Interface description

# Digital I/O interface of the CPX

Parallel I/O, real-time and sync I/O and decentralized I/O interface of the CPX V3 and V4 standard

TRUMPF



Interface description

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Parallel I/O, real-time and sync I/O and decentralized I/O interface of the CPX V3 and V4 standard

Edition **2024-06**

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# Good to know

This interface description provides you with information regarding the following interfaces of the CPX V3 and V4 standard central processor:

- Parallel I/O interface
- Real-time interfaces
- Sync I/O interface
- Decentralized I/O interface

This interface description contains the following information:

- location of the connectors for the digital inputs and outputs of the interfaces.
- technical data of the digital inputs and outputs.
- signals assigned to the interfaces.
- how to use the interfaces.
- How to configure the digital inputs and outputs in TruControl 1000 to use them as parallel I/O, real-time or sync I/O interface.
- How real-time interfaces (max. 3) of a parallel I/O interface can be assigned to any number of fieldbus or OPC interfaces.
- available testing options.

**Target group**

This interface description is intended for system integrators and system administrators who are entrusted with integrating a laser device into a system environment.

**Supplementary documents**

| Document | Doc. No. |
|---|---|
| TruControl 1000 software manual | 10-06-80-A1-CR |
| Interface description OPC UA for CPX | 09-14-11-A6-BA |
| Interface description of fieldbus interfaces of the CPX – CPX V3, CPX V4 and CPX V20 | 18-22-91-A1-BA |
| Interface description for TRUMPF Peripheral Bus | 18-22-12-A1-AB |

Tab. 1

**Laser standby mode:** Most laser devices by TRUMPF do not require the Laser Standby mode, due to their state-of- the-art design. These devices do not have Laser Standby mode. However, it cannot be ruled out for all future times that the Laser Standby mode will be required for individual laser types. Therefore, the present interface description still includes information with regard to the laser Standby mode. How should you - the user - handle the information about the laser standby mode? Detailed information on this is given in a separate section, (see "LASER_STANDBY", pg. 23).

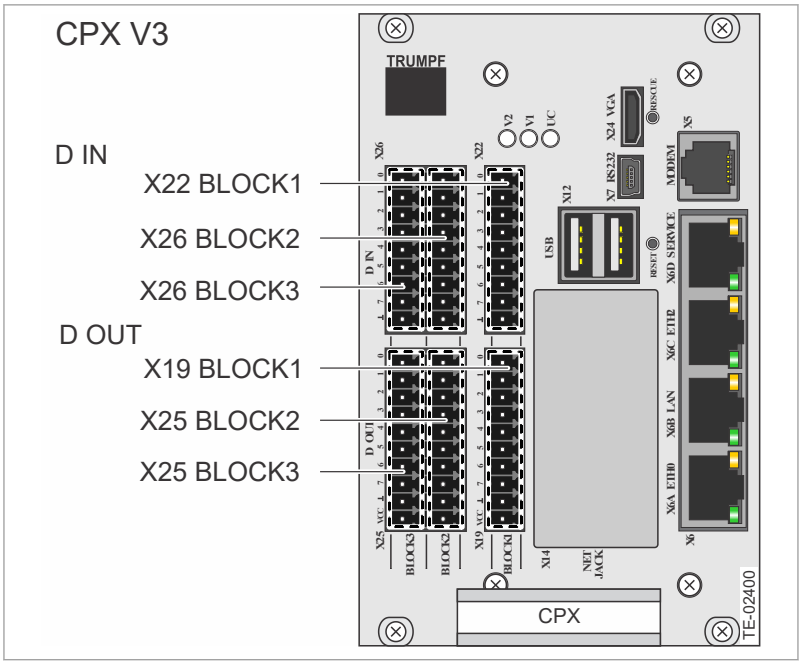
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# 1. Overview

## 1.1 Digital I/O interface of CPX V3



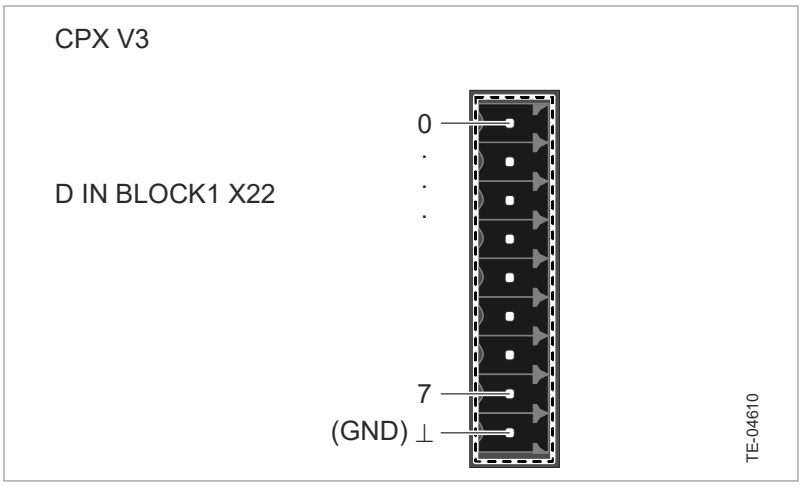

Digital inputs an outputs of the central processor (CPX V3) Fig. TE-02400

The connection of the digital I/O interface is located on the front plate of the central processor (CPX).

The digital inputs and outputs are distributed to 3 input and output channels.

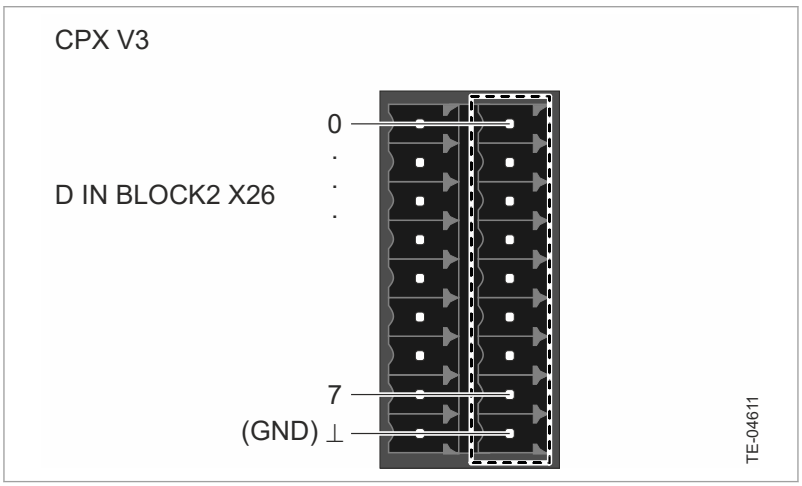
# Input channels

**D IN BLOCK1**



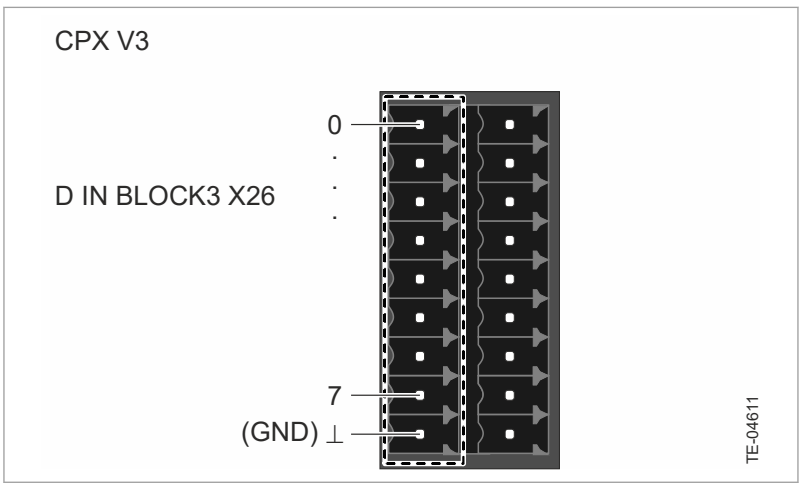

D IN BLOCK1 Fig. TE-04610

**D IN BLOCK2**




D IN BLOCK2 Fig. TE-04611

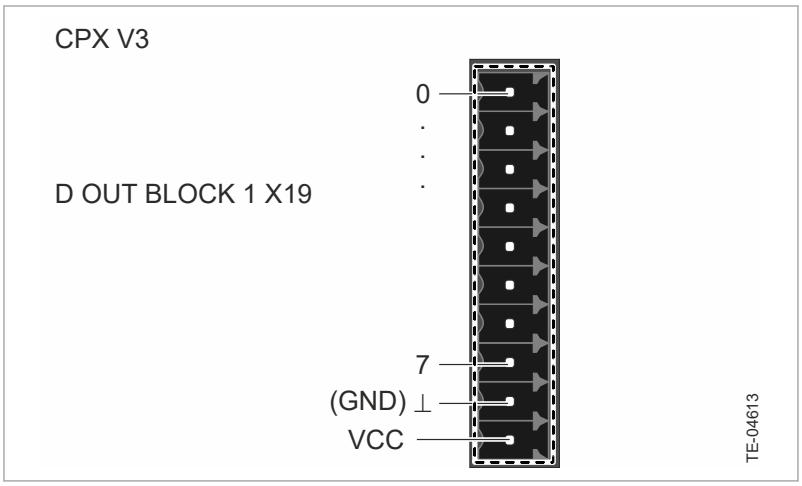
**D IN BLOCK3**




D IN BLOCK3 Fig. TE-04612

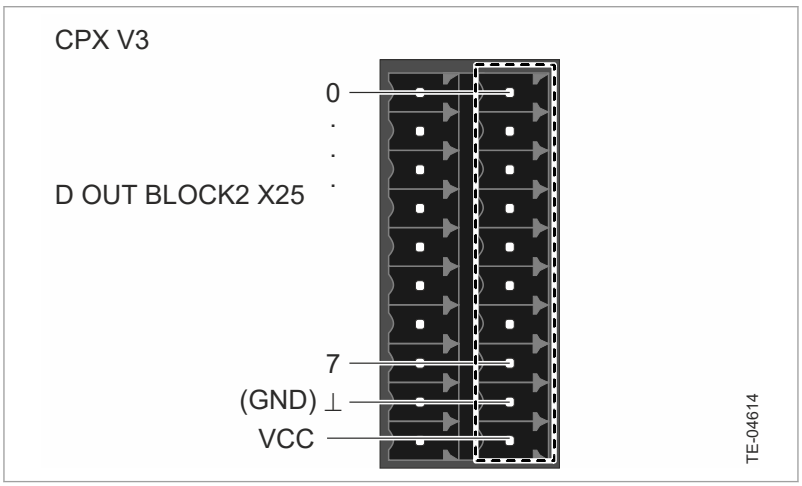
# Output channels

**D OUT BLOCK1**



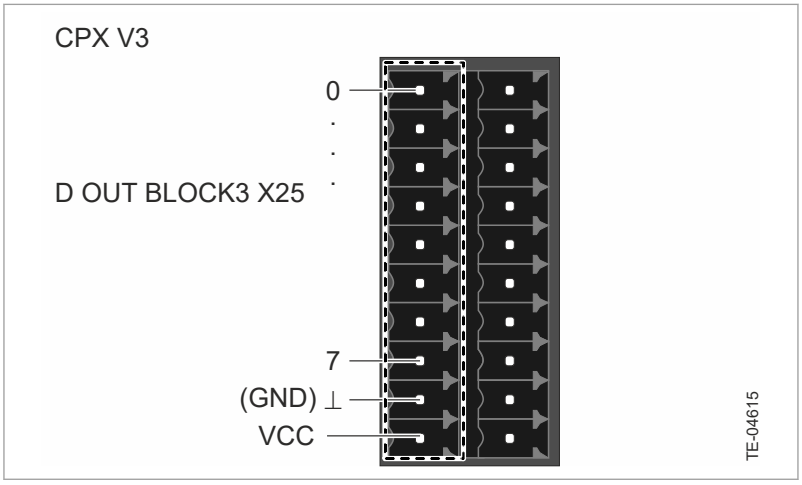

D OUT BLOCK1 Fig. TE-04613

**D OUT BLOCK2**



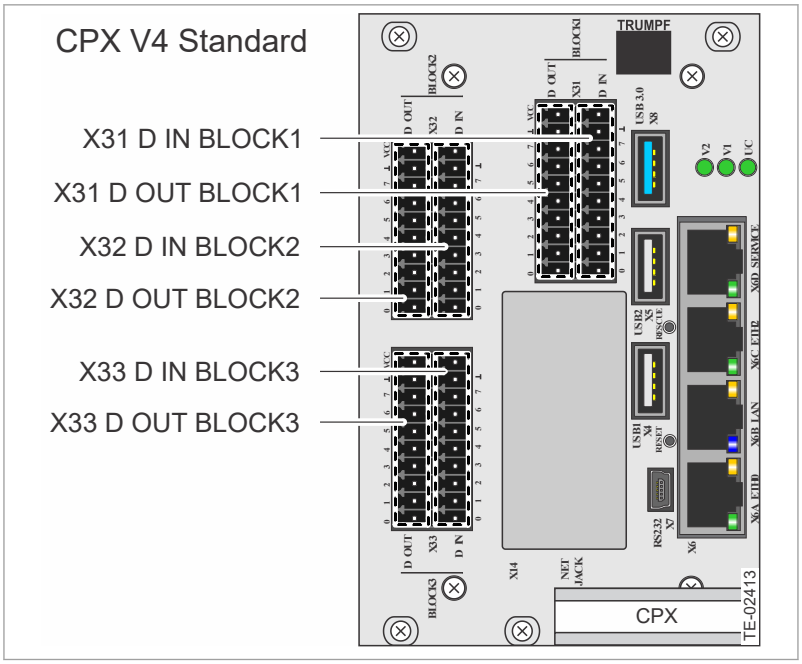

D OUT BLOCK2 Fig. TE-04614

**D OUT BLOCK3**




D OUT BLOCK3 Fig. TE-04615

## 1.2 Digital I/O interface of CPX V4 Standard



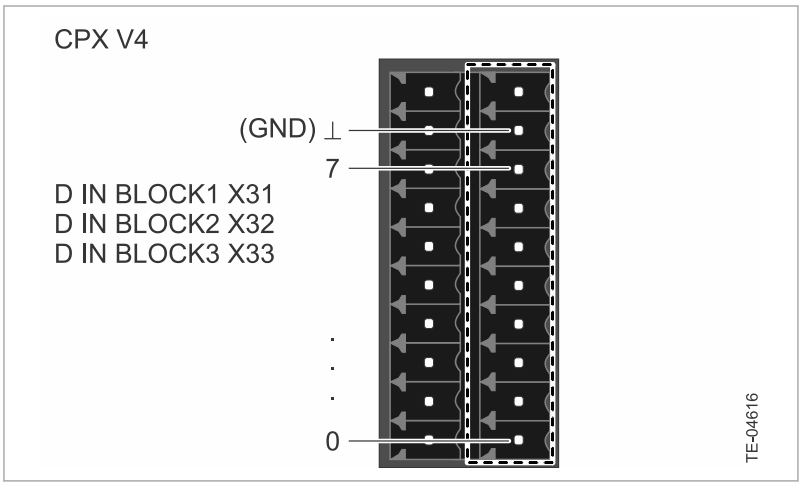

Digital inputs and outputs of the central processor (CPX V4 Standard) Fig. TE-02413

The connection of the digital I/O interface is located on the front plate of the central processor (CPX).

The digital inputs and outputs are distributed to 3 input and output channels.

## Input channels

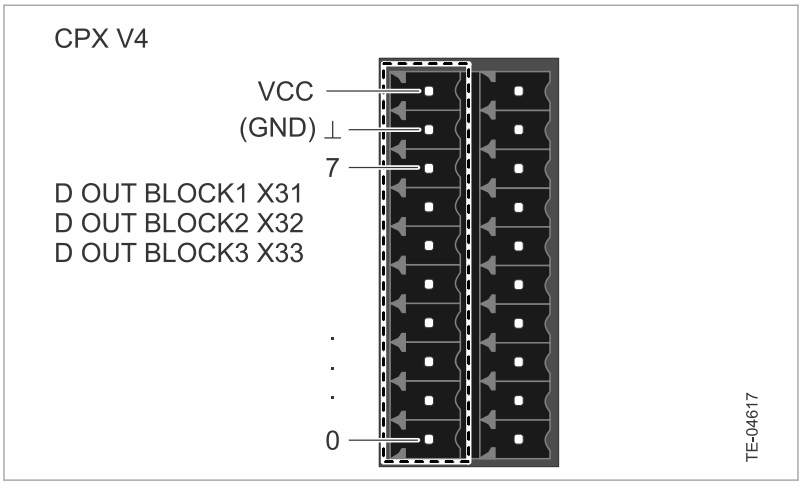
**D IN BLOCK1, 2, 3**




D IN BLOCK1, 2, 3 Fig. TE-04616

## Output channels

**D OUT BLOCK1, 2, 3**




D OUT BLOCK1, 2, 3 Fig. TE-04617

## 1.3 Possible digital I/O interface applications

The digital I/O interface can optionally be configured as:

- Parallel I/O interface with a real-time interface
- Real-time interfaces (max. 3)
- Sync I/O interface
- Decentralized I/O interface

## Functions of the Parallel-I/O interface

Via the parallel I/O interface, an external control (e.g. PLC) can:

- request the laser device.
- switch the laser on and off.
- select a laser program.
- start and end the selected laser program.
- synchronize the sequence of a laser program to external events.
- synchronize the external sequences to the sequence of a laser program.
- evaluate important status signals of the laser device.
- switch the laser off in the event of an external fault.
- acknowledge monitoring messages of the laser device.
- initialize the control unit of the laser device again after a fault.
- switch the pilot laser on and off (if existing).

If the parallel I/O interface is configured, then a real-time interface is also configured.

## Functions of the real-time interface

The real-time interface enables the following:

- triggering of individual laser pulses in realtime.
- starting laser program lines in real time.
- laser pulses or continuous wave laser power (cw) can be suppressed or enabled for a short time.

**Note**

Up to 3 real-time interfaces can be selected.

If the parallel I/O interface is configured, then a real-time interface is also configured.

## Functions of the Sync I/O interface

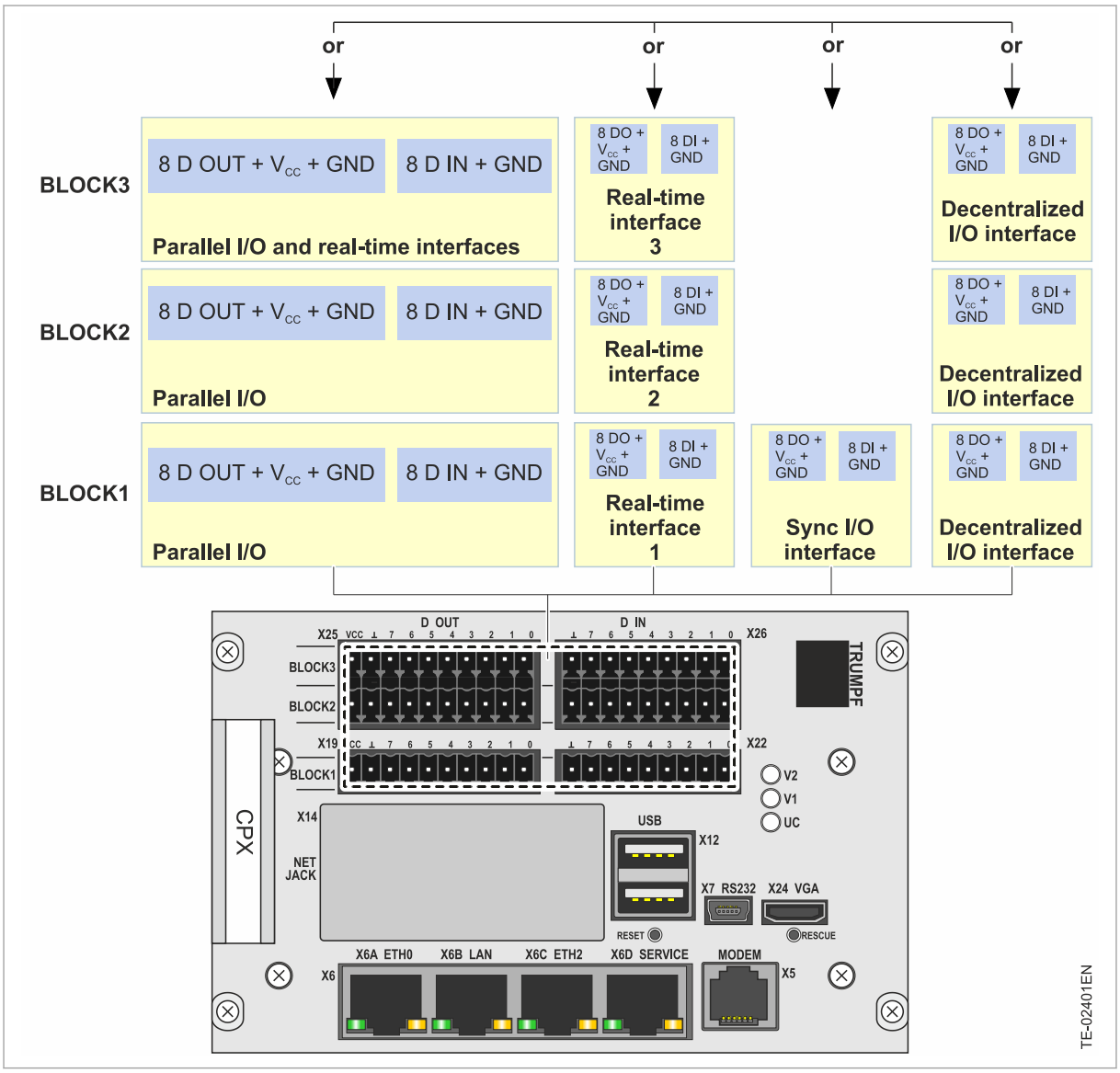
The Sync I/O interface allows to synchronize the the laser program sequence with external sequences.

If the sync I/O interface is selected, 6 parallel inputs are available as inquiry inputs and 6 parallel outputs as set outputs of the CPX. In laser programs, inquiry inputs can be evaluated and set outputs can be set via the parameter *Function*.

## Functions of the decentralized I/O interface

The digital I/O signals of the CPX via OPC are redirected to an external control via the decentralized I/O interface. The TruControl 1000 laser control can neither read inputs nor set outputs when this is the case.

## 1.4 Use of the digital inputs and outputs




Use of the digital inputs and outputs, example CPX V3 Fig. TE-02401

**Parallel I/O interface**

The digital inputs and outputs can be configured in TruControl 1000 as a parallel I/O interface via the >*Setup* >*Multi PLC interface (MPI)* >*Parallel* dialog (see "Configuring the parallel I/O interface", pg. 54).

The 3 digital input and output channels (24 digital inputs and 24 digital outputs) can optionally be used as follows:

- as parallel I/O interface with 20 digital inputs and 19 digital outputs distributed into 3 channels:
  - Channel 1:
    D IN / D OUT BLOCK1 (8 inputs and 8 outputs).
  - Channel 2:
    D IN / D OUT BLOCK2 (8 inputs and 8 outputs).
  - Channel 3:
    D IN / D OUT BLOCK3 (4 inputs and 3 outputs).
- As parallel I/O interface, together with a real-time interface, which are assigned to the 3 channels as follows:
  - Channels 1 and 2:
    D IN / D OUT BLOCK1 and D IN / D OUT BLOCK2 as parallel I/O interface with 16 digital inputs and 16 digital outputs.
  - Channel 3:
    D IN/D OUT BLOCK3 as real-time interface.
- As parallel I/O interface, with which inputs and outputs of channel 3 (20 digital inputs and 19 digital outputs) and the real-time interface of channel 3 can also be used.

  For the joint use of channel 3 as parallel I/O and real-time interface, it is required that the external power supply (VCC) and the reference voltages (GND) come from a common source for channel 3.

**Real-time interfaces**

Real-time interfaces can be assigned to an MPI interface in TruControl 1000 via the dialog >*Setup* >*Multi PLC interface (MPI )* >*New...* or >*Change...* (see "Assigning Real-timeinterface to an MPI interface", pg. 71). A real-time interface can be assigned to several MPI interfaces.

The 3 digital input and output channels (24 digital inputs and 24 digital outputs) can optionally be used as follows:

- As real-time interfaces (max. 3), which are assigned to the 3 channels as follows:
  - Channel 1: real-time interface 1 (D IN/D OUT BLOCK1).
  - Channel 2: real-time interface 2 (D IN/D OUT BLOCK2).
  - Channel 3: real-time interface 3 (D IN/D OUT BLOCK3).
- As parallel I/O interface, together with a real-time interface, see parallel I/O interface

**Sync I/O interface**

The sync I/O interface can be selected in TruControl 1000 via the *>Setup >Multi PLC interface (MPI)* dialog and the *Change properties* button.

Prerequisite:
The Sync I/O interface can only be selected if no other interface is configured.

The 3 digital input and output channels (24 digital inputs and 24 digital outputs) can be used as follows:

- as Sync I/O interface which is assigned to channel 1 as follows:
  - D IN BLOCK1 (6 inputs).
  - D OUT BLOCK1 (6 outputs).

**Decentralized I/O interface**

The decentralized I/O interface can be selected in TruControl 1000 via the *>Setup >Multi PLC interface (MPI)* dialog and the *Change properties* button.

Prerequisite:
The decentralized I/O interface can only be selected if no other interface is configured.

The 3 digital input and output channels (24 digital inputs and 24 digital outputs) are made available to an external control via OPC.

**TRUMPF peripheral bus**

If a parallel I/O interface is needed together with a Sync I/O interface, a decentralized I/O interface or more than one real-time interface, the parallel I/O interface can be realized with TRUMPF peripheral bus.

More information is given in the interface description **TRUMPF peripheral bus**, doc. no. 18-22-12-A1-BA.

**Electromagnetic compatibility (EMC)**

To ensure that the electromagnetic compatibility (EMC) requirements of the laser device are met, cables with shielding braid must be used and the shielding braid of the cables in the laser device's cable entry system must be connected with the ground terminals.
If there is no cable entry system or ground terminals, cables with conductive plug housings must be used, e.g. cables with Sub-D plugs. The shielding braid on the cable must be connected conductively to the plug housing.

# 2. Technical Data

| | |
|---|---|
| **Connector on the front plate of the CPX V3** | |
| X19 | MC 1.5/10-G-3.5 THT, 10-pole, pin<br>Cable plug: FMC 1.5/10-ST-3.5, 10-pole, socket, mat. no. 1433277 |
| X22 | MC 1.5/9-G-3.5 THT, 9-pole, pin<br>Cable plug: FMC 1.5/9-ST-3.5, 9-pole, socket, mat. no. 1433308 |
| X25 | MCDN 1.5/10-G1-3.5 P26THR, 2x10-pole, pin<br>Cable plug: FMCD 1.5/10-ST-3.5, 2x10-pole, socket, mat. no. 1764350 |
| X26 | MCDN 1.5/9-G1-3.5 P26THR, 2x9-pole, pin<br>Cable plug: FMCD 1.5/9-ST-3.5, 2x9-pole, socket, mat. no. 1764349 |
| **Connector on the front plate of the CPX V4 standard** | |
| X31<br>X32<br>X33 | 3 x MCDN 1.5/10-G1-3.5 P26THR, 2x10-pole, pin<br>Cable plug:<br>3 x FMCD 1.5/10-ST-3.5, 2x10-pole, socket, mat. no. 1764350 |
| **Digital inputs** | |
| Number | 24, distributed over 3 channels with 8 digital inputs each |
| Electrical isolation: | Between the inputs and the CPX as well as between the 3 channels |
| Reference voltage | One reference potential GND per channel |
| Reverse polarity protection | Available |
| Debouncing time | Programmable |
| Low level | ≤ +1.5 V |
| High level | +8 V ... +35 V |
| Input current | 5 mA |
| Input filter (CPX V3) | 10 kHz (limit frequency) |
| Maximum input frequency (CPX V4) | ≥ 100 kHz (dependent on the levels of the input voltage) |
| Input protection (ESD) | 1 kV |
| Insulation voltage | 1 kV (between input and CPX) |
| **Digital outputs** | |
| Number | 24, distributed over 3 channels with 8 digital outputs each |
| Electrical isolation: | Between the outputs and the CPX as well as between the 3 channels |
| Power supply and reference potential | One input each for external power supply VCC and one reference potential GND each per channel |
| Overtemperature protection | Output drivers are switched off at > 150°C |
| Maximum output frequency | 68 kHz (depending on the ohmic load) |
| Output current | max. 500 mA per channel |
| Overcurrent protection | In case of overcurrent, the output driver limits the current to 800 mA |
| External VCC power supply | +9.5 V ... +35 V |
| Undervoltage protection | If VCC ≤ +8.5 V, the output drivers are switched off |
| Insulation voltage | 1 kV (between output and CPX) |

Technical Data Tab. 2

# 3. Parallel I/O interface

## 3.1 Interfaces

### Pin assignment of the connector for input channel 1 (D IN BLOCK1)

A signal is active if the bit value is = "1".

| Pin | Signal name | Functions |
|---|---|---|
| 0 | EXT_ACTIVATION | **External activation**<br>The laser device is controlled via the Multi-PLC interface (fieldbus, OPC or parallel I/O interface). The laser control unit considers the following signals only if this signal is active. |
| 1 | RESET | **Reset**<br>Fault and monitoring messages are acknowledged. In case of fault, the control unit of the laser device is reinitialized. |
| 2 | LASER_ON | **Switching on the laser**<br>The laser power supply is turned on. |
| 3 | PROG_STOP | **End laser program**<br>A laser program started with the "PSTART_DYN" signal is aborted. |
| 4 | PSTART_DYN | **Dynamic program start**<br>Dynamical start of a laser program that is predefined via the signals PROGRAM_No: bit 6 to bit 0. |
| 5 | PROGRAM_No: bit 0 | **Program number (Bits 2 ... 0 )**<br>External control specifies the number of the laser program to be executed via the signals PROGRAM_No: Bit 6 to Bit 0.<br>Bits 4 ... 3: (see "Pin assignment of the connector for input channel 2 (D IN BLOCK2)", pg. 15)<br>Bits 6 ... 5: (see "Pin assignment of the connector for input channel 3 (D IN BLOCK3)", pg. 17)<br>Format: binary<br>Value of the Bits:<br>Bit 6 (high), Bit 0 (low )<br>Number of selectable laser programs: max. 127 dec<br>Example for program no. 19 hex:<br>0001 1001 = 19 hex = 25 dec |
| 6 | PROGRAM_No: bit 1 | |
| 7 | PROGRAM_No: bit 2 | |
| GND | GND | Reference voltage of the input channel D IN BLOCK1 |

Input channel 1 D IN BLOCK1 Tab. 3

Figure for connector CPX V3: (see "Fig. TE-04610", pg. 4), CPX V4 Standard: (see "Fig. TE-04616", pg. 7).

Signal description (see "Input signals", pg. 21).

### Pin assignment of the connector for input channel 2 (D IN BLOCK2)

A signal is active if the bit value is = "1".

| Pin | Signal name | Functions |
|---|---|---|
| 0 | LASER_STANDBY | **Activating the laser Standby mode**<br>Only required for laser devices with laser Standby mode. |
| 1 | PSTART_STATICAL | **Static program start**<br>Static start of a laser program defined in input word 1. |
| 2 | PROGRAM_No: bit 3 | **PROGRAM number (Bits 4 ... 3 )**<br>External control specifies the number of the laser program to be executed via the signals PROGRAM_No: Bit 6 to Bit 0.<br>Bit 2 ... 0: (see "Pin assignment of the connector for input channel 1 (D IN BLOCK1)", pg. 15)<br>Bit 6 ... 5: (see "Pin assignment of the connector for input channel 3 (D IN BLOCK3)", pg. 17) |
| 3 | PROGRAM_No: bit 4 | |
| 4 | INQUIRY_1 | **Query input 1**<br>The procedure of a laser program is synchronized to the state of this signal if the wait functions "W1H" or "W1L" are used in the laser program. |
| 5 | INQUIRY_2 | **Query input 2**<br>The procedure of a laser program is synchronized to the state of this signal if the wait functions "W2H" or "W2L" are used in the laser program. |
| 6 | PILOT_LASER_ON | **Switching on the pilot laser**<br>The pilot laser is always switched on even if the laser device has not been assigned. |
| 7 | REQUEST_LASER | **Requesting the laser**<br>The laser device is requested by an external control unit. |
| GND | GND | Reference voltage of the input channel D IN BLOCK2 |

Input channel 2 D IN BLOCK2 Tab. 4

Figure for connector CPX V3: (see "Fig. TE-04611", pg. 4), CPX V4 Standard: (see "Fig. TE-04616", pg. 7).

Signal description (see "Input signals", pg. 21).

# Pin assignment of the connector for input channel 3 (D IN BLOCK3)

A signal is active if the bit value is = "1".

| Pin | Signal name | Functions |
|---|---|---|
| 0 | - | **Reserved**<br>Inputs Pin 0 ... Pin 3 are reserved for the real-time interface (see "Pin assignment of a real-time interface", pg. 59). |
| 1 | - | |
| 2 | - | |
| 3 | - | |
| 4 | FAULT_EXT | **External fault**<br>The laser is switched off and active laser programs are cancelled. |
| 5 | PROGRAM_No: bit 5 | **PROGRAM number (Bits 6 ... 5 )**<br>External control specifies the number of the laser program to be executed via the signals PROGRAM_No: Bit 6 to Bit 0.<br>Bit 2 ... 0: (see "Pin assignment of the connector for input channel 1 (D IN BLOCK1)", pg. 15)<br>Bit 4 ... 3: (see "Pin assignment of the connector for input channel 2 (D IN BLOCK2)", pg. 15) |
| 6 | PROGRAM_No: bit 6 | |
| 7 | LOCK_OPERATING_ PANEL | **Locking the operating panel**<br>The operating panel can only be used as display. |
| GND | GND | Reference voltage of the input channel D IN BLOCK3 |

Input channel 3 D IN BLOCK3 Tab. 5

### Note

Input channel 3 can be used both as a parallel I/O interface and real-time interface if both interfaces have the same reference potential (GND).

Figure for connector CPX V3: (see "Fig. TE-04612", pg. 4), CPX V4 Standard: (see "Fig. TE-04616", pg. 7).

Signal description (see "Input signals", pg. 21).

# Pin assignment of the connector for output channel 1 (D OUT BLOCK1)

A signal is active if the bit value is = "1".

| Pin | Signal name | Function |
|---|---|---|
| 0 | PROG_COMPLETED | **Laser program is completed**<br>A laser program has been run and is completed. |
| 1 | FAULT_LASER | **A fault message of the laser device is active**<br>A limit value for malfunction is outside the permitted range. |
| 2 | LASER_READY | **The laser of the laser device is ready**<br>The laser of the laser device is ready to generate laser power. |
| 3 | PROG_ACTIVE | **Laser program is active**<br>A laser program has been started and is being executed. |
| 4 | MONITORING | **A monitoring message of the laser device is active**<br>A limit value for monitoring is outside of the permitted range. |
| 5 | PROG_CANCELLED | **Laser program has been cancelled**<br>A laser program has been cancelled during execution. |
| 6 | LIGHT_PATH_No: Bit 0 | **Light path number (bits 1 and 0)**<br>The external control unit outputs the number of the set light path via the signals LIGHT_PATH_No: bit 2 to bit 0.<br>Bit 2: (see "Pin assignment of the connector for output channel 2 (D OUT BLOCK2)", pg. 19)<br>Significance of the bits:<br>bit 2 (high), bit 0 (low)<br>Number of light paths: max. 6 |
| 7 | LIGHT_PATH_No: Bit 1 | |
| GND | GND | Reference voltage of the output channel D OUT BLOCK1 |
| VCC | VCC | External voltage supply of the output channel D OUT BLOCK1 |

Output channel 1 D OUT BOCK1 Tab. 6

Figure for connector CPX V3: (see "Fig. TE-04613", pg. 5), CPX V4 Standard: (see "Fig. TE-04617", pg. 7).

Signal description (see "Output signals", pg. 31).

# Pin assignment of the connector for output channel 2 (D OUT BLOCK2)

A signal is active if the bit value is = "1".

| Pin | Signal name | Function |
|---|---|---|
| 0 | LASER_IS_ON | **The laser of the laser device is switched on**<br>The laser can now generate laser light. |
| 1 | EXT_ACTIVATION_ ACTIVE | **External activation is active**<br>The laser device can be controlled by an external control (e.g. PLC) via a Multi-PLC interface (fieldbus, OPC or parallel I/O interface). |
| 2 | LIGHT_PATH_No: Bit 2 | **Light path number (bit 2)**<br>The external control unit outputs the number of the set light path via the signals LIGHT_PATH_No: bit 2 to bit 0 (see "Pin assignment of the connector for output channel 1 (D OUT BLOCK1)", pg. 18). |
| 3 | SIK_OPEN | **The safety circuit (SIK) is open**<br>The safety circuit (SIK) of a shutter or of a shutter switch in the selected light path is interrupted. |
| 4 | SET_1 | **Set outputs 1 and 2**<br>External sequences can be synchronized with the sequence of a laser program if set functions (S1H, S1L, S2H, S2L) are used in the laser programs. |
| 5 | SET_2 | |
| 6 | POWER_LIMIT | **The power limit of the laser has been reached**<br>The state can be corrected by adapting the laser parameters. |
| 7 | LASER_ASSIGNED | **The laser device is assigned to an external control unit**<br>Acknowledgement of the input signal "REQUEST_LASER". |
| GND | GND | Reference voltage of the output channel D OUT BLOCK2 |
| VCC | VCC | External voltage supply of the output channel D OUT BLOCK2 |

Output channel 2 D OUT BLOCK2 Tab. 7

Figure for connector CPX V3: (see "Fig. TE-04614", pg. 5), CPX V4 Standard: (see "Fig. TE-04617", pg. 7).

Signal description (see "Output signals", pg. 31).

# Pin assignment of the connector for output channel 3 (D OUT BLOCK3)

A signal is active if the bit value is = "1".

| Pin | Signal name | Function |
|---|---|---|
| 0 | - | **Real-time interface**<br>The outputs Pin 0 ... Pin 4 are reserved for the real-time interface (see "Pin assignment of a real-time interface", pg. 59). |
| 1 | - | |
| 2 | - | |
| 3 | - | |
| 4 | - | |
| 5 | PILOT_LASER_IS_ON | **Pilot laser is switched on**<br>At least one pilot laser is switched on. |
| 6 | LASER_WARNING_ LAMP_IS_ON | **The laser warning lamp is on**<br>The capacitors of the laser device contain enough energy to allow laser light to be generated. |
| 7 | - | **Reserve** |
| GND | GND | Reference voltage of the output channel D OUT BLOCK3 |
| VCC | VCC | External voltage supply of the output channel D OUT BLOCK3 |

Output channel 3 D OUT BLOCK3 Tab. 8

Figure for connector CPX V3: (see "Fig. TE-04615", pg. 5), CPX V4 Standard: (see "Fig. TE-04617", pg. 7).

Signal description (see "Output signals", pg. 31).

## 3.2 Signal descriptions of the parallel I/O interface

# Input signals

### EXT_ACTIVATION

| | |
|---|---|
| **Functions** | Input signal determines if the laser is controlled:<br>▪ from the operating panel (OP).<br>▪ by an external control unit (e.g. PLC). |
| **Active signal** | The laser can be operated by an external control unit.<br>The following functions can be executed via the operating panel:<br>▪ it is NOT possible to start laser programs.<br>▪ laser parameters can be transferred to the laser device.<br>▪ messages can be acknowledged. |
| **Feedback** | With active input signal **EXT_ACTIVATION**, the output signal **EXT_ACTIVATION_ACTIVE** is activated. |
| **Information** | A laser device is only assigned to an external control unit if it is requested via the input signal **REQUEST_LASER**.<br>When, additionally, the **LOCK_OPERATING_PANEL** input signal is active, laser parameters can no longer be transferred to the laser device via the operating panel. |

Tab. 9

### FAULT_EXT

| | |
|---|---|
| **Function** | The external control reports an error in the environment of the installation. |
| **Active signal** | The laser device carries out the following actions:<br>▪ The central shutter is closed.<br>▪ The laser has been switched off.<br>▪ Laser pulses are interrupted immediately.<br>▪ The active laser program is cancelled.<br>▪ The power supply to the following components is switched off:<br>– Pump sources<br>– Cooling unit<br>– Optical components<br>▪ Laser standby mode is ended (only for laser devices with laser standby mode). |
| **Feedback** | A monitoring message is displayed.<br>The output signal **MONITORING** becomes active. |
| **Information** | The laser device can only be controlled again via the interface when the **RESET** input signal has been activated. If TruControl version ≥ 3.10.0, the input signal **FAULT_EXT** must be deactivated beforehand.<br>**Note:**<br>A fault message is **not** displayed, and the output signal **FAULT_LASER** is **not** activated. |

Tab. 10

## INQUIRY_1 and INQUIRY_2

| | |
|---|---|
| **Function** | Both input signals **INQUIRY_1** and **INQUIRY_2** allow synchronization of the sequence of a laser program to external sequences. |
| **Information** | If a line of the laser program contains a maintenance instruction (W1H, W1L, W2H or W2L), this line is not processed until the respective input signal **INQUIRY_1** (with W1H, W1L) or **INQUIRY_2** (with W2H, W2L) adopts the required state (high or low). |

Tab. 11

## LASER_ON

| | |
|---|---|
| **Functions** | The laser power supply is turned on. |
| **Active signal** | The laser power supply is switched on. Laser light is not yet generated. |
| **Feedback** | About 5 – 10 s after activation of the **LASER_ON** input signal, the output signals **LASER_IS_ON** and **LASER_READY** are activated simultaneously.<br>**Laser device with laser standby mode:**<br>About 8 – 15 s after activation of the **LASER_ON** input signal, the **LASER_IS_ON** output signal is activated. |
| **Information** | The laser power supply remains switched on as long as the input signal **LASER_ON** is active.<br>If the output signal **LASER_READY** is active, a laser program can be started.<br>**Notes:**:<br>▪ The laser must not be switched on and off cyclically (multiple times per minute).<br>Switching off and on in succession is allowed once, e.g. if ALIGNMENT_RECOMMENDED is active .<br>▪ The laser device is also switched on by the signal **LASER_ON** if:<br>– the external activation is not active (output signal **EXT_ACTIVATION_ACTIVE** is inactive).<br>– the laser device is not assigned to the external control unit (output signal **LASER_ASSIGNED** is inactive).<br>▪ **TruDisk, TruDiode**<br>When the cooling water temperature of the series TruDisk and TruDiode laser devices is below a certain threshold value, the laser cannot be switched on within the time mentioned above. The cooling water can be heated up to reduce the waiting time.<br>Heating of the cooling water is activated automatically by the **LASER_ON** signal or via the *Laser* button in the *>Manual mode* main operation.<br>Heating of the cooling water is aborted or not activated if the switching function *Force manual operation* is active or if a user is registered at the laser control with user level ≥ 70.<br>The main operation *>Manual mode* and the function *Force manual operation* are described in the Software manual "TruControl 1000", doc. no. 10-06-80-A1-CR.<br>▪ **Laser device with laser standby mode:**<br>If the **LASER_IS_ON** output signal is active, the laser device can be switched to the laser standby mode by activating the **LASER_STANDBY** input signal. About 2 – 5 s after activation of the **LASER_STANDBY** input signal, the **LASER_READY** output signal is activated. |

Tab. 12

## LASER_STANDBY

| | |
|---|---|
| **Functions** | **Activating the laser standby mode.**<br>The laser power is stabilized in the laser standby mode.<br>This signal is only required for laser devices with laser standby mode. |
| **Active signal** | The laser power defined for the laser standby mode is generated without regulation and conducted from the central shutter into the absorber. |
| **Feedback** | About 2 – 5 s after activation of the **LASER_STANDBY** input signal, the **LASER_READY** output signal is activated. |
| **Using the signal** | On the basis of the following case description you can find out whether the data about the laser standby mode are relevant for your situation:<br>▪ When a laser device with CPX control without laser standby mode is prepared for its use, the information on the laser standby mode in this interface description can be ignored.<br>▪ When a laser device with CPX control with laser standby mode is prepared for its use, please observe the information on the laser standby mode in this interface description.<br>▪ You replace an older laser device with LCU control and laser standby mode with a laser device with CPX control without laser standby mode. Their task is to adapt existing control programs to an external control (e.g. PLC).<br>– In this case, you are often able to continue using the existing control programs without change, in particular if you wait for the LASER_READY signal to continue a process. The LASER_STANDBY signal is inactive.<br>– The standby line must be removed in laser programs which you want to copy from the old to the new laser device. The opening and closing of the central shutter must be programmed explicitly. Further information:<br>Technical information "TruControl 1000 for new users", Doc.-No. 21-A0-57-CP. |
| **Information** | ▪ If the **LASER_READY** output signal is active, a laser program can be started. The laser standby mode remains active as long as the signal **LASER_STANDBY** is active.<br>▪ The function **Stdby** has been automatically entered in the first line of the second column of a laser program.<br>▪ The service life of the pump sources (lamps or laser diodes) can be increased and the power required by the laser can be reduced if laser standby mode is switched off during long waiting times between laser programs.<br>▪ The laser device is also switched to the laser standby mode by the signal **LASER_STANDBY** if:<br>– the external activation is not active (**EXT_ACTIVATION_ACTIVE** inactive).<br>– the laser device has not been assigned to the external control unit (output signal **LASER_ASSIGNED** inactive). |

Tab. 13

## LOCK_OPERATING_PANEL

| | |
|---|---|
| **Functions** | The laser device cannot be controlled any longer via the operating panel (OP). |
| **Active signal** | The following functions can be executed via the operating panel:<br>▪ laser parameters can no longer be transferred to the laser device.<br>▪ messages can further be acknowledged. |
| **Feedback** | None |
| **Information** | An active input signal **LOCK_OPERATING_PANEL** is only considered if the input signal **EXT_ACTIVATION** is active and if the laser device has been assigned. |

Tab. 14

## PILOT_LASER_ON

| | | |
|---|---|---|
| **Functions** | Switching the pilot laser of the laser device on and off. | |
| **Active signal** | The pilot laser is switched on. | |
| **Inactive signal** | Pilot laser is switched off. | |
| **Feedback** | The **PILOT_LASER_IS_ON** output signal becomes active when a pilot laser of the laser device is switched on. | |
| **Information** | The input signal **PILOT_LASER_ON** and the software function "Pilot laser on" in the dialog are linked by OR. | |
| | Different hardware types can exist in a laser device as pilot laser. The existing hardware type is defined as follows in the dialog *>Setup >System settings >PilotLaserType*:<br>1 = Central pilot laser<br>2 = Pilot laser in shutter switch (VW..)<br>3 = Pilot laser in central shutter (VZ) | |
| | The following pilot laser modes can be selected in dialog *>Setup >System settings >PilotLaserMode* for a pilot laser of the hardware type 2 (pilot laser in shutter switch): | |
| | 0 = | Pilot laser is constantly off. |
| | 1 = | The pilot laser is on when the shutter switch is in the neutral position. |
| | 2 = | The pilot laser is on when the safety circuit is open. |
| | 3 = | When the shutter switch is closed, the pilot laser is switched on:<br>▪ via the dialog *>Producing >Light path overview >Pilot laser overview*<br>▪ **or** or when the **PILOT_LASER_ON** input signal is active. |
| | 4 = | Pilot laser is switched on when the safety circuit is open:<br>▪ via the dialog *>Producing >Light path overview >Pilot laser overview*<br>▪ **or** or when the **PILOT_LASER_ON** input signal is active. |
| | 5 = | The pilot laser is switched on:<br>▪ via the dialog *>Producing >Light path overview >Pilot laser overview*<br>▪ **or** or when the **PILOT_LASER_ON** input signal is active. |
| **General condition** | The following boundary condition additionally applies with pilot laser modes 3 ... 5:<br>▪ An external control sends a valid program number to the control unit of the laser device via a Multi-PLC interface (fieldbus, OPC or parallel I/O interface)<br>– with fixed preset light path in the laser program (e.g. light path = 2).<br>– **or** with external preset light path (light path = IW) and defines the number of the light path in the input word 1.<br>The following boundary condition additionally applies to the pilot laser mode 4:<br>▪ The safety circuit (SIK) is open.<br>**Exceptions:**<br>If an external control:<br>▪ sends a program no. "0", the last program no. unequal "0" will be used.<br>▪ sends a light path no. "0", the last light path no. unequal "0" will be used. | |
| | The pilot laser is switched off irrespective of the pilot laser mode set if the 1-channel safety circuit (ASV3, X24 connector) is used for internal functions (e.g. protection of laser light cable in the user's compartment) **and** this is interrupted. | |

Tab. 15

## PROG_STOP

| | |
|---|---|
| **Functions** | Running laser programs can be ended or canceled. |
| **Active signal** | **Canceling laser program:**<br>A running laser program is canceled when the following conditions are fulfilled:<br>▪ The input signal **PROG_STOP** is activated for > 1 ms<br>**and**<br>▪ in the laser program **Pulse type** ≠ "Continuous wave" (for cw lasers) and **Number of pulses** ≠ ∞ (pulse number = not continuous) is set.<br>**Ending laser program:**<br>A running laser program is ended when the following conditions are fulfilled:<br>▪ The input signal **PROG_STOP** is activated for > 1 ms<br>**and**<br>▪ in the laser program **Pulse type** = "Continuous wave" (for cw lasers) or **Number of pulses** = ∞ (pulse number = continuous) is set. |
| **Feedback** | **Laser program canceled:**<br>▪ Output signal **PROG_ACTIVE** becomes inactive.<br>▪ A monitoring message is displayed.<br>▪ The output signals **MONITORING** and **PROG_CANCELLED** become active.<br>The output signal **PROG_COMPLETED** is not activated because the laser program has not been completely executed.<br>**Laser program completed:**<br>The **PROG_ACTIVE** output signal becomes inactive and the **PROG_COMPLETED** output signal becomes active for approx. 6 s.<br>If, before the 6 s have expired, a change in assignment takes place, and the **PLC_ClearProgCompletedOnSlotChange** system parameter is 1, the **PROG_COMPLETED** signal will be set to inactive. |
| **Information** | A canceled laser program cannot be continued.<br>When the **PROG_STOP** input signal is active,<br>and a laser program is supposed to be started:<br>▪ a monitoring message is displayed.<br>▪ the output signal **MONITORING** becomes active.<br>▪ the laser program is not started. |

Tab. 16

## PROGRAM_No: Bit 6 ... Bit 0

| | |
|---|---|
| **Functions** | Using the 7 input signals **PROGRAM_No: Bit 6 ... Bit 0** the laser program to be started is selected. |
| **Coding of the program no.** | The significance of the 7 input signals is defined from **PROGRAM_No: Bit 6** (high) to **PROGRAM_No: Bit 0** (low).<br>Format: Hexadecimal.<br>Program number 0 is used to set the laser device to a defined status if all signals are set to 0. For a laser program to be created with program number 0, the system parameter **min. program no.** in the >*Setup* >*Program setting* menu must be set to 0.<br>Number of selectable laser programs: 127 dec = 7F hex, without program number 0. |
| **Feedback** | If, during program start, an inadmissible program number is applied by the input signals **PROGRAM_No: bit 6 ... bit 0**:<br>▪ a monitoring message is displayed.<br>▪ the output signal **MONITORING** becomes active.<br>▪ no laser program is started. |
| **Information** | The input signals **PROGRAM_No: bit 6 ... Bit 0** are read when the input signal **PSTART_STATICAL** or **PSTART_DYN** has been activated.<br>The next program number may already be created when the **PROG_ACTIVE** output signal is active after the start of a laser program.<br>**Note:**<br>When the **PROG_COMPLETED** signal becomes active after the completion of a laser program and the new program number is already at hand, the control unit keeps the **LASER_READY** signal inactive until the optical components are set to the light path of the new laser program.<br>If in a laser device of the TruMicro 5000 series the basic frequency in the new laser program was changed, the signal **LASER_READY** will remain active until the new basic frequency has been set, which may take up to 30 sec. |

Tab. 17

## PSTART_DYN

| | |
|---|---|
| **Functions** | Laser programs can be started by a short impulse of > 1 ms. |
| **Active signal** | A laser program is started by the ascending edge of the **PSTART_DYN** input signal when the **LASER_READY** output signal is active.<br><br>The program number is read at the start of the laser program. To do so the program number must be continuously available to the inputs signals **PROGRAM_No: bit 0 ... bit 6**.<br><br>**Notes:**:<br><br>▪ If an attempt is made to start a laser program while the **LASER_READY** output signal is inactive, a monitoring message is displayed and the **MONITORING** output signal is activated.<br>▪ The **PSTART_DYN** input signal is triggered by the signal edges and starts a laser program only once. Before starting a program again, the input signal must be switched to inactive for at least 50 ms. |
| **Feedback** | The **PROG_ACTIVE** output signal is activated if a laser program is started and remains active until the laser program is completed or canceled.<br><br>The **PROG_COMPLETED** output signal is activated for approx. 6 s after the laser program has been completed.<br><br>The **PROG_COMPLETED** output signal becomes prematurely inactive if, before the 6 s have expired,<br><br>▪ a laser program is started again<br>▪ a change in assignment takes place, and the **PLC_ClearProgCompletedOnSlotChange** system parameter is 1<br><br>The output signals **MONITORING** and **PROG_CANCELLED** become active if a laser program is canceled. |
| **Information** | The delay in time from the activation of the **PSTART_DYN** input signal to the delivery of the laser power at the processing point is called laser delay time (LEZ).<br><br>**LEZ for pulsed lasers:**<br>35 ... 55 ms, if optical components are moved, depending on the optical components used.<br>15 ... 20 ms, if the optical components are already set correctly.<br>< 1 ms depending on the times set per software for delay and debouncing time (see "Configuring the real time interface", pg. 69) if the functions of the real-time interface are used.<br><br>**LEZ for laser devices with laser standby mode:**<br>35 ... 55 ms (opening time of the shutter)<br><br>If the input signal **PSTART_DYN** or **PSTART_STATCAL** is activated during the execution of a laser program:<br><br>▪ a fault message will be displayed.<br>▪ the output signals **MONITORING** and **FAULT_LASER** will be activated.<br>▪ the running laser program will be cancelled.<br>▪ the output signal **PROG_CANCELLED** will be activated.<br><br>**Note:**<br>If the **Pulse type** = "Continuous wave" is active (for CW lasers) or the **Pulse number** = ∞ ("Continuous") is active within the laser program, the laser program can only be ended by activating the input signal **PROG_STOP**. |

Tab. 18

## PSTART_STATICAL

| | |
|---|---|
| **Functions** | Laser programs can be started, ended or cancelled. |
| **Active signal** | A laser program is started when:<br>▪ the input signal **PSTART_STATICAL** is active for > 1 ms **and**<br>▪ the output signal **LASER_READY** is active.<br>The program number is read at the start of the laser program. To do so the program number must be continuously available to the inputs signals **PROGRAM_No: bit 0 ... bit 6**.<br>**Note:**<br>If an attempt is made to start a laser program while the **LASER_READY** output signal inactive, a monitoring message is displayed and the **MONITORING** output signal is activated. |
| **Setting signal to inactive** | **Ending a laser program:**<br>A laser program started with **PSTART_STATICAL** is ended when:<br>▪ the **PSTART_STATICAL** input signal is set to inactive prior to the end of the laser program<br>▪ **and** in the laser program **Pulse type** "Continuous wave" is active (for CW lasers) or **Pulse number** = ∞ ("Continuous") is active.<br>**Canceling a laser program:**<br>A laser program started with **PSTART_STATICAL** is cancelled when:<br>▪ the **PSTART_STATICAL** input signal is set to inactive prior to the end of the laser program<br>▪ **and** in the laser program **Pulse type** "Continuous wave" is not active (for CW lasers) and **Pulse number** = ∞ ("Continuous") is not active. |
| **Feedback** | The **PROG_ACTIVE** output signal is activated if a laser program is started and remains active until the laser program is completed or canceled.<br>The **PROG_COMPLETED** output signal is activated after the laser program has ended.<br>The output signals **MONITORING** and **PROG_CANCELLED** become active if a laser program is canceled. |
| **Information** | The delay in time from the activation of the **PSTART_STATICAL** input signal to the delivery of the laser power at the processing point is called laser delay time (LEZ).<br>**LEZ for pulsed lasers:**<br>35 ... 55 ms, if optical components are moved, depending on the optical components used.<br>15 ... 20 ms, if the optical components are already set correctly.<br>< 1 ms depending on the times set per software for delay and debouncing time (see "Configuring the real time interface", pg. 69) if the functions of the real-time interface are used.<br>**LEZ for laser devices with laser standby mode:**<br>35 ... 55 ms (opening time of the shutter)<br>When the **PSTART_DYN** input signal is activated while a laser program that was started with the PSTART_STATICAL input signal is running:<br>▪ no static program start is executed.<br>▪ a monitoring message is displayed.<br>▪ the output signal **MONITORING** becomes active. |

Tab. 19

## REQUEST_LASER

| | |
|---|---|
| **Function** | request the laser device. |
| **Active signal** | The laser device is requested by an external control unit. |

| | |
|---|---|
| **Feedback** | If the laser device has been assigned to the requesting external control unit, the output signal **LASER_ASSIGNED** becomes active. |
| **Information** | **The laser device is connected to only one external control unit:**<br>If only one external control unit is connected to the laser device, the input signal **REQUEST_LASER** must be activated by an external control unit as long as the external control unit controls the laser device. The **REQUEST_LASER** signal can also be set to permanently active in this case.<br><br>**The laser device is connected with two or more external controls via additional Multi-PLC interfaces (e.g. fieldbus, OPC or parallel I/O interface):**<br>If two or more external controls are connected to the laser device, the input signal **REQUEST_LASER** must be activated by an external control for as long as the laser device is controlled by the external control. This guarantees that the laser device can be assigned to other external control units.<br><br>**Assignment procedure**<br>The assignment of the laser is carried out according to priority and in case of the same priority according to the round robin algorithm. The assignment process is described in detail in a separate section<br><br>**Optimized standby mode**<br>If the input signal **LASER_ON** is active and the input signal **REQUEST_LASER** remains inactive for a certain time, Optimized standby mode is activated.<br><br>Optimized standby mode is described in detail in a separate document (see "Saving energy", pg. 53). |

Tab. 20

## RESET

| | |
|---|---|
| **Function** | Acknowledges laser device messages and initializes the laser device control again when a malfunction has occurred. |
| **Active signal** | The Reset function is carried out when the **RESET** input signal is active for > 1 ms. |
| **Feedback** | **With “Monitoring”:**<br>▪ Output signal **MONITORING** becomes inactive.<br>▪ The displayed monitoring message is deleted.<br>▪ The laser program is continued.<br>**With "Monitoring" and "Program cancelled":**<br>▪ Output signal **MONITORING** becomes inactive.<br>▪ The displayed monitoring message is deleted.<br>▪ Output signal **LASER_READY** becomes active.<br>▪ The laser programs can be started.<br>**With “Monitoring” and “Laser fault”:**<br>The laser control unit is initialized again.<br>**Note:**<br>If no fault has occurred during initialization, the laser can be switched on again via the interface and the operation can be continued. |
| **Information** | The signal RESET and the message behavior are influenced by different system parameters. This is described in detail in a separate section (see "Messaging and RESET behavior", pg. 50).<br>If the frequency of monitoring and fault messages increases, maintenance and repair measures may be necessary. |

Tab. 21

# Output signals

## EXT_ACTIVATION_ACTIVE

| | |
|---|---|
| **Function** | Acknowledgement signal of the **EXT_ACTIVATION** input signal. |
| **Active signal** | The laser device can be controlled via the Multi PLC interface (fieldbus, OPC or parallel I/O interface). |
| **Information** | As long as the **LOCK_OPERATING_PANEL** input signal is not active, laser parameters and laser programs can continue to be modified on the operating panel (OP). |

Tab. 22

## FAULT_LASER

| | |
|---|---|
| **Function** | The output signal indicates a fault of the laser device. |
| **Active signal** | The laser device control activates the **FAULT_LASER** output signal when a fault limit value for electrical or optical components has been exceeded. |
| **Information** | The displayed message indicates possible causes of the fault.<br>By activating the **RESET** input signal:<br>▪ the displayed message is reset.<br>▪ the output signals **MONITORING** and **FAULT_LASER** are set to inactive.<br>▪ the control unit of the laser device is initialized again.<br>**Note:**<br>If a fault occurs repeatedly, the cause of the fault must be eliminated first.<br>The message behavior and the RESET signal are influenced by different system parameters. This is described in detail in a separate section (see "Messaging and RESET behavior", pg. 50). |

Tab. 23

## LASER_ASSIGNED

| | |
|---|---|
| **Functions** | Acknowledgement signal of the **REQUEST_LASER** input signal. |
| **Active signal** | The laser device is assigned to the requesting external control unit.<br><br>The external control unit receives in the output words status data from the laser. |
| **Assignment process** | The assignment of the laser is carried out according to priority and in case of the same priority according to the round robin algorithm. A priority parameter is assigned to every MPI slot. The value range of the **Priority** parameter is from 0 to 255. The higher the value, the higher the priority of the MPI slot.<br><br>Further information: (see "Configuring the parallel I/O interface", pg. 54).<br><br>If several MPI slots with different priorities have activated the REQUEST_LASER signal, the MPI slot with the highest priority is assigned.<br><br>If several MPI slots with the same priority have activated the REQUEST_LASER signal, the assignment is performed in accordance with the round robin algorithm: in the numerical order of the MPI slots. The assignment process starts at MPI slot 1. As soon as the assignment has finished processing the MPI slots used, it starts again at MPI slot 1.<br>Example for the round robin algorithm:<br>The laser is assigned to the external control unit at the MPI slot 1. The MPI slots 1, 2, 3 and 5 have the same priority value. The external control units at the MPI slots 2, 5 and 3 request the laser one after another. As soon as the external control unit releases the laser at MPI slot 1, the external control unit receives the assignment at MPI slot 2. If this control unit releases the laser, the external control unit at MPI slot 3 is processed and not the external control unit at MPI slot 5. The external control unit at MPI slot 5 receives the assignment as soon as the external control unit at MPI slot 3 releases the laser.<br>If the external control unit at MPI slot 1 sends a request to the laser in the meantime, this request is processed only after release of the external control unit at MPI slot 5. |
| **Information** | When the **LASER_READY** output signal is also active, the external control unit can start laser programs.<br><br>An external control unit can start a laser program of type "No pulse triggering", even if the laser device is not assigned to the external control unit.<br><br>The output mask can be used to define what status signals of the laser are received by the external control even if the **LASER_ASSIGNED** signal is not active.<br>Further information: (see "Configuring the parallel I/O interface", pg. 54). |

Tab. 24

## LASER_IS_ON

| | |
|---|---|
| **Functions** | Acknowledgement signal of the **LASER_ON** input signal. |
| **Active signal** | The laser is on. |
| **Information** | The output signal remains active as long as the laser is switched on. If there is a fault with the laser device, the laser device is automatically switched off.<br><br>**Note**<br>The output signal remains inactive as long as the output signal **CALIBRATION/SELF_TEST** is active.<br><br>If the **LASER_READY** output signal is also active, laser programs can be started.<br><br>**Laser device with laser standby mode:**<br>The laser device can be switched to the laser standby mode by activating the **LASER_STANDBY** input signal.<br><br>**Energy Save Concept** or **Sleep mode**<br>If the laser control unit activates an Energy Save Level or Sleep mode, the output signals **LASER_READY** and **LASER_IS_ON** are deactivated.<br>For further information: see technical information "Energy Save Concept", doc. no. 21-A0-71-CP. |

Tab. 25

## LASER_READY

| | |
|---|---|
| **Functions** | Output signal shows whether laser programs can be started. |
| **Active signal** | The laser programs can be started. |
| **Information** | After the start of a laser program, the signal becomes inactive until the laser program has been ended and a new laser program can be started.<br>The **LASER_READY** output signal becomes inactive when the safety circuit is opened because the laser device, for reasons of safety, becomes disabled to give out laser power.<br><br>If an attempt is made to start a laser program while the **LASER_READY** output signal is inactive:<br>▪ a monitoring message is displayed.<br>▪ the output signal **MONITORING** becomes active.<br>▪ the laser program is not started.<br><br>If a PCU is available, the output signal **LASER_READY** is only activated if the PCU is also ready.<br><br>An external control can start a laser program of the type "No pulse release", even if the laser device is not assigned to the external control. The **LASER_READY** signal becomes active as soon as the program number of a "No pulse release" type laser program is applied.<br><br>**Laser with optical components:**<br>If the program number of another laser program is given after the execution of a laser program, an already active **LASER_READY** output signal is set to inactive again (approx. 35 ms ... 40 ms) until the laser control has set the optical components to the light path specified in the laser program. The output signal **LASER_READY** can only be evaluated once the new program number and light path number (see "LIGHT_PATH_No: Bit 2 ... Bit 0", pg. 35) have been reported to the interface.<br><br>**TruMicro 5000:**<br>If, after execution of a laser program, the program number of another laser is given, an already active **LASER_READY** output signal is again changed to inactive until the new basic frequency has been set, which may take up to 30 sec.<br><br>**Laser device with laser standby mode:**<br>The **LASER_READY** output signal becomes active approx. 2 ... 5 s active after the laser has been switched into laser standby mode.<br><br>**Energy Save Concept** or **Sleep mode**<br>If the laser control unit activates an Energy Save Level or Sleep mode, the output signals **LASER_READY** and **LASER_IS_ON** are deactivated.<br>For further information: see technical information "Energy Save Concept", doc. no. 21-A0-71-CP.<br><br>If system parameter **CV_Beam_Tracker** = 1: After switching on the laser, **LASER_READY** is not set until the beam position check is complete. |

Tab. 26

## LASER_WARNING_LAMP_IS_ON

| | |
|---|---|
| **Functions** | The output signal shows whether the laser warning light is switched on. |
| **Active signal** | The control unit activates the **LASER_WARNING_LAMP_IS_ON** output signal when the laser:<br>■ is ready to generate laser power.<br>■ is generating laser power. |
| **Information** | **Note:**<br>The output signal becomes active when the voltage of a lamp or diode power supply exceeds 40 V and stays active until the voltage drops below 40 V. |

Tab. 27

## LIGHT_PATH_No: Bit 2 ... Bit 0

| | |
|---|---|
| **Function** | The 3 output signals **LIGHT_PATH_No: Bit 2 ... Bit 0** are used by the laser to output the light path number which is set for the emission of laser light. |
| **Coding of the light path no.** | The significance of the 3 output signals is defined from **LIGHT_PATH_No: Bit 2** (high) to **LIGHT_PATH_No: Bit 0** (low).<br>Format: binary. |
| **Information** | Depending on the output number of the light path, an external control unit can:<br>■ check whether the set light path is correct.<br>■ keep a record of the light path used.<br>■ determine whether the output signal **LASER_READY** can be evaluated again after a program change (see "LASER_READY", pg. 34). |

Tab. 28

## MONITORING

| | |
|---|---|
| **Functions** | The output signal indicates when a monitoring message was emitted during operation. |
| **Active signal** | The **MONITORING** output signal becomes active when the control unit of the laser device has detected a condition that:<br>▪ can lead to switching off the laser device.<br>▪ has led to switching off the laser device. |
| **Information** | If, in connection with the output signal **MONITORING**, the output signals **PROG_CANCELLED**, **SIK_OPEN** and **FAULT_LASER** are also evaluated, the causes for a monitoring can be determined more exactly.<br>**MONITORING active:**<br>A condition was detected by the laser device control that has not yet led to the switching off of the laser device. The displayed message gives hints about the possible causes (e.g., the conductivity of the DI water has exceeded the monitoring limit value).<br>**MONITORING + SIK_OPEN active:**<br>A monitoring message was emitted because a safety circuit has been interrupted (see "SIK_OPEN", pg. 40).<br>**MONITORING + FAULT_LASER active:**<br>The laser device was switched off due to a malfunction of the laser device (see "FAULT_LASER", pg. 31).<br>**MONITORING + PROG_CANCELLED active:**<br>A running laser program has been cancelled, for example using the input signal **PROG_STOP** or **FAULT_EXT** (see "PROG_CANCELLED", pg. 38).<br>The message behavior and the RESET signal are influenced by different system parameters. This is described in detail in a separate section (see "Messaging and RESET behavior", pg. 50). |

Tab. 29

## PILOT_LASER_IS_ON

| | |
|---|---|
| **Function** | Acknowledgement signal of the **PILOT_LASER_ON** input signal. |
| **Active signal** | The **PILOT_LASER_IS_ON** output signal becomes active when a pilot laser is switched on. |
| **Information** | **Notes:**<br>Pilot laser in shutters and shutter switches are controlled by the ASV3 boards of the laser control. |

Tab. 30

## POWER_LIMIT

| | |
|---|---|
| **Functions** | The output signal indicates when the power limit of the laser device has been reached (only with pulsed lasers). |
| **Active signal** | The power limit of the laser device has been reached.<br>The following parameters influence reaching the power limit of the laser device:<br>▪ Pulse power<br>▪ Pulse duration<br>▪ Pulse repetition frequency |
| **Information** | When the power limit is reached:<br>▪ a monitoring message is displayed that must be acknowledged by means of RESET before work with the laser device can be continued.<br>▪ the power limit of the laser device can be met by adapting the parameters pulse power, pulse duration and pulse repetition frequency. |

Tab. 31

## PROG_ACTIVE

| | |
|---|---|
| **Functions** | Acknowledgement of the input signals **PSTART_STATICAL** or **PSTART_DYN**. |
| **Active signal** | A laser program has been started and is being executed. |
| **Information** | The output signal **PROG_ACTIVE** remains active as long as the laser program is run. |

Tab. 32

## PROG_CANCELLED

| | |
|---|---|
| **Functions** | The output signal indicates that the laser program was aborted. |
| **Active signal** | The output signal **PROG_CANCELLED** becomes active if a laser program was not completely executed.<br>The following actions proceed:<br>▪ a monitoring message is displayed.<br>▪ The output signal **MONITORING** becomes active.<br>**Note:**<br>Laser programs can only be restarted if the message was reset by activating the input signal **RESET**. |
| **Information** | Laser programs are aborted under the following conditions:<br>▪ Input signal **PSTART_STATICAL** became inactive before a statically started laser program elapsed, if **Pulse type** ≠ "Continuous Wave" (for CW lasers) and **Pulse number** ≠ ∞ ("Continuous") are set.<br>▪ Input signal PROG_STOP was activated during the sequence of a laser program, if **Pulse type** ≠ "Continuous Wave" (for CW lasers) and **Pulse number** ≠ ∞ ("Continuous") are set.<br>▪ Laser control has detected a malfunction.<br>▪ Input signal **FAULT_EXT** was activated.<br>▪ Safety or EMERGENCY STOP circuit was interrupted during the running of a laser program.<br>The output signal **PROG_CANCELLED** remains after an assignment change at the affected MPI slot.<br>The output signal **PROG_CANCELLED** must be reset at the affected MPI slot, independent of the assignment.<br>If there is a change in assignment, the output signal **LASER_ASSIGNED** changes from one MPI slot to another.<br>If the output signal **PROG_CANCELLED** is set in the output mask, the output signal is output at this MPI slot even if this MPI slot is not assigned. This makes sense when, for example, a superordinate system control reacts to this signal.<br>Further information: (see "Configuring the parallel I/O interface", pg. 54). |

Tab. 33

## PROG_COMPLETED

| | |
|---|---|
| **Functions** | The output signal indicates the end of a laser program. |
| **Active signal** | The **PROG_COMPLETED** output signal is:<br>▪ active if a laser program has been executed completely.<br>▪ **not** active when a laser program was canceled. |
| **Information** | The timing of the output signal depends on whether a laser program has been started statically with the input signal **PSTART_STATICAL** or dynamically with the input signal **PSTART_DYN**.<br>**Program start static:**<br>▪ Infinite laser program<br>(Pulse type ≠ "Continuous wave" (for CW lasers) and Pulse number ≠ ∞ ("Continuous")):<br>After the end of a laser program, the **PROG_COMPLETED** output signal becomes active and remains active until the **PSTART_STATICAL** input signal is switched to inactive.<br>▪ Endless laser program<br>(Pulse type = "Continuous wave" (for CW lasers) Pulse number = ∞ ("Continuous")):<br>If the laser program is finished by setting the **PSTART_STATICAL** input signal inactive, the **PROG_COMPLETED** output signal will be activated for approx. 6 seconds[1)].<br>When **PROG_COMPLETED** becomes active, current values of the parameters **PLC output (CV) x words** are available.<br>**Program start, dynamically:**<br>After the end of a laser program, the **PROG_COMPLETED** output signal becomes active for approx. 6 s[1)]. |
| **1)** The **PROG_COMPLETED** output signal becomes prematurely inactive if, before the 6 s have expired,<br>▪ a laser program is started again (PSTART_STATICAL or PSTART_DYN).<br>▪ a change in assignment takes place, and the **PLC_ClearProgCompletedOnSlotChange** system parameter is 1. | |

Tab. 34

## SET_1 and SET_2

| | |
|---|---|
| **Function** | The 2 output signals **SET_1** and **SET_2** can be used to synchronize an external control unit (e.g. PLC) with the sequence of a laser program. |
| **Active signal** | The output signals can be set to active (S1H, S2H) or inactive (S1L, S2L) by commands in the program lines of a laser program. |
| **Information** | Output signals **SET_1** and **SET_2** activated by a laser program remain active and are only reset when:<br>▪ a laser program is started again.<br>▪ a cancelled laser program is reset with the **RESET** input signal.<br>▪ they are reset by commands within a laser program.<br>**Note:**<br>The output signals **SET_1** and **SET_2** can also be used to monitor the running of a laser program externally. |

Tab. 35

## SIK_OPEN

| | |
|---|---|
| **Function** | The output signal indicates that a safety circuit of the laser device is interrupted. |
| **Active signal** | The **SIK_OPEN** output signal becomes active, when the safety circuit is open:<br>▪ of the central shutter (VZ).<br>▪ of the currently selected light path. |
| **Information** | When the **SIK_OPEN** output signal is active, no laser program can be started.<br>**Determining the safety circuit status**<br>The **SIK_OPEN** output signal is updated continuously for all external controls (slots), even if they have not bee assigned.<br>There are two different cases:<br>▪ The light path is preset in the laser program.<br>▪ The light path is predefined externally.<br>**The light path is permanently defined in the laser program**<br>In this case, the SIK_OPEN output signal is determined for all light paths that occur in the laser program.<br>**SIK_OPEN = "0",**<br>if the safety circuits of all light paths given in the laser program are closed.<br>**SIK_OPEN = "1",**<br>if a safety circuit is open that is included in the laser program.<br>**The light path is predefined externally**<br>For this case, the SIK_OPEN output signal is only determined for the externally predefined light path.<br>**SIK_OPEN = "0",**<br>if the safety circuit of the externally predefined light path is closed.<br>**SIK_OPEN = "1",**<br>if the safety circuit of the externally predefined light path is open. |

Tab. 36

## 3.3 Using the parallel I/O interface

**⚠ WARNING**

**Laser light can be emitted without warning following a malfunction in the energy supply (power failure) and restoration of the energy flow.**

**Serious injuries or extensive property damage can result.**

- ➢ Condition external controls so they do not automatically or randomly send signals to the laser control to activate the laser following failure and restoration of the energy flow.

The use of the parallel I/O interface is described by the timing diagrams.

### Timing diagrams

The control of a laser device by means of one or several external control units (e.g. PLC) is explained using timing diagrams and a laser programming example with laser parameters of the external control units.
The external control units are connected to the control of the laser device by means of a multi PLC interface (fieldbus, OPC or parallel I/O interface).

Subsequently there are the timing diagrams for:

- Starting a finite laser program dynamically.
- Starting a finite laser program statically.
- Starting a continuous laser program dynamically.
- Starting a continuous laser program statically.
- Alternating activation of a laser device.

The shown timing diagrams refer to pulsed laser devices. They apply similarly to CW laser devices.

### Start finite laser program dynamically

An external control unit requests the laser device, switches it on and starts the finite laser program number 5 dynamically via the PSTART_DYN input signal.

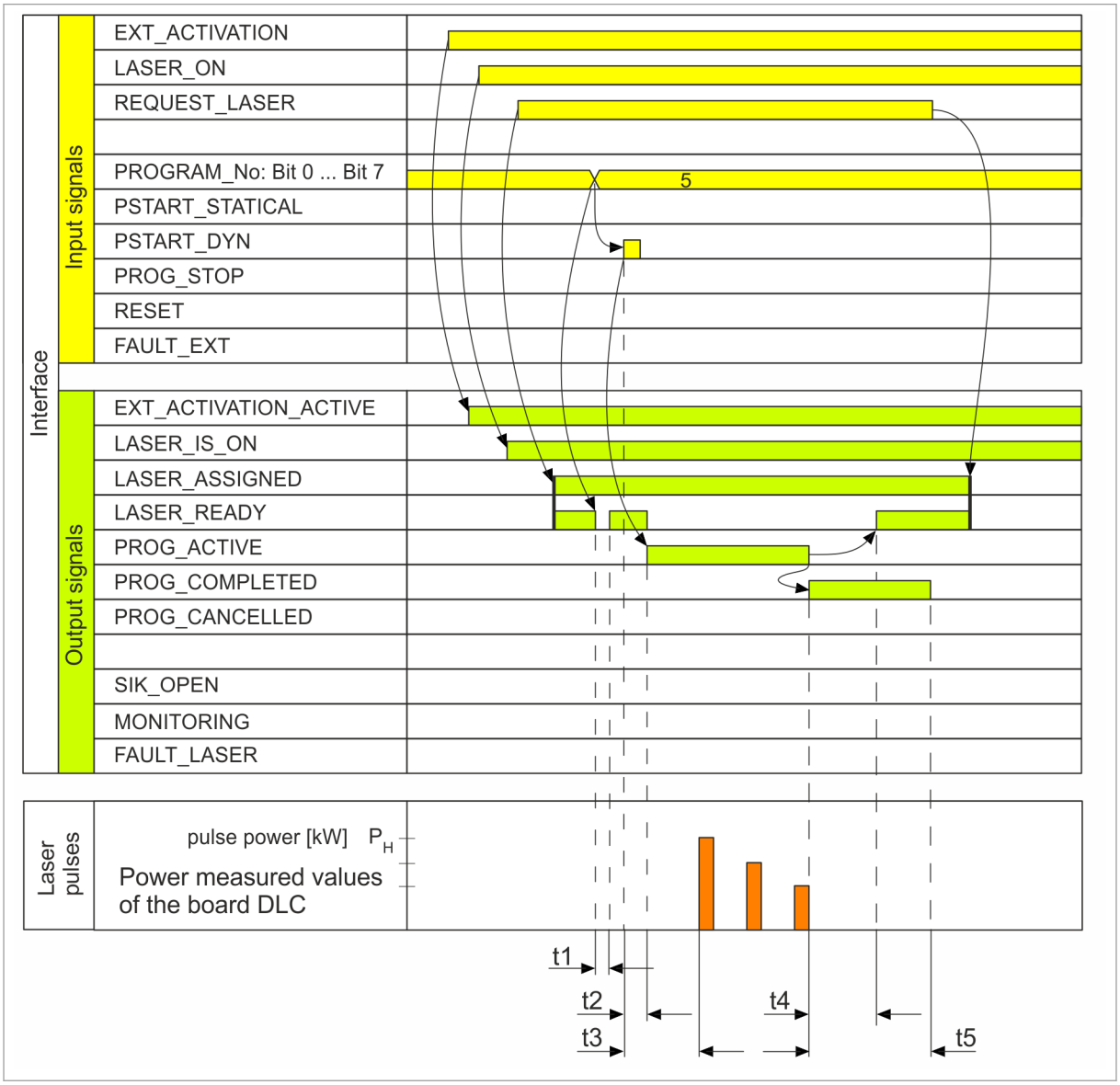



Fig. SR-00110

In laser program 5, 3 laser pulses are programmed with different laser power.

**t1** The laser device control sets the **LASER_READY** output signal to inactive if it has to reset the light path when presetting the laser program. Setting of the light path may take up to 45 ms if several optical components are moved.

If in a laser device of the TruMicro 5000 series the basic frequency in the new laser program was changed, the signal **LASER_READY** will remain active until the new basic frequency has been set, which may take up to 30 sec.

**t2** The time from the start of the laser program to the acknowledgement by the **PROG_ACTIVE** output signal is approx. 150 µs.

**t3** The time from the start of the laser program to the emission of the first laser pulse lies within the range of:

- 15 – 20 ms, if no optical component is moved.
- 35 ms ... 55 ms, if an optical component is moved.

**Note**

The jitter between the call for the laser pulse and the executed laser pulse can be reduced for pulsed lasers to < ±40 µs by using a real-time interface.

**t4** The time the laser needs after the end of a laser program before it is ready again.

The time t4 is determined by:

- the loading time of the capacitor in the laser device (only for pulsed lasers).
- the time needed for moving the optical components.

The loading time of the capacitor in the laser device depends on the pulse energy of the last laser pulse. Depending on the laser device, loading times for minimum to maximum pulse energy are in the range of 1 ms ... 1500 ms.

The time for moving an optical component after the end of a laser program is max. 40 ms. If several optical components are moved, the time is approx. 45 ms ... 55 ms.

The time t4 is at least as long as the longest individual time plus approx. 150 µs of program running time in the laser control.

**t5** After the end of a laser program, the **PROG_COMPLETED** output signal becomes active for approx. 6 s.

The **PROG_COMPLETED** output signal becomes prematurely inactive if, before the 6 s have expired,

- a laser program is started again (with PSTART_STATICAL or PSTART_DYN).
- a change in assignment takes place, and the **PLC_ClearProgCompletedOnSlotChange** system parameter is 1.

**Note**

The times t1 ... t5 given describe exclusively the behavior of the laser device control. The runtimes of the field bus transmission depends on the configuration of a field bus.

### Start finite laser program statically

An external control unit requests the laser device, switches the laser on and starts the finite laser program number 5 statically via the input signal PSTART_STATICAL.

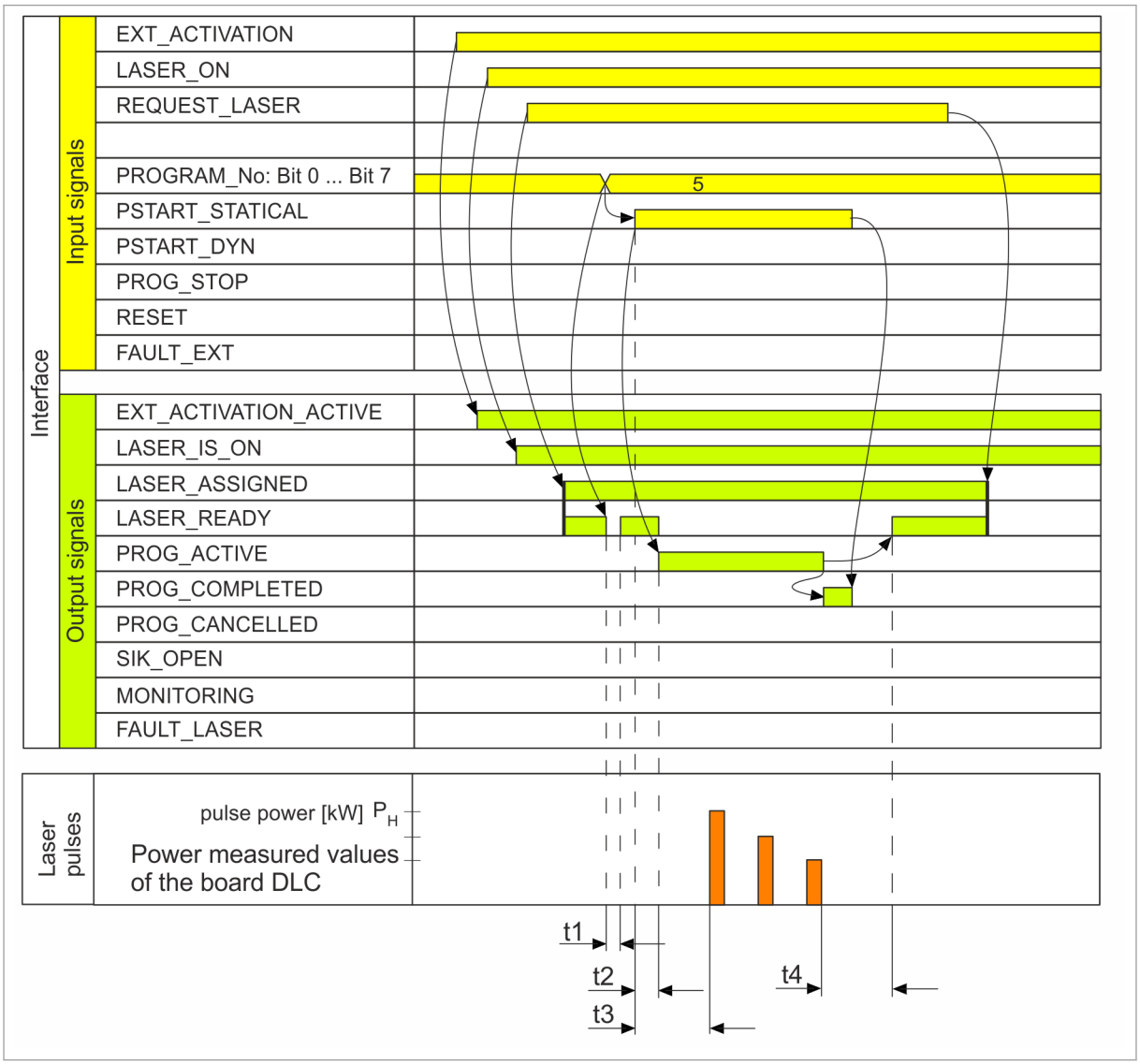



Fig. SR-00112

### Note

The timely sequence of a laser program is identical if the laser program has been started dynamically or statically.

### Start infinite laser program dynamically

An external control requests the laser device, switches on the laser and starts the infinite laser program No 7 dynamically via the input signal PSTART_DYN. A dynamically started laser program with pulse number = ∞ ("Continuous") or with pulse type = "Continuous wave" (with CW lasers) can stop an external control by means of the input signal PROG_STOP.

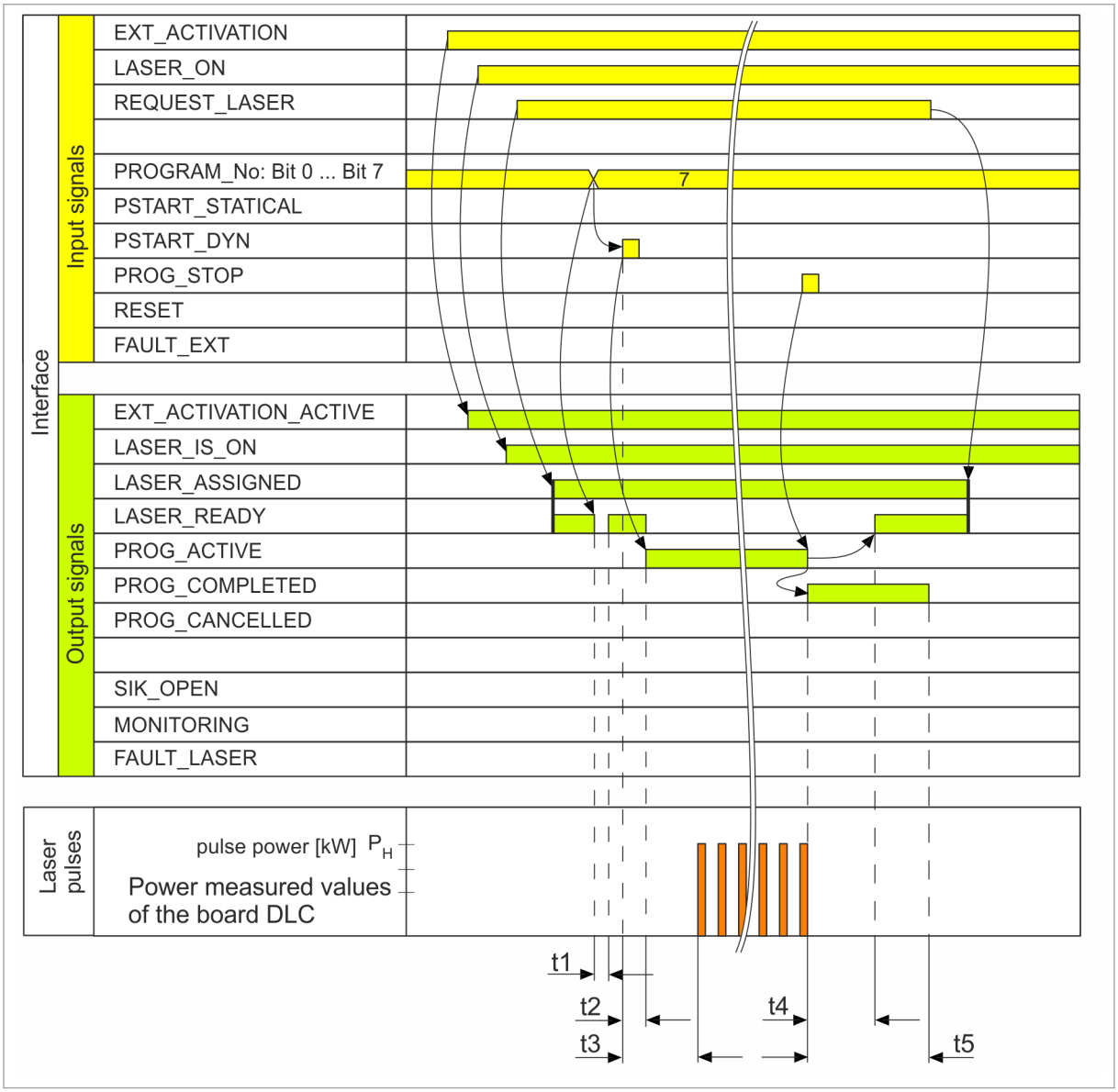



Fig. SR-00297

### Start infinite laser program statically

An external control requests the laser device, switches the laser on and starts the infinite laser program No 7 statically via the input signal PSTART_STATICAL. A statically started laser program with pulse number = ∞ ("Continuous") or with pulse type = "Continuous wave" (with CW lasers) can stop an external control by means of the input signal PSTART_STATICAL.

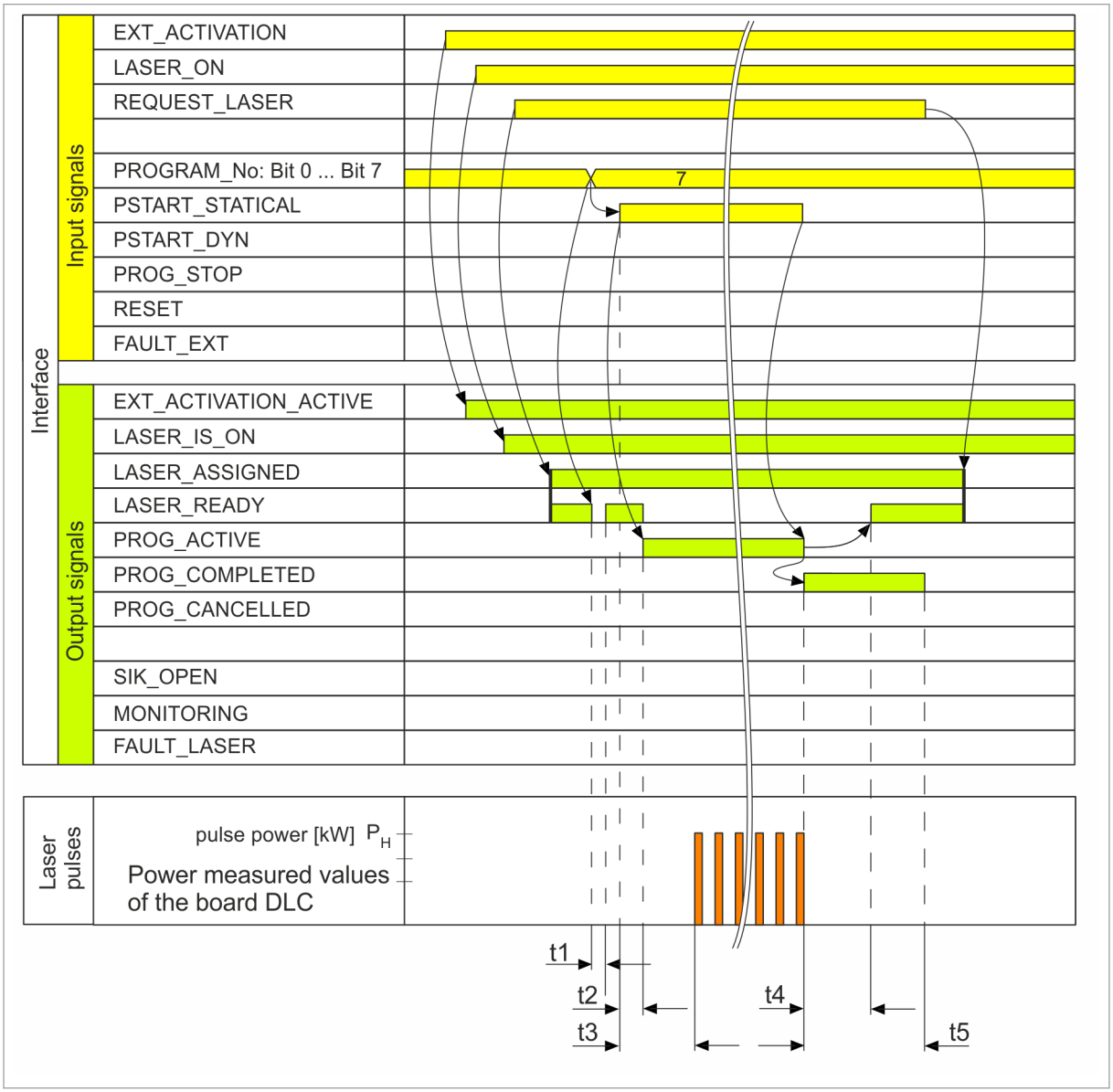
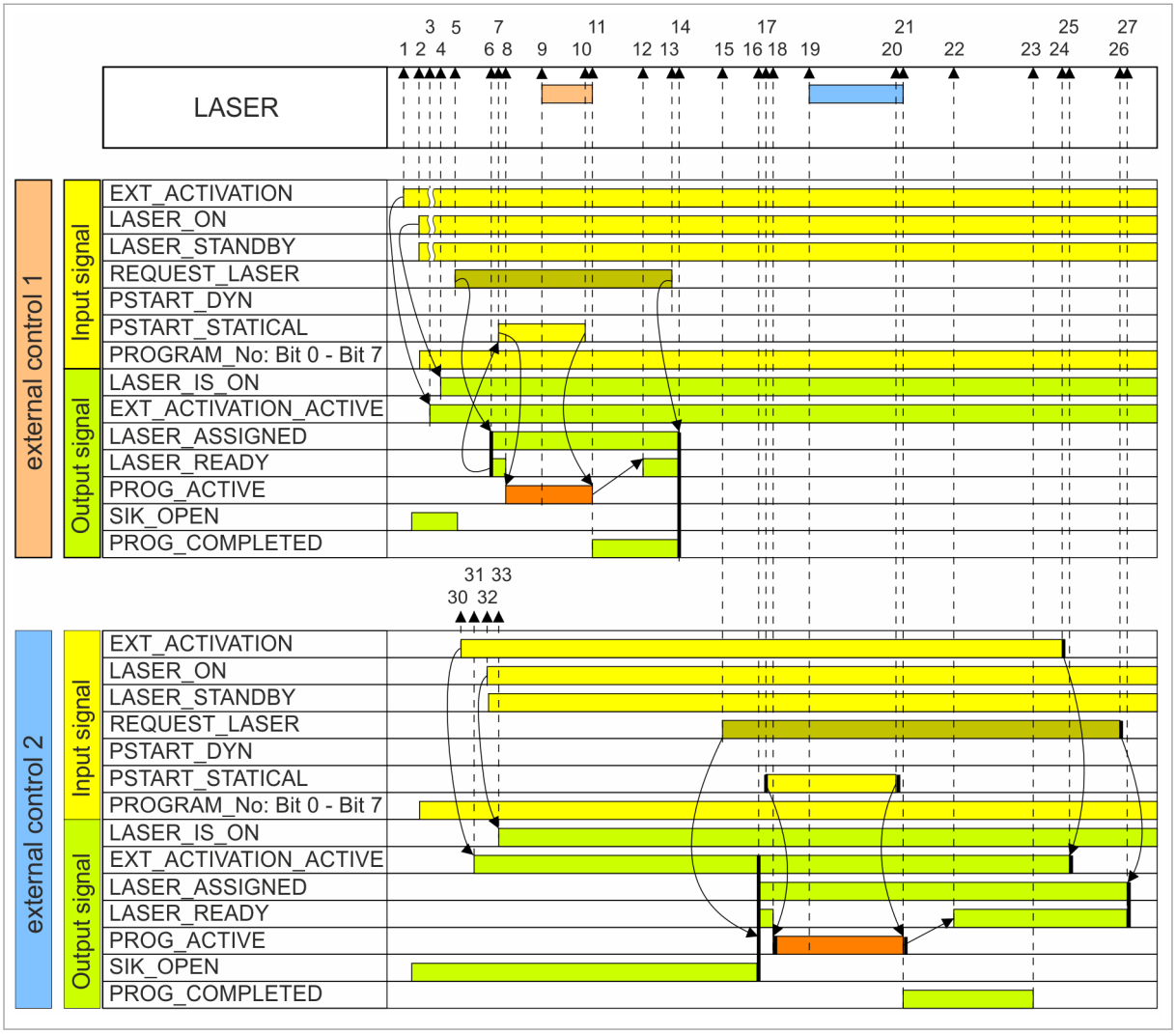



Fig. SR-00298

### Alternating activation of a laser device

Two external controls request the laser device and wait for assignment and start an infinite laser program when being

assigned. In the timing diagram shown below, the two controls are connected with the laser device via a Multi PLC interface (fieldbus, OPC or parallel I/O interface). The entered times are explained in the following table.




Example for an alternating activation of a laser device Fig. SR-00111

| Time of event | Definition |
|---|---|
| 1 | The external control 1 activates the input signal EXT_ACTIVATION for an external control of the laser device. |
| 2 | The external control 1 activates the input signal LASER_ON and with laser devices with laser standby mode also the input signal LASER_STANDBY, so that it is ensured that the laser is already switched on when being requested. |
| 3 | The laser device acknowledges the external activation by the active output signal EXT_ACTIVATION_ACTIVE. |
| 4 | The laser device activates the output signal LASER_IS_ON. |
| 5 | The laser device is requested by the external control 1 using the active REQUEST_LASER input signal. |

| Time of event | Definition |
|---|---|
| 6 | The laser device is assigned by the external control 1 and activates the LASER_ ASSIGNED output signal. If the laser is ready (no fault, safety circuit closed), the laser device activates the output signal LASER_READY. A laser program can be started. |
| 7 | The external control 1 starts a laser program. |
| 8 | The laser device activates the output signal PROG_ACTIVE.<br>If the central shutter is closed, it is opened via a command in the laser program. |
| 9 | Laser light is emitted via the preset light path. |
| 10 | The external control 1 sets the input signal PSTART_STATICAL inactive. |
| 11 | The laser control unit activates the output signal PROG_COMPLETED for approx. 6 s. |
| 12 | The laser device activates the LASER_READY output signal.<br>The central shutter can be closed via a command in the laser program. |
| 13 | The control 1 sets the input signal REQUEST_LASER inactive. |
| 14 | The laser device sets the output signal LASER_ASSIGNED inactive. The output signal PROG_ COMPLETED is likewise deactived if system parameter PLC_ClearProgCompletedOnSlotChange = 1. |
| 30 | The external control 2 activates the input signal EXT_ACTIVATION for an external control of the laser device. |
| 31 | The laser device acknowledges the external activation by the active output signal EXT_ACTIVATION_ACTIVE. |
| 32 | The external control 2 activates the input signal LASER_ON and with laser devices with laser standby mode also the input signal LASER_STANDBY, so that it is ensured that the laser is already switched on when being requested. |
| 33 | The laser device activates the output signal LASER_IS_ON. |
| 15 | The laser device is requested by the external control 2 using the active REQUEST_ LASER input signal. |
| 16 | The laser device is assigned by the external control 2 and activates the LASER_ ASSIGNED output signal. If the laser is ready (no fault, safety circuit closed), the laser device activates the output signal LASER_READY. A laser program can be started. |
| 17 | The external control 2 starts a laser program. |
| 18 | The laser device activates the output signal PROG_ACTIVE.<br>If the central shutter is closed, it is opened via a command in the laser program. |
| 19 | Laser light is emitted via the preset light path. |
| 20 | The external control 2 sets the input signal PSTART_STATICAL inactive. |
| 21 | The laser control activates the output signal PROG_COMPLETED. |
| 22 | The laser device activates the LASER_READY output signal.<br>The central shutter can be closed via a command in the laser program. |
| 23 | The output signal PROG_COMPLETED is deactivated approx. 6 seconds after the end of the laser program. |
| 24 | The input signal EXT_ACTIVATION must be set inactive, if the laser device should to be controlled via the operating panel. The laser device can no longer be addressed via the Multi PLC interface (fieldbus, OPC or parallel-I/O interface). |
| 25 | The laser device set the output signal EXT_ACTIVATION_ACTIVE inactive. The laser device can be controlled via the operating panel. |
| 26 | The external control 2 sets the input signal REQUEST_LASER inactive. |
| 27 | The laser device is no longer assigned to the external control 2. |

Explanation of the times with alternating activation Tab. 37

# Messaging and RESET behavior

**Note**
Only two input and output words are used for parallel I/O interface.

- This is why only **MONITORING** and **FAULT_LASER** signals can be used for parallel I/O interface.
- The signals **MONITORING_SLOT** and **FAULT_SLOT** as well as output words 4 and 5 are only available for fieldbus interfaces or OPC.

  If these signals and output words are needed, a fieldbus or OPC interface must be used (see interface descriptions **Fieldbus interfaces for CPX V3, CPX V4 and CPX V20**, doc. no. 18-22-91-A1-BA, **TRUMPF Peripheral Bus**, doc. no. 18-22-12-A1-BA and OPC UA for CPX, doc. no. 09-14-11-A6-BA).

**Notifications**

There are four categories of messages which are ouput at the MPI interface with the output word 4 and 5.

- Slot monitoring
  Signal **MONITORING_SLOT**, output word 2 bit 9
- Laser monitoring
  Signal **MONITORING**, output word 0 bit 5
- Slot fault
  Signal **FAULT_SLOT**, output word 2 bit 8
- Laser fault
  Signal **FAULT_LASER**, output word 0 bit 4

**RESET**

An external control must respond to messages with **RESET**, input word 0 Bit 8.

**System parameter**

These four message categories and RESET are influenced by the following system parameters:

- **PLC_Word_2_OutShutter**
  Assignment of output word 2
  - 0: Slot fault/-monitoring and status of the focusing optics
  - 1: Shutter position
- **LCU_GlobalLaserFaultReset**
  - 0: RESET for FAULT_LASER only possible from the assigned MPI slot.
  - 1: RESET for FAULT_LASER also possible from an unassigned MPI slot.

- **LCU_GlobalSlotReset**
  - 0: RESET for slot fault/monitoring only for the assigned MPI slot.
  - 1: RESET for slot fault/monitoring for all MPI slots
- **PLC_SeparatedSlotFault**
  - 0: with a slot fault laser monitoring is also output.
  - 1: with a slot fault no laser monitoring is output.

**Status indicators**

The following symbols show monitoring and fault messages in the status bar of TruControl 1000.

| | |
|---|---|
|  | Slot fault |
|  | Laser monitoring |
|  | Laser fault |

Tab. 38

### Slot monitoring

If slot monitoring is used, the message code (output words 4 and 5) and the output signal MONITORING_SLOT are output only at the relevant MPI slot.

Slot monitoring is output, for example when resetting REQUEST_LASER as long as the signal PROGRAM_START is still set.

If additional slot-/laser monitoring follow, then these are output at the MPI interface.

Slot monitoring must be reset using RESET at the relevant MPI slot irrespective of the assignment.

If the system parameter LCU_GlobalSlotReset is 1, all slot monitoring of the assigned MPI slot can be reset by means of RESET.

### Laser monitoring

If laser monitoring is used, the message code (output word 4 and 5) and the output signal MONITORING is output at all MPI slots.

Laser monitoring is output, for example, if the level of the cooling water in the tank is too low.

If additional slot-/laser monitoring follow, then these are output at the MPI interface.

If the system parameter LCU_GlobalLaserFaultReset = 0, a laser monitoring must be reset at the assigned MPI slot by means of RESET.

If the system parameter LCU_GlobalLaserFaultReset = 1, a laser monitoring must be reset at each assigned MPI slot by means of RESET.

**Slot fault**

If a slot fault occurs, the message code (output word 4 and 5) and the output signals FAULT_SLOT, MONITORING_SLOT and MONITORING are output only at the relevant MPI slot.

A slot fault is output, for example, if an attempt is made to start a non-existent laser program.

If additional slot-/laser monitoring or slot faults occur, then these are not output at the MPI interface.

If the system parameter LCU_GlobalSlotReset is 0, a slot fault must be reset at the relevant MPI slot by means of RESET irrespective of the assignment!

If the system parameter LCU_GlobalSlotReset = 1, all slot faults of the assigned MPI slot can be reset by means of RESET.

**Laser fault**

If a laser fault occurs, the message code (output words 4 and 5) and the output signals FAULT_LASER and MONITORING are output at all MPI slots.

A laser fault is output, for example, if an attempt is made to start a laser program which contains a deleted light path.

If additional slot-/laser monitoring or
slot-/laser faults occur, then these are not output at the MPI interface.

If the system parameter LCU_GlobalLaserFaultReset = 0, a laser fault must be reset at the assigned MPI slot by means of RESET.

If the system parameter LCU_GlobalLaserFaultReset is 1, a laser fault can be reset at every MPI slot by means of RESET, irrespective of the assignment!

**Recommended system settings**

We recommend configuring the system as follows:

| Setting | System parameter |
|---|---|
| Output word 2<br>Output of the signals slot fault and monitoring | **PLC_Word_2_OutShutter** = 0 |
| Reset of a slot fault/monitoring only for an MPI slot | **LCU_GlobalSlotReset** = 0 |
| Reset of a laser fault only for the assigned MPI slot | **LCU_GlobalLaserFaultReset** = 0 |
| Separation between laser fault and slot fault | **PLC_SeparatedSlotFault** = 1 |
| Programmable output words 4 and 5 | Factory setting, i.e. the message code is output. |
| MPI settings<br>output mask | **PROG_CANCELLED** =0<br>**PILOT_LASER_IS_ON** =0 |

Tab. 39

## Saving energy

Information about saving energy can be found in the technical information **Energy Save Concept – Saving energy with PROFIenergy, I/O signals and optimized standby mode**, doc. no.: 21-A0-71-CP.

## 3.4 Configuring the parallel I/O interface

### Assigning the interface to an MPI slot and configuring it

| (User level ≥ 60) | | |
|---|---|---|
|  | 1. | Select main activity *Set-up*. |
|  | 2. | Select *Multi PLC interface (MPI)*. |
| | 3. | Select free slot.<br>The selected slot is highlighted in yellow. |
|  | 4. | Select *New*.<br>The *PLC interface editor* dialog is displayed. |
| | 5. | Select parallel. |
|  | 6. | Select *Next*.<br>The *Select connection* dialog is displayed. |
| | 7. | Select connection *CPX module*. |
|  | 8. | Select *Next*.<br>The *Enter name* dialog is displayed. |
| | 9. | Enter the name. |
|  | 10. | Select *Next*<br>The dialog *PLC interface editor* is displayed.<br>The parameters are preset ex works. |
| | 11. | If you want to change an additional parameter, select the parameter. The selected parameter is highlighted in yellow. The parameters are described in a separate table (see "Tab. 42", pg. 56). If you do not want to change any parameters, continue with step 16. |
|  | 12. | Select *Change properties*. |
|  | 13. | Modify parameters. |
|  | 14. | Select Close. |
| | 15. | If you want to change an additional parameter, select the parameter and change it (repeat steps 11. - 14.). |
|  | 16. | Select *Finish*.<br>The **multi PLC interface (MPI)** dialog is displayed. |
|  | 17. | Select *Save*.<br>The dialog for applying and restarting the laser control unit is displayed. |
|  | 18. | Select *Yes*.<br>The interface has been assigned to a slot and configured. |

Tab. 40

## Changing the configuration of the interface

| (User level ≥ 60) | | |
|---|---|---|
|  | 1. | Select main activity *Set-up*. |
|  | 2. | Select *Multi PLC interface (MPI)*. |
| | 3. | Select slot with the parallel I/O interface of the CPX.<br>The selected slot is highlighted in yellow. |
|  | 4. | Select *Modify*.<br>The dialog *PLC interface editor* is displayed.<br>The parameters are preset ex works. |
|  | 5. | If you want to change the name of the slot, select *Change name*.<br>The dialog for entering the name appears.<br>If you do not want to change the name of the slot, continue with step 8. |
| | 6. | Enter name |
|  | 7. | Press the *Apply* button. |
| | 8. | If you want to change a parameter, select the parameter.<br>The selected parameter is highlighted in yellow.<br>The parameters are described in a separate table (see "Tab. 42", pg. 56).<br>If you do not want to change any parameters, continue with step 13. |
|  | 9. | Select *Change properties*. |
|  | 10. | Modify parameters. |
|  | 11. | Select Close. |
| | 12. | If you want to change an additional parameter, select the parameter and change it (repeat steps 8. - 11.). |
|  | 13. | Select *Close*.<br>If you have not changed either the name of the slot or parameters, the configuration is complete. The **multi PLC interface (MPI)** dialog is displayed. You can ignore steps 14. - 16.<br>If you have changed the name of the slot or parameters, the dialog for applying the changes is displayed. |
|  | 14. | Select *Save*.<br>The **multi PLC interface (MPI)** dialog is displayed. |
|  | 15. | Select *Save*.<br>The dialog for applying and restarting the laser control unit is displayed. |
|  | 16. | Select *Yes*.<br>The configuration of the interface has been changed. |

Tab. 41

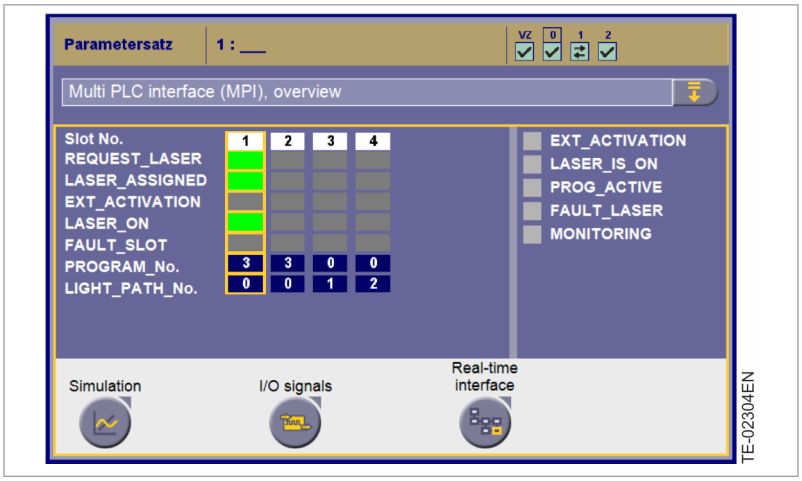
The following table lists the settings possible in the *PLC interface editor* dialog for the parallel I/O interface.

| Parameter | Function | Factory setting | Values |
|---|---|---|---|
| File length | **Setting the data length of the interface.**<br>The data length of a parallel I/O interface is limited to 2 words. | 2 | - |
| Byte swap | **Setting byte swap.**<br>The data are interpreted and transmitted by the laser control unit word by word. The data bytes can be swapped within the data words.<br>**False:**factory setting<br>The two data bytes of the data word are not exchanged.<br>**True:**<br>The two data bytes of the data word are exchanged.<br>This setting is required, for example, for the external control units with Intel processors (Siemens PLC).<br>**Note:**<br>If you notice that the data do not arrive at the expected bit positions, you should change the "byte swap" value. | False | False, True |
| Light path | **Assigning a light path.**<br>A light path can be assigned fixed to the parallel interface of the laser device if a light path-coded activation of the laser device is used. | None | None 0, 1, ... |
| Real-time interface | **Selecting a real-time interface.**<br>The real-time interface 3 is assigned fixed to the parallel I/O interface. | 3 | 3 |
| MFO | **Assigning the manual focusing optics.** | None | None, 1 ... 8 |
| Output mask | **Output mask**<br>Which internal laser signals are forwarded from the laser control to the outputs of the parallel I/O interface can be set in the output mask dialog, if the laser device is not assigned to the control. The following output signals can be masked:<br>▪ EXT_ACTIVATION_ ACTIVE<br>▪ LASER_IS_ON<br>▪ LASER_READY<br>▪ PROG_ACTIVE<br>▪ PROG_COMPLETED<br>▪ PROG_CANCELLED<br>▪ SET_1<br>▪ SET_2<br>▪ SIK_OPEN<br>▪ MONITORING<br>▪ FAULT_LASER<br>▪ LASER_ASSIGNED<br>▪ POWER_LIMIT<br>▪ PILOT_LASER_IS_ON<br>▪ LASER_WARNING_ LAMP_IS_ON | | |
| Inverting mask | **Inverting the inputs.**<br>An inverted input signal applied actively to the parallel I/O interface is interpreted by the laser control unit as inactive and inverted. The following input signals can be inverted:<br>▪ EXT_ACTIVATION<br>▪ LASER_ON<br>▪ LASER_STANDBY*)<br>▪ PSTART_STATICAL<br>▪ PSTART_DYN<br>▪ PROG_STOP<br>▪ RESET<br>▪ FAULT_EXT<br>▪ INQUIRY_1<br>▪ INQUIRY_2<br>▪ PILOT_LASER_ON<br>▪ REQUEST_LASER | | |
| Priority | **Priority of the MPI slot**<br>This parameter defines the priority of the MPI slot for the assignment (see "LASER_ASSIGNED", pg. 32). The higher the value of the parameter, the higher is the priority of the MPI slot. | 3 | 0 ... 255 |
| *) Only for laser devices with laser standby mode | | | |

Tab. 42

## 3.5 Testing options

### Multi-PLC interface (MPI), overview




Multi PLC Interface (MPI), overview dialog Fig. TE-02304

Open the dialog **Multi PLC Interface (MPI), overview**:

| User level ≥ 0 | | |
|---|---|---|
|  | 1. | Select the main activity *Production*. |
|  | 2. | Select *Multi PLC interface (MPI), overview*.<br>The *Multi PLC interface (MPI), overview* dialog is displayed. The statuses of important signals, the pulse energy, the average laser power and the utilization of the laser device are displayed for each assigned machining station (slot). |

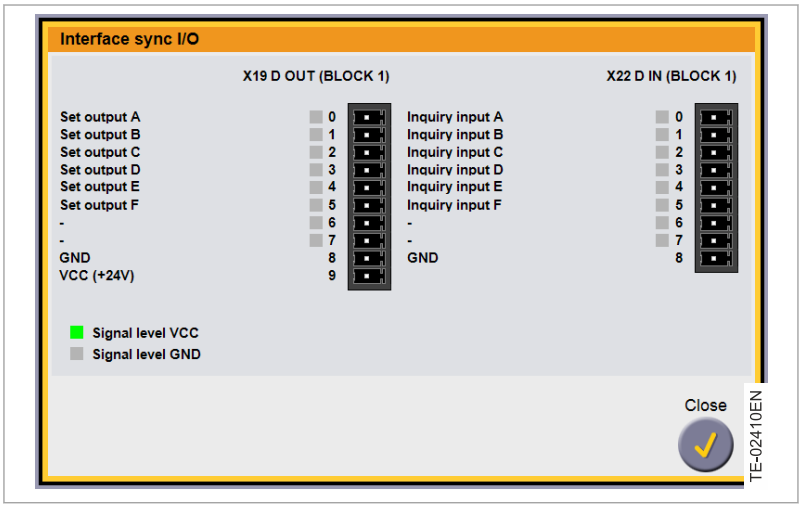
Tab. 43

When selecting a slot, buttons are displayed in the context bar which enable activation of further functions. Depending on the configuration the following buttons are available:

- Simulation
- I/O signals.
- Real-time interface
- Manual focusing optics (option).

Further information can be found in the **TruControl 1000** software manual, doc. no. 10-06-80-A1-CR.

# Diagnosis parallel I/O interface




Parallel I/O interface diagnostics: channel 1 (D IN BLOCK 1 and D OUT BLOCK 1), connectors X19 and X22, example CPX V3 Fig. TE-02410

Open the **Diagnosis parallel I/O interface, channel 1** dialog:

| User level ≥ 0 | | |
|---|---|---|
|  | 1. | Select the main activity *Diagnostics*. |
|  | 2. | Select TruControl laser control (CPX). |
|  | 3. | Select the connector of the required input and output channel.<br>The overwiev showing the input and output signals of the respective channel is displayed. |

Tab. 44

The diagnosis of the parallel I/O interface can be displayed from any user level via the *>Diagnosis >CPX* dialog. By selecting a plug connector (5), an overview showing the signals of the respective channel is displayed.

# 4. Real-timeinterface

## 4.1 Pin assignment of a real-time interface

The real-time interfaces are assigned to the 3 digital input and output channels as follows:

- Real-time interface 1: D IN BLOCK1, D OUT BLOCK1.
- Real-time interface 2: D IN BLOCK2, D OUT BLOCK2.
- Real-time interface 3: D IN BLOCK3, D OUT BLOCK3.

**Note**
A real-time interface has 4 input and 5 output signals. When using a parallel I/O interface, the digital input and output channel 3 (D IN / D OUT BLOCK3) is used for the real-time interface.

The real-time interface 3 of the input and output channel 3 (D IN / D OUT BLOCK3) can be simultaneously used as parallel I/O and real-time interface

- if the inputs (D IN BLOCK3) of both interfaces have the same reference voltage (GND).
- if the outputs (D OUT BLOCK3) of both interfaces also have the same external voltage supply (VCC) in relation to the common reference voltage (GND).

The reference voltages (GND) of the inputs (D IN BLOCK3) and the outputs (D OUT BLOCK3) can be different.

| Inputs of the real-time interface, channels D IN BLOCK1/2/3 | | |
|---|---|---|
| **Pin** | **Signal name** | **Functions** |
| 0 | BREAK | **Abort** the running of program lines in laser programs. |
| 1 | PULSE_ INTERLOCK | **Suppressing** of laser pulses or continuous wave laser power (cw). |
| 2 | REALTIME_ START | Start the laser pulse **in real time**. |
| 3 | EXTERNAL_ FREQUENCY | **External frequency** to start a laser pulse. |
| 4 | - | **Reserved**<br>The 4 inputs Pin 4 ... Pin 7 are reserved for signals of the parallel I/O interface (see "Pin assignment of the connector for input channel 3 (D IN BLOCK3)", pg. 17). |
| 5 | - | |
| 6 | - | |
| 7 | - | |
| GND | GND | Reference potential of an input channel (D IN BLOCK1/2/3). |

Inputs of the real-time interfaces 1 ... 3 Tab. 45

Figures for connector CPX V3: (see "Input channels", pg. 4),
CPX V4 Standard: (see "Input channels", pg. 7)

Signal descriptions (see "Input signals", pg. 61)

| Outputs of the real-time interface, channels D OUT BLOCK1/2/3 | | |
|---|---|---|
| **Pin** | **Signal name** | **Function** |
| 0 | XEO1 | **Output for the pulse number specified via OPC**. |
| 1 | PULSE_ COMPLETED | **End of pulse**. |
| 2 | PULSE_ DURATION | **Pulse duration**. |
| 3 | LASER_READY_ TO_PULSE | **Laser is ready to pulse**. |
| 4 | LASER_IS_ PULSING | **Laser is pulsing**. |
| 5 | - | **Reserved**<br>The 3 inputs Pin 5 ... Pin 7 are reserved for signals of the parallel I/O interface (see "Pin assignment of the connector for output channel 3 (D OUT BLOCK3)", pg. 20). |
| 6 | - | |
| 7 | - | |
| GND | GND | Reference potential of an output channel (D OUT BLOCK1/2/3) |
| VCC | VCC | External voltage supply of an output channel (D OUT BLOCK1/2/3) |

Outputs of the real-time interfaces 1 ... 3 Tab. 46

Figures for connector CPX V3: (see "Output channels", pg. 5),
CPX V4 Standard: (see "Output channels", pg. 7)

Signal descriptions (see "Output signals", pg. 63)

## 4.2 Signal descriptions of the real-time interface

## Input signals

The signal response of the input and output signals is dependent on the system parameters **RTI_LEVEL_SETTING** and **RTI_LEVEL_SETTING_X** (see "Configuring the real time interface", pg. 69).

### BREAK

| | |
|---|---|
| **Functions** | **Cancel** |
| **Active signal** | The running of program lines of a laser program with a fixed or continuous number of pulses is aborted if the "WRS (Wait Realtime Start)" function is entered in the program line. |
| **Information** | The delay time depends on the debouncing time set via the software (see "Configuring the real time interface", pg. 69).<br>Jitter: < ±100 µs |

Tab. 47

### PULSE_INTERLOCK

| | | |
|---|---|---|
| **Function** | **Pulse lock / POWER_GATE** | |
| **Active signal** | Laser pulses or continuous wave laser power (cw) will be suppressed if this input is active. | |
| **Information** | There are 4 modes for the pulse lock. The system parameter **RTI_PULSE_INTERLOCK_MODUS** can be used in the >Setup >System setting >Real-time interface dialog to select the following modes: | |
| | Mode | Description |
| | 1 | The pulse locking is deactivated, factory setting |
| | 2 | The pulse triggering is interrupted, a started pulse is still finished. |
| | 3 | The pulse triggering is interrupted, a started laser pulse is interrupted. |
| | 4 | **POWER_GATE**: The laser beam is suppressed.<br>When mode 4 is selected, the system parameter **RTI_DEBOUNCE_TIME** ≤ 32 µs must be set. |
| | The signal response is dependent on the system parameters **RTI_LEVEL_SETTING** and **RTI_LEVEL_SETTING_X**. | |
| | Delay time between the **POWER_GATE** signal and the switching on or off of the laser power: 50 µs - 600 µs. The actual value depends on the laser device type and on the operating mode set. | |
| | The configuration of the real-time interface is described in detail in a separate paragraph (see "Configuring the real time interface", pg. 69). | |

Tab. 48

## REALTIME_START

| Function | Real-time start |
|---|---|
| Active signal | Starts laser pulses (single pulse, pulse train or continuous pulsing) when the function "WRS" (Wait Real-time Start) has been entered in the program lines of a laser program.<br>"Continuous pulsing" started with the WRS function is ended by deactivating the REAL-TIME_START signal. |
| Information | The output signal "LASER_READY_TO_PULSE" must previously be active.<br>The following can be set via software:<br>▪ Delay time for the start of the laser pulses (see "Configuring the real time interface", pg. 69). A delay time of 1 ms is set at the factory.<br>▪ Debouncing time of the input signals (see "Configuring the real time interface", pg. 69). A debouncing time of 32 µs is set at the factory.<br>Jitter: < ±100 µs |

Tab. 49

## EXTERNAL_FREQUENCY

| Function | External frequency |
|---|---|
| Active signal | Start of a laser pulse when "RT" is entered in the laser program as frequency value:<br>▪ with every positive signal edge.<br>▪ until the number of pulses specified in the laser program has been reached. |
| Feedback | The output signal **PULSE_COMPLETED** becomes active if no further pulse is triggered. |
| Information | The output signal **LASER_READY_TO_PULSE** must previously be active.<br>The maximum permissible frequency can be determined in TruControl 1000 as follows:<br>▪ Define the laser parameters in manual operation.<br>▪ Raise the frequency until the value "Utilization 100 %" is reached.<br>**Note:**<br>The input signal **EXTERNAL_FREQUENCY cannot** be used to start a continuous wave laser power (CW).<br>The following can be set via software:<br>▪ Delay time for the start of the laser pulses (see "Configuring the real time interface", pg. 69). A delay time of 1 ms is set at the factory.<br>▪ Debouncing time of the input signals (see "Configuring the real time interface", pg. 69). A debouncing time of 32 µs is set at the factory.<br>Jitter: < ±100 µs |

Tab. 50

# Output signals

The signal response of the input and output signals is dependent on the system parameters **RTI_LEVEL_SETTING** and **RTI_LEVEL_SETTING_X** (see "Configuring the real time interface", pg. 69).

### XEO1

| | |
|---|---|
| **Function** | **Output for the pulse number specified via OPC** |
| **Active signal** | The output delivers a number of pulses that can be specified via OPC by means of the variable "WR_FGD_XEO1". |
| **Requirement** | An OPC server is installed. |
| **Information** | A maximum number of 255 pulses can be specified.<br>The pulses are generated in the ratio 1:1 (pulse:pulse break). The pulse cycle is set to 40 ms at the factory.<br>**Note:**<br>This output signal can e.g. be used in order to identify an addressed laser device.<br>The evaluation of the delivered pulses must be carried out by external devices (e.g. PLC). |

Tab. 51

### PULSE_COMPLETED

| | |
|---|---|
| **Function** | **End of pulse** |
| **Active signal** | The output becomes:<br>■ active for a time set via software, if no further laser pulse is triggered.<br>■ early inactive when a new laser pulse is triggered. |
| **Information** | The time for an active output signal is set by means of the "RTI_MAXTIME_PULSE_COMPLETED" system parameter (see "Configuring the real time interface", pg. 69).<br>"RTI_MAXTIME_PULSE_COMPLETED" = 100 ms is set at factory.<br>This output can be used as feedback signal for the input signal "EXTERNAL_FREQUENCY". |

Tab. 52

## PULSE_DURATION

| Function | Pulse duration |
|---|---|
| Active signal | During a pulse duration, the output is active in the time:<br>▪ from 50 µs to 500 µs before the laser pulse (depending on the settings and the type of the laser device).<br>▪ up to approx. 300 ms after the laser pulse. |
| Requirement | Output will become active during a pulse duration only if the real-time interface has been assigned to the currently active workstation (MPI slot) (see "LASER_ASSIGNED", pg. 32) and (see "Configuring the parallel I/O interface", pg. 54). |
| Information | The output can be used as a trigger signal, e.g. for external measurement systems or for synchronization of an external camera. |

Tab. 53

## LASER_READY_TO_PULSE

| Function | Laser is ready to pulse |
|---|---|
| Active signal | The output becomes active when the laser is ready to emit pulses. |
| Information | The signal becomes active for the first time 20 ... 30 ms after the start of a laser program.<br>After the triggering of a laser pulse, the signal becomes inactive until the laser is again ready to emit laser pulses.<br>The output can be used for synchronizing to the power limit of the laser device. |

Tab. 54

## LASER_IS_PULSING

| Function | Laser is pulsing |
|---|---|
| Active / inactive signal | For each program line, output becomes:<br>▪ active before the first laser pulse.<br>▪ inactive after the last laser pulse. |
| Information | Output can be used as a feedback signal for the inputs:<br>▪ EXTERNAL_FREQUENCY<br>▪ REALTIME_START. |

Tab. 55

## 4.3 Using the realtime interface

**⚠ WARNING**

**Laser light can be emitted without warning following a malfunction in the energy supply (power failure) and restoration of the energy flow.**

**Serious injuries or extensive property damage can result.**

- Condition external controls so they do not automatically or randomly send signals to the laser control to activate the laser following failure and restoration of the energy flow.

### Trigger individual laser pulses

**Note**

Continuous wave laser power (cw) cannot be started.

Individual laser pulses can be triggered externally via the EXTERNAL_FREQUENCY input signal of a real-time interface, when:

- a real-time interface is assigned.
- "Frequency of the real-time interface (RT)" is selected in the laser program as set value for the frequency.

A laser program can be created new or changed from the user level "40" via the dialog *>Programming >the laser program*.

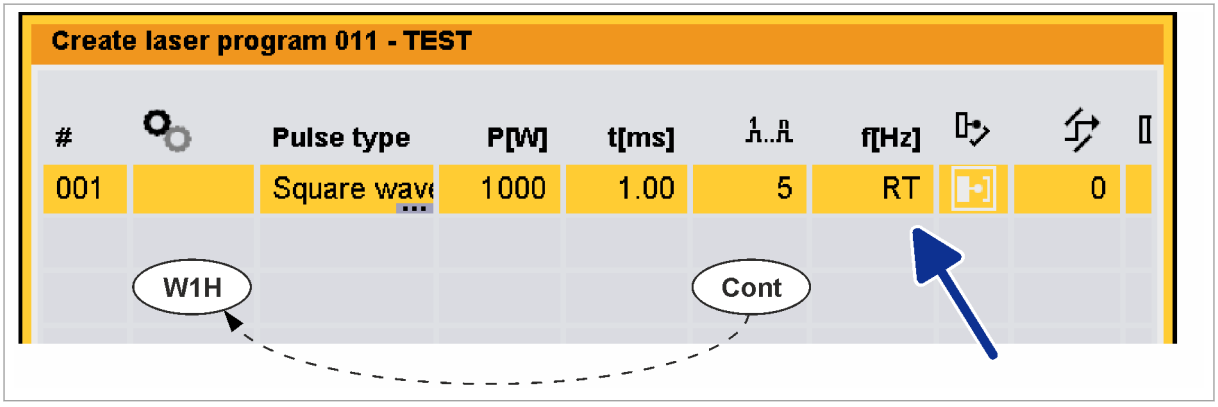



Fig. SR-00106

The laser program only moves on to the next program line when all laser pulses are triggered via the EXTERNAL_FREQUENCY input signal, which are entered in the "Pulse number" field in the program line.

If "Continuous" (Cont) is entered for the pulse number in the laser program, a wait function (W1H, W1L, W2H or W2L) should

be used in the program line if another program line follows. Without a wait function, the laser program will remain stuck in the program line. This condition can be ended by:

- Stopping the laser program.
- Activating the BREAK input signal on the real-time interface.

**Note**

When the EXTERNAL_FREQUENCY input signal is activated while the LASER_READY_TO_PULSE output signal is inactive, TruControl 1000 reports a malfunction. Work cannot be continued until after pressing the *Reset* button.

## Starting program lines in real-time

The running of program lines can be triggered externally via the REALTIME_START input signal of a real-time interface when:

- a real-time interface is assigned.
- the function WRS is selected in the laser program.

A laser program can be created new or changed from the user level "40" via the dialog *>Programming >the laser program*.

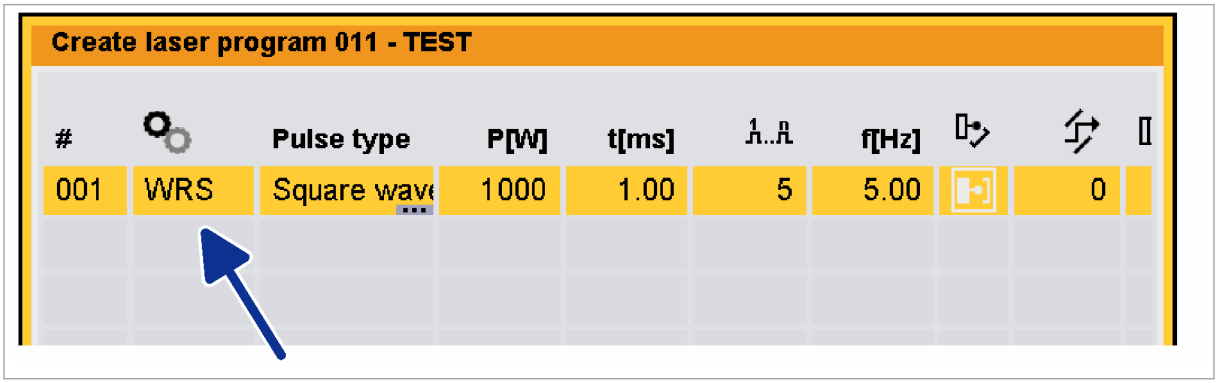



Fig. SR-00107

After activating the input signal REALTIME_START, the output of the laser pulses is started with the predefined frequency until the number of predefined laser pulses is reached.

If "Continuous" (Cont) is entered for the pulse number in the laser program, pulses are triggered until:

- the input signal REALTIME_START is set to inactive.

  **or**
- the BREAK input signal is activated.

  **or**
- the laser program is stopped.

**Note**

When the “REALTIME_START“ input signal is activated while the “LASER_READY_TO_PULSE” output signal is inactive, TruControl 1000 reports a monitoring. Work cannot be continued until after pressing the *Reset* button.

## Example of a laser program

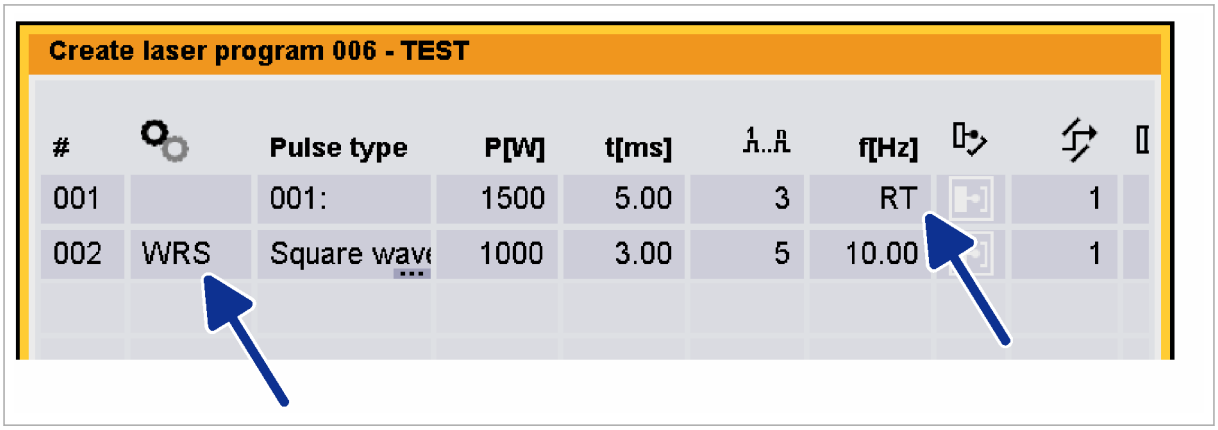



Fig. SR-00109

The laser program shown above consists of 2 program lines:

- In program line 1, three laser pulses are triggered individually via the input signal EXTERNAL_FREQUENCY of the real-time interface. For frequency, the set value selected is *RT* (frequency of the real-time interface).
- In program line 2, the output of 5 rectangular pulses is started via the input signal REALTIME_START. For function, WRS (Wait Realtime Start) is selected.

# Timing diagram for real-time interface

The timing diagram shows the start and running of the laser program number 20 (see "Example of a laser program", pg. 67).




Fig. SR-00108

## 4.4 Configuring the real time interface

| User level ≥ 50 | | |
|---|---|---|
|  | 1. | Select main activity *Set-up*. |
|  | 2. | Select "System settings". |
|  | 3. | Select "Real time interface". |
|  | 4. | Select parameter.<br>The selected parameter is highlighted in yellow. |
|  | 5. | Select *Edit*.<br>The *Edit parameters* dialog is displayed. |
| | 6. | Select a value. |
|  | 7. | Select *Apply*. |

Tab. 56

The following table list the settings possible for the real-time interface.

The settings apply to all real-time interfaces, except for the following settings:

- RTI_LEVEL_SETTING
- RTI_LEVEL_SETTING_1
- RTI_LEVEL_SETTING_2
- RTI_LEVEL_SETTING_3

These settings apply to the respective real-time interface, depending on its current value.

| Variable | Functions | Factory setting | Values |
|---|---|---|---|
| RTI_ DEBOUNCE_ TIME | **Debouncing time of the inputs**:<br>The debouncing time can be set in 8 defined levels.<br>If the **RTI_PULSE_INTERLOCK_MODUS** is = 4, a value of <= 32 µs must be set here. | 32 µs | 30 ns, 8 µs, 32 µs, 128 µs, 500 µs, 2 ms, 8 ms, 32 ms |
| RTI_ DELAY_TIME | **Delay time for pulse triggering**:<br>The triggering of laser pulses started via the input signals REALTIME_START and EXTERNAL_FREQUENCY is delayed by the adjusted time. | 1 ms | 0.0 ms - 100.0 ms<br>Increment: 0.1 ms |
| RTI_EXTERNAL_ FREQUENCY_ NO_READY_ TO_PULSE | Monitoring the input signal **EXTERNAL_FREQUENCY** outside of the active output signal **LaserReadyToPulse**:<br>0 = no monitoring message.<br>1 = monitoring message | | |

| Variable | Functions | Factory setting | Values |
|---|---|---|---|
| RTI_EXTERNAL_ FREQUENCY_ WITHOUT_ FG_IS_ON | Monitoring the input signal **EXTERNAL_FREQUENCY** for trigger pulses outside of the active output signal **PROG_ACTIVE**:<br>0 = no monitoring message<br>1 = monitoring | 0 | 0, 1 |
| RTI_LEVEL_ SETTING | **Active signal level of the real-time interface**:<br>The active signal level applies to all input signals of the real-time interface X (1 ≤ X ≤ 3) if the corresponding system parameter RTI_LEVEL_SETTING_X = 0 or if system parameter RTI_LEVEL_SETTING_X is not available.<br>0 = signal level low-active.<br>1 = signal level high-active. | 1 | 0, 1 |
| RTI_LEVEL_ SETTING_1/2/3 | **Active signal level of the real-time interface X**:<br>The active signal level applies to the input signals of the real-time interface X (1 ≤ X ≤ 3):<br>0 = parameter RTI_LEVEL_SETTING is used for the real-time interface X.<br>1 = signal level for all signals of the real-time interface X is high-active.<br>2 = signal level for all signals of the real-time interface X is low-active.<br>3 = only signal level for **PULSE_INTERLOCK** signal is low-active. | 1 | 0, 1 |
| RTI_MAXTIME_ PULSE_ COMPLETED | Time for active output signal **PULSE_COMPLETED**:<br>If the set pulses are triggered, the output signal **PULSE_COMPLETED** will be activated for the defined time. | 100 ms | 1 ms - 500 ms<br>Increment: 1 ms |
| RTI_PLCVIEW_ ACTIVE | **Recording of real-time signals with PLCView**:<br>If RTI_PLCVIEW_ACTIVE = 1, the real-time signals are recorded with PLCView.<br>If RTI_PLCVIEW_ACTIVE = 0, the recording of the real-time signals with PLCView is deactivated.<br>Exception:<br>If RTI_PLCVIEW_ACTIVE = 0 and RTI_PULSE_INTERLOCK_MODUS = 4, the POWER_GATE signals are recorded. | 0 | 0, 1 |
| RTI_PULSE_ INTERLOCK_ MODE | **Mode for the pulse lock**:<br>1 = The pulse lock is deactivated.<br>2 = The pulse triggering is interrupted, a started laser pulse is still finished.<br>3 = The pulse triggering is interrupted, a started laser pulse is interrupted.<br>4 = POWER_GATE: The laser beam is suppressed if the signal **PULSE_INTERLOCK** is active.<br>5 = POWER_GATE via field bus: The laser beam is suppressed if the signal is active on bit 14.2 (bit 2, input word 14). Available for CW lasers only. | 1 | 1 ... 4 |
| RTI_REAL-TIME_START_ WITHOUT_ WRS_LINE | Monitoring the input signal **REALTIME_START** for trigger pulses without programmed WRS function in the laser program line:<br>0 = no monitoring message<br>1 = monitoring message | 0 | 0, 1 |
| RTI_REALTIME _START_ WITHOUT_ FG_IS_ON | Monitoring the input signal **REALTIME_START** for trigger pulses outside of the active output signal **PROG_ACTIVE**:<br>0 = no monitoring message<br>1 = monitoring message | 0 | 0, 1 |

Tab. 57

# Assigning Real-timeinterface to an MPI interface

### Note

Real-time interfaces can be assigned to an MPI slot only if no parallel I/O interface of the central processor (CPX) is configured.

The real-time interfaces can be assigned to several MPI slots.

The parallel I/O interface of the central processor (CPX) is assigned to real-time interface 3.

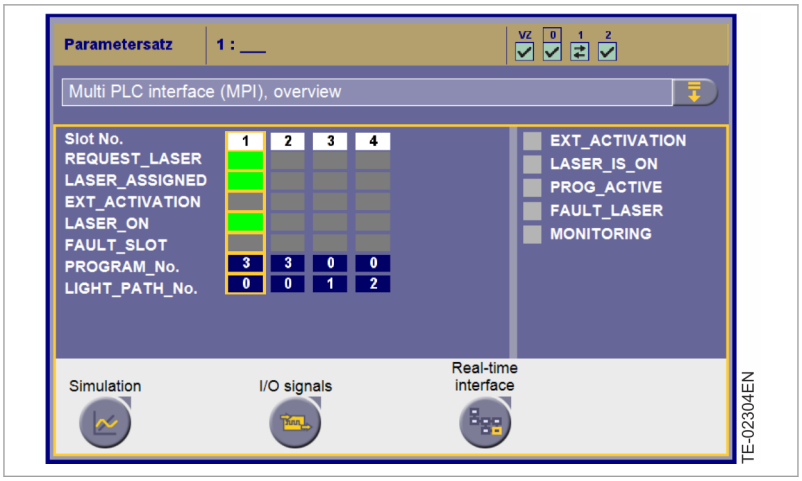
Assigning a real-time interface to an MPI interface:

| User level ≥ 60 | | |
|---|---|---|
|  | 1. | Select main activity *Set-up*. |
|  | 2. | Select *Multi PLC interface (MPI)*. |
| | 3. | Select the desired slot.<br>The selected slot is highlighted in yellow. |
|  | 4. | Select *Change*.<br>The *PLC interface editor* dialog is displayed. |
| | 5. | Select real-time interface parameter.<br>The parameter is highlighted in yellow. |
|  | 6. | Select *Change properties*. |
|  | 7. | Select real-time interface number. |
|  | 8. | Select *Close*. |
|  | 9. | Select Close.<br>The dialog for applying the changes is displayed. |
|  | 10. | Select Save.<br>The real-time interface is assigned to the MPI interface. |

Tab. 58

## 4.5 Testing options

### Multi-PLC interface (MPI), overview




Multi PLC Interface (MPI), overview dialog Fig. TE-02304

Open the dialog **Multi PLC Interface (MPI), overview**:

| User level ≥ 0 | | |
|---|---|---|
|  | 1. | Select the main activity *Production*. |
|  | 2. | Select *Multi PLC interface (MPI), overview*.<br>The *Multi PLC interface (MPI), overview* dialog is displayed. The statuses of important signals, the pulse energy, the average laser power and the utilization of the laser device are displayed for each assigned machining station (slot). |

Tab. 59

When selecting a slot, buttons are displayed in the context bar which enable activation of further functions. Depending on the configuration the following buttons are available:

- Simulation
- I/O signals.
- Real-time interface
- Manual focusing optics (option).

Further information can be found in the **TruControl 1000** software manual, doc. no. 10-06-80-A1-CR.

# Real-time interface status information

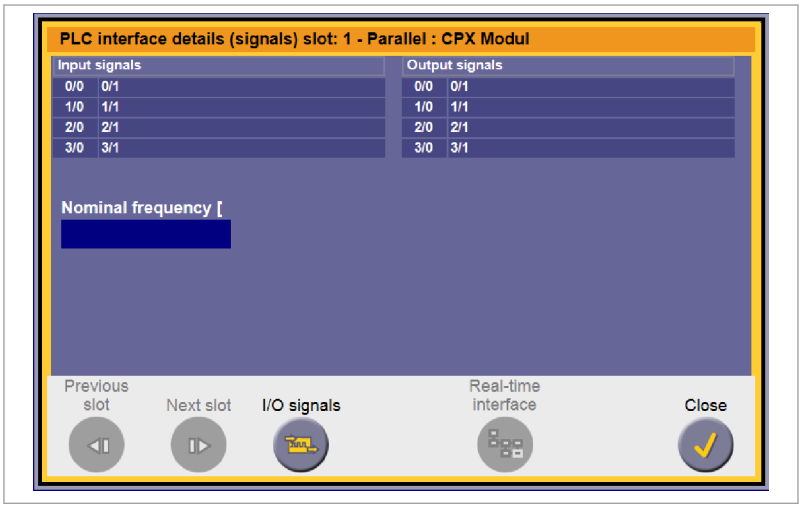



Fig. TE-02411

| User level ≥ 0 | | |
|---|---|---|
|  | 1. | Select the main activity *Production*. |
|  | 2. | Select *Multi PLC interface (MPI), overview*. |
| | 3. | Select the desired slot. |
|  | 4. | Select Real time interface. |

Tab. 60

The status of the real-time interface can be displayed with every user level via the *>Production >Multi PLC interface (MPI), overview* dialog for every allocated Multi-PLC interface. Select the desired Multi-PLC interface in the *>Multi PLC Interface (MPI), overview* dialog and then *>Real-time interface*.

# 5. Sync I/O interface

The sync I/O interface with 6 query inputs and 6 setting outputs is assigned to digital input and output channel 1 (D IN BLOCK1, D OUT BLOCK1).

## 5.1 Pin assignment of the Sync I/O interface

| Inputs of the Sync I/O interface, channel D IN BLOCK1 | | |
|---|---|---|
| **Pin** | **Signal name** | **Function** |
| 0 | INQUIRY_INPUT_A | **Inquiry inputs A ... F** |
| 1 | INQUIRY_INPUT_B | |
| 2 | INQUIRY_INPUT_C | |
| 3 | INQUIRY_INPUT_D | |
| 4 | INQUIRY_INPUT_E | |
| 5 | INQUIRY_INPUT_F | |
| 6<br>7 | - | **Reserved** |
| GND | GND | Reference voltage |

Inputs of the Sync I/O interface Tab. 61

Figures for connector CPX V3: (see "Fig. TE-04610", pg. 4), CPX V4 Standard: (see "Fig. TE-04616", pg. 7)

| Outputs of the Sync I/O interface, channel D OUT BLOCK1 | | |
|---|---|---|
| **Pin** | **Signal name** | **Function** |
| 0 | SET_OUTPUT_A | **Set outputs A ... F** |
| 1 | SET_OUTPUT_B | |
| 2 | SET_OUTPUT_C | |
| 3 | SET_OUTPUT_D | |
| 4 | SET_OUTPUT_E | |
| 5 | SET_OUTPUT_F | |
| 6<br>7 | - | **Reserved** |
| GND | GND | Reference voltage |
| VCC | VCC | External power supply |

Outputs of the Sync I/O interface Tab. 62

Figures for connector CPX V3: (see "Fig. TE-04613", pg. 5), CPX V4 Standard: (see "Fig. TE-04617", pg. 7)

## 5.2 Signal descriptions of the Sync-I/O interface

## Input signals

### INQUIRY_INPUT_A ... _F

| | |
|---|---|
| **Function** | **Inquiry inputs A ... F** |
| **Active signal** | The 6 input signals "INQUIRY_INPUT_A ... INQUIRY_INPUT_F" can be used to synchronize the running of a laser program with external sequences. |
| **Information** | If a line of the laser program contains a inquiry instruction (WxH or WxL), this line is not executed until the respective inquiry input acquires the required status "high" or "low".<br>x = A ... F |
| **Example** | Command **WAH**:<br>The laser program is continued as soon as the inquiry input A acquires the status "high". |

Tab. 63

## Output signals

### SET_OUTPUT_A ... _F

| | |
|---|---|
| **Function** | **Set outputs A ... F** |
| **Active signal** | The 6 output signals "SET_OUTPUT_A ... SET_OUTPUT_F" can be used to synchronize external processes with the running of the laser program. |
| **Information** | The states of the output signals in laser programs can be set to the output level "high" or "low" by means of commands (SxH or SxL).<br>If an output signal is set to the "high" level by the laser program, this output level remains active until:<br>▪ a laser program is started again.<br>▪ a cancelled laser program is reset with the "Reset" button.<br>▪ the output level is set to "low" by means of a command SxL in the laser program.<br>x = A ... F<br>**Note:**<br>The output signals "SET_OUTPUT_A ... SET_OUTPUT_F" can also be used to monitor the running of a laser program. |
| **Example** | The **SAH** command in the laser program sets the output signal "SET_OUTPUT_A" to the output level "high".<br>The **SAL** command in the laser program sets the output signal "SET_OUTPUT_A" to the output level "low". |

Tab. 64

## 5.3 Using the Sync I/O interface

Inquiry inputs and set outputs of the sync I/O interface can be used in laser programs if the sync I/O interface is selected.

The input signals of the 6 inquiry inputs of the CPX can be used to synchronize the running of a laser program to external sequences.

With the output signals of the 6 set outputs of the CPX, external sequences can be synchronized with the laser program sequence.

The column "Function" of a program can be used to define:

- which inquiry input is used and which signal level must be applied for the program line to be run.
- which set output is used and at what signal level the set output is set when the program line is run.

### Example of a laser program

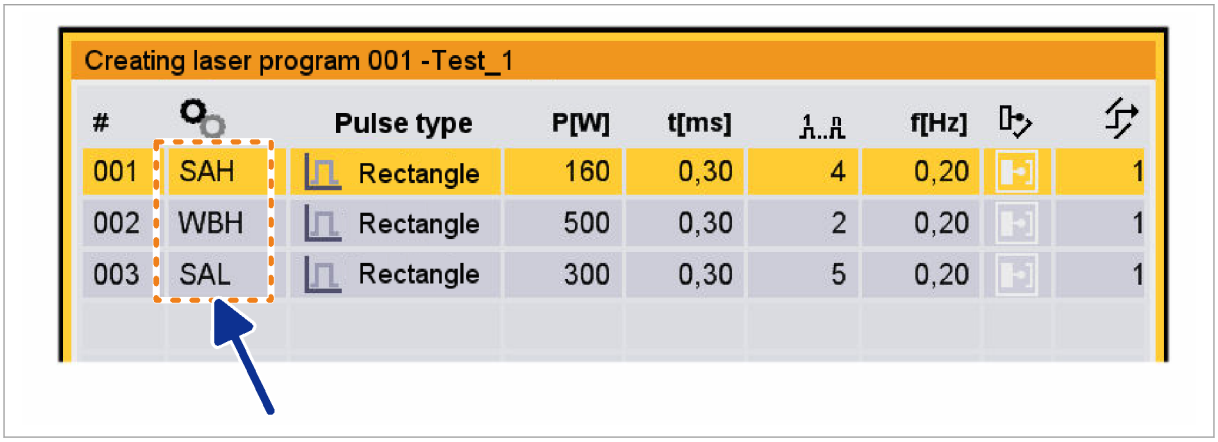



Fig. SR-00704

The laser program shown above consists of 3 program lines:

- **Program line 1:** After the program start, the set output A is set to the signal level "high" according to the function "SAH" and the program line is run.
- **Program line 2:** The program line is only run if a high level is applied at inquiry input B according to the function "WBH".
- **Program line 3:** The set output A is set to the signal level "low" according to the "SAL" function and the program line is run.

## 5.4 Selecting the Sync I/O interface

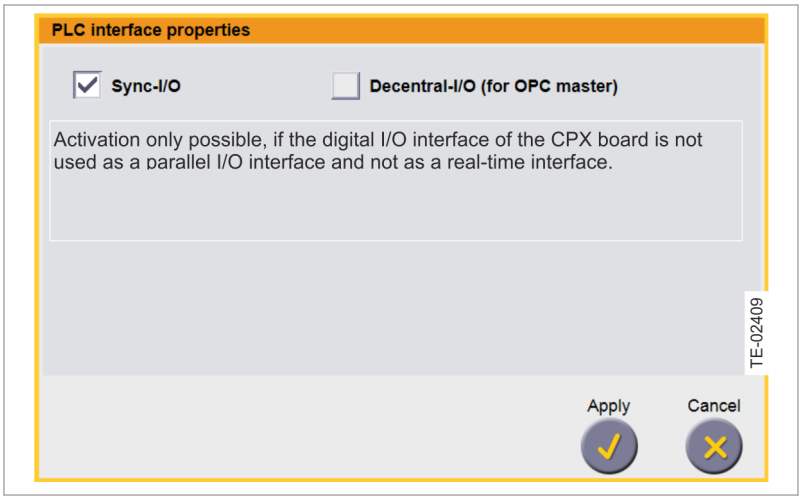



Fig. TE-02409

**Note**

The decentralized I/O interface can only be activated if neither the parallel I/O interface of the central processor (CPX) is allocated to an MPI slot nor a real-time interface assigned to an MPI slot. A sync I/O interface can also not be combined with a decentralized I/O interface. Sync I/O or decentralized I/O (for OPC server) is alternatively selected.

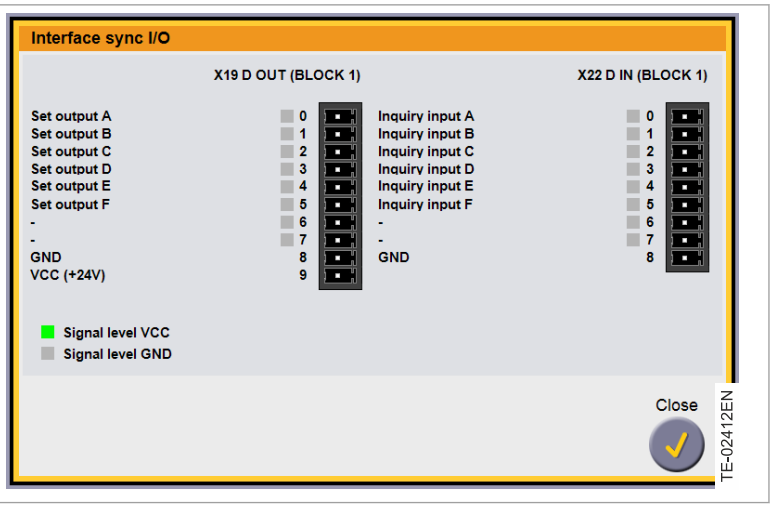
To assign a sync I/O interface to a multi PLC interface:

| User level ≥ 60 | | |
|---|---|---|
|  | 1. | Select main activity *Set-up*. |
|  | 2. | Select the *Multi PLC interface* to which the sync I/O interface should be assigned. |
|  | 3. | Select *Change properties*. |
| | 4. | Enable the Sync I/O option. |
|  | 5. | *Select Apply*. |

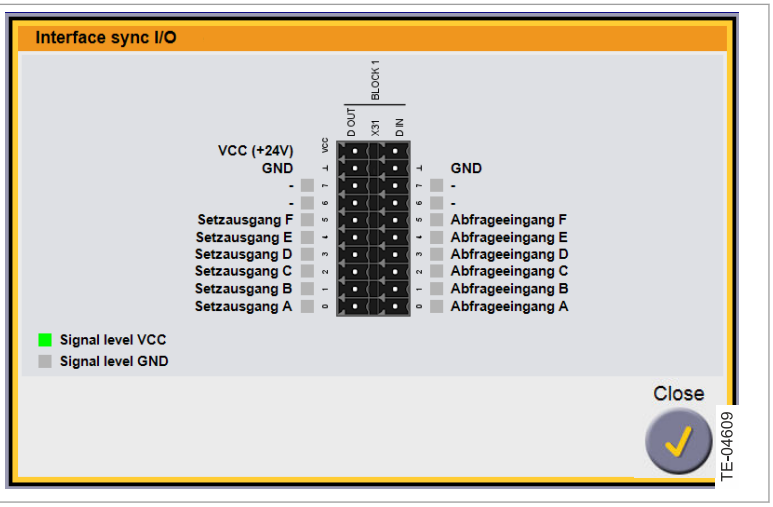
Tab. 65

## 5.5 Testing options

## Diagnosis Sync I/O interface




Diagnostics Sync-I/O, CPX V3 Fig. TE-02412

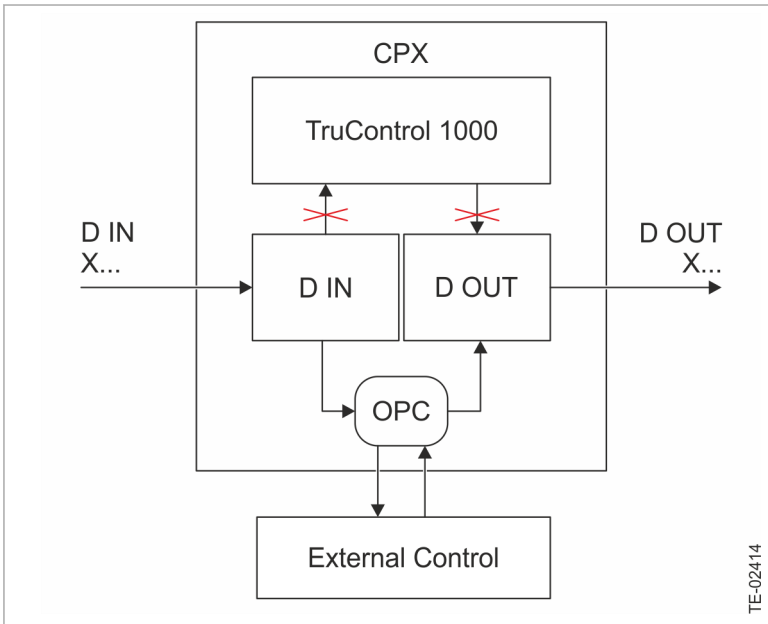



Diagnostics Sync-I/O, CPX V4 Fig. TE-04609

| User level ≥ 0 | | |
|---|---|---|
|  | 1. | Select the main activity *Diagnostics*. |
|  | 2. | Select *TruControl laser control* (CPX). |
|  | 3. | Select the connector of the input and output channel 1 (CPX V3: X19 D OUT BLOCK 1 or X22 D IN BLOCK1, CPX V4 standard: X31 D IN/OUT BLOCK1).<br>The overview showing the set outputs and query inputs of the Sync I/O interface is displayed. |

Tab. 66

# 6. Decentralized I/O interface



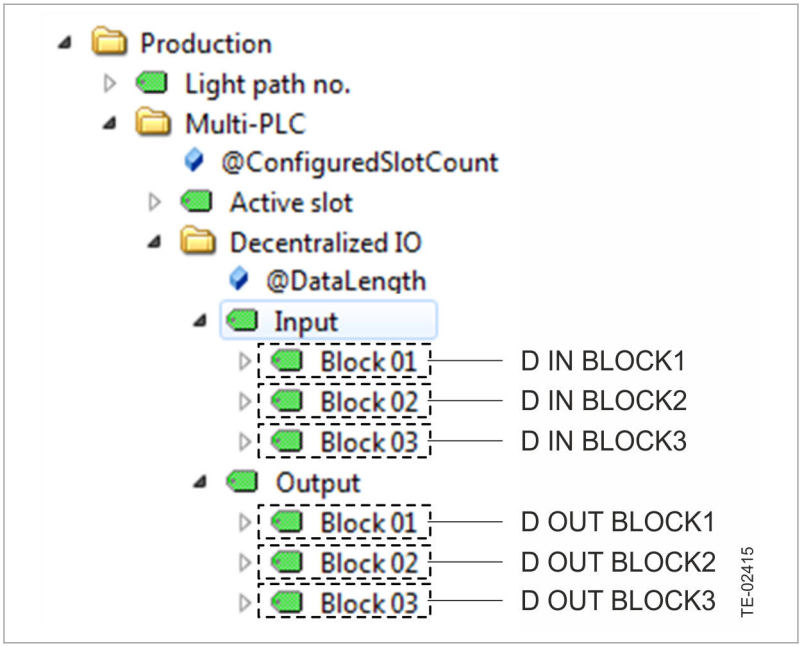

D IN: digital inputs
D OUT: digital outputs
X... Connector to the CPX

Decentralized I/O interface, operating principle Fig. TE-02414

The decentralized I/O interface makes the digital I/O signals (D IN and D OUT) of the central processor (CPX) available to an external control via the OPC.

The TruControl 1000 laser control can neither read inputs nor set outputs when this is the case.

The following figure shows the digital inputs and outputs of the decentralized I/O interface of the CPX in the OPC server.




Digital inputs and outputs of the decentralized I/O interface in the OPC server of the CPX Fig. TE-02415

The decentralized I/O interface is used with the TruMark Station 5000 and TruMicro Mark 2000, for example.

For more information about OPC: Interface description OPC UA for CPX, document no. 09-14-11-A6-BA.

## 6.1 Selecting the decentralized I/O interface

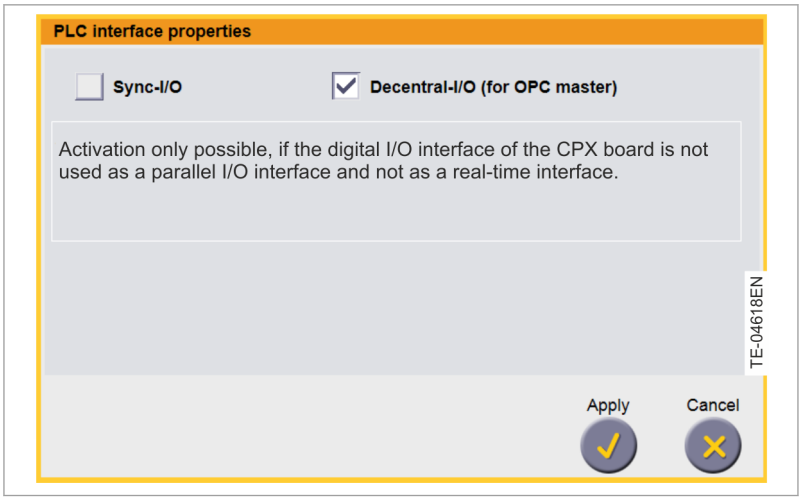



Fig. TE-04618

**Note**

The decentralized I/O interface (for OPC server) can only be activated if neither the parallel I/O interface of the central processor (CPX) is allocated to an MPI slot nor a real-time interface assigned to an MPI slot. A decentralized I/O interface can also not be combined with a sync I/O interface. Sync I/O or decentralized I/O (for OPC server) is alternatively selected.

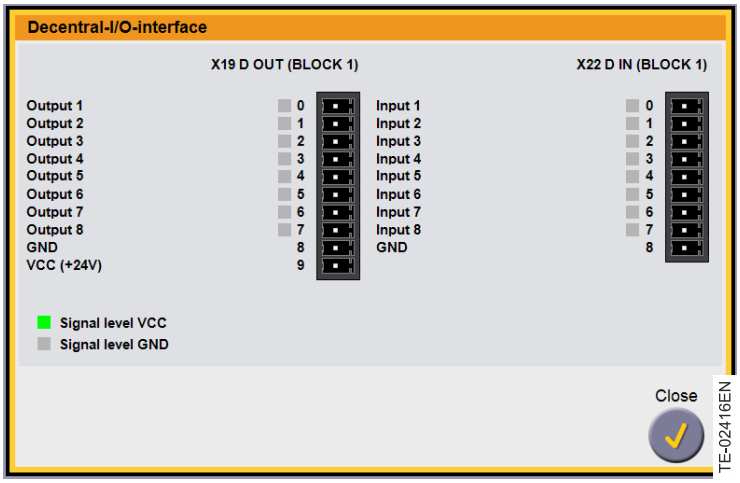
To assign a decentralized I/O interface to a multi PLC interface:

| User level ≥ 60 | | |
|---|---|---|
|  | 1. | Select main activity *Set-up*. |
|  | 2. | Select the *Multi PLC interface* which the decentralized I/O interface is to use as an OPC server. |
|  | 3. | Select *Change properties*. |
| | 4. | Activate the decentralized I/O option (for OPC Server). |
|  | 5. | Select *Apply*. |

Tab. 67

## 6.2 Testing options

## Decentralized I/O interface diagnostics




Decentralized I/O interface diagnostics, channel 1, CPX V3 Fig. TE-02416

| User level ≥ 0 | | |
|---|---|---|
|  | 1. | Select the main activity *Diagnostics*. |
|  | 2. | Select *TruControl laser control* (CPX). |
|  | 3. | Select the connector for the desired channel.<br>The overview of the inputs and outputs of the selected channel of the decentralized I/O interface is displayed. |

Tab. 68

# 7. Terms and abbreviations

**ASV** **A**rbeits- und **S**icherheits**v**erschluss (operating and safety shutter board)

Each safety circuit is connected to an ASV board located in the control unit of the laser device. The ASV board controls the laser in a way which prevents emission of laser light when the safety circuit is open.

The shutter switch (VW) of a light path is connected to the safety circuit (SIK) of this light path by means of an ASV board. The central shutter (VZ) is connected via ASV board to the safety circuit (SIK) for all light paths.

**CPX** **C**entral **P**rocessor E**x**tendable,
German: Erweiterbarer Zentralrechner

The CPX is the central board in the new generation laser control. Both the TruControl 1000 operating software and central processor software of the plug-in control unit run in the operating system Linux on the CPX.

**D IN BLOCK** **D**igital **IN**put **BLOCK**,
German: Digitaler Eingangskanal

Input channel with 8 digital inputs.

**D OUT BLOCK** **D**igital **OUT**put **BLOCK**,
German: Digitaler Ausgangskanal

Output channel with 8 digital outputs.

**high-active**

- If a high-level voltage is present at the input or output, then the bit value of the signal is "1".
- If a low-level voltage is present at the input or output, then the bit value of the signal is "0".

The required voltage values for high and low levels are described in the **Technical Data** section (see "Technical Data", pg. 14).

**I/O interface** **I**nput/**O**utput interface

I/O interface for external control of the laser device via digital input and output signals

**LEZ** **L**aser**e**insatz**z**eit (laser delay time)

The delay in time from the activation of the **PSTART_DYN** or **PSTART_STATICAL** input signal to the delivery of the laser power at the processing point is called laser delay time (LEZ).

**low-active**

- If a high-level voltage is present at the input or output, then the bit value of the signal is "0".
- If a low-level voltage is present at the input or output, then the bit value of the signal is "1".

The required voltage values for high and low levels are described in the **Technical Data** section (see "Technical Data", pg. 14).

**MPI**

**M**ulti-**P**LC **I**nterface

**Multi-PLC interface**

The Multi-PLC interface is a system component of the TRUMPF LaserNetwork (TLN). It is a software interface of the laser control system which allows different (max. 32) control units of machining station to request the laser power. The control units are connected to the laser device via fieldbus, OPC or parallel I/O interfaces.

**OLE**

**O**bject **L**inking and **E**mbedding
English: Linking and embedding objects

**OPC**

**O**LE for **P**rocess **C**ontrol

**PCU**

**P**ower **C**alibration **U**nit
The **P**ower **C**alibration **U**nit is used for measuring the laser power at the workpiece, see Operator's manual CalibrationLine – Focus Calibration Program & Power Calibration Program, doc. no.: 07-12-12-A8-CR.

**PLC**

**P**rogrammable **L**ogic **C**ontrol

**PLCView**

>*PlcView* is a secondary activity in the main activity >*Diagnosis*.

In the secondary activity >*PlcView*, the input and output data of the 32 possible connections of the laser device to the external controls (MPI slots) are displayed and recorded.

**Slot**

A slot within the Multi PLC Interface (MPI) is a virtual slot for connection of an external control unit.

**VW** **V**erschluss**w**eiche; english: shutter switch

The shutter switch is used to block the laser beam emission or enable it for individual light paths. If the shutter switch is locked, the laser beam is guided into the absorber of the shutter switch. The shutter switch of a light path is connected to the safety circuit (SIK) of this light path by means of an ASV board.

**PMS** Central shutter

The central shutter is used to block the laser beam emission or enable it for all light paths. If the central shutter is locked, the laser beam is guided into the absorber of the central shutter. The central shutter is connected to the safety circuit (SIK) by means of an ASV board.

**WRS** **W**ait **R**ealtime **S**tart,

The function **WRS** is used to trigger laser pulses in a laser program by means of the signal **REALTIME_START**.