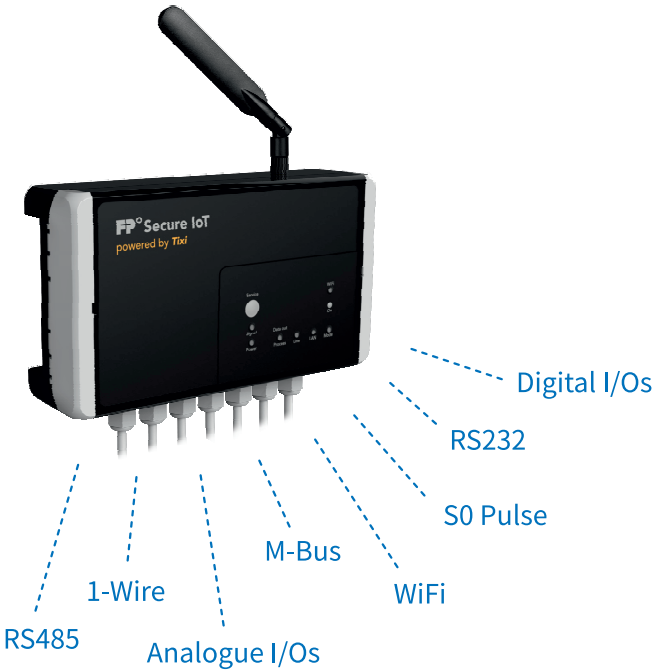
FP Secure IoT




# FP S-ENGuard

Configuration manual

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# Contents

# 1 About this manual

Please read this manual carefully before configuring an FP S-ENGuard. Keep this manual easily accessible near the device.

*Target group*

This manual is intended exclusively for qualified specialists who are familiar with the safety standards of electrical and automation engineering.

The configuration of the device may only be carried out by recognised qualified specialists in measurement, control and regulation technology.

*Contents*

This manual contains important information for your safety and describes the configuration of the devices from the following model series:

- FP S-ENGuard W550 (in this manual: W550)
- FP S-ENGuard W640 (in this manual: W640)
- FP S-ENGuard W667 (in this manual: W667).

*Prerequisites*

The FP S-ENGuard is mounted on the wall and electrically connected as described in the “Installation and Safety” instructions supplied with the device.

*Other documents*

In addition to this manual, the following documents, among others, are available for FP S-ENGuard devices:

- “Installation and Safety” manual
- Datasheet
- FP-SPS-TiXML manual
- Declaration of conformity

Download the documents at https://www.inovolabs.com/infobereich/downloads/handbucher-datenblatter)

*Signal words and symbols*

This manual contains warnings at the appropriate points, which indicate possible dangerous situations or actions and give instructions on how to avoid the danger. Follow these instructions.

The following signal words, colours and safety signs identify the warning instructions and additional information in the set of documentation for the FP S-ENGuard devices:

**⚠ DANGER** Warning of immediate danger to life or serious injury!

**⚠ WARNING** Warning of potential danger to life or serious injuries!

**⚠ CAUTION** Warning of potential minor injuries!

***ATTENTION*** Notice of potential damage to property: Damage to the device, the software or other material assets!

 A useful tip, recommendation or additional information for handling the device.

# 2 For your safety

Please read these safety instructions carefully before configuring the device.
Make sure that you have understood all instructions.
For installation and safe use, read the basic instructions in the “Installation and Safety” manual of the FP S-ENGuard model.

## 2.1 Intended use

FP S-ENGuard devices are gateways, i.e. remote communication computers.
Possible applications are remote maintenance, reporting of faults, data logging or the use as an internal web server.

- ▶ Use FP S-ENGuard only for applications that comply with the device specification. Observe the specified characteristics.
- ▶ When configuring the device, observe the safety and accident prevention regulations applicable for the specific application and location.
- ▶ Operate FP S-ENGuard only as described in the “Installation and Safety” manual and this configuration manual.
- ▶ Do not carry out any unauthorised interventions in the hardware and software.

## 2.2 Safety instructions for working on an already installed FP S-ENGuard

**Hazardous areas with live parts**

When working on an already installed FP S-ENGuard, there are areas where there is a hazard of electric voltage. Inside the device there are live parts behind a protective cover for the mains supply.

- – Danger to life from electric shock when touching live parts.
- – Risk of injury from startled reactions when touching live parts.
- – Danger of injury by triggering an electrical arc.

**Avoiding danger from electrical voltage**

Carry out the following safety measures to avoid hazards due to electrical voltage.

Before removing the protective cover for the power supply inside the FP S-ENGuard:

- ▶ Disconnect the device from the power supply.
- ▶ Secure it against restarting.
- ▶ Keep unauthorised persons away from the device.

Before starting work on the FP S-ENGuard:

- ▶ Make sure that the device is voltage-free.
- ▶ Observe the safety and accident prevention regulations applicable for the specific application and location.

Before putting the FP S-ENGuard back into operation:

- ▶ Make sure that the protective cover for the power supply is properly attached.
- ▶ Close the cover.
- ▶ Make sure that the device is closed correctly.

## 2.3 How to avoid damage to property

Observe the following instructions to avoid damage to the device, the peripherals and potential consequential damage:

- ▶ Only use the device in enclosed and clean spaces.
- ▶ Avoid harmful environmental conditions such as heat, sunlight, strong shocks and vibrations.
- ▶ Please note the special instructions for handling the SIM card.
- ▶ Protect the interfaces from electrical damage by avoiding mixing up connections.
- ▶ Use a torque screwdriver to avoid mechanical damage to the connections.
- ▶ Protect the outputs from destruction by observing the maximum output loads in accordance with the specification.
- ▶ Ensure that the supply voltage and earthing is connected correctly (L, N, PE, compliance with the characteristic values, sufficient cable cross-section).
- ▶ Only carry out a software update if no peripherals are connected.
- ▶ Ensure the correct termination of the end devices. Incorrect or missing termination can lead to communication problems.

# 3 Model and equipment variants

## 3.1 Material numbers

| Model | Material number |
|---|---|
| FP S-ENGuard W550 LAN | 50.0070.0001.00 |
| FP S-ENGuard W550 NB | 50.0070.0003.00 |
| FP S-ENGuard W550 BB | 50.0070.0004.00 |
| FP S-ENGuard W640 LAN | 50.0070.0011.00 |
| FP S-ENGuard W640 NB | 50.0070.0013.00 |
| FP S-ENGuard W640 BB | 50.0070.0014.00 |
| FP S-ENGuard W667 LAN | 50.0070.0021.00 |
| FP S-ENGuard W667 NB | 50.0070.0023.00 |
| FP S-ENGuard W667 BB | 50.0070.0024.00 |
| GETEC FP S-ENGuard W550 BB | 50.0170.0001.00 |

## 3.2 Equipment variants

Legend
● Standard
N× Number
– Not available

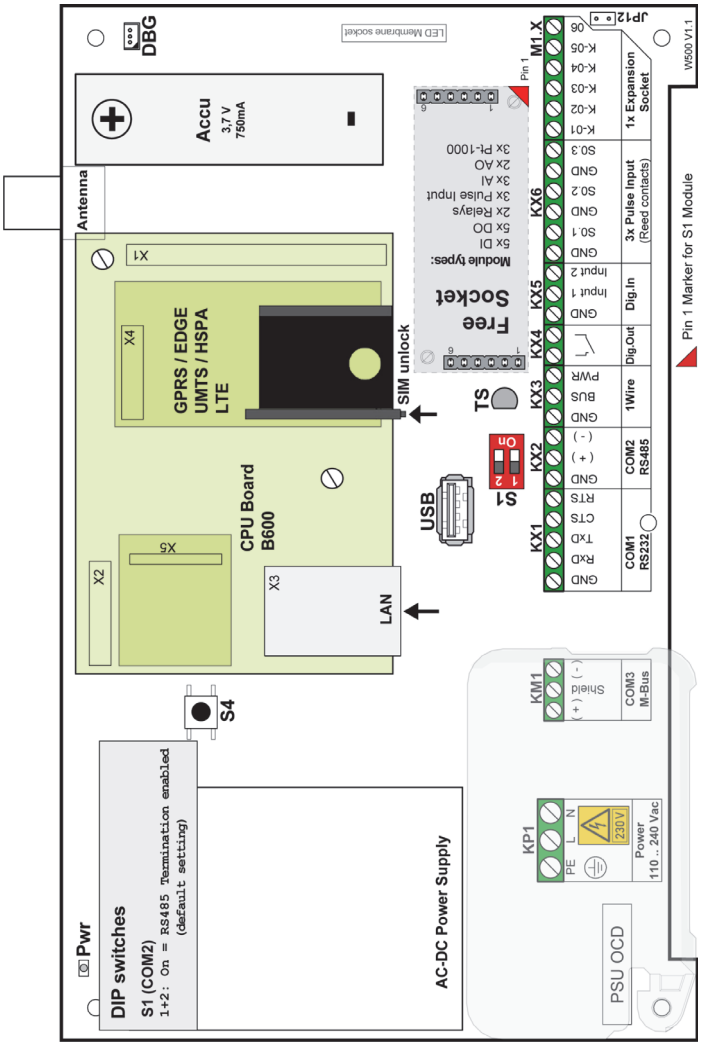
| | W550 LAN | W550 NB | W550 BB | W640 LAN | W640 NB | W640 BB | W667 LAN | W667 NB | W667 BB |
|---|---|---|---|---|---|---|---|---|---|
| Built-in power supply unit, 110 V - 240 V | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| CPU 400 MHz, ARM9 | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| 128 MB RAM | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| 128 MB FLASH Memory | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| USB | 1× | 1× | 1× | 2× | 2× | 2× | 2× | 2× | 2× |
| RS232 | 1× | 1× | 1× | 1× | 1× | 1× | 1× | 1× | 1× |

Legend
● Standard
N× Number
– Not available

| | W550 LAN | W550 NB | W550 BB | W640 LAN | W640 NB | W640 BB | W667 LAN | W667 NB | W667 BB |
|---|---|---|---|---|---|---|---|---|---|
| RS485 | 1× | 1× | 1× | 1× | 1× | 1× | 1× | 1× | 1× |
| M-Bus Master (max. number of end devices) | 25 | 25 | 25 | 100 | 100 | 100 | 100 | 100 | 100 |
| 1-Wire Master (max. number of sensors) | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| Digital inputs 240 V | 2× | 2× | 2× | 2× | 2× | 2× | 2× | 2× | 2× |
| Digital inputs 24 V | - | - | - | - | - | - | 5× | 5× | 5× |
| Digital outputs | 1× | 1× | 1× | - | - | - | - | - | - |
| Analogue inputs | - | - | - | - | - | - | 4× | 4× | 4× |
| Analogue outputs | - | - | - | - | - | - | 3× | 3× | 3× |
| Relay outputs | - | - | - | 2× | 2× | 2× | 2× | 2× | 2× |
| Relay outputs (make contacts) | - | - | - | - | - | - | 3× | 3× | 3× |
| S0 Pulse inputs | 3× | 3× | 3× | - | - | - | - | - | - |
| Pt1000 Sensor inputs | - | - | - | - | - | - | 2× | 2× | 2× |
| Temperature sensor (1-Wire, built-in) | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Socket for S1 Expansion module | 1× | 1× | 1× | 5× | 5× | 5× | 2× | 2× | 2× |
| Ethernet connection | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Antenna connection | - | ● | ● | - | ● | ● | - | ● | ● |
| UMTS Modem | - | ● | - | - | ● | - | - | ● | - |
| LTE Modem | - | - | ● | - | - | ● | - | - | ● |

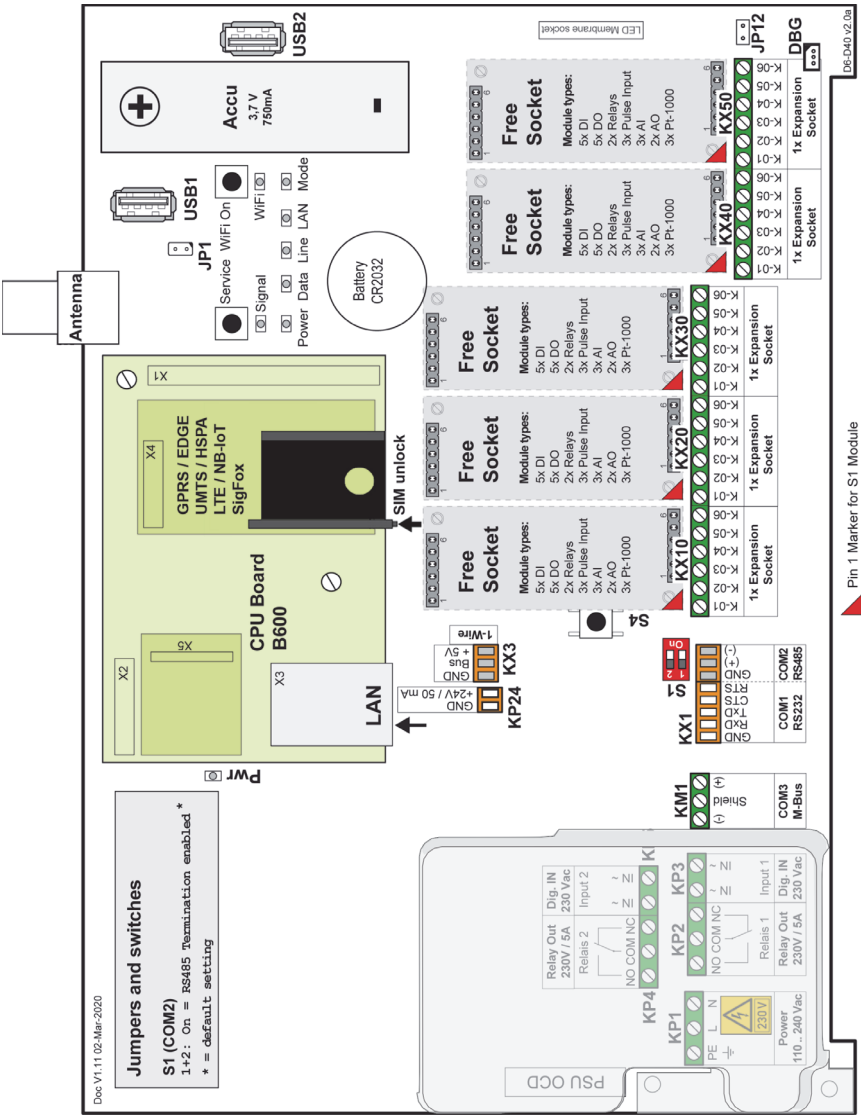
# 4 Overview of all connections

## 4.1 Model series connection assignments W550



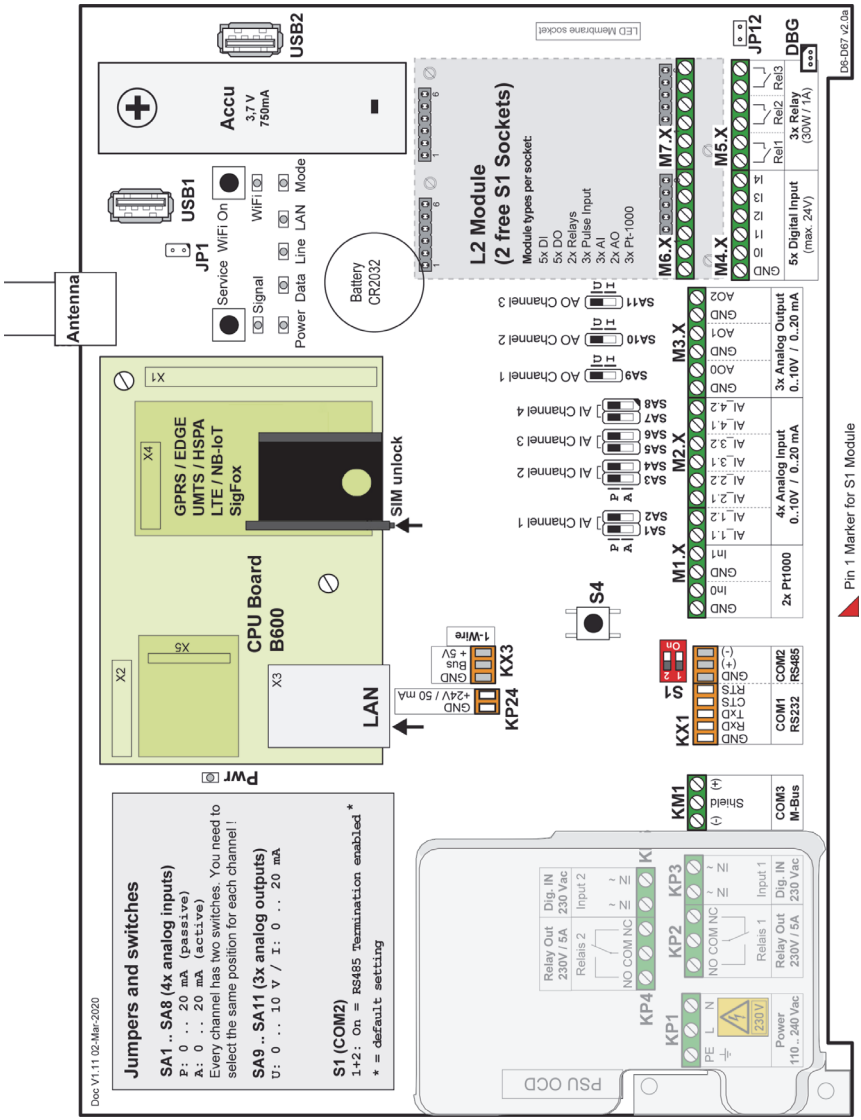

The illustration shows the FP S-ENGuard W550 NB.

## 4.2 Model series connection assignments W640




The illustration shows the FP S-ENGuard W640 BB.

## 4.3 Model series connection assignments W667




The illustration shows the FP S-ENGuard W667 BB.

## 4.4 Socket for backup battery

Most models are equipped with a socket for a backup battery. The backup battery is automatically charged during normal mains operation. The backup battery supplies the device with power for up to 3 hours in the event of a power failure.

A type with 3.7 V / 750 mA must be used as backup battery. Suitable rechargeable batteries are available from FP InovoLabs GmbH.

**ATTENTION**

**Fire or damage to property due to incorrect rechargeable batteries**

Commercially available AA rechargeable batteries (1.2 V) will damage the device and may even cause a fire by destroying the battery.

- ▶ Only use rechargeable batteries of the specified type (3.7 V / 750 mA).
- ▶ Do not use commercially available rechargeable batteries (1.2 V).

Please note that the M-Bus does not work in rechargeable battery mode.

*Variable /Process/SysIO/P0*

The loss of the energy supply can be detected via the system variable `/Process/SysIO/P0`. With normal mains power supply, the variable is set to “1”. As soon as the power supply fails, the variable changes to “0”.

Via an appropriately programmed EventState/EventHandler, emergency actions can still be triggered if the mains power supply fails. Emergency actions can be:

- – Sending a message via GSM (SMS, EMail; only useful for devices with GSM modem)
- – Creating a log entry to document time of power failure

*Variable /Process/SysIO/P3*

The variable `/Process/SysIO/P3` indicates the state of charge of the rechargeable battery.
(1=Charging process running, 0=charging finished)

*Variable /Process/SysIO/P4*

The variable `/Process/SysIO/P4` indicates the battery voltage in mV.

# 5 Ethernet connection

**Key figures at a glance**
- 10/100 Base-T in accordance with IEC 60028-2-6
- 8P8C port (RJ45), shielded EIA/TIA-568 A/B
- Name of connection: LAN

## 5.1 Initial start-up and access

### 5.1.1 IP address of the device

The device can be configured via the LAN connection using the parametrisation software TICO or TILA. Ex works or after a factory reset, the device has a fixed IP address or can be addressed via a defined host name in a network with DHCP server.

With a Tixi WiFi stick, access can also be wireless, see chapter 6.11.2.

*Network without DHCP server*

Direct connection to PC.
The device tries to obtain an IP address from a DHCP server for about 30 seconds after turning on. If it has not received an answer after 30 seconds, the device's LAN LED flashes and the default IP address is set as follows.

| | |
|---|---|
| IP address at the LAN port | 192.168.0.1 |
| IP address over WiFi | 192.168.100.1 |

*Network with DHCP server*

In a network with DHCP server, the host name is formed according to the following scheme:

`Tixicom-`**`Devtype`**`-`**`serial`** (applies to LAN and WiFi)

**`Devtype`** = Device type

**`serial`** = Serial number of the device, see test label inside (8 digits)

**Device types (Devtype)**

**Devtype** is formed according to the following scheme:

Wx*** – where x is E, U or T depending on the model.

E = LAN model (Ethernet)

U = NB model (NB = narrow band, 2G and/or 3G)

T = BB model (BB = broadband/LTE)

Example: for FP S-ENGuard W667 BB the **Devtype** is WT667

---

**Example:** Default host name for a model series device **W667 BB / WT667** with the serial number **04240361**

`Tixicom-WT667-04240361`

---

If you have integrated the device into a domain network with DHCP server, it is usually necessary to add the local address of your domain network to the host name.
In the Tixi.Com corporate network, for example:
`Tixicom-WT667-04240361.tixicom.local`

### 5.1.2 Access to the web server

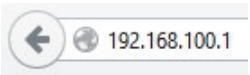
On delivery and after a factory reset, a standard website is installed.

To access the default web page, enter the IP address or host name of your device in the address line of your browser.

---

**Example:**


Access via host names

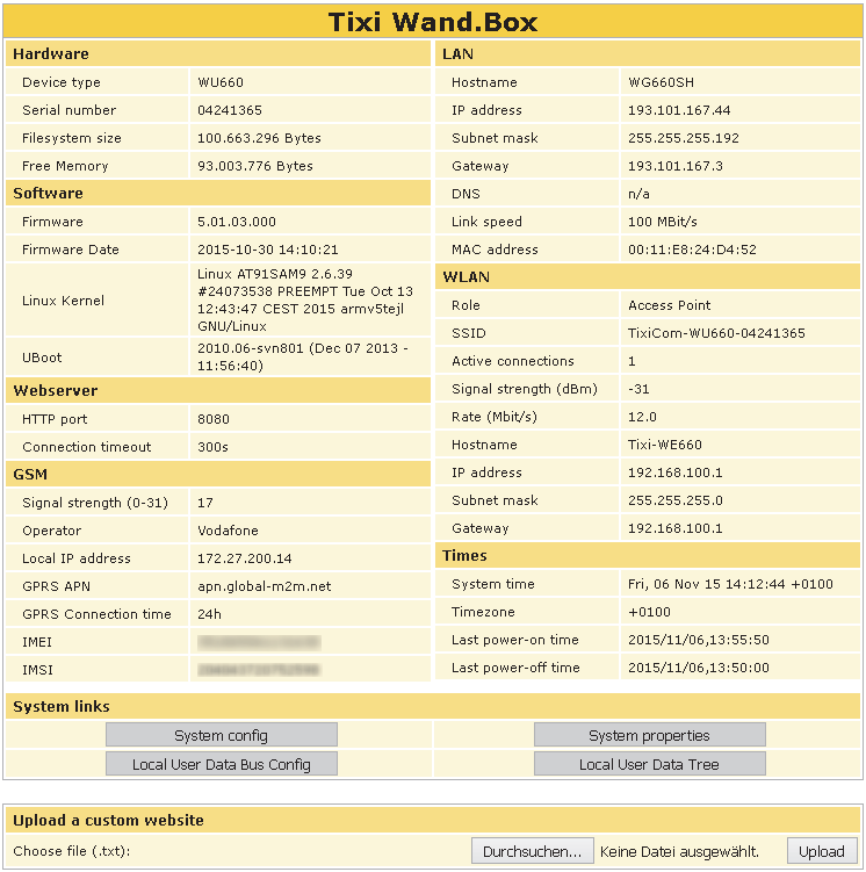



Access via WiFi with fixed IP address

---

The standard website clearly displays a variety of information on the hardware and configuration of the device.

Additionally, the configuration ([System config] button) and the process data ([System properties] button) of the connected sensors (meters, PLCs etc., if configured) can be displayed in separate windows.



**Tixi Wand.Box**

| Hardware | | LAN | |
|---|---|---|---|
| Device type | WU660 | Hostname | WG660SH |
| Serial number | 04241365 | IP address | 193.101.167.44 |
| Filesystem size | 100.663.296 Bytes | Subnet mask | 255.255.255.192 |
| Free Memory | 93.003.776 Bytes | Gateway | 193.101.167.3 |
| **Software** | | DNS | n/a |
| Firmware | 5.01.03.000 | Link speed | 100 MBit/s |
| Firmware Date | 2015-10-30 14:10:21 | MAC address | 00:11:E8:24:D4:52 |
| Linux Kernel | Linux AT91SAM9 2.6.39 #24073538 PREEMPT Tue Oct 13 12:43:47 CEST 2015 armv5tejl GNU/Linux | **WLAN** | |
| | | Role | Access Point |
| UBoot | 2010.06-svn801 (Dec 07 2013 - 11:56:40) | SSID | TixiCom-WU660-04241365 |
| **Webserver** | | Active connections | 1 |
| HTTP port | 8080 | Signal strength (dBm) | -31 |
| Connection timeout | 300s | Rate (Mbit/s) | 12.0 |
| **GSM** | | Hostname | Tixi-WE660 |
| Signal strength (0-31) | 17 | IP address | 192.168.100.1 |
| Operator | Vodafone | Subnet mask | 255.255.255.0 |
| Local IP address | 172.27.200.14 | Gateway | 192.168.100.1 |
| GPRS APN | apn.global-m2m.net | **Times** | |
| GPRS Connection time | 24h | System time | Fri, 06 Nov 15 14:12:44 +0100 |
| IMEI | [redacted] | Timezone | +0100 |
| IMSI | [redacted] | Last power-on time | 2015/11/06,13:55:50 |
| | | Last power-off time | 2015/11/06,13:50:00 |

**System links**

System config | System properties

Local User Data Bus Config | Local User Data Tree

**Upload a custom website**

Choose file (.txt): Durchsuchen... Keine Datei ausgewählt. Upload

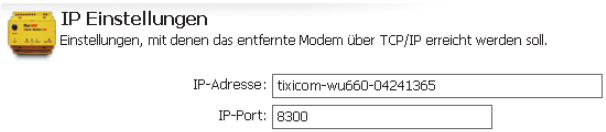
### 5.1.3 Access with the TILA software

- ▶ Start the TILA software.
- ▶ Click the “Online” button on the home page.


- ▶ Double-click on the appropriate entry in the list of possible connections.

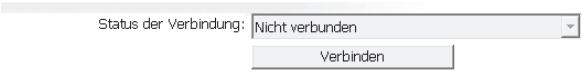
| | |
|---|---|
| GPRS/Internet/LAN | for connections via the LAN port of the device |
| Tixi WLAN stick | for connections via WiFi with the Tixi WiFi stick |

- ▶ Enter the IP address or host name of the device in the “IP Settings” section.




If the “Tixi WLAN stick” option has been selected, the IP address is already preset and need not be adjusted.

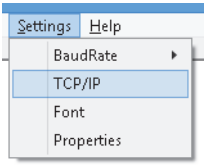
- ▶ Now click on the “Connect” button.



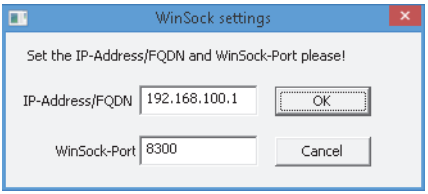

When the connection has been successfully established, this is signalled at the upper right edge of TILA.

### 5.1.4 Access with the TICO software

- ▶ Start the TICO software.
- ▶ Click on the “Settings” menu item and select “TCP/IP”.



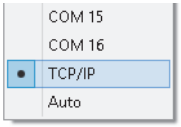

- ▶ Enter the IP address or the host name in the dialogue and click “OK”.




Example: Connection via WiFi stick

- ▶ If the “Online” option in the middle of the TICO window is activated, deactivate the option with a single mouse click.


- ▶ Click on the “Port” menu item and select “TCP/IP”.




After the connection has been successfully established, the “Online” option is activated.

## 5.2 Factory reset

The device can be reset to factory defaults using the “Service” button. To do so, proceed as follows.

- ▶ Switch off the device.
- ▶ Press the “Service” button (membrane keypad on the upper side) and keep it pressed.
- ▶ Switch on the device.
- ▶ Wait until the Power LED (yellow) flashes.
- ▶ Release the “Service” button briefly.
- ▶ Press the “Service” button again. Keep it pressed until the “Power” LED flashes rapidly.
- ▶ Release the “Service” button. The device boots up.

All settings in the device have now been successfully reset to factory defaults. The only exception is the SIM PIN. This is also retained after a factory reset.

# 6 Integrated interfaces

## 6.1 RS232 Interfaces COM1, COM4 *(model dependent)*

**Key figures at a glance**
- ITU-T V.24, V.28 with handshake
- Maximum transmission distance: 12 m
- 5 spring terminals each, max 230,400 bps
- Signals: RTS, CTS, GND, Rx, Tx
- Name of the connection terminal for COM1: `KX1` (all models)
- Name of the connection terminal for COM4: `KX2` (optional)

An RS232 interface is available at connection terminal `KX1`. A second RS232 interface (COM4) is available on the `KX2` connection terminal as an option.

The configuration of the interface is described in the "FP-SPS-TiXML-Manual".

The COM1 interface cannot be used to configure the system via TILA or TICO. Instead, use the LAN interface (chapter 5.1), WiFi stick (chapter 6.11.2) or a USB stick.

## 6.2 RS485 Interfaces COM2, COM5 *(model dependent)*

**Key figures at a glance**
- In accordance with EIA/TIA-485
- maximum transmission distance: 1,200 m
- 3 spring terminals each, max 230,400 bps
- not galvanically isolated
- Termination integrated, can be switched via DIP switch (S1, S2)
- Signals: (+, -, 0 V)
- Name of the connection terminal for COM2: `KX1` (all models)
- Name of the connection terminal for COM5: `KX2` (optional)

An RS485 interface is available at connection terminal KX1 (COM2).

The configuration of the interface is described in the "FP-SPS-TiXML-Manual".

## 6.3 M-Bus Interface

**Key figures at a glance**
- W600 models:
  M-Bus master for 50 slaves (optional: 100 Slaves)
- W500 models:
  M-Bus master for 25 slaves
- Open circuit voltage: 36 V
- Ri = approx. 20 Ω
- Short-circuit proof, galvanic isolation: 1,500 V
- W600 models: max. bus length: 50 m, grid dimension 3.81 mm, cross-section max. 1.5 mm²
- W500 models: max. bus length: 50 m, grid dimension 5.08 mm, cross-section max. 1.5 mm²
- Name of connection terminal: KM1

A fully-fledged M-Bus master is available at connection terminal KM1.

The configuration of the interface is described in the "FP-SPS-TiXML- Manual".

## 6.4 S0 Pulse inputs
*(Model series W550)*

**Key figures at a glance**
- 3x pulse inputs according to IEC 62053-31 for passive S0 devices (contacts)
- Module address: C03E
- Name of connection terminal: S0 interface

Technical data and programming of the S0 pulse inputs are described in the chapter 7.2.

## 6.5 Relay outputs 240 V
*(Model series W640, W667)*

**Key figures at a glance**
- 2x relay changeover contact, 230 V AC 5 A *or* 110 V DC 0.3 A
- Name of connection terminals:
  Relay 1: `KP2`, relay 2: `KP4`

*Representation on the process branch*

```
<Process>
   <MB>
     <IO>
       <Q>
         <P0 _="0"/>
         <P1 _="1"/>
       </Q>
       <QB>
         <P0 _="2"/>
       </QB>
       <QW>
         <P0 _="2"/>
       </QW>
       <QD>
         <P0 _="2"/>
       </QD>
     <IO>
   </MB>
</Process>
```

**Example:** Turning on normally open contact relay 1

```
[<Set _="/Process/MB/IO/Q/P0" value="1" ver="y" />]
```

## 6.6 Digital inputs 240 V
*(Model series W640, W667)*

**Key figures at a glance**
- 2x digital input each 230V AC/3A, Ri = 54 kΩ
- Name of connection terminal:
  `KP3` (input 1), `KP5` (input 2)

*Representation on the process branch*

```
<Process>
   <MB>
     <IO>
       <I>
         <P0 _="1"/>
         <P1 _="1"/>
       </I>
       <IB>
         <P0 _="3"/>
       </IB>
       <IW>
         <P0 _="3"/>
       </IW>
       <ID>
         <P0 _="3"/>
       </ID>
     <IO>
   </MB>
</Process>
```

**Example:** Read the second 240 V input

```
[<Get _="/Process/MB/IO/I/P1" ver="y" />]
```

## 6.7 Analogue inputs
*(Model series W667)*

The model series W667 has permanently installed analogue inputs at address `C092`.
The A/D converter has a total of 8 channels.

The path to the values on the process branch is `/Process/092/I_AAAATPPSSB`.

`A`: Analogue input
`T`: Temperature sensor onboard
`P`: Pt1000
`S`: System (reference voltages)
`B`: Battery voltage of the backup battery

| Process | Function | Value range | Technical data |
|---|---|---|---|
| P0 to P3 | Analogue inputs channel 1 to 4 | 0 to 4095 | 0 to +10 V, Ri=100 kΩ<br>0 to +20 mA, Ri=100 Ω |
| P4 | Temperature sensor onboard<br>Values in milli degrees Celsius | ~ -40 to 125 °C | Resolution < 0.1 °C |
| P5, P6<br>P10, P11 | Pt1000 raw value, input 1 and 2<br>Pt1000 values in milli degrees Celsius | 0 to 4095<br>~ -80 to 190 °C | Measuring current:<br>~ 100 µA |
| P9 | Battery voltage, backup battery [mV] | 0 to 4200 | - |
| P7, P8 | Internal reference voltages | - | - |

### 6.7.1 Analogue inputs 0 to 10 V/0 to 20 mA *(P0 to P3)*

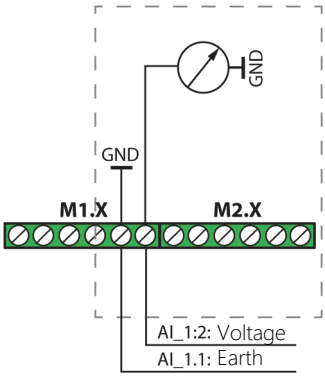
**Key figures at a glance**
- 4x analogue inputs
- Voltage input: 0 to 10 V, Ri=100 kΩ
- Current input (passive): 0 to 20 mA, Ri=100 Ω
- Current input (active): 0 to 20 mA
- Module address: `C092`
- Name of connection terminals: `AI_1.1` to `AI_4.2`

The four analogue inputs can be individually switched electronically between 0 to 10 V and 0 to 20 mA. In operating mode 0 to 20 mA, 2 switches can be used to switch between passive and active current measurement for each channel. The factory setting is 0 to 10 V.

The following table shows the configuration possibilities of the inputs.

| Input | Operating mode | Switch position | Peripheral configuration |
|---|---|---|---|
| AI_1 | 0 to 10 V | SA1 = P, SA2 = P | None |
| AI_1 | 0 to 20 mA passive | SA1 = P, SA2 = P | `<InputMode0 _="I"/>` |
| AI_1 | 0 to 20 mA active | SA1 = P, SA2 = A | `<InputMode0 _="I"/>` |
| AI_2 | 0 to 10 V | SA3 = P, SA4 = P | None |
| AI_2 | 0 to 20 mA passive | SA3 = P, SA4 = P | `<InputMode1 _="I"/>` |
| AI_2 | 0 to 20 mA active | SA3 = P, SA4 = A | `<InputMode1 _="I"/>` |
| AI_3 | 0 to 10 V | SA5 = P, SA6 = P | None |
| AI_3 | 0 to 20 mA passive | SA5 = P, SA6 = P | `<InputMode2 _="I"/>` |
| AI_3 | 0 to 20 mA active | SA5 = P, SA6 = A | `<InputMode2 _="I"/>` |
| AI_4 | 0 to 10 V | SA7 = P, SA8 = P | None |
| AI_4 | 0 to 20 mA passive | SA7 = P, SA8 = P | `<InputMode3 _="I"/>` |
| AI_4 | 0 to 20 mA active | SA7 = P, SA8 = A | `<InputMode3 _="I"/>` |

**“Voltage measurement” operating mode**




The “Voltage measurement” operating mode can be selected separately for each of the four inputs. In this operating mode, voltages of 0 to 10 V can be measured against earth (factory setting).

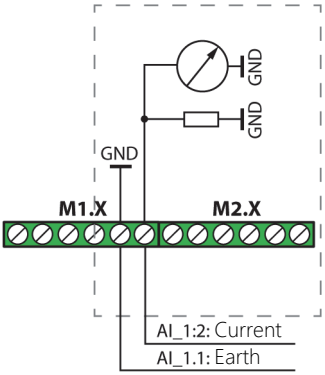
*Activation of the voltage measurement*

- ▶ Set both switches of a channel to "P", e.g. for channel AI_1 the switches SA1 and SA2.
- ▶ Configure the InputMode for the according input to "U" in the peripheral configuration or leave out the InputMode.

*Assignment of the screw terminals*

The left screw terminal of an input (AI_1.1, AI_2.1, AI_3.1, AI_4.1) is the earth connection.
The right screw terminal (AI_1.2, AI_2.2, AI_3.2, AI_4.2) is the voltage input.

**“Current measurement passive” operating mode**




The “Current measurement passive” operating mode can be selected separately for each of the four inputs. In this operating mode, currents from 0 to 20 mA can be measured.

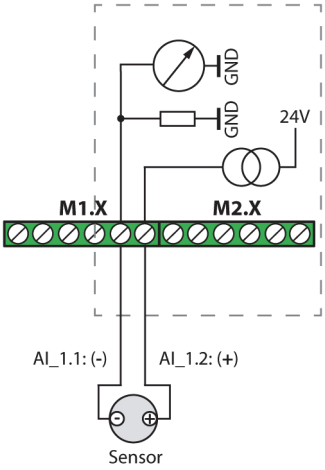
*Activation of passive current measurement*

- ▶ Set both switches of a channel to "P", e.g. for input AI_1 the switches SA1 and SA2.
- ▶ Configure the peripheral configuration: InputMode for the respective channel to "I".

*Assignment of the screw terminals*

The left screw terminal of an input (AI_1.1, AI_2.1, AI_3.1, AI_4.1) is the earth connection.
The right screw terminal (AI_1.2, AI_2.2, AI_3.2, AI_4.2) is the current input.

**“Current measurement active” operating mode**




The "Current measurement active" operating mode for current loop sensors (e.g. for pressure, temperature) can be selected separately for each of the four inputs. A current-limited supply voltage of approx. 24 V is provided for each sensor.

*Activation of active current measurement*

- ▶ Set both switches of an input to "A", e.g. for input AI_1 the switches SA1 and SA2.
- ▶ Configure the peripheral configuration: InputMode for the respective input to "I".

*Assignment of the screw terminals*

The left screw terminal of an input (AI_1.1, AI_2.1, AI_3.1, AI_4.1) is the negative connection.
The right screw terminal (AI_1.2, AI_2.2, AI_3.2, AI_4.2) is the positive connection.

**Example:**

Input 1 = voltage measurement, scaling from 0 to 10000
Input 2 = current measurement passive, scaling from 0 to 20000
Input 3 = current measurement active, scaling from 0 to 2000
Input 4 = voltage measurement, scaling from 0 to 5000

The A/D converters of the analogue inputs provide raw values between 0 and **3943**. 10 V correspond to a raw value of approx. 3943, 20 mA correspond to a raw value of approx. 3315. The scaling of the values, e.g. to 0 to **10000** (corresponds to 0 to 10000 mV) or 0 to **20000** (corresponds to 0 to 20000 µA) is done via the PROCCFG database.

```
[<SetConfig _="PROCCFG">
  <Periphery>
    <Module Name="ADC 8*12bit" Address="C092">
     <!-- Channel 0 = Analogue Input (1) Voltage Measurement, 0 - 10000
-->
      <Numerator0      _="10000"/>
      <Denominator0    _="3943"/>
     <!-- Channel 1 = Analogue Input (2) Current Measurement passive,
0 - 20000 -->
      <Numerator1      _="20000"/>
      <Denominator1    _="3315"/>
      <InputMode1      _="I"/>
     <!-- Channel 2 = Analogue Input (3) Current Measurement active,
0 - 2000 -->
      <Numerator2      _="2000"/>
      <Denominator2    _="3315"/>
      <InputMode2      _="I"/>
     <!-- Channel 3 = Analogue Input (4) Voltage Measurement,0 - 5000
-->
      <Numerator3      _="5000"/>
      <Denominator3    _="3943"/>
      <InputMode3      _="U"/>
      <!-- These values apply to all channels; Samplerate=2s -->
      <Tolerance       _="1"/>
      <Rate            _="2000"/>
    </Module>
  </Periphery>
</SetConfig>]
```

Paths to retrieve the current values from the process branch:
– Input 1: `/Process/C092/AI_AAAATPPSSB/P0`
– Input 2: `/Process/C092/AI_AAAATPPSSB/P1`
– Input 3: `/Process/C092/AI_AAAATPPSSB/P2`
– Input 4: `/Process/C092/AI_AAAATPPSSB/P3`

The values for `Tolerance` can be specified separately for each channel.

```
<Tolerance0 _="5" />
<Tolerance1 _="1" />
<Tolerance2 _="10" />
<Tolerance3 _="2" />
```

If the channel-related values for `Tolerance` are used, the global setting for `Tolerance` must no longer be used within a `Module` definition.

The "Rate" parameter can be used to set the sample rate in milliseconds for all channels.
Default value is 1000. This corresponds to 1 second.

### 6.7.2 Pt1000 inputs
*(P5, P10, P6, P11)*

**Key figures at a glance**
- 2x Pt1000 inputs
- Module address: `C092`
- Name of connection terminal: `M1.X`

The temperature of both Pt1000 inputs is output once as raw value (P5, P6) and converted to milli degrees Celsius (P10, P11).

The measurable temperature range is approx. -80 °C to +190 °C.

The AD converter works with 12 bit resolution. The raw values range from 0 to 4095.

---

**Example:** Process branch with a connected Pt1000 sensor (P5 / P10)

```
<C092>
  <AI_AAAATPPSSB>
    <P0 _="4"/>
    <P1 _="4"/>
    <P2 _="4"/>
    <P3 _="4"/>
    <P4 _="28200"/>
    <P5 _="1100"/>
    <P6 _="2497"/>
    <P7 _="1003"/>
    <P8 _="1504"/>
    <P9 _="4090"/>
    <P10 _="24528"/>
    <P11 _="361494"/>
  </AI_ AAAATPPSSB>
</C092>
```

---

A sensor is connected to Pt1000 input 1. The raw value (P5) is 1100. The converted value (P10) is 24528 milli degrees Celsius.

The Pt1000 input 2 (P6) is open in the example. In this case, the maximum value 4095 and the converted value (P11) 405866 is displayed.

When the input is open, the converted value (P10, P11) may vary approximately +/- 1 %.

## 6.8 Analogue outputs
*(Model series W667)*

**Key figures at a glance**
- 3x analogue outputs
- Voltage output: 0 to +10 V, Ri=100 kΩ
- Current output: 0 to +20 mA, Ri=102 Ω
- Resolution: 12 bit (0 to 4095)
- Module addresses: C010, C012, C014
- Name of connection terminal: M3.X

The three analogue outputs can each be switched between 0 to 10 V and 0 to 20 mA via a switch (SA9, SA10, SA11). The factory setting is 0 to 10 V.

The analogue outputs are scalable via the peripheral database.

---

**Example:** Channel 1, address 0x**010**
Scaling to 0 to **2000**, maximum raw value of the D/A converter: **4006**

```
[<SetConfig _="PROCCFG" ver="y">
<Periphery>
  <! Analogue output 1 with module address C010 -->
  <!-- Max. raw value of the D/A converter: 4006 -->
  <!-- The range 0 - 4095 is scaled to 0 - 2000 in this case -->
  <Module Name="DAC 1*12bit" Address="C010">
    <!-- Channel 1 = Analogue Output (1) -->
    <Numerator0 _="4006"/>
    <Denominator0 _="2000"/>
    <Tolerance _="1"/>
    <Rate _="1000"/>
  </Module>
</Periphery>
</SetConfig>]
```

---

A separate <Module> entry must be defined for each analogue output channel in the peripheral database.
The module name is always `DAC 1*12Bit`.

The first output has the address C**010** and is displayed in the process branch as follows.

```
<C010>
  <AO>
    <P0 _="1000"/>
  </AO>
</C010>
```

The second output has the address C**012** and is displayed in the process branch as follows.

```
<C012>
  <AO>
    <P0 _="1000"/>
  </AO>
</C012>
```

The third output has the address C**014** and is displayed in the process branch as follows:

```
<C014>
  <AO>
    <P0 _="1000"/>
  </AO>
</C014>
```

## 6.9 1-wire bus

**Key figures at a glance**
– Name of connection terminal: `KX3/1Wire`

The 1-wire bus allows the connection of up to 30 sensors, family=10 or family=28.

▶ Use externally supplied sensors with 3 connections: GND, VDD, Data.
Although parasitically supplied operation is supported in principle, it is not recommended because the bus no longer functions reliably in this operating mode for bus lengths over 10 m.

*Configuration* The configuration is carried out via the External database.

```
[<SetConfig _="PROCCFG" ver="v">
<External>
  <Bus Name="Bus0" _="1Wire" protocol="1Wire" type="master"
StrongPullup="enable">
    <Device Name="Device_0" _="0" family="28" serial="000000fbbb1d">
      <Temperature_0 Name="Temp_0" _="DW" simpleType="Int32"/>
    </Device>
    <Device Name="Device_1" _="1" family="28" serial="000000fc8b96">
      <Temperature_1 Name="Temp_1" _="DW" simpleType="Int32"/>
    </Device>
  </Bus>
</External>
</SetConfig>]
```

Enter `"1Wire", type="master"` as bus protocol. The individual sensors are configured via device entries. The family (family="") and the serial number (serial="") must be specified.

The parameter `StrongPullup` can be used to control the power supply of parasitically fed sensors (enable=on, disable=off). In parasitic operation `StrongPullup` should always be set to enable. This can improve the reliability of communication with the sensors. In powered mode the parameter has no effect.

Most 1-Wire sensors output the temperature in 1/1000 °C.

### Scanning the 1-wire bus

To determine which sensors have been detected at the bus the TiXML command `ScanDevices` can be used.
`[<ScanDevices _="1Wire" protocol="1Wire"/>]`.
The command returns all detected sensors in a list view.

```
<ScanDevices>
  <Device Family="10" Serial="000802bdfa08" Value="11240" ExtPower="1" />
  <Device Family="28" Serial="00000556b8d5" Value="15629" ExtPower="1" />
</ScanDevices>
```

The `ScanDevices` command displays the measured temperature value of the Sensor `Value` and the `ExtPower` operating mode (0=parasitic, 1=fed).
The values returned by `ScanDevices` can then be transferred to the External.

```
[<SetConfig _="PROCCFG" ver="v">
<External>
  <Bus Name="Bus0" _="1Wire" protocol="1Wire" type="master">
    <Device Name="Device_0" _="0" family="10" serial="000802bdfa08">
      <Temperature_0 Name="Temp_0" _="DW" simpleType="Int32"/>
    </Device>
    <Device Name="Device_1" _="1" family="28" serial="00000556b8d5">
      <Temperature_1 Name="Temp_1" _="DW" simpleType="Int32"/>
    </Device>
  </Bus>
</External>
</SetConfig>]
```

---

**Example:** Process branch with a configured 1-wire sensor

```
<Device_0>
  <DeviceState _="1" />
  <ChangeToggle _="0" />
  <Temp_0 _="23456" />
  <ExternalPower _="1" />
</Device_0>
```

---

The **`ExternalPower`** parameter (0=parasitic, 1=fed) is displayed.

## 6.10 System I/Os

| Variables path | Meaning | Remarks |
|---|---|---|
| /Process/SysIO/P0 | Mains power supply | 1: Mains power supply available<br>0: No mains power supply (in battery mode) |
| /Process/SysIO/P1 | 1-wire overload | 1: 1-wire overloading (short circuit, too many sensors)<br>0: no overloading |
| /Process/SysIO/P2 | M-Bus overload | 1: M-Bus overloading (short circuit, too many meters)<br>0: no overloading |
| /Process/SysIO/P3 | Battery charging | 1: Rechargeable battery is being charged<br>0: Charging completed |
| /Process/SysIO/P4 | Rechargeable battery voltage | Rechargeable battery voltage in milli-volts |

The system I/Os can be used in process variables, as triggers for events (EventStates) and in log files.

## 6.11 USB host connection

**Key figures at a glance**
– Name of connections: `USB1, USB2`

The USB host port can be used to connect USB devices such as memory sticks or WiFi sticks. Via an external USB hub with its own power supply, several devices can also be connected to the device in parallel.

### 6.11.1 Using a USB memory stick

A USB memory stick (max. 32 GB) can be used for the following tasks.
– Importing a configuration via `config.txt` file
– Firmware update via `Tixi.Gate_FW.tar.gz` file
– Debug recordings via `debtrace.txt` file
– Archiving of log data via the `WriteFile` command

The USB stick should be formatted with the FAT32 file system. Only one partition may be contained on the USB stick.

When the USB stick is mounted, the "WiFi" LED lights up.

***ATTENTION***

**Damage to the file system on the USB stick**

If the stick is not removed properly, the file system on the USB stick may be damaged. Proceed as follows to remove the USB stick.

▶ Press the "On" button briefly (max. 1 second).
▶ Wait until the “WiFi” LED goes out. This can take up to 4 seconds.
▶ Remove the USB stick.

### 6.11.2 Using FP S-ENGuard as WiFi access point

With a WiFi stick in mini format (available from FP InovoLabs GmbH under order number: 90.0072.8100.00), the device can be operated as an access point and thus the configuration with TILA or TICO can be carried out wirelessly.

- ▶ Insert the WiFi stick into the host port.
- ▶ Wait a few seconds.
- ▶ Press the "WiFi On" button for max. 4 seconds.
  The WiFi LED flashes briefly every second. The access point is now active.

**Default values after factory reset**

| | |
|---|---|
| **SSID** | `Tixi-`**`Devtype`**`-`**`serial`**<br>(see chapter 5.1) |
| **Authentication** | `WPA2` |
| **Password** | berlin2000 |
| **Host name** | `Tixi-`**`Devtype`**`-`**`serial`**<br>(see chapter 5.1) |
| **Number of client connections** | 1 |
| **IP address over WiFi** | 192.168.100.1 |

The WiFi configuration can be adjusted via the ISP database `WLAN_AP`.

All following database entries are optional. If individual entries are omitted, the respective default values apply.

```
[<SetConfig _="ISP" ver="v">
<WLAN_AP>
  <SSID _="WE550_Test" />
  <EnableOnStartup _="0" />
  <AllowedConnections _="1" />
  <Authentication _="WPA2" />
  <Password _=”Secret Password" />
  <HostName _="WE550_Test" />
</WLAN_AP>
</SetConfig>]
```

*SSID*
Name of the access point
(ASCII characters, no special characters).
Standard: Tixi-Devtype-serial, see chapter 5.1

*EnableOnStartup*
This parameter determines whether the WiFi access point is automatically activated when the system starts.
0=do not activate automatically
1=activate automatically
Standard: 0

*AllowedConnections*
Defines how many concurrent client connections are allowed.
maximum: 5
Standard: 1

*Authentication*
Specifies the encryption method. Currently only WPA2 is supported.

*Password*
WiFi password
(ASCII characters, no special characters).
Default value: berlin2000

*Host name*
Host name via which the device can be reached
(alternative to the IP address).
Default: see SSID

WiFi IP address: 192.168.100.1

**Automatic connection via WPS (WiFi Protected Setup)**

The WiFi Protected Setup (WPS) option is supported in Access Point Mode.

WPS allows automatic connection to an access point without entering a password. To switch to WPS mode, the access point mode must already be active.

*Turning on WPS mode*

- ▶ Press the "WiFi" button for about 1 second.
- ▶ Hold down the button and then press the "Service" button at the same time.

The "WiFi On" LED flashes rapidly. WPS mode is activated.

You can now use your end device (laptop, smartphone etc.) to establish a connection with the device. Many end devices detect the WPS mode automatically (e.g. Windows 7) and can connect directly to the device.

WPS mode is active for about 2 minutes. The device then switches back to the normal “Access point” mode. WPS mode can be reactivated at any time.

### 6.11.3 Using FP S-ENGuard as WiFi client

With a WiFi stick in mini format (available from FP InovoLabs GmbH under order number: 90.0072.8100.00) the device can be used as a WiFi client. In this mode, the device connects to a WiFi router and can thus be wirelessly integrated into a network.

The “WiFi client” mode must be configured. After a factory reset, the "Access point" mode is initially active. See chapter 6.11.2. For the device to work as a WiFi client, the ISP/ WLAN database must be configured.

```
[<SetConfig _="ISP" ver="y">
<WLAN>
  <Profile_0 SSID="acer">
    <Authentication _="WPA_TKIP"/>
    <Password _="87654321"/>
    <Ethernet>
      <IP _="DHCP"/>
      <HostName _="myDeviceName"/>
    </Ethernet>
  </Profile_0>
</WLAN>
</SetConfig>]
```

*SSID* Name of the access point to which the device should connect (only ASCII characters allowed).

*Authentication* Specifies the encryption method. Currently only WPA_TKIP is supported.

*Password* WiFi password of the router (only ASCII characters, no special characters).

*IP* IP configuration.
Currently only the DHCP mode is supported
(automatic assignment of IP address, gateway and DNS by the router).

*Host name* Host name by which the device can be reached on the network (if supported by the router).

- ▶ After configuring the ISP/WLAN database, plug the WiFi stick into the host port.
- ▶ Wait a few seconds. The WiFi LED flashes briefly every second.

The device is now logged on to the router. If the WiFi LED is not flashing, check the settings, especially the password.

Simultaneous use of the LAN interface *and* WiFi client mode on the same network (both wireless connection and LAN cable to the WiFi router) is currently not supported.

## 6.12 Supply 24V/50 mA
*(Model series W640, W667)*

**Key figures at a glance**
– Name of connection terminal: `KP24`

A 24 V supply is available at the connection terminal `KP24`. The maximum drawable current is 50 mA.

## 6.13 Debug port

**Key figures at a glance**
– Name of connection terminal: DBG

A serial debug connection (Tx/Rx/GND) is available for developers at the DBG port. The debug port provides a password protected Linux console.

Suitable USB adapter cables for connection to a PC are available from FP InovoLabs GmbH.

## 6.14 Reset button

**Key figures at a glance**
– Name of the button: S4

The device can be manually restarted (hardware reset) by pressing button S4. This button is intended for developers.

## 6.15 Power LED

**Key figures at a glance**
– Name of the LED: Pwr

The Power LED lights up red when the device is supplied with mains voltage.

## 6.16 Internal temperature sensor

**Key figures at a glance**
– Name of the sensor: `TS`

An internal temperature sensor is available.

**Model series W550**

The internal temperature sensor is a 1-wire temperature sensor. The temperature sensor must be configured as described in chapter 6.9.

**Model series W640 and W667**

The internal temperature sensor is an analogue sensor and is configured automatically.

| Property | | Value | Unit |
|---|---|---|---|
| Temperature range | | -40 to +125 | °C |
| Accuracy T=0 to 70 °C | min./typ./max. | -2.0 / ± 1.0 / +2.0 | °C |
| Accuracy T=-40 to 125 °C | min./typ./max. | -2.0 / ± 1.0 / +2.0 | °C |
| Resolution | | < 0.1 | °C |

*Calling up of the current values*

Paths to retrieve the current values from the process branch:

Internal temperature sensor:
`/Process/C092/AI_AAAATPPSSB/P0`

**Example:**

```
<P4 _="28200" />
```

The example shows a temperature of 28200 milli degrees Celsius = 28.2 °C.

## 6.17 Digital inputs 24 V

*(Model series W550 and W667)*

*W550*

**W550 key figures at a glance**
- 2x digital inputs
- Module address: `MB/IO/I`
- Name of connection terminal: `Dig.In`

*W667*

**W667 key figures at a glance**
- 5x digital inputs
- Module address: `C040`
- Name of connection terminal: `M4.X`

The digital inputs can be loaded with up to 24 V.
The status of the inputs can be queried with the following command.

*W550*

```
[<Get _="/Process/MB/IO/I/" ver="v"/>]
```

Answer (exemplary):

```
<Get>
   <I>
      <P0 _="0" />
      <P1 _="0" />
   </I>
</Get>
```

*W667*

```
[<Get _="/Process/C040/I/" ver="v"/>]
```

Answer (exemplary):

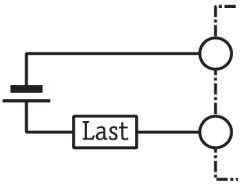
```
<Get>
   <I>
      <P0 _="0" />
      <P1 _="0" />
      <P2 _="1" />
      <P3 _="0" />
      <P4 _="1" />
   </I>
</Get>
```

When not connected, the input shows a "1". If an input is connected to earth, it shows a "0".

## 6.18 Digital outputs 48 V/120 mA
*(Model series W550)*

**Key figures at a glance**
- 1x digital output via optocoupler, max. 48 V / 120 mA
- Module address: `MB/IO/Q`
- Name of connection terminal: `Dig.Out`

The digital output can be wired as follows.




The following command sets the output to 1:

```
[<Set _="/Process/MB/IO/Q/P0" value="1" ver="v"/>]
```

The following command sets the output to 0:

```
[<Set _="/Process/MB/IO/Q/P0" value="0" ver="v"/>]
```

The status of the output can be queried with the following command:

```
[<Get _="/Process/MB/IO/Q/P0" ver="v"/>]
```

## 6.19 Relay outputs 30 V/2 A
*(Model series W667)*

**Key figures at a glance**
- 3x relay close contacts each 30 V DC / 2 A
- Module address: `C040`
- Name of connection terminal: `M5.X`

### Switching of the relay contacts

**Relay 1**

close `[<Set _="/Process/C040/Q/P0" value="1" ver="v"/>]`
open `[<Set _="/Process/C040/Q/P0" value="0" ver="v"/>]`

**Relay 2**

close `[<Set _="/Process/C040/Q/P1" value="1" ver="v"/>]`
open `[<Set _="/Process/C040/Q/P1" value="0" ver="v"/>]`

**Relay 3**

close `[<Set _="/Process/C040/Q/P2" value="1" ver="v"/>]`
open `[<Set _="/Process/C040/Q/P2" value="0" ver="v"/>]`

**All relays**

close `[<Set _="/Process/C040/QB/P0" value="7" ver="v"/>]`
open `[<Set _="/Process/C040/QB/P0" value="0" ver="v"/>]`

**Representation on the process branch**

```
<Process>
   <C040>
       <Q>
         <P0 _="0"/>
         <P1 _="1"/>
         <P2 _="1"/>
       </Q>
       <QB>
         <P0 _="6"/>
       </QB>
       <QW>
         <P0 _="6"/>
       </QW>
       <QD>
         <P0 _="6"/>
       </QD>
   </C040>
</Process>
```

# 7 Expansion modules

Depending on the model, the devices of the FP S-ENGuard series have 1 or 5 free sockets for expansion modules. Every socket is addressed via a bus number and a module address.

**Cbaa**

**C** = Expansion module
**b** = Bus number
**aa** = Module address (Jumper)

The bus numbers are assigned as follows.

| Model series | Slot 1 | Slot 2 | Slot 3 | Slot 4 | Slot 5 | L2 Slot 1 | L2 Slot 2 |
|---|---|---|---|---|---|---|---|
| W550 | 0 | - | - | - | - | - | - |
| W640 | 2 | 3 | 4 | 5 | 6 | - | - |
| W667* | 0 | 0 | 0 | 0 | 0 | 5 | 6 |

* In devices of the W667 model series, all 5 sockets are permanently equipped with expansion modules.

| | |
|---|---|
| Socket 1: | 2x Pt1000 Inputs for temperature sensors;<br>Address C092 (P5, P6) |
| Socket 1/2: | 4x analogue inputs;<br>Address C092 (P0, P1, P2, P3) |
| Socket 3: | 3x analogue outputs;<br>Addresses C010, C012, C014 |
| Socket 4: | 5x digital inputs with common earth; max. 24 V;<br>Address C040 |
| Socket 5: | 3x relay outputs (make contacts);<br>Address C040 |

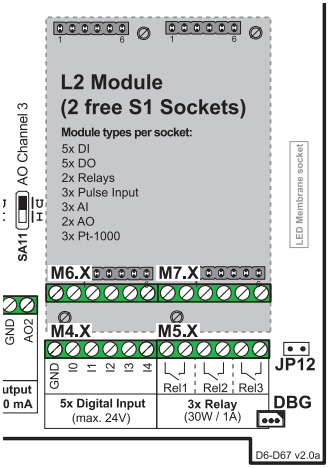
**Example:**

**C694**

Expansion module in socket **5** with module address **94**.

*L2 Adapter Model series W667*

Two additional sockets (bus numbers 5 and 6) for additional S1 expansion modules are available using the L2 adapter.




The screw terminals M6.X and M7.X for connecting sensors are located directly on the L2 adapter.

**ATTENTION**

**Damage to property due to improper installation**

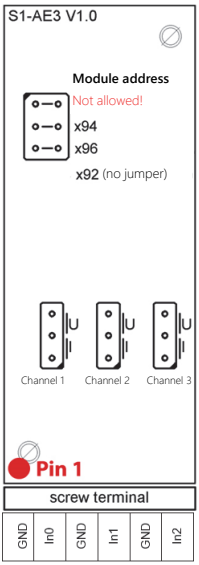
Improper installation of the expansion modules can lead to damage to the device or the expansion modules.

- ▶ Only install the expansion modules when the device is switched off.
- ▶ Make sure the polarity is correct.
- ▶ Always set the default addresses with the jumpers (exceptions: S1-AE3, S1-PT3, S1-S03).
  This way, the expansion modules are automatically detected.

## 7.1 S1-AE3 V1.0

*(3 analogue inputs, replaced by S1-AE3.P V2.0)*

**Key figures at a glance**
- 3x analogue inputs; resolution 11bit
- Voltage input: 0 to 10V, Ri=100 kΩ
- Current input (passive): 0 to 20mA, Ri=120 Ω
- Default address for automatic detection: `0x92`




The analogue inputs can be switched between 0 to 10 V and 0 to 20 mA via jumpers. The factory setting is 0 to 10 V.

The A/D converters of the analogue inputs provide raw values between 0 and 2047. This corresponds to voltage values from 0 to 10 V and current values from 0 to 20 mA.

To scale the values to 0 to **10000**, the PROCCFG database must be configured as follows (the module is jumpered to address **94** in this case, plugged into socket 5, therefore bus number = 6).

```
[<SetConfig _="PROCCFG" ver="y">
  <Periphery>
    <Module Name="S1-AE3" Address="C694">
      <!-- Channel 1 = Analogue Input (1) -->
      <Numerator0_="10000"/>
      <Denominator0_="2047"/>
      <!-- Channel 2 = Analogue Input (2) -->
      <Numerator1_="10000"/>
      <Denominator1_="2047"/>
      <!-- Channel 3 = Analogue Input (3) -->
      <Numerator2_="10000"/>
      <Denominator2_="2047"/>
      <!-- These values apply to all channels -->
      <Tolerance_="1"/>
      <Rate_="1000"/>
    </Module>
  </Periphery>
</SetConfig>]
```

When setting 0 to 20 mA for the analogue inputs, the peripheral database must be adapted (e.g. Numerator**X** _="**2000**", Denominator**X** _="**2047**"; **X** = channel number 0 to 2). In this case the current value 0 to 20 mA is mapped to the values 0 to 2000.

### 7.1.1 Conversion of the analogue values to an input range of 4 to 20 mA

Many analogue sensors use a range from 4 to 20 mA. The main advantage of these sensors is the easy detection of cable breaks, because in case of a cable break the current is < 4 mA.

The conversion into real values is done via process variables.

---

**Example:**

Pressure sensor, range from 0 to **6000** mbar at channel 1 of the internal analogue input.
Dmin = 0 mbar => 4 mA; **Dmax** = **6000** mbar => 20 mA

Maximum value of the analogue input: 1994 (raw value) or 2000 (scaled value, see 7.1)

Scaled values from 0 to **2000** thus correspond to 0 to 20 mA
Scaled values from 0.2*2000 to 2000 then correspond to 4 to 20 mA

AI = **400** (at 4 mA)
AI = **2000** (at 20 mA)

---

**Calculation of the scaling factor**

```
AIcorr = AI-400   AIcorr_max = 2000 - 400 = 1600
Factor = Dmax/AIcorr_max  => Factor = 6000/1600 = 3.75
```

**Calculation of the actual pressure value**

```
Pressure = (AI - 400) * Factor
```

### Configuration via process variables

```
[<SetConfig _="PROCCFG" ver="y">

<ProcessVars>

  <!-- the variable pressure outputs the converted value in mbar -->
  <Pressure type="float" format="F.1" >
    <Value>
      <!-- Channel 1 of the onboard module -->
      <LD _="/Process/C094/AI_PPSSAAA/P0" />

      <!-- Restore value to float stack -->
      <I2F/>

      <!-- Subtract initial value -->
      <SUBF _="400"/>

      <!-- enter the calculated factor here ! -->
      <P2 _="3.75" />
    </Value>
  </Pressure>

  <!-- if Pressure_Err changes to 1, then there is an error -->
  <Pressure_Err>
    <Value>
      <LT v1="/Process/C094/AI_PPSSAAA/P0" v2="400" />
    </Value>
  </Pressure_Err>

</ProcessVars>
</SetConfig>]
```

## 7.2 S1-S03

*(3 pulse inputs)*

**Key figures at a glance**

- 3x pulse inputs according to IEC 62053-31 for passive S0 devices (for connecting Reed contacts)
- S1-S03: 3x S0 inputs, contact current configurable
  a) approx. 5 mA, < 5 V at 230 V; maximum cable length: 30 m
  b) approx. 18 µA, < 5 V battery supply; maximum cable length: 5 m
- Pulse width >= 30 ms (± 2 ms) each
- Default address for automatic detection: `0x3C`

The modules are suitable for counting pulses as defined in standard IEC 62053-31. The inputs are designed for passive S0 devices (Reed contacts).

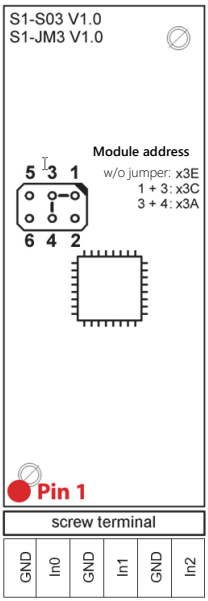
Each channel uses a DWORD (32 bit) count register. Various counting modes and scales are supported, which are configured via the peripheral database.

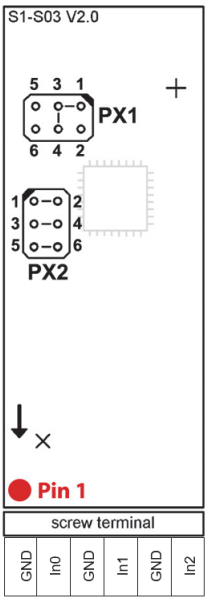
*Synchronisation mechanism*

The pulses counted at the inputs are first loaded into a temporary memory. The data from the temporary memory is then saved either cyclically via an internal configurable timer or a synchronous pulse at one of the pulse inputs into an internal read-only variable, which can then be used as a source for data logging or EventHandler.

For example, the measuring pulse of the power supply can be used as an external synchronous pulse.

Please note:
There are 2 hardware versions **V1.0** and **V2.0**.




**Jumper settings for hardware version V2.0**

| Address | PX1 | PX2 |
|---|---|---|
| 0x3E | - | - |
| **0x3C** | **(3-4)** | **-** |
| 0x3A | (1-3) | - |
| 0xB0 | - | (1-2) |
| 0xB2 | (3-4) | (1-2) |
| 0xB4 | (1-3) | (1-2) |
| 0xB6 | - | (3-4) |
| 0xB8 | (3-4) | (3-4) |
| 0xBA | (1-3) | (3-4) |

| Address | PX1 | PX2 | | |
|---|---|---|---|---|
| 0xBC | – | (1-2) | (3-4) | |
| 0xBE | (3-4) | (1-2) | (3-4) | |
| 0xC0 | (1-3) | (1-2) | (3-4) | |
| 0xC2 | – | (5-6) | | |
| 0xC4 | (3-4) | (5-6) | | |
| 0xC6 | (1-3) | (5-6) | | |
| 0xC8 | – | (1-2) | (5-6) | |
| 0xCA | (3-4) | (1-2) | (5-6) | |
| 0xCC | (1-3) | (1-2) | (5-6) | |
| 0xCE | – | (1-2) | (5-6) | |
| 0xD0 | (3-4) | (3-4) | (5-6) | |
| 0xD2 | (1-3) | (3-4) | (5-6) | |
| 0xD4 | – | (1-2) | (3-4) | (5-6) |
| 0xD6 | (3-4) | (1-2) | (3-4) | (5-6) |
| 0xD8 | (1-3) | (1-2) | (3-4) | (5-6) |

The S0 pulses are counted by a separate, battery-supported microcontroller. Even in the event of a power failure, the pulses continue counting in the modes "sync1", "sync2" or "abs".

If a channel is synchronised by channel 1, then the synchronised channel counts relatively. The displayed count value is always the number of pulses during the last measuring cycle.

The counting registers are cleared under the following circumstances:
– A configuration with "off,off,off" mode is imported.
– When the system is restarted in "rel" mode.

*Database path* `/PROCCFG/Periphery`

*Syntax*

```
[<SetConfig _="PROCCFG" ver="y">
  <Periphery>
    <Module Name="S0 (PIC)" Address="Address">
      <Mode           _="Mode"/>
      <SyncPeriod     _="SyncPeriod"/>
      <Numerator1     _="Numerator"/>
      <Denominator1   _="Denominator"/>
      <StartValue1    _="StartValue"/>
      <Numerator2     _="Numerator"/>
      <Denominator2   _="Denominator"/>
      <StartValue2    _="StartValue"/>
      <Numerator3     _="Numerator"/>
      <Denominator3   _="Denominator"/>
      <StartValue3    _="StartValue"/>
    </Module>
  </Periphery>
</SetConfig>]
```

*Module* Identifies the module.

*Elements*

`Name` `"S0 PIC"` (predefined)
`Address` **Cbaa**
**b**=Bus number **aa**=Module address (Jumper)

*Mode* Defines the Pulse Interface Mode.

**sync1, [off | abs | rel]**
Channel 1 synchronised Channel 2. channel 3 is off, absolute or relative.

*or*

**sync2**
Channel 1 synchronises channels 2 and 3.

*or*

**[ off | abs | rel ] , [ off | abs | rel ] , [ off | abs | rel ]**
No synchronisation input is used. Each channel is configured separately.

**off** Channel is not used.

**abs** Absolute count, synchronised by **`SyncPeriod`**.
During synchronisation the counted value is copied into a read-only variable and the internal channel counter is not reset.

**rel** Relative count, synchronised by **`SyncPeriod`**.
During synchronisation the counted value is copied into a read-only variable and the internal channel counter is reset to 0.

If a channel is synchronised by channel 1, then the synchronised channel counts relatively. The displayed count value is always the number of pulses during the last measuring cycle!

---

**Example:**

**sync1, off** Channel 2 is synchronised by channel 1. Channel 3 is not used.

**sync1, rel** Channel 2 is synchronised by channel 1. Channel 3 counts in relative mode (synchronised by **`SyncPeriod`** ).

**sync2** Channel 2 and channel 3 are synchronised by channel 1.

**rel, abs, off** Channel 1 counts relatively. Channel 2 absolutely. Both channels are synchronised by **`SyncPeriod`**. Channel 3 is not used.

---

`SyncPeriod` *(optional):* Time between two synchronous pulses in seconds.
Default is 900 = 15 minutes.
Is only used for the channels for which no synchronous input is configured.

*Scaling for each channel X (X=1-3)* `Numerator/Denominator`

`NumeratorX` *(optional)* Multiplier for the counted pulses.

`DenominatorX` *(optional)* Number of pulses per energy unit. Must be >0.

`StartValueX` *(optional; X=1-3)* Specifies the start value for each channel.

*Pulse interface variables*

These variables are automatically created by the system and displayed in the process branch below the module address of the S0 module.

P0 Channel 1
Counted pulses converted with numerator and denominator plus start value.

P1 Channel 2
Counted pulses converted with numerator and denominator plus start value.

P2 Channel 3
Counted pulses converted with numerator and denominator plus start value.

P3 Channel 1
Counted pulses without start value.

P4 Channel 2
Counted pulses without start value.

P5 Channel 3
Counted pulses without start value.

P6 Time since the last synchronisation event in seconds.

P7 ChangeToggle
Toggles between 0 and 1 when something has changed on any channel or a synchronisation pulse (expiration of the internal sync period or external sync pulse) has occurred.

P8 Number of channels supported by the module. Can be 2 or 3.

P9 to P11 Digital input values of the three S0 inputs when used as digital input.

P0-P2 are always converted via `Numerator/Denominator`.

All variables of a module in the process branch are always displayed, even if these channels are not used or not available. The displayed value of unused or missing variables is 0 (zero).

In the process branch, current values of a S0 module are only displayed if there is a corresponding configuration. In addition to the module identification (Module), a definition of the operating mode (Mode) is mandatory.

Default values exist for the remaining configuration entries.

| | |
|---|---|
| SyncPeriod | 900 |
| NumeratorX, DenominatorX | 1 |
| StartValueX | 0 |

---

**Example 1:**

S0 module (fixed soldered) with 3 channels has module address 0x**3E** (bus **0**).
Channel 1 = absolute counting
Channel 2 = relative counting
Channel 3 is not used.
Scaling for channel 2 with (4/1). Synchronisation every 5 minutes (300s):

```
  <!-- The range 0 - 4095 is scaled to 0 - 2000 in this case -->

[<SetConfig _="PROCCFG" ver="y">
  <Periphery>
    <Module Name="S0 (PIC)" Address="C03E">
      <Mode            _="abs,rel,off"/>
      <SyncPeriod      _="300"/>
      <Numerator1      _="1"/>
      <Denominator1    _="1"/>
      <Numerator2      _="4"/>
      <Denominator2    _="1"/>
      <Numerator3      _="1"/>
      <Denominator3    _="1"/>
    </Module>
  </Periphery>
</SetConfig>]
```

Values in the first cycle, after **100** pulses on both interfaces in the process branch.

```
<C03E>
   <Counter>
      <P0 _="100" />
      <P1 _="400" />
      <P2 _="0" />
      <P3 _="100" />
      <P4 _="100" />
      <P5 _="0" />
      <P6 _="300" />
      <P7 _="0" />
                  (1 if read within 1 second after synchronisation)
      <P8 _="3" />
   <Counter>
<C03E>
```

Values in the second cycle, after **50** pulses on both channels in the process branch.

```
<C03E>
   <Counter>
      <P0 _="150" />
      <P1 _="200" />
      <P2 _="0" />
      <P3 _="150" />
      <P4 _="50" />
      <P5 _="0" />
      <P6 _="300" />
      <P7 _="0" />
                  (1 if read within 1 second after synchronisation)
      <P8 _="3" />
   <Counter>
<C03E>
```

**Example 2:**

S0 plug-in module with 3 channels in socket 5 has module address 0x**3C** (Bus **6**).
Channel 1 = Synchronous channel for channel 2
Channel 3 = absolute counting
No scaling used. Syncronisation every 15 minutes (900 s; only applies to channel 3 because channel 2 is synchronised by channel 1), start value for channel 3 = 1400.

```
[<SetConfig _="PROCCFG" ver="y">
  <Periphery>
    <Module Name="S0 (PIC)" Address="C63C">
      <Mode           _="sync1,abs"/>
      <SyncPeriod     _="900"/>
      <Numerator1     _="1"/>
      <Denominator1   _="1"/>
      <Numerator2     _="1"/>
      <Denominator2   _="1"/>
      <Numerator3     _="1"/>
      <Denominator3   _="1"/>
      <StartValue3    _="1400"/>
    </Module>
  </Periphery>
</SetConfig>]
```

Values in the process branch for the first cycle after **100** pulses on channel 2 and 3. For simplification, it should be assumed that the synchronous pulse for channel 1 occurs simultaneously with the internal synchronous event after 900 seconds.

```
<C63C>
   <Counter>
      <P0 _="0" />
      <P1 _="100" />
      <P2 _="1500" />
      <P3 _="0" />
      <P4 _="100" />
      <P5 _="100" />
      <P6 _="900" />
      <P7 _="0" />
                (1 if read within 1 second after synchronisation)
      <P8 _="3" />
   Counter>
<C63C>
```

Values for the second cycle after **50** pulses on channel 2 and 3. For simplification, it is assumed that the synchronous pulse for channel 1 occurs simultaneously with the internal synchronous event after 900 seconds.

```
<C63C>
   Counter>
      <P0 _="0" />
      <P1 _="50" />
      <P2 _="1550" />
      <P3 _="0" />
      <P4 _="50" />
      <P5 _="150" />
      <P6 _="900" />
      <P7 _="0" />
                  (1 if read within 1 second after synchronisation)
      <P8 _="3" />
   <Counter>
<C63C>
```

---

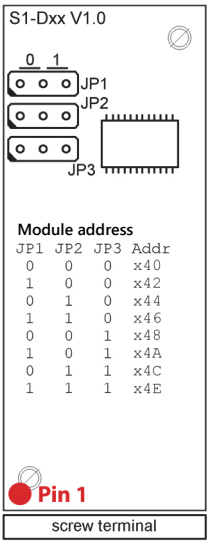
**Using the S0 inputs as digital inputs**

The three S0 inputs can also be used as normal digital inputs. In this case the inputs are switched passively, e.g. passive contact such as relays or buttons. This does not require any configuration to be transferred to the device. The digital input values of the three S0 inputs are mapped in the process branch via the input variables P9 (channel 1), P10 (channel 2) and P11 (channel 3).

An open input has logic level 1, a closed input has logic level 0.

## 7.3 S1-Dxx

*(Digital inputs and outputs)*



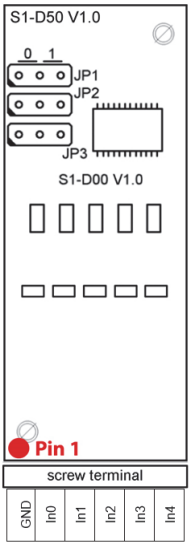

| Module type | Pin assignment on screw terminal | | | | | |
|---|---|---|---|---|---|---|
| S1-D50 | GND | IN0 | IN1 | IN2 | IN3 | IN4 |
| S1-D30G | -IN1 | +IN1 | -IN2 | +IN2 | -IN3 | +IN3 |
| S1-D05 | GND | OUT0 | OUT1 | OUT2 | OUT3 | OUT4 |
| S1-D03G | | OUT0 | | OUT1 | | OUT2 |
| | Standard module address: `x40` (all jumpers set to 0)<br>Please always set all jumpers (0 or 1). | | | | | |

The figure shows the adjustable module addresses. These addresses are valid for all modules of type "S1-Dxx" and "S1-WL2".

The jumpers and some other components may be arranged differently depending on the module type (e.g. S1-D30G).

### 7.3.1 S1-D50
*(5 digital inputs)*

**Key figures at a glance**
- 5x digital inputs
  (for potential-free contacts/relays or digital signals)
- Low: 0 to 1 V, High: 3.5 V .. 24 V
- Internal pull-up approx. 2 kΩ
- Default module address: `0x40`
  (all jumpers JP1 to JP3 set to 0)




Configuration of the modules is not necessary.

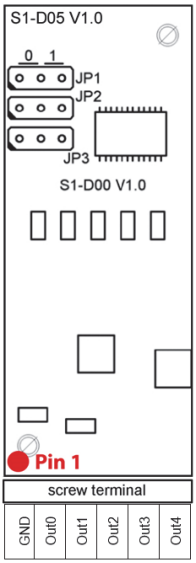
**Representation of the inputs on the process branch**

**Example:** Module S1-D50, module address `0x40`, socket 2 (bus **3**)

```
<Process>
   <C340>
     <I>
       <P0 _="1"/>
       <P1 _="1"/>
       <P2 _="1"/>
       <P3 _="1"/>
       <P4 _="1"/>
     </I>

     <IB>
       <P0 _="31"/>
     </IB>

     <IW>
       <P0 _="31"/>
     </IW>

     <ID>
       <P0 _="31"/>
     </ID>

   </C340>
</Process>
```

### 7.3.2 S1-D05
*(5 digital outputs)*

**Key figures at a glance**
- 5x digital outputs; optocoupler with common earth (earth is connected to device earth)
- Dielectric strength: 48 V
- max. current: 120 mA; OnResistance: approx. 25 Ω
- Default module address: `0x40`
  (all jumpers JP1 to JP3 set to 0)



**Representation of the outputs on the process branch**

**Example:** Module S1-D05, module address `0x40`, socket 1 (bus **2**)

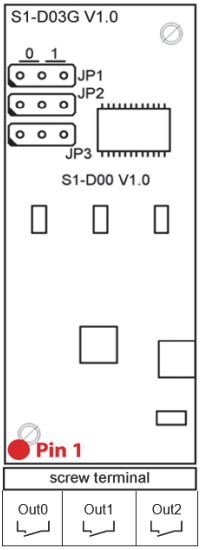
```
<Process>
   <C240>
     <Q>
       <P0 _="1"/>
       <P1 _="0"/>
       <P2 _="1"/>
       <P3 _="1"/>
       <P4 _="0"/>
     </Q>

     <QB>
       <P0 _="31"/>
     </QB>

     <QW>
       <P0 _="31"/>
     </QW>

     <QD>
       <P0 _="31"/>
     </QD>

   </C240>
</Process>
```

### 7.3.3 S1-D03G

*(3 digital outputs, galvanically isolated)*

**Key figures at a glance**

- 3× independent digital outputs; electrically isolated via optocoupler
- Dielectric strength: 48 V
- max. current: 100 mA; OnResistance: approx. 25 Ω
- Default module address: `0x40`
  (all jumpers JP1 to JP3 set to 0)



**Representation of the outputs on the process branch**

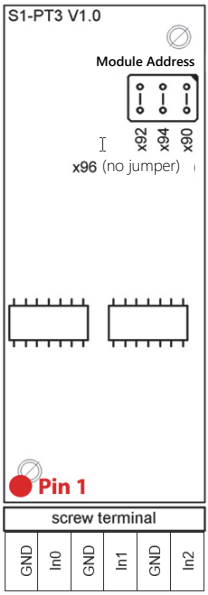
**Example:** Module S1-D03G, module address `0x42`, socket 4 (bus 5)

```
<Process>
   <C542>
     <Q>
       <P0 _="0"/>
       <P1 _="0"/>
       <P2 _="0"/>
     </Q>

     <QB>
       <P0 _="0"/>
     </QB>

     <QW>
       <P0 _="0"/>
     </QW>

     <QD>
       <P0 _="0"/>
     </QD>
   </C542>
</Process>
```

## 7.4 S1-PT3

*(3 Pt1000 inputs)*

**Key figures at a glance**
- 3x Pt1000 inputs
- Default module address: `0x96`




The conversion from voltage U [mV] to degrees Celsius is automatic. The raw value of the A/D converter is not displayed.

The display in the process branch is in milli degrees (m°C).

**Representation of the outputs on the process branch**

**Example:** Module S1-PT3, module address 0x**96**, socket 4 (bus **5**)

```
<Process>
   <C596>
     <I>
       <P0 _="0"/>
       <P1 _="22410"/>
       <P2 _="0"/>
     </I>
   </C596>
</Process>
```

In the example above, the value 22410 milli degrees Celsius = 22.41 °C is displayed for the Pt1000 temperature sensor at input 2, the other PT1000 temperature sensors show the value 0.

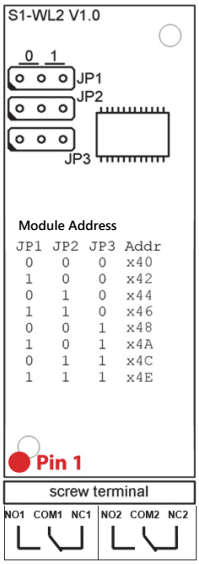
If no Pt1000 temperature sensor is connected, a value of approx. 199996 is displayed.

Please do not use module addresses x90 and x94.

## 7.5 S1-WL2

*(2 relay outputs, changeover contact)*

**Key figures at a glance**
- 2x relay outputs (changeover contacts)
- Maximum 48 V/3 A
- Default module address: `0x42`



**Representation of the outputs on the process branch**

**Example:** Module S1-WL2, module address `0x42`, socket 5 (bus **6**)

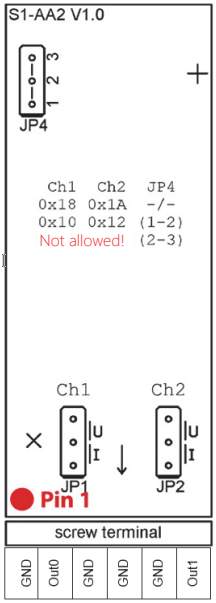
```
<Process>
   <C642>
     <Q>
       <P0 _="0"/>
       <P1 _="1"/>
     </Q>
   </C642>
</Process>
```

In the example, the normally open contact of relay 1 is open (NO1) and the normally open contact of relay 2 is closed (NO2).

## 7.6 S1-AA2

*(2 analogue outputs)*

**Key figures at a glance**
- 2x analogue outputs; resolution 12bit
- Voltage output: 0 to 10 V, Ri=100 kΩ
- Current output: 0 to 20 mA, Ri=120 Ω
- Default address for automatic detection: `0x18/0x1A`




The analogue outputs can be switched between 0 to 10 V and 0 to 20 mA via jumpers. The factory setting is 0 to 10 V.

The D/A converters of the analogue outputs use raw values between 0 and 4035 (corresponds to 0 to 10 V).

**Representation of the outputs on the process branch**

**Example:** Module S1-AA2, address 0x**10**/0x**12**, socket 5 (bus **6**)

Output 1

```
<C610>
  <AO>
    <P0 _="1000"/>
  </AO>
</C610>
```

Output 2

```
<C612>
  <AO>
    <P0 _="1000"/>
  </AO>
</C612>
```

The analogue outputs can be scaled via the peripheral database.

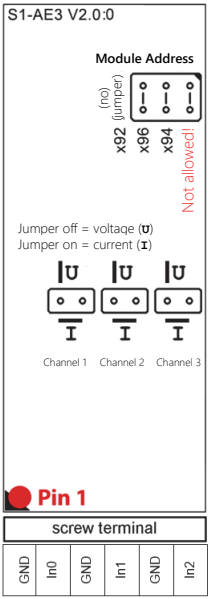
**Example:** Module S1-AA2, address 0x**18** (channel 1), socket 5 (bus **6**)
Scaling to 0 to **2000**, maximum raw value of the D/A converter: **4027**

```
[<SetConfig _="PROCCFG" ver="y">
<Periphery>

  <!-- S1-AA2 in Slot 5 with module address C618 -->
  <!-- Raw value of the D/A converter at 20 mA: 4027 -->
  <!-- The range 0 - 4027 is scaled to 0 - 2000 in this case -->
  <Module Name="S1-AA2" Address="C618">

    <!-- Channel 1 = Analogue Output (1) -->
    <Numerator0 _="4035"/>
    <Denominator0 _="2000"/>

    <Tolerance _="1"/>
    <Rate _="1000"/>
  </Module>

</Periphery>
</SetConfig>]
```

## 7.7 S1-AE3.0 V2.0

*(3 analogue inputs, replaced by S1-AE3.P V2.0)*

**Key figures at a glance**
- 3x analogue inputs; resolution 11bit
- Voltage input: 0 to 10 V, Ri=100 kΩ
- Current input (passive): 0 to 20 mA, Ri=120 Ω
- Default address for automatic detection: `0x92`




In version 2.0 of the expansion module S1-AE3 the arrangement of the jumpers was changed. The electrical characteristics and programming are identical to module S1-AE3 V1.0.

The analogue inputs can be switched between 0 to 10 V and 0 to 20 mA via jumpers. The factory setting is 0 to 10 V.

The A/D converters of the analogue inputs provide raw values between 0 and **2029**. This corresponds to voltage values from 0 to 10 V and current values from 0 to 20 mA.

To scale the values to 0 to **10000**, the PROCCFG database must be configured as follows. The module is jumpered to address **94** in this case, plugged into socket 5, therefore bus number **6**.

```
[<SetConfig _="PROCCFG" ver="y">
  <Periphery>
    <Module Name="S1-AE3" Address="C694">
      <!-- Channel 1 = Analogue Input (1) "In0" -->
      <Numerator0_="10000"/>
      <Denominator0_="2029"/>

      <!-- Channel 2 = Analogue Input (2) "In1" -->
      <Numerator1_="10000"/>
      <Denominator1_="2029"/>

      <!-- Channel 3 = Analogue Input (3) "In2" -->
      <Numerator2_="10000"/>
      <Denominator2_="2029"/>

      <!-- These values apply to all channels -->
      <Tolerance_="1"/>
      <Rate_="1000"/>
    </Module>
  </Periphery>
</SetConfig>]
```

**Representation of the inputs on the process branch**

**Example:** Module S1-AE3.0, voltage measurement, address `0x92`, Scaling 0 to 10000 mV, socket 4 (bus **5**)

```
<Process>
   <C592>
     <AI_AAA>
       <P0 _="5000"/>
       <P1 _="2500"/>
       <P2 _="0"/>
     </AI_AAA>
   </C592>
</Process>
```

***ATTENTION***

**Material damage due to incorrect installation of the modules**

Incorrect installation of the modules may result in material damage to the expansion modules.

▶ Make sure that the polarity of the modules is correct.

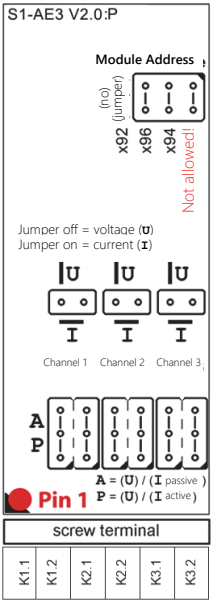
Please do not use the module addresses `x90` and `x92`.

## 7.8 S1-AE3.P V2.0

*(3 analogue inputs)*

**Key figures at a glance**

- 3x analogue inputs; resolution 11bit
- Voltage input: 0 to 10 V, Ri=100 kΩ
- Current input: 0 to 20 mA, Ri=120 Ω
- Current input (active): 0 to 20 mA
- Default address for automatic detection: `0x92`




With the expansion module S1-AE3.P both voltages up to 10 V (factory setting) and currents up to 20 mA (active and passive) can be measured. The operating mode is selected via 9 jumpers.

In the "voltage = U" and "current = I passive" (factory setting) operating mode the lower jumpers per channel must be set to "A" (2 jumpers per channel). In "current = I passive" mode the module behaves like a S1-AE3 in "I" mode.

In the "voltage = U" and "current = I passive" operating mode the lower jumpers per channel must be set to "A" (2 jumpers per channel).

In active mode (for current loop sensors), a current limited voltage of approx. 24 V is provided to supply the sensor. This changes the assignment of the screw terminals.

The A/D converters of the analogue inputs provide raw values between 0 and **2029**. This corresponds to voltage values from 0 to 10 V and current values from 0 to 20 mA.

To scale the values to 0 to **10000**, the PROCCFG database must be configured. The module is jumpered to address **94**, plugged into socket 5, therefore bus number **6**.

```
[<SetConfig _="PROCCFG" ver="y">
  <Periphery>
    <Module Name="S1-AE3" Address="C694">
    <!-- Channel 1 = Analogue Input (1) "Ch1.x"
-->
      <Numerator0_="10000"/>
      <Denominator0_="2029"/>
    <!-- Channel 2 = Analogue Input (2) "Ch2.x"
-->
      <Numerator1_="10000"/>
      <Denominator1_="2029"/>
     <!-- Channel 3 = Analogue Input (3) "Ch3.x
-->
      <Numerator2_="10000"/>
      <Denominator2_="2029"/>
      <!-- Values apply to all channels -->
      <Tolerance_="1"/>
      <Rate_="1000"/>
    </Module>
  </Periphery>
</SetConfig>]
```

**Representation of the inputs on the process branch**

**Example:** Voltage measurement, address `0x`**92**, scaling 0 to 10000 mV, socket 4 (bus **5**)

```
<Process>
   <C592>
     <AI_AAA>
       <P0 _="5000"/>
       <P1 _="2500"/>
       <P2 _="0"/>
     </AI_AAA>
   </C592>
</Process>
```

Measurement:
Input 1 = 5000 mV
Input 2 = 2500 mV
Input 3 = 0 mV

***ATTENTION***

**Material damage due to incorrect installation of the modules**

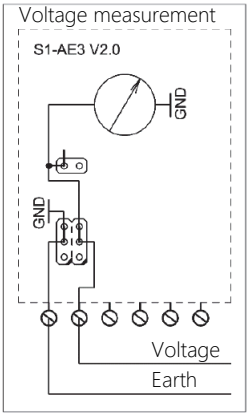
Incorrect installation of the modules may result in material damage to the expansion modules.

▶ Make sure that the polarity of the modules is correct.

Please do not use the module addresses `x90` and `x92`.

## Details on the operating modes

*Voltage measurement*

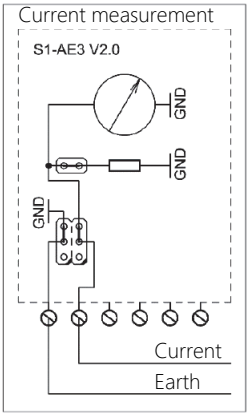



When measuring voltage, voltages of 0 to 10 V can be measured against earth (factory setting).

The left screw terminal of a channel (K1.1, K2.1, K3.1) is the earth connection, the right screw terminal (K1.2, K2.2, K3.2) is the voltage input.

The two-pin upper jumper must be open. For the three-pin lower jumpers the upper two contacts must be connected.

*Current measurement (passive)*



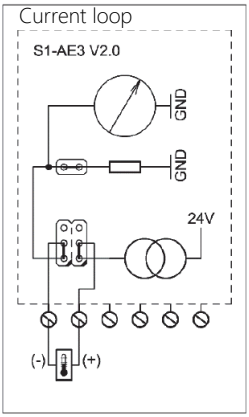
In the "Current measurement passive" mode, current from 0 to 20 mA is measured against earth.

The left screw terminal of a channel (K1.1, K2.1, K3.1) is the earth connection, the right screw terminal (K1.2, K2.2, K3.2) is the current input.

The two-pin upper jumper must be closed. For the three-pin lower jumpers the upper two contacts must be connected.

For conversion of the analogue values to an input range of 4 to 20 mA see chapter 7.1.

*Current measurement (active)*




In the "Current measurement active" mode for current loop sensors a current limited voltage of approx. 24 V is provided.

The left screw terminal of a channel (K1.1, K2.1, K3.1) is the negative input, the right screw terminal (K1.2, K2.2, K3.2) is the current input.

The two-pin upper jumper must be closed. For the three-pin lower jumpers the lower two contacts must be connected.

For conversion of the analogue values to an input range of 4 to 20 mA see chapter 7.1.1.

Information on restrictions for the operation of passive sensors can be found in chapter 7.8.1.

### 7.8.1 Restrictions for the operation of passive sensors

Due to the limitation of the power supply units used, the following restrictions apply to the operation of passive sensors on S1-AE203 and S1-AE3.P depending on the model.

*FP S-ENGuard Model series W640, W667*

If the 24V terminal (KP24) is loaded ***and*** the integrated analogue outputs are not operated as current outputs, max. 1 module S1-AE203/S1-AE3.P can be used.

If the 24V terminal (KP24) is not loaded ***and*** the integrated analogue outputs are not operated as current outputs, max. 2 modules S1-AE203/S1-AE3.P can be used.

*FP S-ENGuard Model series W550*

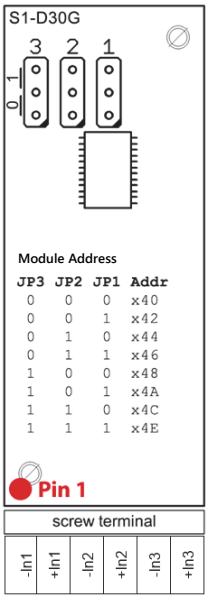
The S1-AE203/S1-AE3.P modules can only be operated on a device of the W550 model series with active sensors.

## 7.9 S1-D30G

*(3 digital inputs, galvanically isolated)*

**Key figures at a glance**

- 3x digital inputs, galvanically isolated
- Low: 0 to +9.2 V, High: +10.4 V to +60 V
- Maximum input voltage: -60 V to +60 V
- Input current: 2.2 to 3.1 mA
- Creepage and clearance distance between individual inputs: 0.8 mm
- Creepage and clearance distance between external input and internal circuit: 2.2 mm
- Default module address: `0x40` (all 3 jumpers in position 0)




The S1-D30G expansion module offers 3 digital inputs which are electrically isolated from each other. Each of the three channels has a status LED which lights up red at high level.

Configuration of the modules is not necessary.

### Display of the logical levels

In contrast to the other digital input modules, an open input in the process branch of the S1-D30G is indicated as "0". When the high level is reached, the display changes to "1".

### Representation of the inputs on the process branch

**Example:** Module S1-D50, module address `0x40`, socket 2 (bus 3)

```
<Process>
   <C340>
     <I>
       <P0 _="1"/>
       <P1 _="0"/>
       <P2 _="1"/>
     </I>

     <IB>
       <P0 _="5"/>
     </IB>

     <IW>
       <P0 _="5"/>
     </IW>

     <ID>
       <P0 _="5"/>
     </ID>
   </C340>
</Process>
```

In the example shown above, input 1 (In1) and input 3 (In3) are at high level and input 2 (In2) at low level.

# 8 Index

## W