ToolConnector TS2

User-Manual
Part II
Commissioning and Operation

Version 1.0.6
Firmware Version 1.06

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1. Content

2. List of Versions

Version	Modification	Date
1.0.0	Initial Version	05.11.2020
1.0.1	1st Revision	15.01.2021
1.0.2	Updated to FW 1.02	19.02.2021
1.0.4	Updated to FW 1.04	15.10.2021

3. Function and Intended Use

The *ToolConnector* is intended for operations on a TS2 Stäubli Robot. The installation, the connection and the operation of the device have to happen according to this manual.
This component delivers no safety functions in terms of human- or machine-safety. Functional safety needs to be ensured by superior systems.

Every use beyond the terms of this manual, is seen as not intended use.

Electrical and mechanical works are allowed to be done by qualified personal only.

4. Commissioning

The following items that are mentioned in User-Manual Part I Mechanics, are the basics for the commissioning:

- Mechanical Attachment to the Robot
- Electrical Connection Supply-Voltage (Power-Supply Unit X200)
- Electrical Connection EtherCAT (Mainboard EtherCAT in)
- Pneumatical Connection Supply-Pressures (P1/P2)
- Electrical Connection Sensors / Actuators
- Installed Version of Stäubli Robotics Suite (SRS)

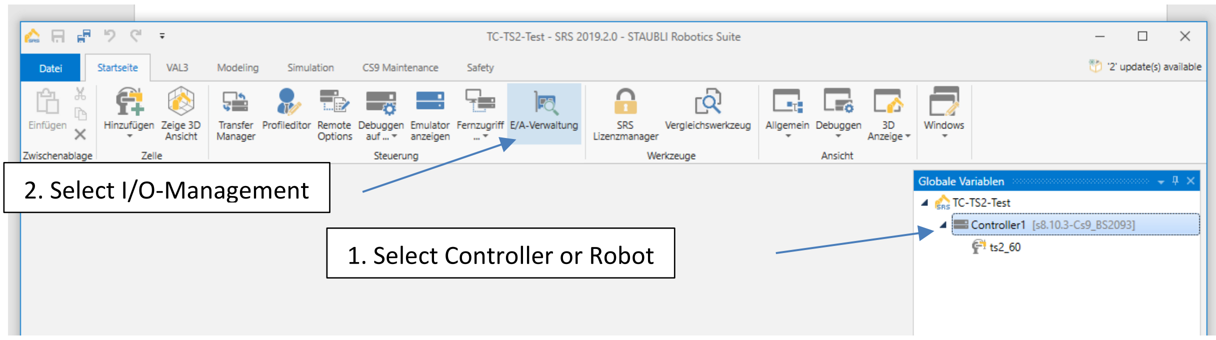
4.1. Installation of the EtherCAT Slave Information File (ESI)

The EtherCAT slave information file (ESI-File) must be imported to the system so that the device can be involved to the controller. This is a XML-file named TC-TS2-Vx.xx whereupon x.xx represents the version. Save this file in a directory on your computer.

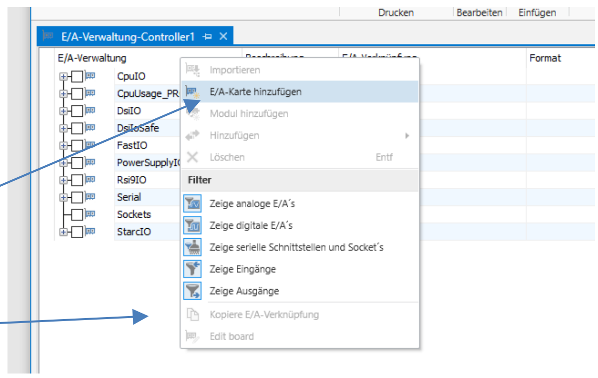
Depending on the used tool, the procedure can be slightly different. Please refer to the relevant documentation for details.

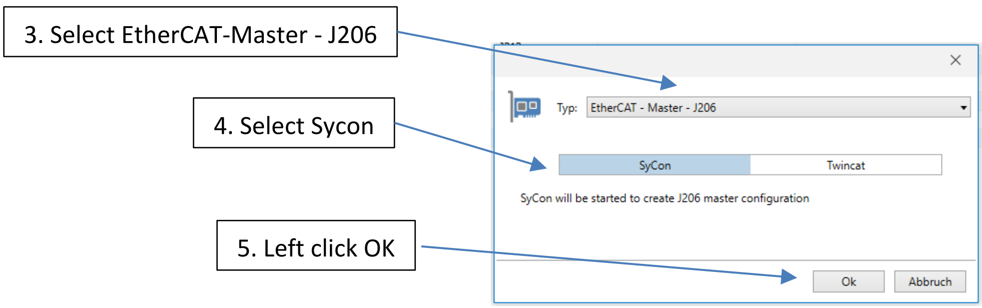
In the following, we describe the integration as an example at the internal EtherCAT bus of the CS9 (J206) with the Tool SyCon.net of Stäubli Robotics Suite (SRS 2019). It is required, that you already have generated a system with a CS9 controller.

Now open the I/O-Management in SRS:

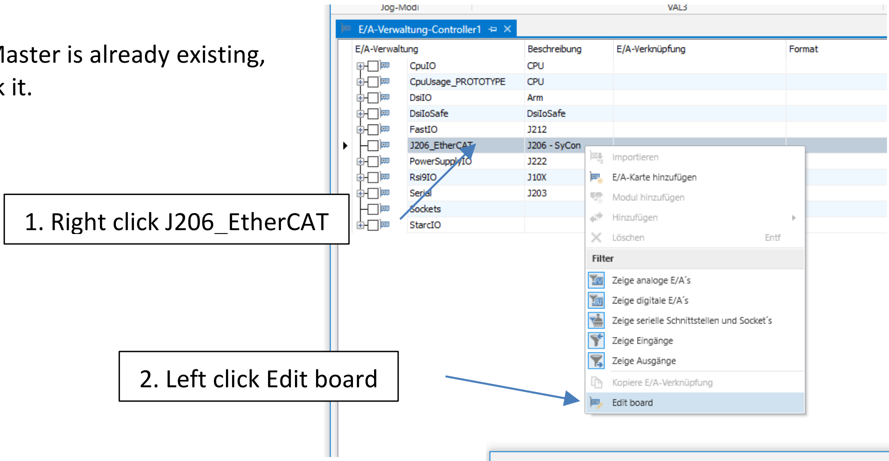


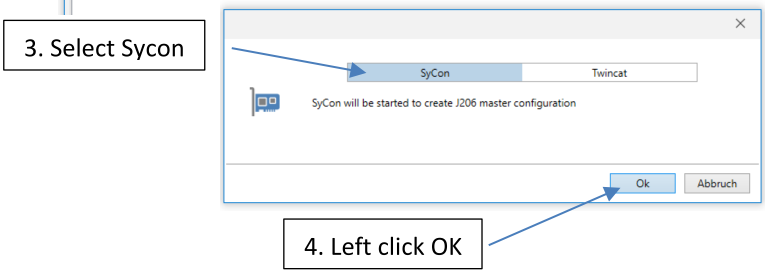
The EtherCAT-Master may need to be generated first in the now opening window. Right click into the window to add another I/O-board.



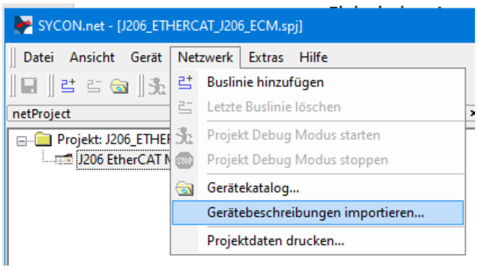


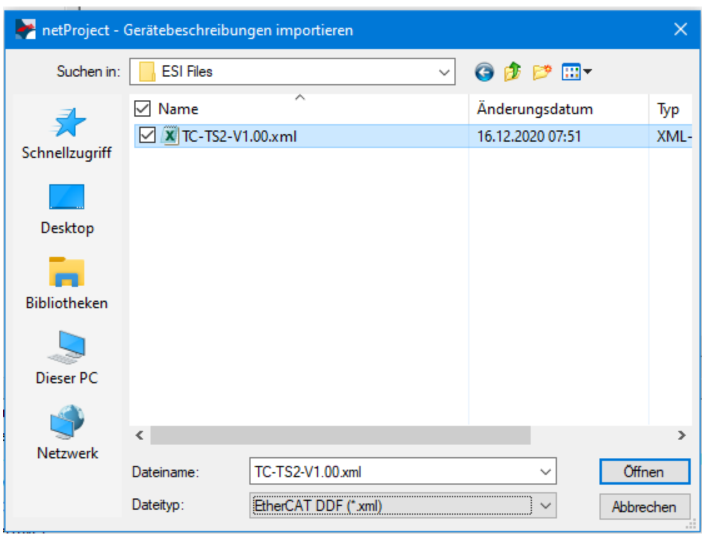
If the EtherCAT-Master is already existing, you can right click it.





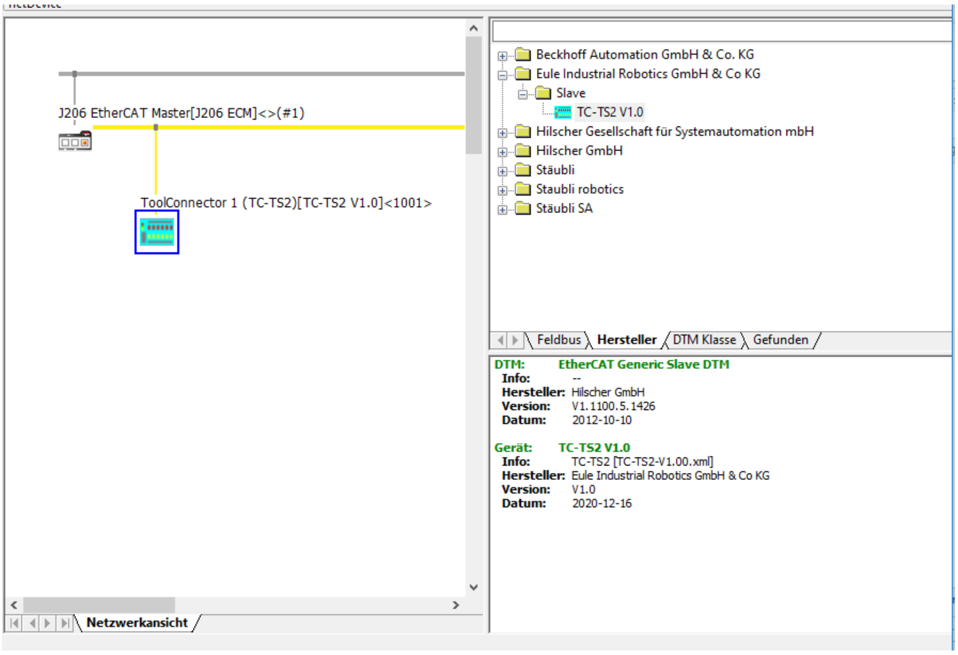
SyCon.net is now opening. Select Network -> Import Slave Information:





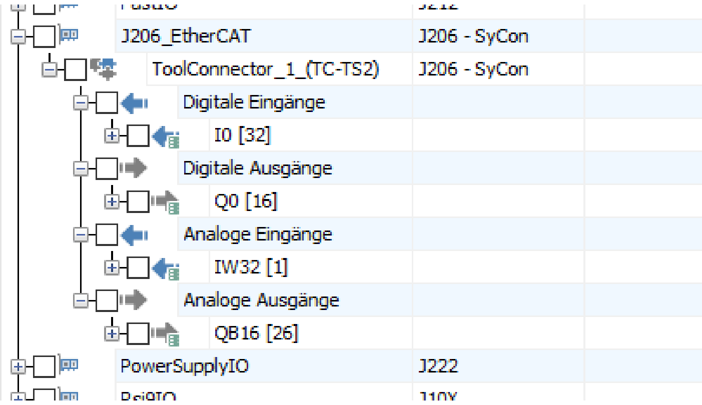
Select „EtherCAT DDF (*XML)“ as datatype in the now opening window, navigate to the directory in which the ESI-file is saved and select it.

After loading the device register again, the device TC-TS2 is now available and can be integrated into your configuration.



After closing SyCon.net, the ToolConnector is available in the I/O-tree of the controller.

Now you can assign the in- and outputs to your project. Details can be seen in the SRS-documentation.



4.2. Control Elements

4.2.1. Displays

The ToolConnector has two 1”-graphic displays to indicate status information and menus.
There is one display on each case side (A/ B).

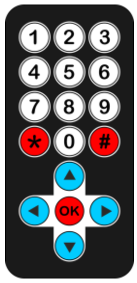
The displays shut down or dim themselves autonomously after an adjustable time of not operating (can be turned off).

4.2.2. Remote Control

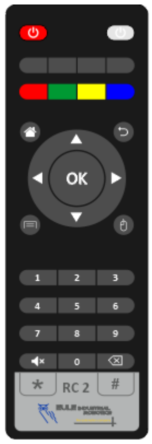
The IR-remote control is needed for the commissioning.
Later in the automatic operation, the remote control is **not** necessary.

The remote control is not coded and can be used for any TC-TS2 ToolConnector. It is necessary to ensure that the right device is controlled, when several Tool-Connectors are located close to each other.

From the delivery date 01/2023, the ToolConnector is delivered with the new RC2 remote control. The RC2 remote control has additional buttons that can be read via the robot program. The remote controls are identical in terms of operating the ToolConnector. When the OK button is pressed several times, the ToolConnector recognizes the remote control used. The RC2 can be used from FW 1.04. From FW 1.05, the remote control type can be preset via the setup menu.

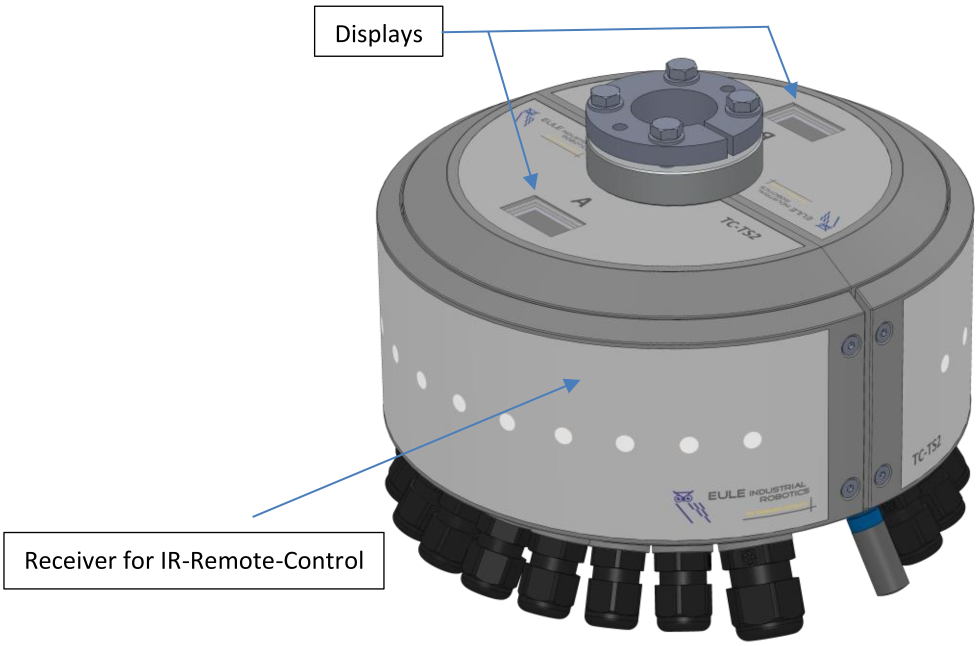


RC 1 (until 12/2022)



RC 2 (from 01/2023)

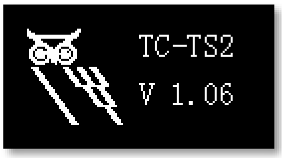
The receiver is placed on the mainboard inside the upper half-case A. The operation is also possible when the case is closed, but makes an aiming at the receiver necessary.



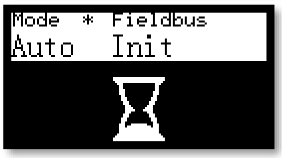
4.3. Power-Up

The ToolConnector is activated by connecting the voltage V1 to the plug-in connector X200. The boot procedure lasts about 1 second. During this time, the splash screen is shown on both displays.

The actual firmware version can be read out here.



When the boot procedure is successful, what means that all parameters and components are initialized successful, the ToolConnector switches into automatic-mode and is ready to operate.
The acoustical feedback occurs by 1 short beep. When the boot procedure is not successful, the ToolConnector switches into setup-mode (2 short beeps).



4.4. Status Displays

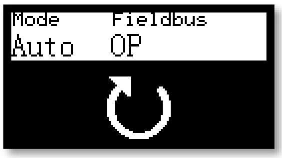
The upper section of both displays is carried out as status-display. The current states are reported here:

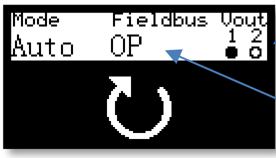
Display A

Display B

Status-Display

Operation-Mode





Output Supply State

Operation-Mode
Field-Bus

This part of the display is equal in all operation-modes.

4.5. Operation Modes

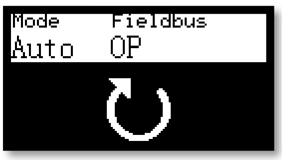
The ToolConnector has 4 operation-modes

Operation-Mode	Name
Auto	Automatic Operation
Manu	Manual Functions
Setup	Setup, Error Identification
Test	Test Functions

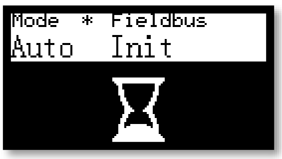
4.5.1. Automatic Operation

The automatic operation is the standard-operation-mode. In addition to the status information, the current state is signalized by 3 different icons.

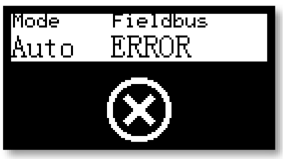
Run



Wait



Error



Run All functions active, no failure, field-bus in operation mode
Wait Field-bus not in operation mode, no signal communication
Error System has a failure, no signal communication

4.6. Manual Mode

The manual mode can be selected while the automatic operation is running. To avoid misuses, the switching of the modes is performed by a button combination on the remote control.

Push the following buttons in sequence * # OK

Through this you reach the manual mode.

Navigation:

With the ▼▲ buttons, you navigate through the menu.

Menu items are selected by pressing OK .

With ◄ you skip back to the beginning of the menu.

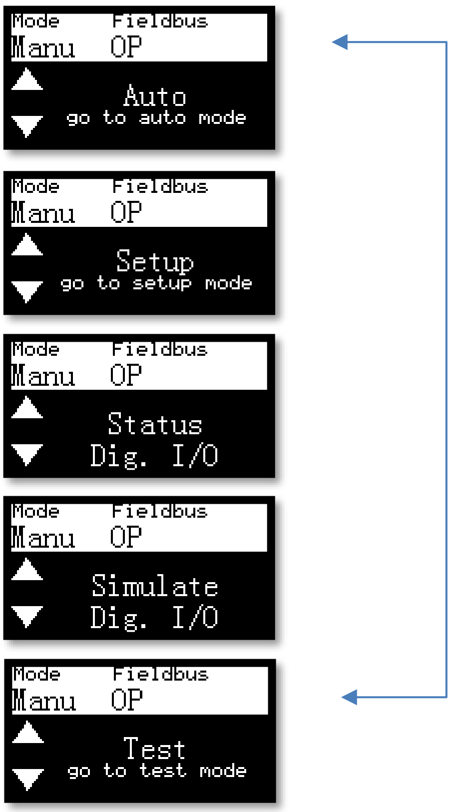
Go to
Automatic-Mode

Go to
Setup-Mode

Status indication
Digital I/O

Simulation
Digital I/O

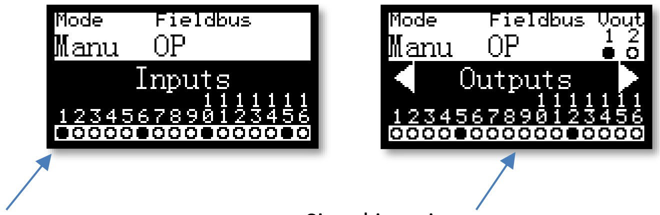
Go to
Test-Mode



4.6.1. Status Indication digital I/O

The states of the digital I/O-signals can be displayed by this function.
With OK you can leave this function.

Display A **Display B**



Signal active

Signal inactive

4.6.1. Simulation digital I/O

Input and output signals can be simulated by this function. The simulation of the inputs happens in direction to the controller, that means that the current input data will be overwritten. The simulation of the outputs over-writes the data from the controller and operates the outputs directly. In the case that this function is active, the direct link of controller and terminals is interrupted. All data will be updated immediately after leaving this function.

You can leave the function by pressing OK .

The in- and outputs are divided into four groups of 8 bit. It is just one group active at a time. The active group is displayed inverted.

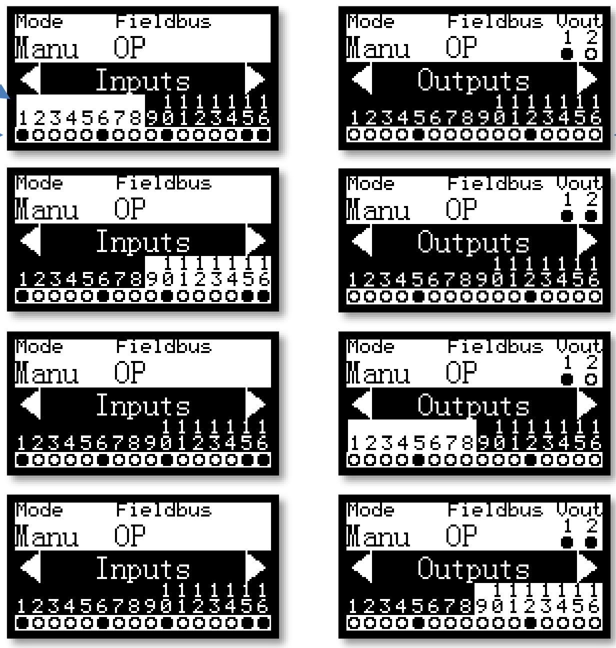
You can switch between the groups with ◀ and ▶.

Inside the active group you can switch the individual signals by pressing the buttons 1 ... 8 .
The button 0 switches the whole group.

Display A **Display B**

Active Group

Signal active



Signal inactive

4.7. Setup Mode

The setup-mode can be selected while the manual mode is running.

Navigation:

With the ▼ ▲ buttons, you navigate through the menu.

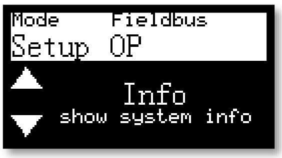
Menu items are selected by pressing OK .

With ◄ you skip back to the beginning of the menu.

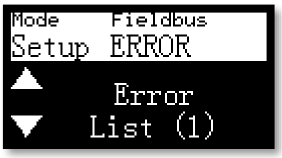
Inside the submenu, values can be changed with ◄ ► . Numerical values can be entered by direct input with # 0 ... 9 * . The value is confirmed with OK . By pressing ▼ or ▲ you leave the submenu without altering any value.

Go to
Manual-Mode

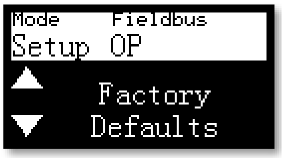
Show System
Information



Show
Failure List

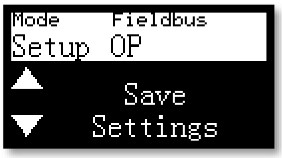


Load
Factory Defaults



Loads standard values into memory
Load with #
Abort with ▼ ▲ or OK

Save
Settings

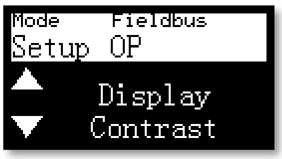


Values are saved permanently
by this function only.
Save with #
Abort with ▼ ▲ or OK

Restart
System

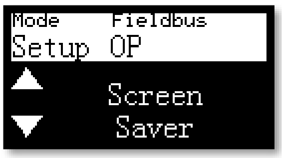
Restart with #
Abort with ▼ ▲ or OK

Set
Display Contrast



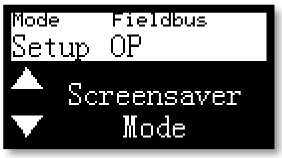
Values between 15 ... 255
Default Value: 127

Set
Screensaver Time



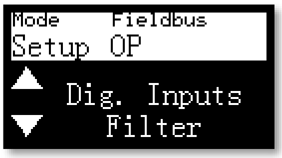
Off, 1 min ... 5 min
Default Value: 1 min

Set
Screensaver Mode



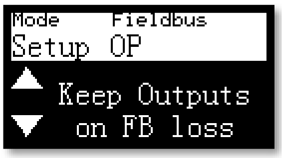
Blank turns off the Display
Dim dims the Display
Default Value: Blank

Set Filter
Digital Inputs



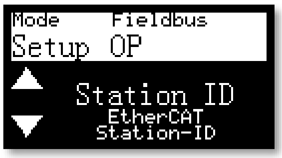
50µS, 100µS, 400µS, 800µS,
1.6mS, 3.2mS, 12.8mS, 20mS
Default Value: 1,6mS
Changes become active after restart only

Keep Outputs
On Fieldbus loss



Yes keeps output status
No sets all outputs on 0
Default Value: Yes

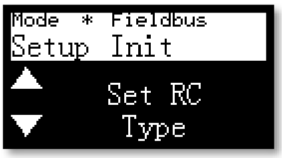
EtherCAT Station ID



Values: 0…65535
Default Value: 1

From firmware 1.05:

Set Remote-Control
Type



Values : 1, 2
Default Value : 2

4.8. Test Mode

The test-mode can be selected while the manual mode is running.
It provides submenus for testing the assembly.

Navigation:

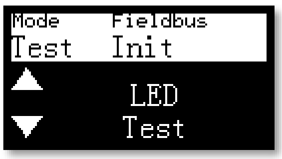
With the buttons, you navigate through the menu.

Menu items are selected by pressing OK .

With you skip back to the beginning of the menu.

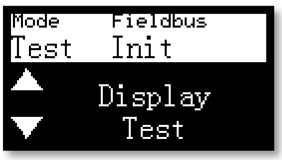
Go to
Manual Mode

LED Tests



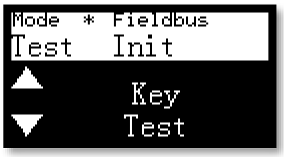
Switch between the tests with
Test 1: Switch speed with 1 … 5
Test 3: Switch color with 1 … 7
Switch brightness with # and *

Display Tests



Switch between the tests with

Key Tests



Shows the keycodes of the remote control
Leave test with * # OK

5. Process Data

5.1. Inputs (ToolConnector -> Controller)

The ToolConnector transmits data to the controller via the input area. These are arranged in 0x1Axx fieldbus objects.

The following process-data-objects (PDO) are available:

PDO	Object(s)	Length	Name	Mandatory Object
0x1A00	6000	2 Byte	Status Word	X
0x1A01	6001	2 Byte	DI16 Input Data	
0x1A02	6002	2 Byte	Keycode	
	Sum	6 Byte		

5.1.1. Status Word (0x6000)

The status word transmits the state of the ToolConnector. The status word is addressable per bit.

Bit	Name	Data Type	Function
0	Mode_Auto	Bit	ToolConnector in Automatic Mode
1	Mode_Manu	Bit	ToolConnector in a Manual Mode (Manu/Setup/Test)
2	StatusBit03	Bit	
3	StatusBit04	Bit	
4	StatusBit05	Bit	
5	StatusBit06	Bit	
6	StatusBit07	Bit	
7	StatusBit08	Bit	
8	VOut1_OK	Bit	Voltage Supply of Outputs 1-8 OK (VOut1 >16V)
9	VOut2_OK	Bit	Voltage Supply of Outputs 9-16 OK (VOut2 >16V)
10	StatusBit11	Bit	
11	StatusBit12	Bit	
12	StatusBit13	Bit	
13	StatusBit14	Bit	
14	StatusBit15	Bit	
15	Error	Bit	Failure Status

5.1.1. DI16 (0x6001)

This Word includes the data of the DI16 input module. It is addressable per bit.

Bit	Name	Data Type	Function
0	DI1	Bit	Digital Input 1
1	DI2	Bit	Digital Input 2
2	DI3	Bit	Digital Input 3
3	DI4	Bit	Digital Input 4
4	DI5	Bit	Digital Input 5
5	DI6	Bit	Digital Input 6
6	DI7	Bit	Digital Input 7
7	DI8	Bit	Digital Input 8
8	DI9	Bit	Digital Input 9
9	DI10	Bit	Digital Input 10
10	DI11	Bit	Digital Input 11
11	DI12	Bit	Digital Input 12
12	DI13	Bit	Digital Input 13
13	DI14	Bit	Digital Input 14
14	DI15	Bit	Digital Input 15
15	DI16	Bit	Digital Input 16

5.1.2. Keycode (0x6002)

Information about pressed buttons can be read out of this word. The button codes of the remote control are described in the least significant byte (LSB). The state of the button SW1 on the mainboard is coded in the most significant byte. The data is always transmitted, even if the button codes are evaluated by the ToolConnector to operate. The button code is transmitted at least 500ms. When a button is pushed permanent, the transmission lasts as long as the button is pushed.

During the automatic mode, the Tool Connector just evaluates the buttons *, # and OK to switch between modes. All other buttons are usable freely.

------------------ RC 1 -------------- ------------------------------------ RC 2 -----------------------------------

Taste	Keycode (LSB)
*	1 (0x01)
#	2 (0x02)
▲	3 (0x03)
▼	4 (0x04)
◀	5 (0x05)
▶	6 (0x06)
OK	7 (0x07)
0	10 (0x0a)
1	11 (0x0b)
2	12 (0x0c)
3	13 (0x0d)
4	14 (0x0e)
5	15 (0x0f)
6	16 (0x10)
7	17 (0x11)
8	18 (0x12)
9	19 (0x13)

Taste	Keycode (LSB)
	1 (0x01)
	2 (0x02)
▲	3 (0x03)
▼	4 (0x04)
◀	5 (0x05)
▶	6 (0x06)
OK	7 (0x07)
0	10 (0x0a)
1	11 (0x0b)
2	12 (0x0c)
3	13 (0x0d)
4	14 (0x0e)
5	15 (0x0f)
6	16 (0x10)
7	17 (0x11)
8	18 (0x12)
9	19 (0x13)

Taste	Keycode (LSB)
	20 (0x14)
	21 (0x15)
	22 (0x16)*
	23 (0x17)*
	24 (0x18)*
	25 (0x19)*
	26 (0x1a)
	27 (0x1b)
	28 (0x1c)
	29 (0x1d)
	30 (0x1e)
	31 (0x1f)
	32 (0x20)
	33 (0x21)

* not available with all RC2

Taste	Bit (MSB)
SW1	0
-	1
-	2
-	3
-	4
-	5
-	6
-	7

5.2. Outputs (Controller -> ToolConnector)

The Controller transmits data to the ToolConnector via the output area. These are arranged in 0x16xx fieldbus objects.

The following process-data-objects (PDO) are available:

PDO	Object(s)	Length	Name	Mandatory Object
0x1600	7000	2 Byte	DO 16 Output Data	
0x1601	7001	25 Byte	Case-LEDs	
0x1602	7002	1 Byte	Buzzer	
	Sum	28 Byte		

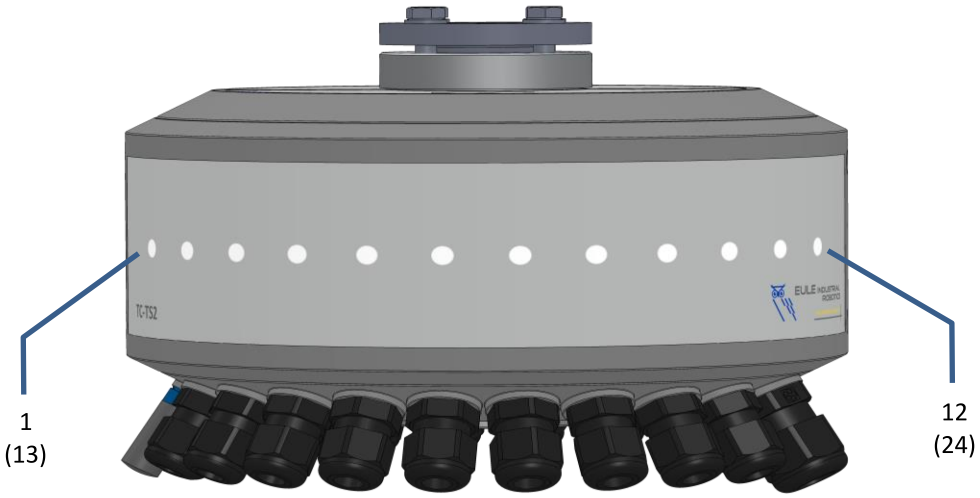
5.2.1. DO16 (0x7000)

This Word includes the data of the DO16 output module. It is addressable per bit.

Bit	Name	Data Type	Function
0	DO1	Bit	Digital Output 1
1	DO2	Bit	Digital Output 2
2	DO3	Bit	Digital Output 3
3	DO4	Bit	Digital Output 4
4	DO5	Bit	Digital Output 5
5	DO6	Bit	Digital Output 6
6	DO7	Bit	Digital Output 7
7	DO8	Bit	Digital Output 8
8	DO9	Bit	Digital Output 9
9	DO10	Bit	Digital Output 10
10	DO11	Bit	Digital Output 11
11	DO12	Bit	Digital Output 12
12	DO13	Bit	Digital Output 13
13	DO14	Bit	Digital Output 14
14	DO15	Bit	Digital Output 15
15	DO16	Bit	Digital Output 16

5.2.2. Case LEDs (0x7001)

The case LEDs are controlled via this data object. 12 LEDs are located in each case cover (optional).



The LEDs 1…12 are located in the case cover of the input side (A), the LEDs 13…24 are located in the case cover of the output side (B).

Byte	Name	Data Type	Function
0	LED1	UINT8	LED 1 Color-/Function Value
1	LED2	UINT8	LED 2 Color-/Function Value
2	LED3	UINT8	LED 3 Color-/Function Value
3	LED4	UINT8	LED 4 Color-/Function Value
4	LED5	UINT8	LED 5 Color-/Function Value
5	LED6	UINT8	LED 6 Color-/Function Value
6	LED7	UINT8	LED 7 Color-/Function Value
7	LED8	UINT8	LED 8 Color-/Function Value
8	LED9	UINT8	LED 9 Color-/Function Value
9	LED10	UINT8	LED 10 Color-/Function Value
10	LED11	UINT8	LED 11 Color-/Function Value
11	LED12	UINT8	LED 12 Color-/Function Value
12	LED13	UINT8	LED 13 Color-/Function Value
13	LED14	UINT8	LED 14 Color-/Function Value
14	LED15	UINT8	LED 15 Color-/Function Value
15	LED16	UINT8	LED 16 Color-/Function Value
16	LED17	UINT8	LED 17 Color-/Function Value
17	LED18	UINT8	LED 18 Color-/Function Value
18	LED19	UINT8	LED 19 Color-/Function Value
19	LED20	UINT8	LED 20 Color-/Function Value
20	LED21	UINT8	LED 21 Color-/Function Value
21	LED22	UINT8	LED 22 Color-/Function Value
22	LED23	UINT8	LED 23 Color-/Function Value
23	LED24	UINT8	LED 24 Color-/Function Value
24	Brightness	UINT8	Brightness Value for all LEDs in % 0...100 (Values > 100 => 100%)

It is possible to assign predefined color- and function values to each LED. The inserted value is combined from the sum of a color- and a function value.

If the brightness value is 0, no LED is glowing!

Color Value:

Value	Color
0	LED off
1	Red
2	Green
3	Blue
4	Yellow
5	Orange
6	Pink
7	White
8	--
9	--

Function Value:

Value	Function	Frequency	Duty-Cycle	Phase
0	Static		100%	1/1
10	Blinking	0.5Hz	50%	1/2
20	Blinking	0.5Hz	50%	2/2
30	Blinking	1Hz	50%	1/2
40	Blinking	1Hz	50%	2/2
50	Blinking	2Hz	50%	1/2
60	Blinking	2Hz	50%	2/2
100	Blinking	1Hz	25%	1/4
110	Blinking	1Hz	25%	2/4
120	Blinking	1Hz	25%	3/4
130	Blinking	1Hz	25%	4/4
140	Blinking	2Hz	25%	1/4
150	Blinking	2Hz	25%	2/4
160	Blinking	2Hz	25%	3/4
170	Blinking	2Hz	25%	4/4

The function values allow different light patterns. So, with the right combination, it is possible to generate moving animations without writing dynamic values.

Examples:

The values 51, 63 for consecutive LEDs deliver a red/blue switching blink with 2Hz.
The values 102, 112, 122, 132 for consecutive LEDs deliver a green running light with 1Hz and 4 phases.

5.2.3. Buzzer (0x7002)

The acoustic buzzer inside the ToolConnector can be controlled via this data object.

Byte	Name	Data Type	Function
0	Buzzer	UINT8	Function Value

By setting the particular function value in the data object, a respective acoustical signal is triggered. The function is started by the signal switching to the new value. By setting the value to 0, the function is ended immediately.

Function Values:

Value	Signal
0	Signal Off
1..10	1...10 Beep Tones (long, 2 Signals/sec)
11..20	1...10 Beep Tones (short, 5 Signals/sec)
31..40	Permanent Signal for 1...10s
97	Beep Tones (long, 2 Signals/sec) continuously
98	Beep Tones (short, 5 Signals/sec) continuously
99	Permanent Signal
All Others	No Function