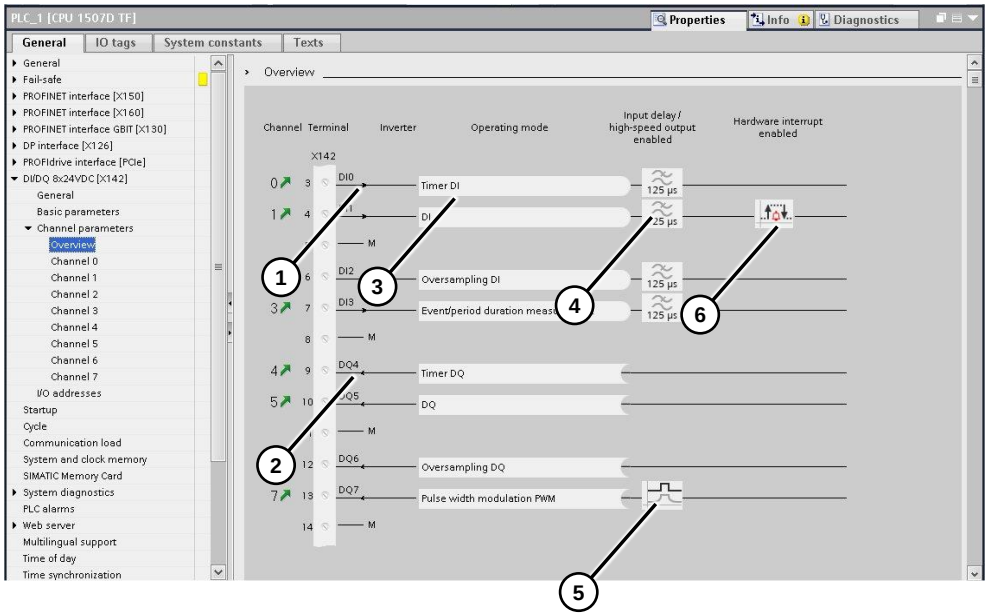
Figure 3-3 Activating the "High-speed output" option with very short pulses

3.1.2 Channel parameters – Overview

The overview of the channel parameter assignment provides the following information on the settings of the individual technology I/Os at a glance:

- Signal direction of the channel: Input (1) or Output (2)
- Operating mode (3) of the channel
- Additional options such as delay time (4) and high-speed output (5)
- Active hardware interrupts (6)

Figure 3-4 Channel parameters - Overview

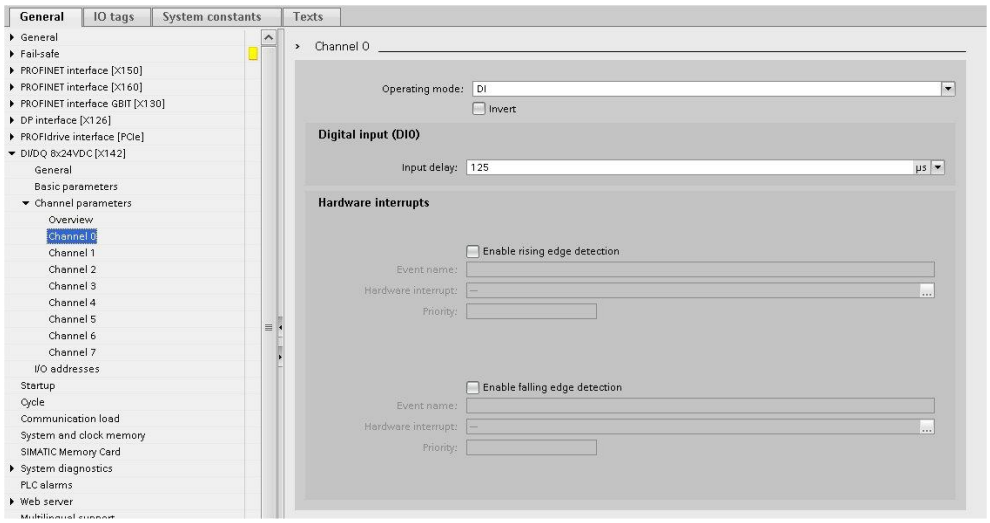


3.1.3 Channel parameters – Channels

The corresponding settings can be made here for each channel. The available setting options depend on the selected operating mode of the channel.

In the default setting, each channel is configured in "DI" mode.

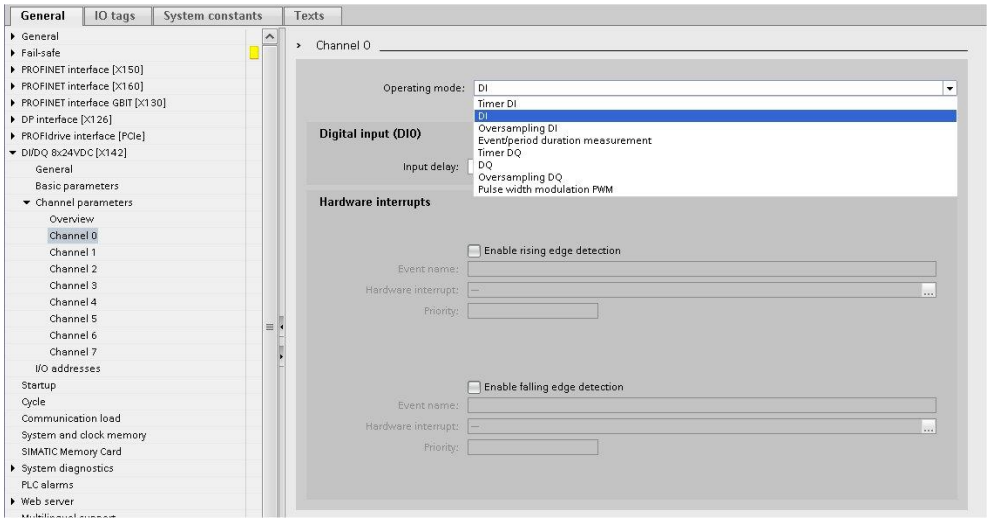
Figure 3-5 Channel parameters



The following modes can be selected for the individual channels:

- Timer DI (e.g. measuring input)
- DI (digital input)
- Oversampling DI (e.g. pulse pattern recognition)
- Event/period measurement (e.g. counters)
- Timer DQ (e.g. output cam)
- DQ (digital output)
- Oversampling DQ (e.g. pulse pattern output)
- Pulse width modulation PWM (e.g. output of recurring pulse patterns)

Figure 3-6 Channel parameters - Operating mode



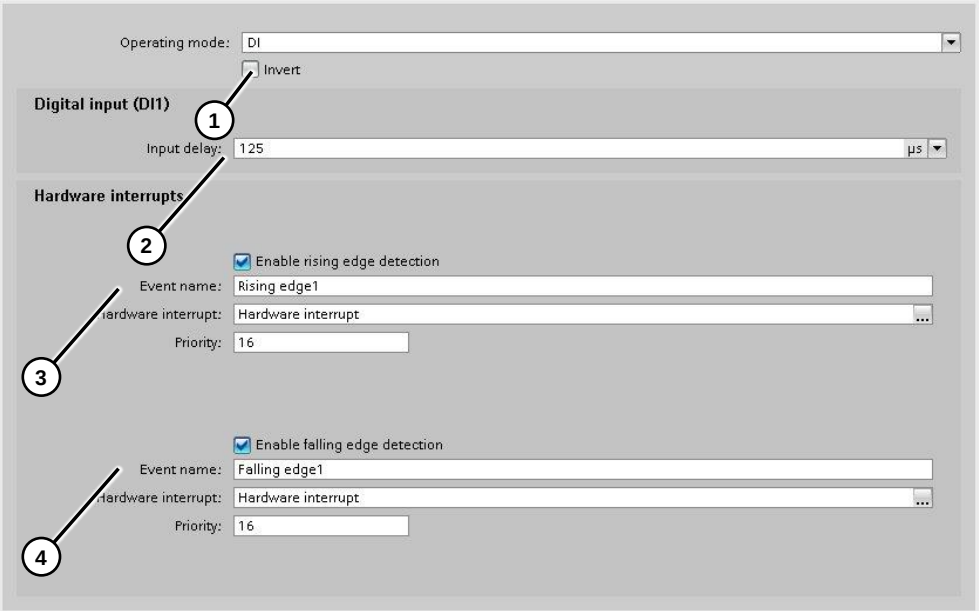
This documentation will now specifically address only the two operating modes "Digital input (DI)" and "Digital output (DQ)" of the channels. You can find additional information on the other operating modes and on the interface to the user program in the section 4.1.2.

Digital input DI

If the channel is configured as digital input (DI), the input signal at the input of the SIMATIC Drive Controller can be inverted (1) in the settings for processing in the user program. Furthermore, the input delay of the input (2) can be set between 1 µs (high-speed) and 125 µs.

Note With a set input delay of 1 µs, very short signal levels or very fast signal changes can be recorded.
For optimum interference immunity, the use of shielded cables is recommended when an input delay of 1 µs is set.

Figure 3-7 Channel settings for a digital input (DI)

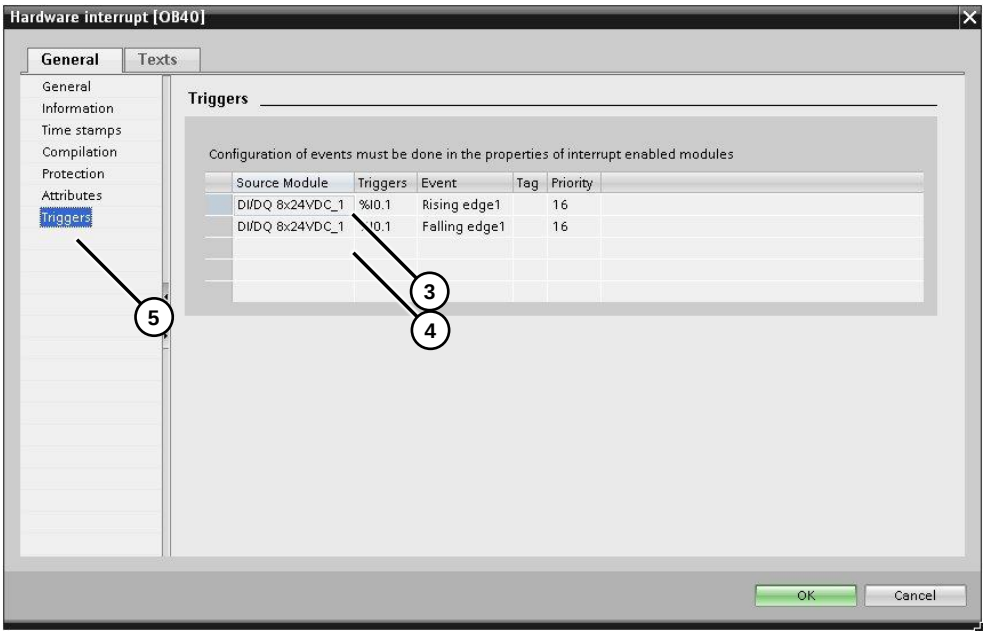


In addition, edge detection of the input signal for a rising edge (3) or a falling edge (4) can be activated for the digital input.

If a corresponding signal edge is detected by the activated edge detection, a hardware interrupt is triggered and the organization block defined in the settings (this is OB 40 "Hardware Interrupt" in the figure) is started with the set priority.

The event name set in the edge detection for the rising edge (3) and the falling edge (4) is used to be able to determine the corresponding event in the interrupt organization block. The event name assigned here is also displayed in the properties of the interrupt organization block as possible start event and can therefore be evaluated in the program code of the organization block.

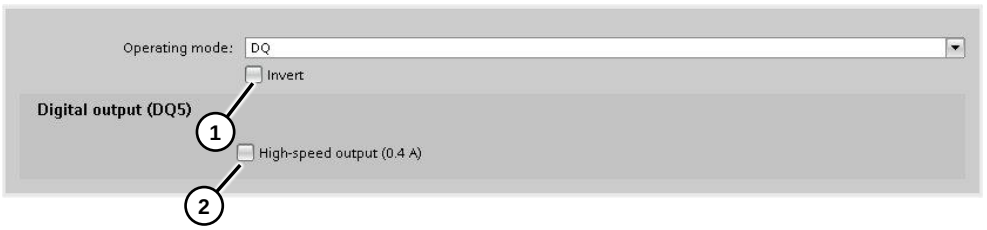
Figure 3-8 Start events in OB 40 "Hardware interrupt"



Digital output DQ

If the channel is configured as digital output (DQ), the output signal at the output of the SIMATIC Drive Controller can be inverted (1) to the user program. The output can also be set as high-speed output (2) for very short pulses.

Figure 3-9 Channel settings for a digital output (DQ)

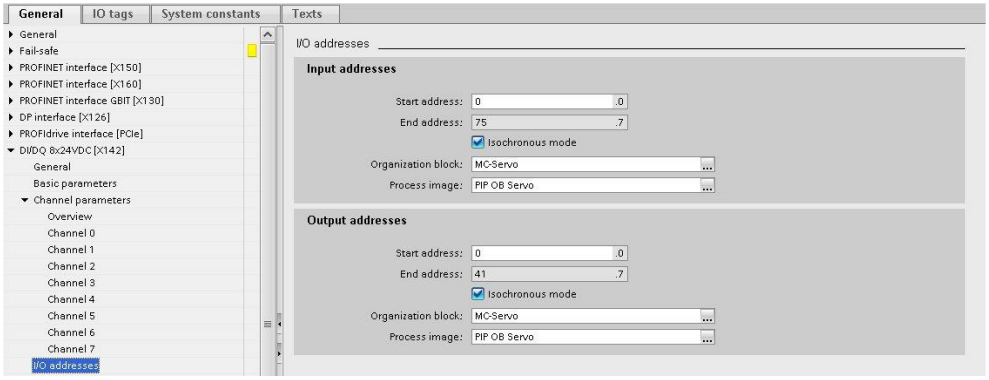


3.1.4 Channel parameters – I/O addresses

The overview of I/O address provides an overview of the address space in the SIMATIC Drive Controller used by the technology I/Os.

You can also activate isochronous processing of the technology I/Os of the X142 interface in this overview. A cyclic organization block and a process image must be assigned here for isochronous mode. With this SIMATIC Drive Controller, this is usually OB 91 "MC-Servo" for influencing the connected axes.

Figure 3-10 I/O addresses – Isochronous mode



3.2 Using DI and DQ in the user program

The organization of the address area of the technology I/Os is explained in greater detail in section 4.1.3 and section 4.1.4. You can recognize there that the first byte (Byte 0) of the interface is responsible for the digital inputs and outputs in each case.

Digital input DI

To be able to access the digital inputs of the interface X142, create corresponding PLC variables:

- Data type of the PLC variables: BOOL
- The initial address of the PLC variable is the start address of the input addresses in the overview of I/O addresses.
- The bit address is the corresponding channel of the technology I/Os

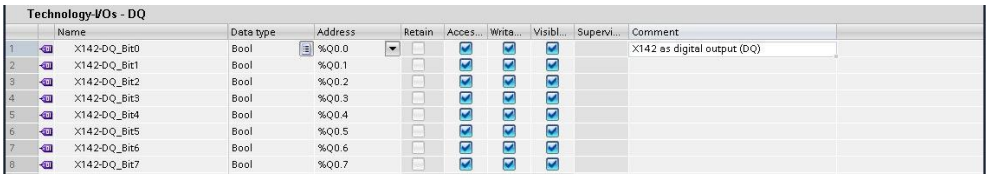
Figure 3-11 PLC variables for digital inputs (DI)

Digital output DQ

To be able to access the digital outputs of the interface X142, create corresponding PLC variables:

- Data type of the PLC variables: BOOL
- The initial address of the PLC variable is the start address of the output addresses in the overview of I/O addresses.
- The bit address is the corresponding channel of the technology I/Os

Figure 3-12 PLC variables for digital outputs (DQ)



4 Additional information

4.1 Special features of the interfaces

4.1.1 Isochronous processing of the technology I/Os on X142

The operating modes timer DI, timer DQ, oversampling DI, oversampling DQ and event/period duration measurement require isochronous processing in OB91 (MC-Servo) or OB6x (isochronous interrupt OBs). If you have configured one of these operating modes and have not set isochronous processing, this will result in an error when compiling the hardware configuration.

If you interconnect the technology I/Os with the technology object measuring input, output cam or cam track, isochronous mode and assignment to the "OB Servo" process image partition are essential. The setting is made automatically as soon as you interconnect a technology I/O with a corresponding technology object.

4.1.2 Operating modes of the X142 interface

You can configure the following operating modes for the individual channels of the X142 interface:

Table 4-1 Overview of operating modes

Mode	Function	Use with TO	Use without TO	IRT
DI	Digital input Deceleration (1 µs/125 µs) Hardware interrupt on edge	Homing mark	No restrictions	Optional
DQ	Digital output	Output cam Cam track, ...	No restrictions	Optional
Timer DI	Switching time of up to two edges per application cycle	Measuring input	OB 91/OB 6x required	Yes
Timer DQ	Time-accurate output of up to two edges per application cycle	Output cam Cam track	OB 91/OB 6x required	Yes
Oversamp. DI	Acquisition of 32 states of a DI signal per application cycle	-	OB 91/OB 6x required	Yes
Oversamp. DQ	Output of 32 states of a DI signal per application cycle	-	OB 91/OB 6x required	Yes
Event / period duration measurement	Measurement of number of edges or period duration	-	OB 91/OB 6x required	Yes
PWM	Output of a configurable pulse-pause ratio with configurable frequency.	-	No restrictions	Optional

Note The function blocks for the use of time-based IO (TIO instructions) are not supported by the X142 interface.

For the timer DI, use the technology object measuring input. For the timer DQ, use the technology object output cam or cam track.

Note If no technology objects are created or used in the project, a created OB 91 "MC-Servo" is automatically deleted again during compilation by the project optimization of the TIA Portal.

4.1.3 Assignment of the control interface

The user program uses the control interface to influence the behavior of the technology inputs and technology outputs at interface X142.

Table 4-2 Assignment of the control interface

Offset from start address	Parameter	Meaning
Byte 0	SET_DQ (DQ0...DQ7)	Set DQ (DQ0…DQ7)
Byte 1…3	Reserved	Must not be used
Byte 4…7	TEC_OUT (DQ0)	• Timer DQ: Byte 0, 1: OFF TIME (output time stamp for resetting DQ) Byte 2, 3: ON TIME (output time stamp for setting DQ) • Oversampling DQ: Byte 0…3: 32 states for oversampling • Pulse width modulation PWM: Byte 0…3: PWM bit pattern
Byte 8…11	TEC_OUT (DQ1)	
Byte 12…15	TEC_OUT (DQ2)	
Byte 16…19	TEC_OUT (DQ3)	
Byte 20…23	TEC_OUT (DQ4)	
Byte 24…27	TEC_OUT (DQ5)	
Byte 28…31	TEC_OUT (DQ6)	
Byte 32…35	TEC_OUT (DQ7)	
Byte 36	SEL (DI0, DI1)	• Bit 0: Cyclic time stamp detection DI0 • Bit 1…3: Edge selection DI0 • Bit 4: Cyclic time stamp detection DI1 • Bit 5…7: Edge selection DI1 Edge selection: 001: Only rising edges 010: Only falling edges 011: Both edges after occurrence 101: First rising, then falling edge 110: First falling, then rising edge
Byte 37	SEL (DI2, DI3)	
Byte 38	SEL (DI4, DI5)	
Byte 39	SEL (DI6, DI7)	
Byte 40…41	STW	Control word • Bit 0: Sync. of X142 with user prog. • Bit 1…11: Reserved (must be 0) • Bit 12…15: Sign of life counter

4.1.4 Assignment of the feedback interface

The user program receives current values and status information from the X142 interface technology I/Os over the feedback interface.

Table 4-3 Assignment of the feedback interface

Offset from start address	Parameter	Meaning
Byte 0	STS_DI (DI0...DI7)	State DI (DI0...DI7)
Byte 1…3	Reserved	Must not be used
Byte 4…7	TEC_IN (DI0)	• Timer DI: Byte 0, 1: 2. Second input time stamp Byte 2, 3: 1. First input time stamp • Oversampling DI: Byte 0…3: Oversampling value • Event measurement (counter): Byte 0, 1: Reserved Byte 2, 3: Counter value • Period duration measurement: Byte 0…3: Measured period duration
Byte 8…11	TEC_IN_EXT (DI0)	
Byte 12…15	TEC_IN (DI1)	
Byte 16…19	TEC_IN_EXT (DI1)	
Byte 20…23	TEC_IN (DI2)	
Byte 24…27	TEC_IN_EXT (DI2)	
Byte 28…31	TEC_IN (DI3)	
Byte 32…35	TEC_IN_EXT (DI3)	
Byte 36…39	TEC_IN (DI4)	
Byte 40…43	TEC_IN_EXT (DI4)	
Byte 44…47	TEC_IN (DI5)	
Byte 48…51	TEC_IN_EXT (DI5)	
Byte 52…55	TEC_IN (DI6)	
Byte 56…59	TEC_IN_EXT (DI6)	
Byte 60…63	TEC_IN (DI7)	
Byte 64…67	TEC_IN_EXT (DI7)	
Byte 68	LEC (DI0, DI1)	• Bit 0...2: Lost edges DI0 • Bit 3: Reserved • Bit 4…6: Lost edges DI1 • Bit 7: Reserved
Byte 69	LEC (DI2, DI3)	
Byte 70	LEC (DI4, DI5)	
Byte 71	LEC (DI6, DI7)	
Byte 72	Reserved	Must not be used
Byte 73	Layout property	Specific value
Byte 74…75	ZSW	Status word • Bit 0…3: Operating mode of the DI or DQ • Bit 4…7 and 9: Number of the DI or DQ • Bit 8: Sync. of X142 with user prog. • Bit 10…11: Reserved • Bit 12…15: Sign of life counter

Note

Signals are only reliably acquired over STS_DI if the level is significantly longer than the input delay + acquisition cycle of the digital inputs/outputs (X142).

Example:
If you operate the digital inputs/outputs (X142) as isochronous to the MC-Servo in a cycle of 2 ms and a set input delay of 125 µs, the level duration must be > 2.125 ms.

4.2 Information for users changing from SIMOTION D4x5-2

The comparison below is based on the hardware differences of the I/Os between a SIMATIC Drive Controller and a SIMOTION D4x5-2 control unit.

Table 4-4

Interface	SIMOTION D4x5-2 DP/PN	SIMATIC Drive Controller
Onboard I/Os (assigned to the drive)	12 DI, 8 DI/DQ	12 DI, 8 DI/DQ Terminal type and terminal assignment same as SIMOTION.
Onboard I/Os (assigned to the controller)	8 DI/DQ, channel-by-channel as: • DI • DQ • Measuring input • Output cam	8 DI/DQ, channel-by-channel as: • DI • DQ Can be operated as high-speed output • Timer DI for measuring input • Timer DQ for output cam • Oversampling DI • Event/period duration measurement • Oversampling DQ • PWM Terminal type and terminal assignment same as SIMOTION.

5 Appendix

5.1 Links and literature

Table 5-1

No.	Subject
\1\	Siemens Industry Online Support https://support.industry.siemens.com
\2\	Link to the entry page of the FAQ https://support.industry.siemens.com/cs/ww/en/view/109782269
\3\	SIMATIC product information on the SIMATIC Drive Controller Product Information – Edition 12/2020 https://support.industry.siemens.com/cs/ww/en/view/109772684
\4\	SIMATIC SIMATIC Drive Controller Manual – Edition 11/2019 https://support.industry.siemens.com/cs/ww/en/view/109766666
\5\	SIMATIC SIMATIC Drive Controller System Manual - Edition 11/2019 https://support.industry.siemens.com/cs/ww/en/view/109766665
\6\	SIMATIC S7-1500, SIMATIC Drive Controller, ET 200SP, ET 200pro Web server Function manual – 11/2019 Edition https://support.industry.siemens.com/cs/ww/en/view/59193560
\7\	SIMATIC S7-1500 S7-1500/S7-1500T Measuring input and cam functions V5.0 in TIA Portal V16 Function manual – 12/2019 Edition https://support.industry.siemens.com/cs/ww/en/view/109766466
\8\	SINAMICS S120/S150 List manual – Edition 12/2018 (FW 5.2) https://support.industry.siemens.com/cs/de/en/view/109763271
\9\	FAQ SINAMICS G/S: Configuration of standard telegrams in TIA Portal FAQ – entry date 30 May 2016 https://support.industry.siemens.com/cs/ww/en/view/82841762
\10\	Application example Libraries with PLC data types (LPD) for STEP 7 (TIA Portal) and SIMATIC S7-1200 / S7-1500 Application example – entry date 9 Sep. 2019 https://support.industry.siemens.com/cs/ww/en/view/109482396